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Results of the Acoustic-Trawl Surveys of Walleye Pollock (*Gadus chalcogrammus*) in the Gulf of Alaska, February-March 2013 (DY2013-02 and DY2013-03)

by

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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 in the Gulf of Alaska (GOA) during late winter and early spring to estimate the distribution and abundance of walleye pollock (*Gadus chalcogrammus*). Historically, most of these efforts have been focused on the Shelikof Strait area, which has been surveyed annually since 1981, except in 1982, when no survey was scheduled, and in 1999 and 2011, when all winter GOA surveys were cancelled (because of vessel delays). The Shumagin Islands area has been surveyed annually since 2001 (except in 2004 and 2011) with prior surveys in 1994-1996. Sanak Trough has been surveyed annually since 2002 (except in 2004 and 2011), and the GOA continental shelf break east of Chirikof Island to Barnabas Trough has been surveyed annually since 2002 with the exception of 2011. Marmot Bay has been surveyed in the winter a total of six times (1989, 1990, 1992, 2007, 2009, and 2010) and Morzhovoi Bay has been surveyed a total of three times (2006, 2007, and 2010). This report presents the results from AT surveys conducted in the aforementioned areas of the GOA during February and March 2013.

METHODS

Surveys were conducted 26 February – 3 March (cruise DY2013-02) in the Shumagin Islands area (comprised of Shumagin Trough, Stepovak Bay, Renshaw Point, Unga Strait, and West Nagai Strait), Sanak Trough, and Morzhovoi Bay, and 15-27 March (cruise DY2013-03) in Marmot Bay, Shelikof Strait, and along the GOA shelf break east of Chirikof Island. Survey itineraries and scientific personnel are listed in Appendices I and II, respectively. Survey activities were delayed following the calibration on February 9 due to vessel mechanical issues that required returning to Kodiak for repairs. Both surveys were conducted aboard the NOAA ship *Oscar Dyson*, a 64-m stern trawler equipped for fisheries and oceanographic research.

Surveys 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 scientific echosounding 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. Multibeam data were collected during all surveys using a Simrad ME70 echosounder (Simrad 2007, Trenkel et al. 2008) mounted on the hull 10 m forward of the centerboard at a depth of 6 m below the water surface. The ME70 ping rate was synchronized with the EK60 to reduce interference.

Standard sphere acoustic system calibrations were conducted 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 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 February and March calibrations were used to provide a final parameter set for data analysis.

Acoustic backscatter was recorded at the five split-beam frequencies using ER60 software (v. 2.2.1) and, as a backup, acoustic telegram data were logged with Myriax EchoLog 500

[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

(v. 4.70.1.14256) software. Multibeam acoustic backscattering was also collected. Results presented in this report are based on 38-kHz acoustic raw data using a post-processing s_v threshold of –70 decibels (dB). Acoustic measurements were collected from 16 m below the sea surface to within 0.5 m of the sounder-detected bottom or a maximum of 1,000 m in deep water. Data were analyzed using Myriax Echoview post-processing software (Version 5.3.36.22078).

Trawl Gear and Oceanographic Equipment

Midwater and near-bottom acoustic backscatter layers were 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 codend, where it was fitted with a single 12 mm (0.5 in) codend liner. Near-bottom and some midwater backscatter was also sampled with a poly Nor'eastern (PNE) bottom trawl, which is a four-panel high-opening trawl equipped with roller gear and constructed with stretch mesh sizes that range from 13 cm (5 in) in the forward portion of the net to 8.9 cm (3.5 in) in the codend. The PNE codend was also fitted with a single 12 mm (0.5 in) codend liner. Both nets were fished with 5 m^2 Fishbuster trawl doors each weighing 1,089 kg (2,400 lb) and average trawling speed was 1.6 m/sec (3.0 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 15 to 30 m (49 to 98 ft) and averaged 22 m (72 ft) while fishing. The PNE vertical mouth opening ranged from 6 to 8 m (20-26 ft) and averaged 7 m (23 ft) while fishing. Detailed trawl gear specifications are described in Guttormsen et al. (2010).

Approximately half of the AWT trawls conducted in the Shelikof Strait sea valley also included a Cam-Trawl stereo imager (Williams et al. 2010b) attached to the net forward of the codend. The Cam-Trawl was used to capture stereo images for species identification and length measurement of individual fish as they pass through the net toward the codend. Images are viewed and annotated using procedures described in Williams et al. (2010a).

During all trawl activities in Shelikof Strait, removable pocket nets (or recapture nets) were affixed at locations around and along the outside of the AWT so that three nets were affixed to each of the starboard, port, and bottom panels. An additional permanently attached pocket net was also affixed to the bottom panel – making a total of 10. A randomized block design was used to determine removable pocket net placement for each haul. Removable pocket nets were affixed to the outside of the AWT meshes using clips for ease of application and removal. Pocket net contents were logged similar to, but separate from, the codend contents. These data were gathered to augment selectivity estimates obtained from previous surveys and will be reported elsewhere.

Physical oceanographic data collected during the cruises included temperature profiles obtained with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope, and conductivity-temperature-depth (CTD) observations collected with a Sea-Bird CTD (SBE 9-11 plus) system at calibration sites. Sea surface temperature data were 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. Surface water temperatures were plotted as 1 nautical mile (nmi) averages along the cruise track.

Survey Design

The survey design consisted of a series of parallel line transects, except in areas where it was necessary to reorient tracklines to maintain a perpendicular alignment to the isobaths and to work around landmasses. A random start position was generated for the first transect for each area. Survey activities were conducted 24 hours/day.

Trawl hauls were conducted to determine species composition and size composition of walleye pollock specimens to classify observed acoustic backscatter. Walleye pollock were sampled to determine sex, fork length (FL), body weight, age, gonad maturity, and ovary weight of selected females. Walleye pollock and other fishes were measured to the nearest 1 mm FL using an electronic measuring board (Towler and Williams 2010), except for capelin (*Mallotus villosus*), which were measured to the nearest millimeter standard length (SL). When large numbers of juvenile walleye pollock were encountered mixed with adults in a haul, the predominant size groups were subsampled separately (e.g., age-1 vs. adults). For each trawl catch, sex and length measurements were collected from an average of 230 randomly sampled walleye pollock, and an additional 35 individuals were sampled for body weight, maturity, and age. An electronic motion-compensating scale (Marel M60) was used to weigh individual walleye pollock to the nearest 2 g. Maturity was determined by visual inspection and was categorized as immature, developing, pre-spawning, spawning, or post-spawning[2]. Trawl station and biological measurements were electronically recorded to the Catch Logger for Acoustic Midwater Surveys (CLAMS) database.

Data Analysis

The detected bottom was calculated using the mean of sounder-detected bottom lines for all five frequencies (Jones et al. 2011). Acoustic backscatter, identified as either walleye pollock, rockfish, unidentified fish, or an undifferentiated mixture of primarily macrozooplankton, was recorded between depths of 16 m below the surface to 0.5 m above the sounder-detected bottom (except where the bottom depth exceeded the 1,000 m lower limit of data collection). Acoustic data were binned at 0.5 nmi horizontal by 10 m vertical resolution.

Walleye pollock length compositions were combined from trawl hauls into regional length strata based on geographic proximity, similarity of length composition, and backscatter characteristics. During three trawls age-1 pollock were found in a dense layer shallower and separated from a deeper layer that contained larger fish mixed with age-1s. Because the shallower age-1 fish were caught in hauls targeting the deeper fish, Cam-Trawl data were used to apportion the catch at these locations to the appropriate depth layer for use in length keys. Using Cam-Trawl images and, image processing software developed by MACE scientists, fish lengths were measured from both layers in a haul. The proportion of fish at length within each depth layer was then combined

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

with length proportions from similar hauls to create length keys for the different strata. Within a survey area mean fish weight-at-length for each length interval (cm) was estimated from the trawl information when six or more walleye pollock were measured within a length interval; otherwise, weight-at-length 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 by the mean backscattering cross section of pollock (MacLennan et al. 2002). 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.

For age determinations, walleye pollock otoliths were collected from all areas and stored in a 50% glycerin/thymol-water solution. Otoliths from Shelikof Strait, Chirikof shelf break, and Marmot areas were processed by AFSC Age and Growth Program researchers to determine individual fish ages. An age-length key based on the age samples (Shelikof Strait, n = 788; Chirikof, n = 139; Marmot, n = 188) was used to convert abundance-at-length estimates to abundance-at-age. Otoliths collected from the Shumagins Islands, Sanak Trough, and Morzhovoi Bay have not been aged as of this writing.

Relative errors for the acoustic-based estimates were derived using a one-dimensional (1-D) geostatistical method (Petitgas 1993, Williamson and Traynor 1996, Rivoirard et al. 2000, Walline 2007). “Relative estimation error” is defined as the ratio of the square root of the estimation variance to the estimate of biomass. Geostatistical methods were used for computation of error because they account for the observed spatial structure in the fish distribution. These errors quantify only transect sampling variability of the acoustic data. Other sources of error (e.g., target strength, trawl sampling) were not evaluated.

RESULTS and DISCUSSION

Calibration

Pre- and post-survey calibration measurements of gain, s_A correction and beam pattern were similar, confirming that the ER60 38-kHz acoustic system was stable throughout the survey (Table 1). The difference in integration gain (i.e., gain + s_A correction) measured before and after the survey was < 0.1 dB, so an averaged value was used in the final analysis.

Shumagin Islands

The Shumagin Islands survey was conducted from 26 February – 1 March. Acoustic backscatter was measured along 756 km (408 nmi) of tracklines. Transects were spaced 1.9 km (1.0 nmi) apart east of Renshaw Point and in the eastern half of Unga Strait, 4.6 km (2.5 nmi) apart in Stepovak Bay, West Nagai Strait, and the western half of Unga Strait, and 9.3 km (5.0 nmi) apart in Shumagin Trough (Fig. 1). Bottom depths did not exceed 225 m along any transect, and transects generally did not extend into waters less than about 50 m depth.

Physical Oceanography

Surface water temperatures averaged 3.1° C throughout the Shumagin Islands survey area and at the 9 trawl locations sampled (Figs. 2 and 3), slightly below the 3.4° C average of the 13 previous surveys in the area. The temperature at the depth from the trawls where most of the adult walleye pollock were captured in Shumagin Trough averaged 4.6° C.

Trawl Samples

Biological data and specimens were collected in the Shumagin Islands from eight AWT hauls conducted in midwater and one on-bottom PNE haul (Fig. 1; Tables 2-5). Walleye pollock was the most abundant species caught by numbers with both gear types, contributing 87.4% and 64.5% to the total catch from AWT and PNE trawls, respectively (Tables 3 and 4). Walleye pollock also dominated the cumulative weight captured in the AWT (92.8%), and Pacific cod

(*Gadus macrocephalus*) comprised most of the catch by weight (51.3%) in the PNE even though only 14 individual fish were captured.

The majority of walleye pollock captured in all trawls in the Shumagin Islands were between 8 and 14 cm fork length (FL), characteristic of age-1 walleye pollock (Fig. 4). The few larger walleye pollock present ranged in length from 26 to 78 cm FL, with a mean of 57 cm FL. The dominance of age-1 walleye pollock in Shumagin Island catches in 2013 was similar to the 2006, 2008, and 2009 surveys, but larger in magnitude. Large numbers of juvenile fish have often been seen in various areas within the Shumagin Islands, often concurrently with larger adults, but dominance of age-1s in all areas has not been seen before this year.

The unweighted maturity composition for males longer than 40 cm FL (n = 64) was 0% immature, 14% developing, 67% pre-spawning, 8% spawning, and 11% spent (Fig. 5a). The maturity composition of females longer than 40 cm FL (n = 68) was 0% immature, 24% developing, 69% pre-spawning, 3% spawning, and 4% spent (Fig. 5b). The high percentage of pre-spawning females together with the low percentage of spawning and spent female adults indicates that survey timing was appropriate. A logistic model fit to the female maturity-at-length data predicted that 50% of females were mature (L_{50}) at 50 cm FL (Fig. 5c). The average GSI [gonadosomatic index: ovary weight/(ovary weight + body weight)] of pre-spawning females, based on 47 samples, was 0.12 (Fig. 5d), which was slightly lower than in 2012 (0.13) but slightly higher than the three previous surveys (0.11, 0.09, and 0.08, respectively, for 2010, 2009, and 2008) and is quite close to the long-term mean value of 0.13.

Distribution and Abundance

Dense aggregations of walleye pollock were detected throughout the outer portion of Shumagin Trough (Fig. 6). During the day the fish formed dense layers approximately 25 m off bottom (Figs. 7 and 8a). At night the aggregations spread throughout the water column but the majority of the backscatter was still in the lower portion of the water column (Fig. 8b). Similar aggregations were detected off Renshaw Point (where the highest quantities of adults have historically been detected), Unga Strait, and the West Nagai Strait area.

The biomass estimate of 91,295 t (48% of which were age-1 fish) is the largest since 2002 and approximately 20% larger than the historical mean for this survey (Table 6; Figs. 9 and 10). The relative estimation error of the biomass based on the one-dimensional (1-D) geostatistical analysis was 17.3%.

Sanak Trough

The Sanak Trough was surveyed on 2 March, the latest this area has been surveyed and at least a week later than any other survey of this area except for in 2010. Acoustic backscatter was measured along 178 km (96 nmi) of tracklines spaced 3.7 km (2 nmi) apart (Fig. 1). Bottom depths ranged from 40 m at the transect end points to 170 m along the deepest part of the southernmost transects.

Physical Oceanography

Surface water temperatures in the Sanak Trough survey area averaged 2.3°C overall and at the two trawl locations (Figs. 2 and 11), similar to temperatures recorded in 2009 but below the 3.1° C average for surveys in this area. Water temperature increased approximately 1.5°C from the surface to trawl depth at both trawl locations.

Trawl Samples

Biological data and specimens were collected in Sanak Trough from one AWT in midwater and one on-bottom PNE haul (Fig. 1; Tables 2, 5, 7, and 8). Walleye pollock was the most abundant species caught in both hauls, contributing 98.3% and 47.2% by weight, respectively, to the AWT and PNE catch (Tables 7 and 8). Arrowtooth flounder (*Atheresthes stomias*) and flathead sole (*Hippoglossoides elassodon*) were the second and third most abundant species contributing 20.8% and 14.8%, respectively, to the total catch weight of the PNE. Adult walleye pollock 42 to 78 cm FL were caught in the AWT in the northeast portion of the survey area (Figs. 1 and 12). The majority of walleye pollock (60%) caught in the PNE in the southwestern portion of Sanak were age-1 fish 9-12 cm FL. Significant numbers of age-1 walleye pollock have not been seen on previous surveys of this area.

The unweighted maturity composition for males longer than 40 cm FL (n = 136) was 1% immature, 6% developing, 66% pre-spawning, 12% spawning, and 15% spent (Fig. 13a). The unweighted maturity composition for females longer than 40 cm FL (n = 78) was 3% immature, 6% developing, 78% pre-spawning, 9% spawning, and 4% spent (Fig. 13b). The low percentage of spawning and spent female adults together with the high percentage of pre-spawning females indicates that survey timing was appropriate. The logistic model fit to the female maturity-at-length data predicted that 50% of females were mature at 45 cm FL (Fig. 13c). The average GSI of pre-spawning females was 0.15 (Fig. 13d) and is quite close to the long-term mean value of 0.16.

Distribution and Abundance

The majority of the walleye pollock biomass was located over the northeast portion of the trough where adults dominated the catch (Fig. 6). Most of the walleye pollock backscattering was located in diffuse schools at depths of ~100 m over bottom depths of 100-150 m (Fig. 14).

The biomass estimate of 13,282 t is approximately a quarter of the historic mean for this survey and the lowest in the surveys history (Table 6). The relative estimation error based on the 1-D geostatistical analysis of the biomass was 5.1%.

Morzhovoi Bay

Morzhovoi Bay was surveyed on 3 March. Acoustic backscatter was measured along 87 km (47 nmi) of trackline (Fig. 1). Morzhovoi Bay transects were spaced 4.6 km (2.5 nmi) apart. Depths ranged from about 35 to 145 m.

Physical Oceanography

The surface water temperature at the trawl site in Morzhovoi Bay was 1.7° C and averaged 1.5°C throughout the bay (Figs. 2 and 15), similar to surface temperatures recorded in 2006. The water column temperature was nearly uniform, varying by less than 0.2° C from surface to trawl depth (Fig. 15).

Trawl Samples

Biological data and specimens were collected in Morzhovoi Bay from one AWT haul in midwater (Fig. 1; Tables 2, 5, and 9). Walleye pollock was the most abundant species caught, contributing 95.1% by weight and 98.0% by numbers (Table 9). Catch length distributions (Fig. 16) were very similar to those found in the Shumagin Islands with a slightly lower contribution of age-1 fish (39%) to the total biomass. The vast majority of walleye pollock captured during previous surveys of this area have been age-2 fish (2010) ranging from 21 to 31 cm and larger adult fish 40 to 62 cm (2006 and 2007). A small number of age-1 walleye pollock were reported in 2006 but they made up less than 1% of the total biomass.

The unweighted maturity composition for males longer than 40 cm FL (n = 23) was 0% immature, 0% developing, 30% pre-spawning, 4% spawning, and 65% spent (Fig. 17a). The maturity composition of females longer than 40 cm FL (n = 10) was 0% immature, 10% developing, 40% pre-spawning, 0% spawning, and 50% spent (Fig. 17b). The high percentage of spent females suggests that the survey timing was late. A logistic model could not be fitted to the female maturity-at-length data because of the lack of immature fish (Fig. 17c). The average GSI of pre-spawning females based on four samples was 0.16 (Fig. 17d).

Distribution and Abundance

Walleye pollock were diffusely scattered throughout Morzhovoi Bay. Most of the backscattering was located within 10 m of the sea floor over bottom depths of ~90 m (Fig. 18). The biomass estimate of 2,476 t was similar to that obtained in 2007 (2,500 t) but is half the historic mean for this survey. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 11.6%.

Marmot Bay

Marmot Bay was surveyed during 15 to 16 March along transects spaced 3.7 km (2.0 nmi) apart in the outer bay and 1.9 km (1.0 nmi) apart in the Spruce Island gully and inner bay. Acoustic backscatter was measured along 278 km (150 nmi) of tracklines (Fig. 19). Bottom depths ranged from 80 to 350 m.

Physical Oceanography

Surface water temperatures averaged 4.2° C throughout the Marmot Bay survey area and at trawl locations (Figs. 20 and 21). Temperatures at depths where most adult walleye pollock biomass occurred (50-180 m) averaged 4.4° C, similar to temperatures in 2010 but 1.6° C higher than in 2007 and 2009 when the coldest surface temperatures for this survey were recorded.

Trawl Samples

Biological data and specimens were collected in Marmot Bay from four AWT hauls in midwater and one on-bottom PNE haul (Fig. 19; Tables 10-13). Test hauls were also conducted in Marmot Bay with a Marinovich net that was modified to have longer wings and fished with various bridal lengths and fishbuster doors to determine the nets vertical opening and catchability of walleye pollock. Walleye pollock was the most abundant species caught by weight and numbers in both the AWT and PNE hauls (Tables 11 and 12).

Walleye pollock ranged in length from 10 to 71 cm with modes at 13 cm, 31 cm, and 55 cm FL (Fig. 22). The 10-16 cm FL and 25-35 cm FL fish were only found in the inner bay near Whale Island. The unweighted maturity composition in Marmot Bay for males longer than 40 cm FL (n = 63) was 0% immature, 2% developing, 49% pre-spawning, 49% spawning, and 0% spent (Fig. 23a). The maturity composition of females longer than 40 cm FL (n = 115) was 0% immature, 4% developing, 95% pre-spawning, 1% spawning, and 0% spent (Fig. 23b). The high percentage of pre-spawning adult females indicates that peak spawning had not occurred and that survey timing was appropriate. The female L_{50} was 43 cm FL (Fig. 23c). The average GSI for pre-spawning females was 0.143, above the historical mean of 0.13 and near the historic high mean of 0.145 (Fig. 23d).

Distribution and Abundance

Dense walleye pollock schools were detected northwest of Spruce Island and in Spruce Gully on average of 21 m off the sea floor over bottom depths of 100-300 m (Figs. 24 and 25). These fish were primarily the 45 to 70 cm FL range. A large aggregation of fish was also detected near Whale Island that consisted of two smaller size groups, 10 to 16 cm FL and 25 to 35 cm FL.

These fish were on average 84 m deep over bottom depths averaging 128 m (Fig. 25). The biomass estimate for Marmot Bay was 19,942 t, similar to the estimate in 2009 (19,800 t) but twice the historic mean for this survey. However, in 2009 the majority of the biomass was found in the northeastern part of the inner bay closer to Afognak Island, and the length distribution was unimodal, centered around 38 cm FL. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 4.1%.

Shelikof Strait

The Shelikof Strait sea valley was surveyed from 16 to 25 March using 13.9 km (7.5 nmi) transect spacing. Acoustic backscatter was measured along 1,265 km (683 nmi) of tracklines (Fig. 19). Bottom depths ranged from 50 m at the shallowest to 325 m at the deepest.

Physical Oceanography

Surface water temperatures in Shelikof Strait averaged 3.7°C overall and 3.5° C at trawl locations (Figs. 20 and 26), similar to the historic mean of the 29 past surveys in this area. Temperatures increased with depth down to approximately 250 m, rising to an average of 4.8° C.

Trawl Samples

Biological data and specimens were collected in the Shelikof Strait area from 22 AWT hauls in midwater and 5 PNE hauls (Fig. 19; Tables 10, 13-15). For these five hauls, the PNE was fished close to but not on the bottom. An additional seven AWT experimental hauls were conducted in midwater at two locations to quantify escapement of juvenile walleye pollock from the net.

Walleye pollock and eulachon (*Thaleichthys pacificus*) were the most abundant species by weight and numbers in AWT hauls, contributing 96.2% and 2.7% by weight, and 80.8% and 18.2% by numbers, respectively (Table 14). Walleye pollock and eulachon were also the most abundant species in the PNE hauls, accounting for 86.7% and 4.9% by weight, and 29.2% and 58.2% by number, respectively (Table 15). However, eulachon, which composed 3% of the overall catch by weight, were less prevalent than in previous years where they have ranged from 4% to 45% of the total catch by weight (average 17% since 2003).

The unweighted maturity composition in the Shelikof Strait area for males longer than 40 cm FL (n = 247) was 7% immature, 6% developing, 23% mature pre-spawning, 63% spawning, and 1% spent (Fig. 27a). The maturity composition of females longer than 40 cm FL (n = 321) was 8% immature, 5% developing, 83% pre-spawning, 4% spawning, and < 1% spent (Fig. 27b). The small fraction of spawning and spent females relative to pre-spawning females suggests that the survey timing was appropriate. The female L_{50} of 47 cm FL (Fig. 27c, n = 530) was similar to that in 2007 and 2008. The average GSI from 160 pre-spawning females of 0.139 (Fig. 27d) is similar to the historical mean of 0.143.

Distribution and Abundance

As in previous years the highest walleye pollock densities were observed along the northwest side of the Strait near Kukak Bay (Fig. 24). Within this deepest section of the strait along the steep banks of the Alaska Peninsula, dense aggregations of pre-spawning adult fish primarily in the 45 to 65 cm FL range were detected (Figs. 28a and 30a). These pre-spawning adult fish were predominantly between the ages of 5 and 9 years old, with some as old as 15 years.

Dense midwater aggregations were detected in the northeast portion of the Strait near Afognak Island, and throughout the remainder of the Strait from Katmai Bay to Sutwik Island. In the northeast near Afognak Island these aggregations consisted mainly of walleye pollock in the 9 to 16 cm FL range (Fig. 28b), representing age-1 fish. Near-bottom aggregations located in the north-central thru southern regions of the Strait also contained age-1 fish along with several different adult size groups. In the north-central area near Katmai Bay age-1 fish were mixed with large adults in the 45 to 65 cm FL range (Fig. 28c). In the mid-central Strait from Katmai Bay to approximately Port Wrangell age-1 fish were mixed with adults in the 30 to 40 cm Fl range (Fig. 28d). The size range remained similar south to the Sutwik Island area but contained a larger proportion of age-1 fish (Fig. 28e). Most adult fish were generally distributed within the bottom 50 m in waters from 200 to 300 m deep (Figs. 29 and 30b) and would partially disperse into the water column at night. In deeper areas the age-1 fish would also school up during the day into very dense aggregations at approximately 180 m depth (Fig. 30c).

The Shelikof Strait biomass estimate of 891,261 t is the largest seen in the region since 1985 and is 40% greater than the historical mean for this survey (Table 6; Fig. 31). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 5.3%. Walleye pollock larger than 45 cm made up 57% of the biomass and only 5% of the numbers in Shelikof Strait in 2013 while fish less than 18 cm made up 81% of the walleye pollock numbers and only 7% of the biomass (Fig. 32; Tables 16-17). The number of age-1 walleye pollock was the largest that has been seen since 1995 (Table 18; Fig. 33) and is six times greater than the 29-survey mean for this age group. Very few age-2 fish were seen and they contributed the lowest amount of biomass for that age class since 2007. Age-3 walleye pollock ranged in length from 30 to 43 cm and represented 10% of all walleye pollock numbers and 31% of the biomass. The biomass of the 6 thru 8-year-old walleye pollock in Shelikof Strait in 2013 was also above the long-term average, even though the numbers were slightly lower (Tables 18 and 19).

GOA Shelf Break from Chirikof Island to Barnabas Trough

The GOA shelf break from south of Barnabas Trough to southeast of Chirikof Island between approximately the 100 and 1,000-m bottom depth contours was surveyed from 25 to 27 March. Acoustic backscatter was measured along 307 km (166 nmi) of trackline (Fig. 19). Transects were placed perpendicular to bottom depth contours on the slope, and transect midpoints were spaced approximately 11.1 km (6 nmi) apart along the 300-m contour.

Physical Oceanography

Surface water temperatures on the Chirikof shelf break area averaged 4.5° C (Figs. 20 and 34), which was roughly the same as in 2003, 2005, and 2010. The temperatures at the depths where most walleye pollock biomass occurred (250 m) averaged 5.2° C, similar to the average in 2010.

Trawl Samples

Biological data and specimens were collected from four AWT hauls in midwater (Tables 10, 13, and 20; Fig. 19). Walleye pollock was the most abundant species caught by weight (90.7%) and numbers (76.1%) on the Chirikof shelf break (Table 20). Two areas containing backscatter that resembled that of walleye pollock were sampled (Hauls 42 and 44) and determined to be Pacific ocean perch (POP; *Sebastes alutus*; 98.6% by weight in hauls). Additional backscatter resembling that of walleye pollock was seen on other transects but no trawl verification was performed so those aggregations were designated as unidentified fish. The backscatter designated as POP comprised 4% of the total in the area and backscatter assigned to unidentified fish totaled 6% of all backscatter in the area.

The walleye pollock captured in the AWT hauls ranged from 47 to 75 cm FL with a mode of 62 cm FL (Fig. 35). As is typical for this survey, no juvenile walleye pollock were captured. The unweighted maturity composition for males longer than 40 cm FL (n = 15) was 0% immature, 0% developing, 27% pre-spawning, 73% spawning, and 0% spent (Fig. 36a). The unweighted maturity composition for females longer than 40 cm FL (n = 130) was 0% immature, 0% developing, 92% pre-spawning, 8% spawning, and 0% spent (Fig. 36b). The high percentage of pre-spawning females together with the very low percentage of spawning and spent female fish suggests that spawning may occur in this area and that survey timing was appropriate to assess the pre-spawners that aggregate here. Because all 130 female walleye pollock observed on the Chirikof shelf break were mature, a logistic model could not be fit to the female maturity-at-length data (Fig. 36c). The average GSI of pre-spawning females based on 40 samples was 0.199, slightly higher than the historical maximum mean of 0.197 (Fig. 36d). Of note is the large ratio of females encountered compared to males (~9:1), which has been seen to a smaller extent in past surveys of this area (~2:1 2004-2007 and ~5:1 2008-2012).

<u>Distribution and Abundance</u>

Most walleye pollock backscatter in the Chirikof survey was detected on two separate transects, one just west of the mouth of Barnabas Trough and the other due south of the Trinity Islands and east of Chirikof Island (Fig. 24). Walleye pollock were primarily in dense layers between 250 and 350 m deep over bottom depths of 300-800 m (Fig. 37).

The walleye pollock biomass estimate of 63,008 t is 1.7 times larger than the 2002-2012 mean for this survey (Table 6). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 31.4%.

Special Projects

Ovaries were collected from prespawning walleye pollock to investigate interannual variation in fecundity of mature females, and from female walleye pollock of all maturity stages for a histological study (Martin.Dorn@noaa.gov, 206-526-6548). Cephalopods of all species and size ranges encountered were collected for use in identifying cephalopod beaks in fish stomachs (Elaina.Jorgensen@noaa.gov, 206-526-4562). During DY2013-03, spawning walleye pollock were collected, spawned, and the fertilized eggs transported to Seattle to examine genomic evidence of localized adaptation and for developing a model to estimate the growth of walleye pollock larvae (Steve.Porter@noaa.gov, 206-206-4271). Results for all special projects will be reported elsewhere.

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TABLES AND FIGURES

Table 1. -- Simrad ER60 38 kHz acoustic system description and settings used during the late winter/early spring 2013 acoustic-trawl surveys of walleye pollock in the Gulf of Alaska. Also presented are results from standard sphere acoustic system calibrations conducted in

	2013 Winter System Settings	9 Feb. Volcano Bay Alaska	27 Mar. Three Saints Bay Alaska	Analysis Parameters
Echosounder	Simrad ER60	--	--	Simrad ER60
Transducer	ES38B	--	--	ES38B
Frequency (kHz)	38	--	--	38
Transducer depth (m)	9.15	--	--	9.15
Pulse length (ms)	1.024	--	--	1.024
Transmitted power (W)	2000	--	--	2000
Angle sensitivity along	22.83	--	--	22.83
Angle sensitivity athwart	21.43	--	--	21.43
2-way beam angle (dB)	-20.77	--	--	-20.77
Gain (dB)	22.97	22.97	22.86	22.91
s_A correction (dB)	-0.66	-0.66	-0.58	-0.62
Integration gain (dB)	22.31	22.31	22.28	22.29
3 dB beamwidth along	6.65	6.65	6.70	6.68
3 dB beamwidth athwart	7.13	7.13	7.18	7.16
Angle offset along	-0.08	-0.08	-0.10	-0.09
Angle offset athwart	-0.09	-0.09	-0.08	-0.09
Post-processing sv threshold (dB)	-70	--	--	-70
Standard sphere TS (dB)	--	-41.68	-42.37	--
Sphere range from transducer (m)	--	23.07	30.07	--
Absorption coefficient (dB/m)	0.0099	0.0095	0.0100	--
Sound velocity (m/s)	1466.0	1453.9	1463.6	--
Water temp at transducer (°C)	--	2.2	4.0	--

Note: Gain and beam pattern terms are defined in the Operator Manual for Simrad ER60 Scientific echosounder application, which is available from Simrad Strandpromenaden 50, Box 111, N-3191 Horten, Norway.

Table 2. -- Summary of trawl and catch data from the 2013 walleye pollock acoustic-trawl surveys of the Shumagin Islands (hauls 1-9), Sanak Trough (hauls 10-11), and Morzhovoi Bay (haul 12).

Haul	Gear[1]	Date	Time	Duration	Start position		Depth (m)		Temp. (° C)[2]		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	footrope	bottom	headrope	surface	(kg)	number	(kg)
1	PNE	26-Feb	20:06	15	55° 45.76'	159° 48.61'	123	126	4.3	2.7	17.1	1,904	84.8
2	AWT	27-Feb	3:33	43	55° 31.20'	159° 45.87'	163	173	3.6	2.9	14.4	527	3.3
3	AWT	27-Feb	12:26	50	55° 19.99'	159° 26.66'	104	170	3.9	3.4	104.9	12,068	16.6
4	AWT	27-Feb	16:08	5	55° 19.34'	159° 17.04'	158	179	4.7	3.3	118.2	16,377	6.2
5	AWT	27-Feb	22:21	3	55° 14.67'	159° 1.58'	155	205	4.9	3.2	78.0	11,748	3.3
6	AWT	28-Feb	5:03	5	55° 9.13'	158° 47.35'	194	202	5.0	3.5	279.8	9,836	22.6
7	AWT	28-Feb	23:19	19	55° 33.24'	160° 7.86'	164	181	4.3	3.0	40.7	4,348	30.7
8	AWT	1-Mar	6:23	9	55° 29.76'	160° 22.52'	122	129	3.8	2.9	104.7	7,322	44.7
9	AWT	1-Mar	16:46	15	55° 8.88'	160° 17.78'	144	192	3.1	3.0	462.9	43,557	44.2
10	AWT	2-Mar	4:37	13	54° 40.34'	162° 36.04'	120	143	3.2	1.9	1,306.3	804	22.2
11	PNE	2-Mar	22:18	10	54° 31.00'	162° 39.15'	137	139	4.3	2.9	111.2	1,242	124.3
12	AWT	3-Mar	4:56	14	54° 58.57'	162° 59.68'	82	91	1.8	1.7	387.1	7,647	19.8

[1]Gear type: AWT = Aleutian wing trawl, PNE = poly Nor' Eastern bottom trawl
[2]Temperature from Sea-Bird Electronics SBE-39 attached to trawl net headrope

Table 3. -- Summary of catch by species in eight Aleutian wing trawls conducted in midwater during the 2013 walleye pollock acoustic-trawl survey of the Shumagin Islands area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	2,510.0	92.8	106,587	87.4
Pacific cod	*Gadus macrocephalus*	91.3	3.4	30	<0.1
eulachon	*Thaleichthys pacificus*	39.0	1.4	6,562	5.4
capelin	*Mallotus villosus*	13.2	0.5	3,812	3.1
arrowtooth flounder	*Atheresthes stomias*	12.6	0.5	39	<0.1
smooth lumpsucker	*Aptocyclus ventricosus*	11.6	0.4	7	<0.1
shrimp unident.	*Decapoda* (order)	8.7	0.3	4,161	3.4
Pacific halibut	*Hippoglossus stenolepis*	6.1	0.2	5	<0.1
flathead sole	*Hippoglossoides elassodon*	5.9	0.2	40	<0.1
squid unident.	*Teuthoidea* (order)	2.7	0.1	536	0.4
northern sea nettle	*Chrysaora melanaster*	1.0	0.0	1	<0.1
sea pen or sea whip unident	*Octocorallia* (subclass)	0.7	<0.1	4	<0.1
rex sole	*Glyptocephalus zachirus*	0.3	<0.1	4	<0.1
poacher unident.	*Agonidae* (family)	0.2	<0.1	28	<0.1
Pacific herring	*Clupea pallasii*	0.2	<0.1	36	<0.1
jellyfish unident.	*Scyphozoa* (class)	0.1	<0.1	23	<0.1
salps unident.	*Thaliacea* (class)	0.1	<0.1	5	<0.1
sculpin unident.	*Cottoidea* (superfamily)	0.1	<0.1	13	<0.1
sculptured shrimp	*Sclerocrangon boreas*	<0.1	<0.1	25	<0.1
Total		2,703.7		121,918	

Table 4. -- Summary of catch by species in the poly-Nor'eastern trawl conducted on bottom during the 2013 walleye pollock acoustic-trawl survey of the Shumagin Islands area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	17.1	16.8	1904	64.5
Pacific cod	*Gadus macrocephalus*	52.3	51.3	14	0.5
flathead sole	*Hippoglossoides elassodon*	16.7	16.4	79	2.7
arrowtooth flounder	*Atheresthes stomias*	11.1	10.9	31	1.1
eulachon	*Thaleichthys pacificus*	2.3	2.2	403	13.7
shrimp unident.	*Decapoda* (order)	1.0	0.9	333	11.3
northern sea nettle	*Chrysaora melanaster*	0.7	0.6	1	0.0
capelin	*Mallotus villosus*	0.3	0.3	156	5.3
rex sole	*Glyptocephalus zachirus*	0.3	0.3	5	0.2
Pacific herring	*Clupea pallasii*	0.1	0.1	21	0.7
eelpout unident.	*Zoarcidae* (family)	0.1	0.1	2	0.1
snail unident.	*Gastropoda* (class)	<0.1	<0.1	1	<0.1
Total		101.9		2,950	

Table 5. -- Number of biological samples and measurements collected during the winter 2013 walleye pollock acoustic-trawl surveys of Shumagin Islands (hauls 1-9), Sanak Trough (hauls 10-11), and Morzhovoi Bay (haul 12).

Haul	Walleye pollock					Eulachon	Capelin
no.	Lengths	Weights	Maturity	Otoliths	Ovaries	lengths	lengths
1	103	8	8	8	3	-	-
2	99	44	44	10	3	-	-
3	122	14	14	14	10	-	-
4	31	5	5	5	2	15	55
5	178	25	-	-	-	-	35
6	294	54	33	33	15	-	-
7	196	8	8	8	5	123	63
8	156	43	43	43	14	-	-
9	271	38	38	38	18	-	-
10	538	167	167	76	26	-	-
11	209	49	49	45	17	-	-
12	327	33	33	33	10	-	-
Total	2524	488	442	313	123	138	153

Table 6. -- Estimates of walleye pollock biomass (in metric tons for the Shelikof Strait, Shumagin Islands, Chirikof Island shelf break, Sanak Trough, Morzhovoi Bay, and Marmot Bay acoustic-trawl surveys.

Year	Shumagin Islands		Sanak Trough		Morzhovoi Bay		Shelikof Strait		Marmot Bay		Chirikof shelf break	
	Biomass	Est. error	Biomass	Est. error	Biomass	Est. error	Biomass	Est. error	Biomass	Est. error	Biomass	Est. error
1981							2,785,800	no est.				
1982							no survey	--				
1983							2,278,200	no est.				
1984							1,757,200	no est.				
1985							1,175,300	no est.				
1986							585,800	no est.				
1987							no estimate	--				
1988							301,700	no est.				
1989							290,500	no est.	2,400	no est.		
1990							374,700	no est.	no estimate	--		
1991							380,300	no est.	no survey	--		
1992							713,400	3.6%	no estimate	--		
1993							435,800	4.6%	no survey	--		
1994	112,000	no est.					492,600	4.5%	no survey	--		
1995	290,100	no est.					763,600	4.5%	no survey	--		
1996	117,700	no est.					777,200	3.7%	no survey	--		
1997	no survey	--					583,000	3.7%	no survey	--		
1998	no survey	--					504,800	3.8%	no survey	--		
1999	no survey	--					no survey	--	no survey	--		
2000	no survey	--					448,600	4.6%	no survey	--		
2001	119,600	no est.					432,800	4.5%	no survey	--		
2002	135,600	27.1%					256,700	6.9%	no survey	--	82,100	12.2%
2003	67,700	17.2%	80,500	21.6%			316,500	5.2%	no survey	--	30,900	20.7%
2004	no survey	--	no survey	--			326,800	9.2%	no survey	--	30,400	20.4%
2005	52,000	11.4%	65,500	7.4%			356,100	4.1%	no survey	--	77,000	20.7%
2006	37,300	10.1%	127,200	10.4%	11,700	15.1%	293,600	4.0%	no survey	--	69,000	11.0%
2007	20,000	8.6%	60,300	5.7%	2,500	15.1%	180,900	5.8%	3,600	5.0%	36,600	6.7%
2008	30,600	9.8%	19,800	6.7%	no survey	--	208,000	5.6%	no survey	--	22,100	9.6%
2009	63,300	10.8%	31,400	17.4%	no survey	--	266,000	5.9%	19,800	no est.	400	32.3%
2010	18,200	11.6%	26,700	11.6%	1,800	no est.	429,700	2.6%	5,600	no est.	9,300	15.0%
2011	no survey	--	no survey	--	no survey	--	no survey	--	no survey	--	no survey	--
2012	15,500	5.2%	24,300	15.6%	no survey	--	335,800	7.9%	no survey	--	21,200	16.4%
2013	**91,300**	**17.3%**	**13,300**	**5.1%**	**2,500**	**11.6%**	**891,261**	**5.3%**	**19,900**	**4.1%**	**63,000**	**31.4%**

[1]Shelikof Strait surveyed in 1987, but no estimate was made due to an equipment malfunction.

[2]Survey conducted after peak spawning had occurred.

[3]Partial survey.

Table 7. -- Summary of catch by species in the Aleutian wing trawl conducted in midwater during the 2013 walleye pollock acoustic-trawl survey of Sanak Trough.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	1,306.3	98.3	804	99.4
Pacific cod	*Gadus macrocephalus*	19.3	1.5	4	0.5
smooth lumpsucker	*Aptocyclus ventricosus*	3.0	0.2	1	0.1
		1,328.6		809	

Table 8. -- Summary of catch by species in the poly-Nor'eastern trawl conducted on bottom during the 2013 walleye pollock acoustic-trawl survey of Sanak Trough.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	111.2	47.2	1,242	72.0
arrowtooth flounder	*Atheresthes stomias*	48.9	20.8	201	11.6
flathead sole	*Hippoglossoides elassodon*	34.9	14.8	127	7.4
Pacific cod	*Gadus macrocephalus*	14.5	6.2	4	0.2
rock sole sp.	*Lepidopsetta* sp.	9.6	4.1	26	1.5
longnose skate	*Raja rhina*	9.5	4.0	1	0.1
Pacific halibut	*Hippoglossus stenolepis*	4.9	2.1	2	0.1
Tanner crab	*Choinoecetes bairdi*	1.4	0.6	2	0.1
eulachon	*Thaleichthys pacificus*	0.6	0.3	117	6.8
basketstar	*Euryalina* (suborder)	0.1	< 0.1	3	0.2
poacher unident.	*Agonidae* (family)	< 0.1	< 0.1	1	0.1
Total		235.5		1,726	

Table 9. -- Summary of catch by species in the Aleutian wing trawl conducted in midwater during the 2013 walleye pollock acoustic-trawl survey of Morzhovoi Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	387.1	95.1	7,647	98.0
smooth lumpsucker	*Aptocyclus ventricosus*	13.1	3.2	6	0.1
salps unident.	*Thaliacea* (class)	3.5	0.9	129	1.7
Pacific cod	*Gadus macrocephalus*	1.8	0.4	1	0.0
northern sea nettle	*Chrysaora melanaster*	0.8	0.2	2	0.0
jellyfish unident.	*Aurelia* sp.	0.5	0.1	4	0.1
eulachon	*Thaleichthys pacificus*	0.2	< 0.1	18	0.2
Total		406.9		7,807	

Table 10. -- Summary of trawl and catch data from the 2013 walleye pollock acoustic-trawl surveys of Marmot Bay (hauls 1-6), Shelikof Strait (hauls 7-40), and the GOA shelf break from Chirikof Island to Barnabas Trough (hauls 41-44).

Haul	Gear[1]	Date	Time	Duration	Start position		Depth (m)		Temp. (° C)[2]		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N) deg	Long. (W) deg	footrope	bottom	headrope	surface	(kg)	number	(kg)
1	Marinovich[3]	15-Mar	6:05	18	57° 56.67	152° 2.58	165	191	4.4	4.3	9.2	4	3.3
2	AWT	15-Mar	15:20	13	57° 56.74	152° 3.55	148	188	4.4	4.4	2,089.7	1,164	6.3
3	AWT	15-Mar	19:16	3	57° 55.66	152° 10.91	151	175	4.4	4.4	3,378.9	1,898	0.1
4	AWT	16-Mar	0:43	2	57° 59.22	152° 18.89	193	248	4.5	4.5	6,985.6	4,258	14.4
5	AWT	16-Mar	6:29	5	58° 0.99	152° 32.8	171	202	4.4	4.4	977.7	595	16.3
6	PNE	16-Mar	11:06	2	57° 55.90	152° 42.19	58	121	4.0	4.0	111.9	855	3.1
7	AWT	16-Mar	22:27	10	58° 21.76	153° 8.36	195	215	5.0	5.0	37.7	3,718	23.6
8	AWT	17-Mar	5:25	5	58° 15.21	153° 16.58	119	221	4.7	4.7	53.6	2,974	0.7
9	PNE	17-Mar	9:30	2	58° 13.78	153° 32.7	172	180	5.0	4.2	29.4	2,502	0.3
10	AWT	17-Mar	13:54	13	58° 14.48	154° 2.3	223	241	4.4	4.4	974.3	660	1.1
11	PNE	17-Mar	16:29	9	58° 13.36	153° 54.2	210	215	5.0	5.0	343.3	253	6.4
12	AWT	17-Mar	19:00	45	58° 14.71	153° 57.42	160	274	4.6	4.6	423.2	265	0.2
13	PNE	18-Mar	0:30	8	58° 1.01	153° 45.97	197	200	5.0	5.0	22.6	737	45.4
14	AWT	18-Mar	4:09	1	58° 9.28	154° 7.55	166	233	4.4	2.5	4,262.0	2,694	0.0
15	AWT	18-Mar	8:38	13	57° 57.49	154° 0.31	190	197	4.9	4.9	139.0	202	18.2
16	AWT	18-Mar	13:32	5	57° 54.59	154° 18	187	215	4.7	4.7	571.0	578	7.1
17	AWT	18-Mar	18:02	3	57° 55.14	154° 41.15	245	256	4.1	2.9	241.8	701	0.4
18	AWT	19-Mar	0:21	3	57° 39.47	154° 27.66	140	190	4.0	4.0	25.5	2,529	0.1
19	AWT[4]	19-Mar	3:08	12	57° 41.42	154° 32.59'	196	212	4.8	4.8	478.0	4,585	61.1
20	AWT[4]	19-Mar	6:05	13	57° 41.51	154° 33.92'	187	213	4.8	4.8	310.8	3,640	44.1
21	AWT[4]	19-Mar	9:52	13	57° 41.31	154° 32.55'	196	211	4.7	4.0	376.6	3,803	30.2
22	AWT[4]	19-Mar	13:01	13	57° 41.38'	154° 31.87'	203	212	4.7	3.2	660.4	3,210	
23	PNE	19-Mar	17:29	1	57° 52.16'	154° 57.07'	216	216	4.5	3.0	113.1	215	5.6
24	AWT	19-Mar	20:52	10	57° 42.94'	154° 58.06'	244	258	4.8	3.6	1,158.5	3,714	69.4
25	PNE	21-Mar	3:37	12	57° 33.06'	155° 27.14'	307	310	4.8	3.1	109.7	1,190	36.9
26	AWT	21-Mar	7:14	5	57° 29.86'	155° 4.74'	222	237	4.9	3.7	883.7	5,813	168.3
27	AWT[4]	21-Mar	10:28	5	57° 29.86'	155° 4.58'	218	236	5.0	3.4	404.5	1,197	94.4
28	AWT[4]	21-Mar	13:19	7	57° 29.94'	155° 4.70'	219	236	4.9	3.4	380.1	3,118	243.8
29	AWT[4]	21-Mar	16:42	6	57° 29.82'	155° 4.36'	225	236	4.9	3.4	349.2	2,571	137.8
30	AWT	21-Mar	19:59	10	57° 25.84'	154° 52.51'	160	205	4.6	3.9	608.4	4,956	13.9
31	AWT	22-Mar	0:14	7	57° 11.4'	155° 5.69'	187	222	4.8	3.9	298.8	7,415	2.9
32	AWT	22-Mar	5:42	8	57° 12.63'	155° 21.25'	240	251	4.9	3.5	837.8	4,501	81.8
33	AWT	22-Mar	11:18	4	57° 12.1'	155° 56.04'	240	256	4.8	3.1	80.1	2,092	7.2
34	AWT	22-Mar	18:55	6	56° 58.63'	155° 27.65'	258	270	5.0	3.8	1,208.6	3,628	38.4
35	AWT	23-Mar	3:02	14	56° 54.82'	155° 52.32'	187	296	3.8	3.9	34.5	1,787	13.4
36	AWT	23-Mar	5:42	10	56° 53.03'	155° 43.94'	271	288	4.9	3.7	219.4	1,993	22.3
37	AWT	23-Mar	12:08	12	56° 44.72'	155° 41.33'	229	265	4.4	3.6	269.2	4,797	8.1
38	AWT	23-Mar	18:32	6	56° 43.59'	156° 16.93'	168	190	4.3	3.6	19.0	2,049	5.8
39	AWT	24-Mar	0:35	5	56° 32.74'	156° 1.46'	256	272	5.1	3.6	565.7	9,526	74.5

Table 10 cont. -- Summary of trawl and catch data from the 2013 walleye pollock acoustic-trawl surveys of Marmot Bay (hauls 1-6), Shelikof Strait (hauls7-40), and the GOA shelf break from Chirikof Island to Barnabas Trough (hauls 41-44).

Haul no.	Gear[1] type	Date (GMT)	Time (GMT)	Duration (minutes)	Start position Lat. (N)	Start position Long. (W)	Depth (m) footrope	Depth (m) bottom	Temp. (° C)[2] headrope	Temp. (° C)[2] surface	Walleye pollock (kg)	Walleye pollock number	Other (kg)
40	AWT	24-Mar	10:04	8	56° 20.73'	156° 23.98'	222	232	4.8	3.7	68.5	3,980	6.8
41	AWT	26-Mar	7:40	14	56° 55.65'	154° 19.09'	281	561	5.0	4.4	291.3	167	17.5
42	AWT	26-Mar	12:27	8	56° 54.93'	153° 49.56'	293	307	5.0	4.4	-	-	23.6
43	AWT	26-Mar	23:57	13	56° 14.79'	152° 51.63'	334	710	5.0	4.7	2,026.5	987	46.5
44	AWT	27-Mar	5:17	7	56° 21.33'	152° 32.18'	276	810	5.5	4.7	-	-	151.2

[1]Gear type: AWT = Aleutian wing trawl, PNE = poly Nor' Eastern bottom trawl

[2]Temperature from Sea-Bird Electronics SBE-39 attached to trawl net headrope

[3]Experimental trawl investigating vertical opening and catchability

[4]Experimental trawls investigating juvenile escapement

Table 11. -- Summary of catch by species in four Aleutian wing trawls conducted in midwater during the 2013 walleye pollock acoustic-trawl survey of the Marmot Bay area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	13431.9	99.7	7,915	95.5
smooth lumpsucker	*Aptocyclus ventricosus*	14.8	0.1	13	0.2
arrowtooth flounder	*Atheresthes stomias*	14.4	0.1	6	0.1
chinook salmon	*Oncorhynchus tshawytscha*	4.6	<0.1	3	<0.1
eulachon	*Thaleichthys pacificus*	2.3	<0.1	146	1.8
shrimp unident.	Decapoda (order)	0.6	<0.1	189	2.3
flathead sole	*Hippoglossoides elassodon*	0.4	<0.1	1	<0.1
Pacific herring	*Clupea pallasi*	0.1	<0.1	11	0.1
capelin	*Mallotus villosus*	<0.1	<0.1	1	<0.1
		13,469.0		8,285	

Table 12. -- Summary of catch by species in the poly-Nor'eastern trawl conducted on bottom during the 2013 walleye pollock acoustic-trawl survey of the Marmot Bay area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	111.9	97.3	855	69.3
arrowtooth flounder	*Atheresthes stomias*	1.3	1.1	1	0.1
shrimp unident.	Decapoda (order)	0.9	0.7	331	26.8
flathead sole	*Hippoglossoides elassodon*	0.7	0.6	1	0.1
Pacific herring	*Clupea pallasi*	0.1	0.1	28	2.3
eulachon	*Thaleichthys pacificus*	0.1	0.1	5	0.4
prickleback unident.	Stichaeidae (family)	<0.1	<0.1	3	0.2
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	3	0.2
euphausiid unident.	Euphausiacea (order)	<0.1	<0.1	6	0.5
Total		115.0		1,233	

Table 13. -- Number of biological samples and measurements collected during the winter 2013 walleye pollock acoustic-trawl surveys of Marmot Bay (hauls 1-6), Shelikof Strait (hauls 7-40), and Chirikof Shelf break (hauls 41-44).

Haul	Walleye pollock					Eulachon	Capelin	POP	other rockfish	Pacific herring
no.	Lengths	Weights	Maturity	Otoliths	Ovaries	lengths	lengths	lengths		
1	4	4	4	-	-	48	42	-	-	-
2	226	44	44	44	6	-	-	-	-	-
3	230	36	36	36	7	-	-	-	-	-
4	283	56	56	34	11	-	-	-	-	-
5	232	45	45	34	8	29	-	-	-	11
6	254	60	55	42	7	5	-	-	-	28
7	221	19	19	7	-	42	-	-	-	-
8	66	66	16	21	8	19*	-	-	-	27
9	55	13	3	8	1	8*	-	-	-	7
10	234	44	44	40	-	-	-	-	-	-
11	213	44	44	40	-	-	-	-	-	-
12	265	47	47	-	-	-	-	-	-	-
13	67	28	18	18	7	50*	-	-	-	-
14	259	46	45	25	8	-	-	-	-	-
15	202	43	33	31	8	51*	-	-	-	-
16	301	43	43	35	10	33	-	-	-	-
17	284	53	48	41	2	23	-	-	-	-
18	56	12	7	8	3	9	1	-	-	2
19	279	-	-	-	-	51	-	-	-	-
20	247	-	-	-	-	51	3	-	-	1
21	292	-	-	-	-	51	3	-	-	10
22	368	-	-	-	-	92	-	-	-	39
23	127	26	26	26	5	56	-	-	-	-
24	431	43	43	43	-	70	-	-	-	-
25	237	64	77	31	9	50	-	-	-	-
26	394	79	52	30	-	50	-	-	-	-
27	358	-	-	-	-	67	-	-	-	-
28	250	-	-	-	-	54	-	-	-	-
29	413	-	-	-	-	101	-	-	-	-
30	275	39	39	39	8	85	-	-	-	-
31	214	57	46	30	9	50	-	-	-	-
32	363	68	58	31	8	51	-	-	-	-
33	107	10	-	10	-	43	18	-	-	3
34	339	77	77	61	7	50	1	-	-	-
35	42	22	12	12	-	30	-	-	-	-
36	322	84	73	73	-	53	5	-	-	-
37	398	71	71	58	12	48	-	-	-	-
38	41	-	-	-	-	47	-	-	-	-
39	369	93	83	53	7	49*	-	-	-	-
40	69	39	29	29	8	33	-	-	-	-
41	167	71	71	71	20	-	-	15	-	-
42	-	-	-	-	-	4	-	37	-	-
43	301	74	74	74	20	-	-	2	5	-
44	-	-	-	-	-	-	-	30	-	-
Total:	9,855	1,620	1,438	1,135	199	1,376	73	84	5	128

* Lengths and Weights measured

Table 14. -- Summary of catch by species in the 22 non-experimental Aleutian wing trawls conducted in midwater during the 2013 walleye pollock acoustic-trawl survey of Shelikof Strait.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	12,414.5	96.2	61,046	80.8
eulachon	*Thaleichthys pacificus*	348.1	2.7	13,771	18.2
smooth lumpsucker	*Aptocyclus ventricosus*	60.6	0.5	44	0.1
magistrate armhook squid	*Berryteuthis magister*	34.0	0.3	141	0.2
chinook salmon	*Oncorhynchus tshawytscha*	24.7	0.2	15	<0.1
longnose skate	*Raja rhina*	12.0	0.1	1	<0.1
northern smoothtongue	*Leuroglossus schmidti*	3.8	<0.1	89	0.1
rougheye rockfish	*Sebastes aleutianus*	2.7	<0.1	1	<0.1
jellyfish unident.	Scyphozoa (class)	1.5	<0.1	3	<0.1
capelin	*Mallotus villosus*	0.7	<0.1	145	0.19
flathead sole	*Hippoglossoides elassodon*	0.4	<0.1	1	<0.1
shrimp unident.	Decapoda (order)	0.4	<0.1	210	0.28
arrowtooth flounder	*Atheresthes stomias*	0.4	<0.1	2	<0.1
Pacific herring	*Clupea pallasi*	0.3	<0.1	51	0.07
squid unident.	Cephalopoda (class)	0.1	<0.1	12	<0.1
Pacific glass shrimp	*Pasiphaea pacifica*	0.1	<0.1	46	0.06
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	7	<0.1
isopod unident.	Isopoda (order)	<0.1	<0.1	5	<0.1
Total		12,904.3		75,590	

Table 15. -- Summary of catch by species in the five poly-Nor'eastern trawls conducted on bottom during the 2013 walleye pollock acoustic-trawl survey of Shelikof Strait.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	618.1	86.7	500	29.2
eulachon	*Thaleichthys pacificus*	34.8	4.9	996	58.2
big skate	*Raja binoculata*	21.2	3.0	1	0.1
arrowtooth flounder	*Atheresthes stomias*	18.5	2.6	17	1.0
magistrate armhook squid	*Berryteuthis magister*	6.7	0.9	15	0.9
smooth lumpsucker	*Aptocyclus ventricosus*	5.9	0.8	4	0.2
flathead sole	*Hippoglossoides elassodon*	4.3	0.6	10	0.6
Dover sole	*Microstomus pacificus*	1.3	0.2	1	0.1
Northern sea nettle	*Chrysaora melanaster*	0.8	0.1	1	0.1
sidestripe shrimp	*Pandalopsis dispar*	0.7	0.1	88	5.1
jellyfish unident.	Scyphozoa (class)	0.2	<0.1	1	0.1
shrimp unident.	Decapoda (order)	0.1	<0.1	40	2.3
northern smoothtongue	*Leuroglossus schmidti*	0.1	<0.1	3	0.2
Pacific herring	*Clupea pallasi*	0.1	<0.1	10	0.6
spinyhead sculpin	*Dasycottus setiger*	<0.1	<0.1	1	0.1
Pacific glass shrimp	*Pasiphaea pacifica*	<0.1	<0.1	15	0.9
sculpin unident.	Cottidae (family)	<0.1	<0.1	1	0.1
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	3	0.2
capelin	*Mallotus villosus*	<0.1	<0.1	1	0.1
isopod unident.	Isopoda (order)	<0.1	<0.1	2	0.1
Total		712.6		1,710	

Table 16. -- Numbers-at-length estimates (millions) from acoustic-trawl surveys of walleye pollock in the Shelikof Strait area.
No surveys were conducted in 1982, 1999, or 2011, and no estimate was produced for 1987 due to mechanical problems.

Length	1981	1983	1984	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	<1	0	0	0	<1	0	0	0	0	0	<1	0	0
9	0	0	0	21	60	0	4	1	1	<1	<1	4	163	0	3	4	29	4	0	0	<1	6	4	<1	7	1	1	<1	82
10	0	0	0	310	175	0	47	5	0	4	3	32	1,120	3	3	16	372	33	0	1	10	106	36	4	25	16	10	2	801
11	2	0	1	581	206	4	133	16	4	27	16	51	3,906	12	20	70	1,162	87	0	8	15	476	61	14	161	74	20	8	1,935
12	10	1	60	810	102	8	153	16	9	74	26	60	3,779	20	21	140	1,565	87	5	14	24	621	39	20	407	134	28	22	2,240
13	26	1	0	278	32	4	50	9	4	79	13	33	1,538	18	15	104	999	52	2	20	3	296	13	11	412	74	21	34	800
14	31	0	1	79	1	1	9	1	4	36	3	6	157	4	7	49	320	24	1	8	1	98	5	4	265	30	7	18	321
15	5	0	0	13	0	<1	3	<1	<1	6	1	<1	25	<1	1	10	30	2	1	1	<1	19	2	1	77	2	1	9	104
16	5	0	0	1	3	0	<1	0	<1	1	0	<1	1	5	<1	2	7	2	0	<1	<1	4	1	0	11	1	<1	2	34
17	1	1	0	<1	7	0	0	4	<1	0	0	0	1	51	<1	<1	1	20	0	<1	<1	<1	7	2	2	0	<1	0	8
18	5	1	0	1	41	1	<1	36	1	0	<1	1	4	249	1	<1	10	185	<1	0	<1	1	23	8	0	6	<1	0	<1
19	12	8	0	2	187	2	1	165	7	<1	<1	<1	16	634	1	1	32	808	3	1	1	2	75	24	5	7	9	11	1
20	70	70	0	6	444	8	2	341	12	1	4	2	39	945	8	3	81	1,407	15	3	4	8	141	54	5	77	16	55	2
21	280	177	<1	20	535	26	7	362	33	2	8	5	68	772	23	10	147	1,043	36	11	10	20	203	60	20	179	36	156	4
22	733	221	1	75	431	32	17	198	48	5	17	7	92	441	50	16	196	460	29	15	20	29	161	42	38	347	64	184	13
23	952	198	7	152	267	29	23	75	41	8	20	6	93	131	48	20	176	107	43	17	23	38	107	20	83	293	89	189	11
24	695	142	15	151	136	9	19	21	23	10	14	5	73	54	48	21	68	20	56	16	18	30	66	9	117	181	50	142	15
25	389	37	21	75	46	4	11	7	23	6	7	4	53	18	89	10	30	22	128	11	12	16	27	6	76	80	27	65	19
26	219	28	12	36	23	11	5	1	59	5	5	2	36	9	208	8	11	31	239	8	9	7	14	7	36	20	16	34	29
27	90	6	5	16	11	40	3	6	108	3	1	3	27	9	275	6	6	60	250	9	4	2	6	11	30	9	8	9	12
28	70	6	6	6	9	107	3	3	142	3	1	1	17	11	268	5	10	85	210	23	2	3	3	15	19	14	9	10	11
29	83	3	9	3	15	158	6	9	123	8	1	1	5	22	205	10	13	91	124	52	3	1	5	23	13	6	28	1	9
30	235	7	26	5	31	191	12	16	72	19	1	3	2	23	104	25	18	50	74	107	4	8	6	30	11	6	55	6	29
31	420	3	48	6	34	129	23	19	32	25	2	6	6	15	59	42	32	37	42	153	7	8	6	23	27	9	91	2	46
32	492	24	67	4	38	92	27	17	22	37	3	7	4	15	31	78	37	15	25	185	16	2	6	23	38	13	108	5	49
33	490	65	68	11	29	85	24	11	8	48	5	11	8	13	21	102	34	14	29	145	25	10	6	19	42	24	91	6	80
34	499	141	53	22	18	89	28	10	8	67	6	6	6	6	16	99	28	7	20	122	41	3	8	16	31	24	66	6	89
35	592	195	27	27	12	63	37	8	7	85	10	7	11	4	11	103	22	6	17	77	56	10	5	12	32	19	32	6	133
36	665	258	21	41	9	41	53	12	8	83	9	6	15	4	10	84	13	8	7	57	59	4	4	8	17	17	25	6	124
37	541	339	20	44	7	28	62	19	9	84	17	3	14	3	10	66	9	9	5	38	54	18	3	5	19	8	14	5	127
38	403	368	35	53	3	24	66	23	8	65	26	3	20	2	9	45	8	9	6	28	47	10	2	4	7	12	11	4	68
39	352	341	87	64	4	12	57	21	6	36	40	2	9	2	5	26	7	11	6	23	39	11	1	4	3	16	8	3	49

Table 16.--Continued.

Length	1981	1983	1984	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013
40	339	343	138	77	3	13	52	33	10	30	53	3	15	2	8	15	11	9	2	14	35	23	2	4	8	10	9	4	27
41	231	290	170	82	8	8	46	34	9	22	57	5	5	2	4	16	13	12	2	13	35	22	2	3	7	14	9	6	16
42	224	326	219	96	8	5	36	37	13	15	57	9	7	2	5	6	19	8	3	7	38	32	2	2	4	16	10	9	13
43	178	311	271	106	12	5	22	32	14	14	48	16	17	4	4	7	19	7	2	6	32	33	4	3	4	15	11	12	11
44	145	304	309	113	22	3	16	37	19	14	37	23	18	6	5	5	18	7	2	5	27	41	5	2	3	14	11	13	13
45	116	256	316	119	35	2	12	34	21	17	33	36	35	7	3	2	19	8	3	3	24	39	7	3	4	12	15	17	5
46	84	201	283	148	39	2	6	25	24	22	23	39	53	13	4	2	22	5	2	3	18	33	9	2	3	9	14	17	7
47	113	171	213	140	50	2	6	23	22	21	19	46	62	25	4	3	19	5	3	3	17	37	11	3	1	6	11	19	9
48	62	116	158	139	57	2	4	20	26	32	17	37	74	37	6	4	17	6	4	2	11	33	14	3	1	5	12	18	14
49	75	91	104	117	52	3	5	16	20	38	16	33	73	53	13	6	13	9	3	2	8	22	15	4	1	3	10	16	15
50	58	52	68	83	51	4	5	15	19	46	17	29	66	64	20	13	16	8	3	2	7	28	18	6	<1	3	12	17	15
51	50	49	40	52	42	4	4	8	20	40	15	24	51	69	30	18	10	5	4	2	5	14	19	8	<1	3	11	13	27
52	25	23	25	28	21	3	4	8	14	38	14	21	40	64	36	24	11	9	4	2	4	7	19	6	1	4	10	13	19
53	12	17	13	23	18	3	5	7	13	35	14	24	30	53	37	26	10	6	3	2	2	6	16	9	1	2	6	11	23
54	9	7	4	9	6	2	4	5	9	35	13	18	22	39	34	23	9	4	3	1	3	4	12	7	2	2	7	9	31
55	15	9	3	4	11	2	2	7	10	30	11	18	16	29	28	20	9	5	2	1	3	3	13	8	2	2	8	10	23
56	5	2	2	2	2	2	1	2	6	15	9	18	14	19	24	19	8	5	1	<1	2	2	7	6	4	3	6	8	31
57	7	2	1	2	<1	1	1	2	3	18	7	13	7	13	12	12	9	3	1	<1	1	1	5	5	1	2	5	8	22
58	3	1	1	1	1	<1	1	1	5	14	7	11	6	10	8	9	6	2	1	<1	1	1	3	4	2	1	6	8	19
59	1	1	<1	1	<1	<1	1	1	2	4	4	9	3	6	5	8	5	3	1	1	1	1	3	3	3	1	6	5	19
60	0	1	<1	2	1	0	1	1	2	2	3	7	2	5	3	4	2	3	<1	1	<1	1	2	2	2	1	4	5	22
61	0	1	<1	<1	1	<1	<1	<1	1	2	2	5	1	3	2	2	1	1	<1	1	<1	<1	2	2	3	1	5	2	10
62	0	0	1	1	<1	<1	<1	<1	<1	3	1	2	2	2	1	2	2	<1	<1	<1	<1	0	1	1	1	1	4	1	10
63	0	0	1	1	<1	0	<1	<1	1	1	1	1	<1	1	1	2	1	1	<1	<1	<1	1	1	1	1	1	4	2	14
64	0	0	<1	0	<1	0	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	1	4	1	3
65	0	0	0	0	<1	0	0	<1	1	0	<1	1	<1	<1	<1	<1	<1	<1	<1	0	<1	<1	<1	<1	<1	<1	4	1	2
66	0	0	0	<1	<1	0	<1	<1	0	<1	<1	<1	0	<1	<1	<1	<1	1	0	0	0	<1	<1	<1	1	1	3	<1	3
67	0	0	0	0	<1	<1	0	<1	<1	<1	<1	<1	0	<1	<1	0	<1	0	<1	<1	0	0	<1	<1	<1	1	3	<1	<1
68	0	0	0	0	0	0	0	<1	0	0	<1	0	0	<1	<1	<1	0	<1	<1	0	<1	0	<1	<1	<1	<1	1	<1	1
69	0	0	0	0	0	0	0	<1	1	0	<1	<1	0	<1	<1	0	0	0	0	0	0	0	0	<1	<1	<1	<1	0	0
70	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1	<1	1
71	0	0	0	0	0	0	0	<1	0	0	0	<1	0	0	0	0	0	0	<1	0	0	0	0	<1	0	<1	<1	0	1
72	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Total	10,121	5,211	2,928	4,259	3,352	1,266	1,119	1,782	1,109	1,339	740	729	11,931	4,024	1,866	1,425	5,742	4,931	1,424	1,224	780	2,252	1,240	575	2,100	1,832	1,165	1,245	7,668

Table 17. -- Biomass-at-length estimates (thousands of metric tons) from acoustic-trawl surveys of walleye pollock in the Shelikof Strait area. No surveys were conducted in 1982, 1999, or 2011, and no estimate was produced for 1987 due to mechanical problems.

Length	1981	1983	1984	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	< 1	0	0	0	0	0	0	0	< 1	0	0	0	0	0	<1	0	0
9	0	0	0	< 1	< 1	0	< 1	< 1	< 1	< 1	< 1	< 1	1	0	< 1	< 1	< 1	< 1	0	0	< 1	< 1	< 1	< 1	<1	<1	<1	<1	<1
10	0	0	0	2	1	0	< 1	< 1	0	< 1	< 1	< 1	7	< 1	< 1	< 1	3	< 1	0	< 1	< 1	1	< 1	< 1	<1	<1	<1	<1	5
11	< 1	0	< 1	6	2	< 1	1	< 1	< 1	< 1	< 1	< 1	35	< 1	< 1	1	11	1	0	< 1	< 1	4	< 1	< 1	2	1	<1	<1	15
12	< 1	< 1	1	10	1	< 1	2	< 1	< 1	1	< 1	1	44	< 1	< 1	1	20	1	< 1	< 1	< 1	7	< 1	< 1	4	1	<1	<1	21
13	< 1	< 1	0	4	< 1	< 1	1	< 1	< 1	1	< 1	< 1	23	< 1	< 1	1	16	1	< 1	< 1	< 1	4	< 1	< 1	6	1	<1	<1	10
14	1	0	< 1	2	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1	3	< 1	< 1	1	7	< 1	< 1	< 1	< 1	2	< 1	< 1	5	1	<1	<1	5
15	< 1	0	0	< 1	0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	<1	<1	<1	2
16	< 1	0	0	< 1	< 1	0	< 1	0	< 1	< 1	0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0	< 1	< 1	< 1	< 1	< 1	<1	<1	<1	<1	1
17	< 1	< 1	0	< 1	< 1	0	0	< 1	< 1	0	0	0	< 1	2	< 1	< 1	< 1	1	0	< 1	< 1	< 1	< 1	< 1	<1	0	<1	0	<1
18	< 1	< 1	0	< 1	2	< 1	< 1	1	< 1	0	< 1	< 1	< 1	9	< 1	< 1	< 1	6	< 1	0	< 1	< 1	< 1	< 1	<1	<1	<1	0	<1
19	1	< 1	0	< 1	8	< 1	< 1	7	< 1	< 1	< 1	< 1	1	27	< 1	< 1	2	33	< 1	< 1	< 1	< 1	3	1	<1	<1	<1	<1	<1
20	4	4	0	< 1	23	< 1	< 1	16	1	< 1	< 1	< 1	2	48	< 1	< 1	5	68	1	< 1	< 1	< 1	7	3	<1	4	<1	3	<1
21	18	11	< 1	1	33	1	< 1	21	2	< 1	< 1	< 1	4	46	1	1	10	59	2	1	1	1	12	4	1	11	2	10	<1
22	53	16	< 1	6	31	2	1	13	3	< 1	1	1	7	30	4	1	16	31	2	1	1	2	11	3	3	25	4	13	1
23	78	16	1	14	22	2	2	6	3	1	2	1	8	10	4	2	17	8	4	1	2	3	8	2	7	23	7	15	1
24	65	13	2	15	13	1	2	2	2	1	1	1	7	5	5	2	7	2	5	2	2	3	6	1	11	16	5	13	1
25	41	4	2	9	5	< 1	1	1	2	1	1	< 1	6	2	10	1	4	2	14	1	1	2	3	1	8	8	3	6	2
26	26	3	2	5	3	1	1	< 1	7	1	1	< 1	5	1	25	1	1	4	29	1	1	1	2	1	5	2	2	4	3
27	12	1	1	2	2	5	< 1	1	14	< 1	< 1	< 1	4	1	38	1	1	8	35	1	< 1	< 1	< 1	1	4	1	1	1	1
28	11	1	1	1	1	16	< 1	< 1	21	< 1	< 1	< 1	3	2	42	1	2	13	33	3	< 1	< 1	< 1	2	3	2	1	2	2
29	14	1	2	1	3	26	1	1	20	1	< 1	< 1	1	4	36	2	2	15	22	9	1	< 1	< 1	4	2	1	5	<1	2
30	44	1	5	1	6	35	2	3	13	4	< 1	1	< 1	4	20	5	4	9	15	20	1	2	1	5	2	1	11	1	6
31	86	1	10	1	7	27	5	4	7	5	< 1	1	1	3	13	9	8	8	9	32	1	2	1	5	6	2	19	<1	10
32	111	5	16	1	9	21	6	4	5	9	1	2	1	3	7	19	10	3	6	43	4	1	1	5	10	3	25	1	12
33	122	16	18	3	7	22	6	3	2	12	1	3	2	3	5	26	10	4	8	37	7	3	2	5	12	6	23	2	21
34	136	39	15	6	5	25	8	3	2	19	2	2	2	2	5	28	9	2	6	34	12	1	2	5	10	7	18	2	26
35	176	59	9	9	4	19	11	2	2	27	3	2	4	1	4	33	8	2	6	24	18	3	2	4	11	6	9	2	43
36	216	84	7	14	3	14	18	4	3	29	3	2	5	1	3	29	5	3	2	19	20	1	1	3	6	6	9	2	43
37	191	121	7	17	2	11	23	7	3	32	6	1	5	1	4	25	4	3	2	14	21	7	1	2	8	3	5	2	49
38	154	142	14	21	1	10	26	9	3	26	11	1	8	1	4	19	4	4	2	11	20	4	< 1	2	3	5	4	1	29
39	146	143	38	28	2	5	25	9	3	16	18	1	4	1	2	12	3	5	3	10	18	5	< 1	2	2	7	4	1	22

Table 17.-- Continued.

Length	1981	1983	1984	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013
40	152	155	66	37	1	6	24	15	5	15	26	2	7	1	4	7	6	4	1	7	17	12	1	2	4	5	4	2	17
41	112	142	87	42	4	4	23	17	4	11	30	3	3	1	2	8	7	6	1	7	19	13	1	2	4	8	5	3	9
42	117	172	121	53	4	3	20	20	7	9	32	5	4	1	3	3	11	5	2	4	22	19	1	1	3	9	6	5	8
43	100	176	161	63	7	3	13	19	9	9	29	10	10	2	2	4	13	5	1	4	20	21	2	2	3	9	7	8	7
44	87	185	197	72	14	2	10	24	12	9	24	16	12	4	3	3	13	5	1	3	19	27	4	2	2	10	8	8	9
45	75	167	215	81	24	2	8	23	15	12	23	26	24	5	2	2	15	6	2	2	17	27	5	2	3	9	11	12	4
46	58	140	206	107	29	2	4	19	18	17	18	31	39	10	3	1	17	4	2	3	15	24	7	2	2	7	11	12	5
47	83	127	166	108	40	1	5	18	18	17	16	39	49	20	3	3	16	4	2	3	14	29	10	3	1	5	10	15	8
48	49	92	131	115	49	2	3	17	22	29	15	34	63	32	6	4	15	6	3	2	10	28	12	3	1	4	11	15	13
49	63	77	92	102	47	2	4	15	19	36	15	32	66	48	13	6	13	8	3	2	8	19	15	4	1	3	11	15	15
50	51	46	63	78	49	4	4	15	19	47	17	30	63	62	20	13	16	8	3	2	8	28	18	6	<1	3	13	17	16
51	47	47	40	52	43	4	4	8	21	43	16	26	52	71	32	20	12	6	4	2	5	14	22	9	<1	3	12	14	30
52	25	23	26	29	24	3	4	8	15	44	15	24	43	70	41	27	13	10	5	2	5	8	23	7	2	5	12	15	24
53	13	19	15	26	21	4	5	8	15	43	17	29	34	62	45	32	12	8	4	2	3	7	20	11	1	3	9	13	30
54	11	8	5	10	7	3	5	6	12	45	17	23	26	48	44	30	13	6	4	1	4	5	16	10	3	4	10	11	43
55	18	11	4	5	14	3	2	9	14	41	15	24	20	38	38	27	12	7	3	2	4	4	19	11	3	3	13	14	33
56	6	2	2	3	3	2	2	3	9	22	13	27	19	27	35	28	12	8	2	< 1	3	3	10	9	6	4	10	12	46
57	10	3	2	3	< 1	1	2	4	5	28	11	21	10	20	19	18	13	5	2	< 1	1	1	8	8	2	3	9	12	34
58	4	1	1	1	2	1	1	2	7	24	12	19	10	15	13	15	11	4	2	1	2	2	6	8	4	2	11	14	33
59	1	1	< 1	2	1	1	1	2	3	8	7	16	4	11	8	13	8	6	2	2	1	1	6	5	5	3	11	8	33
60	0	1	< 1	3	1	0	1	2	4	4	5	13	3	9	5	8	4	6	1	1	< 1	1	4	4	4	2	7	8	42
61	0	1	1	< 1	1	< 1	1	1	1	4	3	9	3	5	4	4	2	3	1	1	< 1	< 1	4	3	6	3	11	4	19
62	0	0	2	1	1	1	< 1	< 1	1	5	2	4	3	3	2	3	3	1	1	< 1	< 1	0	2	2	3	2	9	3	21
63	0	0	2	2	< 1	0	< 1	< 1	1	3	1	3	< 1	2	2	4	1	3	< 1	< 1	1	1	2	2	3	2	8	3	31
64	0	0	1	0	< 1	0	< 1	< 1	< 1	1	< 1	2	1	1	< 1	1	1	1	< 1	1	< 1	< 1	1	1	4	2	9	2	7
65	0	0	0	0	< 1	0	0	< 1	3	0	< 1	2	< 1	1	< 1	1	< 1	< 1	< 1	0	< 1	< 1	< 1	1	1	1	9	2	6
66	0	0	0	< 1	1	0	< 1	< 1	0	1	< 1	< 1	0	< 1	< 1	1	< 1	3	0	0	0	1	< 1	< 1	2	3	6	<1	7
67	0	0	0	0	1	1	0	< 1	< 1	1	< 1	1	0	< 1	< 1	0	< 1	0	< 1	< 1	0	0	< 1	< 1	1	2	7	1	1
68	0	0	0	0	0	0	0	< 1	0	0	< 1	0	0	< 1	1	< 1	0	1	< 1	0	< 1	0	< 1	< 1	<1	1	4	<1	2
69	0	0	0	0	0	0	0	< 1	2	0	< 1	< 1	0	< 1	< 1	0	0	0	0	0	0	0	0	< 1	<1	1	2	0	0
70	0	0	0	0	0	< 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	3	<1	3
71	0	0	0	0	0	0	0	< 1	0	0	0	< 1	0	0	0	0	0	0	< 1	0	0	0	0	< 1	0	1	2	0	4
72	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1	0	0	0	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Total	2,786	2,278	1,757	1,175	586	302	290	375	380	713	436	493	764	777	583	505	449	433	257	317	331	356	294	181	208	266	430	335.8	891.3

Table 18. -- Numbers-at-age estimates (millions) from acoustic-trawl surveys of walleye pollock in the Shelikof Strait area.
No surveys were conducted in 1982, 1999, or 2011, and no estimate was produced for 1987 due to mechanical problems.

Age	1981	1983	1984	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013	Mean
1	78	1	62	2,092	575	17	399	49	22	228	63	186	10,690	56	70	395	4,484	289	8	48	53	1,626	162	54	1,368	332	90	95	6,324	1,032
2	3,481	902	58	544	2,115	110	90	1,210	174	34	76	36	510	3,307	183	89	755	4,104	163	94	94	157	836	232	391	1,205	306	852	149	767
3	1,511	380	324	123	184	694	90	72	550	74	37	49	79	119	1,247	126	217	352	1,107	205	58	56	41	175	250	110	532	43	803	331
4	769	1,297	142	315	46	322	216	63	48	188	72	32	78	25	80	474	16	61	97	800	159	35	12	30	53	99	84	77	61	198
5	2,786	1,171	635	181	75	78	249	116	65	368	233	155	103	54	18	136	67	42	16	56	357	173	17	10	12	60	79	96	69	258
6	1,052	698	988	347	49	17	43	180	70	84	126	84	245	71	44	14	132	23	16	8	48	162	56	17	2	10	29	46	114	165
7	210	599	450	439	86	6	14	46	116	85	27	42	122	201	52	32	17	35	8	4	3	36	75	34	4	3	12	29	65	98
8	129	132	224	167	149	6	4	22	24	171	36	27	54	119	98	36	13	13	7	2	3	4	32	21	11	1	5	4	49	54
9	79	14	41	43	60	4	2	8	29	33	39	44	17	40	53	74	10	6	1	1	3	2	7	2	7	5	5	1	12	22
10	25	12	3	6	11	9	1	8	2	56	16	48	11	13	14	26	8	3	1	< 1	< 1	0	< 1	1	2	6	11	< 1	5	10
11	2	4	0	2	1	2	10	1	4	2	8	15	15	11	2	14	14	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	9	< 1	6	4
12	0	2	1	1	0	2	1	3	1	15	3	7	6	5	3	7	7	2	< 1	0	0	0	< 1	0	0	< 1	3	1	1	2
13	0	0	0	0	0	< 1	< 1	2	4	1	2	1	2	3	1	< 1	2	1	< 1	< 1	< 1	0	0	0	0	0	0	0	2	1
14	0	0	0	0	0	0	0	1	0	< 1	< 1	2	< 1	< 1	< 1	1	1	< 1	< 1	0	0	0	0	0	0	0	0	0	5	< 1
15	0	0	0	0	0	0	0	< 1	0	0	1	< 1	0	0	0	1	0	< 1	0	0	0	0	0	0	0	0	0	0	3	< 1
16	0	0	0	0	0	0	0	< 1	0	0	1	0	0	< 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1
17	0	0	0	0	0	0	0	0	0	0	< 1	< 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1
18	0	0	0	0	0	0	0	< 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1
Total	10,122	5,212	2,928	4,260	3,351	1,267	1,119	1,781	1,109	1,339	740	728	11,932	4,024	1,865	1,425	5,743	4,932	1,424	1,220	777	2,252	1,240	576	2,100	1,832	1,165	1,245	7,668	

Table 19. -- Biomass-at-age estimates (thousands of metric tons) from acoustic-trawl surveys of walleye pollock in the Shelikof Strait area. No surveys were conducted in 1982, 1999, or 2011, and no estimate was produced for 1987 due to mechanical problems.

Age	1981	1983	1984	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013	Mean
1	1	< 1	1	24	4	< 1	4	< 1	< 1	3	1	2	114	1	1	4	57	2	< 1	< 1	< 1	18	1	< 1	19	4	1	1	59	11
2	309	71	6	54	139	8	8	67	12	3	6	3	46	180	15	8	63	214	13	8	8	13	55	15	39	94	24	68	19	54
3	342	117	83	41	40	130	21	15	85	16	11	14	23	24	195	28	60	60	164	42	14	17	11	39	67	29	127	12	279	73
4	255	529	78	159	17	91	86	23	13	60	34	20	41	12	28	153	9	25	29	222	77	19	5	13	26	51	57	50	38	77
5	1,068	650	373	109	56	31	111	61	33	144	136	127	83	50	13	53	54	27	12	25	179	132	14	9	10	44	86	89	80	133
6	496	455	684	253	41	9	27	120	54	68	90	75	220	73	53	12	107	24	16	7	35	119	63	22	3	11	37	62	157	117
7	133	332	331	353	76	6	12	36	106	92	28	48	116	212	61	39	17	40	9	5	4	29	87	47	8	5	22	43	104	83
8	92	94	161	138	140	6	4	24	23	194	43	34	55	132	120	47	17	18	8	2	3	4	43	30	20	2	11	7	87	54
9	68	11	36	35	58	5	3	9	36	36	46	64	19	48	67	95	15	8	2	2	4	3	10	3	13	11	12	2	22	26
10	19	12	3	6	11	11	1	11	3	71	21	68	15	17	20	33	11	5	1	1	< 1	0	1	2	4	13	22	1	11	14
11	1	5	0	2	2	2	12	1	6	3	10	21	20	16	3	21	22	2	1	< 1	< 1	1	2	1	< 1	3	22	< 1	13	7
12	0	1	1	1	0	3	1	4	1	21	4	10	7	7	5	10	11	3	1	0	0	0	1	0	0	< 1	9	< 1	2	4
13	0	0	0	0	0	< 1	< 1	2	7	1	3	2	3	4	1	< 1	4	1	< 1	< 1	< 1	0	0	0	0	0	0	0	4	1
14	0	0	0	0	0	0	0	1	0	1	1	4	1	< 1	1	1	2	1	< 1	0	0	0	0	0	0	0	0	0	11	< 1
15	0	0	0	0	0	0	0	< 1	0	0	1	< 1	0	0	0	1	0	< 1	0	0	0	0	0	0	0	0	0	0	6	< 1
16	0	0	0	0	0	0	0	< 1	0	0	1	0	0	< 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1
17	0	0	0	0	0	0	0	0	0	0	< 1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1
18	0	0	0	0	0	0	0	< 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	< 1
Total	2,786	2,278	1,757	1,175	586	302	290	375	380	713	436	493	764	777	583	505	449	433	257	316	327	356	294	181	208	266	430	336	891.3	

Table 20. -- Summary of catch by species in the four Aleutian wing trawls conducted in midwater during the 2013 walleye pollock acoustic-trawl survey of Chirikof shelf break area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	2317.8	90.7	1,154	76.1
Pacific ocean perch	*Sebastes alutus*	186.4	7.3	280	18.5
shortraker rockfish	*Sebastes borealis*	32.7	1.3	4	0.3
rougheye rockfish	*Sebastes aleutianus*	11.3	0.4	6	0.4
giant grenadier	*Albatrossia pectoralis*	4.3	0.2	2	0.1
smooth lumpsucker	*Aptocyclus ventricosus*	3.5	0.1	2	0.1
lanternfish unident.	Myctophidae (family)	0.2	<0.1	35	2.3
eulachon	*Thaleichthys pacificus*	0.2	<0.1	4	0.3
jellyfish unident.	Scyphozoa (class)	0.1	<0.1	5	0.3
northern smoothtongue	*Leuroglossus schmidti*	0.1	<0.1	6	0.4
squid unident.	Cephalopoda (class)	<0.1	<0.1	9	0.6
Pacific glass shrimp	*Pasiphaea pacifica*	<0.1	<0.1	5	0.3
hatchetfish unident.	Sternoptychidae (family)	<0.1	<0.1	1	0.1
shrimp unident.	Decapoda (order)	<0.1	<0.1	3	0.2
		2,556.7		1,516	

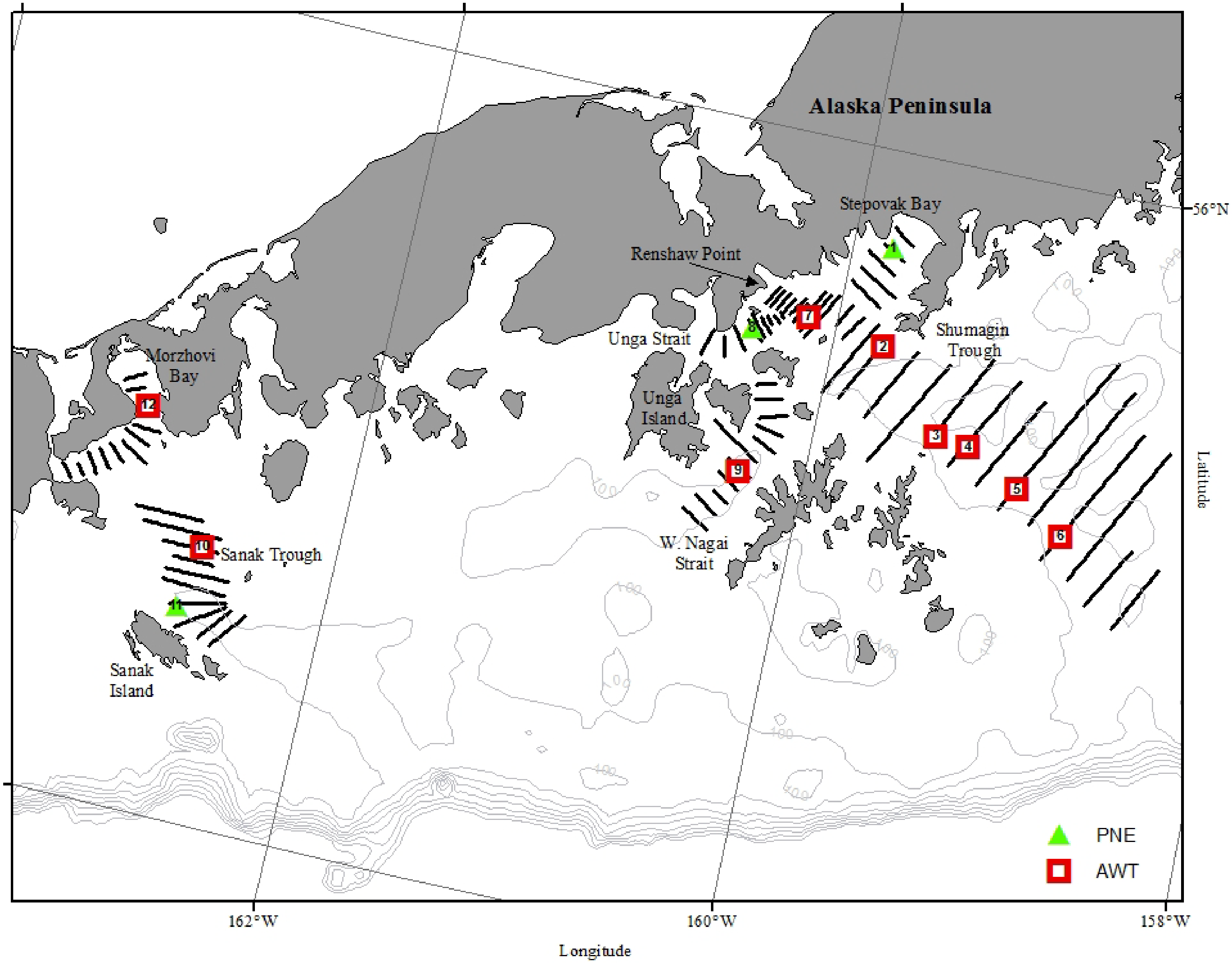


Figure 1. -- Transect lines and locations of Aleutian-wing trawl (AWT) and poly-Nor'eastern trawl (PNE) hauls during the winter 2013 acoustic-trawl survey of walleye pollock in the Shumagin Islands, Sanak Trough, and Morzhovoi Bay. Haul numbers are on top of haul symbols.

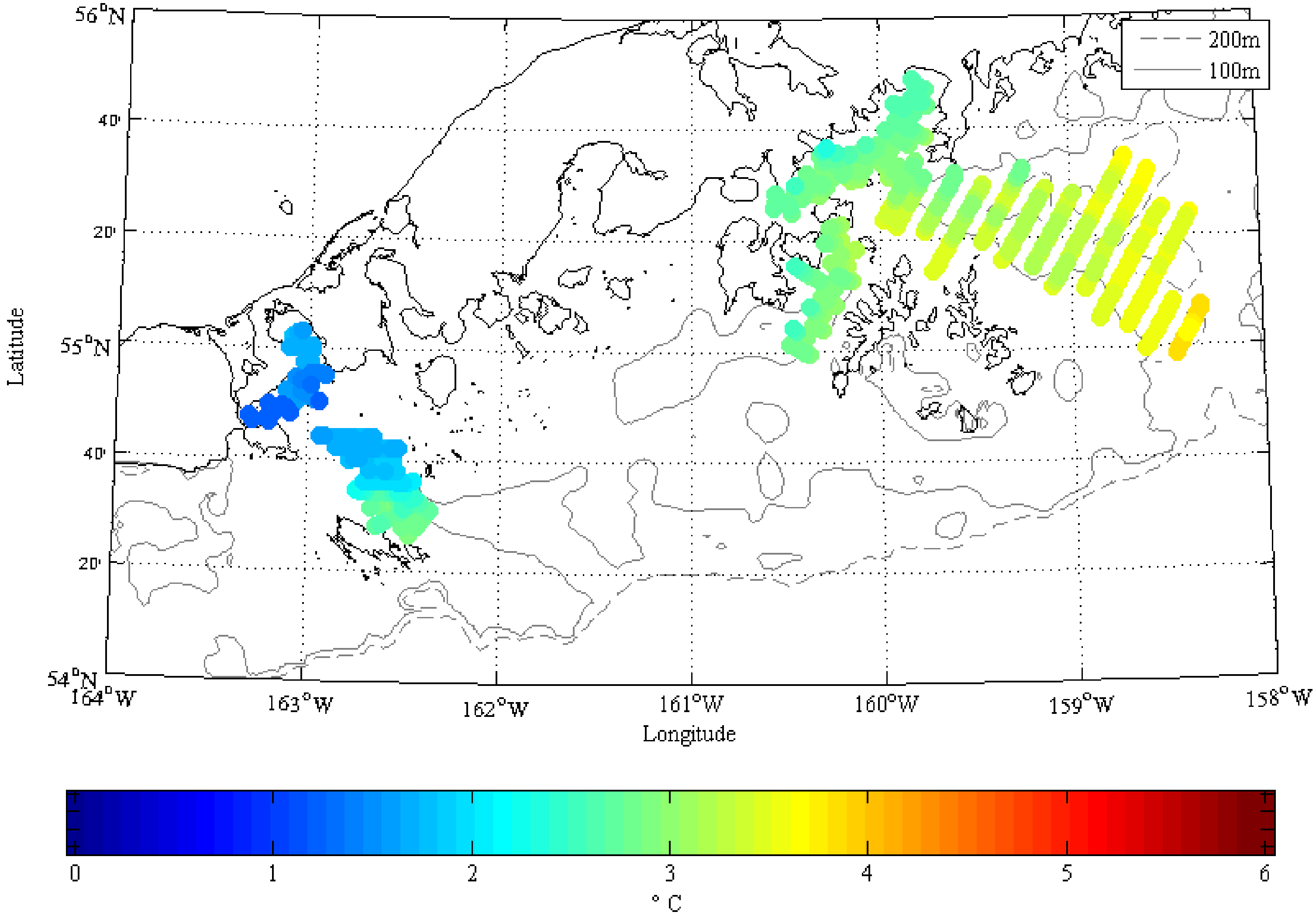


Figure 2. -- Surface water temperatures during the DY1302 acoustic-trawl survey of the Shumagin Islands, Sanak Trough, and Morzhovoi Bay recorded from the ship's Furuno T-2000 temperature probe located 1.4 m below the surface.

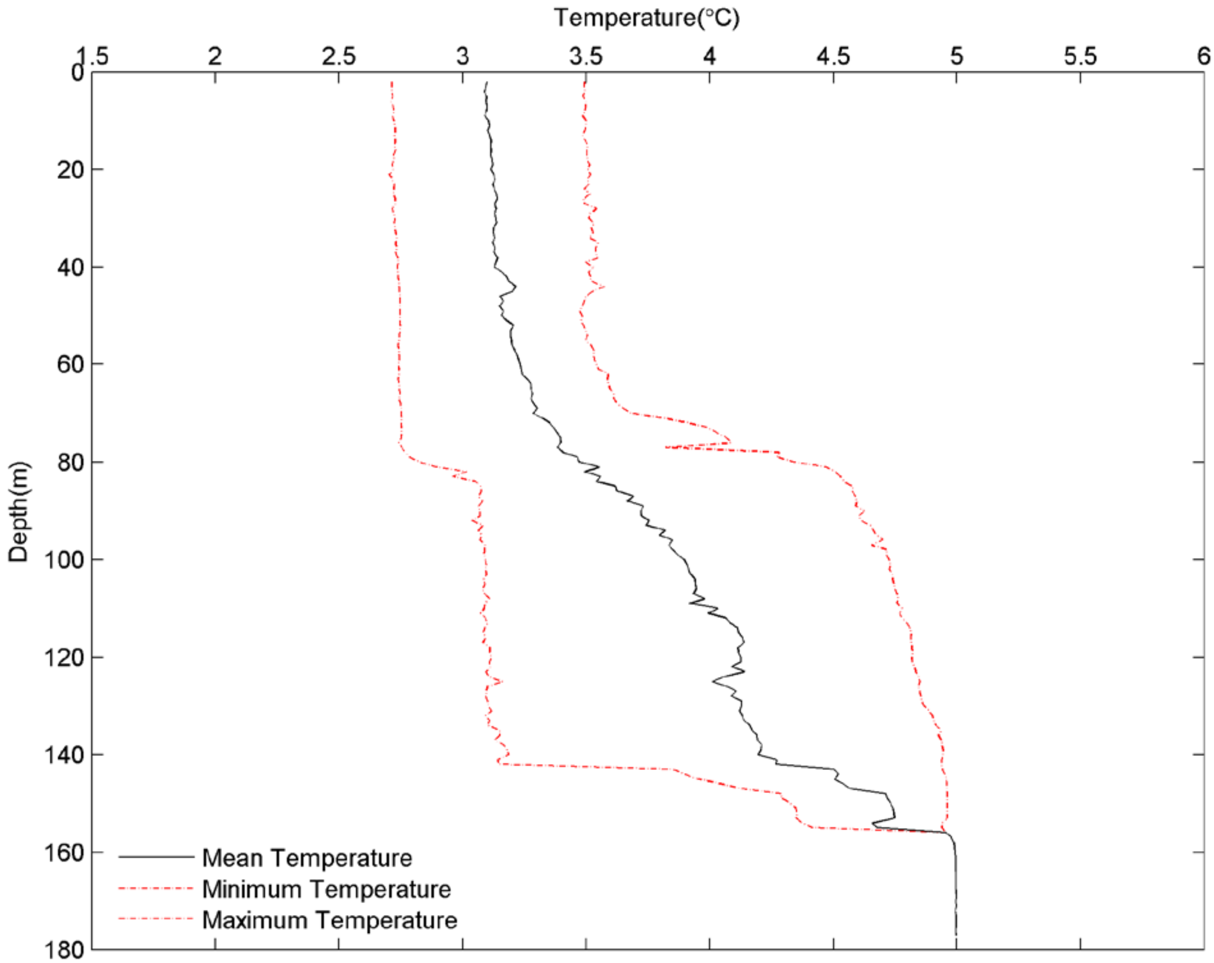


Figure 3. -- Water temperature (°C) by 1-m depth intervals observed during the winter 2013 acoustic-trawl survey of walleye pollock in the Shumagin Trough, W. Nagai Strait, Unga Strait, and Stepovak Bay. Data collected at nine trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope.

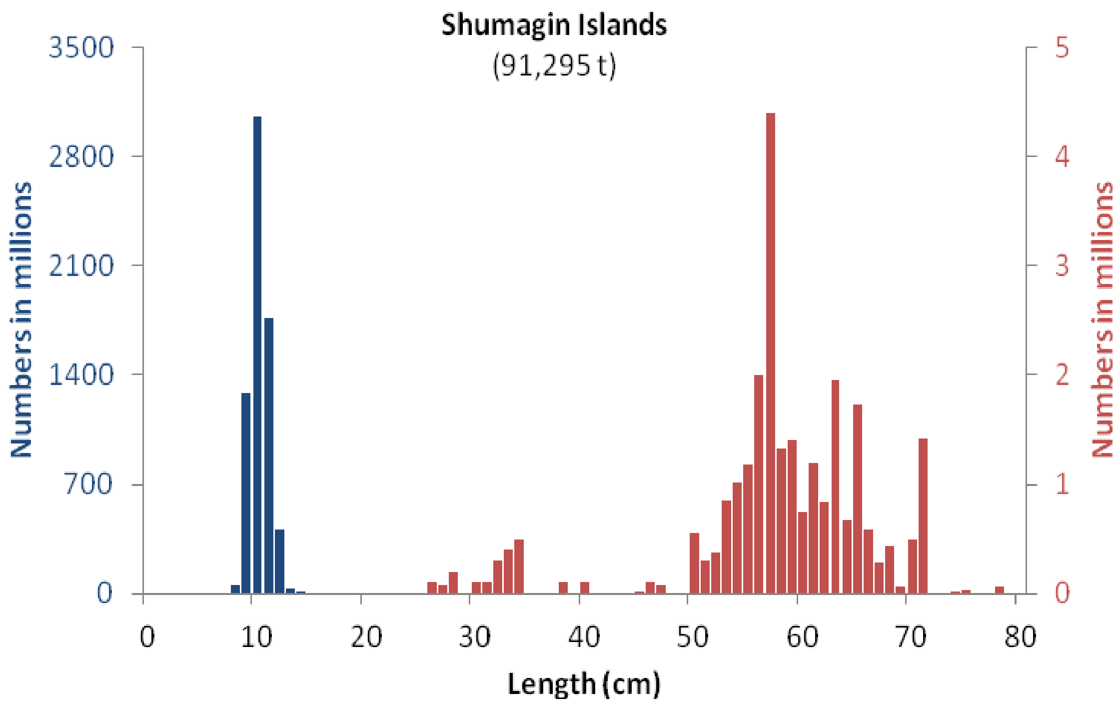


Figure 4. -- Length distribution of walleye pollock (numbers) along with the biomass estimate (metric tons, t) for the 2013 acoustic-trawl survey of Shumagin Islands. Note the numbers of age-1 fish (lengths 8-14cm) are on the primary vertical axis and the rest of the pollock numbers are on the secondary vertical axis.

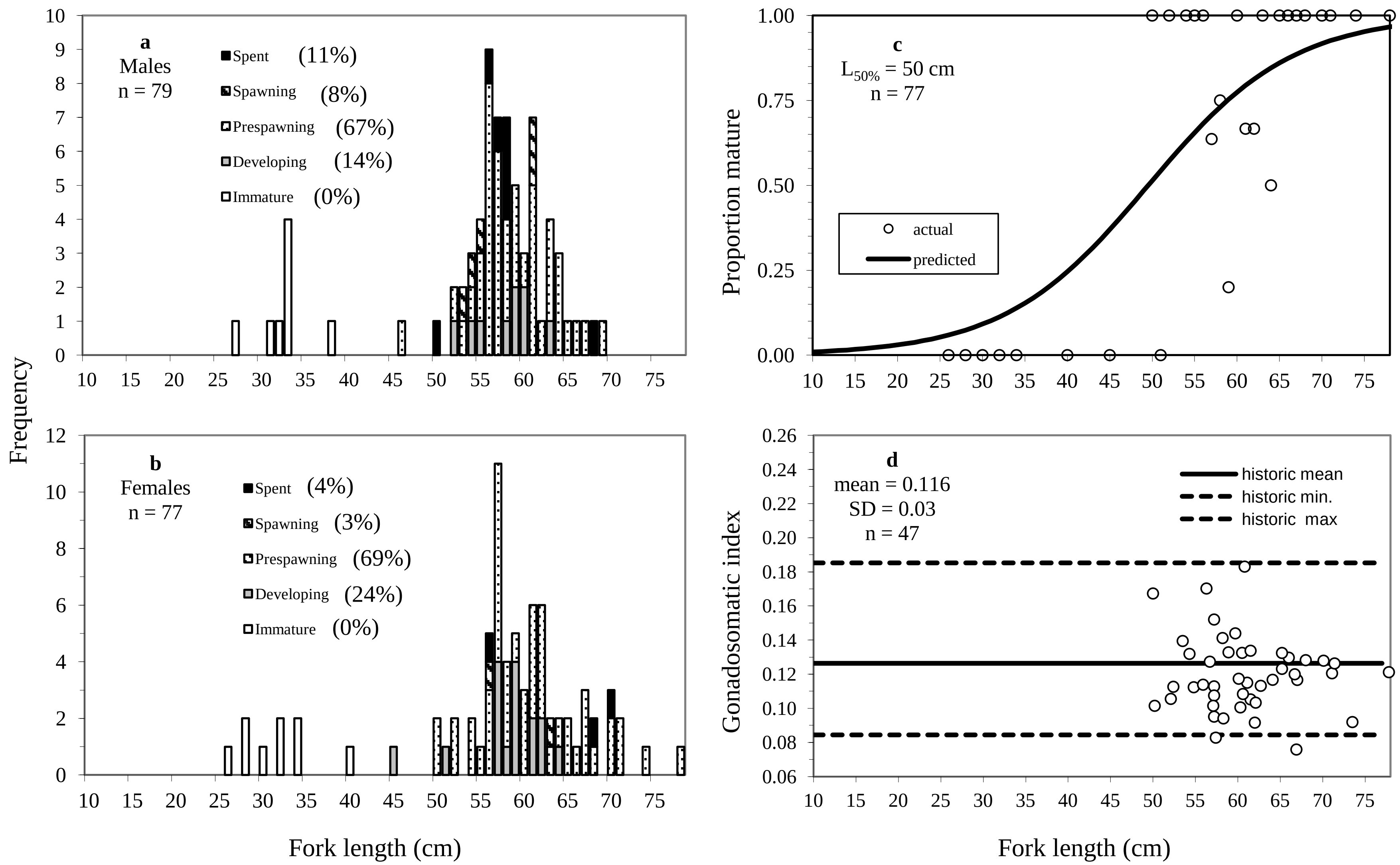


Figure 5. -- Maturity stages, and percentage of fish greater than 40 cm FL within each stage, for (a) male and (b) female walleye pollock; (c) proportion mature (i.e. prespawning, spawning, or spent) by 1-cm size group for female walleye pollock; and (d) gonadosomatic index (with historic survey mean, and minimum and maximum of historic survey means) for pre-spawning females examined during the 2013 acoustic-trawl survey of the Shumagin Islands. Note: these graphs do not include data from age-1 fish.

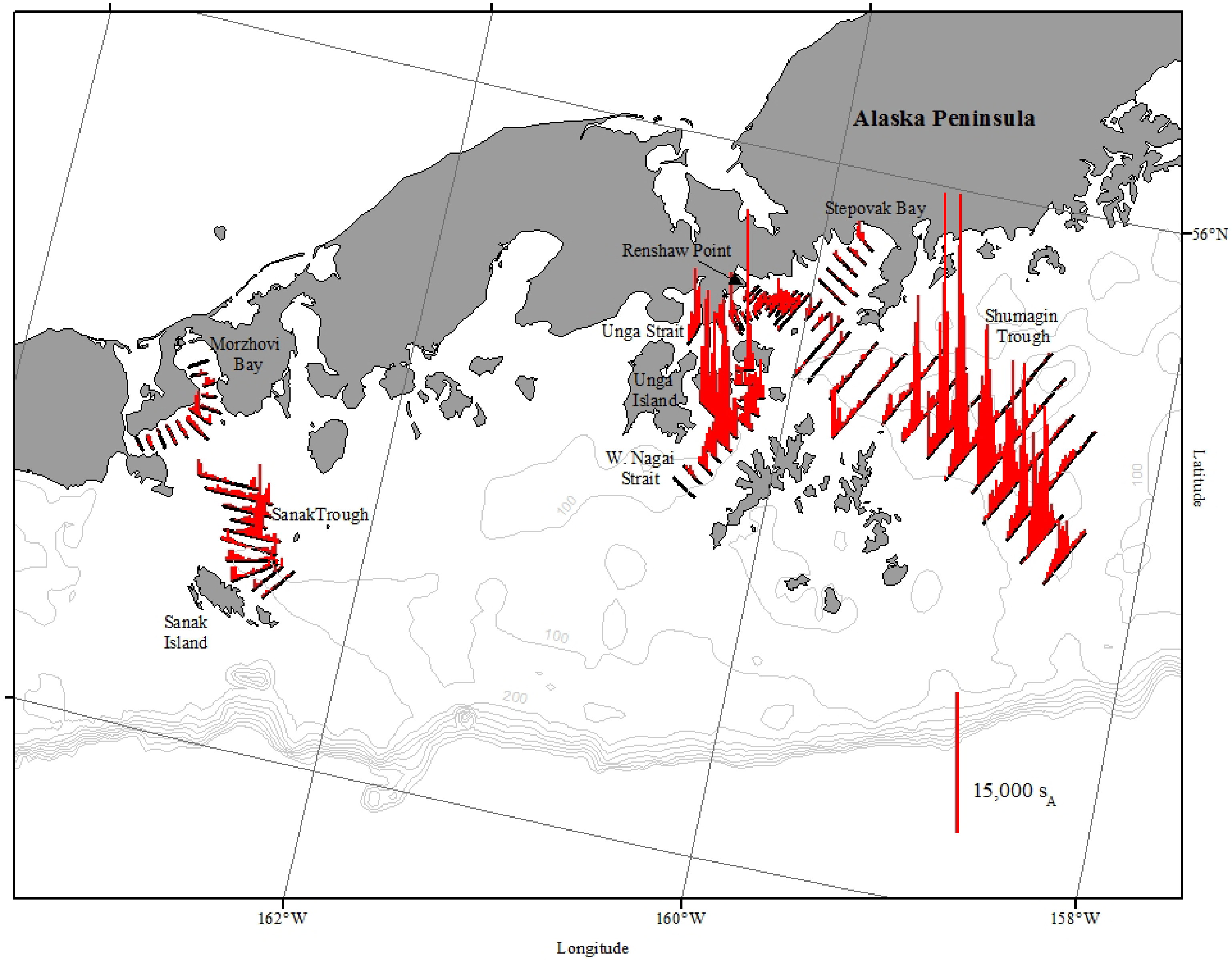


Figure 6. -- Acoustic backscatter (s_A) attributed to walleye pollock (vertical lines) along tracklines surveyed during the winter 2013 acoustic-trawl survey of the Shumagin Islands, Sanak Trough, and Morzhovoi Bay.

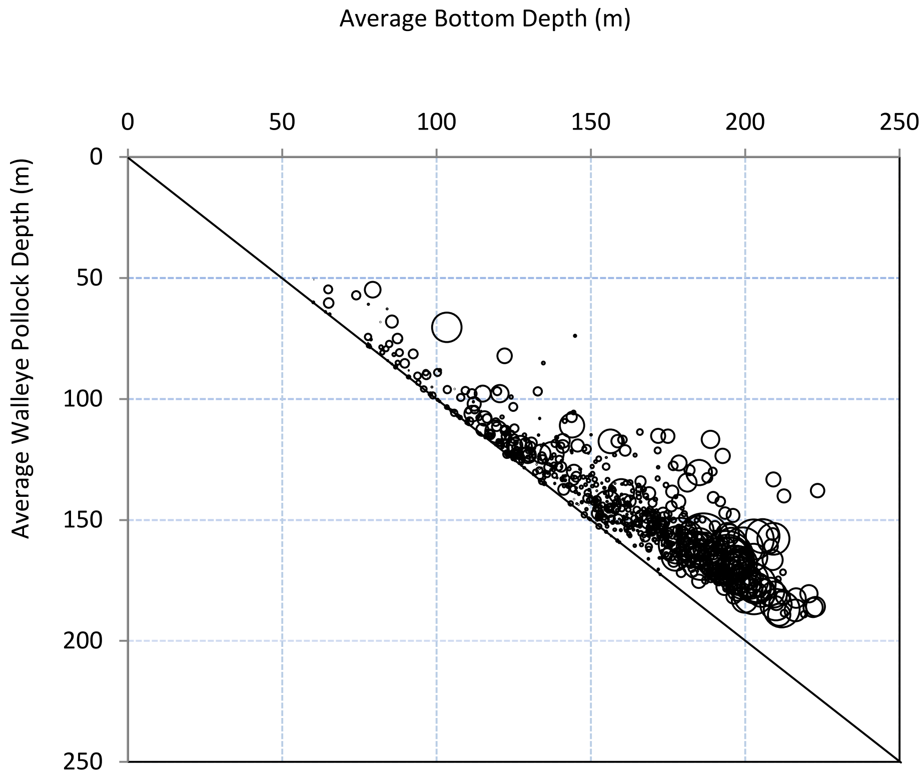


Figure 7. -- Average walleye pollock depth (weighted by biomass) versus bottom depth (m) during the winter 2013 acoustic-trawl survey of the Shumagin Islands area. Circle size is scaled to the maximum biomass per 0.5 nautical mile survey track interval. The diagonal line indicates where the average pollock depth equals bottom depth.

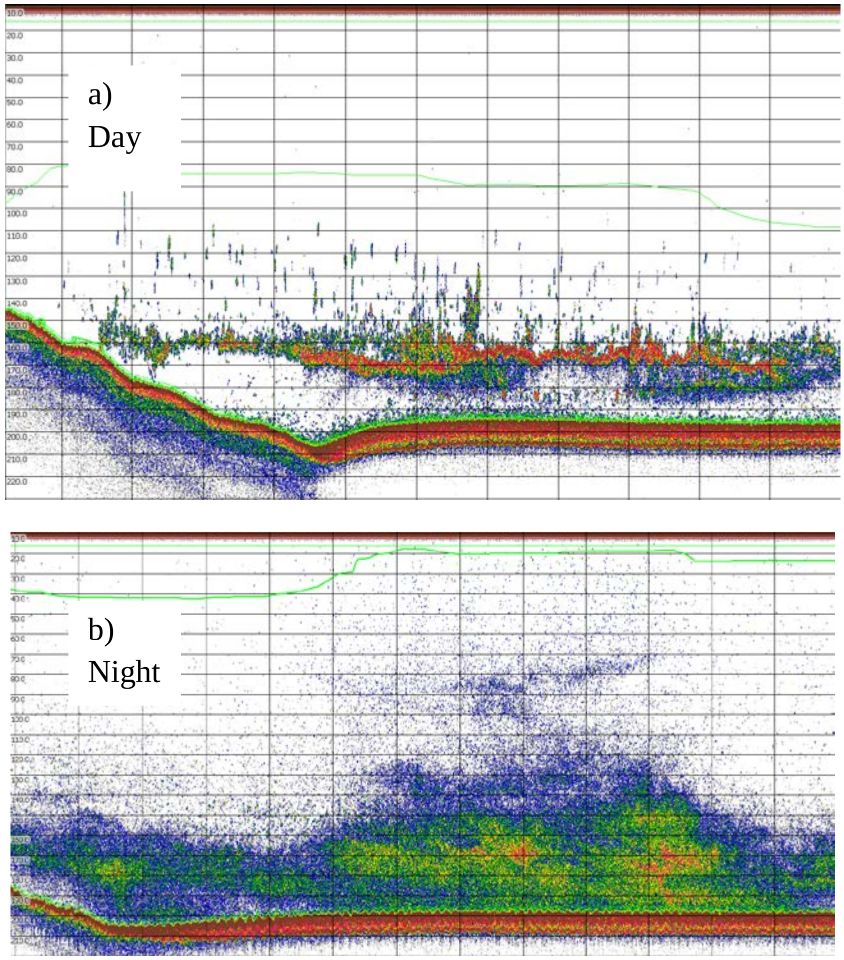


Figure 8. -- Shumagin Trough walleye pollock backscatter recorded from the 38-kHz transducer on a) transect 44 as it was surveyed during daylight (12:35-13:19 local) and b) transect 46 as it was surveyed during nighttime (22:25-23:15 local).

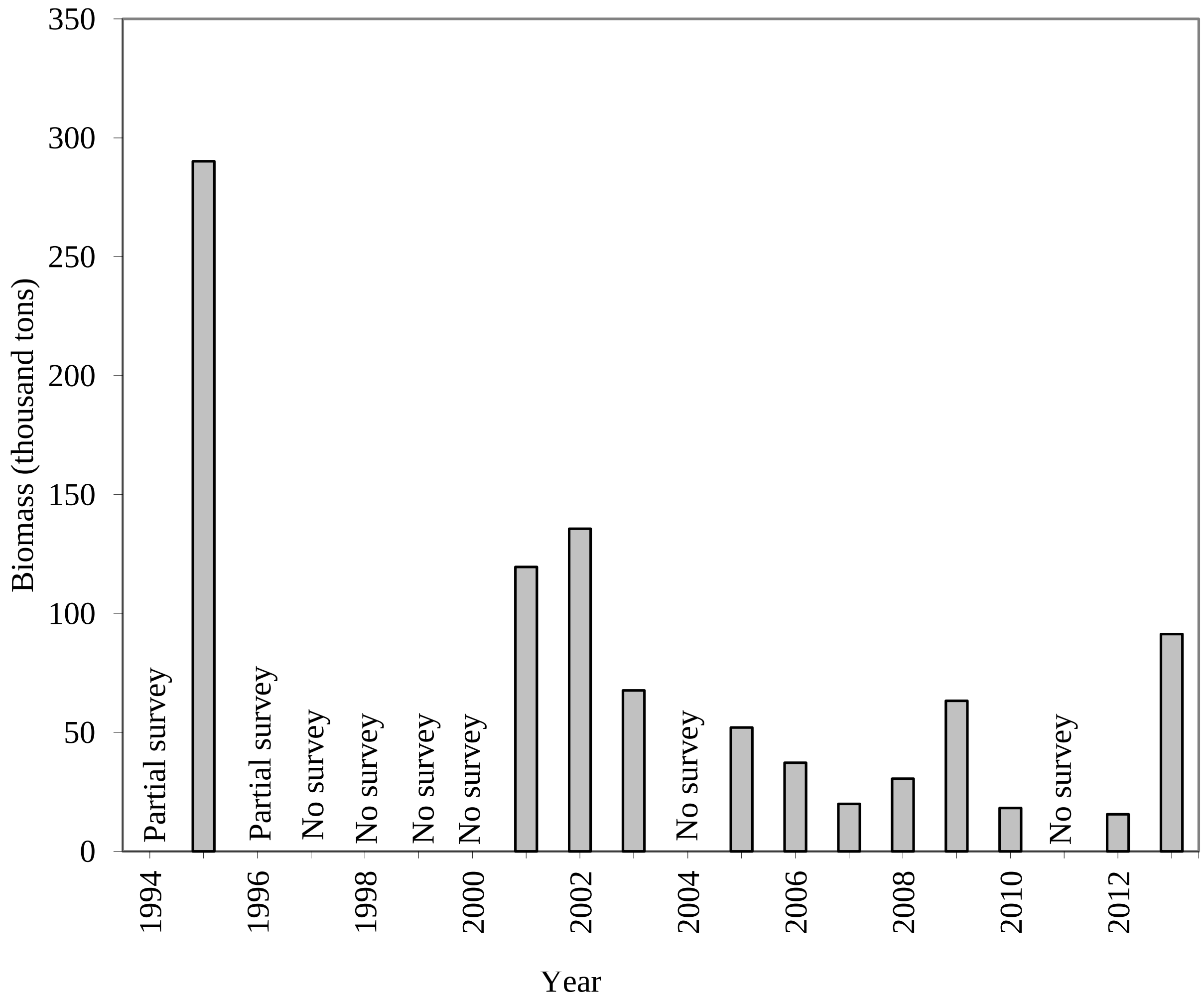


Figure 9. -- Summary of walleye pollock biomass estimates (thousand metric tons) based on acoustic-trawl surveys of the Shumagin Islands area.

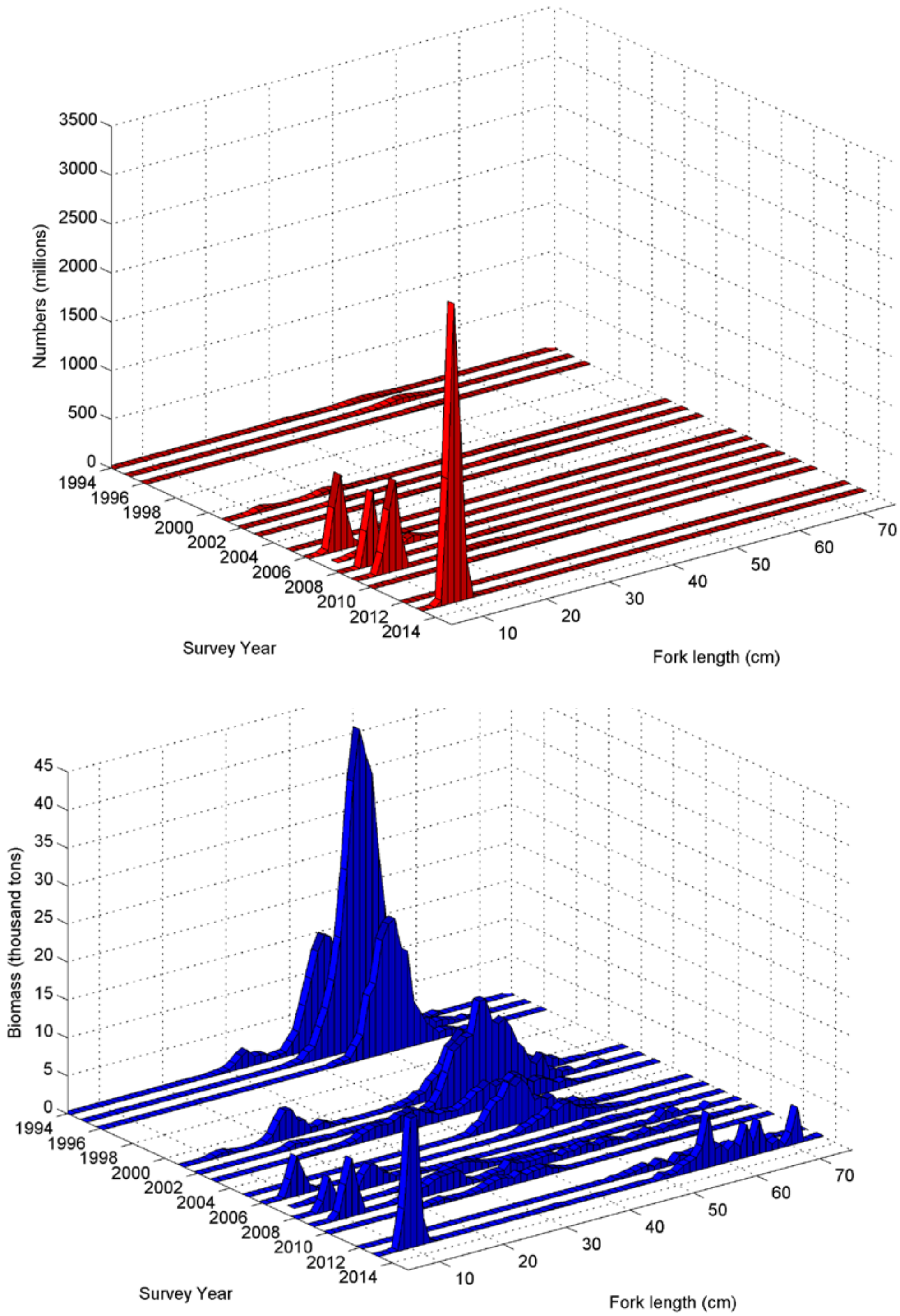


Figure 10. -- Walleye pollock numbers in millions (top) and biomass in thousands of metric tons (bottom) at length from the Shumagin Islands acoustic-trawl surveys since 1994. No surveys were conducted in 1997-2000, 2004, or 2011.

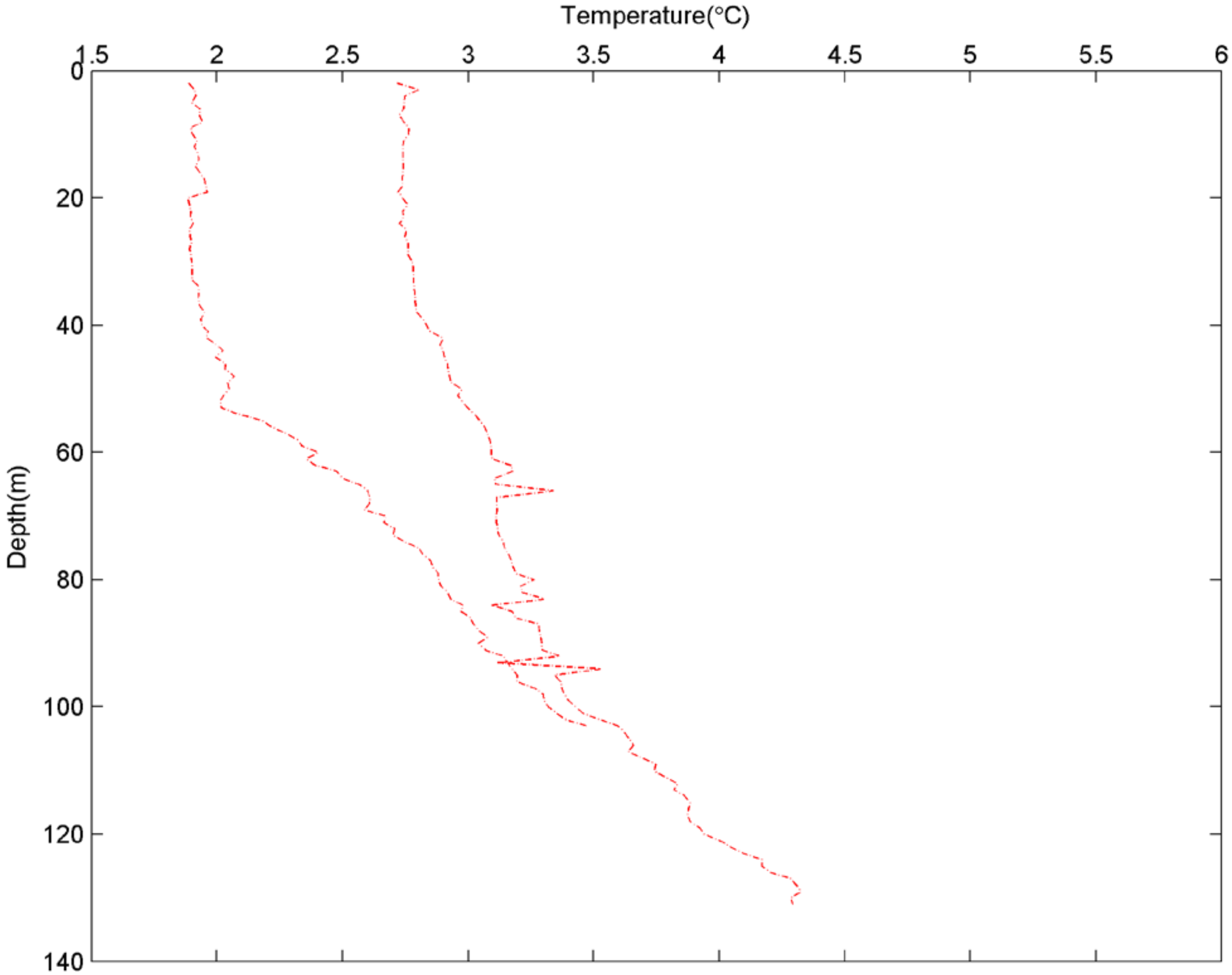


Figure 11. -- Water temperature (°C) by 1-m depth intervals observed during the winter 2013 acoustic-trawl survey of walleye pollock in Sanak Trough. Data collected at two trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope.

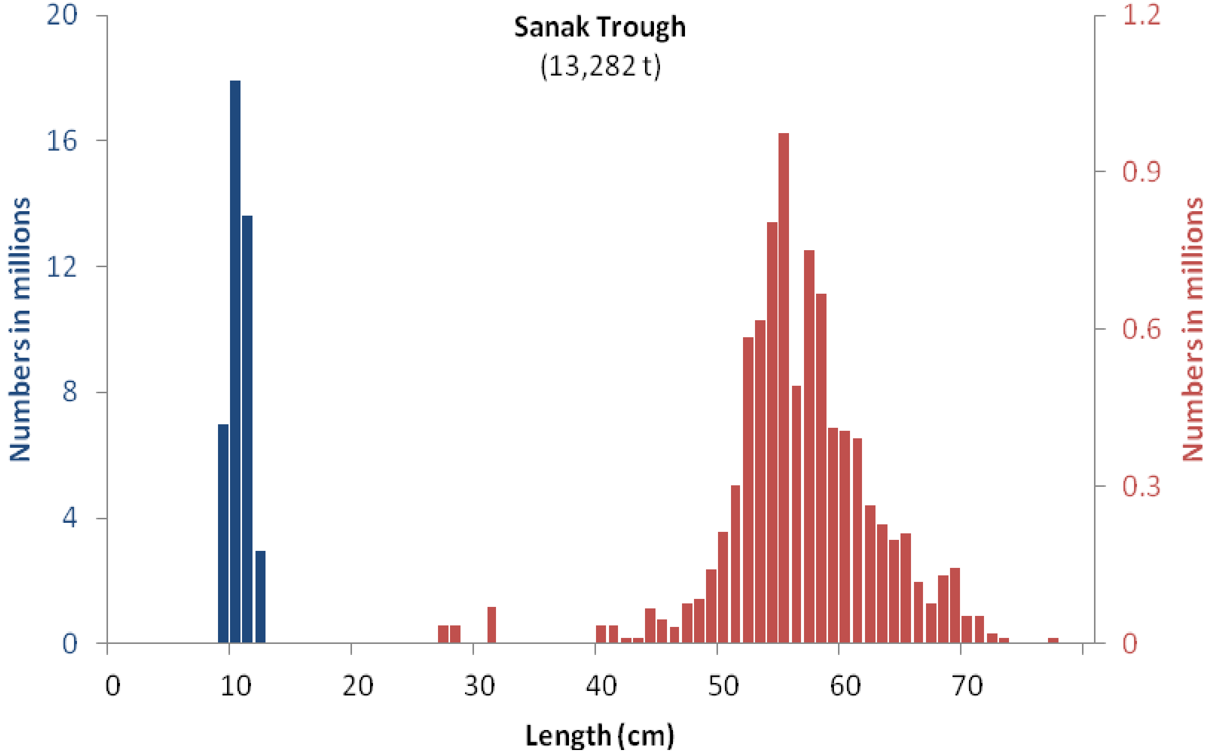


Figure 12. -- Length distribution of walleye pollock (numbers) along with the biomass estimate (metric tons, t) for the 2013 acoustic-trawl survey of Sanak Trough. Note the numbers of age-1 fish (lengths 9-12 cm) are on the primary vertical axis and the rest of the pollock numbers are on the secondary vertical axis.

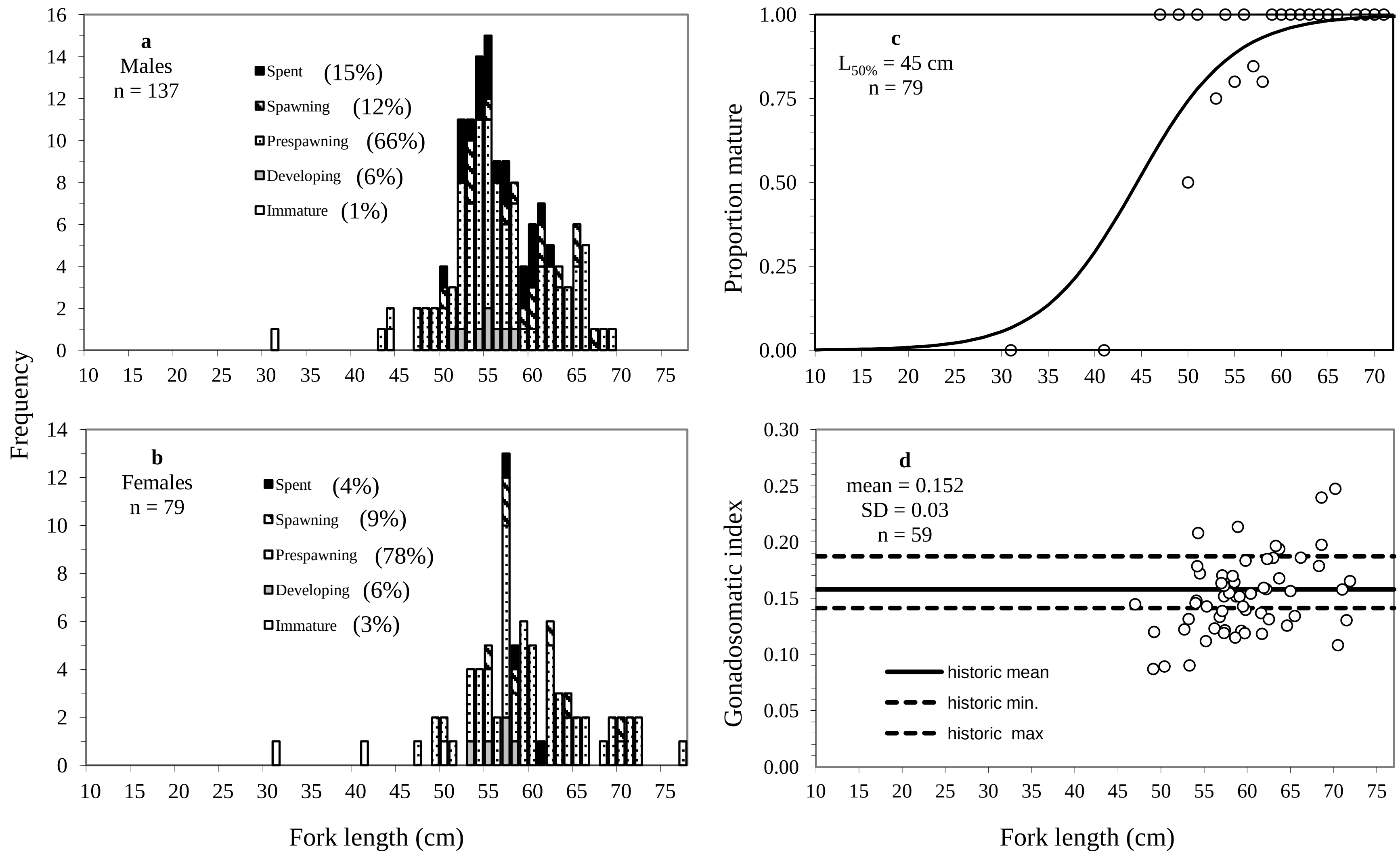


Figure 13. -- Maturity stages, and percentage of fish greater than 40 cm FL within each stage, for (a) male and (b) female walleye pollock; (c) proportion mature (i.e., prespawning, spawning, or spent) by 1-cm size group for female walleye pollock; and (d) gonadosomatic index (with historic survey mean, and minimum and maximum of historic survey means) for pre-spawning females examined during the 2013 acoustic-trawl survey of the Sanak Trough. Note: these graphs do not include data from age-1 fish.

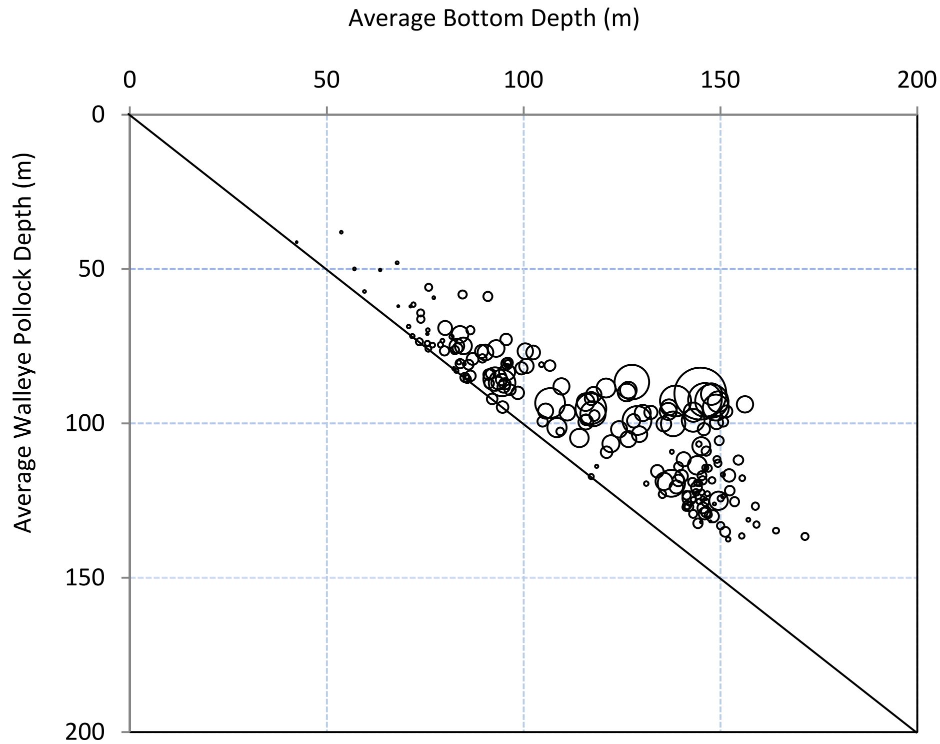


Figure 14. -- Average walleye pollock depth (weighted by biomass) versus bottom depth (m) during the winter 2013 acoustic-trawl survey of Sanak Trough. Circle size is scaled to the maximum biomass per 0.5 nautical mile interval. The diagonal line indicates where the average pollock depth equals bottom depth.

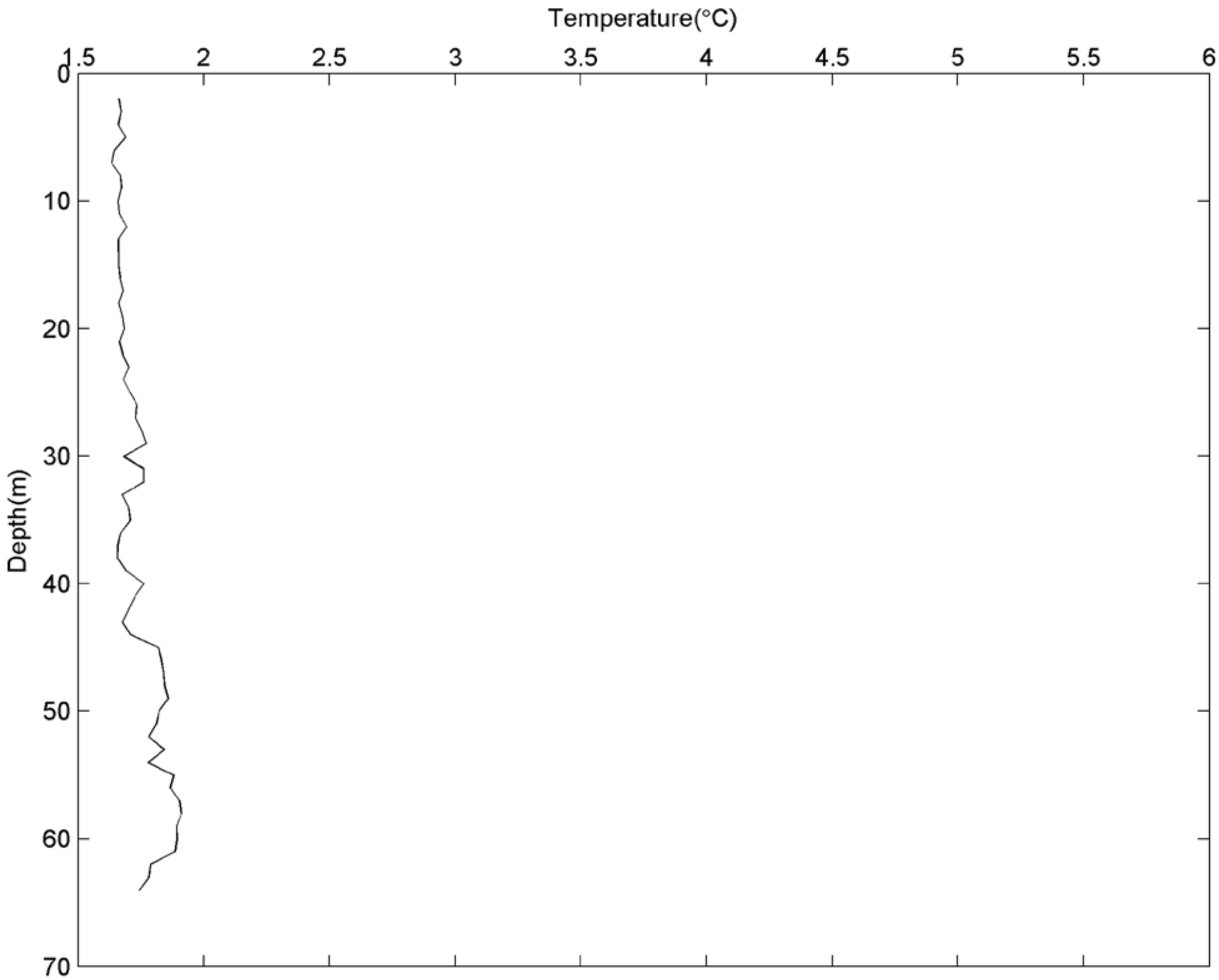


Figure 15. -- Water temperature (°C) by 1-m depth intervals observed during the winter 2013 acoustic-trawl survey of walleye pollock in Morzhovoi Bay. Data collected at one trawl location with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope.

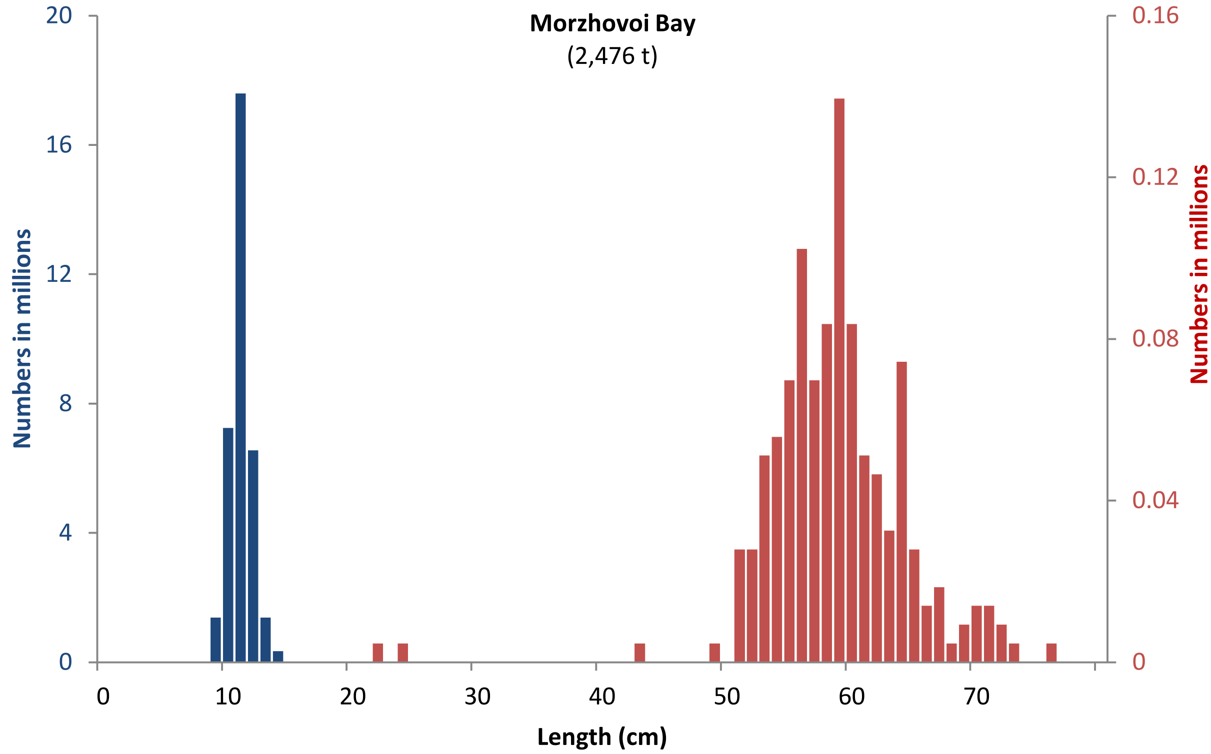


Figure 16. -- Length distribution of walleye pollock (numbers) along with the biomass estimate (metric tons, t) for the 2013 acoustic-trawl survey of Morzhovoi Bay. Note the numbers of age-1 fish (lengths 9-14 cm) are on the primary vertical axis and the rest of the pollock numbers are on the secondary vertical axis.

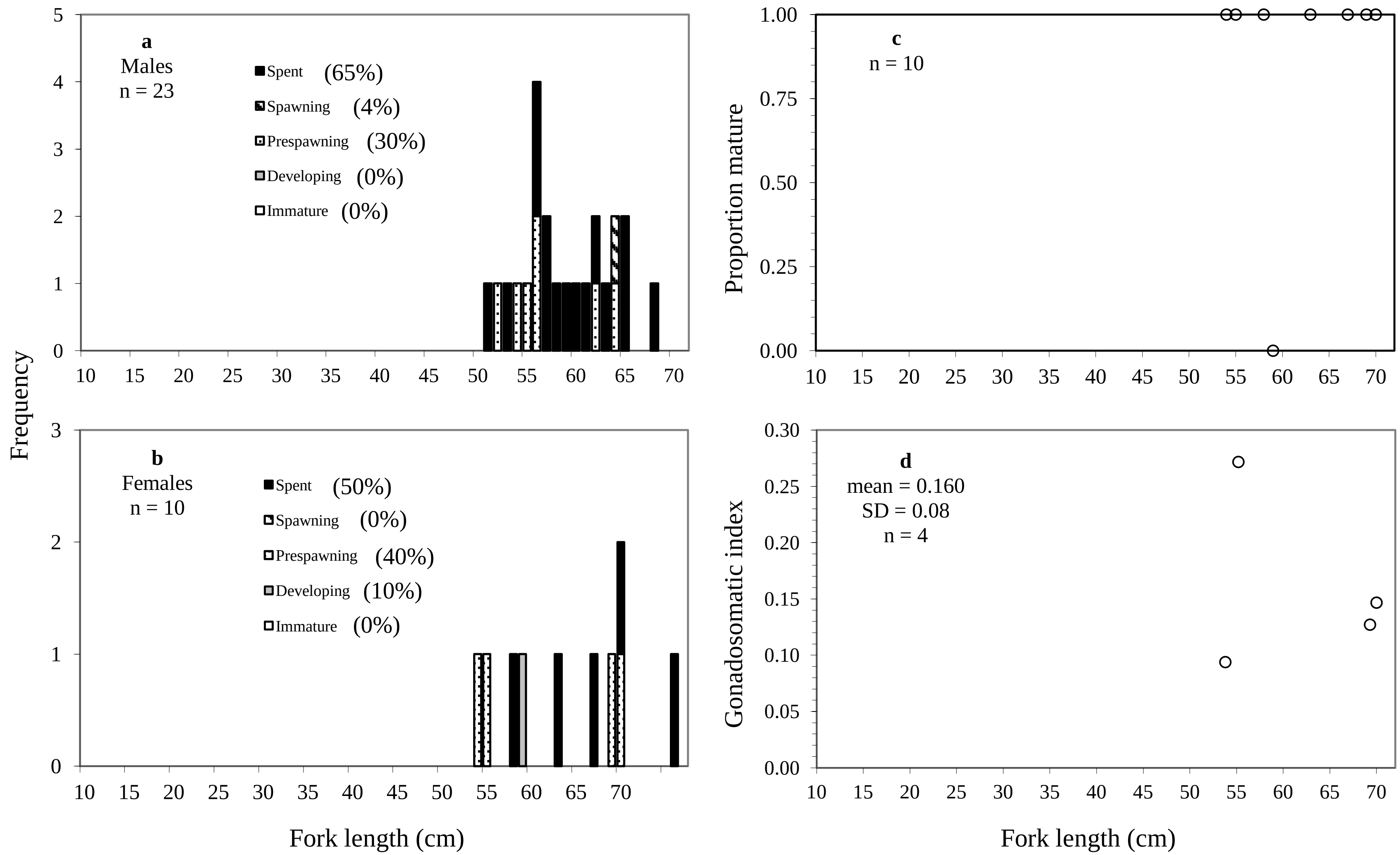


Figure 17. -- Maturity stages, and percentage of fish greater than 40 cm FL within each stage, for (a) male and (b) female walleye pollock; (c) proportion mature (i.e., prespawning, spawning, or spent) by 1-cm size group for female walleye pollock; and (d) gonadosomatic index for pre-spawning females examined during the 2013 acoustic-trawl survey of Morzhovoi Bay. Note: these graphs do not include data from age-1 fish.

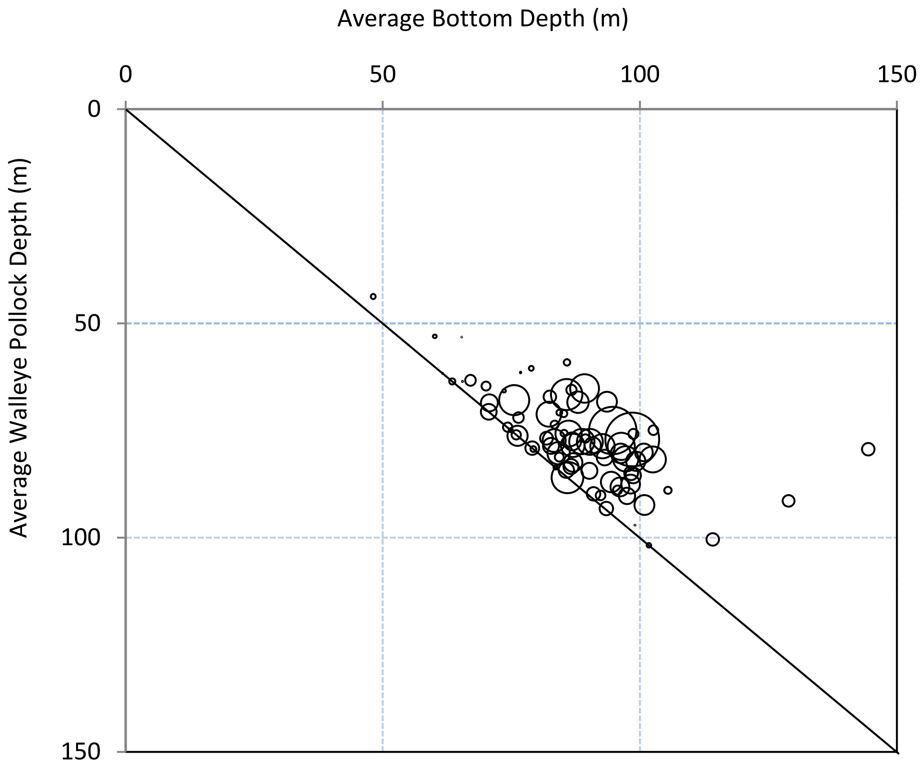


Figure 18. -- Average walleye pollock depth (weighted by biomass) versus bottom depth (m) during the winter 2013 acoustic-trawl survey of Morzhovoi Bay. Circle size is scaled to the maximum biomass per 0.5 nautical mile interval. The diagonal line indicates where the average pollock depth equals bottom depth.

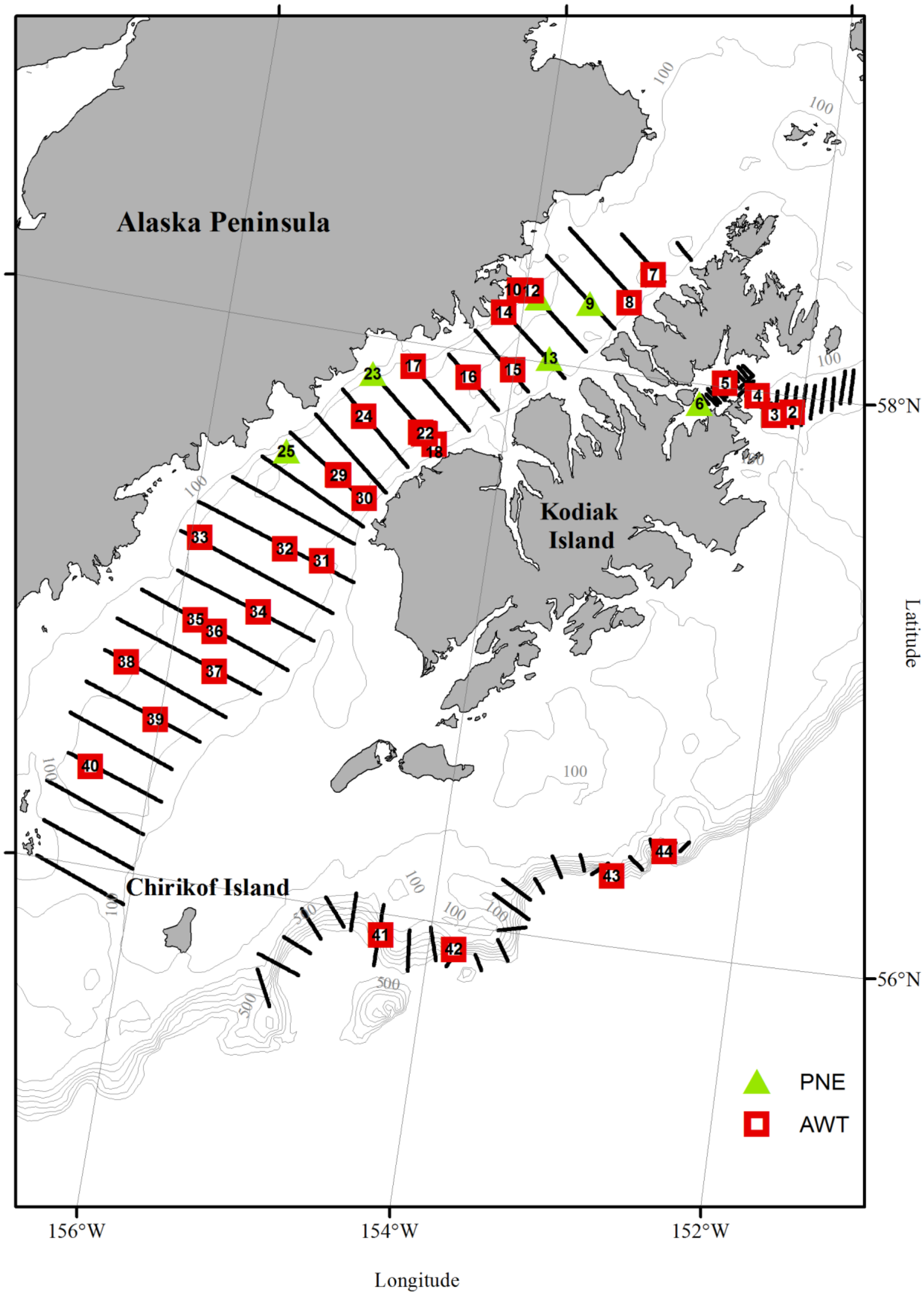


Figure 19. -- Transect lines and locations of Aleutian-wing trawl (AWT) and poly-Nor'eastern trawl (PNE) hauls during the winter 2013 acoustic-trawl survey of walleye pollock in Marmot Bay, Shelikof Strait, and along the Gulf of Alaska shelf break from Chirikof Island to Barnabas Trough. Haul numbers are on top of haul symbols.

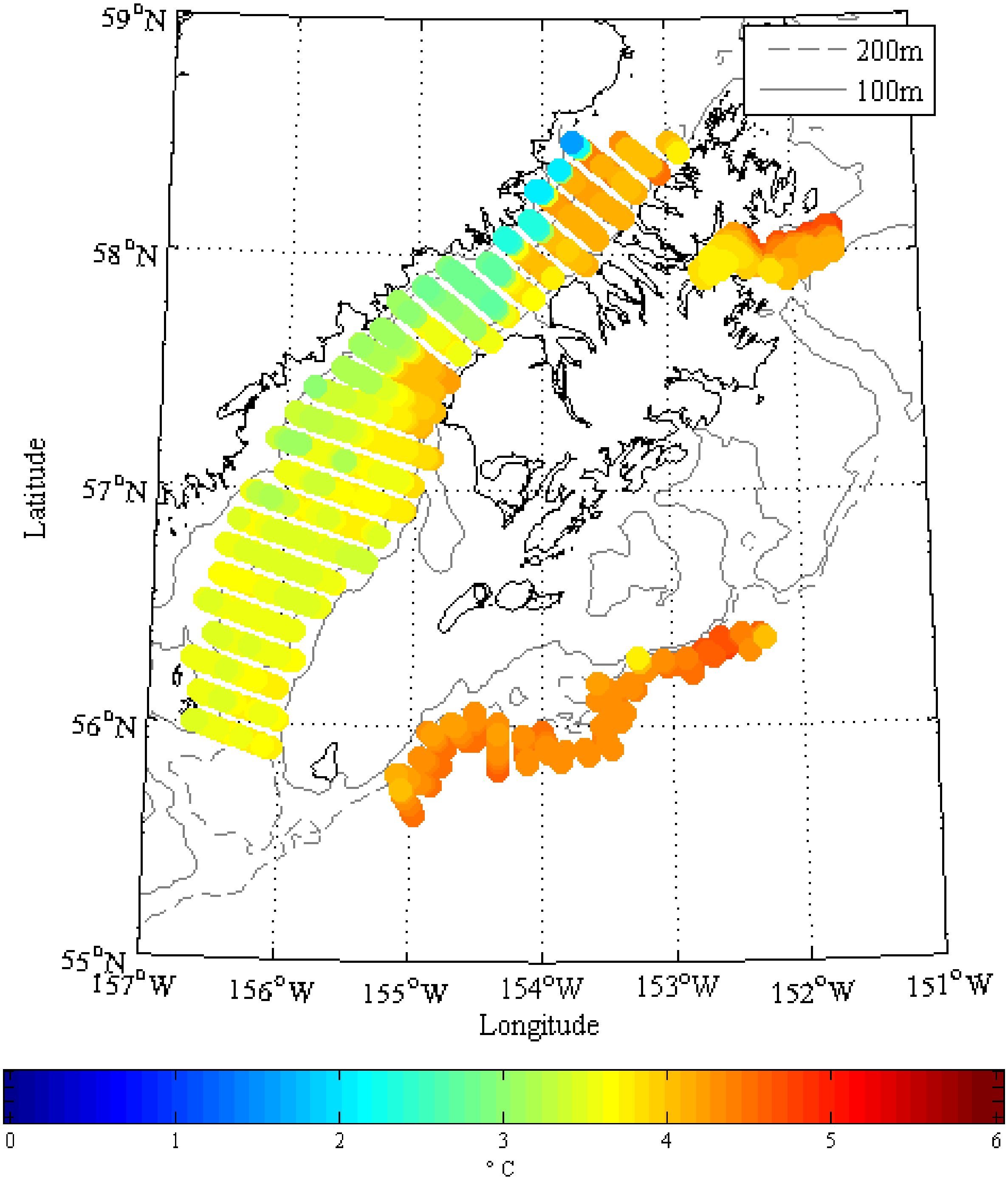


Figure 20. -- Surface water temperatures during the DY1303 acoustic-trawl survey of Marmot Bay, Chirikof shelf break, and Shelikof Strait recorded from the ship's Furuno T-2000 temperature probe located 1.4 m below the surface.

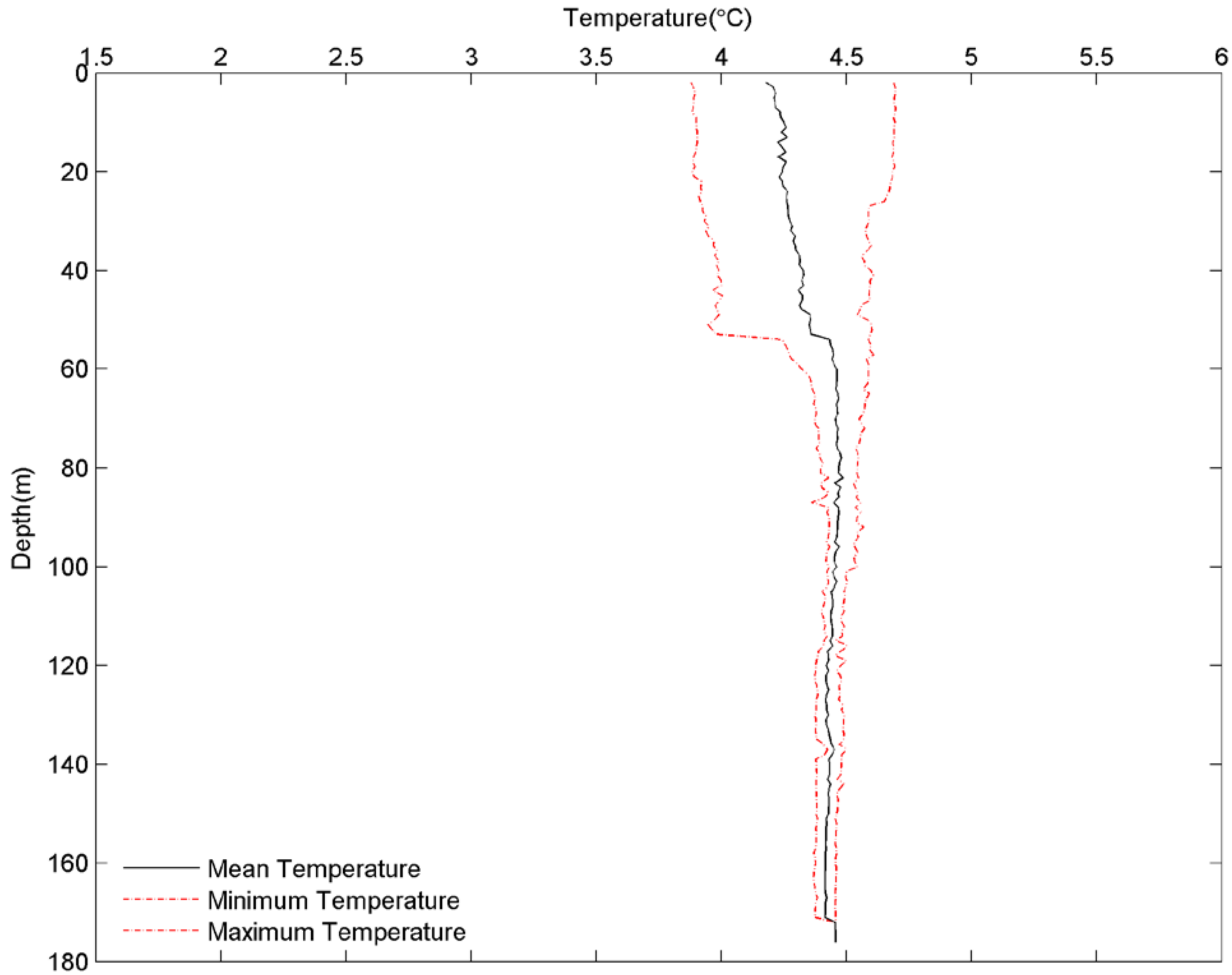


Figure 21. -- Mean water temperature (°C) (solid line) by 1-m depth intervals observed during the winter 2013 acoustic-trawl survey of walleye pollock in Marmot Bay. Data collected at six trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed- lines represent minimum and maximum temperatures observed.

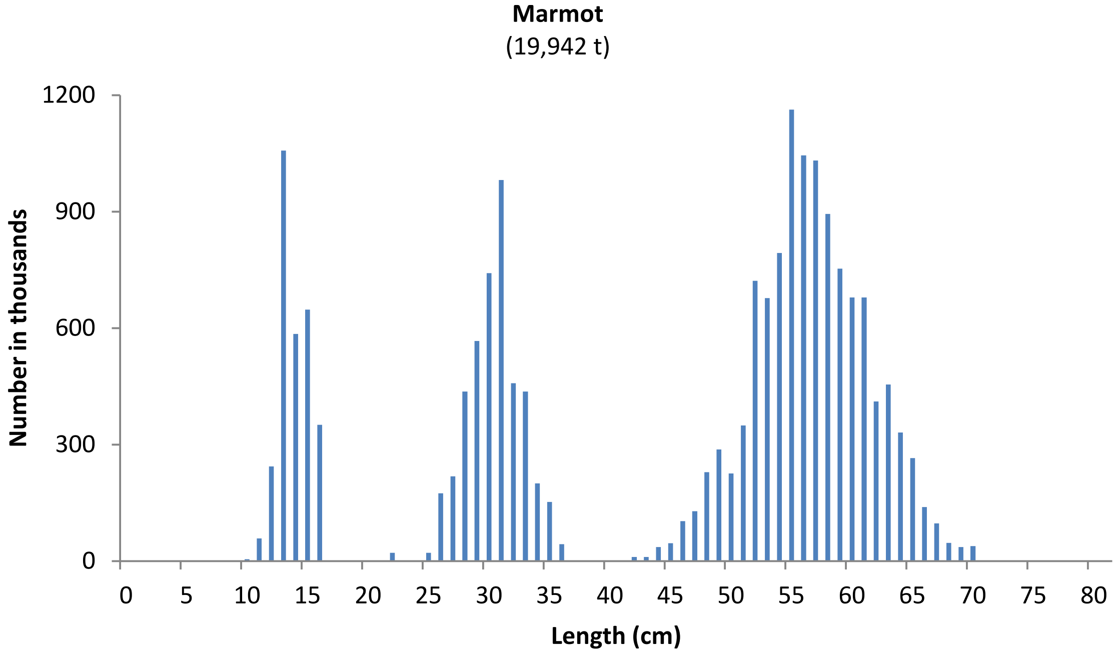


Figure 22. -- Length distribution of walleye pollock (numbers) along with the biomass estimate (metric tons, t) for the 2013 acoustic-trawl survey of Marmot Bay.

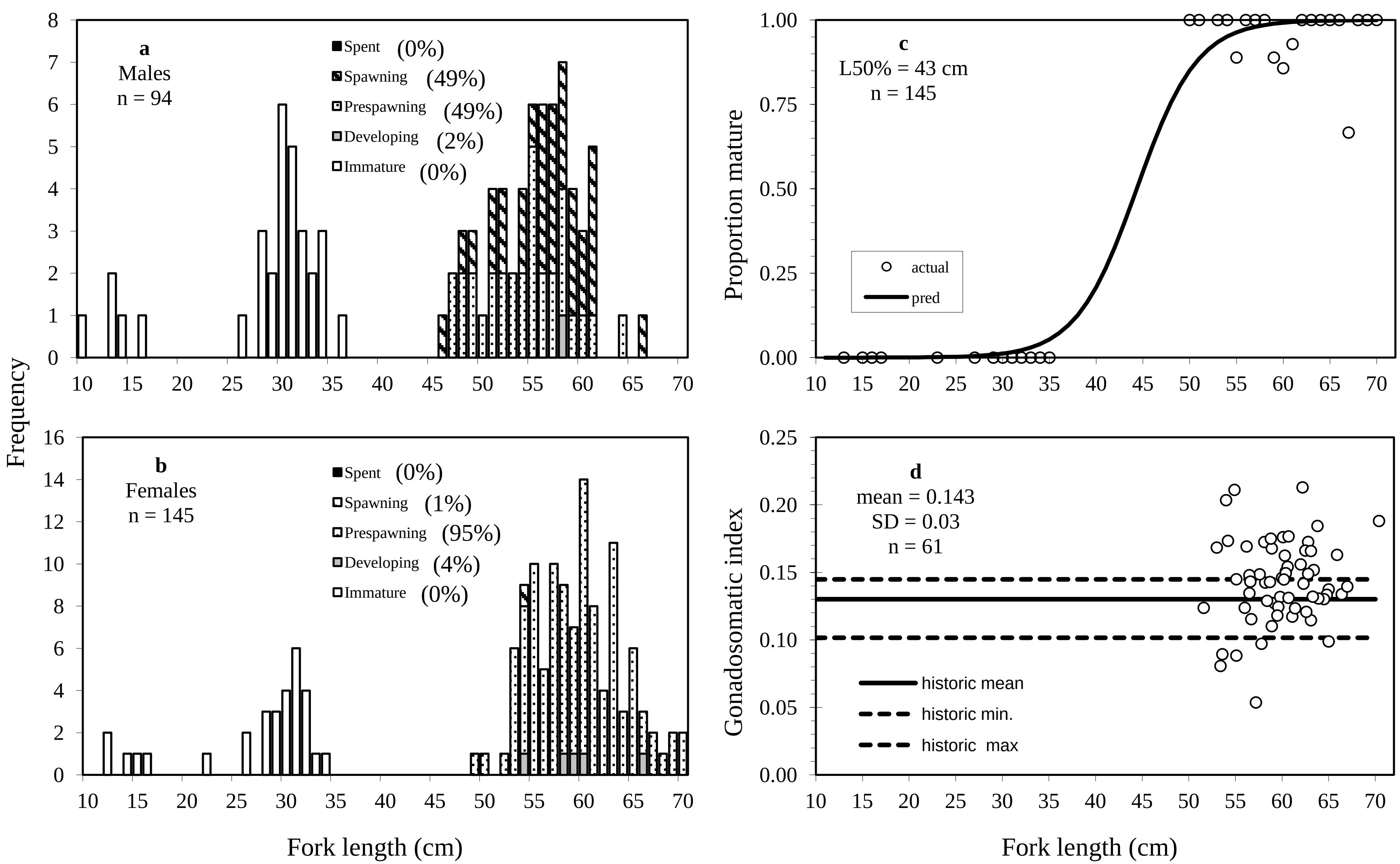


Figure 23. -- Maturity stages, and percentage of fish greater than 40 cm FL within each stage, for (a) male and (b) female walleye pollock; (c) proportion mature (i.e., prespawning, spawning, or spent) by 1-cm size group for female walleye pollock; and (d) gonadosomatic index (with historic survey mean, and minimum and maximum of historic survey means) for pre-spawning females examined during the 2013 acoustic-trawl survey of Marmot Bay. Note: these graphs do not include data from age-1 fish.

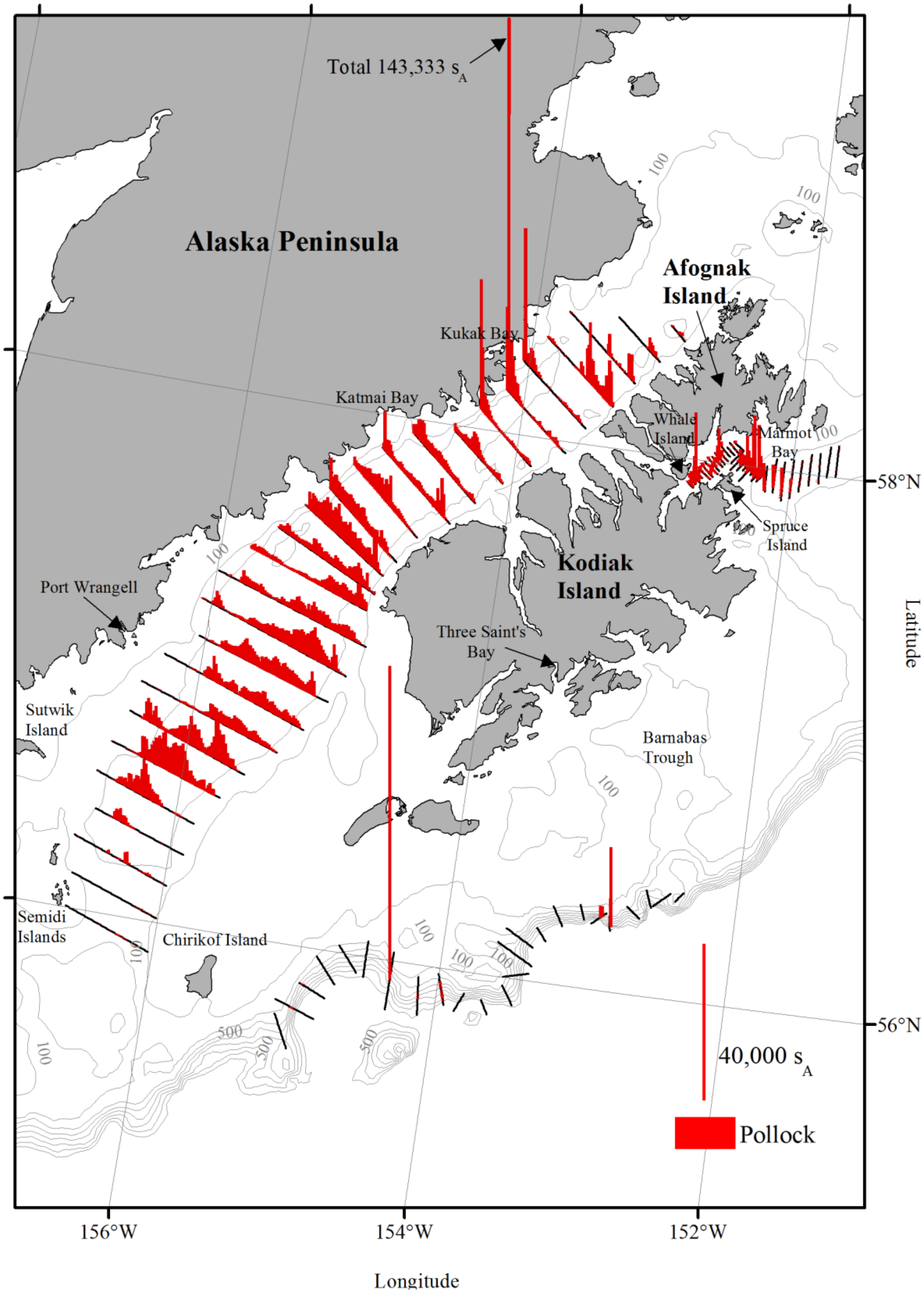


Figure 24. -- Acoustic backscatter (s_A) attributed to walleye pollock (vertical lines) along tracklines surveyed during the winter 2013 acoustic-trawl survey of Marmot Bay, Shelikof Strait, and along the Gulf of Alaska shelf break from Chirikof Island to Barnabas Trough.

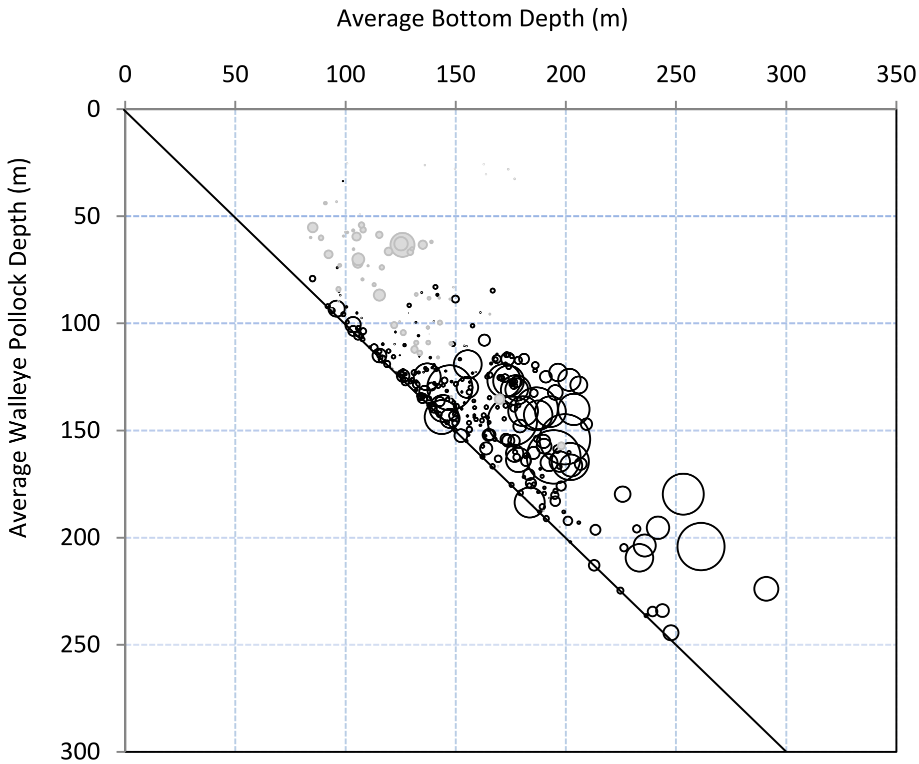


Figure 25. -- Average pollock depth (weighted by biomass) versus bottom depth (m) for age-1 walleye pollock (grey circles) and all other walleye pollock (open circles) observed during the winter 2013 acoustic-trawl survey of Marmot Bay area. Circle size is scaled to the maximum biomass per 0.5 nautical mile survey track interval. The diagonal line indicates where the average pollock depth equals bottom depth.

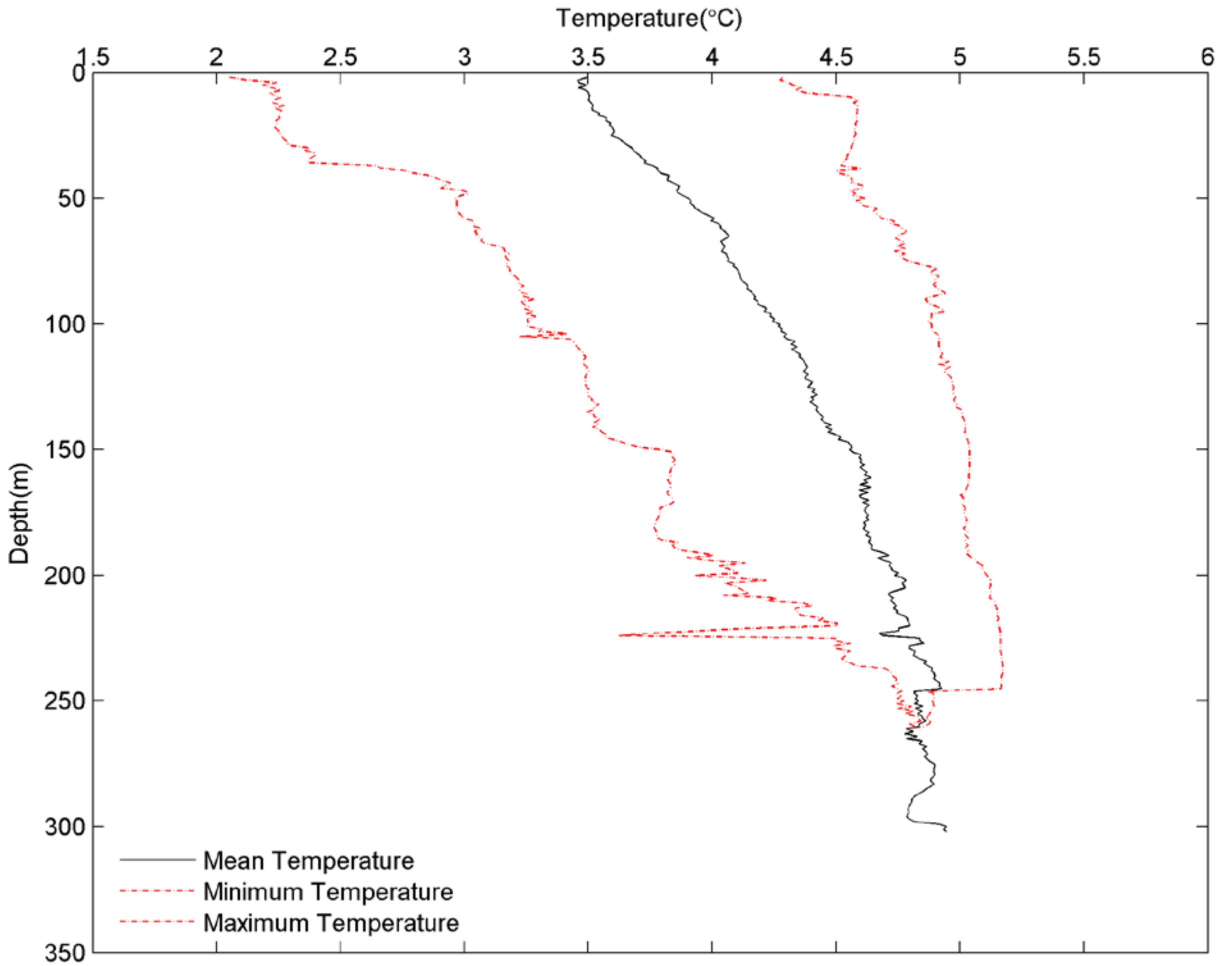


Figure 26. -- Mean water temperature (°C) (solid line) by 1-m depth intervals observed during the winter 2013 acoustic-trawl survey of walleye pollock in Shelikof Strait. Data collected at 34 trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed- lines represent minimum and maximum temperatures observed.

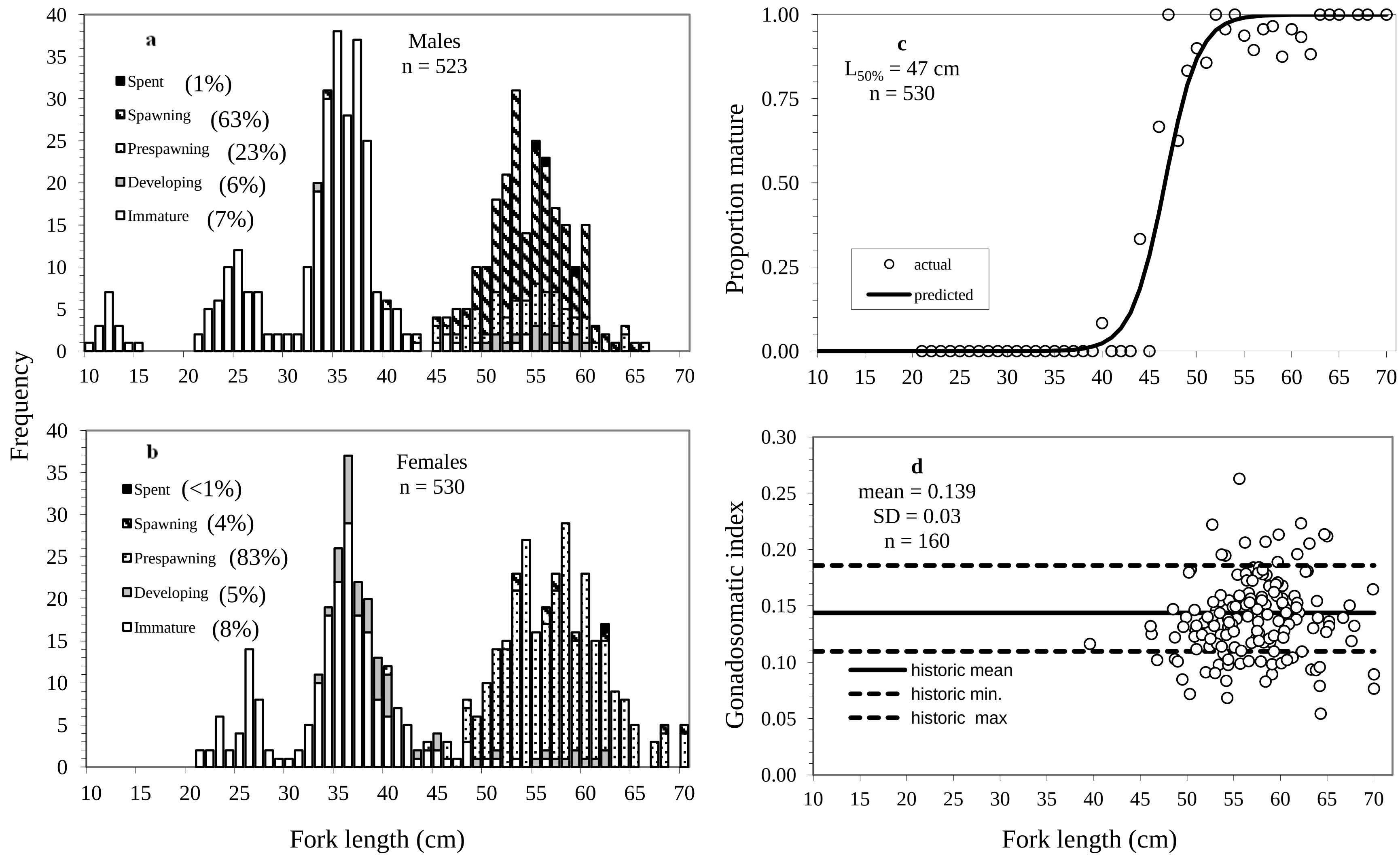


Figure 27. -- Maturity stages, and percentage of fish greater than 40 cm FL within each stage, for (a) male and (b) female walleye pollock; (c) proportion mature (i.e. prespawning, spawning, or spent) by 1-cm size group for female walleye pollock; and (d) gonadosomatic index (with historic survey mean, and minimum and maximum of historic survey means) for pre-spawning females examined during the 2013 acoustic-trawl survey of Shelikof Strait. Note: these graphs do not include data from age-1 fish.

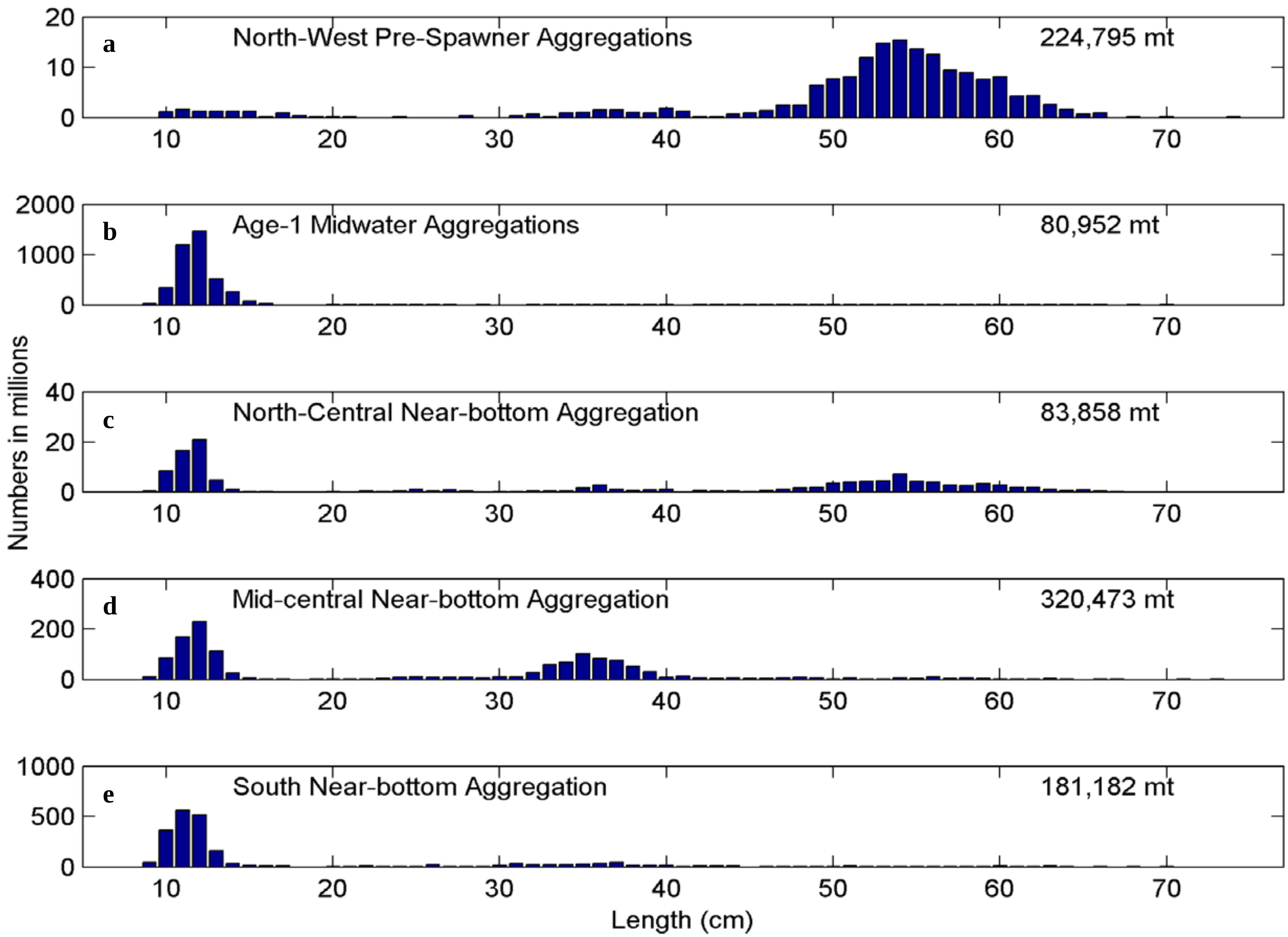


Figure 28. -- Length distribution groups for walleye pollock (numbers) along with the biomass estimates (metric tons, mt) for the 2013 acoustic-trawl survey of Shelikof Strait.

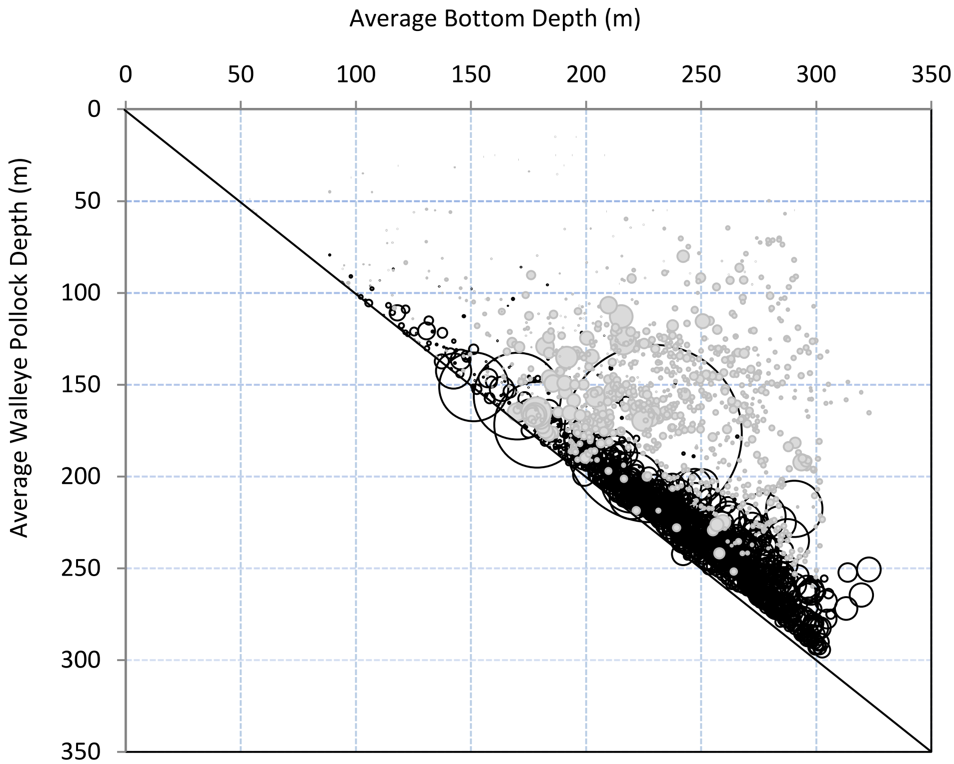


Figure 29. -- Average pollock depth (weighted by biomass) versus bottom depth (m) for age-1 walleye pollock (grey circles) and all other walleye pollock (open circles) observed during the winter 2013 acoustic-trawl survey of Shelikof Strait area. Circle size is scaled to the maximum biomass per 0.5 nautical mile survey track interval. The diagonal line indicates where the average fish depth equals bottom depth.

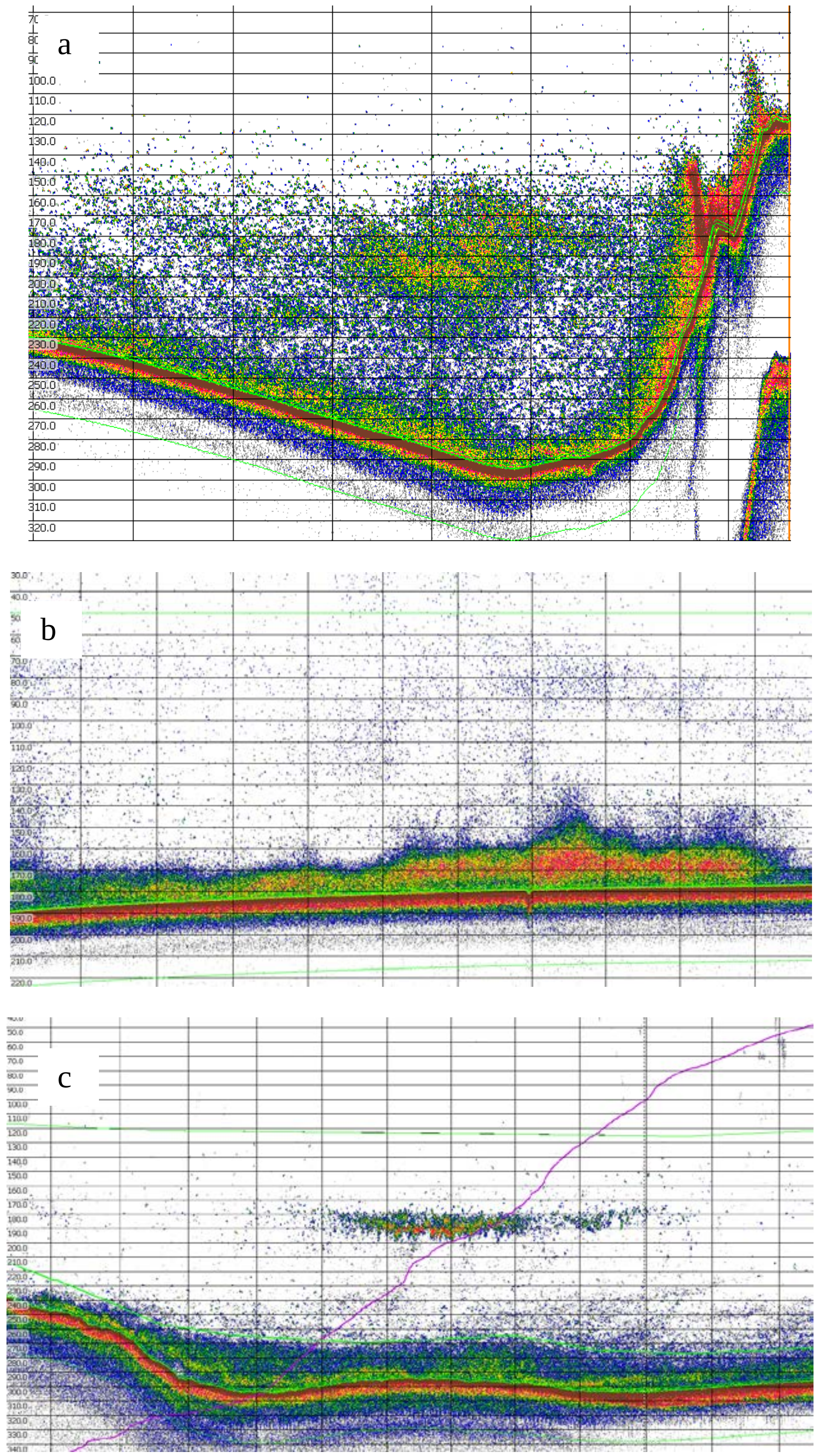


Figure 30. -- Shelikof Strait backscatter recorded from the 38 kHz transducer on a) dense pre-spawner aggregations on steep bank of north-western Shelikof Strait near Kukak Bay b) dense near-bottom walleye pollock layer diffusely scattered into the water column during night and, c) near-bottom walleye pollock layer with additional dense layer of age-1fish at 180 m depth.

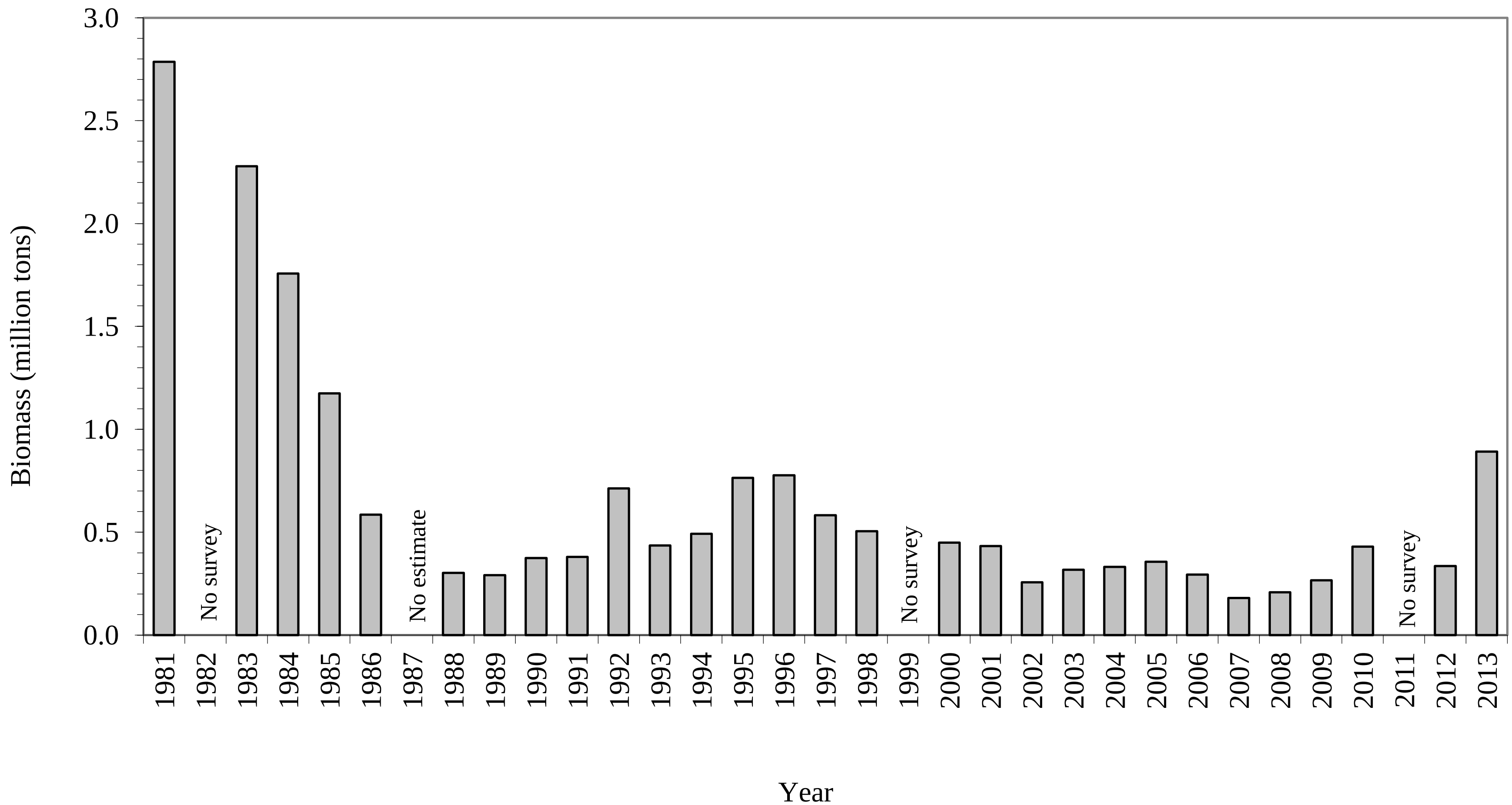


Figure 31. -- Summary of walleye pollock biomass estimates (million tons) based on acoustic-trawl surveys of the Shelikof Strait area.

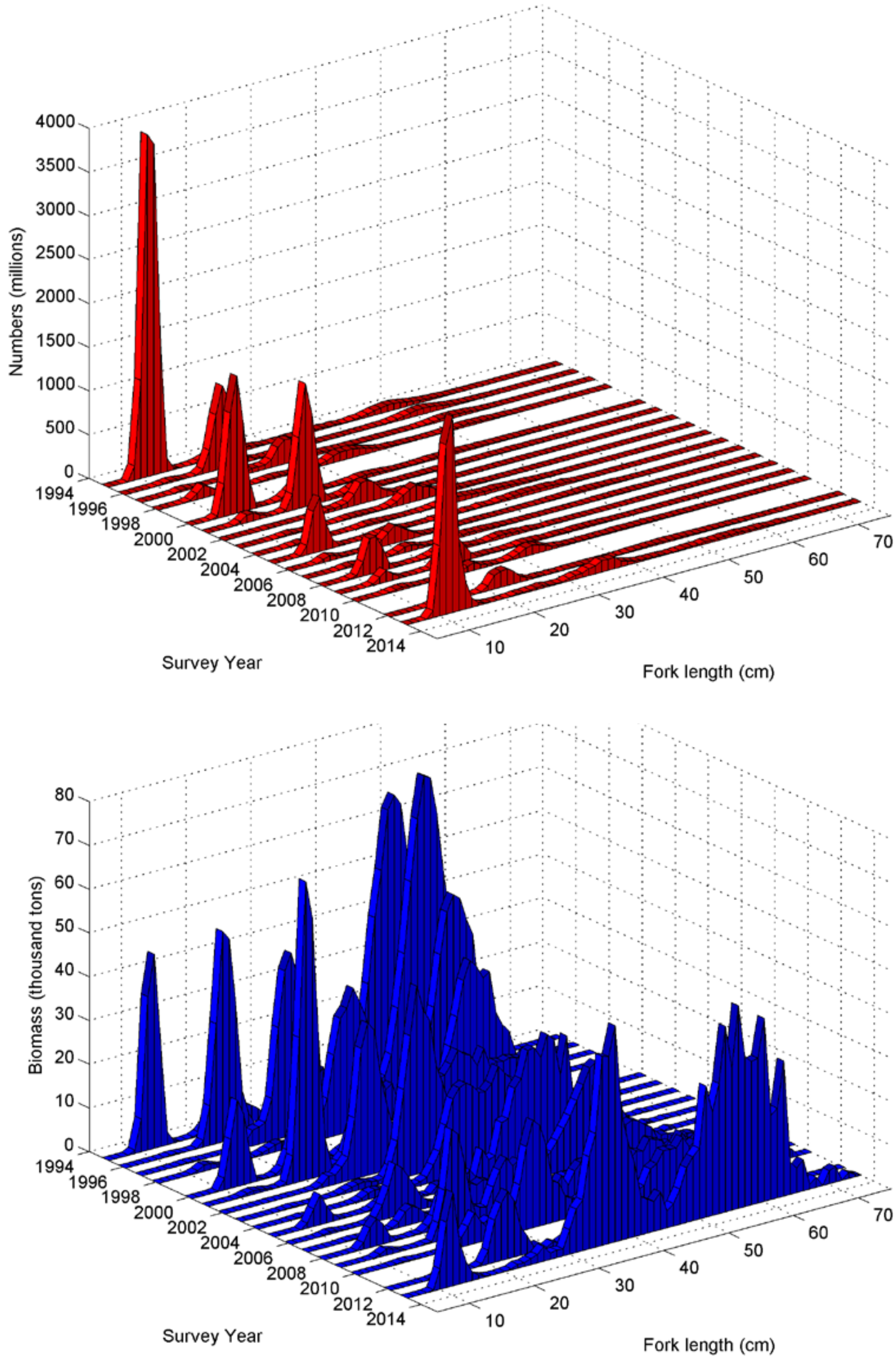
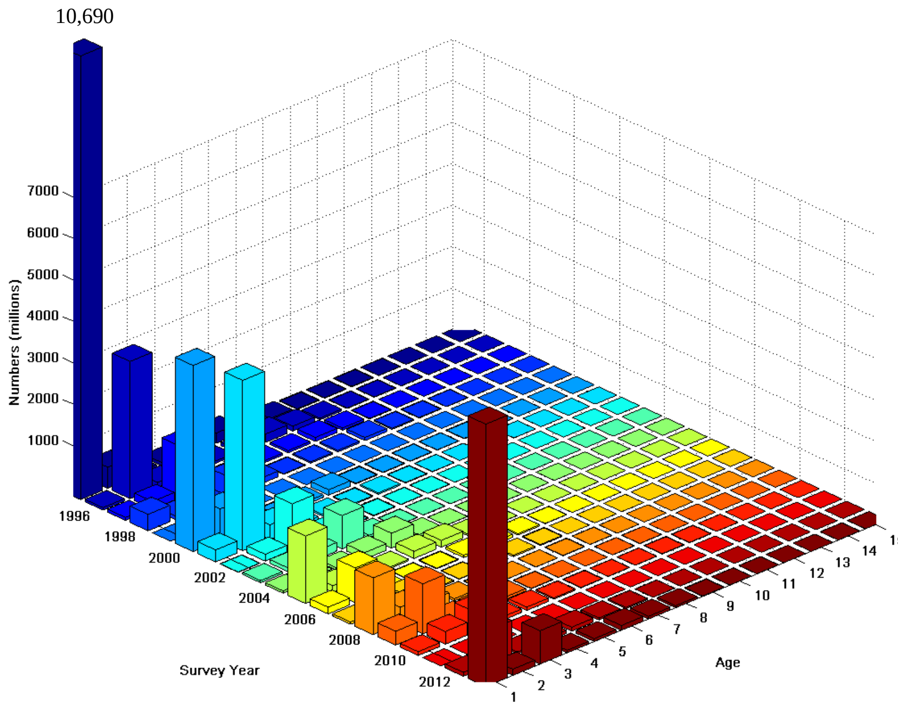


Figure 32. -- Walleye pollock numbers in millions (top) and biomass in thousands of metric tons (bottom) at length from the Shelikof Strait acoustic-trawl surveys since 1994. No surveys were conducted in 1999 or 2011.



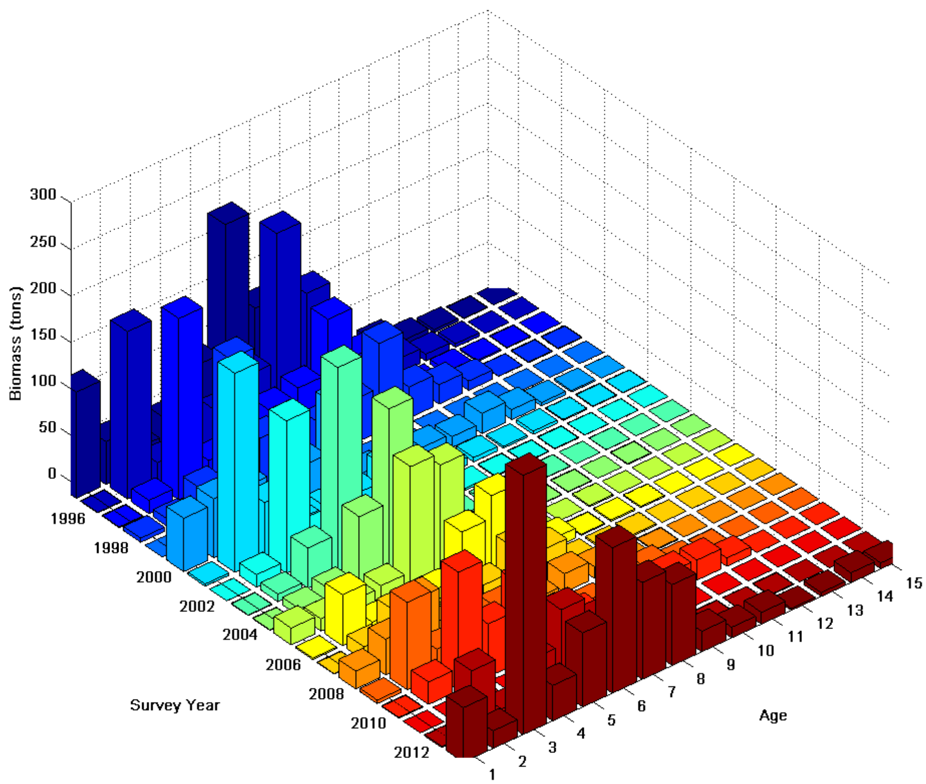


Figure 33. -- Walleye pollock numbers at age in millions of fish (top) and biomass at age in thousands of metric tons (bottom) from the Shelikof Strait acoustic-trawl surveys since 1995. Surveys were not conducted in 1999 or 2011. Note, numbers of age-1 fish in 1995 are truncated at and actual number (in millions) is displayed.

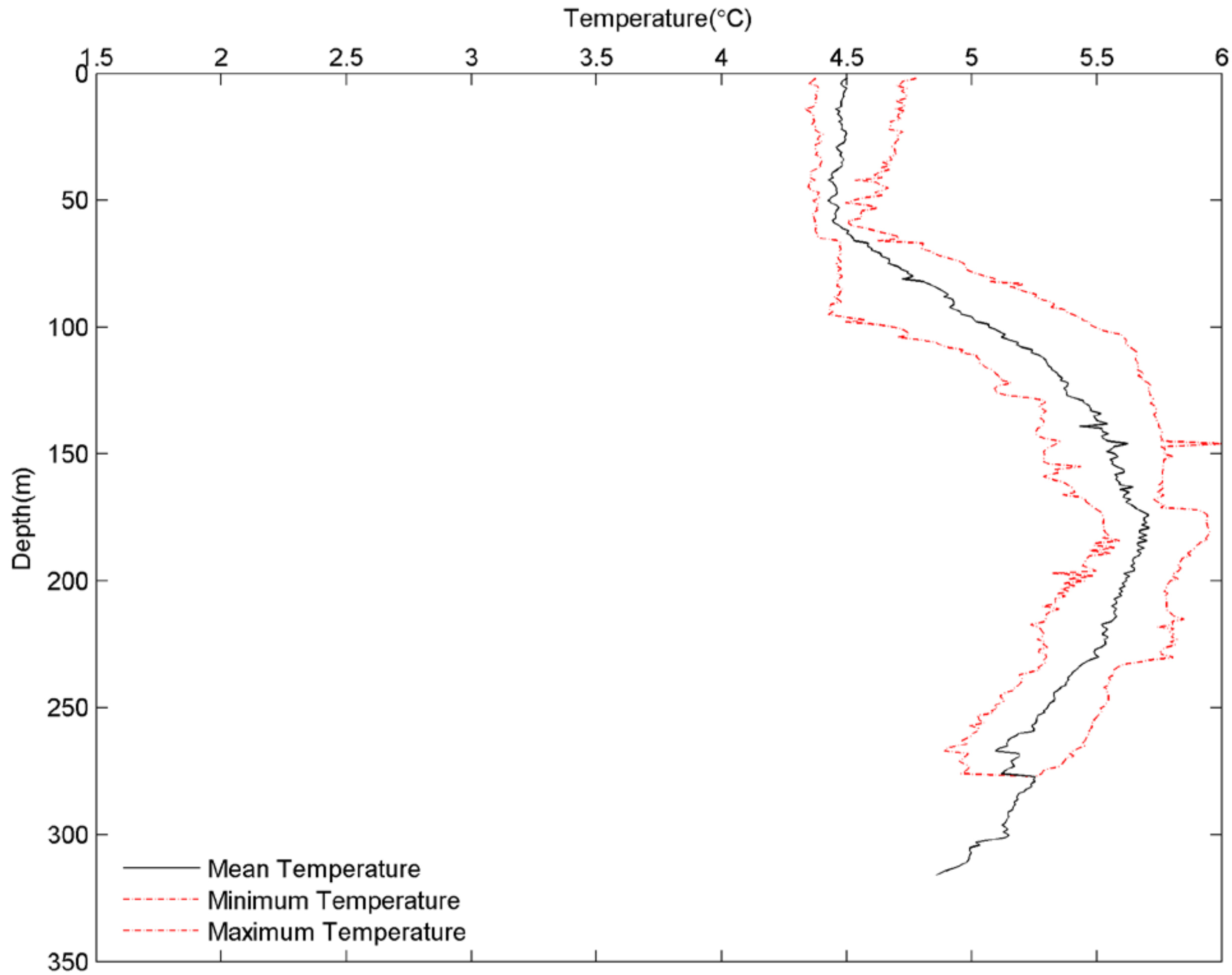


Figure 34. -- Mean water temperature (°C) (solid line) by 1-m depth intervals observed during the winter 2013 acoustic-trawl survey of walleye pollock on the Gulf of Alaska shelf break between Chirikof Island and Barnabas Trough. Data collected at four trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed- lines represent minimum and maximum temperatures observed.

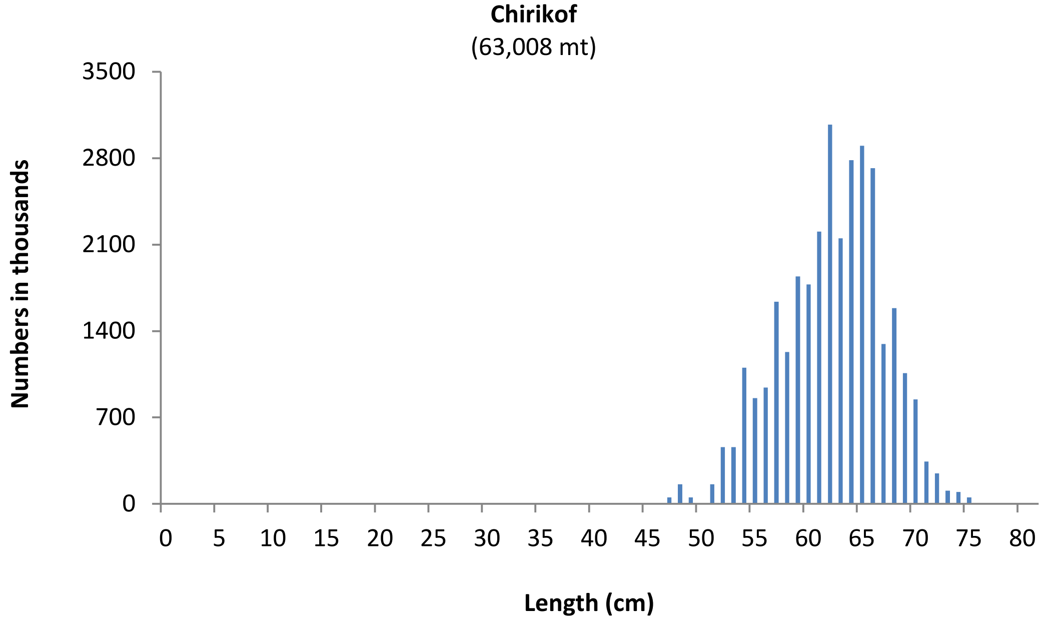


Figure 35. -- Length distribution of walleye pollock (numbers) along with the biomass estimate (metric tons, mt) for the 2013 acoustic-trawl survey of Chirikof shelf break.

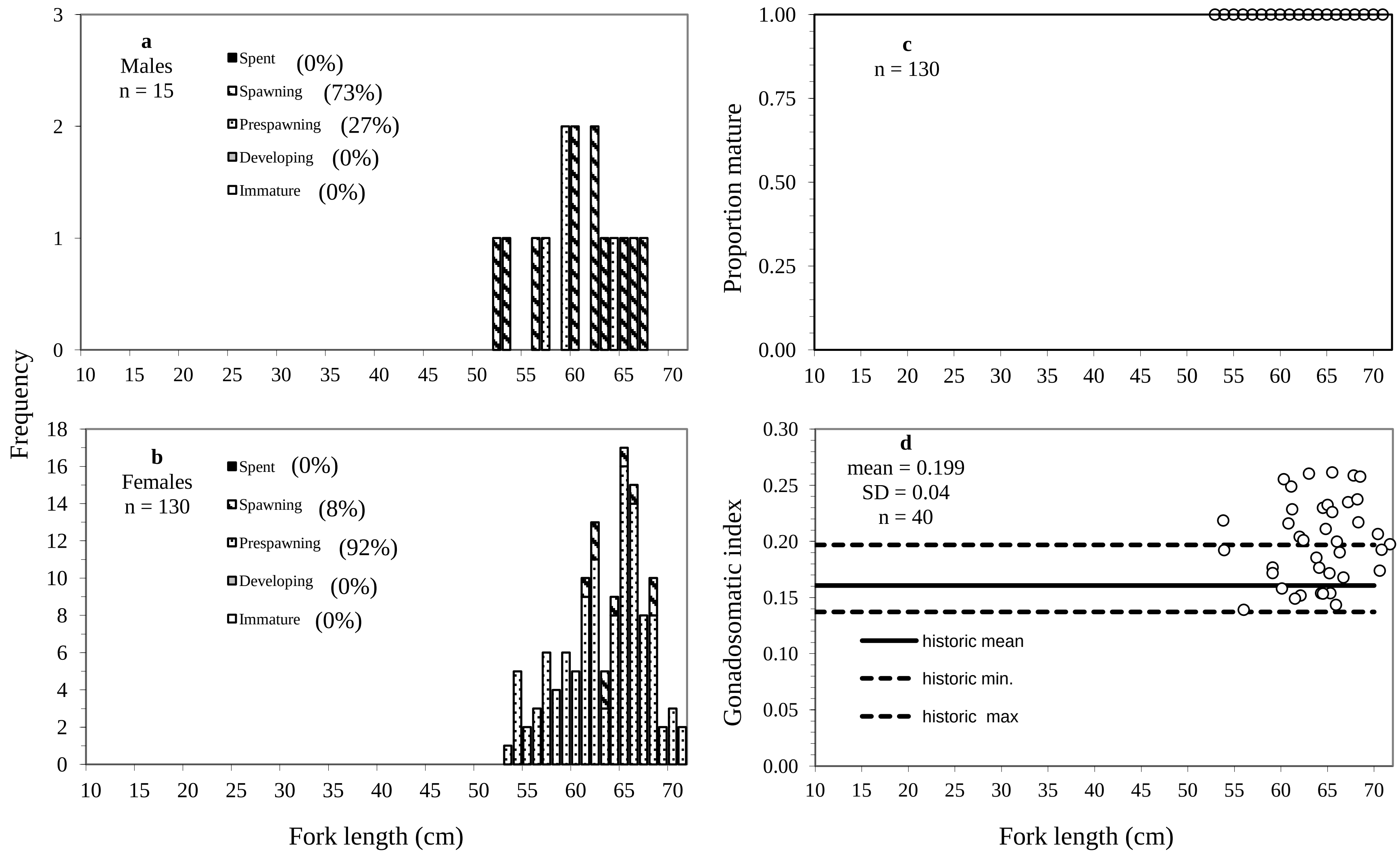


Figure 36. -- Maturity stages, and percentage of fish greater than 40 cm FL within each stage, for (a) male and (b) female walleye pollock; (c) proportion mature (i.e. prespawning, spawning, or spent) by 1-cm size group for female walleye pollock; and (d) gonadosomatic index (with historic survey mean, and minimum and maximum of historic survey means) for pre-spawning females examined during the 2013 acoustic-trawl survey of the Chirikof shelf break. Note: these graphs do not include data from age-1 fish.

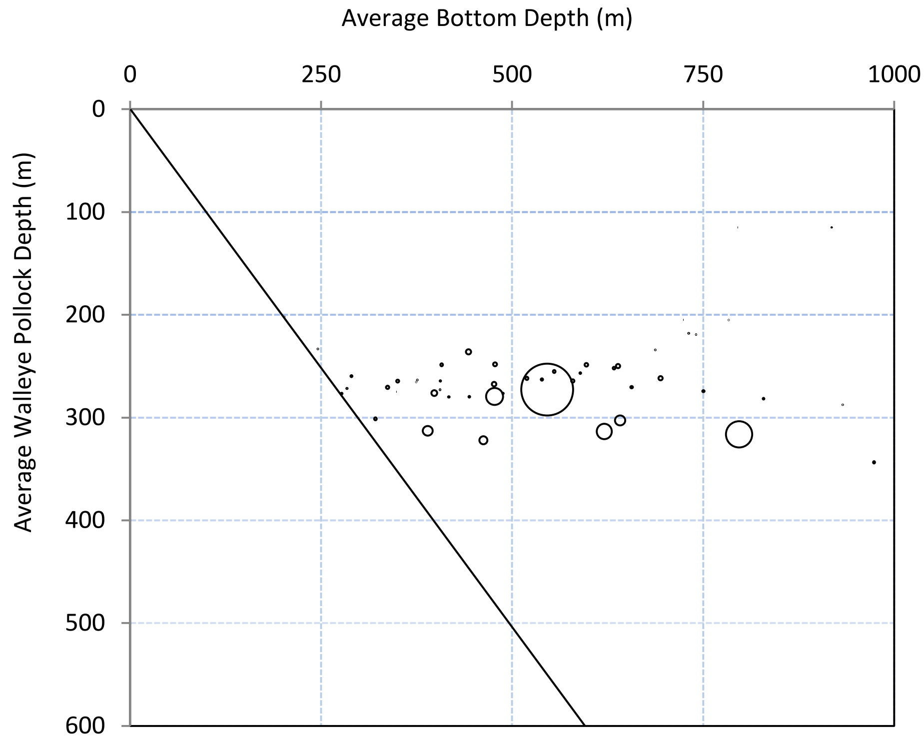


Figure 37. -- Average pollock depth (weighted by biomass) versus bottom depth (m) for walleye pollock observed during the winter 2013 acoustic-trawl survey of Chirikof shelf break area. Circle size is scaled to the maximum biomass per 0.5 nautical mile survey track interval. The diagonal line indicates where the average fish depth equals bottom depth.

APPENDIX I

ITINERARY

DY2013-02

Shumagin Islands\Sanak Trough\Morzhovoi Bay

7 Feb.	Depart Kodiak, AK.
9 Feb.	Acoustic sphere calibration in Volcano Bay, Alaska Peninsula, AK.
10-11 Feb.	Transit back to Kodiak for vessel repair.
12 Feb.	Arrive Kodiak, AK.
24 Feb.	Depart Kodiak, AK.
26 Feb.-1 Mar.	Acoustic-trawl survey of Shumagin Islands.
2 Mar.	Acoustic-trawl survey of Sanak Trough.
3 Mar.	Acoustic-trawl survey of Morzhovoi Bay.
4 Mar.	Arrive Kodiak, AK. End cruise.

DY2013-03

Marmot Bay\Shelikof Strait\Chirikof Shelf Break

14 Mar.	Depart Kodiak, AK.
15-16 Mar.	Acoustic-trawl survey of Marmot Bay.
16-25 Mar.	Acoustic-trawl survey of Shelikof Strait.
25-27 Mar.	Acoustic-trawl survey of Chirikof shelf break.
27 Mar.	Acoustic sphere calibration in Three Saints Bay, Kodiak, AK.
28 Mar.	Arrive Kodiak, AK. End cruise.

APPENDIX II

SCIENTIFIC PERSONNEL

DY2013-02

Shumagin Islands\Sanak Trough\Morzhovoi Bay

Name	Position	Organization
Darin Jones	Chief Scientist	AFSC
Paul Walline	Fishery Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Abigail McCarthy	Fishery Biologist	AFSC
Taina Honkalehto	Fishery Biologist	AFSC
William Floering	Fishery Biologist	AFSC

DY2013-03

Marmot Bay\Shelikof Strait\Chirikof Shelf Break

Name	Position	Organization
Chris Wilson	Chief Scientist	AFSC
Darin Jones	Fishery Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Kresimir Williams	Fishery Biologist	AFSC
Martin Dorn	Fishery Biologist	AFSC
Alex Andrews	Fishery Biologist	AFSC*
Kevin Taylor	Contractor	AFSC
Dan Carney	Consultant	Fishing Industry

AFSC – Alaska Fisheries Science Center, Seattle, WA

AFSC*– Alaska Fisheries Science Center, Juneau, AK