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Results of the Acoustic-Trawl Surveys of Walleye Pollock (*Theragra chalcogramma*) in the Gulf of Alaska, February-March 2010 (DY2010-01 and DY2010-02)

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Results of the Acoustic-Trawl Surveys of Walleye Pollock (*Theragra chalcogramma*) in the Gulf of Alaska, February-March 2010 (DY2010-01 and DY2010-02)

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 (*Theragra chalcogramma*). Historically, most of these efforts have been focused on the Shelikof Strait area, which has been surveyed annually since 1980, except in 1982 and 1999. The Shumagin Islands area has also been surveyed annually since 2005 with prior surveys in 1994-1996 and 2001-2003. Additionally, the GOA continental shelf break east of Chirikof Island to Barnabas Trough has been surveyed annually since 2002. In 2010, survey activities were expanded to include Morzhovoi Bay, Pavlof Bay, the bays along the southern coast of the Kenai Peninsula, and Prince William Sound. This report presents the distribution and abundance of walleye pollock for all AT surveys conducted in the GOA during February and March 2010 along with acoustic system calibration and physical oceanographic results.

METHODS

Surveys were conducted between 22 February and 9 March (cruise DY2010-01) in the Shumagin Islands (comprising Shumagin Trough, Stepovak Bay, Renshaw Point, Unga Strait, and West Nagai Strait), Sanak Trough, Morzhovoi Bay, Pavlof Bay, throughout the Kenai Peninsula bays, Prince William Sound, and in Marmot Bay. The central GOA along the shelf break east of Chirikof Island and throughout Shelikof Strait was surveyed between 18 and 30 March (cruise DY2010-02). Survey itineraries and scientific personnel are listed in Appendices I and II. 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 Simrad EK60 scientific echo sounding system (Simrad 2004, 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. A second 70-kHz transducer was mounted on the port side of the centerboard directed slightly downward (24.5° from horizontal) for assessing the response of near-surface fish not directly in the path of the vessel. A Simrad ME70 multibeam sonar (Simrad 2007, Trenkel et al. 2008) was mounted on the hull 10 m forward of the centerboard at a depth of 6 m below the water surface. Multibeam data were collected during all surveys using the Simrad ME70 multibeam echosounder in the 31-beam configuration used during the MACE winter 2009 field season. 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 *Oscar Dyson* was anchored at the bow and stern. A tungsten carbide sphere (38.1 mm diameter) and a copper sphere (64 mm diameter) were suspended below the centerboard-mounted transducers. The tungsten carbide sphere was used to calibrate the 38, 70, 120 and 200 kHz systems and the copper sphere was used to calibrate the 18-kHz system. After each sphere was centered on the acoustic axis, split-beam target-strength and echo integration 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 EKLOBES software (Simrad 2004).

[1] National Marine Fisheries Service (NMFS) 2009. NOAA protocols for fisheries acoustics surveys and related sampling (Alaska Fisheries Science Center), NOAA Policy Directive 04-105-05, 26 p. Prepared by Midwater Assessment and Conservation Engineering Program, Alaska Fish. Sci. Center, Natl. Mar. Fish. Serv., NOAA.

Acoustic telegram data were logged at the five split-beam frequencies using Myriax EchoLog 500 (v. 4.70.1.14256) and ER60 software (v. 2.2.0). Raw split-beam and multibeam acoustic data were collected. Results presented in this report, including calibration, are based on 38 kHz echo integration telegram data with a post-processing S_v threshold of –70 dB. Acoustic measurements were collected from 16 m below the surface to within 0.5 m of the bottom and were analyzed using Myriax Echoview post-processing software (Version 4.80.45.15976). Acoustic data collection was limited to 750 m depth.

Trawl Gear and Oceanographic Equipment

Midwater and near-bottom acoustic backscatter was sampled using an Aleutian Wing 30/26 Trawl (AWT). This trawl was constructed with full-mesh nylon wings, and polyethylene mesh in the codend and aft section of the body. The headrope and footrope each measured 81.7 m (268 ft). Mesh sizes tapered from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend, where it was fitted with a single 12 mm (0.5 in) codend liner. Near-bottom backscatter was sampled with a poly Nor'eastern (PNE) bottom trawl, which is a high-opening trawl equipped with roller gear and constructed with stretch mesh sizes that range from 13 cm (5 in) in the forward portion of the net to 8.9 cm (3.5 in) in the codend. The PNE codend was also fitted with a single 12 mm (0.5 in) codend liner. Both nets were fished with 5 m^2 Fishbuster trawl doors each weighing 1,089 kg. Vertical net openings and depths were monitored with either a Simrad FS70 third-wire netsonde or a Furuno acoustic-link netsonde attached to the headrope. The vertical net opening for the AWT ranged from 19 to 31 m (62 to 102 ft) and averaged 24 m (79 ft) while fishing. The PNE vertical mouth opening ranged from 6 to 7 m (20-23 ft) and averaged 6 m (20 ft) while fishing. Detailed trawl gear specifications are described in Guttormsen et al. (2010).

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 system at calibration sites and during the special studies. 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 (SCS). For this report, SBE-39 data were used for the reporting of sea surface temperatures because they were collected only in the area where fish were observed.

Survey Design

The survey design consisted of a series of parallel line transects, except where necessary to reorient tracklines to maintain a perpendicular alignment to the isobaths and work around landmasses. In Kenai Peninsula bays, zig-zag transects were used because of the narrowness of many of the bays. A random start position was generated for the first transect for all areas. Survey activities were conducted 24 hours per day.

Trawl hauls were conducted to collect specimens of walleye pollock and to classify observed backscatter to species and size composition. Average trawling speed was approximately 1.5 m/sec (3 knots). Walleye pollock were sampled to determine sex, fork length (FL), body weight, age, 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 accepted), except for capelin (*Mallotus villosus*), which were measured to the nearest millimeter standard length. When large numbers of juveniles mixed with adults were encountered in a haul, the predominant size groups were subsampled separately. For each trawl catch, sex and length measurements were collected for 50 to 400 randomly sampled individuals, and body weight, maturity, and age were determined from an additional 10 to 60 individuals. An electronic motion-compensating scale (Marel M60) was used to weigh individual walleye pollock to the nearest 2 g. For age determinations, walleye pollock otoliths were collected and stored in a 50% glycerin/thymol-water solution. After the survey the otoliths were processed by scientists in the AFSC's Age and Growth Program to determine individual fish ages. 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 an Oracle database using the Fisheries Scientific Computing System (FSCS) on the DY2010-01 cruise and the Catch Logger for Acoustic Midwater Surveys (CLAMS) on the DY2010-02 cruise.

Data Analysis

Walleye pollock abundance was estimated by combining echo integration and trawl information. The detected bottom was calculated using the mean of sounder-detected bottom lines for all five frequencies3. Acoustic backscatter, identified as walleye pollock, rockfish, and an undifferentiated mixture of primarily macrozooplankton, was recorded between depths of 16 m below the surface to 0.5 m above the detected bottom (except where the bottom exceeded the 750 m lower limit of data collection). All acoustic backscatter data were binned at 0.5 nmi horizontal by 10 m vertical resolution using an s_v threshold of –70 decibels (dB) and stored in an Oracle database. Walleye pollock length compositions were combined into regional length strata based on geographic proximity, similarity of length composition, and backscatter characteristics. Mean fish weight-at-length for each length interval (cm) was estimated from the trawl information when there were six or more walleye pollock for that length interval; otherwise it was estimated using a linear regression of the natural logs of all length-weight data (De Robertis and Williams 2008). 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.

Relative errors for the acoustic-based estimates were derived using a one-dimensional (1D) 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

[2] ADP Codebook. 2005. Unpublished document. 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.

[3] Jones, D., A. De Robertis, and N. Williamson. 2010. Statistical combination of multi-frequency sounder-detected bottom lines reduces bottom integrations. Unpublished manuscript.

distribution. These errors quantify only transect sampling variability. Information is not yet available to assess contributions from other sources of error (e.g., target strength, trawl sampling).

RESULTS and DISCUSSION

Calibration

Two acoustic system calibrations, one prior to and one following survey activities, were conducted during the winter 2010 field season (Table 1). The 38-kHz collection system showed no significant differences in gain parameters or transducer beam pattern characteristics between calibrations, confirming that the acoustic system was stable throughout the surveys. Acoustic system settings for the surveys were based on results from the 22 February acoustic system calibration.

Shumagin Islands

The Shumagin Islands survey was conducted from 23 to 25 February. Acoustic backscatter was measured along 493 km (266 nmi) of tracklines. Transects were spaced 9.3 km (5.0 nautical miles (nmi)) apart within Shumagin Trough, 4.6 km (2.5 nmi) apart in Stepovak Bay, West Nagai Strait, and the eastern half of Unga Strait, and 1.9 (1.0 nmi) apart east of Renshaw Point and the northern half of Unga Strait (Fig. 1). Bottom depths did not exceed 225 m along any transect, and transects generally did not extend into waters less than about 60 m depth.

<u>Physical Oceanography</u>

Surface water temperatures ranged from 3.2° to 4.3° C with a mean of 3.6° C (Fig. 2) which was 1° C warmer than the mean temperature in 2009 but within the range of previous surveys, which have ranged from 2.4° to 5.6° C. Overall the thermocline was relatively weak and only two haul locations (hauls 2 and 3) had a temperature difference greater than 1° C from the surface to the trawl depth. The temperature at the depth where most adult walleye pollock biomass occurred (155-180 m off Renshaw Point and northeastern Unga Strait) averaged 4.2° C.

Trawl Samples

Biological data and specimens were collected in the Shumagin Islands in four AWT and three PNE hauls (Tables 2 and 3; Fig. 1). Walleye pollock was the most abundant species caught in both gear types, contributing 92.7% and 60.8% by weight to the total catch from AWT and PNE trawls, respectively (Tables 4 and 5). By numbers, eulachon (*Thaleichthys pacificus*) was the second most abundant species caught in the AWT, comprising 3.1% of the catch (Table 4). Most of the eulachon catch occurred in Shumagin Trough. Arrowtooth flounder (*Atheresthes stomias*; 13.9%) and flathead sole (*Hippoglossoides elassodon*; 9.4%), made up most of the bycatch in the PNE trawls.

Walleye pollock ranged in length from 10 to 71 cm FL (Fig. 3). Age-1 fish[4] were only caught in haul 1 in easternmost Shumagin Trough. Elsewhere, age-2 and -3 fish dominated, except in West Nagai Strait, where age-4 fish dominated.

The unweighted maturity composition for males longer than 40 cm FL (n = 38) was 0% immature, 21% developing, 45% pre-spawning, 32% spawning, and 3% spent (Fig. 4a). The maturity composition of females longer than 40 cm FL (n = 40) was 0% immature, 30% developing, 60% pre-spawning, 10% spawning, and 0% spent (Fig. 4b). The low percentage of spawning and spent female fish indicates that survey timing was appropriate, although the survey start date was delayed by 13 days because of vessel mechanical problems. Because of an insufficient contrast in the data, a logistic model to predict the length at which 50% (L_{50}) of females were mature could not be fit to the female maturity-at-length data (Fig. 4c). The average GSI [gonadosomatic index: ovary weight/(ovary weight + body weight)] of pre-spawning females, although based on only 23 samples, was 0.11 (Fig. 4d), which was slightly higher than for two previous years of 0.09 and 0.08 but within the range of previous surveys.

[4] Based on results of the Shelikof Strait ages, which are the only otoliths to have been read at the time of this report.

Distribution and Abundance

The densest walleye pollock aggregations in the Shumagin Islands area were located in north-eastern Unga Strait and off Renshaw Point (Fig. 5). However, as in 2007-2009, the densities off Renshaw Point were relatively low compared with earlier surveys. High densities were also found in West Nagai Strait and the outer transect of the Shumagin Trough (Fig. 5). An extremely dense individual school of walleye pollock was located in West Nagai Strait. Walleye pollock were distributed near bottom as well as in dense, midwater schools. Most of the biomass was deeper than 160 m and was within 40 m of the bottom except for the large school in West Nagai Strait, which was 110 m below the surface over a bottom depth of 190 m (Fig. 6).

The preliminary biomass estimate of 18,200 t is the lowest in survey history and was less than one-third of the 2009 estimate of 63,300 t (Table 6; Fig. 7). The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 11.6%. The 2010 biomass was slightly greater than half the 2008 estimate (30,600 t) and roughly equivalent to the 2007 estimate of 20,000 t (Table 6; Fig. 7). Similar to surveys conducted prior to 2006, and in contrast to most of the biomass for the 2006-2009 surveys when most of the catch consisted of juvenile fish, catches in 2010 consisted primarily of adults and subadults (Figs. 3 and 8).

Inference about abundance trends based on the entire Shumagin time series is confounded for several reasons. Previous to 2001, only the 1995 survey covered the entire Shumagin Islands area. It is also unknown whether changes in abundance reflect variation in the timing of peak spawning or actual changes in the population. With the exception of the 1994 survey, which occurred in March well after peak spawning, the dates of the Shumagin Island survey have been similar between years, but the timing of peak spawning has varied. For example, 45% of the females in 2001 (third largest Shumagin Islands biomass estimate to date) were either spawning or spent, suggesting that the peak of spawning had already occurred and that some fish might have already left the area.

The Shumagin Islands surveys also may not provide reliable predictions of future walleye pollock abundance. For example, over 50% of the Shumagin Islands adult walleye pollock in 2001 consisted of fish from the 1993, 1994, and 1995 year classes; however, these year classes were either detected in low numbers or were entirely absent as juveniles during the 1994, 1995, and 1996 Shumagin Islands surveys (Fig. 8).

Sanak Trough

The Sanak Trough was surveyed from 26 to 27 February. Acoustic backscatter was measured along 176 km (95 nmi) of tracklines. Sanak Trough transects were spaced 3.7 km (2 nmi) apart (Fig. 1), with bottom depths ranging from 50 m at the transect end points to 165 m along the deepest part of the southernmost transects.

Physical Oceanography

Surface water temperatures averaged 3.4° C for the two trawl locations in this area (Fig. 9). The water column temperature was nearly uniform for the depth of the trawls, varying by 0.2° C from surface to trawl depth. The haul 9 location was shallower and slightly cooler than for haul 8 with a slight temperature increase at the deepest headrope depth of 70 m. Temperatures in haul 8 were uniform from the surface to trawl depth. Mean surface water temperatures were similar to last year's average of 3.5° C, and within the 2003-2007 range of 2.5° C to 5.1° C. The water temperature at depths where most walleye pollock biomass occurred (>75 m) was approximately 3.5° C, which was warmer than in 2006-2009 (2.8°-3.5° C), but cooler than in 2004 (5.3° C) and 2005 (4.4° C).

Trawl Samples

Biological data and specimens were collected in Sanak Trough from two AWT hauls (Tables 2 and 3; Fig. 1). Walleye pollock was the most abundant species caught, contributing 99.2% by weight and 99.1% by numbers (Table 7). The walleye pollock caught in haul 9 ranged from 46 to 72 cm FL (Fig. 10) with a mode of 58 cm FL, which is typical for this survey. However, the walleye pollock caught in haul 8 were age-2 juveniles ranging in length from 21 to 31 cm FL (Fig. 10) with a mode of 25 cm FL. The only other Sanak Trough survey that caught juvenile walleye pollock occurred in 2003.

The unweighted maturity composition for males longer than 40 cm FL (n = 18) was 0% immature, 0% developing, 44% pre-spawning, 6% spawning, and 50% spent (Fig. 11a). The unweighted maturity composition for females longer than 40 cm FL (n = 24) was 0% immature, 0% developing, 54% pre-spawning, 0% spawning, and 46% spent (Fig. 11b). The high percentage of spent females suggests that the survey timing was late. Previous Sanak Trough surveys have also found relatively high numbers of spawning and spent females, which suggests that Sanak Trough should be surveyed earlier in the season. A logistic model could not be fitted to the female maturity-at-length data (Fig. 11c). The average GSI of pre-spawning females was 0.19 (Fig. 11d), which was slightly lower than that estimated by previous surveys in this area.

Distribution and Abundance

The majority of the biomass was located over the center of the trough as has historically been the case (Fig. 5), unlike the 2009 survey when most of the walleye pollock biomass was located along the western slope and along the shelf to the west. Most of the walleye pollock backscattering was located well off the seafloor over bottom depths of 75-140 m (Fig. 12).

The preliminary biomass estimate of 26,700 t was slightly less than in 2009 (31,400 t) but greater than the 2008 low of 19,800 t (Table 6). However, the 2010 estimate is still roughly half the 2007 estimate and only 20% of the 2006 high (127,200 t). The relative estimation error for 2010 based on the one-dimensional geostatistical analysis of the acoustic backscattering was 11.6%.

Morzhovoi and Pavlof Bays

Morzhovoi Bay and Pavlof Bay were surveyed from 27 to 28 February. Acoustic backscatter was measured along 82 km (45 nmi) of trackline in Morzhovoi Bay and 81 km (44 nmi) in Pavlof Bay. Morzhovoi Bay transects were spaced 4.6 km (2.5 nmi) apart and Pavlof Bay transects were spaced 3.7 km (2 nmi) apart. Depths ranged from about 40-150 m in both bays.

Physical Oceanography

The surface water temperature at the trawl site in Morzhovoi Bay was 2.4° C and increased to 2.8° C at trawl depth (Fig. 13). Temperatures were similar to those in 2007 but approximately 0.5° C warmer than temperatures at the surface and at depth in 2006, which were the only two years during which surveys were conducted in this area. No temperature data were collected in Pavlof Bay.

Trawl Samples

Biological data and specimens were collected in Morzhovoi Bay from one AWT haul (Tables 2, 3, and 8; Fig. 1). Walleye pollock was the most abundant species caught, contributing 95.4% by weight and 99.1% by numbers (Table 8). Most of the walleye pollock captured were age-2 fish ranging from 21-31 cm and larger adult fish ranging up to 74 cm (Fig. 10). Primarily adult fish were caught here during the other two surveys of this area (2006 and 2007). No trawl activity was conducted in Pavlof Bay due to the lack of any significant echo sign (Fig. 5) and to inclement weather.

The unweighted maturity composition for males longer than 40 cm FL (n = 12) was 0% immature, 33% developing, 42% pre-spawning, 8% spawning, and 17% spent (Fig. 14a). The maturity composition of females longer than 40 cm FL (n = 54) was 0% immature, 2% developing, 22% pre-spawning, 4% spawning, and 72% spent (Fig. 14b). The high percentage of spent females suggests that the survey timing was late as in Sanak Trough. A logistic model to predict the female L_{50} of females could not be fit to the maturity-at-length data (Fig. 14c). The average GSI of pre-spawning females based on 13 samples was 0.20 (Fig. 14d).

Distribution and Abundance

The greatest walleye pollock backscatter densities were detected near the mouth of Morzhovoi Bay (Fig. 5). Most of the backscattering was located within 40 m of the sea floor over bottom depths of 75-115 m (Fig. 15). The preliminary biomass estimate of 1,800 t was less than the two previous survey estimates from this area (2006 = 11,700 t and 2007 = 2,500 t). The lower biomass estimate and high percentage of spent females suggests that early to mid-February may be a more appropriate time to survey this bay.

Minimal acoustic backscatter was measured along the 81 km (44 nmi) of transects in Pavlof Bay (Fig. 5). Length data from the haul conducted in Morzhovoi Bay produced a biomass estimate of 200 t. A survey of Pavlof Bay was also conducted in 2002, but an equipment malfunction prevented trawling. The amount of acoustic backscattering during the survey, however, was 50-fold greater than in 2010.

Kenai Peninsula Bays and Prince William Sound

The Kenai Peninsula bays were surveyed during 2-5 March along 408 km (221 nmi) of zig-zag transects that varied in width by bay (Fig. 16). Bottom depths did not exceed 320 m along any transect, and transects generally did not extend into waters less than 50 m depth. Prince William Sound was surveyed during 5-7 March along 500 km (270 nmi) of transects spaced 4.6 km (2.5 nmi) apart (Fig. 16). Bottom depths ranged from 60 to 750 m.

Physical Oceanography

The mean surface water temperature in the Kenai Peninsula bays was 4.5° C (Fig. 17), warming to 5.5° C at the maximum depth sampled (300 m). The mean surface water temperature in

Prince William Sound was 4.7° C, warming to 5.8° C at approximately 250 m depth, and decreasing slightly to 5.2° C at the maximum depth sampled (500 m; Fig. 18).

Trawl Samples

Biological data and specimens were collected from nine AWT hauls and one PNE trawl in the Kenai Peninsula bays (Tables 2 and 3; Fig. 16). Walleye pollock was the most abundant species caught by weight (>72%) and was second in numbers (>34%) to Pacific glass shrimp (*Pasiphaea pacifica*, 45.1%) in the AWT trawls conducted in the bays on the Kenai Peninsula (Table 9). Walleye pollock was the most abundant species caught by both weight (72.4%) and numbers (56.6%) in the single bottom trawl conducted (Table 10). Most fish caught along the Peninsula were adults ranging in length from 31 to 68 cm FL (Fig. 19), except in northern Nuka Bay, where the fish were a mixture of age-1 and adult fish. The unweighted maturity composition for males longer than 40 cm FL (n = 108) was 1% immature, 19% developing, 69% pre-spawning, 11% spawning, and 0% spent (Fig. 20a). The unweighted maturity composition for females longer than 40 cm FL (n = 132) was 0% immature, 24% developing, 76% pre-spawning, 0% spawning, and 0% spent (Fig. 20b). The low percentage of spawning and spent female fish indicates that survey timing was appropriate. A logistic model fit to the female maturity-at-length data predicted an L_{50} at 44 cm FL (Fig. 20c). The average GSI of pre-spawning females based on 103 samples was 0.10 (Fig. 20d).

In Prince William Sound, biological collections were conducted with one AWT and two PNE trawls (Tables 2 and 3; Fig. 16). Walleye pollock was the most abundant species caught by weight, making up 75.7% and 86.2% of the catch in the two gear types, respectively (Tables 11 and 12). Northern smoothtongue (*Leuroglossus schmidti*) was the second most abundant by weight (21.7%) and first by numbers (92.6%) in the AWT hauls. Eulachon was the second most abundant by both weight (4.3%) and numbers (39.1%) in the single PNE haul. Most of the walleye pollock caught were adults ranging in length from 21 to 55 cm FL and were generally larger than along the Kenai Peninsula (Fig. 19). Age-1 fish were also caught in haul 22 in the central north area of the Sound.

The unweighted maturity composition for males longer than 40 cm FL (n = 42) was 0% immature, 0% developing, 29% pre-spawning, 71% spawning, and 0% spent (Fig. 21a). The unweighted maturity composition for females longer than 40 cm FL (n = 63) was 0% immature, 2% developing, 98% pre-spawning, 0% spawning, and 0% spent (Fig. 21b). The low percentage of spawning and spent female fish indicating that survey timing was appropriate. A logistic model to predict the female L_{50} of females could not be fit to the maturity-at-length data (Fig. 21c). The average GSI of pre-spawning females based on 61 samples was 0.13 (Fig. 21d).

Distribution and Abundance

All bays contained substantial walleye pollock aggregations, with backscatter increasing towards the center of the peninsula and with the greatest abundance in Resurrection Bay (Fig. 22). Most fish were located within 100 m of the sea floor, except for two extremely dense midwater schools at 100 m from the surface – one located in Knight Passage, which was considered part of the peninsula survey for this report, and one in Resurrection Bay (Fig. 23). The preliminary biomass estimate for the Kenai Peninsula bays is 111,200 t. A relative estimation error was not derived for the zig-zag survey design. This was the first winter survey of these bays.

The densest backscatter in the Sound was detected along the eastern side of the main channel (Fig. 22), with most fish located near the seafloor deeper than 400 m from the surface (Fig. 24). The biomass estimate for Prince William Sound is 111,500 t. The relative estimation error for 2010 based on the one-dimensional geostatistical analysis of the acoustic backscattering was 11.6%. The other two MACE winter AT surveys of this area were conducted in 1984 and 1990. However, the sounder employed for those surveys was not effective deeper than 400 m; thus, no biomass estimate was produced (Karp 1990).

Marmot Bay

Marmot Bay was surveyed during 8-9 March along transects spaced 1.9 km (1.0 nmi) apart. Acoustic backscatter was measured along 157 km (85 nmi) of tracklines (Fig. 25). Bottom depths ranged from 65 to 345 m.

Physical Oceanography

Surface water temperatures averaged 4.5° C (Fig. 26). Temperatures at the depths where most adult walleye pollock biomass occurred (50-250 m) averaged 4.8° C. Water temperatures both at the surface and at depth were approximately 2° C higher that those in 2007 and 2009. One factor in the temperature difference from previous surveys could be the earlier timing of the current survey, which occurred approximately 2 weeks earlier than the previous surveys.

Trawl Samples

Biological data and specimens were collected in Marmot Bay from two AWT hauls (Tables 2, 3, and 13; Fig. 25). Walleye pollock and eulachon were the most abundant species caught, accounting for 97.8% and 1.4% of the catch by weight, respectively, and 70.2% and 26.9% of the catch by numbers, respectively (Table 13).

Walleye pollock ranged in length from 11 to 74 cm with modes at 13 cm, 29 cm, and 47 cm FL (Fig. 27). The unweighted maturity composition in Marmot Bay for males longer than 40 cm FL (n = 18) was 61% immature, 33% developing, 6% pre-spawning, 0% spawning, and 0% spent (Fig. 28a). The maturity composition of females longer than 40 cm FL (n = 18) was 0% immature, 67% developing, 33% pre-spawning, 0% spawning, and 0% spent (Fig. 28b). The high percentage of pre-spawning females indicates that peak spawning had not occurred and that survey timing was appropriate. The female L_{50} was 48 cm FL (Fig. 28c). The average GSI for pre-spawning females was 0.10 (Fig. 28d).

Distribution and Abundance

Dense midwater walleye pollock schools were detected to the northwest of Spruce Island and in Spruce Gully within 25 m of the sea floor over bottom depths of 150-250 m (Fig. 29 and 30). The biomass estimate for the Marmot Bay was 5,600 t, which was higher than in 2007 (3,600 t), but substantially lower than the 2009 estimate of 19,800 t. The two previous surveys of Marmot Bay covered roughly twice the trackline distance of the current survey; however, the additional trackline in the previous surveys extended to the east where only low walleye pollock densities were seen.

GOA Shelf Break from Chirikof Island to Barnabas Trough

The GOA shelf break from south of Barnabas Trough to southwest of Chirikof Island between the 200 and 1,500 m depth contours was surveyed from 18 to 19 March. Acoustic backscatter was measured along 261 km (141 nmi) of trackline (Fig. 25). Transects were spaced 11.1 km (6 nmi) apart.

Physical Oceanography

Surface water temperatures in the Chirikof shelf break area averaged 5.2° C (Fig. 31), 2° C higher than average surface temperatures in the area the previous 3 years and 0.5°-1.0° C higher than temperatures recorded in 2004- 2006. The temperatures at the depths where most walleye pollock biomass occurred (200-400 m) ranged from 5.2° to 6.0° C, approximately 0.5° C warmer than the average of the previous 6 years.

Trawl Samples

Biological data and specimens were collected along the GOA shelf break near Chirikof Island from four AWT hauls and two PNE hauls (Tables 14-17; Fig. 25). In the AWT hauls, Pacific ocean perch (POP; *Sebastes alutus*) was the most abundant species by weight, and walleye pollock was the second most abundant species, making up 69.5% and 26.5% of the catch, respectively (Table 16). Rougheye (*S. aleutianus*) and shortraker rockfish (*S. borealis*) combined contributed an additional 3.6% to the catch by weight. In the PNE hauls, rougheye rockfish were the most abundant species by weight (29.3%), with blackspotted rockfish (*S. melanostictus*; 16.2%), shortraker rockfish (12.8%), and walleye pollock (12.4%) also contributing significantly to the catch (Table 17). By numbers, shortspine thornyhead (*Sebastolobus alascanus*) and rougheye rockfish dominated the catch with 26.1% and 22.3%. POP were found in moderate to dense concentrations throughout most of the survey area over bottom depths of 175 to 300 m.

The walleye pollock captured in the AWT hauls ranged from 43 to 70 cm FL with a mode of 61 cm FL (Fig. 32a). As is typical for this survey, no juvenile walleye pollock were captured. The unweighted maturity composition for males longer than 40 cm FL (n = 12) was 0% immature, 0% developing, 67% pre-spawning, 33% spawning, and 0% spent (Fig. 33a). The unweighted maturity composition for females longer than 40 cm FL (n = 72) was 1% immature, 6% developing, 93% pre-spawning, 0% spawning, and 0% spent (Fig. 33b). The low percentage of spawning and spent female fish indicates that survey timing was appropriate. A logistic model to predict the female L_{50} could not be fit to the maturity-at-length data (Fig. 33c). The average GSI of pre-spawning females based on 61 samples was 0.14 (Fig. 33d).

<u>Distribution and Abundance</u>

This was the second consecutive year when very low densities of walleye pollock were observed along the Chirikof shelf break. A small amount of walleye pollock backscatter was detected near the mouth of Barnabas Trough (Fig. 34). Most of the walleye pollock backscatter occurred in midwater layers between 300 and 400 m depth over bottom depths of 325-650 m (Fig. 35).

The walleye pollock biomass estimate was 9,300 t, which was significantly higher than in 2009 (400 t) but lower than in 2008 (20,100 t) (Table 6). The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 15.0%.

Shelikof Strait

The Shelikof Strait sea valley was surveyed from 22 to 28 March using 13.9 km (7.5 nmi) transect spacing (Fig. 25). Acoustic backscatter was measured along 1,345 km (726 nmi) of tracklines. Bottom depths did not exceed 315 m along any transect, and transects generally did not extend into waters of less than about 60 m depth.

<u>Physical Oceanography</u>

Surface water temperatures ranged from 3.3° to 4.9° C with a mean of 4.0° C (Fig. 36), approximately 2° C higher than in 2007 and 2009 but similar to other recent years. Temperatures increased with depth down to approximately 250 m, rising to an average of 4.8° C, similar to 2009 (4.5° C) but cooler than for 2008 (5.5° C) and warmer than for 2004-2006 (4.0° C).

<u>Trawl Samples</u>

Biological data and specimens were collected in the Shelikof Strait area from 13 AWT hauls and 2 PNE hauls (Tables 14, 15, 18 and 19; Fig. 25). Walleye pollock and eulachon were the most abundant species by weight in midwater trawl hauls, contributing 76.3% and 23.2%, respectively, to the total catch (Table 18). By numbers, walleye pollock and eulachon were also the most abundant species caught, accounting for 27.4% and 71.3% of the catch, respectively. Walleye pollock and eulachon also accounted for 45.8% and 39.5%, respectively, of the number of fish caught in the PNE hauls (Table 19).

Most near-bottom walleye pollock catches consisted of a mixture of age-1, age-2, age-3, and older adult fish, with older fish predominate along the western side in the deepest part of the Strait between Cape Kuliak and Cape Unalishagvak (Fig. 32b), and the reverse being true outside of this area (Fig. 32c). Predominantly age-3 fish were caught in midwater schools on the Kodiak side of the Strait and along the eastern sides of the southernmost transects (Fig. 32d). Eulachon (smelt) were less prevalent than in recent years.

The unweighted maturity composition in the Shelikof Strait area for males longer than 40 cm FL (n = 204) was 6% immature, 5% developing, 24% mature pre-spawning, 65% spawning, and 0% spent (Fig. 37a). The maturity composition of females longer than 40 cm FL (n = 171) was 5% immature, 9% developing, 81% pre-spawning, 4% spawning, and 0% spent (Fig. 37b). These results are similar to previous surveys and suggest that the survey timing was appropriate. The female L_{50} of 44 cm FL (Fig. 37c) was similar to most estimates since 1985. The average GSI for pre-spawning females of 0.13 (Fig. 37d) was similar to GSI values for 2009 (0.13), 2008 (0.12), 2002 (0.12), and 2003 (0.11), but slightly lower than 2004-2007, where the mean GSI ranged from 0.14 to 0.16. The current mean is also lower than the mean GSIs (0.14-0.19) reported for the 1992-2001 surveys.

Distribution and Abundance

For the first time since 2000, the highest walleye pollock densities were observed along the west side of the Strait proper between Cape Unalishagvak and Cape Kuliak (Fig. 34). Dense aggregations were also detected along the eastern sides of the southernmost transects. Most walleye pollock were generally located within 40 m of the seafloor over bottom depths exceeding 200 m, except for scattered aggregations of mostly age-3 fish between about 90 and 150 m below the surface on the Kodiak side of the Strait and between about 150 and 225 m below the surface along the eastern sides of the southernmost transects (Fig. 38).

The biomass estimate of 415,600 t was substantially higher than the 2009 (266,000 t) and 2008 (208,000 t) estimates and is the largest seen in Shelikof Strait since 2001 (Table 6; Fig. 39). The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 2.6% (Table 6). An estimated 434 million 3-year-old walleye pollock indicates that the 2007 year class is still strong, and the estimated 267 million 2-year-old fish continues to suggest an average to above-average 2008 year class. An estimated 68 million 1-year-old fish, however, suggests a weak 2009 year class (Tables 20-23, Fig. 40).

MACE Special Projects

Follow-up data collections pertaining to an NPRB-funded rockfish assessment survey in untrawlable habitat on the 'Snakehead' area of the shelf break south of Kodiak Island (cruise DY2009-12) were conducted during both DY2010-01 and DY2010-02 (Dr. Chris Wilson, 206-526-4163, Chris.Wilson@noaa.gov). Activities during DY2010-01 involved water collections on bubble vents for chromatography and determination of gas constituents. During DY2010-02, activities included deployment of a drop video camera for ground truthing bottom classification, deployment of a lowered acoustic system for target-strength data collection on rockfish schools, and subsequent trawls to acquire length distribution data. Hauls 4 and 5 targeted rockfish.

Pacific cod (*Gadus macrocephalus*) were collected, tagged, and released on several bottom trawls in the Shumagin Islands area (DY2010-01) to evaluate fish movement in the area (Susanne McDermott, 206-526-4417, Susanne.McDermott@noaa.gov). Spawning walleye pollock were collected and strip spawned on DY2010-02 and fertilized eggs were transported to Seattle to examine larval walleye pollock feeding, behavior, physiology, and predation (Steve Porter, 206-206-4271, Steve.Porter@noaa.gov). Walleye pollock, capelin, eulachon, and Pacific herring (*Clupea pallasi*) samples were collected from all areas to provide trophic-level data to multispecies and food web models (Troy Buckley, 206-526-4249, Troy.Buckley@noaa.gov). Ovaries were collected from several rockfish species for use in developing estimates of reproductive parameters to be utilized in stock assessments (Cristina Conrath, 907-481-1732, Christina.Conrath@noaa.gov). Results for all special projects are to be reported elsewhere.

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TABLES AND FIGURES

Table 1. -- Simrad ER60 38 kHz acoustic system description and settings used during the late winter/early spring 2010 echo integration-trawl surveys of walleye pollock in the Gulf of Alaska, and results from standard sphere acoustic system calibrations conducted in association with the surveys.

	Survey system settings	22 Feb Three Saints Bay Alaska	29 Mar Three Saints Bay Alaska
Echosounder	Simrad ER60	--	--
Transducer	ES38B	--	--
Frequency (kHz)	38	--	--
Transducer depth (m)	9.15	--	--
Pulse length (ms)	1.024	--	--
Transmitted power (W)	2000	--	--
Angle sensitivity along	22.83	--	--
Angle sensitivity athwart	21.43	--	--
2-way beam angle (dB)	-20.77	--	--
Gain (dB)	22.97	22.97	23.03
s_A correction (dB)	-0.61	-0.61	-0.71
3 dB beamwidth along	6.69	6.69	6.75
3 dB beamwidth athwart	7.11	7.11	7.17
Angle offset along	-0.04	-0.04	-0.10
Angle offset athwart	-0.10	-0.10	-0.02
Post-processing sv threshold (dB)	-70	--	--
Standard sphere TS (dB)	--	-42.25	-42.07
Sphere range from transducer (m)	--	19.60	19.97
Absorption coefficient (dB/m)	0.0098	0.0098	0.0099
Sound velocity (m/s)	1466.0	1464.8	1464.2
Water temp at transducer (°C)	--	4.2	4.3

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

Table 2. -- Summary of trawl and catch data from the 2010 walleye pollock echo integration-trawl surveys of the Shumagin Islands (hauls 1-7), Sanak Trough (hauls 8-9), Morzhovoi Bay (haul 10), Kenai Peninsula (hauls 11-20), Prince William Sound (hauls 21-23), and Marmot Bay (hauls 24-25).

Haul	Gear[1]	Date	Time	Duration	Start position		Depth (m)		Temp. (° C)		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	footrope	bottom	Headrope[2]	surface[3]	(kg)	number	(kg)
1	AWT	23-Feb	20:58	3	55° 14.36'	159° 04.07'	181	202	5.0	4.0	412.2	2,798	35.8
2	PNE	24-Feb	15:35	6	55° 48.33'	159° 47.74'	117	117	4.4	2.8	310.3	997	97.6
3	PNE	25-Feb	0:37	13	55° 33.47'	160° 19.41'	177	183	4.3	3.0	740.5	737	487.1
4	AWT	25-Feb	3:10	5	55° 35.21'	160° 09.62'	120	168	4.1	3.1	1,775.2	14,227	576.5
5	AWT	25-Feb	10:40	23	55° 25.27'	160° 33.92'	116	127	3.7	3.1	708.6	4,440	21.9
6	PNE	25-Feb	18:02	15	55° 12.44'	160° 12.20'	215	215	4.1	3.5	247.1	167	251.7
7	AWT	26-Feb	0:56	8	55° 13.76'	160° 23.69'	138	194	3.8	3.3	8,720.3	22,560	279.7
8	AWT	26-Feb	13:21	2	54° 28.20'	162° 29.84'	140	144	3.7	3.2	291.6	2,411	8.5
9	AWT	26-Feb	19:36	7	54° 37.59'	162° 34.40'	96	147	3.3	2.9	1,144.6	689	3.7
10	AWT	27-Feb	9:42	17	54° 55.28'	162° 57.45'	92	140	2.7	2.1	1,131.3	5,542	54.9
11	AWT	3-Mar	0:56	15	59° 16.43'	151° 08.55'	217	243	5.4	4.1	598.0	870	25.2
12	AWT	3-Mar	7:31	10	59° 28.21'	150° 33.63'	178	277	6.1	3.7	193.3	1,507	28.3
13	AWT	3-Mar	14:01	21	59° 23.95'	150° 29.80'	225	242	5.9	4.1	2,014.0	2,341	32.9
14	AWT	3-Mar	22:35	1	59° 40.76'	149° 52.92'	200	207	5.8	3.9	2,351.8	1,825	9.0
15	AWT	4-Mar	4:23	20	59° 51.05'	149° 41.90'	71	267	5.1	2.6	19.4	782	9.2
16	AWT	4-Mar	10:49	10	59° 47.98'	149° 41.92'	199	273	5.8	3.0	182.0	453	47.3
17	AWT	4-Mar	16:07	5	60° 00.18'	149° 08.42'	172	191	5.4	4.0	923.5	1,206	32.2
18	AWT	5-Mar	3:49	16	60° 02.10'	149° 21.95'	102	292	5.3	3.6	311.4	608	5.1
19	AWT	5-Mar	6:00	8	59° 54.21'	149° 24.06'	190	241	5.4	3.6	627.6	688	29.8
20	PNE	5-Mar	19:10	16	60° 09.37'	147° 53.24'	221	306	5.7	4.3	182.4	503	69.7
21	AWT	6-Mar	8:40	40	60° 42.38'	147° 36.29'	486	509	5.3	4.2	483.2	458	155.1
22	PNE	6-Mar	20:29	5	60° 45.06'	147° 03.55'	446	446	5.3	4.2	434.8	408	120.4
23	PNE	7-Mar	6:32	4	60° 34.98'	146° 50.61'	450	450	5.3	4.2	612.2	637	46.8
24	AWT	8-Mar	14:58	9	58° 00.18'	152° 21.12'	147	294	4.8	4.2	966.4	1,410	20.2
25	AWT	8-Mar	23:56	4	58° 01.29'	152° 30.39'	178	197	4.9	4.1	12.6	19	1.7

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

[2]Temperature from Seabird electronics SBE-39 attached to trawl net headrope

[3]Temperature from hull-mounted Furuno T-2000, 1.4 m below surface

Table 3. -- Number of biological samples and measurements collected during the winter 2010 walleye pollock echo integration-trawl surveys of the Shumagin Islands (hauls 1-7), Sanak Trough (hauls 8-9), Morzhovoi Bay (haul 10), Kenai Peninsula (hauls 11-20), Prince William Sound (hauls 21-23), and Marmot Bay (hauls 24-25).

Haul	Walleye pollock				Eulachon	Capelin
no.	Lengths	Weights	Maturity	Otoliths	lengths	lengths
1	140	29	29	29	59	50
2	421	30	30	30	51	3
3	349	0	0	0	52	0
4	205	0	0	0	0	0
5	439	134	134	52	62	2
6	167	41	41	26	0	0
7	462	75	75	30	0	0
8	244	26	26	26	24	0
9	230	34	34	34	0	0
10	336	86	86	35	0	0
11	390	70	70	35	50	0
12	365	61	61	35	50	2
13	347	29	29	29	33	0
14	318	44	44	44	0	0
15	136	31	31	26	50	19
16	453	66	66	30	50	5
17	403	58	58	35	56	12
18	352	42	42	0	0	0
19	355	34	34	30	57	0
20	204	0	0	0	32	0
21	380	33	33	30	0	0
22	292	31	31	0	43	0
23	181	43	43	29	51	0
24	403	35	35	0	57	5
25	19	12	12	0	54	34
Total	7,591	1,044	1,044	585	831	132

Table 4. -- Summary of catch by species in four Aleutian wing trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Shumagin Islands area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	11,613.3	92.7	43,062	94.6
Pacific cod	*Gadus macrocephalus*	876.7	7.0	242	0.5
eulachon	*Thaleichthys pacificus*	38.0	0.3	1,405	3.1
capelin	*Mallotus villosus*	2.2	<0.1	801	1.8
sturgeon poacher	*Podothecus acipenserinus*	<0.1	<0.1	1	<0.1
Pacific herring	*Clupea pallasi*	<0.1	<0.1	1	<0.1
Total		12,530.3		45,512	

Table 5. -- Summary of catch by species in three poly-Nor'eastern bottom trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Shumagin Islands area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	1,297.9	60.8	1,857	44.3
arrowtooth flounder	*Atheresthes stomias*	296.8	13.9	439	10.5
flathead sole	*Hippoglossoides elassodon*	201.0	9.4	629	15.0
Pacific cod	*Gadus macrocephalus*	78.9	3.7	21	0.5
Pacific halibut	*Hippoglossus stenolepis*	46.2	2.2	14	0.3
Tanner crab	*Chionoecetes bairdi*	46.0	2.2	86	2.1
big skate	*Raja binoculata*	39.3	1.8	4	<0.1
rex sole	*Glyptocephalus zachirus*	36.1	1.7	117	2.8
eulachon	*Thaleichthys pacificus*	18.5	0.9	430	10.3
Alaska plaice	*Pleuronectes quadrituberculatus*	17.0	0.8	8	0.2
longnose skate	*Raja rhina*	13.6	0.6	1	<0.1
yellow Irish lord	*Hemilepidotus jordani*	10.3	0.5	12	0.3
Chinook salmon	*Oncorhynchus tshawytscha*	7.6	0.4	4	<0.1
starry flounder	*Platichthys stellatus*	6.1	0.3	3	<0.1
giant octopus	*Octopus dofleini*	4.2	0.2	1	<0.1
pandalid shrimp unident.	Pandalidae (family)	2.5	0.1	439	10.5
yellowfin sole	*Limanda aspera*	2.1	<0.1	1	<0.1
smooth lumpsucker	*Aptocyclus ventricosus*	2.0	<0.1	2	<0.1
longsnout prickleback	*Lumpenella longirostris*	1.7	<0.1	55	1.3
Dover sole	*Microstomus pacificus*	1.6	<0.1	3	<0.1
lyre whelk	*Neptunea lyrata*	1.2	<0.1	2	<0.1
sea anemone unident.	Actiniaria (Order)	1.2	<0.1	8	0.2
bigmouth sculpin	*Hemitripterus bolini*	0.9	<0.1	2	<0.1
rougheye rockfish	*Sebastes aleutianus*	0.6	<0.1	1	<0.1
rock sole sp.	*Lepidopsetta* sp.	0.6	<0.1	1	<0.1
spinyhead sculpin	*Dasycottus setiger*	0.3	<0.1	4	<0.1
sidestripe shrimp	*Pandalopsis dispar*	<0.1	<0.1	8	0.2
bivalve unident.	Bivalvia (class)	<0.1	<0.1	2	<0.1
starfish unident.	Asteroidea (class)	<0.1	<0.1	3	<0.1
Pacific herring	*Clupea pallasi*	<0.1	<0.1	7	0.2
sea urchin unident.	Echinoidea (class)	<0.1	<0.1	1	<0.1
capelin	*Mallotus villosus*	<0.1	<0.1	15	0.4
snail unident.	Gastropoda (class)	<0.1	<0.1	1	<0.1
ridged crangon	*Crangon dalli*	<0.1	<0.1	11	0.3
hermit crab unident.	Paguridae (family)	<0.1	<0.1	1	<0.1
sawback poacher	*Leptagonus frenatus*	<0.1	<0.1	1	<0.1
snailfish unident.	Liparidinae (family)	<0.1	<0.1	1	<0.1
Total		2,134.4		4,195	

Table 6. -- Estimates of walleye pollock biomass (in metric tons) and relative estimation error for the Shelikof Strait, Shumagin Islands, Chirikof Island shelf break, and Sanak Trough echo integration-trawl surveys.

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

[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 two Aleutian wing trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Sanak Island area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	1,436.2	99.2	3,165	99.1
Pacific cod	*Gadus macrocephalus*	8.1	0.6	2	<0.1
smooth lumpsucker	*Aptocyclus ventricosus*	2.4	0.2	1	<0.1
northern sea nettle	*Chrysaora melanaster*	1.2	<0.1	1	<0.1
eulachon	*Thaleichthys pacificus*	0.4	<0.1	24	0.8
Total		1,448.4		3,193	

Table 8. -- Summary of catch by species in one Aleutian wing trawl conducted during the 2010 walleye pollock echo integration-trawl survey of the Morzhovoi Bay area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	1,131.3	95.4	5,542	99.1
Pacific cod	*Gadus macrocephalus*	47.6	4.0	17	0.3
smooth lumpsucker	*Aptocyclus ventricosus*	5.1	0.4	2	<0.1
jellyfish unident.	Scyphozoa (class)	2.2	0.2	16	0.3
sturgeon poacher	*Podothecus acipenserinus*	<0.1	<0.1	1	<0.1
pandalid shrimp unident.	Pandalidae (family)	<0.1	<0.1	15	0.3
Total		1,186.2		5,593	

Table 9. -- Summary of catch by species in nine Aleutian wing trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Kenai Peninsula area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	7,221.2	97.1	9,671	34.6
eulachon	*Thaleichthys pacificus*	136.5	1.8	4,015	14.4
Chinook salmon	*Oncorhynchus tshawytscha*	23.7	0.3	20	<0.1
rougheye rockfish	*Sebastes aleutianus*	19.2	0.3	25	<0.1
Pacific cod	*Gadus macrocephalus*	15.1	0.2	4	<0.1
Pacific glass shrimp	*Pasiphaea pacifica*	9.8	0.1	12,611	45.1
northern smoothtongue	*Leuroglossus schmidti*	6.0	<0.1	308	1.1
pandalid shrimp unident.	Pandalidae (family)	4.0	<0.1	1,159	4.1
smooth lumpsucker	*Aptocyclus ventricosus*	2.9	<0.1	4	<0.1
light dusky rockfish	*Sebastes ciliatus*	0.7	<0.1	1	<0.1
squid unident.	Cephalopoda (class)	0.4	<0.1	25	<0.1
capelin	*Mallotus villosus*	0.2	<0.1	48	0.2
Pacific herring	*Clupea pallasi*	0.1	<0.1	30	0.1
Pacific ocean perch	*Sebastes alutus*	<0.1	<0.1	1	<0.1
sturgeon poacher	*Podothecus acipenserinus*	<0.1	<0.1	1	<0.1
sidestripe shrimp	*Pandalopsis dispar*	<0.1	<0.1	6	<0.1
snailfish unident.	Liparidinae (family)	<0.1	<0.1	22	<0.1
eelpout unident.	Zoarcidae (family)	<0.1	<0.1	3	<0.1
Total		7,440.2		27,954	

Table 10. -- Summary of catch by species in one poly-Nor'eastern bottom trawl conducted during the 2010 walleye pollock echo integration-trawl survey of the Kenai Peninsula area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	182.4	72.4	503	56.6
spiny dogfish	*Squalus acanthias*	35.9	14.2	16	1.8
eulachon	*Thaleichthys pacificus*	9.7	3.8	171	19.2
shortraker rockfish	*Sebastes borealis*	9.7	3.8	1	0.1
sablefish	*Anoplopoma fimbria*	4.8	1.9	5	0.6
magistrate armhook squid	*Berryteuthis magister*	3.4	1.3	5	0.6
Pacific cod	*Gadus macrocephalus*	3.3	1.3	1	0.1
arrowtooth flounder	*Atheresthes stomias*	1.4	0.5	1	0.1
shrimp unident.	Decapoda (order)	1.0	0.4	151	17.0
rock sole sp.	*Lepidopsetta* sp.	0.3	0.1	1	0.1
snail unident.	Gastropoda (class)	0.1	<0.1	3	0.3
northern smoothtongue	*Leuroglossus schmidti*	0.1	<0.1	18	2.0
lanternfish unident.	Myctophidae (family)	<0.1	<0.1	7	0.8
heart urchin	*Brisaster latifrons*	<0.1	<0.1	1	0.1
starfish unident.	Asteroidea (class)	<0.1	<0.1	3	0.3
eelpout unident.	Zoarcidae (family)	<0.1	<0.1	2	0.2
Total		252.1		889	

Table 11. -- Summary of catch by species in one Aleutian wing trawl conducted during the 2010 walleye pollock echo integration-trawl survey of the Prince William Sound area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	483.2	75.7	398	1.8
northern smoothtongue	*Leuroglossus schmidti*	138.4	21.7	20,527	92.6
shortraker rockfish	*Sebastes borealis*	11.1	1.7	2	<0.1
lanternfish unident.	Myctophidae (family)	1.7	0.3	182	0.8
Pacific glass shrimp	*Pasiphaea pacifica*	1.5	0.2	940	4.2
squid unident.	Cephalopoda (class)	0.8	0.1	56	0.3
Pacific herring	*Clupea pallasi*	0.7	0.1	5	<0.1
eelpout unident.	Zoarcidae (family)	0.7	0.1	42	0.2
magistrate armhook squid	*Berryteuthis magister*	0.3	<0.1	2	<0.1
lamprey unident.	Petromyzontidae (family)	0.1	<0.1	1	<0.1
pandalid shrimp unident.	Pandalidae (family)	<0.1	<0.1	14	<0.1
Total		638.4		22,169	

Table 12. -- Summary of catch by species in two poly-Nor'eastern bottom trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Prince William Sound area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	1047.0	86.2	1045	42.2
eulachon	*Thaleichthys pacificus*	52.3	4.3	967	39.1
Pacific halibut	*Hippoglossus stenolepis*	45.0	3.7	2	<0.1
spiny dogfish	*Squalus acanthias*	27.7	2.3	14	0.6
magistrate armhook squid	*Berryteuthis magister*	18.6	1.5	42	1.7
shortraker rockfish	*Sebastes borealis*	11.8	1.0	2	<0.1
sablefish	*Anoplopoma fimbria*	4.3	0.4	3	0.1
shortspine thornyhead	*Sebastolobus alascanus*	2.8	0.2	10	0.4
northern smoothtongue	*Leuroglossus schmidti*	1.5	0.1	184	7.4
arrowtooth flounder	*Atheresthes stomias*	1.1	0.1	1	<0.1
sidestripe shrimp	*Pandalopsis dispar*	1.1	0.1	81	3.3
Dover sole	*Microstomus pacificus*	0.5	<0.1	1	<0.1
rex sole	*Glyptocephalus zachirus*	0.2	<0.1	1	<0.1
shrimp unident.	Decapoda (order)	0.1	<0.1	111	4.5
eelpout unident.	Zoarcidae (family)	0.1	<0.1	9	0.4
Pacific lamprey	*Lampetra tridentata*	<0.1	<0.1	1	<0.1
capelin	*Mallotus villosus*	<0.1	<0.1	1	<0.1
Total		1,214.2		2,475	

Table 13. -- Summary of catch by species in two Aleutian wing trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Marmot Bay area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	978.9	97.8	1,298	70.2
eulachon	*Thaleichthys pacificus*	13.9	1.4	498	26.9
arrowtooth flounder	*Atheresthes stomias*	4.1	0.4	2	0.1
smooth lumpsucker	*Aptocyclus ventricosus*	1.8	0.2	1	<0.1
jellyfish unident.	Scyphozoa (class)	1.5	0.2	2	0.1
magistrate armhook squid	*Berryteuthis magister*	0.3	<0.1	2	0.1
capelin	*Mallotus villosus*	0.2	<0.1	39	2.1
Pacific herring	*Clupea pallasi*	<0.1	<0.1	6	0.3
Total		1,000.8		1,848	

Table 14. -- Summary of trawl and catch data from the 2010 walleye pollock echo integration-trawl surveys of the Gulf of Alaska shelf break near Chirikof Island (hauls 1-6) and Shelikof Strait (hauls 7-21).

Haul	Gear[1]	Date	Time	Duration	Start position		Depth (m)		Temp. (° C)		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	Footrope	Bottom	Headrope[2]	surface[3]	(kg)	Number	(kg)
1	PNE	19-Mar	1:33	19	55° 57.50'	153° 30.42'	385	385	5.6	4.8	50.9	26	356.6
2	PNE	20-Mar	10:49	6	55° 54.81'	153° 49.05'	276	302	5.8	4.8	1.3	2	13.0
3	AWT	20-Mar	19:02	4	56° 17.30'	153° 02.52'	415	720	5.0	4.8	974.1	479	8.6
4	AWT	21-Mar	3:18	54	55° 56.28'	153° 53.95'	353	403	5.8	5.3	112.5	73	145.7
5	AWT	21-Mar	11:42	38	55° 55.02'	153° 45.75'	205	216	5.9	5.0	0.0	0	49.8
6	AWT	21-Mar	17:44	<1	55° 54.03'	153° 47.79'	313	468	6.0	5.0	0.0	0	2,813.0
7	AWT	22-Mar	7:33	40	55° 42.79'	156° 31.13'	225	234	3.7	3.7	280.6	1,614	133.7
8	AWT	22-Mar	18:36	11	55° 47.01'	156° 11.46'	216	230	4.7	4.6	1,610.6	5,069	245.4
9	AWT	23-Mar	4:40	10	56° 02.81'	156° 10.13'	196	214	4.0	3.7	297.3	2,033	173.1
10	AWT	23-Mar	12:03	2	56° 16.97'	156° 02.34'	189	226	3.8	3.8	1,594.2	6,417	313.8
11	AWT	23-Mar	23:20	5	56° 29.64'	155° 39.43'	96	118	3.1	3.9	1,406.0	5,287	0.0
12	AWT	24-Mar	3:38	30	56° 37.31'	155° 44.26'	233	243	5.0	3.6	738.0	2,322	431.2
13	PNE	24-Mar	22:18	12	56° 55.82'	155° 13.25'	225	225	3.9	3.7	331.7	613	162.8
14	AWT	25-Mar	5:42	8	57° 15.69'	155° 36.55'	260	279	5.3	3.5	1,028.1	2,078	931.9
15	PNE	25-Mar	15:00	7	57° 24.43'	155° 43.69'	271	276	4.9	3.3	512.8	479	79.2
16	AWT	25-Mar	20:50	19	57° 29.49'	155° 37.97'	250	283	5.1	3.6	418.1	1,568	85.4
17	AWT	26-Mar	3:31	7	57° 31.68'	155° 11.28'	242	252	5.3	3.1	653.3	1,687	435.7
18	AWT	26-Mar	8:06	5	57° 42.18'	155° 13.27'	273	295	4.8	3.4	311.5	338	18.2
19	AWT	26-Mar	14:28	5	57° 44.13'	154° 57.47'	246	262	5.1	4.1	1,249.8	2,154	343.2
20	AWT	27-Mar	9:26	9	58° 02.93'	154° 12.53'	255	275	4.7	4.1	241.6	282	18.0
21	AWT	27-Mar	22:05	<1	58° 11.87'	153° 25.11'	71	196	4.7	4.3	228.9	1,031	0.0

[1]AWT = Aleutian wing trawl, PNE = poly-Nor'eastern bottom trawl.

[2]Temperature from Seabird electronics SBE-39 attached to trawl net headrope.

[3]Temperature from hull-mounted Furuno T-2000, 1.4 m below surface.

Table 15. -- Number of biological samples and measurements collected during the winter 2010 echo integration-trawl survey of walleye pollock of the Gulf of Alaska shelf break near Chirikof Island (hauls 1-6) and Shelikof Strait (hauls 7-21).

Haul	walleye pollock				eulachon	capelin	rougheye rockfish	shortraker rockfish	POP
no.	lengths	weights	maturity	otoliths	lengths	lengths	lengths/otoliths	lengths/otoliths	lengths/otoliths
1	26	26	26	26	0	0	6/5	12/7	0
2	2	2	2	0	0	0	0	0	23/7
3	272	35	35	35	0	0	2/0	0	7/2
4	73	22	22	22	0	0	5/5	0	5/5
5	0	0	0	0	16	17	0	1/0	52/3
6	0	0	0	0	0	0	0	1/0	179/28
7	386	113	113	77	110	0	0	0	0
8	349	40	40	40	50	0	0	0	0
9	316	18	18	18	73	0	0	0	0
10	329	33	33	33	45	0	0	0	0
11	389	87	87	20	0	0	0	0	0
12	341	84	84	30	53	0	0	0	0
13	333	36	36	36	41	0	0	0	0
14	311	90	90	38	82	0	0	0	0
15	322	48	48	37	0	0	0	0	0
16	314	17	17	17	42	0	0	0	0
17	359	114	114	32	80	0	0	0	0
18	325	101	101	55	62	0	0	0	0
19	279	94	94	49	28	0	0	0	0
20	282	75	75	50	56	0	0	0	0
21	313	50	50	0	0	0	0	0	0
Totals	5,321	1,085	1,085	615	738	17	11/10	14/7	266/45

Table 16. -- Summary of catch by species in four Aleutian wing trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Chirikof shelfbreak area.

Common name	Scientific name	Weight kg	Weight Percent	Numbers Nos.	Numbers Percent
Pacific ocean perch	*Sebastes alutus*	2,853.9	69.5	4,811	72.3
walleye pollock	*Theragra chalcogramma*	1,086.6	26.5	552	8.3
rougheye rockfish	*Sebastes aleutianus*	119.0	2.9	71	1.1
shortraker rockfish	*Sebastes borealis*	27.9	0.7	4	<0.1
giant grenadier	*Albatrossia pectoralis*	5.2	0.1	1	<0.1
Chinook salmon	*Oncorhynchus tshawytscha*	2.5	<0.1	2	<0.1
magistrate armhook squid	*Berryteuthis magister*	2.2	<0.1	3	<0.1
eulachon	*Thaleichthys pacificus*	1.7	<0.1	40	0.6
shrimp unident.	Decapoda (order)	1.6	<0.1	903	13.6
smooth lumpsucker	*Aptocyclus ventricosus*	1.1	<0.1	1	<0.1
lanternfish unident.	Myctophidae (Family)	0.8	<0.1	199	3.0
chrysaora jellyfish	*Chrysaora* sp.	0.4	<0.1	1	<0.1
capelin	*Mallotus villosus*	0.2	<0.1	25	0.4
jellyfish unident.	Scyphozoa (class)	0.2	<0.1	5	<0.1
salps unident.	Salpidae (family)	0.2	<0.1	14	0.2
harlequin rockfish	*Sebastes variegatus*	0.1	<0.1	1	<0.1
squid unident.	Cephalopoda (class)	<0.1	<0.1	17	0.3
Total		4,103.7		6,650	

Table 17. -- Summary of catch by species in two poly-Nor'eastern bottom trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Chirikof shelfbreak area.

Common name	Scientific name	Weight kg	Weight Percent	Numbers Nos.	Numbers Percent
rougheye rockfish	*Sebastes aleutianus*	123.6	29.3	75	22.3
blackspotted rockfish	*Sebastes melanostictus*	68.4	16.2	47	13.9
shortraker rockfish	*Sebastes borealis*	54.1	12.8	13	3.9
walleye pollock	*Theragra chalcogramma*	52.3	12.4	28	8.3
shortspine thornyhead	*Sebastolobus alascanus*	36.3	8.6	88	26.1
arrowtooth flounder	*Atheresthes stomias*	32.5	7.7	35	10.4
sablefish	*Anoplopoma fimbria*	25.4	6.0	5	1.5
Pacific ocean perch	*Sebastes alutus*	13.0	3.1	23	6.8
giant grenadier	*Albatrossia pectoralis*	8.0	1.9	2	0.6
spiny dogfish	*Squalus acanthias*	4.6	1.1	2	0.6
brown king crab	*Paralithodes brevipes*	1.6	0.4	1	0.3
rex sole	*Glyptocephalus zachirus*	0.8	0.2	2	0.6
octopus unident.	Octopodidae	0.5	0.1	1	0.3
darkfin sculpin	*Malacocottus zonurus*	0.5	0.1	14	4.2
harlequin rockfish	*Sebastes variegatus*	0.5	0.1	1	0.3
Total		421.8		337	

Table 18. -- Summary of catch by species in thirteen Aleutian wing trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Shelikof Strait area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	10,057.9	76.3	31,880	27.4
eulachon	*Thaleichthys pacificus*	3,054.2	23.2	83,085	71.3
Chinook salmon	*Oncorhynchus tshawytscha*	23.4	0.2	17	<0.1
squid unident.	Cephalopoda (class)	13.3	0.1	498	0.4
Pacific cod	*Gadus macrocephalus*	9.5	<0.1	3	<0.1
magistrate armhook squid	*Berryteuthis magister*	8.4	<0.1	12	<0.1
smooth lumpsucker	*Aptocyclus ventricosus*	5.6	<0.1	7	<0.1
arrowtooth flounder	*Atheresthes stomias*	4.8	<0.1	5	<0.1
northern sea nettle	*Chrysaora melanaster*	3.7	<0.1	5	<0.1
northern smoothtongue	*Leuroglossus schmidti*	2.7	<0.1	112	<0.1
rougheye rockfish	*Sebastes aleutianus*	1.5	<0.1	1	<0.1
shrimp unident.	Decapoda (order)	1.4	<0.1	880	0.8
flathead sole	*Hippoglossoides elassodon*	<0.1	<0.1	3	<0.1
capelin	*Mallotus villosus*	<0.1	<0.1	18	<0.1
sculpin unident.	Cottidae (family)	<0.1	<0.1	3	<0.1
salps unident.	Salpidae (family)	<0.1	<0.1	1	<0.1
Total		13,187.5		116,530	

Table 19. -- Summary of catch by species in two poly-Nor'eastern bottom trawls conducted during the 2010 walleye pollock echo integration-trawl survey of the Shelikof Strait area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	844.5	77.7	1092	45.8
eulachon	*Thaleichthys pacificus*	61.6	5.7	940	39.5
arrowtooth flounder	*Atheresthes stomias*	59.8	5.5	54	2.3
Aleutian skate	*Bathyraja aleutica*	42.1	3.9	7	0.3
big skate	*Raja binoculata*	19.0	1.7	1	<0.1
Pacific halibut	*Hippoglossus stenolepis*	17.0	1.6	3	0.1
magistrate armhook squid	*Berryteuthis magister*	12.5	1.2	26	1.1
rex sole	*Glyptocephalus zachirus*	8.1	0.7	27	1.1
Pacific cod	*Gadus macrocephalus*	4.8	0.4	2	<0.1
rougheye rockfish	*Sebastes aleutianus*	3.9	0.4	3	0.1
flathead sole	*Hippoglossoides elassodon*	3.5	0.3	6	0.3
sidestripe shrimp	*Pandalopsis dispar*	2.9	0.3	216	9.1
smooth lumpsucker	*Aptocyclus ventricosus*	2.8	0.3	2	<0.1
Alaska skate	*Bathyraja parmifera*	2.4	0.2	1	<0.1
rock sole sp.	*Lepidopsetta* sp.	0.9	<0.1	1	<0.1
Tanner crab sp.	*Chionoecetes* sp.	0.6	<0.1	1	<0.1
Total		1,086.5		2,382	

Table 20. -- Numbers-at-age estimates (millions) from echo integration-trawl surveys of walleye pollock in the Shelikof Strait area. No surveys were conducted in 1982 or 1999, 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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 21. -- Biomass-at-age estimates (thousands of metric tons) from echo integration-trawl surveys of walleye pollock in the Shelikof Strait area. No surveys were conducted in 1982 or 1999, 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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 22. -- Numbers-at-length estimates (millions) from echo integration-trawl surveys of walleye pollock in the Shelikof Strait area. No surveys were conducted in 1982 or 1999, 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
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
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
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
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
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
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
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
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
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
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
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
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
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
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	0
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 22.--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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
Total	#####	5,211	2,928	4,259	3,352	1,266	1,119	1,782	1,109	1,339	740	729	#####	4,024	1,866	1,425	5,742	4,931	1,424	1,224	780	2,252	1,240	575	2,100	1,832	1,164

Table 23. -- Biomass-at-length estimates (thousands of metric tons) from echo integration-trawl surveys of walleye pollock in the Shelikof Strait area. No surveys were conducted in 1982 or 1999, 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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 23.-- 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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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	436

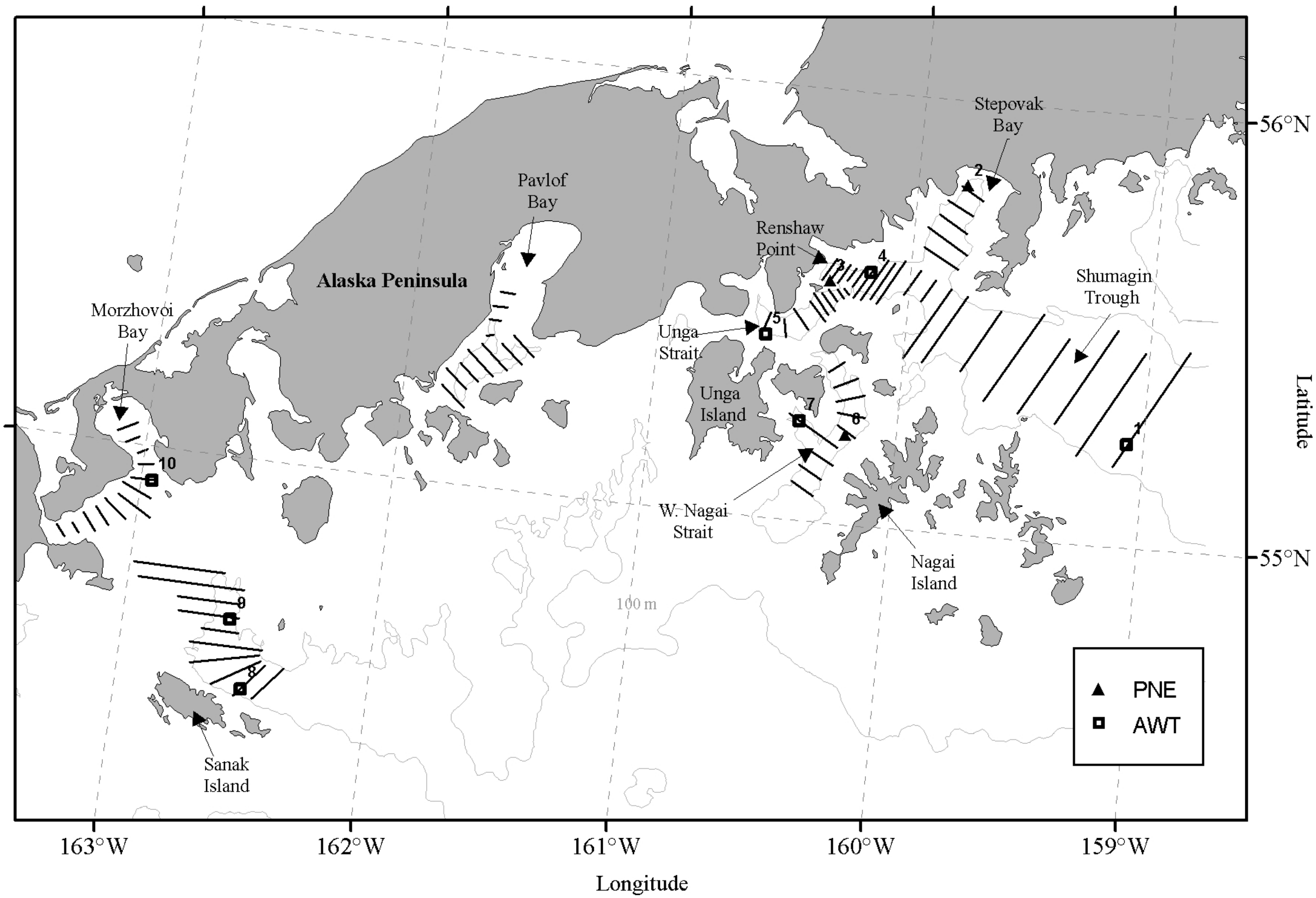

Figure 1. -- Transect lines and locations of Aleutian-wing trawl (AWT) and poly-Nor'eastern trawl (PNE) hauls during the winter 2010 echo integration-trawl survey of walleye pollock in the Shumagin Islands, Sanak Trough, Morzhovoi Bay, and Pavlof Bay.

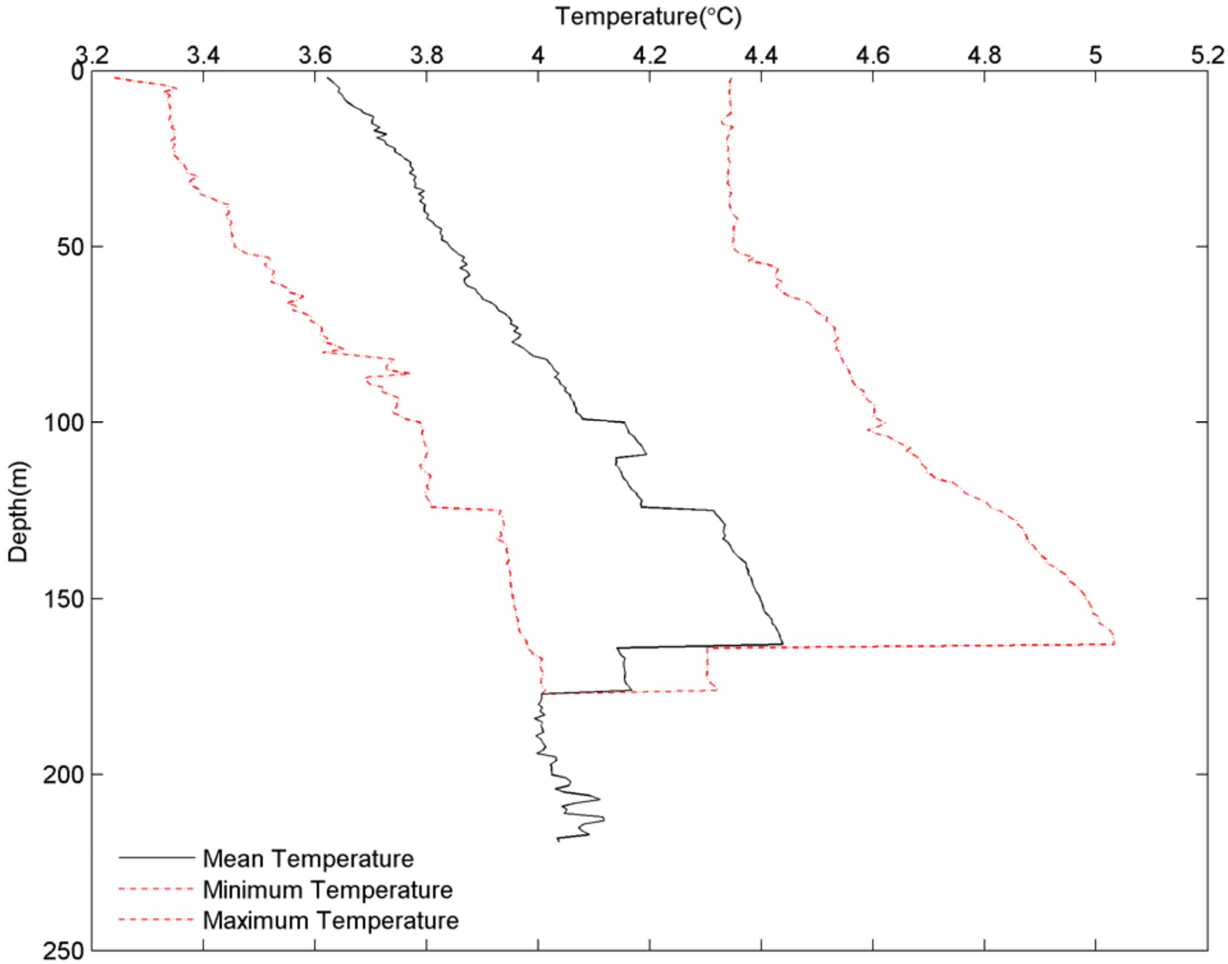

Figure 2. -- Mean water temperature (°C) (solid line) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of walleye pollock in the Shumagin Islands area. Data collected at seven trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed lines represent minimum and maximum temperatures observed.

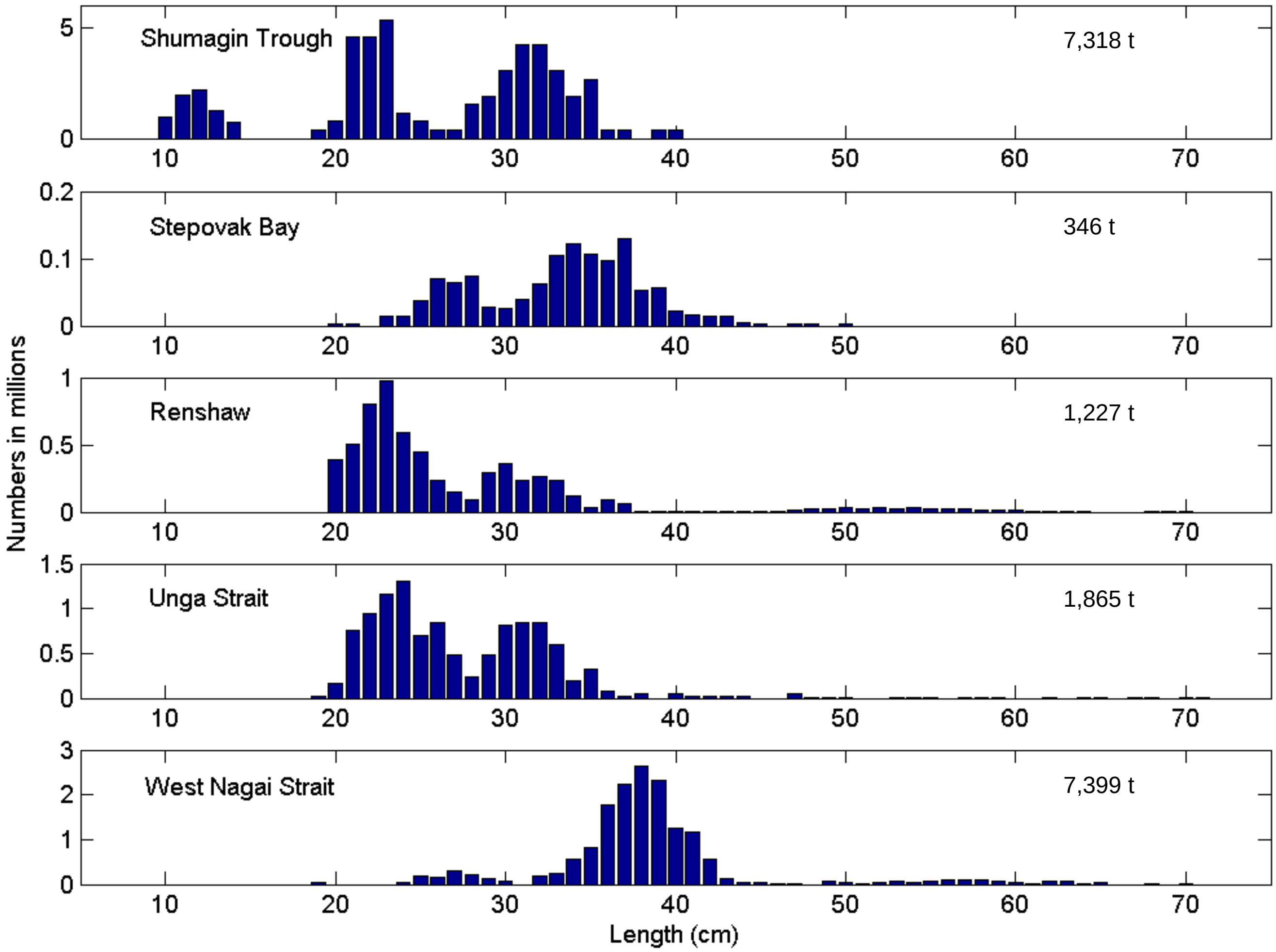

Figure 3. -- Length distribution of walleye pollock (numbers) and biomass (metric tons) for the 2010 echo integration-trawl survey of Shumagin Trough, Stepovak Bay, Renshaw Point, Unga Strait, and West Nagai Strait.

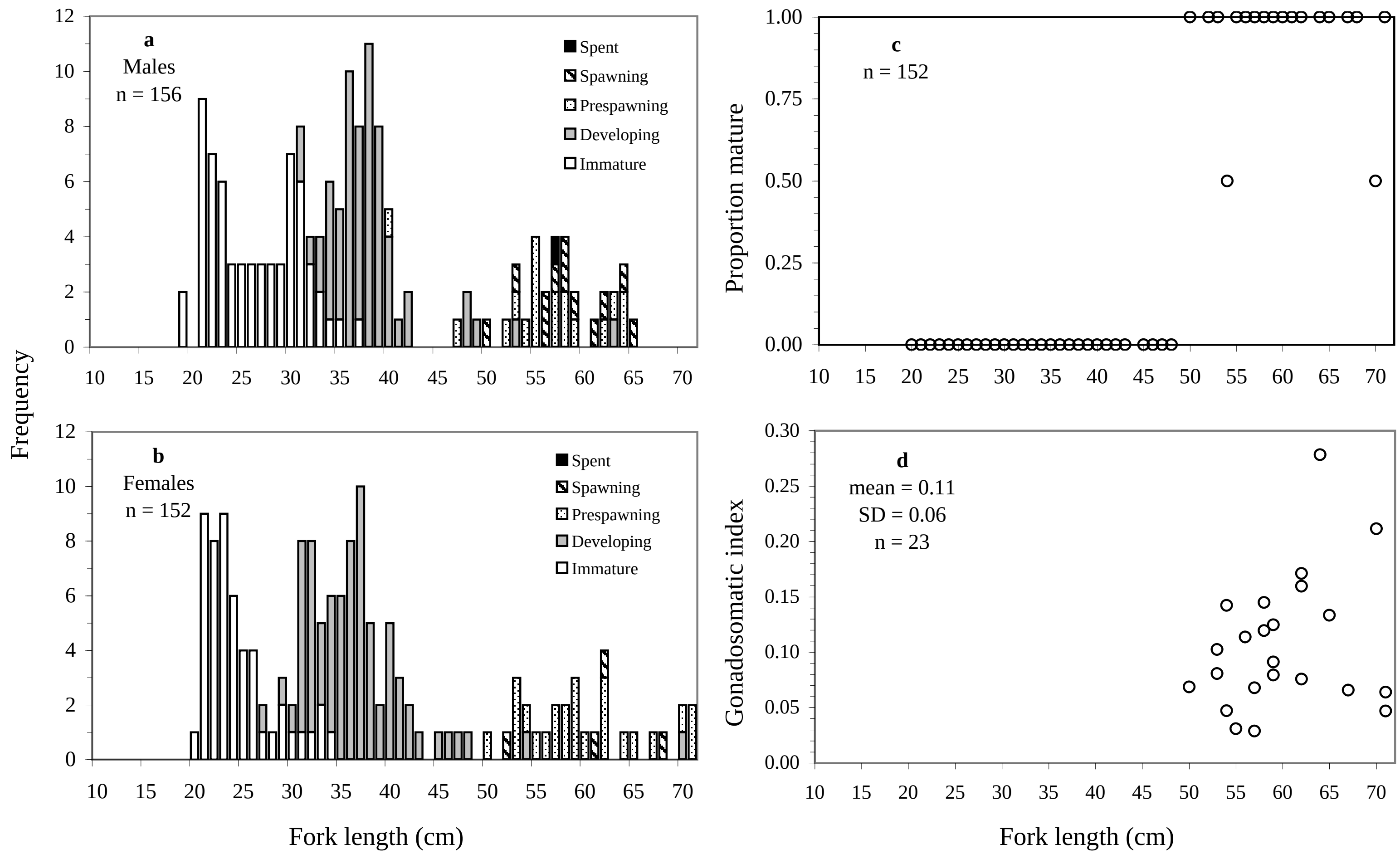

Figure 4. -- Maturity stages for (a) male and (b) female walleye pollock; (c) proportion mature by 1-cm size group for female walleye pollock; and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl survey of the Shumagin Islands.

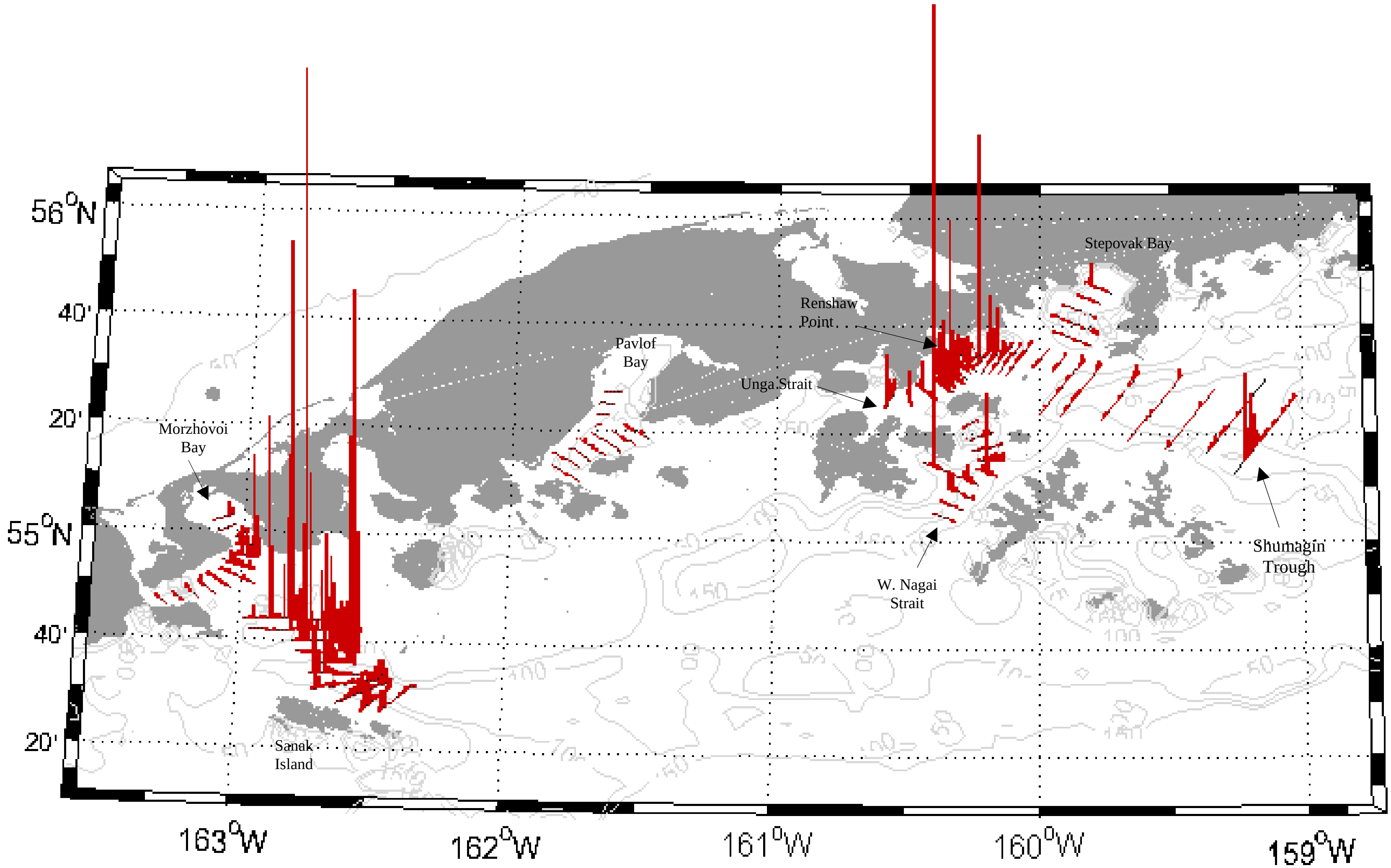

Figure 5. -- Acoustic backscattering (s_A) attributed primarily to walleye pollock (vertical lines) along tracklines surveyed during the winter 2010 echo integration-trawl survey of the Shumagin Islands, Sanak Trough, Morzhovoi Bay, and Pavlof Bay.

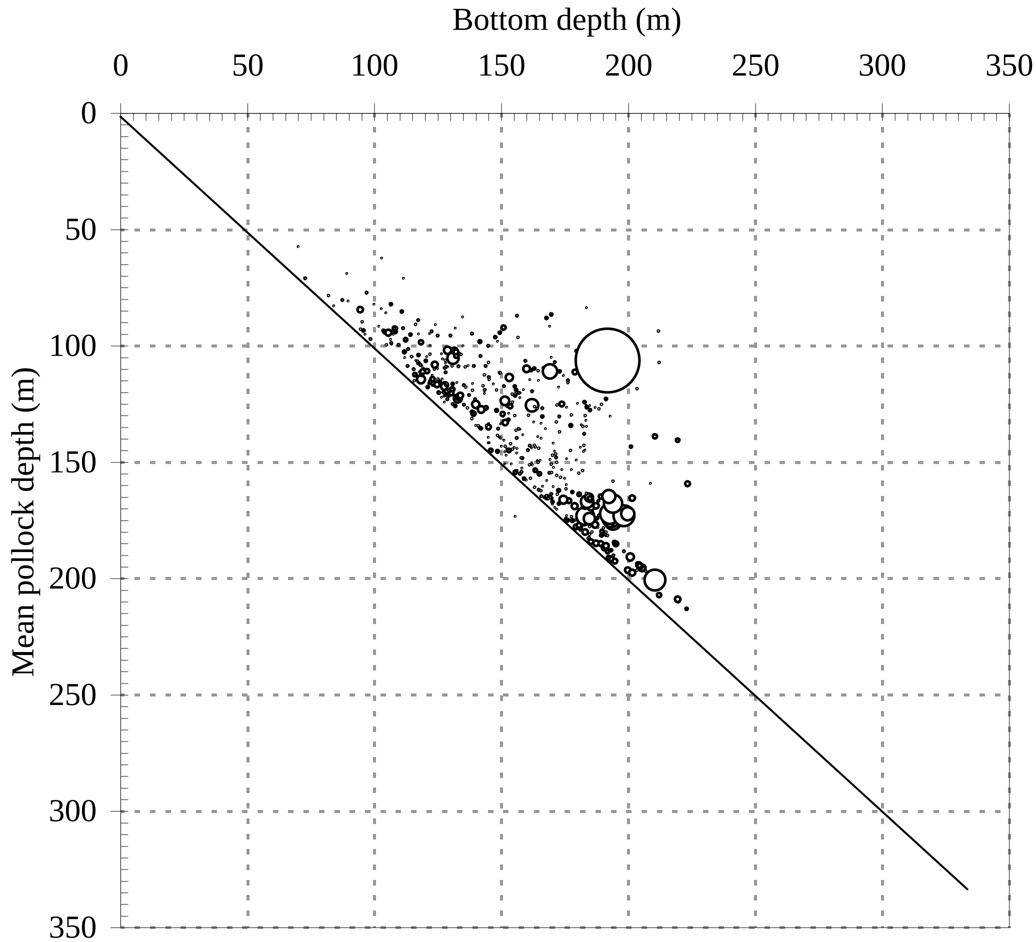

Figure 6. -- Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5 nautical mile for walleye pollock observed during the winter 2010 echo integration-trawl survey of the Shumagin Islands area. Bubble size is scaled to the maximum biomass.

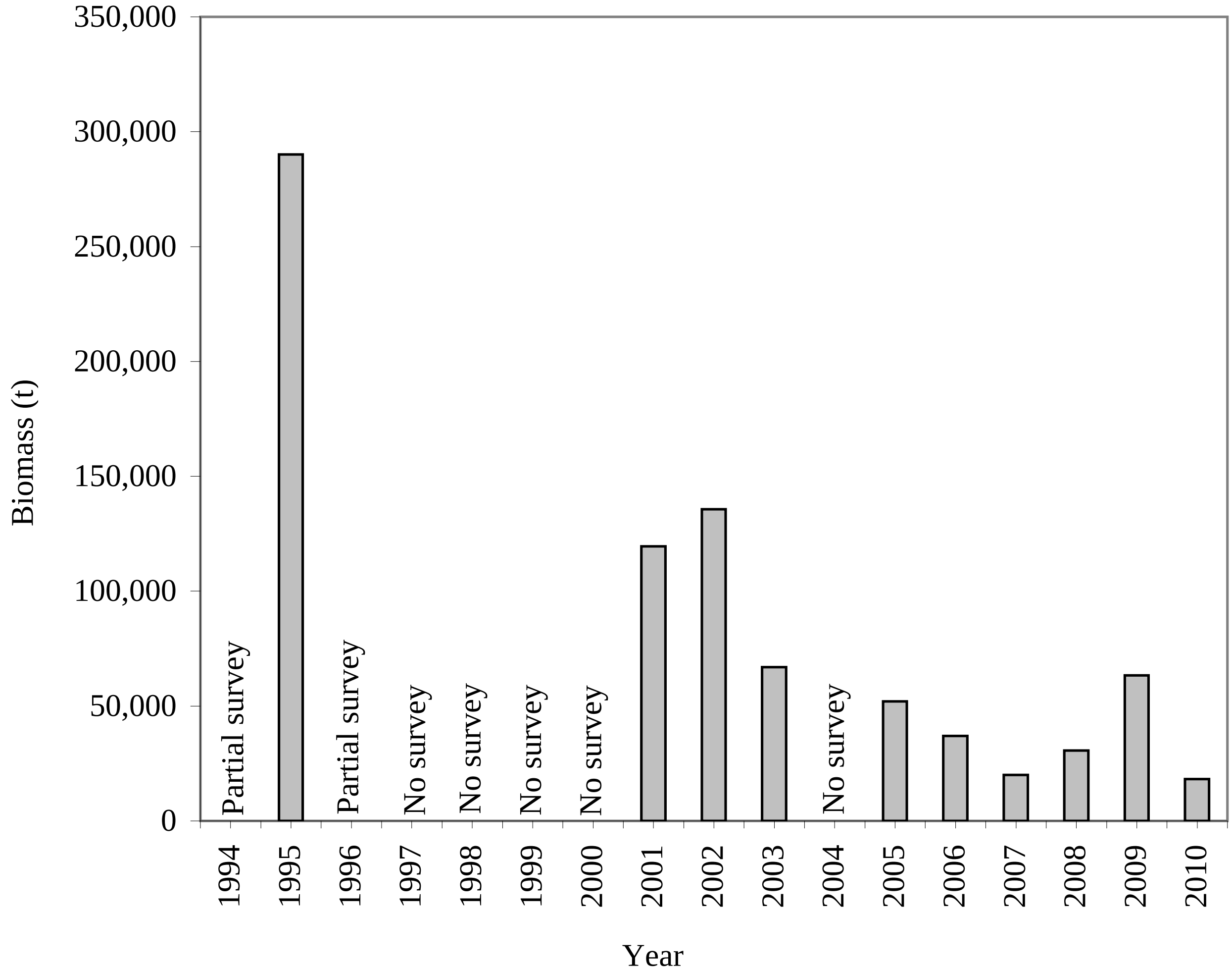

Figure 7.--Summary of annual pollock biomass estimates based on echo integration-trawl surveys of the Shumagin Islands area.

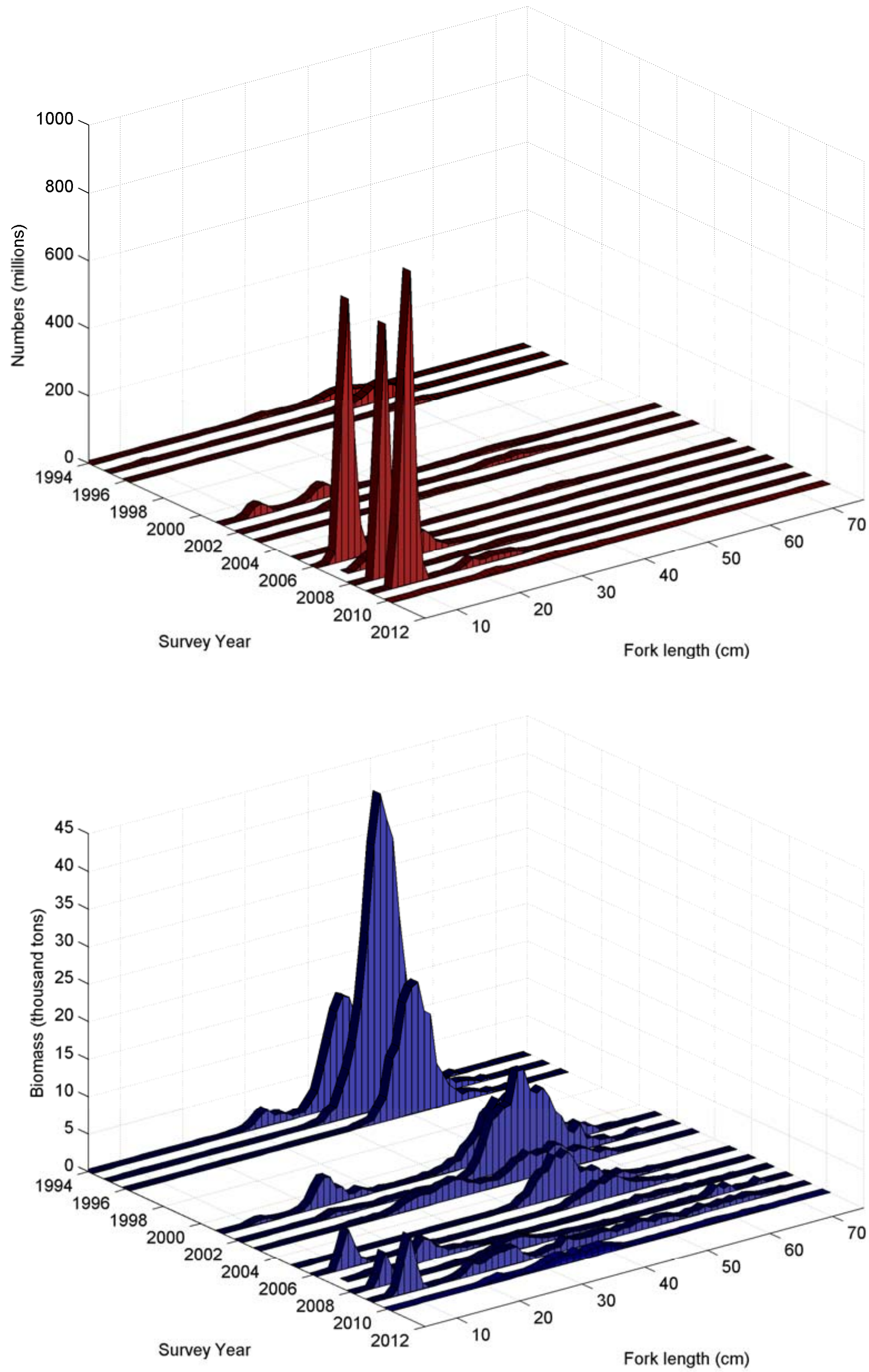

Figure 8. -- Walleye pollock biomass in thousands of metric tons and numbers in millions at length from the Shumagin Islands echo integration-trawl surveys since 1994. No survey was conducted in 1997-2000 or in 2004.

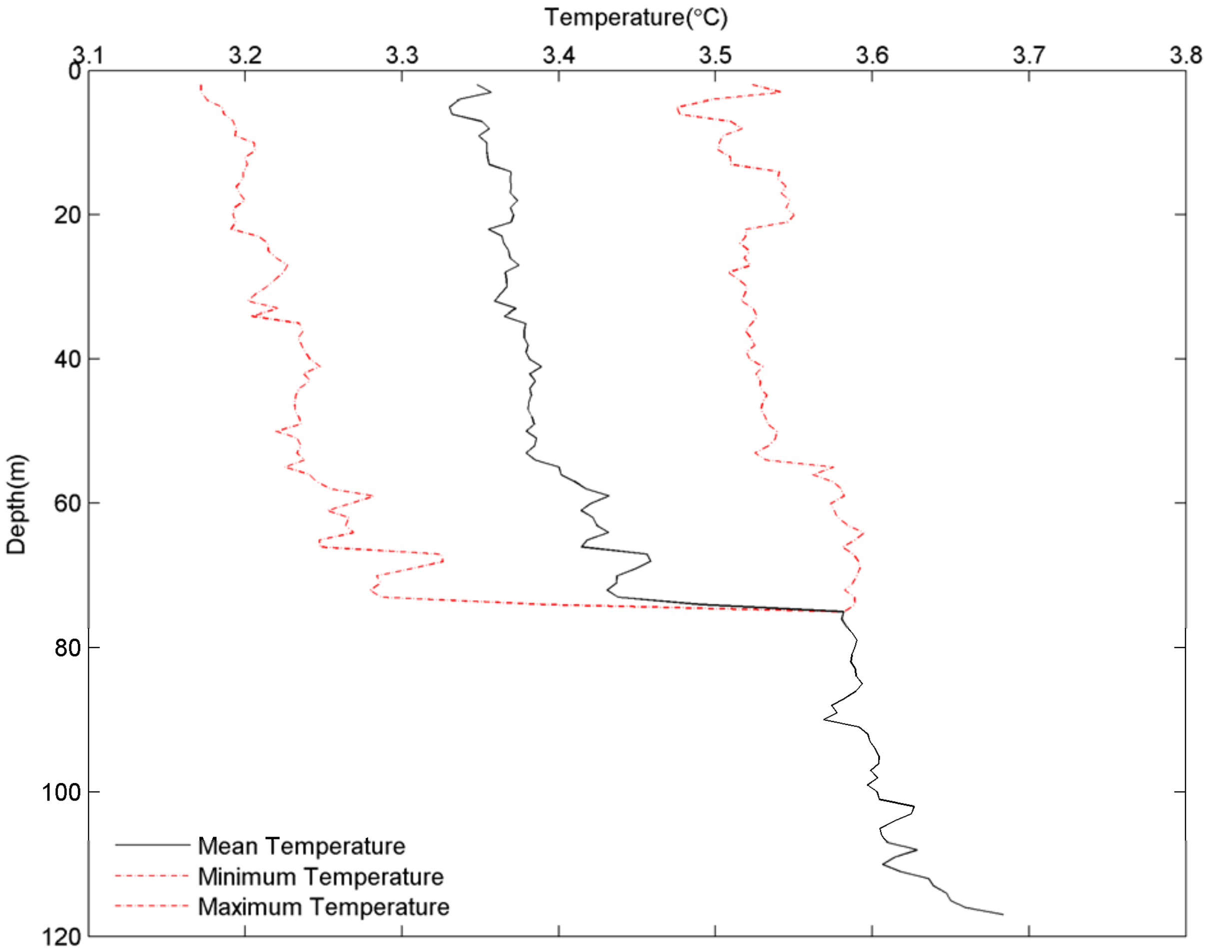

Figure 9. -- Mean water temperature (°C) (solid line) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of walleye pollock in the Sanak Trough area. Data were collected at two trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed lines represent minimum and maximum temperatures observed.

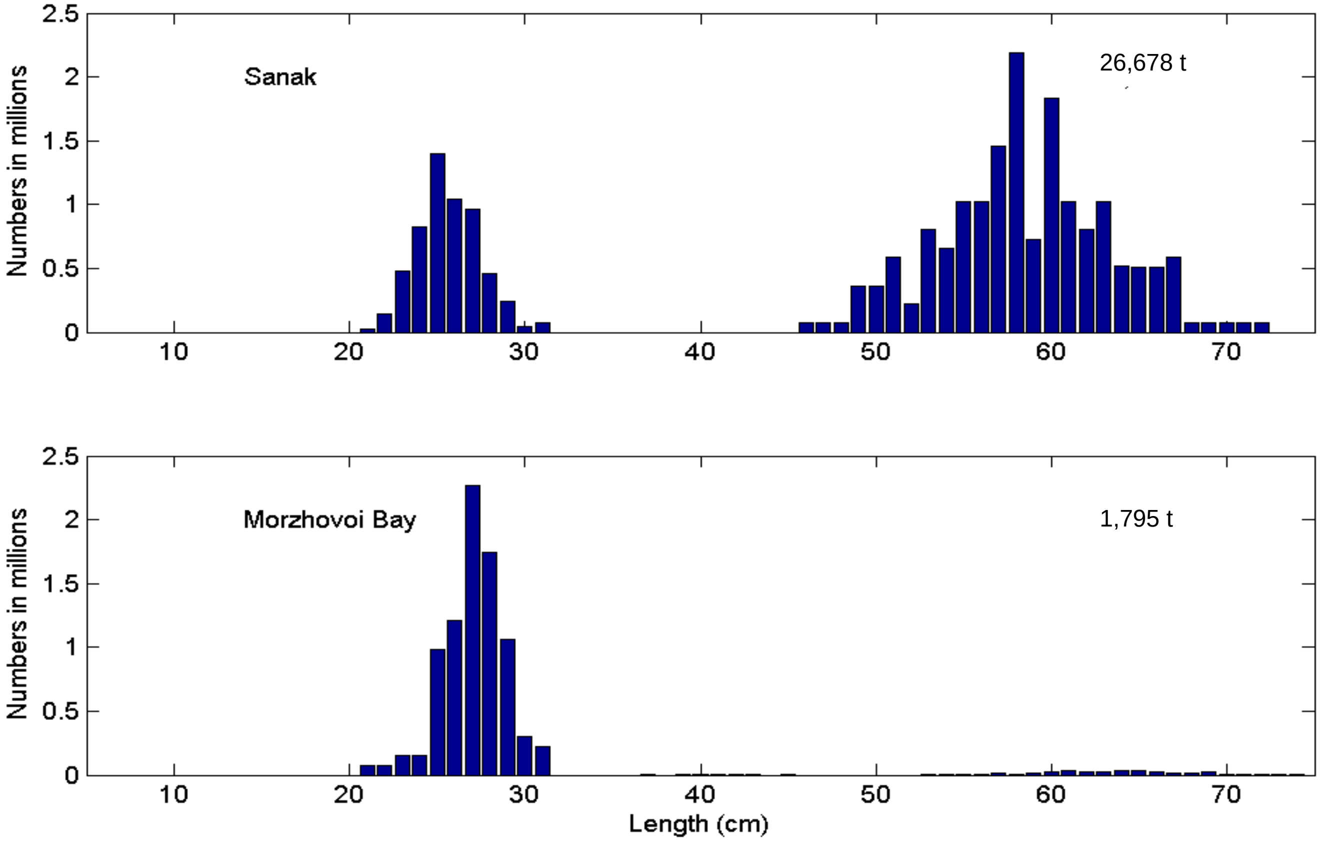

Figure 10. -- Length distribution of walleye pollock (numbers) and biomass estimate (metric tons) for the 2010 echo integration-trawl survey of Sanak Trough and Morzhovoi Bay.

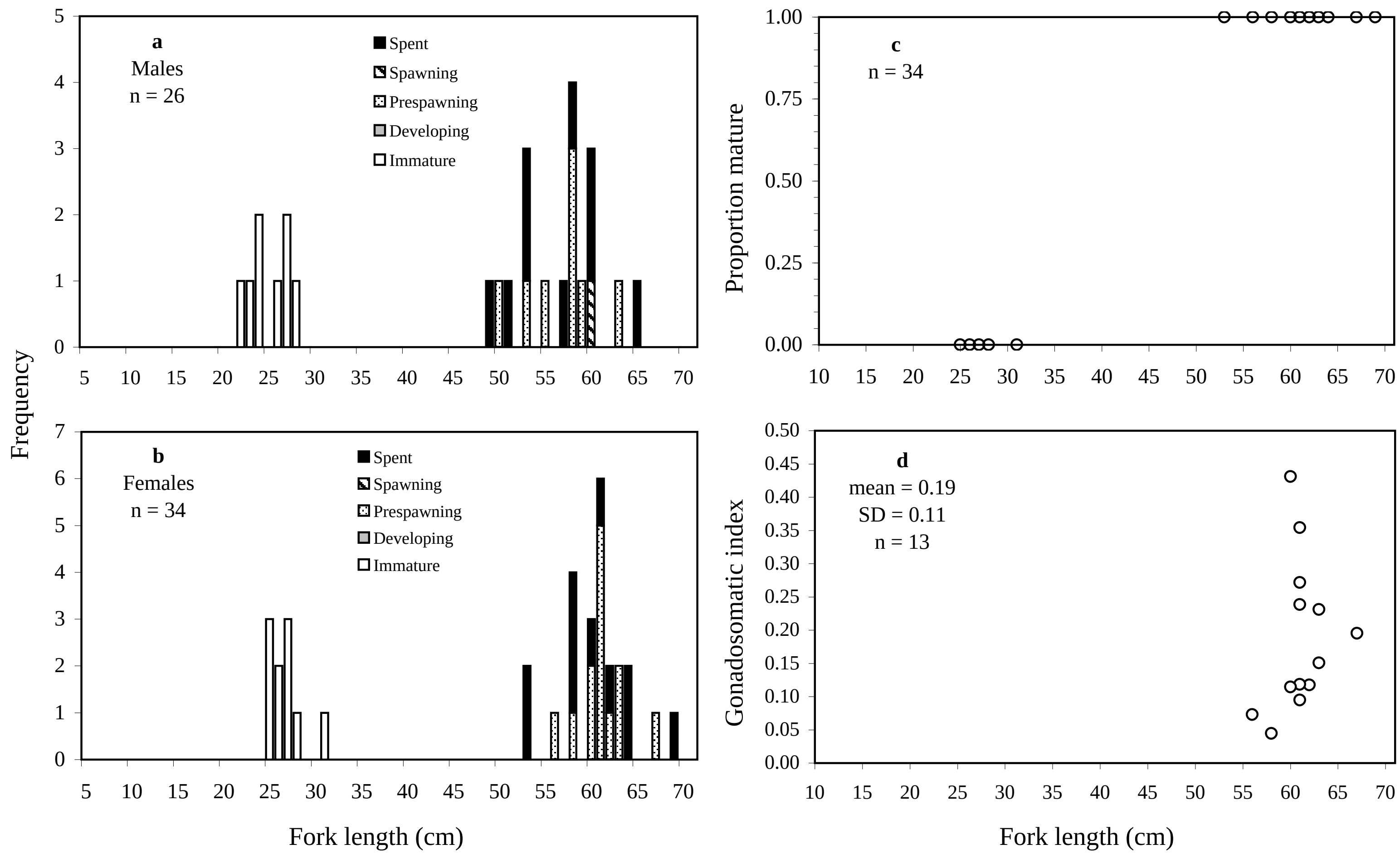

Figure 11. -- Maturity stages for (a) male and (b) female walleye pollock; (c) proportion mature by 1-cm size group for female walleye pollock; and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl survey of the Sanak Trough.

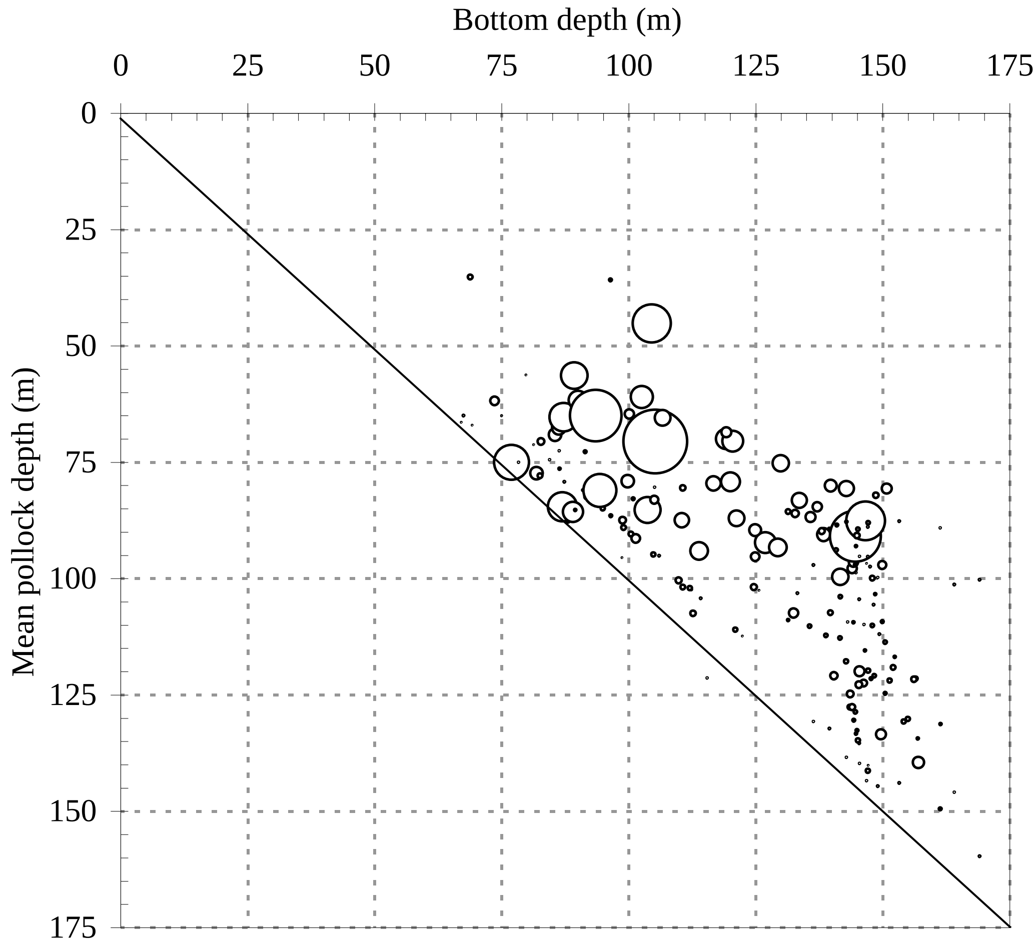

Figure 12.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for walleye pollock observed during the winter 2010 echo integration-trawl survey of Sanak Trough. Bubble size is scaled to the maximum biomass.

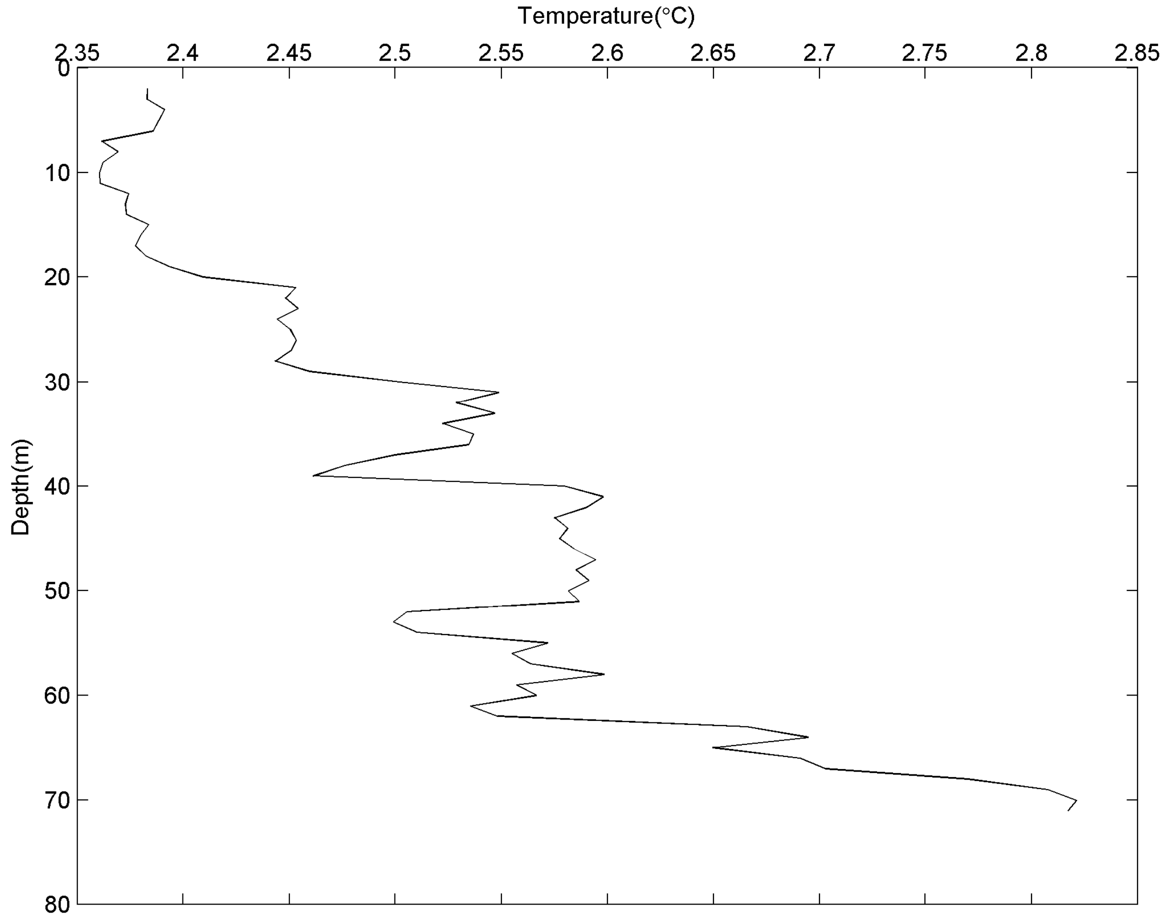

Figure 13. -- Water temperature (°C) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of Morzhovoi Bay. Data were collected from 1 trawl location with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope.

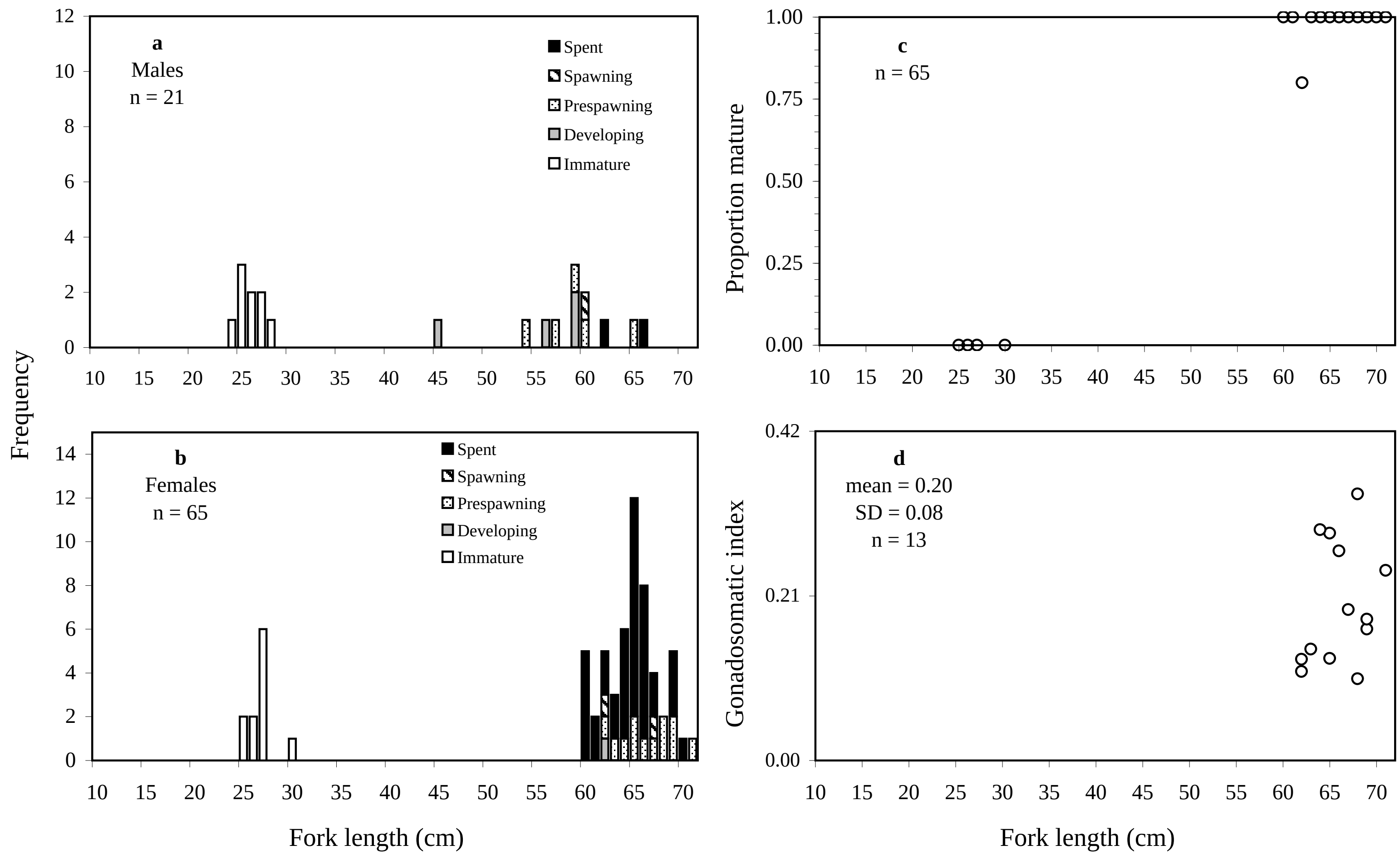

Figure 14. -- Maturity stages for (a) male and (b) female walleye pollock; (c) proportion mature by 1-cm size group for female walleye pollock; and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl survey of Morzhovoi Bay.

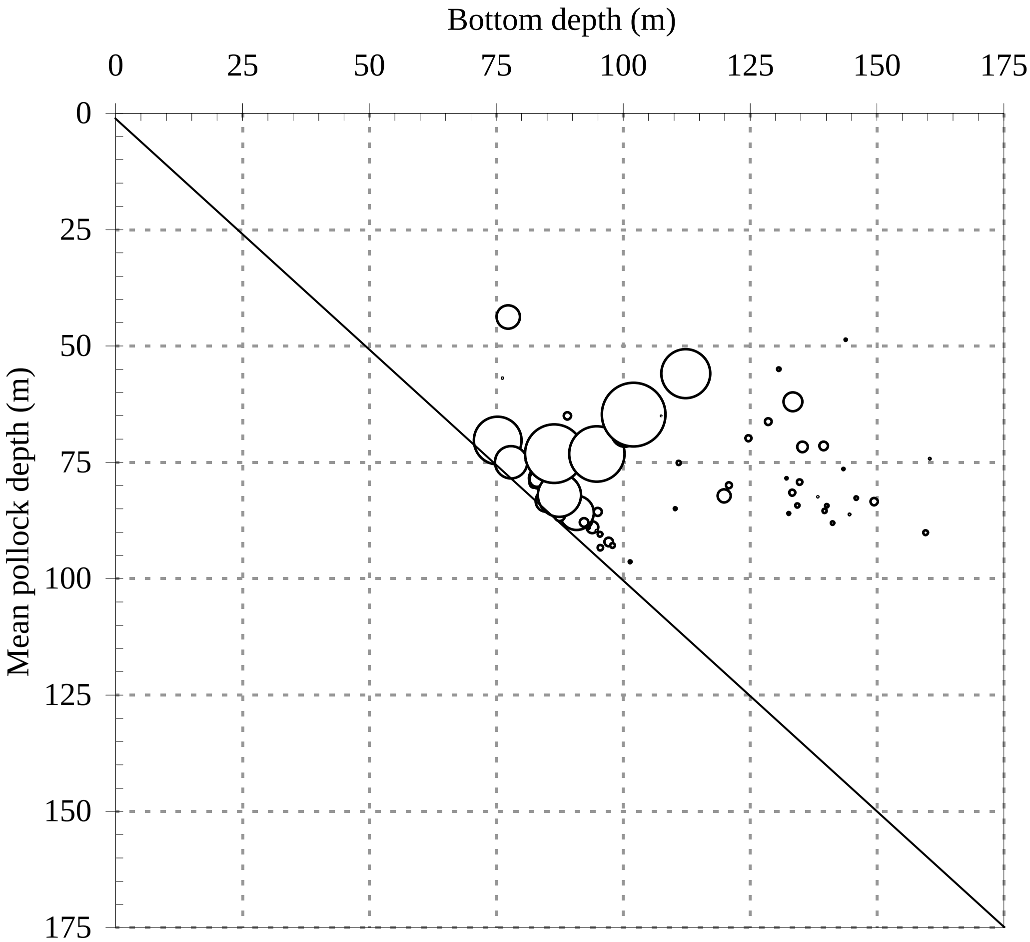

Figure 15.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for walleye pollock observed during the winter 2010 echo integration-trawl survey of Morzhovoi Bay. Bubble size is scaled to the maximum biomass.

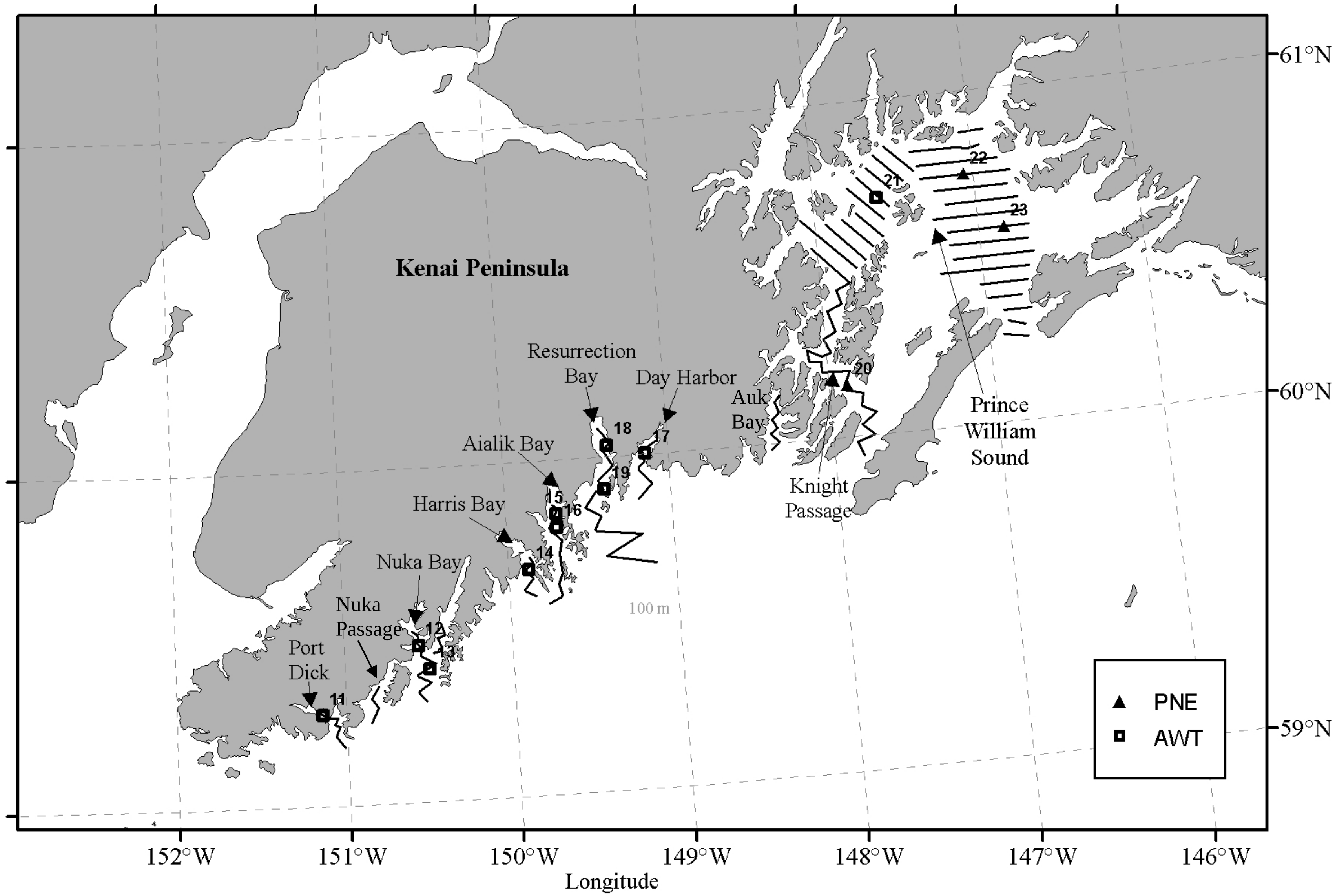

Figure 16. -- Transect lines and location of Aleutian-wing trawl (AWT) and poly-Nor'eastern trawl (PNE) hauls during the winter 2010 echo integration-trawl survey along the Kenai Peninsula and Prince William Sound.

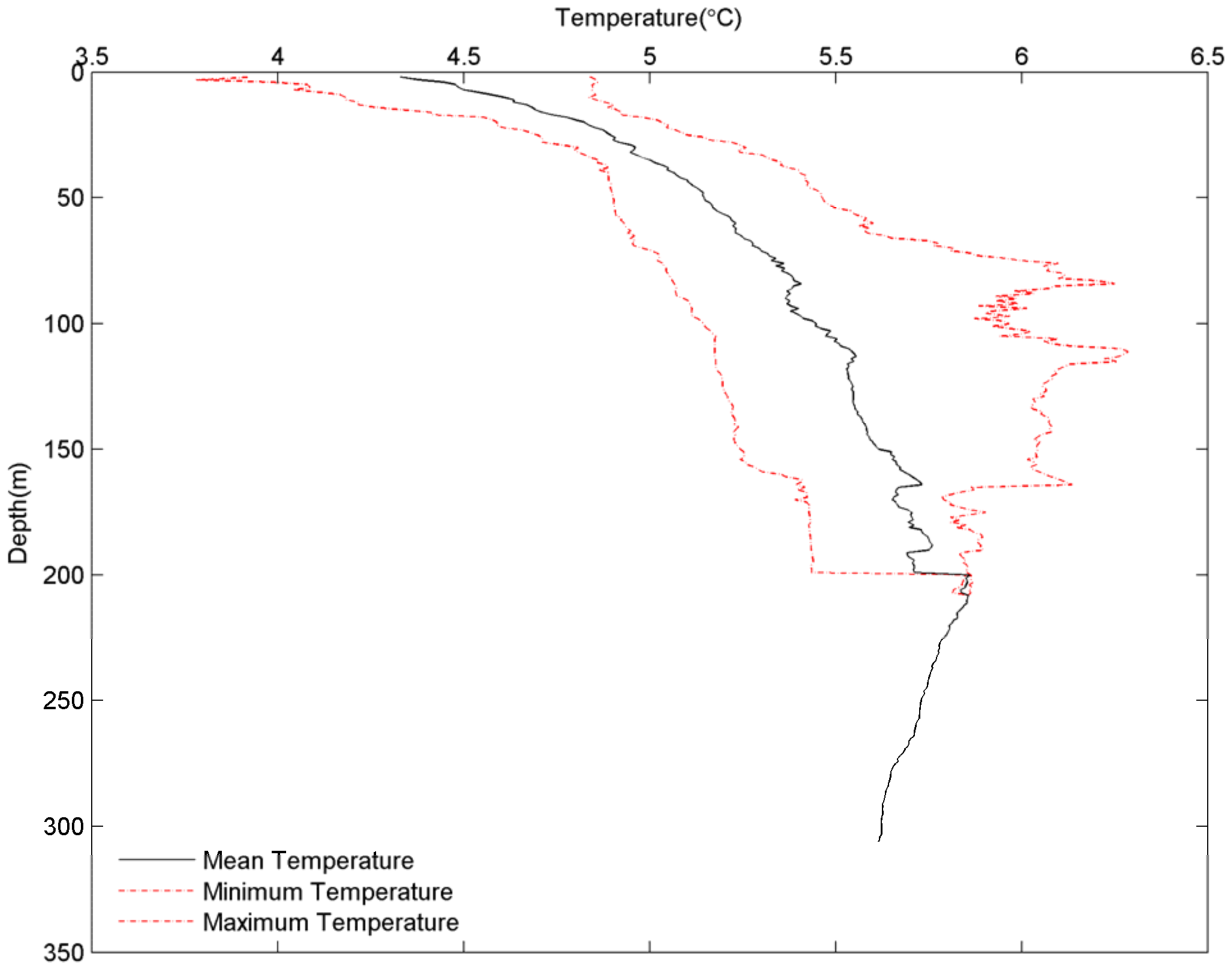

Figure 17. -- Water temperature (°C) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of the Kenai Peninsula Bays. Data were collected from 10 trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed lines represent minimum and maximum temperatures observed.

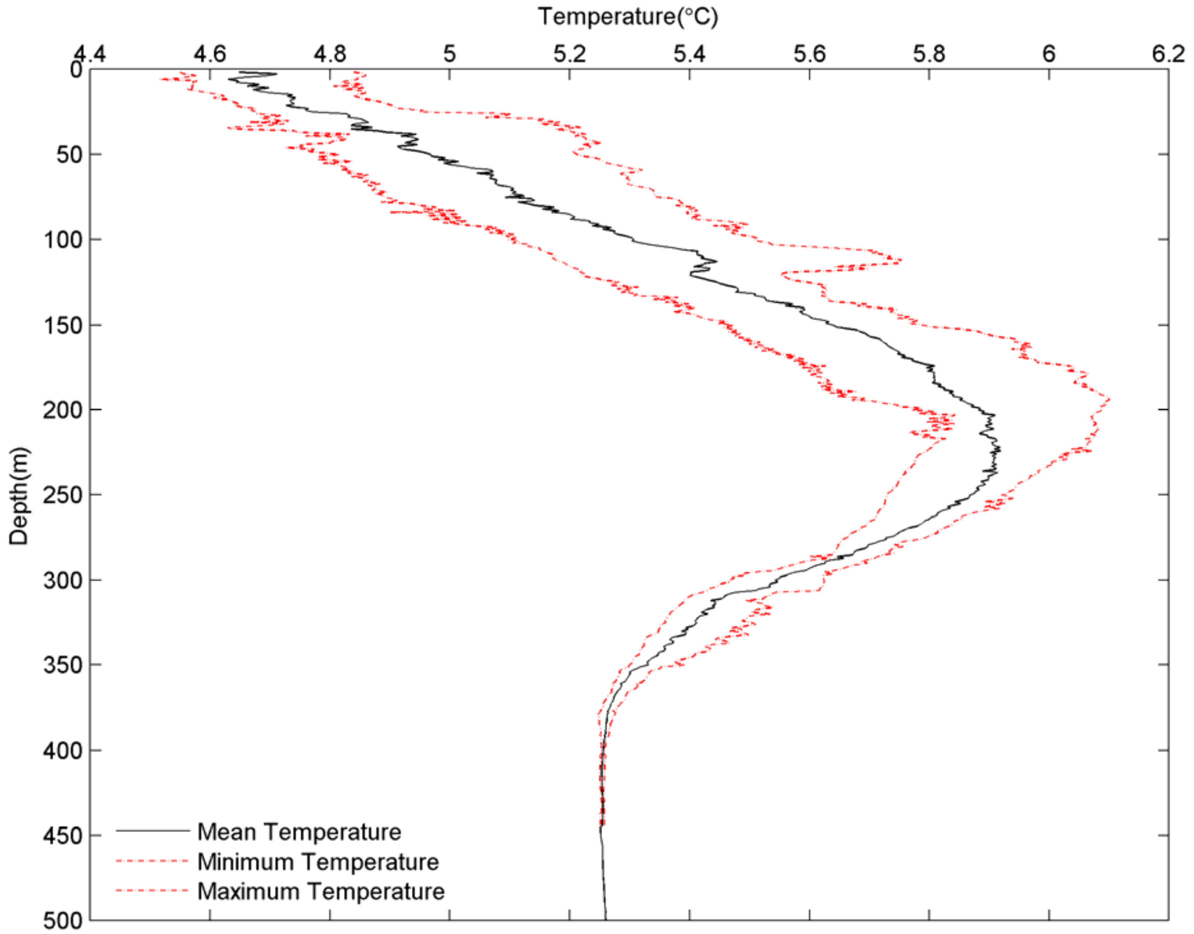

Figure 18. -- Water temperature (°C) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of Prince William Sound. Data were collected from three trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed lines represent minimum and maximum temperatures observed.

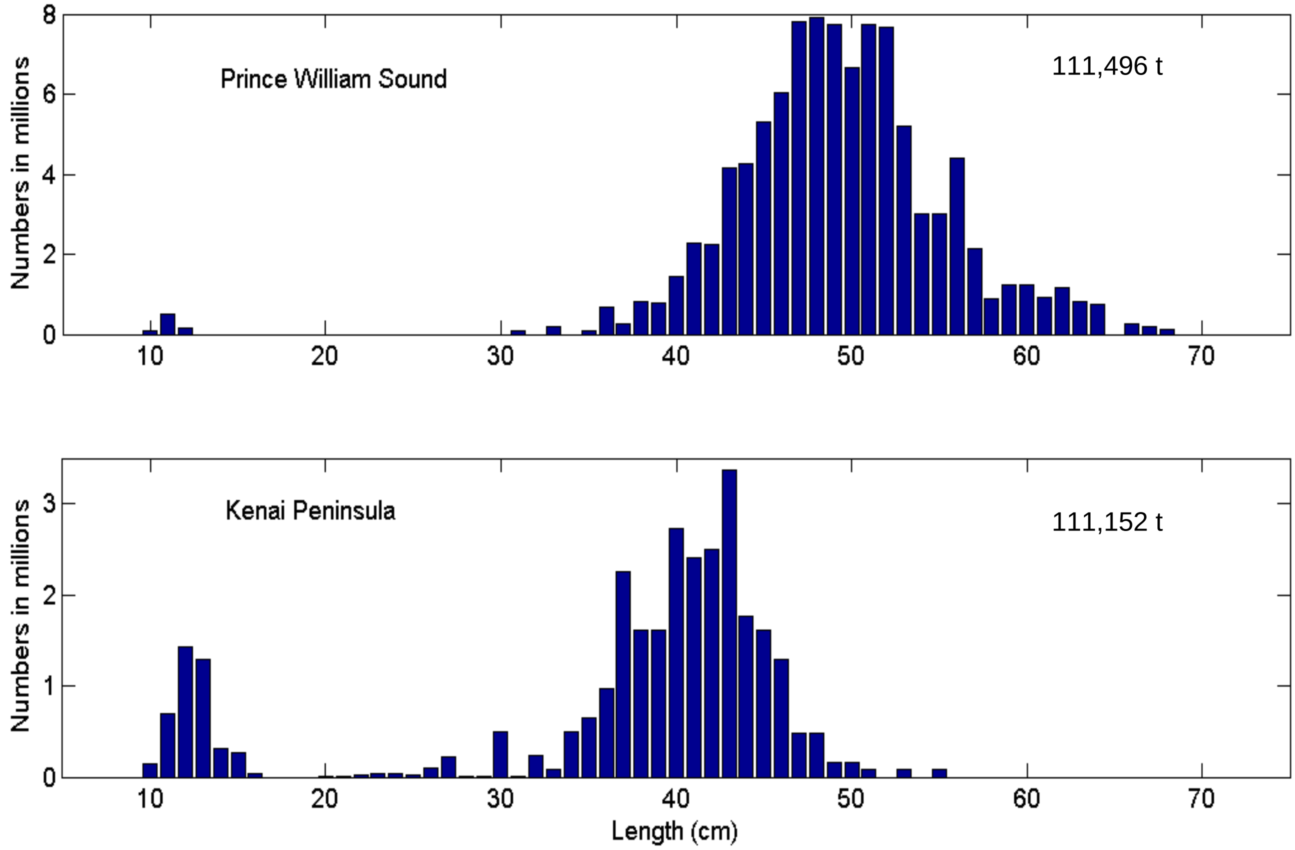

Figure 19. -- Length distribution of walleye pollock (numbers) and biomass estimate (million tons) for the 2010 echo integration-trawl survey of Prince William Sound and the Kenai Peninsula Bays.

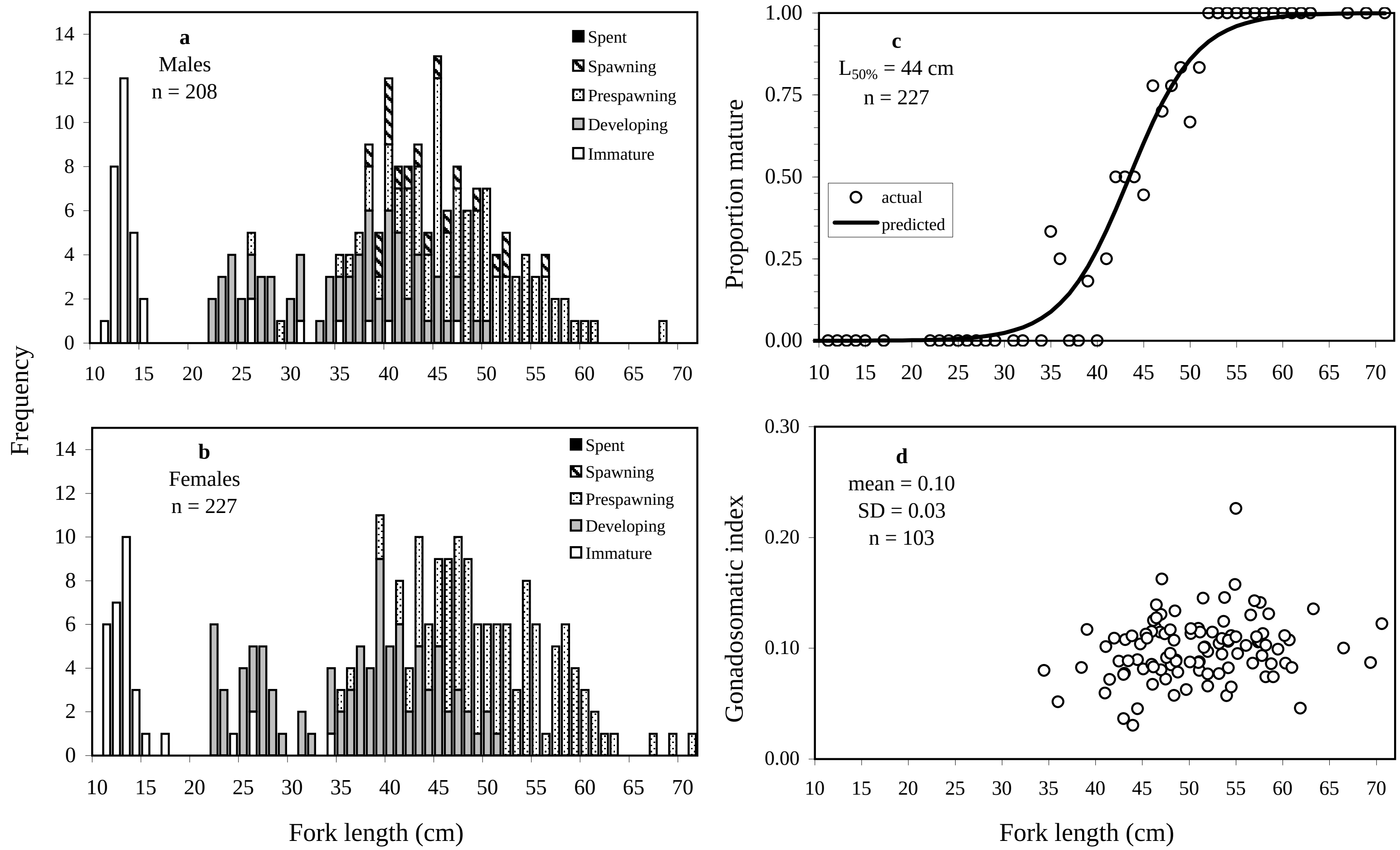

Figure 20. -- Maturity stages for (a) male and (b) female walleye pollock; (c) proportion mature by 1-cm size group for female walleye pollock; and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl survey of the Kenai Peninsula Bays

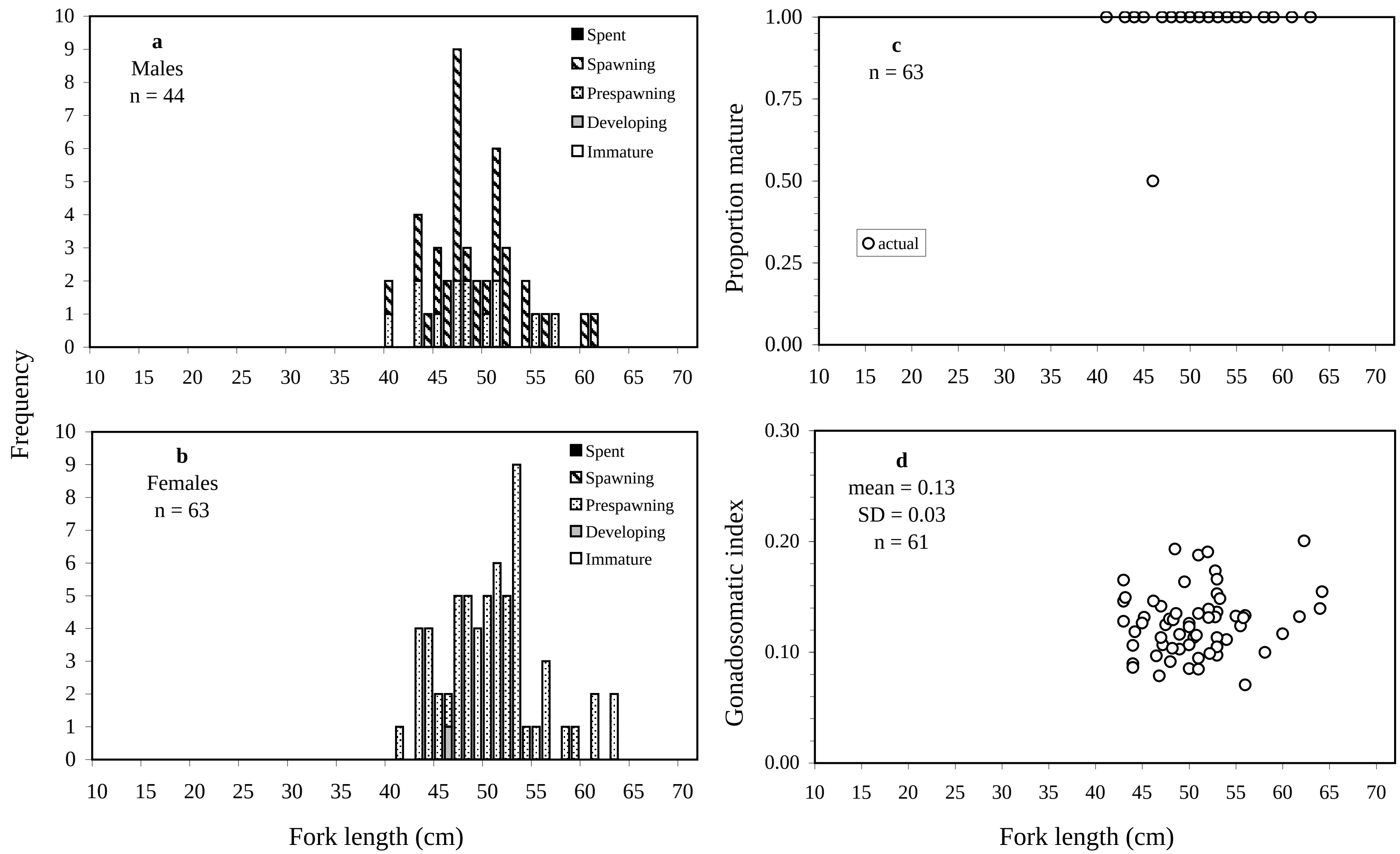

Figure 21. -- Maturity stages for (a) male and (b) female walleye pollock, (c) proportion mature by 1-cm size group for female walleye pollock and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl survey of Prince William Sound.

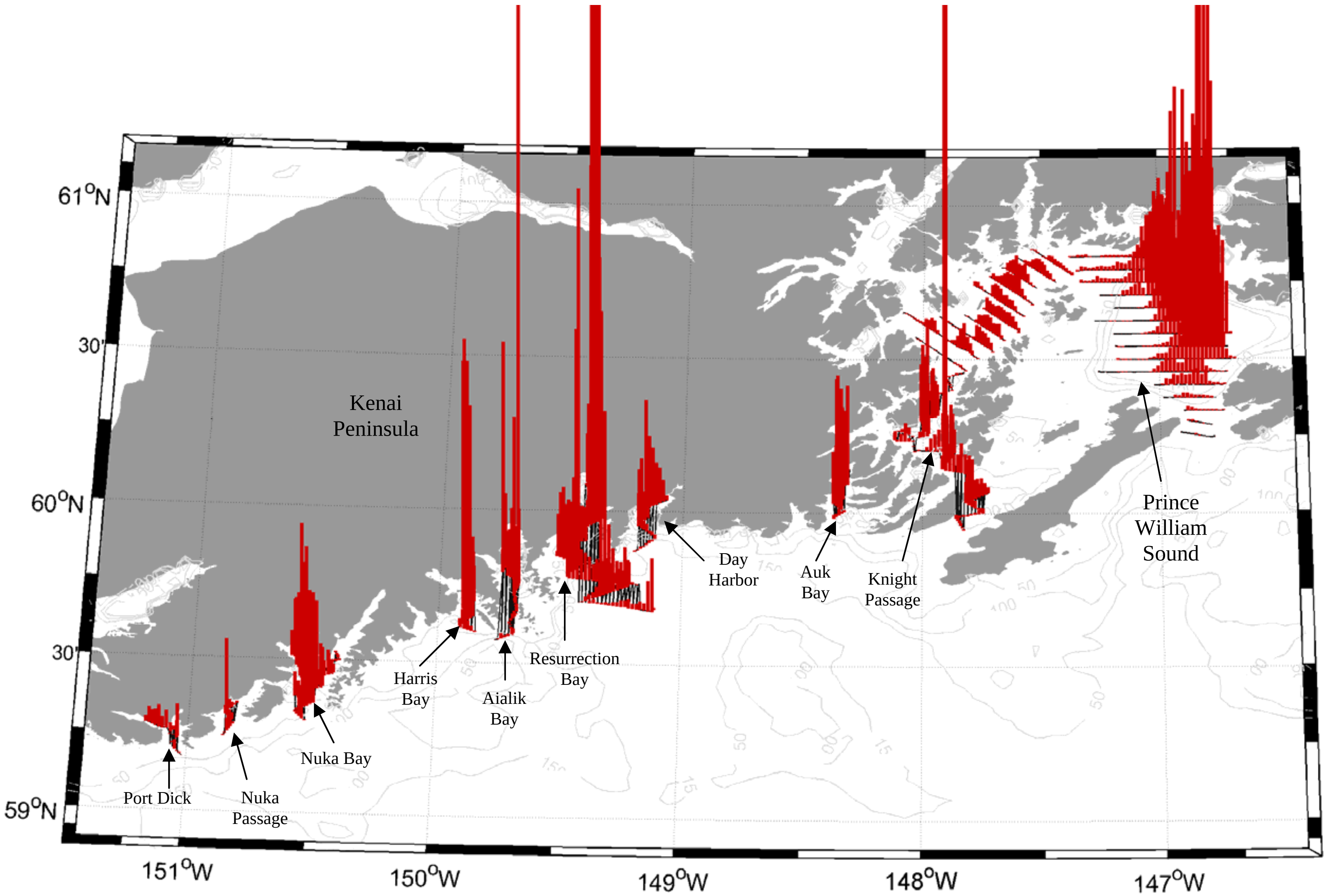

Figure 22. -- Acoustic backscattering (s_A) attributed to walleye pollock (vertical lines) along tracklines surveyed during the winter 2010 echo integration-trawl survey of the Kenai Peninsula bays and Prince William Sound.

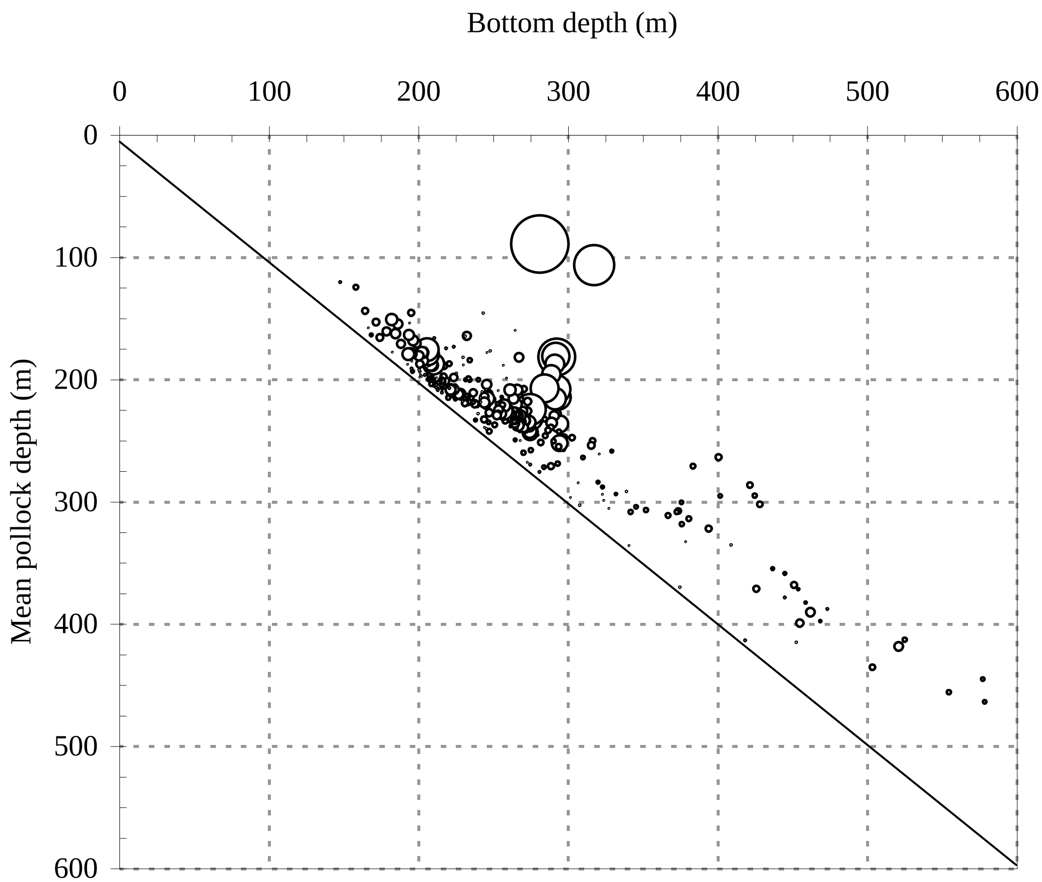

Figure 23. -- Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5 nautical mile for walleye pollock observed during the winter 2010 echo integration-trawl survey of Kenai Peninsula bays. Bubble size is scaled to the maximum biomass.

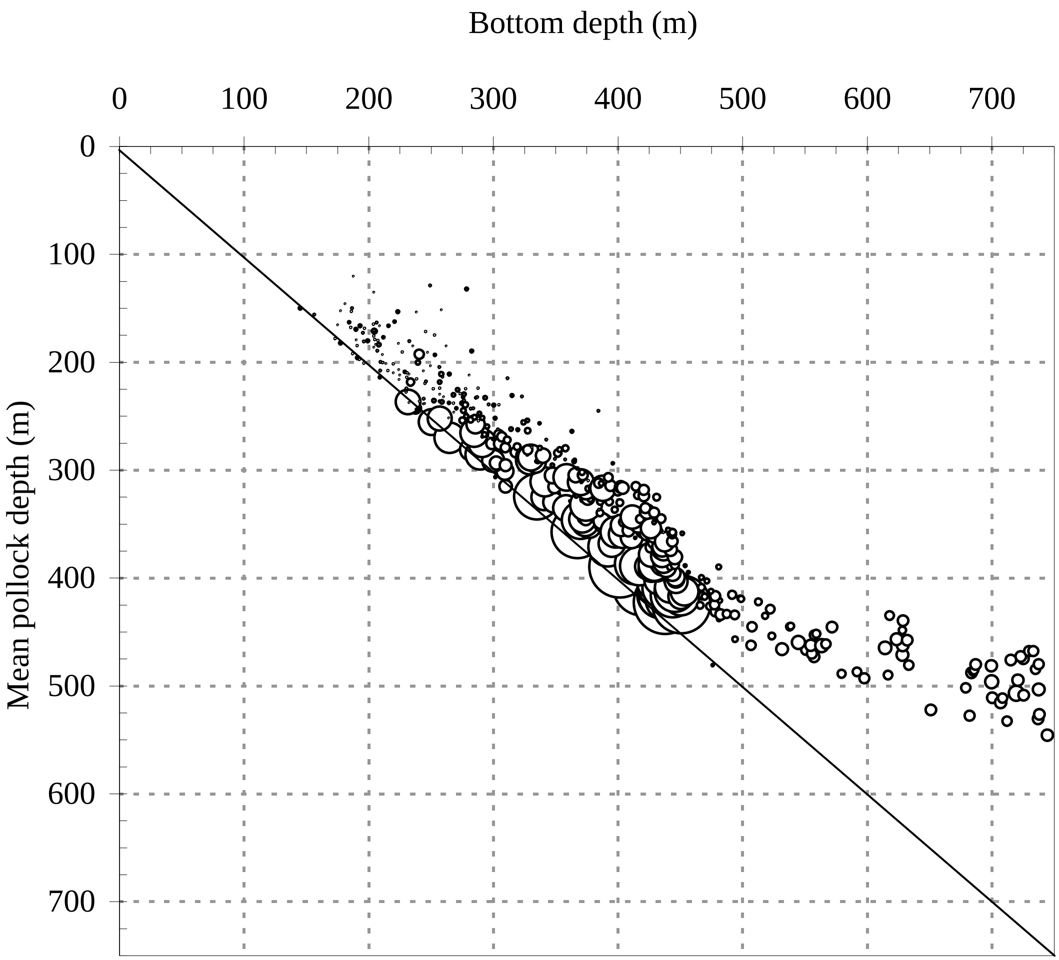

Figure 24. -- Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5 nautical mile for walleye pollock observed during the winter 2010 echo integration-trawl survey of Prince William Sound. Circle size is scaled to the maximum biomass.

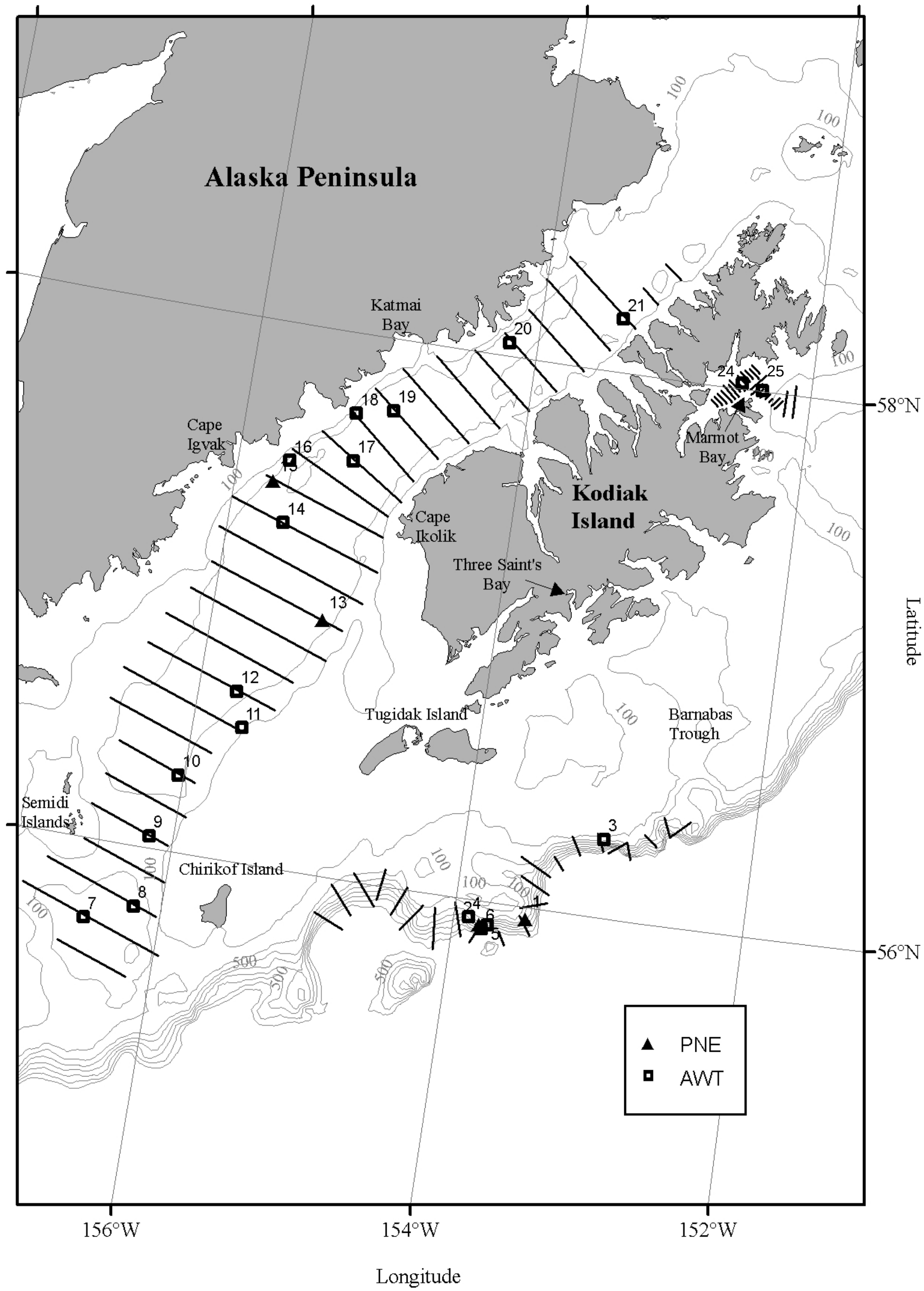

Figure 25. -- Transect lines and locations of Aleutian-wing trawl (AWT) and poly-Nor'eastern trawl (PNE) hauls during the winter 2010 echo integration-trawl survey of walleye pollock in Marmot Bay, the Shelikof Strait area, and along the Gulf of Alaska shelf break from Chirikof Island to Barnabas Trough.

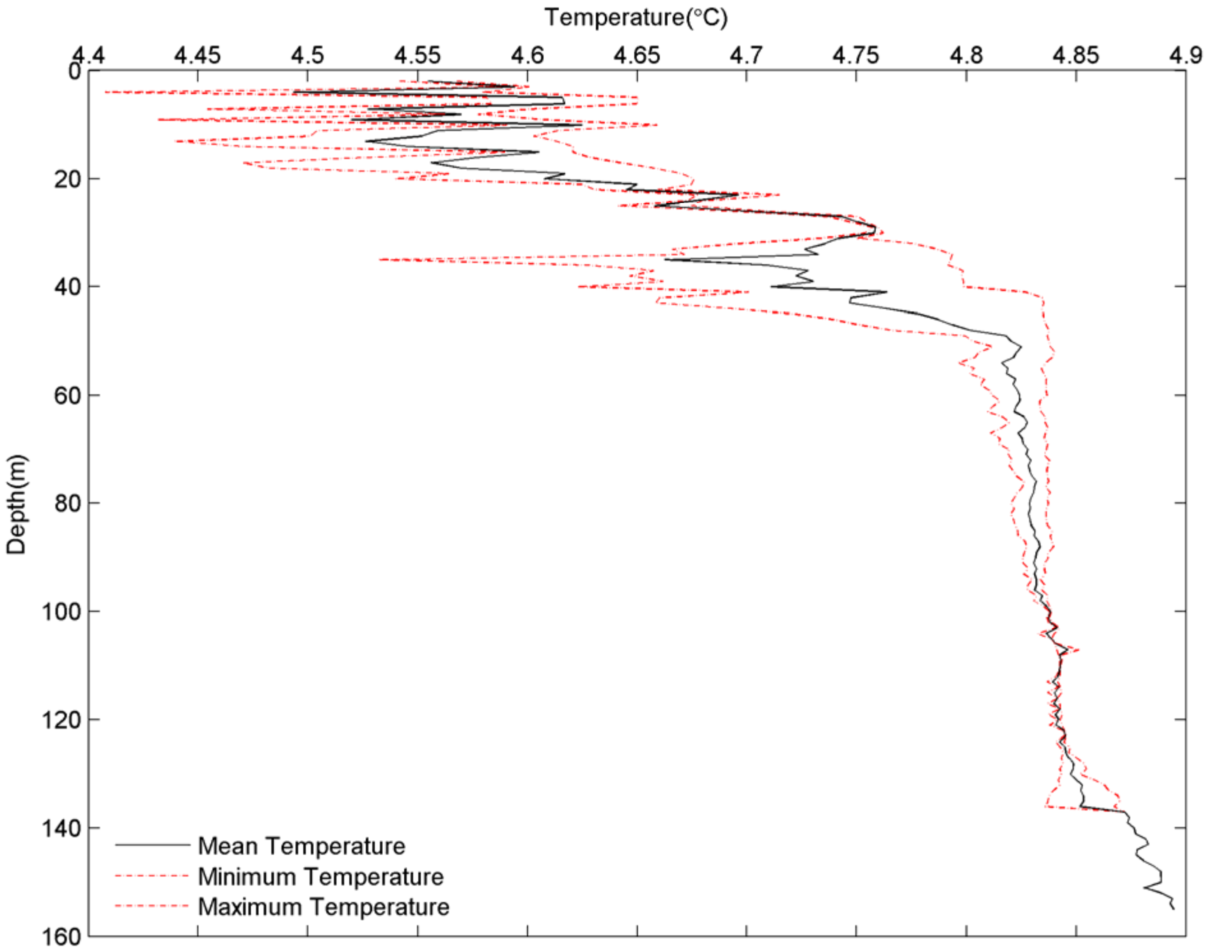

Figure 26. -- Water temperature (°C) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of Marmot Bay. Data were collected from two trawl locations with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope.

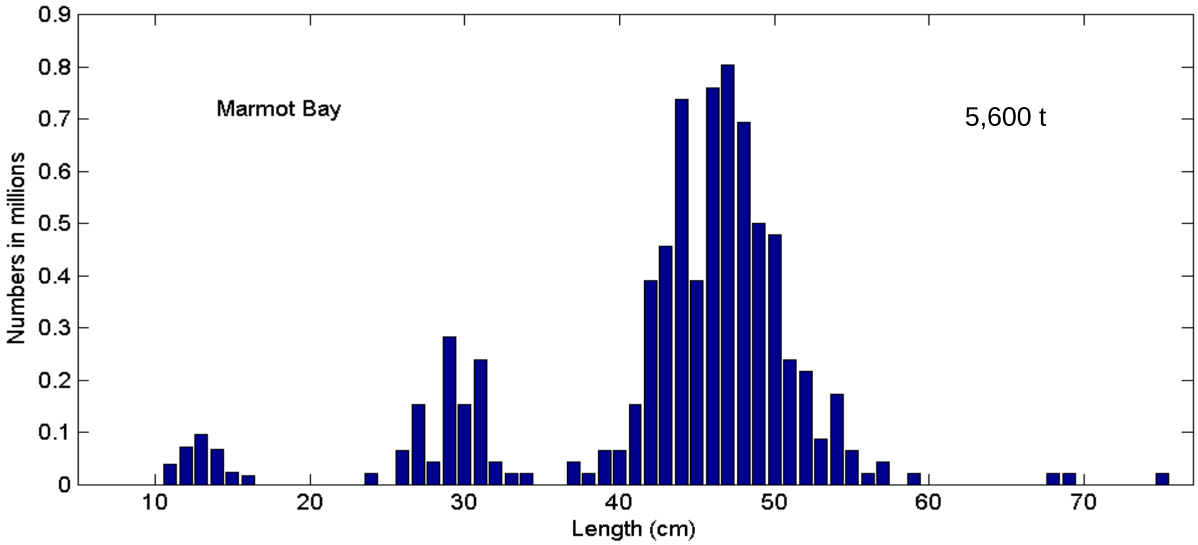

Figure 27. -- Length distribution of walleye pollock (numbers) and biomass estimate (metric tons) for the 2010 echo integration-trawl survey of Marmot Bay.

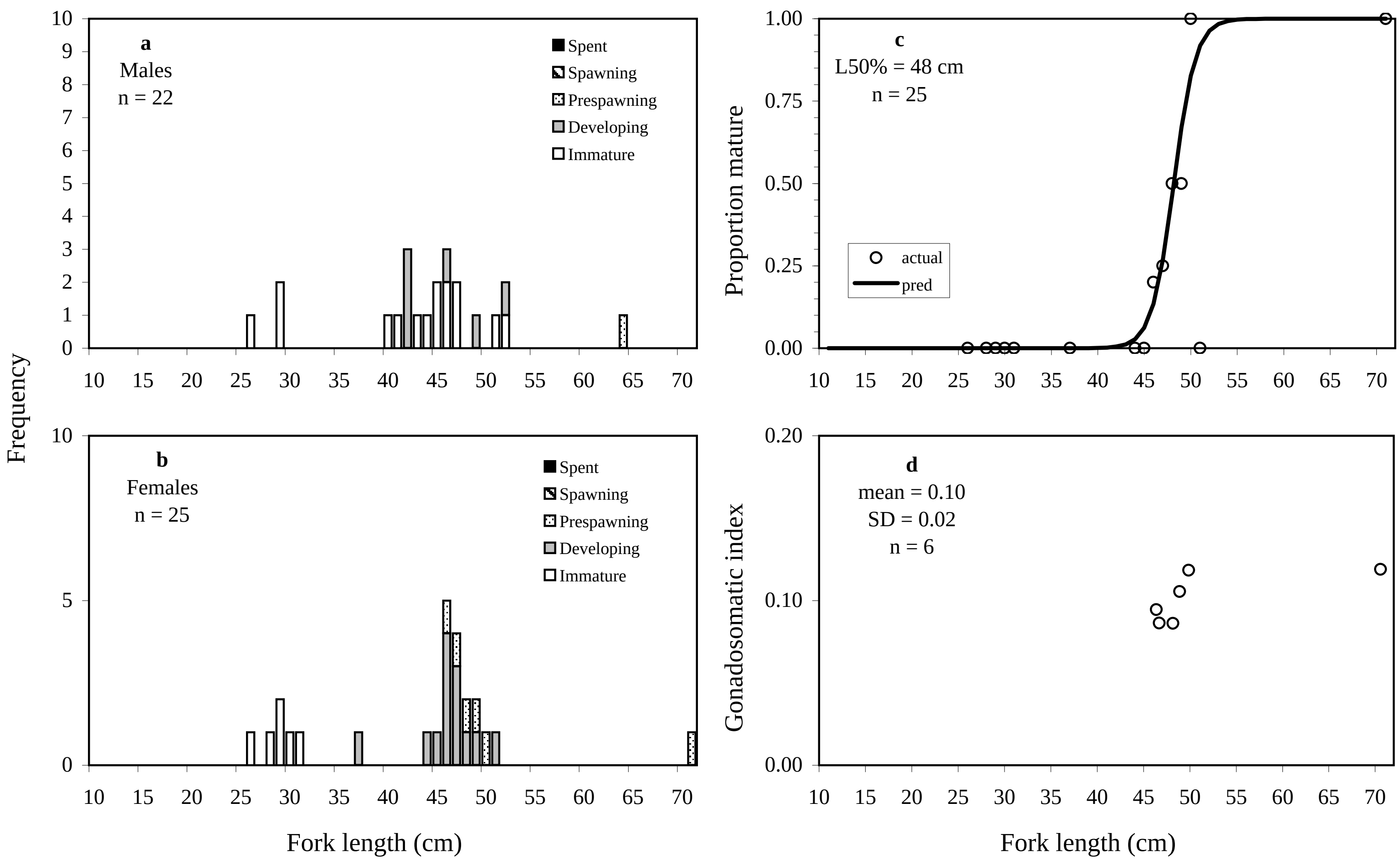

Figure 28. -- Maturity stages for (a) male and (b) female walleye pollock, (c) proportion mature by 1-cm size group for female walleye pollock, and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl survey of Marmot Bay.

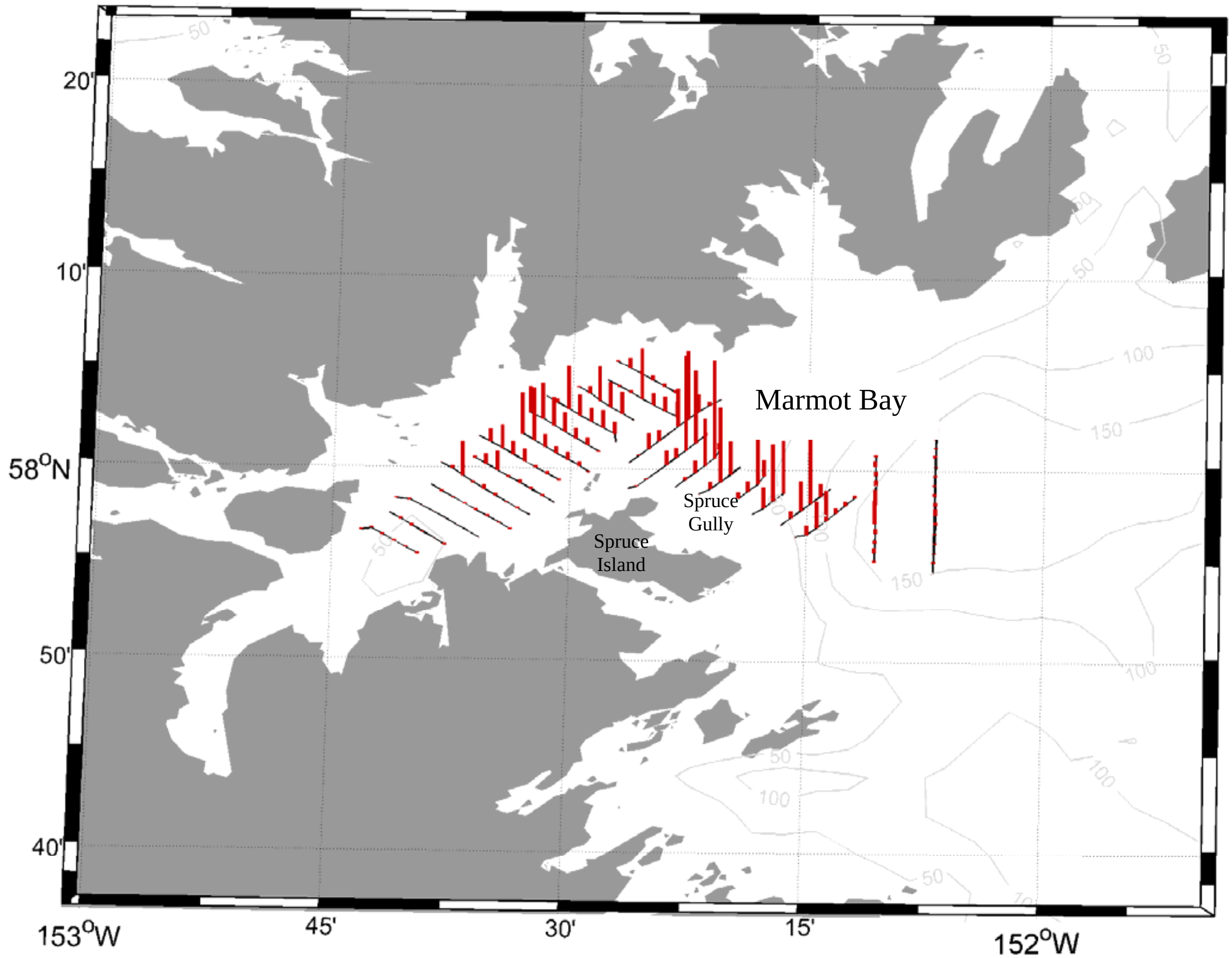

Figure 29. -- Acoustic backscattering (s_A) attributed to walleye pollock (vertical lines) along tracklines surveyed during the winter 2010 echo integration-trawl survey of Marmot Bay.

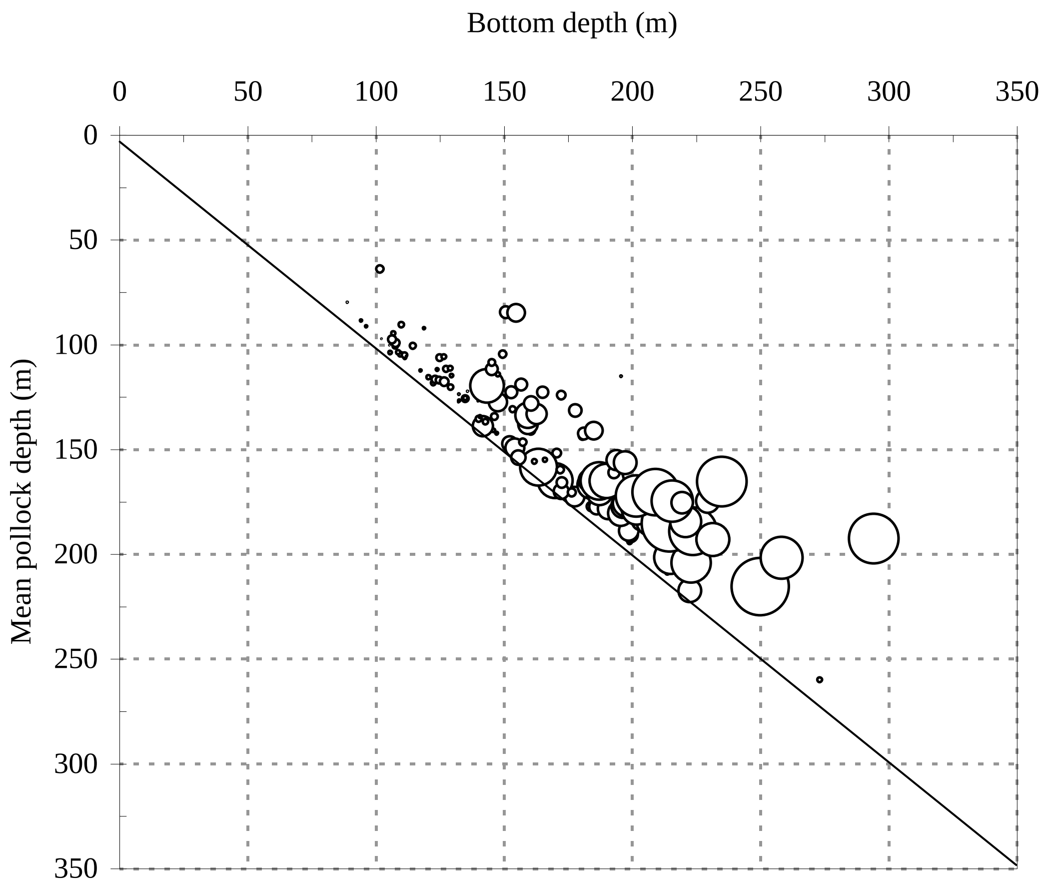

Figure 30. -- Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5 nautical mile for walleye pollock observed during the winter 2010 echo integration-trawl survey of Marmot Bay. Bubble size is scaled to the maximum biomass.

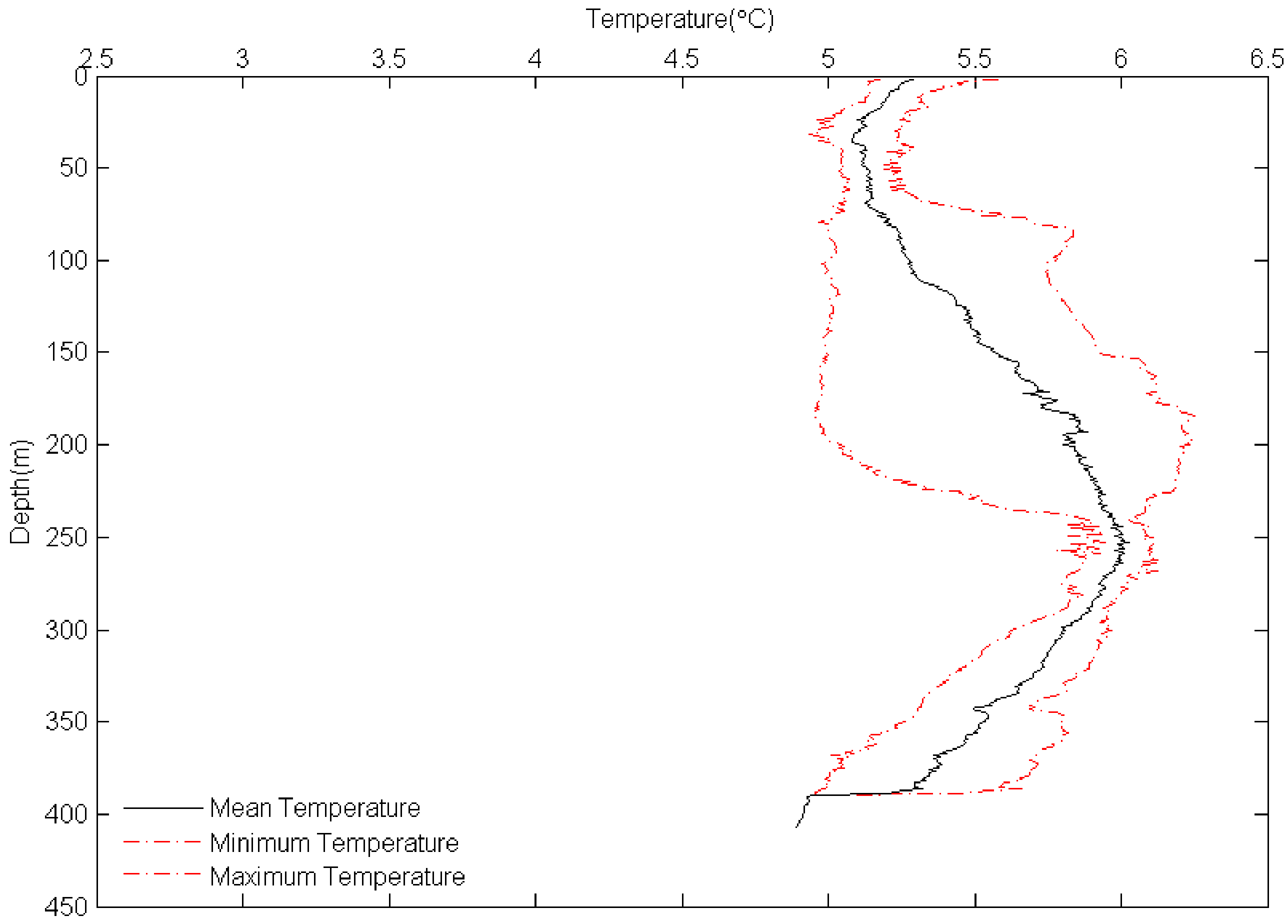

Figure 31. -- Mean water temperature (°C) (solid line) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of walleye pollock along the Chirikof shelf break. Data were collected at six trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed lines represent minimum and maximum temperatures observed.

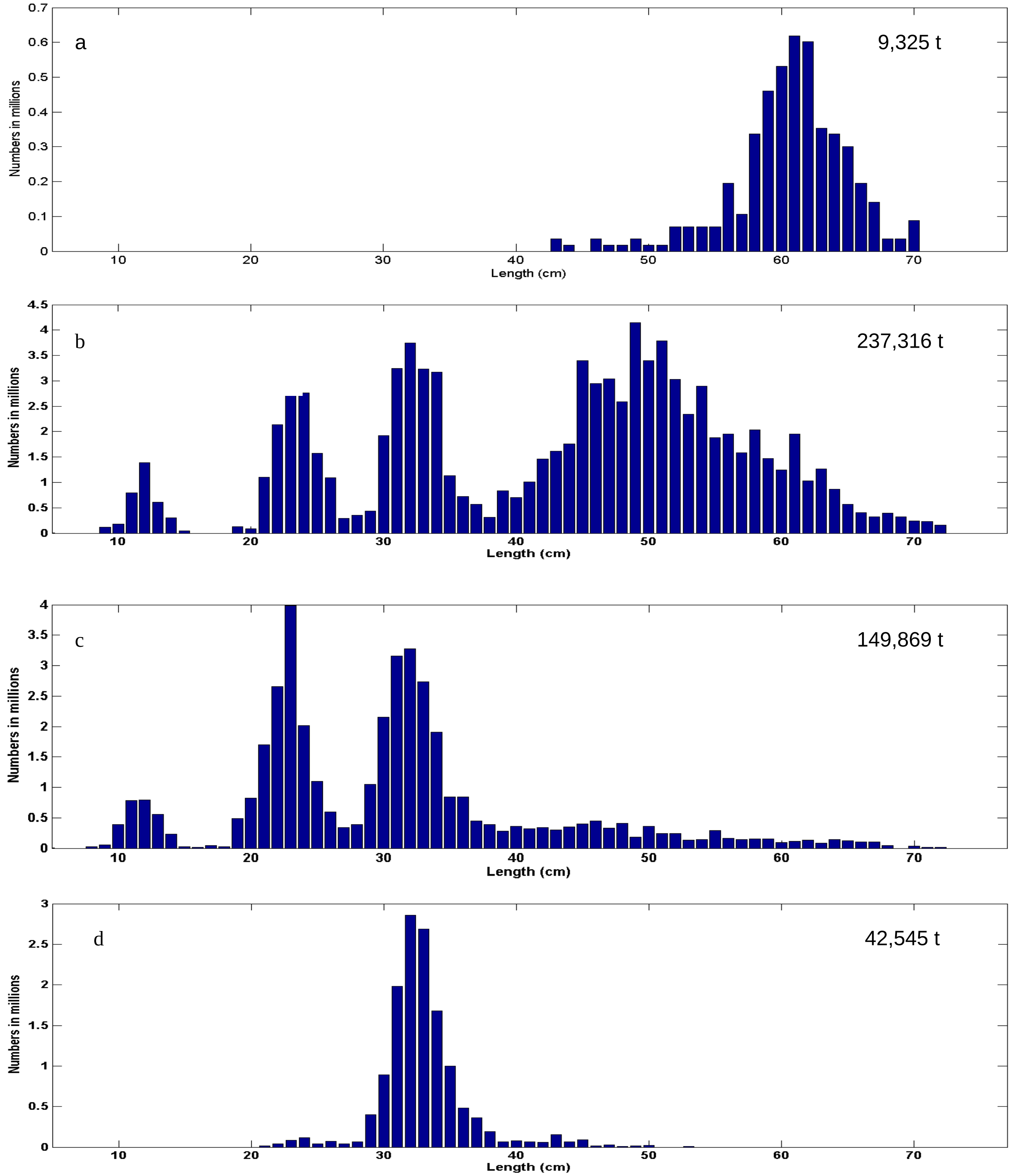

Figure 32. -- Length distribution of walleye pollock (numbers) and biomass for the 2010 echo integration-trawl surveys of (a) the Chirikof shelf break and (b) near-bottom spawners along the west side of Shelikof Strait proper, (c) near-bottom pollock elsewhere, and (d) juvenile midwater schools in the Shelikof Strait area.

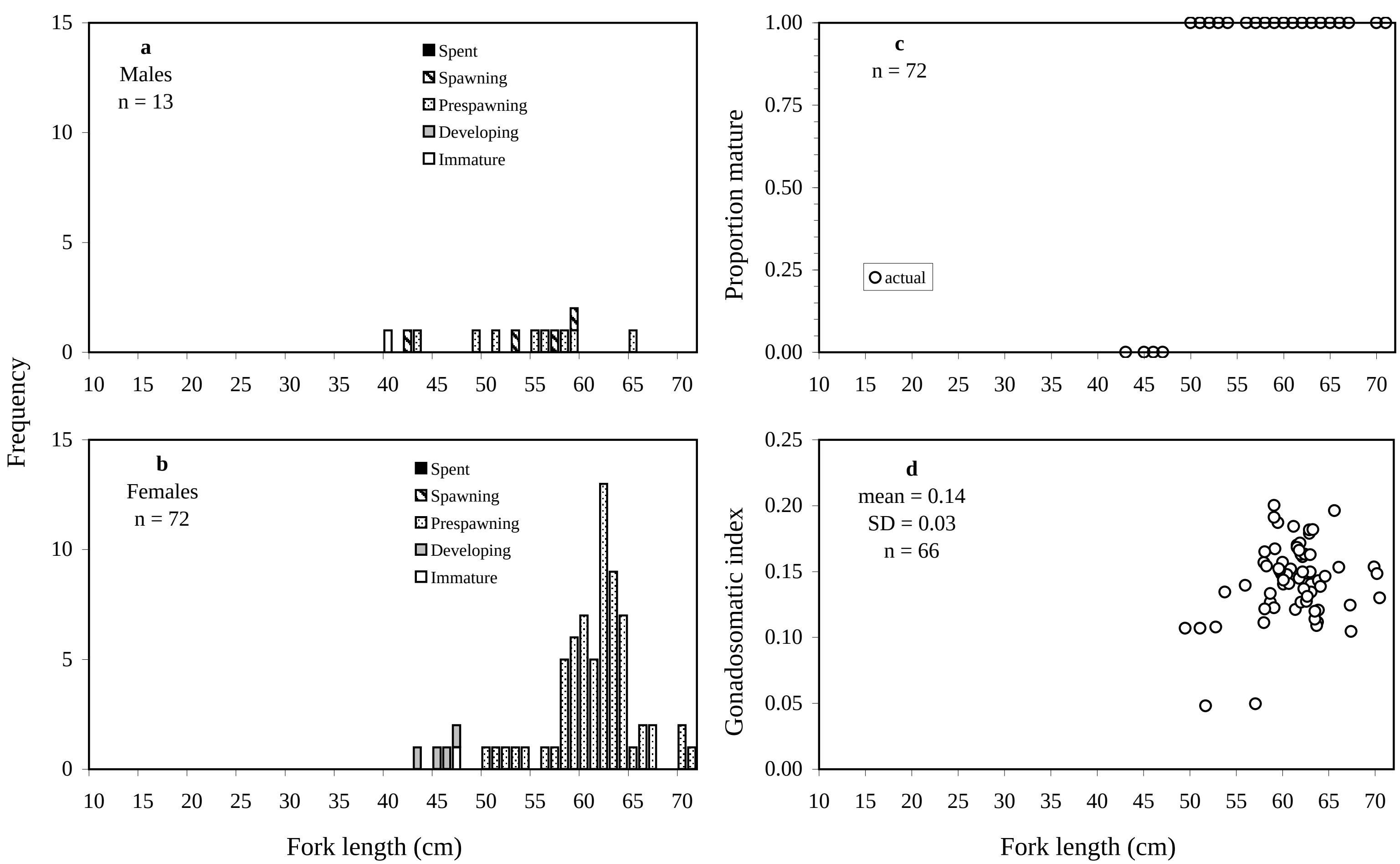

Figure 33. -- Maturity stages for (a) male and (b) female walleye pollock; (c) proportion mature by 1-cm size group for female walleye pollock; and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl survey of the Chirikof shelf break area.

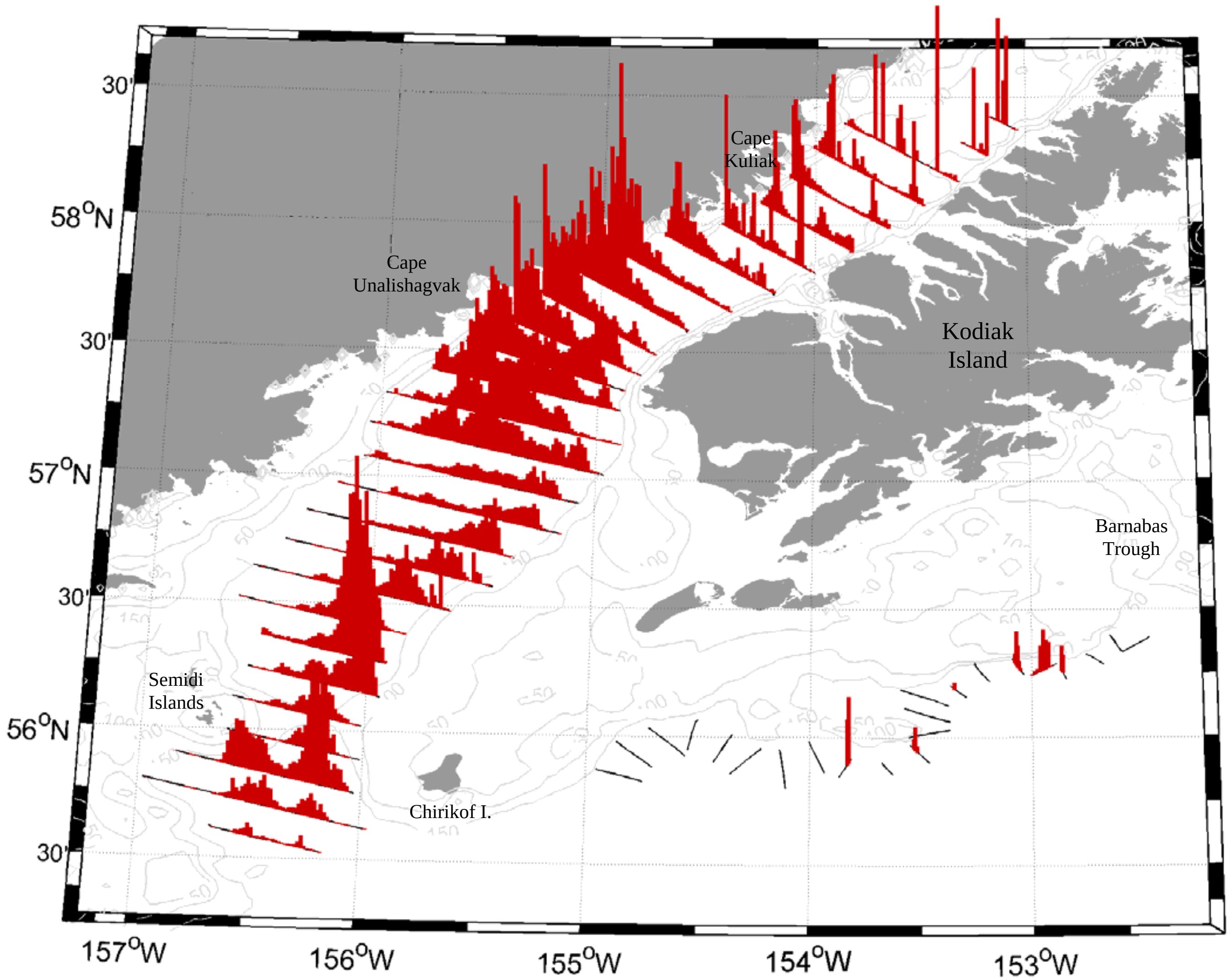

Figure 34. -- Acoustic backscattering (s_A) attributed to walleye pollock (vertical lines) along tracklines surveyed during the winter 2010 echo integration-trawl survey of the Shelikof Strait area and along the Gulf of Alaska shelf break from Chirikof Island to Barnabas Trough.

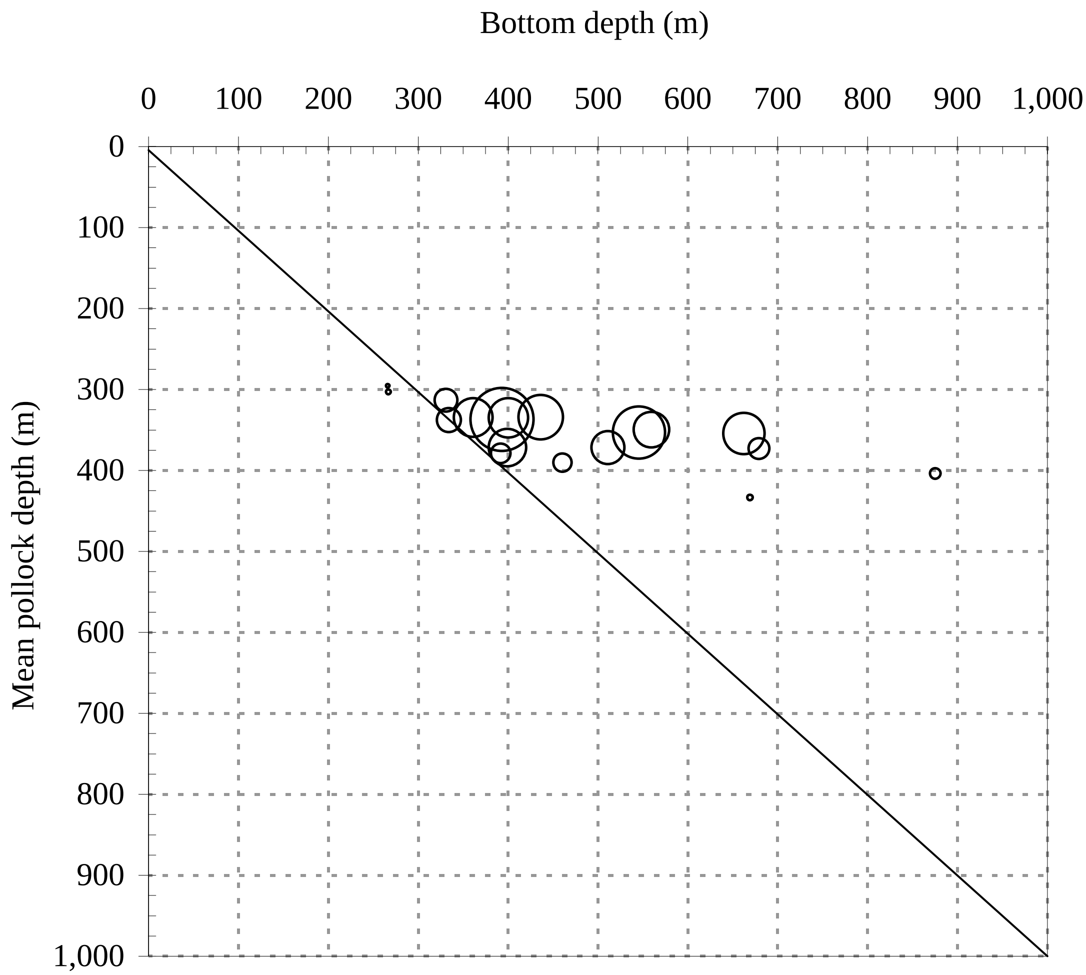

Figure 35.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for walleye pollock observed during the winter 2010 echo integration-trawl survey of the Chirikof Island area. Bubble size is scaled to the maximum biomass.

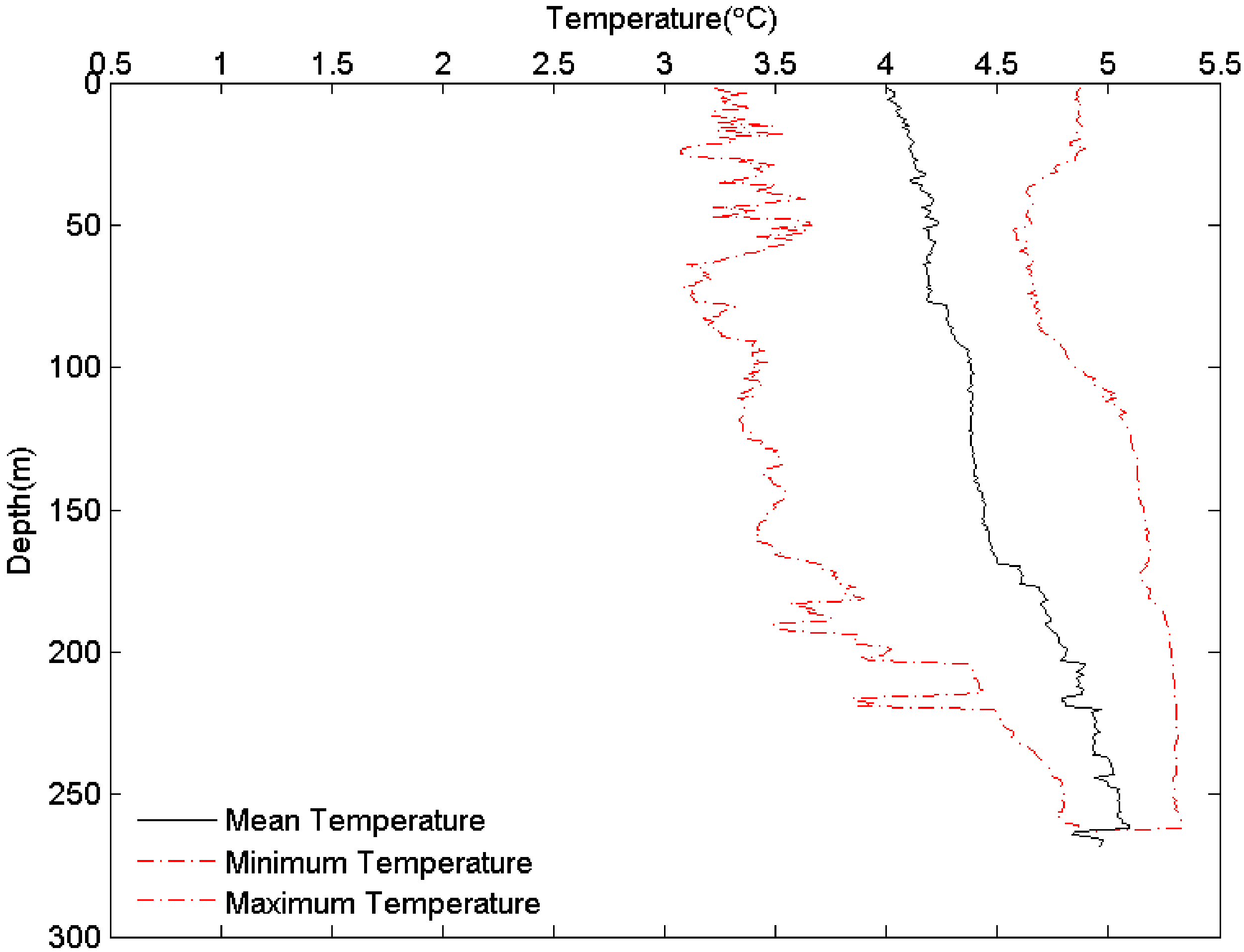

Figure 36. -- Mean water temperature (°C) (solid line) by 1-m depth intervals observed during the winter 2010 echo integration-trawl survey of walleye pollock in the Shelikof Strait. Data were collected at 15 trawl locations with Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed lines represent minimum and maximum temperatures observed.

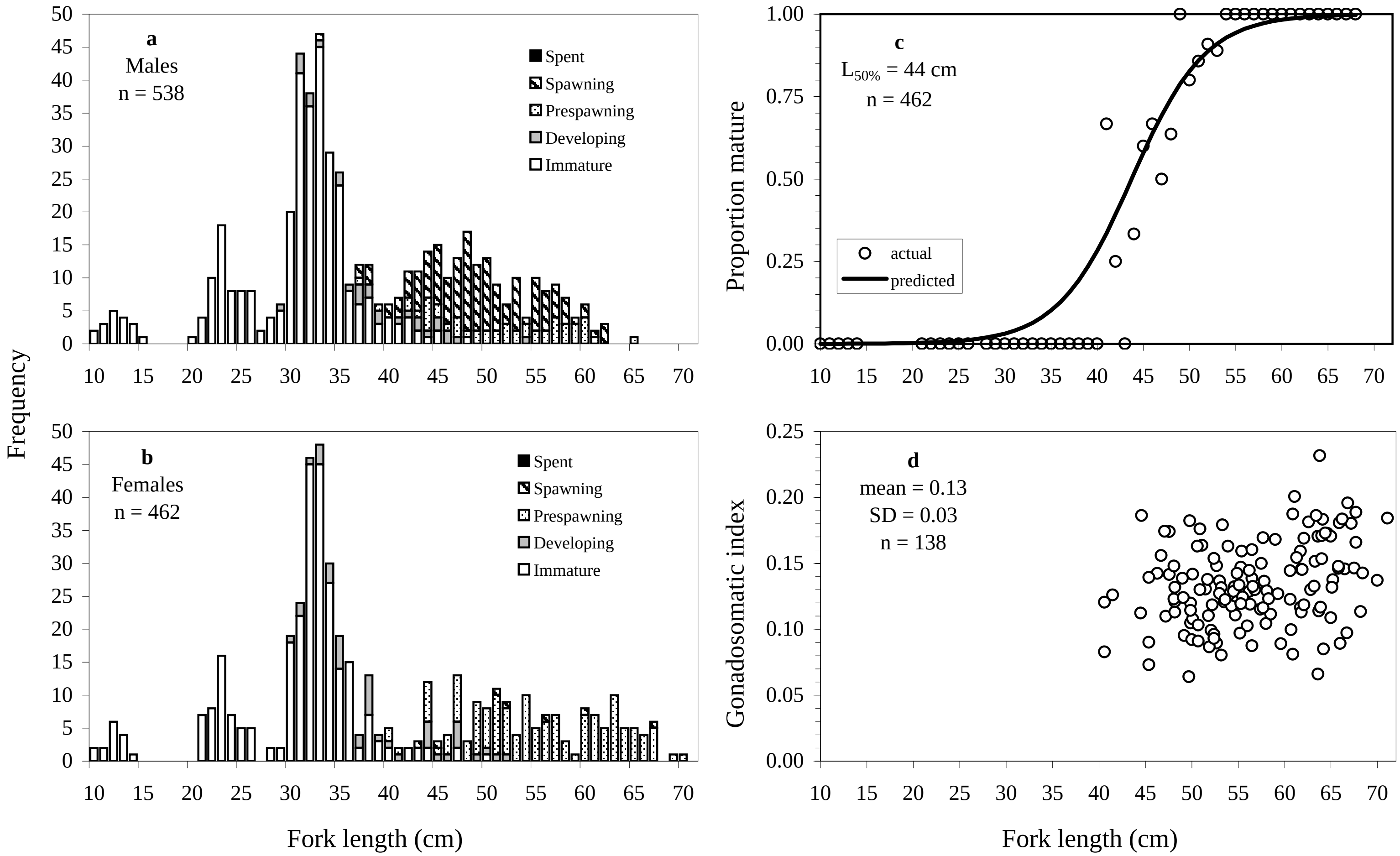

Figure 37. -- Maturity stages for (a) male and (b) female walleye pollock; (c) proportion mature by 1-cm size group for female walleye pollock; and (d) gonadosomatic index for pre-spawning females examined during the 2010 echo integration-trawl surveyof the Shelikof Strait area.

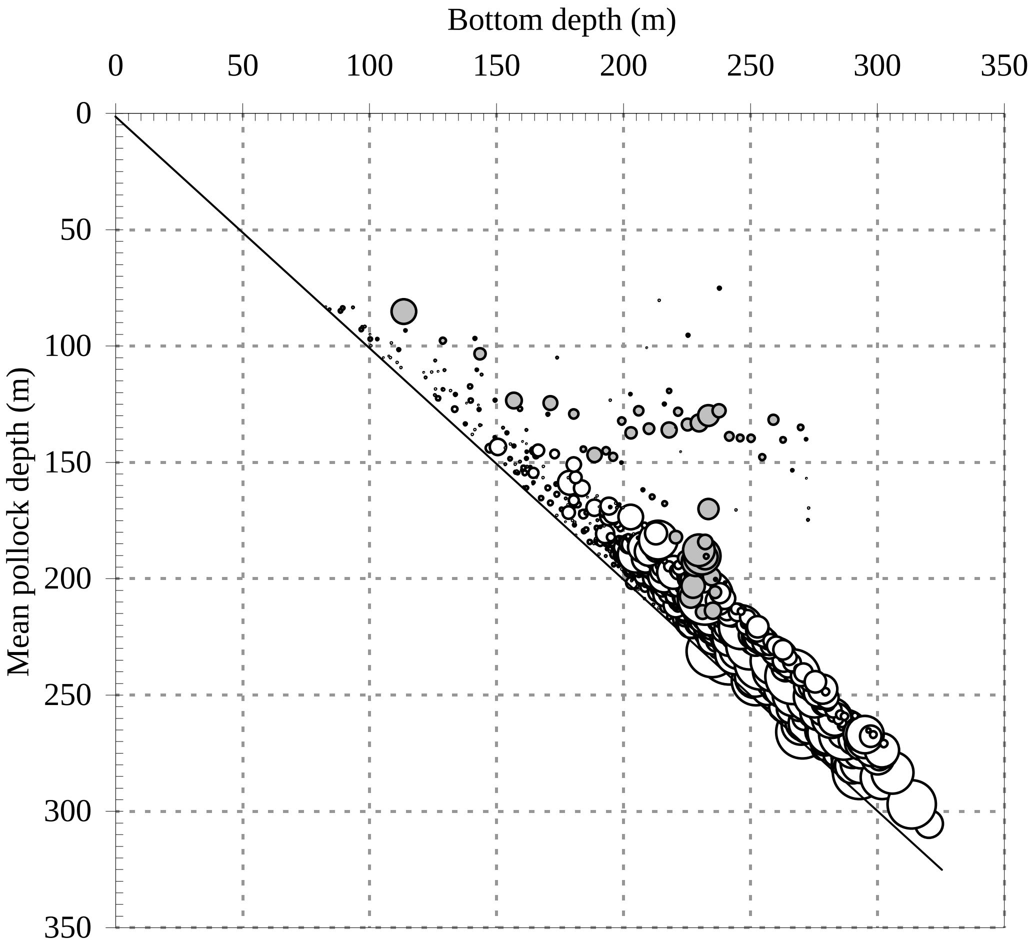

Figure 38.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for near-bottom walleye pollock (open circles) and mid-water juvenile walleye pollock (gray circles) for the winter 2010 echo integration-trawl survey of the Shelikof Strait area. Bubble size is scaled to the maximum biomass.

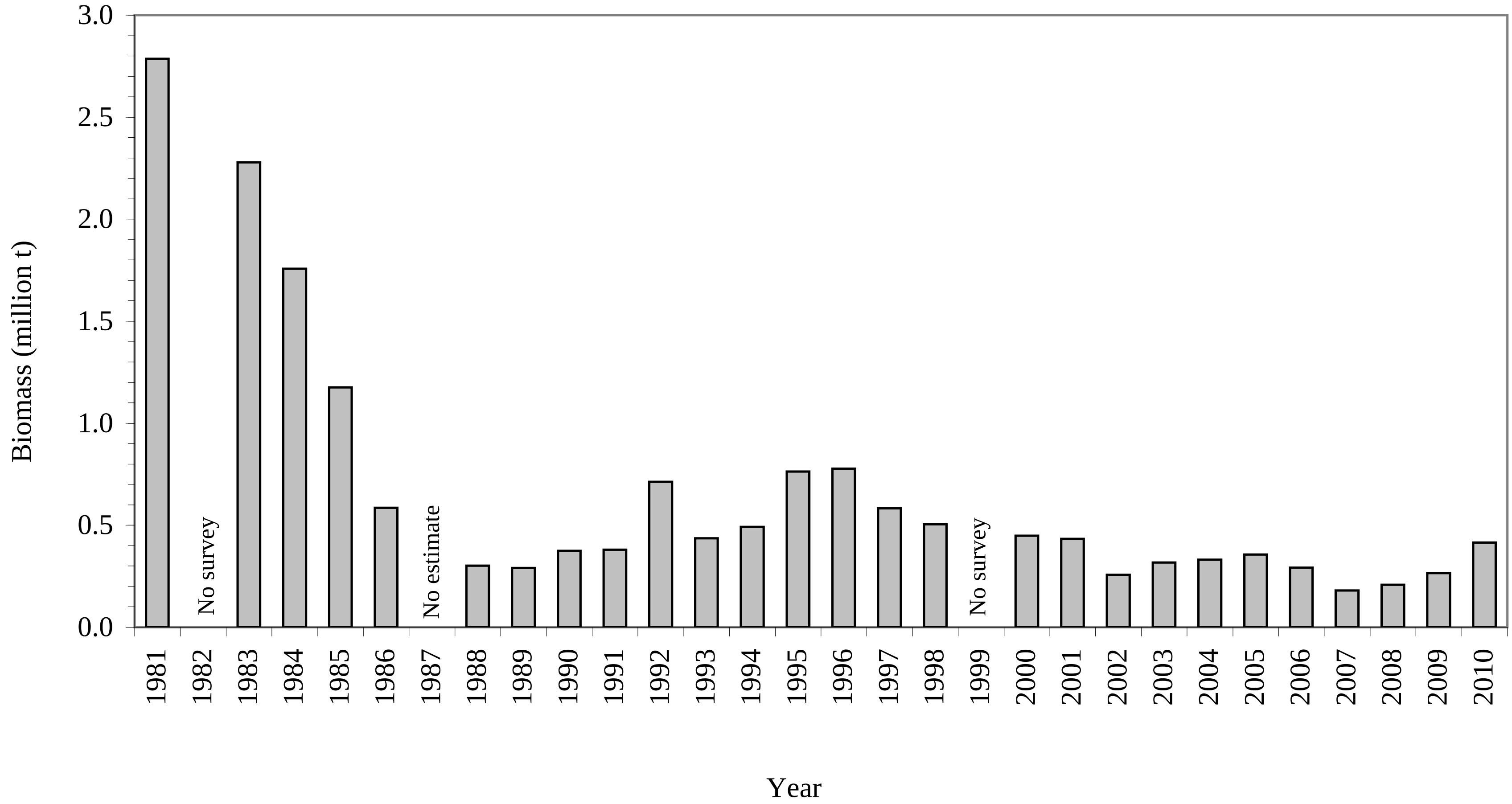

Figure 39.--Summary of annual walleye pollock biomass estimates (in metric tons) based on echo integration-trawl surveys of the Shelikof Strait area.

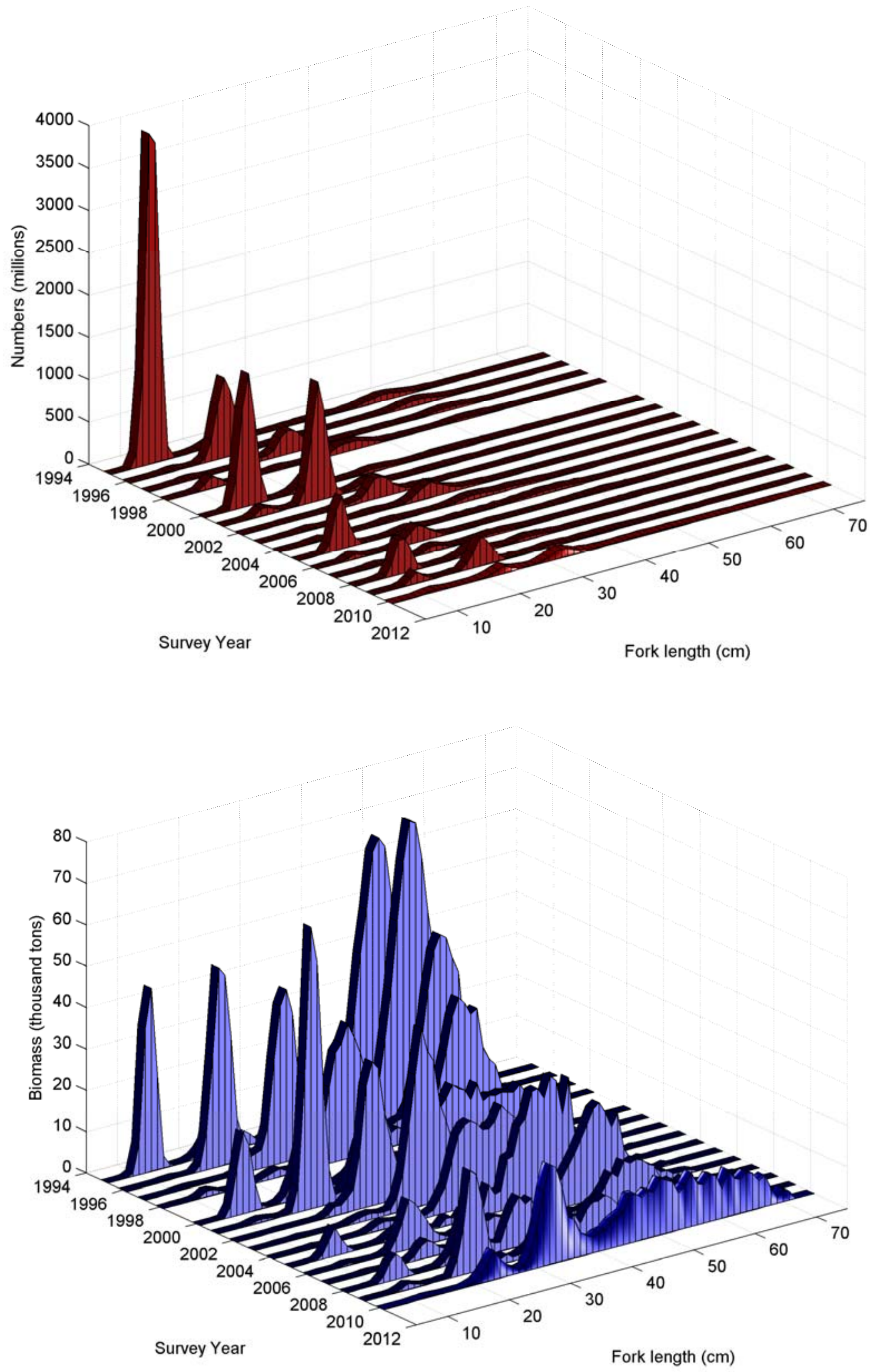

Figure 40. -- Walleye pollock numbers at length in millions and biomass in thousands of metric tons from the Shelikof Strait echo integration-trawl surveys since 1995. No survey was conducted in 1999.

APPENDIX I. ITINERARY

DY2010-01

Shumagins/Sanak/Kenai Peninsula/Prince William Sound

22 Feb.	Depart Kodiak, AK, acoustic sphere calibration in Three Saints Bay, Kodiak Island, AK.
23 Feb.	Transit to first survey transect.
23-25 Feb.	Acoustic-trawl survey of Shumagin Islands.
26-28 Feb.	Acoustic-trawl surveys of Sanak Trough/Morzhovoi Bay/Pavlof Bay.
1-2 Mar.	Research on “Snakehead” shelf.
2-5 Mar.	Acoustic-trawl survey of Kenai Peninsula Bays.
5-7 Mar.	Acoustic-trawl survey of Prince William Sound.
8-9 Mar.	Acoustic-trawl survey of Marmot Bay.
9 Mar.	Arrive Kodiak, AK. End cruise.

DY2010-02

Shelikof/Chirikof Shelf Break

18 Mar.	Depart Kodiak, AK. Transit to first survey transect.
18-19 Mar.	Acoustic-trawl survey of the Chirikof shelf break.
19-22 Mar.	Research on “Snakehead” shelf.
22-28 Mar.	Acoustic-trawl survey of Shelikof Strait.
29-30 Mar.	Acoustic sphere calibration in Three Saints Bay, Kodiak Island, AK.
30 Mar.	Arrive Kodiak, AK. End cruise.

APPENDIX II. SCIENTIFIC PERSONNEL

DY2010-01

Shumagins/Sanak/Kenai Peninsula/Prince William Sound

Name	Position	Organization
Michael Guttormsen	Chief Scientist	AFSC
Sarah Stienessen	Fishery Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Denise McKelvey	Fishery Biologist	AFSC
Darin Jones	Fishery Biologist	AFSC
Susanne McDermott	Fishery Biologist	AFSC
Patrick Calvert	Teacher at Sea	CBF

DY2010-02

Shelikof Strait/Chirikof Shelf Break

Name	Position	Organization
Michael Guttormsen	Chief Scientist	AFSC
Paul Walline	Fishery Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Darin Jones	Fishery Biologist	AFSC
Kresimir Williams	Fishery Biologist	AFSC
Taina Honkalehto	Fishery Biologist	AFSC
Annette Dougherty	Fishery Biologist	AFSC

AFSC – Alaska Fisheries Science Center, Seattle, WA

CBF – Chesapeake Bay Foundation, Annapolis, MD