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Results of the February-March 2007 Echo Integration-Trawl Surveys of Walleye Pollock (*Theragra chalcogramma*) Conducted in the Gulf of Alaska, Cruises MF2007-01 and MF2007-04

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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 echo integration-trawl (EIT) 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*). Most of this effort has been focused on the Shelikof Strait area, which has been surveyed annually since 1980, except in 1982 and 1999. Surveys were also conducted in the Shumagin Islands area in 1994-96, 2001-03, and 2005-06 and along the GOA shelf break east of Chirikof Island in 2002-06. This report presents the distribution and abundance of walleye pollock for surveys conducted in the GOA during February and March 2007.

METHODS

MACE scientists conducted surveys in the western GOA between 6 and 14 February in the Shumagin Islands, Sanak Trough, and Morzhovoi Bay (Cruise MF2007-01) and in the central GOA between 11 and 28 March in the Shelikof Strait area, along the GOA shelf break near Chirikof Island, and in Marmot Bay (Cruise MF2007-04).

Acoustic Equipment

The surveys were conducted aboard the NOAA ship *Miller Freeman*, a 66-m stern trawler equipped for fisheries and oceanographic research that the MACE Program has used for most EIT surveys conducted since 1977. Multi-frequency acoustic data were collected with a Simrad EK60 quantitative echosounding system using 18, 38, 120, and 200 kHz split-beam transducers (Simrad 1997, 2004; Bodholt and Solli 1992) installed on a retractable centerboard extending 9 m below the water surface and logged to files using ER60 software (version 2.1.2) and SonarData EchoLog 500 (version 3.45). We used the SonarData Echoview (version 3.45.53) PC-based application for all

post-processing and analyses of the acoustic data. The 38-kHz echo sounder was the primary source for the quantitative walleye pollock backscatter measurements presented here

Trawl Gear

The vessel was equipped with 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. The net was fitted with a 1.3 cm (0.5 in) nylon mesh codend liner except during the Shelikof Strait survey, for which a 3.2 cm (1.25 in) codend liner was used. The AWT was fished with 82.3 m (270 ft) of 1.9 cm (0.75 in) diameter (8 × 19 wire) non-rotational dandylines, 113.4 kg (250 lb) or 226.8 kg (500 lb) tom weights on each side, and 5 m^2 Fishbuster trawl doors [1,247 kg (2,750 lb) each]. Vertical net opening and depth were monitored using a WESMAR third wire system attached to the headrope. The vertical net opening for the AWT ranged from 13 to 33 m (43-108 ft) and averaged 25 m (80 ft) while fishing.

The vessel was also equipped with a poly Nor'eastern bottom trawl (PNE) with roller gear. The PNE 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 codend was fitted with a 3.2 cm (1.25 in) nylon mesh liner. The 27.2 m (89.1 ft) headrope held 21 floats [30 cm (12 in) diameter]. A 24.7 m (81 ft) chain fishing line was attached to a 24.9 m (81.6 ft) footrope constructed of 1 cm (0.4 in) 6 × 19 wire rope wrapped with polypropylene rope. The trawl was also rigged with triple 54.9 m (180 ft) galvanized wire rope dandylines. The rollergear was attached to the fishing line using chain toggles [2.9 kg (6.5 lb) each] comprised of five links and one ring. The 24.2 m (79.5 ft) roller gear was constructed with 36 cm (14 in) rubber bobbins spaced 1.5-2.1 m (5-7 ft) apart. A solid string of 10 cm (4 in) rubber disks separated some of the bobbins in the center section of the roller gear. Two 5.9 m (19.5 ft) wire rope extensions with 10 cm (4 in) and 20 cm (8 in) rubber disks were used to span the two lower flying wing sections and

were attached to the roller gear. The net was fished with the Fishbuster trawl doors. The vertical net opening and depth were monitored with a Furuno netsounder system attached to the headrope. The PNE trawl vertical mouth opening ranged from 6 to 10 m (20-32 ft) and averaged 7 m (23 ft) while fishing.

Oceanographic Equipment

Physical oceanographic data collected during the cruise 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. Sea surface temperature and salinity data were measured using the *Miller Freeman's* Sea-Bird Electronics SBE-21 probe located mid-ship, approximately 5 m below the water line. These and other environmental data were recorded using the ship's Scientific Computing System.

Survey Design

The walleye pollock populations were surveyed along a series of parallel line transects, except where it was necessary to reorient tracklines to maintain a perpendicular alignment to the isobaths. A random start position was generated for the first transect for all surveys. The Shumagin Islands survey was conducted using transects spaced 9.3 km (5.0 nautical miles (nmi)) apart within Shumagin Trough, 1.9 km (1 nmi) apart east of Renshaw Point, and 4.6 km (2.5 nmi) apart elsewhere (Fig. 1). Bottom depths did not exceed 220 m along any transect, and transects generally did not extend into waters less than about 75 m depth. The Sanak Trough survey was conducted using transects spaced 3.7 km (2 nmi) apart (Fig. 1). Bottom depths did not exceed 165 m along any transect, and transects generally did not extend into waters less than about 50 m depth. The Morzhovoi Bay survey was conducted using transects spaced 4.6 km (2.5 nmi) apart. Bottom depths did not exceed 140 m along any transect, and transects generally did not extend into waters less than about 50 m depth (Fig. 1). The Shelikof Strait sea valley was surveyed from south of Chirikof Island to Swikshak Bay on the Alaska Peninsula using 13.9 km (7.5 nmi) transect spacing

(Fig. 2). Bottom depths did not exceed 340 m along any transect, and transects generally did not extend into waters less than about 100 m depth. The survey of the shelf break southeast of Chirikof Island to near the mouth of Barnabas Trough was conducted along transects spaced 11.1 km (6 nmi) apart between the 200 and 1,000 m depth contours (Fig. 2). Marmot Bay was surveyed using 2.8 km (1.5 nmi) transect spacing (Fig. 2). This was the first survey of this area during late winter/early spring. Bottom depths did not exceed 290 m along any transect, and transects generally did not extend into waters less than about 75 m depth. All surveys were conducted 24 hours per day.

Trawl hauls were used to classify the observed backscatter layers to species and size composition and to collect specimens of walleye pollock. Average trawling speed was approximately 1.5 m/s (3 knots). Walleye pollock were sampled to determine sex, fork length (FL), body weight, age, maturity, and ovary weight of selected females (Tables 1 and 2). Walleye pollock were measured to the nearest centimeter. An electronic motion-compensating scale (Marel M60) was used to weigh individual walleye pollock. For age determinations, walleye pollock otoliths were collected and stored in a 50% ethanol-water solution. Maturity was determined by visual inspection and was categorized as immature, developing, pre-spawning, spawning, or post-spawning[1]. All data were electronically recorded using the Fisheries Scientific Computing System and stored in an Oracle database.

Acoustic system calibrations using standard spheres (Foote et al. 1987) were conducted to measure and document acoustic system performance for the ER60 echosounder. During the calibrations, the *Miller Freeman* was anchored at the bow and stern. Weather, sea state conditions, and acoustic system settings were recorded. 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, 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, the

[1] ADP Codebook. 2005. Unpublished document. Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, NMFS, NOAA; 7600 Sand Point Way NE, Seattle, WA 98115.

backscattering was used to measure both single-echo target strength (TS) and volume backscattering (echo integration). As part of the calibration, transducer beam characteristics were measured by moving each sphere through the beam and collecting target-strength data using Simrad EKLOBES software.

Data Analysis

The range of strata considered for the echo integration analysis along each transect included depths from 16 m of the surface (~ 7 m below the transducer) to 0.5 m above the detected bottom, except where the bottom exceeded 1,000 m, the lower limit of data collection. Values of mean area backscattering (nautical area scattering coefficient) for layers identified as walleye pollock were stored in an Oracle database. Walleye pollock length data were aggregated into strata based on observed aggregation patterns, geographic proximity of hauls, and similarity in size composition data. Estimates of walleye pollock backscattering strength for each stratum were then calculated using an s_V threshold of –70 decibels (dB). The echo integration values were summed and scaled using a previously derived relationship between TS and fish lengths (TS = 20 Log L - 66; Traynor 1996) and the length composition data to produce estimates of walleye pollock numbers by length. Mean weight-at-length was estimated from the trawl data when there were more than five walleye pollock for that length; otherwise mean weight was estimated from a linear regression of the natural logs of all the length-weight data. Age-specific estimates of biomass and numbers will be generated for the surveys after the otolith samples are aged.

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

RESULTS and DISCUSSION

Calibration

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 (Table 3).

Shumagin Islands

Physical Oceanography

Surface water temperatures, which were based on SBE-39 profile data, ranged from 3.0º to 3.4º C with a mean of 3.2º C (Fig. 3). Mean surface temperatures for the 2001-2003 and 2005-2006 surveys ranged from 3.0º to 5.6º C. Temperatures at the depths where most adult walleye pollock biomass occurred ranged from 3.8º to 4.0º C off Renshaw Point (130-180 m) and ranged from 5.2º to 5.8º C in Shumagin Trough (130-160 m).

Trawl Samples

Biological data and specimens were collected in the Shumagin Islands from eight AWT trawl hauls and one bottom trawl (Tables 1 and 4; Fig. 1). In the midwater tows, walleye pollock was the most abundant species, comprising 95.8% by weight and 89.0% by numbers (Table 5). By numbers, eulachon (*Thaleichthys pacificus*) and capelin (*Mallotus villosus*) contributed 5.6% and 4.9% of the catch, respectively. The eulachon and capelin occurred primarily in Shumagin Trough. In the single bottom haul, longnose skate (*Raja rhina*), flathead sole (*Hippoglossoides elassodon*),

arrowtooth flounder (*Atheresthes stomias*), and walleye pollock were the most abundant species by weight, comprising 32.2%, 24.9%, 18.5%, and 8.0%, respectively, by weight of (Table 6).

The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 23% developing, 63% pre-spawning, 5% spawning, and 9% spent (Fig. 5a). The maturity composition of females longer than 40 cm was 0% immature, 13% developing, 79% pre-spawning, 0% spawning, and 8% spent (Fig. 5b). The low numbers of spawning and spent female fish suggests that the survey timing was appropriate. A logistic model fit to the female maturity-at-length data predicted that 50% of females (l_{50}) were mature at 45 cm FL (Fig. 5c), which was longer than the 2005 (36 cm FL) but typical for other recent Shumagin Islands surveys (42 to 45 cm FL). The average GSI (gonadosomatic index: ovary weight/(ovary weight+body weight) of pre-spawning females was 0.10 (Fig. 5d), which was lower than previous Shumagin Island surveys, which ranged from 0.12 to 0.19.

Distribution and Abundance

Acoustic data were collected along 537 km (290 nmi) of tracklines. The densest walleye pollock aggregations were located in Shumagin Trough (Fig. 6). Acoustic densities were low off Renshaw Point, where the highest quantities have been located during all previous Shumagin Islands surveys. Walleye pollock were distributed demersally as well as in dense, midwater schools. Most of the biomass was deeper than 125 m and was within 40 m of the bottom (Fig. 7).

Age-2 walleye pollock[2] were the dominant age class by numbers off Renshaw Point, in Unga Strait, and in Shumagin Trough (Fig. 4). This was the first survey in the Shumagin Islands time series when adult walleye pollock were not the dominant age class off Renshaw Point. Age-1 walleye pollock were the dominant age class in West Nagai Strait and Stepovak Bay.

[2]Because walleye pollock age data are not yet available, length ranges were used as a proxy for age using length-at-age data from previous surveys. Fish between 9-16 cm FL are considered 1-year olds, most fish between 17-25 cm FL are considered 2-year olds, most fish from 26-33 cm FL are considered 3-year olds, and most fish >33 cm FL are adults.

The 2007 biomass estimate of 20,000 t is the lowest in survey history and only 7% of the peak 1995 estimate of 290,000 t (Table 7, Fig. 8). The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 8.6%.

Previous to the survey of the Renshaw Point area, a 2-day commercial walleye pollock fishery consisting of about 15 vessels occurred, delaying the survey until after the vessels had left. Estimated fishery removals in the Shumagin reporting area were 2,100 t, with most of the catch taken from the Renshaw Point area (Tom Pearson, Alaska Regional Office, pers. comm.), which in combination with possible displacement of fish from the area due to the fishing activity might be a partial explanation for the lower biomass estimate.

The abundance of walleye pollock in the Shumagin Islands has declined since the mid-1990s. Inference about abundance trends, however, is difficult to make for several reasons. Previous to 2001, only the 1995 survey covered the entire Shumagin Islands area. Also, it is 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 had occurred, 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 were either spawning or spent, suggesting that the peak had already occurred and that some fish might have already left the area.

The Shumagin Islands surveys also may not provide predictions of future walleye pollock abundance in the Gulf of Alaska. For example, over one-half of the 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 absent entirely as juveniles during the 1994, 1995, and 1996 surveys (Fig. 9).

Sanak Trough

Physical Oceanography

Surface water temperatures ranged from 2.8º to 3.1º C with a mean of 3.0º C (Fig. 10). Mean surface water temperatures were slightly warmer than in 2006 (2.8º C) but were cooler than in 2003 (5.1º C) and 2005 (4.2º C). Temperatures at the depths where most walleye pollock biomass occurred (90-125 m) ranged from 3.1º to 3.4º C, which was similar to 2006 but cooler than in 2003 (5.3º C) and 2005 (4.4º C).

Trawl Samples

Biological data and specimens were collected in Sanak Trough from three bottom trawl hauls, all fished in mid-water to limit catch amounts (Tables 1 and 4; Fig. 1). Walleye pollock was the most abundant species in the catches, comprising 94.8% by weight and 97.9% by numbers (Table 8). Most walleye pollock captured ranged from 45 to 65 cm FL (Fig. 11) with a mode of 52 cm FL.

The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 2% developing, 30% pre-spawning, 13% spawning, and 55% spent (Fig. 12a). The unweighted maturity composition for females longer than 40 cm FL was 0% immature, 2% developing, 33% pre-spawning, 20% spawning, and 46% spent (Fig. 12b). The high percentage of spawning or spent females suggests that spawning and related movements out of the area may have already occurred. Although not as high as for the 2007 survey, previous Sanak Trough surveys have found relatively high numbers of spawning and spent females, which suggests that Sanak Trough should be surveyed earlier in the season. Because of the lack of fish shorter than 40 cm FL, a logistic model could not be fitted to the female maturity at length data (Fig. 12c). Because of a sampling error, female ovaries were not weighed during the Sanak Trough survey, thus there are no GSI estimates for this area (Fig. 12d).

Distribution and Abundance

Acoustic data were collected along 200 km (108 nmi) of tracklines. Most of the abundance was distributed in the northeastern part of Sanak Trough both demersally as well as in dense, midwater schools over bottom depths between 90 and 130 m (Figs. 6, 13). Dense near- and on-bottom schools were detected near several transect endpoints in the southern part of the survey area as well. Walleye pollock were sparse, however, in the northwestern part of the Trough, where about half of the 2006 biomass was detected over bottom depths shallower than 100 m.

The 2007 abundance estimate of 60,300 was less than half of the 2006 estimate (127,000 t) but similar to the 2003 (82,000 t) and 2005 (68,000 t) surveys (Table 7). The relative estimation error for 2007 based on the one-dimensional geostatistical analysis of echosign was 5.7%.

Morzhovoi Bay

Physical Oceanography

The mean surface water temperature of 2.3º C in 2007 (Fig. 14) was warmer than in 2006 (1.9º C). Temperatures at the depths where most walleye pollock biomass occurred (60-100 m) ranged from 2.3º to 2.7º C, which also was warmer than in 2006 (1.5º to 2.2º C).

Trawl Samples

Biological data and specimens were collected in Morzhovoi Bay from one PNE trawl haul (Tables 1 and 4; Fig. 1). Walleye pollock comprised 90.5% by weight of the catch (Table 9). Walleye pollock comprised 63.2% by numbers, followed by flathead sole (27.1%). Walleye pollock in Morzhovoi Bay ranged from 47 to 62 cm FL, with a mode of 54 cm FL (Fig. 15). As in 2006, most fish were males.

The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 3% developing, 91% pre-spawning, 4% spawning, and 3% spent (Fig. 16a). Only one female was collected for length and maturity measurements, thus the maturity composition, logistic model fit, and GSI estimates could not be completed.

Distribution and Abundance

Acoustic data were collected along 122 km (66 nmi) of tracklines. Low densities of walleye pollock were detected along most transects near the sea floor over bottom depths of 60-100 m (Figs. 6, 17). The 2007 biomass estimate of 2,500 t was lower than in 2006 (11,700 t), which was the first time this area had been surveyed (Table 7). The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 15.1%.

Shelikof Strait

Physical Oceanography

Surface water temperatures ranged from 1.4º to 3.2º C with a mean of 2.4º C (Fig. 23), which were cooler than in recent years - 2004 (3.8º C), 2005 (4.0º C), and 2006 (3.5º C). Temperatures increased with depth, rising to an average of 3.2º at 150 m and approximately 4.0º C at 200 m. Similar temperature distributions were observed during 2004-06.

Trawl Samples

Biological data and specimens were collected in Shelikof Strait from 9 AWT trawl hauls and 1 bottom trawl (Tables 2, 10; Fig. 2). Walleye pollock and eulachon were the most abundant species by weight in midwater trawl hauls, comprising 76.2% and 20.4%, respectively, of the total catch (Table 11). By numbers, eulachon and walleye pollock were most abundant, accounting for 68.5%

and 28.9%, respectively. Walleye pollock, arrowtooth flounder, and eulachon accounted for 59.0%, 25.4%, and 7.3% of the catch weight in the single bottom trawl haul (Table 12).

Trawl hauls conducted within Shelikof Strait proper caught a mixture of age-1, age-2, age-3, and older walleye pollock (Fig. 19a). A similar distribution was observed south of the Strait proper, although the contribution of older walleye pollock was less (Fig. 19b). Hauls conducted in mid-water layers caught mostly 2- and 3-year old walleye pollock (Fig. 19c).

The unweighted maturity composition in the Shelikof Strait area for males longer than 40 cm FL was 0% immature, 11% developing, 55% mature pre-spawning, 34% spawning, and 0% spent (Fig. 20a). The maturity composition of females longer than 40 cm FL was 0% immature, 10% developing, 90% pre-spawning, 0% spawning, and <1% spent (Fig. 20b). These results are similar to previous survey results in terms of low numbers of spawning and spent female fish, which suggests that the survey timing was appropriate. The female l_{50} of 45 cm FL (Fig. 20c) was similar to most estimates since 1985. The average GSI for pre-spawning females of 0.14 (Fig. 20d) was similar to the mean GSI in 2004 (0.16), 2005 (0.15), and 2006 (0.14), but greater than the mean GSIs for 2002 (0.12) and 2003 (0.11). The current mean is also similar to the mean GSIs (0.14-0.19) reported for other recent (1992-2001) surveys.

Distribution and Abundance

Acoustic data were collected along 1,760 km (950 nmi) of tracklines. The densest walleye pollock aggregations were detected in the area defined by Cape Unalishagvak to Katmai Bay on the northern side of the Strait and Cape Ikolik to Uyak Bay on the Kodiak side (Fig. 21). The abundance along on the northern side, where historically the highest abundance of mature, pre-spawning walleye pollock are located, was substantially lower than in the mid-to late 1990s. The abundance just south of the Strait proper also was substantially lower than in recent years. Sporadic mid-water layers of juvenile walleye pollock were detected primarily in the northern portion of the survey area on the Kodiak Island side of the Strait (Fig. 22). Most walleye pollock were generally located within 50 m

of the seafloor over bottom depths exceeding 190 m, except for fish in mid-water layers, which were located well off bottom at about 150 m below the surface (Fig. 23).

The abundance estimate for Shelikof Strait of 180,900 t was the lowest in the time series (Fig. 24). The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 5.8%. The biomass in Shelikof Strait declined dramatically in the 1980s, falling from 2.8 million t in 1981 to 290,000 t in 1989. The biomass gradually rose in the 1990s, reaching 777,000 t in 1996, before declining to a then all-time low of 257,000 t in 2002. Since then, the population gradually increased to 356,000 t in 2005 before dropping to its current level (Table 7).

The 1999 year class, which represented the second largest contributor of 1-year old walleye pollock (4.5 billion fish) in the history of the Shelikof Strait area EIT surveys, has dominated biomass estimates since 2001(Figs. 25-26; Tables 13-16). The estimate of 53 million 1-year old walleye pollock in 2007 suggests a relatively weak 2006 year class.

The 10 trawl hauls conducted during 2007 were the lowest number conducted during the history of the Shelikof Strait survey (the previous low was 15 hauls made during the 2004 survey). Although bad weather prevented two trawls in the southernmost part of the survey area, the low number was mostly a result of the lower abundance as well as consistency in the length compositions.

Miller Freeman and *Oscar Dyson* inter-vessel comparison

MACE scientists conducted an inter-vessel comparison (IVC) experiment with the NOAA ships *Miller Freeman* and *Oscar Dyson* during the Shelikof Strait survey. The new, noise-reduced *Oscar Dyson* was designed to meet the ICES specification for underwater-radiated noise to minimize vessel avoidance during fish abundance surveys whereas the conventionally built *Miller Freeman* was not. The *Oscar Dyson* is expected to continue the Shelikof Strait time series of walleye pollock abundance estimates. Thus, the goal of the IVC work is to determine if walleye pollock react

differently to these two vessels. The results will be used to determine the best strategy for combining survey data from these two vessels.

Both vessels continuously collected acoustic backscatter at 18, 38, 120 and 200 kHz while traveling in close proximity to one another. The experimental design required the vessels to travel in two different survey configurations: either traveling alongside one another at a distance of 0.7 nmi along survey tracklines, which allowed for standard survey operations without compromising the data for use in stock assessment, or with one vessel following the other at a distance of 1 nmi with a 0.1-nmi offset to avoid turbulence generated by the lead vessel. Acoustic data from both vessels were collected over a wide range of walleye pollock densities and conditions typical of acoustic surveys in Shelikof Strait. Analysis of these data is in progress. Further fieldwork comparing the two vessels is planned for winter 2008 in the Shumagin Islands area and in Sanak Trough.

Gear Testing

Following the Shelikof Strait survey, 9 AWT trawls were conducted as part of a net selectivity experiment (Table 10). Pocket nets attached to the outside of the forward and intermediate areas of the trawl captured a higher ratio of age-1 to older walleye pollock than was observed in the codend, suggesting that a substantial amount of age-1 walleye pollock are filtered out of the trawl. Further analysis is underway.

Shelf Break Area Near Chirikof Island

Physical Oceanography

Surface water temperatures ranged from 3.0º to 3.5º C with a mean of 3.3º C (Fig. 27). Mean surface temperatures were cooler than in 2004 (4.8º C), 2005 (4.4º C), and 2006 (4.3º C). Temperatures at the depths where most adult walleye pollock biomass occurred (300-330 m) ranged

from 4.7º to 5.1º C with a mean of 4.9º C, which was similar to 2004 (4.7º C), 2005 (4.8º C), and 2006 (4.8º C).

Trawl Samples

Biological data and specimens were collected along the Gulf of Alaska shelf break near Chirikof Island from five AWT trawl hauls (Tables 2, 10; Fig. 2). No bottom trawls were conducted in this area. Pacific ocean perch (POP, *Sebastes alutus*) and walleye pollock were the most abundant species by weight, comprising 65.1% and 32.3%, respectively, of the catch (Table 17). Most of the POP were caught in haul 22. By number, POP, walleye pollock, and myctophids contributed 77.9%, 12.2%, and 4.8% of the catch, respectively.

Most walleye pollock captured ranged from 45 to 65 cm FL with a mode of 54 cm FL (Fig. 28). As was typical for this survey, no juvenile walleye pollock were captured.

The unweighted maturity composition in the Chirikof Island area for males longer than 40 cm FL was 0% immature, 1% developing, 49% mature pre-spawning, 49% spawning, and 1% spent (Fig. 29a). The maturity composition of females longer than 40 cm FL was 0% immature, 1% developing, 96% pre-spawning, 3% spawning, and 0% spent (Fig. 29b). The high percentage of pre-spawning females indicates that peak spawning had not occurred. Because of the lack of fish shorter than 40 cm FL, a logistic model could not be fitted to the female maturity-at-length data (Fig. 29c). The average GSI for pre-spawning females of 0.20 (Fig. 29d) was higher than any previous surveys, which have ranged from 0.14 to 0.18.

Distribution and Abundance

Acoustic data were collected along 300 km (162 nmi) of tracklines. Most of the echosign attributed to walleye pollock occurred in midwater layers between 275 and 330 m depth southwest of the mouth of Barnabas Trough over bottom depths of 300-600 m (Figs. 21, 30). Substantial acoustic

backscattering attributed to myctophids and other micronekton species occurred offshore at about 200-300 m depth. This myctophid scattering layer, which occurred mostly over bottom depths from 800 m to deeper than 1,500 m, may have obscured low densities of walleye pollock.

The abundance estimate for the Chirikof Island survey of 36,600 t was less than the 2006 and 2005 estimates of 69,000 t and 77,000 t, respectively, but greater than the 2004 and 2003 estimates of 30,000 and 31,000 t, respectively (Table 7). The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 6.7%. Because of the absence of age-1 and age-2 walleye pollock during these surveys, forecasts of future walleye pollock abundance are not possible.

Marmot Bay

Physical Oceanography

Surface water temperatures ranged from 1.9º to 2.7º C with a mean of 2.3º C (Fig. 31). Temperatures at the depths where most adult walleye pollock biomass occurred (50-200 m) ranged from 1.9º to 2.8º C with a mean of 2.6º C.

Trawl Samples

Biological data and specimens were collected from 3 AWT trawl hauls and 1 bottom trawl (Tables 2, 10; Fig. 2). Walleye pollock was the most abundant species by weight in the AWT hauls, comprising 95.9% of the catch (Table 18). By numbers, walleye pollock and eulachon contributed 79.4% and 17.4% of the catch, respectively. Walleye pollock and arrowtooth flounder comprised 59.7% and 28.3%, respectively, by weight of the single bottom haul (Table 19). Unidentified shrimp, walleye pollock, and eulachon were the most abundant species by number, comprising 56.9%, 25.6% and 9.4%, respectively. Age-1 and age-2 walleye pollock dominated AWT trawl

haul catches (Fig. 32a). Adults dominated the single bottom trawl catch, although younger fish were present as well (Fig. 32b).

The unweighted maturity composition in Marmot Bay for males longer than 40 cm FL was 0% immature, 56% developing, 29% mature pre-spawning, 15% spawning, and 0% spent (Fig. 33a). The maturity composition of females longer than 40 cm FL was 0% immature, 75% developing, 25% pre-spawning, 0% spawning, and 0% spent (Fig. 33b). The low percentage of spawning and spent females indicates that peak spawning had not occurred. Because of a low sample size, a logistic model could not be fitted to the female maturity-at-length data (Fig. 33c). The average GSI for pre-spawning females was 0.13 (Fig. 33d).

Distribution and Abundance

Acoustic data were collected along 300 km (162 nmi) of tracklines. Most of the echosign attributed to walleye pollock occurred in juvenile midwater layers northwest of Spruce Island between 30 and 175 m depth over bottom depths of 100 to 200 m (Figs. 21-22). A small amount of acoustic backscattering attributed to primarily adult walleye pollock was detected near the southern ends of transects north of Spruce Island near the sea floor over bottom depths of 125-275 m depth.

The abundance estimate for Marmot Bay was 3,600 t. The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 5.0%.

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SCIENTIFIC PERSONNEL

Shumagin Island, Sanak Trough, and Morzhovoi Bay Surveys

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Scott Furnish	Computer Spec.	AFSC
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Table 1.--Number of biological samples and measurements collected during the winter 2007 echo integration-trawl survey of walleye pollock in the Shumagin Islands area (hauls 1-9), Sanak Trough (hauls 10-12), and Morzhovoi Bay (haul 13) in the Gulf of Alaska.

	Walleye pollock					
Haul No.	Lengths	Weights and maturity	Ovaries weighed	Otoliths	Eulachon lengths	Capelin lengths
1	239	--	--	--	105	83
2	174	32	--	32	18	2
3	182	45	18	45	5	5
4	97	19	2	19	44	20
5	235	108	9	65	25	55
6	118	108	1	55	35	27
7	186	55	13	55	9	8
8	330	110	3	50	36	--
9	302	117	--	48	--	--
10	336	59	--	59	--	--
11	341	58	--	58	--	--
12	311	51	--	51	--	--
13	323	81	--	--	--	--
Totals	3,174	843	46	537	277	200

Table 2.--Number of biological samples and measurements collected during the winter 2007 echo integration-trawl survey of walleye pollock of the Shelikof Strait area (hauls 1-10), dedicated pocket net trawls (hauls 11-19), the Gulf of Alaska shelf break near Chirikof Island (hauls 20-24), and Marmot Bay (hauls 25-28).

Haul No.	Lengths	Weights and maturity	Ovaries weighed	Otoliths
1	493	135	6	135
2	342	74	5	74
3	449	16	6	16
4	408	79	4	79
5	527	35	4	35
6	443	134	4	74
7	603	180	27	101
8	420	139	43	62
9	246	30	--	--
10	408	124	4	100
11	153	--	--	--
12	248	--	--	--
13	162	--	--	--
14	174	--	--	--
15	183	--	--	--
16	185	--	--	--
17	303	--	--	--
18	217	--	--	--
19	233	--	--	--
20	108	75	4	72
21	152	51	38	51
22	5	--	--	--
23	334	101	65	41
24	138	70	29	50
25	210	89	5	37
26	240	67	4	67
27	369	67	3	67
28	376	40	4	40
Totals	8,129	1,506	255	1,101

Table 3.--Simrad ER60 38 kHz acoustic system description and settings used during the late winter/early spring 2007 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.

		Calibrations			
	Survey system settings	7-Feb Three Saints Bay Alaska	2-Mar Captains Bay, Alaska	9-Mar Uganik Bay, Alaska	23-Mar Uyak 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:	21.9	--	--	--	--
2-way beam angle (dB):	-21.0	--	--	--	--
Gain (dB)	26.41	26.43	26.41	26.40	26.43
s_a correction (dB)	-0.57	-0.58	-0.57	-0.58	-0.60
3 dB beamwidth (deg)					
Along:	7.00	7.06	7.00	7.04	7.02
Athwart:	7.08	7.04	7.08	6.97	7.00
Angle offset (deg)					
Along:	0.03	0.02	0.03	0.03	0.02
Athwart:	0.02	0.00	0.02	0.03	0.02
Post-processing s_v threshold (dB):	-70	--	--	--	--
Standard sphere TS (dB)	--	-42.13	-42.14	-42.14	-42.10
Sphere range from transducer (m):	--	21.57	19.41	18.91	20.12
Absorption coefficient (dB/m):	0.0099	0.0099	0.0099	0.0098	0.0098
Sound velocity (m/s)	1466.0	1459.1	1460.7	1460.2	1455.8
Water temp at transducer (^{o}C):	--	3.0	3.1	3.2	2.3

Note: Gain and beam pattern terms are defined in the "Operator Manual for Simrad ER60 Scientific echo sounder application (2004)," which is available from Simrad Strandpromenaden 50, Box 111, N-3191 Horten, Norway.

Table 4.--Summary of trawl and catch data from the 2007 walleye pollock echo integration-trawl surveys of the Shumagin Islands area (hauls 1-9), Sanak Trough (hauls 10-12), and Morzhovoi Bay (haul 13) in the Gulf of Alaska.

Haul	Gear[1]	Date	Time	Duration	Start position		Depth (m)		Temp. (deg. C)		Pollock catch		Other catch	
no.	type		(GMT)	(minutes)	Lat. (N)	Long. (W)	footrope	bottom	footrope	surface	kg	number	kg	number
1	AWT	8 Feb	23:41	8	55 13.46	158 38.39	157	198	3.8	3.1	97	1,658	37	1,931
2	AWT	9 Feb	1:05	9	55 15.04	159 4.42	190	193	3.5	3.3	310	6,215	1	21
3	AWT	9 Feb	12:57	5	55 28.95	159 51.22	120	162	3.2	3.2	380	6,620	2	119
4	PNE	9 Feb	22:29	10	55 40.35	159 53.15	129	129	3.6	3.1	8	294	90	1,098
5	AWT	10 Feb	3:54	15	55 17.75	160 11.71	125	227	3.6	3.3	217	819	20	835
6	AWT	10 Feb	8:58	4	55 10.12	160 20.62	167	184	3.7	3.3	47	2,235	14	847
7	AWT	10 Feb	19:53	6	55 30.67	160 20.91	124	167	--	--	288	3,268	2	133
8	AWT	11 Feb	3:02	13	55 34.37	160 19.82	174	185	3.2	3.0	526	5,913	22	239
9	AWT	11 Feb	4:40	20	55 34.25	160 11.28	157	180	3.3	3.2	661	9,387	12	318
10	PNE[2]	11 Feb	23:57	5	54 36.94	162 38.52	92	110	3.1	3.1	421	336	24	5
11	PNE[2]	12 Feb	3:50	1	54 40.91	162 34.73	115	132	3.3	3.0	562	437	14	5
12	PNE[2]	12 Feb	8:51	5	54 39.00	162 36.76	122	136	3.4	2.8	1,049	699	72	22
13	PNE	12 Feb	16:00	15	54 57.51	162 58.19	105	105	2.7	2.3	2,055	1,773	217	1,032

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

[2]PNE was fished in midwater.

Table 5.--Summary of catch by species in eight bottom trawls conducted during the 2007 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*	2,525.5	95.8	36,115	89.0
eulachon	*Thaleichthys pacificus*	53.0	2.0	2,261	5.6
arrowtooth flounder	*Atheresthes stomias*	19.2	0.7	24	0.1
capelin	*Mallotus villosus*	12.0	0.5	1,987	4.9
Pacific cod	*Gadus macrocephalus*	11.2	0.4	3	< 0.1
flathead sole	*Hippoglossoides elassodon*	3.1	0.1	11	< 0.1
rock sole sp.	*Lepidopsetta* sp.	2.9	0.1	6	< 0.1
lumpsucker unident.	*Aptocyclus* sp.	2.0	0.1	2	< 0.1
smooth lumpsucker	*Aptocyclus ventricosus*	1.6	0.1	1	< 0.1
Pacific herring	*Clupea pallasi*	1.6	0.1	26	0.1
dusky rockfish	*Sebastes ciliatus*	1.1	< 0.1	1	< 0.1
squid unident.	Teuthoidea (order)	0.9	< 0.1	39	0.1
shrimp unident.	Decapoda (order)	0.8	< 0.1	79	0.2
rex sole	*Glyptocephalus zachirus*	0.3	< 0.1	1	< 0.1
jellyfish unident.	Scyphozoa	0.2	< 0.1	2	< 0.1
Total		2,635.5		40,558	

Table 6.--Summary of catch by species in one bottom trawl conducted during the 2007 walleye pollock echo integration-trawl survey of the Shumagin Islands area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
longnose skate	*Raja rhina*	31.5	32.2	2	0.1
flathead sole	*Hippoglossoides elassodon*	24.4	24.9	157	11.3
arrowtooth flounder	*Atheresthes stomias*	18.1	18.5	149	10.7
walleye pollock	*Theragra chalcogramma*	7.9	8.0	294	21.1
Pacific cod	*Gadus macrocephalus*	4.7	4.8	1	0.1
shrimp unident.	Decapoda (order)	3.3	3.3	684	49.1
rock sole sp.	*Lepidopsetta* sp.	1.9	1.9	3	0.2
rex sole	*Glyptocephalus zachirus*	1.6	1.6	6	0.4
eulachon	*Thaleichthys pacificus*	1.5	1.5	44	3.2
sablefish	*Anoplopoma fimbria*	0.9	0.9	4	0.3
black rockfish	*Sebastes melanops*	0.8	0.8	1	0.1
Pacific herring	*Clupea pallasi*	0.8	0.8	18	1.3
Chionoecetes bairdi	*Chionoecetes bairdi*	0.3	0.3	2	0.1
spinyhead sculpin	*Dasycottus setiger*	0.2	0.2	4	0.3
English sole	*Parophrys vetulus*	0.2	0.2	1	0.1
capelin	*Mallotus villosus*	0.1	0.1	20	1.4
hermit crab unident.	Paguridae	0.1	0.1	1	0.1
eelpout unident.	Zoarcidae	0.0	< 0.1	1	0.1
Total		97.9		1,392	

Table 7.--Estimates of walleye pollock biomass (in metric tons) and relative estimation error for the Shelikof Strait area, 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	374,800							
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	432,700	4.5%	119,600					
2002	256,700	6.9%	135,600	27.1%	82,100	12.2%		
2003	317,300	5.2%	67,300	17.2%	30,900	20.7%	81,500	21.6%
2004	330,800	9.2%	no survey		30,400	20.4%	no survey	
2005	356,100	4.1%	52,000	11.4%	77,000	20.7%	67,800	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%

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

[2] Survey was conducted after peak spawning had occurred.

[3] Partial survey.

Table 8.--Summary of catch by species in three bottom trawls conducted during the 2007 walleye pollock echo integration-trawl survey of Sanak Trough. Note: all three hauls were conducted in midwater.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	2,031.5	94.8	1,472	97.9
Pacific cod	*Gadus macrocephalus*	56.8	2.7	8	0.5
shark unident.	Squaliformes	42.0	2.0	1	0.1
arrowtooth flounder	*Atheresthes stomias*	5.5	0.3	6	0.4
rock sole sp.	*Lepidopsetta* sp.	5.0	0.2	10	0.7
jellyfish unident.	Scyphozoa	0.4	< 0.1	1	0.1
flathead sole	*Hippoglossoides elassodon*	0.4	< 0.1	2	0.1
Pacific sandfish	*Trichodon trichodon*	0.1	< 0.1	1	0.1
sturgeon poacher	*Podothecus acipenserinus*	0.1	< 0.1	1	0.1
eulachon	*Thaleichthys pacificus*	0.0	< 0.1	1	0.1
rex sole	*Glyptocephalus zachirus*	0.0	< 0.1	1	0.1
Total		2,141.9		1,504	

Table 9.--Summary of catch by species in one bottom trawl conducted during the 2007 walleye pollock echo integration-trawl survey of Morzhovoi Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	2,055.2	90.5	1,773	63.2
flathead sole	*Hippoglossoides elassodon*	104.7	4.6	759	27.1
yellowfin sole	*Limanda aspera*	42.4	1.9	60	2.1
starry flounder	*Platichthys stellatus*	22.8	1.0	17	0.6
arrowtooth flounder	*Atheresthes stomias*	21.0	0.9	174	6.2
Pacific cod	*Gadus macrocephalus*	9.1	0.4	3	0.1
Alaska plaice	*Pleuronectes quadrituberculatus*	6.2	0.3	7	0.2
Chionoecetes bairdi	*Chionoecetes bairdi*	3.4	0.1	10	0.4
rock sole sp.	*Lepidopsetta* sp.	2.2	0.1	10	0.4
Pacific halibut	*Hippoglossus stenolepis*	1.6	0.1	2	0.1
rex sole	*Glyptocephalus zachirus*	1.4	0.1	1	< 0.1
sculpin unident.	Cottidae	1.0	< 0.1	1	< 0.1
eelpout unident.	eelpout unident.	0.9	< 0.1	2	0.1
sturgeon poacher	*Podothecus acipenserinus*	0.3	< 0.1	3	0.1
Total		2,272.0		2,805	

Table 10.--Summary of trawl and catch data from the 2007 walleye pollock echo integration-trawl surveys of the Shelikof Strait area (hauls 1-10), net selectivity study (hauls 11-19), the Gulf of Alaska shelf break near Chirikof Island (hauls 20-24), and Marmot Bay (hauls 25-28).

Haul	Gear[1]	Date	Time	Duration	Start position		Depth (m)		Temp. (deg. C)		Pollock catch		Eulachon catch		Other catch
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	footrope	bottom	headrope	surface	kg	number	kg	number	kg
1	AWT	13-Mar	21:24	15	55 58.72	156 25.68	190	205	4.2	2.3	283.8	1,391	156.6	5,545	7
2	AWT	16-Mar	3:52	14	56 26.49	156 5.01	229	261	3.9	2.5	379.5	1,121	96.9	3,009	27
3	PNE	16-Mar	22:03	12	56 39.09	155 46.63	261	261	3.5	2.3	50.2	449	6.2	227	29
4	AWT	18-Mar	9:34	20	57 3.20	155 51.77	257	304	3.9	2.3	872.3	2,226	239.6	9,497	33
5	AWT	18-Mar	18:29	5	57 9.61	154 57.67	157	202	4.3	3.0	556.1	2,557	132.8	3,169	41
6	AWT	19-Mar	19:06	14	57 34.98	154 54.78	215	228	3.7	1.9	482.9	2,841	576.6	16,530	66
7	AWT	19-Mar	23:48	6	57 46.20	154 59.59	258	315	4.5	2.5	732.9	1,680	35.5	1,388	24
8	AWT	20-Mar	8:42	3	57 51.03	154 48.01	210	279	4.2	2.7	556.0	1,295	31.3	1,335	3
9	AWT	21-Mar	20:57	15	58 12.11	153 22.73	164	204	2.7	2.4	574.2	4,279	0.0	0	1
10	AWT	23-Mar	9:55	17	57 39.96	154 44.54	188	222	4.2	2.8	455.4	611	40.5	2,199	20
11	AWT	24-Mar	7:49	20	57 11.93	154 59.71	174	202	3.5	2.5	78.1	528	24.1	1,808	5
12	AWT	24-Mar	20:04	10	56 27.74	156 10.62	264	274	2.7	2.0	395.4	3,413	298.4	11,436	12
13	AWT	24-Mar	22:57	10	56 27.12	156 8.76	259	273	2.1	2.2	397.6	2,177	308.5	11,171	9
14	AWT	25-Mar	2:38	10	56 27.42	156 9.58	264	276	2.6	2.1	580.5	3,728	808.2	31,141	17
15	AWT	25-Mar	5:59	8	56 27.27	156 8.26	252	274	2.5	2.0	264.8	1,605	201.8	11,483	3
16	AWT	25-Mar	9:38	10	56 27.37	156 8.87	264	275	2.5	2.1	362.9	1,797	167.8	9,682	1
17	AWT	25-Mar	13:08	10	56 27.37	156 7.78	264	275	2.5	2.1	395.0	2,701	510.4	17,824	8
18	AWT	25-Mar	16:57	10	56 27.89	156 9.84	264	277	2.5	2.1	524.2	3,241	390.2	21,761	10
19	AWT	25-Mar	20:08	10	56 27.45	156 7.74	262	273	2.7	2.2	712.8	2,838	127.6	7,996	12
20	AWT	26-Mar	8:53	30	55 58.44	154 38.01	415	598	4.7	3.0	117.6	108	0.0	0	24
21	AWT	26-Mar	14:27	7	55 55.40	154 15.54	284	397	5.0	3.3	1,002.9	594	0.2	3	3
22	AWT	26-Mar	19:00	6	55 57.45	153 58.94	320	352	4.8	3.2	41.7	30	0.0	0	0
23	AWT	27-Mar	5:09	12	56 8.21	153 25.23	334	452	5.0	3.3	449.8	334	0.4	8	31
24	AWT	27-Mar	10:02	10	56 16.74	153 3.45	325	616	5.2	3.4	171.9	138	0.0	1	85
25	AWT	28-Mar	4:36	4	57 58.10	152 36.20	118	147	1.9	1.9	119.9	1,070	0.5	39	4
26	AWT	28-Mar	11:59	6	58 2.97	152 22.88	173	252	2.8	2.8	178.1	2,409	24.8	1,677	2
27	AWT	28-Mar	15:15	5	57 58.59	152 17.35	226	267	2.7	2.6	478.5	4,353	0.6	24	1
28	PNE	28-Mar	18:55	14	57 58.32	152 16.08	287	287	--	2.6	636.3	630	6.8	231	423

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

Table 11.--Summary of catch by species in nine midwater trawls conducted during the 2007 walleye pollock echo integration-trawl survey of the Shelikof Strait

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	4,893.2	76.2	18,001	28.9
eulachon	*Thaleichthys pacificus*	1,309.9	20.4	42,672	68.5
majestic squid	*Berryteuthis magister*	121.3	1.9	185	0.3
arrowtooth flounder	*Atheresthes stomias*	47.1	0.7	81	0.1
chinook salmon	*Oncorhynchus tshawytscha*	27.1	0.4	12	<0.1
squid unident.	Teuthoidea (order)	8.6	0.1	369	0.6
chum salmon	*Oncorhynchus keta*	3.5	<0.1	2	<0.1
northern smoothtongue	*Leuroglossus schmidti*	3.1	<0.1	152	0.2
rougheye rockfish	*Sebastes aleutianus*	2.5	<0.1	3	<0.1
smooth lumpsucker	*Aptocyclus ventricosus*	2.2	<0.1	2	<0.1
Pacific herring	*Clupea pallasi*	1.4	<0.1	35	<0.1
Pacific cod	*Gadus macrocephalus*	1.3	<0.1	1	<0.1
Pacific glass shrimp	*Pasiphaea pacifica*	0.8	<0.1	404	0.6
Pacific ocean perch	*Sebastes alutus*	0.7	<0.1	1	<0.1
shrimp unident.	Decapoda (order)	0.6	<0.1	252	0.4
jellyfish unident.	*Cyanea* sp.	0.6	<0.1	1	<0.1
sidestriped shrimp	*Pandalopsis dispar*	0.2	<0.1	39	<0.1
Myctophidae	Myctophidae	0.2	<0.1	27	<0.1
northern shrimp	*Pandalus borealis*	0.1	<0.1	27	<0.1
slender barracudina	*Lestidiops ringens*	0.1	<0.1	2	<0.1
Total		6,424.4		62,268	

Table 12.--Summary of catch by species in one bottom trawl conducted during the 2007 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*	50.2	59.0	449	60.3
arrowtooth flounder	*Atheresthes stomias*	21.6	25.4	17	2.3
eulachon	*Thaleichthys pacificus*	6.2	7.3	227	30.5
squid unident.	Teuthoidea (order)	4.0	4.7	8	1.1
rex sole	*Glyptocephalus zachirus*	1.8	2.2	1	0.1
flathead sole	*Hippoglossoides elassodon*	0.7	0.9	2	0.3
sidestripe shrimp	*Pandalopsis dispar*	0.5	0.6	38	5.1
northern smoothtongue	*Leuroglossus schmidti*	<0.1	<0.1	1	0.1
mud star	*Ctenodiscus crispatus*	<0.1	<0.1	1	0.1
Total		85.0		744	

Table 13.--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 because of mechanical problems. Note: 2007 age estimates are not yet available.

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	78	--	1	62	2,092	575	--	17	399	49	22	228	63	186	10,690	56	70	395	--	4,484	289	8	51	53	1,626	162
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	90	94	157	836
3	1,511	--	380	324	123	184	--	694	90	72	550	74	37	49	79	119	1,247	126	--	217	352	1,107	208	58	56	41
4	769	--	1,297	142	315	46	--	322	216	63	48	188	72	32	78	25	80	474	--	16	61	97	802	160	35	12
5	2,786	--	1,171	635	181	75	--	78	249	116	65	368	233	155	103	54	18	136	--	67	42	16	57	356	173	17
6	1,052	--	698	988	347	49	--	17	43	180	70	84	126	84	245	71	44	14	--	132	23	16	8	49	162	56
7	210	--	599	450	439	86	--	6	14	46	116	85	27	42	122	201	52	32	--	17	35	8	4	3	36	75
8	129	--	132	224	167	149	--	6	4	22	24	171	36	27	54	119	98	36	--	13	13	7	2	3	4	32
9	79	--	14	41	43	60	--	4	2	8	29	33	39	44	17	40	53	74	--	10	6	1	1	3	2	7
10	25	--	12	3	6	11	--	9	1	8	2	56	16	48	11	13	14	26	--	8	3	1	1	1	--	1
11	2	--	4	0	2	1	--	2	10	1	4	2	8	15	15	11	2	14	--	14	1	< 1	< 1	< 1	1	1
12	0	--	2	1	1	0	--	2	1	3	1	15	3	7	6	5	3	7	--	7	2	< 1	0	0	--	1
13	0	--	0	0	0	0	--	< 1	< 1	2	4	1	2	1	2	3	1	< 1	--	2	1	< 1	< 1	1	--	--
14	0	--	0	0	0	0	--	0	0	1	0	< 1	< 1	2	< 1	< 1	< 1	1	--	1	< 1	< 1	0	0	--	--
15	0	--	0	0	0	0	--	0	0	< 1	0	0	1	< 1	0	0	0	1	--	0	< 1	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	--	--
17	0	--	0	0	0	0	--	0	0	0	0	0	< 1	< 1	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	--	--
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	1,224	781	2,252	1,240

Table 14.--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 because of mechanical problems. Note: 2007 age estimates are not yet available.

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	1	--	< 1	1	24	4	--	< 1	4	< 1	< 1	3	1	2	114	1	1	4	--	57	2	< 1	1	1	18	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
3	342	--	117	83	41	40	--	130	21	15	85	16	11	14	23	24	195	28	--	60	60	164	43	14	17	11
4	255	--	529	78	159	17	--	91	86	23	13	60	34	20	41	12	28	153	--	9	25	29	222	78	19	5
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
6	496	--	455	684	253	41	--	9	27	120	54	68	90	75	220	73	53	12	--	107	24	16	7	37	119	63
7	133	--	332	331	353	76	--	6	12	36	106	92	28	48	116	212	61	39	--	17	40	9	5	4	29	87
8	92	--	94	161	138	140	--	6	4	24	23	194	43	34	55	132	120	47	--	17	18	8	2	5	4	43
9	68	--	11	36	35	58	--	5	3	9	36	36	46	64	19	48	67	95	--	15	8	2	3	5	3	10
10	19	--	12	3	6	11	--	11	1	11	3	71	21	68	15	17	20	33	--	11	5	1	1	1	--	1
11	1	--	5	0	2	2	--	2	12	1	6	3	10	21	20	16	3	21	--	22	2	1	< 1	1	1	2
12	0	--	1	1	1	0	--	3	1	4	1	21	4	10	7	7	5	10	--	11	3	1	0	0	--	1
13	0	--	0	0	0	0	--	< 1	< 1	2	7	1	3	2	3	4	1	< 1	--	4	1	< 1	< 1	1	--	--
14	0	--	0	0	0	0	--	0	0	1	0	1	1	4	1	< 1	1	1	--	2	1	< 1	0	0	--	--
15	0	--	0	0	0	0	--	0	0	< 1	0	0	1	< 1	0	0	0	1	--	0	< 1	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	--	--
17	0	--	0	0	0	0	--	0	0	0	0	0	< 1	1	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	--	--
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

Table 15.--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 because of mechanical problems.

Length	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 15.--Continued.

Length	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
Total	10,121	--	5,211	2,928	4,259	3,352	--	1,266	1,119	1,782	1,109	1,339	740	729	11,931	4,024	1,866	1,425	--	5,742	4,931	1,424	1,224	780	2,252	1,240	575

Table 16.--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 because of mechanical problems.

Length	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 16.--Continued.

Length	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 17.--Summary of catch by species in five midwater trawls conducted during the 2007 walleye pollock echo integration-trawl survey of the Gulf of Alaska shelf break near Chirikof Island.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
Pacific ocean perch	*Sebastes alutus*	3,595.2	65.1	7,458	77.9
walleye pollock	*Theragra chalcogramma*	1,783.9	32.3	1,204	12.6
Pacific grenadier	*Coryphaenoides acrolepis*	56.3	1.0	17	0.2
shortraker rockfish	*Sebastes borealis*	52.6	1.0	27	0.3
rougheye rockfish	*Sebastes aleutianus*	24.5	0.4	8	0.1
arrowtooth flounder	*Atheresthes stomias*	4.4	0.1	4	<0.1
Myctophidae	Myctophidae	4.1	0.1	461	4.8
northern smoothtongue	*Leuroglossus schmidti*	0.8	<0.1	42	0.4
eulachon	*Thaleichthys pacificus*	0.7	<0.1	12	0.1
shrimp unident.	Decapoda (order)	0.6	<0.1	275	2.9
squid unident.	Teuthoidea	0.2	<0.1	32	0.3
majestic squid	*Berryteuthis magister*	0.1	<0.1	1	<0.1
jellyfish unident.	Scyphozoa (class)	0.1	<0.1	26	0.3
lamprey unident.	Petromyzontiformes (order)	<0.1	<0.1	1	<0.1
comb jelly	Ctenophora (phylum)	<0.1	<0.1	2	<0.1
Total		5,523.4		9,570	

Table 18.--Summary of catch by species in three midwater trawls conducted during the 2007 walleye pollock echo integration-trawl survey of Marmot Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	776.4	95.9	7,832	79.4
eulachon	*Thaleichthys pacificus*	25.8	3.2	1,716	17.4
chinook salmon	*Oncorhynchus tshawytscha*	3.8	0.5	1	<0.1
Pacific herring	*Clupea pallasi*	2.3	0.3	67	0.7
shrimp unident.	Decapoda (order)	0.4	0.1	178	1.8
capelin	*Mallotus villosus*	0.3	<0.1	40	0.4
squid unident.	*Teuthoidea*	0.1	<0.1	9	0.1
arrowtooth flounder	*Atheresthes stomias*	<0.1	<0.1	1	<0.1
fish larvae unident.	fish larvae unident.	<0.1	<0.1	20	0.2
Total		809.2		9,864	

Table 19.--Summary of catch by species in one bottom trawl conducted during the 2007 walleye pollock echo integration-trawl survey of Marmot Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Theragra chalcogramma*	636.3	59.7	630	25.6
arrowtooth flounder	*Atheresthes stomias*	301.7	28.3	105	4.3
flathead sole	*Hippoglossoides elassodon*	44.4	4.2	69	2.8
Pacific halibut	*Hippoglossus stenolepis*	23.7	2.2	5	0.2
Sandpaper skate	*Bathyraja interrupta*	15.3	1.4	2	0.1
Longnose skate	*Raja rhina*	12.7	1.2	1	<0.1
shrimp unident.	Decapoda (order)	11.0	1.0	1,402	56.9
sablefish	*Anoplopoma fimbria*	7.0	0.7	3	0.1
eulachon	*Thaleichthys pacificus*	6.8	0.6	231	9.4
rex sole	*Glyptocephalus zachirus*	4.8	0.5	7	0.3
rougheye rockfish	*Sebastes aleutianus*	1.2	0.1	1	<0.1
Bairdi Tanner crab	*Chionoecetes bairdi*	1.2	0.1	2	0.1
Pacific herring	*Clupea pallasi*	0.3	<0.1	4	0.2
longsnout prickleback	*Lumpenella longirostris*	<0.1	<0.1	1	<0.1
spinyhead sculpin	*Dasycottus setiger*	<0.1	<0.1	1	<0.1
Total		1,066.4		2,464	

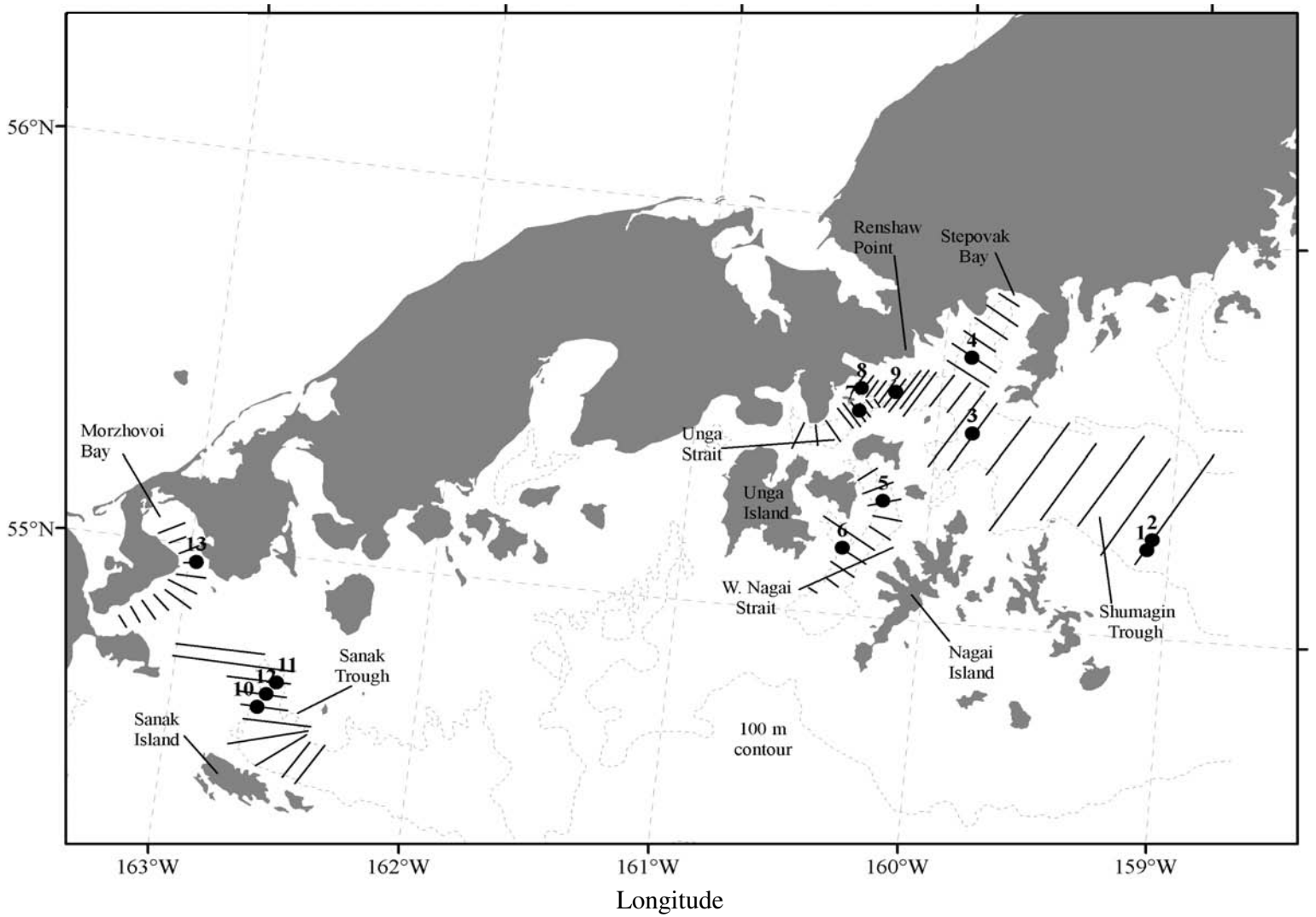

Figure 1.--Transect lines and distribution of trawls during the February 2007 echo integration-trawl surveys of the Shumagin Islands, Sanak Trough, and Morzhovoi Bay in the Gulf of Alaska.

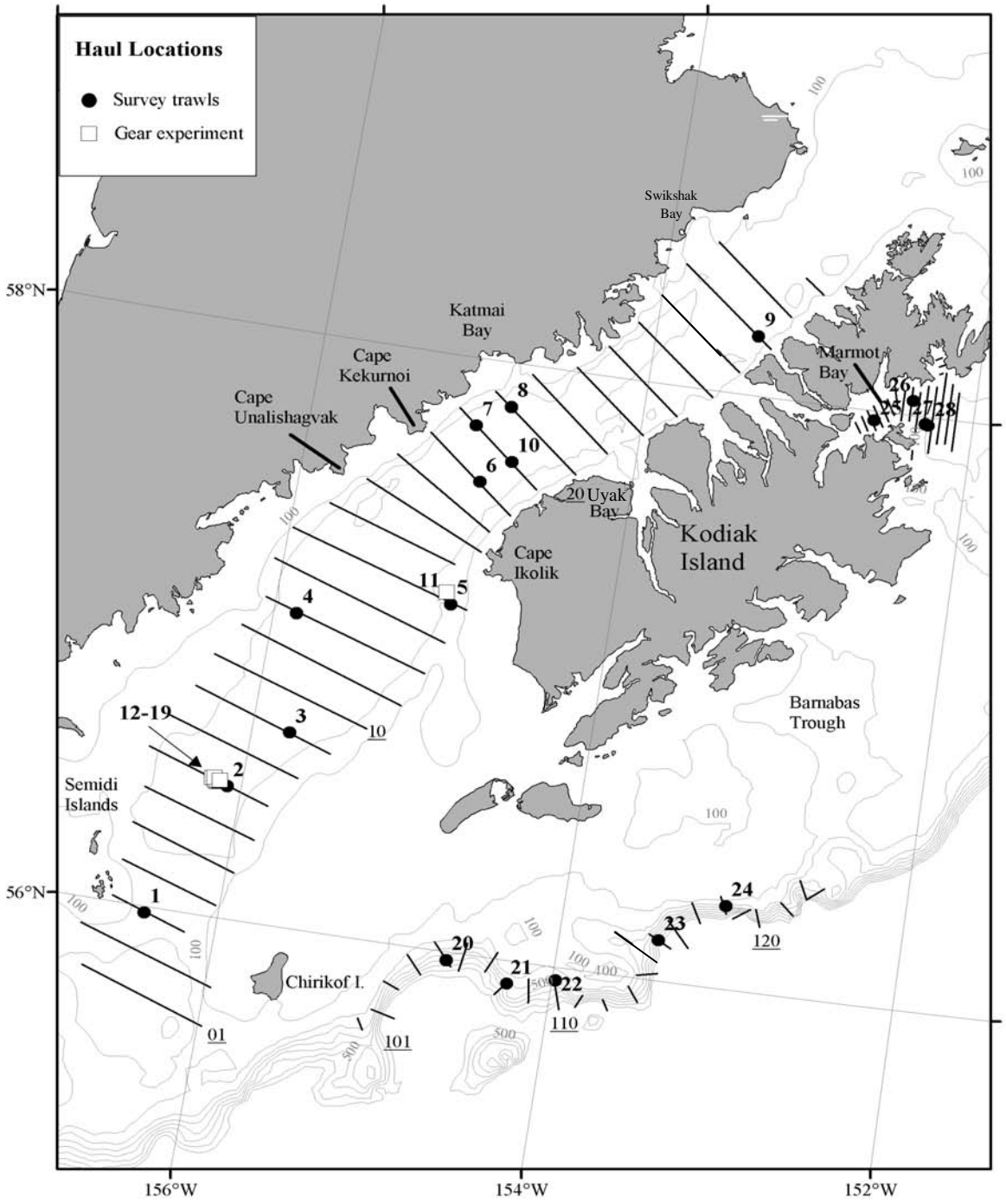

Figure 2.--Transect lines and distribution of trawls in the Shelikof Strait area, along the Gulf of Alaska shelf break near Chirikof Island, and Marmot Bay echo integration-trawl surveys, 11-29 March 2007.

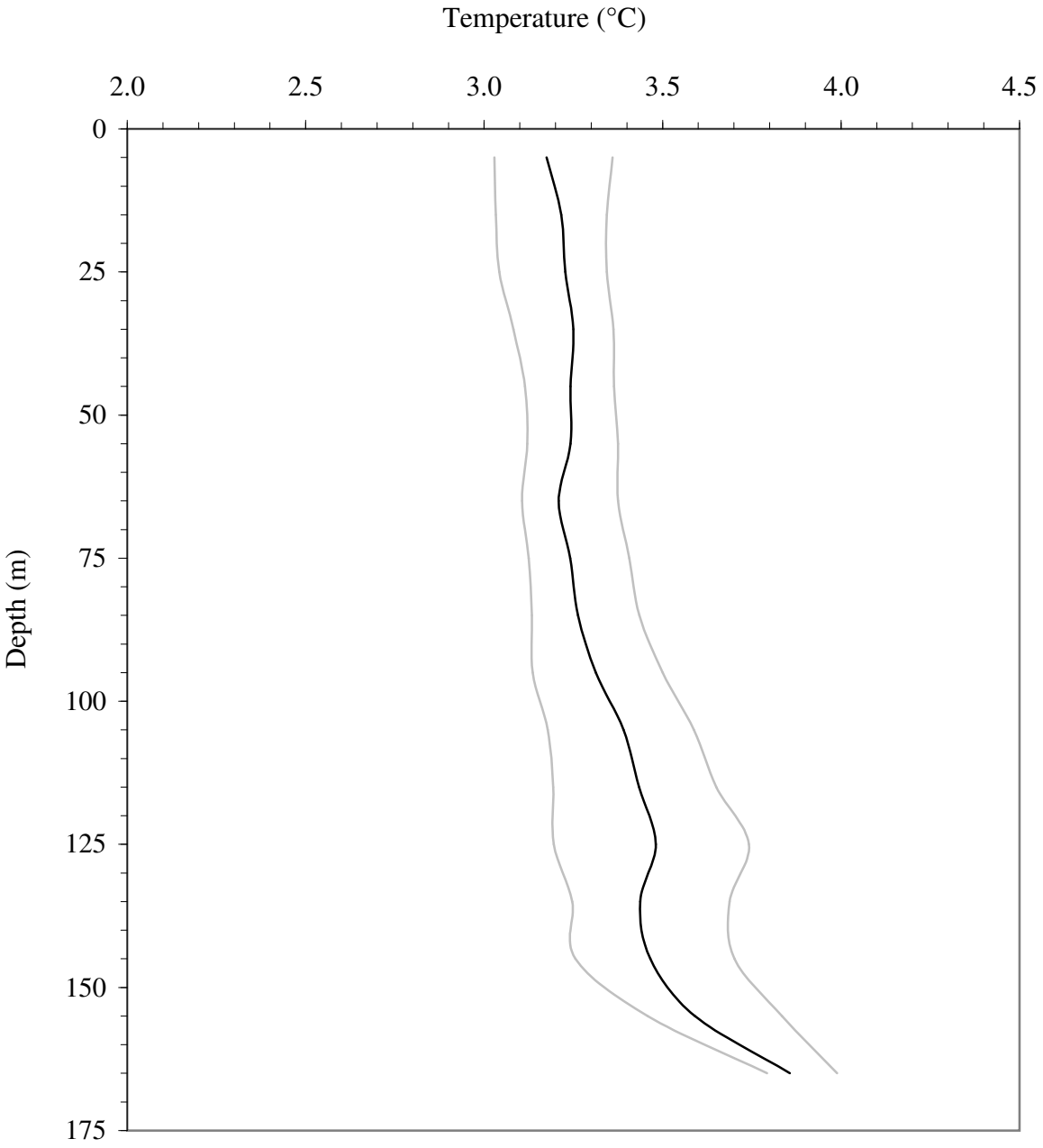

Figure 3.--Average temperature (°C) (black line) by 10-m depth intervals observed during the winter 2007 echo integration-trawl survey of walleye pollock in the Shumagin Islands area. The gray lines represent temperature ranges observed during the survey. Data were collected at 8 locations.

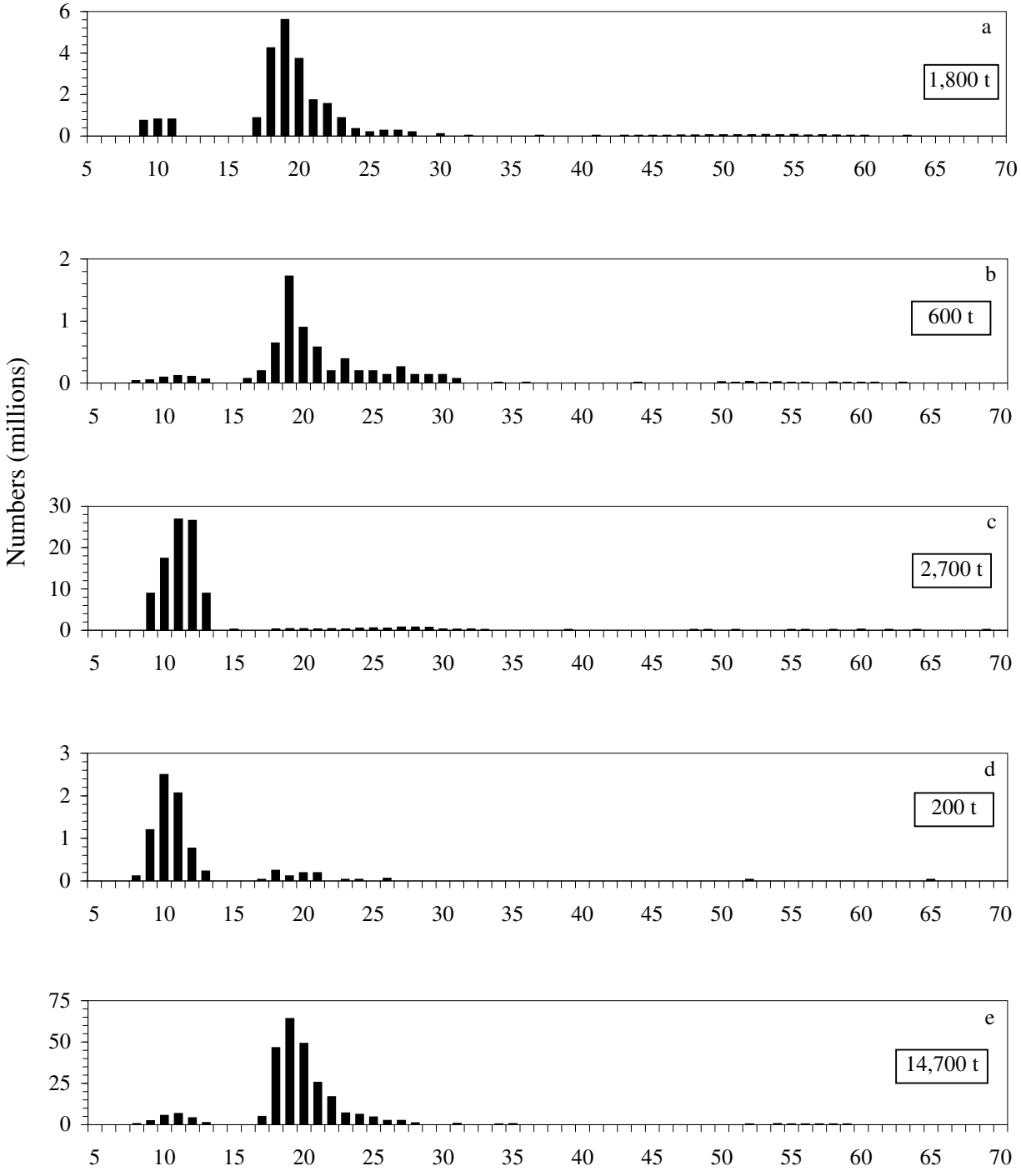

Figure 4.--Size distribution of walleye pollock (numbers) (a) off Renshaw Point, (b) in Unga Strait, (c) in West Nagai Strait, (d) in Stepovak Bay, and (e) in Shumagin Trough for the 2007 echo integration-trawl survey of the Shumagin Islands.

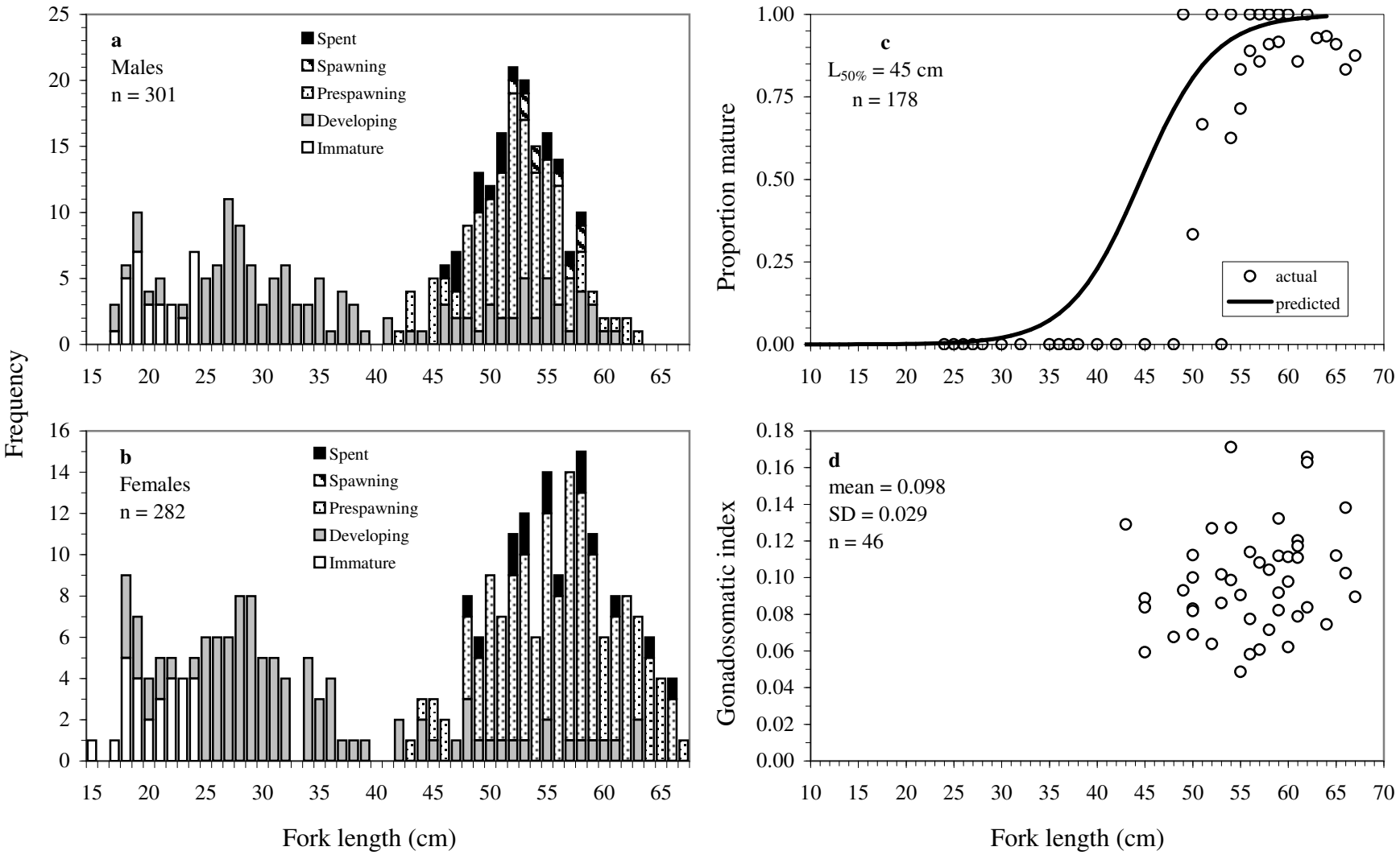

Figure 5.--Maturity stages for (a) male and (b) female pollock, (c) proportion mature by 1-cm size group for female walleye pollock and (d) gonadosomatic index for pre-spawning females examined during the 2007 echo integration-trawl survey of Shumagin Islands in the Gulf of Alaska.

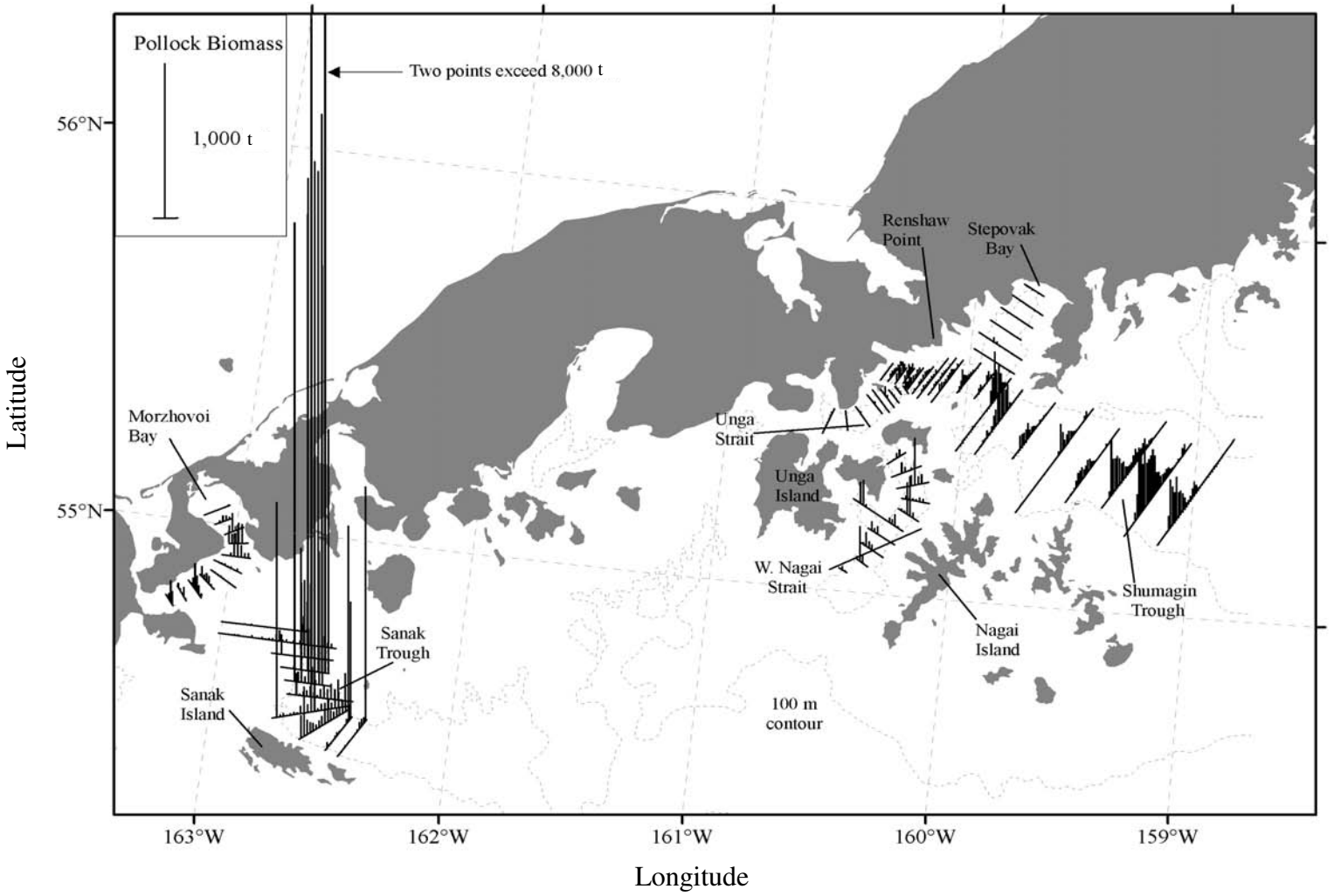

Figure 6.--Pollock biomass along tracklines during the February 2007 echo integration-trawl surveys of the Shumagin Islands, Sanak Trough, and Morzhovoi Bay in the Gulf of Alaska.

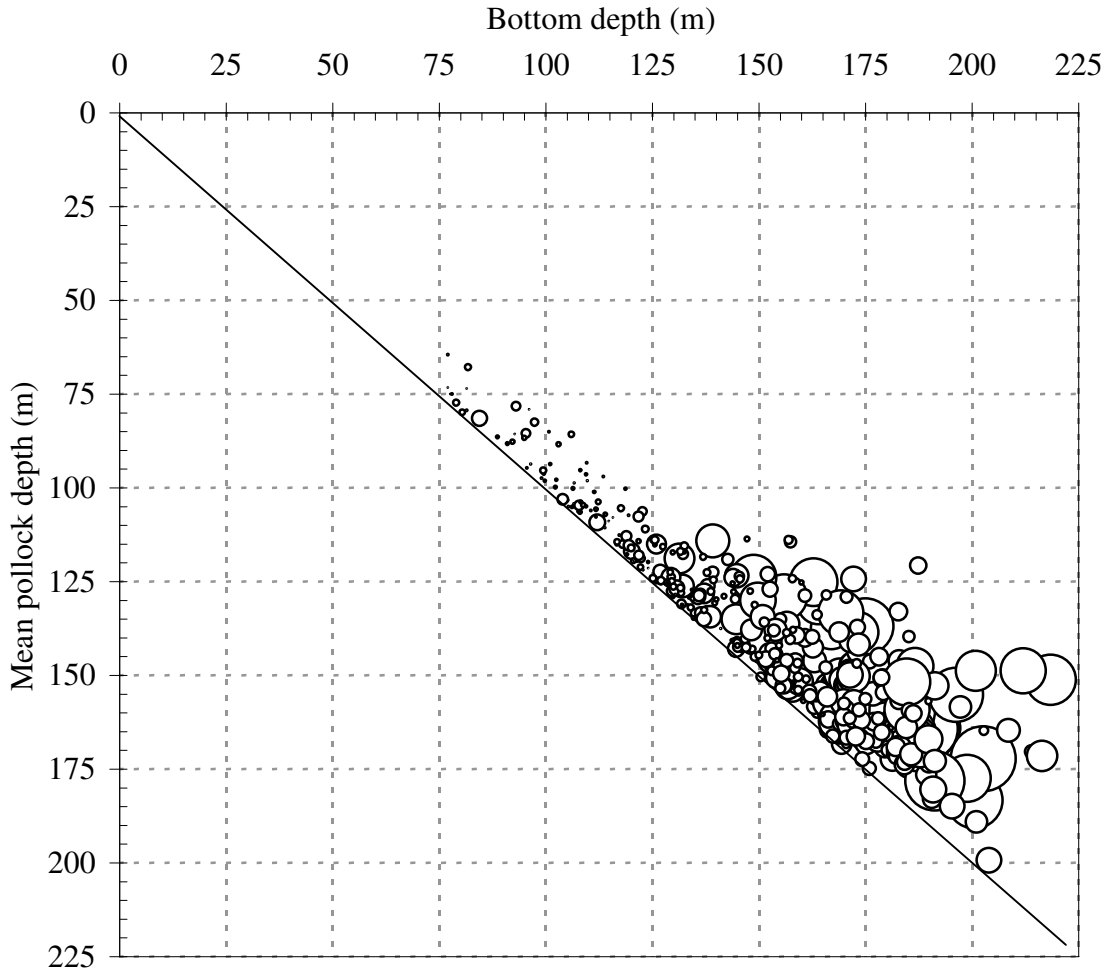

Figure 7.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for pollock observed during the winter 2007 echo integration-trawl survey of walleye pollock in the Shumagin Islands area. Bubble size is scaled to the maximum biomass.

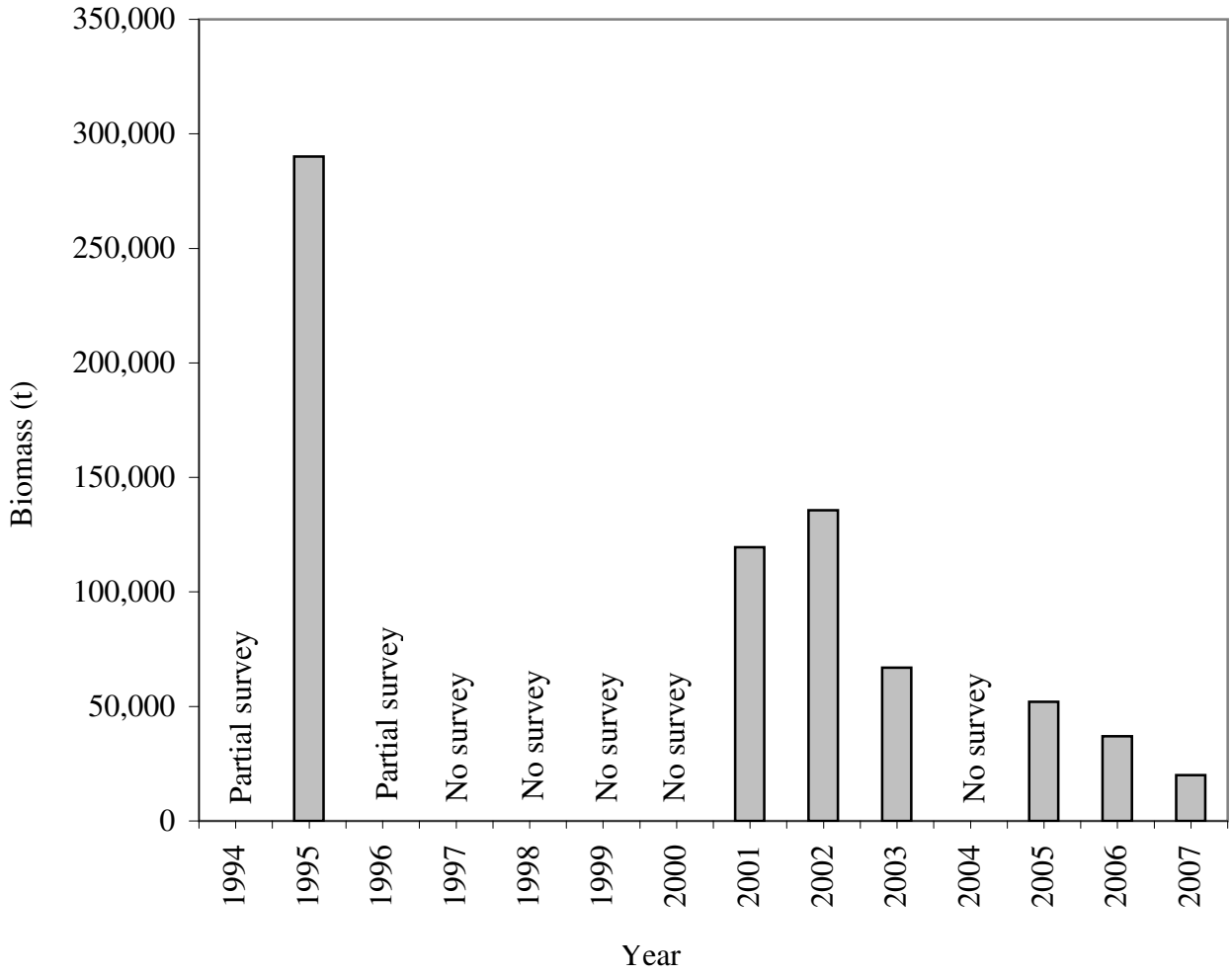

Figure 8.--Summary of annual pollock biomass estimates based on echo integration-trawl surveys of the Shumagin Islands area.

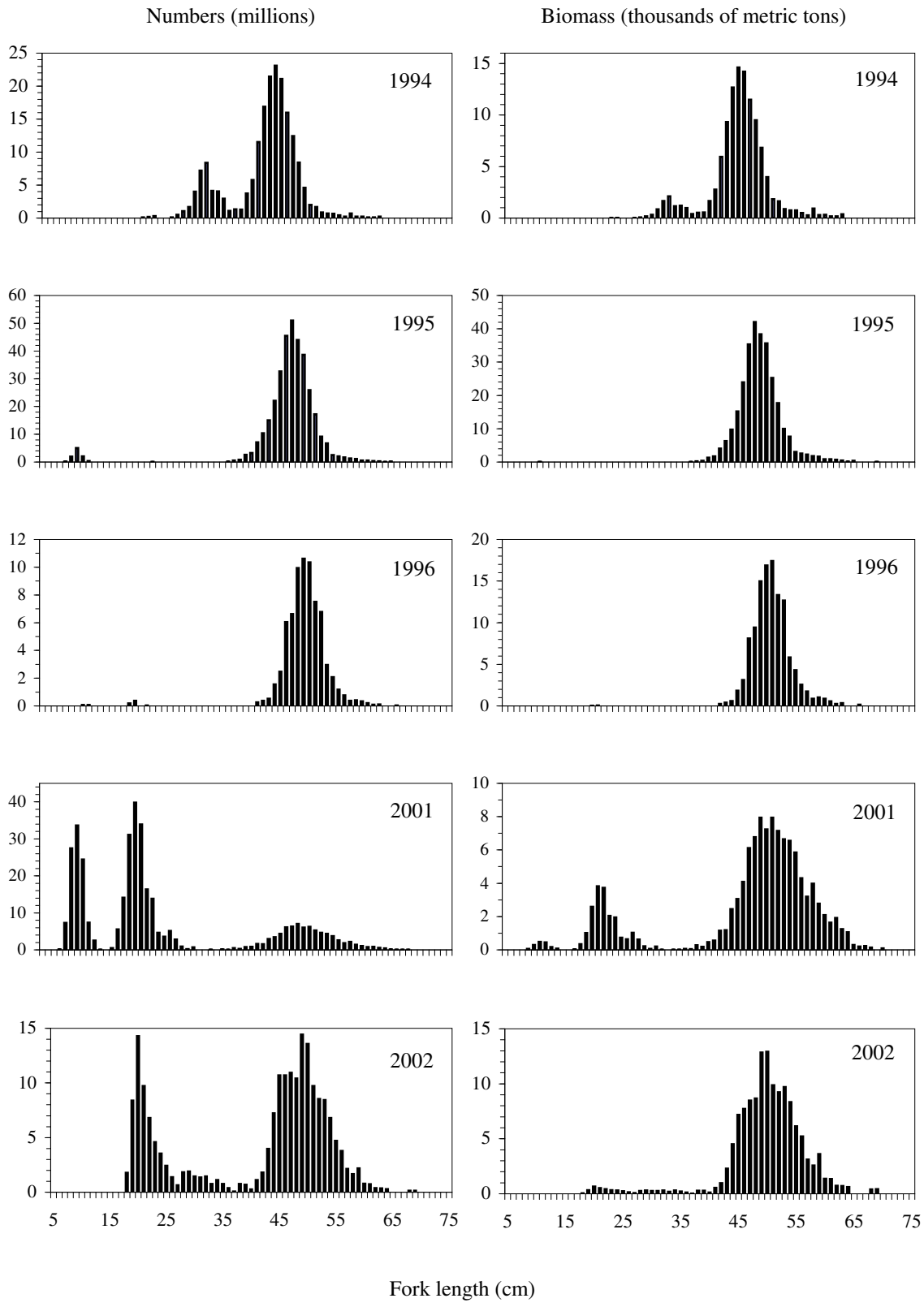

Figure 9.--Walleye pollock size composition estimates for the Shumagin Islands area based on echo integration-trawl surveys during 1994-96, 2001-03, and 2005-07.

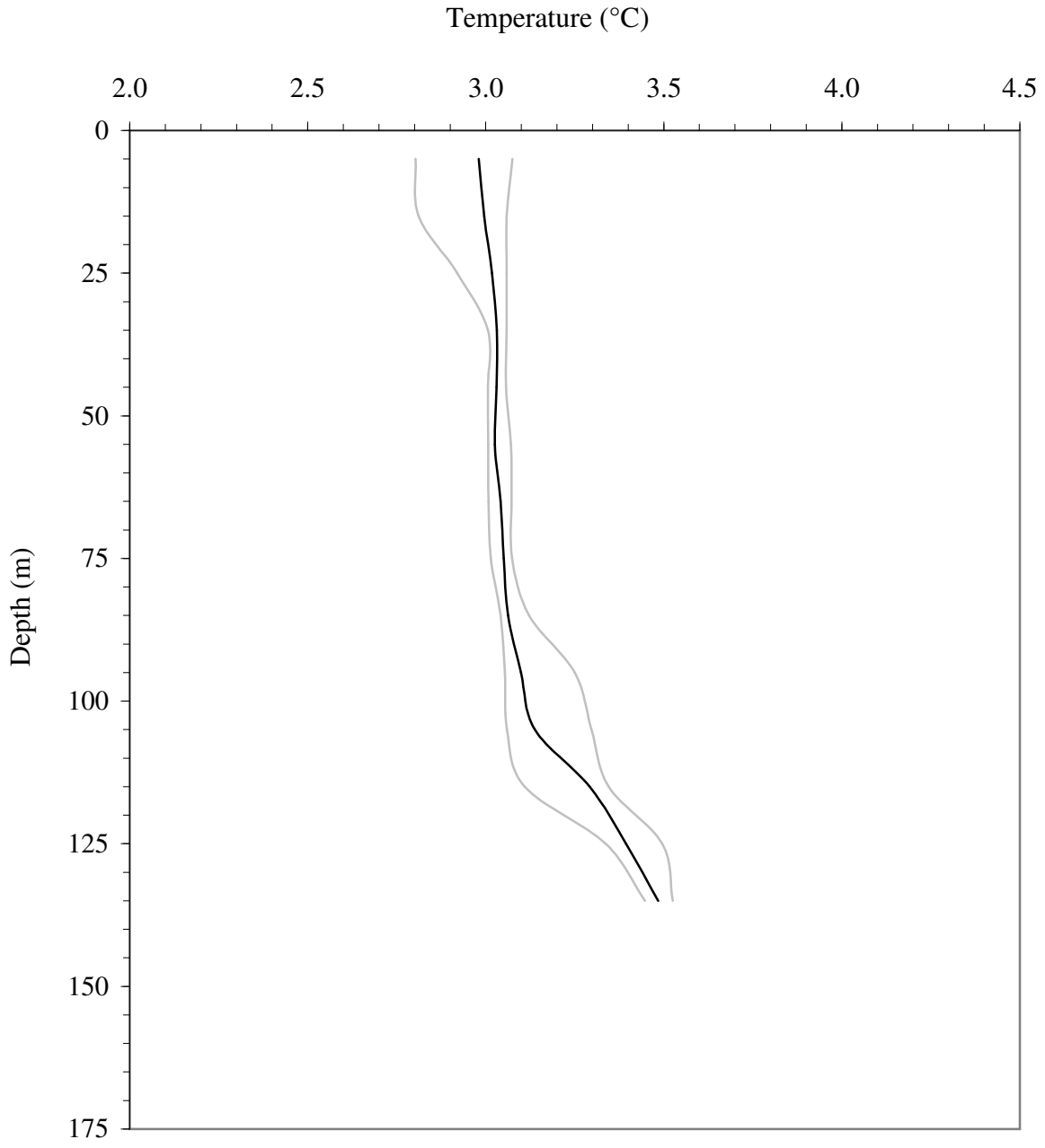

Figure 10.--Average temperature (°C) (black line) by 10-m depth intervals observed during the winter 2007 echo integration-trawl survey of walleye pollock in Sanak Trough. The gray lines represent temperature ranges observed during the survey. Data were collected at three locations.

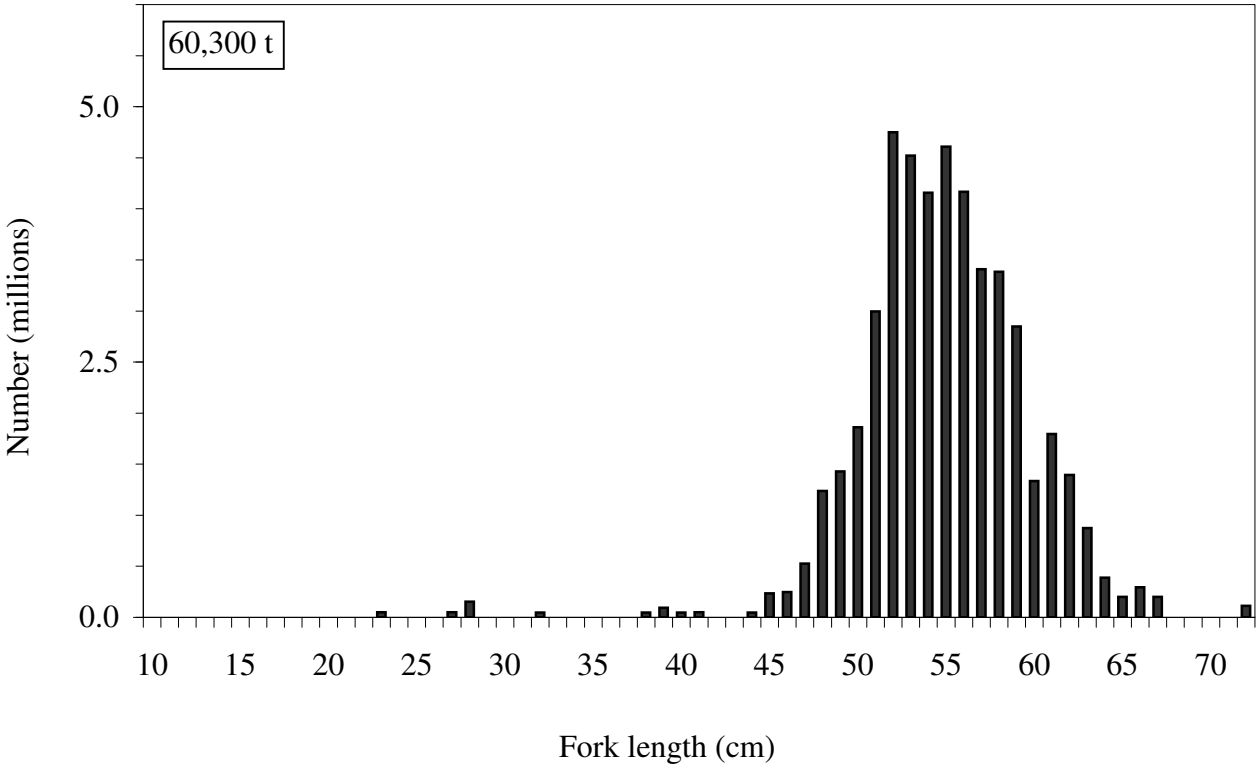

Figure 11.--The size distribution of walleye pollock (numbers) for the 2007 echo integration-trawl survey of Sanak Trough.

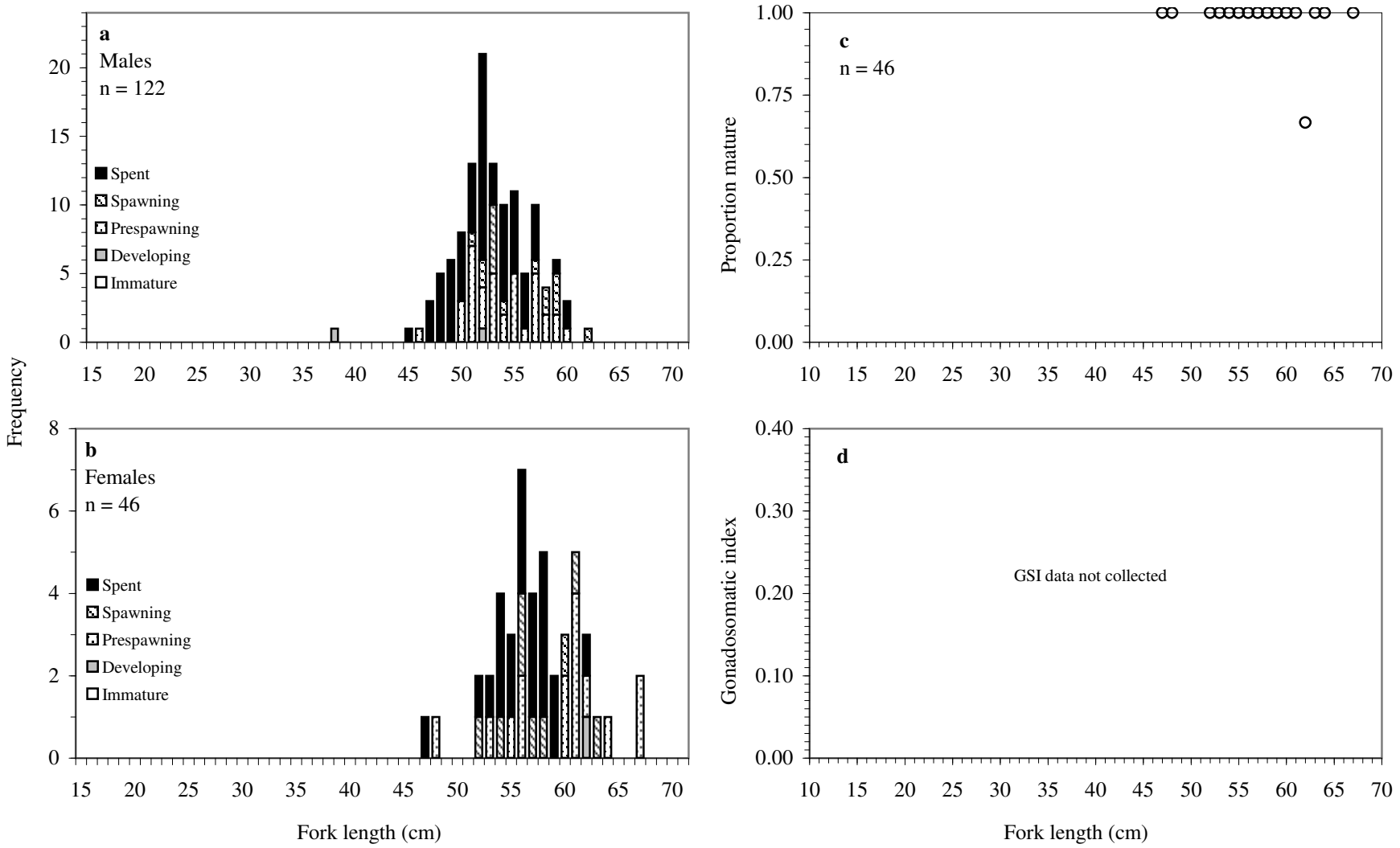

Figure 12.--Maturity stages for (a) male and (b) female walleye pollock, and (c) proportion mature by 1-cm size group for females examined during the winter 2007 echo integration-trawl survey of Sanak Trough in the Gulf of Alaska. A sampling error prevented collection of (d) gonadosomatic information for pre-spawning females.

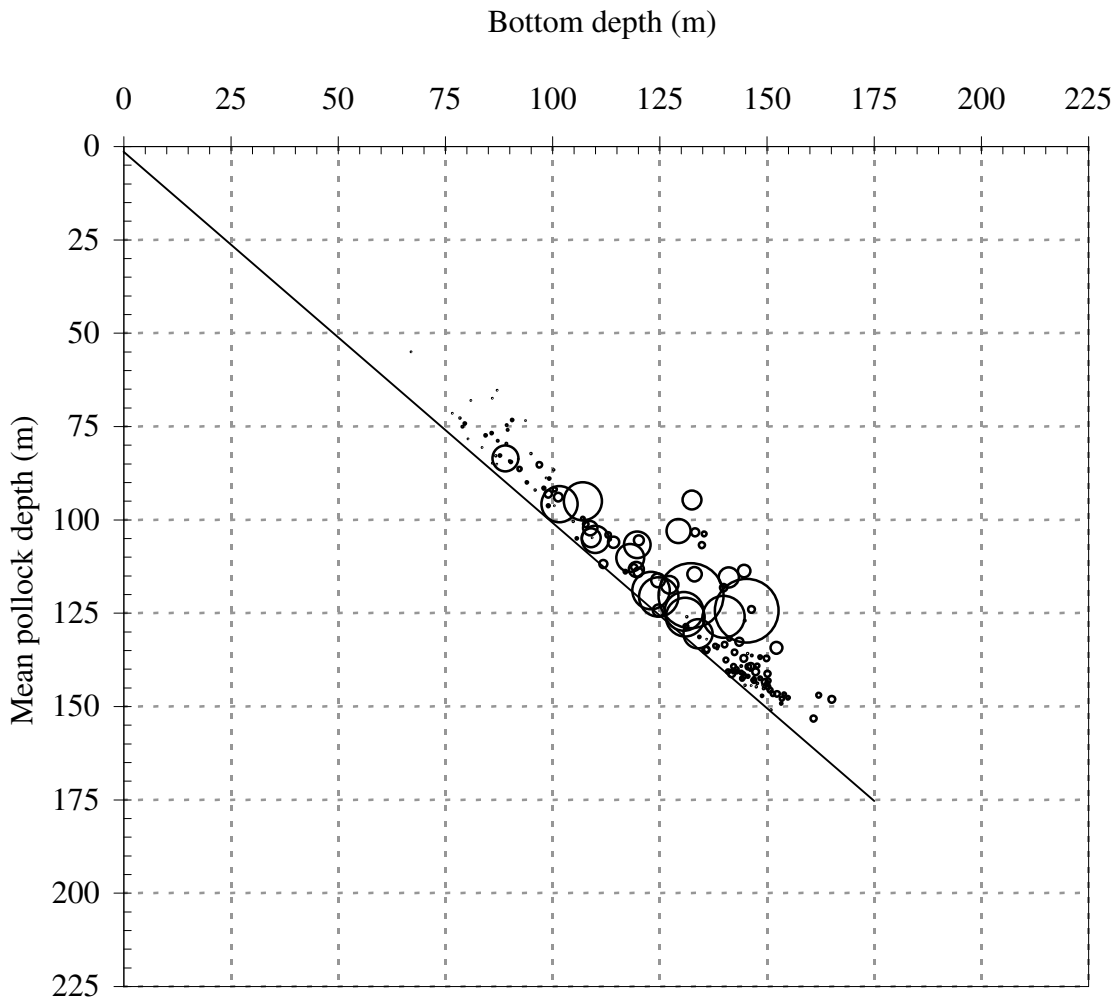

Figure 13.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for pollock observed during the winter 2007 echo integration-trawl survey of walleye pollock in Sanak Trough. Bubble size is scaled to the maximum biomass.

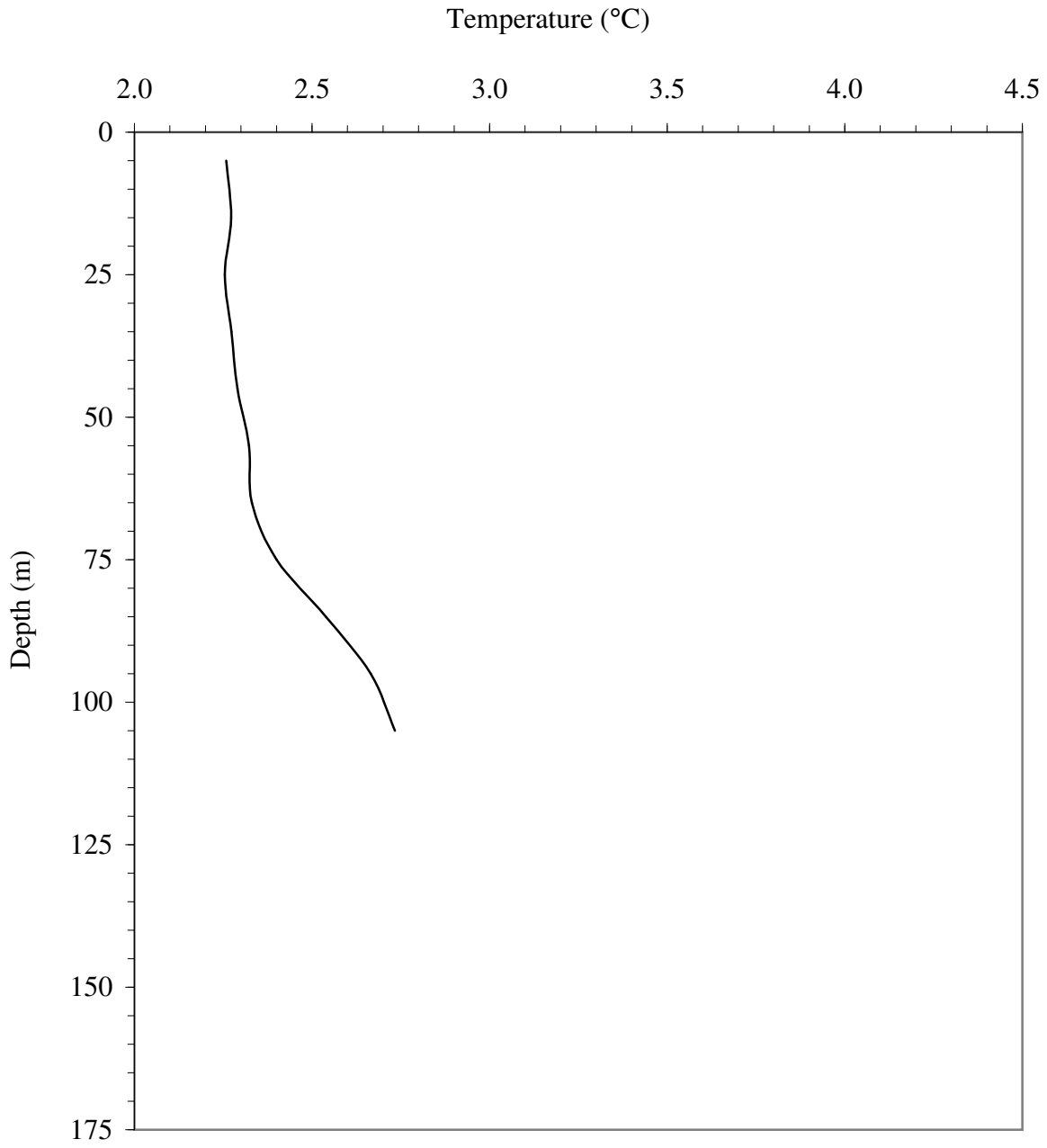

Figure 14.--Average temperature (°C) (symbols) by 10-m depth intervals observed during the winter 2007 echo integration-trawl survey of walleye pollock in Morzhovoi Bay. Data were collected at one location.

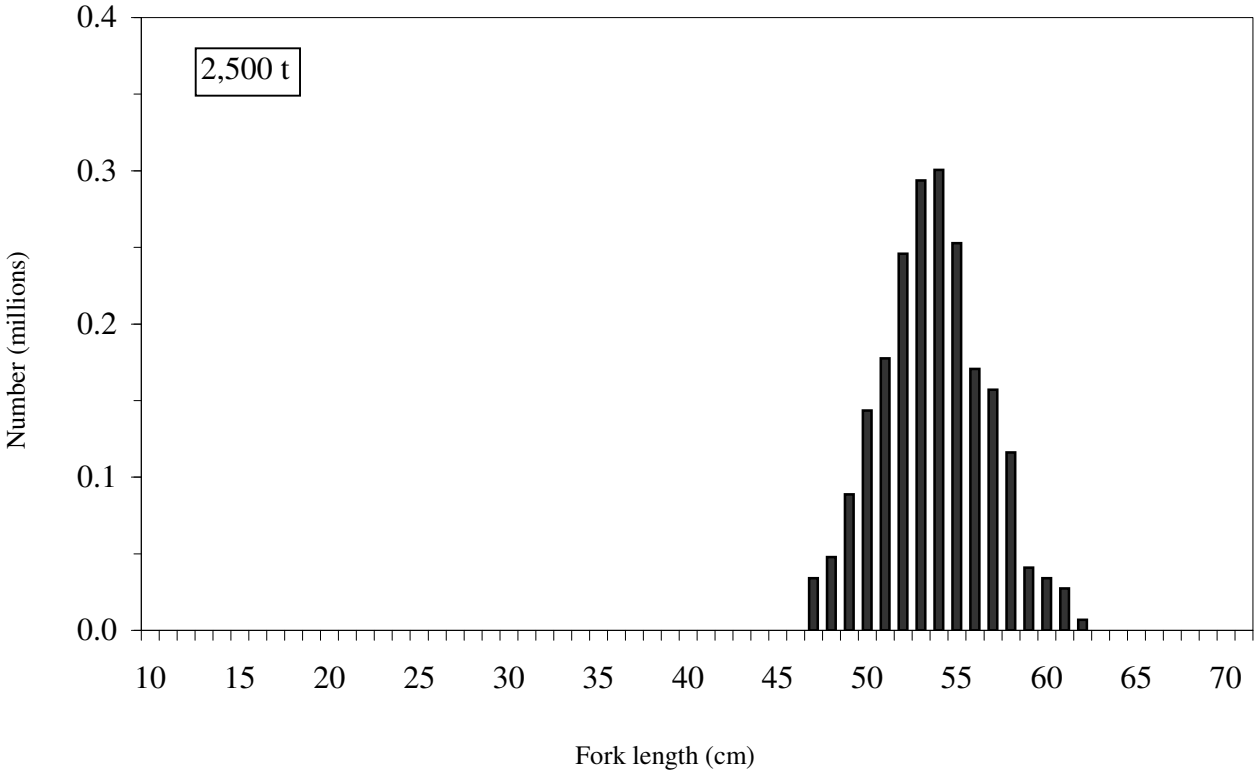

Figure 15.--The size distribution of walleye pollock (numbers) for the 2007 echo integration-trawl survey of Morzhovoi Bay.

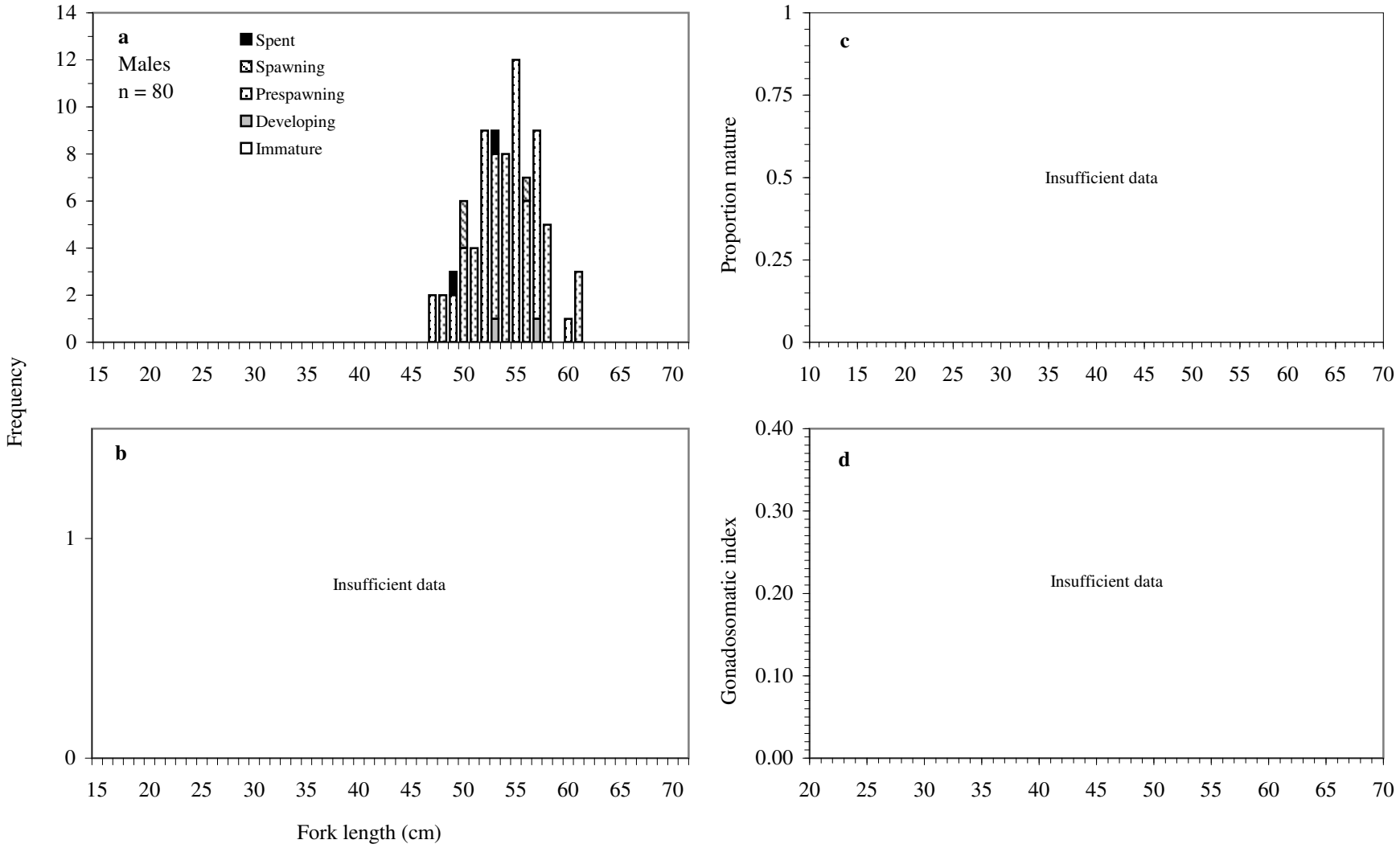

Figure 16.--Maturity stages for (a) male walleye pollock examined during the winter 2007 echo integration-trawl survey of Morzhovoi Bay in the Gulf of Alaska. Due to insufficent data, (b) maturity stages for female walleye pollock, (c) female proportion mature by 1-cm size group and (d) gonadosomatic index for pre-spawning females are not shown.

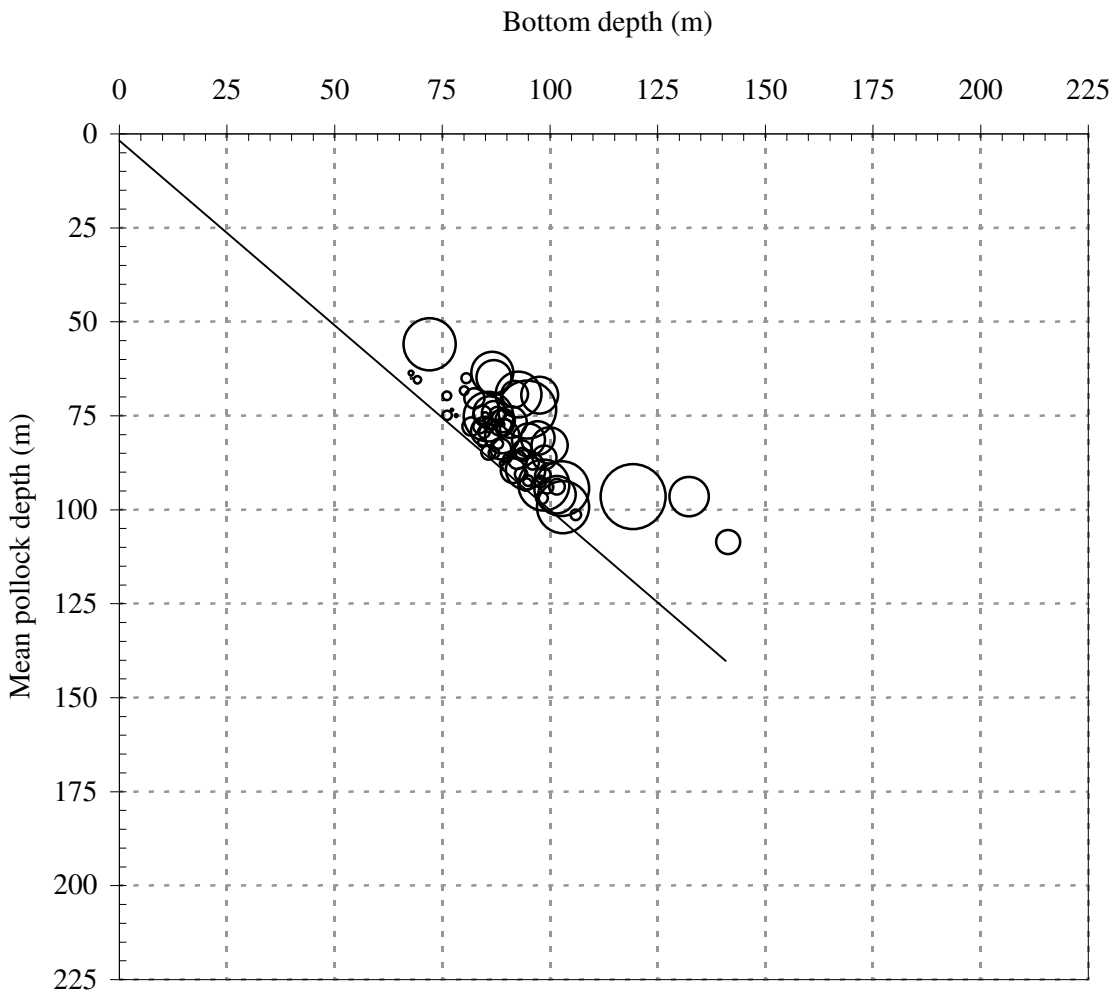

Figure 17.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for pollock observed during the winter 2007 echo integration-trawl survey of walleye pollock in Morzhovoi Bay. Bubble size is scaled to the maximum biomass.

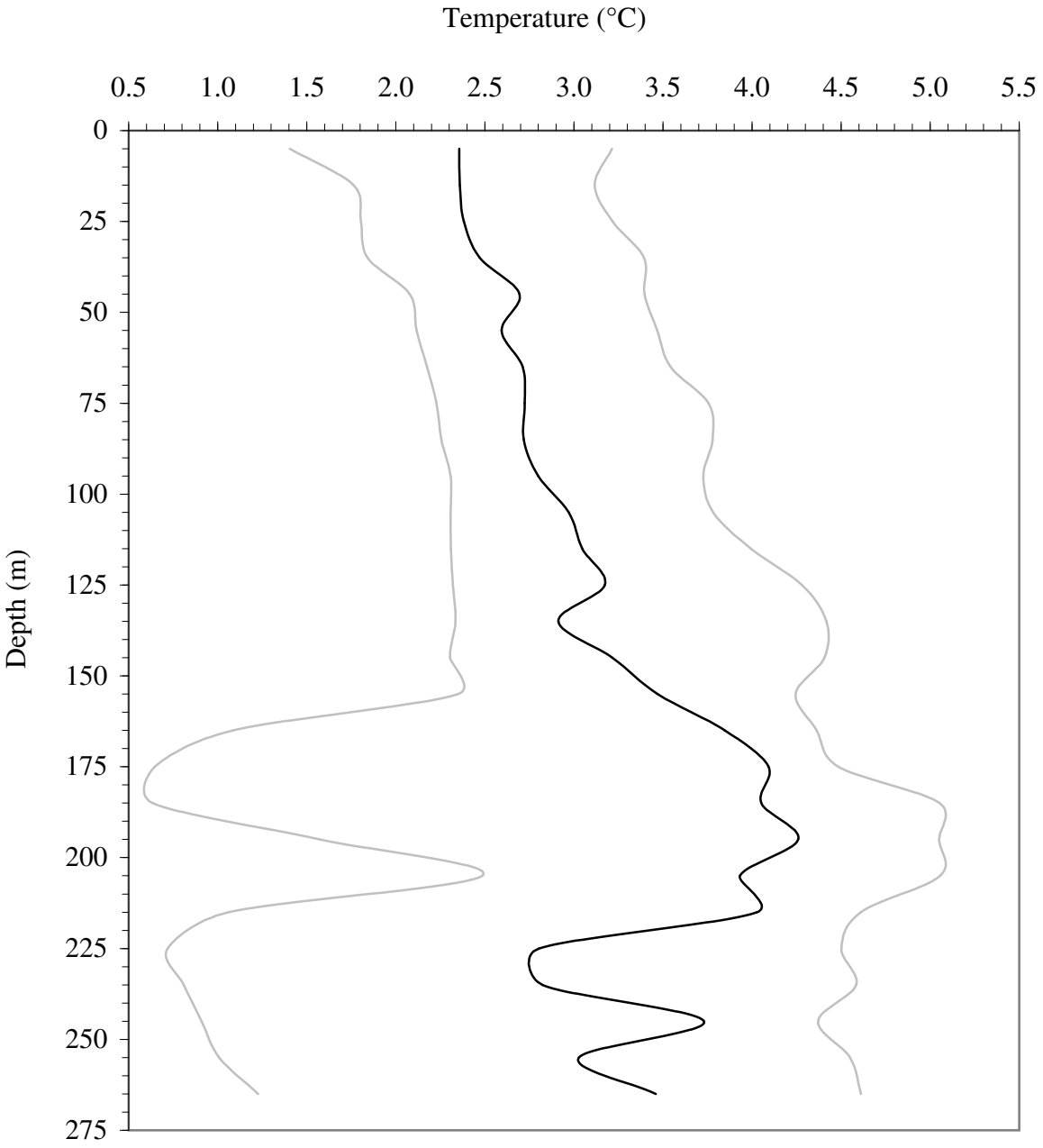

Figure 18.--Average temperature (°C) (black lines) by 10-m depth intervals observed during the winter 2007 echo integration-trawl survey of walleye pollock in the Shelikof Strait area. The gray lines represent temperature ranges observed during the survey. Data were collected at ten locations.

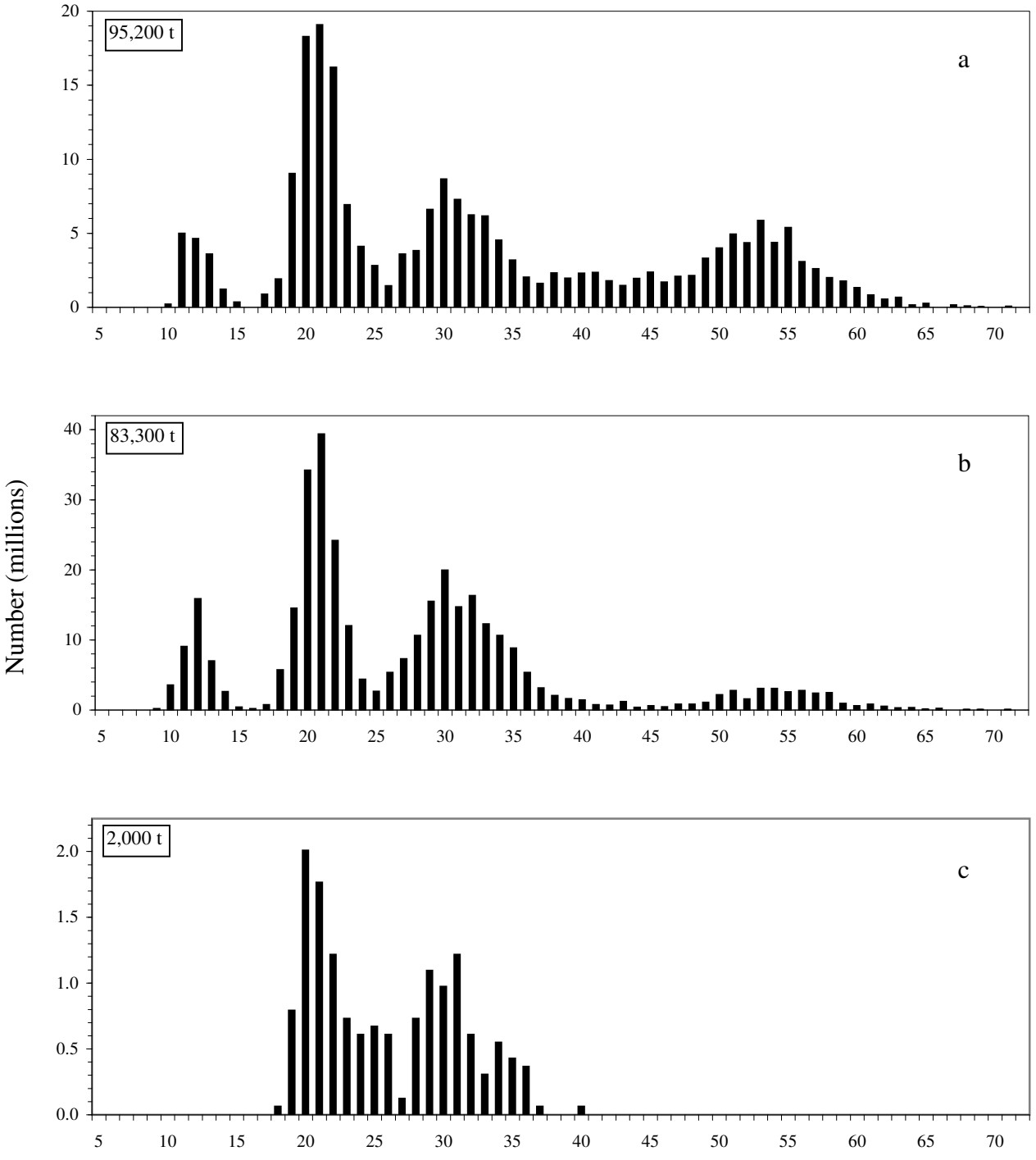

Figure 19.--The size distribution of walleye pollock by numbers (a) along the west side of the Strait, (b) in near-bottom layers in the southern Strait, and (c) in mid-water juvenile layers during the 2007 echo integration-trawl survey of the Shelikof Strait area.

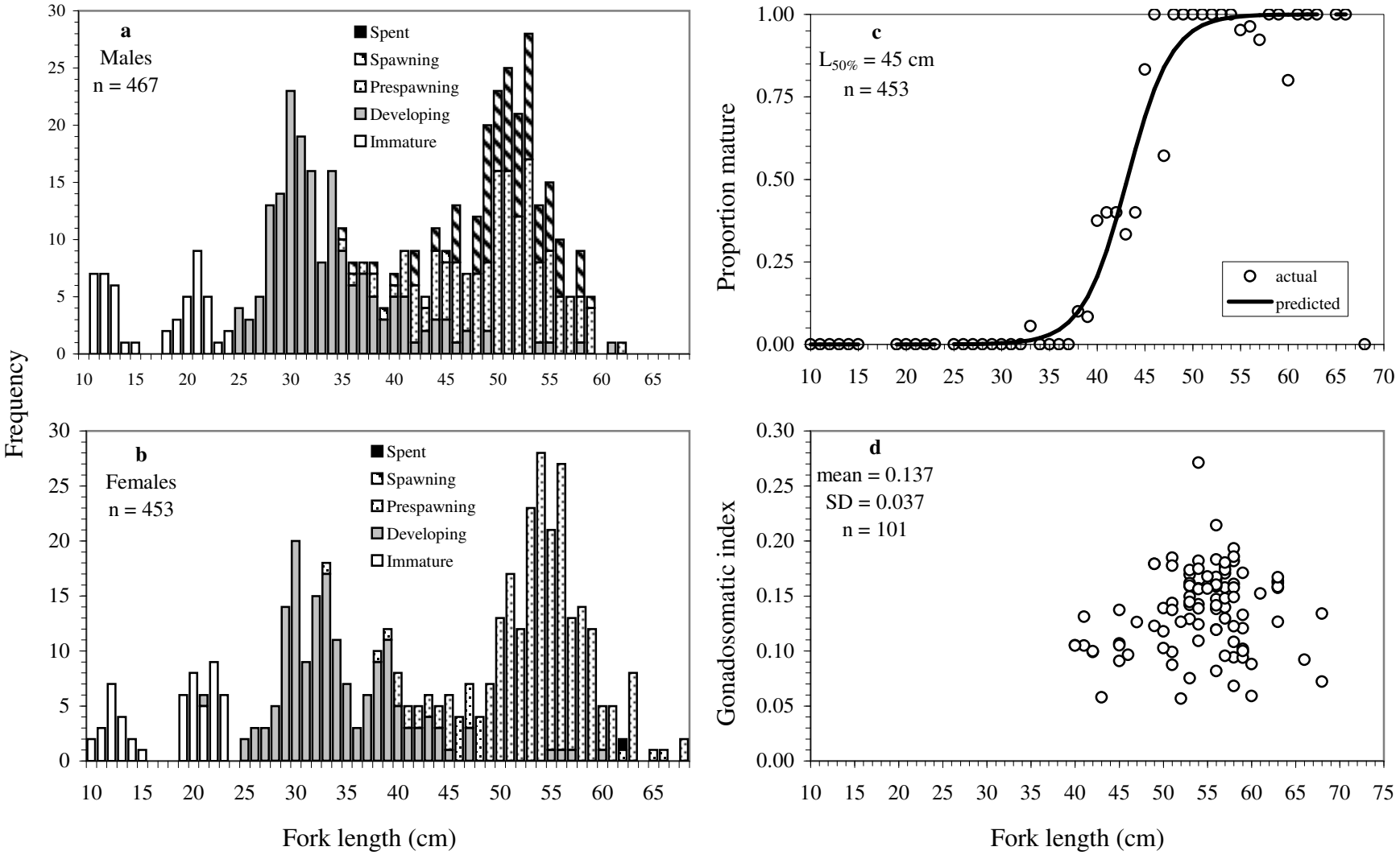

Figure 20.--Maturity stages for (a) male and (b) female pollock, (c) proportion mature by 1-cm size group for female walleye pollock and (d) gonadosomatic index for pre-spawning females examined during the 2007 echo integration-trawl survey of the Shelikof Strait area in the Gulf of Alaska.

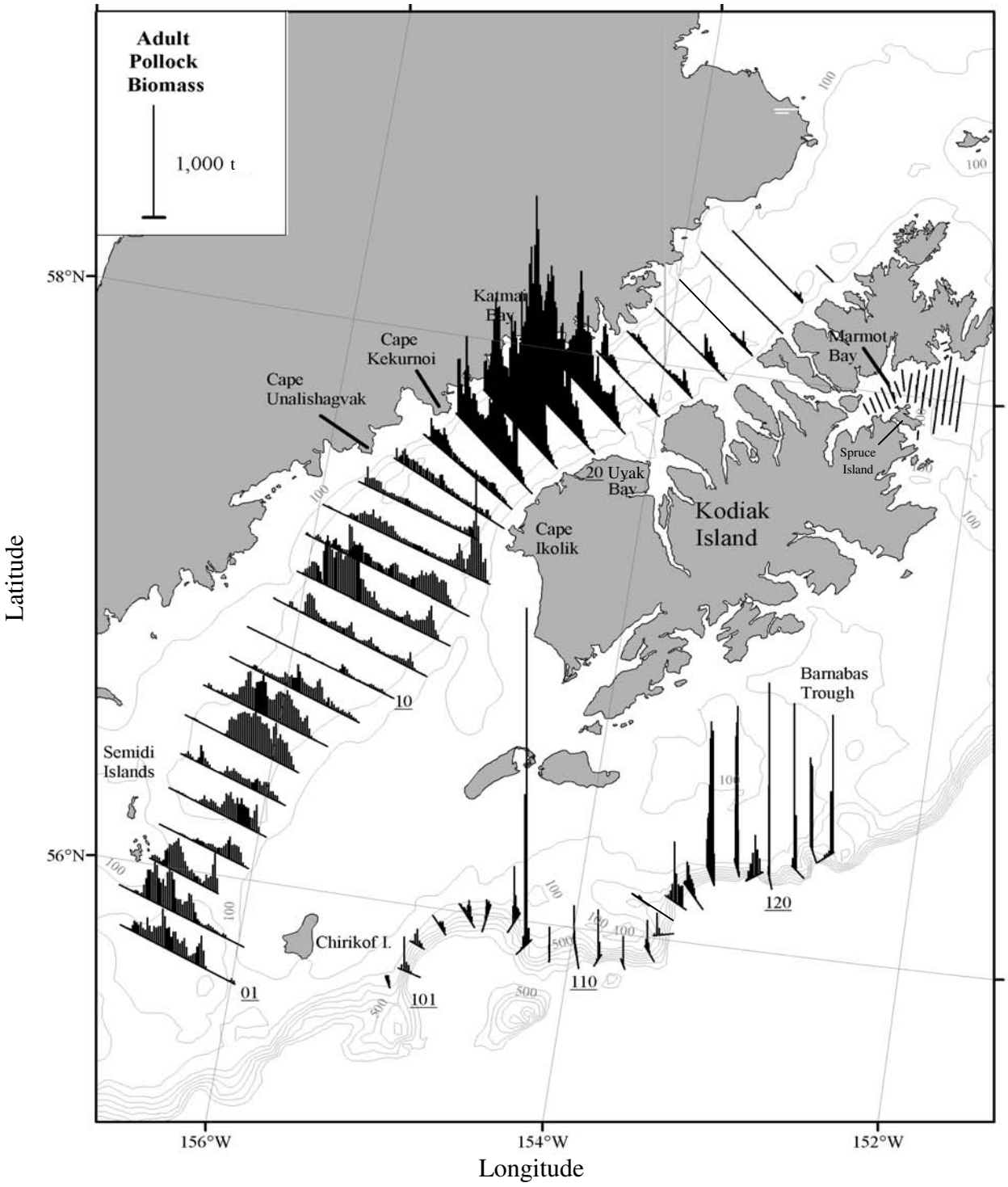

Figure 21.--Near-bottom walleye pollock biomass along transects from the 2007 echo integration-trawl survey of the Shelikof Strait area and Marmot Bay and total walleye pollock biomass along the shelf break near Chirikof Island.

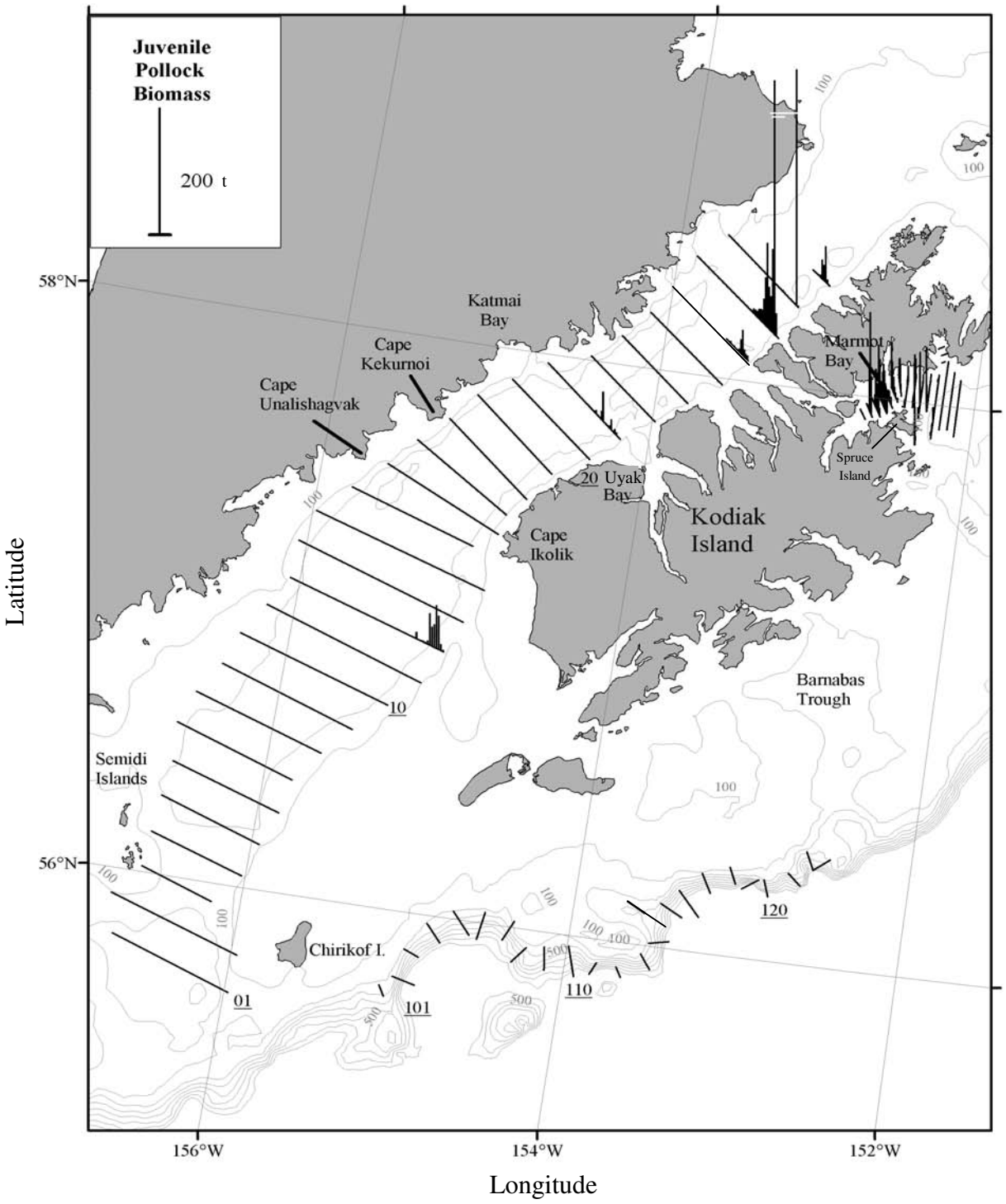

Figure 22.--Mid-water juvenile walleye pollock biomass along transects from the 2007 echo integration-trawl survey of the Shelikof Strait area and Marmot Bay.

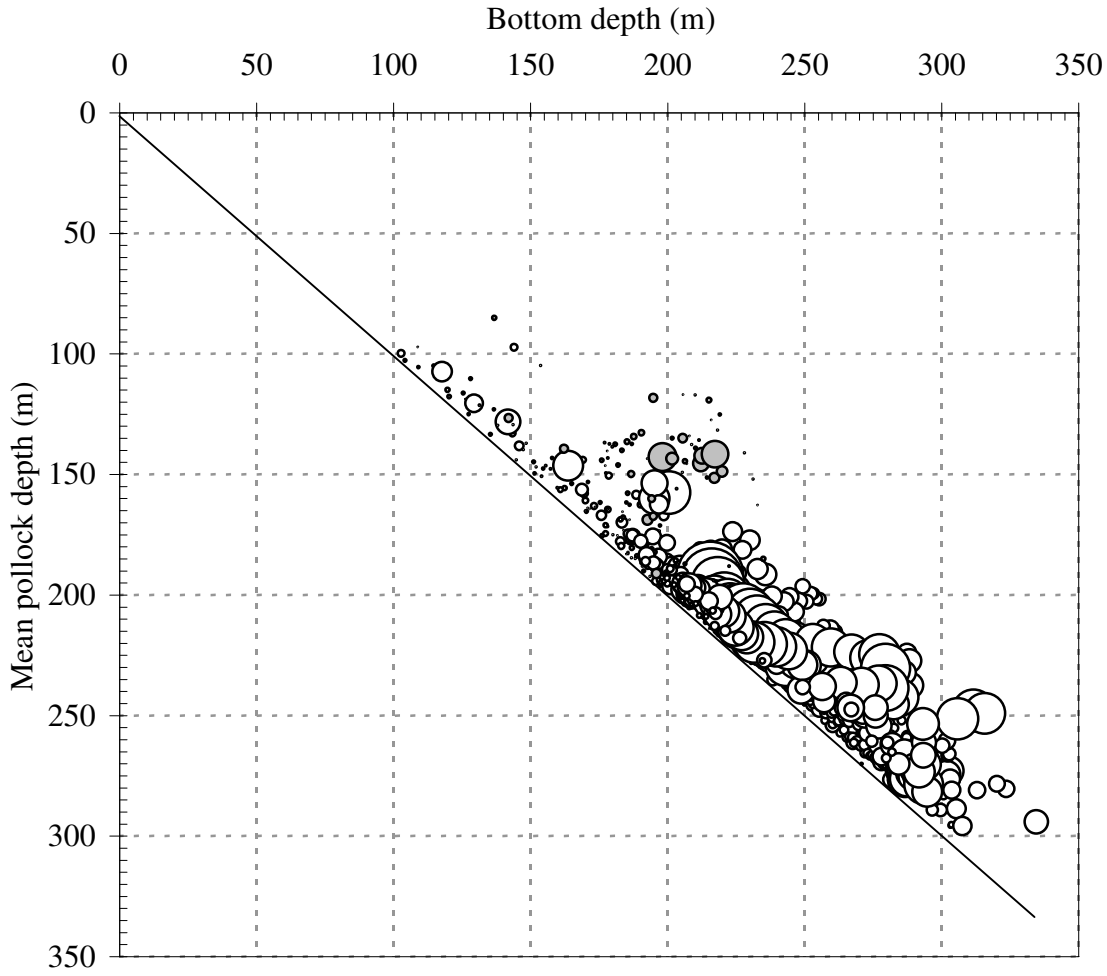

Figure 23.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for near-bottom walleye pollock (open circles) and mid-water juvenile walleye pollock (gray circles) for the winter 2007 echo integration-trawl survey of the Shelikof Strait area. Bubble size is scaled to the maximum biomass.

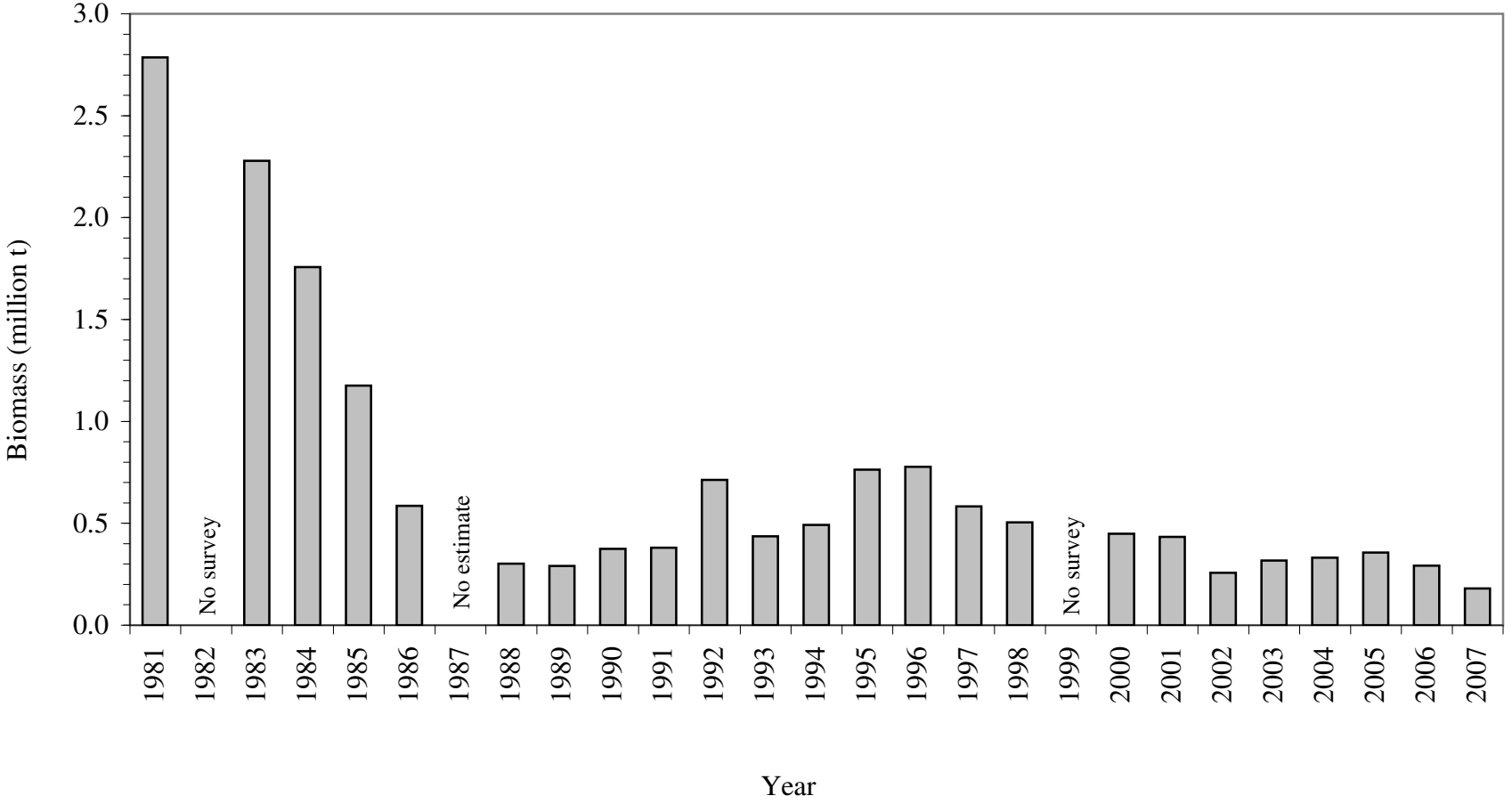

Figure 24.--Summary of annual walleye pollock biomass estimates based on echo integration-trawl surveys of the Shelikof Strait area.

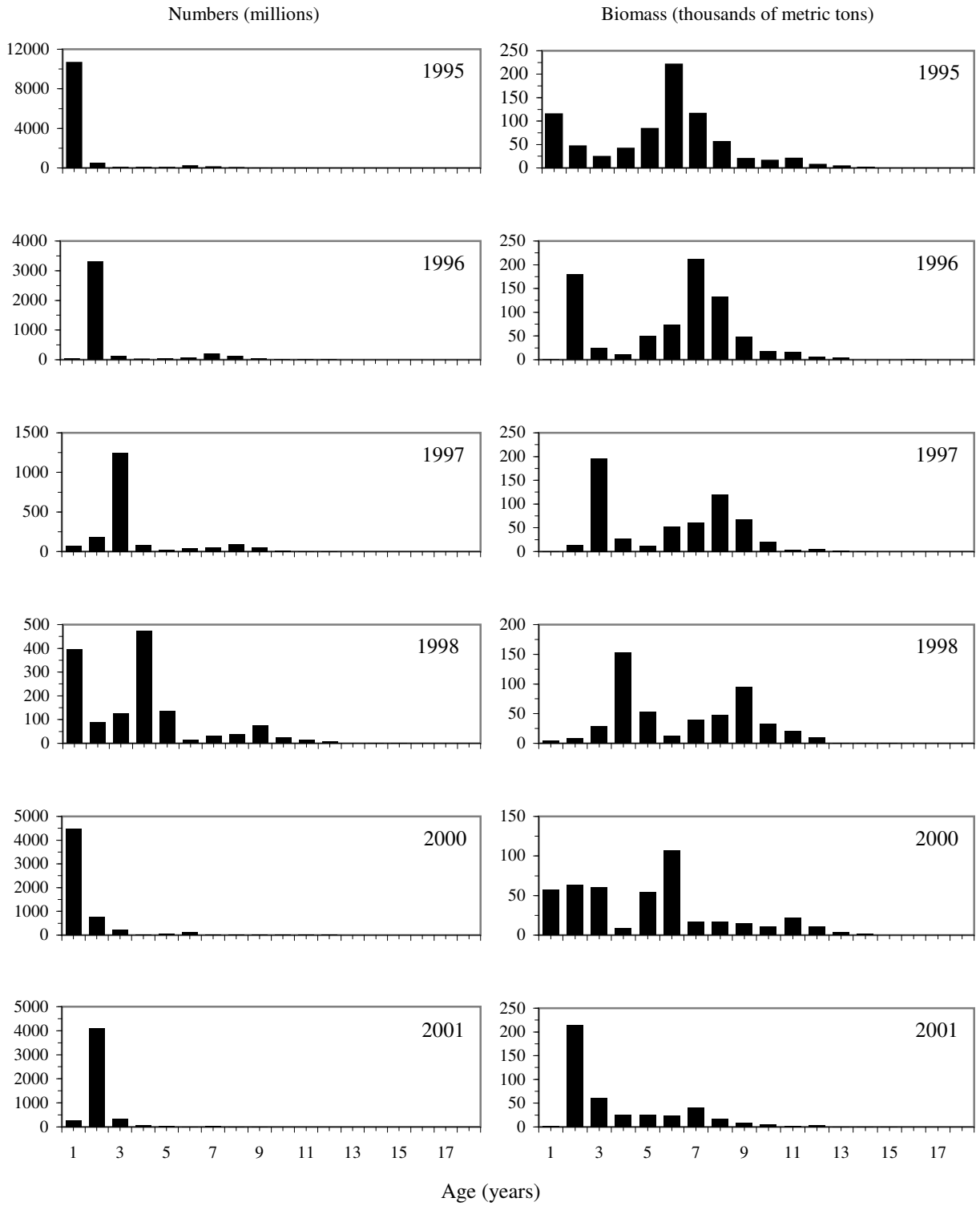

Figure 25.--Annual walleye pollock age compostition estimates for the Shelikof Strait area based on echo integration-trawl surveys conducted from 1995 to 2006 except in 1999 when the area was not surveyed. Note differences in ordinate axis scales.

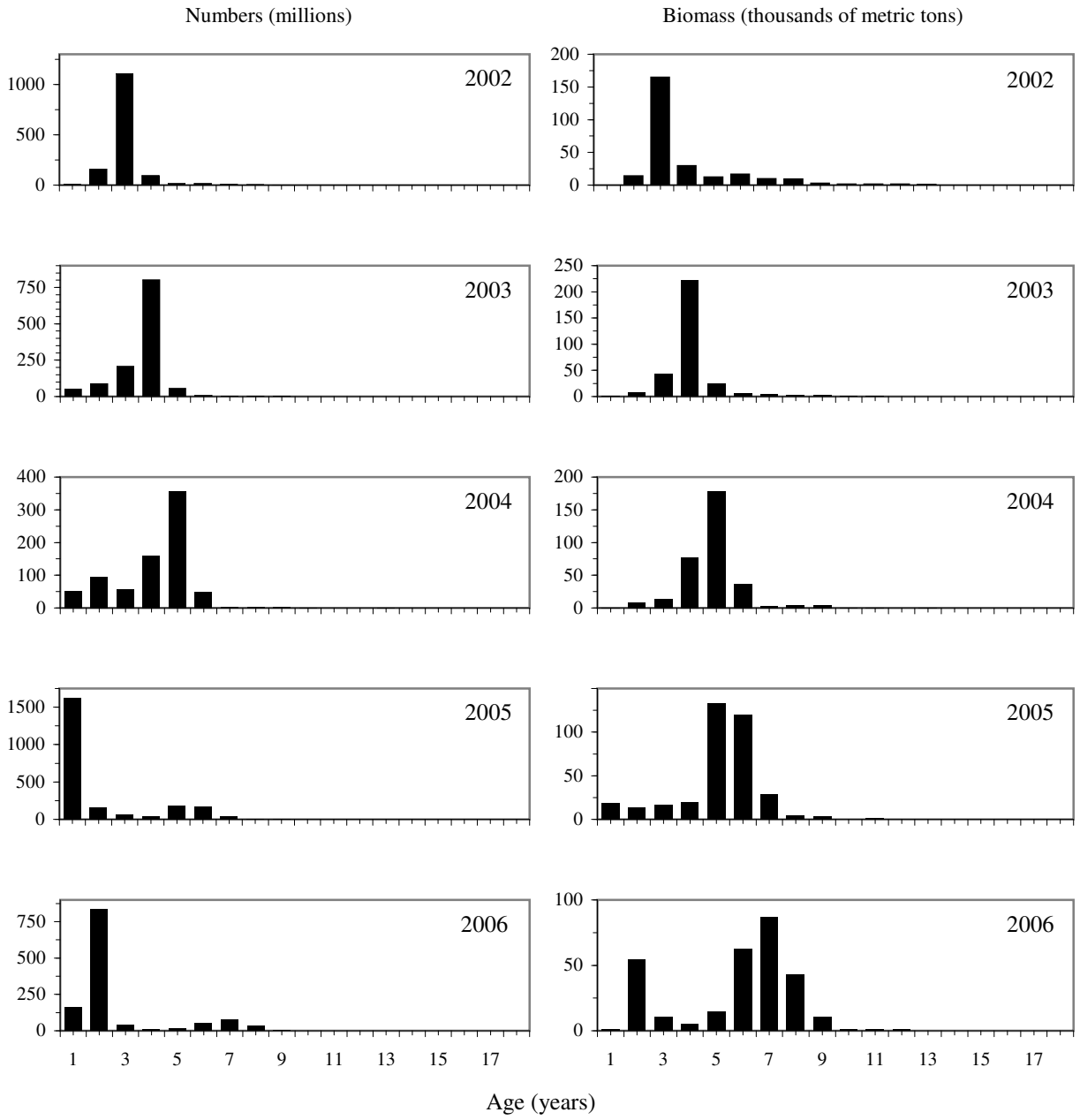

Figure 25.--Continued.

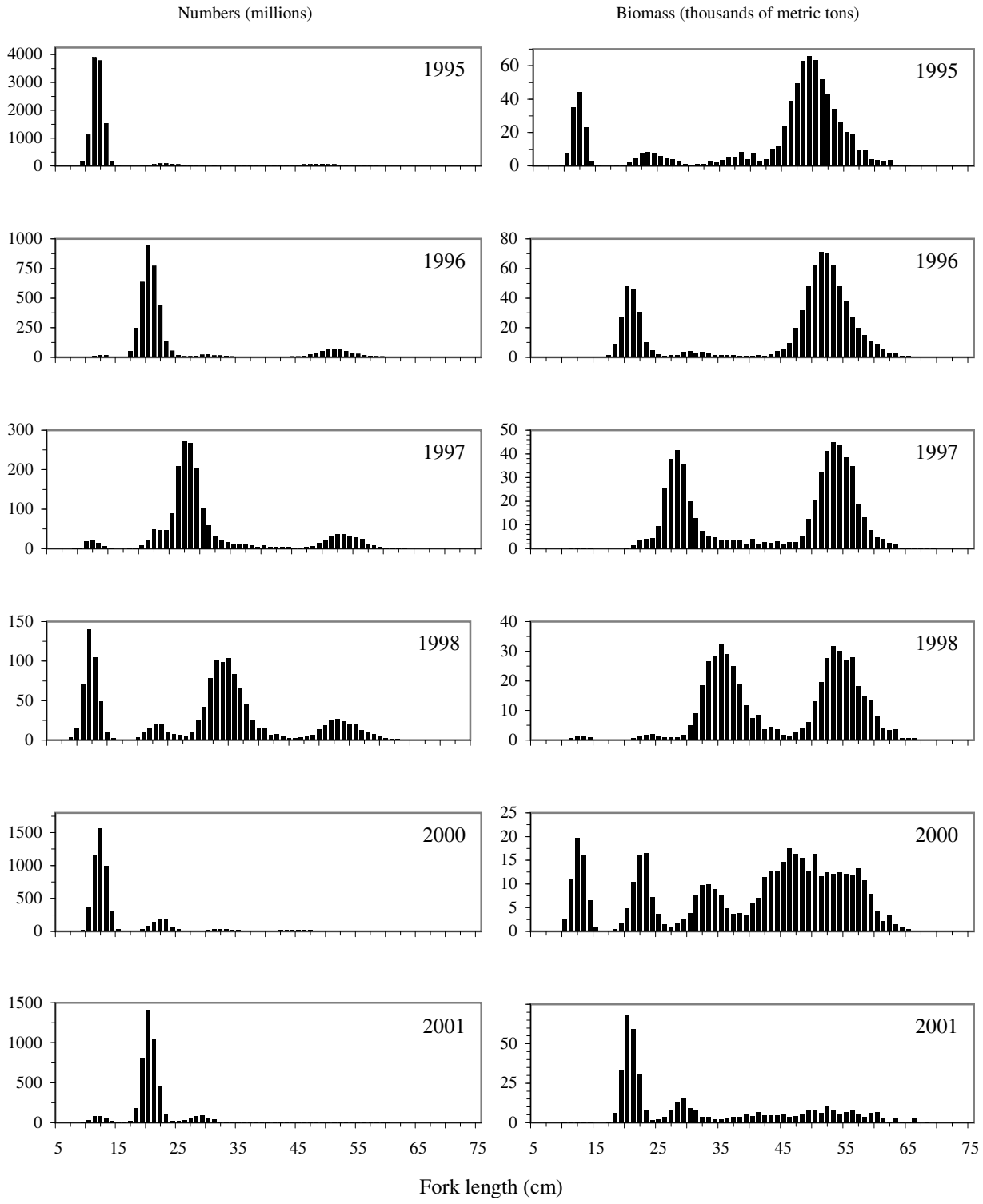

Figure 26.--Annual walleye pollock size compostition estimates for the Shelikof Strait area based on echo integration-trawl surveys conducted from 1995 to 2007 except in 1999 when the area was not surveyed. Note differences in ordinate axis scales.

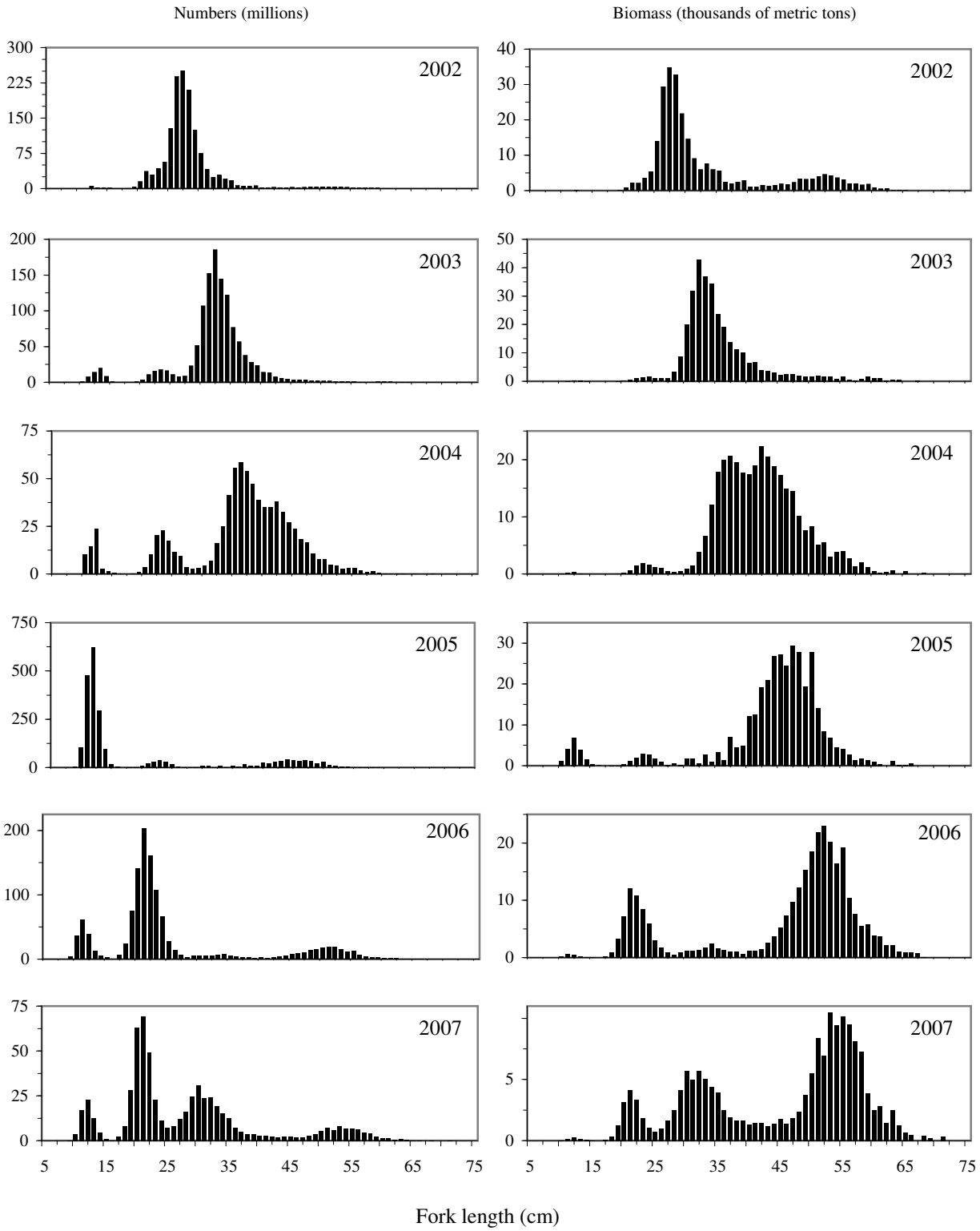

Figure 26.--Continued.

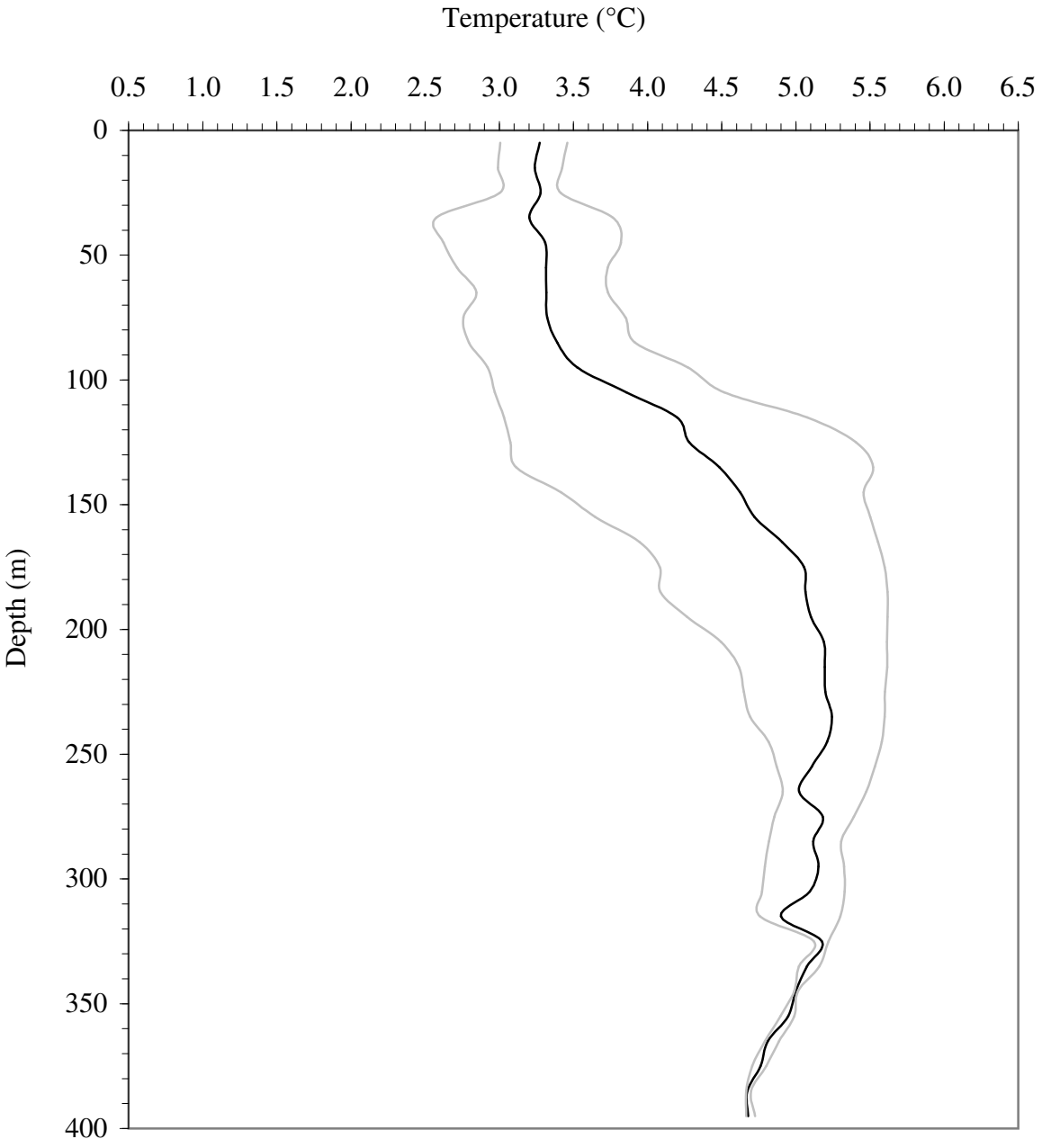

Figure 27.--Average temperature (°C) (black line) by 10-m depth intervals observed during the winter 2007 echo integration-trawl survey of walleye pollock in the Chirikof Island area in the Gulf of Alaska. The gray lines represent temperature ranges observed during the survey. Data were collected at five locations.

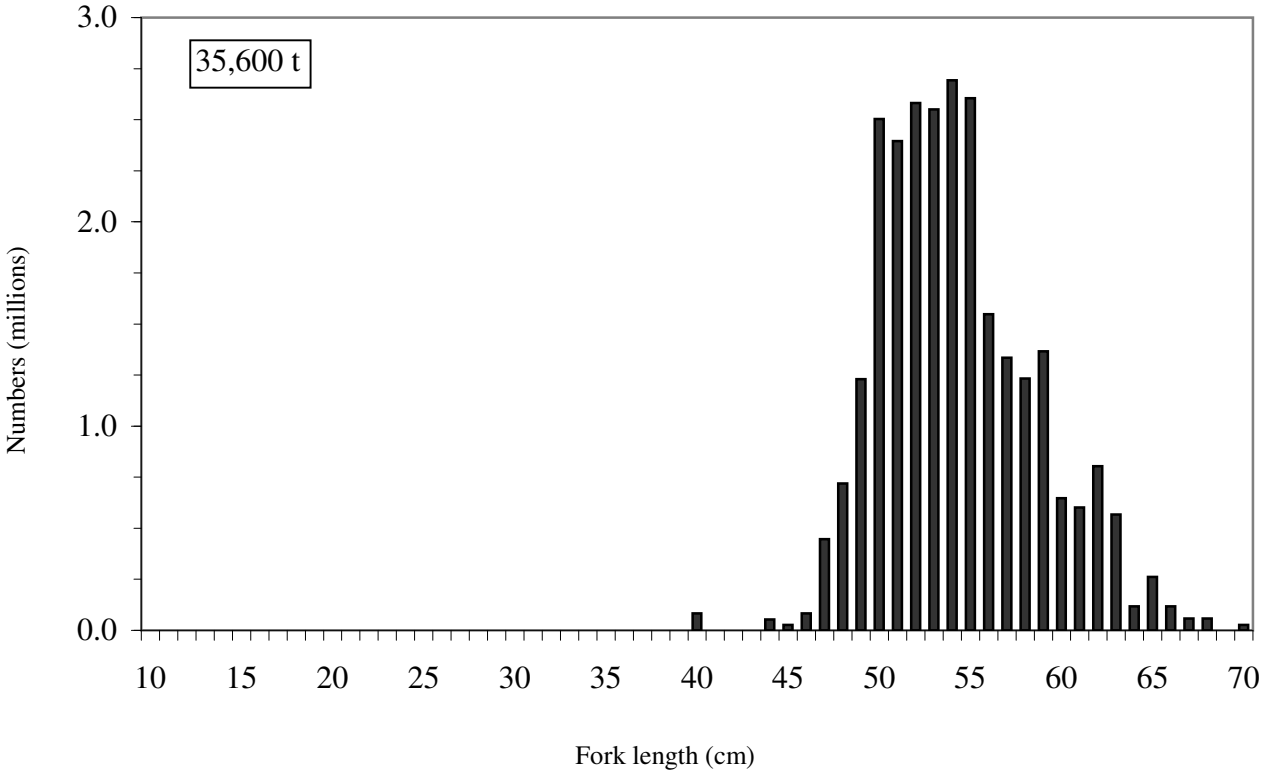

Figure 28.--The size distribution of walleye pollock (numbers) of the shelf-break area near Chirikof Island during the 2007 echo integration-trawl surveys in the Gulf of Alaska.

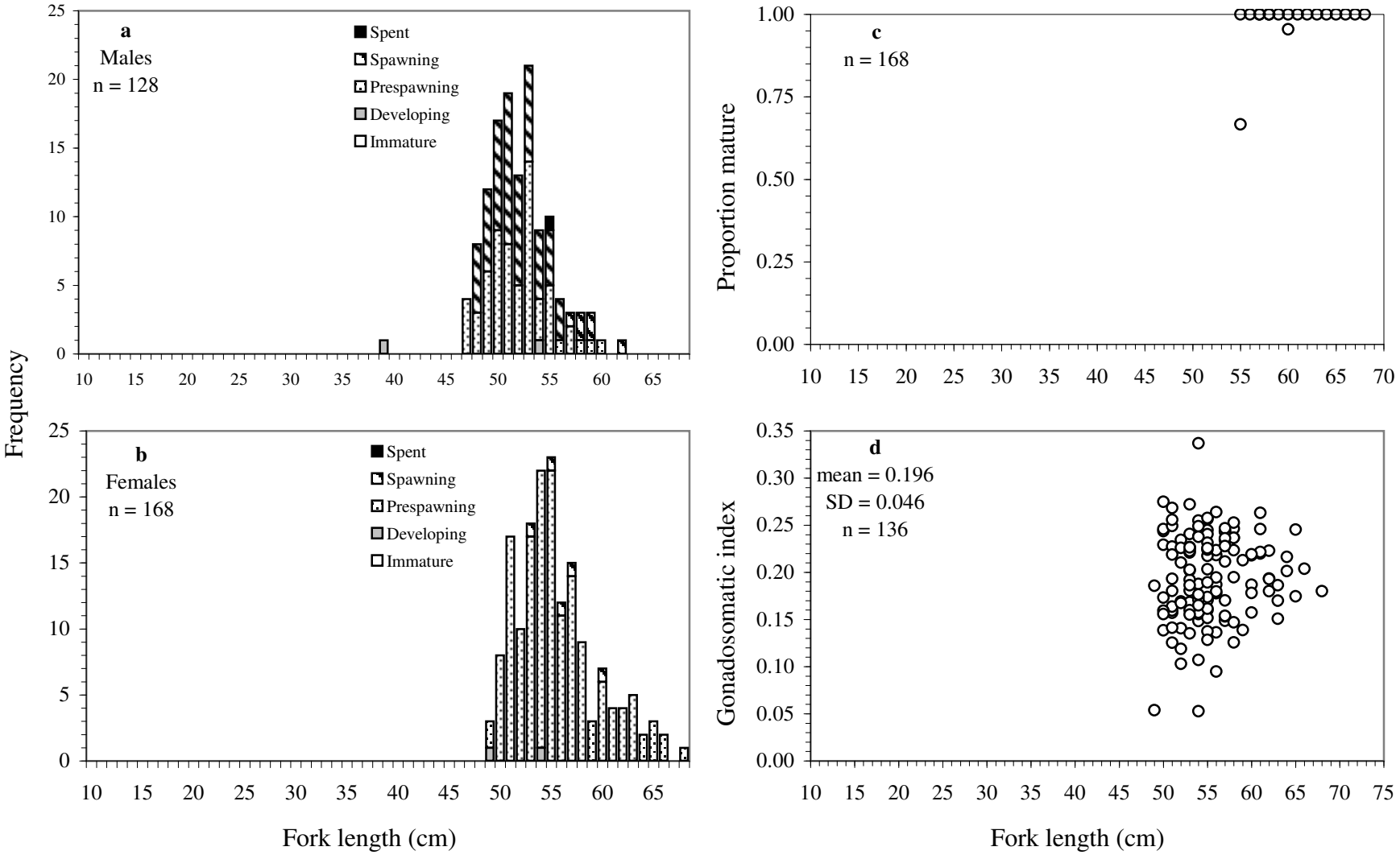

Figure 29.--Maturity stages for (a) male and (b) female pollock, (c) proportion mature by 1-cm size group for female walleye pollock and (d) gonadosomatic index for pre-spawning females examined during the 2007 echo integration-trawl survey of the Chirikof Island area in the Gulf of Alaska.

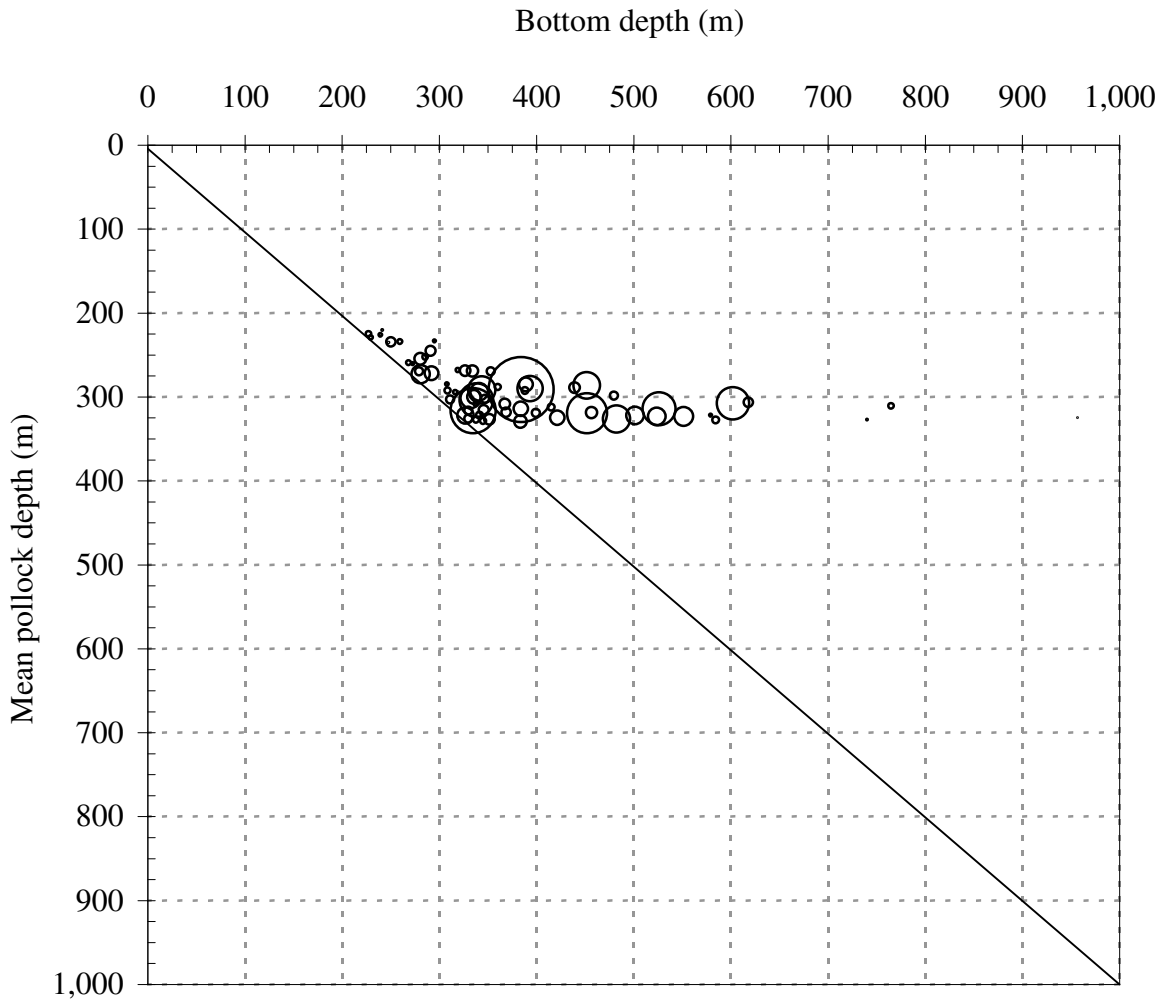

Figure 30.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for walleye pollock observed during the winter 2007 echo integration-trawl survey of the Chirikof Island area. Bubble size is scaled to the maximum biomass.

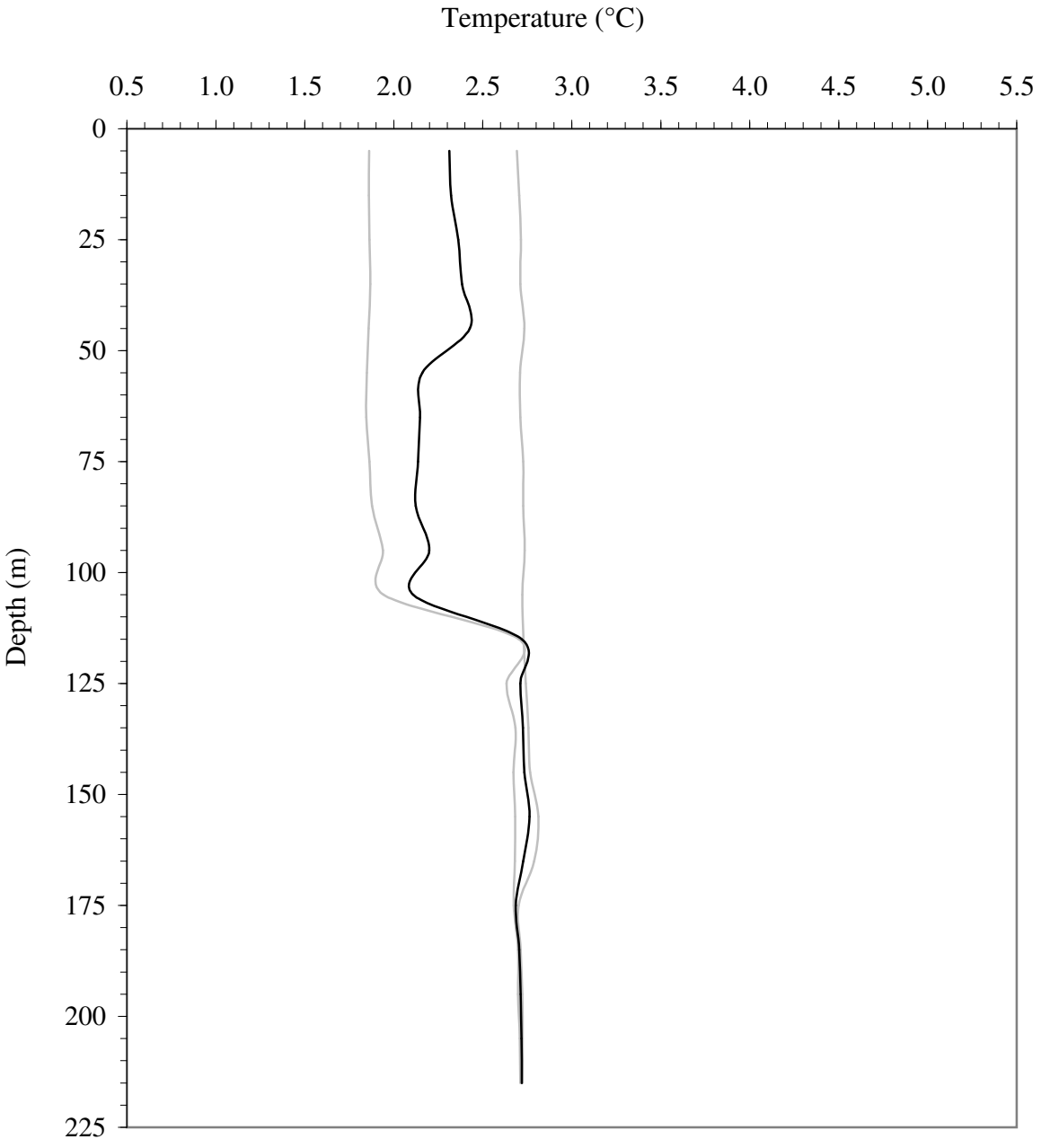

Figure 31.--Average temperature (°C) (black line) by 10-m depth intervals observed during the winter 2007 echo integration-trawl survey of walleye pollock in Marmot Bay. The gray lines represent temperature ranges observed during the survey. Data were collected at three locations.

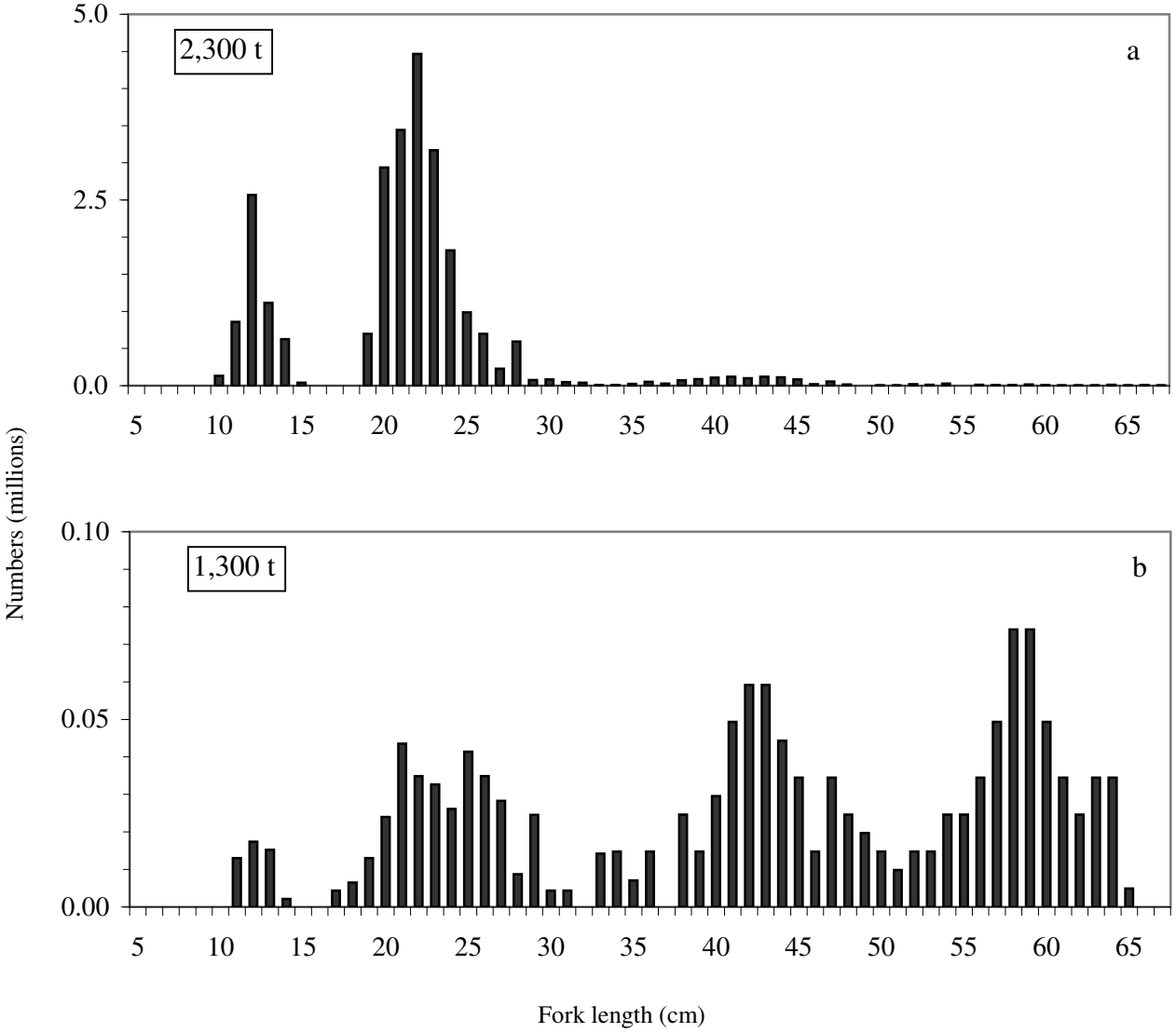

Figure 32.--The size distribution of walleye pollock by numbers (a) in mid-water juvenile layers and (b) in near-bottom layers in Marmot Bay during the 2007 echo integration-trawl surveys in the Gulf of Alaska.

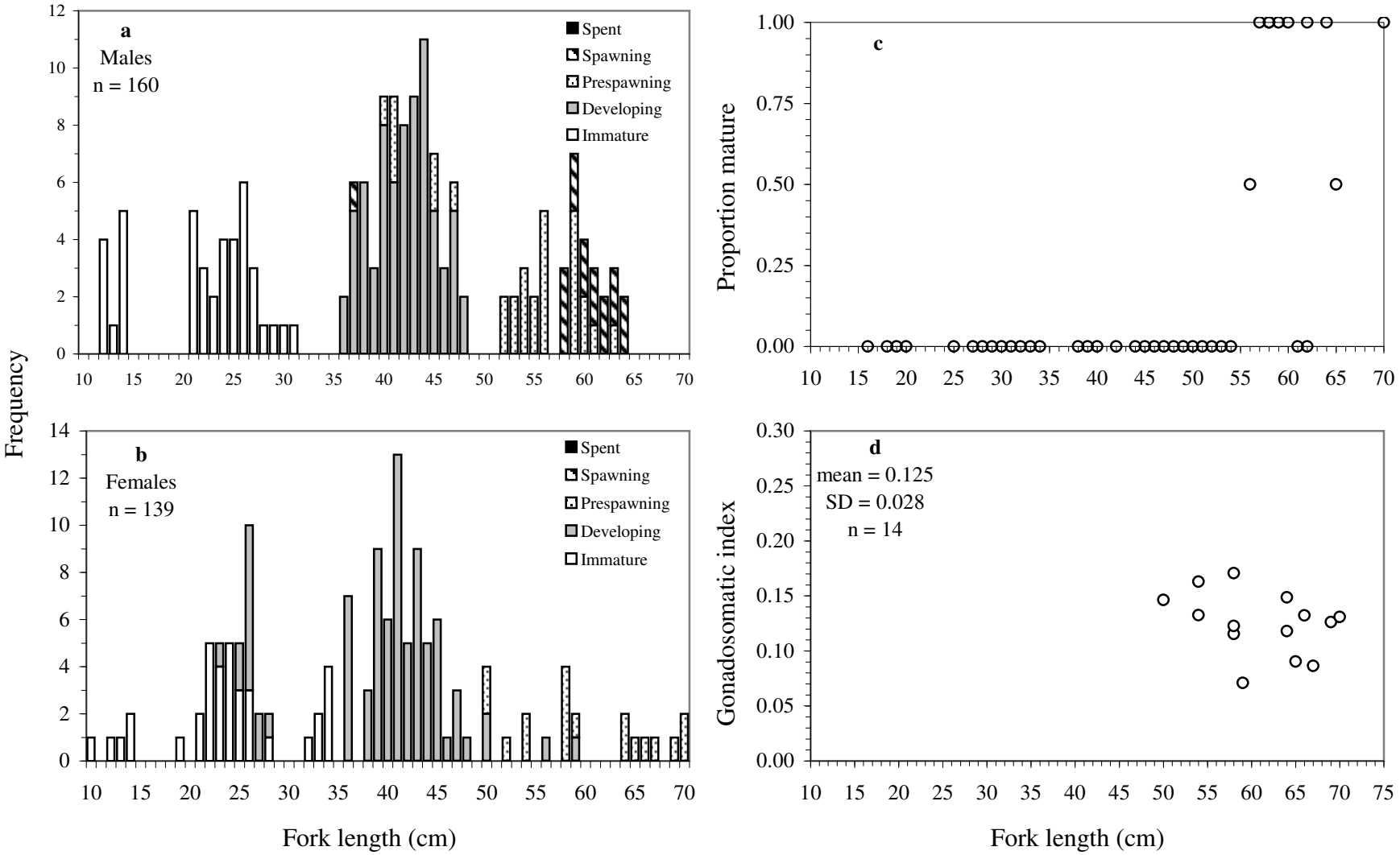

Figure 33.--Maturity stages for (a) male and (b) female pollock, (c) proportion mature by 1-cm size group for female walleye pollock and (d) gonadosomatic index for pre-spawning females examined during the 2007 echo integration-trawl survey of Marmot Bay in the Gulf of Alaska.

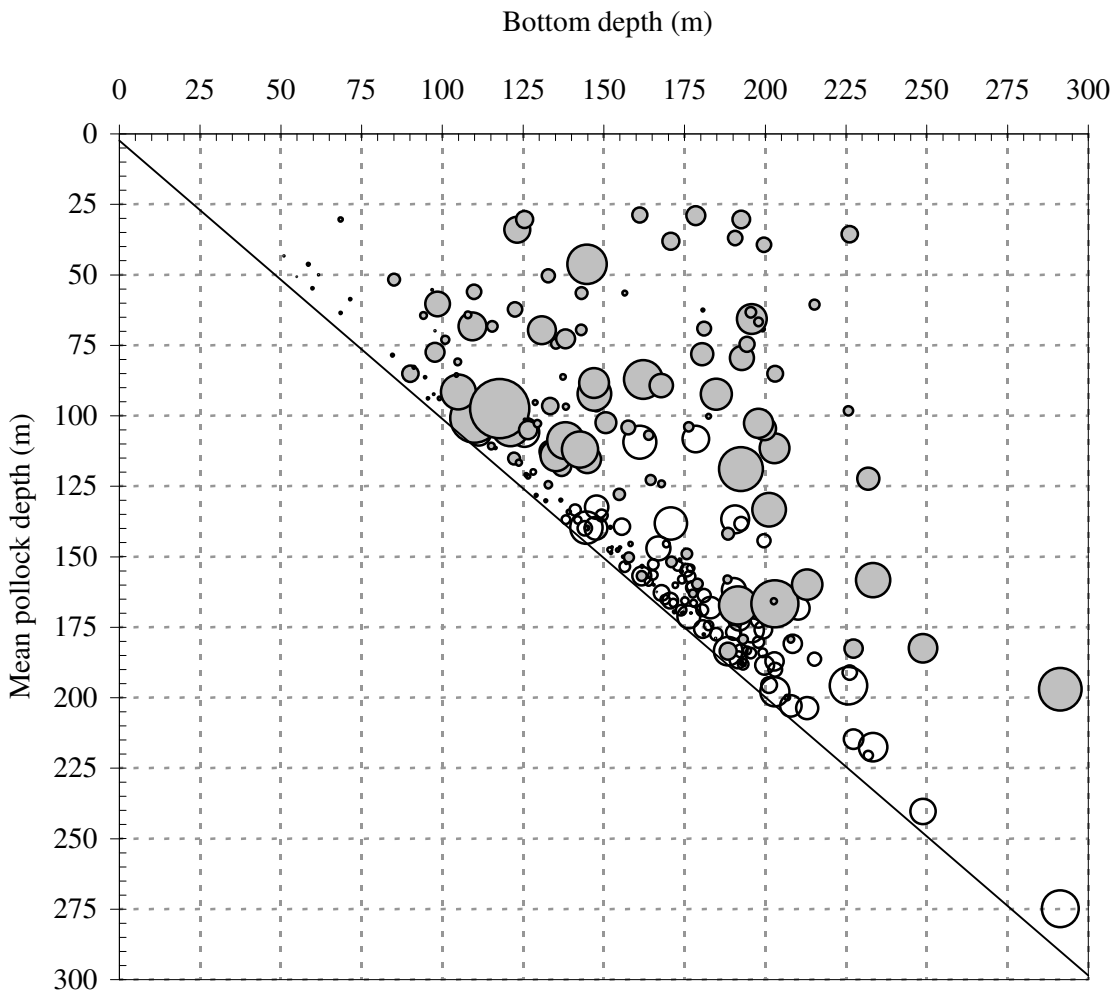

Figure 34.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for near-bottom walleye pollock (open circles) and mid-water juvenile walleye pollock (gray circles) for the winter 2007 echo integration-trawl survey of Marmot Bay. Bubble size is scaled to the maximum biomass.