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Results of the February-March 2006 Echo Integration-trawl Surveys of Walleye Pollock (*Theragra chalcogramma*) Conducted in the Gulf of Alaska, Cruises MF2006-01 and MF2006-04

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Results of the February-March 2006 Echo Integration-Trawl Surveys of Walleye Pollock (*Theragra chalcogramma*) Conducted in the Gulf of Alaska, Cruises MF2006-01 and MF2006-04

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INTRODUCTION

Scientists from the Midwater Assessment and Conservation Engineering Program of the Alaska Fisheries Science Center (AFSC) routinely conduct echo integration-trawl (EIT) surveys in the Gulf of Alaska (GOA) during late winter and early spring to estimate the distribution and abundance of walleye pollock (*Theragra chalcogramma*, hereafter referred to as pollock). 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 and along the GOA shelf break east of Chirikof Island in 2002-05. Results presented here are from EIT surveys carried out between 13 and 21 February in the Shumagin Islands, Sanak Trough, and Morzhovoi Bay (Cruise MF2006-01) and between 13 and 28 March in the Shelikof Strait area, and along the GOA shelf break near Chirikof Island (Cruise MF2006-04).

METHODS

Shumagin Islands/Sanak Trough/Morzhovoi Itinerary

13 Feb	Embark scientists in Kodiak, AK.
13 Feb	Calibration of acoustic system in Three Saints Bay, AK.
14 Feb	In transit.
15-19 Feb	EIT survey of the Shumagin Islands, Sanak Trough, and Morzhovoi Bay.
20 Feb	In transit.
21 Feb	In port in Kodiak, AK.

Shelikof Strait/Shelf Break Itinerary

13 Mar	Embark scientists in Kodiak, AK.
14-16 Mar	EIT survey of the shelf break east of Chirikof Island.
16-22 Mar	EIT survey of the Shelikof Strait area.

22 Mar	Calibration of acoustic system in Uganik Bay, AK.
23-27 Mar	Experimental trawls and orthogonal transects.
28 Mar	In port in Kodiak, AK.

Acoustic Equipment

Acoustic data were collected with a Simrad ER60[1] quantitative echosounding system using 18, 38, 120, and 200 kHz split-beam transducers (Simrad 1997, 2004; Bodholt and Solli 1992). The transducers were installed on the NOAA ship *Miller Freeman*, a 66-m stern trawler equipped for fisheries and oceanographic research, on the bottom of a retractable centerboard extending 9 m below the water surface. Data were logged using ER60 software (version 2.1.2) and SonarData EchoLog 500 (version 3.45). Data were analyzed using SonarData Echoview (version 3.45.53) PC-based post-processing software. Results presented here are based on ER60 38 kHz data.

Trawl Gear

Midwater and near-bottom echosign were sampled using an Aleutian wing 30/26 trawl (AWT). This trawl was constructed with full-mesh nylon wings and polyethylene mesh in the codend and aft section of the body. The headrope and footrope each measured 81.7 m (268 ft). Mesh sizes tapered from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend. 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

[1]Reference to trade names or commercial firms does not constitute U.S. Government endorsement.

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.

Demersal echosign was sampled 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/depth 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 (SCS).

Survey Design

Parallel transect designs were used, except where it was necessary to reorient tracklines in order to maintain a perpendicular alignment to the bathymetry. A random start position was generated for the first transect for all surveys. The Shumagin Islands survey was conducted between 15 and 18 February using transects spaced 9.3 km (5 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 50 m depth. The Sanak Trough survey was conducted between 18 and 19 February using transects spaced 3.7 km (2 nmi) apart. Bottom depths did not exceed 160 m along any transect, and transects generally did not extend into waters less than about 50 m depth (Fig. 1). The Morzhovoi Bay survey was conducted 19 February using transects spaced 4.6 km (2.5 nmi) apart. Bottom depths did not exceed 161 m along any transect, and transects generally did not extend into waters less than about 50 m depth (Fig. 1). The survey of the shelf break southeast of Chirikof Island to near the mouth of Barnabas Trough was conducted between 14 and 16 March along transects spaced 11.1 km (6 nmi) apart between the 200 and 1,000 m depth contours (Fig. 2). The Shelikof Strait sea valley was surveyed from south of Chirikof Island to north of Kuliak Bay on the Alaska Peninsula between 16 and 22 March 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. All surveys were conducted 24 hours per day.

Trawl hauls were conducted to identify echosign and to provide biological samples. Average trawling speed was approximately 1.5 m/s (3 knots). Pollock were sampled to determine sex, fork length (FL), body weight, age, maturity, and ovary weight of selected females (Tables 1 and 2). Pollock were measured to the nearest centimeter. An electronic motion-compensating scale (Marel M60) was used to weigh individual pollock. For age determinations, 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[2]. All data were electronically recorded using the Fisheries Scientific Computing System (FSCS) developed by NOAA's Office of Marine and Aviation Operations to digitally collect data aboard research vessels. Data were stored in a relational database. Additional samples of ovaries were collected for ongoing research by AFSC scientists[3]. Whole fish were frozen for training specimens for the AFSC Fisheries Monitoring and Analysis Division's Observer Program.

Standard sphere acoustic system calibrations (Foote et al. 1987) were conducted to measure acoustic system performance for the ER60. 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, split beam target strength and echo integration data were collected. Transducer beam characteristics were modeled by moving each sphere through the beam and collecting target strength (TS) data using Simrad EKLOBES software.

Data Analysis

Echo integration data were collected between 14 m of the surface and 0.5 m of the bottom, except where the bottom exceeded 1,000 m, the lower limit of data collection. Echosign data identified as pollock were stored in a relational database. Pollock length data were aggregated into strata based on echosign type, geographic proximity of hauls, and similarity in size composition data. Estimates of 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

[2] 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

[3] B. Megrey, Alaska Fisheries Science Center, NMFS, NOAA; 7600 Sand Point Way NE, Seattle WA 98115

composition data to produce estimates of pollock numbers by length. Mean weight-at-length was estimated from the trawl data when there were more than five 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 estimation errors for the acoustic data were derived using a 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 acoustic abundance. Geostatistical methods are 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) are not included.

RESULTS and DISCUSSION

Calibration

Acoustic system calibrations were conducted before, during, and after the winter EIT surveys in the Bering Sea and Gulf of Alaska (Table 3). 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.

Shumagin Islands

Oceanographic Conditions

Surface water temperatures, which were based on SBE-39 data, ranged from 3.0º to 4.2º C with a mean of 3.4º C (Fig. 3). Mean surface temperatures for the 2001-2003 and 2005 surveys ranged from 3.4º to 5.6º C. Temperatures at the depths where the bulk of the pollock biomass occurred off

Renshaw Point (130-180 m) ranged from 3.8º to 4.0º C, whereas temperatures at fish depth in Shumagin Trough (130-160 m) were warmer, ranging from 5.2º to 5.8º C.

Biological Sampling

Biological data and specimens were collected in the Shumagin Islands from nine AWT trawl hauls and two bottom trawls (Tables 1 and 4; Fig. 1). In the midwater tows, pollock was the most abundant species, comprising 95.7% by weight (Table 5). By numbers, pollock, eulachon and capelin contributed 42.9%, 29.6% and 21.8% of the catch, respectively. The eulachon (*Thaleichthys pacificus*) and capelin (*Mallotus villosus*) occurred primarily in Shumagin Trough. Pollock comprised 51.2% by weight of the bottom trawl catches (Table 6). Arrowtooth flounder (*Atheresthes stomias*), flathead sole (*Hippoglossoides elassodon*) and Pacific halibut (*Hippoglossus stenolepis*) were the next most abundant species by weight, comprising 23.1%, 9.1% and 8.0%, respectively.

Trawl catches contained bimodal length distributions of age-1 and adult pollock with few fish between 15 and 40 cm FL (Fig. 4). The length distributions of adults were similar in all areas surveyed. Catches in Shumagin Trough contained primarily age-1 pollock, with trace amounts of age-2 pollock. Within the age-1 category, the distribution was bimodal off Renshaw Point, with modes at 12 and 14 cm FL. Bimodality with the age-1 category has never before been observed in any GOA survey.

The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 3% developing, 66% pre-spawning, 30% spawning, and <1% spent (Fig. 5a). The maturity composition of females longer than 40 cm was 0% immature, 3% developing, 92% pre-spawning, 2% spawning, and 2% spent (Fig. 5b). A logistic model fit to the female maturity-at-length data predicted that 50% of females (l_{50}) were mature at 38 cm FL (Fig. 5c), although there were no observations between 36 and 50 cm FL. The 2006 l_{50} is similar to the 2005 l_{50} of 36 cm FL. The average GSI

(gonadosomatic index: ovary weight/body weight) of pre-spawning females was 0.13 (Fig. 5d), which also was similar to previous Shumagin Island surveys.

Distribution and Abundance

Acoustic data were collected along 723 km (390 nmi) of tracklines. The densest aggregations were off Renshaw Point, although in significantly less quantities than detected in previous surveys (Fig. 6). Pollock were distributed demersally as well as in dense, midwater schools. Most of the biomass was deeper than 140 m and was within 40 m of the bottom (Fig. 7). Little echosign was detected outside of the Renshaw Point area except for the eastern transects in Shumagin Trough.

The abundance estimate for the Shumagin Islands area is 1,788 million pollock weighing 37,000 metric tons (t). The area off Renshaw Point accounted for 43% of the biomass. Significant quantities of age-1 pollock were observed in the Shumagin Trough for the first time since 2001, which accounts for the dramatic increase in the number of pollock, up from the 2005 survey estimate of 64 million. The relative estimation error of the biomass based on the one-dimensional analysis of echosign was 10.1%.

The abundance of pollock in the Shumagin Islands has declined since the mid-1990s. The 2006 biomass estimate is the lowest in survey history and is only 12% of the 1995 estimate of 290,000 t (Table 7, Fig. 8). Inference about abundance trends, however, is difficult to make for several reasons. Only the 1995, 2001-03, and 2005-06 surveys 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, for the 2001 survey, 52% of the adult females were classified as pre-spawning whereas 15% were spawning and 30% were spent, which suggests 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 pollock abundance in the Gulf of Alaska. For example, over one-half of the adult 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

Oceanographic Conditions

Surface water temperatures ranged from 1.9º to 3.3º C with a mean of 2.8º C (Fig. 10). Mean surface temperatures were cooler than in 2003 (5.1º C) and 2005 (4.2º C). Temperatures where most of the pollock biomass was located (60-110 m) ranged from 2.8º to 3.5º C with a mean of 3.1º C, which was cooler than water at depths where most of the pollock biomass was located in 2003 (5.3º C) and 2005 (4.4º C).

Biological Sampling

Biological data and specimens were collected in Sanak Trough from two AWT trawl hauls and two bottom trawl hauls fished in mid-water (Tables 1 and 4; Fig. 1). Pollock was the most abundant species in the AWT catches, comprising nearly 99.5% by weight (Table 8). Pollock comprised 100% of the bottom trawl catches (Table 9). Most pollock captured ranged from 40 to 65 cm FL (Fig. 11) with a mean of 52 cm FL, which was similar to the previous surveys.

The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 2% developing, 19% pre-spawning, 67% spawning, and 11% spent (Fig. 12a). The maturity composition of females longer than 40 cm FL was 1% immature, 1% developing, 64% pre-spawning, 7% spawning, and 17% spent (Fig. 12b). The high percentage of post-spawning fish suggests that the survey timing was late. A similar result was obtained for the 2003 and 2005 Sanak Trough surveys, where 27% and 17% of the females were spent, respectively, which suggests that Sanak Trough should be surveyed earlier in the season. However, competition for vessel time with

other user groups makes this schedule change uncertain. 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). The average GSI for pre-spawning females was 0.16 (Fig. 12d), which was similar to the previous surveys.

Distribution and Abundance

Acoustic data were collected along 200 km (108 nmi) of tracklines. The densest aggregations were observed in the northern part of the trough, which is similar to the 2003 survey results but opposite from 2005, when the densest aggregations were detected off Sanak Island (Fig. 6). Pollock were distributed both demersally as well as in dense, midwater schools over bottom depths between 70 and 130 m (Fig. 13). The abundance estimate for Sanak Trough is 120 million pollock weighing 127,000 t. The relative estimation error of the biomass based on the 1D analysis of echosign was 10.4%. The biomass in 2006 increased substantially from 2003 (82,000 t) and 2005 (68,000 t; Table 7). Age-1 pollock have not been observed in a Sanak Trough survey.

Morzhovoi Bay

Oceanographic Conditions

Surface water temperatures ranged from 1.4º to 1.7º C with a mean of 1.5º C (Fig. 14). Temperatures were slightly warmer where most of the pollock biomass was located (80-100 m), ranging from 1.5º to 2.2º C with a mean of 1.9º C.

Biological Sampling

Biological data and specimens were collected in Morzhovoi Bay from PNE trawl hauls, one of which was fished in mid-water (Tables 1 and 4; Fig. 1). Pollock comprised 99.6% by weight of the

catch (Table 10). Most of the pollock in Morzhovoi Bay ranged from 40 to 60 cm FL, with a mean of 51 cm FL (Fig. 15). A small amount of age-1 pollock was also present in the catches.

The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 1% developing, 15% pre-spawning, 79% spawning, and 4% spent (Fig. 16a). Only four females were collected for length and maturity measurements, thus the maturity composition, logistic model fit, and GSI estimates could not be completed. The large proportion of males categorized as spawning and the absence of females suggest that peak spawning biomass may have already occurred.

Distribution and Abundance

Acoustic data were collected along 122 km (66 nmi) of tracklines. The densest aggregations were detected in the mouth of the bay near the sea floor over bottom depths of 95-115 m (Figs. 6, 17). The abundance estimate for Morzhovoi Bay is 13 million pollock weighing 12,000 t. The relative estimation error of the biomass based on the 1D analysis of echosign was 15.1%. This was the first survey in this area.

Shelf Break Area Near Chirikof Island

Oceanographic Conditions

Surface water temperatures ranged from 4.0º to 4.6º C with a mean of 4.3º C (Fig. 18). Mean surface temperatures were similar to 2004 (4.8º C) and 2005 (4.4º C). Temperatures where most of the pollock biomass was located (300-400 m) ranged from 4.5º to 5.1º C with a mean of 4.8º C, which was similar to 2004 (4.7º C) and 2005 (4.8º C).

Biological Sampling

Biological data and specimens were collected along the Gulf of Alaska shelf break near Chirikof Island from four AWT trawl hauls (Tables 2, 11; Fig. 2). No bottom trawls were conducted in this area. Pollock was the most abundant species by weight, comprising 93.4% of the catch (Table 12). By numbers, pollock, myctophids, and shrimp contributed 35.2%, 28.8, and 26.7% of the catch, respectively. Most pollock captured ranged from 45 to 60 cm FL with a mean of 49 cm FL (Fig. 19), which was similar to the 2004-2005 surveys. In contrast, most of the pollock captured during the 2002-2003 surveys in this area were longer than 50 cm FL. No juvenile pollock have been captured during Chirikof surveys.

The unweighted maturity composition in the Chirikof Island area for males longer than 40 cm FL was 0% immature, 0% developing, 46% mature pre-spawning, 54% spawning, and 0% spent (Fig. 20a). The maturity composition of females longer than 40 cm FL was 0% immature, 2% developing, 98% pre-spawning, 0% spawning, and 0% spent (Fig. 20b). 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. 20c). The average GSI for pre-spawning females of 0.14 (Fig. 20d) was similar to previous surveys.

Distribution and Abundance

Acoustic data were collected along 300 km (162 nmi) of tracklines. Most of the echosign attributed to pollock occurred in midwater layers between 275 and 400 m depth south of the mouth of Barnabas Trough over bottom depths of 300-1,000 m (Figs. 21-22). 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 pollock.

The abundance estimate for the Chirikof Island area is 61 million pollock weighing 69,000 t. The relative estimation error of the biomass based on the one-dimensional analysis of echosign was 11.0%. The biomass in 2006 was slightly less than the 77,000 t observed in 2005, but greater than the 2004 and 2003 estimates of 30,000 and 31,000 t, respectively (Table 7). Because of the absence of age-1 and age-2 pollock during these surveys, forecasts of future pollock abundance are not possible.

Shelikof Strait

Oceanographic Conditions

Surface water temperatures ranged from 2.1º to 4.5º C with a mean of 3.5º C (Fig. 23). Mean surface temperatures were slightly cooler than in 2004 (3.8º C) and 2005 (4.0º C). Temperatures increased with depth, rising to an average of 4.4º at 150 m to 5.3º C at 250 m. Similar temperature distributions were observed during 2004 and 2005.

Biological Sampling

Biological data and specimens were collected in Shelikof Strait from 17 AWT trawl hauls and 2 bottom trawls (Tables 2, 11; Fig. 2). Pollock and eulachon were the most abundant species by weight in midwater trawl hauls, comprising 78.7% and 17.8%, respectively, of the total catch (Table 13). A single Pacific sleeper shark (*Somniosus pacificus*) accounted for 40.8% of the catch weight in the bottom trawls. Arrowtooth flounder comprised 33.4% of the catch in the bottom trawls, while pollock comprised 15.4% of the catch (Table 14).

Trawl hauls conducted in near-bottom pollock echosign between Cape Unalishagvak and Katmai Bay on the western side of the Strait contained fish mostly from 35 to 50 cm FL (Fig. 24a). Trawl hauls conducted in near-bottom pollock echosign south of Cape Ikolik as well as on the Kodiak Island side of the Strait caught significant amounts of 1-and 2-year old pollock (9-16 and 17-24 cm

FL, respectively), although adults dominated by weight (Fig. 24b). Hauls conducted in mid-water layers caught mostly 2-year old pollock with a lesser amount of 1-year old pollock and older fish (Fig. 24c).

The unweighted maturity composition in the Shelikof Strait area for males longer than 40 cm FL was 3% immature, 4% developing, 60% mature pre-spawning, 34% spawning, and 0% spent (Fig. 25a). The maturity composition of females longer than 40 cm FL was 3% immature, 4% developing, 91% pre-spawning, 1% spawning, and 0% spent (Fig. 25b). 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. A logistic model provided a reasonable fit to the female maturity at length data and predicted that 50% of females were mature at 43 cm FL (Fig. 25c), which is similar to most estimates since 1985. The average GSI for pre-spawning females of 0.14 (Fig. 25d) was similar to the mean GSI in 2005 (0.15) and 2004 (0.16), 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. Mature, pre-spawning pollock were detected along the northern side of the Strait from Cape Unalishagvak to Katmai Bay (Fig. 21), although the abundance was lower than in 2005, which in turn was lower than in the mid- to late-1990s. Adult pollock mixed with juvenile pollock were located farther offshore and on the Kodiak Island side of the Strait as well as south of the mouth of the Strait (between Cape Ikolik and Wide Bay) to near the Semidi Islands. Fish were generally located within 50 m of the seafloor over bottom depths exceeding 200 m (Fig. 26). Mid-water layers of juvenile pollock were detected primarily in the northern portion of the survey area on the Kodiak Island side of the Strait (Fig. 27). These fish were located well off bottom from 100 m to 175 m below the surface (Fig. 26).

The abundance estimate for Shelikof Strait is 1.2 billion pollock weighing 294,000 t. The relative estimation error of the biomass based on the one-dimensional analysis of echosign was 4.0%. The pollock biomass in Shelikof Strait declined dramatically in the 1980s, falling from 2.8 million t in 1981 to 290,000 t in 1989 (Fig. 29). The biomass gradually rose in the 1990s, reaching 777,000 t in 1996. The biomass then declined to an 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 of 293,600 t (Table 7).

The 1994 year class, which represented the largest contributor of 1-year old pollock (10.7 billion fish) in the history of the Shelikof Strait area EIT surveys and dominated abundance estimates through 1998, effectively disappeared by 2003 (Figs. 29-30; Tables 15-18). The 1999 year class (4.5 billion fish in 2000) provided the second largest 1-year old estimate in survey history and has dominated biomass estimates since 2001. The estimate of 162 million 1-year old pollock in 2006 is substantially less than the 2005 estimate of 1.6 billion pollock and suggests a relatively weak 2005 year class.

Gear Testing

Following the Shelikof Strait survey, six pairs of alternate AWT trawls were conducted to compare the retention rate of juvenile pollock to older pollock between the two mesh sizes of the codend liners used during GOA surveys (Table 11). An AWT was loaded onto each net reel with a 1.3-cm liner attached to one codend and a 3.2-cm codend liner attached to the other. The study was conducted near the site where Haul 10 was conducted, where a mixture of age-1, age-2, and older pollock were caught. The first choice for each pair of tows was chosen at random. After three pairs of tows were completed, the codends were switched to the opposite AWT in case there was an AWT effect. Preliminary analysis showed about a threefold higher retention of age-1 pollock for the 1.3 cm codend liner than for the 3.2 cm liner (Fig. 31). Additionally, pocket nets attached to the outsides of the forward and intermediate areas of the trawls captured a higher ratio of age-1 to older

pollock than was observed in either codend, suggesting that a substantial amount of age-1 pollock are filtered out of the trawl. Further analysis is in progress.

Another exercise conducted following the Shelikof Strait survey was the continued field testing of an acoustically controlled multiple opening and closing codend (MOCC) device installed in place of the standard AWT codend. The MOCC is controlled by an acoustic link to the ship and contains three codends so up to three discrete samples may be collected during a single trawl haul. Primary objectives of this gear trial were to determine the transit time of fish through the entire length of the AWT and to configure the MOCC so that fish did not accumulate immediately in front of the MOCC frame within the AWT. Thirteen MOCC tows were conducted, the last five with the back end of the codends tied shut so that fish could be retained (Table 11). A video camera attached near the MOCC frame along with the WESMAR net sounder was used for data collection. Preliminary information suggests about 5-10 minutes are required for pollock to transit through the AWT, although more work is needed to verify this under different environmental conditions. Overall, the MOCC performed well, and although needing several minor modifications, the MOCC will soon become a standard component of the MACE gear.

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SCIENTIFIC PERSONNEL

Shumagin Island and Sanak Trough Surveys

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Scott Furnish	Computer Spec.	AFSC
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Shelikof Strait and Shelf Break Area Near Chirikof Island Surveys

Name	Position	Organization
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Table 1.--Number of biological samples and measurements collected during the winter 2006 echo integration-trawl survey of walleye pollock in the Shumagin Islands area (hauls 1-11), Sanak Trough (hauls 12-15), and Morzhovoi Bay (hauls 16-17) in the Gulf of Alaska.

	Pollock						
Haul No.	Lengths	Weights and maturity	Ovaries weighed	Otoliths	Seabird observations	Eulachon lengths	Capelin lengths
1	109	26	--	5	y	91	112
2	127	21	--	11	y	79	30
3	261	101	--	5	y	--	--
4	14	--	--	--	y	--	--
5	308	49	30	49	y	--	--
6	134	80	33	80	y	--	--
7	309	64	26	64	y	--	--
8	334	100	33	100	y	--	--
9	254	42	18	--	y	--	--
10	181	28	7	28	y	--	--
11	306	68	14	30	y	--	--
12	389	88	21	46	y	--	--
13	298	75	36	75	y	--	--
14	345	101	32	101	y	--	--
15	327	60	10	30	y	--	--
16	351	132	--	101	y	--	--
17	304	100	1	100	y		
Totals	4351	1135	261	825		170	142

Table 2.--Number of biological samples and measurements collected during the winter 2006 echo integration-trawl survey of walleye pollock in the Gulf of Alaska shelf break near Chirikof Island (hauls 1-4) and Shelikof Strait area (hauls 5-23).

Haul no.	Pollock				Seabird observations	Eulachon lengths	Eulachon weights	Lanternfish lengths
	Lengths	Weights and maturity	Ovary weights	Otoliths				
1	150	104	46	100	y	--	--	40
2	370	104	62	104	y	--	--	--
3	48	48	27	48	y	30	30	--
4	178	103	47	103	y	23	23	--
5	76	27	4	14	y	41	41	--
6	356	93	22	69	y	51	--	--
7	227	81	19	61	y	100	26	--
8	190	20	--	20	y	38	--	--
9	350	81	30	71	y	35	35	--
10	364	88	20	59	y	80	25	--
11	360	82	26	53	y	49	--	--
12	370	84	29	52	y	50	--	--
13	52	19	2	9	y	32	32	--
14	229	101	31	50	y	37	10	--
15	348	89	38	49	y	82	25	--
16	339	81	43	47	y	73	--	--
17	563	55	34	54	y	70	--	--
18	395	36	15	32	y	52	--	--
19	319	94	33	56	y	48	--	--
20	278	74	51	50	y	65	--	--
21	217	--	--	--	y	55	--	--
22	175	14	4	14	y	16	--	--
23	340	26	10	26	y	51	--	--
Totals	6294	1504	593	1141		1078	247	40

Table 3.--Simrad ER60 38 kHz acoustic system description and settings used during the late winter/early spring 2006 echo integration-trawl surveys of walleye pollock in the Gulf of Alaska and results from standard sphere acoustic system calibrations conducted before and after the surveys.

		Calibrations		
	Survey system settings	13-Feb Three Saints Bay, Alaska	4-Mar Captains Bay, Alaska	22-Mar Uganik 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)	26.43	26.43	26.46	26.46
s_a correction (dB)	-0.57	-0.57	-0.60	-0.56
3 dB beamwidth (deg)				
Along:	7.05	7.03	6.96	6.97
Athwart:	7.02	7.01	7.01	6.98
Angle offset (deg)				
Along:	0.03	0.02	0.04	0.01
Athwart:	0.02	0.03	0.02	0.03
Post-processing s_v threshold (dB):	-70	--	--	--
Standard sphere TS (dB)	--	-42.14	-42.14	-42.14
Sphere range from transducer (m):	--	24.78	21.52	18.95
Absorption coefficient (dB/m):	0.009931	0.009889	0.009942	0.009806
Sound velocity (m/s)	1467.0	1461.5	1460.8	1457.9
Water temp at transducer (^{o}C):	--	3.4	3.3	2.9

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 2006 pollock echo integration-trawl surveys of the Shumagin Islands area (hauls 1-11), Sanak Trough (hauls 12-15), and Morzhovoi Bay (hauls 16-17) 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	15 Feb	4:29	20	55 28.02	158 38.39	155	167	5.7	4.2	2	270	48	7,156
2	AWT	15 Feb	14:50	13	55 21.22	158 57.49	171	182	5.5	4.0	45	3,635	88	12,544
3	AWT	15 Feb	19:11	6	55 19.59	159 08.09	167	184	5.5	3.9	65	8,992	156	3,910
4	AWT	16 Feb	5:15	13	55 29.50	159 39.07	154	169	4.5	3.9	1	14	1	67
5	PNE	16 Feb	17:23	15	55 33.89	160 04.64	168	168	4.0	3.3	332	475	282	1,540
6	AWT	17 Feb	0:16	3	55 35.03	160 17.09	144	193	3.8	3.4	165	134	0	0
7	AWT	17 Feb	2:14	3	55 33.32	160 16.19	152	184	--	--	8,000	6,793	0	0
8	AWT	17 Feb	4:19	19	55 33.21	160 10.54	162	181	--	--	1,834	1,532	2	403
9	AWT	17 Feb	14:35	10	55 26.69	160 29.52	131	148	3.9	3.0	313	3,632	14	3,042
10	PNE	17 Feb	16:21	15	55 25.78	160 34.55	133	133	4.0	3.0	251	6,052	275	579
11	AWT	17 Feb	21:46	20	55 12.88	160 11.43	200	221	3.8	3.5	859	1,459	191	8,030
12	AWT	18 Feb	10:28	1	54 27.60	162 30.40	134	158	3.4	3.0	2,310	2,420	54	12
13	AWT	18 Feb	19:35	1	54 39.80	162 32.96	86	126	2.8	2.7	7,500	6,899	0	0
14	PNE	19 Feb	0:36	1	54 43.11	162 37.77	97	127	3.3	3.4	7,200	7,005	0	0
15	PNE	19 Feb	3:54	2	54 45.00	162 55.42	72	99	3.0	1.9	556	545	0	0
16	PNE	19 Feb	11:14	7	54 55.26	162 59.24	101	120	1.8	1.5	751	804	0	0
17	PNE	19 Feb	15:22	3	54 51.20	163 06.34	100	100	2.1	1.4	463	508	5	2

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

Table 5.--Summary of catch by species in nine midwater trawls conducted during the 2006 pollock echo integration-trawl survey of the Shumagin Islands area.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
walleye pollock	*Theragra chalcogramma*	11,282.5	95.7%	26,461	42.9%
eulachon	*Thaleichthys pacificus*	144.0	1.2%	18,235	29.6%
salmon shark	*Lamna ditropis*	120.0	1.0%	1	< 0.1%
arrowtooth flounder	*Atheresthes stomias*	85.3	0.7%	122	0.2%
capelin	*Mallotus villosus*	73.0	0.6%	13,440	21.8%
Pacific sleeper shark	*Somniosus pacificus*	37.3	0.3%	2	< 0.1%
Pacific cod	*Gadus macrocephalus*	19.2	0.2%	5	< 0.1%
Chinook salmon	*Oncorhynchus tshawytscha*	13.8	0.1%	10	< 0.1%
flathead sole	*Hippoglossoides elassodon*	3.3	< 0.1%	22	< 0.1%
fish larvae unident.	fish larvae unident.	2.2	< 0.1%	2,219	3.6%
shrimp unident.	Decapoda	1.3	< 0.1%	868	1.4%
squid unident.	Teuthoidea	1.0	< 0.1%	151	0.2%
Pacific herring	*Clupea pallasi*	0.3	< 0.1%	44	0.1%
rock sole sp.	*Lepidopsetta* sp.	0.2	< 0.1%	1	< 0.1%
isopod unident.	Isopoda	0.1	< 0.1%	25	< 0.1%
ribbed sculpin	*Triglops pingeli*	< 0.1	< 0.1%	5	< 0.1%
salps unident.	Thaliacea	< 0.1	< 0.1%	2	< 0.1%
Total		11,783.5		61,613	

Table 6.--Summary of catch by species in two bottom trawls conducted during the 2006 pollock echo integration-trawl survey of the Shumagin Islands area.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
walleye pollock	*Theragra chalcogramma*	583.7	51.2%	6,527	75.5%
arrowtooth flounder	*Atheresthes stomias*	263.2	23.1%	415	4.8%
flathead sole	*Hippoglossoides elassodon*	103.2	9.1%	302	3.5%
Pacific halibut	*Hippoglossus stenolepis*	90.6	8.0%	28	< 0.1%
big skate	*Raja binoculata*	23.1	2.0%	1	< 0.1%
rex sole	*Glyptocephalus zachirus*	14.2	1.2%	68	0.8%
Aleutian skate	*Bathyraja aleutica*	11.6	1.0%	1	< 0.1%
Pacific cod	*Gadus macrocephalus*	10.2	0.9%	5	< 0.1%
starry flounder	*Platichthys stellatus*	5.6	0.5%	3	< 0.1%
rock sole spp.	*Lepidopsetta* sp.	5.3	0.5%	8	< 0.1%
eulachon	*Thaleichthys pacificus*	4.9	0.4%	542	6.3%
Alaska plaice	*Pleuronectes quadrituberculatus*	4.9	0.4%	4	< 0.1%
Tanner crab	*Chionoecetes bairdi*	4.5	0.4%	57	0.7%
yellow Irish lord	*Hemilepidotus jordani*	4.1	0.4%	4	< 0.1%
great sculpin	*Myoxocephalus polyacanthocephalus*	2.0	0.2%	1	< 0.1%
Chinook salmon	*Oncorhynchus tshawytscha*	1.5	0.1%	1	< 0.1%
jellyfish unident.	Scyphozoa	1.2	0.1%	1	< 0.1%
sturgeon poacher	*Podothecus veternus*	0.9	0.1%	13	< 0.1%
Oregon triton	*Fusitriton oregonensis*	0.9	0.1%	10	< 0.1%
longsnout prickleback	*Lumpenella longirostris*	0.9	0.1%	5	< 0.1%
sablefish	*Anoplogaster cornuta*	0.6	0.1%	2	< 0.1%
longhead dab	*Limanda proboscidea*	0.6	< 0.1%	2	< 0.1%
spinyhead sculpin	*Dasycottus setiger*	0.6	< 0.1%	4	< 0.1%
northern shrimp	*Pandalus borealis*	0.4	< 0.1%	619	7.2%
Dungeness crab	*Cancer magister*	0.3	< 0.1%	1	< 0.1%
triton unident.	*Fusitriton* sp.	0.3	< 0.1%	7	< 0.1%
Pacific herring	*Clupea pallasi*	0.2	< 0.1%	3	< 0.1%
shortfin eelpout	*Lycodes brevipes*	0.2	< 0.1%	2	< 0.1%
hermit crab unident.	Paguridae	0.1	< 0.1%	1	< 0.1%
common mud star	*Ctenodiscus crispatus*	0.1	< 0.1%	6	< 0.1%
starfish unident.	Asteroidea unident.	0.1	< 0.1%	2	< 0.1%
crangonid shrimp unident.	*Crangon* sp.	< 0.1	< 0.1%	1	< 0.1%
Total		1,139.8		8,646	

Table 7.--Estimates of 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*							
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					
1995	763,600	4.5%	290,100					
1996	777,200	3.7%	117,700					
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%

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

Table 8.--Summary of catch by species in two midwater trawls conducted during the 2006 pollock echo integration-trawl survey of Sanak Trough.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
walleye pollock	*Theragra chalcogramma*	9,810.0	99.5%	6,899	99.9%
Pacific cod	*Gadus macrocephalus*	53.1	0.5%	9	< 0.1%
flathead sole	*Hippoglossoides elassodon*	0.9	< 0.1%	3	< 0.1%
Total		9,864.0		6,911	

Table 9.--Summary of catch by species in two bottom trawls conducted during the 2006 pollock echo integration-trawl survey of Sanak Trough.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
walleye pollock	*Theragra chalcogramma*	7,755.7	100.0%	7,550	100.0%
Total		7,755.7		7,550	

Table 10.--Summary of catch by species in the two bottom trawls conducted during the 2006 pollock echo integration-trawl survey of Morzhovoi Bay.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
walleye pollock	*Theragra chalcogramma*	1,213.8	99.6%	1,312	99.8%
Pacific cod	*Gadus macrocephalus*	3.6	0.3%	1	0.1%
lumpsucker unident.	*Aptocyclus* sp.	1.3	0.1%	1	0.1%
Total		1,218.7		1,314	

Table 11.--Summary of trawl and catch data from the 2006 pollock echo integration-trawl surveys of the Gulf of Alaska shelf break near Chirikof Island (hauls 1-4), the Shelikof Strait area (hauls 5-23), net-liner comparison trawls (hauls 24-35), and multiple opening and closing codend (hauls 36-40).

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	footrope	surface	kg	number	kg	number	kg
1	AWT	15-Mar	2:42	17	55 54.40	154 50.20	394	426	3.6	4.0	166	150	2	37	6
2	AWT	15-Mar	15:47	24	55 52.19	153 46.55	315	703	4.8	4.5	1,111	912	1	27	12
3	AWT	16-Mar	3:51	42	56 16.45	153 07.41	329	451	5.1	4.4	49	48	1	30	53
4	AWT	16-Mar	9:51	6	56 20.24	152 41.28	285	448	5.3	4.3	181	178	1	23	7
5	PNE	17-Mar	5:29	20	55 49.20	156 31.94	251	251	5.5	3.3	6	76	1	37	23
6	AWT	17-Mar	19:57	12	56 17.18	156 12.09	247	261	5.5	3.3	243	1,279	40	1,300	16
7	AWT	18-Mar	3:59	9	56 31.44	156 02.75	254	271	5.6	3.3	228	3,364	37	1,809	0
8	PNE	18-Mar	14:06	20	56 39.89	155 28.36	197	197	4.7	3.3	34	562	1	42	199
9	AWT	18-Mar	23:01	15	57 00.56	155 52.50	289	306	5.4	3.3	243	1,492	44	1,302	13
10	AWT	19-Mar	5:19	20	57 00.51	155 11.15	223	234	5.4	3.3	833	3,101	87	2,295	24
11	AWT	19-Mar	12:05	12	57 13.61	155 35.64	250	279	5.4	2.9	584	2,463	90	2,228	3
12	AWT	19-Mar	22:23	22	57 26.50	155 23.99	259	270	5.5	4.0	814	1,038	67	1,574	24
13	AWT	20-Mar	1:20	12	57 22.07	155 06.72	163	238	5.1	3.8	476	7,912	4	252	17
14	AWT	20-Mar	5:51	12	57 25.64	155 01.15	222	233	5.4	3.6	361	865	328	7,403	36
15	AWT	20-Mar	10:55	30	57 38.39	155 11.12	274	287	--	--	1,415	3,230	35	992	0
16	AWT	20-Mar	17:15	22	57 36.22	154 43.82	217	226	5.4	3.9	822	2,608	437	11,510	47
17	AWT	20-Mar	23:26	25	57 48.54	154 50.35	262	277	5.0	4.0	507	3,276	240	11,736	25
18	AWT	21-Mar	6:14	40	57 52.30	154 36.87	239	262	4.5	2.3	1,302	1,474	99	2,199	24
19	AWT	21-Mar	12:30	9	57 53.84	153 55.94	201	223	5.2	3.9	287	1,245	267	6,897	5
20	AWT	21-Mar	15:51	10	58 02.08	154 15.10	270	274	5.0	2.5	987	851	293	5,283	165
21	AWT	21-Mar	19:54	15	58 05.44	153 59.82	173	206	4.3	4.4	112	1,941	13	385	0
22	AWT	22-Mar	4:51	10	58 08.93	153 23.26	147	220	4.9	4.3	117	1,170	2	79	1
23	AWT	22-Mar	6:48	14	58 09.50	153 24.46	205	219	5.3	4.3	341	1,495	106	3,528	11
24	AWT	23-Mar	13:38	12	57 02.91	155 18.76	241	241	5.5	3.7	388	1,238	254	5,481	16
25	AWT	23-Mar	16:19	12	57 03.22	155 19.63	245	245	5.5	3.7	439	1,656	423	13,178	29
26	AWT	23-Mar	19:03	12	57 02.65	155 19.23	244	255	5.5	3.5	625	2,905	143	5,657	23
27	AWT	23-Mar	21:40	12	57 02.56	155 19.29	240	254	5.5	3.5	554	1,724	99	2,665	112
28	AWT	24-Mar	0:09	12	57 02.45	155 19.34	241	254	5.5	3.5	442	680	67	1,856	24
29	AWT	24-Mar	2:42	12	57 02.53	155 19.39	234	254	5.5	3.5	633	3,912	128	3,419	27
30	AWT	24-Mar	5:59	12	57 02.07	155 19.10	244	254	5.5	3.8	344	1,937	41	1,140	5
31	AWT	24-Mar	8:26	12	57 02.38	155 19.52	244	256	5.5	3.8	354	2,653	42	1,788	12
32	AWT	24-Mar	10:41	12	57 02.09	155 19.23	240	256	5.5	3.7	311	2,355	24	641	203
33	AWT	24-Mar	13:01	12	57 03.46	155 18.94	241	254	5.5	--	357	2,922	43	2,105	8
34	AWT	24-Mar	15:28	12	57 02.54	155 19.29	242	256	5.5	3.6	386	3,277	48	2,094	8

Table 11.--Continued.

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	footrope	surface	kg	number	kg	number	kg
35	AWT	24-Mar	18:19	12	57 02.38	155 18.95	250	255	5.5	3.6	325	2,329	228	5,063	14
36a	AWT	25-Mar	21:19	2	57 43.96	154 17.06	107	238	4.2	3.8	38	770	0	11	2
36b	AWT	25-Mar	22:07	2	57 45.50	154 13.48	83	208	3.9	3.8	70	2,453	1	82	2
36c	AWT	25-Mar	22:55	2	57 47.15	154 09.91	73	200	4.1	3.8	70	5,094	3	523	0
37a	AWT	26-Mar	7:08	2	57 50.49	154 52.26	213	283	5.2	3.5	181	203	8	65	0
37b	AWT	26-Mar	7:17	2	57 50.43	154 53.24	225	284	5.3	3.5	282	335	10	350	0
37c	AWT	26-Mar	7:37	2	57 50.41	154 55.10	230	288	5.3	3.5	522	544	6	203	1
38a	AWT	26-Mar	16:10	3	57 49.95	154 35.30	185	229	5.5	4.1	26	30	3	190	2
38b	AWT	26-Mar	16:14	16	57 50.02	154 35.61	187	233	4.5	4.1	102	143	11	549	2
39a	AWT	26-Mar	18:55	8	57 50.69	154 42.76	210	260	5.4	3.9	320	703	59	2,091	10
39b	AWT	26-Mar	19:03	4	57 50.87	154 43.53	210	262	5.4	3.9	243	362	23	899	6
39c	AWT	26-Mar	19:08	11	57 50.99	154 43.97	210	271	4.3	3.9	155	206	12	415	10
40a	AWT	26-Mar	23:05	8	57 50.29	154 03.28	135	208	4.4	4.3	61	4,959	0	12	0
40b	AWT	26-Mar	23:43	19	57 48.91	154 06.51	167	207	4.4	4.3	35	258	5	246	4

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

Note: Hauls 36-40 were MOC deployments that were fished with the back ends of the codends tied shut so that fish could be retained (see text for a description).

Table 12.--Summary of catch by species in four midwater trawls conducted during the 2006 pollock echo integration-trawl survey of the Gulf of Alaska shelf-break near Chirikof Island.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
walleye pollock	*Theragra chalcogramma*	1,507.3	93.4%	1,289	35.2%
grenadier unident.	Macrouridae	33.1	2.0%	10	0.3%
Pacific ocean perch	*Sebastes alutus*	25.7	1.6%	40	1.1%
shortraker rockfish	*Sebastes borealis*	18.7	1.2%	8	0.2%
Myctophidae	Myctophidae	7.9	0.5%	1,054	28.8%
giant grenadier	*Albatrossia pectoralis*	5.3	0.3%	2	0.1%
jellyfish unident.	Scyphozoa (class)	4.8	0.3%	10	0.3%
eulachon	*Thaleichthys pacificus*	4.0	0.3%	90	2.5%
arrowtooth flounder	*Atheresthes stomias*	2.9	0.2%	4	0.1%
shrimp unident.	Decapoda (order)	2.1	0.1%	978	26.7%
rougheye rockfish	*Sebastes aleutianus*	1.5	0.1%	1	< 0.1%
squid unident.	Teuthoidea	0.8	< 0.1%	88	2.4%
capelin	*Mallotus villosus*	0.3	< 0.1%	49	1.3%
northern smoothtongue	*Leuroglossus schmidti*	0.1	< 0.1%	33	0.9%
salps unident.	Thaliacea	< 0.1	< 0.1%	2	0.1%
Total		1,614.5		3,658	

Table 13.--Summary of catch by species in 17 midwater trawls conducted during the 2006 pollock echo integration-trawl survey of the Shelikof Strait area.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
walleye pollock	*Theragra chalcogramma*	9,679.1	78.7%	38,884	38.2%
eulachon	*Thaleichthys pacificus*	2,190.8	17.8%	60,810	59.7%
Pacific sleeper shark	*Somniosus pacificus*	150.0	1.2%	1	< 0.1%
majestic squid	*Berryteuthis magister*	85.7	0.7%	220	0.2%
squid unident.	Teuthoidea (order)	53.4	0.4%	998	1.0%
Chinook salmon	*Oncorhynchus tshawytscha*	52.3	0.4%	27	< 0.1%
arrowtooth flounder	*Atheresthes stomias*	47.8	0.4%	46	< 0.1%
Bering skate	*Bathyraja interrupta*	13.4	0.1%	1	< 0.1%
northern smoothtongue	*Leuroglossus schmidti*	13.3	0.1%	535	0.5%
smooth lumpsucker	*Aptocyclus ventricosus*	7.5	0.1%	8	< 0.1%
Pacific cod	*Gadus macrocephalus*	3.4	< 0.1%	1	< 0.1%
chum salmon	*Oncorhynchus keta*	2.6	< 0.1%	1	< 0.1%
shrimp unident.	Decapoda (order)	1.5	< 0.1%	297	0.3%
Pacific ocean perch	*Sebastes alutus*	1.2	< 0.1%	1	< 0.1%
flathead sole	*Hippoglossoides elassodon*	1.2	< 0.1%	3	< 0.1%
jellyfish unident.	*Cyanea* sp.	1.0	< 0.1%	1	< 0.1%
Pacific sandfish	*Trichodon trichodon*	0.8	< 0.1%	37	< 0.1%
sablefish	*Anoplopoma fimbria*	0.4	< 0.1%	1	< 0.1%
capelin	*Mallotus villosus*	< 0.1	< 0.1%	3	< 0.1%
rex sole	*Glyptocephalus zachirus*	< 0.1	< 0.1%	1	< 0.1%
Total		12,305.3		101,876	

Table 14.--Summary of catch by species in two bottom trawls conducted during the 2006 pollock echo integration-trawl survey of the Shelikof Strait area.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
Pacific sleeper shark	*Somniosus pacificus*	107.9	40.8%	1	0.1%
arrowtooth flounder	*Atheresthes stomias*	88.2	33.4%	137	14.0%
walleye pollock	*Theragra chalcogramma*	40.7	15.4%	638	65.2%
Alaska skate	*Bathyraja parmifera*	8.7	3.3%	1	0.1%
longnose skate	*Raja rhina*	6.2	2.3%	1	0.1%
eulachon	*Thaleichthys pacificus*	2.3	0.9%	79	8.1%
flathead sole	*Hippoglossoides elassodon*	2.1	0.8%	5	0.5%
Bering skate	*Bathyraja interrupta*	1.9	0.7%	2	0.2%
rougheye rockfish	*Sebastes aleutianus*	1.7	0.6%	1	0.1%
squid unident.	Teuthoidea (order)	0.9	0.3%	2	0.2%
Chinook salmon	*Oncorhynchus tshawytscha*	0.8	0.3%	1	0.1%
shrimp unident.	Decapoda (order)	0.8	0.3%	90	9.2%
majestic squid	*Berryteuthis magister*	0.7	0.3%	1	0.1%
Pacific halibut	*Hippoglossus stenolepis*	0.6	0.2%	1	0.1%
eelpout unident.	Zoarcidae	0.4	0.2%	1	0.1%
Pacific ocean perch	*Sebastes alutus*	0.2	0.1%	1	0.1%
sablefish	*Anoplopoma fimbria*	0.2	0.1%	1	0.1%
rex sole	*Glyptocephalus zachirus*	0.1	< 0.1%	3	0.3%
hermit crab unident.	Paguridae	0.1	< 0.1%	3	0.3%
Pacific herring	*Clupea pallasi*	< 0.1	< 0.1%	3	0.3%
whelk unident.	Gastropoda	< 0.1	< 0.1%	1	0.1%
sculpin unident.	Cottidae	< 0.1	< 0.1%	2	0.2%
starfish unident.	Asteroidea unident.	< 0.1	< 0.1%	2	0.2%
Tanner crab unident.	*Chionoecetes* sp.	< 0.1	< 0.1%	1	0.1%
Total		264.4		978	

Table 15.--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: 2006 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
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
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
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
4	769	--	1,297	142	315	46	--	322	216	63	48	188	72	32	78	25	80	474	--	16	61	97	802	160	35
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
6	1,052	--	698	988	347	49	--	17	43	180	70	84	126	84	245	71	44	14	--	132	23	16	8	49	162
7	210	--	599	450	439	86	--	6	14	46	116	85	27	42	122	201	52	32	--	17	35	8	4	3	36
8	129	--	132	224	167	149	--	6	4	22	24	171	36	27	54	119	98	36	--	13	13	7	2	3	4
9	79	--	14	41	43	60	--	4	2	8	29	33	39	44	17	40	53	74	--	10	6	1	1	3	2
10	25	--	12	3	6	11	--	9	1	8	2	56	16	48	11	13	14	26	--	8	3	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
12	0	--	2	1	1	0	--	2	1	3	1	15	3	7	6	5	3	7	--	7	2	< 1	0	0	--
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

Table 16.--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: 2006 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
1	1	--	< 1	1	24	4	--	< 1	4	< 1	< 1	3	1	2	114	1	1	4	--	57	2	< 1	1	1	18
2	309	--	71	6	54	139	--	8	8	67	12	3	6	3	46	180	15	8	--	63	214	13	8	8	13
3	342	--	117	83	41	40	--	130	21	15	85	16	11	14	23	24	195	28	--	60	60	164	43	14	17
4	255	--	529	78	159	17	--	91	86	23	13	60	34	20	41	12	28	153	--	9	25	29	222	78	19
5	1,068	--	650	373	109	56	--	31	111	61	33	144	136	127	83	50	13	53	--	54	27	12	25	179	132
6	496	--	455	684	253	41	--	9	27	120	54	68	90	75	220	73	53	12	--	107	24	16	7	37	119
7	133	--	332	331	353	76	--	6	12	36	106	92	28	48	116	212	61	39	--	17	40	9	5	4	29
8	92	--	94	161	138	140	--	6	4	24	23	194	43	34	55	132	120	47	--	17	18	8	2	5	4
9	68	--	11	36	35	58	--	5	3	9	36	36	46	64	19	48	67	95	--	15	8	2	3	5	3
10	19	--	12	3	6	11	--	11	1	11	3	71	21	68	15	17	20	33	--	11	5	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
12	0	--	1	1	1	0	--	3	1	4	1	21	4	10	7	7	5	10	--	11	3	1	0	0	--
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

Table 17.--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
5	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
7	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
9	0	--	0	0	21	60	--	0	4	1	1	< 1	< 1	4	163	0	3	4	--	29	4	0	0	< 1	6	4
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
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
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
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
14	31	--	0	1	79	1	--	1	9	1	4	36	3	6	157	4	7	49	--	320	24	1	8	1	98	5
15	5	--	0	0	13	0	--	< 1	3	< 1	< 1	6	1	< 1	25	< 1	1	10	--	30	2	1	1	< 1	19	2
16	5	--	0	0	1	3	--	0	< 1	0	< 1	1	0	< 1	1	5	< 1	2	--	7	2	0	< 1	< 1	4	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
18	5	--	1	0	1	41	--	1	< 1	36	1	0	< 1	1	4	249	1	< 1	--	10	185	< 1	0	< 1	1	23
19	12	--	8	0	2	187	--	2	1	165	7	< 1	< 1	< 1	16	634	1	1	--	32	808	3	1	1	2	75
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
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
22	733	--	221	1	75	431	--	32	17	198	48	5	17	7	92	441	50	16	--	196	460	29	15	20	29	161
23	952	--	198	7	152	267	--	29	23	75	41	8	20	6	93	131	48	20	--	176	107	43	17	23	38	107
24	695	--	142	15	151	136	--	9	19	21	23	10	14	5	73	54	48	21	--	68	20	56	16	18	30	66
25	389	--	37	21	75	46	--	4	11	7	23	6	7	4	53	18	89	10	--	30	22	128	11	12	16	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
27	90	--	6	5	16	11	--	40	3	6	108	3	1	3	27	9	275	6	--	6	60	250	9	4	2	6
28	70	--	6	6	6	9	--	107	3	3	142	3	1	1	17	11	268	5	--	10	85	210	23	2	3	3
29	83	--	3	9	3	15	--	158	6	9	123	8	1	1	5	22	205	10	--	13	91	124	52	3	1	5
30	235	--	7	26	5	31	--	191	12	16	72	19	1	3	2	23	104	25	--	18	50	74	107	4	8	6
31	420	--	3	48	6	34	--	129	23	19	32	25	2	6	6	15	59	42	--	32	37	42	153	7	8	6
32	492	--	24	67	4	38	--	92	27	17	22	37	3	7	4	15	31	78	--	37	15	25	185	16	2	6
33	490	--	65	68	11	29	--	85	24	11	8	48	5	11	8	13	21	102	--	34	14	29	145	25	10	6
34	499	--	141	53	22	18	--	89	28	10	8	67	6	6	6	6	16	99	--	28	7	20	122	41	3	8
35	592	--	195	27	27	12	--	63	37	8	7	85	10	7	11	4	11	103	--	22	6	17	77	56	10	5
36	665	--	258	21	41	9	--	41	53	12	8	83	9	6	15	4	10	84	--	13	8	7	57	59	4	4
37	541	--	339	20	44	7	--	28	62	19	9	84	17	3	14	3	10	66	--	9	9	5	38	54	18	3
38	403	--	368	35	53	3	--	24	66	23	8	65	26	3	20	2	9	45	--	8	9	6	28	47	10	2
39	352	--	341	87	64	4	--	12	57	21	6	36	40	2	9	2	5	26	--	7	11	6	23	39	11	1

Table 17.--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
40	339	--	343	138	77	3	--	13	52	33	10	30	53	3	15	2	8	15	--	11	9	2	14	35	23	2
41	231	--	290	170	82	8	--	8	46	34	9	22	57	5	5	2	4	16	--	13	12	2	13	35	22	2
42	224	--	326	219	96	8	--	5	36	37	13	15	57	9	7	2	5	6	--	19	8	3	7	38	32	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
44	145	--	304	309	113	22	--	3	16	37	19	14	37	23	18	6	5	5	--	18	7	2	5	27	41	5
45	116	--	256	316	119	35	--	2	12	34	21	17	33	36	35	7	3	2	--	19	8	3	3	24	39	7
46	84	--	201	283	148	39	--	2	6	25	24	22	23	39	53	13	4	2	--	22	5	2	3	18	33	9
47	113	--	171	213	140	50	--	2	6	23	22	21	19	46	62	25	4	3	--	19	5	3	3	17	37	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
49	75	--	91	104	117	52	--	3	5	16	20	38	16	33	73	53	13	6	--	13	9	3	2	8	22	15
50	58	--	52	68	83	51	--	4	5	15	19	46	17	29	66	64	20	13	--	16	8	3	2	7	28	18
51	50	--	49	40	52	42	--	4	4	8	20	40	15	24	51	69	30	18	--	10	5	4	2	5	14	19
52	25	--	23	25	28	21	--	3	4	8	14	38	14	21	40	64	36	24	--	11	9	4	2	4	7	19
53	12	--	17	13	23	18	--	3	5	7	13	35	14	24	30	53	37	26	--	10	6	3	2	2	6	16
54	9	--	7	4	9	6	--	2	4	5	9	35	13	18	22	39	34	23	--	9	4	3	1	3	4	12
55	15	--	9	3	4	11	--	2	2	7	10	30	11	18	16	29	28	20	--	9	5	2	1	3	3	13
56	5	--	2	2	2	2	--	2	1	2	6	15	9	18	14	19	24	19	--	8	5	1	< 1	2	2	7
57	7	--	2	1	2	< 1	--	1	1	2	3	18	7	13	7	13	12	12	--	9	3	1	< 1	1	1	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
59	1	--	1	< 1	1	< 1	--	< 1	1	1	2	4	4	9	3	6	5	8	--	5	3	1	1	1	1	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
61	0	--	1	< 1	< 1	1	--	< 1	< 1	< 1	1	2	2	5	1	3	2	2	--	1	1	< 1	1	< 1	< 1	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
63	0	--	0	1	1	< 1	--	0	< 1	< 1	1	1	1	1	< 1	1	1	2	--	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
65	0	--	0	0	0	< 1	--	0	0	< 1	1	0	< 1	1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	0	< 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
67	0	--	0	0	0	< 1	--	< 1	0	< 1	< 1	< 1	< 1	< 1	0	< 1	< 1	0	--	< 1	0	< 1	< 1	0	0	< 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
69	0	--	0	0	0	0	--	0	0	< 1	1	0	< 1	< 1	0	< 1	< 1	0	--	0	0	0	0	0	0	0
70	0	--	0	0	0	0	--	< 1	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	0	0	0
71	0	--	0	0	0	0	--	0	0	< 1	0	0	0	< 1	0	0	0	0	--	0	0	< 1	0	0	0	0
72	0	--	0	0	0	0	--	0	0	0	0	0	0	0	0	< 1	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
74	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
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

Table 18.--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
5	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
7	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
9	0	--	0	0	< 1	< 1	--	0	< 1	< 1	< 1	< 1	< 1	< 1	1	0	< 1	< 1	--	< 1	< 1	0	0	< 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
11	< 1	--	0	< 1	6	2	--	< 1	1	< 1	< 1	< 1	< 1	< 1	35	< 1	< 1	1	--	11	1	0	< 1	< 1	4	< 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
13	< 1	--	< 1	0	4	< 1	--	< 1	1	< 1	< 1	1	< 1	< 1	23	< 1	< 1	1	--	16	1	< 1	< 1	< 1	4	< 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
15	< 1	--	0	0	< 1	0	--	< 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
17	< 1	--	< 1	0	< 1	< 1	--	0	0	< 1	< 1	0	0	0	< 1	2	< 1	< 1	--	< 1	1	0	< 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
19	1	--	< 1	0	< 1	8	--	< 1	< 1	7	< 1	< 1	< 1	< 1	1	27	< 1	< 1	--	2	33	< 1	< 1	< 1	< 1	3
20	4	--	4	0	< 1	23	--	< 1	< 1	16	1	< 1	< 1	< 1	2	48	< 1	< 1	--	5	68	1	< 1	< 1	< 1	7
21	18	--	11	< 1	1	33	--	1	< 1	21	2	< 1	< 1	< 1	4	46	1	1	--	10	59	2	1	1	1	12
22	53	--	16	< 1	6	31	--	2	1	13	3	< 1	1	1	7	30	4	1	--	16	31	2	1	1	2	11
23	78	--	16	1	14	22	--	2	2	6	3	1	2	1	8	10	4	2	--	17	8	4	1	2	3	8
24	65	--	13	2	15	13	--	1	2	2	2	1	1	1	7	5	5	2	--	7	2	5	2	2	3	6
25	41	--	4	2	9	5	--	< 1	1	1	2	1	1	< 1	6	2	10	1	--	4	2	14	1	1	2	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
27	12	--	1	1	2	2	--	5	< 1	1	14	< 1	< 1	< 1	4	1	38	1	--	1	8	35	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
29	14	--	1	2	1	3	--	26	1	1	20	1	< 1	< 1	1	4	36	2	--	2	15	22	9	1	< 1	< 1
30	44	--	1	5	1	6	--	35	2	3	13	4	< 1	1	< 1	4	20	5	--	4	9	15	20	1	2	1
31	86	--	1	10	1	7	--	27	5	4	7	5	< 1	1	1	3	13	9	--	8	8	9	32	1	2	1
32	111	--	5	16	1	9	--	21	6	4	5	9	1	2	1	3	7	19	--	10	3	6	43	4	1	1
33	122	--	16	18	3	7	--	22	6	3	2	12	1	3	2	3	5	26	--	10	4	8	37	7	3	2
34	136	--	39	15	6	5	--	25	8	3	2	19	2	2	2	2	5	28	--	9	2	6	34	12	1	2
35	176	--	59	9	9	4	--	19	11	2	2	27	3	2	4	1	4	33	--	8	2	6	24	18	3	2
36	216	--	84	7	14	3	--	14	18	4	3	29	3	2	5	1	3	29	--	5	3	2	19	20	1	1
37	191	--	121	7	17	2	--	11	23	7	3	32	6	1	5	1	4	25	--	4	3	2	14	21	7	1
38	154	--	142	14	21	1	--	10	26	9	3	26	11	1	8	1	4	19	--	4	4	2	11	20	4	< 1
39	146	--	143	38	28	2	--	5	25	9	3	16	18	1	4	1	2	12	--	3	5	3	10	18	5	< 1

Table 18.--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
40	152	--	155	66	37	1	--	6	24	15	5	15	26	2	7	1	4	7	--	6	4	1	7	17	12	1
41	112	--	142	87	42	4	--	4	23	17	4	11	30	3	3	1	2	8	--	7	6	1	7	19	13	1
42	117	--	172	121	53	4	--	3	20	20	7	9	32	5	4	1	3	3	--	11	5	2	4	22	19	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
44	87	--	185	197	72	14	--	2	10	24	12	9	24	16	12	4	3	3	--	13	5	1	3	19	27	4
45	75	--	167	215	81	24	--	2	8	23	15	12	23	26	24	5	2	2	--	15	6	2	2	17	27	5
46	58	--	140	206	107	29	--	2	4	19	18	17	18	31	39	10	3	1	--	17	4	2	3	15	24	7
47	83	--	127	166	108	40	--	1	5	18	18	17	16	39	49	20	3	3	--	16	4	2	3	14	29	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
49	63	--	77	92	102	47	--	2	4	15	19	36	15	32	66	48	13	6	--	13	8	3	2	8	19	15
50	51	--	46	63	78	49	--	4	4	15	19	47	17	30	63	62	20	13	--	16	8	3	2	8	28	18
51	47	--	47	40	52	43	--	4	4	8	21	43	16	26	52	71	32	20	--	12	6	4	2	5	14	22
52	25	--	23	26	29	24	--	3	4	8	15	44	15	24	43	70	41	27	--	13	10	5	2	5	8	23
53	13	--	19	15	26	21	--	4	5	8	15	43	17	29	34	62	45	32	--	12	8	4	2	3	7	20
54	11	--	8	5	10	7	--	3	5	6	12	45	17	23	26	48	44	30	--	13	6	4	1	4	5	16
55	18	--	11	4	5	14	--	3	2	9	14	41	15	24	20	38	38	27	--	12	7	3	2	4	4	19
56	6	--	2	2	3	3	--	2	2	3	9	22	13	27	19	27	35	28	--	12	8	2	< 1	3	3	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
58	4	--	1	1	1	2	--	1	1	2	7	24	12	19	10	15	13	15	--	11	4	2	1	2	2	6
59	1	--	1	< 1	2	1	--	1	1	2	3	8	7	16	4	11	8	13	--	8	6	2	2	1	1	6
60	0	--	1	< 1	3	1	--	0	1	2	4	4	5	13	3	9	5	8	--	4	6	1	1	< 1	1	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
62	0	--	0	2	1	1	--	1	< 1	< 1	1	5	2	4	3	3	2	3	--	3	1	1	< 1	< 1	0	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
64	0	--	0	1	0	< 1	--	0	< 1	< 1	< 1	1	< 1	2	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
66	0	--	0	0	< 1	1	--	0	< 1	< 1	0	1	< 1	< 1	0	< 1	< 1	1	--	< 1	3	0	0	0	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
68	0	--	0	0	0	0	--	0	0	< 1	0	0	< 1	0	0	< 1	1	< 1	--	0	1	< 1	0	< 1	0	< 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
70	0	--	0	0	0	0	--	< 1	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
72	0	--	0	0	0	0	--	0	0	0	0	0	0	0	0	< 1	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
74	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
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

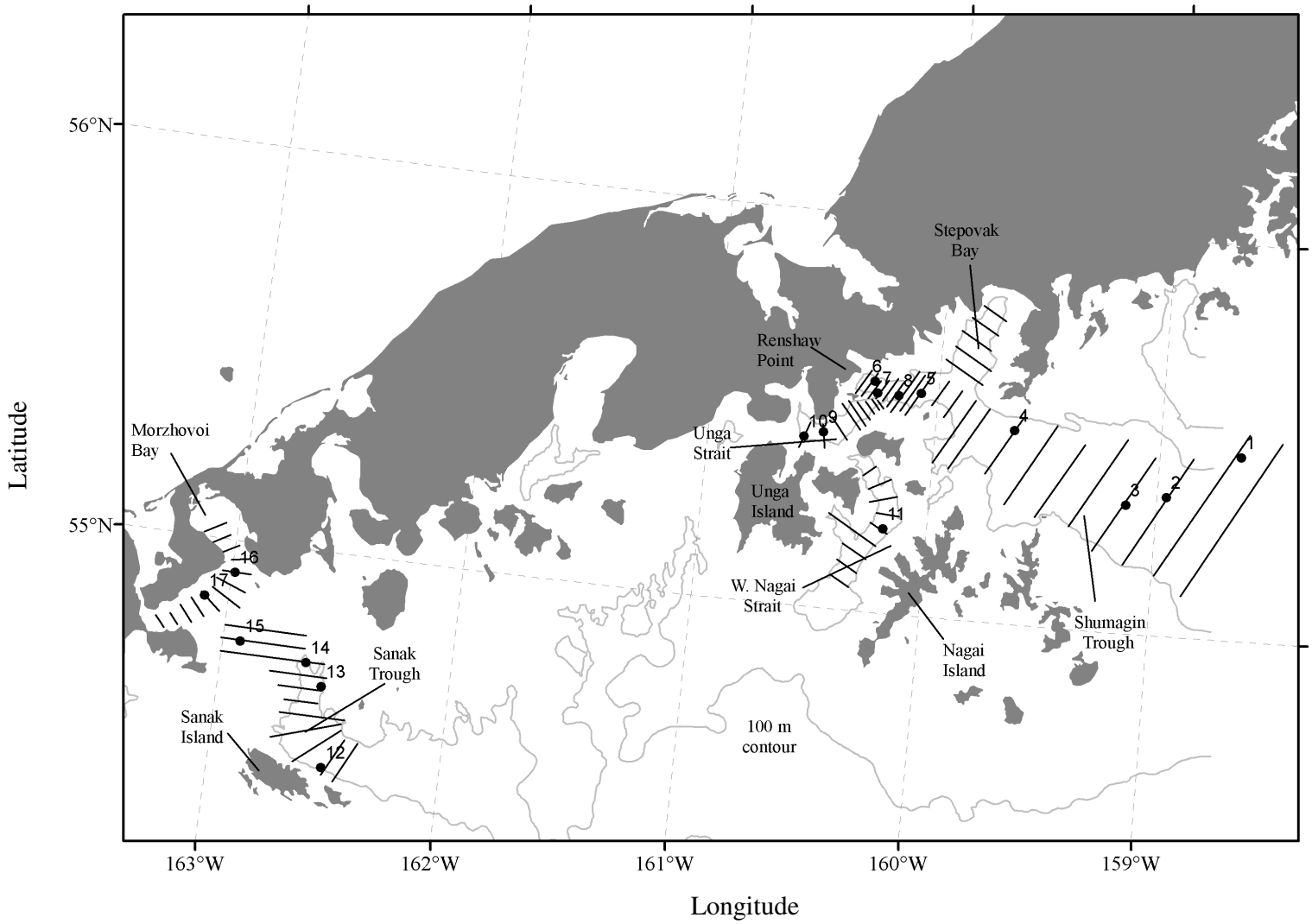

Figure 1.--Transect lines and distribution of trawls during the winter 2006 echo integration-trawl surveys of the Shumagin Islands, Sanak Trough and Morzhovoi Bay in the Gulf of Alaska.

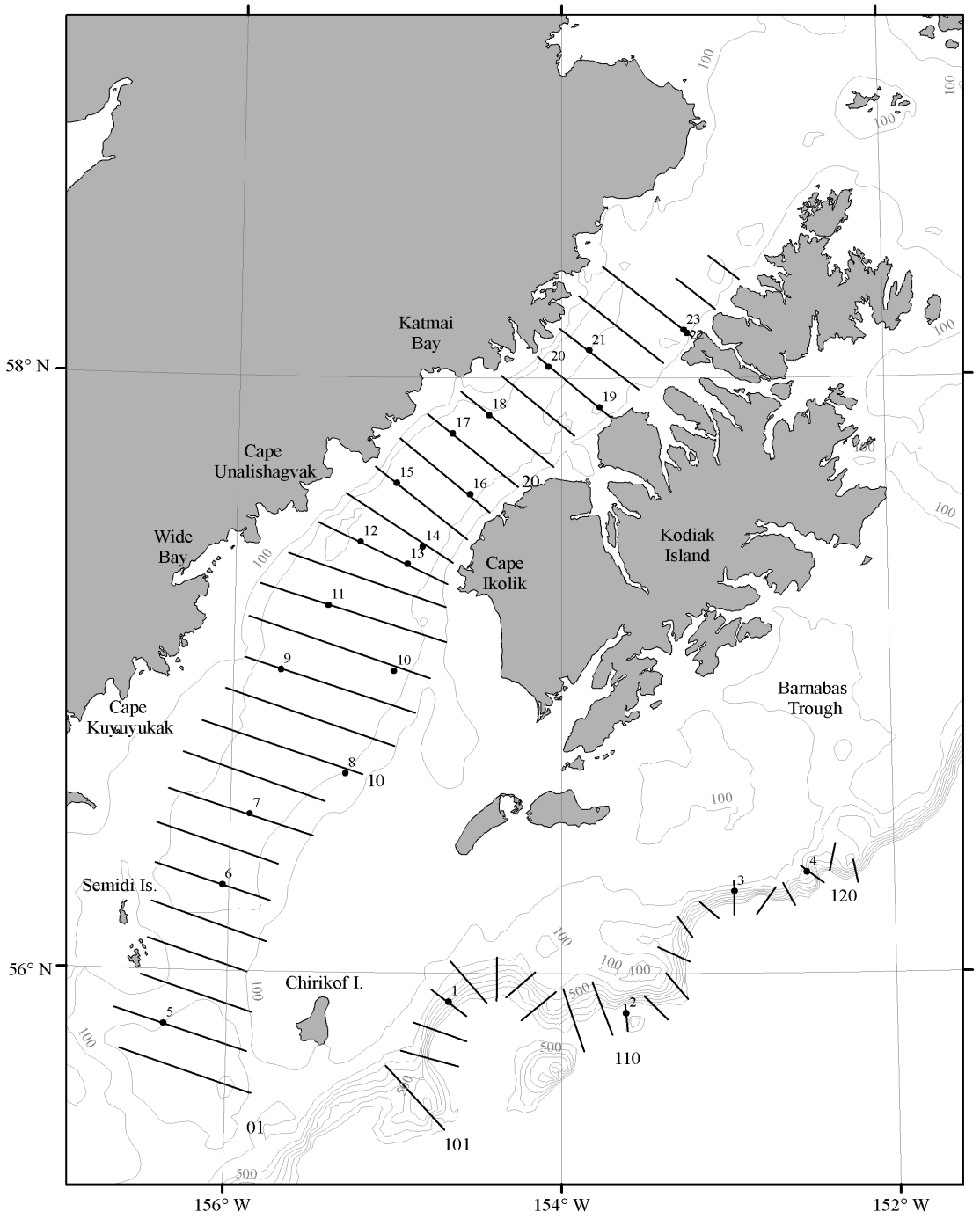

Figure 2.--Transect lines and distribution of trawls in the Shelikof Strait area and along the Gulf of Alaska shelf break near Chirikof Island echo integration-trawl surveys, 12-22 March 2006.

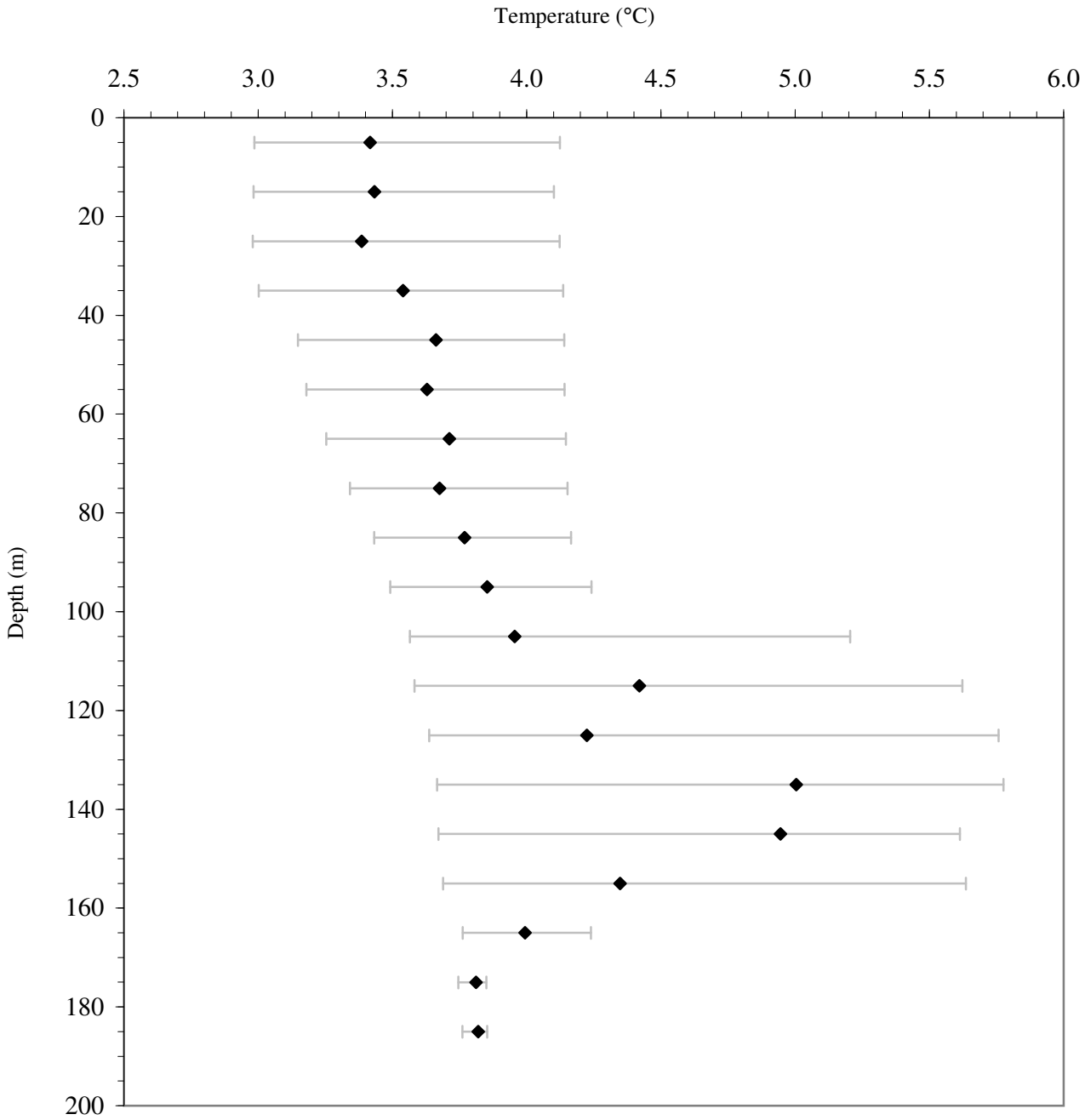

Figure 3.--Average temperature (°C) (symbols) by 10-m depth intervals observed during the winter 2006 echo integration-trawl survey of walleye pollock in the Shumagin Islands area. The horizontal bars represent temperature range observed during the survey. Data were collected at 10 locations.

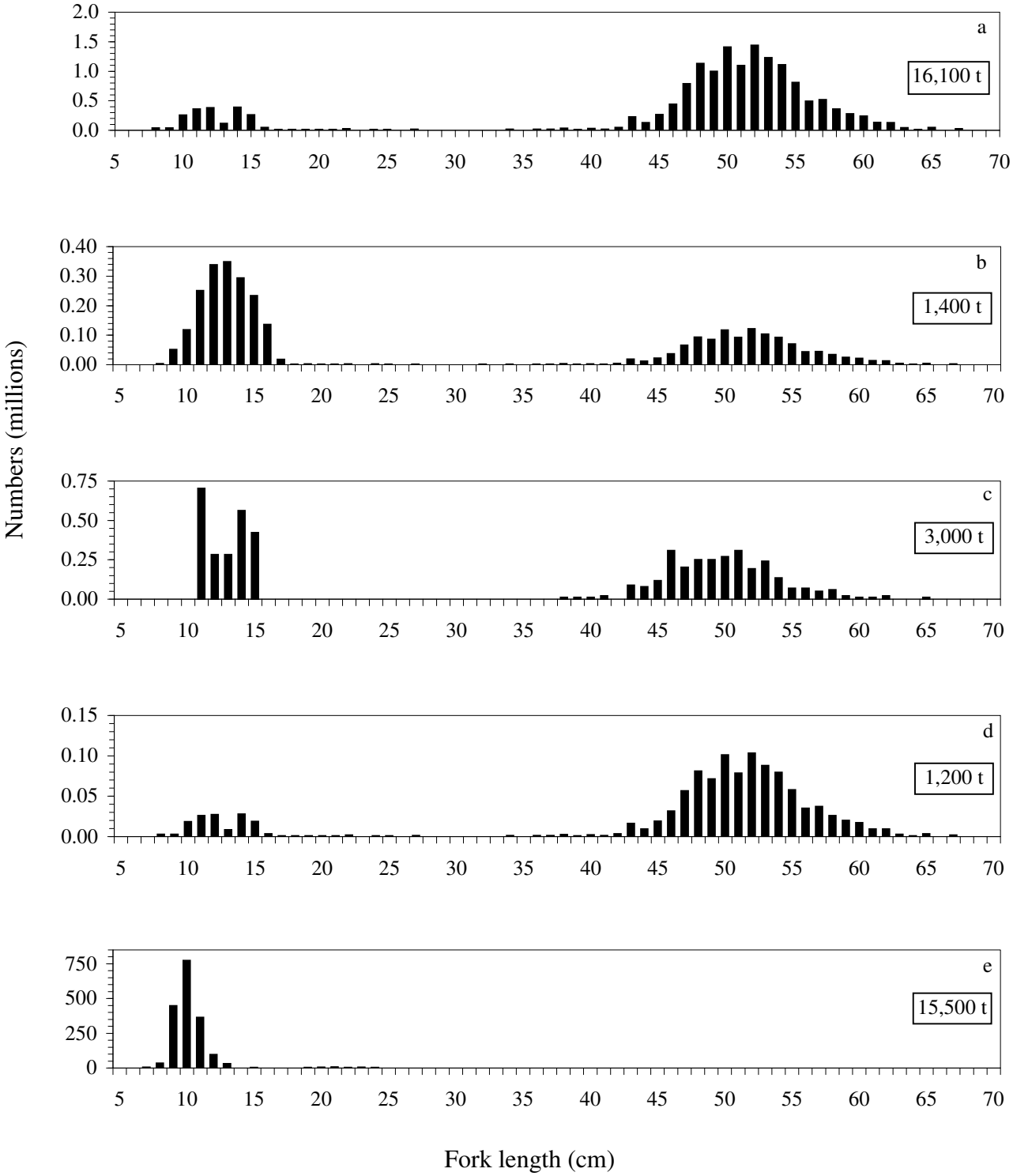

Figure 4.--Size distribution of pollock (numbers) (a) off Renshaw Point, (b) in Unga Strait, (c) in West Nagai Strait, (d) in Stepovak Bay, and (e) in Shumagin Trough for the 2006 echo integration-trawl survey of the Shumagin Islands. Note: because no trawls were conducted in Stepovak Bay, trawls conducted off Renshaw Point were used for scaling the acoustic data collected in this area.

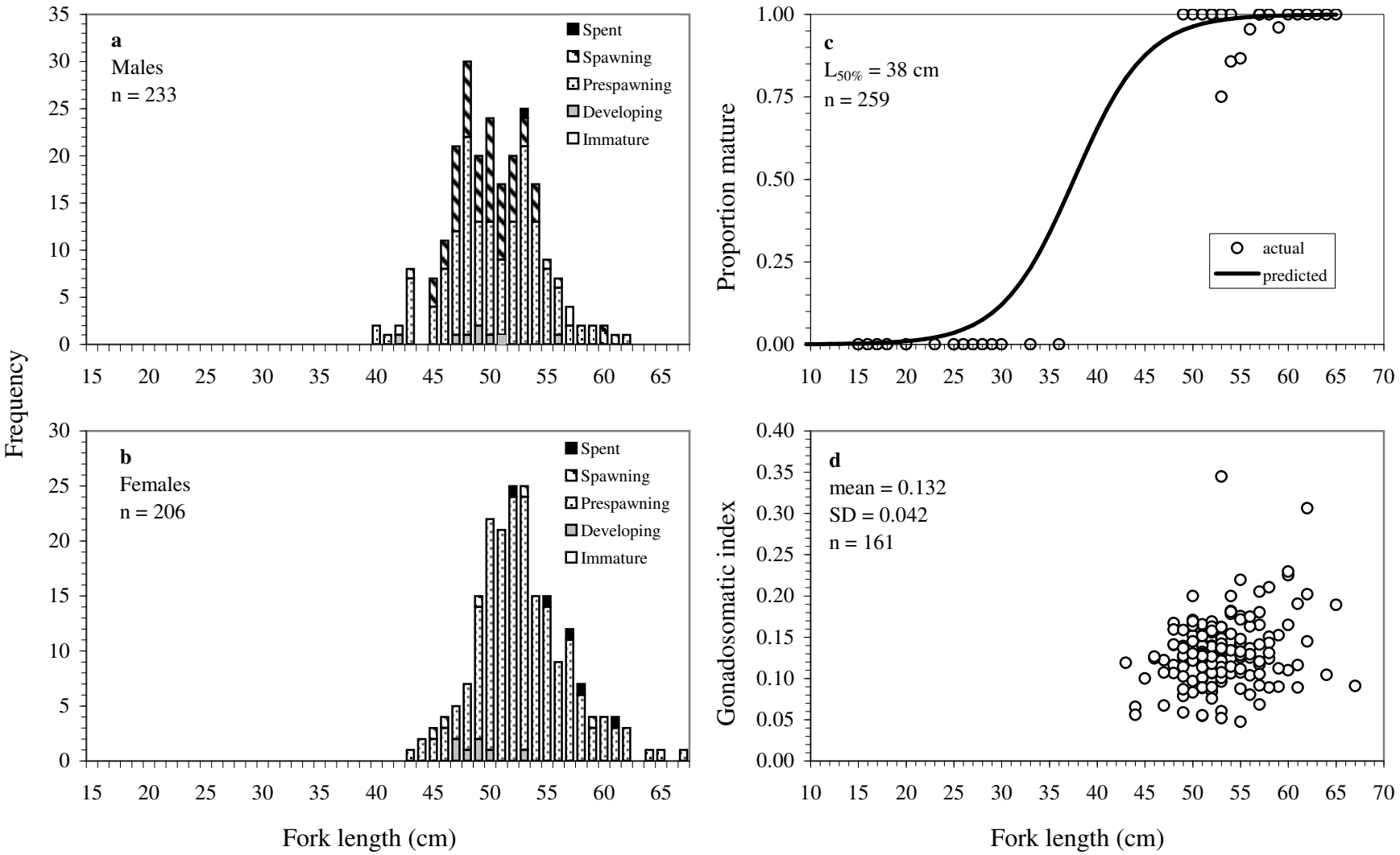

Figure 5.--Maturity stages for (a) male and (b) female pollock, (c) proportion mature by 1-cm size group for female pollock and (d) gonadosomatic index for pre-spawning females examined during the 2006 echo integration-trawl survey of Shumagin Islands in the Gulf of Alaska.

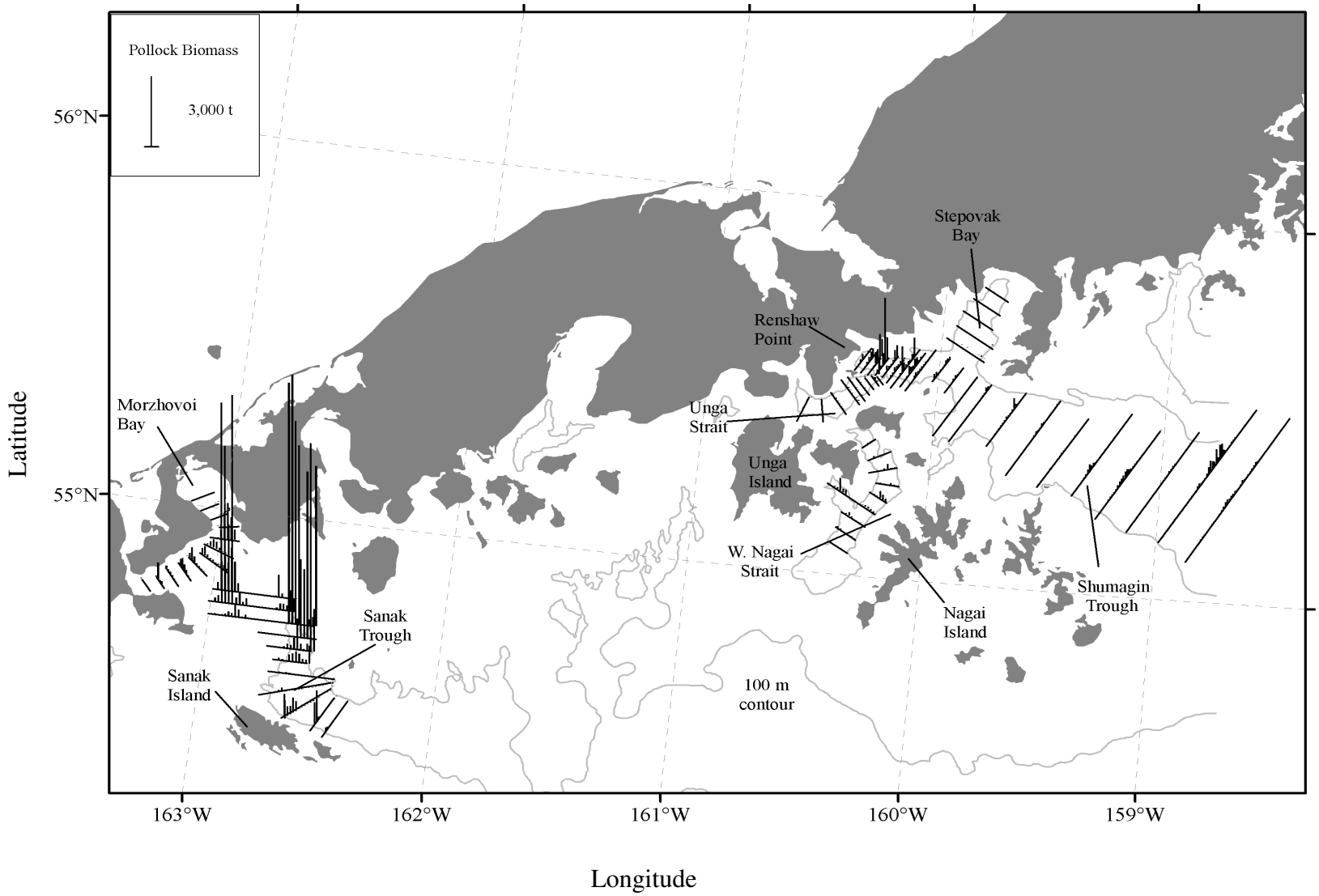

Figure 6.--Pollock biomass (metric tons) along track lines during the February 2006 echo integration-trawl surveys of the Shumagin Islands, Sanak Trough and Morzhovoi Bay in the Gulf of Alaska.

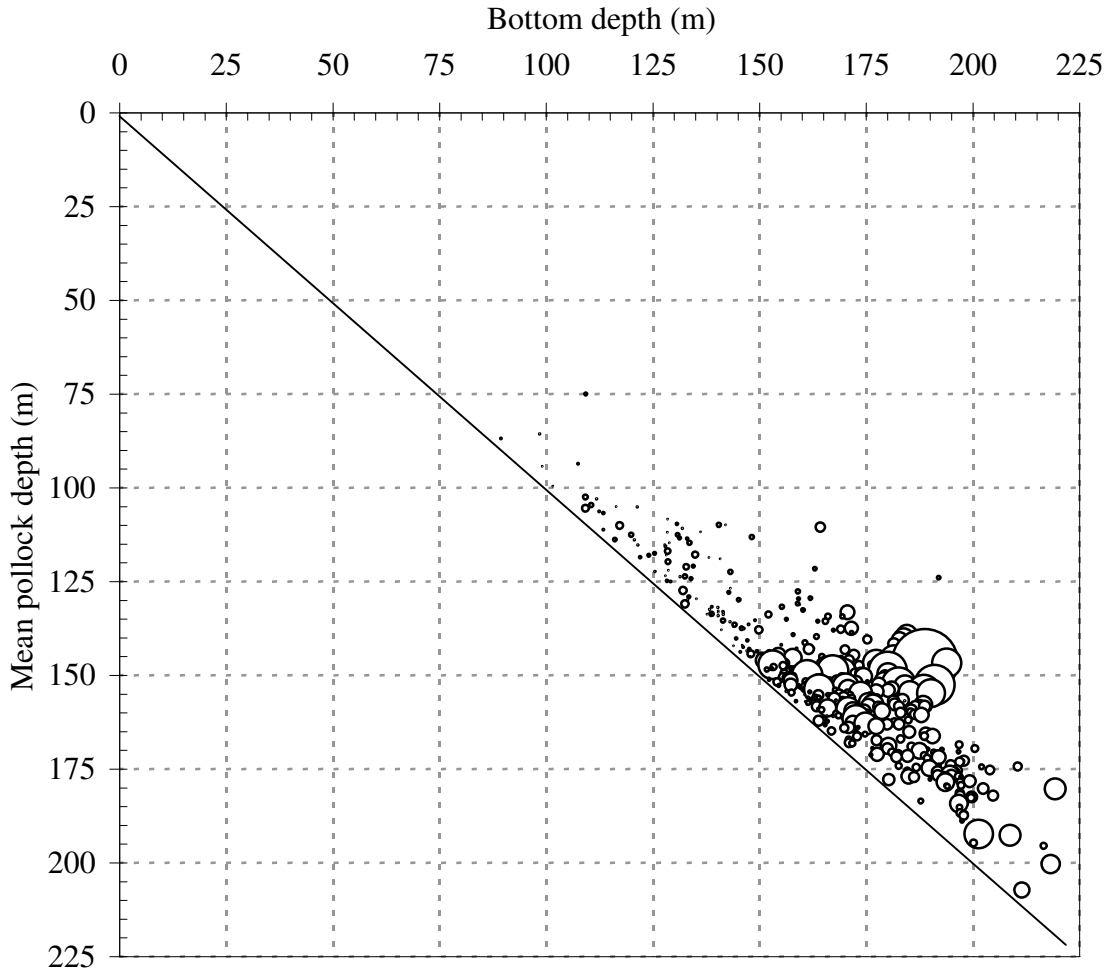

Figure 7.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for pollock observed during the winter 2006 echo integration-trawl survey of walleye pollock in the Shumagin Islands area. Bubble size is scaled to the maximum biomass.

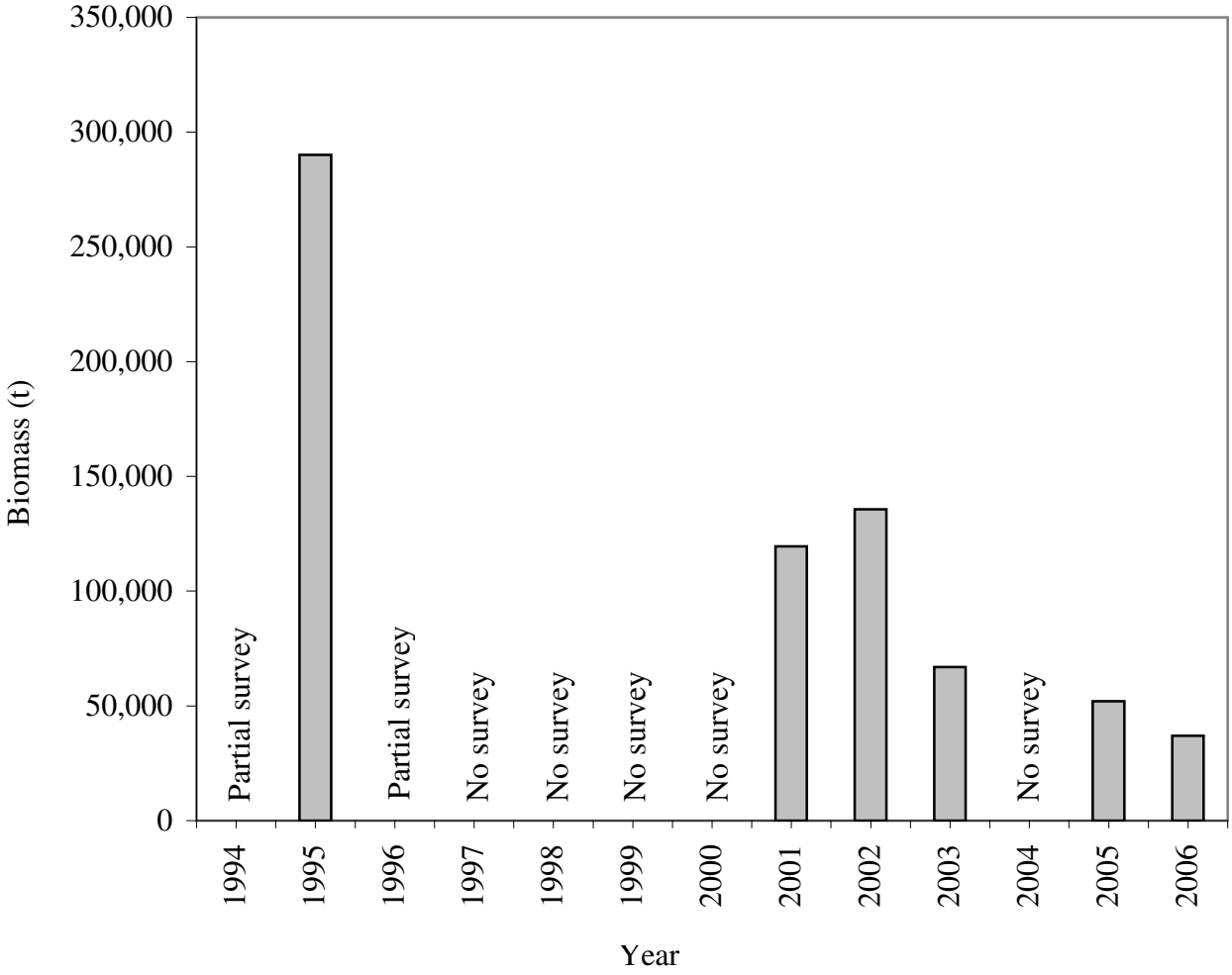

Figure 8.--Summary of annual pollock biomass estimates based on echo integration-trawl surveys of the Shumagin Islands area.

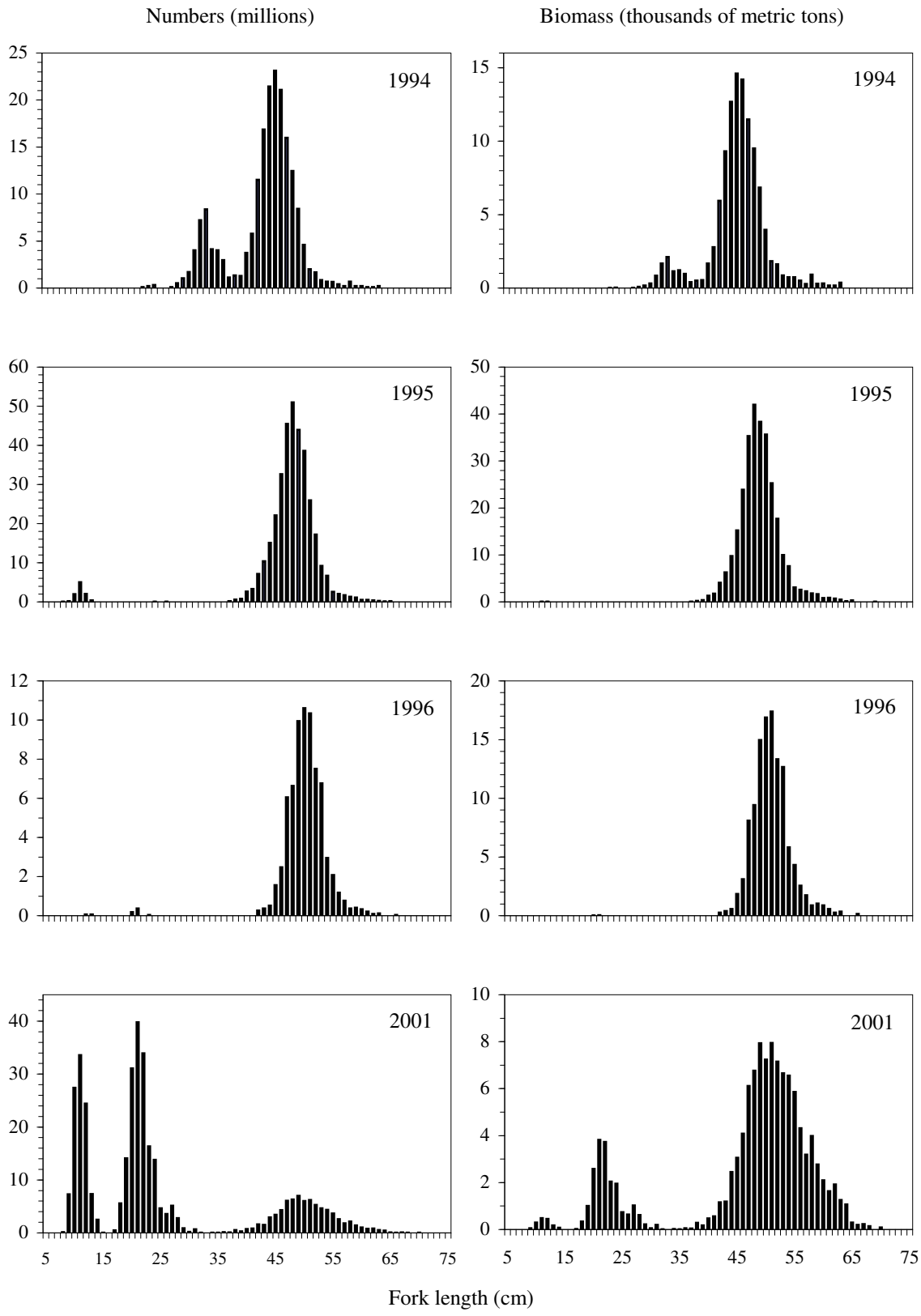

Figure 9.--Pollock size composition estimates for the Shumagin Islands area based on echo integration-trawl surveys during 1994-96, 2001-03, and 2005-06.

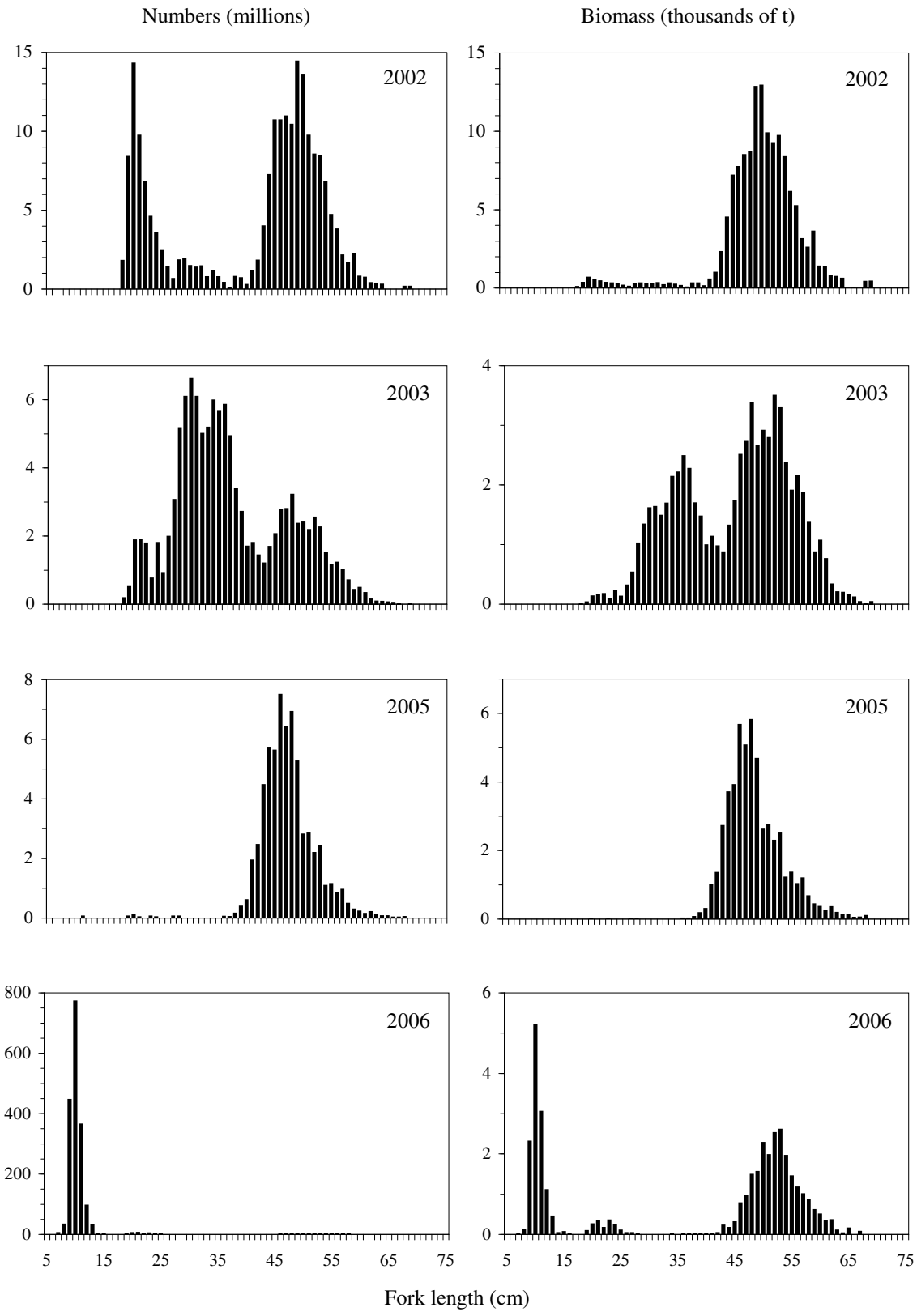

Figure 9.--Continued.

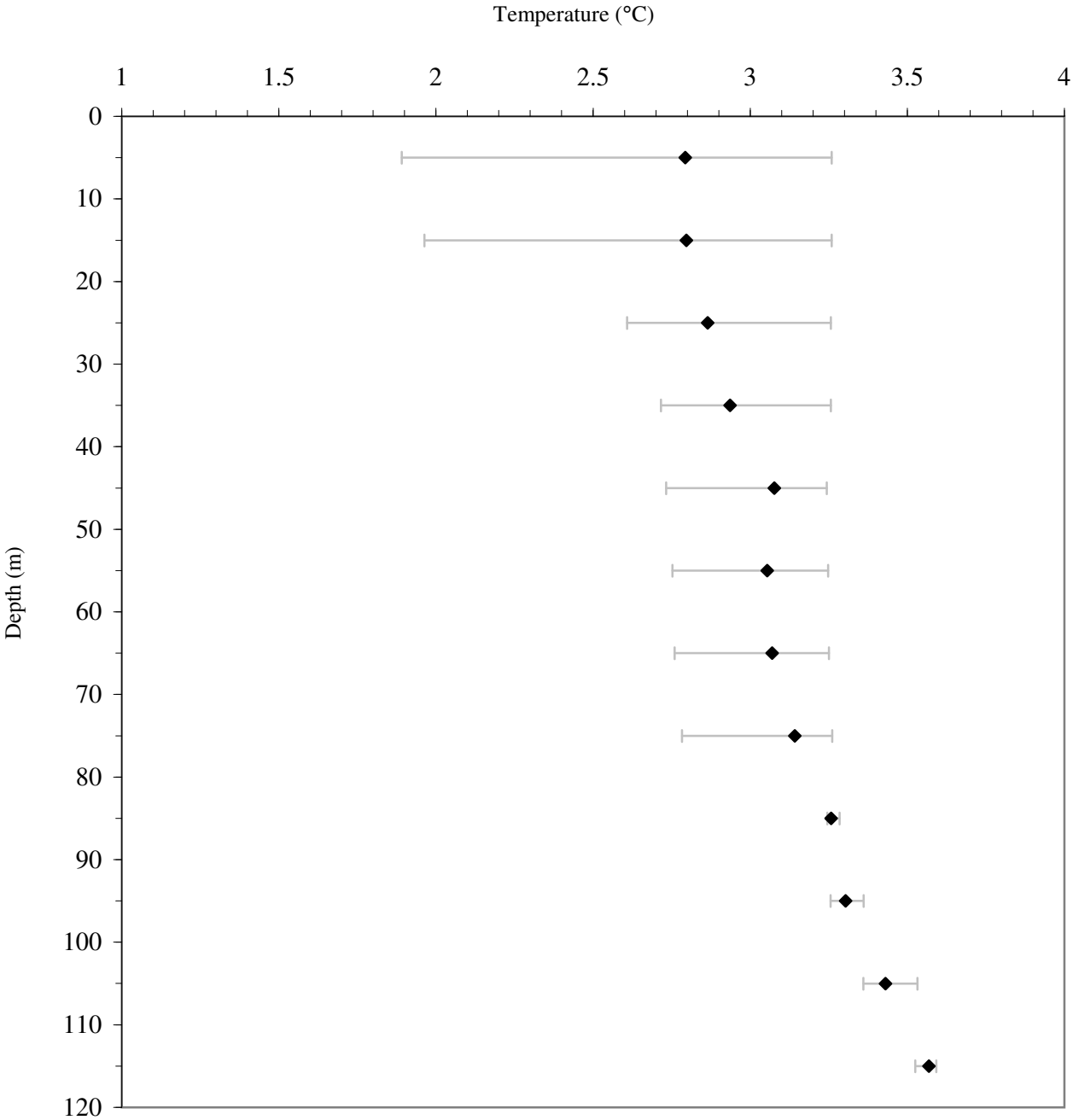

Figure 10.--Average temperature (°C) (symbols) by 10-m depth intervals observed during the winter 2006 echo integration-trawl survey of walleye pollock in the Sanak Trough area. The horizontal bars represent temperature range observed during the survey. Data were collected at four locations.

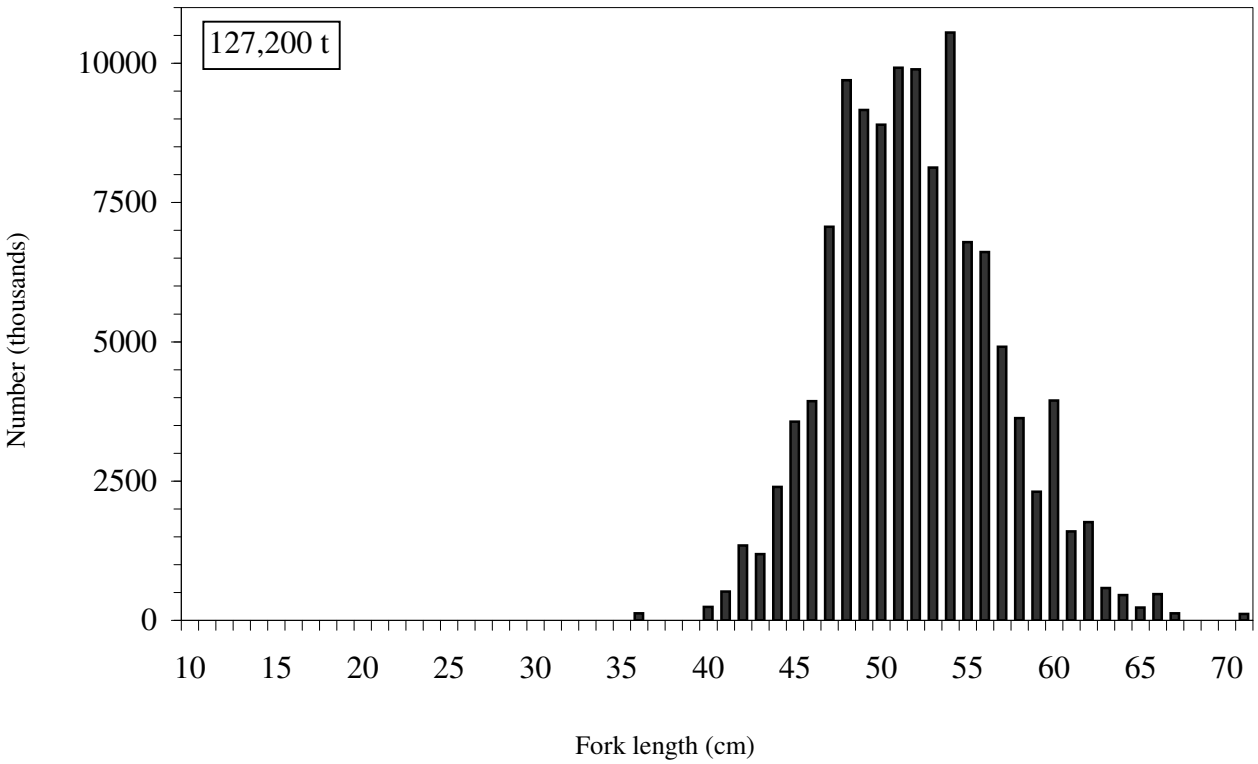

Figure 11.--The size distribution of pollock (numbers) for the 2006 echo integration-trawl survey of Sanak Trough.

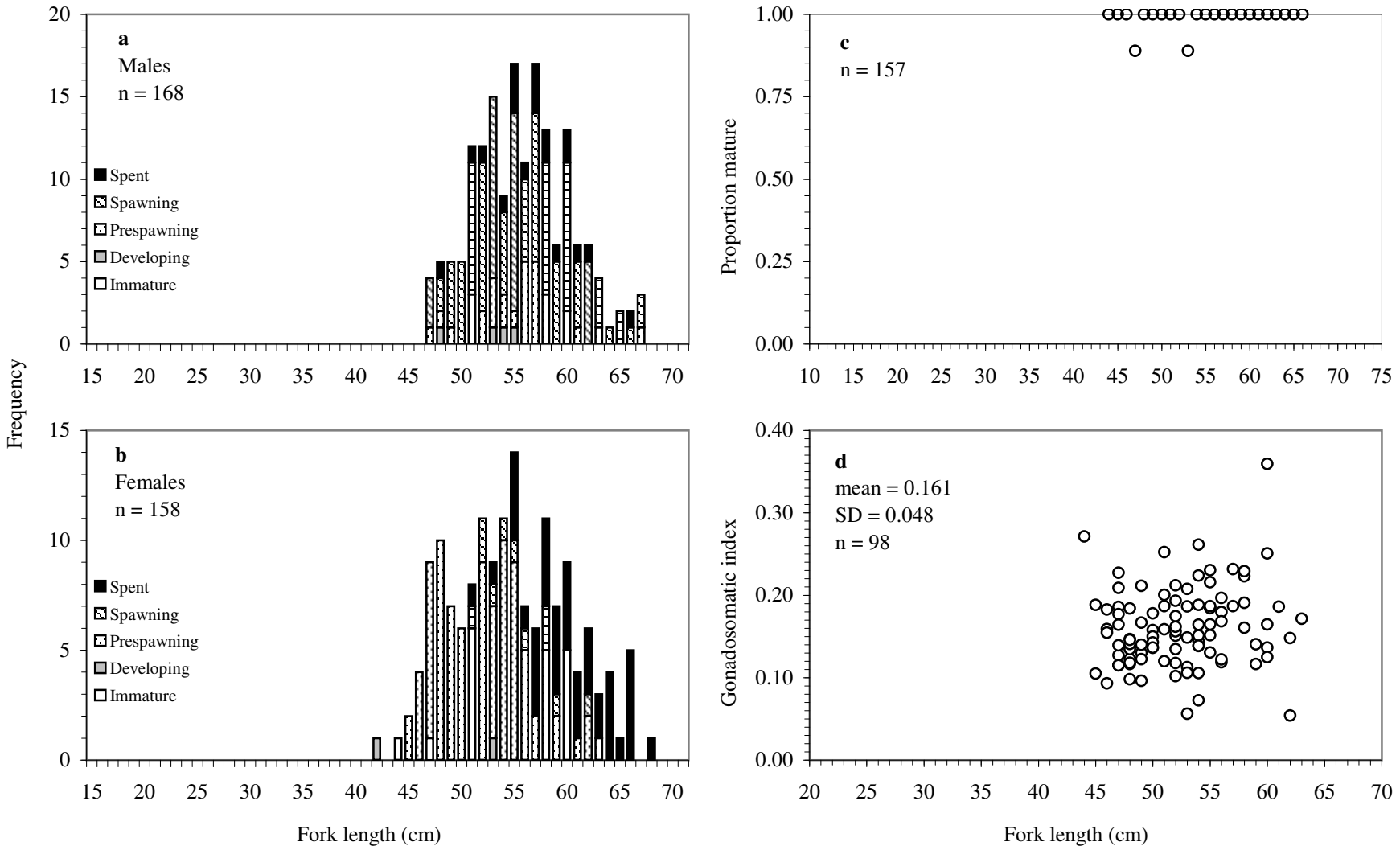

Figure 12.--Maturity stages for (a) male and (b) female pollock, (c) proportion mature by 1-cm size group for female pollock and (d) gonadosomatic index for pre-spawning females examined during the winter 2006 echo integration-trawl survey of Sanak Trough in the Gulf of Alaska.

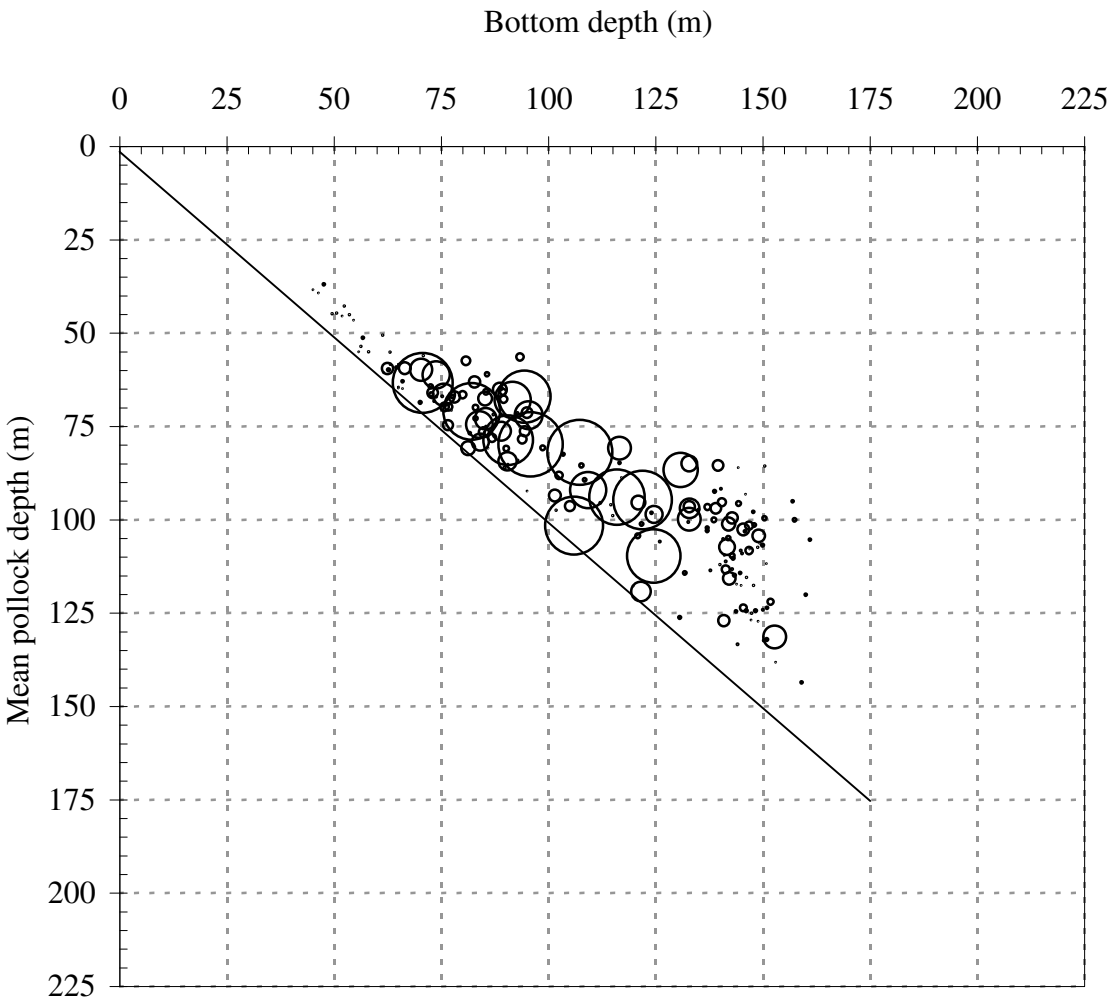

Figure 13.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for pollock observed during the winter 2006 echo integration-trawl survey of walleye pollock in Sanak Trough. Bubble size is scaled to the maximum biomass.

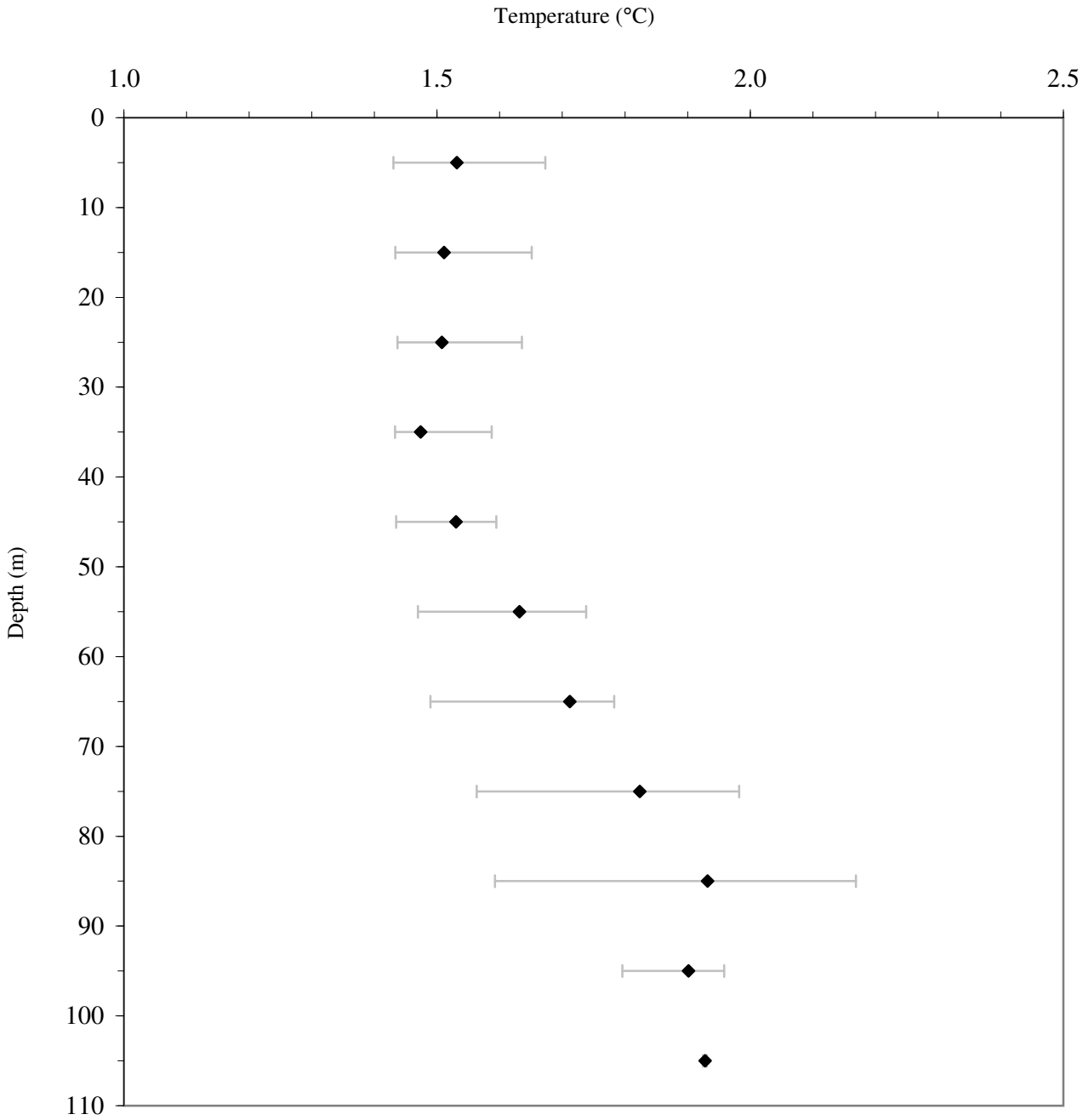

Figure 14.--Average temperature (°C) (symbols) by 10-m depth intervals observed during the winter 2006 echo integration-trawl survey of walleye pollock in the Morzhovoi Bay area. The horizontal bars represent temperature range observed during the survey. Data were collected at two locations.

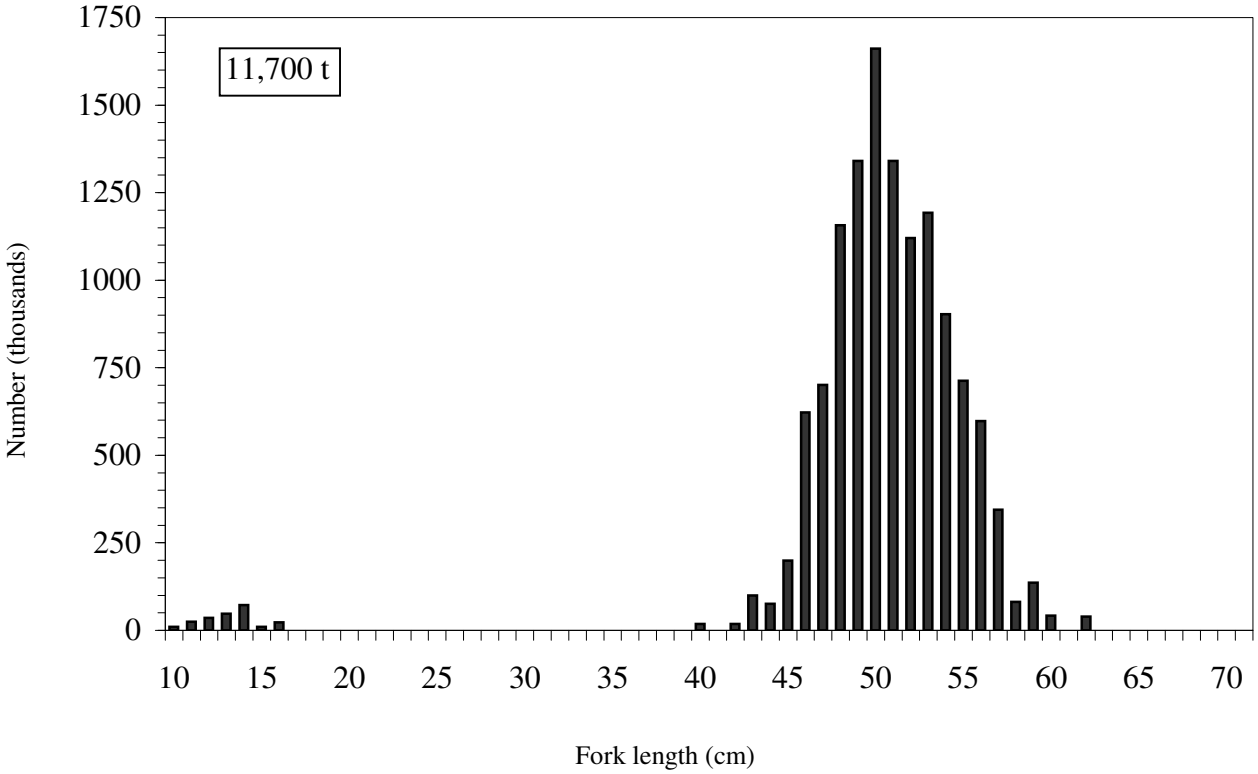

Figure 15.--The size distribution of pollock (numbers) for the 2006 echo integration-trawl survey of Morzhovoi Bay.

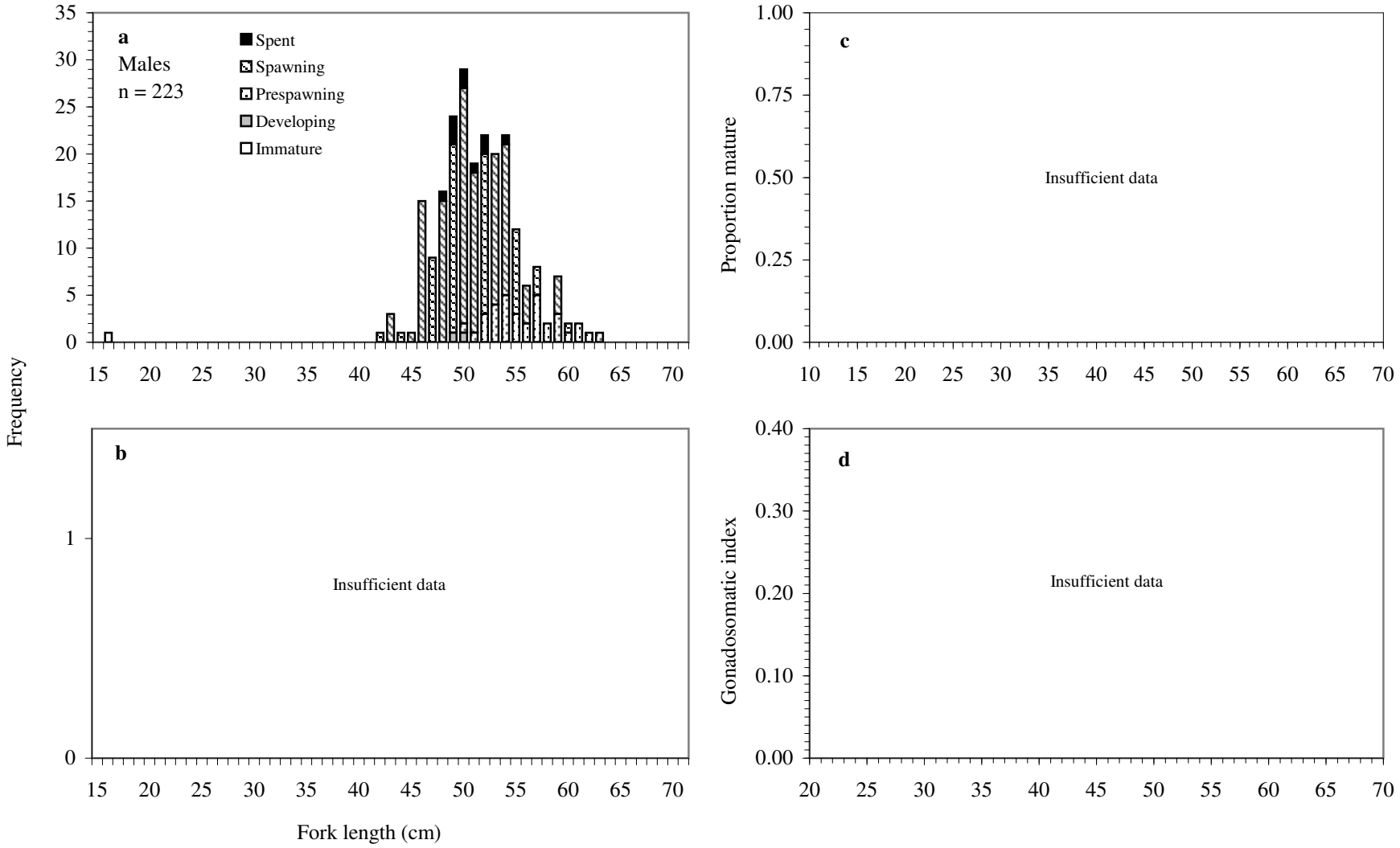

Figure 16.--Maturity stages for (a) male pollock examined during the winter 2006 echo integration-trawl survey of Morzhovoi Bay in the Gulf of Alaska. Due to insufficent data, (b) maturity stages for female pollock, (c) proportion mature by 1-cm size group for female pollock and (d) gonadosomatic index for pre-spawning females are not shown.

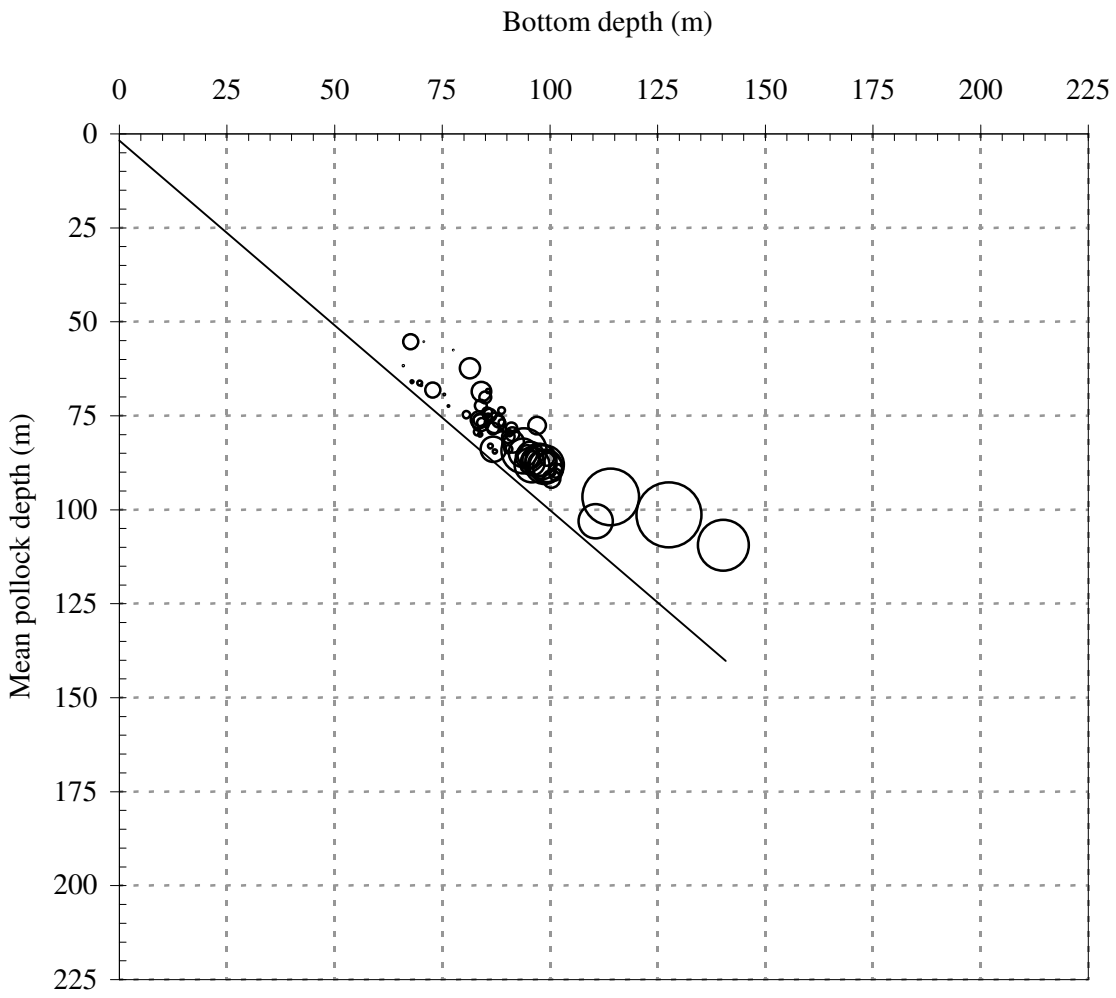

Figure 17.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for pollock observed during the winter 2006 echo integration-trawl survey of walleye pollock in Morzhovoi Bay. Bubble size is scaled to the maximum biomass.

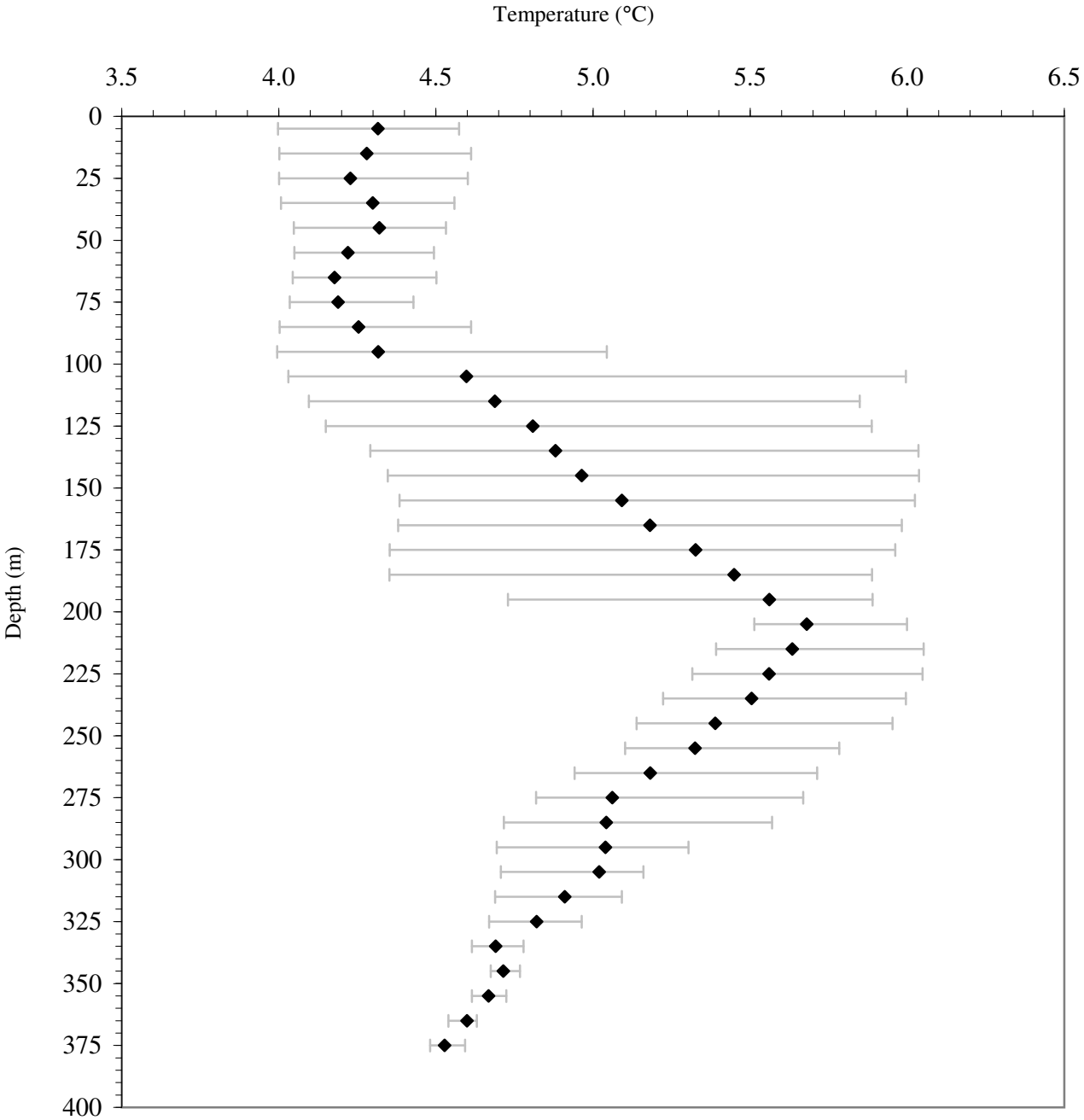

Figure 18.--Average temperature (°C) (symbols) by 10-m depth intervals observed during the winter 2006 echo integration-trawl survey of walleye pollock of the Chirikof Island area in the Gulf of Alaska. The horizontal bars represent temperature range observed during the survey. Data were collected at four locations.

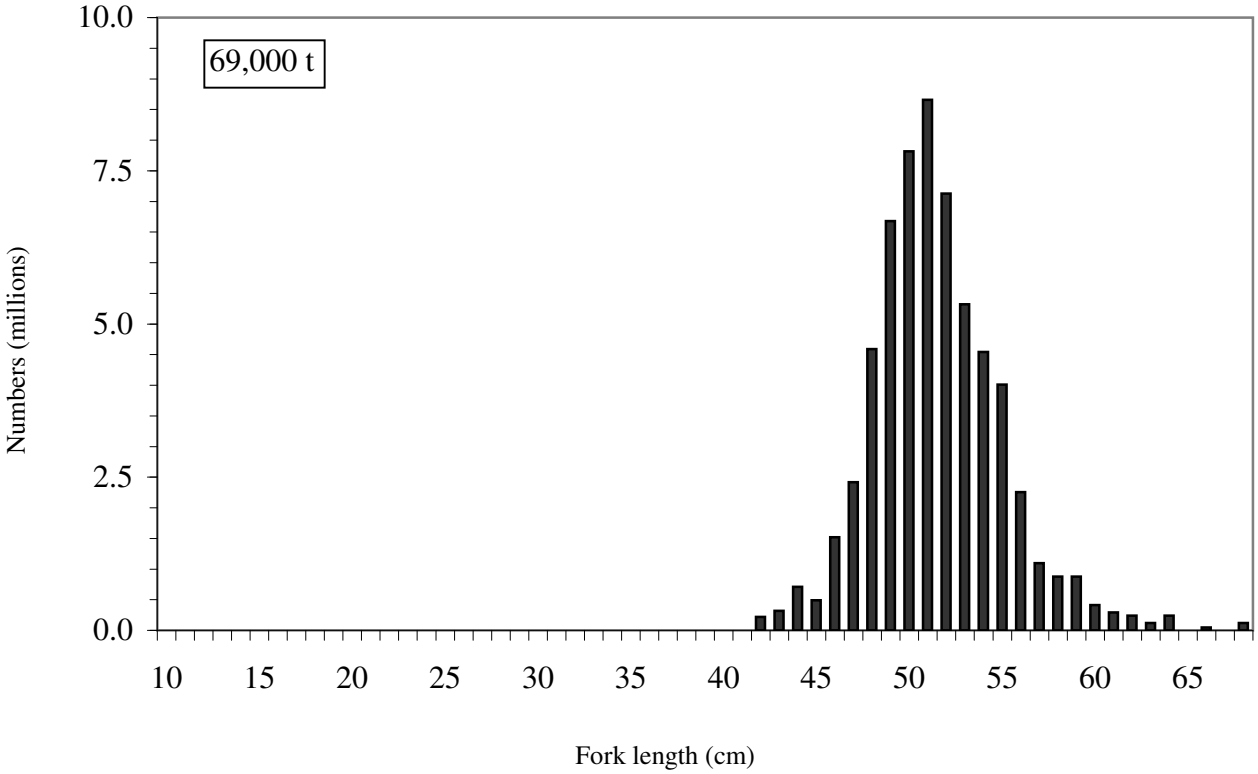

Figure 19.--The size distribution of pollock (numbers) of the shelf-break area near Chirikof Island during the 2006 echo integration-trawl surveys in the Gulf of Alaska.

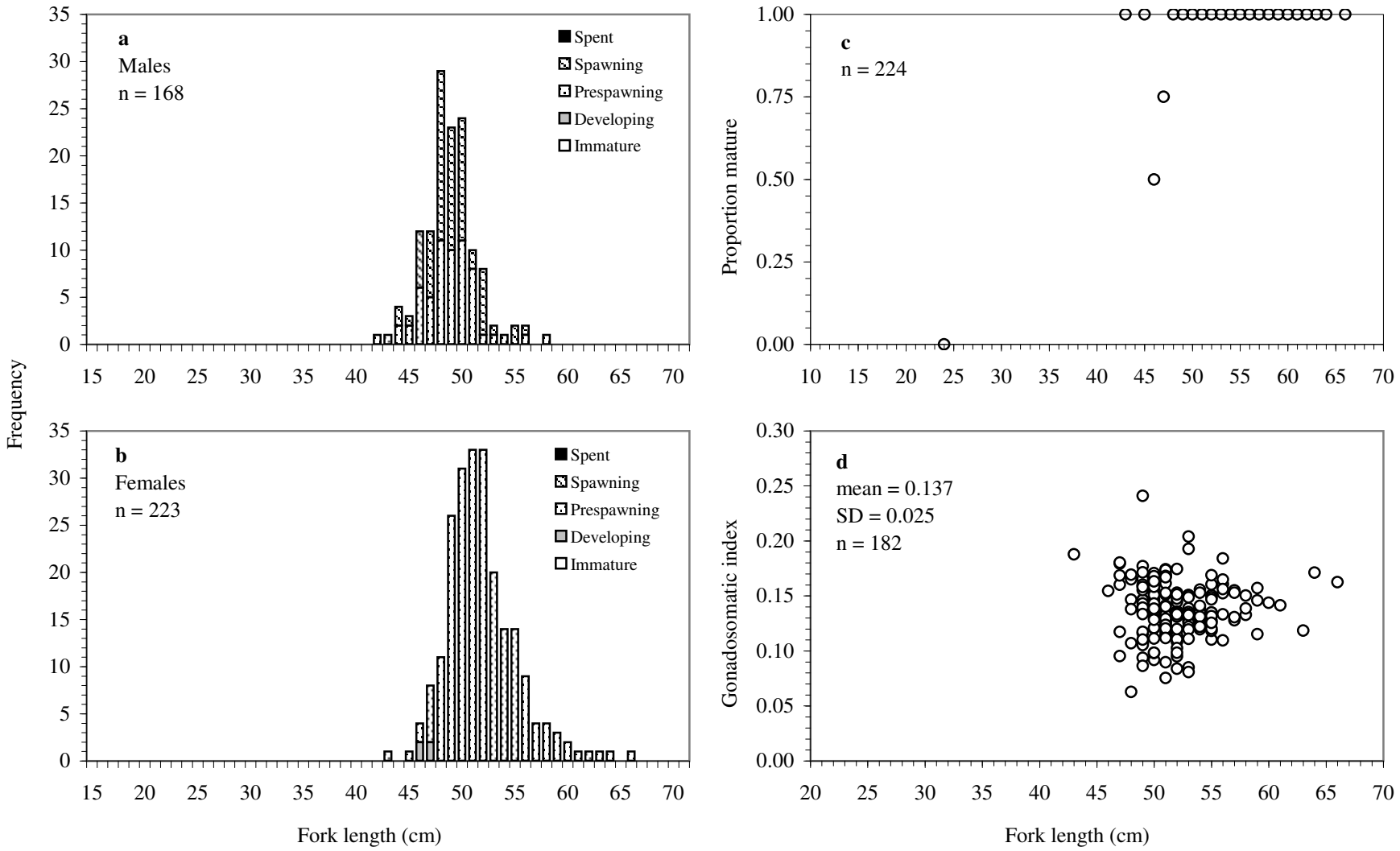

Figure 20.--Maturity stages for (a) male and (b) female pollock, (c) proportion mature by 1-cm size group for female pollock and (d) gonadosomatic index for pre-spawning females examined during the winter 2006 echo integration-trawl survey of the Chirikof Island area in the Gulf of Alaska.

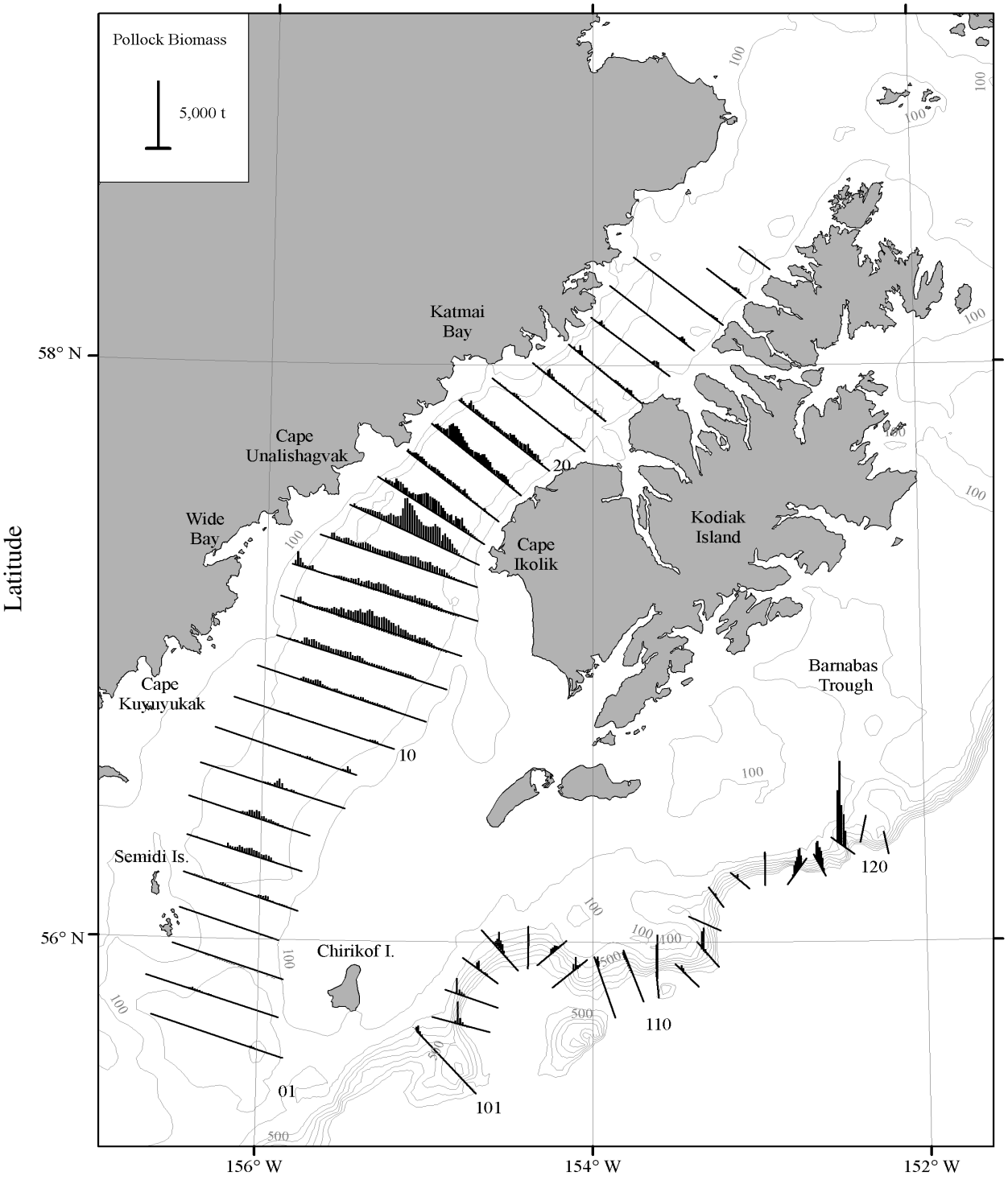

Figure 21.--Near-bottom pollock biomass along transects from the 2006 echo integration-trawl survey of the Shelikof Strait area and all pollock along the Gulf of Alaska shelf break near Chirikof Island.

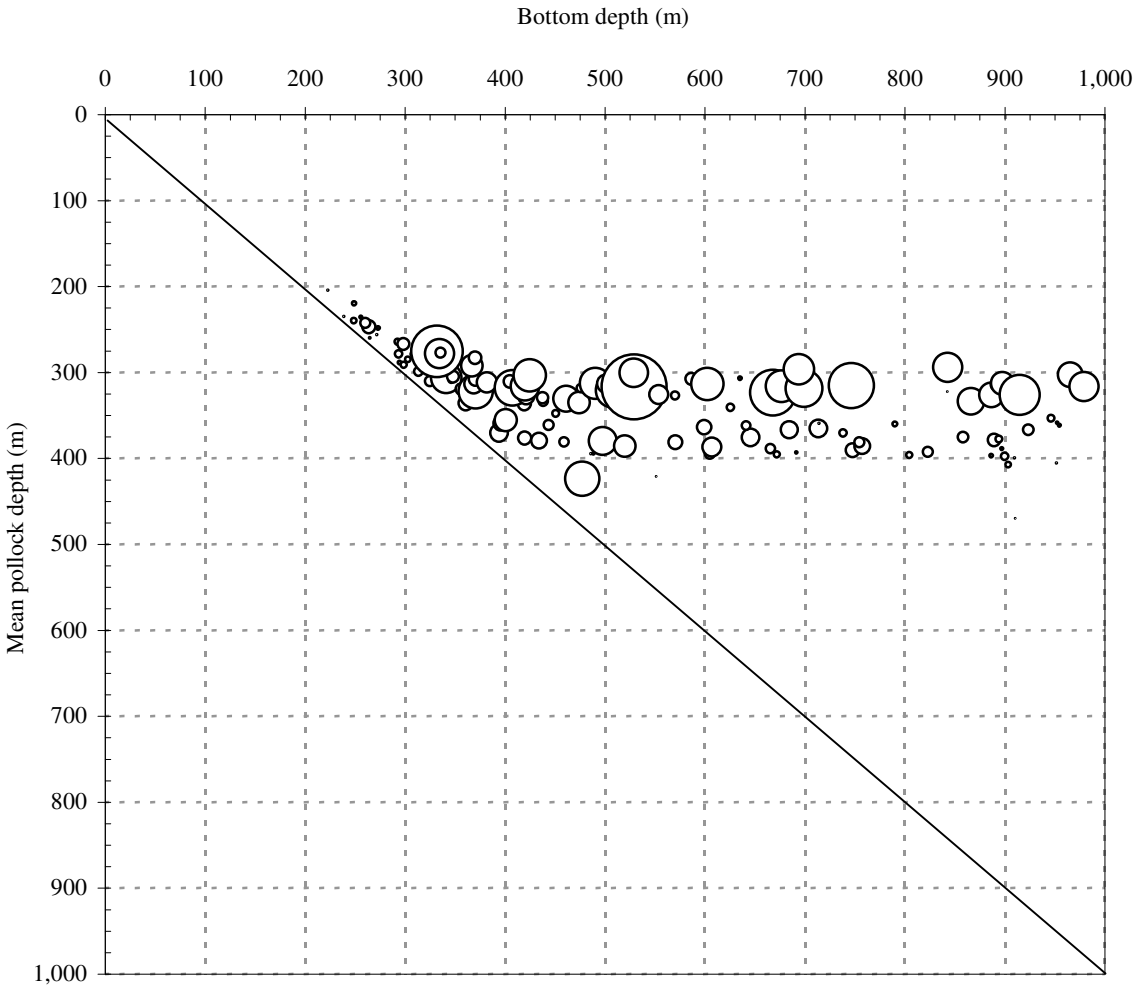

Figure 22.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for pollock observed during the winter 2006 echo integration-trawl survey of walleye pollock in the Chirikof Island area. Bubble size is scaled to the maximum biomass.

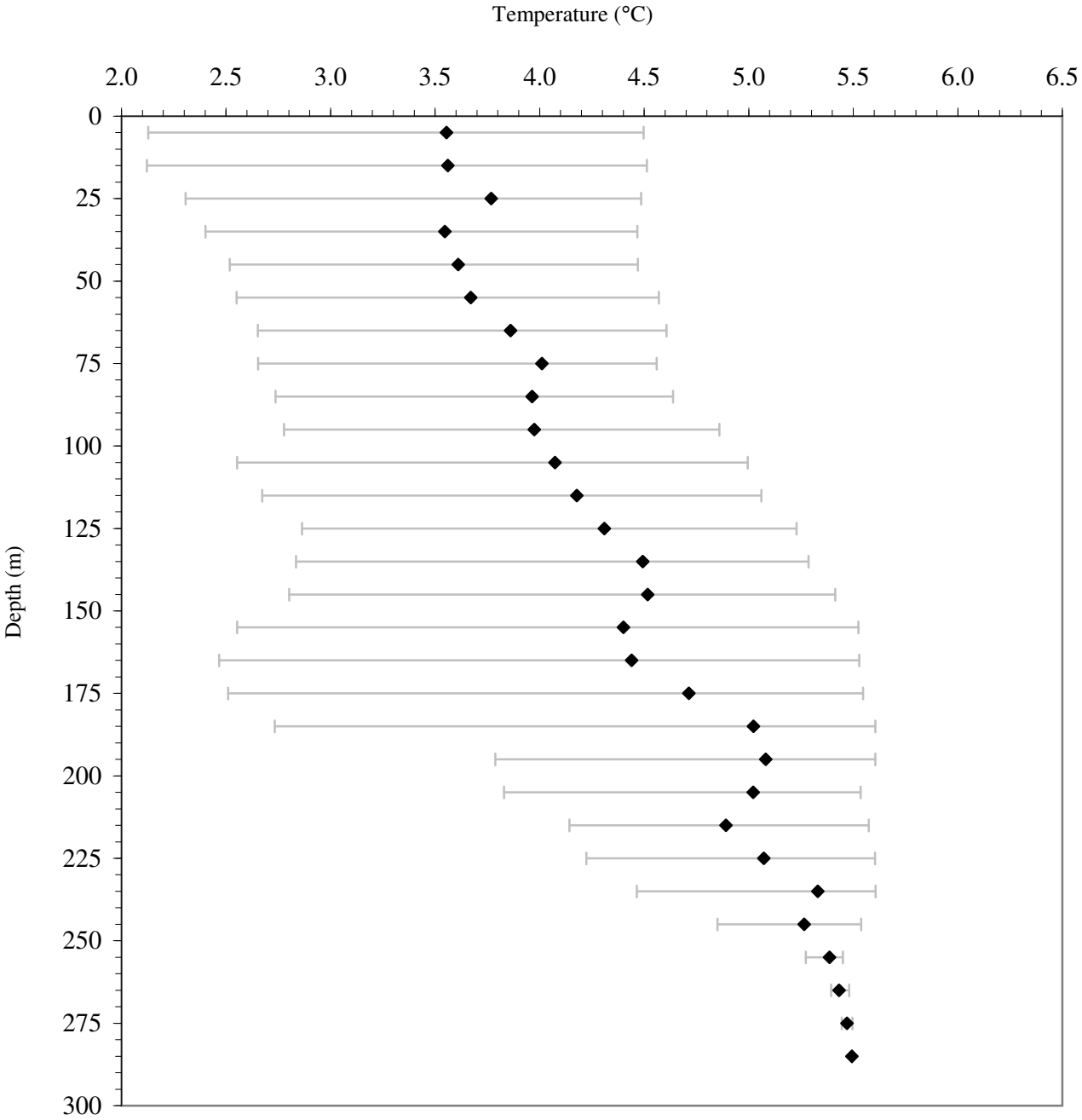

Figure 23.--Average temperature (°C) (symbols) by 50-m depth intervals observed during the winter 2006 echo integration-trawl survey of walleye pollock of the Shelikof Strait area. The horizontal bars represent temperature range observed during the survey. Data were collected at 20 locations.

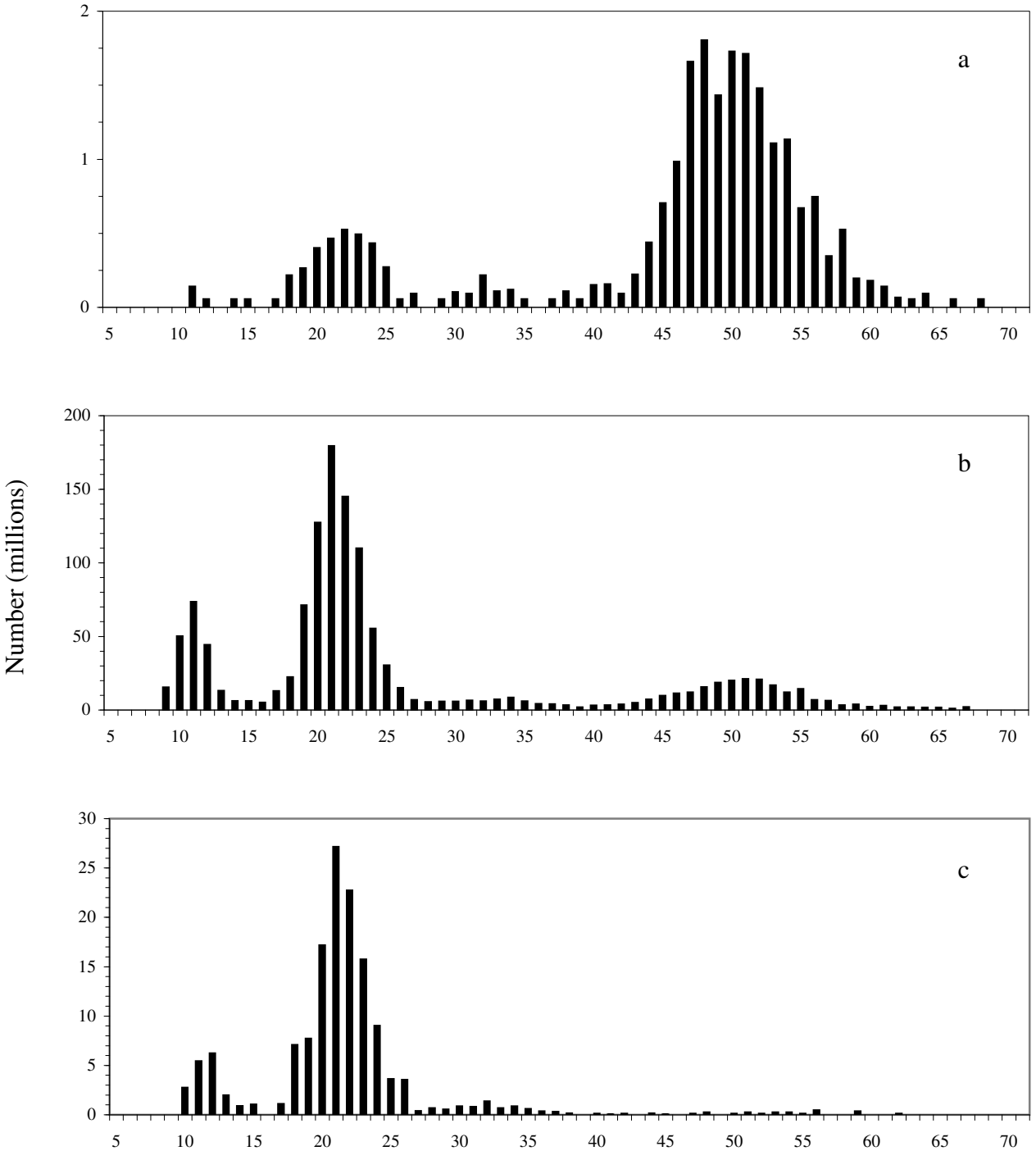

Figure 24.--The size distribution of pollock by numbers (a) along the west side of the Strait, (b) in near-bottom layers in the southern Strait and off Kodiak Island, and (c) in the mid-water juvenile layer during the 2006 echo integration-trawl survey of the Shelikof Strait area.

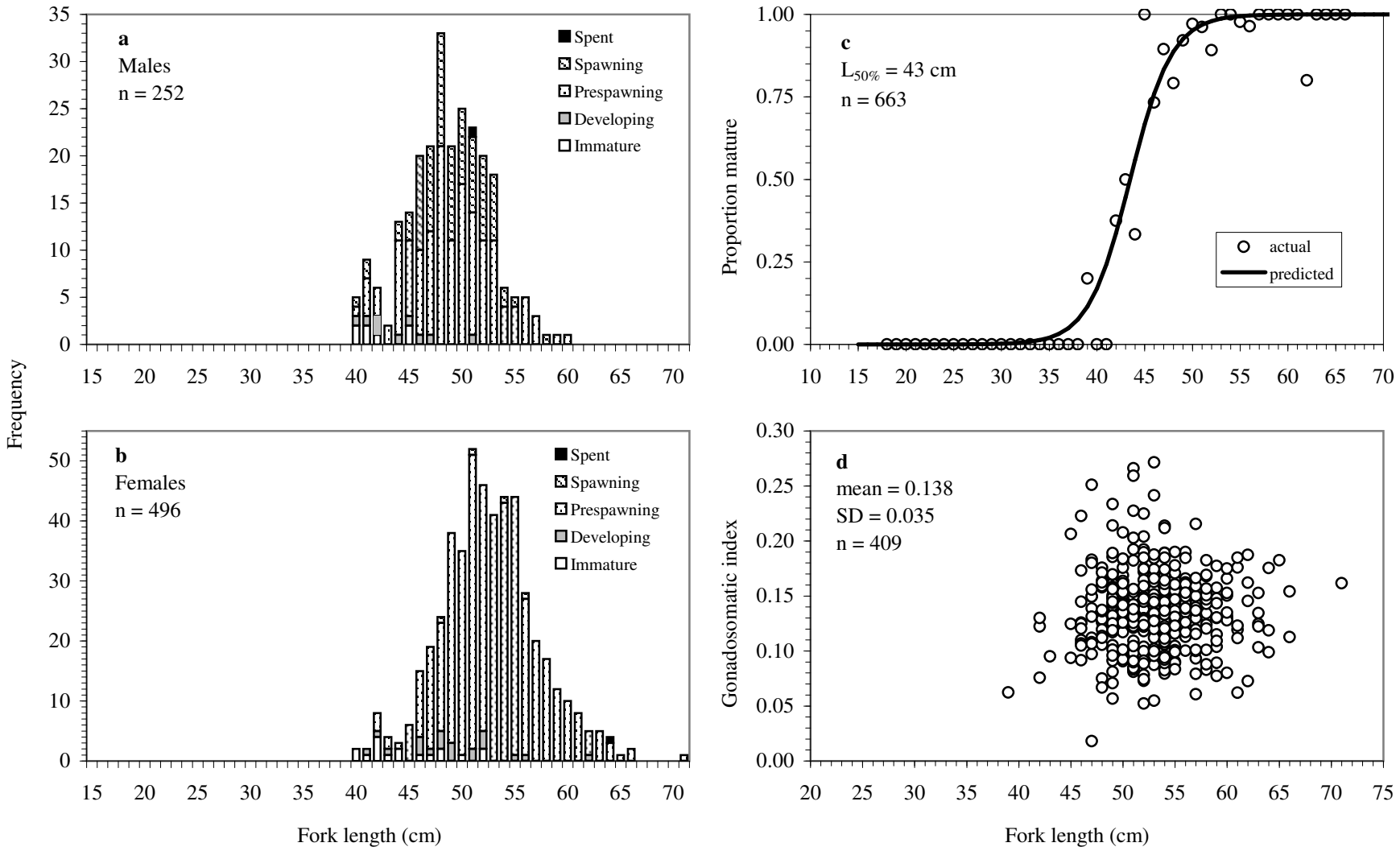

Figure 25.--Maturity stages for (a) male and (b) female pollock, (c) a fitted logistic function and proportion mature by 1-cm size group for female pollock. and (d) gonadosomatic index for pre-spawning females examined during the winter 2006 echo integration-trawl survey of the Shelikof Strait in the Gulf of Alaska.

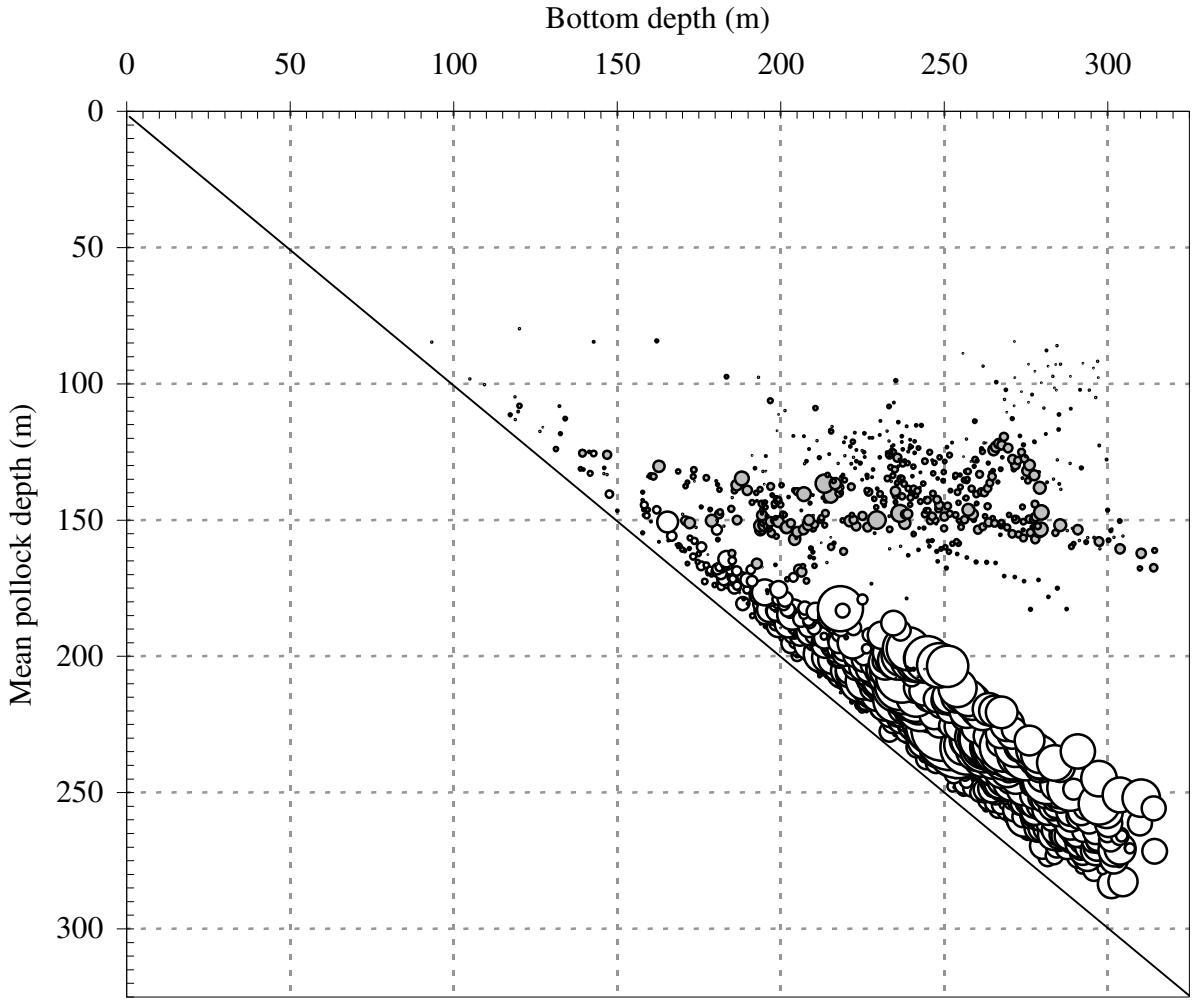

Figure 26.--Average pollock depth (weighted by biomass) versus bottom depth (m) by 0.5-nmi interval for near-bottom pollock (open circles) and mid-water juvenile pollock (gray circles) for the winter 2006 echo integration-trawl survey of walleye pollock in the Shelikof Strait area. Bubble size is scaled to the maximum biomass.

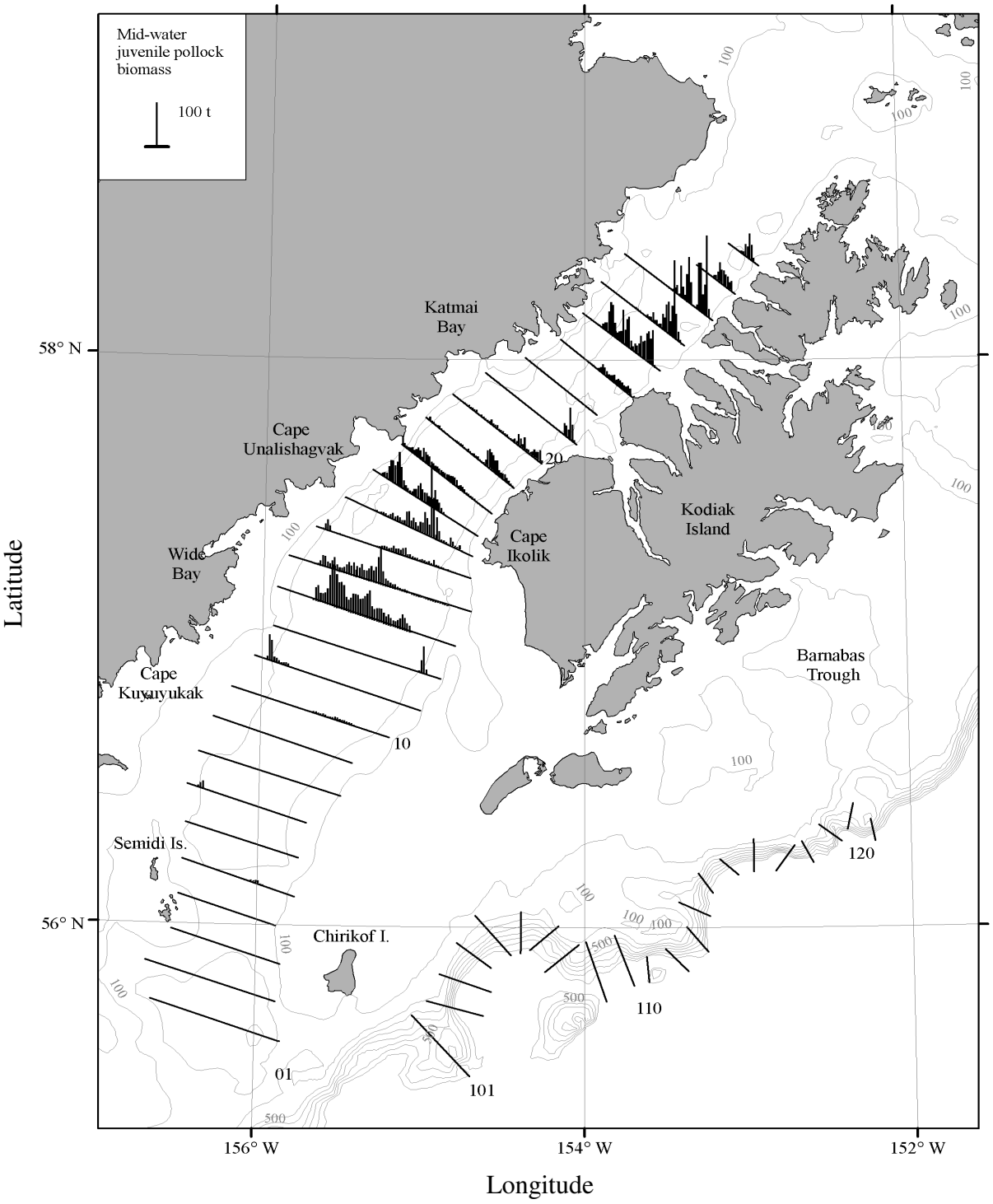

Figure 27.--Mid-water juvenile pollock biomass along transects from the 2006 echo integration-trawl survey of the Shelikof Strait area.

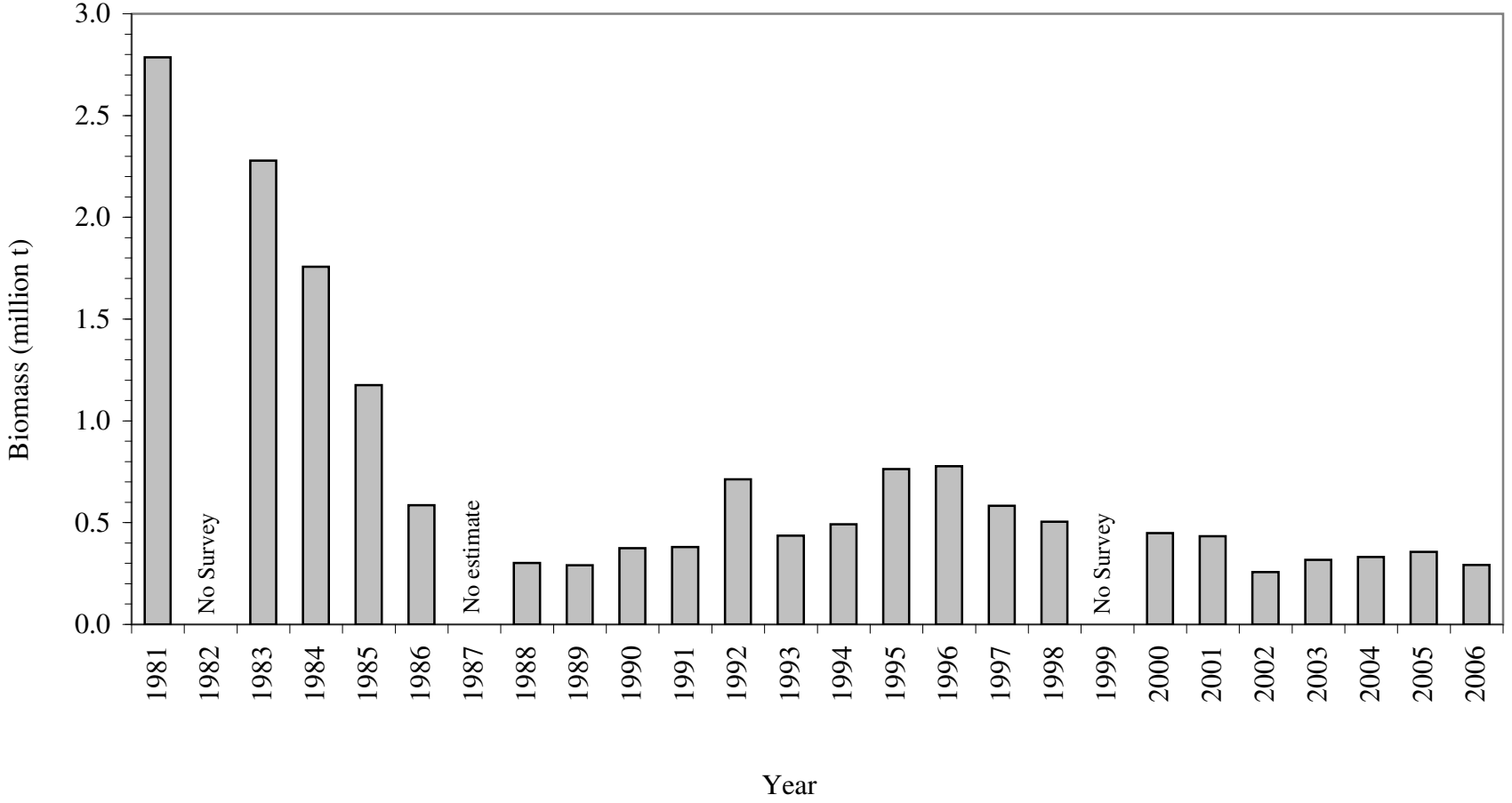

Figure 28.--Summary of annual pollock biomass estimates based on echo integration-trawl surveys of the Shelikof Strait area.

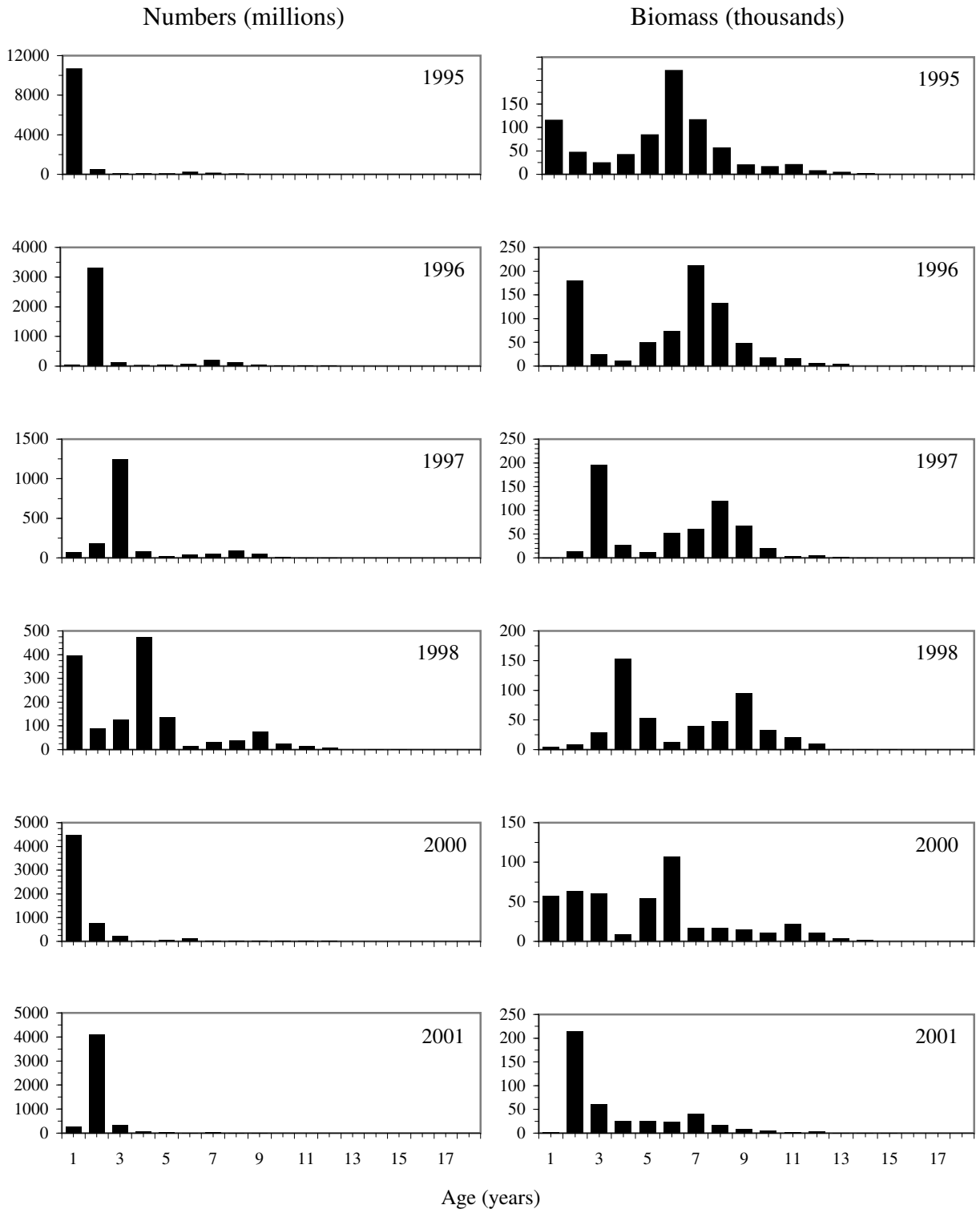

Figure 29.--Annual pollock age compostition estimates for the Shelikof Strait area based on echo integration-trawl surveys conducted from 1995 to 2005. Note: area was not surveyed in 1999.

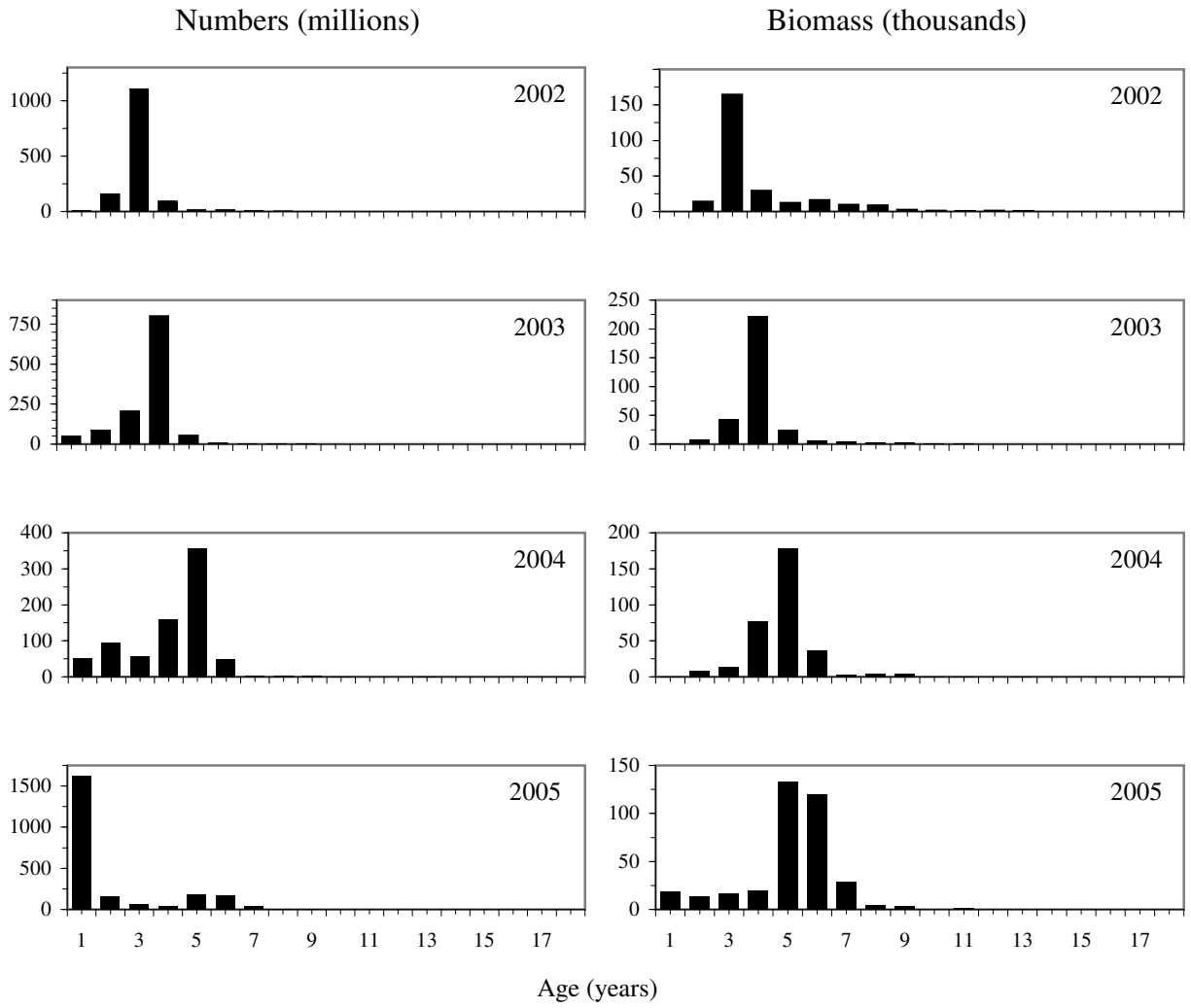

Figure 29.--Continued.

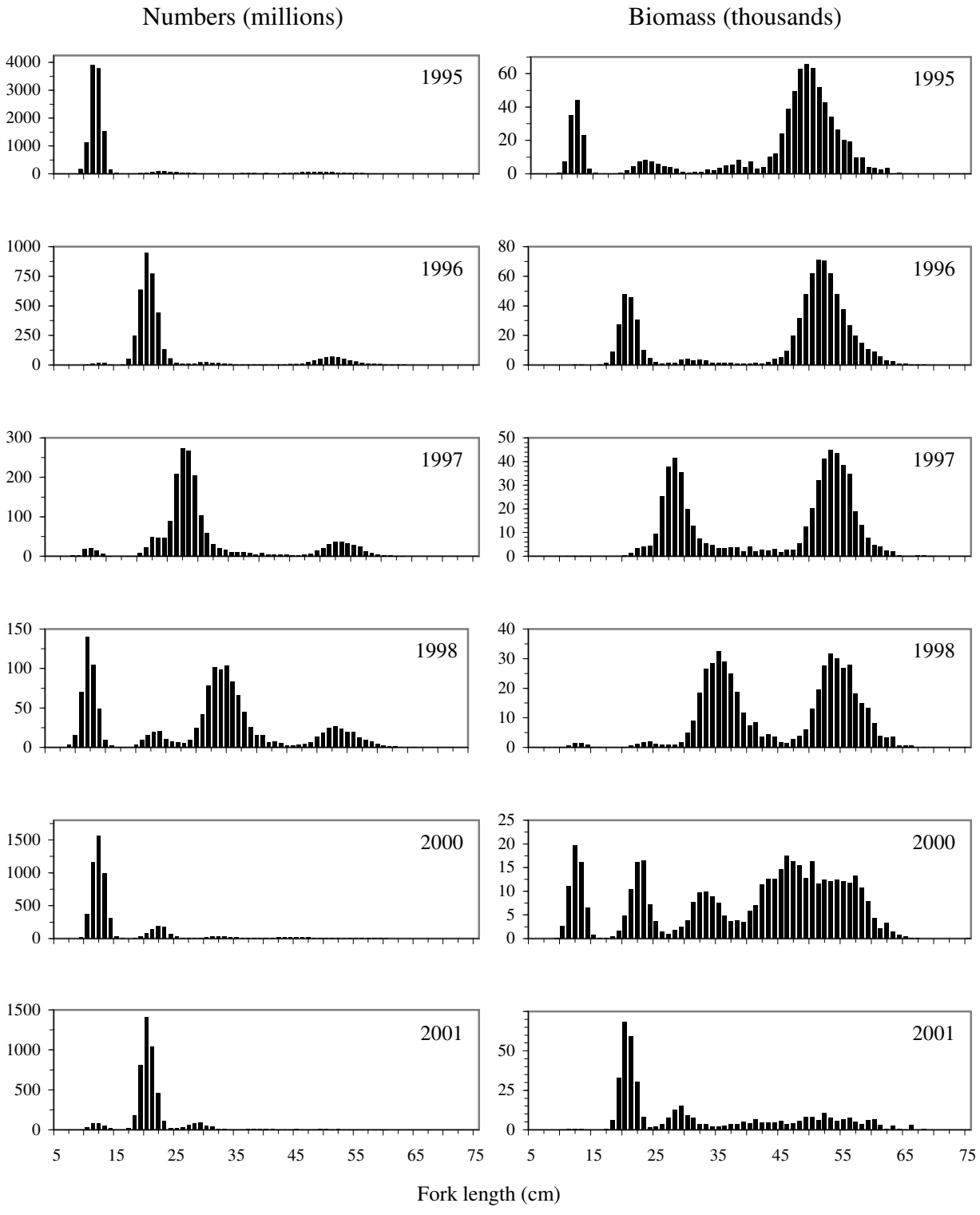

Figure 30.--Annual pollock size compostition estimates for the Shelikof Strait area based on echo integration-trawl surveys conducted from 1995 to 2006. Note: area was not surveyed in 1999.

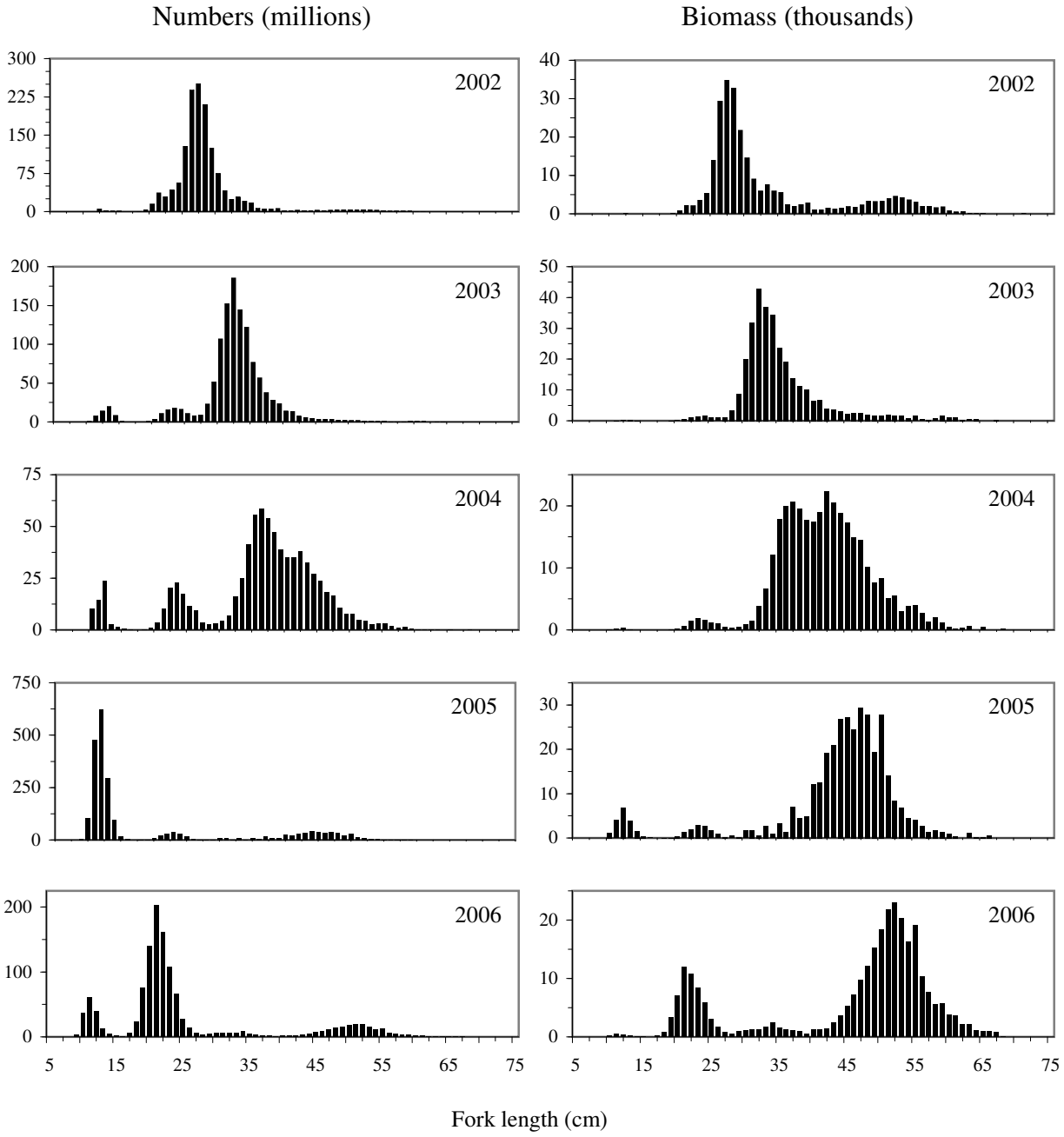

Figure 30.--Continued.

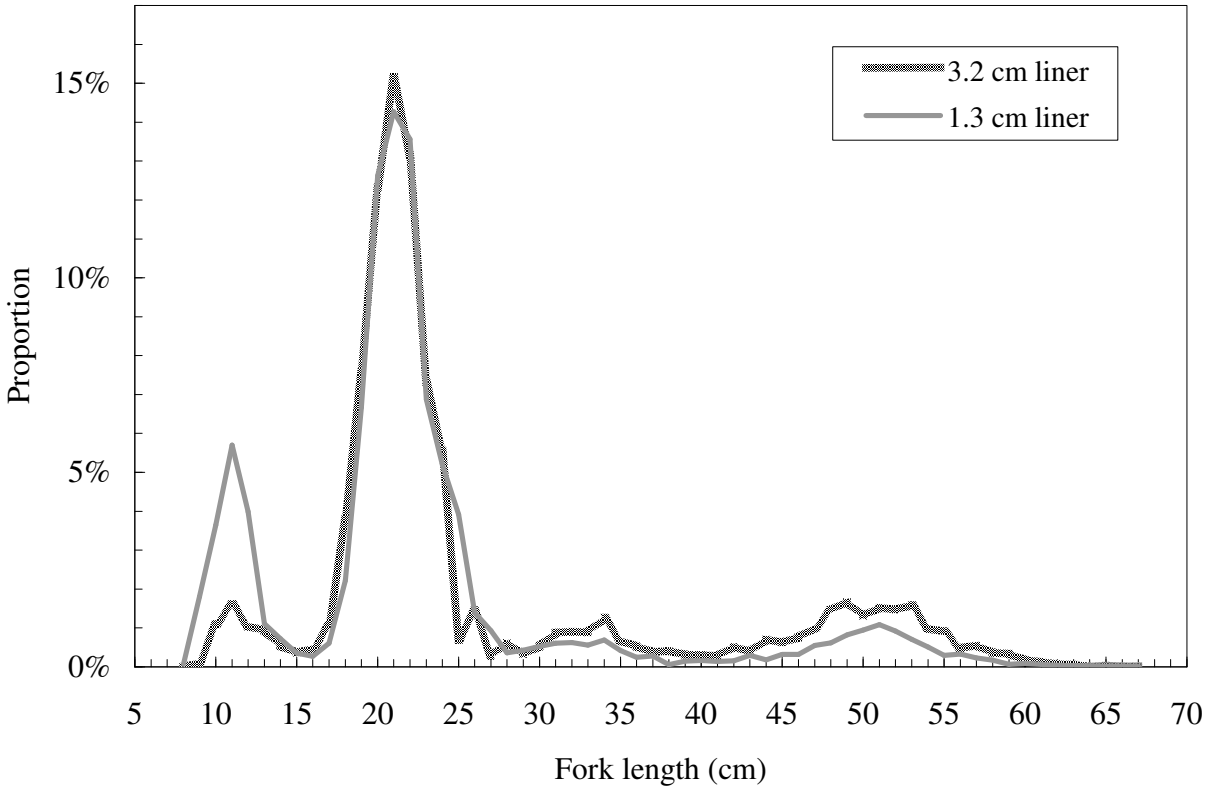

Figure 31.--Mean length distribution by codend liner mesh size for six pairs of tows conducted following the 2006 echo integration-trawl survey of the Shelikof Strait area.