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Results of the 2003 and 2005 Echo Integration-Trawl Surveys in the Gulf of Alaska During Summer, Cruises MF2003-09 and OD2005-01

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Results of the 2003 and 2005 Echo Integration-Trawl Surveys in the Gulf of Alaska During Summer, Cruises MF2003-09 and OD2005-01

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ABSTRACT

Echo integration-trawl (EIT) surveys were conducted in the Gulf of Alaska (GOA) during the summer in 2003 and 2005 to determine the feasibility of using acoustic survey methods to estimate walleye pollock (*Theragra chalcogramma*) distribution and abundance. The 2003 survey was conducted aboard the NOAA ship *Miller Freeman* from 4 June to 16 July and covered the GOA shelf and shelfbreak from the Shumagin Islands to Prince William Sound. The 2005 survey was conducted aboard the NOAA ship *Oscar Dyson* from 30 June to 30 July and covered portions of the GOA shelf and shelfbreak from the Islands of Four Mountains to south of Prince William Sound.

The densest walleye pollock aggregations in 2003 were detected in the vicinity of Kodiak Island, which included Barnabas and Chiniak troughs, the Shelikof Strait sea valley, Marmot and Alitak bays, and on the shelf east of Kodiak Island. Walleye pollock were also detected in the near-shore basins of deeper water off Renshaw Point in the Shumagin Islands and off Nakchamik Island. In 2005, the densest pollock aggregations were detected in the vicinity of Kodiak Island in northern Barnabas and Chiniak troughs, within Shelikof Strait proper, and along the shelf break between Chirikof Island and Barnabas Trough.

Results show that pollock can be successfully assessed using EIT survey methods during summer in the GOA. Of other fish species encountered, capelin (*Mallotus villosus*) and rockfish (*Sebastes* sp.) have the most potential to be assessed using EIT survey methodology.

CONTENTS

INTRODUCTION

Although scientists from the Midwater Assessment and Conservation Engineering (MACE) Program of the Alaska Fisheries Science Center (AFSC) have conducted late winter and early spring echo integration-trawl (EIT) surveys of pre-spawning walleye pollock in the Gulf of Alaska (GOA) most years since 1980, there never has been a GOA-wide summer EIT survey. The only past summer survey efforts conducted by MACE have been very localized and occurred in Chiniak and Barnabas troughs southeast of Kodiak as part of a multi-year study (2000-2002 and 2004-2006) to explore the effect that commercial fishing has on walleye pollock (*Theragra chalcogramma*), a potential prey of endangered Steller sea lions (Wilson et al. 2003). This report presents the distribution and abundance of walleye pollock for large regions of the GOA and discusses the potential value of conducting EIT surveys to assess this species and others during summer sampling surveys.

METHODS

MACE conducted two summer EIT surveys in the GOA during 2003 and 2005 to determine the feasibility of estimating walleye pollock distribution and abundance. The 2003 survey was conducted from 4 June to 16 July and covered the GOA shelf and shelfbreak from the Shumagin Islands to Prince William Sound (Cruise MF2003-09, Fig. 1). The 2005 survey was conducted 30 June to 30 July and covered portions of the GOA shelf and shelfbreak from the Islands of Four Mountains to south Prince William Sound (Cruise OD2005-01, Fig. 2).

Acoustic Equipment

The 2003 survey was conducted aboard the NOAA ship *Miller Freeman*, a 66-m stern trawler equipped for fisheries and oceanographic research that MACE has used for most EIT surveys conducted since 1977. Acoustic data were collected with Simrad EK500[1] and EK60 quantitative

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

echosounding systems using 38, 120, and 200 kHz split-beam transducers (Simrad 1997, 2004; Bodholt and Solli 1992) installed on the bottom of a retractable centerboard extending 9 m below the water surface. The 38 and 120 kHz data were logged using SonarData EchoLog 500 (version 3.0), and the 200 kHz Data were logged using ER60 software (version 1.4.5). Data were analyzed using SonarData Echoview (Version 3.00.75.05) PC-based post-processing software. Results presented here are based on EK500 38 kHz data.

The 2005 survey was conducted aboard the NOAA ship *Oscar Dyson*, a recently built 64-m stern trawler designed to meet the International Council for the Exploration of the Sea's specifications for underwater radiated noise to minimize fish avoidance to the vessel during fish abundance surveys (Mitson 1995). Acoustic data were collected with a Simrad EK60 quantitative echosounding system using 38, 120, and 200 kHz split-beam transducers installed on the bottom of a retractable centerboard extending 9 m below the water surface and a hull-mounted 18 kHz transducer. Data were logged using ER60 software (version 2.1.1) 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 the EK60 38 kHz data.

Trawl Gear

Both vessels were equipped with an Aleutian wing 30/26 midwater 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. The AWT was fished with 82.3 m (270 ft) of 1.9 cm (0.75) 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]. On the *Miller Freeman*, vertical net opening and depth were monitored with a WESMAR third wire or Furuno netsounder system attached to the trawl headrope; on the *Oscar Dyson*, a Simrad ITI net mensuration system or a Simrad FS20 net sounder was used. The vertical net opening for the *Miller Freeman* AWT ranged from 10 to 32 m (33 to 103 ft) and averaged 22 m (74 ft) while fishing. The vertical net opening for the *Oscar Dyson* AWT ranged from 14 to 28 m (46 to 92 ft) and averaged 20 m (66 ft) while fishing.

Both vessels were 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 89 mm (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. Vertical net opening and depth were monitored with a Furuno netsounder system (*Miller Freeman*) or a Simrad ITI net mensuration system (*Oscar Dyson*) attached to the trawl headrope. The PNE trawl vertical mouth opening for the *Miller Freeman* ranged from 5 to 8 m (16 to 26 ft) and averaged 7 m (23 ft) while fishing. The PNE vertical mouth opening for the *Oscar Dyson* ranged from 5 to 7 m (16 to 23 ft) and averaged 6 m (20 ft) while fishing.

The *Miller Freeman* was also equipped with a Marinovich trawl, a small-mesh net designed for age-0 walleye pollock and other small organisms. Trawl meshes measured 7.6 cm (3 in) forward, 3.2 cm (1.3 in) in the codend, and 0.32 cm (0.125 in) in the codend liner. Both the headrope and footrope were 9.1 m (30 ft) long. The net was fished with the Fishbuster doors, but to prevent overspreading and damage to the net, a 15.2-m (50-ft) long, 2.5-cm (1-in) diameter spectra restrictor line was connected between the ends of two 82.3-m (270-ft) long, 1.9-cm (0.75-

in) diameter 6 × 19 wire ropes trailing each trawl door. Two pairs of 18.3-m (60-ft) long, 1.3-cm (0.5-in) diameter 6 × 19 wire ropes led aft from the restrictor line to the headrope and footrope.

The *Oscar Dyson* was also equipped with a Methot trawl, which was used to target smaller near-surface and midwater organisms. A rigid square frame measuring 2.3 m (7.5 ft) on each side formed the mouth of the net. Mesh sizes were 2 × 3 mm (0.08 × 0.12 in) in the body of the net and 1 mm (0.04 in) in the codend. A 1.8-m (6-ft) dihedral depressor was used to generate additional downward force. A calibrated General Oceanics flow meter was attached to the mouth of the Methot trawl to determine the volume of water filtered during trawling. During deployment, the Methot trawl was attached to a single cable that was fed through a stern-mounted A-frame.

Oceanographic Equipment

Physical oceanographic measurements collected during the cruises included temperature profiles obtained with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope, and conductivity, temperature, and depth (CTD) measurements collected with a Sea-Bird CTD system. Continuous sea surface temperature, salinity, and other environmental data were collected using ships' sensors interfaced with the *Miller Freeman* and *Oscar Dyson's* Scientific Computing Systems (SCS).

Survey Design

For the 2003 *Miller Freeman* survey, transects were oriented parallel to one another, except for exploratory excursions into several bays on the south side of the Kenai Peninsula (Fig. 1). The GOA shelf was surveyed over bottom depths that ranged from about 50 m to 1,000 m beyond the shelf break spanning the area south of the Shumagin Islands to the entrance of Prince William Sound at a 20 nmi spacing (Fig. 1). Areas where the commercial walleye pollock fishing fleet has been active in recent years were surveyed using more closely spaced transects: 2 nmi off Renshaw Point, 3 nmi near Nakchamik Island and in Alitak Bay, Barnabas Trough and Chiniak Trough, 3.5 nmi near Mitrofania Island, 4 nmi in West Nagai Strait and Marmot Bay, 8 nmi in

Prince William Sound, and 10 nmi in Shelikof Strait, along the shelf break area south of Kodiak Island, and in Amatuli Trench.

For the 2005 *Oscar Dyson* survey, the GOA shelf was surveyed over bottom depths that also ranged from about 50 m to 1,000 m beyond the shelf break spanning the area south of the Shumagin Islands westward to the Islands of Four Mountains at a 20 nmi spacing, with alternate transect pairs extending about 30 nmi beyond the shelf break (Fig. 2). The shelfbreak (200 to 1,000 m bottom depth) was surveyed from south of the Shumagin Islands eastward to south of Prince William Sound, with alternate transect pairs extending about 30 nmi beyond the shelf break. Barnabas and Chiniak troughs were surveyed using 6-nmi spaced transects, and Shelikof Strait was surveyed using a combination of 10- and 20-nmi spaced transects.

Trawl hauls were conducted to identify scattering layers and to provide biological samples. Average trawling speed was approximately 1.5 m/s (3 kts) for both vessels. Walleye pollock were sampled to determine sex, fork length (FL), body weight, age, and maturity (Tables 1 and 2). Walleye pollock and other selected species such as Pacific ocean perch (*Sebastes alutus*; POP) were measured to the nearest centimeter (cm). Shorter forage fish, such as capelin (*Mallotus villosus*) and Pacific herring (*Clupea pallasi*), were measured to the nearest millimeter (mm) standard length (SL). An electronic motion-compensating scale (Marel M60) was used to weigh individual fish to the nearest 2 g. Walleye pollock otoliths were collected and stored in a 50% ethanol-water solution for later age determinations. 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) and stored in an Oracle database. Whole fish were frozen for AFSC Observer Program training specimens.

[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

Primary EIT survey operations, which included the collection of acoustic and trawl data, occurred during the 17-18 hours of daylight available. Nighttime activities included conducting additional trawl hauls to supplement daytime sampling and to verify nighttime scattering layers, re-running portions of the survey track line to evaluate the diel distribution patterns of the dominant scatterers, CTD sampling to describe water column properties, collection of target strength data for walleye pollock and forage fishes, and conducting ancillary scientific projects. Additionally, for the 2003 survey, nighttime activities included testing an acoustically controlled opening and closing multiple codend device installed in place of the AWT codend.

Acoustic system calibrations using standard spheres (Foote et al. 1987) were conducted to measure and document acoustic system performance for the EK500 and ER60 echosounders. During the calibrations, the *Miller Freeman* and *Oscar Dyson* were anchored at the bow and stern. Weather, sea state conditions, and acoustic systems settings were recorded. On the *Miller Freeman* three calibration spheres were suspended below the transducers: 23- and 60-mm diameter copper spheres for the 120 and 38 kHz echosounder systems, respectively, and a 38.1-mm diameter tungsten carbide sphere for the 200 kHz system. On the *Oscar Dyson* a 38.1-mm tungsten carbide sphere was suspended below the centerboard-mounted transducers, while a copper sphere was suspended below the hull-mounted 18 kHz transducer. A 38.1-mm tungsten carbide sphere was used to calibrate the 38, 120, and 200 kHz systems. A 64-mm copper sphere was used to calibrate the 18 kHz system. After each sphere was centered on the acoustic axis, the 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 confirmed by moving each sphere through the beam and collecting target strength data using Simrad EKLOBES software.

<u>Data Analysis</u>

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. Backscattering identified as walleye pollock were stored in a relational database. Walleye pollock length data were aggregated into strata based on scattering layers type, 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 length (TS = 20 Log L – 66; Traynor 1996) and the length composition data to produce estimates of walleye pollock numbers by length class. Mean weight-at-length was estimated from the trawl data when there were more than 5 individuals 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 were generated for the 2003 survey. Age determinations for the 2005 survey have not yet been completed. Estimated walleye pollock abundance estimates were summarized for all areas surveyed. Also, abundance estimates for the 20 nmi shelf and shelfbreak transects were reported by International North Pacific Fisheries Commission subareas, where the Kodiak area is 147° to 154°W, the Chirikof area is 154° to 159°W, and the Shumagin area is 159° to 170°W longitude (Fig. 1).

Abundance estimates were also made for capelin. A technique using differences in volume backscattering between 38 and 120 kHz was first applied to capelin backscatter validated from trawl catches as a means to confirm that the scrutinized backscatter corresponded to capelin (Logerwell and Wilson 2004). This technique corrected the backscatter attributed to capelin by 17.8%. Capelin length composition was aggregated into analytical strata based on geographic proximity of hauls and similarity in size composition data. Estimates of capelin backscattering strength for each stratum were calculated using an s_V threshold of –70 decibels. The echo integration values were summed and scaled using a target strength to standard length (SL) relationship of TS = 20 Log SL – 69.4 (Guttormsen and Wilson in prep), and length composition data to produce estimates of capelin numbers by length. Mean weight-at-length was estimated from the trawl data and was used to calculate biomass-at-length.

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 acoustic abundance. 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

Calibrations

The 38-kHz collection systems showed no significant differences in gain parameters or transducer beam pattern characteristics between calibrations, thus confirming that the acoustic systems were stable and operated as expected during the surveys (Tables 3 and 4).

Gulf of Alaska 2003 Survey

Oceanographic Conditions

Mean surface water temperatures, based on SBE-39 data, ranged from 6.5 ºC in the Shumagin Islands area to 14.2 ºC in Prince William Sound (Fig. 3). Inferences about surface water temperatures are confounded by the broad time span of the survey. For example, the Shumagin Islands area was surveyed in early June and Prince William Sound was surveyed in mid-July. At the water column depths where walleye pollock densities were highest, temperatures ranged from 5.1 ºC in the Shumagins to 7.1 ºC in the mouth of Alitak Bay.

Biological Sampling

Biological data and specimens were collected from 78 AWT, 14 PNE bottom trawl, and 1 Marinovich trawl hauls (Table 5). Walleye pollock was the most abundant species caught in midwater trawl hauls, comprising 82.3% and 51.8% of the total catch by weight and numbers, respectively (Table 6). POP (7.5%) and Pacific herring (3.8%) were the next most abundant species by weight, and capelin (24.5%) and eulachon (*Thaleichthys pacificus*, 10.4%) were the next most abundant species caught by numbers. In bottom trawls, several of which were conducted in midwater, POP was the most abundant species caught, accounting for 46.6% by weight and 44.4% by numbers (Table 7). Walleye pollock (21.6%) and northern rockfish (*Sebastes polyspinis*, 15.0%) were the next most abundant species by weight. Capelin (15.1%), walleye pollock (14.4%), northern rockfish (7.6%), and eulachon (6.6%) were next most abundant species caught by numbers. In the single Marinovich trawl haul, capelin was the only species caught (51 fish weighing 0.113 kg).

Trawl hauls conducted in the densest walleye pollock aggregations in most of the areas surveyed contained fish between 33 and 45 cm FL walleye pollock (Fig. 4). The majority of these fish are from the 1999 and 2000 year classes (Fig. 5). These two year classes have dominated population estimates during recent late winter and early spring GOA surveys. Only three trawl hauls predominantly older fish (> 45 cm FL): hauls 19 and 88, which were conducted off the shelf break, and haul 48, which was conducted in Marmot Bay (Fig. 1). Most of the catch of age-1 walleye pollock occurred in trawl hauls conducted in Shelikof Strait and on the shelf east of Kodiak Island, particularly along the Kenai Peninsula.

<u>Walleye Pollock Distribution and Abundance</u>

In total, about 6,500 km (3,500 nmi) of transect tracklines were surveyed. The densest aggregations of walleye pollock were detected in the vicinity of Kodiak Island in Barnabas and Chiniak troughs, in the Shelikof Strait sea valley, in Marmot and Alitak bays, and on the shelf east of Kodiak Island (Fig. 6). Walleye pollock were also concentrated in nearshore basins of deep water off Renshaw Point in the Shumagin Islands and off Nakchamik Island. By contrast, virtually no walleye pollock were encountered on the shelf and shelfbreak west of Kodiak Island.

Most walleye pollock were distributed demersally, often within 40 m of the sea floor, such as in the Shumagin Islands area, near Nakchamik Island, in Prince William Sound, and in Alitak Bay, where the shallowest substantial walleye pollock scattering encountered during the survey was detected just outside the mouth of the bay over bottom depths of 55-70 m. (Fig. 7A-D). Most fish were also distributed demersally in Barnabas and Chiniak troughs and Marmot Bay, although there were occurrences of walleye pollock well off bottom as well, sometimes exceeding 75 m above the sea floor (Fig. 8A-C). The only areas where the dominant scattering occurred in mid-water layers were the shelfbreak area, where there were layers at 100-150 m from the surface over bottom depths of 450-1,000 m, in Shelikof Strait, where mid-water layers ranged from 50 m below the surface to 50 m above the sea floor, and in the Kenai Peninsula bays, where there were layers at 100-135 m from the surface over bottom depths of 175 to 225 m (Fig. 9A-C). Shelikof Strait and the shelfbreak also had a lesser amount of near bottom walleye pollock. The shelf was a mixture of near-bottom and off-bottom walleye pollock.

The abundance estimate of the entire survey area is 1.5 billion fish weighing 320,900 metric tons (t) (Table 8). Shelikof Strait at 151,300 t accounted for 47% of the GOA biomass. The next most abundant areas were Barnabas Trough (30,400 t), the Kodiak shelfbreak (29,100 t) and Kodiak shelf area (23,900 t), and Amatuli Trench (23,100 t). Together, these five areas accounted for 80% of the total estimated biomass in the survey area.

Other Species

The densest aggregations of capelin were detected east of Kodiak Island, with lesser amounts south and north of the Island (Fig. 10). The abundance estimate of capelin was 30.3 billion fish weighing 116 thousand t (Table 9). Approximately three-quarters of the abundance in numbers were 7 to 9 cm fish.

Rockfish also aggregated in distinct schools. In areas where the bathymetric features met the shelfbreak – for example, the south end of Shelikof Strait, the mouth of both Barnabas and Chiniak troughs and southwest of the mouth of Amatuli trough - at bottom depths of 175 to 225 m, the scattering layers were comprised almost exclusively of POP. On the shelf south of Mitrofania Island over bottom depths of 80-100 m, the scattering layers were a mixture of POP and northern rockfish (*Sebastes polyspinis*) (Fig. 11).

Gulf of Alaska 2005 Survey

Oceanographic Conditions

Mean surface water temperatures ranged from 10.7º C on the Shumagin shelf and shelfbreak to 13.2º C on the Chirikof/Shelikof shelfbreak (Fig. 12). At the water column depths where walleye pollock densities were highest, temperatures ranged from 5.1º C on the Shumagin shelfbreak to 7.1º C in Chiniak Trough.

Biological Sampling

Biological data and specimens were collected from 28 AWT, 10 PNE bottom trawl, and 6 Methot trawls (Table 10). Walleye pollock was the most abundant species caught in midwater trawl hauls, comprising 58.8% and 58.7% of the total catch by weight and numbers, respectively (Table 11). POP (34.7%) and eulachon (3.4%) were the next most abundant species by weight. Eulachon (18.1%) and capelin (7.7%) were the next most abundant species caught by numbers. In bottom trawls, several of which were conducted in midwater, arrowtooth flounder was the most abundant species caught, accounting for 31.6% by weight and 37.7% by numbers (Table 12). Walleye pollock (20.2%), Atka mackerel (*Pleurogrammus monopterygius*, 19.7%), and northern rockfish (10.3%) were the next most abundant species by weight. Atka mackerel (15.9%), walleye pollock (13.4%), POP (12.3%) and northern rockfish (9.8%) were the next most abundant species caught by numbers. In the Methot trawl hauls, euphausiids were the most abundant species caught, comprising of (54.2%) of the catch by weight (Table 13). Unidentified salps (19.7%) and jellyfish (14.4%) were the next most abundant species by weight.

Trawl hauls conducted in the densest walleye pollock scattering layers on the GOA shelf and shelfbreak contained mostly fish between 40 and 55 cm FL (Fig. 13). Slightly larger fish were captured in Barnabas and Chiniak troughs. Although the otoliths were not aged for the 2005 survey, the majority of the 40 and 55 cm fish are likely from the 1999 and 2000 year classes, which have dominated abundance estimates during recent late winter and early spring surveys in the GOA. Trawl hauls conducted in the densest walleye pollock scattering layers within

Shelikof Strait contained fish mostly between 15 and 20 cm FL walleye pollock (likely 2004 year class) and contained few longer fish.

Walleye Pollock Distribution and Abundance

Acoustic data were collected along about 3,700 km (2,000 nmi) of transect tracklines. The densest walleye pollock aggregations were detected in the vicinity of Kodiak Island in northern Barnabas and Chiniak troughs, within Shelikof Strait proper, and along the shelf break between Chirikof Island and Barnabas Trough (Fig. 14). Also, in the southern part of the Shelikof Strait sea valley, large quantities of age-0 walleye pollock were encountered (Fig. 15).

On the GOA shelf, walleye pollock were located over bottom depths shallower than 100 m. Over the shelfbreak, walleye pollock were located in mid-water schools between depths of 100 and 225 m from the surface over bottoms depth of 175 to 500 m (Fig. 16A). Over the entire GOA survey area, very few walleye pollock were detected over bottom depths between 500 and 1,000 m, and no walleye pollock were detected along any of the offshore transects. Walleye pollock were mostly distributed demersally in Barnabas and Chiniak troughs, with a lesser amount of walleye pollock in Chiniak Trough in midwater schools at 100-110 m and at 150 m. (Figs. 16B-C). In Shelikof Strait, juvenile walleye pollock formed midwater schools between water depths of 50 and 200 m, and adults were mostly within 40 m of the sea floor between bottom depths of 200 and 300 m (Fig. 16D).

The abundance estimate of the entire survey area is 1.4 billion walleye pollock weighing 223,900 t (Table 8). As in 2003, Shelikof Strait contained the highest amount of biomass, accounting for the 36% of the total. The Shumagin shelf accounted for 21%, followed by the Chirikof (14%) and Kodiak (9%) shelfbreaks.

Other Species

As in 2003, capelin were often aggregated in distinct schools. The densest aggregations of capelin were detected in the vicinity of Kodiak Island in Barnabas and Chiniak trough (Fig. 17).

The abundance estimate of capelin was 4.6 billion fish weighing 13.7 thousand t (Table 9). Three-quarters of the abundance in numbers were 7 to 8 cm fish.

Rockfish were aggregated in distinct schools. The densest aggregations were located on the shelf south of Unmak and Unalaska islands and on the shelfbreak south of Shelikof Strait and Amatuli Trench. Hauls conducted on the Shumagin shelf at about 100 m caught mostly a mixture of POP and northern rockfish. Hauls conducted on the shelfbreak caught mostly POP (Fig. 18).

DISCUSSION

Results from the 2003 and 2005 studies show that walleye pollock can be successfully assessed during summer in the GOA, although there is uncertainty as to whether winter surveys, which are conducted when walleye pollock are aggregated for spawning, are more effective at producing abundance estimates more reflective of the total GOA-wide walleye pollock abundance. Additionally, areas outside of the GOA survey trackline such as bays may be areas where substantial walleye pollock occur in the summer. For example, 317,300 t of walleye pollock were estimated during the winter 2003 Shelikof Strait survey as compared to 151,300 t estimated during the summer 2003 survey. Although 7.5-nmi transect spacing was used during winter versus 10 nmi in summer, it is unlikely that transect spacing was a factor for the difference in abundance. Winter survey biomass estimates based on using alternate transects, which creates two sets of 15 nmi-spaced transects, the biomass estimates are 339,100 and 294,600 t. The abundance differences were more pronounced in the Shumagin Islands, where the 2003 winter estimate was 67,300 t and the 2003 summer estimate was 7,400 t, as well as in the area where the 2003 winter and summer Chirikof shelfbreak surveys overlapped, where the winter estimate was 30,900 and the summer estimate was 7,000 t.

Estimation errors were generally larger for both summer surveys than for recent winter GOA surveys, particularly for the 20 nmi-spaced transects along the Kodiak and Chirikof shelf and shelfbreaks, where the estimation errors ranged from 0.214 to 0.384 (Table 8). These large errors could either be an artifact of the wider transect spacing that was necessary to cover the large area assessed during the summer survey or possibly reflect the difference in distributional homogeneity between winter spawning aggregations and summer feeding aggregations. However, if the survey effort is redistributed by eliminating survey effort beyond the shelf break, where no walleye pollock were detected, and reducing effort in areas where the commercial walleye pollock fishery has never targeted walleye pollock, greater transect coverage could be used elsewhere.

Of the other fish species encountered during the 2003 and 2005 summer survey, capelin appear to have good potential for assessment with EIT survey methodology. Capelin were often aggregated in distinct schools and did not appear to avoid the trawl. The AWT, however, may not be the most appropriate gear for capturing capelin. Although dense scattering layers were often observed on the centerboard transducers while transecting and net sounders during trawling, few capelin would be retained in the codend, with a much larger amount of fish shaken out of the intermediate meshes of the net onto the trawl deck during gear retrieval.

Neither the 2003 nor 2005 survey was as comprehensive as originally planned. NOAA-wide budget concerns in spring 2003 resulted in a reduction of 12 surveys days forcing the cancellation of survey effort of the GOA shelf and shelfbreak from the Shumagin Islands to the Islands of Four Mountains and surveys of Sanak Trough and Morzhovoi and Pavlof bays. The 2005 survey, which was originally scheduled to begin on 1 June, was shortened by 28 days because of vessel generator problems. The 2005 survey was also compromised by other vessel mechanical problems, which prompted the vessel command to mandate a 5-nmi minimum distance from shore for safety concerns. This prevented surveying areas where significant quantities of walleye pollock were found during the 2003 survey, including the Shumagin Islands area, Nakchamik Island, Alitak Bay, Marmot Bay, and Kenai Peninsula bays.

It should be pointed out that the 2003 and 2005 surveys were conducted with two different vessels using two different sounders. However, preliminary analyses of data collected during

9 days of inter-vessel calibration between the *Miller Freeman* and *Oscar Dyson* during summer 2006 in the eastern Bering Sea suggest that vessel-induced fish behavior is minimal (de Robertis et al. in prep). Differences between the EK500 and EK60 echosounder systems have been shown to be minimal (Neal Williamson, AFSC, pers. comm.).

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SCIENTIFIC PERSONNEL

2003 Gulf of Alaska Survey

Name	Position	Organization
Leg 1		
Michael Guttormsen	Chief Scientist	AFSC
Paul Walline	Fish. Biologist	AFSC
Bill Floering	Fish. Biologist	AFSC
P. Tyler Yasenak	Fish. Biologist	AFSC
Kresimir Williams	Fish. Biologist	AFSC
Troy Martin	Fish. Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Amanda Miller	Teacher-at-sea	OLA
Leg 2		
Neal Williamson	Chief Scientist	AFSC
Sarah Stienessen	Fish. Biologist	AFSC
Bill Floering	Fish. Biologist	AFSC
Denise McKelvey	Fish. Biologist	AFSC
P. Tyler Yasenak	Fish. Biologist	AFSC
Elaina Jorgensen	Fish. Biologist	AFSC
Robert Self	Fish. Biologist	AFSC
Steve Barbeaux	Fish. Biologist	AFSC
Alex de Robertis	Fish. Biologist	AFSC
Mike Brown	Computer Spec.	AFSC
Doug Kinzey	Biologist	NMML
Paula Olson	Biologist	NMML
Chris Hoefer	Biologist	NMML

AFSC - Alaska Fisheries Science Center, Seattle WA
NMML - National Marine Mammal Laboratory, AFSC, Seattle WA
OLA - NOAA Office of Legislative Affairs, Teachers at Sea Program, Wash DC

2005 Gulf of Alaska Survey

Name	Position	Organization
Leg 1		
Chris Wilson	Chief Scientist	AFSC
Neal Williamson	Fish. Biologist	AFSC
Denise McKelvey	Fish. Biologist	AFSC
Kresimir Williams	Fish. Biologist	AFSC
Robert Self	Fish. Biologist	AFSC
P. Tyler Yasenak	Fish. Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Leg 2		
Paul Walline	Chief Scientist	AFSC
Alex De Robertis	Fish. Biologist	AFSC
Taina Honkalehto	Fish. Biologist	AFSC
Denise McKelvey	Fish. Biologist	AFSC
Kresimir Williams	Fish. Biologist	AFSC
Robert Self	Fish. Biologist	AFSC
P. Tyler Yasenak	Fish. Biologist	AFSC
Josh Millstein	Statistician	AFSC
Rick Towler	Computer Spec.	AFSC
Amanda Koltz	Student Intern	CU

AFSC - Alaska Fisheries Science Center, Seattle WA
NMML - National Marine Mammal Laboratory, AFSC, Seattle WA
OLA - NOAA Office of Legislative Affairs, Teachers at Sea Program, Wash DC
CU - Cornell University, Ithaca NY

Table 1.--Numbers of biological samples and measurements collected during the summer 2003 echo integration-trawl survey of walleye pollock in the Gulf of Alaska.

Haul	Pollock			Eulachon		Capelin		Pacific sand lance		Northern smoothtounge	Pacific herring		Lanternfish	Chinook salmon		Pacific ocean perch		Dusky rockfish	Northern rockfish		Unidentified fish larvae
No.	Lengths	Weights and maturities	Otoliths	Lengths	Weights	Lengths	Weights	Lengths	Weights	Lengths	Lengths	Weights	Lengths	Lengths	Weights	Lengths	Weights	Lengths	Lengths	Weights	Lengths
1	299	42	41	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2	331	45	46	39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3	59	30	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	151	55	--	103	53	--
5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	107	50	--	--	--	--
7	1	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	225	61	61	111	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	230	55	55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	334	73	73	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12	5	5	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
13	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
14	6	6	6	--	--	--	--	--	--	--	--	--	--	--	--	34	--	--	--	--	--
15	369	66	66	25	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
16	178	60	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
17	307	43	--	149	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
19	125	52	52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
20	383	52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
22	260	101	74	30	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
23	109	35	35	--	--	--	--	--	--	--	101	57	--	--	--	--	--	--	--	--	--
24	193	34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
25	436	103	52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
26	332	114	71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
28	397	126	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
29	--	--	--	--	--	103	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--
30	340	98	54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
31	377	107	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
32	311	83	31	18	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
33	280	67	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
34	326	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
35	325	110	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
36	263	95	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
37	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	115	43	--	--	--	--
38	9	9	9	--	--	--	--	--	--	--	--	--	--	--	--	144	47	--	--	--	--
39	35	35	35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
40	320	39	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
41	330	82	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
42	318	99	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
43	279	86	35	69	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
44	338	117	35	76	76	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
45	317	109	30	--	--	51	51	--	--	--	--	--	--	--	--	--	--	--	--	--	--
46	352	125	25	60	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
47	252	2	--	66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 1.--Continued.

Haul No.	Pollock Lengths	Pollock Weights and maturities	Pollock Otoliths	Eulachon Lengths	Eulachon Weights	Capelin Lengths	Capelin Weights	Pacific sand lance Lengths	Pacific sand lance Weights	Northern smoothtounge Lengths	Pacific herring Lengths	Pacific herring Weights	Lanternfish Lengths	Chinook salmon Lengths	Chinook salmon Weights	Pacific ocean perch Lengths	Pacific ocean perch Weights	Dusky rockfish Lengths	Northern rockfish Lengths	Northern rockfish Weights	Unidentified fish larvae Lengths
48	208	87	51	96	44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
49	319	74	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
50	417	135	30	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
51	378	168	62	106	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
52	339	95	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
53	632	194	44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
54	314	150	38	122	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
55	497	131	31	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
56	--	--	--	--	--	53	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
57	526	218	38	3	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
58	327	107	36	99	52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
59	569	149	35	103	52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
60	351	115	35	23	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
61	--	--	--	--	--	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
62	384	190	41	42	42	--	--	--	--	--	134	68	--	--	--	--	--	--	--	--	--
63	378	169	32	126	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
64	348	175	37	134	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
65	7	--	--	--	--	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
66	579	98	48	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
67	384	50	--	5	--	1	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--
68	--	--	--	--	--	122	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
69	476	135	36	102	51	9	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--
70	11	11	5	--	--	58	--	--	--	--	--	--	--	140	70	--	--	--	--	--	--
71	--	--	--	--	--	102	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--
72	341	102	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
73	--	--	--	--	--	490	120	--	--	--	--	--	--	--	--	--	--	--	--	--	--
74	--	--	--	--	--	175	86	--	--	--	--	--	--	--	--	--	--	--	--	--	--
75	--	--	--	--	--	101	--	99	50	--	--	--	--	--	--	--	--	--	--	--	--
76	306	115	70	126	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
77	312	101	60	41	--	50	--	--	--	--	--	--	--	--	--	162	--	--	--	--	--
78	--	--	--	--	--	149	--	--	--	--	--	--	37	--	--	--	--	--	--	--	--
79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	156	58	--	--	--	--
80	71	71	71	--	--	--	--	--	--	--	--	--	--	--	--	153	64	--	--	--	--
81	399	104	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--	--	--
82	430	156	81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
83	91	41	36	--	--	--	--	--	--	--	129	50	--	--	--	--	--	--	--	--	--
84	427	147	40	34	34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
85	1	1	1	36	36	--	--	--	--	--	--	--	--	--	--	137	53	--	--	--	--
86	176	113	35	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--
87	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
88	224	101	79	--	--	--	--	--	--	--	--	--	--	--	--	137	68	--	--	--	--
89	387	123	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
90	279	79	52	4	4	7	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--
91	411	96	59	98	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
92	405	126	52	47	47	--	--	--	--	88	--	--	--	--	--	--	--	--	--	--	22
93	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50
Totals	21,066	6,357	2,722	2,021	1,073	1,593	360	99	50	88	379	175	37	140	70	1,296	438	16	103	53	73

Table 2.--Numbers of biological samples and measurements collected during the summer 2005 echo integration-trawl survey of walleye pollock in the Gulf of Alaska.

	Pollock			Eulachon		Pacific ocean perch		Northern rockfish		Atka mackerel
Haul no.	Lengths	Weights and maturities	Otoliths	Lengths	Weights	Lengths	Weights	Lengths	Weights	Lengths
1	311	10	10	--	--	--	--	--	--	--
2	21	--	--	--	--	--	--	--	--	--
3	408	89	50	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--	--	--
7	268	67	50	--	--	--	--	--	--	--
8	10	--	--	--	--	--	--	--	--	--
9	--	--	--	--	--	247	69	132	58	--
10	--	--	--	--	--	--	--	--	--	--
11	--	--	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	--	--	--	--
13	--	--	--	--	--	--	--	--	--	--
14	53	--	--	--	--	--	--	--	--	--
15	18	18	18	--	--	--	--	--	--	--
16	54	21	21	--	--	--	--	--	--	--
17	--	--	--	--	--	73	--	52	--	49
18	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--
21	6	--	--	--	--	191	54	--	--	--
22	337	91	49	--	--	--	--	--	--	--
23	342	91	50	--	--	--	--	--	--	
24	17	17	17	139	46	--	--	--	--	--
25	--	--	--	--	--	--	--	--	--	--
26	339	75	50	--	--	--	--	--	--	--
27	268	49	49	--	--	--	--	--	--	--
28	276	66	40	--	--	--	--	--	--	--
29	415	97	66	--	--	--	--	--	--	--
30	20	19	20	--	--	106	--	--	--	--
31	3	--	--	--	--	110	30	--	--	--
32	--	--	--	--	--	--	--	--	--	--
33	49	49	49	--	--	93	--	--	--	--
34	108	39	39	--	--	--	--	--	--	--
35	461	34	25	--	--	--	--	--	--	--
36	--	--	--	--	--	--	--	--	--	--
37	153	60	37	23	--	--	--	--	--	--
38	78	--	--	--	--	--	--	--	--	--
39	--	--	--	--	--	--	--	--	--	--
40	--	--	--	--	--	--	--	--	--	--
41	403	104	68	48	--	--	--	--	--	--
42	--	--	--	--	--	--	--	--	--	--
43	5	--	--	23	--	--	--	--	--	--
44	--	--	--	--	--	--	--	--	--	--
Totals	4423	996	708	233	46	820	153	184	58	49

Table 3.--Simrad EK500 38 kHz acoustic system description and settings used aboard the NOAA ship *Miller Freeman* during the summer 2003 echo integration-trawl survey of walleye pollock in the Gulf of Alaska and results from standard sphere acoustic system calibrations conducted before, during, and after the survey.

		Calibrations		
	Survey system settings	5-Jun. Three Saint's Bay, Alaska	24-Jun. Kazakof Bay, Alaska	15-Jul. Ugak Bay, Alaska
Echosounder:	Simrad EK500	--	--	--
Transducer:	ES38B	--	--	--
Frequency (kHz):	38	--	--	--
Transducer depth (m):	9.15	--	--	--
Pulse length (ms):	1.000	--	--	--
Transmitted power (W):	2000	--	--	--
Angle sensitivity:	21.9	--	--	--
2-Way beam angle (dB):	-20.7	--	--	--
TS Gain (dB)	25.70	25.70	25.63	25.60
Sv Gain (dB)	25.40	25.40	25.63	25.38
3 dB beamwidth (deg)				
Along:	6.90	6.94	6.94	7.03
Athwart:	6.87	6.87	6.87	6.92
Angle offset (deg)				
Along:	0.03	-0.09	-0.10	-0.09
Athwart:	-0.08	0.00	0.00	0.00
Post-processing Sv threshold (dB):	-70	--	--	--
Standard sphere TS (dB)	--	-33.7	-33.7	-33.7
Sphere range from transducer (m):	--	33.1	37.0	34.7
Absorption coefficient (dB/m):	0.010000	--	--	--
Sound velocity (m/s)	1471.0	--	--	--
Water temp at transducer (^{o}C):	--	9.5	8.8	9.5

Note: Gain and beam pattern terms are defined in the "Operator Manual for Simrad EK500 Scientific Echo Sounder (1993)" available from Simrad Subsea A/S , Strandpromenaden 50, P.O. Box 111, N-3191 Horten, Norway.

Table 4.--Simrad ER60 38 kHz acoustic system description and settings used aboard the NOAA ship *Oscar Dyson* during the summer 2005 echo integration-trawl survey of walleye pollock in the Gulf of Alaska and results from standard sphere acoustic system calibrations conducted before and after the survey.

	Survey system settings	Calibrations 2-Jun. Three Saint's Bay Alaska	Calibrations 28-Jul. Three Saint's 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):	-20.8	--	--
Gain (dB)	22.74	22.74	22.57
Sa correction (dB)	-0.66	-0.66	-0.67
3 dB beamwidth (deg)			
Along:	7.07	7.07	7.18
Athwart:	7.17	7.17	7.23
Angle offset (deg)			
Along:	0.00	-0.01	-0.10
Athwart:	0.00	-0.04	-0.06
Post-processing Sv threshold (dB):	-70	--	--
Standard sphere TS (dB)	--	-42.30	-42.33
Sphere range from transducer (m):	--	23.0	22.8
Absorption coefficient (dB/m):	0.009595	0.009597	0.008970
Sound velocity (m/s)	1475.6	1475.6	1492.3
Water temp at transducer (^{o}C):	--	8.1	12.5

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 5.--Trawl station summary for the summer 2003 Gulf of Alaska echo integration-trawl survey.

Haul no.	Gear[1] type	Date	Time (GMT)	Dur. (min)	Start position Latitude (N)	Start position Longitude (W)	Depth (m) Footrope	Depth (m) Bottom	Temp (deg. C) Surface	Temp (deg. C) Headrope	Pollock catch kg	Pollock catch number	Other catch (kg) pop[2]	Other catch (kg) capelin	Other catch (kg) eulachon	Other catch (kg) other
1	awt	7 Jun	1:48	6	55 34.03	160 18.07	189	189	6.0	4.9	1,578.0	3,023	0.0	0.0	2.0	0.0
2	awt	7 Jun	17:06	15	55 14.23	160 10.48	191	196	7.9	5.4	1,069.0	2,536	0.0	<0.1	1.4	1.5
3	awt	8 Jun	10:07	20	54 35.86	158 46.18	50	162	8.8	7.1	21.7	59	0.0	<0.1	0.0	26.6
4	pne	8 Jun	15:49	10	54 41.16	158 52.57	96	95	7.0	5.3	0.0	0	512.5	0.0	0.0	743.3
5	awt	9 Jun	21:24	18	55 16.46	158 10.52	47	114	7.3	6.7	0.0	0	0.0	0.0	<0.1	3.2
6	pne	10 Jun	1:04	6	54 59.28	157 50.64	82	84	9.2	6.1	0.0	0	57.3	0.0	0.0	133.5
7	pne	10 Jun	9:13	15	55 8.22	157 27.80	88	88	8.6	6.7	<0.1	1	0.6	0.0	0.0	27.7
8	awt	11 Jun	1:53	17	56 23.97	157 52.09	177	258	8.4	5.4	836.4	2,707	0.0	0.0	14.8	3.5
9	awt	11 Jun	6:32	22	56 26.05	158 1.76	154	174	8.0	6.5	407.8	1,198	0.0	0.0	1.2	0.0
10	awt	11 Jun	15:18	12	56 17.74	157 56.66	149	255	7.6	5.8	437.0	987	0.0	<0.1	0.1	<0.1
11	awt	12 Jun	0:05	20	55 14.87	156 45.09	100	104	7.7	6.6	0.0	0	0.0	0.0	0.0	<0.1
12	awt	12 Jun	6:10	21	55 18.62	156 7.71	244	277	8.6	4.3	5.0	5	3.6	0.0	0.0	0.5
13	awt	12 Jun	8:29	30	55 16.34	156 5.29	284	537	8.5	4.2	1.8	3	0.7	0.0	0.0	116.5
14	awt	12 Jun	12:55	19	55 18.27	156 7.40	241	317	8.2	4.8	3.9	6	75.7	0.0	0.0	14.9
15	awt	12 Jun	17:26	22	55 37.40	156 28.75	160	249	7.8	6.0	366.5	1,080	0.0	0.0	0.6	16.4
16	awt	13 Jun	9:05	16	56 9.72	156 22.91	73	251	8.3	6.3	105.5	356	0.0	0.0	0.0	0.0
17	awt	13 Jun	11:57	26	56 10.42	156 24.19	162	252	8.1	5.9	86.8	307	0.0	0.0	5.5	<0.1
18	pne	15 Jun	0:11	6	56 16.03	154 23.68	78	87	8.7	6.9	0.0	0	0.0	0.0	0.0	3.0
19	awt	15 Jun	17:55	10	56 17.89	153 1.34	182	443	8.8	5.6	155.4	125	2.9	0.0	0.0	3.2
20	awt	15 Jun	19:58	50	56 16.91	153 0.00	179	628	9.4	5.6	589.4	893	2.3	0.0	0.0	0.1
21	pne	16 Jun	3:11	17	56 50.73	153 36.14	58	75	9.5	7.2	0.0	0	0.0	0.0	0.0	0.9
22	awt	16 Jun	5:07	15	56 50.59	153 25.05	71	154	9.5	7.5	197.9	358	0.0	0.0	0.5	0.0
23	awt	16 Jun	17:05	16	56 49.68	154 29.50	65	66	8.9	8.3	82.2	110	0.0	0.1	0.0	48.1
24	pne	16 Jun	18:37	2	56 49.13	154 28.99	62	66	8.7	8.0	89.3	193	0.0	<0.1	0.0	2.8
25	awt	17 Jun	3:49	10	57 6.38	153 51.35	105	139	11.0	4.7	1,641.7	6,269	0.0	0.0	0.0	23.4
26	awt	17 Jun	5:49	32	57 2.27	153 58.08	147	152	10.0	4.4	1,391.1	2,886	0.0	0.0	0.0	7.6
27	awt	17 Jun	18:37	24	56 21.99	152 26.18	92	94	9.6	6.2	0.0	0	0.0	0.0	0.0	23.3
28	awt	18 Jun	7:47	3	56 49.83	152 27.09	111	174	9.7	6.8	473.1	807	2.5	0.0	0.0	0.1
29	awt	18 Jun	17:35	12	56 50.18	152 40.75	81	85	9.6	7.1	0.0	0	0.0	4.3	0.0	24.1
30	awt	18 Jun	20:57	21	56 56.48	152 26.85	132	139	10.1	6.4	2,110.0	3,801	0.0	0.0	0.0	0.0
31	awt	19 Jun	3:29	8	57 3.24	152 25.67	142	146	9.6	6.8	949.4	1,789	0.0	0.0	0.0	0.6
32	awt	19 Jun	7:52	26	57 2.32	152 45.14	147	159	9.4	6.7	448.7	789	0.4	0.1	0.9	23.6
33	awt	19 Jun	16:07	8	57 9.26	152 27.84	134	145	9.8	6.7	461.8	839	0.0	0.0	0.0	1.8

Table 5.--Continued.

Haul no.	Gear[1] type	Date	Time (GMT)	Dur. (min)	Start position Latitude (N)		Longitude (W)		Depth (m) Footrope	Bottom	Temp (deg. C) Surface	Headrope	Pollock catch kg	number	Other catch (kg) pop[2]	capelin	eulachon	other
34	pne	19 Jun	19:41	2	57	10.73	152	36.06	93	93	9.7	7.1	407.9	788	0.0	0.0	0.0	63.2
35	awt	20 Jun	1:29	7	57	18.61	152	30.69	91	103	9.3	7.7	1,229.8	2,706	0.0	0.0	0.0	0.2
36	awt	20 Jun	5:55	12	57	26.30	152	37.53	54	96	10.1	7.8	1,113.7	3,195	0.0	0.0	0.0	1.3
37	pne	20 Jun	20:29	17	56	48.07	151	45.45	181	181	9.7	5.2	7.2	8	434.9	0.0	0.0	303.1
38	pne	21 Jun	9:42	5	57	7.56	151	25.27	141	151	9.1	5.7	20.3	19	1,468.0	0.0	0.0	37.8
39	awt	21 Jun	16:16	17	57	26.57	151	20.90	161	174	8.2	6.0	46.3	35	0.0	0.0	0.0	18.4
40	awt	21 Jun	18:47	2	57	28.03	151	25.95	143	161	9.1	6.3	2,738.1	5,452	0.0	0.0	0.0	1.9
41	awt	22 Jun	1:43	19	57	34.65	151	44.93	111	149	8.8	6.7	1,378.5	3,174	0.0	0.0	0.0	51.5
42	awt	22 Jun	7:36	11	57	41.40	151	56.01	91	122	9.0	7.2	391.0	962	0.0	0.0	0.1	19.7
43	awt	22 Jun	18:58	16	57	39.60	151	58.35	192	206	8.9	6.6	838.2	1,275	0.0	0.1	2.2	34.5
44	awt	23 Jun	1:37	4	57	58.26	151	55.27	172	175	9.9	6.3	370.7	880	0.0	0.0	10.1	18.1
45	awt	23 Jun	6:04	27	57	55.40	152	2.92	164	180	9.8	6.6	294.9	882	0.0	21.1	7.6	21.9
46	awt	23 Jun	9:23	22	58	6.23	152	9.35	61	223	9.4	7.3	668.4	1,762	0.0	0.6	6.7	188.5
47	awt	23 Jun	17:12	5	58	4.48	152	25.95	168	199	9.4	6.5	276.4	528	0.0	<0.1	1.8	0.0
48	pne	23 Jun	18:25	8	58	4.73	152	27.19	179	179	9.0	6.3	372.1	208	0.0	0.0	12.7	333.2
49	awt	23 Jun	22:13	23	57	57.79	152	34.71	133	154	7.8	6.7	230.6	569	0.0	0.0	0.0	0.2
50	awt	27 Jun	19:13	9	56	27.15	156	2.58	186	250	9.9	5.7	1,409.7	5,504	0.0	0.0	0.3	<0.1
51	awt	28 Jun	8:27	50	56	19.60	156	17.94	232	271	5.6	10.4	310.9	702	0.0	0.0	83.9	10.8
52	awt	28 Jun	15:55	31	56	39.68	156	10.32	168	225	10.0	5.8	707.1	2,507	0.0	0.0	0.0	0.5
53	awt	29 Jun	0:29	19	56	49.11	156	6.34	183	219	9.5	5.8	2,492.9	9,292	0.0	0.0	0.8	0.3
54	awt	29 Jun	9:19	58	56	50.18	155	29.04	231	267	9.8	5.3	239.3	540	0.0	0.0	156.1	6.3
55	awt	29 Jun	15:57	46	57	1.92	155	33.82	127	270	9.6	6.0	797.2	3,256	0.0	0.0	0.3	0.1
56	mar	29 Jun	20:18	2	57	10.29	156	7.29	81	97	10.0	8.2	0.0	0	0.0	0.1	0.0	0.0
57	awt	30 Jun	2:23	28	57	4.64	155	2.47	139	190	10.8	5.7	1,203.3	11,841	0.0	0.0	0.2	0.8
58	awt	30 Jun	8:30	28	57	24.62	155	39.86	180	285	10.7	5.8	375.7	1,220	0.0	0.0	15.7	9.4
59	awt	30 Jun	15:30	47	57	27.72	155	9.90	227	244	9.9	5.5	612.2	1,680	0.0	0.0	588.4	156.2
60	awt	1 Jul	1:21	52	57	38.92	154	38.44	152	218	10.4	6.0	1,324.3	4,771	0.0	0.0	2.7	14.4
61	pne	1 Jul	16:25	14	57	58.50	154	40.16	45	49	10.1	8.1	0.0	0	0.0	0.8	0.0	3.1
62	awt	2 Jul	1:15	18	58	7.78	153	45.17	136	196	10.7	6.2	346.9	5,054	0.0	0.0	6.7	1,682.4
63	awt	2 Jul	8:02	23	58	16.76	153	10.35	73	184	10.5	7.3	158.9	1,290	0.0	0.0	101.4	30.8
64	awt	2 Jul	9:21	43	58	18.70	153	12.31	145	220	10.6	6.2	317.0	1,575	0.0	<0.1	14.7	7.0
65	pne	2 Jul	14:53	3	58	31.96	152	44.84	31	44	10.9	9.3	0.0	2	0.0	1.0	0.0	1.0
66	awt	2 Jul	16:24	16	58	34.41	152	50.87	101	201	10.3	7.4	756.7	8,562	0.0	<0.1	0.0	0.0

Table 5.--Continued.

Haul no.	Gear[1] type	Date	Time (GMT)	Dur. (min)	Start position Latitude (N)		Longitude (W)		Depth (m) Footrope	Bottom	Temp (deg. C) Surface	Headrope	Pollock catch kg	number	Other catch (kg) pop[2]	capelin	eulachon	other
67	awt	2 Jul	21:53	35	58	46.66	152	32.30	142	189	10.2	6.8	688.9	2,101	0.0	<0.1	0.3	12.1
68	awt	4 Jul	3:42	9	59	22.03	152	6.79	47	67	9.0	8.8	0.0	0	0.0	2.6	0.0	13.9
69	awt	4 Jul	17:28	7	58	23.56	151	39.58	101	162	10.4	6.8	782.5	20,093	0.0	0.1	5.8	23.2
70	awt	5 Jul	1:04	36	58	14.03	151	30.12	74	83	11.4	7.0	0.4	11	0.0	114.9	0.0	356.4
71	pne	5 Jul	16:25	15	57	33.12	150	48.92	85	90	10.0	6.9	0.0	0	0.0	3.4	0.0	0.0
72	awt	5 Jul	19:58	25	57	20.26	150	36.31	211	333	10.5	5.2	450.1	899	0.0	0.0	0.0	1.0
73	awt	6 Jul	3:11	38	58	4.08	150	37.32	103	137	10.6	6.1	0.0	0	0.0	207.4	0.0	14.0
74	awt	6 Jul	9:20	20	58	23.97	150	42.55	40	72	9.3	8.8	0.0	0	0.0	8.1	0.0	3.1
75	awt	6 Jul	12:34	15	58	23.99	150	42.47	48	73	9.3	8.8	0.0	0	0.0	2.9	0.0	9.6
76	pne	7 Jul	2:31	37	58	38.56	150	28.19	202	209	12.0	5.9	250.9	476	0.0	0.0	12.1	1.4
77	awt	7 Jul	15:15	30	58	8.57	149	58.55	188	233	11.5	5.5	452.6	755	375.1	21.8	7.4	195.7
78	awt	7 Jul	22:19	32	57	42.16	149	33.67	352	519	12.9	4.1	0.0	0	0.0	0.0	0.0	3.7
79	awt	8 Jul	0:39	43	57	49.88	149	41.05	262	284	12.6	4.8	0.0	0	442.9	0.0	0.0	3.5
80	awt	8 Jul	9:18	25	57	57.46	149	6.68	226	371	12.8	5.0	55.7	71	781.7	0.0	0.0	9.5
81	awt	8 Jul	18:50	10	58	49.83	149	56.15	165	209	13.2	6.1	975.4	2,719	1.6	0.0	0.0	29.6
82	awt	9 Jul	1:41	31	59	31.49	150	23.82	99	209	11.6	6.8	954.3	7,343	0.0	<0.1	0.0	14.1
83	awt	9 Jul	14:45	33	59	42.84	149	52.50	123	188	12.8	6.6	88.9	1,876	0.0	<0.1	<0.1	296.5
84	awt	9 Jul	21:06	3	59	0.98	149	24.24	179	230	13.7	5.8	350.0	1,870	0.0	<0.1	0.7	0.1
85	awt	10 Jul	9:01	44	58	37.66	148	40.11	164	182	13.6	5.8	0.4	1	369.4	0.0	1.5	69.5
86	awt	11 Jul	18:44	26	59	54.42	149	8.08	128	210	13.5	6.5	309.3	5,850	0.0	0.0	0.0	2.6
87	awt	11 Jul	23:16	33	59	32.79	148	27.36	103	115	13.9	6.6	0.0	0	0.0	82.0	0.0	36.3
88	awt	12 Jul	6:00	25	58	59.87	147	58.61	256	272	13.7	4.6	257.8	224	1,928.7	0.0	0.0	5.5
89	awt	12 Jul	19:24	61	59	13.57	147	26.14	115	466	14.1	5.5	1,353.1	2,347	0.0	0.0	0.0	13.3
90	awt	13 Jul	2:48	31	59	27.03	147	6.04	185	213	14.8	5.7	1,928.7	3,548	0.0	0.1	0.1	14.2
91	awt	13 Jul	20:53	18	60	9.39	147	0.95	218	292	15.0	6.1	666.2	1,009	0.0	<0.1	24.9	25.4
92	awt	14 Jul	11:46	26	60	48.27	146	20.89	188	206	18.8	6.1	312.4	801	0.0	0.0	54.5	50.5
93	awt	14 Jul	13:16	22	60	48.34	146	19.97	58	206	18.2	6.9	0.0	0	0.0	0.0	0.0	18.7

[1]awt = Aleutian wing midwater trawl; pne = poly nor-eastern bottom trawl; mar = Marinovich trawl

[2]Pacific ocean perch

Table 6.--Summary of catch by species in 78 midwater trawls conducted during the summer 2003 Gulf of Alaska echo integration-trawl survey.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	kg	Percent
Walleye pollock	*Theragra chalcogramma*	43,675.1	82.3	161,441	51.8
Pacific ocean perch	*Sebastes alutus*	3,987.4	7.5	3,987	1.3
Pacific herring	*Clupea pallasi*	2,023.2	3.8	14,276	4.6
Eulachon	*Thaleichthys pacificus*	1,121.9	2.1	32,439	10.4
Capelin	*Mallotus villosus*	466.3	0.9	76,417	24.5
Chinook salmon	*Oncorhynchus tshawytscha*	426.1	0.8	212	0.1
Salmon shark	*Lamna ditropis*	286.0	0.5	2	<0.1
Chum salmon	*Oncorhynchus keta*	258.1	0.5	87	<0.1
Arrowtooth flounder	*Atheresthes stomias*	205.2	0.4	159	0.1
Jellyfish unident.	Scyphozoa (class)	135.2	0.3	339	0.1
Giant grenadier	*Albatrossia pectoralis*	123.4	0.2	43	<0.1
Dusky rockfish	*Sebastes ciliatus*	71.9	0.1	51	<0.1
Pacific cod	*Gadus macrocephalus*	45.8	0.1	13	<0.1
Squid unident.	Teuthoidea	44.7	0.1	4,936	1.6
Northern smoothtongue	*Leuroglossus schmidti*	39.9	0.1	8,020	2.6
Northern rockfish	*Sebastes polyspinis*	33.8	0.1	39	<0.1
Majestic squid	*Berryteuthis magister*	24.7	<0.1	69	<0.1
Pink salmon	*Oncorhynchus gorbuscha*	23.5	<0.1	12	<0.1
Pacific halibut	*Hippoglossus stenolepis*	16.8	<0.1	2	<0.1
Chrysaora jellyfish	Chrysaora sp.	15.4	<0.1	29	<0.1
Market Squid	*Loligo opalescens*	15.0	<0.1	1	<0.1
Shrimp unident.	Decapoda (order)	13.9	<0.1	6,327	2.0
Spiny dogfish	*Squalus acanthias*	12.6	<0.1	5	<0.1
Sablefish	*Anoplopoma fimbria*	4.7	<0.1	1	<0.1
Myctophidae	Myctophidae	4.7	<0.1	471	0.2
Fish larvae unident.	Fish larvae unident.	2.3	<0.1	1,610	0.5
Pacific sand lance	*Ammodytes hexapterus*	1.4	<0.1	172	0.1
Pacific sandfish	*Trichodon trichodon*	0.9	<0.1	7	<0.1
Rex sole	*Glyptocephalus zachirus*	0.8	<0.1	3	<0.1
Ocean shrimp	*Pandalus jordani*	0.6	<0.1	21	<0.1
Flathead sole	*Hippoglossoides elassodon*	0.4	<0.1	2	<0.1
Isopod unident.	Isopod unident.	0.4	<0.1	204	0.1
Pacific lamprey	*Lampetra tridentata*	0.1	<0.1	1	<0.1
Bigmouth sculpin	*Hemitripterus bolini*	0.1	<0.1	1	<0.1
Blackmouth eelpout	*Lycodapus fierasfer*	0.1	<0.1	13	<0.1
Pandalid shrimp unident.	Pandalidae	0.1	<0.1	1	<0.1
Ctenophora (phylum)	Ctenophora (phylum)	0.1	<0.1	2	<0.1
Prowfish	*Zaprora silenus*	<0.1	<0.1	2	<0.1
Fish unident.	Fish unident.	<0.1	<0.1	2	<0.1
Myoxocephalus sp.	Myoxocephalus sp.	<0.1	<0.1	1	<0.1
Pacific viperfish	*Chauliodus macouni*	<0.1	<0.1	3	<0.1
Totals		53,082.7		311,423	

Table 7.--Summary of catch by species in 14 bottom trawls conducted during the summer 2003 Gulf of Alaska echo integration-trawl survey.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	kg	Percent
Pacific ocean perch	*Sebastes alutus*	2,473.2	46.6	5,231	44.4
Walleye pollock	*Theragra chalcogramma*	1,147.6	21.6	1,694	14.4
Northern rockfish	*Sebastes polyspinis*	796.8	15.0	896	7.6
Arrowtooth flounder	*Atheresthes stomias*	328.7	6.2	375	3.2
Sablefish	*Anoplopoma fimbria*	136.0	2.6	84	0.7
Flathead sole	*Hippoglossoides elassodon*	123.6	2.3	260	2.2
Dusky rockfish	*Sebastes ciliatus*	51.9	1.0	35	0.3
Pacific cod	*Gadus macrocephalus*	51.6	1.0	21	0.2
Rex sole	*Glyptocephalus zachirus*	50.0	0.9	116	1.0
Eulachon	*Thaleichthys pacificus*	24.8	0.5	781	6.6
Rockfish unident.	Sebastes sp.	22.2	0.4	24	0.2
Pacific halibut	*Hippoglossus stenolepis*	13.3	0.3	3	<0.1
Northern rock sole	*Lepidopsetta peracuata*	11.9	0.2	19	0.2
Longnose skate	*Raja rhina*	11.6	0.2	1	<0.1
Jellyfish unident.	Scyphozoa (class)	9.8	0.2	24	0.2
Prowfish	*Zaprora silenus*	6.7	0.1	7	0.1
Dover sole	*Microstomus pacificus*	5.2	0.1	5	<0.1
Spiny dogfish	*Squalus acanthias*	5.2	0.1	3	<0.1
Capelin	*Mallotus villosus*	5.2	0.1	1,782	15.1
Kelp greenling	*Hexagrammos decagrammus*	4.8	0.1	8	0.1
Yellow Irish lord	*Hemilepidotus jordani*	3.2	0.1	15	0.1
Chinook salmon	*Oncorhynchus tshawytscha*	3.0	0.1	2	0.0
Chum salmon	*Oncorhynchus nerka*	3.0	0.1	1	<0.1
Redstripe rockfish	*Sebastes proriger*	2.7	0.1	9	0.1
Searcher	*Bathymaster signatus*	1.9	<0.1	11	0.1
Rock sole	Lepidopsetta sp.	1.6	<0.1	11	0.1
Shrimp unident.	Decapoda (order)	1.4	<0.1	287	2.4
Sponge unident.	Sponge unident.	1.3	<0.1	15	0.1
Spinyhead sculpin	*Dasycottus setiger*	1.2	<0.1	1	<0.1
harlequin rockfish	*Sebastes variegatus*	1.0	<0.1	4	<0.1
Pacific sandfish	*Trichodon trichodon*	1.0	<0.1	1	<0.1
Atka mackerel	*Pleurogrammus monopterygius*	0.8	<0.1	1	<0.1
Rougheye rockfish	*Sebastes aleutianus*	0.7	<0.1	1	<0.1
Pacific herring	*Clupea pallasi*	0.4	<0.1	4	<0.1
Sea urchin unident.	Echinacea	0.3	<0.1	8	0.1
Northern ronquil	*Ronquilus jordani*	0.2	<0.1	1	<0.1
Basketstar	*Gorgonocephalus eucnemis*	0.2	<0.1	1	<0.1
Whelk unident.	Whelk unident.	0.1	<0.1	4	<0.1
Bairdi Tanner crab	*Chionoecetes bairdi*	0.1	<0.1	2	<0.1
Starfish unident.	Asteroidea	0.1	<0.1	3	<0.1
Sea cucumber unident.	Holothuroidea	0.1	<0.1	1	<0.1
Hermit crab	Paguridae	0.1	<0.1	2	<0.1
Scissortail sculpin	*Triglops forficata*	0.1	<0.1	1	<0.1
Hydrozoa (class)	Hydrozoa (class)	0.1	<0.1	1	<0.1
Scallop sponge	*Myxilla incrustans*	0.1	<0.1	6	0.1
Tiger rockfish	*Sebastes nigrocinctus*	<0.1	<0.1	1	<0.1
Slim sculpin	*Radulinus asprellus*	<0.1	<0.1	1	<0.1
Coral unident.	Coral unident.	<0.1	<0.1	2	<0.1
Isopod unident.	Isopod unident.	<0.1	<0.1	4	<0.1
Sea anemone unident.	Actiniaria	<0.1	<0.1	1	<0.1
Crab unident.	Crab unident.	<0.1	<0.1	1	<0.1
Totals		5,304.6		11,772	

Table 8.--Pollock numbers (millions), biomass (thousands of metric tons), and relative estimation error by area for the summer 2003 and 2005 Gulf of Alaska echo intergration-trawl surveys.

	2003			2005		
Area	Numbers	Biomass	Est. Error	Numbers	Biomass	Est. Error
Shumagin[a] Shelf (< 200 m)		not surveyed		52.2	46.5	0.137
Shumagin Shelfbreak (200-1,000 m)		not surveyed		16.5	14.7	0.121
Shumagin off shelf (> 1,000 m)		not surveyed		0.0	0.0	
Chirikof[b] Shelf (< 200 m)	4.2	1.9	0.299	0.3	0.3[d]	[e]
Chirikof Shelfbreak (200-1,000 m)	3.4	2.0	0.384	35.2	31.3	0.214
Chirikof off shelf (> 1,000 m)		not surveyed		0.0	0.0	
Kodiak[c] Shelf (< 200 m)	436.9	23.9	0.372	2.5	2.3[d]	[e]
Kodiak Shelfbreak (200-1,000 m)						
10 nmi transects	10.5	9.7	0.151			
20 nm transects	37.3	19.5	0.318			
Total	47.8	29.1		22.0	19.6	0.214
Kodiak off shelf (> 1,000 m)		not surveyed		0.0	0.0	
Shumagin Islands						
Renshaw Point	3.7	2.0	0.032		not surveyed	
West Nagai Strait	12.1	5.3	0.106		not surveyed	
Total	15.8	7.4				
Mitrofania Island	<0.1	<0.1	[e]		not surveyed	
Nakchamik Island	13.0	4.1	0.128		not surveyed	
Shelikof Strait						
South 20 nmi transect	96.8	30.5	[e]			
10 nmi transects	378.1	86.9	0.092			
North 20 nmi transects	218.9	33.9	[e]			
Total	693.8	151.3		1,291.2	81.6	[e]
Alitak Bay	14.6	9.2	0.146		not surveyed	
Amatuli Trench	78.7	23.1	[e]		not surveyed	
Barnabas Trough	65.4	30.4	0.112	12.9	15.1[d]	0.136
Chiniak Trough	29.0	14.0	0.106	9.1	12.6	0.121
Marmot Bay	17.2	8.3	0.180		not surveyed	
Kenai Peninsula bays	17.7	1.5	[e]		not surveyed	
Prince William Sound					not surveyed	
Parallel transects	26.4	13.0	0.141			
Other transects	3.5	1.7	[e]			
Total	29.9	14.7				
Total	1,467.4	320.9		1,442.0	223.9	

[a] Shumagin INPFC area = 159°-170°W
[b] Chirikof INPFC area = 154°-159°W
[c] Kodiak INPFC area = 147°-154°W
[d] Area partially surveyed in 2005.
[e] Survey design was not appropriate for variance estimation.

Table 9.--Capelin abundance-at-length from the 2003 and 2005 summer echo integration-trawl surveys of the Gulf of Alaska.

Standard length (cm)	Numbers (millions)		Biomass (thousand tons)	
	2003	2005	2003	2005
3	23	0	0.002	0.000
4	23	0	0.006	0.000
5	23	0	0.013	0.000
6	2,873	271	3.164	0.298
7	8,135	2,032	15.708	3.924
8	8,488	1,400	24.219	3.994
9	6,286	497	26.088	2.061
10	1,662	226	11.300	1.535
11	1,341	135	12.832	1.296
12	682	45	9.383	0.621
13	552	0	9.511	0.000
14	163	0	3.594	0.000
15	5	0	0.158	0.000
Total	30,256	4,605	115.979	13.729

Note: The shelf area east of Kodiak Island, where capelin abundance was highest in 2003, was not surveyed in 2005; thus, the 2005 abundance estimates are for Barnabas and Chiniak troughs only.

Table 10.--Trawl station summary for the summer 2005 Gulf of Alaska echo integration-trawl survey.

Haul	Gear[1]		Time	Dur.	Start position		Depth (m)		Temp (deg. C)		Pollock catch		Other catch (kg)			
no.	type	Date	(GMT)	(min)	Latitude (N)	Longitude (W)	Footrope	Bottom	Surface	Headrope	kg	number	pop[2]	capelin	eulachon	other
1	awt	2 Jul	6:08	11	57 40.73	152 0.19	100	185	--	--	669.1	614	0.0	0.1	15.3	0.9
2	awt	2 Jul	20:06	4	55 58.43	154 44.09	264	365	--	--	19.4	21	2.4	0.0	0.0	3.5
3	awt	3 Jul	17:36	22	54 25.83	159 14.15	174	340	11.4	5.3	989.7	1,113	0.0	0.0	0.0	0.0
4	awt	5 Jul	3:34	43	54 9.35	161 28.64	272	366	11.4	4.6	1.2	1	0.0	0.0	0.0	9.0
5	pne	6 Jul	8:53	17	54 23.04	163 26.72	104	112	10.8	5.7	0.0	0	0.0	0.0	0.0	96.0
6	met	6 Jul	11:08	15	54 23.61	163 24.14	14	114	10.7	10.1	0.0	0	0.0	0.0	0.0	0.0
7	awt	6 Jul	17:02	36	54 17.94	163 56.58	90	108	--	--	545.7	527	0.0	0.0	0.0	6.4
8	awt	7 Jul	18:07	9	53 42.52	164 47.37	182	231	9.6	5.3	10.0	10	0.0	0.0	0.0	0.1
9	pne	8 Jul	18:26	16	53 33.64	165 53.04	103	103	10.1	5.8	0.0	0	279.0	0.0	0.0	338.3
10	awt	9 Jul	5:34	40	53 5.04	166 49.88	293	825	11.2	4.2	0.0	0	0.0	0.0	0.0	0.9
11	met	9 Jul	8:22	19	53 6.31	166 45.93	18	803	11.0	10.9	0.0	0	0.0	0.0	0.0	2.9
12	pne	9 Jul	11:37	20	53 13.02	166 50.63	181	181	10.8	5.2	0.8	1	0.0	0.0	0.0	6.3
13	pne	9 Jul	13:41	21	53 13.30	166 50.15	167	177	10.7	5.2	1.8	2	0.0	0.0	0.0	10.2
14	pne	10 Jul	2:51	17	53 2.45	167 19.36	192	194	10.6	4.8	47.7	53	0.0	0.0	0.0	49.8
15	pne	10 Jul	6:55	52	52 59.31	167 27.66	127	667	10.9	5.4	14.0	18	0.0	0.0	0.0	0.4
16	pne	10 Jul	18:00	51	53 4.57	167 57.31	60	110	10.6	6.1	48.1	54	0.0	0.0	0.0	1.6
17	pne	10 Jul	21:24	14	52 57.72	167 52.38	113	117	10.6	5.4	8.0	9	320.7	0.0	0.0	3,003.4
18	awt	15 Jul	6:43	40	53 59.11	158 5.89	203	801	13.0	4.1	0.0	0	0.0	0.0	0.0	4.7
19	met	15 Jul	8:52	30	53 56.27	158 14.74	30	850	13.2	--	0.0	0	0.0	0.0	0.0	4.7
20	met	16 Jul	0:04	30	55 9.18	156 54.05	156	194	12.3	5.3	<0.1	2	0.0	0.0	0.0	7.0
21	awt	16 Jul	20:37	13	55 20.01	156 2.03	216	305	13.2	5.1	5.1	6	685.2	0.0	0.0	0.0
22	awt	17 Jul	9:03	13	55 34.28	155 34.03	187	280	13.2	--	294.8	337	0.0	0.0	0.0	2.5
23	awt	18 Jul	8:15	10	56 17.25	152 52.41	166	177	12.0	5.7	896.1	968	3.4	0.0	0.0	0.3
24	awt	19 Jul	7:47	43	56 48.73	152 27.17	141	159	11.8	--	16.3	17	0.0	0.0	341.5	37.3
25	awt	19 Jul	19:19	34	57 1.74	152 27.83	133	143	13.0	5.9	<0.1	41	0.0	19.8	0.0	135.5
26	pne	20 Jul	0:35	17	57 8.04	152 28.12	152	154	13.4	6.0	1,363.2	995	0.0	0.0	0.0	2,892.8
27	pne	20 Jul	9:05	12	57 11.41	152 43.17	141	141	11.4	5.8	376.6	268	0.0	0.1	0.0	351.9
28	awt	21 Jul	0:41	11	57 40.82	152 1.23	164	185	12.4	7.3	2,515.8	1,737	0.0	0.7	0.0	12.8
29	awt	21 Jul	7:39	21	57 32.53	151 30.22	113	132	13.5	6.9	349.0	415	0.0	0.9	0.0	50.7
30	awt	18 Jun	12:19	21	57 39.30	150 12.75	207	228	13.7	5.4	19.7	20	76.2	0.0	0.0	2.2
31	awt	22 Jul	23:03	6	57 58.63	149 3.02	267	266	14.8	5.0	110.1	104	3,853.7	0.0	0.0	34.1
32	met	23 Jul	1:50	12	57 57.98	149 4.22	140	386	14.7	5.5	0.0	0	0.0	0.0	0.0	4.0
33	awt	24 Jul	5:40	13	58 15.62	148 41.70	239	256	15.1	4.9	39.4	49	200.5	0.0	0.0	0.0

Table 10.--Continued.

Haul no.	Gear[1] type	Date	Time (GMT)	Dur. (min)	Start position: Latitude (N)	Start position: Longitude (W)	Depth (m): Footrope	Depth (m): Bottom	Temp (deg. C): Surface	Temp (deg. C): Headrope	Pollock catch: kg	Pollock catch: number	Other catch (kg): pop[2]	Other catch (kg): capelin	Other catch (kg): eulachon	Other catch (kg): other
34	awt	24 Jul	16:46	5	58 4.15	153 35.35	111	303	13.8	6.3	374.0	9,359	0.0	0.0	0.0	14.1
35	awt	25 Jul	2:49	5	57 47.31	154 51.43	153	267	13.1	5.9	374.0	4,356	0.0	0.0	0.0	5.4
36	awt	25 Jul	22:07	2	57 15.72	154 52.34	70	101	11.7	10.1	<0.1	453	0.0	0.8	0.0	12.0
37	awt	26 Jul	0:51	24	57 23.21	154 58.03	144	227	13.2	5.2	210.2	4,827	0.0	0.0	0.6	9.5
38	awt	26 Jul	19:06	29	57 18.21	155 46.89	76	255	12.7	10.1	440.3	15,208	0.0	0.0	0.1	20.4
39	awt	27 Jul	4:09	19	56 47.65	155 50.08	123	295	12.8	5.4	0.3	233	0.0	0.0	0.0	0.7
40	met	27 Jul	5:36	35	56 45.80	155 49.94	78	290	12.9	5.7	0.0	0	0.0	0.0	0.0	0.6
41	awt	27 Jul	9:34	41	56 42.98	155 33.79	231	246	13.0	5.3	430.9	593	0.0	0.1	116.3	27.5
42	awt	27 Jul	16:20	15	56 28.38	155 59.77	127	245	12.3	5.2	9.0	5,606	0.0	0.4	0.0	8.4
43	awt	28 Jul	4:23	33	55 58.58	156 11.25	153	207	11.3	5.4	4.4	3,020	0.0	0.1	3.9	4.9
44	awt	28 Jul	6:25	21	55 58.60	156 12.44	70	208	11.0	7.4	1.0	96	0.0	0.1	0.0	1.2

[1]awt = Aleutian wing midwater trawl; pne = poly nor-eastern bottom trawl; met = Methot trawl

[2]Pacific ocean perch

Table 11.--Summary of catch by species in 28 midwater trawls conducted during the summer 2005 Gulf of Alaska echo integration-trawl survey.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	kg	Percent
Walleye pollock	*Theragra chalcogramma*	8,175.7	58.8	49,731	58.7
Pacific ocean perch	*Sebastes alutus*	4,821.3	34.7	7,021	8.3
Eulachon	*Thaleichthys pacificus*	477.8	3.4	15,352	18.1
Chum salmon	*Oncorhynchus keta*	135.2	1.0	39	<0.1
Jellyfish unident.	Scyphozoa (class)	78.5	0.6	304	<0.1
Arrowtooth flounder	*Atheresthes stomias*	59.1	<0.1	94	<0.1
Pacific sleeper shark	*Somniosus pacificus*	40.0	<0.1	1	<0.1
Capelin	*Mallotus villosus*	22.9	<0.1	6,502	7.7
Shortraker rockfish	*Sebastes borealis*	18.1	<0.1	2	<0.1
Northern rockfish	*Sebastes polyspinis*	16.0	<0.1	35	<0.1
Chinook salmon	*Oncorhynchus tshawytscha*	13.7	<0.1	9	<0.1
Majestic squid	*Berryteuthis magister*	9.6	<0.1	21	<0.1
Giant grenadier	*Albatrossia pectoralis*	9.0	<0.1	3	<0.1
Pink salmon	*Oncorhynchus gorbuscha*	8.7	<0.1	5	<0.1
Pacific herring	*Clupea pallasi*	5.5	<0.1	52	<0.1
Pacific cod	*Gadus macrocephalus*	4.5	<0.1	21	<0.1
Squid unident.	Teuthoidea	2.9	<0.1	197	<0.1
Ctenophora (phylum)	Ctenophora (phylum)	1.1	<0.1	73	<0.1
Salps unidentified	Taliacea unident.	0.8	<0.1	59	<0.1
Euphausiid unidentified	Euphausiacea	0.6	<0.1	3,525	4.2
Flathead sole	*Hippoglossoides elassodon*	0.6	<0.1	1	<0.1
Lanternfish unident.	*Protomyctophum* sp.	0.4	<0.1	1,520	1.8
Shrimp unident.	Decapoda (order)	0.4	<0.1	98	<0.1
California headlightfish	*Diaphus theta*	0.1	<0.1	6	<0.1
Northern lampfish	*Stenobrachius leucopsarus*	0.1	<0.1	42	<0.1
Prowfish	*Zaprora silenus*	0.1	<0.1	8	<0.1
Lamprey unident.	Petromyzontidae	0.1	<0.1	1	<0.1
Sculpin unident.	Cottidae	0.1	<0.1	2	<0.1
Cephalopod unident.	Cephalopod unident.	0.0	<0.1	9	<0.1
Salmon and trouts unident.	Salmonidae	0.0	<0.1	1	<0.1
Isopod unident.	Isopod unident.	0.0	<0.1	4	<0.1
Flatfish larvae	Pleuronectiformes larvae	0.0	<0.1	2	<0.1
Totals		13,902.8		84,740	

Table 12.--Summary of catch by species in 10 bottom trawls conducted during the summer 2005 Gulf of Alaska echo integration-trawl survey.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	kg	Percent
Arrowtooth flounder	*Atheresthes stomias*	2,912.1	31.6	3,940	37.7
Walleye pollock	*Theragra chalcogramma*	1,860.1	20.2	1,400	13.4
Atka mackerel	*Pleurogrammus monopterygius*	1,813.2	19.7	1,665	15.9
Northern rockfish	*Sebastes polyspinis*	950.7	10.3	1,022	9.8
Pacific ocean perch	*Sebastes alutus*	599.6	6.5	1,280	12.3
Dusky rockfish	*Sebastes* sp.	327.8	3.6	198	1.9
Sablefish	*Anoplopoma fimbria*	243.8	2.6	98	0.9
Pacific cod	*Gadus macrocephalus*	187.9	2.0	54	0.5
Pacific halibut	*Hippoglossus stenolepis*	73.2	0.8	9	<0.1
Flathead sole	*Hippoglossoides elassodon*	45.4	<0.1	121	1.2
Rex sole	*Glyptocephalus zachirus*	36.2	<0.1	58	0.6
Harlequin rockfish	*Sebastes variegatus*	30.4	<0.1	43	<0.1
Dark dusky rockfish	*Sebastes ciliatus*	23.7	<0.1	15	<0.1
Sponge unident.	Porifera	23.2	<0.1	94	0.9
Rock sole sp.	*Lepidopsetta* sp.	17.3	<0.1	33	<0.1
Sea anemone unident.	Actiniaria	12.9	<0.1	30	<0.1
Tree sponge	*Mycale loveni*	8.7	<0.1	65	0.6
Jellyfish unident.	Scyphozoa (class)	7.6	<0.1	21	<0.1
Rougheye rockfish	*Sebastes aleutianus*	6.3	<0.1	6	<0.1
Dover sole	*Microstomus pacificus*	4.9	<0.1	3	<0.1
Skate unident.	*Raja* sp.	4.0	<0.1	3	<0.1
Hermit crab unident.	Paguridae	2.8	<0.1	27	<0.1
Aleutian skate	*Bathyraja aleutica*	2.6	<0.1	1	<0.1
Pink salmon	*Oncorhynchus gorbuscha*	1.4	<0.1	1	<0.1
Comb jelly unident.	Ctenophora (phylum)	1.4	<0.1	71	0.7
Sockeye salmon	*Oncorhynchus nerka*	1.4	<0.1	1	<0.1
Chum salmon	*Oncorhynchus keta*	1.2	<0.1	1	<0.1
Kelp greenling	*Hexagrammos decagrammus*	1.1	<0.1	1	<0.1
Tanner crab	*Chionoecetes bairdi*	1.1	<0.1	1	<0.1
Bering skate	*Bathyraja interrupta*	1.0	<0.1	1	<0.1
Irish lord	*Hemilepidotus jordani*	1.0	<0.1	1	<0.1
Sea potato	*Styla rustica*	1.0	<0.1	19	<0.1
Sea urchin unident.	Echinacea unident.	0.9	<0.1	14	<0.1
Snail unident.	Gastropod unident.	0.6	<0.1	14	<0.1
Crab unident.	Crab unident	0.5	<0.1	2	<0.1
Northern rock sole	*Lepidopsetta polyxystra*	0.5	<0.1	1	<0.1
Oregon triton	*Fusitriton oregonensis*	0.4	<0.1	12	<0.1
Blood sea star	*Henricia leviuscula*	0.3	<0.1	5	<0.1
Scallop unident.	Pectinid unident.	0.3	<0.1	22	<0.1
Coral unident.	Coral unident.	0.3	<0.1	6	<0.1
Skate egg case unident.	Skate egg case unident.	0.2	<0.1	11	<0.1
Brittlestarfish unident.	Ophiuroid unident.	0.2	<0.1	28	<0.1

Table 12.--Continued.

Common name	Scientific name	Weight kg	Weight Percent	Numbers kg	Numbers Percent
Sturgeon poacher	*Podothecus acipenserinus*	0.2	<0.1	2	<0.1
Sea cucumber unident.	Holothuroidea unident.	0.2	<0.1	5	<0.1
Tanner crab unident.	*Chionoecetes* sp.	0.2	<0.1	1	<0.1
Northern ronquil	*Ronquilus jordani*	0.2	<0.1	1	<0.1
Basketstarfish unident.	*Gorgonocephalus* sp.	0.2	<0.1	4	<0.1
Rose sea star	*Crossaster papposus*	0.1	<0.1	2	<0.1
Cushion starfish	*Pteraster tesselatus*	0.1	<0.1	2	<0.1
Orange bat star	*Ceramaster patagonicus*	0.1	<0.1	3	<0.1
Capelin	*Mallotus villosus*	0.1	<0.1	11	<0.1
Pacific lyre crab	*Hyas lyratus*	0.1	<0.1	5	<0.1
Common mud star	*Ctenodiscus crispatus*	0.0	<0.1	5	<0.1
Scallop sponge	*Myxilla incrustans*	0.0	<0.1	2	<0.1
Starfish unident.	Asteroidea unident.	0.0	<0.1	1	<0.1
Starfish unident.	*Pseudarchaster* sp.	0.0	<0.1	1	<0.1
Total		9,210.6		10,443	

Table 13.--Summary of catch by species in six Methot trawls conducted during the summer 2005 Gulf of Alaska echo integration-trawl survey.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	kg	Percent
Euphausiid unident.	Euphausiacea	12.7	54.2	247,150	99.5
Salps unident.	Thaliacea unident.	4.6	19.7	556	<0.1
Jellyfish unident.	Scyphozoa	3.4	14.4	222	<0.1
Comb jelly unident.	Ctenophora (phylum)	2.2	9.4	136	<0.1
Squid unident.	Squid unident.	0.3	1.1	1	<0.1
Lanternfish unident.	Myctophidae	0.1	<0.1	81	<0.1
Flatfish larvae	Pleuronectiformes larvae	0.1	<0.1	30	<0.1
Fish larvae unident.	Fish larvae unident.	0.1	<0.1	124	<0.1
Snail unident.	Gastropod unident.	0.0	<0.1	29	<0.1
Walleye pollock	*Theragra chalcogramma*	0.0	<0.1	2	<0.1
Cephalopod unident.	Cephalopoda unident.	0.0	<0.1	1	<0.1
Totals		23.5		248,332	

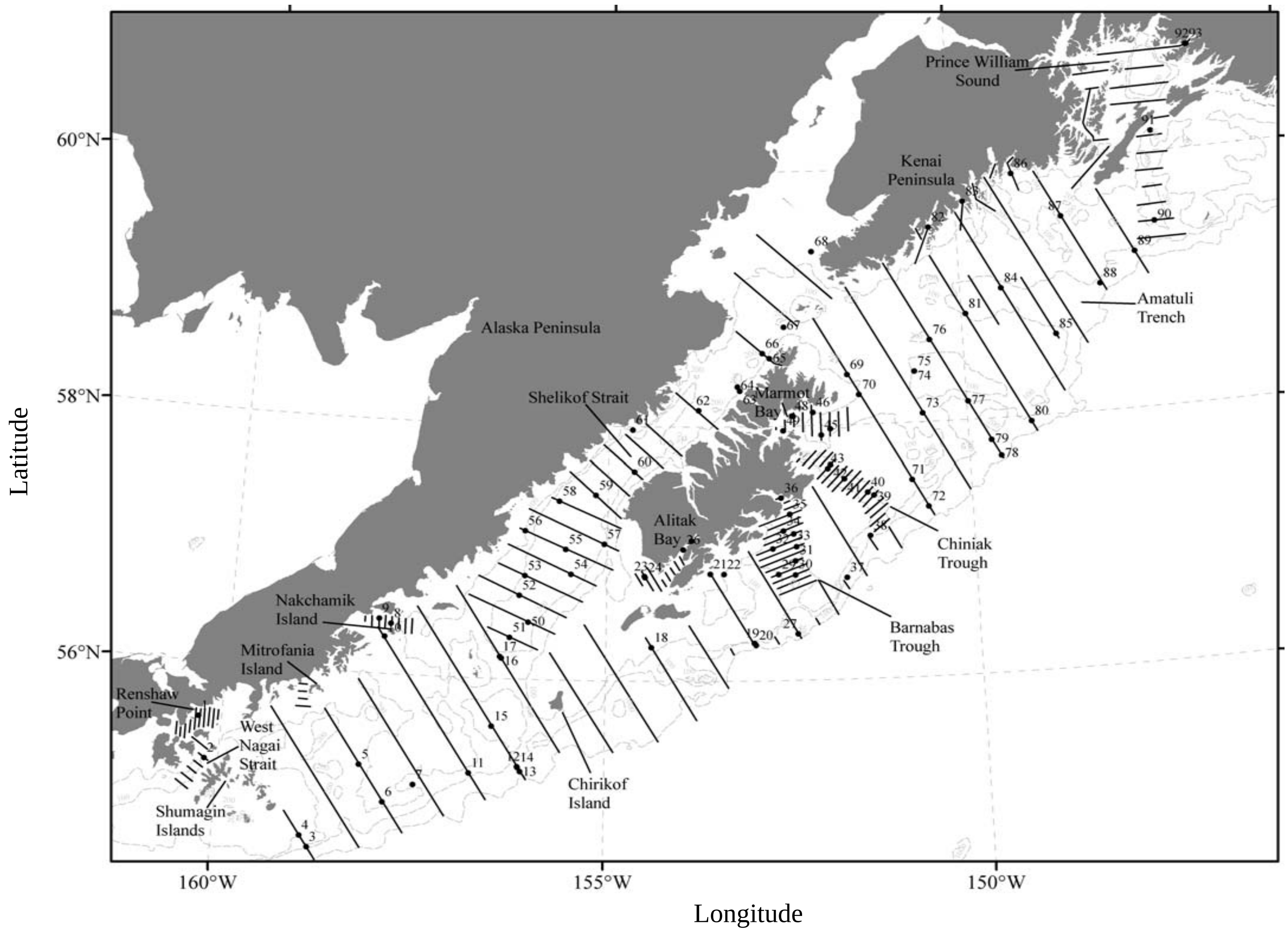

Figure 1.--Transect lines and distribution of trawls during the summer 2003 echo integration-trawl survey of the Gulf of Alaska.

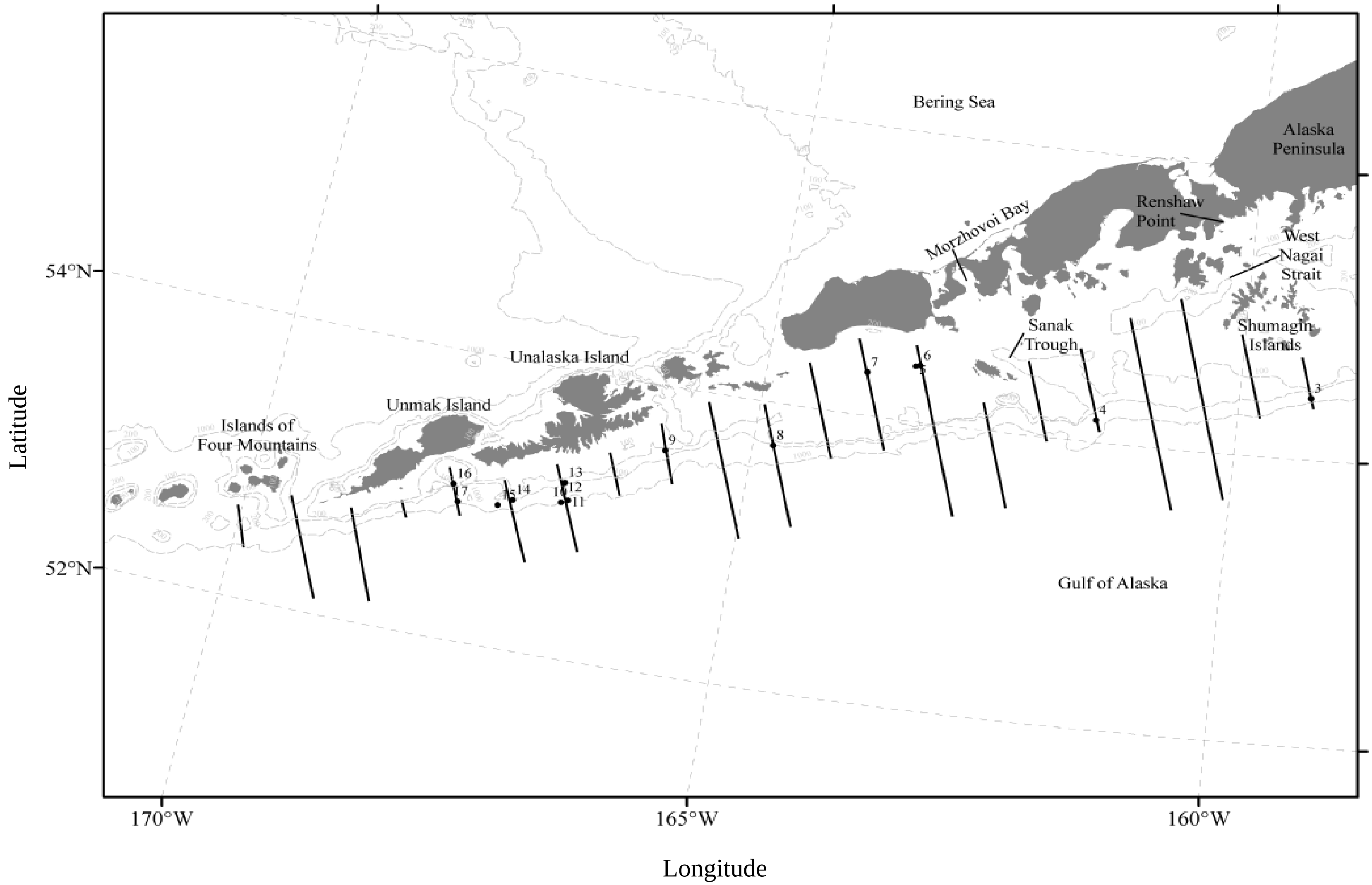

Figure 2.--Transect lines and distribution of trawls during the summer 2005 echo integration-trawl survey of the

survey of the Gulf of Alaska.

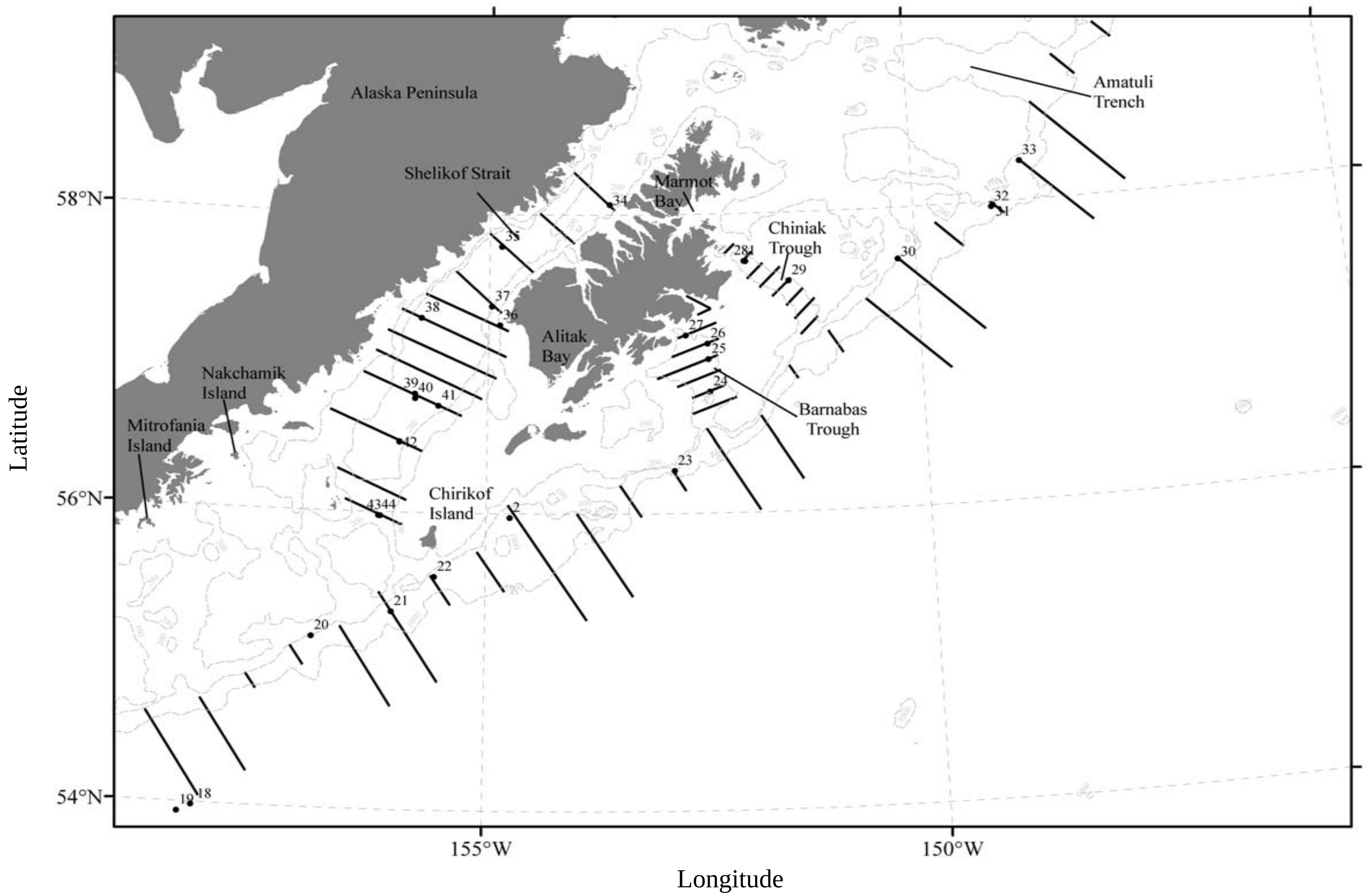

Figure 2.--Continued.

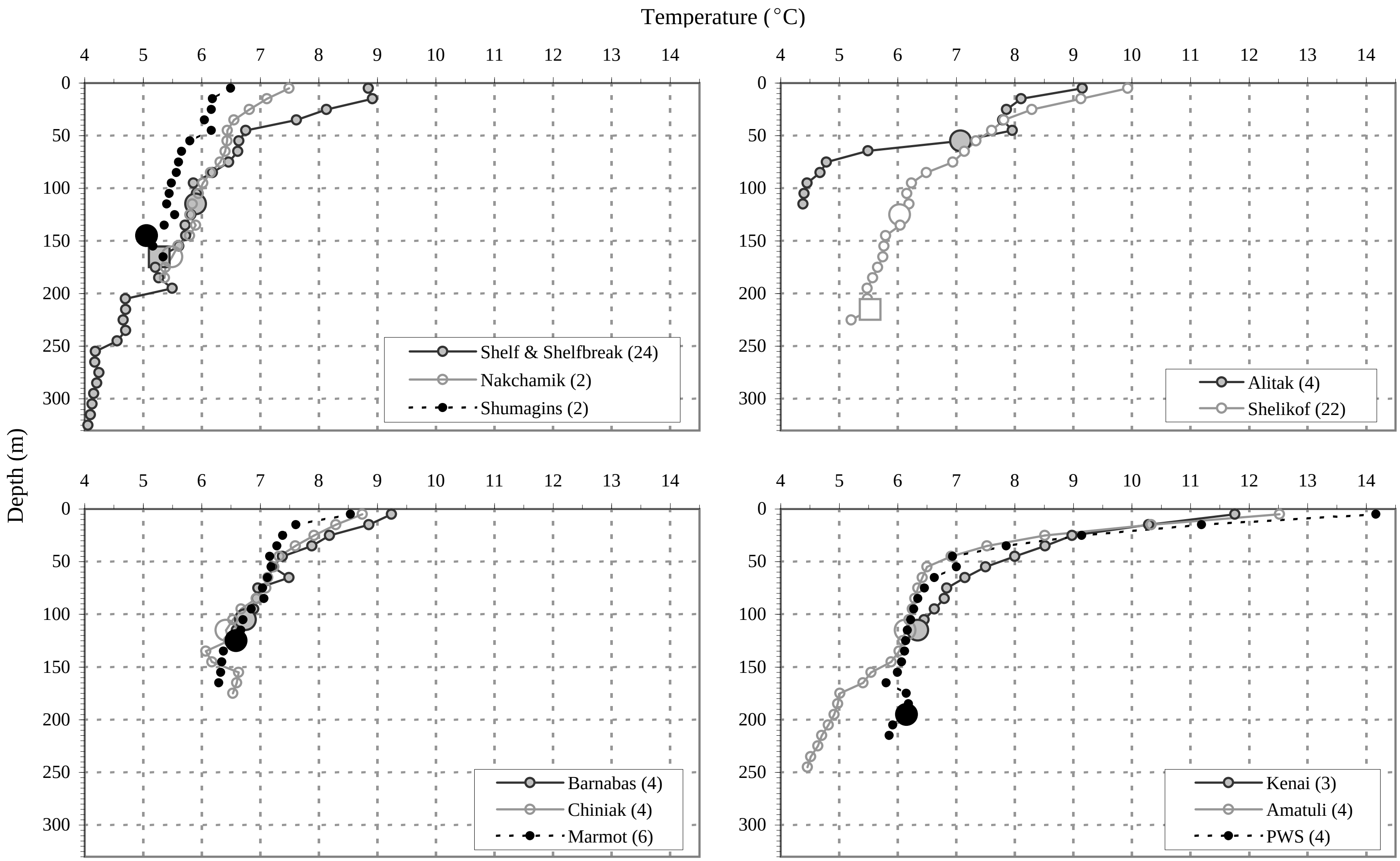

Figure 3--Average temperature (°C) and number of samples taken by area surveyed during the summer 2003 echo integration-trawl survey of the Gulf of Alaska. The largest symbol for each profile represents the mean depth of pollock biomass in that area. Note: the shelfbreak and Shelikof "near-bottom" depth means are represented by squares.

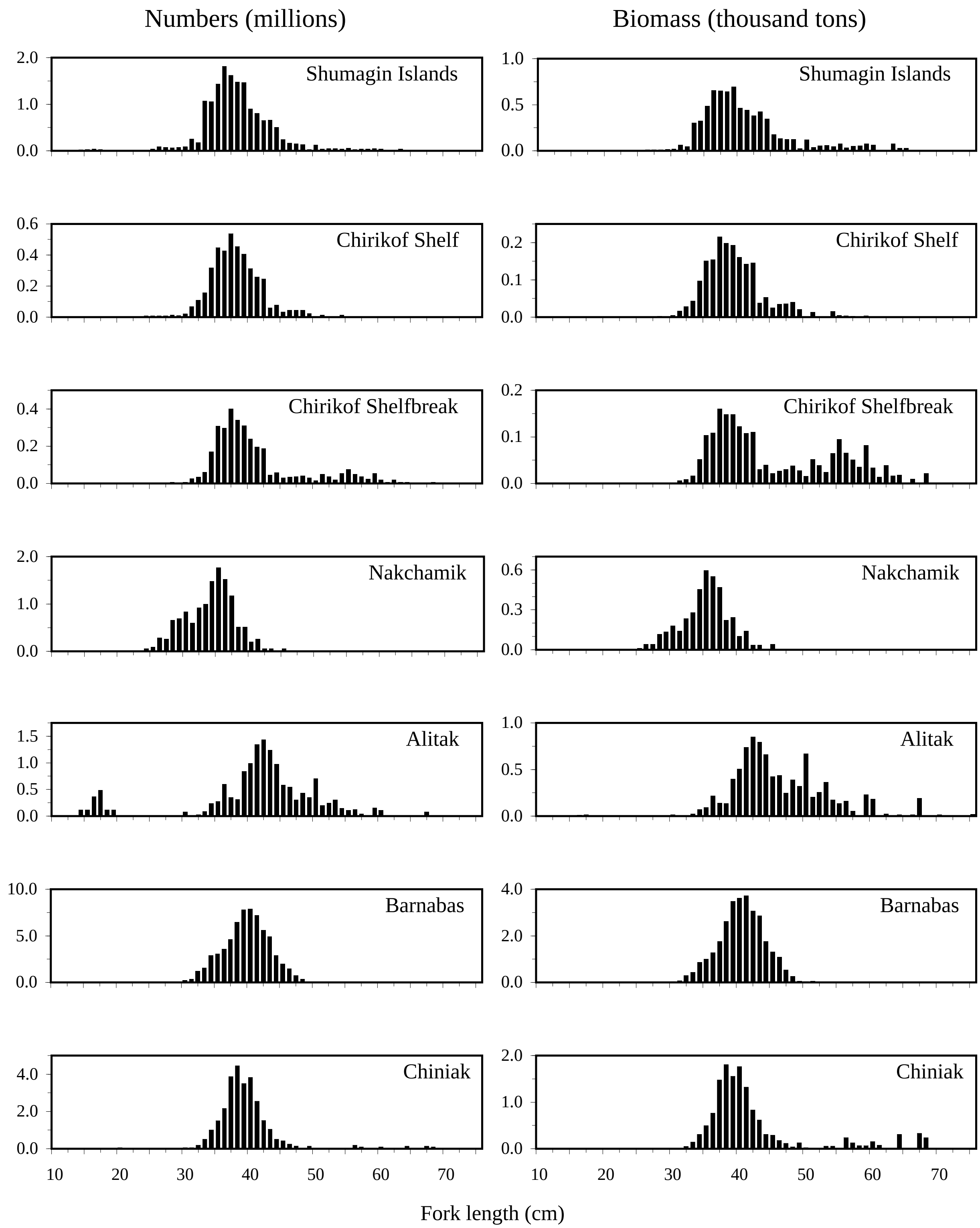

Figure 4.--Pollock size compostition estimates for the summer 2003 echo integration-trawl survey of the Gulf of Alaska.

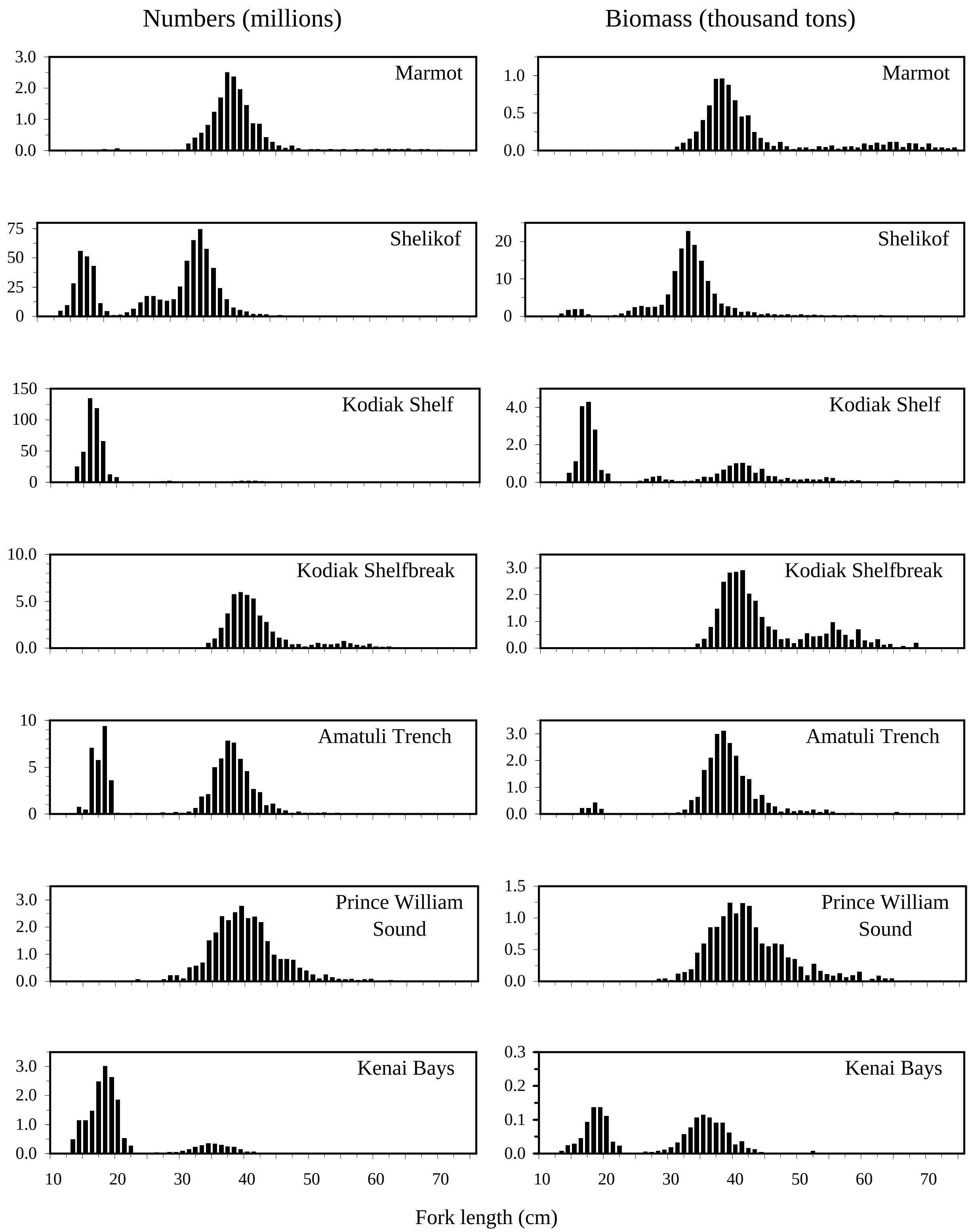

Figure 4.--Continued.

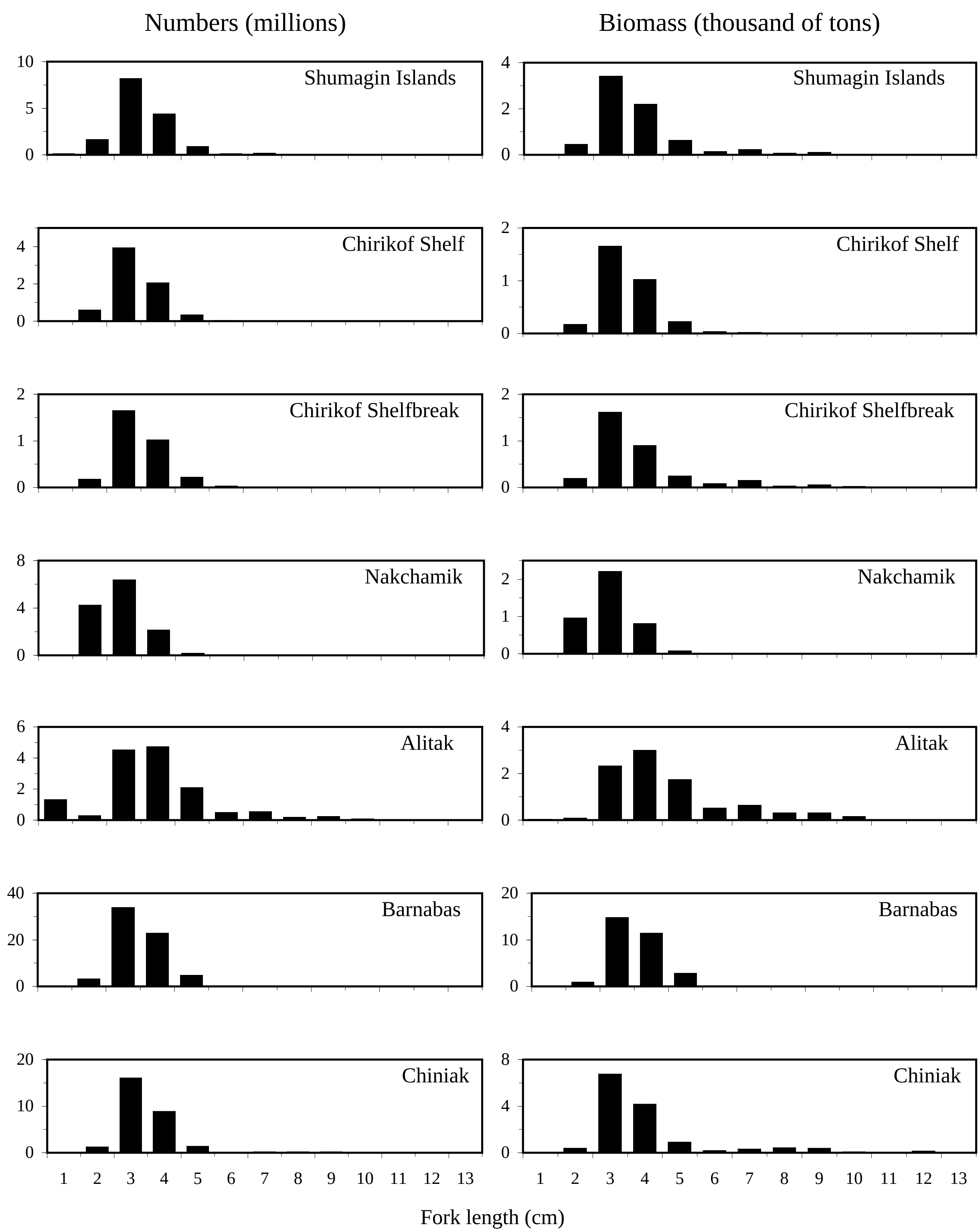

Figure 5.--Pollock age compostition estimates for the summer 2003 echo integration-trawl survey of the Gulf of Alaska.

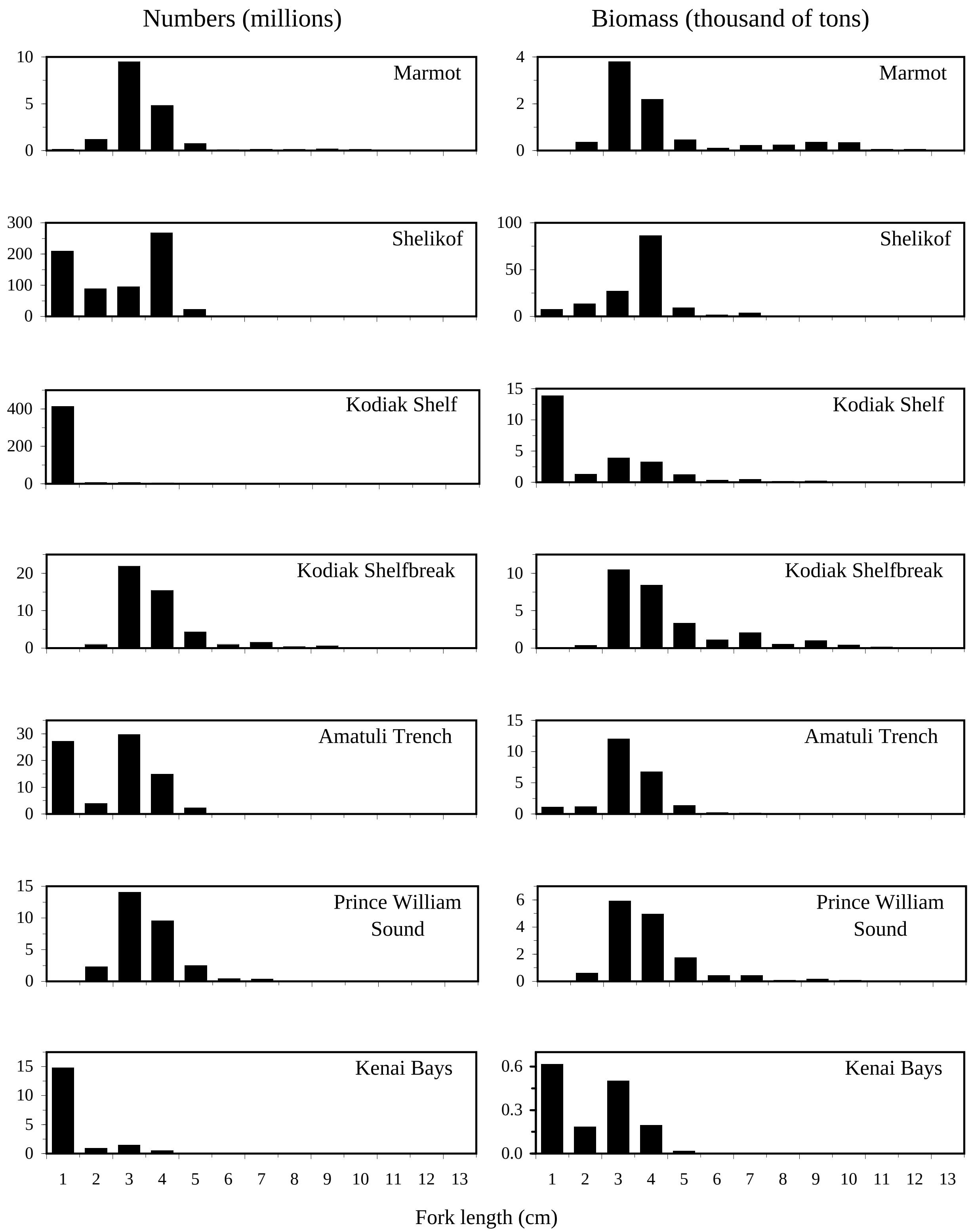

Figure 5.--Continued.

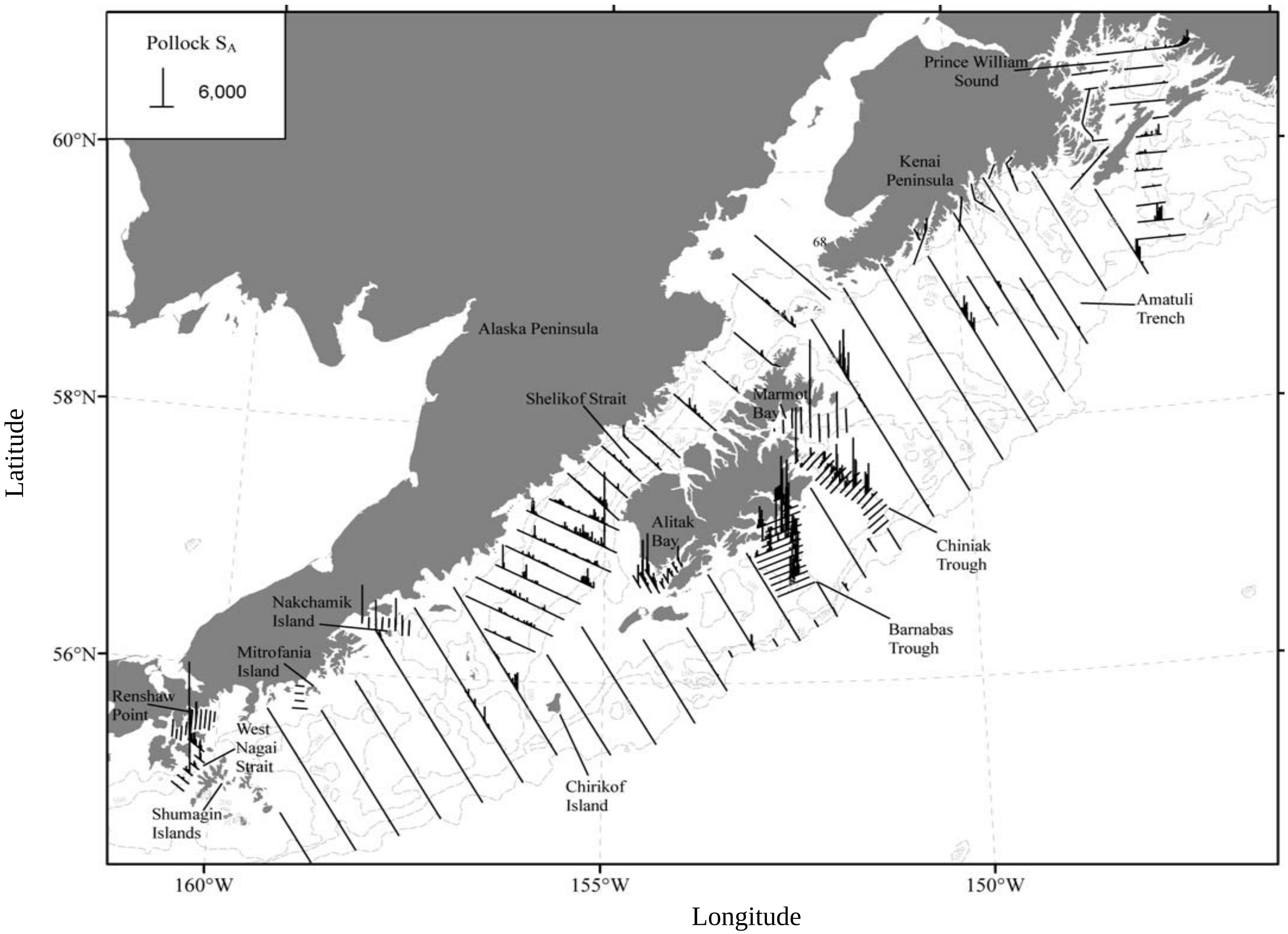

Figure 6.--Acoustic backscatter (S_A) attributed to pollock along transects from 2003 echo integration-trawl survey of the Gulf of Alaska.

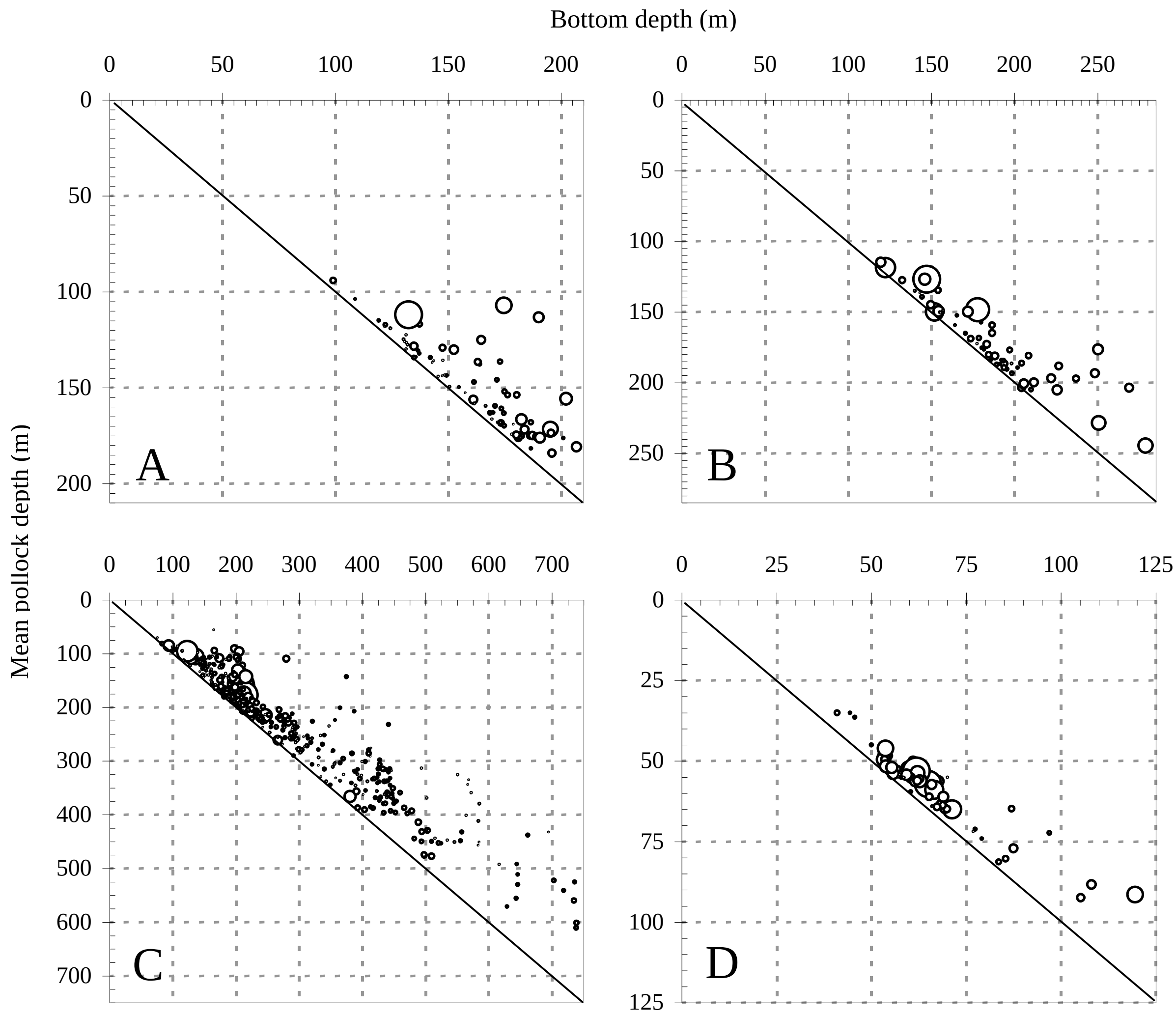

Figure 7.--Mean pollock depth (weighted by biomass) versus bottom depth (m) for each 0.5 of trackline from the summer 2003 echo integration-trawl survey of (A) the Shumagin Islands area, (B) Nakchamik Island, (C) Prince William Sound, and (D) Alitak Bay. Bubble size is scaled to the maximum biomass for each plot.

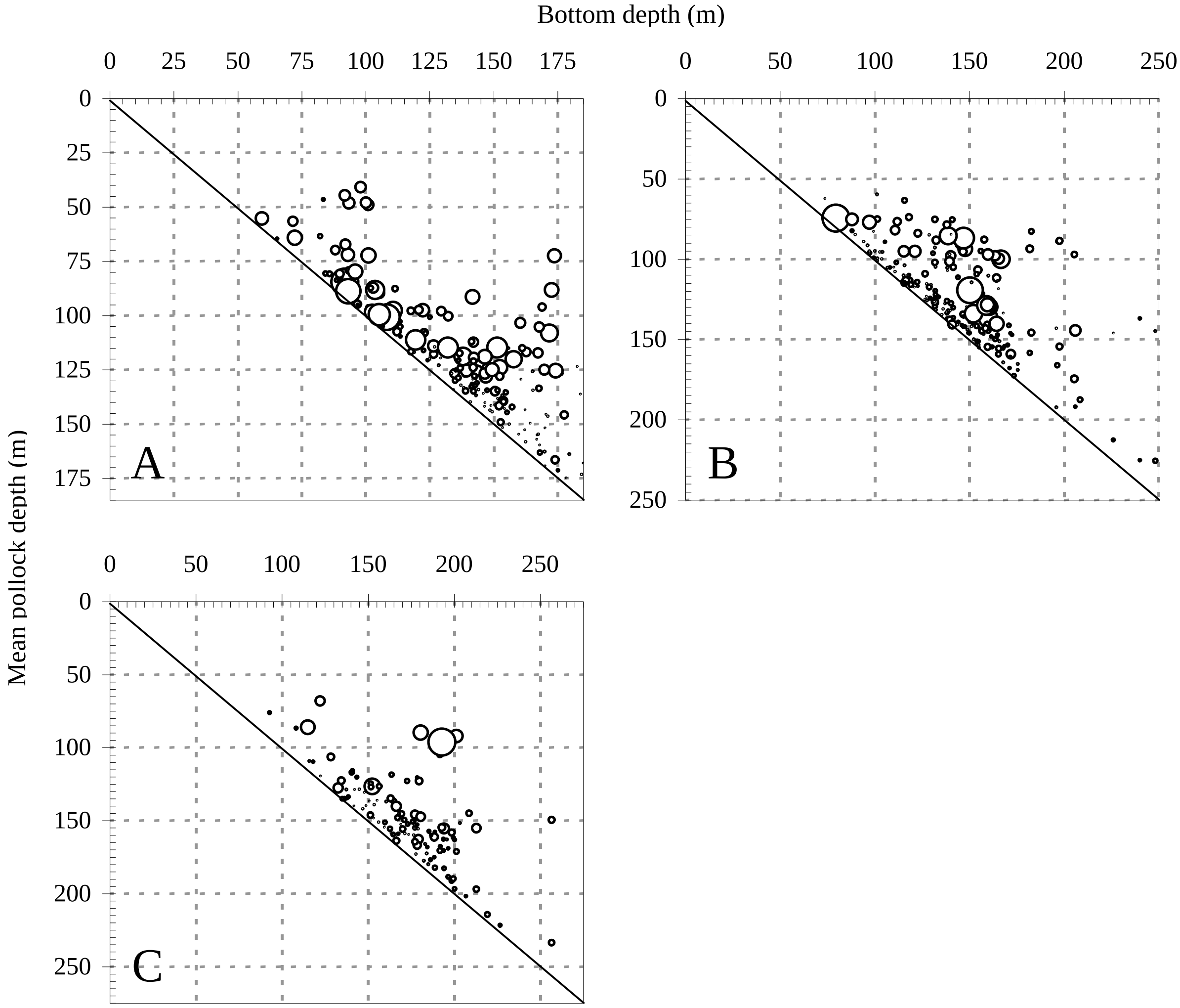

Figure 8.--Mean pollock depth (weighted by biomass) versus bottom depth (m) for each 0.5 of trackline from the summer 2003 echo integration-trawl survey of (A) Barnabas Trough, (B) Chiniak Trough, and (C) Marmot Bay. Bubble size is scaled to the maximum biomass for each plot.

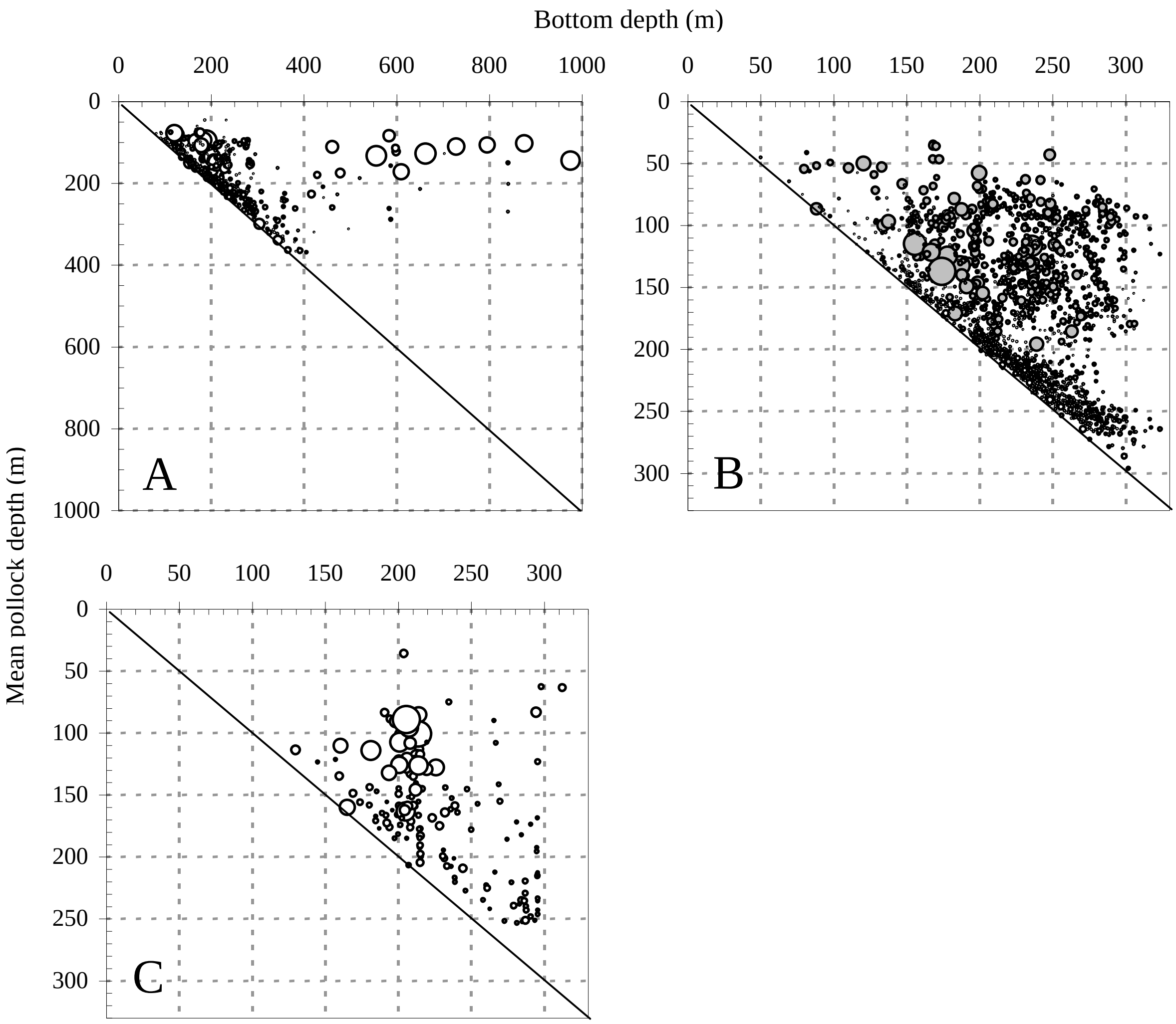

Figure 9.--Mean pollock depth (weighted by biomass) versus bottom depth (m) for each 0.5 of trackline from the summer 2003 echo integration-trawl survey of (A) the Gulf of Alaska shelf and shelfbreak, (B) the Shelikof Strait area (open circles are for near bottom pollock and gray circles are for mid-water juvenile pollock), and (C) Kenai Peninsula bays. Bubble size is scaled to the maximum biomass for each plot.

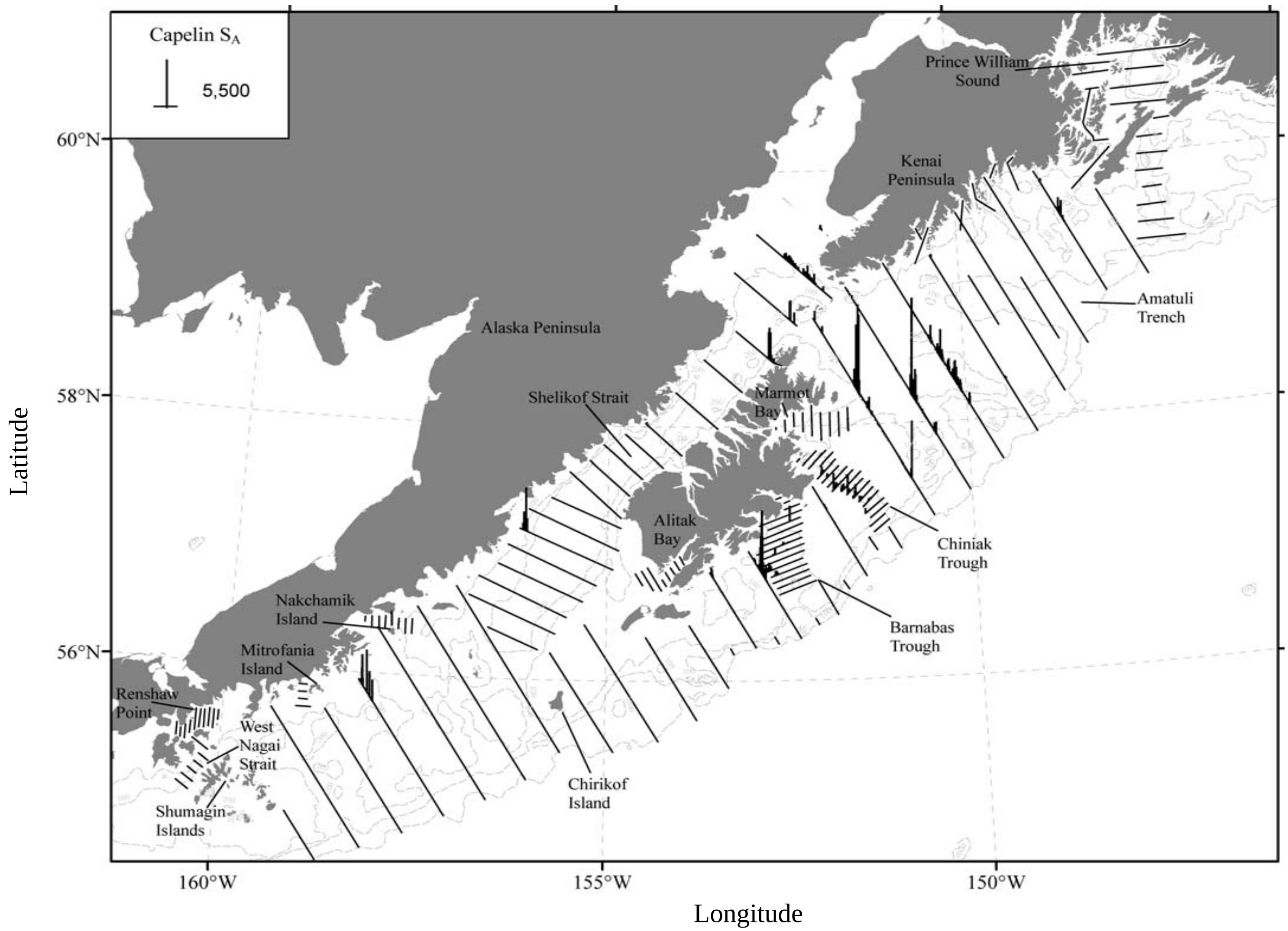

Figure 10.--Acoustic backscattering (S_A) attributed to capelin along transects from the 2003 echo integration-trawl survey of the Gulf of Alaska.

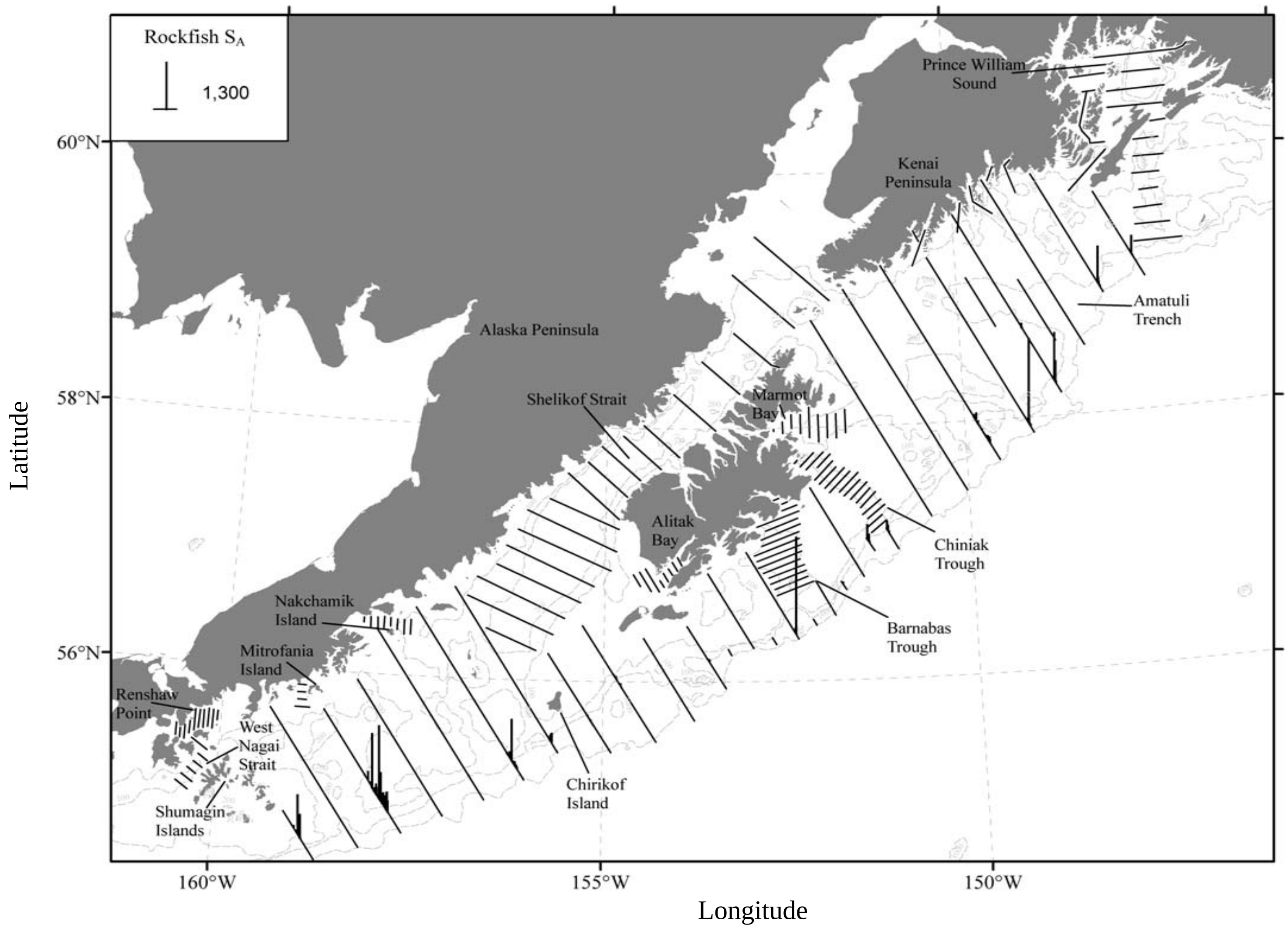

Figure 11.--Acoustic backscatter (S_A) attributed to rockfish along transects from the 2003 echo integration-trawl survey of the Gulf of Alaska.

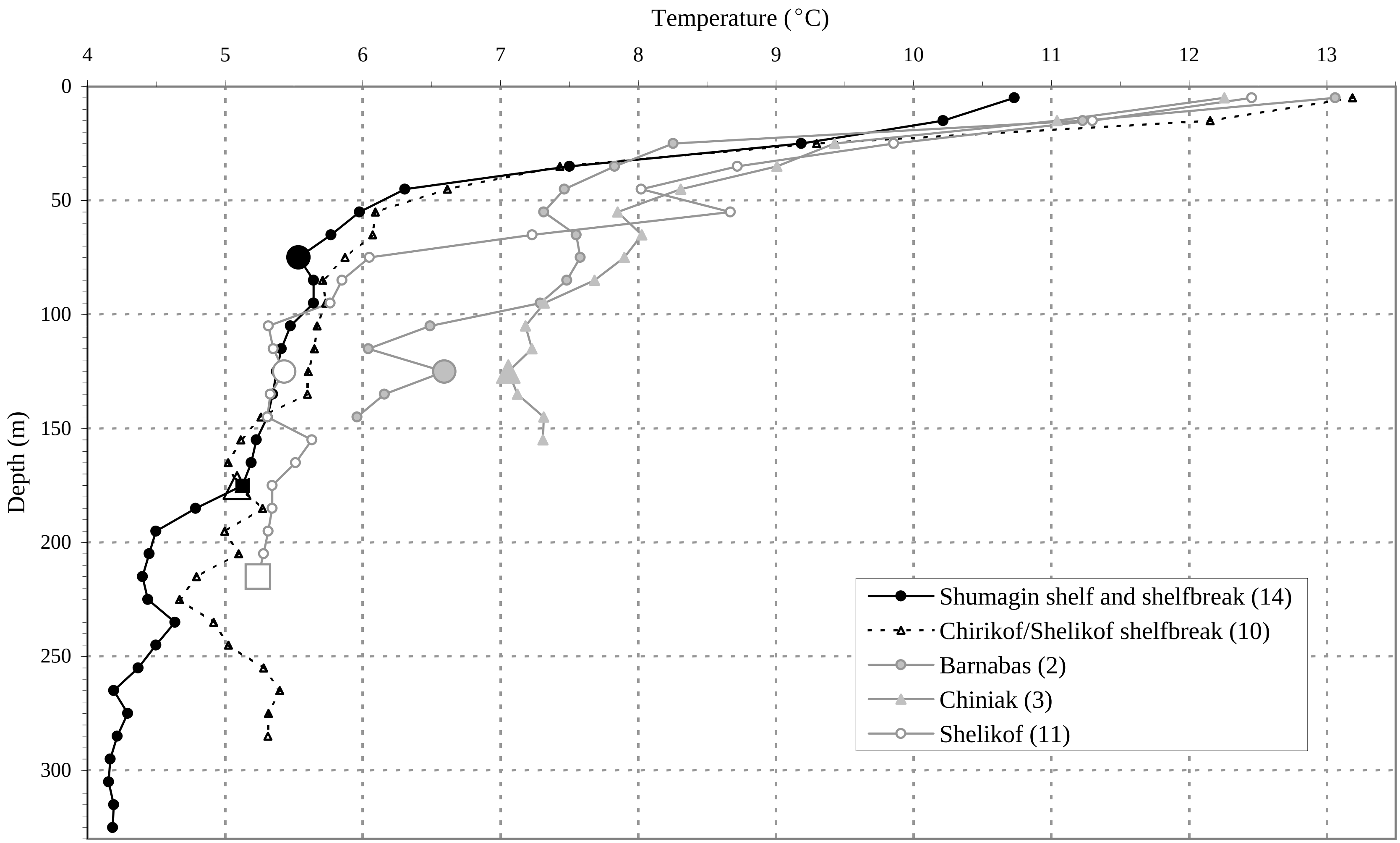

Figure 12.--Average temperature (°C) and number of samples taken by area surveyed during the summer 2005
The largest symbol for each profile represents
Note: the Shumagin shelfbreak and Shelikof

echo integration-trawl survey of the Gulf of Alaska.
the mean depth of pollock biomass in that area.
"near-bottom" depth means are represented by squares.

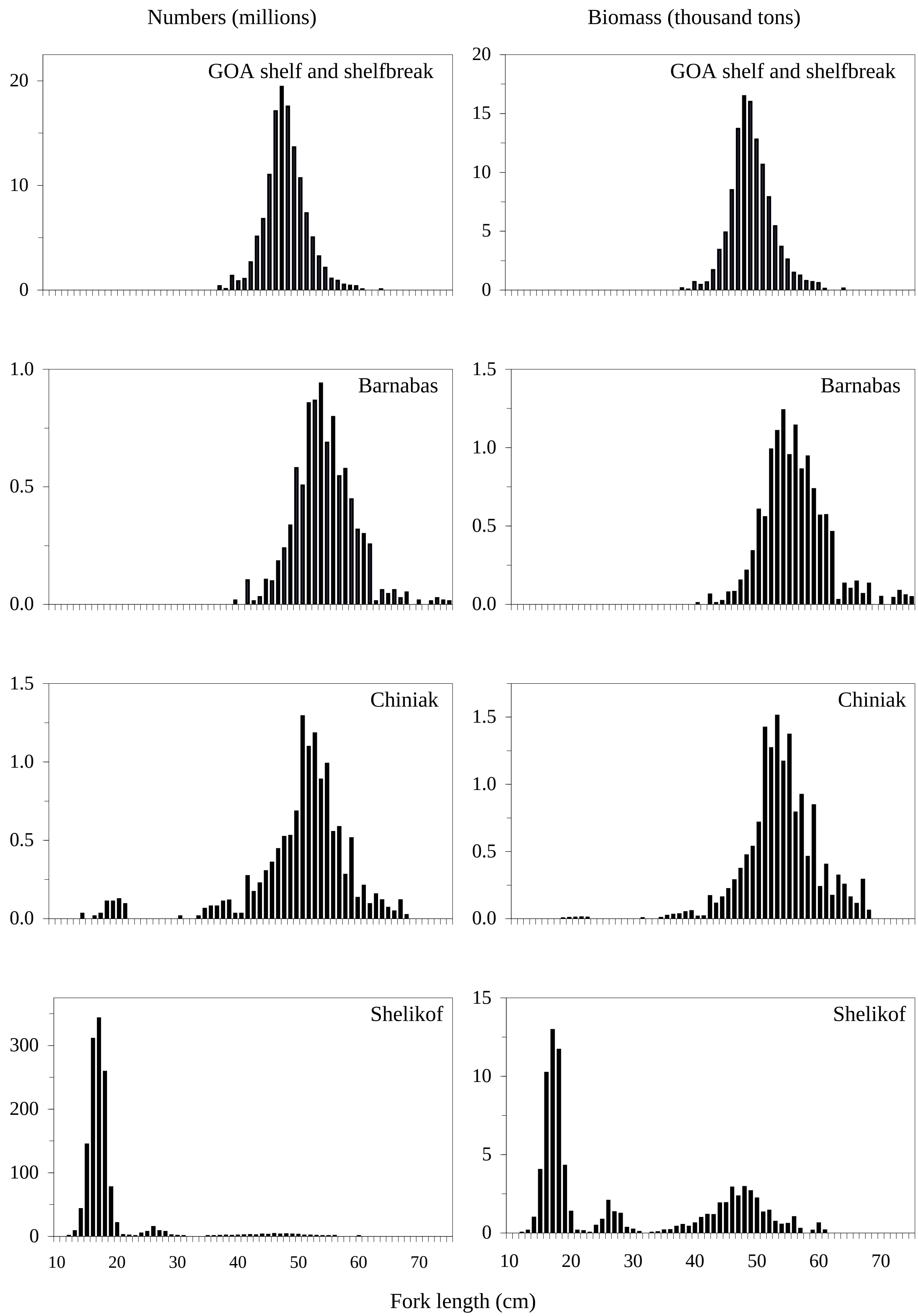

Figure 13--Pollock size composition estimates for the summer 2005 echo integration-trawl survey of the Gulf of Alaska.

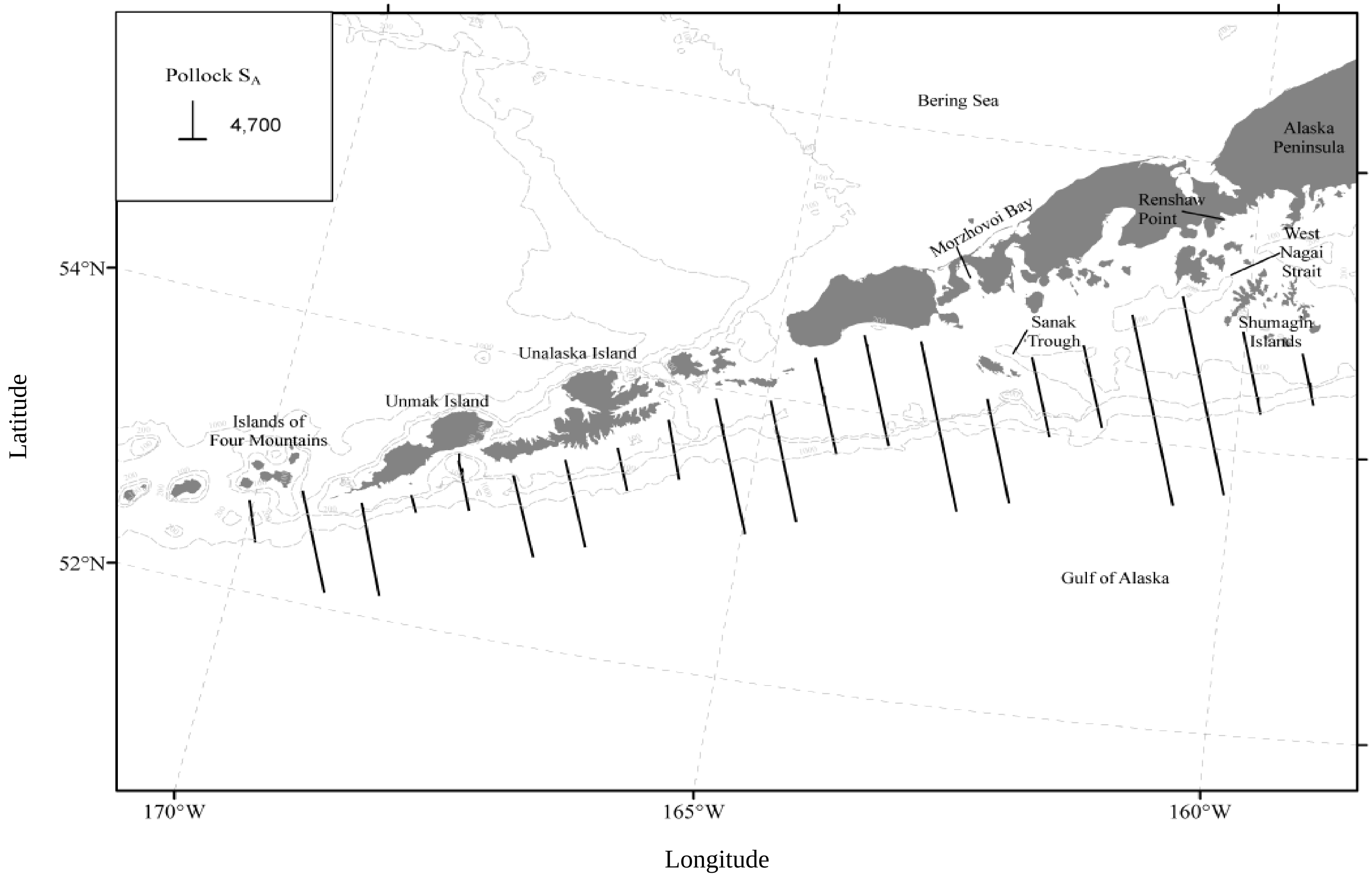

Figure 14.--Acoustic backscattering (S_A) attributed to pollock along transects from the summer 2005 echo integration-trawl survey of the Gulf of Alaska.

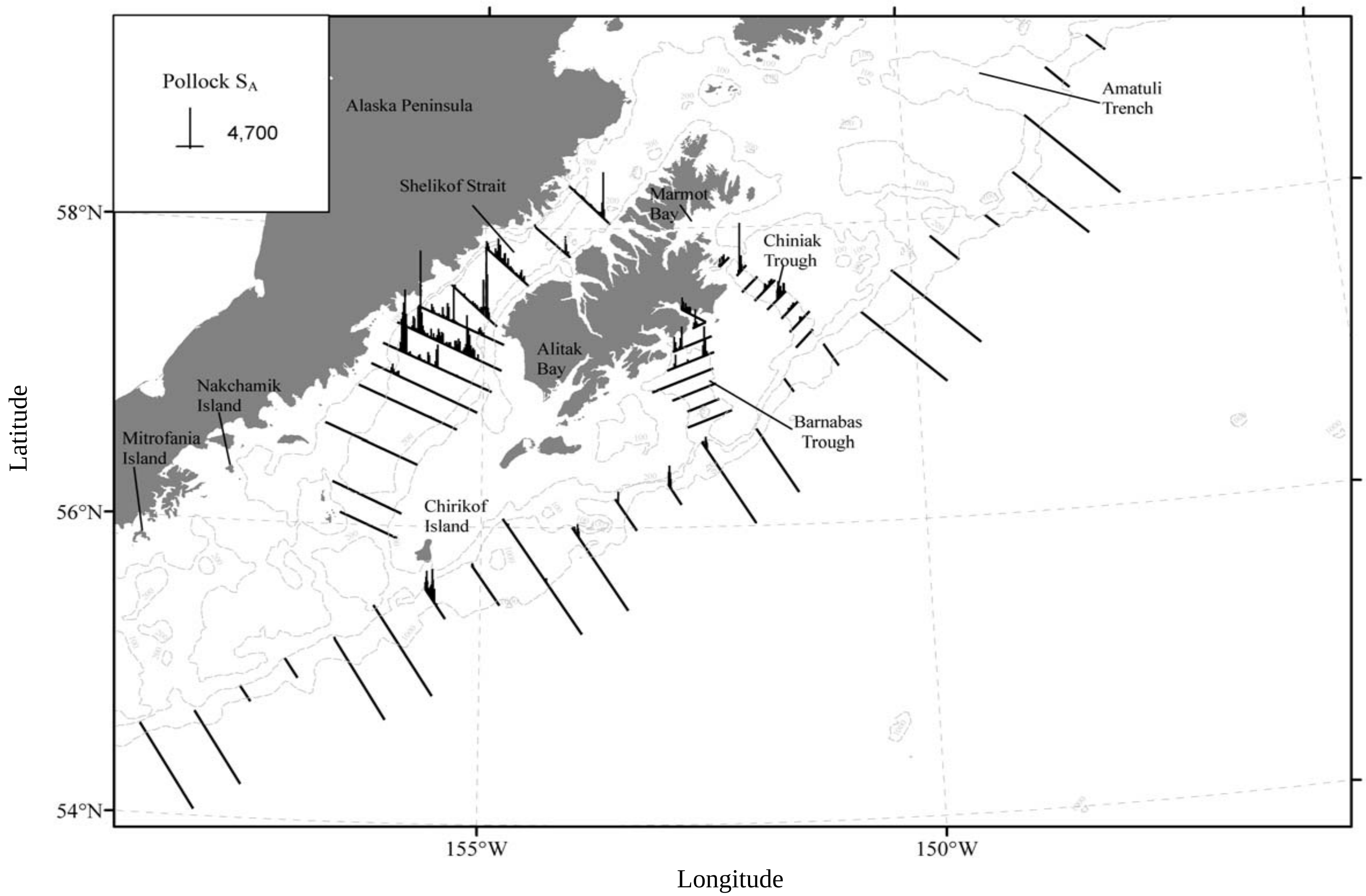

Figure 14.--Continued.

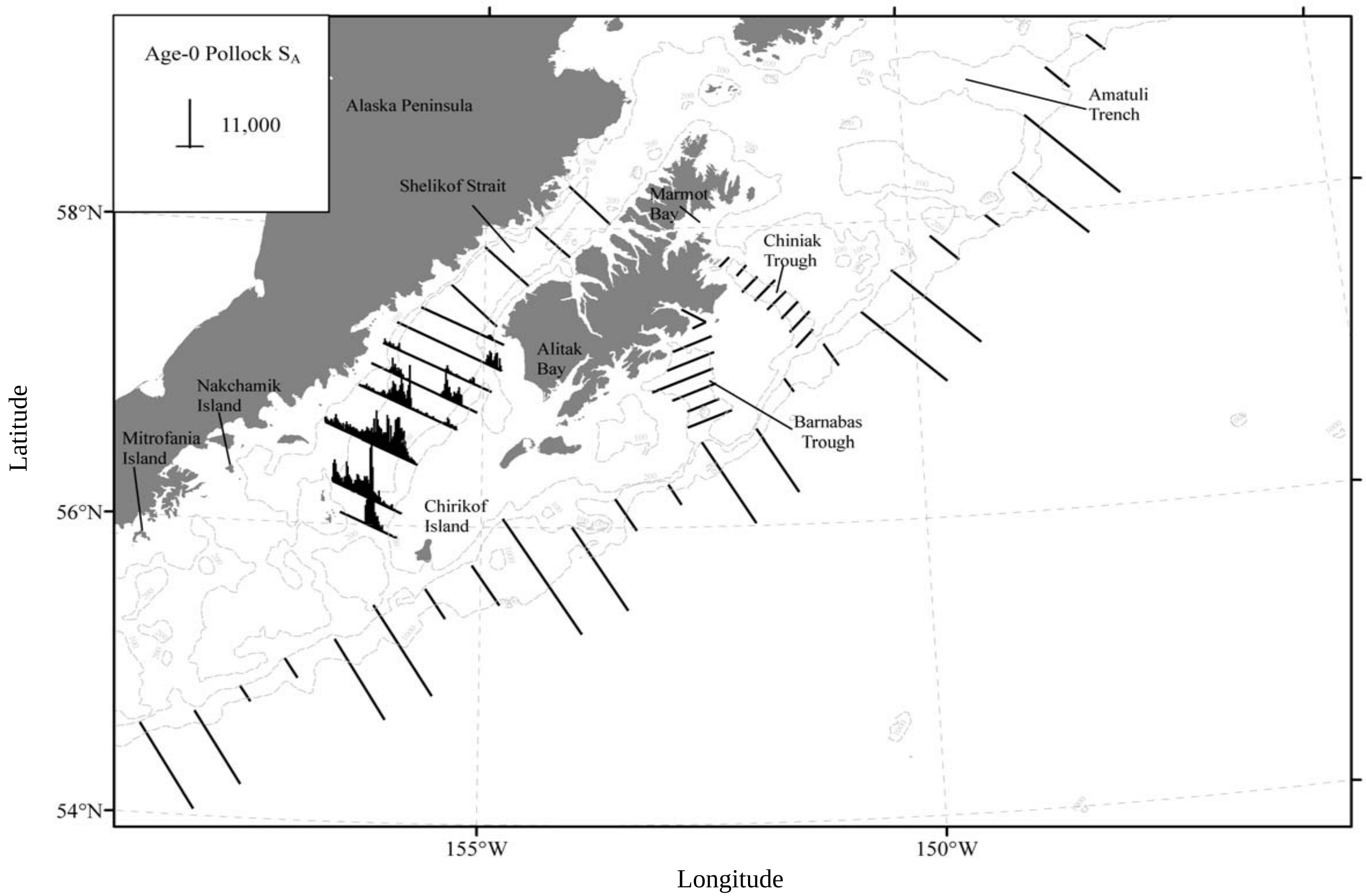

Figure 15.--Acoustic backscatter (S_A) attributed to age-0 pollock along transects from the 2005 echo integration-trawl survey of the Gulf of Alaska.

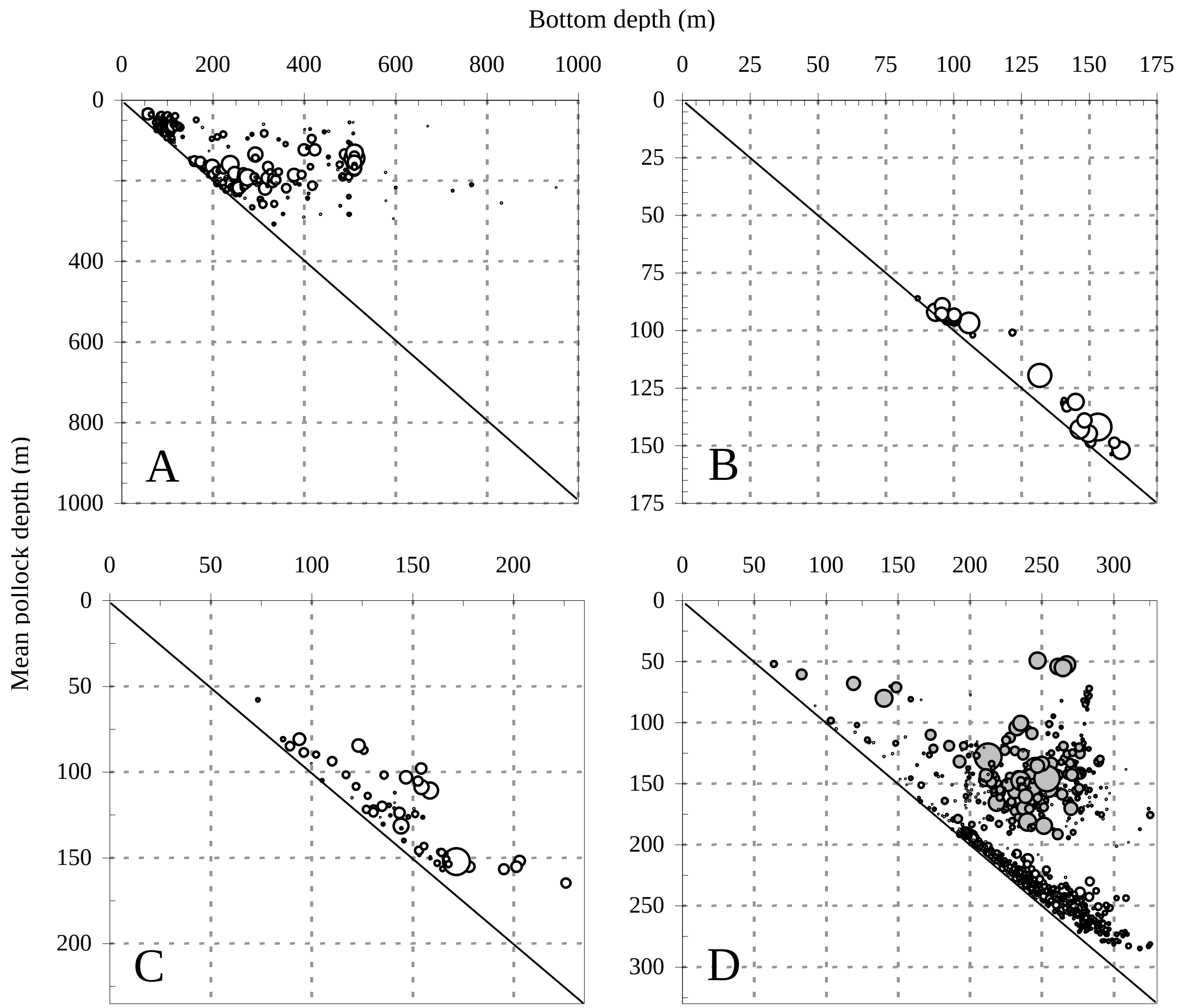

Figure 16.--Mean pollock depth (weighted by biomass) versus bottom depth (m) for each 0.5 of trackline from the summer 2005 echo integration-trawl survey of (A) the Gulf of Alaska shelf and shelfbreak, (B) Barnabas Trough, (C) Chiniak Trough, and (D) the Shelikof Strait area (open circles are for near bottom pollock and gray circles are for mid-water juvenile pollock). Bubble size is scaled to the maximum biomass for each plot.

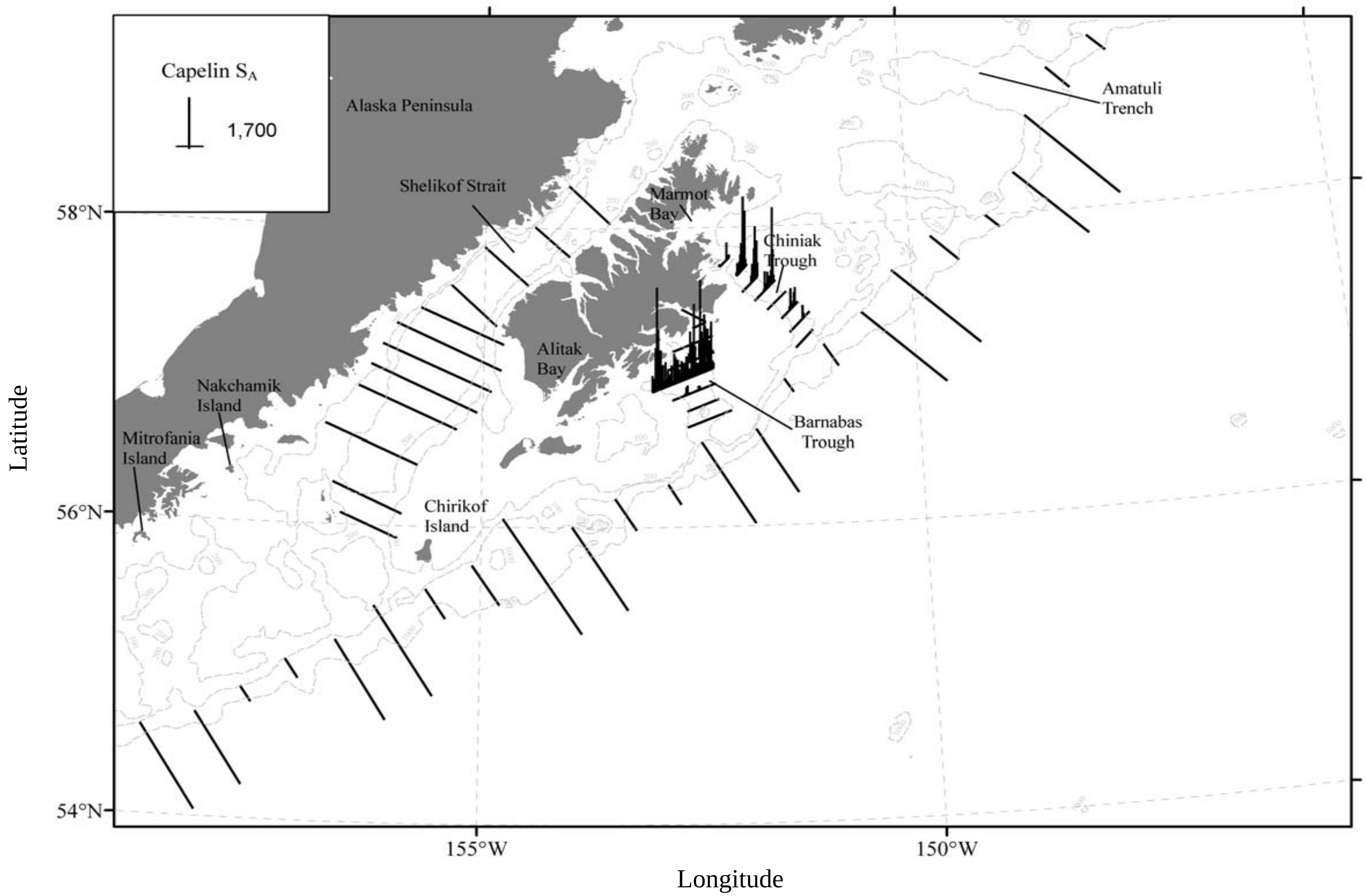

Figure 17.--Acoustic backscatter (S_A) attributed to capelin along transects from the 2005 echo integration-trawl survey of the Gulf of Alaska. Note: No capelin were observed west of Barnabas Trough.

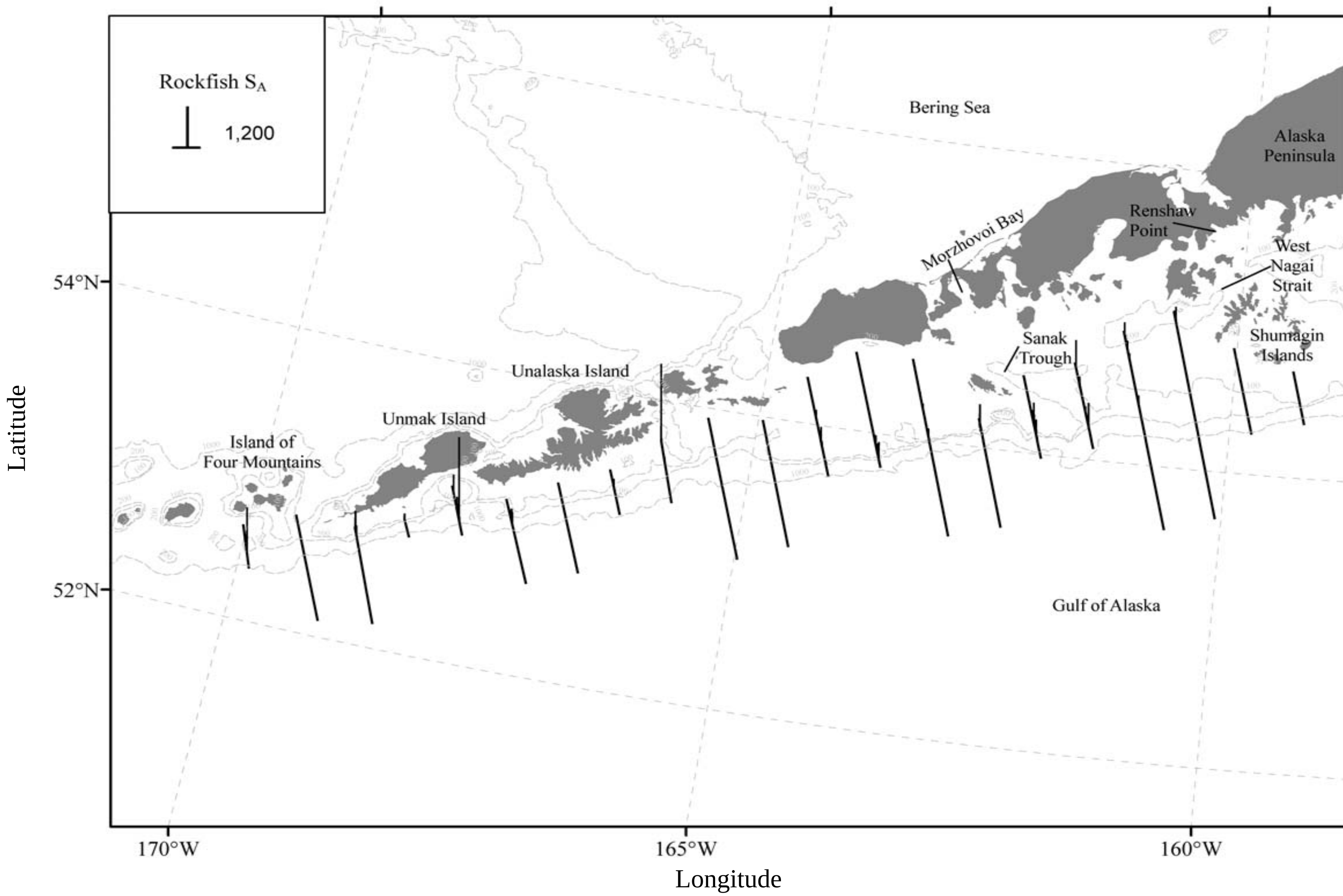

Figure 18.--Acoustic backscatter (S_A) attributed to rockfish along transects from the 2005 echo integration-trawl survey of the Gulf of Alaska.
Note: scale changes at 160°W.

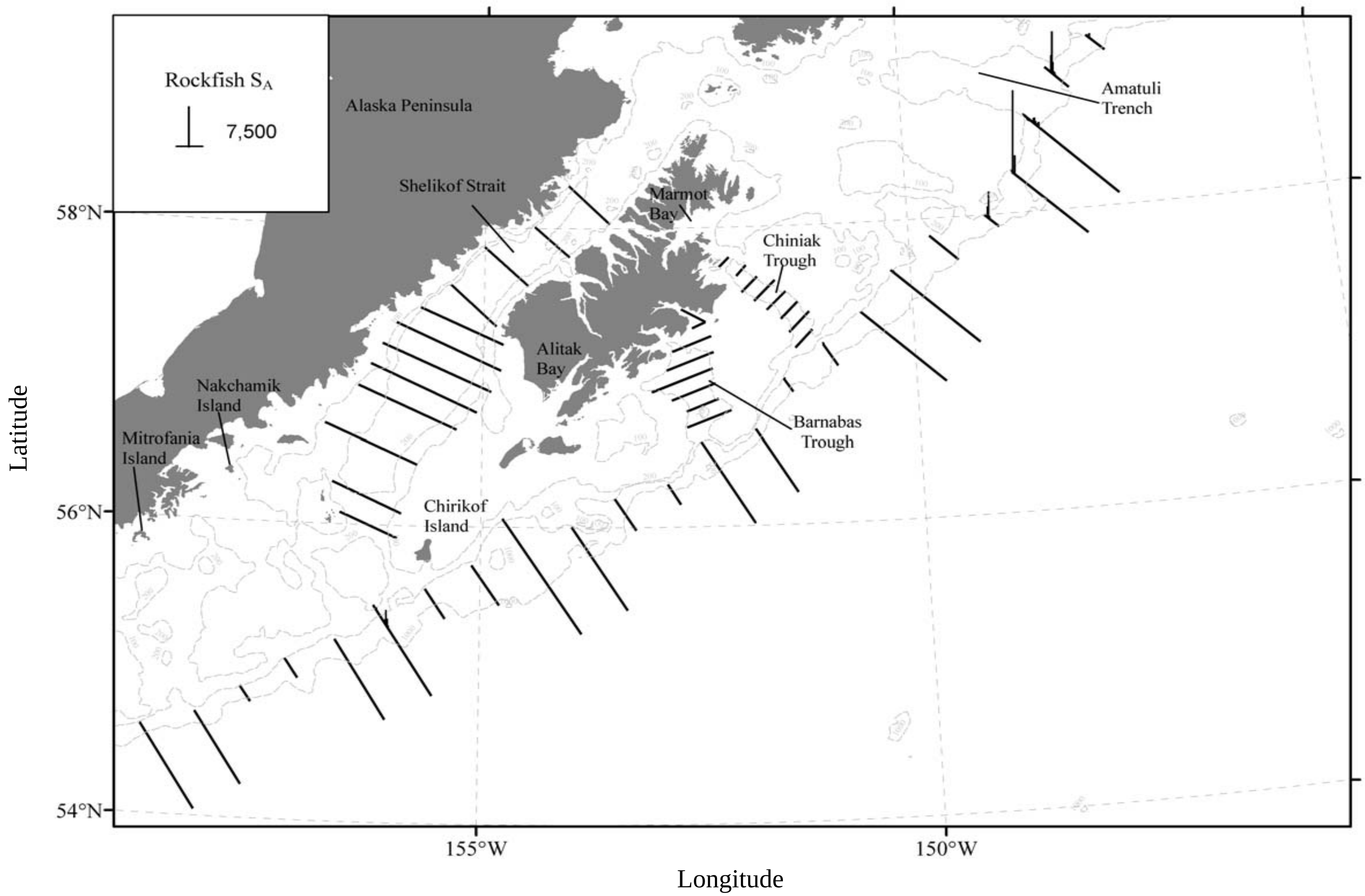

Figure 18.--Continued.