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Results of the Echo Integration-Trawl Survey of Walleye Pollock (*Theragra chalcogramma*) on the U.S. and Russian Bering Sea Shelf in June and July 2007

by
T. Honkalehto, N. Williamson, D. Jones, A. McCarthy, and D. McKelvey

U.S. DEPARTMENT OF COMMERCE
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ABSTRACT

Eastern Bering Sea shelf walleye pollock (*Theragra chalcogramma*) abundance and distribution in midwater were assessed between 2 June and 30 July 2007 using echo integration-trawl techniques aboard the NOAA ship *Oscar Dyson*. The survey also assessed walleye pollock in the Russian Cape Navarin area. In general, ocean conditions were cold in 2007, as in 2006. Surface waters averaged 5.0°C in June and early July, but warmed to an average of 8.9°C in mid- to late July. The water temperature at 60 m did not exceed 3°C, except for parts of the outer shelf and slope between Unimak Island and Zhemchug Canyon. Few walleye pollock were found in the survey region between Port Moller and central Unimak Island. A few very dense aggregations were observed along the 100-m isobath east of the Pribilof Islands. More pollock were observed west of the Pribilof Islands on the outer shelf, where a large aggregation of 1-year-olds was observed. Walleye pollock adults and juveniles (primarily age-1 and a few age-2s and -3s) were also abundant in a large area west of St. Matthew Island. Estimated walleye pollock abundance in midwater (between 14 m from the surface and 3 m off bottom) in the U.S. EEZ portion of the Bering Sea shelf was 9.21 billion fish weighing 1.77 million metric tons (t); in the Russian EEZ, it was 1.08 billion fish weighing 0.10 million t (6% of the total midwater biomass). East of 170°W (13% of total biomass) the predominant length mode was 50 cm. West of 170°W within the U.S. EEZ (81% of total biomass) modal lengths were 14 and 45 cm. In Russia modal lengths were similar to those in the western U.S. EEZ. Fewer walleye pollock were observed east of 170°W than in recent years. Inside the U.S. EEZ, juveniles were dominant numerically (61% age-1s, and 11% age-2s) but these two age groups represented only 11% of the total biomass. By contrast, ages 3+ totaled 28% of the population numerically, and made up 89% of the total biomass. Vertical distribution of walleye pollock is discussed, as well as horizontal and vertical distribution of non-pollock backscatter.

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INTRODUCTION

Scientists from the Midwater Assessment and Conservation Engineering (MACE) Program of the Alaska Fisheries Science Center (AFSC) conduct biennial summer surveys to estimate the abundance and distribution of walleye pollock (*Theragra chalcogramma*) along the eastern Bering Sea shelf. The 2007 echo integration-trawl (EIT) survey was carried out between 2 June and 30 July on the U.S. and Russian Bering Sea shelf (near Cape Navarin) aboard the NOAA ship *Oscar Dyson*. The survey's primary objective was to collect echo integration and trawl information to estimate midwater walleye pollock abundance and distribution. Additional survey objectives included testing an acoustically controlled multiple opening/closing codend device with the Aleutian wing trawl (AWT-MOCC), conducting midwater trawl-selectivity experiments, testing a stereo camera system, towing a sled to capture video footage of demersal trawl effects on the seafloor, collecting conductivity-temperature-depth (CTD) and fluorometer casts to characterize walleye pollock habitat, conducting trawls to improve species identification using multiple frequency techniques, and collecting acoustic-doppler-current-profiler (ADCP) measurements to characterize walleye pollock movement. Underwater light levels were measured to assess the effect of light intensity and penetration on walleye pollock behavior and seabird counts were also recorded.

This report summarizes observed walleye pollock distribution, and estimates abundance by size and age. As historically this species has been observed to grow at different rates and to have different length and age compositions in the southeastern Bering Sea shelf compared to the northwestern shelf, results are stratified into east and west of 170°W. The EIT survey normally covers the U.S. EEZ portion of the EBS shelf, but occasionally extends into Russian waters. Thus these results are further stratified by nation. Acoustic system calibration and physical oceanographic results are also summarized. Results from secondary projects will be presented elsewhere.

METHODS

MACE scientists conducted the EIT survey (Cruise DY2007-07) aboard the NOAA ship *Oscar Dyson*, a 64-m stern trawler equipped for fisheries and oceanographic research. The vessel itinerary (Appendix I) and scientific personnel list (Appendix II) appear near the end of this report.

Acoustic Equipment, Calibration, and Data Collection

Acoustic measurements were collected with a Simrad ER60 scientific echo sounding system (Simrad 2004, Bodholt and Solli 1992). Five split-beam transducers (18, 38, 70, 120, and 200 kHz) were mounted on the bottom of the vessel's retractable centerboard, which extended 9 m below the water surface. System electronics were housed inside the vessel in an acoustics laboratory.

Standard sphere acoustic system calibrations were conducted to measure acoustic system performance at the start of legs 1 and 2, and at the end of legs 2 and 3. During calibrations, the *Oscar Dyson* was anchored at the bow and stern. A tungsten carbide sphere (38.1 mm diameter) and a copper sphere (64 mm diameter) were suspended below the centerboard-mounted transducers. The tungsten carbide sphere was used to calibrate the 38, 70, 120 and 200 kHz systems and the copper sphere was used to calibrate the 18 kHz system. After each sphere was centered on the acoustic axis, split beam target strength and echo integration measurements were collected to estimate transducer gains following methods of Foote et al. (1987). Transducer beam characteristics were modeled by moving each sphere through a grid of angular coordinates and collecting target strength data using EKLOBES software (Simrad 2004).

During the survey, acoustic data were logged at all five frequencies using SonarData EchoLog 500 (v. 4.1) and ER60 software (v. 2.1.2). Results presented in this report, including calibration, are based on 38 kHz echo integration data, the best frequency for detecting walleye pollock.

Acoustic system settings were based on results from the 2 June acoustic system calibration (Table 1). Acoustic measurements were collected from 14 m below the surface (5 m below the centerboard-mounted transducer) to within 0.5 m of the bottom and were analyzed using SonarData Echoview post-processing software (Version 4.1 for preliminary analyses aboard *Oscar Dyson*, and 4.2 for final analyses at AFSC). Acoustic data collection was limited to 500 m depth to provide the best vertical resolution throughout the survey depth range.

Trawl Gear and Oceanographic Equipment

Midwater and near-bottom acoustic backscatter were sampled using an Aleutian Wing 30/26 Trawl (AWT). This midwater trawl was constructed with full-mesh nylon wings and polyethylene mesh in the codend and aft section of the body. The headrope and footrope each measured 81.7 m (268 ft). Mesh sizes tapered from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend, where it was fitted with a 32 mm (1.25 in) codend liner. On or near bottom backscatter was sampled with an 83-112 Eastern bottom trawl without roller gear, which was also fitted with a 32-mm codend liner. The AWT and bottom trawl were fished with 5 m^2 Fishbuster trawl doors. Vertical net openings and depths were monitored with either a Simrad FS70 third wire netsonde or a Furuno acoustic link netsonde attached to the headrope. For AWT hauls, vertical net opening ranged from 16 to 32 m and averaged 26 m. For bottom trawl hauls, vertical net opening ranged from 2 to 3 m. Detailed trawl gear specifications are described in Honkalehto et al. (2002).

A Methot trawl was used to target midwater age-0 walleye pollock and macro-zooplankton. The Methot trawl had a rigid square frame measuring 2.3 m on each side, which formed the mouth of the net. Mesh sizes were 2 by 3 mm in the body of the net and 1 mm in the codend. A 1.8-m dihedral depressor was used to generate additional downward force. A calibrated General Oceanics flow meter was attached to the mouth of the trawl to determine the volume of water filtered during hauling. The trawl was attached to a single cable fed through a stern-mounted A-frame. Real-time trawl depths were monitored using a Simrad ITI acoustic link netsonde attached to the bottom of the frame.

Physical oceanographic measurements were made throughout the cruise (Fig. 2). Temperature/depth profiles were obtained at trawl sites with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Eighty-two conductivity-temperature-depth (CTD) and fluorometer measurements were made with a Sea-Bird SBE 9/11 plus CTD system throughout the survey (Fig. 2b), and at calibration sites. Sea surface temperature and salinity were measured continuously using the vessel's Sea-Bird Electronics SBE-45 external probe located mid-ship, approximately 5 m below the water line. These and other environmental information were recorded using the ship's Scientific Computing System (SCS). Atmospheric (on the vessel's flying bridge) and water column (during the trawl path) ambient light levels were also measured.

Survey Design

The survey design consisted of 35 north-south transects spaced 20 nautical miles (nmi) apart over the Bering Sea shelf from Port Moller, Alaska, across the U.S.-Russia Convention Line to the area around Cape Navarin, Russia (Fig. 1). Acoustic backscatter and trawl information were collected during daylight hours (typically between 0600 and 2400). Nighttime operations included additional trawling for species identification, additional CTD deployments, acoustic system testing, field-testing the AWT-Midwater Opening Closing Codend (AWT-MOCC) (Legs 1 and 2), midwater trawl selectivity experiments (Leg 3) and video monitoring of the seabed (Leg 3). Several Methot trawls deployed day and night targeted scattering layers thought to be either euphausiid or jellyfish to improve identification of those layers with multiple frequencies.

For trawls targeting walleye pollock, a portion of the catch was sampled to determine sex, fork length (FL), body weight, age, and maturity. If a large numbers of juveniles mixed with adults were encountered in a haul, size groups were often subsampled separately. Approximately 50 to

500 individuals were randomly sampled for sex and length, and about 10 to 60 were sampled for body weight, maturity and age. Fork lengths were measured to the nearest centimeter (cm). Smaller fish such as age-0 gadids were measured to the nearest millimeter (mm) standard length. An electronic motion-compensating scale (Marel M60) was used to weigh individual fish specimens to the nearest 2 g. For age determinations, walleye pollock otoliths were collected and stored in individually marked vials containing a 50% ethanol-water solution. Maturity was determined by visual inspection and fish were categorized as immature, developing I, developing II, pre-spawning I, pre-spawning II, spawning, post-spawning I, or post-spawning II[1]. Trawl station and biological measurements were digitally recorded using a Fisheries Scientific Computer System (FSCS) designed and developed by NOAA's Office of Marine and Aviation Operations for NOAA research vessels.

Data Analysis

Walleye pollock abundance was estimated by combining acoustic backscatter and trawl information. Acoustic backscatter that was identified as walleye pollock, non-pollock fish, or an undifferentiated mixture (primarily jellyfish, other macro-zooplankton, and fish) was binned at 0.5 nmi horizontal by 10 m vertical resolution, and stored in a database. Walleye pollock length compositions were combined into length strata based on geographic proximity, similarity of length composition, and backscatter characteristics. Two separate average weight-at-length relationships were used to estimate biomass east and west of 170°W including Russia. For each relationship, mean fish weight-at-length for each length interval (cm) was estimated from the trawl information when there were six or more pollock for that length interval; otherwise weight at a given length interval was estimated from a linear regression of the natural logs of all the length and weight data (De Robertis and Williams 2008). Numbers and biomass for each length stratum were estimated as follows:

1 ADP Code Book. 2008. Unpublished document. Resource Assessment and Conservation Engineering Division, Alaska Fish. Sci. Cent., 7600 Sand Point Way NE, Seattle WA 98115. p.

The echo sounder measures nautical area scattering coefficient s_A (MacLennan et al. 2002), which is assumed to be proportional to fish abundance. The acoustic return from an individual fish is referred to as its backscattering cross-section (σ_{bs}), or in more familiar (logarithmic) terms as its target strength (TS), where

$$TS = 10 \log \sigma_{bs}.$$

The AFSC uses the following TS to length relationship for walleye pollock (Traynor 1996)

$$TS = 20 \log_{10} L - 66.$$

Biological information available from the trawl hauls includes:

length composition, where P_i is the proportion at length L_i,

mean weight-at-length, $\overline{W}_i$, and

an age-length key, where $Q_{i,j}$ is the proportion of j-aged fish of length L_i .

For a given geographic length stratum area (A), backscatter attributed to walleye pollock is scaled to abundance using a weighted mean backscattering cross-section and the biological information as follows:

$$\overline{\sigma}_{bs} = \Sigma_i (P_i \times \sigma_{bsi}), \text{ where } \sigma_{bsi} = 10^{((20 \log L_i - 66)/10)};$$

$$\text{Numbers at length } L_i = N_i = P_i \times \overline{s}_A \times A / 4\pi \overline{\sigma}_{bs};$$

Biomass at length $L_i = B_i = \overline{W}_i \times N_i$;

Numbers at age $j = N_j = \Sigma_i Q_{i,j} \times N_i$;   and

Biomass at age $j = B_j = \Sigma_i Q_{i,j} \times B_i$.

Total biomass or numbers were estimated by summing the stratum estimates. Estimated pollock distribution and abundance were then summarized into three areas: the U.S. EEZ east of 170°W and west of 170°W, and Russian waters.

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

RESULTS AND DISCUSSION

Calibration

Four acoustic system calibrations were conducted during the summer 2007 field season (Table 1). No significant differences in gain parameters or transducer beam characteristics were observed for the Simrad ER 60 38 kHz system.

Physical Oceanographic Conditions

The summer EBS survey encompassed 2 months during which the Bering Sea was gradually stratifying and warming. The range of ocean surface temperatures observed in 2007 (Fig. 2) was slightly greater than that observed in 2006 (see Fig. 2, McKelvey et al. 2007). The coldest surface waters were on the inner shelf east of the Pribilof Islands (2.0°C) and the warmest surface waters were observed in Russian waters over Navarin Canyon (10.9°C) (Fig. 2a). Surface water temperatures observed between early June and early July (transects 1-20) averaged 5.0°C. Temperatures were colder during this period than they were in 2006 (average 5.9°C), particularly on the outer shelf. In contrast, surface temperatures from mid-July onward (transects 21-35) averaged 8.9°C, compared to 7.6°C in 2006. The average temperatures at 60 m (below the thermocline) were warmest on the outer shelf and shelf break between Unimak Island and Zhemchug Canyon (3° to 4°C) and coldest on the inner shelf north of the Pribilofs to about 177° 30' W (0 to –1.7°C) (Fig. 2b). Average temperatures at 60 m were very cold in 2007; only in the deeper parts of the outer shelf and slope between Unimak Island and Zhemchug Canyon did they exceed 3°C. These temperature results reflected not only geographic differences but also temporal changes occurring over the 2-month survey.

Trawl Sampling

Biological data and specimens were collected from 136 trawl hauls (Table 2, Fig. 1). These included: 54 with the AWT midwater trawl, 19 with the bottom trawl, and 27 with the Methot trawl. Additionally there were 15 hauls with the AWT-MOCC, and 21 midwater trawl-selectivity hauls. Pollock was the most abundant species, and northern sea nettle jellyfish (*Chrysaora melanaster*) was the second most abundant species captured by weight in the 54 non-experimental midwater trawl hauls (Table 3). Pollock was also the most abundant species by weight and number in the bottom trawls, followed by arrowtooth flounder (*Atheresthes stomias*) (Table 4). Euphausiids were the most abundant species group by weight in the Methot trawls, followed by northern sea nettles (Table 5). During the cruise 30,623 lengths were measured and 3,231 pairs of otoliths were collected from pollock captured in trawl hauls (Table 6). Less than 1% (n = 4) of the female pollock larger than 29 cm FL were actively spawning; they were captured east of 170°W. Most pollock were either in the developing or post-spawning maturity stage (Fig. 3a-3c). Although not significantly different, pollock 41 to 55 cm FL caught east of

170°W tended to average slightly heavier (1.8%) than those caught west of 170°W, and heavier (5.2%) than those caught in the Russian EEZ (Fig. 4).

Distribution and Abundance

During the 2007 survey, much of the acoustic backscatter across the shelf was attributed to adult or juvenile walleye pollock (Fig. 5). All other backscatter was attributed to an undifferentiated invertebrate-fish species mixture, or in a few isolated areas, to unidentified fish (likely herring or rockfish). Several dense pollock aggregations were observed along the 100-m isobath east of the Pribilof Islands. Substantial aggregations were observed west of the Pribilof Islands on the outer shelf at about 171° 20 to 172°W, including dense aggregations of juveniles. High densities of walleye pollock were also observed covering a large area west of St. Matthew Island on the outer shelf between about 175°W and 179°W, north of 60°N. In this region, juveniles were most concentrated on the outer shelf between Pervenets and Navarin Canyons straddling the U.S.-Russia border.

Estimated walleye pollock abundance in midwater (between 14 m from the surface and 3 m off the bottom) along the U.S. Bering Sea shelf was 9.21 billion fish weighing 1.77 million metric tons (t) (Tables 7-9). Estimated midwater abundance on the Russian shelf was 1.08 billion fish weighing 0.10 million t (6% of total midwater biomass). East of 170°W (13% of midwater biomass) the length composition ranged between 10 and 71 cm FL with a main mode at 49-50 cm FL; few juveniles were present (Fig. 6a). Approximately one-third of the eastern walleye pollock biomass was found inside the Steller sea lion Conservation Area (SCA) (Table 9). West of 170°W inside the US EEZ (81% of total midwater biomass; Fig. 6b), the length composition ranged between 10 and 74 cm FL with a major mode at 14 cm and lesser modes at 45 and 22 cm FL. Based on the 1D analysis, the relative estimation error of the U.S. EEZ biomass estimate was 0.045, a bit higher than those observed since 1999 (Table 9). The walleye pollock length composition in the Navarin area (Fig. 6c) was similar to that west of 170°W inside the U.S. EEZ, although there were proportionally fewer adults (≥ 30 cm FL), and more juveniles (18 to 29 cm FL).

The estimated age composition of eastern Bering Sea walleye pollock varied depending upon geographic area. Inside the U.S. EEZ (Table 10), juveniles were dominant numerically (61%, age-1s, and 11% age-2s) but these two age groups represented only 11% of the total biomass. By contrast, adult fish ages 3+ totaled 28% of the population numerically, and made up 89% of the total biomass. Examining the U.S. EEZ east and west of 170°W and the Cape Navarin area of Russia (Fig. 7) showed that east of 170°W the population was dominated by 6-8 year-old adults, while west of 170°W, and in Russia, it was dominated by age 1 and 2 fish, followed in decreasing numbers, by ages 5, 6, and 4, respectively. In Russia, proportionally more age-2s were observed than in the U.S. EEZ (Fig. 7).

The relative success of the eastern Bering Sea walleye pollock population is thought to depend partially upon the periodic occurrence of large year classes. These are usually first observed as juveniles by assessment surveys; the annual bottom trawl and biennial acoustic-trawl surveys typically both encounter age-1 fish, and the acoustic-trawl survey typically encounters age-2 and -3 fish as they tend to aggregate farther off bottom. Numbers at age from the acoustic trawl surveys between 1994 and 2007 (Fig. 8) showed that the 2006 year class was the most numerous age-1 group detected by the acoustic-trawl survey since the large 1996 year class in 1997. Previous strong recruiting year classes observed in acoustic-trawl survey results included the 1992 year class as 2-year-olds in 1994, the 1996 year class as 1-year-olds in 1997, and the 2000 year class as 2-year-olds in 2002.

In the U.S. EEZ, average length at age for walleye pollock east and west of 170°W for 2007 was compared with the average length at age between 1999 and 2006 (Fig. 9). Results showed that east of 170°W, although not significantly different, 5-10 year-olds' lengths trended above the mean average length for previous survey years. In the west, the 2007 average lengths were very similar to historical averages.

The vertical distribution of walleye pollock biomass was examined east and west of 170°W, and referenced to the surface and the bottom for adults (≥ 30 cm FL) and juveniles (Fig. 10a-d). East and west of 170°W, adults are strongly associated with the seafloor (Fig. 10c), usually remaining within 40 m. East of 170°W, juveniles were rarely observed. West of 170°W, juveniles were found both near the seafloor, in similar depth strata as those inhabited by the adults, and in midwater (Fig. 10b) in depth strata centered at 45 to 55 m from the surface.

Walleye pollock distribution may be influenced by water column temperature (Kotwicki et al. 2005), among other factors. Bottom temperature information from AFSC bottom trawl surveys suggested that 2007 was one of the coldest survey years, along with 2006 and 1999, whereas 2000, 2002, and 2004 were generally categorized as warm years by comparison (Ianelli et al. 2007). Temperatures measured at the trawl headrope for EIT survey midwater trawls capturing more than 100 kg of walleye pollock (Fig. 11) had relatively unimodal distributions. East of 170°W, headrope temperatures ranged from 1° to 8° C with a mode at 4°C. West of 170°W, temperatures were cooler, ranging from -1° to 8°C with a mode at 2°C. Differences between warm and cold years appeared to be primarily in the tails of the temperature distributions.

The EBS EIT survey provides estimates of walleye pollock inhabiting midwater—from near the surface to 3 m off the bottom. Walleye pollock biomass in the depth stratum between the seafloor and 3 m off bottom is estimated separately from the annual EBS bottom trawl survey (Acuna and Lauth 2008). However, the EIT survey is also capable of estimating biomass to within 0.5 m of bottom. The proportions of walleye pollock biomass estimated in both depth strata from recent EIT surveys were compared east and west of 170°W and for the whole survey (Fig. 12). The proportion close to the bottom (between 3 m off bottom and 0.5 m from the bottom) appeared to be relatively stable (about 19%) across survey years between 1999 and 2006, with a slight increase to 26% in 2007 (Fig. 12c). The vertical distribution across years averaged 74% above 3 m and 26% below 3 m east of 170°W, and 82% above and 18% below 3 m west of 170°W. The higher percentage observed above 3 m west of 170°W is consistent with the greater abundance of juveniles usually observed west of 170°W than in the east, as juveniles tend to aggregate higher in the water column than the adults.

Several factors likely influence walleye pollock biomass by affecting the observed condition of growing juveniles (e.g., weight at age) during the summer. These include density-independent factors related to environmental conditions on the eastern Bering Sea shelf, as well as density-dependent factors such as year-class strength, overall population biomass, etc. Summer 2006 was the coldest since 1999, and the mean weight at age for age-2 and -3 juveniles captured during the 2006 AFSC bottom trawl survey was lower than it had been in the previous years (Ianelli et al. 2007). Since the EIT survey encounters relatively more age-2 and -3 juveniles than the bottom trawl survey, mean weights of EIT survey juveniles were also examined to see if they exhibited a similar trend. Results suggested that the mean weight at age from the EIT survey for age-1, -2 and -3 juveniles west of 170°W (Fig. 13) was less variable than those from the bottom trawl survey (see Fig. 1.15, Ianelli et al. 2007). In 2006, mean weight at age for all three age groups was slightly lower than it had been since 2000. Mean weight at age was lowest for age-1 and -2 juveniles during the last relatively very cold year, 1999, and for age-3 juveniles in 1996. Conversely, the mean weight at age for age-3 juveniles in the 2007 survey appeared to increase, even though 2007 was the second sequential cold summer, and was colder than 2006. Unusually high juvenile weights observed in 1997 might be due to ageing difficulties among 2- and 3-year-olds or to lingering effects of the 1996 El Niño or both. Surveys from 1999 to the present were conducted in June and July. Prior to 1999 the surveys were conducted in July and August.

Non-pollock species (jellyfish, macrozooplankton, and individual fish) contributed backscatter at 38 kHz primarily in the upper part of the water column across the shelf (Fig. 14). This backscatter information should be interpreted with care because the exact biological composition of the scatterers is unknown. Additionally, classification of non-pollock backscatter was not always performed as rigorously as classification of walleye pollock, and so may contain small amounts of non-biological scatter. Some scatterers, such as fish with swimbladders and large medusae, are more easily detected at 38 kHz than small and poorly reflective organisms such as copepods and euphausiids, thus direct comparison of backscatter within or between years is not recommended in most cases. Examining the vertical distribution of observed backscatter from all non-pollock species (excluding fish such as rockfishes, which formed a very small component of the total backscatter) indicated that 78% of the non-pollock backscatter east of 170°W was observed shallower than 50 m, and 86% west of 170°W in the U.S. EEZ. West of 170°W, there was little vertical overlap between non-pollock backscatter (Fig. 14) and adult pollock (Fig. 10a). In Russian waters, very little non-pollock backscatter was observed by comparison, and it was more evenly distributed in the water column—only 56% was shallower than 50 m. The presence of non-pollock backscatter as observed in 2007 was more prevalent than that observed in 2006, but still less than that observed during other recent survey years (Fig. 15). Its geographic distribution looked somewhat similar to that in 1999, although with far less backscatter observed on the easternmost survey transects.

Eastern Bering Sea shelf walleye pollock are a trans-boundary species, as their natural range in the Bering Sea crosses the U.S.-Russia border. During the past 15 years the AFSC EIT survey has been permitted to survey the Cape Navarin area of Russia three times: in 1994, 2004, and 2007. In 2002, the U.S. survey took place at the same time the Russian research vessel RV *TINRO* was also conducting an acoustic-trawl survey. The results of these surveys indicate that the distribution of walleye pollock backscatter in the Cape Navarin area has varied between years (Fig. 16). The proportion of walleye pollock biomass estimated in the Russian EEZ from near the surface to within 0.5 m of the bottom (Table 11) has ranged from 2% (in 2002) to 15% (in 1994) of the total U.S. and Russian Bering Sea shelf biomass. In 2007, the Russia EEZ contribution was 4%.

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Table 1. -- Simrad ER60 38 kHz acoustic system description and settings during the summer 2007 pollock echo integration-trawl survey of the Bering Sea shelf, and results from standard sphere acoustic system calibrations conducted before, during, and after the survey.

	Survey system settings	2-Jun Captain's Bay Alaska	21-Jun Captain's Bay Alaska	9-Jul Captain's Bay Alaska	29-Jul Captain'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:	21.90	--	--	--	--
2-way beam angle (dB):	-20.70	--	--	--	--
Gain (dB)	22.97	22.97	22.84	22.82	22.80
Sa correction (dB)	-0.60	-0.60	-0.63	-0.61	-0.41
S_v gain (dB)	22.37	22.37	22.21	22.21	22.39
3 dB beamwidth (deg)					
Along:	6.97	6.97	7.01	7.09	--
Athwart:	6.97	6.97	7.02	7.01	--
Angle offset (deg)					
Along:	-0.08	-0.08	-0.10	-0.10	--
Athwart:	-0.13	-0.13	-0.10	-0.11	--
Post-processing S_v threshold (dB):	-70	-70	-70	-70	-70
Measured standard sphere TS (dB)	--	-42.32	-42.44	-42.51	-42.56
Sphere range from transducer (m):	--	18.8	18.30	21.00	27.40
Absorption coefficient (dB/m):	0.009978	0.010001	0.009914	0.009955	0.009911
Sound velocity (m/s)	1470.0	1461.4	1466.40	1467.5	1469.7
Water temp at transducer (^oC):	2.0-10.9	3.6	5.7	5.8	7.5
Water temp at standard sphere (^oC):	--	3.4	3.9	4.0	4.0

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

Table 2. -- Trawl stations and catch data summary from the summer 2007 Bering Sea shelf walleye pollock echo integration-trawl survey aboard the NOAA ship *Oscar Dyson*.

Haul	Gear[1]	Date	Time	Duration	Start position				Depth (m)		Temp. (deg. C)		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)		Long. (W)		footrope	bottom	headrope	surface[2]	(kg)	number	(kg)
1	Methot	4-Jun	9:56	24	56	24.92	-161	43.3	26	78	1.7	4.4	--	--	14.2
2	Methot	6-Jun	0:39	16	56	9.76	-163	17.1	75	86	1.2	6.5	--	--	18.2
3	83-112	6-Jun	10:15	13	55	28.28	-163	51.53	90	90	2.6	5.3	181.1	137	681.4
4	AWT	6-Jun	16:47	25	55	16.85	-163	53.72	59	67	2.7	4.8	175.3	118	65.2
5	Methot	7-Jun	3:04	5	56	52.56	-164	2.92	47	71	0.2	5.2	--	--	3.7
6	AWT	7-Jun	9:03	19	56	33.22	-164	26.8	64	78	0.9	5.9	--	--	7.3
7	AWT	7-Jun	10:54	20	56	32.84	-164	27.29	61	79	0.6	5.8	--	--	10.9
8	AWT	7-Jun	12:46	30	56	37.24	-164	29.44	57	76	1.2	5.6	--	--	10.8
9	83-112	7-Jun	22:11	25	55	13.43	-164	25.96	93	98	3.1	5.3	2977.5	2785	304
10	AWT	8-Jun	6:45	15	54	55.97	-165	1.53	88	98	3.5	5.1	1509.6	1730	25.4
11	83-112	8-Jun	10:03	16	54	53.81	-165	1.26	91	93	3.7	4.7	75.5	74	313.9
12	Methot	8-Jun	23:36	24	56	25.01	-165	2.53	68	83	0.9	5.8	--	--	4.3
13	Methot	9-Jun	17:09	26	56	24.44	-165	37.48	28	89	1.1	5.3	--	--	4.4
14	83-112	10-Jun	1:35	8	55	8.31	-165	36.51	121	121	3.6	4.7	3073.4	3865	263.6
15	AWT	10-Jun	5:29	26	54	49.7	-165	35.63	142	157	3.6	4.5	427	604	--
16	Methot	10-Jun	17:19	31	54	34.91	-165	34.96	172	289	3.6	4.6	--	--	10.5
17	Methot	12-Jun	2:21	1	55	32.15	-166	11.59	22	126	4.3	5.1	--	--	0.7
18	Methot	12-Jun	2:54	8	55	32.14	-166	11.7	29	126	3.7	5.1	--	--	0.1
19	83-112	12-Jun	10:26	29	56	22.83	-166	15.15	95	99	2.7	4.5	98.9	100	73.1
20	AWT	12-Jun	13:47	60	56	22.32	-166	11.86	88	98	1.7	4.5	614	598	33.9
21	AWT	13-Jun	4:33	30	56	32.77	-166	50.76	96	101	1.9	4.8	1821.8	1816	28.2
22	AWT	13-Jun	23:33	46	54	38.16	-166	42.12	363	375	3.9	5.7	39.6	51	53
23	Methot	14-Jun	12:25	28	55	48.32	-167	26.11	31	136	4.3	5.1	--	--	36.4
24	AWT	14-Jun	22:23	54	56	30.15	-167	30.4	103	110	2.4	4.8	1757.2	2749	52.8
25	AWT	15-Jun	20:35	64	56	48.5	-168	8.52	90	97	1.8	4.9	575.1	588	20.7
26	AWT	16-Jun	1:46	17	56	25.35	-168	7.44	122	134	3.9	5.5	623.5	717	3
27	AWT-MOCC	16-Jun	10:49	4	55	22.12	-168	22.31	591	1376	--	6.7	--	--	0.4
28	AWT-MOCC	16-Jun	11:06	3	55	21.71	-168	23.82	733	1453	--	6.8	--	--	--
29	AWT-MOCC	16-Jun	11:22	2	55	21.4	-168	25.09	827	1497	--	6.9	--	--	18
30	AWT	16-Jun	19:17	57	55	46.69	-168	38.46	135	141	3.6	5.4	16.2	21	--
31	Methot	16-Jun	21:29	27	55	43.98	-168	37.14	93	140	3.6	5.6	--	--	2.7
32	AWT	17-Jun	2:45	23	56	28.05	-168	42.96	107	113	3.7	5.1	1250.1	1435	10.8
33	AWT	17-Jun	7:49	25	56	54.78	-168	45.91	73	85	2.1	4.6	867.9	862	13.6
34	AWT	18-Jun	9:30	40	56	46.45	-169	23	67	80	--	3.1	1097.5	1310	16.5
35	Methot	19-Jun	3:00	5	56	19.24	-170	31.89	29	119	--	4.6	--	--	--
36	Methot	19-Jun	3:29	25	56	20.09	-170	34.11	36	119	--	4.6	--	--	0.2

Table 2. -- Continued.

Haul no.	Gear[1] type	Date (GMT)	Time (GMT)	Duration (minutes)	Start position Lat. (N)		Long. (W)		Depth (m) footrope	bottom	Temp. (deg. C) headrope	surface[2]	Walleye pollock (kg)	number	Other (kg)
37	AWT	19-Jun	11:17	30	56	46.63	-170	37.06	95	107	--	6.0	869.3	1262	6.6
38	Methot	19-Jun	13:55	35	56	46.43	-170	36.72	23	107	4.0	4.4	--	--	4.7
39	83-112	19-Jun	16:28	31	56	47.12	-170	37.99	20	107	4.0	4.4	--	--	5
40	83-112	22-Jun	22:29	16	56	24.92	-169	56.31	102	102	3.3	3.6	2085.5	2365	112.5
41	83-112	25-Jun	5:39	12	56	28.09	-170	33.71	120	120	3.3	5.0	659.3	807	121.9
42	AWT	25-Jun	21:04	30	57	4.8	-171	16.72	97	104	2.3	5.0	1555.3	7745	4.7
43	AWT	28-Jun	2:07	5	57	29.94	-171	57.76	68	108	1.7	5.5	455.8	28927	8.5
44	83-112	28-Jun	3:40	10	57	26.03	-171	57.67	26	109	3.8	5.2	--	--	15.5
45	83-112	28-Jun	5:05	16	57	25.25	-171	58.49	109	109	1.6	5.5	1177	1553	166
46	83-112	28-Jun	8:46	25	57	4.7	-171	54.08	17	116	5.4	5.5	--	--	2.4
47	AWT	28-Jun	16:53	7	57	0.83	-171	52.9	80	115	2.4	5.5	647.7	33664	4
48	Methot	28-Jun	19:13	20	56	50.15	-171	51.7	91	117	2.7	5.6	--	--	0
49	Methot	28-Jun	20:26	20	56	50.14	-171	53.87	98	117	2.7	5.6	--	--	2.1
50	83-112	29-Jun	5:00	8	56	59.83	-172	29.43	122	122	2.7	5.5	645.4	614	211.6
51	AWT	29-Jun	9:51	40	57	22.58	-172	34.25	104	116	2.3	5.3	437.8	628	1.5
52	Methot	30-Jun	2:11	20	59	34.24	-173	4.61	89	97	0.4	4.6	--	--	2.6
53	Methot	30-Jun	16:30	15	60	47.61	-174	0.19	73	86	-1.6	5.5	--	--	11.2
54	Methot	30-Jun	17:58	10	60	48.38	-173	57.45	22	84	-0.8	5.5	--	--	3.6
55	Methot	1-Jul	0:57	20	59	37.09	-173	42.91	68	105	0.7	5.2	--	--	48.5
56	83-112	1-Jul	7:26	7	58	47.56	-173	30.81	119	123	2.5	6.1	76.2	149	29.5
57	AWT	1-Jul	11:17	25	58	48.5	-173	30.61	73	122	1.8	5.9	28.8	38	0.9
58	AWT	1-Jul	19:49	30	58	29.5	-173	26.89	82	120	--	6.6	3374	7266	2
59	83-112	2-Jul	0:39	17	58	5.49	-173	21.42	111	111	2.6	6.1	1558.4	2055	255.6
60	83-112	2-Jul	5:36	20	57	31.16	-173	14.62	131	131	3.2	6.5	885.5	1141	377.5
61	Methot	2-Jul	17:10	17	56	55.56	-173	5.33	129	135	3.4	6.2	--	--	1.2
62	83-112	3-Jul	7:04	23	58	12.27	-174	0.89	125	125	3.1	6.5	295.5	981	207.7
63	AWT	3-Jul	11:32	3	58	44.37	-174	8.87	134	139	2.9	7.2	439.7	568	--
64	AWT	3-Jul	22:02	62	59	5.69	-174	14.25	116	123	1.9	6.6	512.5	728	15
65	AWT	4-Jul	2:38	30	59	30.41	-174	20.52	113	118	1.6	6.6	421.7	619	42
66	Methot	4-Jul	17:42	15	61	6.96	-174	46.83	82	90	-1.5	6.9	--	--	1.4
67	Methot	4-Jul	23:02	16	61	5.31	-175	27.78	95	100	0.2	6.9	--	--	4.8
68	AWT	5-Jul	4:32	11	60	19	-175	14.37	101	111	0.8	7.2	1396.5	1859	29.5
69	AWT	5-Jul	11:10	6	60	9.19	-175	11.48	99	114	1.0	7.2	360.6	1371	11.7
70	AWT	5-Jul	16:31	0	60	8.37	-175	11.22	62	114	-0.3	7.1	114.4	179	11.7
71	AWT	5-Jul	17:46	9	60	8.82	-175	11.35	76	114	--	7.1	1542.2	2340	23.8
72	AWT	5-Jul	21:10	30	59	54.49	-175	7.15	106	119	1.2	7.2	366.8	660	31.4
73	83-112	6-Jul	1:10	10	59	32.84	-175	0.99	129	129	1.8	7.3	960	1720	760
74	83-112	6-Jul	5:58	10	58	52.86	-174	49.89	133	133	2.4	7.8	154.2	228	83.1

Table 2. -- Continued.

Haul	Gear[1]	Date	Time	Duration	Start position				Depth (m)		Temp. (deg. C)		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)		Long. (W)		footrope	bottom	headrope	surface[2]	(kg)	number	(kg)
75	83-112	6-Jul	23:17	15	58	32.8	-174	29.42	25	183	6.4	7.8	--	--	1
76	Methot	7-Jul	0:16	20	58	33.4	-174	29.09	14	184	7.3	7.7	--	--	1.4
77	AWT-MOCC	7-Jul	20:21	4	56	59.33	-171	51.96	85	115	2.7	8.2	237	10604	--
78	AWT-MOCC	7-Jul	20:27	2	56	59.06	-171	51.95	80	115	2.8	8.2	1.3	56	--
79	AWT-MOCC	7-Jul	20:30	2	56	58.91	-171	51.94	79	115	2.8	8.2	--	--	--
80	AWT-MOCC	7-Jul	22:12	2	56	58.95	-171	51.82	80	115	2.6	8.3	44.6	1881	--
81	AWT-MOCC	7-Jul	22:15	4	56	58.8	-171	51.81	77	115	2.6	8.3	1	41	2.3
82	AWT-MOCC	7-Jul	22:19	3	56	58.54	-171	51.8	76	115	2.5	8.3	0.7	30	--
83	AWT-MOCC	7-Jul	23:47	4	56	59.41	-171	52.31	91	115	2.7	8.6	11.1	442	--
84	AWT-MOCC	7-Jul	23:52	3	56	59.16	-171	52.34	87	115	2.7	8.6	22.9	1060	--
85	AWT-MOCC	7-Jul	23:56	3	56	58.95	-171	52.35	87	115	2.6	8.6	--	--	--
86	AWT-MOCC	8-Jul	1:48	5	56	59.71	-171	52.13	97	115	2.7	8.2	39	1225	0.6
87	AWT-MOCC	8-Jul	1:55	3	56	59.38	-171	52.05	96	115	2.6	8.2	0.1	4	1.9
88	AWT-MOCC	8-Jul	1:59	3	56	59.18	-171	52.01	95	115	2.6	8.2	42	1798	--
89	AWT	13-Jul	20:04	32	59	28.99	-175	39.92	133	137	2.0	8.5	1487.3	2626	10.7
90	AWT	14-Jul	0:08	15	59	47.38	-175	45.79	125	133	1.9	8.5	560.4	3830	0.5
91	AWT	14-Jul	4:00	5	60	6.95	-175	49.58	118	124	1.2	8.1	1203.3	3026	59.7
92	AWT	14-Jul	15:44	12	60	47.84	-176	4.84	107	116	0.9	8.6	1262.5	1919	8.5
93	Methot	15-Jul	8:33	19	61	35.33	-177	0.02	49	115	-1.7	8.8	--	--	4.9
94	AWT	15-Jul	17:04	13	61	15.29	-176	55.18	108	119	1.0	8.7	1952	3028	--
95	AWT	15-Jul	20:53	9	61	0.31	-176	48.86	111	120	1.1	8.8	1131.9	2444	15.6
96	AWT	16-Jul	2:03	15	60	19.4	-176	36.36	124	135	1.4	8.1	589.1	6110	1.5
97	AWT	16-Jul	5:08	30	60	11.27	-176	32.14	88	137	1.5	8.5	229.3	3698	7.7
98	AWT	16-Jul	9:59	11	59	45.26	-176	24.33	109	140	1.8	9.1	--	--	--
99	AWT	16-Jul	16:02	1	59	44.62	-176	24.47	116	140	1.8	9.0	399.1	7232	--
100	AWT	17-Jul	5:36	16	59	21.87	-176	56.11	141	147	2.2	9.7	78.5	132	--
101	AWT	17-Jul	18:09	20	59	58.36	-177	9.4	130	137	1.6	8.8	1523.8	2814	19.2
102	AWT	17-Jul	21:02	12	60	2.27	-177	10.62	79	137	1.6	8.9	419.5	3897	1.2
103	AWT	17-Jul	23:48	8	60	1.55	-177	10.29	104	137	1.7	8.9	310	2946	2.9
104	AWT	18-Jul	5:00	15	60	21.17	-176	36.59	129	134	1.3	9.2	564.2	1221	0.4
105	AWT	18-Jul	7:52	20	60	19.86	-176	36.43	125	135	1.3	8.8	493.9	1028	9.3
106	AWT	18-Jul	10:54	33	60	18.98	-176	36.49	125	136	1.3	8.8	510.4	1596	3.5
107	AWT	18-Jul	13:51	35	60	18.62	-176	36.52	121	135	1.3	8.9	622.3	3409	1.6
108	AWT	18-Jul	17:22	18	60	19.68	-176	36.71	118	135	1.3	8.7	977.5	5072	0.8
109	AWT	18-Jul	19:57	20	60	19.9	-176	36.8	131	135	1.3	8.8	300.5	2027	12
110	AWT	18-Jul	22:35	53	60	20.19	-176	36.13	126	135	1.3	8.8	496.4	2945	8.1
111	AWT	19-Jul	1:55	21	60	12.8	-176	46.37	130	141	1.3	8.7	687.1	3426	2

Table 2. -- Continued.

Haul	Gear[1]	Date	Time	Duration	Start position				Depth (m)		Temp. (deg. C)		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)		Long. (W)		footrope	bottom	headrope	surface[2]	(kg)	number	(kg)
112	AWT	19-Jul	6:55	5	60	23.16	-177	16.84	129	150	--	9.2	1298.4	4340	--
113	AWT	19-Jul	11:46	15	60	31.38	-177	23.31	135	153	1.4	8.8	223.2	696	13.2
114	Methot	19-Jul	15:03	20	60	32.16	-177	16.78	27	150	2.6	8.9	--	--	0.2
115	AWT	19-Jul	18:22	15	60	50.88	-177	28.47	123	135	1.3	8.2	453	1211	6
116	AWT	19-Jul	22:05	13	61	11.22	-177	35.35	126	138	1.1	8.4	612.8	3314	4.1
117	AWT	20-Jul	10:25	30	61	55.46	-178	36.07	108	123	0.4	8.0	120.1	154	29.7
118	AWT	20-Jul	17:41	1	61	32.11	-178	26.03	139	156	1.2	8.6	1725	31610	--
119	AWT	20-Jul	20:55	20	61	11.6	-178	17.48	142	158	--	8.7	606.3	13581	0.8
120	AWT	21-Jul	2:26	19	60	32.4	-178	2.24	147	156	1.9	8.9	225.1	410	0.6
121	Methot	21-Jul	6:51	30	60	16.1	-177	54.97	23	150	5.2	9.2	--	--	--
122	AWT	21-Jul	11:38	4	60	6.14	-177	50.88	129	144	1.5	9.1	8.6	32	2.7
123	AWT	21-Jul	13:38	9	60	8.45	-177	52.47	138	145	1.6	9.1	88.6	240	1.3
124	AWT	21-Jul	20:13	4	59	20.49	-177	34.62	227	242	2.8	9.5	992.7	1349	0.5
125	Methot	22-Jul	7:29	15	59	40.16	-178	21.68	173	181	2.6	9.4	0	--	11.9
126	AWT	22-Jul	11:05	25	59	52.07	-178	3.36	138	145	1.7	9.5	166.5	381	1.4
127	AWT	22-Jul	20:05	45	60	31.64	-178	43.19	224	236	2.7	9.2	557.9	918	3.2
128	AWT	23-Jul	4:13	30	61	39.21	-179	11.19	128	136	1.1	9.2	330	463	10.9
129	AWT	24-Jul	6:03	63	60	57.93	179	42.26	207	222	2.2	10.3	147.3	207	0.2
130	AWT	26-Jul	17:32	8	60	18.63	-176	37.73	124	136	1.7	10.7	125.1	340	0.4
131	AWT	27-Jul	0:02	13	59	43.69	-176	23.45	136	139	2.2	10.9	433.6	1446	1.9
132	AWT	27-Jul	3:06	11	59	43.89	-176	22.79	135	140	1.9	10.5	860.8	4815	7.8
133	AWT	27-Jul	5:58	21	59	43.99	-176	22.55	135	140	1.9	10.9	379.2	1670	0.4
134	AWT	27-Jul	9:22	8	59	43.19	-176	25.23	130	140	1.9	10.6	546.9	4540	0.5
135	AWT	27-Jul	12:01	6	59	43.49	-176	24.61	129	140	1.9	10.5	245.8	3932	2.2
136	AWT	27-Jul	14:02	10	59	43.66	-176	23.34	131	140	1.9	10.4	374.3	2489	2.3

[1]AWT = Aleutian wing trawl, AWT-MOCC = Aleutian wing trawl with multiple opening/closing codend, 83-112 = bottom trawl, Methot = Methot trawl
[2]Sea-Bird Electronics (SBE) temperature measured at 1 m depth unless headrope temp missing then surface temp recorded from shipboard sensor at 1.4 m depth. Haul 37 surface temp taken using bucket dip and thermometer reading.

Table 3. -- Catch by species from 54 of the 90 Aleutian wing trawl hauls conducted during the summer 2007 walleye pollock echo integration-trawl survey of the Bering Sea shelf. Catches from experimental trawls are not included.

Common name	Scientific name	Weight (kg)	Weight (%)	Number
walleye pollock	*Theragra chalcogramma*	41,171.8	98.3	198,852
northern sea nettle	*Chrysaora melanaster*	441.3	1.1	367
jellyfish and salp mix	Scyphozoa and Thaliacea (classes)	65.9	0.2	96
northern smoothtongue	*Leuroglossus schmidti*	41.3	0.1	5,143
Pacific cod	*Gadus macrocephalus*	39.0	<0.1	10
yellowfin sole	*Limanda aspera*	24.1	<0.1	59
flathead sole	*Hippoglossoides elassodon*	20.1	<0.1	40
smooth lumpsucker	*Aptocyclus ventricosus*	16.4	<0.1	6
Pacific herring	*Clupea pallasi*	7.6	<0.1	30
lanternfish unident.	Myctophidae (family)	6.6	<0.1	810
rock sole	*Lepidopsetta* sp.	5.1	<0.1	12
eulachon	*Thaleichthys pacificus*	3.8	<0.1	51
squid unident.	Cephalopoda (class)	3.7	<0.1	261
chinook salmon	*Oncorhynchus tshawytscha*	3.0	<0.1	1
Greenland turbot	*Reinhardtius hippoglossoides*	2.9	<0.1	1
Pacific ocean perch	*Sebastes alutus*	2.8	<0.1	2
arrowtooth flounder	*Atheresthes stomias*	2.0	<0.1	3
northern rock sole	*Lepidopsetta polyxystra*	2.0	<0.1	4
yellow Irish lord	*Hemilepidotus jordani*	1.5	<0.1	2
chum salmon	*Oncorhynchus keta*	1.5	<0.1	1
pandalid shrimp unident.	Pandalidae (family)	1.5	<0.1	454
lumpsucker unident.	Cyclopterinae (family)	1.4	<0.1	1
bigmouth sculpin	*Hemitripterus bolini*	1.2	<0.1	1
sturgeon poacher	*Podothecus acipenserinus*	0.7	<0.1	9
Pacific lamprey	*Lampetra tridentata*	0.5	<0.1	2
hydroid unident.	Hydrozoa (class)	0.4	<0.1	60
Alaska plaice	*Pleuronectes quadrituberculatus*	0.2	<0.1	1
fried egg jellyfish	*Phacellophora camtschatica*	0.2	<0.1	1
Aequorean hydrozoan	*Aequorea* sp.	0.0	<0.0	2
helmet jelly	*Periphylla periphylla*	<0.1	<0.1	10
polychaete worm unident.	Polychaeta (class)	<0.1	<0.1	1
nemertean worm unident.	Nemertea (phylum)	<0.1	<0.1	1
shrimp unident.	Decapoda (order)	<0.1	<0.1	92
Pacific viperfish	*Chauliodus macouni*	<0.1	<0.1	1
northern shrimp	*Pandalus borealis*	<0.1	<0.1	5
sea pen or sea whip unident.	Octocorallia (subclass)	<0.1	<0.1	1
Totals		41,869.2		206,393

Table 4. -- Catch by species from 19 bottom trawl hauls (83-112) conducted during the summer 2007 echo integration-trawl survey on the Bering Sea shelf.

Common name	Scientific name	Weight (kg)	Weight (%)	Number
walleye pollock	*Theragra chalcogramma*	14,903.4	78.9	18,574
arrowtooth flounder	*Atheresthes stomias*	882.4	4.7	2,318
flathead sole	*Hippoglossoides elassodon*	580.5	3.1	2,850
Pacific cod	*Gadus macrocephalus*	502.6	2.7	169
northern sea nettle	*Chrysaora melanaster*	377.1	2.0	270
basketstar	*Gorgonocephalus eucnemis* (prev *G. caryi*)	281.8	1.5	1,195
Alaska skate	*Bathyraja parmifera*	252.6	1.3	48
snow crab	*Chionoecetes opilio*	160.8	0.9	479
Pacific halibut	*Hippoglossus stenolepis*	133.7	0.7	31
Tanner crab	*Chionoecetes bairdi*	130.2	0.7	2,697
hermit crab unident.	Paguridae (family)	123.1	0.7	2,112
rock sole	*Lepidopsetta* sp.	117.9	0.6	419
bigmouth sculpin	*Hemitripterus bolini*	85.0	0.4	15
Bering skate	*Bathyraja interrupta*	82.2	0.4	17
snail unident.	Gastropoda (class)	71.0	0.4	904
big skate	*Raja binoculata*	60.4	0.3	12
yellowfin sole	*Limanda aspera*	30.6	0.2	56
sea anemone unident.	Actiniaria (order)	18.4	0.1	99
rex sole	*Glyptocephalus zachirus*	14.8	0.1	32
starfish unident.	Asteroidea (class)	11.9	0.1	157
Alaska plaice	*Pleuronectes quadrituberculatus*	9.8	0.1	11
Oregon triton	*Fusitriton oregonensis*	6.0	<0.1	103
Pacific herring	*Clupea pallasi*	5.4	<0.1	17
tentacle-shedding anemone	*Liponema brevicornis*	5.4	<0.1	43
yellow Irish lord	*Hemilepidotus jordani*	4.9	<0.1	8
great sculpin	*Myoxocephalus polyacanthocephalus*	4.5	<0.1	5
skate unident.	Rajidae (family)	4.1	<0.1	2
Okhotsk skate	*Bathyraja violacea*	2.9	<0.1	1
empty gastropod shells	Gastropoda (class)	2.6	<0.1	35
purple-orange sea star	*Asterias amurensis*	2.4	<0.1	22
soft coral unident.	*Anthomastus* sp.	2.4	<0.1	44
sea urchin unident.	Echinoidia (class)	1.7	<0.1	14
spinyhead sculpin	*Dasycottus setiger*	1.6	<0.1	9
Aequorean hydrozoan	*Aequorea* sp.	1.5	<0.1	8
sponge unident.	Porifera (phylum)	1.4	<0.1	39
lyre crab unident.	*Hyas* sp.	1.3	<0.1	27
sturgeon poacher	*Podothecus acipenserinus*	1.3	<0.1	20
whelk unident.	*Neptunea* sp.	1.2	<0.1	10
shortfin eelpout	*Lycodes brevipes*	1.1	<0.1	19

Table 4.--Continued.

Common name	Scientific name	Weight (kg)	Weight (%)	Number
searcher	*Bathymaster signatus*	0.8	<0.1	10
sea pen or sea whip unident.	Octocorallia (subclass)	0.8	<0.1	6
snail eggs	Gastropoda (class)	0.8	<0.1	16
jellyfish unident.	Scyphozoa (class)	0.7	<0.1	50
lyre whelk	*Neptunea lyrata*	0.7	<0.1	8
whelk unident.	*Volutopsius* sp.	0.6	<0.1	4
pandalid shrimp unident.	Pandalidae (family)	0.5	<0.1	135
roughspine sculpin	*Triglops macellus*	0.4	<0.1	12
redbanded sea star	*Orthasterias koehleri*	0.4	<0.1	1
shrimp unident.	Decapoda (order)	0.3	<0.1	47
nudibranch unident.	Nudibranchia (order)	0.2	<0.1	1
Actinostolid sea anemone	Actinostolidae (family)	0.2	<0.1	12
mud star	*Ctenodiscus crispatus*	<0.1	<0.1	19
Greenland cockle	*Serripes groenlandicus*	<0.1	<0.1	1
hydroid unident.	Hydrozoa (class)	<0.1	<0.1	9
sawback poacher	*Leptagonus frenatus*	<0.1	<0.1	1
sea mouse	*Aphrodita negligens*	<0.1	<0.1	1
eulachon	*Thaleichthys pacificus*	<0.1	<0.1	1
Pacific lyre crab	*Hyas lyratus*	<0.1	<0.1	1
whelk unident.	Buccinidae (family)	<0.1	<0.1	4
bristle worm unident.	Polychaeta (class)	<0.1	<0.1	8
Oregon rock crab	*Cancer oregonensis*	<0.1	<0.1	8
northern shrimp	*Pandalus borealis*	<0.1	<0.1	8
scale worm unident.	Polynoidae (family)	<0.1	<0.1	1
brittlestar unident.	Ophiuroidea (class)	<0.1	<0.1	1
Totals		18,888.2	100	33,256

Table 5. -- Catch by species from 27 Methot trawl hauls conducted during the summer 2007 walleye pollock echo integration-trawl survey on the Bering Sea shelf.

Common name	Scientific name	Weight (kg)	Weight (%)	Number
euphausiid unident.	Euphausiidae (family)	95.3	49.3	1,135,101
northern sea nettle	*Chrysaora melanaster*	94.4	48.8	163
Aequorean hydrozoan	*Aequorea* sp.	1.4	0.7	8
hydroid unident.	Hydrozoa (class)	0.9	0.4	113
jellyfish unident.	Scyphozoa (class)	0.7	0.3	28
Pacific lamprey	*Lampetra tridentata*	0.2	0.1	1
crab unident.	Decapoda (order)	0.2	<0.1	115,500
amphipod unident.	amphipoda (order)	0.2	<0.1	1,860
copepod unident.	Copepoda (subclass)	0.1	<0.1	17,681
moon jelly	*Aurelia* sp.	<0.1	<0.1	3
arrowtooth flounder	*Atheresthes stomias*	<0.1	<0.1	1
brittlestar unident.	Ophiuroidea (class)	<0.1	<0.1	4
isopod unident.	Isopoda (order)	<0.1	<0.1	26
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	101
salps unident.	Thaliacea (class)	<0.1	<0.1	2
flatfish larvae	Pleuronectiformes (order)	<0.1	<0.1	1
walleye pollock (age-0)	*Theragra chalcogramma*	<0.1	<0.1	7
sculpin unident.	Cottidae (family)	<0.1	<0.1	3
Totals		193.5		1,270,603

Table 6. -- Numbers of fish measured and biological samples collected or observed during the summer 2007 echo integration-trawl survey of walleye pollock on the Bering Sea shelf.

Haul	Pollock				*Chrysaora melanaster*	TINRO	Seabird
no.	Length	Weight	Maturity	Otoliths	bell diameter	collection[1]	observations[2]
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	137	34	34	34	-	-	-
4	118	118	118	35	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	x
7	-	-	-	-	-	-	x
8	-	-	-	-	-	-	-
9	407	41	41	41	-	50	-
10	358	39	39	39	-	-	-
11	74	-	-	-	-	-	x
12	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-
14	407	63	63	63	-	-	x
15	389	64	64	64	-	-	x
16	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-
19	100	47	47	47	20	50	x
20	324	67	67	67	-	50	x
21	359	53	53	53	-	50	x
22	51	51	51	51	-	50	x
23	-	-	-	-	-	-	-
24	540	90	90	63	-	50	x
25	426	62	62	50	-	-	x
26	390	65	65	50	-	-	-
27	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-
30	21	-	-	-	-	-	x
31	-	-	-	-	-	-	x
32	481	70	70	52	-	50	x
33	293	58	58	50	-	-	x
34	399	104	104	60	-	50	-
35	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-
37	447	80	80	80	-	50	x
38	-	-	-	-	5	-	-
39	-	-	-	-	8	-	x
40	218	56	56	52	-	50	-
41	417	72	72	55	-	50	x
42	407	67	67	60	-	50	x
43	85	85	85	10	-	-	x
44	-	-	-	-	-	-	x
45	460	107	107	59	-	50	x
46	-	-	-	-	-	-	x
47	76	28	28	28	-	50	-
48	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-
50	352	51	51	51	-	-	x
51	348	75	75	54	-	50	-
52	-	-	-	-	-	-	x
53	-	-	-	-	-	-	-

Table 6. -- Continued.

Haul no.	Pollock Length	Weight	Maturity	Otoliths	*Chrysaora melanaster* bell diameter	TINRO collection[1]	Seabird observations
54	-	-	-	-	-	-	-
55	-	-	-	-	26	-	-
56	149	112	112	70	-	-	-
57	38	38	38	-	-	-	-
58	342	53	53	53	-	50	-
59	353	70	70	61	-	-	-
60	415	83	83	59	-	-	-
61	-	-	-	-	-	-	-
62	403	116	116	59	-	-	-
63	195	32	32	32	-	-	x
64	376	62	62	50	-	50	-
65	386	55	55	50	-	-	-
66	-	-	-	-	-	-	-
67	-	-	-	-	-	-	-
68	376	41	41	35	-	-	-
69	449	49	49	45	-	-	-
70	179	-	-	-	-	-	-
71	319	41	41	-	-	-	x
72	346	45	45	35	-	50	x
73	508	135	135	64	-	-	-
74	228	45	45	45	-	-	-
75	-	-	-	-	-	-	-
76	-	-	-	-	-	-	-
77	78	-	-	-	-	-	x
78	56	-	-	-	-	-	-
79	-	-	-	-	-	-	-
80	53	-	-	-	-	-	-
81	41	-	-	-	-	-	-
82	30	-	-	-	-	-	-
83	112	-	-	-	-	-	-
84	109	-	-	-	-	-	-
85	-	-	-	-	-	-	-
86	96	-	-	-	-	-	-
87	4	-	-	-	-	-	-
88	137	-	-	-	-	-	-
89	325	107	107	50	-	50	x
90	428	30	30	30	-	-	-
91	458	39	39	39	-	-	x
92	331	105	105	51	-	-	x
93	-	-	-	-	-	-	-
94	350	105	105	51	-	-	x
95	532	152	152	50	-	50	x
96	538	73	73	55	-	-	x
97	239	37	37	37	-	-	x
98	-	-	-	-	-	-	-
99	587	174	174	90	-	-	x
100	132	52	52	52	-	-	-
101	454	122	122	60	-	-	x
102	257	61	61	30	-	50	x
103	223	-	-	-	-	-	-
104	313	-	-	-	-	-	-
105	232	-	-	-	-	-	-
106	571	-	-	-	-	-	-
107	585	-	-	-	-	-	-

Table 6. -- Continued.

Haul no.	Pollock Length	Weight	Maturity	Otoliths	*Chrysaora melanaster* bell diameter	TINRO collection[1]	Seabird observations
108	542	-	-	-	-	-	-
109	526	-	-	-	-	-	-
110	494	-	-	-	-	-	-
111	669	-	-	-	-	-	-
112	460	111	111	63	-	-	-
113	274	-	-	-	-	-	-
114	-	-	-	-	-	-	-
115	470	138	138	62	-	-	-
116	511	126	129	60	-	-	-
117	154	79	79	79	-	-	-
118	423	140	140	81	-	50	-
119	452	149	149	80	-	-	-
120	346	101	101	49	-	-	-
121	-	-	-	-	-	-	-
122	32	-	-	-	-	-	-
123	240	26	26	26	-	-	-
124	241	48	48	26	-	-	x
125	-	-	-	-	-	-	-
126	381	-	-	-	-	-	-
127	310	105	105	25	-	-	x
128	325	95	95	94	-	-	-
129	207	87	87	64	-	-	-
130	340	-	-	-	-	-	x
131	454	-	-	-	-	-	-
132	585	-	-	-	-	-	-
133	287	-	-	-	-	-	-
134	449	-	-	-	-	-	-
135	528	-	-	-	-	-	-
136	283	-	-	-	-	-	-
Totals	30,400	4,886	4,889	3,230	59	1,100	42 sites

[1]TINRO center biological sampling included pollock length, weight, sex, maturity, stomach contents, and scales.

[2]"x" indicates that observations were made.

Table 7. -- Numbers-at-length estimates (millions) of walleye pollock between near surface and 3 m off bottom from echo integration-trawl surveys in the U.S. EEZ, 1994-2007.

Length (cm)	**1994**	**1996**	**1997**	**1999**	**2000**	**2002**	**2004**	**2006**	**2007**
0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0.03	0	0	0	0
9	0	0	0	0.01	0.03	0	0	0	0
10	0	0	2.04	0.12	0.76	0.01	0.24	0	30.12
11	0.40	0	0.19	4.78	2.30	0.77	0.20	5.29	259.94
12	5.44	0.47	30.13	14.43	5.50	4.70	2.56	59.83	662.11
13	44.79	5.44	238.10	22.71	19.26	21.36	2.38	144.42	1329.33
14	94.23	38.20	1416.21	22.35	36.70	100.48	4.08	117.62	1497.63
15	179.82	131.29	2949.25	16.20	56.69	194.98	1.84	84.56	803.62
16	166.05	227.77	3364.00	5.20	79.57	178.72	1.80	27.81	563.27
17	105.16	317.31	2207.83	5.20	50.81	99.74	1.76	10.15	304.17
18	129.71	215.26	1309.13	12.92	22.39	33.47	1.12	2.90	114.52
19	212.54	115.39	569.51	44.60	30.27	40.07	4.34	4.73	133.95
20	381.96	64.79	181.06	152.57	47.16	61.90	8.40	10.85	117.76
21	589.69	37.20	74.90	251.49	92.37	162.63	23.15	17.43	145.33
22	794.28	64.41	81.07	314.31	136.41	289.69	34.90	31.71	147.44
23	788.35	60.24	150.80	288.90	185.76	485.72	47.06	37.50	129.53
24	772.58	70.32	255.93	220.31	186.04	734.73	48.21	33.77	142.76
25	581.45	47.68	408.07	164.37	207.95	859.82	39.35	30.25	91.73
26	372.26	38.32	458.83	188.58	186.91	832.36	32.49	24.95	65.22
27	198.97	33.63	519.67	256.04	187.68	718.04	25.99	21.77	49.83
28	122.07	60.16	422.68	302.47	168.93	516.42	29.43	25.52	32.98
29	135.90	85.07	296.50	419.16	164.76	491.26	69.82	29.78	21.87
30	138.25	122.81	175.36	435.28	167.17	507.57	90.09	35.24	18.40
31	178.83	183.98	115.83	417.13	169.72	592.86	148.82	42.19	16.21
32	234.80	240.98	79.12	410.19	167.23	539.68	151.19	45.36	35.23
33	239.39	341.56	69.15	372.65	188.70	533.40	180.25	51.47	46.64
34	291.50	408.41	68.83	393.58	221.59	421.17	185.43	68.74	61.27
35	296.57	458.38	89.48	415.94	332.90	291.90	237.90	82.66	74.85
36	326.66	477.95	146.28	433.11	360.41	239.36	302.68	111.93	64.09
37	343.99	400.98	220.62	393.54	414.22	218.57	430.24	118.70	79.64
38	305.79	333.42	321.35	403.47	369.24	222.31	476.40	124.99	75.28
39	294.82	253.70	397.12	359.07	344.63	218.51	539.43	118.56	83.27
40	311.31	214.24	397.83	304.48	297.14	209.21	499.73	126.41	106.70

Table 7. -- Continued.

Length cm	1994	1996	1997	1999	2000	2002	2004	2006	2007
41	271.09	168.18	350.37	243.06	331.55	200.43	511.11	140.54	113.05
42	289.53	154.99	292.97	240.38	316.41	179.46	475.59	154.29	141.30
43	273.09	149.27	222.05	265.33	331.24	186.32	453.93	163.58	191.31
44	243.93	133.46	172.49	321.32	302.44	185.26	388.07	178.01	189.44
45	256.58	117.96	125.08	328.57	290.08	197.15	339.54	170.87	210.76
46	216.09	103.48	93.20	304.97	249.82	183.59	247.30	158.64	213.99
47	177.93	98.39	74.75	238.84	235.52	182.87	196.13	146.34	185.68
48	148.15	94.29	59.37	182.91	176.81	168.36	150.84	130.84	150.01
49	73.11	83.67	45.51	122.90	143.24	154.43	113.57	105.90	128.80
50	66.74	79.87	40.23	88.16	106.27	133.48	78.29	88.25	101.90
51	33.15	72.52	33.10	60.42	78.54	117.74	64.53	73.93	73.22
52	30.35	60.21	31.72	42.15	48.15	91.92	56.33	62.45	52.96
53	18.15	50.89	29.59	33.02	35.75	88.43	41.08	45.82	41.04
54	15.68	38.44	23.91	26.90	22.09	62.98	30.20	35.31	32.46
55	18.57	25.63	19.77	16.14	16.58	44.34	19.12	23.01	23.25
56	11.05	14.07	14.58	9.26	12.58	40.16	14.43	19.33	16.43
57	9.52	7.65	10.61	9.40	8.92	24.16	8.83	14.93	13.02
58	4.85	7.68	8.60	5.68	6.41	18.77	5.83	10.63	7.51
59	2.96	3.02	5.98	3.24	5.13	11.26	6.16	8.11	4.76
60	3.47	4.71	3.45	3.04	1.87	10.58	4.00	5.39	3.72
61	6.63	2.88	4.58	2.40	2.30	7.11	2.89	4.60	1.86
62	1.39	1.79	1.55	2.12	1.72	3.92	1.95	2.07	1.13
63	0.71	0.28	2.01	0.62	1.57	2.18	2.07	1.17	1.09
64	0.49	0.59	0.47	0.57	0.98	1.74	0.08	1.98	1.06
65	1.86	0.85	0.81	0.93	0.64	1.74	0.30	0.73	0.48
66	0.77	0.35	0.32	1.42	0.70	1.16	0.55	0.85	0.60
67	0.97	0.66	1.27	0.48	0.03	0.27	0.35	0.27	0.35
68	1.46	0	0.19	0.30	0.27	0.17	0.19	0.02	0.21
69	0	0	0.59	0.29	0.59	0	0	0.00	0.02
70	1.93	0	0.10	0	0	0.43	0	0.02	0.30
71	0.49	0.11	0	<0.01	0	0.01	0	0.14	0.21
72	0.97	0	0	0.11	0.15	0	0	0.46	0
73	0.49	0	0.05	0.16	0	0	0	0.02	0
74	0	0	0	0	0.14	0	0	0	0.06
75	0	0	0	0.04	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0
78	0.49	0	0	0	0	0	0	0	0
79	0	0	0	0.39	0	0	0	0.08	0
80	0	0	0	0	0	0	0	0	0
Total	10,821	6,525	18,686	9,601	7,630	12,122	6,835	3,396	9,207

Table 8. -- Biomass-at-length estimates (metric tons) of walleye pollock between near surface and 3 m off bottom on the Bering Sea shelf from echo integration-trawl surveys in the U.S. EEZ, 1994-2007.

Length (cm)	**1994**	**1996**	**1997**	**1999**	**2000**	**2002**	**2004**	**2006**	**2007**
0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	<1	0	0	0	0
9	0	0	0	<1	<1	0	0	0	0
10	0	0	14	1	8	0	2	0	200
11	4	0	2	59	30	9	2	54	2,469
12	71	6	394	227	88	75	30	762	7,313
13	744	92	4,148	445	370	428	36	2,366	19,068
14	1,937	804	31,282	538	859	2,488	81	2,176	25,781
15	4,520	3,384	81,544	472	1,613	5,841	48	1,997	17,771
16	5,040	7,098	111,182	181	2,713	6,393	57	815	14,870
17	3,817	11,818	84,460	214	2,055	4,231	67	365	9,873
18	5,553	9,485	58,223	623	1,064	1,664	50	123	4,401
19	10,655	5,960	28,768	2,499	1,677	2,284	210	235	6,200
20	22,244	3,892	10,677	9,852	3,017	4,072	498	626	6,392
21	39,601	2,579	4,900	18,587	6,782	12,242	1,595	1,133	9,810
22	61,100	5,121	6,101	26,421	11,419	24,828	2,730	2,413	11,643
23	69,048	5,458	12,962	27,464	17,629	47,351	4,265	3,277	11,513
24	76,622	7,221	24,999	23,562	19,911	81,309	4,887	3,259	14,551
25	64,967	5,520	45,081	19,681	24,970	107,760	4,475	3,176	10,266
26	46,652	4,979	56,998	25,168	25,070	117,666	4,347	3,107	8,010
27	27,847	4,884	72,339	37,933	28,002	113,478	3,876	2,946	6,844
28	19,028	9,721	65,700	49,557	27,927	89,827	4,813	3,917	5,073
29	23,550	15,240	51,328	75,679	30,072	92,941	12,745	5,050	3,697
30	26,437	24,307	33,691	86,321	33,574	104,158	17,942	6,561	3,462
31	37,756	40,104	24,685	90,579	37,396	132,640	32,663	9,236	3,428
32	54,180	57,669	18,522	97,251	40,301	131,538	36,257	10,767	8,606
33	60,378	89,480	17,709	96,204	49,614	141,718	48,265	13,252	12,233
34	80,001	116,812	19,201	110,357	63,403	122,045	53,459	19,248	17,643
35	88,546	142,771	27,148	126,368	103,387	92,414	74,135	25,252	23,484
36	105,903	161,724	48,272	142,256	121,237	82,291	103,401	36,989	21,662
37	120,806	147,067	79,075	139,441	150,552	81,503	156,813	41,377	29,517
38	116,110	132,264	124,841	153,908	144,826	88,680	188,084	47,836	30,240
39	121,143	108,629	166,999	147,178	145,465	93,405	229,225	49,056	35,953
40	137,651	98,825	180,668	133,859	135,080	95,675	230,733	55,427	48,709

Table 8. -- Continued.

Length cm	1994	1996	1997	1999	2000	2002	2004	2006	2007
41	129,335	83,422	171,750	114,415	161,884	98,165	252,339	65,790	54,826
42	149,294	82,523	154,670	120,957	165,982	94,168	253,443	78,528	72,602
43	152,526	85,177	125,886	142,492	185,961	104,975	261,967	87,505	105,904
44	147,017	81,478	104,750	183,897	181,482	110,994	239,860	102,839	111,390
45	166,444	76,937	81,320	200,114	185,345	125,772	222,131	103,984	131,381
46	149,720	71,999	64,736	197,389	169,854	124,740	171,216	102,312	143,460
47	131,130	72,930	55,323	164,067	170,024	132,267	142,845	100,258	131,598
48	115,921	74,352	46,750	133,183	135,575	129,623	115,709	94,693	112,575
49	60,566	70,102	38,100	94,742	116,332	126,481	92,215	81,175	101,538
50	58,531	71,016	35,728	71,872	91,389	115,778	67,512	73,481	85,481
51	30,462	68,346	31,145	52,026	71,352	108,641	58,478	63,585	64,652
52	29,789	60,080	31,560	38,303	46,186	89,753	53,394	56,209	49,596
53	18,463	53,710	31,087	31,630	36,163	91,552	41,489	44,479	39,922
54	16,856	42,859	26,500	27,130	23,496	68,832	31,998	36,086	34,719
55	21,296	30,163	23,075	17,129	18,562	51,122	21,285	25,029	26,503
56	13,207	17,456	17,914	10,327	14,788	48,961	17,136	21,089	19,415
57	11,943	9,998	13,712	11,013	11,004	30,986	11,453	17,519	16,742
58	6,368	10,573	11,671	6,984	8,300	25,335	7,517	13,507	9,953
59	4,167	4,365	8,530	4,174	6,962	15,953	8,825	10,892	6,815
60	5,001	7,163	5,155	4,104	2,656	15,550	6,038	7,784	5,687
61	10,199	4,591	7,172	3,394	3,421	11,003	4,574	6,869	2,990
62	2,285	2,998	2,550	3,135	2,679	6,415	3,214	3,241	1,874
63	1,196	498	3,448	953	2,551	3,683	3,585	1,937	1,934
64	844	1,084	843	925	1,660	3,109	139	3,360	1,958
65	3,382	1,637	1,531	1,562	1,122	3,223	562	1,314	928
66	1,467	704	617	2,497	1,296	2,202	1,097	1,587	1,212
67	1,929	1,386	2,622	876	52	505	717	519	734
68	3,021	0	413	567	551	352	406	46	464
69	0	0	1,351	585	1,244	0	0	0	45
70	4,349	0	230	0	0	945	0	51	720
71	1,142	267	0	3	0	33	0	322	538
72	2,380	0	0	238	351	0	0	1,084	0
73	1,239	0	126	362	0	0	0	57	0
74	0	0	0	0	362	0	0	0	181
75	1,340	0	0	90	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0
78	1,503	0	0	0	0	0	0	0	0
79	0	0	0	1,118	0	0	0	253	0
80	0	0	0	0	0	0	0	0	0
Total	2,886,223	2,310,728	2,592,178	3,285,138	3,048,697	3,622,072	3,306,935	1,560,182	1,769,019

Table 9. -- Walleye pollock abundance by area from summer echo integration-trawl surveys on the U.S. EEZ portion of the of the Bering Sea shelf, 1994-2007. Data are estimated pollock biomass between near surface and 3 m off bottom. Relative estimation error for the biomass is indicated.

Date		**Area** (nmi)^2	**Biomass (million metric tons, top) and percent of total (bottom)** **SCA**	**E170-SCA**	**W170**	**Total Biomass (million metric tons)**	**Relative estimation error**
1994	9 Jul-19 Aug	78,251	0.312	0.399	2.176	2.886	0.047
			10.8	13.8	75.4		
1996	20 Jul-30 Aug	93,810	0.215	0.269	1.826	2.311	0.039
			9.3	11.7	79.0		
1997	17 Jul-4 Sept	102,770	0.246	0.527	1.818	2.591	0.037
			9.5	20.3	70.2		
1999	7 Jun-5 Aug	103,670	0.299	0.579	2.408	3.290	0.055
			9.1	17.6	73.2		
2000	7 Jun-2 Aug	106,140	0.393	0.498	2.158	3.049	0.032
			12.9	16.3	70.8		
2002	4 Jun -30 Jul	99,526	0.647	0.797	2.178	3.622	0.031
			17.9	22.0	60.1		
2004	4 Jun -29 Jul	99,659	0.498	0.516	2.293	3.307	0.037
			15.1	15.6	69.3		
2006	3 Jun -25 Jul	89,550	0.131	0.254	1.175	1.560	0.039
			8.4	16.3	75.3		
2007	2 Jun -30 Jul	92,944	0.0837	0.168	1.517	1.769	0.045
			4.7	9.5	85.8		

SCA = Sea lion Conservation Area
E170 - SCA = East of 170°W minus SCA
W170 = West of 170°W

Table 10. Estimated numbers-at-age (millions, top) and biomass-at-age (thousand metric tons, bottom) for walleye pollock observed between near surface and 3 m off bottom in the U.S. EEZ from summer Bering Sea shelf echo integration-trawl surveys 1994-2007.

Age	1994	1996	1997	1999	2000	2002	2004	2006	2007
1	610.2	972.3	12,360.0	111.9	257.9	634.8	15.8	455.6	5588.5
2	4,781.1	446.4	2,745.2	1,587.6	1,272.3	4,850.4	275.1	208.6	1026.2
3	1,336.0	520.4	386.2	3,597.0	1,184.9	3,295.1	1,189.3	282.0	319.7
4	1,655.7	2,686.5	490.9	1,683.6	2,480.0	1,155.0	2,933.9	610.1	430.1
5	1,898.1	820.7	1,921.5	582.6	899.7	507.2	1,442.1	695.3	669.2
6	296.1	509.3	384.4	273.9	243.9	756.8	416.6	551.8	588.8
7	71.2	434.4	205.2	1,169.1	234.0	436.7	199.2	319.7	305.7
8	65.2	84.9	142.5	400.2	725.1	91.4	194.0	110.1	166.2
9	31.9	16.7	32.7	104.6	190.4	110.3	68.3	53.0	60.2
10	23.2	6.3	3.9	66.9	84.7	205.4	33.5	40.3	18.8
11	8.5	5.7	4.9	14.5	35.6	52.1	24.8	23.3	20.2
12	19.3	12.1	2.0	6.5	18.1	17.9	19.8	16.2	5.7
13	4.8	1.3	2.2	1.7	1.2	3.1	12.1	8.6	1.7
14	5.7	4.8	2.3	0.0	1.4	5.9	5.8	9.9	2.1
15	1.2	2.4	2.0	0.1	0.1	0.0	4.3	5.0	1.8
16	7.9	0.5	0.0	0.1	0.3	0.0	0.0	3.8	0.2
17	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1
18	0.0	0.5	0.0	0.4	0.1	0.0	0.0	0.1	0.0
19	0.7	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.6
20	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
21+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Total	10,821	6,525	18,686	9,601	7,630	12,122	6,834	3,396	9,207

Age	1994	1996	1997	1999	2000	2002	2004	2006	2007
1	17.1	36.7	417.8	3.3	8.1	21.2	0.4	8.8	103.4
2	425.3	35.3	369.9	156.6	144.0	645.1	31.6	21.2	89.5
3	312.4	118.7	99.5	847.4	284.6	843.7	329.3	68.8	89.3
4	641.3	888.8	188.6	640.2	974.4	458.2	1349.4	230.7	188.0
5	1,067.2	396.0	921.0	271.7	488.6	286.0	820.9	366.4	389.8
6	187.2	341.8	235.0	164.3	156.0	514.5	288.7	359.8	404.3
7	50.1	359.9	161.3	751.5	166.6	351.6	153.0	244.1	240.9
8	55.3	72.5	139.5	278.9	540.8	85.6	166.3	93.2	144.8
9	30.9	16.3	34.2	84.6	149.0	111.0	62.4	49.5	58.4
10	26.4	6.6	4.4	62.5	76.3	212.5	33.1	39.2	20.7
11	10.5	6.9	6.1	14.2	39.0	59.6	25.3	23.3	22.3
12	27.9	17.1	3.4	7.2	16.7	19.7	21.9	18.7	7.1
13	6.7	1.5	4.5	1.5	1.3	4.6	12.7	10.4	2.1
14	7.7	7.0	3.8	0.0	2.6	8.5	6.2	12.7	3.7
15	2.1	3.8	2.9	0.2	0.1	0.0	5.7	5.9	2.2
16	12.5	0.9	0.0	0.2	0.3	0.0	0.0	4.3	0.3
17	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2
18	0.0	0.9	0.0	0.7	0.3	0.0	0.0	0.3	0.0
19	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.5	1.0
20	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
21+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Total	2,886	2,311	2,592	3,285	3,049	3,622	3,307	1,560	1,769

Table 11. -- Estimated numbers and biomass of walleye pollock observed between near the surface and 0.5 m off bottom from Bering Sea echo integration-trawl surveys in the U.S. and Cape Navarin area of Russia.

Year	Region	Numbers (billions)	Biomass (million metric tons)	% Biomass	Survey Nation	Area (nmi^2)
2007	U.S. EEZ	10.24	2.40	96	U.S.	92,944
	Russia EEZ (Cape Navarin)	1.09	0.11	4	U.S.	12,460
	Total	11.33	2.51			
2004	U.S. EEZ	7.95	4.03	91	U.S.	99,659
	Russia EEZ (Cape Navarin)	1.55	0.40	9	U.S.	7,870
	Total	9.51	4.43			
2002	U.S. EEZ	13.81	4.53	98	U.S.	99,526
	Russia EEZ (Cape Navarin)	0.75	0.08	2	Russia	32,270
	Total	14.56	4.61			
1994	U.S. EEZ	12.60	3.72	85	U.S.	78,250
	Russia EEZ (Cape Navarin)	2.77	0.65	15	U.S.	18,460
	Total	15.37	4.37			

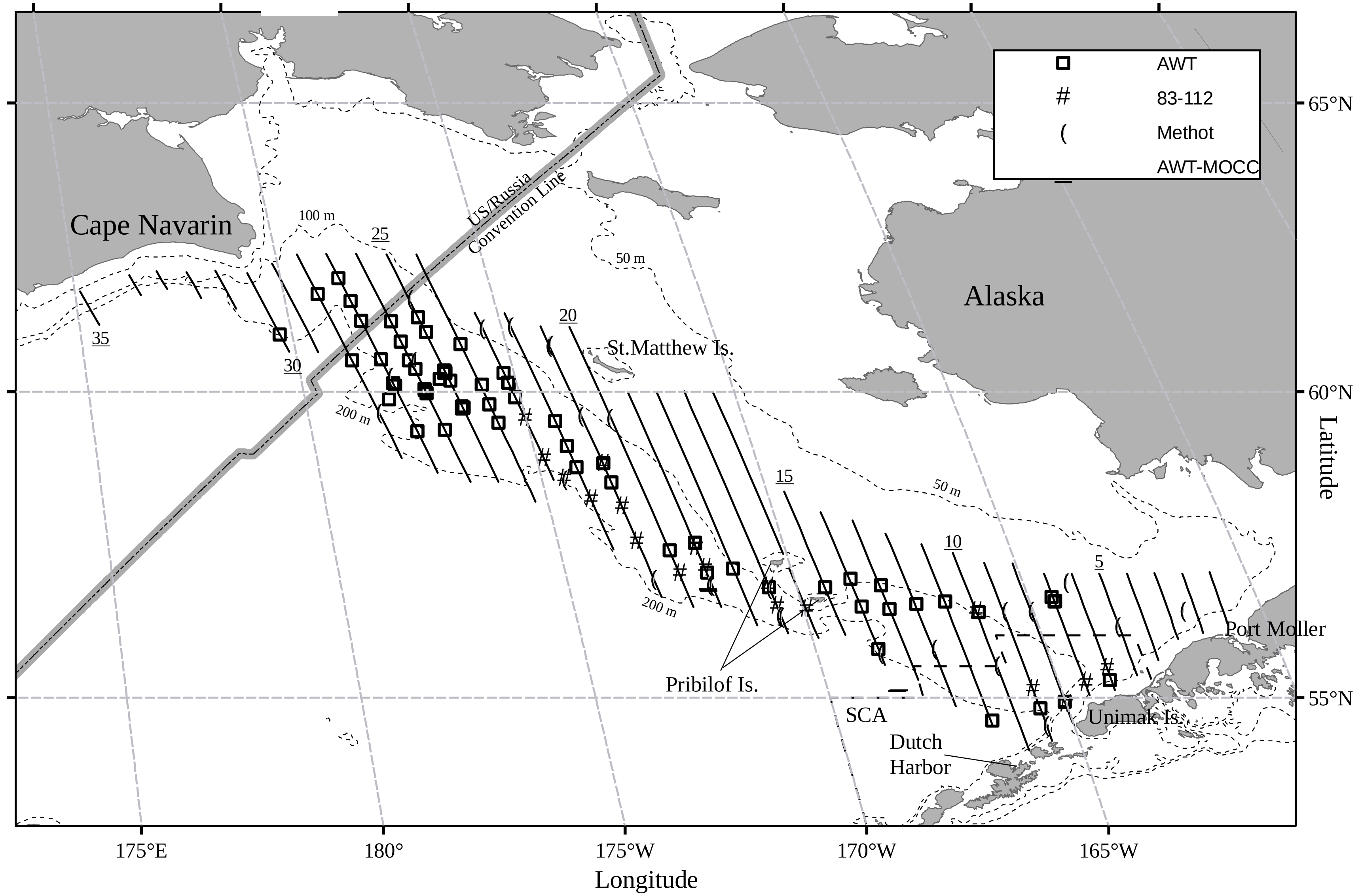


Figure 1. -- Transect lines with locations of midwater (Aleutian wing trawl (AWT), AWT-Multiple Open/Close Codend (AWT-MOCC) and Methot trawls) and bottom trawl (83-112) hauls during the summer 2007 echo integration-trawl survey of walleye pollock on the Bering Sea shelf. Transect numbers are underlined and the Steller sea lion Conservation Area (SCA) is outlined (dashed line).

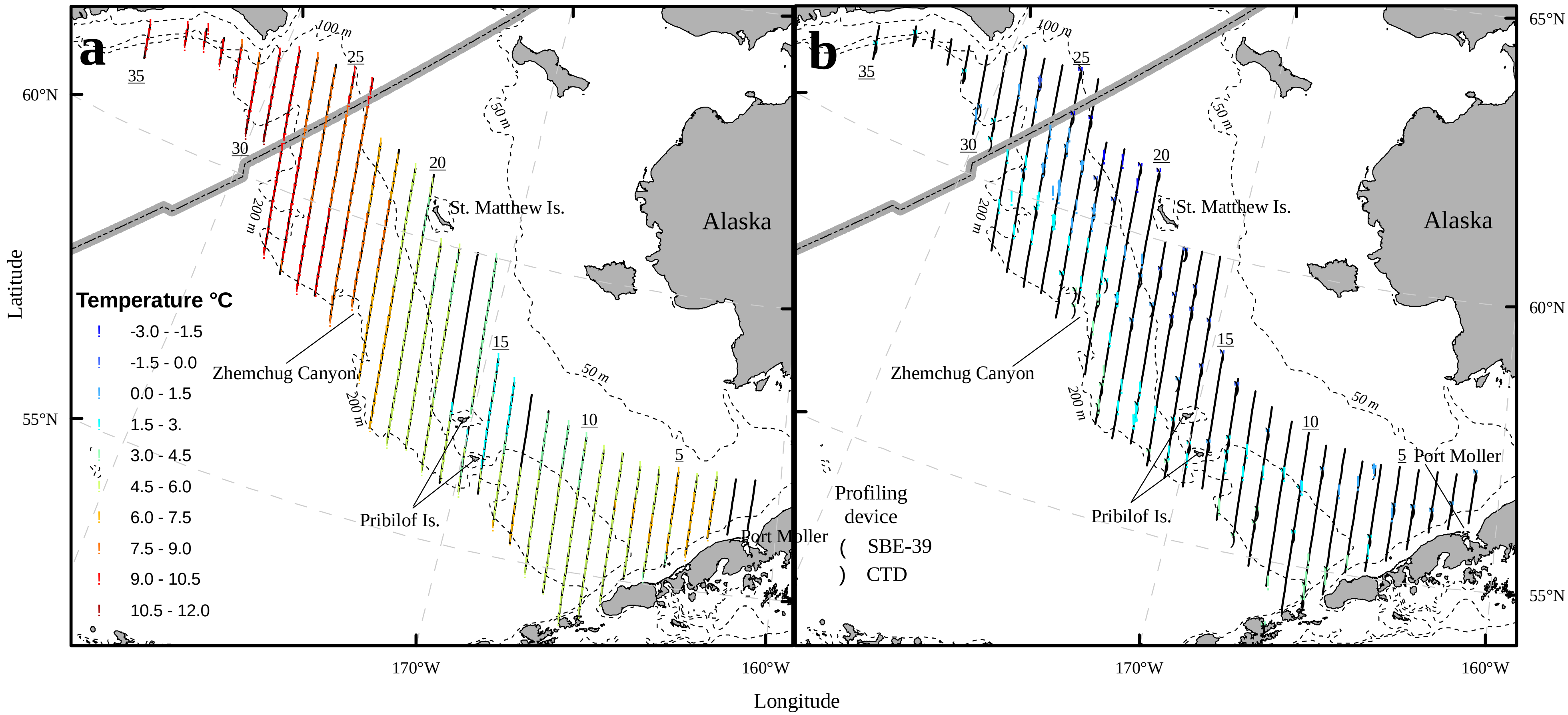


Figure 2. -- Temperature (°C) measured at the sea surface (a) and at 60 m depth (b) using SBE-39s at trawl locations, and CTDs during the summer 2007 echo integration-trawl survey of the Bering Sea shelf.

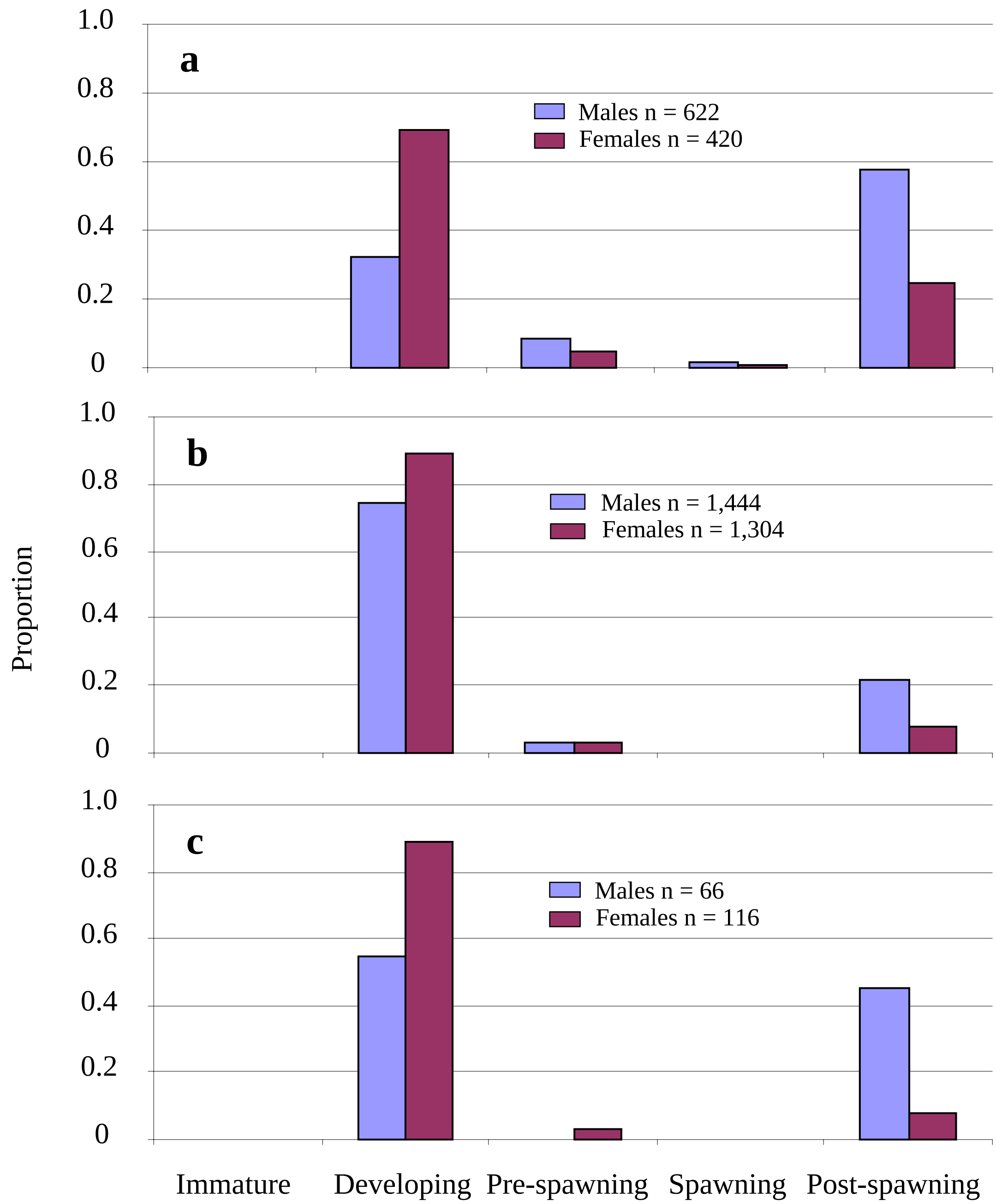


Figure 3. -- Maturity stages by sex for walleye pollock greater than 29 cm observed in (a) U.S. - east of 170°W long. (b) U.S. - west of 170°W long. and (c) Russia-Cape Navarin, during the summer 2007 Bering Sea shelf echo integration-trawl survey.

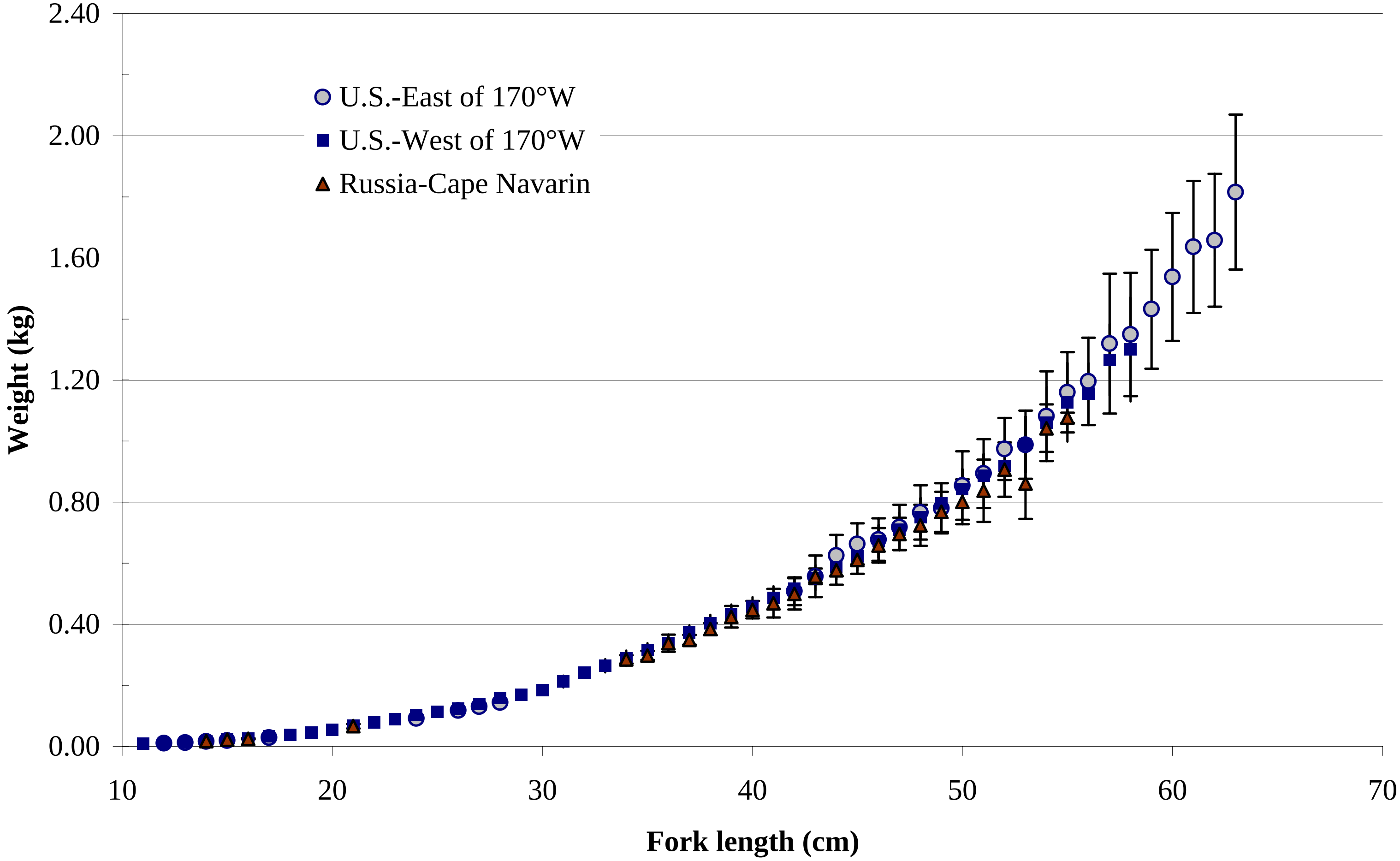


Figure 4. -- Mean weight-at-length for walleye pollock measured east and west of 170°W during the summer 2007 Bering Sea shelf echo integration-trawl survey. Average weights (kg) were computed when > 5 fish were measured at any given length (cm). Error bars represent ±1 standard deviation.

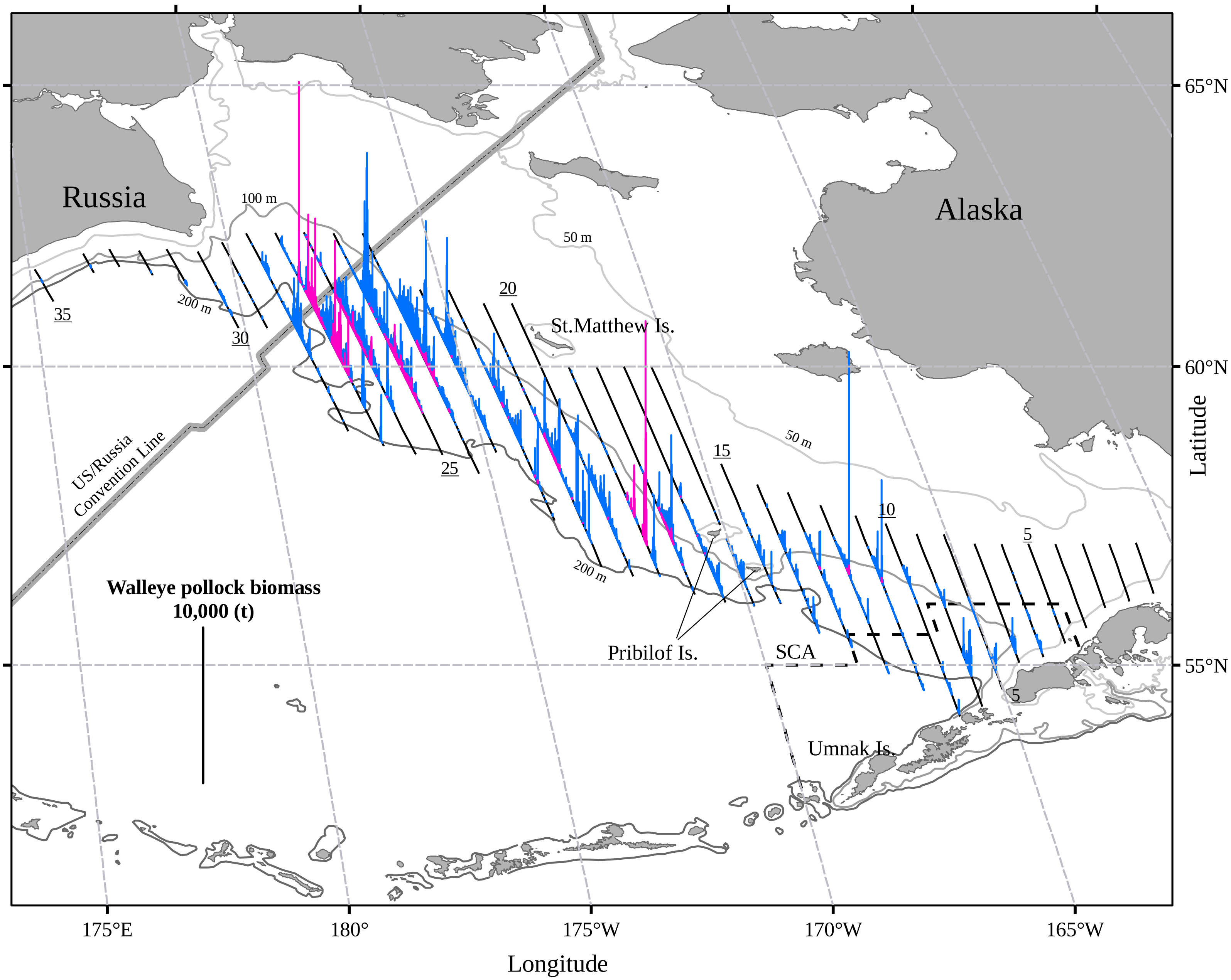


Figure 5. -- Estimated adult (≥30 cm, blue) and juvenile (< 30 cm, pink) walleye pollock biomass (in metric tons, t) between 3 m off bottom and 14 m from the surface along tracklines surveyed during the summer 2007 echo integration-trawl survey of the Bering Sea shelf. Transect numbers are underlined, and the Steller sea lion Conservation Area (SCA) is outlined (dashed line). Biomass points ≤ 0.1 t are not represented.

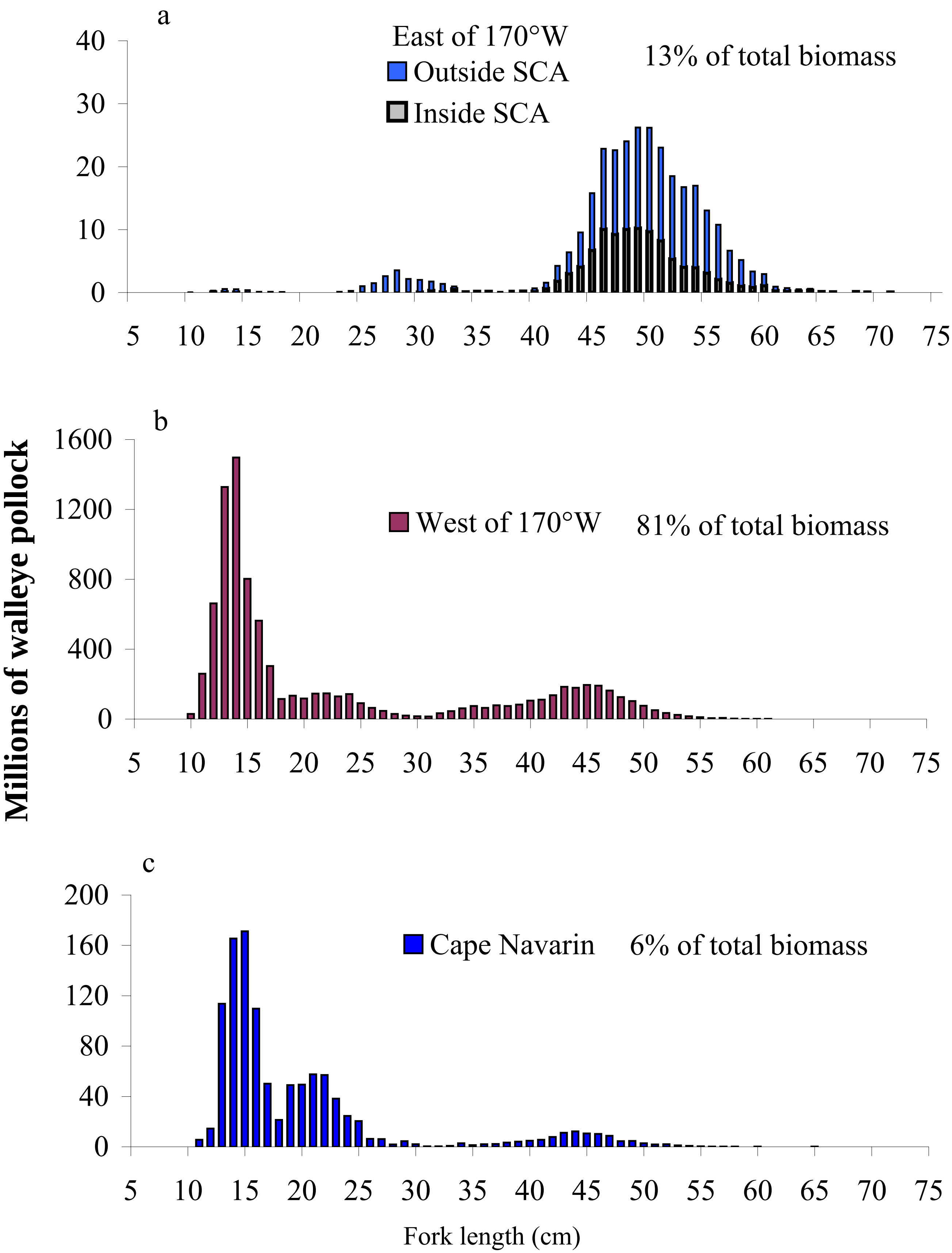


Figure 6. -- Population numbers at length estimated for walleye pollock between 14 m from the surface and 3 m off bottom from the summer Bering Sea shelf acoustic-trawl survey. a) pollock east of 170°W, b) pollock west of 170°W in U.S. waters, and c) pollock in Russian waters near Cape Navarin. Note: Y-axes differ.

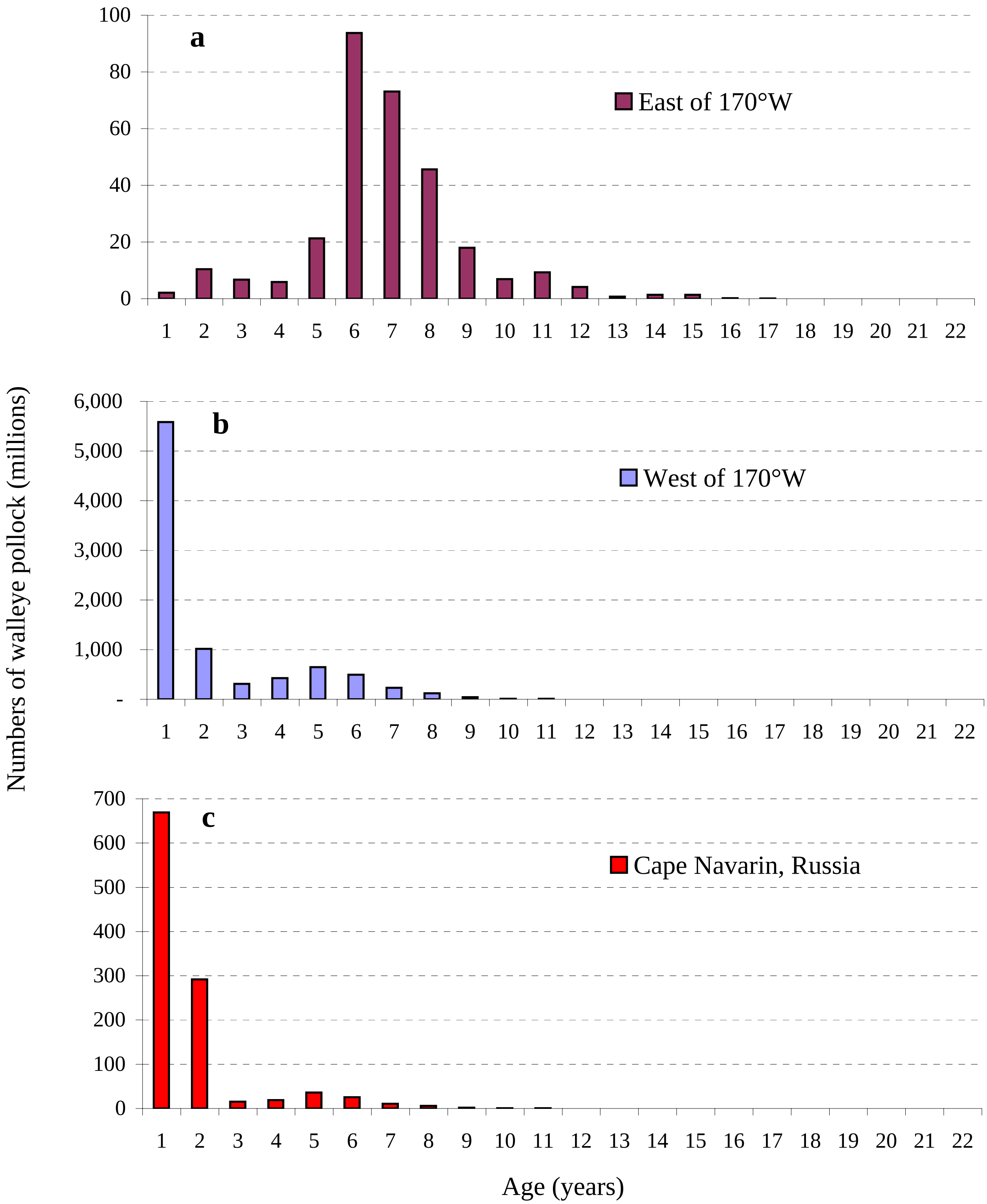


Figure 7. -- Population numbers at age estimated for walleye pollock between 14 m from the surface and 3 m off bottom from the summer eastern Bering Sea shelf acoustic-trawl survey; a) east of 170°W, b) U.S. EEZ west of 170°W, and c) Cape Navarin, Russia. Note: Y-axes differ.

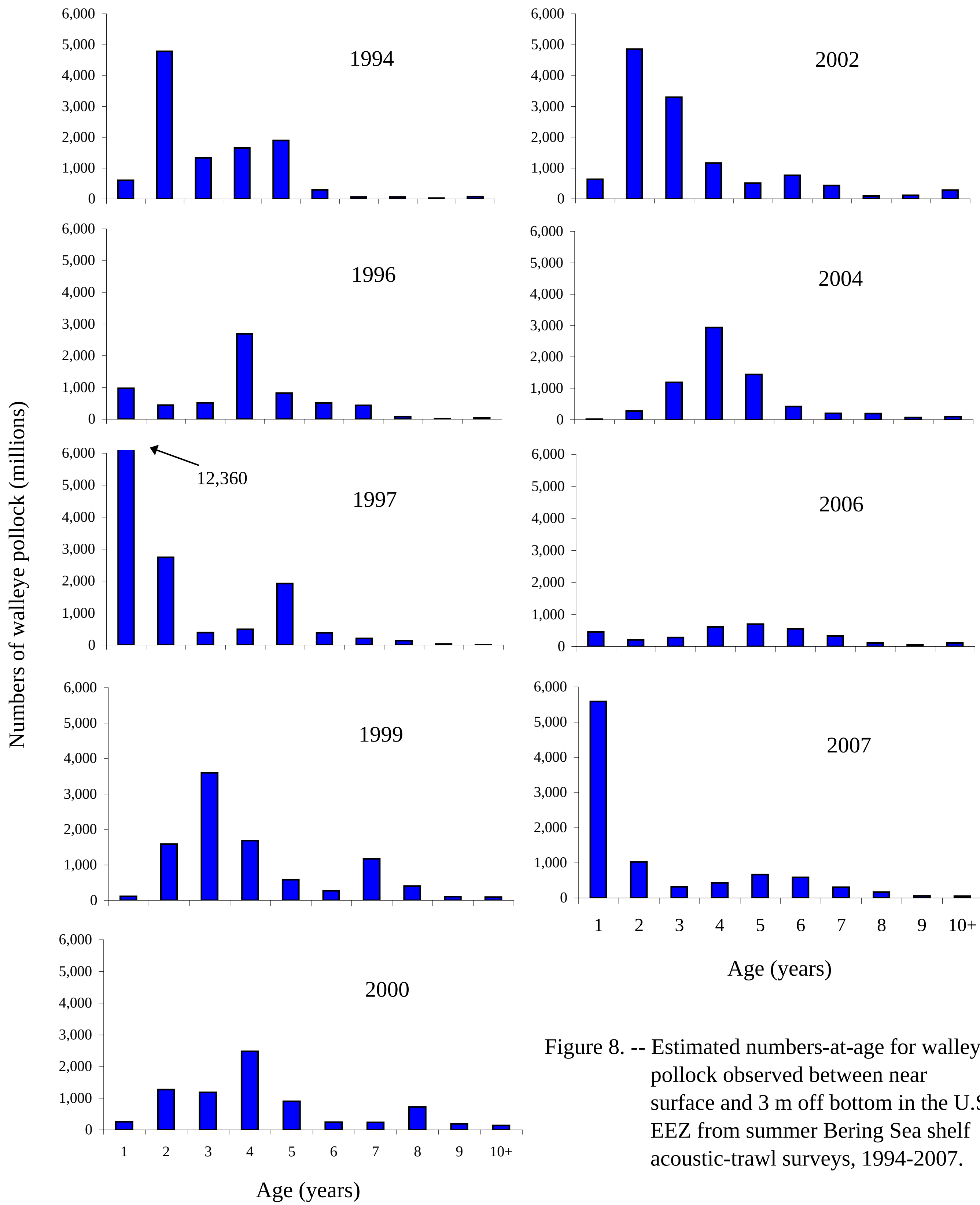


Figure 8. -- Estimated numbers-at-age for walleye pollock observed between near surface and 3 m off bottom in the U.S. EEZ from summer Bering Sea shelf acoustic-trawl surveys, 1994-2007.

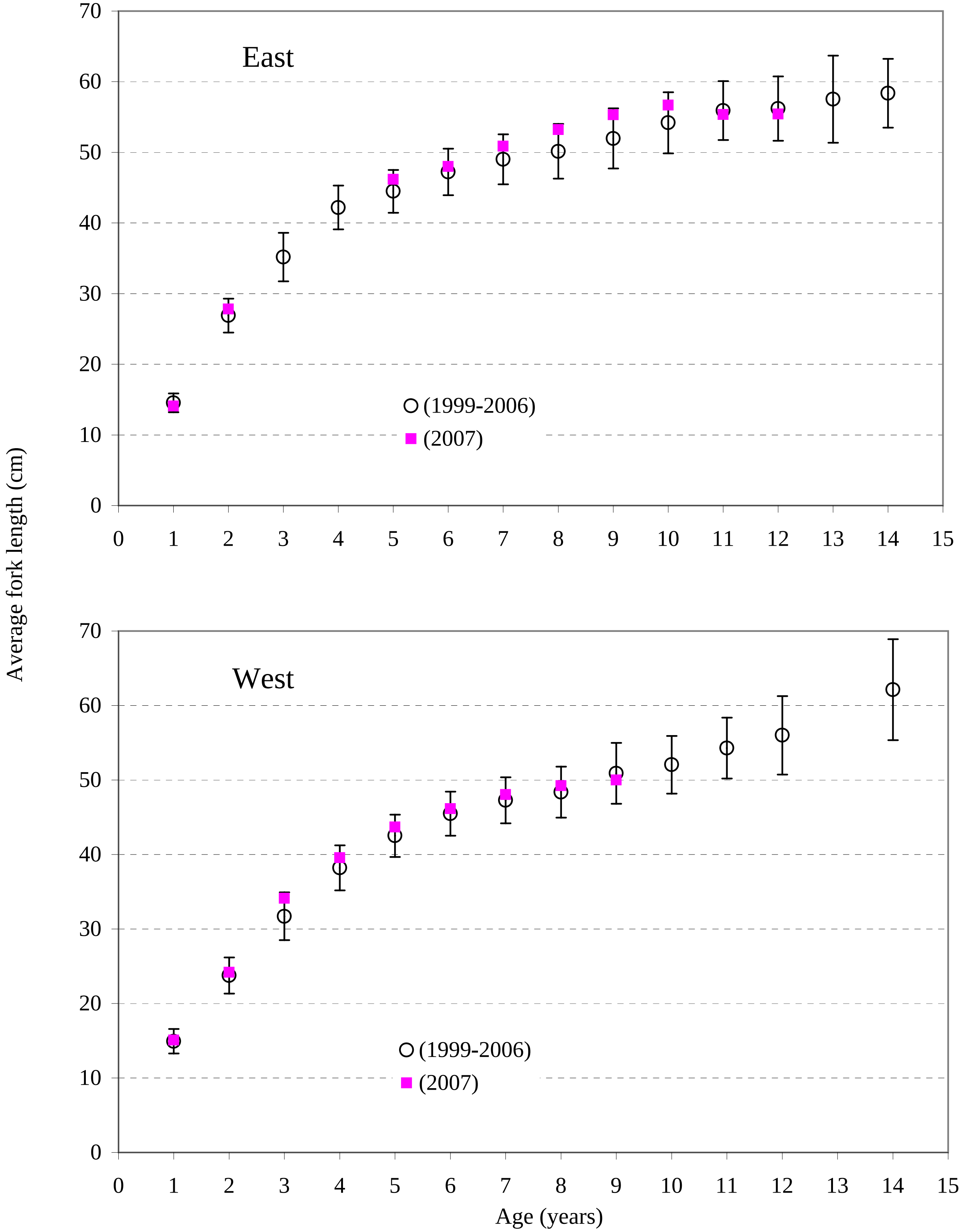


Figure 9. -- Walleye pollock average-length-at-age from summer eastern Bering Sea echo integration-trawl surveys (1999, 2000, 2002, 2004 and 2006) compared with walleye pollock average length-at-age for summer 2007. Results are for midwater tows in the U.S. EEZ, east (top) and west (bottom) of 170°W, where at least 10 fish were measured. Bars show +/- 1 standard deviation.

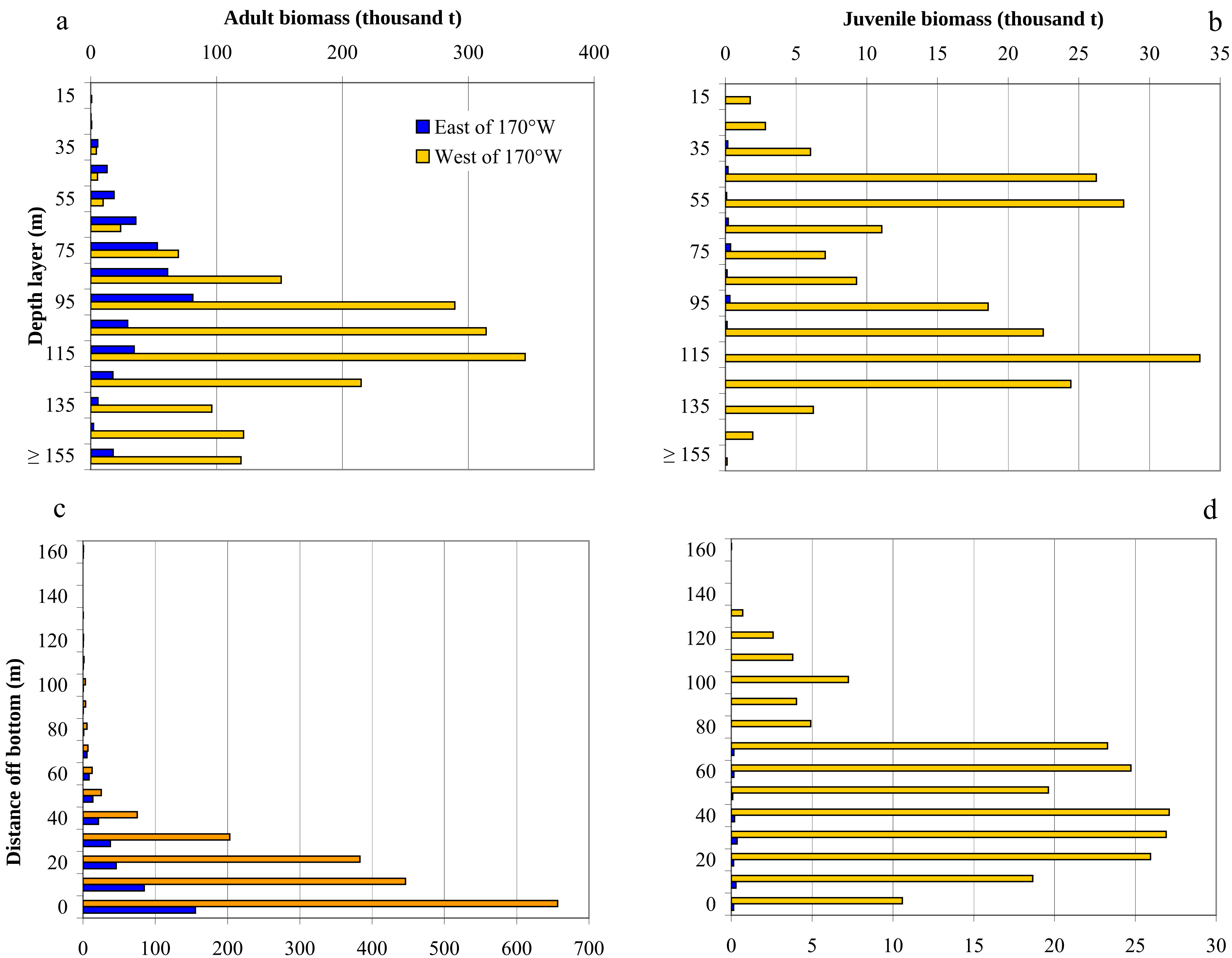


Figure 10. -- Depth distribution of adult (≥ 30 cm FL) and juvenile (< 30 cm FL) walleye pollock biomass in metric tons (t) observed east and west of 170°W longitude in the U.S. EEZ of the Bering Sea shelf during the summer 2007 echo integration-trawl survey. Depth is referenced to the surface (a,b) and to the bottom (c, d). Note: X-axes differ.

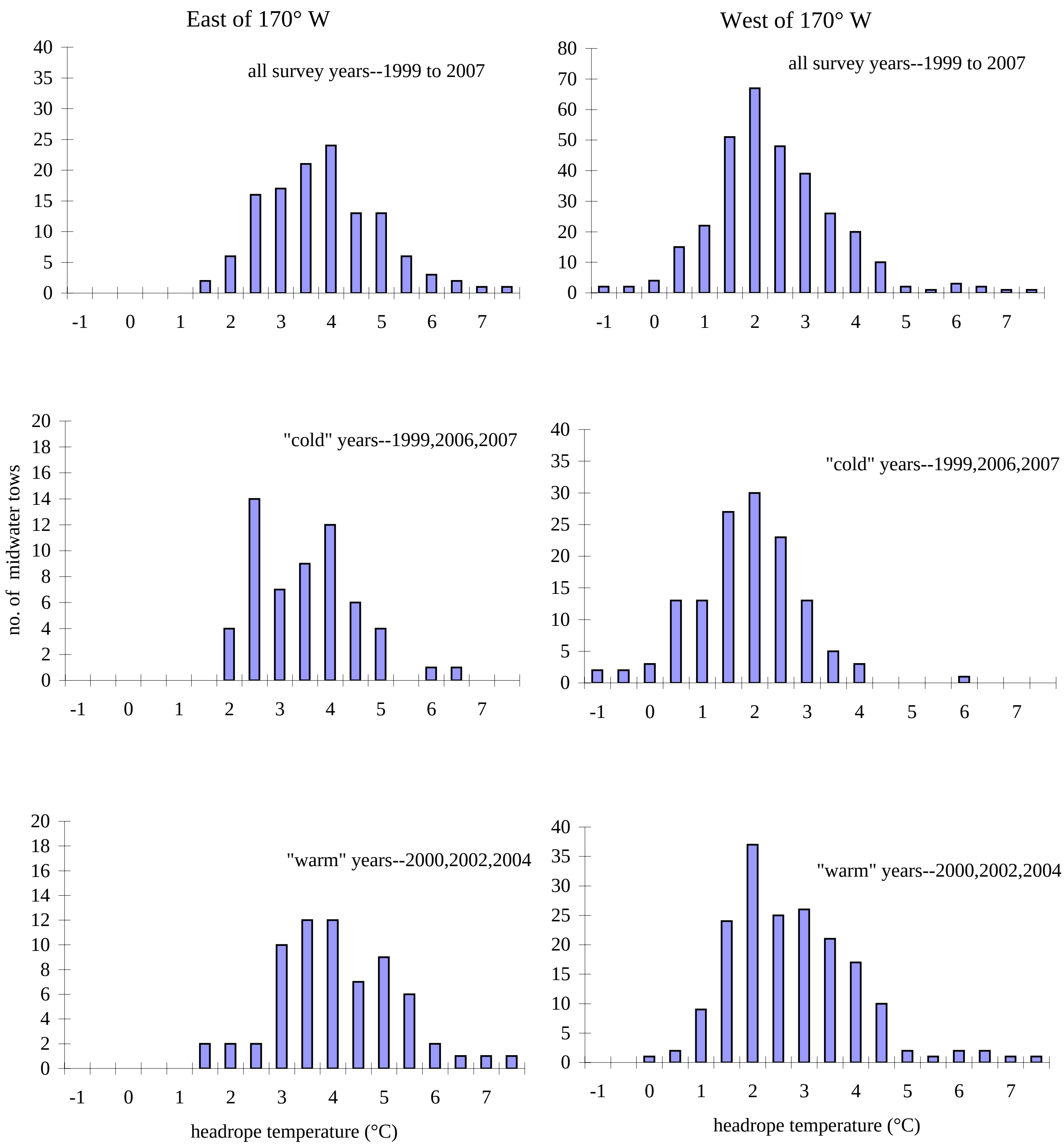
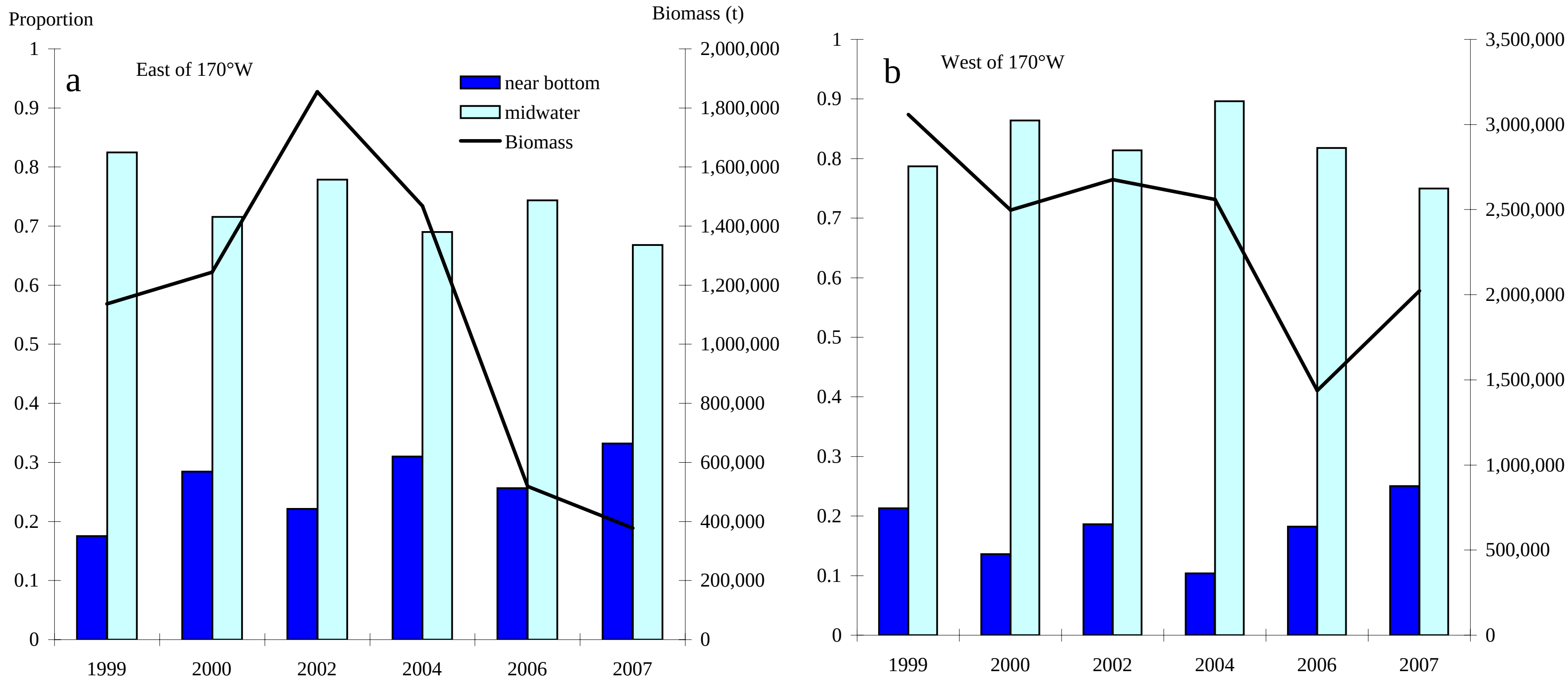


Figure 11. -- Water temperature at midwater trawl headrope depth from trawls capturing > 100 kg walleye pollock during summer Bering Sea shelf echo integration-trawl surveys between 1999 and 2007. Left panel, east of 170° W, right panel, west of 170° W. Note: Y-axes differ. Tows are from U.S. EEZ except for survey years 2004 and 2007 which include some tows from the Cape Navarin area of Russia.



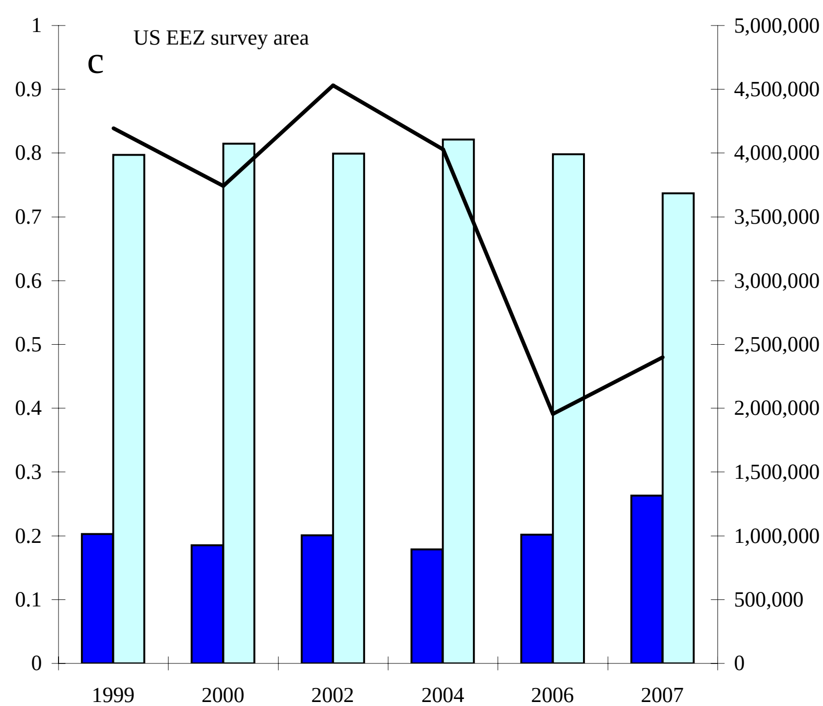


Figure 12. -- Proportion of estimated walleye pollock biomass in metric tons (t) observed in midwater (to 3 m off the bottom) and within 3 m of bottom, east (a) and west (b) of 170°W, and in the U.S. EEZ (c) during the 1999-2007 echo integration-trawl surveys. Total biomass between near the surface and 0.5 m off bottom is plotted on the right Y-axis. Note: Y-axes differ.

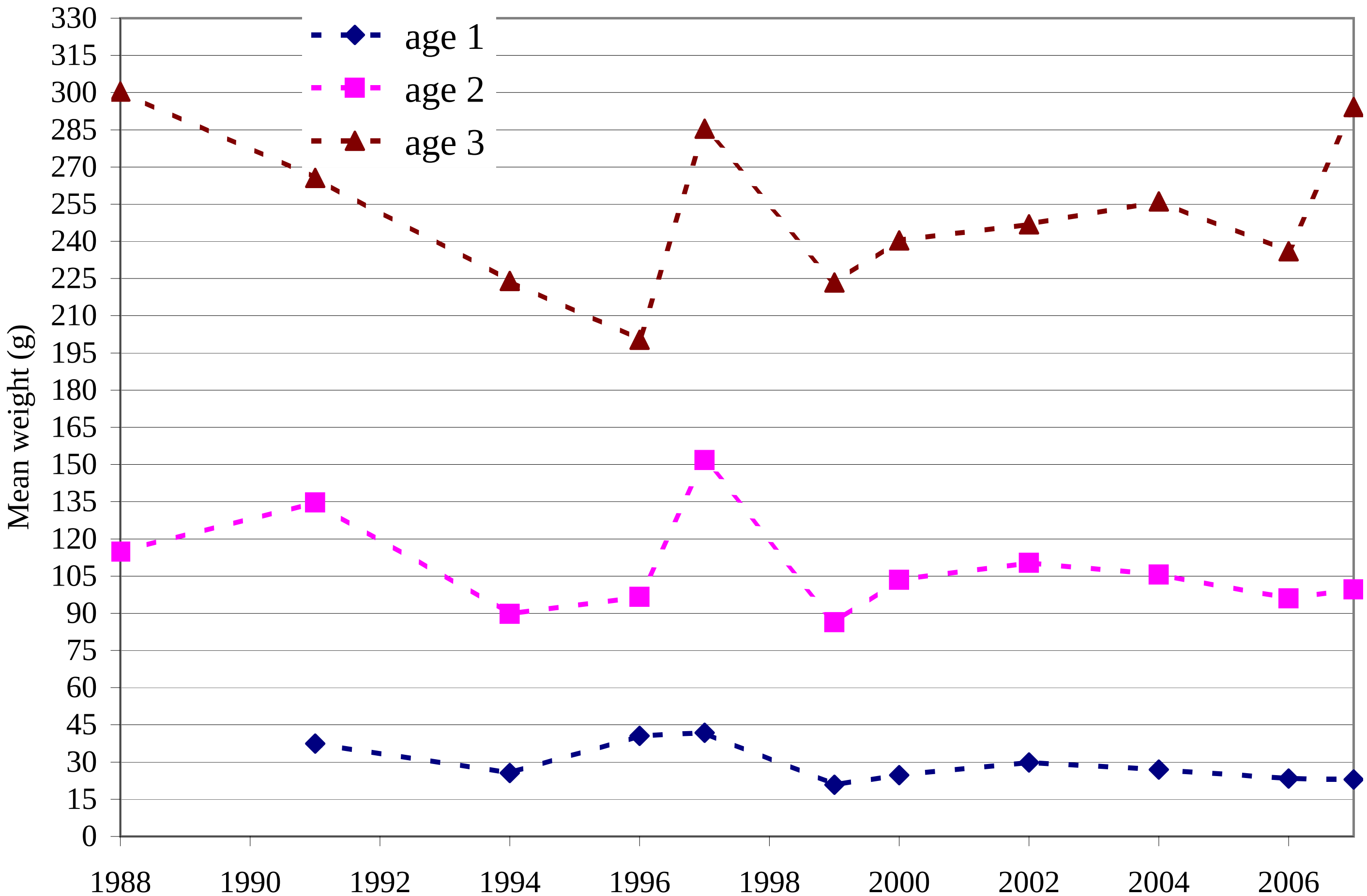


Figure 13. -- Mean weight at age for walleye pollock captured in trawl hauls west of 170°W from summer eastern Bering Sea echo integration-trawl surveys conducted between 1988 and 2007. The 1988-1997 surveys were conducted in July and August, and the 1999-2007 surveys were conducted in June and July.

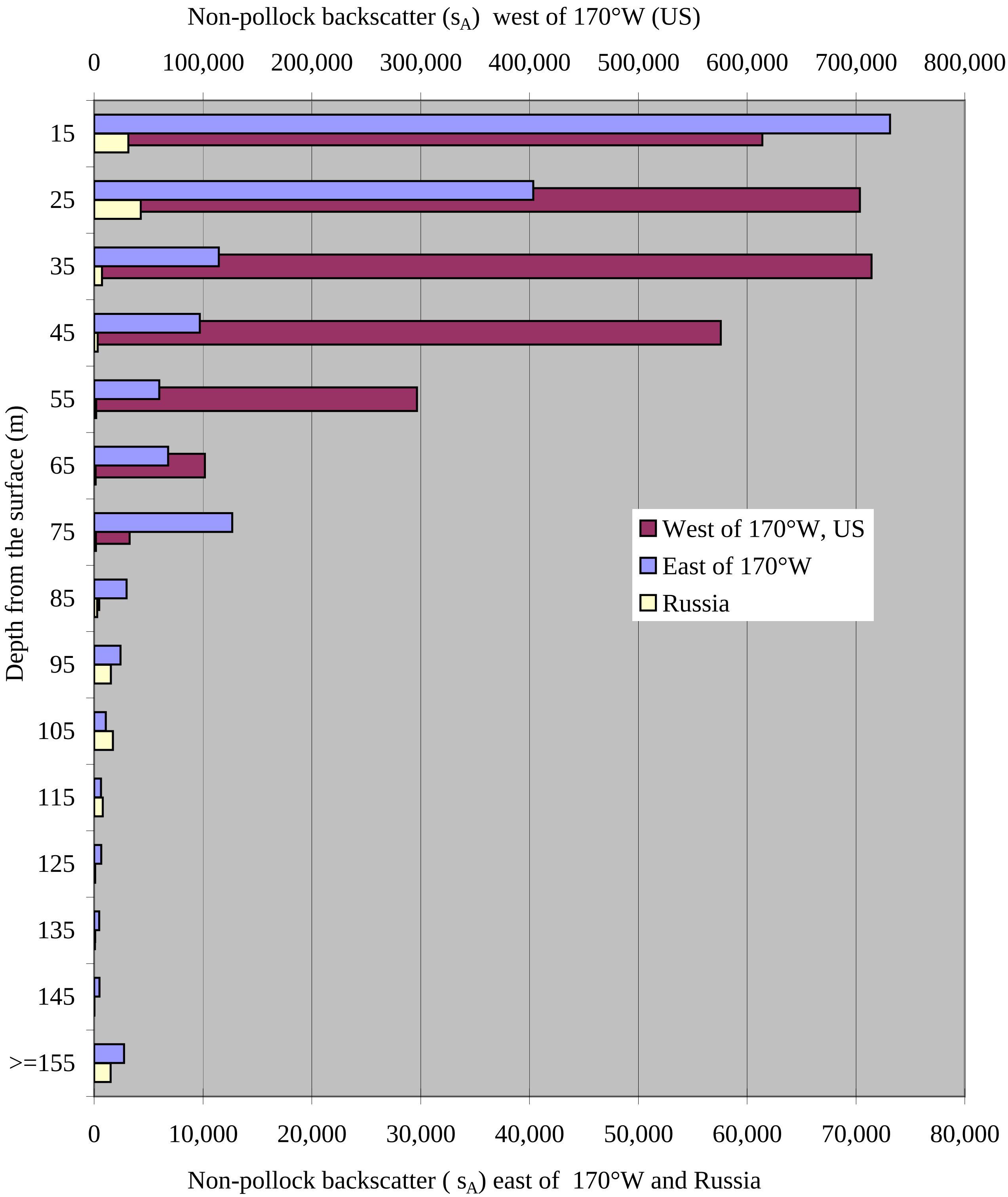


Figure 14. -- Vertical distribution of non-pollock backscatter (s_A) summed by 10-m depth bin relative to the surface in the U.S. EEZ and Russia from the summer 2007 eastern Bering Sea shelf EIT survey. Note: upper and lower Y-axes.

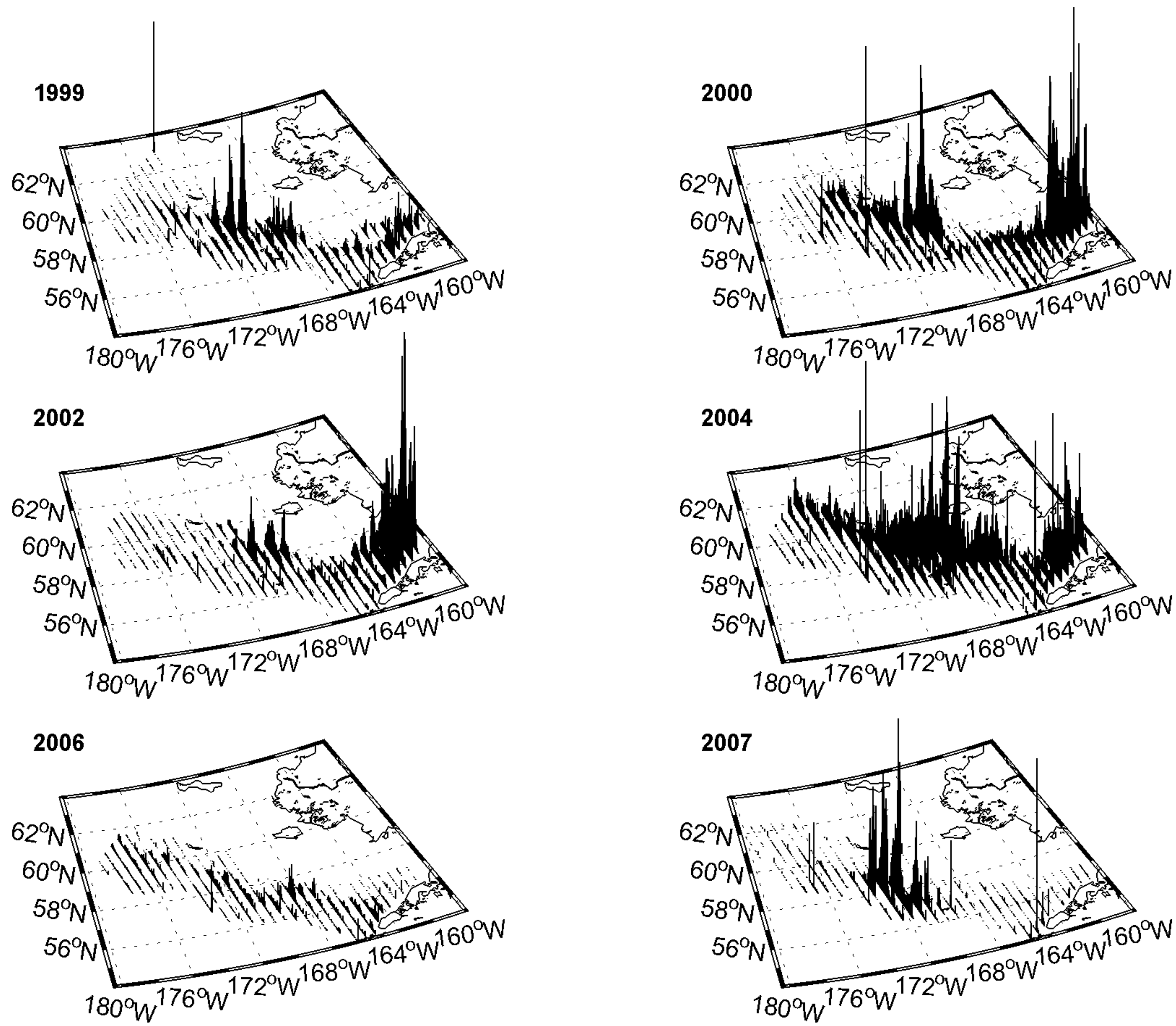


Figure 15.-- Non-pollock backscatter (s_A), including a few isolated aggregations of non-pollock fish, observed along tracklines during summer eastern Bering Sea echo integration-trawl surveys conducted between 1999 and 2007.

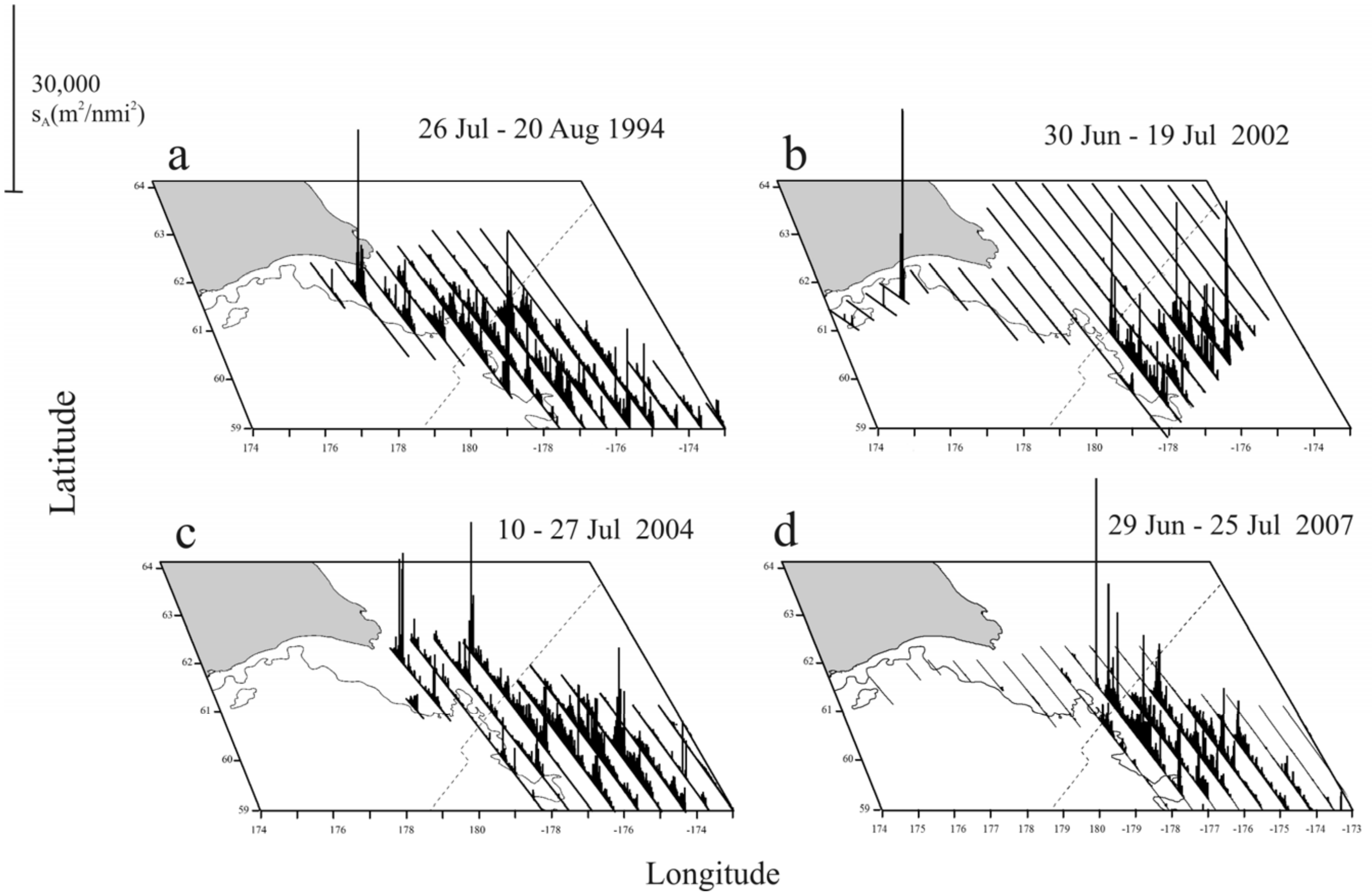


Figure 16. -- Pollock acoustic backscatter (s_A) along tracklines, between near surface and 0.5 m off bottom from four echo integration-trawl surveys in the Cape Navarin area; a) 1994 U.S. survey, b) 2002 Russian survey (RV *TINRO*), c) 2004 U.S. survey and d) 2007 U.S. survey. U.S. surveys in 1994 and 2004 were NOAA ship *Miller Freeman*; 2007 was NOAA ship *Oscar Dyson*.

Appendix I. – Itinerary.

Leg 1

2 Jun	Depart Dutch Harbor, AK. Acoustic sphere calibration in Captains Bay, Unalaska Island, AK.
2 - 3 Jun	Transit to Bering Sea.
3 - 10 Jun	Echo integration-trawl survey of the Bering Sea shelf through transect 9; debark scientific personnel in Dutch Harbor.
10 - 17 Jun	Echo integration-trawl survey of the Bering Sea shelf transects 10 – 15.
18 - 19 Jun	ADCP and species identification trawls west of St. George. Transit to Unalaska Island.
20 Jun	In port Dutch Harbor.

Leg 2

21 Jun	Acoustic sphere calibration in Captains Bay.
21 - 22 Jun	Transit to transect 16 waypoint.
22 Jun - 5 Jul	Echo integration-trawl survey of the Bering Sea shelf (transects 16-23).
6 - 7 Jul	AWT-MOCC experimental gear trials.
7 Jul	Transit to Unalaska Island, AK.
8 Jul	Acoustic sphere calibration in Captains Bay, Unalaska Island, AK.
9 - 10 Jul	In port Dutch Harbor, AK.

Leg 3

11 - 12 Jul	Transit to transect 24 waypoint.
13 - 25 Jul	Echo integration-trawl survey of the Bering Sea shelf (transects 24-35).
26 - 28 Jul	Net selectivity and video sled experiments.
29 - 30 Jul	Transit to Unalaska Island. Acoustic sphere calibration in Captains Bay. End of cruise.

Appendix II. -- Scientific Personnel.

Leg 1 (2-20 June)

Name	Position	Organization	Nation
Neal Williamson	Chief Scientist	AFSC	USA
Chris Wilson	Fishery Biologist	AFSC	USA
Paul Walline	Fishery Biologist	AFSC	USA
Scott Furnish	Info. Tech. Specialist	AFSC	USA
Denise McKelvey	Fishery Biologist	AFSC	USA
William Floering	Fishery Biologist	AFSC	USA
Sandi Neidetcher	Fishery Biologist	AFSC	USA
Mikhail Stepanenko	Fishery Biologist	TINRO[1]	Russia
Tamara Mills	Seabird Observer	USFWS[2]	USA
Gregory Mills	Seabird Observer	USFWS	USA

Leg 2 (21 June-10 July)

Name	Position	Organization	Nation
Taina Honkalehto	Chief Scientist	AFSC	USA
Michael Guttormsen	Fishery Biologist	AFSC	USA
Scott Furnish	Info. Tech. Specialist	AFSC	USA
William Floering	Fishery Biologist	AFSC	USA
Sarah Stienessen	Fishery Biologist	AFSC	USA
Mikhail Stepanenko	Fishery Biologist	TINRO	Russia
Tamara Mills	Seabird Observer	USFWS	USA
Sally Ann Marston	Seabird Observer	USFWS	USA
Rebecca Himschoot	Teacher at Sea	NOAA	USA

Leg 3 (11 -31 July)

Paul Walline	Chief Scientist	AFSC	USA
Patrick Ressler	Fishery Biologist	AFSC	USA
Rick Towler	Info. Tech. Specialist	AFSC	USA
Kresimir Williams	Fishery Biologist	AFSC	USA
Carwyn Hammond	Fishery Biologist	AFSC	USA
Darin Jones	Fishery Biologist	AFSC	USA
Abigail McCarthy	Fishery Biologist	AFSC	USA
Mikhail Stepanenko	Fishery Biologist	TINRO	Russia
Tamara Mills	Seabird Observer	USFWS	USA
Mark Rauzon	Seabird Observer	USFWS	USA
Roy Arrezo	Teacher at Sea	NOAA	USA

[1]TINRO Pacific Research Institute of Fisheries and Oceanography, Vladivostok, Russia

[2]SUSFW United States Fish and Wildlife Service, Juneau, AK

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