Alaska
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U.S DEPARTMENT OF COMMERCE

AFSC PROCESSED REPORT 2015-07

Results of the Acoustic-Trawl Survey of Walleye Pollock (*Gadus chalcogrammus*) on the U.S. and Russian Bering Sea Shelf in June - August 2014 (DY1407)

August 2015

This document should be cited as follows:

Honkalehto, T., and A. McCarthy. 2015. Results of the acoustic-trawl survey of walleye pollock (*Gadus chalcogrammus*) on the U.S. and Russian Bering Sea Shelf in June - August 2014 (DY1407). AFSC Processed Rep. 2015-07, 63 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Available at http://www.afsc.noaa.gov/Publications/ProcRpt/PR2015-07.pdf

Results of the Acoustic-Trawl Survey of Walleye Pollock (*Gadus chalcogrammus*) on the U.S. and Russian Bering Sea Shelf in June - August 2014 (DY1407)

by

T. Honkalehto and A. McCarthy

Resource Assessment and Conservation Engineering Division
Alaska Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
7600 Sand Point Way, NE
Seattle, WA 98115

August 2015

ABSTRACT

Eastern Bering Sea shelf walleye pollock (*Gadus chalcogrammus*) midwater abundance and distribution were assessed from Bristol Bay in the United States, to Cape Navarin, Russia, between 12 June and 13 August 2014 using acoustic-trawl survey methods aboard the NOAA ship *Oscar Dyson*. Water column temperatures were warm in 2014 compared with the cold temperatures of the past several survey years (2006-2012). Most walleye pollock biomass was distributed relatively evenly across the shelf from a region north of Unimak Island to Navarin Canyon, between roughly the 50 m and 1,000 m isobaths. Estimated pollock biomass in midwater (between 16 m from the sea surface and 3 m off bottom) in the U.S. EEZ portion of the Bering Sea shelf was 3.439 million metric tons (t), nearly twice the 2012 estimate (1.843 million t) and the highest that has been observed since 2002. Pollock biomass east of 170° W was 1.425 million t (40% of the total shelf-wide), with 2-year-old pollock (26 cm modal fork length (FL)) comprising 55% of that biomass. Pollock biomass in U.S. waters west of 170° W was 2.013 million t (57% of total shelf-wide biomass), consisting primarily of pollock aged 1, 2, and 4-6 years (15, 26, and 38 cm dominant modal FL, respectively). Two-year-old pollock were more abundant east than west of 170° W and contributed to an eastward shift in distribution of U.S. pollock biomass compared with recent years. Estimated numbers of 2-year-old pollock also surpassed the numbers estimated for the strong 2008 year class in 2010, although the 2008 year class was still evident in the population. In Russia (104 thousand t, 3% of total biomass), primarily 4-year-old fish (38 cm modal FL), were observed, with proportionally fewer 1- and 2-year-olds than observed west of 170° W in the United States. The preliminary spatial distribution of euphausiid backscatter is presented, but analyses are still in progress.

CONTENTS

INTRODUCTION

Scientists from the Midwater Assessment and Conservation Engineering (MACE) Program of the Alaska Fisheries Science Center (AFSC) have conducted summer acoustic-trawl (AT) surveys to estimate the abundance and distribution of walleye pollock (*Gadus chalcogrammus*) on the eastern Bering Sea (EBS) shelf since 1979. Surveys were conducted triennially through 1994 and have been conducted either annually or biennially since 1994. They generally cover the shelf between about the 50 m and 1,000 m isobaths, encompassing roughly the middle (50 to 100 m isobaths) and outer (100 to 200 m isobaths) Bering Sea shelf. The 2014 AT survey was carried out between 12 June and 13 August aboard the NOAA ship *Oscar Dyson*. Its primary objective was to collect acoustic and trawl information to estimate walleye pollock midwater abundance and distribution on the U.S. and Russian Bering Sea shelf. Additional survey sampling included conductivity-temperature-depth (CTD) probes to characterize the Bering Sea shelf temperature conditions, and supplemental trawls to improve acoustic species classification, and to obtain an index of euphausiid biomass using multiple frequency techniques. A number of specialized sampling devices were used during the survey, including a modified Marinovich midwater trawl to sample fishes and macrozooplankton which was rigged with pocket nets to estimate fish escapement, a trawl-mounted stereo camera (CamTrawl) designed to identify species and determine size and density of animals as they pass by the camera during a haul, and a set of six small, bottom-moored, trigger–camera systems to autonomously collect images of fish near the seafloor. This report estimates 2014 walleye pollock abundance by size and age. It also summarizes acoustic system calibration and physical oceanographic results. Walleye pollock vertical distribution and spatial distribution patterns of backscatter at 38 kHz for pollock and non-pollock are shown. A preliminary distribution of the euphausiid biomass index is presented. Further results from these and the other secondary projects will be presented in subsequent reports.

METHODS

MACE scientists conducted the AT survey (cruise DY2014-07) aboard the NOAA ship *Oscar Dyson*, a 64-m stern trawler equipped for fisheries and oceanographic research. The vessel itinerary and scientific personnel list are presented in Appendices I and II.

Acoustic Equipment, Calibration, and Data Collection

Acoustic measurements were collected with a Simrad ER60 scientific echo sounding system (Simrad 2008, 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 was extended 9 m below the water surface. A Simrad ME70 multibeam echosounder (Simrad 2007, Trenkel et al. 2008) was mounted on the hull 10 m forward of the centerboard at 6 m below the water surface. System electronics were housed inside the vessel in a permanent laboratory space dedicated to acoustics.

Standard sphere acoustic system calibrations were conducted to measure acoustic system performance. During calibrations, the *Oscar Dyson* was anchored at the bow and stern. A tungsten carbide sphere (38.1 mm diameter) and a copper sphere (64 mm diameter) were suspended below the 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 the 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 the ER60 calibration software Calibration.exe (Simrad 2008).

Acoustic (raw) data were collected at the five frequencies with Simrad ER60 (v. 2.2.1). As a backup, acoustic telegram data were logged with Echoview EchoLog 500 (v. 5.4.91.24158) software. Raw multibeam acoustic data were collected with the Simrad ME70. Ping rate for the EK60 system was variable depending on range to the seafloor, but was typically about 1.1 s^{-1}.

Results presented in this report, including calibration, are based on 38 kHz raw echo integration data with a post-processing S_v threshold of –70 dB re 1 m^{-1}. Acoustic measurements were analyzed from 16 m below the surface to within 0.5 m off bottom using Echoview post-processing software (v. 6.0.95.25778).

Trawl Gear and Oceanographic Equipment

Midwater and near-bottom acoustic backscatter were sampled using an Aleutian wing 30/26 trawl (AWT). This trawl was constructed with full-mesh nylon wings and polyethylene mesh in the codend and aft section of the body. The headrope and footrope each measured 81.7 m (268 ft). Mesh sizes tapered from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend, where it was fitted with a single 12 mm (0.5 in) codend liner. A small mesh (12 mm) pocket net was permanently attached 10 meshes aft on the 3rd bottom panel of the AWT intermediate, to sample escapement. Near-bottom backscatter was sampled with an 83-112 Eastern bottom trawl without roller gear and fitted with a 12 mm (0.5 in) codend liner. A twice modified Marinovich midwater trawl with a 10 m footrope, 30 m bridle, 6 m vertical opening, and mesh sizes ranging from 6.35 cm (2.5 in; top and sides) to 1.91 cm (0.75 in; codend) with a 3 mm (1/8 in) liner was tested to determine the best midwater fishing configuration, and to determine optimal placement of ‘pocket nets’ for measuring fish escapement from the trawl. The AWT, bottom trawl, and Marinovich were fished with 5 m^2 Fishbuster trawl doors each weighing 1,089 kg. Vertical net openings and depths were monitored with either a Simrad FS70 third-wire netsounder or a Furuno CN24 acoustic-link netsonde attached to the headrope. Tom weights used for midwater trawls were typically 250 lbs for the AWT and 100 lbs for the Marinovich. The AWT vertical net opening ranged from 13.0 to 26.2 m and averaged 20.3 m. The bottom trawl vertical net opening ranged from 2.0 to 4.5 m and averaged 3.1 m. The Marinovich trawl vertical opened ranged from 5.3 to 6.8 m and averaged 5.9 m. Detailed trawl gear specifications are described in Honkalehto et al. (2002).

Daytime Methot trawl samples were made to ground-truth euphausiid backscatter and biomass estimates. 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 suspended below the frame to generate additional downward force. A calibrated General Oceanics flowmeter was attached in the mouth of the trawl; the number of flowmeter revolutions and the total time the net was in the water were used 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 temperature-depth sensor attached to the bottom of the Methot frame. All survey operations were conducted as specified in NOAA protocols for fisheries acoustics surveys and related sampling[1], and the acoustic units used are defined in MacLennan et al. (2002).

The stereo camera-trawl (CamTrawl) system was tested during leg 1 and subsequently used on all AWT hauls during legs 2 and 3. The CamTrawl consists of 2-3 cameras, strobes, and associated electronics all mounted within a frame attached to the midsection of an AWT just forward of the codend (Williams et al. 2010). It operates autonomously, collecting stereo images to identify species and determine density and size of animals as they pass by the device and through the trawl. A set of small, bottom-moored, triggered-camera systems to autonomously collect images of fish near the seafloor was tested separately during the survey.

Physical oceanographic measurements were made throughout the cruise. Temperature-depth profiles were obtained at trawl sites with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Conductivity-temperature-depth (CTD) measurements were made with a Sea-Bird SBE 911*plus* CTD at calibration sites and throughout the survey to describe EBS shelf temperature features associated with pollock and euphausiids. CTD casts were made at the closest point along a survey transect to each of 19 nominal station locations. A cast was also made wherever the ship stopped surveying for the night if it was more than

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[1] National Marine Fisheries Service (NMFS) 2013. NOAA protocols for fisheries acoustics surveys and related sampling (Alaska Fisheries Science Center), 23 p. Prepared by Midwater Assessment and Conservation Engineering Program, Alaska Fish. Sci. Center, Natl. Mar. Fish. Serv., NOAA. Available online: http://www.afsc.noaa.gov/RACE/midwater/AFSC%20AT%20Survey%20Protocols_Feb%202013.pdf

20 nautical miles (nmi) from another nighttime cast. Salinity bottle samples (e.g., one bottle every other day, alternating at surface and bottom of cast) were collected from the casts to calibrate the CTD conductivity sensor. Sea surface temperature (SST) was measured continuously using the vessel's Furuno T-2000 SST system, approximately 1.4 m below the vessel's waterline. These surface temperatures were recorded using the ship's Scientific Computing System (SCS) and subsequently averaged at 10 nmi resolution.Other environmental data (not reported here) were also recorded using the SCS.

Survey Design

The survey design consisted of 27 north-south transects spaced 20 nmi apart over the Bering Sea shelf from 162° W (west of Port Moller, Alaska), across the U.S.-Russia Convention Line to about 178° 20 E, including the area around Cape Navarin, Russia (hereafter "Russia"; Fig. 1). To add an element of randomization to this systematic transect design, the position of the first transect was randomly jittered by an amount less than the inter-transect distance, and then subsequent transects were laid out from that point (Rivoirard et al. 2000).

During Leg 2, a motor control board failed restricting ship speed to about 8.5 kts for about 2 weeks. This resulted in a loss of about 4 days of survey time. After the repair was made, transect spacing was increased to 40 nmi in the Russian EEZ to survey the entire area in the time available.

Echo integration and trawl information were collected during daylight hours (typically between 0600 and 2400 local time). Daytime Methot trawls were conducted on suspected macrozooplankton backscatter to correctly classify non-pollock backscatter and to assess the density of Bering Sea euphausiids (s_A, m^2 nmi^{-2}) based on acoustics. Nighttime activities included collection of additional physical oceanographic data, trawl hauls for species classification, and work with other specialized sampling devices (e.g., the Marinovich trawl to assess trawl performance appropriate pocket net placement, CamTrawl and triggered-camera testing and deployment). A lowered target strength (TS) measurement package (dropTS) was tested, as well as another lowered camera system for imaging pelagic fish and zooplankton.

Trawl hauls conducted on fish backscatter were used to identify the species composition, length, and other biological characteristics of fish in the aggregation. For trawls targeting walleye pollock, a portion of the catch was sampled to determine pollock sexual maturity, and fish length- and weight-at-age, by sex. If large numbers of juveniles mixed with adults were encountered in a haul, the predominant size groups were sub-sampled separately. Approximately 50 to 400 individuals were randomly sampled for length by sex, and about 20 to 50 were sampled for body weight, maturity, and age. Fork lengths (FL) were measured to the nearest millimeter. An electronic motion-compensating scale (Marel M60) was used to weigh individual walleye pollock specimens to the nearest 2 g. Maturity was determined by visual gonad inspection and fish were categorized as immature, developing, pre-spawning, spawning, or post-spawning[2]. Walleye pollock otoliths were collected and stored in individually marked vials containing a glycerol-thymol solution. Otoliths were read by AFSC scientists in the Age and Growth Program following the survey to determine fish ages.

Additional biological samples were taken from most species in the catch. For select species or broader taxonomic groups, 25-100 lengths, and 10-75 lengths paired with individual weights (‘length-weights’), were taken depending on species and dominance in the catch. These included age-0 pollock, forage fishes (e.g., capelin, eulachon, herring, sand lance, northern smoothtongue, myctophids), rockfishes, and large jellyfishes. For all other species except sessile invertebrates caught in bottom trawls, either 10 length-weights were collected (organisms weighing 5 else 10 individuals were weighed in aggregate and then measured separately for lengths (organisms weighing < 5 g). Standard lengths (SL) were measured for capelin, Pacific viperfish, and myctophids. Otherwise fork lengths were measured. Pocket net catches were sorted to species for fishes or broader taxonomic groups for invertebrates, subsampled if necessary,

[2] ADP Code Book. 2012. Unpublished document. Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle WA 98115.

counted and weighed. Twenty or more length samples were taken for all fish species caught in pocket nets. Trawl station and biological measurements were digitally recorded using the Catch Logger for Acoustic Midwater Surveys (CLAMS) customized software program developed by MACE scientists.

For Methot trawls, the catch was transferred to a ~ 0.5 × 1 m rectangular plastic tub. Large organisms such as jellyfish and small fishes were removed, identified to the lowest taxonomic group possible, weighed by taxon, and lengthed (excluding salps). The remainder of the catch was placed on a 1-mm mesh screen and weighed. A subsample of this zooplankton mixture was then weighed and sorted at sea into broad taxonomic groups, while a second subsample was weighed and preserved in a 5% buffered formalin solution for more detailed enumeration at the Polish Sorting Center in Szczecin, Poland. These results will be reported elsewhere.

Several special projects required additional biological sampling. Pollock ovaries were collected from stage-3 females for a reproductive biology study (M. Dorn/S. Neidetcher, AFSC). Whole age-0 and age-1 pollock were collected for a study to determine the size range for Bering Sea age-0 pollock (J. Duffy-Anderson, AFSC). Tissue samples were collected for 1) all sizes of fishes and invertebrates encountered throughout the survey for a food chain/food web study, using a stable isotope ratio approach (S. Wainwright, Auke Bay Laboratories (ABL)) and for 2) selected species (walleye pollock, Pacific herring, salmon, Pacific sand lance, Atka mackerel, and gonatid squid) to estimate diet of northern fur seals using stable isotope signatures from northern fur seal blood and prey species collected from the study region.

<u>Data Analysis</u>

Walleye pollock abundance was estimated by combining acoustic and trawl information. For a detailed explanation of the standard AT survey abundance estimation procedures, refer to Honkalehto et al. (2008). The following is a brief summary. Acoustic backscatter classified as age-1+ walleye pollock, non-pollock fishes, and an undifferentiated mixture (primarily plankton and small fishes) was binned at 0.5 nmi horizontal by 10 m vertical resolution. Walleye pollock length compositions from 90 hauls were combined into 20 regional length strata in 2014 based on geographic proximity, similarity of length composition, and backscatter characteristics. For determination of mean weight-at-length for pollock, hauls were stratified east and west of 170°W, as walleye pollock have been observed historically to grow at different rates in these areas (Traynor and Nelson 1985, Honkalehto et al. 2002). Mean fish weight-at-length for each 1.0 cm-length interval was estimated from the trawl information when there were six or more fish for that length interval in a length-weight key. Otherwise, weight for a given length interval was estimated from a linear regression of the natural logs of the length and weight data from all the 2014 summer EBS hauls (De Robertis and Williams 2008). One weight-at-length key was used for the survey area. For each regional length stratum, walleye pollock numbers-at-length were estimated by dividing the acoustic measurements of area backscattering coefficient by the mean backscattering cross section of pollock (MacLennan et al. 2002) using an acoustic target strength (TS) to length relationship of TS = 20 $\log_{10}$ (FL)-66 (Traynor 1996), and biomass was estimating by multiplying numbers-at-length by mean fish weight-at-length. Results by length are expressed as a function of age through use of two age-length keys, one for east and one for west of 170° W. Total population numbers and biomass were estimated by summing the regional stratum estimates.

Walleye pollock distribution and abundance were summarized for three areas: the U.S. Exclusive Economic Zone (EEZ) east of 170° W and west of 170° W, and Russia. In the area east of 170° W, pollock distribution and abundance were also examined inside and outside of the Steller sea lion Conservation Area (SCA) as walleye pollock catch quotas are determined separately for these two areas. The AT survey results on the U.S. EBS shelf are presented for the water column down to 3 m off bottom as there are likely proportionally more non-pollock species contributing to acoustic backscatter within 3 m of the bottom, and also the BT survey nominally estimates the component of pollock in that depth stratum in the U.S. EEZ (Lauth and Conner 2014, Ianelli et al. 2014). The two exceptions to the latter practice are 1) in describing the vertical distribution of pollock from the AT survey, and 2) in a table summarizing the time series of acoustic-trawl survey results in the Russian EEZ, AT survey results for the water column to within 0.5 m of the bottom were used instead. The vertical distribution of pollock was computed by plotting the mean biomass in each 10 m depth bin, at the midpoint of each bin, relative to 1) the surface and 2) the sea floor. The overall mean weighted depth and the mean weighted distance off the seafloor (mwd) of adult pollock (30 cm FL), and juvenile pollock (< 30 cm FL) east and west of 170° W in the United States was computed as follows: $(D \times biomass_{,D}) / (biomass)$, where D is depth in meters. Pollock backscatter between 3 m and 0.5 m of the bottom is not sampled as frequently as the layers above 3 m, so pollock estimates from this depth zone should be treated with caution. A retrospective analysis to evaluate the relative contribution of pollock and other fishes to the backscatter in this depth layer is underway and will be reported elsewhere (N. Lauffenburger, pers. commun.)[3].

Relative estimation errors in biomass and abundance estimates associated with spatial structure 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 are used for error computation because they account for the observed spatial structure in fish distribution. These errors quantify the acoustic sampling variability (Rivoirard et al. 2000). Other sources of error (e.g., target strength, trawl sampling) are not evaluated.

RESULTS AND DISCUSSION

Calibration

Acoustic system calibrations were conducted at the start and end of the summer 2014 field season (Table 1). Initial acoustic system settings for the survey were based on results from the 7 June acoustic system calibration. The end-of cruise sphere calibration on 10 August revealed a 0.17 dB decrease in integration gain for the 38-kHz system. Acoustic data were analyzed using an average of the pre- and post-cruise (linearized) gain values. For comparison, this increased initial unadjusted backscatter values by 3.9%.

[3] N. Lauffenburger, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, Seattle WA 98115, pers. commun., June 2015.

Water Temperature

Temperature measurements indicated that the 2014 mean SST of 9.6°C (range 6.4°- 12.4°C; Fig. 2) was much warmer than in 2012 (6.2°C, range 0.65°- 9.4°C), and much warmer than in survey years 2006-2010. The warmest SST observations occurred in the western part of the survey area, as is typical due to seasonal warming of surface waters by late July-early August (Overland et al. 1999). Bottom temperatures in 2014 were also much warmer than in recent years (Fig. 2), though the so-called "cold-pool" (bottom temperatures < 2°C; Wyllie-Echevierria and Wooster, 1998) was still visible on northern ends of survey transects, particularly west of the Pribilof Islands. Temperature-depth profiles at haul locations averaged by geographic area and 1-m vertical depth bin indicate that the water column was vertically stratified throughout the EBS with a thermocline at roughly 20-40 m from the surface (Fig. 3). Temperatures below the mixed layer in the northwest portion of the survey area were generally > 0°C, whereas in previous cold years (2007-2012), temperatures for those depths were well below 0°C. Although the 2014 AT survey was conducted about 2 weeks later than recent surveys (Honkalehto et al. 2009, 2010, 2012, 2013), this did not necessarily explain the relatively warmer conditions; for example, the 2014 AFSC summer BT survey, which was conducted earlier than in previous years, measured similar temperature increases (R. Lauth, AFSC, personal communication).

Trawl Sampling

Biological data and specimens were collected from 142 trawl hauls (Table 2, Fig. 1). The majority of these hauls (122) targeted backscatter during daytime for species classification: 88 with an AWT, 18 with a bottom trawl, and 16 with a Methot trawl. The remaining 20 hauls were often nighttime Marinovich tows near the surface to evaluate gear performance, the net’s suitability for catching age-0 pollock, and the placement of pocket nets to monitor escapement. Catch data for some of these hauls assisted with backscatter classification. CamTrawl camera data were successfully collected for 57 of the AWT hauls from July 6 through the end of the survey. Biological information collected by haul for walleye pollock and other species is presented in Tables 3-7.

Among midwater hauls used to classify backscatter for the survey, walleye pollock was the most abundant species by weight (84.8%) and by number (96.1%), followed by northern sea nettle jellyfish (*Chrysaora melanaster*;14.8% by weight and 2.7% by number; Table 3). Among bottom trawls, pollock was the most abundant species (61.7% by weight and 48.5% by number) followed by northern sea nettle jellyfish (16.6% by weight and 9.5% by number; Table 4). In Marinovich hauls (Table 5), northern sea nettles (91.7%), Pacific herring (4.1%), and age-1+ pollock (3.5%) dominated the catch by weight, while euphausiids (91.1%), northern sea nettles (3.7%), and age-0 pollock (1.8%) dominated the catch numerically. Finally, Methot hauls (Table 6) were dominated by northern sea nettles (76.0%), euphausiids (12.6%), and unidentified jellyfish (10.2%) by weight, respectively, and numerically, by euphausiids (98.4%).

Nearly 42,000 lengths were measured and over 7,931 specimen weights were collected across all species. Of those, over 38,000 lengths and over 6,400 weights were for walleye pollock (Table 7). Additional pollock samples included gonad maturities, otolith pairs, whole ovaries, and age-0 lengths. Most U.S. EEZ pollock were either in the developing or post-spawning maturity stage. A few females were actively spawning (0.24%, n = 4 east of 170° W and 0.41%, n = 7 in the U.S. EEZ west of 170° W; Fig. 4). Walleye pollock mean weight-at-length curves plotted by area suggest very little difference between areas for fish < 42 cm FL (Fig. 5). Fish between 42 and 55 cm FL were slightly heavier east than west of 170° W in the U.S. EEZ.

About 45% of the summed acoustic backscatter at 38 kHz observed between near the surface and 3 m off bottom during the 2014 survey was attributed to adult or juvenile walleye pollock. This was less than in 2012 (56%), 2010 (82%), and 2009 (62%; Honkalehto et al. 2012). The remaining non-pollock water column backscatter to 3 m off bottom was attributed to an undifferentiated plankton-fish mixture (53%), or in a few isolated areas, to rockfishes or other fishes (~2%).

Some differences in geographic distribution were observed between regions of high-density backscatter attributed to pollock above 3 m off bottom compared with that nominally attributed to pollock below 3 m. The former was distributed primarily in a band through the middle portion of the outer shelf, whereas the latter was observed more inshore, primarily on the middle shelf from north of the Pribilof Islands to south of St. Matthew Island, and on the eastern edge of the survey area (Fig. 6). A thorough analysis of the near bottom backscatter layer species composition from the AT survey is underway and will be reported elsewhere (N. Lauffenburger, pers. commun.). In general, walleye pollock become increasingly demersal with increasing shoaling of the EBS shelf, thus they are surveyed in the shallowest shelf areas by the BT survey (Lauth and Conner 2014).

Estimated walleye pollock abundance in midwater along the U.S. Bering Sea shelf was 17.4 billion fish weighing 3.439 million t (Tables 8-10). This was the highest estimated biomass since the 2002 AT survey. Based on the 1D analysis, the relative estimation error of the U.S. EEZ walleye pollock biomass estimate was 0.046 (Table 8). Estimated midwater abundance in Russia (to 3 m off the bottom) was 257 million fish weighing 104 thousand t (3% of total midwater biomass). The majority of the 2014 biomass in the U.S. EEZ spanned a region from north of Unimak Island to northwest of Pervenets Canyon, between the 50 and 200 m isobaths (Fig. 7). Within this area, the highest concentration of adult 30 FL) biomass was observed along transects between Pribilof and Zhemchug Canyons. East of 170° W, pollock abundance was 6.623 billion fish, weighing 1.425 million t (40% of total midwater biomass). This was the highest pollock biomass observed east of the Pribilof Islands since 2002. Pollock biomass increased by a similar amount inside the SCA. In the U.S. EEZ west of 170° W, pollock numbered 10.76 billion and weighed 2.014 million t, which was 57% of total midwater biomass (Fig. 8). Although biomass west of 170° W increased moderately since 2012, the relatively large increase in biomass east of 170° W in 2014 resulted in proportionally less biomass west of 170° W (e.g., only 59% of the U.S. EEZ total) than has been observed since 1994 (75% in 1994, and 60 to 92% between 1996 and 2012; Table 8).

The walleye pollock length composition east of 170° W ranged between 11 and 77 cm FL with modes at 26 and 45 cm (Fig. 8). Most pollock were observed as dense aggregations of 20-30 cm

FL juveniles from about 163° W to the Pribilof Islands. This was unusual as juveniles typically occupy areas north and west of the Pribilof Islands (Honkalehto et al. 2013, 2012, and in earlier reports). The pollock length composition in the U.S. EEZ west of 170° W ranged from 10 to 72 cm FL with modes at 15, 26, and 39 cm FL (Fig. 8). Juveniles comprising two size modes (< 20 cm (age 1), and 20 to 30 cm (age 2)) were observed between the 100-m and 200-m isobaths from west of the Pribilof Islands to the region around Pervenets Canyon. Lengths in Russia ranged from 10 to 77 cm FL with the majority of fish comprising a dominant size mode at 38 cm and a lesser mode at 27 cm FL. Relatively few fish > 50 cm FL were observed in either U.S. or Russian waters (Fig. 8).

The age information for pollock in the U.S. EEZ indicated that juvenile pollock (ages 1, 2 and 4) were dominant numerically (accounting for 26%, 50% and 6% of the population, respectively; Table 11). These three age groups represented 50% of the total biomass. Older pollock (ages 5+) totaled 13% of the population numerically, and made up 44% of the total biomass. Six-year-old fish from the 2008 year class represented 20% of the shelf-wide midwater biomass. Pollock east of 170° W were dominated by 2-year-olds, followed by 6-year-olds (55% and 21% of the biomass east of 170° W, respectively). Pollock west of 170° W in the U.S. EEZ were dominated by 1- and 2-year-old fish, followed by 4-year-olds (5%, 19%, and 21% of biomass west of 170° W, respectively; Fig. 9). In Russia, age-4s were most numerous among the mix of predominantly age 3- to 6-year-old fish.

Vertical distribution of adult and juvenile pollock was examined for the U.S. EEZ by plotting mean biomass in 10-m bins from near the surface to within 0.5 m from the bottom (Fig. 10). The mean weighted depth of pollock biomass for adults (30 cm FL) was about 85 m east of 170° W and 96 m west of 170° W. Note that bottom depths gradually increase to the west. The mean weighted depth of juveniles (< 30 cm FL) east of 170° W (mainly 2-year-olds) was much shallower than the adults (51 m), whereas west of 170° W, juveniles (ages 1 and 2) were found roughly 10 m shallower than adults (87 m). More than 93% of adults across the shelf were found within 50 m of the bottom, whereas for juveniles, the proportion within 50 m of bottom ranged from 75% in the east to 81% in the west. Adult biomass increased towards the bottom, whereas juvenile biomass peaked at about 20-40 m off bottom and decreased towards the bottom.

Historical AT survey pollock abundance trends reveal interesting spatial and temporal patterns. Examining spatial distribution trends (2004-2014) shows that in 2004, pollock backscatter was relatively evenly distributed across the survey area. Between 2006 and 2012, pollock backscatter densities were lower and more concentrated west of 170° W than in the east. In 2014 densities both east and west of the Pribilofs were high, and the spatial pattern was similar to 2004 (Fig. 11). Biomass point estimates for midwater pollock between 1994 and 2014 show that 2014 is the highest since 2002, and nearly double 2012 (Table 8). Biomass-at-length and numbers-at-age since 1994 illustrate temporal patterns in the relative contribution of different size and age groups, respectively, to the point estimates (Figs. 12, 13, and Table 11). The 2008 year class, which in 2010 was the most numerous age-2 group detected by the AT survey since 1994, remains abundant in 2014. However the 2-year-old 2012 year class became the most abundant juvenile age group observed in the time series since 1994 (except for the 1996 year class in 1997). The 1-year-old (2013 year class) looks relatively strong, at about ¼ the biomass of the strong 1996 year class. The 2006 year class, which in 2007 was the most numerous age-1 group detected by the AT survey since the 1996 year class, has largely diminished in the 2014 midwater population. Juveniles (pollock smaller than ~35 cm) contributed relatively more to population biomass within a given year in the 1990s-early 2000s, and since 2007, than they did between 2003 and 2006 when recruitment was low.

The 2014 average length-at-age for pollock in the U.S. EEZ east and west of 170° W was similar to the average length-at-age for these two strata between 1999 and 2012 (Fig. 14). In general, length-at-age tended to be greater in the east than in the west, even though it was measured up to one month earlier, supporting the use of two separate age-length keys in scaling abundance-at-length to abundance-at-age. Comparing average weight-at-age for 2014 with average weight-at-age for 1999-2012 showed correspondingly higher weights-at-age east than west of 170° W, especially among older fish (Fig. 14). The 2014 average weights-at-age were similar to those for 1999-2012.

The walleye pollock biomasses estimated in the U.S. EEZ to 3 m off bottom, and from 3 to 0.5 m off bottom, were compared east and west of 170° W and for the whole survey between 1999 and 2014 (Fig. 15). The percentage of total biomass for the U.S. EEZ between 3 and 0.5 m off bottom ranged from 19% to 35% in 1999-2009, decreased to 11% in 2010, and has increased since then to 28% in 2014. East of 170° W, 33% of the pollock biomass was below 3 m off bottom, while west of 170° W, 25% was below 3 m. Typically a much higher percentage of pollock observed above 3 m, west of 170° W, has corresponded to generally greater abundance of juveniles in the west compared to the east, as juveniles tend to aggregate higher in the water column than adults. The percentages in 2014 were more similar due to the unusually large biomass of age-2 juveniles observed east of 170° W. Near-bottom estimates (0.5 to 3.0 m) should be treated with caution and are currently undergoing improvements.

The AFSC has surveyed the Cape Navarin area of Russia during summers 1994, 2004, 2007-2010, 2012, and 2014. The U.S. EEZ survey in 2002 took place at the same time the Russian research vessel *Professor Kaganovskiy* was conducting an acoustic-trawl survey of the Russian EEZ near Cape Navarin. The results of these surveys indicate that the distribution of pollock backscatter in this region of Russia has varied, perhaps due to oceanographic variability or based on the age composition of the population in this northern boundary region (Fig. 16). Abundance estimates have also varied. Pollock biomass in Russia to within 0.5 m of the bottom comprised only 3% of the total combined U.S. and Russian Bering Sea shelf estimate in 2014. The biomass estimates in this region have ranged from 1% (2009) to 22% (2012) of the total since 1994 (Table 12).

The non-pollock portion of observed midwater acoustic backscatter at 38 kHz (“non-pollock backscatter”), comprising a temporally-varying mixture of largely unidentified zooplankton and fishes, has varied spatially over the AT survey time series. Most non-pollock backscatter (at

38 kHz) is observed in the upper part of the water column above the thermocline (Honkalehto et al. 2008). Non-pollock backscatter observed in 2014, a warm year, covered a broad region around the Pribilofs (Fig. 17). Non-pollock backscatter observed in 2004 covered large portions of the survey area on the middle shelf from the Alaska Peninsula to Cape Navarin, Russia. It diminished during years of relatively cold Bering Sea conditions between 2006 and 2010. When concentrations were observed (e.g., in 2007, 2008, 2012), they were generally in the vicinity of the Pribilof Islands. This backscatter information should be interpreted with care because the exact biological composition of the scatterers is unknown.

An Acoustic Index of Euphausiid Biomass in the EBS

Euphausiids, principally *Thysanoessa inermis* and *T. raschii*, are among the most important prey items for walleye pollock in the Bering Sea (e.g., Livingston 1991, Lang et al. 2000, Brodeur et al. 2002). Backscatter data at four frequencies (18, 38, 120, and 200 kHz) and Methot trawl sampling (2004-2014) were used to classify euphausiid backscatter and create an index of euphausiid biomass on the Bering Sea shelf from 2004 to the present (De Robertis et al. 2010, Ressler et al. 2012). Nine Methot trawls targeted suspected euphausiid backscatter during the 2014 AT survey. Preliminary results show the spatial distribution and relative magnitude of the euphausiid backscatter across the survey area, with highest backscatter densities appearing on the southeastern shelf north of Unimak Pass (Fig. 18). The total amount of euphausiid backscatter observed was only slightly greater than in 2004, the lowest value of the euphausiid time series.

ACKNOWLEDGMENTS

The authors thank the officers and crew of the NOAA ship *Oscar Dyson* for their proficient field support. They thank the MACE lead scientists and staff for excellent field work and data analysis support. Thanks to the NOAA Teacher at Sea Program for providing excellent teachers to help staff our scientist team. We also thank the Ministry of Foreign Affairs of the Russian Federation for permitting the *Oscar Dyson* to work in the Russian EEZ.

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TABLES AND FIGURES

Table 1. -- Simrad ER60 38 kHz acoustic system description and settings used during the summer 2014 acoustic-trawl surveys of walleye pollock in the eastern Bering Sea, results from standard sphere acoustic system calibrations conducted in association with the surveys, and final analysis parameters.

		System settings	12 June Captain's Bay Unalaska	13 Aug. Captain's Bay Unalaska	Final analysis parameters
Echosounder		Simrad ER60	--	--	Simrad ER60
Transducer		ES38B	--	--	ES38B
Frequency (kHz)		38	--	--	38
Transducer depth (m)		9.15	--	--	9.15
Pulse length (ms)		0.512	--	--	0.512
Transmitted power (W)		2000	--	--	2000
Angle sensitivity	Along	22.76	--	--	22.76
	Athwart	21.37	--	--	21.37
2-way beam angle (dB)		-20.74	--	--	-20.74
Gain (dB)		21.98	21.98	21.94	21.96
s_A correction (dB)		-0.50	-0.50	-0.63	-0.56
Integration gain (dB)		21.48	21.48	21.31	21.40
3 dB beamwidth	Along	6.73	6.73	6.84	6.79
	Athwart	7.15	7.15	7.23	7.19
Angle offset	Along	-0.04	-0.04	-0.04	-0.04
	Athwart	-0.06	-0.06	-0.06	-0.06
Post-processing sv threshold (dB)		-70	--	--	--
Measured standard sphere TS (dB)		--	-42.46	-42.27	--
Sphere range from transducer (m)		--	19.16	19.89	--
Absorption coefficient (dB/m)		0.0100	0.0100	0.0096	--
Sound velocity (m/s)		1470.0	1470.6	1482.0	--
Water temp at transducer (ºC)		--	6.7	9.8	--

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

Table 2. -- Trawl stations and catch data summary from the summer 2014 eastern Bering sea shelf walleye pollock acoustic trawl survey aboard the NOAA ship *Oscar Dyson*.

Haul	area	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	footrope	bottom	headrope	surface[b]	(kg)	number	(kg)
1	U.S. east of 170	Methot	14-Jun	6:37	20	56 59.07	-162 6.73	13	63	6.1	7.7	-	-	0.1
2	U.S. east of 170	Methot	14-Jun	8:03	10	56 59.18	-162 5.22	16	63	5.2	7.7	-	-	28.4
3	U.S. east of 170	Marinovich	14-Jun	12:35	10	56 58.21	-162 7.10	49	63	4.2	7.4	-	-	182.6
4	U.S. east of 170	Marinovich	14-Jun	16:42	12	56 43.44	-162 6.98	48	74	3.8	7.8	-	-	511.3
5	U.S. east of 170	Marinovich	14-Jun	18:28	10	56 43.42	-162 6.87	25	74	7.4	7.8	-	1	1,174.6
6	U.S. east of 170	Methot	14-Jun	22:54	10	56 20.20	-162 10.26	22	74	6.9	8.6	-	-	-
7	U.S. east of 170	Methot	14-Jun	23:51	5	56 20.00	-162 10.57	19	74	7.5	8.8	-	-	33.4
8	U.S. east of 170	83-112	15-Jun	2:04	23	56 20.00	-162 10.88	74	74	3.6	9.2	216.2	145	589.4
9	U.S. east of 170	83-112	15-Jun	5:26	27	56 9.43	-162 10.40	75	76	3.7	9.6	200.7	369	400.7
10	U.S. east of 170	Marinovich	15-Jun	10:39	15	55 52.82	-162 28.87	64	69	4	8.7	30.8	25	774.4
11	U.S. east of 170	AWT	15-Jun	17:31	25	55 51.92	-162 46.90	76	79	3.7	9.1	225.9	257	847.4
12	U.S. east of 170	AWT	16-Jun	6:38	7	56 54.84	-163 20.70	57	68	3.7	8.3	14.7	98	275.7
13	U.S. east of 170	83-112	16-Jun	8:30	16	57 0.90	-163 20.43	66	66	4	8.1	253.5	172	768.2
14	U.S. east of 170	Marinovich	16-Jun	12:53	5	56 48.64	-163 20.84	62	71	3.5	8.4	4.6	30	947.0
15	U.S. east of 170	AWT	16-Jun	16:10	12	56 42.36	-163 21.03	55	74	3.4	8.4	1,260.5	9,086	372.5
16	U.S. east of 170	AWT	16-Jun	22:31	49	56 0.54	-163 22.09	85	88	3.8	8.8	330.0	373	614.8
17	U.S. east of 170	AWT	17-Jun	16:23	21	55 35.09	-163 57.59	70	95	4.1	8.6	96.9	696	524.9
18	U.S. east of 170	AWT	17-Jun	21:04	1	56 2.88	-163 57.05	71	91	3.9	8.3	566.9	4,455	82.0
19	U.S. east of 170	Methot	17-Jun	23:41	20	56 11.46	-163 59.14	84	89	3.8	8.4	-	-	23.4
20	U.S. east of 170	AWT	18-Jun	7:54	11	56 59.97	-163 56.34	47	69	3.2	7.4	627.7	4,539	288.1
21	U.S. east of 170	Methot	19-Jun	17:08	15	54 23.18	-165 6.76	139	147	4.6	6.5	-	-	3.0
22	U.S. east of 170	AWT	19-Jun	22:26	25	54 59.91	-165 6.89	104	111	4.7	7.1	168.3	223	11.1
23	U.S. east of 170	AWT	20-Jun	5:54	10	55 48.88	-165 8.65	73	100	4.3	7.8	723.3	5,040	403.9
24	U.S. east of 170	AWT	21-Jun	1:20	9	57 13.13	-165 54.44	63	71	2.8	8.4	9.8	18	328.0
25	U.S. east of 170	AWT	21-Jun	8:20	6	56 19.84	-165 47.03	47	92	6.6	7.8	613.9	4,910	185.3
26	U.S. east of 170	AWT	21-Jun	18:03	14	55 43.09	-165 45.37	100	116	4.2	7.8	339.2	1,198	21.8
27	U.S. east of 170	Methot	21-Jun	22:03	16	55 25.34	-165 44.70	97	119	4.2	8.4	-	-	11.6
28	U.S. east of 170	AWT	22-Jun	4:12	44	54 53.76	-165 43.26	131	133	4.1	8.2	1,305.1	1,779	41.9
29	U.S. east of 170	AWT	22-Jun	7:38	20	54 46.88	-165 42.91	131	185	4.1	7.8	538.8	697	45.2
30	U.S. east of 170	Marinovich	22-Jun	10:09	55	54 41.73	-165 45.04	205	328	3.8	7.7	1.4	1	73.9
31	U.S. east of 170	AWT	23-Jun	2:30	25	55 23.87	-166 19.41	128	131	4	9.3	858.2	1,124	6.9
32	U.S. east of 170	AWT	23-Jun	8:49	27	56 2.64	-166 21.61		123	4.1	9.4	499.1	3,406	126.5
33	U.S. east of 170	Methot	23-Jun	21:52	15	57 28.19	-166 26.27	62	68	2.7	7.6	-	-	21.0
34	U.S. east of 170	83-112	23-Jun	23:20	15	57 28.30	-166 26.28	68	68	2.8	7.7	14.0	14	97.2
35	U.S. east of 170	AWT	24-Jun	8:43	39	56 45.08	-167 0.80	62	86	3.1	7.8	131.2	190	98.4
36	U.S. east of 170	AWT	24-Jun	19:57	3	55 42.14	-166 57.44	111	134	4.1	9	2,390.9	14912	13.1
37	U.S. east of 170	AWT	25-Jun	8:35	45	55 8.29	-167 29.62	152	175	4.3	8.6	134.0	158	3.7

Table 2. -- Cont.

Haul	Area	Gear[a]	Date	Time	Duration	Start position				Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)		Long. (W)		footrope	bottom	headrope	surface[b]	(kg)	number	(kg)
38	U.S. east of 170	AWT	25-Jun	18:00	44	55	33.2	-167	32.34	128	137	4.3	8.5	1269.4	1649	0.6
39	U.S. east of 170	AWT	26-Jun	2:27	4	56	37.9	-167	38.08	66	108	4	8.4	423.3	2950	180.9
40	U.S. east of 170	83-112	26-Jun	9:03	30	57	28.3	-167	42.71	71	72	3.2	7.4	419.7	542	578.3
41	U.S. east of 170	Methot	26-Jun	16:15	8	57	45.3	-167	44.34	20	69		7.4	0	0	20.3
42	U.S. east of 170	AWT	26-Jun	23:00	15	57	37	-168	21.18	54	71	2.7	8.2	0	0	28.3
43	U.S. east of 170	AWT	27-Jun	8:32	29	56	7	-168	11.6	124	151	4.4	8.8	107	115	4.3
44	U.S. east of 170	83-112	27-Jun	22:22	30	55	48.8	-168	45.59	145	150	4.2	8.6	203.8	205	29.5
45	U.S. east of 170	Methot	28-Jun	2:40	37	56	16.6	-168	49.15	117	133	4.1	9.1	0	0	0.8
46	U.S. east of 170	AWT	28-Jun	6:06	24	56	33	-168	49.12	90	105	3.5	8.7	1026.5	1406	75.5
47	U.S. east of 170	83-112	28-Jun	16:43	22	57	3.87	-168	53.84	78	80	3.2	8.6	656.4	949	88.4
48	U.S. east of 170	AWT	29-Jun	8:51	12	57	45.7	-169	36.68	31	70	6.9	7.8	0	0	249.9
49	U.S. east of 170	Methot	29-Jun	10:55	10	57	45.7	-169	37.17	16	70	7.2	7.7	0	0	9
50	U.S. east of 170	Methot	29-Jun	11:33	10	57	45.6	-169	36.53	23	70	2.3	7.7	0	0	8.4
51	U.S. east of 170	83-112	29-Jun	17:25	15	57	16	-169	32.32	72	63	3	7.4	439	639	48.7
52	U.S. east of 170	AWT	5-Jul	21:54	27	56	24.6	-169	26.7	84	120	3.9	9.9	143.4	182	137.2
53	U.S. west of 170	AWT	6-Jul	5:46	29	56	20.6	-170	2.19	84	109	3.7	10.1	20.7	29	145.3
54	U.S. west of 170	83-112	6-Jul	17:02	30	56	38.3	-170	4.51	8	98	4.3	9.5	221.4	281	180
55	U.S. west of 170	83-112	7-Jul	0:50	25	57	39.5	-170	13.68	69	73	2.1	9.8	177.2	283	377.1
56	U.S. west of 170	Methot	8-Jul	1:10	20	59	5.82	-171	6.69	65	78	0	8.8	0	0	17
57	U.S. west of 170	AWT	8-Jul	8:16	15	58	8.49	-170	57.02	80	86	3.2	9.7	593.7	1019	84.7
58	U.S. west of 170	AWT	8-Jul	17:33	35	57	43.1	-170	52.77	79	85	3.3	9.9	685.4	1082	970.6
59	U.S. west of 170	AWT	9-Jul	0:35	11	57	3.58	-170	46.1	71	89	4.5	10.7	0	0	513.3
60	U.S. west of 170	83-112	9-Jul	3:26	20	56	55	-170	44.77	101	103	4	10.7	91.6	132	476
61	U.S. west of 170	AWT	9-Jul	10:32	32	56	11.9	-170	36.97	123	130	4.2	10.3	35.8	52	4.5
62	U.S. west of 170	AWT	9-Jul	21:51	20	56	32.8	-171	17.4	120	127	4.1	10.9	723.8	1117	44.4
63	U.S. west of 170	AWT	10-Jul	4:40	15	57	15	-171	24.59	84	103	3.8	12.2	3.2	5	265.8
64	U.S. west of 170	83-112	10-Jul	7:31	23	57	22.3	-171	25.92	99	101	3.4	11.6	37.4	58	74.8
65	U.S. west of 170	Marinovich	10-Jul	11:29	30	57	21.2	-171	26.52	24	102	7.9	11.4	0	0	251.4
66	U.S. west of 170	AWT	10-Jul	17:56	25	57	37.2	-171	28.7	82	99	3.5	9.9	1480.4	10242	39.6
67	U.S. west of 170	AWT	11-Jul	0:22	22	58	5.4	-171	33.85	90	97	2.9	9.9	385.4	880	126.8
68	U.S. west of 170	83-112	11-Jul	4:15	15	58	12.5	-171	35.16	92	97	2.8	9.9	165.1	267	41.4
69	U.S. west of 170	Marinovich	11-Jul	9:29	46	58	38.8	-171	38.36	21	93	6.7	9.2	0	0	431.9
70	U.S. west of 170	83-112	12-Jul	4:03	22	59	36.8	-172	30.02	82	85	1.3	8.6	121.4	215	65.8
71	U.S. west of 170	AWT	12-Jul	21:20	52	58	10.8	-172	12.7	98	103	2.6	9.8	417.8	828	33
72	U.S. west of 170	AWT	13-Jul	1:06	1	58	4.3	-172	11.43	84	104	2.7	10.1	7	14	29.6
73	U.S. west of 170	AWT	13-Jul	5:28	14	57	53.6	-172	9.41	92	107	3.2	9.9	491.2	6940	7.7
74	U.S. west of 170	Marinovich	13-Jul	11:03	6	57	31	-172	1.77	25	109	8.5	10.1	0	0	61.9
75	U.S. west of 170	AWT	13-Jul	17:55	24	57	8.68	-172	0.73	69	113	5.2	9.8	0	0	36.2

Table 2. -- Cont.

Haul no.	Area	Gear[a] type	Date (GMT)	Time (GMT)	Duration (minutes)	Start position Lat. (N)	Start position Long. (W)	Depth (m) footrope	Depth (m) bottom	Temp. (°C) headrope	Temp. (°C) surface[b]	Walleye pollock (kg)	Walleye pollock number	Other (kg)
76	U.S. west of 170	AWT	13-Jul	23:12	77	56 45.19	-171 56.52	57	119	5.8	10.3	-	-	-
77	U.S. west of 170	83-112	14-Jul	4:22	9	56 33.20	-171 54.53	145	145	4	11.1	46.3	68	54.6
78	U.S. west of 170	AWT	14-Jul	10:20	18	56 32.96	-172 31.33	277	303	3.8	10.6	3.5	4	11.6
79	U.S. west of 170	Methot	14-Jul	18:46	15	57 0.96	-172 36.44	116	122	4.1	10.8	-	-	1.9
80	U.S. west of 170	83-112	15-Jul	0:25	8	57 31.44	-172 42.82	117	119	3.2	12	2,119.5	2,959	21.5
81	U.S. west of 170	AWT	15-Jul	4:16	12	57 48.35	-172 46.58	109	116	2.7	12.4	238.3	5,896	6.5
82	U.S. west of 170	AWT	15-Jul	8:04	10	58 2.79	-172 49.37	95	109	2.6	11.3	301.4	10,234	30.8
83	U.S. west of 170	AWT	15-Jul	17:55	9	58 22.54	-172 53.65	91	110	2.6	10.2	1,513.6	16,013	6.4
84	U.S. west of 170	Marinovich	15-Jul	23:30	37	58 50.27	-172 59.82	31	110	5.2	10.2	79.6	431	181.9
85	U.S. west of 170	AWT	16-Jul	6:41	46	59 32.69	-173 8.24	90	99	1.6	9.5	390.6	813	19.3
86	U.S. west of 170	Marinovich	16-Jul	10:11	45	59 36.88	-173 6.55	22	97	8.8	9.6	-	-	466.2
87	U.S. west of 170	Methot	17-Jul	3:21	30	60 44.00	-174 4.73	60	87	1.4	9.1	-	-	17.9
88	U.S. west of 170	AWT	17-Jul	9:46	37	60 15.65	-173 56.52	83	92	0.5	9	426.0	654	8.9
89	U.S. west of 170	AWT	17-Jul	18:18	38	59 50.39	-173 52.17	94	102	1.9	9.4	431.3	782	28.7
90	U.S. west of 170	AWT	18-Jul	0:47	26	59 13.88	-173 42.46	100	112	2.2	9.9	282.9	5,215	27.1
91	U.S. west of 170	AWT	18-Jul	6:32	29	58 55.49	-173 39.02	91	121	2.8	10.1	-	-	-
92	U.S. west of 170	AWT	18-Jul	8:28	8	58 52.38	-173 36.35	89	121	2.8	10.3	230.2	5,724	20.8
93	U.S. west of 170	AWT	18-Jul	21:50	35	58 7.00	-173 27.32	101	112	2.9	10.2	1,016.2	2,301	2.1
94	U.S. west of 170	AWT	19-Jul	19:50	15	58 28.73	-174 11.71	126	135	3.7	10.1	22.2	33	0.7
95	U.S. west of 170	83-112	19-Jul	21:25	17	58 29.52	-174 9.23	132	134	3.8	10.1	280.1	444	93.5
96	U.S. west of 170	AWT	20-Jul	19:42	20	57 17.83	-173 15.48	68	122	4.8	10.1	-	-	11.9
97	U.S. west of 170	AWT	21-Jul	0:24	14	56 52.62	-173 10.49	139	141	3.9	10.6	196.5	307	11.3
98	U.S. west of 170	Marinovich	28-Jul	12:55	30	58 30.46	-174 11.42	19	136	10.4	10.7	-	-	12.4
99	U.S. west of 170	AWT	28-Jul	17:43	14	58 48.92	-174 16.92	127	137	3.4	11.2	587.9	7,050	3.8
100	U.S. west of 170	AWT	29-Jul	1:08	17	59 36.18	-174 29.46	107	118	2.3	10.9	810.6	2,082	6.4
101	U.S. west of 170	AWT	29-Jul	9:15	41	60 39.21	-174 46.40	90	99	0.8	10.5	412.5	1,647	3.4
102	U.S. west of 170	Marinovich	29-Jul	12:17	31	60 38.34	-174 45.85	24	98	9.3	10.3	-	-	214.8
103	U.S. west of 170	83-112	29-Jul	20:37	15	61 40.76	-175 4.15	84	86	-0.7	9.9	1,144.3	1,567	57.7
104	U.S. west of 170	AWT	30-Jul	8:23	33	60 59.09	-175 33.60	93	105	0.7	10.1	447.5	811	1.4
105	U.S. west of 170	Marinovich	30-Jul	11:22	31	60 58.98	-175 33.48	93	104	0.7	10.1	-	-	96.5
106	U.S. west of 170	AWT	30-Jul	18:58	16	60 27.88	-175 24.22	103	111	1.2	10.3	623.8	1,626	31.2
107	U.S. west of 170	AWT	30-Jul	23:42	13	60 2.44	-175 16.82	110	117	2.2	10.8	876.1	2,527	13.5
108	U.S. west of 170	AWT	31-Jul	4:26	4	59 37.75	-175 9.80	109	128	2.3	11.6	1,995.9	10,759	0.1
109	U.S. west of 170	AWT	31-Jul	16:51	13	59 4.42	-175 0.40	115	130	2.8	10.9	163.1	3,258	0.6
110	U.S. west of 170	AWT	1-Aug	2:50	17	58 51.17	-175 35.81	122	131	2.4	11.2	518.5	1,112	0.2
111	U.S. west of 170	AWT	1-Aug	8:16	9	59 24.69	-175 45.61	104	137	2.4	11.6	821.0	7,425	3.7
112	U.S. west of 170	Marinovich	1-Aug	12:53	30	59 28.23	-175 49.15	32	137	10.6	11.5	1.6	9	1.1
113	U.S. west of 170	AWT	1-Aug	18:09	4	59 50.65	-175 54.02	117	135	2.1	11.4	570.1	1,946	15.3
114	U.S. west of 170	AWT	1-Aug	23:32	44	60 35.94	-176 8.21	76	120	3.1	10.9	550.2	3,142	19.4
115	U.S. west of 170	AWT	2-Aug	3:40	40	60 54.24	-176 12.44	58	115	1.9	10.9	500.0	3,190	36.9

Table 2. -- Cont.

Haul no.	Area	Gear[a] type	Date (GMT)	Time (GMT)	Duration (minutes)	Start position Lat. (N)	Start position Long. (W)	Depth (m) footrope	Depth (m) bottom	Temp. (°C) headrope	Temp. (°C) surface[b]	Walleye pollock (kg)	Walleye pollock number	Other (kg)
116	U.S. west of 170	AWT	2-Aug	8:52	30	61 30.13	-176 24.14	95	108	0.8	10.7	723.5	1663	4.2
117	U.S. west of 170	Marinovich	2-Aug	13:16	30	61 30.42	-176 23.27	36	107	2.6	10.3	22.3	61	35.8
118	U.S. west of 170	AWT	3-Aug	2:39	22	61 52.35	-177 56.64	120	126	1.3	11.9	645.5	1,450	1.7
119	U.S. west of 170	AWT	3-Aug	8:22	7	61 14.71	-177 41.75	117	141	2	11.2	1,161.9	3,374	1.4
120	U.S. west of 170	Marinovich	3-Aug	12:32	30	61 12.41	-177 38.02	35	140	4.1	11.4	38.4	201	13.9
121	U.S. west of 170	AWT	3-Aug	18:18	8	60 50.00	-177 33.68	104	137	2	11.2	474.9	3,293	9.4
122	U.S. west of 170	AWT	3-Aug	22:51	12	60 14.24	-177 20.81	134	140	1.8	11.8	456.1	1,221	8.6
123	U.S. west of 170	AWT	4-Aug	3:58	26	59 37.30	-177 8.15	149	189	3.1	11.7	21.6	37	0.6
124	U.S. west of 170	AWT	4-Aug	23:03	14	59 3.78	-176 16.94	134	139	2.4	12	578.4	1,482	10.9
125	U.S. west of 170	AWT	5-Aug	3:00	2	59 23.97	-176 22.71	124	137	1.9	12.1	462.7	3,531	1.6
126	U.S. west of 170	AWT	5-Aug	8:45	6	60 12.80	-176 39.70	100	139	2	12	371.3	4,422	0.4
127	U.S. west of 170	Marinovich	5-Aug	10:51	30	60 12.79	-176 40.04	38	139	3.4	12	27.1	622	3.9
128	U.S. west of 170	AWT	5-Aug	17:38	7	60 31.72	-176 46.83	118	134	1.9	11.6	702.0	6,816	-
129	U.S. west of 170	AWT	5-Aug	22:38	10	61 8.36	-176 59.68	74	122	1.3	11.3	391.0	4,400	0.1
130	U.S. west of 170	AWT	6-Aug	2:29	3	61 34.75	-177 9.60	109	117	1	11.5	1,061.9	3,949	0.9
131	U.S. west of 170	AWT	6-Aug	17:33	8	60 52.32	-178 16.75	136	163	2.1	11.8	384.2	1,159	17.9
132	U.S. west of 170	AWT	6-Aug	22:08	16	60 24.16	-178 5.28	133	157	2	12.3	618.1	1,561	0.3
133	U.S. west of 170	AWT	7-Aug	2:36	11	60 4.60	-177 57.63	134	145	2	11.9	763.7	2,031	2.8
134	U.S. west of 170	Marinovich	7-Aug	14:38	30	59 5.31	-177 36.03	21	142	11.1	11.6	-	-	8.8
135	U.S. west of 170	AWT	8-Aug	17:01	48	60 37.77	-178 51.01	160	228	2.4	11.7	11.0	20	3.4
136	Russia	AWT	9-Aug	1:10	20	61 29.67	-179 14.00	100	145	2.9	11.6	375.5	985	34.0
137	Russia	Marinovich	9-Aug	9:02	30	62 19.46	-179 36.46	23	123	10.7	11.4	-	-	242.6
138	U.S. west of 170	AWT	10-Aug	5:47	30	60 33.87	-178 49.82	237	245	3.3	11.5	223.4	365	0.1
139	U.S. west of 170	AWT	10-Aug	16:16	5	60 52.71	-176 54.38	107	125	1.6	11	205.0	3,023	0.7
140	U.S. west of 170	AWT	11-Aug	1:10	15	60 12.69	-174 42.91	81	106	1.4	11.7	1,085.7	3,380	38.7
141	U.S. west of 170	AWT	11-Aug	15:08	40	58 40.00	-174 52.96	220	228	3.7	11.7	13.3	17	14.9
142	U.S. west of 170	Methot	11-Aug	22:42	20	58 7.42	-174 6.30	136	135	3.7	11.8	-	-	0.9

[a]AWT = Aleutian wing trawl, 83-112 = eastern bottom trawl, Methot = Methot trawl, Marinovich = small mesh midwater trawl
[b]shipboard sensor at 1.4 m depth.

Table 3.--Catch by species, and numbers of individual length and weight measurements taken from 88 Aleutian wing (midwater) trawls during the summer 2014 acoustic-trawl survey of walleye pollock on the eastern Bering Sea shelf.

		Catch				Individual measurements	
Species name	Scientific name	Weight (kg)	%	Number	%	Length	Weight
walleye pollock (age 1+)	*Gadus chalcogrammus*	43,308.5	84.8	224,399	96.1	33,426	5,545
northern sea nettle	*Chrysaora melanaster*	7,543.4	14.8	6,302	2.7	829	580
chum salmon	*Oncorhynchus keta*	98.2	0.2	53	<0.1	46	42
Pacific ocean perch	*Sebastes alutus*	33.4	0.1	35	<0.1	35	10
Pacific cod	*Gadus macrocephalus*	21.6	<0.1	15	<0.1	7	2
Pacific herring	*Clupea pallasi*	19.4	<0.1	116	<0.1	43	42
smooth lumpsucker	*Aptocyclus ventricosus*	11.8	<0.1	7	<0.1	6	6
Aequorea sp .	*Aequorea* spp.	7.7	<0.1	37	<0.1	20	16
jellyfish unident.	Scyphozoa (class)	7.4	<0.1	709	0.3	55	43
chinook salmon	*Oncorhynchus tshawytscha*	6.5	<0.1	2	<0.1	2	1
yellowfin sole	*Limanda aspera*	6.4	<0.1	9	<0.1	1	1
eulachon	*Thaleichthys pacificus*	4.7	<0.1	106	<0.1	106	32
prowfish	*Zaprora silenus*	4.4	<0.1	5	<0.1	3	3
squid unident.	Teuthoidea (order)	3.6	<0.1	124	0.1	63	53
rock sole sp .	*Lepidopsetta* spp.	3.3	<0.1	5	<0.1	4	4
flathead sole	*Hippoglossoides elassodon*	2.4	<0.1	6	<0.1	2	2
Aleutian skate	*Bathyraja aleutica*	1.5	<0.1	1	<0.1		
Pacific lamprey	*Lampetra tridentata*	1.0	<0.1	3	<0.1	1	
fried egg jellyfish	*Phacellophora camtchatica*	0.9	<0.1	5	<0.1	4	4
arrowtooth flounder	*Atheresthes stomias*	0.9	<0.1	1	<0.1	1	1
walleye pollock (age 0)	*Gadus chalcogrammus*	0.9	<0.1	1,413	0.6	297	
Atka mackerel	*Pleurogrammus monopterygius*	0.6	<0.1	1	<0.1	1	
magistrate armhook squid	*Berryteuthis magister*	0.6	<0.1	1	<0.1		
southern rock sole	*Lepidopsetta bilineata*	0.6	<0.1	1	<0.1	1	
moon jelly	*Aurelia labiata*	0.5	<0.1	23	<0.1		
lamprey unident.	Petromyzontidae (family)	0.2	<0.1	1	<0.1		
shrimp unident.	Decapoda (order)	0.2	<0.1	90	<0.1	30	10
capelin	*Mallotus villosus*	0.0	<0.1	2	<0.1	2	2
northern smoothtongue	*Leuroglossus schmidti*	0.0	<0.1		<0.1		
amphipod unident.	Amphipoda (order)	0.0	<0.1	6	<0.1		
euphausiid unident.	Euphausiidae (family)	0.0	<0.1	4	<0.1		
fish larvae unident.	*Actinopterygii (class)*	0.0	<0.1	1	<0.1		
Total		51,090.3		233,483		34,985	6,399

Table 4.--Catch by species, and numbers of individual length and weight measurements taken from 18 83-112 bottom trawls during the summer 2014 acoustic-trawl survey of walleye pollock on the eastern Bering sea shelf.

		Catch				Individual measurements	
Species name	Scientific name	Weight (kg)	%	Number	%	Length	Weight
walleye pollock (age 1+)	*Gadus chalcogrammus*	6807.4	61.7	9309	48.5	4166	918
northern sea nettle	*Chrysaora melanaster*	1831.7	16.6	1824	9.5	247	130
rock sole spp.	*Lepidopsetta* spp.	363.8	3.3	1076	5.6	141	27
yellowfin sole	*Limanda aspera*	246.0	2.2	579	3.0	137	13
Pacific cod	*Gadus macrocephalus*	199.3	1.8	143	0.7	139	30
unsorted shells, etc.	-	189.9	1.7	-	-		
Pacific ocean perch	*Sebastes alutus*	184.8	1.7	204	1.1	20	
sponge unident.	Porifera (phylum)	140.2	1.3	1115	5.8		
sea peach	*Halocynthia aurantium*	133.5	1.2	513	2.7		
snow crab	*Chionoecetes opilio*	101.4	0.9	355	1.8		
red king crab	*Paralithodes camtschaticus*	98.7	0.9	81	0.4		
basketstar	*Gorgonocephalus eucnemis*	90.3	0.8	229	1.2		
starfish unident.	Asteroidea (class)	79.5	0.7	386	2.0		
arrowtooth flounder	*Atheresthes stomias*	67.5	0.6	115	0.6	81	18
flathead sole	*Hippoglossoides elassodon*	57.8	0.5	161	0.8	116	39
snail unident.	Gastropod (class)	53.7	0.5	655	3.4		
Evasterias spp.	*Evasterias* spp.	44.9	0.4	0	0.0		
mottled sea star	*Evasterias troschelii*	43.6	0.4	33	0.2		
hermit crab unident.	Paguridae (family)	33.5	0.3	546	2.8		
Tanner crab	*Chionoecetes bairdi*	33.3	0.3	95	0.5		
great sculpin	*Myoxocephalus polyacathocephalus*	26.4	0.2	8	0.0		
Alaska skate	*Bathyraja parmifera*	23.0	0.2	7	0.0		
Aleutian skate	*Bathyraja aleutica*	21.9	0.2	3	0.0		
empty gastropod shells	-	20.5	0.2	337	1.8		
Pacific halibut	*Hippoglossus stenolepis*	14.1	0.1	5	0.0	1	1
skate unident.	Rajidae (family)	11.9	0.1	3	0.0	2	2
Alaska plaice	*Pleuronectes quadrituberculatus*	11.0	0.1	11	0.1	7	7
yellow Irish lord	*Hemilepidotus jordani*	9.8	0.1	9	0.0	4	4
hybrid tanner crab	*Chionoecetes* spp.	9.7	0.1	68	0.4		
crab unident.	Decapoda (order)	8.7	0.1	59	0.3		
Bering skate	*Bathyraja interrupta*	8.6	0.1	2	0.0		
purple-orange sea star	*Asterias amurensis*	8.3	0.1	208	1.1		
sand dollar unident.	Clypeasteroida (order)	8.1	0.1	391	2.0		
tunicate unident.	Ascidiacea (class)	5.0	<0.1	18	0.1		
sturgeon poacher	*Podothecus acipenserinus*	4.9	<0.1	43	0.2		
Dover sole	*Microstomus pacificus*	4.6	<0.1	4	0.0	4	
sea anemone unident.	Actiniaria (order)	4.6	<0.1	17	<0.1		
crab unident.	*Hyas* spp.	4.1	<0.1	40	0.2		
empty bivalve shells	empty bivalve shells	3.9	<0.1	11	0.1		
horsehair crab	*Erimacrus isenbeckii*	3.8	<0.1	3	<0.1		
barnacle unident.	Cirripedia (infraclass)	3.4	<0.1	6	<0.1		
brittlestarfish unident.	Ophiuroid unident.	2.8	<0.1	224	1.2		
sea potato	*Styela rustica*	2.5	<0.1	48	0.3		
whelk unident.	Buccinidae (family)	2.1	<0.1	30	0.2		
jellyfish unident.	Scyphozoa (class)	1.9	<0.1	32	0.2	10	10
starry flounder	*Platichthys stellatus*	1.7	<0.1	1	<0.1		
snail eggs	Gastropod (class)	1.7	<0.1	79	0.4		
snailfish unident.	Liparidae (family)	1.2	<0.1	1	<0.1	1	1

Table 4.--Cont.

Species name	Scientific name	Catch				Individual measurements	
		Weight (kg)	%	Number	%	Length	Weight
sea onion	*Boltenia ovifera*	1.2	<0.1	24	0.1		
sea urchin unident.	Echinacea (superorder)	0.9	<0.1	9	<0.1		
Pacific lyre crab	*Hyas lyratus*	0.5	<0.1	10	0.1		
Pacific herring	*Clupea pallasi*	0.3	<0.1	2	<0.1	1	1
nudibranch unident.	Nudibranchia (order)	0.2	<0.1	2	<0.1		
moon jelly	*Aurelia labiata*	0.2	<0.1	1	<0.1	1	
sawback poacher	*Leptagonus frenatus*	0.2	<0.1	9	<0.1		
bivalve unident.	Bivalvia (class)	0.1	<0.1	2	<0.1		
rex sole	*Glyptocephalus zachirus*	0.1	<0.1	1	<0.1	1	1
Aequorea spp.	Aequoreidae (family)	0.1	<0.1	0	<0.1		
eulachon	*Thaleichthys pacificus*	0.1	<0.1	1	<0.1		
northern shrimp	*Pandalus borealis*	0.1	<0.1	20	0.1		
shrimp unident.	Decapoda (order)	0.0	<0.1	22	0.1		
sea whip unident.	Pennatulacea (order)	0.0	<0.1	1	<0.1		
Aleutian alligatorfish	*Aspidophoroides bartoni*	0.0	<0.1	3	<0.1		
smooth alligatorfish	*Agnoplagonus inermis*	0.0	<0.1	1	<0.1		
prowfish	*Zaprora silenus*	0.0	<0.1	1	<0.1		
Total		11,035.1		19,196		5,079	1202

Table 5.--Catch by species, and numbers of individual length and weight measurements taken from 20 Marinovich (midwater) trawls during the summer 2014 acoustic-trawl survey of walleye pollock on the eastern Bering Sea shelf.

Species name	Scientific name	Catch				Individual measurements	
		Weight (kg)	%	Number	%	Length	Weight
northern sea nettle	*Chrysaora melanaster*	5,402.6	91.7	4,545	3.7	252	217
Pacific herring	*Clupea pallasi*	241.4	4.1	743	0.6	25	25
walleye pollock (age 1+)	*Gadus chalcogrammus*	205.8	3.5	1,381	1.1	654	22
Aequorea spp.	Aequoreidae (family)	16.7	0.3	45	0.0	14	14
euphausiid unident.	Euphausiidae (family)	6.9	0.1	112,522	91.1		
northern smoothtongue	*Leuroglossus schmidti*	6.1	0.1	1,186	1.0	74	
salps unident.	Salpidae (family)	4.8	0.1	223	0.2		
jellyfish unident.	Scyphozoa (class)	2.1	<0.1	288	0.2	13	13
rock sole spp.	*Lepidopsetta* spp.	1.3	<0.1	2	<0.1	2	2
Pacific lamprey	*Lampetra tridentata*	1.2	<0.1	4	<0.1		
chum salmon	*Oncorhynchus keta*	1.1	<0.1	1	<0.1	1	1
walleye pollock age 0	*Gadus chalcogrammus*	0.8	<0.1	2,244	1.8	449	
moon jelly	*Aurelia labiata*	0.6	<0.1	3	<0.1	2	2
lamprey unident.	*Lampetra* spp.	0.5	<0.1	1	<0.1		
prowfish	*Zaprora silenus*	0.3	<0.1	20	<0.1	16	16
fried egg jellyfish	*Phacellophora camtchatica*	0.3	<0.1	1	<0.1	1	1
Aurelia spp.	Aureliinae (subfamily)	0.2	<0.1	31	<0.1		
squid unident.	Teuthoidea (order)	0.1	<0.1	39	<0.1	1	1
shrimp unident.	Decapoda (order)	<0.1	<0.1	162	0.1		
amphipod unident.	Amphipoda (order)	<0.1	<0.1	57	<0.1		
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	38	<0.1		
capelin	*Mallotus villosus*	<0.1	<0.1	3	<0.1	3	
Total		5,892.7		123,539		1,507	314

Table 6.--Catch by species, and numbers of individual length and weight measurements taken from 16 Methot trawls during the summer 2014 acoustic-trawl survey of walleye pollock on the eastern Bering Sea shelf.

		Catch				Individual measurements	
Species name	Scientific name	Weight (kg)	%	Number	%	Length	Weight
northern sea nettle	*Chrysaora melanaster*	149.8	76.0	244	0.1	171	4
euphausiid unident.	Euphausiidae (family)	24.9	12.6	325,139	98.4		
jellyfish unident.	Scyphozoa (class)	20.1	10.2	1,183	0.4	10	10
Aequorea spp.	Aequoreidae (family)	0.6	0.3	44	<0.1	8	2
moon jelly	*Aurelia labiata*	0.6	0.3	1	<0.1	1	
walleye pollock age 0	*Gadus chalcogrammus*	0.4	0.2	2,430	0.7	104	
crangonid shrimp unident.	Crangonidae (family)	0.2	0.1	718	0.2		
unsorted shells, etc.		0.1	0.1				
salps unident.	Salpidae (family)	0.1	0.1	197	0.1		
Aurelia spp.	Aureliinae (subfamily)	0.1	0.1	11	<0.1	11	
nemertean worm unident.	Nemertea (phylum)	0.1	<0.1	4	<0.1		
amphipod unident.	Amphipoda (order)	0.1	<0.1	268	0.1		
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	104	<0.1		
pandalid shrimp unident.	Pandalidae (family)	<0.1	<0.1	36	<0.1		
flatfish larvae	Pleuronectifomes (order)	<0.1	<0.1	16	<0.1		
Pacific sand lance	*Ammodytes hexapterus*	<0.1	<0.1	10	<0.1	10	
isopod unident.	Isopoda (order)	<0.1	<0.1	1	<0.1		
Total		197.2		330,406		315	16

Table 7. -- Number of walleye pollock biological samples and measurements collected during the summer 2014 acoustic-trawl survey of the eastern Bering Sea shelf and Cape Navarin area of Russia.

Haul	Walleye pollock age 1+					Age-0 walleye pollock
no.	Lengths	Weights	Maturity	Otoliths	Ovaries	lengths
1						26
2						25
4						19
5	1	1				19
7						31
8	145	29	28	29	11	
9	275	44	41	44	20	
10	25					
11	257	56	40	42	21	
12	98	31	27	31	14	
13	172	38	36	38	16	
14	30					
15	253	62	12	14	6	
16	373	30	30	30	14	
17	290	78	11	11	6	
18	291	73	10	10	6	
20	410	48	10	10	3	
22	223	40	40	40	19	
23	405	73	14	15	9	
24	18	18	14	18	8	
25	414	49	10	10	6	
26	332	98	45	45	22	
28	358	40	40	40	17	
29	342	39	39	39	11	
30	1	1	1			
31	367	40	40	40	12	
32	437	73	25	28	14	
34	14	14	14	14	6	
35	190	44	44	44	22	
36	182	53	26	26	14	
37	158	38	38	38	18	
38	341	54	54	44	24	
39	349	38	5	5	1	
40	353	45	40	40	25	
43	115	20	20	20	14	
44	205	12	12	12	9	
46	375	20	20	20	8	
47	306	29	12	12	7	
51	358	26	20	21	5	
52	182	65	65	19	10	8
53	29	29	29	20	3	
54	281	61	61	20	7	
55	283	33	33	20	11	
57	330	82	82	20	9	
58	540	106	106	30	15	
59						35

Table 7. -- Cont.

Haul no.	Walleye pollock					Age-0 walleye pollock lengths
	Lengths	Weights	Maturity	Otoliths	Ovaries	
60	132	69	69	30	15	
61	52					
62	481	96	96	30	18	
63	5	5				30
64	58	58	58	30	15	
65						10
66	649	113	111	30	10	
67	455	81	81	30	13	
68	267	80	80	30	14	
69						131
70	215	79	79	30	14	
71	546	93	93	30	14	
72	14	14				
73	317	95	75	30	20	
75						77
77	68	68	68	30	18	
78	4	4	4			
80	352	80	80	30	18	
81	319	100	80	35	22	
82	329	49	29	5	5	
83	637	25	14	10	8	
84	135	20	20	5	1	26
85	337	81	81	31	13	
86						50
87						22
88	287	80	80	30	19	
89	434	87	87	31	15	
90	489	120	100	40	24	
92	326	120	100	40	21	
93	562	159	159	30	11	
94	33					
95	360	82	78	30	20	
96						119
97	307	80	80	30	18	
98						35
99	1289	116	56	30	16	
100	552	90	45	45	29	
101	727	122	40	40	16	
102						40
103	322	71	52	40	34	
104	404	59	44	45	29	
105						23
106	528	99	99	40	17	
107	637	78	42	46	20	

Table 7. -- Cont.

Haul no.	Walleye pollock Lengths	Weights	Maturity	Otoliths	Ovaries	Age-0 walleye pollock lengths
108	885	82	40	40	20	
109	1381	137	36	40	23	
110	491	58	44	44	23	1
111	1380	123	24	40	22	
112	6					1
113	514	111	111	40	21	
114	593	52	33	40	27	
115	540	73	10	10	3	
116	418	89	20	20	11	
117	61					13
118	418	101	25	26	14	2
119	521	88	25	25	10	
120	201					51
121	540	105	104	20	11	
122	384	75	25	25	15	2
123	37	37				1
124	386	51	26	26	18	
125	829	90	20	20	11	
126	432	150	20	20	8	
127	194					9
128	889	99	59	30	21	
129	569	84	56	10	7	
130	451	58	25	25	11	
131	367	52	52	30	14	
132	332	49	49	30	13	
133	355	82	40	25	13	
134						22
135	20	20	20	20	12	1
136	329	85	46	46	27	20
138	365	40	40	40	25	
139	1165	61	51	25	12	
140	439	114	54	35	18	
141	17	16	16	16	11	1
Total	38,246	6,485	4,445	2,660	1,371	850

Table 8. -- Walleye pollock biomass from summer acoustic-trawl surveys on the U.S. EEZ portion of the Bering Sea shelf, 1994-2014. Data for the Steller sea lion Conservation Area (SCA), east of 170°W minus the SCA (E170-SCA), and the U.S. west of 170°W (W170) are estimated pollock biomass between near surface and 3 m off bottom. Relative estimation error for the biomass is indicated.

Date		Area	Biomass, million metric tons (top) and percent of total (bottom)			Total biomass	Relative estimation error
		(nmi)^2	SCA	E170-SCA	W170	(million metric tons)	
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	2.592	0.037
			9.5	20.3	70.1		
1999	7 Jun-5 Aug	103,670	0.299	0.579	2.408	3.285	0.055
			9.1	17.6	73.3		
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	0.084	0.168	1.517	1.769	0.045
			4.7	9.5	85.8		
2008	2 Jun -31 Jul	95,374	0.085	0.029	0.883	0.997	0.076
			8.5	2.9	88.6		
2009	9 Jun -7 Aug	91,414	0.070	0.018	0.835	0.924	0.088
			7.6	2.0	90.4		
2010	5 Jun -7 Aug	92,849	0.067	0.113	2.143	2.323	0.060
			2.9	4.8	92.3		
2012	7 Jun -10 Aug	96,852	0.142	0.138	1.563	1.843	0.042
			7.7	7.5	84.8		
2014	12 Jun -13 Aug	94,361	0.426	1.000	2.014	3.439	0.046
			12.4	29.1	58.6		

Table 9. -- Numbers-at-length estimates (millions) of walleye pollock between near surface and 3 m off bottom from acoustic- trawl surveys in the U.S. EEZ, 1994-2014.

Length (cm)	**1994**	**1996**	**1997**	**1999**	**2000**	**2002**	**2004**	**2006**	**2007**	**2008**	**2009**	**2010**	**2012**	**2014**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0
9	0	0	0	0.01	0.03	0	0	0	0	0	4.42	0	0.23	0
10	0	0	2.04	0.12	0.76	0.01	0.24	0	30.12	0	45.53	0	0.12	0.22
11	0.40	0	0.19	4.78	2.30	0.77	0.20	5.29	259.94	0.74	221.44	0.92	0.83	15.20
12	5.44	0.47	30.13	14.43	5.50	4.70	2.56	59.83	662.11	2.82	768.23	8.56	3.05	73.28
13	44.79	5.44	238.10	22.71	19.26	21.36	2.38	144.42	1329.33	6.70	1112.48	65.31	5.75	471.20
14	94.23	38.20	1416.21	22.35	36.70	100.48	4.08	117.62	1497.63	9.47	1087.89	259.44	9.52	915.69
15	179.82	131.29	2949.25	16.20	56.69	194.98	1.84	84.56	803.62	6.13	1046.86	508.46	14.37	1131.56
16	166.05	227.77	3364.00	5.20	79.57	178.72	1.80	27.81	563.27	4.38	535.32	799.69	14.04	922.81
17	105.16	317.31	2207.83	5.20	50.81	99.74	1.76	10.15	304.17	7.78	266.25	698.61	11.66	560.93
18	129.71	215.26	1309.13	12.92	22.39	33.47	1.12	2.90	114.52	49.99	84.01	304.04	8.78	294.77
19	212.54	115.39	569.51	44.60	30.27	40.07	4.34	4.73	133.95	128.23	82.88	155.46	24.43	102.72
20	381.96	64.79	181.06	152.57	47.16	61.90	8.40	10.85	117.76	264.22	55.95	175.31	78.52	70.99
21	589.69	37.20	74.90	251.49	92.37	162.63	23.15	17.43	145.33	402.13	77.20	228.58	188.37	101.82
22	794.28	64.41	81.07	314.31	136.41	289.69	34.90	31.71	147.44	440.61	106.28	374.84	311.68	209.38
23	788.35	60.24	150.80	288.90	185.76	485.72	47.06	37.50	129.53	568.91	135.13	629.53	391.40	434.88
24	772.58	70.32	255.93	220.31	186.04	734.73	48.21	33.77	142.76	447.11	112.14	938.65	357.38	1019.60
25	581.45	47.68	408.07	164.37	207.95	859.82	39.35	30.25	91.73	357.46	114.43	1170.05	290.16	1729.30
26	372.26	38.32	458.83	188.58	186.91	832.36	32.49	24.95	65.22	241.72	114.22	1174.04	224.05	1977.02
27	198.97	33.63	519.67	256.04	187.68	718.04	25.99	21.77	49.83	115.47	129.48	931.46	192.24	1520.76
28	122.07	60.16	422.68	302.47	168.93	516.42	29.43	25.52	32.98	79.93	139.98	578.26	207.61	950.43
29	135.90	85.07	296.50	419.16	164.76	491.26	69.82	29.78	21.87	104.00	181.74	273.70	261.16	486.46
30	138.25	122.81	175.36	435.28	167.17	507.57	90.09	35.24	18.40	129.13	205.96	131.43	304.50	324.20
31	178.83	183.98	115.83	417.13	169.72	592.86	148.82	42.19	16.21	119.63	253.04	89.40	279.21	216.79

Table 9. -- Cont.

Length (cm)	**1994**	**1996**	**1997**	**1999**	**2000**	**2002**	**2004**	**2006**	**2007**	**2008**	**2009**	**2010**	**2012**	**2014**
32	234.80	240.98	79.12	410.19	167.23	539.68	151.19	45.36	35.23	135.96	243.92	103.67	223.70	164.12
33	239.39	341.56	69.15	372.65	188.70	533.40	180.25	51.47	46.64	117.44	197.30	114.41	188.73	151.82
34	291.50	408.41	68.83	393.58	221.59	421.17	185.43	68.74	61.27	112.26	149.26	129.05	200.60	121.32
35	296.57	458.38	89.48	415.94	332.90	291.90	237.90	82.66	74.85	82.94	100.61	162.44	246.99	165.12
36	326.66	477.95	146.28	433.11	360.41	239.36	302.68	111.93	64.09	40.17	76.70	233.18	311.10	182.14
37	343.99	400.98	220.62	393.54	414.22	218.57	430.24	118.70	79.64	28.85	50.97	288.73	381.18	233.20
38	305.79	333.42	321.35	403.47	369.24	222.31	476.40	124.99	75.28	23.58	34.05	382.43	397.66	247.01
39	294.82	253.70	397.12	359.07	344.63	218.51	539.43	118.56	83.27	32.67	26.29	400.38	363.86	245.55
40	311.31	214.24	397.83	304.48	297.14	209.21	499.73	126.41	106.70	23.19	20.55	359.88	304.71	214.08
41	271.09	168.18	350.37	243.06	331.55	200.43	511.11	140.54	113.05	24.95	15.78	278.88	200.56	182.09
42	289.53	154.99	292.97	240.38	316.41	179.46	475.59	154.29	141.30	26.81	18.00	196.02	127.26	192.21
43	273.09	149.27	222.05	265.33	331.24	186.32	453.93	163.58	191.31	38.14	14.29	127.23	78.63	242.26
44	243.93	133.46	172.49	321.32	302.44	185.26	388.07	178.01	189.44	39.27	11.12	86.81	63.74	257.74
45	256.58	117.96	125.08	328.57	290.08	197.15	339.54	170.87	210.76	44.81	11.44	57.23	58.98	266.42
46	216.09	103.48	93.20	304.97	249.82	183.59	247.30	158.64	213.99	50.85	13.24	36.97	55.40	242.74
47	177.93	98.39	74.75	238.84	235.52	182.87	196.13	146.34	185.68	54.78	12.35	21.51	57.10	184.11
48	148.15	94.29	59.37	182.91	176.81	168.36	150.84	130.84	150.01	54.71	21.23	11.68	50.86	148.74
49	73.11	83.67	45.51	122.90	143.24	154.43	113.57	105.90	128.80	47.05	22.51	7.53	42.00	111.65
50	66.74	79.87	40.23	88.16	106.27	133.48	78.29	88.25	101.90	41.79	20.42	6.85	30.46	78.56
51	33.15	72.52	33.10	60.42	78.54	117.74	64.53	73.93	73.22	39.74	19.56	6.24	21.95	54.24
52	30.35	60.21	31.72	42.15	48.15	91.92	56.33	62.45	52.96	29.92	20.66	3.61	17.31	43.54
53	18.15	50.89	29.59	33.02	35.75	88.43	41.08	45.82	41.04	23.84	15.37	2.75	12.90	30.24
54	15.68	38.44	23.91	26.90	22.09	62.98	30.20	35.31	32.46	21.89	13.54	1.69	11.94	19.01
55	18.57	25.63	19.77	16.14	16.58	44.34	19.12	23.01	23.25	16.11	16.29	3.16	7.02	14.93
56	11.05	14.07	14.58	9.26	12.58	40.16	14.43	19.33	16.43	12.38	9.96	2.24	4.88	10.64
57	9.52	7.65	10.61	9.40	8.92	24.16	8.83	14.93	13.02	10.47	8.63	3.51	4.24	10.08
58	4.85	7.68	8.60	5.68	6.41	18.77	5.83	10.63	7.51	9.21	9.24	3.05	4.61	6.47
59	2.96	3.02	5.98	3.24	5.13	11.26	6.16	8.11	4.76	8.31	5.28	2.79	3.07	7.71
60	3.47	4.71	3.45	3.04	1.87	10.58	4.00	5.39	3.72	7.39	4.50	3.20	4.16	5.58
61	6.63	2.88	4.58	2.40	2.30	7.11	2.89	4.60	1.86	4.09	2.37	4.29	2.88	6.04
62	1.39	1.79	1.55	2.12	1.72	3.92	1.95	2.07	1.13	4.94	2.41	1.76	3.00	3.41
63	0.71	0.28	2.01	0.62	1.57	2.18	2.07	1.17	1.09	2.62	1.70	1.26	1.18	3.48
64	0.49	0.59	0.47	0.57	0.98	1.74	0.08	1.98	1.06	2.12	1.21	1.55	2.04	1.74

Table 9. -- Cont.

Length (cm)	**1994**	**1996**	**1997**	**1999**	**2000**	**2002**	**2004**	**2006**	**2007**	**2008**	**2009**	**2010**	**2012**	**2014**
65	1.86	0.85	0.81	0.93	0.64	1.74	0.30	0.73	0.48	1.48	1.42	1.16	1.55	2.34
66	0.77	0.35	0.32	1.42	0.70	1.16	0.55	0.85	0.60	0.67	1.15	1.26	0.72	0.71
67	0.97	0.66	1.27	0.48	0.03	0.27	0.35	0.27	0.35	0.58	0.50	1.13	0.00	0.40
68	1.46	0	0.19	0.30	0.27	0.17	0.19	0.02	0.21	0.51	0.30	1.36	0.55	0.64
69	0	0	0.59	0.29	0.59	0	0	0	0.02	0.12	0.44	0.14	0.00	0.24
70	1.93	0	0.10	0	0	0.43	0	0.02	0.30	0.21	0.04	0.36	0.40	0.76
71	0.49	0.11	0	<0.01	0	0.01	0	0.14	0.21	0.06	0	0	0	0.10
72	0.97	0	0	0.11	0.15	0	0	0.46	0	0.42	0	0.17	0	0.27
73	0.49	0	0.05	0.16	0	0	0	0.02	0	0.04	0	0.83	0	0
74	0	0	0	0	0.14	0	0	0	0.06	0.05	0	0.17	0.31	0.08
75	0	0	0	0.04	0	0	0	0	0	0.03	0.03	0.00	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0.14	0	0
77	0	0	0	0	0	0	0	0	0	0	0	0	0	0.07
78	0.49	0	0	0	0	0	0	0	0	0	0	0.14	0	0
79	0	0	0	0.39	0	0	0	0.08	0	0.06	0	0	0	0
80	0	0	0	0	0	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	4,704	8,075	12,549	6,667	17,384

Table 10. -- Biomass-at-length estimates (metric tons) of walleye pollock between near surface and 3 m off bottom on the Bering Sea shelf from acoustic-trawl surveys in the U.S. EEZ, 1994-2014.

Length (cm)	**1994**	**1996**	**1997**	**1999**	**2000**	**2002**	**2004**	**2006**	**2007**	**2008**	**2009**	**2010**	**2012**	**2014**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	<1	0	0	0	0	0	0	0	0	0
9	0	0	0	<1	<1	0	0	0	0	0	24	0	1	0
10	0	0	14	1	8	0	2	0	200	0	336	0	1	2
11	4	0	2	59	30	9	2	54	2,469	7	2,003	9	8	139
12	71	6	394	227	88	75	30	762	7,313	34	9,219	112	36	840
13	744	92	4,148	445	370	428	36	2,366	19,068	104	17,136	1,064	86	7,104
14	1,937	804	31,282	538	859	2,488	81	2,176	25,781	168	21,613	5,436	165	17,128
15	4,520	3,384	81,544	472	1,613	5,841	48	1,997	17,771	145	25,658	12,983	319	26,458
16	5,040	7,098	111,182	181	2,713	6,393	57	815	14,870	125	16,147	25,180	357	26,150
17	3,817	11,818	84,460	214	2,055	4,231	67	365	9,873	254	10,147	26,219	357	18,947
18	5,553	9,485	58,223	623	1,064	1,664	50	123	4,401	1,923	3,671	13,313	307	11,997
19	10,655	5,960	28,768	2,499	1,677	2,284	210	235	6,200	5,880	4,185	7,577	1,146	4,750
20	22,244	3,892	10,677	9,852	3,017	4,072	498	626	6,392	14,049	3,204	10,002	4,154	3,863
21	39,601	2,579	4,900	18,587	6,782	12,242	1,595	1,133	9,810	24,584	5,259	15,444	11,763	6,377
22	61,100	5,121	6,101	26,421	11,419	24,828	2,730	2,413	11,643	31,976	8,715	29,774	22,304	15,711
23	69,048	5,458	12,962	27,464	17,629	47,351	4,265	3,277	11,513	48,149	12,534	56,840	33,139	39,878
24	76,622	7,221	24,999	23,562	19,911	81,309	4,887	3,259	14,551	42,932	11,518	97,422	34,485	107,266
25	64,967	5,520	45,081	19,681	24,970	107,760	4,475	3,176	10,266	38,541	14,070	137,766	31,345	208,239
26	46,652	4,979	56,998	25,168	25,070	117,666	4,347	3,107	8,010	29,360	15,332	154,353	27,161	267,901
27	27,847	4,884	72,339	37,933	28,002	113,478	3,876	2,946	6,844	15,725	20,391	136,592	26,428	228,940
28	19,028	9,721	65,700	49,557	27,927	89,827	4,813	3,917	5,073	12,102	23,816	95,619	31,668	156,028
29	23,550	15,240	51,328	75,679	30,072	92,941	12,745	5,050	3,697	17,423	35,978	49,597	44,989	86,420
30	26,437	24,307	33,691	86,321	33,574	104,158	17,942	6,561	3,462	23,802	44,259	25,366	57,178	64,579
31	37,756	40,104	24,685	90,579	37,396	132,640	32,663	9,236	3,428	24,696	60,686	19,576	59,223	46,661
32	54,180	57,669	18,522	97,251	40,301	131,538	36,257	10,767	8,606	30,634	63,679	24,976	51,591	39,050
33	60,378	89,480	17,709	96,204	49,614	141,718	48,265	13,252	12,233	29,302	56,444	30,732	47,159	39,535
34	80,001	116,812	19,201	110,357	63,403	122,045	53,459	19,248	17,643	29,881	46,340	38,481	54,640	34,538
35	88,546	142,771	27,148	126,368	103,387	92,414	74,135	25,252	23,484	24,798	33,904	52,816	72,975	51,898
36	105,903	161,724	48,272	142,256	121,237	82,291	103,401	36,989	21,662	13,229	27,902	82,376	100,285	62,907
37	120,806	147,067	79,075	139,441	150,552	81,503	156,813	41,377	29,517	10,234	19,593	110,112	134,105	86,816
38	116,110	132,264	124,841	153,908	144,826	88,680	188,084	47,836	30,240	9,163	14,455	160,201	148,383	99,388
39	121,143	108,629	166,999	147,178	145,465	93,405	229,225	49,056	35,953	13,611	11,726	178,105	146,555	105,423
40	137,651	98,825	180,668	133,859	135,080	95,675	230,733	55,427	48,709	10,622	9,876	173,381	132,499	99,352

Table 10. -- Cont.

Length (cm)	1994	1996	1997	1999	2000	2002	2004	2006	2007	2008	2009	2010	2012	2014
41	129,335	83,422	171,750	114,415	161,884	98,165	252,339	65,790	54,826	11,866	8,172	143,345	93,497	91,794
42	149,294	82,523	154,670	120,957	165,982	94,168	253,443	78,528	72,602	13,379	9,940	107,271	63,506	102,788
43	152,526	85,177	125,886	142,492	185,961	104,975	261,967	87,505	105,904	20,806	8,596	73,519	41,934	139,170
44	147,017	81,478	104,750	183,897	181,482	110,994	239,860	102,839	111,390	22,429	6,934	53,494	36,511	156,242
45	166,444	76,937	81,320	200,114	185,345	125,772	222,131	103,984	131,381	27,203	7,500	37,336	36,256	171,248
46	149,720	71,999	64,736	197,389	169,854	124,740	171,216	102,312	143,460	32,686	9,387	26,169	36,036	165,883
47	131,130	72,930	55,323	164,067	170,024	132,267	142,845	100,258	131,598	37,569	9,438	15,750	40,265	132,669
48	115,921	74,352	46,750	133,183	135,575	129,623	115,709	94,693	112,575	38,443	16,576	9,524	39,020	112,824
49	60,566	70,102	38,100	94,742	116,332	126,481	92,215	81,175	101,538	36,199	18,743	6,433	33,595	89,084
50	58,531	71,016	35,728	71,872	91,389	115,778	67,512	73,481	85,481	34,038	18,222	6,199	25,604	66,638
51	30,462	68,346	31,145	52,026	71,352	108,641	58,478	63,585	64,652	33,569	18,440	6,300	19,684	48,778
52	29,789	60,080	31,560	38,303	46,186	89,753	53,394	56,209	49,596	26,625	20,583	3,889	16,239	42,644
53	18,463	53,710	31,087	31,630	36,163	91,552	41,489	44,479	39,922	23,325	15,872	2,942	13,233	30,283
54	16,856	42,859	26,500	27,130	23,496	68,832	31,998	36,086	34,719	22,249	14,241	1,945	13,440	20,268
55	21,296	30,163	23,075	17,129	18,562	51,122	21,285	25,029	26,503	17,789	17,943	3,908	8,339	16,845
56	13,207	17,456	17,914	10,327	14,788	48,961	17,136	21,089	19,415	15,024	12,046	3,032	6,059	12,796
57	11,943	9,998	13,712	11,013	11,004	30,986	11,453	17,519	16,742	13,074	11,371	4,615	5,545	12,308
58	6,368	10,573	11,671	6,984	8,300	25,335	7,517	13,507	9,953	12,444	11,563	4,159	6,376	8,237
59	4,167	4,365	8,530	4,174	6,962	15,953	8,825	10,892	6,815	11,544	8,251	4,250	4,169	10,857
60	5,001	7,163	5,155	4,104	2,656	15,550	6,038	7,784	5,687	11,354	7,402	5,271	6,400	8,005
61	10,199	4,591	7,172	3,394	3,421	11,003	4,574	6,869	2,990	6,534	4,100	7,381	4,387	9,196
62	2,285	2,998	2,550	3,135	2,679	6,415	3,214	3,241	1,874	8,250	4,373	2,936	5,028	5,838
63	1,196	498	3,448	953	2,551	3,683	3,585	1,937	1,934	4,528	3,241	2,241	2,028	5,604
64	844	1,084	843	925	1,660	3,109	139	3,360	1,958	3,835	2,423	2,844	3,478	3,009
65	3,382	1,637	1,531	1,562	1,122	3,223	562	1,314	928	2,717	2,978	2,325	2,921	4,148
66	1,467	704	617	2,497	1,296	2,202	1,097	1,587	1,212	1,303	2,525	2,802	1,432	1,446
67	1,929	1,386	2,622	876	52	505	717	519	734	1,201	1,150	2,522	0	864
68	3,021	0	413	567	551	352	406	46	464	1,072	729	3,292	1,192	1,422
69	0	0	1,351	585	1,244	0	0	0	45	273	1,096	343	0	556
70	4,349	0	230	0	0	945	0	51	720	493	101	911	947	1,845
71	1,142	267	0	3	0	33	0	322	538	132	0	0	0	253
72	2,380	0	0	238	351	0	0	1,084	0	1,016	0	453	0	707
73	1,239	0	126	362	0	0	0	57	0	112	0	2,365	0	0
74	0	0	0	0	362	0	0	0	181	135	0	492	858	232
75	1,340	0	0	90	0	0	0	0	0	90	86	11	0	0
76	0	0	0	0	0	0	0	0	0	0	0	457	0	0
77	0	0	0	0	0	0	0	0	0	0	0	0	0	220
78	1,503	0	0	0	0	0	0	0	0	0	0	494	0	0
79	0	0	0	1,118	0	0	0	245	0	181	0	0	0	0
80	0	0	0	0	0	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	1,560,174	1,769,019	996,939	923,843	2,322,643	1,842,792	3,438,986

Table 11. -- Estimated numbers-at-age (millions, top panel) and biomass-at-age (thousand metric tons, bottom panel) 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 1994-2014. Trace amounts are indicated as 'tr'.

Age	1994	1996	1997	1999	2000	2002	2004	2006	2007	2008	2009	2010	2012	2014
1	610.2	972.3	12,360.0	111.9	257.9	634.8	15.8	455.6	5588.5	36.5	5127.9	2525.5	66.9	4438.3
2	4,781.1	446.4	2,745.2	1,587.6	1,272.3	4,850.4	275.1	208.6	1026.2	2905.3	797.5	6395.2	1963.1	8614.9
3	1,336.0	520.4	386.2	3,597.0	1,184.9	3,295.1	1,189.3	282.0	319.7	1031.6	1675.9	973.5	1640.6	941.3
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	144.4	202.8	2183.5	2444.1	1100.7
5	1,898.1	820.7	1,921.5	582.6	899.7	507.2	1,442.1	695.3	669.2	106.9	40.1	383.6	202.6	892.3
6	296.1	509.3	384.4	273.9	243.9	756.8	416.6	551.8	588.8	170.2	44.0	46.3	246.1	974.6
7	71.2	434.4	205.2	1,169.1	234.0	436.7	199.2	319.7	305.7	132.4	62.0	6.2	63.6	316.9
8	65.2	84.9	142.5	400.2	725.1	91.4	194.0	110.1	166.2	70.7	55.5	7.4	13.1	66.9
9	31.9	16.7	32.7	104.6	190.4	110.3	68.3	53.0	60.2	58.2	32.6	6.8	8.3	21.5
10	23.2	6.3	3.9	66.9	84.7	205.4	33.5	40.3	18.8	15.0	21.2	6.5	6.5	5.8
11	8.5	5.7	4.9	14.5	35.6	52.1	24.8	23.3	20.2	15.1	8.2	6.0	6.6	2.7
12	19.3	12.1	2.0	6.5	18.1	17.9	19.8	16.2	5.7	6.9	3.8	2.6	2.0	1.8
13	4.8	1.3	2.2	1.7	1.2	3.1	12.1	8.6	1.7	4.5	2.0	1.9	2.5	2.8
14	5.7	4.8	2.3	0.0	1.4	5.9	5.8	9.9	2.1	1.9	1.2	1.3	0.6	1.2
15	1.2	2.4	2.0	0.1	0.1	0.0	4.3	5.0	1.8	0.9	0.1	1.1	0.2	1.5
16	7.9	0.5	0.0	0.1	0.3	0.0	0.0	3.8	0.2	2.0	0.0	0.3	0.3	0.2
17	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.6	0.0	0.3	0.3	tr
18	0.0	0.5	0.0	0.4	0.1	0.0	0.0	0.1	0.0	0.6	tr	0.4	0.0	tr
19	0.7	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.6	0.4	tr	0.1	0.0	tr
20	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.0	0.0
21+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	tr	0.0	tr	0.0	tr
Total	10,821	6,525	18,686	9,601	7,630	12,122	6,834	3,396	9,207	4,704	8075.5	12,549	6,667	17,384

Age	1994	1996	1997	1999	2000	2002	2004	2006	2007	2008	2009	2010	2012	2014
1	17.1	36.7	417.8	3.3	8.1	21.2	0.4	8.8	103.4	0.8	104.4	80.0	1.6	112.0
2	425.3	35.3	369.9	156.6	144.0	645.1	31.6	21.2	89.5	242.7	78.5	750.4	182.3	1159.2
3	312.4	118.7	99.5	847.4	284.6	843.7	329.3	68.8	89.3	220.7	399.6	215.4	333.3	210.5
4	641.3	888.8	188.6	640.2	974.4	458.2	1349.4	230.7	188.0	58.7	84.1	963.2	922.9	434.0
5	1,067.2	396.0	921.0	271.7	488.6	286.0	820.9	366.4	389.8	61.5	23.4	216.8	112.1	488.4
6	187.2	341.8	235.0	164.3	156.0	514.5	288.7	359.8	404.3	117.3	35.7	33.4	183.2	676.9
7	50.1	359.9	161.3	751.5	166.6	351.6	153.0	244.1	240.9	106.6	56.0	5.8	54.1	241.8
8	55.3	72.5	139.5	278.9	540.8	85.6	166.3	93.2	144.8	69.4	57.0	9.9	14.1	66.7
9	30.9	16.3	34.2	84.6	149.0	111.0	62.4	49.5	58.4	56.4	36.8	10.7	10.7	24.5
10	26.4	6.6	4.4	62.5	76.3	212.5	33.1	39.2	20.7	18.9	25.1	10.5	9.9	7.4
11	10.5	6.9	6.1	14.2	39.0	59.6	25.3	23.3	22.3	18.9	10.7	10.1	8.8	4.0
12	27.9	17.1	3.4	7.2	16.7	19.7	21.9	18.7	7.1	8.6	5.5	4.9	3.4	3.1
13	6.7	1.5	4.5	1.5	1.3	4.6	12.7	10.4	2.1	6.2	3.4	3.7	4.1	5.3
14	7.7	7.0	3.8	0.0	2.6	8.5	6.2	12.7	3.7	3.2	2.5	2.5	1.0	2.2
15	2.1	3.8	2.9	0.2	0.1	0.0	5.7	5.9	2.2	1.1	0.3	2.1	0.4	2.6
16	12.5	0.9	0.0	0.2	0.3	0.0	0.0	4.3	0.3	3.3	0.0	0.7	0.5	0.3
17	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.9	0.0	0.6	0.5	tr
18	0.0	0.9	0.0	0.7	0.3	0.0	0.0	0.3	0.0	1.1	tr	1.2	0.0	tr
19	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.5	1.0	0.5	tr	0.2	0.0	tr
20	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.2	0.0	0.0
21+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	0.0	tr	0.0	0.1
Total	2,886	2,311	2,592	3,285	3,049	3,622	3,307	1,560	1,769	997	924	2,323	1,843	3,439

Table 12. -- Estimated numbers and biomass of walleye pollock observed between near the surface and 0.5 m off bottom[1] from Bering Sea acoustic-trawl surveys in the United States and in the Cape Navarin area of Russia.

Year	Bering Sea EEZ region	Numbers (billions)	Biomass (million metric tons)	% Biomass	Survey nation	Area (nmi^2)
1994	US	12.60	3.72	85	US	78,250
	Russia	2.77	0.65	15	US	18,460
	Total	15.37	4.37			
2002	US	13.81	4.53	98	US	99,526
	Russia	0.75	0.08	2	Russia	32,270
	Total	14.56	4.61			
2004	US	7.95	4.03	91	US	99,659
	Russia	1.55	0.40	9	US	7,870
	Total	9.51	4.43			
2007	US	10.24	2.40	96	US	92,944
	Russia	1.09	0.11	4	US	12,460
	Total	11.33	2.51			
2008	US	5.47	1.54	98	US	95,374
	Russia	0.07	0.03	2	US	12,073
	Total	5.54	1.58			
2009	US	9.25	1.33	99	US	91,414
	Russia	0.02	0.01	1	US	11,714
	Total	9.27	1.34			
2010	US	13.50	2.62	95	US	92,849
	Russia	1.03	0.13	5	US	12,260
	Total	14.53	2.75			
2012	US	7.83	2.38	78	US	96,852
	Russia	2.97	0.66	22	US	15,180
	Total	10.80	3.04			
2014	US	19.77	4.79	97	US	94,353
	Russia	0.34	0.14	3	US	10,800
	Total	20.11	4.93			

[1] Note: near bottom estimates (0.5-3 m off bottom) should be interpreted with caution as there is a greater likelihood for species contamination and fewer hauls were made in this zone than in the midwater zone above.

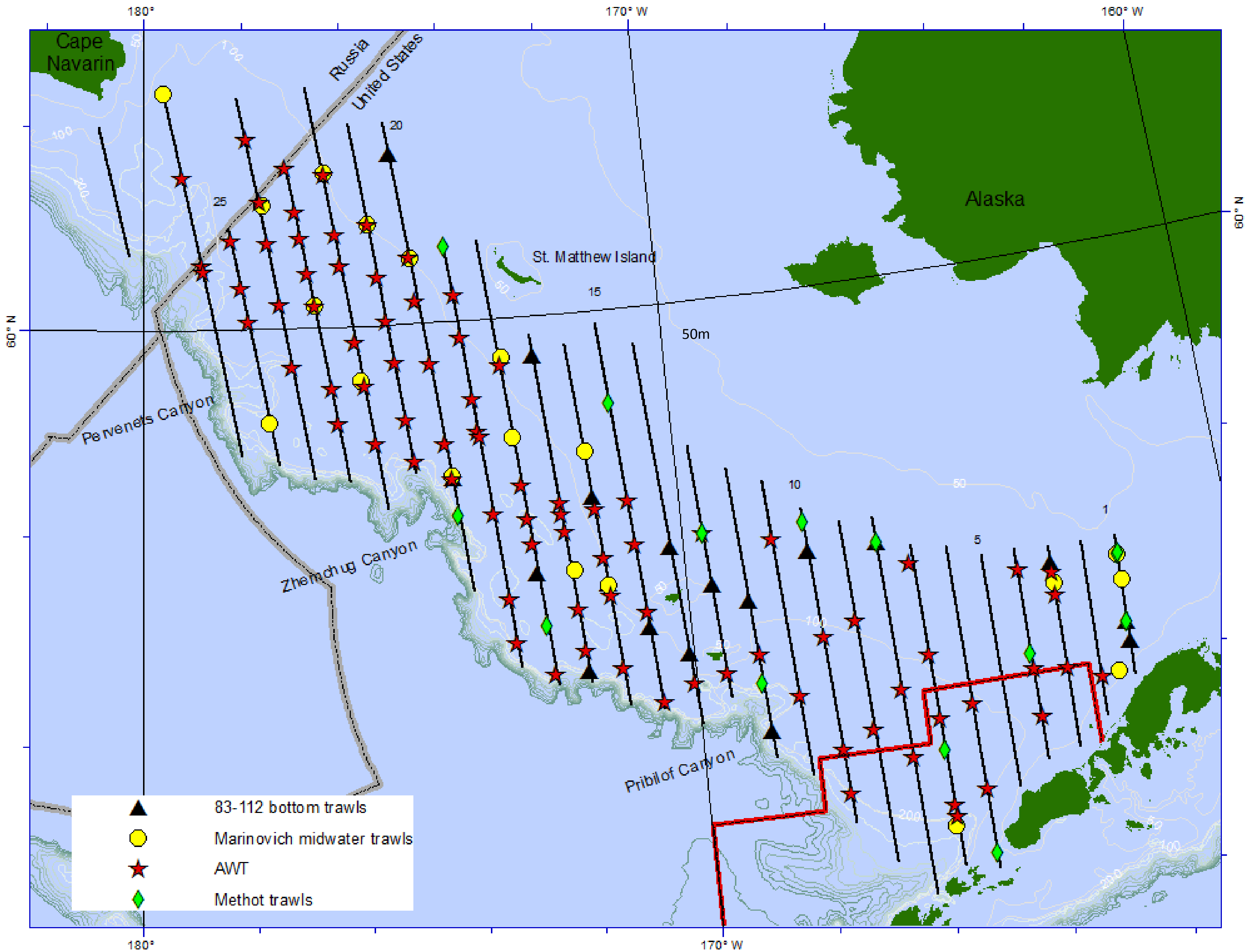


Figure 1.-- Transect lines with locations of Aleutian wing trawls, 83-112 trawls, Marinovich, and Methot trawls during the summer 2014 acoustic-trawl survey of walleye pollock on the eastern Bering Sea shelf. Transect numbers are noted above transects. Steller sea lion conservation area is outlined in red.

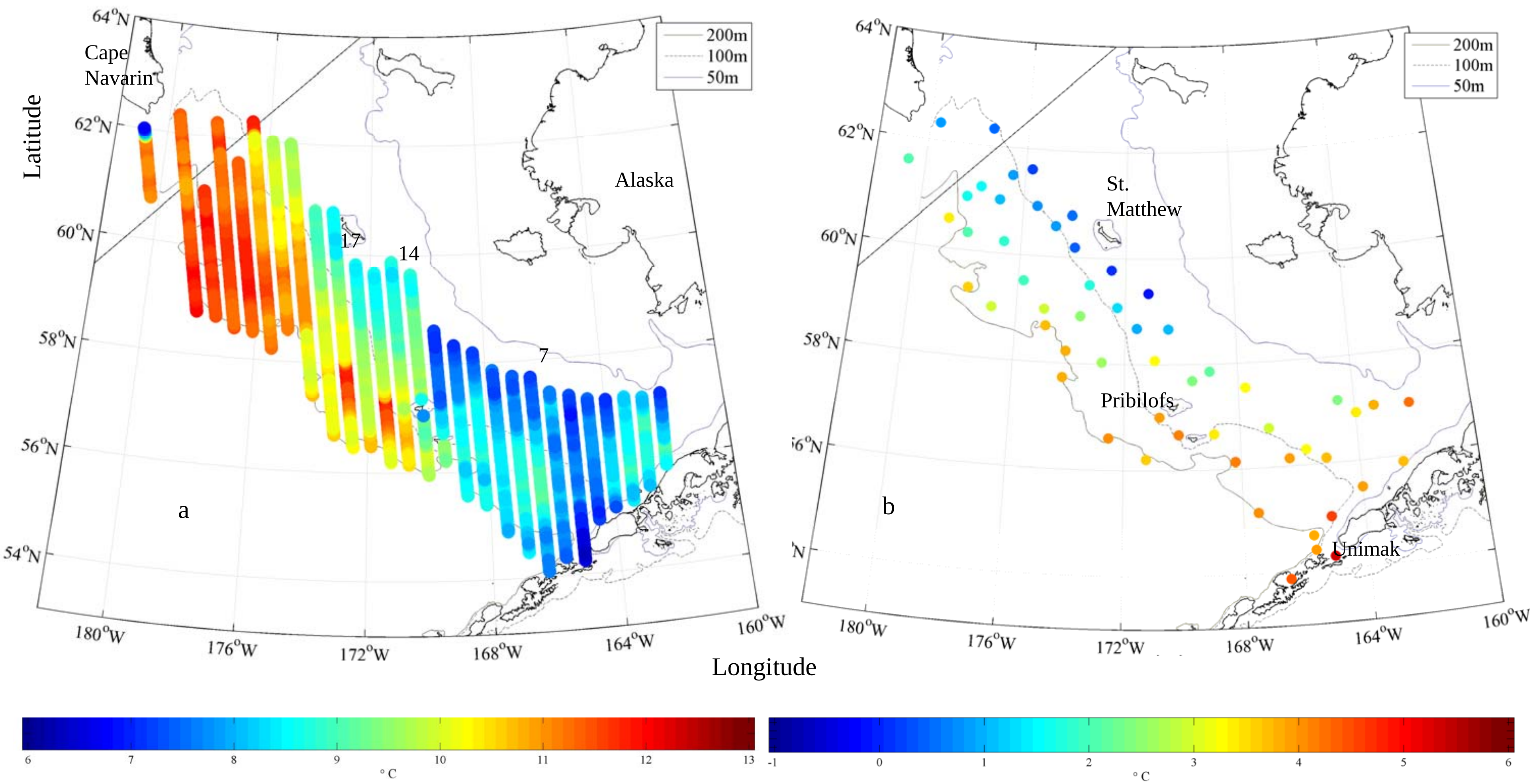


Figure 2. -- Temperature (°C) a) measured at the sea surface using shipboard surface temperature sensors along survey transects averaged at 10 nautical mile resolution, and b) at the bottom using conductivity-temperature-depth profilers (CTDs, n=56), during the summer 2014 acoustic-trawl survey of the eastern Bering Sea shelf.

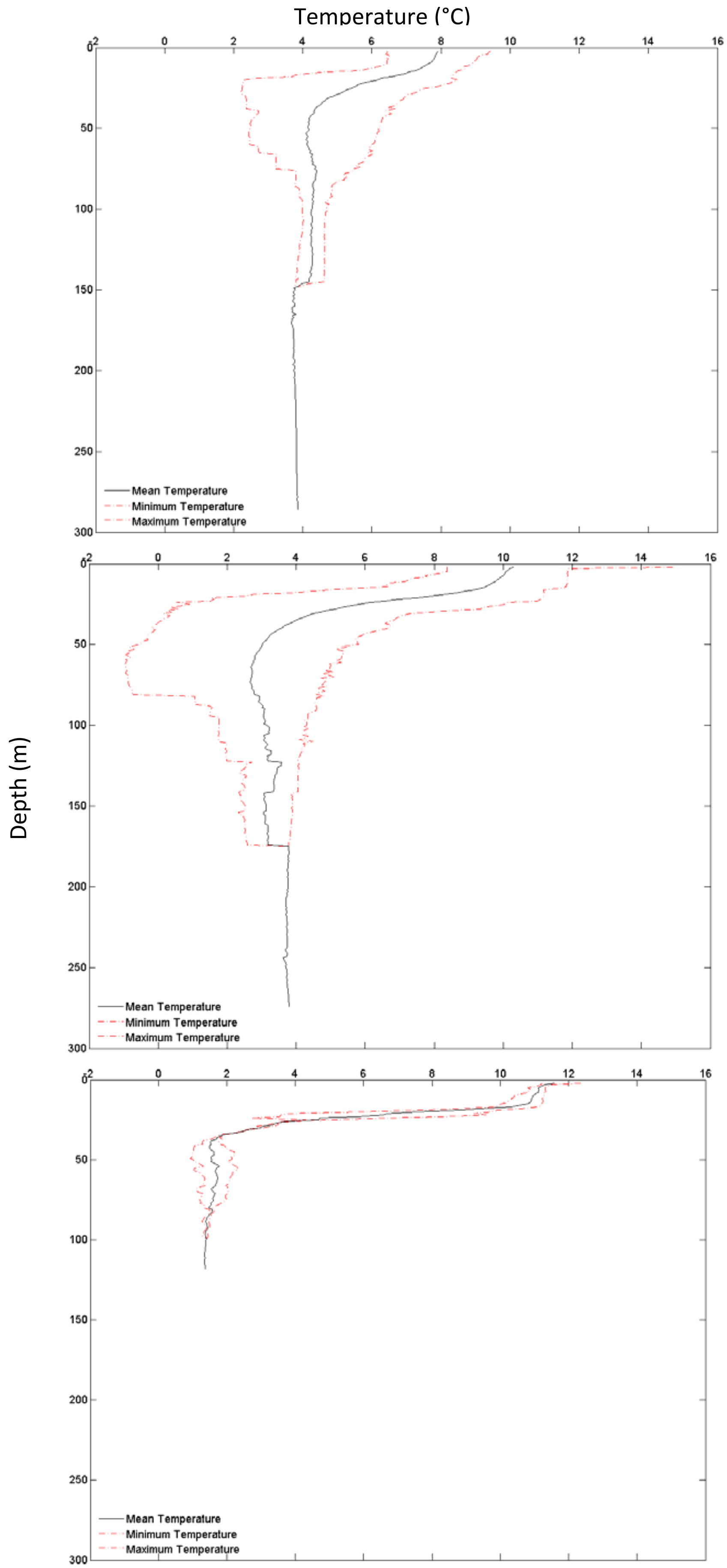


Figure 3. -- Mean water temperature (°C; solid line) by 1-m depth intervals for trawl haul locations during the summer 2014 eastern Bering Sea acoustic-trawl survey. Data were collected with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope. Dashed- lines represent minimum and maximum temperatures observed. Profiles are shown for trawls east of 170 °W (n=51; top), west of 170 °W in the U.S. EEZ (n=82; middle), and in Russian waters (n=3; bottom).

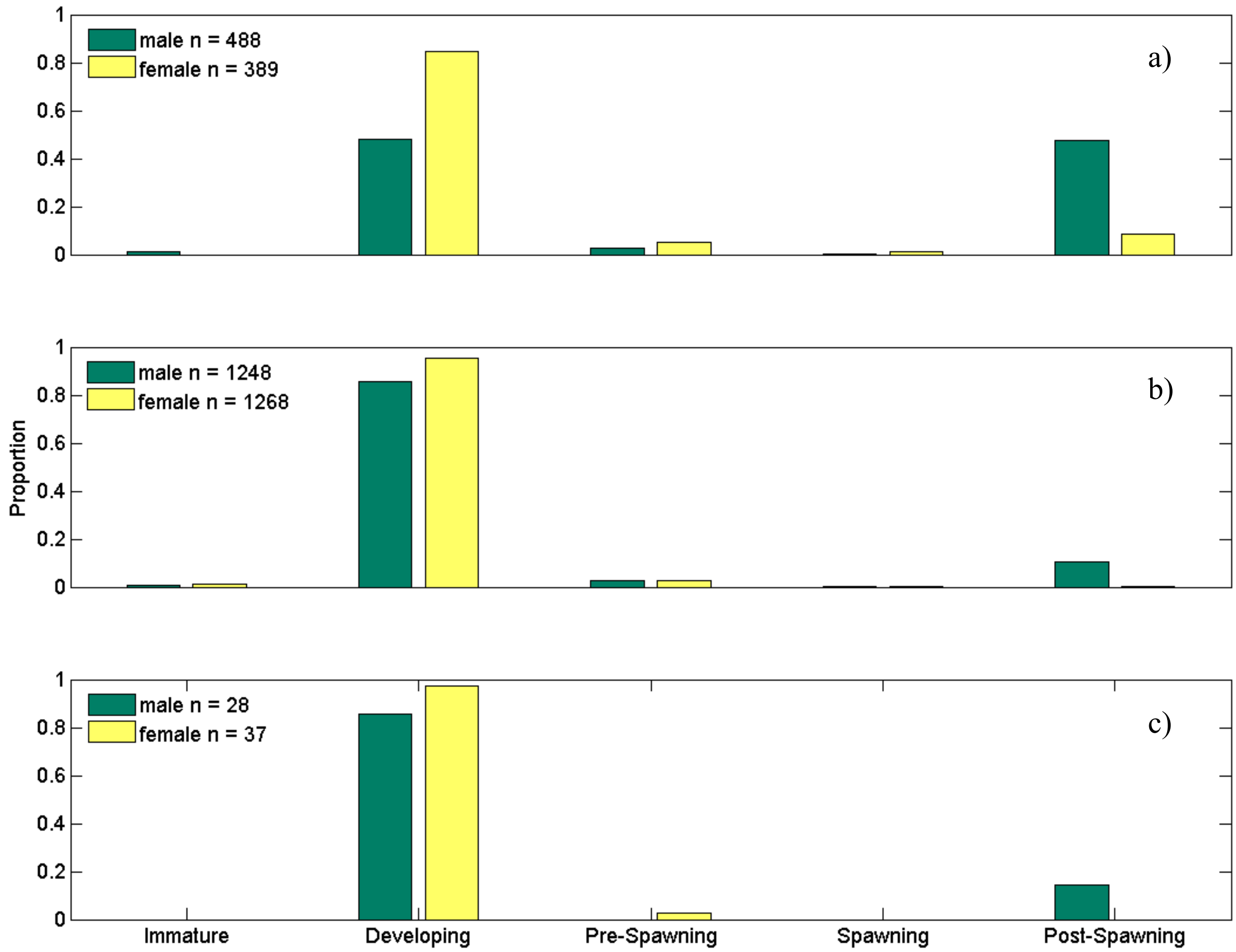


Figure 4. -- Maturity stages by sex for walleye pollock 34 cm observed during the summer 2014 eastern Bering Sea shelf acoustic-trawl survey a) east of 170° W, b) in U.S. waters west of 170° W, and c) in Russian waters.

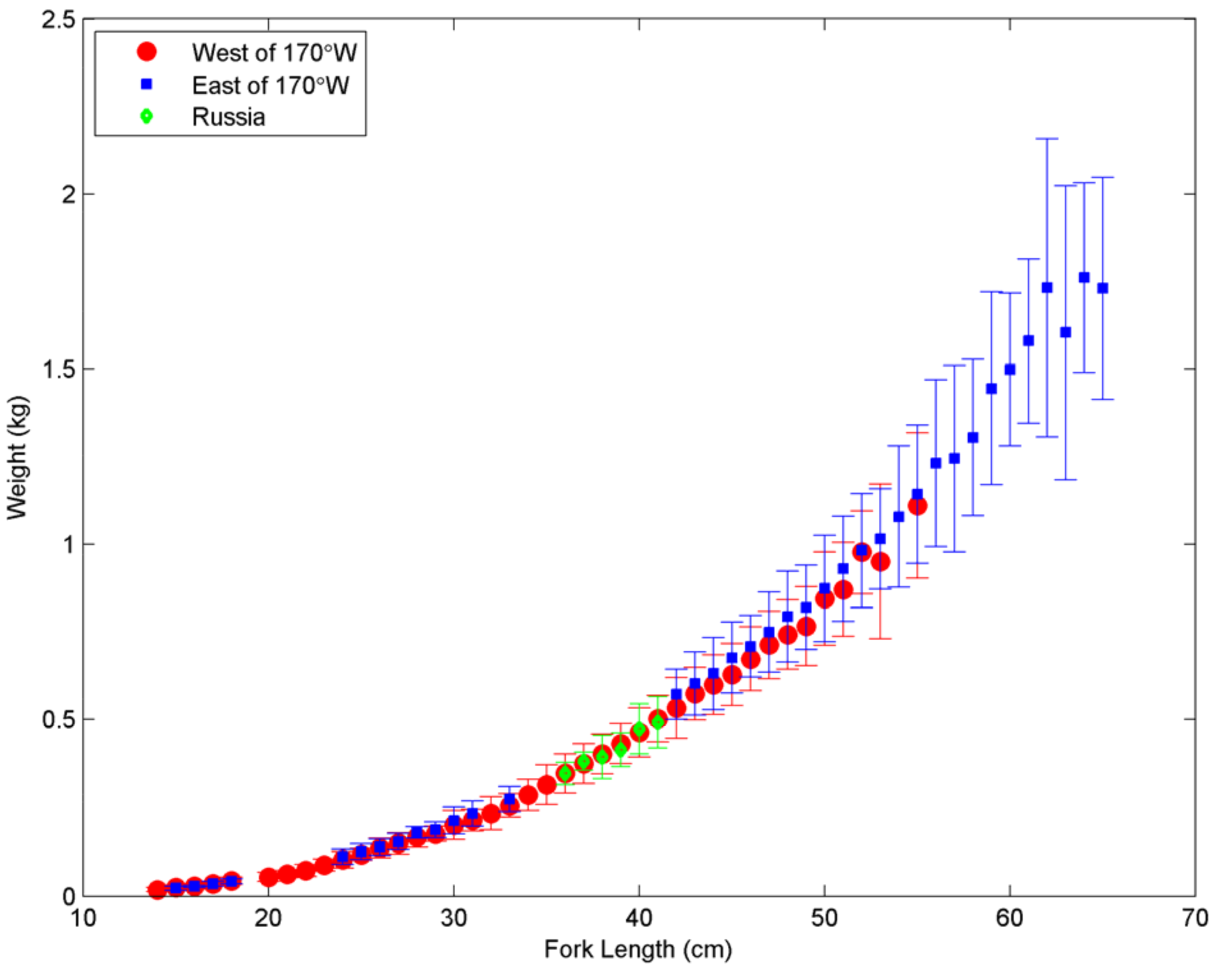


Figure 5. -- Mean weight-at-length for walleye pollock measured in the U.S. EEZ east and west of 170°W, and in Russia during the summer 2014 eastern Bering Sea shelf acoustic-trawl survey. Error bars represent ± 1 standard deviation.

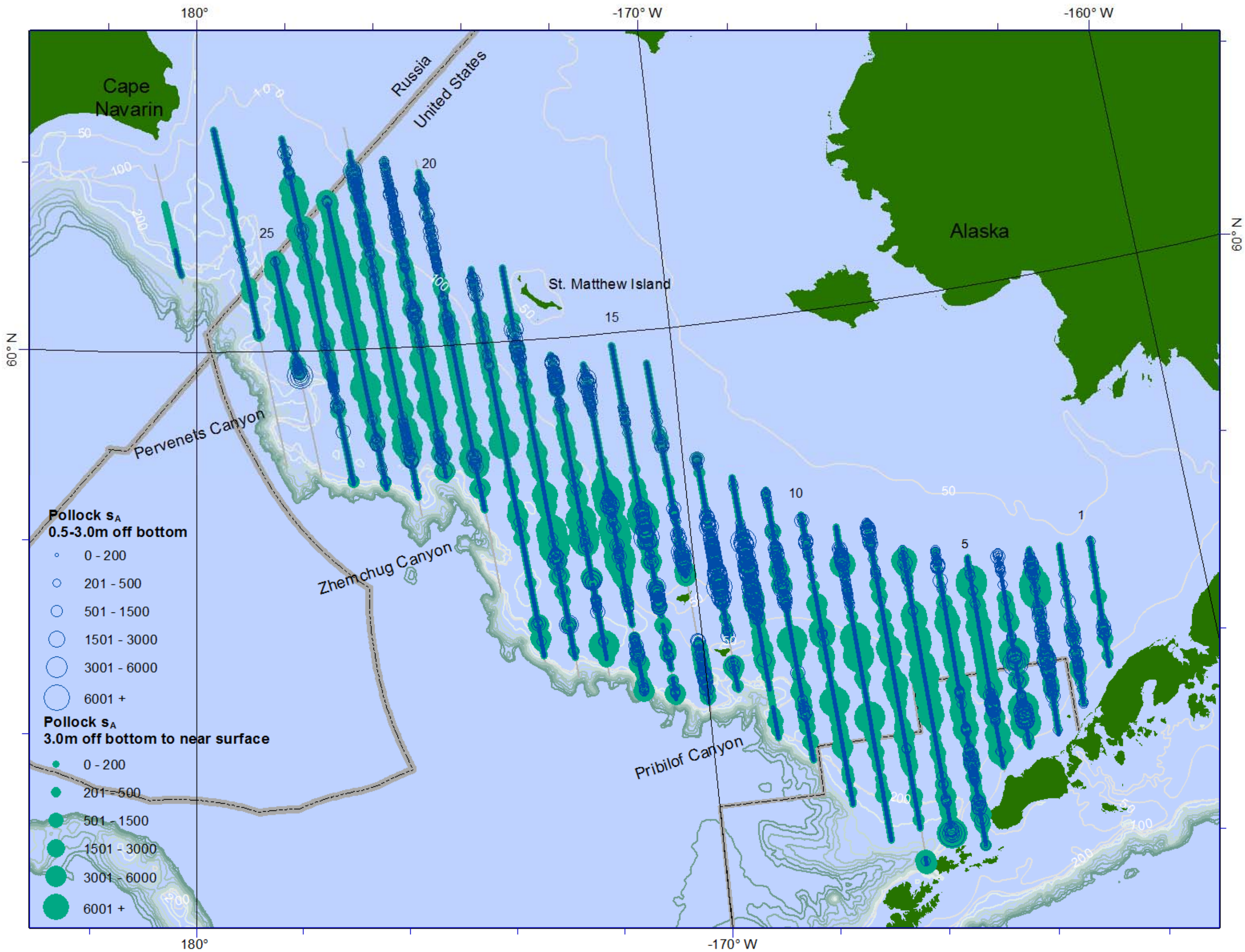


Figure 6. – Midwater (3 m to 16 m from surface; solid circles) and near bottom (0.5 m to 3 m off bottom; open circles) backscatter (s_A) along transects from the summer 2014 acoustic-trawl survey in the eastern Bering Sea.

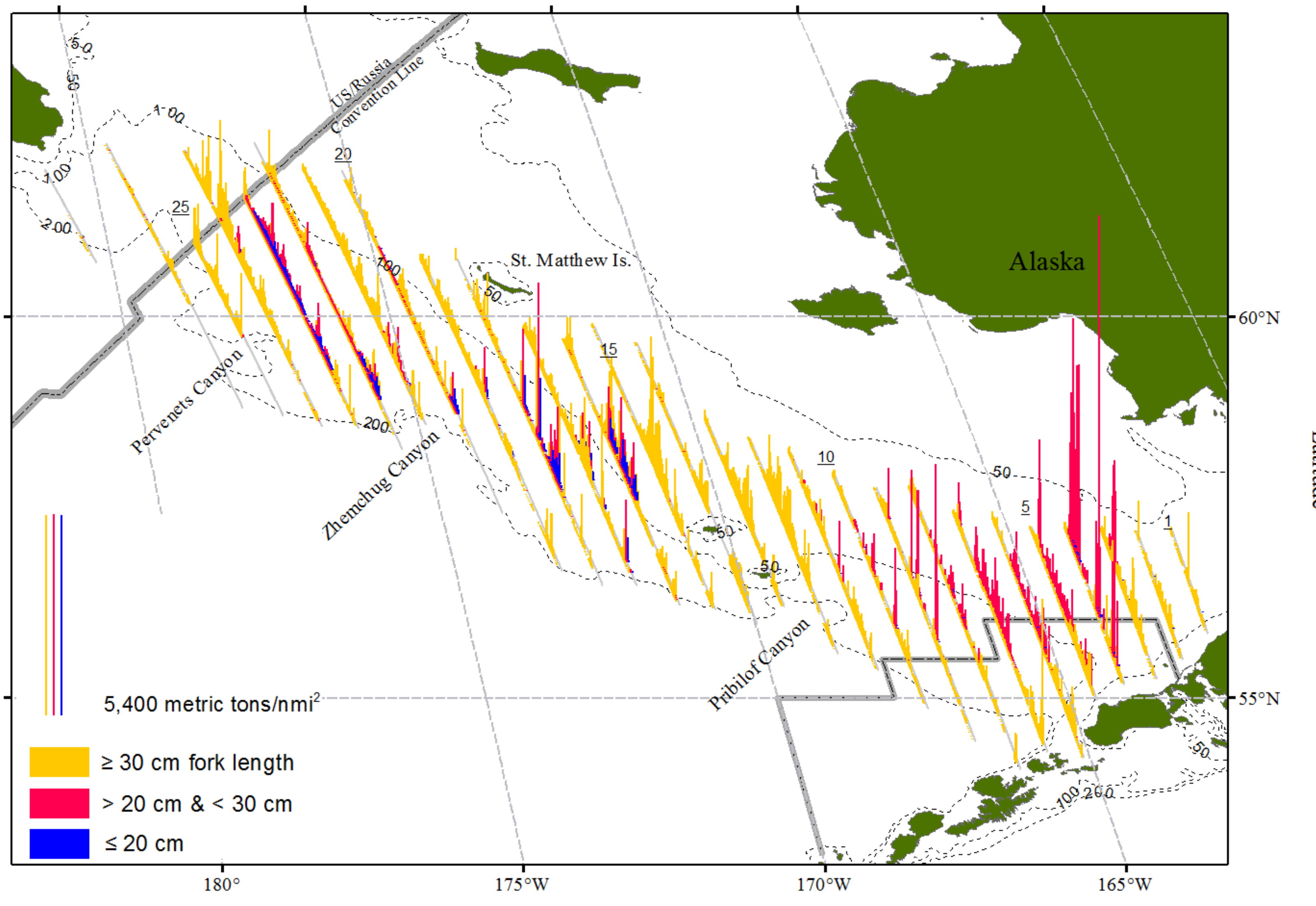


Figure 7. – Estimated juvenile and adult (20 cm fork length, blue; > 20 cm & < 30 cm, pink; 30 cm, yellow) walleye pollock biomass per sq. nmi for the summer 2014 acoustic-trawl survey (16 m from the surface to 3 m off bottom). Transect numbers are underlined, and the Steller sea lion Conservation Area (SCA) is outlined (gray solid line).

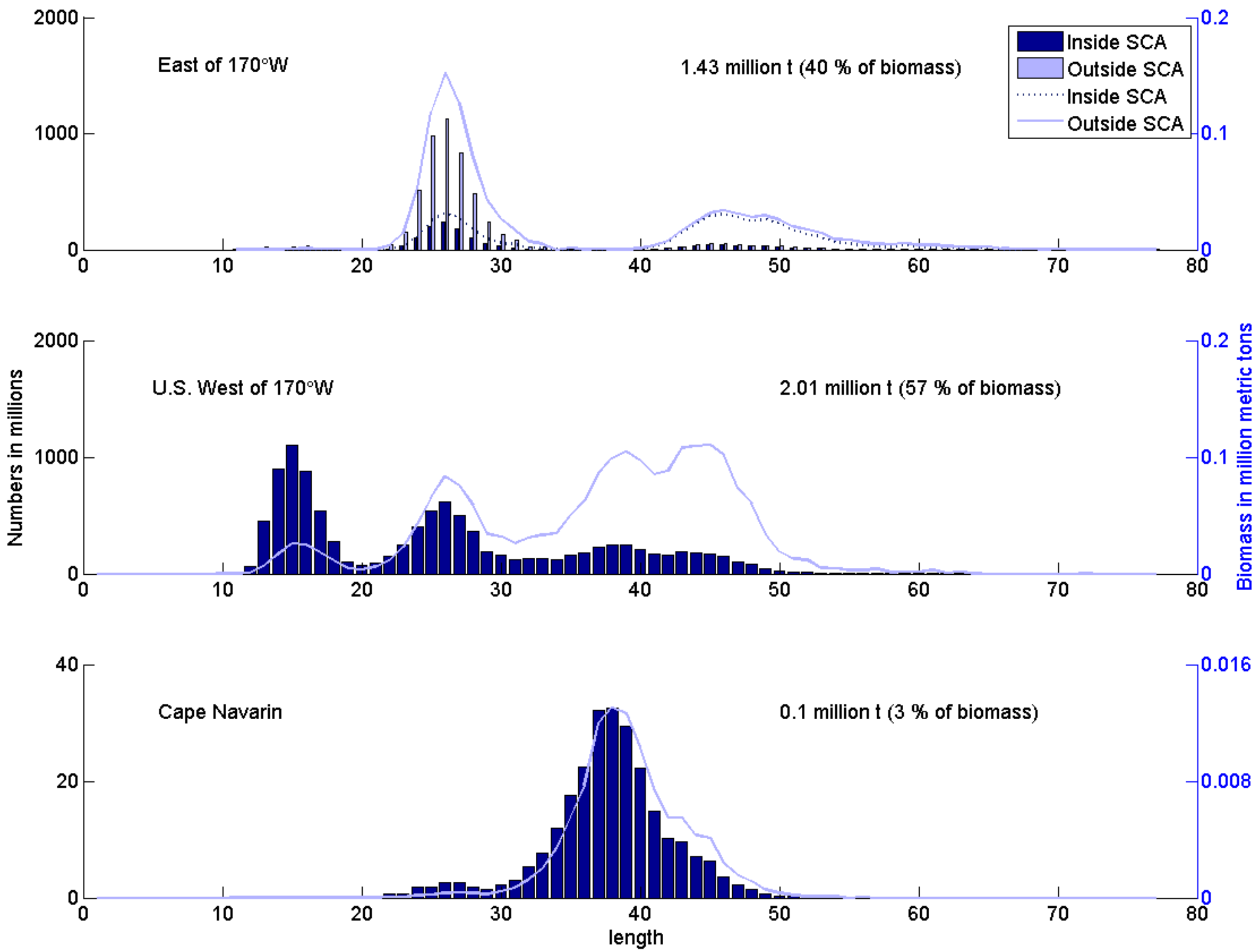


Figure 8. -- Population numbers (histogram bars) and biomass (lines) at length (cm) estimated for walleye pollock between 16 m from the surface and 3 m off the bottom from the summer 2014 eastern Bering Sea shelf acoustic-trawl survey in three geographic regions.

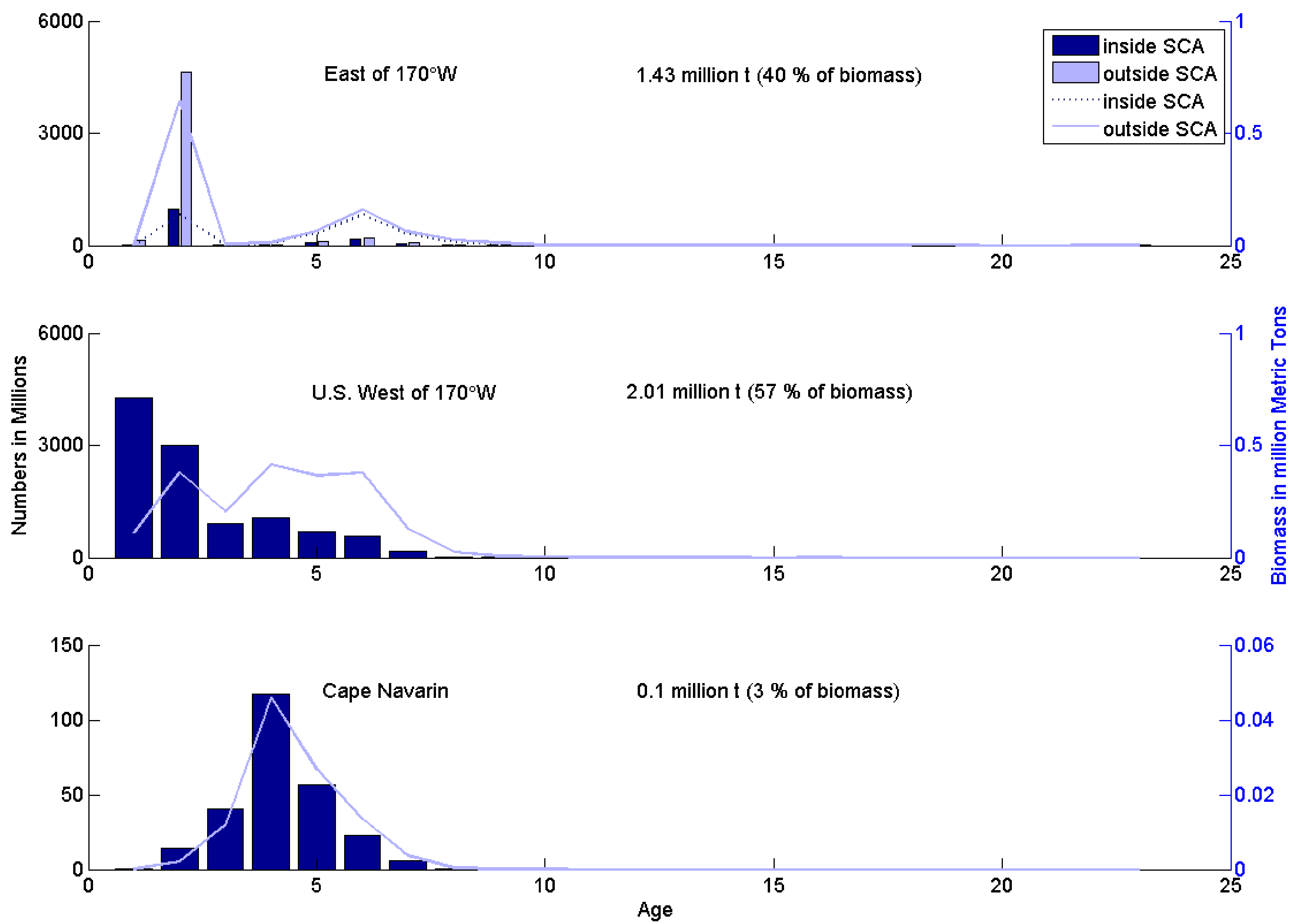


Figure 9. -- Population numbers (histogram bars) and biomass (lines) at age estimated for walleye pollock between 16 m from surface and 3 m off bottom for three different geographic regions during the summer eastern Bering Sea shelf acoustic-trawl survey. Note: Y-axis scales differ.

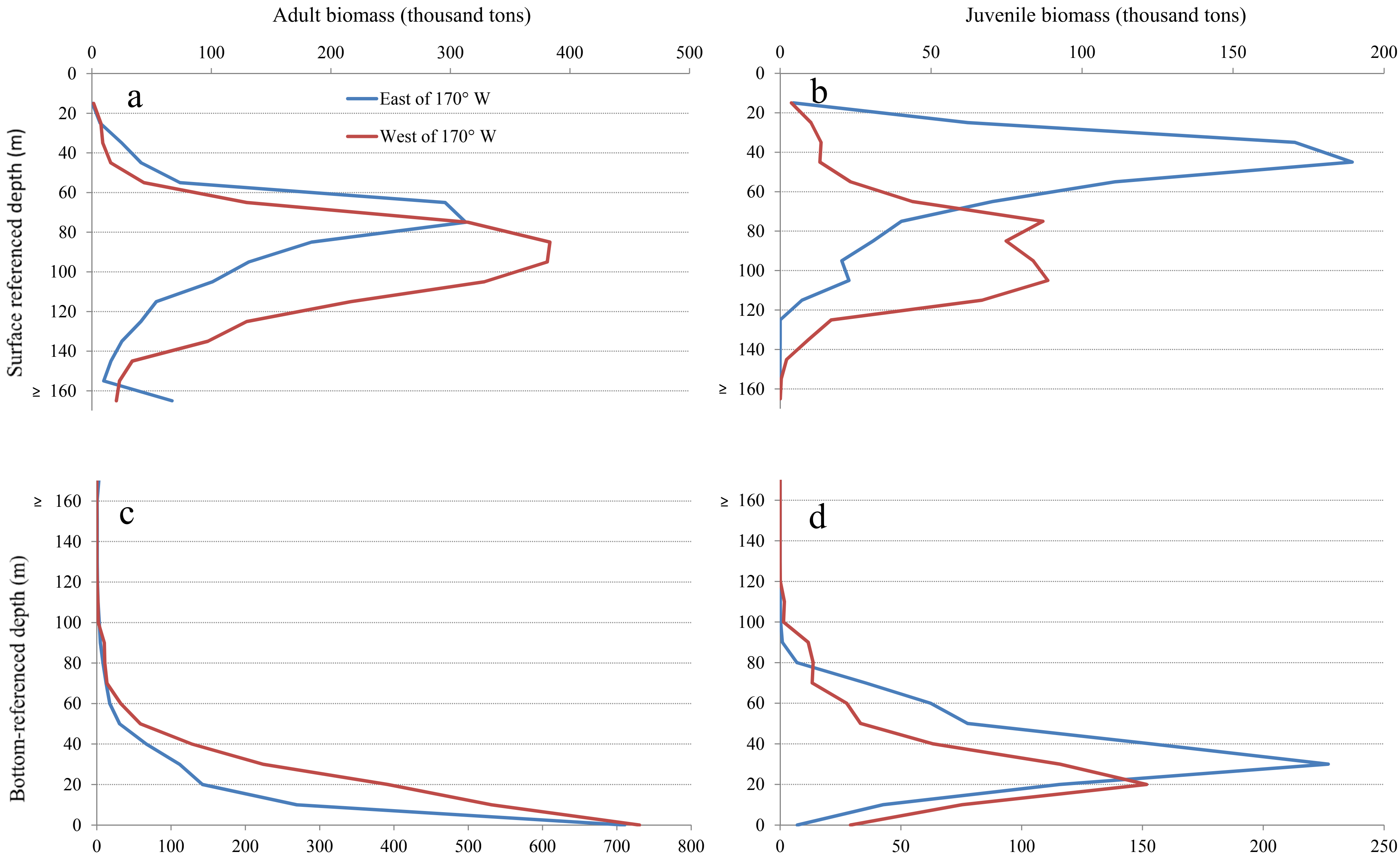


Figure 10.-- Depth distribution (m) of adult (30 cm FL) or juvenile (< 30 cm FL) walleye pollock biomass in metric tons (t) observed east and west of 170°W longitude in the U.S. EEZ of the Bering Sea shelf during the summer 2014 acoustic-trawl survey. Depth is referenced to the surface (a,b) and to the bottom (c, d) and is averaged in 10 m depth bins. Note: biomass estimates (3 m to 0.5 m off bottom) should be treated with caution. Fewer hauls were made in this zone than in midwater and there is higher probability that some non-pollock backscatter was included.

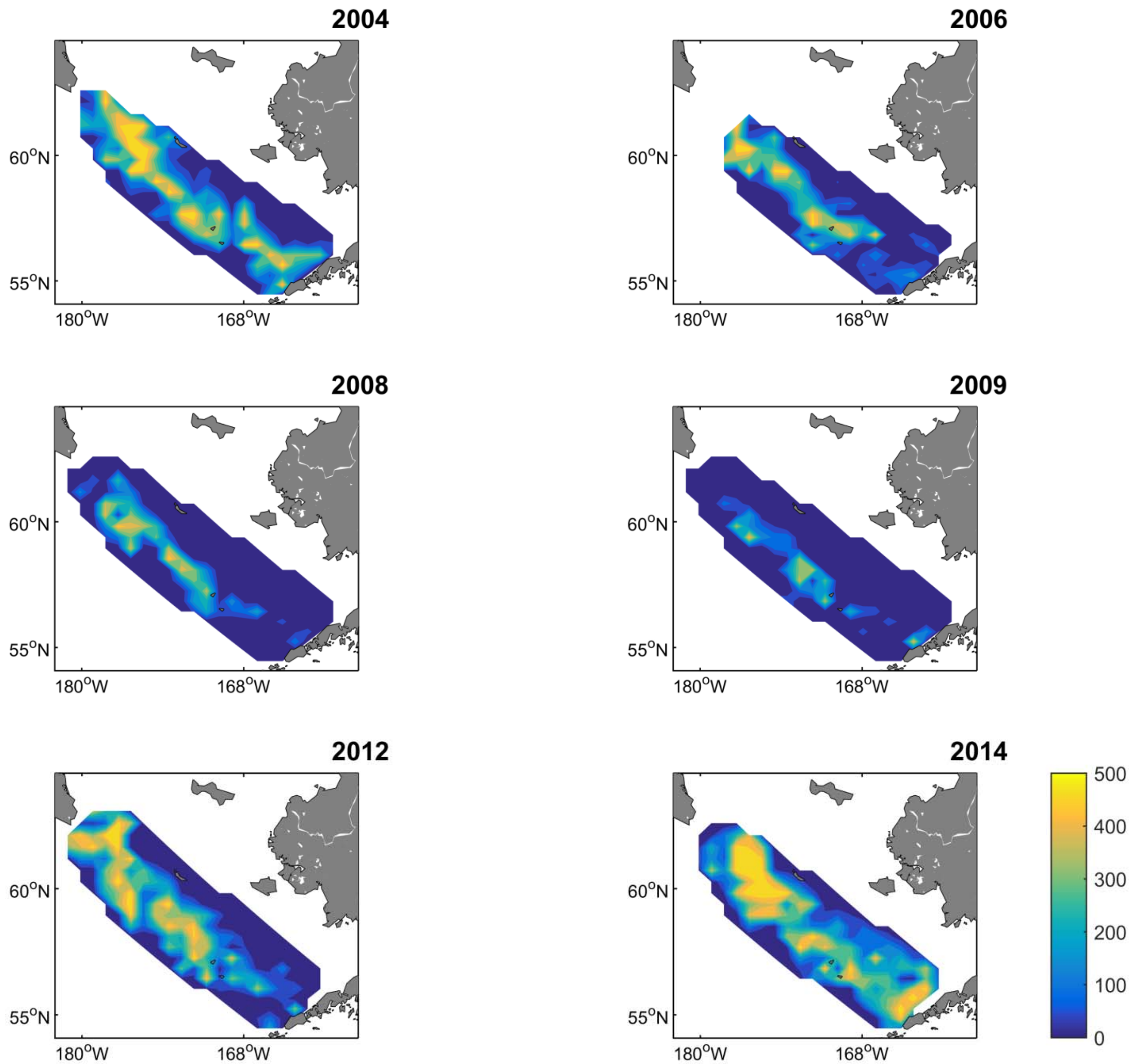


Figure 11. – Walleye pollock backscatter (s_A, m^2 nmi^{-2}) between near surface and 3 m off bottom at 38 kHz observed along tracklines during summer eastern Bering Sea acoustic-trawl surveys conducted between 2004 and 2014.

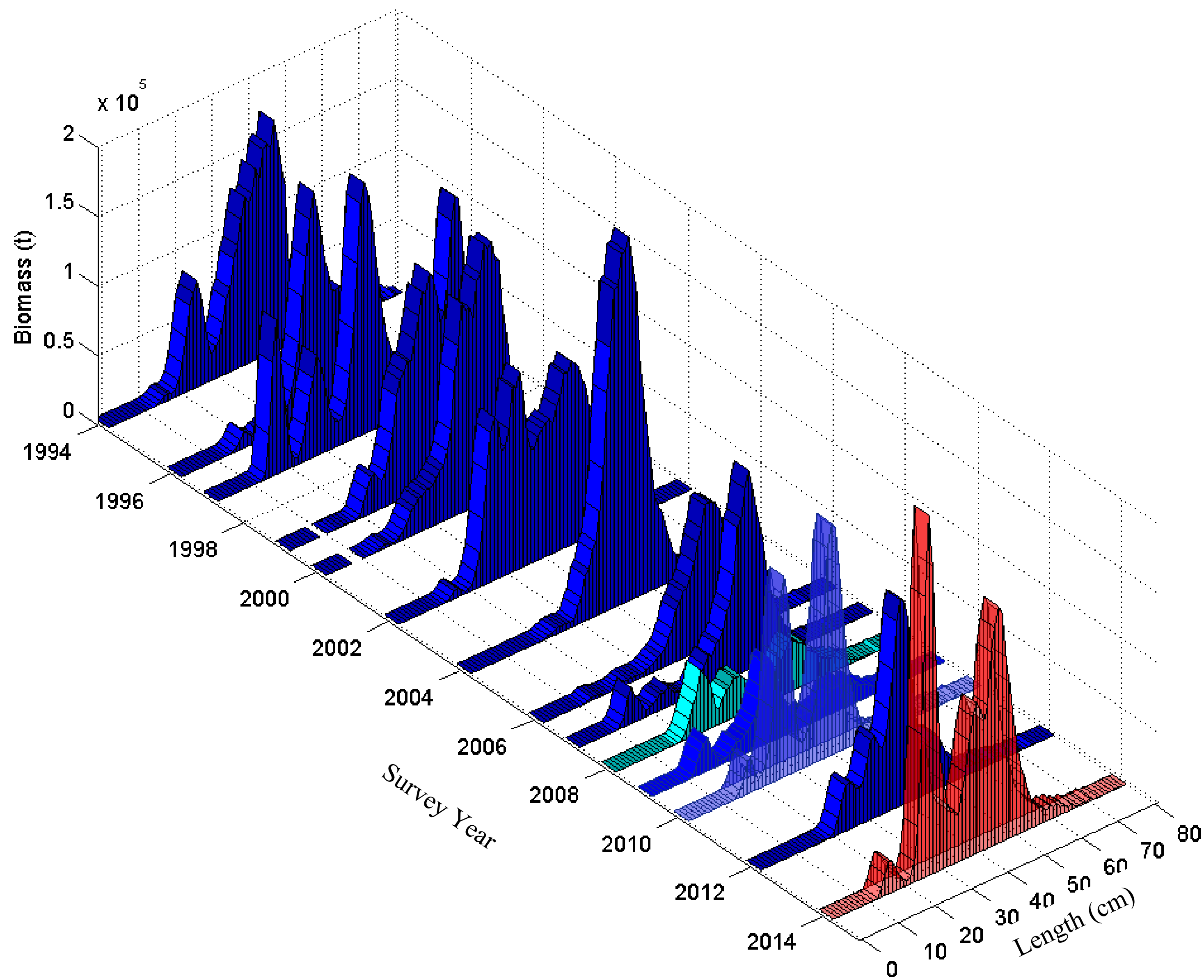


Figure 12. – Historical biomass at length between near surface and 3 m off bottom in the U.S. EEZ for the summer eastern Bering Sea shelf acoustic-trawl surveys between 1994 and 2014. Red bars indicate the most recent survey, and light blue indicates the year with the lowest biomass of the time series.

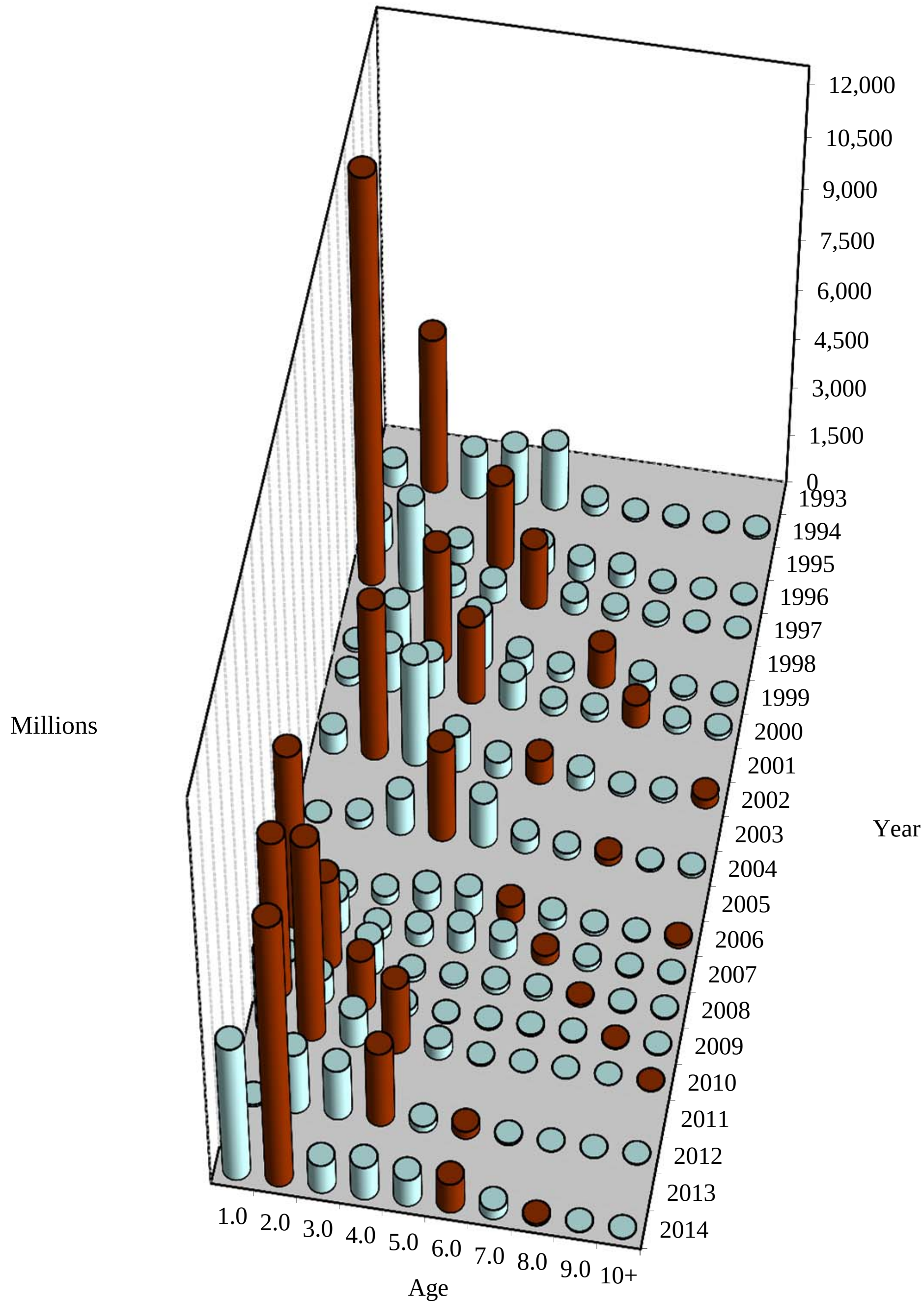


Figure 13. -- Historical numbers at age of walleye pollock between near surface and 3 m off bottom in the U.S. EEZ for summer eastern Bering Sea shelf acoustic-trawl surveys between 1994 and 2014. Strong year classes are indicated with dark columns.

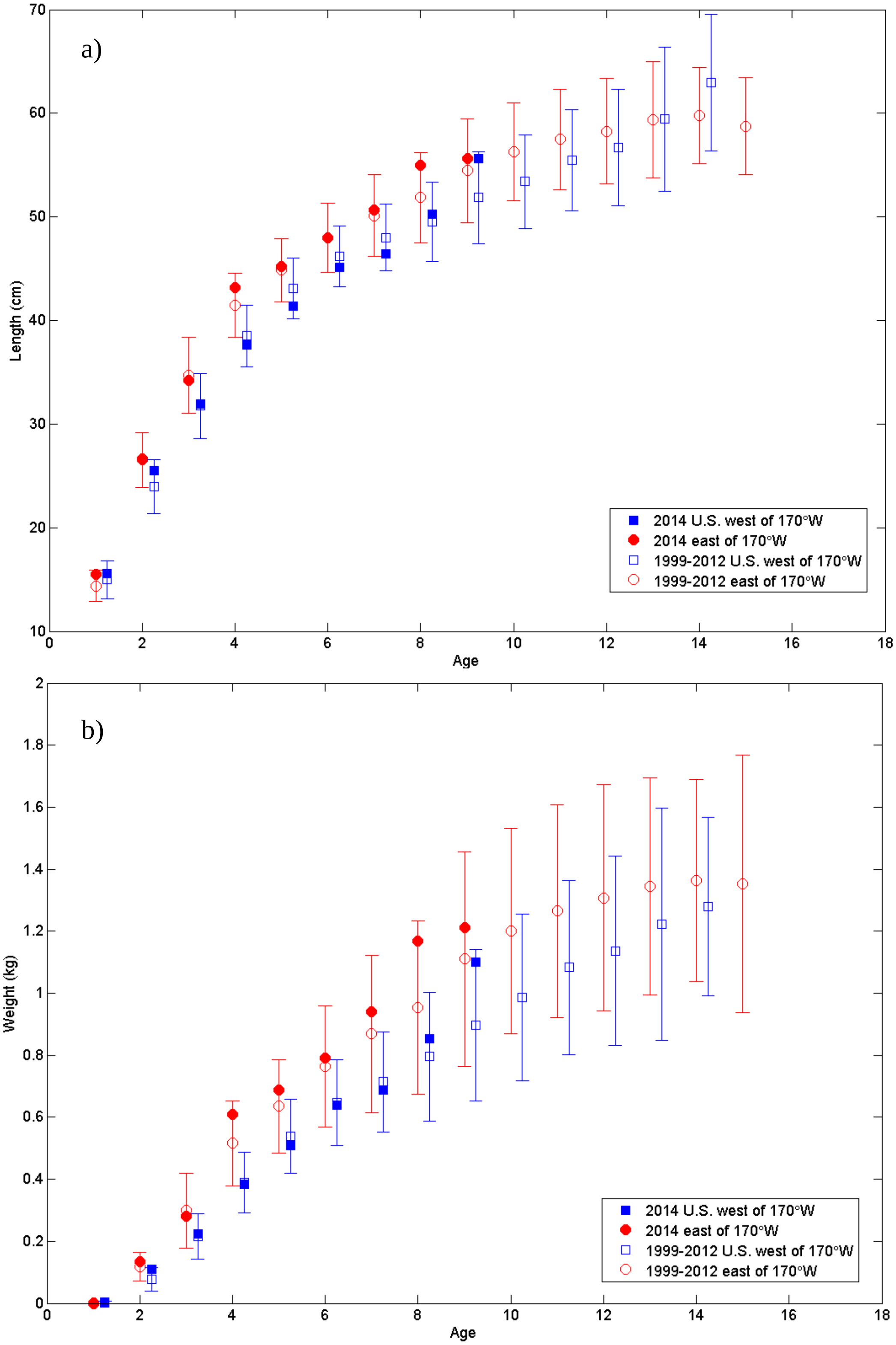
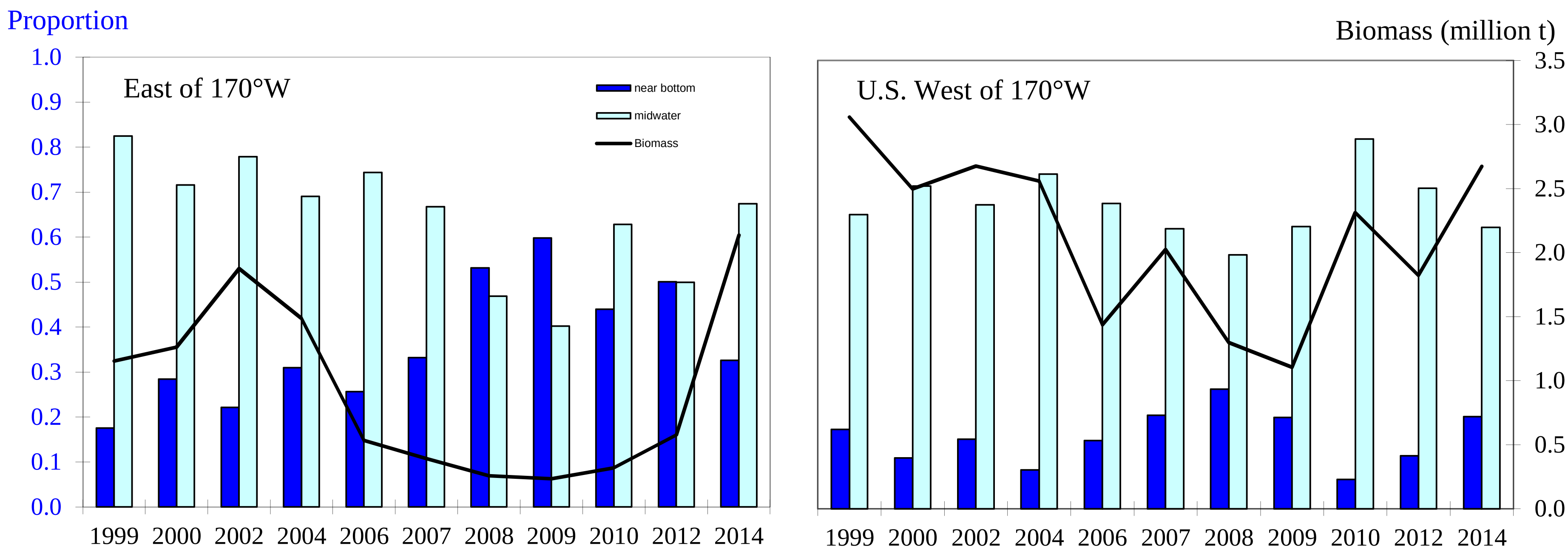


Figure 14. -- Walleye pollock average length (a) and weight (b) at age from summer eastern Bering Sea acoustic-trawl surveys (1999, 2000, 2002, 2004, 2006-2010, 2012) compared with data from summer 2014 for the U.S. EEZ east and west of 170°W. Results are limited to age classes where at least 5 fish were aged and weighed. Bars show +/- 1 standard deviation.



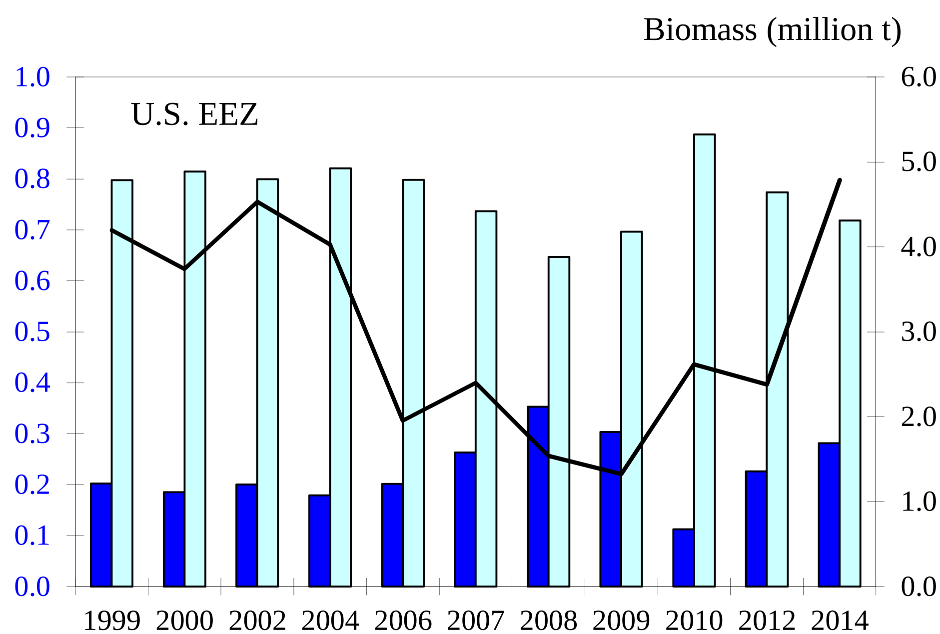


Figure 15. -- Proportion of walleye pollock biomass in midwater (surface to 3 m off the bottom), and near bottom (3 m to 0.5 m off bottom), east and west of 170°W, and in the U.S. EEZ during the 1999-2014 acoustic-trawl surveys. Total (midwater + near bottom) biomass (black lines) is plotted on right Y-axes. Note: near bottom biomass estimates (3 m to 0.5 m) should be treated with caution as fewer hauls were made in this zone than in midwater, and there is a higher probability that some non-pollock backscatter was included.

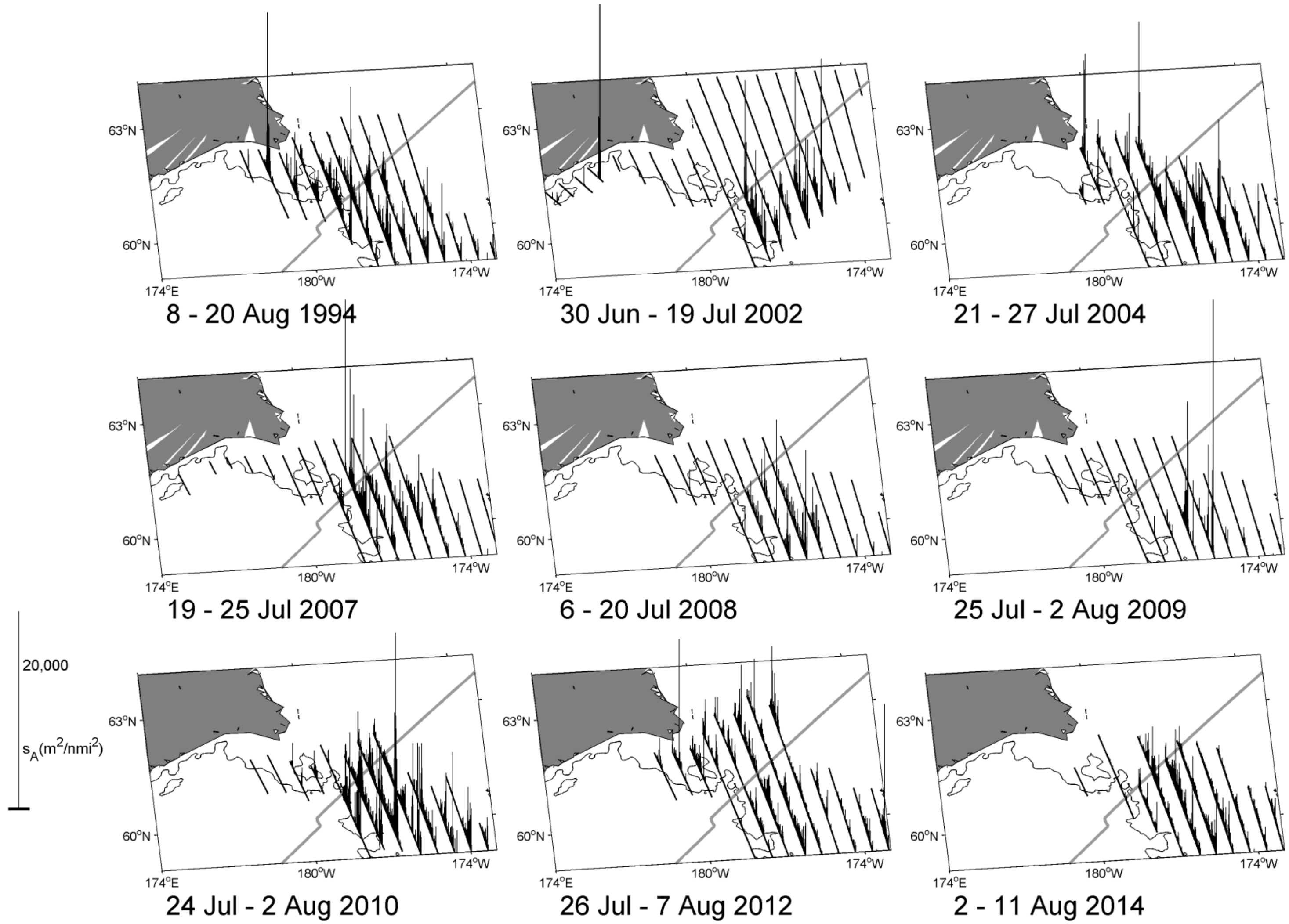


Figure 16. -- Walleye pollock acoustic backscatter (s_A, m^2 nmi^{-2}) along tracklines between near surface and 0.5 m off bottom from acoustic-trawl surveys in the Cape Navarin area of Russia. The United States conducted surveys in 1994, 2004, 2007-2010, 2012 and 2014. Russia conducted the 2002 survey. Start dates are first crossing to Russia.

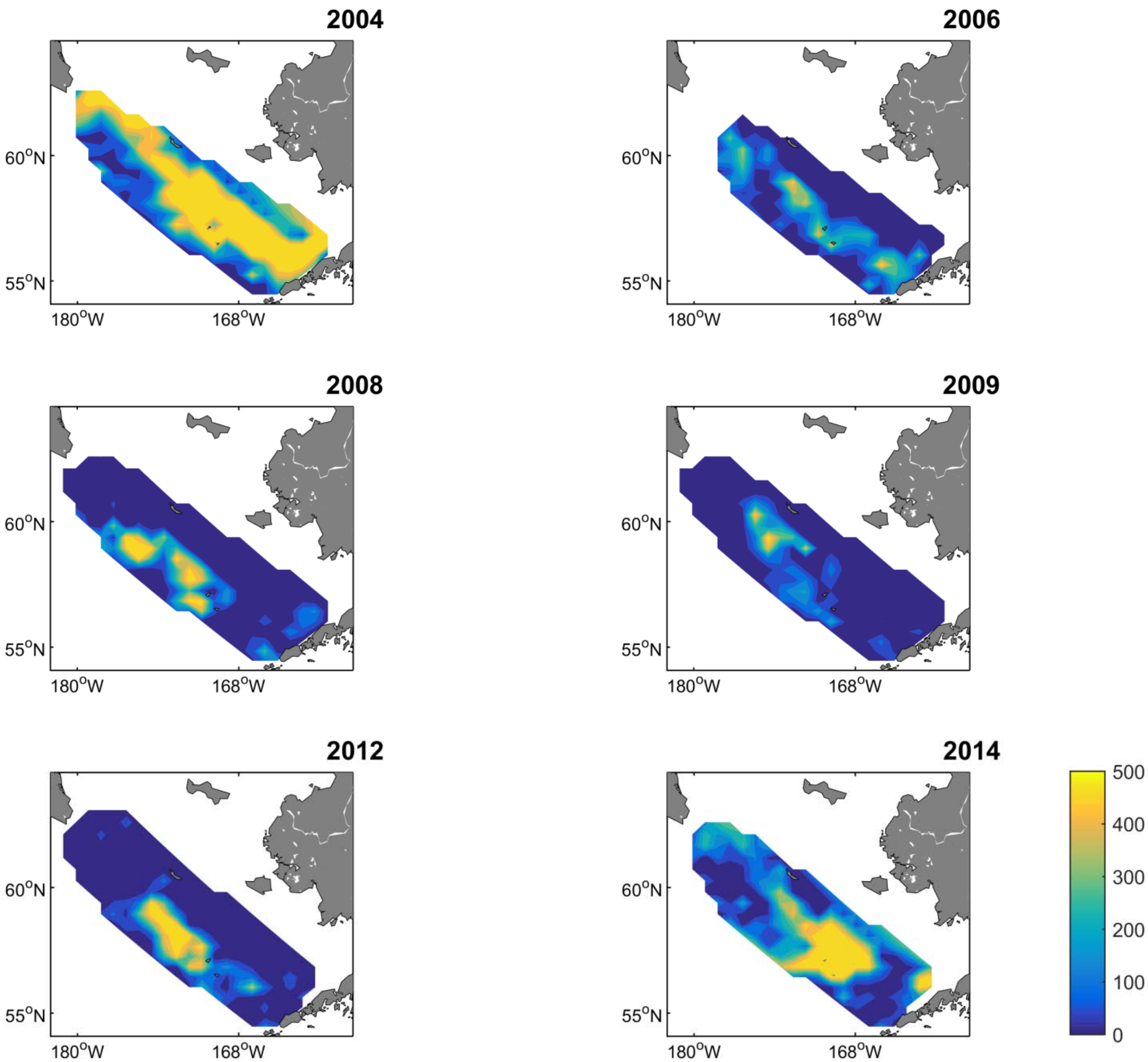


Figure 17. – Non-pollock, non-fish backscatter (s_A, m^2 nmi^{-2}) from near surface to 0.5 m off bottom at 38 kHz frequency along tracklines during summer eastern Bering Sea acoustic-trawl surveys 2004-2014.

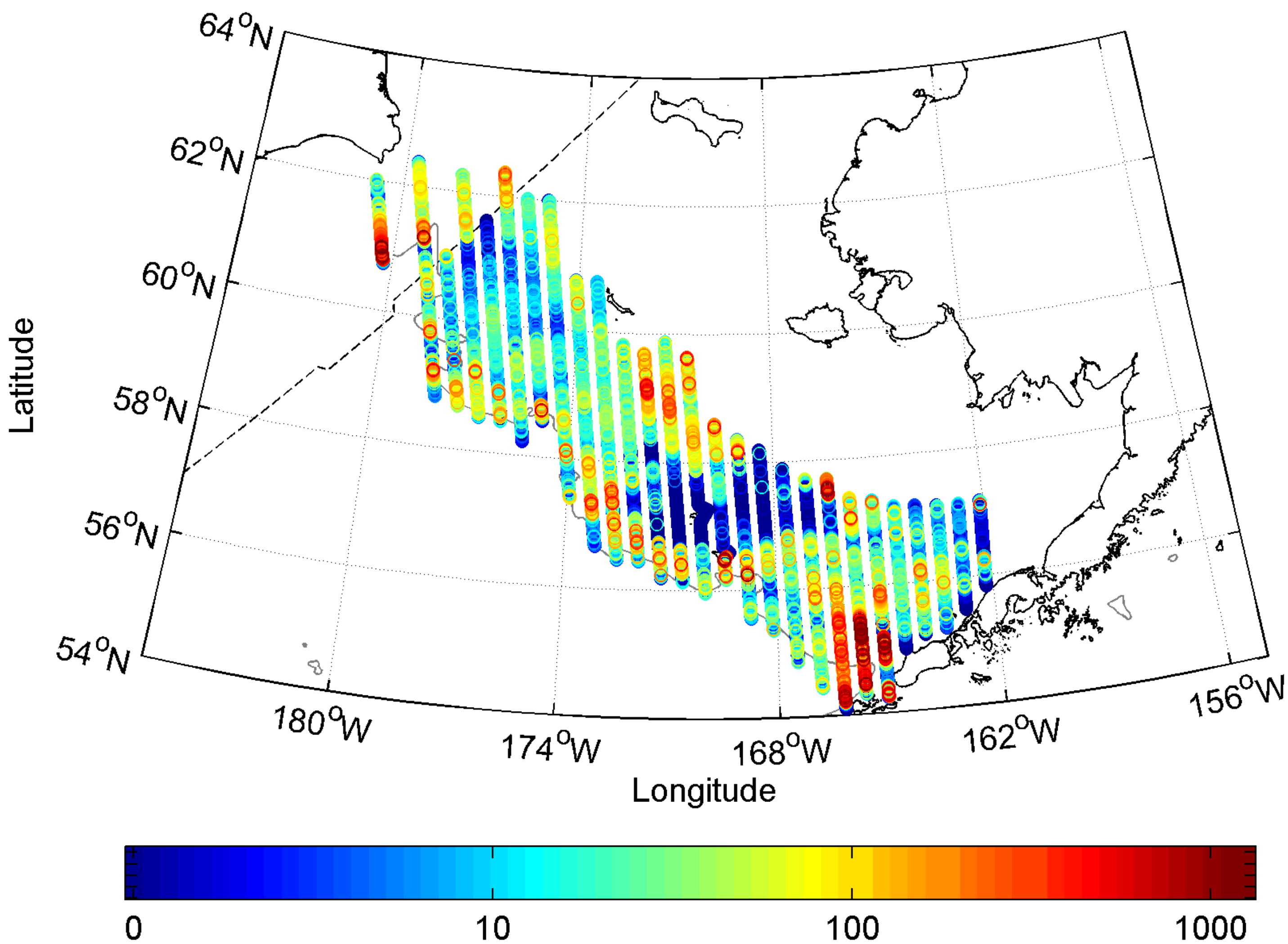


Figure 18. -- Preliminary map of the spatial distribution of euphausiid backscatter (s_A, $m^2 nmi^{-2}$) during the summer 2014 acoustic-trawl survey. Data are displayed at 120 kHz.

Appendix I. -- Itinerary

<u>Leg 1</u>

12-14 June	Calibration in Captains Bay. Depart Dutch Harbor, AK. Transit to survey start area in Bristol Bay, eastern Bering Sea
14-30 June	Acoustic-trawl survey of the Bering Sea shelf (through north part of transect 13). Transit to Dutch Harbor.
1-3 July	In port Dutch Harbor

<u>Leg 2</u>

4 – 5 July	Transit to survey resume point
5-20 July	Acoustic-trawl survey of the Bering Sea shelf (transects 13 – 19, part of 20)
21-22 July	Transit to Unalaska Island, AK
23-25 July	In port Dutch Harbor, AK

<u>Leg 3</u>

26-28 July	Transit to survey resume point
28 Jul.-11 Aug.	Acoustic-trawl survey of the Bering Sea shelf including Russian waters (transects 20 - 28).
11-12 Aug.	AWT trawl and Methot sampling. Transit to Dutch Harbor, AK.
13 Aug.	Acoustic sphere calibration in Captains Bay. End of cruise.

Appendix II. -- Scientific Personnel

Leg 1 (12-30 June)

Name	Position	Organization	Nation
Patrick Ressler	Chief Scientist	AFSC	USA
Denise McKelvey	Fishery Biologist	AFSC	USA
Rick Towler	Info. Tech. Specialist	AFSC	USA
Darin Jones	Fishery Biologist	AFSC	USA
Robert Levine	Fishery Biologist	OAI	USA
William Floering	Fishery Biologist	AFSC	USA
Emily Collins	Observer	AIS	USA

Leg 2 (4 -22 July)

Alex De Robertis	Chief Scientist	AFSC	USA
Kresimir Williams	Fishery Biologist	AFSC	USA
Carwyn Hammond	Fishery Biologist	AFSC	USA
Nate Lauffenburger	Fishery Biologist	AFSC	USA
Emily Collins	Observer	AIS	USA
Mikhail Stepanenko	Fishery Biologist	TINRO	Russia
Mary Murrian	Teacher	NOAA	USA

Leg 3 (26 July -13 August)

Taina Honkalehto	Chief Scientist	AFSC	USA
Scott Furnish	Info. Tech. Specialist	AFSC	USA
Darin Jones	Fishery Biologist	AFSC	USA
Mikhail Stepanenko	Fishery Biologist	TINRO	Russia
Nate Lauffenburger	Fishery Biologist	AFSC	USA
Rober Levine	Fishery Biologist	OAI	USA
Emily Collins	Observer	AIS	USA
Sandi Neidetcher	Fishery Biologist	AFSC	USA
Kacey Shaffer	Teacher	NOAA	USA
Greg Cook	Teacher	NOAA	USA

AFSC	Alaska Fisheries Science Center, Seattle WA
AIS	AIS, Inc., New Bedford, MA
APL	Applied Physics Laboratory, University of Washington, Seattle WA
OAI	Ocean Associates, Inc.
TINRO	Pacific Research Institute of Fisheries and Oceanography Vladivostok, Russia
NOAA	National Oceanic and Atmospheric Administration, Teacher at Sea Program