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NATIONAL MARINE FISHERIES SERVICE
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PRELIMINARY CRUISE RESULTS NOAA SHIP MILLER FREEMAN CRUISE NO. 94-07

ECHO-INTEGRATION TRAWL SURVEY OF WALLEYE POLLOCK IN THE BERING SEA

CRUISE PERIOD, AREA, AND SCHEDULE

Scientists from the Alaska Fisheries Science Center (AFSC) conducted an echo-integration trawl (EIT) survey of walleye pollock (Theragra chalcogramma) aboard the NOAA ship Miller Freeman from June 27 to September 14, 1994. The cruise began in Seattle, Washington, and ended in Dutch Harbor, Alaska. The survey area included the eastern Bering Sea (EBS) shelf and slope from the Alaska Peninsula in the southeast to Cape Navarin in the north, the western Bering Sea (WBS) shelf and slope from Cape Navarin to the southern edge of the Gulf of Kamchatka in the southwest, and a portion of Aleutian Islands waters. This cruise was part of a cooperative survey effort involving research vessels from the United States, Japan, and South Korea. In addition to the Miller Freeman, the Japan Fisheries Agency's chartered vessel F/V No. 1 Kyowa maru and the Korean National Fisheries Research and Development Agency's vessel Pusan 851 conducted EIT surveys of the Aleutian basin. Researchers from Russia and the People's Republic of China participated as cooperating scientists aboard the Miller Freeman; an AFSC scientist participated in the Pusan 851 survey. Additionally, four groundfish vessels chartered by the AFSC conducted bottom trawl surveys in the Bering Sea. F/V Arcturus and F/V Aldebaran surveyed the EBS shelf, and F/V Pacific Knight and F/V Vesteraalen surveyed the Aleutian Islands shelf.

The itinerary for the Miller Freeman was as follows:

Jun 27-28	Shakedown cruise--gear trials in Puget Sound; sphere calibration and fish specimen collection in Port Susan
Jun 28-Jul 3	Transit to Dutch Harbor

Leg 1

Jul 4	Embark scientific personnel in Dutch Harbor; sphere calibration in Broad Bay, Unalaska Island
Jul 5	Transit to northwest of Pribilof Islands
Jul 6-7	Comparative EIT survey with the F/V Arcturus and F/V Aldebaran of groundfish trawl station tracklines
Jul 8	Transit to Port Moller area for mooring recovery
Jul 9-26	EIT survey of EBS shelf; target-strength data collection; vessel avoidance experiment
Jul 27-28	Transit to Adak
Jul 29	Inport Adak; exchange scientific personnel

Leg 2

Jul 30	Sphere calibration in Cabin Cove, Kagalaska Island
Jul 31	Transit to EBS shelf
Aug 1-19	EIT survey of EBS shelf and Zemchung Canyon; target-strength data collection; vessel avoidance experiment
Aug 20-21	Transit to Adak
Aug 21-22	Sphere calibration in Cabin Cove, Kagalaska Island
Aug 23-24	Inport Adak; exchange scientific personnel; repair net

Leg 3

Aug 25-26	Transit to WBS shelf
Aug 27-Sep 7	EIT survey of WBS shelf; target-strength data collection; intership calibration with Japanese survey vessel
Sep 8-10	EIT survey along western Aleutian Islands
Sep 11	Sphere calibration in Korovin Bay, Atka Island
Sep 12-13	EIT survey of Seguam Pass/Amukta Pass area; CTD operations in Amukta Pass; transit to Dutch Harbor
Sep 14	Disembark scientific personnel in Dutch Harbor; end of cruise.

OBJECTIVES

The principal objectives of the cruise were to collect echo-integration data and midwater and demersal trawl data necessary to determine the distribution, biomass, and biological composition of walleye pollock in the survey area, and to collect walleye pollock target-strength data for use in scaling echo-integration data to estimates of absolute abundance.

Secondary objectives were to:

1. calibrate both the Miller Freeman centerboard-mounted acoustic system and small boat portable acoustic system using standard sphere techniques;
2. study fish reaction to trawl gear and to vessel presence while bottom trawling and transecting;
3. conduct a coordinated midwater-bottom investigation to validate the current practice of summing midwater (acoustic) and bottom (trawl) estimates to provide total walleye pollock abundance;
4. conduct an intership calibration of the acoustic systems aboard the U.S. and Japanese survey vessels;
5. collect oceanographic and environmental data including temperature and salinity profiles at selected sites, plus continuous monitoring of sea surface parameters (e.g., temperature, salinity, light level, and productivity) and currents through the water column;
6. collect ichthyoplankton samples with a Neuston net to supplement Bering Sea FOCI studies (contact: Ric Brodeur, AFSC);
7. investigate selectivity characteristics of Marinovich and Methot midwater gears in sampling age-0 fishes;
8. collect and preserve whole pollock stomachs for food habits studies (contact: Patricia Livingston, AFSC);
9. photograph pollock gonads to document developmental stages;
10. collect tissue samples from potential marine mammal prey species for use in a stable isotope study to determine important prey of several marine mammal taxa (contact: Amy Hirons, University of Alaska, Fairbanks);
11. collect age-0 pollock for studies estimating hatch-dates (contact: Akira Nishimura, National Research Institute of Far Seas Fisheries, Shimizu, Japan), and
12. collect samples of cephalopods for studies on taxonomy and marine mammal prey items (contacts: Beth Sinclair, AFSC; and Janet Voight, The Field Museum, Chicago).

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship Miller Freeman, a 66-m (216-foot) stern trawler equipped for fisheries and oceanographic research. Acoustic data were collected with a quantitative echo-sounding system (Simrad EK500[1]). A Simrad 38-kHz split-beam transducer was mounted on the bottom of the vessel's centerboard. With the centerboard fully extended, the transducer was 9 m below the water surface. System electronics were housed in a portable laboratory mounted on the vessel's weather deck. Data from the Simrad EK500 echo sounder/receiver were stored and processed using Simrad BI500 echo-integration and target-strength data analysis software on a SUN workstation.

Midwater echosign was sampled using a modified Northern Gold 1200 midwater rope trawl (NET Systems, Inc.). The trawl was constructed with ropes in the forward section and stretch mesh sizes ranging from 163 cm (64 in) immediately behind the rope section to 8.9 cm (3.5 in) in the codend. It was fished in a bridleless configuration and was fitted with a 3.2-cm (1.25-in) mesh codend liner. Headrope and footrope lengths were 94.5 m (310 ft) and 50 m (164 ft), respectively, and breastlines measured 79.4 m (260.5 ft). The headrope length was measured between the points of attachment at the breastline. The footrope length was measured between the points where tom weights were attached. The net was fished with 1.8-m X 2.7-m (6-ft X 9-ft) steel V-doors [1,000 kg (2,200 lb)], and 227-kg (500-lb) tom weights on each side. Vertical net opening, depth, and temperature were monitored with a Furuno wireless netsounder system attached to the headrope of the trawl.

Three additional trawls were used to sample adult fish under different circumstances. In the EBS, fish on and near bottom were sampled with an 83/112 bottom trawl without roller gear. Net mesh sizes ranged from 10.2 cm (4 in) forward and 8.9 cm (3.5 in) in the codend to 3.2 cm (1.25 in) in the codend liner. Headrope and footrope lengths were 25.6 and 34.1 m (83.9 and 111.9 ft), respectively, and the breastlines measured 3.4 and 3.2 m (11.3 and 10.5 ft).

On the WBS shelf, an 83/112 with bobbin roller gear was used, except for the first two bottom trawls when a nylon nor'eastern net with roller (cookie) gear was used. The nylon nor'eastern trawl was constructed with stretch mesh sizes that ranged from 13 cm (5 in) in the forward portion of the net to 8.9 cm (3.5 in) in the codend. It was fitted with a nylon codend liner with a mesh size of 3.2 cm (1.25 in). Headrope and footrope lengths were 27.2 and 24.9 m (89.1 and 81.6 ft), respectively. The trawl

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

was rigged with triple 54.9-m (180-ft) galvanized wire rope dandylines. Both 83/112 demersal trawls and the nylon nor'eastern were fished with the same steel V-doors that were used with the rope trawl. Trawl mouth opening, depth, and temperature were monitored with the Furuno netsounder system.

Age-0 fish in midwater were targeted with Marinovich and Methot trawls. Meshes in the Marinovich trawl measured 7.6 cm (3.0 in) forward, 3.2 cm in the codend, and 0.32 cm (1/8 in) in the codend liner. Headrope and footrope lengths were each 9.1 m (30 ft). The Marinovich trawl was also fished with the same steel V-doors used with the rope trawl. Trawl mouth opening, depth, and temperature were monitored with the Furuno netsounder system. A square frame measuring 2.27 m (89.5 in) on each side formed the mouth of the Methot trawl. Mesh size was 2 mm X 3 mm (0.08 in X 0.12 in) in the main part of the net, and 1 mm (0.04 in) in the codend; a 1.83-m (6-ft) dihedral depressor modified from an Isaacs-Kidd midwater trawl was used. The Methot was not fished with steel V-doors. Instead, it was attached by a single cable that was fed through a stern-mounted A-frame. The Methot trawl was often fished in an oblique manner: a maximum depth was initially obtained, followed by successively shallower depths. Tow depth profiles for the Methot trawl were obtained by attaching a Seabird CTD (conductivity/temperature/depth) unit or microBT (small, retrievable temperature profilers) to the frame. The Neuston net was used to sample ichthyoplankton at sea surface. It consisted of 30-cm X 50-cm (11.8-in X 19.7-in) Sameoto samplers with a 0.505-mm (0.02-in) mesh size, and was deployed off the vessel's starboard side using a winch system.

Water temperature and salinity profile data were collected at trawl and calibration sites with the Seabird CTD system. Additional temperature profile data were obtained by launching expendable bathythermographs (XBTs) and by attaching microBTs to selected trawls. Sea surface oceanographic data and environmental data were collected using the Miller Freeman's Scientific Collection System (SCS). Ocean current profile data were provided by the vessel's acoustic doppler current profiler system whose transducer is mounted in the centerboard.

SURVEY METHODS

The EIT survey of the EBS shelf and slope consisted of parallel, north-south transects that started in Bristol Bay (Fig. 1) and proceeded northwest to just west of Cape Navarin, Russia (62° N, 179° E). Transects were spaced about 20 nmi apart and were chosen to coincide with lines of groundfish trawl stations sampled by demersal survey vessels. The southern extent of most transects was near the 1000-m depth contour of the shelf. The seven easternmost transects, whose southern extents were limited

by Unimak Island and the Alaska Peninsula, had endpoints that ranged in depths from 37-68 m. The northern extents of transects east of Cape Navarin were in depths ranging from 57-104 m, and coincided roughly with disappearance of adult pollock echosign. However, four transects (23-26) extended north to the 63° N parallel, well past the disappearance of pollock echosign. Transects 29-30, whose northern extents were limited by the Russian coast, had endpoints that ranged in depths from 37-58 m. Trackline mileage (including cross transects and mileage for haul operations) totalled approximately 7600 nmi.

An irregular, narrow, and relatively uncharted shelf along the east Siberian coast necessitated that the survey design for the western portion of the Bering Sea shelf and slope be modified from that of the eastern portion. Transects in this area formed zig-zags from Cape Navarin southwest along the coast to Cape Kronotski (55° N, 163° E), approaching shore usually to within a depth of 35-60 m and extending offshore in most cases to a depth of at least 1000 m. Zig-zag trackline mileage totalled approximately 1530 nmi.

Four additional transects, oriented southwest-northeast and spaced about 25 nmi apart, were run in the Zemchung Canyon area (58° N, 175° W). During early July 1993, a Chinese EIT survey of the Aleutian Basin discovered an extensive aggregation of age-0 pollock in this area. AFSC scientists sought to verify the presence of a similar aggregation during this summer's survey. Trackline mileage in this area totalled approximately 350 nmi. Secondary EIT survey work was also conducted along the Aleutian Islands shelf and Seguam-Amukta Pass areas as the Miller Freeman was transiting back to Dutch Harbor from the WBS.

Standard survey operations occurred only during daylight hours. Night operations were reserved for collection of target-strength data, age-0 trawling, and ichthyoplankton sampling. While transecting, vessel speed averaged between 12 and 13 kts when weather conditions were favorable, less when seas were rough. The acoustic system collected echo-integration data and split-beam target-strength data concurrently. Whenever suitable conditions (e.g., low fish density, monospecific aggregation, calm seas) were encountered, survey operations focused on target-strength data collection. These opportunities occurred most often at night. Routine target-strength collection involved transecting slowly (3 kts) over the aggregation to collect target-strength data, then comparing acoustic information to biological data from hauls conducted just prior to and just after collection of acoustic data. On one occasion, the vessel was held stationary while a transducer was lowered over the side to collect data in close proximity to the aggregation of fish. A standard sphere was suspended 9.1 m (30 ft) below the lowered transducer to allow an in situ calibration. Target-strength data

will be interpreted together with historical target-strength information, then used to scale echo-integration values to provide estimates of pollock density (numbers/m^2).

Midwater and demersal trawl hauls were made at selected locations (Figs. 2-4) to identify echosign and to provide biological samples. The average trawling speed for all gear types except Marinovich trawls was about 3 kts; trawling speed for Marinovich trawls was about 2 kts. The vertical net opening for the midwater rope trawl averaged about 21 m and ranged from 13-26 m. The net opening for the Marinovich midwater trawl was 3-4 m. The 83/112 mouth opening was about 2 m and the nylon nor'eastern mouth opening averaged 5.5 m. Standard catch sorting and biological sampling procedures were used to provide weight and number by species for each haul. Pollock were further sampled to determine sex, fork length (FL) or standard length (SL), body weight, age, maturity, and mature ovary weight. An electronic platform scale was used to determine all weights taken from individual pollock specimens. Fork lengths of adult and juvenile pollock were measured to the nearest cm and recorded with a Polycorder measuring device (a combination of bar code reader and hand-held computer), then downloaded into a personal computer. Standard lengths of age-0 pollock were measured to the nearest mm. When collected, pollock stomachs were preserved in a 10% formalin solution. In selected areas, tissue samples of pollock, Pacific cod, herring, and capelin were collected and frozen. All cephalopods captured in catches were preserved in formalin or frozen. When present in a catch, a sample of age-0 pollock was lengthed, then frozen. Catch processing for Methot and Neuston trawls differed slightly from standard procedures in that euphausiid/macrozooplankton catch fractions were not identified to species, but rather preserved all together in a formalin solution.

PRELIMINARY RESULTS

Standard Sphere Calibrations

Standard sphere calibrations were conducted on five separate occasions during the cruise (Table 1). The centerboard acoustic system was calibrated each time; the portable acoustic system on the small boat was calibrated twice. For calibration, the Miller Freeman was anchored fore and aft in 64-94 m of water. Acoustic properties of a copper sphere suspended below the transducer were measured. This sphere (60.0 mm diameter) has a known target-strength of -33.6 dB. Split-beam target-strength and echo-integration data collected with the Simrad EK500 system described acoustic system gain parameters and transducer beam pattern characteristics. Presence of fish in the water column or poor sea state conditions sometimes made it impossible to conduct a complete calibration. At these times, only a subset of calibration

parameters was measured. No significant differences in the acoustic system gain parameters or transducer beam pattern characteristics were observed among any of the five calibrations.

Intership Calibration

From Aug 30-Sep 1, 1994, the Miller Freeman and the Japanese vessel No.1 Kyowa maru conducted an intership calibration of their acoustic data collection systems to enable comparison of cruise results from this survey. Twenty-four transects (average length 8.3 nmi) were run with one vessel leading the other; the two vessels were separated by 0.25 nmi. After completing each pair of transects, the vessels switched leader-follower positions to reduce potential biases affecting acoustic data collection due to vessel noise, wave direction, or weather. Vessel speeds averaged around 6 kts. The transects were bordered by 61° 45' N on the north, 178° 32' E on the east, 178° 29' E on the west, and 61° 32' N on the south. Bottom depths ranged from 132-260 m. Most pollock echosign was observed below 75 m. Preliminary analysis suggests that acoustic densities measured by the U.S. centerboard-mounted system were higher than those measured by the Japanese towed-fin system. Further detailed analysis will be required to explain this difference.

Midwater-bottom Investigation

Before starting standard survey operations, the Miller Freeman cooperated with the two crab/groundfish Bering Sea bottom trawl vessels, F/V Aldebaran and F/V Arcturus, in collecting acoustic data and bottom trawl catch data for a comparison of near-bottom assessment techniques. These data will allow a comparison of the traditional approach of combining an acoustic estimate of midwater pollock biomass and a bottom trawl estimate of demersal pollock biomass to arrive at a total estimate of biomass with an approach using echo-integration data only to estimate total biomass. An area measuring approximately 8,000 sq. nmi. on the shelf west of the Pribilof Islands was chosen for the study which took place during daylight hours on July 6-7. Catch data from 19 groundfish stations and acoustic data from 451 nmi of trackline provide a data set for future analysis.

Trawl Gear/Vessel Avoidance Studies

How pollock react to 1) a transecting vessel and 2) a vessel towing bottom trawl gear was investigated on two separate occasions during daylight hours. The Miller Freeman's small boat was equipped with a portable acoustic system for data collection. This portable system consisted of a Simrad 38-kHz split-beam transducer "strapped" to the keel, a Simrad EK500 echosounder, and a Sun workstation (loaded with Simrad BI500 software) housed in the boat's cabin. For this work to be successful, sea state must be extremely calm and significant echosign must be present.

A suitable situation was first encountered on July 22 at 56° 42′ N and 170° 06′ W in about 95 m of water. After deployment, the small boat attempted to maintain its position over a sizable aggregation of pollock that was within about 25 m of the bottom. The Miller Freeman then made 3 passes at transecting speed (12-13 kts), coming within 0.1 nmi of the stationary small boat each time. On each pass, echosign below the small boat diminished as the larger vessel approached and then reappeared as the larger vessel moved away. A fourth pass was made with the Miller Freeman towing the 83/112 trawl on the bottom at a speed of 3 kts. On this pass, echosign diminished well before the larger vessel reached its closest point of contact, and this diminished state persisted for a much longer time. Small boat work was attempted again on August 3 at 58° 15' N and 174° 21' W in about 135 m bottom depth. On this occasion, the small boat attempted to acoustically locate the 83/112 trawl as it was towed along the bottom with codend open. This effort was unsuccessful and was abandoned after a couple hours of searching. Two passes of the Miller Freeman transecting by the stationary small boat were made. On neither pass was there any discernible reaction of the fish to the vessel passing by. Data from these observations will be further analyzed.

Biological and Oceanographic Data Collection

Biological data were collected and specimen and tissue samples preserved from all survey areas. Trawl station and catch data from 123 midwater (87 rope, 21 Marinovich, and 15 Methot) and 22 bottom trawl hauls are summarized in Table 2. Table 3 summarizes trawl station data for 10 Neuston tows.

Walleye pollock was the dominant fish species captured in midwater rope trawl hauls in all areas (Tables 4, 5, and 6). Jellyfish were markedly more prevalent east of the Pribilof Islands than west of the islands. Walleye pollock and jellyfish together accounted for greater than 99% of midwater rope trawl catch composition by weight in all areas. Bottom trawl catch composition (Tables 7, 8, and 9) was also dominated by walleye pollock; this dominance was greatest in the WBS. East of the Pribilof Islands, yellowfin sole were the next most dominant fish species, whereas west of the Pribilofs and on the WBS shelf, Pacific cod were. Marinovich and Methot trawl hauls in the EBS (Tables 10 and 11) caught mostly jellyfish. Age-0 walleye pollock were the most numerous fish species captured. Markedly fewer age-0s were caught west of the Pribilof Islands than east. Adult walleye pollock accounted for a large percentage of the WBS Marinovich and Methot trawl catch composition (Table 12) only because a school of adults was caught inadvertently during the one Marinovich trawl. Had these adults not been caught, jellyfish and age-0 fish would have accounted for approximately the same

percentages as they did in the EBS. Types of biological data and numbers of samples and measurements collected from walleye pollock by all trawl types are listed in Table 13.

Walleye pollock captured in trawls ranged in length from 9 mm-78 cm. In the following discussion, raw length measurements were summed into unweighted length frequency distributions. Pollock caught in midwater rope trawl hauls east of the Pribilof Islands were generally larger than pollock caught west of the islands (Fig. 5). The length composition of pollock caught east of the islands was trimodal, with a small mode at 3 cm, a larger mode at 31 cm, and the largest mode at 46 cm; virtually no fish between 6 and 25 cm were caught. West of the Pribilofs to Cape Navarin, pollock in the 15-25 cm range were very common. Three modes were observed at 15, 37, and 22 cm (in order of increasing dominance). On the WBS shelf, a dominant mode at 25 cm was observed; only a few pollock larger than 29 cm were caught, and none smaller than 18 cm were caught.

Pollock caught in bottom trawl hauls east of the Pribilofs were, as in the case with midwater rope trawl hauls, larger than pollock caught west of the Pribilofs (Fig. 6). East of the Pribilofs, a dominant mode at 46 cm and a minor mode at 58 cm were observed; 97% of fish caught were 40 cm or larger. West of the Pribilofs, 56% of fish caught were 40 cm or smaller. There were modes at 16, 24, and 43 cm (in order of increasing dominance). Lengths observed along the WBS shelf ranged from 16-61 cm with a dominant mode at 49 cm and a lesser one at 24 cm.

Marinovich trawl hauls east of the Pribilof Islands (Fig. 7A) caught age-0 walleye pollock whose average length was 25 mm (range = 13-43 mm). Pollock caught in Methot trawl hauls in the same area averaged 21 mm and ranged from 9-42 mm (Fig. 7B). Far fewer age-0 pollock were captured west of the Pribilofs and in the WBS than east of the Pribilofs. Marinovich trawl hauls west of the Pribilofs and in the WBS caught only 51 and 47 age-0 pollock, respectively, and Methot trawl hauls caught only 103 and 3, respectively.

Of 3,702 female walleye pollock whose gonad maturity was determined, only three were in spawning condition; of 3,944 males examined, only 18 were in spawning condition. Almost 95% of females and 91% of males were immature, developing, or rematuring.

All walleye pollock in spawning condition were encountered east of 173° W with most of the males found east of 163° W. Spawning individuals of both sexes were encountered in only one haul.

Oceanographic data were collected from 91 CTD casts (Figs. 8 and 9, Table 14), 44 successful XBT casts (Fig. 8, Table 15), and 15 microBT casts (Table 16).

Echosign Distribution

Walleye pollock echosign varied markedly throughout the survey area (Fig. 1). Aggregations of highest density were encountered on the EBS shelf between the Pribilof Islands and Cape Navarin. Although aggregations were generally less dense east of the Pribilofs, high densities were encountered just north of Unimak Island. Very little echosign was encountered along the Russian coast. No age-0 pollock echosign was detected in the Zemchung Canyon area.

As the survey progressed from east to west, the contribution toward total observed pollock density from the bottom 10 m (excluding the near-bottom 1/2 m) of the water column generally decreased (Fig. 10). During transects 1-6 (which were north and northeast of Unimak Island), the on-bottom component was markedly larger than the off-bottom component (10 m above bottom to the surface). However, in almost all other transects on the EBS shelf, the off-bottom component became increasingly dominant as the survey neared Cape Navarin. In transects of the WBS shelf, no clear relationship between on-bottom and off-bottom components was discernable.

For further information contact Dr. Gary Stauffer, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE., Building 4, BIN C15700, Seattle, WA 98115-0070. Telephone (206) 526-4170.

SCIENTIFIC PERSONNEL

Name	Sex/ Nationality	Position	Organization
Shakedown (Jun 27-28)			
Neal Williamson	M/USA	Chief Scientist	AFSC
Daniel Twohig	M/USA	Electronics Chief	AFSC
Jim Traynor	M/USA	Fish. Biologist	AFSC
Chris Wilson	M/USA	Fish. Biologist	AFSC
Ned Cokelet	M/USA	Oceanographer	PMEL
Dan Daugherty	M/USA	Oceanographer	PMEL
Dennis Benjamin	M/USA	Fish. Biologist	AFSC
Matt Wilson	M/USA	Fish. Biologist	AFSC
Ric Brodeur	M/USA	Fish. Biologist	AFSC
Leg 1 (Jul 4-28)			
Neal Williamson	M/USA	Chief Scientist	AFSC
Daniel Twohig	M/USA	Electronics Chief	AFSC
Chris Wilson	M/USA	Fish. Biologist	AFSC
Steve de Blois	M/USA	Fish. Biologist	AFSC
Mikhail Stepanenko	M/Russia	Fish. Biologist	TINRO
Vladimir Vologdin	M/Russia	Acoustician	TINRO
Xiangyong Zhao	M/PRC	Acoustician	YSFRI
Susan Willson	F/USA	Teacher-at-sea	MHS
Leg 2 (Jul 30-Aug 22)			
Neal Williamson	M/USA	Chief Scientist	AFSC
Daniel Twohig	M/USA	Electronics Chief	AFSC
Denise McKelvey	F/USA	Fish. Biologist	AFSC
Steve de Blois	M/USA	Fish. Biologist	AFSC
Lynn Faughnan	F/USA	Fish. Biologist	AFSC
Gordie Swartzman	M/USA	Professor	APL
Mikhail Stepanenko	M/Russia	Fish. Biologist	TINRO
Vladimir Vologdin	M/Russia	Acoustician	TINRO
Marlexx Memmel	F/USA	Teacher-at-sea	HES
Leg 3 (Aug 24-Sep 14)			
Jim Traynor	M/USA	Chief Scientist	AFSC
Daniel Twohig	M/USA	Electronics Chief	AFSC
Taina Honkalehto	F/USA	Fish. Biologist	AFSC
Lynn Faughnan	F/USA	Fish. Biologist	AFSC
Terry Tinker	M/USA	Electronics Tech.	AFSC
Dennis Benjamin	M/USA	Fish. Biologist	AFSC
Mikhail Stepanenko	M/Russia	Fish. Biologist	TINRO
Lynn Granstom	F/USA	Teacher-at-sea	ECC

AFSC - Alaska Fisheries Science Center, Seattle, Washington
APL - Applied Physics Laboratory, University of Washington, Seattle, Washington
ECC - Everett Community Colege, Everett, Washington
HES - Hazelwood Elementary School, Lynnwood, Washington
MHS - McNeil High School, Austin, Texas
PMEL - Pacific Marine Environmental Laboratory, Seattle, Washington
PRC - People's Republic of China
TINRO - Pacific Research Institute of Fisheries and Oceanography, Vladivostok, Russia
YSFRI - Yellow Sea Fisheries Research Institute, Qingdao, China

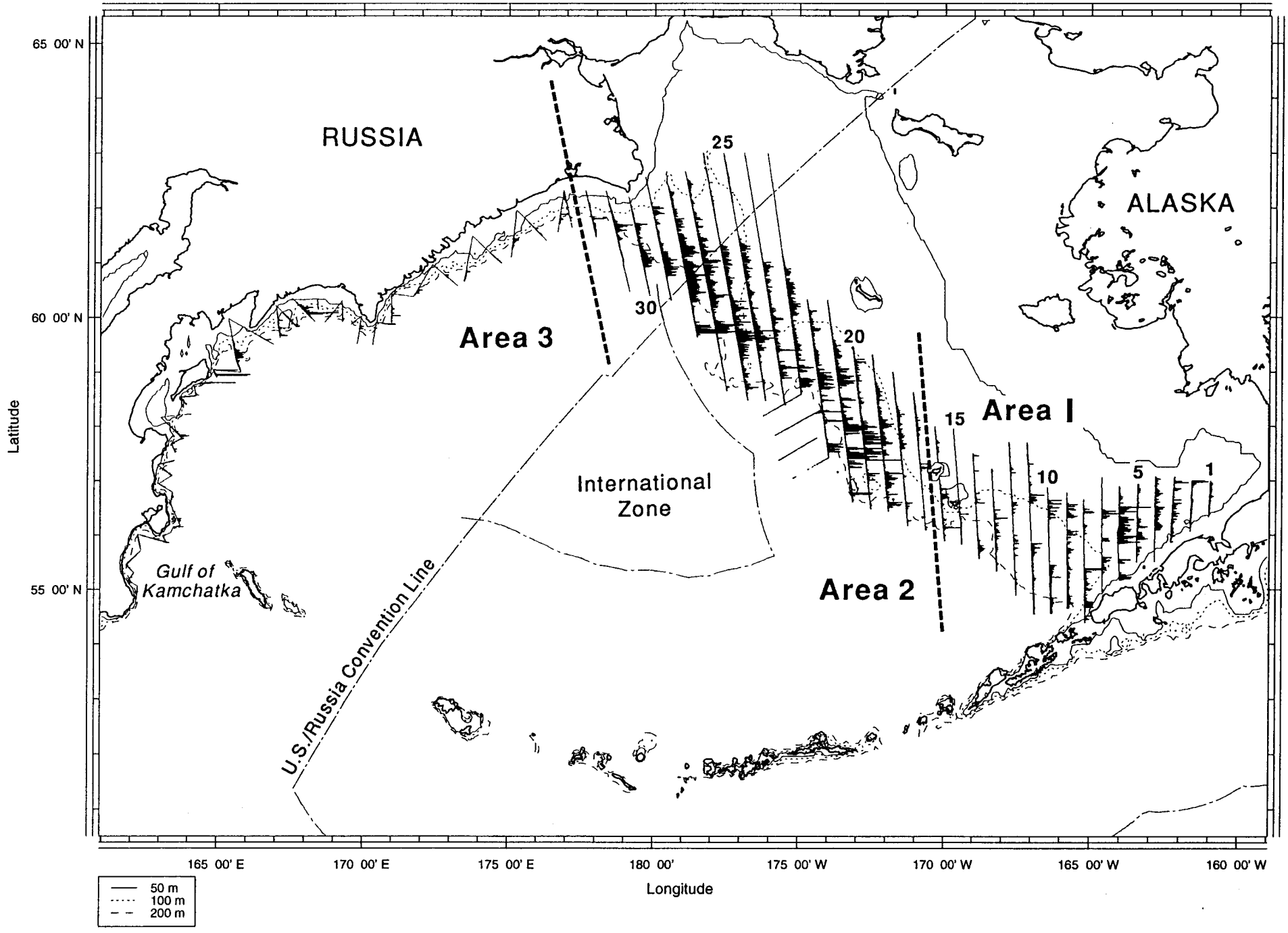

Fig. 1. Transects during the 1994 echo integration-trawl survey of the Bering Sea shelf, MF94-07. Deflections off transect lines indicate relative fish density.

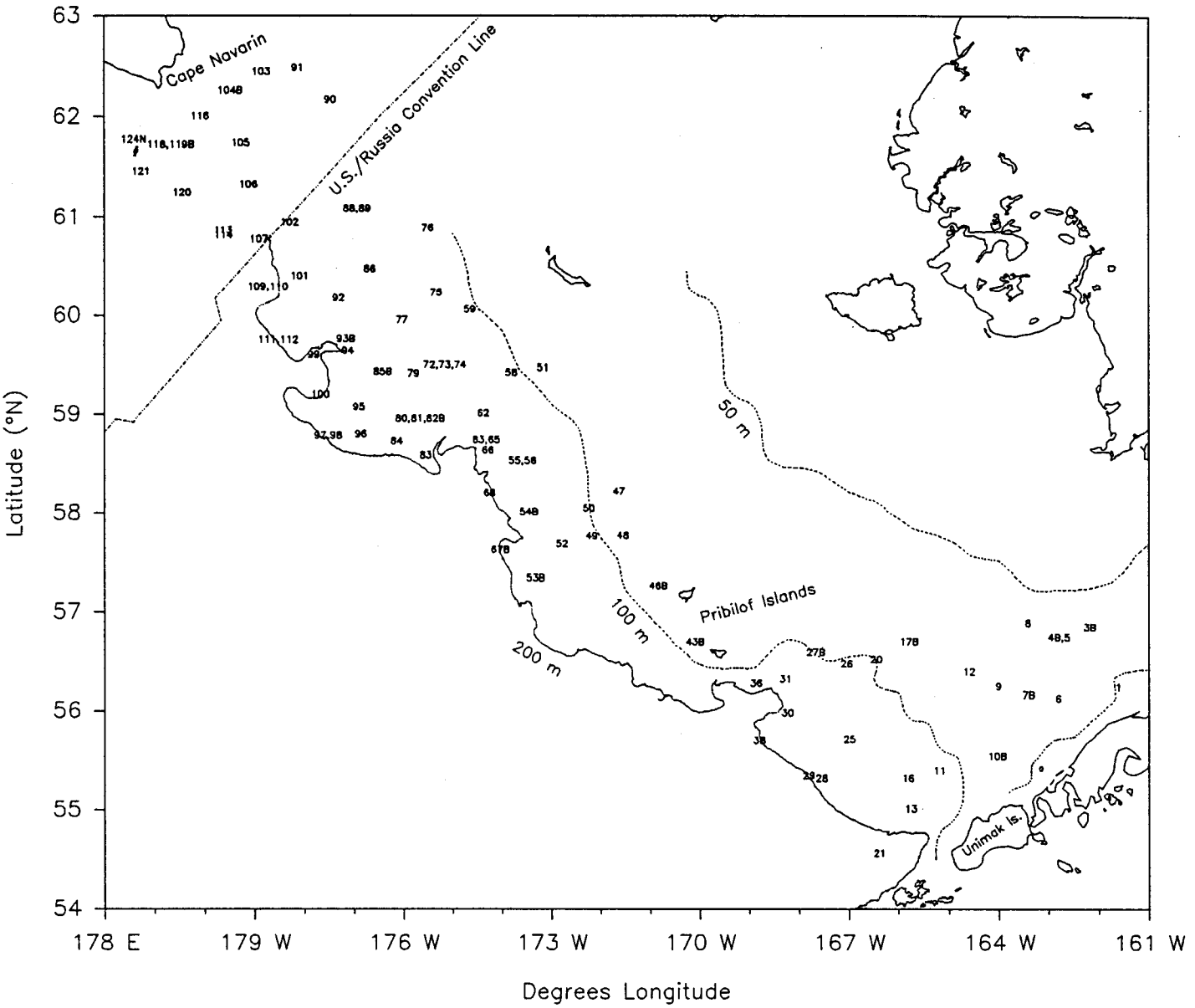

Figure 2. Trawl haul locations in the EBS during the 1994 echo integration–trawl survey of the Bering Sea shelf and slope, MF94–07. Numbers and numbers followed by "B" or "N" represent midwater rope, 83/112 bottom, or nylon nor'eastern bottom trawls, respectively. "#" represents hauls 122, 123, 127, and 128.

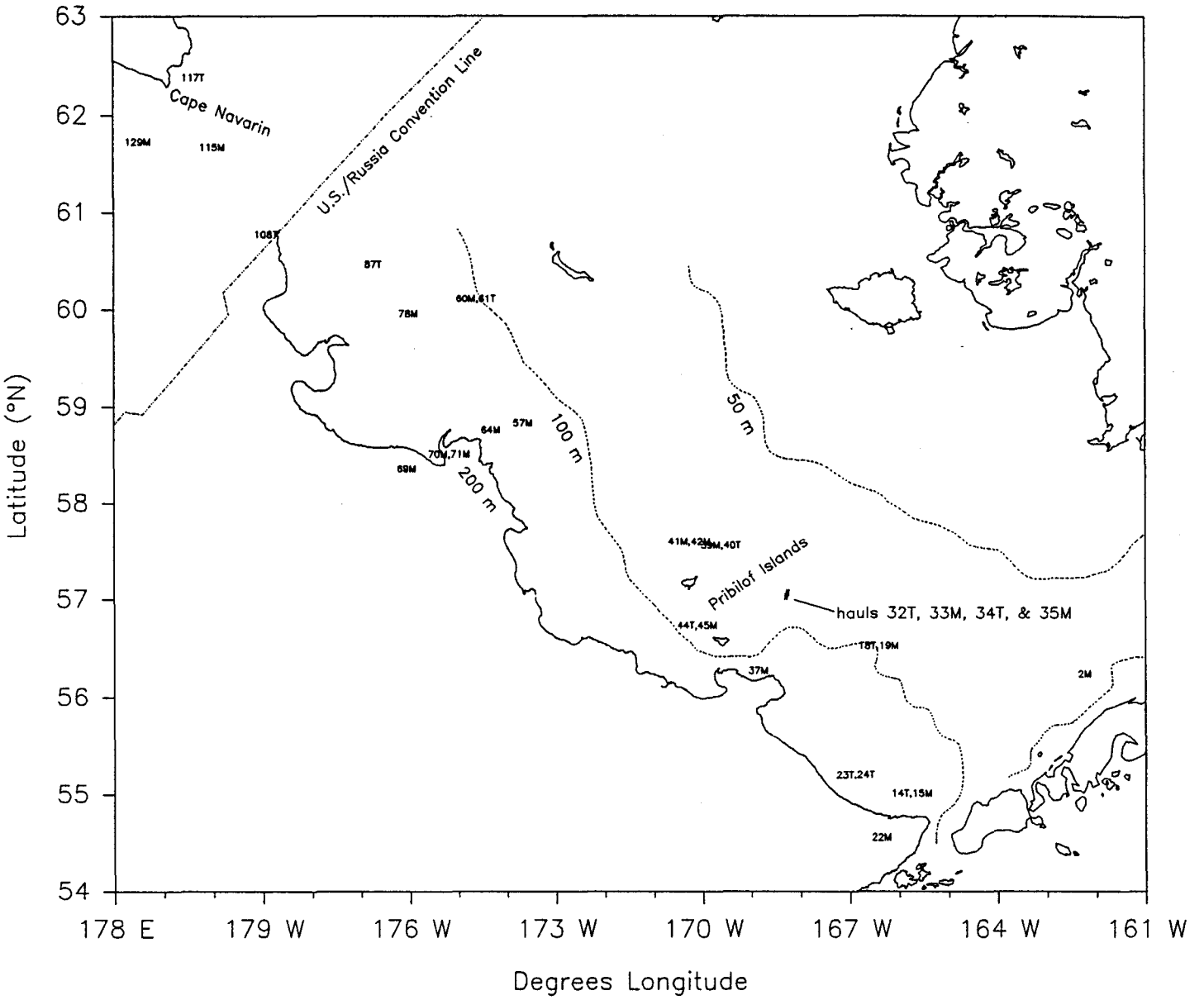

Figure 3. Trawl haul locations in the EBS during the 1994 echo integration–trawl survey of the Bering Sea shelf and slope, MF94–07. Numbers followed by "M" or by "T" represent Marinovich rope trawls or Methot trawls, respectively.

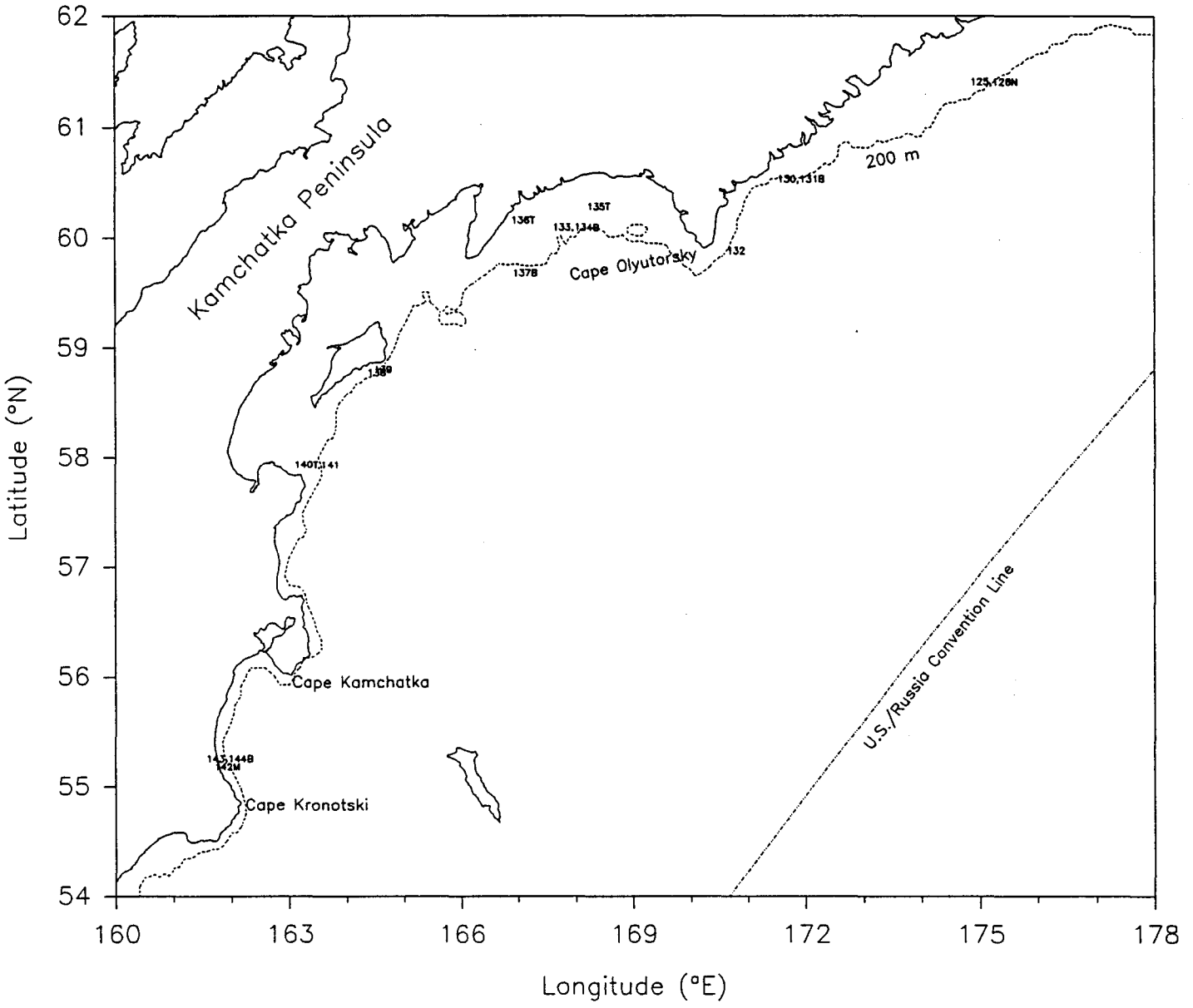

Figure 4. Trawl haul locations in the WBS during the 1994 echo integration–trawl survey of the Bering Sea shelf and slope, MF94–07. Numbers and numbers followed by "B," "N," "M," or "T" represent midwater rope, 83/112 bottom, nylon nor'eastern bottom, Marinovich, or Methot trawls, respectively.

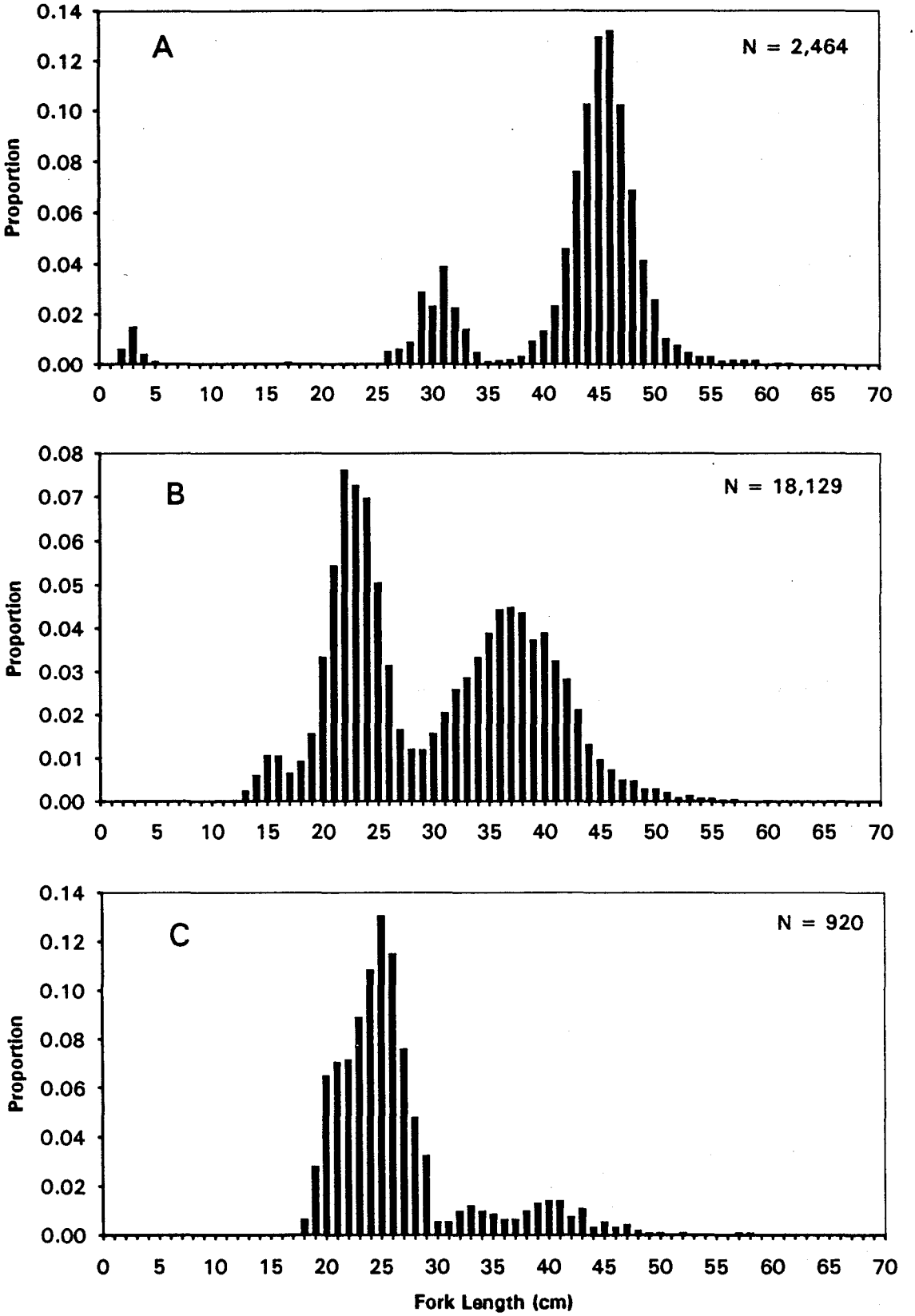

Figure 5. Unweighted pollock size compositions from midwater rope trawl hauls made in A) the EBS shelf east of the Pribilof Islands, B) the EBS shelf between the Pribilofs and Cape Navarin, and C) the WBS shelf during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07. N is the total number of fish measured.

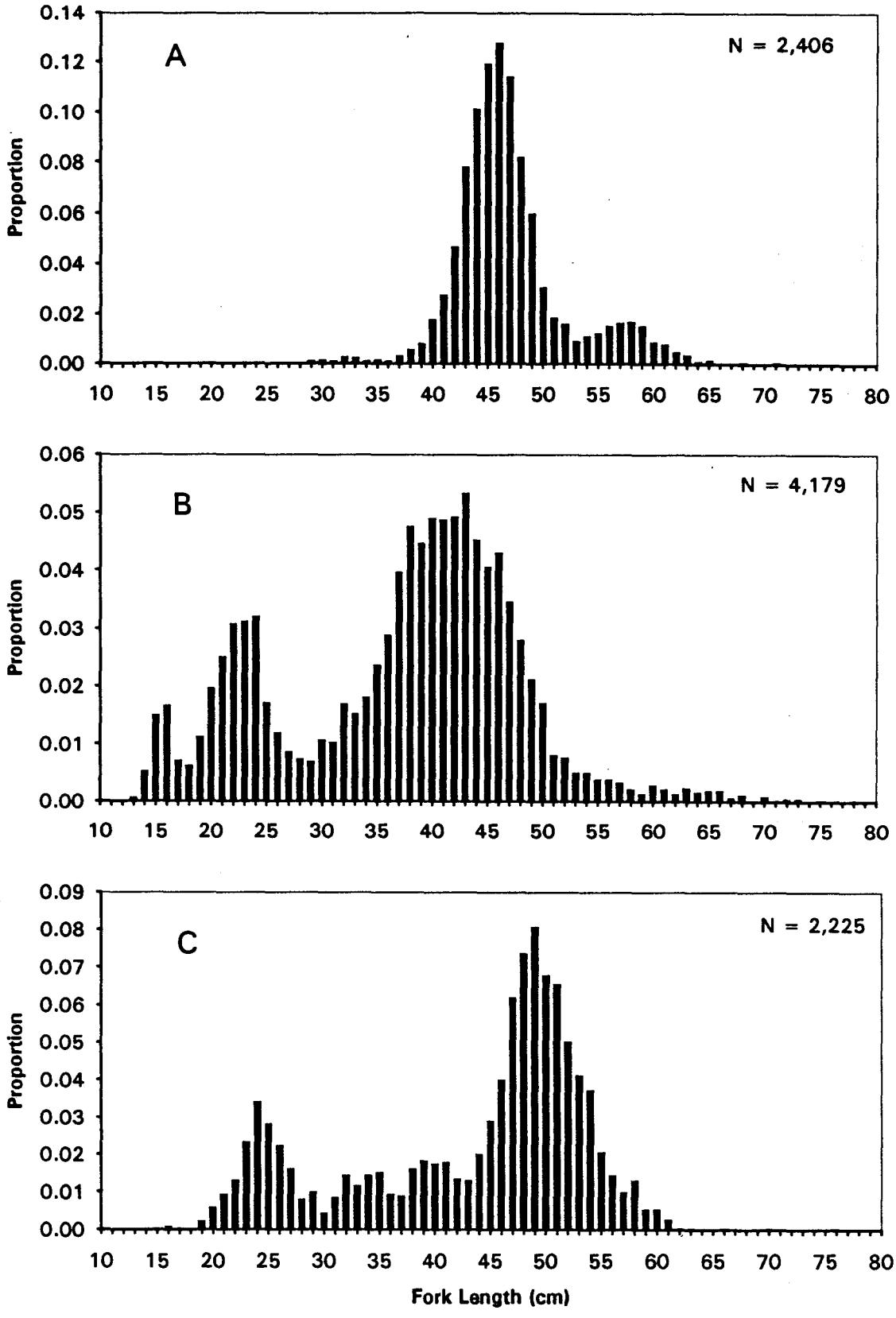

Figure 6. Unweighted pollock size compositions from bottom trawl hauls made in A) the EBS shelf east of the Pribilof Islands, B) the EBS shelf between the Pribilofs and Cape Navarin, and C) the WBS shelf during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07. N is the total number of fish measured.

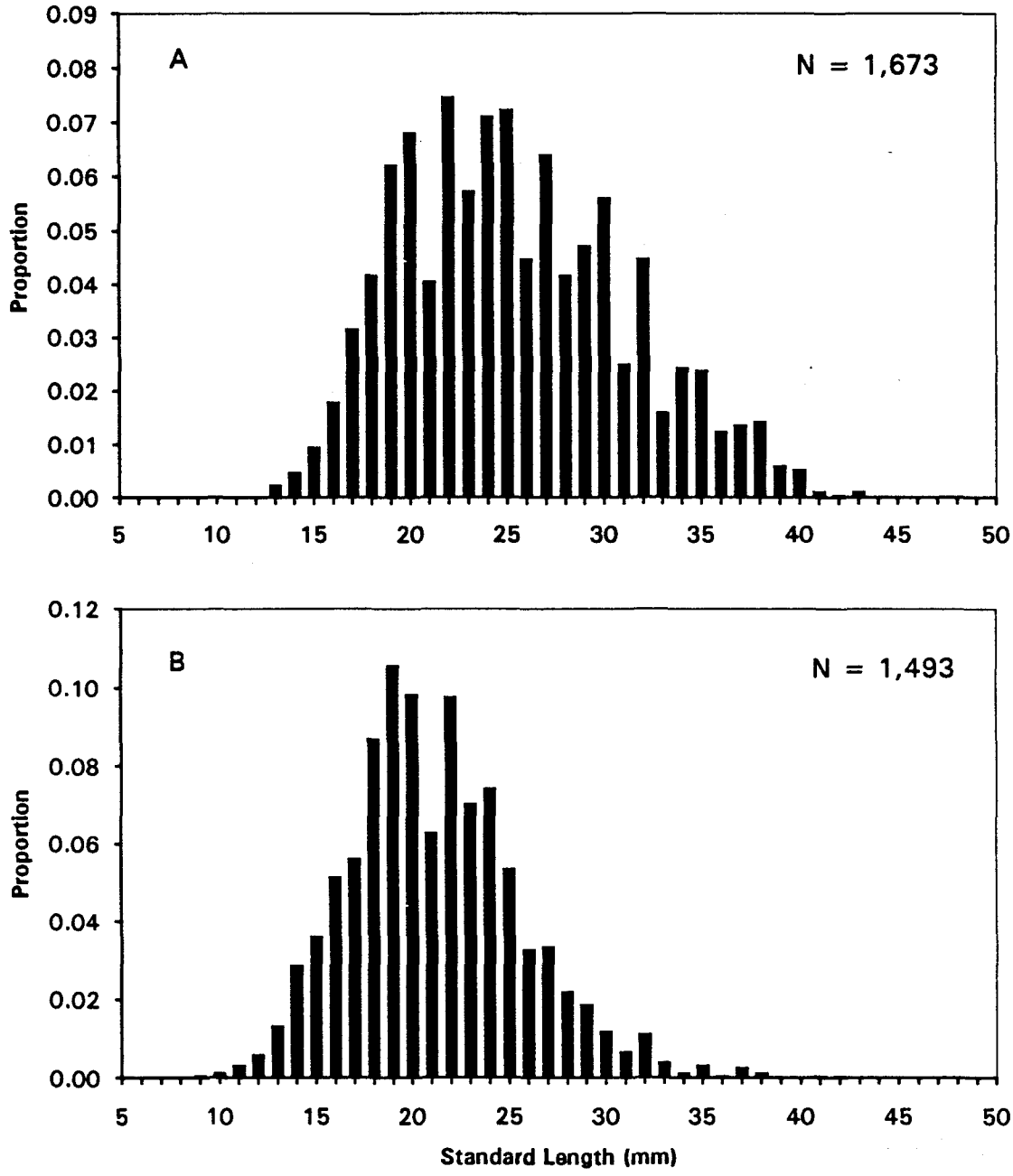

Figure 7. Unweighted size compositions of age-0 pollock from A) Marinovich and B) Methot trawl hauls made on the EBS shelf east of the Pribilof Islands during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07. N is the total number of fish measured.

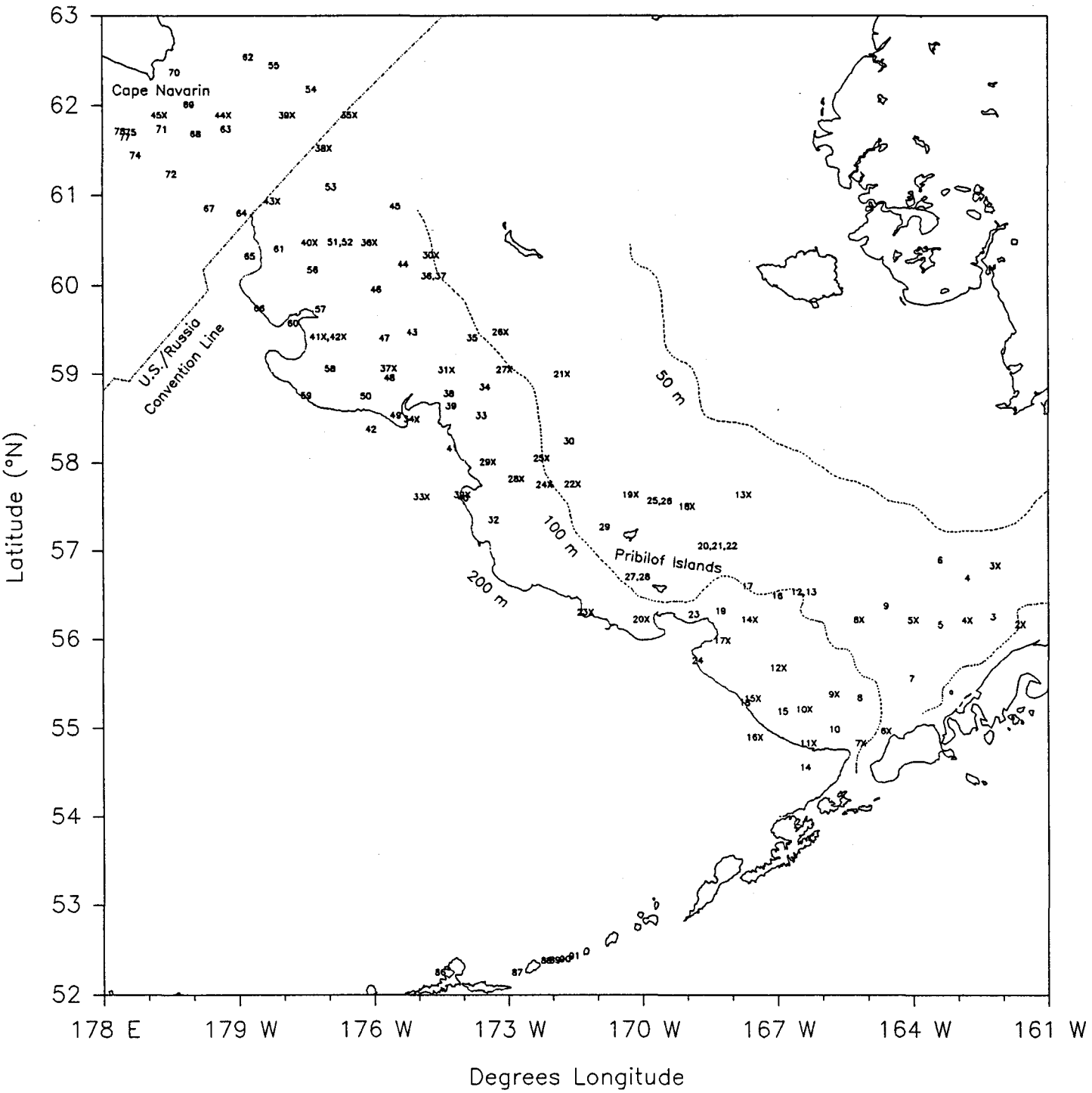

Figure 8. CTD and XBT cast locations in the EBS during the 1994 echo integration–trawl survey of the Bering Sea shelf and slope, MF94–07. Numbers and numbers followed by "X" represent CTD casts and XBT casts, respectively.

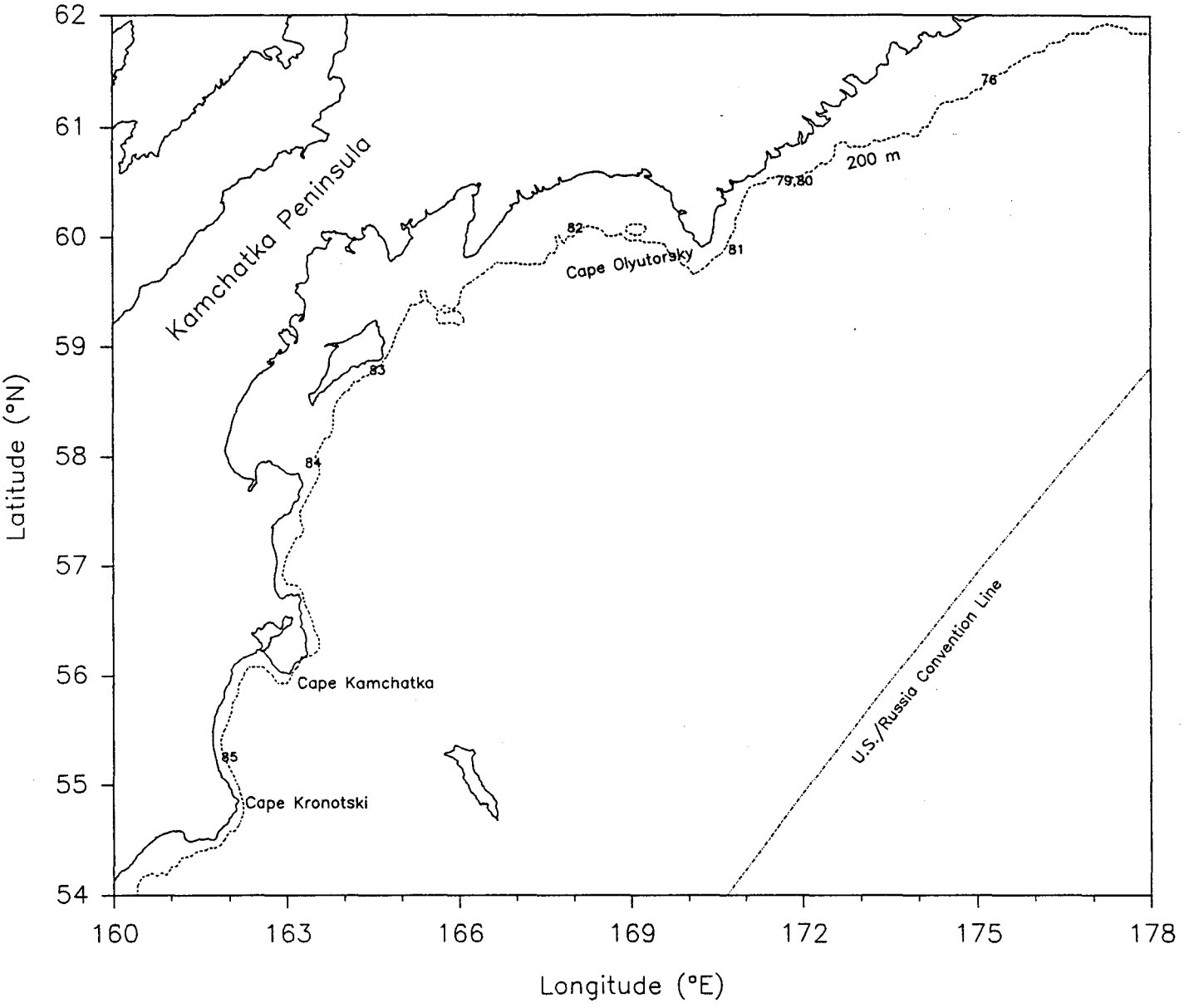

Figure 9. CTD cast locations in the WBS during the 1994 echo integration–trawl survey of the Bering Sea shelf and slope, MF94–07.

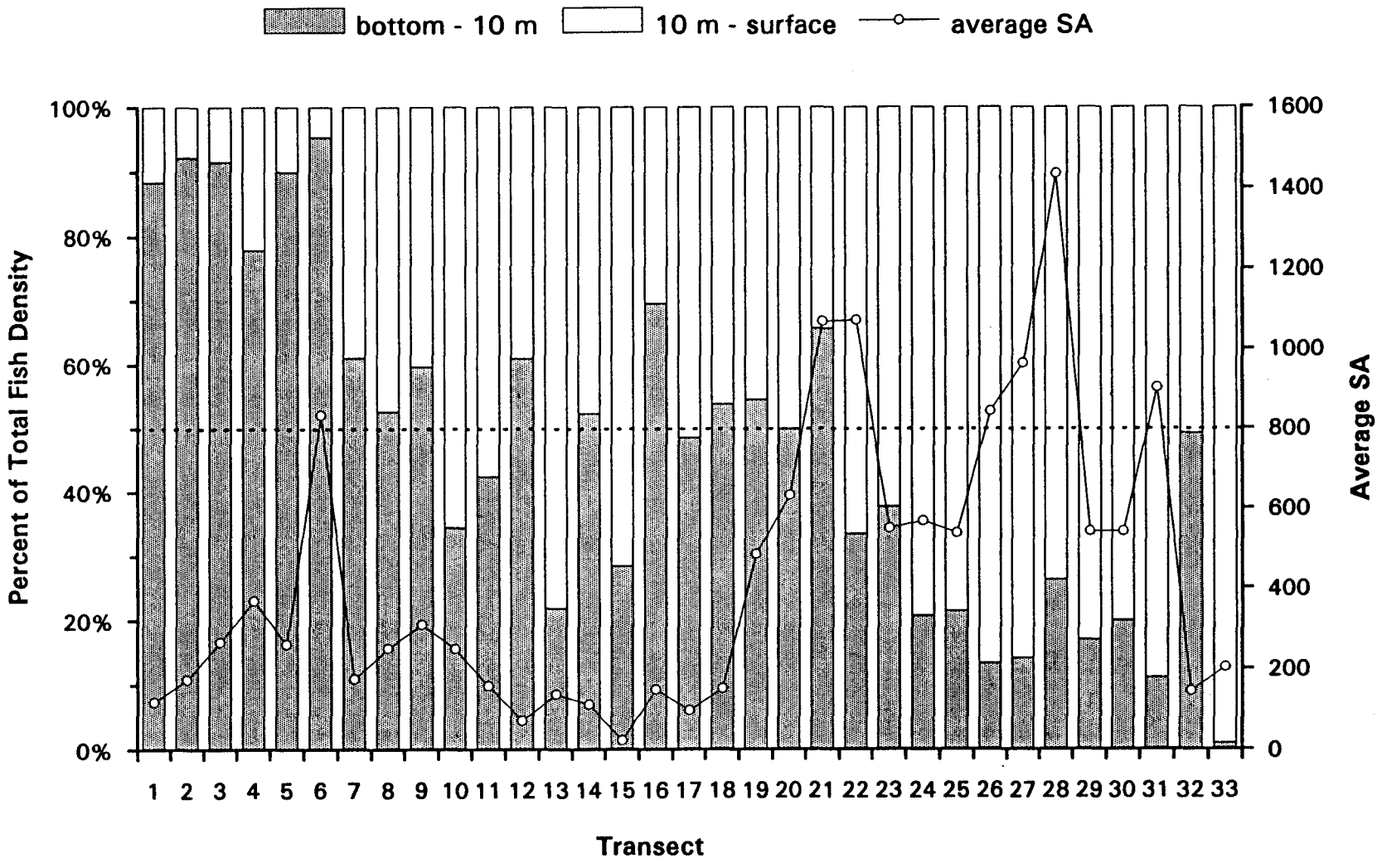

Figure 10. Breakdown by depth of pollock density encountered while conducting parallel transects in the EBS during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07. Average SA represents relative pollock density values averaged over an entire transect.

Table 1. Summary of sphere calibrations during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Date	Location	Acoustic System	Water Temp (deg. C) at Transducer	Water Temp (deg. C) at Sphere	Sphere Range From Transducer (m)	TS Gain	SV Gain	3db Beam Width	Angle Offset Along	Angle Offset Athwart
27 Jun	Port Susan, WA	centerboard	11.6	10.0	22.1	27.4				
5 Jul	Broad Bay, AK	centerboard	7.0	6.6	17.8	27.4	27.5			
"	"	portable	7.5	6.6	19.0	27.5				
31 Jul	Cabin Cove, AK	centerboard	5.8	5.6	26.6	27.3	27.1	7.15	-0.09	-0.02
"	"	"	5.8	5.7	20.4		27.3			
"	"	"	5.8	5.7	15.1		27.2			
"	"	"	5.8	5.6	25.1		27.4			
"	"	"	5.8	5.6	29.6		27.1			
"	"	"	5.8	5.5	35.4		27.0			
"	"	"	5.8	5.5	40.4		27.0			
"	"	"	5.8	5.6	25.0		27.1			
"	"	portable	5.9	5.6			27.3	7.18	-0.06	-0.15
22 Aug	Cabin Cove, AK	centerboard	6.4	6.2	26.1	27.3	27.1	7.19	-0.11	-0.02
11 Sep	Korovin Bay, AK	centerboard	8.3	7.7	16.3	27.3	27.1			

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

Table 2. Summary of trawl stations and catch data from the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Haul	Gear		Date	Time	Start Position		Depth (m)		Temp. (deg. C)		Catch	
No.	Type*	Area**	(1994)	(GMT)	Lat. (deg. N)	Long. (deg.)	Gear	Bottom	Gear	Surface	Pollock (kg/no)	Other (kg)
1	R	1	10 Jul	0434-0504	56 14.73	161 36.71 W	28	64	7.4	8.0	8.4/7	2,476.8
2	M	1	10 Jul	1846-1930	56 14.80	162 14.50 W	77	77	3.8	8.2	16.0/28	271.0
3	B	1	10 Jul	2330-2359	56 50.96	162 11.02 W	73	73	3.4	8.6	1,517.1/2,749	2,179.0
4	B	1	11 Jul	0616-0631	56 44.69	162 47.71 W	68	68	2.8	8.9	1,416.2/2,051	1,078.1
5	R	1	11 Jul	1005-1035	56 45.27	162 47.30 W	53	67	2.8	8.9	343.3/499	409.2
6	R	1	11 Jul	1728-1744	56 07.58	162 48.58 W	70	83	3.0	8.8	24.6/47	1,481.1
7	B	1	12 Jul	0255-0310	56 09.87	163 24.13 W	88	88	2.4	8.9	827.6/1,087	389.3
8	R	1	12 Jul	1140-1150	56 53.47	163 25.05 W	40	69	2.1	8.9	263.8/1,202	765.2
9	R	1	12 Jul	1821-1839	56 15.05	164 00.13 W	80	89	3.0	8.8	87.3/135	865.1
10	B	1	12 Jul	2340-0012	55 32.33	164 01.47 W	93	93	4.3	9.0	828.0/1,192	1,140.3
11	R	1	14 Jul	0116-0156	55 23.60	165 10.90 W	62	111	5.0	9.2	5.9/14	280.0
12	R	1	14 Jul	1616-1633	56 23.80	164 35.57 W	73	85	2.2	9.1	1,324.8/1,810	634.4
13	R	1	15 Jul	0606-0616	55 00.42	165 45.16 W	42	130	5.8	8.1	0.1/45	161.0
14	T	1	15 Jul	0813-1824	55 00.84	165 45.43 W	56	130	5.2	8.1	0.1/519	10.0
15	M	1	15 Jul	1005-1020	55 00.41	165 45.10 W	29	131	6.6	8.1	0.6/239	37.2
16	R	1	15 Jul	1811-1838	55 18.81	165 48.75 W	111	122	3.9	8.6	325.1/454	98.7
17	B	1	16 Jul	0312-0322	56 42.01	165 47.31 W	78	78	1.9	8.3	830.9/629	537.6
18	T	1	16 Jul	0946-0956	56 31.99	166 25.43 W	82	97	3.4	8.7	0.1/232	7.9
19	M	1	16 Jul	1052-1107	56 31.94	166 25.85 W	27	96	8.5	8.8	0.3/1,714	70.6
20	R	1	16 Jul	1229-1249	56 31.12	166 26.89 W	55	97	3.8	8.8	1,221.0/1,951	52.0
21	R	1	17 Jul	0155-0225	54 33.60	166 22.90 W	148	430	3.8	9.4	33.6/39	13.4
22	M	1	17 Jul	0320-0335	54 33.40	166 21.96 W	131	433	3.8	9.4	1.8/109	5.6
23	T	1	17 Jul	0909-0955	55 12.20	166 54.13 W	***	145	***	8.8	0.1/1,250	10.2
24	T	1	17 Jul	1132-1201	55 11.44	166 52.96 W	***	145	***	8.8	0.2/1,597	12.2
25	R	1	17 Jul	1737-1807	55 42.57	166 59.21 W	117	135	3.8	8.8	1,858.3/2,630	23.8
26	R	1	18 Jul	0008-0019	56 28.43	167 02.55 W	73	108	3.6	8.6	43.5/61	401.9
27	B	1	18 Jul	1938-2008	56 35.31	167 39.80 W	109	109	3.6	8.4	3,839.7/6,499	831.5
28	R	1	19 Jul	0422-0437	55 18.81	167 32.45 W	98	151	4.1	8.8	1.5/18	15.8
29	R	1	19 Jul	1243-1343	55 20.54	167 47.95 W	141	178	4.3	8.7	19.7/21	4.3
30	R	1	19 Jul	2011-2036	55 58.79	168 13.68 W	129	149	3.9	9.2	8.4/9	15.5
31	R	1	20 Jul	0018-0048	56 19.15	168 16.07 W	128	157	3.9	9.3	6.9/14	23.9
32	T	1	20 Jul	0920-0930	57 03.25	168 20.16 W	17	80	8.0	8.4	0.2/3,105	13.6
33	M	1	20 Jul	1020-1030	57 03.35	168 20.78 W	19	80	8.0	8.4	0.1/150	26.5
34	T	1	20 Jul	1808-1825	57 01.86	168 20.15 W	***	80	***	8.4	0.5/5,165	15.5
35	M	1	20 Jul	1941-1958	57 02.24	168 20.17 W	45	80	2.8	8.4	0.4/2,468	11.5
36	R	1	21 Jul	0602-0612	56 16.63	168 51.20 W	98	134	3.9	8.6	0.1/32	16.8
37	M	1	21 Jul	0706-0718	56 16.68	168 51.63 W	63	132	3.7	8.6	0.2/659	1.3

Table 2. (cont.)

Haul No.	Gear Type*	Area**	Date (1994)	Time (GMT)	Start Position Lat. (deg. N)	Start Position Long. (deg.)	Depth (m) Gear	Depth (m) Bottom	Temp. (deg. C) Gear	Temp. (deg. C) Surface	Catch Pollock (kg/no)	Catch Other (kg)
38	R	1	21 Jul	1737-1837	55 41.80	168 47.52 W	162	197	4.2	7.1	46.7/52	2.5
39	M	1	22 Jul	0908-0938	57 33.78	169 37.36 W	19	73	7.8	7.9	0.1/32	220.8
40	T	1	22 Jul	1111-1141	57 32.90	169 38.53 W	13	73	7.9	7.9	0.1/2,303	35.5
41	M	1	22 Jul	1819-1834	57 36.22	170 15.95 W	49	73	2.4	7.0	0.1/630	111.3
42	M	1	22 Jul	1936-1946	57 36.26	170 16.03 W	27	73	6.8	6.8	0.3/3,216	393.7
43	B	1	23 Jul	0512-0525	56 41.73	170 05.62 W	95	95	3.6	7.9	7,228.4/10,569	481.4
44	T	1	23 Jul	0930-1000	56 44.08	170 06.93 W	6	94	7.8	8.0	0.1/1,386	25.9
45	M	1	23 Jul	1109-1139	56 42.41	170 06.94 W	20	95	7.5	7.9	0.2/1,035	142.9
46	B	2	24 Jul	0309-0324	57 15.79	170 50.15 W	84	84	3.6	7.7	3,705.2/5,094	603.2
47	R	2	24 Jul	1735-1755	58 13.32	171 37.79 W	85	98	0.7	7.9	1,498.6/3,213	324.5
48	R	2	24 Jul	2209-2301	57 46.36	171 32.98 W	91	99	1.9	8.5	35.3/72	111.5
49	R	2	25 Jul	2253-2353	57 46.00	172 10.89 W	103	107	1.9	8.7	43.0/115	105.6
50	R	2	26 Jul	0233-0248	58 02.91	172 14.46 W	94	106	1.2	9.1	1,175.8/3,926	78.1
51	R	2	26 Jul	1408-1458	59 28.52	173 09.96 W	91	99	-0.6	8.1	505.5/679	111.1
52	R	2	27 Jul	0134-0204	57 41.18	172 46.95 W	97	119	1.8	8.4	27.2/73	21.0
53	B	2	1 Aug	2132-2157	57 20.54	173 18.95 W	121	121	3.0	8.2	2,085.2/3,462	408.8
54	B	2	2 Aug	0258-0304	58 00.57	173 27.23 W	117	117	2.4	8.7	1,404.4/2,714	182.6
55	R	2	2 Aug	0716-0746	58 31.98	173 34.99 W	94	123	2.7	8.3	1,903.3/18,541	1.7
56	R	2	2 Aug	1235-1320	58 32.34	173 35.15 W	70	124	2.7	8.3	661.9/8,389	5.6
57	M	2	2 Aug	1934-1949	58 49.84	173 39.86 W	31	123	3.5	8.1	0.1/31	17.3
58	R	2	2 Aug	2329-2357	59 25.54	173 48.35 W	101	110	1.4	7.7	1,334.1/3,037	26.4
59	R	2	3 Aug	0941-1011	60 03.73	174 38.80 W	95	109	0.2	8.5	1,236.3/3,743	69.7
60	M	2	3 Aug	1207-1222	60 06.47	174 37.29 W	22	108	1.8	8.5	0.1/1	131.0
61	T	2	3 Aug	1304-1311	60 05.78	174 35.56 W	16	108	7.8	8.4	0.1/96	22.0
62	R	2	3 Aug	2201-2229	59 00.59	174 22.43 W	69	127	1.8	8.7	908.6/9,538	68.9
63	R	2	4 Aug	0901-0931	58 44.44	174 18.63 W	116	144	2.8	8.9	121.5/1,277	1.6
64	M	2	4 Aug	1134-1204	58 45.33	174 19.53 W	27	144	5.4	8.9	2.0/8	2.5
65	R	2	4 Aug	1908-1933	58 44.28	174 12.45 W	136	139	4.1	8.9	852.6/2,009	11.9
66	R	2	5 Aug	0124-0214	58 38.22	174 16.80 W	142	148	3.2	8.6	48.5/109	5.4
67	B	2	5 Aug	0950-1010	57 37.45	174 01.89 W	135	135	3.5	9.4	894.4/1,429	983.7
68	R	2	6 Aug	0132-0232	58 12.45	174 15.00 W	193	652	3.2	8.8	199.7/375	53.2
69	M	2	6 Aug	1443-1543	58 21.64	176 03.78 W	29	2140	7.6	8.8	0.1/4	0.7
70	M	2	6 Aug	1948-2018	58 30.88	175 10.55 W	14	729	8.4	8.7	0.1/1	0.1
71	M	2	6 Aug	2228-2258	58 30.61	175 11.34 W	14	594	8.4	8.6	0.1/13	5.2
72	R	2	7 Aug	0508-0525	59 30.24	175 09.34 W	122	133	2.1	8.6	1,365.5/3,694	17.8
73	R	2	7 Aug	1052-1152	59 28.53	175 11.06 W	101	133	2.0	8.6	293.9/829	24.8
74	R	2	7 Aug	1241-1341	59 30.98	175 07.02 W	100	133	2.0	8.6	602.8/1,667	6.1
75	R	2	7 Aug	2125-2134	60 13.98	175 19.92 W	105	114	0.9	7.8	1,029.0/3,162	3.4

Table 2. (cont.)

Haul No.	Gear Type*	Area**	Date (1994)	Time (GMT)	Start Position Lat. (deg. N)	Start Position Long. (deg.)	Depth (m) Gear	Depth (m) Bottom	Temp. (deg. C) Gear	Temp. (deg. C) Surface	Catch Pollock (kg/no)	Catch Other (kg)
76	R	2	8 Aug	0214-0235	60 53.05	175 30.27 W	101	106	-0.2	7.8	997.2/3,120	13.1
77	R	2	9 Aug	1026-1056	59 57.42	176 01.89 W	100	134	1.9	8.4	188.1/1,260	14.5
78	M	2	9 Aug	1226-1250	59 57.15	176 00.65 W	26	134	3.7	8.4	0.8/26	3.0
79	R	2	9 Aug	1924-1946	59 24.98	175 47.62 W	116	137	1.9	8.2	454.7/1,996	15.2
80	R	2	10 Aug	0026-0031	58 57.34	175 39.41 W	127	133	2.3	8.5	1,130.6/11,463	0.6
81	R	2	10 Aug	0137-0202	58 57.08	175 39.02 W	117	132	2.3	8.5	3,129.3/36,029	–
82	B	2	10 Aug	0334-0340	58 57.34	175 39.25 W	134	134	2.3	8.5	705.5/3,250	280.2
83	R	2	10 Aug	0957-1057	58 35.20	175 32.75 W	79	142	2.9	8.7	4.9/14	15.0
84	R	2	10 Aug	2035-2132	58 43.90	176 08.10 W	127	133	2.6	8.4	71.2/299	1.7
85	B	2	11 Aug	0241-0256	59 26.17	176 25.26 W	138	138	2.2	8.4	481.9/1,204	274.8
86	R	2	11 Aug	0939-1009	60 28.42	176 40.84 W	96	134	1.6	7.8	232.8/2,344	–
87	T	2	11 Aug	1124-1140	60 28.26	176 44.34 W	***	136	***	7.8	0.1/6	2.9
88	R	2	11 Aug	1928-1943	61 05.03	176 56.19 W	79	122	1.0	7.7	391.5/5,564	15.2
89	R	2	11 Aug	2124-2143	61 05.19	176 55.90 W	113	122	1.3	7.7	1,197.1/8,173	54.3
90	R	2	12 Aug	0437-0524	62 10.05	177 28.18 W	102	109	-0.2	8.3	496.5/1,794	116.8
91	R	2	12 Aug	1537-1637	62 29.17	178 07.45 W	97	103	-0.3	8.3	258.6/605	55.4
92	R	2	13 Aug	0912-0932	60 10.64	177 18.43 W	79	141	1.4	7.8	525.5/4,653	1.7
93	B	2	13 Aug	1937-2011	59 45.84	177 09.65 W	131	149	2.4	8.1	154.8/641	20.3
94	R	2	13 Aug	2316-2350	59 38.77	177 07.26 W	141	181	2.4	8.1	2,529.2/20,073	1.4
95	R	2	14 Aug	0937-1022	59 04.52	176 53.93 W	68	144	2.7	8.0	102.3/1,012	7.7
96	R	2	14 Aug	1910-2010	58 47.93	176 51.61 W	105	127	2.6	8.0	75.0/562	4.6
97	R	2	15 Aug	0200-0230	58 47.12	177 31.04 W	125	142	3.1	8.6	0.1/3	19.9
98	R	2	15 Aug	0405-0414	58 45.58	177 30.46 W	218	247	2.8	8.6	448.1/885	2.7
99	R	2	15 Aug	1014-1054	59 36.50	177 48.28 W	244	273	2.3	8.0	285.8/701	6.0
100	R	2	15 Aug	1434-1514	59 12.23	177 40.33 W	216	233	1.9	8.0	31.4/69	1.8
101	R	2	15 Aug	2143-2149	60 24.09	178 05.26 W	140	157	1.8	8.0	1,247.2/11,712	–
102	R	2	16 Aug	0208-0217	60 56.63	178 17.46 W	141	162	1.5	7.9	1,156.0/11,590	5.0
103	R	2	16 Aug	1247-1347	62 26.87	178 51.40 W	93	108	0.5	7.7	3,092.2/7,563	9.8
104	B	2	16 Aug	2005-2020	62 15.59	179 28.71 W	121	121	1.2	7.5	1,297.6/3,779	153.7
105	R	2	17 Aug	0047-0059	61 44.51	179 16.27 W	128	133	1.2	7.3	534.2/1,827	1.6
106	R	2	17 Aug	0428-0434	61 19.75	179 07.24 W	177	197	***	7.3	660.7/5,511	7.5
107	R	2	17 Aug	0845-0900	60 46.32	178 54.41 W	216	232	2.0	8.3	140.3/358	4.4
108	T	2	17 Aug	1009-1010	60 46.42	178 55.34 W	71	235	2.1	8.3	0.1/1	2.3
109	R	2	17 Aug	1851-1921	60 17.67	178 43.69 W	157	440	2.3	8.7	0.8/2	4.4
110	R	2	17 Aug	2131-2211	60 16.84	178 43.21 W	235	438	2.1	8.7	352.6/1,277	16.7
111	R	2	18 Aug	0320-0330	59 45.38	178 31.34 W	153	164	2.1	8.3	251.7/2,440	1.8
112	R	2	18 Aug	0446-0447	59 44.29	178 31.35 W	170	179	2.1	8.3	1,513.1/13,343	1.6
113	R	2	18 Aug	1250-1257	60 51.65	179 37.69 W	140	222	2.1	7.9	52.6/633	–

Table 2. (cont.)

Haul No.	Gear Type*	Area**	Date (1994)	Time (GMT)	Start Position Lat. (deg. N)	Start Position Long. (deg.)	Depth (m) Gear	Depth (m) Bottom	Temp. (deg. C) Gear	Temp. (deg. C) Surface	Catch Pollock (kg/no)	Catch Other (kg)
114	R	2	18 Aug	1512-1522	60 48.89	179 37.02 W	229	251	2.4	7.9	296.5/1,097	6.3
115	M	2	18 Aug	2301-2331	61 40.44	179 56.90 W	26	143	7.7	8.1	0.1/1	0.3
116	R	2	19 Aug	0300-0314	62 00.17	79 54.92 E	127	134	1.3	8.1	395.6/1,209	1.1
117	T	2	19 Aug	0836-0837	62 22.34	79 36.66 E	25	71	1.7	8.6	--/--	0.3
118	R	2	19 Aug	1545-1640	61 43.45	79 19.73 E	130	140	1.9	8.6	1.2/2	0.6
119	B	2	19 Aug	2004-2019	61 42.61	79 20.75 E	131	131	1.9	8.6	1,059.9/2,811	191.7
120	R	2	20 Aug	0226-0239	61 14.73	79 32.95 E	153	168	1.5	7.9	1,630.0/10,097	11.7
121	R	2	28 Aug	0250-0320	61 27.60	178 43.88 E	189	277	2.0	7.2	24.8/93	19.7
122	R	2	28 Aug	0705-7110	61 40.69	178 37.28 E	72	155	1.6	8.3	688.8/8,089	1.7
123	R	2	28 Aug	0824-0832	61 40.31	178 38.04 E	87	154	1.8	8.3	1,370.0/13,456	--
124	N	2	28 Aug	1031-1046	61 46.58	178 35.14 E	128	128	1.7	8.3	199.6/531	66.2
125	R	3	29 Aug	2144-2155	61 25.05	175 15.77 E	81	107	1.7	8.9	59.8/449	0.5
126	N	3	29 Aug	2320-2345	61 25.88	175 15.72 E	108	108	1.7	8.9	177.8/1,248	42.2
127	R	2	30 Aug	1232-1307	61 39.68	178 33.81 E	82	172	1.5	7.7	54.1/503	0.1
128	R	2	30 Aug	1802-1829	61 38.58	178 29.91 E	167	188	1.9	7.7	398.4/1,472	1.4
129	M	2	1 Sep	2234-2341	61 43.91	178 30.09 E	***	148	***	8.8	4.8/45	0.5
130	R	3	2 Sep	2159-2239	60 32.17	171 55.83 E	123	134	1.7	8.4	8.6/15	7.8
131	B	3	3 Sep	0019-0050	60 31.00	171 53.39 E	139	140	1.7	8.4	3,603.0/8,146	70.0
132	R	3	3 Sep	0934-0955	59 52.98	170 48.39 E	213	361	1.7	10.1	27.3/59	6.7
133	R	3	4 Sep	0239-0256	60 05.68	168 00.98 E	108	141	0.6	11.7	1,035.4/15,090	5.3
134	B	3	4 Sep	0412-0417	60 05.17	168 02.44 E	145	145	0.8	11.7	1,001.0/3,220	36.5
135	T	3	4 Sep	1004-1020	60 17.03	168 24.82 E	***	73	***	10.7	0.1/2	1.5
136	T	3	4 Sep	1952-2012	60 09.60	167 06.06 E	***	80	***	10.6	--/--	0.6
137	B	3	5 Sep	0109-0124	59 40.97	167 07.86 E	265	265	2.2	10.4	1,045.5/1,189	31.3
138	R	3	5 Sep	0240-0330	58 46.47	164 36.05 E	72	105	0.2	9.6	14.4/30	64.4
139	R	3	6 Sep	0513-0520	58 48.17	164 38.36 E	97	107	0.1	9.6	1,517.0/10,575	13.2
140	T	3	6 Sep	1550-1551	57 56.00	163 29.00 E	16	95	10.6	11.1	0.1/1	6.6
141	R	3	6 Sep	1844-1855	57 55.64	163 30.17 E	95	100	0.8	11.1	593.7/4,424	22.1
142	M	3	8 Sep	0023-0142	55 10.85	161 55.62 E	33	64	7.7	11.6	56.0/227	64.4
143	R	3	8 Sep	0341-0354	55 15.41	161 58.17 E	65	197	1.1	11.3	--/--	22.4
144	B	3	8 Sep	0534-0557	55 15.12	161 57.84 E	136	136	0.8	10.7	1,112.6/1,212	335.3
145	R	SP	12 Sep	1218-1228	52 14.92	172 47.90 W	104	125	3.7	8.5	632.8/535	21.1

* R=midwater rope trawl, M=Marinovich trawl, B=83/112 bottom trawl, N=nylon nor'eastern bottom trawl, T=Methot trawl

** 1=East of Pribilof Islands, 2=West of Pribilofs to Cape Navarin, Russia, 3=Cape Navarin to Cape Kronotski, SP=Seguam Pass

*** Gear depths and temperatures unavailable because tows were oblique

Table 3. Summary of Neuston tows from the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Haul No.	Area*	Date (1994)	Time (GMT)	Start Position		Bottom Depth (m)
				Lat. (deg. N)	Long. (deg.)	
1	1	17 Jul	1044	55 10.7	166 49.7 W	146
2	1	20 Jul	1124	57 03.0	168 20.2 W	80
3	1	22 Jul	1033	57 33.2	169 36.9 W	73
4	2	23 Jul	1046	56 41.8	170 07.1 W	95
5	2	3 Aug	1106	60 06.0	174 39.6 W	109
6	2	4 Aug	1028	58 46.2	174 19.8 W	140
7	2	11 Aug	1222	60 27.2	176 44.9 W	134
8	2	17 Aug	1053	60 44.6	178 56.3 W	249
9	2	19 Aug	0927	62 21.6	179 36.0 E	71
10	3	6 Sep	1723	57 56.1	163 29.4 E	96

* 1 = East of Pribilof Islands, 2 = West of Pribilofs to Cape Navarin, Russia, 3 = Cape Navarin to Cape Kronotski

Table 4. Summary of catch by species in 19 midwater rope trawls east of the Pribilof Islands during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Jellyfish Unidentified	Scyphozoa	7,646.9	57.2	--
Walleye Pollock	*Theragra chalcogramma*	5,623.0	42.1	9,040
Chum Salmon	*Oncorhynchus keta*	42.4	0.3	23
Yellowfin Sole	*Pleuronectes asper*	14.8	0.1	43
Pacific Cod	*Gadus macrocephalus*	14.1	0.1	5
Bathyrajid Skate Unidentified	*Bathyraja sp.*	10.9	0.1	1
Pacific Sandfish	*Trichodon trichodon*	3.4	<0.1	88
Smooth Lumpsucker	*Aptocyclus ventricosus*	2.8	<0.1	1
Arrowtooth Flounder	*Atheresthes stomias*	1.6	<0.1	1
Pink Salmon	*Oncorhynchus gorbuscha*	1.4	<0.1	1
Magistrate Armhook Squid	*Berryteuthis magister*	0.9	<0.1	1
Pacific Herring	*Clupea pallasi*	0.6	<0.1	2
Rock Sole	*Pleuronectes bilineatus*	0.5	<0.1	2
Squid Unidentified	Teuthoidea	0.3	<0.1	41
Atka Mackerel	*Pleurogrammus monopterygius*	0.2	<0.1	1
Eulachon	*Thaleichthys pacificus*	0.2	<0.1	6
Sturgeon Poacher	*Podothecus acipenserinus*	0.1	<0.1	1
Pacific Sandlance	*Ammodytes hexapterus*	0.1	<0.1	2
Ocean Shrimp	*Pandalus jordani*	0.1	<0.1	35
Humpy Shrimp	*Pandalus goniurus*	0.1	<0.1	1
Totals		13,364.4	100.0	

Table 5. Summary of catch by species in 59 midwater rope trawls west of the Pribilof Islands during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Walleye Pollock	*Theragra chalcogramma*	40,254.0	96.4	257,343
Jellyfish Unidentified	Scyphozoa	1,299.5	3.1	--
Smooth Lumpsucker	*Aptocyclus ventricosus*	108.2	0.3	49
Rock Sole	*Pleuronectes bilineatus*	30.0	0.1	101
Pacific Herring	*Clupea pallasi*	13.4	<0.1	41
Greenland Turbot	*Reinhardtius hippoglossoides*	9.6	<0.1	3
Pacific Cod	*Gadus macrocephalus*	8.0	<0.1	3
Arrowtooth Flounder	*Atheresthes stomias*	5.2	<0.1	4
Flathead Sole	*Hippoglossoides elassodon*	4.8	<0.1	32
Chum Salmon	*Oncorhynchus keta*	3.9	<0.1	3
Yellowfin Sole	*Pleuronectes asper*	2.1	<0.1	3
Pacific Lamprey	*Lampetra tridentata*	1.9	<0.1	4
Alaska Plaice	*Pleuronectes quadrituberculatus*	1.8	<0.1	3
Northern Shrimp	*Pandalus borealis*	1.7	<0.1	--
Sturgeon Poacher	*Podothecus acipenserinus*	0.5	<0.1	1
Opilio Tanner Crab	*Chionoecetes opilio*	0.3	<0.1	1
Capelin	*Mallotus villosus*	0.2	<0.1	2
Pacific Spiny Lumpsucker	*Eumicrotremus orbis*	0.1	<0.1	1
Lanternfish Unidentified	Myctophidae	0.1	<0.1	1
Totals		41,745.3	100.0	

Table 6. Summary of catch by species in 8 midwater rope trawls along the WBS shelf during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Walleye Pollock	*Theragra chalcogramma*	3,256.2	95.8	30,642
Jellyfish Unidentified	Scyphozoa	135.6	4.0	--
Pacific Herring	*Clupea pallasi*	3.9	0.1	38
Smooth Lumpsucker	*Aptocyclus ventricosus*	1.8	<0.1	1
Squid Unidentified	Teuthoidea	0.4	<0.1	--
Magistrate Armhook Squid	*Berryteuthis magister*	0.3	<0.1	1
Northern Smoothtongue	*Leuroglossus schmidti*	0.1	<0.1	1
Crested Sculpin	*Blepsias bilobus*	0.1	<0.1	1
Pacific Spiny Lumpsucker	*Eumicrotremus orbis*	0.1	<0.1	2
Sponge Unidentified	Porifera	0.1	<0.1	1
Totals		3,398.6	100.0	

Table 7. Summary of catch by species in 7 bottom trawls east of the Pribilof Islands during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Walleye Pollock	*Theragra chalcogramma*	16,487.9	71.3	24,776
Yellowfin Sole	*Pleuronectes asper*	1,748.2	7.6	7,012
Rock Sole	*Pleuronectes bilineatus*	761.9	3.3	4,506
Pacific Cod	*Gadus macrocephalus*	620.7	2.7	303
Arrowtooth Flounder	*Atheresthes stomias*	531.0	2.3	767
Flathead Sole	*Hippoglossoides elassodon*	505.8	2.2	1,823
Unsorted Shab		383.8	1.7	--
Jellyfish Unidentified	Scyphozoa	310.4	1.3	--
Bairdi Tanner Crab	*Chionoecetes bairdi*	279.0	1.2	568
Alaska Plaice	*Pleuronectes quadrituberculatus*	217.6	0.9	291
Starfish Unidentified	Asteroidea	215.9	0.9	2,569
Hermit Crab Unidentified	Paguridae	201.0	0.9	1168
Sponge Unidentified	Porifera	171.0	0.7	--
Bathyrajid Skate Unidentified	*Bathyraja sp.*	116.2	0.5	20
Great Sculpin	*Myoxocephalus polyacanthocephalus*	86.0	0.4	20
Skate Unidentified	Rajidae	84.4	0.4	16
Red King Crab	*Paralithodes camtschatica*	77.5	0.3	57
Brittlestarfish Unidentified	Ophiuroidea	59.9	0.3	--
Snail Unidentified	Gastropoda	48.6	0.2	178
Pacific Halibut	*Hippoglossus stenolepis*	43.4	0.2	15
Aleutian Skate	*Bathyraja aleutica*	40.5	0.2	7
Sturgeon Poacher	*Podothecus acipenserinus*	33.9	0.1	358
Empty Gastropod Shells	Gastropoda	29.4	0.1	--
Neptune Snail Unidentified	*Neptunea sp.*	17.7	0.1	80
Bigmouth Sculpin	*Hemitripterus bolini*	17.1	0.1	3
16 Remaining Species		36.5	0.2	240
Totals		23,125.3	100.0	

Table 8. Summary of catch by species in 10 bottom trawls west of the Pribilof Islands during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Walleye Pollock	*Theragra chalcogramma*	11,988.2	79.3	24,915
Pacific Cod	*Gadus macrocephalus*	973.6	6.4	302
Arrowtooth Flounder	*Atheresthes stomias*	452.9	3.0	414
Gorgon Basketstarfish	*Gorgonocephalus caryi*	286.6	1.9	--
Pacific Halibut	*Hippoglossus stenolepis*	246.0	1.6	34
Flathead Sole	*Hippoglossoides elassodon*	176.5	1.2	660
Opilio Tanner Crab	*Chionoecetes opilio*	140.5	0.9	1,952
Skate Unidentified	Rajidae	132.3	0.9	29
Starfish Unidentified	Asteroidea	83.2	0.6	--
Sea Urchin Unidentified	Echinoidea	82.0	0.5	--
Kamchatka Flounder	*Atheresthes evermanni*	81.6	0.5	115
Snail Unidentified	Gastropoda	65.1	0.4	761
Hermit Crab Unidentified	Paguridae	63.2	0.4	1,073
Yellow Irish Lord	*Hemilepidotus jordani*	41.8	0.3	103
Rock Sole	*Pleuronectes bilineatus*	41.2	0.3	130
Sea Anemone Unidentified	Actiniaria	34.1	0.2	173
Bathyrajid Skate Unidentified	*Bathyraja sp.*	25.3	0.2	4
Bairdi Tanner Crab	*Chionoecetes bairdi*	25.2	0.2	153
Scissortail Sculpin	*Triglops forficatus*	24.9	0.2	377
Great Sculpin	*Myoxocephalus polyacanthocephalus*	23.9	0.2	22
43 Remaining Species		124.0	0.8	421
Totals		15112.1	100.0	

Table 9. Summary of catch by species in 5 bottom trawls along the WBS shelf during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Walleye Pollock	*Theragra chalcogramma*	6,939.9	93.1	15,015
Pacific Cod	*Gadus macrocephalus*	105.6	1.4	20
Rock Sole	*Pleuronectes bilineatus*	71.0	1.0	201
Great Sculpin	*Myoxocephalus polyacanthocephalus*	61.2	0.8	17
Alaska Plaice	*Pleuronectes quadrituberculatus*	53.6	0.7	44
Armorhead Sculpin	*Gymnocanthus galeatus*	41.7	0.6	95
Magistrate Armhook Squid	*Berryteuthis magister*	32.0	0.4	112
Yellow Irish Lord	*Hemilepidotus jordani*	23.2	0.3	30
Flathead Sole	*Hippoglossoides elassodon*	18.6	0.2	61
Alaska Skate	*Bathyraja parmifera*	16.4	0.2	1
Pacific Ocean Pearch	*Sebastes alutus*	15.5	0.2	22
Sea Urchin Unidentified	Echinoidea	10.3	0.1	1,878
Kamchatka Flounder	*Atheresthes evermanni*	10.1	0.1	16
Pacific Herring	*Clupea pallasi*	6.7	0.1	19
Pacific Halibut	*Hippoglossus stenolepis*	5.9	0.1	1
Darkfin Sculpin	*Malacocottus zonurus*	5.3	0.1	3
Skate Unidentified	Rajidae	4.5	0.1	1
Bigmouth Sculpin	*Hemitripterus bolini*	3.7	0.0	2
Jellyfish Unidentified	Scyphozoa	3.3	0.0	--
Sakhalin Sole	*Limanda sakhalinensis*	3.0	0.0	41
35 Remaining Species		23.7	0.3	162
Totals		7,455.2	100.0	

Table 10. Summary of catch by species in 10 successful Marinovich and 8 Methot trawls east of the Pribilof Islands during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07. Catch data from Marinovich haul no. 2 were excluded because fishing performance was unsatisfactory after the trawl hit bottom.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Jellyfish Unidentified	Scyphozoa	1,137.6	98.3	--
Crustacean Unidentified	Crustacea	13.8	1.2	--
Age-0 Walleye Pollock	*Theragra chalcogramma*	3.0	0.3	25,806
Walleye Pollock (>age 0)	*Theragra chalcogramma*	2.4	0.2	3
Yellowfin Sole	*Pleuronectes asper*	0.4	<0.1	1
Squid Unidentified	Teuthoidea	0.2	<0.1	19
Pacific Sandlance	*Ammodytes hexapterus*	<0.1	<0.1	2
Shrimp Unidentified	Natantia	<0.1	<0.1	2
Totals		1,157.4	100.0	

Table 11. Summary of catch by species in 9 Marinovich and 4 Methot trawls west of the Pribilof Islands during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Jellyfish Unidentified	Scyphozoa	182.1	93.3	--
Walleye Pollock (>age 0)	*Theragra chalcogramma*	7.6	3.9	78
Crustacean Unidentified	Crustacea	2.6	1.3	--
Euphausiid Unidentified	Euphausiacea	2.3	1.2	--
Fish Larvae Unidentified	Teleostei	0.4	0.2	--
Lanternfish Unidentified	Myctophidae	0.1	<0.1	15
Northern Shrimp	*Pandalus borealis*	0.1	<0.1	11
Age-0 Walleye Pollock	*Theragra chalcogramma*	<0.1	<0.1	154
Flatfish Larvae	Pleuronectiformes	<0.1	<0.1	4
Totals		195.2	100.0	

Table 12. Summary of catch by species in 1 Marinovich and 3 Methot trawls on the WBS shelf during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07. The Marinovich trawl touched bottom briefly, but otherwise fished satisfactorily.

Common Name	Scientific Name	Weight (kg)	Percent	Numbers
Jellyfish Unidentified	Scyphozoa	71.1	55.2	--
Walleye Pollock (>age 0)	*Theragra chalcogramma*	55.9	43.4	181
Pacific Sandlance	*Ammodytes hexapterus*	0.3	0.2	--
Pacific Sandfish	*Trichodon trichodon*	0.3	0.2	2
Amphipod Unidentified	Pandalidae	0.3	0.2	--
Age-0 Walleye Pollock	*Theragra chalcogramma*	0.1	0.1	50
Flatfish Larvae	Pleuronectiformes	0.1	0.1	--
Sakhalin Sole	*Limanda sakhalinensis*	0.1	0.1	1
Scuplin Unidentified	Cottidae	0.1	0.1	--
Capelin	*Mallotus villosus*	0.1	0.1	1
6 Remaining Species		0.5	0.4	--
Totals		128.9	100.0	

Table 13. Summary of pollock biological samples and measurements collected during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

									International Samples			
											Russia	
Haul	Length	Maturity	Otoliths	Fish Weight	Ovary Weight	Stomachs	Tissue Isotopes	Maturity Stage Photographs	Japan Age-0	China Otoliths	Otoliths	Scales, Stom. Scans
1	6	6	6	6	2	-	-	-	-	-	-	-
2	28	26	26	26	6	9	-	-	-	-	-	-
3	299	95	95	95	9	-	-	-	-	20	20	50
4	378	111	109	111	4	-	-	-	-	-	-	-
5	309	95	95	95	3	-	-	-	-	-	-	-
6	47	47	47	47	1	-	-	-	-	-	-	-
7	275	91	91	91	4	-	-	-	-	-	-	-
8	304	82	80	82	-	10	-	-	-	-	-	-
9	135	135	133	135	4	10	-	-	-	-	-	-
10	380	96	94	96	2	-	-	12	-	20	20	50
11	14	14	14	14	-	4	-		-	-	-	-
12	427	87	87	87	2	11	-	8	-	-	-	-
13	45	-	-	-	-	-	-	-	45	-	-	-
14	136	-	-	-	-	-	-	-	136	-	-	-
15	129	1	-	1	-	-	-	-	129	-	-	-
16	309	97	97	97	3	10	-	-	-	-	-	-
17	285	85	85	85	2	-	-	-	-	20	20	50
18	144	-	-	-	-	-	-	-	144	-	-	-
19	230	-	-	-	-	-	-	-	230	-	-	-
20	340	92	92	92	-	11	-	-	-	-	-	-
21	39	39	39	39	1	8	-	-	-	-	-	-
22	107	2	2	2	-	-	-	-	-	-	-	-
23	123	-	-	-	-	-	-	-	123	-	-	-
24	405	-	-	-	-	-	-	-	405	-	-	-
25	316	108	106	108	4	10	20	-	-	-	20	50
26	61	61	61	61	2	27	-	-	-	-	-	-
27	472	127	127	127	1	-	-	11	-	20	-	-
28	16	2	2	2	-	-	-	-	-	-	-	-
29	21	21	21	21	-	7	-	-	-	-	-	-
30	9	9	9	9	-	-	4	-	-	-	-	-
31	14	8	8	8	-	4	1	-	-	-	-	-
32	174	-	-	-	-	-	-	-	174	-	-	-
33	150	-	-	-	-	-	-	-	150	-	-	-
34	259	-	-	-	-	-	-	-	259	-	-	-
35	158	-	-	-	-	-	-	-	158	-	-	-

Table 13 (cont.)

Haul	Length	Maturity	Otoliths	Fish Weight	Ovary Weight	Stomachs	Tissue Isotopes	Maturity Stage Photographs	International Samples: Japan Age-0	China Otoliths	Russia Otoliths	Russia Scales, Stom. Scans
36	-	-	-	-	-	-	-	-	32	-	-	-
37	269	-	-	-	-	-	-	-	269	-	-	-
38	52	52	52	52	3	11	1	-	-	-	-	-
39	26	-	-	-	-	-	-	-	26	-	-	-
40	115	-	-	-	-	-	-	-	115	-	-	-
41	233	-	-	-	-	-	-	-	233	-	-	-
42	181	-	-	-	-	-	-	-	181	-	-	-
43	317	119	119	119	4	-	-	-	-	20	20	50
44	137	-	-	-	-	-	-	-	231	-	-	-
45	190	-	-	-	-	-	-	-	190	-	-	-
46	306	100	98	100	8	-	-	-	-	-	-	-
47	362	118	117	118	5	10	-	-	-	20	20	50
48	72	72	70	72	1	14	-	-	-	-	-	-
49	113	113	113	113	1	10	-	-	-	-	-	-
50	436	119	119	119	1	11	-	12	-	20	20	50
51	376	109	109	109	6	12	-	-	-	-	20	50
52	73	73	73	73	3	17	-	-	-	-	-	-
53	395	93	93	93	4	-	-	-	-	-	20	50
54	326	85	85	85	2	-	-	-	-	-	-	-
55	357	100	50	100	-	10	9	-	-	-	20	50
56	380	100	-	100	-	-	7	-	-	-	-	-
57	31	-	-	-	-	-	-	-	31	-	-	-
58	318	84	84	84	-	10	7	11	-	-	-	-
59	323	100	75	100	3	9	-	-	-	-	-	-
60	1	-	-	-	-	-	-	-	-	-	-	-
61	89	-	-	-	-	-	-	-	-	-	-	-
62	374	111	111	111	-	10	-	-	-	-	-	-
63	439	93	93	93	-	10	-	-	-	-	-	-
64	8	-	-	-	-	-	-	-	-	-	-	-
65	295	94	94	94	3	10	-	-	-	-	-	-
66	109	109	75	109	0	10	-	-	-	-	-	-
67	339	83	83	83	1	-	-	-	-	-	-	-
68	295	62	62	62	1	10	-	-	-	-	-	-
69	4	-	-	-	-	-	-	-	4	-	-	-
70	1	-	-	-	-	-	-	-	-	-	-	-
71	11	-	-	-	-	-	-	-	-	-	-	-
72	448	103	103	103	2	9	-	-	-	-	20	50
73	362	65	-	65	-	-	-	-	-	-	-	-

Table 13 (cont.)

									International Samples			
											Russia	
Haul	Length	Maturity	Otoliths	Fish Weight	Ovary Weight	Stomachs	Tissue Isotopes	Maturity Stage Photographs	Japan Age-0	China Otoliths	Otoliths	Scales, Stom. Scans
74	316	91	91	91	3	10	-	-	-	-	-	-
75	303	87	87	87	-	10	-	-	-	-	-	-
76	312	65	65	65	-	-	-	-	-	-	20	50
77	372	80	80	80	-	10	-	-	-	-	-	-
78	26	-	-	-	-	-	-	-	-	-	-	-
79	551	60	60	60	-	10	-	-	-	-	-	-
80	384	55	55	55	-	10	-	-	-	-	-	-
81	502	-	-	-	-	-	-	-	-	-	-	-
82	569	88	88	88	2	-	-	-	-	-	-	-
83	14	-	-	-	-	-	-	-	-	-	-	-
84	299	80	80	80	1	10	-	-	-	-	-	-
85	508	82	82	82	1	-	-	-	-	-	-	-
86	299	94	94	94	-	10	-	-	-	-	-	-
87	5	-	-	-	-	-	-	-	6	-	-	-
88	472	78	78	78	-	10	-	-	-	-	-	-
89	380	74	74	74	-	10	-	-	-	-	-	-
90	265	70	70	70	-	10	-	-	-	-	20	50
91	312	75	75	75	1	20	-	-	-	-	-	-
92	306	104	104	104	-	10	-	-	-	-	-	-
93	641	45	45	45	1	10	-	-	-	-	-	-
94	440	60	60	60	-	10	-	-	-	-	-	-
95	309	68	68	68	-	10	-	-	-	-	-	-
96	291	64	64	64	-	10	-	-	-	-	-	-
97	3	-	-	-	-	-	-	-	2	-	-	-
98	413	65	65	65	-	9	-	-	-	-	20	50
99	321	54	54	54	-	10	-	-	-	-	-	-
100	69	69	69	69	-	10	-	-	-	-	-	-
101	326	75	75	75	-	10	-	-	-	-	-	-
102	391	-	-	-	-	-	-	-	-	-	-	-
103	423	84	84	84	1	20	-	-	-	-	-	-
104	319	78	78	78	-	20	-	-	-	-	20	50
105	337	69	69	69	-	20	-	-	-	-	-	-
106	463	85	85	85	-	20	-	-	-	-	-	-
107	290	68	67	68	-	10	-	-	-	-	-	-
108	1	-	-	-	-	-	-	-	1	-	-	-
109	2	-	-	-	-	-	2	-	-	-	-	-
110	363	59	59	59	-	10	13	-	-	-	-	-
111	348	0	0	0	-	-	-	-	-	-	-	-

Table 13 (cont.)

Haul	Length	Maturity	Otoliths	Fish Weight	Ovary Weight	Stomachs	Tissue Isotopes	Maturity Stage Photographs	International Samples: Japan Age-0	International Samples: China Otoliths	International Samples: Russia Otoliths	International Samples: Russia Scales, Stom. Scans
112	321	0	0	0	-	-	-	-	-	-	-	-
113	302	105	0	105	-	-	-	-	-	-	-	-
114	343	78	77	78	-	20	-	-	-	-	-	-
115	1	-	-	-	-	-	-	-	-	-	-	-
116	329	77	77	77	0	20	-	-	-	-	20	50
117	-	-	-	-	-	-	-	-	-	-	-	-
118	2	-	-	-	-	-	-	-	-	-	-	-
119	349	51	51	51	1	10	-	-	-	-	-	-
120	414	76	76	76	-	20	5	-	-	-	20	50
121	93	-	-	-	-	-	-	-	-	-	-	-
122	353	31	31	31	-	20	-	-	-	-	-	-
123	331	-	-	-	-	-	-	-	-	-	-	-
124	427	104	104	104	-	20	-	-	-	-	-	-
125	216	58	58	58	-	-	10	-	-	-	20	50
126	386	70	70	70	-	20	4	-	-	-	-	-
127	313	128	-	128	-	20	-	-	-	-	-	-
128	322	94	75	94	-	-	1	-	-	-	20	50
129	44	-	-	-	-	-	-	-	1	-	-	-
130	15	-	-	-	-	-	12	9	-	-	-	-
131	348	125	125	125	-	13	1	3	-	-	20	50
132	59	59	59	59	-	20	-	-	-	-	-	-
133	204	70	50	70	-	19	6	-	-	-	20	50
134	327	123	123	123	-	20	7	-	-	-	-	-
135	2	-	-	-	-	-	-	-	2	-	-	-
136	-	-	-	-	-	-	-	-	-	-	-	-
137	418	124	124	124	2	20	11	-	-	-	20	50
138	30	-	-	-	-	-	-	-	-	-	-	-
139	278	81	81	81	-	20	-	-	-	-	-	-
140	1	-	-	-	-	-	-	-	1	-	-	-
141	334	95	53	95	-	19	12	-	-	-	20	50
142	227	84	84	84	1	20	7	-	46	-	-	-
143	-	-	-	-	-	-	-	-	-	-	-	-
144	328	101	101	101	4	7	4	-	-	-	20	50
145	287	92	90	92	-	20	-	-	-	-	-	-
Total	34,056	7,646	7,038	7,646	116	931	144	66	3,324	140	480	1,200

Note -- Length includes samples from random length frequency only

Table 14. Summary of CTD casts conducted during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Cast	Haul	Date (1994)	Time (GMT)	Position Latitude (N)	Position Longitude	Depth (m) CTD cast	Depth (m) Bottom	Transect
1	calibration	28 Jun	1816	48 09.2	122 25.4 W	82	94	Port Susan
2	calibration	5 Jul	0931	53 55.4	166 37.5 W	66	64	Broad Bay
3	2	10 Jul	1706	56 15.3	162 14.1 W	69	77	3.0
4	4,5	11 Jul	0541	56 41.8	162 48.0 W	66	71	4.0
5	7	12 Jul	0353	56 09.9	163 24.0 W	83	88	5.0
6	8	12 Jul	1239	56 53.9	163 24.1 W	65	69	5.0
7	10	13 Jul	0120	55 33.9	164 01.9 W	89	95	6.0
8	11	14 Jul	0231	55 20.8	165 10.9 W	105	111	8.0
9	12	14 Jul	1724	56 22.5	164 36.4 W	81	86	7.0
10	13-15	15 Jul	0652	54 59.5	165 44.7 W	124	131	9.0
11	17	16 Jul	0242	56 41.9	165 49.0 W	74	78	9.0
12	Methot 18	16 Jul	0946	56 32.0	166 25.4 W	88	97	10.0
13	19,20	16 Jul	1345	56 30.7	166 23.9 W	93	96	10.0
14	21,22	17 Jul	0058	54 33.7	166 23.2 W	419	425	10.1
15	Methot 23,24	17 Jul	1134	55 11.5	166 53.3 W	63	144	11.0
16	26	18 Jul	0054	56 29.3	167 00.7 W	101	107	11.0
17	27	18 Jul	1855	56 35.9	167 40.0 W	103	109	12.0
18	29	19 Jul	1425	55 17.5	167 43.6 W	179	185	12.1
19	31	19 Jul	2317	56 19.0	168 16.0 W	150	154	13.0
20	Methot 32	20 Jul	0920	57 03.3	168 20.2 W	18	79	13.0
21	33	20 Jul	1201	57 03.1	168 19.6 W	74	80	13.0
22	Methot 34,35	20 Jul	1803	57 01.9	168 20.2 W	76	79	13.0
23	36,37	21 Jul	0749	56 16.7	168 51.4 W	128	133	14.0
24	38	21 Jul	2000	55 45.8	168 46.8 W	218	226	14.0
25	39	22 Jul	0833	57 33.7	169 37.0 W	68	73	15.0
26	Methot 40	22 Jul	1111	57 32.9	169 38.5 W	18	73	15.0
27	43,45	23 Jul	0202	56 42.2	170 07.0 W	85	95	16.0
28	Methot 44	23 Jul	0930	56 44.1	170 06.9 W	12	93	16.0
29	46	24 Jul	0227	57 15.9	170 50.3 W	75	83	17.0
30	47	24 Jul	1836	58 14.4	171 37.6 W	89	98	18.0
31	calibration	31 Jul	1508	51 49.8	176 17.8 W	85	88	Cabin Cove
32	53	1 Aug	2258	57 20.7	173 19.3 W	114	122	21.0
33	55	2 Aug	0852	58 31.7	173 35.6 W	118	121	21.0
34	57	2 Aug	1744	58 51.0	173 30.9 W	115	121	21.0
35	58	3 Aug	0041	59 24.3	173 47.7 W	104	110	21.0
36	59	3 Aug	1051	60 06.2	174 39.2 W	102	108	22.0
37	Methot 61	3 Aug	1304	60 05.8	174 35.6 W	20	107	22.0
38	63-65	4 Aug	1007	58 46.5	174 19.6 W	135	140	22.0
39	66	5 Aug	0319	58 38.2	174 16.5 W	146	152	22.0
40	67	5 Aug	1101	57 35.7	174 00.1 W	129	135	22.0
41	68	6 Aug	0339	58 09.4	174 14.9 W	521	898	22.4
42	69	6 Aug	1405	58 22.3	176 04.1 W	525	2,140	22.7
43	72-74	7 Aug	0617	59 28.3	175 08.5 W	128	134	23.0
44	75	7 Aug	2212	60 13.5	175 20.3 W	107	114	23.0
45	76	8 Aug	0320	60 52.1	175 30.7 W	99	106	23.0

Table 14 (cont.)

Cast	Haul	Date (1994)	Time (GMT)	Position Latitude (N)	Longitude	Depth (m) CTD cast	Bottom	Transect
46	77,78	9 Aug	1144	59 56.9	175 56.9 W	128	133	24.0
47	79	9 Aug	2021	59 24.0	175 46.1 W	131	139	24.0
48	80,81,82	10 Aug	0427	58 57.2	175 39.3 W	126	132	24.0
49	83	10 Aug	1130	58 31.8	175 30.8 W	137	145	24.0
50	84	10 Aug	1812	58 44.7	176 11.3 W	126	132	25.0
51	86	11 Aug	1045	60 27.0	176 38.3 W	128	134	25.0
52	Methot 87	11 Aug	1124	60 28.3	176 44.3 W	46	135	25.0
53	88,89	11 Aug	2024	61 05.0	176 56.4 W	117	122	25.0
54	90	12 Aug	0605	62 10.3	177 22.5 W	102	109	25.0
55	91	12 Aug	1721	62 26.2	178 11.8 W	96	103	26.0
56	92	13 Aug	1010	60 10.0	177 21.0 W	133	139	26.0
57	93,94	13 Aug	2059	59 43.8	177 10.7 W	147	155	26.0
58	95,96	14 Aug	1056	59 03.7	176 58.5 W	138	143	26.0
59	98	15 Aug	0501	58 45.2	177 30.3 W	251	266	27.0
60	99,100	15 Aug	1143	59 34.3	177 47.6 W	256	262	27.0
61	101	15 Aug	2236	60 23.9	178 05.4 W	152	158	27.0
62	103	16 Aug	1453	62 31.9	178 46.3 W	99	106	27.0
63	105	17 Aug	0000	61 43.7	179 16.4 W	124	134	28.0
64	107,108	17 Aug	0939	60 47.6	178 55.3 W	226	234	28.0
65	109,110	17 Aug	2005	60 19.2	178 44.7 W	446	452	28.0
66	111,112	18 Aug	0543	59 44.4	178 32.2 W	175	182	28.0
67	113,114	18 Aug	1349	60 50.8	179 38.4 W	218	225	29.0
68	115	18 Aug	2203	61 40.6	179 56.6 W	135	142	29.0
69	116	19 Aug	0410	62 00.3	179 54.8 E	133	140	29.0
70	117	19 Aug	0910	62 21.9	179 36.0 E	66	70	29.1
71	118,119	19 Aug	1855	61 43.7	179 18.7 E	120	124	30.0
72	120	20 Aug	0108	61 13.7	179 31.5 E	161	167	30.0
73	calibration	22 Aug	0815	51 49.7	176 17.9 W	84	83	Cabin Cove
74	121	28 Aug	0415	61 26.0	178 43.4 E	220	227	31.0
75	122,123,124	28 Aug	0816	61 41.5	178 37.5 E	146	155	31.0
76	125,126	29 Aug	2238	61 25.5	175 13.4 E	102	106	intercal
77	127,128	30 Aug	1351	61 38.5	178 29.9 E	176	182	target strength
78	129	2 Sep	0006	61 42.1	178 23.1 E	157	164	enroute to 38.0
79	Bad cast	2 Sep	2323	60 30.7	171 52.4 E	N/A	170	40.0
80	130,131	3 Sep	0147	60 32.3	171 55.3 E	115	122	40.0
81	132	3 Sep	1044	59 53.0	170 51.2 E	374	374	41.0
82	133,134	4 Sep	0334	60 05.0	168 02.0 E	139	147	50.0
83	138,139	6 Sep	0118	58 46.9	164 34.9 E	97	101	61.1
84	140,141	6 Sep	1624	57 56.3	163 27.9 E	81	88	65.0
85	143	8 Sep	0432	55 15.3	161 59.9 E	327	327	enroute to 999
86	calibration	11 Sep	2029	52 16.1	174 19.3 W	65	72	Korovin Bay
87	145	12 Sep	1326	52 14.8	172 48.7 W	136	149	1210
88	PMEL CTD	12 Sep	2004	52 22.9	172 09.6 W	N/A	372	1270
89	PMEL CTD	12 Sep	2122	52 23.1	171 57.9 W	N/A	314	1270
90	PMEL/AFSC	12 Sep	2238	52 23.9	171 44.1 W	318	320	1270
91	PMEL CTD	13 Sep	0004	52 25.9	171 31.6 W	N/A	499	1270

Table 15. Summary of XBT casts conducted during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Drop*	Probe	Haul	Date (1994)	Time (GMT)	Position Latitude (N)	Position Longitude	Bottom Depth (m)	Transect
2	T-6	1	10 Jul	0328	56 10.2	61 38.0 W	57	2.0
3	T-6	3	10 Jul	2347	56 50.1	62 11.2 W	73	3.0
4	T-6	6	11 Jul	1610	56 13.0	62 48.3 W	81	4.0
5	T-6	9	12 Jul	1725	56 12.9	64 00.4 W	89	6.0
6	T-4	-	13 Jul	0516	54 58.2	64 36.2 W	59	6.0
7	T-6	-	13 Jul	2154	54 50.0	65 09.8 W	105	8.0
8	T-6	-	14 Jul	0636	56 13.0	65 12.3 W	93	8.0
9	T-6	16	15 Jul	1922	55 23.0	65 44.6 W	119	9.0
10	T-6	-	16 Jul	1553	56 12.9	66 24.6 W	110	10.0
11	T-6	-	16 Jul	2231	54 50.0	66 19.8 W	169	10.0
12	T-6	25	17 Jul	1630	55 41.0	66 58.9 W	135	11.0
13	T-6	-	18 Jul	0908	57 38.0	67 45.6 W	70	12.0
14	T-6	-	18 Jul	2247	56 13.0	67 37.7 W	133	12.0
15	T-4	28	19 Jul	0510	55 20.2	67 33.1 W	149	12.0
16	T-4	-	19 Jul	0711	54 54.0	67 30.4 W	485	12.0
17	T-4	30	19 Jul	2114	55 58.8	68 13.7 W	149	13.0
18	T-4	-	20 Jul	2310	57 30.0	69 00.0 W	71	14.0
19	T-4	41,42	22 Jul	1738	57 38.0	70 16.1 W	74	16.0
20	T-4	-	23 Jul	1654	56 13.1	70 02.4 W	117	16.0
21	T-4	-	24 Jul	1307	58 59.8	71 47.3 W	89	18.0
22	T-4	48	24 Jul	2142	57 45.3	71 33.0 W	99	18.0
23	T-4	-	25 Jul	0710	56 18.0	71 16.7 W	148	18.0
24	T-4	49	25 Jul	2155	57 45.1	72 10.8 W	108	19.0
25	T-4	50	26 Jul	0321	58 03.0	72 14.5 W	106	19.0
26	T-4	51	26 Jul	1539	59 28.4	73 10.0 W	100	20.0
27	T-4	-	26 Jul	1746	59 03.0	73 04.6 W	106	20.0
28	T-6	52	26 Jul	2356	57 48.9	72 48.6 W	116	20.0
29	T-6	54	2 Aug	0337	58 00.4	73 26.8 W	117	21.0
30	T-6	-	3 Aug	0731	60 20.0	74 42.6 W	105	22.0
31	T-6	62	3 Aug	2038	59 02.8	74 22.7 W	125	22.0
32					*** bad probe ***			
33	T-7	-	5 Aug	2018	57 36.6	74 55.6 W	2,733	22.1
34	T-7	70,71	6 Aug	2052	58 29.1	75 09.3 W	596	22.7
35	T-6	-	8 Aug	2136	61 52.9	76 32.2 W	105	24.0
36	T-6	-	9 Aug	0507	60 28.0	76 05.7 W	122	24.0
37	T-6	-	9 Aug	2221	59 03.7	75 40.7 W	136	24.0
38	T-6	-	12 Aug	0019	61 30.6	77 06.5 W	117	25.0
39	T-6	-	12 Aug	2221	61 53.0	77 55.1 W	124	26.0
40	T-6	-	13 Aug	0630	60 28.0	77 25.2 W	154	26.0
41					*** bad probe ***			
42	T-4	-	14 Aug	0327	59 24.9	77 00.9 W	148	26.0
43	T-6	102	16 Aug	0304	60 55.5	78 14.8 W	160	27.0
44	T-6	104	16 Aug	2246	61 53.0	79 19.9 W	130	28.0
45	T-6	-	19 Aug	1252	61 53.0	79 15.1 E	109	30.0
46	T-7	-	28 Aug	1733	61 48.7	77 51.0 W	126	32.0

* Drop sequence began with 2
Maximum depth for T-4 and T-6 probes is 460 m. For T-7s, maximum depth is 767 m.

Table 16. Summary of MBT casts conducted during the 1994 echo integration-trawl survey of the Bering Sea shelf and slope, MF94-07.

Drop	Haul	Date (1994)	Time (GMT)	Position		Depth (m)		Transect	Trawl Type
				Latitude (N)	Longitude	MBT Cast	Bottom		
1	54	2 Aug	0259	58 00.6	173 27.2 W	119	119	21.0	Bottom
2	55	2 Aug	0852	58 31.7	173 35.6 W	124	124	21.1	Rope w/Rosette comparison
3	Munson	4 Aug	0346	58 55.4	174 19.6 W	132	107	22.0	Bottom
4	67	5 Aug	0949	57 37.5	174 01.9 W	137	132	22.0	Bottom
5			*** bad cast -- MBT malfunctioned ***						
6	72	7 Aug	0617	59 28.3	175 08.5 W	133	134	23.0	Rope w/Rosette comparison
7	85	11 Aug	0241	59 26.2	176 25.3 W	140	140	25.0	Bottom
8	108	17 Aug	1010	60 46.4	178 55.3 W	143	235	28.0	Methot
9	117	19 Aug	0837	62 22.3	179 36.6 W	50	71	29.0	Methot
10	135	4 Sep	1003	60 17.0	168 24.8 E	41	73	52.0	Methot
11	136	4 Sep	1952	60 09.1	167 06.1 E	58	80	54.0	Methot
12	137	5 Sep	0109	59 41.0	167 07.9 E	276	276	55.0	Bottom
13	140	6 Sep	1550	57 56.0	163 29.0 E	34	95	65.0	Methot
14	142	8 Sep	0023	55 10.9	161 55.6 E	71	71	81.0	Marinovich
15	144	8 Sep	0534	55 15.1	161 57.8 E	143	143	82.0	Bottom