UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Alaska Fisheries Science Center
Resource Assessment and Conservation Engineering Division
7600 Sand Point Way Northeast
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Seattle, Washington 98115-0070

April 28, 1994

NOAA SHIP MILLER FREEMAN
Cruise No. 94-02
Preliminary Cruise Results
Echo-Integration Trawl Survey of the Southeast Aleutian Basin near Bogoslof Island

CRUISE PERIOD, AREA, AND SCHEDULE

Scientists from the Alaska Fisheries Science Center conducted an echo-integration trawl (EIT) survey of walleye pollock (Theragra chalcogramma) aboard the NOAA ship Miller Freeman from February 27 to March 9, 1994. The cruise began and ended in Dutch Harbor, Alaska. The survey area was the Aleutian Basin waters near Bogoslof Island.

The vessel's itinerary was as follows:

February 26	Embark scientists in Dutch Harbor
February 27-March 9	EIT survey of Bogoslof Island region
March 9	Arrive Dutch Harbor

OBJECTIVES

The principal objective of the cruise was to collect echo-integration data and midwater trawl data necessary to determine the distribution, biomass, and biological composition of walleye pollock in the survey area.

Secondary objectives included:

1. collection of temperature and salinity profile data in the survey area,

2. collection of macrozooplankton samples for a numerical simulation model of Bering Sea plankton and to investigate the nutritional content of zooplankton,

3. spawning of mature pollock and then culturing the fertilized eggs for laboratory experiments on larval pollock growth rate and metabolism,

4. collection of ovary tissue samples for genetic stock structure studies,

5. collection of chlorophyll samples for calibration of moored chlorophyll sensors,

6. photographing pollock gonads to document pollock maturity stages,

7. collection and freezing of whole pollock specimens for calorimetric studies, and

8. collection and freezing of specimens for marine mammal diet studies.

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship Miller Freeman, a 66-m (216-ft) 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 distal end of the vessel's centerboard. With the centerboard fully extended, the transducer was 9 m below the water's 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 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 the breastlines measured 79.4 m (260.5 ft). The headrope length was measured between the points of attachment to the breastline. The footrope length was measured between the points where the tom weights are 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

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

(500-lb) tom weights on each side. Trawl mouth opening and depth were monitored with a Furuno wireless netsounder system attached to the headrope of the trawl.

Ichthyoplankton and zooplankton were sampled with a 20-cm bongo frame with 153-μm mesh attached to the wire 1 m above a 60-cm bongo frame with 333-μm mesh nets. A 40-kg lead weight was used as a depressor. A Seabird conductivity/temperature/depth (CTD) system was attached to the wire above the 60-cm bongo frame.

Water temperature/salinity profile data were collected at selected trawl sites using a Seabird CTD system. Expendable bathythermographs (XBT) were launched routinely during the survey period to provide additional temperature profile data.

SURVEY METHODS

Two standard sphere calibrations were conducted prior to the start of the survey. The first took place in Puget Sound, Washington, on February 10 and the second occurred in Inanudak Bay near Umnak Island, Alaska, on February 25. No significant differences in the acoustic system parameters were observed between the two calibrations.

The survey began the evening of February 27 and ended the morning of March 9. The trackline consisted of north-south transects beginning at 165°51'W longitude and proceeding westward to 169°53'W (Fig. 1). Transect spacing at the eastern and western ends of the survey area was 10 nmi. In the central part of the survey area where pollock densities were higher, transect spacing was decreased to 5 nmi. The southern ends of the transects extended in to about 100 m bottom depth on the Aleutian shelf. In the eastern part of the survey area, the northern extent of transects was similar to that of previous winter surveys in the Bogoslof region. Because of time restrictions due to inclement weather, transects in the western part of the survey area were not extended as far north as in past years. However, we do not believe any significant portion of the Bogoslof spawning population was missed.

Echo-integration trawl survey operations were conducted both day and night. While transecting, vessel speed ranged between 5 and 11 kts, depending upon weather conditions. The acoustic system collected echo-integration data which, when properly scaled, is used to provide estimates of pollock density. Midwater trawl hauls were made at selected locations to identify echosign and provide biological samples. The average trawling speed was about 3 kts. The vertical opening for the midwater rope trawl averaged about 20 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, length, body weight, age, maturity, and ovary weight. Ovary tissue samples were collected and frozen for stock structure studies.

When weather permitted, a bongo tow was conducted each evening at approximately 2300 (AST). The nets were deployed at a constant wire speed of 40 m/min to a maximum depth of 400 m. The winch was stopped and the nets allowed to stabilize for up to 30 sec. The nets were then retrieved at a wire speed of 20 m/min. The ship's speed was adjusted to attempt to maintain a wire angle of 45 degrees during the entire tow. When the nets reached the surface, they were brought aboard and the samples were washed into the codends. Flow meters in the nets recorded the amount of water filtered and the CTD recorded the time/depth history of the tow.

PRELIMINARY RESULTS

Biological data were collected and specimen and tissue samples preserved from 13 midwater rope trawl catches and 5 bongo tows within the survey area (Fig. 2). Midwater trawl and bongo tow station and catch data are summarized in Tables 1 and 2, respectively. Pollock dominated the midwater trawl catches in both weight and numbers (Table 3). Significant numbers of lanternfish (Myctophidae) and northern smoothtongues (Leuroglossus schmidti) were also captured. A tally of biological data collected and specimens preserved is presented in Table 4. Oceanographic data were collected from 11 CTD casts and 12 XBT casts (Tables 5 and 6, Fig. 3).

Chlorophyll samples were collected from the sea surface approximately every hour while the vessel was underway. Samples were filtered and then frozen at -70°C. Chlorophyll samples were also collected from several depths in the water column on March 8 near the site of the Peggy mooring (CTD cast c6, Fig. 3).

Pollock echosign was observed throughout the survey area. High density aggregations were encountered in the region near Bogoslof Island south of 54°N and between longitudes 167°17'W and 168°17'W, and south of 53°23'N along longitude 169°19'W (Fig. 1). The vertical distribution of pollock echosign ranged from 250 m to 750 m below the surface.

Pollock size and sex composition data by haul are presented in Figure 4. Fork lengths ranged from 38 to 67 cm. Two general size modes were observed during the survey. For nearshore hauls conducted in bottom depths < 500 m (i.e., hauls 1 and 9), pollock in the 40-50 cm range dominated the catch; whereas, for offshore

hauls in bottom depths > 500 m (i.e., hauls 2-8, 10, 11, and 13), fish in the 50-60 cm range were more abundant in the catch. The exception was haul 12 at 987 m bottom depth where the size composition was bimodal.

Sex ratio by haul ranged from a low of 28% female (haul 6) to a high of 98% female (haul 3). In some areas, two layers of echosign could be discerned. On two occasions (i.e., hauls 3-4 and hauls 7-8) both the upper and lower layers were sampled with the midwater rope trawl. In each instance, the fraction of males captured was significantly higher in the deeper tow--implying that some vertical stratification by sex is occurring.

Maturity composition data are presented in Figure 5. For the 11 offshore hauls, 90% of all female pollock ≥ 40 cm were in a pre-spawning stage. For the two nearshore hauls, the larger females (i.e., > 51 cm) were all in a pre-spawning stage; whereas, 58% of those ≤ 51 cm were in a developing stage and not expected to spawn soon. Very few actively-spawning females had been observed by the survey ending date of March 9.

SCIENTIFIC PERSONNEL

Name	Sex/ Nationality	Position	Organization
Neal Williamson	M/USA	Chief Scientist	AFSC
Steve de Blois	M/USA	Fish. Biologist	AFSC
Lynn Faughnan	F/USA	Biological Tech.	AFSC
Taina Honkalehto	F/USA	Fish. Biologist	AFSC
Norris Jeffrey	M/USA	Fish. Biologist	AFSC
Denise McKelvey	F/USA	Fish. Biologist	AFSC
Steve Pyrczak	M/USA	Computer Spec.	AFSC
Terry Tinker	M/USA	Electronics Tech.	AFSC
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Table 1. Summary of midwater rope trawl station and catch data from the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

Haul No.	Date (1994)	Time (AST)	Start Position Latitude (N)	Start Position Longitude (W)	Depth (m) Gear	Depth (m) Bottom	Temp (deg. C) Gear	Temp (deg. C) Surface	Catch (kgs/nos) Pollock	Catch (kgs/nos) Other
1	28-Feb	0125-0155	54 22.3	165 51.8	341	394	3.8	3.9	64 / 96	9 / 19
2	1-Mar	1837-1847	53 52.5	167 17.2	460	850	3.7	4.0	80 / 68	12 / 310
3	2-Mar	0405-0414	53 43.7	167 34.2	400	1,043	3.8	4.1	1,609 / 1,258	2 / 36
4	2-Mar	0746-0809	53 43.6	167 34.3	521	925	3.7	4.1	154 / 137	13 / 403
5	3-Mar	0832-0907	53 40.9	168 09.0	399	1,086	3.2	3.9	309 / 261	10 / 819
6	3-Mar	1731-1748	54 05.4	167 25.3	320	1,656	3.8	3.7	1,200 / 1,224	1 / 3
7	4-Mar	0554-0610	53 54.9	167 42.6	251	1,671	3.5	4.2	1,130 / 995	7 / 5
8	4-Mar	0820-0859	53 53.9	167 39.0	412	1,659	3.5	4.0	630 / 583	15 / 546
9	4-Mar	2133-2202	53 34.4	168 17.2	245	487	4.2	4.2	128 / 155	6 / 191
10	5-Mar	0105-0134	53 41.3	168 17.2	459	1,403	4.0	4.2	694 / 647	4 / 171
11	6-Mar	2302-2341	53 31.9	169 02.0	367	1,640	4.1	4.5	678 / 587	7 / 15
12	7-Mar	1114-1214	53 03.1	169 19.0	536	987	3.4	4.0	1,346 / 1,344	21 / 264
13	8-Mar	2354-0044	53 56.9	167 55.9	258	1,663	3.6	4.4	255 / 230	5 / 410

Table 2. Summary of bongo stations from the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

Bongo Cast	Date (1994)	Time (AST)	Latitude (N)	Longitude (W)	Depth (m) Cast	Depth (m) Bottom	Comments
1	1-Mar	2251	53 54.3	167 17.2	408	957	
2	2-Mar	2314	54 02.5	167 51.0	412	1,695	
3	4-Mar	2314	53 39.7	168 15.6	-	1,166	Haul 9&10
4	6-Mar	0118	53 35.3	168 59.0	408	1,778	Haul 11, pollock eggs
5	8-Mar	0148	53 16.9	169 54.1	401	1,279	

Table 3. Summary of catch by species in 13 midwater rope trawls from the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

Species	Weight (kg.)	Percent	Numbers	Percent
Walleye Pollock (Theragra chalcogramma)	8,277.1	98.7	7,585	70.4
Smooth Lumpsucker (Aptocyclus ventricosus)	46.2	0.6	24	0.2
Lanternfish (Myctophidae)	15.3	0.2	1,528	14.2
Jellyfish Unidentified (Scyphozoa)	14.6	0.2	24	0.2
Northern Smoothtongue (Leuroglossus schmidti)	11.1	0.1	1,484	13.8
Arrowtooth Flounder (Atheresthes stomias)	10.3	0.1	2	<0.1
Squid Unidentified (Teuthoidea)	5.9	0.1	47	0.4
Giant Grenadier (Albatrossia pectoralis)	4.2	0.1	1	<0.1
Pacific Lamprey (Lampetra tridentata)	3.6	<0.1	9	0.1
Prowfish (Zaprora silenus)	0.3	<0.1	1	<0.1
Atka Mackerel (Pleurogrammus monopterygius)	0.2	<0.1	4	<0.1
Popeye Grenadier (Coryphaenoides cinereus)	0.2	<0.1	1	<0.1
Sergestid Shrimp (Sergestidae)	0.2	<0.1	45	0.4
Pacific Viperfish (Chauliodus macouni)	0.2	<0.1	7	0.1
Shrimp Unidentified (Natantia)	<0.1	<0.1	9	0.1
Bigscales (Melamphaidae)	<0.1	<0.1	1	<0.1
Northern Shrimp (Pandalus borealis)	<0.1	<0.1	4	<0.1
Deepsea Smelt (Bathylagidae)	<0.1	<0.1	1	<0.1
Totals	8,389.7	100.0	10,777	100.0

Table 4. Summary of pollock biological samples and measurements from the winter 1994 echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island , Miller Freeman cruise 94-02.

	United States									Korea
Haul No.	Length	Maturity	Otolith	Fish Wt	Ovary Wt	Genetics	Caloric Study	NMML* Diet Study	Pollock Spawned	Otolith
1	96	96	96	96	43	-	-	x	-	-
2	68	68	68	68	54	-	-	x	-	-
3	287	116	116	116	105	10	5	x	-	-
4	137	108	108	108	50	14	-	x	-	-
5	261	103	103	103	71	18	-	x	-	-
6	269	130	100	130	30	19	5	-	-	30
7	321	100	100	100	74	20	-	-	-	-
8	301	100	100	100	55	-	-	x	-	-
9	155	155	120	155	46	-	-	x	-	35
10	296	101	101	101	49	19	-	x	-	-
11	362	100	100	100	77	-	-	x	x	-
12	379	146	146	146	63	-	-	x	x	-
13	230	100	100	100	62	-	6	x	-	-
Total	3,162	1,423	1,358	1,423	779	100	16			65

*These samples include squid, bathylagidae, and myctophidae.

Table 5. Inventory of CTD casts conducted during the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

CTD Cast*	Haul	Transect	Date (1994)	Time (AST)	Latitude (N)	Longitude (W)	Depth (m) Cast	Depth (m) Bottom
1	1	1.0	28-Feb	0405	54 23.7	165 50.4	383	392
2	2	6.0	1-Mar	2114	53 52.4	167 16.7	586	843
B1	-	6.0	1-Mar	2251	53 54.3	167 17.2	408	957
3	3 & 4	7.0	2-Mar	0553	53 44.2	167 34.3	684	1,100
B2	-	8.0	2-Mar	2314	54 02.5	167 51.0	412	1,695
4	6	6.5	3-Mar	2041	54 07.8	167 23.1	588	1,855
B3	9 & 10	9.5	4-Mar	2314	53 39.7	168 15.6	-	1,166
B4	11	12.0	6-Mar	0118	53 35.3	168 59.0	408	1,778
5	12	13.0	7-Mar	1322	53 06.8	169 22.1	815	1,219
B5	-	15.0	8-Mar	0148	53 16.9	169 54.1	401	1,279
C6	-	-	8-Mar	1506	54 50.6	168 36.8	-	2,286

* B_ indicates bongo/CTD combination.
C_ indicates CTD conducted at the Peggy Mooring.

Table 6. Inventory of XBT casts conducted during the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

XBT Drop	Haul	Transect	Date (1994)	Time (AST)	Latitude (N)	Longitude (W)	Probe	Bottom Depth (m)	Comments
3	-	1.1	28-Feb	0628	54 40.0	165 58.0	T-4	329	
4	-	2.0	28-Feb	0927	54 15.8	166 08.9	T-4	639	
5	-	3.0	28-Feb	1525	54 18.0	166 25.9	T-7	1,250	
6	-	3.0	28-Feb	1855	54 39.0	166 26.1	T-4	346	
7	-	5.0	1-Mar	0543	54 18.3	167 00.0	T-7	1,107	
8	-	5.0	1-Mar	0929	54 39.5	166 59.7	T-4	412	
9							T-7		Bad probe
10	-	7.0	2-Mar	1516	54 18.6	167 34.0	T-4	880	
11	-	7.1	2-Mar	1854	54 35.9	167 42.3	T-4	818	
12							T-7		Bad probe
13	5	9.0	3-Mar	1043	53 47.0	168 09.0	T-6	1,341	
14							-		Bad probe
15	7-8, 13	7.5	4-Mar	0702	53 56.3	167 43.2	T-4	1,726	
16							T-7		Bad probe
17							T-7		Bad probe
18							T-6		Bad probe
19							T-6		Bad probe
20	-	11.0	6-Mar	1617	53 49.7	168 45.0	T-6	2,034	
21							-		Bad probe
22							T-4		Bad probe
23							-		Bad probe
24	-	15.0	8-Mar	0546	53 48.6	169 53.2	T-7	2,359	

Note: XBT drops 1 and 2 occurred prior to the survey.
The maximum depth for probes T-4 , T-6 is 460 m and T-7 is 767 m.

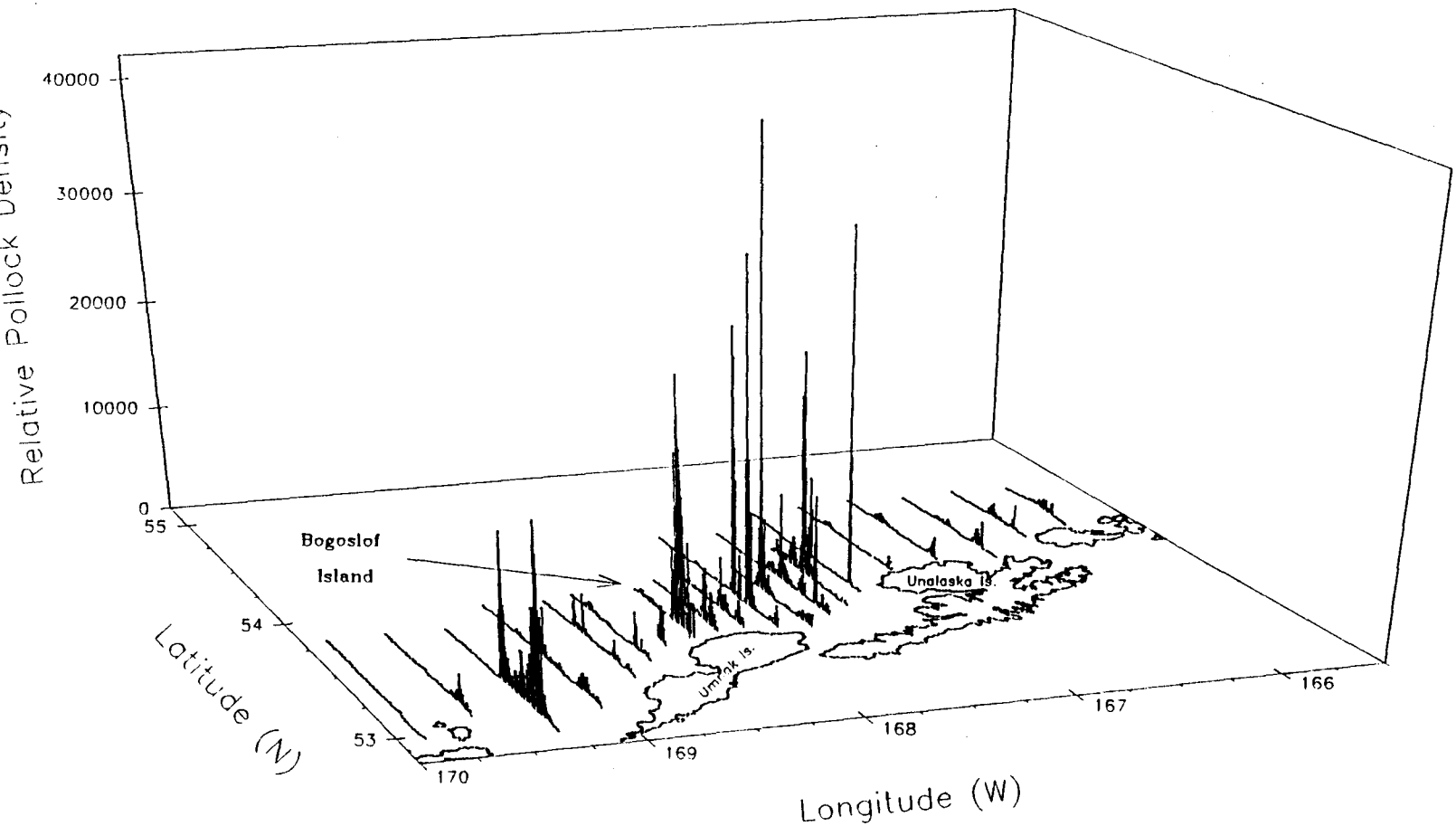

Figure 1. Relative pollock density along trackline from the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

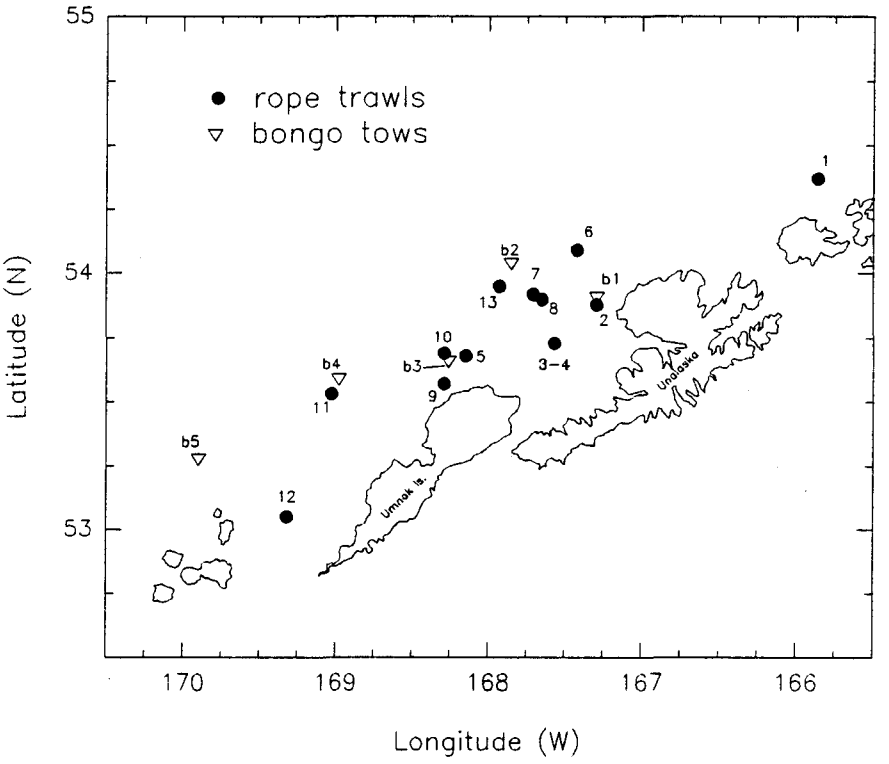

Figure 2. Rope trawl and bongo tow locations during the winter 1994 pollock echo integration–trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94–02.

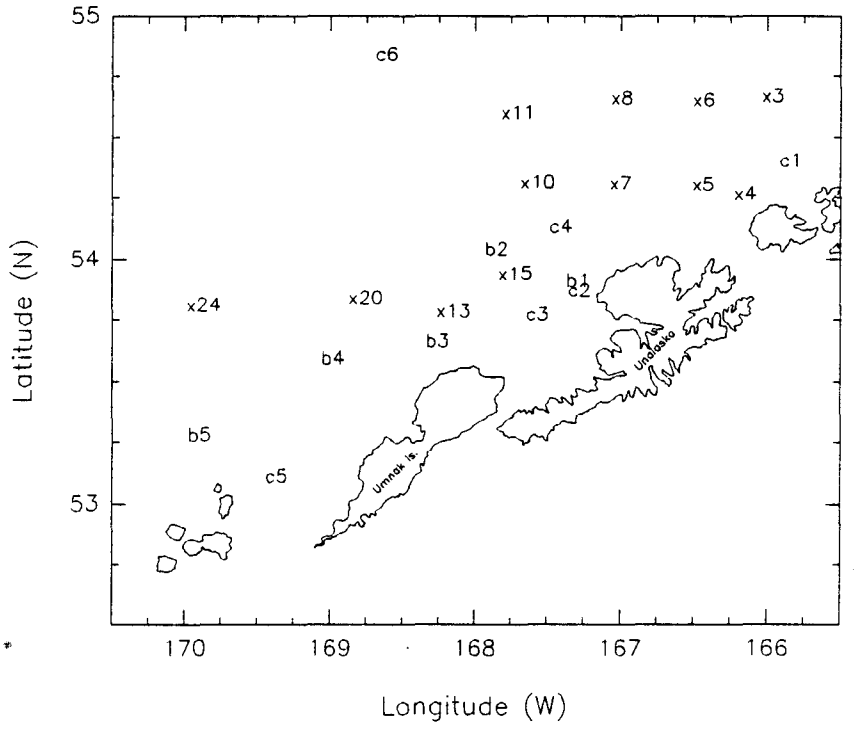

Figure 3. Locations of XBT casts (x followed by station number), CTD casts (c followed by station number), and CTD–bongo casts (b followed by station number) during the winter 1994 pollock echo integration–trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94–02.

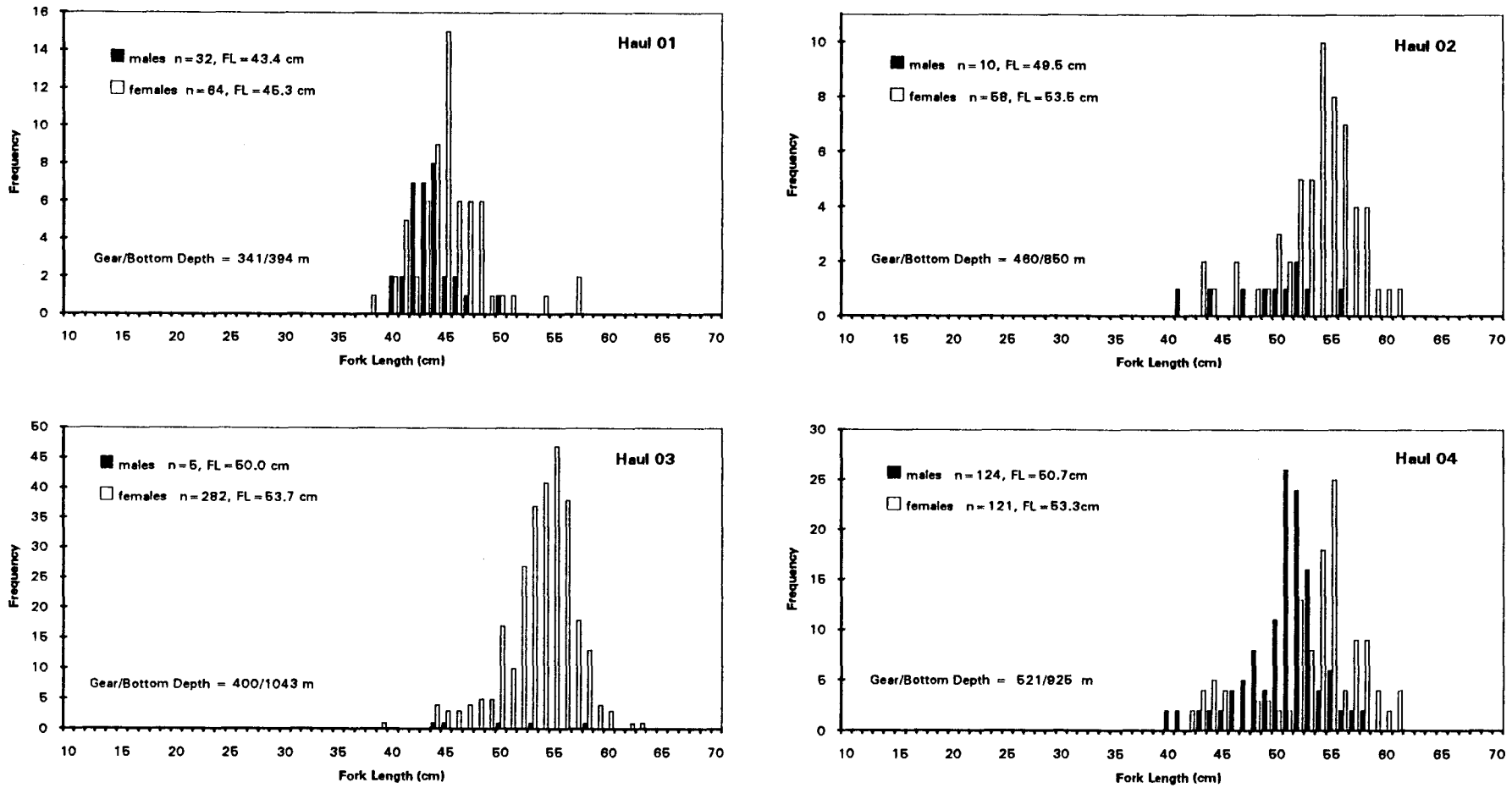

Figure 4. Length-frequency plots of pollock caught in midwater trawls during the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

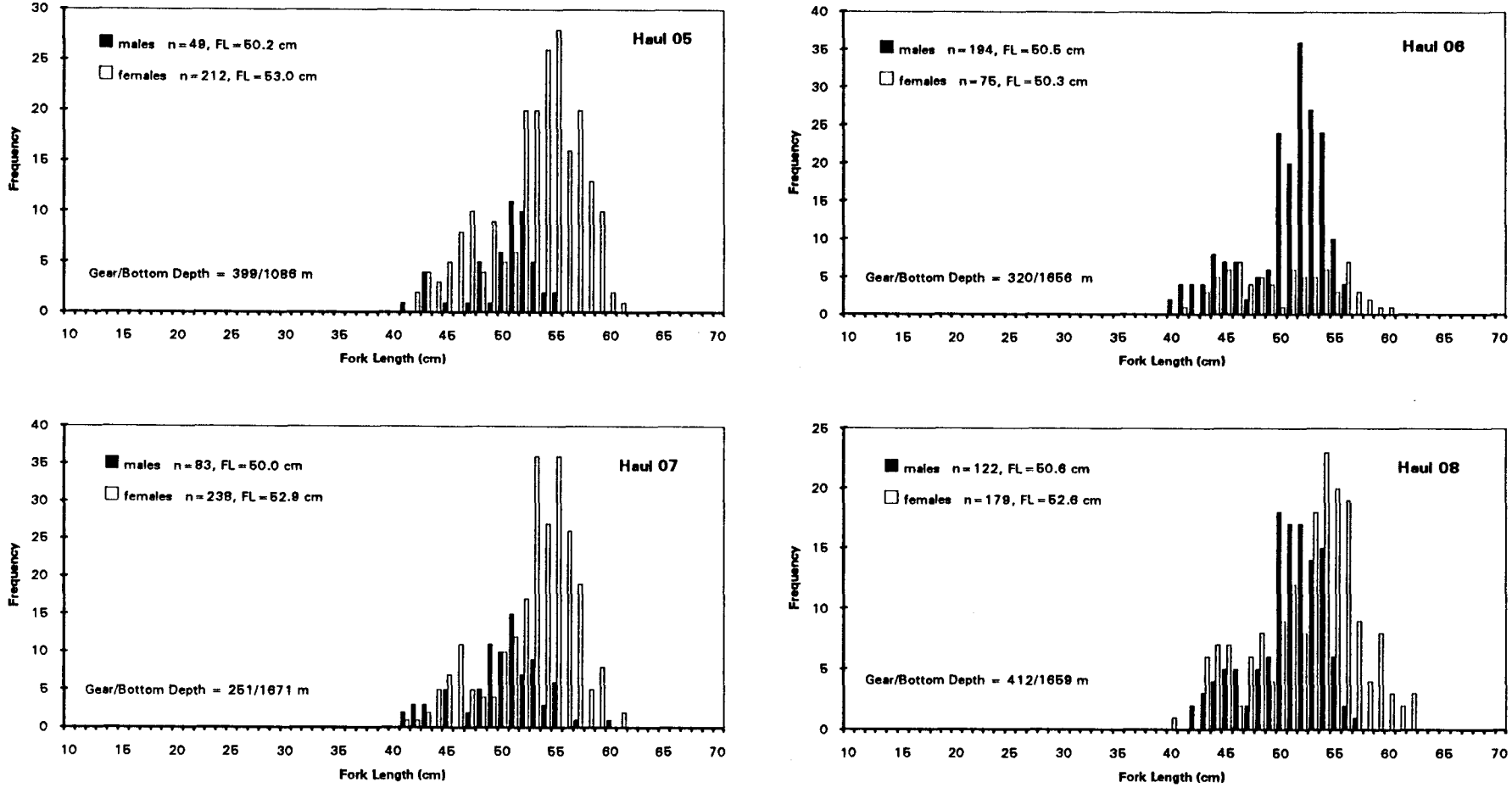

Figure 4(cont.). Length-frequency plots of pollock caught in midwater trawls during the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

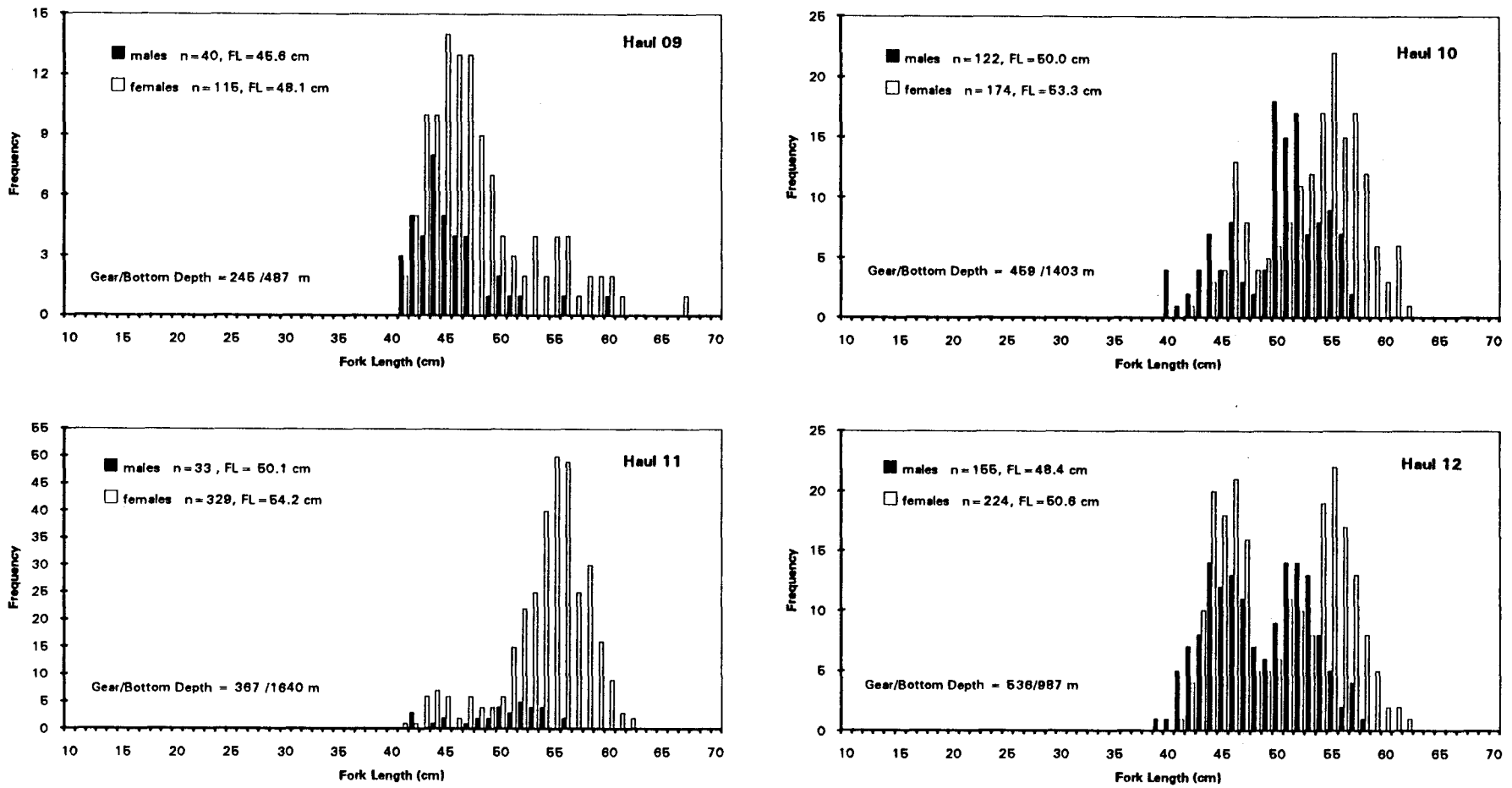

Figure 4(cont.). Length-frequency plots of pollock caught in midwater trawls during the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

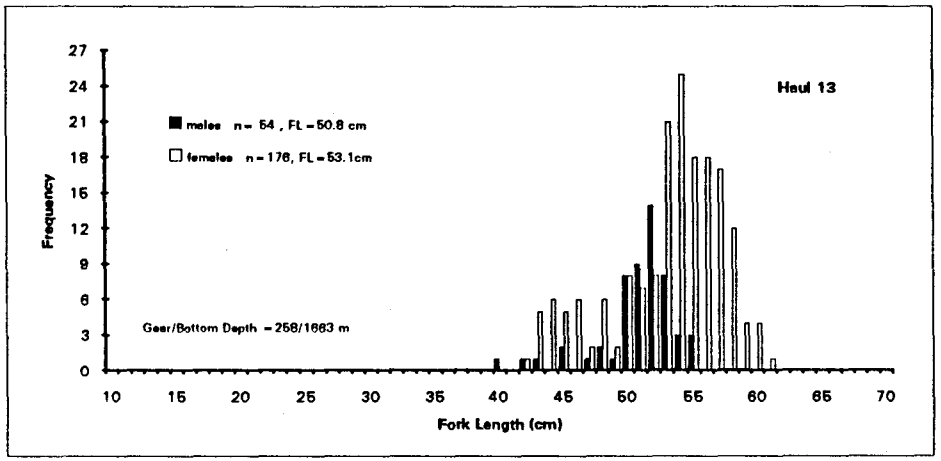

Figure 4(cont.). Length-frequency plots of pollock caught in midwater trawls during the winter 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.

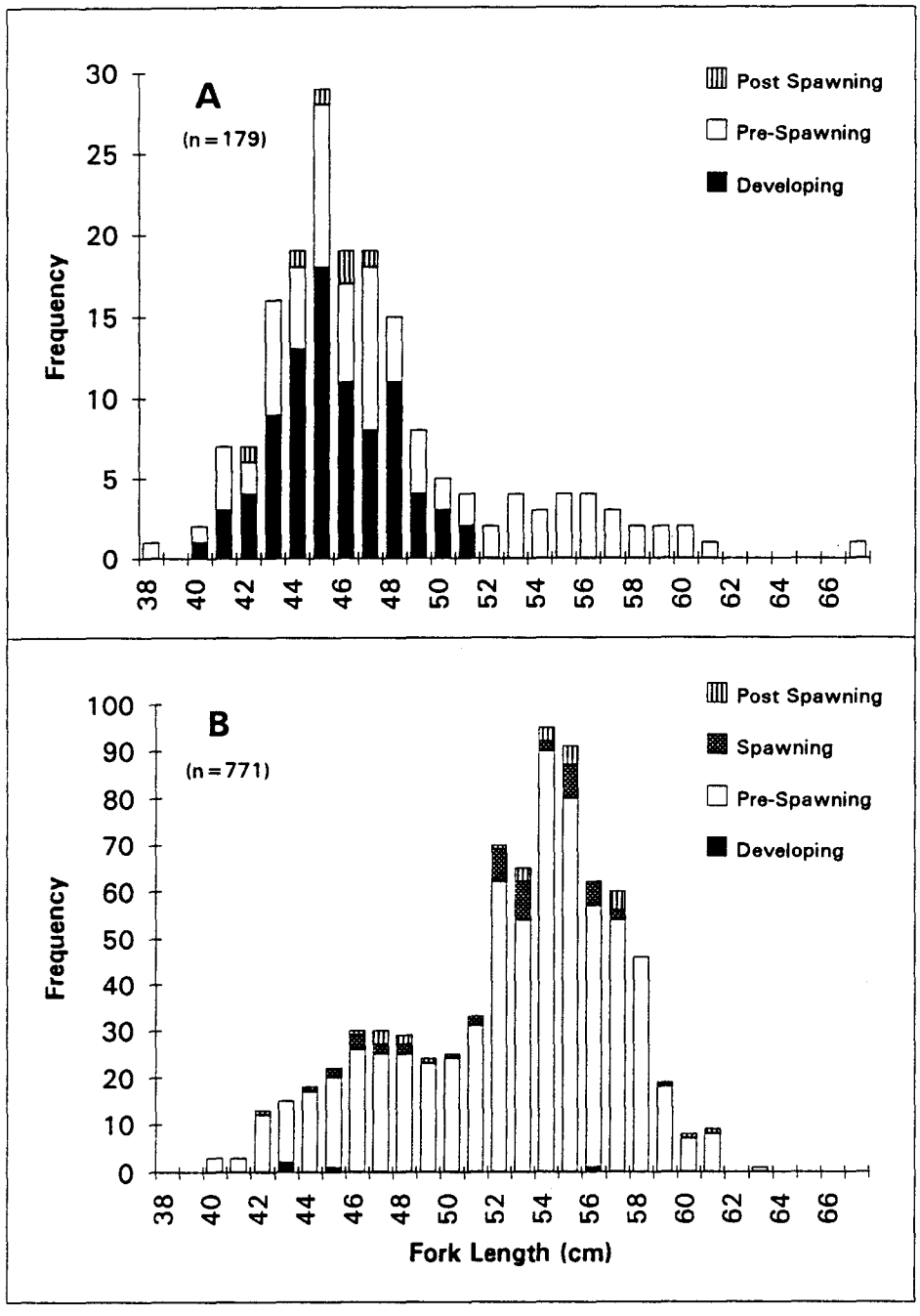

Figure 5. Female pollock maturity-length composition from trawl catches A) in bottom depths < 500 m, and B) in bottom depths > 500 m, sampled during the 1994 pollock echo integration-trawl survey of the southeast Aleutian Basin near Bogoslof Island, Miller Freeman cruise 94-02.