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NATIONAL MARINE FISHERIES SERVICE
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PRELIMINARY CRUISE RESULTS
NOAA SHIP MILLER FREEMAN
CRUISE NO. 96-05

ECHO INTEGRATION-TRAWL SURVEY OF WALLEYE POLLOCK IN SHELIKOF STRAIT

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*) in the Shelikof Strait area in the Gulf of Alaska aboard the NOAA ship *Miller Freeman* from March 15-27, 1996 for a total of 13 sea days. The cruise began and ended in Kodiak, Alaska.

The itinerary for the *Miller Freeman* was as follows:

VESSEL ITINERARY

Mar 14	Embark scientists in Kodiak
Mar 15	Transit to survey start location near Chirikof Island.
Mar 15-26	EIT survey of Shelikof Strait area
Mar 26-27	Conduct sphere calibration; transit to Kodiak.
Mar 27	Disembark scientists; end of cruise

OBJECTIVES

The primary objectives of the cruise were to:

1) collect echo integration data and midwater and bottom trawl data necessary to determine the distribution, abundance, and biological composition of walleye pollock in the area of operations; and

2) collect pollock target strength data for use in scaling echo integration data to estimates of absolute abundance.

The secondary objectives of the cruise were to:

1) calibrate the 38-kHz and 120-kHz scientific acoustic systems using standard sphere techniques;

2) collect physical oceanographic data including temperature and salinity profiles at selected sites, and conduct continuous monitoring of sea surface parameters (e.g., temperature, salinity, light level, and productivity) and water current profiles;

3) collect stomachs from walleye pollock, arrowtooth flounder (*Atheresthes stomias*), Pacific cod (*Gadus macrocephalus*), and all species of shark except spiny dogfish (*Squalus acanthius*);

4) spawn mature pollock and culture the fertilized eggs for laboratory experiments on eggs and larvae;

5) collect samples of pollock ovary tissue for studying interannual variation in fecundity; and

6) collect micronekton samples with fine-mesh nets attached to trawl gear.

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship *Miller Freeman*, a 66 m stern trawler equipped for fisheries and oceanographic research. Acoustic data were collected with a Simrad[1] EK500 quantitative echo-sounding system. Simrad 38 kHz and 120 kHz split-beam transducers were mounted on the bottom of the vessel's retractable centerboard. The centerboard was fully extended during all scientific operations. This positioned the transducers 9 m below the surface. All results presented here are based on data collected with the 38 kHz transducer. 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 echo sign was sampled with an Aleutian Wing 30/26 trawl (AWT), which is a full mesh wing trawl constructed of nylon except for polyethylene towards the aft section of the body and the codend. The headrope and footrope both measured 81.7 m (268 ft). Mesh sizes tapered from 3.25 m (128 in) in the forward section of the net

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

to 89 mm (3.5 in) in the codend. The codend was fitted with a 32 mm (1.25 in) liner. The AWT was fished with 82.3 m (270 ft) of 1.9 cm (0.75 in) diameter 8x19 non-rotational dandylines, 455 kg (1,000 lb) tom weights on each side, and 5 m^2 (53.8 ft^2) "Fishbuster" doors (1,250 kg [2,750 lb]). Additionally, one or two small-mesh nets, each 6.1 m (20 ft) long with a 10.8 m^2 opening and 0.5 cm mesh, were attached to several locations along the AWT to sample micronekton and macrozooplankton in the path of the trawl.

Fish on and near bottom were sampled with a polyethylene Nor'eastern high-opening bottom trawl equipped with roller gear. The trawl was constructed with stretch mesh sizes that ranged from 13 cm (5 in) in the forward portion of the net to 89 mm (3.5 in) in the codend. It was fitted with a nylon codend liner with a mesh size of 32 mm (1.25 in). The 27.2 m (89.1 ft) headrope held 21 floats [30 cm (12 in) diameter]. A 24.7-m (81 ft) chain fishing line was attached to the 24.9 m (81.6 ft) footrope which was constructed of 1 cm (0.4 in) 6 x 19 wire rope wrapped with polypropylene rope. The 24.2 m (79.5 ft) roller gear was constructed with 36 cm (14 in) rubber bobbins spaced 1.5-2.1 m (5-7 ft) apart. A solid string of 10 cm (4 in) rubber disks separated some of the bobbins in the center section of the roller gear. Two 5.9 m (19.5 ft) wire rope extensions with 10 cm (4 in) and 20 cm (8 in) rubber disks were used to span the two lower flying wing sections and were attached to the roller gear. The roller gear was attached to the fishing line using chain toggles [2.9 kg (6.5 lb) each] which were comprised of five links and one ring. The trawl was rigged with triple 54.9 m (180 ft) galvanized wire rope dandylines. The net was fished with the "Fishbuster" doors.

Trawl hauls were monitored with a WesMar third wire trawl sonar attached to the headrope of the trawl. Vertical and horizontal net openings, depth, and temperature at depth were measured.

Vertical profile measurements of water temperature and salinity were collected at most trawl stations using a Seabird CTD (conductivity/temperature/depth) system. Temperature profile data were also collected by attaching micro bathythermographs (MBT) to most trawls. The acoustic Doppler current profiler was slaved to the EK500 and operated continuously throughout the cruise in the water profiling mode.

SURVEY METHODS

An echo integration-trawl survey was conducted in the Shelikof Strait area to assess the distribution, abundance, and biological characteristics of pollock. The "Shelikof Strait area" refers to Shelikof Strait and the area surveyed between Middle Cape and Chirikof Island. Survey transects were oriented parallel

to one another. Transects were spaced about 14 km (7.5 nmi) apart except along the western side of the Strait, where 7 km (3.75 nmi) spacing was used (Fig. 1). Greater sampling effort was allocated to the western side of the strait since it has historically contained most of the pollock spawning biomass. Transects generally did not extend into waters less than about 75 m in depth.

Survey operations were conducted 24 hours a day. Typical vessel speed was about 11-12 knots when running transects. Echo integration data were collected with a horizontal resolution of 9 m and a vertical resolution of 1-2 m. The acoustic system was used to collect echo-integration and *in situ* target-strength data during survey operations. Estimates of absolute pollock abundance will be derived from the former data after they are appropriately scaled.

Midwater and bottom trawl hauls were made at selected locations to identify echosign and provide biological samples. Average trawling speed was about 3 knots. The vertical net opening for the midwater AWT trawl averaged about 31 m (range 27-34 m). The PNE trawl's vertical mouth opening was about 9 m (range 8-10 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), age, maturity, and body and ovary weights. An electronic scale was used to determine weights of individual pollock specimens. Fish lengths were usually taken with a Polycorder measuring device (a combination of a bar code reader and a hand held computer). Stomachs were collected from pollock, Pacific cod, and arrowtooth flounder and were preserved in 10% formalin. Fecundity samples were removed from mature females and preserved in 10% formalin. Adult pollock were successfully spawned, and the fertilized eggs were transported to Seattle, Washington, and Newport, Oregon, where various studies utilizing pollock eggs and larvae are conducted.

PRELIMINARY RESULTS

Four standard sphere calibrations were carried out in conjunction with the survey (Table 1). Three calibrations were completed prior to the cruise: on February 4 in Puget Sound, Washington, on February 16 in Belkofski Bay, Alaska, and on March 8 in Nateekin Bay, Unalaska Is., Alaska. Upon completion of the cruise a calibration was conducted on March 27 in Malina Bay, Kodiak Is., Alaska. No significant differences in the 38 kHz system parameters were observed between the four calibrations.

Acoustic data were collected between March 15-26 in the Shelikof Strait area along about 2,175 km (1,350 nmi) of tracklines

(Fig. 1). A distributional plot of acoustic backscattering attributed primarily to adult pollock (>31 cm) is presented in Fig. 2. The densest adult pollock aggregations were broadly distributed near Capes Kekurnoi and Kuliak along the west side of the strait, where historically the greatest densities of pollock have been observed during surveys conducted in March. Most fish were detected within 50-100 m of the bottom. Acoustic backscattering attributed primarily to age-2 pollock (17-30 cm) was often detectable in a well-defined, mid-water layer about 150-200 m below the surface from Uyak Bay to the southern limits of the surveyed area near Chirikof Island (Fig. 3).

Biological data were collected at the 30 AWT midwater and 8 PNE bottom trawl locations (Tables 2-3, Fig. 1). In 19 of the 30 AWT midwater tows, the numbers of age-2 pollock exceeded the catch of older pollock. Tows made between Cape Kekurnoi and Kuikpalik Island on the Alaska Peninsula side of the strait (Hauls 24-35) caught mostly adult pollock, while tows conducted elsewhere caught mostly age-2 pollock, with varying amounts of age-1 (9-16 cm) and adult pollock (Fig. 4).

Pollock was the dominant fish species captured in midwater trawl hauls, comprising 92.5% by weight and 77.1% by numbers of the total catch (Table 4). Eulachon (*Thaleichthys pacificus*) was the next most common species caught and were primarily associated with tows occurring within 25 m of the bottom on the Kodiak Island side of the strait or south of Middle Cape. Pollock ranked first in weight and numbers among fishes captured in bottom trawl hauls, comprising 97.8% and 95.3%, respectively (Table 5). Arrowtooth flounder (1.1% by weight) and eulachon (2.8% by numbers) were the next most common species caught.

A total of 4,181 pollock were sampled for maturity from the trawl catches during the survey. No females less than 43 cm FL or males less than 41 cm FL were determined to be mature (Fig. 5). The mean gonadosomatic index, defined as the ratio of gonad weight to total body weight for mature females, was 0.18 (Fig. 6).

A total of 26 CTD casts and 34 successful MBT casts were made during the acoustics group's operations (Tables 6-7, Fig. 7).

SCIENTIFIC PERSONNEL

(15 - 27 March 1996)

Name	Nationality	Position	Organization
Chris Wilson	USA	Chief Scientist	AFSC
Dan Twohig	USA	Electronics Tech.	AFSC
Michael Guttormsen	USA	Fish. Biologist	AFSC
Dennis Benjamin	USA	Fish. Biologist	AFSC
Tom Wilderbuer	USA	Fish. Biologist	AFSC
Skip Zenger	USA	Fish. Biologist	AFSC
Jay Clark	USA	Fish. Biologist	FOCI
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Table 1. Summary of sphere calibrations associated with the 1996 pollock echo integration-trawl survey of the Shelikof Strait area, MF96-05.

Date (1996)	Location	Freq (kHz)	Water temp (deg. C) At transducer*	Water temp (deg. C) At sphere	Sphere range from Transducer (m)	TS gain (dB)	S_V gain (dB)	3dB beam width (deg.)	Angle offset Along	Angle offset Athwart
4 Feb	Port Susan, WA	38	7.4	9.6	27.3	27.2	27.1	6.72	-0.11	-0.08
16 Feb	Belkofski Bay, AK	38	2.2	2.3	26.9	27.2	27.0	6.74	-0.09	-0.05
8 Mar	Nateekin Bay, AK	38	3.6	3.6	27.3	27.2	27.1	6.72	-0.10	-0.06
27 Mar	Malina Bay, AK	38	3.7	3.8	27.4	27.2	27.2	6.73	-0.10	-0.07
Feb-Mar	System settings during surveys	38	--	--	--	27.3	27.1	7.20**	-0.09	-0.02

*The transducer is located approximately 9 m below the water surface.

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.

** 3 dB beamwidth setting differs from 3 dB beamwidths measured during calibrations because we used a new measurement algorithm during calibrations, not because of physical changes in the transducer.

Table 2. Summary of trawl stations and catch data from the Shelikof Strait area during the 1996 echo integration-trawl survey, MF96-05.

Haul	Date	Gear	Time	Start Position		Depth (m)		Temp (°C)		Pollock		Other	
No.	(1996)	type	(GMT)	Lat	Long	Gear	Bottom	Gear	Surface	kg	nos	kg	nos
1	17-Mar	A	0934-1004	55 52.4	156 29.4	230	246	5.0	3.4	178	416	54	540
2	17-Mar	A	2008-2023	56 14.2	156 21.0	220	271	4.7	3.3	1,073	21,384	2	22
3	17-Mar	P	2340-0010	56 13.5	156 22.2	267	268	4.1	3.3	263	1,128	226	239
4	18-Mar	A	0428-0434	56 18.5	156 06.4	210	244	4.6	3.4	378	7,745	<1	6
5	18-Mar	A	1143-1213	56 28.0	156 11.9	62	274	3.5	3.4	37	700	<1	2
6	18-Mar	A	1437-1452	56 27.6	156 11.7	207	273	4.3	3.4	155	2,246	1	12
7	18-Mar	A	2212-2237	56 31.9	156 08.0	282	288	5.5	3.3	5,266	8,878	749	9,367
8	19-Mar	A	0837-0843	56 43.1	155 29.1	199	232	5.2	2.0	364	4,363	5	124
9	19-Mar	A	1250-1255	56 48.5	155 57.7	268	291	5.3	3.3	2,713	12,497	522	6,574
10	19-Mar	A	1953-1954	56 53.8	155 43.5	206	290	4.0	2.7	589	10,885	0	0
11	20-Mar	P	0223-0240	56 56.9	155 20.5	238	256	5.0	2.8	85	444	10	287
12	20-Mar	A	0945-0952	57 07.7	155 30.0	252	267	5.3	2.9	391	4,292	121	3,287
13	20-Mar	A	1117-1132	57 07.0	155 26.3	174	264	3.8	2.8	254	4,510	2	25
14	20-Mar	A	2130-2143	57 24.4	155 35.4	282	293	5.3	3.3	3,244	11,746	286	2,910
15	21-Mar	A	0354-0357	57 26.0	154 55.1	167	221	4.1	2.6	25	350	<1	5
16	21-Mar	A	0956-1006	57 33.6	155 15.4	254	274	5.1	2.5	1,019	3,357	79	1,234
17	21-Mar	A	1800-1812	57 36.1	154 58.7	218	231	5.0	3.4	1,821	16,366	939	16,619
18	22-Mar	A	0005-0006	57 44.8	155 07.0	285	293	5.2	3.4	4,800	5,056	100	389
19	22-Mar	A	0417-0420	57 44.1	154 56.4	173	259	4.2	3.8	1,020	14,374	<1	1
20	22-Mar	A	1014-1045	57 46.8	154 49.8	96	247	4.1	3.3	56	910	2	14
21	22-Mar	A	1524-1530	57 46.2	154 52.4	95	262	4.3	3.7	68	1,008	<1	3
22	22-Mar	A	1837-1838	57 46.7	155 00.4	266	312	4.9	3.5	3,308	7,563	62	945
23	23-Mar	A	0219-0231	57 51.0	154 54.5	244	284	4.3	3.3	3,160	4,107	75	1,455
24	23-Mar	A	0859-0900	57 58.8	154 25.0	286	352	4.1	2.7	1,873	2,034	17	63
25	23-Mar	A	1330-1331	58 01.3	154 17.5	251	276	4.3	2.2	1,258	1,353	22	94
26	23-Mar	P	1809-1810	58 02.2	154 12.2	237	250	4.4	2.2	322	394	11	20
27	23-Mar	A	1948-2026	58 02.7	154 11.5	180	255	2.3	4.4	570	476	13	32
28	24-Mar	P	0248-0251	58 09.2	154 02.5	255	258	4.7	3.7	2,754	2,569	23	5
29	24-Mar	A	0535-0541	58 09.8	154 05.0	167	295	4.3	2.5	2,170	1,809	10	10
30	24-Mar	A	0801-0819	58 04.0	154 13.2	157	277	3.9	2.5	416	392	4	12
31	24-Mar	P	1141-1141	58 13.6	154 05.1	152	156	3.8	1.2	5,400	4,050	0	0
32	24-Mar	P	1755-1800	58 19.5	153 52.5	203	245	4.7	3.6	475	424	0	0
33	24-Mar	A	1951-2001	58 19.6	153 51.9	152	238	4.5	3.6	6,744	5,907	6	9
34	25-Mar	P	0453-0459	58 33.8	153 26.8	130	130	1.1	4.2	1,167	886	17	20
35	25-Mar	P	1150-1151	58 27.2	153 44.2	144	144	1.2	4.4	2,100	1,598	0	0
36	25-Mar	A	1641-1706	58 10.9	153 22.2	213	219	3.8	4.8	304	1,170	100	2,394
37	26-Mar	A	0619-0649	57 47.6	154 19.3	160	205	1.7	4.5	92	128	9	68
38	26-Mar	A	0933-0958	57 53.2	154 30.3	217	237	2.1	4.3	319	326	348	136

* A=Aleutian wing trawl (midwater), P=poly Nor'eastern bottom trawl

Table 3. Summary of pollock biological samples and measurements collected from the Shelikof Strait area during the 1996 echo integration-trawl survey, MF96-05.

Haul	Length	Maturity	Otoliths	Fish Weight	Ovary Weight	Stomachs	Fecundity Samples
1	224	138	123	138	19	20	16
2	335	50	20	50	0	20	0
3	483	176	130	176	14	0	0
4	199	48	0	48	0	0	0
5	112	54	20	54	0	0	0
6	186	50	50	50	5	7	3
7	473	165	135	165	28	11	5
8	431	189	137	189	0	0	0
9	406	59	59	59	4	0	0
10	200	94	49	94	2	0	1
11	232	143	111	143	14	17	0
12	345	129	80	129	8	0	0
13	113	54	22	54	3	0	0
14	529	172	125	172	72	20	0
15	158	59	27	59	1	14	0
16	392	132	103	132	25	0	0
17	712	196	108	196	23	7	1
18	366	102	102	102	34	9	1
19	222	50	5	50	0	0	0
20	195	59	30	59	3	0	0
21	204	72	40	72	0	0	0
22	440	149	112	149	2	20	0
23	539	163	118	163	3	5	0
24	387	128	110	128	9	0	0
25	313	103	103	103	3	0	0
26	291	103	103	103	56	0	0
27	369	107	107	107	59	17	0
28	341	105	35	105	22	0	0
29	319	100	100	100	47	0	0
30	385	108	0	108	36	0	0
31	302	116	0	116	101	0	0
32	319	105	105	105	51	0	0
33	364	80	80	80	27	8	0
34	412	120	120	120	83	10	0
35	351	100	100	100	83	0	0
36	406	161	101	161	35	18	3
37	128	128	0	128	0	20	0
38	326	114	0	114	11	0	0
Total	12,509	4,181	2,770	4,181	883	223	30

Table 4. Summary of catch by species in 30 midwater trawls fished in the Shelikof Strait area during the 1996 pollock echo integration-trawl survey MF96-05.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
Walleye pollock	*Theragra chalcogramma*	43,664.1	92.5%	156,348	77.1%
Eulachon	*Thaleichthys pacificus*	2,377.0	5.0%	45,131	22.3%
Pacific Sleeper Shark	*Somniosus pacificus*	504.0	1.1%	3	<0.1%
Red Squid	*Berryteuthis magister*	454.9	1.0%	942	0.5%
Big Skate	*Raja binoculata*	42.9	0.1%	2	<0.1%
Chinook Salmon	*Oncorhynchus tshawytscha*	42.4	0.1%	24	<0.1%
Pacific Cod	*Gadus macrocephalus*	31.3	0.1%	8	<0.1%
Arrowtooth Flounder	*Atheresthes stomias*	20.8	0.0%	16	<0.1%
Smooth Lumpsucker	*Aptocyclus ventricosus*	19.2	0.0%	13	<0.1%
Squid Unidentified	Teuthoidea	18.6	<0.1%	45	<0.1%
Rougheye Rockfish	*Sebastes aleutianus*	12.7	<0.1%	8	<0.1%
Northern Smoothtongue	*Leuroglossus schmidti*	2.5	<0.1%	140	0.1%
Jellyfish Unidentified	Scyphozoa	1.0	<0.1%	5	<0.1%
Flathead Sole	*Hippoglossoides elassodon*	0.7	<0.1%	2	<0.1%
Octopus Unidentified	Octopodidae	0.3	<0.1%	3	<0.1%
Rock Sole	*Lepidopsetta bilineata*	0.2	<0.1%	1	<0.1%
Shrimp Unidentified	Natantia	0.1	<0.1%	2	<0.1%
Sidestripe Shrimp	*Pandalopsis dispar*	0.1	<0.1%	6	<0.1%
Salps unidentified	Thaliacea	<0.1	<0.1%	1	<0.1%
Total		47,192.9		202,700	

Table 5. Summary of catch by species in 8 bottom trawls from the Shelikof Strait area during the 1996 pollock echo integration-trawl survey MF96-05.

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
Walleye pollock	*Theragra chalcogramma*	12,565.5	97.8%	11,493	95.3%
Arrowtooth Flounder	*Atheresthes stomias*	144.0	1.1%	113	0.9%
Longnose Skate	*Raja rhina*	43.8	0.3%	3	<0.1%
Smooth Lumpsucker	*Aptocyclus ventricosus*	22.0	0.2%	12	0.1%
Red Squid	*Berryteuthis magister*	19.8	0.2%	27	0.2%
Big Skate	*Raja binoculata*	14.5	0.1%	1	<0.1%
Pacific Halibut	*Hippoglossus stenolepis*	13.2	0.1%	1	<0.1%
Eulachon	*Thaleichthys pacificus*	12.3	0.1%	337	2.8%
Alaska plaice	*Pleuronichthys quadrituberculatus*	6.3	<0.1%	6	0.0%
Pacific Cod	*Gadus macrocephalus*	4.8	0.0%	1	<0.1%
Flathead Sole	*Hippoglossoides elassodon*	2.5	0.0%	7	0.1%
Rex Sole	*Glyptocephalus zachirus*	1.8	<0.1%	2	<0.1%
Rougheye Rockfish	*Sebastes aleutianus*	1.4	0.0%	1	<0.1%
Sidestripe Shrimp	*Pandalopsis dispar*	0.6	<0.1%	52	0.4%
Jellyfish Unidentified	Scyphozoa	0.3	0.0%	1	<0.1%
Sablefish	*Anoplopoma fimbria*	0.3	<0.1%	1	<0.1%
Northern Smoothtongue	*Leuroglossus schmidti*	0.1	0.0%	2	<0.1%
Glass shrimp	*Pasiphaea pacifica*	<0.1	<0.1%	3	<0.1%
Ctenodiscus sp.		<0.1	<0.1%	1	<0.1%
Total		12,853.1		12,064	

Table 6. Summary of CTD casts conducted during the 1996 echo integration-trawl survey of the Shelikof Strait area, MF96-05.

		Date	Time	Position		Depth (m)		Temp. (°C)	
Cast	Haul	(1996)	(GMT)	Lat (N)	Long (W)	CTD cast	Bottom	Surface	Bottom
1	1	17-Mar	1113	55 51.36	156 31.30	127	251	3.9	3.3
2	2/3	17-Mar	2128	56 13.61	156 22.07	254	269	3.2	5.1
3	4	18-Mar	0528	56 18.46	156 07.12	239	248	3.6	4.9
4	5/6	18-Mar	1601	56 24.90	156 15.02	254	264	3.4	5.3
5	8	19-Mar	0950	56 43.55	155 29.56	229	235	1.2	5.3
6	9	19-Mar	1447	56 48.37	155 57.45	285	290	3.3	5.3
7	10	19-Mar	2115	56 54.16	155 43.93	285	292	2.7	5.3
8	11	20-Mar	0344	56 57.33	155 21.59	250	257	3.0	5.2
9	12/13	20-Mar	1252	57 07.12	155 26.32	258	264	2.8	5.3
10	14	20-Mar	2334	57 25.08	155 35.69	288	294	3.3	5.3
11	15	21-Mar	0458	57 25.78	154 55.01	216	220	2.7	5.2
12	16	21-Mar	1109	57 33.32	155 14.76	268	272	2.6	5.1
13	17	21-Mar	1952	57 36.34	154 57.89	227	230	3.7	5.0
14	18	22-Mar	0153	57 44.79	155 07.14	287	293	3.4	5.2
15	19	22-Mar	0510	57 44.09	154 56.75	256	259	3.8	5.1
16	20	22-Mar	1157	57 45.96	154 49.63	241	249	3.4	5.0
17	22	22-Mar	1958	57 46.34	155 00.88	304	315	3.5	5.1
18	24	23-Mar	1008	57 58.81	154 25.01	331	353	2.8	4.3
19	25	23-Mar	1455	58 01.51	154 17.66	268	275	2.4	4.4
20	27	23-Mar	2125	58 03.66	154 09.79	250	254	2.3	4.5
21	28	24-Mar	0342	58 09.07	154 02.51	249	256	3.9	4.7
22	31	24-Mar	1256	58 13.36	154 05.48	126	145	1.3	3.8
23	33	24-Mar	2148	58 19.11	153 52.59	233	242	2.3	4.7
24	34	25-Mar	0539	58 33.49	153 26.92	124	131	1.5	4.2
25	36	25-Mar	1818	58 09.72	153 24.33	214	221	4.0	4.8
26	Cal.	27-Mar	0516	58 13.28	153 02.88	100	107	3.9	3.7

Table 7. Summary of MBT casts conducted during the 1996 echo integration-trawl survey of the Shelikof Strait area, MF96-05.

Drop	Haul	Date (1995)	Time (GMT)	Position Lat	Position Long	Depth (m) MBT Cast	Depth (m) Bottom	Transect	Trawl type*
1	1	17-Mar	0934	55 52.4	156 29.4	230	246	3.0	A
2	2	17-Mar	2008	56 14.2	156 21.0	220	271	6.0	A
3	3	17-Mar	2340	56 13.5	156 22.2	267	268	6.0	P
4	4	18-Mar	0428	56 18.5	156 06.4	210	244	7.0	A
5	5	18-Mar	1143	56 28.0	156 11.9	62	274	8.0	A
6	6	18-Mar	1437	56 27.6	156 11.7	207	273	8.0	A
7	7	18-Mar	2212	56 31.9	156 08.0	282	288	9.0	A
8	8	19-Mar	0837	56 43.1	155 29.1	199	232	11.0	A
9	9	19-Mar	1250	56 48.5	155 57.7	268	291	11.0	A
10	10	19-Mar	1953	56 53.8	155 43.5	failed	290	12.0	A
11	11	20-Mar	0223	56 56.9	155 20.5	238	256	13.0	P
12	12	20-Mar	0945	57 07.7	155 30.0	failed	267	14.0	A
13	13	20-Mar	1117	57 07.0	155 26.3	failed	264	14.0	A
14	14	20-Mar	2130	57 24.4	155 35.4	282	293	16.0	A
15	15	21-Mar	0354	57 26.0	154 55.1	167	221	17.0	A
16	16	21-Mar	0956	57 33.6	155 15.4	254	274	18.0	A
17	17	21-Mar	1800	57 36.1	154 58.7	218	231	20.0	A
18	18	22-Mar	0005	57 44.8	155 07.0	285	293	21.0	A
19	19	22-Mar	0417	57 44.1	154 56.4	failed	259	22.0	A
20	20	22-Mar	1014	57 46.8	154 49.8	96	247	23.0	A
21	21	22-Mar	1524	57 46.2	154 52.4	95	262	23.0	A
22	22	22-Mar	1837	57 46.7	155 00.4	266	312	22.0	A
23	23	23-Mar	0219	57 51.0	154 54.5	244	284	24.0	A
24	24	23-Mar	0859	57 58.8	154 25.0	286	352	28.0	A
25	25	23-Mar	1330	58 01.3	154 17.5	251	276	29.0	A
26	26	23-Mar	1809	58 02.2	154 12.2	237	250	30.0	P
27	27	23-Mar	1948	58 02.7	154 11.5	180	255	30.0	A
28	28	24-Mar	0248	58 09.2	154 02.5	255	258	32.0	P
29	29	24-Mar	0535	58 09.8	154 05.0	167	295	32.0	A
30	30	24-Mar	0801	58 04.0	154 13.2	157	277	30.0	A
31	31	24-Mar	1141	58 13.6	154 05.1	152	156	33.0	P
32	32	24-Mar	1755	58 19.5	153 52.5	203	245	35.0	P
33	33	24-Mar	1951	58 19.6	153 51.9	152	238	35.0	A
34	34	25-Mar	0453	58 33.8	153 26.8	130	130	40.0	P
35	35	25-Mar	1150	58 27.2	153 44.2	144	144	37.0	P
36	36	25-Mar	1641	58 10.9	153 22.2	213	219	46.0	A
37	37	26-Mar	0619	57 47.6	154 19.3	160	205	51.0	A
38	38	26-Mar	0933	57 53.2	154 30.3	217	237	26.0	A

* A=Aleutian wing trawl (midwater), P=poly Nor'eastern bottom trawl

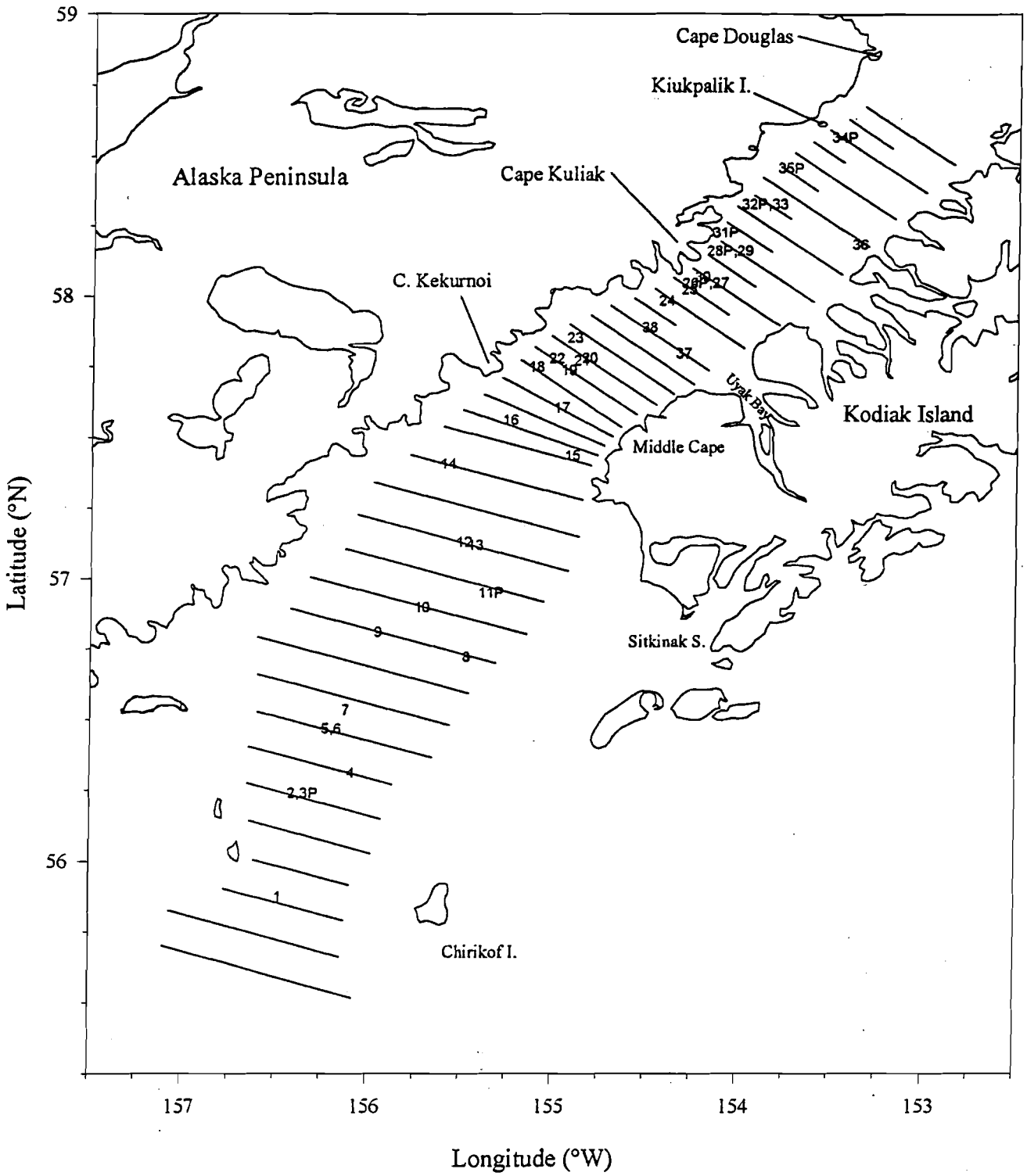

Figure 1. Survey trackline and haul locations during the 1996 echo integration-trawl survey of the Shelikof Strait area. Numbers followed by a "P" represent hauls made with the poly nor'eastern bottom trawl.

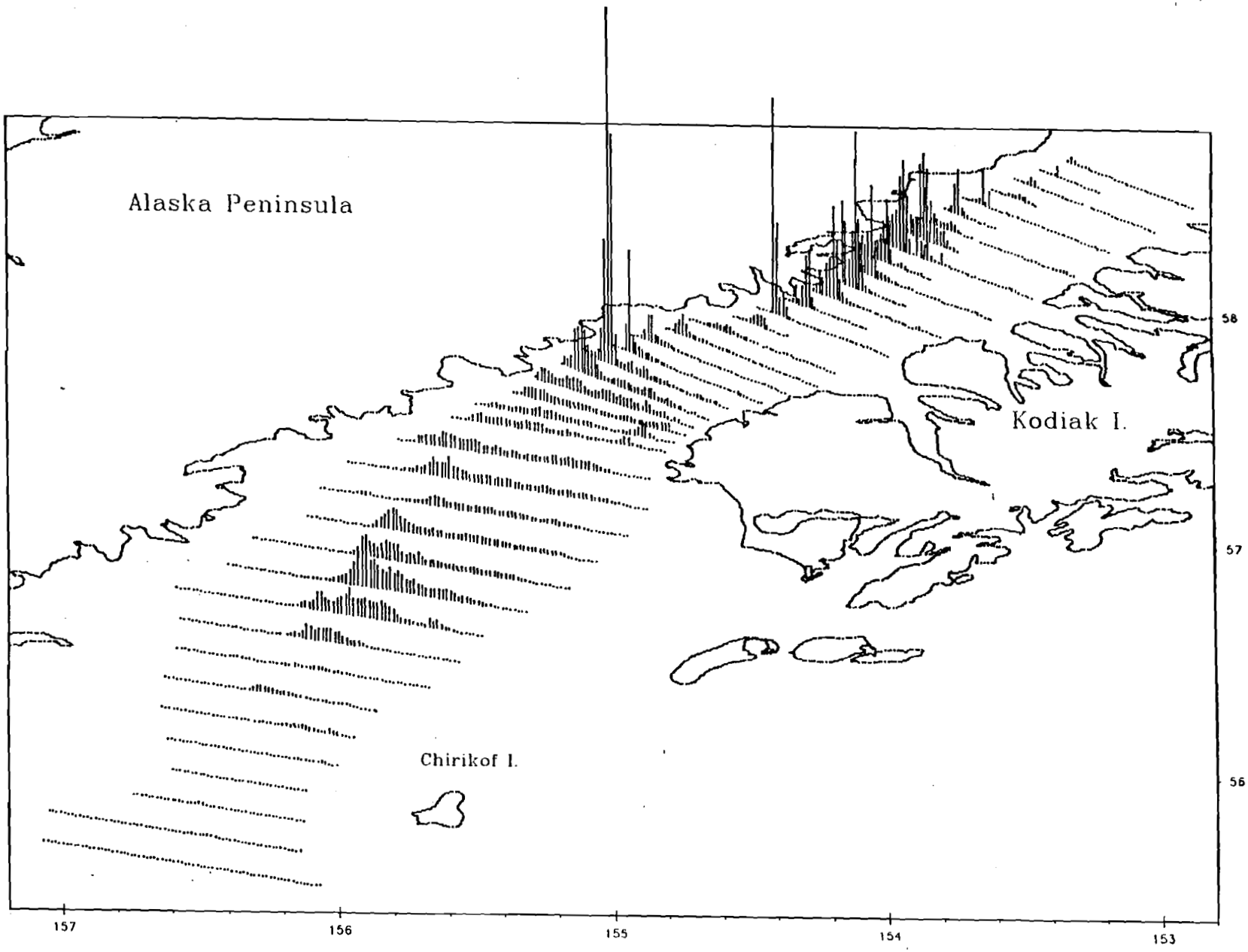

Figure 2. Acoustic backscattering (S_A) attributed primarily to greater than age-2 pollock along tracklines during the 1996 echo integration-trawl survey of the Shelikof Strait area.

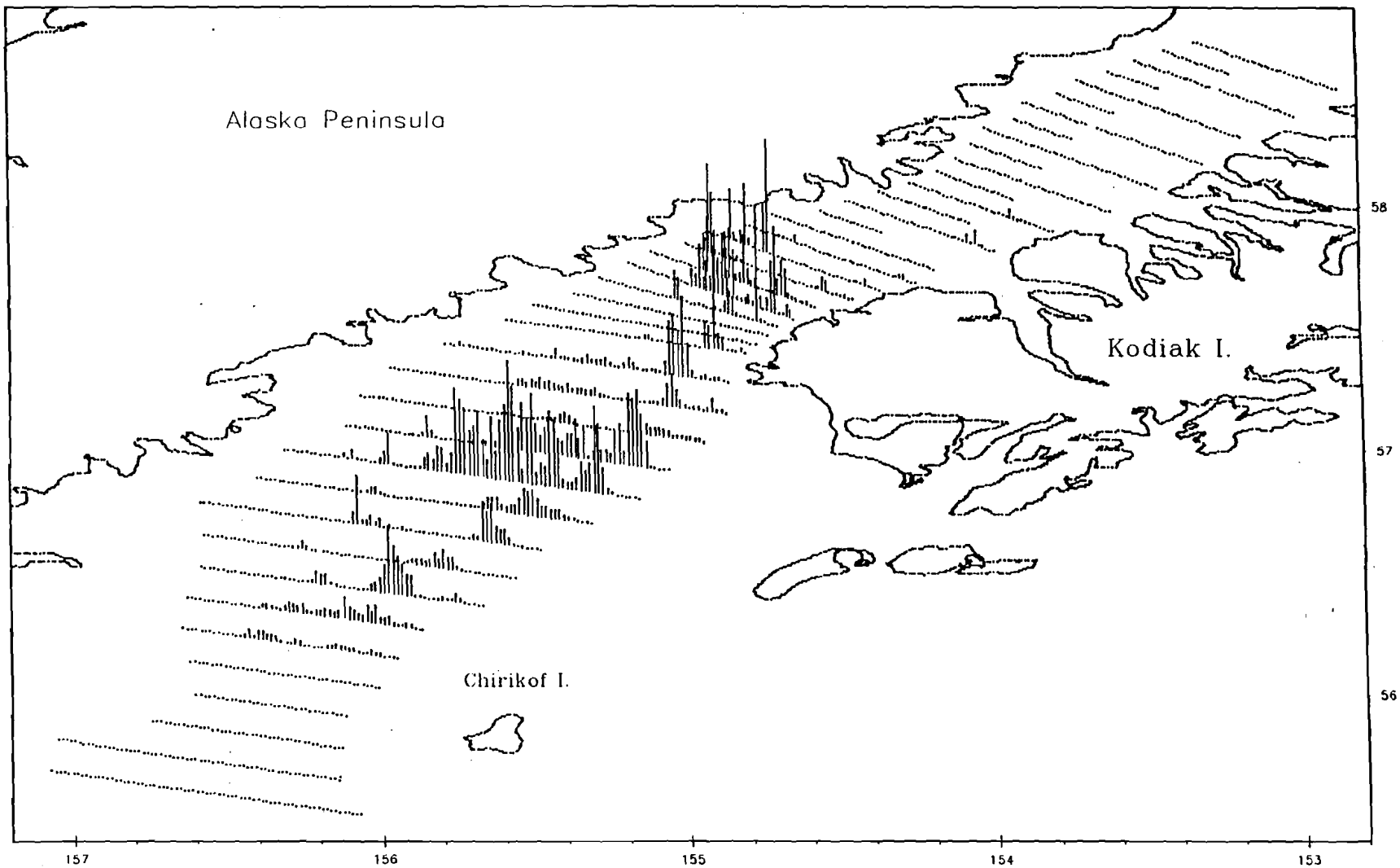

Figure 3. Acoustic backscattering (S_A) attributed primarily to age-2 pollock along tracklines during the 1996 echo integration-trawl survey of the Shelikof Strait area.

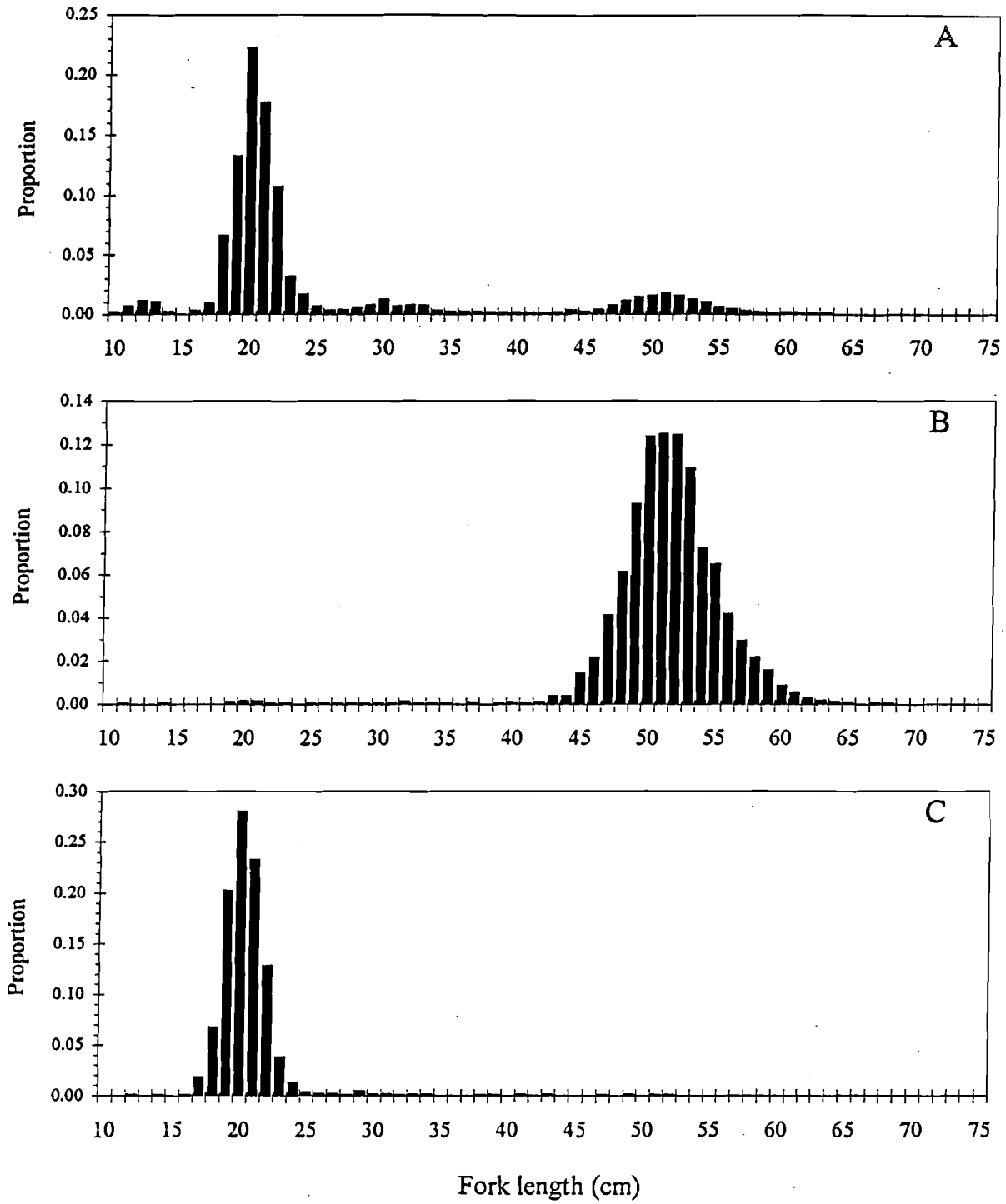

Figure 4. Size distribution of walleye pollock that composed (A) the near-bottom acoustic scattering in the southern and eastern Strait area, (B) the spawning aggregation along the west side of the Strait, and (C) the midwater scattering layer of fish found in the southern half of the survey area.

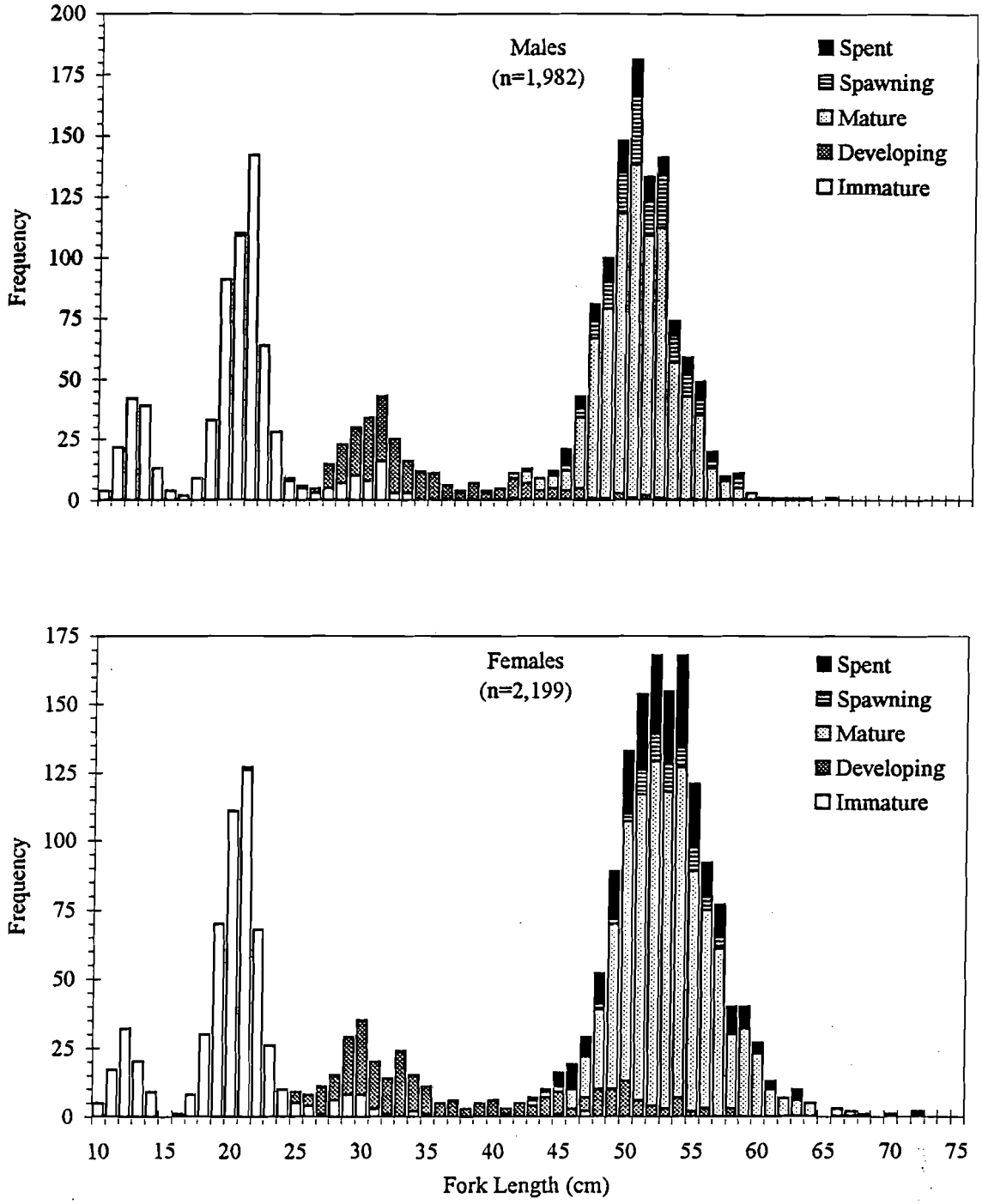

Figure 5. Maturity-length compositions for male and female pollock taken during the 1996 echo integration-trawl survey of the Shelikof Strait area. Relative proportion by size for the maturity-length composition reflects the number of maturity samples collected and is not necessarily indicative of the actual size composition of the population.

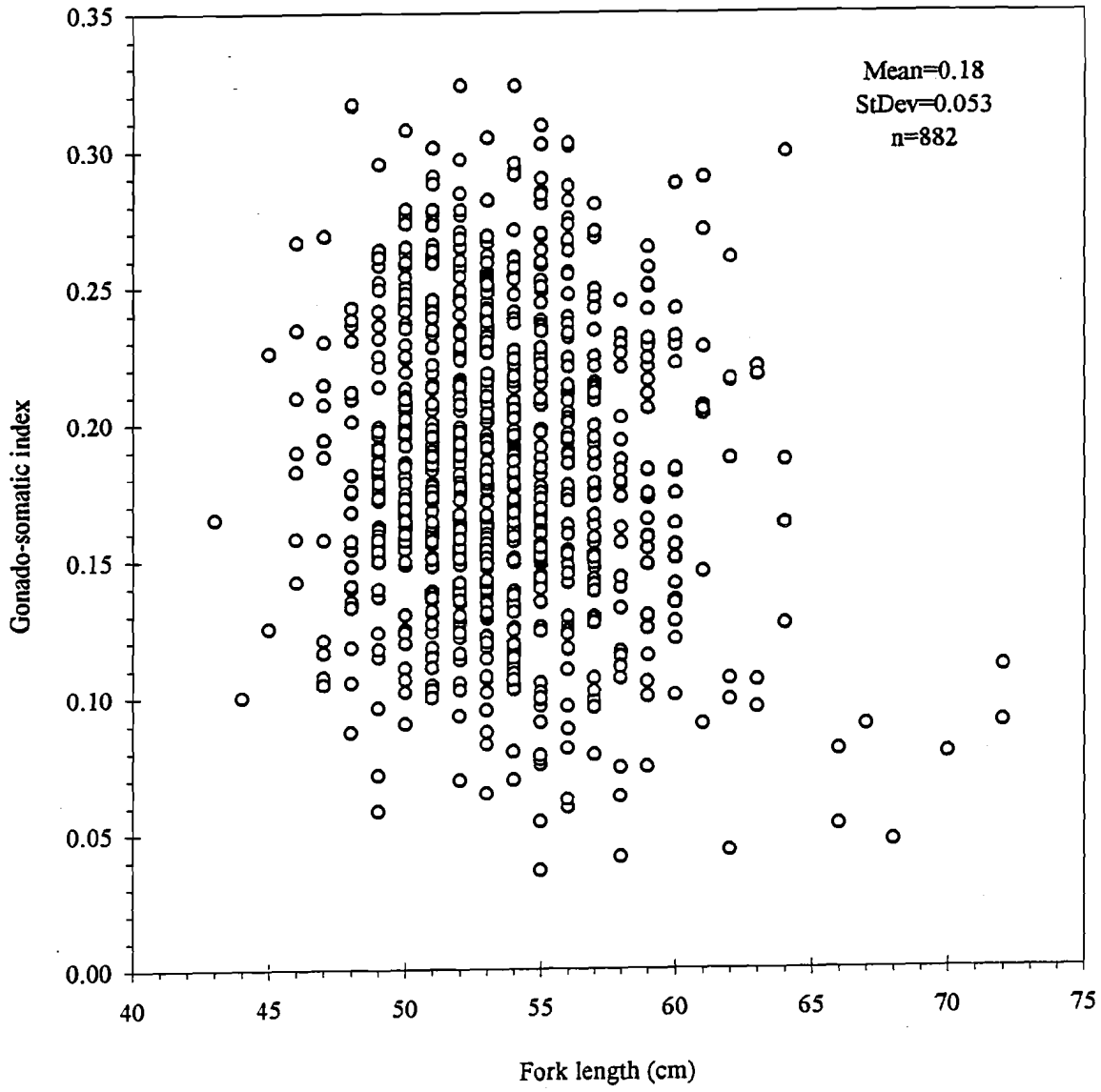

Figure 6. Pollock gonado-somatic indices plotted as a function of length for mature females caught during the 1996 echo integration-trawl survey of the Shelikof Strait area, MF96-05.

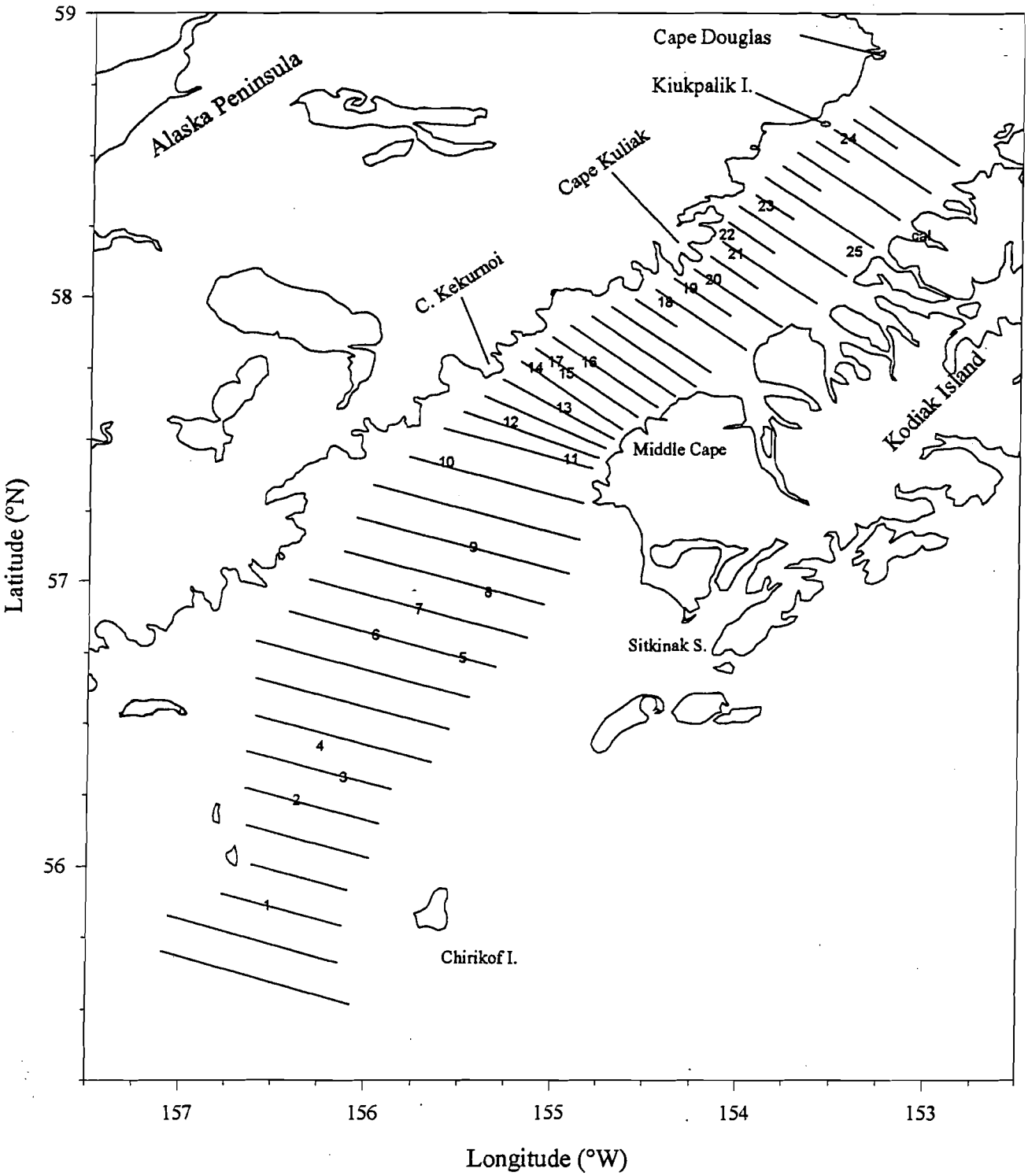

Figure 7. CTD cast locations during the 1996 echo integration-trawl survey of the Shelikof Strait area.