



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

February 15, 1991

**CRUISE RESULTS**  
**NOAA SHIP MILLER FREEMAN**  
Cruise No. 90-01

Echo Integrator/Midwater Trawl Survey  
of Spawning Pollock in the Gulf of Alaska

**CRUISE PERIOD, AREA, AND SCHEDULE**

National Marine Fisheries Service, Alaska Fisheries Science Center personnel conducted an echo integrator/midwater trawl (EIMWT) survey of pelagic walleye pollock (Theragra chalcogramma) resources in the Gulf of Alaska aboard NOAA R/V Miller Freeman during February and March 1990. Areas surveyed include Shelikof Strait, along the outer edge of the continental shelf between Cape Spencer and Davidson Bank; Prince William Sound; Marmot Bay; Chiniak; Barnabus Canyon; Chirikof Island; and Sanak Island. The vessel's itinerary was as follows:

LEG I

February 5	Depart Pacific Marine Center, Seattle, Washington.
February 6-7	Standard sphere calibration in Port Susan, Washington.
February 11-12	Transit to U.S. Coast Guard pier, Juneau, Alaska.
February 14-16	Survey Prince William Sound, Alaska.
February 20	Touch and go, Kodiak, Alaska. Pick up additional scientists.
February 21	Survey Marmot Bay, Alaska.
February 23-24	Standard sphere calibration in Three Saints Bay, Alaska.



February 25 Survey Barnabus Gully area.  
 February 26-March 1 Survey south and east of Chirikof Island.  
 March 1-3 Survey Sanak Bank area.  
 March 4 Survey Shumagin Bank. Break survey to seek shelter from icing spray storm.  
 March 7 Standard sphere calibration in Castle Bay, Alaska.  
 March 8 Arrive Kodiak, Alaska.

#### LEG II

March 11 Depart Kodiak, Alaska.  
 March 12-13 Standard sphere calibration in Three Saints Bay, Alaska.  
 March 13 Transit to area south of Chirikof Island.  
 March 13-15 Chirikof Island survey.  
 March 15-20 Shelikof Strait survey 1.  
 March 20-24 Bottom trawl and midwater trawl series comparison. Transit to south end of Shelikof.  
 March 24-31 Shelikof Strait survey 2.  
 March 31-April 1 Standard sphere calibration in Malina Bay, Alaska.  
 April 1 Acoustic survey of Marmot Bay.  
 April 2 Arrive Kodiak, Alaska.

#### OBJECTIVES

Echo integration/midwater trawl surveys have been conducted in the Gulf of Alaska annually since 1980 (with the exception of 1982). Each of these surveys was designed to estimate the biomass of spawning pollock in Shelikof Strait. In 1983, 1984, and 1989, additional regions within the Gulf of Alaska were surveyed to investigate winter patterns of pollock distribution and abundance outside Shelikof Strait. The 1990 Gulf of Alaska pelagic pollock survey was designed to cover Shelikof Strait and

extensive regions of the Gulf of Alaska outside the strait. The principal objectives of this cruise were to:

1. Collect echo integration and midwater trawl data necessary to determine the distribution, biomass, and biological composition of spawning pollock in selected areas of the Gulf of Alaska, including Shelikof Strait.
2. Evaluate a recently acquired acoustic assessment system and compare the performance of the new system with the Resource Assessment and Conservation Engineering Division's standard acoustic system. The transducer for the new system was mounted in the centerboard of the Miller Freeman and the transducer for the standard system was mounted in a towed body.
3. Collect standard sphere measurements to calibrate both acoustic systems. Collect measurements for the towed-body transducer to evaluate possible changes in performance with depth.
4. Collect biological samples of pollock for reproduction and stock structure studies. Collect pollock tissue samples from different areas of the Gulf of Alaska, including Shelikof Strait, for hydrocarbon contamination studies.
5. Conduct an experiment to compare bottom trawl catches and EIMWT biomass estimates in a selected area inside Shelikof Strait.

#### VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was completed on board the NOAA research vessel Miller Freeman, a 66-m stern trawler equipped for fisheries and oceanographic research. The primary acoustic assessment system (System 1) used during this cruise was a scientific quality, 38 KHz echo sounding system installed in a portable container attached to the deck of the vessel. The receiver was interfaced to a Hewlett-Packard HP 1000 computer which processed the acoustic survey data. The transducer was mounted in a dead weight towed-body that was towed 12-15 m below the surface.

A new fisheries acoustic system (System 2) was also used during this survey in an evaluation and back-up mode. This system consisted of three components: the Simrad<sup>1</sup> EK500, a single unit incorporating the functions of an echo sounder and receiver and

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<sup>1</sup> Reference to trade names or commercial firms does not constitute U.S. government endorsement.

the signal processing capabilities necessary for echo integration and in situ target strength estimation; a Unix workstation computer equipped with software designed to manage and process data acquired from the EK500; and a Simrad 38 Khz split beam transducer mounted on the distal end of the ship's centerboard.

Midwater echo sign was primarily sampled using a modified Northern Gold 1200 midwater rope trawl (NET Systems, Inc.<sup>1</sup>). The Northern Gold 1200 net was constructed with ropes in the forward section and mesh sizes decreasing from 64 in (163 cm) immediately behind the rope section to 3.5 in (8.9 cm) in the codend. The net was fished in a bridle-less configuration and fitted with a 1.25 in (3.13 cm) mesh codend liner; an additional .125-in (.3-cm) liner was fitted during some hauls.

The headrope length was 310 ft (94.5 m), the footrope length was 164 ft (50 m) and the breastlines were 260.5 ft (79.4 m) long. The net was fished with 600-lb tomweights (273 kg) and the vertical net opening, as observed with a Furuno<sup>1</sup> wireless netsonde (mounted to the headrope of the trawl), was generally 42-54 ft (12.8-16.5 m).

The Diamond 1000 midwater rope trawl was used as a substitute to the Northern Gold net for hauls 9-20 because of damage that occurred to the Northern Gold net during haul 8. This net was constructed of 16-in (40.6-m) stretch mesh in the wings, 32-in (81.3-cm) mesh in the body and 3.5-in (8.9-cm) mesh in the codend. A 1.25-in (3.13-cm) mesh liner was fitted to the codend, and on some hauls a .125-in (.3-cm) liner was used. For hauls 9-12, 250-lb (114-kg) tomweights were used on each side; subsequently, 370-lb (168-kg) weights were used. The vertical opening ranged between 18 and 36 ft (5.5-11.0 m).

Bottom trawl sampling was conducted with a Nor'eastern high rise rockfish trawl constructed of polyethylene with an 89-ft 1-in (27.2-m) headrope and a 122-ft 8-in (37.4-m) footrope. The codend was constructed of 3.5-in (8.9-cm) stretch mesh polypropylene fitted with a 1.25-in (3.2-cm) stretch mesh nylon liner. The vertical net opening ranged between 24 and 30 ft (7.3-9.1 m), as observed by the Scanmar<sup>1</sup> net mensuration system used on selected tows.

Conductivity-temperature-depth (CTD) profiles were collected at each trawl site and other selected locations using a Seabird<sup>1</sup> CTD system. Additional information was obtained by making occasional expendable bathythermograph (XBT) casts. Surface temperatures were measured with a bucket thermometer.

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## SURVEY METHODS

The survey began at Cape Spencer on February 12, 1990. The basic survey design consisted of a series of zigzag transects, covering the 50-500 fm (91-910 m) depth range, although closely spaced parallel transects were surveyed in localized areas where pollock were observed (Figure 1). A zigzag transect survey was conducted within Prince William Sound between February 14 and 16 (Figure 2) and the areas adjacent to Kodiak Island (Marmot Bay and Barnabus Gully) were surveyed between February 21 and 25. After completing the transects adjacent to Chirikof Island on March 1, the vessel cruised to the western limit of the survey area and transecting resumed in an easterly direction from Davidson Bank to the Shumagin Islands. The vessel docked at Kodiak to resupply and exchange scientists March 8-11. Survey data collection resumed in the Chirikof region on March 13 and the vessel then proceeded to Shelikof Strait (Figure 3a).

The first survey of Shelikof Strait took place between March 15 and 20 and consisted of a series of 7.5 nm spaced parallel transects traversing the strait between the 50-fm (91-m) isobaths. During the period March 20-24, a bottom/midwater trawl comparison experiment was conducted in the northwest portion of the strait (Figure 3c), an area of high pollock concentration. Shelikof Strait was surveyed a second time between March 24 and 31; survey design was identical to that employed during the first pass although the transect lines were offset 3.5 nmi to the north (Figure 3b).

Survey operations were conducted both day and night. Vessel speed varied between 6 and 12 knots depending upon weather conditions. Echo integrator density estimates were computed at 1-minute intervals for each of up to 400 contiguous 1-m depth strata between the transducer and the bottom. Midwater trawl hauls were made at selected locations to identify echo sign and provide biological samples (Tables 1-5). The duration of each trawl haul depended on the time considered necessary (based on observation of the netsounder display) to capture enough fish for biological sampling purposes. The average trawling speed was about 3 knots. For each trawl haul, the total catch weight and the number of each species of finfish caught was determined. Walleye pollock were further sampled to determine sex, length, weight, age, maturity, ovary weight, and stomach composition. Other pollock samples were preserved for reproduction and stock structure studies. To determine the exposure of pollock to hydrocarbon contamination, bile, tissue, and stomach samples were collected.

Standard sphere calibrations were conducted on five occasions during the cruise to provide data for scaling the results obtained from both acoustic systems (Table 6). This was accomplished by suspending a copper sphere with known acoustic properties under the transducer while the vessel was anchored

fore and aft in 60-100 m of water. For calibrating System 2, the ship's centerboard was extended to the position used during normal survey operations. Additional measurements were made for System 1 by lowering the fin and copper sphere through the water column to evaluate possible changes in system performance with transducer depth.

## RESULTS

Trawl station and catch data from the 50 midwater and 13 bottom trawl hauls are summarized in Tables 1 and 2. Total catch numbers and weight for each species taken are shown in Tables 3 and 4. A tally of the biological data collected for pollock is presented in Table 5. A total of 53 CTD casts (Table 7) and 19 XBT casts (Table 8) were made.

For midwater collections in Shelikof Strait, Marmot Bay, and along the outer shelf, estimated size compositions have been weighted to take into account echo integration estimates of relative biomass. During this weighting process, the contribution of the size composition from an individual haul to the overall size composition of the population is determined by the relative biomass of pollock in the vicinity of each haul location. For Prince William Sound and the demersal trawl collections in Shelikof Strait, the results are based on unweighted aggregations of trawl catch data and may not represent the size composition of the entire pollock population in these areas (Fig 7).

### OUTSIDE SHELIKOF STRAIT

Walleye pollock echo sign was not observed to the east of Prince William Sound but was observed throughout Prince William Sound and to the west of Montague Island (Fig. 4). Most of the pollock observed ranged between 40 cm to 65 cm; however, a marked proportion of juveniles was also present (Fig. 7).

In areas along the outer shelf between Amatuli and Sanak (with the exception of Marmot Bay), juvenile pollock were rarely encountered (Fig. 4). Adults with fork lengths between 38 cm and 64 cm predominated (Fig. 7).

Pollock aggregations in Marmot Bay (Fig. 6) revealed length compositions similar to those found in Prince William Sound. Although most of the pollock ranged between 40 cm and 65 cm, juveniles were also in abundance (Fig. 7).

Maturity compositions for Marmot Bay, Prince William Sound, and along the outer shelf show approximately 80% of the female pollock contained mature ovaries and very few were in spawning condition (Table 9).

SHELIKOF STRAIT

During both surveys of Shelikof Strait, juvenile and immature young adult pollock predominated in the southern portion of the strait and dense schools of mature adults were observed in the northwest portion of the strait. Aggregations of older fish were found in the upper, northern portion of the strait although younger adults and juveniles were encountered, especially towards the east shore (Fig. 5). Most of the pollock taken in the midwater trawl hauls were between 17 cm and 60 cm in length (Fig. 7); 46% of the adult ( $\geq 20$  cm) female pollock ovaries were found to be in the developing stage, 35% mature, 11% spawning, and 7% spent (Table 9). Almost all of the mature and spent female pollock were observed during the second pass.

The distribution of prespawning and spawning fish changed somewhat between the two passes. During the first pass, the schools extended along the northwest edge of the strait and the approximate center of distribution was off Cape Kuliak (Fig. 5). During the second pass, about one week later, the distribution was concentrated in a smaller area and shifted slightly to the south, centered off Katmai Bay (Fig. 5).

The demersal trawl samples were taken during the period between the two midwater passes through Shelikof Strait in the region where substantial aggregations of maturing adult pollock had been observed during the first pass (Fig. 5). Pollock length distribution ranged between 9 cm and 75 cm (Fig. 7); 75% of the adult females were found to be mature, 7% spawning, and 1% spent (Table 9).

**SCIENTIFIC PERSONNEL**Leg I (February 5-March 9)

William Karp	Chief Scientist	AFSC
Daniel Twohig	Electronics Technician	AFSC
John Garrison	Watch Leader	AFSC
Joe Klein <sup>2</sup>	Biological Technician	AFSC
Kaare Hansen	Acoustics Engineer	IMR
Egil Ona <sup>1</sup>	Fishery Biologist	IMR
Jim Traynor <sup>2</sup>	Fishery Biologist	AFSC
Taina Honkalehto <sup>2</sup>	Fishery Biologist	AFSC
Robin Harrison	Fishery Biologist	AFSC
Eric Brown <sup>2</sup>	Fishery Biologist	AFSC
Patrick Cordue <sup>2</sup>	Bio-mathematician	MAF

Leg II (March 11-April 2)

Taina Honkalehto	Chief Scientist	AFSC
Ed Nunnallee	Fishery Biologist	AFSC
John Garrison	Watch Leader	AFSC
Dan Twohig	Electronics Technician	AFSC
Joe Klein	Biological Technician	AFSC
Mike Bailey	Programmer/Analyst	AFSC
Sarah Hinckley	Fishery Biologist	AFSC
Nazila Merati	Fishery Biologist	AFSC
Dennis Benjamin	Fishery Biologist	AFSC

AFSC - Alaska Fisheries Science Center, Seattle, Washington  
 IMR - Institute of Marine Research, Bergen, Norway  
 MAF - Ministry of Agriculture and Fisheries, New Zealand

- <sup>1</sup> February 5-20  
<sup>2</sup> February 20-March 8

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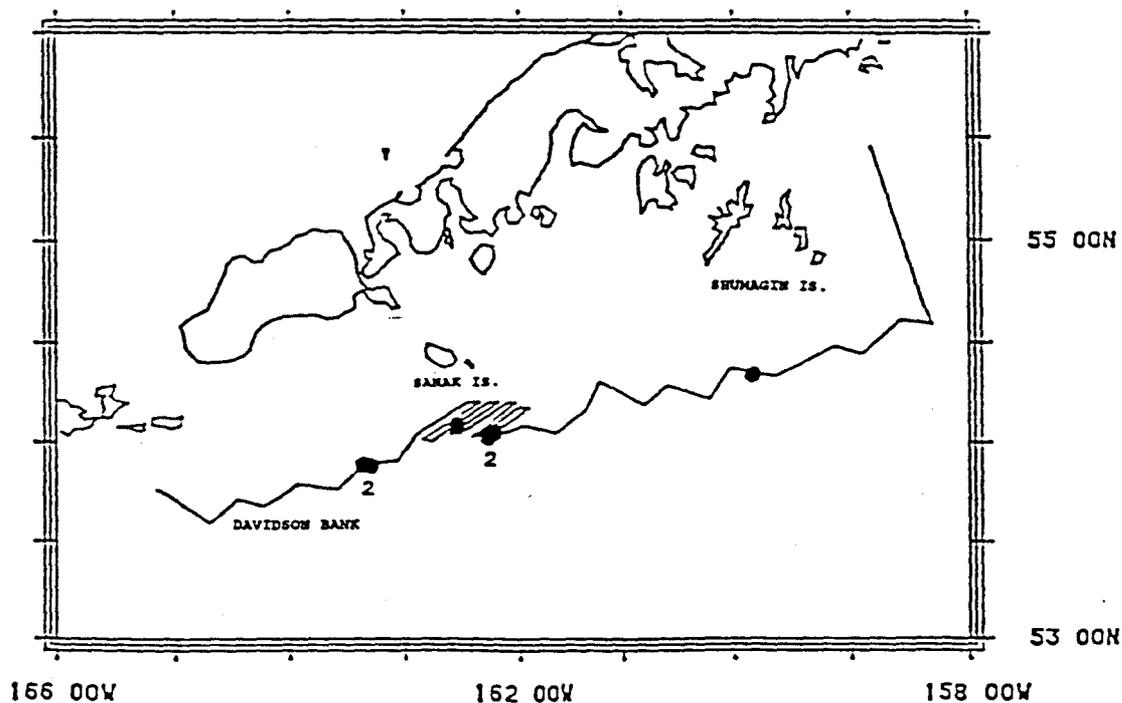
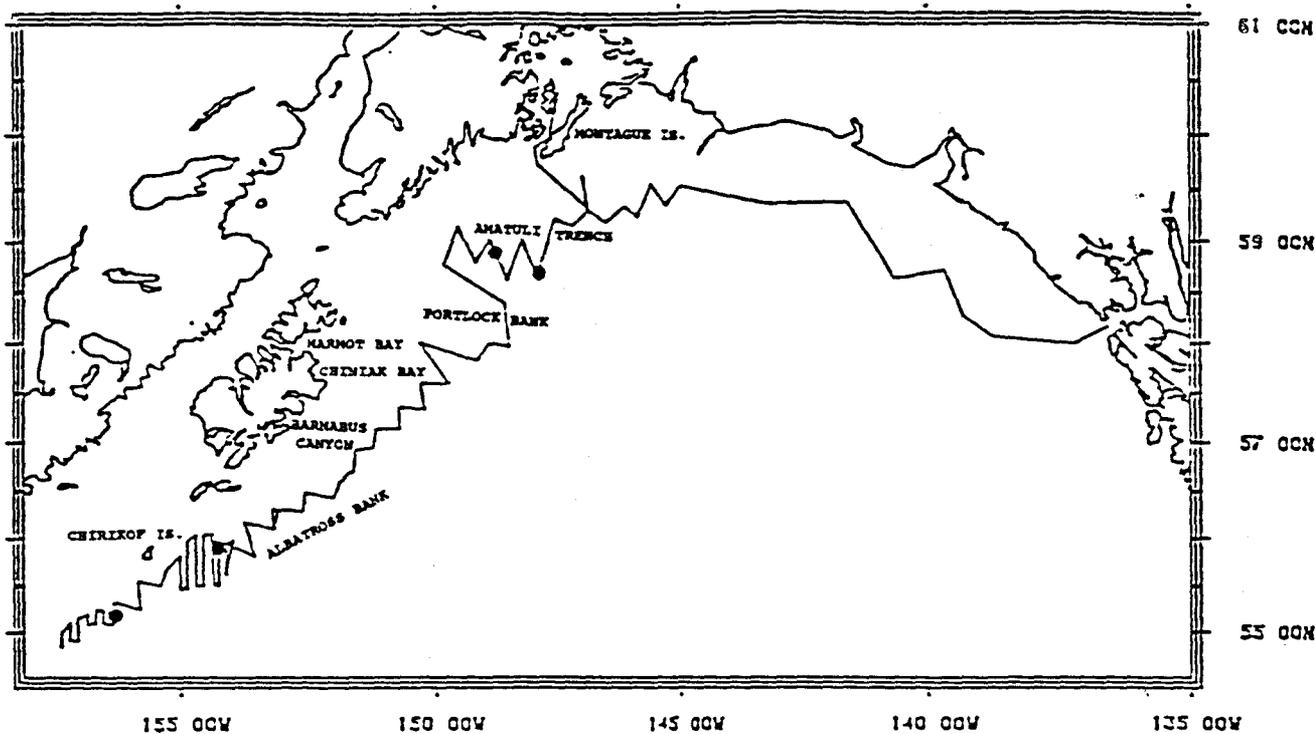


Figure 1. Survey trackline and trawl stations (•) along shelf break between Cape Spencer and Chirikof Island (top) and between Shumagin Islands and Davidson Bank (bottom). Numbers indicate locations where more than one trawl was made.

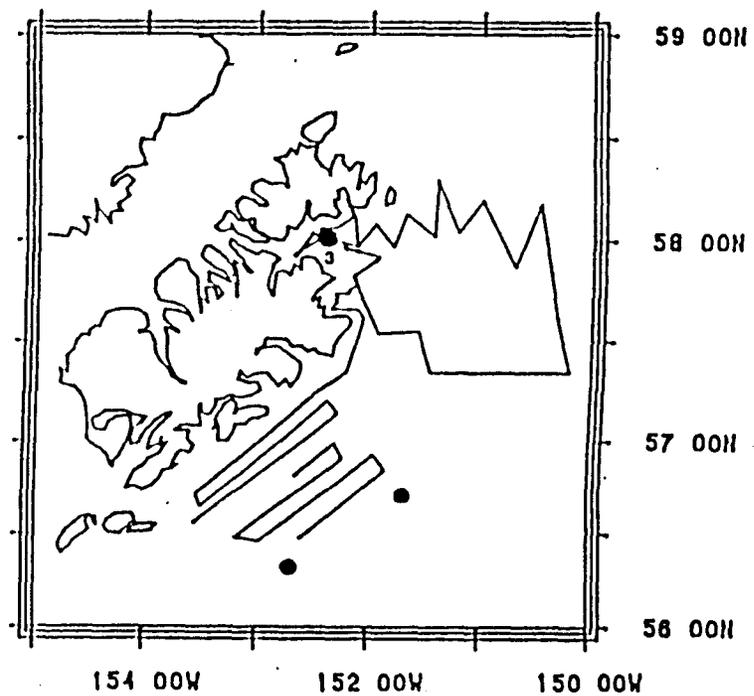
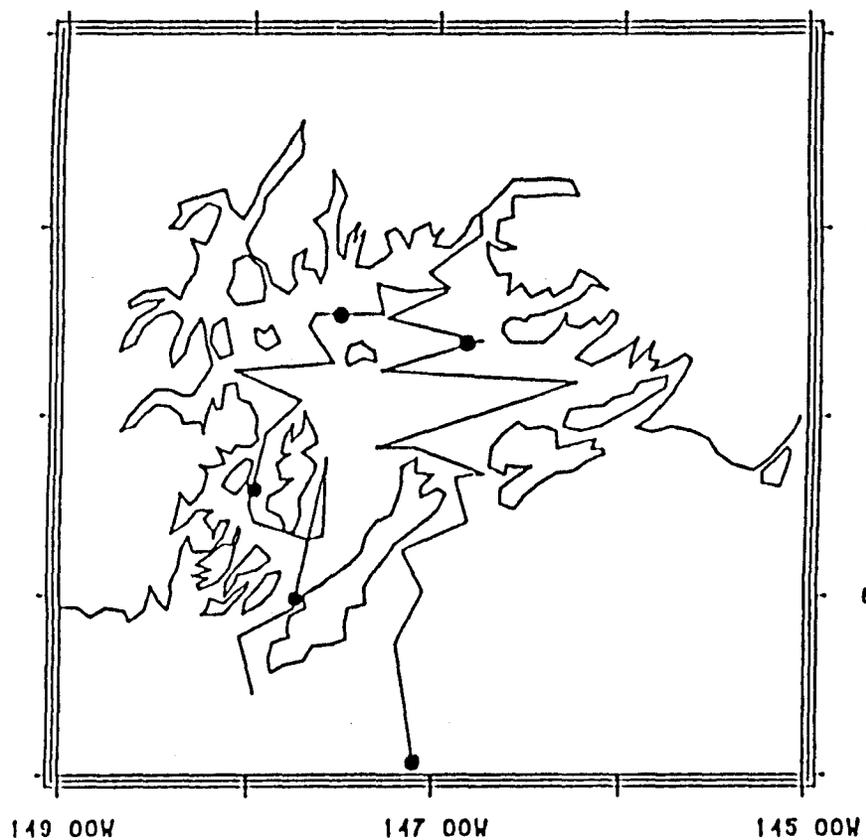


Figure 2. Survey trackline and trawl stations (•) in Prince William Sound (left) and in areas adjacent to the west side of Kodiak Island (right). Numbers indicate locations where more than one trawl was made.

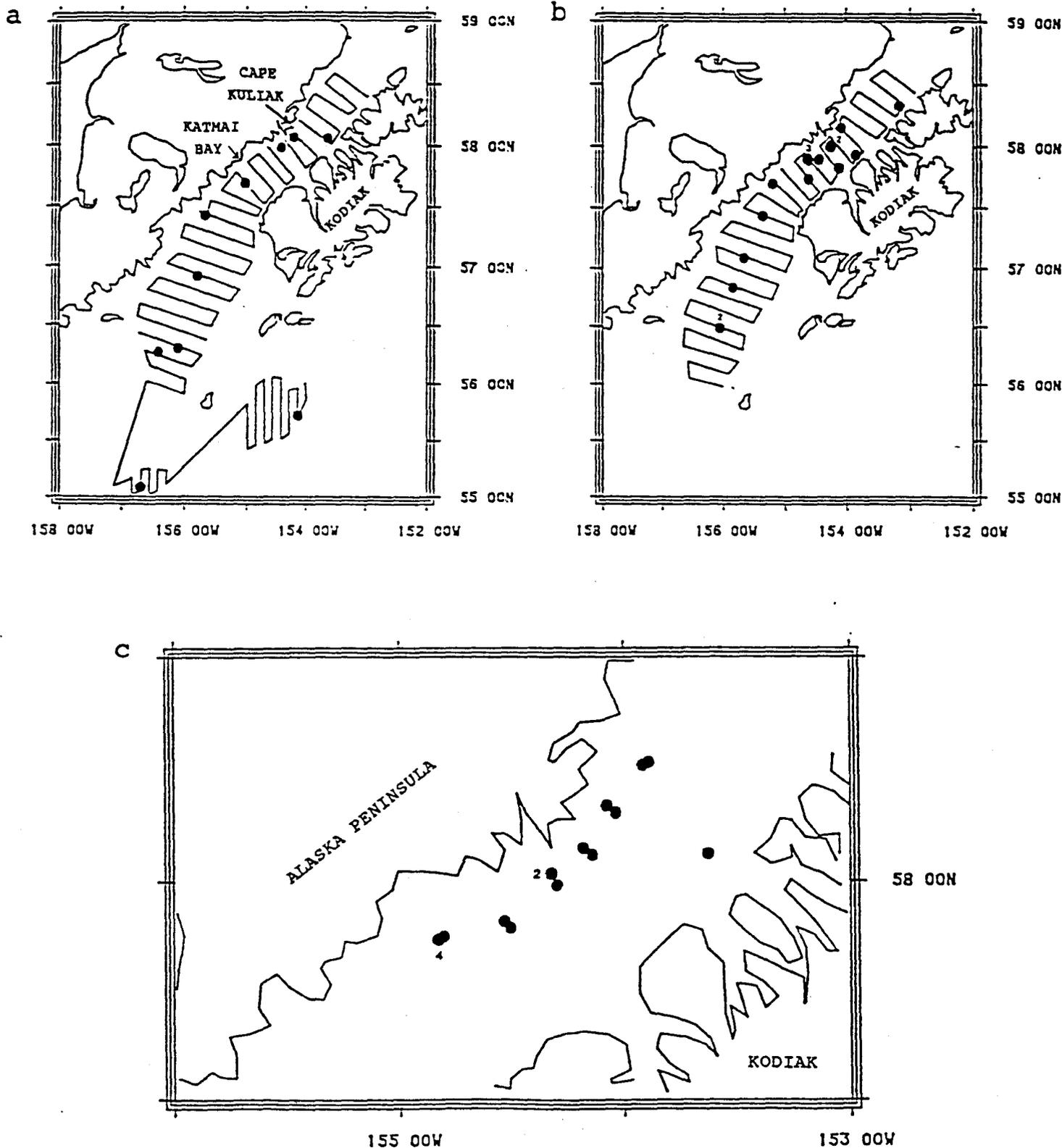


Figure 3. Survey trackline and trawl stations (•) for a) the first pass through Shelikof Strait and areas adjacent to Chirikof Island that were surveyed during the second leg b) second pass through Shelikof Strait indicating midwater trawls and c) Shelikof Strait indicating bottom trawls. Numbers indicate locations where more than one trawl was made.

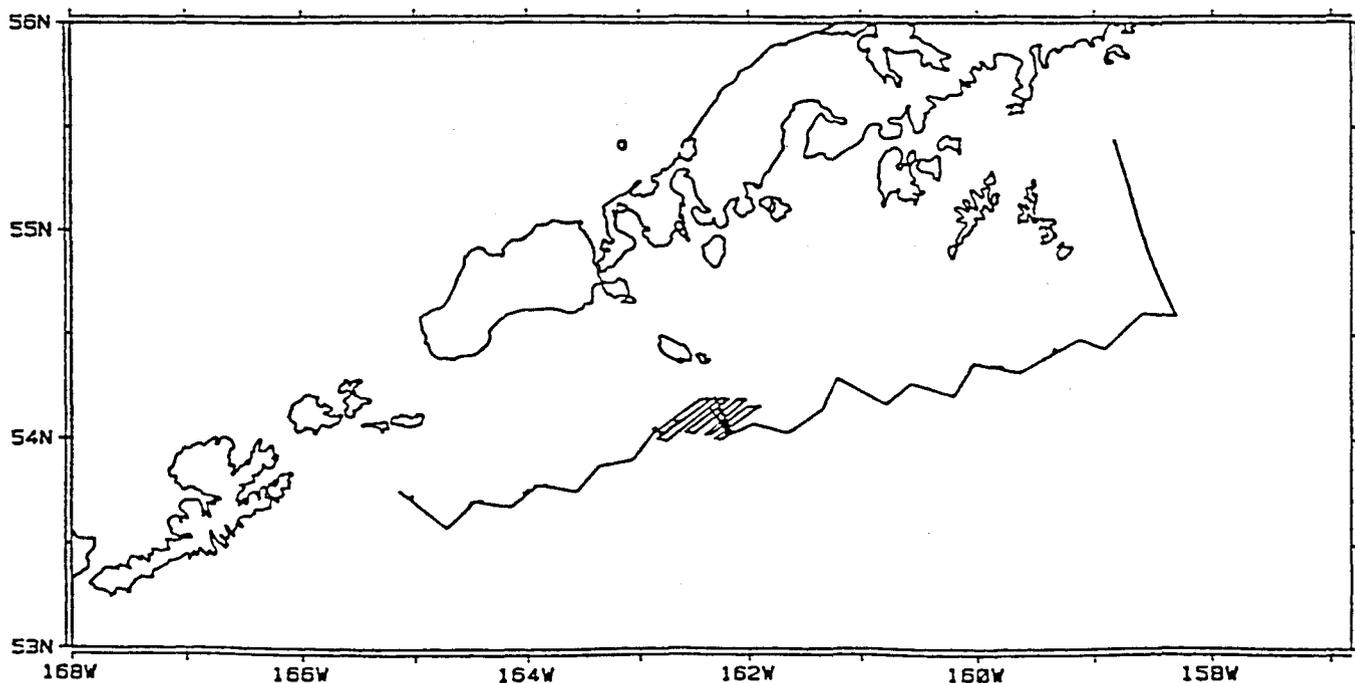
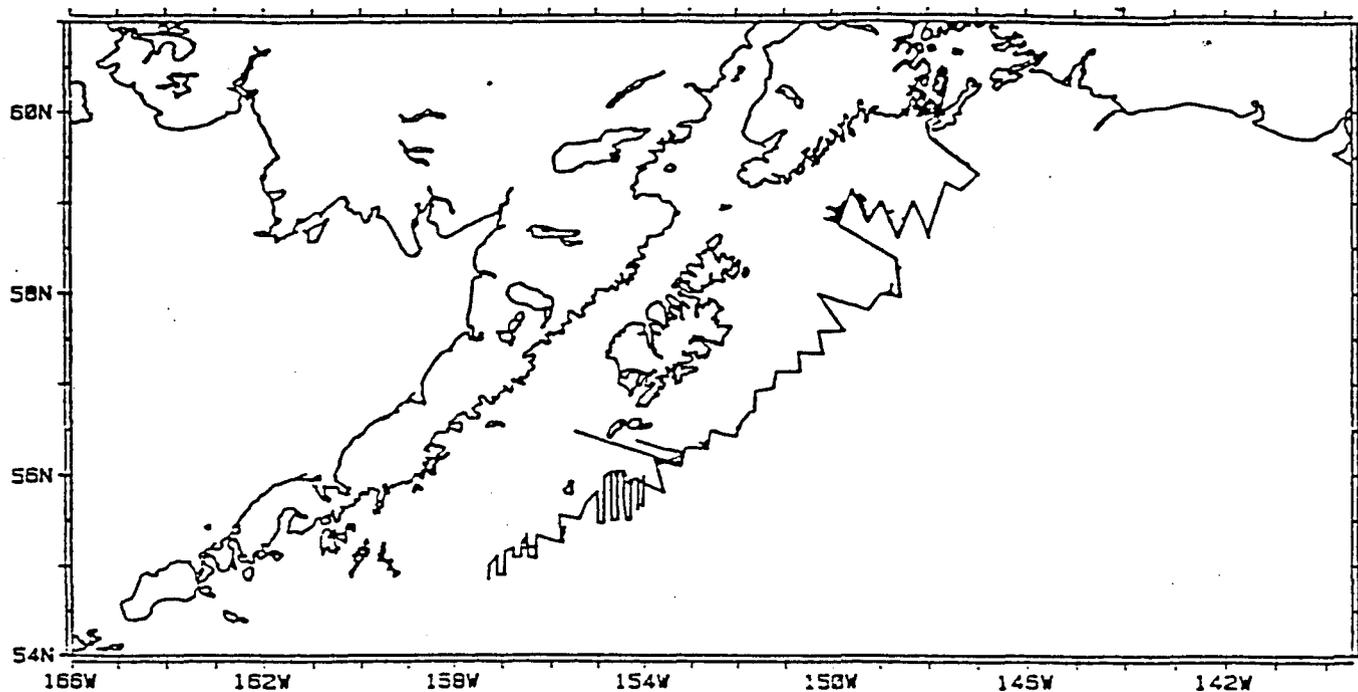


Figure 4. Distribution of midwater pollock biomass in areas surveyed between Montague Island and Chirikof Island (top) and between Shumagin Islands and Davidson Bank (bottom). Deflections off transect lines indicate relative fishing density.

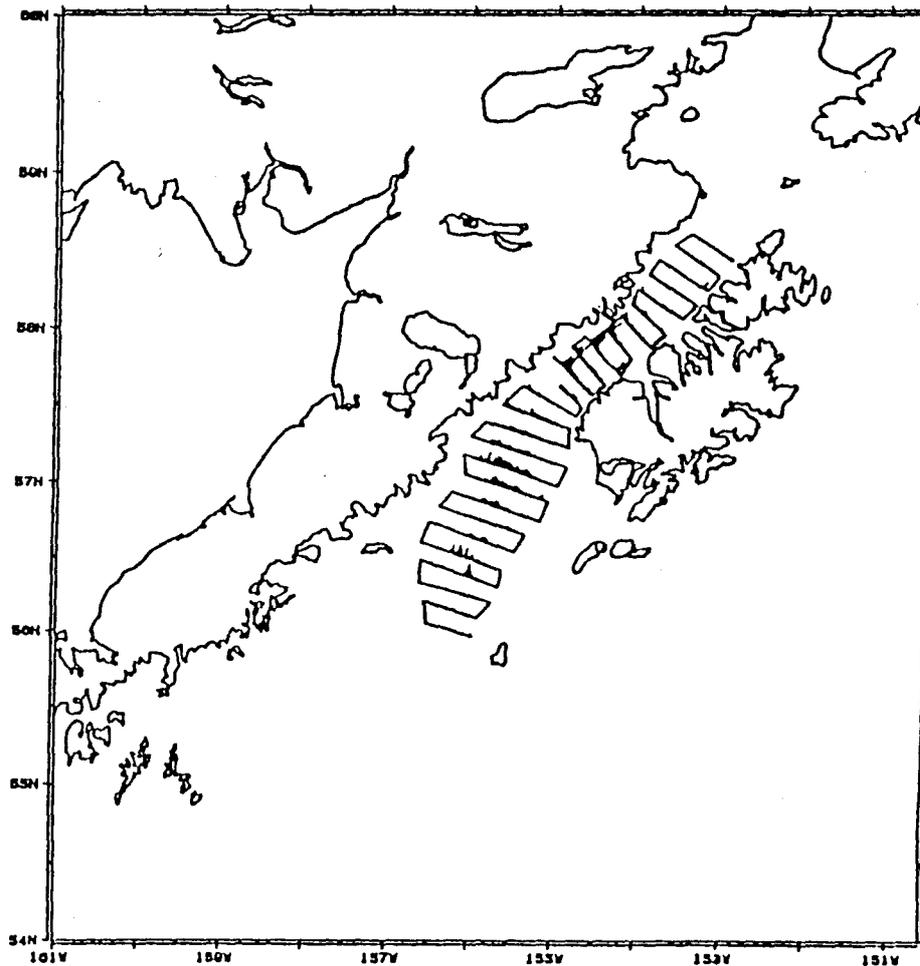
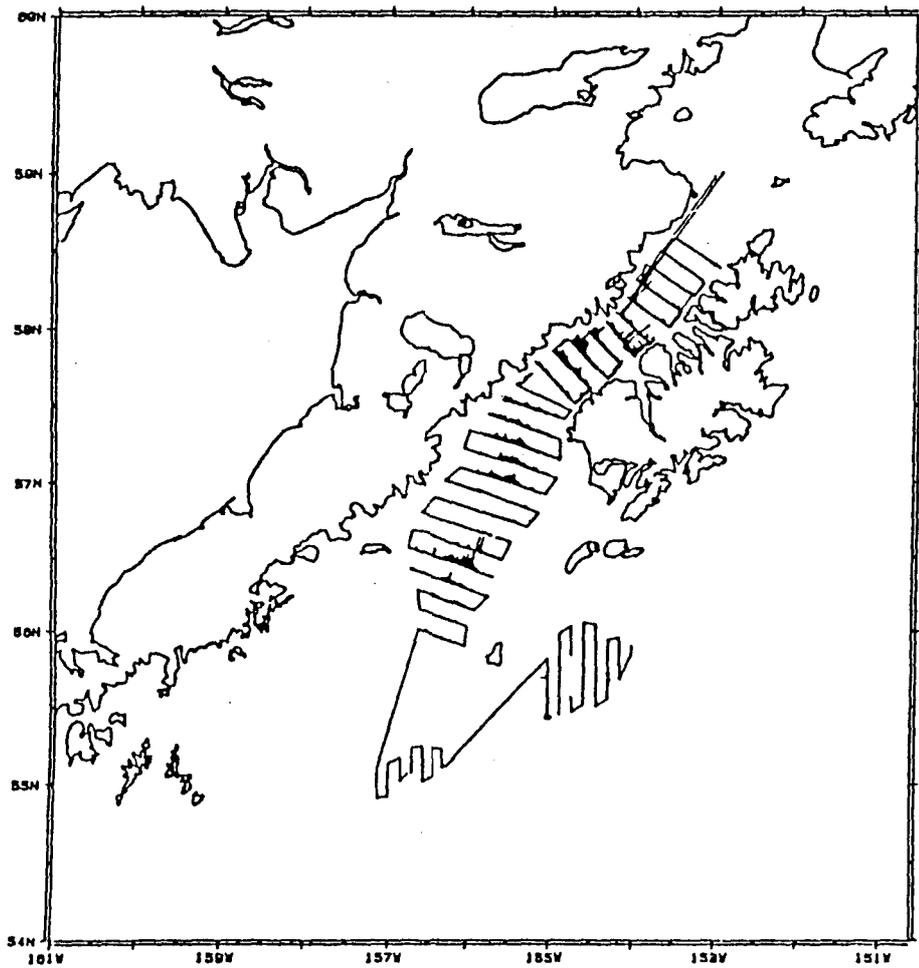


Figure 5. Distribution of midwater pollock biomass observed during first pass (left) and second pass (right) through Shelikof Strait. Deflections off transect lines indicate relative fish density.

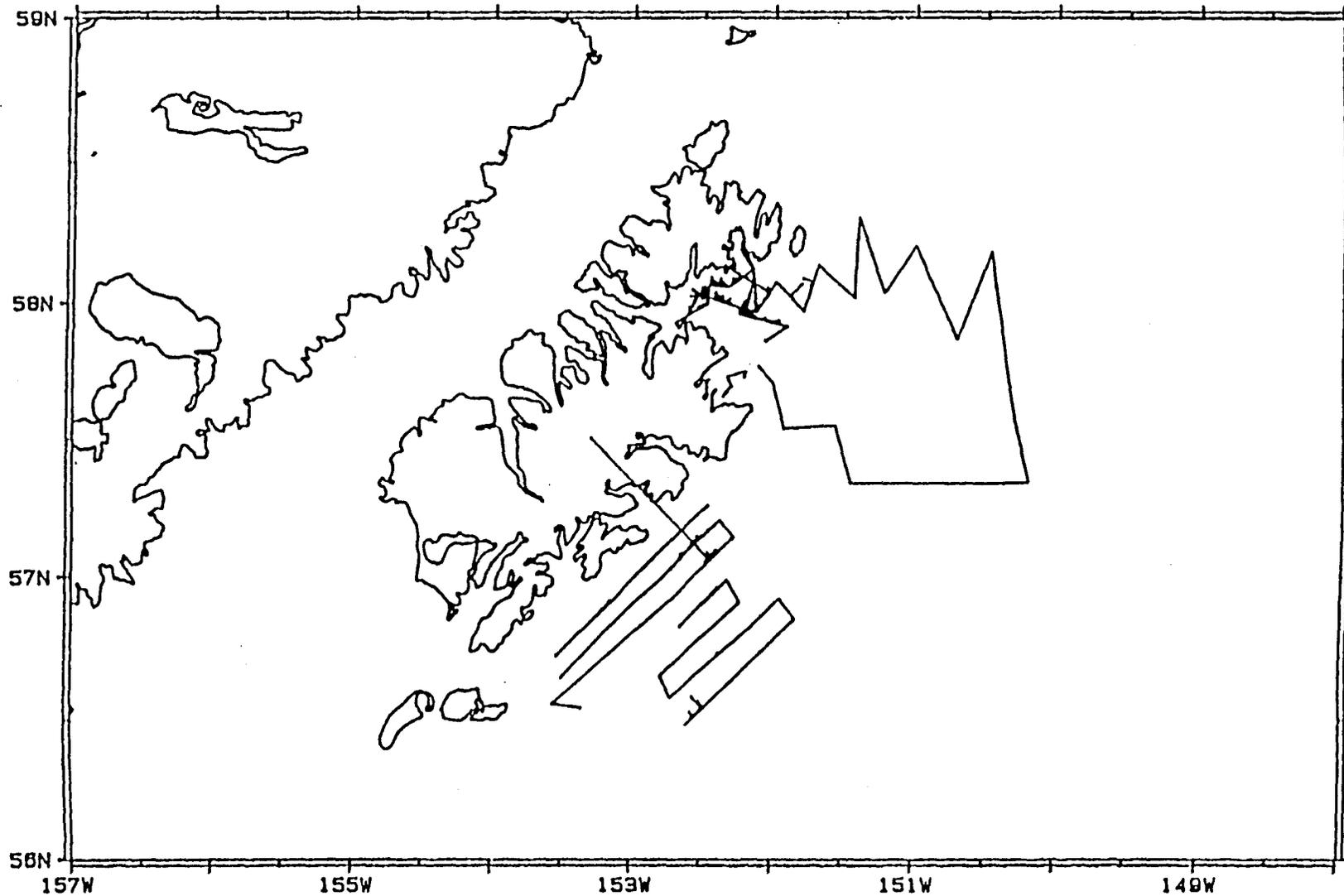


Figure 6. Distribution of midwater pollock biomass in areas surveyed along the west side of Kodiak Island. Deflections off transect lines indicate relative fish density.

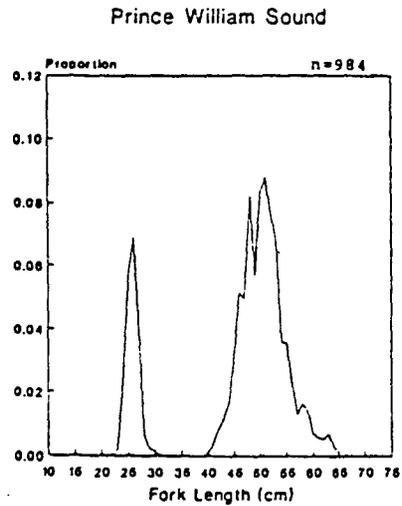
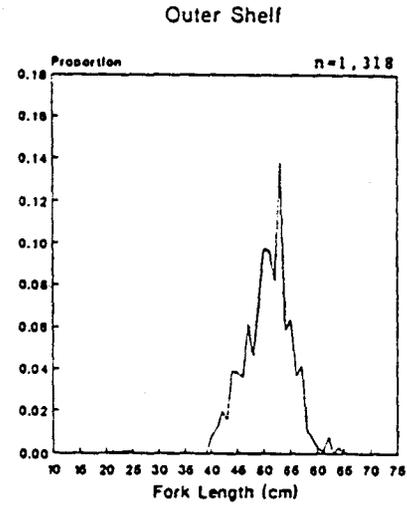
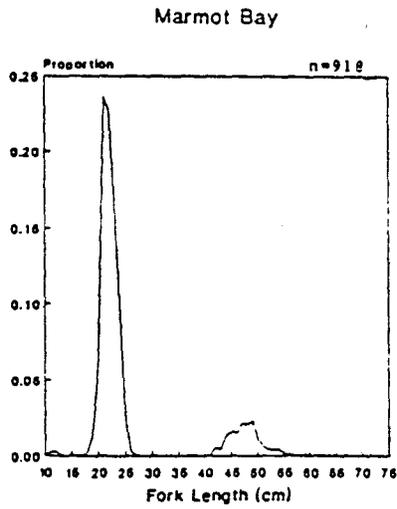
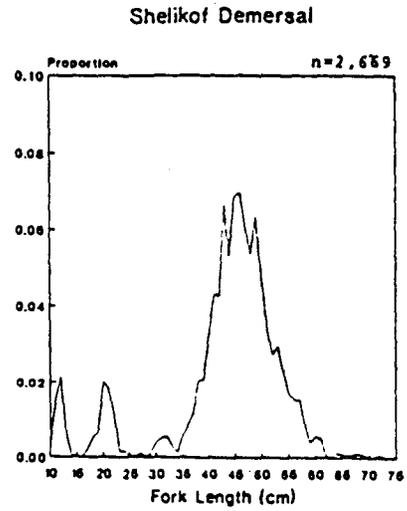
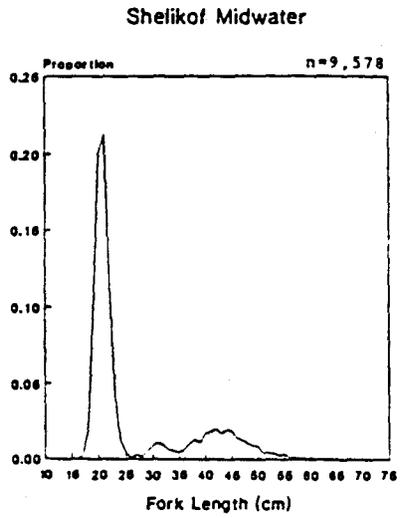


Figure 7. Estimated size compositions by numbers for pollock. Shelikof midwater, outer shelf, and Marmot Bay estimates have been weighted by estimated population size and represent the size composition in these areas. Shelikof demersal and Prince William Sound estimates are unweighted and may not represent the size composition of the entire population in these areas.

Table 1. Winter 1990 Gulf of Alaska pollock survey. Midwater trawl station and catch summary data.

Haul No.	Date (1990)	Time (AST)	Start Position		Temp. (C)		Depth (fm)		Catch (lb/nos.)				
			Lat. (N)	Long. (W)	Surf	Gear	Gear	Botm	Walleye Pollock	Eulachon	Other Species		
1	14 FEB	1425-1441	59	32.0	147	6.0	5.1	5.7	113	118	475/4,124	T	T
2	15 FEB	0903-0929	60	41.6	146	50.5	3.8	5.4	191	231	626/368	11/146	120/417
3	15 FEB	2325-0020	60	46.0	147	31.1	2.4	5.5	197	255	81/49	58/3,801	17/3,811
4	16 FEB	0906-0924	60	17.9	147	58.2	3.2	5.5	166	293	174/104	52/3,422	13/366
5	16 FEB	1845-1906	59	59.4	147	44.2	3.7	5.0	75	112	6,611/4,305	8/76	2/19
6	17 FEB	1008-1023	58	41.0	147	57.9	5.1	4.8	155	556	0	0	2/97
7	17 FEB	1932-1952	58	52.8	148	50.7	4.4	5.5	100	154	103/955	4/62	7/317
8	19 FEB	1100-1114	56	42.7	151	40.3	3.5	***	***	***	0	0	0
9	21 FEB	0038-0040	58	0.6	152	24.6	3.1	***	49	105	360/2,487	0	0
10	21 FEB	0927-0941	58	0.4	152	23.2	2.8	3.0	81	120	654/336	0	39/4
11	21 FEB	1149-1152	58	0.8	152	24.8	3.1	3.0	85	100	1,981/7,903	0	66/8
12	25 FEB	1122-1209	56	19.2	152	41.2	3.6	4.4	192	258	196/91	0	18/122
13	26 FEB	0635-0652	55	53.8	154	17.8	3.9	4.3	207	340	180/77	T	1/23
14	27 FEB	1757-1830	55	11.1	156	15.5	1.6	4.4	176	247	0	0	0
15	1 MAR	0833-1014	54	5.0	162	33.1	3.1	4.7	195	371	293/112	0	46/138
16	1 MAR	1344-1515	54	2.8	162	13.8	3.2	4.5	190	350	572/211	0	24/75
17	2 MAR	1150-1300	53	52.7	163	18.2	3.2	4.3	175	300	0	0	4/62
18	2 MAR	1440-1450	53	52.9	163	21.3	3.1	4.3	206	340	0	0	1/29
19	3 MAR	1126-1239	54	1.4	162	16.8	3.2	4.4	190	400	2,289/1,180	0	16/5
20	4 MAR	0352-0435	54	20.3	159	50.7	3.0	4.1	201	204	139/61	0	2/201
21	13 MAR	1457-1602	55	43.0	154	8.5	4.1	4.7	174	452	0	0	2/61
22	15 MAR	0537-0607	55	5.1	156	42.1	2.3	4.4	205	490	1,432/862	0	81/53
23	16 MAR	0744-0756	56	15.9	156	25.4	1.6	3.9	96	138	1,190/9,806	T	1/1
24	16 MAR	1140-1153	56	17.9	156	6.1	1.7	3.9	126	137	3,074/7,677	257/3,342	109/211
25	17 MAR	1123-1205	56	54.9	155	47.2	3.2	5.1	146	160	947/4,103	29/615	28/33
26	18 MAR	0748-0759	57	25.0	155	40.1	2.2	5.0	144	156	1,299/6,539	87/1,224	13/48
27	18 MAR	1859-1914	57	41.3	155	2.0	2.3	4.3	121	149	1,512/6,318	29/191	10/15
28	19 MAR	0744-0755	57	58.6	154	25.4	2.8	3.2	146	180	5,498/4,799	601/6,372	1/13
29	19 MAR	1508-1511	58	3.7	154	12.6	1.5	4.6	147	157	5,568/4,109	102/624	0
30	20 MAR	0938-1036	58	3.4	153	38.1	4.2	4.4	93	131	2,971/6,534	0	89/20

Table 1. Continued.

Haul No.	Date (1990)	Time (AST)	Start Position		Temp. (C)		Depth (fm)		Catch (lb/nos.)		
			Lat. (N)	Long. (W)	Surf	Gear	Gear	Botm	Walleye Pollock	Eulachon	Other Species
43	23 MAR	1543-1603	57 52.6	154 48.5	3.2	4.4	129	151	113/108	T	103/7
45	23 MAR	1854-1934	57 52.1	154 49.8	3.7	3.8	90	151	18/99	0	0
46	23 MAR	2046-2102	57 52.1	154 49.9	3.8	4.8	139	151	1,066/706	0	21/5
47	25 MAR	1150-1220	56 29.2	156 3.8	3.2	***	***	147	659/4,016	339/5,612	310/28
48	25 MAR	1358-1437	56 29.2	156 3.9	3.2	2.5	103	152	7,575/56,813	0	325/1
49	26 MAR	0516-0526	56 50.3	155 50.4	3.2	5.0	131	170	969/5,901	68/578	232/5
50	26 MAR	1505-1513	57 5.2	155 39.5	2.8	5.0	135	156	4,285/20,575	134/1,202	21/11
52	27 MAR	1722-1726	57 26.2	155 21.4	3.2	5.0	135	148	2,696/7,479	211/2,114	53/75
53	28 MAR	0146-0241	57 44.2	154 37.5	3.2	4.0	87	122	1,792/10,385	0	57/18
54	28 MAR	1107-1109	57 53.5	154 38.1	3.2	4.6	104	148	2,800/1,582	0	0
55	28 MAR	1223-1226	57 53.9	154 38.7	3.2	4.1	130	150	12,000/7,802	0	0
56	28 MAR	1401-1406	57 54.1	154 37.7	2.3	4.3	144	152	3,135/2,146	0	75/1
57	29 MAR	1358-1428	58 19.5	153 10.5	2.7	4.6	122	127	1,468/4,715	44/550	67/24
58	29 MAR	2004-2043	57 55.9	153 51.2	4.1	4.5	111	119	2,774/2,710	9/135	67/327
59	30 MAR	0839-0909	57 53.8	154 27.4	2.4	4.5	113	127	2,694/2,165	148/1,361	98/77
60	30 MAR	1215-1229	57 49.8	154 7.7	3.7	4.5	88	127	2,167/5,382	2/34	22/15
61	30 MAR	1755-1810	58 59.7	154 15.8	3.9	4.7	125	137	2,819/2,617	280/2,268	1/11
62	30 MAR	1922-1941	58 0.4	154 14.8	4.1	4.3	91	134	671/2,645	8/54	0
63	31 MAR	0924-0929	58 8.9	154 5.5	1.3	4.7	144	162	7,230/4,718	0	0

"T" represents trace amount.

"\*" represents no data.

Table 2. Winter 1990 Gulf of Alaska pollock survey. Bottom trawl station and catch summary data.

Haul No.	Date (1990)	Time (AST)	Start Position		Temp. (C)		Depth (fm)		Catch (lb/nos.)					
			Lat. (N)	Long. (W)	Surf	Gear	Gear	Botm	Walleye Pollock	Arrowtooth Flounder	Pacific Halibut	Other Species		
31	20 MAR	1435-1441	58	3.8	153	37.4	4.1	4.8	132	132	511/436	67/33	63/7	58/136
32	21 MAR	0839-0910	57	54.6	154	32.7	1.8	5.0	156	156	171/110	1,337/358	38/2	131/125
33	21 MAR	1134-1149	57	59.5	154	18.5	2.2	4.9	147	147	1,229/624	350/236	13/1	134/164
34	21 MAR	1433-1453	58	4.5	154	11.1	2.5	5.0	159	159	11,958/5,811	42/21	0	0
35	21 MAR	1720-1724	58	9.2	154	2.5	3.0	4.8	139	139	3,986/1,974	84/28	0	1/7
36	21 MAR	2054-2058	58	15.6	153	54.9	3.7	4.8	133	133	3,765/2,050	139/52	0	197/27
37	22 MAR	0816-0831	57	53.8	154	31.2	2.2	4.9	139	139	455/227	477/127	0	243/68
38	22 MAR	1056-1058	58	1.0	154	20.2	2.2	4.8	148	148	0	0	0	0
39	22 MAR	1209-1214	58	1.1	154	19.9	4.1	4.4	147	147	9,644/5,541	0	0	16/16
40	22 MAR	1437-1507	58	3.6	154	8.7	4.1	4.5	133	133	52/52	224/69	43/1	208/304
41	22 MAR	1803-1807	58	10.2	154	4.9	1.2	4.9	161	161	4,830/2,789	70/20	0	0
42	22 MAR	2050-2130	58	16.0	153	53.3	4.2	4.3	129	129	1,524/817	176/63	101/3	180/105
44	23 MAR	1737-1749	57	52.3	154	49.5	3.7	5.0	151	151	1,832/1,154	100/33	18/1	51/27

Table 3. Winter 1990 Gulf of Alaska pollock survey. Summary of catch by species in midwater trawls.

<u>Species</u>	<u>Numbers</u>	<u>Percent</u>	<u>Weight (lb)</u>	<u>Percent</u>
Walleye Pollock ( <u>Theragra chalcogramma</u> )	225,138	84.7	104,462	95.7
Eulachon ( <u>Thaleichthys pacificus</u> )	30,566	11.5	2,441	2.2
Pacific Cod ( <u>Gadus macrocephalus</u> )	19	<.1	168	0.2
Pacific Herring ( <u>Clupea pallasii</u> )	203	0.1	16	<.1
Smooth Lump sucker ( <u>Aptocyclus ventricosus</u> )	34	<.1	124	0.1
Squid Unidentified	461	0.2	83	0.1
Lanternfish Unidentified (Myctophidae)	483	0.2	14	<.1
Euphausiid Unidentified (Euphausiacea)	4,605	1.7	18	<.1
Shark Unidentified	7	<.1	1,145	1.0
Isopod Unidentified (Isopoda)	33	<.1	1	<.1
Eelpout Unidentified (Zoarcidae)	110	<.1	1	<.1
Jellyfish Unidentified (Scyphozoa)	69	<.1	43	<.1
Salps Unidentified (Thaleiacea)	18	<.1	2	<.1
Comb Jelly Unidentified (Ctenophora)	53	<.1	1	<.1
Viperfish Unidentified (Chauliodontidae)	16	<.1	T	<.1
Flathead Sole ( <u>Hippoglossoides elassodon</u> )	1	<.1	T	<.1
Arrowtooth Flounder ( <u>Atheresthes stomias</u> )	39	<.1	150	0.1
Shrimp Unidentified	324	0.1	9	<.1
Capelin ( <u>Mallotus villosus</u> )	194	0.1	3	<.1
Sockeye Salmon ( <u>Oncorhynchus nerka</u> )	1	<.1	1	<.1
Chinook Salmon ( <u>Oncorhynchus tshawytscha</u> )	48	<.1	124	0.1
Rougheye Rockfish ( <u>Sebastes aleutianus</u> )	19	<.1	91	0.1
Pacific Lamprey ( <u>Lampetra tridentata</u> )	1	<.1	T	<.1
Grenadier Unidentified (Macrouridae)	9	<.1	91	0.1
Pacific Ocean Perch ( <u>Sebastes alutus</u> )	2	<.1	3	<.1
Pacific Halibut ( <u>Hippoglossus stenolepis</u> )	2	<.1	69	0.1
Bairdi Tanner Crab ( <u>Chionoecetes bairdi</u> )	2	<.1	3	<.1
Dover Sole ( <u>Microstomus pacificus</u> )	1	<.1	T	<.1
Smelt Unidentified (Osmeridae)	3,422	1.3	52	<.1
Unidentified	<u>1</u>	<u>&lt;.1</u>	<u>T</u>	<u>&lt;.1</u>
Totals	265,881	100.0	109,115	100.0

"T" represents trace amount.

Table 4. Winter 1990 Gulf of Alaska pollock survey. Summary of catch by species in bottom trawls.

<u>Species</u>	<u>Numbers</u>	<u>Percent</u>	<u>Weight (lb)</u>	<u>Percent</u>
Walleye Pollock ( <u>Theragra chalcogramma</u> )	21,585	91.4	39,955	89.8
Eulachon ( <u>Thaleichthys pacificus</u> )	410	1.7	56	0.1
Pacific Cod ( <u>Gadus macrocephalus</u> )	14	0.1	78	0.2
Smooth Lumpsucker ( <u>Aptocyclus ventricosus</u> )	3	<.1	11	<.1
Squid Unidentified	11	<.1	12	<.1
Jellyfish Unidentified (Scyphozoa)	4	<.1	9	<.1
Sea Urchin Unidentified	1	<.1	T	<.1
Flathead Sole ( <u>Hippoglossoides elassodon</u> )	206	0.9	189	0.4
Arrowtooth Flounder ( <u>Atheresthes stomias</u> )	1,030	4.4	3,066	6.9
Shrimp Unidentified	152	0.6	14	<.1
Rougheye Rockfish ( <u>Sebastes aleutianus</u> )	7	<.1	16	<.1
Pacific Ocean Perch ( <u>Sebastes alutus</u> )	1	<.1	2	<.1
Pacific Halibut ( <u>Hippoglossus stenolepis</u> )	15	0.1	276	0.6
Bairdi Tanner Crab ( <u>Chionoecetes bairdi</u> )	83	0.4	46	0.1
Skate Unidentified (Rajidae)	40	0.2	768	1.7
Snail Unidentified	24	0.1	5	<.1
Dover Sole ( <u>Microstomus pacificus</u> )	12	0.1	7	<.1
Rex Sole ( <u>Glyptocephalus zachirus</u> )	8	<.1	4	<.1
Sculpin Unidentified (Cottidae)	2	<.1	T	<.1
Sablefish ( <u>Anoplopoma fimbria</u> )	1	<.1	3	<.1
Totals	23,609	100.0	44,517	100.0

"T" represents trace amount.

Table 5. Winter 1990 Gulf of Alaska pollock survey. Summary of biological samples and measurements.

Haul Number	Length	Maturity	Otoliths	Fish Weights	Ovary Weights	Stomach Scans	Blood	Ovaries	Bile
1	382	100	50	100	0	0	0	0	0
2	223	209	100	209	0	0	0	0	20
3	49	49	49	49	0	0	0	0	20
4	104	104	104	104	0	0	21	20	20
5	226	100	100	100	0	0	14	14	20
6	0	0	0	0	0	0	0	0	0
7	149	100	50	152	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	361	100	0	100	0	0	0	0	0
10	232	100	100	100	0	0	0	0	0
11	325	128	78	128	0	0	0	0	0
12	91	91	91	91	0	0	0	0	0
13	77	76	76	76	0	0	11	10	0
14	0	0	0	0	0	0	0	0	0
15	112	111	100	111	0	23	0	0	20
16	211	109	100	109	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	335	100	100	100	40	0	0	0	0
20	61	61	61	61	38	0	0	0	0
21	0	0	0	0	0	0	0	0	0
22	282	112	112	112	24	0	21	22	20
23	558	70	70	70	0	0	12	5	16
24	526	102	102	102	20	5	0	20	0
25	445	117	117	117	6	0	17	11	20
26	471	109	109	109	13	13	0	13	0
27	431	114	114	114	14	0	14	14	20
28	310	116	116	116	34	6	0	27	0
29	299	105	105	105	10	0	10	10	20
30	405	116	116	116	15	0	15	15	0
*31	436	120	120	120	25	0	3	25	20
*32	110	52	52	52	11	13	0	0	0
*33	249	51	51	51	15	15	0	0	0
*34	156	50	50	50	19	16	0	0	0

Table 5. Continued.

Haul Number	Length	Maturity	Otoliths	Fish Weights	Ovary Weights	Stomach Scans	Blood	Ovaries	Bile
*35	160	47	47	47	13	10	0	0	0
*36	171	52	52	52	2	0	0	2	0
*37	148	51	51	51	0	0	0	0	0
*38	0	0	0	0	0	0	0	0	0
*39	181	50	50	50	13	13	0	0	0
*40	43	19	19	19	12	0	0	0	0
*41	179	50	50	50	23	0	0	0	0
*42	156	50	50	50	15	0	0	0	0
43	108	50	50	50	4	0	0	0	0
*44	260	51	51	51	13	0	0	1	0
45	99	13	13	13	0	0	0	0	0
46	213	50	50	50	20	0	0	0	0
47	326	100	100	100	66	18	0	0	0
48	300	17	17	17	0	0	17	8	0
49	516	100	100	100	0	0	0	0	20
50	446	113	113	113	13	0	13	13	0
51	488	118	118	118	0	0	16	16	20
52	442	111	111	111	0	0	16	17	0
53	743	104	104	104	0	0	0	1	20
54	172	92	92	92	0	0	3	4	17
55	184	88	88	88	31	0	0	0	0
56	204	100	100	100	0	0	0	0	0
57	453	103	103	103	0	0	1	2	20
58	335	114	114	114	0	0	3	13	20
59	248	110	110	110	0	0	10	10	20
60	315	106	106	106	0	0	6	2	0
61	253	64	64	64	0	0	2	0	20
62	508	50	50	50	0	0	1	0	0
63	200	97	97	97	7	30	17	0	0
Totals	15,085	4,842	4,463	4,894	516	162	243	295	373

"\*" represents bottom trawl hauls.

Table 6. Standard sphere calibration summary for the Miller Freeman cruise 90-1.

Date	Location	Transducer	
		System 1 Fin depth (m)	System 2 (Centerboard mounted)
Feb. 6-7	Port Susan, Puget Sound, WA	10, 15, 20	X
Feb. 23-24	Three Saints Bay, Kodiak, AK	2, 10, 15, 20	X
Mar. 7	Castle Bay, Kodiak, AK	due to weather, no calibration completed	X
Mar. 12-13	Three Saints Bay, Kodiak, AK	2, 10, 15, 20	X
Mar. 4	Malina Bay, Kodiak, AK	2, 10, 15, 20	X

Table 7. Inventory of CTD casts for the Gulf of Alaska pollock survey, MF901.

CAST	HAUL	DATE	TIME (AST)	POSITION		STRATUM	COMMENT .
				LAT.	LONG.		
-	-	90 206	0841	4808.0	12222.2	0	CALIBRATION
1	1	90 214	1540	5930.2	14705.7	1	ENTRANCE P.W.S.
2	2	90 215	1022	6041.7	14652.4	1	P.W. SOUND
3	3	90 216	0124	6046.2	14724.1	1	P.W. SOUND
4	4	90 216	1038	6018.6	14757.8	1	P.W. SOUND
5	5	90 216	2018	5959.9	14744.1	1	P.W. SOUND
6	6	90 217	1121	5841.6	14756.6	1	AMATULI TRNCH
7	7	90 217	2046	5852.4	14849.5	1	CAST FAILURE
8	9	90 221	0122	5800.6	15227.1	1	CAST FAILURE
9	10-11	90 221	1046	5759.9	15220.2	1	MARMOT BAY
-	--	90 224	----	5710.5	15330.4	1	CALIBRATION
10	12	90 225	1349	5623.2	15227.5	1	ALBATROSS BANK
11	13	90 226	0806	5555.8	15418.4	1	CHIRIKOF IS.
12	14	90 227	1948	5512.8	15612.2	1	CHIRIKOF IS.
13	15	90 301	1117	5408.3	16223.3	1	SANAK IS.
14	16	90 301	1610	5402.8	16213.1	1	SANAK IS.
15	17	90 302	1555	5353.0	16319.7	1	SANAK IS.
16	19	90 303	1237	5403.6	16210.9	1	SANAK IS.
17	20	90 304	0529	5420.0	15947.7	1	SHUMAGIN IS.
18	--	90 312	1246	5710.6	15330.5	2	CALIBRATION
19	21	90 313	1735	5543.7	15410.4	2	CHIRIKOF IS.
20	22	90 315	0720	5506.7	15641.9	2	CHIRIKOF IS.
21	23	90 316	0843	5614.5	15624.0	2	TRINITY IS.
22	24	90 316	1316	5618.6	15607.2	2	TRINITY IS.
23	25	90 317	1245	5655.0	15546.0	2	CAPE ALITAK
24	26	90 318	0905	5724.3	15539.4	2	SHELIKOF STRAIT
25	27	90 318	2019	5742.2	15503.1	2	SHELIKOF STRAIT
26	28	90 319	0915	5759.4	15425.8	2	SHELIKOF STRAIT
27	29	90 319	1624	5803.9	15412.8	2	SHELIKOF STRAIT
28	30-31	90 320	1103	5804.8	15335.0	2	SHELIKOF STRAIT
29	32	90 321	1016	5756.0	15429.9	2	SHELIKOF STRAIT
30	33	90 321	1244	5800.4	15417.1	2	BOTTOM SURVEY
31	34	90 321	1620	5805.7	15409.2	2	BOTTOM SURVEY
32	35	90 321	1833	5809.7	15401.5	2	BOTTOM SURVEY
33	36	90 321	2207	5816.3	15353.6	2	BOTTOM SURVEY
34	37	90 322	0936	5754.6	15429.6	2	BOTTOM SURVEY
35	38-39	90 322	1327	5801.7	15419.3	2	BOTTOM SURVEY
36	40	90 322	1603	5805.2	15406.5	2	BOTTOM SURVEY
37	41	90 322	1929	5810.4	15404.6	2	BOTTOM SURVEY
38	42	90 322	2238	5817.5	15355.7	2	BOTTOM SURVEY
39	43-46	90 323	2153	5753.2	15448.0	2	BOTTOM SURVEY
40	47-48	90 324	1556	5630.1	15606.7	2	TRINITY IS.
41	49	90 326	0619	5650.5	15551.5	2	CAPE ALITAK
42	50	90 326	1606	5705.7	15540.1	3	SHELIKOF STRAIT
43	51	90 327	1520	5742.5	15510.9	3	SHELIKOF STRAIT
44	52	90 327	1820	5726.5	15521.9	3	SHELIKOF STRAIT
45	53	90 328	0336	5742.9	15433.9	3	SHELIKOF STRAIT
46	54-56	90 328	1508	5754.7	15437.5	3	SHELIKOF STRAIT
47	57	90 329	1512	5021.4	15308.1	3	SHELIKOF STRAIT
48	58	90 329	2136	5757.9	15348.6	3	SHELIKOF STRAIT
49	59	90 330	1018	5754.1	15427.5	3	SHELIKOF STRAIT
50	60	90 330	1313	5750.1	15407.9	3	SHELIKOF STRAIT
51	61-62	90 330	2028	5759.9	15416.3	3	SHELIKOF STRAIT
52	--	90 331	1807	5812.6	15302.9	3	CALIBRATION
53	--	90 331	2304	5812.6	15302.9	3	CALIBRATION

Note: CTD depth recorded from the AFSC Seabird CTD system, other data recorded from the Marine Operations Abstracts (MOA).

Table 8. Inventory of XBT casts for the Gulf of Alaska pollock survey, MF901.

CAST	HAUL	DATE	TIME (AST)	POSITION		DEPTH (m)	STRATUM
				LAT	LONG		
1	0	90/02/13	1738	5922.0	14218.0	1098	1
2	0	90/02/15	0746	6041.0	14653.0	403	1
3	0	90/02/17	1557	5843.5	14831.3	276	1
4	0	90/02/19	1543	5627.8	15226.0	291	1
5	0	90/02/22	0809	5721.0	15033.0	436	1
6	0	90/02/25	1449	5617.0	15239.0	1700	1
7	0	90/02/27	1439	5459.0	15641.0	695	1
8	0	90/03/01	0811	5404.0	16235.0	783	1
9	0	90/03/02	1333	5352.0	16326.0	646	1
10	0	90/03/03	1428	5402.0	16216.0	1098	1
11	0	90/03/04	1226	5439.0	15822.0	207	1
12	0	90/03/13	1038	5554.0	15400.0	454	2
13	0	90/03/15	1101	5454.7	15704.1	1061	2
14	0	90/03/16	1620	5626.1	15600.6	258	2
15	0	90/03/18	1820	5740.2	15500.0	253	2
16	0	90/03/20	1908	5811.0	15403.8	271	2
17	0	90/03/25	1734	5634.3	15629.2	198	3
18	0	90/03/27	2346	5741.9	15432.3	218	3
19	0	90/03/30	2050	5801.0	15616.0	275	3

Note: XBT data were collected to satisfy NOAA's Shipboard Environmental Data Acquisition System (SEAS) program requirement.

Table 9. Proportion of pollock samples ( $\geq 20\text{cm}$ ) by maturity stage as observed in Shelikof Strait and other areas surveyed, (Marmot Bay, Prince William Sound, outer shelf), Miller Freeman, cruise 90-1.

Data Set	Maturity Stage - Males						Maturity Stage - Females					
	1	2	3	4	5	N	1	2	3	4	5	N
Outside Shelikof February 15- March 15, 1990 Hauls 1-22	.17	.10	.18	.55	-	637	.05	.15	.80	.01	-	928
Shelikof Midwater March 16-19, 24-29, 1990 Hauls 23-30, 47-63	.02	.40	.09	.48	-	1,155	.01	.46	.35	.11	.07	1,267
Shelikof Demersal March 20-21, 1990 Hauls 31-46	.01	.16	.08	.75	-	287	-	.17	.75	.07	.01	466

Note<sup>1</sup>: Stage 1=immature, stage 2=developing, stage 3=mature, stage 4=spawning and stage 5=spent.

Note<sup>2</sup>: Differences in sums of maturity proportions are due to rounding.