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Resource Assessment and Conservation Engineering
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CRUISE RESULTS
NOAA Ship MILLER FREEMAN
Cruise No. 85-03, Legs I and II
Shelikof Strait Pollock Acoustic-Midwater Trawl Surveys
February 20 - March 29, 1985

CRUISE PERIOD, AREA and SCHEDULE

Four acoustic (echo integrator)-midwater trawl surveys of the spawning stock of walleye pollock (Theragra chalcogramma) in Shelikof Strait were completed between February 21 and March 28, 1985. The surveys were conducted in the area between Cape Chiniak and Chirikof Island (Fig. 1). The four survey periods were (1) February 21-28, (2) March 1-9, (3) March 14-20, and (4) March 21-28. The cruise began and ended in Kodiak on February 20 and March 29, respectively; the vessel was in Homer for a mid-cruise break during March 11-13.

OBJECTIVES

The 1985 acoustic surveys of the Shelikof pollock stock were designed to be comparable to those conducted during 1981, 1983 and 1984. The estimates of stock size and age composition obtained from the acoustic survey program are a primary data base for assessment and management of the western Gulf of Alaska pollock resource. The objectives of the 1985 surveys were:

(1) to collect acoustic and biological data necessary to provide age-specific estimates of abundance of the off-bottom portion of the spawning pollock stock; a series of surveys was conducted to determine changes in abundance during the prespawning and spawning periods.

(2) to obtain in situ measurements of the target strengths (acoustic sizes) of pollock in order to better define the accuracy of acoustic estimates of pollock density.

(3) to obtain data on the relative abundance of juvenile pollock in the survey area.

(4) to collect XBT (expendable bathythermograph) and CTD (conductivity-temperature-depth) data for studies of the distribution of pollock and pollock eggs in relation to the physical environment.

(5) to obtain samples of pollock tissues and whole pollock for genetic and energetics studies, respectively.

This report summarizes the results of the 1985 surveys and includes a comparison of all pollock abundance and age composition estimates determined from the 1981, 1983 and 1984 surveys. The estimates for previous years have been included to provide a timely summary of information on changes in stock size and recruitment obtained by the survey program. Because of the pronounced decline in the survey estimates of stock size, especially the large decrease estimated to have occurred between 1984 and 1985, effective communication of the survey findings at the present time is particularly important. More complete information on the status of the pollock resource, based upon both survey and fishery data analyses, will be included in a report, "Condition of Groundfish Resources in the Gulf of Alaska Region as Assessed in 1985", which will be available from the Northwest and Alaska Fisheries Center in November, 1985.

VESSEL, ACOUSTIC EQUIPMENT and TRAWL GEAR

The Miller Freeman is a 66 m (216 ft) stern trawler with a 2,200 horsepower single main engine. Acoustic system electronics were installed in standard equipnent racks in a data processing laboratory. The system's towed transducer was operated using 600 ft of 1-inch steel cable on a winch drum attached to a hydraulic crane located on the starboard side of the main deck. The vessel's cable netsounder system was used during midwater trawling operations.

Acoustic data were collected using a 38 khz echo sounder together with a digital echo integrator and a dual beam target strength measurement system. The integrator and dual beam system were interfaced to a microcomputer. The sounder's transducer had 6° (transmit and receive) and 25° (receive only) beams and was mounted in a dead weight towed body which was deployed behind the vessel at a depth of approximately 20 m. The sounder was operated at a pulse repitition rate of 1 per second and a transmitted pulse length of 0.6 milliseconds.

Echo sign was sampled using a Diamond 1000 midwater trawl. The trawl was fished with either 1.5 x 2.1 m or 1.8 x 2.7 m steel V-doors, 55 m dandylines (2 per side), and a 113 kg tom weight attached to each lower wing tip. Mesh sizes (stretched measure) tapered from 81 cm in the wings and forward part of the body to 3.8 cm in the codend. The average vertical mouth opening of the trawl was approximately 15 to 18 m.

SURVEY and ANALYSIS METHODS

Sur-vey operations were conducted 24 hours per day along zig-zag trackline patterns which covered the area between the 91 m (50 fm) bottom depth contours on either size of the Strait (Figure 1). The average distance between adjacent transects was about 5 nmi during surveys 1-3 and about 7.5 nmi during survey 4. Surveys 1-3 were run "down" the Strait (NE to SW direction); survey 4 was run in the opposite direction. Vessel speed along transects was approximately 9 kn. Echo integrator density estimates were obtained along each transect at 5 minute intervals (equivalent to 300 sounder transmissions and a distance of 1,389 m

at 9 kn) for each of up to 30 non-overlapping depth strata in the depth zone between 15 m below the transducer and the bottom. Intrusion of the bottom into the preselected depth strata was compensated for automatically by the echo integrator system. Generally, targets located more than about 3 m above the bottom could be detected and isolated from bottom echoes.

Midwater trawl hauls were made during each survey to provide data on the biological composition (length, sex, weight, age and maturity) of the pollock stock and on the occurrence of other midwater species. The distribution of trawl haul stations was roughly proportional to the relative abundance of pollock echo sign. The duration of each haul depended on the density of the target echo sign, the time required to accurately position the trawl and the time necessary (based on interpretation of the netsounder echo display) to capture a sample of fish large enough to satisfy biological sampling requirements. The average trawl towing speed was approximately 3 kn. Standard catch sorting and enumerations procedures were used to provide estimates of weight and numbers by species for each haul. The total catch was sorted except when it exceeded approximately 2,500 lbs. Pollock length, sex, age (otoliths) and maturity composition data were obtained from a randomly selected sample, or subsample, from each haul. Collections of individual pollock weight data were stratified by length. Only length frequency data were collected for species other than pollock.

Pollock biomass estimates for each survey were determined by multiplying the average surface density estimate (kg/m^2) by the survey area.[1/] The ~~survey~~ surface density estimates were calculated by summing volumetric densities (kg/m^3) over depth. For fish older than age 1, the echo integrator data were scaled to estimates of absolute density by assuming an average target strength (i.e., the target strength of the average scattering cross section) of -31.3 dB/kg. Age specific biomass and population (number) estimates were determined for each survey using the total biomass estimate, length frequency data, a length-weight relationship and an age-length key. For age 1 fish, which were found primarily in a distinctive midwater layer that contained few older fish, density estimates were calculated using an average target strength of -23 dB/kg.

Target strength measurements were obtained only at night because pollock could usually not be detected as single target echoes during the day. During target strength data collection, the transducer was towed at a speed of approximately 5 kn. Trawl sampling at appropriate depths was done just before or after nearly all the data collection periods in order to provide species composition and biological data.

RESULTS

Sampling Effort

Trackline distances on surveys 1-4 were 844 nmi (1,563 km), 840 nmi (1,557 km), 792 nmi (1,467 km), and 600 nmi (1,111 km), respectively. Fifty

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[1/] Because species other than pollock occurred in minor quantities, no corrections were made for their contribution to the echo integrator output.

seven midwater trawl hauls were completed during the surveys (Table 1 and Figure 1). The frequency of occurrence and total catch of each species are shown in Table 2. The type and quantity of pollock biological data obtained from each haul are shown in Table 3. As indicated in Table 1 (haul 57) and Table 2, one large catch of Pacific herring occurred during survey 4. This catch was from an isolated aggregation of herring that was located at the northeast corner of the survey area. Its occurrence does not indicate that herring could have been mixed in significant quantities with pollock. Without this catch, species other than pollock were only 1.6% of the total catch (in weight) of all species, which is very close to the percentage observed during previous years' surveys, as well as in the Shelikof joint venture fishery catches.

Pollock target strength data, which have not yet been analyzed, were collected 12 times during the surveys; the data collection periods were 1.5 to 6.5 hours in duration. XBT data were obtained at 47 of the 57 trawl stations. Nineteen CTD casts were made along selected transects during survey 4.

Pollock Abundance, Distribution and Biological Composition

The survey estimates of average pollock density and total biomass were significantly lower than those for previous years (1981, 1983 and 1984) in which comparable surveys were conducted (Table 4 and Figure 2). The "annual estimate" of biomass for 1985 (0.70 million t) is only 38% of the corresponding estimate for 1984 (1.84 million t). The geographic distribution of pollock in the Strait region, and its variation with time during the overall survey period, are shown in Figure 3. The distribution pattern is similar to that observed in previous years, but the areas of high density where spawning was most concentrated were relatively small. Survey to survey changes in mean density and the areas occupied by significant densities and, consequently, changes in the total biomass estimates, were smaller than observed in past years (Table 4). Also, during the period that surveys 1–3 were completed, there was relatively little variability in age and length compositions between surveys (Figures 4 and 5). Maturity data indicate that the surveys were completed prior to the time a significant percentage of the stock had completed spawning (Table 5).

The continuous decline in the survey estimates of abundance between 1981 and 1985 corresponds with the diminishing contribution of five strong year classes (1975-1979) and a lack of recruitment, i.e., the relative weakness of the 1980, 1981 and 1982 year classes (ages 3–5 in 1985) (Figures 6 and 7 and Tables 6 and 7). The 62% reduction in total biomass between 1984 and 1985 is significantly larger than the year-to-year changes that occurred between 1981 and 1984. The decrease in the abundance of the 1978 and 1979 year classes (ages 6 and 7 in 1985) was unusually large and may reflect changes in the distribution and availability of spawning pollock in the western Gulf of Alaska. An assessment of the condition of the western Gulf pollock resource, which incorporates both the survey results and analyses of joint venture and foreign fisheries data, is currently being completed.

The 1985 and previous years' surveys have provided information on the abundance of age 2 and, to a very limited extent, age 1 pollock. These age groups are substantially less available to the surveys than older fish and,

generally, estimates of their abundance cannot be expected to provide reliable information on either the absolute or relative strengths of the year classes they represent.[1/] However, in 1985, age 1 fish, which were aggregrated in a readily detectable midwater layer, were much more abundant than in earlier years (Table 8). The very marked difference between 1985 and past years, suggests that the 1984 year class could be unusually strong. The geographic distribution of age 1 fish during the surveys is illustrated in Figure 7.

Pollock length-weight relationships estimated for each of the four 1985 surveys are shown in Figure 8. Estimates of sex ratio, by age and survey, are shown in Table 9.

SCIENTIFIC PERSONNEL

Edmund Nunnallee	Chief Scientist	NWAFC
Neal Williamson	Statistician	NWAFC
John Garrison	Electronics Technician	NWAFC
Jan McCrory	Biological Technician	NWAFC
Denise Adams	Biological Technician	NWAFC
Jeffree Stewart	Biological Technician	NWAFC
Robert Fagen (3/12-29)	Biometrician	Univ. of Alaska

1/ Although age 2 fish have been significant fractions of the total population (number) estimates, their contribution to the estimates of total biomass has been small. In 1981 and 1983-1985, 2 year old fish were 9.0, 2.0, 0.4 and 3.2 percent, respectively, of the annual estimates of total biomass.

Table 1.--Hidwater trawl haul station and catch data, Miller Freeman Cruise 85-03, Legs I and II.

Haul no.	Date	Time (AST)	Start position Lat.(N)	Long.(W)	Average depth (fm) (footrope/ bottom)	Catch (lb) Pollock Age 1	>Age 1	Eulachon	Pacific cod	Pacific herring	Other species
survey 1											
1	2/22	0302-0313	58°17'	153°56'	70/116	0	460	T[a]	0	0	1
2	2/22	1448-1508	58°02'	154°16'	124/130	0	3995	10	15	0	12
3	2/22	1937-1957	57°54'	154°17'	75/114	0	123	4	24	0	1
4	2/23	1809-1829	57°19'	155°18'	88/141	40	1	0	0	0	15
5	2/23	1949-1959	57°18'	155°20'	120/140	T	2531	38	0	0	0
6	2/24	0526-0546	57°21'	155°41'	130/154	0	953	4	17	0	17
7	2/24	0959-1009	57°07'	155°10'	88/128	7	107	1	0	0	8
8	2/24	1611-1621	57°07'	155°22'	98/145	5	109	T	0	0	8
9	2/24	1821-1831	57°04'	155°21'	136/145	1	2930	37	9	0	9
10	2/25	0948-0958	56°52'	155°53'	130/165	0	1186	T	0	0	23
11	2/25	1225-1235	56°57'	155°53'	101/163	13	0	0	0	0	0
12	2/25	1910-1025	56°38'	155°32'	92/112	4	67	T	0	0	9
13	2/26	0645-0715	56°29'	155°43'	42/75	0	928	0	37	0	0
14	2/27	1234-1244	56°25'	156°27'	101/121	124	0	0	0	0	0
15	2/28	0517-0617	56°26'	155°44'	55/78	0	698	T	41	0	6
16	2/28	1710-1740	55°58'	156°16'	115/120	15	240	1	0	0	1
Survey 2											
17	3/01	2138-2202	58°26'	153°45'	82/91	0	1161	0	20	0	T
18	3/02	0448-0508	58°23'	153°42'	74/100	0	478	T	0	0	2
19	3/02	1622-1632	58°07'	154°03'	87/126	0	3103	0	0	0	0
20	3/02	1842-1847	58°06'	154°05'	132/137	0	1697	T	0	0	14
21	3/02	2338-0005	57°60'	153°55'	72/109	0	349	1	11	0	T
22	3/03	1307-1330	57°56'	155°46'	65/115	1	2010	0	0	0	0
23	3/03	2217-2257	57°44'	154°51'	62/139	0	112	0	0	0	2
24	3/04	0510-0610	57°47'	154°58'	63/160	0	257	T	0	0	5
25	3/04	1225-1240	57°37'	155°11'	64/154	0	633	0	0	0	2
26	3/04	1320-1325	57°39'	155°14'	104/169	13	157	0	0	0	0
27	3/04	1420-1425	57°40'	155°14'	147/162	0	3633	T	63	0	54
28	3/04	0105-0130	57°09'	154°55'	52/62	0	614	2	4	0	3
29	3/05	0958-1008	57°17'	155°35'	110/157	23	445	T	0	0	3
30	3/05	1031-1057	57°15'	155°33'	128/153	0	813	23	0	0	4
31	3/06	0713-0719	56°55'	155°52'	150/167	0	2731	6	0	0	13
32	3/06	1543-1553	56°52'	156°05'	109/116	23	5	T	0	0	3
33	3/08	2236-2303	56°28'	156°06'	108/150	9	35	2	0	0	31
34	3/09	1300-1310	56°10'	156°17'	101/129	18	0	0	0	0	0
Survey 3											
35	3/14	2228-2234	58°06'	154°09'	155/160	0	1049	94	0	0	23
36	3/15	0627-0652	57°52'	154°15'	65/118	0	1004	2	35	0	18
37	3/15	1747-1757	57°49'	154°58'	100/125	T	1077	T	7	0	0
38	31/6	1827-1847	57°33'	155°17'	50/156	0	869	0	0	0	0
39	3/18	2010-2025	57°14'	155°15'	108/135	2	151	2	0	0	4
40	3/19	1238-1248	56°59'	155°29'	103/151	104	41	T	0	0	5
Survey 4											
41	3/21	1051-1101	56°38'	155°60'	101/162	49	10	T	0	0	2
42	3/22	0530-5045	56°53'	155°13'	38/128	0	41	0	0	0	T
43	3/22	1548-1603	57°05'	155°13'	120/135	0	742	47	0	0	9
44	3/23	0027-0124	57°22'	155°29'	56/154	T	214	2	17	0	1
45	3/23	2254-2354	57°21'	154°56'	55/117	T	602	8	4	0	8
46	3/24	1813-1818	57°41'	155°14'	115/167	0	3277	0	0	0	0
47	3/24	1935-1942	57°40'	155°16'	140/168	0	14706	0	0	0	0
48	3/25	0413-0513	57°43'	155°14'	63/166	T	128	T	10	0	1
49	3/25	1907-1937	57°59'	154°24'	152/166	0	1028	3	0	0	2
50	3/26	0700-0715	58°01'	153°43'	100/125	T	101	37	0	0	13
51	3/26	0836-0851	58°02'	153°45'	103/110	8	430	43	0	0	22
52	3/26	2224-2244	58°23'	153°47'	105/117	0	174	T	0	T	0
53	3/27	0619-0707	58°14'	153°13'	51/66	0	0	0	0	14700	0
54	3/27	1810-1822	57°47'	155°00'	115/164	T	2765	T	0	0	T
55	3/28	0141-0251	57°43'	155°06'	64/159	0	122	1	5	0	T
56	3/28	0806-0826	57°57'	154°33'	130/138	0	833	6	6	0	2
57	3/28	1041-1049	58°02'	154°19'	132/147	0	1497	0	0	0	0
					Totals	265	63438	380	323	14700	340

[a]T (catch <1 lb).

Table 2.--Frequency of occurrence and total catch by species in 57 midwater trawl hauls made during Miller Freeman Cruise 85-3, Legs I and II.

Species	Freuuency		Total catch	
	No.	%	lb.	%
Walleye pollock (Theragra chalcogramma)	56	98.3	63,703	80.2
Eulachon (Thaieichthys pacificus)	44	77.2	380	0.5
Jellyfish (Unidentified)	42	73.7	117	0.1
Smooth lumpsucker (Aptocyclus ventricosus)	18	31.6	103	0.1
pacific cod (Gadus macrocephalus)	16	28.1	323	0.4
Arrowtooth flounder (Atheresthes stomias)	14	24.6	89	0.1
shrimp (Pandalidae)	10	17.5	4	<0.1
Flathead sole (Hippoglossoides elassodon)	5	8.8	9	<0.1
Rock sole (Lepidopsetta bilineata)	5	8.8	8	<0.1
pacific sandfish (Trichodon trichodon)	4	7.0	2	<0.1
Squid (Unidentified)	3	5.3	1	<0.1
Pacific herring (Clupea harengus pallasi)	2	3.5	14,700	18.5
Chinook salmon (Oncorhynchus tshawytscha)	1	1.8	3	<0.1
Ragfish (Icosteus aenigmaticus)	1	1.8	1	<0.1
	Total		79,446	

Table 3.--Pollock biological data/samples collected, by midwater trawl haul, during Miller Freeman Cruise 85-03, Legs I and II.

Haul no.	Sample type: Lengths Age 1	Lengths >Age 1	Maturity (Female)	Otoliths	Weights	Tissues[a]	Whole fish[b]
1	-	3ZS	90	47	43	-	-
2	-	3OE	7P	47	-	-	-
3	-	9Z	90	44	46	-	-
4	171	777	-	-	22	-	-
5	-	264	1OS	60	45	-	-
6	-	316	777	69	48	-	200
7	189	ZOE	-	-	-	-	-
8	101	112	59	-	59	-	-
9	14	410	76	76	-	-	-
10	-	319	101	65	36	-	-
11	777	1ZE	7Z	-	12	-	-
12	8Z	61	61	61	-	-	-
13	-	210	S3	31	22	-	-
14	198	ZOP	S	-	5	-	-
15	-	3ZE	10S	35	108	-	-
16	77	14	14	14	14	-	-
17	-	270	80	39	41	-	-
18	-	326	1PO	-	140	-	-
19	-	3OP	9Z	52	40	-	-
20	-	286	1EE	75	58	-	-
21	-	191	144	40	104	-	-
22	-	3SO	9Z	58	34	-	-
23	-	1OE	91	28	91	-	-
24	-	Z3S	190	59	131	-	-
25	-	228	56	49	7	-	-
26	63	109	77	59	12	-	-
27	-	281	86	75	11	-	-
28	-	3OE	137	47	90	-	-
29	-	7SP	S1	39	12	-	-
30	-	3SP	69	61	8	-	-
31	-	488	91	72	19	-	-
32	1PZ	7	-	-	-	-	-
33	136	30	11	-	11	-	-
34	108	-	-	-	-	-	-
35	-	3ZE	78	43	35	-	-
36	-	380	95	43	52	-	-
37	-	Z89	80	39	41	-	-
38	-	3ZS	777	61	56	-	-
39	-	186	SP	54	-	-	-
40	142	7Z	7Z	27	-	-	-
41	1ZP	Z8	-	-	-	-	-
42	-	41	P1	41	41	-	-
43	-	7PP	116	32	84	-	-
44	-	282	81	81	81	-	-
45	-	387	1PO	69	140	-	-
46	-	3ZP	7S	75	75	-	-
47	-	290	P8	48	48	-	-
48	-	165	4S	45	-	-	-
49	13	3OE	48	48	48	-	-
50	-	9E	1OS	81	24	-	-
51	-	209	S	5	-	-	-
52	-	8E	81	81	24	-	-
53	-	-	-	-	-	-	-
54	Z	381	100	100	100	100	100
55	-	108	108	-	108	-	-
56	-	100	100	100	100	100	-
57	-	166	-	-	-	-	100
Totals	1,671	1 Z69P	4,013	Z,3ZS	2,326	ZOO	POO

[a]Genetic studies (electrophoretic analysis).

[b]Energetics studies (Univ. of Alaska).

Table 4.--Pollock biomass estimates determined from 1981 and 1983 through 1985 Shelikof Strait acoustic-midwater trawl surveys.

Year	Survey number and period	Mean density ($kg/10^3m^2$)	Total area (km^2)	Biomass ($t \times 10^6$)	95% confidence interval ($t \times 10^6$)
1981[a]	1 March 3-15	637.6	6,870	4.38	2.92 to 5.84 (±33.3%)
	2 March 24-27	363.6	8,674	3.15	2.07 to 4.23 (±34.3%)
	3 April 4-10	251.0	12,138	3.06	2.02 to 4.08 (±33.3%)
1982	No survey				
1983[a]	1 March 6-15	144.9	17,587	2.46	1.54 to 3.40 (+37.7%)
	2 March 16-19	194.7	12,123	2.36	1.26 to 3.46 (±46.6%)
	3 April 6-13	41.2	19,733	0.82	0.57 to 1.07 (±30.5%)
1984[a]	1 March 3-9	133.6	16,567	2.03	1.43 to 2.64 (±29.9%)
	2 March 9-16	107.1	15,043	1.57	1.31 to 1.84 (±17.1%)
	3 March 16-18	139.3	14,383	1.90	1.06 to 2.75 (±44.2%)
	4 March 22-25	127.5	15,641	1.72	0.98 to 2.46 (±42.9%)
	5 April 1-7	119.8	15,147	1.66	1.19 to 2.13 (±28.3%)
1985[a]	1 Feb. 21-28	39.6	16,361	0.65	0.47 to 0.82 (±27.3%)
	2 March 1-9	43.8	15,975	0.70	0.48 to 0.92 (±31.3%)
	3 March 14-20	46.8	16,389	0.77	0.55 to 0.98 (±27.8%)
	4 March 21-28	51.9	13,736	0.71	0.51 to 0.91 (±27.8%)

Annual estimates

Year	Biomass ($t \times 10^6$)	95% confidence interval ($t \times 10^6$)	Source of estimates
1981	3.77	2.86 to 4.67	Mean of estimates for surveys 1 and 2
1982	No survey		
1983	2.43	1.69 to 3.13	Mean of estimates for surveys 1 and 2
1984	1.84	1.21 to 2.47	Mean of estimates for surveys 1, 2, 3
1985	0.70	0.50 to 0.91	Mean of estimates for surveys 1, 2, 3

[a]Estimates for 1981, 1983 and 1984 include very small amounts of age 1 fish, e.g., the biomass of age 1 fish in the "annual estimates" for these years did not exceed 0.024% of the total biomass. The 1985 estimates include only fish age 2 and older.

Table 5.--Percentage maturity compositions for age-3 and older female pollock sampled during 1983 through 1985 Shelikof Strait acoustic-midwater trawl surveys.

Year	Survey number and period			Maturity stage				
				Immature	Developing	Mature	Spawning	Spent
1983	1	March	6-15	0.0	17.4	82.1	0.5	0.0
	2	March	16-19	0.0	15.2	81.2	2.8	0.8
	3	April	6-12	0.0	17.9	5.8	12.8	63.5
1984	1	March	1-9	6.4	21.6	72.0	0.0	0.0
	2	March	9-16	0.0	11.9	86.3	1.4	0.4
	3	March	16-18[a]	---	--	--	--	--
	4	March	22-25	0.6	14.2	48.5	33.0	3.6
	5	April	1-7	0.0	2.3	14.1	28.5	55.1
1985	1	Feb.	21-28	0.0	15.4	84.6	0.0	0.0
	2	March	1-9	3.7	33.9	62.4	0.0	0.0
	3	March	14-20	0.7	30.3	65.5	3.5	0.0
	4	March	21-28	0.3	17.9	55.4	20.1	6.3

[a]Maturity by age data were not obtained for the March 16-18 survey.

Table 6.--Pollock population and biomass estimates, by age (ages ≥2), determined from 1981 and 1983 through 1985 Shelikof Strait acoustic-midwater trawl surveys.

Numbers (millions)

Survey year	Age 2	3	4	5	6	7	8	9	10	11	12
1981	3,704.6	1,490.7	888.5	3,480.1	1,464.1	258.6	151.2	115.7	31.4	3.5	0.0
1982	No survey										
1983	757.8	325.7	1,410.0	1,270.3	761.7	648.4	145.2	19.5	11.9	4.1	1.9
1984	74.2	258.9	231.1	700.9	1,045.0	464.8	239.8	42.1	3.7	0.0	0.9
1985	218.6	92.4	194.9	111.5	214.0	269.2	103.5	26.0	2.9	1.5	0.6

Biomass (thousands of metric tons)

Survey year	Age 2	3	4	5	6	7	8	9	10	11	12
1981	350.6	375.0	339.4	1,509.0	756.1	177.3	115.8	111.0	27.9	3.2	0.0
1982	No survey										
1983	58.9	103.9	570.7	700.8	497.2	360.6	105.1	17.3	12.1	4.8	1.6
1984	8.0	64.1	105.5	405.8	710.5	333.8	169.8	34.8	4.9	0.0	0.9
1985	22.4	27.1	99.8	67.9	157.2	217.0	86.6	21.5	2.9	1.9	0.6

Table 7.--Pollock population estimates (numbers in millions), by year class and age (ages ≥2), determined from 1981 and 1983 through 1985 Shelikof Strait acoustic-midwater trawl surveys.

	Year class														
Age	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
2											3704.6	*	757.8	74.2	218.6
3										1490.7	*	325.7	258.9	92.4	
4									888.5	*	1410.0	231.1	194.9		
5								3480.1	*	1270.3	700.9	111.5			
6							1464.1	*	761.7	1045.0	214.0				
7						258.6	*	648.4	464.8	269.2					
8					151.2	*	145.2	239.8	103.5						
9				115.7	*	19.5	42.1	26.0							
10			31.4	*	11.9	3.7	2.9								
11		3.5	*	4.1	0.0	1.5									
12	0.0	*	1.9	0.9	0.6										

*No survey in 1982.

Table 8.--Relative abundance of age 1 pollock determined from Shelikof Strait acoustic-midwater trawl surveys in 1981 and 1983-1985.

Survey year	Year class	Relative abundance index[a]	
		Number	Biomass
1981	1980	26.3	26.3
1982	- - - - - - - - - - -	No survey	- - - - - - - - - - -
1983	1982	1.2	1.3
1984	1983	1.0	1.0
1985	1984	5,682.0	5,750.0

[a]Small differences between the number and biomass indices are caused by differences between years in estimates of average weight.

Table 9.--Pollock sex ratio (percent males), by age, estimates determined from the 1985 Shelikof Strait acoustic-midwater trawl surveys.

	Survey number and period			
Age	1 (Feb. 21-28)	2 (March 1-9)	3 (March 14-20)	4 (March 21-28)
2	52.2	48.0	51.3	58.3
3	64.5	48.3	44.4	47.6
4	60.6	49.5	43.9	38.7
5	57.1	51.9	46.7	40.3
6	57.0	54.4	42.9	41.9
7	46.7	55.4	36.5	39.7
8-12	20.0	36.5	20.5	47.3
Total	51.5	49.5	39.9	43.9
N	549	697	268	733

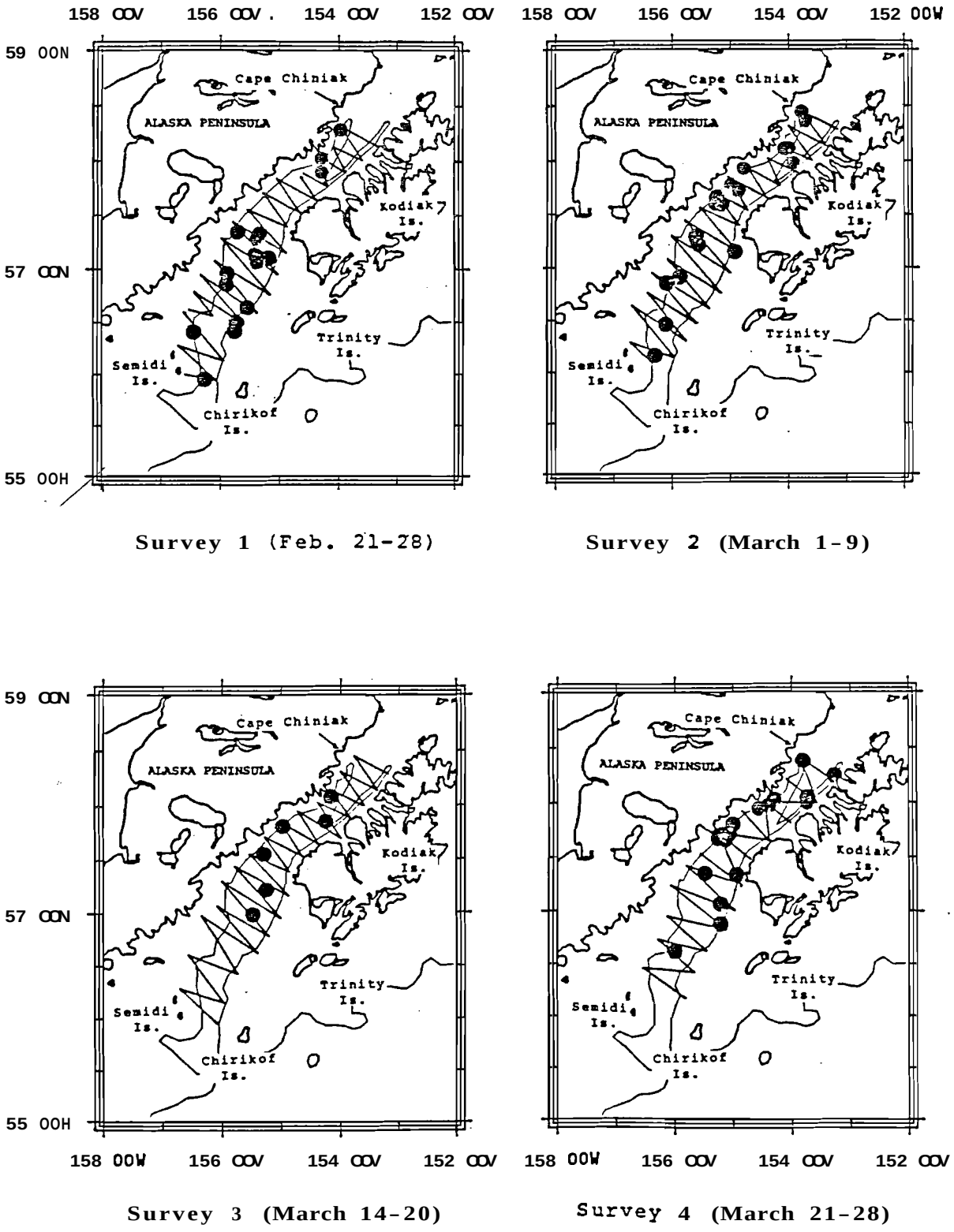


figure 1.--Acoustic survey tracklines and midwater trawl stations, Miller Freeman Cruise 85-03, Legs I and II.

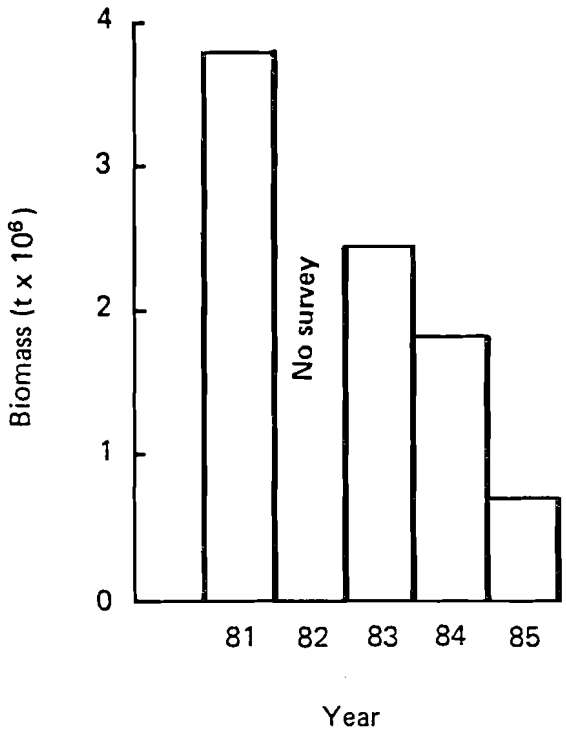
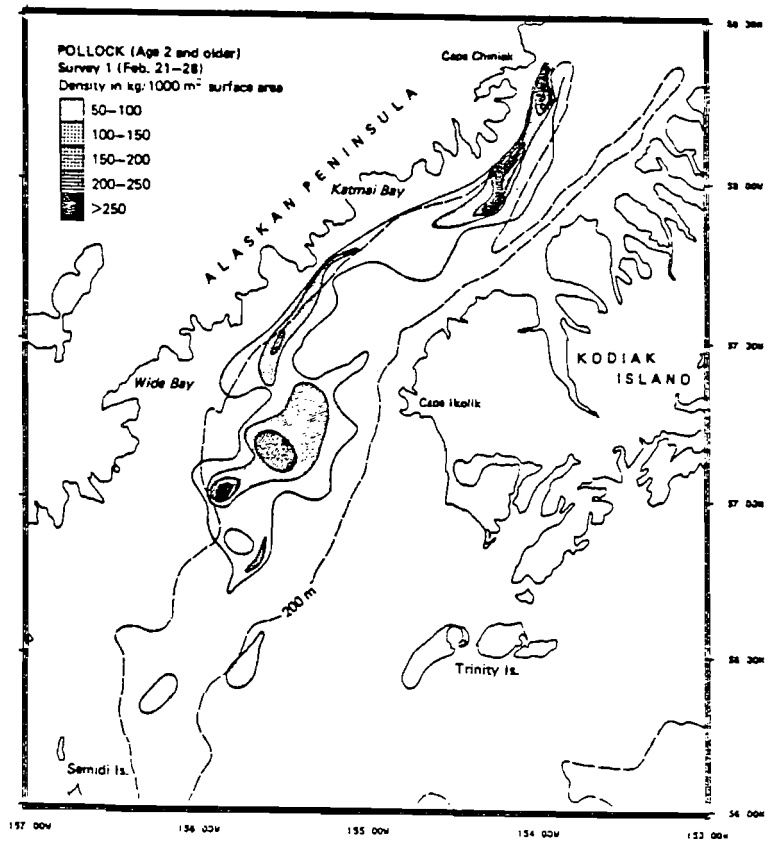


Figure 2.--Annual estimates of pollock biomass determined from 1981 and 1983-1985 Shelikof Strait acoustic-midwater trawl surveys.



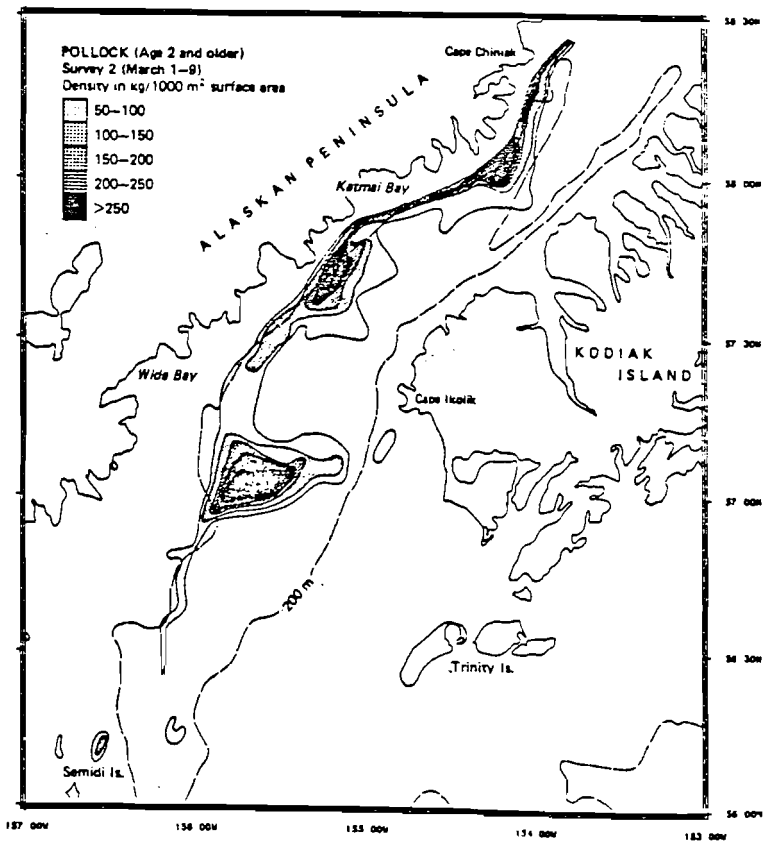
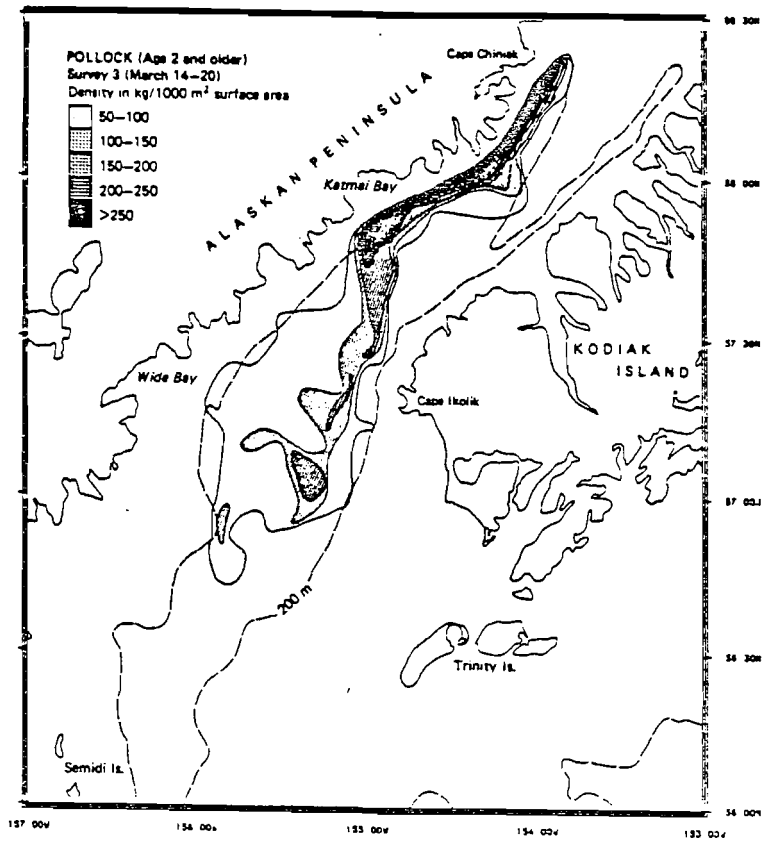


Figure 3.--Density distributions of pollock (ages ≥2) in Shelikof Strait during each of the four 1985 acoustic-midwater trawl surveys.



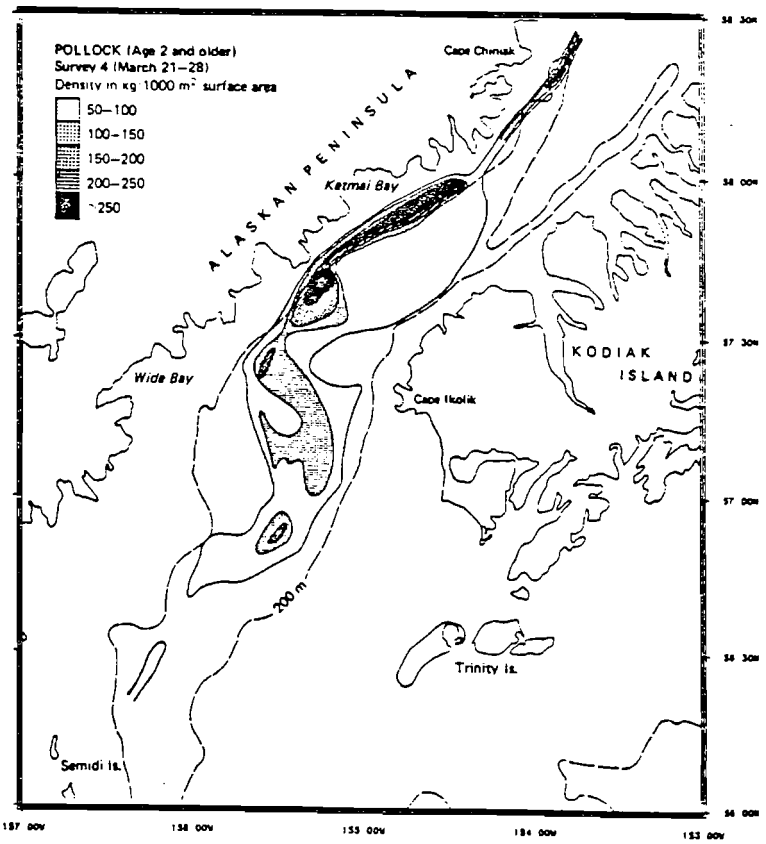


Figure 3.--Continued.

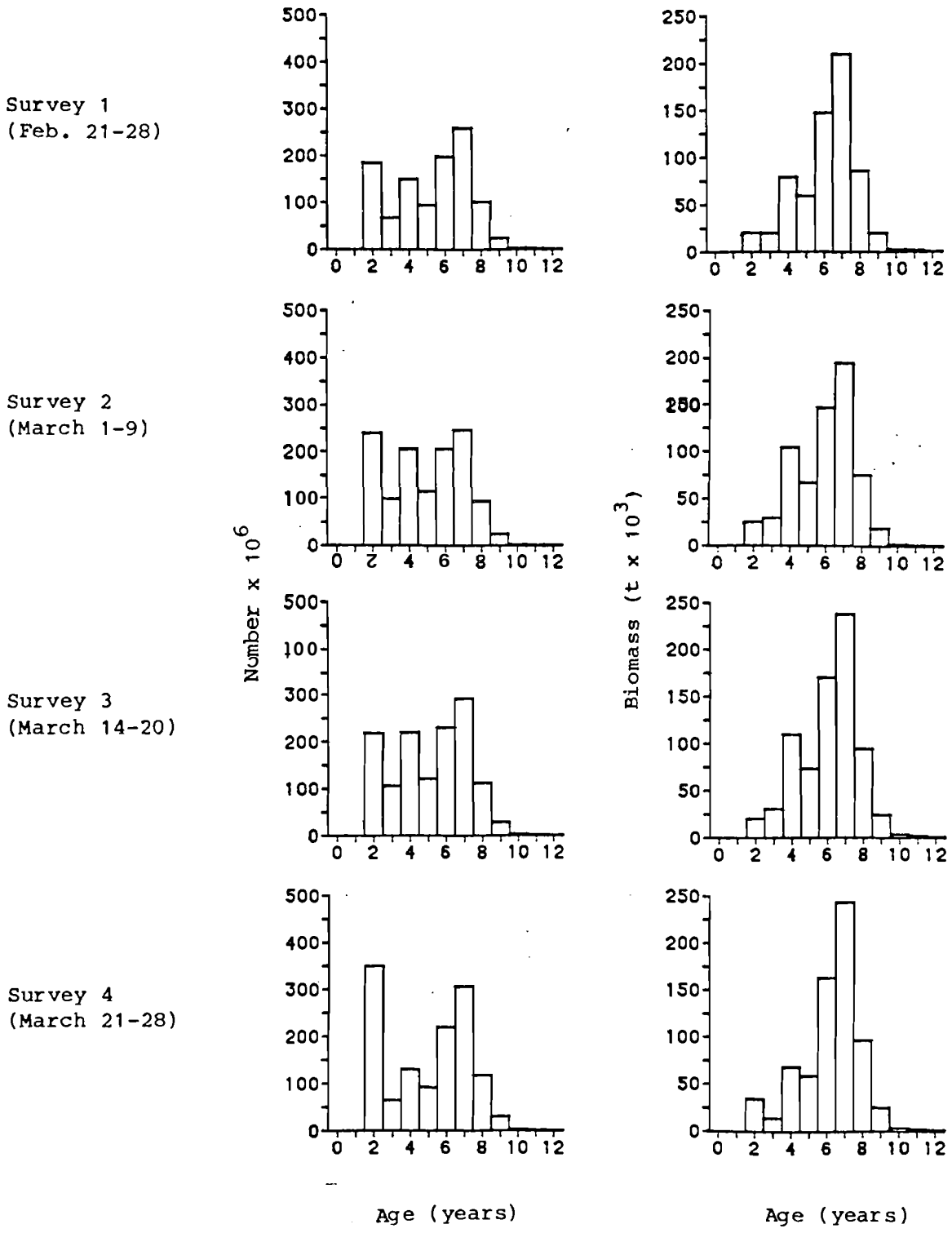


Figure 4.--Pollock population and biomass age distributions (ages ≥2) determined from each of the 1985 Shelikof Strait acoustic-midwater trawl surveys.

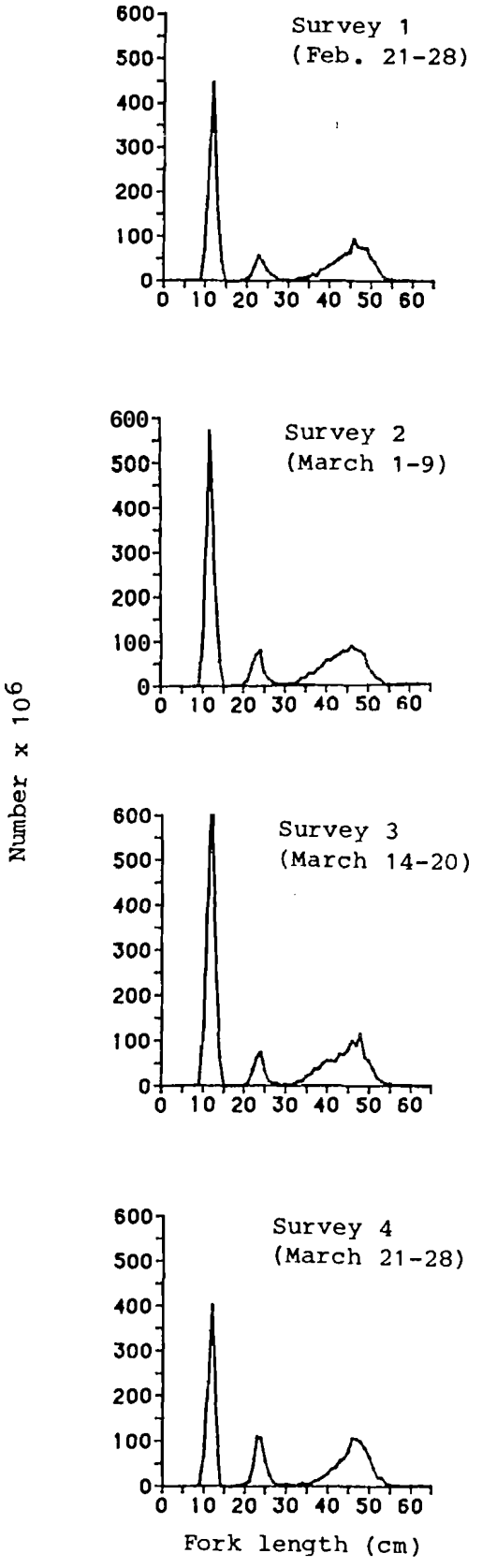


Figure 5.--Pollock population length distributions (sexes combined) determined from each of the four 1985 Shelikof Strait acoustic-midwater trawl surveys. The first mode in each distribution (9-14 cm length range) represents 1-year-old fish.

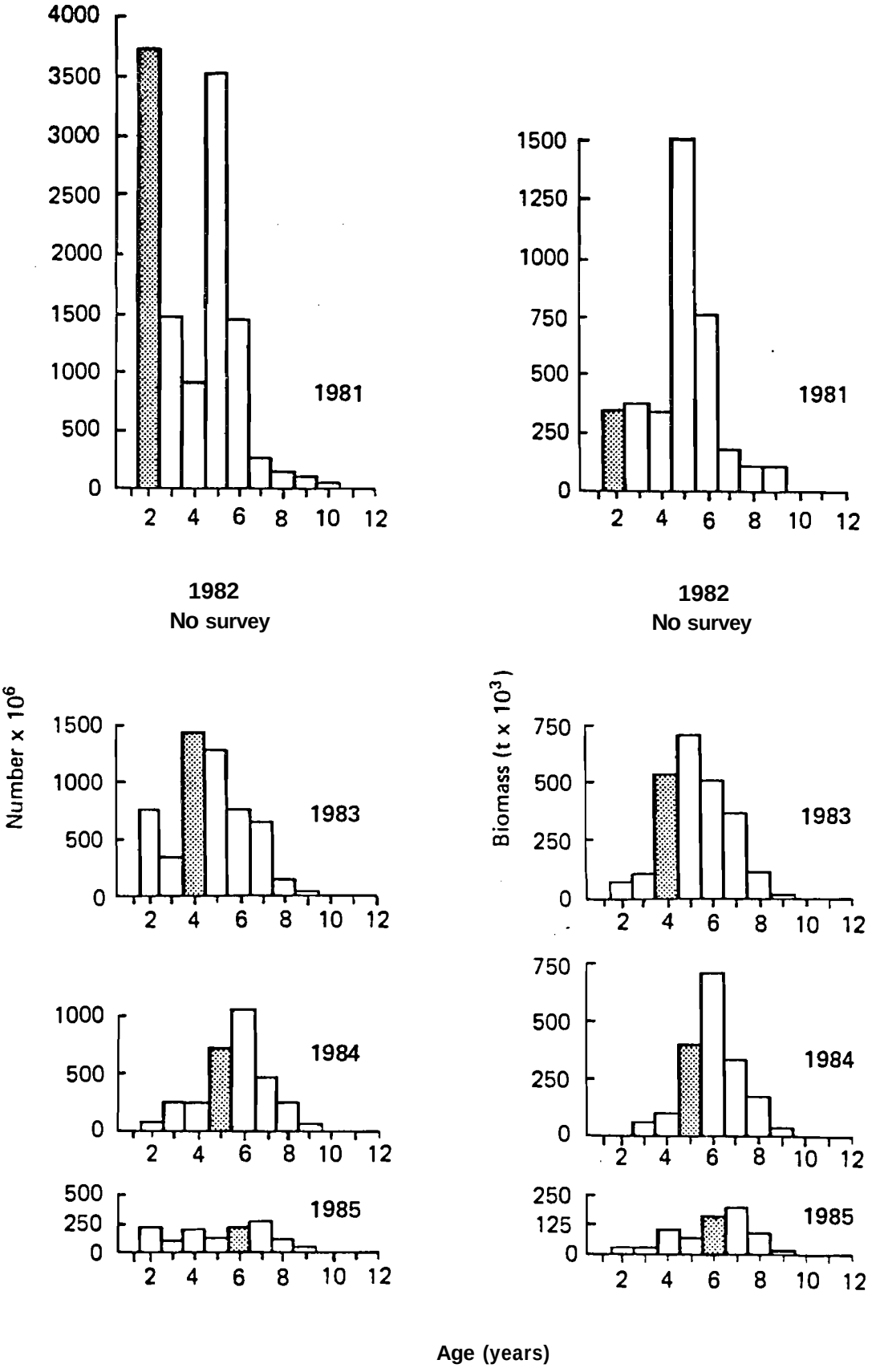


Figure 6.--Pollock age distributions (numbers and biomass) determined from 1981 and 1983–1985 Shelikof Strait acoustic–midwater trawl surveys.

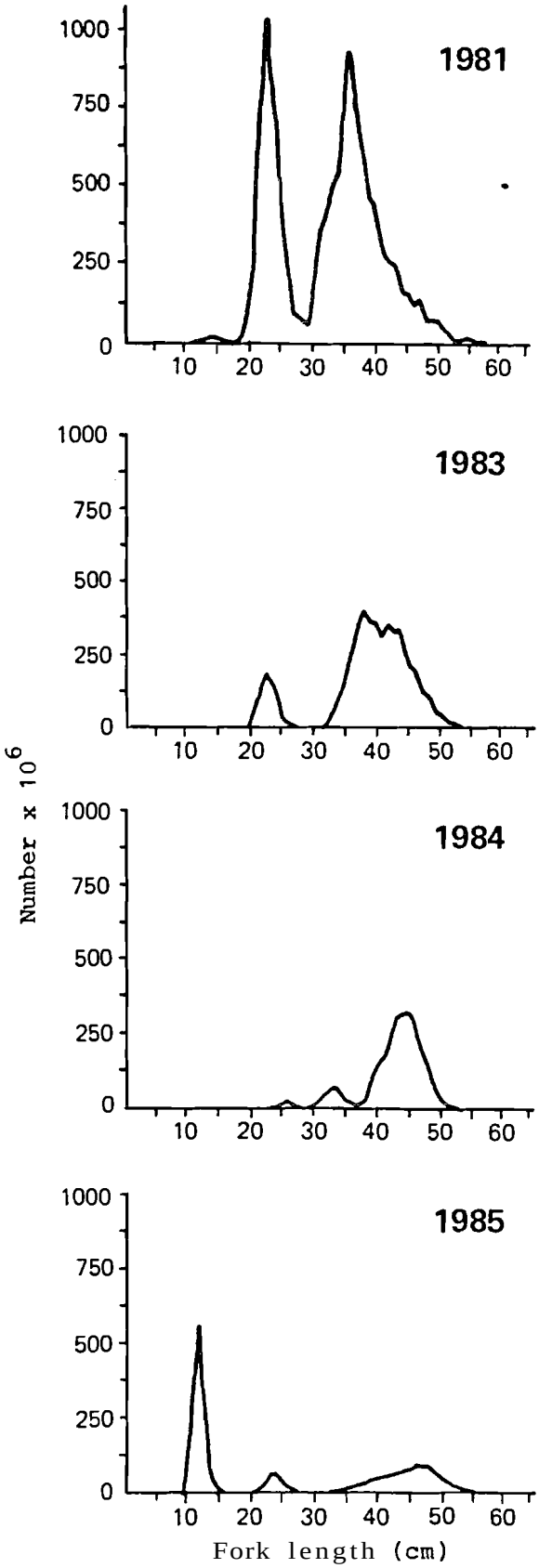
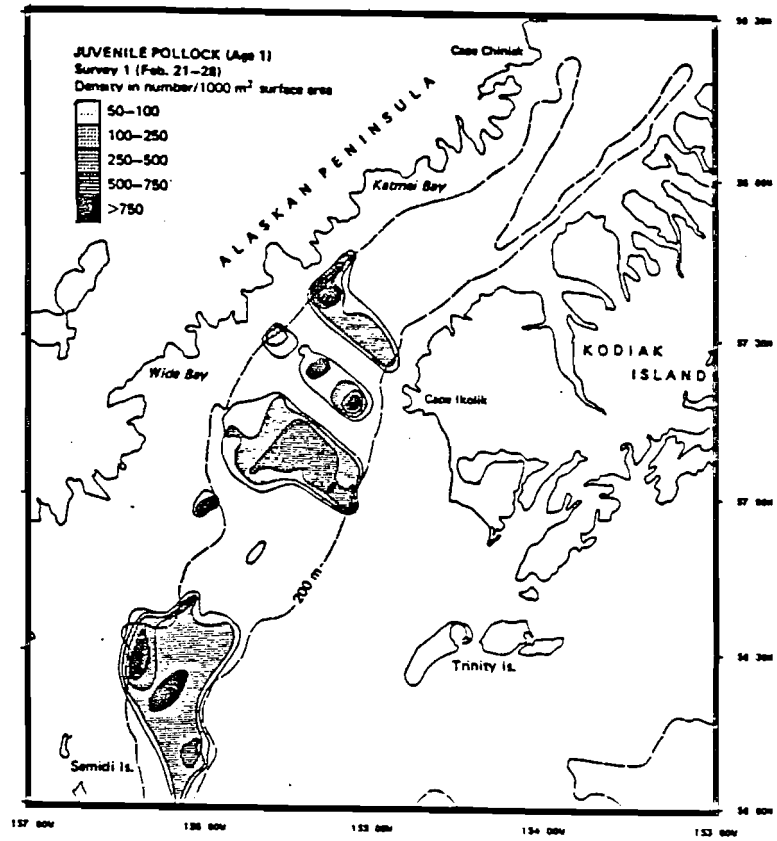


Figure 7.--Pollock population length distributions determined from the 1981 and 1983-1985 Shelikof Strait acoustic-midwater trawl survey.



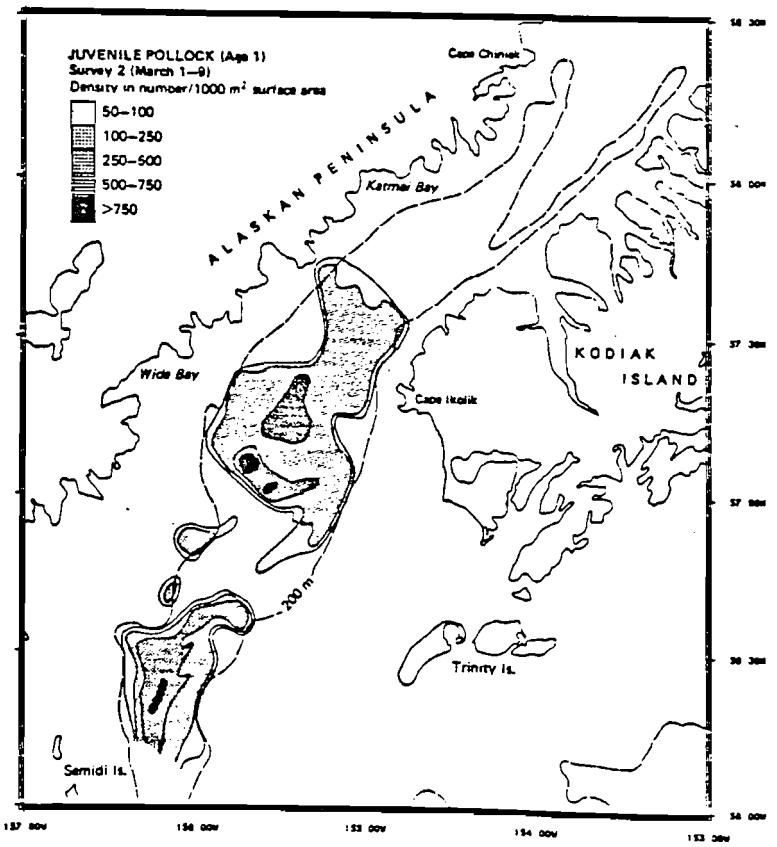
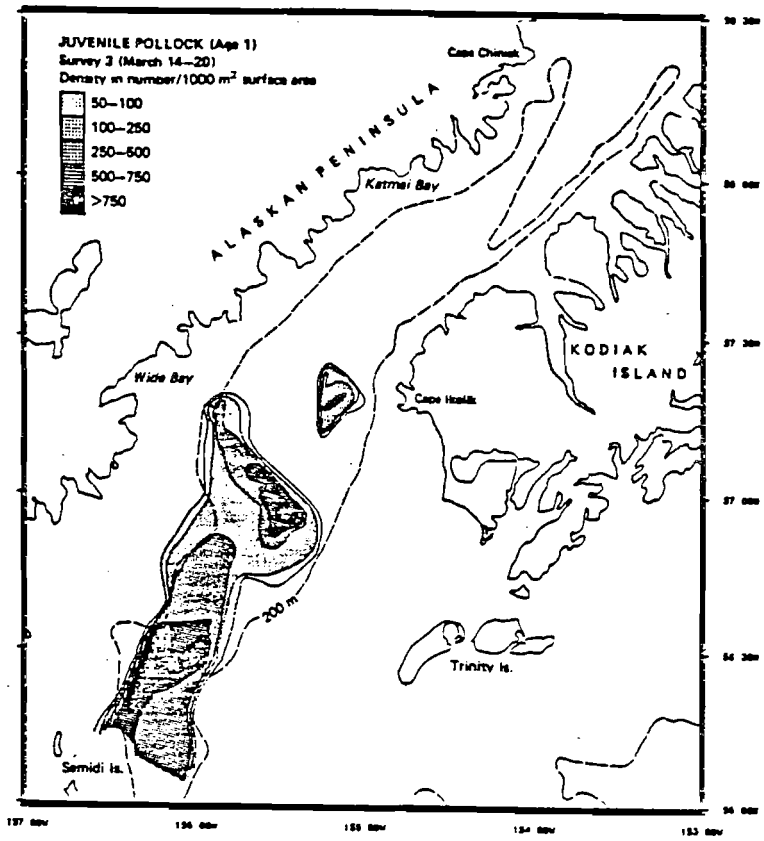


Figure 8.--Density distributions of age 1 pollock in Shelikof Strait during each of the four 1985 acoustic-midwater trawl surveys.



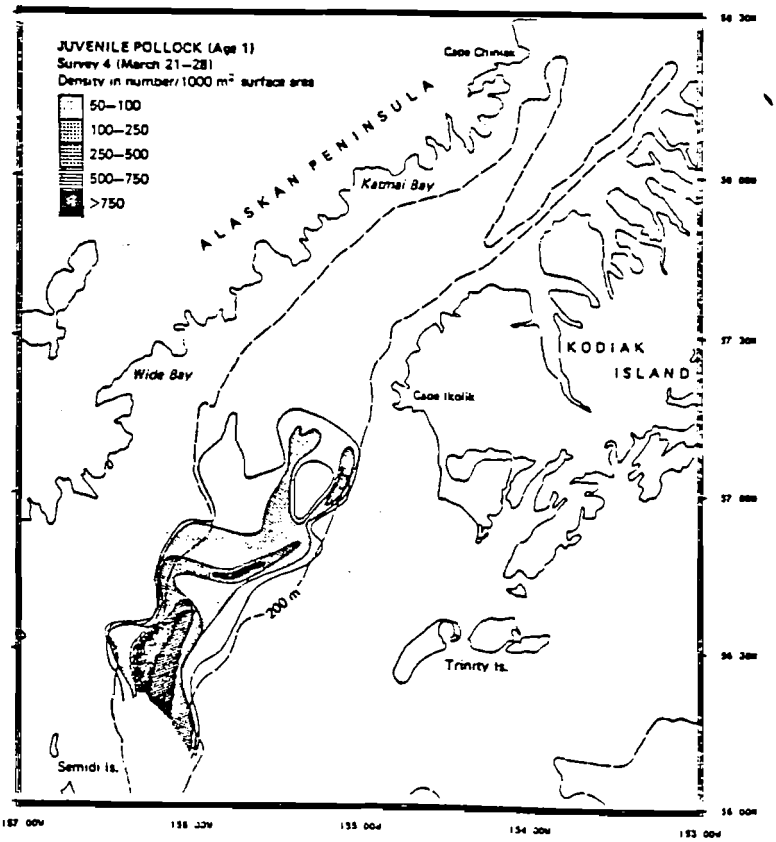


Figure 8.--Continued.

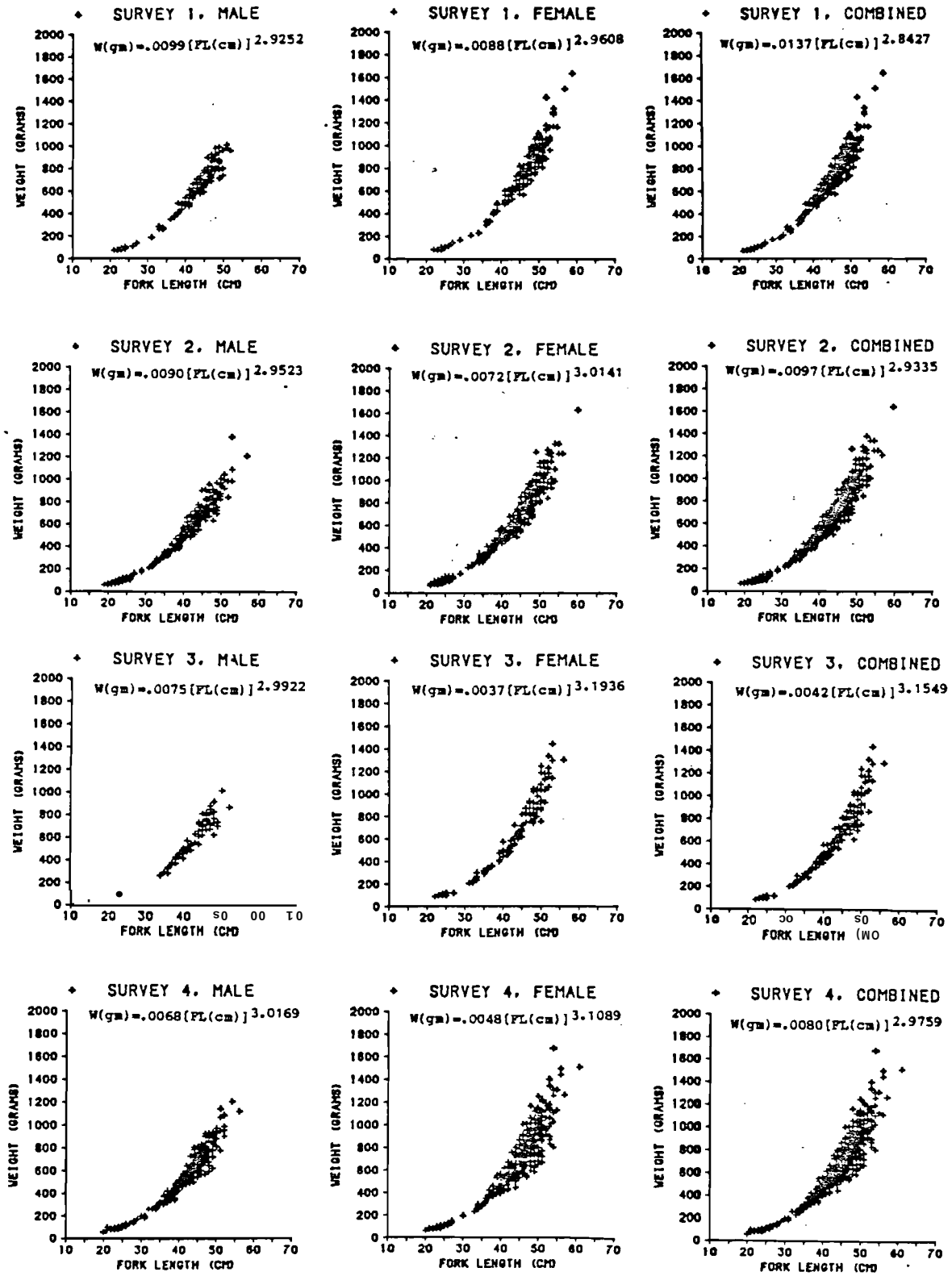


Figure 9.--Pollock length-weight relationships determined from 1985 Shelikof Strait acoustic-midwater trawl surveys.