Not to be cited by INPFC
Document number

INPFC
Doc. 2423

TRANSLATION

REPORT ON THE MULTI-VESSEL TRAWL SURVEY ON POLLOCK ON THE EASTERN BERING SEA CONTINENTAL SHELF IN 1980

Hirotsune Yamaguchi
Fisheries Agency of Japan
1981 August

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
Yamaguchi, Hirotsune. 1981. Report on multi-vessel trawl survey on pollock on the eastern Bering Sea continental shelf in 1980. (Document submitted to the International North Pacific Fisheries Commission.) 8 p. Fisheries Agency of Japan, Tokyo, Japan 100.

I. Summary of the survey

A multi-vessel trawl survey aimed at estimating the abundance of stocks of young pollock on the eastern Bering Sea continental shelf was conducted in 1980 as a continuation of past surveys. It was the third of the spring surveys (conducted from early to mid-June) which started in 1978, and the fifth of the fall surveys (late August through early September) which started in 1976.

The survey methods were the same as used in the previous years, i.e., four surimi mothership fleets during commercial operations covered about equal numbers of designated stations (spring survey - 125 stations; fall survey - 152 stations) on the eastern Bering Sea continental shelf and conducted one haul at each station using one or two Danish seiners attached to the mothership. Studies conducted at each station included: species composition, length composition of pollock, collection of age structures (scales), collection of pollock samples, and observations of water temperature.

The spring survey lasted for 13 days from June 7 through June 19, and the fall survey for 14 days from August 25 through September 7. Location of the stations, area of responsibility, and sampling strata for each fleet during the spring and fall surveys are shown in Fig. 1 (spring) and Fig. 2 (fall).

The following are the fleets and stations covered in the spring survey: the Mineshima maru fleet covered stations 1 to 36 using the Mitsu maru No. 50 (124.10 tons, 1,300 hp) during June 9 to 19; the Hoyo maru fleet covered 36 stations (31 through 62) using the Soyo maru No. 32 (124.70 tons, 1,300 hp) during June 11 to 19; the Shikishima maru fleet covered 36 stations (62 through 92) using the Hokko maru No. 17 (124.54 tons, 1,350 hp) during June 7 to 14; and the Nisshin maru No. 2 fleet covered 35 stations (91 through 125) using the Akatsuki maru No. 1 (96.61 tons, 950 hp) and the Shoken maru No. 8 (96.94 tons, 1,200 hp) during June 7 to 11.

In the fall survey, the Nisshin maru No. 2 fleet covered stations 1 to 43 using the Akatsuki maru No. 1 and Shoken maru No. 8 during August 25 to September 7; the Mineshima maru fleet covered 43 stations (39 through 81) using the Mitsu maru No. 50 during August 25 to September 1; the Hoyo maru fleet covered 43 stations (77 through 119) using the Soho maru No. 32 during August 25 to September 2; and the Shikishima maru fleet covered 43 stations (110 through 152) using the Hokko maru No. 17 during August 25 to September 2.

During the spring survey, operations could not be conducted at two stations of the total 125; at 16 stations operations were conducted by two vessels of neighboring fleets. In the fall survey, operations could not be conducted at five stations out of the total 152; at 18 stations, operations were made by two vessels.

All surveys were with Danish seiners and there were no differences in fishing method among fleets. Specifications of the gear (net) used for both spring and fall surveys were the same as those used in the past.

II. Survey results

1. Horizontal distribution of pollock

Horizontal distribution of the pollock catch by station in the spring and fall surveys is shown in Figs. 3 and 4, respectively.

In Area E during the spring survey, the density was higher than in the previous year at depths less than 80 m and high density was found at depths less than 100 m in the vicinity of the pot sanctuary area. In Area M, high density was found at depths of 50 to 80 m and 100 to 150 m in the vicinity of the Pribilof Islands, and density at depths less than 80 m were higher than in the previous year. In Area M, the trend of high density at depths of 100 to 200 m remained unchanged

from the situation in 1979 and a significant feature was that at almost all stations, the density was higher than in 1979.

In the fall survey, in Area SE (Fig. 2), an area of high density was observed at depths of around 100 m but when compared with the 1979 results, the density was higher in depths less than 100 m. In Area SC, the density was high in waters west of the Pribilof Islands, and the central part of the survey area. In Area NC, the density was the highest of the three areas northwest of the Pribilof Islands. In Area NW, high density was observed at depths greater than 100 m. In these four areas, stock density similar to the previous year was observed and a significant point is that at almost all these stations, the density was higher than in 1979.

2. Size distribution of pollock by station

Figures 5 and 6 show the average fork lengths of pollock caught during the spring and fall surveys by station.

During the spring survey, in Area E, fairly large pollock of over 35 cm were observed at every depth, and particularly at depths less than 80 m. The average fork length was over 45 cm at every station, which was similar to the trend in 1978.

In Area M, large pollock of 40 cm or larger were observed at depths shallower than 80 m, but at almost all stations deeper than 80 m, the average was 35 cm or smaller.

In Area W, distribution of pollock of 30 to 34 cm was similar to that in the previous year.

During the fall survey, in Area SE, the distribution of fish with average fork length of over 30 cm was similar to that in 1979. However, fish of average fork length less than 40 cm which were

distributed mainly at depths of 100 to 150 m in 1979, were found mainly at depths shallower than 100 m. In Area SC, pollock of 20 to 30 cm, a group observed in the northern part in 1979, were not particularly evident and most fish were over 30 cm.

In Area NC, where the average size was less than 30 cm in 1979 at almost all stations, in 1980 except for the northwest part, the average size was over 30 cm. In Area NW, most stations showed average size of over 30 cm in surveys up to the previous year, but in 1980 significant distributions of small sized, in the 21 to 26 cm range, were found except at around 100 m where fish were over 30 cm.

3. CPUE by stratum

CPUEs (kg/haul) of pollock found during the spring surveys of 1978 to 1980 and fall surveys of 1976 to 1980 by area by depth zone are shown in Tables 1 and 2.

In the spring survey of 1980, CPUEs in both areas E and M were higher than in the previous year at depths to 100 m and lower at depths greater than 100 m. In Area W, the CPUE was higher than in 1979 in all depth zones and significantly higher in zones deeper than 150 m.

Comparison by area for all depth zones indicates that the CPUE remained unchanged in Areas E and M but it increased to more than three times in Area W as compared with the previous year. Comparison by depth zone for all areas indicates that the CPUE was higher in 1980 in all zones but particularly so in the zone to 100 m. On the whole, CPUE in 1980 was higher than in 1979 though lower than in 1978.

During the fall survey, in Area SE, CPUE in 1980 increased from that in 1979 in all depth zones except the 150 to 200 m strata and was noticeably higher in the zone to 100 m. In Area SC, higher CPUEs were recorded in all zones except the 100 to 150 m strata and in particular

in the 150 to 200 m strata the CPUE was the highest in history. In Area NC, there was a trend to slightly lower CPUE than in the previous year in the zone to 100 m but in zones deeper than 100 m the CPUE increased substantially.

In Area NW, higher CPUE than in the previous year was found in all depth zones except the zone to 80 m, where no survey was conducted, and in zones deeper than 200 m.

Comparison of CPUEs over all depth zones showed an increase in Area SE over the preceding year, though not as high as in 1978, and in Areas SC, NC, and NW, the CPUEs were either higher than in the previous year or the highest in history. Comparison of CPUEs over all survey areas shows higher CPUEs in all depth zones. On the whole, CPUEs found in the fall survey in 1980 were higher than in 1977 to 1979, though not as high as in 1976.

4. CPUEs in common areas in the spring and fall surveys

Figure 7 shows CPUEs of pollock by year, season, and area for the area south of 60°N for the five fall and three spring surveys from 1976 to 1980 according to the strata classification used for the spring survey. The pattern of stock density being higher in the fall than in the spring each year did not change in 1980.

In Area E, the density until fall 1977 had been about twice that in other areas, but after the spring of 1978, the figures for spring and fall surveys have been about the same and this trend remained unchanged in 1980. A possible cause of apparent higher density in Area E in 1976 and 1977 may be inadequate station designation.

In Area M, where no drastic fluctuations were observed from the fall of 1976 to the spring of 1979, the seasonal fluctuations since that time have paralleled those in other areas. Area W had higher CPUE than other areas in both the spring and fall surveys of 1980.

With CPUE values for all areas combined, there was a decreasing trend both in the spring and fall surveys up to 1979 but an increase was observed in 1980.

5. Size and age composition of pollock in relative population numbers

The relative population numbers of pollock expressed as size composition was estimated as follows. First, the size composition and weight of the sample was obtained at each station and it was assumed that the area covered by one haul of the net was one km^2. Then, the size composition of the CPUE by stratum was estimated and multiplied by the area at each stratum to arrive at an estimate of the relative population numbers. The age composition by stratum was estimated using an age-length key based on collected age material (scale).

The age compositions by year for the period 1976 to 1980 is shown in Table 3 (spring) and Table 4 (fall). The length and age composition for 1979 and 1980 are shown in Fig. 8 (spring) and Fig. 9 (fall). In both spring and fall surveys in 1980, the form of the length composition was similar to that of 1979 but the dominant mode moved to slightly larger fish.

The dominance of 3-year-old fish remained unchanged in the age composition of the spring survey but the number of age 4 and older fish gradually increased and 1-year-old fish were often caught. The fall survey indicates that the 1977 year class fish, which had appeared as dominant year class in the survey of the previous year, maintained dominancy as 3-year-old fish in 1980. The 1978 year class fish appeared as 2-year-old fish with abundance exceeding that of the 1977 year class fish. Fish of ages 4 and greater also appeared in greater abundance.

Table 3 shows that the appearance of 1-year-olds (1979 year class) is the strongest in history in the spring sampling; 1.9 times the strength of the 1978 year class. Table 4 also indicates their abundance in the fall sampling when they were in higher abundance than the 1977 year class though lower than the 1979 year class.

6. Bottom water temperature

Horizontal distribution of bottom water temperature in spring and fall is shown in Figs. 10 and 11, respectively. In 1979, a warm water mass covered two-thirds of the survey area both in spring and fall, but in 1980, the existence of a cold water mass with temperature less than $0^{\circ}C$ was observed. Thus, we can assume relatively cold oceanographic conditions in 1980. This condition might have an effect on the distribution of large-sized and small-sized fish.

To summarize all results, there is no unfavorable trend in the appearance of pollock year classes including that of 1977 and onwards. Since these dominant year classes will be recruited in succession, any decrease in stock of pollock in the eastern Bering Sea is inconceivable for several years to come.

TABLES 1 TO 4 AND FIGS. 1 TO 11 ARE IN ENGLISH IN THE JAPANESE DOCUMENT

Table 1. CPUE(in kg per haul) of pollock by stratum in June, 1978-1980.

Area	Year	Depth zone (m) 50/80	80/100	100/150	150/300	Depth Total
E	1978	146.8	4,931.5	2,002.0	2,396.2	2,042.3
	1979	476.7	922.1	1,250.3	567.4	844.4
	1980	993.4	2,456.8	484.2	102.0	951.2
M	1978	137.4	1,128.3	3,472.1	-	1,961.2
	1979	234.8	377.3	1,924.3	3,550.0	1,229.9
	1980	704.6	765.5	1,686.3	150.0	1,164.0
W	1978	130.0	540.0	1,738.9	2,820.0	1,616.1
	1979	11.0	47.4	521.4	935.0	508.1
	1980	800.0	511.3	1,798.9	3,701.7	1,901.1
Total	1978	141.8	2,799.3	2,419.0	2,588.8	1,904.2
	1979	376.4	480.4	1,228.1	1,195.9	904.8
	1980	859.5	1,441.9	1,333.0	1,767.1	1,249.2

Table 2. CPUE(in kg per haul) of pollock by stratum in Aug.- Sept., 1976-1980.

Area	Year	Depth zone (m) 70/80	80/100	100/150	150/200	200/350	Depth Total
SE	1976	-	533.3	11,308.3	14,250.0	3,050.0	8,758.3
	1977	600.0	6,442.9	10,280.0	16,000.0	5,166.7	8,570.4
	1978	575.0	590.0	6,667.6	10,380.0	5,133.3	4,952.6
	1979	437.5	1,404.5	4,295.2	8,687.5	666.7	3,104.3
	1980	3,185.4	4,673.1	5,492.9	1,796.7	1,787.5	4,239.6
SC	1976	-	45.5	1,875.5	268.0	-	1,612.2
	1977	15.0	3,090.0	1,848.1	3,600.0	1,650.0	2,043.7
	1978	69.3	708.7	2,260.4	3,780.0	-	1,901.3
	1979	546.7	4,121.0	2,559.4	305.0	-	2,662.9
	1980	762.6	4,361.4	2,317.1	8,975.0	-	2,666.0
NC	1976	-	-	4,105.9	5,560.0	88.0	4,247.3
	1977	-	750.0	3,828.0	750.0	-	3,403.4
	1978	55.0	2,912.5	6,427.7	1,066.7	-	5,177.2
	1979	-	4,500.6	3,134.1	632.5	580.0	3,300.7
	1980	202.0	3,402.1	6,549.6	6,854.0	-	5,990.0
NW	1976	-	160.0	3,987.5	2,800.0	-	3,629.3
	1977	-	285.4	1,195.4	1,000.0	1,000.0	990.8
	1978	25.0	67.5	4,220.8	1,430.0	10.0	2,422.1
	1979	400.0	1,030.5	3,160.8	3,010.0	850.0	2,537.0
	1980	-	1,608.6	5,156.4	3,243.8	-	3,586.5
Total	1976	-	308.5	4,917.8	5,639.8	2,062.7	4,511.9
	1977	375.0	3,340.9	3,962.0	3,137.5	3,300.0	3,700.5
	1978	331.2	1,183.2	4,752.5	4,716.4	3,852.5	3,728.7
	1979	461.7	2,979.0	3,188.9	4,101.4	686.0	2,948.9
	1980	2,188.3	3,695.5	4,802.6	4,921.9	1,787.5	4,242.3

Table 3. Age composition of pollock in relative population number($\times 10^3$) in June, 1978-1980.

Area	Year	Age 1	2	3	4	5	6	7	8	9	10	Total
E	1978	-	11,782	47,670	54,139	101,850	52,585	18,782	8,157	1,234	840	297,039
	1979	16,609	73,676	81,181	61,495	14,676	5,279	928	510	50	40	254,444
	1980	-	3,428	79,353	58,568	38,278	29,772	13,472	5,116	1,628	-	229,615
M	1978	819	136,556	225,000	88,212	37,008	9,432	849	-	1	-	497,875
	1979	14,808	135,139	199,191	104,430	22,508	9,537	2,368	57	25	-	489,062
	1980	35,056	113,032	151,711	72,028	16,003	5,602	1,788	127	19	-	395,366
W	1978	320	330,304	155,870	19,985	14,809	3,602	957	111	60	-	526,018
	1979	3,409	17,728	37,731	19,098	7,044	4,937	2,192	720	202	-	93,041
	1980	31,912	76,194	117,711	64,807	27,092	16,461	4,155	1,175	601	-	340,108
Total	1978	1,137	478,642	428,540	162,336	153,667	65,619	20,588	8,268	1,294	840	1,320,932
	1979	34,826	226,543	318,103	185,005	45,228	19,753	5,487	1,287	276	40	836,547
	1980	66,168	192,654	348,775	195,403	81,373	51,835	19,415	6,418	2,248	-	965,089

Table 4. Age composition of pollock in relative population number($\times 10^3$) in Aug.- Sept., 1976-1980.

Area	Year	Age 1	2	3	4	5	6	7	8	9	10	Total
SE	1976	358	578,393	517,851	284,661	36,306	15,786	8,745	388	-	-	1,442,488
	1977	2,314	639,070	324,573	175,634	110,432	42,968	19,475	-	-	-	1,314,466
	1978	10,990	319,718	391,522	50,727	18,258	14,056	5,853	-	-	-	811,124
	1979	40,079	278,615	135,394	81,301	25,993	7,207	11,324	10,589	-	-	590,502
	1980	-	441,400	394,185	95,675	42,142	9,960	3,759	1,550	140	-	988,811
SC	1976	82,195	244,215	50,977	11,368	3,356	2,075	1,398	22	18	-	395,624
	1977	23,200	292,058	288,490	30,935	6,558	4,254	2,653	913	-	-	649,061
	1978	4,227	43,929	124,240	45,010	14,655	10,545	1,679	372	61	-	244,718
	1979	536,435	266,948	145,747	48,548	9,004	4,145	1,806	693	-	-	1,013,326
	1980	993	222,681	320,955	43,094	15,880	3,996	1,790	597	597	201	610,706
NC	1976	150,154	310,551	109,086	93,911	25,996	18,402	14,783	4,025	1,118	60	728,086
	1977	9,600	162,326	403,928	110,233	17,559	6,290	3,784	1,357	-	-	715,077
	1978	2,327	124,287	475,549	115,111	44,704	15,751	6,024	4,250	100	-	788,103
	1979	179,403	456,325	382,044	76,408	17,754	6,410	2,489	2,007	-	-	1,122,840
	1980	308,158	402,186	541,950	144,694	67,659	30,943	13,663	5,280	2,885	-	1,517,418
NW	1976	4,030	127,898	123,658	81,797	16,590	7,798	4,299	332	51	12	366,465
	1977	913	36,540	49,734	38,657	12,290	3,517	656	95	-	-	142,402
	1978	316	15,209	95,592	98,845	33,390	9,454	2,542	1,829	539	-	257,716
	1979	12,242	143,101	165,610	81,805	15,004	6,684	4,718	3,549	-	-	432,713
	1980	294,025	434,095	423,136	125,848	50,195	18,068	5,971	1,996	882	140	1,354,356
Total	1976	236,737	1,261,057	801,572	471,737	82,248	44,061	29,225	4,767	1,187	72	2,932,663
	1977	36,027	1,129,994	1,066,725	355,459	146,839	57,029	26,568	2,365	-	-	2,821,006
	1978	17,860	503,143	1,086,903	309,693	111,007	49,806	16,098	6,451	700	-	2,101,661
	1979	768,159	1,144,989	828,795	288,062	67,755	24,446	20,337	16,838	-	-	3,159,381
	1980	603,176	1,500,362	1,680,226	409,311	175,876	62,967	25,183	9,423	4,426	341	4,471,291

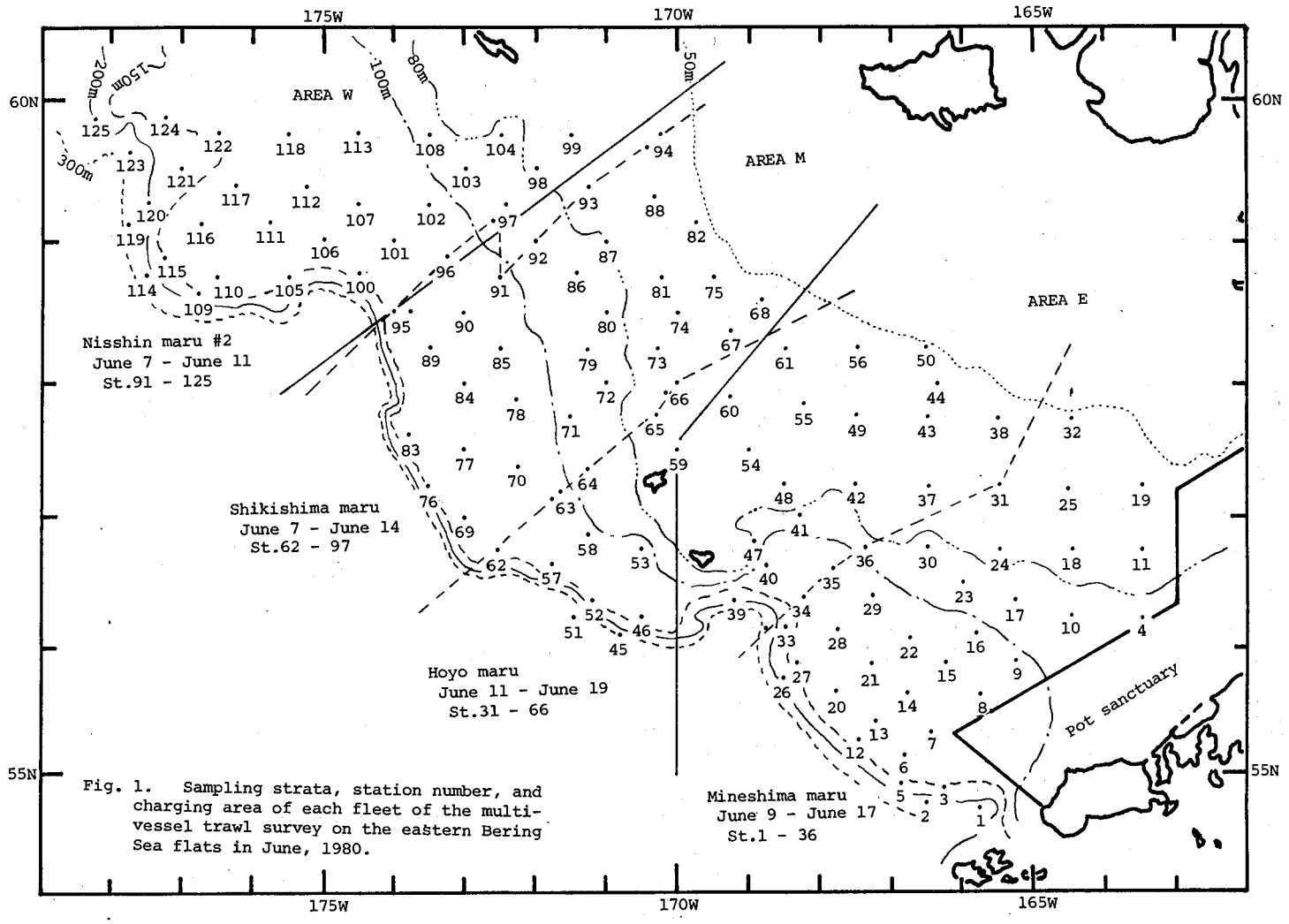

Fig. 1. Sampling strata, station number, and charging area of each fleet of the multi-vessel trawl survey on the eastern Bering Sea flats in June, 1980.

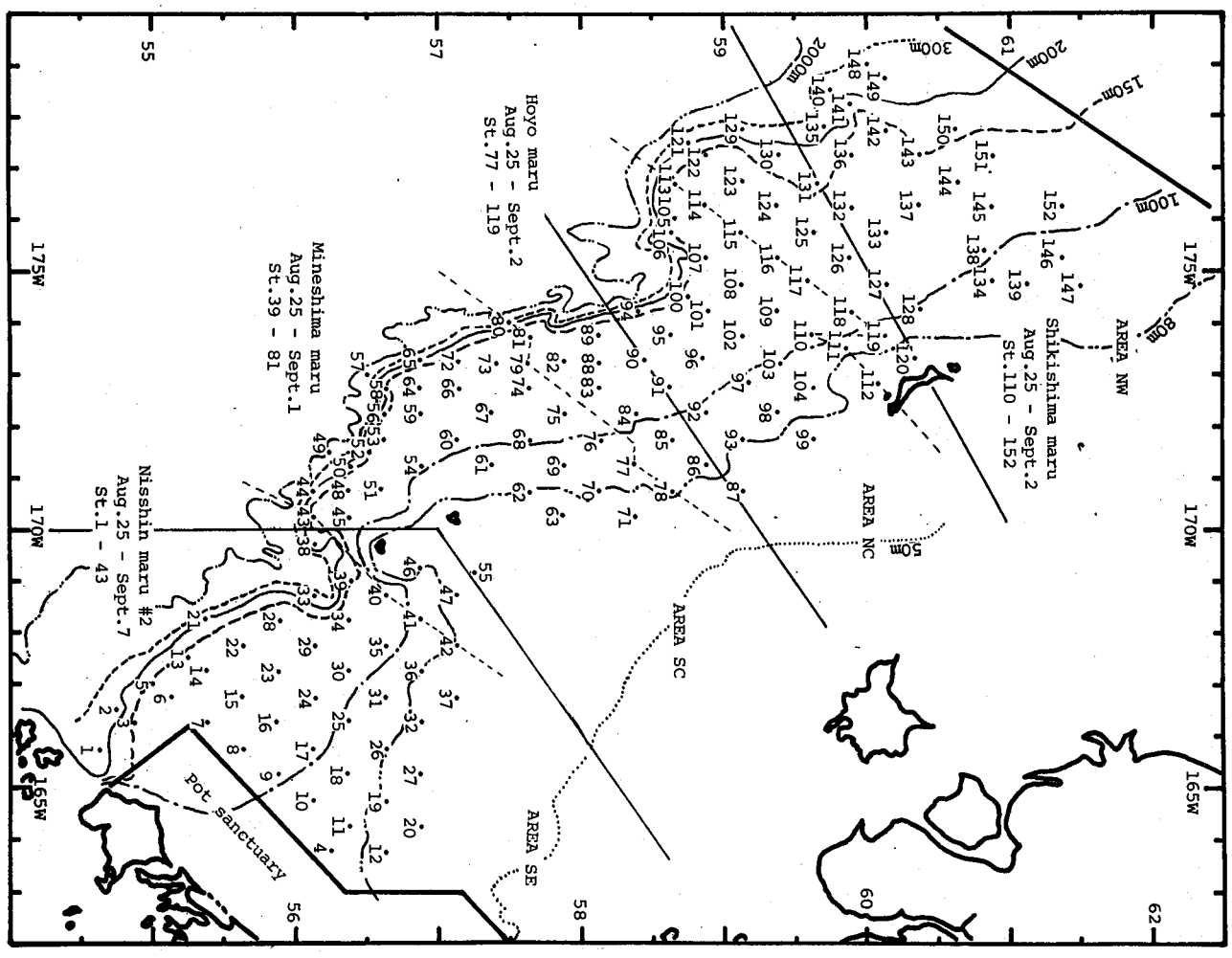

Fig. 2. Sampling strata, station number, and charging area of each fleet of the multi-vessel trawl survey on the eastern Bering Sea flats in Aug. - Sept., 1980.

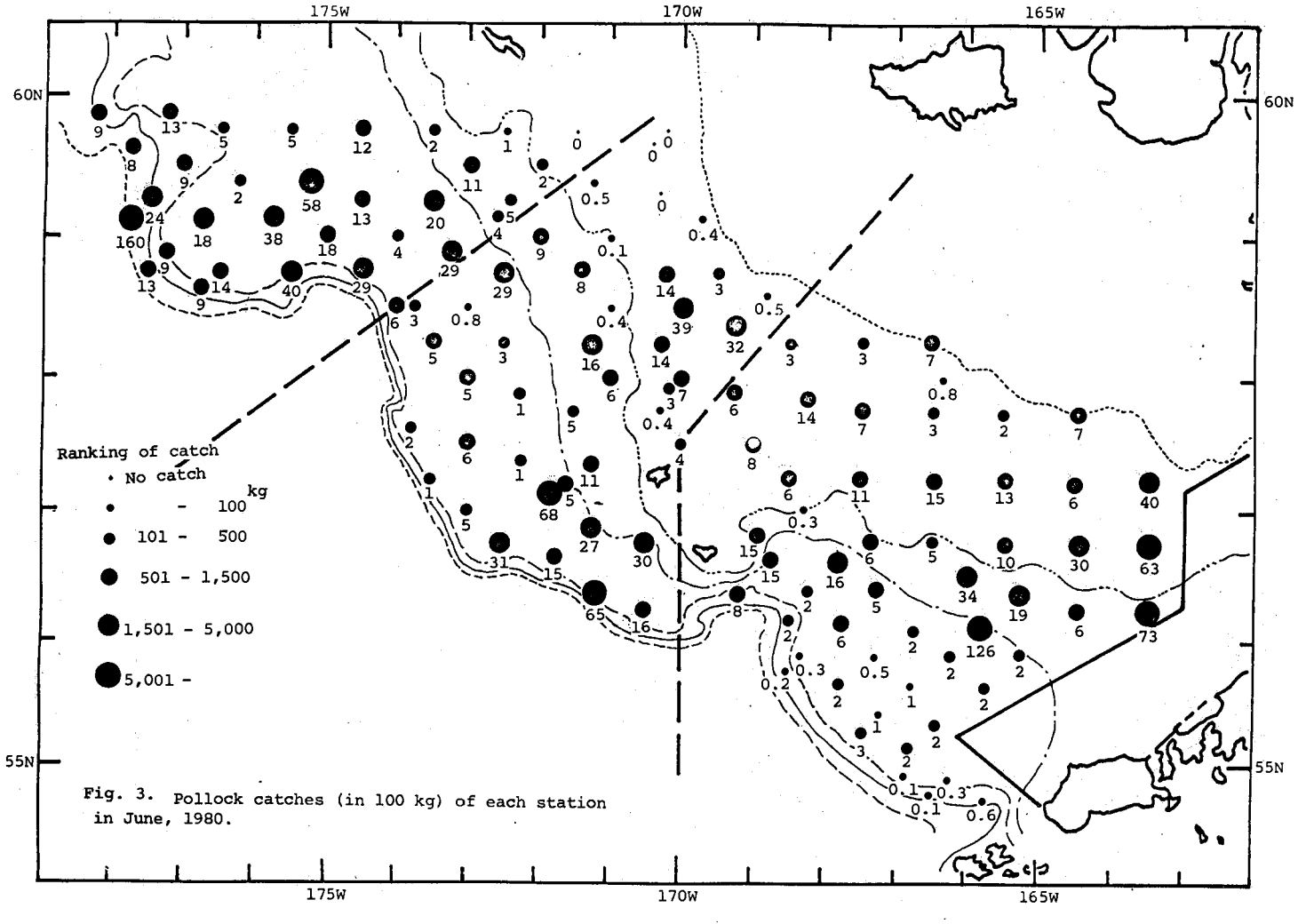

Fig. 3. Pollock catches (in 100 kg) of each station in June, 1980.

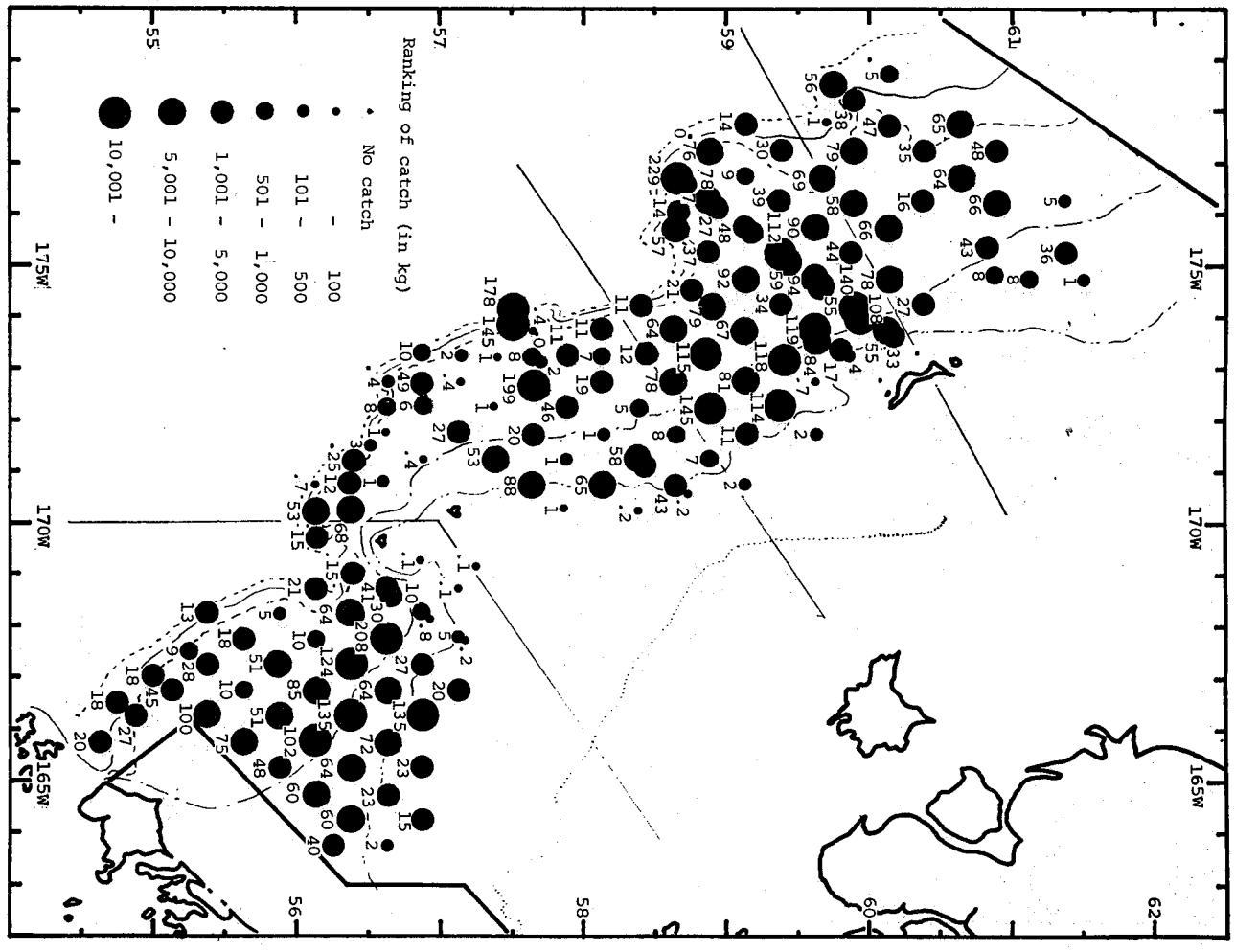

Fig. 4. Pollock catches (in 100 kg) of each station in Aug. - Sept., 1980.

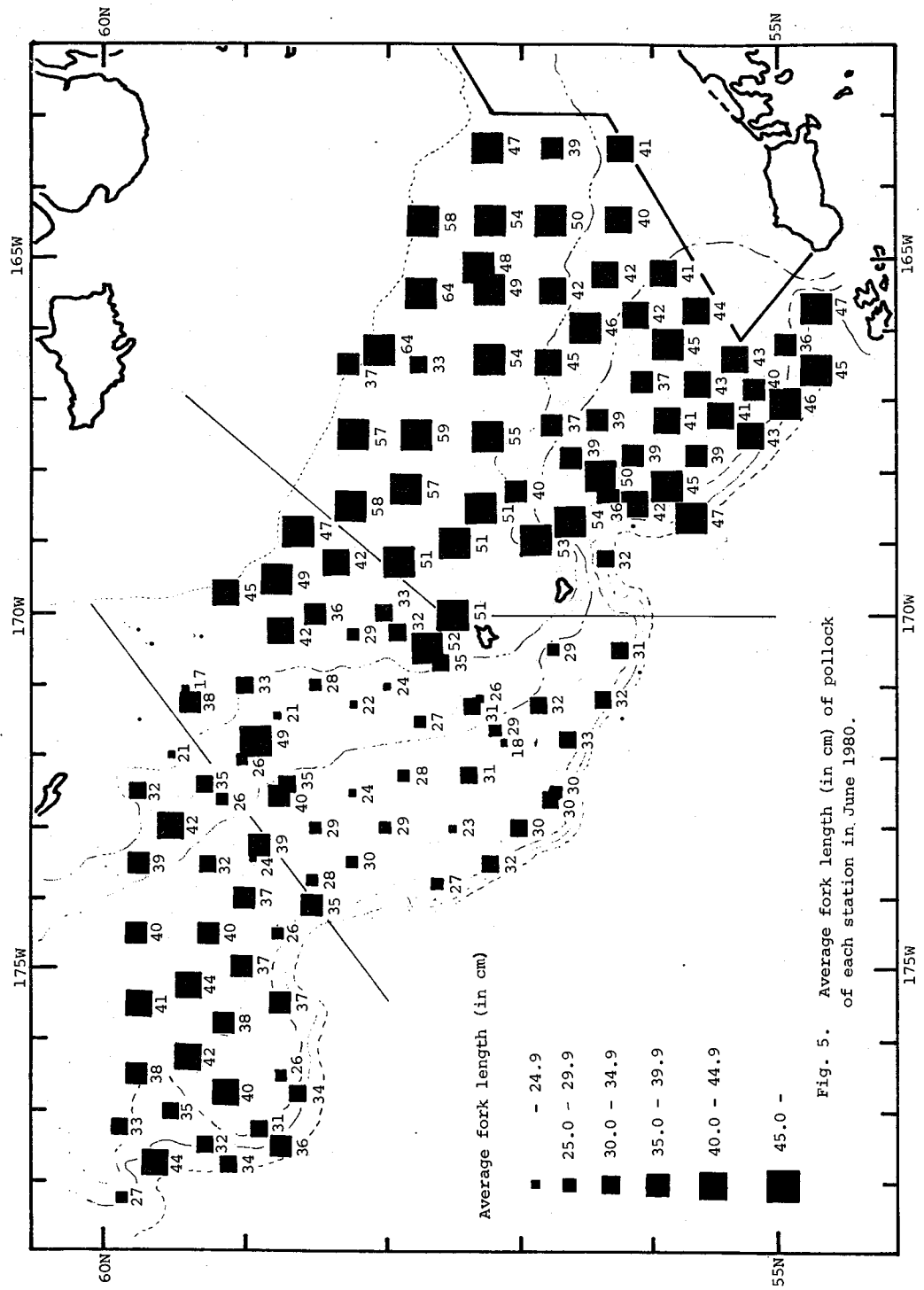

Fig. 5. Average fork length (in cm) of pollock of each station in June 1980.

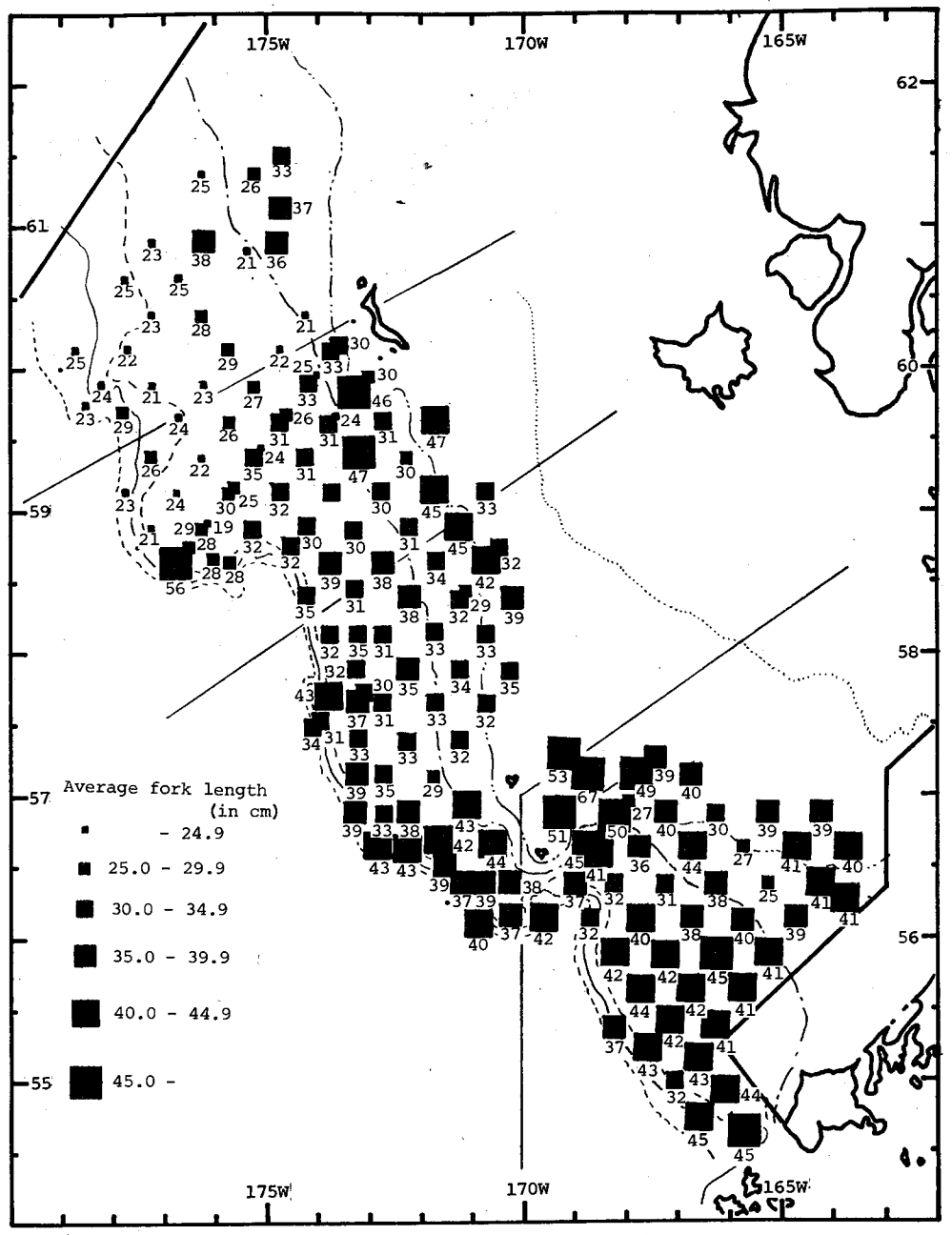

Fig. 6. Average fork length (in cm) of pollock of each station in Aug. - Sept., 1980.

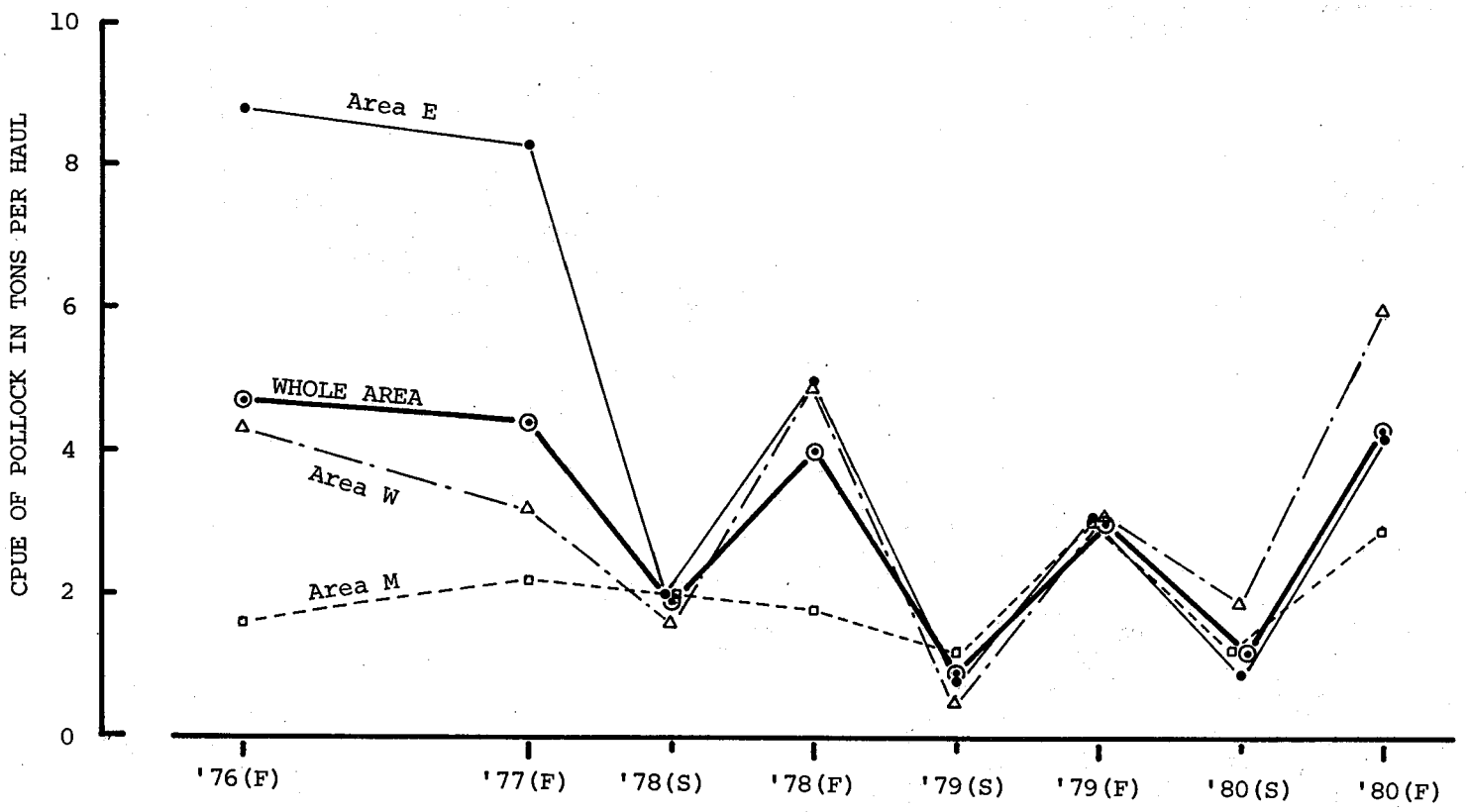

Fig. 7. CPUE of pollock (in kg per haul) by spring season's area from 1976 to 1980.

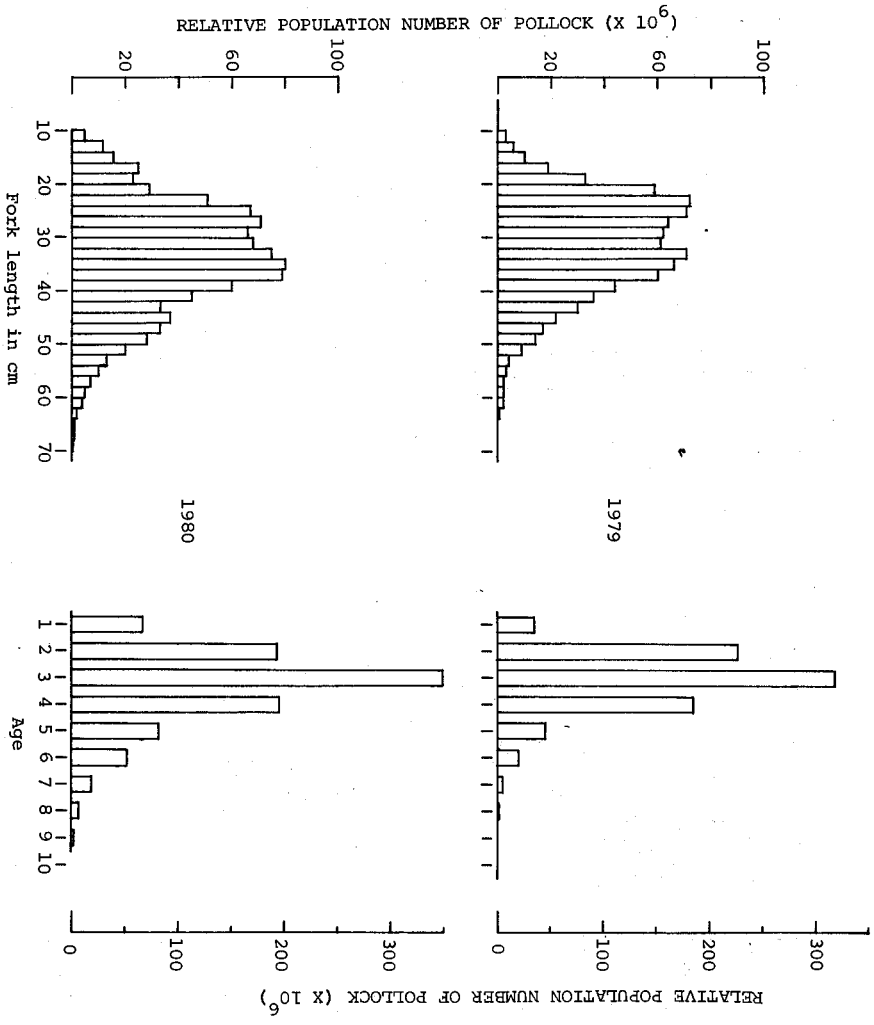

Fig. 8. Size and age compositions of pollock in relative population number by year in June, 1979-1980.

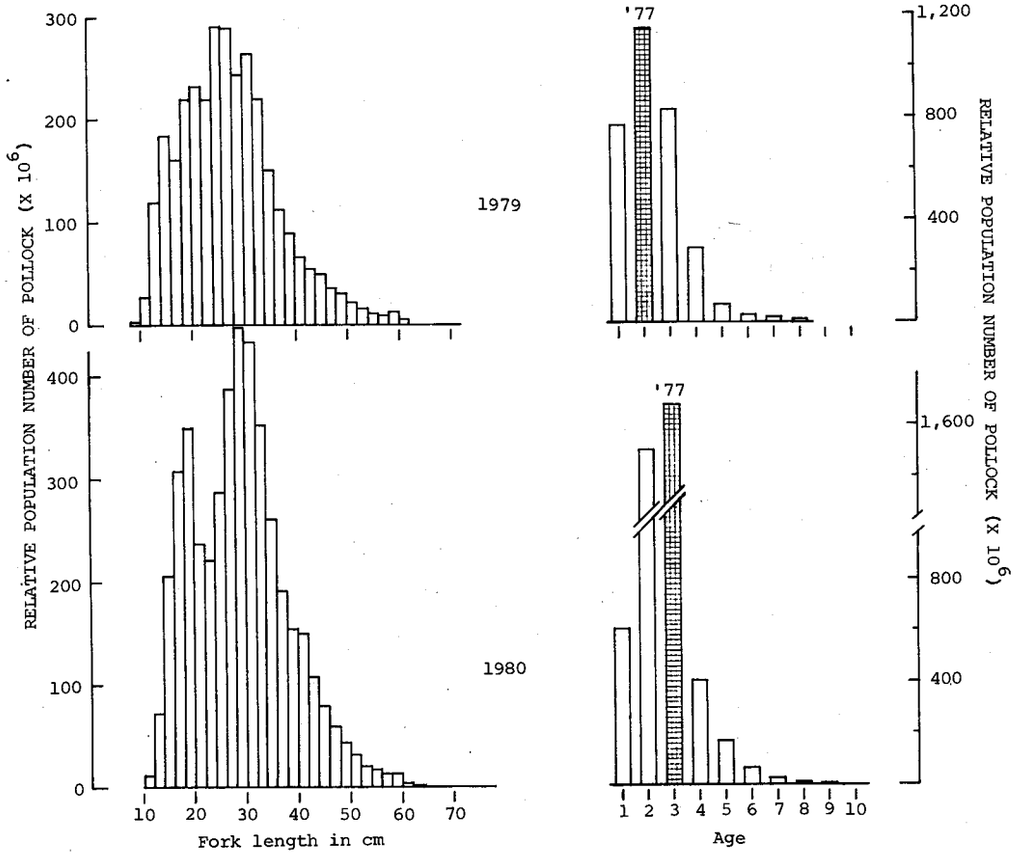

Fig. 9. Size and age compositions of pollock in relative population number by year in Aug. - Sept., 1979-1980.

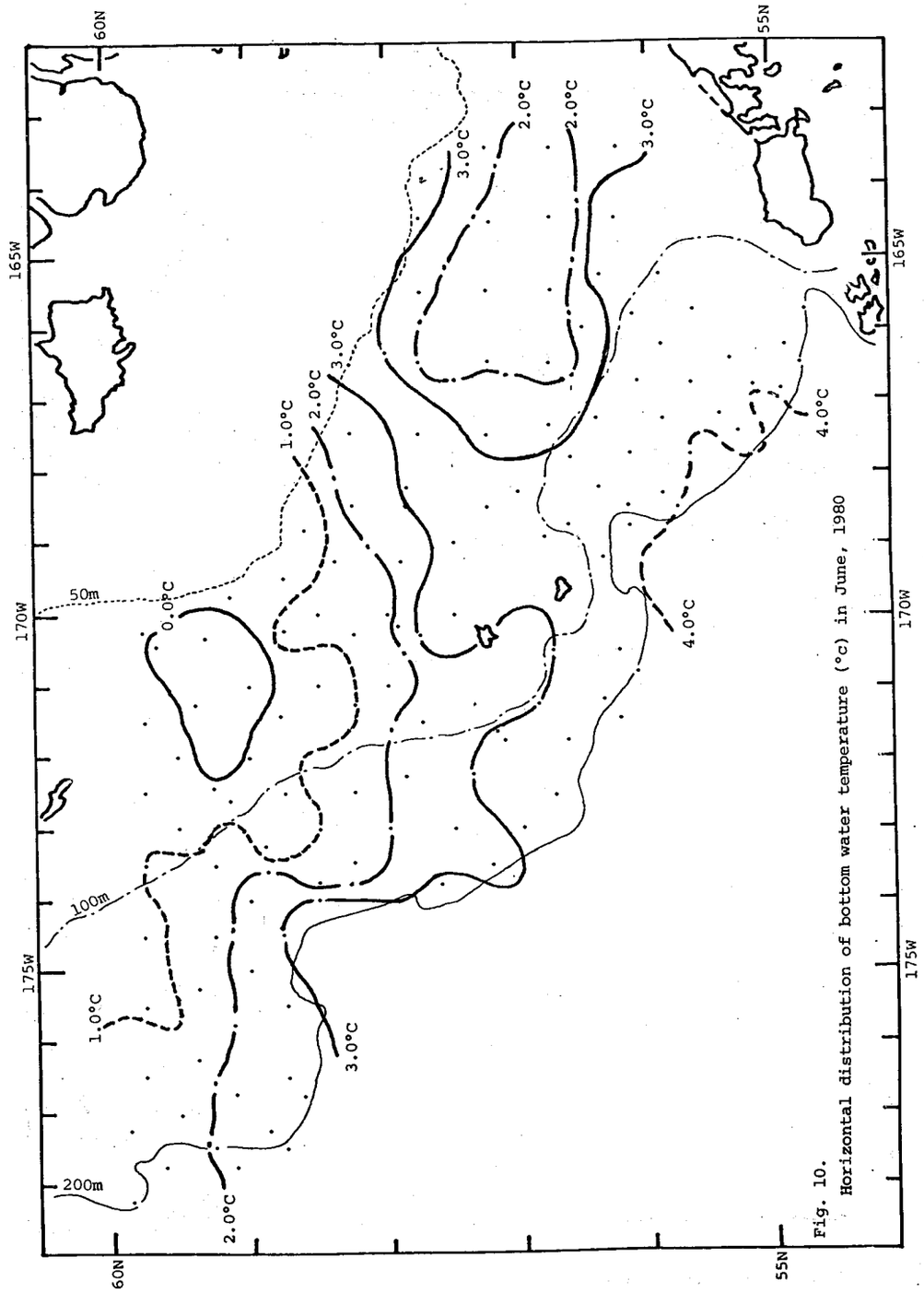

Fig. 10. Horizontal distribution of bottom water temperature (°c) in June, 1980

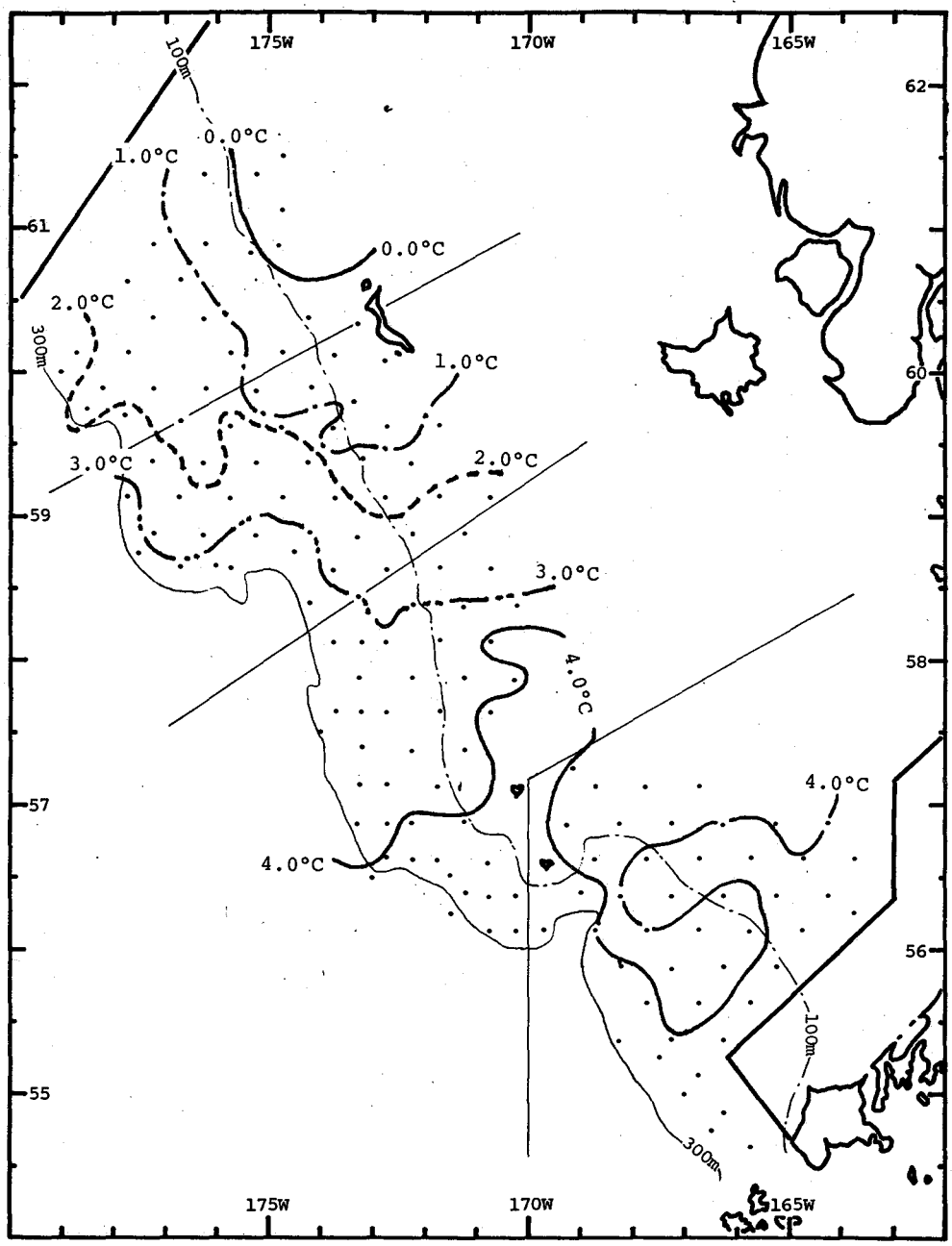

Fig. 11. Horizontal distribution of bottom water temperature (°c) in Aug. - Sept., 1980.