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THE NORWEGIAN GROUNDFISH SURVEY AT BEAR ISLAND AND WEST-SPITSBERGEN IN THE AUTUMN 1981

by

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ABSTRACT

This report describes the results from a stratified bottom trawl survey with R/V "Michael Sars" and M/Tr "Vikheim" in the period 7 September to 10 October. The most abundant species in the trawl catches were long rough dab and redfish. Cod were mostly caught in the southern part and the small fish were taken in very shallow water. The 1979 and 1978 year classes were the most numerous in the area. Haddock was very scarce. Redfish was abundant, but specimens longer than 35 cm were few in the catches.

INTRODUCTION

The investigations described in this report are partly a supplement to the investigations carried out on cod and haddock in the Barents Sea during the winter and partly a monitoring of the other demersal fish stock in the area. In earlier years the investigations at Spitsbergen have been carried out as acoustic survey (DALEN, RØRVIK and SMEDSTAD 1977 and DALEN and SMEDSTAD 1978). However, the drastic reduction of the cod stock in the area have made it almost impossible to record the cod with acoustic equipment. Therefore the investigations in 1981 were carried out as a stratified bottom trawl survey.

MATERIAL AND METHODS

Gear and vessel

The survey was carried out by two vessels. R/V MICHAEL SARS and the commercial trawler M/Tr VIKHEIM. The survey started on the 7th of September 1981 and was finished on the 10th of October. Both vessel used a similar gear; a Campelen 1800 shrimp trawl with rubber bobbins and codend meshsize of 35 mm. Sweepwires were 80 m. The trawl was towed for 3 n.miles at a speed of 3 knots. In addition to trawling R/V MICHAEL SARS made hydrographical observations using a CTD sonde (Fig. 2).

Survey design

The survey was designed as a stratified random trawl survey. The investigated area was divided into 45 strata based on depth boundaries and geographical areas (Fig. 1). The following depth intervals were used: 0-100 m, 100-200 m, 200-300 m, 300-400 m and >400 m. This stratification was chosen because earlier investigations have shown that depth is a factor influencing fish distribution.

Number of trawlhauls per stratum were estimated by areaproportional allocation with a total of 210 trawlhauls. Number of stations in each strata were calculated as:

$$n_i = \frac{a_i}{A} \cdot 210$$

where n_i = number of stations in stratum i

a_i = area of stratum i

A = total area of all strata

Later the total number of stations were reduced due to limited ship time and some stations in the southern and southeastern strata were transferred to the western strata. This because earlier investigations have shown that the variations in catches were greater on the western side than in the south and southeast.

Each strata were divided in rectangles of 3.75 minutes longitude and 7.5 minutes lattitude and numbered sequently. Rectangles were drawn at random to give the trawling position. Table 1 gives strata-areas, number of trawlhauls to be taken in each strata and number of hauls actually taken. Some of the positions drawn were not trawlable due to rough bottom. The position of the trawl stations are shown in Fig. 3.

Statistical calculations

As a basic index of fish abundance the stratified mean catch in number per haul is used. The formulae for the stratified mean and its variance are (PENNINGTON and GROSSLEIN 1978):

$$\bar{X}_{st} = \frac{1}{A} \sum_{i=1}^{k} a_i \bar{x}_i$$

$$\mathrm{Var}\ (\bar{X}_{st}) = \frac{1}{A^2} \sum_{i=1}^{k} \frac{a_i\ s_i^2}{n_i}$$

where $\bar{X}_{st}$ = stratified mean catch per haul

$\mathrm{Var}(\bar{X}_{st})$ = variance of stratified mean

A = total area of all strata

a_i = area of stratum i

x_i = sample mean catch in stratum i

s_i^2 = sample variance in stratum i

n_i = number of hauls in stratum i

k = number of strata

Approximate 95% confidence limits for the stratified mean is calculated using the following assumption: As the number of trawlhauls increase, the stratified mean becomes normally distributed. The confidence limits are calculated as

$$C = \overline{X}_{st} \pm SD(\overline{X}_{st}) \cdot t$$

where t is the 95% quartile of the Student's t-distribution with N-k degrees of freedom and N is the number of trawlhauls.

For some combinations of strata the lower confidence limit becomes negative. This is due to the fact that the assumptions used to calculate the confidence limits do not hold. In tables these limits are given as zeros.

RESULTS

Hydrography

The temperatures in 100 m and at the bottom are shown in Figs. 4 and 5. In Storfjordrenna and the Bear Island Channel the temperatures are lower in 1981 than to the same time in 1980 (unpublished data).

Cod

Cod was recorded in most of the area. In the cold water northeast of Bear Island the cod was absent, and along West-Spitsbergen north of 77°30'N the cod was very scattered (Fig. 6). The greatest consentrations were recorded in the 0-100 m depth zone south of 76°N with an average catch of 150 specimen per haul (Table 3). Calculated by weight the highest catches were taken in the 200-300 m depth zone south of 76°N with an average catch of 148 kg per haul. North of 76°N the highest catches were between 0 m and 100 m by number (16 specimen per haul, Table 3) and between 100 m and 200 m by weight (18 kg per haul, Table 2).

Table 5 shows the age distribution in the area. The yearclasses 1979 and 1978 are the most numerous of the younger agegroups while the yearclasses 1975 and 1974 are the most numerous of the older age groups.

Fig. 7 shows that the age distribution changes with depth. The younger fish are found in shallow water while the older are in deeper water. Young fish were caught especially in strata 42 and to some extent in strata 16.

There is an increase in the catches of cod from 1980 to 1981 (Table 4). This is partly due to the increase in the length of the sweepwires from 40 m to 80 m in 1981. Some experiments in the Barents Sea have indicated that the catch of cod increases with a factor of about 1.8 when the sweepwires increase from 40 m to 80 m in length. In addition, the survey in 1981 was a random trawl survey while the earlier years, the surveys were carried out as acoustic surveys. The results in 1981 are therefore not directly comparable with the results from earlier years. The results indicate, however, an increase in the cod catches, especially south of 76°N.

Haddock

Haddock were caught in small numbers. Totaly only 104 specimens were caught, most of them north of 76°N. According to depth most of the haddock was caught between 100 and 200 m depth. The length distributions are shown in Fig. 8.

Redfish

Sebastes mentella is dominating the redfish catches at Bear Island and Spitsbergen. North of 76°N *S. mentella* amounts to 93% in numbers (Table 3), while it amounts to 76% south of 76°N. In weight the corresponding percentages are 97% and 81% (Table 2). *S. mentella* were most numerous north of 76°N and in this area it was caught in greatest numbers below 400 m depth. South of 76°N *S. mentella* was most numerous between 300 m and 400 m depth (Table 3).

Fig. 9 shows that the length-distributions change with depth. Fish smaller than 20 cm are dominating down to 300 m, while specimens between 20 and 35 cm are dominating deeper than

300 m. Totally it is fish between 20 and 35 cm that are dominating in the samples.

Sebastes marinus amounts to about 20% in the redfish catches and it is most numerous south of 76°N. North of 76°N S. marinus is caught in greatest numbers between 200 and 300 m depth, while the greatest catches in the southern area are caught deeper than 400 m (Table 3).

Fig. 10 shows that the catch of specimens smaller than 15 cm are greater for S. marinus than for S. mentella. In this connection it has to be mentioned that this length group may be difficult to separate into the different species for untrained people. Some of the small fish identified as S. marinus are therefore most possibly S. mentella.

In weight it was caught more redfish in 1981 than in 1980. This are mainly due to the very small catches in the northern area in 1980. In 1981 there has been a decrease in the catches from 1980 to 1981 (Table 4).

Greenland halibut

Greenland halibut was caught in relatively small numbers. It was most numerous in the northern area. There the greatest catches were taken between 200 and 400 m, while in the southern area the greatest catches were taken deeper than 300 m. Small specimens were caught down to 400 m, while deeper than 400 m only big specimens were caught (Fig. 11).

Long rough dab

Long rough dab was the most numerous species in the catches. The greatest catches were taken in the southern area. Both in the southern and in the northern area it was most numerous between 100 and 300 m. Fig. 12 shows that the length distribution differ very little with depth and area.

Blue whiting

Blue whiting was caught in small numbers in the bottom trawl. This is mainly due to the pelagic distribution of the blue whiting. The greatest catches were taken in the southern area, and they increased with depth. It was mainly fish between 30 cm and 40 cm in the catches (Fig. 13).

Shrimps

Shrimps were caught in the whole area, but they were caught in greatest numbers in the northern area, where the greatest catches were taken between 200 m and 300 m. In the southern area the greatest catches were taken between 300 m and 400 m depth. The catches in 1981 were on average smaller than the catches in 1980 (Table 4).

Other species

Catfishes were caught in small numbers in the whole area, and capelin was recorded pelagical in the southern part of the area.

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Table 1. Area (nautical mile^2) and number of trawlstations in the different strata.

Depth		North of 76°N						South of 76°N					
0	Strata	1	6	11	16	21	Sum	25	26	31	42		Sum
-	Area	218	212	622	96	205	1354	862	2378	2371	3504		9116
100	Planned hauls	2	2	2	2	2	10	3	9	9	13		34
	Numb.of hauls	2	2	2	3	2	11	3	5	6	7		21
100	Strata	2	7	12	17	22	Sum	24	27	32	40	43	Sum
-	Area	535	311	1070	603	1345	3864	586	1211	1302	2117	3487	8702
200	Planned hauls	2	2	4	2	5	15	2	4	5	8	13	32
	Numb.of hauls	2	2	5	3	4	16	3	5	6	6	7	27
200	Strata	3	8	13	18		Sum	23	28	33	39	44	Sum
-	Area	89	829	525	353		1797	1530	786	1399	1285	1910	6909
300	Planned hauls	2	3	2	2		9	6	3	5	5	7	26
	Numb.of hauls	1	6	4	4		15	5	3	7	5	4	24
300	Strata	4	9	14	19		Sum	29	34	38	41	45	Sum
-	Area	155	208	102	611		1075	1217	871	1434	3871	1377	8770
400	Planned hauls	2	2	2	2		8	4	3	5	14	5	31
	Numb.of hauls	3	2	3	3		11	6	4	2	7	3	22
	Strata	5	10	15	20		Sum	30	35	36	37		Sum
>400	Area	846	269	249	246		1610	357	3861	4020	2876		11114
	Planned hauls	3	2	2	2		9	2	14	14	10		40
	Numb.of hauls	4	3	3	3		13	3	7	9	5		24

Table 2. Stratified mean catches in kg per hour in different depths and areas 1981.

	North of 76°N						South of 76°N						
Species Depth	0 -100	100 -200	200 -300	300 -400	>400	Tot.	0 -100	100 -200	200 -300	300 -400	>400	Tot.	Tot.
Cod	3.2	18.4	9.2	14.9	12.9	13.3	79.7	50.1	147.5	48.6	27.2	65.2	56.0
Haddock	0.3	8.2	3.1	0.0	0.0	3.9	1.0	2.7	0.3	0.0	0.0	0.8	1.3
Sebastes marinus	0.0	0.3	4.6	5.6	0.1	1.6	0.0	0.6	2.9	12.5	18.7	7.7	6.6
Sebastes mentella	2.6	1.0	16.5	11.5	261.9	48.5	0.0	11.3	18.6	92.5	33.8	31.7	34.7
Greenland halibut	9.4	12.3	22.7	19.8	25.2	16.8	0.1	0.4	1.8	7.1	12.6	4.9	7.0
Long rough dab	4.7	24.4	32.3	7.1	1.9	17.4	6.2	89.7	41.4	15.5	25.4	34.6	31.5
Blue whiting	0.1	0.5	0.0	0.9	0.7	0.4	0.1	0.1	4.6	11.9	13.4	6.5	5.4
Jelly cat	0.0	0.1	0.0	1.7	0.0	0.2	0.0	29.6	4.5	4.9	6.2	9.0	7.4
Catfish	0.4	2.8	12.5	2.8	1.8	4.1	0.7	3.8	1.5	0.0	0.8	1.3	1.8
Smaller catfish	3.0	2.9	3.6	2.9	3.1	3.1	1.1	10.8	1.3	1.4	0.9	3.0	3.0
Shrimp	4.0	12.8	80.8	34.4	41.5	31.3	1.6	10.3	24.9	65.2	27.8	25.9	26.9

Table 3. Stratified mean catches in numbers per hour in different depths and areas 1981.

Species Depth	North of 76°N 0 -100	100 -200	200 -300	300 -400	>400	Tot.	South of 76°N 0 -100	100 -200	200 -300	300 -400	>400	Tot.	Tot.
Cod	16.3	6.3	2.2	4.8	2.5	6.1	149.5	17.1	30.2	14.8	7.1	43.2	36.6
Haddock	1.3	6.8	0.8	0.0	0.0	3.0	0.6	1.0	0.2	0.0	0.0	0.4	0.8
Sebastes marinus	0.0	4.6	50.3	13.0	0.3	12.6	0.0	1.3	4.2	53.9	107.6	38.3	33.7
Sebastes mentella	12.9	12.7	127.5	57.7	827.5	174.3	0.0	60.0	61.5	391.2	114.8	122.9	132.0
Greenland halibut	17.6	60.3	82.1	89.9	33.6	57.2	0.2	0.7	2.9	10.1	13.1	5.8	15.0
Long rough dab	48.0	277.3	360.2	60.2	9.5	192.2	29.5	660.5	372.0	114.0	124.7	246.0	236.4
Blue whiting	0.1	2.1	0.0	3.0	2.9	1.7	0.2	0.6	22.4	48.4	68.0	30.1	25.0
Jelly cat	0.0	0.1	0.0	1.8	0.0	0.2	0.0	3.0	0.7	0.5	1.4	1.2	1.0
Catfish	0.4	3.1	4.7	1.2	0.4	2.4	0.7	2.1	0.7	0.0	0.4	0.8	1.1
Smaller catfish	4.9	3.5	4.0	3.3	2.6	3.6	0.3	3.4	1.2	0.8	0.3	1.2	1.6

Table 4. Unstratified mean catches in kg per hour in different years.

Area	Year	Number of hauls	Cod	Haddock	Red-fish	Greenl. halibut	Long rough dab	Blue whiting	Jelly cat	Cat-fish	Smaller catfish	Shrimps	Total
North of 76°N	1976	16	70	19	100	13	84	93	4	1	10	-	403
	1977	14	36	+	45	8	45	133	2	(+	13)	63	365
	1978x)	19	27	2	22	5	44	99	1	5	11	49	285
	1979x)	19	29	+	80	27	32	433	+	3	+	107	726
	1980x)	20	5	+	9	8	26	1	(+	5	+)	69	129
	1981xx)	66	14	3	78	19	16	1	+	4	4	40	179
South of 76°N	1976	32	61	4	57	7	75	103	12	6	5	-	339
	1977	8	73	3	21	3	114	83	13	(+	15)	40	365
	1978x)	12	27	2	69	4	75	21	8	7	9	57	279
	1979x)	12	60	+	130	6	122	215	41	-	6	76	657
	1980x)	24	23	-	82	8	33	12	(+	10	+)	46	216
	1981xx)	118	79	1	58	6	42	8	12	2	3	23	234
Total	1976	48	64	9	71	9	78	100	9	4	6	-	358
	1977	22	49	1	36	6	70	115	6	(+	14)	55	365
	1978x)	31	27	2	40	4	56	68	4	5	10	52	280
	1979x)	31	41	+	99	19	67	349	16	2	2	95	700
	1980x)	44	15	+	49	8	30	7	(+	8	+)	56	177
	1981xx)	184	55	2	65	6	42	8	12	2	3	23	218

x) Data from unpublished reports at The Institute of Marine Research, Bergen.

xx) Not directly comparable with earlier years due to change in sweepwire length (from 40 m to 80 m) and change from acoustic survey design to stratified random trawl survey.

Table 5. Stratified mean catch (in numbers) with confidence limits of cod for different year classes and depths.

	Depth	Age 1 / Yearclass 1980	2 / 1979	3 / 1978	4 / 1977	5 / 1976	6 / 1975
North of 76°N	0-100 m	0.5 (0.0-1.6)	8.7 (0.0- 20.3)	6.3(0.0- 16.3)	0.6(0.3- 1.4)	0.0(0.0- 0.2)	0.0(0.0- 0.1)
	100-200 m	0.0 (0.0-0.0)	0.8 (0.0- 1.8)	1.0(0.0- 2.2)	0.8(0.3- 1.9)	0.2(0.0- 0.4)	1.5(0.2- 9.2)
	200-300 m	0.0 (0.0-0.0)	0.2 (0.0- 0.6)	0.0(0.0- 0.0)	0.1(0.0- 0.1)	0.0(0.0- 0.0)	0.7(0.0- 1.6)
	300-400 m	0.0 (0.0-0.0)	0.0 (0.0- 0.0)	0.0(0.0- 0.0)	0.2(0.0- 0.6)	0.0(0.0- 0.0)	1.5(0.0- 3.5)
	>400 m	0.0 (0.0-0.0)	0.0 (0.0- 0.0)	0.1(0.0- 0.2)	0.0(0.0- 0.0)	0.1(0.0- 0.2)	0.9(0.6- 2.3)
	Total	0.1 (0.0-0.2)	1.6 (0.2- 3.0)	1.3(0.1- 2.5)	0.4(0.0- 0.9)	0.1(0.0- 0.1)	1.0(0.5- 1.6)
South of 76°N	0-100 m	0.1 (0.0-0.3)	42.9 (0.0-121.7)	71.5(0.0-184.9)	22.7(9.0-36.3)	5.5(0.3-10.6)	4.8(0.4- [illegible].8)
	100-200 m	0.2 (0.0-0.5)	3.2 (0.0- 7.8)	3.3(0.0- 8.2)	1.0(0.4- 1.7)	0.5(0.2- 0.8)	2.7(0.7- 4.7)
	200-300 m	0.0 (0.0-0.0)	0.1 (0.0- 0.3)	0.3(0.0- 0.6)	0.8(0.2- 0.6)	0.9(0.0- 1.7)	8.4(0.0-18.6)
	300-400 m	0.0 (0.0-0.0)	0.0 (0.0- 0.0)	0.2(0.0- 0.6)	0.9(0.2- 2.1)	0.5(0.1- 1.0)	4.6(2.0- 7.1)
	>400 m	0.0 (0.0-0.0)	0.0 (0.0- 0.0)	0.0(0.0- 0.1)	0.4(0.0- 0.8)	0.1(0.0- 0.4)	2.4(0.9- 3.8)
	Total	0.1 (0.0-0.1)	9.4 (0.0- 24.5)	15.3(0.0- 37.1)	5.2(2.6- 7.9)	1.5(0.5- 2.5)	4.3(2.5- 6.1)
	Total	0.1 (0.0-0.1)	8.0 (0.0- 20.3)	12.8(0.0- 30.5)	4.4(2.2- 6.5)	1.2(0.4- 2.1)	3.7(2.2- 5.2)

Table 5 cont.

	Depth	Age 7 / Yearclass 1974	8 / 1973	9 / 1972	10+ / 1971+	Total
North of 76°N	0-100	0.0 (0.0- 0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	16.3 (0.0- 36.3)
	100-200	1.2 (0.2- 2.1)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.6 (0.0-1.7)	6.3 (2.2- 10.4)
	200-300	0.8 (0.0- 1.7)	0.0 (0.0-0.2)	0.0 (0.0-0.0)	0.2 (0.0-0.6)	2.2 (0.6- 3.8)
	300-400	2.0 (0.0- 4.3)	0.2 (0.0-0.6)	0.2 (0.0-0.6)	0.8 (0.0-1.9)	4.8 (0.0- 10.2)
	>400	1.0 (0.0- 3.0)	0.1 (0.0-0.3)	0.1 (0.0-0.2)	0.4 (0.0-1.0)	2.5 (0.0- 6.6)
	Total	1.0 (0.5- 1.5)	0.0 (0.0-0.1)	0.0 (0.0-0.1)	0.4 (0.0-0.8)	6.1 (3.1- 9.2)
South of 76°N	0-100	1.6 (0.1- 3.1)	0.1 (0.0-0.2)	0.0 (0.0-0.1)	0.1 (0.0-0.4)	149.5 (0.0-343.6)
	100-200	3.4 (0.5- 6.2)	0.4 (0.0-0.9)	0.2 (0.0-0.1)	1.7 (0.4-3.0)	17.1 (5.5- 28.7)
	200-300	12.1 (0.0-29.3)	1.8 (0.0-4.9)	0.8 (0.0-2.0)	4.5 (0.0-9.5)	30.2 (0.0- 66.6)
	300-400	5.8 (3.0- 8.6)	0.6 (0.1-1.0)	0.3 (0.0-0.5)	0.9 (0.3-1.6)	14.8 (7.5- 22.1)
	>400	3.0 (1.6- 4.4)	0.2 (0.0-0.4)	0.1 (0.0-0.3)	0.5 (0.0-0.9)	7.1 (3.9- 10.3)
	Total	4.7 (2.1- 7.4)	0.5 (0.0-1.0)	0.2 (0.0-0.5)	1.4 (0.6-2.2)	43.2 (5.2- 81.3)
	Total	4.1 (1.9- 6.2)	0.4 (0.0-0.8)	0.2 (0.0-0.4)	1.2 (0.6-1.8)	36.6 (5.7- 67.6)

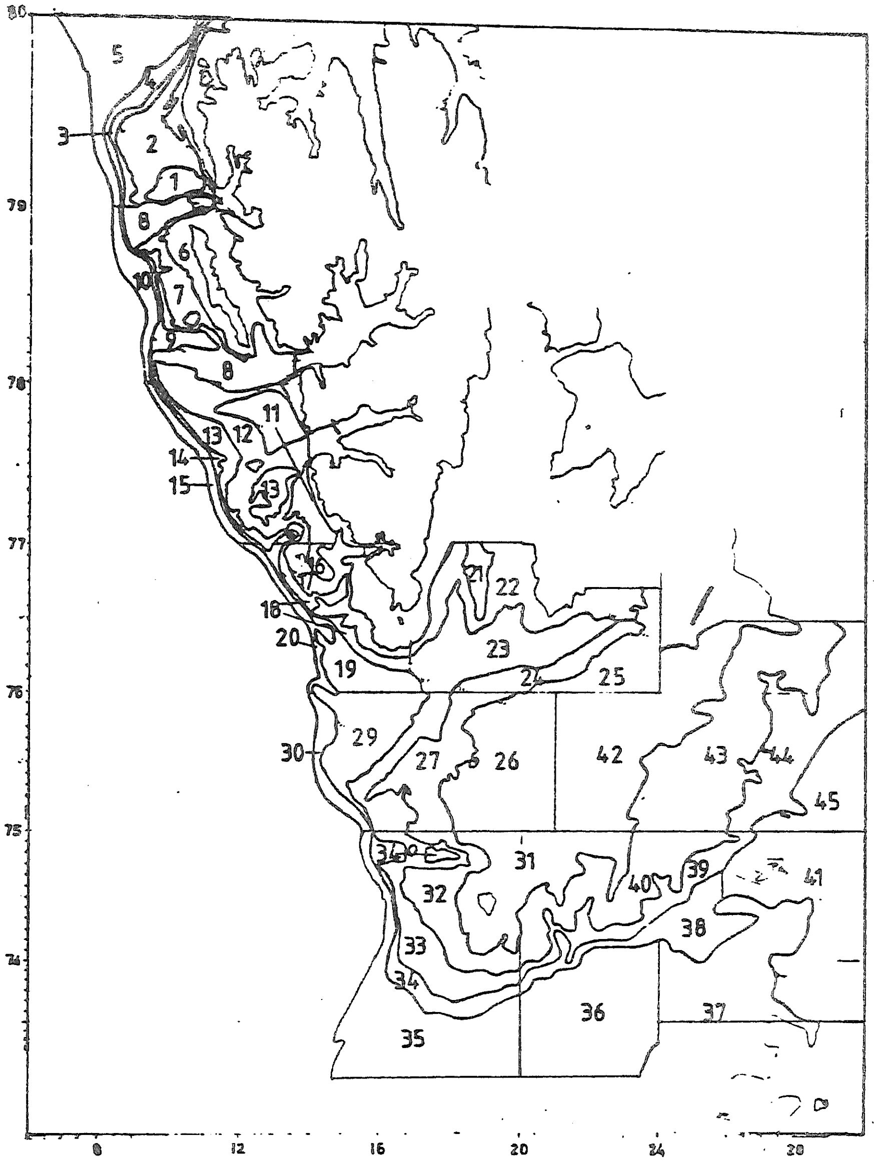

Fig. 1. The investigation area with the different strata.

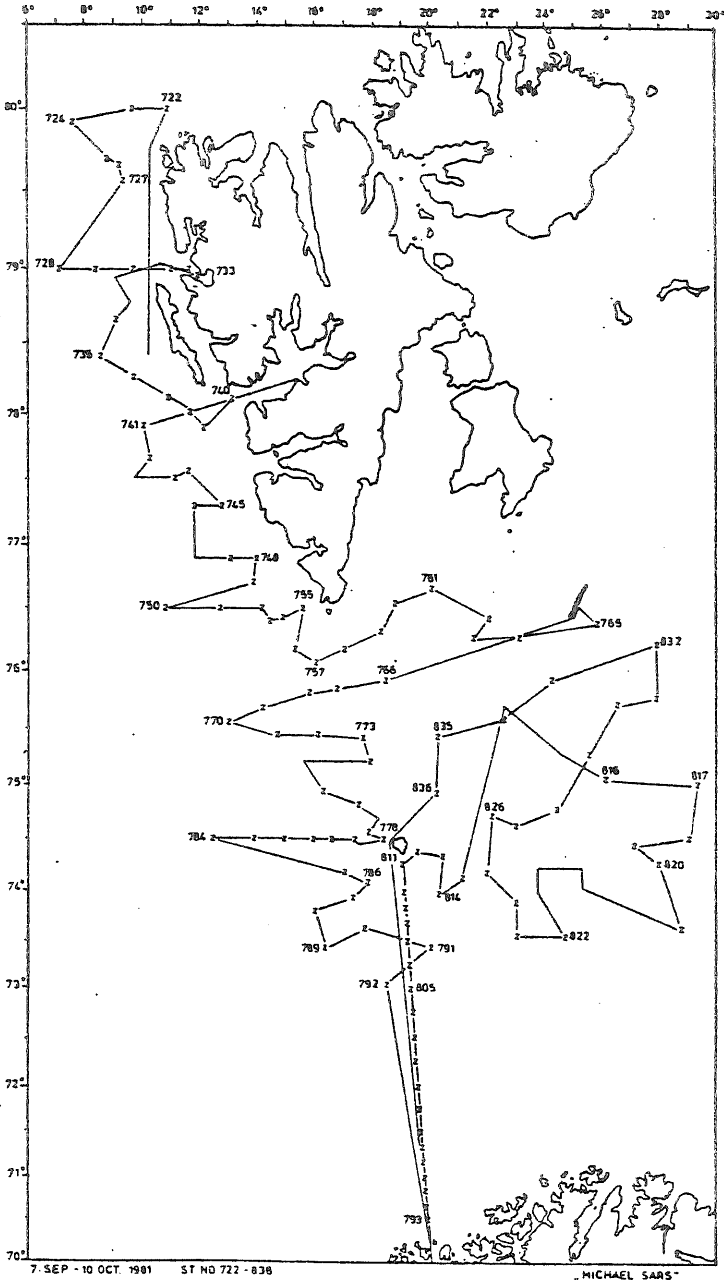

Fig. 2. Survey tracks and hydrographical stations taken by R/V "Michael Sars" in the period 7 September - 10 October.

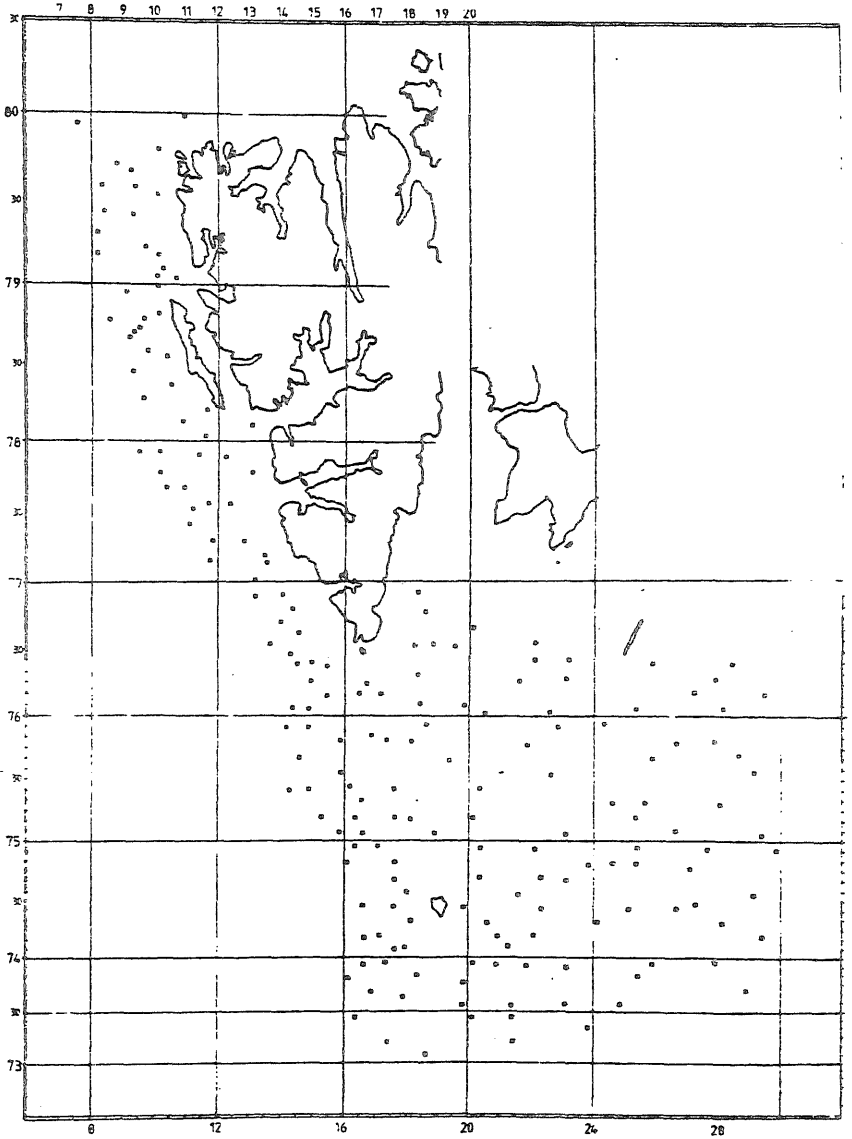

Fig. 3. Bottom trawl stations taken by R/V "Michael Sars" and M/Tr "Vikheim" in the period 7 September - 10 October.

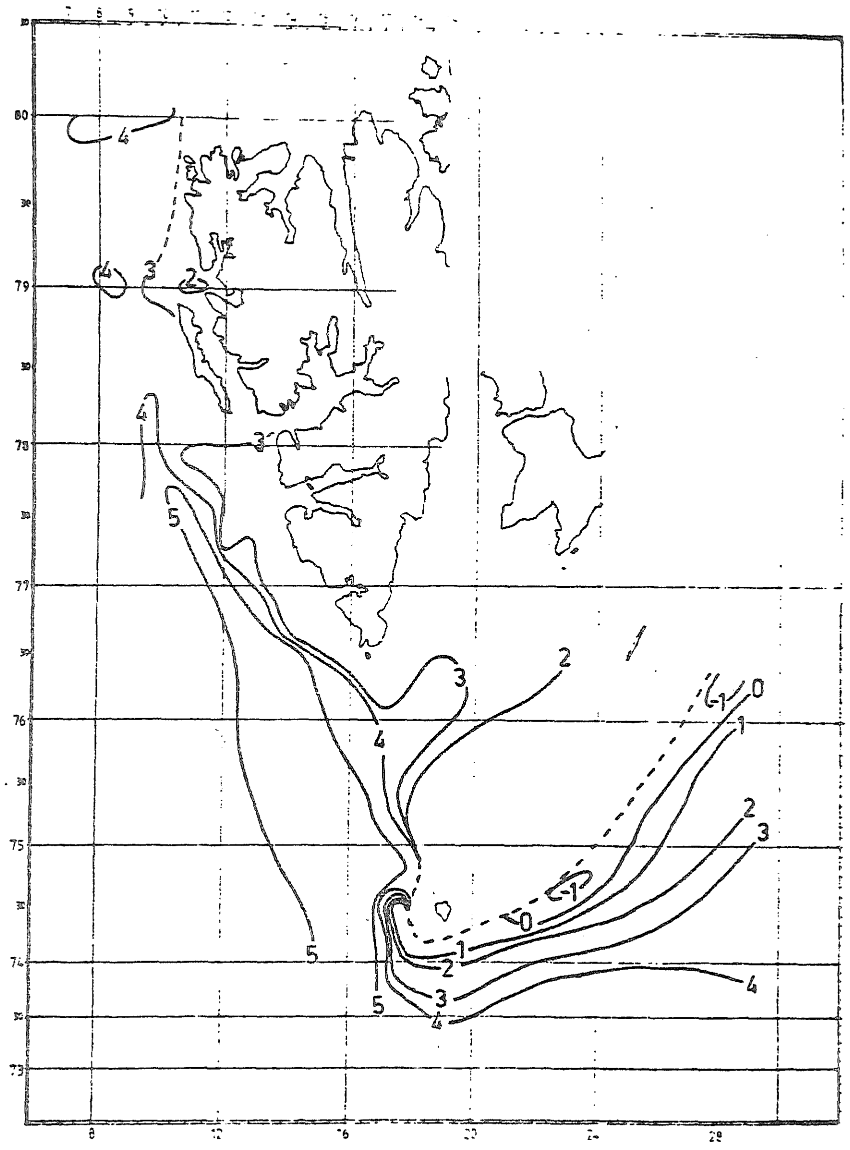

Fig. 4. Temperature distribution in 100 m depth.

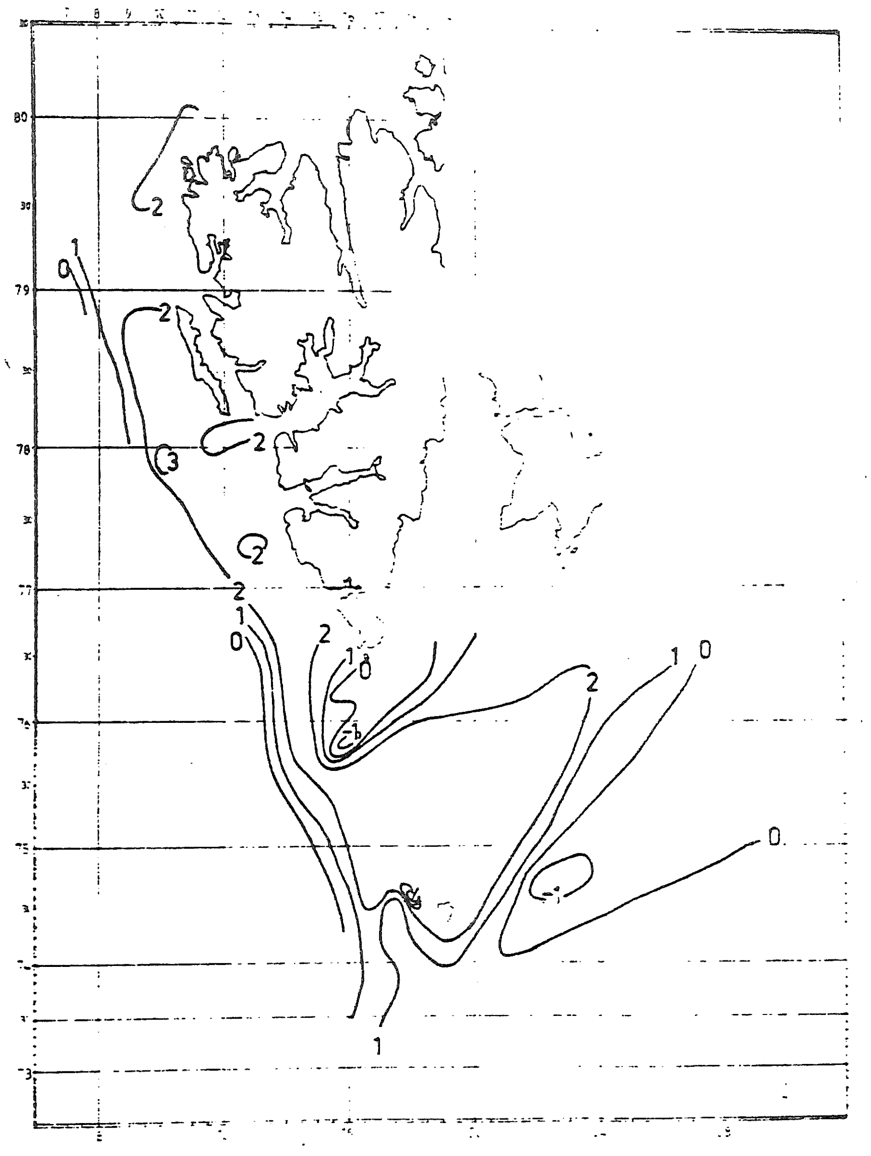

Fig. 5. Temperature distribution at the bottom.

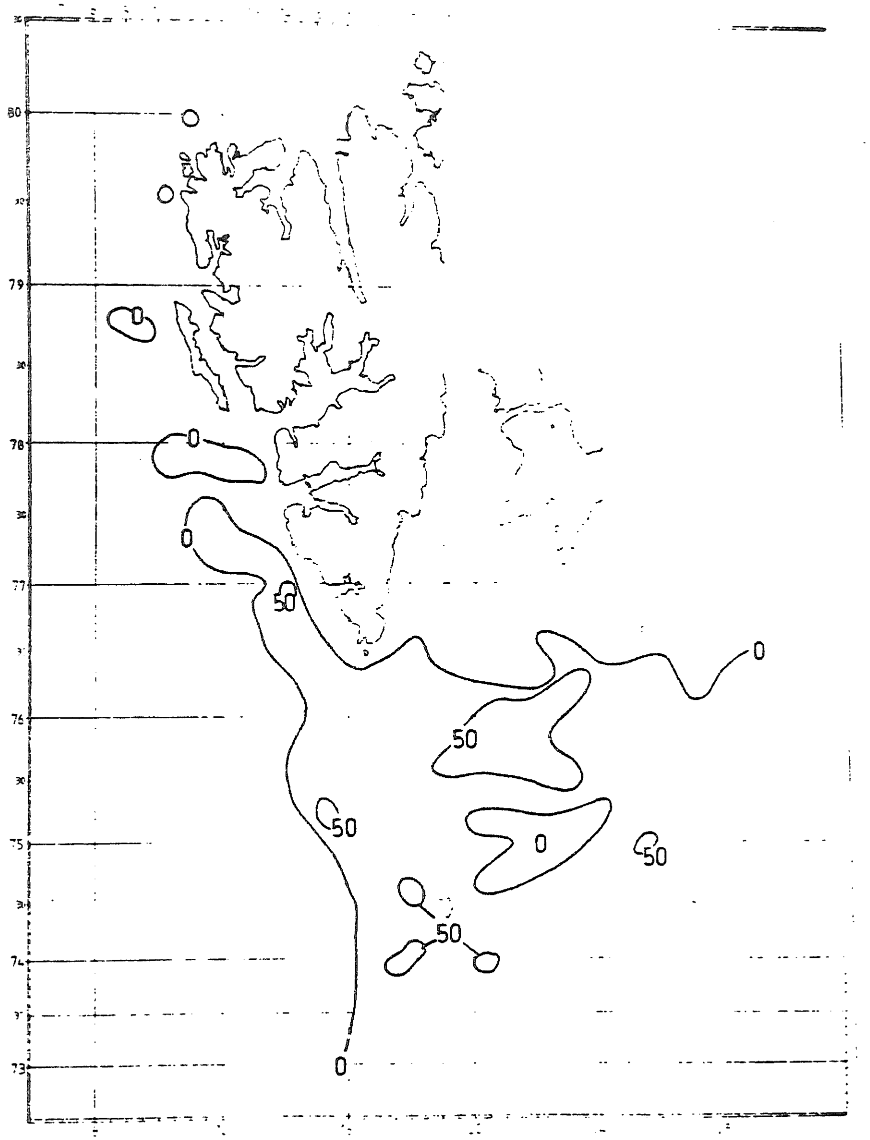

Fig. 6. Distribution of cod in the trawl catches (numbers per hour).

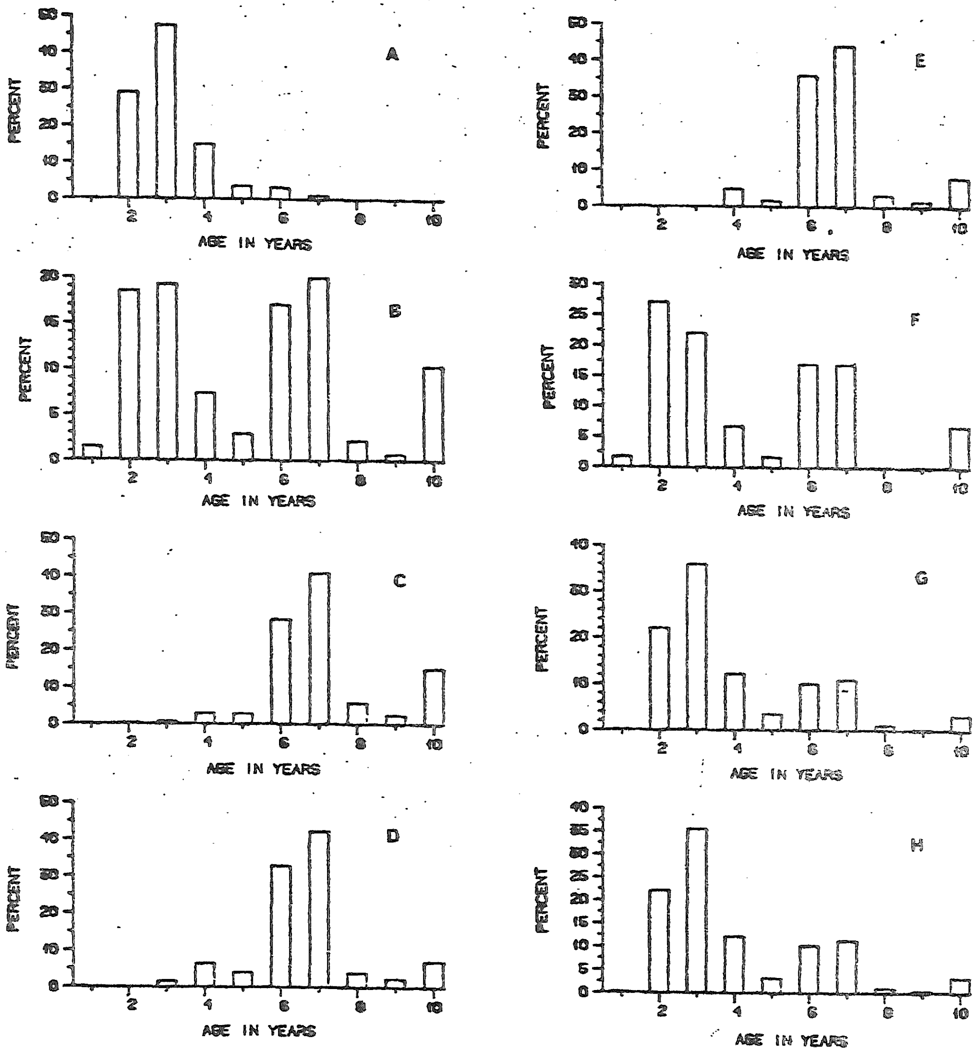

Fig. 7. Age distribution of cod. A: 0 m - 100 m depth, B: 100 m - 200 m depth, C: 200 m - 300 m depth, D: 300 m - 400 m depth, E: Deeper than 400 m, F: North of 76°N, G: South of 76°N, H: The total area.

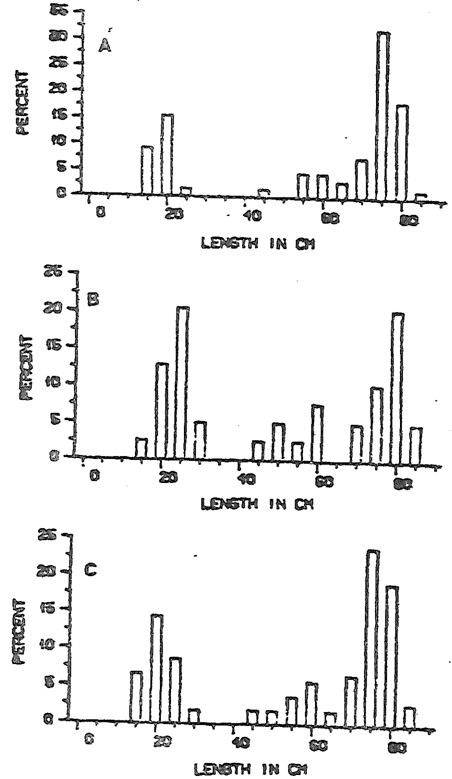

Fig. 8. Length distribution of haddock. A: North of 76°N, B: South of 76°N, C: The total area.

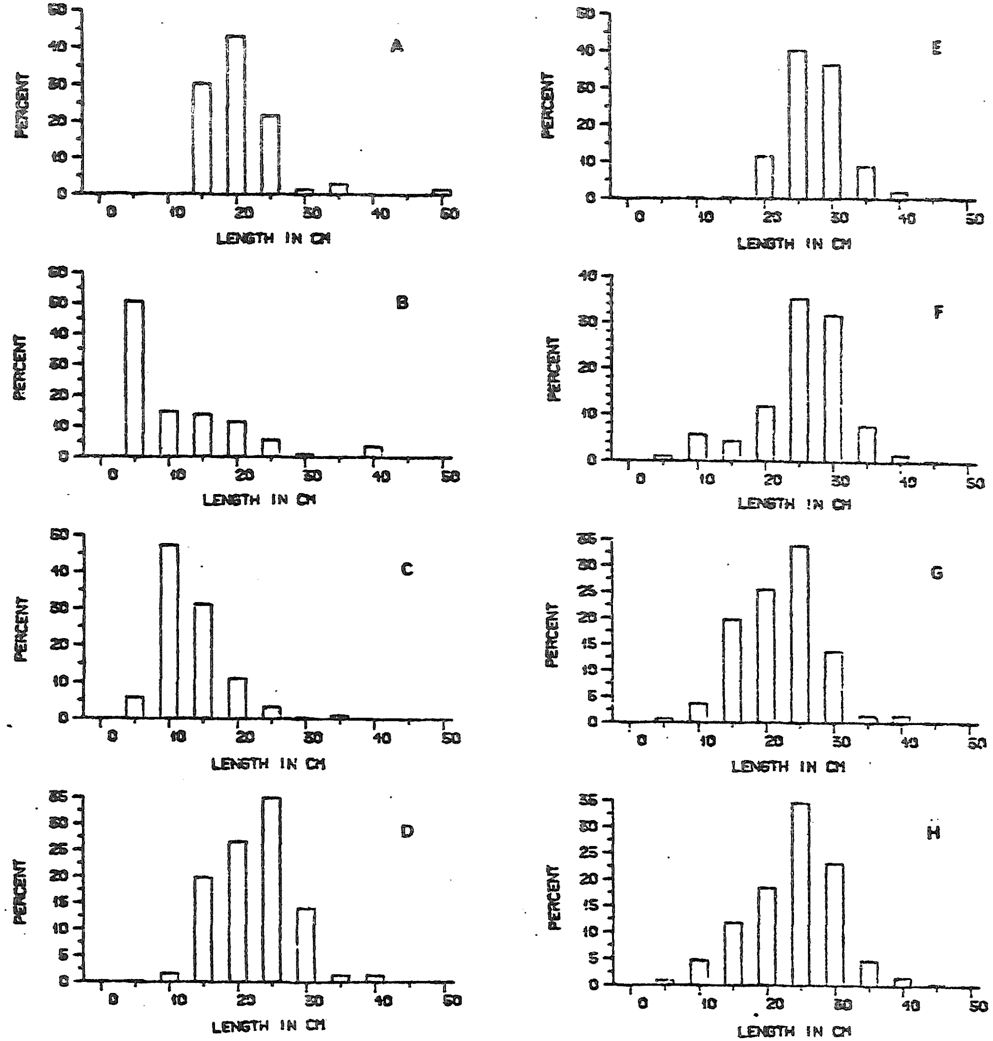

Fig. 9. Length distribution of <u>Sebastes mentella</u>. (Legends: see Fig. 7).

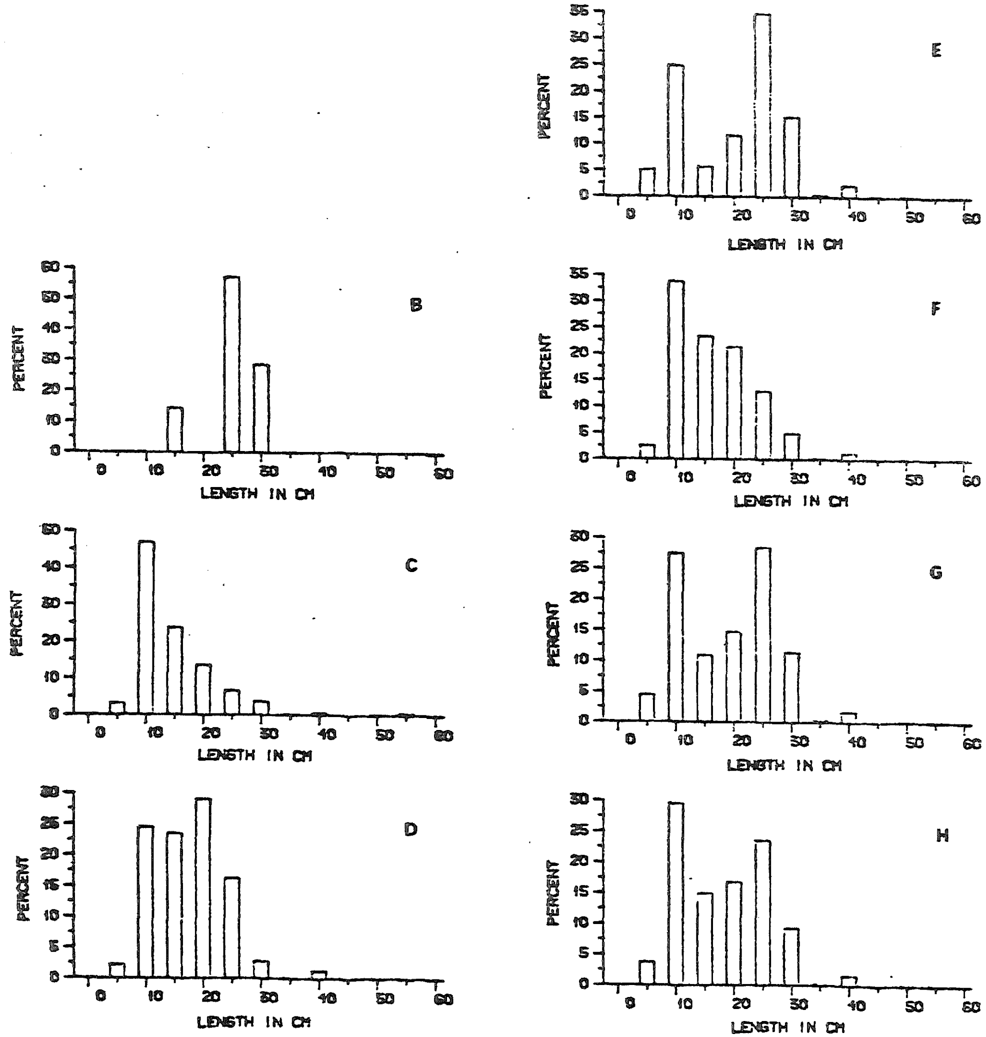

Fig. 10. Length distribution of <u>Sebastes marinus</u>. (Legends: see Fig. 7).

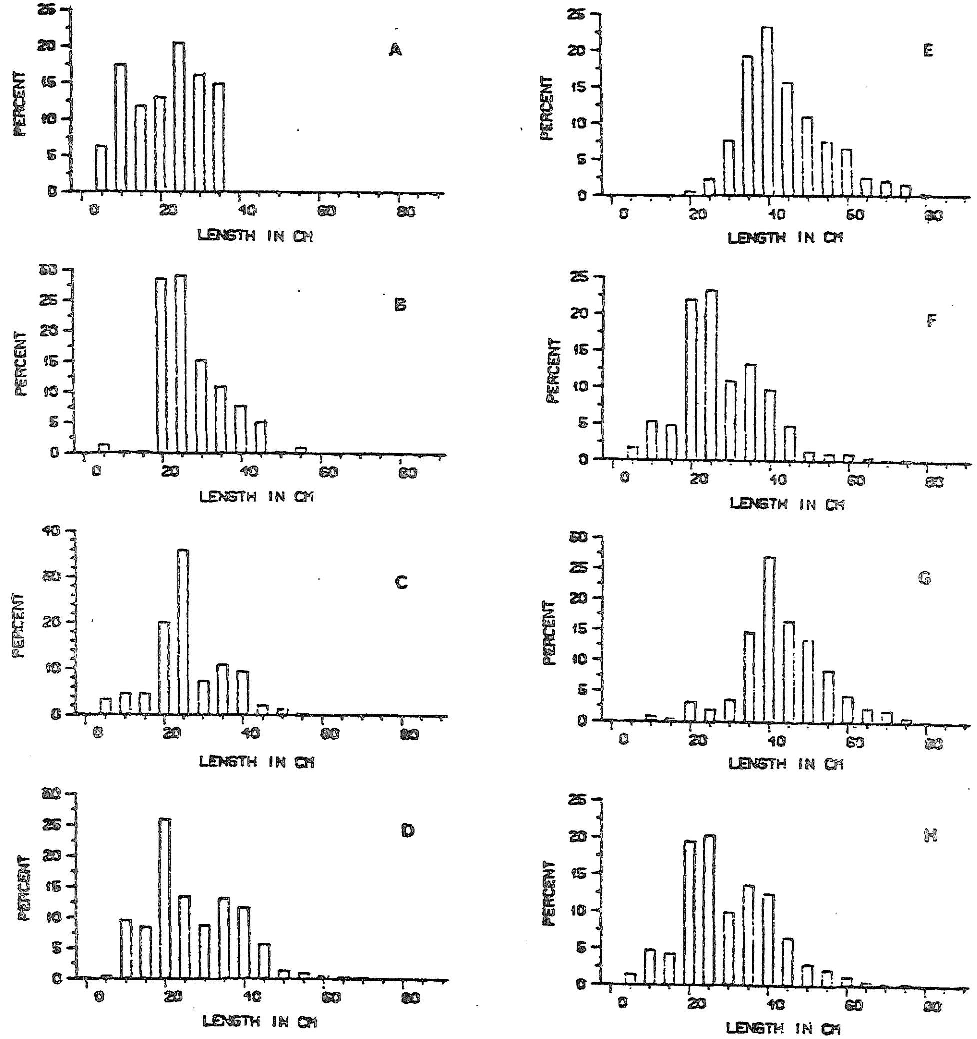

Fig. 11. Length distribution of Greenland halibut.
(Legends: see Fig. 7).

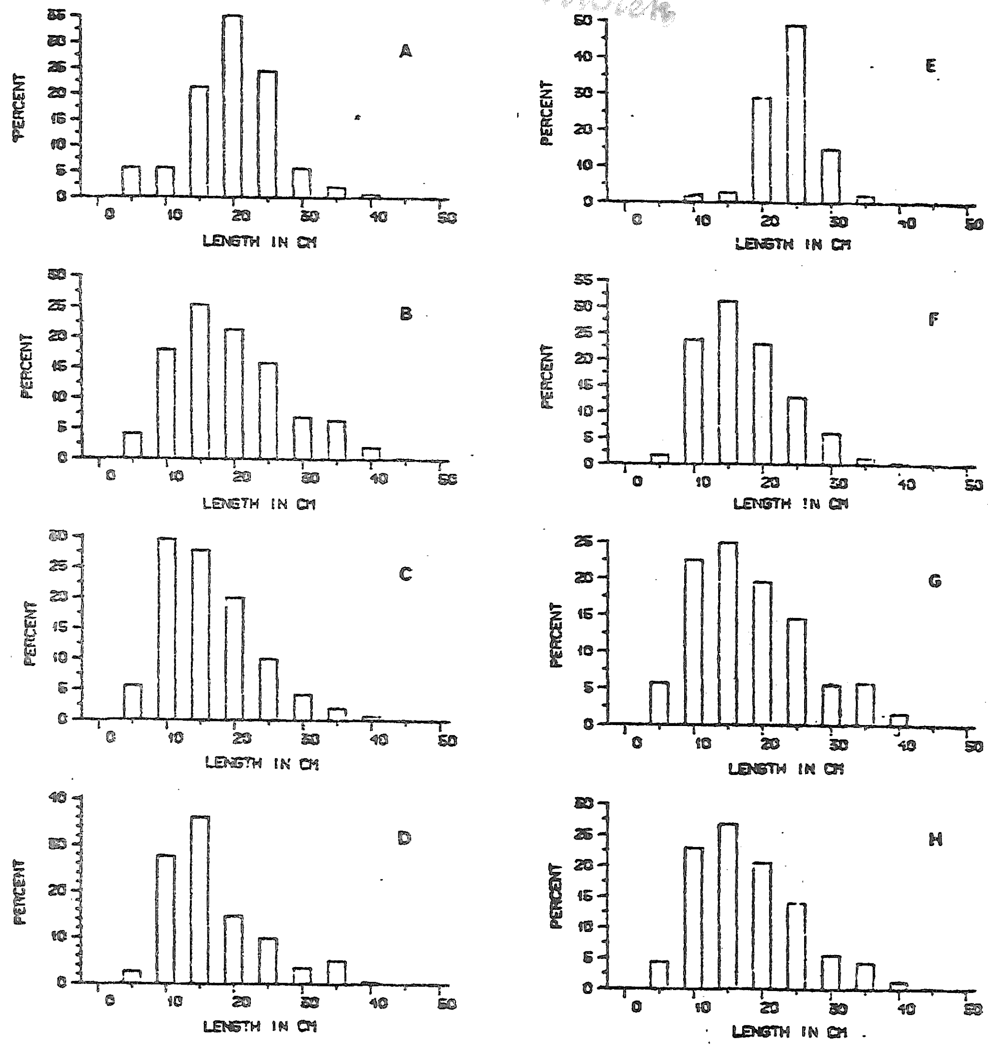

Fig. 12. Length distribution of Long rough dab.
(Legends: see Fig. 7).

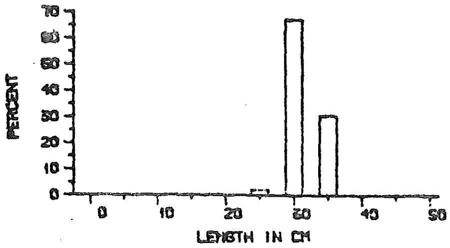

Fig. 13. Length distribution of blue whiting.