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Report on the distribution of cod,haddock,whiting and
Norway pout from a cruise with R/V "G.O.Sars" in June-
July 1972.

by

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INTRODUCTION

The main objectives of the cruise were to investigate the hydrographical conditions, the distribution of plankton, fish eggs and larvae, and the resources of demersal and pelagic fish in the northern North Sea and Skagerrak. The region covered is shown in fig.1.

This paper mainly deals with the distribution and abundance of cod,haddock,whiting and Norway pout in relation to the hydrographical conditions.

MATERIAL AND METHODS

Hydrographical conditions were investigated by sampling 261 stations. On almost every stations the STD-sonde was used as shown in fig.1.

Acoustic registrations were continually recorded during the cruise by means of an echosounder (38 kHz) and 3 integrators.

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Assessments were made by estimating the running mean value of echo abundance pr.naut.mile based on intervals of 5 naut.miles each.

Identification of registrations were made by trawling, which usually was carried out on apparently good registrations. A total of 35 trawl hauls were made, out of which 18 pelagic (Harstad and Engel trawl) and 17 demersal (fig.1). Adequate samples were taken from every haul. The samples were sorted according to species and length measurements made to the nearest $\frac{1}{2}$ cm below for 0-groups and to the nearest cm below for bigger fish. The total number and weight were estimated. Otoliths were collected from cod, haddock, whiting, Norway pout and several other species.

RESULTS AND DISCUSSION

HYDROGRAPHY

In the figure 2 and 3 are shown the temperature and salinity of the mixed bottom layer, the thickness of which varies from min. 20 m on the North Sea shelf to approximately 200 m in the inner part of the Skagerrak.

The investigated region may be divided into 3 areas reflecting significant different hydrographical conditions. The differences seem to have some relation to the fish distribution. The areas are as follows: A) The Norwegian Deeps up to 150 m, B) The shallow Danish coastal area and C) The northern North Sea with depths between 100 and 150 m.

As indicated in fig.1 the whole region covered corresponds mainly to the ICES areas IVa and IIIa.

The water masses of area A are mostly of North Atlantic origin and have high salinity and lowest temperature. Only under exceptional winter conditions the temperature of the bottom layer is drastically changed (Ljøen and Svansson 1972).

In area B, with salinity below $35^{\circ}/\text{oo}$, continental coastal waters are dominant. The temperature, the annual variation of which is significant, was high compared to the other areas.

The water mass of area C is also of a North Atlantic type, however locally cooled during the winters. The typical qualities of the central part of it are slow movements and high stability to the upper layers in the summer. The area is limited by warmer North Atlantic water intruding on the western and eastern side, and divided into two parts by a tongue of water with relatively high temperature and salinity below 35,1 ‰. Such a hydrographic situation is frequently observed in this season (Ljøen 1971).

The observed temperature of the central parts (6.5-7.0°C) is comparable to that of the summers 1967 and 1971 (Ljøen 1971).

ACCUSTIC ASSESSMENTS OF FISH ABUNDANCE

Fig. 4 shows the estimated abundance of fish in the region covered. The highest values were obtained in the northern central part and along the slope of the western and southern sections of the Norwegian Deep with maxima south of Lindesnes, and in the central northern North Sea respectively. Norway pout appeared to be the dominating contributor to the high values in the central and southwestern part of area C while blue whiting was the most predominate species in area A. The concentrations of Norway pout found in the northern North Sea corresponds with the observations made by Raitt and Mason (1968) and others. Abundant occurrence of blue whiting has been reported by Hamre and Nakken (1970, 1971) in area A.

RELATIVE COMPOSITION OF FISH

Area A: - Cod, haddock and whiting contributed very little to the total catch. In general also catches of Norway pout were small, but on two stations the yield was comparatively high, about 1/3 of the total (table 1). The most important species in the trawl hauls were blue whiting, coalfish, greater silver smelt and other deep water species.

Area B: - About 2/3 of the quantity caught in this area consisted of cod, haddock and whiting and the by-catch mainly of dab, sandeel, horse-mackerel and plaice (table 1).

Area C: - On an average Norway pout made up nearly 3/4 of the total yield, and cod, haddock and whiting together about 1/10 (table 1). The remaining by-catch consisted of coalfish, herring and several other species.

I-GROUP AND OLDER GADOIDS

COD: - The species was found in rather small numbers in the whole region (table 1). In area A cod occurred in nearly all the hauls, but very few in numbers. On the Danish coast (area B) station 142 gave a good catch on the contrary to station 140 with only 3 individuals per hour of trawling. In the northern North Sea (area C) the number of specimens were comparatively small, but cod was found on all stations.

Due to the small numbers caught the length frequency distributions and the age compositions are made separately for each area only, and the length material is presented in 5-cm groups (fig. 5).

In area A the cod was comparatively large with an age of 2 to 7 years, belonging mainly to the II-IV groups. The samples from area B consist of smaller fish from the I-IV group, with the II-group being predominant. In area C fish from the I to VII-group occurred with the I to III-group as dominating.

HADDOCK: - Table 1 indicates that area B and C gave the best catches of haddock, the species was occasionally found in area A.

Fig. 6 shows that specimens caught in area A generally were small and belonged mainly to the I-group. Trawl station 156 also includes some older individuals. In area B several age-groups were represented with a predominating II-group as shown in fig. 6a. In area C as in area A the I-group was strongly represented (fig. 6b). In the northern part of the area, however, the contribution of the V-group (1967-year-class) was exceptionally high. As reported by Anon (1971) this was an extremely strong year-class.

WHITING: - Whiting was well represented both in area B and C, but did almost not occur in area A (table 1). Fig. 7 shows that the younger age groups were abundant in area B. In area C there were more older individuals. On trawl station 155 there was an exceptionally high catch of the V-group (1967 year-class). This was also reported by Anon (1971) as being a very good year-class in the North Sea. Knudsen 1968 mentions that it seems to be a migration with increasing age from southeast to northwest and that this also was in accordance with his tagging experiments (Knudsen 1964) for the part of the stock north of Dogger Bank.

NORWAY POUT: - Area C is by far the most important one with catches up to 1700 kgs per hour of trawling. Norway pout is also represented in area A, occurring in all hauls, but in substantial numbers in a few hauls only. At the Danish coast (area B) Norway pout was absent.

By comparing catch data (table 1) and integrator values (fig. 4) it is indicated that the biggest concentrations of Norway pout probably can be divided into a northern, central sub-area between 58° and 61° N (trawl station 145 and 155), and a south-western sub-area which southern boundary is unknown (fig. 3). Fig. 9 shows that the samples in area A mainly consist of I-group fish, but the II-group was also represented in all hauls. On trawl stations 133 and 156 the III-group even occurred. In area C the I-group is strongly dominating. In the northern part of the area the II-group and even the III-group were represented.

0-GROUP GADOID FISH

Table 2 gives the number of 0-group fish per hour of trawling. These were mostly caught by pelagic trawl, occasionally also by bottom trawl.

0-group cod occurred both in area B and C, though always in small numbers. The best catch was 162 fish per hour of trawling. Those taken by pelagic trawl ranged in length from 3.0 to 7.0 cm and by bottom trawl from 4.5 to 11.0 cm.

Haddock occurred frequently in the whole region, but appeared

to be concentrated to a certain extent in the central part of the northern North Sea, the largest haul being 2700 number per hour. The specimens taken by pelagic trawl measured from 2.5 to 10.0 cm, and those taken by bottom trawl from 3.5 to 11.0 cm.

Whiting occurred only in area A and B, and were caught both pelagic and demersal in very small numbers, the largest individual catch per hour being 50. Taken by pelagic trawl it ranged from 5.5 to 10.0 cm in length and from 4.0 to 9.0 cm in bottom hauls.

0-group Norway pout was only caught in the central part of area C except on trawl station 128 in area A where a few numbers occurred. In this central part Norway pout was found in great numbers. The best catch taken was 31510 fish per hour. It appears that the distribution this year was more to the north than in 1970 (Hislop 1971) when the highest concentrations were found in the Fladen Ground area. Norway pout was only caught by pelagic trawl and ranged from 1.5-5.5 cm. Fig. 9 shows the echo registration of 0-group Norway pout in about 50 m depth on trawl station 152.

Catches of 0-group gadoids gave bigger individuals in demersal than in pelagic trawl. The mean length in the pelagic catches is in accordance with Hislop (1971) except for haddock which is larger in his material. The abundance in the area covered appear to be small with regard to cod and whiting. The haddock was more abundant than the former, but the far most abundant species was Norway pout which was also found to be the most abundant species in 1969 and 1970 as mentioned by Hislop (1970, 1971). From the results of this cruise and also Hislop's data (Hislop loc. cit.) the northern North Sea appears to be an important 0-group area, especially with regard with N also to some extent to haddock.

CONCLUSION

The hydrographical condition in the investigated region of the North Sea and Skagerrak revealed the existence of different water masses with typical qualities. The distribution of Norway pout and blue whiting seems to be strongly correlated to such differences.

Of the four species dealt with in this paper Norway pout seems to be by far the most important one, especially in the central northern North Sea. The other species occurred in comparably small numbers.

The concentrations of 0-group fish, particularly of the Norway pout was mainly restricted to the central part of the northern North Sea where the exchange of intermediate and bottom water probably has been much less than in areas with intruding Atlantic water.

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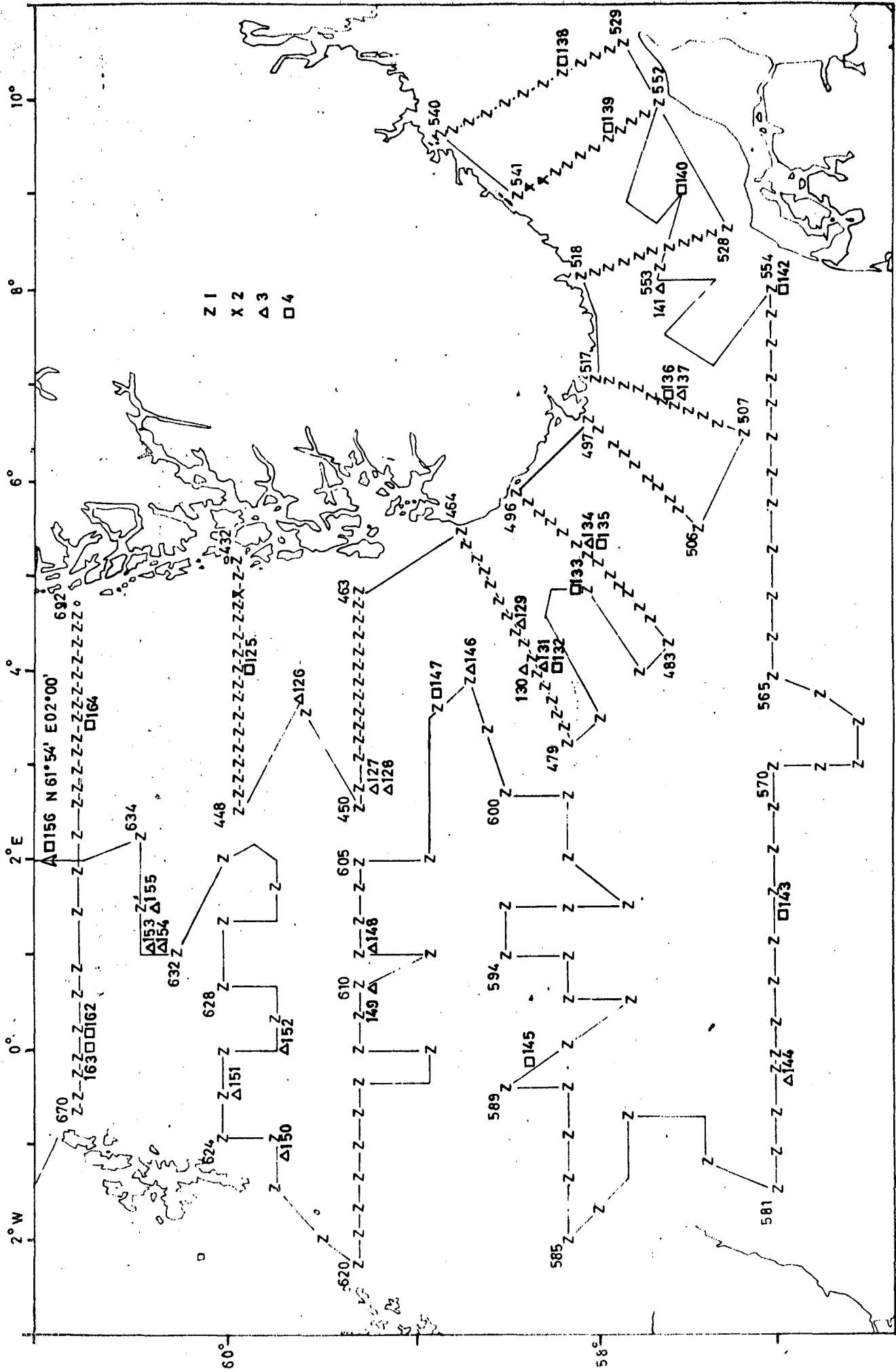


Fig. 1. Survey route and grid of stations. 1) STD sonde, 2) Nansen cast, 3) pelagic trawl, 4) demersal trawl.

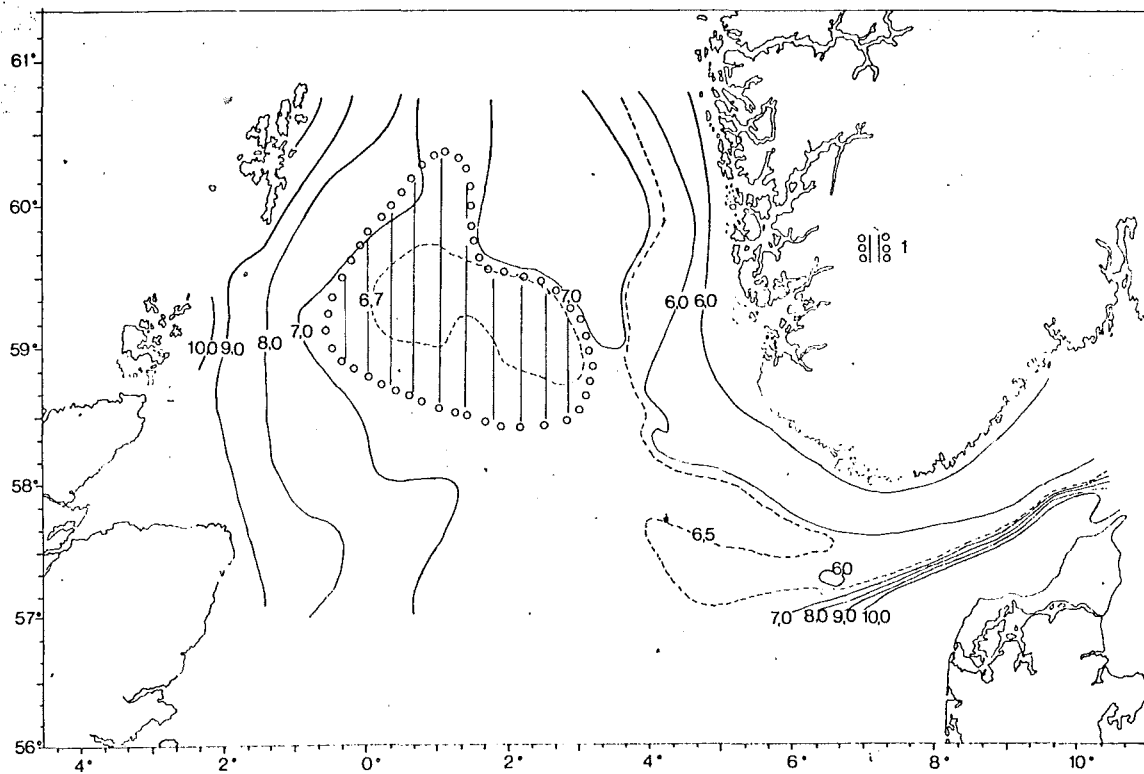


Fig.2. Temperature of the mixed bottom layer in the North Sea and Skagerrak. 1) 0-group Norway pout.

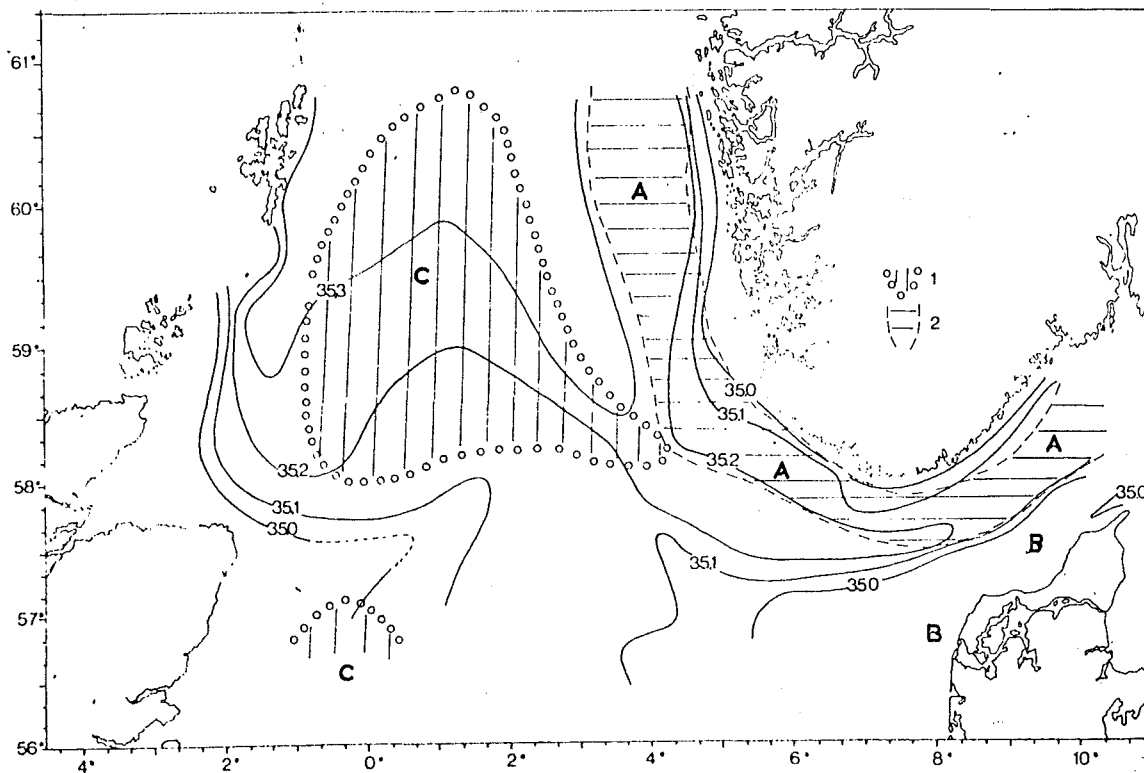


Fig.3. Salinity of the mixed bottom layer in the North Sea and Skagerrak. 1) Norway pout, 2) blue whiting, A, B and C indicate the different areas as referred to in the text.

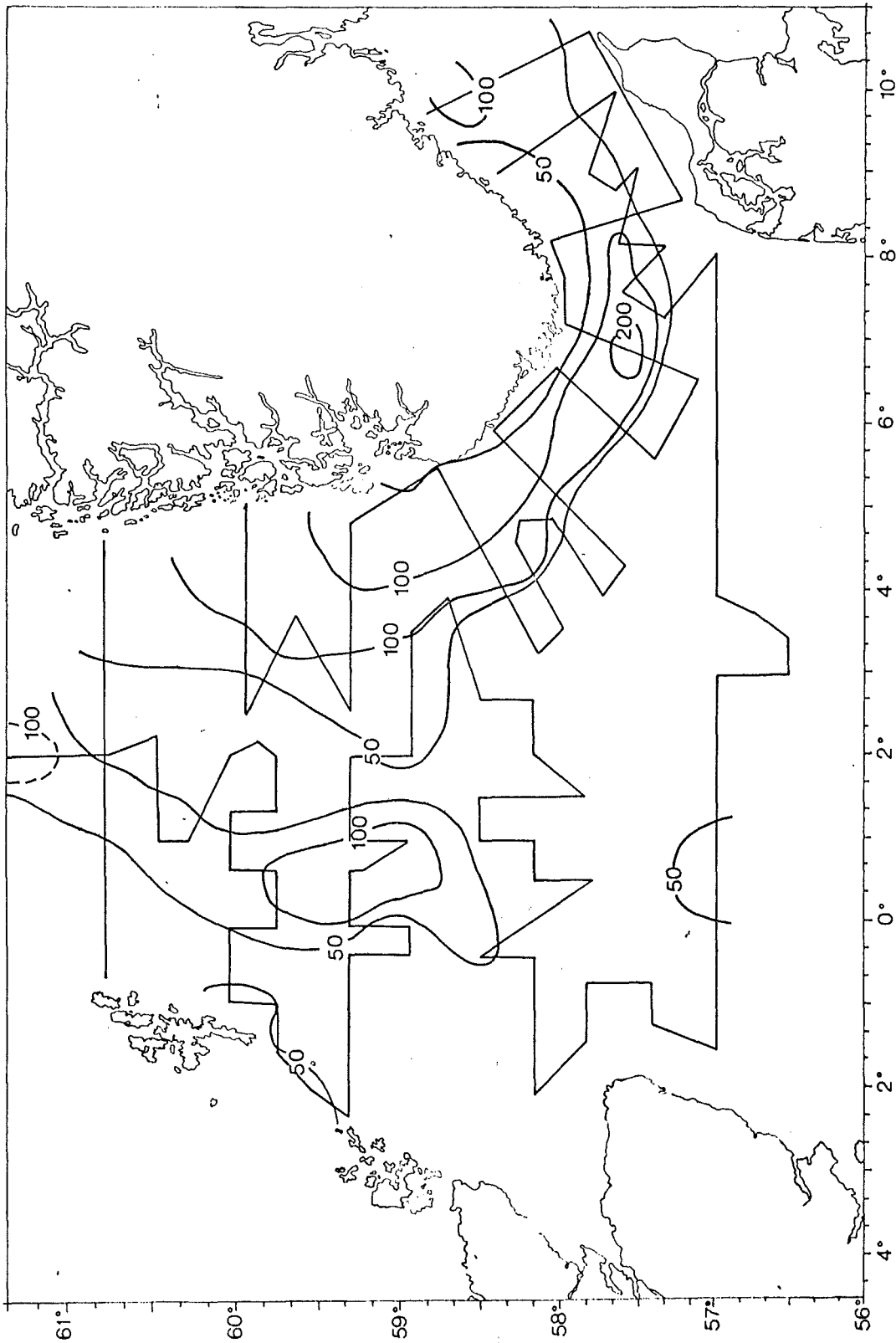


Fig.4. Relative fish abundance. Isolines indicate deflection (in mm x 10) of echo abundance in the North Sea and Skagerrak in June-July 1972. (Relative values).

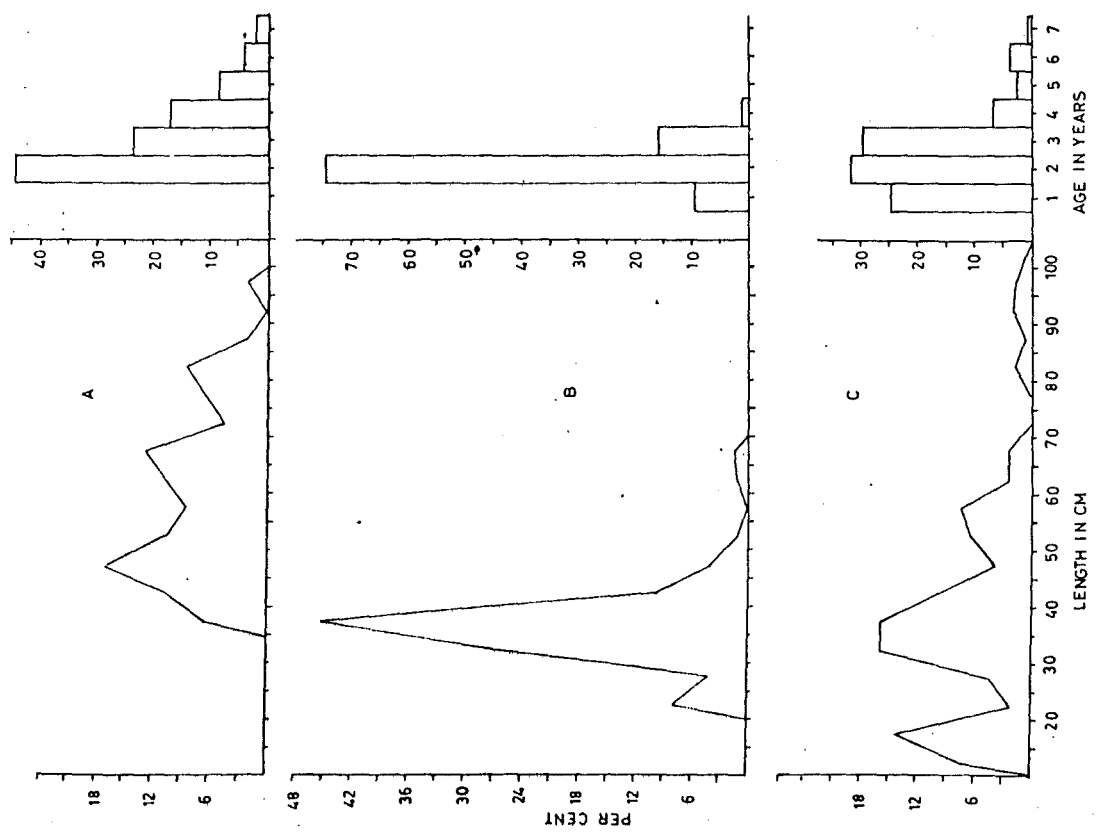


Fig. 5. Cod. Length frequency distribution and age composition. A) Norwegian Deeps, B) Danish coast, C) northern North Sea.

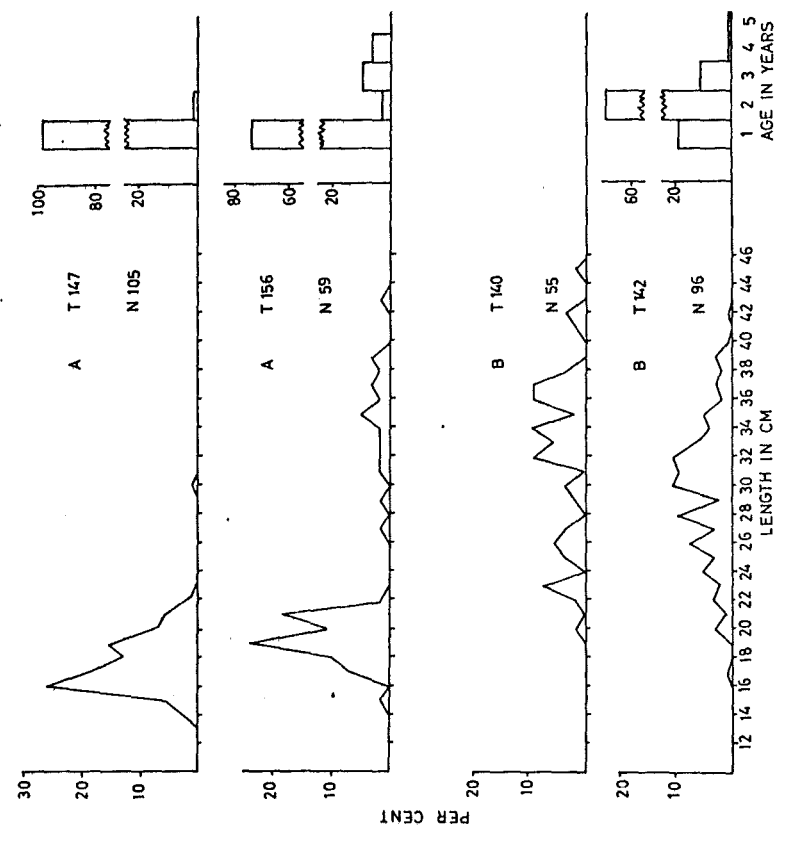


Fig. 6a. Haddock. Length frequency distribution and age composition. A) Norwegian Deeps, B) Danish coast.

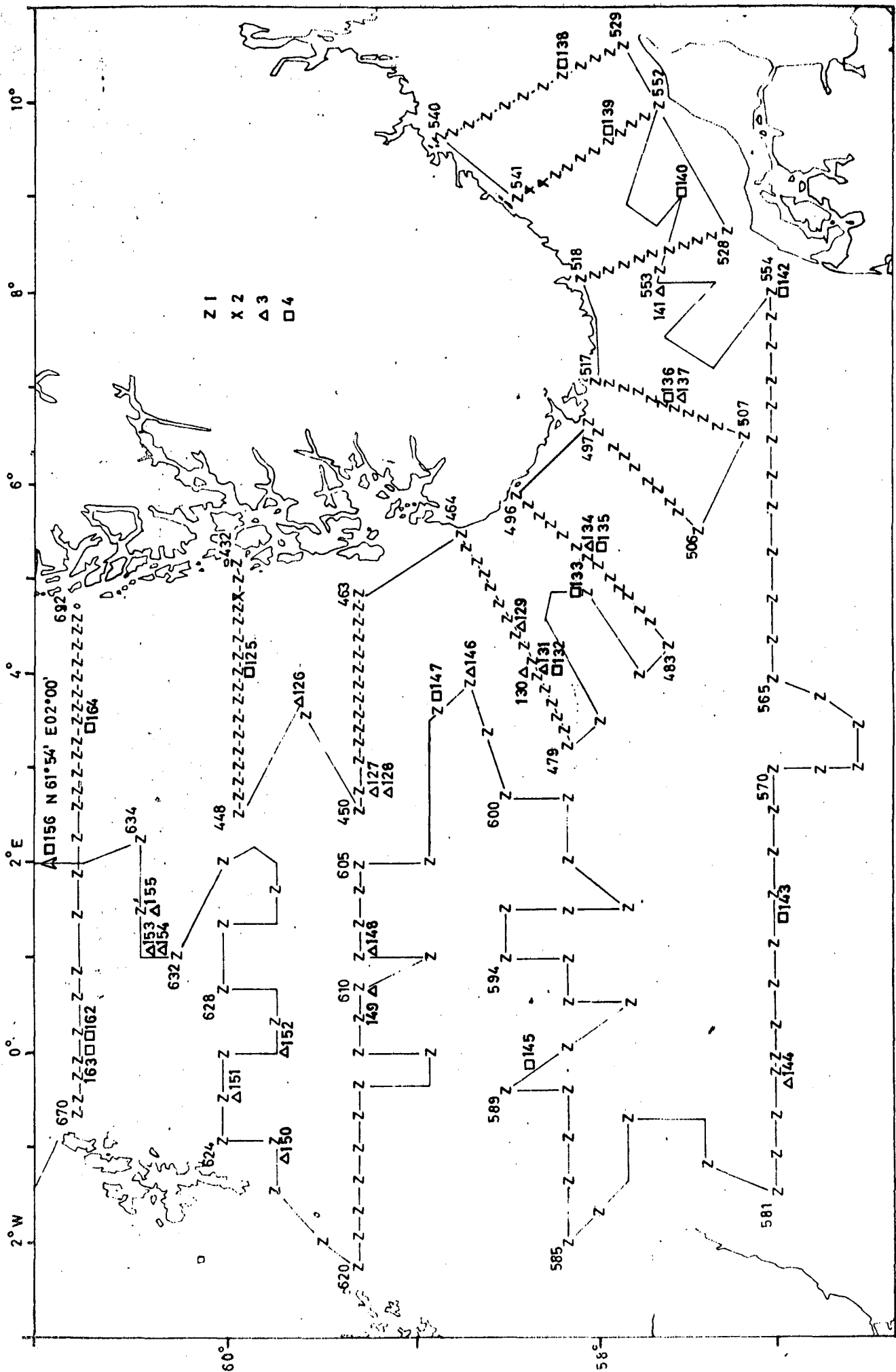


Fig. 1. Survey route and grid of stations. 1) STD sonde, 2) Nansen cast, 3) pelagic trawl, 4) demersal trawl.

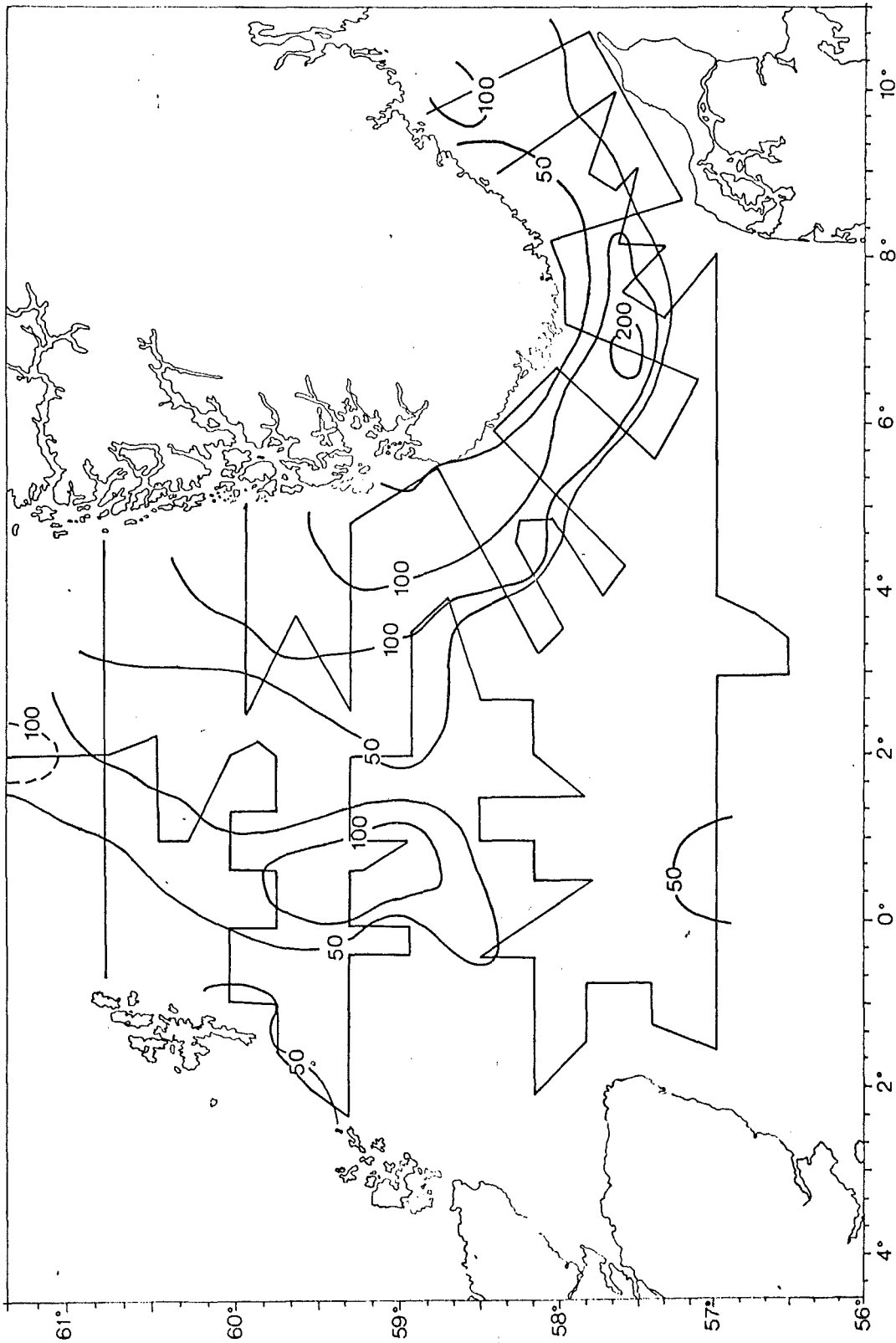


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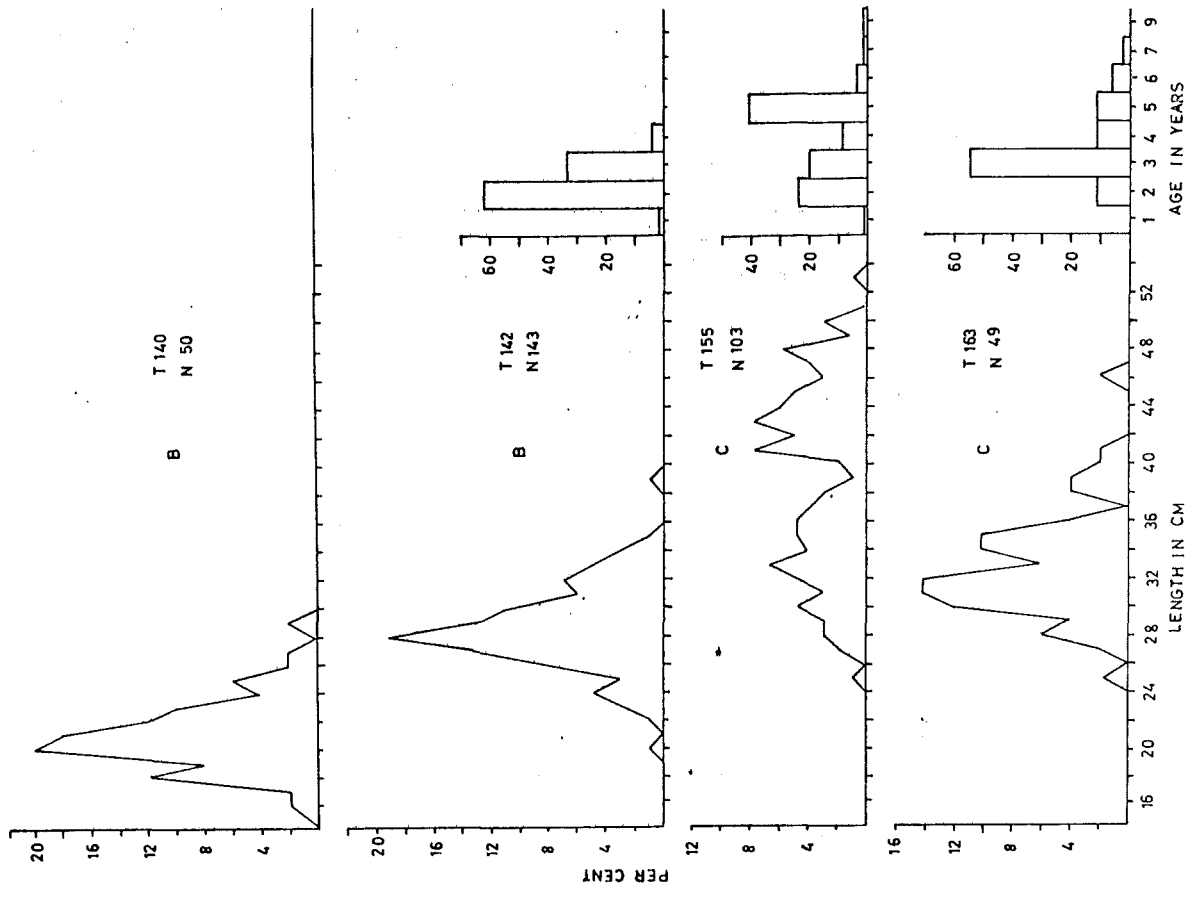


Fig.7. Whiting. Length frequency distribution and age composition. B)Danish coast,C)northern North Sea.

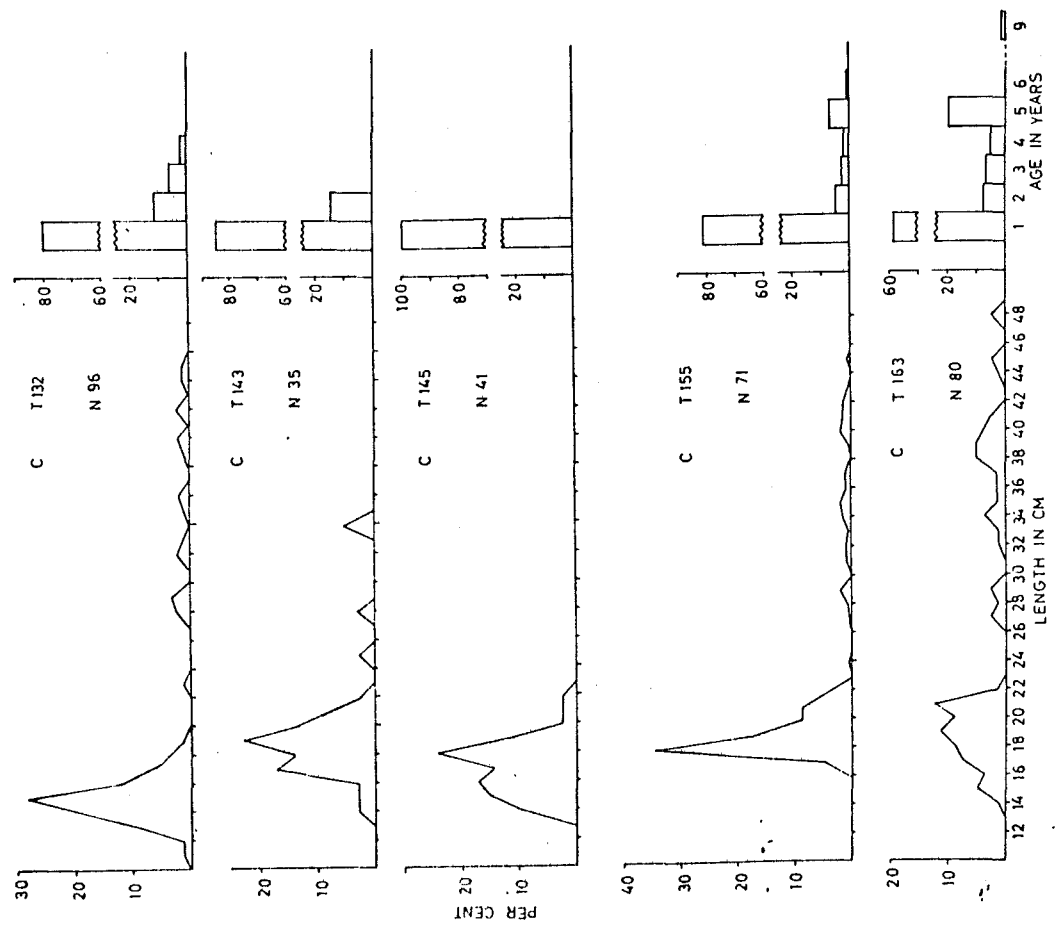


Fig.6b. Haddock. Length frequency distribution and age composition. C)northern North Sea.

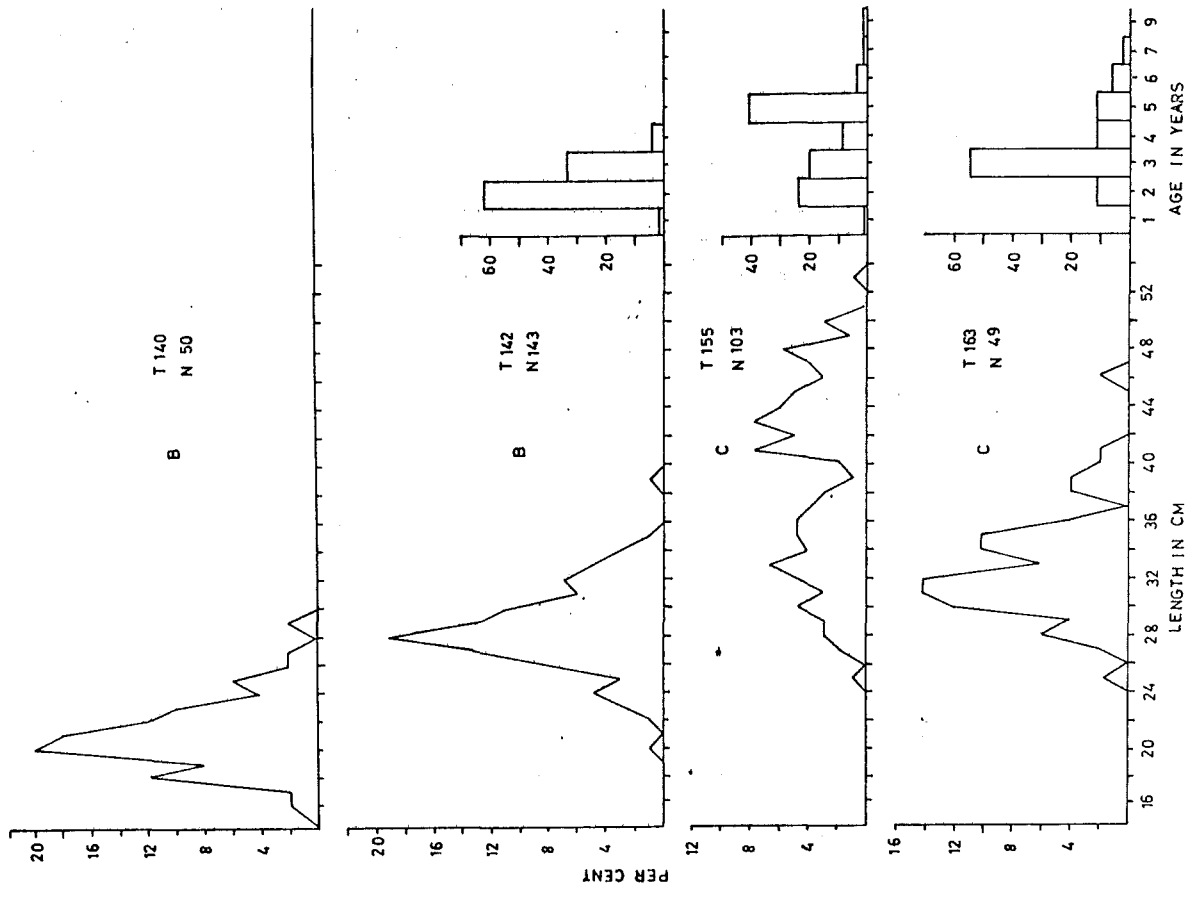


Fig.7. Whiting. Length frequency distribution and age composition. B)Danish coast,C)northern North Sea.

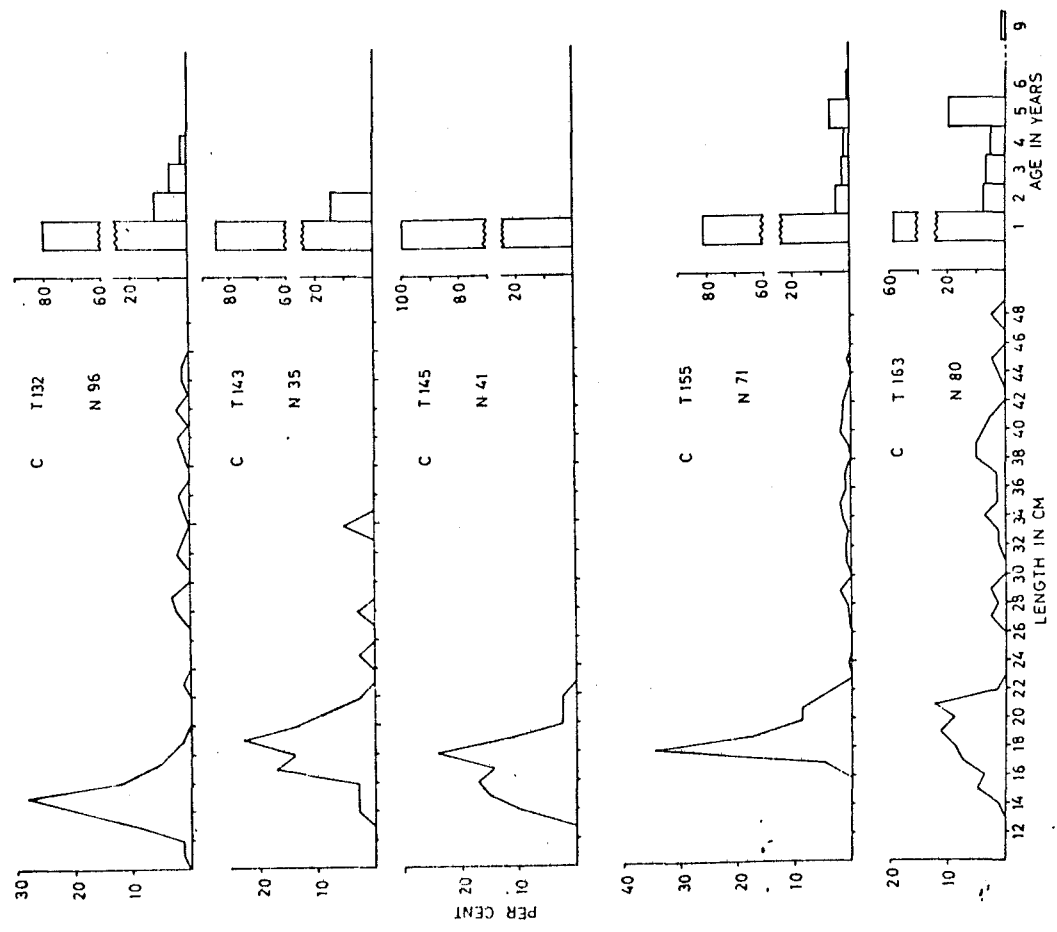


Fig.6b. Haddock. Length frequency distribution and age composition. C)northern North Sea.

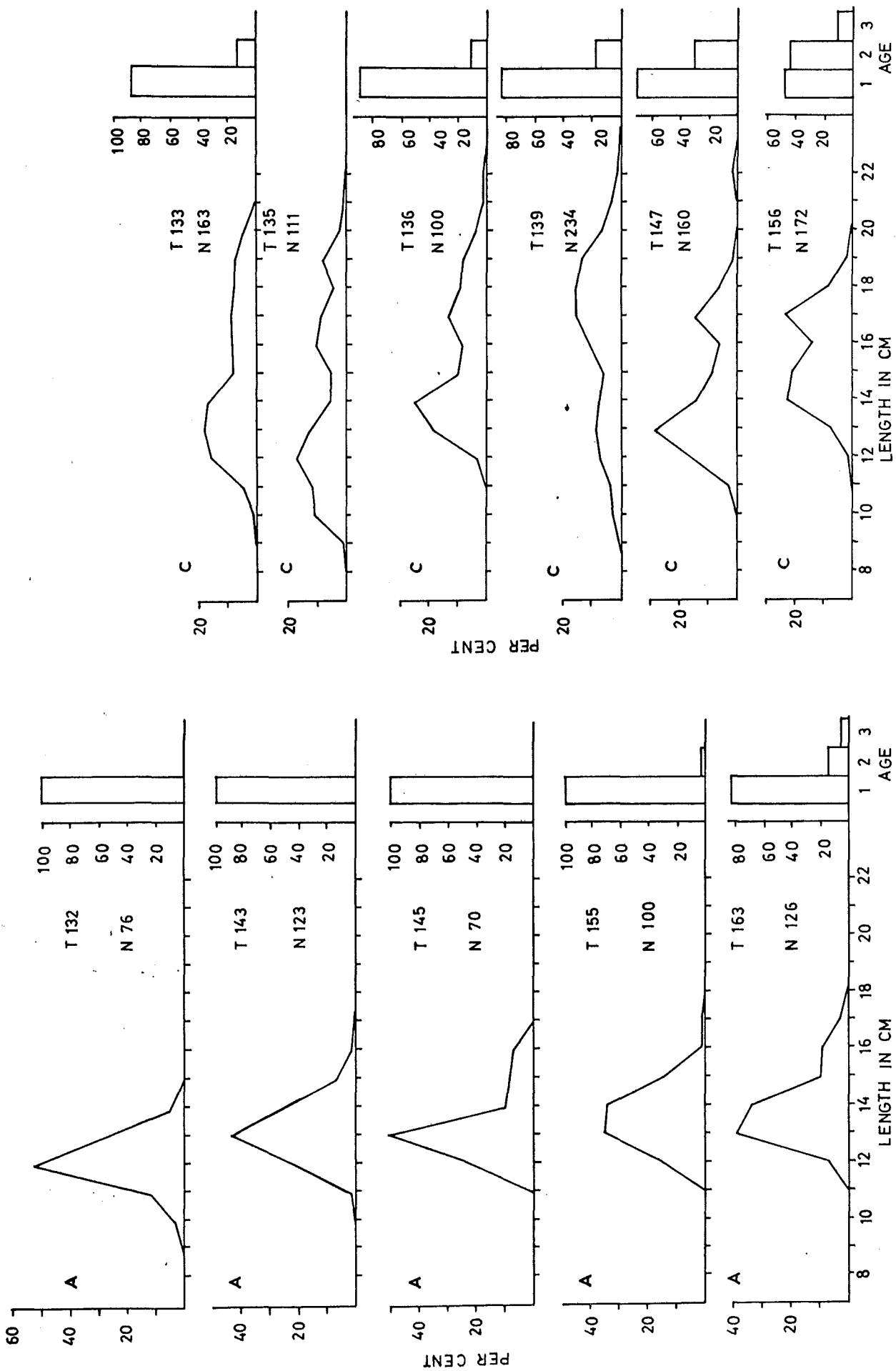


Fig.8. Norway pout. Length frequency distribution and age composition.

A) Norwegian Deepes, C) northern North Sea.

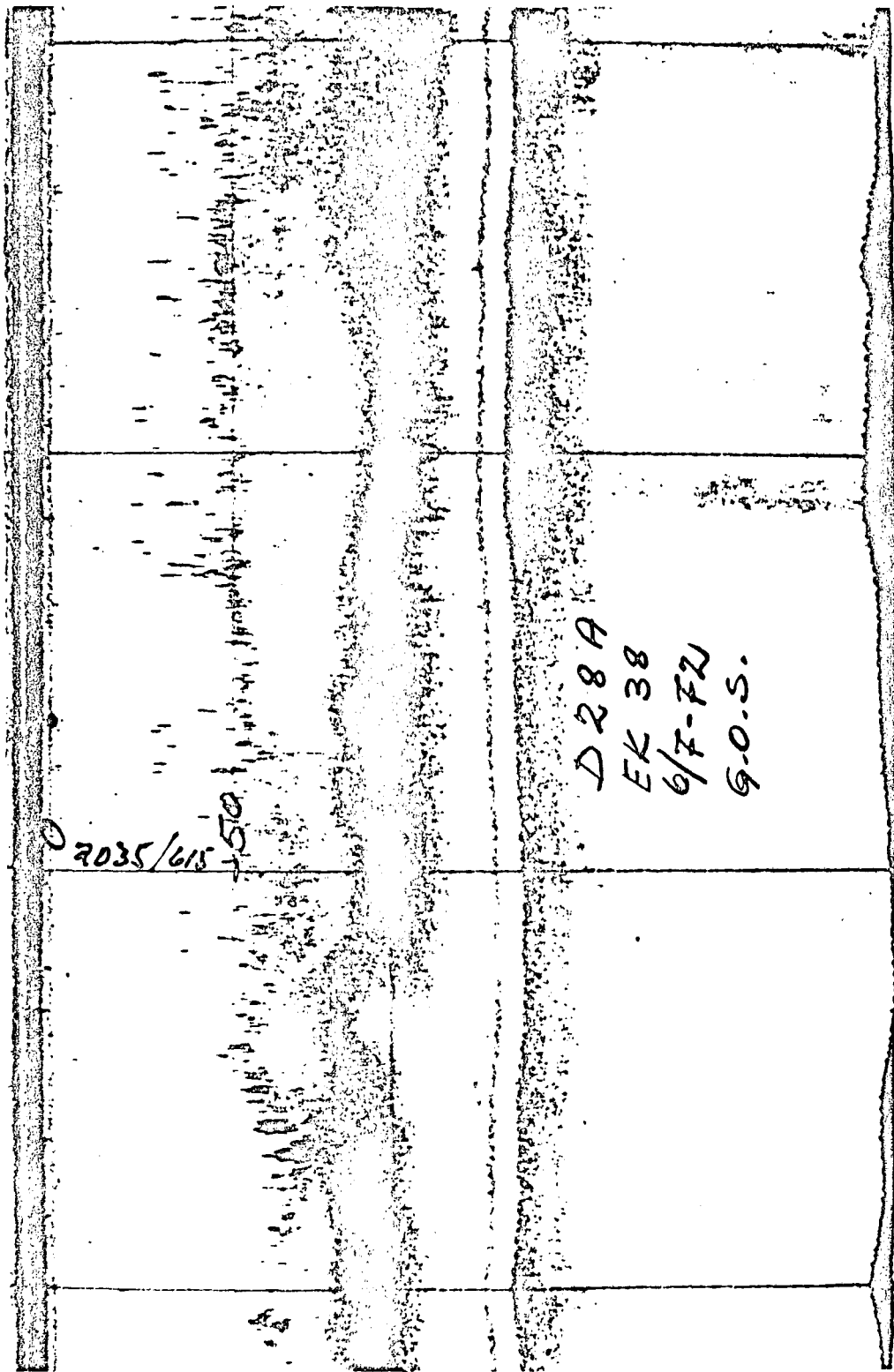


Fig. 9. Echo record of 0-group of Norway pout at approx. 50 m depth on trawl station 152.

Table 1. Catch and number per hour of cod, haddock, whiting and Norway pout from demersal trawl hauls in the northern North Sea and Skagerrak during June and July 1972.

Area A: The Norwegian Deeps													
Trawl station	Date	Depth metres	Total catch kgs/hour	Cod kgs	Cod No.	Haddock kgs	Haddock No.	Whiting kgs	Whiting No.	Sum kgs	Sum No.	Norway pout kgs	Norway pout No.
125	22.6	284	552	-	-	-	-	-	-	-	-	1	36
133	25.6	191	476	3	4	-	-	-	-	3	4	8	326
135	26.6	232	213	9	3	-	-	-	-	9	3	4	182
136	27.6	216	647	49	19	-	-	-	-	49	19	227	9080
138	28.6	218	374	35	12	-	-	-	-	35	12	1	38
139	30.6	150	415	42	17	1	1	-	-	43	18	27	664
147	04.7	201	677	1	2	38	664	1	8	40	674	254	10160
156	08.7	222	653	-	-	29	207	-	-	29	207	95	1996
164	17.7	319	305	3	1	1	1	-	-	4	2	2	43
Mean		226	479	16	6	8	97	+	1	24	104	69	2503
Area B: The Danish coast													
140	30.6	29	80	+	3	18	46	29	231	47	280	-	-
142	01.7	34	467	119	240	171	558	29	143	319	941	-	-
Mean		32	274	60	122	95	302	29	187	183	611	-	-
Area C: The northern North Sea													
132	25.6	142	670	12	4	46	363	-	-	58	367	377	31593
143	02.7	100	2188	117	126	36	107	14	82	167	315	1718	76860
145	03.7	135	1639	20	8	13	290	35	170	68	468	1437	72944
155	07.7	135	2454	86	46	53	422	109	206	248	674	1689	84440
163	17.7	137	275	25	6	37	160	30	98	92	264	99	4456
Mean		130	1445	52	38	37	268	38	111	127	418	1064	54058

Table 2 0-group gadoid fish. Number per hour of trawling from pelagic and demersal trawl hauls in the northern North Sea and Skagerrak during June and July 1972.

Area A: The Norwegian Deepes									
Trawl station	Date	Depth metres	Trawl depth m. ¹⁾	Type of trawl	Cod	Haddock	Whiting	Norway pout	
128	23.6	130	85	Pelagic	2	20	-	28	
131	25.6	158	110-145	"	-	2	2	-	
135	26.6	232	-	Demersal	-	14	10	-	
137	27.6	183	85-125	Pelagic	-	2	18	-	
138	28.6	218	-	Demersal	-	5	5	-	
139	30.6	150	-	"	-	75	29	-	
146	04.7	283	165-206	Pelagic	-	1	6	-	
147	04.7	201	-	Demersal	-	10	2	-	
Area B: The Danish coast									
140	30.6	29	-	Demersal	50	9	50	-	
Area C: The northern North Sea									
148	05.7	109	40	Pelagic	58	296	-	24800	
149	05.7	158	100	"	22	116	-	13600	
150	06.7	137	20	"	-	12	-	2	
151	06.7	131	100	"	-	36	-	2	
152	06.7	136	45	"	26	18	-	28320	
153	07.7	160	50-100	"	33	569	-	4190	
154	07.7	164	115	"	162	2700	-	31510	

1) Depth of headline