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INVESTIGATIONS ON DEMERSAL FISH IN THE BARENTS SEA IN WINTER 1977.

by

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INTRODUCTION

The investigation during the winter 1977 shall be regarded as a continuation of a project initiated in 1970. The aim of the first part of the project was to find the most suitable time of the year to carry out acoustic surveys on demersal fish in the Barents Sea (HYLEN et al. 1972, HYLEN, GJØSÆTHER og SMEDSTAD 1972 and HYLEN and SMEDSTAD 1972). January - February was found to be the most suitable time for such investigations in the sentral and eastern parts of the Barents Sea (JAKOBSEN og NAKKEN 1973, MONSTAD og MIDTTUN 1973, ANON 1974 and ANON 1975a). From 1974 the aim of the acoustic investigations gradually changed to assess absolute abundance of recruits of north-east arctic cod and haddock. The most extensive investigations were carried out in 1977.

MATERIAL AND METHODS

The investigation was carried out from 10 January to 4 February 1977 by R.V. "G.O.Sars" and R.V "Johan Hjort". Survey tracks, stations and the boarder between the eastern and western part of the survey area are shown in Figs. 1 and 2.

An acoustic intercalibration was carried out north of Nordkyn. Unfortunately, the quality of this calibration was too low for any use. This, together with a break-down on the bottom trawl winches onboard

R.V. "Johan Hjort" made it impossible to assess any absolute abundance of demersal fish west of Nordkyn. The area surveyed by R.V. "G.O.Sars" cover approximately the same area as in 1974 - 1976.

Echo intensity was observed by a Simrad EK 38 kHz echosounder and three analog echo integrators (SIMRAD QM). Average integrator reading from each depth channel was recorded at each 5th nautical mile. When more than one species were observed in the same depth interval, the integrator values were distributed on the species by judging the echo recordings and/or according to the frequencies of the species caught on the nearest trawl stations.

The survey area was divided into squares (30' in the north-south direction and 1^{o} in the east-west direction). Echo abundance was calculated for each square, and each square was given a length distribution obtained from the nearest trawl stations. For each species the number of specimens within the different length groups were estimated for each square by a method described by NAKKEN and DOMMASNES (1975) and extended by DALEN (1975). The abundance of each year class is then estimated by age-length keys obtained during the survey.

RESULTS AND DISCUSSIONS

Hydrography and fish distribution

The relation between the abundance of cod and haddock and the temperature conditions in the deeper water layers is shown in Figs. 3 - 5. Cod and haddock were mainly distributed in water warmer than 1^{o}C. This temperature condition was found west of 35^{o}E and in a narrow belt over the Skolpen Bank towards Novaya Zemlja.

COD

Geographical distribution

Figs. 6 - 9 show the distribution of the year classes 1976, 1975, 1974 and the 1973 and older respectively. Both the 1976 and 1975 year class were most abundant in the eastern part of the survey area, while the 1974 year class and the older ones had a more western distribution. However, the distribution of the 1975 year class in 1977 indicates that this year class has moved westward after February 1976 (DALEN, HYLEN og SMEDSTAD 1977).

The geographical distributions of the 1975 and 1976 year class were different as 1 year old fish. In 1976 about 93% by numbers of the 1975 year class was recorded in the eastern part of the survey area, while in 1977 about 66% of the 1976 year class was distributed in the eastern part (Table 1). The eastern distribution of the 1975 year class was also recorded during the 0-group investigation, and at that time it was supposed that this distribution was due to a considerably greater than average inflow of the Norwegian Current water into the Barents Sea (ANON 1975b).

1 - 3 year old cod has been expected to be more or less stationary. However, the results from the 1977 investigations (Table 1) indicate that young cod already from their first year of life start to move westwards from the eastern part of their area of distribution. These indications confirm the 1976 findings. In general the distribution of three year old cod and older depends on the distribution of the capelin which in January - February undertakes a spawning migration towards the coast.

Stock composition

Good agreement is observed between the relative year class strength in the immature part of the stock in 1976 and 1977 (Table 1 and Fig. 10). These correspond fairly well to those expected from the 0-group surveys (ANON 1976).

An increased abundance by numbers have been observed for the year classes 1971 - 1973 by age (Fig. 10). This might be an effect of an insufficient biological sampling in the years 1974 and 1975. Any mortality estimation can therefore only be made for the year classes 1971 - 1973 on the basis of the 1976/1977 survey data (Table 2). The mortalities estimated for the year classes 1969 - 1970 on the data from the cruises in 1974 - 1976 might also have been effected by insufficient sampling.

In Table 2 are given the total mortality coefficients Z(AM), calculated from the acoustic data and Z(VPA) estimated from the method of Virtual Population Analysis where the natural mortality coefficient is assumed equal to 0.20 (ANON 1977).

For the year classes 1969 and 1970 the Z(AM) which are estimated on the basis of the 1976/1977 survey data, are higher than the corresponding Z(VPA). This is partly due to maturation of these year classes which in the beginning of the year are on their way to the spawning grounds outside the survey area.

For all year classes, except the 1974 year class, thére is observed a reduction in numbers from 1976 to 1977. However, the 1974 year class and earlier poor year classes have been difficult to measure by acoustic methods. Bias in the estimated numbers of poor year classes is at least to some extent caused by insufficient biological sampling (DALEN, HYLEN og SMEDSTAD 1977).

The total mortality Z(AM) of the year classes 1971 - 1972 are higher than the respective mortalities assumed to initiate the Virtual Population Analysis Z(VPA), while the respective mortality for the 1973 year class is much lower. However, one shall not pay too great attention to these differences, because the Z(VPA) for 1976 are assumed figures. Even with correct fishing mortality coefficient to initiate VPA, differences might be caused by the fact that Z(AM) only refers to the Barents Sea component of the stock. On the other hand yearly variations in the ratio of fish which are close to the bottom during the survey, would also effect the Z(AM). To try to overcome some of the problems acoustic surveys with the aim of estimating the absolute abundance of the recruits shall therefore be undertaken at the same time of the year.

HADDOCK

Geographical distribution

Figs. 11 and 12 show the distribution of 1 year old fish and older ones respectively. Both area of distribution and abundance were found to be greater in 1977 than in 1976. Mainly 1 - 4 year old fish were observed in the eastern area, while the western area had a greater component of older fish (Table 3).

Stock composition

The 1975 year class was the most abundant year class in 1977 (Fig. 13). It made up 58.6% by number, while the 1976 and 1974 made up 19.2% and 14.8% respectively (Table 3). The 1975 year class was reduced by number from 1976 to 1977, while the abundance of the other year classes apparently increased in number. This was possibly caused by insufficient sampling of haddock in 1976, which involved a great overestimation of the 1975 year class and a corresponding underestimation of the other year classes (DALEN, HYLEN og SMEDSTAD 1977). The estimated relative year class strength based on the 1977 survey, corresponds with that expected from the 0-group surveys (ANON 1976). A more extensive biological sampling of the fish might be responsible for the observed improvement in the abundance estimates.

REDFISH

Fig. 14 shows the echo abundance of redfish. This species had a more western distribution than cod and haddock. Mostly small redfish is observed in the eastern part of the distribution.

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Table 1. Distribution of cod on year classes, numbers in millions and percentages, in the eastern and western part of the survey area in 1976 and 1977.

Area	Year class / Year		1976 N	1976 %	1975 N	1975 %	1974 N	1974 %	1973 N	1973 %	1972 N	1972 %	1971 N	1971 %	1970 N	1970 %	1969 N	1969 %	Older N	Older %	Total N	Total %
East	1976		-		934	93	50	86	240	78	83	39	17	20	6	6	1	5	+	+	1332	74
	1977		29	66	897	92	67	66	136	47	34	28	6	15	4	9	+	4	+	4	1175	72
West	1976		-		68	7	8	14	69	22	129	61	66	80	104	94	19	95	3	100	465	26
	1977		15	34	78	8	34	34	151	53	90	72	39	85	37	91	7	96	2	96	454	28
Total	1976	N	-		1002		58		309		212		83		110		20		3		1797	
		%	-		55.8		3.2		17.2		11.8		4.6		6.1		1.1		0.2		100.0	
	1977	N	44		975		101		288		124		45		41		7		3		1629	
		%	2.7		59.9		6.2		17.7		7.6		2.7		2.1		0.4		0.2		100.0	

Table 2. Yearly reduction in percent and total mortality (Z) calculated from abundance estimates from acoustic methods (AM) and virtual population analysis (VPA).

Year classes	% (AM)			Z (AM)			Z (VPA)		
	1974-1975	1975-1976	1976-1977	1974-1975	1975-1976	1976-1977	1974-1975	1975-1976	1976-1977
1969	35	43	65	0.40	0.56	1.06	0.64	0.69	0.62
1970	36	35	63	0.45	0.43	0.98	0.60	0.57	0.55
1971			46			0.61			0.48
1972			42			0.54			0.38
1973			7			0.07			0.27

Table 3. Distribution of haddock on year classes, numbers in millions and percentages, in the eastern and western part of the survey area in 1977.

	Yearclass	1976	1975	1974	1973	1972	1971	1970	Older	Total
East	N in millions	105	529	110	24	1	1	+	1	770
	% of yearclass	42	69	57	43	12	9	4	5	59
West	N in millions	145	233	82	32	7	7	10	14	531
	% of yearclass	58	31	43	57	88	91	96	95	41
Total	N in millions	250	762	192	56	8	8	10	15	1301
	% of stock	19.2	58.6	14.8	4.3	0.7	0.6	0.8	1.1	

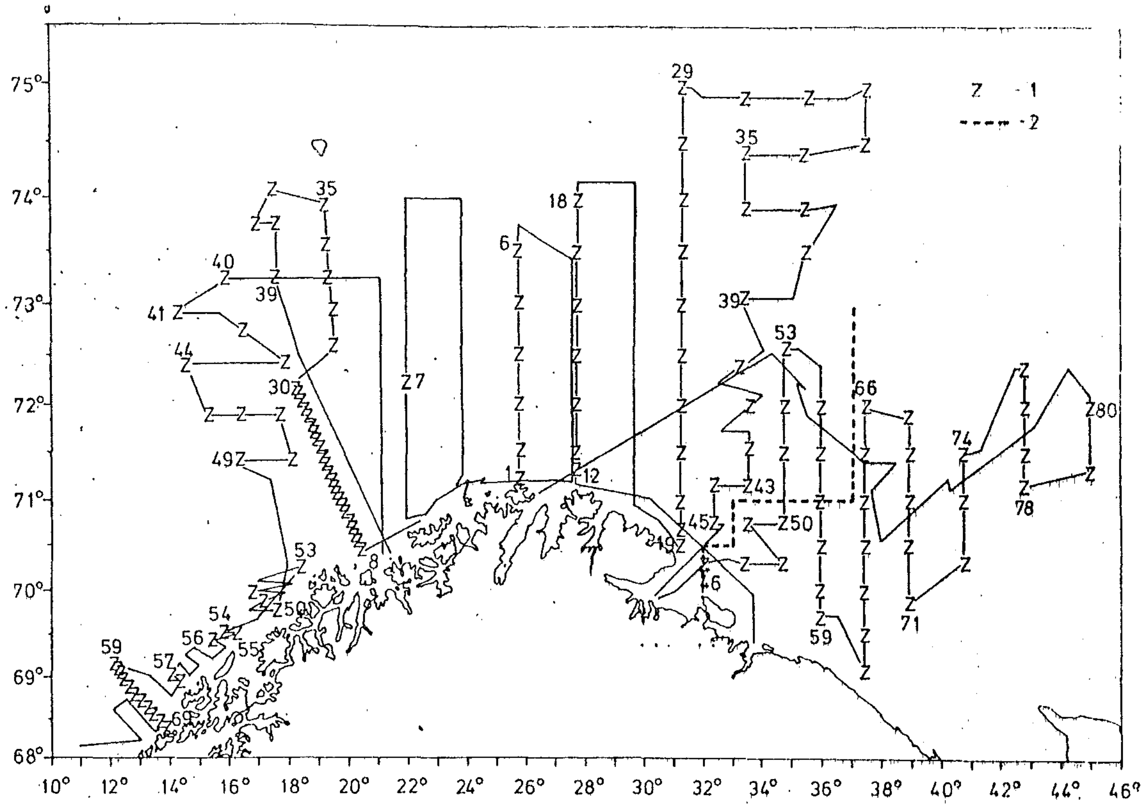

Fig. 1. Survey routes and hydrographic stations. 1) Sonde station, 2) boarder between eastern and western area.

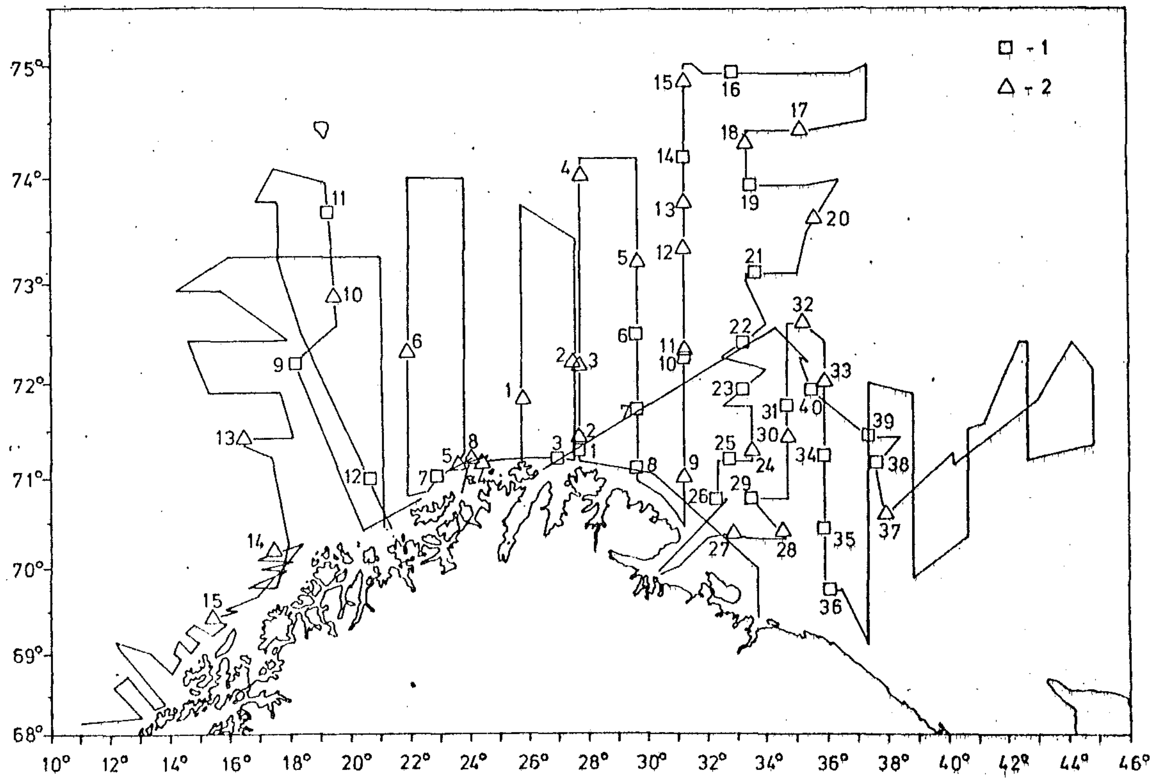

Fig. 2. Trawl stations. 1) Bottom trawl, 2) Midwater trawl.

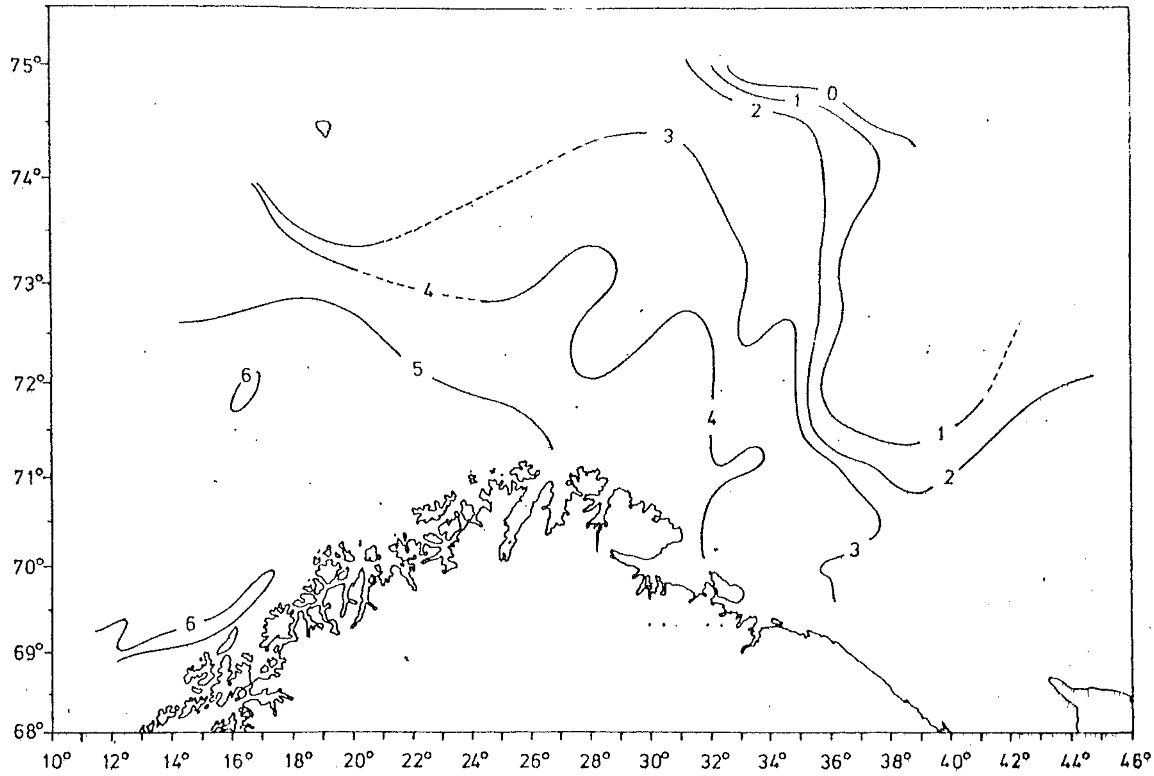

Fig. 3. Temperature t°C at 150 m depth.

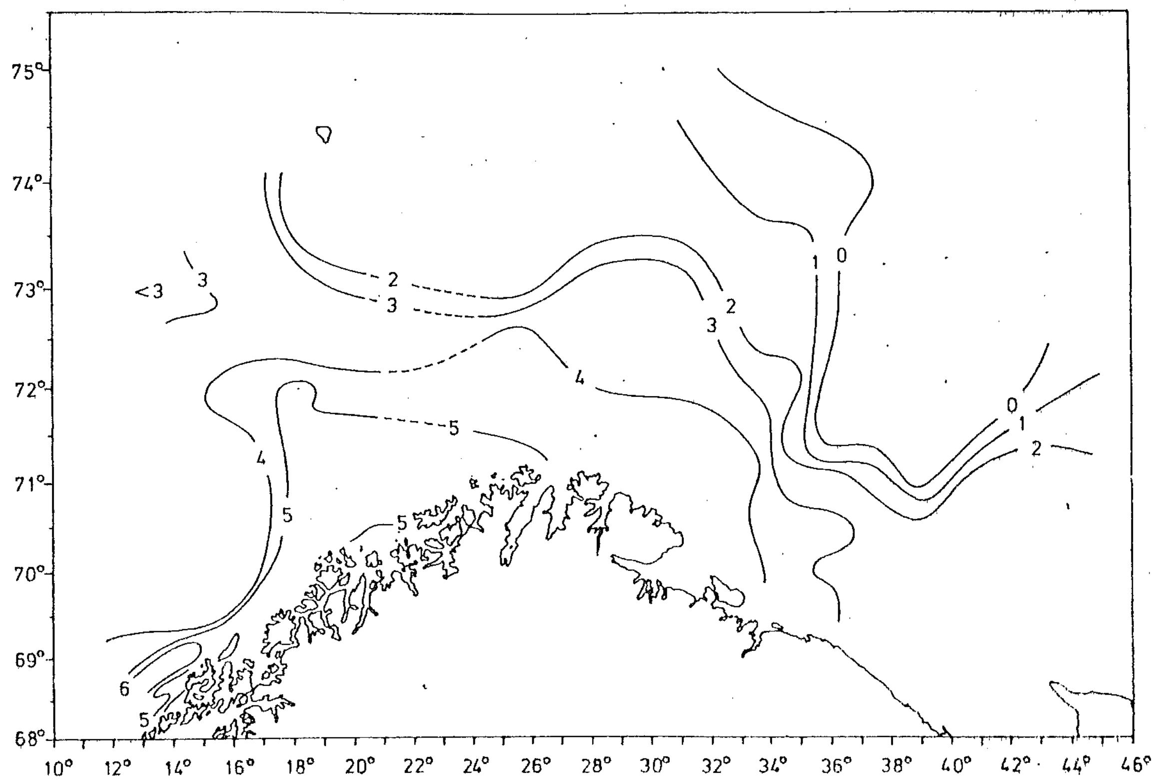

Fig. 4. Temperature t°C near the bottom.

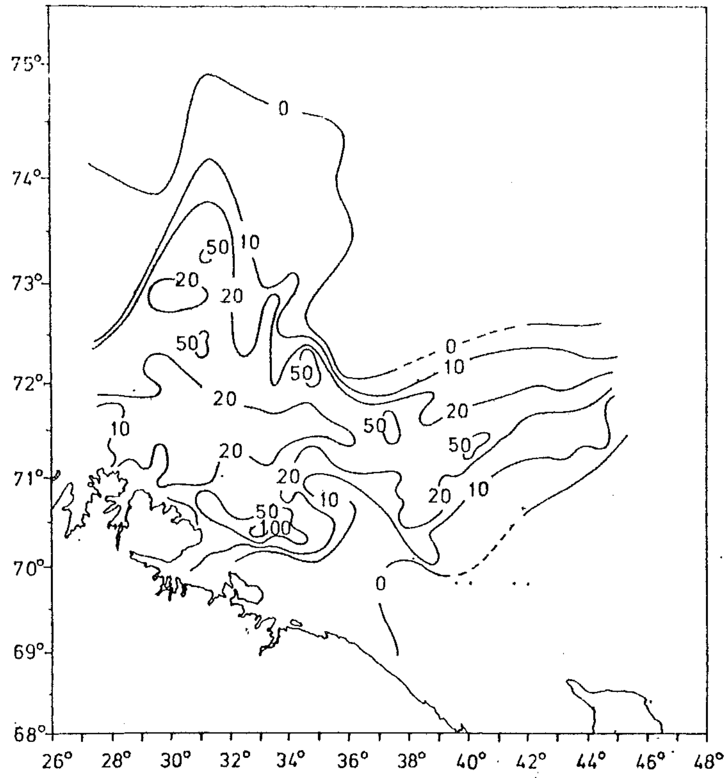

Fig. 5. Echo abundance of cod and haddock observed by R/V "G.O.Sars".

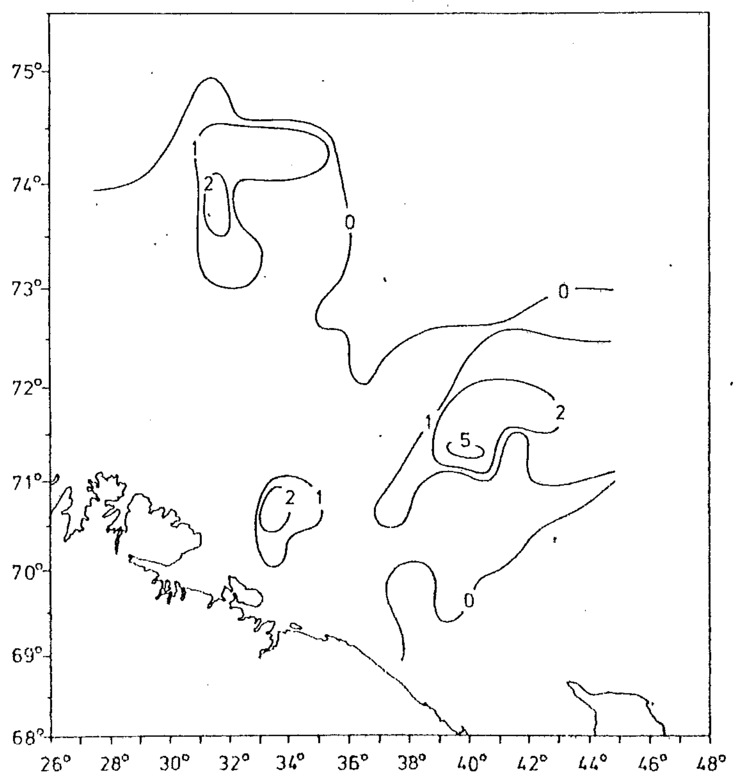

Fig. 6. Distribution of 1 year old cod in 1000 per (nautical mile)^2.

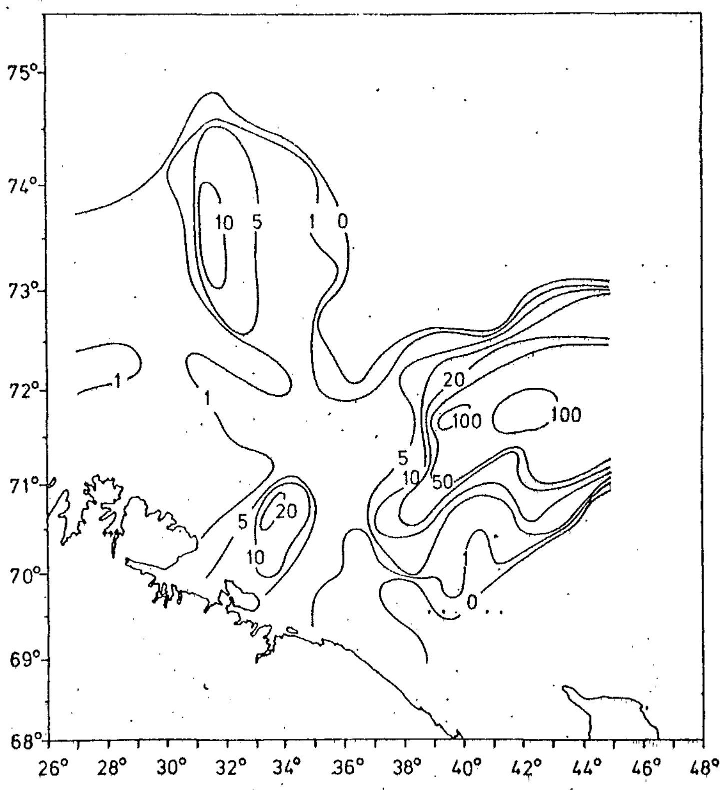

Fig. 7. Distribution of 2 years old cod in 1000 per (nautical mile)^2.

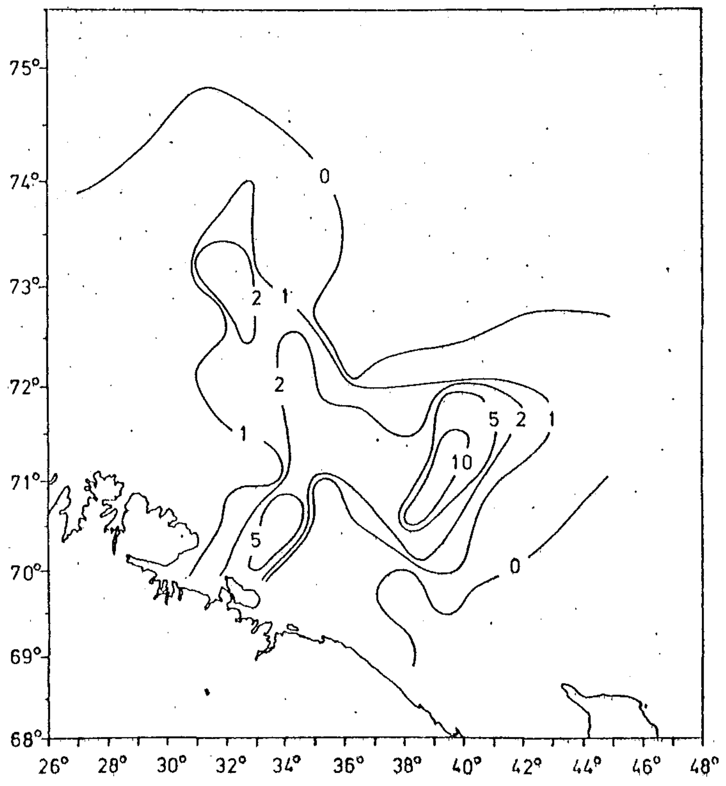

Fig. 8. Distribution of 3 years old cod in 1000 per (nautical mile)^2.

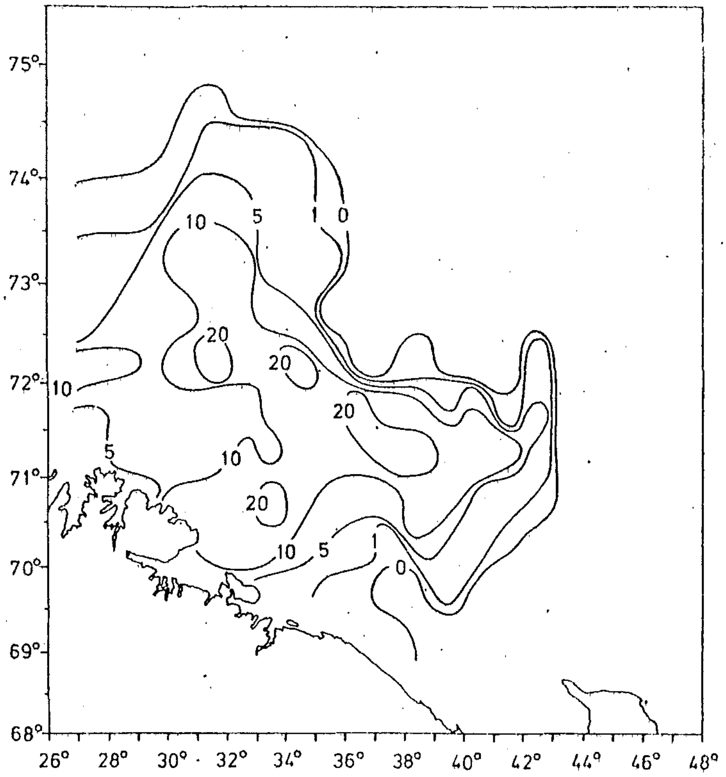

Fig. 9. Distribution of 4 years and older cod - numbers in 1000 per (nautical mile)^2.

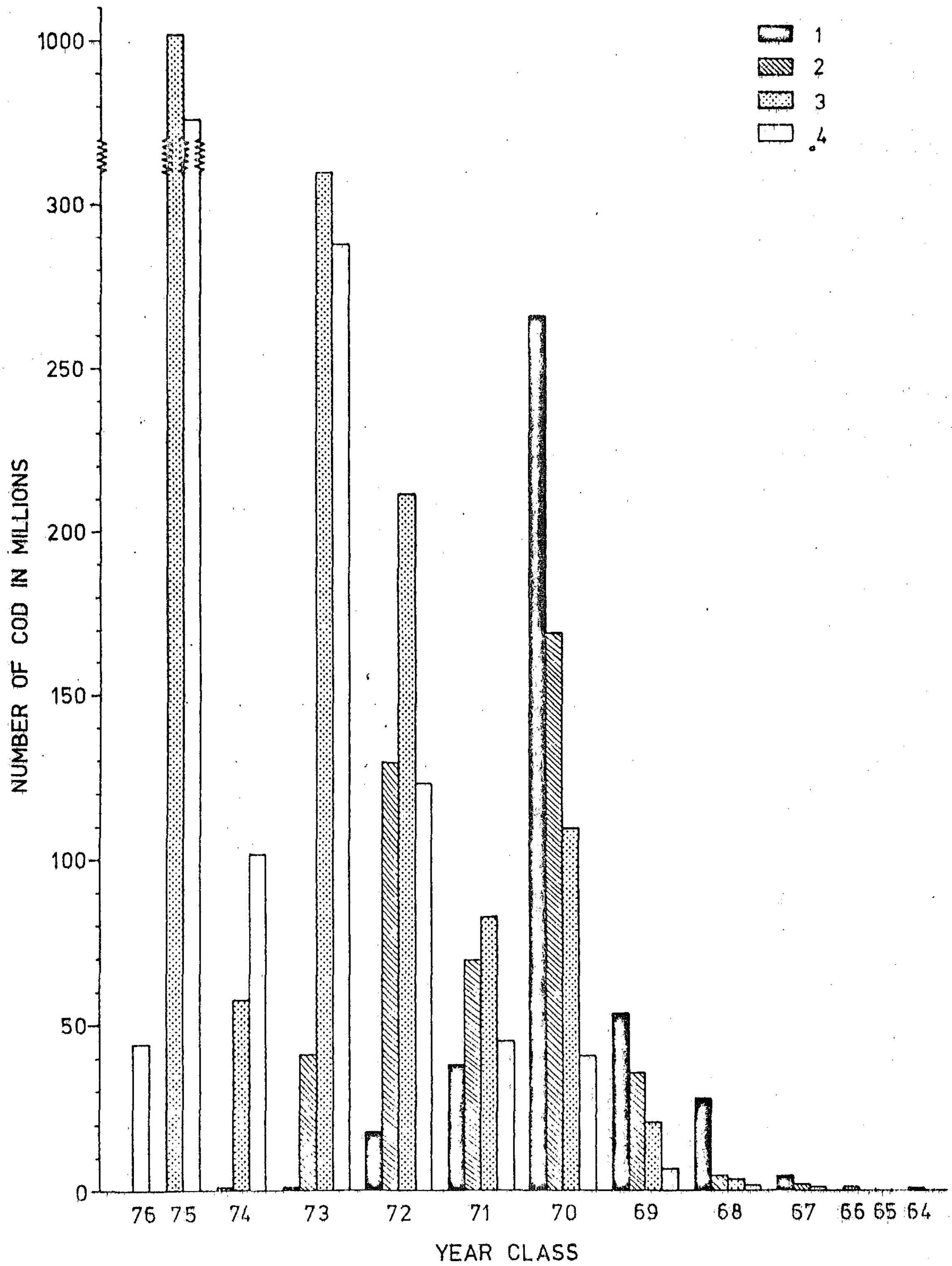

Fig. 10. Numbers in millions of cod versus year classes as observed on surveys in 1) 1974, 2) 1975, 3) 1976, 4) 1977.

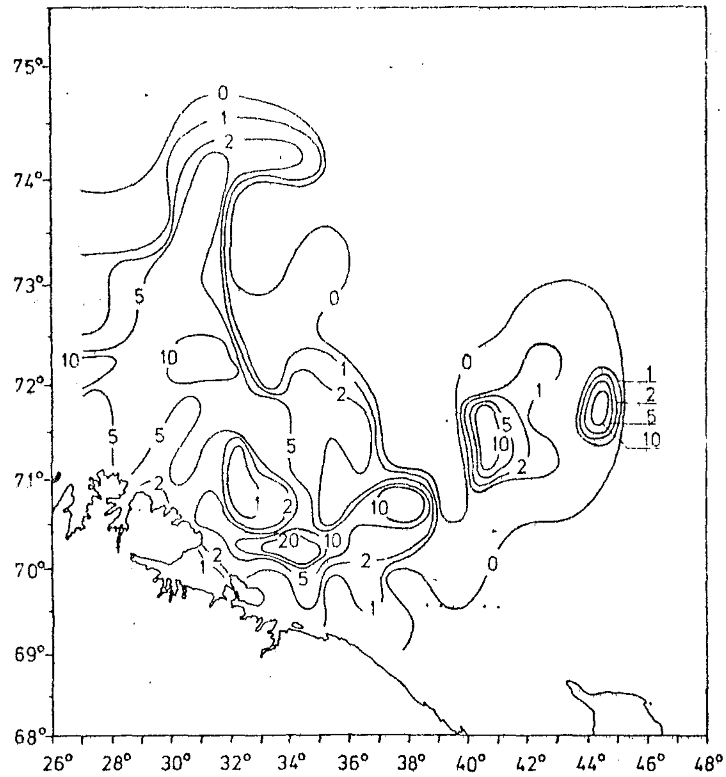

Fig. 11. Distribution of 1 year old haddock in 1000 per (nautical mile)^2.

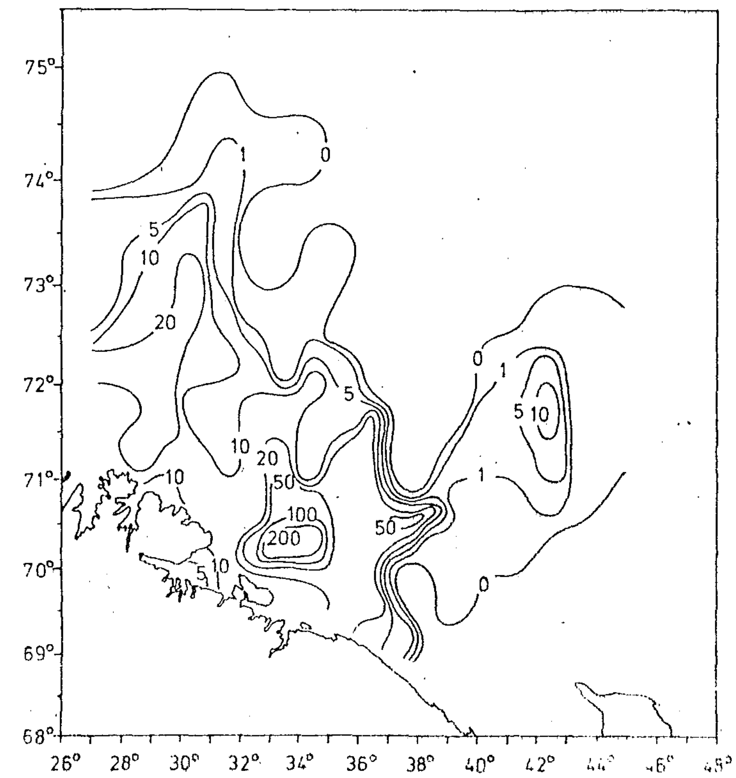

Fig. 12. Distribution of 2 years and older haddock - numbers in 1000 per (nautical mile)^2.

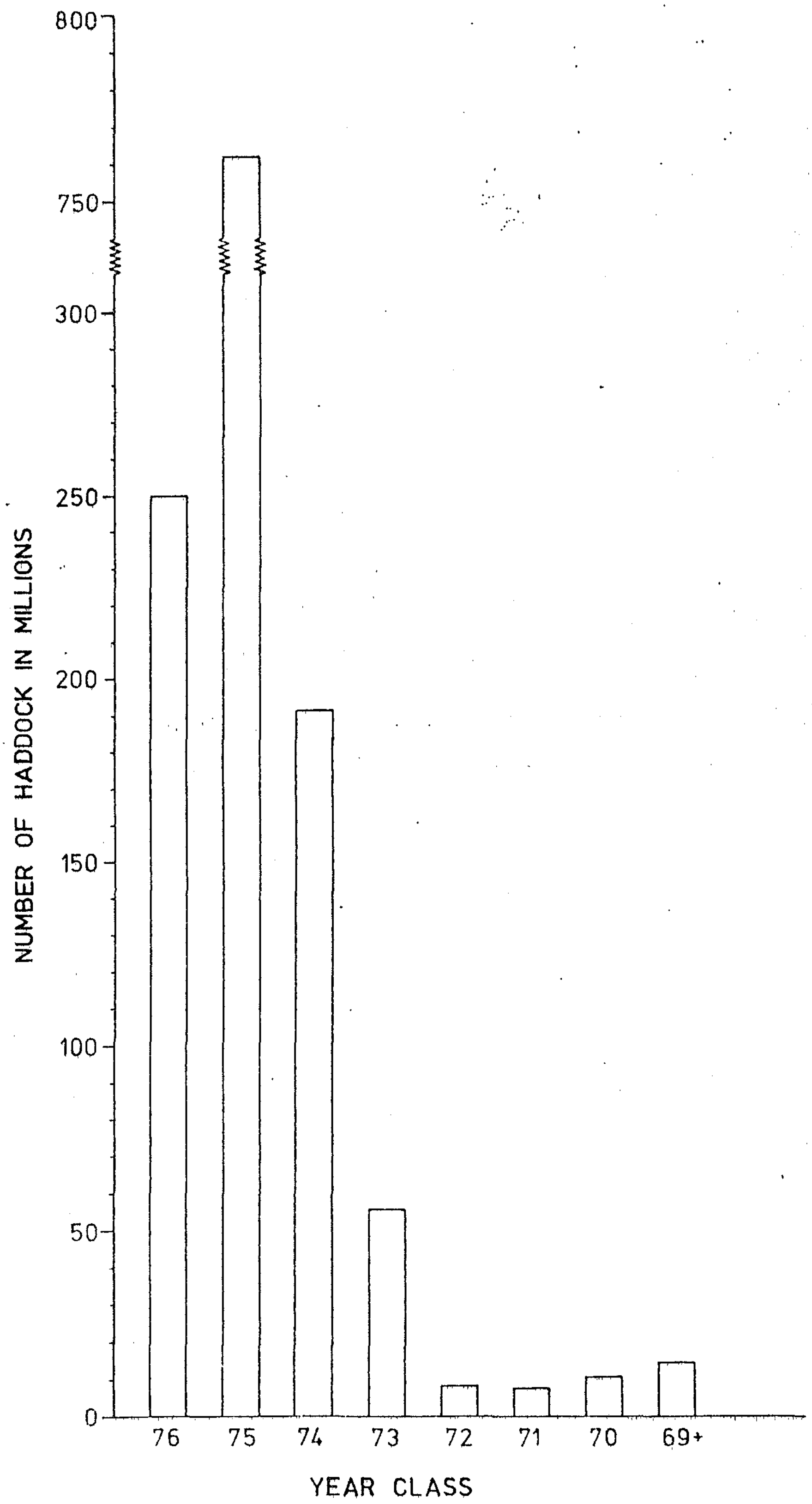

Fig. 13. Numbers in millions of haddock versus year classes as observed on cruise in 1977.

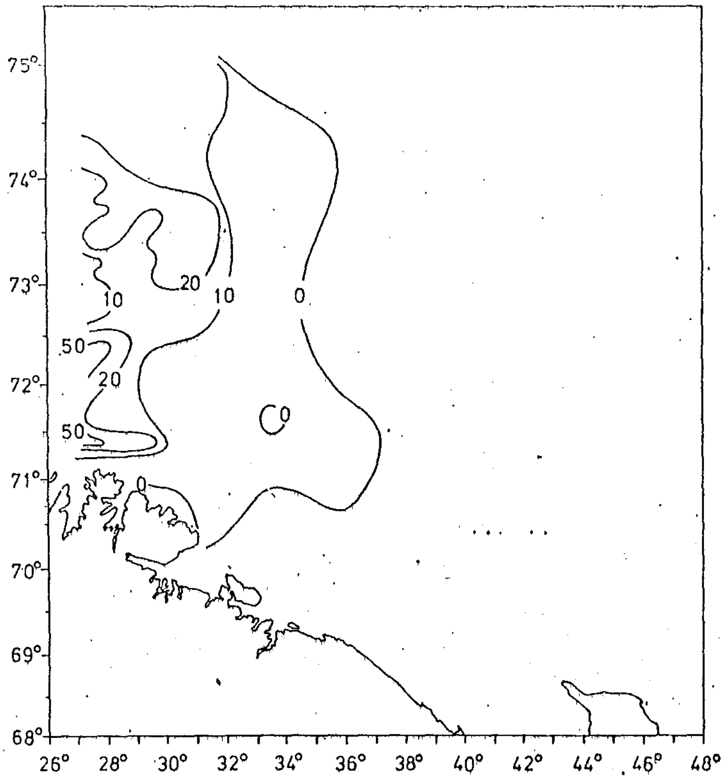

Fig. 14. Echo abundance of redfish observed by R/V "G.O.Sars".