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NORWEGIAN INVESTIGATIONS ON YOUNG COD AND HADDOCK IN THE BARENTS SEA DURING THE WINTER 1982

by

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ABSTRACT

An acoustic survey and a bottom trawl survey were carried out in the Barents Sea during winter 1982. Both surveys showed that there has been a reduction in the total number of cod of about 50% and about 75% for haddock in the area surveyed. This reduction mostly reflect the reduction of fish 6 years and older for cod and 5 years and older for haddock. This is probably due to an early maturing of the 1975 yearclass of cod and the 1976 yearclass of haddock and a migration to spawning areas south of the area surveyed. For cod 2-4 years old no reduction was observed, and for young haddock the 1979 yearclass was reduced. The investigations indicate that the yearclasses 1977-1980 are very poor for both cod and haddock.

INTRODUCTION

Each year since 1975 a Norwegian acoustic survey has been carried out during the winter in the Barents Sea. The aim of these surveys have been to estimate the absolute number of cod and haddock in the area surveyed. The results from these surveys may be found in DALEN and SMEDSTAD (1979, 1982).

In 1981 a stratified random trawl survey was started in the same area at the same time of the year. This survey is a supplement to the acoustic survey and may be very valuable in future when the stock level of cod and haddock becomes so low that the acoustic method will be insufficient.

MATERIAL AND METHODS

General

The surveys were carried out in the period 26 January to 5 March 1982 by three vessels. R/V "G.O. Sars" was used in the acoustic survey and the two commercial trawlers M/T "Vikheim" and M/T "Masi" did the trawling for the bottom trawl survey.

"G.O. Sars" started the survey at the Goose Bank and the trawlers in an area north-east of the Skolpen Bank. All vessels gradually worked westwards. "G.O. Sars" finished on the 2 March and the two trawlers on the 5 March.

"G.O. Sars" worked during the survey 124 hydrographical stations, using a CTD sonde.

The acoustic investigations

The acoustic investigations were performed as described by DALEN and SMEDSTAD (1979, 1982). Two echo sounder systems working at 38 kHz were used, one with a hull-mounted transducer and the other with a towed transducer. Both sounders were connected to a digital echo integrator.

The integrator recordings were usually logged at each five nautical mile. During the last part of the survey in the western area the integrator recordings were often logged at each nautical mile in near-shore areas or where the bottom depth showed great variations. The reason for this is to improve the assignation of the echo abundance to the observed fish categories.

One integrator channel was used as a bottom channel during the whole survey. This channel was integrating in an interval from the bottom and ten meters off bottom. The reason for this was to have more comparative informations from the depth interval swept by the bottom trawl.

The two echosounders, EKS-38 and EK-400, have different performance which requires an intercalibration between the systems. This is based on calibration data instead of a parallel integration of the same layer of fish. The procedure and particulars of the standard target calibration are described by FOOTE et al. (1981, 1982).

The integrator recordings have been adjusted due to bubble attenuation during bad weather when using the hull-mounted transducer (DALEN and LØVIK 1981). Often prevailing weather-conditions, i.e. wind forces of 15-24 knots, required correction factors for the integrator values between 1.4 and 2.2. But the bulk of the acoustic data (75 per cent) was sampled under conditions requiring correction factors less than 1.5.

The length distributions from all trawl stations, and all age-readings are considered during the acoustic abundance estimation.

The survey tracks, hydrographical stations and trawl stations worked by "G.O. Sars" are shown in Figs 1 and 2.

Bottom trawl survey

A total of 262 trawl stations were taken as part of the bottom trawl survey. 7 hauls were taken east of 36°E by "G.O. Sars", the rest were taken by "Vikheim" and "Masi" (Fig. 3). In addition 26 trawl hauls were taken in an experiment to compare the fishing powers of the three vessels, and 36 hauls were taken by "Masi" and "Vikheim" in an experiment comparing the effect of different sweepwire length (40 and 80 m).

During the survey all vessels used the same type of trawl, a Campelen 1800 shrimp-trawl with rubber bobbins and codend mesh.

size of 35 mm. The length of the sweepwires were 40 m. The trawl was towed for 3 nautical miles, measured with a doppler-log at a speed of 3 knots.

Survey design

The total area was devided into 35 strata (Fig. 4) based on the fish distribution in the period 1977-1980 and the knowledge of important fishing grounds. The number of trawl stations were allocated to the strata using the following method:

A minimum of 250 trawl stations should be taken in strata 10-34. This gives 10 stations per stratum. The number of stations to be taken in each stratum is given by the formula

$$n_i = 10 \cdot \frac{a_i}{\bar{a}} \cdot V_i \qquad i = 1,34$$

a_i = area of stratum i

$\bar{a}$ = mean stratum area (strata 10-34) = 2612.8 nautical mile^2

V_i = factor giving the importance of stratum i

V_i is a subjective factor giving the importance of the stratum based on the distribution of cod and haddock during the surveys in 1977-1980. This factor may take the values 0.25, 1.0, 2.0 and 3.0. It is used in order to consentrate the survey effort in those strata were the highest catch rates are expected. Table 1 gives the area, V_i and number of trawl hauls to be taken in each stratum. It also gives the actual number of trawl hauls taken in 1981 and 1982. In both 1981 and 1982 some hauls allocated to the eastern strata were transferred to western strata due to the western fish distribution.

The strata were devided into rectangels, 15' longitude and 7.5' lattitude, and numbered sequently. Rectangels to be trawled in were chosen at random. For large strata containing few stations, the stations were placed at random within the main parts of the strata to ensure good areal coverage. Within a chosen rectangle trawling was allowed anywhere.

Statistical computations

The standard abundance index is the stratified mean catch per haul. The computational formulas for the stratified mean catch and its variance are (PENNINGTON and GROSSLEIN 1978):

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

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

where:

- $\bar{X}_{st}$ - stratified mean
- $\mathrm{Var}(\bar{X}_{st})$ - variance of stratified mean
- A - total surveyed area
- a_i - area of stratum i
- n_i - number of hauls in stratum i
- $\bar{X}_i$ - sample mean catch in stratum i
- s_i^2 - sample variance in stratum i
- k - number of strata

Table 1 shows that in 1982 no hauls were taken in strata 1-4 and just one haul in each of the strata 5a, 5b, 7, 8. In these strata both mean and variance are set to zero. This was done because of the western distribution of fish in 1982. The single hauls in strata 5a, 5b, 7, 8 gave no catch of cod or haddock and the same is expected in the even more eastern strata 1-4.

In order to compute confidence limits of the stratified mean, it is assumed that the stratified mean follows a normal distribution. This assumption becomes more realistic as the number of trawl hauls increases (COCHRAN 1953).

The confidence limits are calculated as:

$$C = \bar{X}_{st} \pm S_{\bar{X}_{st}} \cdot t$$

where t is the .95% quartile of a Student's t-distribution with N-k degrees of freedom, where N is number of trawl hauls.

RESULTS

Hydrography

Fig. 5, 6 and 7 show the horizontal temperature distributions for 0, 100 m depth and bottom. In the eastern Barents Sea the temperature was somewhat lower than in 1981 (unpublished data) and in the western area the temperature was somewhat higher. Still the temperature conditions in the Barents Sea is below average.

Distribution of cod and haddock

Fig. 8 shows the distribution of integrated echo abundance for cod and haddock. As in previous years the highest abundance was found in the western part of the investigated area. The highest concentrations were found on the "Nordkapp" bank. This was fish following a western capelin spawning migration towards the area between "Fugløya" and "Sørøya". In the eastern part of the investigated area cod and haddock were only found scattered and in small numbers, except for a narrow area along the coast of East-Finnmark. In general the integrated echo abundance were lower than in 1981.

Table 2 shows roughly the vertical distribution of fish in 1981 and 1982. The table also shows roughly how much the total fish abundance was reduced from 1981 to 1982. The figures indicate that the total biomass of cod and haddock were reduced by approximately 50% from 1981 to 1982. This reduction was greatest in the pelagic recordings (61%) and less for the fish in the bottom layer (41%). The percentage of fish in the bottom layer has increased significant from 36% in 1981 to 46% in 1982. If this trend is to continue it may influence acoustic surveys in years to come. The precision of acoustic abundance estimate of fish near bottom is lower than of fish distributed more pelagic.

Acoustic abundance estimate for cod and haddock

Cod

Table 3 gives acoustic abundance estimates of cod for different age groups and areas, and Fig. 9-14 show the distribution of age groups within the area surveyed. Fish of age 3-5 years dominate in the eastern areas, while fish of age 4-7 years are most abundant in the western areas. If the results in Table 3 are compared with the results from earlier years, there is a considerable decrease in the total number of cod in the surveyed area from 1981 to 1982. Table 4 shows that this reduction is about 50%, and especially fish 6 years and older is missing in this year's investigation. This is mostly due to the fact that these age-groups are becoming mature and are migrating south along the coast to areas outside the investigated area. This observation is being confirmed by observations of the length distribution of cod landed in the Lofoten area and on Møre during the "skrei" fishery. The youngest age groups, the 1977-1980 year classes, show no significant reduction from 1981 to 1982. These four year classes were measured to 258 millions fish in 1981 and 254 millions in 1982. This reduction is less than expected, and is partly due to the 1978 year class becoming more abundant in the 1982 survey.

In Table 4 is also given the expected stock size in numbers at the 1st of January 1982. The prognosis was given by ICES (ANON 1982) in the autumn 1981 and is to a high degree based on the

Norwegian acoustic survey in the winter 1981. A comparison between the prognosis and the results of the survey shows that for the younger year classes (3-5 years), which was sufficiently covered by the survey, the sum of these agegroups in the results and the prognosis agree with a difference of about 6%. This is less than the errors of such estimates and the confidence of the results is confirmed. The greatest difference between the survey and the prognosis is found for the 1979 year class which seems to be underrepresented in the survey. The prognosis also includes the Spitsbergen-Bear Island component of the Arcto-Norwegian cod stock, while the survey results only include the Barents Sea component. Therefore, the estimate of 71 million fish of the 1979 year class in the Barents Sea seems reasonable.

Totally, the results from the 1982 acoustic survey seems to confirm earlier results for cod: A high percentage of the relatively abundant 1975-year class has become mature and is recruited to the spawning stock. The following year classes are all poor, especially the 1980 and 1981 year classes. This has led to a drastic reduction in the abundance of young cod during the last years (Table 4, last column).

Haddock

Table 5 gives the acoustic abundance estimates of haddock for different age groups and areas, and Fig. 15-20 show the geographical distribution of the different age groups. The age groups are distributed in the same general manner as for cod. Four year old haddock dominates in the eastern part, while 6 and 7 year old fish is most abundant in the western part. The great reduction of the total number of haddock from 1981 to 1982 (Table 6) is probably due to fish 5 years and older has migrated south of the investigated area to spawn.

Table 6 also shows that the 1979 year class has been significantly reduced from 1981 to 1982. It is difficult to explain this reduction before the total international catch statistics for Arcto-Norwegian haddock for 1981 is available. Although the acoustic abundance estimate for haddock probably is more subjected to error and bias than for cod, the results indicate that the level of recruitment to the Arcto-Norwegian haddock stock will be very low in the coming years.

Bottom trawl survey

Cod

Table 7-9 give the abundance indices for cod in 1981 and 1982 based on the bottom trawl surveys. Since the biological data from these investigations are also used in the acoustic survey, both age distribution and geographical distribution are approximately equal in the two investigations: For both years most of the smaller fish is in the east and the larger ones in the west. By comparing the figures in Tables 7 and 8 it looks like the main distribution is more to the west in 1982 than in 1981. The indices in subarea A (west) is somewhat higher in 1982, but indices in subarea D (east) is somewhat lower.

The total stratified mean catch of cod (Table 9) is reduced from 51.5 in 1981 to 41.9 in 1982. This is a recuction of about 20 percent which is far less than the 50 percent reduction estimated from the acoustic survey. Looking at the reduction of the different year classes in the bottom trawl survey there is a great reduction of the 1976 and older year classes, while the younger year classes (1977 and younger) are more abundant in 1982. It appears that the catchability of young cod has increased from 1981 to 1982.

In Table 2 it was shown that a greater part of the total biomass were distributed close to bottom in 1982 than in 1981. This makes a greater part of the total stock available to the bottom trawl in 1982. A reduction of the same size as measured from the acoustic survey can therefore not be expected in the bottom trawl survey. This has been corrected for in the following manner: A corrected index has been calculated by dividing the uncorrected index by the ratio between the integrated echo values between 10 m above bottom and bottom and the total integrated echo values for each year (Table 2).

The reductions measured by the corrected indices are much closer to the results from the acoustic survey (Table 9). Of the younger fish only the 1978 year class shows a significant increase. Corrected indices were also computed using correction factors for each strata, but this did not change the results.

The total number of fish caught in 1982 makes up 65% of the number caught in 1981. Table 9, however, shows that only the number of older fish have been reduced. The 1976- and 1975-year classes make in 1982 up 37% and 33% of the 1981 level respectively. In the acoustic survey the corresponding figures were 30% and 27% for the 1976- and 1975-year classes. The acoustic survey gives a greater reduction than the bottom trawl survey. As already mentioned, a great part of the 1975-year class and a part of the 1976-year class are mature and have migrated out of the area surveyed. The reduction of these two year classes are therefore not as great as these results indicate. No reduction of the younger year classes was observed in the bottom trawl survey. However, they had a higher catchability in 1982 than in 1981. On the other hand, this survey confirms the low abundance of the younger year classes.

Haddock

Tables 10-12 give the abundance indices for haddock in 1981 and 1982. The bottom trawl surveys give nearly the same results as the acoustic survey. The great reduction observed for the 1977 and 1976 yearclasses is probably due to the fact that a high percentage of them have become mature and have migrated outside the surveyed areas to spawn. The real reductions are therefore not as great as suggested in Table 12. Comparing the stratified mean catch of the 1979 yearclass in 1981 and 1982 (Table 12) it may be seen that this year class also have been severely reduced. However, looking at the confidence limits of the uncorrected index (Tables 10 and 11) the lower limit in 1981 is 1.5 and the upper limit in 1982 is 1.2. Although the reduction is significant it is of a magnitude that has to be expected from one year to another.

The bottom trawl survey confirms the low level of recruitment of the Arcto-Norwegian haddock.

CONCLUSIONS

The Barents Sea winter survey in 1982 has shown:

The hydrographical situation with relatively low temperatures in the Barents Sea, especially in the east, continues.

The western distribution of young cod and haddock continues.

The abundance of young cod and haddock is very low and will continue to decrease due to poor recruitment.

Totally there is a reasonably good agreement between the abundance estimates given in 1981 and 1982. There is also a reasonably good agreement between the results from the bottom trawl survey and the acoustic survey.

REFERENCES

ANON, 1982. Report of the Arctic Fisheries Working Group. Coun. Meet. int. Coun. Explor. Sea, 1981 (G:2): 1-53 (Mimeo.)

COCHRAN, W.G. 1953. Sampling techniques. John Wiley & Sons, Inc., New York 330 p.

DALEN, J. and SMEDSTAD, O.M. 1979. Acoustic method for estimating absolute abundance of young cod and haddock in the Barents Sea. Coun. Meet. int. Coun. Explor. Sea, 1979 (G:51): 1-14 (Mimeo.)

DALEN, J. and SMEDSTAD, O.M. 1982. Abundance estimation of demersal fish in the Barents Sea by an extended acoustic method. Contr. to Symp. in Fisheries Acoustics, 21-24 June, Bergen, Norway.

DALEN, J. and LØVIK, A. 1981. The influence of wind-induced bubbles on echo integration surveys. J. Acoust. Soc. Am., 69(6): 1653-1659.

FOOTE, K.G., KNUDSEN, H.P., VESTNES, G., BREDE, R. and NIELSEN, R.L. 1981. Improved calibration of hydroacoustic equipment with copper spheres. Coun. Meet. int. Coun. Explor. Sea, 1981 (B:20): 1-18 (Mimeo.)

FOOTE, K.G., KNUDSEN, H.P. and VESTNES, G. 1982. Standard calibration of echo sounders and integrators with optimal copper spheres. Contr. to Symp. in Fisheries Acoustics, 21-24 June, Bergen, Norway.

PENNINGTON, M.R. and GROSSLEIN, M.D. 1978. Accuracy of abundance indices based on stratified random trawl surveys. Coun. Meet. int. Coun. Explor. Sea, 1978 (D:31): 1-35 (Mimeo.)

Table 1. Strata-areas, factor of importance, number of hauls to be taken and number of hauls taken in 1981 and 1982.

Stratum	Area (N.Mile^2)	Factor of importance	Number of hauls	Hauls taken 1981	Hauls taken 1982
1	4363	0.25	4	2	0
2	3357	0.25	3	2	0
3	2496	1.00	10	5	0
4	991	0.25	2	2	0
5a	2130	0.25	2	4	1
5b	1720	0.25	2	2	1
6	2950	0.25	3	2	2
7	4327	0.25	4	2	1
8	4641	0.25	4	2	1
9	1442	1.00	6	3	3
10	1847	1.00	7	8	7
11	2504	2.00	19	17	19
12	5210	0.25	5	5	5
13	4662	0.25	4	4	4
14	2740	1.00	10	10	10
15	1689	2.00	13	13	13
16	3078	2.00	24	23	24
17	1024	2.00	8	9	8
18	779	3.00	9	9	9
19	903	3.00	11	10	9
20	2258	2.00	17	17	17
21	1407	2.00	11	14	11
22	3200	2.00	24	24	24
23	4588	0.25	4	4	4
24	1509	0.25	2	2	2
25	2901	0.25	3	3	3
26	3051	1.00	11	10	10
27	1673	2.00	13	20	21
28	1372	1.00	5	4	5
29	3333	1.00	13	14	13
30	3936	0.25	4	3	4
31	1407	1.00	5	5	5
32	1741	1.00	7	7	6
33	1904	2.00	15	9	14
34	1680	1.00	6	3	6
Total	88834		290	273	262

Table 2. Proportions of fish (cod and haddock) distributed pelagical and near bottom represented by average echo-integrator values for the whole investigated area.

	1981		1982		Reduction from 1981 to 1982	
	mm	%	mm	%	mm	%
Pelagic:						
From surface to 10 m above bottom	13.7	64	5.4	54	8.3	61
At bottom:						
From 10 m above bottom to bottom	7.8	36	4.6	46	3.2	41
Total	21.5	100	10.0	100	11.5	53

[The figures in the table are weighted means (using area as weight factor) of echointegrator values greater than 1. Areas with no recordings (echointegrator values = 0) are not used. Since the figures are not corrected for the observed length distritubion the figures are only approximate estimate for the corresponding biomass proportions].

Table 3. Cod. Acoustic abundance estimate for each agegroup/yearclass in the surveyed areas 26.1-2.3 1982. (Number in millions).

Age in years (Yearclass)	1 (81)	2 (80)	3 (79)	4 (78)	5 (77)	6 (76)	7 (75)	8 (74)	9+ (73+)	TOTAL
Area A			12	25	38	25	31	2		133
Area B			2	12	13	13	22	2		65
Area C		1	4	8	9	14	11			48
Area D	1	3	53	41	33	21	10			162
TOTAL	1	4	71	86	93	73	74	5	1	408
%	0	1	17	21	21	18	18	1	0	99

Table 4. Cod. Estimate of yearclass abundance in the acoustic survey for the period 1977-1982. (Number in millions).

Year of investigation	YEARCLASS 1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	older	TOTAL
1977						45	882	104	315	139	52	47	12	1596
1978					28	235	797	153	172	25	14	17	1	1
1979				16	14	109	502	77	45	14	4	2	+	783
1981		3	73	58	124	243	270	41	8	3	4			827
1982	1	4	71	86	93	73	74	5	1					408
1982 (ICES-prognosis)			100	76	90	168	156	20	10	4	1	2		627

Table 5. Haddock. Acoustic abundance estimate for each agegroup/yearclass in the surveyed areas 26.1-2.3 1982. (Number in millions).

Age in years Yearclass	1 (81)	2 (80)	3 (79)	4 (78)	5 (77)	6 (76)	7 (75)	8+ (74+)	TOTAL
Area A	1			1	2	8	4	1	17
Area B		2	4	2	4	14	7		33
Area C		1	2	2	4	6	2		17
Area D	1	1	1	5	2	1	1		12
TOTAL	3	4	7	10	12	29	14	1	79

Table 6. Haddock. Estimate of yearclass abundance in the acoustic survey for the period 1977-1982. (Number in millions).

Year of investigation	YEARCLASS 1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	older	TOTAL
1977						267	755	198	60	10	9	12	17	1328
1978					111	149	737	55	1					1053
1979				17	11	181	251	13	+	2				475
1981		2	25	14	66	160	50	2	1					320
1982	3	4	7	10	12	29	14	1						80

Table 7. Cod 1981. Stratified mean catch (number per hour) for each agegroup/yearclass with confidence limits in the surveyed areas, and stratified mean catch corrected for the vertical distribution found by the acoustic method.

Age in years	1	2	3	4	5	6
Yearclass	80	79	78	77	76	75
Area A	0.0(0.0- 0.0)	0.2(0.1- 0.3)	1.4(0.9-1.9)	6.3(4.7- 7.9)	11.1(8.4-13.8)	22.8(17.4-28.1)
Area B	0.0(0.0- 0.1)	0.7(0.0- 1.9)	1.2(0.3-2.1)	2.7(0.9- 4.5)	9.0(4.2-13.7)	24.8(9.9-39.6)
Area C	0.0(0.0- 0.0)	1.3(0.8- 1.8)	2.4(1.6-3.1)	9.4(7.5-11.3)	44.3(35.3-53.3)	55.8(43.6-67.9)
Area D	0.6(0.2- 0.9)	8.4(5.9-10.9)	5.8(4.4-7.1)	9.0(7.0-11.0)	15.7(11.9-19.5)	9.5(6.8-12.1)
Total	0.3(0.1- 0.5)	5.0(3.6- 6.5)	3.9(3.1-4.7)	7.7(6.5- 9.0)	15.5(13.1-17.9)	17.3(14.7-19.8)
Corrected	0.8	13.9	10.8	21.4	43.1	48.1
%	0.6	9.6	7.4	14.7	29.6	33.1

Table 7 cont.

Age in years	7	8	9	10+	Total
Yearclass	74	73	72	71+	
Area A	2.5(1.7- 3.2)	1.0(0.0- 1.9)	0.0(0.0-0.0)	0.0(0.0- 0.0)	45.9(35.8- 55.9)
Area B	6.9(2.6-11.2)	0.2(0.0- 0.4)	0.4(0.2-0.6)	0.2(0.0- 0.4)	47.8(23.0- 72.6)
Area C	8.9(6.2-11.5)	1.8(0.7- 2.9)	1.4(0.7-2.0)	2.1(1.0- 3.2)	128.3(102.7-153.9)
Area D	0.6(0.4- 0.8)	0.1(0.0- 0.2)	0.0(0.0-0.0)	0.0(0.0- 0.0)	46.7(36.4- 57.0)
Total	2.2(1.7- 2.7)	0.5(0.2- 0.7)	0.1(0.1-0.2)	0.2(0.1- 0.2)	51.5(44.5- 58.5)
Corrected	6.1	1.4	0.3	0.6	143.1
%	4.2	1.0	0.2	0.4	

Table 8. Cod 1982. Stratified mean catch (number per hour) for each agegroup/yearclass with confidence limits in the surveyed areas, and stratified mean catch corrected for the vertical distribution found by the acoustic method.

Age in years	1	2	3	4	5	6
Yearclass	81	80	79	78	77	76
Area A	0.0(0.0- 0.0)	0.2(0.1-0.4)	7.0(2.9-11.2)	13.0(8.5-17.5)	16.4(12.2-20.6	10.0(7.8-12.3)
Area B	0.0(0.0- 0.0)	0.0(0.0-0.1)	0.8(0.3- 1.3)	7.3(3.7-10.8)	8.4(4.4-12.3	8.0(5.6-10.5)
Area C	0.1(0.0- 0.3)	1.1(0.5-1.6)	8.4(5.5-11.2)	16.8(8.1-25.6)	19.4(10.1-28.7)	29.3(18.3-40.3)
Area D	0.1(0.0- 0.2)	0.5(0.3-0.7)	8.4(4.1-12.7)	7.1(4.1-10.1)	5.9(4.2- 7.5)	3.6(3.5- 8.4)
Total	0.1(0.0- 0.1)	0.4(0.3-0.5)	7.3(4.6-10.0	9.3(7.1-11.4)	9.7(8.2-11.3)	7.3(6.2- 8.4)
Corrected	0.2	0.9	15.9	20.2	21.1	15.9
%	0.2	1.0	17.4	22.1	23.1	17.4

Table 8 cont.

Age in years	7	8	9	10+	Total
Yearclass	75	74	73	72+	
Area A	12.8(9.9-15.7)	1.2(0.8-1.7)	0.2(0.0- 0.3)	0.0(0.0- 0.0)	59.4(43.8- 74.9)
Area B	14.0(9.9-18.1)	1.7(1.1-2.4)	0.2(0.0- 0.3)	0.0(0.0- 0.0)	41.0(27.5- 54.5)
Area C	22.9(15.0-30.7)	1.5(0.8-2.2)	0.2(0.0- 0.4)	0.0(0.0- 0.0)	102.0(66.0-138.0)
Area D	1.8(1.0- 2.6)	0.1(0.0-0.2)	0.0(0.0- 0.0)	0.0(0.0- 0.0)	27.5(16.9- 38.1)
Total	7.2(6.1- 8.3)	0.6(0.5-0.8)	0.1(0.0- 0.1)	0.0(0.0- 0.0)	41.9(34.1- 49.6)
Corrected	15.6	1.3	0.2	0.0	91.1
%	17.1	1.4	0.2	0.0	

Table 9. Cod. Uncorrected and corrected stratified mean catch (number per hour) from the bottom trawl survey.

	Yearclass											
	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	Total
Uncorrected:												
1981	-	0.3	5.0	3.9	7.7	15.5	17.3	2.2	0.5	0.1	0.2	51.5
1982	0.1	0.4	7.3	9.3	9.7	7.3	7.2	0.6	0.1	0.0	-	41.9
Corrected:												
1981		0.8	13.9	10.8	21.4	43.1	48.1	6.1	1.4	0.3	0.6	143.1
1982	0.2	0.9	15.9	20.2	21.1	15.9	15.6	1.3	0.2	0.0		91.1

Table 10. Haddock 1981. Stratified mean catch (number per hour) for each agegroup/yearclass with confidence limits in the surveyed areas, and stratified mean catch corrected for the vertical distribution found by the acoustic method.

Age in years	1	2	3	4	5
Yearclass	80	79	78	77	76
Area A	0.0(0.0- 0.0)	0.8(0.2-1.5)	0.6(0.2-0.9)	1.3(0.8- 1.9)	4.5(2.9- 6.1)
Area B	0.0(0.0- 0.0)	1.0(0.4-2.4)	0.7(0.0-1.6)	2.3(0.7- 4.0)	26.6(15.9-37.2)
Area C	0.1(0.0- 0.2)	2.9(1.4-4.3)	1.7(0.9-2.6)	23.8(16.7- 31.0)	55.0(38.9-71.1)
Area D	0.2(0.0- 0.4)	2.9(1.7-4.1)	1.2(0.7-1.7)	4.0(2.9- 5.1)	3.5(2.7- 4.3)
Total	0.1(0.0- 0.2)	2.2(1.5-2.9)	1.0(0.7-1.4)	4.3(3.5- 5.1)	9.1(7.6-10.6)
Corrected	0.3	6.1	2.8	11.9	25.3
%	0.5	11.1	5.1	21.6	45.9

Table 10 cont.

Age in years	6	7	8+	Total
Yearclass	75	74	73+	
Area A	1.5(0.8- 2.1)	0.2(0.0-0.2)	0.0(0.0-0.1)	9.0(6.2- 11.8)
Area B	10.7(6.0-15.4)	1.3(0.3-2.3)	0.5(0.0-1.4)	43.2(25.4- 61.1)
Area C	13.8(9.4-18.1)	0.3(0.1-0.4)	0.1(0.0-0.1)	97.8(71.1-124.5)
Area D	1.0(0.7- 1.2)	0.1(0.0-0.1)	0.0(0.0-0.1)	12.9(9.7- 16.1)
Total	2.8(2.2- 3.3)	0.2(0.1-0.3)	0.1(0.0-0.2)	19.8(16.8- 22.9)
Corrected	7.8	0.6	0.3	55.0
%	14.2	1.1	0.5	

Table 11. Haddock 1982. Stratified mean catch (number per hour) for each agegroup/yearclass with confidence limits in the surveyed areas, and stratified mean catch corrected for the vertical distribution found by the acoustic method.

Age in years	1	2	3	4	5
Yearclass	81	80	79	78	77
Area A	0.3(0.1- 0.5)	0.1(0.0-0.2)	0.1(0.0- 0.2)	0.1(0.1- 0.2)	0.5(0.3-0.8)
Area B	0.1(0.0- 0.3)	1.1(0.4-1.8)	2.5(1.3- 3.7)	0.9(0.5- 1.3)	2.4(1.8-3.1)
Area C	0.9(0.5- 1.4)	3.3(1.7-5.0)	8.2(2.3-14.2)	6.7(3.1-10.4)	7.1(5.0-9.3)
Area D	0.1(0.0- 0.2)	0.1(0.1-0.2)	0.1(0.1- 0.2)	0.8(0.3- 1.2)	0.4(0.2-0.5)
Total	0.2(0.1- 0.3)	0.4(0.3-0.5)	0.8(0.5- 1.2)	1.0(0.6- 1.3)	1.0(0.8-1.2)
Corrected	0.4	0.9	1.7	2.2	2.2
%	2.6	5.8	10.9	14.1	14.1

Table 11 cont.

Age in years	6	7	8+	Total
Yearclass	76	75	74+	
Area A	3.3(1.9- 4.6)	2.0(1.1-3.0)	0.2(0.0- 0.4)	7.0(4.2- 9.8)
Area B	9.1(7.1-11.2)	4.4(3.3-5.4)	0.1(0.0- 0.2)	21.7(17.3-26.0)
Area C	10.3(7.6-13.0)	3.1(2.3-4.0)	0.3(0.1- 0.4)	41.0(27.6-54.4)
Area D	0.2(0.1- 0.3)	0.2(0.1-0.2)	0.0(0.0- 0.0)	2.0(1.2- 2.8)
Total	2.5(2.0- 2.9)	1.2(1.0-1.5)	0.1(0.1- 0.2)	7.5(6.3- 8.8)
Corrected	5.4	2.6	0.2	16.3
%	34.6	16.7	1.3	

Table 12. Haddock. Uncorrected and corrected stratified mean catch (number per hour) from the bottom trawl survey.

	Yearclass									
	1981	1980	1979	1978	1977	1976	1975	1974	1973	Total
Uncorrected:										
1981		0.1	2.2	1.0	4.3	9.1	2.8	0.2	0.1	19.8
1982	0.2	0.4	0.8	1.0	1.0	2.5	1.2	0.1		7.5
Corrected:										
1981		0.3	6.1	2.8	11.9	25.3	7.8	0.6	0.3	55.0
1982	0.4	0.9	1.7	2.2	2.2	5.4	2.6	0.2		16.3

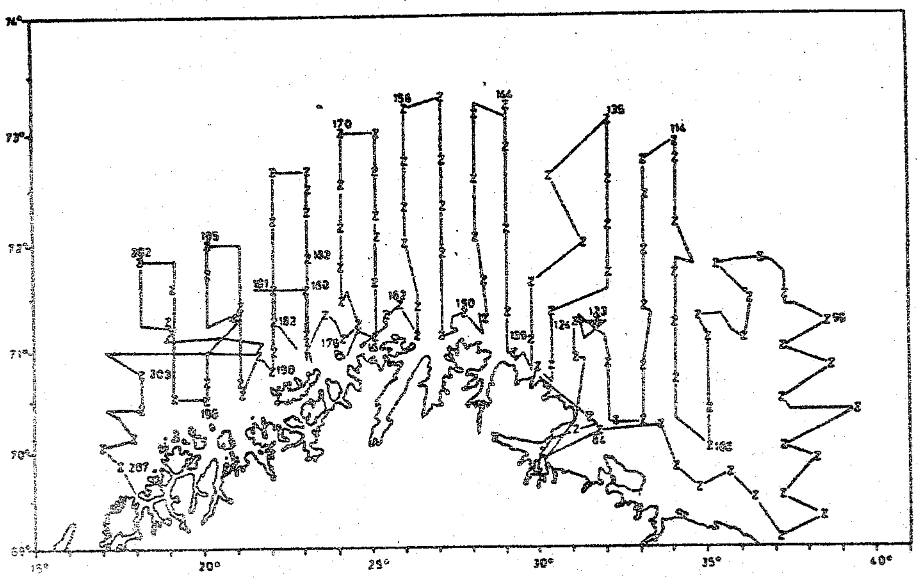

Fig. 1 Survey tracks and hydrographical stations (CTD) 26.1 - 2.3 1982, "G.O. Sars"

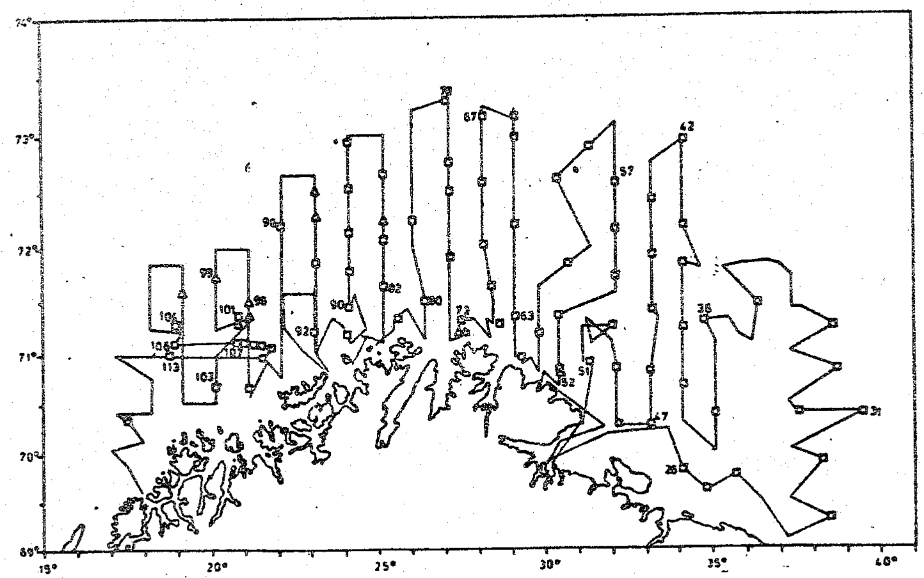

Fig. 2 Survey tracks and trawlstations 26.1 - 2.3 1982, "G.O. Sars". ◻ Bottomtrawl △ Pelagic trawl.

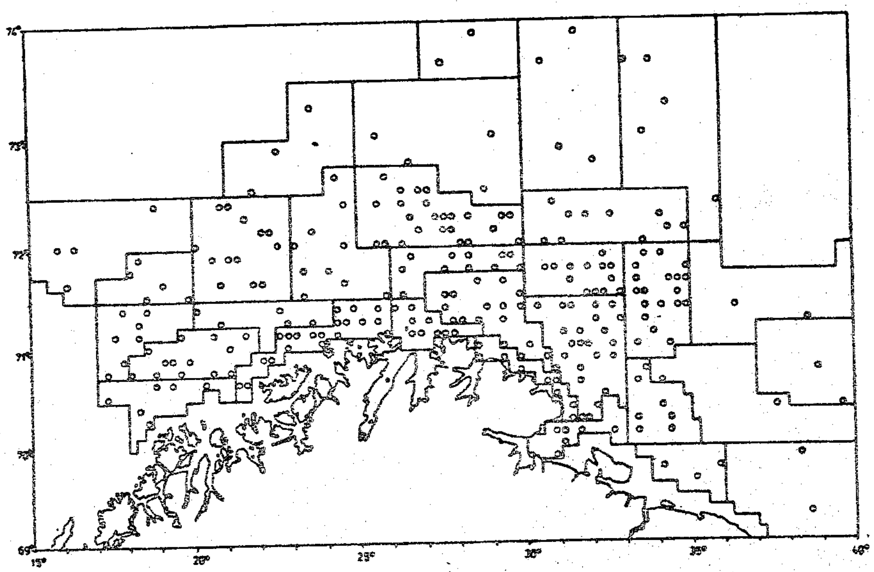

Fig. 3 Bottomtrawl stations taken by "Masi" and "Vikheim" 26.1 - 5.3 1982, and "G.O. Sars" bottomtrawl stations east of 36°E.

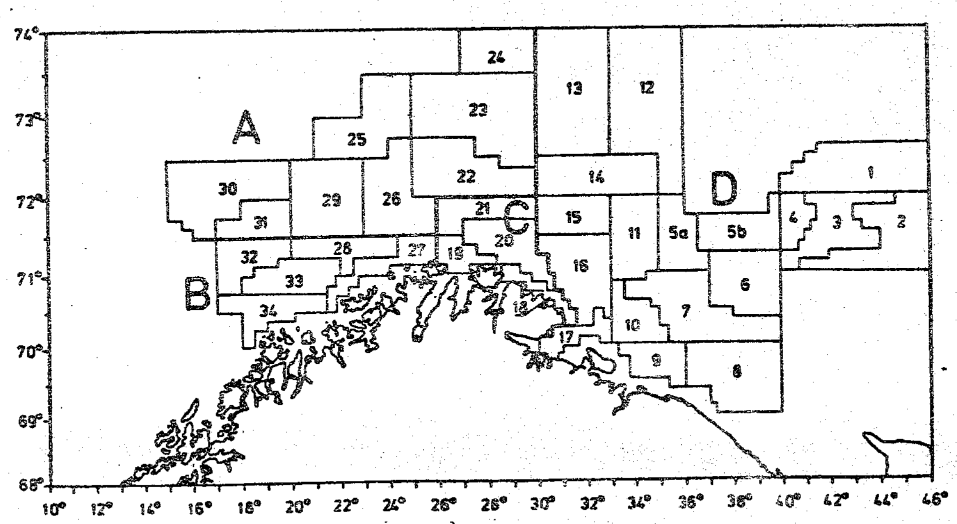

Fig The surveyed area with subarea (A,B,C,D) and strata (figurs) in the bottomtrawl survey.

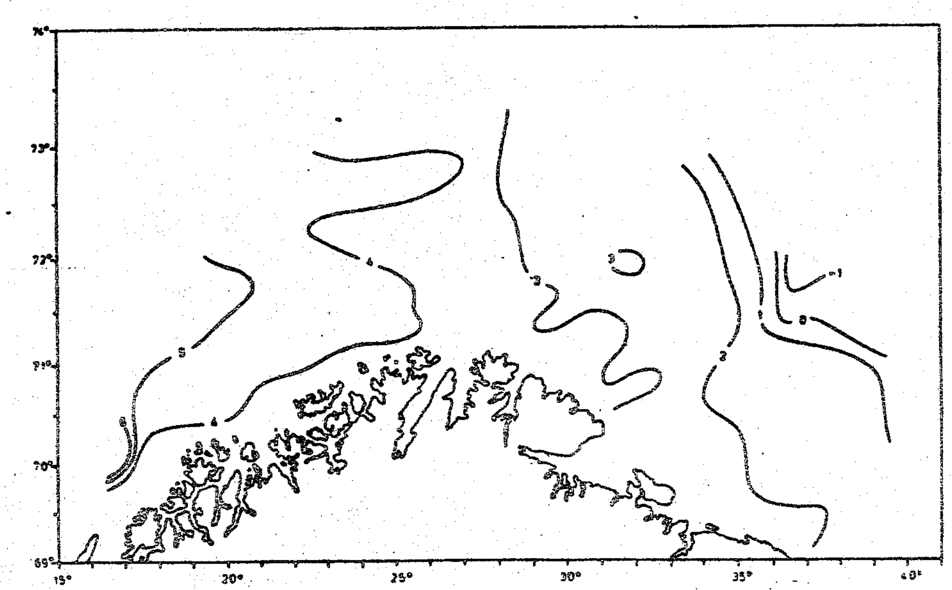

Fig. 5 Isoterms at 0 m (t ^{o}C).

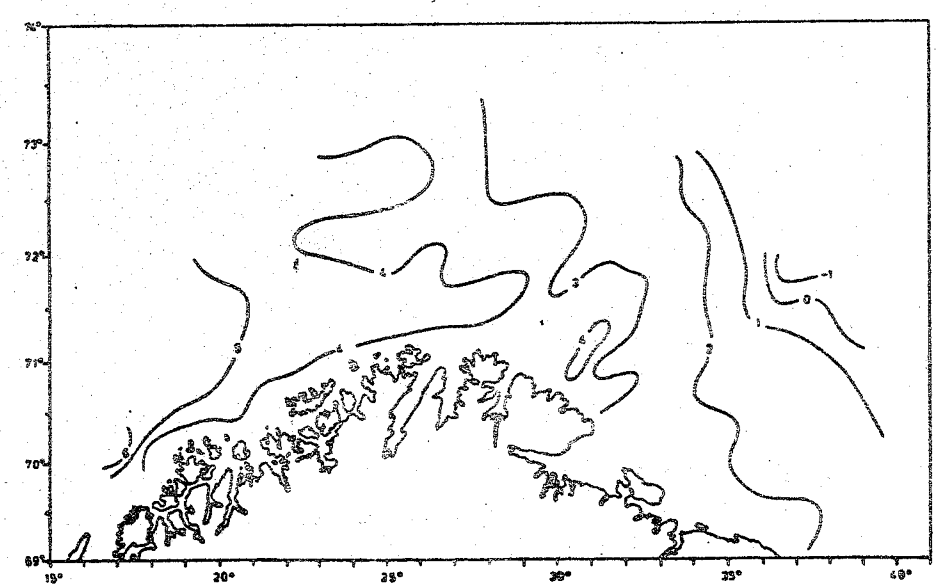

Fig. 6 Isoterms at 100 m (t ^{o}C).

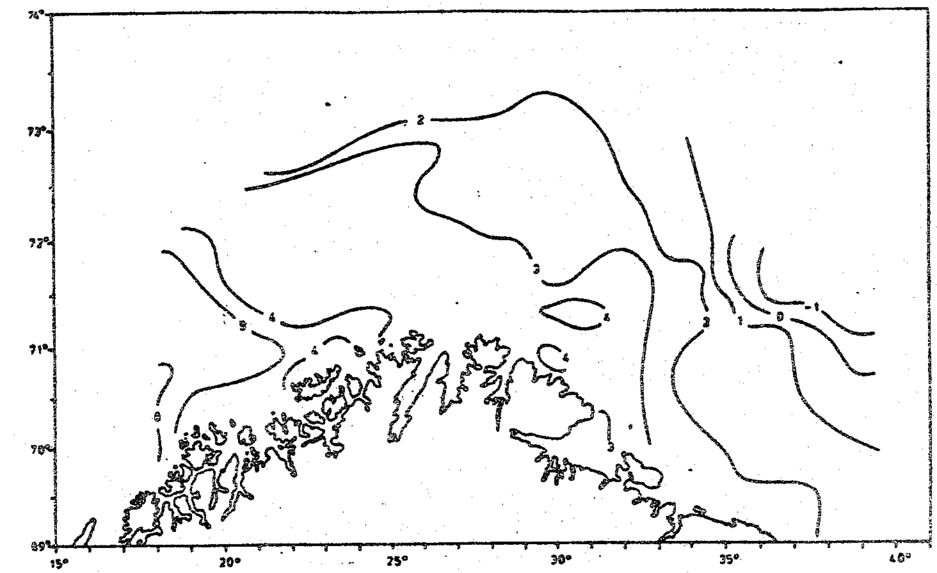

Fig. 7 Isoterms at bottom (t ^{o}C).

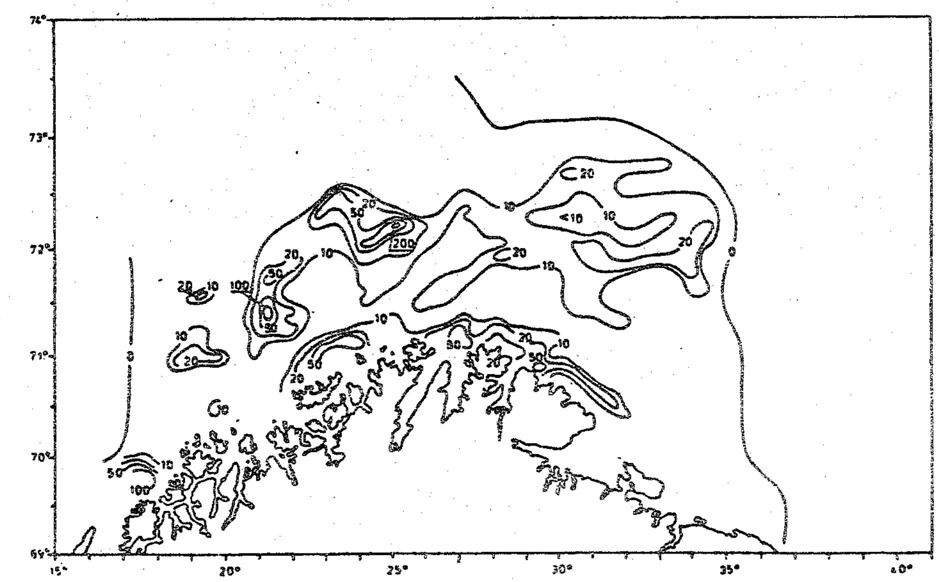

Fig. 8 Distribution of echo abundance of cod and haddock 26.1 - 2.3 1982 (mm deflection per nautical mile).

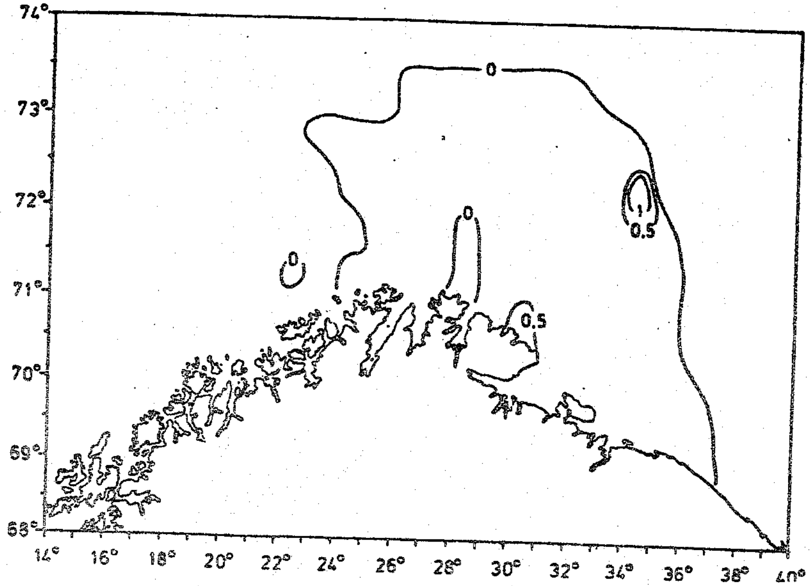

Fig. 9 Distribution of 2 years old cod 26.1 - 2.3 1982 (Number of specimen per square nautical mile in thousands).

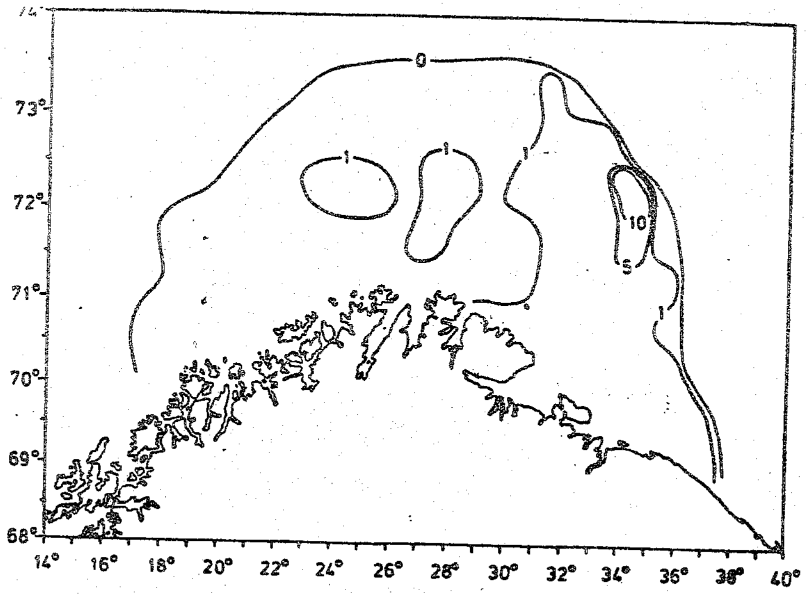

Fig. 10 Distribution of 3 years old cod 26.1 - 2.3 1982 (Units as fig. 9).

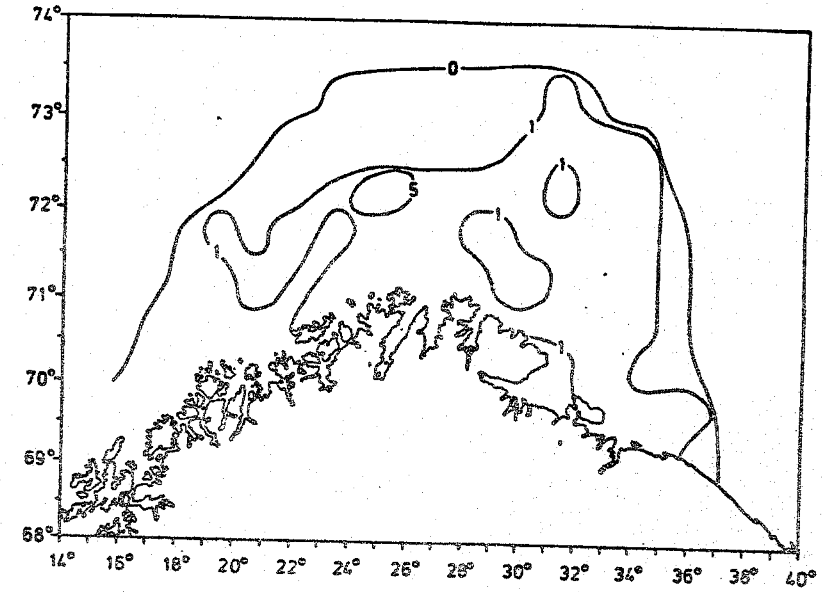

Fig. 11 Distribution of 4 years old cod 26.1 - 2.3 1982 (Units as fig. 9).

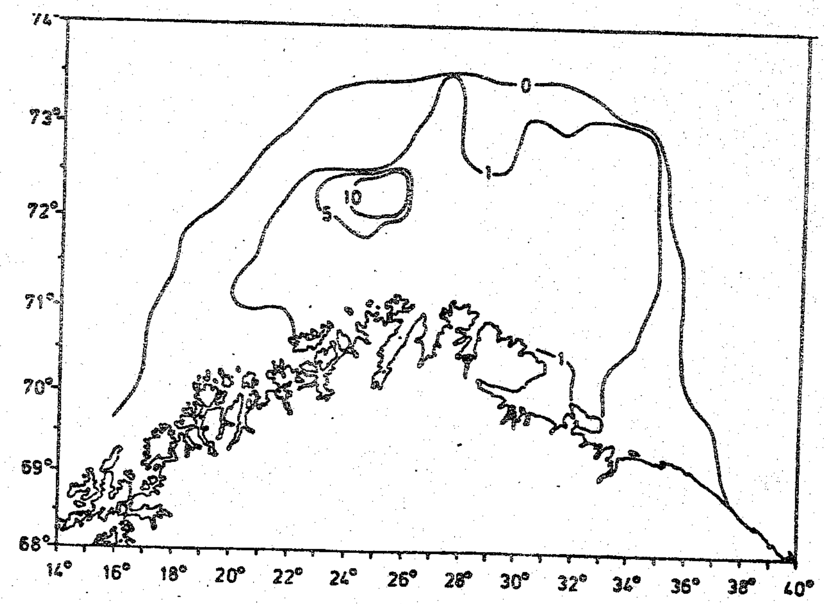

Fig. 12 Distribution of 5 years old cod 26.1 - 2.3 1982 (Units as fig. 9).

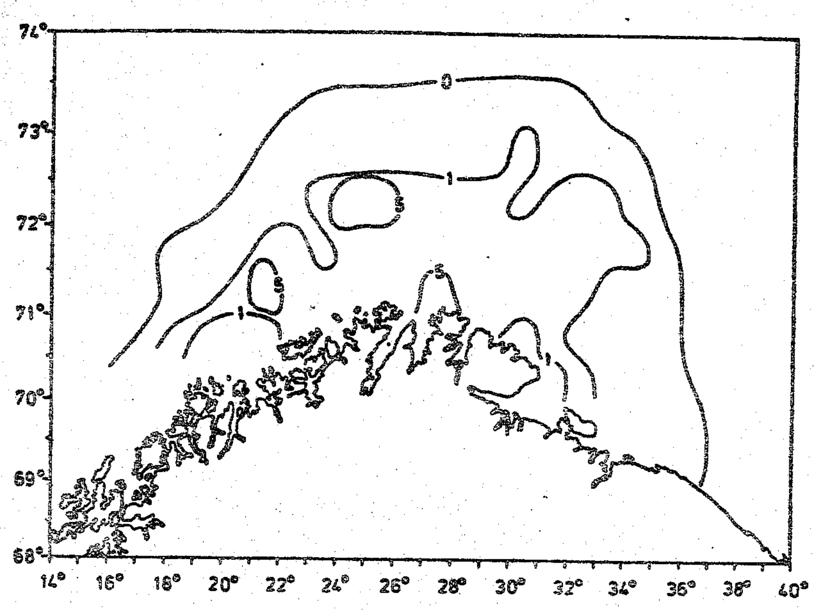

Fig. 13 Distribution of 6 years old cod 26.1 - 2.3 1982 (Units as fig. 9).

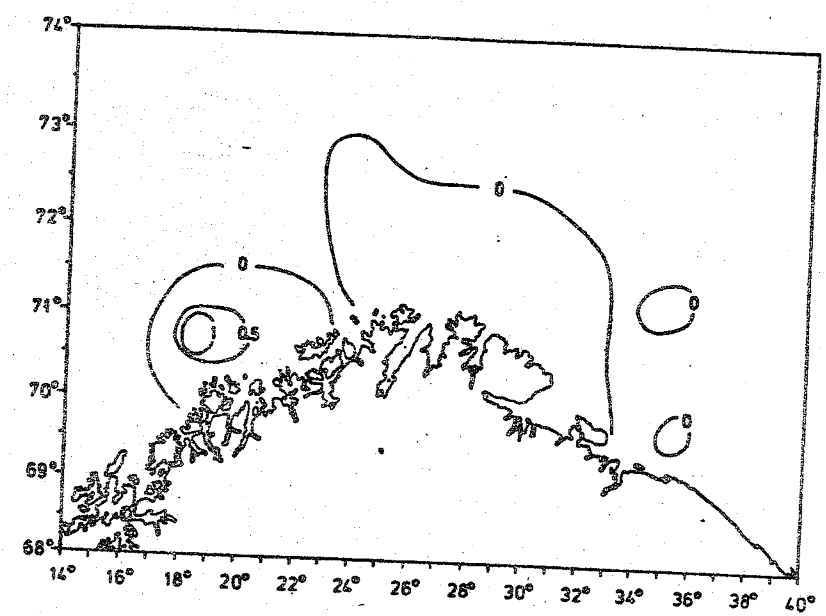

Fig. 15 Distribution of 2 years old haddock 26.1 - 2.3 1982 (Units as fig. 9).

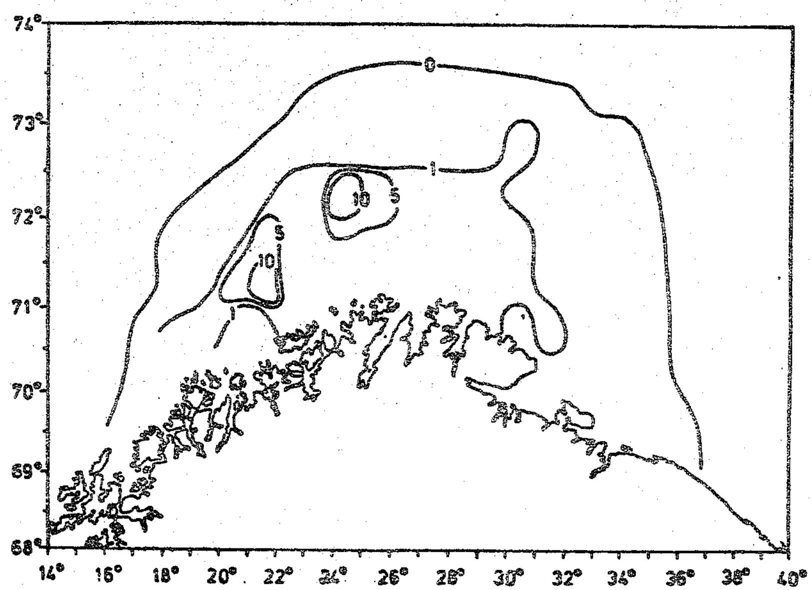

Fig. 14 Distribution of 7 years old cod 26.1 - 2.3 1982 (Units as fig. 9).

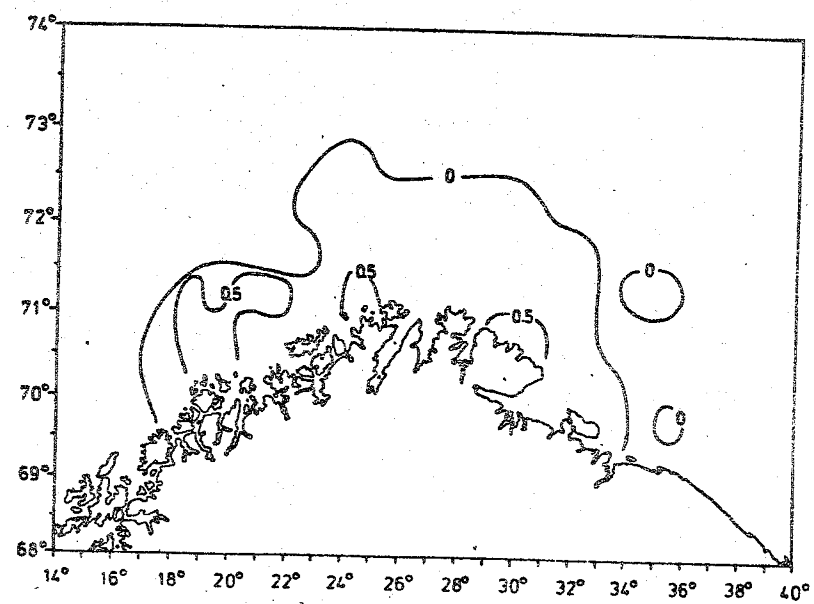

Fig. 16 Distribution of 3 years old haddock 26.1 - 2.3 1982. (Units as fig. 9).

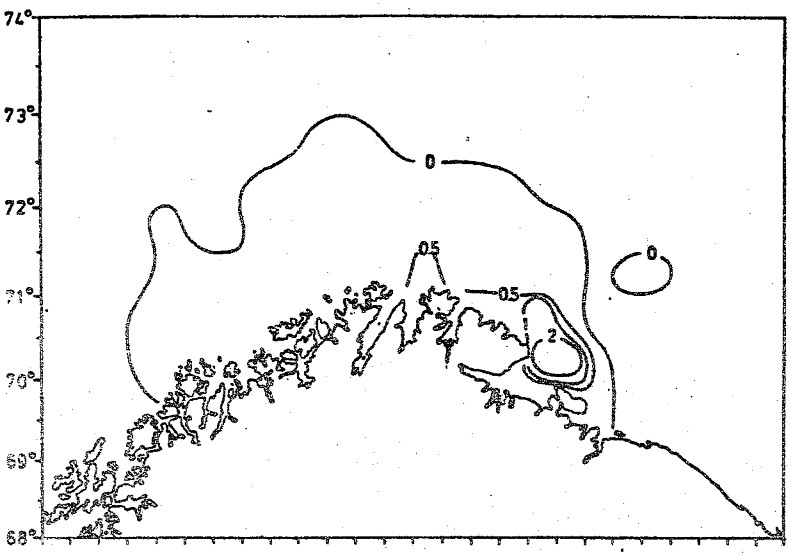

Fig. 17 Distribution of 4 years old haddock 26.1 - 2.3 1982
(Units as fig. 9).

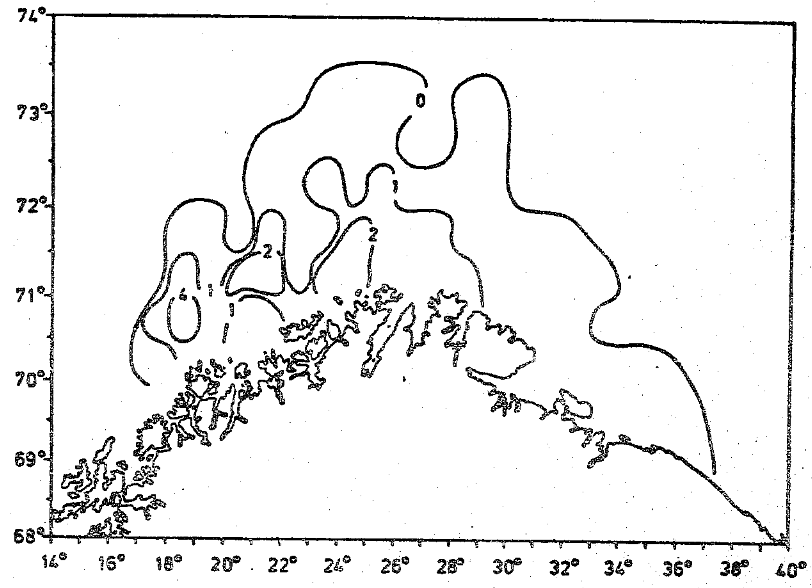

Fig. 19 Distribution of 6 years old haddock 26.1 - 2.3 1982
(Units as fig. 9).

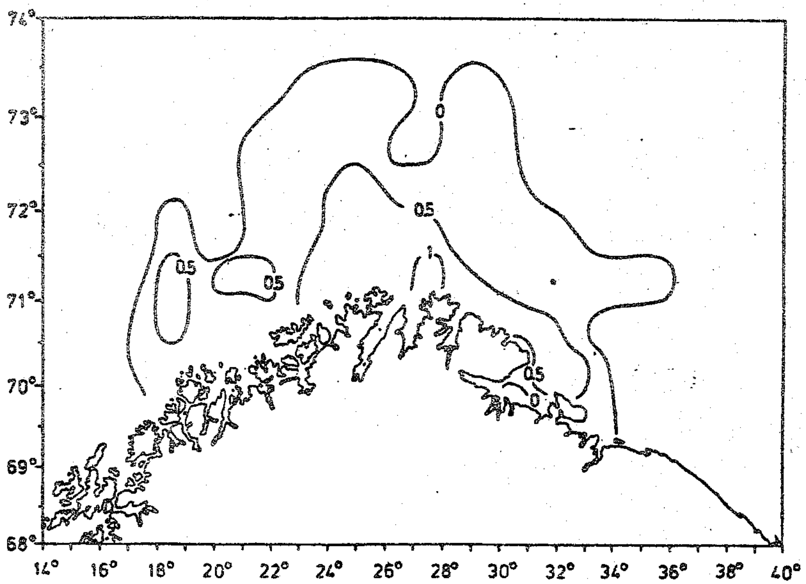

Fig: 18 Distribution of 5 years old haddock 26.1 - 2.3 1982
(Units as fig. 9).

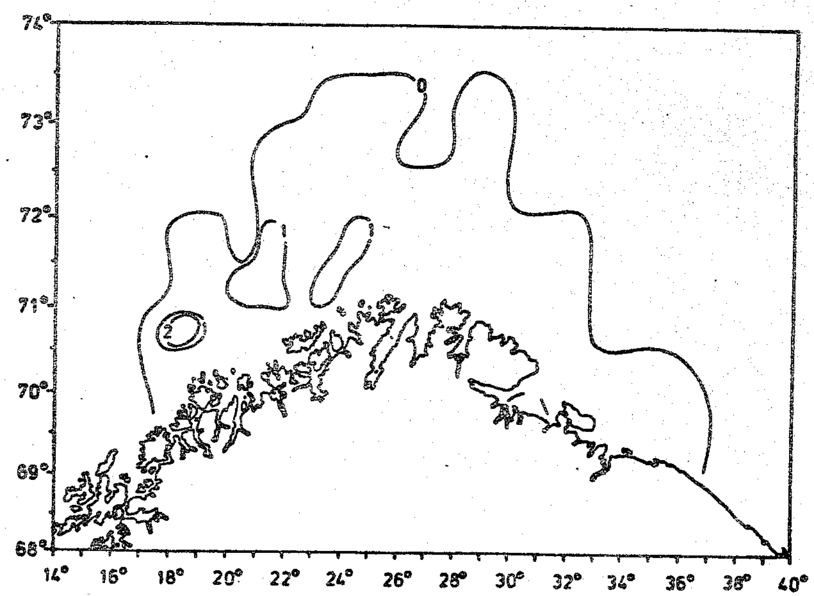

Fig. 20 Distribution of 7 years old haddock 26.1 - 2.3 1982
(Units as fig. 9).