

This paper not to be cited without prior reference to the author

International Council for the
Exploration of the Sea

C.M. 1980/H: 61
Pelagic Fish Committee

NORWEGIAN BLUE WHITING INVESTIGATION IN APRIL/MAY 1980

by

Terje Monstad and Lars Midttun

Institute of Marine Research
P.box 1870-72, 5011 Bergen, Norway

ABSTRACT

An acoustic survey on the blue whiting stock was conducted from 8 April to 14 May 1980. The area west of the British Isles was covered twice and then the area around the Faroes and further up to Shetland and the Norwegian coast covered once.

Blue whiting was recorded in the area around the Faroes and along the slope continuously south to the Porcupinebank, with densest concentrations found off the Hebrides.

The hydrographical situation is presented and also the age and length compositions, maturity conditions and the length-weight relationships of the blue whiting in the area.

Higher contributions of young fish were found to represent the blue whiting stock in the spawning area, than observed in recent years.

Acoustic abundance estimate gave a figure of 5.4 mill.tonnes of blue whiting, which is 2.5 mill.tonnes lesser than the re-calculated figure of 1979.

INTRODUCTION

From 1977 to 1979 the Norwegian directed fishery for blue whiting increased from 40 000 to 200 000 tonnes. In 1980 the landing dropped to around 140 000 tonnes. In addition the by-catch of blue whiting in the Industrial mixed fishery has increased considerably the recent years. The total landings of blue whiting, that have increased from 110 000 tonnes in 1975 to 1.1 mill.tonne in 1979, underline the importance of knowing the size of the stock.

Analysis of the results from previous Norwegian surveys indicates a spawning stock size of 6 mill.tonnes for the period 1972-74 (BUZETA and NAKKEN, 1975).

The survey carried out with the Norwegian research vessel "Michael Sars" in second half of April 1979 gave the result of 7.9 mill.tonnes for the spawning stock size. This figure differs from the rough and preliminary value given in earlier report (MONSTAD, 1979) due to an intercalibration between "Michael Sars" and "G.O. Sars" and the use of a more appropriate C-value (ANON. 1980).

In 1980 the Norwegian research vessel "G.O. Sars" conducted an acoustic survey from 8 April to 14 May in the area west and north of the British Isles. The main objectives was to measure the size of the spawning stock and to study the migration from the spawning area.

During the survey, it was arranged for acoustic intercalibration between the Norwegian, a Faroese and a Scottish research vessels. This was for checking the similarity of the recordings, and to make easier the comparison of various estimates obtained by the different vessels.

The results of intercalibration with the Scottish vessel are discussed in the report from the Blue Whiting Assessment Working Group in 1980 (ANON. 1980). The intercalibration with the Faroes vessel will be discussed in another report together with results from other objectives of the cruise.

METHODS

Recordings of the fish concentrations was made with a Simrad 38 kHz echosounder that was connected to three integrators each with two channels. The recordings were made in 100 m intervals in the actual depths where the blue whiting was located, and the echo intensity expressed as 40 dB-values.

The technique of handling the acoustic data for the abundance estimates, is the same as used during the similar survey in 1979 (MONSTAD, 1979), and the theoretical background as described by Forbes and Nakken (1972).

The total observed area of the blue whiting distribution was divided into rectangles of 0.5° latitude and 1° longitude size. The area of distribution, the mean integrator value, and the representative mean lengths and weights for each rectangle were then calculated.

During the survey a number of single fish counts were carried out. Various C-values (the coefficient of fish density that causes 1 mm deflection on the echo integrator) were then calculated, but due to the great depths of the fish during this period of the year, the method gave not very accurate results. Some of the problems are to distinguish single from multiple echoes, and to define the volume of water insonified. Therefore the C-values used for the survey in 1980 and for recalculation of the result from the survey in 1979, is the same value that is used for cod;

$$C = 5.25 \times 10^6 \times l^{-2.18},$$

where l is the fish length.

This is based on observations on young cod in the Barents Sea under very good conditions (DALEN, SMEDSTAD and NAKKEN, pers. com.). Target strength values measured on blue whiting and young cod are approximately the same for fish of same size (NAKKEN and OLSEN, 1977). The C-value used are therefore considered to be the most appropriate one for blue whiting until further investigations give more data.

Identifications of the recordings and collection of biological samples were done by use of pelagic trawl (Engel net). The hydrographical data were obtained with a CTD-sonde.

RESULTS AND DISCUSSION

Distribution

The area from Shetland/Faroes to the Porcupinebank west of Ireland was covered twice with a southward and then a northward criss-crossing. A third coverage was made around the Faroes, up to Shetland and eastwards into the Norwegian Sea. Fig. 1 and 2 shows the complete survey track with hydrographical and trawl stations respectively.

During the first coverage, from 9 to 20 April, blue whiting was recorded more or less continuously from south of the Faroes to the southern part of the Porcupinebank (Fig. 3). The distribution was widest in the area northwest of Scotland with the densest concentrations in the St.Kilda area west of the Hebrides. Further south, up to Porcupinebank, the blue whiting was distributed along the continental slope in a very narrow belt, while it widened out over the whole bank area with scattered recordings. The distribution limits in this southern part of the area covered, were not clearly defined. Much probably blue whiting was scattered over a wider area than observed.

Fig. 4 shows the distribution of blue whiting observed during the second coverage, from 18 to 29 April. Due to the continuation from the southward to the northward surveying, the recordings obtained in the Porcupinebank area are included in the results from both of these coverages. The picture has therefore changed only very little in the southern part. In the area west of the Hebrides, however, the concentrations of blue whiting had diminished significantly between the two periods. The majority of the fish had migrated northward, and the highest concentrations were found midway between the Hebrides and the Faroes.

During the third coverages, from 2 to 14 May, blue whiting was observed from the slope northwest of Scotland to the area around the Faroes and further into the Norwegian Sea (Fig. 5).

Abundance

The abundances are calculated for each of the three coverages, and in Table 1 are these values given together with the area of distribution and the density.

During the first coverage, from 9 to 20 April (Fig. 3) the abundance within the area surveyed was estimated to be 5.4 mill.tonnes with a mean density of 119 tonnes per square nautical mile. The value of 2.3 mill.tonnes calculated for the second coverage, clearly reflects the northward migration that took place during second half of April.

The third coverage, in the Faroes-Shetland-Norwegian coast area (Fig. 5) gave 3.6 mill.tonnes of blue whiting observed. The two last coverages had a density around half of the density observed during the first coverage. This shows that while migrating into the Norwegian Sea, the blue whiting gradually dissolves its high concentrations and scatters over wide areas.

As mentioned above, the result from the 1979-survey in second half of April (MONSTAD, 1979) has been recalculated after an

intercalibration and use of the more appropriate C-value. Though the area covered in 1979 was only half the size of the area covered in 1980, 2.5 mill.tonnes more of blue whiting were observed.

The value of 5.4 mill.tonnes observed during the first coverage in 1980, however, has to be considered as a minimum estimate. A minor part of the stock most probably had already left the spawning area, and besides, blue whiting was also recorded at the same time by a Scottish research vessel in the Rock All area (ANON. 1980). A small part of the recordings belonged to immature fish, but prespawners may also still be on its way to the spawning area. The size of the spawning stock of 1980 can therefore be considered at the level of 6 mill.tonnes. This is the same level as resulted from Buzeta and Nakken's (1975) analysis for the years 1972-74.

Structure

The length- and age composition of the blue whiting stock observed is given in Tables 2 and 3 respectively. Two years old fish dominated with more than 25%, with the rest of the stock consisting of fish mainly from 3 to 8 years old. The high number of young fish is caused by the samples taken from the northernmost and the southernmost part of the area surveyed from 9 to 20 April. In Fig. 6 are shown the length- and age composition in four subareas during this period. The subarea B, from 60° to 57°N, representing nearly 70 percentage of the estimated biomass, however, has an composition that is more comparable with the corresponding part of the stock in 1979. Even so, the blue whiting stock in the spawning area was found to have more contributions from younger fish in 1980 than recent years.

Table 4 gives the maturity composition of blue whiting from the same four subareas. In correspondance with the age composition, most immature fish were found in the area between Scotland and the Faroes, and in the Porcupinebank area.

In Table 6 are shown the length-weight relationship from the period 9 - 20 April. The mean weight in each lengthgroup are found to be higher than those observed in 1979 which, however, are considered to be rather low.

Hydrography

The horizontal distribution of the temperature at surface, 200 m and 400 m depths are shown in Figs. 7, 8 and 9 respectively, and the corresponding salinity in Figs. 10, 11 and 12. In the western part of the area surveyed, the hydrographical conditions were quite homogenous regarding the depth. West of Ireland the temperatures were around 10°C, and from the Hebrides to the slope south of the Faroes it was 9°C, which is approximately 1° warmer than the 1979 - situation.

References

- ANON. 1980. Report of the Blue Whiting Assessment Working Group, Bergen 5-10 May 1980. Coun.Meet.int.Coun. Explor.Sea, 1980 (H: 5): 1-64. [Mimeo.]
- BUZETA, R. and NAKKEN, O. 1975. Abundance estimates of the spawning stock of blue whiting (Micromesistius poutassou (Risso, 1810)) in the area west of the British Isles in 1972-1974. FiskDir.Skr.Ser.HavUnders., 16: 245-257.
- FORBES, S.T. and NAKKEN, O. 1972. Manual of methods for fisheries resource survey and appraisal. Part 2. FAO Manual in Fisheries Science No. 5. 1972.

MONSTAD, T. 1979. Preliminary Results of Norwegian Blue Whiting Survey Northwest of Scotland in April 1979. Coun.Meet.int.Coun.Explor.Sea, 1979 (H: 33): 1-11. [Mimeo.]

NAKKEN, O. and OLSEN, K. 1977. Target strength measurements of fish. Rapp.P.-v.Réun.Cons.int.Explor.Mer, 170: 52-69.

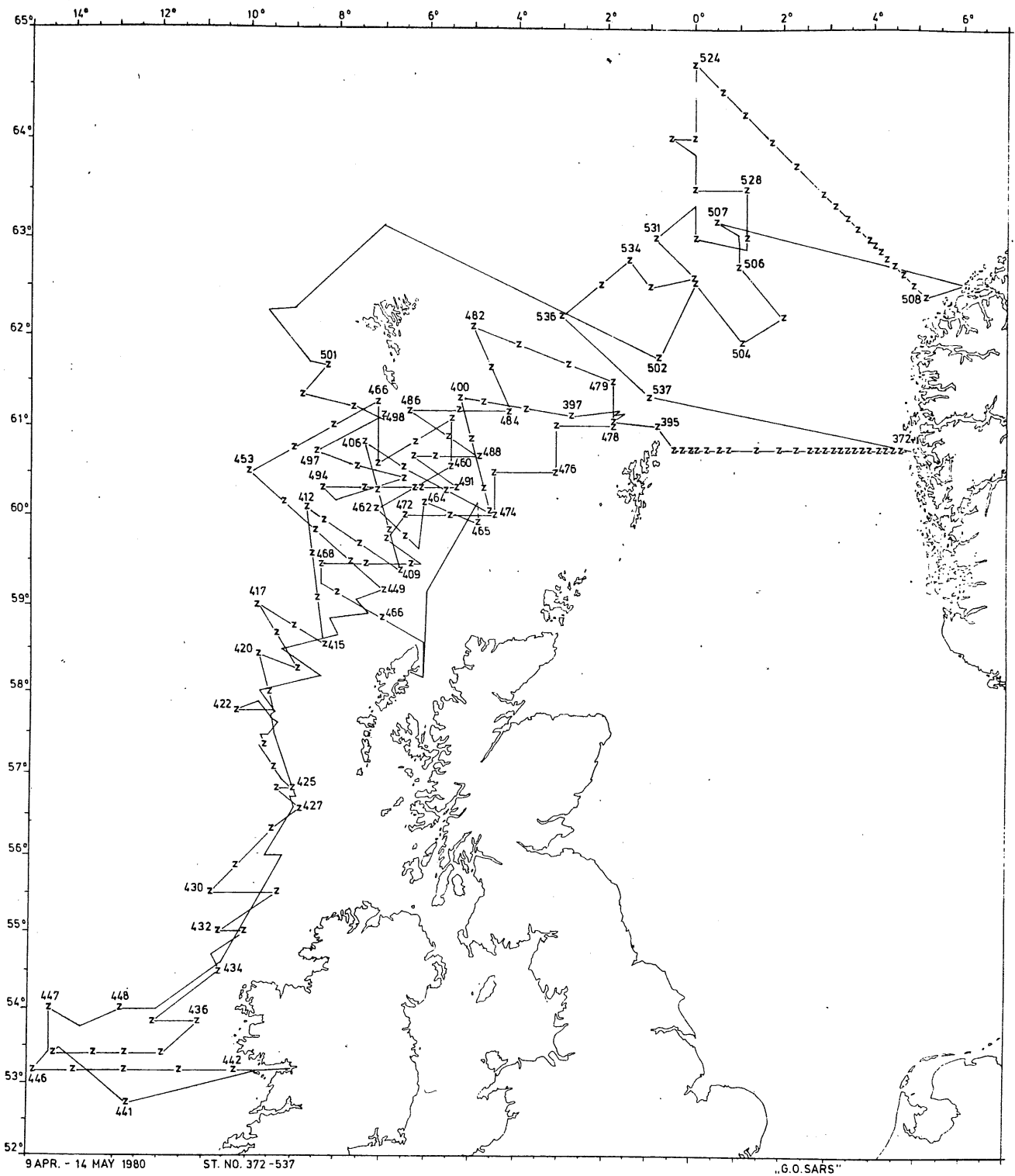


Fig. 1. Cruise track with hydrographical stations (Z) of R/V "G.O. Sars", 9 April - 14 May 1980.

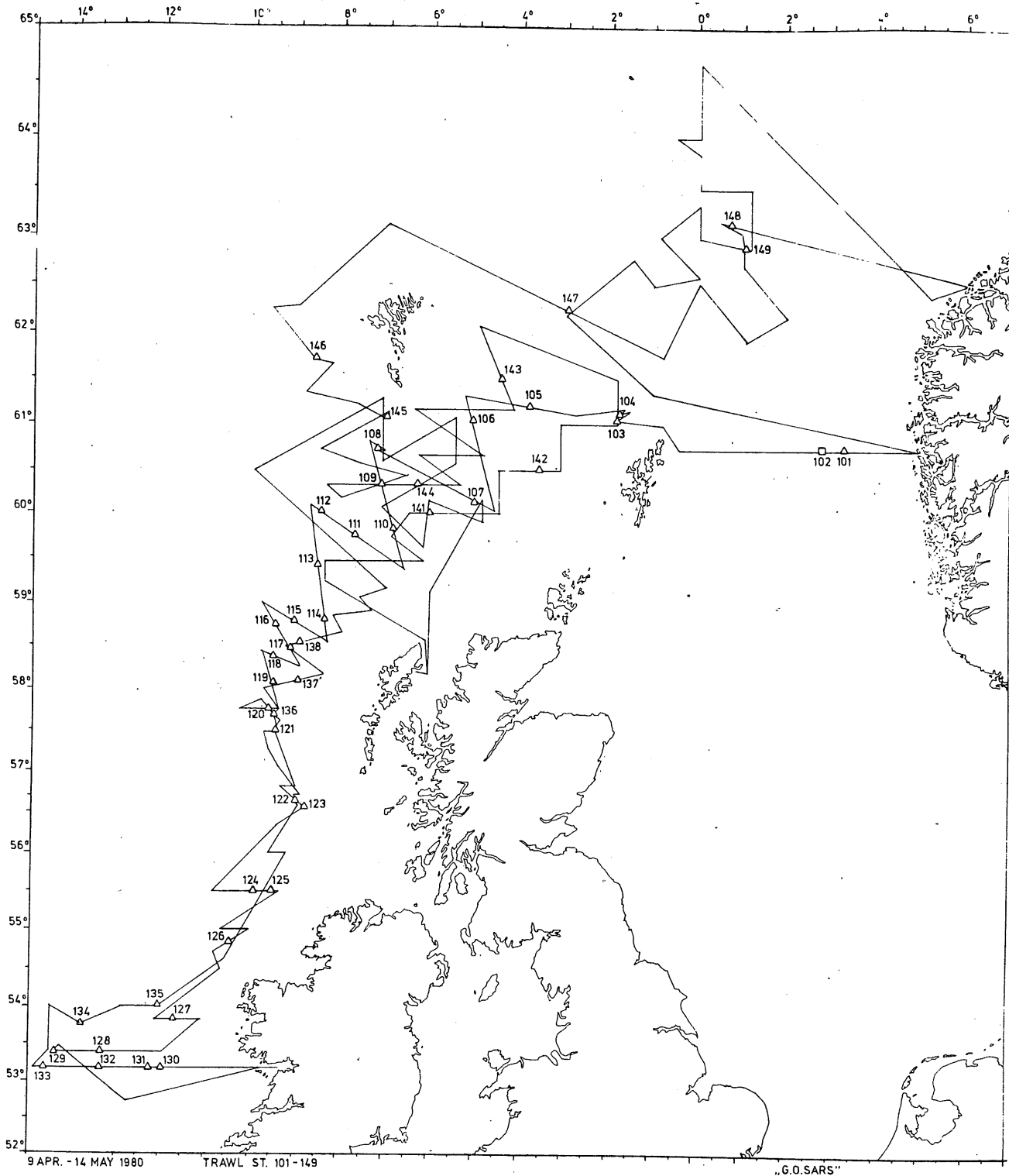


Fig. 2. Cruise track with pelagic trawl (triangle) and bottom trawl (square) of R/V "G.I. Sars", 9 April - 14 May 1980.

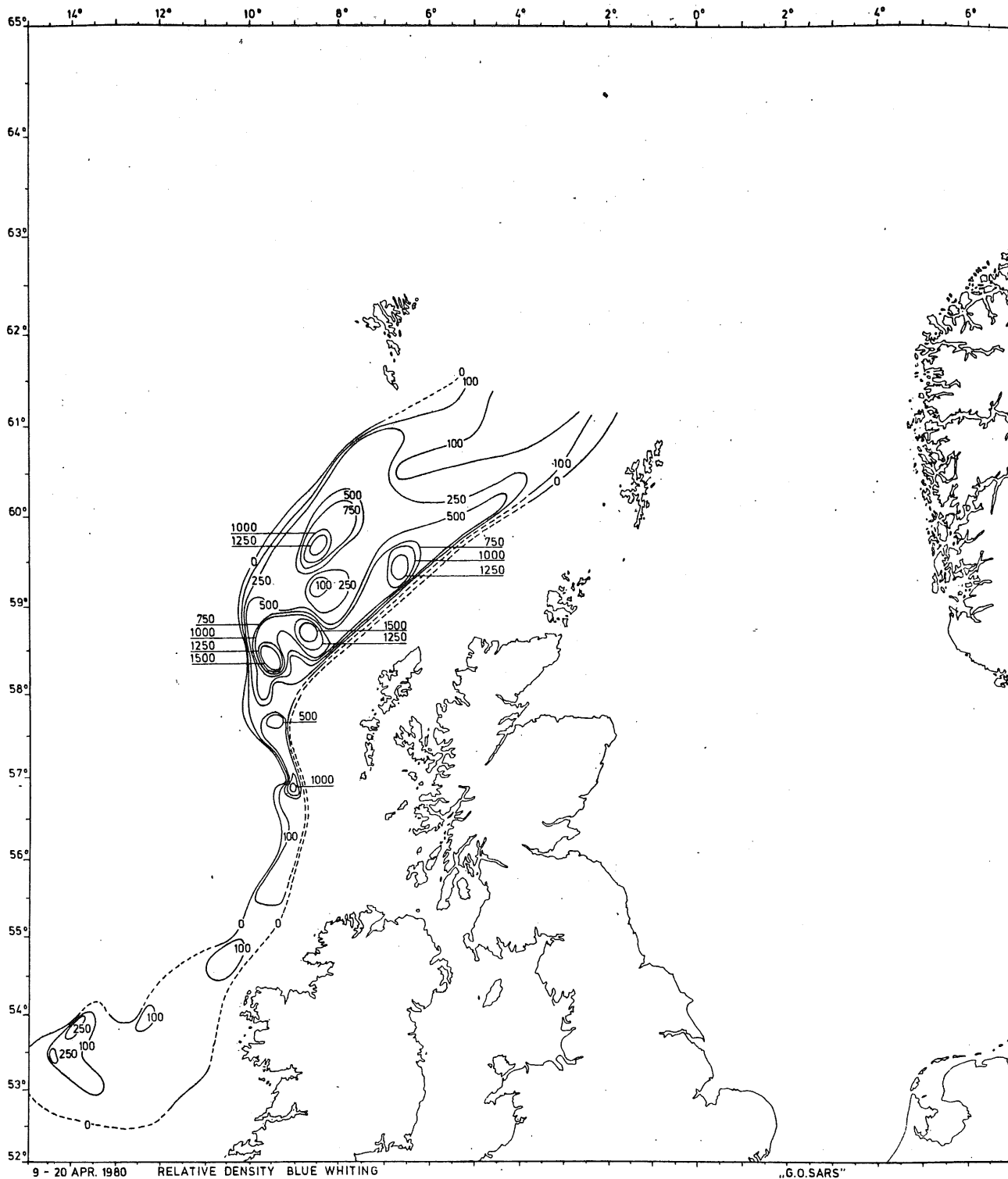


Fig. 3. Integrated echo intensity of blue whiting in mm deflection per nautical mile, during the first coverage, 9 - 20 April 1980.

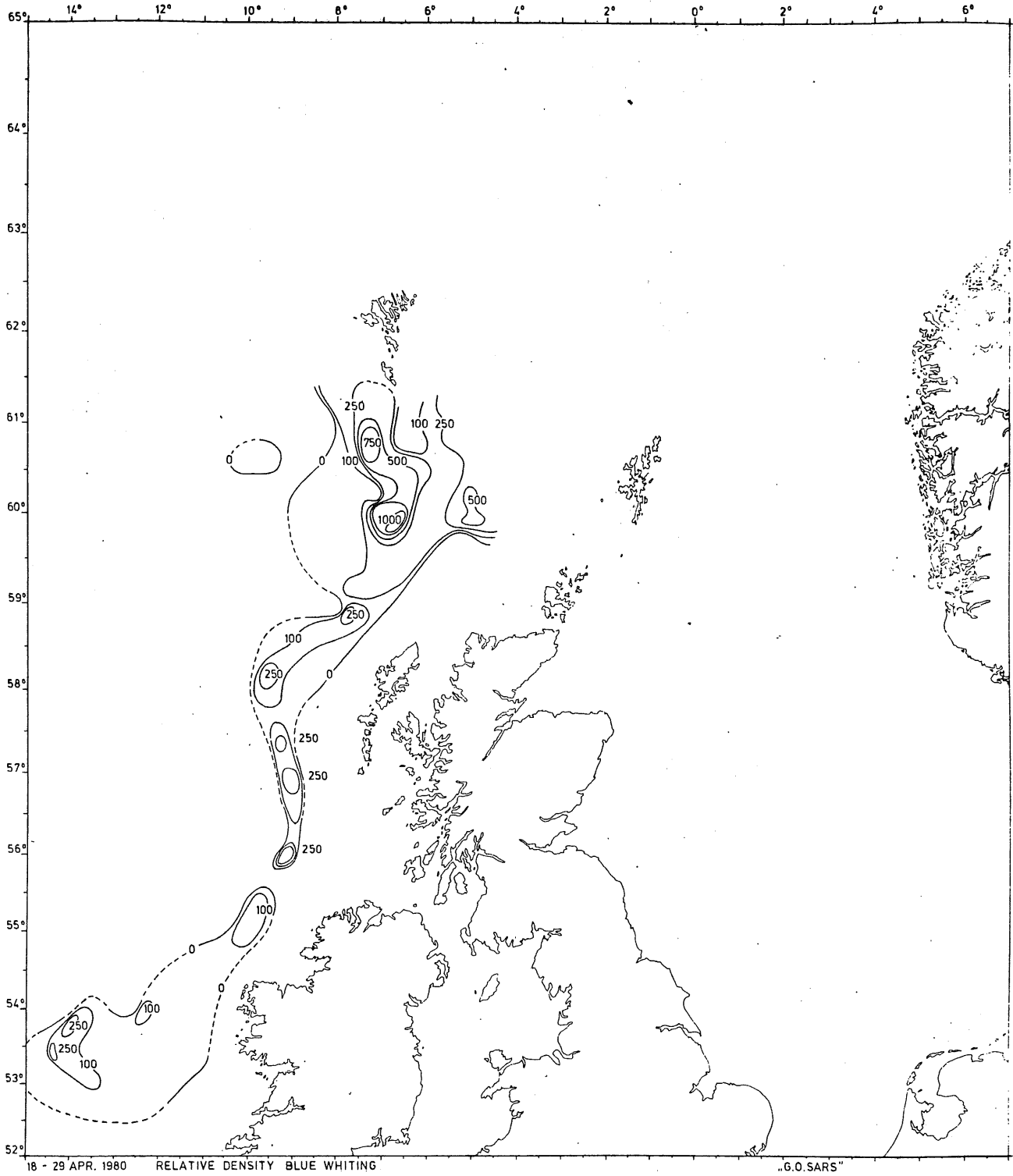


Fig. 4. Integrated echo intensity of blue whiting in mm deflection per nautical mile, during second coverage, 18 - 29 April 1980.

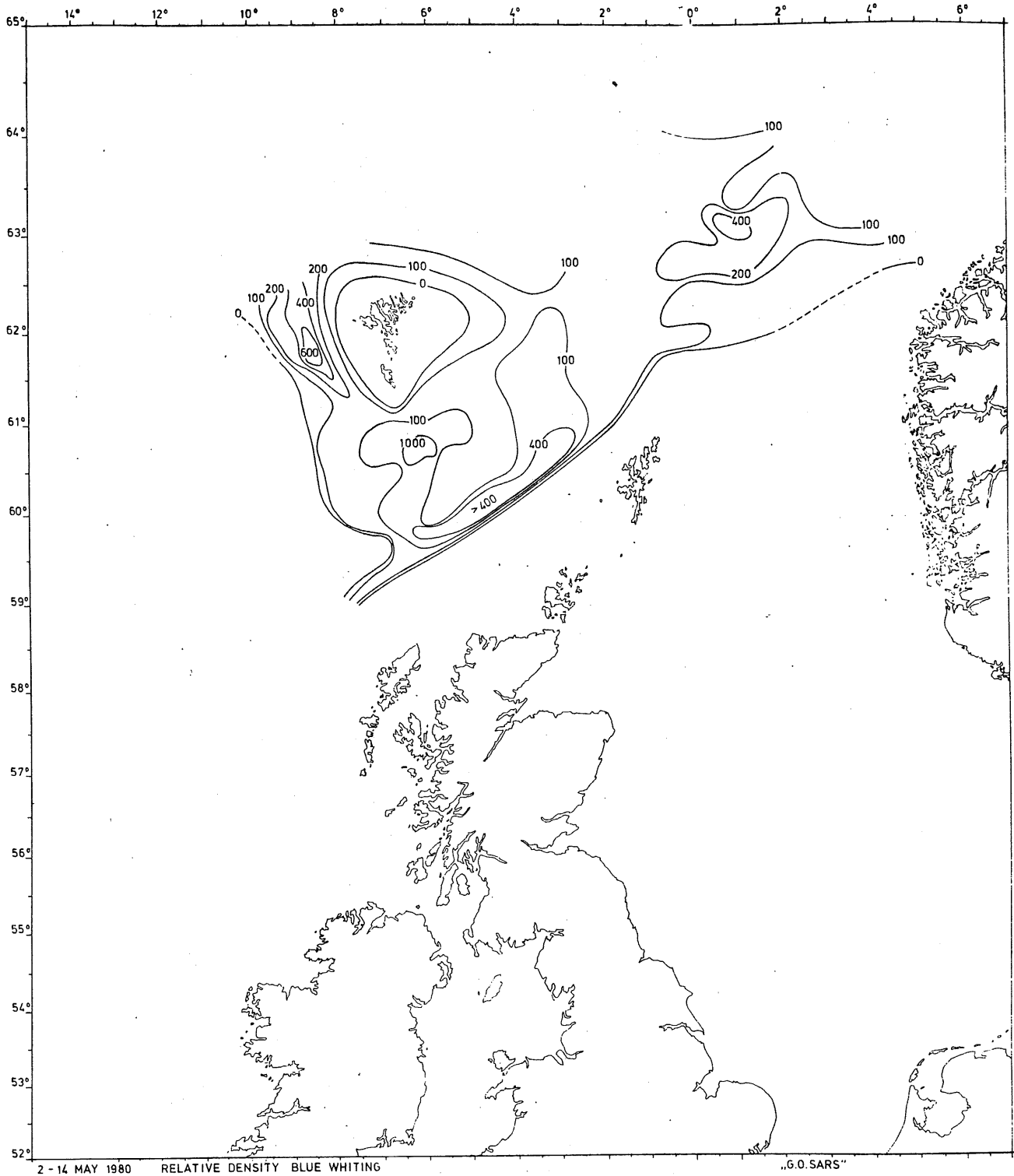


Fig. 5. Integrated echo intensity of blue whiting in mm deflection per nautical mile, during third coverage, 2 - 14 May 1980.

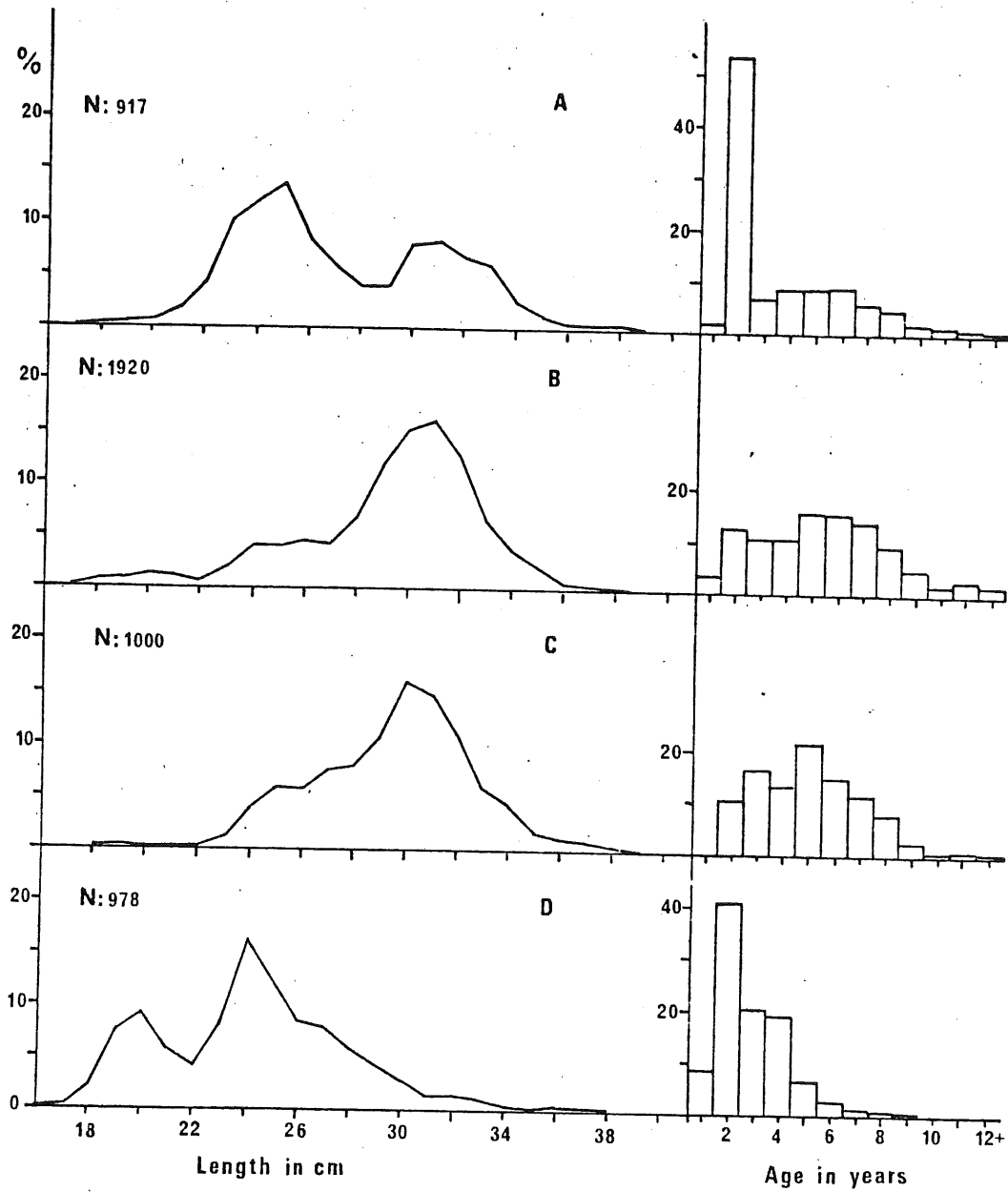


Fig. 6. Length- and age composition in percentages of blue whiting from four different areas west of the British Isles 9-20 April 1980. A: north of 60°N , B: $60^{\circ}-57^{\circ}\text{N}$, C: $57^{\circ}-53^{\circ}30'\text{n}$, D: south of $53^{\circ}30'\text{N}$.

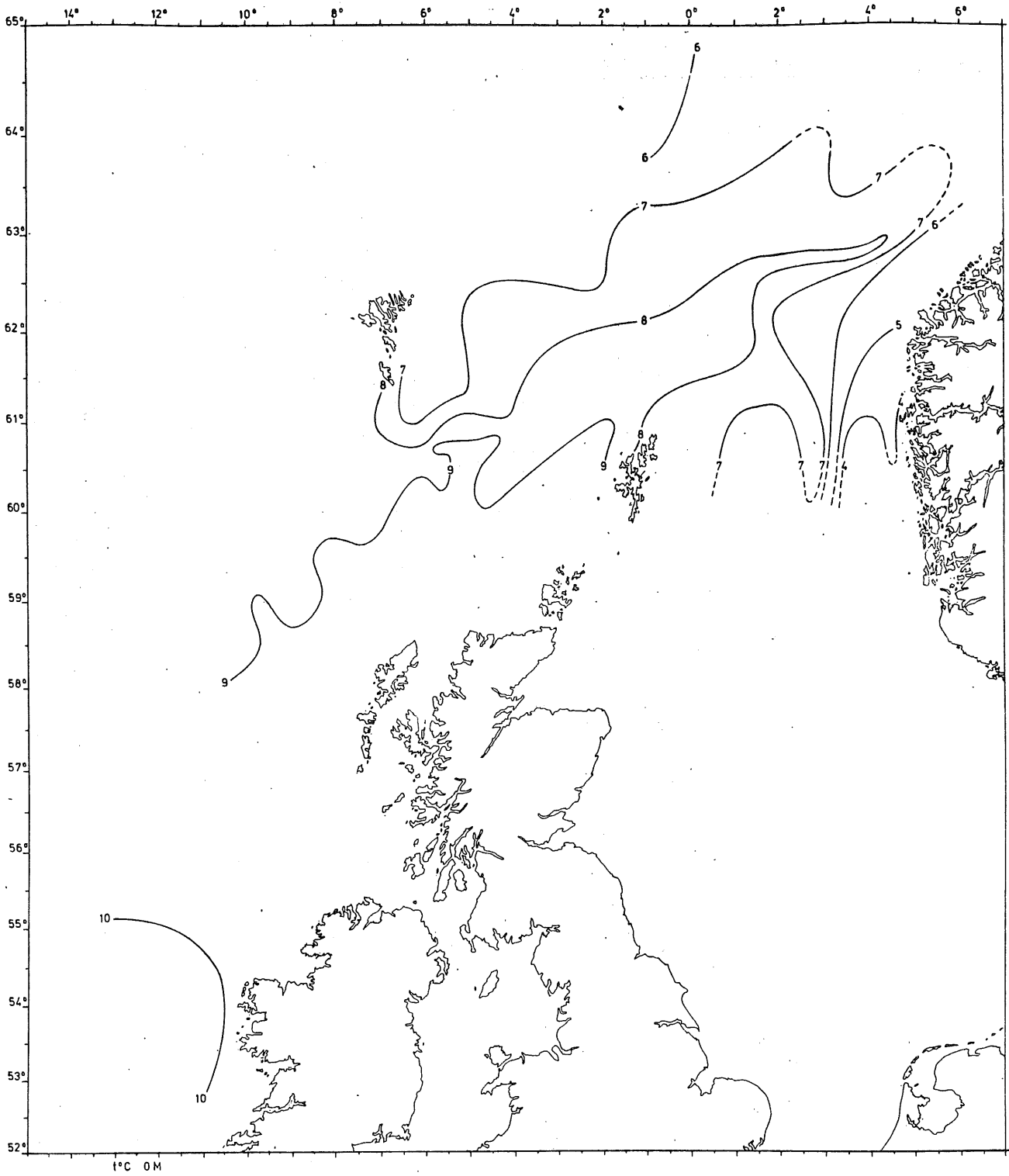


Fig. 7. Temperature of the surface, 9 April - 14 May 1980.

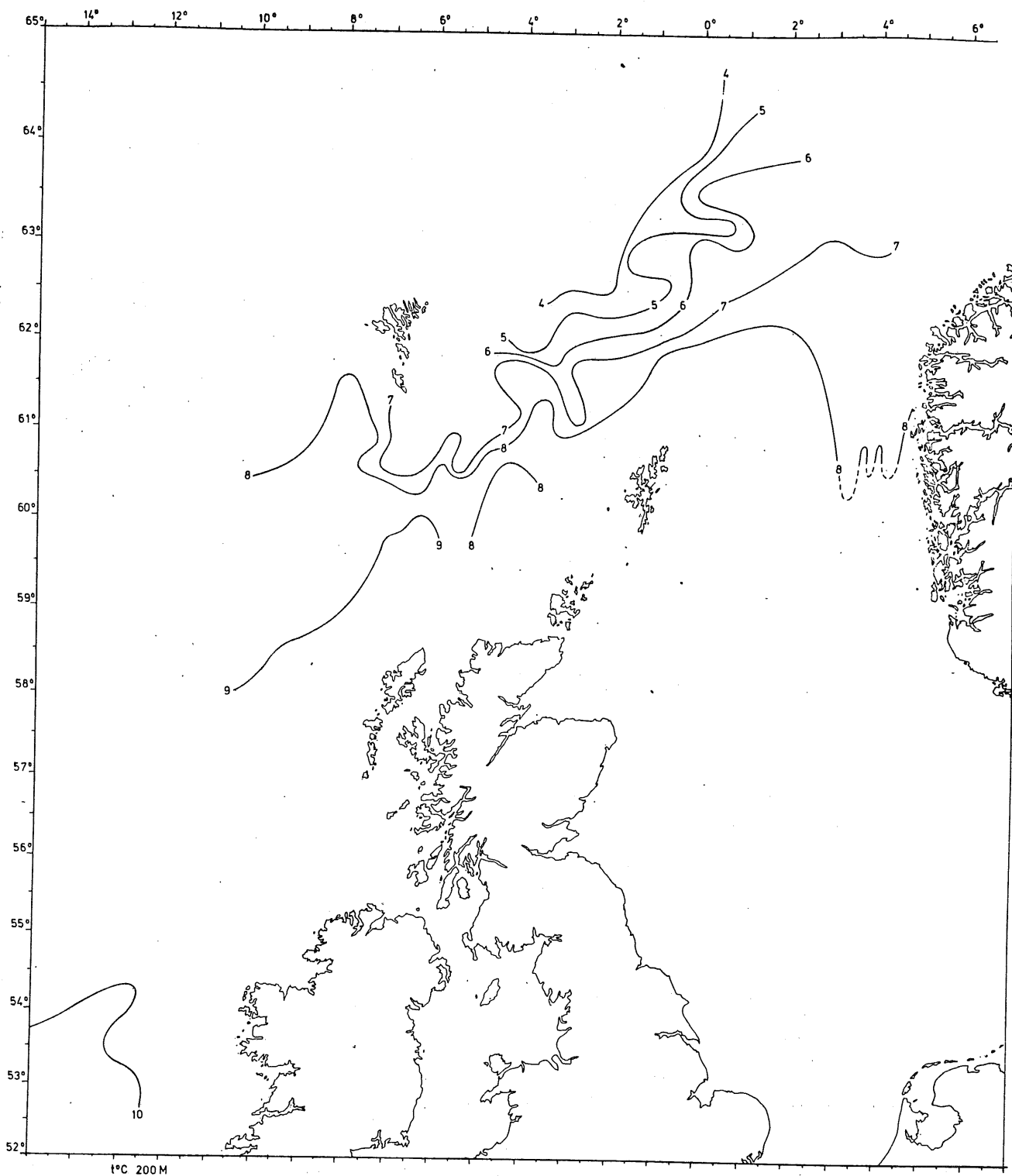


Fig. 8. Temperature at 200 m depth, 9 April - 14 May 1980.

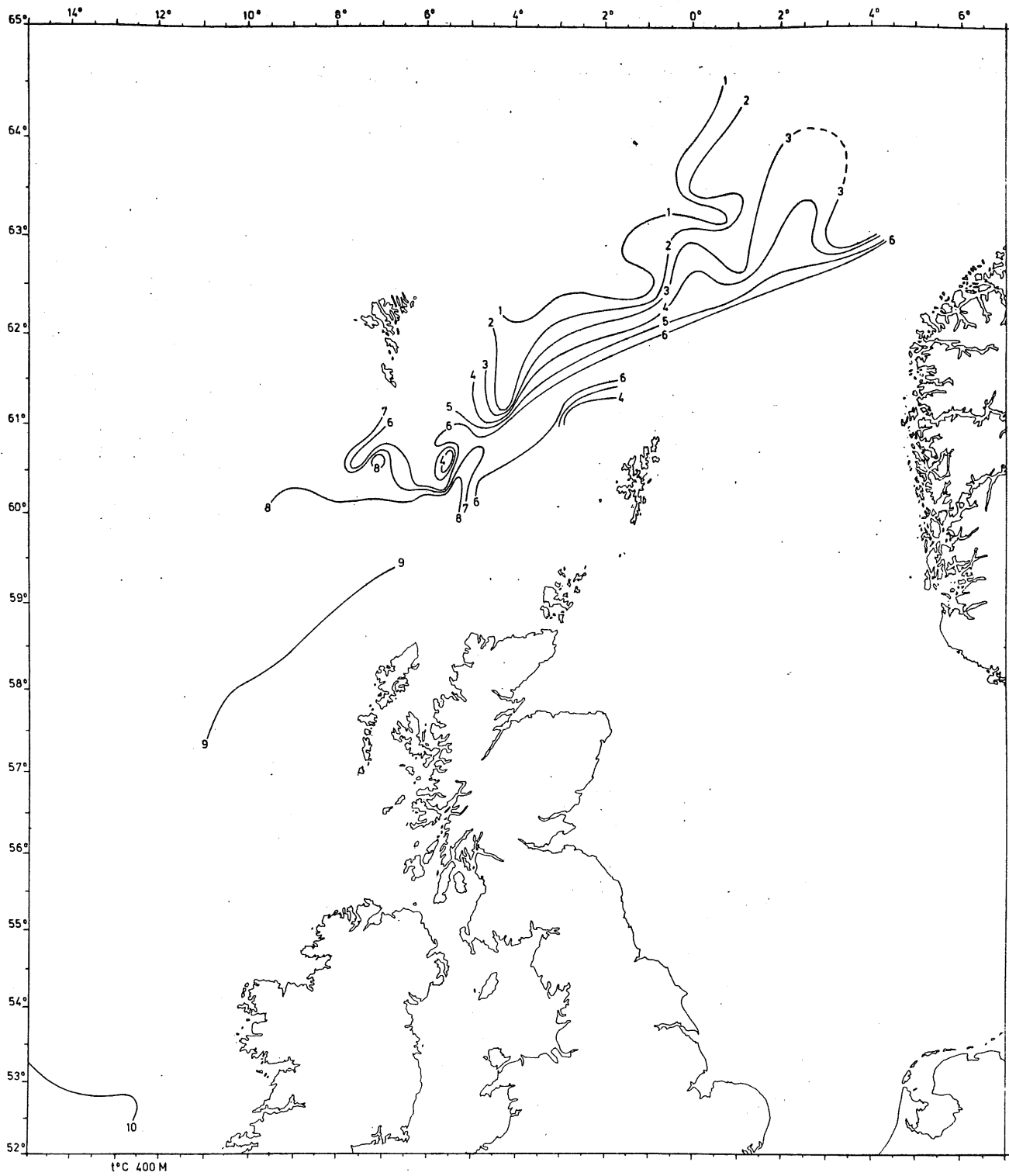


Fig. 9. Temperature at 400 m depth, 9 April - 14 May 1980.

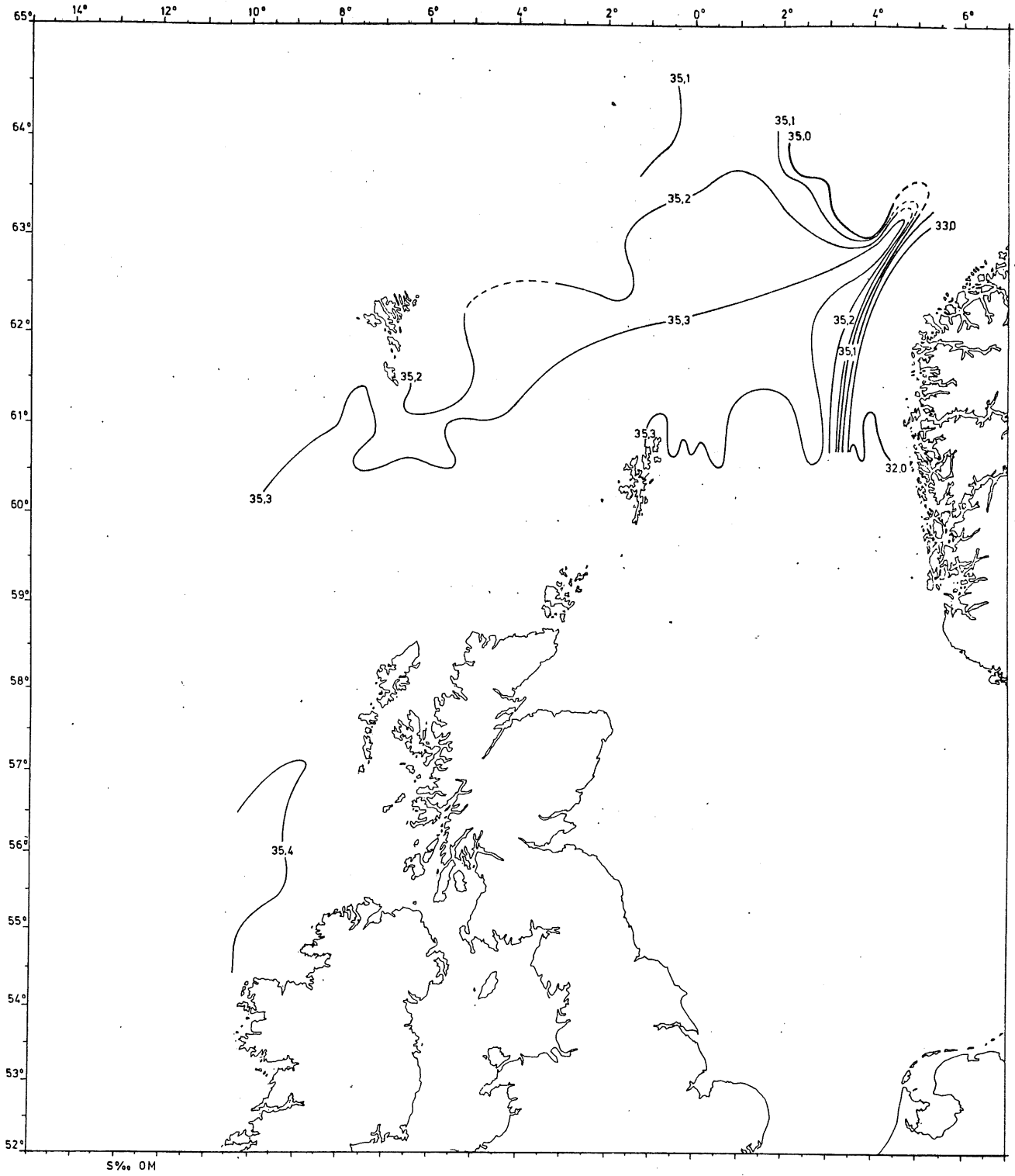


Fig. 10. Salinity at the surface, 9 April - 14 May 1980.

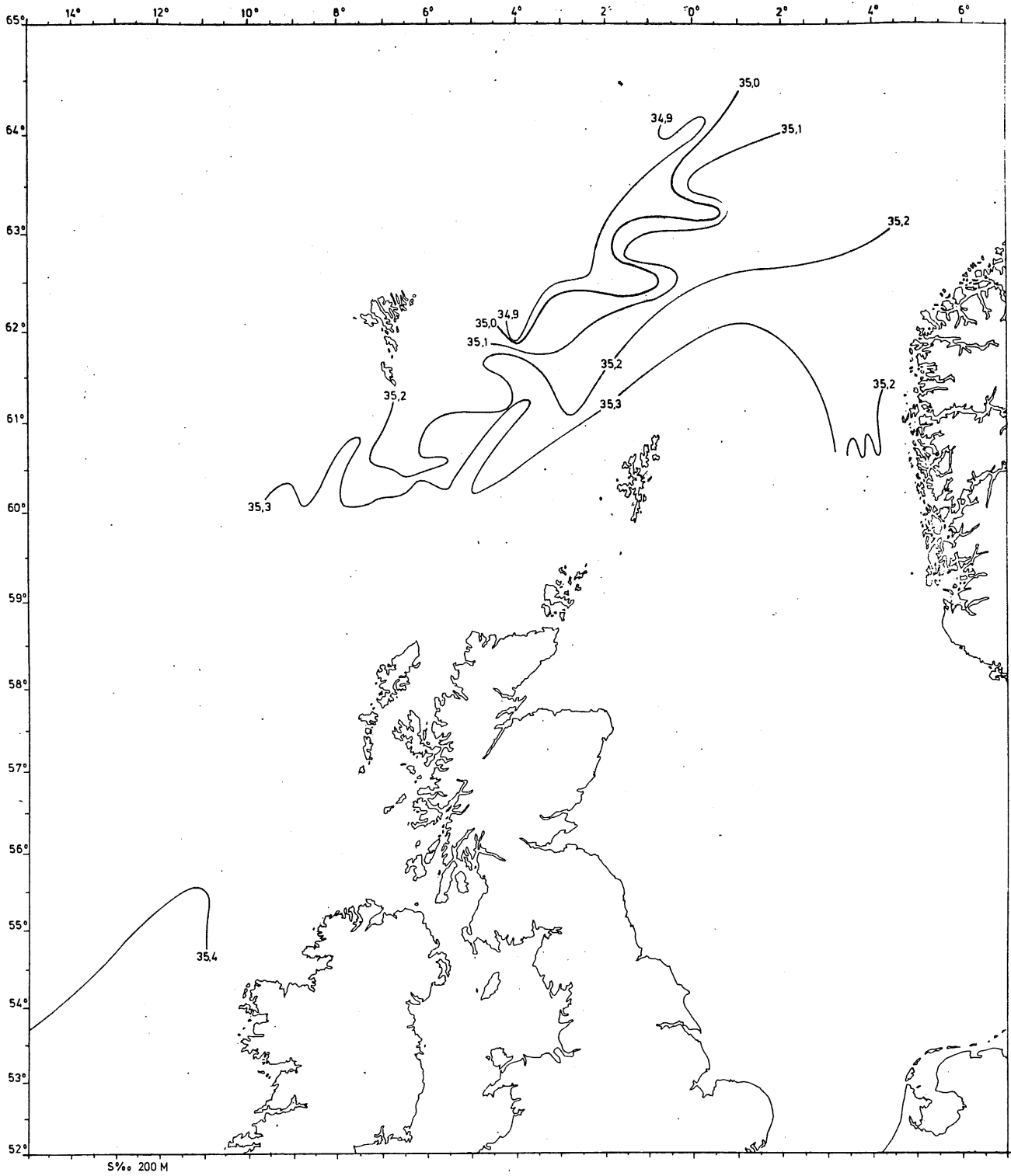


Fig. 11. Salinity at 200 m depth, 9 April - 14 May 1980.

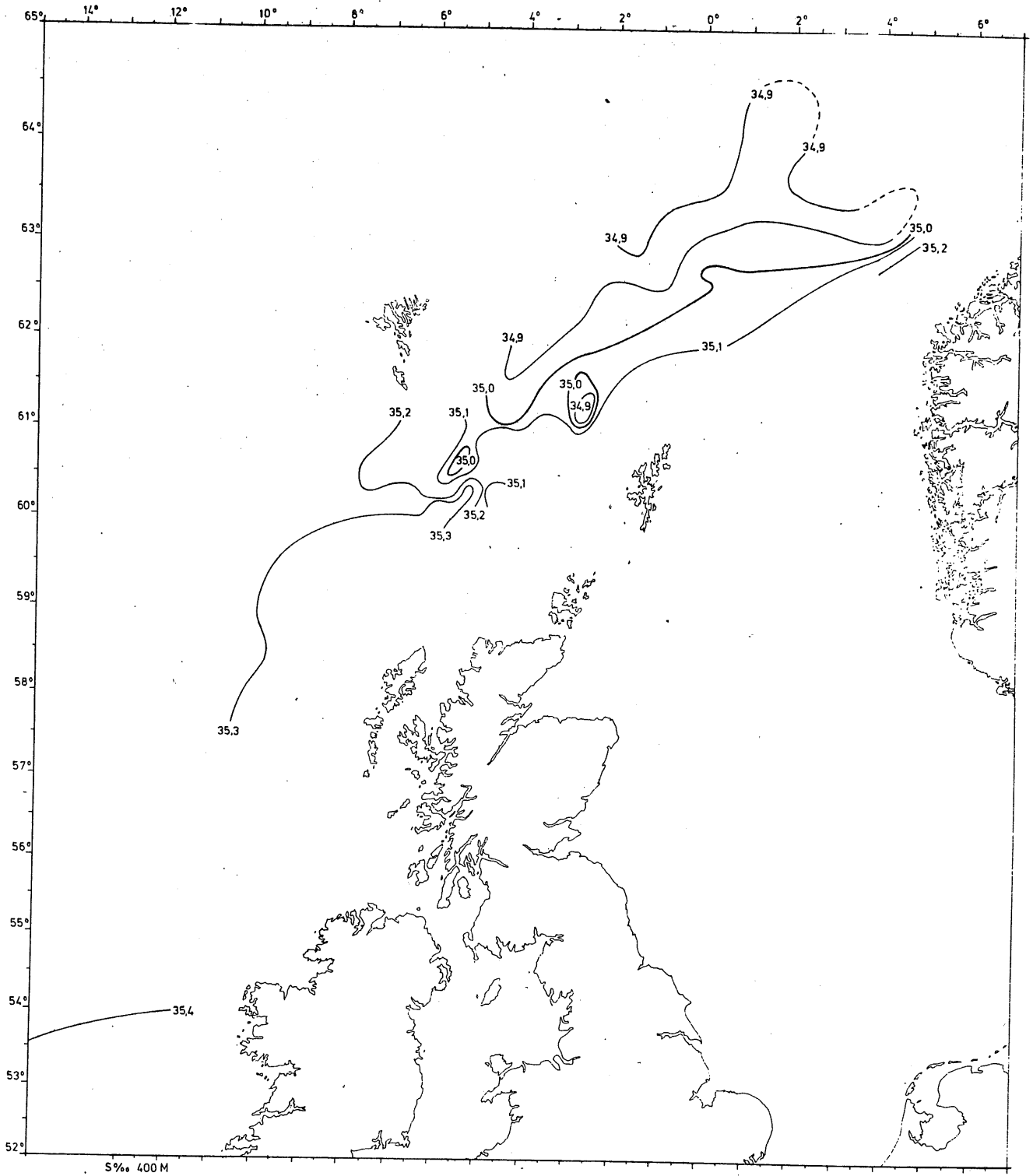


Fig. 12. Salinity at 400 m depth, 9 April - 14 May 1980.

Table 1. Abundance, area of distribution and density of blue whiting observed with R/V "G.O. Sars" during three different coverages in the British Isles - Faroes area, April-May 1980.

Coverage and period	Abundance $\times 10^6$ tonnes	Area of distri- bution sq.n.mile	Density t/sq.n.mile
1. 9 - 20 April	5.4	45 293	119
2. 18 - 29 April	2.3	35 476	65
3. 2 - 14 May	3.6	52 644	69

Table 2. Length frequencies of blue whiting from west of the British Isles,
9 - 20 April 1980.

cm	18	20	22	24	26	28	30	32	34	36	38	40													
%	0.1	0.9	2.1	2.6	2.0	2.0	4.7	8.0	8.1	6.3	6.0	6.3	8.6	11.5	11.4	9.0	5.1	2.9	1.5	0.6	0.4	0.2	-	+	4815

- 22 -

Table 3. Age composition of blue whiting from west of the British Isles,
9 - 20 April 1980.

Year	1	2	3	4	5	6	7	8	9	10	11	12+	N
%	3.5	25.5	13.0	12.3	13.5	11.3	9.2	6.2	2.6	1.0	1.1	0.9	4815

Table 4. Maturity stages, in percentages, of blue whiting in four subareas west of the British Isles 9-20 April 1980. x) also including recovering specimens.

Maturity	Area			
	A N.of 60°N	B 60°-57°N	C 57°-53°30'N	D S.of 53°30'
immature	54.2	5.4	0.6	25.3
maturing ^{x)}	44.7	67.5	23.4	49.8
ripe	1.2	16.4	3.2	1.0
spent	-	10.7	72.8	23.9
n	517	1000	500	490

- 23 -

Table 5. Mean weights in different lengthgroups of blue whiting from west of the British Isles 9 - 20 April 1980.

Cm	18	20	22	24	26	28	30	32	34	36	38	40											
w	31	36	42	49	60	65	74	82	93	103	114	127	139	150	161	172	188	197	225	237	266	-	320
n	19	36	59	36	69	129	211	243	183	160	176	243	312	322	224	148	77	39	17	11	6	-	1