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INVESTIGATIONS ON BLUE WHITING IN THE AREA WEST OF THE BRITISH
ISLES, SPRING 1994.

by

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ABSTRACT

From March 25 to April 15 the Norwegian R.V. "Johan Hjort" carried out acoustic surveying and biological and plankton sampling on the blue whiting population congregated for spawning along the shelf edge west of the British Isles.

Due to extremely bad weather conditions the survey was notably amputated, causing the rate of area coverage and number of trawl, hydrological and plankton stations to become rather low.

The spawning stock size was estimated to 4.1 mill. tonnes, which, however, must be considered as an underestimate. Like last year, the 1989-yearclass was found to dominate the stock.

The temperature in the upper 200m layer was generally lower than observed in 1993.

Blue whiting eggs and larvae were taken at the shelf-edges and over Porcupine Bank. Eggs were taken in increasing abundance from the surface to a maximum at 380-400m depth.

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INTRODUCTION

Four joint Norwegian-Russian surveys on the blue whiting spawning stock were carried out during 1990-1993 by research vessels from IMR, Bergen and PINRO, Murmansk (Monstad and Belikov 1990, 1991, 1993; Monstad et al. 1992). The main objectives of these surveys were to obtain acoustic estimates of the blue whiting spawning stock size and to record the distribution and migration pattern in relation to the hydrological situation, as well as recording the structure and composition of the stock.

In spring 1994 the spawning stock was estimated by R.V. "Johan Hjort" with a representative from PINRO participating. For several years before 1994, both countries carried out separate surveys during springtime in the area west of the British Isles. Although the contact was rather informal, an exchange of biological and hydrological information took place.

The survey was also included in the SEFOS-programme (Shelf Edge Fisheries and Oceanographic Studies), and personnel from Plymouth Marine Laboratory, UK, participated for studies of blue whiting eggs and larvae.

MATERIAL AND METHODS

The research vessel operated an echo sounder of 38 KHz frequency (Simrad EK 500), which was pre-calibrated and connected to the Bergen Echo Integrator-system (BEI). The settings of the instruments are shown in Appendix 1.

The shelf edge area between latitude 50°30' and 60°00'N, i.e. from southwest of Ireland to north of Scotland, was surveyed during the period March 25 - April 15 (Fig.1).

By use of a pelagic trawl with 25 m vertical opening (500m circumference) and a Rock-hopper bottom trawl with 4 x 18 m opening, both having 11 mm meshes in the cod end, the echo traces were identified and biological samples collected.

The area surveyed was divided into two subareas, i.e. south and north of 55°30'N, which were further divided into rectangles of 30 minutes latitude and 1 degree longitude. The method used for the acoustic estimation was the same as used for previous blue whiting surveys, described in e.g. Anon. (1982) and Monstad (1986). The echo recordings were scrutinized for allocation of the integrator values (S_a) to various species or groups of species. The target strength used for blue whiting was:

$$TS = 21.8 \log L - 72.8 \text{ dB}$$

where L is fish length. This gives the density coefficient value used of:

$$C_F = 1.488 \times 10^6 \times L^{-2.18}.$$

For hydrographic observations a CTD sonde was used at a number of stations, operated from sea surface to 600 m depth in general, and to 1.500 m depth at the section worked south of the Porcupine Bank, i.e. along latitude 51°30'.

Plankton sampling was carried out at a limited selection of stations by means of double oblique 50 cm diameter bongo net tows (200 µm mesh size) at a towing speed of 2-3 knots. Sampled depth was to a maximum of 790 m, monitored by Scanmar acoustic depth monitor, when conditions permitted. Vertical distribution sampling was carried out to 600 m depth at stations using a real-time cored cable LHPR system at a towing speed of 3-4 knots.

RESULTS

Distribution

Blue whiting was recorded over the Porcupine bank and along the shelf edge area from south of Ireland to north of Scotland (Fig. 2). The densest concentrations were found at position 54°25'-54°55'N between 10°50'-11°20'W and 56°10'-56°35'N between 09°00'-09°35'W. Rather dense concentrations were also observed in the area north of the Porcupine bank, 53°45'-54°15'N along the continental slope. In the north, between 58°00'-60°00', only weak concentrations of blue whiting were found, close to the shelf edge as well as over deeper waters.

Generally the horizontal distribution of blue whiting was found in a pattern more or less similar to previous years. The concentrations of high density, however, were located at the depth of approximately 450-600 m, which is somewhat deeper than observed during the last few years' surveys.

Stock size.

The biomass of the observed blue whiting stock within the surveyed area was estimated at 4.1 mill tonnes with the abundance of 26.8×10^9 individuals. The immature part of the stock was calculated to be only 39 thousand tonnes representing 0.7×10^9 individuals. The results are shown in Fig. 3 on a rectangular basis and in Table 1 and 2 for the two subareas and the total. The spawning stock, then estimated at 4.1 mill tonnes, is 0.8 mill tonnes less than observed in 1993 (Monstad and Belikov, 1993). However, due to the rather extremely bad weather conditions during the survey this year, the estimate must be considered as a larger underestimate than the ones obtained earlier.

The survey results are also shown in the text table below, together with the last three years' combined Norwegian-Russian estimates.

	N x 10 ⁹	t x 10 ³	\bar{w} (g)	\bar{l} (cm)
1991	35.2	4.4	121.8	28.0
1992	36.9	4.3	113.0	27.5
1993	39.3	4.9	123.6	28.1
1994	26.8	4.1	152.9	31.1

Stock composition

The total distribution of length and age of the blue whiting stock are shown in Fig. 4. The 5-year olds (1989-yearclass) dominated and contributed to the observed stock with about 45%, which is actually 15% less than in 1993. The contributions of younger age groups were mainly from the northern area (II). The 1989-yearclass is the most numerous one observed since 1983.

Most of the individuals from the biological samples were females. For this reason the mean weight and length of blue whiting were relative greater than previous years, (text-table above). During the survey most of the fishes had post spawning gonads and hence the peak of spawning most probably have been like last year.

Hydrography

During the study period the meteorological situation was represented by predominantly W and NW cyclonic winds with a velocity of 15-20 m/s. For about 10 days storm weather with wind more than 30 m/s were observed. Atmospheric pressure ranged from 930-1000 mbars and the height of waves was 5-10 m. The mean meteorological situation during the cruise was extremely unfavorable.

The horizontal temperature distributions are shown in Figs. 5a-d for the sea surface, 200, 400 and 600m respectively. In 1994 the highest temperatures were recorded in the southern part of the surveyed area where the temperature in the 0-200m layer was generally lower than in 1993. The temperature in the 400 and 600m layers were the same as last year in the central and northern parts of the surveyed area.

During the survey a hydrographic section of 18 stations was worked along the latitude 51°30' from South Ireland and westwards (SEFOS' Mizen Head section) (Fig.6).

Plankton Sampling

Results from analysis of the plankton samples showed that blue whiting eggs (*Micromesistius poutassou*) were numerically the most abundant (68%) followed by eggs of mackerel (*Scomber scombrus*, 13.6%), dragonets (*Callionymus spp.*, 5.2%), haddock (*Melanogrammus aeglefinus*, 4.0%) megrim (*Lepidorhombus whiffagonis*, 3.6%), soles (*Solea spp.*, 1.6%), hake (*Merluccius merluccius*, 1.2%) and rocklings (1.2%). Larval numbers were dominated by blue whiting (69%)

with larvae of megrim (9.2%), Norway pout (*Trisopterus esmarkii*, 6.0%), dragonets (4.9%), soles (2.7%) and *Maurolicus muelleri* (1.3%) being taken in much lower abundance.

Blue whiting eggs were found at relatively high spawning levels ($>100^{-2}$) at the shelf edge to the south-west of Ireland, as expected (Fig.7a). Lower concentrations were identified over and to the west of Porcupine Bank and extending along the shelf-edge to the west of Scotland. Blue whiting larvae (mostly around 3.5 mm in length, Fig.8) were found at the sampling stations in the Porcupine Bank area but not along the shelf-edge to the west of Scotland, implying that spawning had not been occurring much before the time of sampling in that area (3-14 April). Highest numbers of larvae were taken at the shelf-edge west of Porcupine Bank (205 m^{-2} , Fig 7b). Within the limitations of the relatively few samples taken, these results are expected from previous information (Coombs and Pipe, 1978).

Only eggs of blue whiting were taken in appreciable numbers on two of the vertical distribution hauls. They were taken in increasing abundance from the surface to a maximum of 2.03 m^3 at 380-400 m depth (Fig. 9); below 400 m the numbers declined to negligible levels at 600 m.

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APPENDIX 1

Acoustic equipment and settings of the instruments:

Echo sounder:	Simrad EK-500
Frequency:	38 kHz
Noise margin:	1 dB
Absorption:	10 dB/km
Pulse length:	Medium
Band width:	Wide
Max power:	200 W
Angle sensitivity:	21.9 dB
2-way beam angle:	-21.0 dB
Sv Transducer gain:	26.6 dB
TS Transducer gain:	26.8 dB
3 dB Beam width:	7.4 dg
Bottom detection:	ca. -55 dB (varying)
Range:	Max. 1000m (varying)

Table 1. Abundance estimate of the blue whiting stock west of The British Isles, March- April 1994. R.V. "Johan Hjort".

length cm	Age										Abundance $\times 10^{-6}$	Biomass 1000 t	Mean Weight	
	1	2	3	4	5	6	7	8	9	10				
19	65											65	2.6	40.4
20	220											220	10.1	45.8
21	274	84										358	18.2	50.8
22	134	179										313	17.7	56.4
23	403	405										808	53.5	66.2
24	10	425	143									578	41.6	72.0
25		184	258									442	38.1	86.1
26		233	477	45								755	71.5	94.7
27		93	568	362	57							1080	118.4	109.7
28			584	705	138							1427	174.0	122.0
29			857	1314	677							2848	363.7	127.7
30			63	1192	1485	93						2833	396.9	140.1
31				693	3040	275	118					4126	607.4	147.2
32				145	2288	299	201	84				3017	483.2	160.2
33					1833	225	316			52		2426	441.6	182.0
34				20	709	134	117	129				1109	220.9	199.2
35					534	299	165	234	189	189		1610	358.7	222.8
36					472	397	421	166	312			1768	405.0	229.1
37					121		97	162	161			541	138.6	256.3
38						20	64	113	34	18		249	68.3	274.4
39							188	20				208	60.5	290.8
40									11			11	4.0	365.0
41									11			11	4.0	365.0
Abundance	1106	1603	2950	4476	11354	1742	1687	908	770	207		26803		
\bar{l} (cm)	22.06	24.45	27.86	29.85	32.37	34.01	35.34	36.08	36.48	35.76		31.11		
Biomass 1000 t	63.7	116.8	329.2	585.7	1846.0	345.5	360.2	210.1	191.1	50.4		4098.6		
\bar{w} (g)	57.6	72.9	111.6	130.9	162.6	198.3	213.5	231.4	248.1	243.7				152.9

Table 2. Assessment factors of blue whiting west of The British Isles, spring 1994.

Latitude	n.mile ²	Abundance N x 10 ⁻⁶			Biomass t x 10 ⁻³			\bar{w}	\bar{l}	Density t/n.mile ²
		IMM	MAT	SUM	IMM	MAT	SUM			
II 55° 30' - 60° 00'	7434	499	7209	7708	28	1154	1182	153.3	31.2	159
I 50° 30' - 55° 30'	23506	207	18888	19095	11	2906	2917	152.8	31.1	124
ALL	30940	706	26097	26803	39	4071	4099	152.9	31.1	132

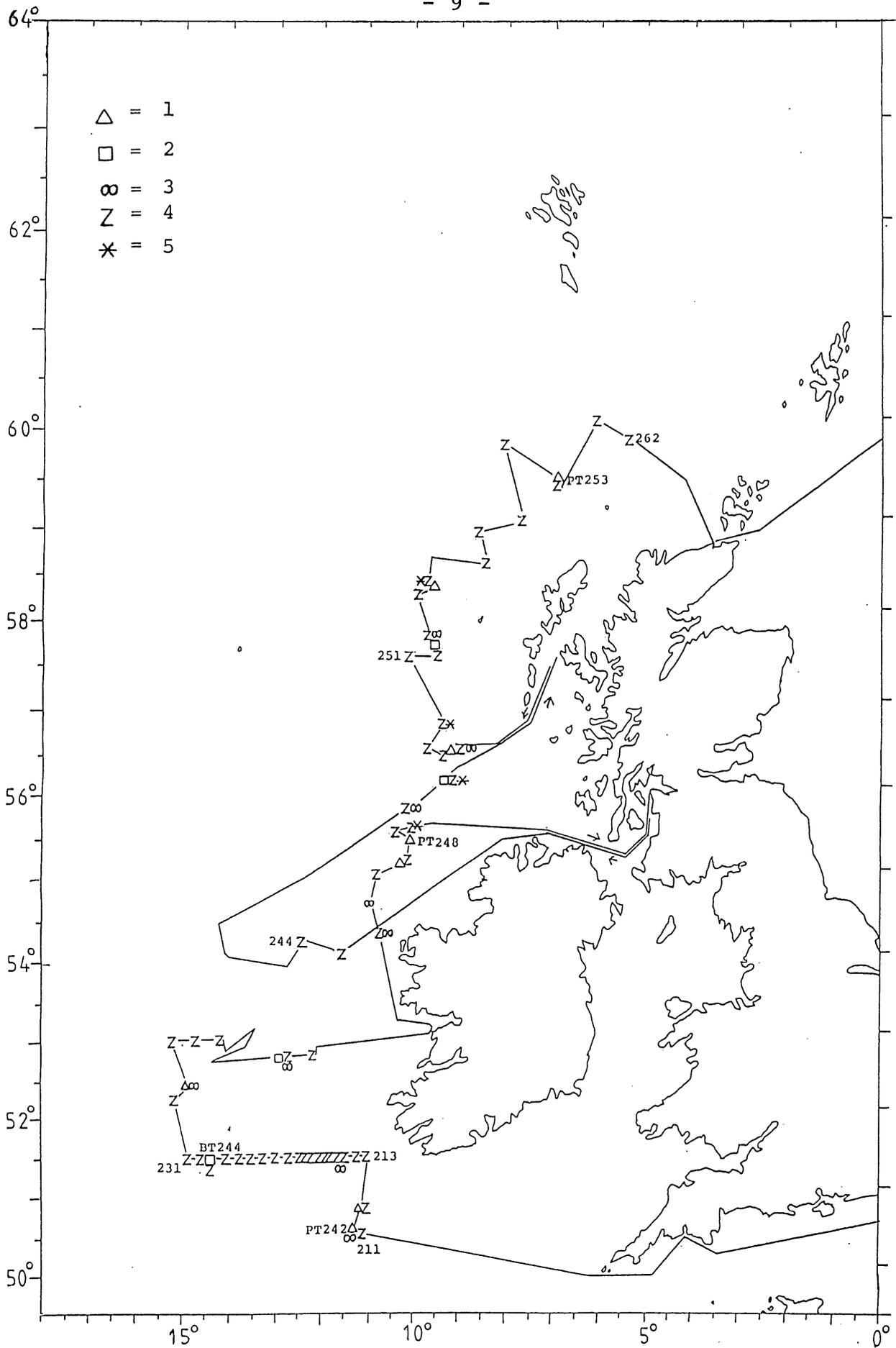


Fig. 1. Cruise track and stations of R.V. "Johan Hjort", 25 March- 15 APRIL 1994. Symbols: 1) Pelagic trawl, 2) Bottom trawl, 3) Bongo net, 4) CTD sonde, 5) LHPR (Longhurst Plankton Recorder).

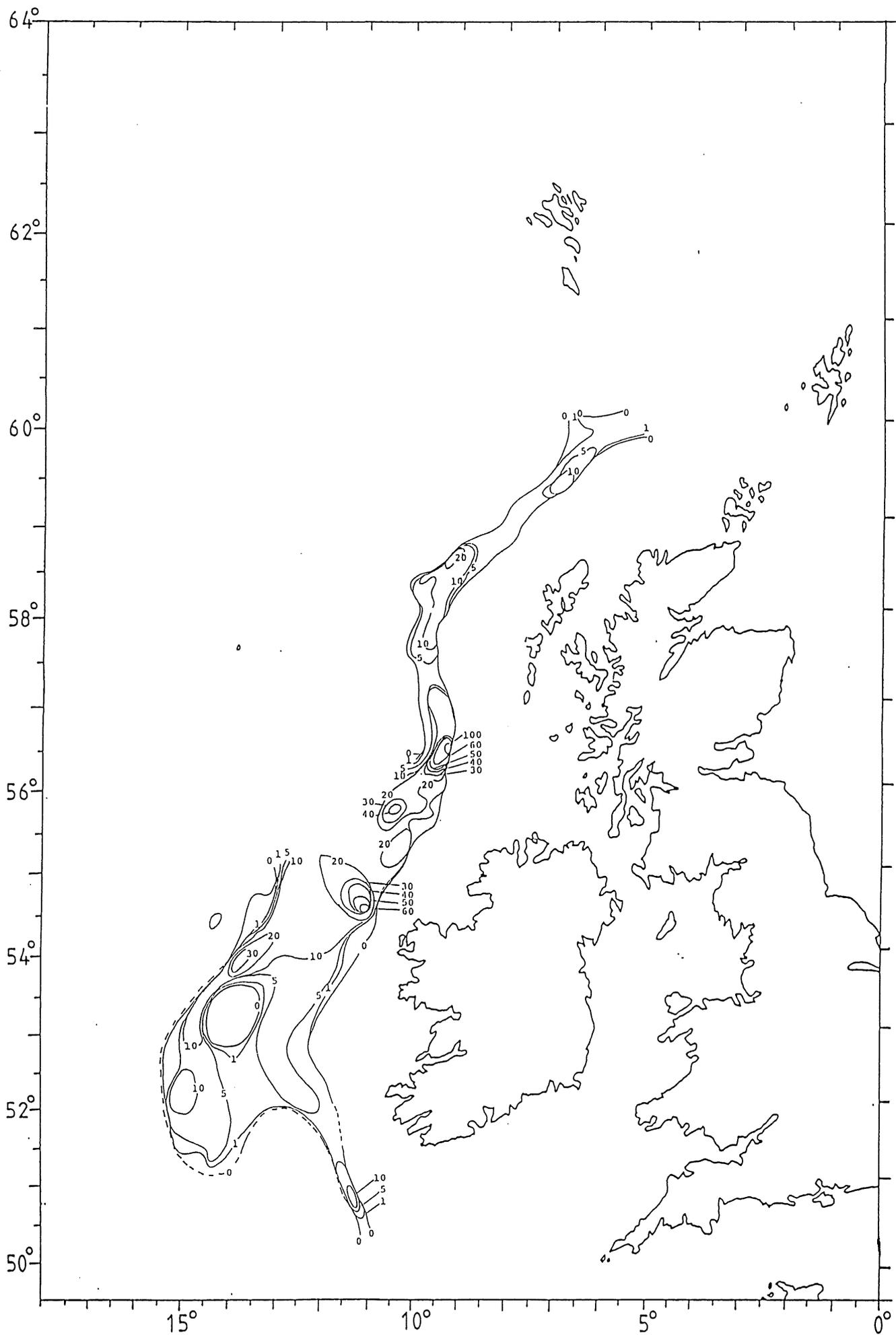


Fig. 2. Density distribution of blue whiting in spring 1994. Echo intensity in square m per square nautical mile x 1/100.

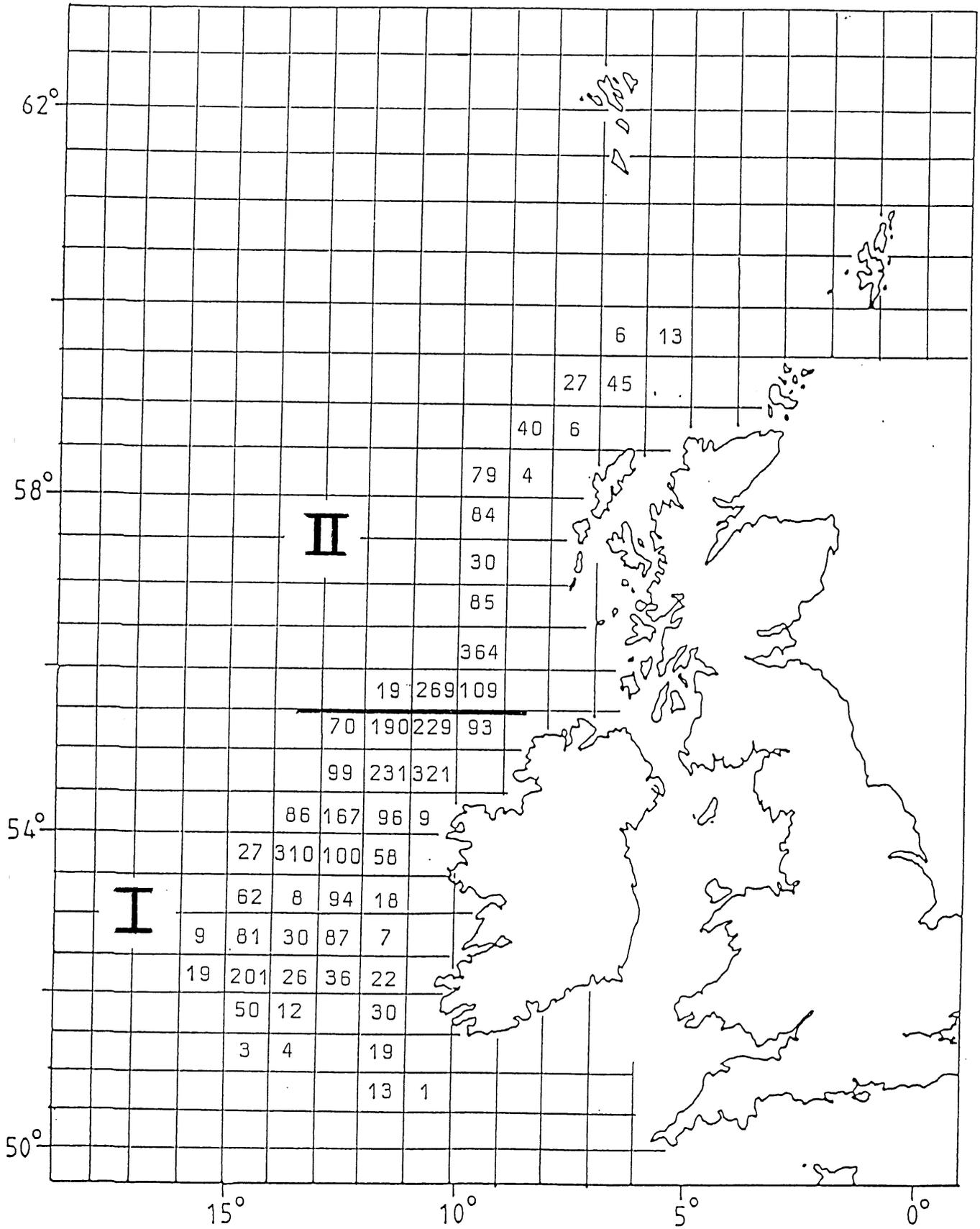


Fig. 3. Blue whiting biomass ('000 tonnes) in spring 1994. Marking of subarea I and II used in the assessment.

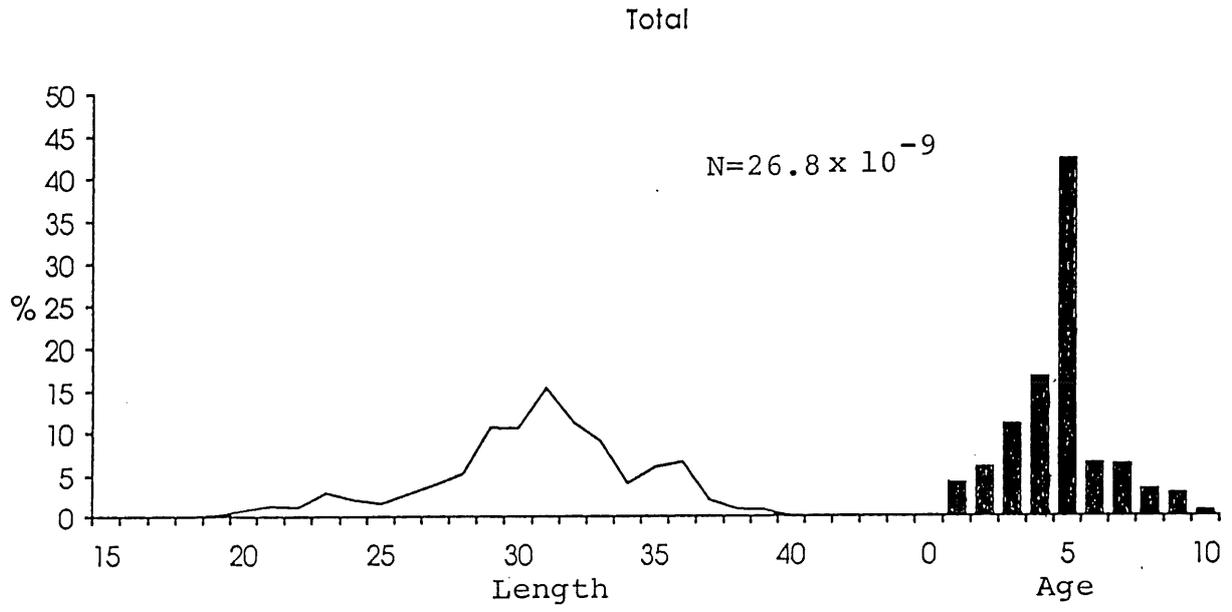


Fig. 4. Total length and age distribution (N%) of blue whiting in the area west of The British Isles, spring 1994, weighed by abundance.

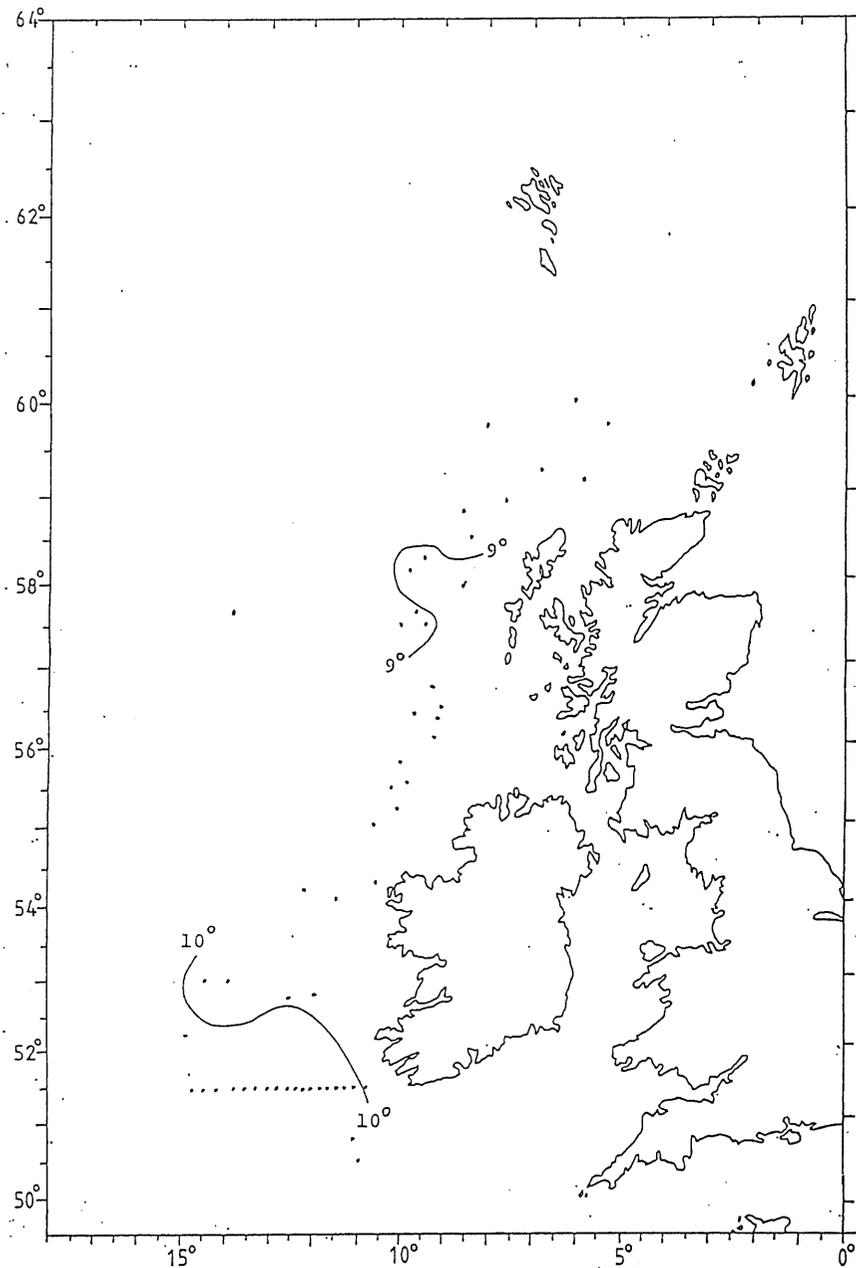


Fig. 5a. Temperature, t°C, at sea surface, spring 1994. Dots indicate positions of observations.

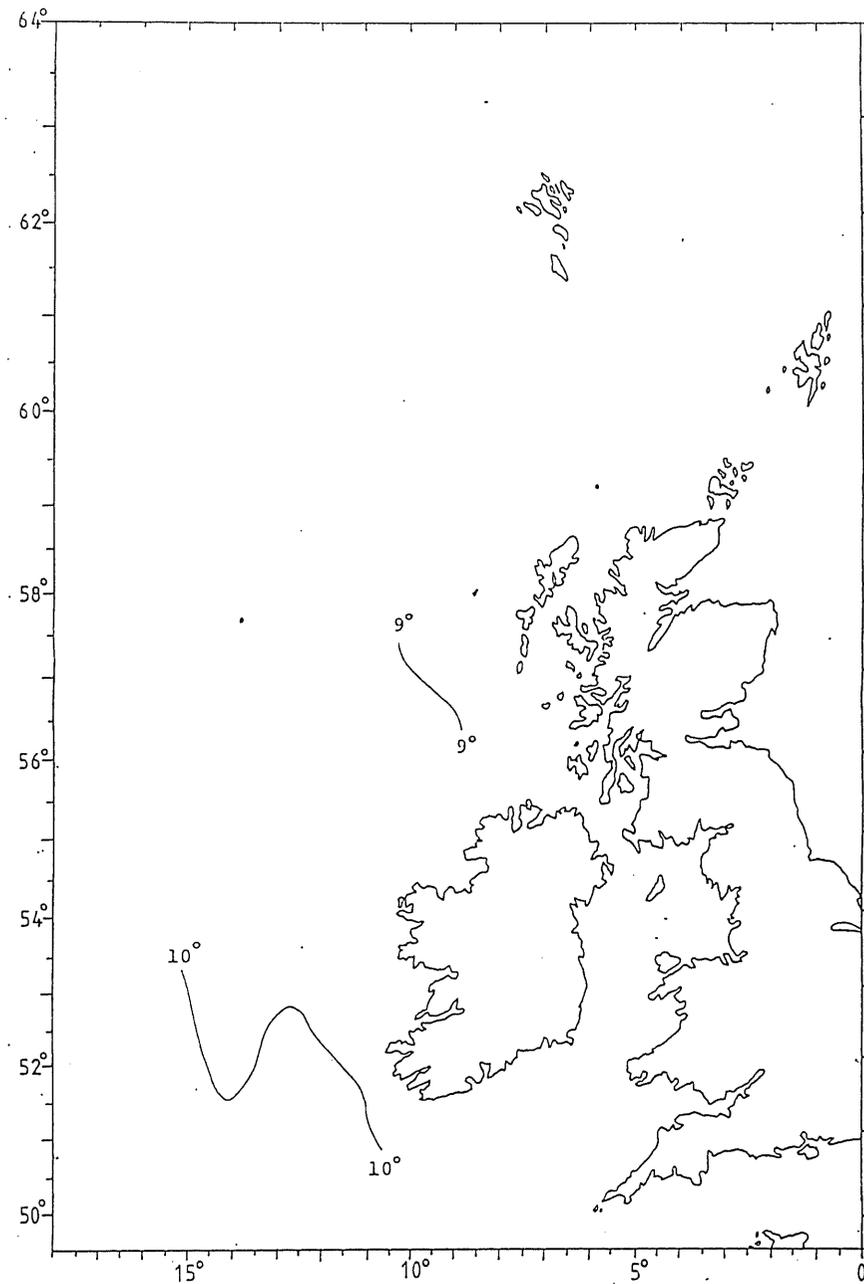


Fig. 5b. Temperature, t°C, at 200m depth, spring 1994.

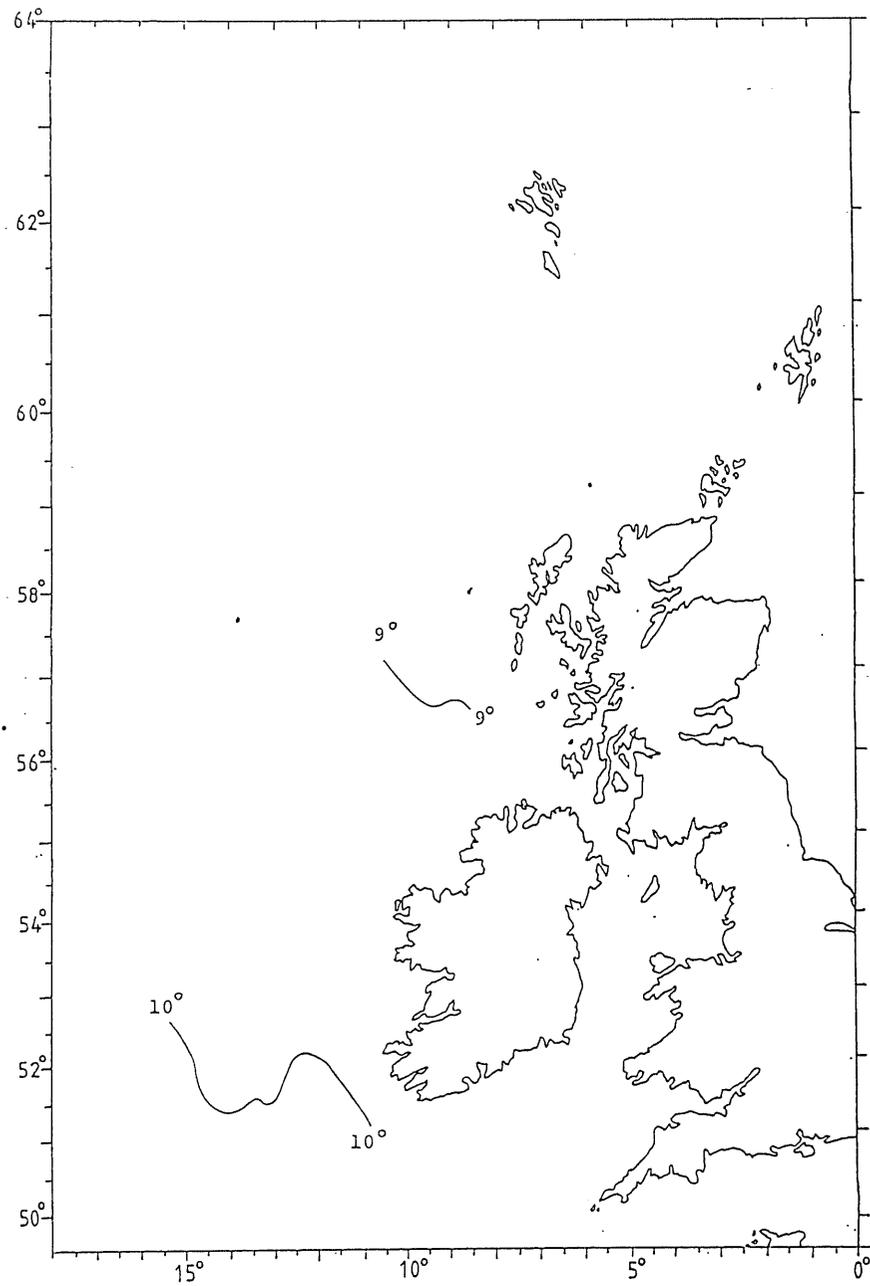


Fig. 5c. Temperature, $t^{\circ}\text{C}$, at 400m depth, spring 1994.

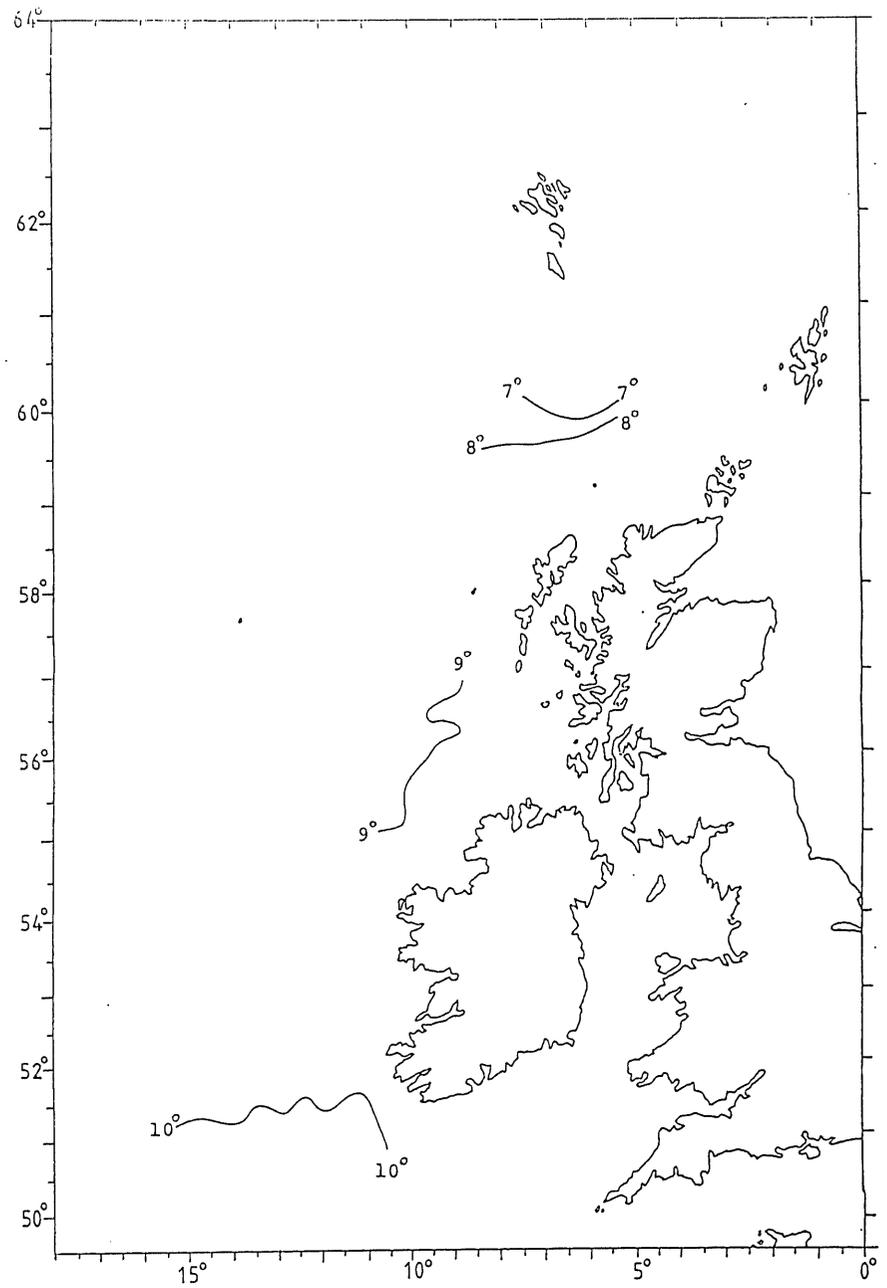


Fig. 5d. Temperature, $t^{\circ}\text{C}$, at 600m depth, spring 1994.

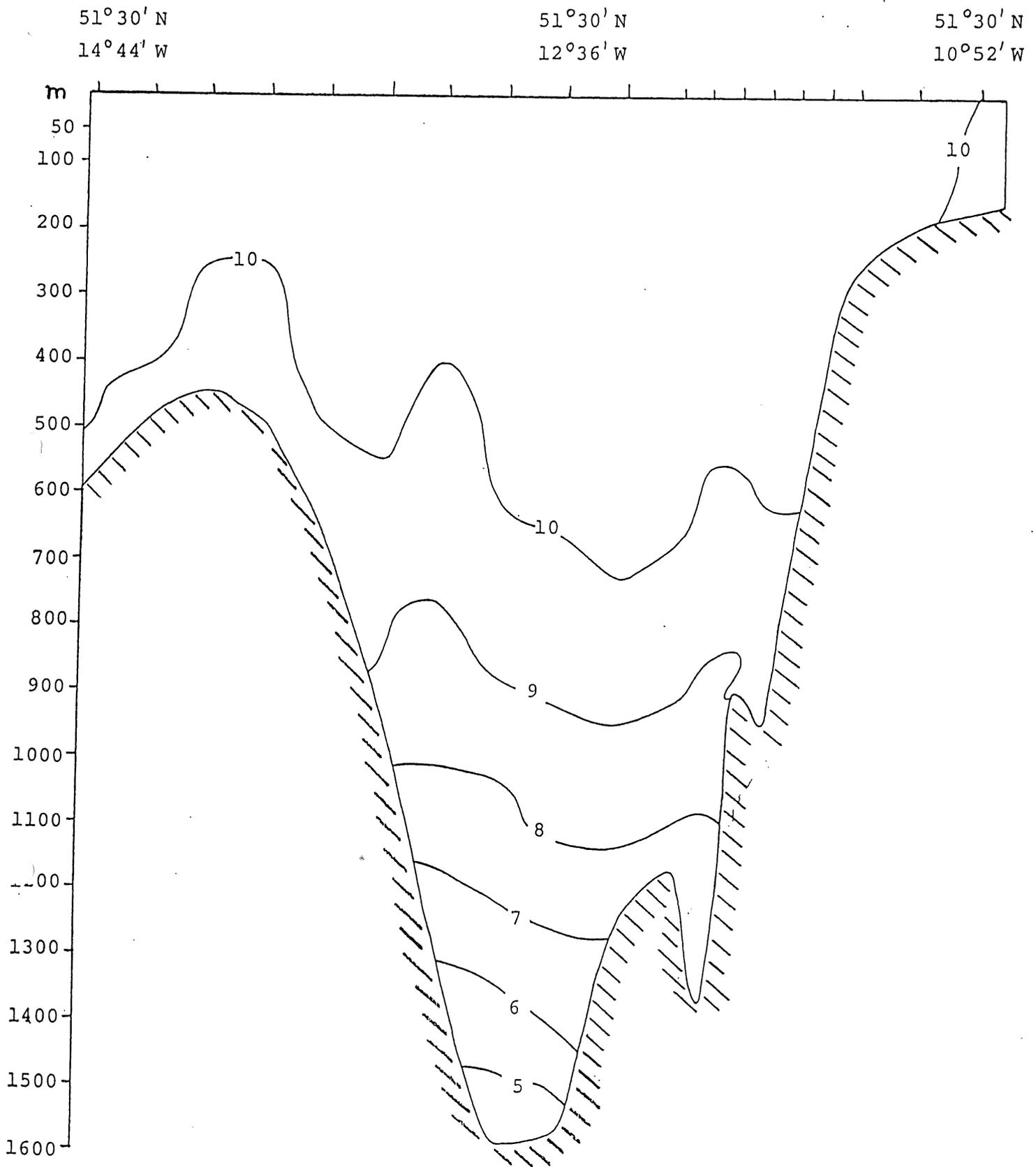


Fig. 6. Vertical distribution of temperature, t°C, in the Mizen Head section, i.e. along 51°30' N from the SW Ireland towards the west.

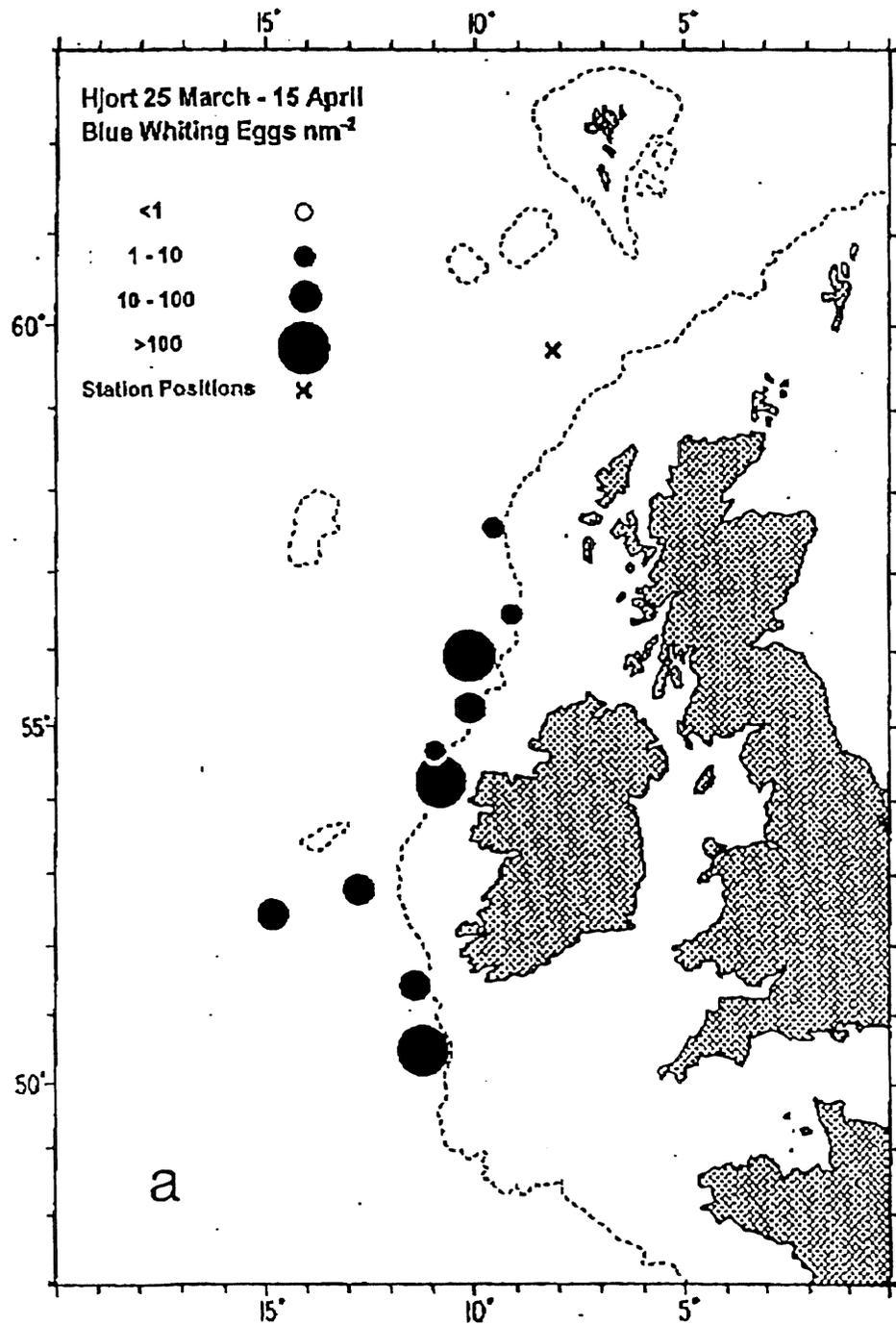


Fig. 7a. The distribution of blue whiting eggs.

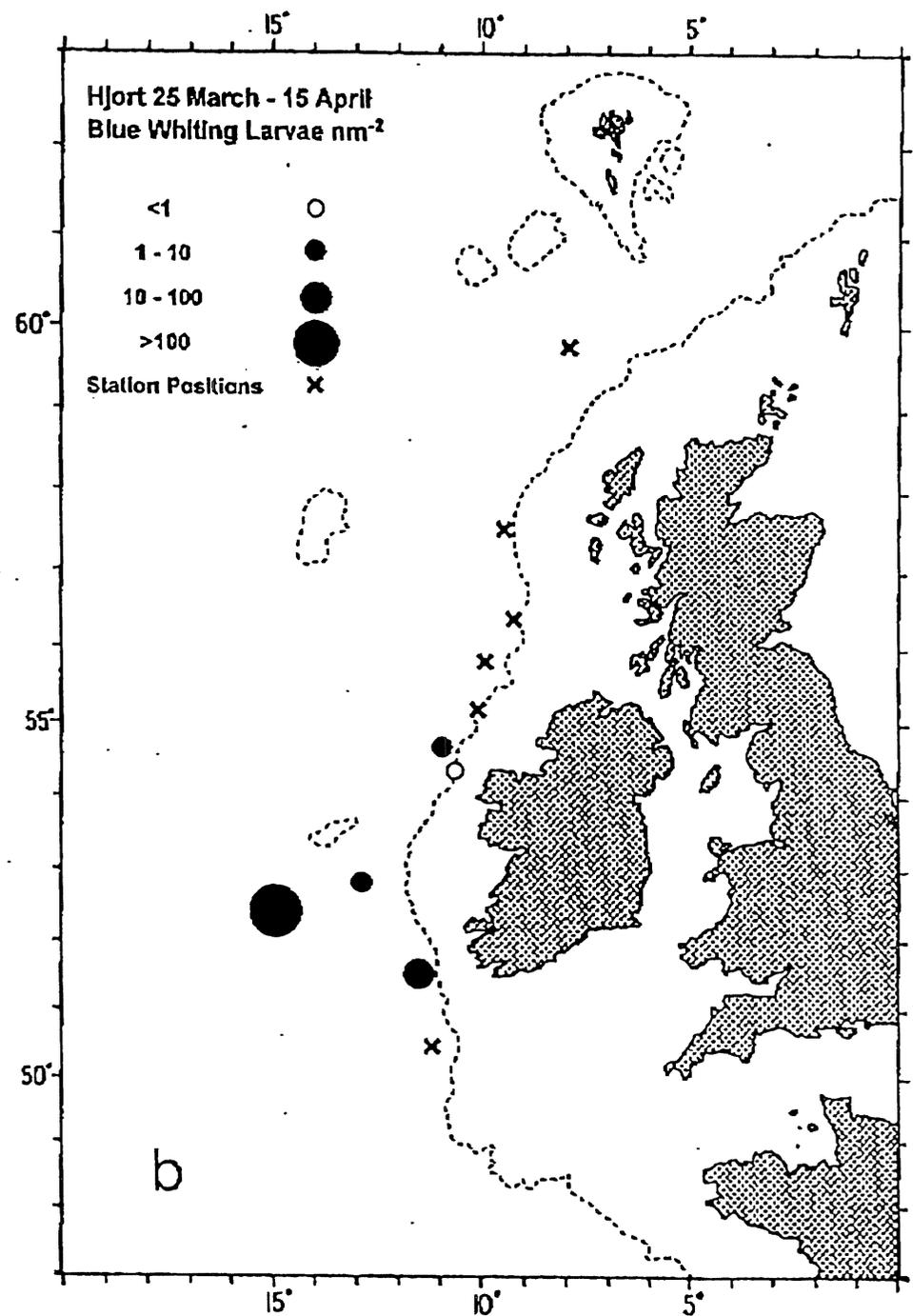


Fig. 7b. The distribution of blue whiting larvae.

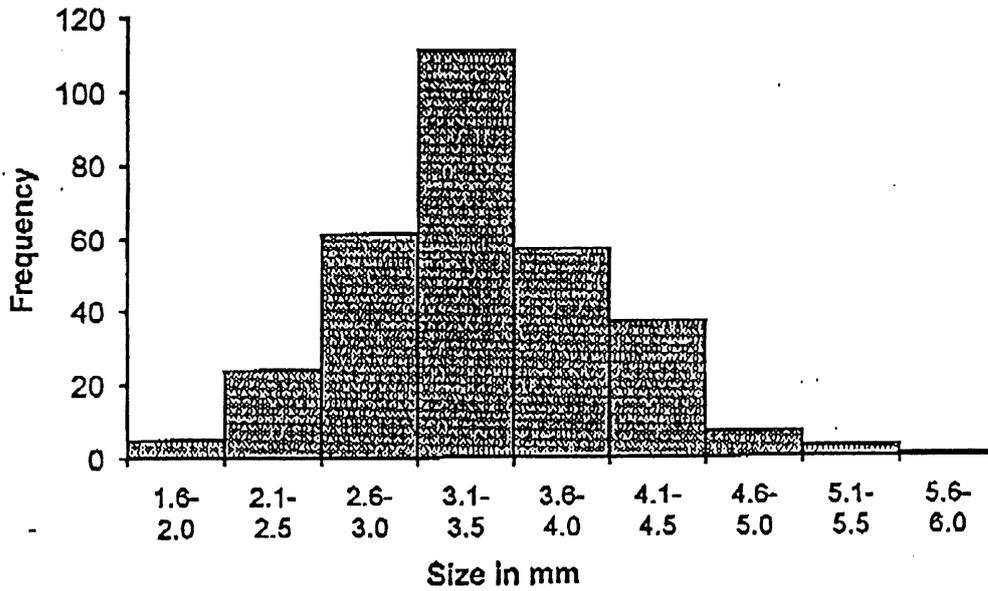


Fig. 8. The size-frequency distribution of blue whiting larvae.

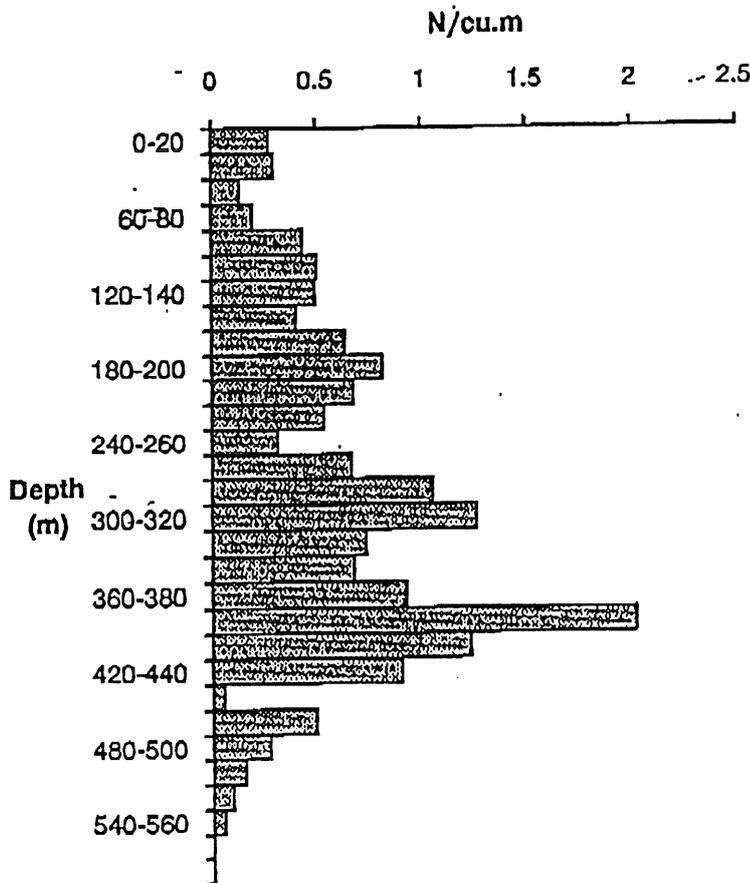


Fig. 9. The mean vertical distribution of blue whiting eggs (n=427).