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REPORT OF A JOINT NORWEGIAN-SOVIET ACOUSTIC SURVEY ON BLUE WHITING, SPRING 1991

by

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ABSTRACT

During spring 1991 the second Norwegian-Soviet joint survey on the blue whiting spawning stock was carried out. The result of a ship-to-ship calibration of the acoustic instruments allowed a 1:1 relationship between the two vessels' acoustic data to be used. According to this, the data were then combined and presented as common results.

Blue whiting was recorded from south of the Porcupine bank to north of Shetland, but this year the densest concentrations over the Porcupine bank were distributed more to the east than previous years.

While the abundance in the southern part of the surveyed area was approximately the same as estimated the last years, it was found to be significantly reduced in the north. The over all spawning stock size was then estimated to 4.4 mill. tonnes which is 1 mill. tonnes less than observed in 1990. The 1989-yearclass as expected was found to be the richest one, with a contribution of 23% of the stock.

Although the temperature below 200 m depth in the southern part was in general higher than in 1990, the maturation process of the blue whiting gonads was observed to be somewhat retarded with the peak of spawning 1-2 weeks later than in 1990.

INTRODUCTION

The first Norwegian-Soviet joint survey on blue whiting during spring was carried out in 1990 . For several years, however, both countries have conducted likewise, but separate surveys in the area west of the British Isles.

The main objectives of the surveys are to obtain reliable estimates of the blue whiting spawning stock size, to record the distribution pattern and migration routes, the stock structure and observations of the hydrological conditions. Although both vessels' instruments are pre-calibrated by use of a copper sphere, a valuable excercise for joint surveys will be to support it with a ship-to-ship calibration. The result of this will actually give basis for the combination of the acoustic data.

The second Norwegian-Soviet joint survey on blue whiting during spawning season was then carried out from 17 March to 16 April 1991.

MATERIAL AND METHODS

Preliminary plans for the survey were settled at the post-survey meeting in 1990 with follow-up details exchanged by correspondance, and finally during an open sea meeting of the vessels in the first period of the survey.

One vessel from each country participated:

R.V. "Pinro", USSR, from 17/3 - 12/4
R.V. "Johan Hjort", Norway, from 18/3 - 16/4

Survey data were exchanged daily by radio communication, by open sea meetings and by mail. A post-survey meeting was then held in Bergen for discussion and combination of the results.

The survey started from the south with both vessels covering the Porcupine bank and the near area south and west of it. The shelf edge area further northwards to The Faroe Islands and north of it were then criss-crossed, and the Soviet vessel in addition surveyed the southern part of the Rockall bank (Fig. 1 and 2).

For identification of the echo recordings and for collection of biological samples, Norway used a bottom trawl with 18 x 4.5 m opening and a pelagic trawl with 30 m vertical opening, both equipped with 11 mm mesh-sized inner net in cod end. For the same purpose the USSR used a pelagig trawl with 45 m vertical opening and an inner net of 16 mm mesh size in cod end.

The biological samples of blue whiting obtained, were worked up with emphasize on length, weight, age, sex and maturity.

The Bergen Echo Integrator system (BEI) connected to EK-500 echo sounder was used by R.V."Johan Hjort", while R.V."Pinro" operated a Siors integrator connected to a EK-400 echo sounder. The recorded echo intensities, continuously integrated throughout the survey, were given in terms based on copper sphere calibration, i.e. as cross section in reflected square meters per square nautical mile. These were allocated to fish species or groups of species for each 5 nautical mile, in accordance with the results of representative trawl hauls.

For the calculations and presentaton of the results, the area surveyed was treated as six separate subareas agreed upon, and further divided into rectangles (Fig. 4). The blue whiting abundance was calculated by use of the following value of the target strength:

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

where L is the fish length. For a 30 cm fish this gives the the density coefficient value of:

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

The method used was then the same as for previous blue whiting estimations, described in for instance Anon. (1982), Monstad (1986) and Belikov et al. (1990).

A ship-to-ship calibration conducted over 56 nautical miles at the southern part of the Porcupine bank the 24 March, resulted in the conclusion that the relationship between the two vessels could be treated as 1:1 for blue whiting recordings in the actual depth layers (Hansen and Dorchenkov 1991).

Separate estimates were made by either country, and the results were then combined at rectangular and subarea basis.

For hydrological observations a Neil Brown Mk IIIB "Rosette" CTD system was used. Temperature and salinity were observed from sea surface to bottom on the continental shelf, and down to 600, 1000 or 1500 m in the deep sea area west of the shelf. In addition to own stations visited, the avaible hydrological material also includes temperature observations made by a soviet fish scouting vessel in the area between longitudes $16^0 30'$ and $19^0 00'$ W (Belikov pers.com.).

RESULTS AND CONCLUSION

Distribution

Blue whiting was recorded over the Porcupine bank and along the shelf edge area from south of Ireland to north of The Faroes, in addition to parts of the Rockall bank (Fig. 3). The densest concentrations were found in the south, at position $51^0 00'$-$53^0 00'$ N between 11^0-13^0 W. Rather dense concentrations were also observed in the area north of the Porcupine bank, $53^0 30'$-$54^0 30'$N, along the continental slope. The blue whiting observations over the Rockall bank, made by "Pinro" during the first days of April were, however, of only weak character.

Compared to previous years the blue whiting over the Porcupine bank area this year was found to be more easterly distributed. This difference in the attitude may be due to changes in the hydrological situation in the depths, with warmer water than usual along the Irish coast (Fig. 7D). As a result of this, the dense concentrations usually fished upon at westerly parts of the bank and further west, were not observed this year.

Stock size estimates

The observed blue whiting stock in the survey area was estimated at 4.7 mill. tonnes, and of this combined result 4.4 mill. tonnes

belonged to the spawning stock. It corresponds to an abundance of 38.6 x 10^{-9} and 35.2 x 10^{-9} individuals respectively. The results are shown in Fig. 4 on a rectangular basis and in Tables 1 and 2 for the subareas and for the total. The spawning stock biomass is then found to be 1 mill. tonnes less than observed in 1990 (Anon. 1991).

In the southern parts (subarea I and II) 43 000 tonnes only, i.e. about 1.5 % in weight, were immature, while in the north (subarea VI) 240 000 tonnes, or 51 % were immature. Hence the biggest fish were found in the south, having mean length and mean weight of 29.4 cm and 135.7 g respectively. In the north the corresponding values were 25.9 and 102.9 only. The blue whiting observed at the Rockall bank was even smaller and about 50 % at immature stage.

Stock composition

In Fig. 5 the total length and age distributions are shown. As expected from earlier observations since 1989 (Anon 1991), this survey confirmed that the 1989-yearclass was a rich one. In number it contributed with approximately 23 % of the stock observed. The length distribution has two peaks, one at 23 cm for the 1989-yearclass and one at 30 cm for the 1986- and 1987-yearclasses.

Fig. 6 show the weight - length relationship of the total observed blue whiting.

The maturation of the blue whiting gonads was found to be retarded in 1991 compared to previous years, and the peak of spawning was observed to be 1 - 2 weeks later than last year (Monstad and Belikov 1990).

Hydrography

During the study period the meteorological situation consisted of SW cyclonic winds with 5-8 m/s predominating. Pressure range of 970 - 990 mbars was observed, and during the survey period occasional changes in air masses and wind direction took place. In periods of good weather, the sea surface conditions improved and a more well developed spring phytoplankton bloom than in 1990 was observed.

The horizontal temperature distributions are shown in Figs. 7A-D for the sea surface, 200, 400 and 600 m respectively. In general 0-200 m layer temperatures throughout the area were lower in 1991 than in 1990 and close to Norm (1983-1990). In both years the highest temperatures were recorded in southern parts of the surveyed area. In 1991, warm water (>10.0^0 C) was observed to extend from the south to 54^{0}30' N close to the Irish coast. Water of similar temperature was also more extensive in the western parts and close to the Irish coast than recorded in 1990.

Except for the northern parts, the temperatures below 200 m depth was generally higher in 1991 than in 1990. In the north, e.g. the Faroes/ Shetland area, water penetrating from the Norwegian Sea, however, had created temperatures in the water column below 200 m which were 1-3^0 C lower than observed in 1990 (Monstad and Belikov 1990).

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Table 1. Estimates of blue whiting by subareas west of The British Isles, spring 1991. combined results of R.V."J. Hjort" and R.V."PINRO".

Sub-area	Latitude	Square naut. miles	Abundance N x 10^{-6}			Biomass t x 10^{-3}			w	l	condition factor
			Immat.	Mature	Σ	Immat.	Mature	Σ			
VI	60°00'-62°30'	11491	2075	1304	3379	214	134	348	102.9	25.9	5.9
V	58°00'-60°00'	6391	274	1019	1293	26	95	121	93.7	25.2	5.7
IV	55°30'-58°00'	6667	94	2019	2113	13	265	278	131.5	29.7	5.8
III	53°30'-55°30'	11425	17	8180	8197	2	927	929	113.3	27.0	5.7
II	51°30'-53°30'	19246	314	12369	12683	40	1588	1628	128.4	28.7	5.4
I	50°00'-51°30'	14678	25	9537	9562	3	1294	1297	135.7	29.4	5.2
VII	Rockall	8700	592	816	1408	45	61	106	75.2	22.8	5.5
All subareas		78598	3391	35244	38635	343	4364	4707	121.8	28.0	5.6

Table 2. Total estimates of blue whiting west of The British Isles, spring 1991. Combined results of R.V."Johan Hjort" and R.V."Pinro".
Mean weight:$\bar{w}$ in gram, mean length: $\bar{l}$ in cm, abundance: N x 10^{-6}, biomass: tonnes x 10^{-3}.

cm	years 1	2	3	4	5	6	7	8	9	10	11	12+	Total	W	Biomass
18	29												29	31.0	0.9
19	52	112											164	36.6	6.0
20	31	825	10										866	43.1	37.3
21	11	1121	45										1177	48.9	57.6
22		1518	175	19									1712	57.4	98.2
23	50	1873	685	21									2629	66.1	173.8
24		1959	1311	94	30	20							3414	77.2	263.5
25		1127	1834	295	42								3298	87.6	288.8
26		398	1537	463	105								2503	99.5	249.1
27		51	816	978	278	20	20						2163	109.3	236.5
28			561	1701	685	42	33						3022	116.4	351.9
29			300	1632	1415	411	94	30	10	13			3905	131.3	512.6
30			211	1284	1398	755	246	101					3995	141.3	564.6
31		10	35	715	977	684	292	115	10				2838	159.4	452.5
32				334	887	543	448	171					2383	173.9	414.5
33				79	538	565	428	58	30		3	10	1711	190.8	326.5
34			10	60	219	488	300	103	27	27		25	1259	210.6	265.1
35				15	91	292	243	121	21			7	790	234.6	185.3
36					65	164	139	57	7			12	444	251.1	111.5
37						27	38	13	10	31	4	8	131	277.9	36.4
38						20			39	13	9	14	95	326.3	31.0
39					15					12		9	36	366.7	13.2
40									10	12			22	381.8	8.4
41								15				14	29	444.8	12.9
42						20							20	445.0	8.9
$\bar{l}$	20.6	23.2	25.8	29.0	30.6	32.2	32.8	33.0	35.0	36.1	37.3	36.5	28.0		
N	173	8994	7530	7690	6745	4051	2281	784	164	108	16	99	38635		
Bio mass	6.8	608.3	718.5	971.6	988.5	701.2	409.9	172.2	48.2	46.7	4.6	30.5			4707.0
$\bar{w}$	39.9	67.6	95.4	126.3	146.6	173.1	179.7	219.6	293.9	432.4	287.5	308.1		121.8	

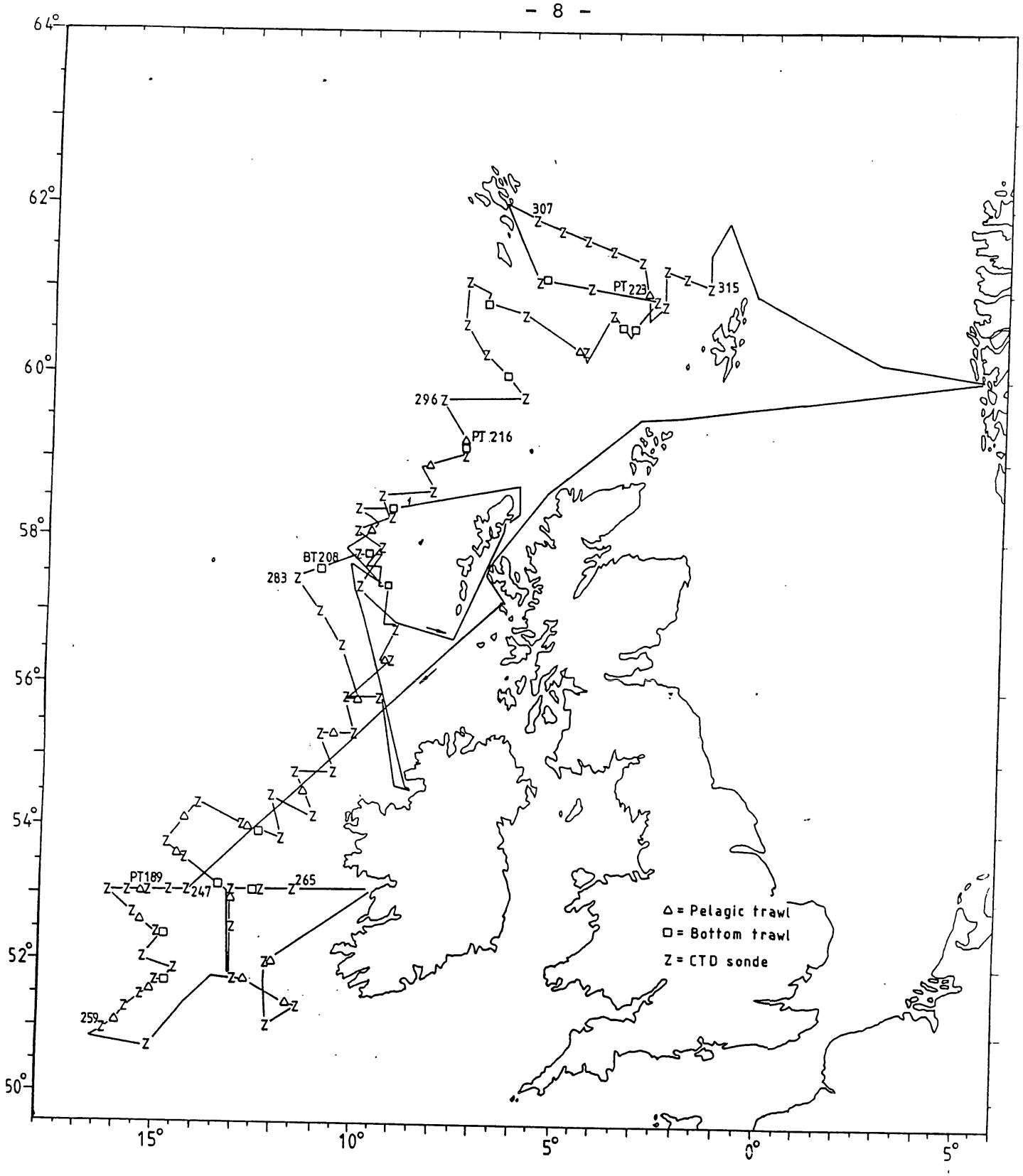

Fig. 1. Cruise track and stations of R.V."Johan Hjort" 18 March-16 April 1991.

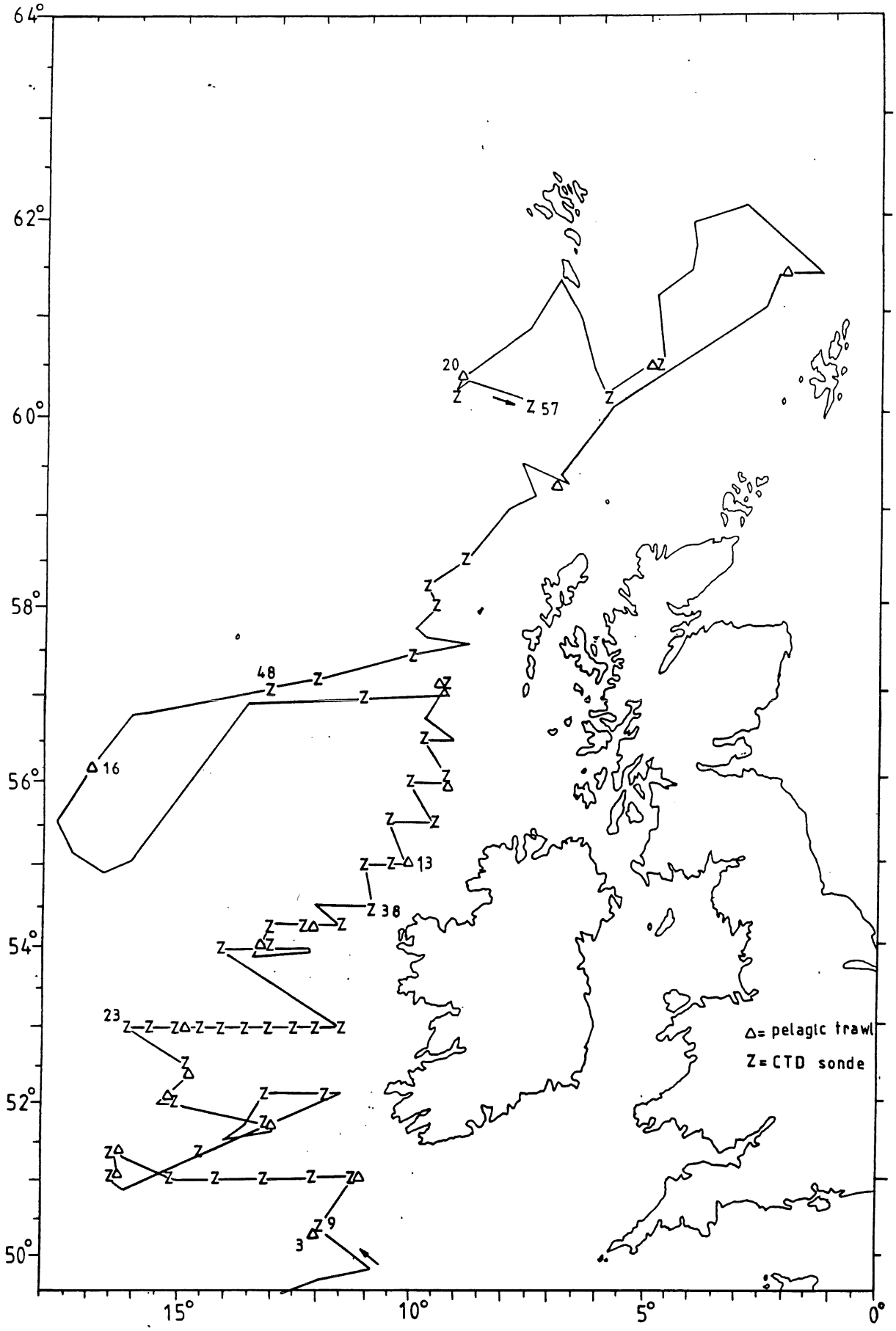

Fig. 2. Cruise track and stations of R.V."Pinro" 17 March-12 April 1991.

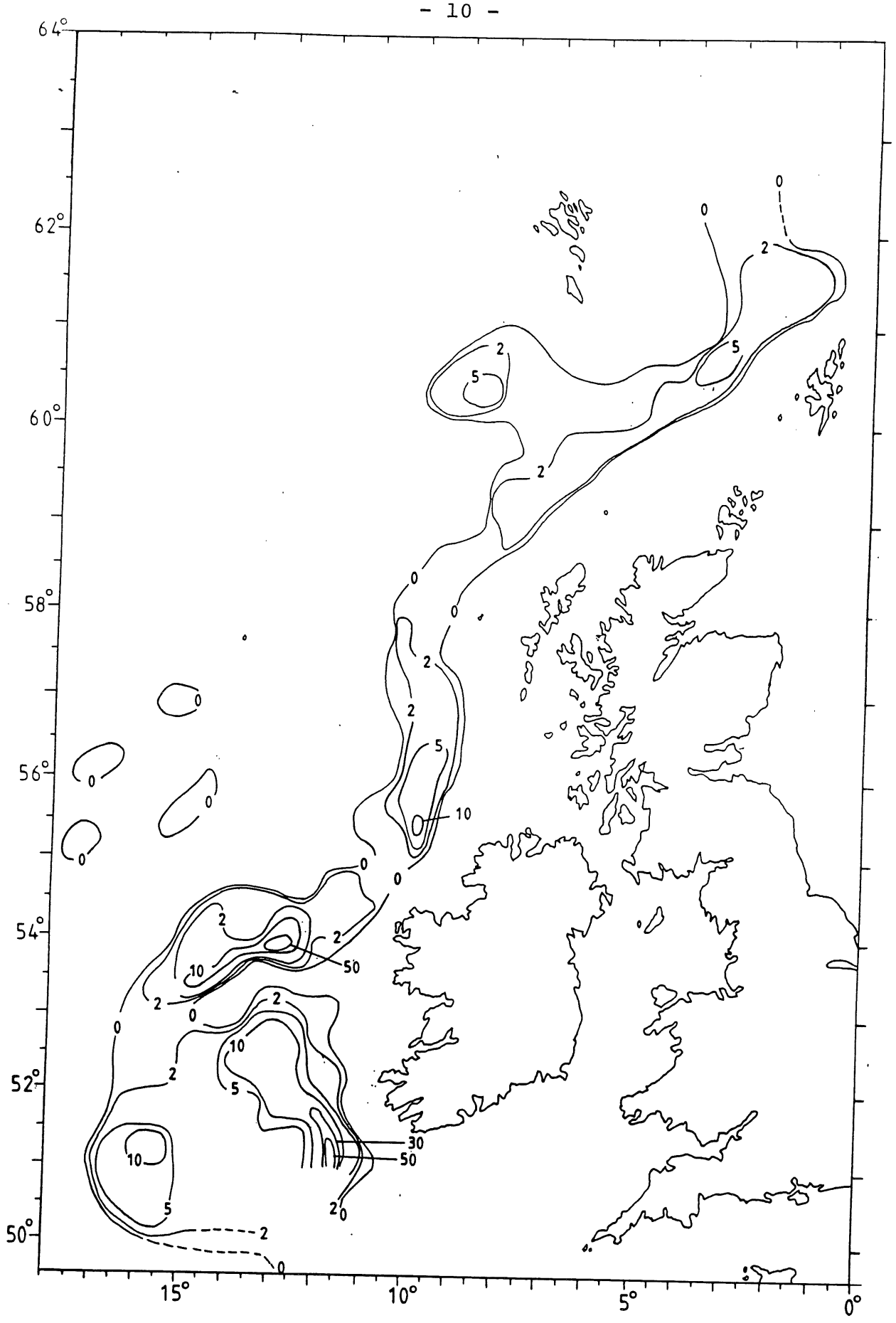

Fig. 3. Density distribution of blue whiting, spring 1991. Combined recordings of R.V."Johan Hjort" and R.V."Pinro". Echo intensity in m^2 per square nautical mile x 1/100.

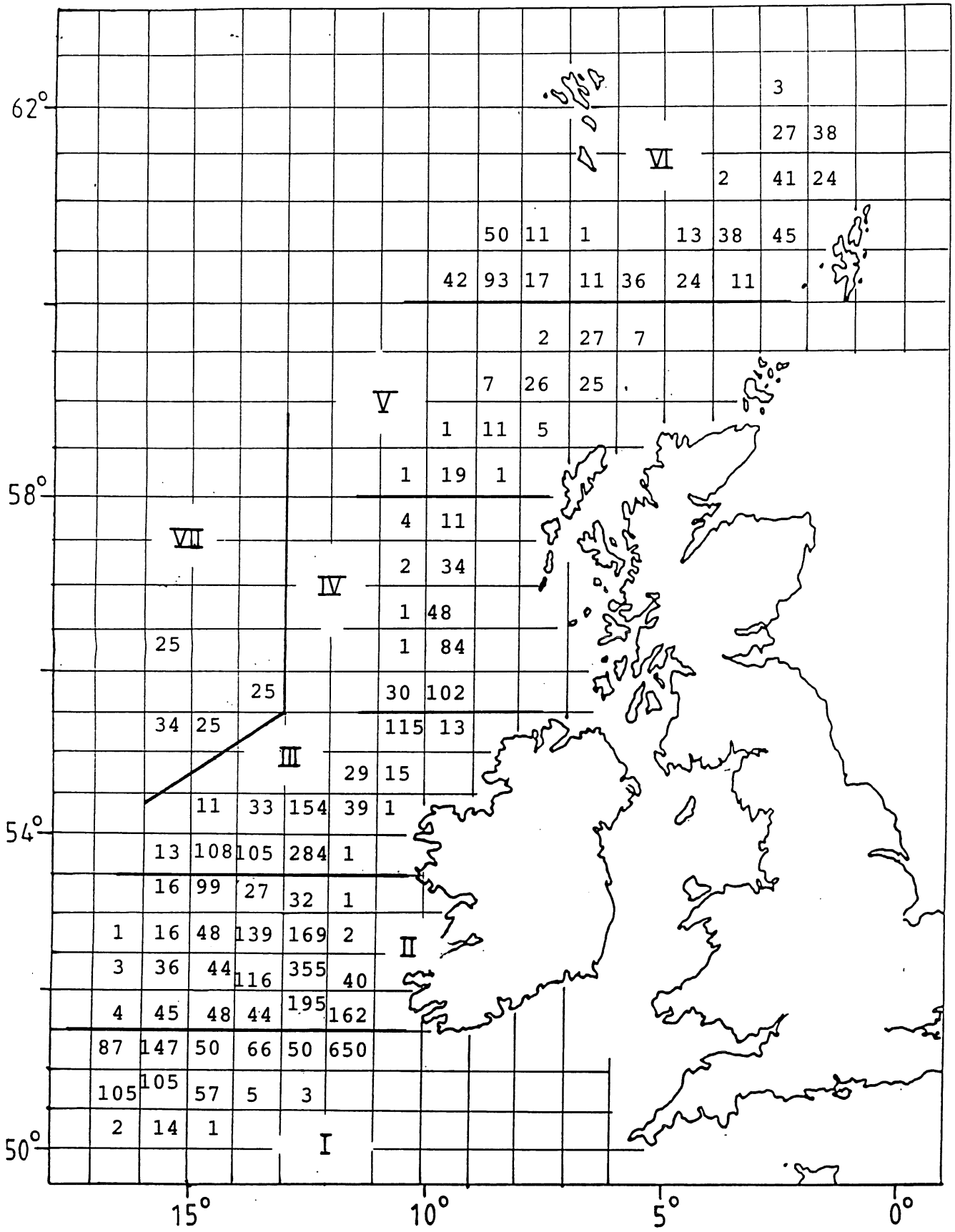

Fig. 4. Estimated biomass ('000 tonnes) of blue whiting, spring 1991. Rectangles and subareras I-VII used in the assessment.

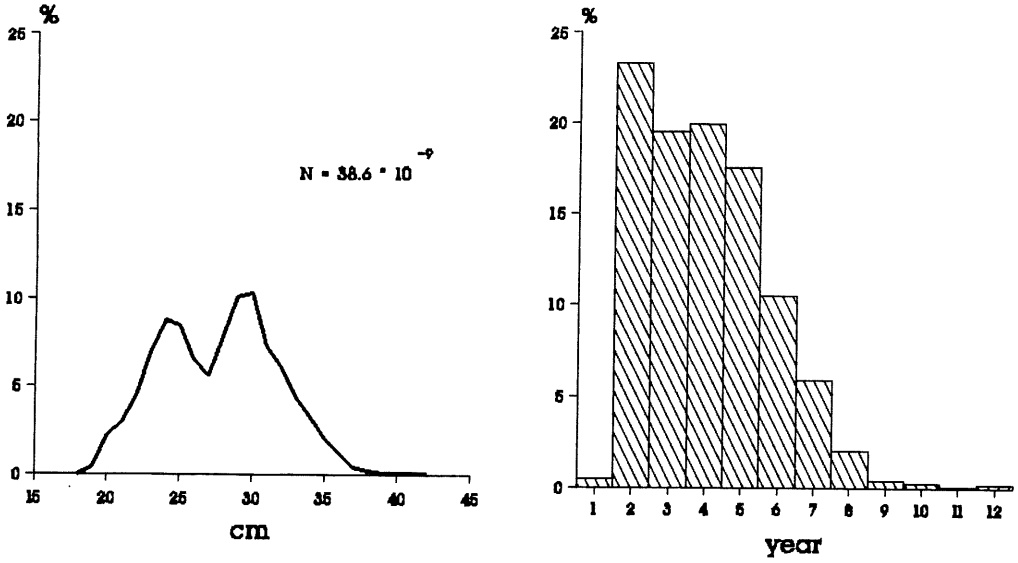

Fig. 5. Total length- and age distribution (%) of blue whiting in the spawning area west of The British Isles, spring 1991. Numbers weighted by abundance.

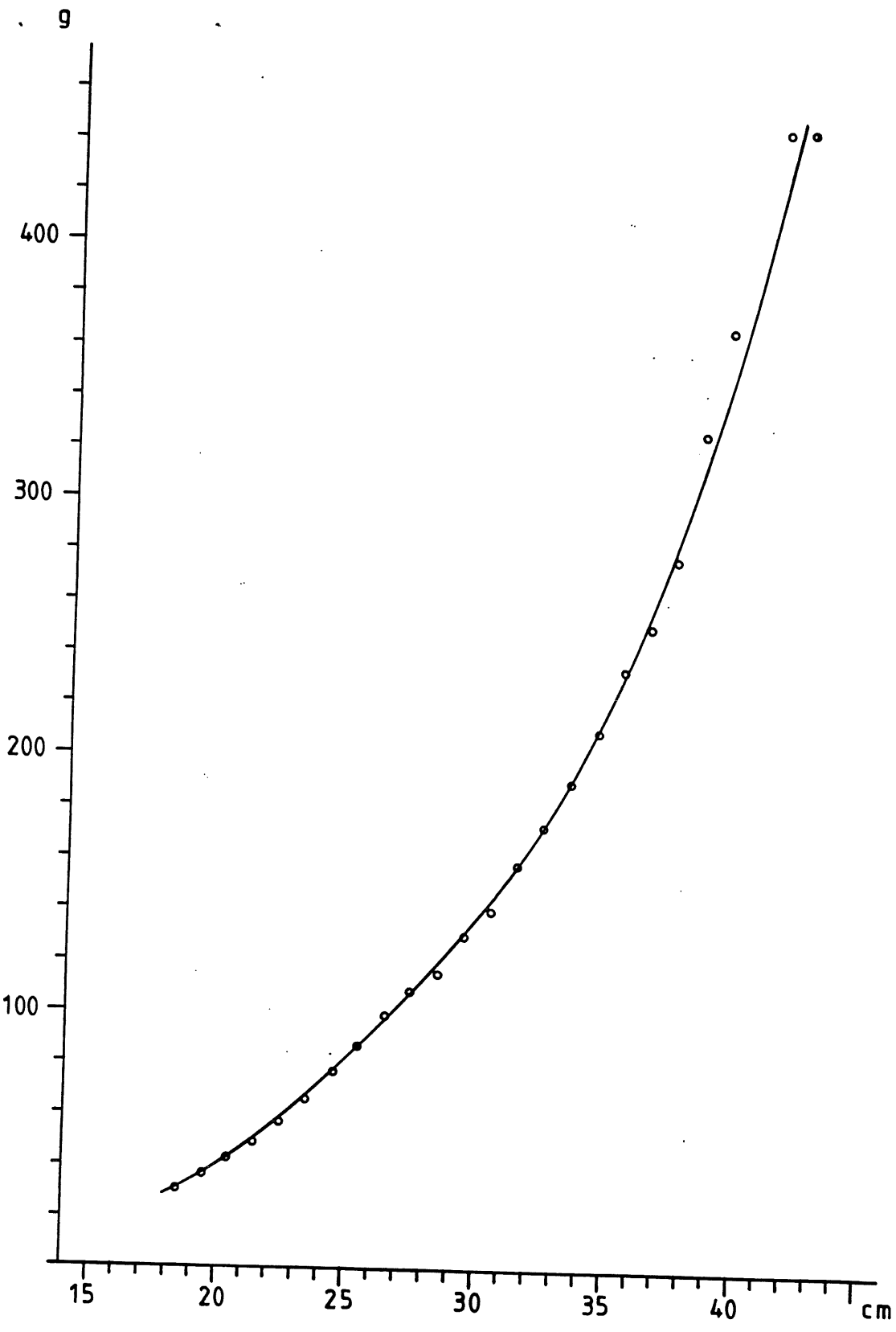

Fig. 6. Weight-length relationship of blue whiting observed west of The British Isles, spring 1991.

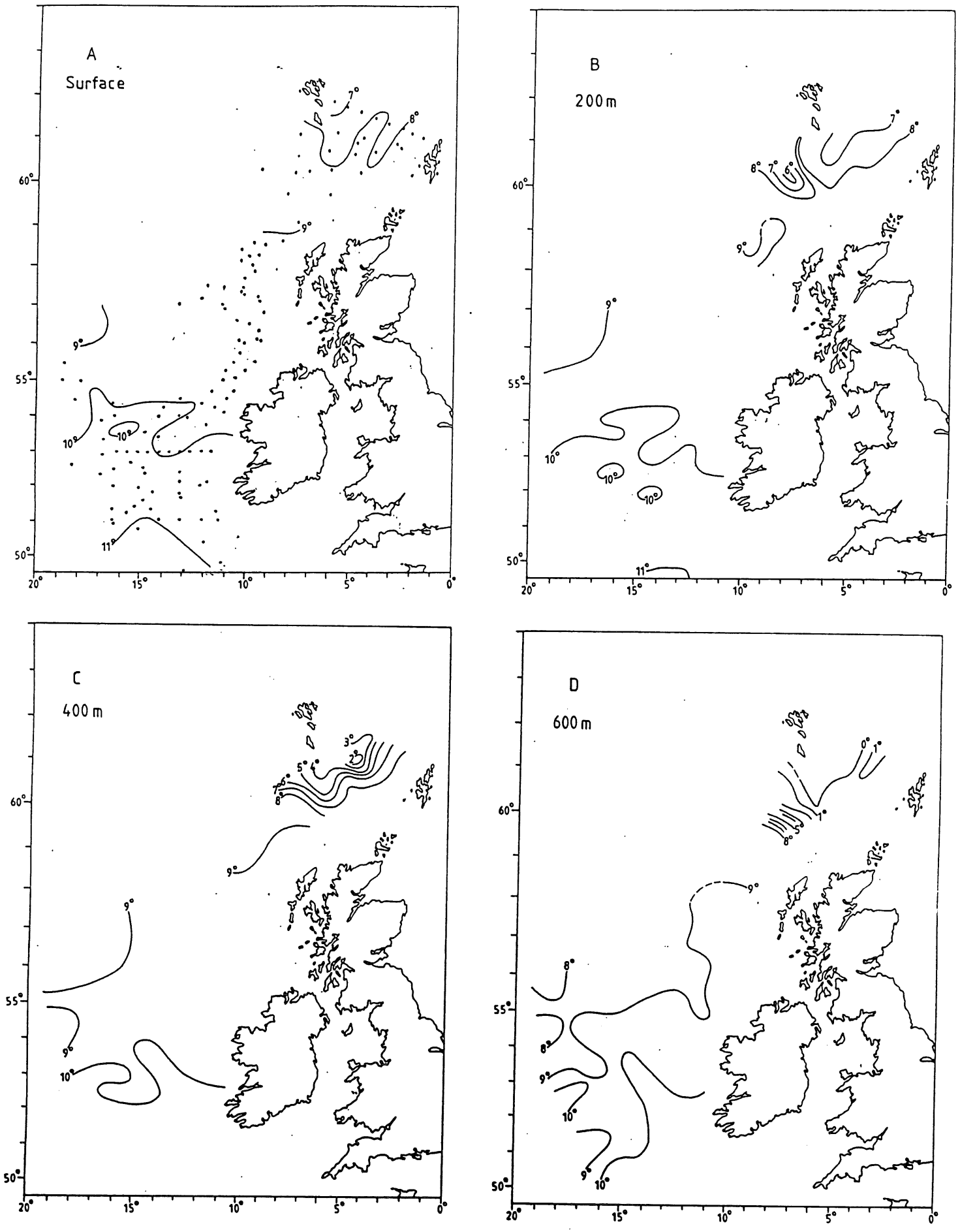

Fig. 7. Temperature, t^0 C, at sea surface, 200 m, 400 m and 600 m depths, spring 1991. Dots in 7A show the positions of observations.