Sommaire

Le présent mémoire présente de nouvelles données concernant la distribution, l'abondance et les caractéristiques biologiques du poutassou obtenues grâce aux études de pêche/sondage ultrasonore entreprises par des navires de recherche à l'Ouest des Iles Britanniques au cours de la période de mars à juin 1977. Les résultats des observations avec l'intégrateur de sondage ultrasonore ont indiqué que l'importance du cheptel dans le secteur d'étude au mois de mars était de 6,1 millions de tonnes (l'estimation correspondante en 1976 était de 6,3 millions de tonnes).

Les données concernant la longueur, l'âge, le sexe et la maturité indiquaient une progression de l'époque du frai du Sud au Nord au cours de la période entre fin mars et début de juin. Les facteurs de condition étaient inversement liés à l'état de maturation, étant les plus faibles dans les poissons ayant lâché leurs oeufs et les plus élevés dans les poissons atteignant la maturité et les poissons vides en voie de rétablissement.

On a procédé à des observations sur l'incidence de l'infestation du poutassou par le parasite nématode Anisakis. Bien que le pourcentage des poissons contenant un ou plusieurs vers ait été élevé pendant toute la période, le pourcentage de ceux qui manifestaient un niveau d'infestation plus élevé était relativement faible.

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International Council for the
  Exploration of the Sea

C.M. 1977/H:33
Pelagic Fish (Northern) Cmtte

PRELIMINARY RESULTS OF THE 1977
BLUE WHITING SURVEYS TO THE WEST OF SCOTLAND

by

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Summary

    This paper presents further data on the distribution, abundance and
biological characteristics of blue whiting obtained in research vessel
echosounder/fishing surveys to the west of the British Isles in the period
March-June 1977. The results of echo integrator observations indicated a
stock size in the survey area in March of 6.1 million tonnes (the corresponding
estimate in 1976 was 6.3 million tonnes).

    Data on length, age, sex and maturity indicated a progression in spawning
time from south to north during the period late March-early June. Condition
factors were inversely related to state of maturation, being lowest in spent,
and highest in maturing and recovering spent fish.

    Observations were made on incidence of infestation of blue whiting by the
nematode parasite Anisakis. Although the proportion of fish containing one or
more worms was high throughout the period, the proportion having a high intensity
of infestation was relatively small.

Introduction

    In March 1977 a survey to investigate the distribution, abundance and
biology of blue whiting (Micromesistius poutassou) in the area to the west
of Scotland was carried out by FRV "Explorer". Samples of blue whiting were
also obtained from vessels landing in Stornoway and from the RV "G A Reay"
in the period March-June to investigate changes in the population structure of
blue whiting in the area during this period.

The Survey

    A quantitative acoustic survey was made of blue whiting distribution and
abundance in the area west of Scotland from 55°40'N to 61°30'N using the
Aberdeen echo integration system, consisting of a Simrad EK38 scientific
sounder, with its transducer mounted in a towed body and the Marine Laboratory
Digital Echo Integrator. The survey track followed, Fig. 1, was not considered
ideal for abundance estimation but resulted from adverse weather conditions
restricting movement of the vessel. Estimates of fish density were made at
half hourly intervals and from these estimates a mean density for the survey
track was calculated. The mean density was then raised by the area surveyed

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to give an estimate of the biomass within the area.   The mean density
calculated was a geometric mean adjusted by a factor of 1.15 σ^2 before
conversion to an arithmetic value to avoid bias.

Distribution

The distribution of blue whiting observed on the survey is shown in
Fig. 2.   The highest concentrations observed were along the edge of the
continental shelf, the south eastern edge of Rockall Bank, south of Rosemary
Bank and along the Wyville-Thomson Ridge.   In the Rockall channel south of
58°N the blue whiting were found as a very patchy layer at 450-550 m depth
whilst in the area north of 58°N they formed a more continuous layer at 400-
500 m depth.   The layers were at around 300 m depth along the edge of the
continental shelf and on the slopes of the oceanic banks.

Abundance

Calculation of biomass in the area surveyed depends on the value of
target strength used.   Estimates of target strength used in previous papers
(Pawson et al. 1975, Pawson et al. 1976) have ranged from -29.1 dbKg^{-1} to
-34 dbKg^{-1}; consequently it was decided, for comparative purposes, to calculate
estimates of the total biomass of blue whiting within the area surveyed, for
assumed target strengths of -29.0, -31.5 and -34.0 dbKg^{-1}.   The estimates
were 1.9, 3.4 and 6.1 million tonnes respectively.

Biology

Midwater trawling was used during the March survey to sample the echo
traces assumed to be blue whiting.   The catches which consisted almost entirely
of blue whiting were sampled to collect data on length, weight, age, sex and
maturity of blue whiting.   Similarly, catches of blue whiting taken by the
RV "G A Reay" and landed at Stornoway in the period April-early June, were sampled
to provide further data on these parameters.   A number of the samples were
also examined for infestation with the nematode worm Anisakis sp.   The degree
of infestation by the worm was classified arbitrarily as high, medium or low.
The data collected are summarised in Tables 1 to 7.

The mean length of blue whiting in the samples varied from 29.1 cm to
31.5 cm with a range of sizes from 18 to 40 cm with over 95% of the fish in
the range 25 to 35 cm (Table 1).   The variation in mean lengths of samples was
presumably associated with variation in the age and sex composition of the
catches (Tables 2, 3 and 4).   It can be seen from examination of Table 2 that
in the March samples, the modal age was 8 years with few fish in the 4 and 5 year
age groups whilst as April progressed the catches contained an increasing
proportion of fish in these younger age groups.   The mean lengths in the March
samples were also higher than in the April samples.   The proportion of the
sexes present in the catches (Table 4) also affects the overall mean length
since the mean length at age for females was higher than for males (Table 3).
This was reflected in the difference in mean length of the two March samples;
the second sample contained a much higher proportion of females and had a
higher mean length despite the higher proportion of older fish in the first
sample.   It would appear from Table 2 that early in the season the catches
contained a higher proportion of older fish presumably indicating that early
spawning fish belong to the older age groups.   The proportion of younger fish
in the samples taken west of the Hebrides increased until the third week in
April.   The samples taken in May from catches in the Faroes area contained a
lower proportion of younger fish, and this change in the age composition of the

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catches probably reflects a mixture of spent early spawners and late spawners in this area.

Table 5 shows the composition of the catches with respect to maturity state. The two March samples differed markedly; the sample from the Porcupine Bank area consisted mostly of spent fish whilst that from west of the Hebrides was mostly prespawning fish, suggesting that spawning began earlier in the south of the area. The samples from west of the Hebrides in April, whilst consisting mainly of spent fish, showed an increase in the proportion of fish in both this category and the recovering category with time. These data suggest that spawning in this area took place during the first fortnight in April. The catches from the Faroes, though taken later in the season contained a mixture of spawning, spent and recovering fish. This suggests a mixture of migrating spent fish which had spawned earlier to the south, and late spawners on the more northern grounds. Again there was an increase with time in the proportion of spent and recovering fish in this area.

The difference in maturity stages present in the samples is probably the major factor affecting the mean weight and condition factor of the fish present in the samples (Table 6). The mean weight and condition factor in the first of the March samples were high, whilst those in the second March sample from Porcupine Bank, consisting mainly of spent fish, were low. Similarly in the samples from west of the Hebrides there was a decrease in condition factor and mean weight as the season progressed. The samples from the Faroes had higher mean weights and condition factors in May than those on the more southerly grounds, due to the higher proportion of spawning fish. The mean weight and condition factor also increased in June as the fish recovered from spawning.

The degree of infestation by the nematode worm _Anisakis_ is shown in Table 7. The proportion of fish classified as highly infested was usually low (less than 15%). There was no apparent trend in infestation with time or area.

Discussion

The distribution and abundance of fish in the area surveyed in March was very similar to that found in March-April 1975 (Pawson et al. 1975). The estimated biomass in the area was 6.1 million tonnes (using the target strength value of -34.0 dbKg^{-1}) in 1977 compared with 6.3 million tonnes in 1975.

The samples of blue whiting taken in the period March to June show a progression from mainly pre-spawning fish to mainly spent and recovering fish, with associated loss of weight and condition factor in April and May followed by a slight recovery in June. The samples could be grouped into one from the Porcupine Bank, those taken west of the Hebrides and those taken around the Faroes, showing a change in spawning time from south to north as the season progressed. There also appeared to be an increase in the proportion of younger fish in the spawning stock as the season progressed.

References

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Table 1 Percentage Length Distributions

Length (cm)	23/3 -1/4	End of March	14/4	16/4	19/4	Date 21/4	21/4	23/4	25/4	28/4	9/5	11/5
18			0.6									
19												
20	0.2			0.7					0.4			
21						0.3		0.5	0.9		0.2	
22	0.2			0.4					0.9	0.3	0.2	
23	0.5		1.2	1.1	0.3	0.6			0.4	0.5	0.2	
24	0.1	0.5	1.8	1.4	1.3	0.3	1.4	1.0	1.3	1.1	0.7	
25	0.6	0.9		1.8	1.6	3.7	3.3	3.0	3.1	2.9	1.8	0.3
26	1.1	1.9	4.9	4.6	4.9	8.6	2.8	4.0	5.4	6.3	2.1	3.7
27	1.2	0.9	9.2	7.1	5.2	8.3	6.0	5.5	8.5	7.1	10.5	12.1
28	3.4	5.2	8.0	12.4	10.7	11.0	6.0	9.0	8.1	10.0	11.8	18.8
29	11.2	7.5	12.3	10.6	15.3	12.0	14.0	14.0	24.2	14.2	21.9	18.8
30	24.9	12.3	22.1	14.8	19.2	16.9	17.7	20.5	18.8	23.4	18.0	19.5
31	20.8	16.5	20.2	15.2	15.3	16.9	16.7	19.0	17.5	15.0	12.8	11.1
32	15.2	23.6	14.1	13.8	7.8	11.3	11.6	7.0	4.0	8.4	8.4	7.7
33	11.6	14.6	3.7	9.2	9.4	5.5	10.2	7.0	3.1	6.1	5.0	2.3
34	5.4	8.5		3.5	5.2	2.5	4.2	7.0	2.2	3.9	3.9	2.3
35	2.0	5.7	0.6	1.8	1.6	1.5	1.4	1.0	0.9	0.3	1.8	2.0
36	1.2	1.4	0.6	0.4	0.3	0.3	1.4	0.5		0.3	0.7	1.0
37	0.5	0.5			1.6	0.3	2.3	1.0				
38				0.4			0.9					0.3
39			0.6							0.3		
40					0.3							
mean length	30.9	31.5	29.7	29.9	30.1	29.6	30.5	30.1	29.1	29.6	29.7	29.5

Length (cm)	4/6	Date 13/6	17/6
18			
19			
20		0.5	0.5
21			
22			
23			
24		0.5	
25		0.5	
26	3.3		
27	8.4	1.6	0.5
28	9.2	5.7	0.9
29	14.2	14.6	6.0
30	8.4	22.4	17.6
31	20.1	21.4	21.8
32	11.7	14.6	21.3
33	8.4	10.4	14.4
34	3.3	6.2	13.4
35	0.8	1.0	1.4
36	0.8		1.4
37	0.8		0.9
38			
39	0.4	0.5	
40			
mean length	30.3	30.7	31.7

Table 2 Percentage Age Distributions

Age	23/3 -1/4	End of March	14/4/77	16/4	19/4	Date 21/4	21/4	23/4	25/4	28/4	9/5	11/5
0												
1												
2	0.2		0.6	0.4					0.4			
3	1.8	1.4	3.1	5.7	3.6	4.3	2.3	5.0	5.8	3.7	0.7	
4	0.9	4.7	4.3	14.5	11.7	19.9	14.9	15.0	13.5	11.8	10.5	8.4
5	2.9	4.2	6.7	18.0	15.3	16.6	2.8	14.0	6.3	9.2	9.6	14.1
6	8.7	2.5	11.7	8.8	5.8	7.1	6.0	5.5	5.4	12.4	13.2	20.8
7	8.4	20.3	23.3	7.4	10.4	12.3	11.2	15.5	13.0	15.0	8.4	12.8
8	18.6	24.5	24.5	15.2	16.2	10.1	11.6	10.0	19.7	20.3	8.2	4.0
9	7.0	17.9	14.1	14.5	10.1	14.4	15.8	14.0	15.2	11.3	9.3	12.4
10	11.0	12.3	5.5	8.5	14.0	7.7	19.1	15.0	10.8	11.3	11.2	9.1
11	12.5	5.2	4.9	3.5	6.8	4.6	7.9	3.0	5.8	1.6	18.7	3.4
12	11.6	0.9	1.2	1.8	4.2	0.5	4.7	1.0	0.4	3.4	3.2	7.4
13	4.5			0.4		2.5	2.3	2.0	1.8		2.7	2.3
14	3.1				0.3				1.8		1.6	
15+	8.6			1.4	1.6		1.4				2.7	5.4

Age	4/6/77	13/6	17/6
0			
1			
2		0.5	0.5
3		1.0	
4	14.6	0.5	
5	10.9	7.8	0.5
6	6.7	5.7	3.7
7	9.2	10.9	8.8
8	10.0	19.3	12.0
9	12.6	16.7	16.2
10	7.9	8.9	19.0
11	7.9	9.4	9.7
12	10.9	15.1	13.0
13	0.8	1.6	5.1
14	3.8	1.6	6.0
15+	4.6	1.0	5.6

Table 3 Mean length at Age

Age	23/3 – 1/4 ♂	♀	End of March ♂	♀	14/4 ♂	♀	16/4 ♂	♀	19/4 ♂	♀	21/4 ♂	♀
0												
1												
2	20.00					18.00		20.00				
3	24.20	25.07	25.00		23.67	23.50	23.29	26.00	25.12	25.67	24.30	25.25
4	25.85	27.00	26.50	28.00	27.00	27.00	25.31	27.96	26.70	27.46	26.46	28.19
5	27.96	30.00	27.80	28.75	27.00	27.67	28.21	29.84	27.00	30.25	26.29	29.38
6	29.10	30.82	30.18	31.00	26.75	30.45	28.29	30.25	29.54	29.00	28.00	29.79
7	29.81	31.23	29.62	32.91	28.00	30.70	26.00	32.60	29.45	33.17	29.96	31.41
8	29.89	32.55	29.00	32.68	29.50	31.25	31.00	31.89	30.00	33.45	30.50	32.61
9	29.99	32.32	30.14	32.13	29.90	31.23	29.94	32.29	31.00	31.45	30.32	32.53
10	30.59	33.01	30.82	32.60	27.50	32.57	30.09	32.77	30.38	33.56	30.38	31.11
11	30.35	32.64	31.00	32.75	28.67	30.80		33.00	29.55	32.60	29.56	33.50
12	30.35	33.23		34.00	31.00		30.00	34.00	33.00	32.60		34.00
13	31.42	33.92						35.00			32.00	34.00
14	31.11	34.16								34.00		
15+	30.67	34.36					30.00		31.00			

Age	21/4 ♂	♀	23/4 ♂	♀	25/4 ♂	♀	28/4 ♂	♀	9/5 ♂	♀	11/5 ♂	♀
0												
1												
2					20.00							
3	25.00	24.67	25.00	24.25	22.75	25.80	24.92	25.00	25.00	21.50		
4	26.00	28.24	26.40	28.95	26.33	26.83	25.85	27.17	26.76	27.48	25.88	28.18
5	27.00	28.75	27.78	30.11	27.33	28.75	28.08	27.70	27.87	27.89	27.61	30.00
6	27.67	32.00	29.18		28.08		29.53	31.22	26.90	28.85	28.33	28.75
7	29.50	32.62	29.67	33.00	29.36	33.00	29.92	33.50	27.00	30.54	28.50	30.45
8	30.44	32.89	30.40	32.00	29.79	31.87	30.13	33.50	30.29	33.07	28.20	32.00
9	30.55	33.71	30.55	33.38	30.06	33.00	30.43	32.00	29.17	31.31	29.60	31.88
10	30.70	32.89	30.14	33.38	30.12	32.50	29.85	33.41	29.84	32.88	30.11	33.22
11	30.64	33.67	30.75	33.50	30.50	31.60	33.00	32.50	29.44	30.87	28.00	32.40
12	30.90		32.00	34.00	32.00		31.38	33.00	30.00	33.29	29.80	33.29
13	29.00	36.00	30.00		30.00				31.86	33.60	31.00	32.75
14					30.00					32.14		
15+	31.00								29.00	34.00	30.22	34.57

1.

Table 3 (cont.)

Age	4/6 ♂	4/6 ♀	13/6 ♂	13/6 ♀	17/6 ♂	17/6 ♀
0						
1						
2			20.00		20.00	
3			25.00	24.00		
4	26.90	28.00		28.00		
5	28.47	30.56	28.10	30.00	27.00	
6	29.06		28.75	32.67	30.00	30.00
7	30.22	30.00	29.33	32.33	30.17	32.08
8	30.12	32.29	30.56	32.04	30.91	34.00
9	29.39	32.58	29.65	32.33	30.96	33.67
10	28.00	33.47	31.00	31.70	30.83	33.00
11		31.47	30.88	36.50	31.00	32.43
12	31.13	31.00	29.79	33.60	31.60	33.54
13		33.00		34.00	30.91	
14	30.00	34.00		33.67	32.11	34.50
15+		32.91		32.00	31.00	34.33

TABLE 4   SEX RATIOS

DATE	% ♂	% ♀
23/3-1/4	58	42
End of March	28	72
14/4	31	69
16/4	35	65
19/4	55	45
21/4	48	52
21/4	59	41
23/4	56	44
25/4	75	25
28/4	78	22
9/5	44	56
11/5	60	40
4/6	58	42
13/6	56	44
17/6	63	37

Table 5   Percentage Distribution of Maturity Stages

Date	Area	Sex	Immature 0	Ripening 1	2	3	Spawning 4	Spent 5	Recovering 6
23/3 - 1/4	West of Hebrides	♂	0.4	0.6	12.7	64.2	22.1		
		♀	0.8	1.8	39.1	58.3			
last week in March	Porcupine Bank	♂					5.0	95.0	
		♀						98.0	2.0
14/4	West of Hebrides	♂					3.9	96.1	
		♀	1.8				5.4	88.4	4.5
16/4	West of Hebrides	♂	2.0				9.1	88.9	
		♀	3.3				15.8	71.2	9.8
19/4	West of Hebrides	♂					5.3	94.7	
		♀	2.9				2.2	84.2	10.8
21/4	West of Hebrides	♂					0.6	99.4	
		♀	0.6					84.5	14.8
21/4	West of Hebrides	♂					4.7	95.3	
		♀	1.1				1.1	96.6	1.1
23/4	West of Hebrides	♂					0.9	99.1	
		♀	4.5					72.7	22.7
25/4	West of Hebrides	♂	1.2				0.6	98.2	
		♀	19.5					60.7	19.5
28/4	West of Hebrides	♂	0.3					99.0	0.7
		♀	9.5				2.4	66.7	21.5
9/5	Faroe	♂	9.7				24.6	64.6	1.0
		♀	7.0			0.4	39.8	47.1	5.7
11/5	Faroe	♂					44.1	55.9	
		♀					37.0	62.2	0.8
4/6	Faroe	♂					2.2	97.8	
		♀	4.0				14.9	80.2	1.0
13/6	Faroe	♂	1.9				4.6	85.2	8.3
		♀	2.4					84.5	13.1
17/6	Faroe	♂						83.9	15.3
		♀					3.8	75.9	20.3

TABLE 6   MEAN WEIGHT AND CONDITION FACTOR

Date	Mean Weight (gm)	Condition Factor ($100W/L^3$)
23/3-1/4		
End of March	139	0.45
14/4	131	0.48
16/4	122	0.46
19/4	129	0.45
21/4	123	0.47
21/4	134	0.46
23/4	122	0.44
25/4	110	0.45
28/4	112	0.43
9/5	124	0.45
11/5	141	0.49
4/6	137	0.48
13/6	145	0.49
17/6	161	0.50

TABLE 7   DEGREE OF INFESTATION WITH ANISAKIS

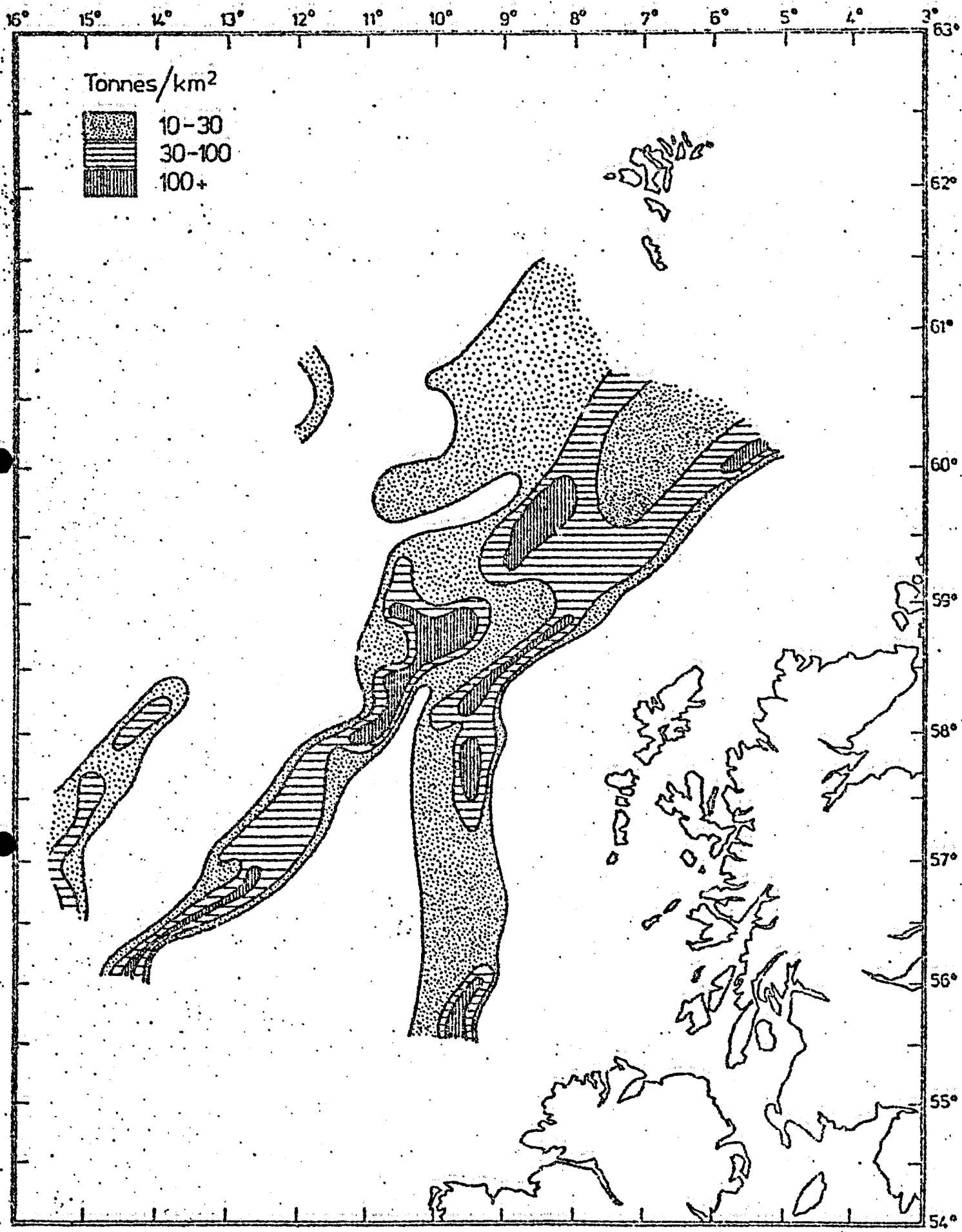| Date	Area	High	Medium	Low
End of March	Porcupine Bank	5.4	23.6	71.0
16/4	W of Hebrides	10.7	22.3	67.0
19/4	W of Hebrides	9.8	24.1	66.1
21/4	W of Hebrides	12.8	12.8	74.4
21/4	W of Hebrides	9.2	22.9	67.9
23/4	W of Hebrides	7.8	18.6	73.5
25/4	W of Hebrides	6.1	22.2	71.7
28/4	W of Hebrides	7.1	15.9	77.0
13/6	Faroe	8.9	26.6	64.6
17/6	Faroe	9.2	31.5	59.3

Fig. 1   "Explorer" Survey Track March 1977

Fig. 2   "Explorer" Blue Whiting Survey March–April 1977