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MR BACIE

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK, ENGLAND

1974 RESEARCH VESSEL PROGRAMME

REPORT: R V CIROLANA: CRUISE 3

STAFF: D H Cushing (NIC)
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DURATION: Left Grimsby 1600 h 21 March
Arrived Grimsby 0100 17 March *Ap-*

LOCALITY: West coast of Scotland

AIMS:

- 1 To carry out an acoustic survey of blue whiting in the area Porcupine Bank to St Kilda, including Rockall.
- 2 To compare results for about a day on the same course in a small area with R V G O SARS and R V SCOTIA.
- 3 To collect material on age and length of blue whiting, maturation and fecundity.
- 4 To fish intensively for blue whiting for a period of 3 to 4 days.
- 5 To use the Continuous Plankton Recorder and Longhurst Hardy Plankton Recorder (LHPR) where possible.
- 6 To work with the MT ST BENEDICT on catching blue whiting.

NARRATIVE

R V CIROLANA sailed to a point 200 miles southwest of Ireland at which the survey was to start. Because the reverberation was rather higher than expected, the survey speed was restricted to 8 knots. The survey started at 0800 h on Sunday 24 March and was planned on somewhat open zigzags. For the first two or three days, no echo trace was recognized as blue whiting and the trawl was shot on two or three occasions on a layer of myctophids. South of the Porcupine Bank a layer trace at about 350 m was found and subsequently identified as blue whiting. Such a trace was found by day and by night from south of the Porcupine to St Kilda.

The survey between 24 March and 5 April covered the area between Rockall, St Kilda and about 50 miles south of the Porcupine Bank. The blue whiting were in a layer by light and in a shoaled layer by day. In general they were outside the 200 m line and extended seawards for 30-50 miles except in the Rockall Channel where they lay much further to seaward. On April 5, R V CIROLANA and R V G O SARS met southwest of St Kilda and conducted a small joint survey for 24 hours or so. On 6 April a party from G O SARS visited CIROLANA and were shown the towed body and counting equipment. They brought a chart of their survey between the Faroe-Shetland Channel and the Porcupine, which was very useful for our subsequent planning. Notes were compared on the stages of maturation.

After the joint survey was over, a second survey was made from St Kilda southward to the Porcupine Bank. By this time R V SCOTIA was at sea intending to survey the area to the north. On the southbound survey the fish appeared to be denser and to extend a little further to seaward. On 10 April, when the sea was flat calm, an attempt was made to measure the target strength of blue whiting. On subsequent days the survey continued southward over the Porcupine Bank and in the area of the bank no records of blue whiting were found. A thin layer occurred west of the Bank, when it was too rough to fish, and as the layer rose above 80 m at night it was considered not to be blue whiting. During 13 and 14 April the search continued until it became quite clear that the blue whiting had moved north from the Porcupine Bank to the area between Donegal and St Kilda. Consequently the search had taken us too far south to return and fish intensively (Aim 4), so this project had to be abandoned. The survey was finished on 14 April.

Results

Aim 1

Two surveys were made in the area between the Porcupine Bank and St. Kilda. A comparison of the two shows a northerly movement from the Porcupine Bank area by the time the second survey had been completed. The surveys were carried out with fish counters, shoal integrators, pulse height analyzer and SIMRAD integrator.

Acoustic techniques

1 Estimation of noise

Reverberation was measured either on a time base with no fish signals in deep water or above the second bottom echo where fish signals were absent. It was found that the reverberation on the towed transducer was greater than that on the hull mounted one. At first an arbitrary signal-to-noise ratio was used. Later, however, the counting equipment was used to set a threshold (above the bottom echo) above which no single targets were recorded.

2 Calibration of transducers

A series of measurements on suitable bottom signals showed that the signal from the hull mounted transducer was 2-3 db higher than that of the towed transducer, more than might have been expected from any angular bias in the towed body. Although the towed transducer was used throughout the voyage, this factor and the difference in noise between the two suggests that it would have been better to have used the hull mounted one.

3 Threshold voltage and calibration

The blue whiting were found between 180 m and 500 m. From the measurements of reverberation the counting zero was set at 14 μ v. With the time varied gain, threshold varies with range and a set of thresholds was established for each range. Lengths of the fish ranged from 20 to 40 cm and the full range could not be detected below 300 m. A relationship was also established between threshold voltage and number of cycles, together with the voltage expected from different sizes of fish. It was shown that the blue whiting tended to live in small shoals and at long range such small shoals could be classified as single fish if the discriminator was set too high. The following schedule was used:-

<u>Depth (m)</u>	<u>Threshold (v)</u>	<u>Cycles</u>
210-180	0.3	28
220-210	0.5	20
300-220	1.0	14
360-300	2.0	No discrimination
400-360	3.0	
500-400	7.0	

At any level, a signal of cycles greater than the discriminating number must be from a shoal. A signal of few cycles must have a voltage attributable to a fish of 20-40 cm and therefore cannot be a shoal, on average; it is conceivable that a very small shoal might be so classified, but this cannot be decided until the shoal analysis is complete. At depths greater than 300 m, all signals were classified as shoals and all voltages grouped as shoal voltage; the only single fishes beyond that range would comprise only one or two cycles.

4 Pulse height analysis

Analysis was restricted to voltages corresponding to 20-40 cm fish at depths less than 300 m. The counting zero should ensure that no noise signals were counted and the 40 cm limit and the discriminator should ensure that no shoals were classed as single fish. From the catches the mean length at depths less than 300 m was 28.6 cm and that from 300-500 m was 30.3 cm. The pulse height analysis was restricted to observations at depths less than 300 m.

5 Target strength measurements

From one haul it was noticed that the fish were very lively and on examination it appeared that some had their air bladders intact. They were deep frozen and thawed until the bodies possessed a light stiffness. A fish was suspended in its swimming position on monofilament nylon below a trawl float from the hydrographic wire. Measurements were made down to 350 cm on two fish. The fish were opened at the surface and the air bladders were intact. One fish was re-examined after its air bladder had been removed.

6 Shoal character

With an oscilloscope camera, a number of records of shoals were obtained. The original intention was to estimate the degree of occlusion of the beam in order to arrive at a rule for deciding on 20 log range amplification or 40 log range. The shoals were in general small; from the numbers in shoals and the shoal volume it should be possible to obtain estimates of packing density and hence the volume sampled for shoals by the echo sounder.

Aim 2

For 24 hours over a small grid area, R V G O SARS and R V CIROLANA steamed on parallel courses at 8 knots. The acoustic equipment was used all the time during this period.

Aims 3 and 4

Fishing

19 hauls using the 1600 mesh Engel midwater trawl and 3 hauls using a Granton trawl were carried out, of which 13 midwater and 1 bottom trawl caught Blue Whiting. Quantities ranged from $\frac{1}{4}$ basket to a maximum of 140 baskets for $1\frac{1}{2}$ hours' fishing. Some 20 hours' fishing yielded 255 baskets of Blue Whiting, averaging around 13 baskets per hour.

The midwater trawl was fished at depths down to 500 metres, but usually within the depth range 250-450 metres.

4 samples of Blue Whiting totalling 3,330 fish were measured and otoliths taken from 1,263 of these, with additional observations on sex and maturity stages. 5 samples of ovaries in maturity stages II-V were also preserved for fecundity studies.

The length distributions showed only small differences between samples and overall 5% of fish fell within the length range 24-34 cm inclusive, with principal modes in the 29 and 30 cm length groups. There was, however, a considerable difference in the length distributions of males and females. The principal modes for males fell at 28 and 29 cm, with an overall mean length of 28.6 cm, whilst the females peaked at 30 and 31 cm, with a mean length of 30.9 cm. Males were thus on average 2.3 cm less in length than females. The largest males recorded were 35 cm, whereas the largest female was 45 cm, but fish exceeding 40 cm in length were very scarce. The smallest fish caught was 17 cm.

48% of the total fish examined were males and 52% females, although the sex ratio tended to vary quite markedly between some samples. The maturity analysis showed that in most hauls very few ripe fish were evident. About 5% ripe and recently spent fish were found in samples taken to the south of the Porcupine Bank between 27/29 March, but the only region where spawning fish formed a significant proportion of the population was to the northeast of Rockall and west of St Kilda, near the northernmost limits of the survey region. Hauls made in this area on 4/6 April suggested that 20-30% of the females were ripe-running (Stage IV). On most of the remaining hauls the great majority of fish were in Stages I and II (the early and later stages of initial maturation).

The accompanying table summarises the overall maturity distributions and mean lengths in each maturity stage.

		0	1	2	3	4	5	6
Males	No.	42	811	526	81	3	82	53
	%	2.63	50.75	32.91	5.07	0.19	5.13	3.32
	L (cm)	25.2	28.2	28.9	30.1	30.8	29.9	29.7
Females	No.	60	278	741	316	78	93	166
	%	3.46	16.05	42.78	18.24	4.50	5.38	9.58
	L	25.9	30.6	31.1	30.4	31.5	31.5	32.0

Very few juvenile fish were found, and the mean length at this stage was closely similar for both sexes (25.2/25.9 cm). The length at first maturity can only be approximately estimated from the available data, but probably falls between 26-30 cm for females and 25-28 cm for males.

Blue whiting formed the predominant catch on most of the midwater tows, but on some of the Granton trawl hauls other species were taken and sampled. These included mackerel, hake, Red Sea bream, John Dory and spurdogs. A few large Ray's bream (54-56 cm) and a Porbeagle shark (about 1½ metres in length) were also caught. Various myctophid and small bathypelagic species were often noted hanging on the meshes in fairly large quantities, and some of these were preserved for identification.

Additional Samples

- 1 Various species were present for muscle-fibre analysis by Dr Greer Walker.
- 2 Mackerel samples were deep-frozen for biological analysis by Mr Bolster and genetic studies by Dr Jamieson.
- 3 A sample of blue whiting was deep-frozen.
- 4 A few specimens were deep-frozen for modelling purposes.

It proved impossible to fish intensively for three or four days on the same position because the area south of the Porcupine on the survey yielded no blue whiting.

Aim 5

- a 2,400 miles of records, which constituted the majority of the cruise track, were obtained with the Continuous Plankton Recorder. Considerable numbers of larvae were obtained in some localities.
- b 14 hauls of approximately 1 hr's duration were made with the Plankton Indicator giving limited information about the surface plankton.
- c 6 oblique hauls to approx 500 m were made with the Longhurst Hardy Plankton Recorder. Detailed analyses are to be made subsequently but they are expected to include both eggs and larvae of blue whiting. Temperature data from the LH PR indicated a uniform decrease of 1-2°C between the surface and 500 m depth.
- d Blue whiting eggs were artificially fertilized and kept alive with no catastrophic mortality for 12 days. Samples at different stages were preserved for identification and staging of eggs and larvae in the plankton hauls.

Aim 6

Communication with M T ST BENEDICT was poor because she was working in the Shetland area. Although contact was made at a regular schedule, R V CIROLANA was not informed of her departure to Stornoway or Aberdeen. Because we sailed two days after the ST BENEDICT we had no information of any value until about 27 March. One signal from her said that the fish were small and catches low; a signal was sent immediately, giving our catches and size ranges, with the recommendation that she steamed south to join CIROLANA. There is no evidence that this signal was received.

D H Cushing
24.4.74

Seen in Draft: W C (Master)
G W A (Fishing Skipper)

A J L

Distribution:

Basic list

Dr Cushing
Dr Johnson
Mr Scholes
Mr Hood
Mr Paws on
Mr Pearson
Mr Dann
Mr Turner
Mr Coombs (IMER)

