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A PRELIMINARY REPORT OF THE MACKEREL EGG AND LARVAL SURVEYS TO THE WEST OF THE BRITISH ISLES AND FRANCE IN 1977

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INTRODUCTION

Since 1970 there have been considerable annual increases in the international landings of mackerel (Scomber scombrus L.) caught in the waters to the west of Britain (Lockwood and Dann, 1976; Anon., 1977). These increases have given rise to widespread concern for the stock, and, as a result of reviewing all available data, recent mackerel working groups have recommended total allowable catches (TAC) well below the previous years' total landings (Anon., 1976; 1977). The data available to the working groups for stock size estimation have been limited to the Norwegian tag releases off south-west Ireland each May since 1969, the English acoustic survey estimates of the shoals off Cornwall made each winter since 1973, and virtual population analysis (VPA). The first two probably do not include the entire western stock and the VPAs were made with minimal catch and age data.

In an effort to obtain a stock estimate for the whole western stock the Fisheries Laboratory, Lowestoft decided to carry out plankton surveys over the western stock spawning grounds for the duration of the 1977 spawning season. The spawning is known to cover the continental shelf area from Spain northwards to the west of Ireland (Corbin, 1947; Arbault and Lacroix, 1975), and lasts from February/March to June/July. This area (Figure 1) was surveyed with five cruises by the MAFF ship RV CIROLANA and one by the ISTPM ship RV LA PELAGIA. Throughout these cruises members of staff from the Institute of Marine Environmental Research (IMER), Plymouth participated by undertaking aspects of work not of immediate application to a stock assessment.

This paper summarizes the results of these cruises in terms of the data collected as well as presenting some of the preliminary findings.

MATERIALS AND METHODS

The survey area was divided into ½ degree by ½ degree rectangles. Samples were collected at the centre of each rectangle on alternate latitudinal rows. They were taken with a 30 inch Lowestoft-pattern tin towed net (TTN) (Beverton and Tungate, 1967) towed at 5 knots from the surface to a maximum depth of 100 m and back to the surface. The majority of mackerel eggs float less than 100 m from the surface (Sette, 1943). During each tow the flow rate, sampling depth and temperature were monitored and recorded aboard CIROLANA (Harding et al., 1971), but aboard LA PELAGIA depth was recorded by Kelvin tube and flow rates were measured mechanically (Tungate and Mummery, 1965). On all cruises a 275 micron nylon net was used but the nose cone opening diameter was varied to minimize clogging.

Additional samples were collected with a Hardy continuous plankton recorder (CPR) (Hardy, 1936) towed at cruising speed between TTN stations. At selected positions both on and off the continental shelf vertical distribution samples were collected by towing a Hardy-Longhurst plankton recorder (LHPR) (Longhurst, 1967) from the sea-bed, or about 500 m maximum, to the surface.

On all cruises a continuous surface temperature record was kept and salinity samples were taken at each TTN station. A number of other environmental parameters were monitored aboard CIROLANA. A continuous record was kept of: % oxygen saturation, % light transmission (turbidity), pH, and in vivo total chlorophyll 'a' measured with a fluorometer. At each TTN station 250 ml sea-water samples were filtered and discrete measurements made of total chlorophyll 'a' and phaeopigments, and nannoplankton chlorophyll 'a' and phaeopigments (Lincoln, 1976).

Throughout the CIROLANA cruises an echo-sounder was run and major fish concentrations were identified by trawling with either a Granton trawl or Engels trawl. The trawling not only identified the echo trace but also provided material for studying egg development rates, fecundity and age-length compositions of the spawning mackerel.

RESULTS

No two cruises covered exactly the same area but the Celtic Sea, probably the most important area, was covered every month from March to July. The areas covered on each cruise and the number of samples collected are summarized in Table 1.

A preliminary inspection of the TTN samples has shown that the spawning commences in March along the very edge of the continental shelf from southern Biscay at least as far north as 52°N. Few, if any, eggs were taken at stations off the shelf edge and the egg counts dropped rapidly from several hundreds to tens at stations a little way on to the shelf. By May the spawning was far more widespread, and eggs were taken at most stations on the continental shelf but there was still an apparent concentration along the 200 m contour from Biscay to west of Ireland.

From March to June there were dense demersal echo traces in a narrow band along the edge of the shelf at 180-200 m depth. In March these traces extended from southern Biscay to 49°N. As the cruises proceeded this distribution moved further north until in June it was restricted to the Porcupine Bank area, and by July it had dispersed so that only small, scattered shoals were found. By trawling these major concentrations were identified as being predominantly scad (Trachurus trachurus L.) with a mixture of other species including mackerel. Even though trawl hauls were made with both the Granton and Engels trawls in the vicinity of high mackerel egg counts, mackerel were only ever caught when fishing on these dense 'scad' traces.

Mackerel at maturity stages IV-VI (Macer, 1976) were found in association with scad from March to June, and at stages VII-VIII in July. In March and June stage IV-V ovaries were taken from about 100 mackerel for fecundity estimates, and running fish were used to obtain material for development rate studies of both mackerel (Lockwood et al., 1977) and scad (Walker and Pipe, 1977).

Otoliths were taken from a sample of mackerel in each trawl haul to construct an age-length key. If it is assumed that all the mackerel caught on these cruises are part of the same spawning stock, irrespective of trawling position, two features are apparent. The first is that the large, older fish are dominant at the start of the spawning season, 40% older than 10 years in March, and the modal age decreases as the season progresses so that in June and July 3- and 4-year-olds dominate, 30% of the total. The second feature was that mean length at age also decreased as the season progressed, e.g.

	Age (years)		
	4	6	8
March	34.7 cm	36.2 cm	38.9 cm
May	32.5 cm	34.6 cm	36.3 cm
June	32.0 cm	33.4 cm	34.5 cm

At the end of each CPR tow between TTN stations the plankton silk was marked with the ship's position. This enabled the silk to be divided accurately into strips corresponding to 5 miles towed when it was removed from the CPR. The total numbers of valid 5 mile sections are given in Table 1, and these will be used to obtain a detailed geographical distribution of the eggs and larvae at 10 m depth. The vertical distribution will be established by analysis of the 34 samples collected with the LHPR.

Apart from the preliminary information on the distribution of the mackerel eggs there are no data available from any of the plankton samples yet. While sampling there were frequent problems with clogging due to the presence of salps and mucilaginous phytoplankton. Samples of this phytoplankton were sent to Dr G Boalch at the Marine Biological Association laboratory, Plymouth, who has identified it as Coscinodiscus nobilis, a diatom not previously recorded from this area. It occurred on all cruises over large areas of the survey grid.

The data collected with the environmental monitoring system are summarized in Table 2.

DISTRIBUTION OF THE DATA

The TTN samples are being worked up by staff at the Fisheries Laboratories of MAFF and ISTPM with a view to having a stock estimate by early in 1978.

The CPR and LHPR samples are being worked up by IMER staff and will probably be presented in conjunction with the TTN results to facilitate direct comparisons between the CPR and TTN sampling systems and their results.

Distribution charts and data tables of the environmental parameters monitored throughout these cruises will be made available through the MAFF Fisheries Laboratory Technical Report series.

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Table 1 Summary of the areas surveyed and the samples collected during the mackerel egg and larval surveys

Ship	CIROLANA	CIROLANA	LA PELAGIA	CIROLANA	CIRCLANA	CIROLANA
Cruise	3/77	4/77	OLMAC 77	5/77	6/77	8/77
Dates	10-31 Mar	6-27 Apr	23 Apr-10 May	4-22 May	31 May-15 Jun	12-27 Jul
Area	Bay of Biscay Celtic Sea	Celtic Sea Porcupine Bank	Bay of Biscay	Celtic Sea Porcupine Bank	Celtic Sea Porcupine Bank	Porcupine Bank Celtic Sea Bay of Biscay
No. of TTN tows	83	74	37	85	70	84
No. of CPR tows 5 mile sections	77 324	60* 263	-	76 267	76 391	-
No. of LHPR tows	7	13*	-	7	7	-
Trawl hauls containing mackerel	3	0†	-	1	3	1

* Includes samples collected on blue whiting survey north of Porcupine Bank.

† Large mackerel were caught north of Porcupine Bank.

Table 2 Environmental parameters monitored during the egg and larval cruises.
+ Parameters monitored
- Parameters omitted

	CIROLANA 3/77	CIROLANA 4/77	LA PELAGIA OLMAC 77	CIROLANA 5/77	CIROLANA 6/77	CIROLANA 8/77
Surface records						
Salinity	+	+	+	+	+	+
Temperature (continuous)	+	+	+	+	+	+
Turbidity (")	+	+	-	+	+	+
% oxygen (")	+	+	-	+	+	+
pH (")	+	-	-	+	-	-
In vivo chlorophyll 'a' fluorescence (continuous)	+	+	-	+	+	+
Total chlorophyll 'a'	+	+	-	+	+	+
Total phaeopigments	+	+	-	+	+	+
Nanno-plankton chlorophyll 'a'	+	+	-	+	+	+
Nanno-plankton phaeopigments	+	+	-	+	+	+
Temperature at 10 m (CPR)	+	+	-	+	+	-
Temperature-depth profiles						
TTN stations	+	+	-	+	+	+
LHPR stations	+	+	-	+	+	+

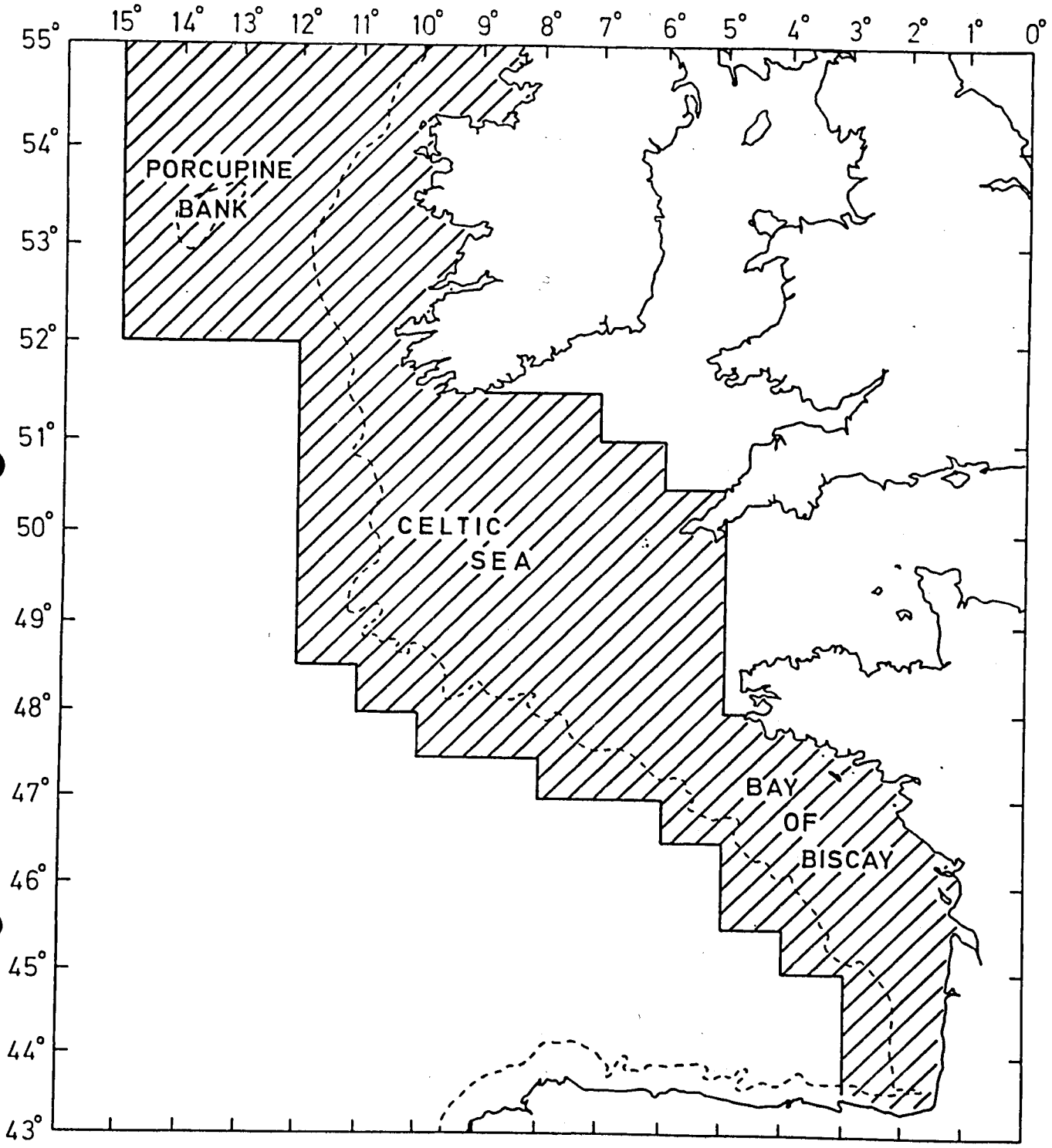

Figure 1. Shaded area shows mackerel spawning grounds surveyed during 1977