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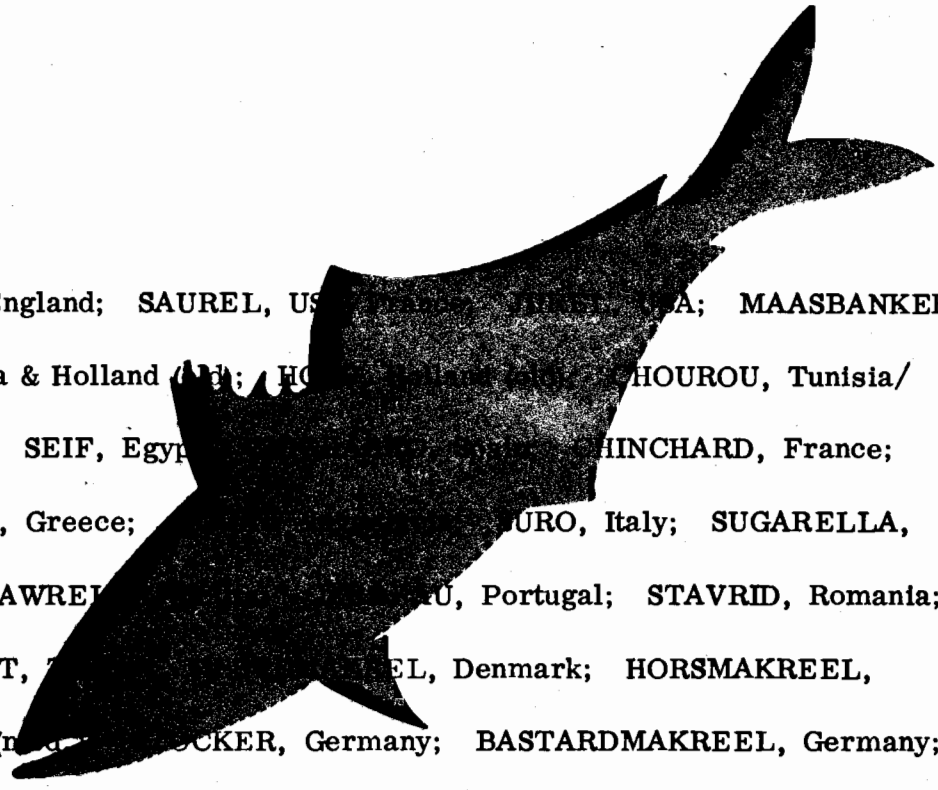
MINISTRY OF AGRICULTURE FISHERIES AND FOOD

DIRECTORATE OF FISHERIES RESEARCH

HORSE MACKEREL

Trachurus trachurus



SCAD, England; SAUREL, US[illegible]A; MAASBANKER, S. Africa & Holland (Ad); HO[illegible]HOUROU, Tunisia/ Algeria; SEIF, Egyp[illegible]HINCHARD, France; SAVRIDI, Greece; [illegible]URO, Italy; SUGARELLA, Italy; SAWREI[illegible]U, Portugal; STAVRID, Romania; ISTAVRIT, [illegible]EL, Denmark; HORSMAKREEL, Holland (m[illegible]CKER, Germany; BASTARDMAKREEL, Germany; TAGGMAKRELL, Norway; STAVRIDA, Russia.

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S.J. LOCKWOOD AND P.O. JOHNSON

LABORATORY LEAFLET No. 38

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Laboratory Leaflet Number 38

HORSE MACKEREL

by S. J. Lockwood and P. O. Johnson

INTRODUCTION

During the past ten years some of the fish stocks traditionally fished by UK vessels in the North Atlantic have declined to the point where rigid quota control is necessary. In the case of other stocks the extended national fishery limits of coastal states have limited access to UK vessels. This has resulted in a major cut-back in the UK fishing fleet and a redeployment of fishing effort.

Around 1972-74 there was a period of considerable interest in some deep-water species found to the west of Britain. Subsequently this interest waned and was replaced by renewed consideration of the possible utilization of the blue whiting stock west of Britain. This potential fishery holds great promise but there are a number of processing problems which must be overcome before it will be widely used to provide white fish meat. Since 1970 the Cornish mackerel fishery, and more recently that west of Scotland, have expanded dramatically as more and more vessels have turned to them to assist in their immediate economic survival. Prior to 1970 the total UK mackerel landings were less than 4 000 tons but by the end of 1977 this figure will have risen to about 150 000 tons. As well as providing a living to the traditional west country handline fleet, the fishery has also provided short-term relief to certain other sectors of the industry, notably the displaced herring fishermen. Unfortunately, the rapid rise in UK effort has been matched by an international increase such that the western mackerel fishery must be controlled to avoid over-exploitation of the stock. This may result in vessels equipped to fish mackerel looking for an alternative resource. The most suitable home-water stock to offer this is the horse mackerel or scad, Trachurus trachurus (L.), which forms dense overwintering shoals not unlike those of mackerel.

In this leaflet we review what is known about the horse mackerel's biology, its distribution, both seasonal and diurnal, and also what is known of potential catch rates. As the amount of horse mackerel landed in the UK has never yet been very great the information we have is based almost entirely on the results of research vessel fishing. This limits the amount of information available, particularly with respect to catch rates.

THE BIOLOGY OF HORSE MACKEREL

Appearance

The common name, horse mackerel, is misleading as it is applied to a wide variety of fish throughout the English speaking world. With the exception of the blue fin tuna (Thunnus thynnus L.) and the bonito (Sarda sarda Block) which are sometimes called horse mackerel on the east coast of the USA, the majority of horse mackerels are members of the trachurid family and look similar to our own horse mackerel, Trachurus trachurus. In the UK it is also known as the scad.

The horse mackerel (Figure 1) is relatively deeper for its length and is laterally more compressed than the mackerel. The head is heavy and large, about one-third the

total length. Along the lateral line, which is prominent and stepped, the scales have developed into bony scutes which carry spines. The spines increase in size towards the tail. The back is blue-grey with greenish tints, the flanks are silvery and the belly is white.

In British waters the majority of horse mackerel caught are between 25 and 35 cm total length, but they do grow up to 45 cm. In the southern Celtic Sea and Bay of Biscay much larger horse mackerel can be caught but they are the related species Trachurus picturatus (Bowditch).

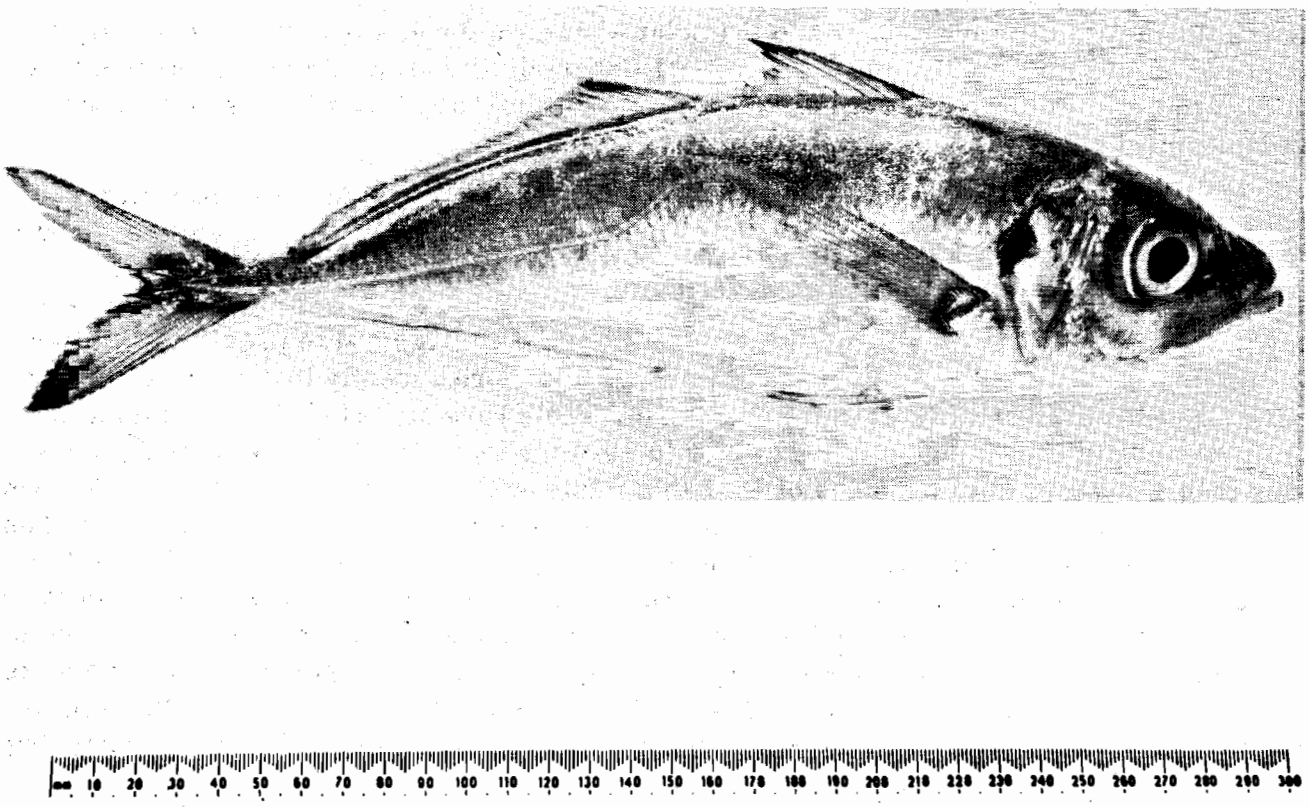

Figure 1 The horse mackerel or scad, Trachurus trachurus L.

Geographic distribution

The species Trachurus trachurus is limited to the Atlantic basin. In contrast to the mackerel which is common on both sides of the North Atlantic, the horse mackerel is rarely caught off North America. It is, however, found throughout the eastern Atlantic from the Norwegian fjords in the north to the southern tip of Africa. (The South Africans have exploited this species, known locally as 'maasbanker', since the early 1940s.)

Trachurus trachurus also occurs in the Mediterranean and possibly even the Black Sea, but whether or not it is common or locally abundant is difficult to say as it may be easily confused with other Trachurus species.

Spawning and early life history

In common with mackerel the horse mackerel overwinter in very dense shoals. These shoals are found along the edge of the continental shelf (Figure 2) and also in more localized coastal waters such as off Start Point (50°13'N 3°38'W) and Beachy Head (49°33'N 00°15'E). During the spring spawning commences and the shoals begin to disperse.

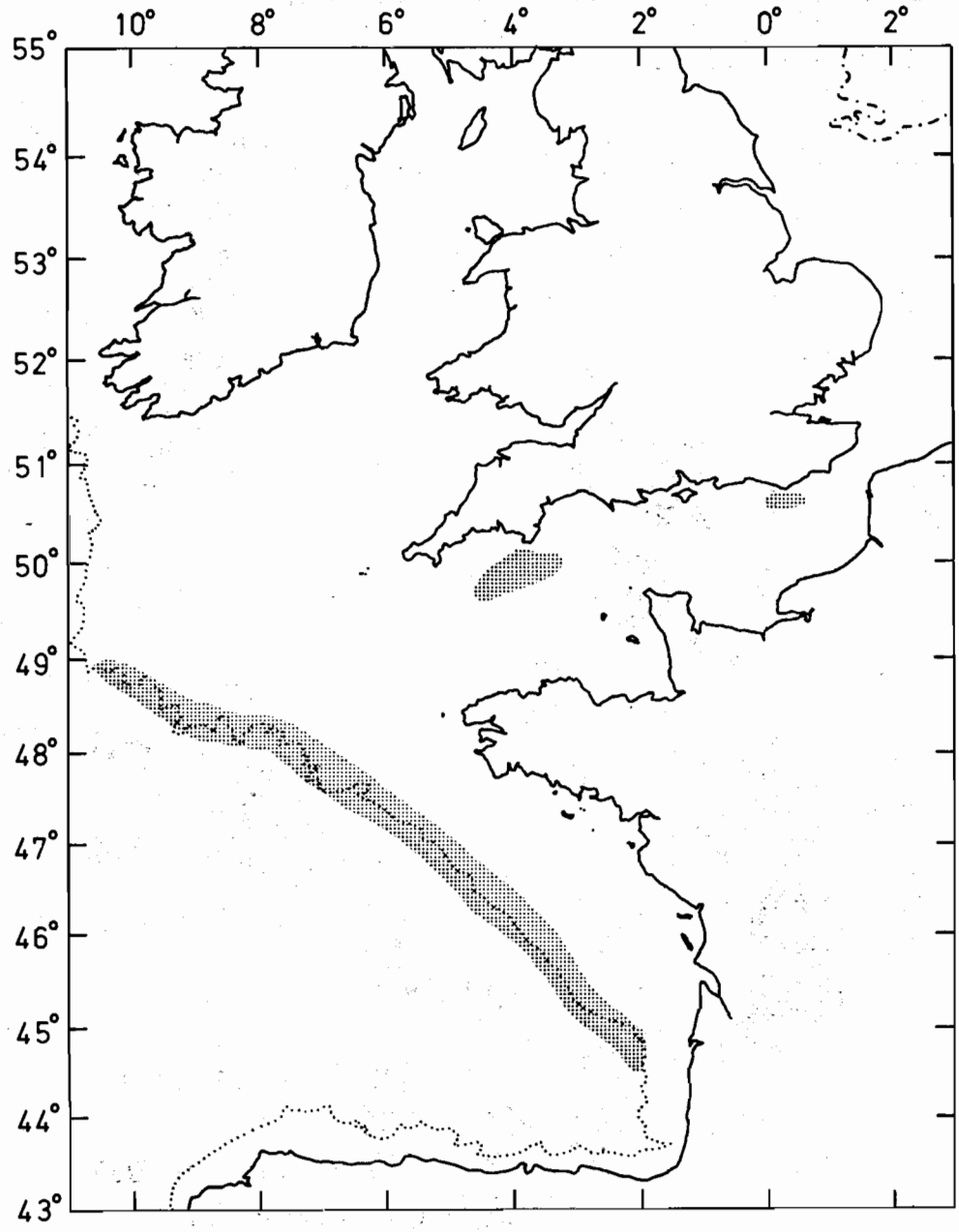

Figure 2 The distribution of major horse mackerel concentrations (shaded areas) found in winter months on recent MAFF research vessel cruises.

As horse mackerel eggs will not develop at temperatures below 10°C, the spawning begins in southern Biscay in March and spreads northwards as the sea temperature rises. From May to August horse mackerel eggs may be found in the plankton anywhere from the Bay of Biscay and Celtic Sea area eastward to the North Sea south of the Dogger Bank (Figure 3). At 16°C (the middle of the viable development temperature range) horse mackerel eggs take $2\frac{1}{2}$-3 days to hatch as a planktonic larva 2.5 mm long (Figure 4). By the end of the year they will be recognizable small horse mackerel about 10 cm long. At

this size the young horse mackerel feed mainly on zooplankton and usually form shoals independent of larger fish. During their second year their diet gradually changes to include an increasingly greater proportion of other small fish. They grow a further 10 cm to reach about 20 cm by their second winter. By this time they begin to form shoals with larger fish which have been feeding all summer on fish and crustaceans.

Following their second winter the larger young fish will spawn for the first time but the majority will not spawn until they are 3 or even 4 years old.

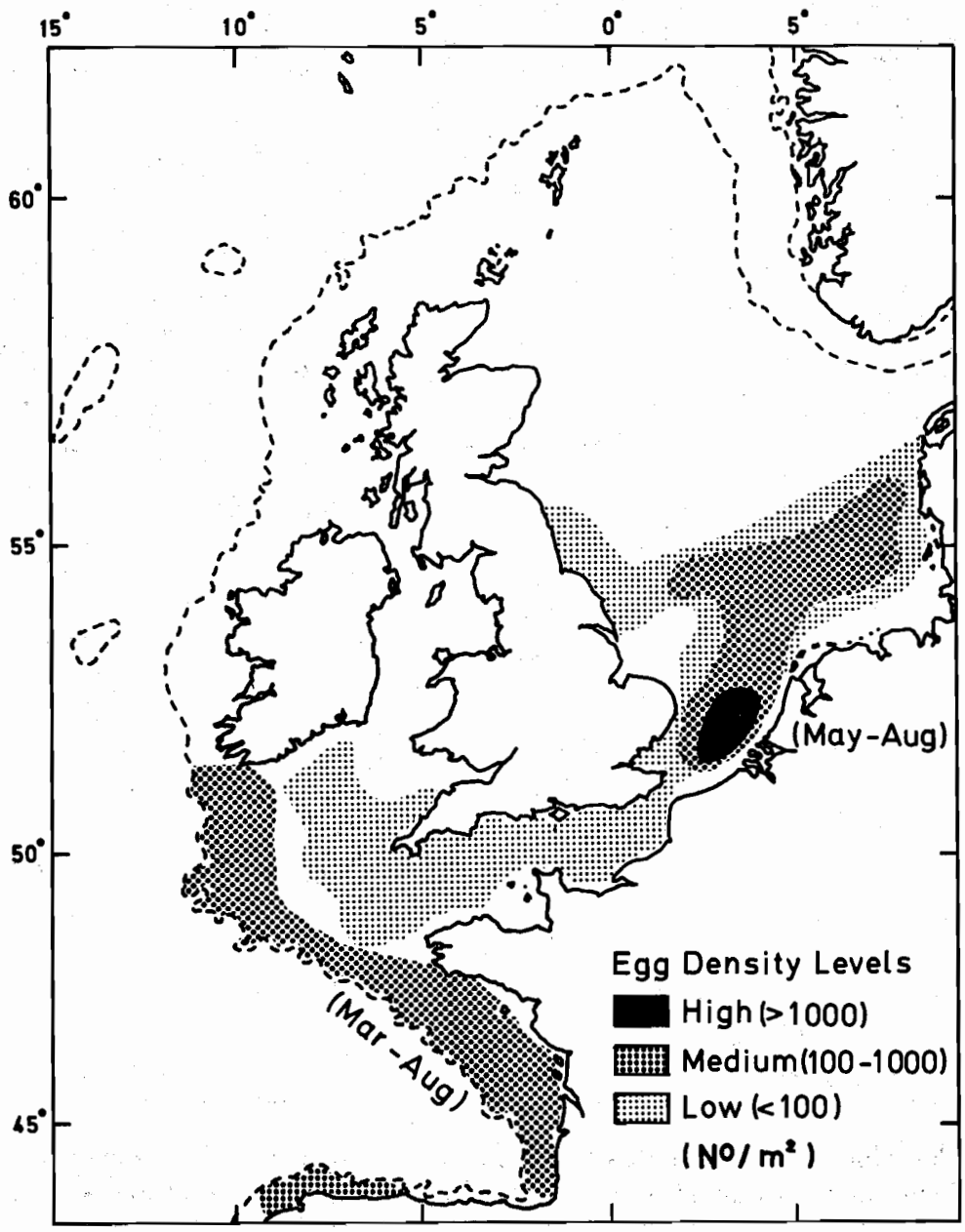

Figure 3 The spawning distribution of horse mackerel. The egg distribution is based on the results of several surveys from different years.

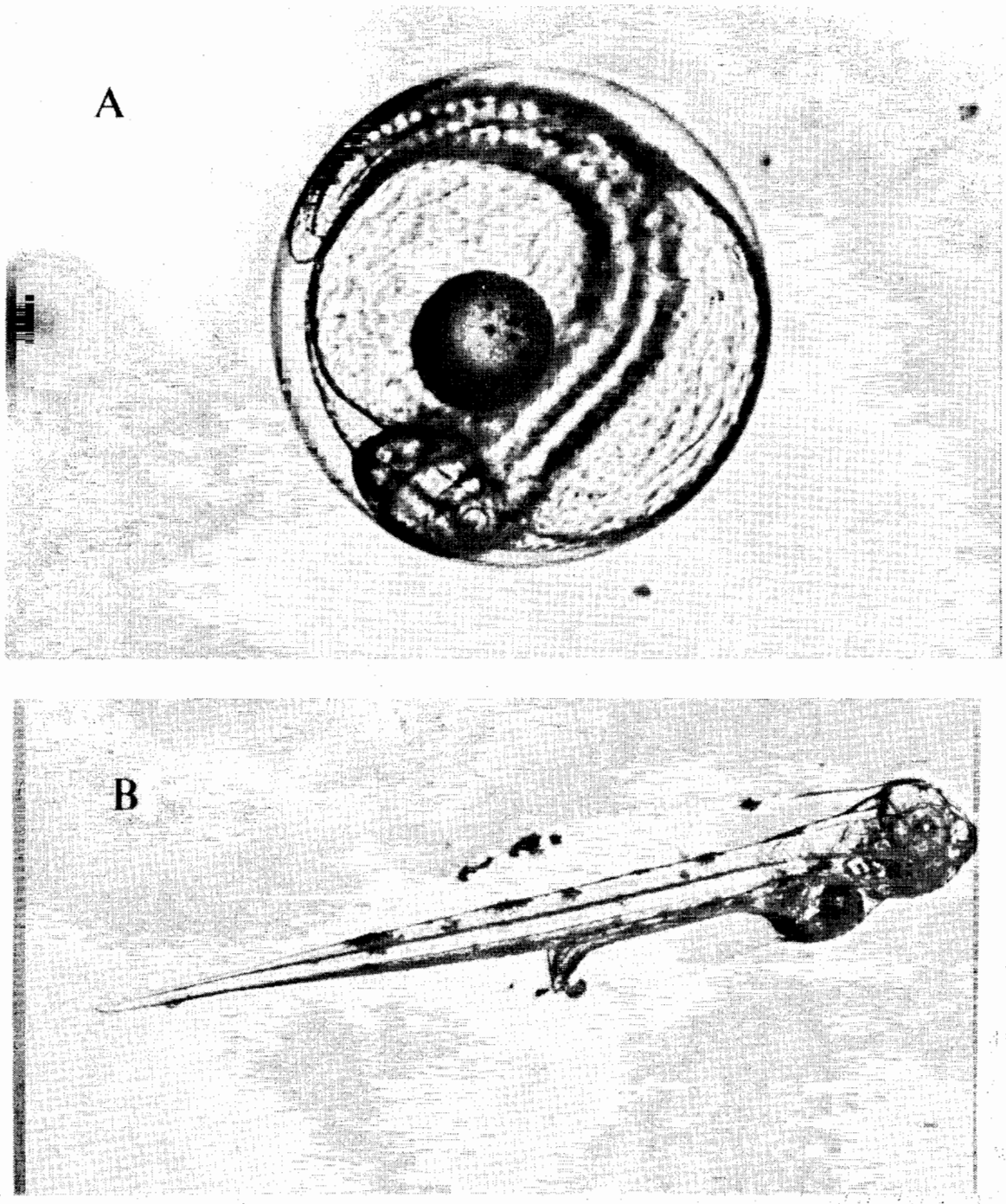

Figure 4 A: A horse mackerel egg showing a well-developed larva prior to hatching; B: a recently-hatched larva less than 3 mm long. At this stage it still takes in the food stored in the yolk sac below the abdomen.

Annual fat cycle

In common with most fish, but particularly other pelagic species, the horse mackerel has an annual fat cycle which is linked to its feeding and spawning activity. The fat level reaches a peak of about 15% in the autumn after the summer period feeding and is lowest, 6-7%, during the spawning season (Figure 5). As with other pelagic species the moisture content varies inversely with fat content so that the fat/moisture content maintains a very stable 80% of the total weight. This stable relationship is very similar to those found by Wallace and Hulme (1977) for mackerel, pilchard and sprats from the English Channel, the main difference being that the fat/moisture content accounts for about 85% the total weight in these species and the annual fluctuations in fat content are greater, particularly in mackerel.

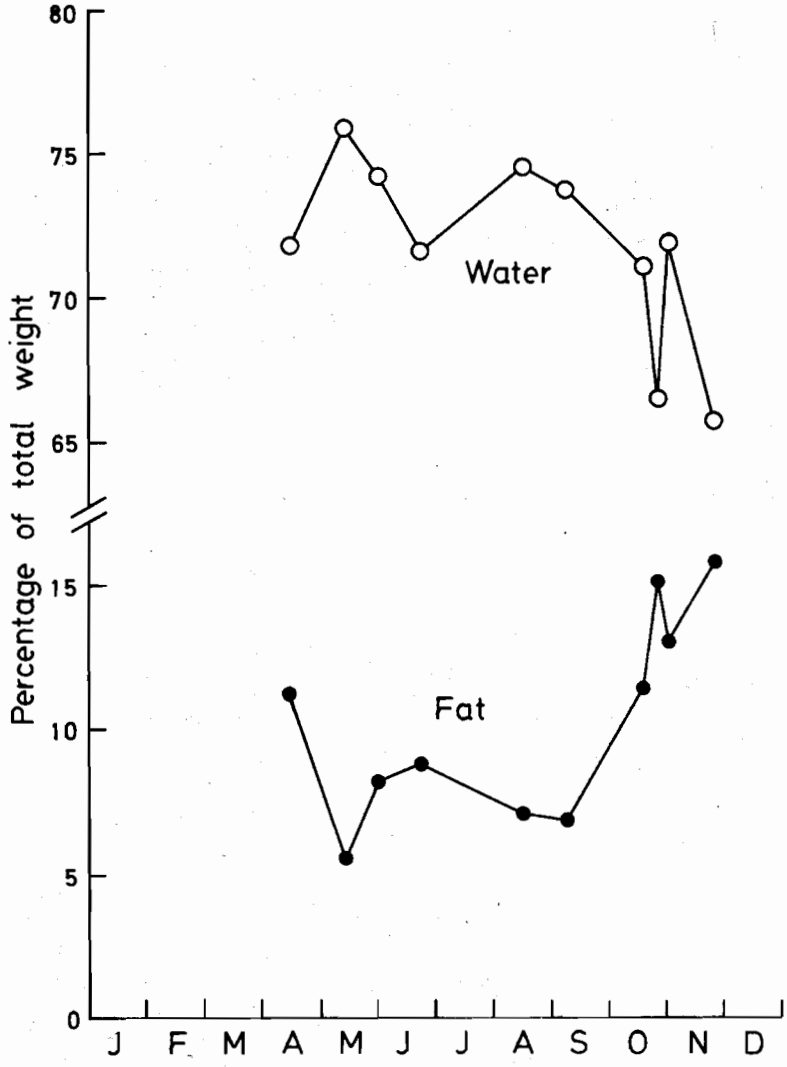

Figure 5 The annual fat/water cycle in horse mackerel flesh.

Growth

A simplified outline of growth patterns for the first 2-3 years has already been given - about 10 cm after one year, 20 cm after 2 years, 25 cm after 3 years. Thereafter growth is less easy to define.

The usual technique for assessing the growth rate of fish is to remove the otoliths, small loose ear stones, from the middle ear cavity and to count the annual growth check rings and then to relate these to the length of the fish. From a large sample of fish the average lengths at age are obtained and a growth curve fitted mathematically. Although the rings on horse mackerel otoliths are clearly visible, the relationship between length and growth check rings is not adequately described by the standard mathematical technique using the von Bertalanffy equation (Figure 6). The observed growth rate levels off considerably faster than the theoretical curve fitted to the observed data. This suggests that the otolith rings may not be annual check rings. One possible, but as yet unconfirmed, explanation for this phenomenon is the possibility of more than one growth check per season, e.g. the usual winter check and another at the onset of spawning. Despite these ageing problems, Figure 6 shows quite clearly that the initial growth rate is rapid, but that at 3-4 years of age, with the onset of sexual maturity, the growth rate diminishes markedly.

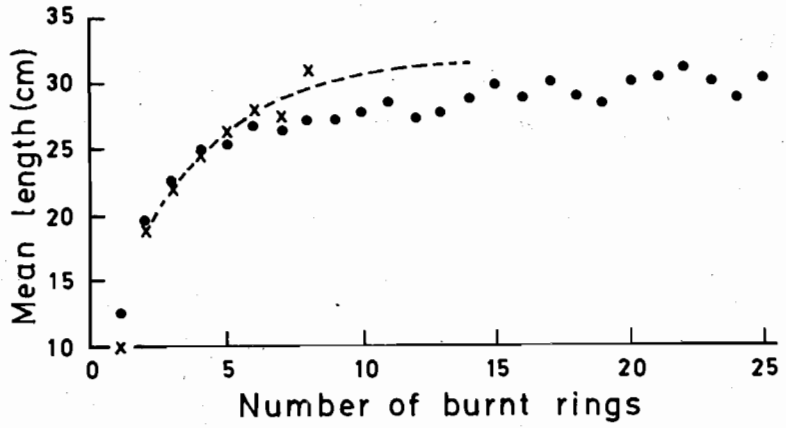

Figure 6 The relationship between mean body length and the number of otolith check rings (•Macer 1977, xPolonsky 1967). The broken line is the 'growth curve' fitted to the data by the von Bertalanffy equation.

What is of greater interest to the fisherman is the rate at which the fish increase in weight rather than length. The rapid increase in length lasts until the fish are about 25 cm long, but at this size they weigh less than 200 g or about 6 oz (Figure 7). It is not until they are over 30 cm (1 ft) long that their weight begins to increase very markedly. Even so, it is unusual to catch a horse mackerel in British waters which compares in size and weight to the large or 'jumbo' mackerel which are characteristic of the Cornish and west of Scotland fisheries.

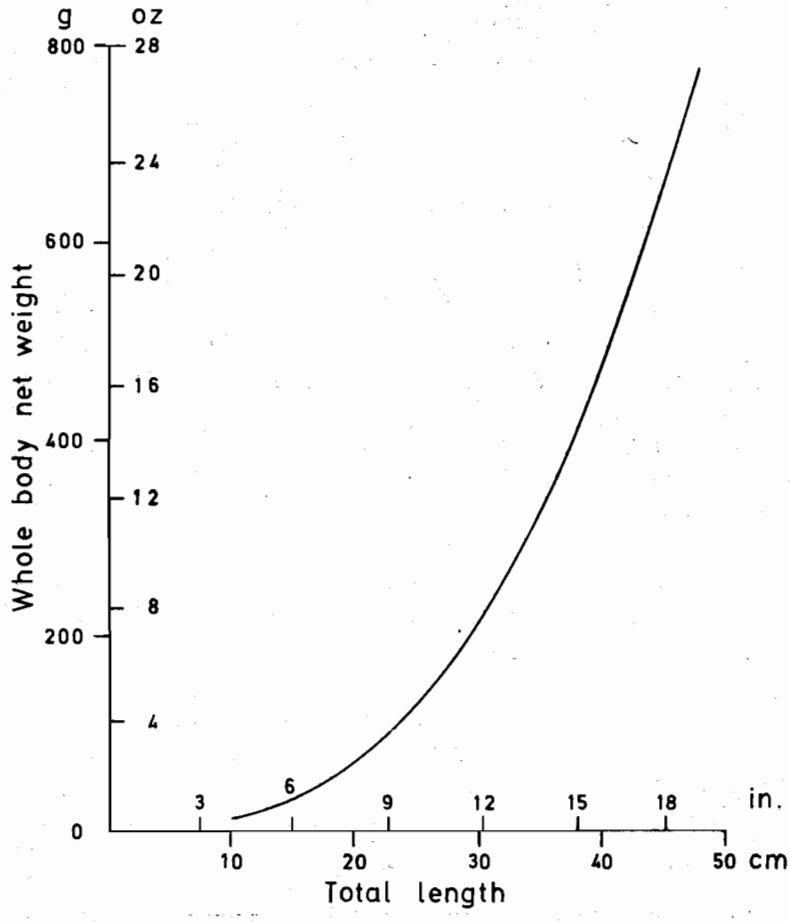

Figure 7 The weight/length relationship for horse mackerel collected from several positions around the UK between March and December.

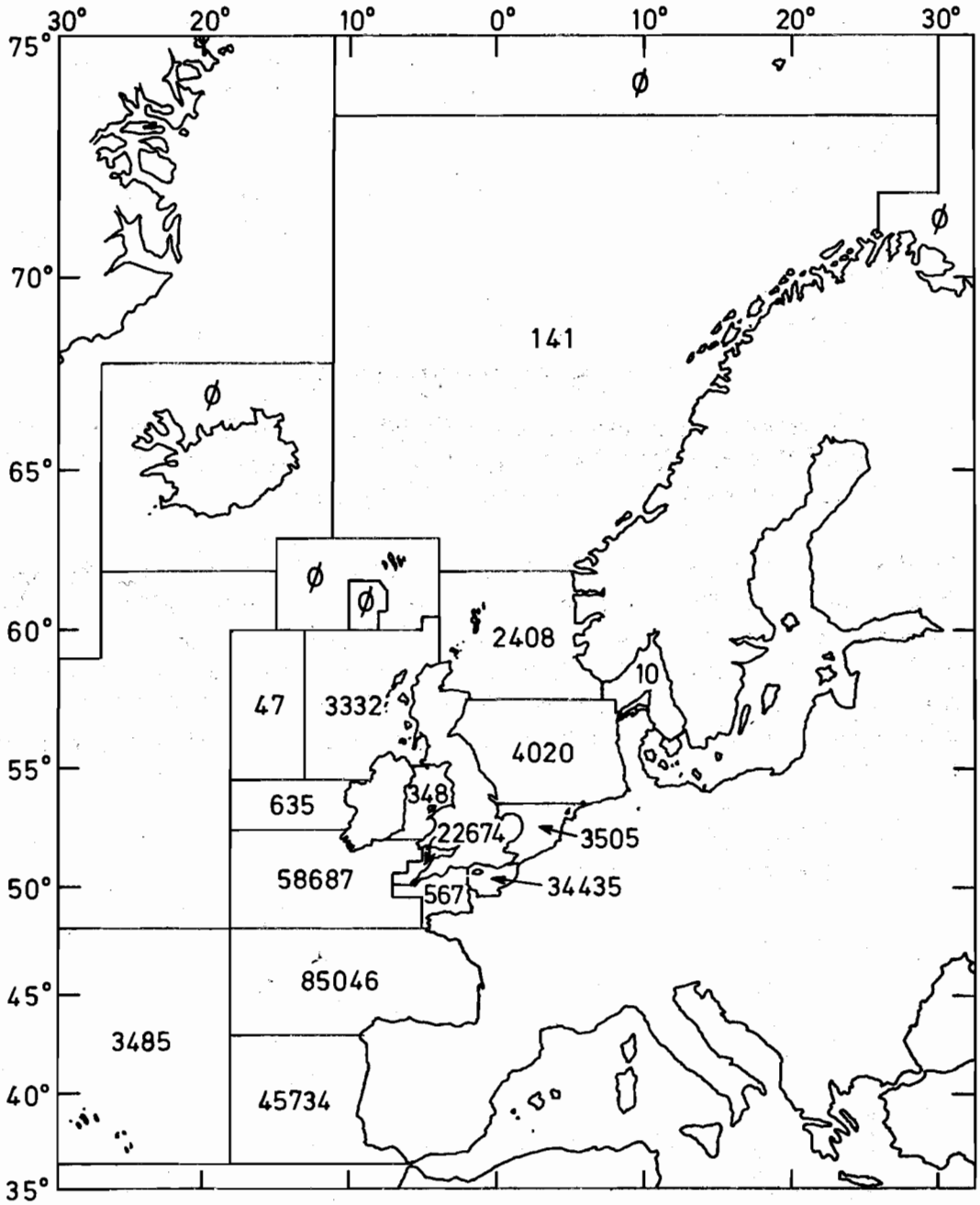

Figure 8 The total international horse mackerel catch in 1975 by ICES divisions. Divisions where landings were not made in 1975 but have been made previously are marked Ø.

HORSE MACKEREL FISHERIES

The best documented long-term fishery for the horse mackerel has been the South African 'maasbanker' fishery. The average total landings for the period 1950-71 were 49 500 tons or 21% of the total South African pelagic fish landings. During the early 1950s over 100 000 tons were landed in each of three separate years, but since 1967 catches have only once exceeded 10 000 tons.

Within the ICES (International Council for the Exploration of the Sea) areas of the North-east Atlantic (Figure 8) only the Spanish and Portuguese catches have shown the

same long-term consistency as the South African catches. Their combined total contributed over 90% of the total international catch of horse mackerel reported to ICES until the late 1960s when other nations began to land increasing quantities. Figure 8 shows that large quantities of horse mackerel are still taken in the areas most actively worked by the Spanish and Portuguese fleets, i.e. south of 50°N, but the importance of UK home waters is increasing (Figure 9). Since the mid-1960s the catches from Biscay and west of Portugal have declined whereas catches west of Britain, in the English Channel and in the North Sea have increased more than tenfold.

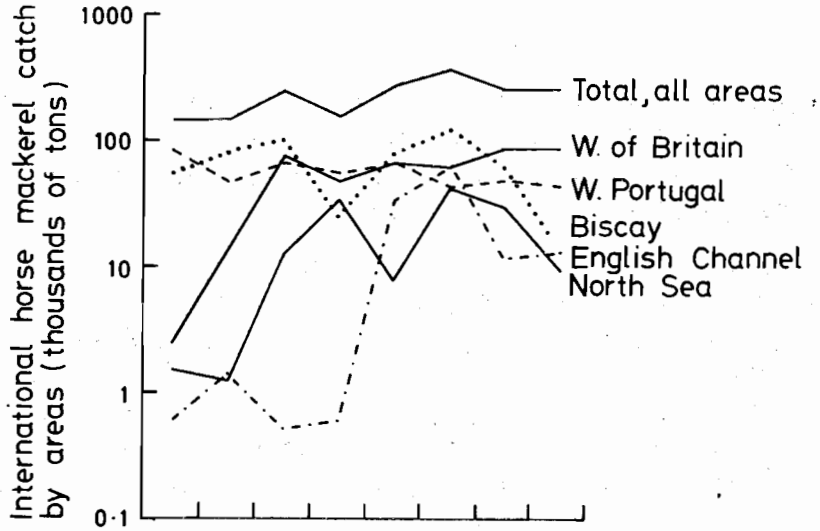

Figure 9 The total international horse mackerel catch and the international catch in each of the more important areas, 1968-75.

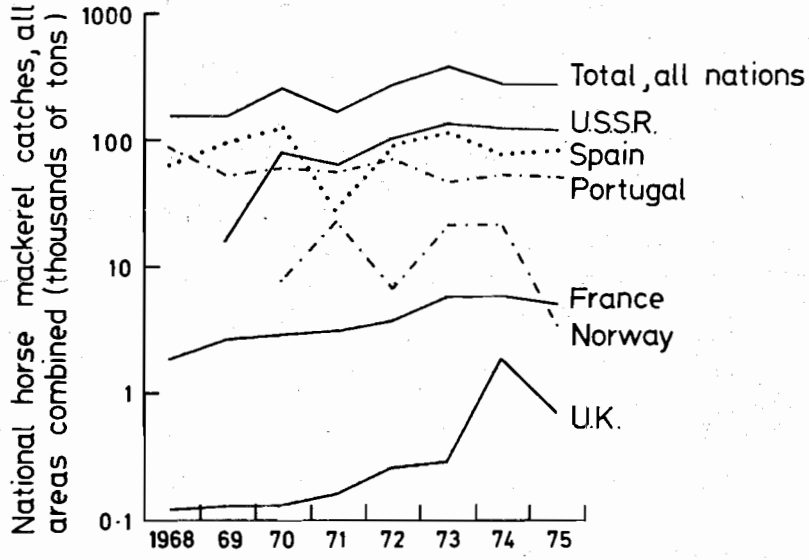

Figure 10 The horse mackerel catch by nations, 1968-75.

Despite these increases within our home waters the total annual UK catch has only once exceeded 1 000 tons in the past decade (Figure 10). The French catch has risen steadily but has not exceeded 10 000 tons. The Norwegian catch, which is primarily a by-catch from their North Sea mackerel fishery, has fluctuated around 10 000 tons per annum. Apart from Spain and Portugal the only nation to report annual catches in excess

of 10 000 tons has been the USSR. Since 1972 Soviet vessels have taken over 100 000 tons, much of it from the waters around the UK, and so accounted for almost 50% of the total international catch. This rapid rise in the Soviet catch does not necessarily signify an increased interest on the part of the USSR in fishing specifically for horse mackerel. It is more probably just another feature of its increased pelagic fishing activity in the North-east Atlantic. Over the same period, 1968-75, that the USSR's horse mackerel catch increased from 13 000 to 120 000 tons its mackerel catch increased from 6 000 to 320 000 tons and its total herring catch from 70 000 to 108 000 tons.

CATCH RATES

It is difficult to give an accurate picture of catch rates as the size of vessels and the gear being used varies so much. It is also difficult to obtain detailed catch rate data from specific vessels of other nations. However, we do have some information relating to vessels working in the Celtic Sea and English Channel.

In the Celtic Sea area the French and Spanish vessels are usually less than 35-40 m in length and those using demersal fishing gear rarely catch more than 1 ton of horse mackerel per day. These vessels are primarily white fishing and the horse mackerel is a by-catch which, unlike UK vessels, they retain. The larger Soviet vessels, 70-100 m long, using both pelagic and demersal gear have recorded catch rates of horse mackerel as high as 50 tons per day but 5-10 tons per day is probably a more consistent figure. In all cases the horse mackerel is mixed with a high proportion of mackerel or white fish.

In the English Channel the only information available is from Soviet commercial vessels and English research vessels. The Soviet catch rates have been reported as 4 tons per hour's fishing and also as 50 tons per day during the winter months. MAFF research vessels (73 m CIROLANA, 59 m ERNEST HOLT and 41 m CORELLA) have recorded catch rates of 8-15 tons per hour off Plymouth, Start Point, and Beachy Head on a number of occasions during the winter months.

SEASONAL AND DIURNAL DISTRIBUTION AND AVAILABILITY

The horse mackerel is at minimum availability during its spawning season, March-August, when shoals are individually small and widely scattered. A research vessel survey of the Southern Bight of the North Sea during July 1969 found that even within the main spawning area catch rates with a midwater trawl were only a few baskets per hour. This was also found to be the case on surveys in the Celtic Sea during June and July 1977. In contrast, it should be possible to commercially exploit the overwintering shoals of horse mackerel as a directed fishery as these shoals are large and at a high density.

Research vessels have shown that one of these overwintering grounds is readily accessible to UK vessels; it is that between the Eddystone (50°10'N 4°12'W) and Start Point and from 10 to 25 miles off the coast (Figure 11). Large shoals have consistently been found within this region in the winter months and they have occasionally been exploited by Plymouth-based pelagic trawlers, as well as fleets of Eastern Bloc vessels. The horse mackerel is the dominant pelagic species in the area, but small quantities of other species are caught with it, particularly near the coast, e.g. sprats, mackerel, anchovy and pilchards. The main winter mackerel fishery is geographically well separated from the horse mackerel shoals (Figure 11) but quite large pilchard shoals are sometimes found in the area east of the Eddystone.

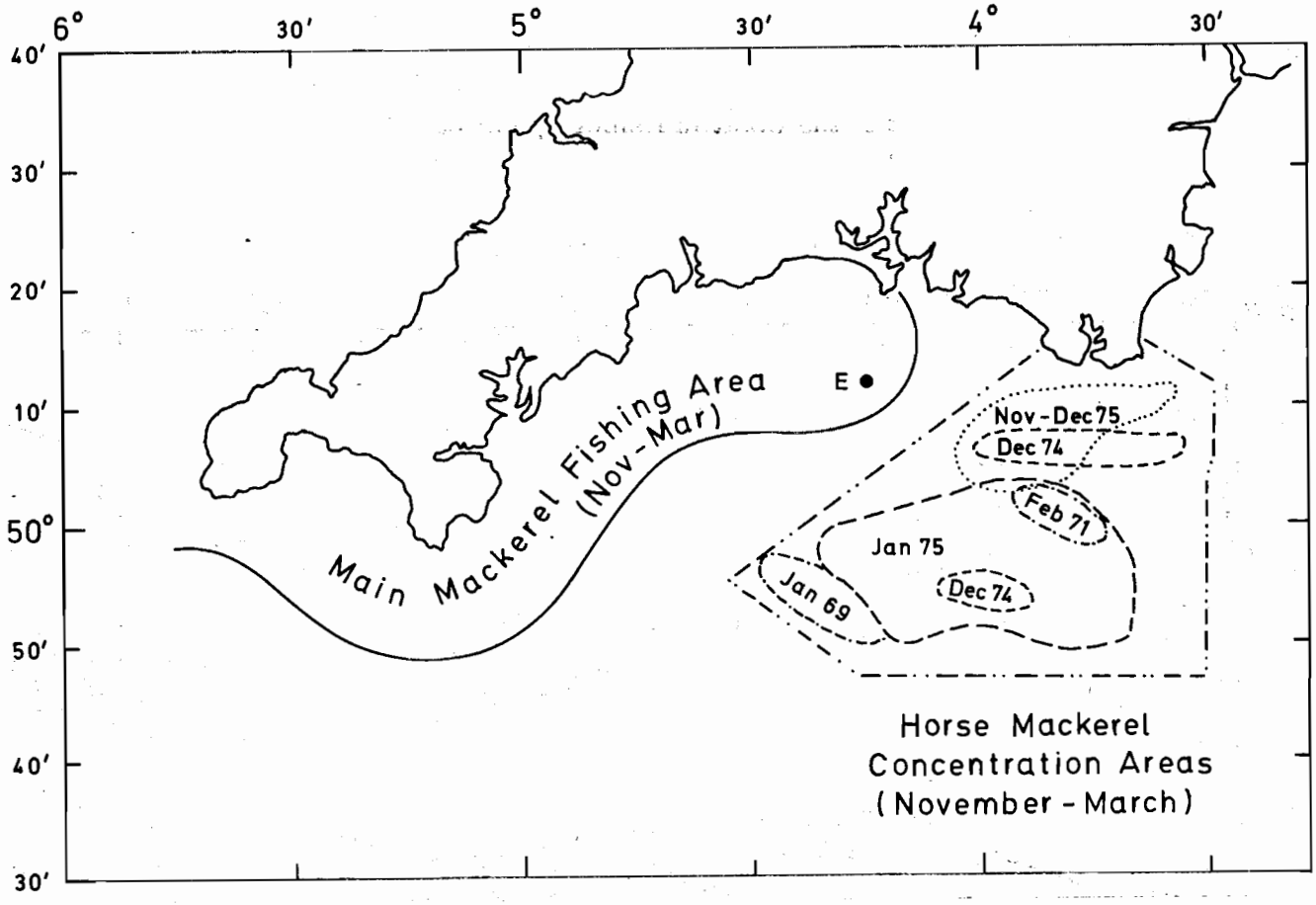

Figure 11 The distribution of major horse mackerel concentrations off south Devon between November and March in recent years. E - Eddystone Lighthouse.

Large shoals of horse mackerel have also been found in the winter a few miles off Beachy Head (Figure 12). They are probably fish which have spent the summer in the southern North Sea and are on their way west to their overwintering grounds.

The most extensive overwintering grounds are those which occur along the edge of the continental shelf from southern Biscay to about latitude 49°N (Figure 2). The fish occur as an almost continuous layer, on or near the bottom at a depth of 180-250 m. The density of this layer varies but there are areas, particularly at the northern end of the distribution, where it is very dense and potentially high catch rates are indicated. As with the Start Point shoals, these shoals are mixed with other species: mackerel, blue whiting, hake and a variety of small gadoid (cod family) species.

During the winter months the horse mackerel shoals follow a characteristic daily behaviour pattern which can be seen on an echo-sounder record. During the day they remain very close to the sea-bed (Figure 13) and can be caught with a Granton trawl, but a high headline bottom trawl or a pelagic trawl used very close to the sea-bed are more suitable. At night the shoals lift a few metres clear of the sea-bed and then gradually spread out laterally to merge with neighbouring shoals, a process which results in a more diffuse but continuous layer (Figure 14). Under these conditions the fish are vulnerable to a pelagic trawl. This layer usually remains in the lower half of the water column and maintains a fairly uniform thickness throughout the night. In this respect the horse mackerel differs from other pelagic species such as mackerel, pilchard and sprat where the process of dispersal can lead to the total loss of shoals or layers as the fish move toward the surface.

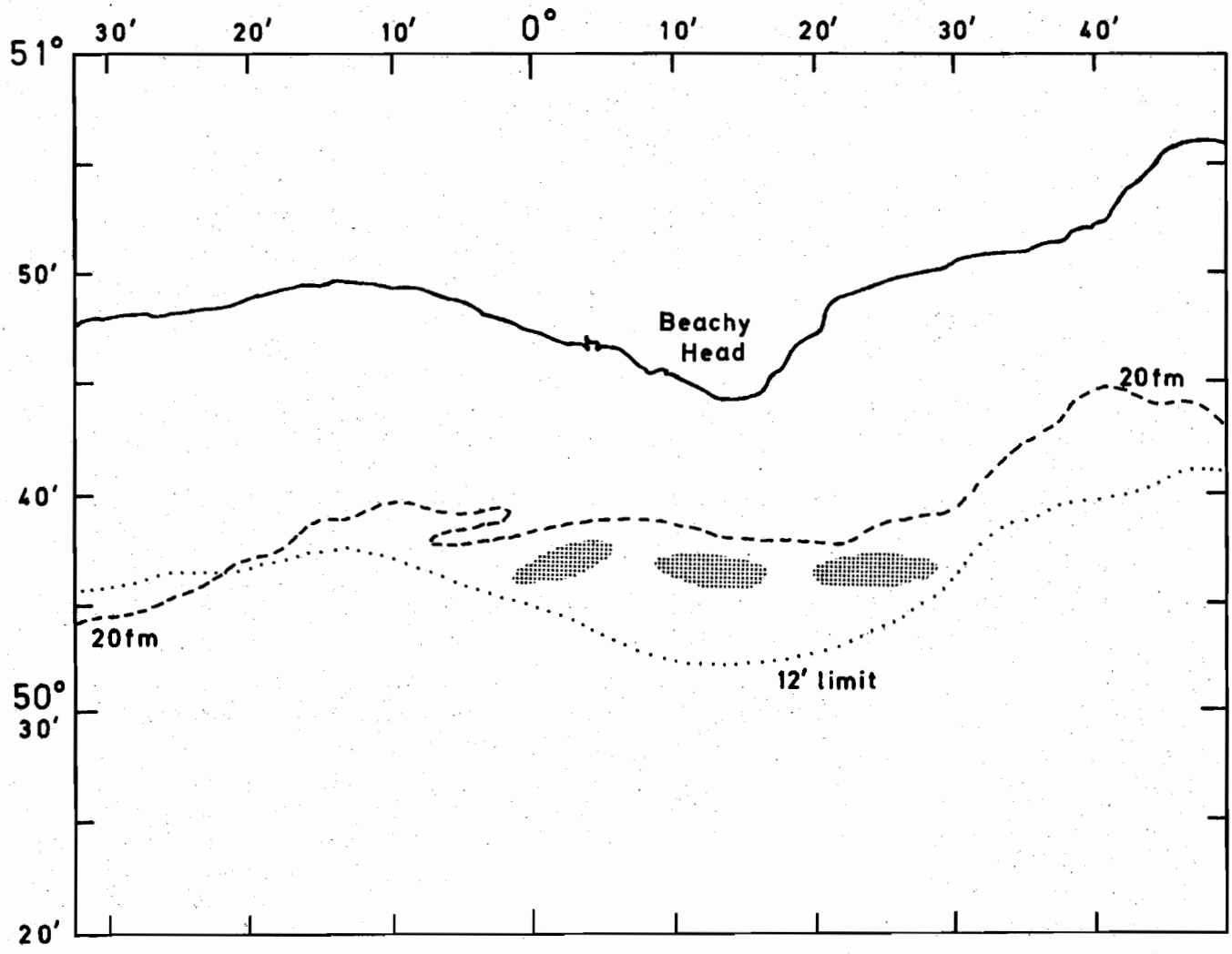

Figure 12 The position of large horse mackerel shoals found off Beachy Head by RV CORELLA in the winter of 1970/71.

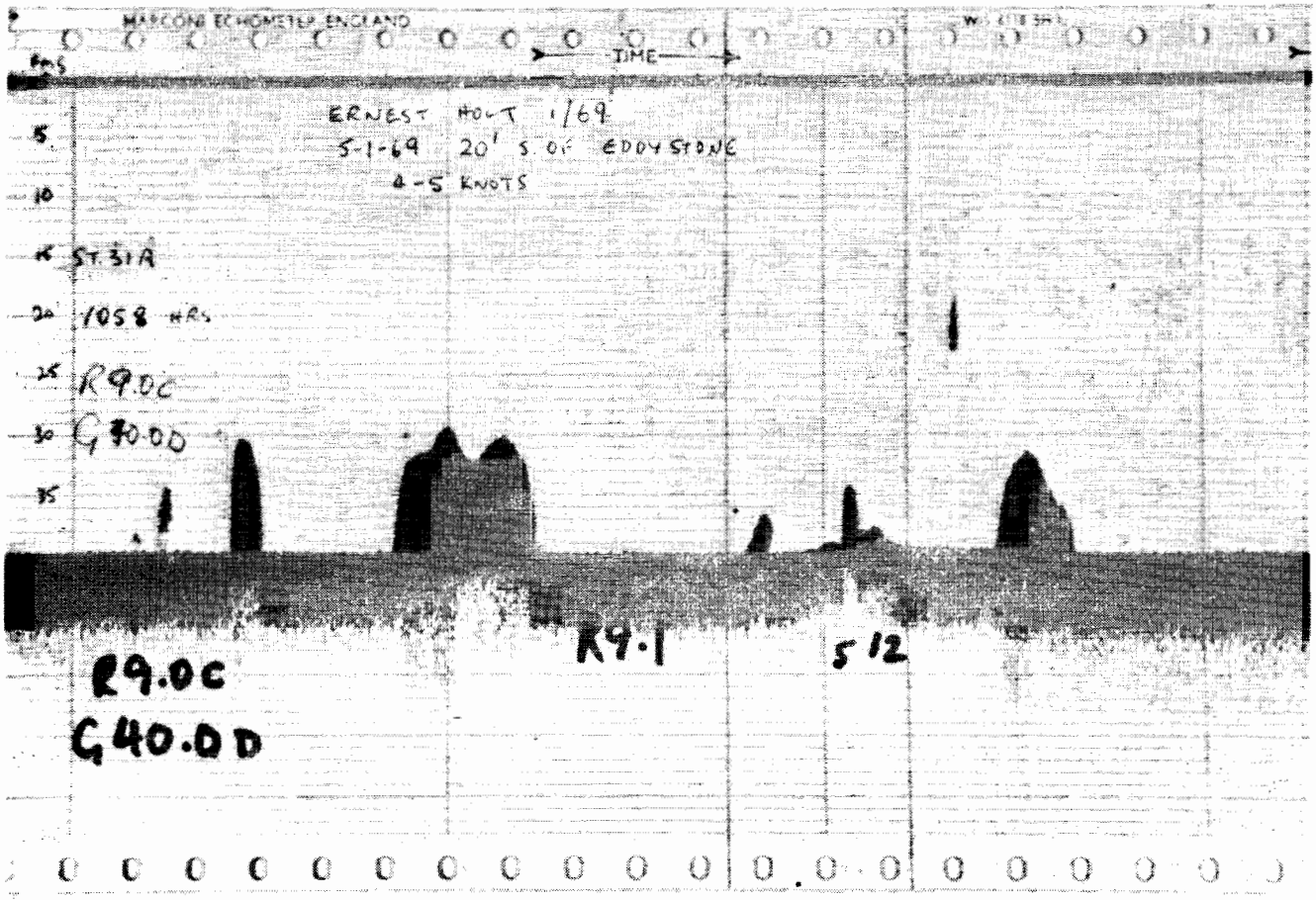

Figure 13 A characteristic echo record of horse mackerel shoals in daylight.

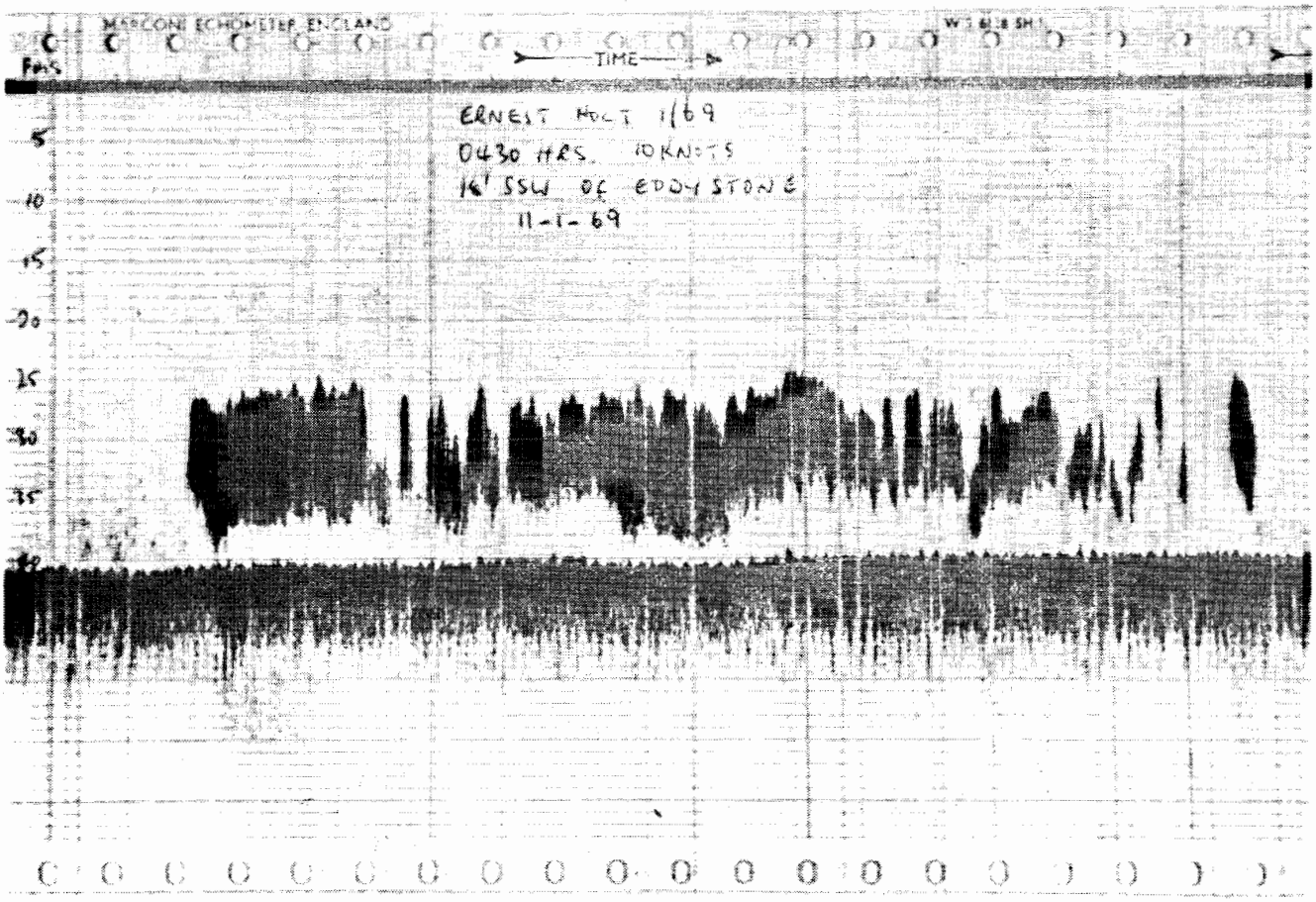

Figure 14 A characteristic echo record of horse mackerel shoals at night.

LENGTH COMPOSITION OF THE STOCK

At present there is no minimum size regulation applying to horse mackerel but it is in the interests of fishermen to avoid catching juvenile fish (less than 20 cm). Larger fish are less likely to become enmeshed in trawls and seines, which makes handling the net on deck easier. It is also important to avoid catching small, young fish in order to safeguard the continuing recruitment to the spawning stock.

Measurements of samples taken at different times of year from areas around the British Isles show that the largest fish are consistently found along the edge of the continental shelf from the west of Scotland to the Bay of Biscay. Length frequency distributions from this region for the period January to June are shown in Figure 15a. The longest fish recorded was 44 cm with the majority from 30 to 40 cm, but in Biscay smaller (5-15 cm) fish were also caught. There were very few fish in the intermediate (15-30 cm) size range. By comparison this group dominates the samples taken from the western English Channel (Figure 15b), particularly in the winter. In the central and southern North Sea the fish were predominantly 25-30 cm with occasional groups of fish smaller than 25 cm, but rarely more than the odd individuals greater than 30 cm (Figure 15c).

The general picture from these length distributions suggests that most of the fish which spawn and feed during the summer and autumn months in the southern and central North Sea originate from the fish overwintering in the English Channel. Furthermore, the relative scarcity of larger fish (30-40 cm) overwintering in the Channel compared with the predominance of these fish along the edge of the continental shelf suggests that there could be emigration of fish away from the coastal overwintering grounds as they reach the larger size.

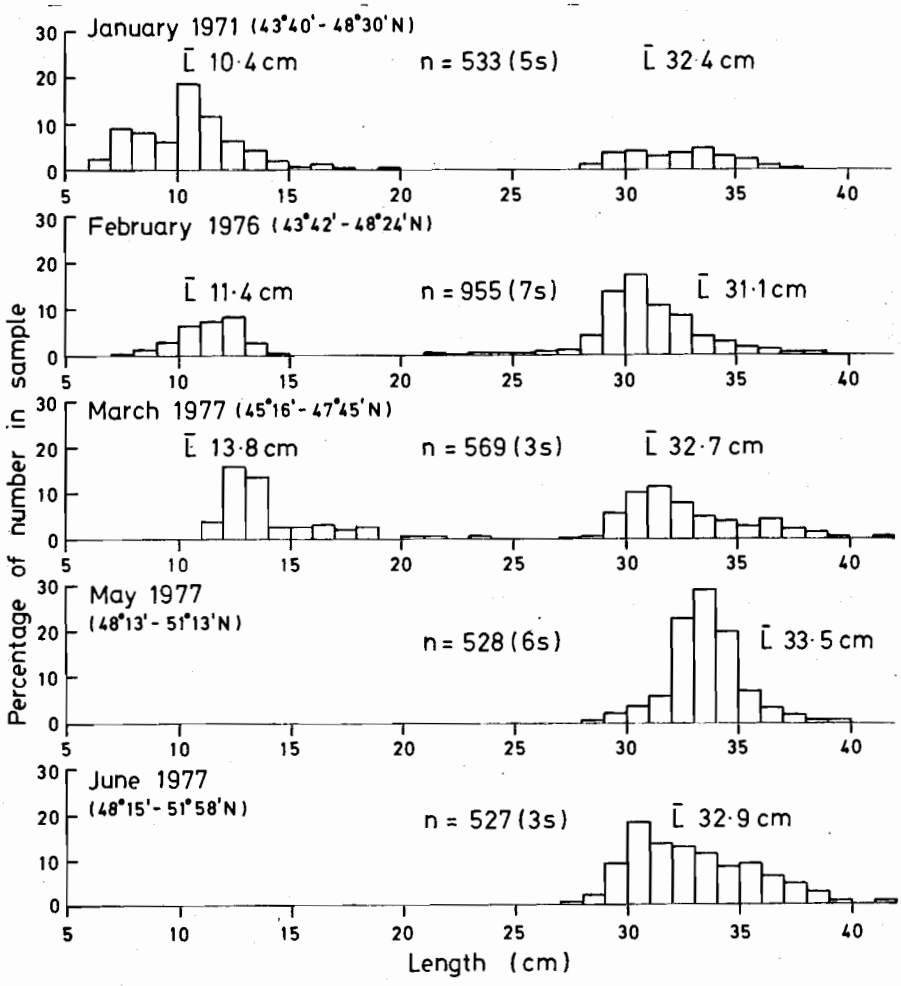

Figure 15A Length frequency distributions of horse mackerel from the Bay of Biscay and Celtic Sea area, January to June.

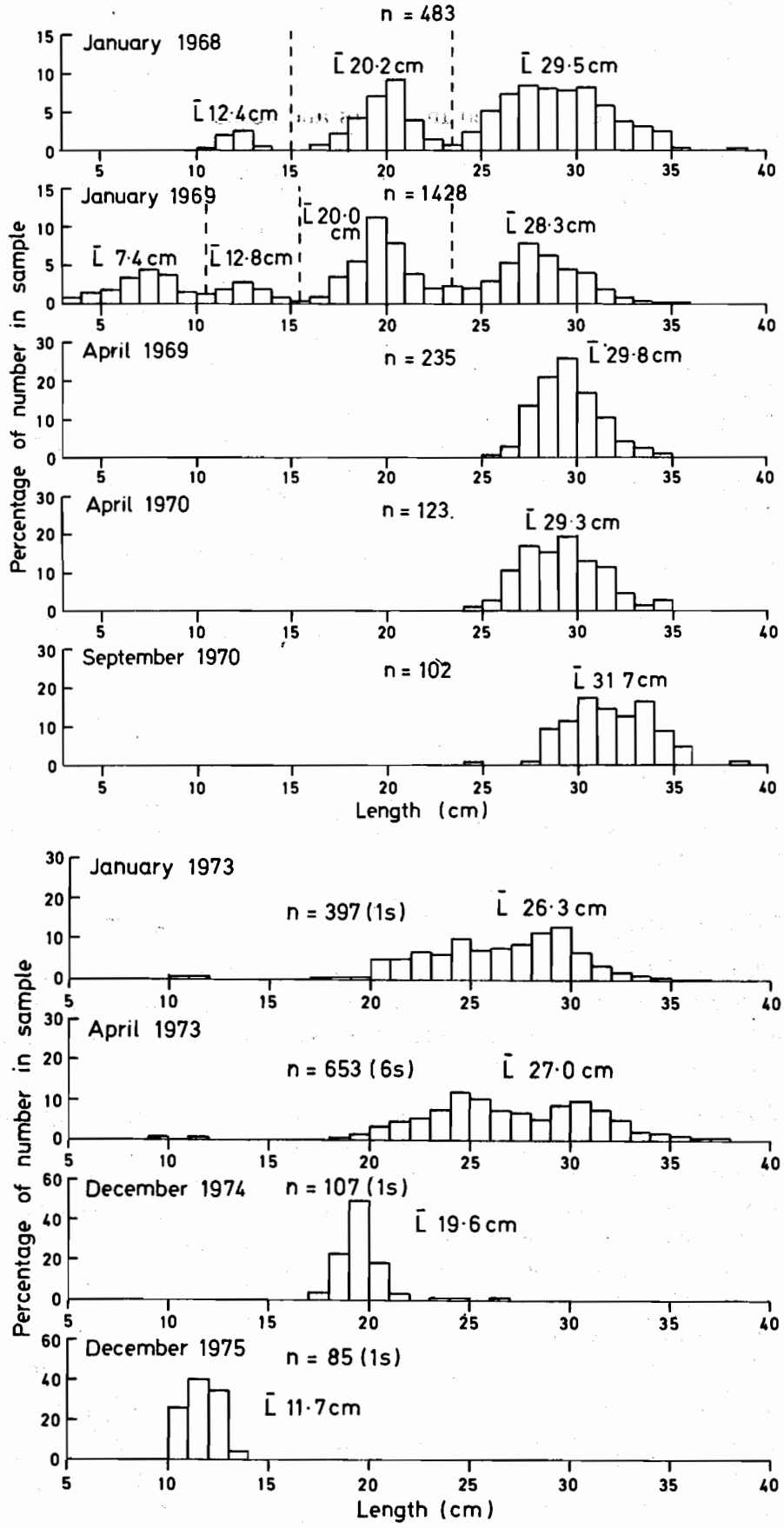

Figure 15B Length frequency distributions of horse mackerel from the vicinity of Eddystone and Start Point, September to April.

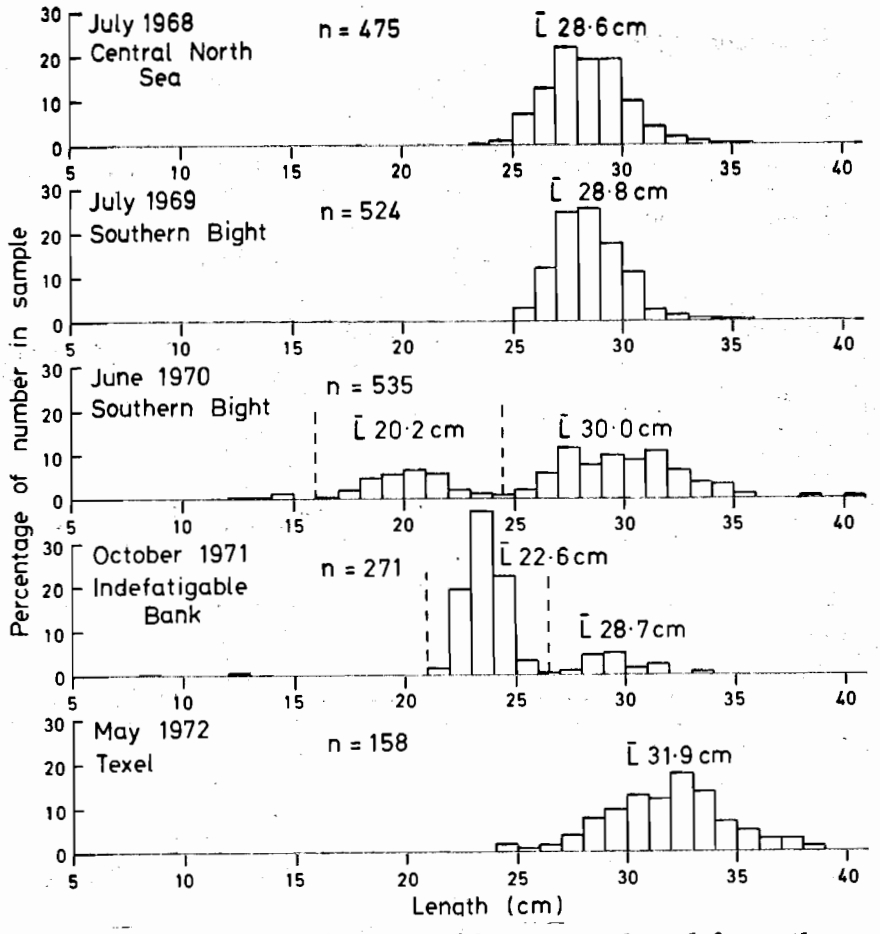

Figure 15C Length frequency distributions of horse mackerel from the central and southern North Sea, May to October.

HANDLING, DISPOSAL AND PROCESSING OF HORSE MACKEREL

Large numbers of horse mackerel occurring as by-catch in the trawl (or even drift nets) have never been popular with the British fishermen. There are a number of reasons for this, not least of which are that the fish are physically uncomfortable to handle and that there has been no market for them.

Like most pelagic species the horse mackerel is prone to 'mesh' in the trawl belly meshes just forward of the cod-end. These fish must be removed by hand and this can be unpleasant due to the spiny nature of the fish. Once in the small mesh of a midwater trawl cod-end there are few problems, and in the experience of research vessels the fish run from the cod-end without any difficulty. Once on the deck they can also be a problem as the spines tend to 'bind' the fish together so that they remain in a pile. On commercial vessels, handling the fish in bulk may require crew members' going into the hold to trim the catch and ensure even distribution of the load. This problem may be minimized if the fish are pumped aboard and it is certainly eased if they are pumped ashore.

At present the UK market for horse mackerel is limited to that for fish meal and oil, but there are potentially other, possibly more profitable, markets. They are sold fresh for human consumption in Mediterranean countries and the Soviet factory trawlers use only the head and gut for meal and freeze the body of the fish for human consumption. There are probably marketing possibilities in a number of the developing countries, particularly in Africa where they are already eaten in South Africa.

A recipe for cooking 'maasbanker', from Lydia Morris' 'Sea Foods of Southern Africa' (Purnell and Sons, Cape Town), is given below. It is a typically European dish which is equally suitable for other pelagic species.

8 servings

4 large horse mackerel
1 large cooking apple
1 dessertspoon sugar
1 level dessertspoon fresh breadcrumbs
1 dessertspoon seedless raisins
1 tablespoon finely chopped suet
Lemon juice, salt, pepper
1 tablespoon each butter and oil
1 small onion, chopped

Ask the fishmonger to remove the heads and to take out the roes without splitting the fish. Wash, and remove bits and pieces from the cavities with a sharp knife. Season inside and out and cut through the skin diagonally three times, on each side of the fish.

Now make the stuffing. Peel and chop the apple. Mix with raisins (which have been soaked for 5 minutes in hot water), suet, crumbs, sugar, and lemon juice. Season.

Stuff the fish, and lay them on the chopped onion in a buttered fireproof dish. Melt butter and oil together and brush them over. Set in a fairly hot oven (mark 6; 400°F) until cooked; about 20-30 minutes.

Serve with the following mustard sauce:

1 generous tablespoon butter
1 tablespoon flour
¼ pint light chicken stock
¼ pint milk
1 scant tablespoon French mustard
1 teaspoon sugar
Pinch cayenne pepper
Dash of Worcester sauce
Salt, pepper, vinegar

Melt the butter, stir in the flour. Cook for 2 minutes, then pour in the stock and milk. When the sauce has a good consistency, add the rest of the ingredients; add vinegar last of all, and only if necessary to sharpen the taste a little more.

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