

# THE ASSESSMENT OF THE WESTERN MACKEREL STOCK

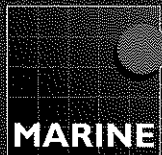
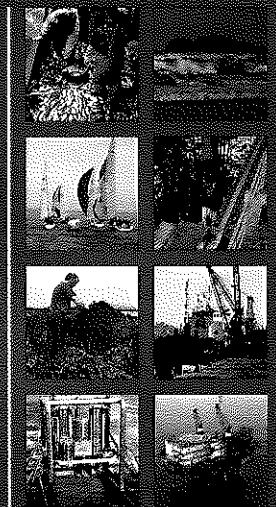
by

**JOHN MOLLOY**

Fisheries Research Centre, Abbotsotwn, Dublin 15

14 NOV 1996

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## THE ASSESSMENT OF THE WESTERN MACKEREL STOCK

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### Summary

The mackerel fishery is one of the most important components of the Irish fishing industry. The annual Irish quota is based on the scientific assessments of the size of the spawning stock. These assessments are based on the mackerel egg surveys which are carried out every three years and on the age composition of the total catches. The assessments have indicated that the stock in recent years has declined substantially and is now below 2 million tonnes. Predictions on the development of the stock indicate that it will decline even further unless catches are substantially reduced. The management target for the stock is that it should be rebuilt to a level above 2 million tonnes as quickly as possible.

The decline in the stock has resulted in severe reductions in the Irish annual quota and this in turn has had a serious effect on both the catching and processing sectors of the industry.

### *Introduction*

The assessment of the size of the Western mackerel stock has always posed major problems for fishery scientists. The problems result mainly from the very large area over which the stock is distributed - from the Bay of Biscay to the Norwegian Sea - and because it appears to mix with the North Sea stock and with the Southern stock. In addition large changes have taken place in the migrations and in the distribution of the adult and juvenile components of the stock. The assessments are further complicated by inadequate and inaccurate catch statistics. It has therefore been extremely difficult to carry out comprehensive annual research programmes, which give accurate indications of stock sizes. To do so requires considerable international co-operation because of the number of countries who have major fisheries on the stock.

At present the scientific assessments are based on two main research programmes.

1. The triennial egg surveys
2. The age composition of the catches.

### *Spawning Stock Biomass*

The egg surveys were started in 1977 and cover the area shown in Fig. 1. Ireland has participated in these since 1986. The most recent surveys, carried out in 1995, involved research vessels from Ireland, England, Scotland, Germany, Norway, Netherlands and Spain and covered the entire spawning season from March to July. The egg surveys estimate the total number of mackerel eggs produced during each spawning season and this number is then used to calculate the size of the parent population both in numbers of fish and in total weight. During the 1995 surveys the peak egg production occurred during the period 17 May - 6 June, well off the shelf edge between 46°30 and 53° N, and the highest values were recorded south of the Porcupine Bank.

The spawning stock biomass, estimated from all the egg surveys carried out since 1977, was as follows:-

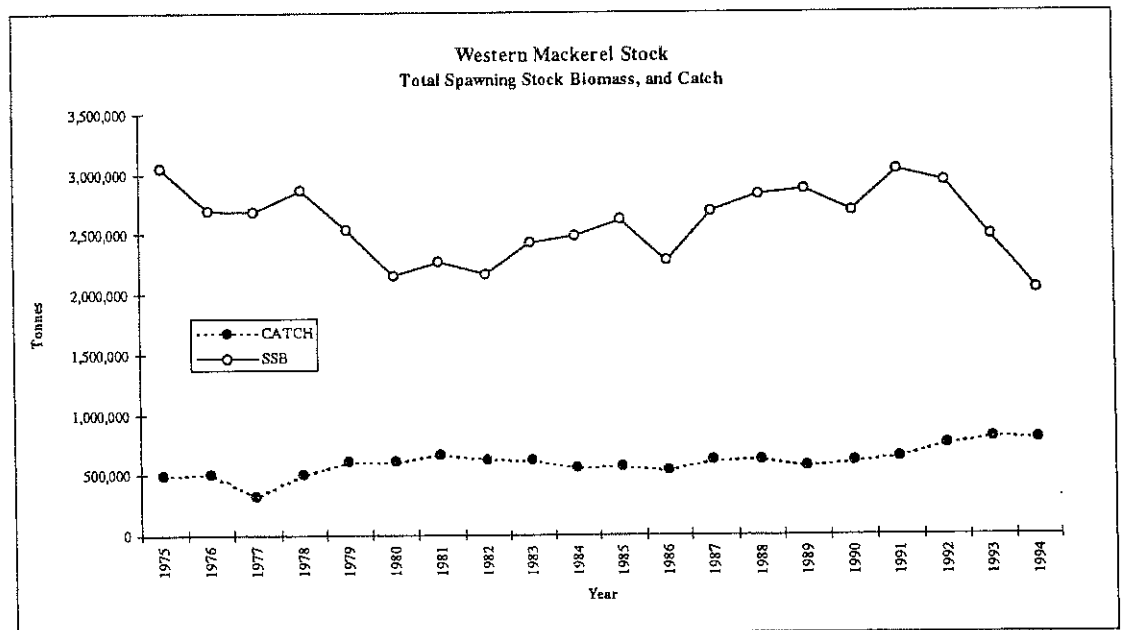
1977	3.20 million tonnes
1980	2.41
1983	2.49
1986	2.01
1989	2.24
1992	2.93
1995	1.97

As can be seen, the spawning stock in 1995 was the lowest recorded since 1977 and was nearly 1 million t lower than that estimated for 1992. The surveys carried out in 1992 estimated the spawning stock to be about 2.93 million t, which was the second highest

value recorded in the series and it had increased to that level as a result of a succession of good recruitments.

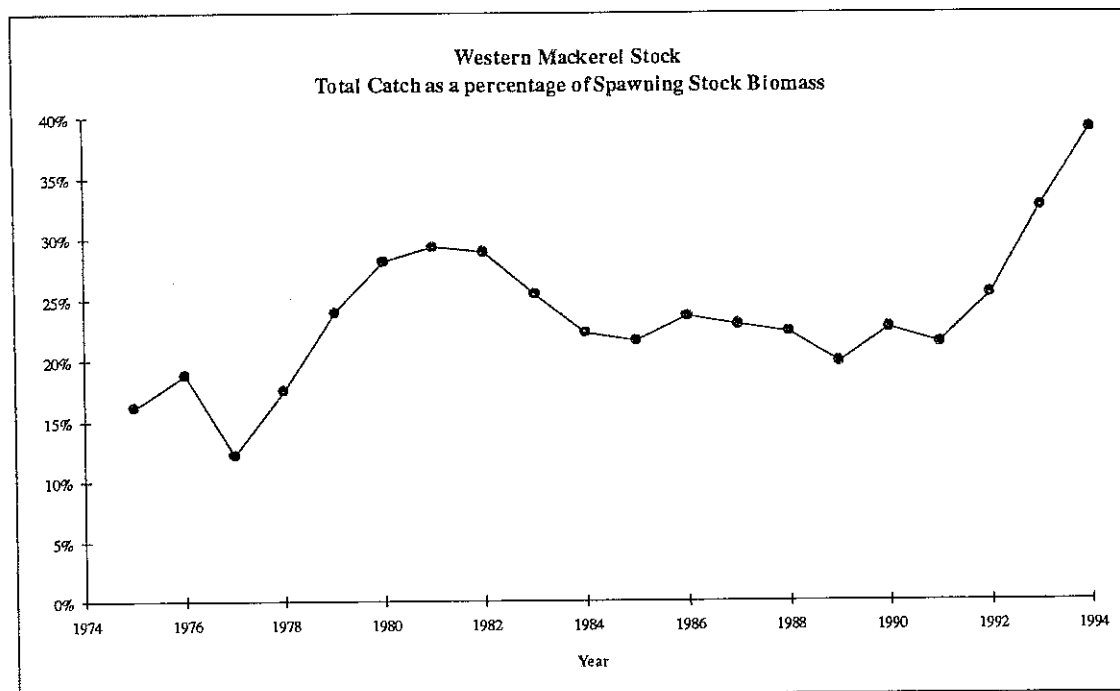
The second main area of scientific investigations concerns the age composition of the catches. All the main mackerel fishing nations carry out sampling programmes on their catches and the results are pooled to give an annual age composition of the total catch. An examination of the changes that occur in the age compositions gives an indication of how the overall stock is reacting to fishing. Obviously, as a stock becomes increasingly exploited it becomes increasingly dependent on young fish. The overall age distributions of catches taken from the Western mackerel stock in the North Sea (Div IVa) from 1990-1995, compared with catches taken from northwest of Ireland (Div VIa south) during the same period are shown in Fig. 2.

There are now considerably fewer older fish in the catches than in earlier years, although obviously these age distributions must be examined in relation to where the catches have been taken. The above age distributions are from the catches taken during the October to December period from the North Sea because these are the best indication of the age distribution of the fully recruited adult population of the Western stock. These age distributions of the annual catches can be used to calculate the size of the spawning stock. This, together with the annual catch is shown below.



An examination of the catches, expressed as a percentage of the spawning stock, shows that the proportion of the adult stock removed each year as a result of fishing has been steadily increasing in recent years after a long period in which it was reasonably steady. In 1993, and 1994, the catches removed over 30 % of the adult stock and this is obviously an

extremely high and dangerous level of fishing mortality. This is also clearly shown in the figure below.



These trends and the enormous decrease in the spawning stock size as shown from the egg surveys have caused the serious concern expressed by the fishery scientists.

### *Predictions*

The annual scientific assessments of the stock represent the best estimates of the size of the stock at a particular time. The best estimate of the size of the spawning stock of Western mackerel is about 2 million t at spawning time (April to June) in 1995. The management of the fishery and the TAC level for future years requires that the size of the adult stock should be predicted as accurately as possible for a number of years. In order to carry out a prediction it is essential to have some indication of the number of young mackerel that will recruit to the adult population and also to assume some level of the expected annual catches.

Normally, information on the abundance of young fish is available from "recruit surveys" - fishery surveys which compare the abundance of juvenile mackerel from year to year in standard areas. Such surveys have in fact been carried out for a number of years and, like the egg surveys, are co-ordinated on an international basis. Ireland has also participated in these surveys since 1982. The areas covered by the surveys are shown in Fig. 3, together with the areas where small mackerel have consistently been found in high abundance.

The results of the recent surveys indicated that the recruitment was increasing each year and in fact there were two very high recruitments of young mackerel - in 1989 and again in 1990. The 1990 year class, according to the surveys, was the strongest to recruit to the adult stock since records became available. However, this year class and, to a lesser extent, that of 1989 did not subsequently appear in the catches of adult fish in 1993 and in 1994 in anything like the numbers that were suggested from the surveys.

There were two possible reasons for this - either (1) the surveys were giving an overestimate of the abundance of young mackerel or (2) the young fish did actually recruit to the adult stocks and were caught as normal but were then discarded in large quantities and did not appear in the catch statistics.

Although discarding of mackerel by some fleets is known to occur, there was no evidence from the fisheries to suggest that discarding of young mackerel takes place on a scale large enough to explain the non-appearance of the 1989 and 1990 year classes in the catches in subsequent years. The fishery scientists, therefore, re-examined the survey data and observed that, in each year in which the surveys were conducted, the area surveyed was expanded, and the index of young mackerel appeared to be higher. This suggested that there was an inherent fault in the design of the surveys which either did not allow for changes in the distribution of juvenile mackerel, or that there was a possible increase in the efficiency of the boats in catching juvenile mackerel. It was therefore decided that the survey results should not be used to make predictions on recruitment to the adult stocks because they appeared to give unreliable estimates. The only other source of information on year class strength is an examination of the historical age composition of the stocks estimated from the catches. The average numbers of one year old mackerel that recruited to the adult stock over the period for which data were available was therefore used in the stock predictions. This estimate was substantially lower than that suggested by the recruit surveys.

Thus there are major differences between the latest predictions carried out on the stock and those carried out prior to 1994. The spawning stock in 1995 is over a million t lower than in 1992, and the assumed recruitment level is also considerably lower. In addition the reported catches in 1993 and 1994 are also considerably higher than anticipated. The results of the predictions suggest that the stock is in a very serious condition and will further decline in the near future - even if there is no fishing whatsoever. The EU management target for the fishery is to prevent the stock from falling below 2 million t and it already appears to be below this level. In order to rebuild it **quickly** to above 2 million t the 1996 catches would require to be reduced by 80%. Smaller "cuts" would result in a slower rebuilding of the stock. Scientists are of course reluctant to suggest drastic reductions in catches because they are only too aware of the effects that they have on both the catching and processing sectors of the industry. It is, however, difficult to interpret the scientific data in any way that will lead to any other conclusion than that of a declining stock. Scientists are also very aware of the situation that existed in the North Sea during the early 1960s when a stock which was estimated to be over 3 million t and which yielded catches of about 1 million t. for a very short time, mainly to the Norwegian purse-seine

fleet, collapsed within a very short period. This stock, which spawned in the North Sea, never subsequently recovered.

### *Discussion*

The difficulties in carrying out the assessments have been mentioned already and it has been often suggested that in fact the scientists have got "the whole thing wrong". This suggestion has been put forward because there appears to have been no reports yet from fishermen from any country that difficulties have been experienced in locating shoals and in filling national quota. However, it is also apparent that in recent years there have been revolutionary changes in gear efficiency and size of nets, fish detection equipment and design of vessels, all of which may mask any reduction in size or number of shoals.

The development of a "local" fishery in recent years off the Irish coast has also been put forward as an indication of a "whole new stock" of fish which had never been previously exploited. However, the age distributions of samples of these fish, shown in Fig 2 and available since 1989, indicate clearly that each year the catches are mainly composed of young fish in the age groups 1 - 4.

These mackerel appear to overwinter along the Irish coast after which they migrate offshore and recruit to the adult population. It would be very nice to think that they remained along the Irish coast and that the age distributions got progressively older each year. That unfortunately has not been the case and there is no evidence to suggest that they are anything other than recruits to the main Western stock. Indeed any further development of this fishery, in which large quantities of juveniles are taken, can only have a further detrimental effect on the stock. The increased presence of these juvenile fish may herald another change in the distribution of the mackerel stocks. This, if it does take place, will create further difficulties for the long term assessments.

The assessment of the stock will again largely depend on the results of the international egg surveys which, however, will not be repeated until 1998. In the meantime monitoring of the age distribution of the catches will continue, together with the young fish surveys and the tagging experiments. Improvements in the assessment will require some new revolutionary techniques which will enable the entire stock to be assessed quickly over its entire area of distribution. Any such improvement must be accompanied by accurate estimates of the total annual catch taken from the stock, including discards. These must be made available if meaningful predictions are to be made and realistic management advice given.

Scientists and industry are both fully aware that the stock assessments and predictions, although the best that can be made under the circumstances, are unsatisfactory. It must be stressed, however, that the scientific predictions represent the most reliable information available and the best basis for forward planning by the industry.

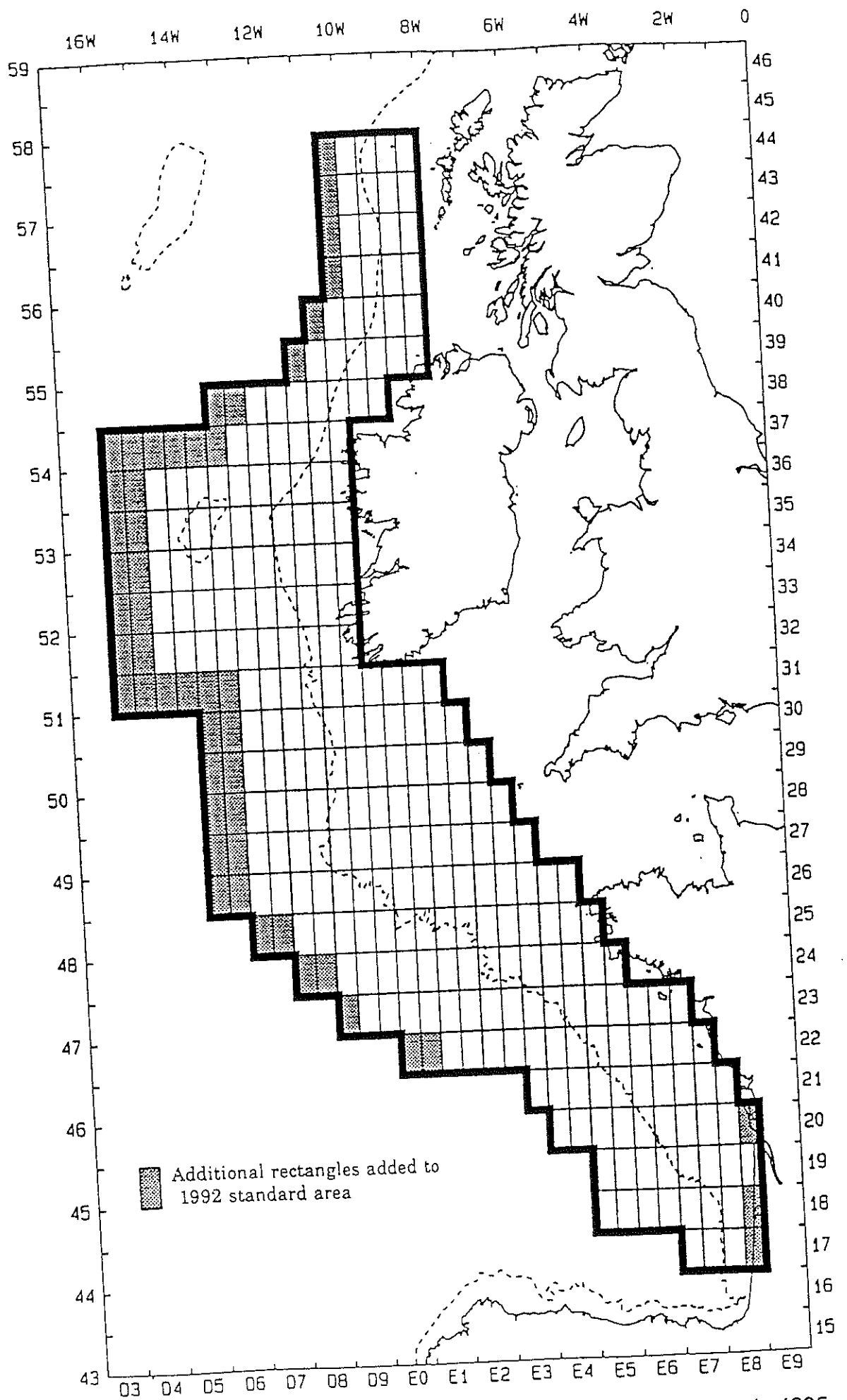


Fig.1. Standard sampling area for western mackerel egg survey in 1995



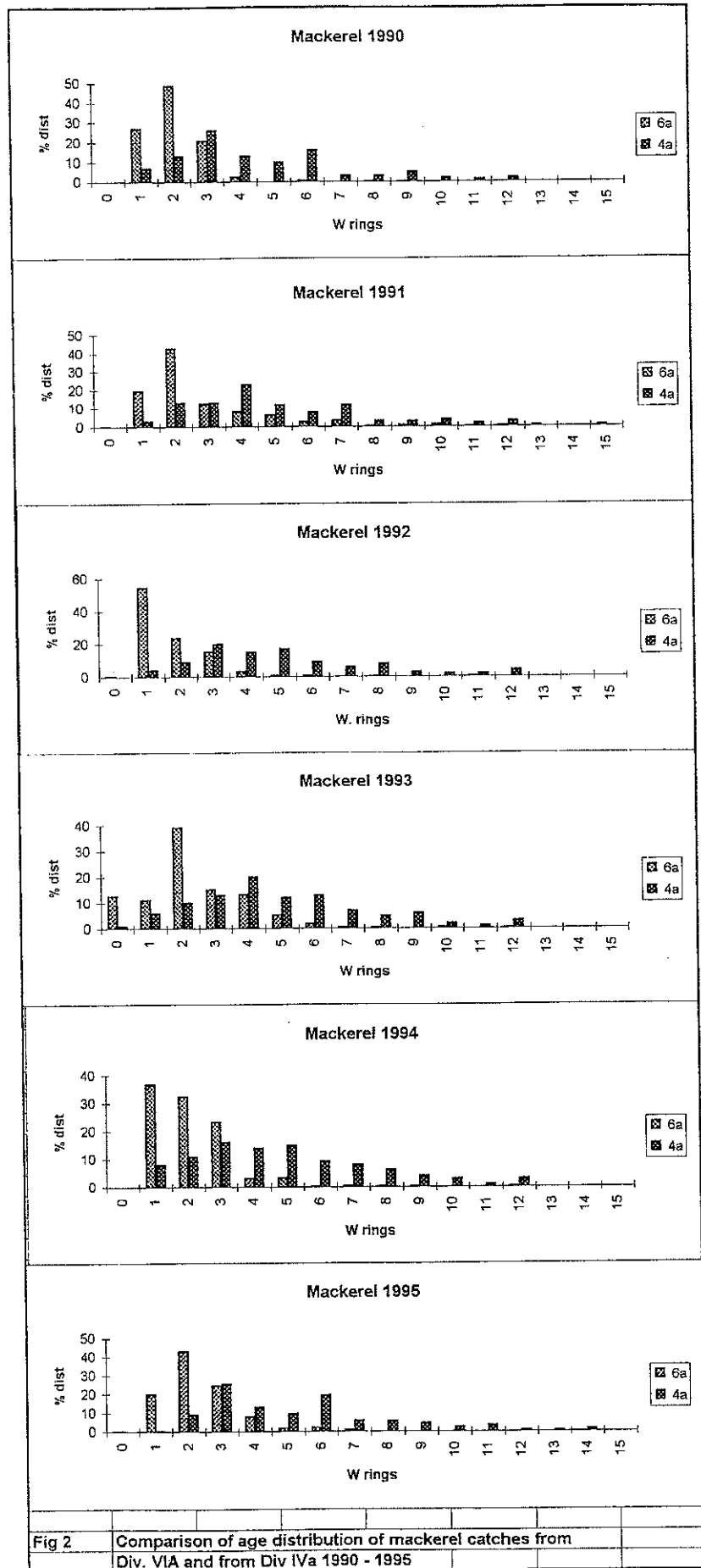
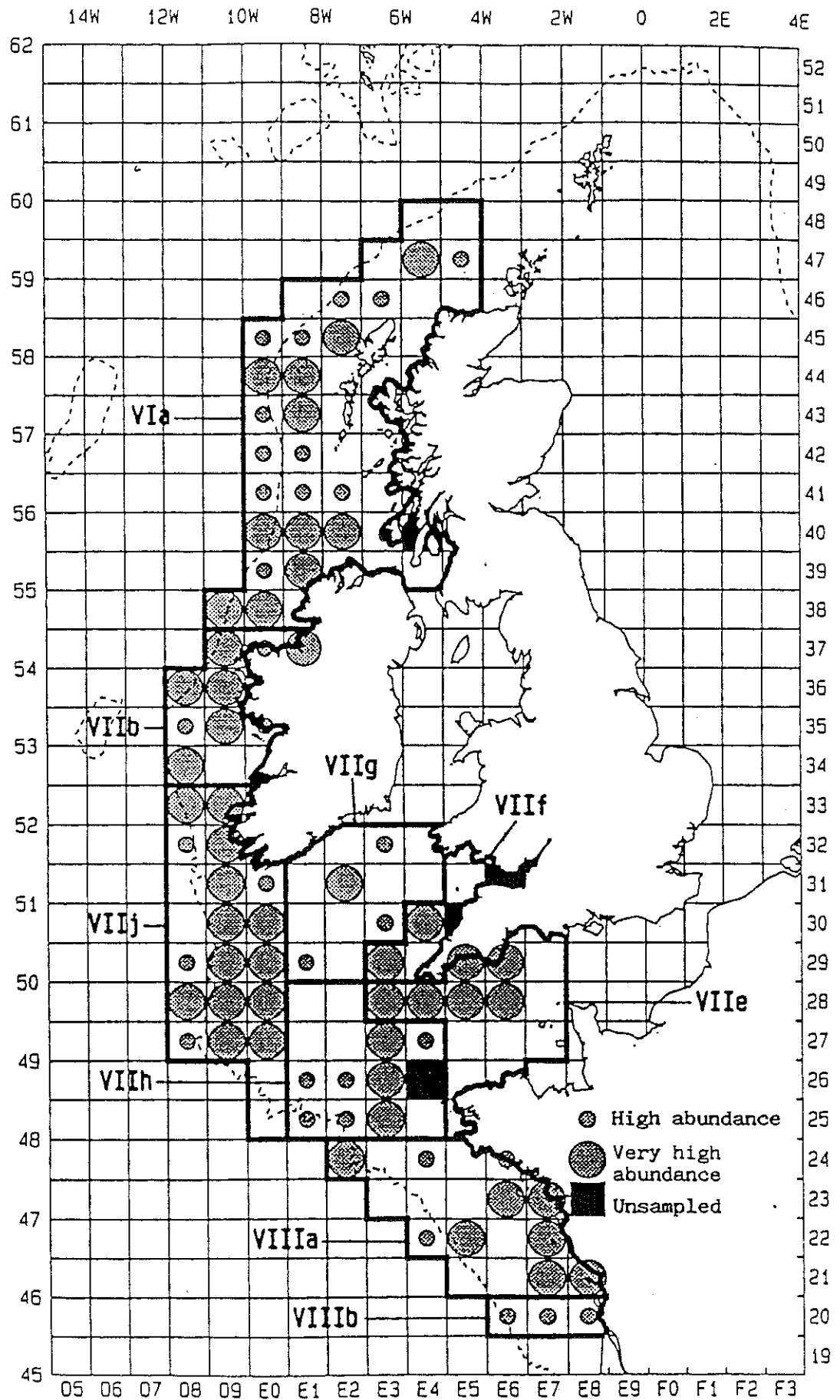


Fig 2 Comparison of age distribution of mackerel catches from Div. VIA and from Div IVa 1990 - 1995

Fig.3. Trawl survey area for estimation of abundance of juvenile western mackerel.



1. High abundance => 100 fish/hr 1st or 2nd winter fish in one survey (1981-1993)

2. Very high abundance = 100 fish/hr 1st or 2nd winter fish in more than one survey



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