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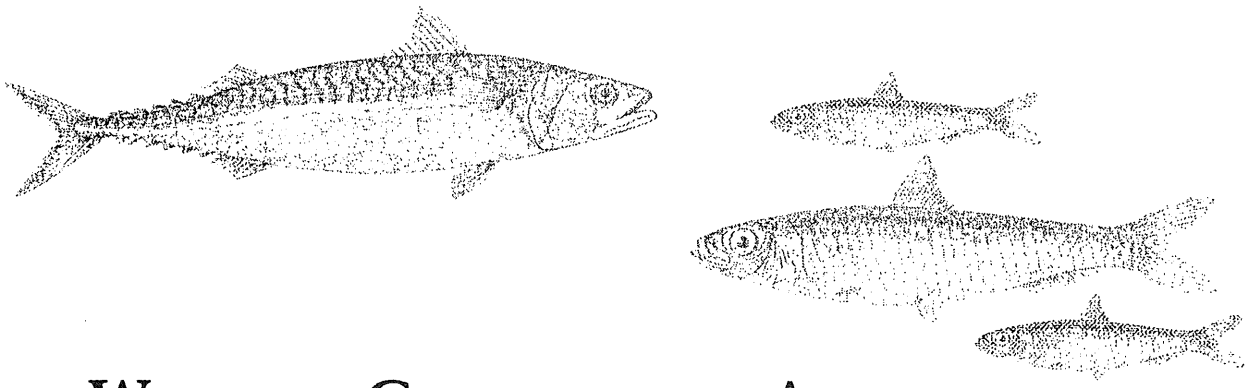
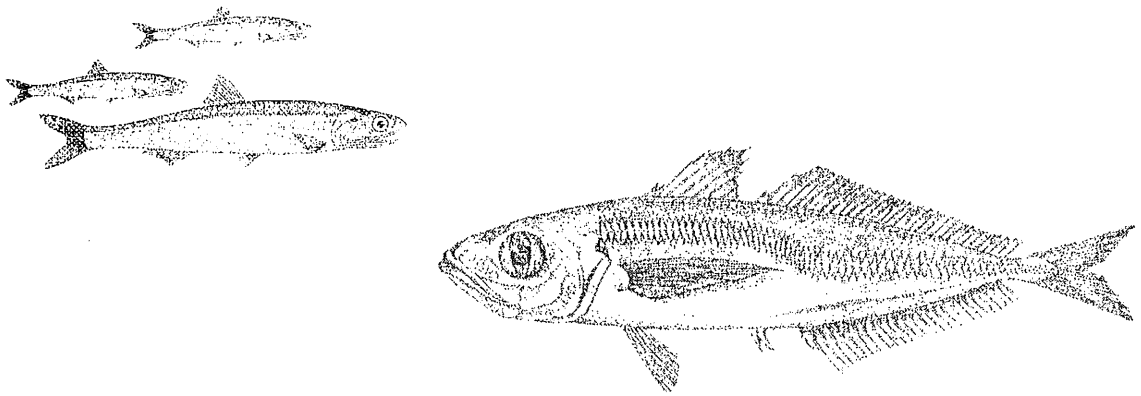


WORKING GROUP ON THE ASSESSMENT OF MACKEREL, HORSE MACKEREL, SARDINE AND ANCHOVY.

COPENHAGEN 22-30 JUNE 1992



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1 INTRODUCTION

1.1 Terms of Reference

At the 79th ICES Statutory Meeting in La Rochelle, France in 1991, it was decided (C.Res.1991/2:5:9) that the Mackerel Working Group and the Working Group on the Assessment of Sardine, Horse Mackerel and Anchovy will be merged to form a Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy (Chairman: A. Eltink, the Netherlands) and will meet at ICES Headquarters from 22-30 June 1992 to:

a) Evaluate the status of the western stock of mackerel and the western stock of horse mackerel in relation to the advice given by ACFM for 1993, and identify any major changes;

b) Assess the status of and provide catch options for 1993 within safe biological limits for the North Sea and Southern mackerel stocks, the North Sea and Southern horse mackerel stocks, the sardine in Divisions VIIIc and IXa, and the anchovy stock in Subarea VIII;

c) Advice on appropriate management measures for all of the above stocks and consider whether the fishery on the sardine stock should be regulated by a TAC and whether management boundaries for mackerel are appropriate;

d) Provide quarterly catch-at-age and catch and stock mean weight-at-age data and information on the relative distribution at different ages by quarter for North Sea mackerel and North Sea horse mackerel for 1991 to the Multispecies Assessment Working Group as input for the multispecies VPA, and provide information on the likely levels of the Western mackerel and Western horse mackerel which are seasonally present in the North Sea.

Additional terms of reference were received from the Chairman of ACFM, because ICES recently received additional requests from the Commission of the European Communities. ICES is requested to:

e) determine whether the current patterns of distribution and migration of mackerel and horse mackerel have become more or less permanent;

f) advise on the appropriateness of the existing management units of mackerel and horse mackerel;

g) advise on the most adequate strategies for managing the stock of anchovy.

1.2 Participants

The Working Group met in Copenhagen with the following participants:

P. Abaunza	Spain
R.S. Bailey	UK (Scotland)
M.F. Borges	Portugal
A. Eltink (Chairman)	Netherlands
S.A. Iversen	Norway
B.W. Jones	UK (England)
E. Kirkegaard (part-time)	Denmark
P. Lucio (part-time)	Spain
M.M. Martins	Portugal
J. Massé (part-time)	France
J. Molloy	Ireland
G. Pestana	Portugal
C. Porteiro	Spain
P. Prouzet	France
K.J. Stæhr (part-time)	Denmark
A. Uriarte	Spain
B. Villamor	Spain

Dr. R. Grainger, ICES Fisheries Secretary, and H. Sparholt, ICES Fisheries Assessment Scientist, also participated in parts of the meeting.

1.3 Merging of two Working Groups

The Mackerel Working Group and the Working Group on the Assessment of Sardine, Horse Mackerel and Anchovy were merged to form a Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, which met for the first time at ICES Headquarters from 22-30 June 1992.

At the ACFM Consultations meeting in September 1991 a warning was given that ICES member countries may be tempted to reduce participation so that, for example, one member may attend a new Working Group meeting where two attended meetings of the preceding Working Groups. At that meeting it was recognized that this could place an intolerable strain on the Working Groups. The importance of maintaining participation is something that ICES Delegates have been made aware of. Despite this warning, however, a reduction of more than 30% in the participation of the merged Working Group in 1992 was observed compared to the participation of the separate Working Groups in 1991 as is shown in the text table below:

Country	Number of participants Mackerel WG 1991	Number of participants Sardine WG 1991	Expected participants Combined WG 1992	Actual participants Combined WG 1992
Denmark	1	0.5	1.5	1.5
England	0.5	0	0.5	1
France	0	2	2	1.5
Germany	0	1	1	0
Ireland	1	0	1	1
Netherlands	1	1	2	1
Norway	1	1	2	1
Portugal	1	2	3	2
Scotland	1.5	0	1.5	1
Spain	2	5	7	4.5
Total	9	12.5	21.5	14.5

This is a relatively strong reduction in the participation, realising that the number of stocks increased from 3 and 5 to 9 for the combined Working Group. However, the number of meeting days of the merged Working Group remained about the same as for the earlier separate Working Groups. The reduction in the participation of the merged Working Group stresses the need of very good pre-processing before the meeting, which should be preferred above extending the meeting with a number of days. However, since a full assessment of both western mackerel and western horse mackerel will be included in next year's terms of reference, a Working Group meeting of 12 days will be required.

1.4 Standardization of Sub-divisions in Divisions VIIIc and IXa

In earlier Working Group reports, the Divisions VIIIc and IXa were often divided into smaller areas (e.g., Divisions VIIIc center, VIIIc west. IXa south, etc.), but it was often not clear which areas were meant. The Working Group members agreed on standardised sub-divisions as shown in Figure 1.1. The borders of the agreed sub-divisions are given in the text table below:

VIIIc east	2°00'W - 7°50'W
VIIIc west	7°50'W - 11°00'W
IXa north	41°50'N - 43°00'N
IXa central-north	40°00'N - 41°50'N
IXa central-south	38°00'N - 40°00'N
IXa south	36°00'N - 38°00'N

From now onwards, all data such as landings, catch in numbers, mean length at age, mean weight at age will be reported according to these sub-divisions. This will be helpful in detecting fish migrations and distributions around the Iberian peninsula and in understanding how these sub-divisions relate to the more northern divisions.

2 MACKEREL - GENERAL

2.1 Stock Distribution and Mixing

2.1.1 Review of the Report of the Study Group on the Stock Identity of Mackerel and Horse Mackerel

The Study Group on the Stock Identity of Mackerel and Horse Mackerel (Anon., 1992a) met in Vigo (Spain), from 21-23 January, to:

a) identify appropriate data and methods for stock separation for mackerel and horse mackerel in Sub-areas VIII and IX;

b) design a cooperative research programme and a sampling scheme for the purpose of investigating the migration and stock identity of mackerel and horse mackerel in Sub-areas VIII and IX.

For both mackerel and horse mackerel three "stocks" are recognised for assessment purposes and for the provision of management advice: "North Sea", "Western" and "Southern" stocks. Because of the implications for assessment and management purposes, the objectives of this Study Group were to review the available information on the identity of the mackerel and horse mackerel stocks in Sub-areas VIII and IX and to propose a programme for investigating migrations and stock identities in these sub-areas.

In relation to the stock identity problem, the available information on biological data (growth, spatial distribution and reproduction), morphometric and genetic studies, biological tags (parasites) and tag experiments

was analyzed. Also the oceanographic conditions in the area were reviewed. In addition the appropriate data and methods for stock separation were discussed.

The degree of separation of the mackerel and horse mackerel stocks in the Western and Southern areas is of relevance when considering how the stocks should be assessed and managed. The present assumption is that, for both species, there are separate stocks in the two areas and that there is no substantial interchange of fish between them. The validity of this assumption has not been clearly demonstrated. The evidence currently available is not adequate to determine whether two separate stocks or one single stock occupies the Western and Southern areas. Further work is needed to establish the status of the stocks of mackerel and horse mackerel in these areas.

To obtain better information on the status of the stocks, the Study Group considered a number of different approaches and came to the following conclusions with regard to the formulation of a programme of future work:

1. Biological Parameters

These in themselves are unlikely to provide any convincing evidence. Many of the data required for these studies are, in any case, being collected routinely for other purposes and could provide useful back-up information for stock discrimination purposes.

2. Egg Distribution

Data currently available show that for both species, although there are clear centres of egg production, there is no major discontinuity in the distribution of eggs between the Western and Southern areas. The Western area egg surveys have been more extensive with regard to both area and time than the surveys in the Southern area. It was suggested that future egg surveys in the Southern area should be conducted in a way that would give a clearer picture of the distribution of spawning.

3. Tags

Certain parasites act as biological tags. *Anisakis* data have been collected from different locations in the Western and Southern areas for both mackerel and horse mackerel. Preliminary results are promising but more samples are required before the full potential of such studies can be evaluated for stock separation studies. It was proposed that a coordinated sampling programme should be undertaken which should concentrate particularly on obtaining samples from the spawning aggregations.

Tagging experiments have the potential to demonstrate conclusively migrations of fish between the two areas. Although tagging mortality is likely to be high and the recovery of recaptured tags may be low, it was recommended that consideration be given to setting up experiments to tag spawning adults and juveniles in both areas for both mackerel and horse mackerel.

4. Genetic and Morphometric Studies

If there are genetically isolated stocks corresponding to the two areas there are a number of methods that may be able to distinguish between the stocks. It was recommended that extensive electrophoretic techniques for allozymes should be applied to both species and that the potential of methods based on mitochondrial DNA should be further investigated. Complementary morphometric studies should be continued for horse mackerel and initiated for mackerel.

The Working Group supported the conclusions of this Workshop and agreed that further progress in establishing the relationship between the Southern and Western stocks of both species is unlikely until further research is carried out.

2.1.2 Stock units

Three stocks units (North Sea, Western and Southern stocks) are used by the Working Group in the assessment of mackerel (see also Section 14.2).

The North Sea and Western stocks have distinct spawning areas which have been defined by a series of egg surveys. However, mackerel is a migratory species and, outside the spawning season, the distributions of the western and the North Sea stocks overlap making it difficult or even impossible to allocate catches to stock in the areas where they overlap (Anon., 1991a). This is discussed further in Section 2.2.

Mackerel are also known to spawn in the Southern area. There is, however, insufficient information available to confirm whether the fish spawning in this area belong to a separate stock or to the same stock as the Western fish (Anon., 1992a).

Until further information is available (see Section 2.1.1), the Working Group considers that this area should continue to be treated separately for the assessment and management of mackerel.

2.1.3 Distribution of juveniles

The distribution of juvenile mackerel was reviewed by the Mackerel Working Group in 1990 (Anon., 1990a) and updated in 1991 (Anon., 1991a) using data up to and

including the first quarter of 1991. A detailed analysis of historic data on the winter distribution and abundance of juveniles of the western stock was also undertaken for the Study Group on the Coordination of Bottom Trawl Surveys held in April 1991 (Walsh, WD, 1991; Anon., 1991d).

In 1991 a more intensive programme of ICES-coordinated quarterly bottom trawl surveys was initiated in the North Sea to provide abundance indices and distribution patterns of all age groups of all commercially important species (Anon., 1992b). In western areas a reasonably full international coverage of the area north of 47°30'N was achieved in the fourth quarter of 1991 (Anon., 1991d) and a less complete coverage in the first quarter of 1992. Additional bottom trawl surveys, covering more limited areas, were carried out in the Bay of Biscay and Celtic Sea in the second quarter of 1991 (by France), and around the north and west coasts of the Iberian peninsula during the third and fourth quarters of 1991 (by Spain and Portugal) (Anon., 1991d).

First quarter 1991

For reference, the results of the International Bottom Trawl Survey of the North Sea in 1991 are shown in Figure 2.1 (Anon., 1991c). At this time the 1990 year class was almost absent, except in the extreme north-eastern part.

Second quarter 1991

The distribution of the 1990 year class in the North Sea is given in Figure 2.2. The main concentration was located in the southeastern part around the Dutch coast. This change in abundance compared with the first quarter thus indicates a probable immigration from the west through the Channel. Data for the 1989 year class on this survey are not yet available.

Third quarter 1991

Complete data from the international bottom trawl survey are not yet available. Surveys of Iberian waters indicated the presence of juveniles along both the north and west coasts but in low abundance. No surveys of western areas were carried out.

Fourth quarter 1991

The distributions of the 1991 and 1990 year-classes are shown in Figures 2.3 and 2.4, respectively. The 1991 year class was found in greatest abundance over the outer half of the continental shelf to the west of the UK and Ireland between 49°30'N and 58°N. Abundance in this area was high, both to the north and south of 52°30'N. This is similar to the distribution of this age group found in some recent years, but different from the more frequent pattern of the last decade (see Table 2.3), during which the main concentrations have tended to be south of this latitude. Abundance in the North Sea and in inshore areas was low.

The distribution of the 1990 year class was patchy. In the North Sea there were two areas of medium abundance, one in the southeast, the other in the north, with very low densities elsewhere. One isolated catch of high abundance was made to the east of the Pentland Firth (between Orkney and the Scottish mainland). In western areas there were isolated patches of high abundance north and south of Ireland and the Cornish peninsula. They were also taken in the majority of rectangles to the west and southwest of Ireland but in relatively low numbers.

First quarter 1992

The distributions of the 1991 and 1990 year classes are given in Figures 2.5 and 2.6, respectively. The 1991 year class was very abundant around the Cornish peninsula and also relatively abundant to the west of Scotland and in the northeastern North Sea. The high abundance around Cornwall was in marked contrast to the previous quarter and suggests significant immigration from another area over the winter.

Distributional data for the 1990 year class are currently only available from western surveys. These indicate relatively high abundance over much of the area sampled, both north and south of Ireland. As with the 1991 year class, abundance was particularly high around Cornwall and a marked increase in catch rates had occurred over most of the western area compared to the previous quarter.

2.2 Allocation of Catches to Stock

Since 1987 the Working Group has not been able to split catches made in the North Sea and adjacent areas into their component stocks.

As for the years 1987-1990, the Working Group decided to allocate all mackerel caught in Sub-area IV, Divisions IIIa, IIa and Vb, Sub-areas VI and VII and Divisions VIIIa,b,d,e in 1991 to the western stock. The fishery in the North Sea, Skagerrak and Kattegat takes some North Sea mackerel. However, owing to the depleted state of the North Sea stock, the catch of this stock forms an insignificant part of the total catch in this area. In 1990 the catch of the North Sea stock was estimated to be about 10,000 t, i.e., 1.6% of the mackerel catch in this area (Anon., 1991a). Including such a small catch of North Sea mackerel in the western stock will have very little influence on the assessment of the Western stock. Since there is no evidence of any substantial recruitment

to the North Sea stock in 1991, it has once again been assumed that the catch of this stock was of the order of 10,000 t (see Section 13.1).

2.3 Recruitment Indices

North Sea surveys

Abundance indices from the International Bottom Trawl Survey carried out during the first quarter are given in Table 2.1. The abundance index of 1-group mackerel in 1992 (the 1991 year class) was a little higher than the average of the last 20 years but still very low compared with the values at the beginning of the series in the early 1970s. The 1992 index was dominated by a single high catch in rectangle 45F2.

Western surveys

Recruitment indices for the western stock are calculated from the mean catch rates in the bottom trawl surveys carried out during the fourth quarter and during the first quarter of the following year by England, France, Ireland, Netherlands and Scotland (Dawson *et al.*, 1988). These are given in Table 2.2.

Data from the winter of 1991/1992 indicate that the 1991 year class is the largest so far recorded. Although some caution should be exercised in using these indices as a forecast of recruitment until the abundance of a year class has been evaluated from two successive surveys, the indications are that this year class is a very strong one. Abundance was high during surveys in both the last quarter of 1991 and the first quarter of 1992 and high catch rates were taken over a wide area.

Catch rates of the 1990 year class were also relatively high, indicating, as during the previous winter, that this is a year class of above-average strength.

Table 2.3 shows the index values calculated separately for the areas north and south of 52°30'N. The 1991 year class was relatively most abundant in the south of the area surveyed in distinct contrast to the distribution of 1/2 group mackerel in the previous two winters. The 1990 year class was also concentrated in the south of the area.

2.4 Distribution of the Mackerel Fisheries

The total international catches of mackerel in 1991, in ICES Sub-areas II, III, IV, V, VI, VII, VIII, and IX, by quarter, are given in Table 3.4. The distribution of the fishery by sub-area or division was rather similar to that in 1990. In 1991 more than the 53% of the total north-eastern North Atlantic mackerel catches were taken in Division IVa (46%, in 1990). Significant changes were observed only in Divisions IIa and Vb, where the catches decreased compared with 1990, and in Divisions VIIIa,b and d, where the catches increased markedly, in part due to better reporting.

The distribution of the fishery by quarter in 1991 differs in some ways from that in 1988-1990 (Anon., 1989, 1990a, 1991a). In 1991, the largest catches were taken in the first quarter (cf. the fourth quarter in 1990) and the smallest in the second quarter. In the third quarter the catches were rather similar to those of 1990 but in the fourth quarter catches were less than in the previous year.

The Working Group estimated the distribution of the fishery by ICES statistical rectangle, on the basis of quarterly data submitted by Denmark, France, Ireland, the Netherlands, Norway, Portugal, Russia, Spain and the United Kingdom (England & Wales, and Scotland, separately). This is shown in Figure 2.7a-d. These data cover 94% of the catches and the coverage of the quarterly distribution by statistical rectangle has improved compared with previous years.

First quarter

In the first quarter (Figure 2.7a), the main catches were taken along the edge of the continental shelf to the west, and especially to the north of the British Isles, off Ireland, and in the western part of the Channel during the migration to the spawning grounds in Divisions VIa, VIIb,c,j, VIIIa,b and the extreme eastern part of Division VIIIc. At the end of this quarter, catches increased in the Bay of Biscay and Cantabrian Sea, in both of which areas fishing took place in the same areas as in 1990. Most of the catch was taken by trawlers, and in the Cantabrian Sea purse seiners and hand line boats took significant catches. In Divisions VIIIc west and IXa, fishing was mainly on juvenile 1-group mackerel.

Second quarter

In the second quarter (Figure 2.7b), the main reported catches were taken southwest of Ireland and in the Bay of Biscay and east of the Cantabrian Sea along the edge of the continental shelf. The fishing area appears to be the same as in previous years, but it should be pointed out that information about the catch distribution improved in 1991 particularly in the North Sea and Bay of Biscay. Catches north and west of Ireland were mainly taken as by-catch in the herring fishery. Another mackerel fishery in the second quarter took place in the Skagerrak. Only a small quantity was taken in this fishery mainly by drift nets and as by-catch in the trawl fisheries. In the eastern Cantabrian Sea and in the southern Bay of Biscay the main catches were obtained by a directed hand-line fishery and by purse seiners.

Third quarter

In the third quarter (Figure 2.7c), the major fishery took place in Division IIa and the eastern part of Division IVa, as in 1990. However, catches were reported in the offshore area north of 67°N. Most of the catches in these northern areas were taken by purse seiners. The distribution of mackerel in the offshore part of Division IIa was confirmed by a Norwegian survey in July-August 1991 (Holst and Iversen, 1992). Small by-catches were recorded in the southern and west-central North Sea. In the Bay of Biscay and in the eastern Cantabrian Sea, the catches were negligible, as in the previous years. Other catches, mainly of small mackerel, were taken in the western part of Division VIIIc and in Division IXa.

Fourth quarter

In the fourth quarter (Figure 2.7d), the main fishery presented a similar pattern to that in 1990, shifting southwestwards from Division IIa and concentrating in the northwest of Division IVa. According to the available data, most of the catches were taken to the north and east of Shetland, by purse seiners, as in 1990. In addition to the Shetland fishery, smaller quantities were taken off northwest Ireland, off Cornwall and in Divisions IIIa and IVb,c. In the Bay of Biscay and in Divisions VIIIc and IXa, the fishery in the fourth quarter was at a low level and very similar to that in the third quarter, as in the previous years.

2.5 Length Compositions by Fleet and by Country

Annual length compositions by fleet were provided by Denmark, Ireland, Netherlands, Norway, Portugal, Spain and United Kingdom (England and Wales, Scotland). Length distributions were available from all of the major fishing fleets in 1991, accounting for about 63% of the total landings.

The percentage length distributions by country and fleet for 1991 are shown in Table 2.4.

2.6 Discards

The problem of discards in the various mackerel fisheries was discussed in detail by the 1991 Working Group and the reasons for discarding mackerel, both adults and juveniles, were identified. In general it was apparent that there was a very serious lack of data about the rate of discarding for all countries except the Netherlands. However, the 1991 Working Group considered that 1) discarding of mackerel - particularly juveniles - had decreased in recent years - and 2) even if the quantities could not be estimated, the levels were low and the lack of accurate data was not likely seriously to affect the accuracy of the stock estimates (Anon., 1991a).

The present Working Group again discussed the problem of discards because there have been reports of considerable quantities of mackerel discarded during 1991 in Divisions IVa and IIa. This "discarding" has apparently taken place because of the large price differential between large and small mackerel on the Norwegian markets and vessels landing into this market may therefore discard considerable quantities of small mackerel at sea. (In this context, "small" refers to the smaller size groups above the 30 cm minimum landing size.) However, it has not been possible to obtain any information on the extent of this practice. Information is available from an EC-sponsored study carried out on Danish purse-seiners fishing for mackerel in the North Sea during September 1991 (Kirkegaard, 1991). The results of this survey indicate that discarding of mackerel by this fleet varied between 0 and 15% of the catch. Fishermen in general, however, appear to avoid discarding if at all possible and tend to avoid areas where juvenile mackerel are known to exist.

At present it is not illegal to discard fish under EC regulations, but it is illegal under Norwegian regulations to discard any mackerel at sea. The introduction of a ban on discarding at sea for all fleets has been discussed but reservations have been expressed about the effectiveness of such a measure mainly because it would be un-enforceable and because fishermen would be reluctant to disclose whether discarding was still continuing.

For a number of reasons the Working Group considers that it is becoming increasingly necessary to obtain accurate information about the level of discards by all fleets. If the discard rate is unknown and varies from year to year it will not be possible to calculate changes that might occur in recruitment levels and consequently in yield per recruit or to predict the effect of different TAC options. It is also important to point out that while the tonnages discarded may in fact be small the numbers of fish may be quite large because of the small average weights. The lack of information about discards also makes it extremely difficult to make accurate comparisons between the age distribution of predicted catches and that recorded from actual catches. A comparison of this type made by the present working group indicated that the predicted catches in age had in fact overestimated the catches of 1-4 year old fish. This may have been because of avoidance of areas where juvenile fish were found or because discarding of juveniles had in fact taken place.

The Working Group would, therefore, like to emphasize the importance of obtaining accurate estimates of discard levels. Countries which have significant fisheries are therefore encouraged to collect the appropriate information as soon as possible.

3 NORTH SEA AND WESTERN MACKEREL, DIVISIONS IIa, IIIa, IVa-c, Vb, VIa,b, VIIa-k, VIIIa,b,d,e

3.1 The Fishery in 1991

The catches from the fisheries in the Norwegian Sea (Division IIa) and off the Faroes (Division Vb) are shown in Tables 3.1. The total estimated landings from 1991 are about 98,000 t which is approximately 21,000 t less than in 1990. The biggest decrease took place in the Russian catch which fell from 30,000 t in 1990 to 13,600 t in 1991. Approximately 6,300 t were reported to have been taken in Division Vb - mainly by the Faroes.

The catches taken from the fisheries in the North Sea, Skagerrak and Kattegat (Sub-area IV and Division IIIa) are shown in Table 3.2. The total catch is estimated to have been around 366,000 t. The table includes an "unallocated" catch in 1991 of approximately 154,000 t. About 130,000 t of this total is a result of the catches reported as having been taken in Division VIa. About 7,000 t is discards. The balance, 17,000 t is mainly unreported catches. The equivalent table shown in previous working group reports does not show these misreported catches and was always considered to be inaccurate on this account. There were increases in the catches of Norway and Denmark and UK (Scotland), while catches of the Netherlands decreased.

The catches estimated to have been taken from the western areas (Sub-areas VI and VII and VIIIa,b,d,e) are shown in Table 3.3. The total catch in 1991 includes a negative unallocated catch of approximately 130,000 t which is the amount reported as having been caught in Division VIa but which the Working Group believe to have been taken in Division IVa. The catches reported by some countries are, therefore, considered to be very unreliable and these figures should not be used to study trends in national fleets for these areas. Again the equivalent table in the 1991 Working Group report does not include the misreported catches.

It is important to point out that the qualities of discards shown in Tables 3.1 - 3.5 are based on reports from one fleet only. They cannot, therefore, be taken as the total quality of discards from these areas about which no information is available.

The amount of catches taken in Division IVa but reported in Division VIa is estimated to have been 130,000 t. The amounts of similar misreported catches in previous years were:

1986	148,000 t
1987	117,000 t
1988	180,000 t
1989	92,000 t
1990	126,000 t

The total catch taken from all areas is estimated to have been about 647,000 t. This compares with a total catch of 606,000 t estimated for 1990. The estimated catch is, therefore, the highest recorded since 1981 when over 662,000 t were taken. The TAC recommended by ACFM for the western stock for 1991 was 500,000 t while that accepted by the management authorities (although for a slightly different area - see Section 14) was 575,000 t.

The estimated catches by quarter for the various sub-areas and divisions are given in Table 3.4. This table is based on information provided by Working Group members. In cases where no quarterly information was available the catches were allocated to the most appropriate quarter. The increase in the total catch since 1990 appears to have been taken mainly in the first quarter and from Division IVa. There have been corresponding decreases from quarters 3 and 4 from both Division IVa and from Division IIa. The seasonal distributions of the catches throughout Sub-areas VI and VII appears to have been very similar to those of 1990.

The trends in catches taken in the different sub-areas are shown in Table 3.5. The long-term changes that have occurred in the fisheries are clearly shown in the decreases in catches in Divisions VI and VII being matched by corresponding increases in Sub-areas IV and Division IIa. The catches in recent years, however, i.e., 1988-1991, have been very stable in Sub-areas VI and VII but have fluctuated somewhat in Sub-areas IV and Division IIa. The catches in Divisions VIIIa,b,d,e have increased in 1991, partly as a result of improved catch statistics. However, the contribution of catches in that area to the total catches is small.

3.2 Fishery-Independent Information

3.2.1 Egg surveys

The egg surveys in the western spawning area were not finished at the time of the Working Group meeting. A provisional estimate of egg production and SSB will be available at the ACFM meeting in November.

A single coverage of the spawning area in the North Sea was carried out in June in 1991 and 1992 (Iversen, pers.comm). It is difficult to evaluate the state of the SSB based on one coverage of the spawning area. However, since the survey both years were carried out in mid June, which is close to the peak of spawning in

previous years and only small amounts of eggs were observed the Working Group concluded that the SSB has not increased. The size is most likely to be similar to that estimated in 1990 (about 80,000 t) (Iversen *et al.*, 1991).

3.3 Catch in numbers at age

The catch in numbers at age by quarter for Divisions IIa, IIIa, IVa, IVb,c, VIa, VIIb,c,j,k, VIIa,e,f,g,h, VIId, VIIIa,b,d,e are shown in Table 3.6. The total catches in numbers for 1991 by age are given in Table 3.9.

Countries providing sampling data were Denmark, Ireland, Netherlands, Norway, Portugal, Spain, United Kingdom (England and Wales, Scotland) and Russia. Catches for which there were no sampling data were converted to numbers at age using data from the most appropriate fleet working in the same area. The sampling intensity is discussed in Section 15.

3.4 Mean Length and Weight at Age

Mean length and weight in the catch

Mean lengths and mean weights at age in the catches by quarters in 1991 were provided by Scotland (Divisions IVa, IVb, VIa), England and Wales (Divisions VIIe,f), Ireland (Divisions IVa, VIa, VIIb,j), Norway (Divisions IIa, IIIa, IVa), Denmark (Division IVa), the Netherlands (Divisions IVa,IVb,c, VIa, VIIb,c,j, VIIe,) and Spain (Divisions VIIh and VIIIa,b,d). Russia provided mean weight at age for Division IIa and Vb.

Weighted (by number) mean length and mean weight at age in the catches were made by Divisions by quarter and year for the western and North Sea areas. These are shown in Table 3.7 and 3.8. The overall mean lengths and mean weights at age in the catches are given in Table 3.9

Mean weight at age in the stock in 1991

Mean weights at age of the spawning stock at spawning time were estimated for 1991 by using samples from Dutch commercial freezer trawlers in Division VIIj in March, April and May. These weights (in kg) are shown in Table 3.9. The 1-year-olds are rarely taken in samples, therefore, the same weight (0.070 kg) as used previously was also assumed for 1991.

3.5 North Sea Mackerel Stock

3.5.1 Assessment

No assessment of the North Sea stock has been done since the egg surveys in 1990 (Iversen *et al.* 1991).

3.5.2 Biologically safe limits

The North Sea stock is still at a historically low level (about 2% of the stock size in the 1960s). No significant year class has been produced since the mid-1970s and the last really big one was the 1969 year class. Therefore, the Working Group considers this stock at present to be below biologically safe limits.

3.5.3 Management measures and considerations

As for the recent years, the management policy should reflect the necessity of providing maximum protection for the North Sea spawning stock until it shows some evidence of recovery, while at the same time allowing fishing on the western stock to be continued at the optimum exploitation level.

The adopted management regime in recent years seems to have achieved this (see Section 2.2). The Working Group recommends that the North Sea should be closed to mackerel fishery until the Western stock enters the area in late July/early August, and thereby supports the recommendations made by ACFM in 1991:

> "There should be no fishing for mackerel in Divisions IIIa and IVb,c at any time of the year".
>
> "There should be no fishing for mackerel in Division IVa during the period 1 January - 31 July".
>
> "The 30 cm minimum landing size at present in force in the North Sea area (Sub-area IV and Division IIIa) should be maintained and the present by-catch regulations should be continued".

The closure of Divisions IVb,c and IIIa the whole year will protect the North Sea stock in this area and juvenile western fish which are numerous particularly in Divisions IVb,c during the second half of the year.

3.6 Western Mackerel Stock

3.6.1 Status of the western mackerel stock

At its meetings in 1991 ACFM provided TAC advice for western mackerel for both 1992 and 1993. The Working Group has been asked to review this advice in the light of the status of the stock and to identify if any major changes are required.

Since egg surveys are taking place in 1992, the Working Group considered that it would be premature to carry out a new assessment at the present meeting. They decided,

nevertheless, to check that the inputs to the prediction carried out in 1991 (Anon., 1991a) are still appropriate.

a) Catch in number and mean weight at age in 1991

The total catch from the North Sea and western areas in 1991 was approximately 647,000 t compared with a predicted catch of 668,000 t. The total catch in number was 1551 million compared with 1751 million predicted. In terms of number at age, the actual catches of the younger age groups were consistently lower than those predicted whereas the actual catches of the older age groups were higher (Table 3.10). This is also shown as percentages of 3-group and older in Figure 3.1. In general terms, the actual catches are close enough to the predicted not to affect the outcome of the prediction. In terms of fishing mortality, the implication is that the exploitation pattern may have changed towards the older age groups. However, this is entirely dependent on the validity of the catch at age data and of the estimated stock size in number at 1 January 1991 which will be revised as soon as a new assessment based on the 1992 egg surveys is available.

The mean weights at age in the 1991 catches are very close to those used in the prediction (Table 3.10).

b) Recruitment

The major change in input values in 1991 occurs in the assumed recruitment values. The 1990 year class at 1 January 1992 is now estimated from the RCRTINX2 program to be 4090 million compared with 3796 million in the prediction carried out last year. This change is unlikely to be significant. The 1991 year class at 1 January 1992 is estimated from the RCRTINX2 program to be 9106 million compared with 2837 million used in the prediction (based on average year class strength). It should be noted, however, that the index value for the 1991 year class is over twice as high as the highest value used in the regression and the predicted recruitment must, therefore, be treated with caution. While this year class is almost certainly a very strong one, the Working Group chose to use the value of 5400 which was used in earlier years as typical of a high recruitment value, pending confirmation of the size of this year class.

Using the new values for the 1990 and 1991 year classes, a new prediction was carried out keeping all the other parameters the same (see Table 6.18 in Anon., 1991a). It was assumed that the catch in 1992 would be equal to the predicted *status quo* catch of 720,000 t. For 1993, the fishing mortalities at age used are the same as those assumed in last year's prediction for 1991.

The detailed results of the new prediction are given in Table 3.11. The expected catch in 1992 is predicted to generate a fishing mortality very close to the *status quo* of 0.28. At this fishing mortality the expected catch in 1993 is 795,000 t, compared with last year's prediction of 741,000 t. The predicted spawning stock biomass in 1992 is 2.46 million t. If the size of the 1991 year class is as high as predicted by RCRTINX2, then the *status quo* catch in 1993 is considerably higher. However, further information on the size of this year class will not be available until the beginning of the second quarter of 1993 when a new bottom trawl index is available. The Working Group, therefore, considers that there should be no change in the TAC advice for 1993 simply on the basis of the revised recruitment estimates. It should also be noted that the expected catch in 1992 of 720,000 t is higher than the figure of 670,000 t preferred by ACFM for 1992 and 1993 in order to make a small reduction in fishing mortality.

4 SOUTHERN MACKEREL (DIVISION VIIIc AND IXa)

4.1 The Fishery in 1991

Catches by Division and country are given in Table 4.1. Catches in 1991 remained almost at the same level as in 1990 in both Divisions. The highest catches were in the first and second quarters. Division VIIIc accounted for the greater part of the landings 17,000 t (i.e., 82% of the southern mackerel) representing a small increase (about 1,000 t) compared with 1990. In Division VII e the main fishery takes place during the spawning season. The catches in Division IXa (about 4,000 t) decreased slightly compared with 1990. Landings by gear and country are given in Table 4.2.

A Spanish fishery of Spanish mackerel (*S. japonicus*) also occurred in the south of Division VIIIb and in Subdivision VIIIc east, mainly in autumn (2,500 t caught in 1991, and 1,925 t in 1990) (Lucio et Villamor, WD 1992). Catches and length distributions of *S. japonicus* in the Spanish fishery in Divisions VIII b,c are reported separately from the catches and length distributions of *S. scombrus*. There is no misidentification of species in the Spanish fishery in Divisions VIII b and c. In this area the catches were composed of fish greater than 30 cm.

A Portuguese fishery of *S. japonicus* took place also in the Sub-divisions IXa central-north and south in 1991 as in the past years. Portuguese catches of this species are increasing. In 1991 the Portuguese catches are estimated at around 10,000 t (M. Martins pers. comm.). There is no misidentification of species in the Portuguese fishery in Division IX a.

Also there is a small Spanish fishery for mixed mackerel species in Sub-Division IXa south, Gulf of Cadiz (about 700 t as average in 1988-1990) (M. Millan pers. comm.), which includes an unknown proportion of *S. scombrus*. These catches have not been included in catches as reported to the Working Group.

4.2 Catch in Numbers at Age

The annual catches in numbers at age for the years 1982-1991 are shown in Table 4.3. For the year 1991 the numbers are given by quarter and by sub-division in Table 4.4. For Portugal the data available were by half-year. The numbers for each quarter were estimated by weighting the total number for the semester by the corresponding quarterly catches.

In Division VIIIc in the first and second quarters most of the catches consisted of fish more than 3 years old, while the fish caught in Division IXa were 1 and 2 years old. In the third and fourth quarters most of the catches (around 70%) consisted of juveniles (0-2 years old) in both Divisions.

In addition, it is noted that individuals older than 7 years were absent in Division IXa in the third and fourth quarters. In Division VIIIc there were a few older individuals corresponding to catches in July and December.

4.3 Mean Length and Mean Weight at Age

Mean lengths and mean weights at age by sub-division and quarter are shown in Tables 4.5 and 4.6.

The age/length key for the adult fish at the spawning time in Division VIIIc was used for Sub-division IXa North. For Division IXa Central-North and Central-South, a key from Division IXa Central-South was used, since it is known that there are no differences in growth of mackerel for the whole coast of Portugal (Martins and Gordo, 1985).

4.4 Assessment

No assessment of the southern mackerel has been made, partly because of insufficient data and partly because the uncertainties about the identity of mackerel in this area have not been resolved. However, it should be noted that mackerel catches in this area have been very stable around 22,000 t over the past 11 years. The age composition in some parts of the area, moreover, consists of fish up to at least 15 years of age. It is, therefore, likely that, in the area as a whole, the mackerel are exploited at a fairly low level.

4.5 Safe Biological Limits

In the absence of a series of stock and recruitment estimates, no indication of a safe biological limit for this stock unit can be provided.

4.6 Management Measures

The Working Group is not in a position to make an analytical forecast for this stock unit. However, the stability of the catches and age composition indicates that it can support catches at the level of recent years.

Whereas the catches in Sub-division VIIIc east consist predominantly of adult fish more than 30 cm in length, those in Division VIIIc west and Division IXa contain a high proportion of juveniles.

Previous working groups and ACFM have suggested methods for reducing the catches of juveniles. A minimum landing size of 20 cm has now been implemented in both Divisions VIIIc and IXa.

5 HORSE MACKEREL - GENERAL

5.1 The Fishery in 1991

The total international catches of horse mackerel in the northeastern Atlantic from ICES Sub-areas II, IV+IIIa, VI, VII, VIII and IX are shown in Table 5.1. The total catches increased considerably during the 1980s and reached a peak of over 441,000 t in 1990. The preliminary catch for 1991 has decreased to about 390,000 t.

The TACs for the various areas agreed for 1991 were:

Division IIa and Sub-area IV (EC waters only)	45,000 t
Division Vb (EC waters only), Sub-areas VI and VII, VIIIa,b,d,e	230,000 t
Divisions VIIIc and IXa	73,000 t
	348,000 t

5.2 Stock Distribution and Mixing

Division IIa. The total catch for this Division in 1991 (Table 5.2) was approximately 4,500 t compared with 11,400 t in 1990. The main catch was taken by Norway (71%).

Sub-area IV. The total catch by country from this Sub-area in 1991 was approximately 78,000 t (Table 5.3). This was a considerable decrease compared with the 1990 catch of 145,000 t. Catches from this Sub-area had consistently increased during the 1986-1990 period. Over 64% of the total catch was taken by Norway - mainly in the fourth quarter.

Division VIa. The total catch for this Division was 34,500 (Table 5.4). The figure for 1990 was 21,000 t. The catches for this area have fluctuated between 20,000 t to 45,000 t from 1983 to 1991. Over 70% of the total catch in 1991 was taken by the Irish fleet which fish mainly in the southern part of the area during the third quarter.

Sub-area VII. The total catch from this Sub-area in 1991 was over 201,000 t compared with 192,000 t in 1990 (Table 5.5). This total catch is the highest ever recorded from this Sub-area. The average catch during 1990 and 1991 was nearly double the average taken during the previous three years. Over 50% of the total catch is taken by the Netherlands mainly in Division VIIj during quarters 1-3, and in Divisions VIIe and h during quarter 4. Considerable catches are also taken by Denmark from Division VIIe in the first quarter, Ireland from Divisions VIIb and VIIj (Q2 and Q3), and Germany from Division VIIj (Q2) and Division VIIe (Q.1).

Sub-area VIII. The total catch from Sub-area VIII was approximately 50,500 t compared with 48,000 t in 1991 (Table 5.6). The main catches are taken by Spain from Division VIIIc. The total Spanish catch for this Sub-area was approximately 28,000 t in 1991 which is slightly lower than in 1989 and 1990. The catch recorded by the Netherlands was 12,400 t which was nearly twice that taken in 1990. This catch was taken entirely from Division VIIIa in Q4.

Division IXa The total catch taken from Division IXa in 1991 was 21,778 t compared with 24,000 t in 1990 (Table 5.7). The catch for the area has fallen considerably in the last two years compared with the period 1986-1989, when the average catch was over 35,000 t. Over 80% of the total catch in 1991 was taken by Portugal.

The total catches per Division from 1982-1991 estimated by the Working Group are shown in Table 5.8. The main feature of this table is the increase that has occurred in the catches that have been taken from Divisions VIIa,c and e-k during the last three years.

The quarterly distribution of the catches by division is shown in Table 5.9 (see Section 5.3).

5.2.1 Review of the Report of the Study Group on the Stock Identity of Mackerel and Horse Mackerel

The review of this report is discussed in Section 2.1.1 (Mackerel - General).

5.2.2 Stock units

Three stock units (North Sea, Western and Southern stocks) are used by the Working Group in the assessment of horse mackerel (see also Section 14.2).

The North Sea and Western stocks have distinct spawning areas which have been defined by a series of egg surveys. Outside the spawning season, western horse mackerel migrate north, some reaching the northern North Sea. The distribution of the North Sea stock is not certain but, from the distribution of catches, it appears to remain in Divisions IVb and c, extending into the eastern part of Division IIIa and into Division VIId. There may be some mixing with the western stock but the separation between two areas in which horse mackerel are caught in the North Sea suggests that the two stocks remain largely separate. The Working Group has, therefore, been able to allocate catches to stock on the basis of their distribution (see Section 5.3). For assessment purposes North Sea and western horse mackerel are treated as separate stocks.

This species is also known to spawn in the Southern area (Divisions VIIIc and IXa). There is, however, insufficient information available to confirm whether the fish spawning in these areas belong to a separate stock or to the same stock as the Western fish (Anon., 1992a). Until further information is available (see Section 2.1.1), the Working Group considers that this area should continue to be treated separately for the assessment and management of horse mackerel.

5.2.3 Species mixing

In line with the Working Group recommendation (Anon., 1990b), special care was taken by Spain and Portugal again in 1991 to ensure that catch and length distributions and numbers at age of *T. trachurus* provided to the Working Group did not include *T. mediterraneus* and *T. picturatus*.

A marked increase in the catches of *T. mediterraneus* was observed in 1991 in Divisions VIII a and b and Subdivision VIIIc east. More than 7,100 t of this species were reported from this area in 1991 (Table 5.10). In 1990 the catches amounted to 3,241 t from the same area (Anon., 1991b).

In the Western horse mackerel area, a more accurate allocation of the *Trachurus* spp. in the Spanish catches was made in 1991 compared with 1990. This gave an estimate of 2,122 t of *T. mediterraneus* in Divisions VIIIa and b in 1991 (Lucio and Villamor, WD 1992). Most of these were caught in Division VIIIb, mainly by purse seiners, and less than 100 t were caught in the southern part of Division VIIIa, by trawlers.

In the Southern horse mackerel area, the fishery for *T. mediterraneus* in 1991 occurred only in Sub-division VIIIc, as in recent years. The catches amounted to 5,020 t (2,943 t in 1990, Anon., 1991b) and more than 95% were obtained by purse seiners.

Catches and length distributions of *T. mediterraneus* in the Spanish fishery in Divisions VIIIa,b, and Division VIIIc were reported separately from the catches and length distributions of *T. trachurus*.

Data on the distribution of *T. mediterraneus* in the Spanish fishery in Divisions VIIIa,b,c are in agreement with the information available from French surveys in 1990 and 1991, in the same area (Anon., 1990b, 1991b).

A fishery for *T. picturatus* occurred only in the southern part of Division IXa, as in recent years. Data on the catches of *T. picturatus* in the Portuguese fishery in Divisions IXa - continental waters, and in Azorean and Madeira's for the period 1986-1990 are shown in Table 5.11 (Borges, WD 1992). Catches and length distributions for the Portuguese fishery for *T. trachurus* in Division IXa do not include data for *T. picturatus*.

The Working Group recommends that, as there is information available about the amounts and the distributions of the catches of *T. mediterraneus* and *T. picturatus* from at least three years ago (Anon., 1990b, 1991b), and as the evaluations and assessments are made only for *T. trachurus*, the TACs and the other management regulations to be stabilised in the future, they should be referred only to *T. trachurus* species, and not to *Trachurus* spp. in general, as at present. In this case, it would be appropriate also to set TACs for the other species.

The Working Group also recommends that special care should continue to be taken by the countries that fish in Divisions VIIIa,b,c and IXa to ensure that catch and length distributions, and numbers at age of *T. trachurus* provided to the Working Group did not include *T. mediterraneus* and *T. picturatus*.

5.3 Allocation of Catches to Stock

Based on the migration pattern of horse mackerel in recent years, which is described in Anon. (1990b) and Anon. (1991b), the catches have been allocated to three stocks, the southern, the western and the North Sea stock. It should be pointed out that the allocation of these catches to stocks is based mainly on the known distribution of eggs combined with the location of the different fisheries in recent years. The distributions should, however, be treated with caution until more positive information is available. The distribution of the fishery in 1991 indicates no changes in the migration pattern compared to previous years. Therefore, the Working Group allocated the catches in 1991 to the different stocks as in recent years (1991b):

Western stock: the catches in Divisions IIa, Vb, IVa, VIa, VIIa-c,e-k and VIIIa,b,d,e. As in 1988, 1989 and 1990 (Anon., 1991b) the Norwegian catches in 1991 in Divisions IVb (3,600 t) and IIIa and the Danish catches in IIIa were taken so close to Division IVa that they were allocated to the western stock.

North Sea stock: the rest of the catches in Divisions IVb, IVc and VIId.

Southern stock: the catches in Divisions VIIIc and IXa.

The catches by stock are given in Table 5.8

5.4 Distribution of the Horse Mackerel Fisheries

The total international catches of horse mackerel in 1991, in the northeastern North Atlantic, ICES Sub-areas II, III, IV, VI, VII, VIII, and IX, are shown in Table 5.1 from 1979 to 1991.

In the late 1970s and early 1980s, the catches declined, but since 1982 the catches have increased steadily each year from about 102,000 t to 441,000 in 1990, the highest record registered in the period. In 1991, the catches reported were 393,000 t, (i.e., about 11% less than in 1990). In Figure 5.1 the development of the northeastern North Atlantic horse mackerel fishery is presented as total catches from 1965-1991.

The distribution of the fishery by sub-area or division in 1991 was similar to that in 1990, except for the more northern Divisions (IIa, IIIa, IVa,b,c) in all of which the catches decreased significantly (Table 5.8). In 1991 more than the 51% of the total northeastern North Atlantic mackerel catches reported were taken in Divisions VIIa,b,d,e (43%, in 1990).

The distribution of the fishery by quarter in 1991 presents a marked decrease of the catches in the fourth quarter in relation to 1990, the catches in the remainder of the year were at a rather similar level to that in the past year (Table 5.9). However, the fourth quarter in

1991 was, as in 1990, the period of the highest catches of horse mackerel.

The Working Group was able to estimate the distribution of the fishery by ICES statistical rectangles on the basis of the quarterly data submitted by Denmark, France, Ireland, the Netherlands, Norway, Portugal, Spain and the United Kingdom (Figure 5.2a-d). The coverage by statistical rectangle has improved in relation to recent years, especially in some areas. The data represent 91% of the catches.

First quarter

In the first quarter (70,000 t), the main catches were taken along the edge of the continental shelf in the western part of the Channel, in the Bay of Biscay and around the Iberian peninsula (Figure 5.2a).

Second quarter

In the second quarter (57,000 t), the highest reported catches were taken to southwest of Ireland. Around the Iberian peninsula the catches increased in relation to the first quarter (Figure 5.2b).

Third quarter

In the third quarter (89,000 t), part of the fishery appeared further north both in Division VIa and in Sub-area IV. Catches were taken also in the Skagerrak and in the southern part of Division IIa. The major fishery continued to be in Sub-area VII, in the Channel and to the west of Ireland. The catches in the Bay of Biscay and in the more eastern part of Division VIIIc decreased. In the remainder of the area around the Iberian peninsula, the catches were rather similar to those in the second quarter (Figure 5.2c).

Fourth quarter

The fourth quarter (171,000 t) was the more important for the catches in 1991. Two main fisheries appeared in two very distant areas, as in 1990: one on the north, mainly in Sub-area IV; the other one in the Channel and in the more northern part of the Bay of Biscay. The significant decrease of the catches of horse mackerel in the northern areas (Sub-area IV and Divisions IIa and IIIa) and the increase of the catches in Divisions VIIe-h and VIIIa north, in relation to 1990, should be pointed out. Scattered catches were taken also around the British Isles and off Ireland. The catches around the Iberian peninsula decreased slightly in this quarter (Figure 5.2d).

5.5 Length Compositions by Fleet and by Country

The 1991 annual length compositions by fleet were provided by Ireland , the Netherlands, Denmark, Norway, Portugal, Spain and England (UK). These length distributions were available for all the major fishing fleets accounting for about 82% of the total landings in 1991.

The length distributions by country for each fleet (in millions) of fish per cm-length group are shown in Table 5.12.

5.6 Discards

The total estimated catch of horse mackerel for all areas for 1991 is about 390,000 t which includes discards reported by only one country. Apart from data supplied by the Netherlands, there is little information available about the rate of discarding in any of the other fisheries. About 5,400 t of horse mackerel is estimated to be discarded by the Netherlands fleet which is less than 2% of the total catch of all countries. As has been pointed out by the 1991 Working Group, the total quantity discarded is likely to have been higher. A report commissioned by the EC (Anon., 1992c) has summarized the available knowledge about discards for various fisheries, but it has not been possible to use this to estimate the actual quantities discarded.

The lack of data may not at present affect the accuracy of the estimate of spawning stock size, particularly as this is largely based on the egg surveys which are independent of catch data. However, as the spawning stock appears to be declining and as recruitment is poor it is becoming increasingly important to obtain accurate total catch information, particularly in relation to the younger age groups.

It is, therefore, recommended once again that all countries which have fisheries in which horse mackerel are caught should collect information about discard levels as a matter of urgency and this information should be made available to the Working Group as soon as possible.

6 NORTH SEA HORSE MACKEREL (DIVISIONS IIIa EXCEPT THE WESTERN PART OF THE SKAGERRAK, IVb,c AND VIId)

6.1 The Fishery in 1991

The horse mackerel catches in 1991 are described by sub-area in Section 5.1. The total landings of the North Sea horse mackerel stock are given by year in Table 5.8. The catches of the North Sea stock are estimated assuming all fish caught in Divisions IVb, IVc, VIId and

Division IIIa except the western part of the Skagerrak are of North Sea origin, while horse mackerel caught in Division IVa and the western part of the Skagerrak are considered as belonging to the Western stock (see Section 5.3).

The estimated catches of the North Sea stock declined from 33,000 t in 1989 to 19,000 t in 1990 and 12,000 t in 1991. The majority of the catches in 1991 was taken as by-catch in the small-meshed industrial fishery in Division IVb in the third and fourth quarters, while landings from the directed fishery for horse mackerel were very limited.

6.2 Fishery-Independent Information

6.2.1 Egg surveys

During the period 18 February - 11 July 1991, the spawning area of North Sea horse mackerel was investigated by research vessels from the Netherlands (Eltink, 1992). Based on the plankton samples and temperature observations obtained during this period the egg production and spawning stock size were estimated. The total horse mackerel egg production in 1991 of 195 x 10^{12} stage I eggs represents a spawning stock biomass of 247,000 t. In 1988, 1989, and 1990 the egg surveys estimated the spawning stock biomass to be 120,000 t, 217,000 t and 255,000 t, respectively.

6.2.2 Acoustic surveys

No acoustic estimates of North Sea horse mackerel were available for 1991.

6.3 Age Composition

Samples taken from the Dutch commercial catches and research vessel catches were available for the period 1987 - 1991. The Dutch samples cover only a small proportion of the total catch and are not considered representative of the total international catch. The data, however, give a rough indication of the age composition of the stock (Table 6.1). The age composition is very similar to that of the western horse mackerel stock, with the 1982 year class as very strong, and the 1986 and 1989 year classes as relatively strong.

6.4 Assessment

As the available biological samples are not considered to be representative of the total catch, no estimates of the catch in numbers at age were made and it was not possible to do an analytical assessment.

The egg survey indicates a spawning stock biomass of more than 200,000 t for the last three years. The 1982 year class accounts for more than 30% of the spawning stock biomass (SSB). Even if the 1986 and 1989 year classes are estimated to be relatively strong, a small decrease in SSB may be expected within the next few years.

The estimated catch of 12,000 t of North Sea horse mackerel in 1991 is a relatively small proportion of the estimated SSB indicating a relatively low fishing mortality.

As there is little directed fishing for horse mackerel in Divisions IVb,c and VIId, the Working Group believes that effort has been relatively constant and that the high catches since 1984 reflect a large stock size due to the strong 1982 year class.

6.5 Biologically Safe Limits

As there is no series of SSB or recruitment estimates for this stock, it is not at present possible to define a minimum biologically acceptable level. However, there is no indication that a historically low level of SSB will be reached in 1992 or 1993 with the present level of fishing.

6.6 Management Measures and Considerations

No forecast is available for 1993. If a TAC is set for this stock, however, it should apply only to those areas where North Sea horse mackerel are fished, i.e. Divisions IVb,c, VIId, and in Division IIIa, the Kattegat and the eastern parts of the Skagerrak.

7 WESTERN HORSE MACKEREL (DIVISIONS IIa, IVa, VIa, VIIa-c, e-k, AND VIIIa,b,d,e)

7.1 The Fishery in 1991

The fishery for Western horse mackerel is carried out mainly in Divisions IIa, IVa, VIa and Sub-areas VII and VIII. The catches for the various sub-areas and divisions are shown in Section 5 which deals with the general horse mackerel fisheries. The catches are shown in the general section because both the Western and North Sea stocks are exploited together in certain areas. A short description of the fisheries in the different areas is given in Section 5.1.

7.2 Catch in Numbers at Age

The catch in numbers at age by quarter and divisions for western horse mackerel are shown in Table 7.1 The catch in numbers by age for 1991 is shown in Table 7.4.

Sample data with age readings were provided only by three countries, the Netherlands, Norway and Spain. Catches in the different areas were converted to numbers at age using data from the most appropriate fleet working in the same or neighbouring area. The sampling intensity is discussed in Section 15.

7.3 Mean Length and Mean Weight at Age

Mean length and mean weight at age in the catches in 1991

Mean lengths and mean weight at age in the catches by quarters in 1991 were provided by the Netherlands (Divisions IVb,c, VIa, and Sub-areas VII and VIII), Norway (Divisions IIa, IIIa, IVa,b) and Spain (Divisions VIIh and VIIId). Mean length and mean weight at age by quarters and divisions are given in Tables 7.2 and 7.3, respectively. Weighted (by number) mean weight and mean length by age in the catch of western horse mackerel are shown in Table 7.4.

Mean weight at age in the stock in 1991

The mean weights at age of the spawning stock at spawning time for 1991 are shown in Table 7.4. They are weighted means of the mean weight at age for the first and second quarters in Divisions VIIj,k and were based on fish in all maturity stages from the spawning area caught by Dutch freezer trawlers.

The weights of 2- and 3-year-old horse mackerel are not estimated but are the same weights as used in previous years (Table 7.4).

7.4 Recruitment

Since the influx of the 1982 year class there have been no indications of recruiting year classes of any significant strength. The young fish surveys, which have proved useful in providing an index of recruitment for the western mackerel stock, have not so far provided any information about the abundance of horse mackerel, the catches of which each year were negligible.

Young fish surveys carried out by Ireland in September 1991 located quantities of 0-group horse mackerel south east of Ireland. The length distributions of these fish ranged from 7-10 cm with a mode of 8 cm. Further concentrations were located northwest of Ireland in a young fish survey carried out during November. The length distribution of these 0-group fish ranged from 6-11 cm (mode at 8 cm). A further survey again carried out in June 1992 again located small horse mackerel south east of Ireland in a similar area to those located during the September 1991 survey. The length distribution ranged from 10-15 cm with the mode at 13 cm. The results of these surveys are presented in a working document (Connolly, WD 1992).

This was the first time since 1982 that 0-group horse mackerel have been caught in these surveys. Dense concentrations of 1-group horse mackerel have also been evident in French acoustic surveys carried out in April 1992 in the south of the Bay of Biscay. In addition, large quantities of 0- and 1-group horse mackerel have been taken in Spanish catches during the quarter 4 of 1991 and in quarter 1 of 1992 from Divisions VIIIb and VIIIc (east). These observations may suggest that the 1991 year class may become the first significant one to recruit to the adult stock since that of 1982. However, these observations have not been confirmed by surveys carried out by the Netherlands and the UK in the areas south of Ireland.

7.5 Status of the Western Horse Mackerel Stock

No new information about the SSB based on egg surveys since 1989 is available until this year's surveys are finished. Preliminary results from these surveys will be presented at the ACFM meeting in November.

Compared with the predicted catch in 1991 of 400,000 t (Anon., 1991b), the catch in 1991 turned out to be about 333,000 t, which is a reduction of about 40,000 t since 1990. This reduction was mainly caused by a reduction of 50% of the Norwegian catches which was caused by reduced availability of horse mackerel particularly in Division IVa. This might be caused by the reduction in the stock and changes in migratory patterns.

The catches in numbers by year class in 1991 fitted rather well with what the Working Group predicted last year (Figure 7.1) considering a reduction in the actual catch compared with that predicted of 17%. However, there are some differences particularly for the 4- and 5-year-old fish. This is probably caused by lesser availability of the 1987 year class to the fishery in 1990 than in 1991. The predicted catch in 1991 of this year class was based on the availability in 1990. Besides it has to be mentioned that the sampling intensity of the catches for ageing was rather low (see Section 15.2).

Based on the fishery there are no signs of an incoming year class of considerable strength. Since the fishery, therefore, will also in the near future be rather dependent on the 1982 year class, it is useful looking at the analysis given in last year's Working Group report on the development of this year class under different options. With a catch level of 200,000 t per year of this year class, which is similar to the catch in 1991 (217,000 t, Table 7.4), it will last until 1996/1997, while a catch rate of 100,000 t per year will make the cohort last beyond this century.

8 SOUTHERN HORSE MACKEREL (DIVISIONS VIIIc AND IXa)

8.1 Review of the Report of the Workshop for Revising the Horse Mackerel Data Base of Divisions VIIIc and IXa

At the 79th ICES Statutory Meeting in La Rochelle, France, it was decided (C.Res.1991/2:24) to hold a Workshop for Revising the Horse Mackerel Database of Divisions VIIIc and IXa under the chairmanship of M.F. Borges (Portugal), in Lisbon, Portugal, from 2-4 June 1992, following the recommendation of last year's Working Group, to:

a) revise the catch in numbers-at-age back to 1984 according to the now-accepted ring interpretation;

b) analyse the length/weight relationships by quarter and area;

c) revise the mean weight-at-age in the catch and stock;

d) revise the maturity-at-age data by area and adopt a combined maturity ogive for assessment purposes;

e) revise the CPUE at age from the fleets and surveys for use in VPA tuning.

The report of this Workshop was presented to this Working Group (Anon., 1992d).

For 1984 the Portuguese data could not be revised due to lack of time to reread the otoliths.

Revised catch in numbers-at-age back to 1985 are now available for Divisions VIIIc and IXa, according to the now-accepted interpretation of one hyaline ring per year (see Report of the Horse Mackerel (Scad) Age Determination Workshop, Anon., 1991e).

Annual catch in numbers-at-age have been presented by quarter and disaggregated by area. It was observed that, whereas in the Spanish area (Sub-divisions VIIIc east, west and IXa north), the strong 1982 year class has always given a strong signal; in the Portuguese area (Sub-divisions IXa central, north, central south, and south), this year class was not conspicuous in some quarters and years but in others it appeared well marked. This may have been due to a misleading otolith interpretation since the reader was subject to a timing pressure. Nevertheless the sum of all the areas presents a strong signal in the 1982 year class. The 1979 year class is sometimes also noticeable in the data.

The length-weight relationships used to calculate the mean weight-at-age have been analysed. For Sub-divisions IXa central north, central south and south, a length-weight relationship by quarter was estimated from data obtained during 1988-1990 (Borges and Gordo, 1991) and during 1991, and it was considered appropriate to apply a mean quarterly relationship using pooled samples from the period 1988-1991, by quarter.

A unique length-weight relationship was applied to Subdivision IXa north. Nevertheless SOPs show good agreement with the catches by quarter. For Sub-division VIIIc east quarterly length-weight relationships were available by quarter for the period 1987-1991 (Lucio, WD 1992).

Maturity at age data by area were revised. For Subdivisions IXa central north, central south and south, a pooled maturity ogive was estimated from all the individuals sampled during 1987-1990 (Borges and Gordo, 1991). This indicates that 50% of horse mackerel attain first maturity at 22.5 cm. Proportions of maturity at age were calculated using the age-length keys of the period.

In this area, spawning time starts in November increasing to a peak in February and lasts until June. The maturity ogive for the area was calculated using the females at maturity stage 3+ in the first half year.

In Sub-Division VIIIc east the spawning has a peak from April to June. A maturity ogive based on samples obtained during 1987-1991 from this area was available (Lucio, WD 1992), indicating that 50% of horse mackerel attain the first maturity at 19.5 cm (males), 21.3 (females) and 20.5 (both sexes).

The data were combined to obtain a maturity ogive at age for Divisions IXa + VIIIc for assessment purposes, by combining frequencies at age from both areas.

Revised VPA tuning data were presented at the Workshop. Two survey bottom trawl series were available from 1985 to 1991, with revised numbers-at-age up to 15+, one relating to the September Spanish bottom trawl survey and another to the Portuguese October survey, although in the older age groups the values tend to be very low.

CPUE at age from three trawl fleets has also been revised, from two ports in Spain and from Portugal.

The Workshop recommended that in future:

a) the mean weight-at-age and maturity-at-age be calculated from the fish aged;

b) age-length keys be made available by sub-division and quarter;

c) catch-at-age from 1985 backwards be revised according to the same methodology;

The Working Group endorses the recommendations made by the Workshop.

8.2 The Fishery in 1991

Total catches from Divisions VIIIc and IXa were estimated by the Working Group as 45,511 t. Tables 8.1 and 8.2 present the estimated catch by country and gear and by quarter, respectively. ICES' official catches are requested for *Trachurus* spp. and not to each species of *Trachurus* separately; therefore, the catch data had to be revised by the Working Group in order to obtain the catch of *Trachurus trachurus* L., which is the species the Working Group analyses for stock assessment purposes. The quantities of *T. mediterraneus* and *T. picturatus* are usually small but variable (Section 5.13).

Table 8.2 presents the annual catch data by quarter which have been adopted by the Working Group for the stock assessment of *Trachurus trachurus* L. in Divisions VIIIc and IXa.

8.3 Effort and Catch per Unit of Effort

Table 8.3 presents the commercial catch rates from the Portuguese trawl fleet and for the Spanish purse-seine and trawl fleets from two ports. Spanish trawl fleet catch rates are relatively stable in the available period (1983-1991), while the purse seine catch rates show fluctuations and indicate an increase relative to 1990. The 1991 Portuguese trawl catch rate is low compared to the period 1979-1991 and indicates a decrease of 60% compared with 1990.

The effort data presented in Table 8.4 correspond to the trawl fleets referred to in Table 8.3. These indicate a slightly decreasing trend during the period for the Spanish trawl fleets, while the Portuguese trawl fleet seems to indicate a marked increase. Nevertheless, in the latter case the estimate is preliminary since this effort value does not correspond to the boats which effectively caught horse mackerel. CPUE indices obtained by the bottom trawl surveys indicate a decrease in 1991 in the three surveys carried out in these Divisions (Table 8.5).

8.4 Catch per Unit Effort at Age

CPUE at age from three fleets have been revised using the now-accepted otolith interpretation. These relate to two trawl fleets in Spain (La Coruña and Aviles), respectively in Sub-divisions VIIIc west and east (1984-1991) and to the Portuguese trawl fleet fishing in Sub-divisions IXa central north, central south and south (1985-1991).

Table 8.6 presents the results by fleet. The 1982 year class is well defined in the data.

8.5 Fishery-Independent Information

8.5.1 Trawl surveys

Table 8.7 presents the revised numbers-at-age per hour from the Portuguese October bottom trawl survey series. This survey covers Sub-divisions IXa central south, central north and south (Portugal) from 29-750 meters depth during the fourth quarter (October-November) which is the peak time for recruitment of horse mackerel on the Portuguese coast. At this time of the year the juveniles (before 1st maturation) are mainly concentrated between 20-100 meters depth and the presence of early spawners is already observed in Sub-division IXa central south and south close to 200 m depth, especially in recent years (Borges and Gordo, 1991).

Portugal carries out three bottom trawl surveys: one in the first quarter (February/March - at the spawning time), a second one at the end of the 2nd quarter/beginning of the 3rd quarter (June/July) at the end of the spawning season (Borges and Gordo, 1991), and a third one during the fourth quarter at the peak period of recruitment. The objective of these survey series is to estimate mainly horse mackerel and hake abundance indices for VPA tuning purposes. The sampling scheme and methodology have been described by several authors and are concisely described in the report of the Study Group on the Coordination of Bottom Trawl Surveys in Sub-areas VI, VII, VIII and Division IXa (Anon., 1991d).

Table 8.8 shows the revised numbers-at age per tow (30 minutes) for the Spanish September bottom trawl survey. This survey covers Sub-divisions IXa north, VIIIc west and VIIIc east. Although in the third quarter the recruitment season in these Sub-divisions has already started, the strength of the peak in the fourth quarter seems to be more stable (Anon., 1992d). This survey has been designed to estimate abundance indices of hake and covers the area from 20-500 meters, (Sanchez *at al.*, 1991). The bottom trawl net used has a vertical opening of 1.9 metres and does not have rollers in order to catch flatfish. Sub-divisions IXa north, and VIIIc west are difficult to trawl in depth from 20 to 100 meters, but further east, in Sub-division VIIIc east these depths are sampled. The trawling speed used is 3 knots and the duration of the tow is 30 minutes. This reduces the catchability of adult horse mackerel because the adult fish swim at speeds greater than 4 knots and to be caught by trawling at 3 knots the duration of tow has to be at least 1 hour (J. Casey, pers. comm.).

8.5.2 Egg surveys

In Divisions VIIIc and IXa, egg surveys for 1992 were planned by the Mackerel\Horse Mackerel Egg Production Workshop. These surveys were carried out in February/March on the Portuguese coast (Sub-divisions IXa central-north, central-south and south) and in April/May in the Spanish coast (Sub-divisions IXa, VIIIc west and east). The data are being processed according to the agreed methodology and will be available at the next Mackerel\Horse Mackerel Egg Production Workshop which meets during the first quarter of 1993 to analyse the 1992 Egg Survey results in the ICES area. Studies on batch fecundity estimates were started by collecting material on the same surveys.

8.6 Catch in Numbers at Age

Catch in numbers at age (Table 8.9) for 1991 are presented by quarter and area, disaggregated by sub-division.

These have been obtained by applying a quarterly ALK to each of the catch length distributions estimated from the samples of each sub-division. The Portuguese age-length keys are by quarter whereas the Spanish ones are by semester (half year).

The total annual catches-at-age from 1985-1991 are presented in Table 8.10 as revised by Anon. (1992d). The strong 1982 year class is well defined in the data matrix from age groups 3-9. Total catches in number were 1,438 million in 1986 and since then have been decreasing, as the 1982 year class has declined in abundance, reaching about 400 million individuals in 1991.

8.7 Mean Length at Age

Table 8.11 presents the 1991 mean length-at-age in the catch by quarter and sub-division. Revised mean lengths at age in the catch by quarter and country are available from 1985-1990.

8.8 Mean Weight at Age

Table 8.12 presents the 1991 mean weights at age in the catch by quarter and sub-division. Tables 8.13 and 8.14 present the mean weights at age in the catch and in the stock, respectively, for the period 1985-1991, revised by Anon. (1992d). The stock weights at age have been estimated as the mean of the weight at age in the catch in the fourth quarter and in the first quarter from the period 1985-1990.

8.9 Maturity at Age

Proportions of maturity at age have been considered to be constant over the assessment period. Table 8.15 shows the maturity at age calculated at the time of spawning as the 3+ females frequency divided by the total numbers of females sampled (during the first semester on the Portuguese coast Sub-division IXa central south and during the second quarter in the east of Sub-division VIIIc east. The proportions mature are similar in both areas, (see item 8.1). Table 8.16 indicates the maturity-at-age data used as input for the present assessment.

The proportion of F and M before the spawning time was set as 0.25, at the beginning of the second quarter.

8.10 Fishing Mortality and Tuning of the VPA

Terminal fishing mortality coefficients were estimated by tuning using the method of Laurec and Shepherd and by using CPUE-at-age data obtained from four sources:

- Fleet 1 Portuguese October Survey (Sub-divisions IXa central north, central south, south)
- Fleet 2 La Coruña bottom trawl fleet (Sub-division VIIIc west)
- Fleet 3 Aviles bottom trawl fleet (Sub-division VIIIc east)
- Fleet 4 Portuguese bottom trawl fleet (Sub-divisions IXa central north, central south, south)

The input files correspond to Tables 8.6 and 8.7. A first trial was made including the Spanish September bottom trawl survey (Table 8.8) and it was noted that the 1985 CPUE estimates of Fleets 1 and 4 were giving high residuals. A second trial was made without 1985 CPUE estimates from these fleets and subsequently a third trial run without the Spanish September survey series which gave high residuals which was expected for the reasons explained in Section 8.5.1.

Table 8.17 presents the final tuning output indicating that log-catchability residuals have no trend. The assumption of constant catchability was, therefore, accepted and Sigma values in the summary statistics at age were about 0.5 for age 1, varying between 0.2 and 0.4 for the other ages, which is within the acceptable limits.

Table 8.18 shows the terminal Fs estimated using the Laurec-Shepherd method, given the assumption of 0.15 for natural mortality.

The separable VPA was then run with terminal F = 0.38 on age 3 and terminal S = 0.70 in order to obtain an average value in the final VPA equal to the one given by the tuning VPA. Table 8.19 shows the matrix of residuals, the F values at age group 3, and the selection pattern estimated by the separable VPA.

Tables 8.20 and 8.21 indicate the F matrix estimated by the traditional VPA, and the stock numbers at age. Table 8.22 and Figure 8.1 summarize the stock assessment showing a decreasing trend in total biomass, exploitable biomass, total spawning biomass, and an increase in fishing mortality in 1991.

To inspect the selection pattern at age, several trials of separable VPA were run and the results plotted. Figure 8.2 shows the shape of the exploitation pattern over the period, indicating a deep valley in the catch curve corresponding to less catchability/availability of age groups 4-7 which again seems to indicate a natural non-availability of this fish in the area which might be caused by a migration.

8.11 Recruitment

Estimates of 0-group recruitment were available from the Portuguese October bottom trawl survey and from the Spanish September survey.

The abundance of the 1991 year class at age 1 and 2 to be used in the prediction was estimated by regressing final VPA estimates against the corresponding year class survey indices, using RCT3. Table 8.23 presents the input file. The predicted values for the 1991 year class at 1-year-old are given in Table 8.24. The predicted value of 430,424 for the 1991 year class was adopted for the prediction.

8.12 Yield per Recruit

The long-term yield per recruit and spawning stock biomass per recruit curves against F, derived using the input data in Table 8.25, are shown in Figure 8.3. The estimated $F_{0.1}$ = 0.09 is 30% of the 1991 reference level of F and the F_{max} = 0.14 is 44% of the 1991 level of F.

8.13 Forecast

The terminal population in 1992 from the final VPA was used as input to the catch forecast. Numbers at age from age group 1 have been estimated by RCT3. The recruitment at age 0 was assumed to be 1269 million fish.

Table 8.25 shows the input parameters, and Tables 8.26 and Figure 8.4 show the result of the predictions for 1993.

At *status quo* fishing mortality, the predicted catch is estimated to be 49,000 t in 1992 corresponding to 163,000 t of spawning stock biomass which would represent a 23% decrease from the 1991 level. Continuing fishing at the 1991 fishing mortality level would cause the spawning stock biomass to decrease by 23% from the 1992 level. The *status quo* catch for 1993 is 46,300 t.

8.14 Biologically Safe Limits

The reference mortality levels of F_{high} and F_{med} are shown in Figure 8.5 which is the plot of the spawning stock biomass versus recruitment at age 1 for the period 1986-1990 from the final VPA. The estimated F_{med} is equal to 0.19 and F_{high} corresponds to 0.31, which indicates that the 1991 F level is close to F_{high}. With such a short data series, however, these values are not likely to be well estimated.

8.15 Management Measures and Considerations

There are continuing uncertainties concerning the stock definitions of horse mackerel in the ICES area and this obviously is of importance for assessment and management of horse mackerel in Divisions VIIIc and IXa. Nevertheless, it would seem advisable to control the fishery by TAC enforcement.

9 SARDINE (DIVISIONS VIIIc AND IXa)

9.1 Stock Unit

For assessment purposes the sardine from Divisions VIIIc and IXa are regarded as one stock unit. The small catches of sardine from Divisions VIIIa-b and Sub-area VII were not included in the assessment.

9.2 Distribution of the Sardine Fisheries

Figure 9.1a-d shows the distribution of the sardine catches by quarter during 1991.

The main directed fisheries of sardine are in Divisions VIIIc and IXa. The distribution of catches in 1991 was similar to that in recent years, being mainly from Sub-divisions XIa central-north and central south.

The distribution of the catches of 0-group sardine in Divisions VIIIc and IXa is shown in Figure 9.2a and b, indicating that high catches of this age group occur mainly in Sub-divisions IXa north and central-north. 0-group sardine occur in small quantities in the catches in Sub-division VIIIc east and west and in Sub-division IXa south.

The geographical areas of the catch distribution of the juveniles and adult fish in Divisions VIIIc and IXa are similar to those recorded by the Spanish and Portuguese acoustic surveys during recent years (1984-1992) (Dias *et al.*, WD 1987; Dias *et al.*, 1989; Porteiro *et al.*, 1990; Carrera and Meixide, WD 1991; Dias *et al.*, WD 1992).

9.3 The Fishery in 1991

From Sub-areas VII, VIII and IX landings were reported by UK (England & Wales), France, Spain and Portugal (Table 9.1). Annual landings of sardine by Sub-areas (VII-IX) and Divisions, from 1981 to 1991, are presented in Table 9.2.

About 2,000 t of anchovy were included in the official statistics of sardine in Division VIIIa in 1991. The Working Group decided to take off about 2,000 t of anchovy from those sardine catches.

Catch data, including discards where known, for the period 1975 to 1991 by country from the sardine stock areas (Divisions VIIIc, IXa) are presented in Table 9.3. They are obtained mainly by Spanish and Portuguese purse seine fleets (96% of the total catch) (Table 9.4.). Total landings for 1977 and 1991 were the lowest during the period 1975 to 1991, both about 60% of the 1981 highest landing. Since 1986 the total catch has decreased after nearly stable catches of about 200,000 t during 1980-1985. This was caused by the decrease in the Spanish catch from about 98,000 t, mean value in 1980-1985, to 35,000 t in 1991 (Table 9.3).

During 1991, about 30% and 70% of the annual catches were landed in the first and second halves of the year, respectively, confirming the normal seasonal pattern of catches by Spain and Portugal, as reported in previous Working Group reports (Table 9.5).

About 60% of the sardine was caught in Sub-divisions IXa central-north and south in 1991.

During the first and third quarters in 1991 in Sub-divisions IXa central north and central south, it is known that juveniles (fish under regulated length - 11 cm) have been discarded in the Portuguese fishery. No information is available concerning discards by Spain. The discards amounted to about 1,512 t and 3,980 t in the first and third quarters of 1991, respectively, and they were included in the catch.

9.4 Effort and Catch per Unit Effort

Table 9.6 shows the effort, in fishing days, and the catch per unit effort (t/fishing day) for the Spanish and Portuguese purse-seine fleets.

Figure 9.3 presents the CPUE (t/fishing days) for the purse-seine fleets by areas. The CPUE trends for different fleets and areas indicate a decrease.

9.5 Fishery-Independent Information

9.5.1 Acoustic surveys

In April/May 1992, an acoustic survey was carried out in Spanish Atlantic waters (Division IXa - northern part and VIIIc) to estimate abundance at each age of sardine. The same area has been covered during these surveys each year since 1986 (1989 excluded). The surveyed area was covered by a zig-zag track and was delimited by the 1000 m isobath, but was extended further offshore when blue whiting shoals appeared (2870 nautical miles integrated). The methodology used was that adopted by the Planning Group for Acoustic Surveys in ICES Sub-areas VIII and IX (Anon., 1986).

The total biomass estimated in 1992 was about 45,016 t, the lowest estimate since 1986. In the central part of the Cantabrian waters no sardines were detected. For the total area, age groups 1 and 5 (1991 and 1987 year classes) were the most abundant, 27 and 19% in number and 16 and 24% in biomass. The 1983 year class (9 age group) is still strong (13% of the total biomass).

The biomass estimation in this survey was 61,000 t less than the 105,934 t estimated in 1991 (Table 9.7).

A sardine acoustic survey was carried out by Portugal off the Portuguese coast from 17 September to 4 October 1991 in order to contribute to the Iberian sardine stock assessment. This survey aimed at estimating the sardine abundance (in number and biomass) by length class and age group, and to observe its distribution in the surveyed area and also to estimate the 0-group sardine (1991 recruitment) (Dias *et al.*, WD 1992). Due to an integrator malfunction that occurred during the survey it was only possible to undertake the sardine integration in Sub-division IXa central-north. Sardine concentrations were distributed in the usual areas within the continental shelf limits. For fish abundance estimation, the surveyed area was divided into two sectors based on the fish distribution pattern and the fishing samples. The total biomass estimated was 121,766 t, the 1991 year class (0-group) was 79% in number and 75% in biomass (Table 9.8).

Small fish (<16 cm total length), unsuitable for the sardine canning industry, predominated in the sardine landings in the northern Portuguese fishing harbours in the second half of 1991. A sardine acoustic survey was carried out from 16-27 January 1992 in that area to estimate sardine length and age composition, define the offshore limit of the sardine distribution area, and to

study any possible changes of the fish behaviour pattern (horizontal and diel vertical distributions).

The main surveyed area was located between 41°50'N and 39°40'N. As echointegration was still not available, it was only possible to undertake echo-sounding and trawl sampling. The survey results were in agreement with those obtained in the same area in September 1991 showing a low occurrence of adult sardine (>16 cm) in the northern area. The largest sardine concentrations were found in Sub-division IXa central-north.

9.5.2 Egg surveys

From April to May 1990, a daily egg production survey was carried out off the Galician and Cantabrian shelf waters (Divisions VIIIc and north of IXa) for the purpose of sardine spawning biomass estimation (Garcia *et al.*, 1991).

The distribution pattern indicates differences which were taken into account in the regional stratification. Galicia (Region I) is distinguished by spawning occurring in coastal areas in the mouths of the Rias (south Galicia), whereas in the western (Region II) and the central (Region III) part of the Cantabrian sardine egg distribution is widespread and extending to offshore waters. The eastern Cantabrian area showed an intermediate situation, with a littoral distribution of sardine eggs predominating.

Higher values of batch fecundity were observed in Cantabrian waters, due to the larger size classes in the sardine population within this region. Relative fecundity estimates of 1988 and 1990 show significant differences in both years, with smaller relative fecundity and Daily Specific Fecundity in 1990. The spawning fraction obtained showed quite pronounced differences between regions. Values in regions I and II were of the order of 0.10, while those in region III were 0.20. Sex ratio in all regions was close to 50% (Table 9.9).

The total biomass estimated in 1990 was 77,720 t, which was less than the 1988 estimate (Table 9.10). Survey results for 1988 and 1990 are shown in the table for each region for both the daily egg production method and from acoustic surveys.

9.6 Length Compositions by Fleet and by Country

In 1991, the quarterly and annual catch length compositions by fleet were provided by Portugal and Spain for Divisions VIIIc and IXa (Table 9.11) and were provided by England (UK) for Division VIIe (Table 9.12).

The smallest fish (5.0-8.5 cm) were caught off the west coast of Galicia (Sub-division IXa north) and the largest fish (>24.5 cm) were caught in Divisions VIIIc and VIIe.

The mean length of fish caught was 24 cm in Divisions VIIe and 16.5 cm in Divisions VIIIc and IXa, the mean length being smallest in Sub-division IXa north (13.5 cm).

9.7 Catch in Numbers at Age

Based on data submitted by Working Group members, the 1991 catch in number at age was compiled by quarter and sub-division of Divisions VIIIc and IXa (Table 9.13).

The Portuguese data (catch in number length composition, and age/length key) were collected on a quarterly basis by Sub-division (IXa central-north, central-south and south). To estimate catch in length composition, 388 samples were taken in 1991 from the commercial fishery with a mean number of 76 individuals in each sample. An average of 298 fish were aged in each quarter.

The estimate of discards (in number of fish) was obtained with the catch mean weights of age 0 and age 1 at same date and same area.

The Spanish data were collected on a quarterly basis, using the length composition by quarter and the two half-year age/length keys. The catch length composition was estimated from 385 samples from the commercial fishery, averaging 82 individuals in each sample. The age/length keys contained an average of 806 fish obtained from the commercial fishery and acoustic surveys.

The 1991 0-group catches are greatest in Sub-divisions IXa north and IXa central-north. The quarterly catches of the 0-group in the third and fourth quarters of 1991 are about 550% and 1040% greater than the 1990 catches of this age group. This information and the available data from the acoustic surveys seem to indicate a strong 1991 year class.

Table 9.13 shows that the oldest fish are not present in the catches of the southern Sub-divisions (IXa central-north, central-south and south) during the year. The oldest ages (above age group 7) occurred, as usual, mainly in the catches of the northern part of the stock (Sub-divisions IXa north and VIIIc east and west).

9.8 Mean Length at Age

For 1991, mean length at age in the catches by quarter were provided by Spain (Sub-divisions VIIIc east, west and IXa north) and by Portugal (Sub-divisions IXa central-north, central-south and south) (Table 9.14).

9.9 Mean Weight at Age

The mean weights at age in the catch in 1991 were based on Spanish and Portuguese biological sampling. Table 9.15 shows the mean weight at age by sub-division and quarter. The oldest ages (above age 6) are not represented in Sub-divisions IXa central-north, central-south and south, so their mean weights in the catch for the total area were based only on the data for the other sub-divisions.

It seems that there are small differences in the mean weights at age in the catch for fish aged above 2 years old compared with previous years (see Table 9.16).

The mean weights at age in the stock at the beginning of 1991 have been calculated from commercial sampling during December 1990 - January 1991 and from the Spanish accustic survey carried out during the first quarter of 1991 (Table 9.17).

9.10 Maturity at Age

The maturity ogive was revised for 1989 and 1990 and estimated for 1991 using the first quarter data from Portuguese biological sampling (1989-1991), from Spanish biological sampling (1989-1990) and from acoustic survey (March 1991) (Table 9.18). Of a total of 1,510 individuals examined 1,269 were mature.

Figure 9.4 shows the maturity ogives for the stock for 1989 to 1991. It seems that the 1989 maturity ogive is significantly different from the others. Maturity ogive for 1990 and 1991 are similar those for previous years (Table 9.18).

9.11 Fishing Mortality and Tuning of the VPA

The catches in number are given in Table 9.19 and the fleet input data for tuning the VPA in Table 9.20. A value of M of 0.33 was used for all ages for all years and the proportion of M and F before spawning was taken to be 0.25.

For the estimation of terminal fishing mortality coefficients by tuning, CPUE data from five sources were available.

- Spanish acoustic surveys carried out in Division VIIIc and Sub-division IXa north during spring 1986-1991.
- Portuguese purse seiner fleet (Sub-divisions IXa central-north and central-south and south) 1988-1991.
- Spanish purse seiner fleet from Vigo and Riviera (Sub-division IXa north) 1982-1991.
- Spanish purse seiner fleet from Sada (Sub-division VIIIc west) 1988-1991.

  Spanish purse seiner fleet from Santoña (Sub-division VIIIc east) 1988-1991.

Owing to different problems on the Spanish and Portuguese research vessels, no acoustic data were available in 1989. The tuning program cannot handle missing values in a data set and to overcome this problem the Shepherd multiplicative model was used to estimate interpolated values for 1989. The abundance estimates in number by age group from 1986-1992 were used. Table 9.20 shows the file used as input to tune the VPA (Laurec-Shepherd method).

A first trial was made using all fleets (Option A). A high standard error in the log catchability was associated with the acoustic survey, and for the Spanish purse seine fleet (Vigo and Riviera) raised values of F were exceptionally high (Table 9.21).

The Working Group discussed the results and considered omitting the acoustic survey and the Spanish purse seine fleet (Vigo and Riviera) from the tuning. It was considered desirable to retain the acoustic survey, however, as this was a fishery-independent data set and all the remaining data sets were commercial purse-seine fleets for which measurement of fishing effort is difficult. It was decided, however, to make a trial excluding the Spanish purse-seine fleet (Vigo and Riviera) (Option B). The results of this analysis are given in Table 9.22.

The results of the two tuning options were used as the basis for two assessments.

Separate VPAs were made using the terminal F for age 2, the values chosen using the outputs of the two tuning runs, (F = 0.374 Option A, and F = 0.278 Option B), and a value of terminal S = 1. The results show a flat exploitation pattern (Tables 9.23a and 9.24a). Final VPAs were performed using the terminal populations from SVPA for the two options. Fishing mortalities, stock size and biomass estimates generated by the final VPAs are given in Tables 9.23b,c,d and 9.24b,c,d and in Figures 9.5 and 9.6 for Options A and B, respectively. It might have been better to use F for age 2 which resulted in corresponding F_{2-5} between the tuning VPAs and the SVPAs as recommended in the "blue pages". However, time did not allow the Working Group to try this.

The total biomass estimated by the VPA has decreased since 1984 from 950,000 t to 290,000 t in 1991 (Option A) or from 983,00 t to 370,00 t (Option B). By comparison, the biomass estimated from the egg survey in 1990 was less than half the 1988 survey estimate, and in the

areas covered by the Spanish acoustic surveys, estimates of biomass in 1990- 1992 have been lower than in earlier years (Figures 9.5 and 9.6).

Both results from the two options A and B indicate a decreasing trend in biomass and spawning stock biomass and an increasing trend in fishing mortality.

An attempt was made to run an Extended Survivors Analysis for this stock but there were problems with the implementation of the program and the analysis failed. C. Darby took the data set to Lowestoft and succeeded in making a run excluding the Spanish (Santoña) purse-seine fleet data. The results, sent by telefax to the Working Group, appear to be reasonably consistent with Option A.

The Working Group, therefore, adopted Option A for management purposes (tuning with the five fleets).

9.12 Recruitment

Tables 9.23 and 9.24 show the stock sizes from the VPA for the two options. In the period 1976-1991, the 1983 year class was the strongest in the historical series and the 1987 year class was relatively strong. The 1988, 1989 and 1990 year classes were the poorest in this period, but they may not yet have been reliably estimated. After low recruitment in recent years it seems possible, from analysis of the catches of age group 0 and the surveys carried out during 1991 and 1992, that the year class of 1991 may be a good one.

The recruitment regression program was used to regress the numbers at age O from final VPA for 1984-1989 against data from the acoustic surveys (November surveys in Sub-division IXa central-north, and March surveys in Sub-divisions IXa north and VIIIc west and east) and the indices of Spanish purse seiners (juvenile catches in numbers in the second half of the year by number of fishing days from directed fishery). Input data are given in Table 9.25a. Table 9.25b shows the predicted values for the 1989-1991 year classes.

9.13 Yield per Recruit

The input data for the yield per recruit and catch forecast are given in Table 9.26.

$F_{0.1}$ was estimated as 0.35.

9.14 Forecast

Stock size for ages 3 and older in 1992 is taken from the final VPA. For ages 1 and 2 the estimates from the recruitment regression program were used, in combination with the fishing mortalities from the VPA (Tables 9.23b and 9.26). The level of recruitment of 0-group in 1992 was assumed as the arithmetic mean of the 1976-1989 year classes from VPA (12.551 million).

Catch predictions for 1992 and 1993 are given in Table 9.27 and Figure 9.8.

Fishing at the *status quo* level would be expected to give a catch of 140,000 t in 1992. For 1993, the predicted catch will be about 164,000 t.

9.15 Biologically Safe Limits

The fishing mortality levels of F_{high}, F_{med} and F_{low} were estimated from the plot of recruitment (0-group) versus spawning stock biomass at spawning time for the period 1982-1991 (Figure 9.9).

If the low recruitment levels from 1984-1990, combined with the increased mortality which is above the F_{med} level continue, the SSB may decrease further in the near future.

The 1991 SSB was the lowest in the historical series (1976-1991).

9.16 Management Measures and Considerations

The catches of sardine have been decreasing since 1985, and the fishing mortality has increased slightly since 1984 (Figure 9.5). For this stock:

$$F_{high} = 0.557,\ F\ status\ quo = 0.413,\ F_{med} = 0.1.$$

The F *status quo* is between F_{med} and F_{high}, but very close to F_{high}.

The fishery in Division IXa is mainly based on fish 0-3 years old. Therefore, closures of the fishery should be recommended in the juvenile area (Sub-division IXa north and central-north) during the peak of juvenile abundance, which is usually in the fourth quarter.

A TAC should be implemented for this stock (see Section 14.3).

10 ANCHOVY - GENERAL

10.1 Unit Stocks

Preliminary results from studies on the enzyme polymorphism of anchovy of the Bay of Biscay do not confirm the results from the studies on phenotypic characteristics which indicates that three geographic groups can be well discriminated. From about twenty loci analysed, no significant variations were noted

between 5 samples caught in the north (46°36'N), the center (45°N) and in the south (44°N) along the French coast. For that reason, the Working Group decided, as in previous years, to consider the Bay of Biscay anchovy population as a single management unit in Sub-area VIII and assumed that the landings of anchovy off Portugal, the west Galician coasts and the Bay of Cadiz (Sub-Division IXa) were another management unit.

10.2 Distribution of the Anchovy Fisheries

Figures 10.1a-d sum up all the information on the fisheries directed towards anchovy in Sub-area VIII for the period 1985-1991 (Uriarte and Motos, 1992; Prouzet and Luro, 1991). Spring fisheries take place in the southeastern area of the Bay of Biscay, whereas, in the remainder of the year, the French and Spanish fisheries spread out towards the north and west.

Concerning Division IXa, the main fishery is the Spanish which takes place mainly in the south of Division IXa in spring and summer (Millan and Villamor, WD 1992) (see Figure 10.1). The Portuguese catch occurs in central-north of Sub-Division IXa in autumn, from the coast to a depth of 200 m.

10.3 Length Compositions by Fleet and by Country

1991 annual length compositions of landings of the Bay of Biscay anchovy (Sub-area VIII) by fleet were provided by France and Spain (Table 10.1). Half-yearly distributions for the two countries are very similar (Figures 10.2a and b) but some differences are observed for the second semester due to the fishing of different age groups by the two fleets. The smallest mean length of fish caught was in Division VIIIc.

The Spanish length distributions of the Bay of Cadiz anchovy (Division IXa) from 1988-1991 are shown in Tables 10.2a-d and Figure 10.3. The mean length and weight in the catch are lower than those recorded for the Bay of Biscay anchovy all over the year. The Portuguese length distributions of anchovy in Division IXa are not available.

11 ANCHOVY SUB-AREA VIII

11.1 The Fishery in 1991

11.1.1 Landings in Sub-area VIII

This fishery is regulated with an agreed TAC of 30,000 t. The key of dispatching is 10% for France (3,000 t) and 90% for Spain (27,000 t).

Total international landings in Sub-area VIII amounted to 19,281 t in 1991 (Table 11.1 and Figure 11.1). The French fishery was officially closed under EC legislation around May 1991 as the French quota had been exceeded. Estimated French landings reached 9,700 t (similar to the Spanish landings for the first time), and the Spanish landings were 9,600 t (much lower than the 1990 level). The main seasons for the French fishery were winter (January to end of March) and spring (April to end of June) while the spring season was the principal one for the Spanish fishery. The winter fishery started around 1986 and became important in 1989 (Table 11.2). No discards were observed from the Spanish fishery and the discards have not been recorded from the French fishery.

In 1992 during the first half of the year, catches have reached 24,943 t.

11.1.2 Landings by Divisions

The distribution of Spanish catches in 1991 was similar to that in the two previous years, the main landings being taken in Division VIIIc in spring (Table 11.3). The French catches were taken from Divisions VIIIa and VIIIb (46% and 54%, respectively). As in the previous year, some French landings occurred in autumn (September to December) in Division VIIIa (Table 11.3). However, in 1991 the main fisheries for the two countries were less well separated than in 1990. For both countries the spring fisheries are always located in the southeastern part of the Bay of Biscay while in autumn and summer, the fisheries are separated (Figure 11.2).

11.1.3 Landings by EC categories

The distribution of Spanish and French landings by EC market category in Sub-area VIII by half year are given in Table 11.4. The main category for the two countries is T2 (30-51 fish per kg). The T2 category has accounted for the majority of the landings since 1989.

11.2 Effort

Table 11.5 and Figure 11.3 show an increase in the size of the French fleet fishing for anchovy (purse seiners and mid-water trawlers) in 1991. This figure is provisional for mid-water trawlers. The number of mid-water trawlers that have effectively fished for anchovy is lower than the number declared (it is a maximum nominal effort) and some boats fish only during a small part of the year. It is important to note that the majority of the mid-water trawlers fish in pairs and consequently the number of mid-water trawls is roughly divided by 2. Nevertheless, it seems that the number of mid-water trawlers involved in this fishery during the past years has

increased, and the winter fishery has become more important.

For the Spanish purse-seine fleet fishing in the spring, the number of boats has remained more or less constant. At other times of the year, fewer vessels are employed in the fishery.

11.3 Fishery-Independent information

11.3.1 Egg surveys

In 1991 and 1992 the Daily Egg Production Method (DEPM) was again applied to the Bay of Biscay anchovy in order to estimate the Spawning Stock Biomass (SSB) (Motos and Uriarte, WD 1992a). The 1992 survey ended the 10th of June and, therefore, the result is still preliminary, whereas the authors believe that the final result will be within the range provided in Table 11.6. The preliminary egg production estimate was based on an incomplete set of egg samples and adult parameters are obtained from fishing during the survey. An assumption on the spawning frequency was required in order to get this preliminary result, and it explains the range of spawning biomasses assigned to the estimate.

As in previous years, spawning in 1992 took place mainly in two big areas (Figure 11.4): one along the French continental coasts, with a peak in the Gironde estuary, and a second one extends over the offshore areas and of the continental shelf, mainly on the "Cap Breton" area.

Table 11.6 shows the SSB estimates obtained by DEPM surveys for the period 1987-1992. The low biomass observed in 1991, 19,726 t, has been followed by a larger one in 1992, between 50,000 t and 80,000 t. In this year, anchovies of age 1 predominate and account for more than 95% of the population in numbers. This explains the increase of biomass observed between 1991 and 1992. The 1989 year class, still present in 1991, has practically disappeared.

The estimations of SSB equals the total stock biomass in the Bay of Biscay since all anchovies are fully mature in May at the time the surveys are made (Motos and Uriarte, 1992b).

Figure 11.5 shows the relationship between spawning area and biomass for the set of surveys performed. This positive relationship and the fact of having already several times measured the daily batch fecundity of the stock will probably allow certain assumptions to be made in order to get quick provisional results of SSB estimates of this DEPM survey.

11.3.2 Acoustic survey

A French acoustic survey was carried out in the Bay of Biscay in April 1992. Acoustic data were collected using the IFREMER Acquisition System (Diner *et al.*, 1989) and the methodology of Massé (1988), and Massé and Rouxel (1991).

The anchovy distribution in April 1992 (Figure 11.6 and Table 11.7) was similar to that in 1991. Anchovy were found in two areas:

- a dense concentration from the French coast out to a depth of 70 m and between 45°05'N and 46°05'N of anchovies entirely belonging to age group 1;

- smaller quantities from the French coast to a depth of 80 meters and between 43°40'N and 45°00'N, mixed with sardine and horse mackerel. About 95% of these anchovies belonged to age group 1.

The estimates of the abundance index were 85,000 t for the first area and 28,000 t for the second one.

This survey suggests a good recruitment of the 1991 year class and confirms the lower abundance of the 1990 year class as observed during the 1991 surveys.

The 1990 acoustic data are presently being re-analysed with a view to providing a reliable index for that year but the results are not yet available.

A first analysis of the hydrographic data collected during the 1992 survey (part of an EC project undertaken by Spanish and French scientific organisations) shows that the area separating the two concentrations described above corresponds to surface water with high salinity between the influences of the Gironde and the Adour fluvial systems (Massé and Leroy, WD 1991) as in 1991.

The school structures corresponding to anchovy have been observed in the northern area as compact layers close to the bottom. This behaviour had never been observed previously during acoustic surveys or, to our knowledge, from fishermen's observations. Compared to the previous years (1990 and 1991), the hydrological structure shows a deeper distribution of the low salinity layer which could suggest an explanation, but further investigation is needed to confirm this hypothesis.

11.3.3 Comparison of abundance indices

Table 11.8 sums up the results from both types of survey for the stock. From 1989 to 1992, only three points can be compared, because the 1990 acoustic result is not available. Figures 11.7a and b gives an idea of the relative performance of the methods.

The acoustic data must be considered as relative indices and not absolute estimates of biomass. Consequently, the differences observed have to be interpreted carefully. However, it seems to have, especially for 1991, some contradictory results from the two methods: the acoustic survey seems to indicate a relative stability of the biomass while the egg survey showed a sharp decrease in the abundance of the stock of anchovy in the Bay of Biscay, from 1990 to 1991 (see Figure 11.7a).

A full analysis of the two assessment methods as applied to anchovy of the Bay of Biscay is provided within the international FAR project carried out by Spain and France. Based on the two assessments carried out in 1991 and 1992, this study is expected to end at the end of 1993.

Pending the final report of this study, the Working Group considered possible reasons for the difference between the two methods.

In the case of the acoustic survey, it should be noted that pelagic trawl hauls are the only available identification method in situations where more than one species is encountered. Because of the possibility of different catchabilities of different species, a first hypothesis may be advanced for the acoustic result in 1991. In that year, anchovy was mainly mixed with sardine and mackerel, which are more active species. As a result, the abundance of anchovy may have been over-estimated. This was not the case during the survey in 1992 because only anchovy were found in the northern area where 75% of the biomass was observed.

Concerning the DEPM estimate of biomass it has to be noted that some work is also done in order to check different sources of errors: e.g., variances between replicates of CALVET hauls at different distances (variogram), development of eggs at different temperatures, etc.

Considering the age composition of the catches and of the stock biomass estimates in 1992 (see Section 11.6), and the values of Z for the 1990 cohort (see Section 11.9), it seems that the egg survey gave, at least for that year, more consistent results than the acoustic survey. However, this subject will be dealt with in detail within the International FAR project carried out jointly by Spain and France.

11.4 Recruitment

In 1992, both estimation methods (acoustic and egg surveys) indicate a higher recruitment than in 1991. The series of recruitments shown in Figure 11.7b show the variability of recruitment since 1987.

1992 confirms the high variability of recruitment (expressed by the number of 1-year-olds per unit of SSB) for the anchovy stock in the Bay of Biscay (Figure 11.8). If we refer to the biomass estimated by the DEPM, as in 1989, significant recruitment was produced at a low level of spawning biomass.

11.5 Catch in Numbers at Age

Table 11.9 shows the catches of anchovy from the live bait fishery (Santiago, WD 1992).

In 1991 (Table 11.10), French landings consisted mainly of 1-year-old (49%) and 2-year-old (46%) anchovies. 1-year-old anchovies accounted for more than 80% of the total catches in number during the second semester. The contribution of these all groups in the Spanish catches were 1-year-olds (51%) and 2-year-olds (33%). Nevertheless, differences in the age/length keys from commercial biological sampling of both countries have been found for the spring season. This difference should be checked further to investigate its origin.

Table 11.11 records the age composition of the international catches since 1989, on a half-yearly basis, including the catches achieved in 1992, up to the end of May. Age 1 was largely predominant in the catches.

The current EC size categories used to record the landings of anchovies since 1988 have mainly shown the same pattern of distribution between years, without reflecting the changes that have occurred in the age composition of the catches during these years (Table 11.12). It seems that especially the T2 EC category (between 30 to 50 anchovies per kg) is too wide to stratify the landings for the determination of age distributions.

11.6 Mean Weight and Mean Length at Age

Mean weights at age for both countries were estimated by the methods described in last year's report (Anon., 1991b). Mean weight and mean length data are shown in Tables 11.13 and 11.14. The French mean weights at age in the catches were based on biological sampling of scientific survey and commercial catches. Spanish mean weights at age were calculated from routine biological sampling of commercial catches.

11.7 Maturity at Age

As reported in previous years, all age groups are fully mature in spring. No differences in specific fecundity (number of eggs per gram of body weight) have been found according to age (Motos and Uriarte, WD 1992a).

11.8 Assessment: Natural and Fishing Mortalities

The methodology to calculate these estimates was explained in a previous Working Group report (Anon., 1991b). These rates of mortality were calculated from direct estimations of abundance (acoustic and egg surveys) and especially from the Daily Egg Production Method. These calculations showed between 1987 and 1992 (Table 11.15 and Figure 11.9):

* M fluctuates between years and is high with values between 0.5 and 2.2;
* the natural mortality on 1-group was estimated to be higher than the fishing mortality;
* the fishing mortality obtained for all age groups pooled was in the range of 0.32 to 1.1;
* an increase in fishing mortality can be seen in recent years.

Figure 11.9 shows the evolution of the 1989 and 1990 cohorts. Several comments can be made:

- the values of M estimated from acoustic indices as 3 and 7 seem to be unrealistic;
- high values of M have been found for the 1989 year class (around 2) in 1990 and 1991;
- for age 1 the natural mortality was low in 1991 (0.3). In this year very different natural mortalities between age groups are observed (1.9 for age 2 an 0.3 for age 1).

It has to be remembered that natural mortality includes discards at sea and misreported landings, even though they cannot explain the high values found.

The assessment is highly dependent on the direct estimates of the stock. The estimates have been used without taking into account their uncertainties, and no sensitivity analysis is performed. Unlike other stock assessments, no tuning of the data can be made.

11.9 Trends in Biomass and Recruitment

From Figure 11.1 it is clear that the stock size is at a greatly reduced size compared to the 1950s and 1960s. In those years there was a much bigger fleet than the current one and since then there has been a continuous improvement of fishing facilities. There is the possibility that overfishing took place in the earlier period but this cannot be proved. In recent years M estimated by DEPM was much higher than F, especially for age 1 (see Section 11.8).

Alternatively, a change in environmental factors might have caused a reduction of the spatial distribution of this stock in the Bay of Biscay (Junquera, 1986 and 1991). In the 1950s and 1960s the absolute recruitment and the biomass had to be larger on average to sustain the catches which were taken. The analysis of the direct biomass estimations of anchovy shows a decrease in the recruitment with increasing biomass since 1987 (Figure 11.10). This relationship shows the possible existence of regulatory mechanisms which decrease the yield of the stock when the biomass increases. However, this relationship is based only on 6 years of observations (5 points). Thus it is necessary to wait for more observations and to be very cautious in order to avoid further interpretation.

For the time being, we note that the large fluctuations of SSB observed during the last six years are mainly due to the variations of the 1-year-old recruitment (see Figures 11.7b and 11.8).

11.10 Forecast

As mentionned in last year's report, only a rough estimate of the catches from the 1+ group can be made. In 1992 only a rough estimate on the biomass is given by the DEPM and we start only from a medium value of 60,000 t (50,000-80,000) knowing that the acoustic estimates gave a higher acoustic index (around 110,000 t) (see Section 11.3).

According to different values of natural mortality (M_{min} = 1; M_{mean} = 1.5 ; M_{max} = 2) and fishing mortality (F_{min} = 0.4; F_{mean} = 0.7; F_{max} = 1.1) recorded in these last years, we can estimate the catches from June 1992 to end of May 1993. They range between 11,000 t and 34,000 t according to the level of F and M chosen. For the remainder of 1993, with the same calculation on the same age class, the catches would range between 1,300 t and 5,200 t (Table 11.16).

For the second half of 1993, the high variability of recruitment (estimated to be between 6,000 t and 95,000 t in the last 6 years) do not allow an estimate to be made before the middle of 1993 of the potential total catches for 1993. We can only mention than the total catches made on age 1 fluctuated from 4,500 t to 28,000 t during the period 1987-1992 (Table 11.17).

11.11 Biologically Safe Limits

Biologically safe limits are presently difficult to define. No calculations have been made on F_{med}, F_{low} and F_{high}, because of the short series of biomass and recruitment estimates. From a short-term point of view, the data obtained from acoustic or egg surveys indicate that environmental factors may affect recruitment and thereby

cause fluctuations in the stock (Figures 11.7b and 11.10). Similar patterns have been observed in other anchovy stocks for which a minimum spawning stock biomass has been chosen as a management objective in order to protect the stock from depletion and recruitment failure.

The data available show that an SSB of 15,000 t and 20,000 t produced the highest recruitment of these last 6 years. This gives a reference for a minimum precautionary biomass level.

However, no information is available on the size of year classes produced in the 1950s and 1960s when the spawning stock size is likely to have been much larger than at present.

11.12 Mananagement Measures and Considerations

In its last report, the Working Group described three different options that could be defined to manage this fishery (Anon., 1991b, Annex 3). The choice between the "Opportunistic solution" (fish whatever you want over the Biologically Safe Limit), the "Intermediate solution" (modulation and regulation of catch and effort according to the SSB) and "Smoothing solution" (conservative solution with F low and constant) will depend on the final objective of the managers.

Nevertheless some further considerations can be made in order to answer the EC request on what are the most appropriate management measures for anchovy (see Prouzet and Metuzals-Sebedio, WD 1992; Uriarte, WD 1992):

a) The recent low level of anchovy biomass observed in the Bay of Biscay requires a general attitude of caution and to define regulation measures that allow an increase of the average level of spawning stock biomass. However, the degree of uncertainty on the potential for the current stock biomass to rebuild the stock up to the higher levels of abundance of the past decades is high, because of the possible influence of environment on the recruitment success.

According to this the "Opportunistic solution" would be certainly too risky a management policy for the stock from a biological and probably an economical point of view. On the contrary, the "Smoothing solution" or an "Intermediate Solution" would be the better solutions. For these reasons, several technical measures to improve the exploitation of the stock and management in general are recommended.

b) Regulation of effort and mechanisms for protecting the stock at low levels of biomass will always be necessary for this fishery, in order to adapt the fishing efficiency to the productivity of the stock. The anchovy, being a highly valuable resource, on which fishing effort has been increasing since 1985, and taking into account the current low levels of biomass, effectively requires some form of effort regulation.

A discussion on the concrete management options which could be undertaken is presented here below. The different possibilities of management (paragraphs 11.12.1 and 11.12.2) could be mixed, according the objectives of the managers.

11.12.1 Regulations of effort and catch

Table 11.18 shows the management possibilities for the stock from a short (1 year) and medium-long-term point of view.

The preferred management system of the stock should be via Analytical TAC and/or a system of fishing licences:

Analytical TAC: The adoption of this TAC must be based on an annual monitoring of the stock at a time just before the start of the main fishing season. In this way, management options on the levels of available catches could be undertaken, as soon as recruitment takes place so the uncertainties on the fishable stock are minimized.

Acoustic surveys performed in April could be the basis for such a management system. However, the conflicting results between DEPM and acoustic surveys seem to indicate that some time will still be required for checking the performance of these methods, before the management system could be implemented.

System of fishing licences: Licences by themselves could not prevent stock collapse at low levels of biomass, due to possible increases of catchability with decreasing biomass, as recorded on other pelagic stocks (MacCall, 1976). For this reason, this system should be complemented with a close monitoring of the stock and mechanisms of protecting the stock at low levels of biomasses (such as a TAC or appropriate additional measures, see below).

The use of an annual precautionary TAC, by itself, on the basis recommended for 1991 by ACFM, was subsequently rejected as a suitable solution for the management of this fishery (Anon., 1991b). In Table 11.18, an intermediate solution is proposed until a full monitoring of the stock could be achieved:

Annual revisable TAC.: TAC for the first half of the season could be set based on a rough forecast of the catch according to:

a) The proportion of the stock expected to survive assuming average natural mortality and derived from direct biomass estimates of the stock.

b) The recruitment at age 1, as average from recent years.

The TAC for the second half of the season could then be determined in the middle of the year, as soon as the size of recruitment year class becomes available, to take into account the high variability of recruitment and M observed in recent years. This process allows the uncertainties of annual TACs to be minimized and makes the best use of the current monitoring of the stock.

11.12.2 Technical measures to increase the spawning stock biomass

These measures are summarized in Table 11.19. The basis of these measures is to protect as much as possible the juveniles from capture prior to the spawning season by introducing a minimum size category and to add some complementary regulations to prevent an increase in discardings (Table 11.20).

1. Size limit

This possibility of management is explained in a Working Document submitted to the Working Group members (Prouzet and Metuzals-Sebedio, WD 1992). The basis of this regulation is to prevent the majority of juveniles being caught before the spawning season (April to end of June).

A minimum size category of 60 anchovy per kg has been defined according to the observations made from biological sampling of commercial and scientific catches. This size category generally separates samples containing a significant proportion of anchovies that have already spawned (lower size categories) from samples constituted mainly of juveniles (higher size categories). The use of automatic sorting equipment should be banned.

2. Closure areas

In order to prevent the increase of discards due to captures of smaller anchovies, which may occur with a size limit regulation, some closure areas have to be defined to supplement the above measure.

These areas are defined for the first semester when the population of juveniles is available for the fisheries.

According to the scientific surveys and the biological information gathered on the commercial fishing boats, it is now well established that during the main part of winter and spring, the population of anchovy is distributed with increasing size from the shore to the open sea (Prouzet and Luro, 1991; Prouzet, WD 1991) especially during and before the spawning season in the center and the south of the Bay of Biscay (Figure 11.11).

Boundaries may be defined as follows:

- 1°35'W long. from the Spanish coast to the North of "Bassin d'Arcachon" (44°45'W lat.);

- 1°45'W long. from this point up to 46°N of latitude.

Inside this area from January to the end of June anchovy fishing would be strictly prohibited.

It seems, however, difficult to define such closure areas for the autumn fisheries in the north of the Bay of Biscay and along the Spanish coast in the Division VIIIc due to the mixture of adults and juveniles coming from the open sea during this period, particularly in the northern part of the Bay of Biscay.

To increase the efficiency of such a regulation, some additional measures have to be taken: control of the location of boats with the electronic log-book and the prohibition of automatic sorting devices on board.

The potential of this measure could be illustrated by the French fishery in 1992, when roughly 3,000 t of 4,000 t caught during the winter and the beginning of spring were in the prohibited size category.

3. Closure periods

According the level of biomass estimated or according the objectives of managers (more or less restrictive regulations), some different durations can be defined between November and end of June for closure of the whole fishery during the recruitment and spawning periods. November coincides with the beginning of the presence of juveniles in the fisheries and the end of June to the last part of the spawning season.

So three possibilities could be suggested:

- January to March: to prevent some important catches on the immature 1-year-old anchovies;

- November to April: to allow a greater proportion of the juveniles to spawn at least one time and to allow a part of the adult population to survive to spawn another time;

- November to May: to reduce the fishing mortality on all age groups until the middle of the spawning season and to protect the majority of juveniles from capture.

The precise impact of these measures on landings are indicated in Table 11.21.

12 ANCHOVY - DIVISION IXa

12.1 The Fishery in 1991

The fishery involves Portuguese and Spanish fleets. The Portuguese fleet is made up mainly of purse-seiners. There are also some trawlers and artisanal ships which fish anchovies but their landings are very small (1% and 2% of the total catch). In Portugal the anchovy is not a target species.

In Spain there are two very distinct fishing areas, west of the coast of Galicia (ICES Sub-Division IXa north) and the Bay of Cadiz area (Sub-Division IXa south). The main fishery takes place in the Bay of Cadiz in the first half of the year (Millan and Villamor, WD 1992) where anchovy is the target species. Here the fleet is made up of two types of vessels: the dedicated purse-seiners and multi-purpose vessels which use purse-seines part of the time. The dedicated purse-seiners take 95% of the total Spanish landings. In Galicia, anchovy is not a target species, it is only occasionally fished by purse-seiners in the first half of the year.

Fishing in the Bay of Cadiz begins in March and ends in November (the fleet stops voluntarily from December to February), the highest catches coming in the first six months of the year and not coinciding with the peak spawning time which occurs in summer (Millan and Villamor, WD 1992).

12.1.1 Landings in Division IXa

The landings by countries for the period 1943-1991 are shown in Table 12.1. The landings for Portugal are large in the 1940s and 1950s and the highest landings in the series were recorded in 1957 with a total of 12,610 t. The landings for Portugal are now at a level of 210 t.

The Spanish landings since 1988 increase from year to year. These landings correspond in the main part to the Bay of Cadiz, making up 97% of the total Spanish landing, the remainder coming from the area to the west of the coast of Galicia. The Spanish landing is now at a level of 5,700 t.

The total international landings in Division IXa reached a level of 5,921 t in 1991. The Spanish landings make up 96% of the total international landings. The seasonal distributions of the Spanish and Portuguese landings are very different (Table 12.2). Spring was the most important season for Spain, while the highest landings by Portugal were made in the autumn.

12.1.2 Landings by Sub-division (Figure 10.1 and Table 12.3)

The Spanish fishery is centred in Sub-Division IXa south in spring and summer. The Portuguese fishery is centred in Sub-division IXa central-north in autumn. The main fisheries of the two countries are completely separated in location (the southern part for Spain and the Northern part for Portugal) and season (spring for Spain and autumn for Portugal).

12.2 Effort and Catch per Unit Effort

The data provided for fishing effort and CPUE indices of anchovy in Division IXa relate to the Spanish purse seine fleet in the Bay of Cadiz (Millan and Villamor, WD 1992). The fishing effort, number of effective trips of the three fleets of the Bay of Cadiz show a steady increase since 1988, except in 1991 when the fleets of Barbate suffered a decrease (Table 12.4).

The CPUE is stable for the single-purpose purse-seiner fleet. CPUE for the multi-purpose fleet of Sanlucar, however, increased from 1988 to 1990 before falling in 1991 (Table 12.5).

12.3 Assessment

This is the first year where the data have been presented. However, the data available at present are insufficient to make any assessment of this fishery. The limited CPUE data available do not show any consistent indications of trend in abundance over the past 4 years (1988-1991).

12.4 Biologically Safe Limits

Since there is no information on stock abundance, it is not possible to give any biologically safe limits.

12.5 Management Measures and Considerations

The management measures taken until now are summarized by Millan and Villamor (WD 1992). The most important regulations are:

a) EC regulations according to a precautionary TAC of 12,000 t;

b) Spanish regulations:
   - minimum landing size of 10 cm;
   - five fishing days per week;
   - prohibition of fishing in bays and estuaries;

c) Local regulations: voluntary stop of fishing from December to February in the Bay of Cadiz.

Given the reduced knowledge of the biology and dynamic of this population, it is recommended that the precautionary TAC should continue, in order to avoid an increase of effort.

13 DATA REQUESTED BY THE MULTISPECIES WORKING GROUP

13.1 Mackerel

13.1.1 Catch in numbers at age by quarter for the North Sea mackerel stock

As for the previous years 1987-1990 (Anon., 1988, 1989, 1990a, 1991a), the catches of North Sea mackerel in Sub-area IV and Division IIIa in 1991 were included in the catches of the western stock.

As no changes in the fisheries in Sub-area IV and Division IIIa have taken place in 1991 compared to 1990 and information obtained during a Norwegian egg survey indicates a spawning stock in 1991 at the same level as in 1990 (Iversen, pers. com.), the total catch of the North Sea stock was assumed to be the same in 1991 as in 1990 (10,000 t). Based on the age composition of mackerel caught during the egg survey in the North Sea in 1991 (Iversen, pers.com.) and the mean weight in the catches from 1990 (Anon., 1991a) the catch in numbers for 1991 was estimated (Table 13.1). The catch in numbers are split by quarter for each of the years according to the quarterly total catches in Sub-area IV and Division IIIa.

13.1.2 Weight at age for the North Sea mackerel stock

The weights by age group as obtained during the egg survey in 1991 (Iversen, pers.com.) were similar to the weights given in last year's Working Group Report (Anon., 1991a) for the second and third quarters. Therefore, the Working Group considered the weight at age in the stock by quarter in 1991 to be the same as in 1989 (Table 13.2).

13.1.3 Stock distribution by quarter

As there is no evidence of changes in the migration of the North Sea stock, the Working Group decided to assume the same quarterly distribution of the two stocks in 1991 as during the period 1986-1990 (Table 13.3). As for previous years the Working Group assumes that no western 0-group are migrating into the North Sea.

13.2 Horse Mackerel

13.2.1 Catch in numbers at age by quarter for the North Sea horse mackerel stock

As explained in Section 6.3 the available samples from the commercial fishery are not representative of the majority of the catches, and it is not possible to give a reliable estimate of the catch in numbers at age.

13.2.2 Weight at age by quarter for the North Sea horse mackerel stock

The weights at age in the catches given in Table 13.4 are based on Dutch samples of research vessel catches and commercial catches. The weights at age in the stock are taken as the estimated weights at age in the catches in the second quarter.

13.2.3 Stock distribution by quarter

There is no information available about the amount of western horse mackerel which migrates into the North Sea during the third and fourth quarters. In the period 1982-1986, the catches of horse mackerel in Division IVa were very low indicating very little, if any, migration of western fish into the North Sea. In 1987 the catches in Division IVa started to increase and reached a maximum of 113,000 t in 1990 corresponding to about 30% of the total catch of the western stock. This increase was mainly due to the appearance of the strong 1982 year class of western origin in the North Sea in the third and fourth quarters.

Based on the catches by division of the western horse mackerel (Table 5.9), the Working Group considers that between 5% and 40% of the western stock was present in the North Sea in the second half of 1991 (Table 13.5).

14 REQUESTS BY THE COMMISSION OF THE EUROPEAN COMMUNITIES

14.1 Have Current Patterns of Distribution and Migration of Mackerel become more or less Permanent?

Of the three mackerel stocks which are recognised by the Working Group it is only in the Western stock that significant changes in the distribution and migration patterns are known to have occurred.

Walsh and Martin (1986) and Anon. (1990a) have extensively reviewed the distribution and migrations of the adult component of the western stock and they have described the changes which have taken place since the mid-1970s. Data prior to this period are inadequate to

determine the earlier distribution and migrations of this stock. The changes which have occurred have been progressive over a period of years, but from one year to the next major changes have not taken place. At present there is no evidence to indicate that the migrations and distributions of the Western mackerel stock have stabilized on a permanent basis. In the long term changes must be expected to take place and they are likely to be unpredictable. However, in terms of practical stock management any short-term (two to three years) changes can be expected to be minimal.

14.2 Are Existing Management Units of Mackerel and Horse Mackerel Appropriate?

14.2.1 Introduction

For biological and assessment purposes, mackerel and horse mackerel within the ICES area are each considered to be divided into three unit stocks: the North Sea stock, the Western stock and the Southern stock. The ACFM advice on both species is concerned with the conservation and management of each of these stocks in terms of control of the fishing mortality rate and the exploitation pattern. In this section the geographical units currently used by the management bodies are evaluated in relation to these objectives and in relation to the geographical units used in the ACFM advice.

14.2.2 Mackerel

Existing management units in relation to the units used in the ACFM advice

The management units included in the ACFM advice and in the management regulations are given in Table 14.1 and the area units advised by ACFM are also shown in Figure 14.1.

The geographical limits of the management units used by the management bodies to set TACs do not in all cases correspond to those used in the ACFM advice. The main differences between the areas listed in the regulations and those listed in the ACFM advice for each management unit relate to outlying areas such as Sub-areas X, XII and XIV and Divisions IIb, IIIb,c,d, VIIId,e and IXb. These are outside the normal range of mackerel (or are areas in which small quantities of mackerel are found) and are presumably included in the regulations to prevent misreporting.

The Working Group would point out that those parts of Divisions VIIId and e on or close to the continental shelf are within the main range of the western mackerel stock and so should be included within the units listed in the ACFM advice for this stock.

There is also an additional major difference between the management areas included in the ACFM advice and those included in the TAC regulations. Division IVa and the EC zone of Division IIa are included in the TAC regulation applying to North Sea mackerel, whereas the ACFM advice, which is based on available information about the distribution and migrations of each stock, indicates that they should be included in the management area of the western stock for the period August-December. During this period of the year a large proportion of adult western mackerel are in Divisions IIa and IVa. The TAC regulation applying to Division IVa and the EC zone of Division IIa imposes a major constraint on the fisheries of some countries that have quotas to exploit mackerel of the western stock in these areas even though the scientific advice indicates that such severe restrictions are not needed. The result of this limitation is that large quantities of mackerel caught in Division IVa are misreported from adjacent areas, particularly Division VIa.

In terms of the assessment of the western mackerel stock, this misreporting prevents accurate estimation of the quantities of each age group caught in different parts of the stock distribution area. Until now, this appears not to have caused major errors in the estimates of the overall fishing mortality rate and total stock size, partly because biological sampling has followed the distribution of the fishery and partly because the catches in Divisions IIa and IVa are predominantly of the western stock (see Sections 3 and 6). It is possible in future, however, that misreporting could affect the ability of ACFM to do accurate assessments of the two stocks that mix in this area and to determine the exploitation pattern of the stock and how this is influenced by different fishing patterns, eg the proportion of the catch taken in different areas. Misreporting of catches could also make it difficult to detect future changes in stock distribution and migration patterns.

Protection of the North Sea stock

The current ICES advice for North Sea mackerel is that, on biological grounds, there should be no fishing on the stock. To approach this objective, ACFM advises that there should be no fishing for mackerel in Divisions IIIa, IVb or IVc at any time of year and that no fishing for mackerel should be allowed in Division IVa in the period January-July, inclusive. This advice recognises that, although there may be North Sea mackerel in Division IVa from August-December, the fishing mortality on the North Sea stock caused by fishing in this area at this time is very low (Section 6). Furthermore, any restrictions on fishing within the TAC for western mackerel in Divisions IIa and IVa during this period will impede the optimal exploitation of the western stock, because the western mackerel caught there at that time are predominantly adults. The ACFM advice for Division IVa is thus

aimed at protecting North Sea mackerel from January-July when western mackerel are absent and at improving the exploitation pattern on western mackerel during the rest of the year. In the light of current knowledge about the distribution of the two stocks and about the fishing mortality on them caused by fisheries in Division IVa, the ACFM advice appears to be appropriate for the protection of the North Sea stock. It is, however, clearly necessary for ACFM to review its advice at regular intervals in the light of any further changes in the distribution and state of the two stocks.

The Southern stock

For assessment purposes a separate Southern stock of mackerel is recognised. The Western and Southern stocks are divided by the line between Divisions VIIIb,d and Division VIIIc. The basis for the separation of the two stocks and the division between them is not well established. An ICES Study Group on Stock Identity of Mackerel and Horse Mackerel met in 1992 (Anon., 1992) to review the information available on this question and concluded that further work is needed to establish the status of these stocks. Until information becomes available to establish the identity of the stocks and to delimit the areas of their distributions it is considered that the present policy of managing the southern area separately from the western area is appropriate.

The management area currently adopted for the Southern stock is Division VIIIc, Sub-areas IX and X and COPACE 34.1.1. The main area occupied by the Southern stock is considered to be Divisions VIIIc and IXa. If Division IXb, Sub-area X and COPACE 34.1.1 are included to control misreporting of landings, then the management area currently adopted for the Southern stock is appropriate.

Control of the exploitation pattern

It has been shown by the Working Group in previous years that the optimum exploitation pattern for the western mackerel stock can be achieved by concentrating fishing at times and in areas where adults are caught with relatively small amounts of juveniles. In most years it is possible to avoid catching large quantities of juveniles by fishing in the northern parts of the stock distribution in the autumn and early winter and around the spawning grounds in parts of Sub-area VII in the spring. The current ACFM advice that the TAC for western mackerel should apply to all areas in which the stock occurs, including Division IVa from August-December, appears to be appropriate. It should be noted in this context, however, that this advice should not apply to Divisions IIIa, IVb and IVc. Even though western mackerel are present in these areas, they are mainly juveniles. Thus the advice to close these areas to mackerel fishing at all times of year would not only protect the North Sea stock itself, but also reduce catches of juveniles of both the North Sea and western stocks.

Conclusions and recommendations

In the light of the above, the areas used by ACFM in giving its advice appear on biological grounds to be more appropriate than those implemented by the management bodies. The Working Group, therefore, considers that there is no reason for ACFM to modify its current advice on the geographical units to be used in the management of mackerel stocks, except in the case of Divisions VIIId and e, which should be included in the units specified for the Western stock TAC.

14.2.3 Horse mackerel

The management units included in the ACFM advice and in the management regulations are given in Table 14.2, and the area units advised by ACFM are also shown in Figure 14.2.

As in the case of mackerel, the geographical limits of the management units used to set TACs do not in all cases correspond to those specified in the ACFM advice. The TAC regulations for horse mackerel, furthermore, are not specific to *Trachurus trachurus* but include all species in this genus. In practice, there are some landings of *T. picturatus* and *T. mediterraneus* in the southern parts of the ICES area. The inclusion of all species of the genus in the regulation may be a precaution against misreporting of *T. trachurus* as *T. picturatus* or *T. mediterraneus*.

There are no agreed stock TACs for horse mackerel. However, the EC has implemented TACs in various zones of the EC EEZ. Several areas into which horse mackerel stocks extend are not covered by TACs. These include the whole of Division IIIa and parts of Divisions IIa and IVa. In addition, Division IVa, which is included in the western TAC area advised by ACFM, is included in the North Sea TAC regulation set by the EC; and Division VIId, which is included in the North Sea area by ACFM, is included in the western TAC regulation set by the EC. Up to now, the fact that there are area differences between the advice and the regulations has had little impact on the fisheries because the catches within each management unit have not been restricted by inappropriate TAC management. Information available to the Working Group does not indicate that there has been any misreporting of horse mackerel catches.

As in the case of mackerel, western horse mackerel migrate into the northern North Sea. At present this may not be a problem because the proportion of the stock that leaves the western area appears to be lower than in the

case of mackerel (Tables 13.3 and 13.5). However, in the last three years about a quarter of the catch of western stock horse mackerel has been caught in zones not subject to TAC regulation. It should be noted, however, that the migration pattern of horse mackerel has changed, although available information on the distribution and migrations of this species is far less complete than in the case of mackerel.

Conclusions and recommendations

The existing management units for horse mackerel do not correspond to those advised by ACFM and it is desirable to match the management areas to the areas of distribution of each stock and to include all areas of the distribution of each stock within the respective management areas in the interests of managing these stocks as distinct units in future.

Since there are recognisable fisheries for *T. mediterraneus* and *T. picturatus* in the southern parts of the ICES area, these species should not be included in the TAC for *T. trachurus*, but should be regulated by separate TACs.

14.3 Should the Sardine Fishery in Divisions VIIIc and IXa be Regulated by Means of TAC?

The Commission of the European Community has requested advice as to whether it is appropriate to regulate the sardine fishery in Divisions VIIIc and IXa by TAC.

The sardine stock in ICES Divisions VIIIc and IXa has been assessed since 1981 by different methods in the Working Group which studied these resources. From 1983 ACFM annually recommended a TAC as a management measure, which until 1990 was based on the results of analytical assessments. In 1990, due to the uncertainties of the results caused by the treatment of the missing 1989 acoustic survey in the assessment, a precautionary TAC for 1991 was recommended by ACFM based on the average landings for the period 1980-1989. No TAC recommendation was made for 1992. No TACs have been implemented for this stock and the only management measure introduced so far has been a minimum landing size regulation.

Although there are some problems in assessing this stock, the indications are that fishing mortality has been increasing in recent years. Catch rates have been declining (Figure 9.3) and recruitment in the last few years may have been at a lower level than previously. Furthermore, biomass estimated from egg survey in 1990 was less than half of the 1988 estimate (Table 9.10) and, in the areas covered by the Spanish acoustic survey, estimates of biomass in 1990-1992 have been lower than in earlier years (Table 9.7). These warning signs suggest that it would be prudent to have a management regime in place in case of further decline.

The minimum landing size regulation should be helpful in discouraging fishing on shoals of small fish but, due to the non-selective nature of purse seines, will not prevent the capture of undersized fish when these are mixed with the larger fish.

There appears to be a need for a management measure capable of controlling the exploitation rate on this stock. Direct effort control may not be satisfactory in a pelagic fishery where shoal density may be maintained while the stock is declining. Regulation by TAC should provide a suitable method of control. Recruitment to the sardine stock is relatively stable and only a small proportion of the catch is made up of recruits, the greater part consisting of fish of ages up to six. There is no reason to think why regulation by TAC should not be effective for this stock.

14.4 What are the Most Adequate Strategies for Managing the Stocks of Anchovy?

This question is dealt with in detail in Section 11.12.

15 DEFICIENCIES IN DATA

15.1 Mackerel

Coverage of age and length sampling

Table 15.1 shows by division(s)/sub-area and by quarter/year the number of fish samples taken, the number of fish measured, the number of otoliths aged in relation to the catches taken in those areas. The sampling seems to be inversely proportional to the catches. All areas and quarters were sampled where a major fishery took place.

Stock identity

For the southern mackerel stock, more biological information is needed, especially on egg distribution and fish migrations.

Age/length key

For the southern mackerel the age/length key of Division VIIIc should not be used for Division IXa.

Discards

Not sufficiently accurate estimates of discard levels are obtained.

15.2 Horse mackerel

Coverage of age and length sampling

Table 15.2 shows by division(s)/sub-area and by quarter/year the number of fish samples taken, the number of fish measured, the number of otoliths aged in relation to the catches taken in those areas. The sampling seems to be inversely proportional to the catches. All quarters were sampled well in Sub-areas VII, VIII and IX, while sampling should be intensified in Sub-areas II, III, IV and VI. In Division IVa, only 28 fish were aged for a catch of about 60,000 t.

Discards

Not sufficiently accurate estimates of discard levels are obtained.

15.3 Sardine

Acoustic surveys

The Spanish and Portuguese acoustic surveys are not carried out at the same time and in the whole area of sardine distribution.

Discards

Not sufficiently accurate estimates of discard levels are obtained.

15.4 Anchovy

Coverage of age and length sampling

Length and age data are available from France and Spain. However, during the second semester the distribution and the number of samples do not allow a distribution by age and by length according to quarter.

Discards

Data on discardings at sea by the French fleet are lacking.

Length distributions

The Portuguese length distributions are lacking for the anchovy of Division IXa.

Catch-at-age data

No catch-at-age data are available for the anchovy of Division IXa.

Fishery-independent information

No fishery-independent information is available for the anchovy of Division IXa.

16 RECOMMENDATIONS

16.1 Research Recommendations

Mackerel

The Working Group endorses all recommendations made by the Study Group on the Stock Identity of Mackerel and Horse Mackerel.

The Working Group recommends that accurate information on discards, i.e. discards in numbers at age in all fisheries should become available.

Horse Mackerel

The Working Group endorses all recommendations made by the Study Group on the Stock Identity of Mackerel and Horse Mackerel.

The Working Group endorses all recommendations made by the Workshop for Revising the Horse Mackerel Database of Divisions VIIIc and IXa.

The Working Group recommends that accurate information on discards, i.e. discards in numbers at age in all fisheries should become available.

The Working Group recommends that for southern horse mackerel, the catch at age, the mean weight in the catch and in the stock should be revised from 1982-1984 according to the same methodology as used for 1985-1991.

The Working Group recommends that special care should continue to be taken by the countries that fish in Divisions VIIIa,b,c and IXa to ensure that the catch, the length distribution, and the numbers at age of *Trachurus trachurus* provided to the Working Group do not include *Trachurus mediterraneus* and *Trachurus picturatus*.

Sardine

The Working Group recommends that joint acoustic surveys be undertaken by Spain and Portugal in the whole area of the sardine stock in the period September-November (recruitment season) in order to obtain stock abundance and recruitment estimates.

The Working Group recommends that further studies should be undertaken on the maturity ogive of sardine.

The Working Group recommends that more information should be provided on catches from Sub-area VII and Divisions VIIIa,b,d,e.

The Working Group recommends that accurate information on discards, i.e. discards in numbers at age in all fisheries should become available.

Anchovy

The Working Group recommends that the number of anchovy samples to be collected in the Bay of Biscay should be increased during the second semester.

The Working Group recommends that the estimates of recruitment and fishing and natural mortalities of the Bay of Biscay anchovy continue through the direct estimates in order to evaluate their reliability. It is necessary to get estimates of the precision of the survey estimates.

The Working Group recommends that fishery-independent surveys, i.e., egg and acoustic surveys, be carried out for the anchovy in Division IXa.

The Working Group recommends that data on effort and catch-at-age data should be collected on a quarterly basis for monitoring the anchovy fishery.

The Working Group recommends that the improvement of age readings should be continued by means of otolith exchange and direct validation techniques.

The Working Group recommends that the CPUE series for anchovy in Division IXa should be continued.

16.2 Management Recommendations

Mackerel

The Working Group recommends that:

- There should be no fishing for mackerel in Divisions IIIa and IVb,c, at any time of the year.
- There should be no fishing for mackerel in Division IVa during the period 1 January - 31 July.
- The 30-cm minimum landing size at present in force in the North Sea area (Sub-area IV and Division IIIa) should be maintained and the present catch regulations should be continued.

The closure of Divisions IVb,c and IIIa the whole year will protect the North Sea stock in this area and juvenile western fish which are numerous, particularly in Division IVb,c during the second half of the year.

If a TAC is set for a mackerel stock, it should apply only to those areas where this stock is fished.

Horse Mackerel

The Working Group recommends that, as there is information available on the amounts and distribution of catches of *Trachurus mediterraneus* and *T. picturatus* from at least the last three years (Anon., 1990b, 1991b), and as the evaluations and assessments are carried out only for *T. trachurus*, the TAC and the other management regulations to be established in future should only refer to *T. trachurus* and not to *Trachurus* spp. in general, as at present. In this case, it would be appropriate also to set TACs for the other species.

If a TAC is set for a horse mackerel stock, it should apply only to those areas where this stock is fished.

Sardine

The Working Group recommends that the sardine stock in Divisions VIIIc and IXa be regulated by a TAC regulation.

The Working Group recommends that the fishery in the juvenile area of sardine (Division IXa between 40° and 43°latitude) should be closed during the peak of juvenile abundance, which is usually in the fourth quarter.

Anchovy

The different management options for anchovy are given in detail in Section 11.12.

For the management of the Bay of Biscay anchovy stock, both acoustic and egg surveys should be continued.

The Working Group recommends that the automatic sorting devices on board for anchovy be prohibited.

Given the reduced knowledge of the biology and dynamics of the anchovy population in Division IXa, the Working Group recommends that the precautionary TAC should continue in order to avoid an increase of effort.

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Table 2.1 Mackerel abundance indices from the North Sea International Bottom Trawl Surveys (first quarter). Values are mean numbers per 10 hr.

Year	1-group	2-group
1970	6536	13
1971	3250	576
1972	13	226
1973	28	2
1974	14	12
1975	165	1
1976	4	2
1977	14	<.5
1978	23	<.5
1979	2	<.5
1980	<.5	<.5
1981	1	<.5
1982	1	1
1983	19	52
1984	1	4
1985	7	0
1986	5	21
1987	89[1]	<.5
1988	13	1
1989	11	17
1990	350	12
1991	69[1]	2
1992	160	4

Notes: Data for 1970-1974 based on standard area south of 59 30'N, 1975-1992 based on standard area south of 61°30'N.
[1]Values dominated by catch in 1 or 2 rectangles only.

Table 2.2 Abundance indices of western mackerel in Sub-areas VI and VII north of 45°30'N and west of 0°W, based on surveys over the period October-March.

Survey year	Rects. sampled	Total area indices (with year class in parenthesis) Arith. mean no/hr			
		0/1 group		1/2 group	
1981-82	65	125	(1981)	50	(1980)
1982-83	63	6	(1982)	78	(1981)
1983-84	36	4	(1983)	46	(1982)
1984-85	78	149	(1984)	8	(1983)
1985-86	88	37	(1985)	210	(1984)
1986-87	96	89	(1986)	37	(1985)
1987-88	115	110	(1987)	25	(1986)
1988-89	126	192	(1988)	570	(1987)
1989-90	126	162	(1989)	138	(1988)
1990-91	147	126	(1990)	399	(1989)
1991-92	113	493	(1991)	190	(1990)

Table 2.3 Abundance indices of western mackerel North and South of 52°30'N, based on surveys over the period October-March (year class in parenthesis).

Survey year		0/1 group Arith. mean no/hr North	South	Ratio N:S.	1/2 group	Arith. mean no/hr North	South	Ratio N:S.
1981-82	(1981)	3	258	.01	(1980)	1	104	.01
1982-83	(1982)	3	14	.21	(1981)	8	228	.04
1983-84	(1983)	-	5	-	(1982)	-	55	-
1984-85	(1984)	137	161	.95	(1983)	*	14	.02
1985-86	(1985)	*	85	<.01	(1984)	26	453	.06
1986-87	(1986)	14	178	.08	(1985)	21	57	.37
1987-88	(1987)	30	187	.16	(1986)	5	43	.12
1988-89	(1988)	43	318	.14	(1987)	108	972	.11
1989-90	(1989)	253	106	2.39	(1988)	179	133	1.35
1990-91	(1990)	227	58	3.91	(1989)	292	470	.62
1991-92	(1991)	199	734	.27	(1990)	29	322	.09

- insufficient data.
* <0.5.

Table 2.4 Annual length distribution (percent) of mackerel catches by fleet and country in 1991.

Length (cm)	Denmark	Ireland	Netherland	Norway			UK (England)			UK (Scotland)			Spain			Portugal		
	P. seine	Pr trawl	Pel Trwl	Ind.fish.	P.seine	Artisan	Pel Trwl	Handline	P. seine	P.seine	2-Bt Pel^	1-Bt Pel^	P. seine	Trawl	Artisan*	P. seine	Trawl	Artisan
13	–	–	–	–	–	–	–	–	–	–	–	–	–	-	–	–	–	-
14	–	–	–	–	–	–	–	–	–	–	–	–	0	-	–	–	–	-
15	–	–	–	–	–	–	–	–	–	–	–	–	0	-	–	–	–	-
16	–	–	–	–	–	–	–	–	–	–	–	–	0	0	–	–	–	-
17	–	0	–	–	–	–	–	–	–	–	–	–	0	0	–	–	–	-
18	–	0	–	–	–	–	–	–	–	–	–	–	2	0	–	–	–	-
19	–	0	1	–	–	–	–	–	–	–	–	–	4	0	–	–	–	-
20	–	0	1	–	–	–	1	–	0	–	–	–	2	2	–	–	–	-
21	–	0	1	–	–	–	0	–	0	–	–	–	1	1	–	–	–	-
22	–	0	0	–	–	–	0	–	0	–	–	–	1	3	0	–	0	-
23	–	0	–	–	–	–	0	–	0	–	–	–	2	3	–	–	0	-
24	–	0	0	–	–	–	0	0	0	–	–	–	2	5	0	–	0	0
25	–	0	0	–	–	–	3	1	2	0	–	–	2	3	0	–	4	0
26	–	0	0	–	–	0	15	4	6	0	–	–	1	5	0	–	6	1
27	–	1	0	–	0	1	23	5	13	0	–	–	1	4	0	7	11	0
28	–	1	1	0	0	2	21	6	15	0	–	–	1	4	1	8	13	2
29	–	1	1	0	0	1	13	12	13	1	–	–	2	6	2	9	15	1
30	1	3	2	0	1	2	9	21	13	1	–	–	5	7	5	6	15	4
31	4	3	2	4	3	2	6	10	10	3	–	–	9	4	7	5	11	7
32	5	5	4	4	6	5	5	7	10	6	–	–	15	5	9	6	7	18
33	9	9	6	8	8	9	2	8	7	9	–	–	12	5	8	5	6	16
34	13	9	8	13	10	10	1	13	5	12	–	–	6	8	10	7	3	12
35	15	11	11	13	13	12	0	7	2	12	–	–	5	6	10	11	4	14
36	16	11	12	13	13	12	0	4	1	13	–	–	5	7	9	8	1	9
37	13	11	12	14	14	12	0	1	0	11	–	–	5	6	9	7	1	5
38	8	9	10	11	11	11	0	1	–	9	–	–	4	5	7	7	1	4
39	6	7	8	8	7	7	–	0	–	8	–	–	3	5	7	7	1	2
40	4	6	6	6	6	6	0	0	–	5	–	–	3	2	5	4	0	2
41	3	4	4	2	3	3	–	0	–	3	–	–	3	2	4	1	0	2
42	2	2	4	2	2	3	–	0	–	3	–	–	2	1	2	1	–	0
43	1	2	3	1	2	1	–	–	–	2	–	–	1	1	2	–	–	1
44	–	3	2	1	1	1	–	–	–	1	–	–	1	1	1	–	–	0
45	–	1	1	0	1	1	–	–	–	0	–	–	0	0	0	–	–	0
46	–	0	–	–	0	0	–	–	–	0	–	–	0	0	0	–	–	-
47	–	0	–	–	0	0	–	–	–	0	–	–	0	0	0	–	–	-
48	–	0	–	–	–	–	–	–	–	0	–	–	–	0	0	–	–	-
49	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	-
50	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	–	-
51	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
52	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
53	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
54	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
55	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
56	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
57	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
58	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
SUM	100	100	100	100	100	100	100	100	100	100	–	–	100	100	100	100	100	100

* Handline and gillnet

^ Included in purse seine.

Table 3.1 Catches (t) of MACKEREL in the Norwegian Sea (Division IIa) and off the Faroes (Division Vb), 1982-1991. (Data submitted by Working Group members.)

Country	1982	1983	1984	1985	1986
Denmark	1,008	10,427	11,787	7,610	1,653
Faroe Islands	180	-	137	-	-
France	8	-	-	16	-
Germany, Fed. Rep.	-	5	-	-	99
German Dem. Rep.	-	-	-	-	16
Ireland	-	-	-	-	-
Norway	34,540	38,453	82,005	61,065	85,400
Poland	231	-	-	-	-
UK (Engl. & Wales)	-	-	-	-	-
UK (Scotland)	-	-	-	-	2,131
USSR	1,641	65	4,292	9,405	11,813
Discards	-	-	-	-	-
Total	37,608	48,950	98,222	78,096	101,112

Country	1987[1]	1988[2]	1989	1990[2]	1991[2]
Denmark	3,133	4,265	6,433	6,800	1,098
Faroe Islands	-	22	1,247	3,100	5,793
France	-	-	11	-	23
Germany, Fed. Rep.	-	380	-	-	-
German Dem. Rep.	292	-	2,409	-	-
Ireland	-	-	-	-	-
Norway	25,000	86,400	68,300	77,200	76,760
Poland	-	-	-	-	-
UK (Engl. & Wales)	-	-	-	+	-
UK (Scotland)	157	1,413	-	400	514
USSR	18,604	27,924	12,088	30,000	13,631[5]
Discards	-	-	-	2,300	-
Total	47,186	120,404	90,488	118,700	97,819

[1]Includes catches probably taken in the northern part of Division IVa.
[2]Preliminary.
[5]Russia.

Table 3.2 Catch (t) of MACKEREL in the North Sea, Skagerrak, and Kattegat (Sub-area IV and Division IIIa), 1982-1991. (Data submitted by Working Group members.)

Country	1982	1983	1984	1985	1986
Belgium	102	93	68	-	49
Denmark	2,034	11,285	10,088	12,424	23,368
Faroe Islands	720	-	-	1,356	-
France	3,041	2,248	-	322	1,200
Germany, Fed. Rep.	28	10	112	217	1,853
Ireland	-	-	-	-	-
Netherlands	390	866	340	726	1,949
Norway	27,966	24,464	27,311	30,835	50,600
Sweden	692	1,903	1,440	760	1,300
UK (Engl. & Wales)	16	16	2	143	18
UK (Scotland)	44	4	13	7	541
UK (N.Ireland)	-	-	-	-	-
USSR	-	-	-	-	-
Unallocated, discards, and misreported	450	96	202	3,656	7,431
Total	35,483	40,985	39,576	50,466	88,309

Country	1987[1]	1988	1989	1990	1991[2]
Belgium	14	20	37	-	125
Denmark	28,217	32,588	26,831	29,000	38,834
Faroe Islands	-	-	2,685	5,900	5,338
France	2,146	1,806	2,200	1,600	2,362
Germany, Fed. Rep.	474	177	6,312	3,500	4,173
Ireland	-	-	8,880	12,800	13,000
Netherlands	2,761	2,564	7,343	13,700	4,591
Norway	108,250	59,750	81,400	74,500	102,350
Sweden	3,162	1,003	6,601	6,400	4,227
UK (Engl. & Wales)	94	160	5,618	1,300	2,671
UK (Scotland)	19,763	616	33,042	28,100	33,991
UK (N.Ireland)	-	100	-	1,400	255
USSR	-	-	-	-	-
Unallocated, discards and misreported	10,789	29,766	4,777	4,300	153,958[3]
Total	175,670	128,550	185,726	182,500	365,884

[1]May includes catches taken in Division IIa.
[2]Preliminary.
[3]Including approximately 130,000 t believed caught in these sub-areas but reported as having been taken in Division VIa + approximately 7,000 t of discards.

Table 3.3 Catch (t) of MACKEREL in the Western area (Sub-areas VI and VII and Divisions VIIIa,b,d,e).
(Data submitted by Working Group members.)

Country	1982	1983	1984	1985	1986
Belgium	-	+	+	-	+
Denmark	15,000	15,000	200	400	300
Faroe Islands	11,100	14,900	9,200	9,000	1,400
France	12,300	11,000	12,500	7,400	11,200
Germany, Fed. Rep.	11,200	23,000	11,200	11,800	7,700
Ireland	109,700	110,000	84,100	91,400	74,500
Netherlands	67,200	73,600	99,000	37,000	58,900
Norway	19,000	19,900	34,700	24,300	21,000
Poland	-	-	-	-	-
Spain	-	-	100	+	-
UK (Engl. & Wales)	82,900	62,000	30,000	9,600	9,100
UK (N.Ireland)	9,600	800	10,600	12,200	9,700
UK (Scotland)	147,400	120,100	157,700	184,100	137,500
USSR	-	+	200	+	-
Unallocated	97,300	105,500	18,000	75,100	51,000
Discard	24,900	11,300	12,100	4,500	-
Grand Total	607,700	567,100	479,600	467,700	380,500

Country	1987	1988[1]	1989[2]	1990[2]	1991[2]
Belgium	-	-	-	-	-
Denmark	100	-	1,000?	-	1,573
Faroe Islands	7,100	2,600	1,100	1,000	4,095
France	11,100	8,900	12,700	17,400	10,364
Germany, Fed. Rep.	13,300	15,900	16,200	18,100	17,138
Ireland	89,500	85,800	61,100	61,500	64,827
Netherlands	31,700	26,100	24,000	24,500	29,156
Norway	21,600	17,300	700	-	-
Poland	-	-	-	-	-
Spain	-	1,500	1,400	400	4,020
UK (Engl. & Wales)	25,200	24,100	14,700	19,200	25,500
UK (N.Ireland)	10,700	8,900	11,000	12,800	2,995
UK (Scotland)	164,800	175,400	123,400	130,700	134,093
USSR	-	+	-	-	-
Unallocated	25,800	4,700	16,700	6,000	-133,802
Discard	-	5,800	4,900	11,300	23,550
Grand Total	401,700	377,000	288,900	302,900	183,509

[1]Includes catches taken in Division IVa, but misreported to Division VIa.
[2]Preliminary.

IIa + Vb	97,819
IV + IIIa	365,881
VI, VII, VIIIa	183,509
Total	647,209

Table 3.4 Catches of mackerel by division and sub-area in 1991. (Data submitted by Working Group members.)

Division/ Sub-area	Quarter				Total
	1	2	3	4	
IIa + Vb	600	700	75,100	21,400	97,800
IVa	111,400	100	81,800	164,800	358,100
IVb	0	600	3,500	100	4,200
IVc	100	300	1,000	300	1,700
IIIa	+	300	1,600	0	1,900
VI	102,700	1,300	1,000	15,200	120,200
VII	29,600	13,900	3,400	9,900	56,800
VIIIa,b,d,e	2,400	3,500	400	200	6,500
Sub-total	246,800	20,700	167,800	211,900	647,200
VIIIc	3,700	11,000	1,800	400	16,900
IXa	1,100	1,600	900	300	3,900
Grand total	251,600	33,300	170,500	212,600	668,000

Table 3.5 Actual catches of MACKEREL by area. Discards not estimated prior to 1978. (Data submitted by Working Group members.)

Year	Sub-area VI			Sub-area VII and Divisions VIIIa,b,d,e			Sub-area IV and Division IIIa			Divs. IIa,Vb[1]	Total		
	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Discards[2]	Catch	Landings	Landings	Discards	Catch
1969	4,800	-	4,800	66,300	-	66,300	739,182	-	739,182	+	810,282	-	810,282
1970	3,900	-	3,900	100,300	-	100,300	322,451	-	322,451	163	426,814	-	426,814
1971	10,200	-	10,200	122,600	-	122,600	243,673	-	243,673	358	376,831	-	376,831
1972	10,000	-	10,000	157,800	-	157,800	188,599	-	188,599	88	356,487	-	356,487
1973	52,200	-	52,200	167,300	-	167,300	326,519	-	326,519	21,600	567,619	-	567,619
1974	64,100	-	64,100	234,100	-	234,100	298,391	-	298,391	6,800	603,391	-	603,391
1975	64,800	-	64,800	416,500	-	416,500	263,062	-	263,062	34,700	779,062	-	779,062
1976	67,800	-	67,800	439,400	-	439,400	303,842	-	303,842	10,500	821,542	-	821,542
1977	74,800	-	74,800	259,100	-	259,100	258,131	-	258,131	1,400	593,431	-	593,431
1978	151,700	15,100	166,900	355,500	35,500	391,000	148,817	-	148,817	4,200	660,217	50,700	710,917
1979	203,300	20,300	223,600	398,000	39,800	437,800	152,323	500	152,823	7,000	760,623	60,600	821,223
1980	218,700	6,000	224,700	386,100	15,600	401,700	87,391	-	87,391	8,300	700,491	21,600	722,091
1981	335,100	2,500	337,600	274,300	39,800	314,100	64,172	3,216	67,388	18,700	692,272	45,516	737,788
1982	340,400	4,100	344,500	257,800	20,800	278,600	35,033	450	35,483	37,600	670,833	25,350	696,183
1983	315,100	22,300	337,400	245,400	9,000	254,400	40,889	96	40,985	49,000	650,389	31,396	681,785
1984	306,100	1,600	307,700	176,100	10,500	186,600	39,374	202	39,576	93,900	615,474	12,302	627,776
1985	308,140	2,735	390,875	75,043	1,800	76,843	46,790	3,656	50,446	78,000	587,973	8,191	596,164
1986	104,100	+	104,100	128,499	+	128,499	236,309	7,431	243,740	101,000	569,908	7,431	577,339
1987	183,700	+	183,700	100,300	+	100,300	290,829	10,789	301,618	47,000	621,829	10,789	632,618
1988	115,600	3,100	118,700	75,600	2,700	78,300	308,550	29,766	338,316	116,200	615,950	35,566	651,516
1989	121,300	2,600	123,900	72,900	2,300	75,200	279,410	2,190	281,600	86,900	560,510	7,090	567,600
1990	114,800	5,800	120,600	56,300	5,500	61,800	300,800	4,300	305,100	116,800	588,700	15,600	604,300
1991	109,500	10,700	120,200	50,500	12,800	63,300	358,700	7,200	365,900	97,800	616,500	30,700	647,200

[1]For 1976-1985 only Division IIa.
[2]Discards estimated only for one fleet.

NB: Landings from 1969-1978 were taken from the 1978 Working Group report (Tables 2.1, 2.2 and 2.5).

Table 3.6 Catch in numbers ('000) at age by quarter and by Division(s) for MACKEREL in Sub-areas II-VIII except Div. VIIIc in 1991.

1991	IIa	IIIa	IVa	IVb,c	VIa	VIIb,c,j,k	VIIa,e,f,g,h	VIId	VIIIa,b,d,e	All areas
	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q
Age	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch ('000)
0	-	-	-	-	-	-	-	-	-	-
1	-	0	-	-	-	133	512	135	14	794
2	24	1	4,375	-	5,869	994	14,367	3,777	86	29,492
3	76	1	18,519	-	17,253	5,412	6,154	1,615	917	49,947
4	400	4	66,089	-	75,627	13,373	2,928	761	2,636	161,818
5	176	2	37,371	-	40,651	7,670	868	225	803	87,766
6	124	1	28,486	-	27,679	5,491	582	151	652	63,167
7	365	4	45,170	-	45,362	13,339	202	51	702	105,194
8	35	1	14,000	-	12,811	1,045	91	24	131	28,137
9	53	1	10,210	-	6,401	1,652	150	39	280	18,786
10	94	2	18,649	-	14,689	7,016	171	44	594	41,259
11	41	1	8,153	-	5,133	1,737	69	18	88	15,240
12	18	1	6,050	-	4,946	1,244	52	14	96	12,421
13	12	0	1,589	-	3,664	440	7	2	1	5,714
14	6	0	1,366	-	1,025	249	33	9	1	2,687
15+	24	2	4,197	-	3,448	693	20	5	21	8,409
Total	1,447	20	264,225	-	264,557	60,489	26,207	6,869	7,020	630,833
Tonnes	110	10	111,179	0	108,673	24,977	4,601	1,203	2,387	253,140

	IIa	IIIa	IVa	IVb,c	VIa	VIIb,c,j,k	VIIa,e,f,g,h	VIId	VIIIa,b,d,e	All areas
	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q
Age	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch ('000)
0	-	-	-	-	-	-	-	-	-	-
1	-	0	-	-	198	80	49	166	261	754
2	15	34	18	428	6,029	4,306	1,232	4,657	962	17,681
3	77	61	49	291	756	3,389	515	1,991	1,891	9,021
4	511	201	244	291	306	8,440	254	939	3,390	14,577
5	247	102	102	174	252	5,524	73	278	1,122	7,875
6	232	66	70	192	476	3,235	51	186	754	5,263
7	170	204	218	318	0	5,684	20	63	1,133	7,809
8	31	32	16	120	40	790	8	29	193	1,259
9	47	73	31	72	0	555	13	48	343	1,182
10	123	116	56	95	0	1,110	15	54	722	2,292
11	47	61	23	72	0	642	6	22	121	994
12	15	29	8	143	0	714	4	17	130	1,061
13	-	17	0	23	0	242	1	2	5	290
14	15	7	0	-	0	14	3	11	3	54
15+	15	87	16	120	0	162	2	6	31	440
Total	1,545	1,090	852	2,341	8,059	34,887	2,246	8,470	11,060	70,550
Tonnes	721	558	392	1,122	1,327	11,844	394	1,483	3,451	21,292

	IIa	IIIa	IVa	IVb,c	VIa	VIIb,c,j,k	VIIa,e,f,g,h	VIId	VIIIa,b,d,e	All areas
	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q
Age	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch ('000)
0	-	-	-	-	-	-	14	128	-	142
1	-	369	468	2,374	700	347	892	8,182	-	13,331
2	9,197	9,562	14,590	3,648	1,507	719	634	5,821	72	45,750
3	26,330	1,358	28,067	1,619	368	77	88	804	395	59,107
4	47,517	519	41,522	1,636	233	21	62	565	789	92,863
5	17,842	100	21,364	446	325	9	28	257	108	40,480
6	8,316	63	16,229	850	255	-	3	29	36	25,781
7	19,000	79	19,111	477	235	-	2	17	72	38,993
8	2,387	13	6,041	476	76	4	-	-	14	9,012
9	4,063	26	6,073	326	50	-	4	37	14	10,594
10	3,637	53	6,812	319	75	-	-	-	36	10,930
11	1,704	16	2,392	266	25	-	-	-	14	4,416
12	870	16	2,148	52	0	-	-	-	14	3,100
13	-	0	698	0	6	-	-	-	11	716
14	82	5	610	52	0	-	-	-	11	760
15+	2,645	42	2,673	0	25	-	-	-	11	5,396
Total	143,590	12,221	168,798	12,539	3,880	1,178	1,727	15,842	1,596	361,371
Tonnes	74,808	2,975	85,076	4,164	961	258	305	2,799	430	171,776

	IIa	IIIa	IVa	IVb,c	VIa	VIIb,c,j,k	VIIa,e,f,g,h	VIId	VIIIa,b,d,e	All areas
	4'th Q	4'th Q	4'th Q	4'th Q	4'th Q	4'th Q	4'th Q	4'th Q	4'th Q	4'th Q
Age	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch('000)	catch ('000)
0	-	-	-	-	32	-	4,619	102	-	4,753
1	614	3	3,910	1,259	3,381	67	16,509	6,503	-	32,244
2	9,184	55	66,805	2,263	12,373	139	14,281	4,627	35	109,761
3	6,977	42	61,698	1,016	3,404	15	2,777	639	230	76,799
4	10,370	61	76,932	1,049	2,194	4	2,117	449	345	93,521
5	5,923	34	35,908	284	2,308	2	995	205	35	45,691
6	3,359	18	24,961	515	1,445	-	437	23	35	30,794
7	3,954	24	34,278	298	1,466	-	216	14	35	40,283
8	1,147	5	9,437	286	320	1	100	-	35	11,331
9	1,024	5	9,734	191	353	-	72	30	35	11,443
10	1,935	11	10,768	191	516	-	-	-	35	13,455
11	1,538	8	6,737	160	128	-	-	-	-	8,571
12	550	3	3,617	31	33	-	-	-	-	4,234
13	240	0	2,250	1	106	-	-	-	-	2,598
14	89	0	687	31	-	-	-	-	-	808
15+	263	0	3,161	1	256	-	-	-	-	3,682
Total	47,166	270	350,882	7,576	28,315	228	42,122	12,591	817	489,967
Tonnes	21,643	132	157,103	2,558	8,086	50	7,936	2,224	229	199,961

Table 3.7 Length (cm) at age by quarter and by Division(s) for MACKEREL in Sub-areas II-VIII except Div. VIIIc in 1991.

1991 Age	IIa 1'st Q length(cm)	IIIa 1'st Q length(cm)	IVa 1'st Q length(cm)	IVb,c 1'st Q length(cm)	VIa 1'st Q length(cm)	VIIb,c,j,k 1'st Q length(cm)	VIIa,e,f,g,h 1'st Q length(cm)	VIId 1'st Q length(cm)	VIIIa,b,d,e 1'st Q length(cm)	All areas 1'st Q length(cm)
0	-	-	-	-	-	-	-	-	-	-
1	-	23.5	-	-	-	19.9	20.5	21.4	22.0	20.6
2	29.2	30.1	30.2	-	30.0	29.2	28.0	27.9	30.2	28.8
3	32.3	32.3	32.7	-	32.5	32.3	30.6	30.5	32.6	32.3
4	35.0	34.6	34.9	-	35.2	35.1	32.9	32.8	34.2	35.0
5	35.9	35.7	35.9	-	36.0	36.6	33.1	33.0	36.1	36.0
6	37.5	37.2	37.2	-	37.4	37.7	33.9	33.7	37.1	37.3
7	38.2	38.1	38.2	-	38.5	38.3	35.4	35.3	37.7	38.3
8	39.5	39.3	39.1	-	39.0	40.6	37.0	36.9	39.3	39.1
9	41.0	41.0	40.5	-	40.3	40.7	36.6	36.4	41.1	40.4
10	40.4	40.4	40.9	-	40.8	41.2	37.7	37.5	40.8	40.9
11	40.6	40.6	41.5	-	41.7	41.1	36.9	36.8	39.1	41.5
12	41.7	41.4	41.3	-	41.4	41.8	38.1	38.1	38.9	41.4
13	43.7	43.7	42.1	-	42.6	42.8	36.0	37.5	45.0	42.4
14	43.0	43.0	43.1	-	42.1	41.6	39.6	41.3	45.0	42.6
15+	43.5	43.3	43.2	-	43.9	43.9	38.0	39.6	44.3	43.6
0-15+	37.1	37.8	37.1	-	36.9	37.3	29.6	29.5	35.8	36.6

Age	IIa 2'nd Q length(cm)	IIIa 2'nd Q length(cm)	IVa 2'nd Q length(cm)	IVb,c 2'nd Q length(cm)	VIa 2'nd Q length(cm)	VIIb,c,j,k 2'nd Q length(cm)	VIIa,e,f,g,h 2'nd Q length(cm)	VIId 2'nd Q length(cm)	VIIIa,b,d,e 2'nd Q length(cm)	All areas 2'nd Q length(cm)
0	-	-	-	-	-	-	-	-	-	-
1	-	23.5	-	-	19.9	24.6	21.3	21.4	23.9	22.2
2	29.2	30.1	29.3	29.8	27.9	28.0	27.9	27.9	29.4	28.1
3	32.3	32.3	32.3	33.6	31.0	32.2	30.5	30.5	31.4	31.5
4	35.0	34.6	35.0	35.0	33.5	35.1	32.8	32.8	34.0	34.6
5	35.9	35.7	35.9	36.1	35.1	36.0	33.2	33.0	36.5	35.9
6	37.5	37.2	37.5	38.7	31.9	37.5	33.8	33.7	37.3	36.8
7	38.2	38.1	38.2	39.8	38.4	38.1	35.7	35.3	37.6	38.1
8	39.5	39.3	39.5	41.1	38.5	39.0	37.1	36.9	38.9	39.1
9	41.0	41.0	40.9	40.8	41.3	39.6	36.7	36.4	40.5	40.0
10	40.4	40.4	40.4	41.2	41.1	41.4	37.9	37.5	40.6	40.9
11	40.6	40.6	40.6	40.8	41.3	39.0	36.9	36.8	39.0	39.3
12	41.7	41.4	41.7	42.0	42.6	40.6	38.1	38.1	38.8	40.6
13	-	43.7	42.7	46.5	43.0	45.0	37.5	37.5	45.7	45.0
14	43.0	43.0	43.1	-	42.5	40.5	41.3	41.3	45.0	42.0
15+	43.5	43.3	43.5	46.3	42.3	42.7	40.3	39.6	45.1	44.0
0-15+	36.8	37.8	36.9	37.0	28.7	35.4	29.5	29.5	34.6	33.8

Age	IIa 3'rd Q length (cm)	IIIa 3'rd Q length (cm)	IVa 3'rd Q length (cm)	IVb,c 3'rd Q length (cm)	VIa 3'rd Q length (cm)	VIIb,c,j,k 3'rd Q length (cm)	VIIa,e,f,g,h 3'rd Q length (cm)	VIId 3'rd Q length (cm)	VIIIa,b,d,e 3'rd Q length (cm)	All areas 3'rd Q length(cm)
0	-	-	-	-	-	-	21.4	21.4	-	21.4
1	-	23.5	27.5	27.6	26.2	28.1	27.7	27.7	-	27.5
2	32.4	30.1	31.8	31.7	30.0	30.5	31.0	31.0	29.9	31.4
3	34.3	32.3	34.4	32.5	31.6	31.2	32.7	32.7	32.1	34.2
4	36.3	34.6	36.3	34.9	32.8	34.2	33.2	33.2	33.3	36.2
5	36.8	35.7	37.1	37.8	33.7	38.0	33.7	33.7	34.8	36.9
6	37.6	37.2	37.8	36.5	35.3	-	36.3	36.3	35.9	37.6
7	38.8	38.1	38.6	39.7	35.2	-	35.9	35.9	35.8	38.7
8	40.5	39.3	39.5	39.5	38.8	39.5	-	-	38.5	39.8
9	40.8	41.0	40.4	37.1	39.0	-	34.5	34.5	40.0	40.4
10	42.7	40.4	41.0	41.0	37.5	-	-	-	40.1	41.5
11	40.5	40.6	41.0	38.1	43.5	-	-	-	37.9	40.6
12	39.5	41.4	42.2	42.5	35.7	-	-	-	38.7	41.5
13	-	43.7	43.0	42.9	39.6	-	-	-	45.8	43.0
14	43.5	43.0	42.5	41.5	41.9	-	-	-	45.0	42.6
15+	43.5	43.3	44.5	42.4	43.5	-	-	-	45.5	44.0
0-15+	36.7	30.6	36.8	33.2	31.2	30.0	29.5	29.5	33.7	36.0

Age	IIa 4'th Q length(cm)	IIIa 4'th Q length(cm)	IVa 4'th Q length(cm)	IVb,c 4'th Q length(cm)	VIa 4'th Q length(cm)	VIIb,c,j,k 4'th Q length(cm)	VIIa,e,f,g,h 4'th Q length(cm)	VIId 4'th Q length(cm)	VIIIa,b,d,e 4'th Q length(cm)	All areas 4'th Q length(cm)
0	-	-	-	-	20.5	-	20.5	21.4	-	20.6
1	31.3	31.3	30.5	27.7	27.9	28.1	27.7	27.7	-	28.1
2	33.0	33.0	33.2	31.7	30.7	30.5	31.2	31.0	29.7	32.5
3	34.0	34.0	34.5	32.6	32.5	31.2	33.5	32.7	31.8	34.3
4	36.0	36.0	36.3	35.0	34.3	34.2	34.6	33.2	33.1	36.1
5	36.7	36.7	36.8	37.7	34.8	38.0	35.3	33.7	34.2	36.7
6	37.9	37.9	38.1	36.6	35.7	-	36.8	36.3	34.7	37.9
7	38.5	38.5	38.9	39.6	36.4	-	38.1	35.9	34.4	38.8
8	39.9	39.9	39.9	39.5	38.9	39.5	36.5	-	37.0	39.9
9	39.8	39.8	40.7	37.3	39.6	-	34.5	34.5	36.2	40.5
10	41.3	41.3	41.7	41.0	39.9	-	-	-	36.0	41.6
11	41.3	41.3	41.6	38.2	42.5	-	-	-	-	41.5
12	41.5	41.5	41.4	42.5	40.3	-	-	-	-	41.4
13	40.8	40.8	42.5	42.9	38.7	-	-	-	-	42.2
14	43.5	43.5	44.2	41.5	-	-	-	-	-	44.0
15+	43.5	43.5	43.4	42.4	43.6	-	-	-	-	43.4
0-15+	36.2	36.1	36.4	33.4	32.3	30.0	29.2	29.5	33.2	35.3

Table 3.8 Weight (g) at age by quarter and by Division(s) for MACKEREL in Sub-areas II-VIII except Div. VIIIc in 1991.

1991 Age	IIa 1'st Q weight(g)	IIIa 1'st Q weight(g)	IVa 1'st Q weight(g)	IVb,c 1'st Q weight(g)	VIa 1'st Q weight(g)	VIIb,c,j,k 1'st Q weight(g)	VIIa,e,f,g,h 1'st Q weight(g)	VIId 1'st Q weight(g)	VIIIa,b,d,e 1'st Q weight(g)	All areas 1'st Q weight(g)
0	-	-	-	-	-	-	-	-	-	-
1	-	163	-	-	-	41	62	65	70	59
2	174	263	216	-	202	153	145	143	194	167
3	274	310	278	-	261	230	191	188	247	253
4	357	362	347	-	346	315	241	238	289	341
5	382	402	390	-	378	372	250	245	347	381
6	438	438	438	-	429	409	272	267	377	429
7	466	498	470	-	471	445	316	311	397	466
8	519	549	527	-	499	547	372	368	451	514
9	601	629	567	-	569	557	354	345	523	564
10	563	619	601	-	583	583	391	385	510	589
11	583	623	633	-	618	587	368	366	449	620
12	644	680	621	-	602	620	410	409	437	611
13	740	752	666	-	663	645	371	387	695	662
14	721	713	723	-	640	587	509	531	695	676
15+	712	764	720	-	723	708	441	460	660	719
0-15+	434	504	438	-	419	412	178	175	344	413

Age	IIa 2'nd Q weight(g)	IIIa 2'nd Q weight(g)	IVa 2'nd Q weight(g)	IVb,c 2'nd Q weight(g)	VIa 2'nd Q weight(g)	VIIb,c,j,k 2'nd Q weight(g)	VIIa,e,f,g,h 2'nd Q weight(g)	VIId 2'nd Q weight(g)	VIIIa,b,d,e 2'nd Q weight(g)	All areas 2'nd Q weight(g)
0	-	-	-	-	-	-	-	-	-	-
1	-	163	-	-	46	104	63	65	92	73
2	230	263	172	168	145	150	142	143	179	148
3	251	310	272	307	210	229	188	188	221	218
4	409	362	363	343	271	307	240	238	287	302
5	443	402	389	406	319	345	250	245	357	347
6	482	438	436	515	233	407	270	267	383	389
7	501	498	469	578	458	430	326	311	396	434
8	544	549	517	635	440	460	376	368	436	475
9	626	629	598	595	563	480	356	345	501	504
10	623	619	564	620	561	563	399	385	503	547
11	592	623	583	628	561	459	370	366	447	486
12	602	680	641	720	626	513	411	409	433	536
13	-	752	681	966	624	732	387	387	728	749
14	706	713	708	-	644	498	531	531	695	607
15+	823	764	713	898	608	603	489	460	702	732
0-15+	467	504	430	458	166	341	176	175	315	302

Age	IIa 3'rd Q weight (g)	IIIa 3'rd Q weight (g)	IVa 3'rd Q weight (g)	IVb,c 3'rd Q weight (g)	VIa 3'rd Q weight (g)	VIIb,c,j,k 3'rd Q weight (g)	VIIa,e,f,g,h 3'rd Q weight (g)	VIId 3'rd Q weight (g)	VIIIa,b,d,e 3'rd Q weight (g)	All areas 3'rd Q weight(g)
0	-	-	-	-	-	-	66	66	-	66
1	-	163	182	171	149	175	145	145	-	152
2	340	220	295	269	210	229	203	203	189	269
3	403	279	389	283	244	246	236	236	237	385
4	491	338	474	361	272	338	250	250	266	476
5	519	385	508	498	297	477	259	259	308	509
6	568	463	543	449	345	-	322	322	340	545
7	618	550	593	594	338	-	313	313	339	603
8	701	586	638	572	482	-	-	-	424	649
9	739	727	675	468	463	-	276	276	480	690
10	840	765	716	669	407	-	-	-	487	753
11	705	760	722	483	664	-	-	-	407	700
12	632	791	762	649	362	-	-	-	429	722
13	-	883	780	779	486	-	-	-	735	777
14	632	825	825	700	696	-	-	-	695	794
15+	914	907	935	751	629	-	-	-	721	923
0-15+	521	242	508	331	248	217	177	177	283	477

Age	IIa 4'th Q weight(g)	IIIa 4'th Q weight(g)	IVa 4'th Q weight(g)	IVb,c 4'th Q weight(g)	VIa 4'th Q weight(g)	VIIb,c,j,k 4'th Q weight(g)	VIIa,e,f,g,h 4'th Q weight(g)	VIId 4'th Q weight(g)	VIIIa,b,d,e 4'th Q weight(g)	All areas 4'th Q weight(g)
0	-	-	-	-	54	-	59	66	-	59
1	230	239	228	173	165	175	146	145	-	160
2	321	318	319	263	232	229	214	203	184	289
3	363	363	366	284	282	246	292	236	230	357
4	443	442	436	361	341	338	335	250	260	430
5	476	475	462	490	353	477	348	259	288	455
6	531	531	515	451	377	-	403	322	304	507
7	550	550	545	589	409	-	436	313	294	540
8	610	610	598	571	490	-	388	-	371	593
9	623	624	641	477	535	-	276	276	371	630
10	701	702	703	670	570	-	-	-	344	696
11	714	715	704	490	641	-	-	-	-	701
12	725	726	673	652	618	-	-	-	-	679
13	678	679	737	775	544	-	-	-	-	723
14	825	825	839	701	-	-	-	-	-	832
15+	817	817	785	747	752	-	-	-	-	785
0-15+	459	451	450	334	286	217	188	177	266	409

Table 3.9 Catch in numbers, mean length and mean weight in catch and mean weight in stock of Western mackerel in 1991.

Age	Catch in numbers millions	Mean length (cm)	Mean weight (kg)	
			in catch	in stock
0	4.89	20.6	0.060	-
1	47.12	27.7	0.155	0.070
2	202.68	31.3	0.255	0.149
3	194.87	33.6	0.332	0.227
4	362.78	35.6	0.397	0.307
5	181.81	36.4	0.426	0.356
6	125.01	37.5	0.471	0.408
7	192.28	38.5	0.508	0.431
8	49.74	39.4	0.556	0.506
9	42.01	40.4	0.612	0.547
10	67.94	41.1	0.635	0.574
11	29.22	41.3	0.651	0.574
12+	52.38	42.5	0.708	0.574

Table 3.10 Comparison of predicted and out-turn catch in number, mean weights at age and fishing mortalities in 1991.

Age	No. (millions)		Mean weight (kg)		Fishing mortalities	
	Predicted	Actual	Predicted	Actual	Predicted	Actual
0	3	5	0.061	0.060	0.001	-
1	83	47	0.168	0.155	0.020	-
2	383	203	0.234	0.255	0.086	0.045
3	204	195	0.338	0.332	0.154	0.147
4	427	363	0.381	0.397	0.215	0.180
5	188	182	0.425	0.426	0.275	0.266
6	103	125	0.470	0.471	0.291	0.366
7	207	192	0.529	0.508	0.312	0.287
8	20	50	0.559	0.555	0.308	1.035
9	22	42	0.612	0.612	0.301	0.670
10	51	68	0.608	0.635	0.300	0.422
11	24	29	0.591	0.651	0.275	0.397
>12	36	52	0.683	0.708	0.275	0.397
Σ	1,751	1,551				

Table 3.11 Inputs and outputs of a prediction for the Western Mackerel stock.

WESTERN MACKEREL									
Year 1992 F Factor		0.979				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock Biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
0	0.00	3.00	0.18	3300	0	0	0	0	0
1	0.02	97.25	16.34	5400	378	432	30	404	28
2	0.08	307.00	71.84	4090	601	2454	361	2235	328
3	0.15	514.18	173.79	3949	904	3554	814	3151	722
4	0.21	200.05	76.22	1132	325	1098	315	951	273
5	0.27	362.20	153.94	1647	562	1598	545	1351	461
6	0.28	127.06	60.74	550	211	545	209	458	175
7	0.31	69.19	36.60	282	118	282	118	235	98
8	0.30	126.42	70.67	521	221	521	221	435	185
9	0.29	12.13	7.42	51	23	51	23	43	19
10	0.29	13.99	8.51	59	29	59	29	49	24
11	0.27	29.47	17.42	134	69	134	69	113	58
12+	0.27	38.49	26.29	175	103	175	103	148	87
TOTAL		1900	720	21290	3543	10902	2836	9572	2459

Year 1993 F Factor		1				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock Biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
0	0.00	3.06	0.19	3300	0	0	0	0	0
1	0.02	52.19	8.77	2838	199	227	16	212	15
2	0.09	349.14	81.70	4558	670	2735	402	2488	366
3	0.15	429.73	145.25	3236	741	2912	667	2579	591
4	0.22	526.57	200.62	2923	839	2836	814	2450	703
5	0.28	176.85	75.16	789	269	766	261	646	220
6	0.29	254.84	121.81	1083	415	1072	411	899	344
7	0.31	88.96	47.06	356	149	356	149	296	124
8	0.31	44.19	24.70	179	76	179	76	149	63
9	0.30	80.36	49.18	332	148	332	148	277	123
10	0.30	7.90	4.80	33	16	33	16	27	13
11	0.28	8.48	5.01	38	19	38	19	32	16
12+	0.28	45.52	31.09	203	119	203	119	171	100
TOTAL		2068	795	19867	3660	11688	3098	10227	2680

Table 4.1 Landings (tonnes) of MACKEREL in Divisions VIIIc and IXa, 1977-1991. (Data submitted by Working Group members.)

Division VIIIc

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Spain	19,852	18,543	15,013	11,316	12,834	15,621	10,390	13,852	11,810	16,533	15,982	16,844	13,446	16,086	16,940
Total	19,852	18,543	15,013	11,316	12,834	15,621	10,390	13,852	11,810	16,533	15,982	16,844	13,446	16,086	16,940

Division IXa

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Portugal	1,743	1,555	1,071	1,929	3,108	3,018	2,239	2,250	4,178	6,419	5,650	4,150	3,016	3,509	2,789
Spain	2,935	6,221	6,280	2,719	2,111	2,437	2,224	4,206	2,123	1,837	491	3,540	1,763	1,406	1,051
Poland	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
USSR	2,879	189	111	-	-	-	-	-	-	-	-	-	-	-	-
Total	7,565	7,965	7,462	4,648	5,219	5,455	4,463	6,456	6,301	8,256	6,141	7,690	4,779	4,915	3,840

Table 4.2 Spanish and Portuguese landings of MACKEREL by gear (tonnes) in Divisions VIIIc and IXa, 1985-1991. (Data submitted by Working Group members.)

Division VIIIc

Gear	1985	1986	1987	1988	1989	1990	1991
Spain	11,810	16,533	15,982	16,845	13,446	16,086	16,940
Purse seine	4,208	2,105	4,277	7,413	5,659	5,370	6,994
Trawl	1,135	2,850	1,900	2,321	2,273	3,842	3,340
Hook	6,371	11,323	9,739	6,799	5,208	6,532	6,224
Gillnet	96	255	66	312	306	343	382

Division IXa

Gear	1985	1986	1987	1988	1989	1990	1991
Spain	2,123	1,837	491[1]	3,540	1,763	1,406	1,052
Purse seine	1,221	1,436	254[1]	2,644	1,151	910	604
Trawl	902	401	237[1]	896	612	496	448
Artisanal	-	-	-	-	-	-	-
Portugal	4,178	6,419	5,650	4,150	3,016	3,509	2,788
Purse seine	13	1,511	1,564	1,623	1,458	1,470	330
Trawl	3,658	3,544	2,776	1,656	1,312	1,650	1,794
Artisanal	507	1,364	1,310	871	246	389	665

[1]Estimated catch does not include Riveira landing port.

Table 4.3 Mackerel in Divisions VIIIc and IXa. Catch in numbers ('000 t) and age groups in 1982-1991.

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Age
0	10,966	4,507	292,138	98,495	25,632	4,559	118,385	46,069	15,320	5,015	0
1	6,638	6,045	15,633	48,877	34,832	17,132	44,313	16,829	28,285	9,984	1
2	8,242	4,474	4,208	3,699	10,302	8,104	4,137	5,634	7,000	8,542	2
3	3,009	6,190	8,838	2,102	4,180	10,623	6,364	3,429	2,567	10,759	3
4	1,619	5,205	4,755	10,537	2,608	4,697	9,544	3,667	2,723	12,491	4
5	1,000	1,011	6,488	3,341	9,232	9,540	3,114	6,110	4,632	6,708	5
6	1,675	324	1,647	2,051	2,682	7,028	5,523	2,546	6,602	4,083	6
7	4,675	420	932	723	227	1,712	12,974	4,043	1,927	5,571	7
8	3,900	2,238	1,584	525	1,099	1,824	5,603	4,972	4,715	1,325	8
9	2,700	1,683	1,542	1,025	449	1,082	1,822	1,861	5,464	1,376	9
10+	11,795	3,364	2,554	3,479	6,489	3,849	577	593	1,531	2,890	10
							284	154	697	523	11
							752	112	596	56	12
							713	246	57	108	13
							124	59	136	79	14
							931	334	145	361	15+
Tonnes	21,076	14,853	20,308	18,111	24,789	22,123	24,574	18,225	21,001	20,775	

Table 4.4 Catch in numbers ('000) at age by quarter and by sub-division of SOUTHERN MACKEREL in 1991.

1991 Age	VIIIc East 1'st Q catch('000)	VIIIc West 1'st Q catch('000)	IXa North 1'st Q catch('000)	IXa Centr-N 1'st Q catch('000)	IXa Centr-S 1'st Q catch('000)	IXa South 1'st Q catch('000)	All areas 1'st Q catch ('000)
0	-	-	-	-	-	-	-
1	2,933	99	715	601	127	6	4,481
2	692	1,118	322	622	94	9	2,858
3	540	1,188	136	375	60	8	2,307
4	1,260	781	15	82	20	3	2,161
5	746	400	5	45	15	2	1,212
6	511	286	1	18	8	1	825
7	864	295	1	16	7	1	1,184
8	231	98	-	6	2	0	337
9	238	85	-	7	2	0	333
10	572	121	1	1	0	0	695
11	103	27	-	-	-	-	130
12	15	2	-	-	-	-	17
13	32	2	-	-	-	-	34
14	20	3	-	-	-	-	23
15+	106	7	-	-	-	-	113
Total	8,863	4,512	1,196	1,772	336	29	16,708
Tonnes	2,443	1,270	157	744	154	15	4,784

Age	VIIIc East 2'nd Q catch('000)	VIIIc West 2'nd Q catch('000)	IXa North 2'nd Q catch('000)	IXa Centr-N 2'nd Q catch('000)	IXa Centr-S 2'nd Q catch('000)	IXa South 2'nd Q catch('000)	All areas 2'nd Q catch ('000)
0	-	-	-	-	-	-	-
1	420	50	211	656	176	25	1,538
2	1,460	154	839	679	131	41	3,304
3	4,424	941	632	409	83	36	6,525
4	7,322	1,204	245	90	28	11	8,900
5	3,423	582	102	49	20	7	4,183
6	2,371	464	72	19	11	4	2,942
7	3,697	543	71	18	10	4	4,342
8	773	176	19	6	3	1	978
9	824	182	16	8	3	1	1,034
10	1,850	301	24	1	0	0	2,176
11	329	57	5	-	-	-	391
12	33	5	-	-	-	-	38
13	61	12	1	-	-	-	74
14	42	13	1	-	-	-	56
15+	213	28	2	-	-	-	243
Total	27,242	4,712	2,240	1,934	466	129	36,724
Tonnes	9,343	1,690	497	812	214	66	12,623

Age	VIIIc East 3'rd Q catch('000)	VIIIc West 3'rd Q catch('000)	IXa North 3'rd Q catch('000)	IXa Centr-N 3'rd Q catch('000)	IXa Centr-S 3'rd Q catch('000)	IXa South 3'rd Q catch('000)	All areas 3'rd Q catch ('000)
0	11	-	2,983	207	94	13	3,308
1	95	2,248	289	251	133	16	3,032
2	55	1,400	188	254	129	15	2,040
3	47	1,165	153	208	87	10	1,670
4	46	1,058	148	39	10	1	1,303
5	64	905	154	25	5	1	1,153
6	18	172	33	28	4	1	255
7	7	10	7	-	-	-	24
8	2	1	1	-	-	-	4
9	2	1	1	-	-	-	4
10	4	3	2	-	-	-	9
11	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
15+	1	-	-	-	-	-	1
Total	352	6,963	3,959	1,012	462	55	12,803
Tonnes	89	1,709	387	342	149	18	2,694

Age	VIIIc East 4'th Q catch('000)	VIIIc West 4'th Q catch('000)	IXa North 4'th Q catch('000)	IXa Centr-N 4'th Q catch('000)	IXa Centr-S 4'th Q catch('000)	IXa South 4'th Q catch('000)	All areas 4'th Q catch ('000)
0	1,451	10	79	144	19	3	1,707
1	616	103	8	176	27	4	934
2	52	76	5	177	26	4	340
3	23	65	4	146	18	3	258
4	23	70	4	28	2	0	127
5	45	92	4	17	1	0	159
6	21	19	1	19	1	0	61
7	18	3	-	-	-	-	21
8	6	-	-	-	-	-	6
9	5	-	-	-	-	-	5
10	10	-	-	-	-	-	10
11	2	-	-	-	-	-	2
12	1	-	-	-	-	-	1
13	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
15+	4	-	-	-	-	-	4
Total	2,277	438	105	707	93	15	3,635
Tonnes	278	113	10	239	30	5	675

Table 4.5 Length (cm) at age by quarter and by sub-division of SOUTHERN MACKEREL in 1991.

1991 Age	VIIIc East 1'st Q length(cm)	VIIIc West 1'st Q length(cm)	IXa North 1'st Q length(cm)	IXa Centr-N 1'st Q length(cm)	IXa Centr-S 1'st Q length(cm)	IXa South 1'st Q length(cm)	All areas 1'st Q length(cm)
0	-	-	-	-	-	-	-
1	23.4	27.8	25.0	29.3	28.1	29.6	24.7
2	27.6	29.3	27.7	31.5	31.1	32.3	29.3
3	31.2	30.7	28.9	33.4	34.2	34.4	31.3
4	34.7	34.0	32.8	36.0	36.8	36.6	34.5
5	35.7	35.7	34.7	37.5	37.8	37.8	35.8
6	37.6	37.4	35.3	39.3	39.3	39.6	37.6
7	39.0	38.2	38.3	40.8	40.6	40.7	38.8
8	40.1	38.7	-	41.9	41.7	41.3	39.7
9	40.6	39.0	-	42.5	42.0	41.4	40.2
10	41.2	39.7	40.5	45.5	45.5	45.5	40.9
11	41.1	40.1	-	-	-	-	40.9
12	44.7	44.5	-	-	-	-	44.7
13	44.1	43.7	-	-	-	-	44.1
14	44.0	42.6	-	-	-	-	43.8
15+	44.5	44.3	-	-	-	-	44.5
0-15+	31.8	32.9	26.3	31.8	31.7	33.7	31.7

Age	VIIIc East 2'nd Q length(cm)	VIIIc West 2'nd Q length(cm)	IXa North 2'nd Q length(cm)	IXa Centr-N 2'nd Q length(cm)	IXa Centr-S 2'nd Q length(cm)	IXa South 2'nd Q length(cm)	All areas 2'nd Q length(cm)
0	-	-	-	-	-	-	-
1	24.8	26.1	27.0	29.3	28.1	29.6	27.5
2	29.5	29.9	28.7	31.5	31.1	32.3	29.8
3	31.8	31.8	30.1	33.4	34.2	34.4	31.8
4	34.2	34.0	33.6	36.0	36.8	36.6	34.2
5	35.7	35.6	35.4	37.5	37.8	37.8	35.7
6	37.6	37.5	37.2	39.3	39.3	39.6	37.6
7	38.5	38.7	38.0	40.8	40.6	40.7	38.5
8	39.8	39.2	38.3	41.9	41.7	41.3	39.7
9	40.3	39.8	38.7	42.5	42.0	41.4	40.2
10	40.4	40.8	39.5	45.5	45.5	45.5	40.4
11	40.3	40.8	39.5	-	-	-	40.4
12	45.4	43.4	-	-	-	-	45.1
13	44.0	43.8	44.0	-	-	-	44.0
14	43.5	43.4	44.0	-	-	-	43.5
15+	45.0	43.7	44.0	-	-	-	44.8
0-15+	35.5	35.5	30.7	31.8	31.7	33.7	34.9

Age	VIIIc East 3'rd Q length (cm)	VIIIc West 3'rd Q length (cm)	IXa North 3'rd Q length (cm)	IXa Centr-N 3'rd Q length (cm)	IXa Centr-S 3'rd Q length (cm)	IXa South 3'rd Q length (cm)	All areas 3'rd Q length(cm)
0	24.2	-	19.4	28.7	28.6	28.6	20.3
1	30.4	31.2	31.1	32.0	31.9	31.8	31.3
2	31.5	31.5	31.7	33.2	32.9	32.9	31.8
3	32.6	32.4	32.5	34.6	33.9	34.0	32.8
4	33.0	32.5	32.7	36.8	36.0	36.0	32.7
5	34.1	33.2	33.8	37.8	37.4	37.4	33.4
6	35.1	33.5	34.2	39.0	38.8	39.0	34.4
7	37.5	35.6	36.1	-	-	-	36.3
8	38.9	36.0	37.0	-	-	-	37.7
9	39.4	36.0	36.8	-	-	-	37.9
10	39.5	36.0	36.8	-	-	-	37.7
11	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
15+	45.6	-	-	-	-	-	45.6
0-15+	32.3	32.0	22.6	32.7	32.1	32.0	29.1

Age	VIIIc East 4'th Q length(cm)	VIIIc West 4'th Q length(cm)	IXa North 4'th Q length(cm)	IXa Centr-N 4'th Q length(cm)	IXa Centr-S 4'th Q length(cm)	IXa South 4'th Q length(cm)	All areas 4'th Q length(cm)
0	23.8	26.0	19.4	28.7	28.6	28.6	24.1
1	25.7	30.9	31.2	32.0	31.9	31.8	27.7
2	29.8	32.0	31.7	33.2	32.9	32.9	32.4
3	33.0	32.9	32.5	34.6	33.9	34.0	33.9
4	33.4	33.1	32.7	36.8	36.0	36.0	34.0
5	34.8	34.0	33.8	37.8	37.4	37.4	34.7
6	36.5	34.1	34.2	39.0	38.8	39.0	36.5
7	38.3	35.1	-	-	-	-	37.8
8	39.1	-	-	-	-	-	39.1
9	39.5	-	-	-	-	-	39.5
10	40.9	-	-	-	-	-	40.9
11	40.8	-	-	-	-	-	40.8
12	45.8	-	-	-	-	-	45.8
13	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
15+	45.6	-	-	-	-	-	45.6
0-15+	25.3	32.4	22.6	32.7	32.1	32.0	27.7

Table 4.6 Weight (g) at age by quarter and by sub-division of SOUTHERN MACKEREL in 1991.

1991 Age	VIIIc East 1'st Q weight(g)	VIIIc West 1'st Q weight(g)	IXa North 1'st Q weight(g)	IXa Centr-N 1'st Q weight(g)	IXa Centr-S 1'st Q weight(g)	IXa South 1'st Q weight(g)	All areas 1'st Q weight(g)
0	-	-	-	-	-	-	-
1	89	155	108	365	351	377	138
2	149	183	152	432	421	459	234
3	222	212	175	494	521	527	267
4	307	301	266	586	614	598	318
5	342	352	318	639	654	651	360
6	404	409	340	712	712	724	416
7	452	442	448	774	767	770	456
8	496	459	-	821	813	795	493
9	517	472	-	851	827	802	515
10	543	506	537	992	992	992	537
11	536	516	-	-	-	-	532
12	727	732	-	-	-	-	728
13	679	685	-	-	-	-	679
14	686	630	-	-	-	-	679
15+	707	717	-	-	-	-	708
0-15+	276	280	131	444	454	508	289

Age	VIIIc East 2'nd Q weight(g)	VIIIc West 2'nd Q weight(g)	IXa North 2'nd Q weight(g)	IXa Centr-N 2'nd Q weight(g)	IXa Centr-S 2'nd Q weight(g)	IXa South 2'nd Q weight(g)	All areas 2'nd Q weight(g)
0	-	-	-	-	-	-	-
1	105	124	140	365	351	377	254
2	178	195	170	432	421	459	242
3	228	237	200	494	521	527	249
4	292	300	289	586	614	598	297
5	337	349	342	639	654	651	344
6	400	416	402	712	712	724	406
7	433	460	431	774	767	770	439
8	485	480	442	821	813	795	487
9	505	507	462	851	827	802	509
10	510	553	495	992	992	992	516
11	505	550	495	-	-	-	511
12	765	669	-	-	-	-	752
13	666	688	699	-	-	-	670
14	660	671	703	-	-	-	663
15+	730	685	703	-	-	-	725
0-15+	342	357	222	444	454	508	344

Age	VIIIc East 3'rd Q weight (g)	VIIIc West 3'rd Q weight (g)	IXa North 3'rd Q weight (g)	IXa Centr-N 3'rd Q weight (g)	IXa Centr-S 3'rd Q weight (g)	IXa South 3'rd Q weight (g)	All areas 3'rd Q weight(g)
0	99	-	47	242	240	241	66
1	230	224	223	317	315	314	236
2	225	233	236	347	340	341	255
3	254	255	257	386	368	368	278
4	261	256	262	449	426	426	264
5	292	276	292	482	470	468	284
6	324	284	305	520	512	519	319
7	411	346	366	-	-	-	371
8	471	359	396	-	-	-	424
9	489	359	391	-	-	-	432
10	493	359	391	-	-	-	426
11	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
15+	791	-	-	-	-	-	791
0-15+	259	244	98	338	322	320	210

Age	VIIIc East 4'th Q weight(g)	VIIIc West 4'th Q weight(g)	IXa North 4'th Q weight(g)	IXa Centr-N 4'th Q weight(g)	IXa Centr-S 4'th Q weight(g)	IXa South 4'th Q weight(g)	All areas 4'th Q weight(g)
0	93	122	47	242	240	241	106
1	119	219	224	317	315	314	175
2	194	244	236	347	340	341	298
3	264	267	257	386	368	368	342
4	278	272	262	449	426	426	314
5	319	298	292	482	470	468	325
6	380	302	305	520	512	519	401
7	445	329	-	-	-	-	428
8	479	-	-	-	-	-	479
9	496	-	-	-	-	-	496
10	558	-	-	-	-	-	558
11	551	-	-	-	-	-	551
12	801	-	-	-	-	-	801
13	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
15+	790	-	-	-	-	-	790
0-15+	122	258	97	338	322	320	185

Table 5.1 Landings (t) of HORSE MACKEREL by Sub-area.
(Data as submitted by Working Group members.)

Sub-area	1979	1980	1981	1982	1983	1984
II	2	-	+	-	412	23
IV + IIIa	1,412	2,151	7,245	2,788	4,420	25,987
VI	7,791	8,724	11,134	6,283	24,881	31,716
VII	43,525	45,697	34,749	33,478	40,526	42,952
VIII	47,155	37,495	40,073	22,683	28,223	25,629
IX	37,619	36,903	35,873	39,726	48,733	23,178
Total	137,504	130,970	129,074	104,958	147,195	149,485

Sub-area	1985	1986	1987	1988	1989	1990
II	79	214	3,311	6,818	4,809	11,414
IV+IIIa	24,238	20,746	20,895	62,892	112,047	145,062
VI	33,025	20,455	35,157	45,842	34,870	20,904
VII	39,034	77,628	100,734	90,253	138,890	192,196
VIII	27,740	36,061	37,703	34,177	42,991	47,802
IX	20,237	31,159	34,243	37,888	38,259	24,023
Total	144,353	186,263	232,043	277,870	371,866	441,401

Sub-area	1991[1]
II	4,487
V + IIIa	77,994
VI	34,455
VII	201,326
VIII	50,466
IX	21,778
Total	390,506

[1]Preliminary.

Table 5.2 Landings (t) of HORSE MACKEREL in Sub-area II.
(Data as submitted by Working Group members.)

Country	1979	1980	1981	1982	1983	1984
Denmark	-	-	-	-	-	-
France	1	-	-	-	-	1
Germany, Fed.Rep.	2	-	+	-	-	-
Norway	-	-	-	-	412	22
USSR	-	-	-	-	-	-
Total	2	-	+	-	412	23

Country	1985	1986	1987	1988	1989	1990
Faroe Islands	-	-	-	-	-	964
Denmark	-	-	39	-	-	-
France	1	-[2]	-[2]	-[2]	-	-
Germany, Fed.Rep.	-	-	-	64	12	+
Norway	78	214	3,272	6,285	4,770	9,135
USSR	-	-	-	469	27	1,298
UK (England + Wales)	-	-	-	-	-	17
Total	79	214	3,311	6,818	4,809	11,414

Country	1991[1]
Faroe Islands	1,115
Denmark	-
France	-
Germany	-
Norway	3,200
Russia	172
UK (England + Wales)	-
Total	4,487

[1]Preliminary.
[2]Included in Sub-area IV.

Table 5.3 Landings (t) of HORSE MACKEREL in Sub-area IV by country. (Data submitted by Working Group members.)

Country	1979	1980	1981	1982	1983	1984
Belgium	9	8	34	7	55	20
Denmark	496	199	3,576	1,612	1,590	23,730
Faroe Islands	-	260	-	-	-	-
France	221	292	421	567	366	827
Germany, Fed.Rep.	376	+	139	30	52	+
Ireland	-	1,161	412	-	-	-
Netherlands	88	101	355	559	2,029[4]	824[4]
Norway	199	119	2,292	7	322	94
Poland	-	-	-	-	2	-
Sweden	+	-	-	-	-	-
UK (Engl. + Wales)	23	11	15	6	4	3
UK (Scotland)	+	-	-	-	-	489
USSR	-	-	-	-	-	-
Total	1,412	2,151	7,245	2,788	4,420	25,987

Country	1985	1986	1987	1988	1989	1990	1991[1]
Belgium	13	13	9	10	10	13	-
Denmark	22,495	18,652[2]	7,290[2]	20,323[2]	23,329[2]	20,605[2]	6,982[2]
Faroe Islands	-	-	-	-	-	942	340
France	298	231[3]	189[3]	784[3]	248	220	174
Germany, Fed.Rep.	+	-	3	153	506	2,469[6]	5,995
Ireland	-	-	-	-	-	687	2,657
Netherlands	160[4]	600[4]	850[4]	1,060[4]	14,172	1,970	3,852
Norway[2]	203	776	11,728[5]	34,425[5]	84,161	117,903[2]	50,000[2]
Poland	-	-	-	-	-	-	-
Sweden	-	2[2]	-	-	-	102	953[2]
UK (Engl. + Wales)	71	3	339	373	10	10	132
UK (N. Ireland)	-	-	-	-	-	-	350
UK (Scotland)	998	531	487	5,749	2,093	458	7,309
USSR	-	-	-	-	-	-	-
Unallocated + discards	-	-	-	-	-12,482[5]	-317[5]	-750[5]
Total	24,238	20,746	20,895	62,892	112,047	145,062	77,994

[1]Preliminary.
[2]Includes Division IIIa.
[3]Includes Division IIa.
[4]Estimated from biological sampling.
[5]Assumed to be misreported.
[6]Includes 13 t from the German Democratic Republic.

Table 5.4 Landings (t) of HORSE MACKEREL in Sub-area VI by country. (Data submitted by Working Group members.)

Country	1979	1980	1981	1982	1983	1984
Denmark	443	734	341	2,785	7	-
Faroe Islands	-	-	-	1,248	-	-
France	151	45	454	4	10	14
Germany, Fed. Rep.	155	5,550	10,212	2,113	4,146	130
Ireland	-	-	-	-	15,086[2]	13,858
Netherlands	6,910	2,385[2]	100[2]	50	94	17,500[2]
Norway	-	-	5	-	-	-
Spain	20	-	-	-	-	-
UK (Engl. + Wales)	73	9	5	+	38	+
UK (Scotland)	39	1	17	83	-	214
USSR	-	-	-	-		-
Total	7,791	8,724	11,134	6,283	24,881	31,716

Country	1985	1986	1987	1988	1989	1990	1991[1]
Denmark	-	-	769	1,655	973	615	-
Faroe Islands	4,014	1,992[2]	4,450[4]	4,000[4]	3,059	628	255
France	13	12	20	10	2	17	4
Germany, Fed. Rep.	191	354	174	615	1,162	2,474	24,766
Ireland	27,102	28,125	29,743	27,872	19,493	15,91174	2,500
Netherlands	18,450[2]	3,450[2]	5,750[2]	3,340[2]	1,907[2]	660[2]	3,369[2]
Norway		83	75	41	-	-	-
Spain		-[3]	-[3]	-[3]	-[3]	-[3]	1
UK (Engl. + Wales)	996	198	404	475	44	145	1,229
UK (N.Ireland	-	-	-	-	-	-	1,970
UK (Scotland)	1,427	138	1,027	7,834	1,737	267	1,640
USSR	-	-	-	-	-	44	-
Unallocated + discards	-19,168	-13,897	-7,255	-	6,493	143	-1,278
Total	33,025	20,455	35,157	45,842	34,870	20,904	34,455

[1]Preliminary.
[2]Estimated from biological sampling.
[3]Included in Sub-area VII.
[4]Includes Divisions IIIa, IVa,b and VIb.

Table 5.5 Landings (t) of HORSE MACKEREL in Sub-area VII by country. Data submitted by the Working Group members.)

Country	1979	1980	1981	1982	1983	1984
Belgium	3	-	1	1	-	-
Denmark	4,287	5,045	3,099	877	993	732
France	4,407	1,983	2,800	2,314	1,834	2,387
Germany, Fed.Rep.	5,333	2,289	1,079	12	1,977	228
Ireland	-	-	16	-	-	65
Netherlands	25,174	23,002	25,000[2]	27,500[2]	34,350[2]	38,700[2]
Norway	959	394	-	-	-	-
Spain	676	50	234	104	142	560
UK (Engl. + Wales)	2,686	12,933	2,520	2,670	1,230	279
UK (Scotland)	-	1	-	-	-	1
USSR	-	-	-	-	-	-
Total	43,525	45,697	34,749	33,478	40,526	42,952

Country	1985	1986	1987	1988	1989	1990	1991[1]
Faroe Islands	-	-	-	-	-	28	-
Belgium	+	+	2	-	-	+	-
Denmark	1,477[3]	30,408[3]	27,368	33,202	34,474	30,594	28,888
France	1,881	3,801	2,197	1,523	4,576	2,538	1,230
Germany, Fed.Rep.	-	5	374	4,705	7,743	8,109	12,919
Ireland	100	703	15	481	12,645	17,887	19,074
Netherlands	33,550[2]	40,750[2]	69,400[2]	43,560[2]	43,582[2]	111,900[2]	104,107[2]
Norway	-	-	-	-	-	-	-
Spain	275	137	148	150	14	16	113
UK (Engl. + Wales)	1,630	1,824	1,228	3,759	4,488	13,371	6,436
UK (N.Ireland)	-	-	-	-	-	-	2,026
UK (Scotland)	1	+	2	2,873	+	139	1,992
USSR	120	-	-	-	-	-	-
Unallocated + discards	-	-	-	-	28,368	7,614	24,541
Total	39,034	77,628	100,734	90,253	138,890	192,196	201,326

[1]Provisional.
[2]Estimated from biological sampling.
[3]Includes Sub-area VI.

Table 5.6 Landings (t) of HORSE MACKEREL in Sub-area VIII by country. (Data submitted by Working Group members.)

Country	1979	1980	1981	1982	1983	1984
Denmark	127	-	-	-	-	-
France	4,240	3,361	3,711	3.073	2,643	2,489
Netherlands	-	-	-	-	-	-[2]
Spain	42,766	34,134	36,362	19,610	25,580	23,119
UK (Engl. + Wales)	22	-	+	1	-	1
USSR	-	-	-	-	-	20
Total	47,155	37,495	40,073	22,683	28,223	25,629

Country	1985	1986	1987	1988	1989	1990	1991[1]
Danmark	-	446	3,283	2,793	6,729	5,726	1,349
France	4,305	3,534	3,983	4,502	4,719	5,082	6,164
Germany	-	-	-	-	-	-	80
Netherlands	-[2]	-[2]	-[2]	-	-	6,000	12,437[3]
Spain	23,292	31,033	30,098	26,629	31,475	29,488	27,803
UK (Engl. + Wales)	143	392	339	253	68	6	70
USSR	-	656	-	-	-	-	-
Unallocated + discards	-	-	-	-	-	1,500	2,563
Total	27,740	36,061	37,703	34,177	42,991	47,802	50,466

[1]Preliminary.
[2]Included in Sub-area VII.
[3]Estimated from biological sampling.

Table 5.7 Landings (t) of HORSE MACKEREL in Sub-area IX by country. (Data submitted by Working Group members.)

Country	1979	1980	1981	1982	1983	1984
Portugal	24,489	25,224	23,753	30,886	30,951	17,307
Spain	12,880	11,679	12,120	8,840	17,782	5,871
USSR	250	-	-	-	-	-
Total	37,619	36,903	35,873	39,726	48,733[3]	23,178

Country	1985	1986	1987	1988	1989	1990	1991[1]
Portugal	9,420	17,682	21,444	25,629	25,231	19,958	17,497
Spain	10,817	13,477	12,799	12,259	13,028	4,065	4,281
USSR	-	-	-	-	-	-	-
Total	20,237	31,159	34,243	37,888	38,259	24,023	21,778

[1]Preliminary.

Table 5.8 Landings and discards of HORSE MACKEREL (t) by year and division, for the North Sea, Western and Southern horse mackerel.(Data submitted by Working Group members.)

Year	North Sea horse mackerel					Western horse mackerel							Southern horse mackerel		
	IIIa		IVb,c	VIId	Total	IIa	IVa	VIa	VIIa-c,e-k	VIIIa,b,d,e	Discards	Total	VIIIc	IXa	Total
1982	-	2,788[3]	-	1,247	4,035	-	-	6,283	32,231	3,073	-	41,587	19,610	39,726	59,336
1983	-	4,420[3]	-	3,600	8,020	412	-	24,881	36,926	2,643	-	64,862	25,580	48,733	74,313
1984	-	25,893[3]	-	3,585	29,478	23	94	31,716	38,782	2,510	500	73,625	23,119	23,178	46,297
1985	1,138		22,897	2,715	26,750	79	203	33,025	35,296	4,448	7,500	80,551	23,292	20,237	43,529
1986	396		19,496	4,756	24,648	214	776	20,343	72,761	3,071	8,500	105,665	31,033	31,159	62,192
1987	436		9,477	1,721	11,634	3,311	11,185	35,197	99,942	7,605	-	157,240	30,098	34,243	64,341
1988	2,261		18,290	3,120	23,671	6,818	42,174	45,842	81,978	7,548	3,740	188,100	26,629	37,888	64,517
1989	913		25,830	6,522	33,265	4,809	85,304[2]	34,870	131,218	11,516	1,150	268,867	31,475	38,259	69,734
1990	14,872[1]		17,437	1,325	18,762	11,414	112,753[2]	20,794	182,580	21,120	9,930	373,463	25,182	24,023	49,205
1991	2,725[1]		11,400	600	12,000	4,487	63,869[3]	34,415	196,926	25,693	5,440	333,555	23,733	21,778	45,511

[1]Norwegian and Danish catches are included in the Western horse mackerel.
[2]Norwegian catches in Division IVb included in the Western horse mackerel.
[3]Divisions IIIa and IVb,c combined.

Table 5.9 Quarterly catches of HORSE MACKEREL ('000 t) by division and sub-areas in 1991. (Data submitted by Working Group members).

Division	Quarter				Total	Not given by quarter	Σ
	1	2	3	4			
IIa	0	0	2	1	3	1	4
IIIa	0	0	1	2	3	+	3
IVa	0	+	3	57	60	1	61
IVb,c VIId	1	+	6	9	16	0	16
VIa	9	+	16	7	32	2	34
VIIa-c,e-k	46	41	45	67	199	2	201
VIIIa-b,d,e	5	3	2	17	27	0	27
VIIIc	5	6	8	6	25	0	25
IXa	4	7	6	5	22	0	22
Sum	70	57	89	171	387	6	393

Table 5.10 Catches (t) and percentages (%) of *Trachurus mediterraneus* in relation to total landings of *Trachurus trachurus* in Divisions VIIIa,b, VIIIc and IXa in 1991.

	Trachurus mediterraneus										*T. trachurus*
	1Q		2Q		3Q		4Q		Total		Total
	(t)	%	(t)	(%)	(t)	(%)	(t)	(%)	(t)	(%)	(t)
Div. VIIIc (Spain)	1,208	25.8	535	8.7	1,134	14.8	2,142	37.1	5,020	17.5	23,734
Sub-div. VIIIc East											
East of 3°W	825	82.7	365	42.7	607	58.3	592	68.9	2,390	63.7	1,363
West of 3°W	383	21.7	170	15.1	527	39.1	1,550	80.4	2,630	42.6	3,544
Sub-div. VIIIc West	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	18,827
Sub-div. IXa north	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4,275
Sub-div. IXa central north central south south	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	17,497
Div. VIIIa,b (Spain)	727	36.2	566	31.7	15	1.9	816	51.7	2,122	34.5	4,030

Table 5.11 Catches (t) of *Trachurus trachurus* and *Trachurus picturatus* in ICES Division IXa and Sub-area X, and in the CECAF Division 34.1., in the period 1986-1990.

		1986	1987	1988	1989	1990
Trachurus trachurus (*)	Div. IXa	28,526	19,554	25,125	25,226	19,959
Trachurus picturatus	Div. IXa	367	181	2,370	2,394	2,012
	Div. X Azorean area	3,331	3,020	3,079	2,866	2,510
	34.1.1 Madeira's area	2,006	1,533	1,687	1,564	1,863

(*) As estimated by the Working Group (Anon., 1992).

Table 5.12 Annual length distributions (millions) of HORSE MACKEREL catches by fleet and by country in 1991.

Length	Ireland	Netherlands	Norway	Denmark	Spain				Portugal			UK (ENGLAND)
(cm)	Trawl	Pel. tr.	P.seine	Trawl	Trawl	P.seine	Hook	Gillnet	Trawl	P.seine	Artisanal	Trawl
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	0.01	-	-	-	-	-	-
9	-	-	-	-	-	0.10	-	-	-	-	-	-
10	-	-	-	-	0.26	9.74	-	-	-	0.73	0.02	-
11	-	-	-	6.04	0.59	15.13	-	-	-	1.35	0.03	-
12	-	-	-	9.06	1.00	18.33	-	-	0.23	2.15	0.01	-
13	-	-	-	6.04	1.85	6.55	-	-	1.17	3.96	0.01	-
14	-	-	-	3.02	2.72	4.10	-	-	3.37	10.15	0.05	-
15	-	-	-	-	5.50	6.43	-	-	7.65	11.97	0.06	-
16	-	-	-	6.04	5.85	7.89	-	-	12.00	10.28	0.04	-
17	-	-	-	3.02	4.95	7.85	-	-	11.10	11.57	0.02	-
18	-	-	-	6.04	4.01	5.48	-	0.01	10.28	8.05	0.05	-
19	-	1.01	-	12.08	2.14	4.75	-	-	8.40	4.34	0.03	-
20	-	1.02	-	18.12	2.03	4.92	-	0.01	6.87	1.54	0.05	-
21	0.29	1.90	-	30.20	1.32	5.64	0.01	0.01	4.74	1.30	0.07	0.04
22	2.59	2.76	-	33.20	0.83	6.22	0.02	0.03	2.95	0.49	0.13	0.09
23	9.80	24.42	-	51.34	1.25	7.35	0.03	0.05	2.33	2.52	0.21	0.24
24	21.04	100.97	-	45.30	2.26	11.01	0.03	0.05	2.52	3.70	0.35	0.72
25	33.43	207.39	-	27.18	4.08	13.49	0.02	0.04	2.98	3.72	0.63	0.61
26	52.74	167.56	-	12.08	4.85	15.95	0.06	0.05	3.35	2.88	0.77	0.20
27	64.85	123.72	0.08	9.06	5.86	17.15	0.05	0.04	3.22	0.82	0.87	0.12
28	41.79	83.31	0.77	6.04	8.83	11.45	0.06	0.04	3.55	0.59	0.74	0.20
29	20.18	40.48	1.06	9.06	7.72	5.92	0.05	0.03	3.34	0.18	1.03	0.25
30	6.05	25.80	4.08	3.02	5.53	3.41	0.05	0.03	2.84	0.30	1.00	0.22
31	3.17	16.22	6.27	-	4.42	2.12	0.05	0.04	2.10	0.22	0.93	0.26
32	2.31	13.28	6.64	3.02	3.32	1.33	0.05	0.04	1.29	0.07	0.77	0.20
33	0.58	5.97	5.55	-	2.27	0.89	0.06	0.04	0.78	-	0.69	0.20
34	0.29	7.18	3.73	-	2.23	0.58	0.11	0.03	0.50	-	0.69	0.23
35	-	3.21	1.90	-	2.03	0.33	0.11	0.03	0.32	-	0.62	0.09
36	-	2.30	0.80	-	1.22	0.20	0.12	0.03	0.30	-	0.64	0.11
37	-	1.42	0.68	-	0.86	0.17	0.10	0.03	0.24	-	0.54	0.04
38	-	0.16	0.09	-	0.42	0.09	0.05	0.01	0.22	-	0.47	0.06
39	-	0.47	0.01	-	0.21	0.07	0.04	0.01	0.10	-	0.22	0.02
40	-	-	-	-	0.08	0.03	0.05	0.02	0.06	-	0.09	-
41	-	-	-	-	0.04	0.02	0.04	0.02	-	-	0.03	-
42	-	-	-	-	0.01	0.03	0.01	0.01	-	-	-	-
43	-	-	-	-	-	-	0.01	0.01	-	-	-	-
44	-	-	-	-	-	-	0.01	0.01	-	-	-	-
45+	-	-	-	-	-	-	0.01	0.01	-	-	-	-
Total	259.11	904.56	31.65	302.00	90.52	194.71	1.22	0.72	98.81	82.89	11.85	3.92

Table 6.1 Age composition (%) in commercial and research vessel catches of North Sea horse mackerel taken by the Netherlands in 1987-1991.

Age	Year				
	1987	1988	1989	1990	1991
0	0	0	1	0	2
1	1	0	0	5	3
2	2	4	3	3	15
3	0	2	28	10	3
4	0	0	13	10	7
5	28	4	2	5	11
6	3	38	4	0	5
7	7	2	33	4	0
8	19	3	4	40	4
9	3	14	1	5	24
10	3	0	2	2	4
11	6	5	1	7	2
12	5	6	1	1	6
13	2	6	1	2	0
14	2	1	1	1	2
15+	23	15	5	5	13

Table 7.1 Catch in numbers ('000) at age of WESTERN HORSE MACKEREL by quarter and by Division(s) in 1991.

1991 Age	IIa 1'st Q catch('000)	IVa 1'st Q catch('000)	VIa 1'st Q catch('000)	VIIb,c,j,k 1'st Q catch('000)	VIIa,e,f,g,h 1'st Q catch('000)	VIIIa,b,d,e 1'st Q catch('000)	All areas 1'st Q catch ('000)
0	-	-	-	-	-	-	-
1	-	-	-	-	0	6,423	6,423
2	-	-	-	328	11,116	28,563	40,007
3	-	-	-	-	3	3,259	3,262
4	-	-	548	328	21,308	3,171	25,354
5	-	-	548	983	26,864	2,974	31,369
6	-	-	1,681	983	15,746	878	19,289
7	-	-	-	1,130	1	446	1,576
8	-	-	-	802	5,559	699	7,060
9	-	-	40,070	104,098	37,066	5,608	186,842
10	-	-	-	1,932	0	53	1,985
11	-	-	37	1,639	2	274	1,952
12	-	-	74	7,141	1	291	7,507
13	-	-	-	983	2	225	1,210
14	-	-	37	1,785	5	1,113	2,940
15+	-	-	-	3,571	15,756	2,282	21,610
Total	-	-	42,995	125,704	133,431	56,258	358,387
Tonnes	0	0	8,549	27,131	18,536	4,509	58,725

Age	IIa 2'nd Q catch('000)	IVa 2'nd Q catch('000)	VIa 2'nd Q catch('000)	VIIb,c,j,k 2'nd Q catch('000)	VIIa,e,f,g,h 2'nd Q catch('000)	VIIIa,b,d,e 2'nd Q catch('000)	All areas 2'nd Q catch ('000)
0	-	-	-	-	-	-	-
1	-	-	-	-	-	2,363	2,363
2	-	-	-	-	0	2,642	2,643
3	-	-	-	-	445	1,056	1,501
4	-	-	8	1,980	1,706	1,245	4,938
5	-	0	8	1,584	869	1,360	3,821
6	-	4	24	2,376	453	517	3,374
7	-	8	-	3,562	3	244	3,817
8	-	11	-	2,182	14	777	2,984
9	-	243	562	188,286	3,930	6,662	199,683
10	-	5	-	396	1,254	110	1,765
11	-	6	1	1,980	8	180	2,175
12	-	40	1	4,759	7	231	5,038
13	-	8	-	396	8	141	553
14	-	2	1	1,584	27	671	2,284
15+	-	12	-	3,764	2,160	1,302	7,239
Total	-	339	604	212,848	10,885	19,502	244,177
Tonnes	0	100	120	38,663	2,088	2,686	43,657

Age	IIa 3'rd Q catch('000)	IVa 3'rd Q catch('000)	VIa 3'rd Q catch('000)	VIIb,c,j,k 3'rd Q catch('000)	VIIa,e,f,g,h 3'rd Q catch('000)	VIIIa,b,d,e 3'rd Q catch('000)	All areas 3'rd Q catch ('000)
0	-	-	-	-	-	712	712
1	-	-	-	-	-	4,244	4,244
2	-	-	-	-	-	148	148
3	-	-	-	-	-	165	165
4	-	-	1,182	12,633	20,728	443	34,985
5	18	5	1,182	4,084	12,862	585	18,738
6	91	122	3,627	1,852	4,919	525	11,136
7	129	228	0	-	1,676	289	2,322
8	317	293	0	3,158	0	176	3,945
9	10,764	6,462	86,430	149,855	61,830	3,249	318,591
10	170	144	0	5,853	1	286	6,455
11	289	160	80	463	2	418	1,412
12	1,465	1,070	159	463	2	401	3,559
13	315	225	0	-	0	16	556
14	53	63	80	-	3	555	754
15+	432	331	1	2,695	7	1,264	4,731
Total	14,044	9,101	92,742	181,057	102,031	13,477	412,453
Tonnes	2,900	2,650	18,441	31,890	13,685	2,100	71,666

Age	IIa 4'th Q catch('000)	IVa 4'th Q catch('000)	VIa 4'th Q catch('000)	VIIb,c,j,k 4'th Q catch('000)	VIIa,e,f,g,h 4'th Q catch('000)	VIIIa,b,d,e 4'th Q catch('000)	All areas 4'th Q catch ('000)
0	-	-	-	-	-	2,515	2,515
1	-	-	-	-	4,012	2,524	6,536
2	-	-	-	-	4,012	425	4,437
3	-	-	-	-	5,350	3,704	9,054
4	-	-	432	99	90,622	30,982	122,135
5	-	0	432	74	54,771	17,106	72,383
6	-	0	1,326	99	26,392	6,648	34,466
7	-	0	-	-	9,559	1,586	11,145
8	37	2,673	-	25	4,013	57	6,806
9	1,176	126,986	31,596	2,102	230,304	64,947	457,111
10	15	2,673	-	25	6,886	1,060	10,660
11	28	5,347	29	25	1,442	100	6,970
12	148	29,407	58	25	2,683	115	32,436
13	29	6,683	-	-	1	4	6,718
14	-	1,337	29	-	1,348	148	2,862
15+	37	6,683	-	-	8,051	340	15,112
Total	1,470	181,792	33,902	2,473	449,446	132,262	801,345
Tonnes	415	58,280	6,741	438	67,547	17,399	150,820

Table 7.2 Length (cm) at age of WESTERN HORSE MACKEREL by quarter and by Division(s) in 1991.

1991 Age	IIa 1'st Q length(cm)	IVa 1'st Q length(cm)	VIa 1'st Q length(cm)	VIIb,c,j,k 1'st Q length(cm)	VIIa,e,f,g,h 1'st Q length(cm)	VIIIa,b,d,e 1'st Q length(cm)	All areas 1'st Q length(cm)
0	-	-	-	-	-	-	-
1	-	-	-	-	14.0	13.7	13.7
2	-	-	-	29.5	20.0	16.2	17.4
3	-	-	-	-	20.1	19.1	19.1
4	-	-	27.5	27.5	22.8	22.2	22.9
5	-	-	28.5	27.5	27.1	24.5	26.9
6	-	-	28.5	27.8	26.5	24.9	26.7
7	-	-	-	30.4	26.6	26.1	29.2
8	-	-	-	30.1	28.5	26.1	28.4
9	-	-	29.0	29.9	25.5	27.7	28.8
10	-	-	-	33.0	30.8	32.0	32.9
11	-	-	31.5	34.9	35.5	35.9	35.0
12	-	-	34.0	34.6	35.3	35.1	34.6
13	-	-	-	36.8	34.4	34.5	36.4
14	-	-	35.5	37.1	35.3	35.2	36.3
15+	-	-	-	37.4	32.2	36.0	33.5
0-15+	-	-	29.0	30.6	26.0	19.8	27.0

Age	IIa 2'nd Q length(cm)	IVa 2'nd Q length(cm)	VIa 2'nd Q length(cm)	VIIb,c,j,k 2'nd Q length(cm)	VIIa,e,f,g,h 2'nd Q length(cm)	VIIIa,b,d,e 2'nd Q length(cm)	All areas 2'nd Q length(cm)
0	-	-	-	-	-	-	-
1	-	-	-	-	-	12.4	12.4
2	-	-	-	-	21.0	17.3	17.3
3	-	-	-	-	23.5	19.6	20.8
4	-	-	27.5	26.1	23.0	22.4	24.1
5	-	27.0	28.5	27.0	27.9	24.9	26.5
6	-	27.6	28.5	27.2	26.5	25.7	26.9
7	-	28.0	-	26.6	26.5	27.3	26.6
8	-	31.5	-	27.6	27.1	27.2	27.5
9	-	32.1	29.0	29.1	29.5	27.9	29.1
10	-	33.5	-	27.5	29.5	30.6	29.1
11	-	35.5	31.5	31.5	35.5	35.7	31.9
12	-	34.2	34.0	33.4	35.3	34.5	33.4
13	-	35.7	-	35.5	34.4	34.3	35.2
14	-	37.5	35.5	36.5	35.3	35.3	36.1
15+	-	37.5	-	36.6	32.6	35.5	35.2
0-15+	-	32.6	29.0	29.3	28.6	24.5	28.9

Age	IIa 3'rd Q length (cm)	IVa 3'rd Q length (cm)	VIa 3'rd Q length (cm)	VIIb,c,j,k 3'rd Q length (cm)	VIIa,e,f,g,h 3'rd Q length (cm)	VIIIa,b,d,e 3'rd Q length (cm)	All areas 3'rd Q length(cm)
0	-	-	-	-	-	12.7	12.7
1	-	-	-	-	-	13.8	13.8
2	-	-	-	-	-	20.1	20.1
3	-	-	-	-	-	23.0	23.0
4	-	-	27.5	25.4	24.7	24.7	25.0
5	27.0	27.0	28.5	26.9	25.4	26.7	26.0
6	27.6	27.6	28.5	26.5	25.0	26.3	26.5
7	28.0	28.0	33.4	-	24.0	29.0	25.2
8	31.5	31.5	37.0	26.8	37.0	30.0	27.7
9	32.1	32.1	29.0	28.1	25.9	29.9	28.2
10	33.5	33.5	35.0	29.0	35.0	34.5	29.4
11	35.5	35.5	31.5	31.5	35.7	34.3	33.6
12	34.2	34.2	34.0	28.5	36.9	35.7	33.6
13	35.7	35.7	38.0	-	38.0	38.0	35.8
14	37.5	37.5	35.5	-	37.1	35.7	36.0
15+	37.5	37.5	37.1	35.5	37.1	35.7	35.9
0-15+	32.6	32.6	29.0	28.0	25.5	24.5	27.7

Age	IIa 4'th Q length(cm)	IVa 4'th Q length(cm)	VIa 4'th Q length(cm)	VIIb,c,j,k 4'th Q length(cm)	VIIa,e,f,g,h 4'th Q length(cm)	VIIIa,b,d,e 4'th Q length(cm)	All areas 4'th Q length(cm)
0	-	-	-	-	-	11.2	11.2
1	-	-	-	-	20.5	15.9	18.7
2	-	-	-	-	23.2	19.5	22.8
3	-	-	-	-	26.0	23.8	25.1
4	-	-	27.5	25.0	25.4	25.4	25.4
5	-	27.0	28.5	25.8	26.3	25.9	26.2
6	-	27.6	28.5	26.5	26.0	25.2	26.0
7	-	28.0	-	-	25.8	25.9	25.8
8	31.5	31.5	-	28.5	26.2	29.9	28.4
9	32.1	32.1	29.0	28.2	26.4	26.1	28.2
10	33.5	33.5	-	28.5	27.3	28.9	29.0
11	35.5	35.5	31.5	31.5	27.5	34.5	33.8
12	34.2	34.2	34.0	28.5	29.5	35.9	33.8
13	35.7	35.7	-	-	38.0	38.0	35.7
14	-	37.5	35.5	-	32.5	35.9	35.1
15+	37.5	37.5	-	-	33.5	35.8	35.3
0-15+	32.6	32.9	29.0	28.0	26.3	25.4	27.8

Table 7.3 Weight (g) at age of WESTERN HORSE MACKEREL by quarter and by Division(s) in 1991.

1991 Age	IIa 1'st Q weight(g)	IVa 1'st Q weight(g)	VIa 1'st Q weight(g)	VIIb,c,j,k 1'st Q weight(g)	VIIa,e,f,g,h 1'st Q weight(g)	VIIIa,b,d,e 1'st Q weight(g)	All areas 1'st Q weight(g)
0	-	-	-	-	-	-	-
1	-	-	-	-	21	19	19
2	-	-	-	167	53	32	39
3	-	-	-	-	62	53	53
4	-	-	180	141	80	85	84
5	-	-	199	143	153	113	150
6	-	-	187	150	130	118	135
7	-	-	-	197	151	140	181
8	-	-	-	206	214	139	206
9	-	-	201	196	116	174	181
10	-	-	-	270	227	255	270
11	-	-	233	330	347	360	332
12	-	-	296	308	343	342	309
13	-	-	-	369	314	317	359
14	-	-	338	389	341	355	376
15+	-	-	-	412	275	366	307
0-15+	-	-	200	215	137	81	163

Age	IIa 2'nd Q weight(g)	IVa 2'nd Q weight(g)	VIa 2'nd Q weight(g)	VIIb,c,j,k 2'nd Q weight(g)	VIIa,e,f,g,h 2'nd Q weight(g)	VIIIa,b,d,e 2'nd Q weight(g)	All areas 2'nd Q weight(g)
0	-	-	-	-	-	-	-
1	-	-	-	-	-	14	14
2	-	-	-	-	70	40	40
3	-	-	-	-	90	57	67
4	-	-	180	119	87	87	100
5	-	175	199	134	159	119	135
6	-	198	187	141	138	130	139
7	-	199	-	135	147	162	137
8	-	241	-	145	153	156	149
9	-	284	201	176	206	171	177
10	-	322	-	127	214	223	195
11	-	345	233	226	347	353	237
12	-	331	296	277	344	324	280
13	-	330	-	311	314	313	312
14	-	434	338	342	341	343	342
15+	-	343	-	357	274	348	330
0-15+	-	291	200	181	191	140	179

Age	IIa 3'rd Q weight (g)	IVa 3'rd Q weight (g)	VIa 3'rd Q weight (g)	VIIb,c,j,k 3'rd Q weight (g)	VIIa,e,f,g,h 3'rd Q weight (g)	VIIIa,b,d,e 3'rd Q weight (g)	All areas 3'rd Q weight(g)
0	-	-	-	-	-	15	15
1	-	-	-	-	-	20	20
2	-	-	-	-	-	62	62
3	-	-	-	-	-	93	93
4	-	-	180	136	124	116	130
5	175	175	199	154	138	148	145
6	190	198	187	153	129	142	154
7	196	199	289	-	108	193	132
8	255	241	393	158	393	214	175
9	282	284	201	178	138	214	183
10	322	322	331	198	331	319	209
11	353	345	233	229	357	315	293
12	331	331	296	213	392	354	317
13	336	330	426	-	426	426	336
14	434	434	338	-	399	354	365
15+	330	343	400	344	400	354	345
0-15+	290	291	200	177	134	159	178

Age	IIa 4'th Q weight(g)	IVa 4'th Q weight(g)	VIa 4'th Q weight(g)	VIIb,c,j,k 4'th Q weight(g)	VIIa,e,f,g,h 4'th Q weight(g)	VIIIa,b,d,e 4'th Q weight(g)	All areas 4'th Q weight(g)
0	-	-	-	-	-	11	11
1	-	-	-	-	73	31	57
2	-	-	-	-	115	57	109
3	-	-	-	-	166	109	143
4	-	-	180	130	134	131	133
5	-	175	199	147	153	135	149
6	-	196	187	153	142	129	141
7	-	198	-	-	146	137	144
8	266	253	-	182	151	210	192
9	275	292	201	181	149	139	192
10	322	322	-	192	170	199	211
11	337	358	233	229	170	320	317
12	316	343	296	213	232	360	334
13	329	358	-	-	426	426	358
14	-	434	338	-	312	360	372
15+	266	382	-	-	339	357	358
0-15+	281	309	200	178	150	132	186

Table 7.4 Catch in numbers, mean length and mean weight in catch and mean weight in stock of Western horse mackerel in 1991.

Age	Catch in numbers (millions)[1]	Mean length (cm)	Mean weight (kg)	
			in catch	in stock
0	3.23	11.5	0.012	0
1	19.57	15.5	0.031	0
2	47.24	17.9	0.046	0.050
3	13.98	23.2	0.113	0.080
4	187.41	25.0	0.125	0.121
5	126.31	26.4	0.148	0.137
6	68.33	26.3	0.141	0.143
7	19.00	26.2	0.144	0.144
8	21.09	28.1	0.187	0.150
9	1173.94	28.4	0.185	0.182
10	21.14	29.5	0.215	0.189
11	13.06	33.6	0.303	0.266
12+	119.31	34.4	0.332	0.332

[1]Includes 11.69 millions from Division IVb and 5.55 millions from Division IIIa.

Table 8.1 Annual catches (tonnes) of SOUTHERN HORSE MACKEREL by countries by gear in Divisions VIIIc and IXa. Data from 1984-1991 are Working Group estimates.

Year	Portugal (Division IXa)				Spain (Divisions IXa + VIIIc)					Total VIIIc+IXa
	Trawl	Seine	Artisanal	Total	Trawl	Seine	Hook	Gillnet	Total	
1962	7,231	46,345	3,400	56,976	-	-	-	-	53,202	110,778
1963	6,593	54,267	3,900	64,760	-	-	-	-	53,420	118,180
1964	8,983	55,693	4,100	68,776	-	-	-	-	57,365	126,141
1965	4,033	54,327	4,745	63,105	-	-	-	-	52,282	115,387
1966	5,582	44,725	7,118	57,425	-	-	-	-	47,000	104,425
1967	6,726	52,643	7,279	66,648	-	-	-	-	53,351	119,999
1968	11,427	61,985	7,252	80,664	-	-	-	-	62,326	142,990
1969	19,839	36,373	6,275	62,487	-	-	-	-	85,781	148,268
1970	32,475	29,392	7,079	59,946	-	-	-	-	98,418	158,364
1971	32,309	19,050	6,108	57,467	-	-	-	-	75,349	132,816
1972	45,452	28,515	7,066	81,033	-	-	-	-	82,247	163,280
1973	28,354	10,737	6,406	45,497	-	-	-	-	114,878	160,375
1974	29,916	14,962	3,227	48,105	-	-	-	-	78,105	126,210
1975	26,786	10,149	9,486	46,421	-	-	-	-	85,688	132,109
1976	26,850	16,833	7,805	51,488	89,197	26,291	376[1]	-	115,864	167,352
1977	26,441	16,847	7,790	51,078	74,469	31,431	376[1]	-	106,276	157,354
1978	23,411	4,561	4,071	32,043	80,121	14,945	376[1]	-	95,442	127,485
1979	19,331	2,906	4,680	26,917	48,518	7,428	376[1]	-	56,322	83,239
1980	14,646	4,575	6,003	25,224	36,489	8,948	376[1]	-	45,813	71,037
1981	11,917	5,194	6,642	23,733	28,776	19,330	376[1]	-	48,482	72,235
1982	12,676	9,906	8,304	30,886	-[2]	-[2]	-[2]	-	28,450	59,336
1983	16,768	6,442	7,741	30,951	8,511	34,054	797	-	43,362	74,313
1984	8,603	3,732	4,972	17,307	12,772	15,334	884	-	28,990	46,297
1985	3,579	2,143	3,698	9,420	16,612	16,555	949	-	34,109	43,529
1986	-[2]	-[2]	-[2]	28,526	9,464	32,878	481	143	42,967	71,493
1987	11,457	6,744	3,244	21,445	-[2]	-[2]	-[2]	-[2]	33,193	54,648
1988	11,621	9,067	4,941	25,629	-[2]	-[2]	-[2]	-[2]	30,763	56,392
1989	12,517	8,203	4,511	25,231	-[2]	-[2]	-[2]	-[2]	31,170	56,401
1990	10,060	5,985	3,913	19,958	10,876	17,951	262	158	29,247	49,205
1991	9,437	5,003	3,056	17,497	9,681	18,019	187	127	28,014	45,511

[1]Estimated value.
[2]Not available by gear.

Table 8.2 Southern horse mackerel catches by quarter and area.

Country/Sub-division	Spain 8c-E, 8c-W, 9a-N			Unit:tonnes	Total
Quarter/ Year	1	2	3	4	
1984	-	-	-	-	28990
1985	-	-	-	-	34116
1986	-	-	-	-	42967
1987	5179	8678	11067	8269	33193
1988	6445	7936	7918	8464	30763
1989	7824	7480	8011	7855	31170
1990	6827	7871	7766	6783	29247
1991	5369	7220	8741	6686	28016
Country/ Sub-division	Portugal 9a-CN, 9a-CS, 9a-S			Unit:tonnes	Total
Quarter/ Year	1	2	3	4	
1984	4669	6506	3577	2358	17110
1985	1226	3055	2946	2192	9419
1986	4627	8093	7542	8264	28526
1987	3902	5474	6654	3524	19554
1988	3069	7402	7554	7100	25125
1989	4074	9096	8543	3513	25226
1990	3341	5753	5873	4992	19959
1991	3101	5630	5094	3672	17497

Table 8.3 SOUTHERN HORSE MACKEREL. CPUE series in commercial fisheries.

Year	Portugal	Spain IXa South Galicia	Spain VIIIc	
	Trawl	Purse seine	Trawl	
			Aviles	Coruña
	kg/h	t/day	kg/Hp.day. 10^{-2}	kg/Hp.day.10^{-2}
1979	87.7	-	-	-
1980	69.3	-	-	-
1981	59.1	1.2	-	-
1982	56.2	3.2	-	-
1983	98.0	2.4	123.46	90.4
1984	55.9	0.7	142.94	135.87
1985	24.4	0.7	131.22	118.00
1986	41.6	1.7	116.90	130.84
1987	71.0	1.1	109.02	176.65
1988	91.1	1.0	88.96	146.63
1989	69.5	0.7	98.24	172.84
1990	98.9	0.7	125.35	146.27
1991	39.5	1.7	106.42	145.09

Table 8.4 SOUTHERN HORSE MACKEREL. Effort data by fleets.

Year	Spain Division VIIIc		Portugal Division IXa
	Trawl		Trawl
	Aviles (Cantabrian Sea) (Σ HP x fishing days x 10^{-2})	La Coruña (North Galicia)(Σ av. HP x fishing days x 10^{-2})	Hours ('000)
1981	-	-	-
1982	-	-	225.4
1983	12,568	33,999	176.6
1984	10,185	32,487	154.0
1985	9,856	30,255	147.0
1986	10,845	26,539	155.3
1987	8,309	23,122	161.3
1988	9,047	28,119	127.6
1989	8,063	29,628	179.5
1990	8,492	29,579	101.7
1991	7,677	26,959	238.7[1]

[1]Provisional.

Table 8.5 SOUTHERN HORSE MACKEREL. CPUE indices from research surveys.

	Portugal IXa (20-500 m depth)		Spain (20-500m depth)
	Bottom trawl (20-mm codend)		
Year	kg/h Jun-Jul	kg/h Oct	kg/h Sept-Oct
1979	12.2[2]	5.5[2]	-
1980	20.6[2]	2.5[2]	24.74[1]
1981	11.6	1.8	6.42
1982	42.1	36.9	20.10[1]
1983	79.1	24.6	28.14
1984	-	-	27.30
1985	9.5	3.8	43.44
1986	4.8[2]	23.5	3.78
1987	-	6.9	-
1988	-	26.0	8.58
1989	14.9	11.7	10.40
1990	14.4	21.5	7.74
1991	11.8	16.9	2.38

[1]Covering only part of Divisions IXa+VIIIc, area defined by 41°50' N - 08°00'W, and less than 200 m depth.
[2]Codend mesh size 40 mm.

Table 8.6

Horse mackerel in Fishing Areas VIIIc and IXa

FLT02: CPUE at age from Aviles trawl fleet

Year	Effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1984	1	4	882	759	141	42	39	11	65	18	31	3	4	1	6	3	11
1985	1	1	167	613	574	13	18	16	13	17	21	14	4	4	1	4	19
1986	1	36	223	271	174	527	42	19	14	10	8	9	2	1	1	0	2
1987	1	1	244	350	166	48	396	40	19	7	9	6	5	3	1	1	4
1988	1	181	264	53	23	18	19	148	14	17	22	15	12	22	6	5	27
1989	1	65	275	62	105	50	42	18	100	13	38	35	1	1	18	2	15
1990	1	1	726	373	257	72	19	21	24	192	10	13	3	4	4	4	9
1991	1	39	495	882	41	85	51	10	12	9	67	3	2	1	1	1	1

FLT01: CPUE at age from La Coruna bottom trawl fleet

Year	Effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1984	1	1	356	644	124	38	38	8	87	30	42	5	6	1	6	3	12
1985	1	3	12	134	399	19	42	39	25	27	43	22	8	3	1	3	27
1986	1	3	79	58	118	400	40	31	22	15	15	41	16	6	10	2	33
1987	1	1	33	113	92	143	672	76	61	13	22	20	16	8	2	1	13
1988	1	5	167	258	58	58	51	408	40	29	22	11	11	16	4	2	9
1989	1	23	152	48	115	56	57	38	299	40	103	78	6	2	23	2	16
1990	1	1	84	128	37	71	17	27	39	394	21	27	5	6	6	7	15
1991	1	1	1	41	2	20	39	27	65	49	376	37	17	12	2	9	5

FLT05: Portuguese Trawl Fleet CPUE at age

Year	Effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1985	147.0	40410	23075	8833	4857	2827	2186	601	370	146	289	324	322	250	90	45	117
1986	155.3	3705	31608	33422	28766	11616	6805	3621	3568	1625	1385	1248	1842	1842	931	521	421
1987	161.3	31831	121581	52031	22178	9096	9588	4961	1784	948	591	364	340	316	239	228	183
1988	127.6	3382	85788	31760	15226	5975	4589	10230	4569	2612	2185	1906	749	632	406	281	214
1989	179.5	3334	40000	31049	21234	6226	4207	6033	8308	4177	2990	1651	1420	1234	679	640	1792
1990	101.7	3141	12203	38786	20521	6427	3923	2467	3440	9233	3949	1913	1429	768	462	514	796
1991	238.7	3924	28240	20417	8765	5098	4150	3166	2665	2756	4588	2285	1598	1143	791	576	473

Table 8.7

Horse mackerel in Fishing Areas VIIIc and IXa

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FLT03: Portuguese October Bottom Trawl Survey

Year	Effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1985	1	70.580	60.151	2.837	1.144	0.618	0.240	0.096	0.025	0.001	0.006	0.004	0.015	0.003	0.003	0.006	0.003
1986	1	706.196	123.479	82.500	70.046	12.621	2.445	0.313	0.552	0.370	0.238	0.189	0.286	0.181	0.126	0.051	0.115
1987	1	95.243	24.377	29.541	12.419	9.802	5.673	1.163	0.519	0.487	0.368	0.225	0.165	0.248	0.047	0.022	0.019
1988	1	29.416	704.046	54.984	20.207	13.920	6.472	21.741	8.294	1.834	0.878	0.298	0.030	0.001	0.001	0.001	0.001
1989	1	377.665	93.538	40.406	20.064	6.196	3.956	3.847	2.395	0.662	0.320	0.430	0.398	0.162	0.139	0.012	0.004
1990	1	508.494	269.582	28.907	16.472	17.014	9.822	1.794	1.187	3.577	2.600	1.532	0.624	0.770	0.266	0.239	0.179
1991	1	336.245	97.414	14.704	13.411	14.272	6.571	3.895	2.275	2.331	1.951	1.006	0.405	0.350	0.238	0.220	0.185

Table 8.8

Horse mackerel in Fishing Areas VIIIc and IXa

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FLT04: Spanish Bottom Trawl Survey

Year	Effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1985	1	182.630	84.360	322.510	467.600	7.090	6.500	4.710	4.050	4.840	5.390	3.580	0.880	0.840	0.260	0.770	5.010
1986	1	289.420	44.600	12.640	7.000	41.810	4.920	5.150	11.110	4.680	7.200	8.540	3.050	1.310	0.800	0.980	3.840
1987	1	217.665	64.153	20.035	8.053	18.482	16.448	5.100	7.979	5.662	5.879	4.712	4.630	1.470	1.389	4.147	0.001
1988	1	145.910	14.650	14.220	9.000	5.130	8.170	54.990	5.050	5.730	6.850	4.800	2.600	7.030	1.650	2.410	17.550
1989	1	115.000	6.540	1.900	21.300	4.680	17.500	15.620	65.040	7.680	10.470	26.160	0.570	0.410	4.770	0.400	5.440
1990	1	26.620	17.790	2.730	2.680	15.920	5.680	7.630	6.090	73.350	3.050	4.730	0.860	0.810	0.600	0.770	1.670
1991	1	48.470	15.370	5.100	0.150	1.440	1.820	0.710	0.640	2.170	28.900	6.420	6.520	2.220	1.070	2.780	0.640

Table 8.9 Catch in numbers ('000) at age by quarter and by sub-division of SOUTHERN HORSE MACKEREL in 1991.

1991 Age	VIIIc East 1'st Q catch('000)	VIIIc West 1'st Q catch('000)	IXa North 1'st Q catch('000)	IXa Centr-N 1'st Q catch('000)	IXa Centr-S 1'st Q catch('000)	IXa South 1'st Q catch('000)	All areas 1'st Q catch ('000)
0	-	-	-	-	-	-	-
1	1,244	2	22,557	2,620	534	813	27,770
2	15,518	1,930	331	4,548	1,330	1,374	25,031
3	217	81	63	1,454	2,338	950	5,103
4	397	607	245	625	1,431	307	3,612
5	319	1,026	245	800	1,332	232	3,954
6	173	806	115	589	836	110	2,629
7	274	1,809	195	606	575	63	3,522
8	186	1,139	78	740	482	48	2,673
9	1,605	8,075	659	1,231	393	31	11,994
10	147	673	43	936	229	14	2,042
11	48	277	24	374	75	2	800
12	203	154	8	359	71	2	797
13	17	28	2	216	48	1	312
14	67	68	4	224	47	-	410
15+	262	130	8	154	36	-	590
Total	20,677	16,805	24,577	15,476	9,757	3,947	91,239
Tonnes	1,559	3,119	691	1,799	1,060	242	8,470

Age	VIIIc East 2'nd Q catch('000)	VIIIc West 2'nd Q catch('000)	IXa North 2'nd Q catch('000)	IXa Centr-N 2'nd Q catch('000)	IXa Centr-S 2'nd Q catch('000)	IXa South 2'nd Q catch('000)	All areas 2'nd Q catch ('000)
0	-	-	-	-	-	-	-
1	1,304	667	687	4,993	560	1,087	9,298
2	5,991	4,625	4,760	3,097	1,660	836	20,969
3	578	696	154	1,452	2,832	332	6,044
4	1,013	2,463	646	825	2,734	149	7,830
5	879	2,683	764	839	2,166	58	7,389
6	352	1,403	439	761	1,356	28	4,339
7	568	2,693	826	944	1,664	38	6,733
8	332	1,238	424	1,054	1,172	27	4,247
9	2,891	9,729	3,136	2,237	2,184	45	20,222
10	153	745	240	908	699	14	2,759
11	73	343	116	853	628	12	2,025
12	125	147	54	557	269	6	1,158
13	2	27	10	345	116	2	502
14	28	64	21	245	57	1	416
15+	97	122	38	191	39	1	488
Total	14,386	27,645	12,315	19,301	18,136	2,636	94,419
Tonnes	1,488	4,188	1,544	2,497	2,386	193	12,296

Age	VIIIc East 3'rd Q catch('000)	VIIIc West 3'rd Q catch('000)	IXa North 3'rd Q catch('000)	IXa Centr-N 3'rd Q catch('000)	IXa Centr-S 3'rd Q catch('000)	IXa South 3'rd Q catch('000)	All areas 3'rd Q catch ('000)
0	5,059	8	-	664	68	50	5,849
1	697	7,111	556	1,774	169	9,203	19,510
2	430	4,042	1,643	695	885	4,109	11,804
3	215	3,497	74	334	1,727	646	6,493
4	721	8,799	523	615	2,273	261	13,192
5	774	6,807	660	941	1,293	83	10,558
6	236	1,512	232	955	763	56	3,754
7	177	522	106	777	1,084	60	2,726
8	194	844	258	930	837	43	3,106
9	2,790	11,962	2,574	1,982	1,340	79	20,727
10	182	423	179	1,035	373	33	2,225
11	107	274	105	903	340	31	1,760
12	64	207	71	702	146	17	1,207
13	28	15	7	553	73	8	684
14	56	116	32	378	34	4	620
15+	50	53	24	313	18	3	461
Total	11,780	46,192	7,044	13,551	11,423	14,686	104,676
Tonnes	1,222	6,385	1,134	2,569	1,651	874	13,835

Age	VIIIc East 4'th Q catch('000)	VIIIc West 4'th Q catch('000)	IXa North 4'th Q catch('000)	IXa Centr-N 4'th Q catch('000)	IXa Centr-S 4'th Q catch('000)	IXa South 4'th Q catch('000)	All areas 4'th Q catch ('000)
0	12,279	56	6,800	916	3,184	2,702	25,937
1	507	2,458	4,664	1,515	2,430	1,394	12,968
2	1,799	8,140	700	1,346	977	684	13,646
3	431	3,339	47	1,284	552	929	6,582
4	595	5,746	185	1,246	392	1,033	9,197
5	437	3,837	254	1,158	149	943	6,778
6	80	838	88	1,160	73	990	3,229
7	44	282	55	675	36	504	1,596
8	48	513	152	690	21	498	1,922
9	618	8,036	1,537	877	8	482	11,558
10	19	505	142	632	2	316	1,616
11	19	448	85	347	1	186	1,086
12	6	218	79	331	1	136	771
13	5	152	4	227	-	85	473
14	9	323	46	214	-	74	666
15+	19	310	13	213	-	70	625
Total	16,915	35,201	14,851	12,831	7,826	11,026	98,650
Tonnes	644	5,135	907	1,994	405	1,273	10,358

Table 8.10

Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2

Table 8.10 Catch numbers at age Numbers*10**-3

YEAR	1985	1986	1987	1988	1989	1990	1991
AGE							
0	715429	615298	53320	121951	242537	48100	31786
1	133861	425659	618570	271052	158646	164206	69544
2	80541	96999	170015	94945	70438	100833	71451
3	151119	64701	66303	39364	93590	60289	24222
4	11706	122560	28789	22598	37363	35931	33833
5	11236	27584	81020	20507	25474	14307	28678
6	4877	13610	21825	92897	22839	11786	13952
7	3362	24346	10485	17212	52657	12913	14578
8	3193	12080	5042	11669	11308	76713	11948
9	4566	6694	3795	10279	14892	9463	64501
10	3803	8198	2337	7042	11182	6562	8641
11	1861	6349	1999	4523	2728	3481	5671
+gp	7781	14068	5552	13660	11756	11424	10180
TOTALNUM	1133335	1438146	1069052	727699	755410	556008	388985
TONSLAND	43535	71258	52747	55888	56396	49207	45511
SOPCOF %	100	102	99	98	99	101	101

Table 8.11 Length (cm) at age by quarter and by sub-division of SOUTHERN HORSE MACKEREL in 1991.

1991 Age	VIIIc East 1'st Q length(cm)	VIIIc West 1'st Q length(cm)	IXa North 1'st Q length(cm)	IXa Centr-N 1'st Q length(cm)	IXa Centr-S 1'st Q length(cm)	IXa South 1'st Q length(cm)	All areas 1'st Q length(cm)
0	-	-	-	-	-	-	-
1	14.6	15.8	12.4	16.3	15.5	16.0	13.1
2	17.5	19.3	16.9	17.1	17.5	17.7	17.6
3	22.2	23.7	24.0	20.3	21.0	20.3	20.8
4	24.5	27.1	25.2	22.9	22.9	22.1	23.9
5	25.9	27.8	26.1	25.1	24.1	23.3	25.5
6	27.2	28.2	27.3	26.8	25.0	24.5	26.6
7	27.9	28.8	27.5	27.9	26.1	25.8	28.0
8	28.0	29.6	28.4	28.7	27.0	26.8	28.7
9	28.9	29.7	28.2	30.3	29.2	28.5	29.6
10	32.3	30.0	29.3	31.7	30.7	29.3	31.0
11	30.3	29.9	28.8	32.9	33.0	31.2	31.6
12	36.9	33.3	34.4	33.4	33.8	31.9	34.3
13	34.6	33.8	34.0	34.4	35.2	32.3	34.5
14	34.6	34.7	34.8	35.0	35.9	-	35.0
15+	39.1	36.9	35.6	35.2	36.1	-	37.4
0-15+	19.5	28.2	13.5	22.6	22.8	19.2	20.4

Age	VIIIc East 2'nd Q length(cm)	VIIIc West 2'nd Q length(cm)	IXa North 2'nd Q length(cm)	IXa Centr-N 2'nd Q length(cm)	IXa Centr-S 2'nd Q length(cm)	IXa South 2'nd Q length(cm)	All areas 2'nd Q length(cm)
0	-	-	-	-	-	-	-
1	13.8	14.7	14.3	17.1	15.5	17.7	16.2
2	18.2	17.8	18.9	19.6	22.3	19.6	18.9
3	21.3	23.7	23.8	22.0	23.2	21.6	22.7
4	24.6	25.4	25.7	23.6	24.1	22.9	24.6
5	25.6	26.5	26.7	26.6	25.8	25.1	26.2
6	27.1	27.6	27.7	27.7	26.8	26.7	27.3
7	27.4	28.0	28.1	27.7	26.6	26.4	27.6
8	27.3	28.9	29.1	28.8	27.7	27.8	28.4
9	27.7	28.7	28.9	29.6	28.3	28.3	28.7
10	28.5	29.5	29.6	30.4	29.2	29.1	29.7
11	28.6	29.1	29.3	31.0	29.3	29.1	30.0
12	37.5	34.5	34.8	31.9	30.0	29.6	32.5
13	33.4	33.9	34.0	33.7	31.5	31.0	33.2
14	35.4	34.9	34.9	35.0	32.2	32.2	34.6
15+	39.8	36.0	35.4	35.5	32.8	33.2	36.2
0-15+	22.0	25.9	23.8	24.0	25.5	19.9	24.4

Age	VIIIc East 3'rd Q length (cm)	VIIIc West 3'rd Q length (cm)	IXa North 3'rd Q length (cm)	IXa Centr-N 3'rd Q length (cm)	IXa Centr-S 3'rd Q length (cm)	IXa South 3'rd Q length (cm)	All areas 3'rd Q length(cm)
0	10.7	13.5	-	14.5	14.5	14.3	11.2
1	17.5	16.8	18.2	17.4	20.5	17.8	17.4
2	22.2	22.5	21.1	19.9	23.3	19.3	21.1
3	24.4	24.6	24.3	24.2	23.9	21.9	24.1
4	26.7	26.1	27.6	26.4	24.9	23.5	26.0
5	27.7	26.6	28.3	28.2	26.1	26.5	26.9
6	28.5	27.6	28.5	29.2	27.0	27.7	28.0
7	29.5	27.3	29.3	29.4	25.9	26.5	27.5
8	30.1	29.2	29.8	30.2	26.7	26.1	28.9
9	29.9	28.3	29.6	30.2	27.2	28.4	28.8
10	31.3	31.7	31.3	30.8	28.8	29.3	30.7
11	31.8	31.0	31.0	30.8	28.5	29.1	30.4
12	32.6	31.9	31.7	31.9	30.1	30.3	31.7
13	31.2	36.0	35.7	33.0	31.0	31.7	32.8
14	34.6	34.3	34.3	33.6	31.4	32.3	33.7
15+	36.8	36.4	35.5	34.0	32.2	32.8	34.6
0-15+	20.3	25.2	26.5	27.1	25.6	18.8	24.1

Age	VIIIc East 4'th Q length(cm)	VIIIc West 4'th Q length(cm)	IXa North 4'th Q length(cm)	IXa Centr-N 4'th Q length(cm)	IXa Centr-S 4'th Q length(cm)	IXa South 4'th Q length(cm)	All areas 4'th Q length(cm)
0	10.7	12.5	12.0	16.0	16.1	14.5	12.3
1	17.1	17.8	15.0	18.4	17.6	16.4	16.7
2	21.8	22.1	21.3	21.3	20.6	21.8	21.8
3	24.0	24.2	23.9	24.4	21.7	25.0	24.1
4	25.7	25.9	27.6	25.6	22.4	25.6	25.7
5	26.4	26.6	28.5	27.6	22.9	27.1	26.8
6	27.4	27.6	28.7	27.7	23.4	27.2	27.4
7	27.6	27.9	30.2	28.7	23.8	27.8	28.2
8	28.4	29.6	30.6	29.3	24.6	28.1	29.1
9	28.0	29.1	30.7	29.9	25.8	28.8	29.3
10	31.7	33.5	32.0	31.0	27.2	30.2	31.7
11	31.1	33.2	32.3	30.9	27.7	29.4	31.7
12	32.9	33.2	32.4	32.1	28.3	30.6	32.2
13	35.1	36.7	35.9	32.7	-	31.8	33.9
14	35.4	35.1	34.0	33.2	-	32.6	34.1
15+	39.6	36.5	35.6	34.2	-	33.7	35.5
0-15+	14.3	25.6	16.7	25.5	18.1	22.5	21.4

Table 8.12 Weight (g) at age by quarter and by sub-division of SOUTHERN HORSE MACKEREL in 1991.

1991 Age	VIIIc East 1'st Q weight(g)	VIIIc West 1'st Q weight(g)	IXa North 1'st Q weight(g)	IXa Centr-N 1'st Q weight(g)	IXa Centr-S 1'st Q weight(g)	IXa South 1'st Q weight(g)	All areas 1'st Q weight(g)
0	-	-	-	-	-	-	-
1	27	34	17	35	30	33	20
2	47	61	43	41	52	45	47
3	90	110	114	68	74	67	73
4	118	161	131	98	97	87	112
5	139	173	144	128	113	102	135
6	158	179	163	156	126	119	153
7	173	190	168	174	143	138	176
8	174	206	185	189	159	153	189
9	192	209	182	222	200	184	206
10	271	215	203	254	232	201	238
11	222	213	194	283	289	241	253
12	385	290	318	297	310	257	319
13	318	300	303	325	349	267	326
14	333	322	326	340	369	-	339
15+	460	395	349	349	374	-	410
0-15+	76	187	28	116	106	61	93

Age	VIIIc East 2'nd Q weight(g)	VIIIc West 2'nd Q weight(g)	IXa North 2'nd Q weight(g)	IXa Centr-N 2'nd Q weight(g)	IXa Centr-S 2'nd Q weight(g)	IXa South 2'nd Q weight(g)	All areas 2'nd Q weight(g)
0	-	-	-	-	-	-	-
1	23	28	26	43	34	47	38
2	51	50	58	64	91	64	58
3	79	109	111	87	101	84	96
4	118	134	139	108	113	98	122
5	133	151	154	151	138	128	145
6	156	169	171	168	154	153	163
7	164	175	178	170	151	148	168
8	160	193	196	189	170	172	183
9	166	191	194	205	181	180	188
10	184	206	208	223	196	195	208
11	186	197	202	235	200	197	214
12	405	322	329	257	213	204	274
13	279	302	303	300	244	234	287
14	334	329	329	333	259	260	322
15+	481	362	342	348	274	284	372
0-15+	101	152	125	129	137	70	131

Age	VIIIc East 3'rd Q weight (g)	VIIIc West 3'rd Q weight (g)	IXa North 3'rd Q weight (g)	IXa Centr-N 3'rd Q weight (g)	IXa Centr-S 3'rd Q weight (g)	IXa South 3'rd Q weight (g)	All areas 3'rd Q weight(g)
0	10	22	-	25	25	24	12
1	45	41	51	44	72	48	45
2	91	95	78	68	107	60	80
3	118	121	117	121	115	88	116
4	152	144	168	155	129	110	142
5	168	152	182	188	149	157	158
6	182	169	184	212	167	180	181
7	199	166	200	219	146	158	176
8	214	198	210	235	162	188	201
9	210	184	208	235	171	195	194
10	241	252	242	249	202	213	240
11	254	237	238	251	196	209	237
12	271	256	251	277	229	235	265
13	232	360	351	304	251	268	297
14	316	314	312	323	259	284	316
15+	382	371	345	334	279	296	342
0-15+	104	138	161	191	145	58	132

Age	VIIIc East 4'th Q weight(g)	VIIIc West 4'th Q weight(g)	IXa North 4'th Q weight(g)	IXa Centr-N 4'th Q weight(g)	IXa Centr-S 4'th Q weight(g)	IXa South 4'th Q weight(g)	All areas 4'th Q weight(g)
0	10	17	16	34	34	25	17
1	43	48	30	52	46	39	41
2	86	89	81	81	72	88	86
3	114	115	112	125	85	134	117
4	133	140	168	145	94	141	139
5	142	151	184	177	100	168	158
6	159	168	188	179	107	169	171
7	164	176	218	199	112	179	186
8	178	209	226	212	124	188	204
9	174	200	230	223	143	201	204
10	249	293	258	251	168	231	261
11	237	289	266	251	176	214	261
12	279	284	266	280	187	244	273
13	337	379	356	295	-	273	319
14	342	334	305	311	-	292	320
15+	482	373	347	340	-	325	359
0-15+	38	146	61	155	52	115	105

Table 8.13

Run title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2

Catch weights at age (kg)

YEAR	1985	1986	1987	1988	1989	1990	1991
AGE							
0	.0110	.0160	.0240	.0270	.0160	.0160	.0160
1	.0330	.0290	.0310	.0360	.0410	.0350	.0330
2	.0670	.0550	.0490	.0660	.0620	.0470	.0630
3	.0920	.0760	.0580	.0820	.0890	.0760	.1020
4	.1310	.1040	.0960	.1110	.1090	.1240	.1330
5	.1550	.1370	.1060	.1260	.1320	.1300	.1510
6	.2020	.1850	.1310	.1560	.1520	.1550	.1680
7	.2330	.1940	.1610	.1560	.1890	.1700	.1730
8	.2990	.2090	.1980	.2020	.2000	.1820	.1930
9	.2940	.2900	.2110	.2390	.2030	.2140	.1960
10	.3190	.3010	.2460	.2490	.2480	.2600	.2330
11	.3140	.3190	.3020	.2750	.3200	.2720	.2360
+gp	.3730	.3380	.3360	.3300	.3680	.3600	.3130
SOPCOFAC	.9979	1.0191	.9883	.9782	.9860	1.0057	1.0123

Table 8.14

Run title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2

Stock weights at age (kg)

YEAR	1985	1986	1987	1988	1989	1990	1991
AGE							
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.0320	.0320	.0320	.0320	.0320	.0320	.0320
2	.0550	.0550	.0550	.0550	.0550	.0550	.0550
3	.0750	.0750	.0750	.0750	.0750	.0750	.0750
4	.1050	.1050	.1050	.1050	.1050	.1050	.1050
5	.1270	.1270	.1270	.1270	.1270	.1270	.1270
6	.1540	.1540	.1540	.1540	.1540	.1540	.1540
7	.1760	.1760	.1760	.1760	.1760	.1760	.1760
8	.2130	.2130	.2130	.2130	.2130	.2130	.2130
9	.2400	.2400	.2400	.2400	.2400	.2400	.2400
10	.2690	.2690	.2690	.2690	.2690	.2690	.2690
11	.3040	.3040	.3040	.3040	.3040	.3040	.3040
+gp	.3600	.3440	.3520	.3440	.3540	.3550	.3450

Table 8.15 Horse Mackerel Southern. Proportions of Maturity

Sub-areas IXa-CN, IXa-CS, IXa-S

AGE	Fem. 3+	Total Fem	%
0	0	0	0.00
1	0	62	0.00
2	0	93	0.00
3	23	107	0.21
4	46	72	0.64
5	71	106	0.67
6	103	120	0.86
7	74	82	0.90
8	97	104	0.93
9	53	55	0.96
10	34	35	0.97
11	34	35	0.97
12	64	65	0.98
13	48	48	1.00
14	65	65	1.00
15+	85	86	0.99
TOTAL	796	1135	

Sub-area VIIIc-E.

AGE	Fem. 3+	Total Fem	%
0	0	0	0.00
1	0	25	0.00
2	6	61	0.10
3	23	63	0.37
4	36	38	0.95
5	33	37	0.89
6	66	73	0.90
7	92	101	0.91
8	149	160	0.93
9	74	75	0.99
10	32	32	1.00
11	20	20	1.00
12	37	37	1.00
13	22	22	1.00
14	19	19	1.00
15+	68	68	1.00
TOTAL	677	831	

Data combined for Southern Stock

AGE	Fem. 3+	Total Fem	%
0	0	0	0.00
1	0	87	0.00
2	6	154	0.04
3	46	170	0.27
4	82	110	0.75
5	104	143	0.73
6	169	193	0.88
7	166	183	0.91
8	246	264	0.93
9	127	130	0.98
10	66	67	0.99
11	54	55	0.98
12	101	102	0.99
13	70	70	1.00
14	84	84	1.00
15+	153	154	0.99
TOTAL	1474	1966	

Table 8.16

Run title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2

Proportion mature at age

YEAR	1985	1986	1987	1988	1989	1990	1991
AGE							
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0400	.0400	.0400	.0400	.0400	.0400	.0400
3	.2700	.2700	.2700	.2700	.2700	.2700	.2700
4	.7500	.7500	.7500	.7500	.7500	.7500	.7500
5	.7300	.7300	.7300	.7300	.7300	.7300	.7300
6	.8800	.8800	.8800	.8800	.8800	.8800	.8800
7	.9100	.9100	.9100	.9100	.9100	.9100	.9100
8	.9300	.9300	.9300	.9300	.9300	.9300	.9300
9	.9800	.9800	.9800	.9800	.9800	.9800	.9800
10	.9900	.9900	.9900	.9900	.9900	.9900	.9900
11	.9800	.9800	.9800	.9800	.9800	.9800	.9800
+gp	.9900	.9900	.9900	.9900	.9900	.9900	.9900

Table 8.17

VPA Version 3.0 (MSDOS) - Jan 1991
Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA3
with cpue data from file J:\IFAPWORK\WG_201\HOM_SOTH\FLEET.FA3
Disaggregated Qs
Log transformation
The final F is the (reciprocal variance-weighted) mean of the raised fleet F
No trend in Q (mean used)

Terminal Fs estimated using Laurec-Shepherd method
Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
Oldest age F = 1.000*average of 5 younger ages.

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1,	.244,	.637,	.740,	.522,	.555,	.666,	.340
2,	.182,	.265,	.534,	.219,	.233,	.790,	.647
3,	.124,	.207,	.276,	.212,	.329,	.301,	.407
4,	.055,	.133,	.127,	.135,	.300,	.191,	.258
5,	.073,	.170,	.116,	.118,	.209,	.170,	.215
6,	.043,	.113,	.186,	.178,	.177,	.133,	.233
7,	.062,	.290,	.113,	.207,	.138,	.136,	.228
8,	.069,	.308,	.085,	.168,	.194,	.287,	.169
9,	.130,	.192,	.141,	.235,	.317,	.233,	.389
10,	.108,	.342,	.090,	.395,	.406,	.212,	.321
11,	.082,	.249,	.123,	.237,	.246,	.200,	.270

Log catchability residuals

Fleet 1

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	,	.57,	2.42,	-1.42,	.00,	-1.20,	-.38
2 ,	,	-.42,	.47,	.16,	.11,	-.42,	.10
3 ,	,	-.72,	.75,	.00,	.43,	.28,	-.74
4 ,	,	1.37,	.22,	-.43,	.08,	-.52,	-.71
5 ,	,	.72,	1.34,	-.19,	-.05,	-1.33,	-.48
6 ,	,	1.97,	.63,	-.80,	-.47,	-.08,	-1.26
7 ,	,	.81,	.97,	-1.91,	.86,	.16,	-.89
8 ,	,	.45,	.59,	-.58,	.26,	.10,	-.81
9 ,	,	.76,	.06,	-.32,	.76,	-1.48,	.21
10 ,	,	.82,	.73,	.07,	.14,	-1.02,	-.75

Fleet 2

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	1.34,	-.34,	.75,	-1.34,	-1.85,	-1.40,	2.84
2 ,	.13,	.78,	-.02,	-.54,	.78,	-1.06,	-.07
3 ,	-.34,	-.48,	-.50,	-.29,	-.55,	.23,	1.93
4 ,	1.21,	-.37,	-.74,	-.14,	-.40,	-.23,	.67
5 ,	.22,	.33,	-1.04,	.15,	-.32,	.52,	.14
6 ,	.17,	.46,	-.47,	-.66,	.32,	.28,	-.11
7 ,	.15,	.71,	-.21,	.10,	-.38,	.26,	-.65
8 ,	-.07,	.36,	.92,	.27,	-.23,	-.99,	-.25
9 ,	-.29,	.76,	.12,	.61,	-.87,	.58,	-.91
10 ,	.55,	-.46,	.34,	.56,	-.96,	.22,	-.25

Table 8.17 (Cont'd)

Fleet 3

Age	1985	1986	1987	1988	1989	1990	1991
1	.87	.77	.91	.35	-.28	-1.40	-1.21
2	-.39	.24	-.15	2.04	1.53	-1.13	-2.14
3	.05	-.11	-.33	1.39	.30	-.95	-.34
4	1.44	-.79	.21	.89	-.44	-.39	-.92
5	.75	-.04	-.83	.81	-.33	.09	-.45
6	.35	.23	-.54	-.36	.35	-.18	.16
7	-.13	.22	.02	.21	-.23	-.19	.10
8	-.40	-.03	.74	.01	.10	-1.07	.65
9	-.39	.58	.20	-.21	-.68	.51	.00
10	.02	.07	.56	-.73	-1.15	-.04	1.27

Fleet 4

Age	1985	1986	1987	1988	1989	1990	1991
1		.76	-.32	-.68	-.17	.30	.12
2		.40	-.14	.42	.43	-1.23	.12
3		.05	.08	-.03	.40	-.49	-.01
4		.95	-.16	-.28	-.28	-.47	.25
5		-.32	.83	-.06	.01	-.85	.39
6		.14	-.16	.37	-.15	-.21	.00
7		-.23	.60	-.68	.59	-.49	.22
8		-.12	.87	-.22	-.52	-.36	.36
9		.11	.74	-.32	-.22	-1.21	.89
10		.04	1.39	-.88	.04	-.56	-.03

SUMMARY STATISTICS FOR AGE 1

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-8.02	1.511	.0003	.2343	.000E+00	.000E+00	-8.022	.571
2	-9.39	1.837	.0001	5.8338	.000E+00	.000E+00	-9.386	.649
3	-7.23	1.053	.0007	.1017	.000E+00	.000E+00	-7.231	.372
4	-7.33	.548	.1562	.3845	.000E+00	.000E+00	-7.332	.207

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.340	.448	.506	.506	1.274

SUMMARY STATISTICS FOR AGE 2

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-8.81	.380	.0001	.7218	.000E+00	.000E+00	-8.815	.144
2	-7.97	.713	.0003	.6044	.000E+00	.000E+00	-7.967	.252
3	-6.97	1.549	.0009	.0764	.000E+00	.000E+00	-6.966	.548
4	-7.04	.693	.2093	.7326	.000E+00	.000E+00	-7.039	.262

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.647	.296	.244	.296	.675

SUMMARY STATISTICS FOR AGE 3

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-9.13	.664	.0001	.1965	.000E+00	.000E+00	-9.126	.251
2	-8.36	.951	.0002	2.8231	.000E+00	.000E+00	-8.364	.336
3	-7.61	.776	.0005	.2930	.000E+00	.000E+00	-7.609	.274
4	-7.39	.308	.1480	.4089	.000E+00	.000E+00	-7.386	.116

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.407	.253	.344	.344	1.845

Table 8.17 (Cont'd)

SUMMARY STATISTICS FOR AGE 4

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-9.83	.822	.0001	.1275	.000E+00	.000E+00	-9.830	.311
2	-8.11	.732	.0003	.5086	.000E+00	.000E+00	-8.109	.259
3	-8.25	.948	.0003	.1035	.000E+00	.000E+00	-8.255	.335
4	-8.47	.566	.0502	.3331	.000E+00	.000E+00	-8.467	.214

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.258	.363	.346	.363	.909

SUMMARY STATISTICS FOR AGE 5

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-10.39	1.006	.0000	.1345	.000E+00	.000E+00	-10.388	.380
2	-7.99	.560	.0003	.2503	.000E+00	.000E+00	-7.985	.19(
3	-8.31	.650	.0002	.1390	.000E+00	.000E+00	-8.306	.230
4	-8.54	.626	.0465	.3216	.000E+00	.000E+00	-8.543	.237

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.215	.332	.206	.332	.385

SUMMARY STATISTICS FOR AGE 6

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-10.89	1.254	.0000	.0670	.000E+00	.000E+00	-10.887	.474
2	-7.81	.454	.0004	.2100	.000E+00	.000E+00	-7.808	.161
3	-8.53	.385	.0002	.2764	.000E+00	.000E+00	-8.527	.136
4	-8.41	.242	.0534	.2353	.000E+00	.000E+00	-8.405	.092

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.233	.185	.119	.185	.413

SUMMARY STATISTICS FOR AGE 7

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-11.12	1.259	.0000	.0946	.000E+00	.000E+00	-11.123	.476
2	-7.53	.482	.0005	.1201	.000E+00	.000E+00	-7.533	.170
3	-8.47	.201	.0002	.2536	.000E+00	.000E+00	-8.474	.071
4	-8.43	.595	.0520	.2846	.000E+00	.000E+00	-8.431	.225

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.228	.175	.166	.175	.894

SUMMARY STATISTICS FOR AGE 8

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-11.12	.617	.0000	.0756	.000E+00	.000E+00	-11.124	.233
2	-7.51	.638	.0005	.1331	.000E+00	.000E+00	-7.513	.226
3	-8.31	.660	.0002	.3276	.000E+00	.000E+00	-8.307	.233
4	-8.35	.563	.0564	.2444	.000E+00	.000E+00	-8.351	.213

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.169	.308	.322	.322	1.091

Table 8.17 (Cont'd)

SUMMARY STATISTICS FOR AGE 9

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-11.14	.902	.0000	.4824	.000E+00	.000E+00	-11.135	.341
2	-6.99	.750	.0009	.1579	.000E+00	.000E+00	-6.991	.265
3	-7.81	.495	.0004	.3924	.000E+00	.000E+00	-7.805	.175
4	-8.16	.831	.0681	.9570	.000E+00	.000E+00	-8.162	.314

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.389	.342	.323	.342	.891

SUMMARY STATISTICS FOR AGE 10

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-10.93	.811	.0000	.1540	.000E+00	.000E+00	-10.929	.307
2	-6.83	.614	.0011	.2527	.000E+00	.000E+00	-6.829	.217
3	-7.82	.851	.0004	1.1618	.000E+00	.000E+00	-7.816	.301
4	-7.96	.839	.0831	.3141	.000E+00	.000E+00	-7.963	.317

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.321	.379	.395	.395	1.086

Table 8.18

Run title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA3 At 30/06/1992
Traditional vpa Terminal Fs estimated using Laurec-Shepherd method

	Fishing mortality (F) at age						
YEAR	1985	1986	1987	1988	1989	1990	1991
AGE							
1	.2436	.6359	.7384	.5197	.5530	.6635	.3400
2	.1816	.2642	.5326	.2183	.2313	.7848	.6465
3	.1239	.2056	.2746	.2107	.3271	.2992	.4068
4	.0552	.1327	.1257	.1339	.2988	.1898	.2582
5	.0732	.1688	.1154	.1175	.2077	.1687	.2154
6	.0427	.1130	.1851	.1777	.1758	.1326	.2332
7	.0617	.2904	.1133	.2061	.1371	.1350	.2276
8	.0693	.3077	.0848	.1684	.1920	.2855	.1688
9	.1303	.1918	.1413	.2347	.3168	.2303	.3891
10	.1078	.3418	.0898	.3947	.4058	.2120	.3209
11	.0823	.2489	.1230	.2367	.2462	.2003	.2704
+gp	.0823	.2489	.1230	.2367	.2462	.2003	.2704
FBAR 2- 6	.0953	.1769	.2467	.1716	.2481	.3150	.3520

Table 8.19

Title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2 At 30/06/1992 13:24

Separable analysis
from 1985 to 1991 on ages 0 to 11
with Terminal F of .380 on age 3 and Terminal S of .700

Initial sum of squared residuals was 40.652 and
final sum of squared residuals is 20.510 after 104 iterations

Matrix of Residuals

Years	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91		WTS
Ages								
0/ 1	1.756	.095	-.897	.304	.498	.094	.000	.321
1/ 2	.087	-.624	1.066	.348	-1.116	-.297	.000	.359
2/ 3	.239	-.833	.950	-.626	-1.007	.683	.000	.330
3/ 4	.276	-.328	.628	-.488	-.088	-.052	.000	.676
4/ 5	-.508	-.417	.186	-.346	.244	-.083	.000	.861
5/ 6	.361	-.384	-.082	-.122	.273	-.069	.000	1.000
6/ 7	-1.209	-.515	.138	.402	-.081	-.457	.000	.482
7/ 8	-.599	1.089	.078	.540	-.737	.119	.000	.400
8/ 9	.104	.839	-.364	.028	-.028	.364	.000	.673
9/10	.076	.539	-.461	-.016	.403	.073	.000	.785
10/11	-.192	.542	-.849	.672	.395	-.218	.000	.474
	.000	.000	.000	.000	.000	.000	.394	
WTS	.001	.001	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1985	1986	1987	1988	1989	1990	1991
F-values	.1229	.2741	.1936	.2671	.3594	.3014	.3800

Selection-at-age (S)

	0	1
S-values	.9678	2.5446

	2	3	4	5	6	7	8	9	10	11
S-values	1.4996	1.0000	.6465	.5338	.5368	.4580	.5194	.7149	.8431	.7000

Table 8.20

Run title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2 At 30/06/1992 13:25
Traditional vpa Terminal populations from weighted Separable populations

Fishing mortality (F) at age

YEAR	1985	1986	1987	1988	1989	1990	1991
AGE							
0	.5112	.3749	.0725	.2438	.4661	.3094	.3670
1	.2429	.6175	.7526	.5826	.5375	.6276	.9277
2	.1917	.2632	.5058	.2250	.2740	.7429	.5827
3	.1079	.2196	.2732	.1957	.3405	.3754	.3696
4	.0518	.1135	.1359	.1331	.2721	.1999	.3526
5	.0713	.1570	.0969	.1284	.2061	.1500	.2296
6	.0402	.1098	.1699	.1456	.1949	.1314	.2025
7	.0550	.2704	.1097	.1859	.1090	.1525	.2251
8	.0723	.2684	.0778	.1623	.1695	.2165	.1948
9	.1380	.2014	.1194	.2125	.3021	.1979	.2691
10	.0939	.3678	.0950	.3185	.3548	.1994	.2640
11	.0860	.2117	.1350	.2530	.1852	.1677	.2503
+gp	.0860	.2117	.1350	.2530	.1852	.1677	.2503
FBAR 2- 6	.0926	.1726	.2363	.1656	.2575	.3199	.3474

Table 8.21

Run title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2 At 30/06/1992 13:25
Traditional vpa Terminal populations from weighted Separable populations

Stock number at age (start of year) Numbers*10**-3

YEAR	1985	1986	1987	1988	1989	1990	1991	1992
AGE								
0	1912692	2109367	819875	605124	697015	193901	110916	0
1	666517	987352	1247901	656297	408145	376423	122481	66139
2	496038	449980	458296	506042	315457	205227	172971	41692
3	1589062	352471	297690	237863	347799	206452	84034	83128
4	249689	1227839	243569	194978	168334	212974	122075	49981
5	175631	204067	943374	183003	146909	110373	150088	73849
6	133376	140762	150125	736965	138535	102895	81763	102677
7	67618	110280	108557	109028	548364	98121	77656	57475
8	49242	55085	72429	83731	77924	423241	72507	53365
9	38082	39426	36253	57671	61274	56611	293376	51360
10	45620	28553	27746	27691	40136	38988	39976	192927
11	24284	35745	17012	21717	17333	24227	27490	26425
+gp	101535	79203	47248	65589	74694	79508	49348	51489
TOTAL	5549388	5820129	4470075	3485701	3041920	2128941	1404681	850507

Table 8.22

Run title : Horse mackerel in Fishing Areas VIIIc and IXa (run name: FA2 At 30/06/1992 13:25

Summary (with SOP correction)
Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS	TOTALBIO	EXPLTBIO	TOTSPBIO	LANDINGS	SOPCOFAC	FBAR 2- 6
1985	1912692	323905	470332	162381	43535	.9979	.0926
1986	2109367	352303	412833	212586	71258	1.0191	.1726
1987	819875	324612	223189	187732	52747	.9883	.2363
1988	605124	304574	337571	200252	55888	.9782	.1656
1989	697015	280499	219010	193402	56396	.9860	.2575
1990	193901	259600	153798	188218	49207	1.0057	.3199
1991	110916	202322	131002	153857	45511	1.0123	.3474
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 8.23

HORSE MACKEREL SOUTHERN as 1-GROUP
2 7 2 (No. Surveys, No. Yearclasses, VPA column)

'YEARCL'	'VPA'	'PTOS'	'SPSS'
1985	987352	71	183
1986	1247901	706	289
1987	656297	95	-11
1988	408145	29	146
1989	376423	378	115
1990	-11	508	27
1991	-11	336	48

Table 8.24

Analysis by RCT3 ver3.1 of data from file :

HRECR1.DAT

HORSE MACKEREL SOUTHERN as 1-GROUP

Data for 2 surveys over 7 years : 1985 - 1991

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1990

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
PTOS	1.17	7.59	1.63	.123	5	6.23	14.90	2.546	.036
SPSS	1.69	4.66	.32	.848	4	3.33	10.31	1.320	.133
					VPA Mean =		13.40	.528	.831

Yearclass = 1991

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
PTOS	1.17	7.58	1.64	.123	5	5.82	14.42	2.447	.035
SPSS	1.69	4.67	.32	.849	4	3.89	11.25	.994	.213
					VPA Mean =		13.39	.529	.752

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	459533	13.04	.48	.78	2.64		
1991	430424	12.97	.46	.65	1.98		

Table 8.25

13:38 Tuesday, June 30,

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Initial stock size and Recruitment (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	1269	430	41.7	83.1	50	73.8	102.7	57.5	53.4	51.4	192.9	26.4	51.5
1993	1269	.	.	.	.	.	.	.	.	.	.	.	.
1994	.	.	.	.	.	.	.	.	.	.	.	.	.

13:38 Tuesd

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Weight in stock (Kilograms)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318
1993	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318
1994	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318

13:38 Tuesday, June 30,

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Natural mortality

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1993	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1994	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

13:38 Tuesday, Jun

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Maturity ogive

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	0.00	0.00	0.04	0.27	0.75	0.73	0.88	0.91	0.93	0.98	0.99	0.98	0.99
1993	0.00	0.00	0.04	0.27	0.75	0.73	0.88	0.91	0.93	0.98	0.99	0.98	0.99
1994	0.00	0.00	0.04	0.27	0.75	0.73	0.88	0.91	0.93	0.98	0.99	0.98	0.99

13:38 Tuesday, June

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Proportion of F before spawning

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1993	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1994	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Table 8.25 (Cont'd)

13:38 Tuesday,

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Proportion of M before spawning

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1993	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1994	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

13:38 Tuesday, June 3

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Exploitation pattern

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	0.4	1.06	0.62	0.42	0.26	0.22	0.22	0.19	0.22	0.29	0.35	0.29	0.29
1993	0.4	1.06	0.62	0.42	0.26	0.22	0.22	0.19	0.22	0.29	0.35	0.29	0.29
1994	0.4	1.06	0.62	0.42	0.26	0.22	0.22	0.19	0.22	0.29	0.35	0.29	0.29

13:38 Tue

Horse mackerel in Fishing Areas VIIIc and IXa

Prediction run HENPRED3: Weight in catch (Kilograms)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1992	0.016	0.033	0.063	0.102	0.133	0.151	0.168	0.173	0.193	0.196	0.233	0.236	0.280
1993	0.016	0.033	0.063	0.102	0.133	0.151	0.168	0.173	0.193	0.196	0.233	0.236	0.280
1994	0.016	0.033	0.063	0.102	0.133	0.151	0.168	0.173	0.193	0.196	0.233	0.236	0.280

Table 8.26

Horse mackerel in Fishing Areas VIIIc and IXa

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass

F factor 1992	Reference F 1992	Stock biomass 1992	Sp.stock biomass 1992	Catch weight 1992	F factor 1993	Reference F 1993	Stock biomass 1993	Sp.stock biomass 1993	Catch weight 1993	Stock biomass 1994	Sp.stock biomass 1994
1.0000	0.3480	162847	119852	48689	0.0000	0.0000	139410	98217	0	181307	98437
.	.	.	.	.	0.2000	0.0696	.	96890	11451	165617	91653
.	.	.	.	.	0.4000	0.1392	.	95583	21633	151803	85386
.	.	.	.	.	0.6000	0.2088	.	94293	30732	139580	79589
.	.	.	.	.	0.8000	0.2784	.	93022	38903	128709	74220
.	.	.	.	.	1.0000	0.3480	.	91768	46275	118994	69243
.	.	.	.	.	1.2000	0.4176	.	90531	52954	110273	64624
.	.	.	.	.	1.4000	0.4872	.	89312	59030	102409	60335
.	.	.	.	.	1.6000	0.5568	.	88110	64580	95289	56349
.	.	.	.	.	1.8000	0.6264	.	86924	69666	88817	52642
.	.	.	.	.	2.0000	0.6960	.	85755	74343	82913	49193

Run name : HENPRED3
Computation of ref. F: Unweighted mean of age 2 - 6
Unit of measurement : Tonnes

Table 9.1 Landings (t) of SARDINE by country. (Data provided by the W.G. members).

SARDINE VII

Country	1981	1982	1983	1984	1985	1986
France	1,124	907	803	809	2,089	2,570
UK (Eng.&Wales						

Country	1987	1988	1989	1990	1991
France	965	2,586	1,141	1,107	1,957
UK (Eng.&Wales					3,011
Total				1,107	4,968

SARDINE VIII

Country	1975	1976	1977	1978	1979	1980
France						
Spain	50,260	51,901	36,149	43,522	18,271	35,787

Country	1981	1982	1983	1984	1985	1986
France	9,676	5,928	6,467	4,491	8,169	10,229
Spain	33,550	31,756	32,374	27,970	25,907	39,195
Total	45,226	37,684	38,841	32,461	34,076	49,424

Country	1987	1988	1989	1990	1991
France	7,708	7,808	8,976	8,485	9,637
Spain	36,377	40,944	29,856	27,500	20,735
Total	44,085	48,752	38,832	35,985	30,372

SARDINE IX

Country	1975	1976	1977	1978	1979	1980
Portugal	95,877	79,649	79,819	86,553	91,294	106,302
Spain	12,236	10,140	9,782	12,915	43,876	49,593
Total	108,113	89,789	89,601	96,468	135,170	155,895

Country	1981	1982	1983	1984	1985	1986
Portugal	113,253	100,859	85,922	95,110	111,709	103,451
Spain	65,330	71,889	62,843	79,606	66,491	37,960
Total	178,583	172,748	148,765	174,716	178,200	141,411

Country	1987	1988	1989	1990	1991
Portugal	90,214	93,591	91,091	92,404	92,638[1]
Spain	42,234	24,005	16,179	19,253	14,383
Total	132,448	117,596	107,270	111,657	107,021

[1]Portuguese catches of 1991 included 5,492 t of discards.

Table 9.2 Annual landings (t) of SARDINE by sub-area and division. (Data provided by the Working Group members).

Sub-area	1981	1982	1983	1984	1985	1986
VIId	172	59	211	147	465	512
VIIe	952	828	590	661	1,624	2,058
VIIf		20				
VIIg				1		
VIIh			2			
VII		**907**	**803**	**809**	**2,089**	**2,570**
VIIIa	8,482	5,928	6,013	4,472	8,090	10,186
VIIIb	1,194		454	19	79	77
VIIIc	35,550	31,756	32,374	27,970	25,907	39,195
VIIId						
VIII		**37,684**	**38,841**	**32,461**	**34,076**	**49,458**
IXa	178,583	172,748	148,765	174,716	178,200	141,411
Total	**224,933**	**249,930**	**228,053**	**241,256**	**250,530**	**245,467**

Sub-area	1987	1988	1989	1990	1991
VIId	67	29	93	64	170
VIIe	682	438	91	808	4,687
VIIf					
VIIg					
VIIh	216	2,119	957	235	110
VII	**965**	**2,586**	**1,141**	**1,107**	**4,968**
VIIIa	7,631	7,770	8,885	8,381	1,113
VIIIb	77	38	85	104	482
VIIIc	36,377	40,944	29,862	27,500	20,735
VIIId					42
VIII	**44,085**	**48,752**	**38,832**	**35,985**	**22,372**
IXa	132,448	117,596	107,270	111,657	107,021
Total	**222,548**	**220,272**	**187,216**	**185,841**	**161,700**

Sub-area VII - 1981-1990 only French data were available.

Table 9.3 Annual landings (t) of SARDINE in Divisions VIIIc and IXa by country.

Country	1975	1976	1977	1978	1979	1980
Portugal	95,877	79,649	79,819	83,553	91,294	106,302
Spain	62,496	62,041	45,931	56,437	62,147	85,380
Total	158,373	141,690	125,750	139,990	153,441	191,682

Country	1981	1982	1983	1984	1985	1986
Portugal	113,253	100,859	85,922	95,110	111,709	103,451
Spain	100,880	103,645	95,217	107,576	92,398	77,155
Total	214,133	204,504	181,139	202,686	204,107	180,606

Country	1987	1988	1989	1990	1991
Portugal	90,214	93,591	91,091	92,404	92,638[1]
Spain	78,611	64,949	46,035	46,753	35,118
Total	168,825	158,540	137,126	139,157	127,756

[1]Discards included.

Table 9.4 SARDINE (VIIIc + 1Xa). Quarterly catches (t) by gear and discards by country and fleets in 1991.

Country/Quarter	1st	2nd	3rd	4th	Year
Total	19,456	18,813	44,381	45,106	127,756
Spain (VIIIc+IXa):					
P.seine	7,232	5,612	10,476	11,798	35,118
Portugal (IXa):	12,224	13,201	33,905	33,308	92,638
P.seine	10,712	12,371	28,019	31,614	81,848
Artisanal	608	708	1,797	1,576	4,689
Trawl	259	122	109	118	609
Discard	1,512	-	3,980	-	5,492

Table 9.5 SARDINE - Total nominal catches (tonnes), including discards (see Table 9.4), by quarter and areas of Divisions VIIIc and IXa during 1991.

Area	1st Q	2nd Q	3rd Q	4th Q	Total 1991
VIIIc East	3,946	1,630	1,865	2,715	10,156
VIIIc West	1,703	1,986	2,966	3,924	10,579
IXa North	1,583	1,996	5,645	5,159	14,383
IXa Central-North	2,759	5,487	18,009	18,124	44,378
IXa Central-South	4,582	3,717	10,506	7,349	26,154
IXA South (>7° 24'W)	4,884	3,997	5,390	7,835	22,106
Total	19,456	18,813	44,381	45,106	127,756

Table 9.6 SARDINE (VIIIc + IXa). Effort (fishing day) and CPUE (ton/fishing day) series in commercial fisheries (P. seine).

Year	Spain						Portugal	
	VIIIc East (Santona)		VIIIc West (Sada)		IXa N(Vigo+Riveira)		IXa Central+South	
	f-day	t/f day	f-day	t/f day	f-day	t/f day	f-day	t/fday
1982					7,685	4.87		
1983					7.863	4.01		
1984					8,369	4.65		
1985					5,731	4.86		
1986					3,541	4.23		
1987					4,099	4.71		
1988					3,601	2.75	22,080	3.91
1989	314	4.10	3,886	2.02	3,059	2.45	21,432	3.93
1990	389	3.65	3,244	1.65	3,488	2.80	25,710	3.50
1991	394	3.13	2,609	1.03	3,279	2.44	20,872	3.64

Table 9.7 SARDINE in Divisions VIIIc and IXa. Abundance estimates from acoustic surveys 1986-1992.

Age	1986				1987			1988			1990	1991	1991	1992
	Spain Divs. VIIIc and IXA	Portugal Division IXA			Spain Divs. VIIIc and IXa	Portugal Division IXa		Spain Divs. VIIIa and IXa	Portugal Division IXa		Spain Divs. VIIIc and IXa (N)	Spain Divs. VIIIc and IXa (N)	Portugal Sub-divs. central north (N)	Spain Divs. VIIIc and IXa
	Mar	Mar	Aug	Dec	Mar	Aug	Nov	Apr	Mar	Aug	Apr	Mar/Apr	Sep/Oct	Apr/May
0	-	-	3,949	3,545	-	4,185	3,690	-	-	3,139	-	-	4,638	-
1	55	2,326	2,772	1,535	632	753	2,413	221	7,743	1,823	69	25	1,199	159
2	21	4,124	2,504	1,503	257	1,482	1,355	63	2,684	987	56	150	30	76
3	1,040	1,496	615	610	27	1,230	932	72	1,617	801	274	126	-	85
4	215	467	41	309	2,390	802	643	64	1,447	426	55	314	-	29
5	409	486	3	123	586	249	245	858	804	70	88	51	-	115
6	279	21	3	48	481	104	78	175	425	9	134	79	-	24
7	192	-	-	-	528	-	-	310	104	-	249	56	-	20
8	50	-	-	-	159	-	-	342	-	-	70	345	-	12
9	36	-	-	-	61	-	-	53	-	-	49	29	-	57
10	12	-	-	-	25	-	-	18	-	-	46	71	-	3
11	3	-	-	-	4	-	-	-	-	-	23	6	-	9
12	-	-	-	-	-	-	-	-	-	-	8	2	-	
Total biomass	161	318	331	258	363	325	331	176	481	243	97	106	122	45

Numbers in millions.
Biomass in thousands tonnes.

Table 9.8 Sardine abundance in number ($x10^5$) and biomass (tonnes) by age group and average weight (g) by age group off the northern Portuguese coast (September/October acoustic survey).

Age group	Number	Biomass	W
0	4,638	91,636	19.8
1	1,199	28,598	23.8
2	30	1,532	51.2
Total	5,867	121,766	

Table 9.9 Estimates of DEPM (daily egg production method) parameters, variances, coefficients of variation by region and total area in 1990.

	Galicia I	W. Cant. II	E. Cant. III
P. (eggs/0.05 m^2)	1.1454	1.7784	4.248
Standard error	0.3927	0.44544	0.9242
Ave. Female weight			
W(gr)	68.14	83.65	83.61
CV	0.12	0.02	0.01
Batch fecundity			
F	26 946.96	32 980.32	32 976.92
CV	0.26	0.19	0.20
Spawning fraction			
S (Day-1)	0.10	0.11	0.20
CV	0.32	0.91	0.20
Sex ratio			
R	0.56	0.53	0.45
CV	0.08	0.38	0.28
Spawning biomass (t)	24 232	46 125	7 363
CV	0.40	0.72	0.27

Table 9.10 Sardine biomass estimated in 1988 and 1990 by the DEPM and acoustic methods.

	Galicia I	W. Cant. II	E. Cant. III	Total
1988				
DEPM. SSB	134.195	33.503	12.467	180.165
CV	0.66	0.30	0.56	0.50
1990				
DEPM. SSB	24.232	46.125	7.363	77.720
CV	0.40	0.72	0.27	0.50
1988				
Acoustic Biomass.	102.394	58.010	13.612	174.016
1990				
Acoustic Biomass.	53.325	25.690	17.485	96.500

Table 9.11

Sardine in Divisions VIIIc and IXa. Catch length composition ('000) by quarter, by country and by gear during 1991.

	QUARTER 1				QUARTER 2				QUARTER 3				QUARTER 4				TOTAL			
	PORTUGAL	SPAIN			PORTUGAL	SPAIN			PORTUGAL	SPAIN			PORTUGAL	SPAIN			PORTUGAL	SPAIN		
Length (cm)	Seine IXa	Seine IXa	Seine VIIIc	Total	Seine IXa	Seine IXa	Seine VIIIc	Total	Seine IXa	Seine IXa	Seine VIIIc	Total	Seine IXa	Seine IXa	Seine VIIIc	Total	Seine IXa	Seine IXa	Seine VIIIc	Total
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.5	-	-	-	-	-	177	-	177	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	884	-	884	-	141	-	141	-	-	-	-	-	177	-	177
8.5	-	-	-	-	-	1743	-	1743	-	1899	-	1899	-	-	-	-	-	1024	-	1024
9	-	-	10	10	-	2491	-	2491	60	4468	-	4528	149	-	-	149	209	6959	10	7178
9.5	-	-	42	42	-	3434	-	3434	91	10358	23	10472	102	-	18	120	193	13793	82	14068
10	-	-	83	83	-	5231	-	5231	123	13916	68	14106	689	103	54	846	812	19250	205	20266
10.5	-	-	146	146	495	5902	-	6397	1218	19493	68	20779	1040	1028	54	2122	2753	26423	267	29443
11	3	-	83	86	3774	9612	-	13386	4673	19910	642	25225	1067	4715	511	6294	9517	34237	1236	44991
11.5	104	-	2424	2528	4858	12792	3372	21022	9311	25139	1661	36111	2233	11221	1337	14791	16506	49151	8794	74452
12	266	-	5218	5484	6461	16955	7316	30732	17482	40746	3721	61949	6143	23587	2982	32712	30352	81289	19237	130878
12.5	54	-	3630	3684	9808	12008	5068	26884	38903	30244	3937	73084	12115	22673	3230	38017	60880	64925	15865	141669
13	312	2	485	799	10216	7855	572	18643	79749	42289	883	122921	21172	27744	853	49769	111449	77891	2793	192132
13.5	291	2	21	313	9813	2541	1	12354	84584	35695	357	120636	51060	38013	561	89634	145748	76250	940	222937
14	304	3	76	384	4979	782	46	5808	92792	31530	1339	125661	77486	36054	1557	115097	175561	68370	3019	246950
14.5	559	2	213	773	3260	812	194	4266	73428	12996	1384	87808	74044	28905	2041	104991	151291	42715	3832	197838
15	992	3	650	1646	2918	403	322	3643	40889	8069	1116	50074	54053	13282	1947	69281	98852	21756	4035	124644
15.5	1051	11	602	1664	4229	395	298	4922	19200	3798	446	23444	34622	5941	2276	42840	59102	10145	3623	72870
16	1358	31	956	2345	10024	333	259	10615	14960	1984	292	17236	17975	2102	3078	23155	44317	4449	4585	53351
16.5	4098	130	589	4817	14349	196	198	14743	17030	1594	223	18847	10133	1077	3275	14485	45610	2998	4285	52892
17	10366	129	212	10707	20619	212	94	20925	24459	1664	426	26550	9312	555	1882	11749	64756	2561	2614	69931
17.5	14488	577	373	15438	28758	419	66	29244	27520	1812	866	30198	17160	452	888	18500	87926	3261	2193	93379
18	22073	612	352	23037	34049	193	106	34348	23039	1005	1284	25328	32713	230	358	33301	111874	2039	2101	116014
18.5	29179	1398	883	31461	36010	405	278	36693	28218	1081	1579	30878	49150	735	769	50654	142557	3619	3509	149685
19	34792	976	1596	37365	26379	604	1382	28365	39850	625	1082	41556	67015	824	1835	69673	168036	3028	5894	176959
19.5	37020	2330	2155	41504	21268	1192	1960	24420	41134	841	1875	43850	70287	715	2301	73303	169709	5078	8291	183078
20	25227	1748	3190	30165	18579	1566	3876	24021	38293	596	4601	43490	62146	999	4227	67372	144245	4910	15893	165048
20.5	14270	3036	3969	21275	11888	1597	4935	18419	26753	576	6010	33339	36189	1249	4167	41605	89100	6457	19081	114638
21	8401	3159	6298	17858	6447	1605	4799	12851	14603	682	7855	23141	21559	2361	6716	30636	51010	7807	25668	84486
21.5	5164	2284	8105	15553	2468	863	4716	8048	4932	146	5739	10817	8604	2143	10754	21502	21168	5437	29315	55920
22	1772	2778	10284	14834	661	896	4279	5836	1720	130	4438	6287	2955	1826	13063	17844	7108	5630	32063	44801
22.5	1291	1667	8781	11740	311	505	2855	3671	604	57	4265	4926	621	661	10725	12007	2827	2890	26627	32344
23	675	600	8131	9406	146	174	2730	3049	143	17	3095	3255	64	293	9036	9393	1028	1084	22991	25103
23.5	68	557	5632	6257	44	186	1517	1746	-	2	1564	1565	51	59	4596	4706	163	803	13309	14275
24	38	125	2914	3077	127	14	1060	1201	-	-	609	609	156	85	2582	2822	321	223	7165	7709
24.5	-	108	1142	1250	-	23	592	615	55	-	353	408	2	5	835	842	57	136	2922	3115
25	36	34	213	282	-	-	70	70	-	-	57	57	2	-	71	73	38	34	411	483
25.5	-	-	66	66	-	-	15	15	-	-	-	-	-	-	-	-	-	-	81	81
26	-	-	-	-	-	-	-	-	-	-	28	28	-	-	72	72	-	-	100	100
26.5	-	-	81	81	-	-	-	-	-	-	-	-	-	-	42	42	-	-	123	123
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27.5	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total N	214251	22301	79610	316164	292956	95000	52975	440913	765939	313502	61885	1141202	742067	229636	98694	1070399	2015075	660439	293164	2968678
Catch(t)	12225	1583	5649	19457	13197	1996	3616	18809	32905	5645	4831	43381	33308	5159	6639	45106	91635	14383	20735	126753
L	19.2	20.9	20.4	19.6	17.6	12.8	18.6	16.7	15.9	12.8	19.2	15.3	17.1	14.1	20.1	16.7	17.0	13.5	19.7	16.5

Table 9.12 Sardine in Division VIIe. Catch length composition ('000) by quarter and by gear during 1991.

	QUARTER 1 ENGLAND			QUARTER 4 ENGLAND		TOTAL ENGLAND		
Length (cm)	Seine VIIe	Trawl VIIe	Total	Trawl VIIe	Total	Seine VIIe	Trawl VIIe	Total
15	-	-	-	-	-	-	-	-
15.5	-	-	-	-	-	-	-	-
16	-	93	93	-	-	-	93	93
16.5	-	66	66	-	-	-	66	66
17	-	-	-	-	-	-	-	-
17.5	-	93	93	-	-	-	93	93
18	-	206	206	-	-	-	206	206
18.5	-	-	-	-	-	-	-	-
19	36	461	497	-	-	36	461	497
19.5	-	658	658	-	-	-	658	658
20	108	179	288	-	-	108	179	288
20.5	108	93	202	230	230	108	323	432
21	108	113	221	153	153	108	266	375
21.5	144	319	463	307	307	144	626	770
22	216	312	528	230	230	216	542	758
22.5	325	604	929	307	307	325	911	1235
23	577	1135	1712	1304	1304	577	2438	3015
23.5	577	1714	2291	1074	1074	577	2787	3364
24	469	2013	2482	920	920	469	2934	3402
24.5	541	1569	2110	1304	1304	541	2872	3413
25	325	1481	1805	1534	1534	325	3014	3339
25.5	252	958	1210	920	920	252	1878	2130
26	72	791	863	537	537	72	1327	1399
26.5	108	724	833	153	153	108	878	986
27	-	66	66	153	153	-	220	220
27.5	36	47	83	-	-	36	47	83
28	-	-	-	-	-	-	-	-
Total N	4002	13281	17698	9124	9124	4002	22820	26822
Catch (T)	397	1309	1705	1150	1150	397	2459	2856
L	23.8	24.5	23.8	24.3	24.3	23.8	24.0	24.0

Table 9.13 Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1991.

1991 Age	VIIIc East 1'st Q catch('000)	VIIIc West 1'st Q catch('000)	IXa North 1'st Q catch('000)	IXa Centr-N 1'st Q catch('000)	IXa Centr-S 1'st Q catch('000)	IXa South 1'st Q catch('000)	All areas 1'st Q catch ('000)
0	-	-	-	-	-	-	-
1	4,107	11,370	894	34,564	36,718	383	88,036
2	5,656	1,135	5,347	4,039	14,716	3,475	34,368
3	5,141	2,311	3,725	9,608	31,597	37,259	89,641
4	14,069	7,132	7,209	11,213	22,836	40,240	102,699
5	2,437	1,153	1,254	4,785	6,572	15,589	31,790
6	2,644	879	589	5,305	1,045	483	10,945
7	1,905	618	354	1,048	255	72	4,252
8	10,997	4,001	2,452	-	-	-	17,450
9	1,043	353	186	-	-	-	1,582
10	1,817	564	262	-	-	-	2,643
11	127	35	8	-	-	-	170
12+	83	34	22	-	-	-	139
Total	50,026	29,585	22,302	70,562	113,739	97,501	383,715
Tonnes	3,946	1,703	1,583	2,759	4,582	4,884	19,457

Age	VIIIc East 2'nd Q catch('000)	VIIIc West 2'nd Q catch('000)	IXa North 2'nd Q catch('000)	IXa Centr-N 2'nd Q catch('000)	IXa Centr-S 2'nd Q catch('000)	IXa South 2'nd Q catch('000)	All areas 2'nd Q catch ('000)
0	-	-	-	-	-	-	-
1	1,428	16,369	84,859	42,575	20,805	10,879	176,915
2	2,346	3,461	3,014	31,331	16,618	37,543	94,313
3	1,987	3,535	1,872	22,555	31,819	33,565	95,333
4	4,811	7,312	3,299	15,133	7,505	9,099	47,159
5	831	1,301	577	7,150	2,100	743	12,702
6	832	606	222	3,408	126	-	5,194
7	588	368	149	-	-	-	1,105
8	3,537	2,247	931	-	-	-	6,715
9	310	163	60	-	-	-	533
10	579	270	89	-	-	-	938
11	37	21	5	-	-	-	63
12+	26	12	7	-	-	-	45
Total	17,312	35,665	95,084	122,152	78,973	91,829	441,015
Tonnes	1,630	1,986	1,996	5,487	3,713	3,997	18,809

Age	VIIIc East 3'rd Q catch('000)	VIIIc West 3'rd Q catch('000)	IXa North 3'rd Q catch('000)	IXa Centr-N 3'rd Q catch('000)	IXa Centr-S 3'rd Q catch('000)	IXa South 3'rd Q catch('000)	All areas 3'rd Q catch ('000)
0	105	15,795	302,444	494,995	138,576	26,699	978,614
1	4,533	2,065	6,893	13,827	7,923	53,030	88,271
2	2,491	4,478	2,160	27,123	68,485	45,686	150,423
3	859	1,665	183	25,743	33,508	6,828	68,786
4	3,965	8,170	986	25,532	5,017	98	43,768
5	1,082	2,192	193	1,863	761	-	6,091
6	967	994	163	159	268	-	2,551
7	937	1,326	92	-	-	-	2,355
8	3,426	4,326	320	-	-	-	8,072
9	439	675	49	-	-	-	1,163
10	494	569	19	-	-	-	1,082
11	119	41	15	-	-	-	175
12+	70	36	1	-	-	-	107
Total	19,487	42,332	313,518	589,242	254,538	132,341	1,351,458
Tonnes	1,865	2,966	5,645	17,009	10,506	5,390	43,381

Age	VIIIc East 4'th Q catch('000)	VIIIc West 4'th Q catch('000)	IXa North 4'th Q catch('000)	IXa Centr-N 4'th Q catch('000)	IXa Centr-S 4'th Q catch('000)	IXa South 4'th Q catch('000)	All areas 4'th Q catch ('000)
0	7,709	12,566	215,022	261,871	97,725	72	594,965
1	5,837	3,845	3,988	47,936	27,583	13,957	103,146
2	2,653	5,160	2,345	49,122	26,334	39,363	124,977
3	1,682	2,968	791	39,428	27,705	53,552	126,126
4	6,749	12,196	3,282	21,827	2,512	15,570	62,136
5	2,210	3,588	927	10,300	399	3,719	21,143
6	1,614	2,551	453	3,013	-	78	7,709
7	2,067	2,981	585	-	-	-	5,633
8	7,048	9,446	1,663	-	-	-	18,157
9	797	1,309	271	-	-	-	2,377
10	1,178	1,704	291	-	-	-	3,173
11	271	255	10	-	-	-	536
12+	150	162	10	-	-	-	322
Total	39,965	58,731	229,638	433,497	182,258	126,311	1,070,400
Tonnes	2,715	3,924	5,159	18,124	7,349	7,835	45,106

Table 9.14 Length (cm) at age by quarter and by sub-division of SARDINE in 1991.

1991 Age	VIIIc East 1'st Q length(cm)	VIIIc West 1'st Q length(cm)	IXa North 1'st Q length(cm)	IXa Centr-N 1'st Q length(cm)	IXa Centr-S 1'st Q length(cm)	IXa South 1'st Q length(cm)	All areas 1'st Q length(cm)
0	-	-	-	-	-	-	-
1	15.4	12.3	18.1	14.6	14.8	15.6	14.5
2	19.7	20.9	19.6	17.6	17.5	18.2	18.4
3	21.0	21.6	20.7	18.8	18.7	18.6	19.0
4	21.9	22.0	21.4	20.2	20.1	19.7	20.4
5	22.1	22.0	21.3	20.8	20.6	20.2	20.6
6	23.2	22.9	22.3	21.7	21.2	20.8	22.1
7	23.3	23.1	22.5	22.4	21.8	22.8	22.9
8	23.2	23.0	22.5	-	-	-	23.1
9	23.3	23.0	22.9	-	-	-	23.2
10	23.4	23.3	23.0	-	-	-	23.3
11	24.3	24.5	24.5	-	-	-	24.4
12+	22.8	22.8	22.8	-	-	-	22.8
0-12+	21.5	18.4	20.9	17.3	17.7	19.3	18.8

Age	VIIIc East 2'nd Q length(cm)	VIIIc West 2'nd Q length(cm)	IXa North 2'nd Q length(cm)	IXa Centr-N 2'nd Q length(cm)	IXa Centr-S 2'nd Q length(cm)	IXa South 2'nd Q length(cm)	All areas 2'nd Q length(cm)
0	-	-	-	-	-	-	-
1	15.9	12.4	11.9	13.2	14.4	16.1	12.8
2	19.7	20.5	19.6	18.5	18.5	17.2	18.1
3	20.8	21.0	20.6	19.5	19.0	18.3	19.0
4	21.8	21.4	21.2	20.3	20.4	19.2	20.5
5	22.0	21.4	21.1	20.7	21.0	20.0	20.9
6	23.2	22.2	22.0	21.7	23.2	-	22.0
7	23.2	22.4	22.2	-	-	-	22.8
8	23.2	22.3	22.3	-	-	-	22.8
9	23.2	23.0	23.0	-	-	-	23.1
10	23.5	22.9	23.2	-	-	-	23.3
11	24.4	24.3	25.1	-	-	-	24.4
12+	22.8	22.7	22.8	-	-	-	22.8
0-12+	21.4	17.2	12.9	17.3	17.9	17.7	16.7

Age	VIIIc East 3'rd Q length (cm)	VIIIc West 3'rd Q length (cm)	IXa North 3'rd Q length (cm)	IXa Centr-N 3'rd Q length (cm)	IXa Centr-S 3'rd Q length (cm)	IXa South 3'rd Q length (cm)	All areas 3'rd Q length(cm)
0	16.4	13.1	12.6	14.0	12.6	13.6	13.3
1	18.7	19.8	17.8	17.3	18.0	16.8	17.2
2	19.8	20.9	18.7	19.4	19.5	17.6	18.9
3	21.7	21.6	20.4	20.3	20.1	18.9	20.1
4	21.7	21.4	20.6	20.8	21.3	19.8	21.0
5	22.1	21.6	21.0	21.1	21.5	-	21.5
6	22.6	21.7	20.3	23.5	22.9	-	22.2
7	22.5	21.8	21.1	-	-	-	22.1
8	22.7	21.9	21.0	-	-	-	22.2
9	23.1	21.8	21.4	-	-	-	22.3
10	23.2	22.3	22.1	-	-	-	22.7
11	23.9	23.9	23.8	-	-	-	23.9
12+	23.3	23.3	23.3	-	-	-	23.3
0-12+	21.1	18.3	12.8	14.9	15.8	16.5	15.0

Age	VIIIc East 4'th Q length(cm)	VIIIc West 4'th Q length(cm)	IXa North 4'th Q length(cm)	IXa Centr-N 4'th Q length(cm)	IXa Centr-S 4'th Q length(cm)	IXa South 4'th Q length(cm)	All areas 4'th Q length(cm)
0	15.5	13.1	13.6	14.7	14.2	14.3	14.2
1	17.2	19.6	18.1	18.9	17.8	17.9	18.4
2	19.7	20.9	20.1	19.7	19.4	18.7	19.4
3	22.1	21.7	21.5	20.3	20.1	19.7	20.1
4	22.3	21.8	21.4	20.7	21.5	20.3	21.1
5	22.4	22.0	21.6	21.0	22.5	21.2	21.4
6	23.1	22.6	21.4	21.2	-	22.8	22.1
7	22.6	22.4	21.9	-	-	-	22.4
8	22.8	22.6	21.8	-	-	-	22.6
9	22.9	22.8	21.7	-	-	-	22.7
10	22.9	22.9	22.2	-	-	-	22.8
11	23.9	24.0	24.0	-	-	-	23.9
12+	23.3	23.3	23.3	-	-	-	23.3
0-12+	20.2	20.0	14.0	16.7	16.5	19.3	16.7

Table 9.15 Weight (g) at age by quarter and by sub-division of SARDINE in 1991.

1991 Age	VIIIc East 1'st Q weight(g)	VIIIc West 1'st Q weight(g)	IXa North 1'st Q weight(g)	IXa Centr-N 1'st Q weight(g)	IXa Centr-S 1'st Q weight(g)	IXa South 1'st Q weight(g)	All areas 1'st Q weight(g)
0	-	-	-	-	-	-	-
1	28	15	45	22	23	26	22
2	58	69	58	38	37	42	45
3	71	77	67	46	45	45	48
4	80	81	75	57	56	53	61
5	82	81	74	63	61	57	62
6	95	91	85	71	67	62	79
7	96	93	87	79	72	82	89
8	94	92	86	-	-	-	93
9	96	93	91	-	-	-	94
10	97	96	93	-	-	-	97
11	108	111	111	-	-	-	109
12+	90	90	90	-	-	-	90
0-12+	78	57	70	39	40	50	51

Age	VIIIc East 2'nd Q weight(g)	VIIIc West 2'nd Q weight(g)	IXa North 2'nd Q weight(g)	IXa Centr-N 2'nd Q weight(g)	IXa Centr-S 2'nd Q weight(g)	IXa South 2'nd Q weight(g)	All areas 2'nd Q weight(g)
0	-	-	-	-	-	-	-
1	34	15	13	18	23	32	17
2	69	78	67	50	50	39	48
3	83	85	79	59	54	48	55
4	95	90	87	67	68	57	73
5	92	90	86	71	74	64	75
6	118	102	99	83	102	-	92
7	118	105	102	-	-	-	111
8	117	103	103	-	-	-	111
9	118	114	114	-	-	-	116
10	123	113	117	-	-	-	119
11	138	136	152	-	-	-	138
12+	110	110	110	-	-	-	110
0-12+	93	55	20	45	47	44	42

Age	VIIIc East 3'rd Q weight (g)	VIIIc West 3'rd Q weight (g)	IXa North 3'rd Q weight (g)	IXa Centr-N 3'rd Q weight (g)	IXa Centr-S 3'rd Q weight (g)	IXa South 3'rd Q weight (g)	All areas 3'rd Q weight(g)
0	39	17	15	22	16	20	19
1	62	77	52	46	53	41	46
2	77	92	62	68	68	49	63
3	105	103	84	79	76	62	77
4	106	100	88	86	92	72	91
5	113	104	94	91	96	-	100
6	123	106	83	129	119	-	114
7	119	107	96	-	-	-	112
8	124	109	94	-	-	-	115
9	132	108	100	-	-	-	117
10	133	117	112	-	-	-	124
11	148	148	145	-	-	-	148
12+	135	135	135	-	-	-	135
0-12+	98	69	17	31	41	41	33

Age	VIIIc East 4'th Q weight(g)	VIIIc West 4'th Q weight(g)	IXa North 4'th Q weight(g)	IXa Centr-N 4'th Q weight(g)	IXa Centr-S 4'th Q weight(g)	IXa South 4'th Q weight(g)	All areas 4'th Q weight(g)
0	28	17	19	25	22	22	22
1	39	57	45	58	47	47	52
2	58	69	62	66	63	55	62
3	83	78	75	73	72	66	70
4	85	79	75	78	89	73	78
5	85	81	77	82	104	84	83
6	94	88	74	84	-	107	87
7	88	85	80	-	-	-	86
8	91	87	79	-	-	-	88
9	92	90	78	-	-	-	89
10	92	92	83	-	-	-	91
11	104	105	106	-	-	-	104
12+	96	96	96	-	-	-	96
0-12+	67	66	22	42	40	62	42

Table 9.16

9:06 Wednesday, June

Sardine in Fishing Areas VIIIc and IXa

Mean Weight of Catch (Kilograms)

(WECA)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1977	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1978	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1979	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1980	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1981	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1982	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1983	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1984	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1985	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1986	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1987	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1988	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1989	0.013	0.035	0.052	0.059	0.066	0.071	0.087	0.093
1990	0.024	0.032	0.047	0.057	0.061	0.067	0.070	0.096
1991	0.020	0.031	0.058	0.063	0.073	0.074	0.087	0.097

Table 9.17

8:00 Thursday, June

Sardine in Fishing Areas VIIIc and IXa

Mean Weight of Stock (Kilograms)

(WEST)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1977	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1978	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1979	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1980	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1981	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1982	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1983	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1984	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1985	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1986	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1987	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1988	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1989	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1990	-1.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1991	-1.000	0.019	0.042	0.050	0.064	0.071	0.076	0.088

Table 9.18

9:06 Wednesday, June 24,

Sardine in Fishing Areas VIIIc and IXa

Proportion Mature at Year Start

(MATPROP)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1977	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1978	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1979	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1980	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1981	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1982	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1983	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1984	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1985	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1986	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1987	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1988	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1989	0.00	0.23	0.83	0.91	0.92	0.94	0.97	1.00
1990	0.00	0.60	0.81	0.88	0.89	0.94	0.97	1.00
1991	0.00	0.74	0.91	0.96	0.97	1.00	1.00	1.00

Table 9.19

9:06 Wednesday, June 24,

Sardine in Fishing Areas VIIIc and IXa

Catch in Numbers (Millions)

(CANUM)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	420	1871	1426	252	71	12	3	0
1977	844	2421	954	110	22	3	1	0
1978	854	2145	913	281	127	40	16	0
1979	643	1479	935	423	187	93	36	0
1980	842	1997	1542	372	155	47	30	0
1981	1021	1920	1720	666	192	102	76	0
1982	60	769	1854	701	350	130	129	0
1983	1061	553	838	795	322	140	139	0
1984	109	3289	470	488	295	176	116	0
1985	258	527	2343	457	290	197	101	0
1986	238	702	987	903	322	194	166	0
1987	1401	512	615	520	521	147	170	0
1988	439	979	525	428	303	291	189	0
1989	244	512	895	381	215	198	183	61
1990	234	562	488	680	275	142	104	142
1991	1574	456	404	380	256	72	26	79

Table 9.20

```
Sardine in Fishing Areas VIIIc and IXa (run name: SARVPA1)
105
       Spanish Purse Seine (Vigo & Riveira) (Catch: Millions)
1982 1991
1 1                                                    Fleet 1
1 6
   7685   137   254   159    98    23    18
   7867   107   133   146    58    18     9
   8369   657    91   107    81    24    10
   5731    39   444    71    75    60    23
   3541    26    31   100    20    27    15
   4099    22    29    20    49     8    12
   3601    89    22    17    13    32    15
   3059    25    72    18    11     7    15
   3488    56    28    50    12     7    11
   3279    50     6     3     7     2     4
       Spanish Acoustic surveys - Spring (Catch: Millions)
1986 1991                                              Fleet 2
1 1
1 7
   1     55     21   1040    215    409    279    192
   1    632    257     27   2390    586    481    528
   1    221     63     72     64    858    175    310
   1     47    192     54     66     38    547     73
   1     69     56    274     55     88    134    249
   1     25    150    126    314     51     79     56
       Portugal Purse Seine Fleet (Catch: Millions)
1988 1991                                              Fleet 3
1 1
1 6
   22080   640   411   271   192    61    21
   21432   444   653   288   153   129    23
   25740   431   398   470   213    97    67
   20872   255   299   290   145    44    11
       Spain Purse Seine Fleet (Sada) (Catch: Millions)
1989 1991                                              Fleet 4
1 1
1 6
   7831    2   25   12   10   13   34
   5359    2    5   23    7    6   23
   2681    2    3    2    8    2    9
       Spain Purse Seine Fleet (Santona) (Catch: Millions)
1989 1991                                              Fleet 5
1 1
3 5
   1289   3   2   2
   1420   3   1   1
   1235   1   4   1
```

Table 9.21a SARDINE. Tuning analysis (Option A)

VPA Version 3.0 (MSDOS) - Jan 1991
Sardine in Fishing Areas VIIIc and IXa (run name: SARVPA1)
with cpue data from file J:\IFAPWORK\WG_201\SARDINE\FLEET.SA1
Disaggregated Qs
Log transformation
The final F is the (reciprocal variance-weighted) mean of the raised fleet F'
No trend in Q (mean used)

Terminal Fs estimated using Laurec-Shepherd method
Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
Oldest age F = 1.000*average of 3 younger ages.

Fishing mortalities

Age,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1,	.101,	.090,	.287,	.102,	.208,	.161,	.207,	.251,	.273,	.246
2,	.307,	.176,	.118,	.398,	.327,	.329,	.285,	.345,	.472,	.374
3,	.246,	.242,	.170,	.186,	.305,	.333,	.470,	.404,	.566,	1.024
4,	.192,	.197,	.152,	.166,	.223,	.337,	.385,	.543,	.684,	.509
5,	.109,	.126,	.181,	.166,	.184,	.173,	.372,	.553,	1.058,	.444
6,	.183,	.188,	.168,	.173,	.237,	.281,	.409,	.500,	.770,	.662

Log catchability residuals

Fleet 1

Age,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	.38,	.44,	-.69,	.96,	.46,	.71,	-.42,	-.15,	-.82,	-.87
2 ,	-.21,	.23,	.49,	-1.08,	.43,	.16,	.29,	-.71,	-.56,	.96
3 ,	-.28,	-.02,	.22,	.09,	-.55,	.57,	.06,	-.12,	-.77,	.80
4 ,	-.17,	.27,	.17,	-.23,	.42,	-.26,	.26,	-.42,	-.37,	.33
5 ,	.68,	.88,	.52,	-.57,	-.37,	.77,	-.83,	-.25,	-1.10,	.27

Fleet 2

Age,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	,	,	,	,	.74,	-1.76,	-.32,	.39,	.02,	.92
2 ,	,	,	,	,	2.00,	-.98,	.40,	-.37,	-.05,	-1.00
3 ,	,	,	,	,	-1.13,	1.88,	.36,	.69,	-.70,	-1.10
4 ,	,	,	,	,	.53,	-1.81,	1.14,	.42,	.62,	-.90
5 ,	,	,	,	,	.11,	-.47,	-.93,	1.40,	-.42,	.31

Fleet 3

Age,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	,	,	,	,	,	,	.22,	-.29,	-.07,	.14
2 ,	,	,	,	,	,	,	.20,	.05,	-.19,	-.07
3 ,	,	,	,	,	,	,	.30,	.25,	.18,	-.73
4 ,	,	,	,	,	,	,	.33,	-.15,	-.29,	.11
5 ,	,	,	,	,	,	,	1.23,	-.32,	-.84,	-.07

Fleet 4

Age,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	,	,	,	,	,	,	,	.51,	.14,	-.66
2 ,	,	,	,	,	,	,	,	-.16,	.15,	.01
3 ,	,	,	,	,	,	,	,	.34,	-.45,	.12
4 ,	,	,	,	,	,	,	,	.21,	.20,	-.41
5 ,	,	,	,	,	,	,	,	.19,	-.39,	.20

Table 9.21a (Cont'd)

Fleet 5

Age,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
3								-.15,	.19,	-.03
4								-.10,	.70,	-.60
5								.11,	-.08,	-.03

SUMMARY STATISTICS FOR AGE 1

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-19.49	.706	.0000	.1029	.000E+00	.000E+00	-19.487	.213
2	-10.29	1.054	.0000	.6224	.000E+00	.000E+00	-10.286	.398
3	-18.69	.253	.0002	.2840	.000E+00	.000E+00	-18.694	.113
4	-22.29	.691	.0000	.1279	.000E+00	.000E+00	-22.287	.346
5	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.246	.220	.238	.238	1.171

SUMMARY STATISTICS FOR AGE 2

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-19.23	.658	.0000	.9826	.000E+00	.000E+00	-19.230	.198
2	-9.88	1.209	.0001	.1382	.000E+00	.000E+00	-9.878	.457
3	-18.21	.187	.0003	.3496	.000E+00	.000E+00	-18.206	.084
4	-20.68	.180	.0000	.3786	.000E+00	.000E+00	-20.676	.090
5	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.374	.127	.126	.127	.989

SUMMARY STATISTICS FOR AGE 3

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-19.02	.496	.0000	2.2921	.000E+00	.000E+00	-19.015	.149
2	-9.08	1.289	.0001	.3424	.000E+00	.000E+00	-9.083	.487
3	-17.82	.544	.0004	.4980	.000E+00	.000E+00	-17.821	.243
4	-19.90	.470	.0000	1.1575	.000E+00	.000E+00	-19.902	.235
5	-19.97	.198	.0000	.9947	.000E+00	.000E+00	-19.972	.099

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.024	.162	.185	.185	1.302

SUMMARY STATISTICS FOR AGE 4

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-18.94	.335	.0000	.7118	.000E+00	.000E+00	-18.942	.101
2	-8.28	1.204	.0003	.2069	.000E+00	.000E+00	-8.279	.455
3	-17.99	.310	.0003	.5687	.000E+00	.000E+00	-17.987	.139
4	-19.35	.405	.0000	.3401	.000E+00	.000E+00	-19.346	.203
5	-19.46	.759	.0000	.2796	.000E+00	.000E+00	-19.460	.380

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.509	.190	.172	.190	.825

SUMMARY STATISTICS FOR AGE 5

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
1	-19.12	.751	.0000	.5867	.000E+00	.000E+00	-19.120	.226
2	-7.75	.883	.0004	.6093	.000E+00	.000E+00	-7.748	.334
3	-18.23	.987	.0003	.4152	.000E+00	.000E+00	-18.225	.441
4	-18.99	.392	.0000	.5441	.000E+00	.000E+00	-18.994	.196

Table 9.21a (Cont'd)

```
5  ,-19.14   ,   .115, .0000 , .4315,    .000E+00,    .000E+00,-19.144,    .058
Fbar       SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
   .444        .108            .419E-01        .108              .150
```

Table 9.21b (Option A)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARVPA1) At 27/06/1992
Traditional vpa Terminal Fs estimated using Laurec-Shepherd method

Table 8 Fishing mortality (F) at age

YEAR	1976	1977	1978	1979	1980	1981
AGE						
1	.2863	.2995	.2588	.1553	.2091	.1802
2	.5500	.2682	.2029	.1978	.2783	.3253
3	.2848	.0830	.1352	.1568	.1292	.2145
4	.2457	.0411	.1494	.1439	.0907	.1044
5	.3310	.0166	.1120	.1791	.0558	.0909
6	.2872	.0469	.1322	.1603	.0924	.1377
+gp	.2872	.0469	.1322	.1603	.0924	.1377
FBAR 2- 5	.3529	.1022	.1499	.1694	.1385	.1838

Table 8 Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
1	.1014	.0903	.2871	.1022	.2075	.1608	.2071	.2505	.2723	.2455
2	.3069	.1761	.1184	.3983	.3267	.3286	.2849	.3446	.4702	.3740
3	.2465	.2416	.1696	.1859	.3051	.3328	.4703	.4030	.5659	1.0240
4	.1924	.1970	.1525	.1658	.2231	.3369	.3850	.5426	.6823	.5094
5	.1094	.1259	.1811	.1660	.1836	.1731	.3725	.5533	1.0584	.4441
6	.1827	.1882	.1677	.1725	.2373	.2809	.4093	.4999	.7697	.6621
+gp	.1827	.1882	.1677	.1725	.2373	.2809	.4093	.4999	.7697	.6621
FBAR 2- 5	.2138	.1851	.1554	.2290	.2596	.2929	.3782	.4609	.6942	.5879

Table 9.22a SARDINE. Tuning Analysis (Option B)

VPA Version 3.0 (MSDOS) - Jan 1991
Sardine in Fishing Areas VIIIc and IXa (run name: SARVPA2)
with cpue data from file J:\IFAPWORK\WG_201\SARDINE\FLEET.SA2
Disaggregated Qs
Log transformation
The final F is the (reciprocal variance-weighted) mean of the raised fleet F'
No trend in Q (mean used)

Terminal Fs estimated using Laurec-Shepherd method
Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
Oldest age F = 1.000*average of 3 younger ages.

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991
1,	.200,	.155,	.161,	.205,	.221,	.231
2,	.312,	.314,	.272,	.250,	.358,	.278
3,	.294,	.313,	.439,	.378,	.357,	.597
4,	.213,	.320,	.353,	.486,	.612,	.251
5,	.175,	.164,	.347,	.484,	.842,	.362
6,	.227,	.266,	.380,	.449,	.603,	.416

Log catchability residuals

Fleet 2

Age,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	.65,	-1.85,	-.19,	.46,	.10,	.84
2 ,	1.87,	-1.11,	.28,	-.22,	.05,	-.89
3 ,	-1.29,	1.74,	.23,	.55,	-.44,	-.80
4 ,	.40,	-1.94,	1.04,	.35,	.55,	-.39
5 ,	.03,	-.53,	-.98,	1.42,	-.31,	.38

Fleet 3

Age,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	,	,	.29,	-.27,	-.03,	.01
2 ,	,	,	.02,	.14,	-.14,	-.02
3 ,	,	,	.09,	.04,	.37,	-.50
4 ,	,	,	.17,	-.29,	-.43,	.55
5 ,	,	,	1.15,	-.35,	-.76,	-.04

Fleet 4

Age,	1986,	1987,	1988,	1989,	1990,	1991
1 ,	,	,	,	.56,	.20,	-.76
2 ,	,	,	,	-.13,	.13,	.00
3 ,	,	,	,	.06,	-.34,	.28
4 ,	,	,	,	.01,	.00,	-.02
5 ,	,	,	,	.15,	-.35,	.20

Fleet 5

Age,	1986,	1987,	1988,	1989,	1990,	1991
1,	No data for this fleet at this age					
2,	No data for this fleet at this age					
3 ,	,	,	,	-.43,	.30,	.12
4 ,	,	,	,	-.30,	.51,	-.21
5 ,	,	,	,	.06,	-.03,	-.03

Table 9.22a (Cont'd)

SUMMARY STATISTICS FOR AGE 1

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
2	-10.42	1.061	.0000	.5458	.000E+00	.000E+00	-10.417	.401
3	-18.87	.255	.0001	.2376	.000E+00	.000E+00	-18.872	.114
4	-22.44	.790	.0000	.1097	.000E+00	.000E+00	-22.441	.395
5	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.231	.236	.209	.236	.779

SUMMARY STATISTICS FOR AGE 2

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
2	-10.05	1.149	.0000	.1167	.000E+00	.000E+00	-10.047	.434
3	-18.44	.132	.0002	.2775	.000E+00	.000E+00	-18.437	.059
4	-20.97	.154	.0000	.2827	.000E+00	.000E+00	-20.968	.077
5	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.278	.997E-01	.539E-01	.997E-01	.292

SUMMARY STATISTICS FOR AGE 3

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
2	-9.28	1.173	.0001	.2803	.000E+00	.000E+00	-9.284	.443
3	-18.10	.404	.0003	.3781	.000E+00	.000E+00	-18.097	.181
4	-20.25	.358	.0000	.8201	.000E+00	.000E+00	-20.247	.179
5	-20.32	.441	.0000	.7047	.000E+00	.000E+00	-20.317	.221

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.597	.225	.210	.225	.873

SUMMARY STATISTICS FOR AGE 4

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
2	-8.46	1.141	.0002	.1722	.000E+00	.000E+00	-8.463	.431
3	-18.24	.501	.0003	.4426	.000E+00	.000E+00	-18.238	.224
4	-19.65	.015	.0000	.2505	.000E+00	.000E+00	-19.652	.007
5	-19.77	.511	.0000	.2060	.000E+00	.000E+00	-19.765	.256

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.251	.149E-01	.107E-01	.149E-01	.515

SUMMARY STATISTICS FOR AGE 5

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcp
2	-7.87	.903	.0004	.5400	.000E+00	.000E+00	-7.869	.341
3	-18.38	.919	.0002	.3553	.000E+00	.000E+00	-18.381	.411
4	-19.18	.349	.0000	.4527	.000E+00	.000E+00	-19.178	.174
5	-19.33	.063	.0000	.3590	.000E+00	.000E+00	-19.328	.031

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.362	.613E-01	.280E-01	.613E-01	.208

Table 9.22b (Option B)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARVPA2) At 27/06/1992
Traditional vpa Terminal Fs estimated using Laurec-Shepherd method

Table 8 Fishing mortality (F) at age

YEAR	1976	1977	1978	1979	1980	1981
AGE						
1	.2834	.2972	.2566	.1539	.2071	.1776
2	.5447	.2646	.2009	.1956	.2751	.3214
3	.2812	.0819	.1330	.1550	.1276	.2114
4	.2426	.0405	.1472	.1412	.0895	.1029
5	.3272	.0164	.1102	.1761	.0546	.0896
6	.2837	.0463	.1302	.1574	.0906	.1346
+gp	.2837	.0463	.1302	.1574	.0906	.1346
FBAR 2- 5	.3489	.1009	.1478	.1670	.1367	.1813

Table 8 Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
1	.0990	.0876	.2817	.0986	.2002	.1541	.1598	.2014	.2175	.2311
2	.3013	.1713	.1145	.3879	.3124	.3136	.2703	.2482	.3490	.2778
3	.2425	.2358	.1642	.1789	.2940	.3129	.4391	.3745	.3522	.5966
4	.1890	.1931	.1480	.1596	.2129	.3203	.3530	.4857	.6038	.2506
5	.1076	.1233	.1768	.1603	.1755	.1636	.3469	.4837	.8416	.3623
6	.1797	.1847	.1637	.1677	.2275	.2656	.3797	.4490	.6033	.4156
+gp	.1797	.1847	.1637	.1677	.2275	.2656	.3797	.4490	.6033	.4156
FBAR 2- 5	.2101	.1809	.1509	.2217	.2487	.2776	.3523	.3980	.5366	.3718

Table 9.23a Separable exploitation pattern and log catch residuals (Option A)

Title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 19:09

Separable analysis
from 1976 to 1991 on ages 0 to 6
with Terminal F of .374 on age 2 and Terminal S of 1.000

Initial sum of squared residuals was 83.438 and
final sum of squared residuals is 34.837 after 150 iterations

Matrix of Residuals

Years	1976/77	1977/78	1978/79	1979/80	1980/81
Ages					
0/ 1	-2.944	.024	-.075	-1.120	-.403
1/ 2	-1.078	1.451	.799	-.530	.083
2/ 3	.525	1.480	.501	.197	.549
3/ 4	.119	-.113	-.099	.037	.136
4/ 5	.744	-.671	-.294	.310	-.211
5/ 6	.263	-1.590	-.334	.229	-.949
	.001	.001	.001	.000	.000
WTS	.001	.001	.001	.001	.001

Years	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91		WTS
Ages												
0/ 1	.643	-1.874	-.918	-1.069	-.408	-.354	.838	.256	-.178	-.554	.000	.109
1/ 2	-.094	-.227	-.107	.365	-.526	.042	-.056	-.022	.160	-.123	.000	.181
2/ 3	.543	.481	.049	-.165	.829	.315	.090	-.041	.120	-.489	.000	.227
3/ 4	.053	.177	.265	.096	-.008	-.014	.028	.083	-.073	-.024	.000	1.000
4/ 5	-.305	.210	-.230	-.127	-.058	.120	-.027	-.275	-.069	.253	.000	.314
5/ 6	-.767	-.610	-.484	.184	-.128	-.367	-.694	-.066	.333	.797	.000	.174
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-7.168	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1976	1977	1978	1979	1980	1981
F-values	.5587	.1223	.2203	.2513	.1775	.1868

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
F-values	.1851	.1808	.1530	.1740	.2197	.2343	.2711	.2967	.4361	.3740

Selection-at-age (S)

	0	1	2	3	4	5	6
S-values	.3150	.6942	1.0000	1.2064	1.1712	1.0064	1.0000

Table 9.23b (Option A)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 20:10
Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1976	1977	1978	1979	1980	1981
AGE						
0	.0393	.0743	.0599	.0414	.0496	.0864
1	.3728	.3831	.3157	.1605	.2006	.1752
2	.7204	.3861	.2818	.2555	.2898	.3084
3	.5225	.1222	.2156	.2357	.1761	.2260
4	.5887	.0881	.2334	.2517	.1460	.1489
5	.6174	.0490	.2637	.3110	.1059	.1553
6	.5525	.1058	.4595	.4710	.1794	.2876
+gp	.5525	.1058	.4595	.4710	.1794	.2876
FBAR 2- 5	.6123	.1614	.2486	.2635	.1794	.2097

Table 8 Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
0	.0067	.0523	.0128	.0431	.0458	.1669	.0991	.0759	.0962	.1177
1	.0993	.0898	.2616	.0905	.1815	.1506	.1940	.1846	.2892	.3174
2	.2963	.1718	.1177	.3504	.2816	.2768	.2628	.3166	.3117	.4069
3	.2297	.2307	.1647	.1846	.2556	.2724	.3682	.3604	.4971	.5010
4	.2052	.1806	.1442	.1602	.2213	.2661	.2925	.3724	.5677	.4125
5	.1638	.1358	.1632	.1555	.1763	.1714	.2703	.3685	.5324	.3286
6	.3481	.3062	.1832	.1526	.2192	.2671	.4038	.3162	.3936	.1992
+gp	.3481	.3062	.1832	.1526	.2192	.2671	.4038	.3162	.3936	.1992
FBAR 2- 5	.2238	.1797	.1474	.2127	.2337	.2467	.2984	.3545	.4772	.4123

Table 9.23c (Option A)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 20:10
Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1976	1977	1978	1979	1980	1981
AGE						
0	1278636	1381616	1721863	1859557	2039936	1444996
1	698757	883830	922183	1165924	1282669	1395585
2	319780	346028	433184	483484	713922	754506
3	71673	111858	169088	234955	269218	384128
4	18436	30557	71164	97983	133441	162299
5	3008	7356	20116	40510	54767	82903
6	817	1166	5036	11110	21340	35417
+gp	0	0	0	0	0	0
TOTAL	2391106	2762411	3342633	3893522	4515292	4259835

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE											
0	1055799	2441153	1005061	717675	623545	1065465	545037	391136	298841	1658887	0
1	952868	753975	1665576	713365	494202	428218	648274	354886	260645	195145	1060187
2	842036	620307	495489	921791	468484	296335	264818	383864	212138	140321	102138
3	398472	450133	375554	316676	466817	254134	161524	146388	201077	111670	67157
4	220291	227673	256931	228990	189287	259918	139138	80359	73398	87934	48643
5	100541	128996	136635	159912	140256	109068	143205	74658	39808	29911	41852
6	51028	61358	80965	83441	98408	84537	66062	78572	37128	16806	15481
+gp	0	0	0	0	0	0	0	26191	50694	51063	39978
TOTAL	3621035	4683596	4016212	3141850	2480998	2497675	1968058	1536054	1173730	2291739	1375435

Table 9.23d (Option A)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 20:10

Table 17 Summary (with SOP correction)
Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS	TOTALBIO	EXPLTBIO	TOTSPBIO	LANDINGS	SOPCOFAC	FBAR 2- 5
1976	12786360	236179	231422	159124	141690	.8538	.6123
1977	13816161	280834	779325	202794	125750	.8131	.1614
1978	17218626	383213	563052	288309	139990	.8507	.2486
1979	18595572	560002	582376	426632	153441	.9744	.2635
1980	20399358	703041	1068258	545871	191682	.9536	.1794
1981	14449961	786256	1021357	614794	214133	.8981	.2097
1982	10557986	891272	913967	717759	204504	.9786	.2238
1983	24411526	904824	1007915	747445	181149	1.0589	.1797
1984	10050607	915976	1374737	725516	202686	.9684	.1474
1985	7176748	894329	959700	732040	204107	.9563	.2127
1986	6235453	770780	772836	638947	180606	.9902	.2337
1987	10654645	628316	684037	518575	168735	1.0298	.2467
1988	5450366	544402	531241	430543	158540	1.0554	.2984
1989	3911357	449084	386834	312934	137126	.9798	.3545
1990	2988413	385261	291613	274537	139157	1.0503	.4772
1991	16588872	288941	309895	226870	127756	1.0065	.4123
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 9.24a Separable exploitation pattern and log catch residuals (Option B)

Title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 20:02

Separable analysis
from 1976 to 1991 on ages 0 to 6
with Terminal F of .278 on age 2 and Terminal S of 1.000

Initial sum of squared residuals was 77.489 and
final sum of squared residuals is 34.512 after 150 iterations

Matrix of Residuals

Years	1976/77	1977/78	1978/79	1979/80	1980/81
Ages					
0/ 1	-2.921	.048	-.052	-1.098	-.383
1/ 2	-1.068	1.461	.809	-.521	.091
2/ 3	.523	1.481	.501	.196	.547
3/ 4	.114	-.116	-.102	.032	.131
4/ 5	.743	-.670	-.293	.310	-.212
5/ 6	.266	-1.585	-.330	.232	-.946
	.001	.001	.001	.000	.000
WTS	.001	.001	.001	.001	.001

Years	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91		WTS
Ages												
0/ 1	.664	-1.854	-.900	-1.051	-.390	-.339	.849	.261	-.183	-.580	.000	.108
1/ 2	-.086	-.220	-.101	.372	-.518	.048	-.052	-.021	.158	-.134	.000	.178
2/ 3	.542	.479	.047	-.166	.828	.315	.089	-.042	.122	-.488	.000	.224
3/ 4	.049	.172	.259	.092	-.011	-.017	.025	.081	-.071	-.019	.000	1.000
4/ 5	-.306	.209	-.232	-.128	-.059	.120	-.028	-.276	-.069	.254	.000	.309
5/ 6	-.764	-.609	-.483	.186	-.125	-.364	-.693	-.066	.333	.794	.000	.172
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-6.909	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1976	1977	1978	1979	1980	1981
F-values	.5567	.1215	.2186	.2488	.1751	.1834

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
F-values	.1807	.1752	.1470	.1656	.2066	.2166	.2444	.2580	.3567	.2780

Selection-at-age (S)

	0	1	2	3	4	5	6
S-values	.3050	.6875	1.0000	1.2066	1.1669	1.0025	1.0000

Table 9.24b (Option B)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 20:03
Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1976	1977	1978	1979	1980	1981
AGE						
0	.0391	.0736	.0591	.0408	.0486	.0837
1	.3710	.3805	.3125	.1582	.1972	.1713
2	.7169	.3834	.2791	.2521	.2847	.3017
3	.5204	.1214	.2136	.2329	.1732	.2209
4	.5855	.0876	.2314	.2488	.1438	.1460
5	.6137	.0486	.2619	.3074	.1044	.1526
6	.5506	.1049	.4550	.4665	.1768	.2828
+gp	.5506	.1049	.4550	.4665	.1768	.2828
FBAR 2- 5	.6091	.1602	.2465	.2603	.1765	.2053

Table 8 Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
0	.0064	.0508	.0122	.0407	.0424	.1519	.0860	.0635	.0756	.0847
1	.0959	.0864	.2527	.0860	.1702	.1385	.1736	.1571	.2347	.2383
2	.2880	.1653	.1127	.3343	.2649	.2556	.2373	.2749	.2549	.3066
3	.2232	.2224	.1574	.1756	.2400	.2515	.3303	.3144	.4052	.3760
4	.1995	.1743	.1379	.1518	.2082	.2455	.2635	.3196	.4611	.3043
5	.1602	.1313	.1565	.1478	.1655	.1592	.2436	.3197	.4231	.2416
6	.3406	.2975	.1762	.1453	.2062	.2470	.3666	.2758	.3219	.1452
+gp	.3406	.2975	.1762	.1453	.2062	.2470	.3666	.2758	.3219	.1452
FBAR 2- 5	.2177	.1733	.1411	.2024	.2197	.2279	.2687	.3072	.3861	.3071

Table 9.24c (Option B)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 20:03
Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1976	1977	1978	1979	1980	1981
AGE						
0	1285644	1392845	1743242	1887769	2080694	1488812
1	701556	888868	930254	1181293	1302950	1424885
2	320876	348033	436792	489271	724963	769071
3	71903	112635	170524	237543	273371	392048
4	18514	30722	71722	99014	135299	165283
5	3021	7412	20234	40911	55506	84238
6	820	1176	5076	11195	21628	35949
+gp	0	0	0	0	0	0
TOTAL	2402333	2781689	3377844	3946995	4594411	4360287

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE											
0	1095892	2513541	1055087	759504	672140	1162466	623927	464448	376313	2269260	0
1	984361	782799	1717614	749330	524273	463152	717963	411589	313343	250830	1498878
2	863083	642943	516207	959135	494334	317935	289919	433919	252871	178138	142089
3	408917	465230	391815	331565	493579	272681	177023	164403	236977	140891	94252
4	225978	235172	267769	240672	199982	279126	152447	91465	86310	113604	69543
5	102684	133079	142021	167700	148649	116747	156989	84206	47767	39128	60243
6	51987	62898	83900	87311	104003	90566	71579	88464	43971	22492	22093
+gp	0	0	0	0	0	0	0	29488	60037	68343	56476
TOTAL	3732903	4835663	4174414	3295217	2636960	2702675	2189847	1767983	1417589	3082686	1943575

Table 9.24d (Option B)

Run title : Sardine in Fishing Areas VIIIc and IXa (run name: SARSVP) At 27/06/1992 20:03

Table 17 Summary (with SOP correction)
Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS	TOTALBIO	EXPLTBIO	TOTSPBIO	LANDINGS	SOPCOFAC	FBAR 2- 5
1976	12856442	237043	232623	159809	141690	.8538	.6091
1977	13928448	282506	784718	204119	125750	.8131	.1602
1978	17432424	386417	567877	290892	139990	.8507	.2465
1979	18877694	566622	589519	431931	153441	.9744	.2603
1980	20806940	713747	1085803	554650	191682	.9536	.1765
1981	14888118	801625	1042944	627510	214133	.8981	.2053
1982	10958920	914539	939368	737433	204504	.9786	.2177
1983	25135412	935771	1045085	774129	181149	1.0589	.1733
1984	10550874	951490	1436238	755506	202686	.9684	.1411
1985	7595038	935239	1008493	767599	204107	.9563	.2024
1986	6721403	814946	822206	677915	180606	.9902	.2197
1987	11624660	674579	740267	559261	168735	1.0298	.2279
1988	6239273	597017	590067	475293	158540	1.0554	.2687
1989	4644479	508548	446433	357449	137126	.9798	.3072
1990	3763129	457067	360422	332147	139157	1.0503	.3861
1991	22692598	373059	415966	300139	127756	1.0065	.3071
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 9.25a Input data for RCT3 Analysis

```
SARDINE IN DIVISIONS VIIIc IXa (0 GROUP DATA)
3 8 2
'YEAR' 'VPA' 'PIXcnS' 'SPmS' 'GpsQ2'
1984,10551,56,-11,227
1985,7595,1004,55,162
1986,6721,1445,632,85
1987,11625,1781,221,259
1988,6239,-11,-11,210
1989,4644,-11,69,139
1990,-11,-11,25,109
1991,-11,4638,159,131
```

PIXcnS = Portuguese acoustic survey.

SPnS = Spanish March Survey, acoustic.

GpsQ2 = Spanish purse seiners.

Table 9.25b

Analysis by RCT3 ver3.1 of data from file : SARRCT3

SARRCT3

SARDINE IN DIVISIONS VIIIc IXa (0 GROUP DATA)

Data for 3 surveys over 8 years : 1984 - 1991

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1989

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
PIXcnS									
SPmS	-1.29	15.78	2.19	.032	3	4.25	10.31	4.973	.003
GpsQ2	1.19	2.77	.50	.314	5	4.94	8.66	.734	.138
					VPA Mean =		8.94	.294	.859

Yearclass = 1990

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
PIXcnS									
SPmS	1.21	2.72	1.58	.094	4	3.26	6.65	3.255	.012
GpsQ2	1.71	.03	.65	.300	6	4.70	8.08	.948	.137
					VPA Mean =		8.83	.380	.851

Yearclass = 1991

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
PIXcnS	-.42	11.75	.77	.151	4	8.44	8.19	1.496	.051
SPmS	1.20	2.76	1.57	.097	4	5.08	8.84	2.521	.018
GpsQ2	1.72	-.01	.66	.299	6	4.88	8.39	.906	.140
					VPA Mean =		8.82	.382	.790

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	7377	8.91	.27	.09	.10	3911	8.27
1990	5997	8.70	.35	.24	.47		
1991	6190	8.73	.34	.11	.11		

Table 9.26 Input data for the prediction program

Sardine in Fishing Areas VIIIc and IXa

Prediction run OPTIONAGP5: Initial stock size and Recruitment (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1992	12551	4288	2413	672	486	419	155	400
1993	12551	.	.	.	.	.	.	.
1994	.	.	.	.	.	.	.	.

Sardine in Fishing Areas VIIIc and IXa

Prediction run SARDINEOPTAGP6: Natural mortality

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33

Sardine in Fishing Areas VIIIc and IXa

Prediction run SARDINEOPTAGP6: Weight in stock (Kilograms)

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
0	0.017	0.04	0.05	0.064	0.069	0.078	0.087

Sardine in Fishing Areas VIIIc and IXa

Prediction run SARDINEOPTAGP6: Maturity ogive

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
0	0.67	0.86	0.92	0.92	0.97	0.99	1

Sardine in Fishing Areas VIIIc and IXa

Prediction run SARDINEOPTAGP6: Exploitation pattern

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
0.1177	0.3174	0.4123	0.4123	0.4123	0.4123	0.4123	0.4123

Sardine in Fishing Areas VIIIc and IXa

Prediction run SARDINEOPTAGP6: Weight in catch (Kilograms)

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
0.022	0.032	0.053	0.06	0.067	0.071	0.079	0.097

Table 9.27

Sardine in Fishing Areas VIIIc and IXa

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass

F factor 1992	Reference F 1992	Stock biomass 1992	Sp.stock biomass 1992	Catch weight 1992	F factor 1993	Reference F 1993	Stock biomass 1993	Sp.stock biomass 1993	Catch weight 1993	Stock biomass 1994	Sp.stock biomass 1994
1.0000	0.4123	309921	222077	140207	0.0000	0.0000	358545	270820	0	575429	443119
.	.	.	.	.	0.1000	0.0412	.	268241	18789	558698	425422
.	.	.	.	.	0.2000	0.0825	.	265686	36994	542525	408489
.	.	.	.	.	0.3000	0.1237	.	263157	54636	526891	392285
.	.	.	.	.	0.4000	0.1649	.	260651	71735	511776	376779
.	.	.	.	.	0.5000	0.2061	.	258170	88308	497163	361937
.	.	.	.	.	0.6000	0.2474	.	255713	104375	483032	347732
.	.	.	.	.	0.7000	0.2886	.	253279	119953	469367	334133
.	.	.	.	.	0.8000	0.3298	.	250869	135058	456151	321114
.	.	.	.	.	0.9000	0.3711	.	248482	149706	443370	308648
.	.	.	.	.	1.0000	0.4123	.	246118	163914	431006	296712
.	.	.	.	.	1.1000	0.4535	.	243777	177697	419046	285281
.	.	.	.	.	1.2000	0.4948	.	241458	191068	407475	274334
.	.	.	.	.	1.3000	0.5360	.	239162	204042	396280	263847
.	.	.	.	.	1.4000	0.5772	.	236888	216633	385447	253801
.	.	.	.	.	1.5000	0.6185	.	234636	228853	374964	244177
.	.	.	.	.	1.6000	0.6597	.	232405	240715	364818	234955
.	.	.	.	.	1.7000	0.7009	.	230196	252231	354999	226118
.	.	.	.	.	1.8000	0.7421	.	228008	263413	345493	217649
.	.	.	.	.	1.9000	0.7834	.	225842	274272	336291	209531
.	.	.	.	.	2.0000	0.8246	.	223696	284818	327381	201749

Run name : SARDINEAOPTION
Computation of ref. F: Unweighted mean of age 2 - 5
Unit of measurement : Tonnes

Table 10.1. Length distribution ('000) of Bay of Biscay ANCHOVY by country, gear and divisions in 1991.

Length (cm)	SEMESTER 1 FRANCE P.trawl VIIIb	SPAIN Seine VIIIb	SPAIN Seine VIIIc	Total	SEMESTER 2 FRANCE P.trawl VIIIb	SPAIN Seine VIIIb	SPAIN Seine VIIIc	Total	TOTAL FRANCE P.trawl VIIIb	SPAIN Seine VIIIb	SPAIN Seine VIIIc	Total
7	-	-	-	-	-	-	-	-	-	-	-	-
7.5	51	-	-	51	6	-	-	6	57	-	-	57
8	51	-	-	51	23	-	1	24	74	-	1	75
8.5	257	-	-	257	11	-	7	18	268	-	7	275
9	308	-	-	308	50	-	8	57	358	-	8	365
9.5	205	-	-	205	99	-	8	107	305	-	8	312
10	543	-	-	543	279	-	114	393	822	-	114	936
10.5	1997	-	-	1997	430	-	419	850	2427	-	419	2846
11	5325	111	2502	7939	2069	-	1024	3093	7395	111	3526	11032
11.5	7048	170	4799	12017	1376	-	3203	4579	8424	170	8001	16596
12	6900	190	9879	16970	1612	-	8438	10051	8513	190	18317	27020
12.5	10097	782	19565	30444	2659	-	11726	14385	12756	782	31290	44828
13	13662	2144	23930	39736	8892	-	14991	23883	22554	2144	38921	63619
13.5	21716	4713	28227	54657	15172	-	14710	29882	36888	4713	42937	84538
14	32193	7672	35516	75381	20876	-	10723	31599	53069	7672	46239	106980
14.5	34009	6998	38692	79698	28971	-	6164	35134	62979	6998	44856	114833
15	39067	8203	34783	82053	4129	-	2997	7126	43196	8203	37780	89179
15.5	45250	6583	29132	80966	7126	-	1255	8382	52377	6583	30388	89348
16	40464	6861	24864	72190	11910	-	691	12601	52374	6861	25555	84790
16.5	31328	5704	16426	53458	1733	-	640	2373	33061	5704	17066	55831
17	17561	5624	13945	37130	3539	-	406	3945	21100	5624	14351	41075
17.5	4591	2447	6651	13689	169	-	278	447	4760	2447	6930	14136
18	674	1134	3132	4940	75	-	84	159	749	1134	3216	5099
18.5	503	341	833	1676	10	-	71	80	513	341	903	1757
19	18	-	115	133	10	-	17	27	27	-	133	160
19.5	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
20.5	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
21.5	-	-	-	-	-	-	-	-	-	-	-	-
Total N	313819	59678	292992	666489	111227	-	77974	189200	425046	59678	370965	855689
Catch (T)	6682	1631	6712	15025	3026	-	1230	4256	9708	1631	7942	19281
SOP	7356	1527	6470	15353	2144	-	1195	3340	9500	1527	7666	18693
%	110	94	96	102	71	-	97	78	98	94	97	97
$\underline{L}$	15.1	15.5	14.8	15.0	14.5	-	13.5	14.1	14.9	15.5	14.5	14.8
$\underline{W}$(catch)	21.3	27.3	22.9	22.5	27.2	-	15.8	22.5	22.8	27.3	21.4	22.5
W(SOP)	23.4	25.6	22.1	23.0	19.3	-	15.3	17.7	22.4	25.6	20.7	21.8

Table 10.2a. Spanish length distribution ('000) of Bay of Cadiz ANCHOVY from the purse seiner in Division IXa in 1988.

Length (cm)	1st Q	2nd Q	3rd Q	4th Q	Total
4	-	-	-	-	-
4.5	-	-	-	-	-
5	65	63	-	-	128
5.5	87	84	-	-	170
6	-	-	-	-	-
6.5	-	-	-	-	-
7	130	126	-	-	255
7.5	122	118	-	107	347
8	894	870	1288	107	3159
8.5	2857	2802	644	1705	8009
9	3639	4068	473	4261	12440
9.5	5568	7311	644	7777	21299
10	9324	10340	3499	10723	33886
10.5	14866	15679	5704	13172	49422
11	17342	21435	14453	10230	63460
11.5	10958	23226	14175	6578	54937
12	8130	28325	17405	6809	60669
12.5	4138	16703	12996	3488	37324
13	1569	12571	6279	2109	22528
13.5	423	4656	2252	787	8119
14	89	3143	782	246	4261
14.5	-	-	474	-	474
15	-	2449	1064	369	3882
15.5	-	-	2406	29	2434
16	-	-	2079	45	2124
16.5	-	-	1690	-	1690
17	-	-	1096	-	1096
17.5	-	-	209	-	209
18	-	-	-	-	-
18.5	-	-	-	-	-
19	-	-	-	-	-
19.5	-	-	-	-	-
20	-	-	-	-	-
20.5	-	-	-	-	-
21	-	-	-	-	-
21.5	-	-	-	-	-
Total N	80201	153968	89611	68541	392322
Catch (T)	724	1810	1154	553	4242
$\bar{L}$	11.0	11.7	12.3	11.0	11.6
w(catch)	9.0	11.8	12.9	8.1	10.8

Table 10.2b. Spanish length distribution ('000) of Bay of Cadiz ANCHOVY from the purse seiner in Division IXa in 1989.

Length (cm)	1st Q	2nd Q	3rd Q	4th Q	Total
4	-	-	-	-	-
4.5	127	-	-	-	127
5	452	-	-	-	452
5.5	813	-	-	-	813
6	994	-	-	-	994
6.5	868	340	-	-	1207
7	1270	1121	-	-	2391
7.5	1910	3854	-	-	5764
8	4805	19699	204	-	24708
8.5	13802	48687	306	-	62795
9	13259	38720	102	-	52082
9.5	19248	22867	271	-	42387
10	29827	36103	1622	-	67553
10.5	31135	35930	2728	-	69793
11	27463	37460	3463	-	68387
11.5	13041	37049	5438	-	55528
12	9806	24601	6692	-	41099
12.5	2771	20706	9522	718	33717
13	1168	9882	4594	1387	17032
13.5	-	4553	4528	1435	10515
14	-	3301	2991	861	7153
14.5	410	825	985	574	2794
15	-	825	854	335	2014
15.5	-	413	1097	96	1605
16	-	-	4595	48	4643
16.5	-	-	7271	-	7271
17	-	-	4349	-	4349
17.5	-	-	1241	-	1241
18	-	-	571	-	571
18.5	-	-	-	-	-
19	-	-	-	-	-
19.5	-	-	-	-	-
20	-	-	-	-	-
20.5	-	-	-	-	-
21	-	-	-	-	-
21.5	-	-	-	-	-
Total N	173172	346937	63426	5453	588988
Catch (T)	1308	2568	1298	96	5270
$\bar{L}$	10.4	10.6	13.8	13.8	10.9
w(catch)	7.6	7.4	20.5	17.5	8.9

Table 10.2c. Spanish length distribution ('000) of Bay of Cadiz ANCHOVY from the purse seiner in the Division IXa in 1990.

Length (cm)	1st Q	2nd Q	3rd Q	4th Q	Total
4	-	-	-	3707	3707
4.5	-	-	-	15341	15341
5	686	11	-	26269	26965
5.5	3016	46	-	37570	40632
6	71	183	-	36711	36965
6.5	1782	701	4	32735	35222
7	4394	1837	22	21569	27821
7.5	6109	3234	842	15669	25854
8	13038	3553	1163	6063	23817
8.5	26189	2721	755	3477	33141
9	29988	4849	1148	9475	45461
9.5	40534	12384	4142	16416	73475
10	48816	23384	4890	17331	94421
10.5	41071	32674	10936	10583	95264
11	28671	23466	14488	5354	71980
11.5	26035	19810	16100	1369	63315
12	17926	11873	12993	1369	44161
12.5	10759	7418	9994	312	28483
13	3973	4508	6650	122	15253
13.5	3291	3302	4018	8	10619
14	1063	1663	1905	54	4685
14.5	175	277	724	28	1204
15	-	149	450	6	604
15.5	128	1	179	9	317
16	-	4	308	26	337
16.5	-	6	518	38	562
17	-	3	336	32	371
17.5	-	1	174	21	197
18	-	1	125	15	141
18.5	-	-	19	-	19
19	-	-	-	-	-
19.5	-	-	-	-	-
20	-	-	-	-	-
20.5	-	-	-	-	-
21	-	-	-	-	-
21.5	-	-	-	-	-
Total N	307714	158059	92885	261677	820335
Catch (T)	2271	1535	1129	731	5666
$\bar{L}$	10.3	10.9	11.8	7.2	9.6
w(catch)	7.4	9.7	12.2	2.8	6.9

Table 10.2d. Spanish length distribution ('000) of Bay of Cadiz ANCHOVY from the purse seiner in Division IXa in 1991.

Length (cm)	1st Q	2nd Q	3rd Q	4th Q	Total
4	258	-	-	-	258
4.5	3306	-	-	-	3306
5	43707	107	-	-	43814
5.5	76983	161	-	-	77144
6	42575	803	-	-	43378
6.5	22631	2093	-	-	24724
7	12340	3130	-	-	15470
7.5	9168	7099	-	267	16533
8	7532	7631	-	1278	16440
8.5	5837	5649	-	3682	15168
9	4414	2690	10	10965	18080
9.5	9163	1087	760	17144	28155
10	11300	12954	5399	8534	38187
10.5	16789	33629	17679	2576	70674
11	20957	45157	17212	443	83768
11.5	13672	49594	18511	134	81911
12	6125	54360	16763	108	77356
12.5	1209	37210	13513	-	51932
13	547	30079	12683	-	43309
13.5	-	9394	15922	-	25316
14	-	7374	10468	-	17842
14.5	-	1265	3925	17	5208
15	-	1037	903	41	1981
15.5	-	320	513	97	930
16	-	-	1343	165	1509
16.5	-	-	1606	418	2024
17	-	-	1381	238	1619
17.5	-	-	399	138	537
18	-	-	79	-	79
18.5	-	-	-	-	-
19	-	-	-	-	-
19.5	-	-	-	-	-
20	-	-	-	-	-
20.5	-	-	-	-	-
21	-	-	-	-	-
21.5	-	-	-	-	-
Total N	308512	312824	139068	46246	806650
Catch (T)	1024	3670	690	272	5656
$\bar{L}$	7.5	11.6	12.5	9.8	10.1
w(catch)	3.3	11.7	5.0	5.9	7.0

TABLE 11.1 ANNUAL CATCHES OF THE BAY OF BISCAY ANCHOVY (Subarea VIII)
As estimated by the working group. (Tonnes)

YEAR/COUNTRY & DIVISION	FRANCE VIIIab	SPAIN VIIIbc	INTERNATIONAL SUBAREA VIII	
1960	1085	57000	58085	
1961	1494	74000	75494	
1962	1123	58000	59123	
1963	652	48000	48652	
1964	1973	75000	76973	
1965	2615	81000	83615	
1966	839	47519	48358	
1967	1812	39363	41175	
1968	1190	38429	39619	
1969	2991	33092	36083	
1970	3665	19820	23485	
1971	4825	23787	28612	
1972	6150	26917	33067	
1973	4395	23614	28009	
1974	3835	27282	31117	
1975	2913	23389	26302	
1976	1095	36166	37261	
1977	3807	44384	48191	
1978	3683	41536	45219	
1979	1349	25000	26349	
1980	1564	20538	22102	
1981	1021	9794	10815	
1982	381	4610	4991	
1983	1911	12242	14153	
1984	1711	33468	35179	
1985	3005	8481	11486	
1986	2311	5612	7923	
1987	5061 (1)	9863	14924	
1988	6743	8266	15009	
1989	2200	8174	10374	
1990	10598 (2)	23258	33856	
1991	9708	9573	19281	
1992	4000 (3)	20943	24943	(*)
Average (1960-91)	3053	31162	34215	

* Preliminary data for the first semester.

(1) Accurate data since 1987, before catches were underestimated.
(2) Fishery was closed in November.
(3) The French fishery was closed under EC legislation around the middle of April.

TABLE: 11.2:
MONTHLY CATCHES OF THE BAY OF BISCAY ANCHOVY BY COUNTRY (SUBAREA VIII)

COUNTRY: FRANCE

Units: tonnes

YEAR\MONTH	J	F	M	A	M	J	J	O	S	O	N	D	TOTAL
1987	0.0	0.0	0.0	1225.0	1716.0	283.0	162.0	643.0	749.0	273.0	15.0	1.0	5067
1988	0.0	0.4	14.0	784.0	1388.0	781.0	296.0	1154.0	2000.0	324.0	0.2	0.0	6741
1989	699.6	81.4	11.0	378.4	763.4	11.0	59.4	8.8	30.8	151.8	4.4	0.0	2200
1990	0.4	0.0	15.9	1330.0	1511.3	127.2	269.2	1904.5	3274.8	1446.3	635.9	82.7	10598
1991	1318.0	2135.4	603.1	808.0	1622.0	195.2	124.2	419.1	1587.3	556.7	53.7	285.5	9708
1992	----------	4000	----------										4000

COUNTRY: SPAIN

YEAR\MONTH	J	F	M	A	M	J	J	O	S	O	N	D	TOTAL
1987	0.0	0.0	453.5	4133.0	3677.0	514.0	80.6	53.5	27.9	456.9	202.1	265.1	9863
1988	6.0	0.0	27.9	785.7	2931.4	3203.8	292.1	97.6	421.1	118.3	136.2	245.9	8265
1989	1.9	2.3	25.1	257.8	4295.5	794.9	90.0	509.7	115.6	198.4	1609.6	272.7	8173
1990	79.2	5.6	2084.7	1327.8	9947.4	2956.7	1202.4	3226.9	2278.3	123.2	16.4	9.5	23258
1991	99.6	39.7	23.0	1227.6	5290.8	1662.7	90.5	59.5	34.1	265.3	184.4	596.2	9573
1992(*)	353.5	330.2	339.9	3457.0	13058.7	3404.0	0.0	0.0	0.0	0.0	0.0	0.0	20943

(*) up to 13 June

TABLE 11.3: ANCHOVY CATCHES IN THE BAY OF BISCAY BY COUNTRY AND DIVISIONS IN 1991. (in tonnes)

COUNTRY	DIVISIONS	QUARTERS 01	02	03	04	ANNUAL	%
SPAIN	VIIIB	0	1948	0	0	1948	20.4
	VIIIC	162	6233	184	1046	7625	79.6
	TOTAL	162	8181	184	1046	9573	
	%	1.7	85.5	1.9	10.9		100.00
FRANCE	VIIIA	1259	650	1744	805	4458	45.9
	VIIIB	2797	1975	386	91	5249	54.1
	VIIIC	0	0	0	0	0	0.0
	TOTAL	4056	2625	2130	896	9707	
	%	41.8	27.0	21.9	9.2		100.00
INTERNATION.	VIIIA	1259	650	1744	805	4458	23.1
	VIIIB	2797	3923	386	91	7197	37.3
	VIIIC	162	6233	184	1046	7625	39.5
	TOTAL	4218	10806	2314	1942	19280	
	%	21.9	56.0	12.0	10.1		100.00

TABLE 11.4: BAY OF BISCAY ANCHOVY CATCHES BY COUNTRY AND EEC CATEGORIES IN 1991

COUNTRY	EEC CAT.	QUARTERS				Units: tonnes	
		01	02	03	04	ANNUAL	%
SPAIN	T1	0	574	24	0	599	6.3
	T2	6	6458	14	116	6594	68.9
	T3	156	1142	146	872	2317	24.2
	T4	0	6	0	57	63	0.7
	TOTAL	162	8181	184	1046	9573	100.0
FRANCE	T1	0	32	17	0	49	0.5
	T2	3423	2225	1981	852	8481	87.4
	T3	466	349	133	25	973	10.0
	T4	168	19	0	18	205	2.1
	TOTAL	4057	2625	2131	896	9708	100.0
INTERN.	T1	0	606	41	0	648	3.4
	T2	3429	8682	1995	969	15075	78.2
	T3	622	1492	279	898	3291	17.1
	T4	168	26	0	75	269	1.4
	TOTAL	4219	10806	2315	1942	19282	100.0

T1 <= 30 anchovies/kg.
T2 between 31 and 50 per kg.
T3 between 51 and 83 per kg.
T4 more than 84 per kg.

Table 11.5 Evolution of the French and Spanish fleet for ANCHOVY (from Working Group members).

	France			Spain	Total
	P. seiner	P. trawl	Total	P. seiner	
1960*	52	0	52	571	623
1972*	35	0	35	492	527
1976*	24	0	24	354	378
1980*	14	n/a	14	293	307
1984*	n/a	4	4	269	273
1987*	9	36	45	259	314
1988	10	61	71	267	338
1989	2	51	53	210	263
1990	30	80[1]	110[1]	265	375
1991	30	115[1]	145[1]	251	396

*Only St. Jean de Luz and Hendaya.
n/a = Not available.
[1]Maximum number of potential boats; the number of mid-water trawls is roughly half of this number due to the fishing in pairs of mid-water trawlers.

Table 11.6 Daily Egg Production Method. Egg surveys on Anchovy - Bay of Biscay.

Year		1987	1988	1989	1990	1991	1992[1]
Period of year		2-7 June	21-28 May	10-21 May	4-15 May	16 May-10 Jun	15 May-10 Jun
Positive area (km^2)		23,850	45,384	17,546	57,764	24,264	54,021
Surveyed area (km^2)		34,934	59,840	37,930	78,215	84,032	92,781
Daily total egg production		$2,198x10^{12}$	$5,015x10^{12}$	$0.73x10^{12}$	$5.12x10^{12}$	$1.27x10^{12}$	
C.V.		0.32,	0.21	0.4	0.17	0.06	
SSB (t)		29,365	63,500	11,860	97,736	19.276	50-80,000
C.V.		0.48	0.31	0.41	0.18	0.14	
Coastal egg production		$2.319x10^{12}$	$5.312x10^{12}$	$0.328x10^{12}$	$3.35x10^{12}$	$0.524x10^{12}$	
No/age: 1		656[2]	2,349[2]	246[3]	5,581	591	(2,818-4,508)
(millions)	2	331	258	206	184	292	(118-188)
	3	76	66	18	39	9.5	(9-14)
	4	41	2	-		-	
	5	25	-	-		-	

[1]Preliminary data.
[2]Calculated as in Martin and Uriarte (1989).
[3]Revised.

Table 11.7

Evaluation of abundance index from French acoustic surveys.

	1983	1984	1989[2]	1990	1991	1992
	20/4–25/4	30/4–13/5	23/4–2/5	12/4–25/4	6/4–29/4	
Surveyd area	3267	3743	5112	3418[3]	3388[3]	2440
Density (t/nm^2)	15.4	10.3	3.0	14.5–32.2[4]	23.6	46.2
Biomass (t)	50.000	38.500	15.500	60–110.000[4]	80.000	113.000
Number (10^{-6})	2.600	2.000	805	4.300–7.900[4]	3.750	8.260
Number of 1–group (10^6)	1.800[1]	600[1]	400	4.100–7.500[4]	2.000	8.196

[1] Rough estimation.
[2] Assumption of overestimate.
[3] Positive area.
[4] Must be revised.

Table 11.8 Summary of egg and acoustic surveys of Bay of Biscay Anchovy.

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
SSB (tonnes)	-	-	-	-	29,365	63,500	11,860	97,736	19.726	50-80.0000
Positive area for Egg (km^2)	-	-	-	-	23,850	45,384	17,546	59,764	24,264	54.202
Acoustic index (tonnes)	50,000	38,500	-	-	-	-	15,500	N.A	80.000	113.000
Acoustic index in numbers (millions)	2,600	2,000	-	-	-	-	805	N.A.	3,750	8.260
Egg survey (1-year-old)	65	-	-	-	656	2,349	209	5,581	591 (2.818-4.508)	
Acoustic survey (1-year-old) millions	1,800	600	-	-	-	-	440	N.A.	2,000	8.196
Y.C.C.[0]	1,444	352	177	267	340	542	284		1,383[1]	
Catch	14,153	35,179	11,486	7,923	14,924	15,009	10,374	33,856	19,281	

[0]Year class cumulative in numbers $\sum_{i=1}^{N} Cij$ { Cij: Catch from year class j the year i; N: Number of catch years for the year class j

[1]Incomplete. Y.C.C.; only catch of 1-year-old anchovies.

Table 11.9 ANCHOVY in the Bay of Biscay. Spanish half-yearly catches (Semester 2) by age ('000) of Bay of Biscay anchovy; from the live bait tuna fishing boats.

	Catch in numbers				
Age	1987	1988	1989	1990	1991
0	10,020	97,581	n/a	27,993	6,098
1	24,975	17,353	n/a	22,238	13,736
2	1,461	203	n/a	109	-
3	912	3	n/a		
4			n/a		
5+			n/a		
Total	37,368	115,410		5,034	19,834
Catch (t)	546	493		416	353
av. W	14.6	4.3		8.3	17.8

TABLE 11.10 NUMBERS AT AGE IN THE CATCH OF 1991 by quarters and divisions.
(Without live bait catches) Units: ('000)

YEAR:							1991		
SEMESTER:		1	1	1	2	2	1	2	ANNUAL
COUNTRY:		SPAIN	SPAIN	FRANCE	SPAIN	FRANCE	INTERNACIONAL		
AREA:		VIIIC	VIIIB	VIIIAB	VIIIC	VIIIAB	VIII	VIII	VIII
AGES:	0	0	0	0	68820	3841	0	72661	72661
	1	174034	36652	117242	7376	91859	327928	99235	427163
	2	100933	38394	182960	1716	14333	322287	16049	338336
	3	2206	450	13617	62	1195	16273	1257	17530
	4	0	0	0	0	0	0	0	0
	TOTAL	277173	75496	313819	77974	111228	666488	189202	855690
	CATCH	6394939	1948277	6681753	1230108	302648	915024969	425659	719281566
	SOP	6061516	1838678	6689000	1201399	294500	014589194	414639	918735593
	VARIA.%	-5.21	-5.63	0.11	-2.33	-2.69	-2.90	-2.59	-2.83
	AVER(W)	23.07	25.81	21.29	15.78	27.21	22.54	22.50	22.53

Table 11.11 Catches at age of ANCHOVY (in millions) from 1989-1992 on a half-yearly basis.

Year	1989[1]		1990		1991[1]		1992[2]
Half-year	1	2	1	2	1	2	1
Age 0	0	175	0	33	0	79	0
1	157	8	842	541	328	113	894
2	130	12	62	58.4	322	16	130
3	14	3.4	10	5	16.3	1.3	6.5
4	0.1	-	-	-	-	-	-
Total no.	301	198.4	915	6.37	666	209.1	1.031
Catch (t)	7,321	3,052	19,385	14,887	15,025	4,609	22,050

[1]Including live bait catches.
[2]To the end of May (preliminary).

Table 11.12 · Catch in numbers (millions) of ANCHOVY in the Bay of Biscay.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	776	0	156	31	0	1	14	3	0	388	161	53
2	602	861	1322	1687	1307	405	688	0	25	166	813	105
3	0	77	262	435	574	535	267	330	133	69	309	177
4	0	0	0	0	7	7	0	0	0	10	46	4
5+	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1378	938	1740	2153	1888	948	969	333	158	633	1329	339

	1986	1987	1988	1989	1990*	1991*
0		31	128	175	33	79
1	52	220	385	164	1383	441
2	80	187	128	142	120	338
3	63	42	29	18	15	18
4	54	22	3	0	0	
5+	0	12	1	0	0	
TOTAL	249	514	674	499	1551	876

* Including Spanish live bait catches.

TABLE 11.13 HALF YEARLY MEAN WEIGHT AT AGE FOR THE BAY OF BISCAY ANCHOVY IN 1991.

Units: g.

YEAR:							1991		
SEMESTER:		1	1	1	2	2	1	2	ANNUAL
COUNTRY:		SPAIN	SPAIN	FRANCE	SPAIN	FRANCE	INTERNACIONAL		
AREA:		VIIIC	VIIIB	VIIIABVIIIC		VIIIAB	VIII	VIII	VIII
AGES:	0				15.0	10.0		14.7	14.7
	1	18.4	19.0	16.0	17.5	26.0	17.6	25.4	19.4
	2	27.6	29.4	24.0	22.4	33.0	25.8	31.9	26.1
	3	34.3	35.0	31.0	38.9	38.0	31.6	38.0	32.0
	4								

TABLE 11.14 HALF YEARLY MEAN LENGTH AT AGE FOR THE BAY OF BISCAY ANCHOVY IN 1991.

Units: cm.

YEAR:							1991		
SEMESTER:		1	1	1	2	2	1	2	ANNUAL
COUNTRY:		SPAIN	SPAIN	FRANCE	SPAIN	FRANCE	INTERNACIONAL		
AREA:		VIIIC	VIIIB	VIIIABVIIIC		VIIIAB	VIII	VIII	VIII
AGES:	0				13.2	11.5		13.1	13.1
	1	14.0	14.2	13.2	13.8	15.3	13.8	15.2	14.1
	2	16.0	16.1	14.9	15.0	16.4	15.4	16.2	15.4
	3	16.9	16.9	16.1	0.0	17.1	16.2	17.1	16.3
	4								

Table 11.15 Estimation of mean F and M between surveys of DEPM on the Bay of Biscay anchovy, (F/M).

Age group/Year	1987/88	1988/89	1989/90	1990/91	1991/92
1+ to 2+	0,39/0.96	0,44/1.77	0,41/0.71	0,84/2.2	1,15/0.51
2+ to 3+	-	0,45/1.96	0,44/1.66	1,35/1.49	0,93/2.2

Table 11.16 Forecast of the cumulative catches ('000 t) of the 1991 year class for the year 1993 according to three values of F and M (since June 1992), and the final levels of biomass.

		M								
		1			1.5			2.0		
		Jan.	Jun.	Dec.	Jan.	Jun.	Dec.	Jan.	Jun.	Dec.
F	0.4	10.4 (33.3)	16.5 (27.0)		9.1 (24.9)	13.4 (16.4)		8.1 (18.6)	11.1 (9.9)	12.4 (2.7)
	0.7	17.2 (28.1)	25.5 (20.0)		15.2 (21.0)	21.0 (12.1)	24.0 (3.7)	13.5 (15.6)	17.6 (7.4)	
	1.1	24.4 (22.3)	34.2 (13.4)	39.3 (5.1)	21.6 (16.5)	28.5 (8.1)		18.7 (11.4)	24.2 (4.9)	

Table 11.17 : Distribution of the levels of catches of 1-year-old anchovies since 1987.

Catches:	C < 8000 t.	8000t. - 15000 t.	C > 15000 t.	TOTAL
Number of years	2	2	2	6
%	33	33	33	100
Average C (t.)	4443	8767	28164 (*)	13832
s	820	676	2604	11372

s = Standard deviation

(*) Assuming in 1992 a total international catch of 31.000 t.

TABLE 11.18: DIFFERENT POLICIES FOR EFFORT REGULATIONS AND SSB PROTECTION FOR ANCHOVY.

Nº	OPTION	DESCRIPTION	BIOLOGICAL JUSTIFICATION
1	Annual revisable TACs	Annual TAC, based on rough estimations of catches a year in advance assuming average recruitment. Updated for the second half of the year, based on SSB estimations.	Limiting effort and allowing to protect the stock by means of stopping the fishery untill the next spawning season, whenever SSB is equal or close to Minimun precautionary biomass.
2	Licence system	Establishing allowable nominal effort for both countries by licences per vessel + System of protection of the stock, limiting catches if necessary	To keep the effort within safe biological limits and prevent increasing effort by new fleets.
3	Annual analytical TAC	Setting catch Forecast in March-April after acoustic estimates of stock are available, through a scientific reunion.	Modulation of annual mortality according to SSB biomass and manager criteria. It is a valid mean to protect the stock at low levels.

Table 11.19 Technical measures proposed to increase the spawning stock biomass (see text for further explanation).

Propositions	Biological Effects	Landing Effects
Size Limit (1)	- to protect the population of juveniles. - to allow the main part of the population of anchovy to spawn at least one time.	Decrease of the international landings between 6% and 23% (1987-1991)
Closure Area (2)	- to prevent an increase of discards during and before the spawning season. - additional measures to the size limit.	
Closure Period (3)	- to prevent the catch of fish from the recruitment stage to the spawning period: from the beginning of November to the end of May. - to prevent an increase of discards. - additional measure to the size limit.	Duration of the closure period: January-March. Decrease of the international landings between 0.3% and 22% November to April. Decrease of the international landings between 13 and 42% November to May. Decrease of the international landings between 42 and 74%.

TABLE 11.20: Schematic representation of the Biological life cycle of the Bay of Biscay anchovy and its seasonal fisheries in the area.

ANCHOVY\MONTHS	A	M	J	J	A	S	O	N	D	J	F	M
Juveniles	Hatching and larvals developpement 1 y.o. maturation, first spawning in May				small juveniles widely spread intensive growth			Migration to shores, growing		Shore wintering with adults, Recruitment		Matura-tion
Adults	Maturing and spawning, since mid April			Growth in weight				Wintering in seashore areas mainly on French platform with new recruits				Matura-tion
FISHERIES (Catches/month in %) (1987-91)												
Life bait.				25	25	25	25					
SPAIN PurseSeine	14.6	44.7	16.8	2.3	4.5	3.4	2.4	5.1	3.1	0.3	0.1	2.9
FRANCE (All gears)	14.8	24	4.2	2.8	10.5	18.6	7.3	1.4	0.8	9.1	5.1	1.4
TOTAL COMMERCIAL	14.2	36.7	11.7	2.5	7.1	9.5	4	4.2	2.2	2.9	2.4	2.6
TOTAL COMMERCIAL	62.6			23.1				14.3				
Percentage of immature catches per month (Approximate assessment)												
Life bait				0	0	60	80					
SPANISH SEINERS	25	0	0	0	0	0	20	70	90	-	-	70
FRANCE	25	0	0	0	0	0	10	20	?	35-90	35-90	35-90
TOTAL COMMERCIAL	25	0	0	0	0	0	20	50	50-90	35-90	35-90	50-100

TABLE: 11.21:
CATCHES DURING THE CLOSING FISHING PERIODS PROPOSED FOR THE BAY OF BISCAY ANCHOVY (SUBAREA VIII)

COUNTRY: FRANCE

YEAR\MONTH	JAN.MAR	NOV.APR	NOV.MAY	ANNUAL
1987	0.0	1241.0	2957.0	5067.0
1988	14.4	798.6	2186.6	6741.6
1989	792.0	1174.8	1938.2	2200.0
1990	16.3	2064.9	3576.2	10598.1
1991	4056.5	5203.6	6825.7	9708.2

COUNTRY: SPAIN

YEAR\MONTH	JAN.MAR	NOV.APR	NOV.MAY	ANNUAL
1987	453.5	5053.7	8730.7	9863.6
1988	33.8	1201.6	4133.0	8265.9
1989	29.2	2169.3	6464.8	8173.5
1990	2169.5	3523.3	13470.7	23258.2
1991	162.2	2170.4	7461.1	9573.3

COUNTRY: INTERNATIONAL

YEAR\MONTH	JAN.MAR	NOV.APR	NOV.MAY	ANNUAL
1987	453.5	6294.7	11687.7	14930.6
1988	48.2	2000.2	6319.6	15007.6
1989	821.2	3344.1	8403.0	10373.5
1990	2185.8	5588.2	17046.9	33856.3
1991	4218.7	7374.0	14286.8	19281.6

percentages by country
COUNTRY: FRANCE

YEAR\MONTH	JAN.MAR	NOV.APR	NOV.MAY	TOTAL
1987	0.0	24.5	58.4	100.0
1988	0.2	11.8	32.4	100.0
1989	36.0	53.4	88.1	100.0
1990	0.2	19.5	33.7	100.0
1991	41.8	53.6	70.3	100.0

COUNTRY: SPAIN

YEAR\MONTH	JAN.MAR	NOV.APR	NOV.MAY	TOTAL
1987	4.6	51.2	88.5	100.0
1988	0.4	14.5	50.0	100.0
1989	0.4	26.5	79.1	100.0
1990	9.3	15.1	57.9	100.0
1991	1.7	22.7	77.9	100.0

COUNTRY: INTERNATIONAL

YEAR\MONTH	JAN.MAR	NOV.APR	NOV.MAY	TOTAL
1987	3.0	42.2	78.3	100.0
1988	0.3	13.3	42.1	100.0
1989	7.9	32.2	81.0	100.0
1990	6.5	16.5	50.4	100.0
1991	21.9	38.2	74.1	100.0

Table 12.1 Portuguese and Spanish annual landings (t) of ANCHOVY in Division IXa (from Pestana, 1989 and Working Group members).

Year	Portugal	Spain	Total
1943	9,975	-	-
1944	6,651	-	-
1945	992	-	-
1946	6,520	-	-
1947	3,392	-	-
1948	4,938	-	-
1949	2,684	-	-
1950	3,377	-	-
1951	3,594	-	-
1952	4,415	-	-
1953	1,033	-	-
1954	3,919	-	-
1955	4,523	-	-
1956	7,898	-	-
1957	12,610	-	-
1958	3,030	-	-
1959	3,788	-	-
1960	9,503	-	-
1961	2,492	-	-
1962	4,446	-	-
1963	5,714	-	-
1964	4,181	-	-
1965	4,460	-	-
1966	4,460	-	-
1967	3,818	-	-
1968	970	-	-
1969	1,243	-	-
1970	1,172	-	-
1971	326	-	-
1972	207	-	-
1973	126	-	-
1974	238	-	-
1975	372	-	-
1976	88	-	-
1977	3,261	-	-
1978	1,011	-	-
1979	655	-	-
1980	980	-	-
1981	978	-	-
1982	656	-	-
1983	673	-	-
1984	392	-	-
1985	2,122	-	-
1986	2,153	-	-
1987	1,622	-	-
1988	442	4,263	4,705
1989	823	5,336	6,159
1990	541	5,911	6,452
1991	210	5,711	5,921

- = No data.

Table 12.2 Distribution of ANCHOVY landings (t) by half year in Division IXa.

		1st half year[1]		2nd half year[2]	
1988	Spain	2,534	(60%)	1,708	(40%)
1989	Spain	3,876	(74%)	1,394	(27%)
1990	Spain	3,806	(67%)	1,860	(33%)
1991	Spain	4,736	(83%)	975	(17%)
1991	Portugal	39	(18%)	172	(82%)

[1]Corrresponds to the spring fishery in Division IXa.
[2]Corresponds to the summer and autumn Spanish fisheries and autumn Portuguese fisheries in Division IXa.

Table 12.3 Distribution of ANCHOVY landings in t in Sub-division IXa during 1991.

Sub-division	IXa North	IXA Central North	IXa Central South	IXa South
Spain	15			5,697
	(0.3%)			(99.7%)
Portugal		187	2	21
		(89%)	(1%)	(10%)

Table 12.4 ANCHOVY in Division IXa. Effort data: Spain IXa (Bay of Cadiz) number of fishing trips.

	PURSE SEINE		
Year	BARBATE Single purpose	BARBATE Multi purpose	SAN LUCAR Multi purpose
	No. fishing trip		
1988	3,958	17	210
1989	4,415	39	234
1990	4,622	92	660
1991	3,981	40	910

Table 12.5 ANCHOVY in Division IXa. Spain IXa (Bay of Cadiz) CPUE series in commercial fisheries.

	PURSE SEINE		
Year	BARBATE Single purpose	BARBATE Multi purpose	SAN LUCAR Multi purpose
	Kg fishing trip		
1988	1,047	461	420
1989	1,139	534	943
1990	1,128	287	643
1991	1,312	339	456

Table 13.1 Estimated catch in numbers ('000) of North Sea mackerel stock in 1988-1991 by quarter.

Year	1988					1989					1990					1991				
Quarter	1	2	3	4	Sum	1	2	3	4	Sum	1	2	3	4	Sum	1	2	3	4	Sum
Age %	2.8	0.4	25.5	71.3		5.5	0.6	36.4	57.5		13.2	0.6	22.8	63.4		31.2	0.3	25.2	45.3	
1	81	12	741	2,072	2,906	115	13	746	1,206	2,098	172	8	297	825	1,302	153	1	114	222	489
2	87	12	795	2,224	3,118	449	49	2,969	4,689	8,156	571	26	986	2,740	4,323	3,841	37	2,856	5,077	12,311
3	94	13	859	2,402	3,368	445	49	2,947	4,654	8,095	2,795	127	4,829	13,429	21,180	4,112	40	3,058	5,871	13,180
4	53	8	486	1,358	1,905	129	14	854	1,349	2,346	744	34	1,286	3,576	5,640	1,995	19	1,485	2,896	6,393
5	11	2	99	276	388	73	8	482	760	1,323	216	10	374	1,040	1,640	443	4	330	644	1,421
6	45	6	414	1,158	1,623	16	1	103	162	282	121	6	209	581	917	172	2	128	250	552
7	27	4	243	678	952	62	7	411	649	1,129	26	1	44	123	194	394	4	293	572	1,263
8	30	4	274	768	1,076	37	4	245	387	673	105	5	181	503	794	+	+	+	+	+
9	1	+	9	25	35	41	4	270	426	741	60	3	104	291	458	148	1	110	215	494
10	15	2	139	391	547	2	+	13	20	35	70	3	121	335	529	172	2	128	250	552
11	3	+	31	88	123	21	2	142	223	388	2	+	4	12	18	123	1	92	179	395
12	1	+	5	12	18	5	1	32	51	88	35	2	60	168	265	49	+	37	72	158
13	4	1	36	101	142	1	+	7	10	18	7	+	12	34	53	49	+	37	72	158
14	2	+	22	61	85	3	+	21	36	59	+	+	+	1	1	25	+	18	36	79
15	16	2	146	403	567	27	3	178	280	488	51	2	89	246	388	98	1	93	143	316

Table 13.2 Mean weight at age (g) by quarter in the North Sea mackerel stock and mean weight in catch.

Age	Quarter				Mean weight in catch
	1	2	3	4	
1	180	140	180	180	180
2	210	255	240	210	215
3	240	330	280	240	250
4	260	395	330	260	275
5	300	450	375	300	320
6	325	500	420	325	350
7	355	540	465	355	380
8	380	570	510	380	410
9	410	605	550	410	445
10	435	635	585	435	470
11	465	670	620	465	500
12	500	700	650	500	535
13	530	730	680	530	565
14	560	765	705	560	595
15	590	790	720	590	620

Table 13.3 Percentages of each mackerel stock assumed to be present in the North Sea by quarter in 1991.

Age	North Sea Stock				Western Stock			
	1	2	3	4	1	2	3	4
1	100	100	100	100	-	20	30	30
2	80	100	100	80	10	10	50	70
>2	80	100	50	70	10	+	50	70

Table 13.4 Mean weight at age (g) by quarter in the catches of North Sea horse mackerel in 1991.

AGE	QUARTER			
	1	2	3	4
1		NO DATA	66	66
2	96		108	109
3			127	128
4	170		139	140
5	178		150	150
6	191		177	181
7				
8	260		219	237
9	244		189	197
10	218			
11	301		202	
12	263		213	221
13				
14	297		337	387
15+	277		258	278

Table 13.5 Percentages of each horse mackerel stock assumed to be present in the North Sea by quarter in 1991.

Age	North Sea Stock				Western Stock			
	1	2	3	4	1	2	3	4
1-4	100	100	100	100	0	0	0	0
5+	100	100	100	100	0	0	5	40

Table 14.1 Allocation of ICES sub-areas and divisions to management unit for mackerel. TAC units are as stated in the regulations.

Sub-area/ Division	ACFM Advice			TAC Units				
	1	2	3	A	B	C	D	E
IIa		*		* EC zone	* excl.EC zone		* Norwegian zone	
IIb					* excl.EC zone			
IIIa	*			*				
IIIb,c,d				EC zone *				
IVa	* Jan-Jul	* Aug-Dec		*				
IVb	*			*				
IVc	*			*				
Vb		*			* EC zone			* Faroese zone
VI		*			*			
VII		*			*			
VIIIa,b		*			*			
VIIIc			*			*		
VIIId,e					*			
IXa			*			*		
IXb						*		
X						*		
XII					*			
XIV					*			
COPACE 34.1.1						EC zone *		

1. Advice for North Sea stock area.
2. Advice for Western stock area.
3. Advice for Southern stock area.
A. EC/Norway regulation.
B. EC regulation.
C. EC regulation
D. Norwegian regulation (Norwegian waters north of 62°N).
E. Faroese regulation (Faroese - mainly Division Vb).

Table 14.2 Allocation of ICES sub-areas and divisions to management unit for horse mackerel. The TAC units are as stated in the regulations.

Sub-area/ Division	ACFM Advice			TAC Units		
	1	2	3	A	B	C
IIa	*	*		EC zone *		
IIIa		x)				
IVa		*		EC zone *		
IVb	*			EC zone *		
IVc	*			*		
Vb					EC zone *	
VIa		*			*	
VIb					*	
VIIa-c		*			*	
VIId	*				*	
VIIe-k		*			*	
VIIIa,b,d,e		*			*	
VIIIc			*			*
IXa			*			*
IXb						*
XII					*	
XIV					*	

1. Advice for North Sea stock area.
2. Advice for Western stock area.
3. Advice for Southern stock area.

A,B,C = EC regulations

x) Included in Western area advice in 1991.

Table 15.1 Summary of commercial MACKEREL fishery samples taken by quarter and division in 1991.

Div/Subarea	Quarter	Catch ('000t)	N samples	N samp/Catch	N measured	N meas/Catch	Nmeas/Nsamp	N aged	N aged/Catch	N aged/Nsamp
IIa+Vb	1	1	0	0.0	0	0	0	0	0	0
	2	1	0	0.0	0	0	0	0	0	0
	3	75	33	0.4	1799	24	55	779	10	24
	4	21	0	0.0	0	0	0	0	0	0
	Annual	98	33	0.3	1799	18	55	779	8	24
IVa	1	111	25	0.2	2989	27	120	1566	14	63
	2	0	0	0.0	0	0	0	0	0	0
	3	82	177	2.2	9203	113	52	573	7	3
	4	191	138	0.7	8788	46	64	2002	10	15
	Annual	358	340	0.9	20980	59	62	4141	12	12
IVb,c	1	0	0	0.0	0	0	0	0	0	0
	2	1	3	3.3	117	130	39	75	83	25
	3	5	6	1.3	510	113	85	150	33	25
	4	0	0	0.0	0	0	0	0	0	0
	Annual	6	9	1.5	627	106	70	225	38	25
IIIa	1	0	0	0.0	0	0	0	0	0	0
	2	0	15	50.0	680	2267	45	68	227	5
	3	2	27	16.9	1477	923	55	662	414	25
	4	15	0	0.0	0	0	0	0	0	0
	Annual	17	42	2.5	2157	126	51	730	43	17
VIa	1	103	62	0.6	5401	53	87	1575	15	25
	2	1	5	3.8	590	454	118	234	180	47
	3	1	9	9.0	624	624	69	211	211	23
	4	10	26	2.6	3023	305	116	1358	137	52
	Annual	120	102	0.8	9638	80	94	3378	28	33
VII	1	30	33	1.1	3899	132	118	1605	54	49
	2	14	42	3.0	2778	200	66	1598	115	38
	3	3	9	2.6	975	287	108	173	51	19
	4	0	16	80.0	0	0	0	385	1925	24
	Annual	47	100	2.1	7652	162	77	3761	80	38
VIII	1	6	82	13.4	6476	1062	79	309	51	4
	2	15	138	9.5	10448	721	76	559	39	4
	3	2	24	10.9	785	357	33	0	0	0
	4	0	21	52.5	1399	3498	67	101	253	5
	Annual	23	265	11.4	19108	824	72	969	42	4
IXa	1	1	50	45.5	5176	4705	104	103	94	2
	2	2	61	38.1	5255	3284	86	93	58	2
	3	1	48	53.3	3363	3737	70	66	73	1
	4	0	23	76.7	1338	4460	58	63	210	3
	Annual	4	182	46.7	15132	3880	83	325	83	2

Table 15.2 Summary of commercial HORSE MACKEREL fishery samples taken by quarter and division in 1991.

Div/Subarea	Quarter	Catch ('000t)	N samples	N samp/Catch	N measured	N meas/Catch	Nmeas/Nsamp	N aged	N aged/Catch	N aged/Nsamp
IIa+Vb	1	0	0	0.0	0	0	0	0	0	0
	2	0	0	0.0	0	0	0	0	0	0
	3	2	7	3.5	220	110	31	69	34	10
	4	1	2	2.0	96	96	48	0	0	0
	Annual	3	9	3.0	316	105	35	69	23	8
IVa	1	0	0	0.0	0	0	0	0	0	0
	2	0	0	0.0	0	0	0	0	0	0
	3	3	5	1.7	191	64	38	28	9	6
	4	57	40	0.7	2026	36	51	0	0	0
	Annual	60	45	0.7	2217	37	49	28	0	1
IVb,c VIId	1	1	0	0.0	0	0	0	0	0	0
	2	0	2	-	148	-	74	140	-	70
	3	6	6	1.0	1011	168	168	150	25	25
	4	9	4	0.4	100	11	25	0	0	0
	Annual	16	12	0.7	1259	79	105	290	18	24
IIIa	1	0	0	0.0	0	0	0	0	0	0
	2	0	0	0.0	0	0	0	0	0	0
	3	1	0	0.0	0	0	0	0	0	0
	4	2	2	1.0	88	44	44	0	0	0
	Annual	3	2	0.7	88	29	44	0	0	0
VIa	1	9	0	0.0	0	0	0	0	0	0
	2	0	0	0.0	0	0	0	0	0	0
	3	16	12	0.7	1337	84	111	125	8	10
	4	7	0	0.0	0	0	0	0	0	0
	Annual	32	12	0.4	1337	42	111	125	4	10
VII	1	46	18	0.4	2034	44	113	300	7	17
	2	41	28	0.7	3457	84	123	575	14	21
	3	45	14	0.3	2123	47	152	150	3	11
	4	67	13	0.2	2119	32	163	325	5	25
	Annual	199	73	0.4	9733	49	133	1350	7	18
VIII	1	10	116	11.6	8232	823	71	531	53	5
	2	9	166	18.4	9366	1041	56	839	93	5
	3	10	138	13.8	7683	768	56	320	32	2
	4	23	161	7.0	11811	514	73	757	33	5
	Annual	52	581	11.2	37092	713	64	2447	47	4
IXa	1	4	384	96.0	34276	8569	89	242	60	1
	2	7	374	53.4	33553	4793	90	360	51	1
	3	6	249	41.5	21016	3503	84	1014	169	4
	4	5	332	66.4	28124	5625	85	633	127	2
	Annual	22	1339	60.9	116969	5317	87	2249	102	2

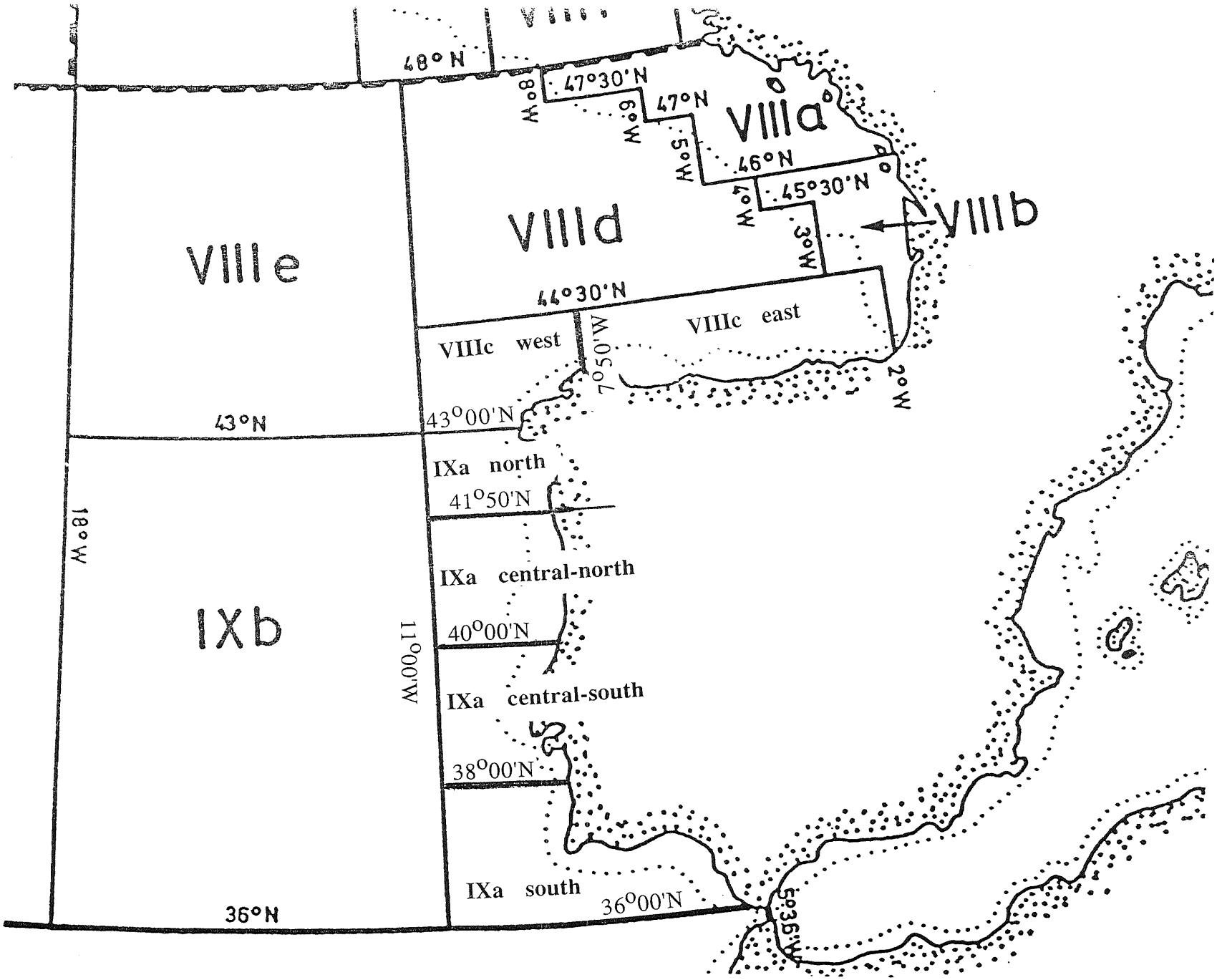


Figure 1.1 **ICES Divisio' VIIIc and IXa divided into sm 'ler sub-divisions.**

Figure 2.1 Distribution of the 1990 year-class of mackerel in the North Sea, 1st Quarter 1991 (Anon.1991c).

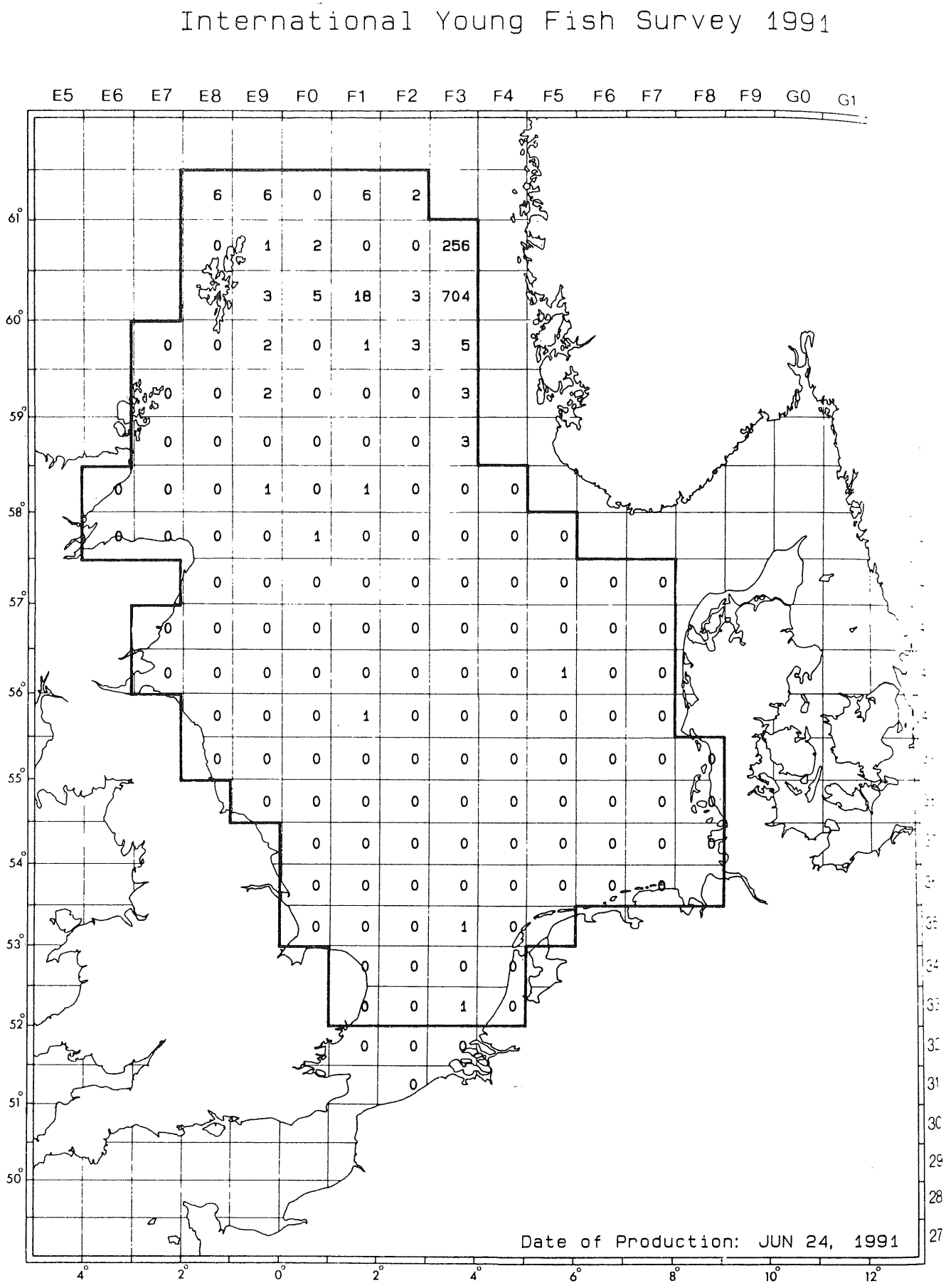


Figure 2.2 Distribution of the 1990 year-class of mackerel in the North Sea, 2nd quarter 1991.

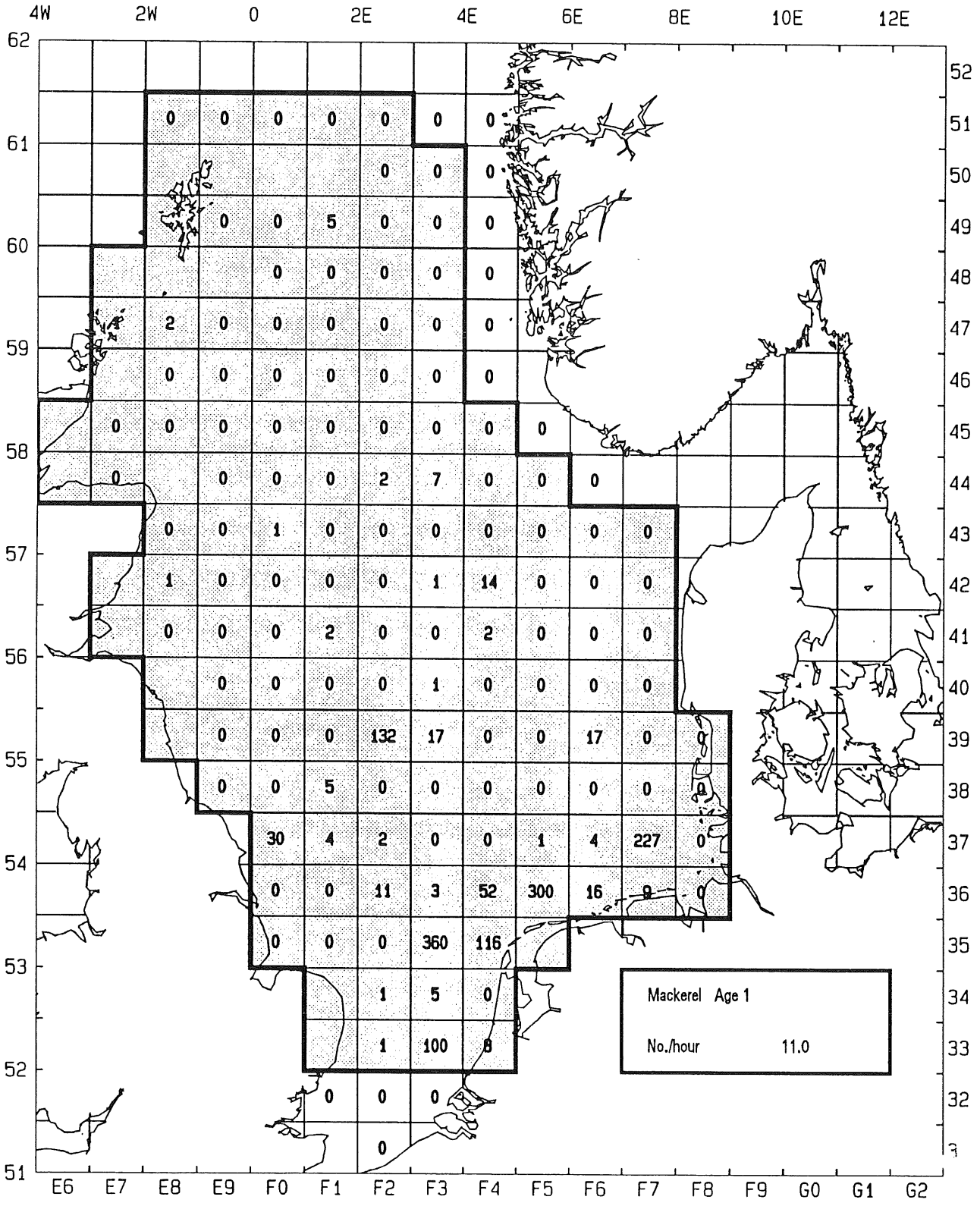


Figure 2.3 Distribution of the 1991 year-class of mackerel, 4th quarter 1991.

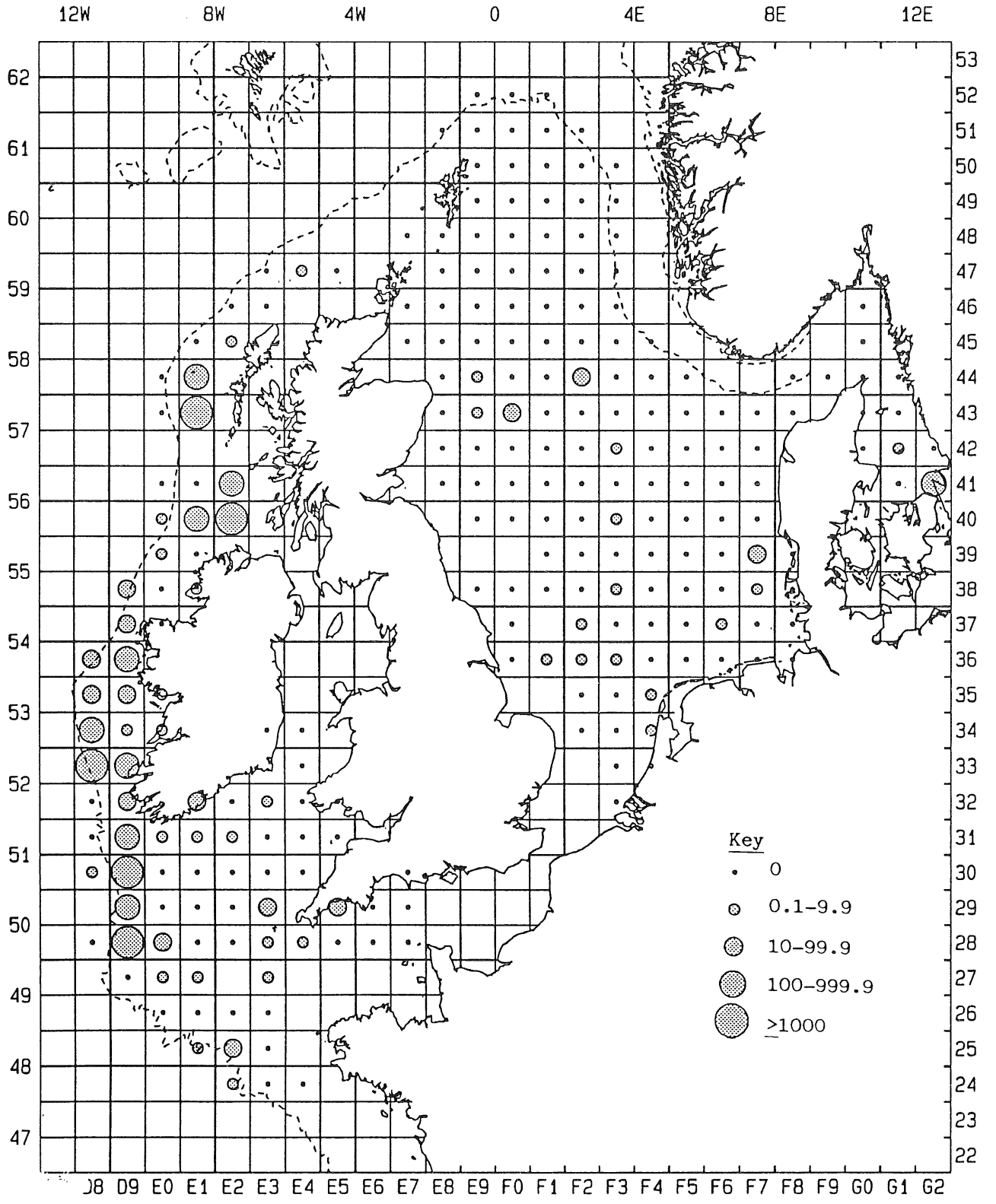


Figure 2.4 Distribution of the 1990 year-class of mackerel, 4th quarter 1991.

walsh

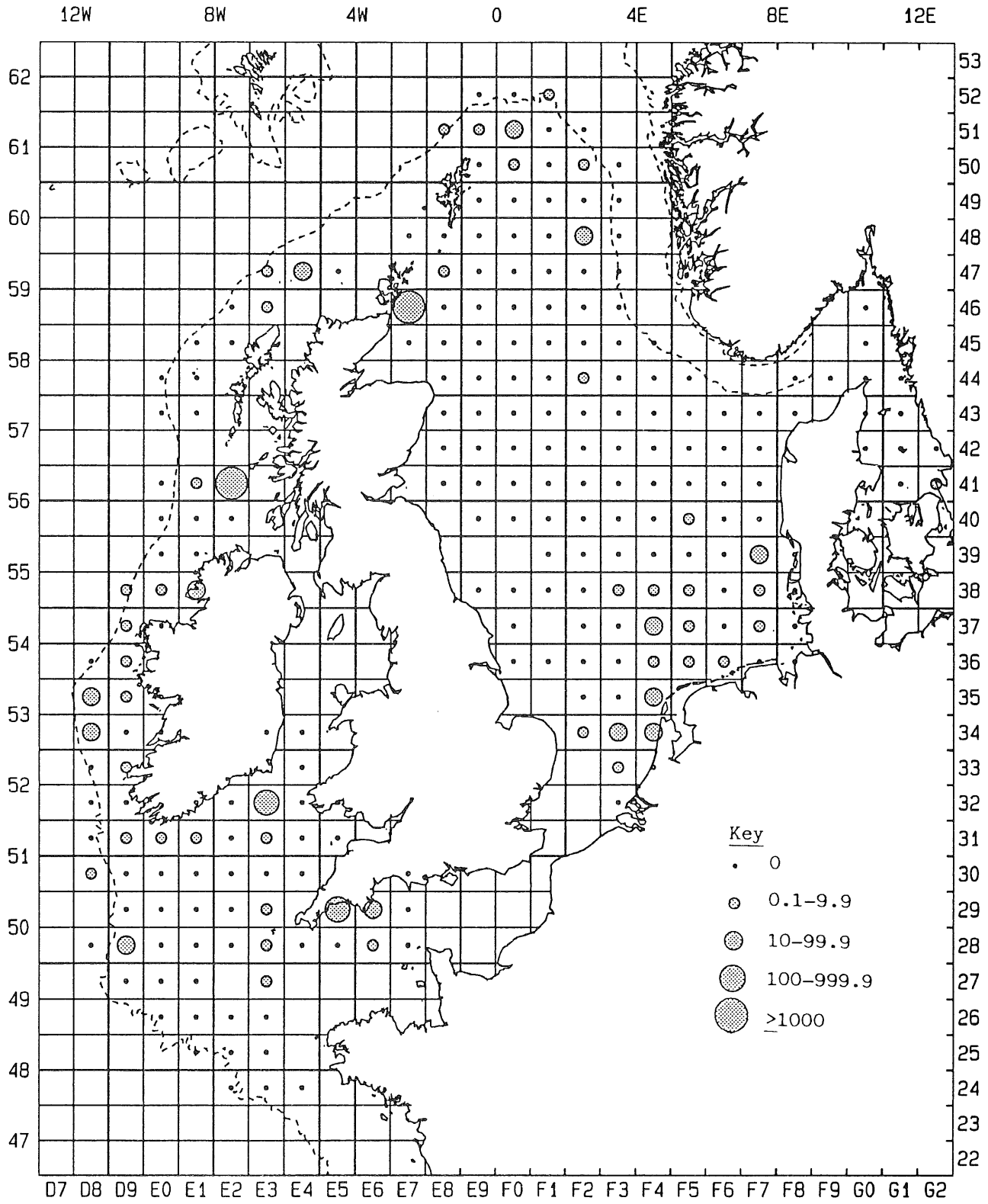


Figure 2.5 Distribution of the 1991 year-class of mackerel, 1st quarter 1992.

walsh

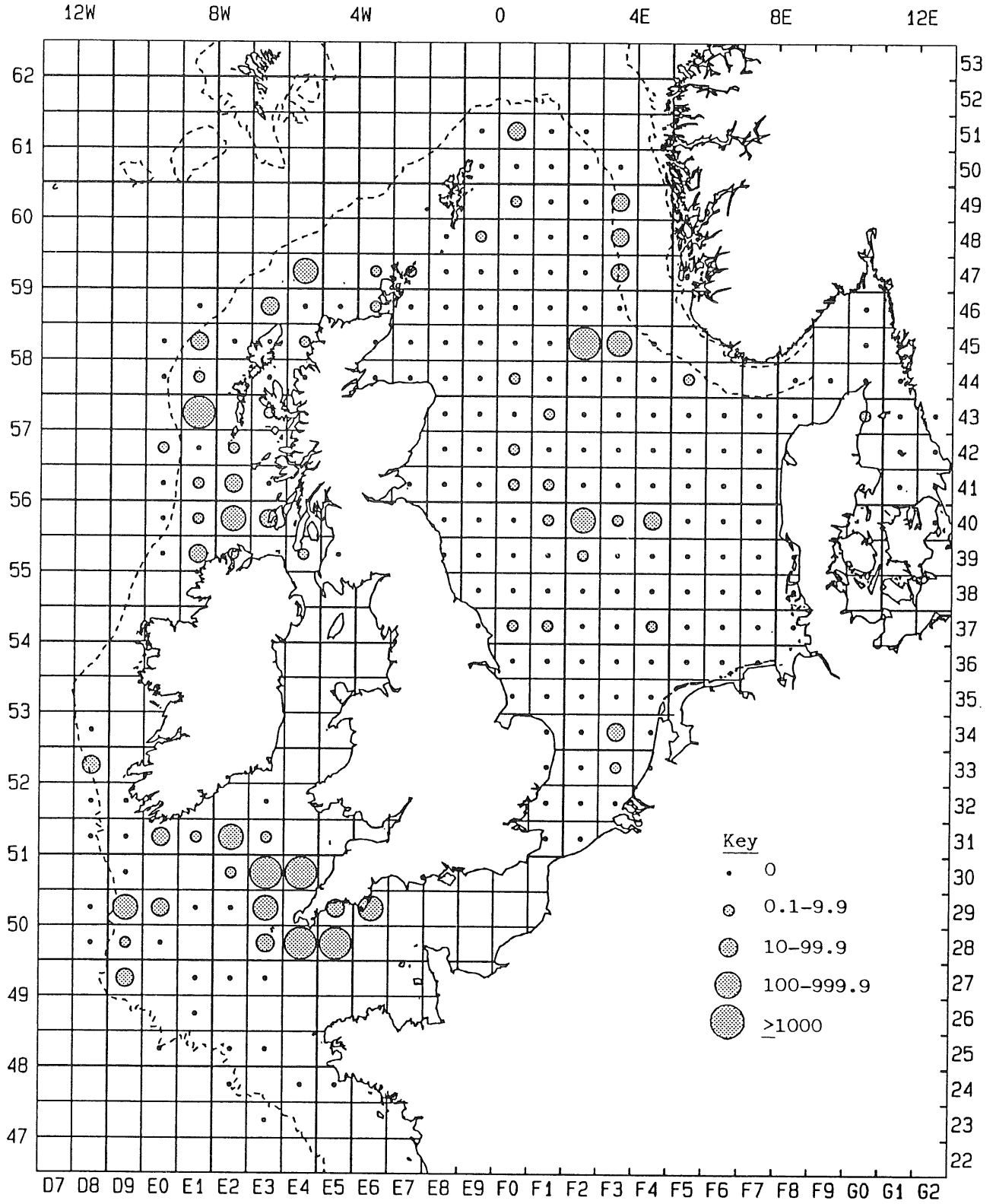
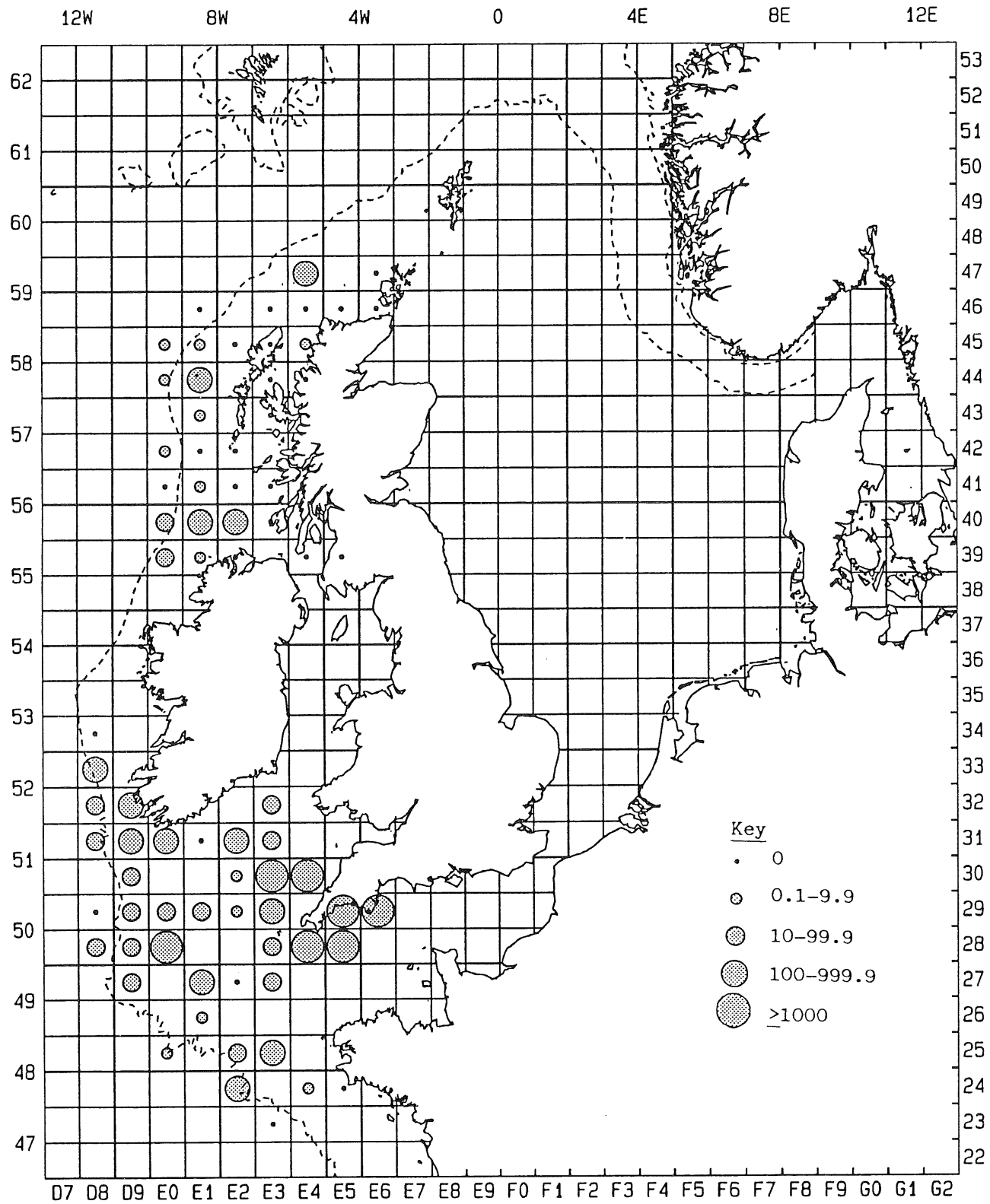


Figure 2.6 Distribution of the 1990 year-class of mackerel, 1st quarter 1992.

walsh



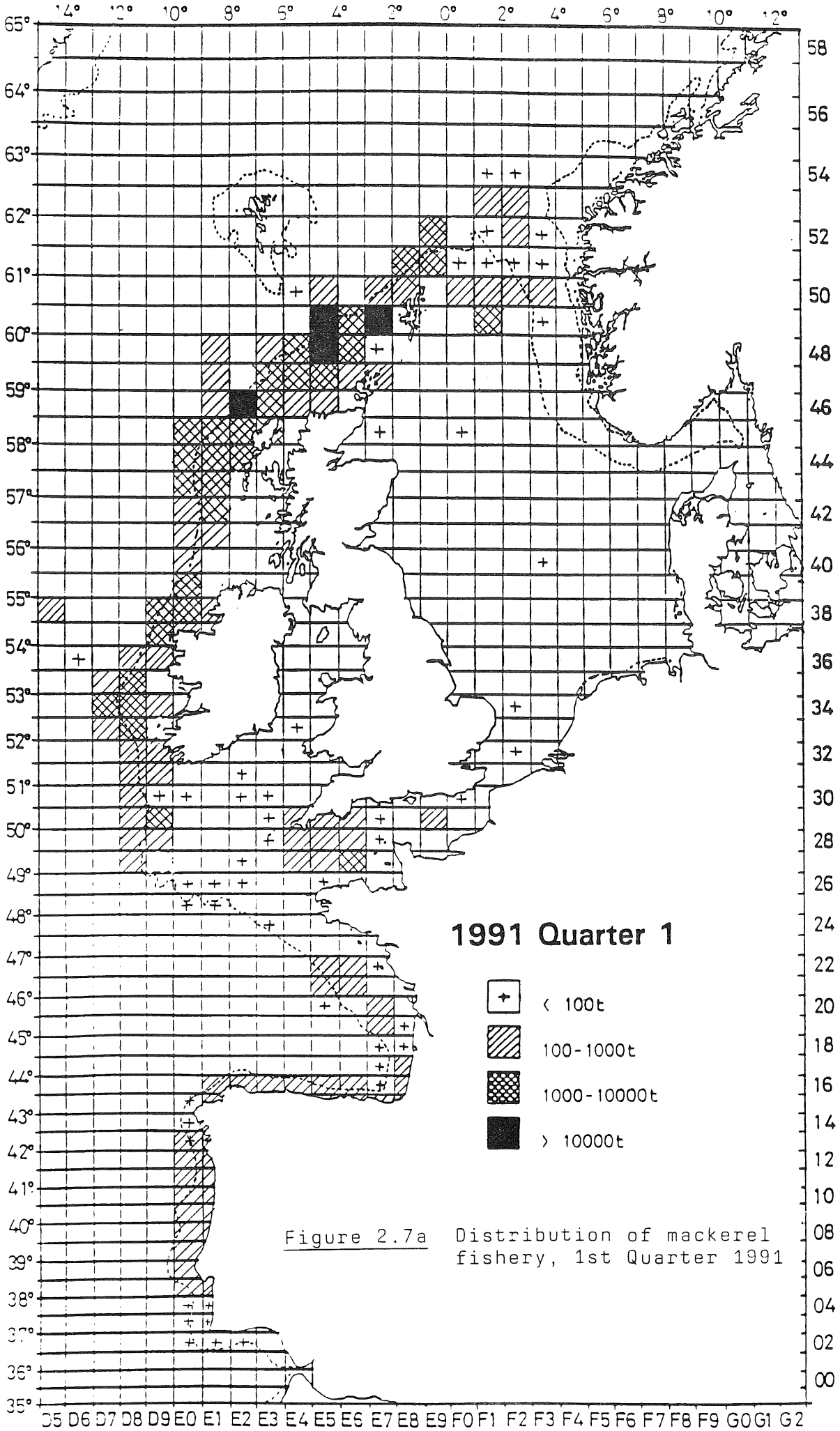


Figure 2.7a Distribution of mackerel fishery, 1st Quarter 1991

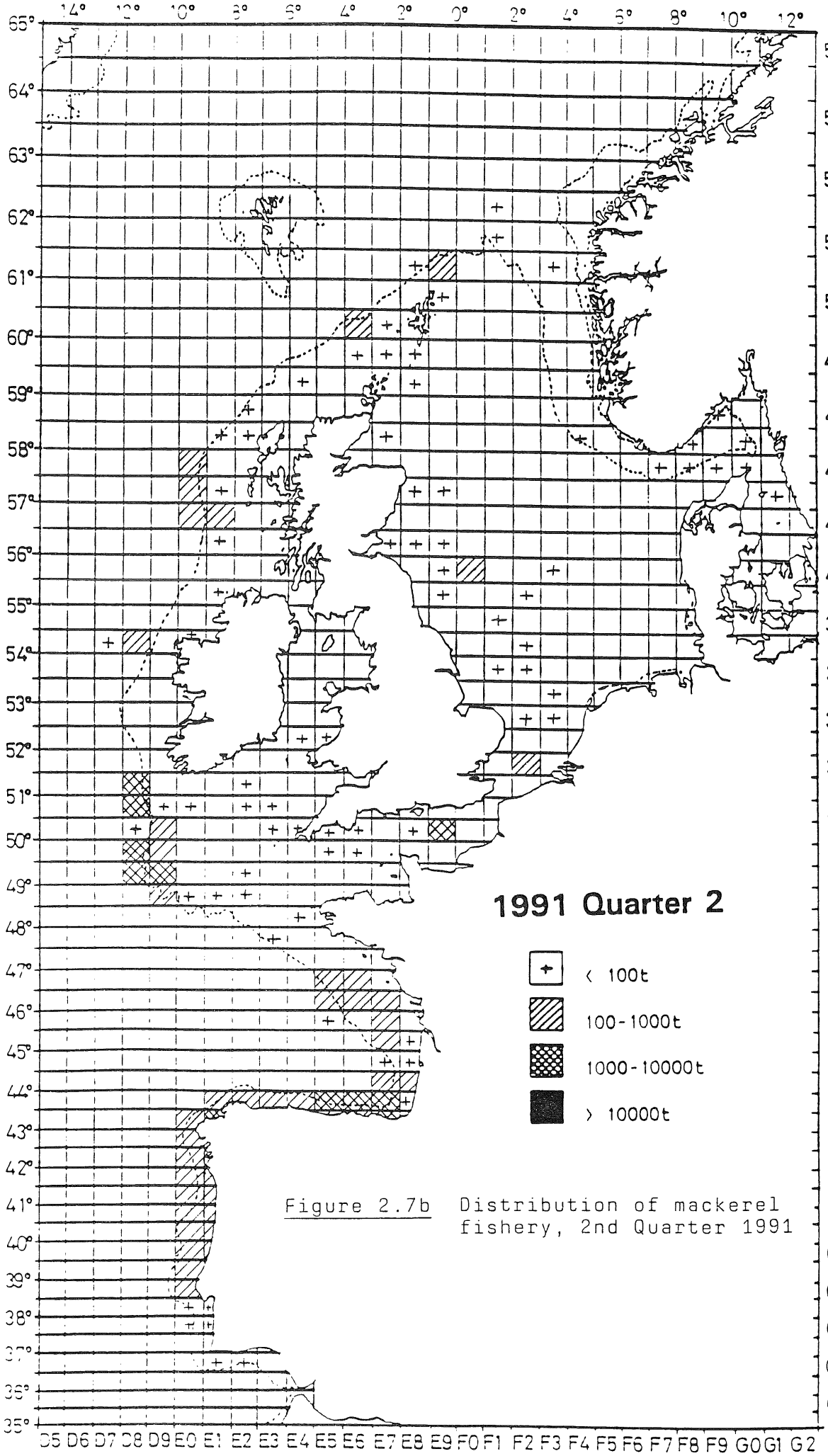


Figure 2.7b Distribution of mackerel fishery, 2nd Quarter 1991

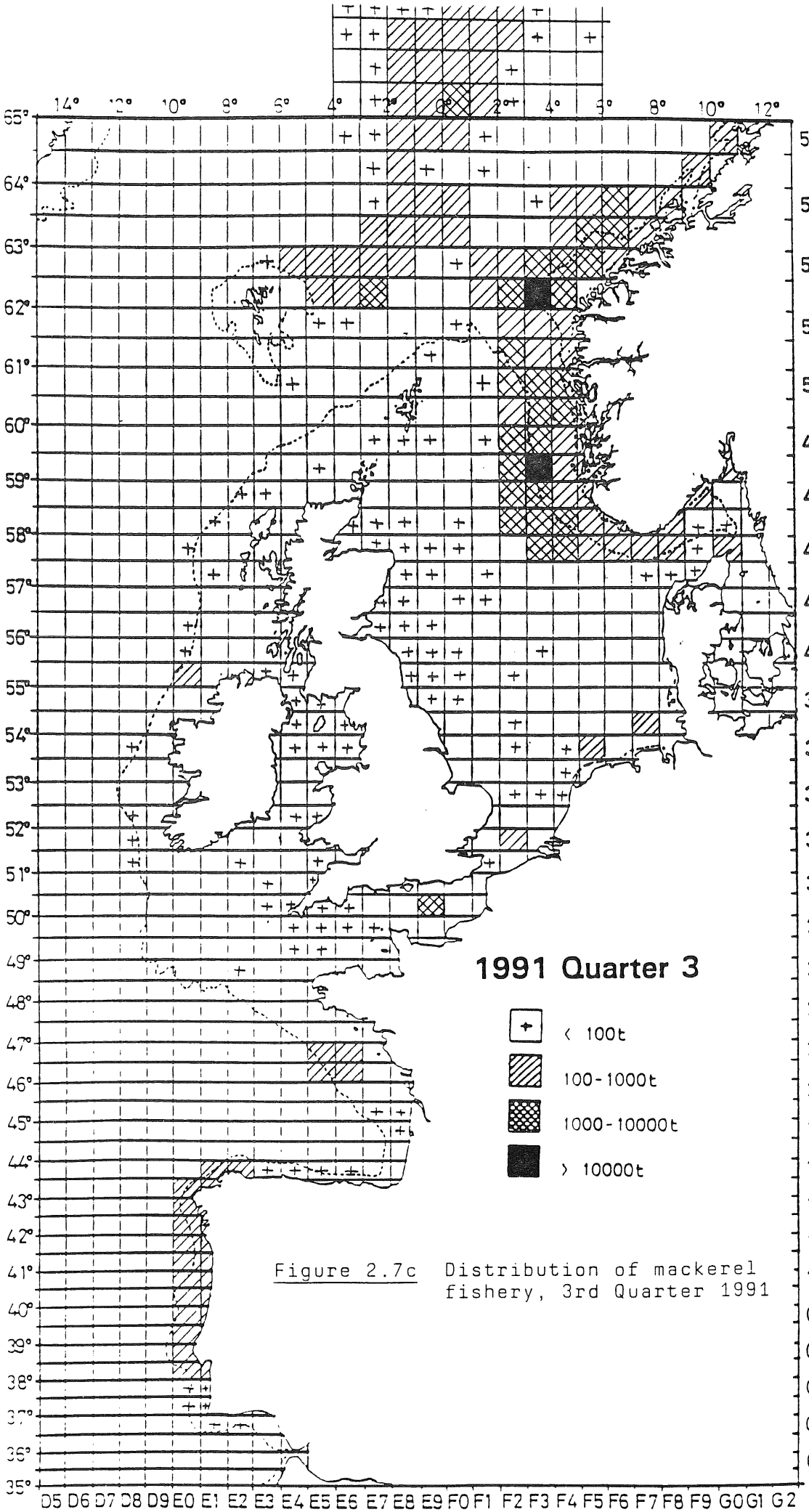


Figure 2.7c Distribution of mackerel fishery, 3rd Quarter 1991

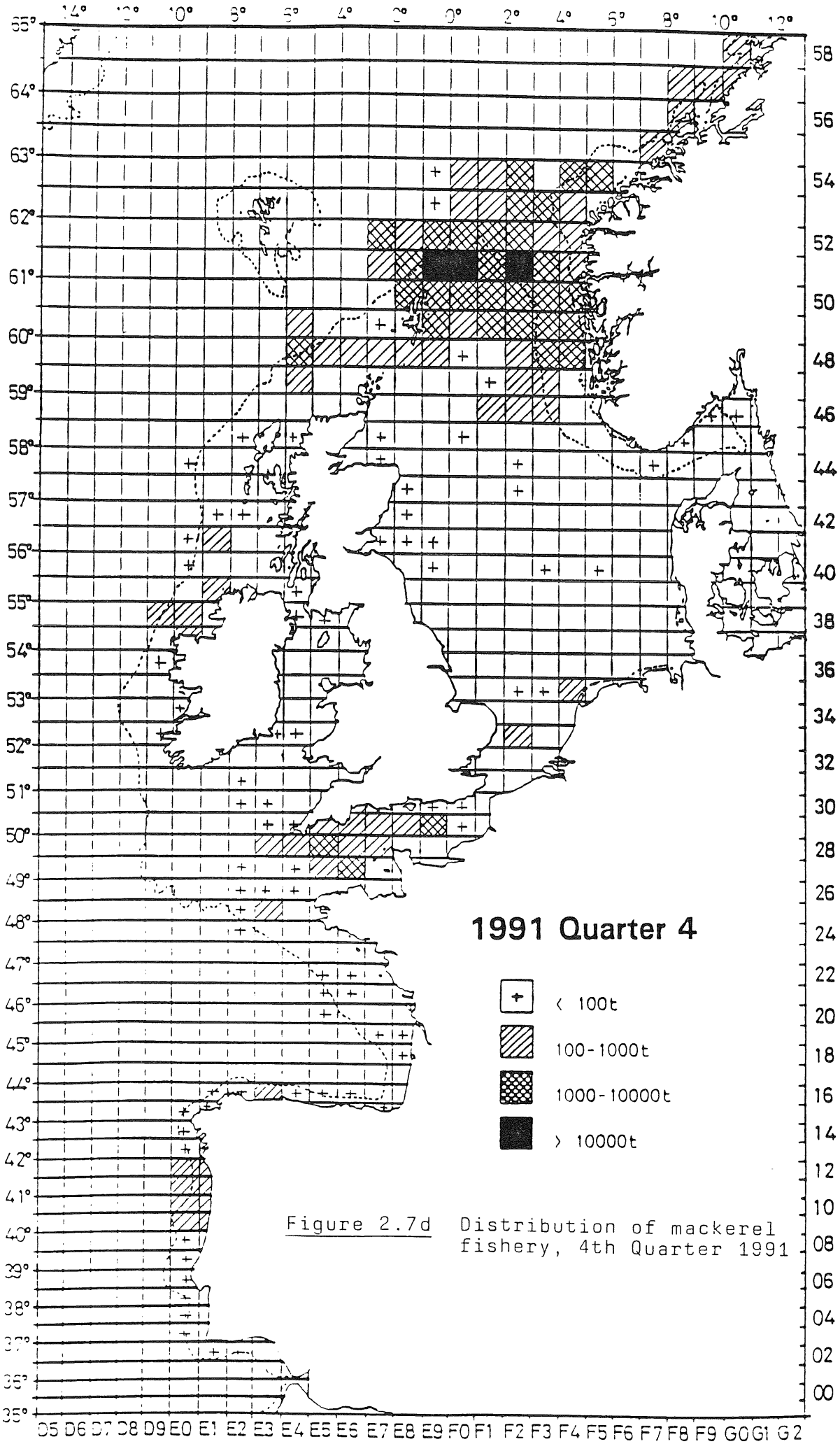


Figure 2.7d Distribution of mackerel fishery, 4th Quarter 1991

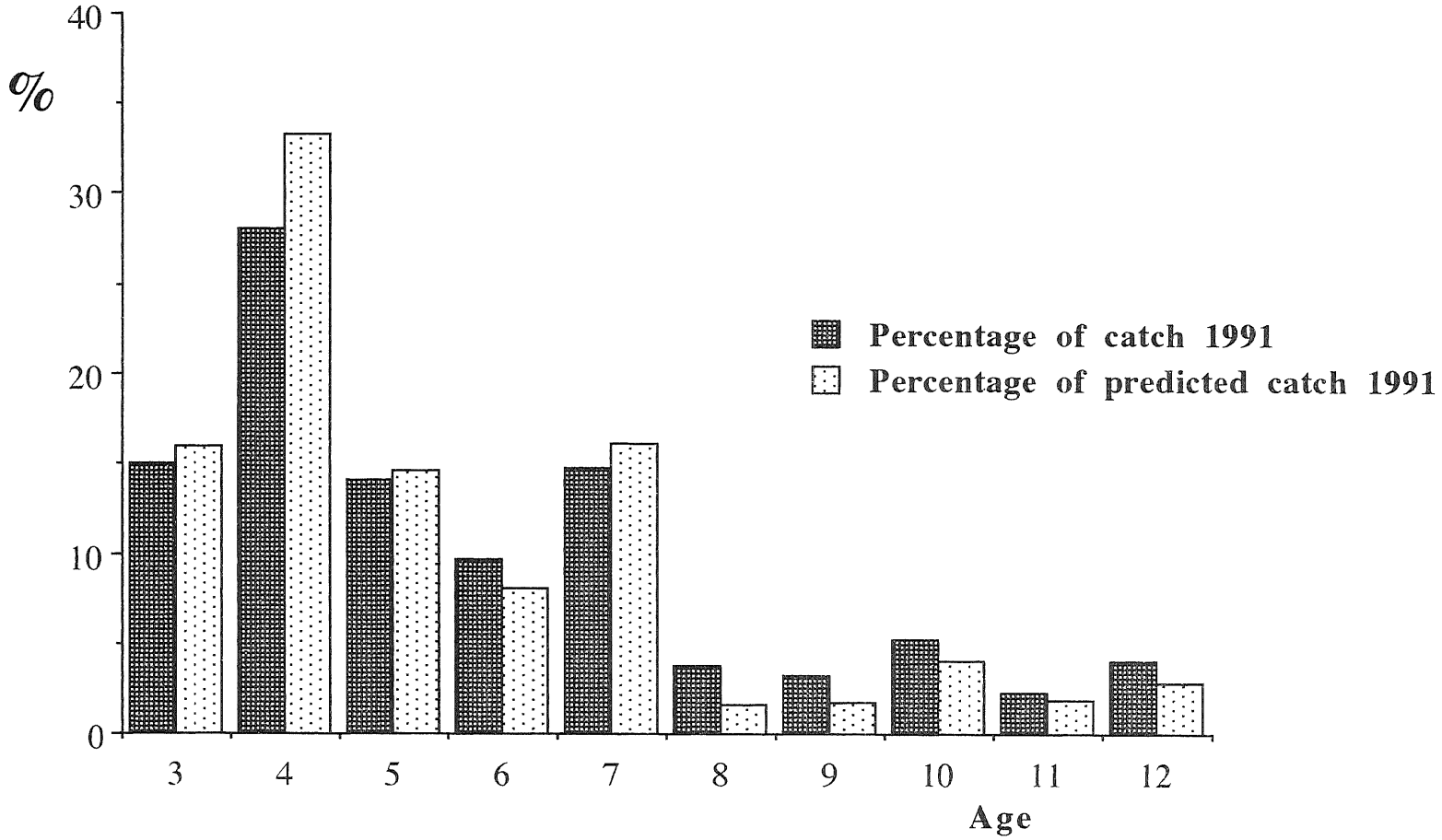


Figure 3.1 Comparison of actual and predicted catches by age groups of mackerel in 1991.

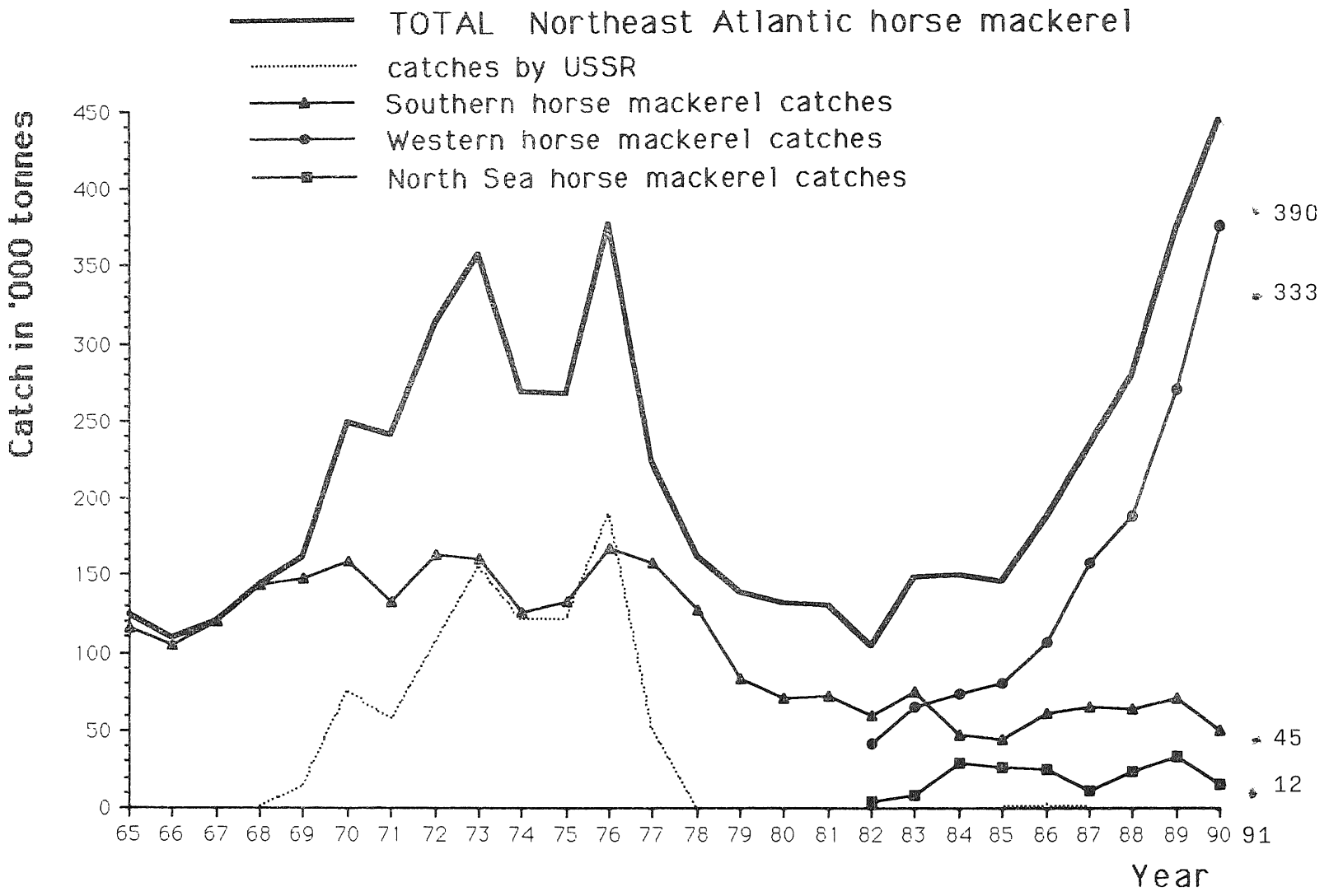


Figure 5.1 Total catches of horse mackerel in the northeast Atlantic from 1965-1991. The catches taken by the USSR and catches taken from the southern, western and North Sea horse mackerel stocks are shown in relation to the total catches.

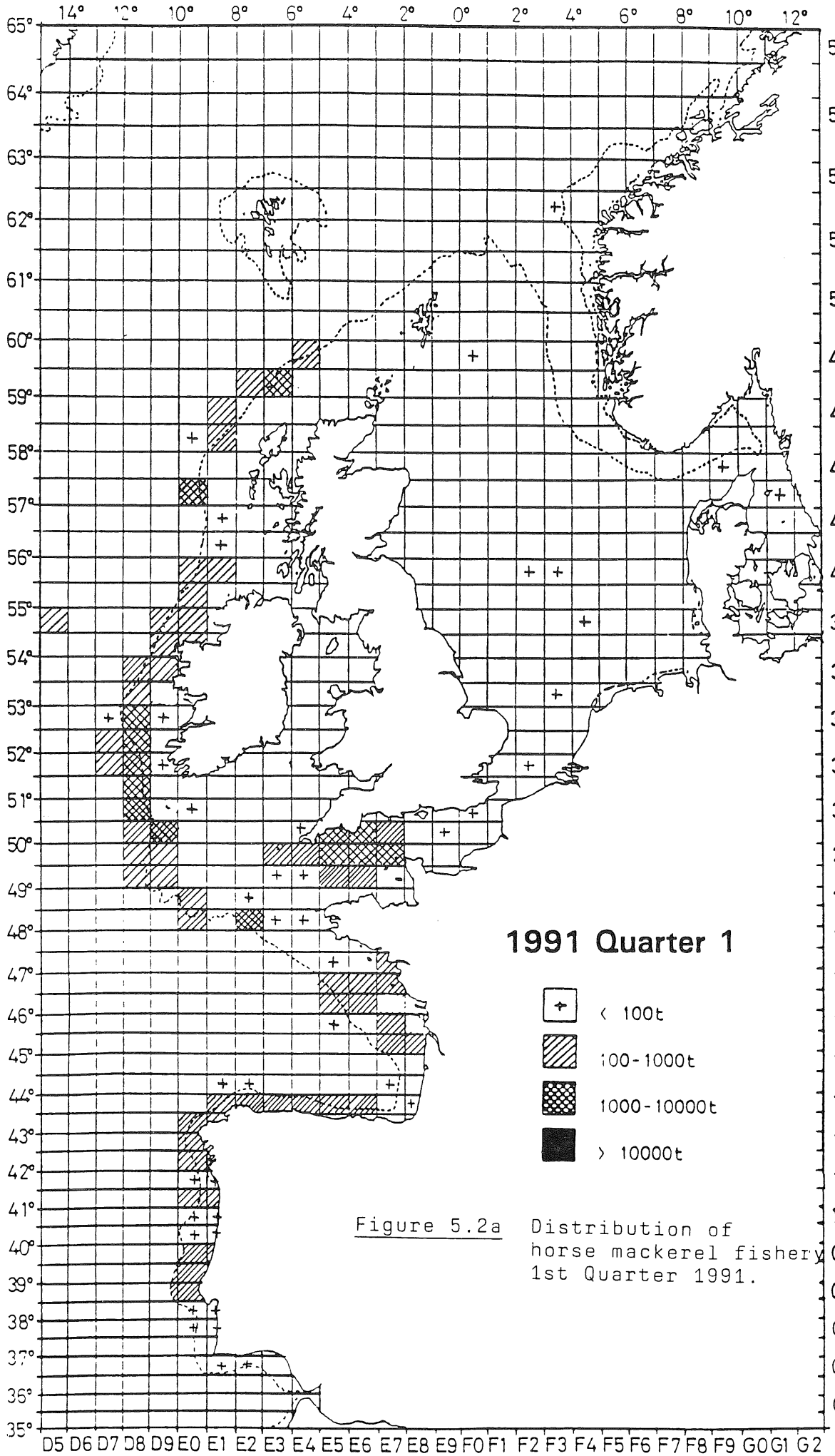


Figure 5.2a Distribution of horse mackerel fishery 1st Quarter 1991.

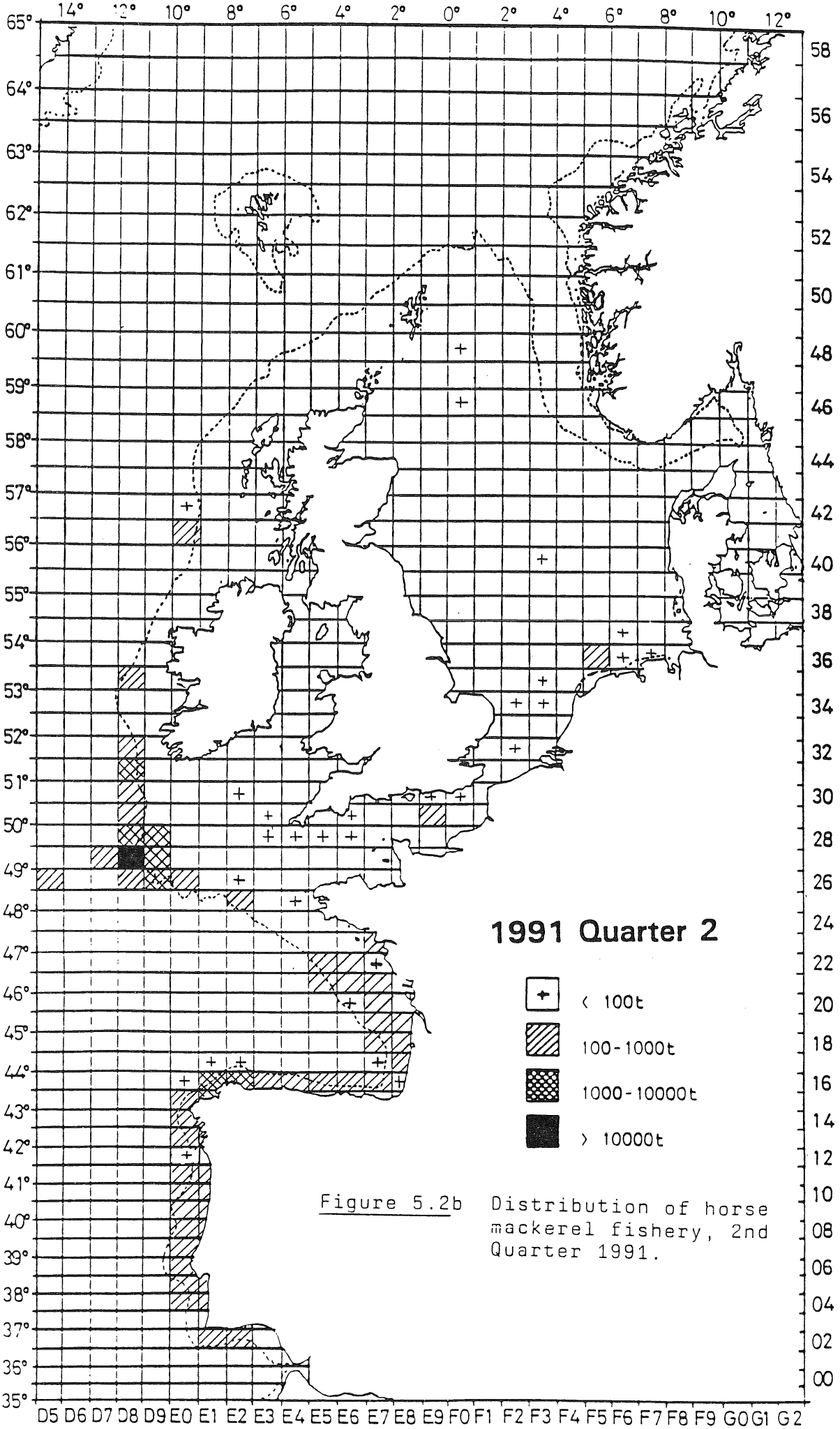


Figure 5.2b Distribution of horse mackerel fishery, 2nd Quarter 1991.

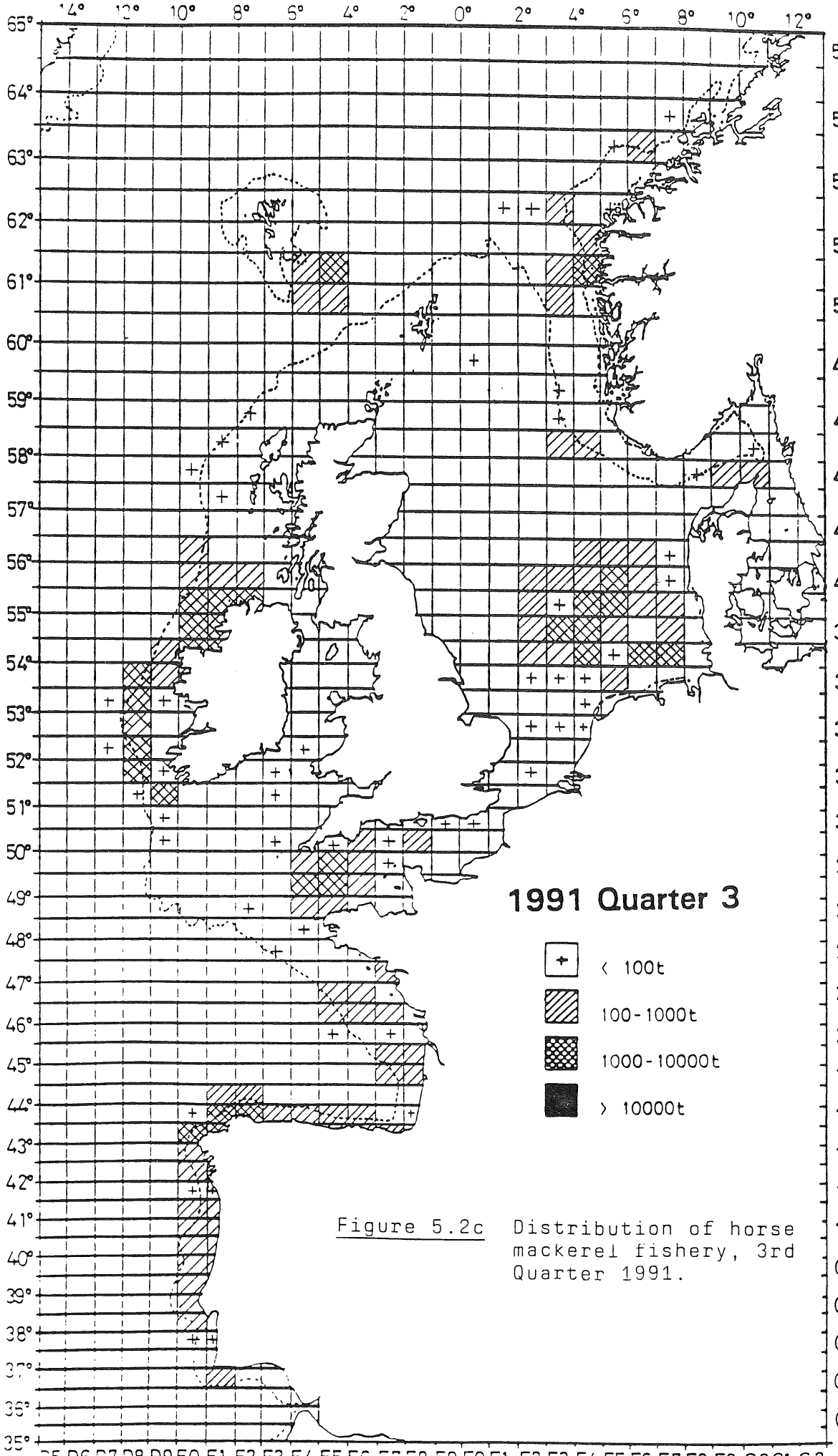


Figure 5.2c Distribution of horse mackerel fishery, 3rd Quarter 1991.

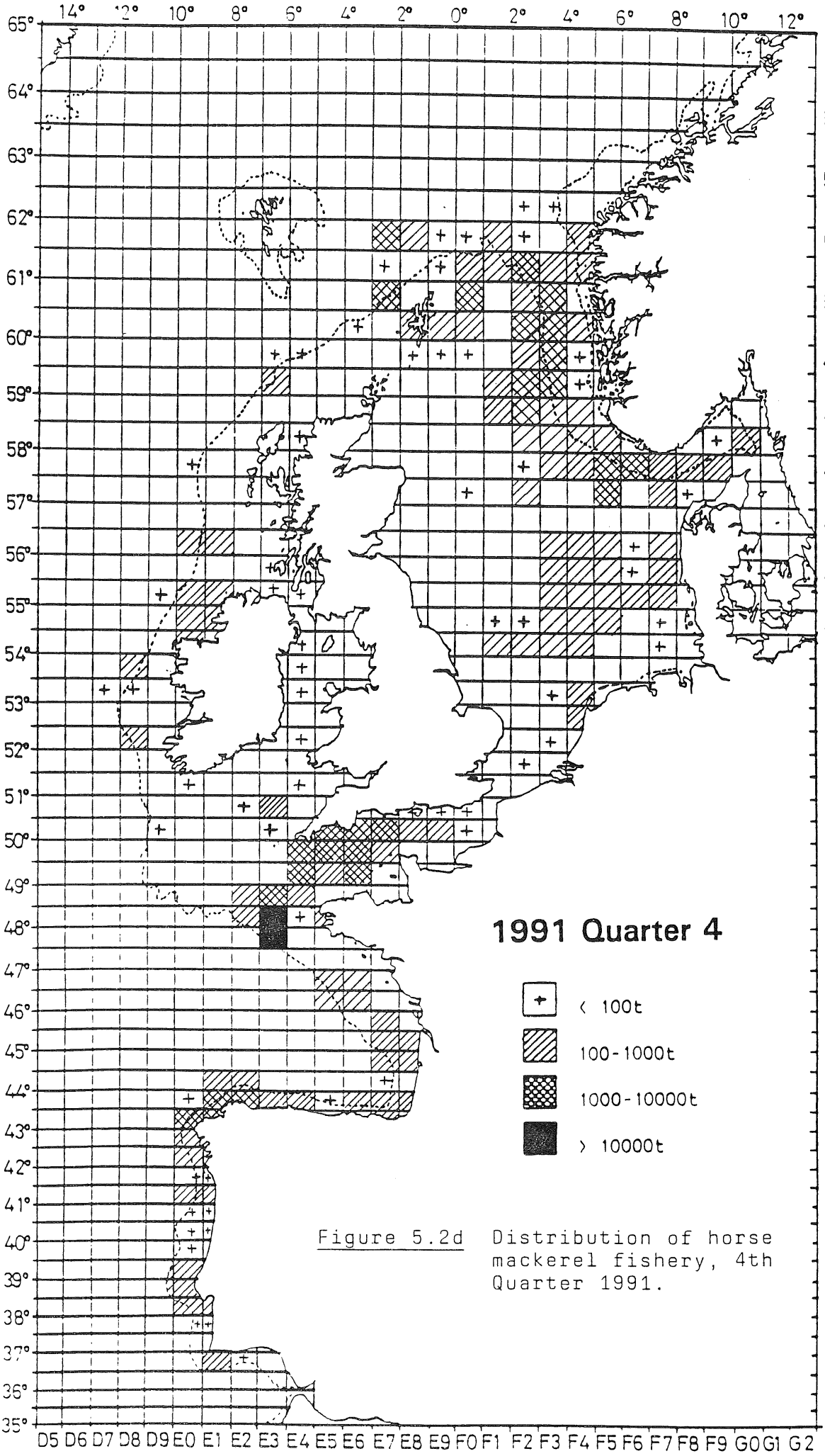


Figure 5.2d Distribution of horse mackerel fishery, 4th Quarter 1991.

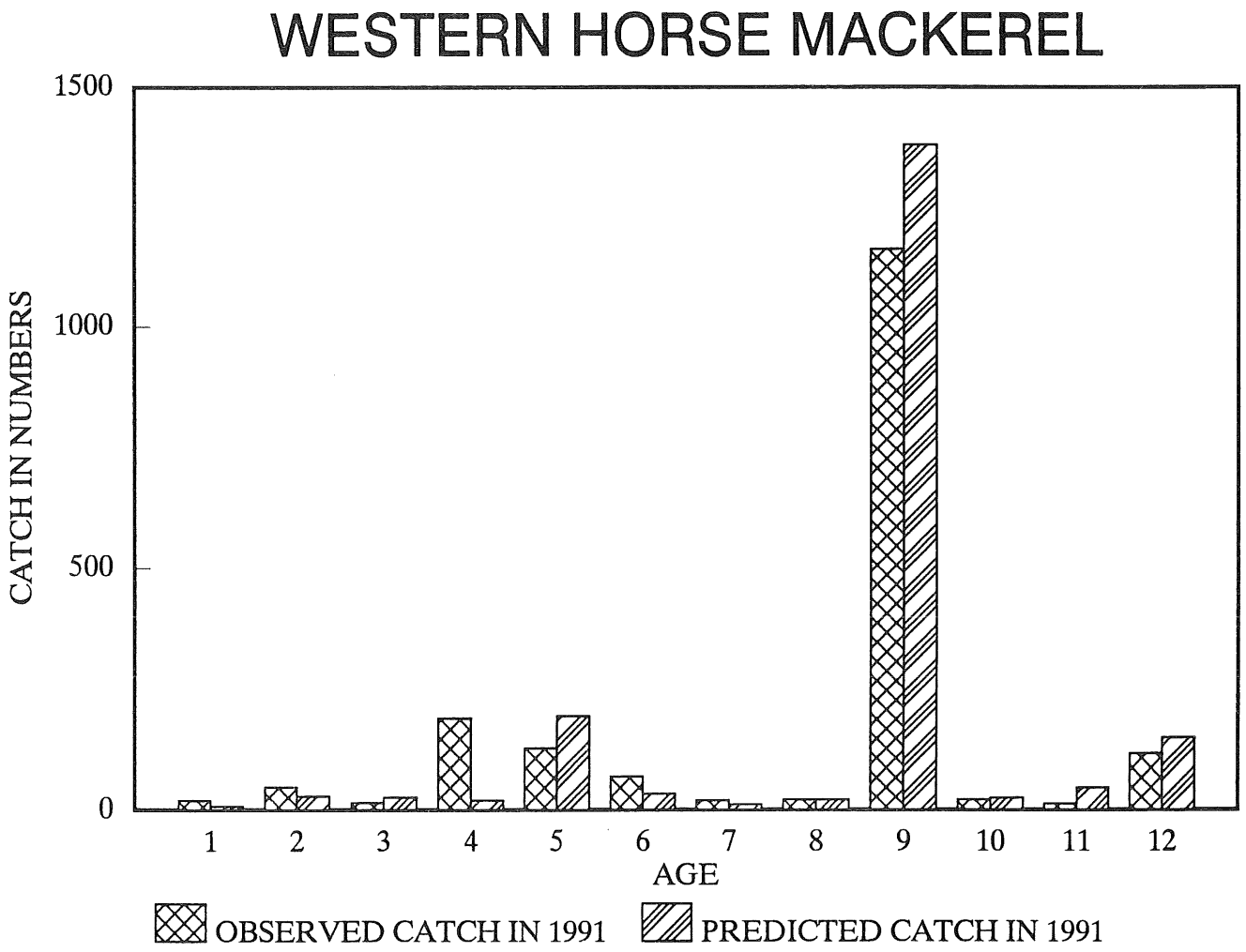


Figure 7.1 Comparison of actual and predicted catch in numbers of western horse mackerel in 1991.

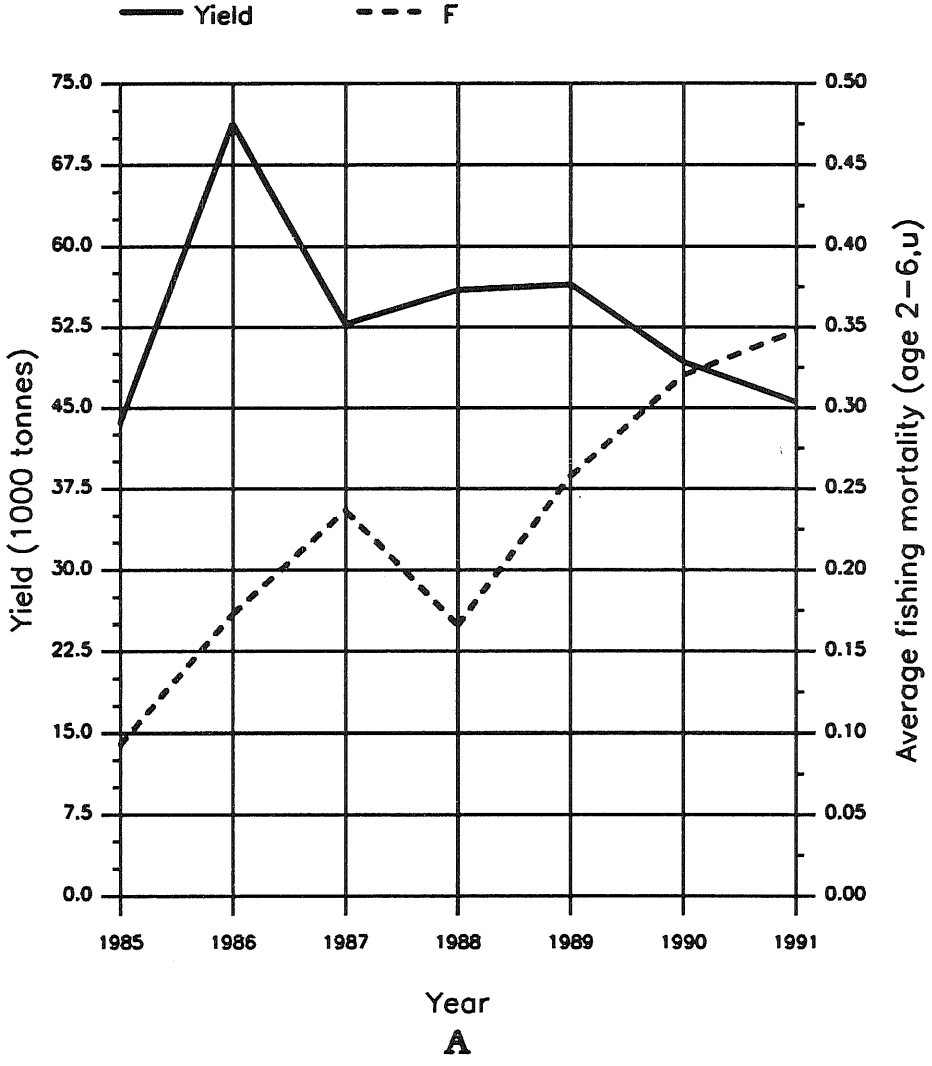
Figure 8.1

FISH STOCK SUMMARY

STOCK: Horse mackerel in Fishing Areas VIIIc and IXa

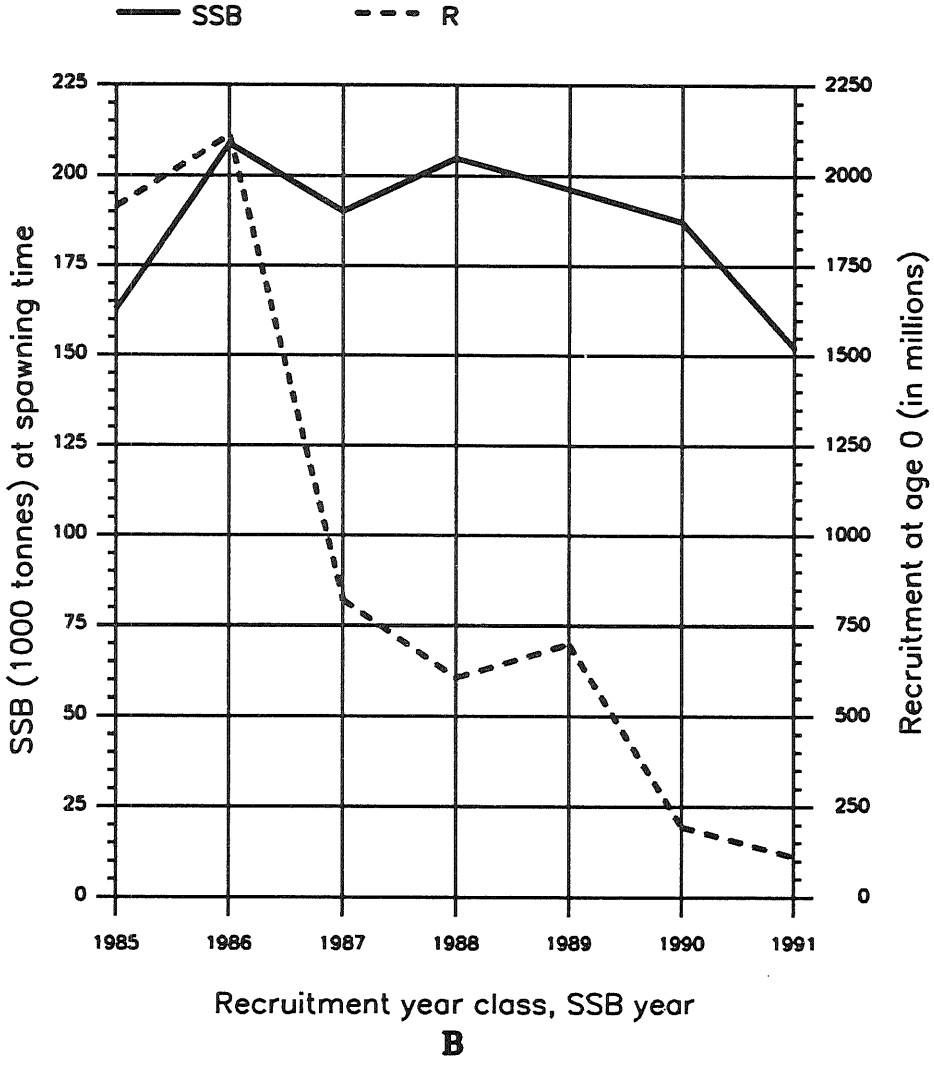
30–6–1992

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



B

Figure 8.2

Horse mackerel Southern

Selection pattern (various terminal S)

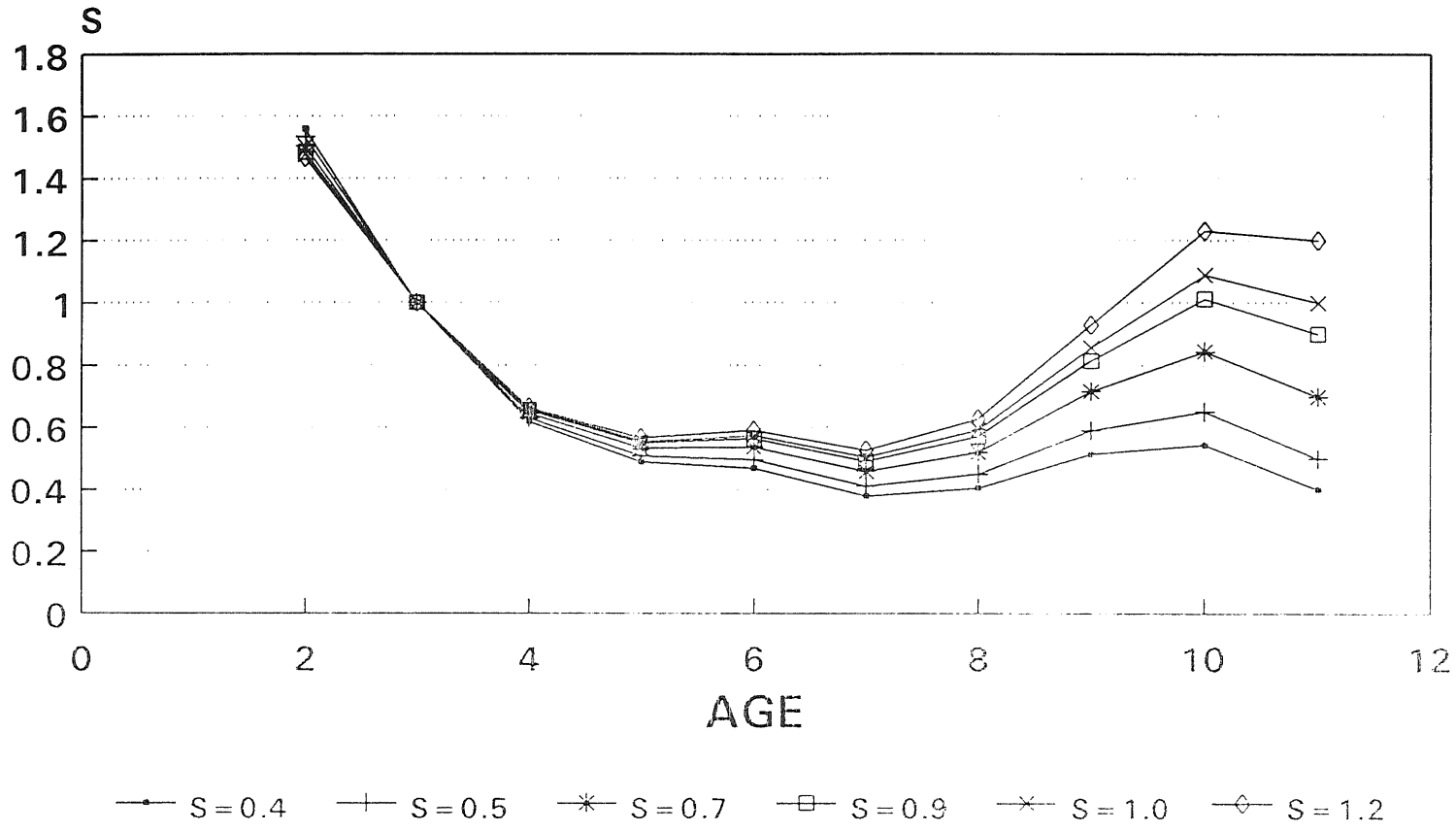
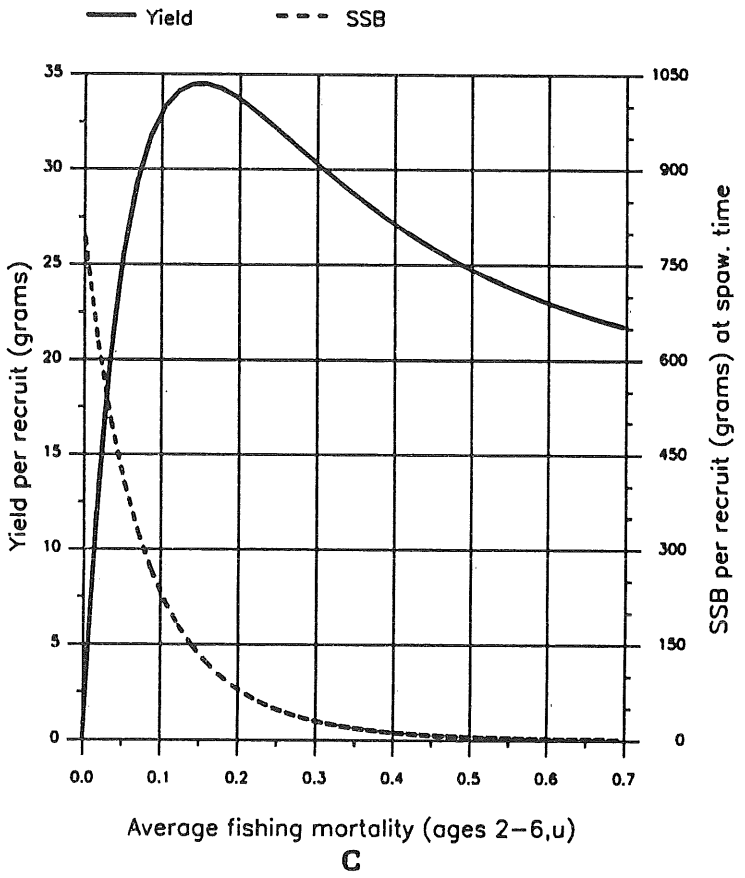
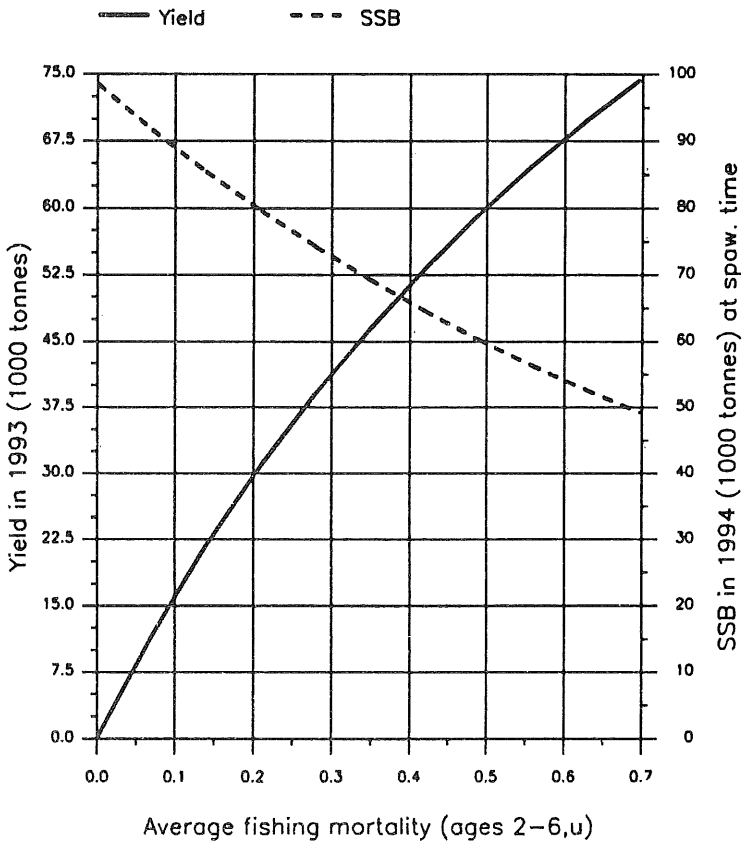


Figure 8.3 Long term yield and spawning stock biomass



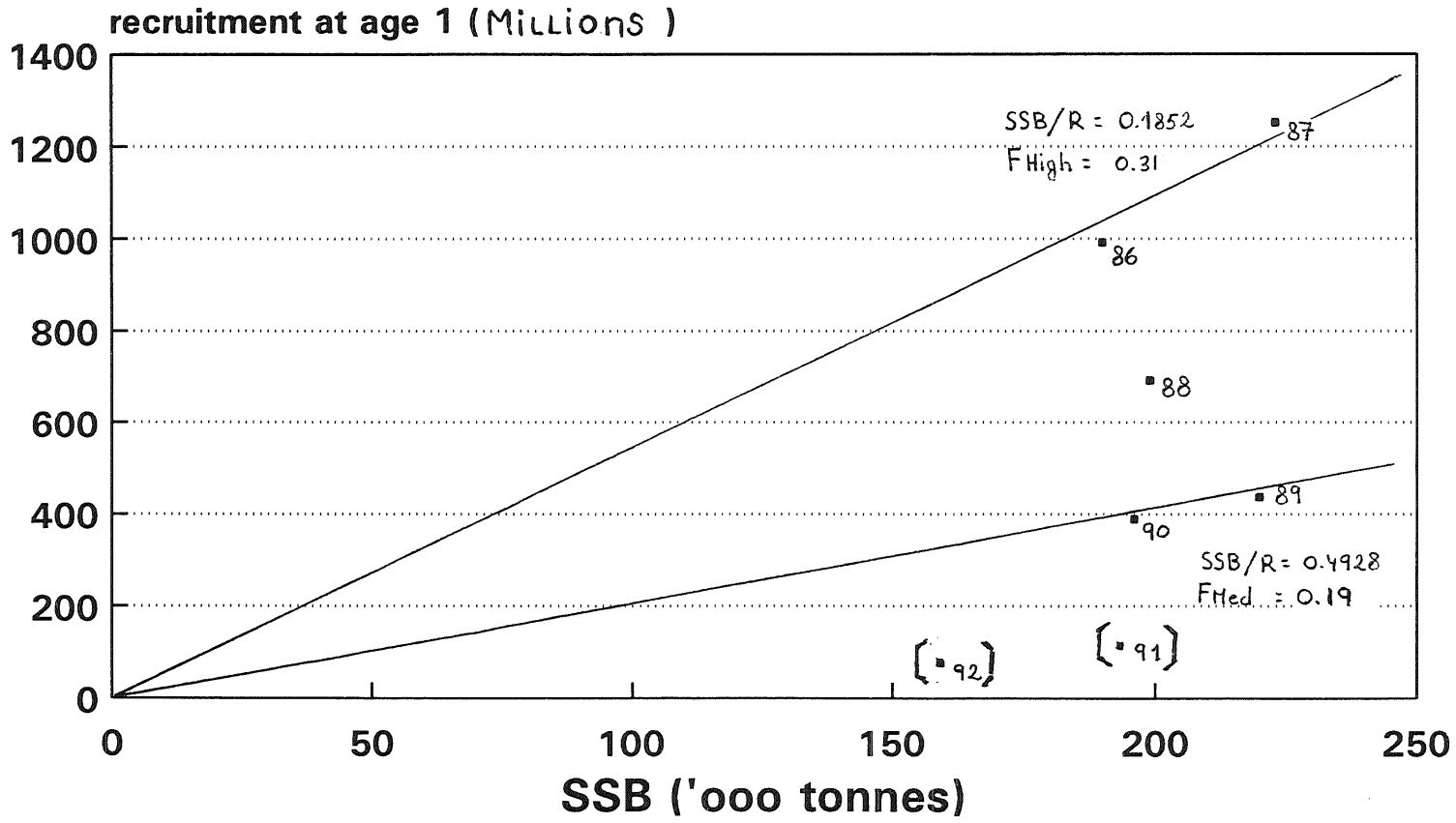
C

Figure 8.4 Short-term yield and spawning stock biomass



D

Figure 8.5


recruitment at age 1 (Millions)
1400
1200
1000
800
600
400
200
0
0
50
100
150
200
250
SSB ('ooo tonnes)
SSB/R = 0.1852
FHigh = 0.31
87
86
88
89
90
SSB/R = 0.4928
FMed = 0.19
92
91

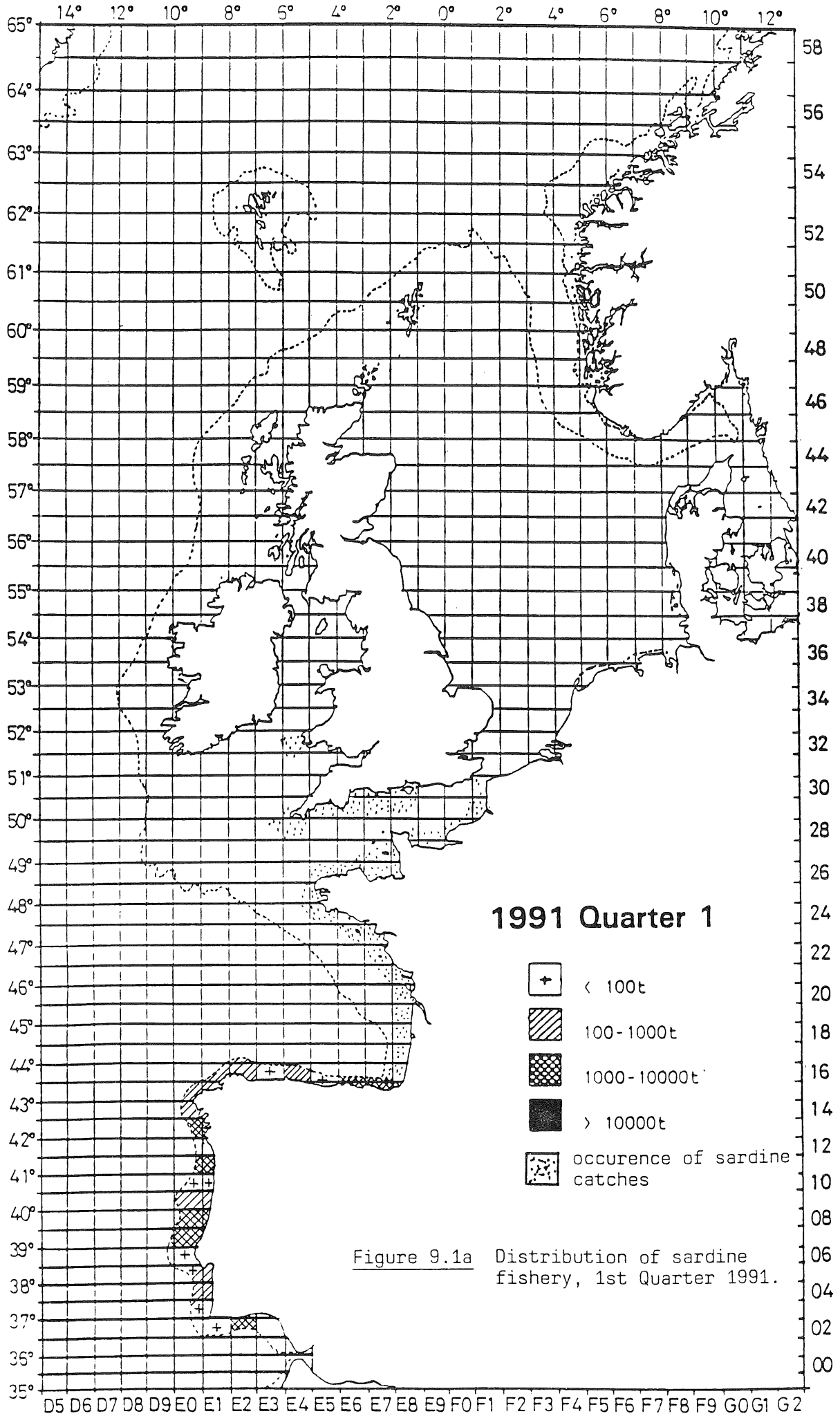


Figure 9.1a Distribution of sardine fishery, 1st Quarter 1991.

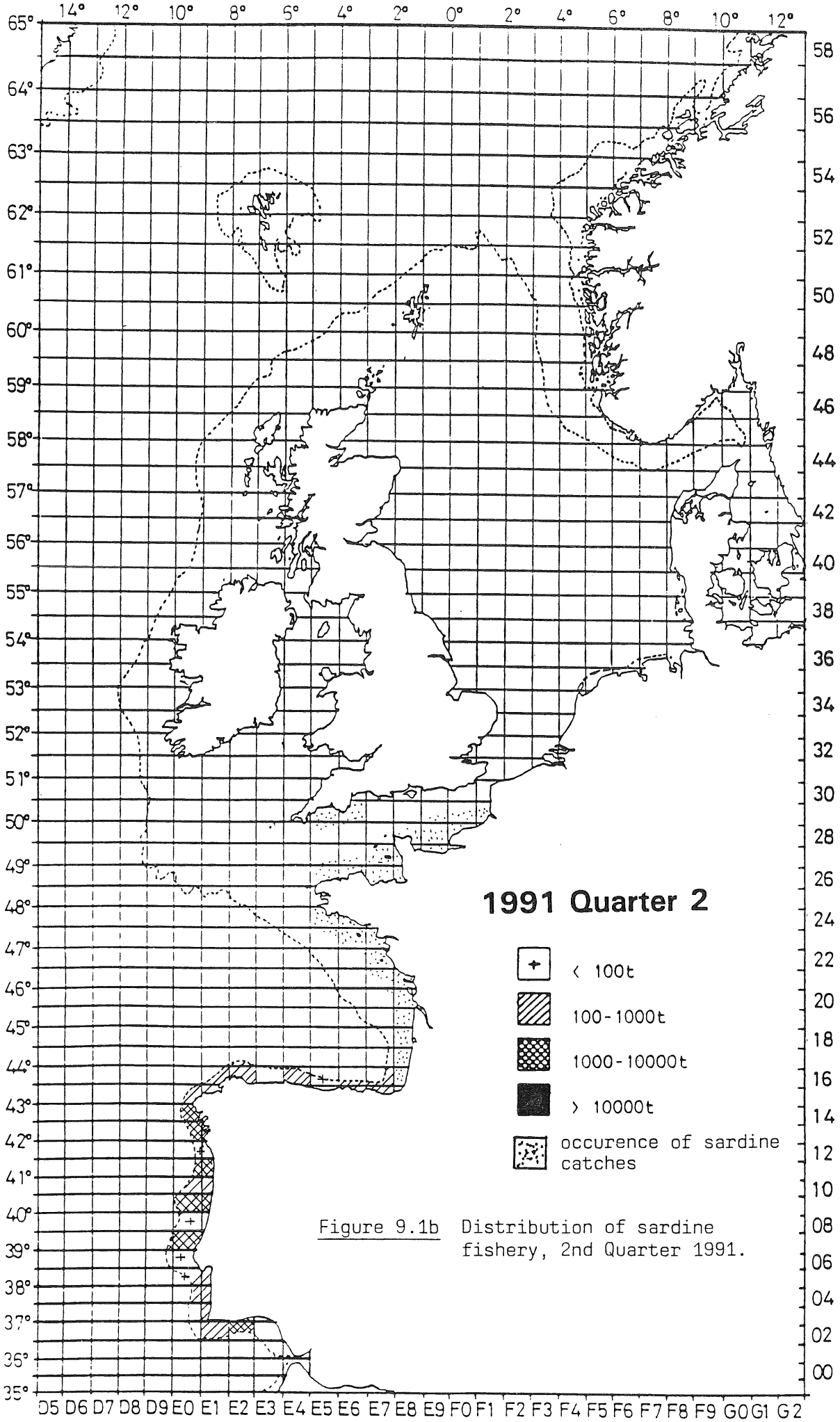


Figure 9.1b Distribution of sardine fishery, 2nd Quarter 1991.

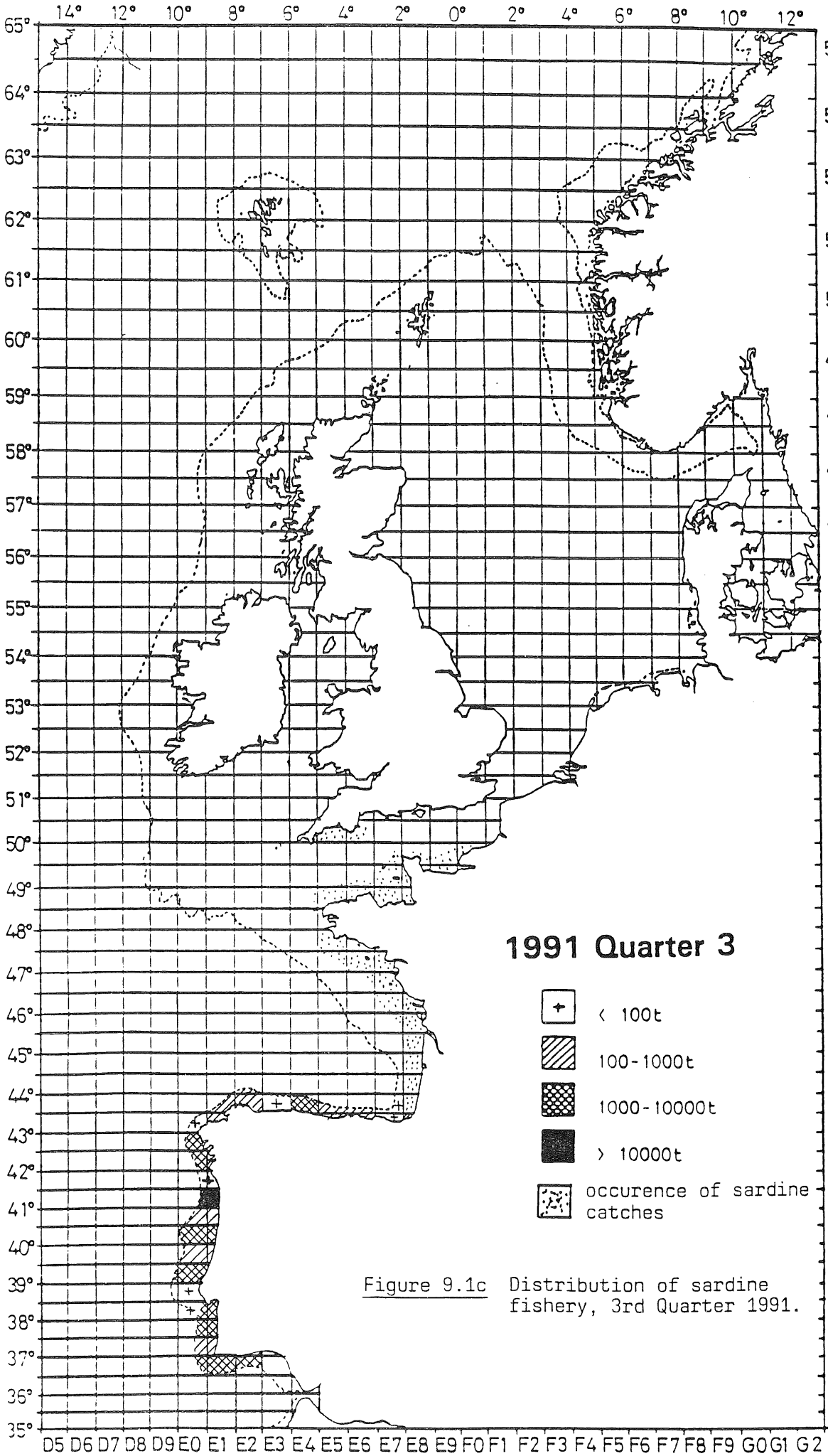


Figure 9.1c Distribution of sardine fishery, 3rd Quarter 1991.

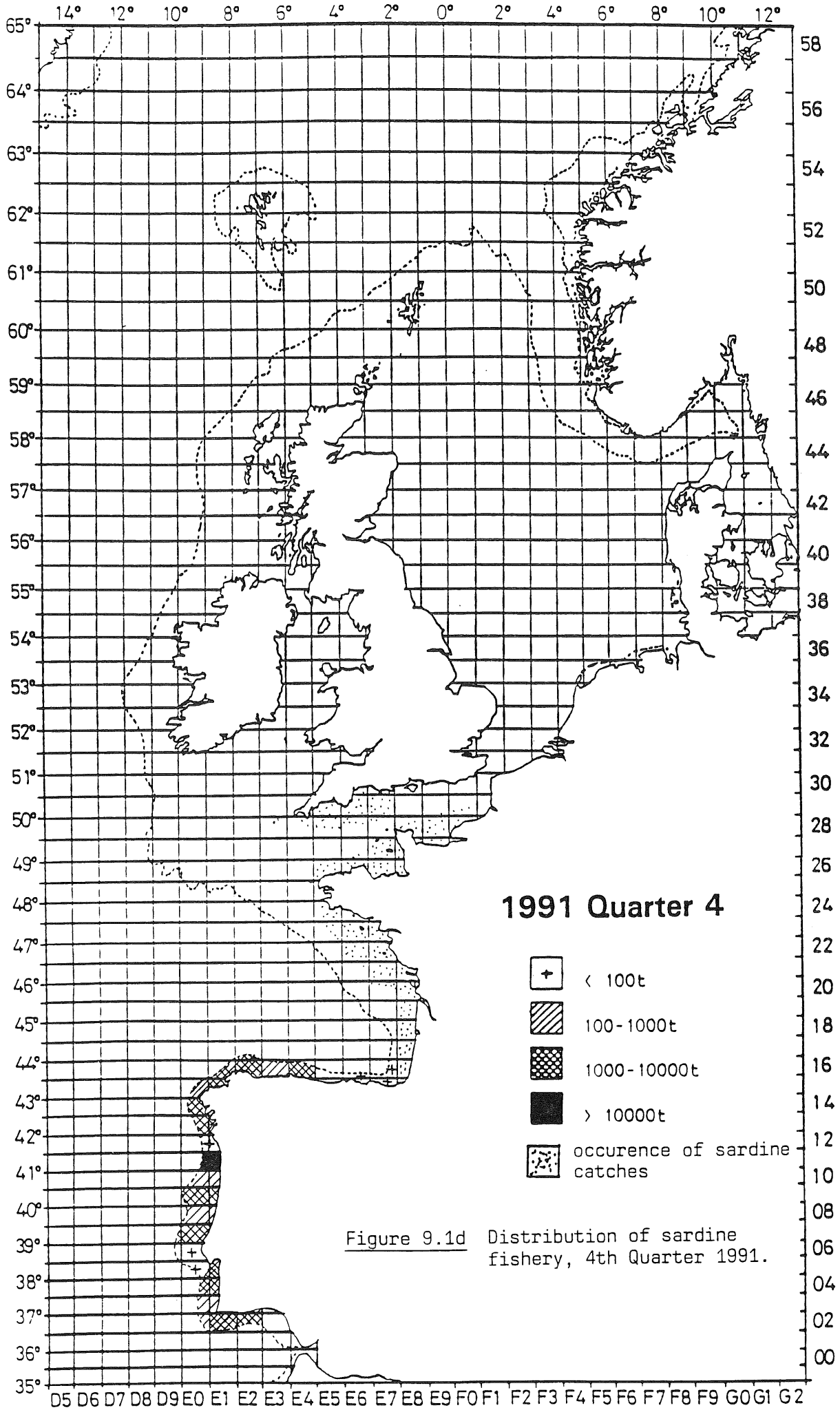


Figure 9.1d Distribution of sardine fishery, 4th Quarter 1991.

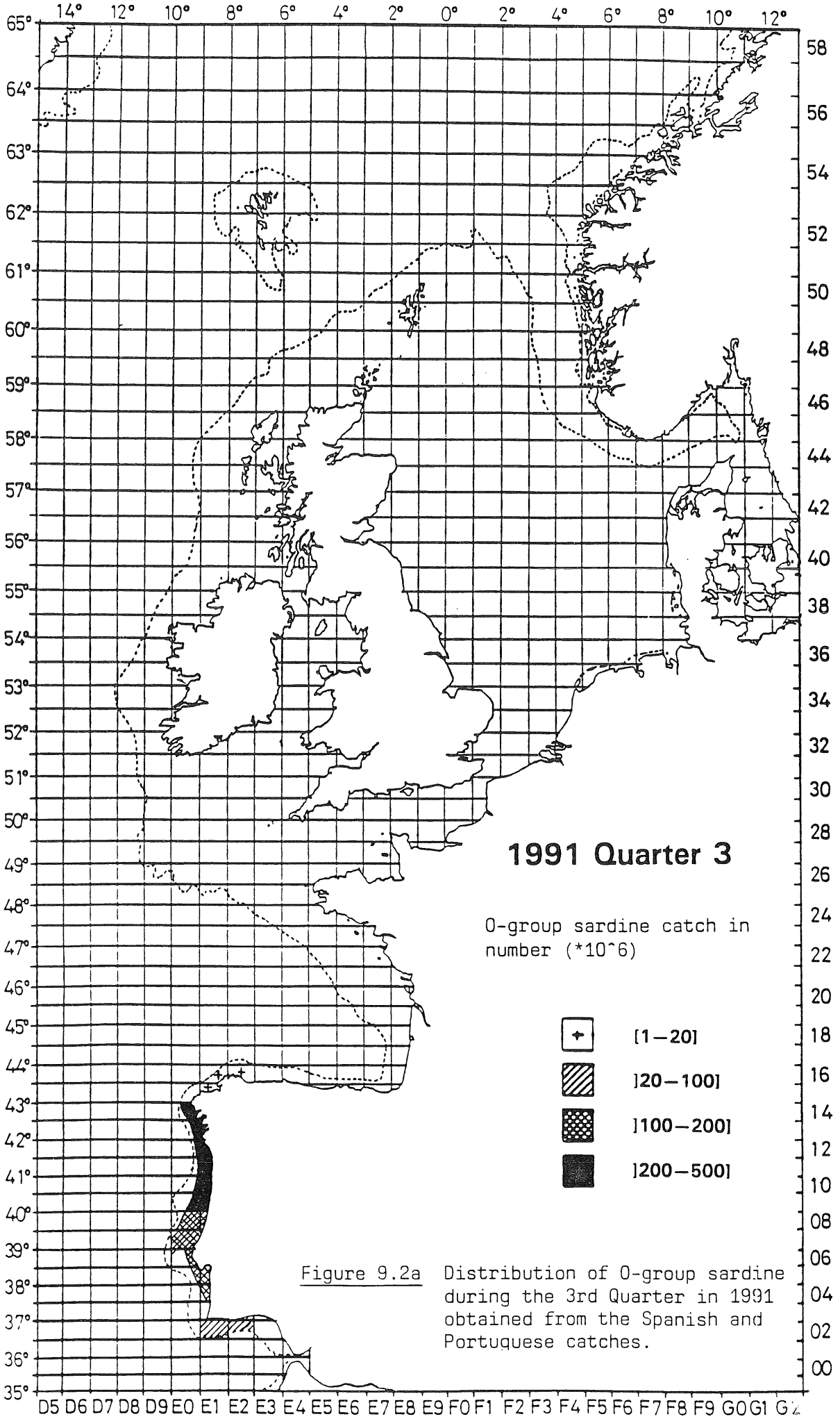


Figure 9.2a Distribution of 0-group sardine during the 3rd Quarter in 1991 obtained from the Spanish and Portuguese catches.

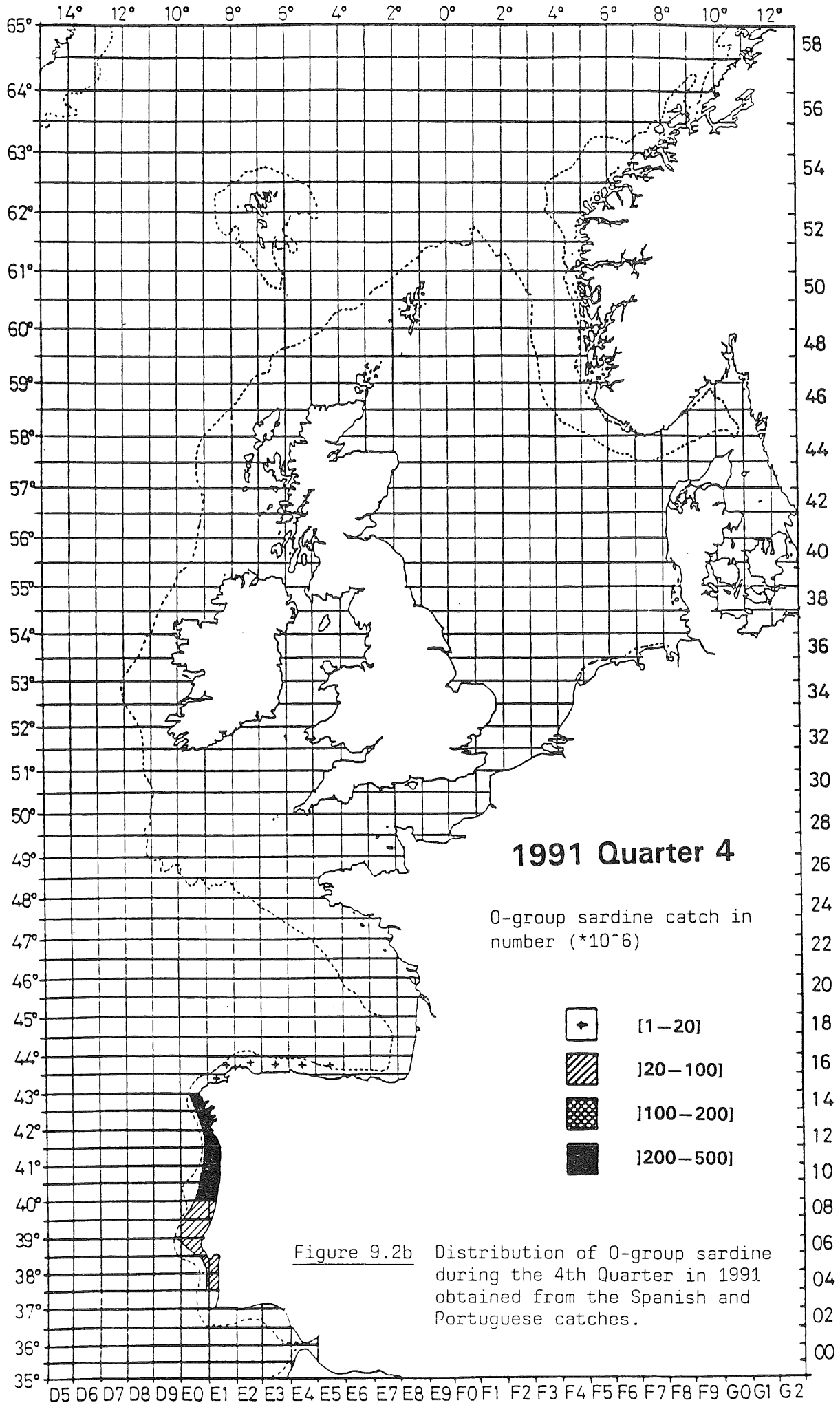


Figure 9.2b Distribution of 0-group sardine during the 4th Quarter in 1991 obtained from the Spanish and Portuguese catches.

Figure 9.3.SARDINE. CPUE data

from Purse seine fleets

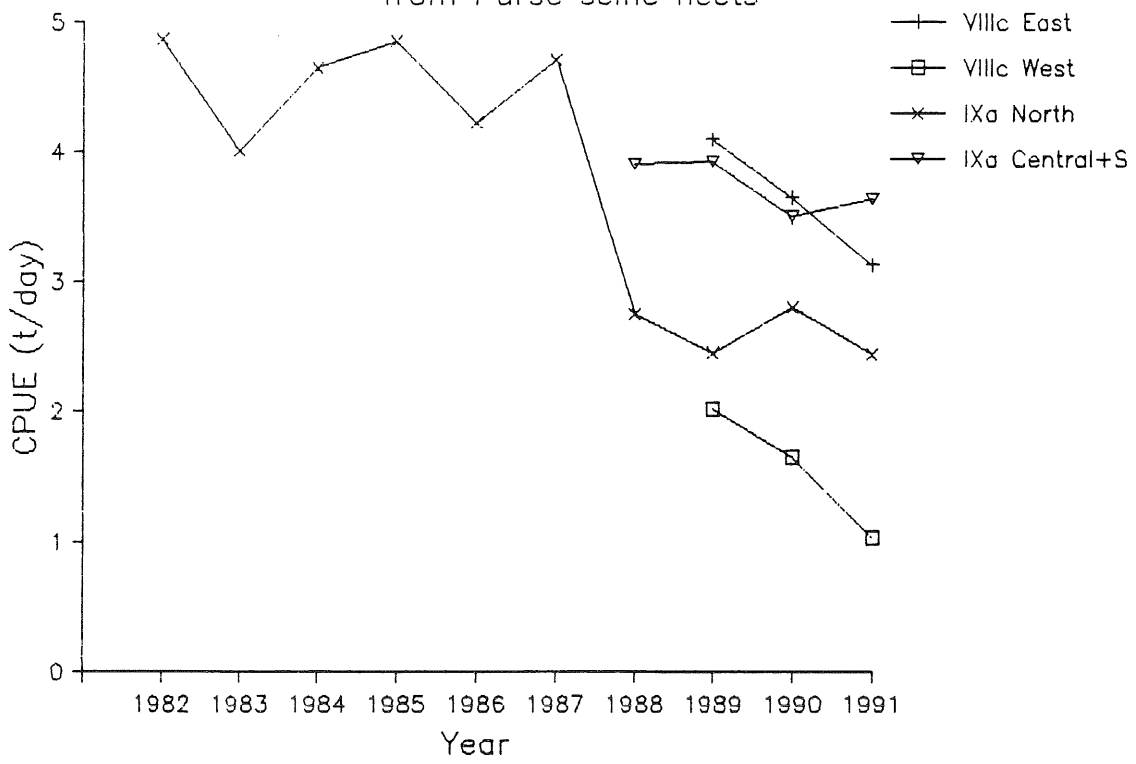


Figure 9.4 SARDINE – DIV. VIIIc, IXa

MATURITY OGIVE

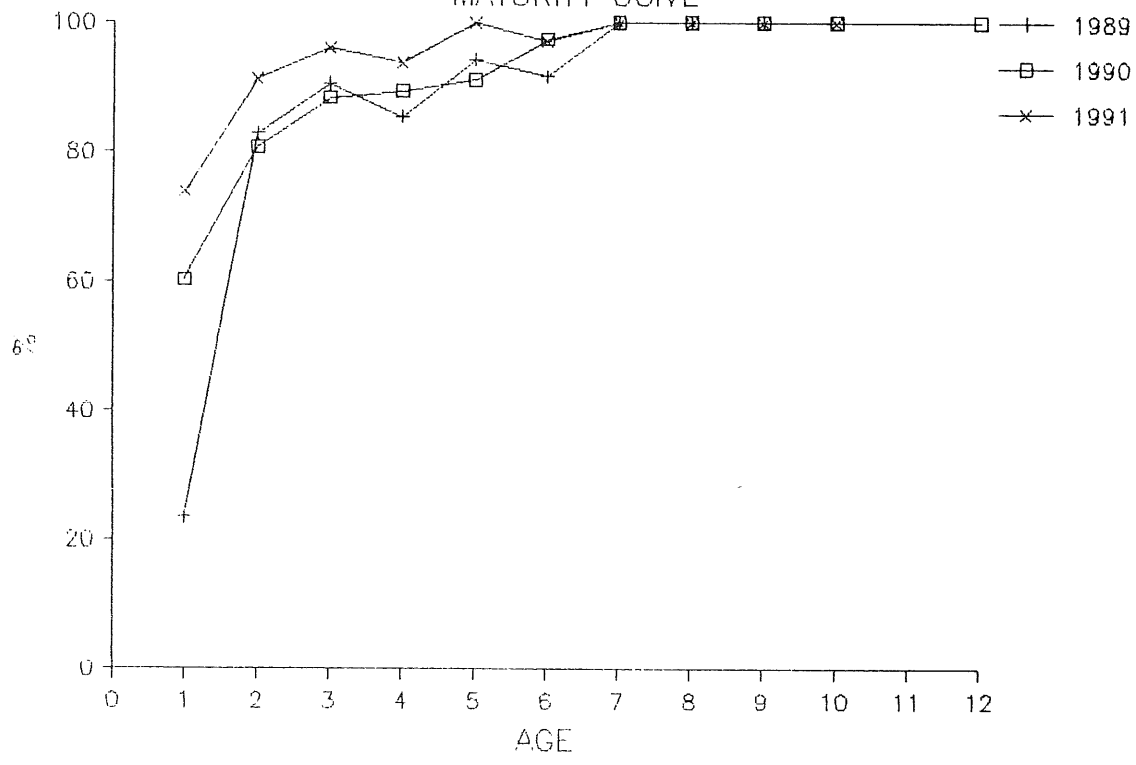
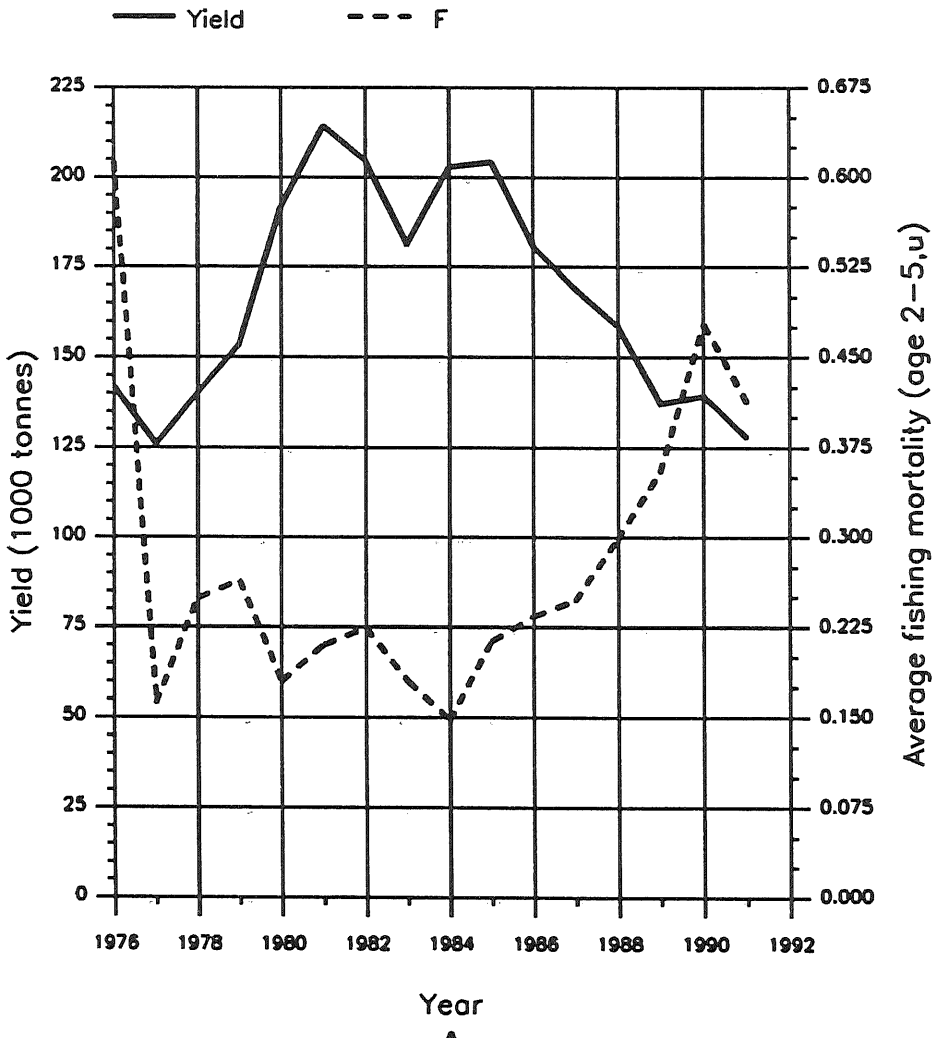


Figure 9.5 (Option A)

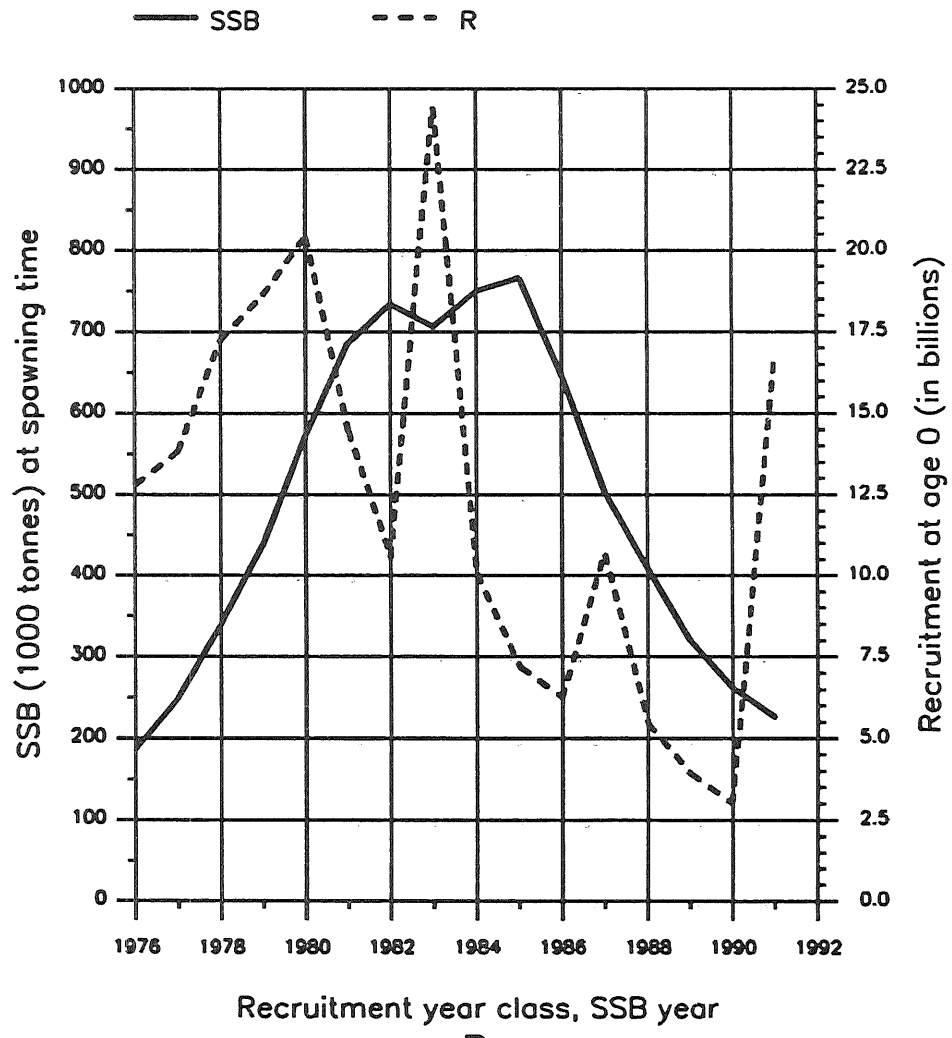
FISH STOCK SUMMARY
STOCK: Sardine in Fishing Areas VIIIc and IXa
27–6–1992

Trends in yield and fishing mortality (F)



A

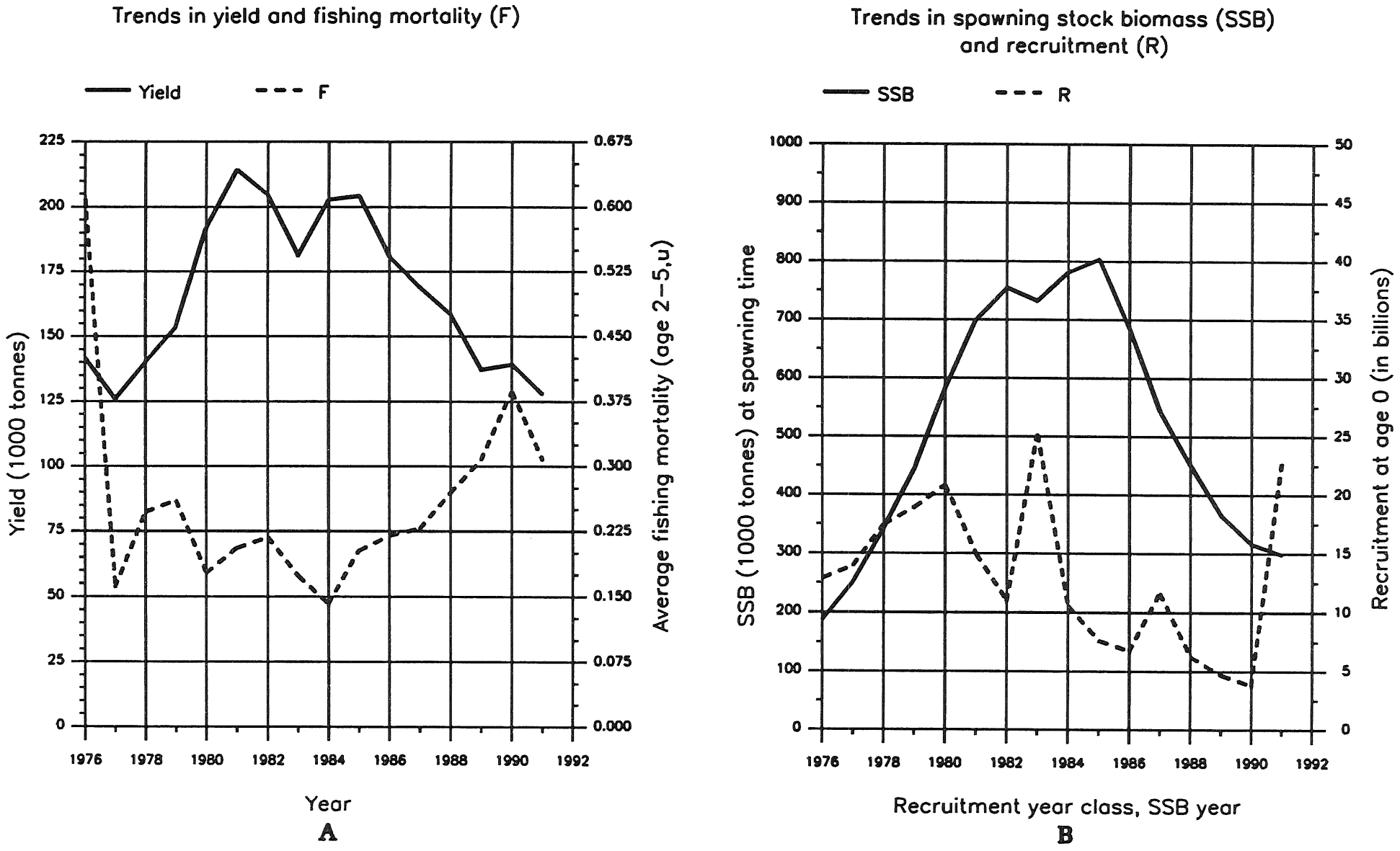
Trends in spawning stock biomass (SSB) and recruitment (R)



B

Figure 9.6 (Option B)

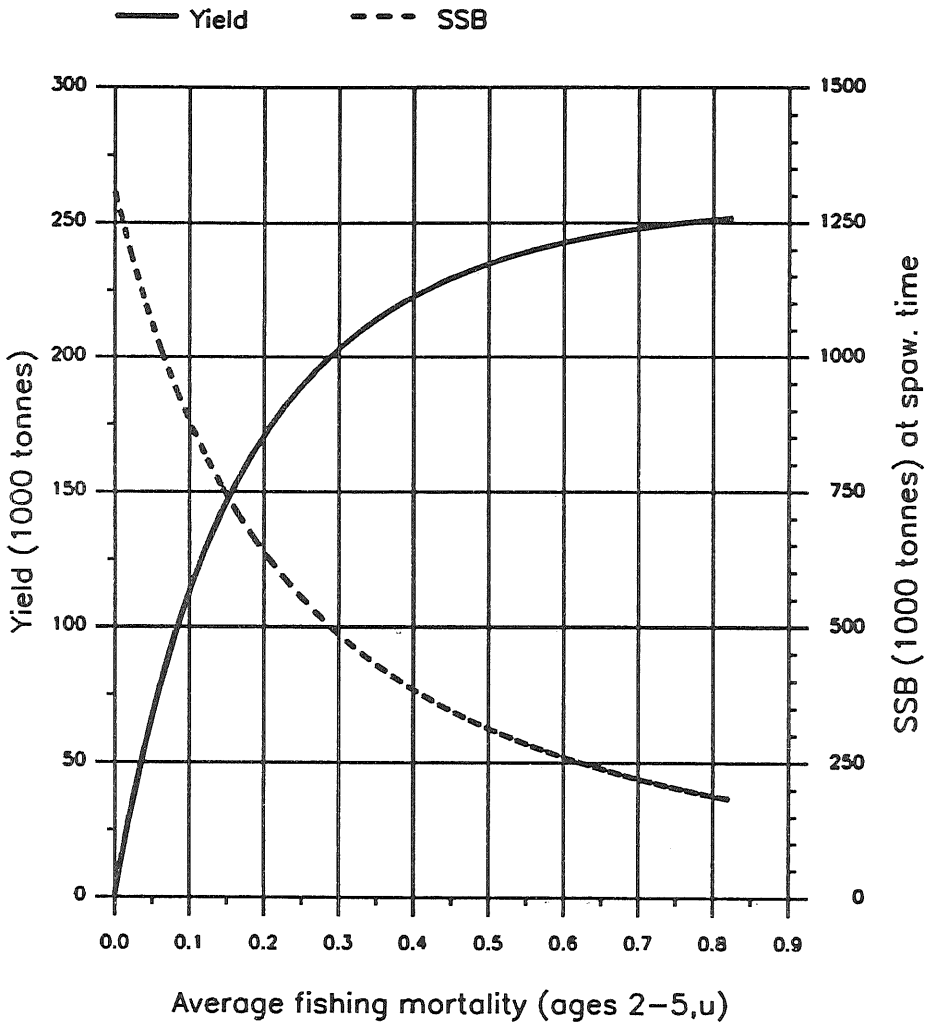
FISH STOCK SUMMARY
STOCK: Sardine in Fishing Areas VIIIc and IXa
29–6–1992



FISH STOCK SUMMARY
STOCK: Sardine in Fishing Areas VIIIc and IXa
29-6-1992

Figure 9.7

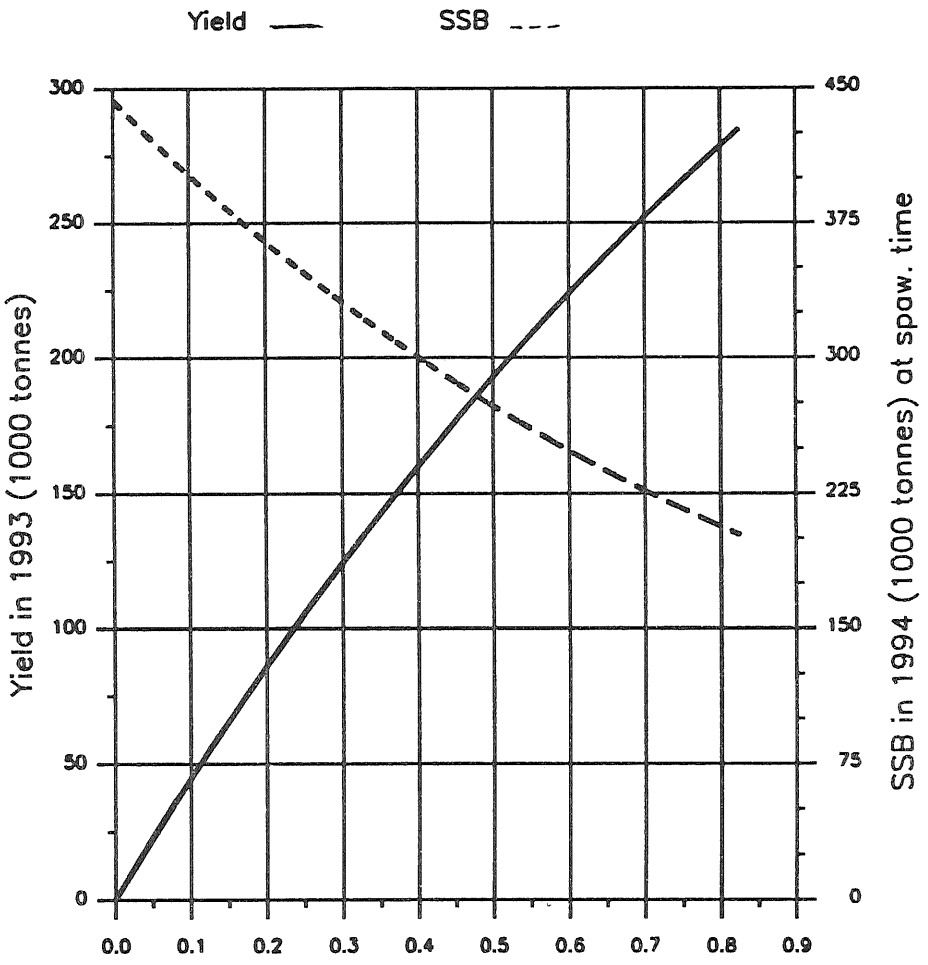
Long term yield and spawning stock biomass



C

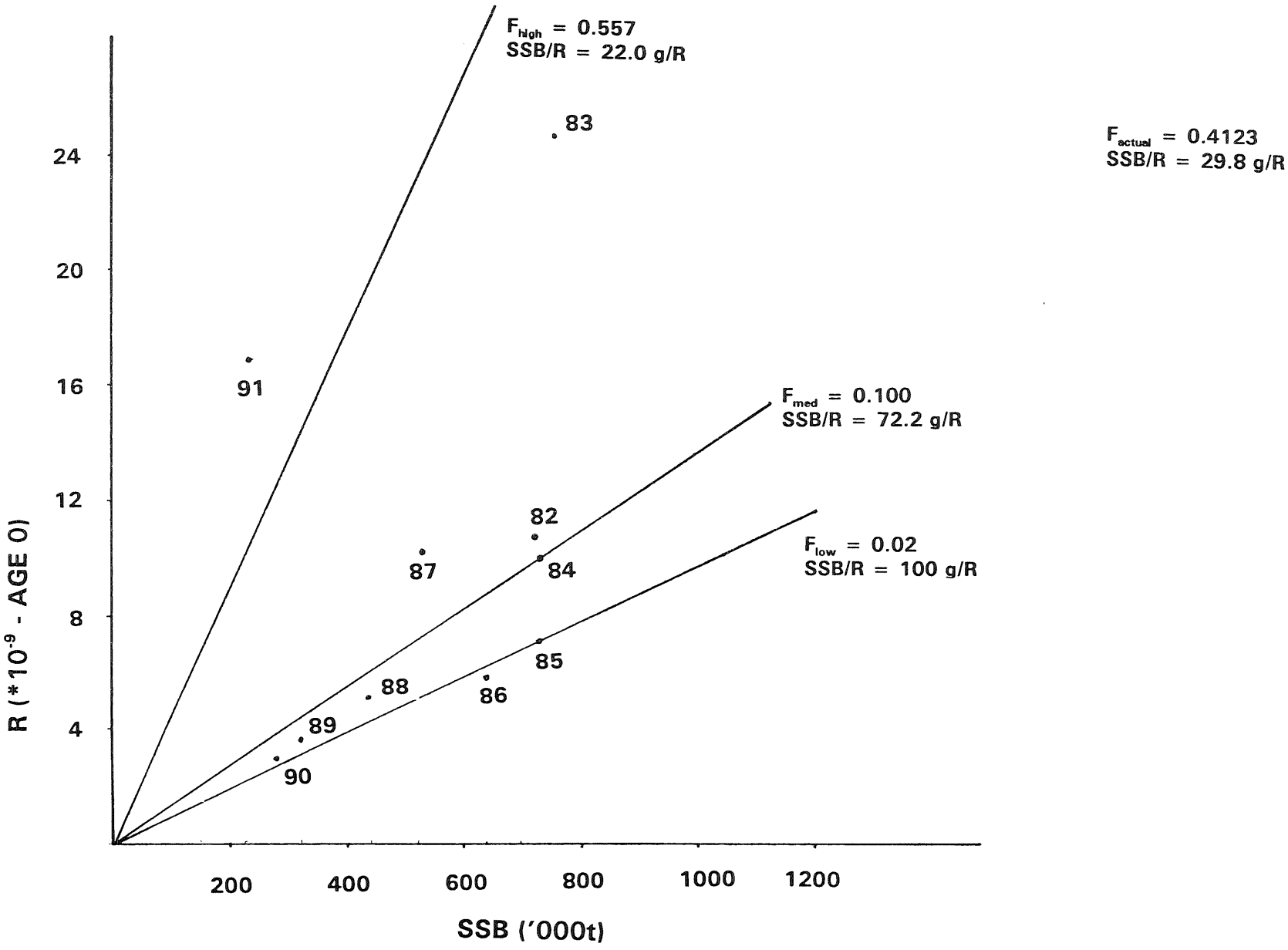
Figure 9.8

Short-term yield and spawning stock biomass



D

Figure 9.9 Sardine - Recruitment VS. Spawning stock biomass at spawning time.



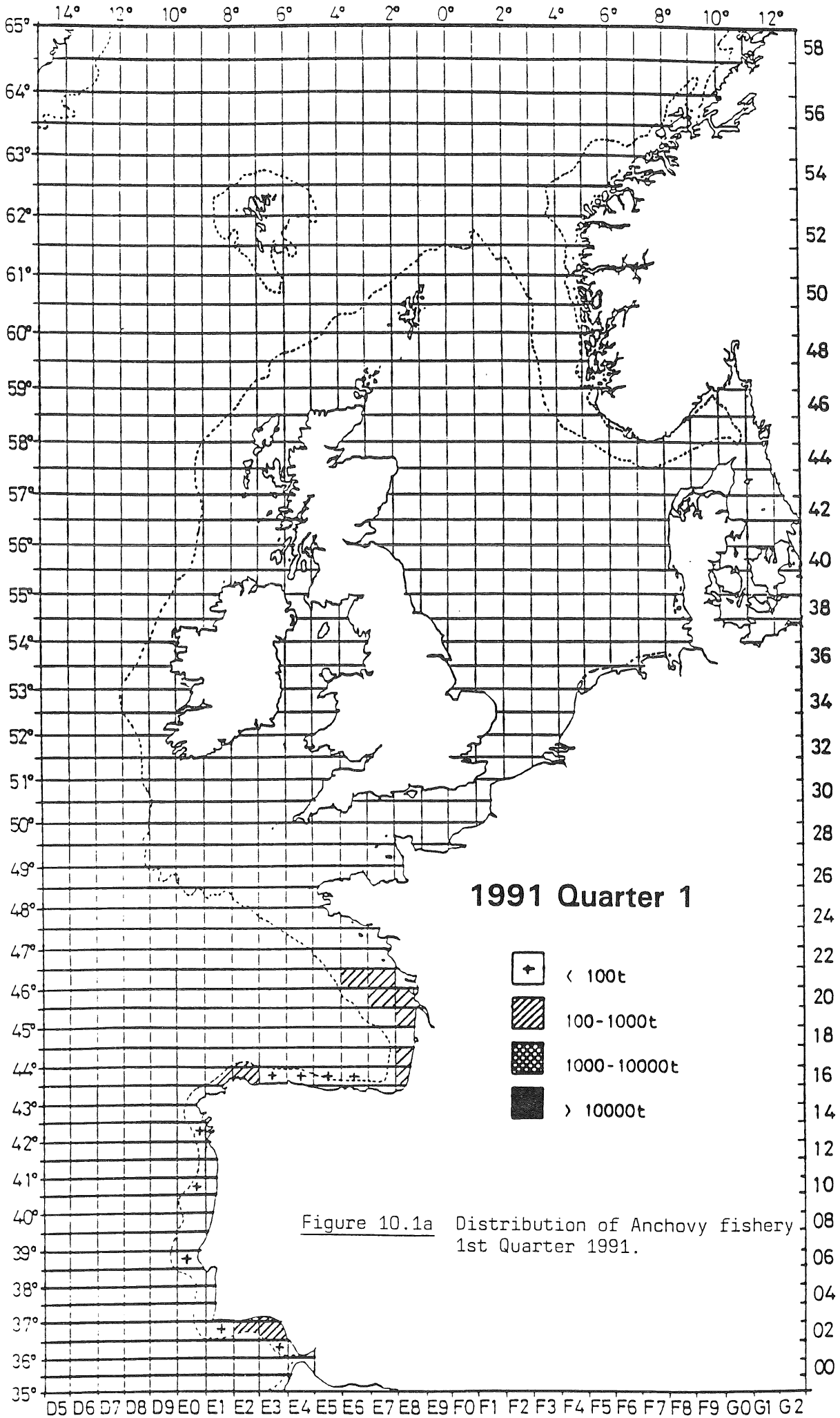


Figure 10.1a Distribution of Anchovy fishery 1st Quarter 1991.

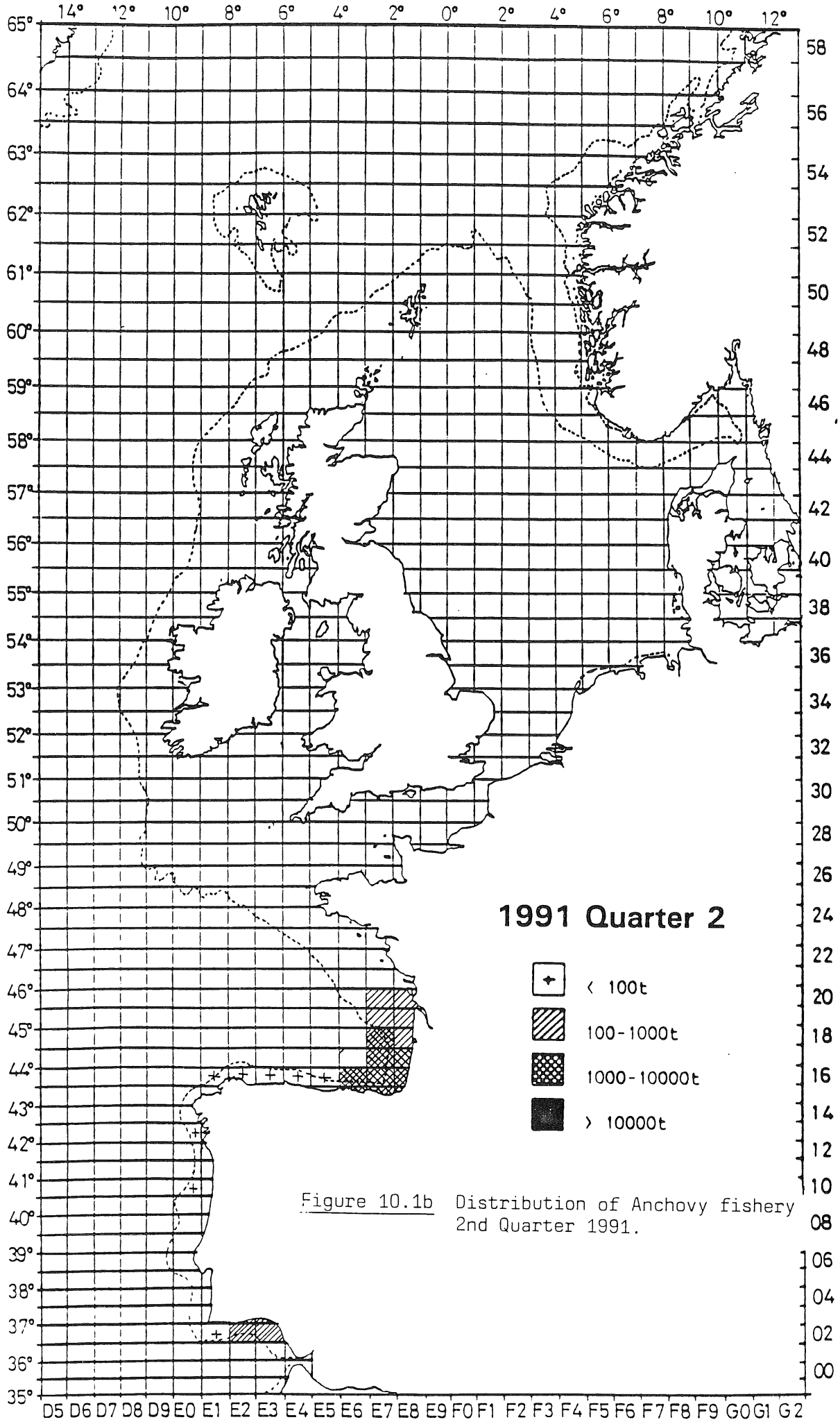


Figure 10.1b Distribution of Anchovy fishery 2nd Quarter 1991.

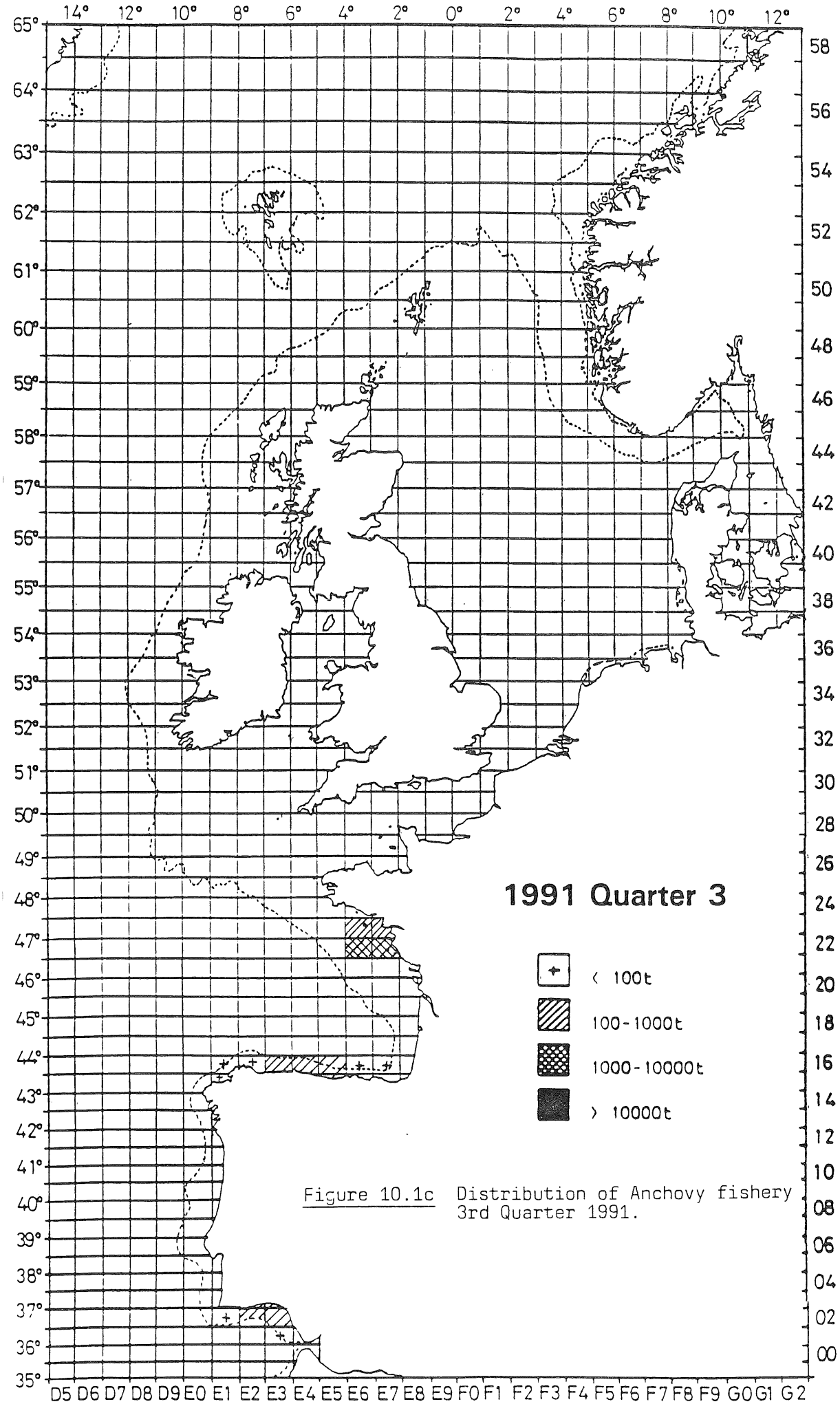


Figure 10.1c Distribution of Anchovy fishery 3rd Quarter 1991.

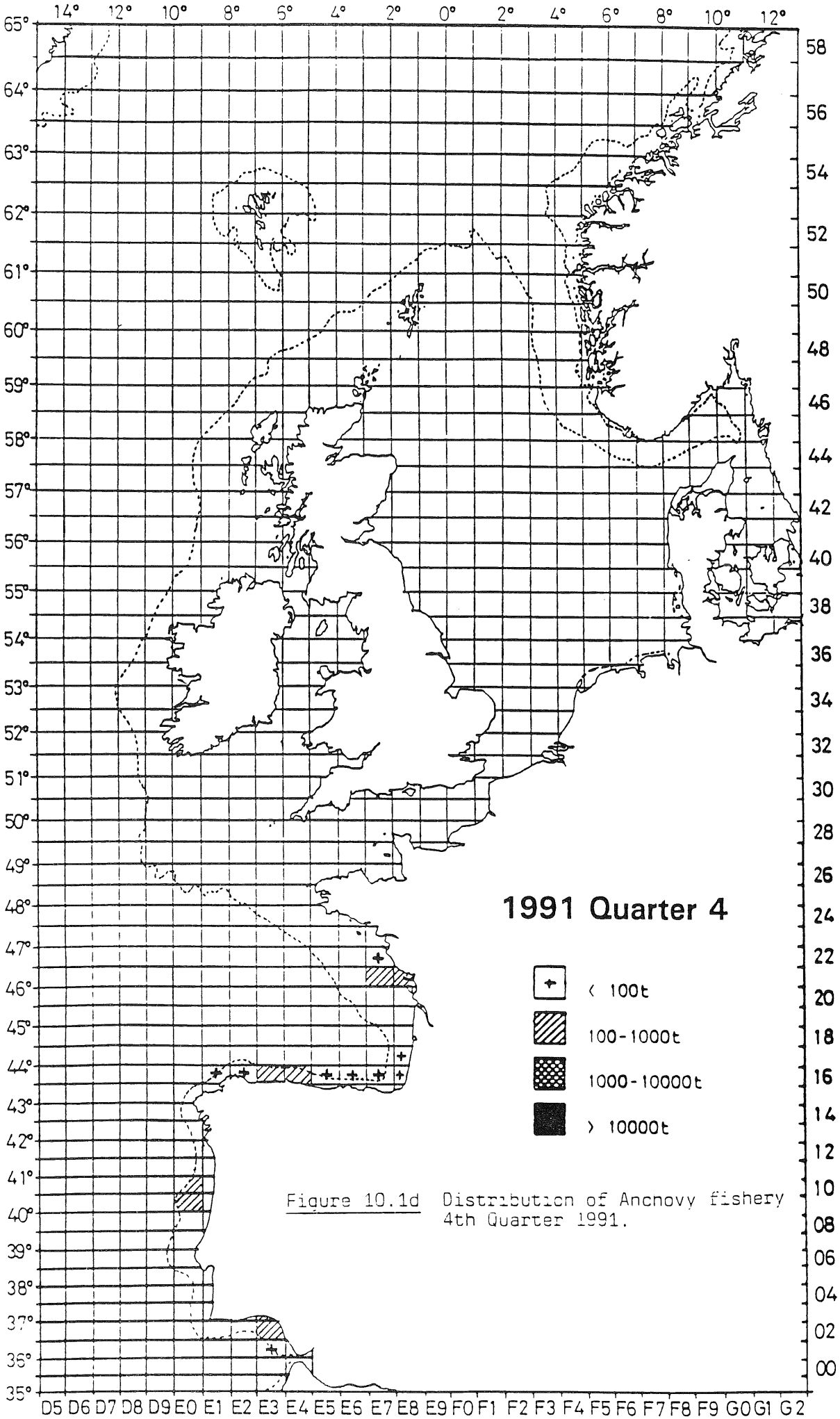


Figure 10.1d Distribution of Anchovy fishery 4th Quarter 1991.

Figure 10.2a.- Length distributions of Landings of Bay of Biscay anchovy (January-June) in Divisions VIIIa,b and c.

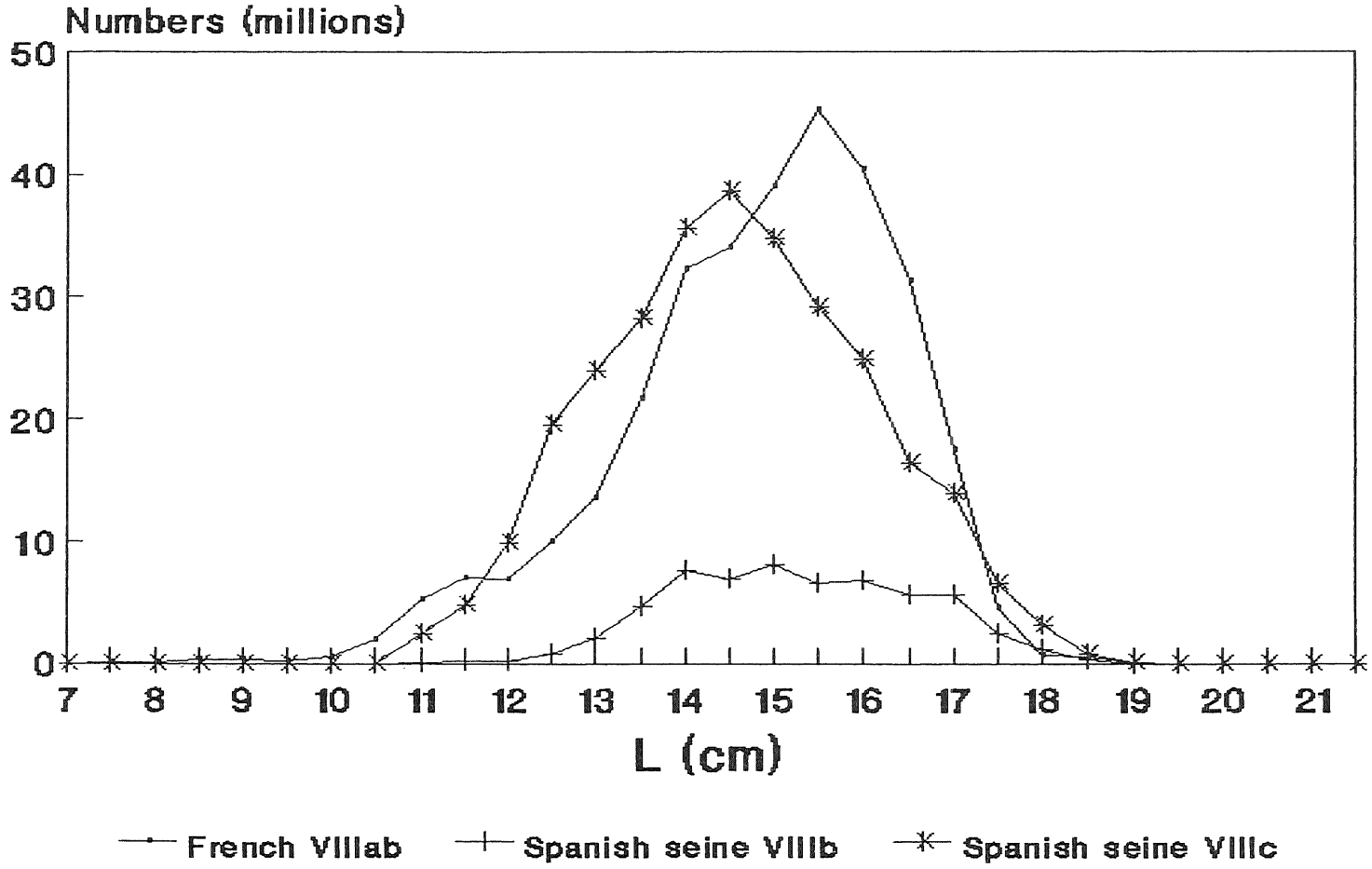


Figure 10.2b - Length distributions of landings of Bay of Biscay anchovy (July-December) in Divisions VIIIa,b and c in 1990.

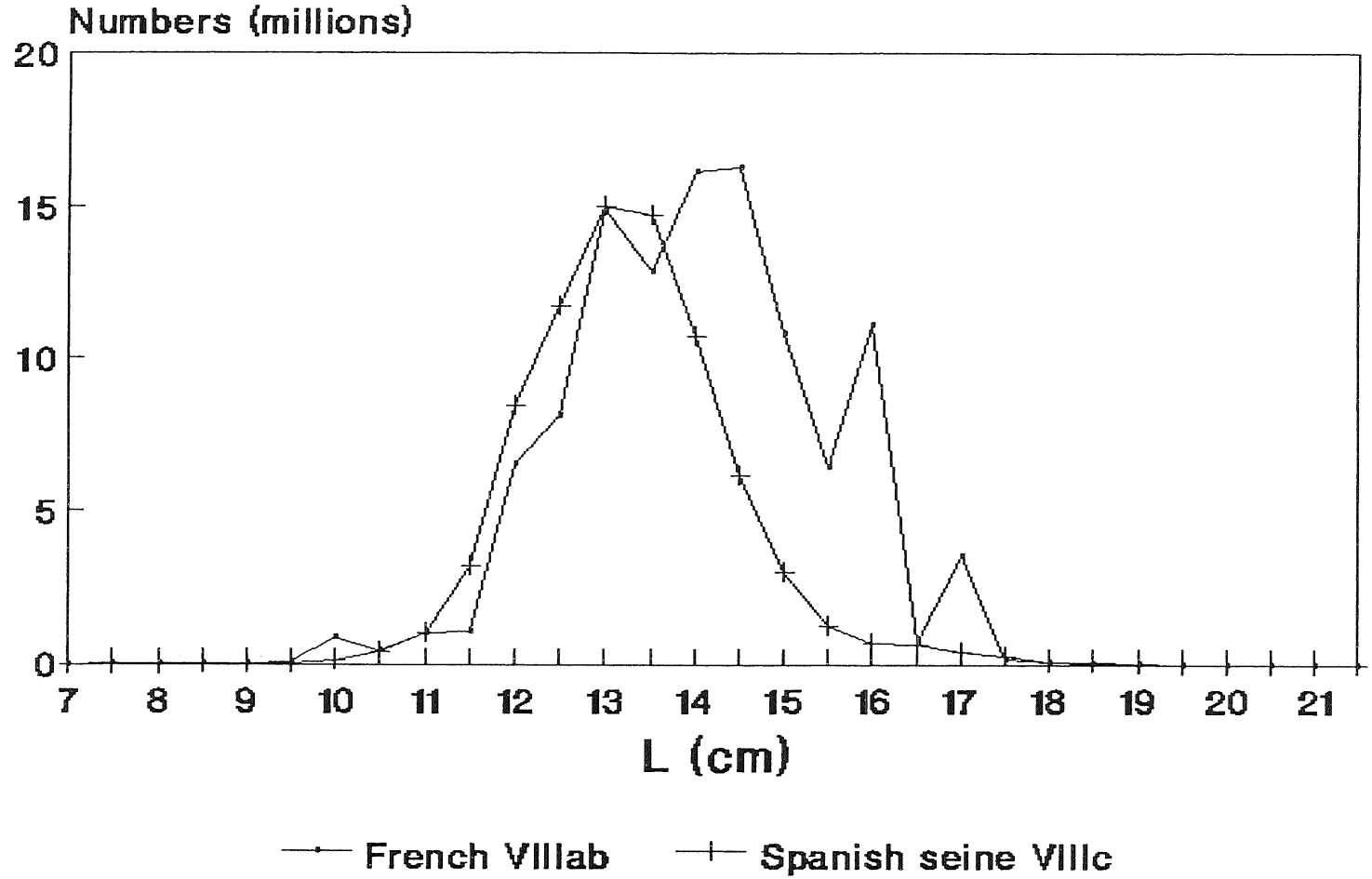


Figure 10.3 - Length distributions of landings of Bay of Cadiz anchovy in Sub-division IXa Suratlantica during 1988 - 1991.

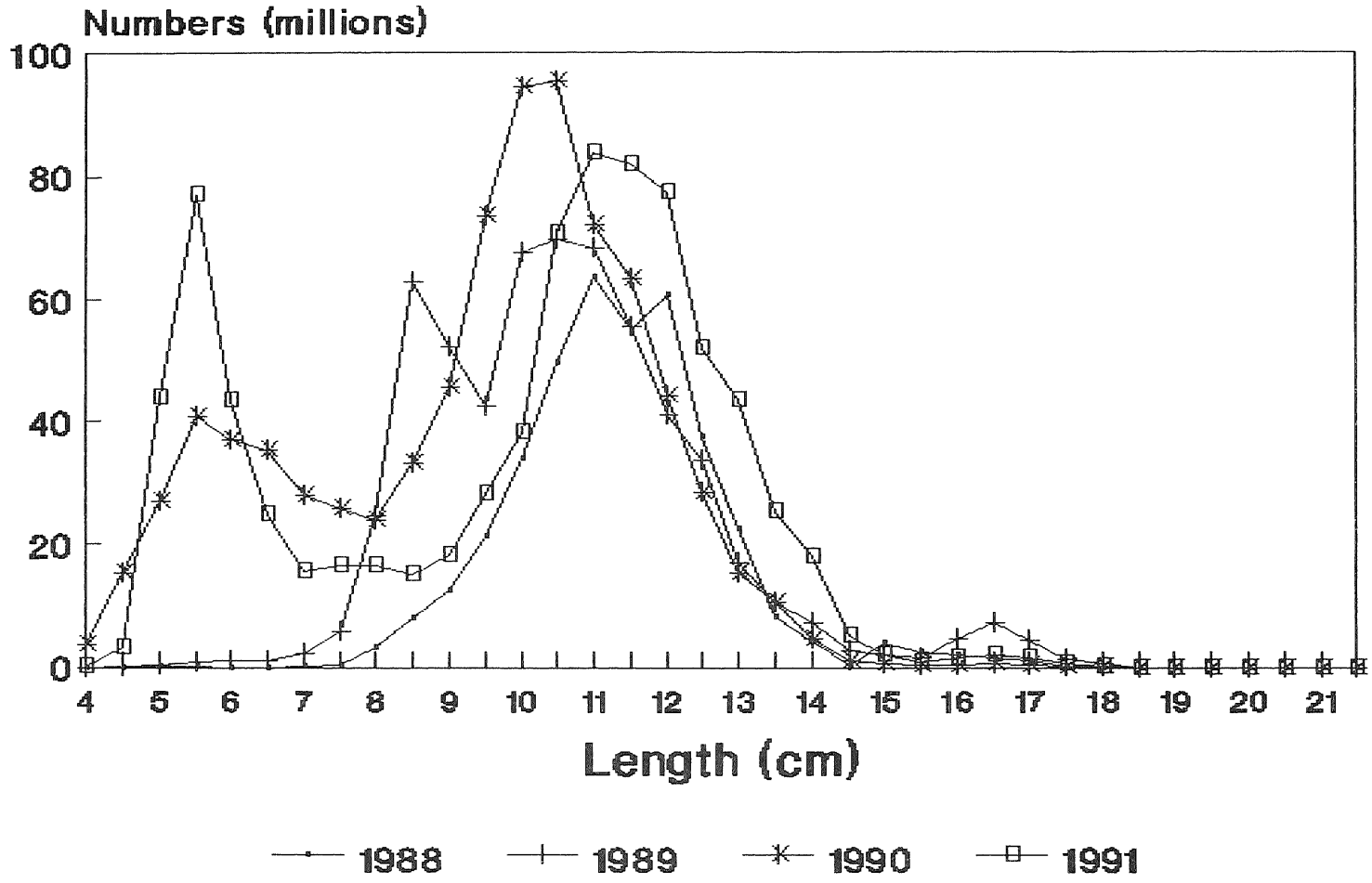


Figure 11.1 Bay of Biscay anchovy. Historical evolution of the Spanish purse seine fishery, the main events are marked.

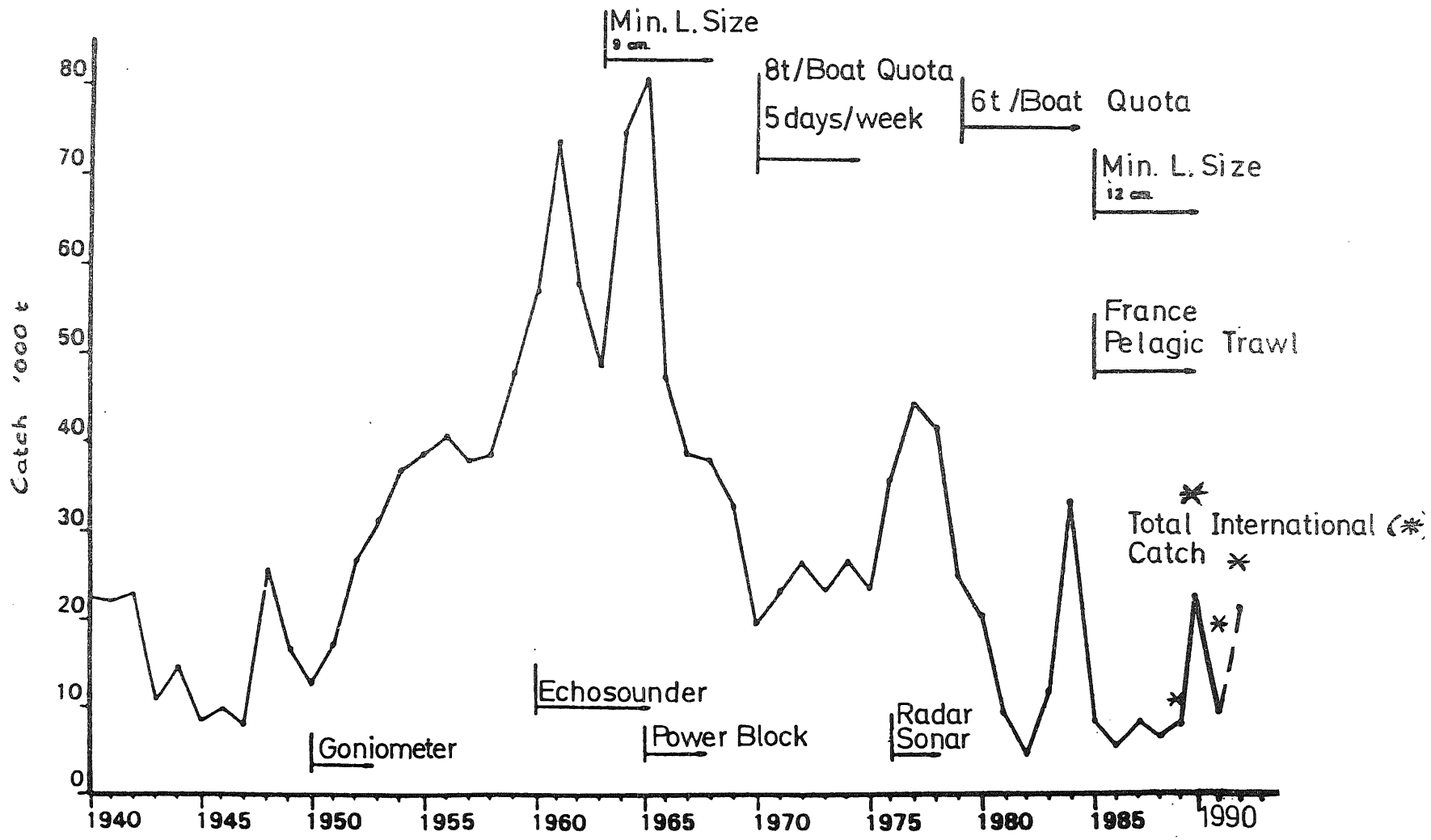
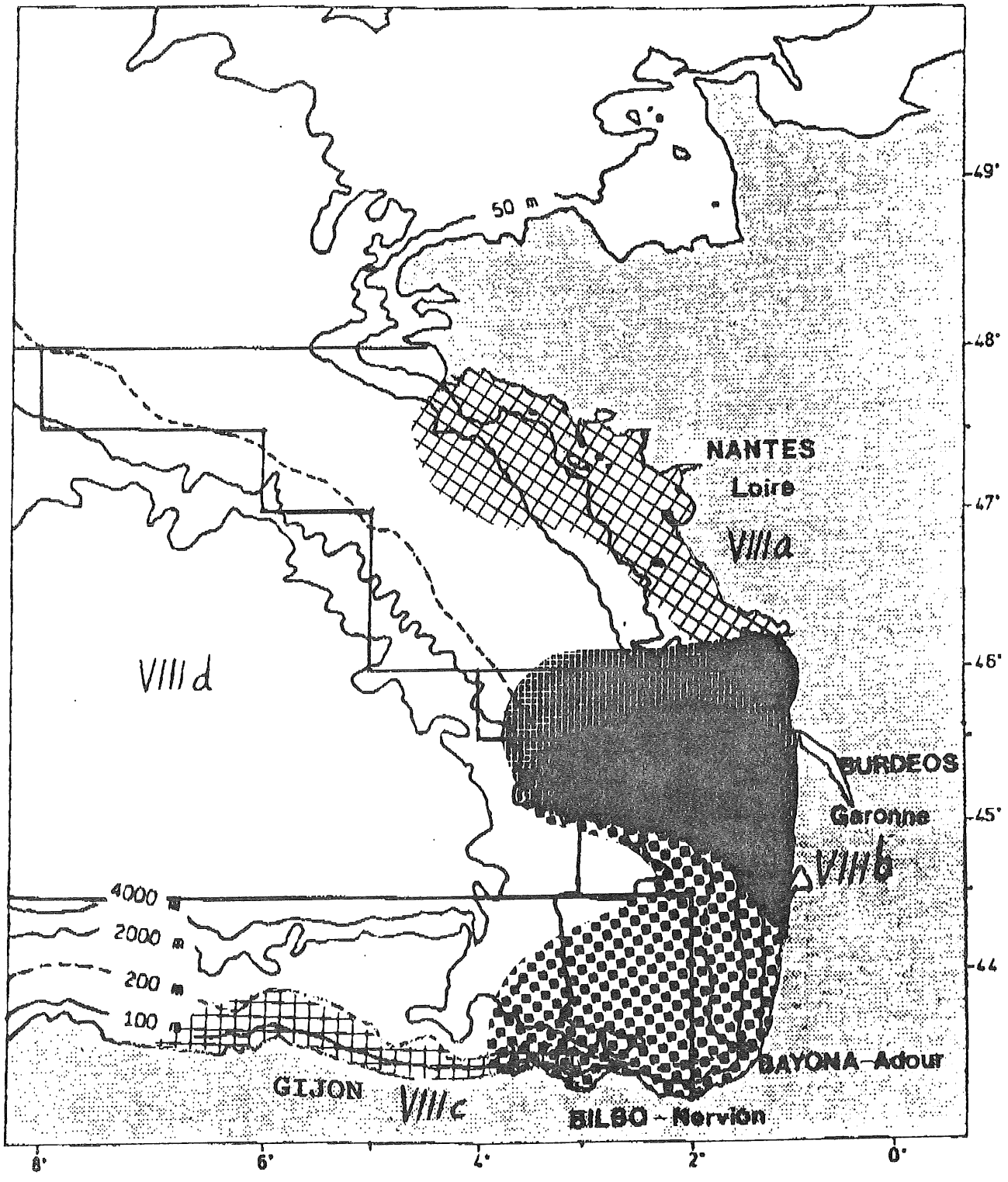
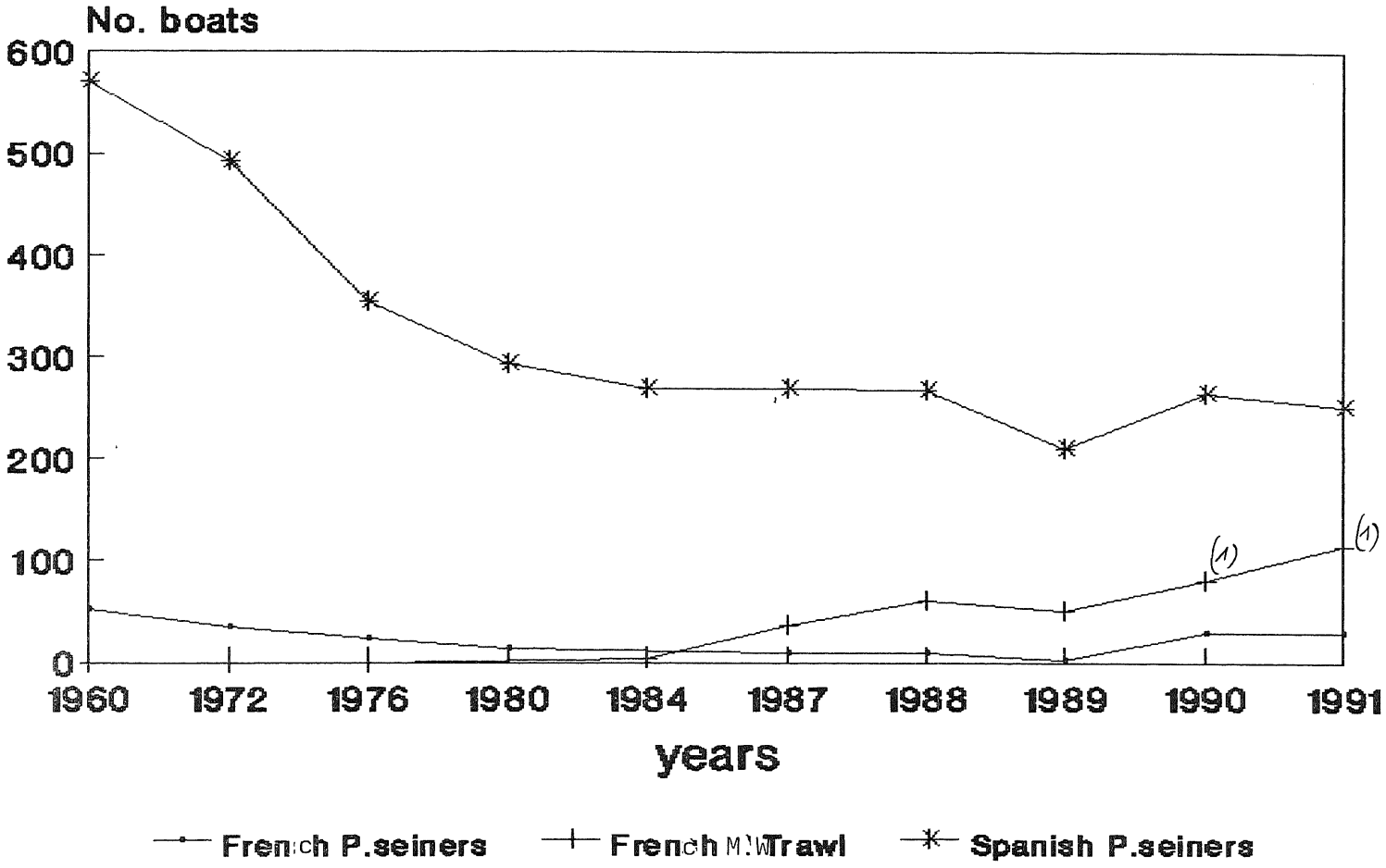


Figure 11.2 : General spatial distribution of the anchovy fisheries along the year (1985-91 period)(Sub-area VIII)



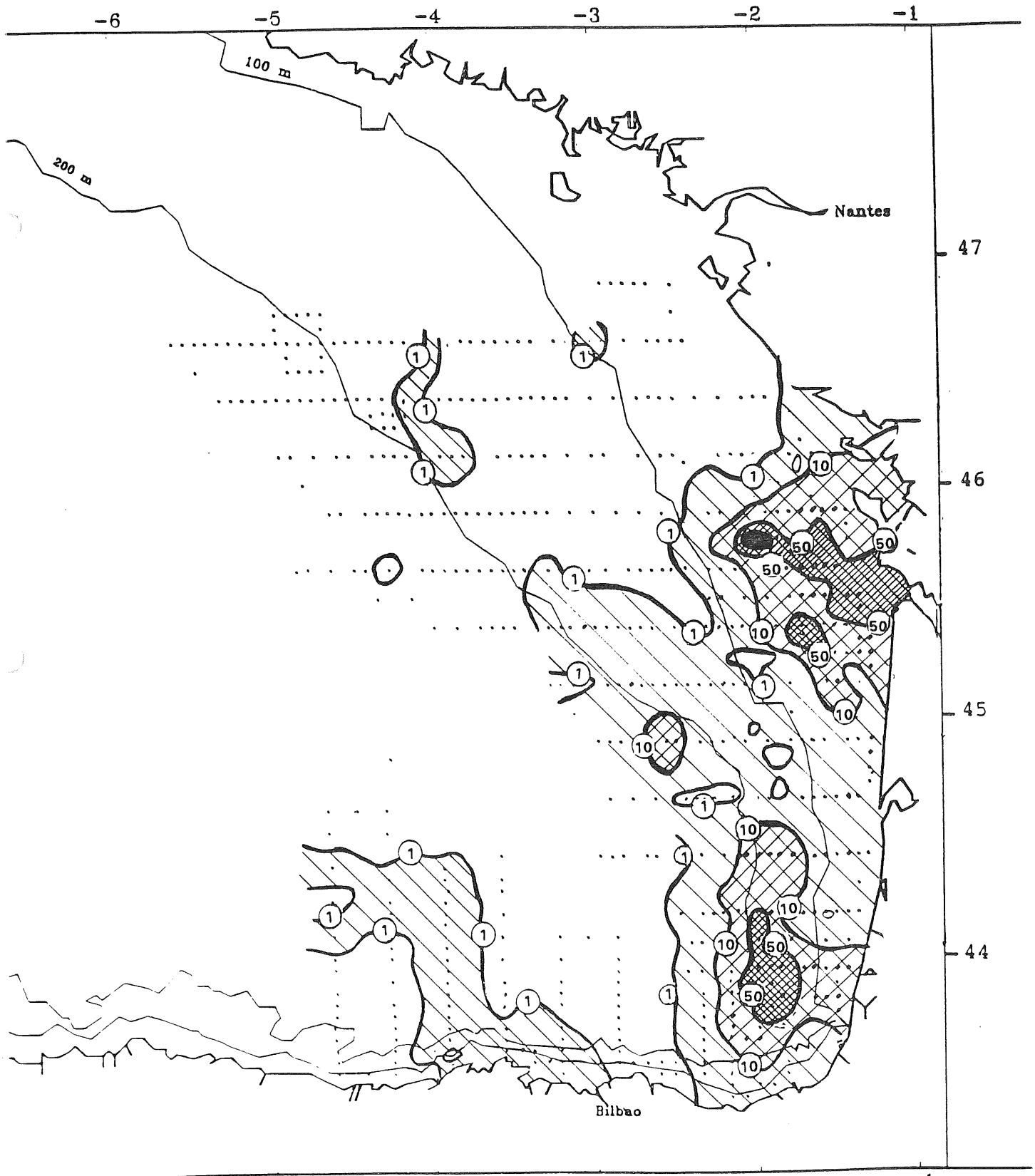
Spring Summer & Autumn Winter

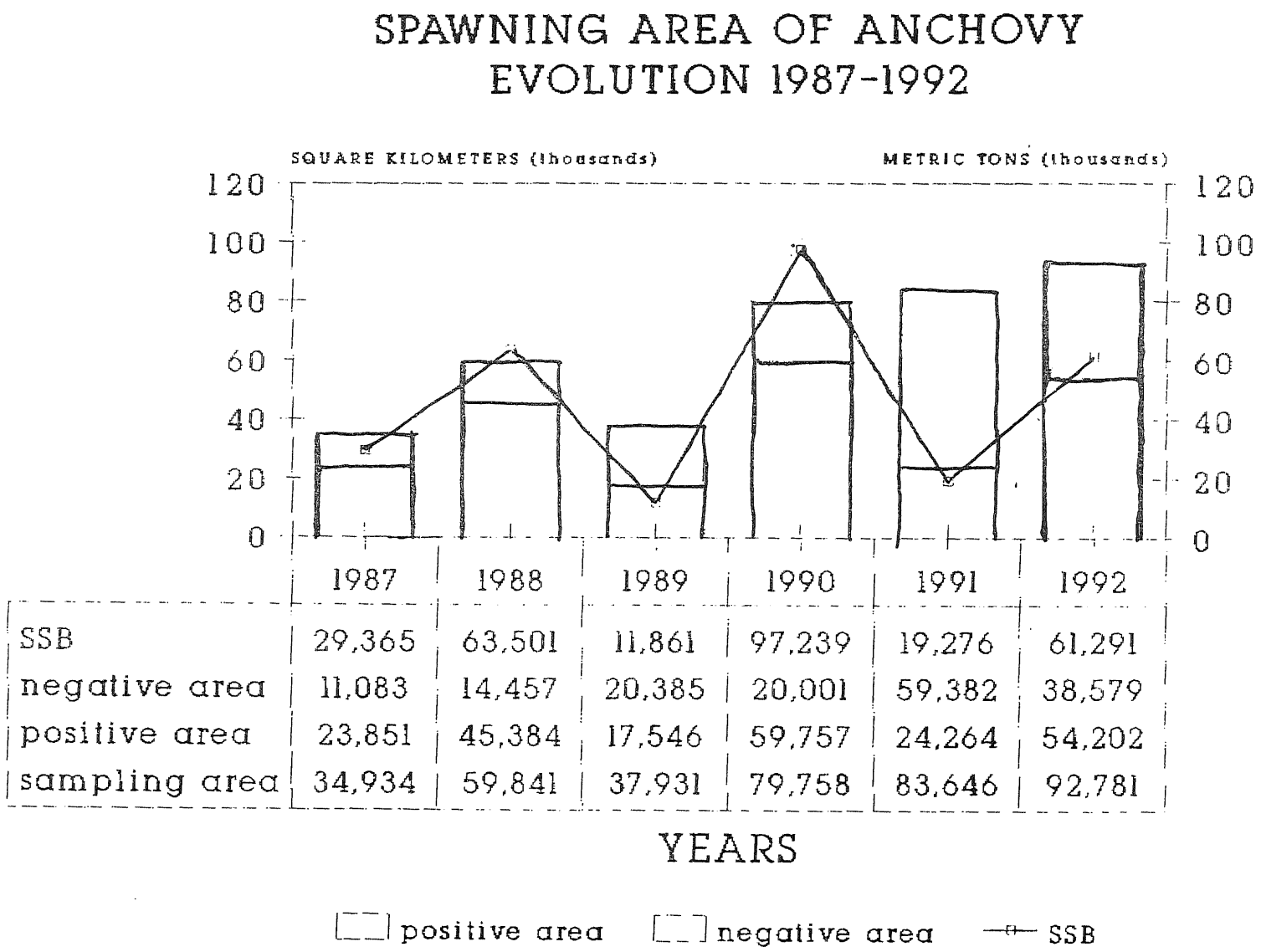
Figure 11.3 Evolution of the French and Spanish fleet for anchovy (from Working Group members).



(1) The number of mid-water trawls is roughly the half of the number of boats.

Figure 11.4 Distribution and abundance of Anchovy eggs (number under 0.05 m^2) in the Bay of Biscay during the period 15 May to 13 June 1992.





* 1992 - provisional results

Figure 11.5 Estimates of anchovy spawning biomass and positive spawning area.

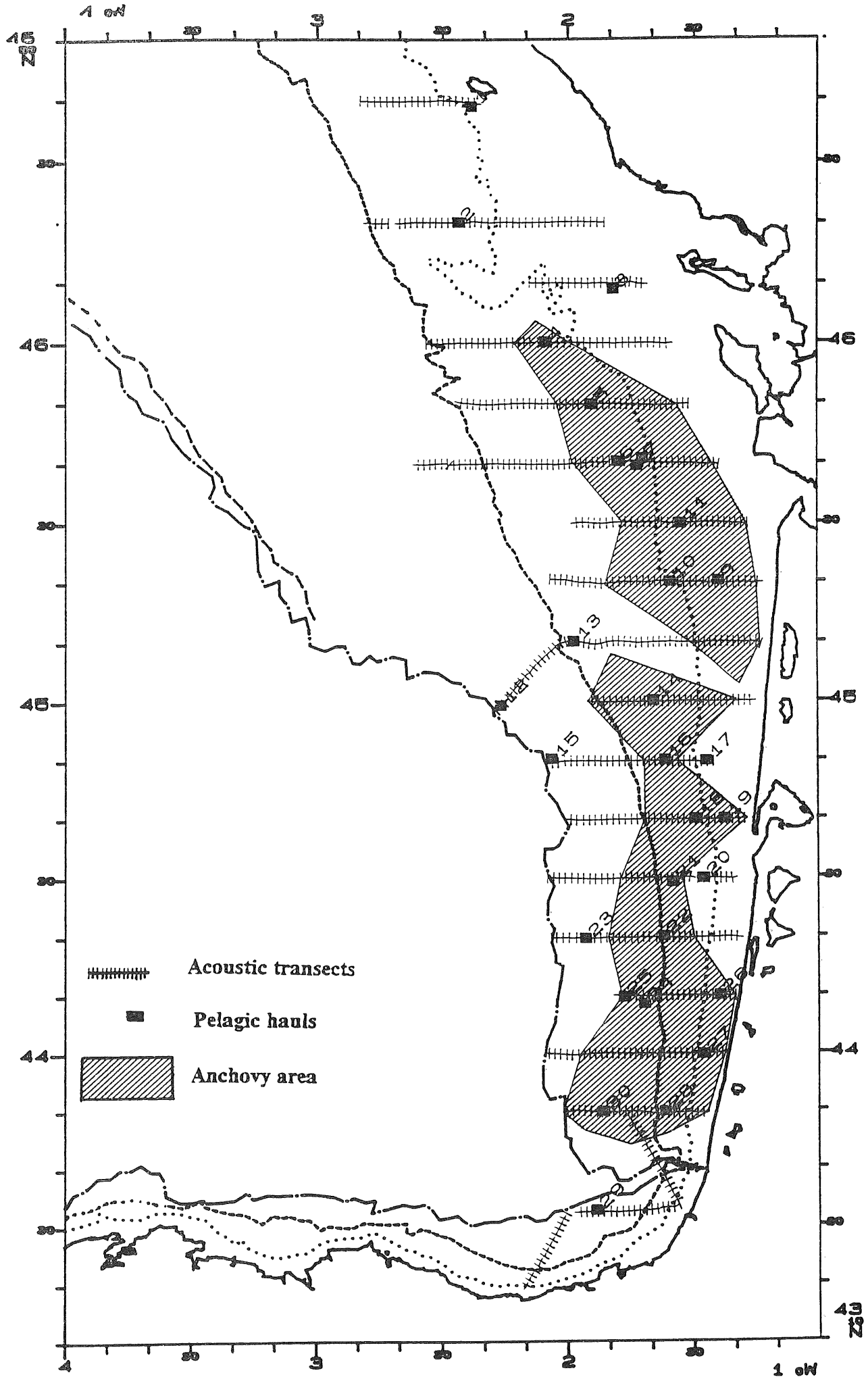


Figure 11.6 French acoustic survey (April 1992)

Figure 11.7a

COMPARISON OF STOCK BIOMASS ESTIMATES ON ANCHOVY

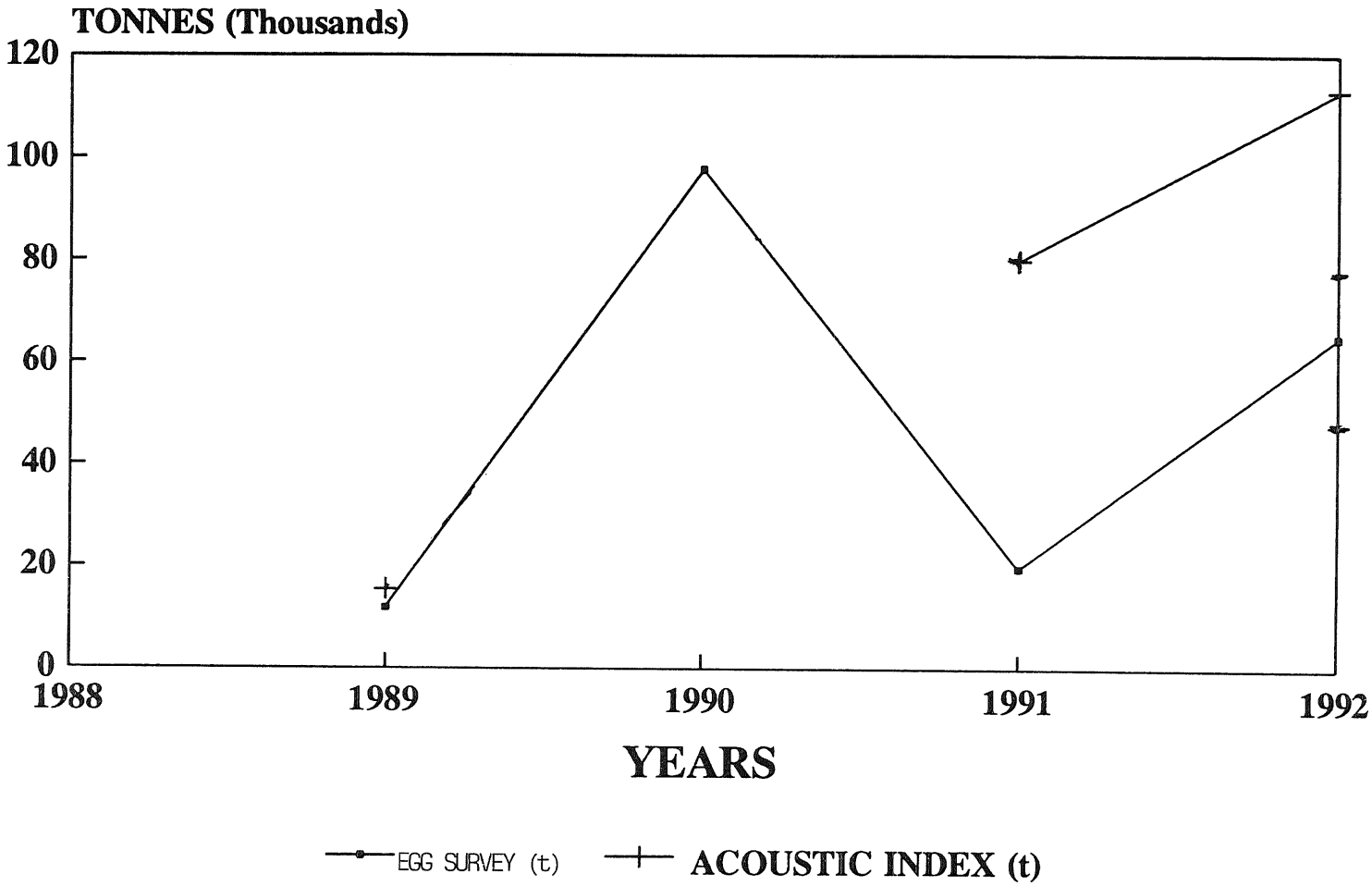


Figure 11.7b Comparison of recruitment indices of ANCHOVY.

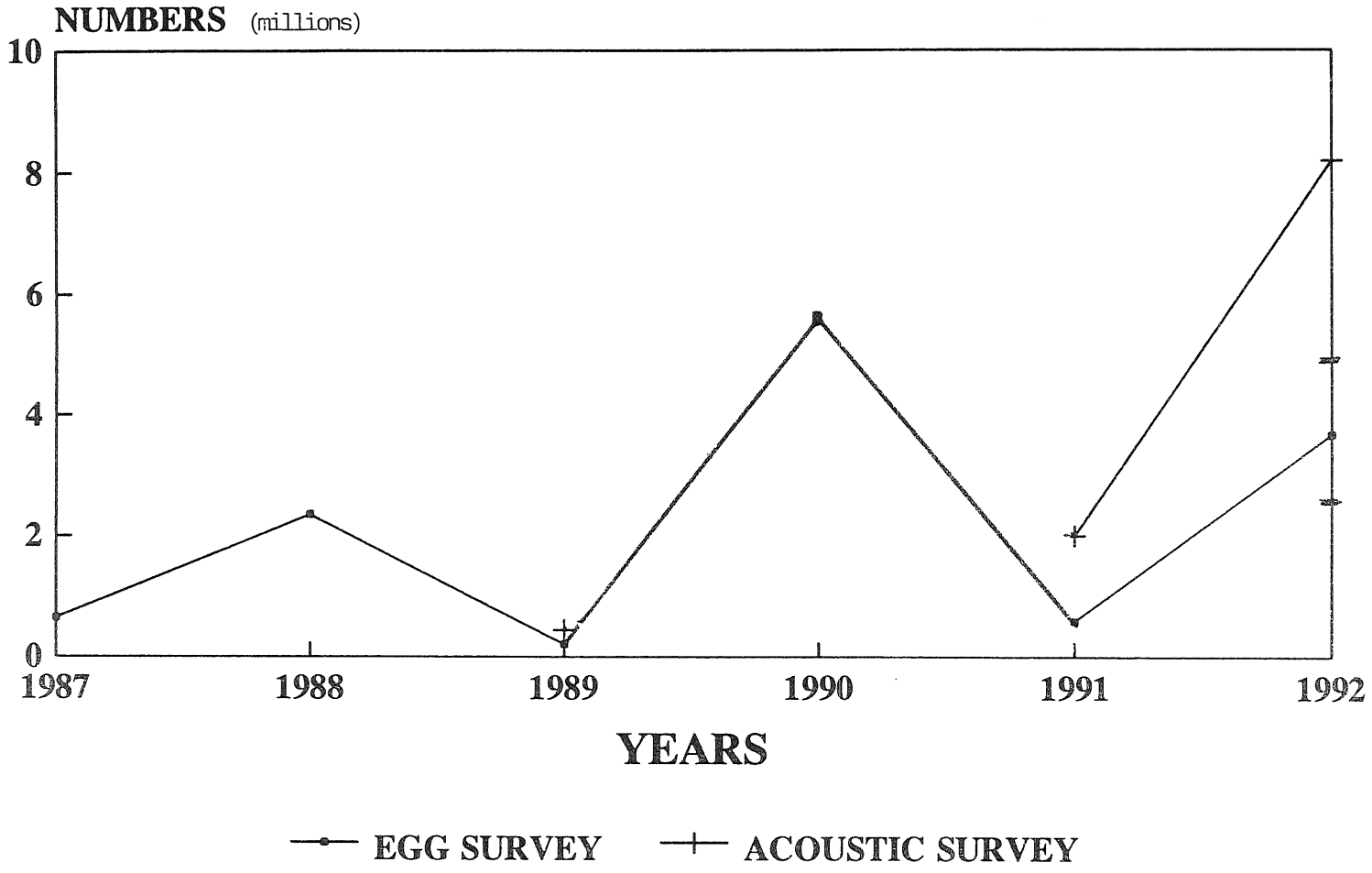
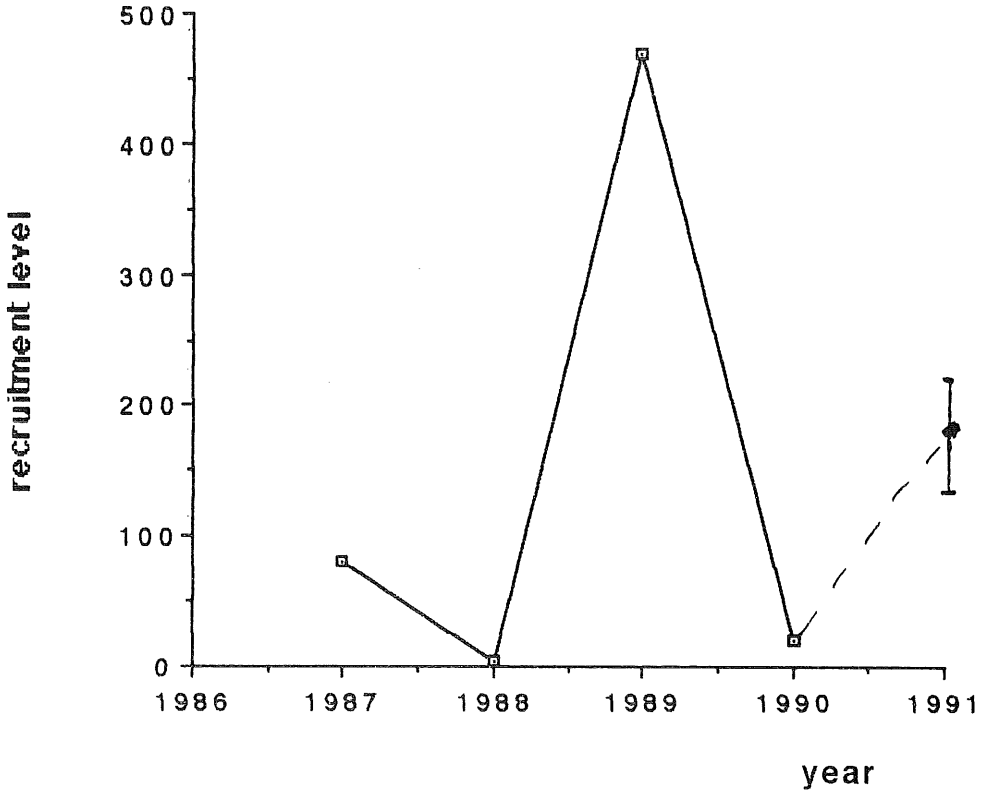


Figure 11.8 Variation of the recruitment level (expressed as the number of 1-year old in million per 1,000 tonnes of SSB the year before) during the 1987-1991 period.



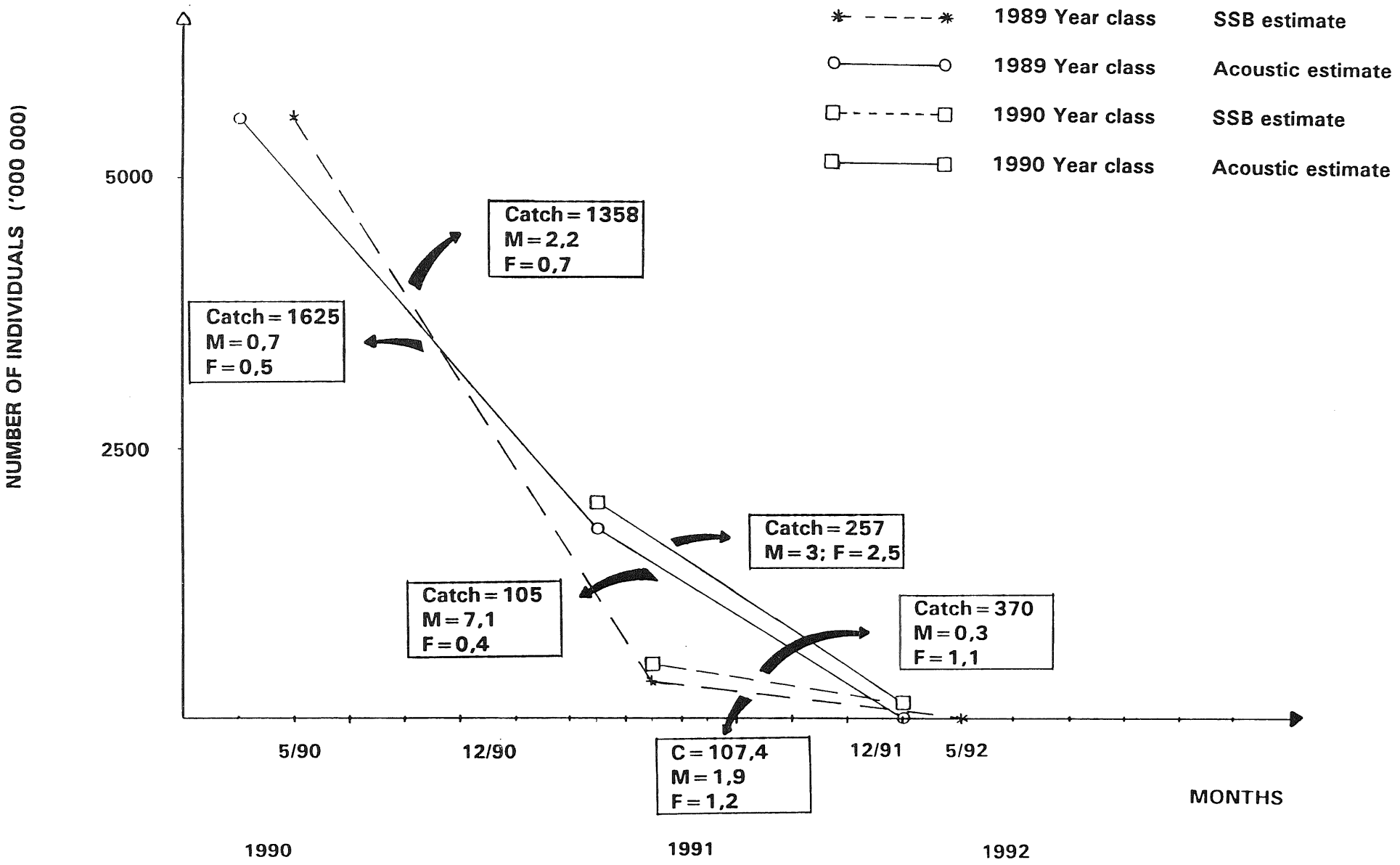


Figure 11.9 Assessment of natural and fishing mortalities for the 1990 and 1991 year classes.

Figure 11.10 Relationship between number of recruits(1-year old) and the SSB estimated from direct estimation methods.

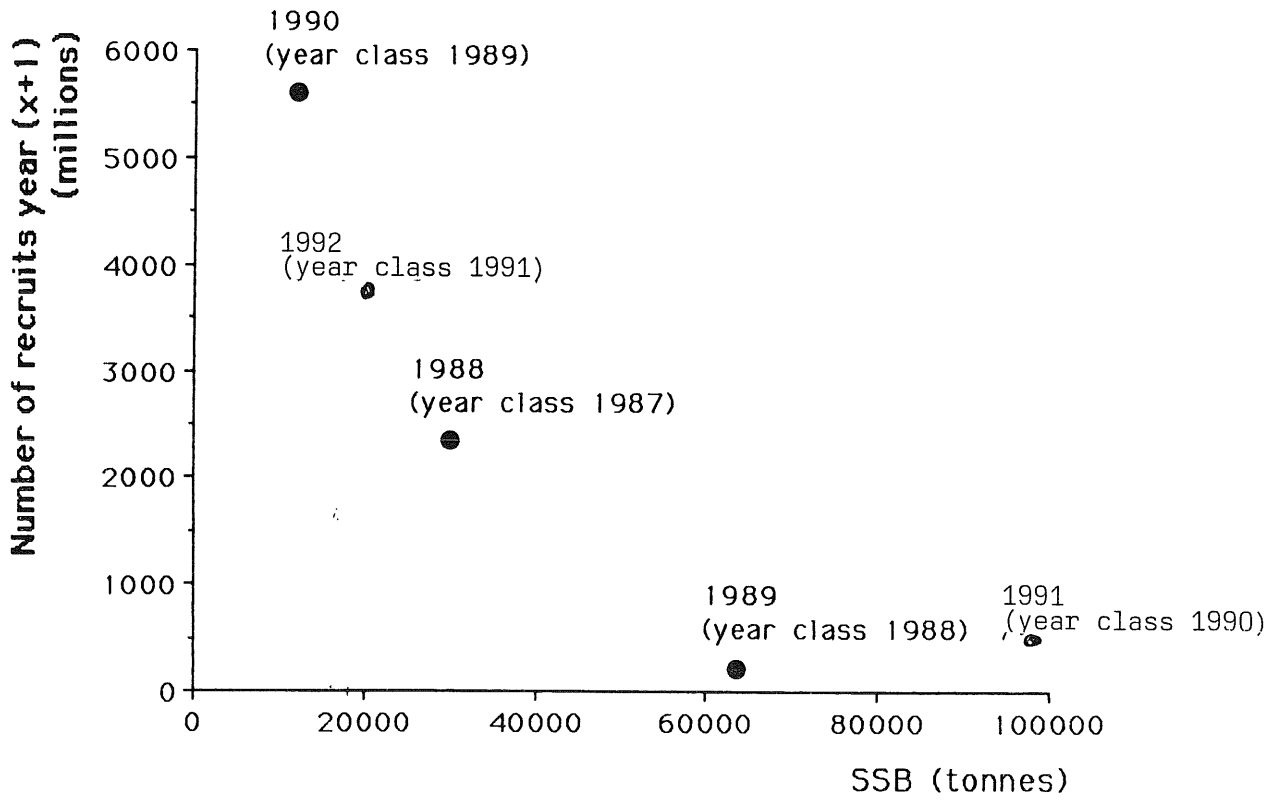
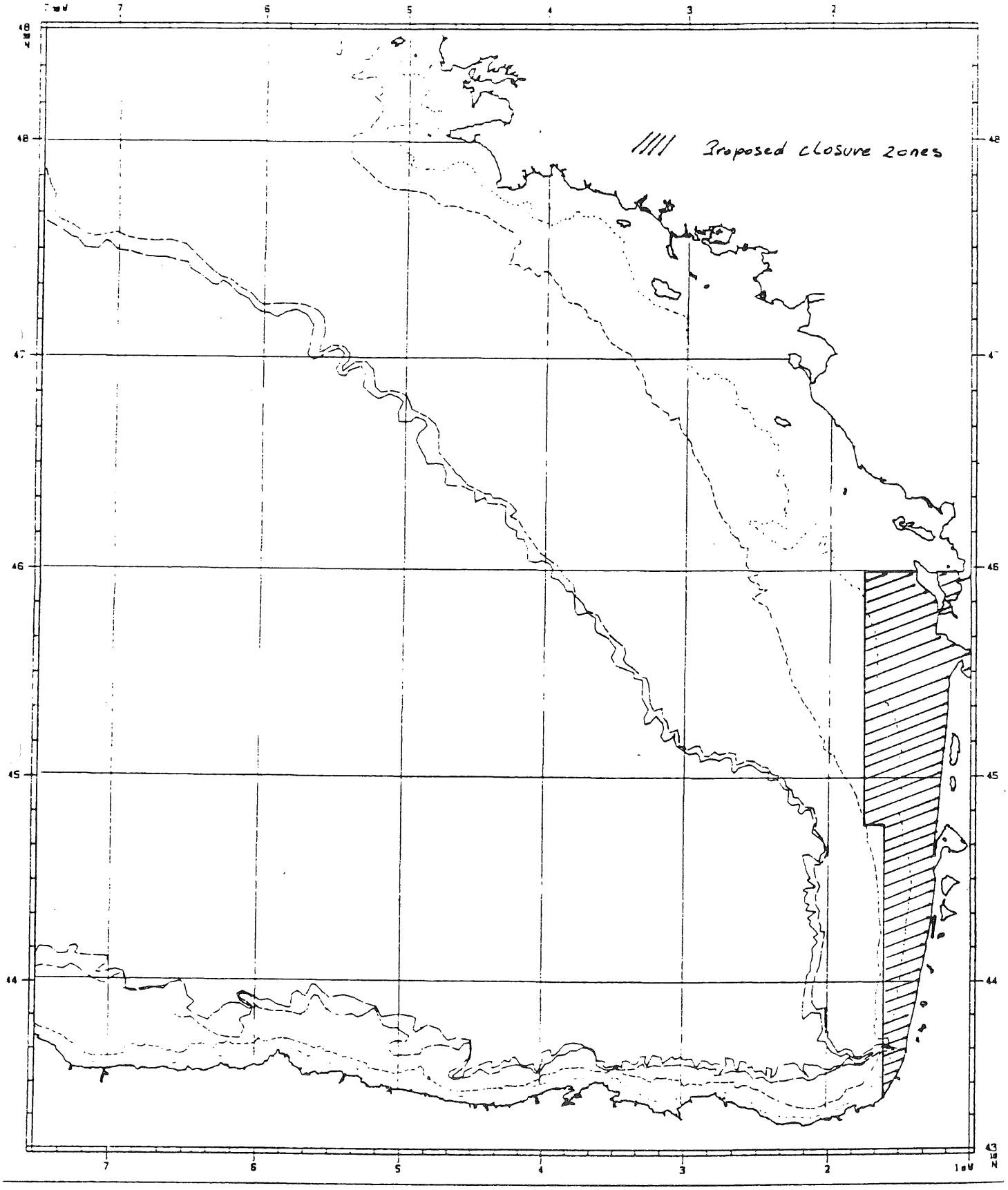


Figure 11.11 Closure areas for anchovy for winter and spring fisheries



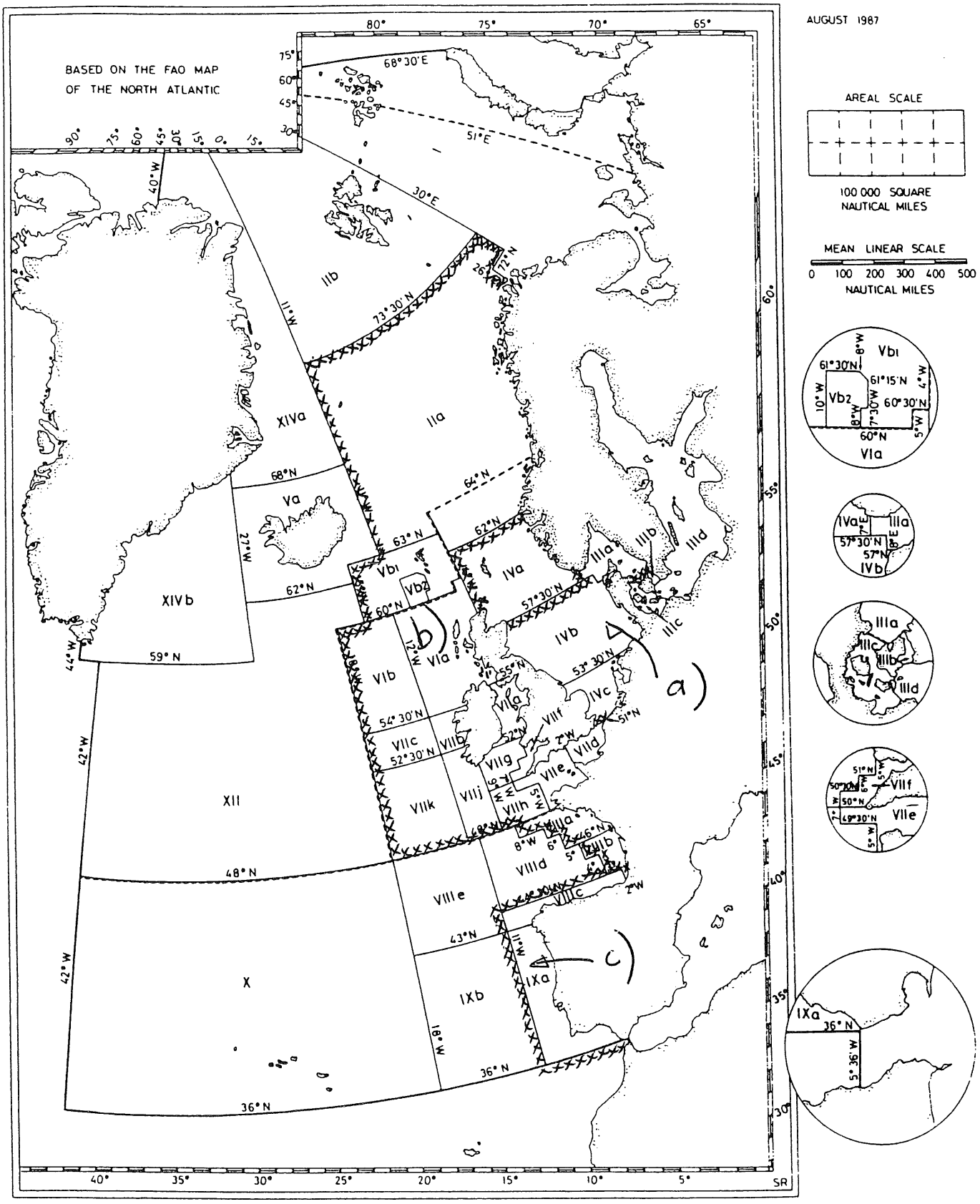


Figure 14.1 Management units for mackerel used by ACFM.

(a) North Sea stock (Divisions IIIa, IVb, IVc and IVa (from January-July)
(b) Western stock (Subareas VI, VII, Divisions IIa, Vb, VIIIa, VIIIb and IVa (August-December)
(c) Southern stock (Divisions VIIIc and IXa)

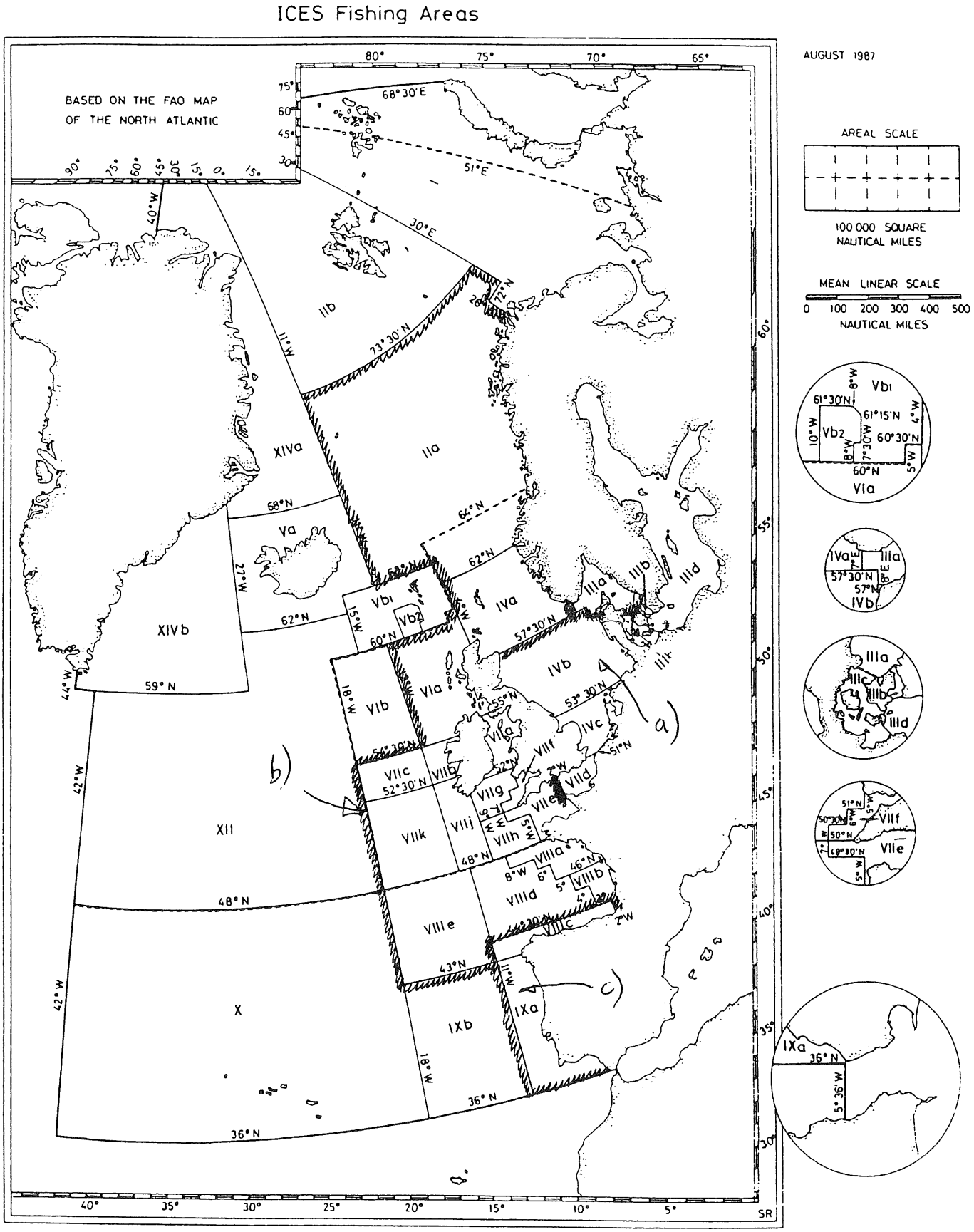


Figure 14.2 Management units for horse mackerel used by ACFM.

a) North Sea Stock (IVb,c VIId)
b) Western stock (IIa, IIIa, IVa, VIa, VII, VIIIa,b,d,e)
c) Southern stock (VIIIc, IXa)