Advisory Committee on Fishery Management

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REPORT OF THE

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

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Part 2 of 2

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8 SARDINE (DIVISIONS VIIIc AND IXa)

8.1 ACFM Advice Applicable to 1997 and 1998

In October 1997 ACFM considered that this stock was in a serious state and advised that to prevent a further decline there should be no fishing on this stock and that a recovery plan should be developed and implemented.

Thus, ACFM considered that a phased recovery plan should be implemented but an immediate and significant reduction in fishing mortality would be required in 1998. There were already national management measures, which included the seasonal closing of the fishery during the spawning time and in 1997 a minimum landing size of 11 cm was legislated.

Considering the seriousness of the situation the European Commission, Directorate General of Fisheries, requested in 22 January 1998 advice from ICES, as follows:

The stock of sardine in ICES Divisions VIIIc and IXa is subject to several management measures, adopted by national authorities from the concerned EU Member States, following the delicate state of the stock described in recent ACFM reports.

Given the seriousness of the situation, it has become evident that a closer follow-up of the stock status is required in order to take any further remedial action.

With this in mind, ICES is requested to review, in the course of the 1998 May meeting of the ACFM, the assessment carried out in 1997 in the light of any new scientific information available. In particular, it is requested to consider the results of the acoustic surveys conducted at the end of 1997 and in spring of 1998, as well as the catch figures for 1997.

In May 1998, the ACFM revised the former advice applying to 1998 based on new information provided on Anon. (1998): *This stock is in a serious state. To prevent further decline in the stock during this period of poor recruitment, an immediate and significant reduction of at least 80% in fishing mortality is required in 1998.*

Following ACFM advice for 1997 and 1998, Portugal implemented a recovery plan for the sardine fishery on a national basis, which aims at a reduction of the directed effort during 1997 and 1998. Following agreements with the purse-seiner owner associations and the Portuguese Government it was legislated on 30 April 1997 that the purse-seine sardine fishery should close during one week per month. The maximum number of fishing days per vessel was fixed by fishing area. The maximum amount of sardine as by-catch of purse seine fisheries directed to other species was limited to 10% of the total catch retained onboard each vessel by fishing day. It was also legislated on 30 April 1997 that the trawl fisheries should close during 24 consecutive hours in each week, during which the fishing vessels had to be retained at the harbour, excepting the crustacean trawl fishery.

Given the ACFM advice from May 1998, the Portuguese Government legislated (1 July 1998) that in 1998 the catches of sardine had to be reduced by 10% relatively to 1997, for which individual vessel quotas where negotiated.

For the Spanish fleet the maximum catch per vessel was reduced in 1998. For 1999 Spain proposes a recovery plan for this fishery, which involves the increase of the minimum landing size in order to protect the sardine juveniles, the closure of the sardine fishery for a period and the reduction of the maximum catch by vessel.

8.2 The Fishery in 1997

8.2.1 Catch estimates

Catches in Divisions VIIIc and IXa were estimated at 115,814 tonnes (including Cadiz) and 109,034 tonnes (excluding Cadiz) in 1997. Landings from Divisions IVc (120 tonnes), VIId,e,f,h (3,593 tonnes) and VIIIa,b (11,520 tonnes), reported by United Kingdom (England and Wales) and France were 15,234 tonnes in 1997 (Tables 8.2.1.1 and 8.2.1.2).

In Sub-Area VII the sardine catches increased from 1,100 tonnes in 1990 to about 17,000 tonnes in 1995 and decreased to about 4,000 tonnes in 1997. In Sub-Area VIII, catches decreased from 49,000 tonnes in 1988 to 27,000 tonnes in 1997.

Historic catches from 1940 to 1997 are shown in Figure 8.2.1.1.

The Portuguese catches decreased from about 86,000 tonnes in 1996 to about 81,200 tonnes in 1997 and the Spanish (Cadiz not included) slightly increased from about 25,700 tonnes in 1996 to about 28,000 tonnes in 1997 (Table 8.2.1.3 and Figure 8.2.1.2).

Catches in the Gulf of Cadiz (Sub-Division IXa South, Spain) are available only since 1978 (Table 8.2.1.6 and Figure 8.2.1.3). Sardine quarterly catches during 1978–1997 are also presented (Table 8.2.1.6). In 1997 the catches in this area were estimated in 6,780 tonnes, which was close to the 1986 and 1990 catch level. Practically all the catches came from purse-seiners (99,9%) and in 1997 were mainly undertaken in the second half of the year (57%), as in the whole stock.

About 85% of the total catch in the stock (Divisions VIIIc and IXa, not including Cadiz) in 1997 was taken by the purse seine fleets from Spain and Portugal (Table 8.2.1.4). Portuguese catches in 1997 represented about 70% of the total catch, and more than 50% of the total catch of the stock in 1997 comes from catches made by the Portuguese purse seine fleet on the Portuguese mainland shelf (Table 8.2.1.5).

Table 8.2.1.7 and Figure 8.2.1.1 show all the available catch data from 1940–1997 for Divisions VIIIc and IXa (Cadiz not included). Three periods of high catches can be distinguished, from 1944 to 1947, 1960 to 1965 and 1980 to 1985, which have been followed by periods of low catches from 1948 to 1950, 1972 to 1976 and 1992 to 1997.

In Division IXa (Cadiz not included), catches decreased from 97,000 tonnes in 1996 to about 93,000 tonnes in 1997 (Table 8.2.1.2). In this Division, where sardine catches have reached the highest levels in this century, during the 1984–1997 period, catches have oscillated between 179,000 tonnes in 1984 and about 93,450 tonnes in 1997.

Catches split by country in Divisions VIIIc and IXa are shown in Figure 8.2.1.2 (Cadiz not included). The trend in the catches of both Portugal and Spain are similar. After a period of high catches from 1980 to 1985, the Spanish catches (Division VIIIc and Sub-division IXa-North) show a decreasing trend since 1987. The Portuguese catches (Division IXa) have remained quite stable at around 90,000–100,000 t per year during the period 1980–94, but since 1995 they show a slight decrease trend reaching around 81,000 tonnes in 1997.

Figure 8.2.1.3 shows the Spanish sardine landings by Division (VIIIc and IXa North and South) in 1960–1997. Three periods of low catches in Sub-Division IXa North can be shown (from 1973 to 1978, from 1989 to 1991 and since 1994). According to Carrera (WD 1997) catches in these Divisions, especially those of the Vigo harbour, can reflect the strength of the recruitment. Thus, it may be concluded that this first period of low catches could be a consequence of a period of low recruitment levels. The other two correspond to periods of low recruitment estimations. Landings in VIIIc remained quite stable around 30,000 t until 1998. After that, there is a decreasing trend. This year, Figure 8.2.1.3 also includes landings of the Gulf of Cadiz since 1978. Catches are in general low, around 7,000 t. Nevertheless two peaks can be distinguished, in 1987 and 1990, which match to those found in the Sub-division IXa-North. Since 1993 this series shows an increasing trend (Table 8.2.1.6).

During 1997 the seasonal pattern of landings by the two countries was the same as reported in previous years with about 60% of the annual catches being landed in the second half of the year (Table 8.2.1.4).

Total nominal catches of sardine by quarters and areas in Divisions VIIIc and IXa in 1997 are shown in Table 8.2.1.5. The distribution of catches in 1997 by quarter and area in Divisions VIIIc and IXa (Cadiz not included) was similar to that in recent years, with about 92% of the total catches from Division IXa (IXa North, Central North, Central South and South, including Cadiz). In addition, catches in VIIIc East (Cantabric) has increased in about 60% (from 5,838 t to 9,803 t) from that of 1996. This increase was observed in all quarters and especially in the first quarter of the year. In Sub-Division VIIIc-West (Galicia North) the opposite occurred, the catches decreased in all the quarters about 30% from 8,585 t in 1996 to 5,785 t in 1997 (ICES 1998a).

In IXa-North (Galicia South), the total catches slightly increased from 11,251 t in 1996 to 12,291 t in 1997. Nevertheless in 1997, there was a change on the quarterly distribution of catches as compared to 1996. In 1997 about 93% of the catches in IXa-North were caught during the second and the third quarters. Comparatively in 1996 the bulk of the catch was only 32% of the catches caught during the second and third quarters (ICES 1998a). This pattern is different from that found in the previous years where the catches were rather distributed throughout the whole year.

8.2.2 Discards

There are no estimates of discards available for this stock.

8.3 Stock Units

Historical and recent information on both non-exploited fraction and recruits and adults distribution of the populations of the Atlantic sardine (ICES 1978) have been reviewed (Anon. 1998). Main spawning grounds are located in the western coast of the Iberian Peninsula (Portugal) and in the Bay of Biscay (Cantabrian Sea and along the French continental shelf). Despite the wide length of the spawning season, different spawning peaks can be noticed. In the west coast of the Iberian Peninsula the main spawning season occurs in fall/beginning of winter whereas in the Bay of Biscay (Cantabrian Sea) the peak is reached at the beginning of spring. In French waters there seems to be a marked peak between April and June. Despite this wide egg distribution, recruits can be essentially found in three main areas (South of Portugal/Gulf of Cadiz, North of Portugal and South of Galicia and between the Gironde and Loire estuaries). Information about distribution of adult sardine around the Celtic sea is scarce and is mainly related on both acoustic and bottom trawl surveys. There is some available information on English Channel sardine egg distribution (Haynes and Nichols, 1994).

The extent of the distribution area of sardine seems to vary according to the size of the stock. At a high stock size, the stock seems to have a clear migration pattern, which makes a differential age distribution along the Iberian coast (Porteiro *et al.* 1986, 1993). This pattern might have changed as the stock has decreased (Barnes *et al.* 1992, Lluch-Belda 1992). The migration patterns might also have changed due to climatic changes.

There was also an increase of the catches of fish older than 4 years in the Portuguese area since 1991, which could be related to changes in fish distribution, selection pattern, environmental factors, or changing distribution. A continuity in the distribution of adult sardine between the inner part of the Bay of Biscay and the French continental shelf has been found in 1997.

During the first quarter of 1997 catches in Sub-Divisions IXa-North and VIIIc-West were lower when compared with previous years. The catches increased during the second and the third quarter and descend again in the fourth quarter. As most of the catches have been reported close to Portugal, the most probable migration takes place in the third and fourth quarters in the Atlantic waters, with adult fish coming from Portugal at the beginning of spring and coming back again to the Portuguese shore at the end of the third quarter, which coincides with the major spawning concentration in the Portuguese area, located in the northern part. Nevertheless, this theory must be supported by further research in this field. This perception of migration refers to recent years and the earlier pattern may have been different.

These changes in the stock composition in the distribution area, migrations and aggregation patterns, make it difficult to define the boundaries of the different stock components and, hence, further investigations should be carried out prior to redefining the stock units. Until further information becomes available, the Working Group continues to treat the Atlantic Iberian sardine in Division VIIIc and IXa as a stock unit for assessment purposes.

8.4 Biological Data

Biological data have been provided for both Spain and Portugal from biological and length samples collected all around the year. This information is compiled on a quarterly and ICES Sub-Division basis.

8.4.1 Catch in numbers at age

Data on catch in number at age by quarter and Sub-Division in 1997 submitted by Working Group members are shown in Table 8.4.1.1.

The catch in numbers at age relative to Portugal have been updated by improving the length/weight relationships since the last sardine stock re-assessment undertaken in Vigo in May 1998.

From the available data series in catch in numbers (1976–1997) (Figure 8.4.1.1) there is a declining trend from 1981 to 1995 when the lowest value of the time series was reached (1,9 million fish). Since then the catch in number increased to about 2,2 million fish. Since 1994 the total catch in number was the lowest values in the time series. Catches-at-age are shown in Figures 8.4.1.2 and 8.4.1.3. As well as the declining trend in numbers, there is a shift in the catches from younger fish to older ones. This is specially clear since 1992, suggesting a change in the exploitation pattern. The increasing trend of the older fish in the catches (i.e. 3+) follows a cyclic fluctuation of 3–5 years, according to the

strength of the incoming recruitment. In 1995, the catches of fish older than 2 reached its maximum with a 75% of the total catch.

In 1997, a change was detected in both Iberian countries in the pattern of otolith structure of some of the younger sardines, making it difficult to allocate them to the appropriate age group. The Working Group recommends an extension of the otolith sampling scheme and further exchange among the otolith readers and a study on the daily ring increments.

8.4.2 Mean length and mean weight at age

Mean length, as well as mean weight-at-age are shown in Tables 8.4.2.1 and 8.4.2.2 respectively. First and fourth quarters gave higher values in both mean length and weight in IXa North and VIIIc West than in the Portuguese area, whereas in the second and third quarters these values are rather similar. On the other hand, sardines of VIIIc East are in general longer and heavier.

8.4.3 Maturity at age

The maturity ogive for 1997 was based on the biological sampling made during the fourth quarter of 1996 and the first quarter of 1997 for both Spain and Portugal, giving the following result:

0	1	2	3	4	5	6
0	72.70	91.80	95.00	97.20	99.30	100

This ogive is similar to that estimated last year.

8.4.4 Natural mortality

According to Pestana (1989), natural mortality is estimated to be 0.33, which is used as a fixed value for all ages.

8.5 Fishery Independent Information

8.5.1 Egg surveys

In 1997 a joint Daily Egg Production Method (DEPM) survey was undertaken by Portugal and Spain covering all the sardine spawning area from Gibraltar to Arcachon (45°N) in order to evaluate the spawning stock biomass (ICES 1997, Anon. 1997, Cunha *et al.*, WD 1997, Lago de Lanzos *et al.* 1998).

The survey was planned according to the information from previous DEPM surveys carried out by Portugal and Spain in 1988 and 1990 (Cunha *et al.* 1992, Perez *et al.* 1992, Garcia *et al.* 1991a,b, 1992) and in order to coincide with the highest spawning activity of sardine in the area.

As it was already pointed out (ICES 1997, Cunha *et al.* WD 1997, ICES 1998, EU Sardine Study Group 1998), in the Portuguese area eggs distributed only south of Oporto in low concentrations. Two interruptions in the continuity of the distribution area were found: one in Nazaré and the second one in front of Tagus estuary. South of this area till the strait of Gibraltar they distributed almost continuously over the continental shelf and the strongest concentration was located in front of Cape S. Vicente.

In the Spanish area sardine eggs were not found in the Galician coast and occurred in the Cantabrian West Coast, increasing to the Eastern area, where high concentrations were found. The spawning area in 1997 was reduced almost exclusively to coastal regions, where major egg concentrations were found. Here two nuclei of high density were detected: one in the coast of Asturias and the other in the coast of the Basque Country. This situation was quite different from that observed in previous years. In 1988 and 1990 the spawning area was considerably more extensive, reaching oceanic waters, but with a considerably lower egg abundance.

All the sardine adults in the adult parameters survey were caught in the Eastern Cantabric. No adult data were obtained in Galicia and Western Cantabric. Although sardine was detected in West Cantabric in some areas near the coast, it was not possible to collect samples due to the rocky bottoms or to the presence of fishing gears.

Preliminary estimations of parameters for sardine spawning biomass in the Portuguese area were presented in Cunha *et al.* (WD 1997), some of them based on the estimates obtained in 1988. Gordo *et al.* (WD 1998) presented the revised estimates of batch fecundity and spawning fraction, based on the data collected during the Portuguese DEPM survey. Lago de Lanzós (WD 1998) presented the revised estimates of parameters for the spawning biomass of sardine in the Spanish area.

Tables 8.5.1.1 and 8.5.1.2 show the estimated values of the different parameters of spawning biomass obtained in this survey and in the DEPM surveys held in 1988 and 1990 in the same area by both countries.

The value of Daily Egg Production (p_0) estimated for the East Cantabric in 1997 is similar to that obtained in 1990 in the same area and much lower than that of 1988. In the West Cantabric that value decreased from 1988 to 1997. Spawning fraction (f) in 1997, the fraction of mature females with less than 48 hour-old post ovulatory follicles, was slightly lower in the East Cantabric, although this value remains higher than those estimated for the other two areas in the previous years.

The average female weight estimate (W) was lower than in previous years, as it was expected due to the changes occurred in the species distribution pattern in East Cantabric in 1997, which was mainly composed of age group II fish. These accounted for more than 80% of the age data. Batch fecundity (F) was lower than that estimated in previous years due to the differences in female weight, as both are strongly correlated. Sex ratio R was higher than in 1990 and lower than in 1988.

In the Portuguese coast and Gulf of Cadiz, the value of P_0 was higher than that estimated in 1988. The Average Female Weight (W) was similar to that obtained in 1988. The Batch Fecundity (F) was higher than in 1988 and the Sex Ratio was also higher.

Egg surveys in the Spanish and Portuguese areas show different trends, with abundance in the Spanish area showing a marked decline from 1988 to 1997 (Table 8.5.1.1) whilst in the Portuguese areas egg surveys do not show evidence of a decline in the spawning population (Table 8.5.1.2).

8.5.2 Acoustic surveys

During surveys undertaken in 1997 in Portugal and Spain, frequent situations of mixture of sardine with other species, mainly mackerel, horse mackerel and anchovy occurred. Due to these situations it was difficult to identify the acoustic records to species level and to attribute the integration values to sardine. The "Planning Group for Acoustic Surveys in ICES Divisions VIII and IX" (ICES 1998b) discussed this problem and it was agreed that it was appropriate to assign the acoustic records by species using the data of catch rates by sampling haul and to split the acoustic records by species proportion. This was followed in the estimations for 1998 survey in both countries and the results of the Portuguese survey in March and November 1997 were also revised accordingly (Simmonds and Marques, 1998 *in* Annex to Marques *et al.* WD 1998).

Portugal

In order to use them in the assessments, Portugal recovered and analysed the results of the acoustic surveys from the three available time series: March, August and November (Marques *et al.* WD 1998), (Tables 8.5.2.2 to 8.5.2.4). The consistency of the acoustic system performance and methodology in the Portuguese surveys was revised by Simmonds and Marques (1998) (*in* Annex to Marques *et al.* WD 1998, Anon. 1998).

The trends of the abundance (numbers at age) provided by the three Portuguese series and the Spanish March acoustic surveys series are summarised in Tables 8.5.2.2 to 8.5.2.4 and Figure 8.5.2.1. A comparative analysis of the abundance trends obtained from each of the surveys series indicates that the older adult fish (Age 3+) increased in the Portuguese March surveys from 1996 to 1998. Similarly, in the November series, it shows a higher abundance in 1997 than in previous years in the same series. The opposite is shown in the Spanish March acoustic surveys series, where the abundance of the older adult fish sharply decreases from 1996 to 1998. In the Portuguese August series the abundance of the older adult fish decreased from 1995 to 1996. The abundance of the younger fish (age ≤3) is quite variable for all survey data series.

During 1997 Portugal undertook two acoustic surveys for sardine onboard R.V. "Noruega", one in March covering the whole Portuguese coast and the Gulf of Cadiz (Spain) and the second in November covering only the Portuguese coast. In 1998, one acoustic survey was carried out with R.V. "Noruega", from 6 March to 8 April covering the whole Portuguese coast and the Gulf of Cadiz (Spain). This was part of a joint Spanish-Portuguese acoustic survey in the whole distribution area of the Atlantic-Iberian sardine stock which was programmed by the "Planning Group for

Acoustic Surveys in ICES Sub-Areas VIII and IX" (ICES, 1998b). The surveys design and methodology were those adopted by the "Planning Group for Acoustic Surveys in ICES Divisions VIII and IX" (ICES 1986, 1998b).

Table 8.5.2.1 presents the sardine abundance and biomass in each area estimated in March 1997, November 1997 and March 1998.

Figures 8.5.2.2 to 8.5.2.5 show the acoustic track and location of trawl sampling stations and sardine density distribution of the most recent Portuguese acoustic surveys carried out in November 1997 and March 1998. Higher sardine concentrations observed in the November 1997 survey (Figure 8.5.2.4) were closer to the shelf edge than those observed during the March 1998 survey (Figure 8.5.2.5).

Spain

Spain has carried out an acoustic survey from 16 March to 12 April with R.V. "Thalassa" which covered the northern part of the Iberian Peninsula and the southern and central waters of the French coast.

Survey design and data analysis followed the methodologies proposed in the "Planning Group for Acoustics Surveys in ICES Divisions VIII and IX" (ICES 1986, 1998b).

Figure 8.5.2.6 shows the survey track, fishing stations as well as the allocated backscattering values of sardine. Sardine distribution presented two different situations. In the South of Galicia as well as in the western part of the Cantabrian Sea, sardine has been found in isolated schools, close to the seashore as in the previous year. On the other hand, in the southern French waters and in the eastern part of the Cantabrian Sea, sardine has been found in a more or less continuous layer but mixed with other fish species, in which the fish density was low. This situation had not been seen previously. Besides, there was a spatial continuity. In the north part of the French area, sardine formed small schools, mixed with those of anchovy, which had the same shape, over a mixed layer of horse mackerel and mackerel. This kind of distribution had already been seen in the previous French acoustic surveys.

Table 8.5.2.5 shows the main results by each evaluation area. The distribution area has increased in the eastern part of the Spanish surveyed areas but it has decreased in the South of France. Thus, and taking into account the low fish density found, the total sardine biomass estimated has decreased in almost all of the surveyed area.

Estimated numbers at age are presented in Table 8.5.2.6 and Figure 8.5.2.7. Age group 1 was the most abundant in all the areas, meaning that the 1997 year class seems to be better than the previous ones. On the other hand, the 1995 year class whose estimation in 1997 was the most important in both number and biomass, especially in French waters, has a little influence on the total estimated.

The total biomass estimated was 35,000 tonnes corresponding to 773 million fish, which represent a decrease of 25% in biomass relatively to 1997.

France

In May 1997 a French research survey 'PEGASE' was carried out from 47°N down to 43°45'N. The main objective of this survey was to estimate the abundance of anchovy stock in the French waters. For this reason, the coverage of sardine area distribution is incomplete. Only the centre and the southern parts of the distribution area of this species in the Bay of Biscay were investigated.

During the May 1997 survey two zones were identified, the first one located in the North of the surveyed area (from 47°N to 44°45'N) and the second one (South of 44°45'N) down to the Spanish border from the acoustic data and pelagic trawls (Figure 8.5.2.8, Prouzet and Massé WD 1998). Three main groups of sardine were identified. One group situated in the centre of the Bay (between 45°N and 45°30'N), which showed a bimodal length distribution (Table 8.5.2.8, Figure 8.5.2.9, Prouzet and Massé WD 1998). The smaller sub-group belongs to the group 1. The majority of the sampled sardine belongs to age group 2 fish and older.

The distribution of the different species has been determined from the acoustic data and pelagic trawls (Figure 8.5.2.8, Prouzet and Massé WD 1998). Results concerning abundance of the different pelagic species are given in Table 8.5.2.7. From these data, it can be observed that in spring, the most part of the population is concentrated in the Northern area of the Bay of Biscay.

In 1998 France carried out an acoustic survey "PEGASE98" from 20 May to 21 July. The 1998 survey results were presented in Massé (WD 1998) (see Section 10.4.2). Table 8.5.2.9 presents the biomass (tonnes) of sardine by length classes and in the three regions of the French coast during the 1998 survey. The highest estimated biomass (6,400 tonnes) (about 70% of the total estimated biomass) was found in the north zone, as it happened last year. The majority of the sampled sardine in this area belongs to age group 2 fish and older, the same pattern in 1997. In 1998 sardine was less abundant than in 1997 in the South area being composed of lower length classes.

8.6 Effort and Catch per Unit Effort

Table 8.6.1 gives the historical series of effort, in fishing days and the catch per unit effort (tonnes/fishing day) for four different purse seine fleets, from Spain and Portugal.

The fishing days of the Portuguese purse seine fleet remained at the same level during the last three years and the CPUE shows a slight decrease. The number of vessels decreased from 148 in 1996 to 129 in 1997.

The Sada fleet in Spain (Sub-Division VIIIc-West) showed a sharp decrease in effort (fishing days) in 1997. For this fleet there is a strong decrease in the effort since 1987 which is not so evident in the CPUE (t/f.days).

For the Vigo-Riveira fleet (Sub-Division IXa-North) the effort has also decreased since 1982 and remained stable in the last three years. The CPUE shows a decreasing trend since 1988.

The CPUE in Portugal remains stable while the Galician fleets show a decreasing trend, which is more evident in the Sada fleet.

8.7 Distribution of Sardine

The available information on the sardine distribution in 1997 comes from both catches and acoustic surveys. As in the Celtic Sea and in the French waters sardine is not a target species, the information on these areas should be regarded as qualitative rather than quantitative. Nevertheless, the southern part of the Bay of Biscay has been covered for both Spain and France in spring during their acoustic surveys. The distribution area reaches as far as the English Channel. In the southern part it is noticeable that the high quantities of sardine detected in spring in the southern French waters were corroborated by both the Spanish and the French acoustic surveys. This high concentration had a continuity across the inner part of the Bay of Biscay in the Spanish waters. Moreover, the catches of the VIIIc East Sub-Division during the first quarter as well as the French in VIIIa,b were the most important ever reported.

In the areas where sardine is a target species, there seems to have been an important change in the distribution pattern. The abundance estimated in both VIIIc West and IXa North during the Spanish acoustic survey showed an important area in the Cantabrian sea with almost no sardine, and only a few patches have been found in the western part of the area. In addition, the catches during the first and fourth quarter in both Sub-Divisions were lower compared to previous years. At the beginning of the second quarter sardine seemed to arrive to these areas with an increasing in catches, but during the last quarter sardine tended to move outside.

8.8 Recruitment Forecasting and Environmental Effects

The stock recruitment ratio in short life cycle pelagic species is low. An important amount of the variability in the recruitment is explained by the variability of the environmental factors (Cury and Roy 1989).

The Atlantic Iberian waters suffered a temperature increase during the last years (Lavin *et al.* 1997, Dias *et al.* 1996). This increase can also be noticed from the analysis of the temperature data from the period 1988–1997. The intensification of frequency of northern winds during winter implies the offshore larval transportation away from the favourable feeding areas and increasing their mortality (Dias 1994).

The decreasing trends in recruitment of small pelagic fish stocks observed in the Portuguese upwelling system in the last years was inversely related with NAO positive phase and the increase of upwelling events observed off Portugal in the last 10–15 years (Borges *et al.* 1997, Santos *et al.* 1997).

It is argued in Cabanas and Porteiro (1998) that recruitment appears to be higher when the northern boundary of the Gulf Stream does not extend so far to the north.

In the last ten years, in the period 1990–1995 the Gulf stream index showed a high value of 1.0 coinciding with weak recruitment year classes. In 1997 the Gulf stream index was low (around 0 or negative) and the recruitment was slightly better than in previous years (Cabanas and Porteiro 1998).

8.9 State of the Stock

8.9.1 Data exploration and preliminary analysis

Considerable data exploration was carried out prior to the meeting. In Anon (1998) the sensitivity of the Working Group's assessment model was tested to the following:

a. Aggregation of ages 7 to 11+ into a 7+ group.
b. Choice of only three, rather than eleven years, for the imposition of a separable constraint.
c. Choice of only six, rather than eleven years, for the imposition of a separable constraint.
d. Choice of 100,000 rather than 1 million fish for the assumed values of low catches in the assessment.
e. Choice of 0.1 rather than 0.01 for the arbitrary weighting factors for the assumed values of low catches in the assessment.
f. Choices of 1.0 or 0.5 instead of 0.05 for the assumed value of terminal selection in the assessment.
g. Replacement of zero values in the survey indices with missing values rather than by arbitrarily setting to 1,000 as was used in the Working Group's previous assessment (Anon. 1997).
h. Replacement of zero values in the survey indices with the lowest observed non-zero values rather than by arbitrarily setting to 1,000 as was used in the Working Group's previous assessment.

After this exploration it could be concluded that the perception of stock size as having a declining trend in recruitment, declining spawning stock size and increasing fishing mortality in recent years was rather robust to these alternative model choices. However, perceptions of stock size at the start of the time-period (1977 to 1985) were very sensitive to choices made in the assumed selection pattern and to the assumed values of catches in the higher age-groups.

Further exploration was carried out by Borges (WD, 1998) who explored alternative assessments using an aggregated 6+ group, iterative reweighting of the March Spanish and Portuguese acoustic survey data, and tested the sensitivity of the assessment to the inclusion of Portuguese acoustic November surveys. Using these alternative assumptions, a different perception of the stock was obtained with lower fishing mortality and higher stock size, although the trend of increasing fishing mortality and declining recruitment in recent years persisted.

The Working Group reviewed these exploratory exercises and concluded that:

1. The treatment of the plus-group in the data is different by year, as a 6+ group has been used in the period 1976 to 1988 and 7+ group has been used from 1989 onwards. Either all data should be aggregated consistently, or the assessment model should be modified to account for this.
2. The assessment models are unstable, with conflicting tendencies from different sources of information (particularly from March and November surveys).

Further analyses carried out presently at the Working Group indicated that there is strong evidence of a change in selection, with different patterns in the fishery between 1976–1991 and 1991 and later. Inspection of the catch data revealed that from approximately 1991 onwards, about equal numbers from within each cohort were taken at ages 2, 3, 4 and sometimes 5, indicating a rising fishing mortality up to ages 4–5. In earlier years, the decline in the numbers caught started to decline in each cohort at approximately ages 2–3. This also showed up as a distinct time trend in the catch residuals when a common exploitation pattern was assumed. Accordingly, assumption of a constant selection pattern in the whole time series, as has been made previously (ICES 1998/Assess:6, Anon. 1998) appears inappropriate.

However, attempts to include changing selection patterns in an assessment model proved to lead to model instability unless additional constraints were imposed or additional information added to the assessment. Changes in selection pattern in time periods for which there are no surveys and for a stock in which there are few age-classes makes it impossible reliably to estimate stock abundances before the start of the survey time-series.

An attempt was made to explore ways of stabilising the estimates of fishing mortalities in the last period, by making a simplified version of ICA on a spreadsheet. Including the SSB estimates from the egg-surveys in 1988 and 1997 did not change the assessment to any large extent, although the residuals were very small. Furthermore, using the March Spanish acoustic survey data for estimating the relative year class strength at oldest true age was explored. This is the only source of information about the state of the cohorts beyond the age 7, and was the reason for using 11 as plus age in previous years. Values of Z were derived from these indices as $Z_{y,a} + \ln(I_{y,a}/I_{y+1,a+1})$. These raw values were smoothed by

assuming that each Z is a sum of a year component and an age component. A 'survey population' with these mortalities was fitted to the indices, and the numbers at age 6 were used as stock numbers at oldest true age. This had a clear stabilising effect on the assessment; attempting to estimate these numbers as parameters led to extremely low fishing mortalities back in time. The SSB, F and recruitment estimates from this exploratory assessment with both egg survey data (DEPM) and survey-derived terminal stock numbers included, are shown in Figure 8.9.1.1.

Based on the foregoing, it was decided to revise the assessment model in order to account for new perceptions of data treatment and of appropriate selection pattern, and to use supplementary information as necessary to stabilise the parameter estimates. Only data consistently aged to 6+ were included (years 1989 and later), and selection was modelled as separate in the periods 1976–1990 and 1991–1997, based on a terminal selection of 1.0 on age 5 relative to age 3.

The inclusion of the egg surveys and the commercial catch rate information was made to attempt to derive a more robust assessment of the stock. Otherwise, the assessment model tends to be overparameterised and unstable. Commercial CPUE indices were then treated as indices of spawning biomass, with a power relationship being assumed.

Using the new selection model, an assessment calculation was made using all the available plausible indices of abundance:

a. Portuguese and Spanish March Acoustic Surveys
b. Egg Surveys
c. Vigo CPUE
d. Sada CPUE
e. November Portuguese Acoustic Surveys
f. Matosinhos CPUE (later removed on account of an estimated negative catchability relationship).

Three different weighting factors options were considered:

a. equal weights to each index
b. Iterative reweighing of indices from items (a–d)
c. down weighing the CPUE fleets c and d.

From this preliminary model different runs have been carried out. Figure 8.9.1.2 presents the results of all of the different runs.

The inclusion of the CPUE data has stabilised the model which for all the different trials gave similar perceptions (i.e. declining trend in SSB and increasing trend in fishing mortality and similar estimations on recruitment). On the other hand the inclusion of the November Portuguese acoustic surveys series generates lower estimation on fishing mortality and higher estimation on SSB. Besides, this time series has only two points in the second period of the selection pattern (1991–1997). The Working Group discussed whether this time series should be included because of the gaps that this series presents and the different final estimation from the other models. In spite of this time series coming from the most important fishery area in Division IXa, the Working Group decided to remove it for the time being and to analyse this time series when further surveys have been undertaken. The stock assessment will be modelled according to the information of the Spring acoustic surveys in both areas of Portugal (1996–98) and Spain (1988–98), SSB estimation from the DEPM applied in 1988 and in 1997 and CPUE time series of Vigo/Ribeira (Sub-Division IXa-North) (1982–1997) and Sada (Sub-Division VIIIc-West) (1988–97) purse seiners fleets. The results of the assessment model including the Portuguese November survey are shown in Figure 8.9.1.3 and Table 8.9.1.1.

8.9.2 Stock assessment

Based on the previous analysis, an Integrated Catch at Age analysis (Patterson and Melvin 1996) has again been used for the assessment of sardine. The model was fitted by a non-linear minimisation of the following objective function:

$$\sum_{0}^{6+}\sum_{1988}^{1990}\lambda_a\left[\ln\left(C_{a,y}\right)-\ln\left(F_y\cdot S_{1,a}\cdot\bar{N}_{ay}\right)\right]^2+\sum_{0}^{6+}\sum_{1991}^{1997}\lambda_a\left[\ln\left(C_{a,y}\right)-\ln\left(F_y\cdot S_{2,a}\cdot\bar{N}_{ay}\right)\right]^2+$$

$$+\sum_{1988}^{1990}\sum\left[\ln\left(DEPM_y\right)-\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{1,a}\cdot PM\cdot M)\right)\right]^2+$$

$$\sum_{1991}^{1997}\sum\left[\ln\left(DEPM_y\right)-\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{2,a}\cdot PM\cdot M)\right)\right]^2+$$

$$+\sum_{1988}^{1990}\sum\left[\ln\left(Cpue1_y\right)-Q_1\left[\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{1,a}\cdot PM\cdot M)\right)\right]^{K1}\right]^2+$$

$$+\sum_{1991}^{1997}\sum\left[\ln\left(Cpue1_y\right)-Q_1\left[\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{2,a}\cdot PM\cdot M)\right)\right]^{K1}\right]^2+$$

$$+\sum_{1988}^{1990}\sum\left[\ln\left(Cpue2_y\right)-Q_2\left[\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{1,a}\cdot PM\cdot M)\right)\right]^{K2}\right]^2+$$

$$+\sum_{1991}^{1997}\sum\left[\ln\left(Cpue2_y\right)-Q_2\left[\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{1,a}\cdot PM\cdot M)\right)\right]^{K2}\right]^2+$$

$$+\sum_{1988}^{1990}\sum_{1}^{6}\left[\ln(ASP_{a,y})-\ln\left(Q_{ASPa}\cdot\bar{N}\cdot\exp\left(-F_y\cdot S_{1,a}\cdot M\right)\right)\right]^2+\sum_{1991}^{1997}\sum_{1}^{6}\left[\ln(ASP_{a,y})-\ln\left(Q_{ASPa}\cdot\bar{N}\cdot\exp\left(-F_y\cdot S_{2,a}\cdot M\right)\right)\right]^2+$$

$$+\sum_{1988}^{1990}\sum_{1}^{6}\left[\ln(ASS_{a,y})-\ln\left(Q_{ASSa}\cdot\bar{N}\cdot\exp\left(-F_y\cdot S_{1,a}\cdot M\right)\right)\right]^2+\sum_{1991}^{1997}\sum_{1}^{6}\left[\ln(ASS_{a,y})-\ln\left(Q_{ASSa}\cdot\bar{N}\cdot\exp\left(-F_y\cdot S_{2,a}\cdot M\right)\right)\right]^2$$

with constrains on $S1_3 = S1_5 = S2_3 = S2_5$

and $\bar{N}$ average exploited abundance over the year

- population abundance on 1st January
- $O_{a,y}$: maturity ogive
- Natural mortality
- PM and PF: Proportion of M and F before spawning
- S1a, S2a: Selection patterns at age for the separable model in the time periods 1988–1990 and 1991–1998 respectively
- DEPM: SSB estimation from the daily egg production method
- Cpue1, Cpue2: Cpue indices from Vigo/Ribeira (1) and Sada(2) respectively
- Q_{ASP}, Q_{ASS}: Catchability of the linear indices from Portuguese (P) and Spanish (S) March surveys
- Q and K: Linear and power term in catchability models
- $\lambda_{a,y}$: weighting factors for the catches at age (0.5 for age group 0 and 1.0 for the others)

Results of the assessment are shown in Table 8.9.2.1 and Figure 8.9.2.1. The inclusion of two selection patterns as well as the new indices gave a better fitted model than the previous assessment (Anon 1998). The two selection patterns reflect the change found in the catch at age matrix. SSB indices from the DEPM match with the estimated SSB. CPUE indices seem to stabilise the model and the assumed power catchability relationship have low variances. As in previous assessments, the assumed linear catchability of the Spanish March acoustic surveys match better for age 3 and older whereas the Portuguese March acoustic one gave lower variances at age 1 and 2. Separable model residuals are lower than ±0.5 except those of age group 0 in 1987, 1991 and 1993 and age group 2 in 1994. CV expressed in % of the parameters estimates are lower than in previous assessment (Anon. 1998).

Figure 8.9.2.2 shows the estimated recruitment, F_{2-5} and SSB for the whole time series. Estimated recruitments are similar to those estimated in the previous assessment and these are in agreement with the estimation of the spring acoustic survey at age 1. 1995 recruitment is the lowest of the time series, whereas the last five estimated recruitments in the time series are lower compared to the previous five. The recruitment of 1997 was estimated to be 5,800 million fish. Fishing mortality shows estimated values around 0.5, with no clear trends until 1995. Since then an important increasing trend has been estimated, reaching an expected value of 0.7. Estimated SSB shows two clear peaks of higher abundance

(1982–85 and 1993–94), with a declining trend after these. In 1990 the estimated SSB was 290,000 tonnes whereas in 1997 the SSB was estimated to be 220,000 tonnes which is the lowest value in the time series, and half of that estimated in 1995. This decrease could be explained by the change in the exploitation pattern.

8.9.3 Reliability of the assessment and uncertainty estimation

The assessment might not be considered to provide reliable estimates of levels of fishing mortality nor of stock size in the long term, on account of important structural uncertainties due mostly to uncertainty in the appropriate treatment of selection. In particular, due to selection pattern changes, it is difficult to obtain a meaningful comparison between the levels of stock size and of fishing mortality in the mid 1970s and the late 1990s.

Purse-seine catch rate information from two ports of Galicia appears approximately to indicate similar trends in stock size to the acoustic surveys carried out in the same area (Division VIIIc and IXa-North), and its inclusion appears justified although there is a risk that these indices may fail to detect a stock decline due to concentration effects. Nevertheless, an attempt made downweighting this CPUE's series in 0.01, gave similar results.

The assessment includes the Spanish and Portuguese catch at age data, DEPM estimates, the Spanish and Portuguese March acoustic surveys and the CPUE indices of the Vigo-Ribeira (Sub-Division IXa-North) and Sada (Sub-Division VIIIc-East) purse seine fleets. For the Portuguese area in IXa, where the bulk of the catch is taken, the Portuguese March acoustic survey data indicate an increasing trend but only the three most recent years could be used (1995–1997) because the data available in the period of 1985–1988 had to be removed due to methodological problems of consistency in acoustical instrumentation (Anon. 1998). There are no March Portuguese survey data available for the period from 1989 to 1994. The Portuguese November acoustic survey series started in 1984 but it was not carried out from 1988 to 1991 nor from 1993 to 1996. In 1997 this survey estimated the highest abundance of the November series but this increasing trend needs to be confirmed in this year's 1998 November survey. The SSB estimated by DEPM during March 1997 for the Portuguese area was not carried out during the peak of spawning which is November/December. The independent data used for IXa are lacking as compared with the VIIIc area. The more general question of about how well the stock is represented in the older ages on the March Acoustic Survey in the eastern part of Division VIIIc has no simple answer. There are uncertainties in the assessment related to the distribution of the older age groups which may not be available to some of the surveys. As an example of this, the French acoustic survey in 1997 showed that there was a high abundance of sardine in Division VIIIa,b which is north of the area normally assessed.

Additional survey data in 1998–99, both from VIIIc and IXa will help to reduce the uncertainty.

Despite these uncertainties, the stock in VIIIc and IXa appears to have an increasing trend in fishing mortality and decreasing trends in recruitment and stock size. This trend appears in most of the various assessment models used by the Working Group to assess this stock.

8.10 Catch Predictions

A deterministic catch forecast was based on the estimated number of fish at the beginning of 1998 from the ICA assessment. Input data for natural mortality was estimated to be 0.33 and the proportion of M and F before the spawning was equal to 0.25 as in the assessment model. Maturity ogive, stock and catch weights were calculated as the mean value of the three last years. Due to the increasing trend observed in the fishing mortality, input values for exploitation pattern were those estimated for the fishing mortality in 1997 in the assessment model. Recruitment input was fixed at 4,917 million fish, which corresponds to the geometric mean of the last six years. Geometric mean of the poorest recruitment values gave 4,375 million fish, which is similar to that of the last six years. Thus, the value of 4,917 million fish was used as a single recruitment input. The projection has been made until 2000 (Table 8.10.1).

Results of the deterministic catch predictions are shown in Table 8.10.2. Estimated catch for 1998 at $F_{status\ quo}$ (F_{2-5}=0.70) should be 108,000 tonnes and the SSB 253,000 tonnes. The predicted catch for 1999 at $F_{status\ quo}$ will be 112,000 tonnes and the SSB will decrease to 245,000 tonnes. Predicted SSB for year 2000 will be 230,000 tonnes.

8.11 Short-Term Risk Analysis

A sensitivity analysis (ICES CM 1991/Assess:22) has been made for *status quo* forecast using the same input value as in the catch projections. The forecast will be sensitive to the estimated exploitation pattern at age group 3 as well as to the estimated numbers at age group 1 and 2 and to the estimated fishing mortality in 1999. Expected SSB in 2000 will be sensitive to the estimated recruitment in 1998; this value and the estimated numbers at age 0 will explain up to 49% of the total variability (Figure 8.11.1).

As it was pointed out in Section 8.9, the uncertainties in the assessment model structure could generate a low accuracy in the parameter estimations and hence, in spite of the clear trends, the true values of those parameters could likely be biased.

8.12 Medium-Term Predictions

Due to the uncertainties in the model structure explained in Section 8.9, this analysis will be not performed this year.

8.13 Long-Term Yield

Input data for yield per recruit analysis are shown in Table 8.13.1. As in the deterministic catch projections, maturity ogive, weight in stock and weight in catch have been calculated as a the mean value of the six last years. Fishing exploitation pattern is the estimated fishing mortality for 1997 for the assessment model. Natural mortality has been fixed at 0.33 and the proportion of M and F before spawning was equal to 0.25. Recruitment input was fixed at 4,917 million fish which corresponds to the geometric mean of the last three years.

Results are shown in Table 8.13.2 and Figure 8.13.1.

8.14 Reference Points for Management Purposes

From the last Working Group report some reference points have been addressed. The suggestion for F_{crash} should be equal to F_{lim} which has been estimated at 0.34 and the alternative to rebuild the stock was estimated to be 0.17. These estimations have been calculated according to SSB/Recruitment and Yield/SSB relationships from the estimated values of the assessment model (ICES 1998a). The Study Group on the Precautionary Approach to Fisheries Management (ICES 1998/ACFM:10) had no alternative suggestions for these values.

The perception of the SSB in the first period for which fishery-independent information is not available has changed. Moreover, the selection pattern in recent years, which determines yield and SSB per recruit has also changed. This has led to profound changes in the former basis for estimating reference points.

Some new calculations of values of reference points based on the Working Group's new assessment model have been made using the PA software (CEFAS, Lowestoft (1998)). The first three points of the SSB/Recruitment relationship seem to have a high influence on the final estimations (Figure 8.14.1), but, as noted above, estimates of stock size in the early part of the time series are unreliable, and reference points based on estimates of historic SSB should not be used for management purposes. Estimated values of the reference points are shown in Figure 8.14.2.

Hence, due to the uncertainties in model structure and specially the SSB/Recruitment relationship, the calculated reference points were not considered to be reliable. Further investigations are needed in order to derive reliable estimates.

8.15 Harvest Control Rules

No harvest control rules were proposed for sardine by the Study Group on the Precautionary Approach to Fisheries Management (ICES 1998/ACFM:10), and none are proposed here.

8.16 Environmental Effects

As it was pointed out in Section 8.8, recruitment has been studied in relation to different environmental factors. In spite of some factors having shown a significant relation, there is some variability which is not explained by these relations, which might be related to the spawning stock size (Cabanas and Porteiro WD 1998).

Therefore, no attempt has been made to use an external index to improve the recruitment estimation.

8.17 Management Considerations

For the time being and taking into account the low level of the most recent recruitment, the increasing trend of the fishing mortality and the shift in the exploitation pattern from the younger fish to the older ones, the SSB could be in a serious risk to decrease.

Although the Working Group has not proposed any reference points, the immediate target in order to prevent a dangerous decline of SSB is to reduce the F. The Working Group suggests that a reduction to below $F_{0.1}$ (= 0.44) and close to the mean estimated fishing mortality of recent historical fishing mortality (1988–1995) may be a useful guideline. Further research on the migrations and aggregation patterns, spawning areas and periods and growth and their relations to the environmental processes must be accomplished.

Table 8.2.1.1 - Landings (tonnes) of SARDINE by country (Data provided by the Working Group members)

SARDINE VII

COUNTRY	1982	1983	1984	1985	1986	1987	1988	1989
France	907	803	809	2,089	2,570	965	2,586	1,141
Denmark								
UK (Eng.& Wales)								
TOTAL	**907**	**803**	**809**	**2,089**	**2,570**	**965**	**2,586**	**1,141**

COUNTRY	1990	1991	1992	1993	1994	1995	1996	1997
Denmark			17,843		17,327	10,068	2,921	
France	1,107	1,957	1,769	585	272			2,584
UK (Eng.& Wales)		3,011	4,494	4,917	2,061	6,852	6,886	4,907
Netherlands			42					
TOTAL	**1,107**	**4,968**	**24,148**	**5,502**	**19,660**	**16,920**	**9,807**	**7,491**

SARDINE VIII

COUNTRY	1982	1983	1984	1985	1986	1987	1988	1989
France	5,928	6,467	4,491	8,169	10,229	7,708	7,808	8,976
Spain	31,756	32,374	27,970	25,907	39,195	36,377	40,944	29,856
UK (Eng.& Wales)								
TOTAL	**37,684**	**38,841**	**32,461**	**34,076**	**49,424**	**44,085**	**48,752**	**38,832**

COUNTRY	1990	1991	1992	1993	1994	1995	1996	1997
France	8,485	9,637	8,713	5,329	7,283		8,706	11,521
Spain	27,500	20,735	26,160	24,486	22,181	19,538	14,423	15,587
UK (Eng.& Wales)			1					
TOTAL	**35,985**	**30,372**	**34,874**	**29,815**	**29,464**	**19,538**	**23,129**	**27,108**

SARDINE IX

COUNTRY	1975	1976	1977	1978	1979	1980	1981	1982
Portugal	95,877	79,649	79,819	86,553	91,294	106,302	113,253	100,859
Spain	12,236	10,140	9,782	12,915	43,876	49,593	65,330	71,889
Spain (IXa South, Cadiz)				5,619	3,800	3,120	2,384	2,442
TOTAL (not including Cadiz)	**108,113**	**89,789**	**89,601**	**99,468**	**135,170**	**155,895**	**178,583**	**172,748**
TOTAL (including Cadiz)				105,087	138,970	159,015	180,967	175,190

COUNTRY	1983	1984	1985	1986	1987	1988	1989	1990
Portugal	85,922	95,110	111,709	103,451	90,214	93,591	91,091	92,404
Spain	62,843	79,606	66,491	37,960	42,234	24,005	16,179	19,253
Spain (IXa South, Cadiz)	2,688	3,319	4,333	6,757	8,870	2,990	3,835	6,503
TOTAL (not including Cadiz)	**148,765**	**174,716**	**178,200**	**141,411**	**132,448**	**117,596**	**107,270**	**111,657**
TOTAL (including Cadiz)	151,453	178,035	182,533	148,168	141,318	120,586	111,105	118,160

COUNTRY	1991	1992	1993	1994	1995	1996	1997
Portugal	92,638	83,315	90,404	94,468	87,818	85,757	81,156
Spain (IXa North)	14,383	16,579	23,905	16,151	13,928	11,251	12,291
Spain (IXa South, Cadiz)	4,834	4,196	3,664	3,782	3,996	5,304	6,780
TOTAL (not including Cadiz)	**107,021**	**99,894**	**114,309**	**110,619**	**101,746**	**97,008**	**93,447**
TOTAL (including Cadiz)	111,855	104,090	117,973	114,401	105,742	102,312	100,227

- Data not available

Table 8.2.1.2 - 1982-1997: Annual landings (tonnes) of SARDINE by Division and Sub-area

DIVISION	1982	1983	1984	1985	1986	1987	1988	1989
VIId	59	211	147	465	512	67	29	93
VIIe	828	590	661	1,624	2,058	682	438	91
VIIf	20	-	-					
VIIg	-	-	1	-				
VIIh		2	-			216	2,119	957
total VII	**907**	**803**	**809**	**2,089**	**2,570**	**965**	**2,586**	**1,141**
VIIIa	5,928	6,013	4,472	8,090	10,186	7,631	7,770	8,885
VIIIb		454	19	79	77	77	38	85
VIIIc	31,756	32,374	27,970	25,907	39,195	36,377	40,944	29,862
VIIId								
total VIII	**37,684**	**38,841**	**32,461**	**34,076**	**49,458**	**44,085**	**48,752**	**38,832**
IXa	**172,748**	**148,765**	**174,716**	**178,200**	**141,411**	**132,448**	**117,596**	**107,270**
IXa (including Cadiz)	175,190	151,453	178,035	182,533	148,168	141,318	120,586	111,105
TOTAL YEAR*	**211,339**	**188,409**	**207,986**	**214,365**	**193,439**	**177,498**	**168,934**	**147,243**

DIVISION	1990	1991	1992	1993	1994	1995	1996	1997
IVc		-	8	19	-	-	0	120
VIa		-	1	-	-	-	-	-
VIb					49	24		-
VIId	64	170	153	127	2,086	1,621	179	71
VIIe,f	808	4,687	19,635	5,304	20,985	13,787	8,278	2,584
VIIg			0		0			
VIIh	235	110	4	71	-	1,439	1,350	1,058
VIIj			0					
total VII	1,107	4,968	19,793	5,502	23,071	16,846	9,807	3,713
VIIIa	8,381	9,113	8,565	4,703	7,164		8,180	11,361
VIIIb	104	482	141	548	119		526	160
VIIIc	27,500	20,735	26,166	24,486	22,181	19,538	14,423	15,587
VIIId		42	2	78	0			
total VIII	**35,985**	**30,372**	**34,874**	**29,815**	**29,464**	**19,538**	**23,129**	**27,108**
IXa	**111,657**	**107,021**	**99,894**	**114,309**	**110,619**	**101,746**	**97,008**	**93,447**
IXa (including Cadiz)	118,160	111,855	104,090	117,973	114,401	105,742	102,312	100,227
TOTAL YEAR*	**148,749**	**142,361**	**154,569**	**149,645**	**163,154**	**138,130**	**129,944**	**124,388**

*not including Cadiz (IXa-South, Spain)
Sub-area VII - 1982-1990 only French data was available
(a) - In Div VIIe, 1992 17,507t were caught by Denmark
(-) Unknown catches

Table 8.2.1.3 - Annual landings (t) of SARDINE in Divisions VIIIc and IXa by country.

COUNTRY	1977	1978	1979	1980	1981	1982	1983
Portugal	79,819	83,553	91,294	106,302	113,253	100,859	85,922
Spain	45,931	56,437	62,147	85,380	100,880	103,645	95,217
Cadiz (IXa South, Spain)		5,619	3,800	3,120	2,384	2,442	2,688
Total*	**125,750**	**139,990**	**153,441**	**191,682**	**214,133**	**204,504**	**181,139**

COUNTRY	1984	1985	1986	1987	1988	1989	1990
Portugal	95,110	111,709	103,451	90,214	93,591	91,091	92,404
Spain	107,576	92,398	77,155	78,611	64,949	46,035	46,753
Cadiz (IXa South, Spain)	3,319	4,333	6,757	8,870	2,990	3,835	6,503
Total*	**202,686**	**204,107**	**180,606**	**168,825**	**158,540**	**137,126**	**139,157**

COUNTRY	1991	1992	1993	1994	1995	1996	1997
Portugal	92,638[1]	83,315	90,404	94,468	87,818	85,757	81,156
Spain	35,118	42,739	48,391	38,332	33,566	25,674	27,878
Cadiz (IXa South, Spain)	4,834	4,196	3,664	3,782	3,996	5,304	6,780
Total*	**127,756**	**126,054**	**138,795**	**132,800**	**121,384**	**111,431**	**109,034**

*not including Cadiz

[1] Discards included

Table 8.2.1.4 - SARDINE (VIIIC+IXa not including Cadiz). Quarterly catches (t) by gear by country and fleets in 1997 (Provided by the WG members)

Country/Quarter	1st Q	2nd Q	3rd Q	4th Q	Year
Total	**16,871**	**26,805**	**40,842**	**24,516**	**109,035**
Spain (VIIIc+IXa):					
Purse seine	6,507	9,238	9,218	2,916	27,879
Portugal (IXa):	10,364	17,567	31,624	21,601	81,156
Purse-seine	9,335	17,100	30,635	20,980	78,049
Artisanal	124	177	778	206	1,285
Trawl	905	290	211	415	1,822

Table 8.2.1.5 - SARDINE (VIIIC+IXa Including Cadiz). Total nominal catches (t) by quarter and areas of Divisions VIIIc and IXa during 1997

Area	1st Q	2nd Q	3rd Q	4th Q	Total 1997
VIIIc East	5,475	1,393	1,068	1,866	9,803
VIIIc West	640	2,548	1,972	624	5,785
IXa North	392	5,296	6,178	425	12,291
IXa Central-North	2,000	6,728	16,375	9,052	34,156
IXa Central-South	5,702	5,160	7,239	7,761	25,863
IXa South (Portugal)	2,662	5,679	8,010	4,788	21,137
IXa South (Cadiz, Spa	2,040	890	1,550	2,299	6,780
Total	**18,911**	**27,695**	**42,392**	**26,816**	**115,814**

Table 8.2.1.6 - 1978-1997: Sardine quarterly catches (tonnes) in Sub-Division IXa-South, Gulf of Cadiz (Spain)

Year/Quarter	1st Q	2nd Q	3rd Q	4th Q	Total
1978	1,033	1,571	1,267	1,748	5,619
1979	1,302	468	1,263	767	3,800
1980	787	413	1,054	867	3,120
1981	492	259	774	860	2,384
1982	627	273	680	862	2,442
1983	485	595	851	756	2,688
1984	1,269	796	492	762	3,319
1985	767	506	1,514	1,545	4,333
1986	1,620	703	2,254	2,180	6,757
1987	1,908	700	2,369	3,893	8,870
1988	360	561	725	1,344	2,990
1989	764	892	1,377	803	3,835
1990	1,941	893	1,588	2,081	6,503
1991	503	1,240	1,412	1,680	4,834
1992	1,052	1,226	1,213	706	4,196
1993	1,080	999	611	975	3,664
1994	845	949	972	1,016	3,782
1995	2,609	436	439	512	3,996
1996	612	1,003	1,274	2,415	5,304
1997	2,040	890	1,550	2,300	6,780

Table 8.2.1.7 - Sardine catches (1,000 t) in Divisions VIIIc and IXa during 1940-1997 and IXa during 1940-1997(not including Cadiz)

YEAR	PORTUGAL	SPAIN	TOTAL
1940	98	67	165
1941	76	28	104
1942	82	47	129
1943	133	46	179
1944	128	76	204
1945	109	68	177
1946	107	33	140
1947	98	65	163
1948	78	28	106
1949	36	31	67
1950	75	40	115
1951	83	40	123
1952	89	38	127
1953	97	32	129
1954	112	38	150
1955	92	38	130
1956	100	42	142
1957	113	52	165
1958	131	71	202
1959	121	78	199
1960	139	99	238
1961	139	111	250
1962	130	76	206
1963	119	85	204
1964	163	78	241
1965	138	79	217
1966	125	76	201
1967	115	69	184
1968	80	76	156
1969	64	79	143
1970	69	61	130
1971	84	91	175
1972	88	79	167
1973	101	63	164
1974	75	49	124
1975	96	62	158
1976	80	62	142
1977	80	46	126
1978	84	56	140
1979	91	62	153
1980	106	86	192
1981	113	101	214
1982	101	104	205
1983	86	95	181
1984	95	108	203
1985	112	92	204
1986	103	78	181
1987	90	79	169
1988	94	65	159
1989	91	46	137
1990	92	47	139
1991	93	35	128
1992	83	43	126
1993	90	49	139
1994	95	38	133
1995	87	33	120
1996	86	26	111
1997	81	28	109

Table 8.4.1.1 Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1997

1997 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	468	1,509	1,054	2,199	53,389	30,181	88,800
2	9,908	459	656	3,230	11,265	7,028	32,546
3	14,486	785	518	7,766	29,719	19,985	73,258
4	19,595	1,964	944	9,775	29,860	25,096	87,236
5	19,157	2,227	1,173	9,772	8,155	12,784	53,268
6	9,671	1,360	827	1,232	2,009	3,054	18,154
7	1,639	361	272	1,480			3,752
8	862	219	207				1,289
9	435	129	87				651
10							
11							
12							
13							
14							
15+							
Total	76,221	9,014	5,738	35,453	134,398	98,128	358,952
Tonnes	5,475	640	392	2,000	5,702	4,702	18,911

1997 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	757	5,726	68,771	130,226	17,287	27,752	250,519
2	3,018	10,786	35,658	36,683	18,879	16,086	121,109
3	2,887	5,271	9,598	9,461	23,419	31,415	82,052
4	3,911	6,684	8,456	9,670	21,459	32,991	83,171
5	4,209	6,639	7,799	12,715	17,140	25,002	73,504
6	2,439	3,373	3,367	3,888	1,588	9,132	23,787
7	604	670	424	2,122		145	3,966
8	418	354	204				975
9	177	206	95				477
10							
11							
12							
13							
14							
15+							
Total	18,420	39,709	134,372	204,765	99,773	142,523	639,561
Tonnes	1,393	2,548	5,296	6,728	5,160	6,569	27,694

1997 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	631	7,356	70,708	33,899	17,268	18,463	148,325
1	866	1,929	11,066	50,461	25,086	10,934	100,342
2	1,766	3,667	18,309	95,180	41,396	49,529	209,847
3	2,019	4,626	17,451	59,641	20,673	46,310	150,720
4	3,185	6,526	13,313	29,608	19,446	26,309	98,386
5	3,123	5,190	10,057	14,456	6,516	15,621	54,964
6	1,201	1,480	2,006	1,106	545	1,920	8,256
7	167	170	189		65		591
8	292	236	152				679
9	32	20	5				57
10							
11							
12							
13							
14							
15+							
Total	13,282	31,200	143,254	284,350	130,995	169,086	772,167
Tonnes	1,068	1,972	6,178	16,375	7,239	9,560	42,392

Table 8.4.1.1 (continued)

1997 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	13,961	5,946	9,450	23,794	3,445	3,649	60,245
1	2,447	245	577	62,917	18,280	24,467	108,933
2	2,885	396	190	34,436	22,973	28,942	89,821
3	3,009	715	130	28,713	35,041	17,481	85,089
4	4,028	1,592	297	14,415	23,075	25,081	68,489
5	3,288	1,445	336	15,794	14,583	7,989	43,435
6	975	513	157	2,503	2,157	809	7,114
7	107	60	25				192
8	152	103	45				300
9	14	10	5				30
10							
11							
12							
13							
14							
15+							
Total	30,867	11,024	11,212	182,573	119,553	108,419	463,648
Tonnes	1,865	624	425	9,052	7,761	7,087	26,814

1997 Age	VIIIc East 1-4 Q catch('000)	VIIIc West 1-4 Q catch('000)	IXa North 1-4 Q catch('000)	IXa Centr-N 1-4 Q catch('000)	IXa Centr-S 1-4 Q catch('000)	IXa South 1-4 Q catch('000)	All areas 1-4 Q catch ('000)
0	14,591	13,302	80,158	57,693	20,713	22,113	208,570
1	4,539	9,409	81,467	245,803	114,042	93,334	548,594
2	17,576	15,308	54,813	169,529	94,513	101,585	453,324
3	22,401	11,397	27,697	105,581	108,852	115,191	391,118
4	30,720	16,767	23,010	63,468	93,840	109,477	337,282
5	29,778	15,501	19,364	52,736	46,395	61,396	225,170
6	14,286	6,725	6,356	8,729	6,300	14,914	57,310
7	2,517	1,261	910	3,602	65	145	8,501
8	1,723	912	607				3,243
9	658	364	192				1,214
10							
11							
12							
13							
14							
15+							
Total	138,790	90,947	294,575	707,141	484,720	518,155	2,234,327
Tonnes	9,801	5,784	12,291	34,156	25,863	27,917	115,812

Table 8.4.2.1 Length (cm) at age by quarter and by sub-division of SARDINE in 1997.

1997 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	18.8	13.8	14.5	16.3	15.1	15.9	15.4
2	20.0	19.8	18.4	18.4	18.1	18.3	18.8
3	20.6	21.4	20.9	19.2	19.3	19.0	19.5
4	21.2	21.9	21.7	20.1	20.2	19.8	20.4
5	21.4	22.1	22.2	20.5	21.1	20.5	21.0
6	21.7	22.4	22.6	21.0	21.8	21.0	21.6
7	22.7	22.8	23.2	21.5			22.3
8	23.4	23.2	23.4				23.4
9	23.1	22.9	23.1				23.1
10							
11							
12							
13							
14							
15+							
0-15+	21.1	20.6	20.3	19.7	17.9	18.5	19.0

1997 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	16.5	16.5	14.6	14.5	16.1	15.5	14.8
2	19.4	18.6	17.7	16.0	18.0	17.6	17.3
3	20.6	20.4	20.1	19.6	19.3	18.8	19.4
4	21.3	21.3	20.8	19.9	20.2	19.6	20.1
5	21.7	21.4	20.9	20.2	20.6	20.2	20.6
6	22.2	21.9	21.3	20.6	21.5	20.6	21.1
7	23.1	22.7	22.4	21.0		21.3	21.8
8	23.6	23.2	23.1				23.4
9	23.2	22.9	23.0				23.0
10							
11							
12							
13							
14							
15+							
0-15+	21.0	19.9	16.8	15.8	19.0	18.6	17.5

1997 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	17.1	13.1	13.0	14.5	14.4	11.8	13.4
1	19.5	19.7	19.1	17.1	16.7	17.6	17.3
2	19.9	19.8	19.4	18.2	18.1	18.2	18.3
3	20.3	20.4	19.9	19.6	19.0	19.2	19.5
4	21.6	21.3	20.7	20.2	20.0	20.1	20.3
5	22.0	21.5	20.8	20.4	20.7	20.4	20.7
6	22.7	22.1	21.4	21.1	21.6	20.6	21.5
7	23.6	22.4	21.2		21.3		22.2
8	23.4	23.0	22.6				23.1
9	24.0	23.9	24.5				24.0
10							
11							
12							
13							
14							
15+							
0-15+	21.1	19.0	16.5	18.2	17.9	18.3	17.9

Table 8.4.2.1 (continued)

1997 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	15.7	14.0	15.3	13.7	14.8	16.8	14.7
1	18.4	18.8	16.8	16.5	17.2	18.1	17.0
2	19.6	20.7	19.1	18.2	18.7	19.0	18.6
3	20.3	20.8	20.4	19.6	19.3	19.6	19.5
4	21.3	21.6	22.0	20.4	20.3	20.2	20.4
5	21.6	22.0	22.4	20.7	20.8	20.9	20.9
6	22.2	22.5	23.0	22.5	22.0	21.2	22.2
7	22.7	23.1	23.8				23.0
8	23.2	23.2	23.4				23.2
9	24.1	23.9	23.9				24.0
10							
11							
12							
13							
14							
15+							
0-15+	18.4	17.5	16.1	17.7	19.2	19.3	18.4

1996 Age	VIIIc East 1-4 Q length(cm)	VIIIc West 1-4 Q length(cm)	IXa North 1-4 Q length(cm)	IXa Centr-N 1-4 Q length(cm)	IXa Centr-S 1-4 Q length(cm)	IXa South 1-4 Q length(cm)	All areas 1-4 Q length(cm)
0	15.8	13.5	13.3	14.2	14.5	12.6	13.8
1	18.3	16.8	15.2	15.6	15.9	16.6	15.8
2	19.8	19.0	18.3	17.7	18.2	18.3	18.2
3	20.5	20.5	20.0	19.6	19.2	19.1	19.5
4	21.3	21.4	20.8	20.2	20.2	19.9	20.3
5	21.5	21.6	21.0	20.5	20.8	20.4	20.8
6	21.9	22.1	21.5	21.3	21.8	20.7	21.5
7	22.9	22.7	22.4	21.2	21.3	21.3	22.1
8	23.4	23.1	23.1				23.3
9	23.2	23.0	23.1				23.1
10							
11							
12							
13							
14							
15+							
0-15+	20.5	19.4	16.7	17.4	18.4	18.6	18.1

Table 8.4.2.2 Weight (g) at age by quarter and by sub-division of SARDINE in 1997.

1997 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	50	19	22	31	25	29	26
2	60	58	46	44	42	43	48
3	66	74	69	50	50	48	53
4	72	80	77	57	57	54	60
5	75	82	83	60	65	60	67
6	78	85	88	64	71	64	75
7	89	91	95	69			82
8	98	95	99				98
9	94	92	94				93
10							
11							
12							
13							
14							
15+							
0-15+	71	70	67	54	42	45	52

1997 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	34	22	24	33	27	25
2	56	50	42	32	46	39	40
3	68	66	63	58	56	47	55
4	77	77	71	61	63	53	61
5	82	79	73	63	67	57	66
6	89	84	77	67	76	61	71
7	101	94	91	71		67	81
8	108	101	101				104
9	102	98	99				100
10							
11							
12							
13							
14							
15+							
0-15+	75	63	38	33	54	46	43

1997 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	40	18	17	29	29	13	21
1	61	66	57	47	44	48	48
2	65	68	60	56	55	54	56
3	70	73	66	70	64	64	67
4	85	84	75	76	74	75	76
5	90	87	76	78	82	78	80
6	100	95	82	86	92	81	88
7	112	99	80		89		96
8	110	107	99				106
9	119	121	128				120
10							
11							
12							
13							
14							
15+							
0-15+	80	65	42	58	55	58	55

Table 8.4.2.2 (continued)

1997 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	32	22	29	21	27	41	26
1	55	59	41	39	45	53	43
2	69	83	63	54	59	62	58
3	77	85	79	69	65	69	68
4	91	96	102	78	77	76	78
5	96	102	109	82	84	85	85
6	105	111	118	109	101	89	104
7	115	121	134				119
8	123	124	127				124
9	139	136	136				138
10							
11							
12							
13							
14							
15+							
0-15+	59	56	37	52	65	65	59

Age	VIIIc East 1-4 Q weight(g)	VIIIc West 1-4 Q weight(g)	IXa North 1-4 Q weight(g)	IXa Centr-N 1-4 Q weight(g)	IXa Centr-S 1-4 Q weight(g)	IXa South 1-4 Q weight(g)	All areas 1-4 Q weight(g)
0	32	20	18	26	28	17	22
1	52	39	27	33	33	37	33
2	61	55	48	50	53	53	52
3	68	71	65	67	59	57	62
4	76	82	74	71	67	64	69
5	80	84	75	73	74	67	73
6	83	88	81	81	84	66	79
7	94	95	91	70	89	67	83
8	105	104	101				104
9	98	98	98				98
10							
11							
12							
13							
14							
15+							
0-15+	70	70	70	70	70	70	70

Table 8.5.1.1 - Spain: comparative results of DEPM surveys in 1988, 1990 and 1997

		Year	Galicia	West Cantabric	East Cantabric
P0	Daily Egg Production (10^12 eggs.day^-1)	1988	3.57	2.87	4.25
		1990	1.14	1.78	1.37
		1997	0	0.94*	1.42
W	Average Female Weight (g)	1988	64.93	79.34	86.31
		1990	68.14	83.65	83.61
		1997	0	70.05	70.05
F	Batch Fecundity (10^3 eggs)	1988	27275	33801.8	33910.7
		1990	26947	32980.3	32976.9
		1997	0	26562.5*	26562.5
f	Spawning Fraction (day^-1)	1988	0.08	0.13	0.21
		1990	0.1	0.11	0.2
		1997	0	0.18*	0.18
R	Sex Ratio	1988	0.35	0.65	0.66
		1990	0.56	0.53	0.45
		1997	0	0.52*	0.52
B	Spawning Biomass (t)	1988	134195	33503	12467
		1990	24232	46125	7363
		1997	0	10259	9920.26

*assumed for this area the same adult parameters of East Cantabric for the spawning stock biomass estimation

Table 8.5.1.2 - Portugal: comparative results of DEPM surveys in 1988 and 1997

		Year	Value
P0	Daily Egg Production (10^12 eggs.day^-1)	1988	2.873
		1997	4.405
W	Average Female Weight (g)	1988	40.935
		1997	41.963*
			41.28**
F	Batch Fecundity (10^3 eggs)	1988	15.581
		1997	15.4*
			17.914**
f	Spawning Fraction (day^-1)	1988	0.1262
		1997	0.1262*
			0.1307**
R	Sex Ratio	1988	0.52
		1997	0.57*
			0.61**
B	Spawning Biomass (t)	1988	115100
		1997	168258*

* Cunha *et al.*, 1997

**Gordo *et al.*, 1998

Table 8.5.2.1 Portugal: Sardine abundance (N-millions) and Biomass (B-thousand tonnes) in each zone and in the total surveyed area in November 1997, March 1997 and March 1998.

	Survey	Northern West coast (Oc.Norte)	Southern West coast (Oc.Sul)	Algarve	Cadiz	Portugal	Total
N	SAR97NOV	2801	3447	1908	-	8156	8156
	SAR97MAR	4760	3735	1904	3558	10399	13957
	SAR98MAR	**4750**	**3130**	**1282**	**2279**	**9162**	**11441**
B	SAR97NOV	87	135	106	-	328	328
	SAR97MAR	153	152	96	107	401	508
	SAR98MAR	**191**	**131**	**65**	**97**	**387**	**484**

Table 8.5.2.2 - Sardine - February/March Portuguese acoustic surveys series

	IDADE	SAR86MAR	%	SAR88MAR	%	SAR96FEV	%	SAR97MAR	%	SAR98MAR	%
	0	0	0.0	0	0.0	0	0.0	0	0.0		
	1	1120268	32.7	7349646	72.3	600012	57.9	3127000	65.7	594707	12.5
OCN	2	1506747	44.0	777398	7.6	399054	38.5	274000	5.8	2321336	48.9
	3	496750	14.5	539745	5.3	28590	2.8	816000	17.1	728370	15.3
	4	194373	5.7	707387	7.0	9148	0.9	405000	8.5	384597	8.1
	5	88078	2.6	549034	5.4			137000	2.9	354342	7.5
	6	21325	0.6	188333	1.9					335273	7.1
	7+		0.0	53378	0.5					31818	0.7
		3427541		**10164921**		**1036804**		**4759000**		**4750445**	
	0	0	0.0	0	0.0	0	0.0	0	0.0		
	1	171599	5.8	254253	7.5	646714	23.8	1217000	32.6	694503	22.2
OCS	2	1510804	50.8	1327803	39.2	224381	8.3	1131000	30.3	757999	24.2
	3	859078	28.9	675027	19.9	399989	14.7	268000	7.2	540972	17.3
	4	100224	3.4	606338	17.9	1185810	43.6	478000	12.8	417042	13.3
	5	330434	11.1	239305	7.1	256687	9.4	544000	14.6	342935	11.0
	6		0.0	232503	6.9	4646	0.2	96000	2.6	342778	11.0
	7+		0.0	50686	1.5					33295	1.1
		2972139		**3386115**		**2718227**		**3734000**		**3129524**	
	0	0	0	0	0.0	0	0.0	0	0.0		
	1	1051999	41.70002	139099	10.9	47921	2.2	37000	1.9	106883	8.3
ALGARVE	2	1007153	39.92238	579046	45.4	530280	24.7	479000	25.2	109265	8.5
	3	188648	7.477788	402469	31.6	504982	23.5	259000	13.6	200831	15.7
	4	222927	8.836568	133206	10.5	1018007	47.4	349000	18.3	243053	19.0
	5	52051	2.063241	15737	1.2	47067	2.2	674000	35.4	391980	30.6
	6		0	4476	0.4			106000	5.6	183704	14.3
	7+		0							46444	3.6
		2522778		**1274033**		**2148257**		**1904000**		**1281960**	
	0	0	0	0	0.0	0	0.0	0	0.0		
	1	2343866	26.26927	7742997	52.2	1294647	21.9	4093000	39.4	1395893	15.2
	2	4024705	45.10756	2684245	18.1	1153715	19.5	2130000	20.5	3188602	34.8
PORTUGAL	3	1544477	17.30999	1617241	10.9	933561	15.8	1256000	12.1	1470173	16.0
	4	517525	5.800249	1446931	9.8	2212965	37.5	1353000	13.0	1044692	11.4
	5	470564	5.273926	804077	5.4	303754	5.1	1375000	13.2	1089257	11.9
	6	21325	0.239004	425311	2.9	4646	0.1	192000	1.8	861755	9.4
	7+		0	104264	0.7					111557	1.2
		8922462		**14825066**		**5903288**		**10399000**		**9161929**	
	0					0	0.0	0	0.0		
	1					330338	9.4	1962000	55.1	262870	11.5
	2					928482	26.4	1355000	38.1	601182	26.4
CÁDIZ	3					1480967	42.0	208000	5.8	826689	36.3
	4					693043	19.7	27000	0.8	389662	17.1
	5					82722	2.3	6000	0.2	158636	7.0
	6					7318	0.2		0.0	26416	1.2
	7+								0.0	13841	0.6
		0		**0**		**3522870**		**3558000**		**2279096**	
	0					0	0.0	0	0.0		
	1					1624985	17.2	5990000	42.9	1658763	14.5
	2					2082197	22.1	3556000	25.5	3789784	33.1
TOTAL	3					2414528	25.6	1498000	10.7	2296862	20.1
	4					2906008	30.8	1377000	9.9	1434354	12.5
	5					386476	4.1	1347000	9.7	1247893	10.9
	6					11964	0.1	189000	1.4	888171	7.8
	7+					0				125198	1.1
		0		**0**		**9426156**		**13957000**		**11441025**	

Table 8.5.2.3 - Sardine - August Portuguese acoustic surveys series

	IDADE	SAR85AGO	%	SAR86AGO	%	SAR87AGO	%	SAR88AGO	%	SAR95MAI	%	SAR95JUL	%
OCN	0	60913	1.5	1278410	34.0	3448347	55.5	420693	14.2			351398	11.3
	1	534373	13.0	1749310	46.6	533227	8.6	1562425	52.6	189681	11.7	895055	28.8
	2	3453152	83.9	379782	10.1	925826	14.9	378728	12.7	125473	7.7	639483	20.6
	3	35589	0.9	338816	9.0	570769	9.2	251910	8.5	275261	16.9	554252	17.9
	4	33208	0.8	11210	0.3	517738	8.3	315419	10.6	748635	46.0	607384	19.6
	5					143374	2.3	39551	1.3	231511	14.2	38859	1.3
	6					46283	0.7	5350	0.2	56760	3.5	18250	0.6
	7+					29682	0.5						
		4117215		**3757528**		**6215246**		**2972078**		**1627331**		**3104681**	
OCS	0	3510	0.2	2594026	46.7	562441	27.9	448605	25.4			31423	1.1
	1	508304	32.4	649416	11.7	306154	15.2	113333	6.4	26946	1.3	414507	14.2
	2	502951	32.1	1953831	35.2	451370	22.4	567064	32.1	53507	2.5	229524	7.9
	3	345297	22.0	354817	6.4	524920	26.0	503747	28.5	582625	27.5	859091	29.5
	4	149362	9.5			151911	7.5	103935	5.9	1124759	53.1	1178150	40.4
	5	52146	3.3			19764	1.0	26895	1.5	260673	12.3	201680	6.9
	6	6436	0.4					3331	0.2	46668	2.2		
	7+									21973	1.0		
		1568006		**5551890**		**2016566**		**1766910**		**2117161**		**2914376**	
ALGARVE	0	393746	60.7	134946	21.4	535840	57.1	2269930	90.1			32100	1.6
	1	141745	21.9	304191	48.1	383922	38.8	147436	5.9	11798	0.4	132878	6.7
	2	73986	11.4	158116	25.0	31063	3.3	44866	1.8	58112	2.2	265615	13.4
	3	29219	4.5	24583	3.9	6628	0.7	46816	1.9	1252983	47.1	808067	40.7
	4	6135	0.9	10005	1.6			6787	0.3	1075557	40.4	490404	24.7
	5	2176	0.3					3498	0.1	237524	8.9	205257	10.3
	6	1186	0.2							24818	0.9	51539	2.6
	7+												
		648193		**631841**		**957253**		**2519333**		**2660792**		**1986860**	
PORTUGAL	0	458169	7.2	4007382	40.3	4546428	49.6	3139228	43.3			414921	5.2
	1	1184421	18.7	2702917	27.2	1203302	13.1	1823194	25.1	228435	3.6	1442440	18.0
	2	4030089	63.6	2491529	25.1	1408260	15.4	988659	13.6	237092	3.7	1134822	14.2
	3	410085	6.5	718216	7.2	1102317	12.0	802473	11.1	2110869	33.0	2221410	27.8
	4	188705	3.0	21215	0.2	669649	7.3	426141	5.9	2948951	46.0	2275938	28.4
	5	54323	0.9			183138	1.8	69944	1.0	729708	11.4	445796	5.6
	6	7622	0.1			42283	0.5	8882	0.1	128248	2.0	69789	0.9
	7+					29682	0.3			21973	0.3		
		6333414		**9941259**		**9185069**		**7258321**		**6406274**		**8004916**	
CÁDIZ	0											782086	28.5
	1											1242749	46.5
	2											580692	21.7
	3											87381	3.3
	4												
	5												
	6												
	7+												
		0		**0**		**0**		**0**				**2672908**	
TOTAL	0											1177007	11.0
	1											2685189	25.1
	2											1715314	16.1
	3											2308791	21.6
	4											2275938	21.3
	5											445796	4.2
	6											69789	0.7
	7+												
		0		**0**		**0**		**0**				**10677934**	

Table 8.5.2.4 - Sardine - November/December Portuguese acoustic surveys series

	IDADE	SAR84NOV	%	SAR85DEZ	%	SAR86DEZ	%	SAR87NOV	%	SAR92NOV	%	SAR97NOV	%
	0	41852	0.7	1004091	20.2	1251898	35.8	1781349	44.4	3897568	46.3	881535	31.5
	1	4913277	77.9	169704	3.4	1015161	29.0	621717	15.5	3580127	42.5	1374279	49.1
OCN	2	693480	11.0	2918694	58.8	797920	22.8	702157	17.5	468989	5.6	424366	15.2
	3	417112	6.6	388379	7.8	312757	8.9	284117	7.1	327976	3.9	57484	2.1
	4	240346	3.8	282916	5.7	89818	2.6	494627	12.3	139288	1.7	16995	0.6
	5			134881	2.7	15806	0.5	109517	2.7	10362	0.1	35584	1.3
	6			56352	1.1	11360	0.3	4327	0.1	1003	0.0	8902	0.2
	7+			9181	0.2			11311	0.3	427	0.0	3640	0.1
		6306067		**4964198**		**3494720**		**4009122**		**8425740**		**2800785**	
	0	1800487	71.7	493813	11.7	1192877	51.0	1594069	37.9	585597	16.9	1540183	44.7
	1	410604	16.4	1513939	35.8	289824	12.4	1623943	38.6	1936167	58.0	496295	14.4
OCS	2	149857	6.0	1272134	30.1	565093	24.2	467537	11.1	466841	14.0	200598	5.8
	3	137122	5.5	550354	13.0	172925	7.4	340988	8.1	273061	8.2	302217	8.8
	4	13173	0.5	388026	9.2	62893	2.7	93327	2.2	83670	2.5	327704	9.5
	5			8908	0.2	41021	1.8	53730	1.3	15593	0.5	385268	11.2
	6			4454	0.1	14885	0.6	22370	0.5			160466	4.7
	7+							10023	0.2			34460	1.0
		2511243		**4231630**		**2339518**		**4205987**		**3340928**		**3447191**	
	0	1114282	41.2	565273	24.6	48327	4.4	339122	29.9	174288	14.7	2984	0.2
	1	409350	15.1	1059882	46.2	306910	27.9	133717	11.8	427319	36.1	90628	4.7
ALGARVE	2	308823	11.4	357412	15.6	306550	27.9	174001	15.4	269282	22.8	281484	14.6
	3	482592	17.8	144704	6.3	172703	15.7	303577	26.8	215783	18.2	369198	19.3
	4	274824	10.2	168271	7.3	170201	15.5	77646	6.9	84119	7.1	695895	36.5
	5	76423	2.8			70439	6.4	73226	6.5	12026	1.0	350953	18.4
	6	40140	1.5			23389	2.1	22532	2.0			106580	5.6
	7+							9340	0.8			10373	0.5
		2706434		**2295542**		**1098519**		**1133161**		**1182817**		**1908095**	
	0	2956621	25.7	2063177	18.0	2493103	36.0	3714539	39.7	4637454	35.8	2315422	28.4
	1	5733231	49.8	2743525	23.9	1611896	23.3	2379377	25.5	5943613	45.9	2017799	24.7
	2	1152159	10.0	4548240	39.6	1669563	24.1	1343696	14.4	1205111	9.3	1129194	13.8
PORTUGAL	3	1036825	9.0	1083437	9.4	658385	9.5	928681	9.9	816819	6.3	839362	10.3
	4	528343	4.6	839215	7.3	322912	4.7	665601	7.1	307077	2.4	833294	10.2
	5	76423	0.7	143789	1.3	127268	1.8	236474	2.5	37981	0.3	719100	8.8
	6	40140	0.3	60806	0.5	49634	0.7	49226	0.5	1003	0.0	251045	3.1
	7+		0.0	9181	0.1			30674	0.3	427	0.0	50834	0.6
		11523742		**11491370**		**6932759**		**9348268**		**12949485**		**8156070**	
	0									1510346	48.0		
	1									1314679	41.8		
	2									219547	7.0		
CÁDIZ	3									94339	3.0		
	4									8169	0.3		
	5												
	6												
	7+												
		0		**0**		**0**		**0**		**3147080**			
	0									6147800	38.2		
	1									7258292	45.1		
	2									1424658	8.9		
TOTAL	3									911158	5.7		
	4									315246	2.0		
	5									37981	0.2		
	6									1003	0.0		
	7+									427	0.0		
										16096565			

Table 8.5.2.5 Summary of the Spanish acoustic survey (area in square nautical miles).

ZONE	Area	No	Mean Sa	ō^2	Surface	Fishing st	No	Biomass (t)
VIIIb	Francia Norte 1	114	122.95	12386.69	1392.67	P36, P38, P39	1178362152	25578
	Francia Norte 2	55	101.31	8018.63	768.29	P37, P40	257354542	18133
	Francia Sur 1	33	36.09	1473.34	359.01	P31, P32, P33	68965816	2267
	Francia Sur 2	39	24.26	1652.31	369.79	P30	31722152	2019
			Total		**2889.76**		**1536404661**	**47996**
VIIIc-Este	Galastur	23	501.96	1570879	189.54	P12	420645391	18947
	Cantabrico 1	110	20.41	4519.57	924.72	18, P22, P25, P.	57492305	4625
	Cantábrico 2	33	27.88	2508.55	279.08	P26, P28	33382794	1623
			Total		**1393.34**		**511520489**	**25194**
VIIIc-Oeste	Ferrol	8	65	33800	50.6	P12	14541527	655
			Total		**50.6**		**14541527**	**655**
IXa-Norte	Rias Baixas	62	294.1	573252.8	171.08	P4	247145979.4	9456
			Total		**171.08**		**247145979**	**9456**
TOTAL					**3008**		**2309612657**	**83301**

Table 8.5.2.6 Spanish acoustic survey, March 1998: Biomass (tonnes), mean weight (grams), % and number of fish (millions), %, mean length and its standard deviation estimated by age group and ICES Sub-Divisions.

	AGE GROUPS											
	1	2	3	4	5	6	7	8	9	10	11	Total
Area: IXa-N												
Total biomass	**6276**	**1466**	**429**	**302**	**373**	**358**	**252**					**9456**
%	66.4	15.5	4.5	3.2	3.9	3.8	2.7					
M. weight	30.8	54.4	57.0	74.4	85.0	87.4	96.1					36.0
No fish	**197.87**	**26.78**	**7.46**	**4.02**	**4.35**	**4.05**	**2.62**					**247**
%	80.1	10.8	3.0	1.6	1.8	1.6	1.1					
M. length	16.2	19.3	19.6	21.3	22.2	22.4	23.1					17.0
s.d.	1.5	0.8	1.0	1.1	1.2	1.2	0.6					2.2
Area: VIIIc-W												
Total biomass	**349**	**121**	**94**	**44**	**13**	**25**	**6**	**2**	**2**			**655**
%	53.3	18.5	14.3	6.7	1.9	3.8	0.9	0.2	0.3			
M. weight	34.8	55.0	63.8	77.8	84.2	86.0	94.0	94.0	105.6			42.9
No fish	**9.81**	**2.18**	**1.45**	**0.56**	**0.15**	**0.29**	**0.07**	**0.02**	**0.02**			**15**
%	67.4	15.0	10.0	3.9	1.0	2.0	0.5	0.1	0.1			
M. length	16.9	19.4	20.3	21.6	22.1	22.3	22.9	22.9	23.8			18.0
s.d.	1.3	1.0	1.1	1.0	1.1	1.0	0.2	0.2				2.1
Area VIIIc-E												
Total biomass	**10606**	**4209**	**4915**	**2347**	**1405**	**1007**	**429**	**129**	**117**		**17**	**25182**
%	42.1	16.7	19.5	9.3	5.6	4.0	1.7	0.5	0.5		0.05	
M. weight	34.3	56.2	68.1	79.9	86.9	88.4	93.7	101.5	109.5		128.71	46.3
No fish	**302.16**	**74.17**	**71.49**	**29.18**	**16.10**	**11.31**	**4.57**	**1.27**	**1.07**		**133**	**511**
%	59.1	14.5	14.0	5.7	3.1	2.2	0.9	0.2	0.2			
M. length	16.8	19.5	20.7	21.8	22.4	22.5	22.9	23.5	24.0		25.25	18.4
s.d.	1.3	1.0	1.1	0.9	0.8	1.1	0.5	0.8	0.4		0.02	2.4
SPAIN												
Total biomass	**17231**	**5796**	**5437**	**2693**	**1791**	**1390**	**687**	**131**	**120**		**17**	**35293**
%	48.82	16.42	15.41	7.63	5.07	3.94	1.95	0.37	0.34		0.05	
M. weight	32.94	55.69	66.94	79.22	86.48	88.08	94.56	101.37	109.39		128.71	42.77
No fish	**509.84**	**103.13**	**80.40**	**33.76**	**20.59**	**15.65**	**7.26**	**1.28**	**1.09**		**133**	**773**
%	65.95	13.34	10.40	4.37	2.66	2.02	0.94	0.17	0.14			
M. length	16.57	19.49	20.63	21.73	22.33	22.46	22.95	23.45	24.01		25.25	17.96
s.d.	1.41	0.98	1.11	0.96	0.88	1.09	0.54	0.80	0.42		0.02	2.42
Area: VIIIb												
Total biomass	**27179**	**5969**	**8790**	**4023**	**1577**	**458**						**47996**
%	56.6	12.4	18.3	8.4	3.3	1.0						
M. weight	21.5	62.3	69.0	78.6	89.3	84.8						28.0
No fish	**1240.34**	**95.48**	**126.62**	**50.99**	**17.60**	**5.38**						**1536**
%	80.7	6.2	8.2	3.3	1.1	0.4						
M. length	14.5	20.2	20.8	21.7	22.6	22.2						15.7
s.d.	1.0	0.6	0.8	0.7	0.7	0.8						2.7

Table 8.5.2.7 France: Abundance estimates of the main small pelagic species in May 1997.

Biomass (tonnes)	Anchovy	Sardine	Sprat	Mackerel	Spanish Mackerel	Horse Mackerel
North	25,000	193,000	18,000	105,000	1,000	37,000
South	38,000	28,000	0	3,000	2,000	16,000
Total area	**63,000**	**221,000**	**18,000**	**108,000**	**3,000**	**53,000**

Table 8.5.2.8 France, May 1997: sardine biomass (tonnes) by length class and area in the Bay of Biscay.

Length class (cm)	South	Center	North
15.0		2.523	
15.5		3.819	
16.0		8.206	
16.5		6.001	
17.0	0.215	4.836	0.376
17.5	0.732	3.862	1.399
18.0	4.041	4.438	5.913
18.5	7.544	6.215	6.539
19.0	17.374	12.279	13.746
19.5	18.344	13.553	15.226
20.0	19.166	10.023	16.436
20.5	12.433	7.425	10.316
21.0	7.319	5.788	9.558
21.5	4.593	3.980	7.147
22.0	3.936	3.429	5.364
22.5	3.231	1.508	3.542
23.0	0.342	1.255	2.096
23.5	0.729	0.282	0.643
24.0		0.165	0.794
24.5		0.064	0.318
25.0		0.004	0.159
25.5			0.306
26.0			0.125

Table 8.5.2.9 France, May 1998: sardine biomass (tonnes) by length class and area in the Bay of Biscay.

Length class (cm)	South (Gironde)	Center (Adour)	North (Accores)
11.0	0.000	0.000	0.000
11.5	0.000	0.007	0.000
12.0	0.000	0.341	0.000
12.5	0.000	1.013	0.000
13.0	0.000	3.839	0.146
13.5	1.000	2.888	0.049
14.0	0.000	6.337	0.728
14.5	0.000	7.128	1.020
15.0	11.000	11.543	3.545
15.5	23.000	7.160	1.651
16.0	37.000	3.330	1.942
16.5	15.000	2.963	0.923
17.0	8.000	0.766	1.756
17.5	2.000	5.566	2.560
18.0	1.000	15.912	3.473
18.5	0.000	10.522	7.984
19.0	0.000	10.610	7.843
19.5	0.000	3.023	13.530
20.0	1.000	0.684	15.751
20.5	1.000	4.205	14.737
21.0	0.000	0.837	10.427
21.5	0.000	0.510	4.241
22.0	0.000	0.463	2.325
22.5	0.000	0.154	2.656
23.0	0.000	0.124	1.583
23.5	0.000	0.077	0.800
24.0	0.000	0.000	0.330
Total	**1,200**	**1,550**	**6,400**

Table 8.6.1 - SARDINE (Divisions 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/f day	f-No.boat	t/boat
1982					7,685	4.87			184	340
1983					7,867	4.01			196	312
1984					8,369	4.65			192	329
1985					5,731	4.86			192	527
1986					3,541	4.23			198	517
1987			4,455	2.07	4,099	4.71			196	437
1988			4,192	2.34	3,601	2.75	22,080	3.91	180	495
1989	314	4.10	4,008	1.95	3,059	2.45	21,432	3.93	223	383
1990	389	3.65	3,465	1.55	3,488	2.80	25,740	3.50	221	394
1991	394	3.13	2,891	0.93	3,279	2.44	21,798	3.56	206	377
1992	570	1.63	2,619	1.42	3,790	2.44	26,418	2.97	206	381
1993	498	1.70	2,054	2.07	4,758	2.66	24,678	3.43	180	470
1994	274	4.00	2,029	2.03	4,452	2.28	21,896	4.15	148	614
1995	459	4.08	1,580	2.05	3,911	2.43	20,132	4.14	141	590
1996	297	2.78	1,346	1.97	3,971	2.10	21,294	3.70	148	538
1997	571	4.42	838	1.73	3,998	2.05	20,193	3.93	129	615

Table 8.9.1.1 Sardine in Divisions VIIIc and IXa. Results of ICA analysis including Portuguese November surveys for comparative purposes.

Output Generated by ICA Version 1.4

Sardine in VIIIc + IXa

Catch in Number

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	844.0	854.0	643.0	842.0	1021.0	62.0	1070.0	118.0
1	2421.0	2145.0	1479.0	1997.0	1920.0	795.0	577.0	3312.0
2	954.0	913.0	935.0	1542.0	1720.0	1869.0	857.0	487.0
3	110.0	281.0	423.0	372.0	666.0	709.0	803.0	502.0
4	22.0	127.0	187.0	155.0	192.0	353.0	324.0	299.0
5	3.0	40.0	93.0	47.0	102.0	131.0	141.0	179.0
6	2.0	17.0	37.0	31.2	77.0	130.0	140.0	118.0

x 10 ^ 6

Catch in Number

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	268.0	304.0	1437.0	521.0	248.0	258.0	1581.0	498.0
1	564.0	755.0	543.0	1061.0	566.0	602.0	477.0	1002.0
2	2371.0	1027.0	667.0	535.0	909.0	517.0	436.0	451.0
3	469.0	919.0	569.0	439.0	389.0	707.0	407.9	340.0
4	294.0	333.0	535.0	304.0	221.0	295.0	266.0	186.0
5	201.0	196.0	154.0	292.0	200.0	51.0	75.0	111.0
6	104.0	168.0	172.0	190.0	245.0	248.0	105.0	83.0

x 10 ^ 6

Catch in Number

AGE	1993	1994	1995	1996	1997
0	88.0	121.0	31.0	276.9	208.6
1	566.0	61.0	189.0	103.9	548.6
2	1082.0	542.0	281.0	359.4	453.3
3	521.0	1095.0	830.0	518.4	391.1
4	257.0	272.0	473.0	663.9	337.3
5	114.0	113.0	70.0	198.9	225.2
6	120.0	72.0	64.5	46.4	70.3

x 10 ^ 6

Predicted Catch in Number

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	349.4	668.6	412.0	406.0	372.8	521.2	369.8	133.4
1	612.5	581.2	1107.3	647.4	615.3	317.8	669.5	526.7
2	956.9	612.0	574.8	1036.0	585.7	489.0	463.3	1086.4
3	1047.3	625.8	394.3	349.1	609.2	465.5	448.1	478.0
4	362.7	635.6	372.9	221.0	189.7	434.0	204.8	226.0
5	189.7	148.4	255.2	140.5	80.6	93.9	134.8	73.3

x 10 ^ 6

Predicted Catch in Number

AGE	1994	1995	1996	1997
0	109.2	70.4	256.0	298.2
1	152.9	148.4	144.5	465.9
2	697.3	242.2	349.0	293.9
3	935.6	735.4	369.7	438.1
4	203.1	502.3	570.4	224.5
5	67.7	77.6	280.9	248.1

x 10 ^ 6

Table 8.9.1.1 (continued)

Weights at age in the catches (Kg)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	0.01700	0.01700	0.01700	0.01700	0.01700	0.01700	0.01700	0.01700
1	0.03400	0.03400	0.03400	0.03400	0.03400	0.03400	0.03400	0.03400
2	0.05200	0.05200	0.05200	0.05200	0.05200	0.05200	0.05200	0.05200
3	0.06000	0.06000	0.06000	0.06000	0.06000	0.06000	0.06000	0.06000
4	0.06800	0.06800	0.06800	0.06800	0.06800	0.06800	0.06800	0.06800
5	0.07200	0.07200	0.07200	0.07200	0.07200	0.07200	0.07200	0.07200
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the catches (Kg)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	0.01700	0.01700	0.01700	0.01700	0.01300	0.02400	0.02000	0.01800
1	0.03400	0.03400	0.03400	0.03400	0.03500	0.03200	0.03100	0.04500
2	0.05200	0.05200	0.05200	0.05200	0.05200	0.04700	0.05800	0.05500
3	0.06000	0.06000	0.06000	0.06000	0.05900	0.05700	0.06300	0.06600
4	0.06800	0.06800	0.06800	0.06800	0.06600	0.06100	0.07300	0.07000
5	0.07200	0.07200	0.07200	0.07200	0.07100	0.06700	0.07400	0.07900
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the catches (Kg)

AGE	1993	1994	1995	1996	1997
0	0.01700	0.02000	0.02500	0.01900	0.02200
1	0.03700	0.03600	0.04700	0.03800	0.03300
2	0.05100	0.05800	0.05900	0.05100	0.05200
3	0.05800	0.06200	0.06600	0.05800	0.06200
4	0.06600	0.07000	0.07100	0.06100	0.06900
5	0.07100	0.07600	0.08200	0.07100	0.07300
6	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the stock (Kg)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500
2	0.03800	0.03800	0.03800	0.03800	0.03800	0.03800	0.03800	0.03800
3	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000
4	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400
5	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the stock (Kg)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01900	0.02700
2	0.03800	0.03800	0.03800	0.03800	0.03800	0.03800	0.04200	0.03600
3	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000
4	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400	0.06200
5	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.07100	0.06900
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the stock (Kg)

AGE	1993	1994	1995	1996	1997
0	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.02200	0.03100	0.02900	0.03600	0.02500
2	0.04500	0.04000	0.05000	0.04700	0.05000
3	0.05700	0.04900	0.06200	0.06100	0.05800
4	0.06400	0.06000	0.07200	0.06900	0.06800
5	0.07300	0.06700	0.07900	0.07500	0.07400
6	0.10000	0.10000	0.10000	0.10000	0.10000

Table 8.9.1.1 (continued)

Natural Mortality (per year)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
1	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
2	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
3	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
4	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
5	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
6	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000

Natural Mortality (per year)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
1	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
2	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
3	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
4	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
5	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
6	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000

Natural Mortality (per year)

AGE	1993	1994	1995	1996	1997
0	0.33000	0.33000	0.33000	0.33000	0.33000
1	0.33000	0.33000	0.33000	0.33000	0.33000
2	0.33000	0.33000	0.33000	0.33000	0.33000
3	0.33000	0.33000	0.33000	0.33000	0.33000
4	0.33000	0.33000	0.33000	0.33000	0.33000
5	0.33000	0.33000	0.33000	0.33000	0.33000
6	0.33000	0.33000	0.33000	0.33000	0.33000

Proportion of fish spawning

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.6500	0.6500	0.6500	0.6500	0.6500	0.6500	0.6500	0.6500
2	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Proportion of fish spawning

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.6500	0.6500	0.6500	0.6500	0.2300	0.6000	0.7400	0.7900
2	0.9500	0.9500	0.9500	0.9500	0.8300	0.8100	0.9100	0.9100
3	1.0000	1.0000	1.0000	1.0000	0.9100	0.8800	0.9600	0.9500
4	1.0000	1.0000	1.0000	1.0000	0.9200	0.8900	0.9700	0.9800
5	1.0000	1.0000	1.0000	1.0000	0.9400	0.9400	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	0.9770	0.9870	1.0000	1.0000

Proportion of fish spawning

AGE	1993	1994	1995	1996	1997
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.4700	0.8000	0.7300	0.8300	0.7270
2	0.9300	0.8900	0.9800	0.8900	0.9180
3	0.9400	0.9600	0.9700	0.9200	0.9500
4	0.9700	0.9600	0.9900	0.9600	0.9720
5	0.9900	0.9700	1.0000	1.0000	0.9930
6	1.0000	1.0000	1.0000	1.0000	1.0000

Table 8.9.1.1 (continued)

INDICES OF SPAWNING BIOMASS

DEPM

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	295.00	*******

x 10 ^ 3

DEPM

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	188.44

x 10 ^ 3

Vigo

	1982	1983	1984	1985	1986	1987	1988	1989
1	4870.0	4010.0	4650.0	4860.0	4230.0	4710.0	2750.0	2450.0

x 10 ^ -3

Vigo

	1990	1991	1992	1993	1994	1995	1996	1997
1	2800.0	2440.0	2440.0	2660.0	2280.0	2430.0	2100.0	2050.0

x 10 ^ -3

Sada

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	207.00	234.00	195.00

Sada

	1990	1991	1992	1993	1994	1995	1996	1997
1	155.00	93.00	142.00	207.00	203.00	205.00	197.00	173.00

AGE-STRUCTURED INDICES

PT MARCH ACOUSTIC SURVEY INC. CADIZ,,,,

AGE	1996	1997	1998
1	1625.0	5990.0	1658.8
2	2082.2	3556.0	3789.8
3	2414.5	1498.0	2296.9
4	2906.0	1377.0	1434.4
5	386.5	1347.0	1247.9
6	12.0	189.0	888.2

x 10 ^ 6

SP MARCH ACOUSTIC SURVEY

AGE	1988	1989	1990	1991	1992	1993	1994	1995
1	221.0	73.0	69.0	25.0	168.0	239.0	*******	*******
2	63.0	304.0	56.0	208.0	77.0	427.0	*******	*******
3	72.0	66.0	274.0	164.0	88.0	136.0	*******	*******
4	64.0	96.0	55.0	401.0	31.0	126.0	*******	*******
5	858.0	76.0	88.0	62.0	117.0	146.0	*******	*******
6	898.0	1389.0	571.0	574.0	123.0	1119.0	*******	*******

x 10 ^ 6

Table 8.9.1.1 (continued)

SP MARCH ACOUSTIC SURVEY

AGE	1996	1997	1998
1	10.6	56.1	509.8
2	54.2	262.8	103.1
3	90.5	126.0	80.4
4	364.0	123.0	33.8
5	221.3	65.3	20.6
6	24.8	52.6	25.4

x 10 ^ 6

PT November ACOUSTIC SURVEY,,,,

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	2956.6	2063.2	2493.1	3714.5	*******	*******	*******	*******
1	5733.2	2743.5	1611.9	2379.4	*******	*******	*******	*******
2	1152.2	4548.2	1669.6	1343.7	*******	*******	*******	*******
3	1036.8	1083.4	658.4	928.7	*******	*******	*******	*******
4	528.3	839.2	322.9	665.6	*******	*******	*******	*******
5	76.4	143.8	127.3	236.5	*******	*******	*******	*******
6	40.1	70.0	49.6	79.9	*******	*******	*******	*******

x 10 ^ 6

PT November ACOUSTIC SURVEY,,,,

AGE	1992	1993	1994	1995	1996	1997
0	4637.5	*******	*******	*******	*******	2315.4
1	5943.6	*******	*******	*******	*******	2017.8
2	1205.1	*******	*******	*******	*******	1129.2
3	816.8	*******	*******	*******	*******	839.4
4	307.1	*******	*******	*******	*******	833.3
5	38.0	*******	*******	*******	*******	719.1
6	1.4	*******	*******	*******	*******	30.2

x 10 ^ 6

Fishing Mortality (per year)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	0.09255	0.07507	0.05004	0.06093	0.11475	0.00917	0.05702	0.01492
1	0.50204	0.41523	0.20718	0.24908	0.22116	0.14110	0.12651	0.28905
2	0.60308	0.41980	0.37458	0.40357	0.41154	0.40568	0.25684	0.17213
3	0.15339	0.41678	0.40988	0.29040	0.35535	0.34594	0.35582	0.27246
4	0.14764	0.30804	0.64569	0.29975	0.27708	0.37744	0.30518	0.25099
5	0.50958	0.50824	0.45569	0.38482	0.38449	0.35999	0.29483	0.32039
6	0.50958	0.50824	0.45569	0.38482	0.38449	0.35999	0.29483	0.32039

Fishing Mortality (per year)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	0.05033	0.07141	0.07487	0.07863	0.07850	0.07532	0.04546	0.04049
1	0.10503	0.17857	0.18722	0.19663	0.19630	0.18834	0.09730	0.08666
2	0.40450	0.30104	0.31563	0.33149	0.33094	0.31752	0.25960	0.23122
3	0.28876	0.36620	0.38395	0.40324	0.40258	0.38625	0.52890	0.47106
4	0.29434	0.44418	0.46571	0.48911	0.48831	0.46850	0.62386	0.55564
5	0.30972	0.36620	0.38395	0.40324	0.40258	0.38625	0.52890	0.47106
6	0.30972	0.36620	0.38395	0.40324	0.40258	0.38625	0.52890	0.47106

Fishing Mortality (per year)

AGE	1993	1994	1995	1996	1997
0	0.03985	0.03127	0.02890	0.04079	0.05192
1	0.08529	0.06692	0.06186	0.08730	0.11113
2	0.22756	0.17856	0.16505	0.23294	0.29651
3	0.46362	0.36379	0.33626	0.47457	0.60409
4	0.54686	0.42911	0.39663	0.55978	0.71255
5	0.46362	0.36379	0.33626	0.47457	0.60409
6	0.46362	0.36379	0.33626	0.47457	0.60409

Table 8.9.1.1 (continued)

Population Abundance (1 January)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	11181.	13835.	15445.	16695.	11023.	7975.	22632.	9350.
1	7104.	7328.	9227.	10562.	11293.	7065.	5681.	15369.
2	2433.	3091.	3478.	5392.	5919.	6508.	4411.	3599.
3	904.	957.	1460.	1719.	2589.	2820.	3118.	2453.
4	187.	558.	454.	697.	924.	1305.	1434.	1571.
5	9.	116.	295.	171.	371.	504.	643.	760.
6	6.	49.	117.	113.	280.	500.	639.	501.

x 10 ^ 6

Population Abundance (1 January)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	6401.	5940.	10859.	6383.	6299.	6020.	13752.	10931.
1	6622.	4376.	3976.	7244.	4242.	4187.	4014.	9447.
2	8275.	4286.	2632.	2370.	4278.	2506.	2493.	2618.
3	2178.	3970.	2281.	1380.	1223.	2209.	1312.	1383.
4	1343.	1173.	1979.	1117.	663.	588.	1079.	556.
5	879.	719.	541.	893.	492.	292.	265.	416.
6	455.	637.	627.	665.	858.	899.	296.	256.

x 10 ^ 6

Population Abundance (1 January)

AGE	1993	1994	1995	1996	1997	1998
0	4006.	4161.	2899.	7512.	6908.	6838.
1	7546.	2767.	2899.	2025.	5185.	4715.
2	6228.	4982.	1861.	1959.	1334.	3335.
3	1494.	3566.	2996.	1134.	1116.	713.
4	621.	675.	1782.	1539.	507.	438.
5	229.	258.	316.	862.	632.	179.
6	375.	274.	263.	142.	179.	319.

x 10 ^ 6

Weighting factors for the catches in number

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Weighting factors for the catches in number

AGE	1994	1995	1996	1997
0	0.5000	0.5000	0.5000	0.5000
1	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000

Predicted SSB Index Values

DEPM

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	355.28	*******

x 10 ^ 3

DEPM

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	262.20

x 10 ^ 3

Table 8.9.1.1 (continued)

Vigo

	1982	1983	1984	1985	1986	1987	1988	1989
1	4026.3	3807.0	4065.5	4385.5	3840.7	3095.6	2771.4	2348.2

x 10 ^ -3

Vigo

	1990	1991	1992	1993	1994	1995	1996	1997
1	2317.0	2149.6	2974.9	3416.2	3344.2	3416.8	2526.2	2045.5

x 10 ^ -3

Sada

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	195.39	180.42	160.10

Sada

	1990	1991	1992	1993	1994	1995	1996	1997
1	158.56	150.22	189.87	209.78	206.58	209.81	168.76	144.94

Predicted Age-Structured Index Values

PT MARCH ACOUSTIC SURVEY INC. CADIZ,,,, Predicted

AGE	1996	1997	1998
1	1398.1	3563.4	3240.9
2	2917.6	1961.2	4904.1
3	2418.6	2318.7	1481.3
4	4019.8	1285.3	1110.9
5	1650.2	1179.5	333.8
6	90.9	111.4	198.3

x 10 ^ 6

SP MARCH ACOUSTIC SURVEY Predicted

AGE	1988	1989	1990	1991	1992	1993	1994	1995
1	127.78	74.83	73.97	72.22	170.34	136.11	*******	*******
2	111.11	200.56	117.80	118.56	125.21	298.06	*******	*******
3	120.56	106.89	193.66	111.74	119.17	128.93	*******	*******
4	152.78	90.69	80.77	143.74	75.01	83.93	*******	*******
5	237.27	130.82	77.96	68.56	108.99	60.15	*******	*******
6	425.78	549.84	577.84	184.76	161.80	237.26	*******	*******

x 10 ^ 6

SP MARCH ACOUSTIC SURVEY Predicted

AGE	1996	1997	1998
1	36.50	93.03	84.61
2	93.66	62.96	157.44
3	97.68	93.65	59.83
4	207.56	66.37	57.36
5	225.68	161.31	45.65
6	89.85	110.16	196.07

x 10 ^ 6

PT November ACOUSTIC SURVEY,,,, Predicted

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	3448.2	2288.7	2084.8	3800.1	*******	*******	*******	*******
1	6182.7	3129.6	1939.2	1748.5	*******	*******	*******	*******
2	1946.1	3651.6	2070.7	1255.2	*******	*******	*******	*******
3	1177.8	1031.0	1756.1	993.2	*******	*******	*******	*******
4	958.5	789.0	604.6	1000.8	*******	*******	*******	*******
5	185.7	216.7	168.8	125.0	*******	*******	*******	*******
6	37.8	34.7	46.2	44.8	*******	*******	*******	*******

x 10 ^ 6

Table 8.9.1.1 (continued)

PT November ACOUSTIC SURVEY,,,, Predicted

AGE	1992	1993	1994	1995	1996	1997
0	3941.8	*******	*******	*******	*******	2466.5
1	4536.8	*******	*******	*******	*******	2437.0
2	1344.4	*******	*******	*******	*******	646.9
3	558.0	*******	*******	*******	*******	400.8
4	259.7	*******	*******	*******	*******	206.7
5	89.0	*******	*******	*******	*******	120.5
6	17.0	*******	*******	*******	*******	10.6

x 10 ^ 6

Fitted Selection Pattern

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	0.6034	0.1801	0.1221	0.2098	0.3229	0.0265	0.1602	0.0548
1	3.2730	0.9963	0.5055	0.8577	0.6224	0.4079	0.3555	1.0609
2	3.9317	1.0072	0.9139	1.3897	1.1581	1.1727	0.7218	0.6318
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	0.9625	0.7391	1.5753	1.0322	0.7797	1.0911	0.8577	0.9212
5	3.3221	1.2194	1.1118	1.3251	1.0820	1.0406	0.8286	1.1759
6	3.3221	1.2194	1.1118	1.3251	1.0820	1.0406	0.8286	1.1759

Fitted Selection Pattern

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	0.1743	0.1950	0.1950	0.1950	0.1950	0.1950	0.0860	0.0860
1	0.3637	0.4876	0.4876	0.4876	0.4876	0.4876	0.1840	0.1840
2	1.4008	0.8221	0.8221	0.8221	0.8221	0.8221	0.4908	0.4908
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0193	1.2129	1.2129	1.2129	1.2129	1.2129	1.1795	1.1795
5	1.0726	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0726	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Fitted Selection Pattern

AGE	1993	1994	1995	1996	1997
0	0.0860	0.0860	0.0860	0.0860	0.0860
1	0.1840	0.1840	0.1840	0.1840	0.1840
2	0.4908	0.4908	0.4908	0.4908	0.4908
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.1795	1.1795	1.1795	1.1795	1.1795
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 2- 5	SoP (%)
1977	11180840	257383	177468	125750	0.7086	0.3534	81
1978	13834870	323650	232270	139990	0.6027	0.4132	84
1979	15444720	404074	293217	153441	0.5233	0.4715	96
1980	16694590	516684	381917	191682	0.5019	0.3446	95
1981	11022690	635831	477600	214133	0.4484	0.3571	89
1982	7974760	661504	516201	206005	0.3991	0.3723	96
1983	22631500	607491	488072	183827	0.3766	0.3032	104
1984	9350140	691464	521233	206005	0.3952	0.2540	95
1985	6401370	712970	562264	208440	0.3707	0.3243	94
1986	5939550	613985	492395	187363	0.3805	0.3694	97
1987	10859400	499238	396846	177695	0.4478	0.3873	100
1988	6382980	465514	355278	161530	0.4547	0.4068	101
1989	6299150	448613	301015	140961	0.4683	0.4061	96
1990	6019810	415631	297004	145660	0.4904	0.3896	106
1991	13751630	364000	275547	132590	0.4812	0.4853	99
1992	10930660	507197	381365	130250	0.3415	0.4322	99
1993	4005580	625360	437961	142459	0.3253	0.4254	98
1994	4160590	545067	428723	136582	0.3186	0.3338	98
1995	2898610	542397	438034	125381	0.2862	0.3086	98
1996	7511790	419173	323828	116735	0.3605	0.4355	99
1997	6908420	360192	262196	115812	0.4417	0.5543	98

No of years for separable analysis : 12

Table 8.9.1.1 (continued)

```
Age range in the analysis : 0  . . . 6
Year range in the analysis : 1977  . . . 1997
Number of indices of SSB : 3
Number of age-structured indices : 3

Parameters to estimate : 60
Number of observations : 215

Two selection vectors to be fitted.
Selection assumed constant up to and including : 1990
Abrupt change in selection specified.
```

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1986	0.3662	20	0.2435	0.5507	0.2974	0.4509	0.3742
2	1987	0.3839	20	0.2586	0.5701	0.3138	0.4698	0.3918
3	1988	0.4032	20	0.2700	0.6021	0.3286	0.4948	0.4118
4	1989	0.4026	20	0.2704	0.5994	0.3286	0.4932	0.4110
5	1990	0.3862	19	0.2618	0.5699	0.3167	0.4710	0.3939
6	1991	0.5289	20	0.3569	0.7838	0.4327	0.6464	0.5397
7	1992	0.4711	20	0.3165	0.7011	0.3845	0.5770	0.4809
8	1993	0.4636	21	0.3037	0.7078	0.3736	0.5753	0.4745
9	1994	0.3638	21	0.2380	0.5560	0.2930	0.4517	0.3724
10	1995	0.3363	20	0.2229	0.5072	0.2727	0.4147	0.3437
11	1996	0.4746	20	0.3188	0.7064	0.3874	0.5814	0.4844
12	1997	0.6041	21	0.3970	0.9191	0.4876	0.7483	0.6181
Separable Model: Selection (S1) by age 1986 1990								
13	0	0.1950	25	0.1176	0.3232	0.1507	0.2524	0.2016
14	1	0.4876	20	0.3241	0.7336	0.3959	0.6006	0.4983
15	2	0.8221	19	0.5570	1.2133	0.6740	1.0027	0.8384
	3	1.0000		Fixed : Reference Age				
16	4	1.2129	17	0.8581	1.7146	1.0166	1.4472	1.2320
	5	1.0000		Fixed : Last true age				
Separable Model: Selection (S2) by age from 1991 to 1997								
17	0	0.0860	24	0.0535	0.1382	0.0675	0.1095	0.0885
18	1	0.1840	19	0.1255	0.2697	0.1513	0.2236	0.1875
19	2	0.4908	18	0.3430	0.7024	0.4088	0.5893	0.4991
	3	1.0000		Fixed : Reference Age				
20	4	1.1795	14	0.8797	1.5816	1.0156	1.3700	1.1928
	5	1.0000		Fixed : Last true age				
Separable model: Populations in year 1997								
21	0	6908428	39	3212236	14857679	4674119	10210775	7456349
22	1	5184543	24	3208677	8377125	4058746	6622609	5342251
23	2	1333789	20	890590	1997542	1085407	1639009	1362411
24	3	1115818	18	771974	1612813	924625	1346547	1135703
25	4	507270	20	342365	751605	415070	619950	517579
26	5	632035	22	409746	974916	506649	788451	647678
Separable model: Populations at age								
27	1986	719268	34	363764	1422202	507965	1018467	764119
28	1987	540927	27	317244	922325	412004	710192	561350
29	1988	893028	24	551839	1445164	698563	1141627	920370
30	1989	492304	23	310784	779843	389321	622528	506050
31	1990	292419	22	187112	456992	232849	367228	300105
32	1991	264592	22	171500	408214	212080	330106	271147
33	1992	415814	23	263644	655813	329564	524637	427203
34	1993	229155	25	139765	375714	178063	294907	236563
35	1994	258217	25	156820	425175	200209	333032	266712
36	1995	316160	24	196726	508104	248189	402747	325560
37	1996	861613	21	562244	1320383	692990	1071267	882292

SSB Index catchabilities

DEPM

Absolute estimator. No fitted catchability.

Vigo

Power model fitted. Slopes (Q) and exponents (K) at age

38	2	Q	2.718	14	2.950	5.305	3.406	4.595	4.001
39	2	K	.7829E-05	14	.7513E-03	.1351E-02	.8674E-03	.1170E-02	.1086E-02

Sada

Power model fitted. Slopes (Q) and exponents (K) at age

40	3	Q	2.056	14	2.698	4.850	3.114	4.201	3.658
41	3	K	.1802E-01	14	18.21	32.74	21.03	28.36	26.32

Table 8.9.1.1 (continued)

Age-structured index catchabilities

PT MARCH ACOUSTIC SURVEY INC. CADIZ,,,,

Linear model fitted. Slopes at age :

42	1	Q	750.7	50	460.3	3391.	750.7	2080.	1423.
43	2	Q	1667.	49	1039.	7165.	1667.	4465.	3080.
44	3	Q	2505.	49	1561.	.1076E+05	2505.	6708.	4628.
45	4	Q	3121.	50	1928.	.1377E+05	3121.	8510.	5845.
46	5	Q	2250.	51	1366.	.1048E+05	2250.	6363.	4331.
47	6	Q	750.1	51	459.1	3408.	750.1	2086.	1425.

SP MARCH ACOUSTIC SURVEY

Linear model fitted. Slopes at age :

48	1	Q	19.60	28	14.92	45.41	19.60	34.58	27.10
49	2	Q	53.51	28	40.83	123.1	53.51	93.97	73.78
50	3	Q	101.2	28	76.94	235.3	101.2	179.0	140.1
51	4	Q	161.2	29	120.9	391.0	161.2	293.3	227.4
52	5	Q	307.7	32	225.7	799.4	307.7	586.5	447.5
53	6	Q	741.6	30	554.4	1818.	741.6	1359.	1051.

PT November ACOUSTIC SURVEY,,,,

Linear model fitted. Slopes at age :

54	0	Q	498.7	36	350.6	1478.	498.7	1039.	770.0
55	1	Q	691.5	36	487.6	2030.	691.5	1432.	1063.
56	2	Q	839.1	36	591.5	2466.	839.1	1739.	1291.
57	3	Q	813.4	36	571.3	2418.	813.4	1698.	1258.
58	4	Q	1015.	37	707.3	3086.	1015.	2151.	1585.
59	5	Q	431.6	38	298.2	1349.	431.6	932.3	683.2
60	6	Q	133.4	37	93.01	405.9	133.4	282.9	208.5

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1986	1987	1988	1989	1990	1991	1992	1993
0	-0.139	0.765	0.235	-0.493	-0.368	1.110	0.298	-0.416
1	0.209	-0.068	-0.043	-0.134	-0.022	0.406	0.403	0.072
2	0.071	0.086	-0.072	-0.131	-0.125	-0.115	-0.027	-0.004
3	-0.131	-0.095	0.107	0.108	0.149	-0.132	-0.276	0.086
4	-0.086	-0.172	-0.204	0.000	0.441	-0.489	-0.096	0.129
5	0.032	0.037	0.135	0.353	-0.458	-0.225	-0.194	0.441

Separable Model Residuals

Age	1994	1995	1996	1997
0	0.103	-0.820	0.078	-0.357
1	-0.919	0.242	-0.330	0.163
2	-0.252	0.149	0.029	0.433
3	0.157	0.121	0.338	-0.113
4	0.292	-0.060	0.152	0.407
5	0.512	-0.103	-0.345	-0.097

SPAWNING BIOMASS INDEX RESIDUALS

DEPM

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	-0.1859	*******

Table 8.9.1.1 (continued)

DEPM

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	-0.3303

Vigo

	1982	1983	1984	1985	1986	1987	1988	1989
1	0.1902	0.0520	0.1343	0.1027	0.0966	0.4197	-0.0078	0.0424

Vigo

	1990	1991	1992	1993	1994	1995	1996	1997
1	0.1894	0.1267	-0.1982	-0.2502	-0.3830	-0.3408	-0.1848	0.0022

Sada

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	0.0577	0.2601	0.1972

Sada

	1990	1991	1992	1993	1994	1995	1996	1997
1	-0.0227	-0.4795	-0.2905	-0.0133	-0.0175	-0.0232	0.1547	0.1770

AGE-STRUCTURED INDEX RESIDUALS

PT MARCH ACOUSTIC SURVEY INC. CADIZ,,,,

Age	1996	1997	1998
1	0.150	0.519	-0.670
2	-0.337	0.595	-0.258
3	-0.002	-0.437	0.439
4	-0.324	0.069	0.256
5	-1.452	0.133	1.319
6	-2.028	0.528	1.499

SP MARCH ACOUSTIC SURVEY

Age	1988	1989	1990	1991	1992	1993	1994	1995
1	0.548	-0.025	-0.070	-1.061	-0.014	0.563	*******	*******
2	-0.567	0.416	-0.744	0.562	-0.486	0.359	*******	*******
3	-0.515	-0.482	0.347	0.384	-0.303	0.053	*******	*******
4	-0.870	0.057	-0.384	1.026	-0.884	0.406	*******	*******
5	1.285	-0.543	0.121	-0.101	0.071	0.887	*******	*******
6	0.746	0.927	-0.012	1.134	-0.274	1.551	*******	*******

Table 8.9.1.1 (continued)

SP MARCH ACOUSTIC SURVEY

Age	1996	1997	1998
1	-1.233	-0.505	1.796
2	-0.546	1.429	-0.423
3	-0.076	0.297	0.295
4	0.562	0.617	-0.530
5	-0.020	-0.905	-0.796
6	-1.288	-0.740	-2.043

PT November ACOUSTIC SURVEY,,,,

Age	1984	1985	1986	1987	1988	1989	1990	1991
0	-0.154	-0.104	0.179	-0.023	*******	*******	*******	*******
1	-0.075	-0.132	-0.185	0.308	*******	*******	*******	*******
2	-0.524	0.220	-0.215	0.068	*******	*******	*******	*******
3	-0.127	0.050	-0.981	-0.067	*******	*******	*******	*******
4	-0.596	0.062	-0.627	-0.408	*******	*******	*******	*******
5	-0.888	-0.410	-0.283	0.637	*******	*******	*******	*******
6	0.059	0.703	0.072	0.579	*******	*******	*******	*******

PT November ACOUSTIC SURVEY,,,,

Age	1992	1993	1994	1995	1996	1997
0	0.163	*******	*******	*******	*******	-0.063
1	0.270	*******	*******	*******	*******	-0.189
2	-0.109	*******	*******	*******	*******	0.557
3	0.381	*******	*******	*******	*******	0.739
4	0.168	*******	*******	*******	*******	1.394
5	-0.852	*******	*******	*******	*******	1.787
6	-2.473	*******	*******	*******	*******	1.051

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1986 to 1997

Variance	0.1613
Skewness test stat.	-0.1071
Kurtosis test statistic	1.7502
Partial chi-square	0.4581
Significance in fit	0.0000
Degrees of freedom	39

PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES

DISTRIBUTION STATISTICS FOR DEPM

Index used as absolute measure of abundance
Last age is a plus-group

Variance	0.0718
Skewness test stat.	-0.6367
Kurtosis test statistic	-0.4996
Partial chi-square	0.0115
Significance in fit	0.0057
Number of observations	2
Degrees of freedom	2
Weight in the analysis	1.0000

Table 8.9.1.1 (continued)

DISTRIBUTION STATISTICS FOR Vigo

Power catchability relationship assumed
Last age is a plus-group

Variance	0.0504
Skewness test stat.	-0.3446
Kurtosis test statistic	-0.4538
Partial chi-square	0.6166
Significance in fit	0.2653
Number of observations	16
Degrees of freedom	14
Weight in the analysis	1.0000

DISTRIBUTION STATISTICS FOR Sada

Power catchability relationship assumed
Last age is a plus-group

Variance	0.0534
Skewness test stat.	-1.3475
Kurtosis test statistic	0.1463
Partial chi-square	0.0945
Significance in fit	0.0462
Number of observations	11
Degrees of freedom	9
Weight in the analysis	1.0000

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR PT MARCH ACOUSTIC SURVEY INC. CADIZ,,,,

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	0.0617	0.0445	0.0319	0.0146	0.3220	0.5532
Skewness test stat.	-0.3014	0.4867	0.0050	-0.2860	-0.1230	-0.3451
Kurtosis test statisti	-0.5303	-0.5303	-0.5303	-0.5303	-0.5303	-0.5303
Partial chi-square	0.0056	0.0041	0.0030	0.0014	0.0315	0.0595
Significance in fit	0.0028	0.0021	0.0015	0.0007	0.0156	0.0293
Number of observations	3	3	3	3	3	3
Degrees of freedom	2	2	2	2	2	2
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

DISTRIBUTION STATISTICS FOR SP MARCH ACOUSTIC SURVEY

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	0.1406	0.0885	0.0217	0.0809	0.0878	0.2409
Skewness test stat.	0.6161	0.9508	-0.4384	0.0025	0.6010	-0.4387
Kurtosis test statisti	-0.1143	-0.3405	-0.8993	-0.8640	-0.4396	-0.6428
Partial chi-square	0.0622	0.0386	0.0094	0.0350	0.0377	0.1010
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	9	9	9	9	9	9
Degrees of freedom	8	8	8	8	8	8
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

DISTRIBUTION STATISTICS FOR PT November ACOUSTIC SURVEY,,,,

Linear catchability relationship assumed

Age	0	1	2	3	4	5	6
Variance	0.0028	0.0074	0.0199	0.0479	0.0826	0.1531	0.2302
Skewness test stat.	0.4031	0.6107	0.1200	-0.5495	1.0913	0.8984	-1.4365
Kurtosis test statisti	-0.7360	-0.7452	-0.4081	-0.1711	-0.0320	-0.2955	0.3002
Partial chi-square	0.0006	0.0017	0.0048	0.0116	0.0211	0.0411	0.0691
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
Number of observations	6	6	6	6	6	6	6
Degrees of freedom	5	5	5	5	5	5	5
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

Table 8.9.1.1 (continued)

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	71.7297	215	60	155	0.4628
Catches at age	7.3208	72	37	35	0.2092
SSB Indices					
DEPM	0.1437	2	0	2	0.0718
Vigo	0.7056	16	2	14	0.0504
Sada	0.4810	11	2	9	0.0534
Aged Indices					
PT MARCH ACOUSTIC SURVEY INC. CADIZ,,,	12.3363	18	6	12	1.0280
SP MARCH ACOUSTIC SURVEY	31.7031	54	6	48	0.6605
PT November ACOUSTIC SURVEY,,,,	19.0391	42	7	35	0.5440

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	8.5888	215	60	155	0.0554
Catches at age	5.6467	72	37	35	0.1613
SSB Indices					
DEPM	0.1437	2	0	2	0.0718
Vigo	0.7056	16	2	14	0.0504
Sada	0.4810	11	2	9	0.0534
Aged Indices					
PT MARCH ACOUSTIC SURVEY INC. CADIZ,,,	0.3427	18	6	12	0.0286
SP MARCH ACOUSTIC SURVEY	0.8806	54	6	48	0.0183
PT November ACOUSTIC SURVEY,,,,	0.3886	42	7	35	0.0111

Table 8.9.2.1 Sardine in Divisions VIIIc and IXa. Results of ICA stock assessment.

Output Generated by ICA Version 1.4

Sardine South (run: ICAPCL14/I14)

Catch in Number

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	844.0	854.0	643.0	842.0	1021.0	62.0	1070.0	118.0
1	2421.0	2145.0	1479.0	1997.0	1920.0	795.0	577.0	3312.0
2	954.0	913.0	935.0	1542.0	1720.0	1869.0	857.0	487.0
3	110.0	281.0	423.0	372.0	666.0	709.0	803.0	502.0
4	22.0	127.0	187.0	155.0	192.0	353.0	324.0	299.0
5	3.0	40.0	93.0	47.0	102.0	131.0	141.0	179.0
6	2.0	17.0	37.0	31.2	77.0	130.0	140.0	118.0

x 10 ^ 6

Catch in Number

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	268.0	304.0	1437.0	521.0	248.0	258.0	1581.0	498.0
1	564.0	755.0	543.0	1061.0	566.0	602.0	477.0	1002.0
2	2371.0	1027.0	667.0	535.0	909.0	517.0	436.0	451.0
3	469.0	919.0	569.0	439.0	389.0	707.0	407.9	340.0
4	294.0	333.0	535.0	304.0	221.0	295.0	266.0	186.0
5	201.0	196.0	154.0	292.0	200.0	51.0	75.0	111.0
6	104.0	168.0	172.0	190.0	245.0	248.0	105.0	83.0

x 10 ^ 6

Catch in Number

AGE	1993	1994	1995	1996	1997
0	88.0	121.0	31.0	276.9	208.6
1	566.0	61.0	189.0	103.9	548.6
2	1082.0	542.0	281.0	359.4	453.3
3	521.0	1095.0	830.0	518.4	391.1
4	257.0	272.0	473.0	663.9	337.3
5	114.0	113.0	70.0	198.9	225.2
6	120.0	72.0	64.5	46.4	70.3

x 10 ^ 6

Predicted Catch in Number

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	339.9	700.8	409.0	401.7	372.2	524.8	337.8	130.2
1	602.4	586.6	1124.4	644.5	605.7	315.7	624.2	516.2
2	937.3	620.0	557.6	1048.3	576.1	478.7	435.8	1106.7
3	1101.5	648.4	393.4	346.4	625.1	455.2	414.2	488.0
4	354.8	682.6	366.8	217.7	184.2	434.1	192.9	232.4
5	197.2	150.2	262.9	138.0	78.6	88.5	125.8	75.0

x 10 ^ 6

Predicted Catch in Number

AGE	1994	1995	1996	1997
0	108.1	69.6	268.8	321.7
1	150.0	148.5	145.0	518.4
2	697.8	243.5	357.4	310.7
3	957.9	739.4	369.8	449.1
4	211.1	521.9	572.5	221.5
5	68.9	79.5	283.7	239.5

x 10 ^ 6

Table 8.9.2.1 (continued)

Weights at age in the catches (Kg)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	.01700	.01700	.01700	.01700	.01700	.01700	.01700	.01700
1	.03400	.03400	.03400	.03400	.03400	.03400	.03400	.03400
2	.05200	.05200	.05200	.05200	.05200	.05200	.05200	.05200
3	.06000	.06000	.06000	.06000	.06000	.06000	.06000	.06000
4	.06800	.06800	.06800	.06800	.06800	.06800	.06800	.06800
5	.07200	.07200	.07200	.07200	.07200	.07200	.07200	.07200
6	.10000	.10000	.10000	.10000	.10000	.10000	.10000	.10000

Weights at age in the catches (Kg)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	.01700	.01700	.01700	.01700	.01300	.02400	.02000	.01800
1	.03400	.03400	.03400	.03400	.03500	.03200	.03100	.04500
2	.05200	.05200	.05200	.05200	.05200	.04700	.05800	.05500
3	.06000	.06000	.06000	.06000	.05900	.05700	.06300	.06600
4	.06800	.06800	.06800	.06800	.06600	.06100	.07300	.07000
5	.07200	.07200	.07200	.07200	.07100	.06700	.07400	.07900
6	.10000	.10000	.10000	.10000	.10000	.10000	.10000	.10000

Weights at age in the catches (Kg)

AGE	1993	1994	1995	1996	1997
0	.01700	.02000	.02500	.01900	.02200
1	.03700	.03600	.04700	.03800	.03300
2	.05100	.05800	.05900	.05100	.05200
3	.05800	.06200	.06600	.05800	.06200
4	.06600	.07000	.07100	.06100	.06900
5	.07100	.07600	.08200	.07100	.07300
6	.10000	.10000	.10000	.10000	.10000

Weights at age in the stock (Kg)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
1	.01500	.01500	.01500	.01500	.01500	.01500	.01500	.01500
2	.03800	.03800	.03800	.03800	.03800	.03800	.03800	.03800
3	.05000	.05000	.05000	.05000	.05000	.05000	.05000	.05000
4	.06400	.06400	.06400	.06400	.06400	.06400	.06400	.06400
5	.06700	.06700	.06700	.06700	.06700	.06700	.06700	.06700
6	.10000	.10000	.10000	.10000	.10000	.10000	.10000	.10000

Weights at age in the stock (Kg)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
1	.01500	.01500	.01500	.01500	.01500	.01500	.01900	.02700
2	.03800	.03800	.03800	.03800	.03800	.03800	.04200	.03600
3	.05000	.05000	.05000	.05000	.05000	.05000	.05000	.05000
4	.06400	.06400	.06400	.06400	.06400	.06400	.06400	.06200
5	.06700	.06700	.06700	.06700	.06700	.06700	.07100	.06900
6	.10000	.10000	.10000	.10000	.10000	.10000	.10000	.10000

Table 8.9.2.1 (continued)

Weights at age in the stock (Kg)

AGE	1993	1994	1995	1996	1997
0	.00000	.00000	.00000	.00000	.00000
1	.02200	.03100	.02900	.03600	.02500
2	.04500	.04000	.05000	.04700	.05000
3	.05700	.04900	.06200	.06100	.05800
4	.06400	.06000	.07200	.06900	.06800
5	.07300	.06700	.07900	.07500	.07400
6	.10000	.10000	.10000	.10000	.10000

Natural Mortality (per year)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
1	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
2	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
3	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
4	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
5	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
6	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000

Natural Mortality (per year)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
1	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
2	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
3	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
4	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
5	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000
6	.33000	.33000	.33000	.33000	.33000	.33000	.33000	.33000

Natural Mortality (per year)

AGE	1993	1994	1995	1996	1997
0	.33000	.33000	.33000	.33000	.33000
1	.33000	.33000	.33000	.33000	.33000
2	.33000	.33000	.33000	.33000	.33000
3	.33000	.33000	.33000	.33000	.33000
4	.33000	.33000	.33000	.33000	.33000
5	.33000	.33000	.33000	.33000	.33000
6	.33000	.33000	.33000	.33000	.33000

Proportion of fish spawning

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500
2	.9500	.9500	.9500	.9500	.9500	.9500	.9500	.9500
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 8.9.2.1 (continued)

Proportion of fish spawning

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.6500	.6500	.6500	.6500	.2300	.6000	.7400	.7900
2	.9500	.9500	.9500	.9500	.8300	.8100	.9100	.9100
3	1.0000	1.0000	1.0000	1.0000	.9100	.8800	.9600	.9500
4	1.0000	1.0000	1.0000	1.0000	.9200	.8900	.9700	.9800
5	1.0000	1.0000	1.0000	1.0000	.9400	.9400	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	.9770	.9870	1.0000	1.0000

Proportion of fish spawning

AGE	1993	1994	1995	1996	1997
0	.0000	.0000	.0000	.0000	.0000
1	.4700	.8000	.7300	.8300	.7270
2	.9300	.8900	.9800	.8900	.9180
3	.9400	.9600	.9700	.9200	.9500
4	.9700	.9600	.9900	.9600	.9720
5	.9900	.9700	1.0000	1.0000	.9930
6	1.0000	1.0000	1.0000	1.0000	1.0000

INDICES OF SPAWNING BIOMASS

INDEX1

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	295.00	*******

x 10 ^ 3

INDEX1

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	188.44

x 10 ^ 3

INDEX2

	1982	1983	1984	1985	1986	1987	1988	1989
1	4870.0	4010.0	4650.0	4860.0	4230.0	4710.0	2750.0	2450.0

x 10 ^ -3

INDEX2

	1990	1991	1992	1993	1994	1995	1996	1997
1	2800.0	2440.0	2440.0	2660.0	2280.0	2430.0	2100.0	2050.0

x 10 ^ -3

INDEX3

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	204.00	234.00	195.00

Table 8.9.2.1 (continued)

INDEX3

	1990	1991	1992	1993	1994	1995	1996	1997
1	155.00	93.00	142.00	207.00	203.00	205.00	197.00	173.00

AGE-STRUCTURED INDICES

FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Cat

AGE	1988	1989	1990	1991	1992	1993	1994	1995
1	221.0	73.0	69.0	25.0	168.0	239.0	*******	*******
2	63.0	304.0	56.0	208.0	77.0	427.0	*******	*******
3	72.0	66.0	274.0	164.0	88.0	136.0	*******	*******
4	64.0	96.0	55.0	401.0	31.0	126.0	*******	*******
5	858.0	76.0	88.0	62.0	117.0	146.0	*******	*******
6	898.0	1389.0	571.0	574.0	123.0	1119.0	*******	*******

x 10 ^ 6

FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Cat

AGE	1996	1997	1998
1	10.6	56.1	509.8
2	54.2	262.8	103.1
3	90.5	126.0	80.4
4	364.0	123.0	33.8
5	221.3	65.3	20.6
6	24.8	52.6	25.4

x 10 ^ 6

F9704: PT MARCH ACOUSTIC SURVEY INC. CAD

AGE	1996	1997	1998
1	1625.0	5990.0	1658.8
2	2082.2	3556.0	3789.8
3	2414.5	1498.0	2296.9
4	2906.0	1377.0	1434.4
5	386.5	1347.0	1247.9
6	12.0	189.0	888.2

x 10 ^ 6

Fishing Mortality (per year)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	.09283	.07530	.05009	.06103	.11373	.00933	.05600	.01511
1	.50395	.41684	.20792	.24936	.22156	.13968	.12884	.28294
2	.60567	.42232	.37674	.40551	.41216	.40668	.25370	.17581
3	.15503	.41973	.41360	.29274	.35784	.34670	.35711	.26814
4	.14983	.31219	.65348	.30364	.28003	.38125	.30612	.25222
5	.52146	.51872	.46471	.39256	.39152	.36528	.29899	.32173
6	.52146	.51872	.46471	.39256	.39152	.36528	.29899	.32173

Fishing Mortality (per year)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	.05110	.07138	.07795	.07957	.07988	.07643	.04681	.03928
1	.10645	.17838	.19479	.19885	.19963	.19100	.09834	.08252
2	.39257	.29879	.32629	.33309	.33439	.31993	.26257	.22033
3	.29657	.37232	.40658	.41505	.41668	.39866	.53107	.44564
4	.28820	.44905	.49038	.50060	.50256	.48083	.63520	.53301
5	.31172	.37232	.40658	.41505	.41668	.39866	.53107	.44564
6	.31172	.37232	.40658	.41505	.41668	.39866	.53107	.44564

Table 8.9.2.1 (continued)

Fishing Mortality (per year)

AGE	1993	1994	1995	1996	1997
0	.04231	.03414	.03266	.04809	.06730
1	.08888	.07172	.06860	.10101	.14137
2	.23731	.19151	.18316	.26972	.37746
3	.47998	.38734	.37047	.54553	.76345
4	.57408	.46328	.44310	.65249	.91314
5	.47998	.38734	.37047	.54553	.76345
6	.47998	.38734	.37047	.54553	.76345

Population Abundance (1 January)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	11149.	13794.	15430.	16669.	11116.	7840.	23033.	9233.
1	7082.	7304.	9197.	10551.	11274.	7133.	5584.	15657.
2	2425.	3076.	3461.	5371.	5911.	6495.	4459.	3529.
3	895.	952.	1450.	1707.	2574.	2814.	3109.	2488.
4	185.	551.	450.	689.	916.	1294.	1431.	1564.
5	9.	114.	290.	168.	366.	498.	635.	757.
6	6.	49.	115.	112.	276.	494.	631.	499.

x 10 ^ 6

Population Abundance (1 January)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	6307.	5782.	10949.	6264.	6130.	5927.	13456.	10284.
1	6538.	4308.	3870.	7281.	4159.	4069.	3947.	9231.
2	8482.	4226.	2591.	2290.	4291.	2449.	2416.	2572.
3	2128.	4118.	2253.	1344.	1180.	2208.	1278.	1336.
4	1368.	1137.	2040.	1079.	638.	559.	1065.	540.
5	874.	737.	522.	898.	470.	278.	249.	406.
6	452.	628.	598.	649.	835.	876.	295.	268.

x 10 ^ 6

Population Abundance (1 January)

AGE	1993	1994	1995	1996	1997	1998
0	3686.	3778.	2539.	6713.	5793.	6454.
1	7109.	2540.	2625.	1767.	4599.	3894.
2	6111.	4676.	1700.	1762.	1148.	2871.
3	1483.	3465.	2776.	1017.	967.	566.
4	615.	660.	1691.	1378.	424.	324.
5	228.	249.	299.	781.	516.	122.
6	365.	260.	242.	128.	151.	224.

x 10 ^ 6

Weighting factors for the catches in number

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Weighting factors for the catches in number

AGE	1994	1995	1996	1997
0	.5000	.5000	.5000	.5000
1	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000

Table 8.9.2.1 (continued)

Predicted SSB Index Values

INDEX1

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	347.98	*******

x 10 ^ 3

INDEX1

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	219.90

x 10 ^ 3

INDEX2

	1982	1983	1984	1985	1986	1987	1988	1989
1	4073.1	3869.6	4131.1	4459.3	3922.8	3157.5	2830.3	2422.8

x 10 ^ -3

INDEX2

	1990	1991	1992	1993	1994	1995	1996	1997
1	2387.2	2226.8	3033.5	3422.3	3265.7	3245.8	2353.3	1846.3

x 10 ^ -3

INDEX3

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	194.37	182.66	167.22

INDEX3

	1990	1991	1992	1993	1994	1995	1996	1997
1	165.82	159.40	190.00	203.47	198.13	197.45	164.48	143.30

Predicted Age-Structured Index Values

FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Ca Predicted

AGE	1988	1989	1990	1991	1992	1993	1994	1995
1	137.24	78.37	76.82	75.99	178.31	137.13	*******	*******
2	114.29	214.09	122.55	122.40	131.45	311.19	*******	*******
3	126.73	111.20	208.87	117.62	125.15	137.96	*******	*******
4	162.49	96.08	84.58	156.00	80.84	91.23	*******	*******
5	264.93	138.61	82.14	71.54	118.93	66.33	*******	*******
6	452.89	581.92	613.13	200.75	185.55	251.00	*******	*******

x 10 ^ 6

FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Ca Predicted

AGE	1996	1997	1998
1	34.00	87.75	74.28
2	89.12	56.78	141.95
3	93.32	84.76	49.59
4	201.01	58.54	44.76
5	224.01	141.40	33.52
6	86.63	98.17	144.94

x 10 ^ 6

Table 8.9.2.1 (continued)

F9704: PT MARCH ACOUSTIC SURVEY INC. CA Predicted

AGE	1996	1997	1998
1	1420.0	3665.0	3102.5
2	3024.0	1926.6	4816.5
3	2581.9	2345.0	1372.1
4	4456.2	1297.9	992.4
5	1901.7	1200.4	284.6
6	101.9	115.5	170.5

x 10 ^ 6

Fitted Selection Pattern

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	.5988	.1794	.1211	.2085	.3178	.0269	.1568	.0564
1	3.2507	.9931	.5027	.8518	.6192	.4029	.3608	1.0552
2	3.9067	1.0062	.9109	1.3852	1.1518	1.1730	.7104	.6557
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	.9665	.7438	1.5800	1.0372	.7826	1.0996	.8572	.9406
5	3.3636	1.2358	1.1236	1.3410	1.0941	1.0536	.8373	1.1998
6	3.3636	1.2358	1.1236	1.3410	1.0941	1.0536	.8373	1.1998

Fitted Selection Pattern

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	.1723	.1917	.1917	.1917	.1917	.1917	.0881	.0881
1	.3589	.4791	.4791	.4791	.4791	.4791	.1852	.1852
2	1.3237	.8025	.8025	.8025	.8025	.8025	.4944	.4944
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	.9718	1.2061	1.2061	1.2061	1.2061	1.2061	1.1961	1.1961
5	1.0511	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0511	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Fitted Selection Pattern

AGE	1993	1994	1995	1996	1997
0	.0881	.0881	.0881	.0881	.0881
1	.1852	.1852	.1852	.1852	.1852
2	.4944	.4944	.4944	.4944	.4944
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.1961	1.1961	1.1961	1.1961	1.1961
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 2- 5	SoP (%)
1977	11148530	256144	176427	125750	.7128	.3580	81
1978	13793850	321844	230723	139990	.6067	.4182	84
1979	15430400	401720	291187	153441	.5269	.4771	96
1980	16669020	514263	379751	191682	.5048	.3486	95
1981	11116090	633182	475237	214133	.4506	.3604	89
1982	7840240	660032	514516	206005	.4004	.3750	96
1983	23032850	605866	486950	183827	.3775	.3040	104
1984	9233130	694087	522393	206005	.3943	.2545	95
1985	6306830	718090	567111	208440	.3675	.3223	94
1986	5781670	616102	494144	187363	.3792	.3731	97
1987	10948890	494517	391382	177695	.4540	.4075	100
1988	6263520	457606	347977	161530	.4642	.4159	101
1989	6129940	440215	294462	140961	.4787	.4176	96
1990	5926830	406458	289820	145660	.5026	.3995	106
1991	13455780	355737	268953	132590	.4930	.4900	99
1992	10284390	496922	374898	130250	.3474	.4112	99
1993	3685510	608436	426749	142459	.3338	.4428	98
1994	3778000	517906	405808	136582	.3366	.3574	98
1995	2539400	502769	403156	125381	.3110	.3418	98
1996	6712790	374865	285400	116735	.4090	.5033	99
1997	5792750	310637	219903	115812	.5266	.7044	98

Table 8.9.2.1 (continued)

IFAP run code: I14

No of years for separable analysis : 12
Age range in the analysis : 0 . . . 6
Year range in the analysis : 1977 . . . 1997
Number of indices of SSB : 3
Number of age-structured indices : 2

Parameters to estimate : 53
Number of observations : 173

Two selection vectors to be fitted.
Selection assumed constant up to and including : 1990
Abrupt change in selection specified.

PARAMETER ESTIMATES

Parm. No.	Mean of Param. Distrib.	Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.
Separable model : F by year							
1	1986	.3723	23	.2368	.5854	.2956	.4690	.3824
2	1987	.4066	21	.2643	.6255	.3264	.5065	.4165
3	1988	.4151	21	.2711	.6353	.3340	.5158	.4250
4	1989	.4167	21	.2732	.6354	.3360	.5168	.4264
5	1990	.3987	21	.2640	.6021	.3230	.4920	.4076
6	1991	.5311	21	.3477	.8111	.4279	.6592	.5436
7	1992	.4456	22	.2880	.6897	.3566	.5569	.4568
8	1993	.4800	22	.3075	.7492	.3824	.6024	.4925
9	1994	.3873	22	.2479	.6052	.3085	.4864	.3975
10	1995	.3705	22	.2403	.5712	.2970	.4621	.3796
11	1996	.5455	21	.3581	.8311	.4401	.6762	.5583
12	1997	.7635	23	.4781	1.2191	.6013	.9694	.7855
Separable Model: Selection (S1) by age 1986 1990							
13	0	.1917	27	.1124	.3269	.1460	.2517	.1990
14	1	.4791	22	.3098	.7409	.3836	.5984	.4911
15	2	.8025	21	.5292	1.2169	.6489	.9924	.8208
	3	1.0000		Fixed : Reference Age				
16	4	1.2061	18	.8410	1.7298	1.0034	1.4497	1.2267
	5	1.0000		Fixed : Last true age				
Separable Model: Selection (S2) by age from 1991 to 1997							
17	0	.0881	25	.0531	.1462	.0681	.1141	.0911
18	1	.1852	20	.1229	.2789	.1502	.2282	.1893
19	2	.4944	19	.3372	.7249	.4067	.6010	.5039
	3	1.0000		Fixed : Reference Age				
20	4	1.1961	15	.8815	1.6229	1.0236	1.3976	1.2106
	5	1.0000		Fixed : Last true age				
Separable model: Populations in year 1997							
21	0	5792751	44	2427246	13824707	3716589	9028700	6392254
22	1	4599406	26	2733408	7739251	3526931	5997999	4764401
23	2	1148274	22	743772	1772764	920064	1433088	1176809
24	3	967284	20	651022	1437183	790351	1183825	987224
25	4	423874	21	275415	652356	340174	528167	434254
26	5	515821	24	316135	841636	401806	662188	532167
Separable model: Populations at age							
27	1986	737082	39	343161	1583188	499021	1088709	795339
28	1987	521871	30	286076	952018	384023	709199	547005
29	1988	898267	27	526464	1532649	683942	1179755	932269
30	1989	470135	25	285009	775509	364186	606908	485716
31	1990	277550	24	171574	448983	217152	354745	286034
32	1991	248557	23	156094	395791	196040	315143	255658
33	1992	405831	25	246662	667709	314788	523206	419140
34	1993	227983	27	133165	390313	173286	299944	236724
35	1994	249077	27	145562	426206	189370	327610	258609
36	1995	298534	26	179086	497654	230019	387459	308856
37	1996	780613	23	490676	1241873	615967	989268	802825

Table 8.9.2.1 (continued)

SSB Index catchabilities

INDEX1
Absolute estimator. No fitted catchability.

INDEX2
Power model fitted. Slopes (Q) and exponents (K) at age

38	2	Q	2.537	15	2.636	4.853	3.061	4.179	3.620
39	2	K	.1966E-04	15	.1221E-02	.2248E-02	.1418E-02	.1936E-02	.1791E-02

INDEX3
Power model fitted. Slopes (Q) and exponents (K) at age

40	3	Q	1.697	15	2.095	3.856	2.432	3.321	2.877
41	3	K	.2143	15	111.1	204.6	129.1	176.2	163.0

Age-structured index catchabilities
FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Ca

Linear model fitted. Slopes at age :

42	1	Q	21.06	29	15.87	50.44	21.06	38.00	29.55
43	2	Q	57.37	29	43.35	136.0	57.37	102.8	80.14
44	3	Q	110.2	29	82.95	265.0	110.2	199.4	154.9
45	4	Q	179.3	31	132.6	455.0	179.3	336.4	258.1
46	5	Q	344.9	34	248.2	950.6	344.9	684.2	515.1
47	6	Q	815.6	31	600.8	2094.	815.6	1542.	1180.

F9704: PT MARCH ACOUSTIC SURVEY INC. CA

Linear model fitted. Slopes at age :

48	1	Q	879.7	53	526.6	4282.	879.7	2563.	1732.
49	2	Q	1947.	51	1190.	8878.	1947.	5427.	3707.
50	3	Q	3050.	51	1863.	.1396E+05	3050.	8523.	5818.
51	4	Q	3975.	52	2393.	.1902E+05	3975.	.1145E+05	7758.
52	5	Q	2928.	55	1720.	.1509E+05	2928.	8865.	5940.
53	6	Q	959.8	54	571.5	4748.	959.8	2827.	1906.

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1986	1987	1988	1989	1990	1991	1992	1993
0	-.112	.718	.242	-.482	-.367	1.103	.388	-.392
1	.226	-.077	-.058	-.130	-.006	.413	.473	.092
2	.091	.073	-.041	-.143	-.108	-.093	.034	-.023
3	-.181	-.131	.110	.116	.123	-.110	-.197	.065
4	-.063	-.244	-.188	.015	.471	-.490	-.037	.100
5	-.006	.025	.105	.371	-.432	-.166	-.125	.419

Separable Model Residuals

Age	1994	1995	1996	1997
0	.113	-.808	.030	-.433
1	-.900	.241	-.333	.057
2	-.253	.143	.006	.378
3	.134	.116	.338	-.138
4	.254	-.098	.148	.420
5	.495	-.128	-.355	-.062

SPAWNING BIOMASS INDEX RESIDUALS

INDEX1

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	-.1652	*******

Table 8.9.2.1 (continued)

INDEX1

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	-.1544

INDEX2

	1982	1983	1984	1985	1986	1987	1988	1989
1	.1787	.0356	.1183	.0860	.0754	.3999	-.0288	.0112

INDEX2

	1990	1991	1992	1993	1994	1995	1996	1997
1	.1595	.0914	-.2177	-.2520	-.3593	-.2895	-.1139	.1047

INDEX3

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	.0483	.2477	.1537

INDEX3

	1990	1991	1992	1993	1994	1995	1996	1997
1	-.0675	-.5388	-.2912	.0172	.0243	.0375	.1804	.1884

AGE-STRUCTURED INDEX RESIDUALS

FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995
1	.476	-.071	-.107	-1.112	-.060	.556	*******	*******
2	-.596	.351	-.783	.530	-.535	.316	*******	*******
3	-.565	-.522	.271	.332	-.352	-.014	*******	*******
4	-.932	-.001	-.430	.944	-.958	.323	*******	*******
5	1.175	-.601	.069	-.143	-.016	.789	*******	*******
6	.685	.870	-.071	1.051	-.411	1.495	*******	*******

FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Ca

Age	1996	1997	1998
1	-1.162	-.447	1.926
2	-.496	1.532	-.319
3	-.030	.397	.483
4	.594	.743	-.282
5	-.012	-.773	-.487
6	-1.252	-.625	-1.741

F9704: PT MARCH ACOUSTIC SURVEY INC. CA

Age	1996	1997	1998
1	.135	.491	-.626
2	-.373	.613	-.240
3	-.067	-.448	.515
4	-.428	.059	.368
5	-1.593	.115	1.478
6	-2.143	.492	1.650

Table 8.9.2.1 (continued)

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1986 to 1997

Variance	.1575
Skewness test stat.	.0181
Kurtosis test statistic	1.7335
Partial chi-square	.4463
Significance in fit	.0000
Degrees of freedom	39

PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES

DISTRIBUTION STATISTICS FOR INDEX1

Index used as absolute measure of abundance

Last age is a plus-group

Variance	.0256
Skewness test stat.	-.5783
Kurtosis test statistic	-.5760
Partial chi-square	.0041
Significance in fit	.0020
Number of observations	2
Degrees of freedom	2
Weight in the analysis	1.0000

DISTRIBUTION STATISTICS FOR INDEX2

Power catchability relationship assumed

Last age is a plus-group

Variance	.0430
Skewness test stat.	-.2802
Kurtosis test statistic	-.3687
Partial chi-square	.5300
Significance in fit	.2328
Number of observations	16
Degrees of freedom	14
Weight in the analysis	1.0000

DISTRIBUTION STATISTICS FOR INDEX3

Power catchability relationship assumed

Variance	.0597
Skewness test stat.	-1.7087
Kurtosis test statistic	.5006
Partial chi-square	.1051
Significance in fit	.0512
Number of observations	11
Degrees of freedom	9
Weight in the analysis	1.0000

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (Ca

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	.1469	.0928	.0269	.0823	.0672	.2026
Skewness test stat.	.8621	1.1027	-.3365	-.1392	.8348	-.2513
Kurtosis test statisti	.0808	-.0954	-.8844	-.8232	-.3331	-.7402
Partial chi-square	.0652	.0407	.0117	.0355	.0287	.0853
Significance in fit	.0000	.0000	.0000	.0000	.0000	.0000
Number of observations	9	9	9	9	9	9
Degrees of freedom	8	8	8	8	8	8
Weight in the analysis	.1667	.1667	.1667	.1667	.1667	.1667

Table 8.9.2.1 (continued)

DISTRIBUTION STATISTICS FOR F9704: PT MARCH ACOUSTIC SURVEY INC. CA

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	.0543	.0477	.0392	.0268	.3948	.6296
Skewness test stat.	-.2898	.4652	.1760	-.1874	-.0967	-.3079
Kurtosis test statisti	-.5303	-.5303	-.5303	-.5303	-.5303	-.5303
Partial chi-square	.0050	.0044	.0037	.0025	.0386	.0676
Significance in fit	.0025	.0022	.0018	.0012	.0191	.0332
Number of observations	3	3	3	3	3	3
Degrees of freedom	2	2	2	2	2	2
Weight in the analysis	.1667	.1667	.1667	.1667	.1667	.1667

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	52.3782	173	53	120	.4365
Catches at age	7.1767	72	37	35	.2050
SSB Indices					
INDEX1	.0511	2	0	2	.0256
INDEX2	.6027	16	2	14	.0430
INDEX3	.5373	11	2	9	.0597
Aged Indices					
FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (C	29.7005	54	6	48	.6188
F9704: PT MARCH ACOUSTIC SURVEY INC. C	14.3099	18	6	12	1.1925

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	7.9261	173	53	120	.0661
Catches at age	5.5125	72	37	35	.1575
SSB Indices					
INDEX1	.0511	2	0	2	.0256
INDEX2	.6027	16	2	14	.0430
INDEX3	.5373	11	2	9	.0597
Aged Indices					
FLT04: SP MARCH ACOUSTIC SURVEY 1-7 (C	.8250	54	6	48	.0172
F9704: PT MARCH ACOUSTIC SURVEY INC. C	.3975	18	6	12	.0331

Table 8.10.1

The SAS System 11:30 Tuesday, October 6, 1998

Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

Prediction with management option table: Input data

Year: 1998								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	4917.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0673	0.022
1	3894.000	0.3300	0.7623	0.2500	0.2500	0.030	0.1414	0.039
2	2871.000	0.3300	0.9293	0.2500	0.2500	0.049	0.3775	0.054
3	566.000	0.3300	0.9467	0.2500	0.2500	0.060	0.7635	0.062
4	324.000	0.3300	0.9740	0.2500	0.2500	0.070	0.9131	0.067
5	122.000	0.3300	0.9977	0.2500	0.2500	0.076	0.7635	0.075
6+	224.000	0.3300	1.0000	0.2500	0.2500	0.100	0.7635	0.100
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	4917.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0673	0.022
1	.	0.3300	0.7623	0.2500	0.2500	0.030	0.1414	0.039
2	.	0.3300	0.9293	0.2500	0.2500	0.049	0.3775	0.054
3	.	0.3300	0.9467	0.2500	0.2500	0.060	0.7635	0.062
4	.	0.3300	0.9740	0.2500	0.2500	0.070	0.9131	0.067
5	.	0.3300	0.9977	0.2500	0.2500	0.076	0.7635	0.075
6+	.	0.3300	1.0000	0.2500	0.2500	0.100	0.7635	0.100
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	4917.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0673	0.022
1	.	0.3300	0.7623	0.2500	0.2500	0.030	0.1414	0.039
2	.	0.3300	0.9293	0.2500	0.2500	0.049	0.3775	0.054
3	.	0.3300	0.9467	0.2500	0.2500	0.060	0.7635	0.062
4	.	0.3300	0.9740	0.2500	0.2500	0.070	0.9131	0.067
5	.	0.3300	0.9977	0.2500	0.2500	0.076	0.7635	0.075
6+	.	0.3300	1.0000	0.2500	0.2500	0.100	0.7635	0.100
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANPCL01
Date and time: 06OCT98:11:32

Table 8.10.2

The SAS System 11:30 Tuesday, October 6, 1998

Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

Prediction with management option table

Year: 1998					Year: 1999					Year: 2000	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.7044	345892	253488	107523	0.0000	0.0000	335523	274982	0	424181	352911
.	.	.	.	.	0.1000	0.0704	.	271780	13938	410710	336494
.	.	.	.	.	0.2000	0.1409	.	268626	27165	397955	321206
.	.	.	.	.	0.3000	0.2113	.	265520	39726	385868	306953
.	.	.	.	.	0.4000	0.2818	.	262461	51663	374407	293653
.	.	.	.	.	0.5000	0.3522	.	259448	63015	363531	281229
.	.	.	.	.	0.6000	0.4226	.	256481	73819	353202	269612
.	.	.	.	.	0.7000	0.4931	.	253558	84108	343386	258737
.	.	.	.	.	0.8000	0.5635	.	250679	93914	334051	248547
.	.	.	.	.	0.9000	0.6339	.	247843	103268	325165	238989
.	.	.	.	.	1.0000	0.7044	.	245050	112195	316701	230013
.	.	.	.	.	1.1000	0.7748	.	242298	120722	308634	221576
.	.	.	.	.	1.2000	0.8453	.	239586	128873	300938	213636
.	.	.	.	.	1.3000	0.9157	.	236915	136670	293591	206156
.	.	.	.	.	1.4000	0.9861	.	234284	144133	286571	199102
.	.	.	.	.	1.5000	1.0566	.	231691	151283	279860	192443
.	.	.	.	.	1.6000	1.1270	.	229137	158136	273439	186149
.	.	.	.	.	1.7000	1.1974	.	226620	164710	267291	180196
.	.	.	.	.	1.8000	1.2679	.	224140	171022	261399	174557
.	.	.	.	.	1.9000	1.3383	.	221696	177085	255749	169212
.	.	.	.	.	2.0000	1.4088	.	219287	182913	250327	164139
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL01
Date and time : 06OCT98:11:32
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

Table 8.13.1

11:30 Tuesday, October 6, 1998

Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	4917.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0673	0.022
1	.	0.3300	0.7623	0.2500	0.2500	0.025	0.1414	0.039
2	.	0.3300	0.9293	0.2500	0.2500	0.050	0.3775	0.054
3	.	0.3300	0.9467	0.2500	0.2500	0.058	0.7635	0.062
4	.	0.3300	0.9740	0.2500	0.2500	0.068	0.9131	0.067
5	.	0.3300	0.9977	0.2500	0.2500	0.074	0.7635	0.075
6+	.	0.3300	1.0000	0.2500	0.2500	0.100	0.7635	0.100
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDPCL01
Date and time: 06OCT98:11:45

Table 8.13.2

11:30 Tuesday, October 6, 1998

Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0	17493473	722138	11422947	684018	10518381	629852
0.0500	0.0352	266120	18029	16695034	652090	10634474	614466	9726730	561288
0.1000	0.0704	483839	31932	16043047	596146	9992172	559001	9081344	506707
0.1500	0.1057	665704	42884	15499487	550548	9458030	513864	8544224	462363
0.2000	0.1409	820283	51669	15038395	512740	9006106	476502	8089435	425713
0.2500	0.1761	953619	58831	14641458	480926	8618096	445119	7698683	394972
0.3000	0.2113	1070098	64753	14295390	453810	8280727	418420	7358698	368855
0.3500	0.2465	1172977	69712	13990325	430436	7984146	395450	7059631	346414
0.4000	0.2818	1264724	73914	13718786	410084	7720885	375488	6794018	326934
0.4500	0.3170	1347244	77511	13475008	392200	7485190	357984	6556104	309871
0.5000	0.3522	1422030	80621	13254476	376358	7272555	342508	6341384	294802
0.5500	0.3874	1490265	83332	13053604	362217	7079402	328725	6146281	281393
0.6000	0.4226	1552902	85715	12869513	349510	6902860	316365	5967922	269381
0.6500	0.4579	1610716	87825	12699861	338020	6740595	305211	5803971	258551
0.7000	0.4931	1664343	89705	12542727	327569	6590695	295087	5652514	248732
0.7500	0.5283	1714309	91390	12396521	318014	6451575	285851	5511965	239781
0.8000	0.5635	1761055	92910	12259917	309234	6321915	277381	5380999	231582
0.8500	0.5987	1804951	94286	12131798	301130	6200604	269580	5258503	224037
0.9000	0.6340	1846311	95538	12011217	293619	6086702	262363	5143535	217066
0.9500	0.6692	1885403	96681	11897370	286631	5979409	255662	5035290	210599
1.0000	0.7044	1922456	97730	11789564	280104	5878038	249416	4933079	204578
1.0500	0.7396	1957670	98694	11687205	273990	5781999	243575	4836308	198955
1.1000	0.7748	1991216	99584	11589774	268243	5690778	238095	4744460	193686
1.1500	0.8101	2023245	100407	11496822	262826	5603931	232939	4657086	188735
1.2000	0.8453	2053888	101171	11407956	257706	5521067	228074	4573793	184070
1.2500	0.8805	2083262	101880	11322828	252855	5441844	223473	4494235	179664
1.3000	0.9157	2111468	102541	11241134	248249	5365959	219111	4418106	175493
1.3500	0.9509	2138598	103157	11162602	243865	5293146	214966	4345137	171536
1.4000	0.9862	2164732	103732	11086992	239684	5223167	211019	4275085	167774
1.4500	1.0214	2189942	104271	11014088	235690	5155809	207254	4207737	164191
1.5000	1.0566	2214294	104775	10943698	231867	5090883	203656	4142898	160772
1.5500	1.0918	2237846	105249	10875649	228202	5028219	200212	4080397	157506
1.6000	1.1270	2260651	105693	10809786	224683	4967664	196909	4020077	154379
1.6500	1.1623	2282755	106111	10745966	221300	4909079	193738	3961796	151382
1.7000	1.1975	2304202	106504	10684063	218043	4852339	190688	3905427	148505
1.7500	1.2327	2325032	106873	10623961	214903	4797330	187753	3850853	145741
1.8000	1.2679	2345280	107222	10565553	211872	4743948	184923	3797968	143081
1.8500	1.3031	2364980	107550	10508743	208944	4692099	182192	3746674	140520
1.9000	1.3384	2384161	107860	10453443	206112	4641697	179553	3696884	138050
1.9500	1.3736	2402850	108153	10399571	203371	4592661	177002	3648515	135666
2.0000	1.4088	2421075	108429	10347053	200714	4544920	174532	3601493	133363
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDPCL01
Date and time : 06OCT98:11:49
Computation of ref. F: Simple mean, age 2 - 5
F-0.1 factor : 0.6342
F-max factor : Not found
F-0.1 reference F : 0.4468
F-max reference F : Not found
Recruitment : 4917 (Millions)

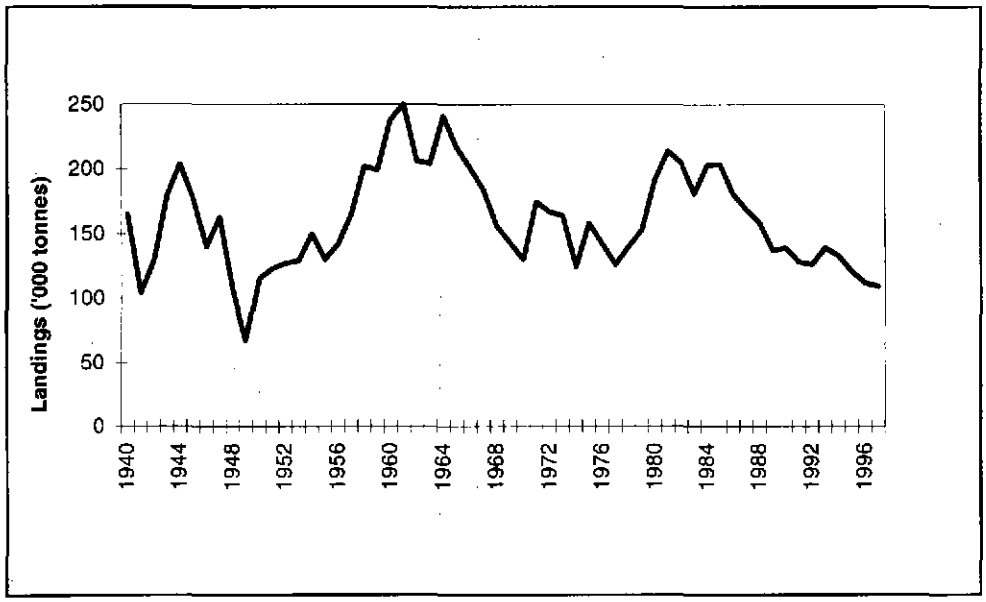


Figure 8.2.1.1 - Total landings of sardine in Divisions VIIIc and IXa from 1940-1997 (not including Cadiz)

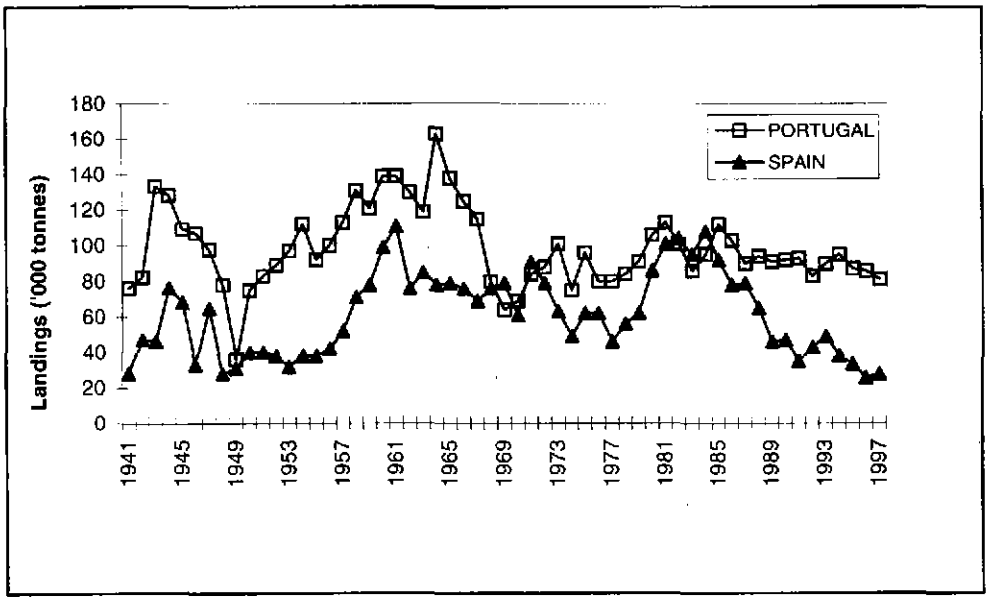


Figure 8.2.1.2 - Landings of sardine in Divisions VIIIc and IXa by country during 1940-1997 (not including Cadiz).

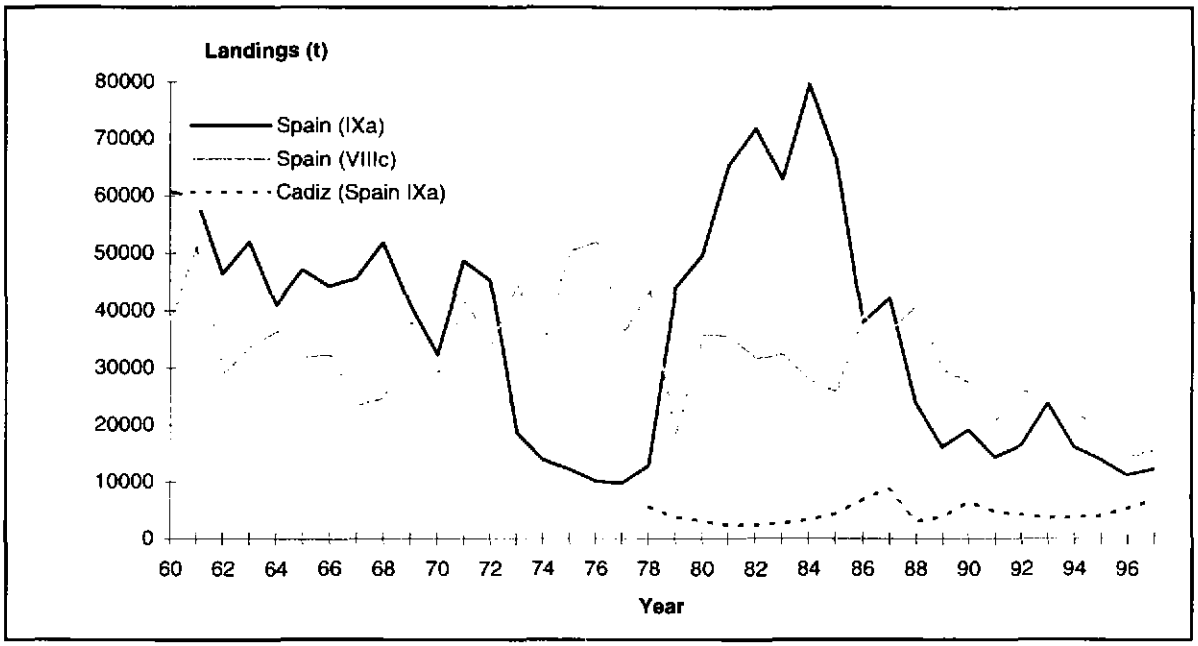


Figure 8.2.1.3 - Annual Spanish landings by ICES Division.

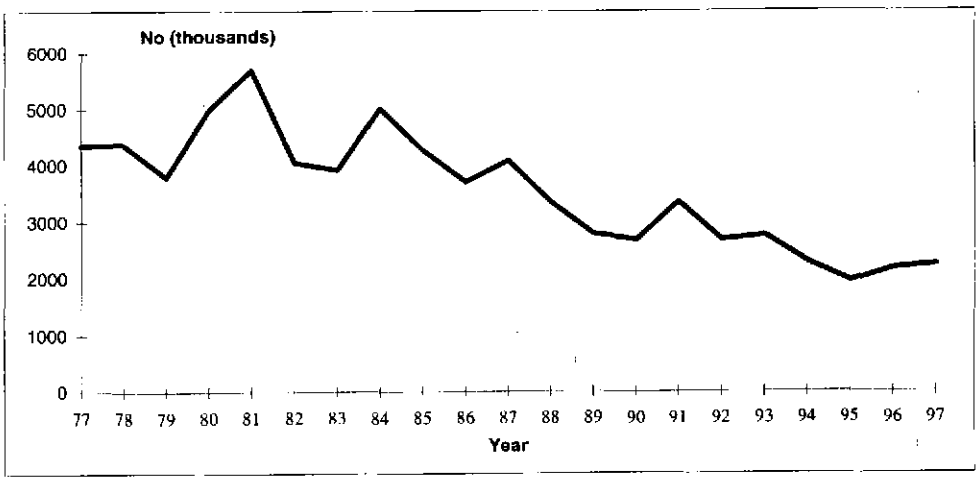


Figure 8.4.1.1 Total catch in number (thousands) per year

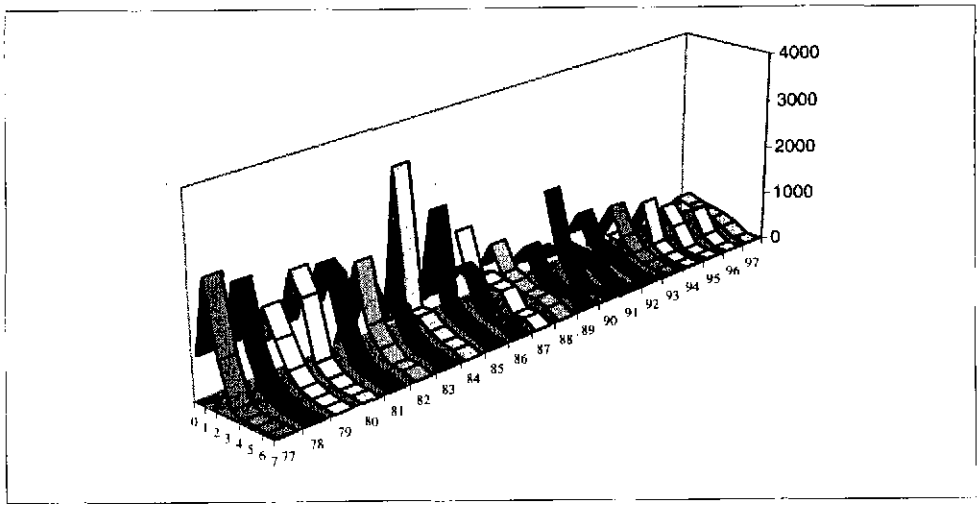


Figure 8.4.1.2 Catch-at-age in number (thousands) per year

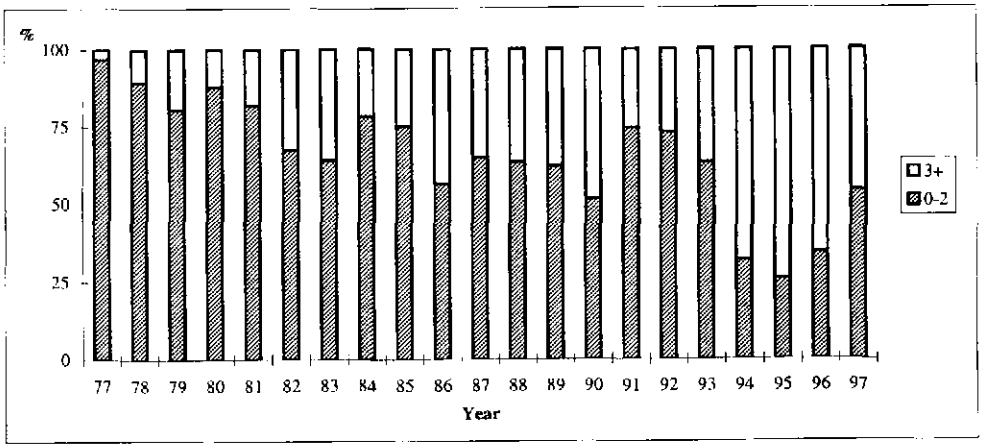


Figure 8.4.1.3 Relative composition of the catches slipt in two categories: 0-2 age groups and 3 and older

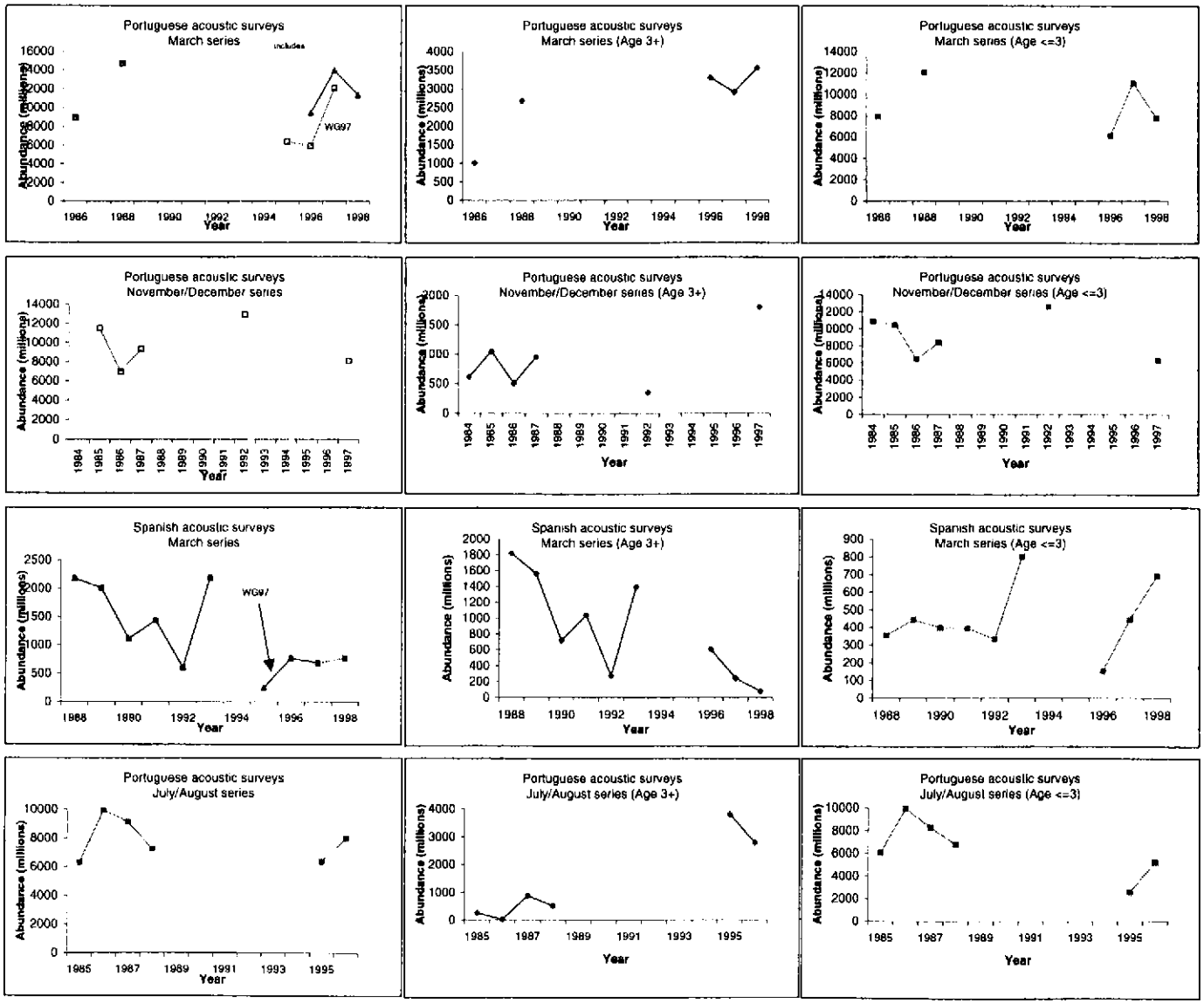


Figure 8.5.2.1 - Trends of the abundance (numbers at age) provided by the March, August and November Portuguese acoustic surveys series and the Spanish March series.

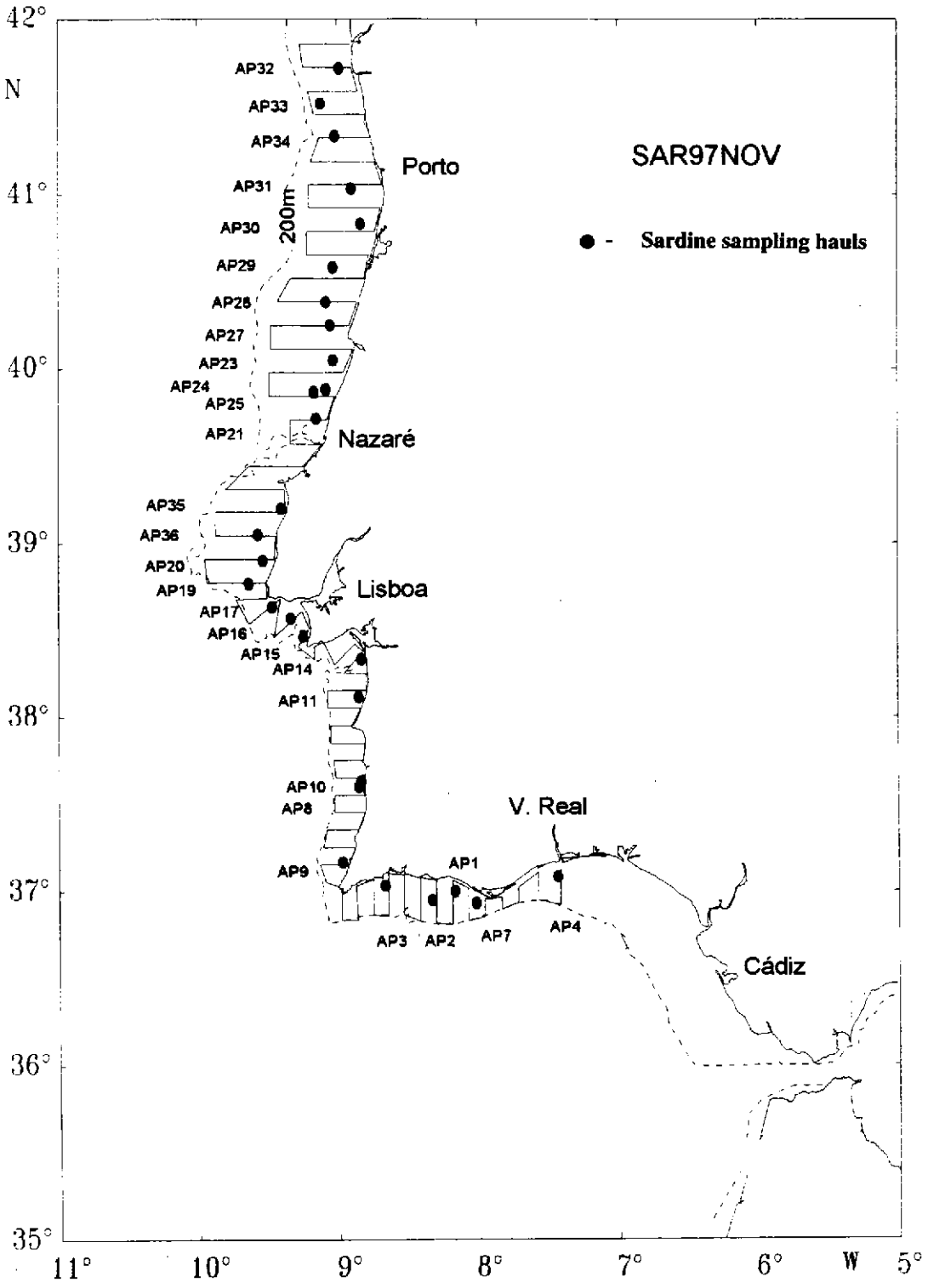


Figure 8.5.2.2 Portugal, November 1997: acoustic track and sardine sampling hauls.

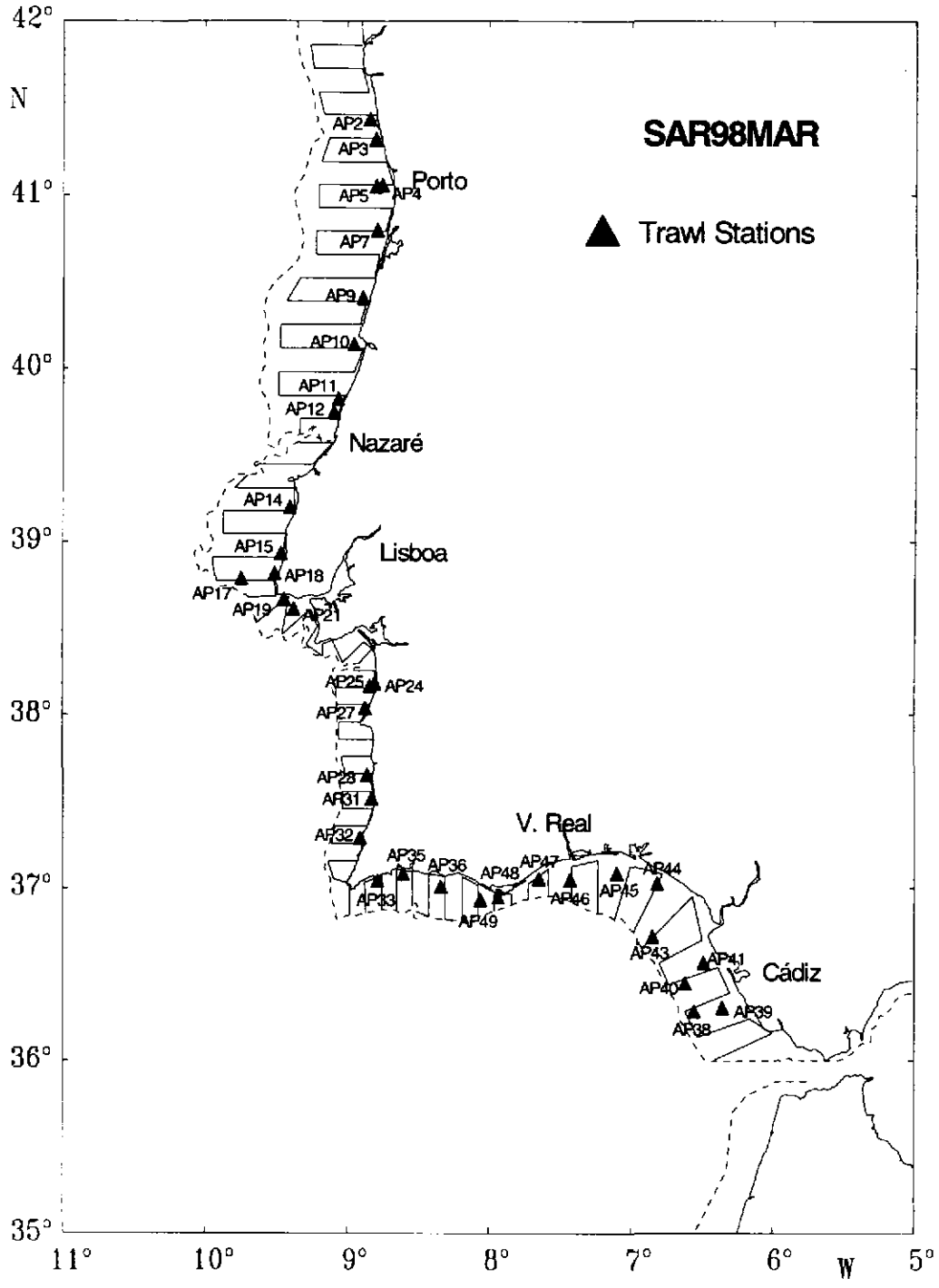


Figure 8.5.2.3 Portugal, March 1998: acoustic track design and sardine sampling hauls.

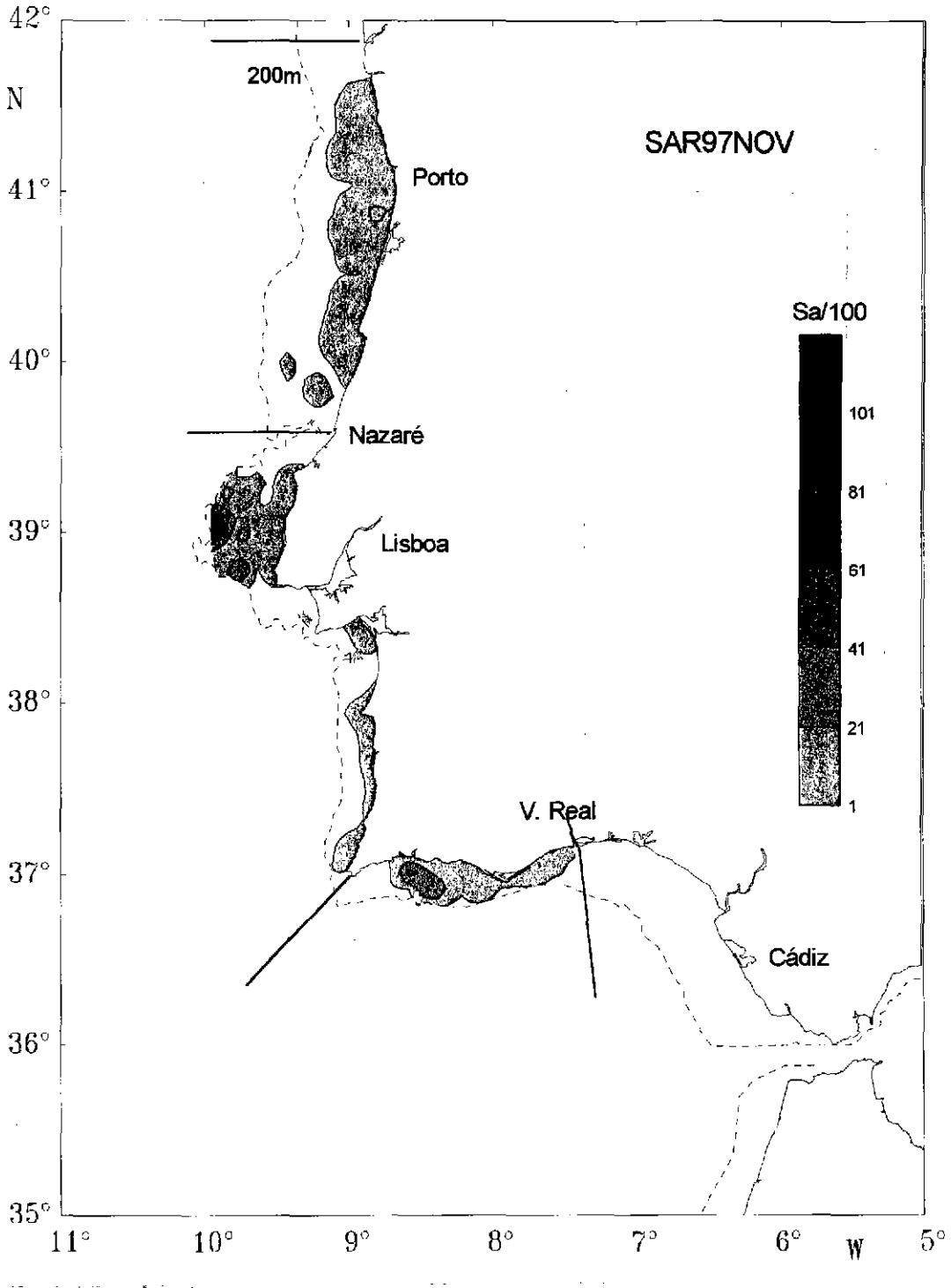


Figure 8.5.2.4 Portugal, November 1997: sardine density contour map (Sa $m^2.nm^{-2}$)

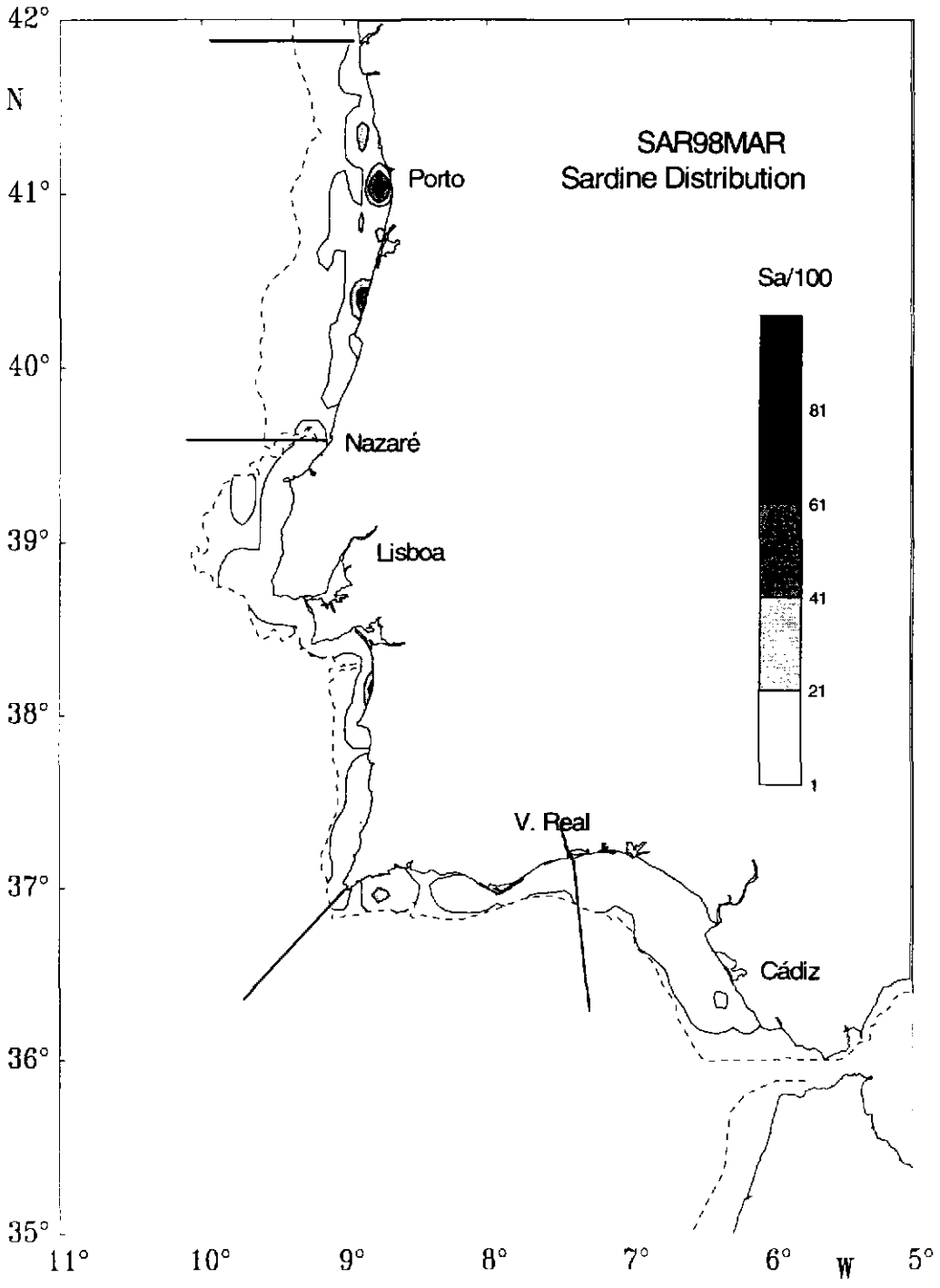


Figure 8.5.2.5 Portugal, March 1998: sardine density contour map (SA - m^2nm^{-2}).

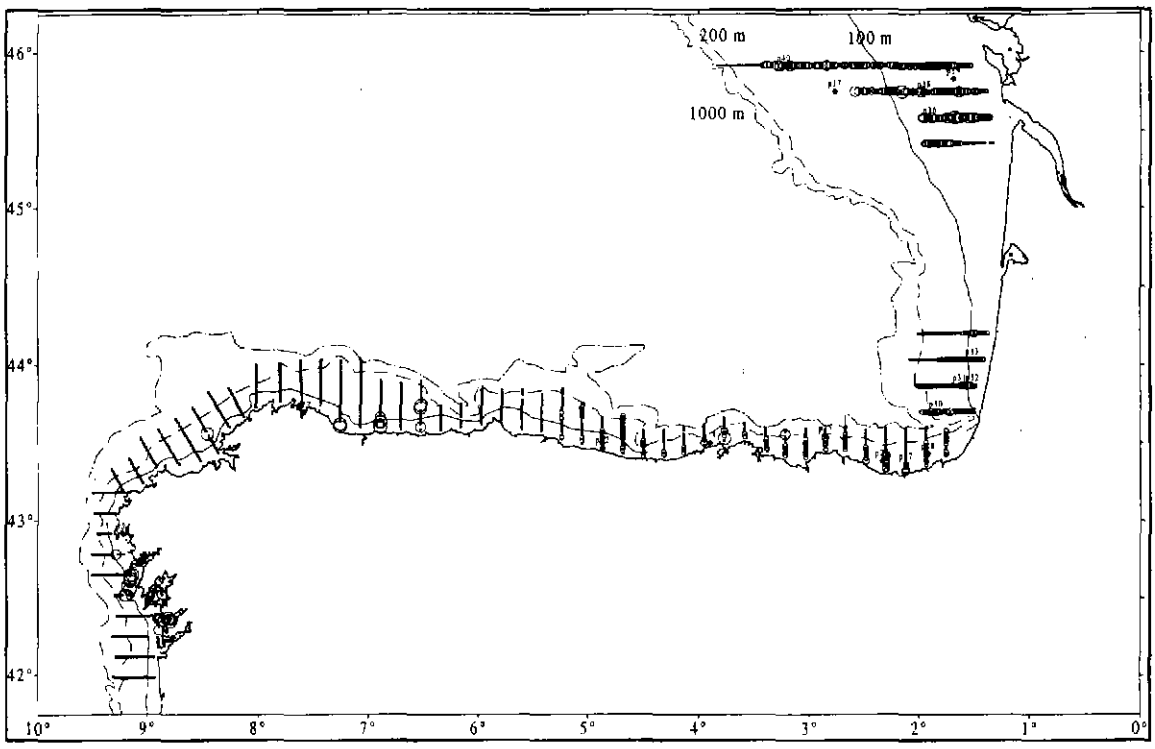


Figure 8.5.2.6 Spain, March 1998: Relative sardine abundance (S_a values) and positive fishing stations.

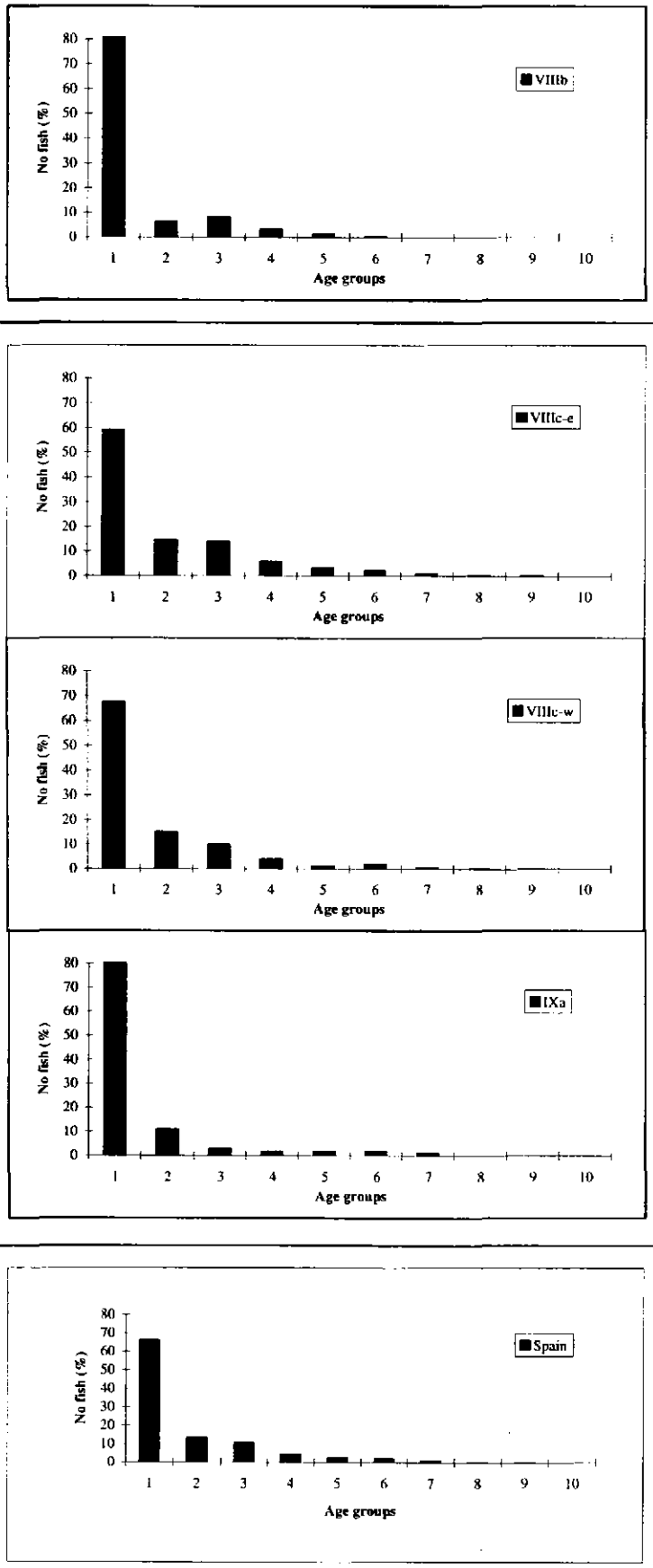


Figure 8.5.2.7 - Spain, March 1997: estimated sardine abundance (in numbers) by age group in each surveyed area.

Figure 8.5.2.8 Pelagic fish species distribution in Bay of Biscay, May 1997 (*in* Massé 1997).

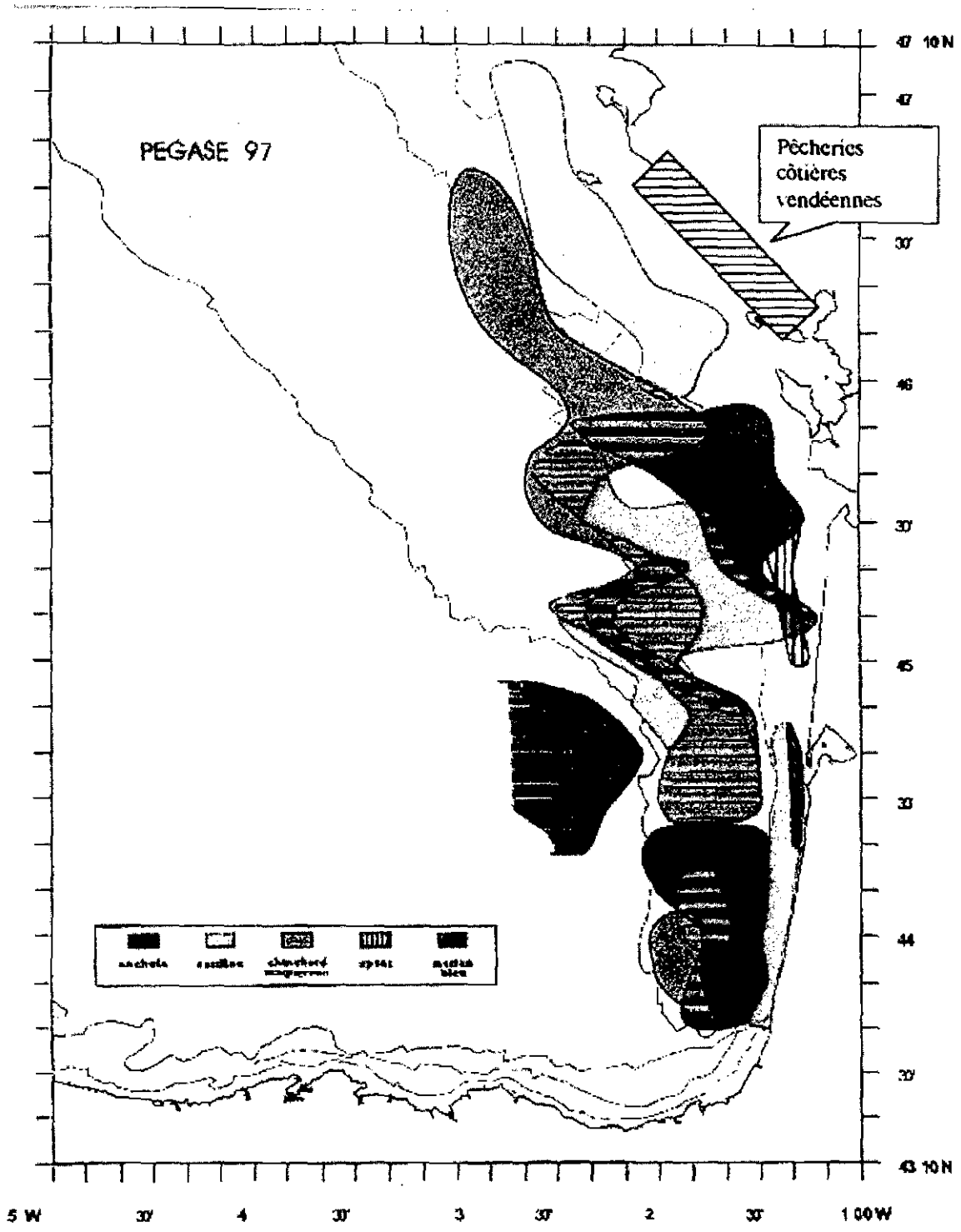
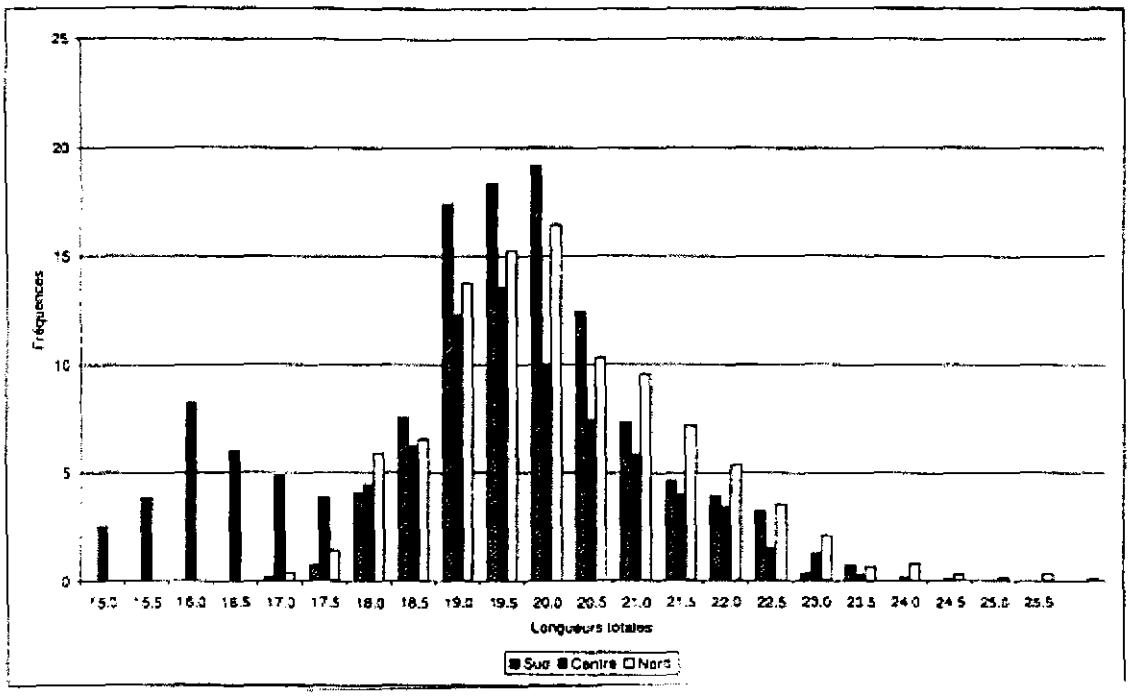


Figure 8.5.2.9 Length distribution (%) of the different sardine groups identified in May 1997 during the French acoustic survey "Pegase" in the Bay of Biscay.



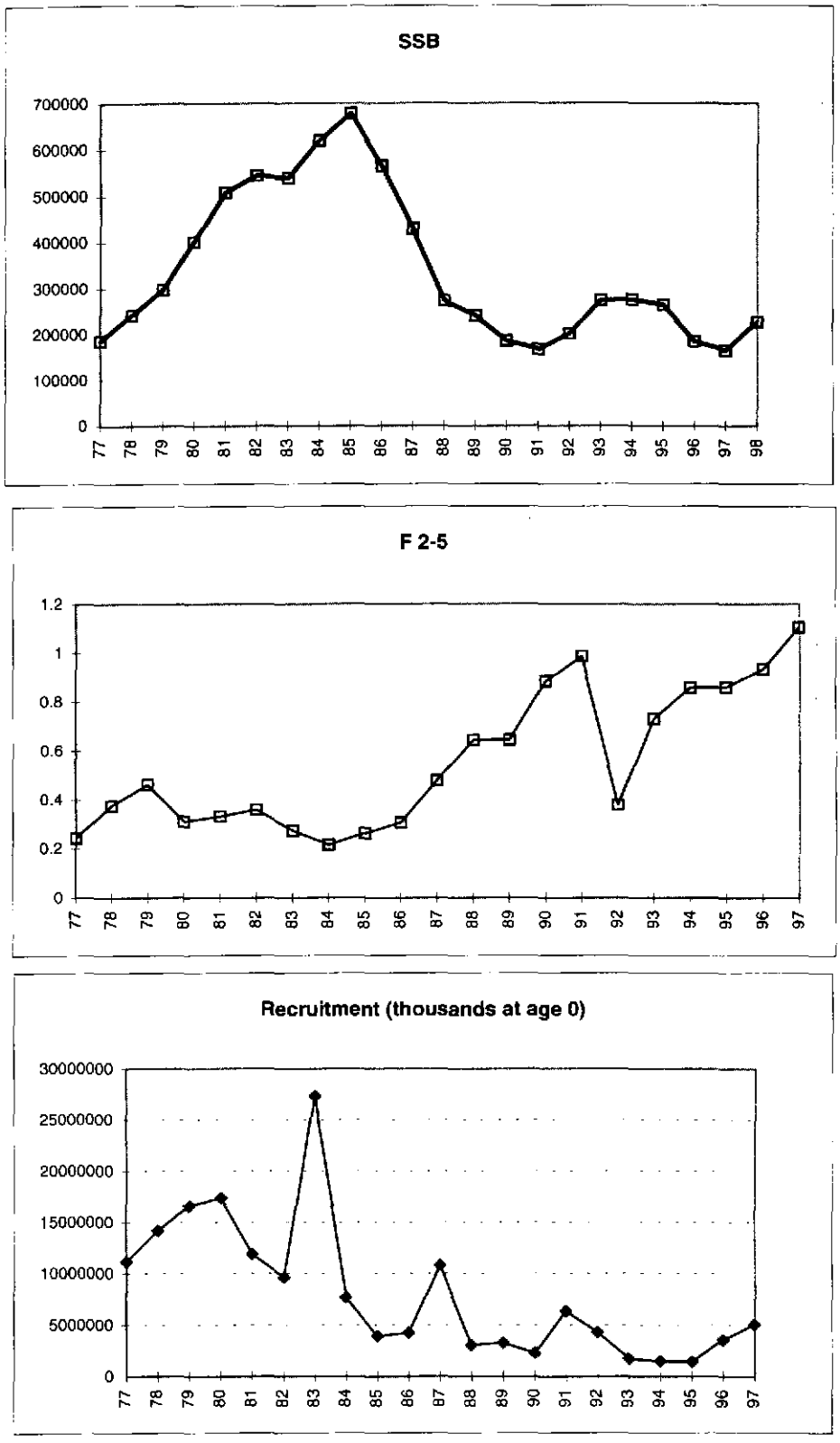


Figure 8.9.1.1 Estimated SSB, Fbar and recruitment for the exploratory analysis

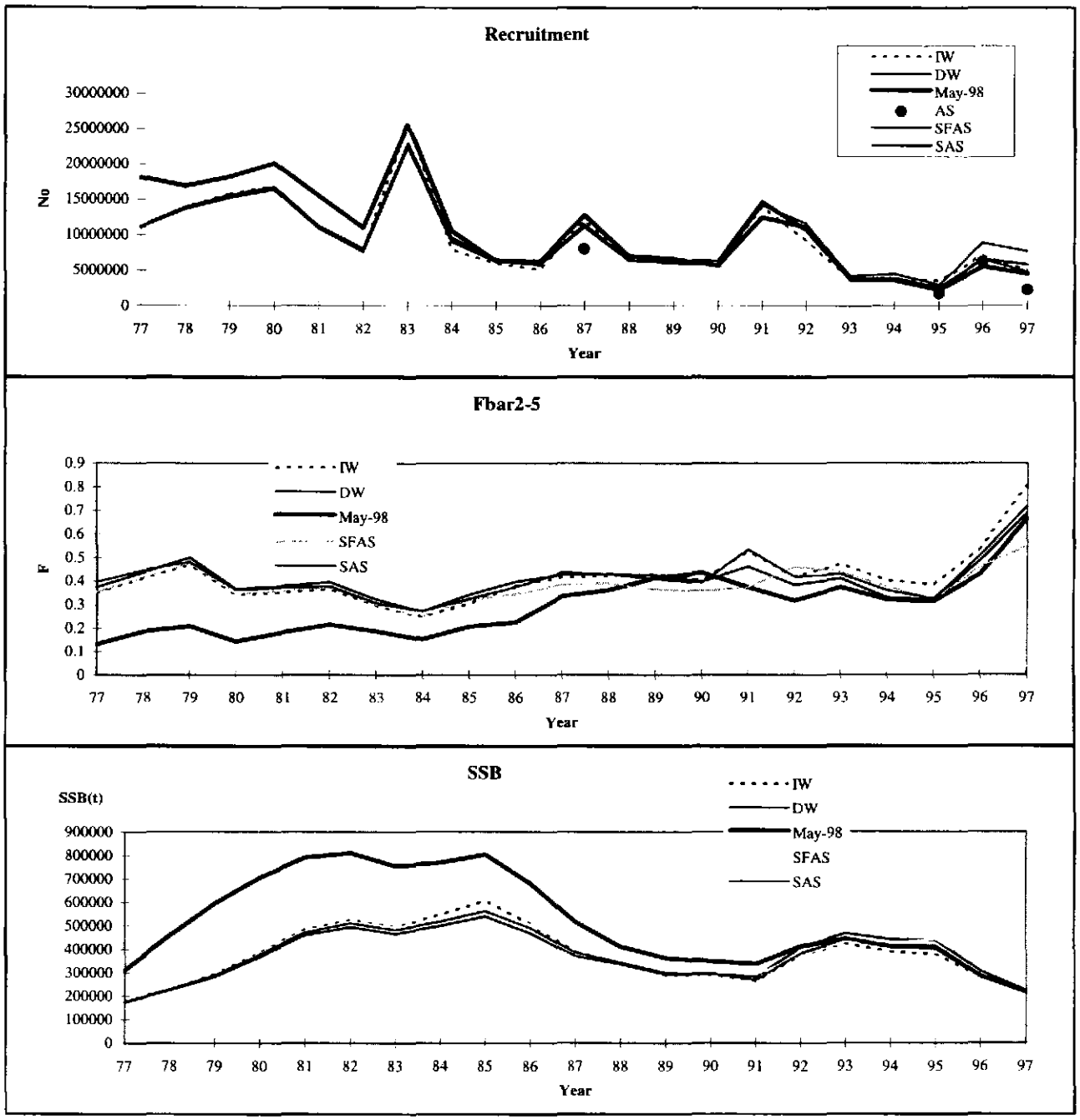


Figure 8.9.1.2 Estimated recruitment, Fbar2-5 and SSB for different assessment models at 6+.
IW: Iterative weighting. Fleets (Acoustic surveys, Purse seine fleets and DEPM)
DW: Manual weights, downweighting 0.01 purse seine fleets
SFAS: Including Portuguese November acoustic survey
SAS: Without Portuguese November acoustic survey
May-98: Assessment made in May.
AS: Estimated recruitment at age 1 in the next year from the acoustic survey

Figure 8.9.1.3 Sardine in Divisions VIIIc and IXa. ICA diagnostic plots of comparative assessment including Portuguese November surveys.

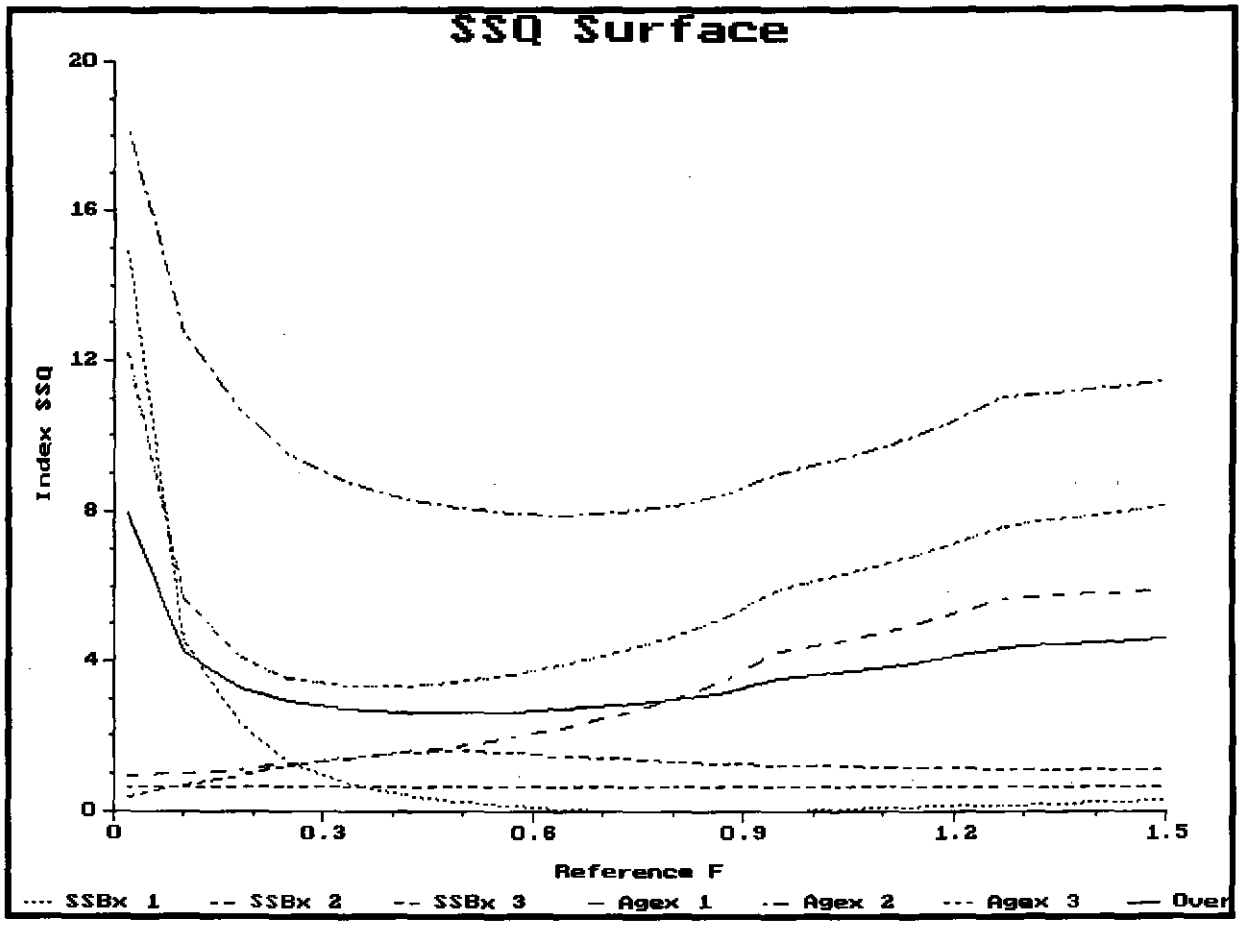
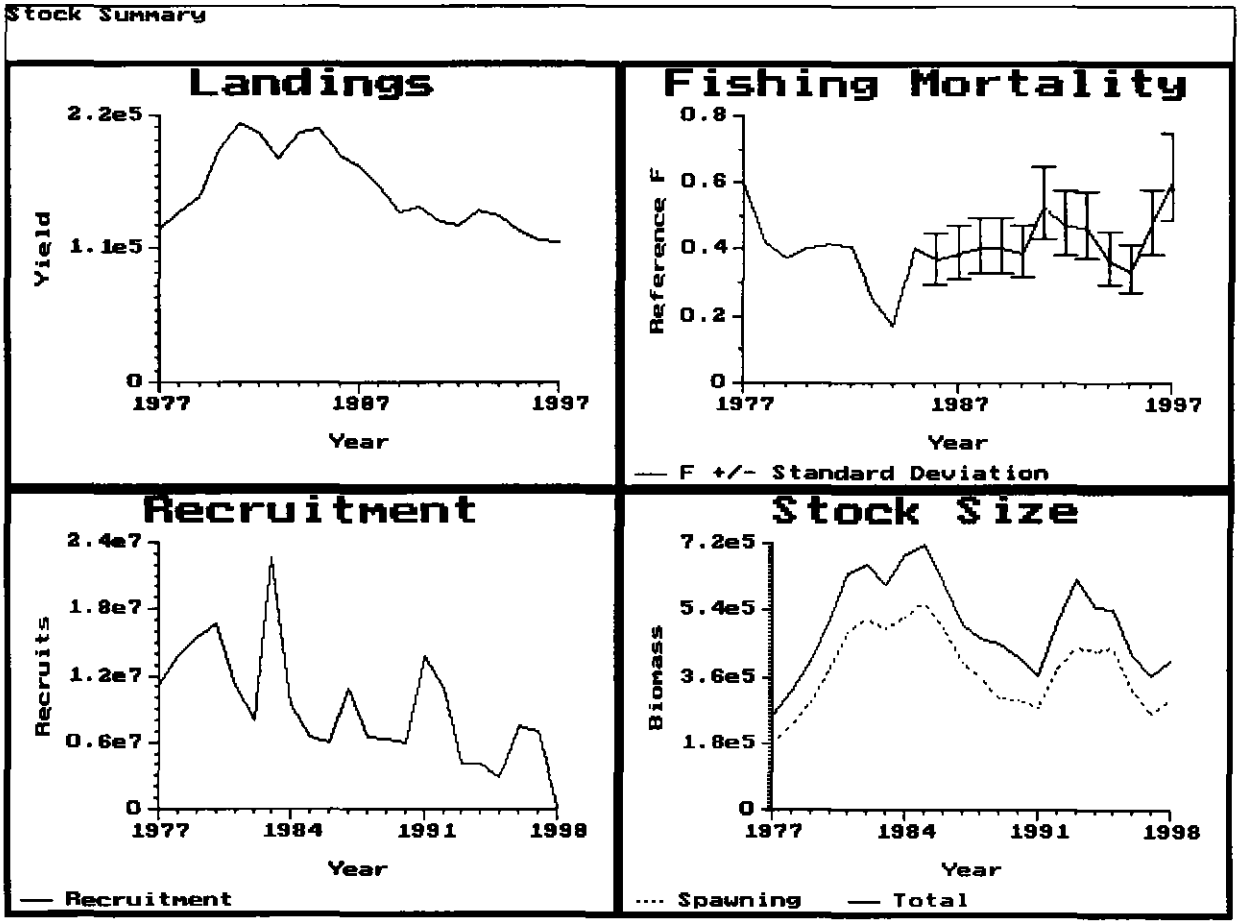


Figure 8.9.1.3 (continued)



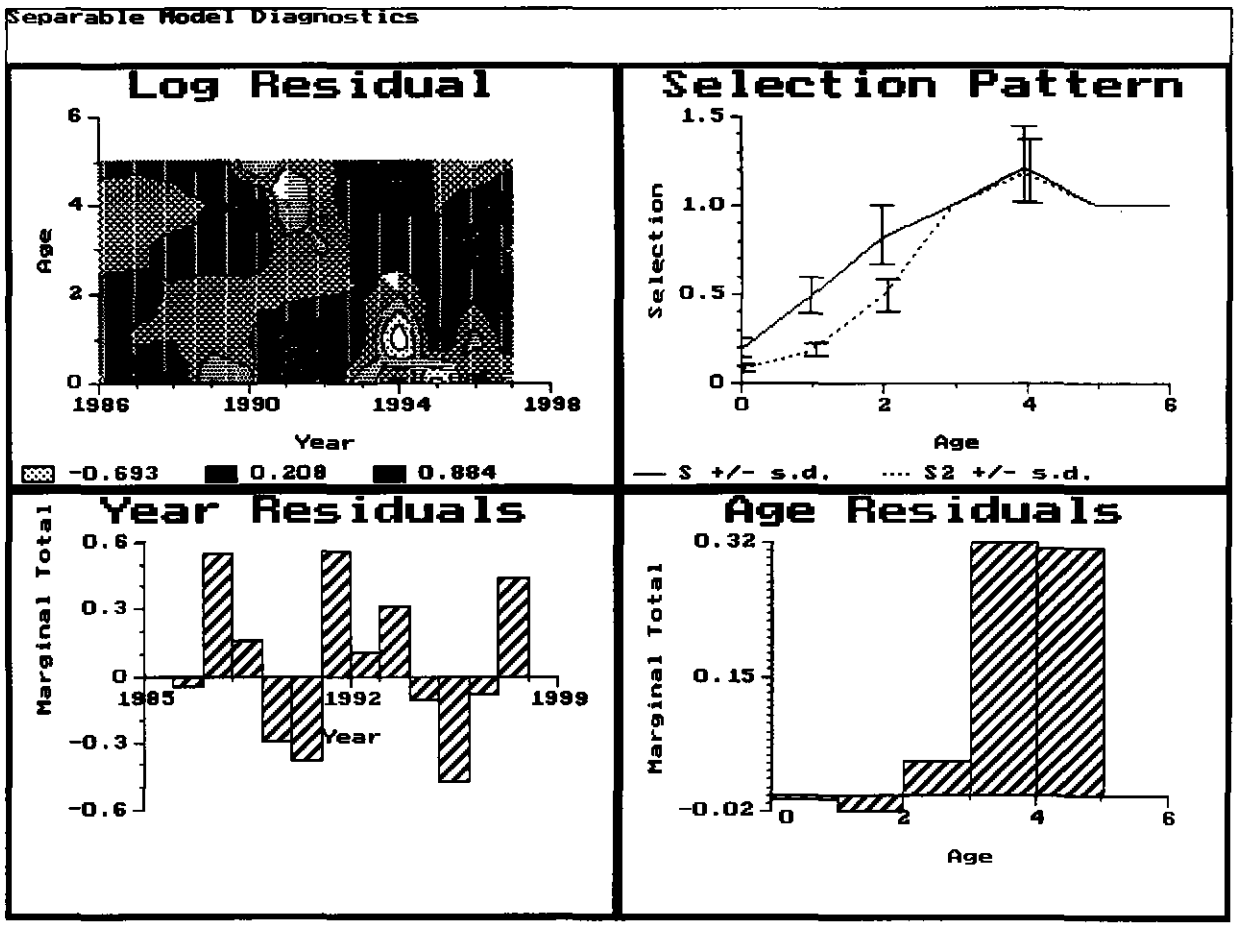
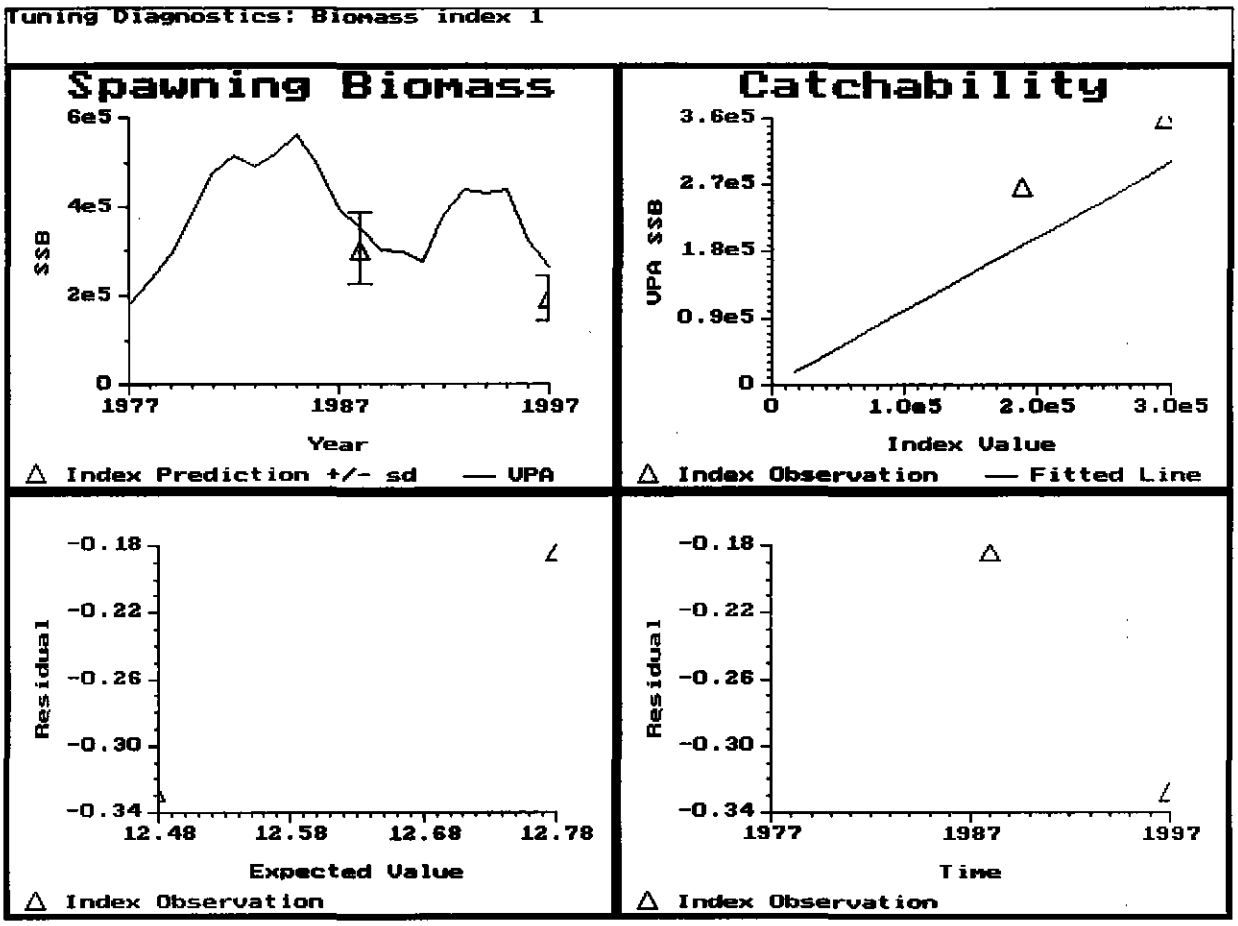


Figure 8.9.1.3 (continued)



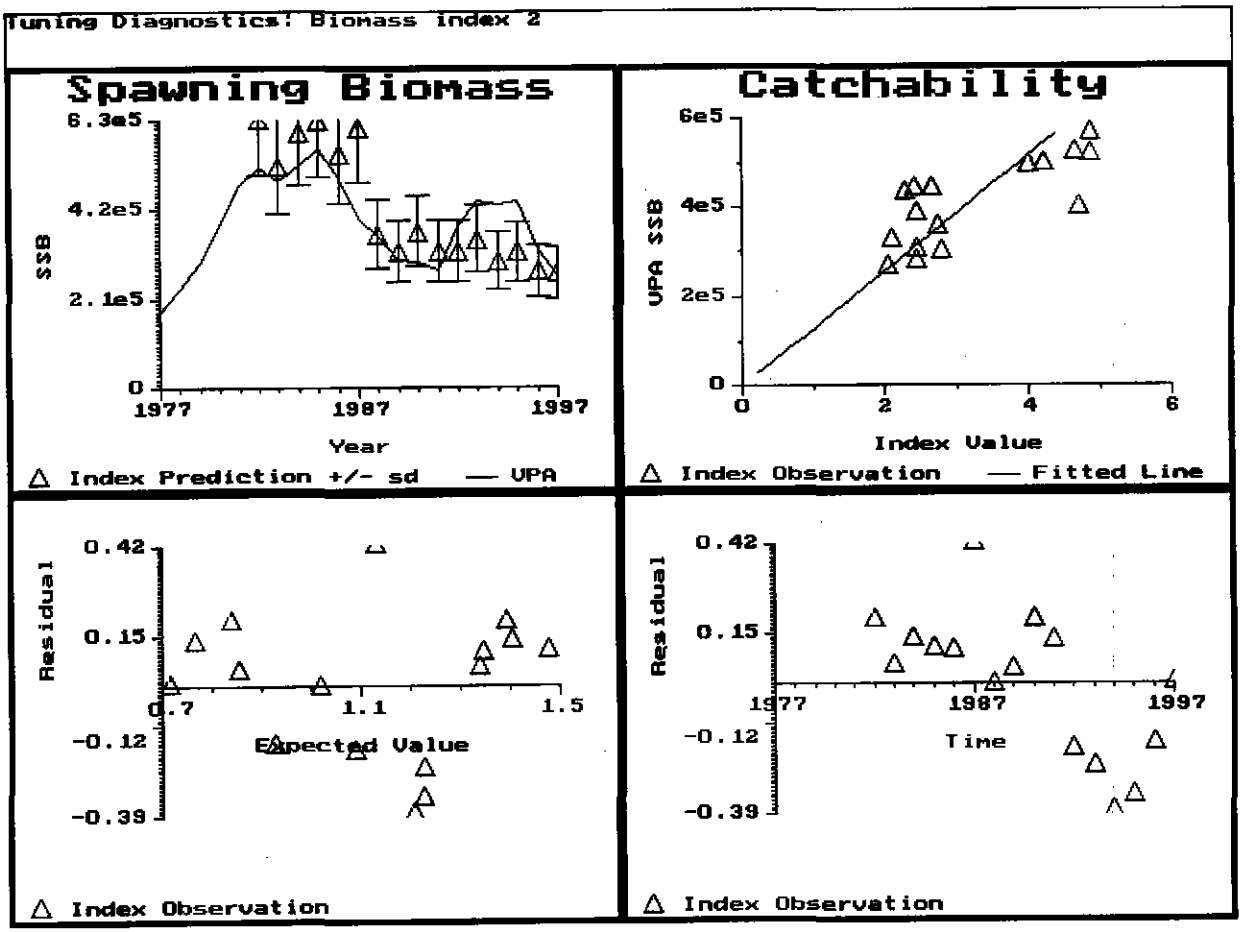
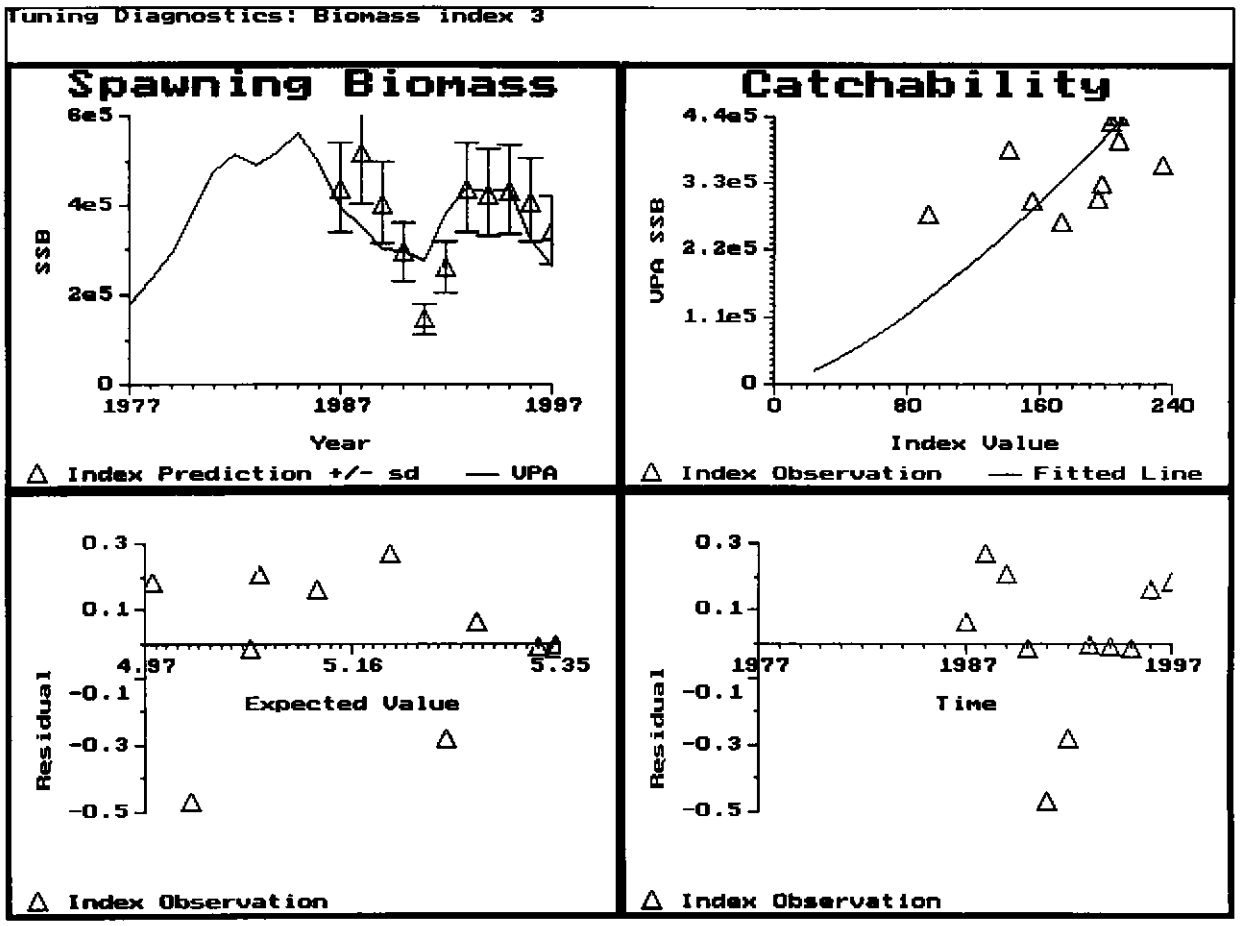


Figure 8.9.1.3 (continued)



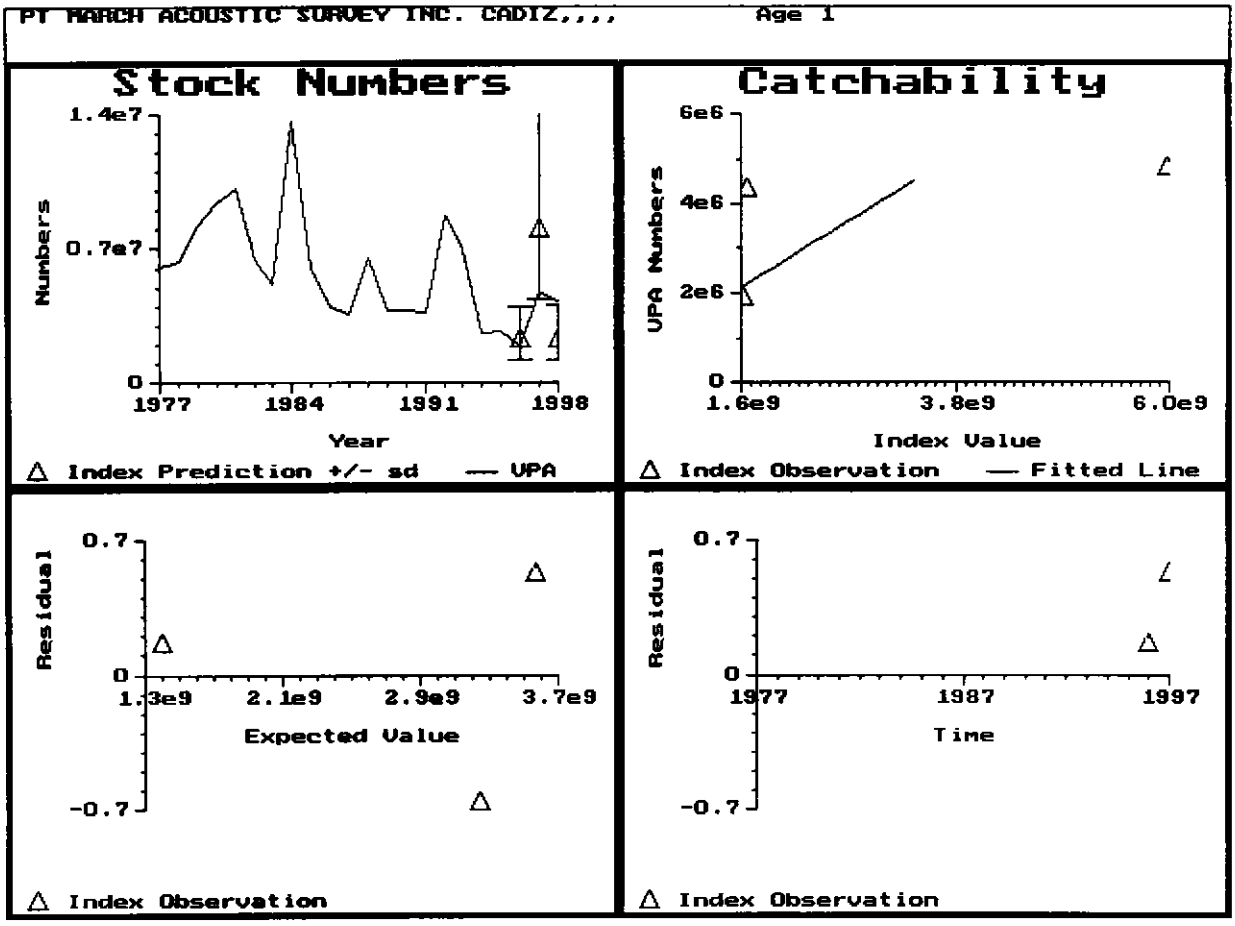
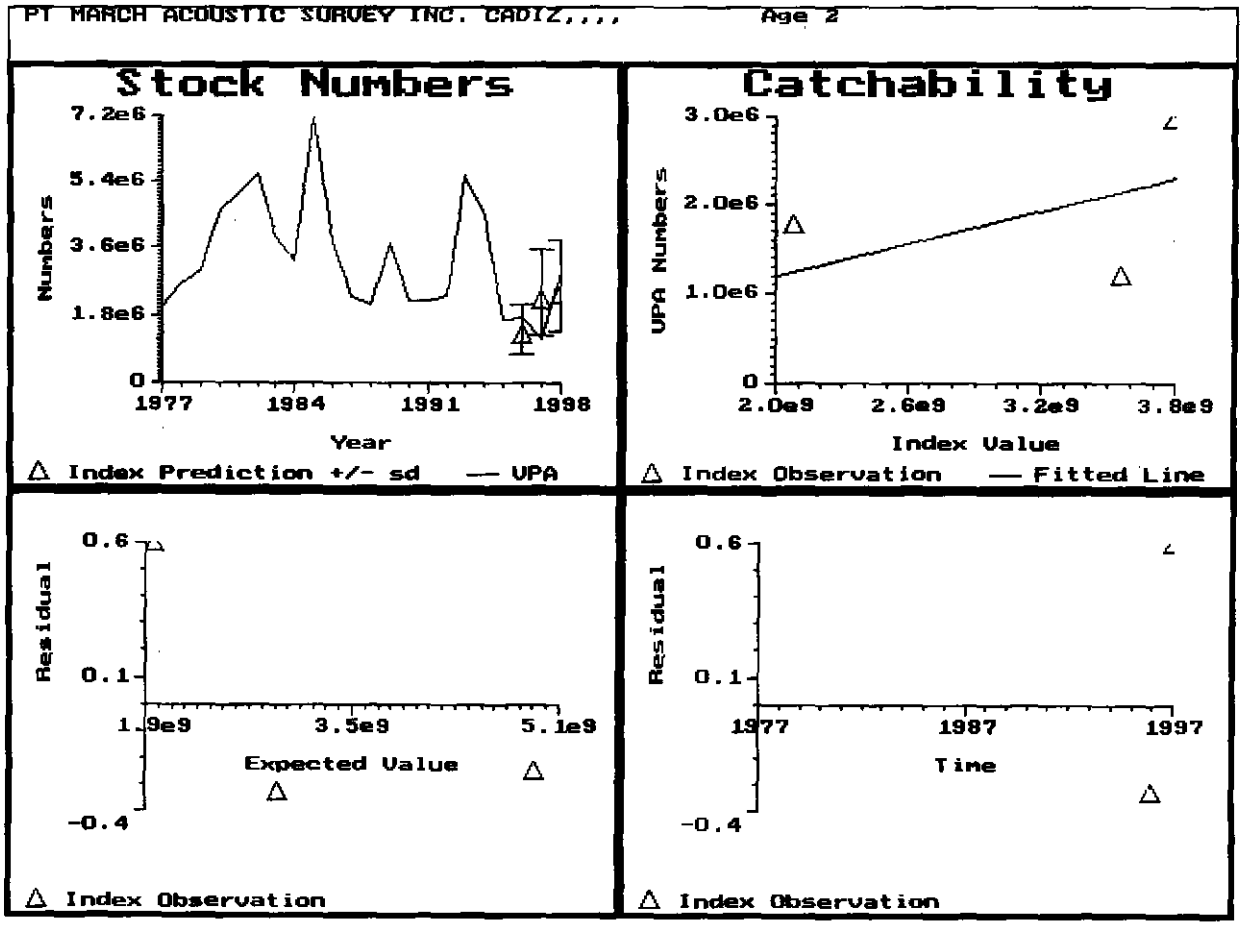


Figure 8.9.1.3 (continued)



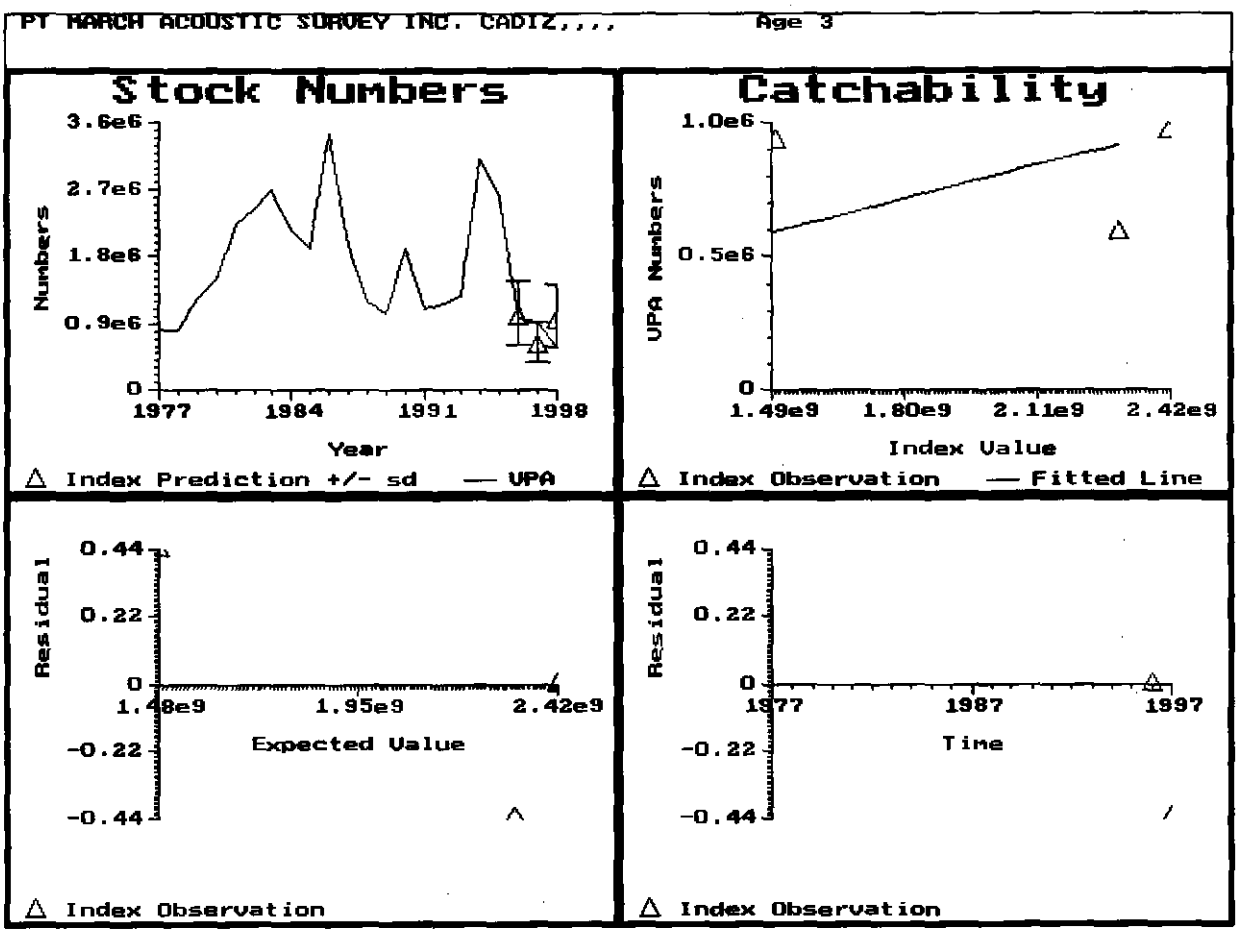
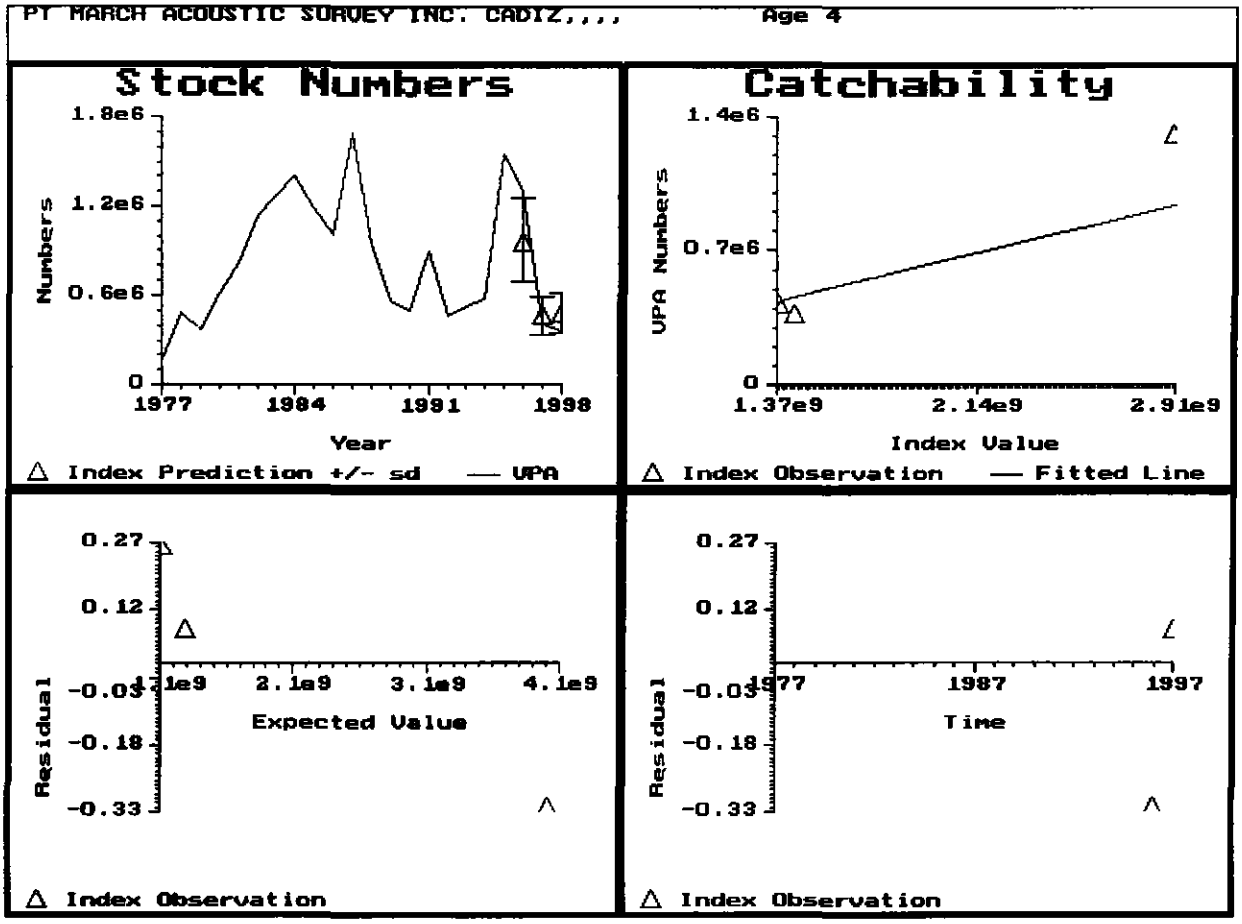
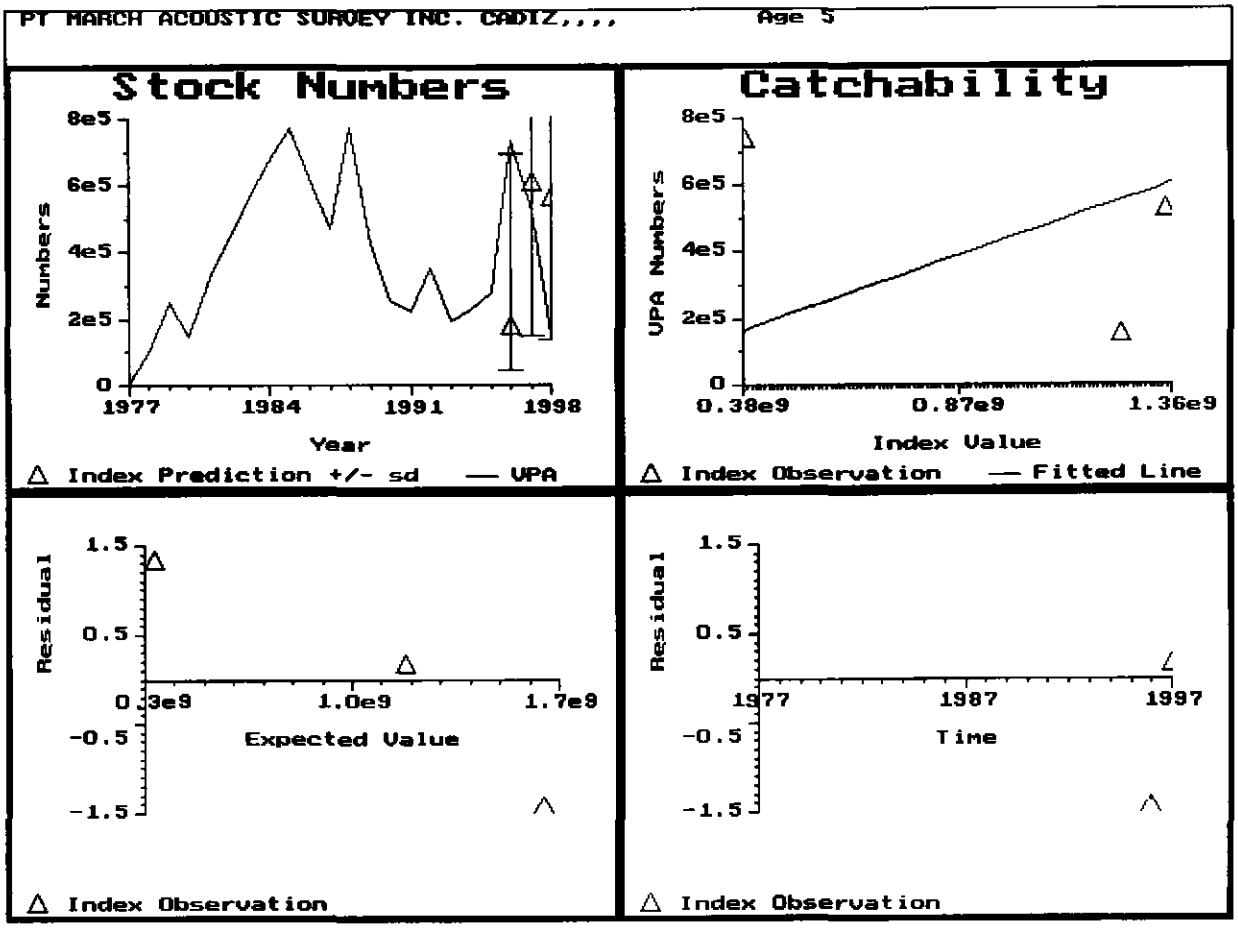


Figure 8.9.1.3 (continued)





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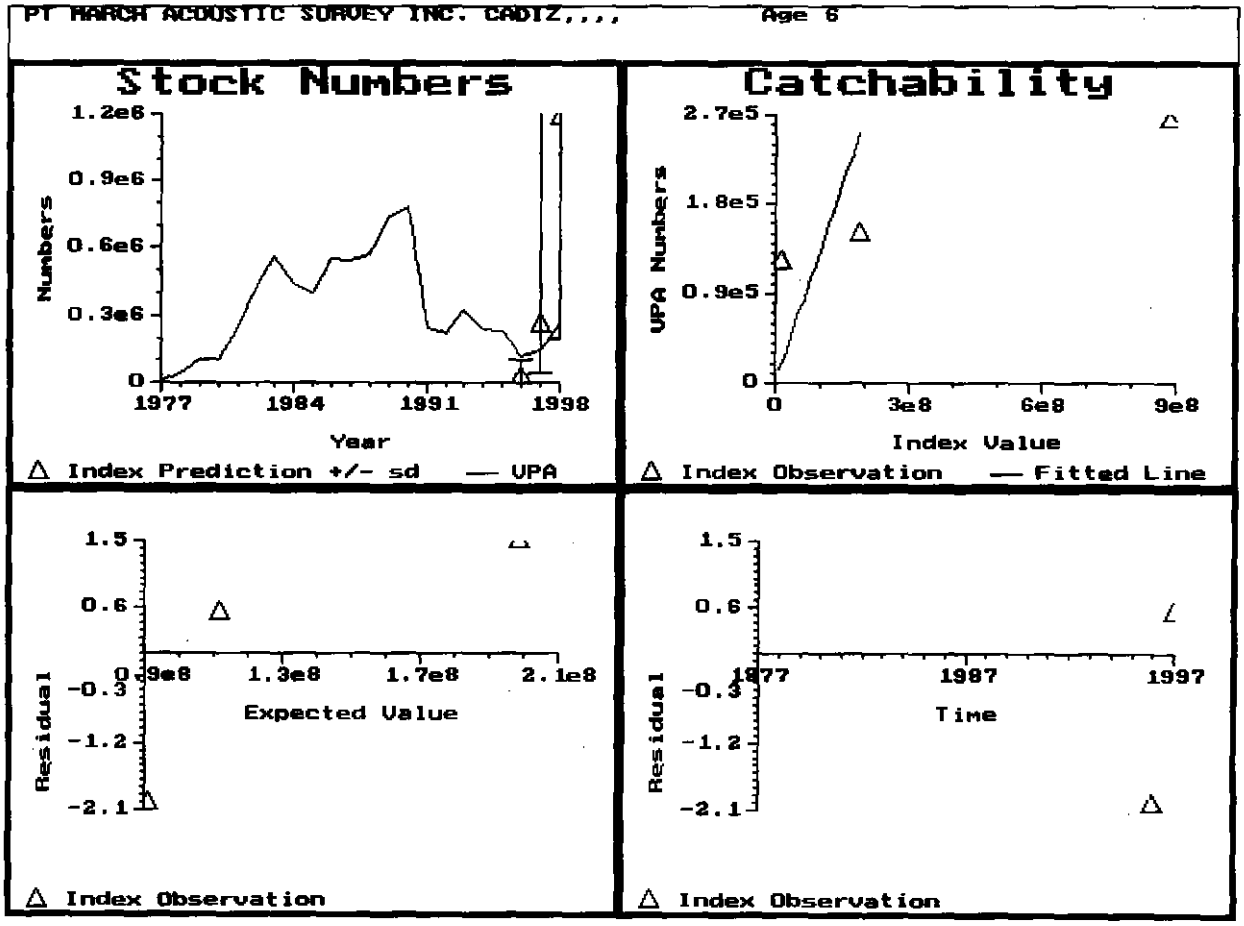

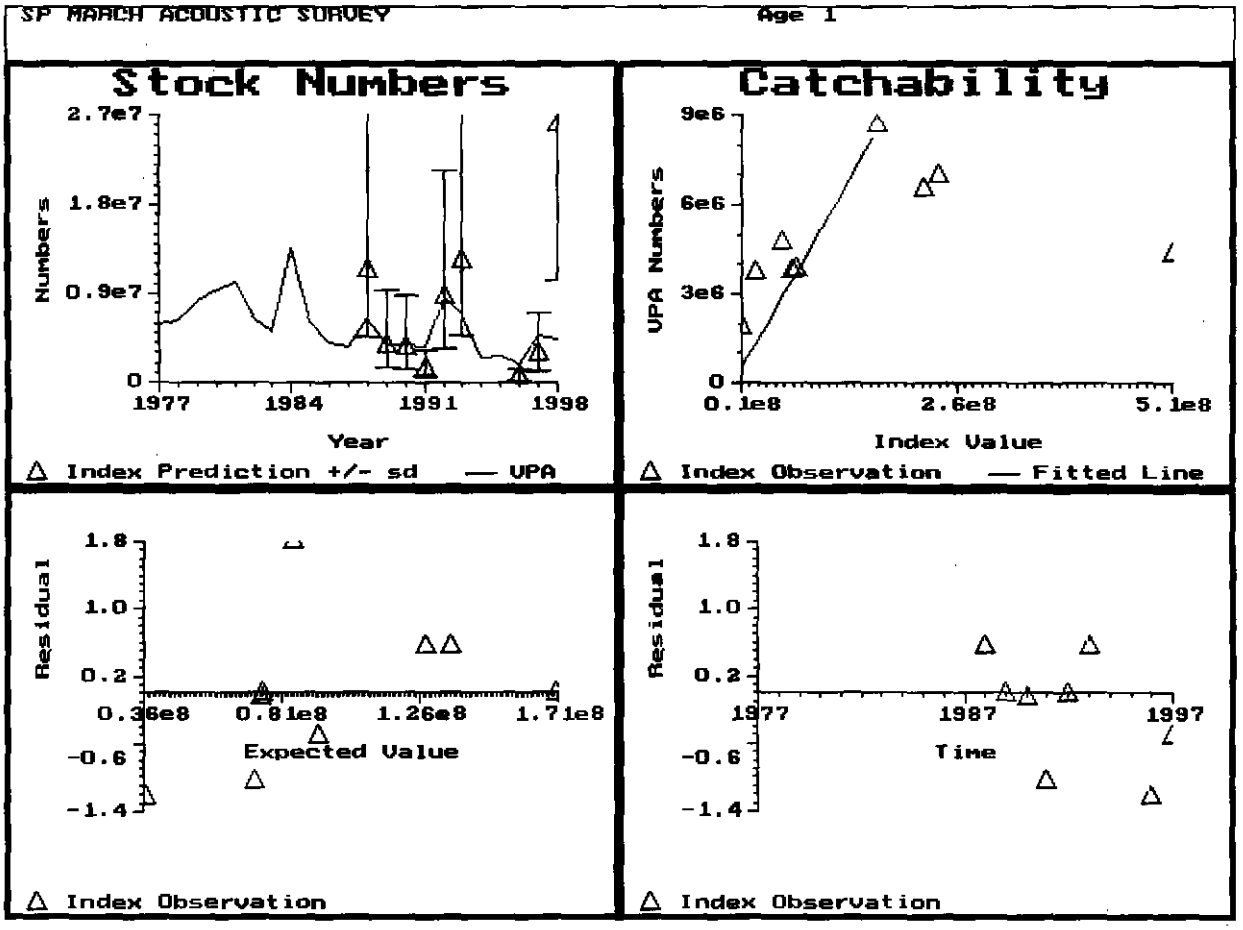

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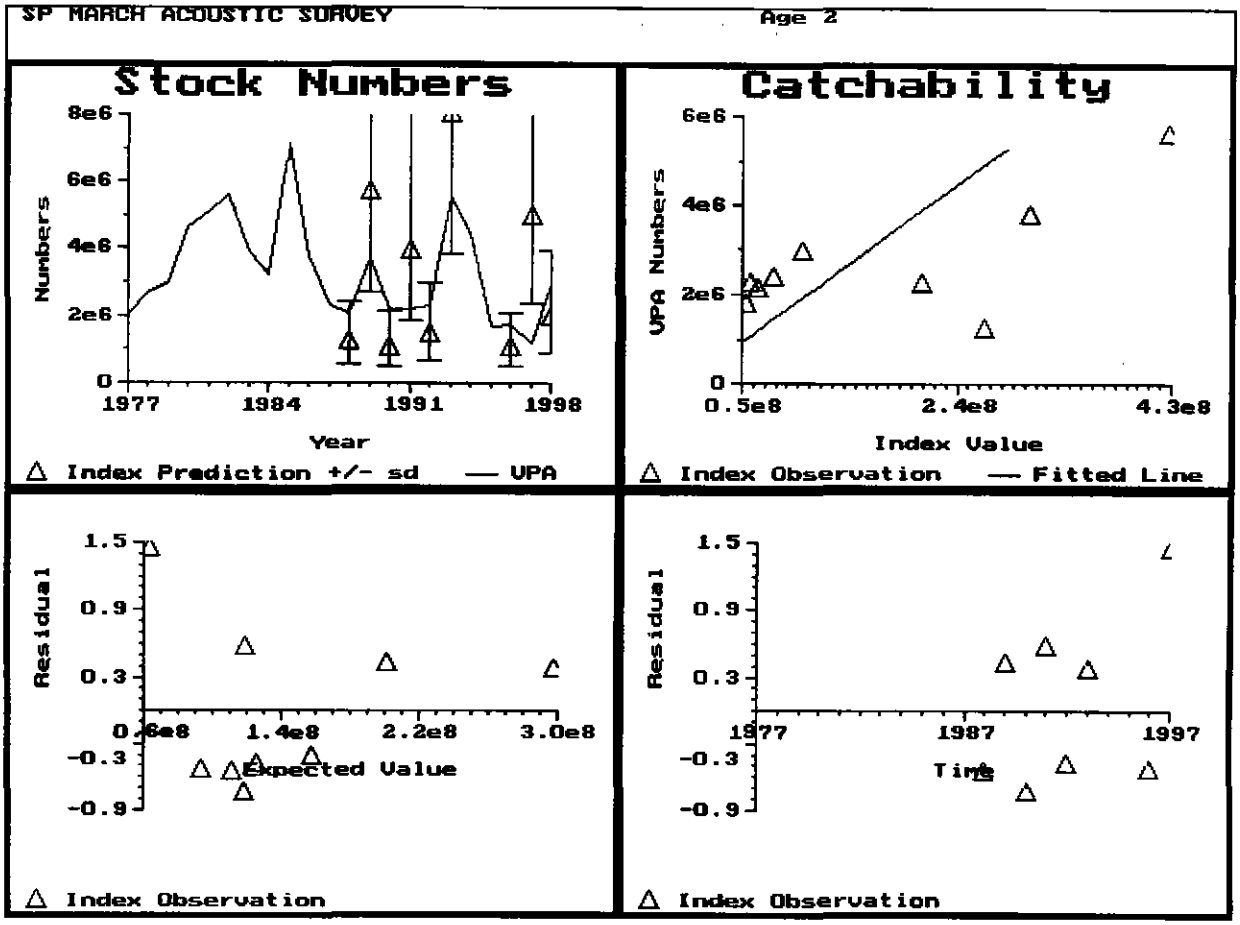

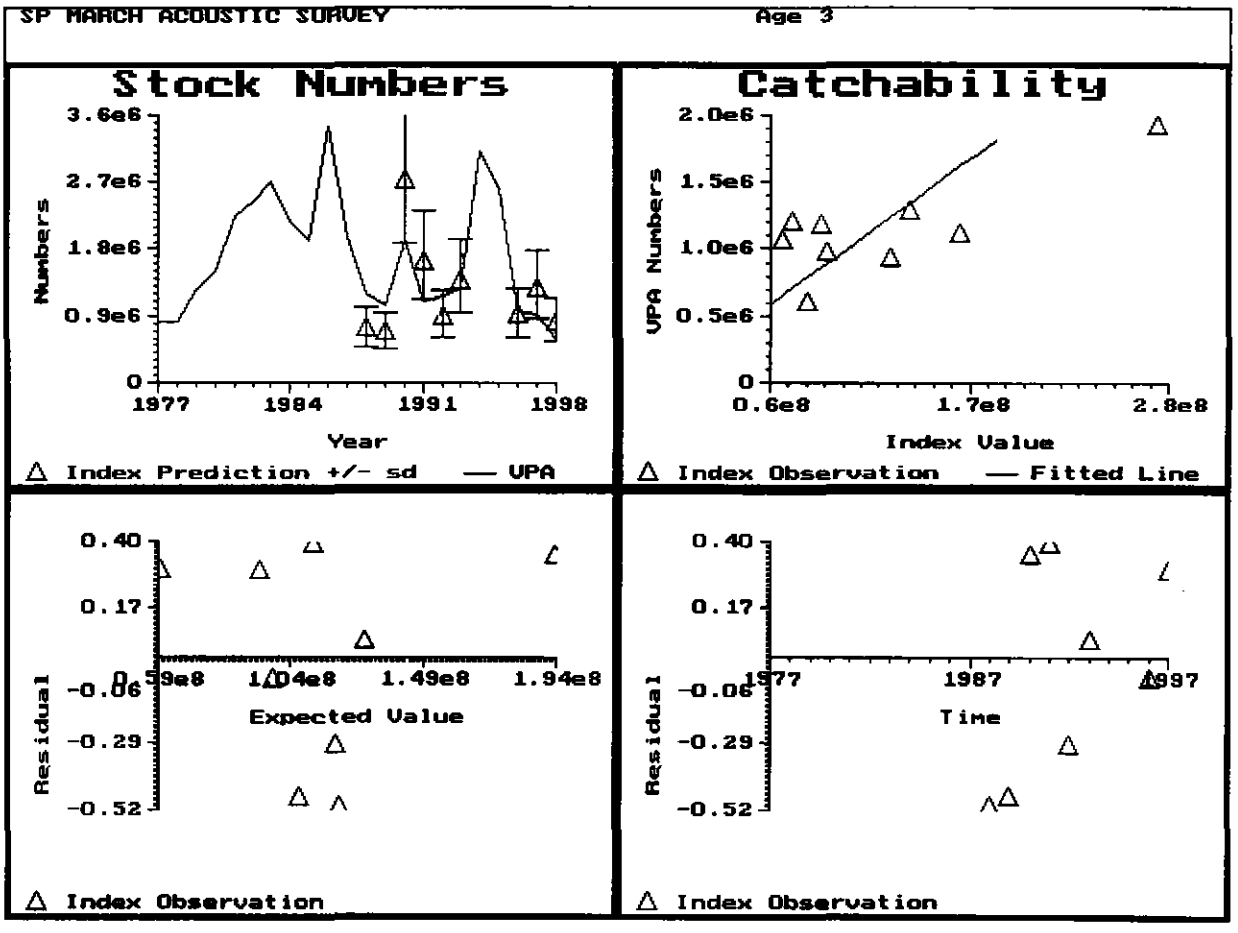

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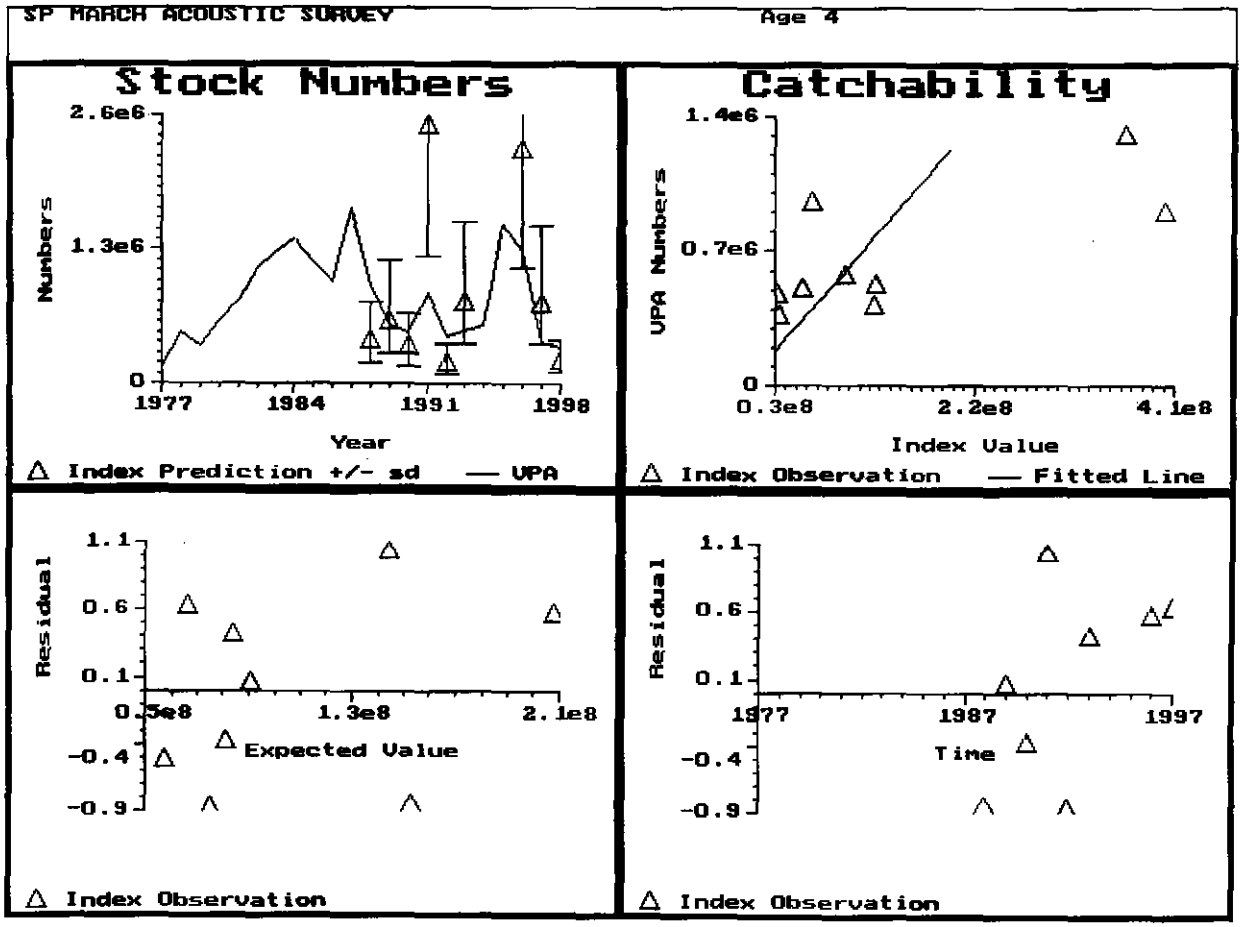

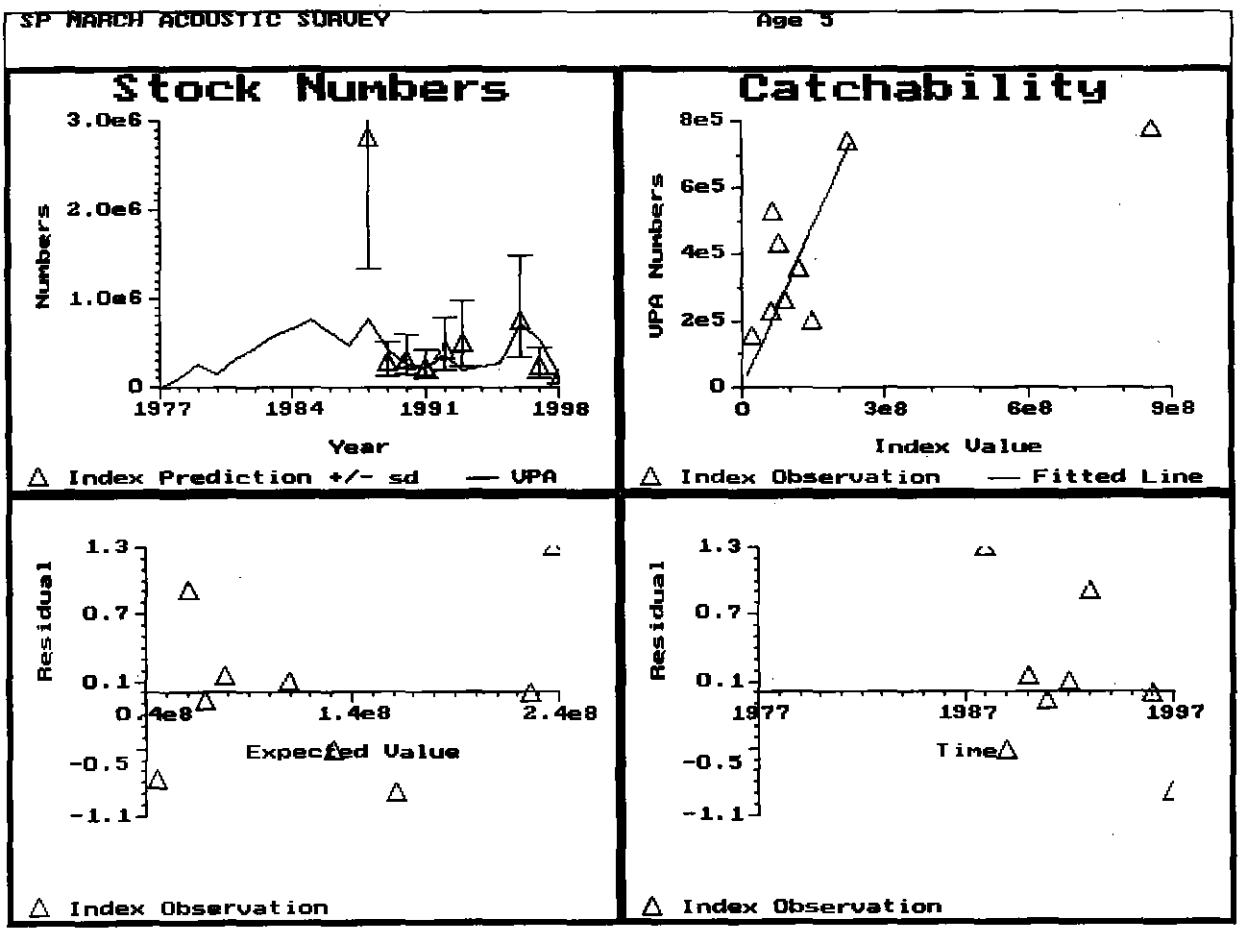

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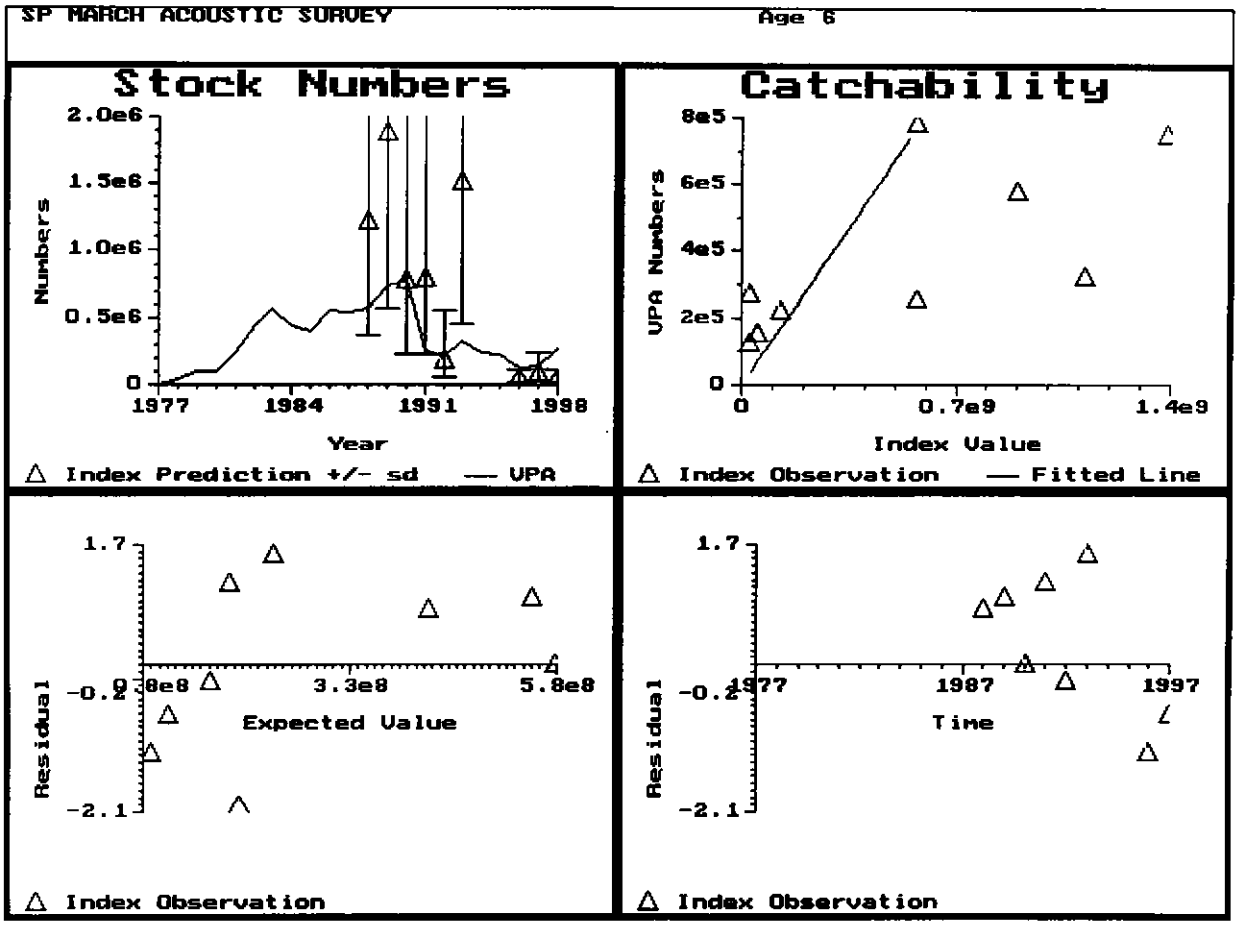

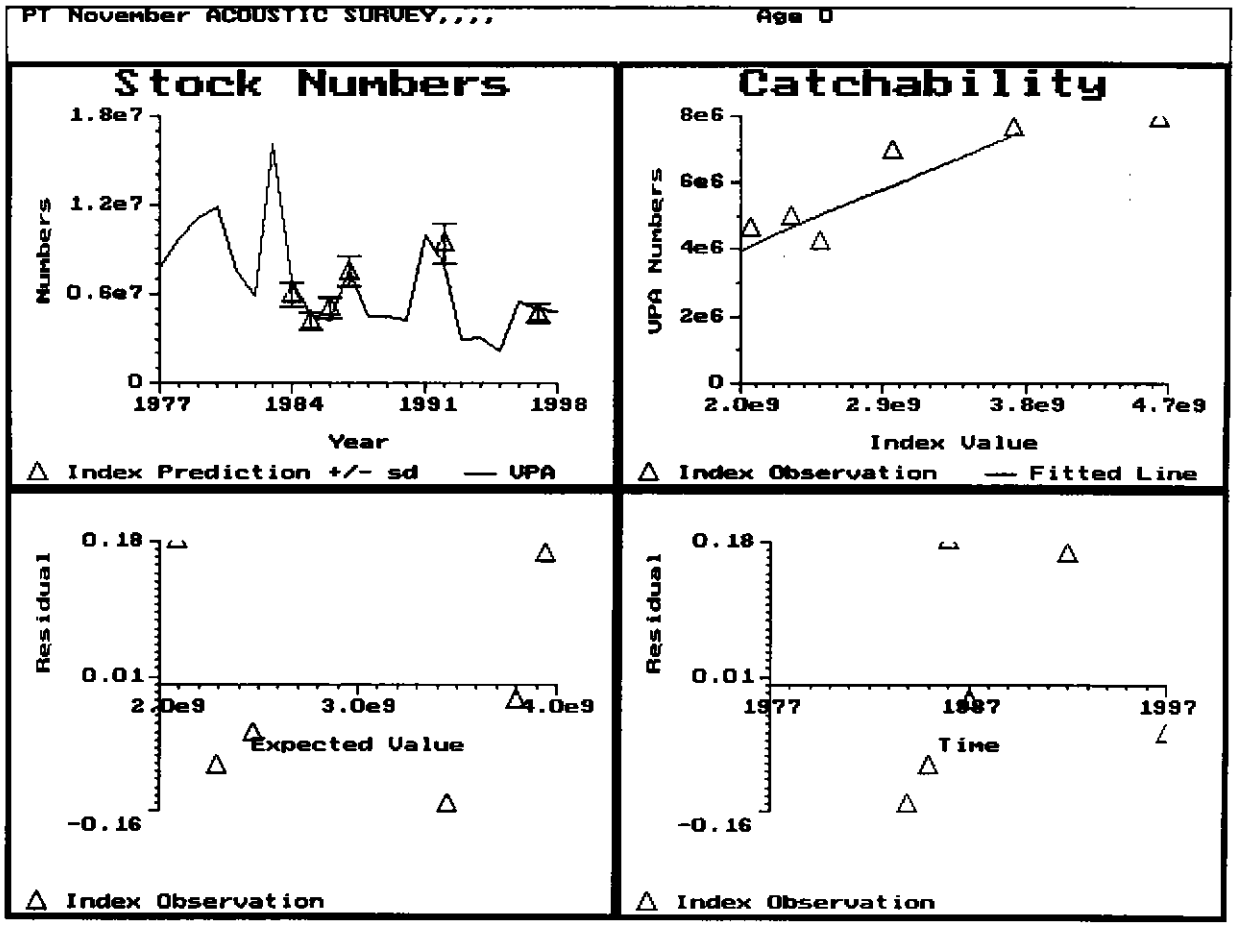

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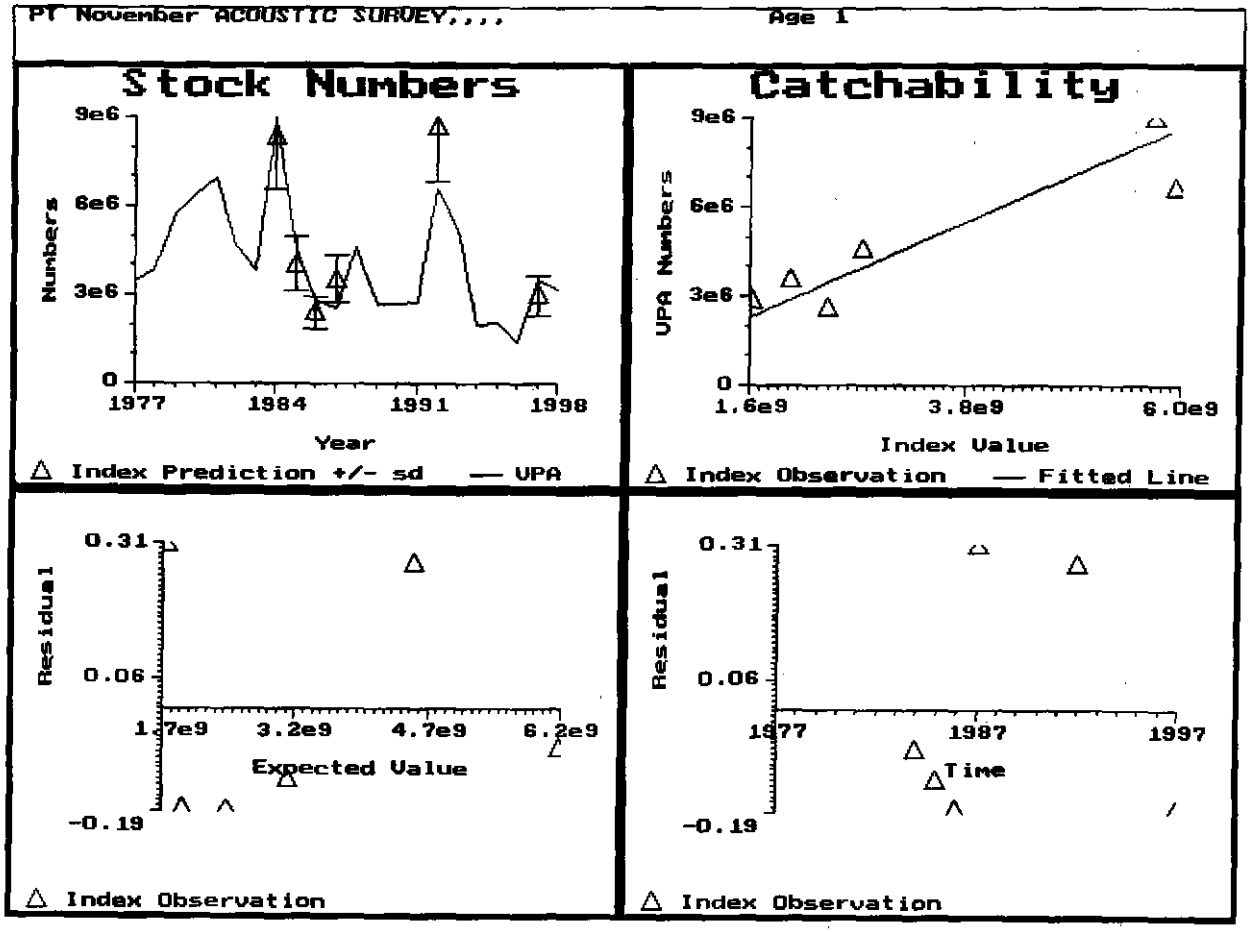

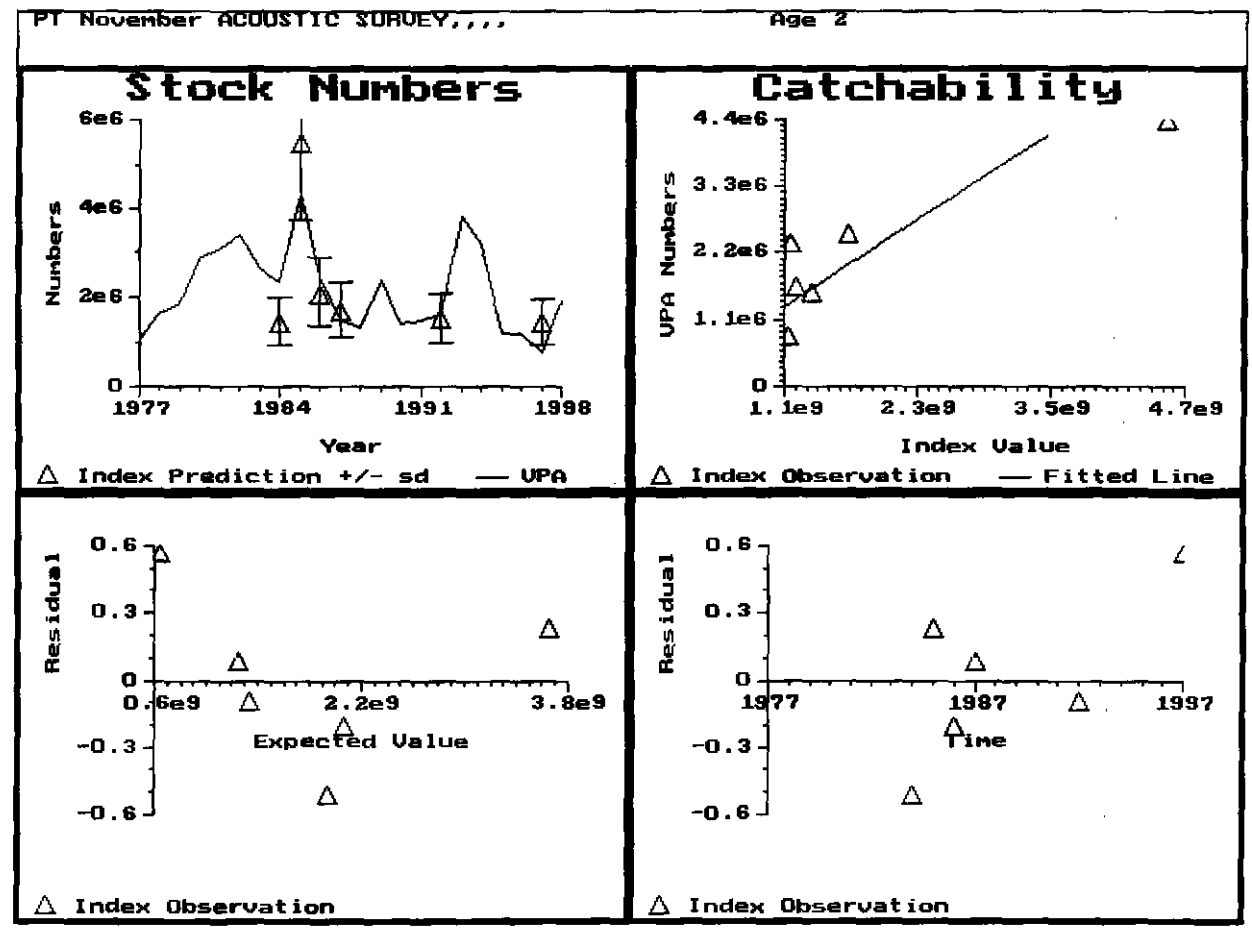

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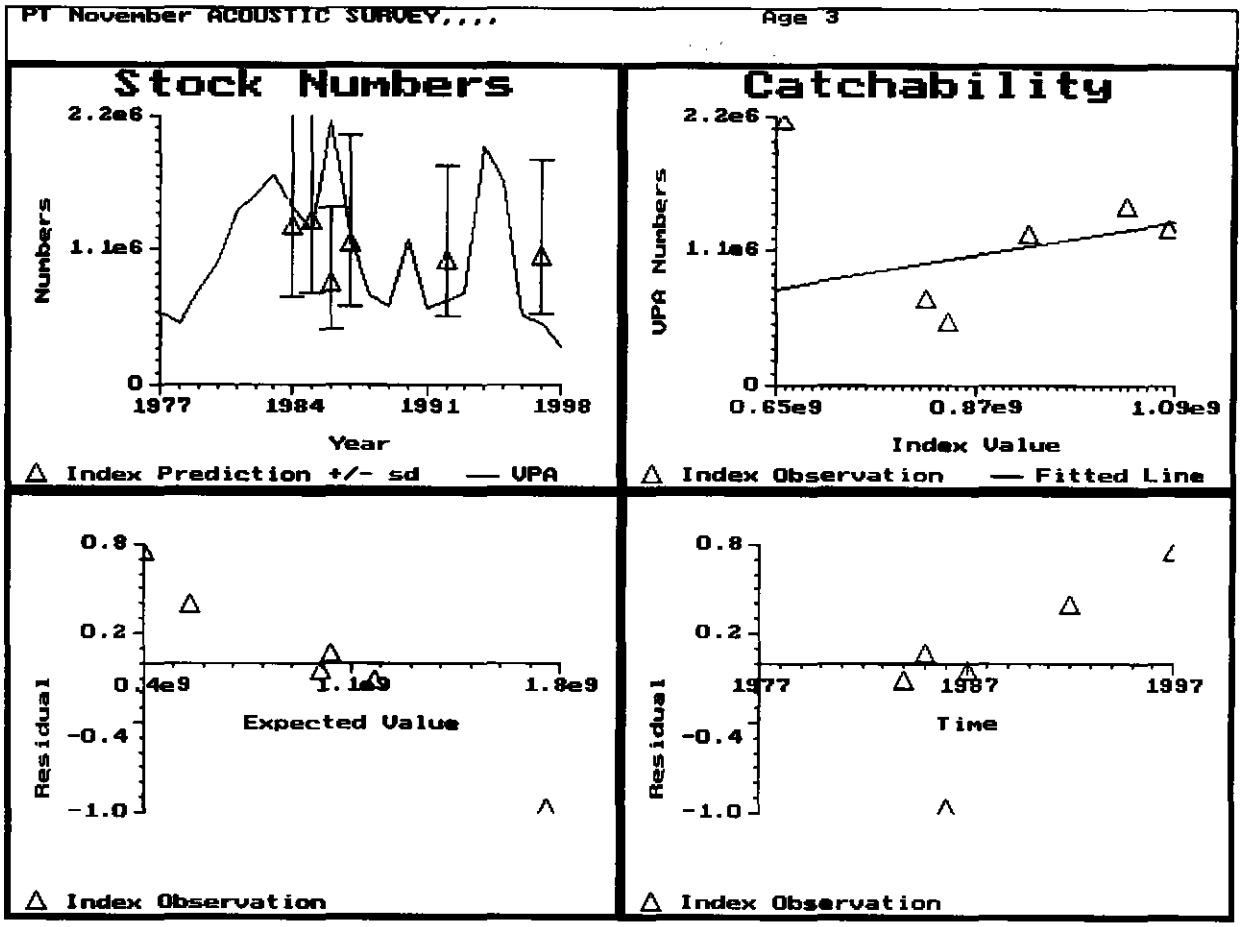

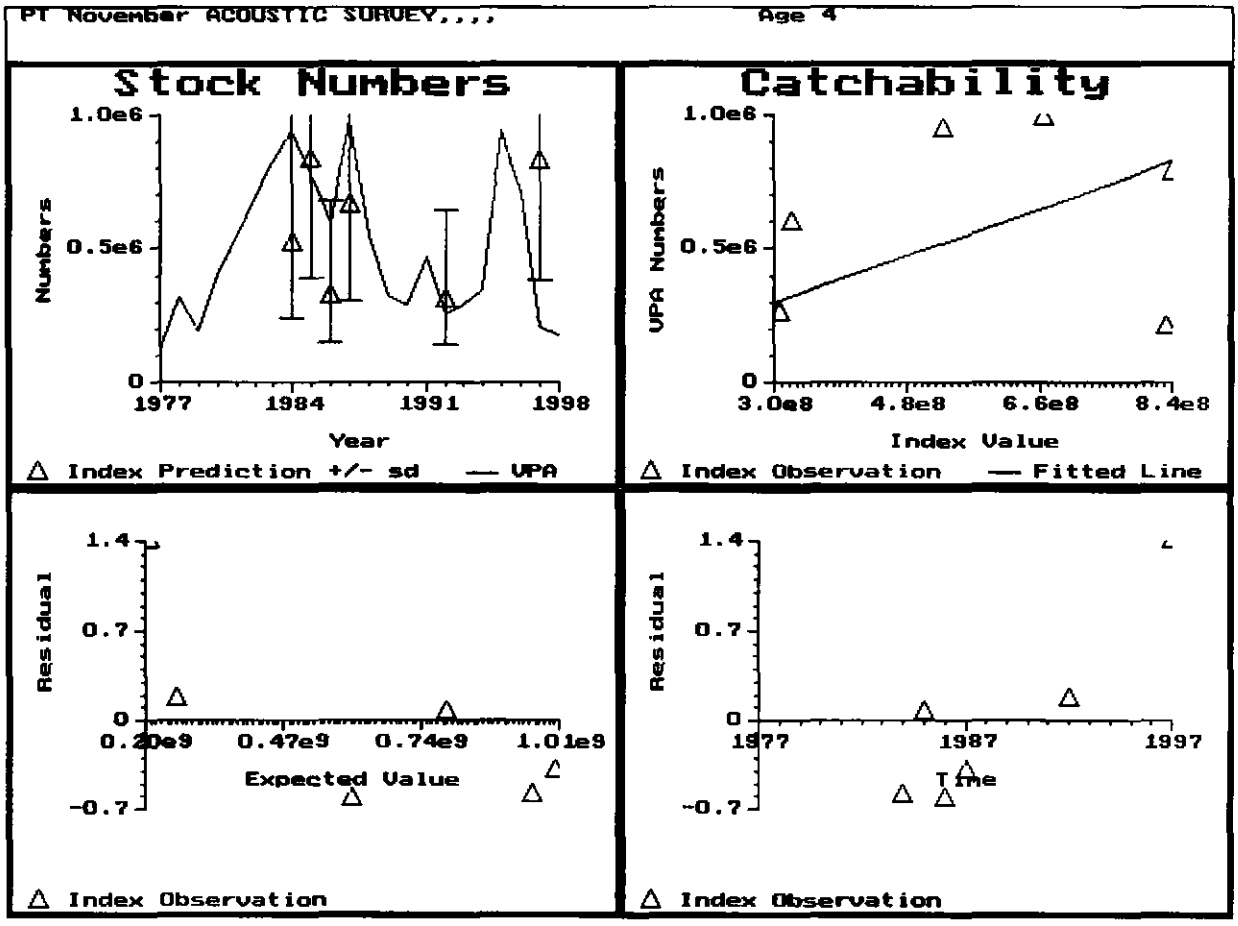

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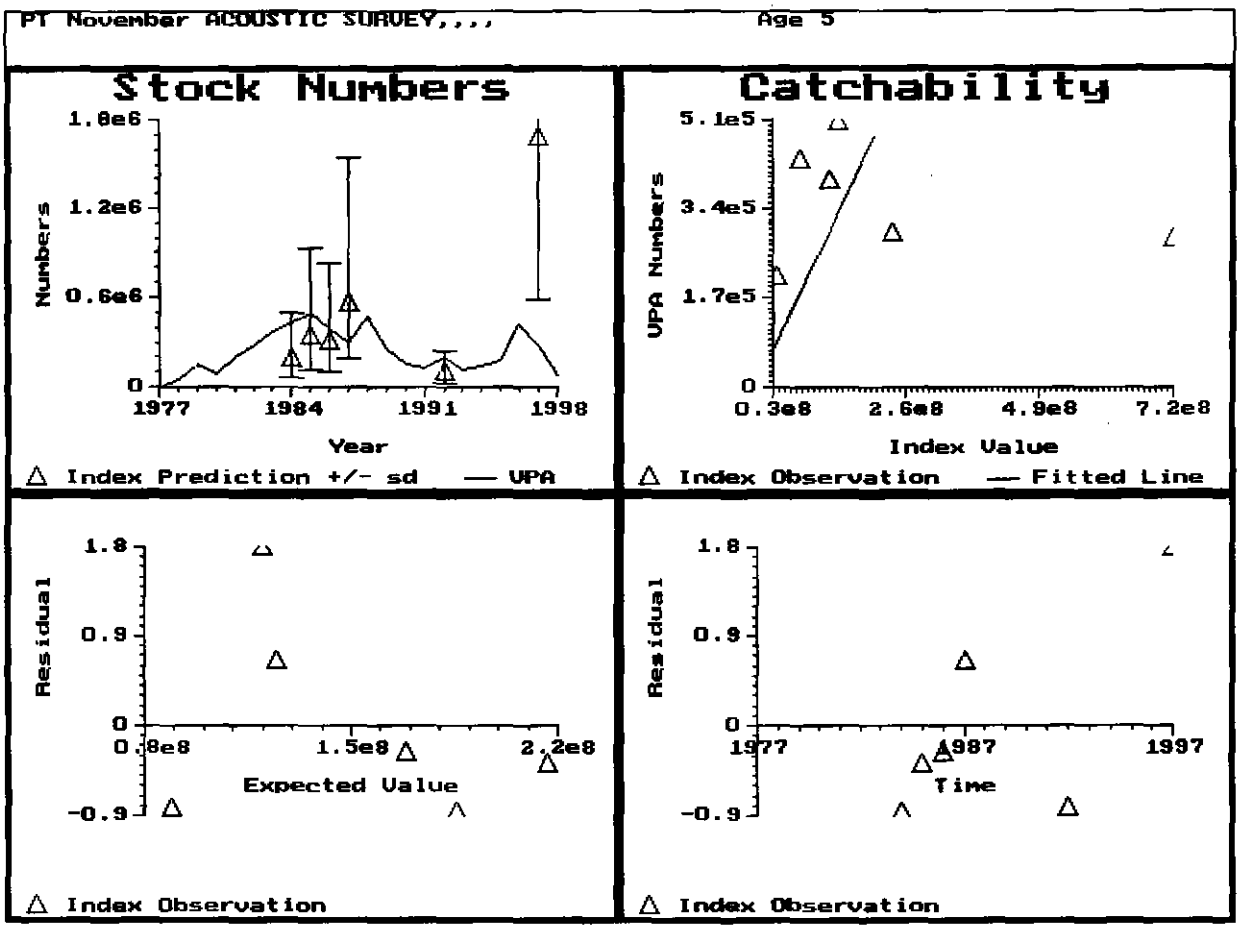


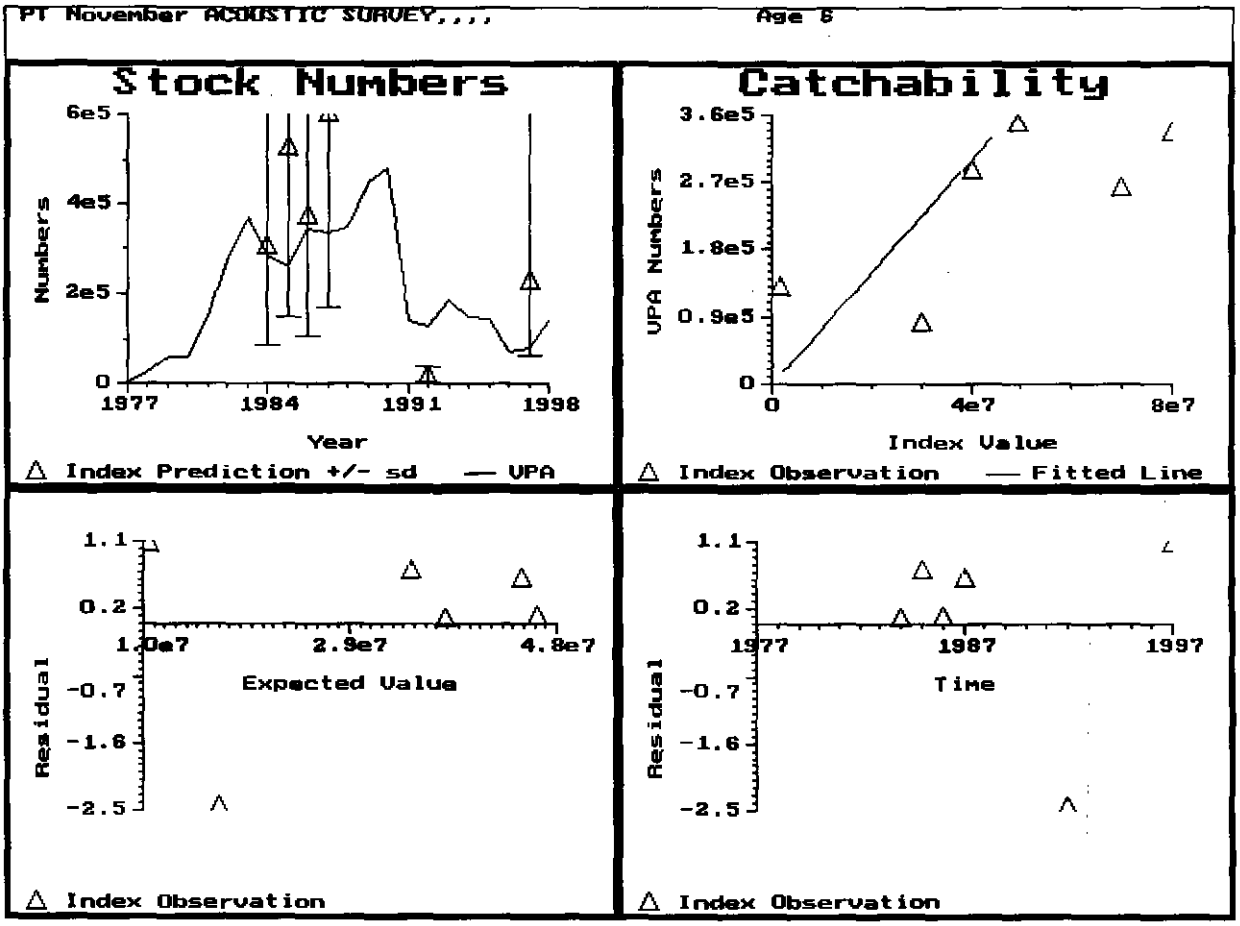
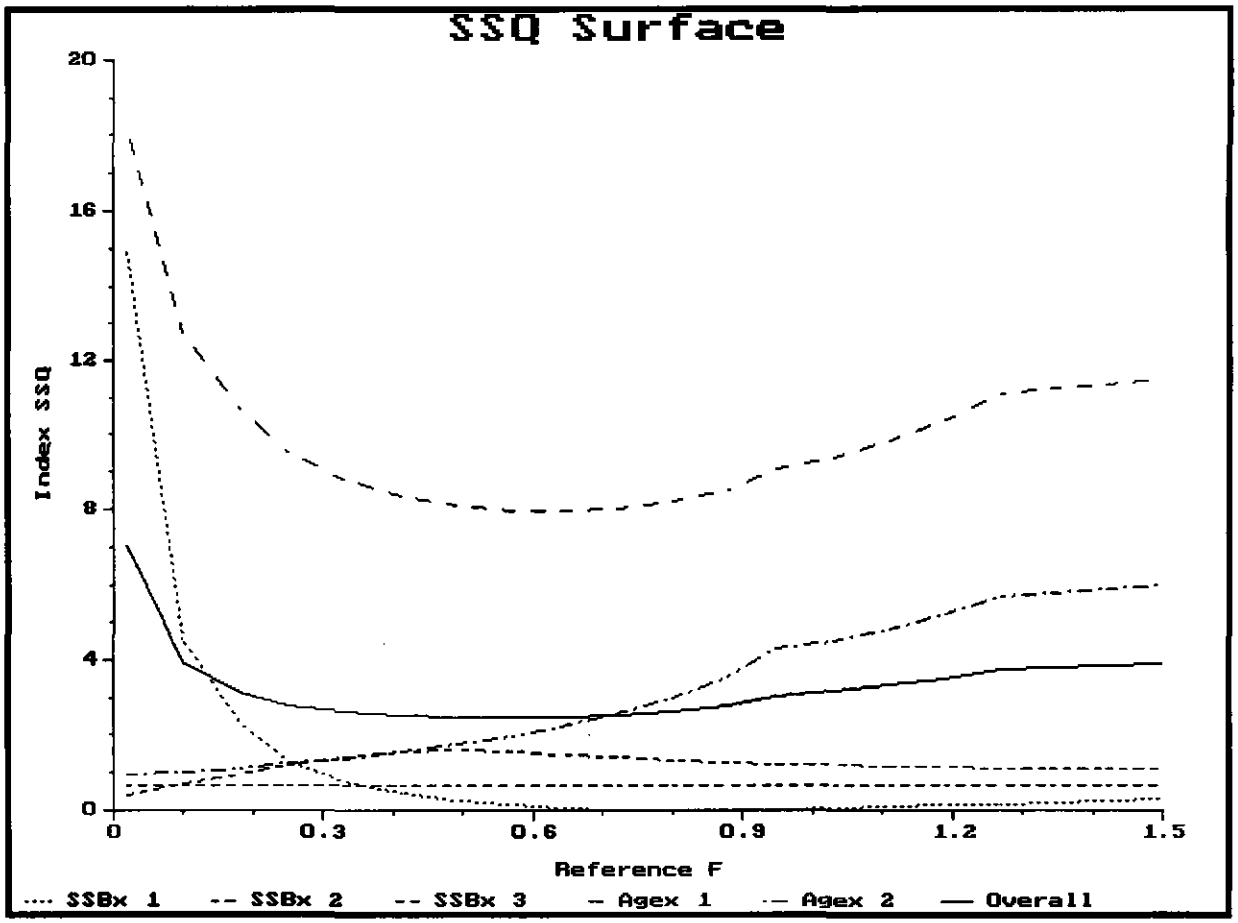


Figure 8.9.2.1 Sardine in Divisions VIIIc and IXa. ICA diagnostic plots of stock assessment.



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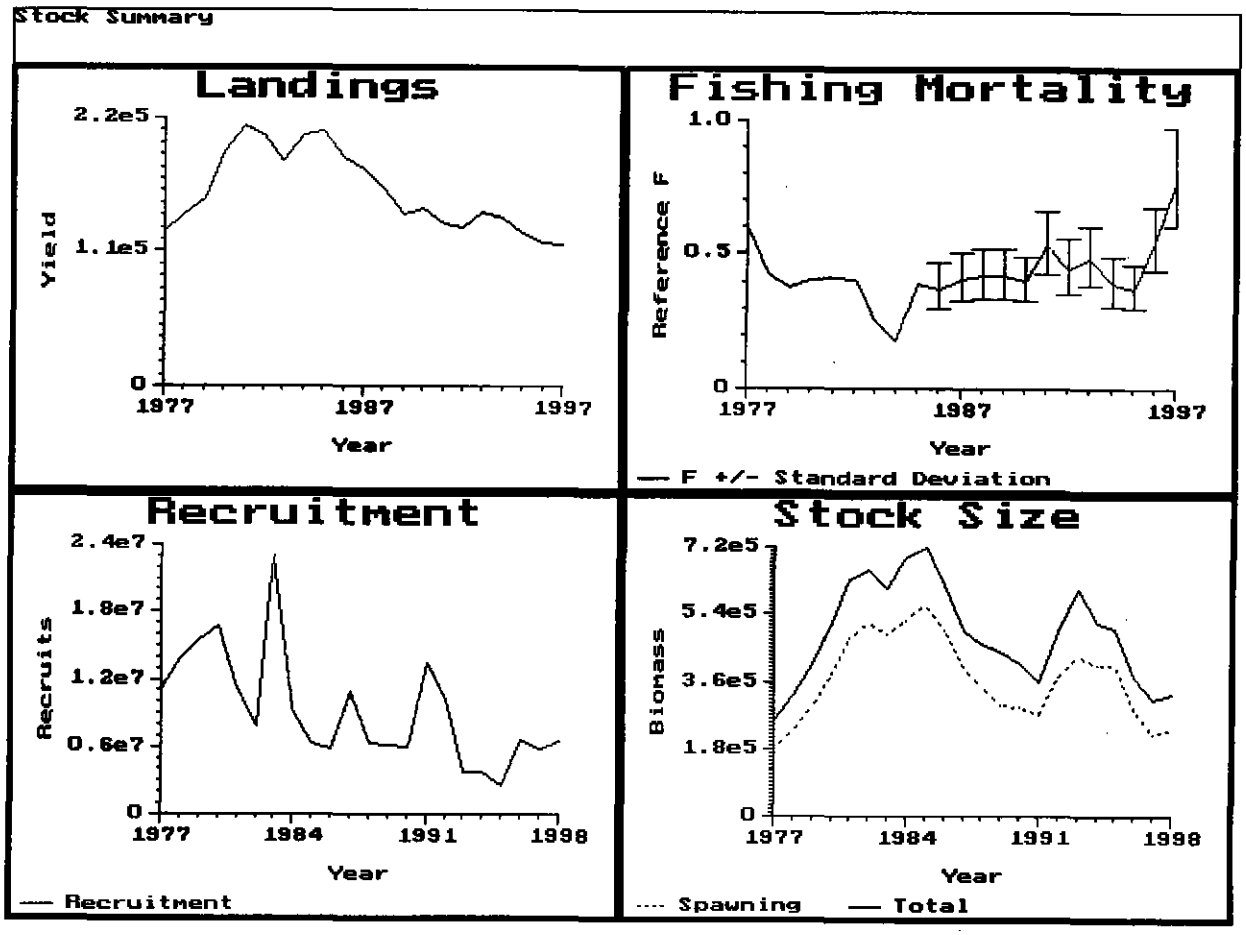

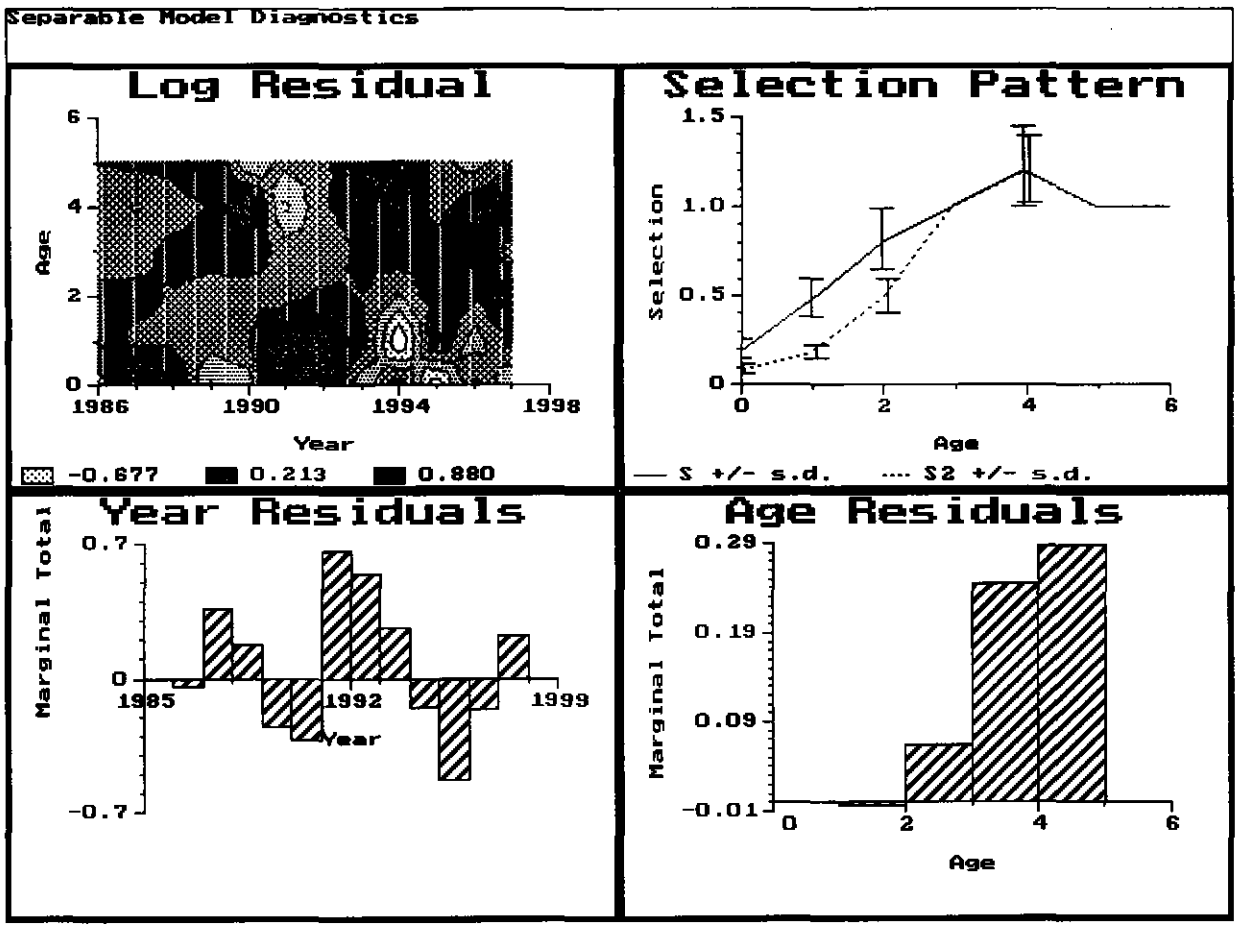

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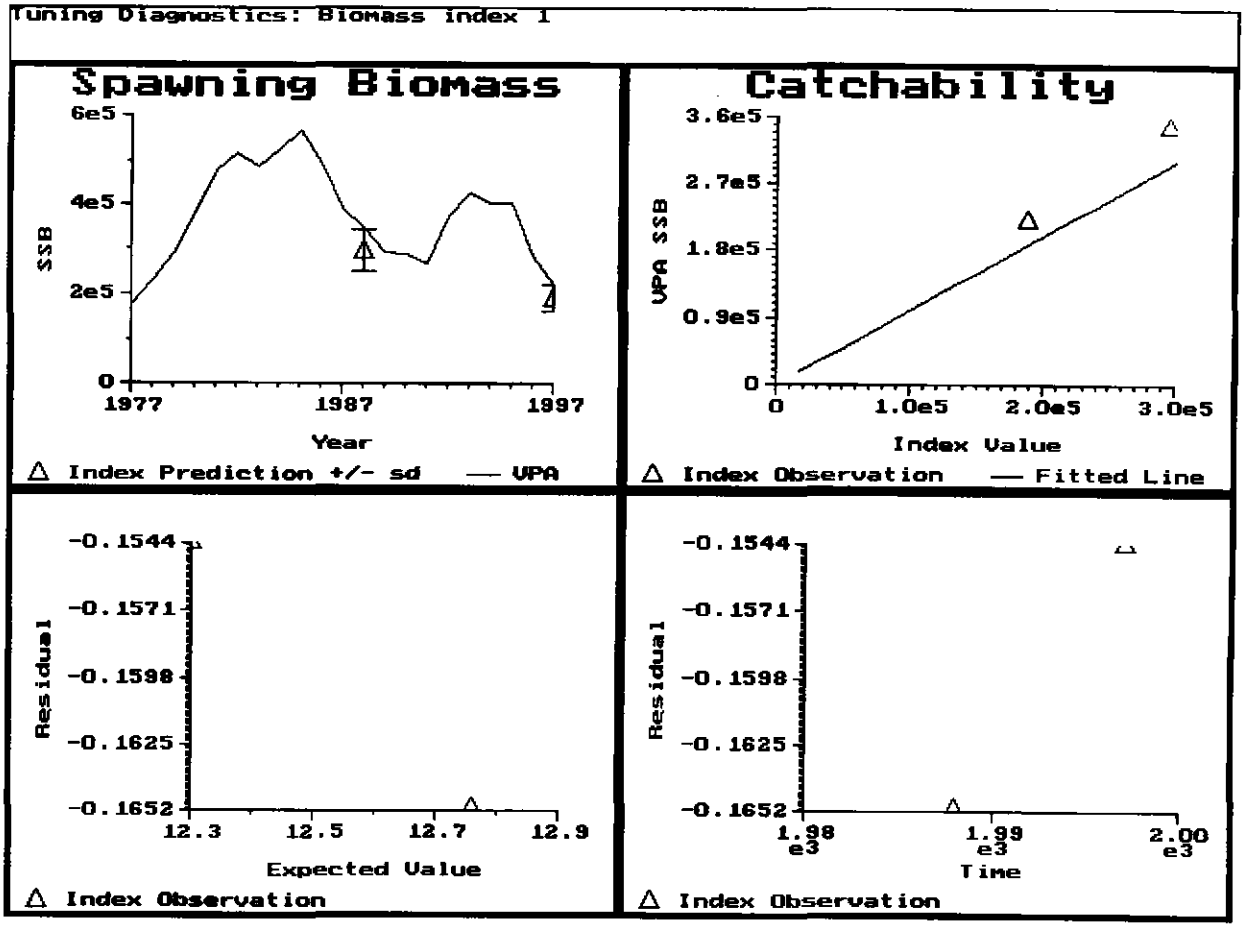

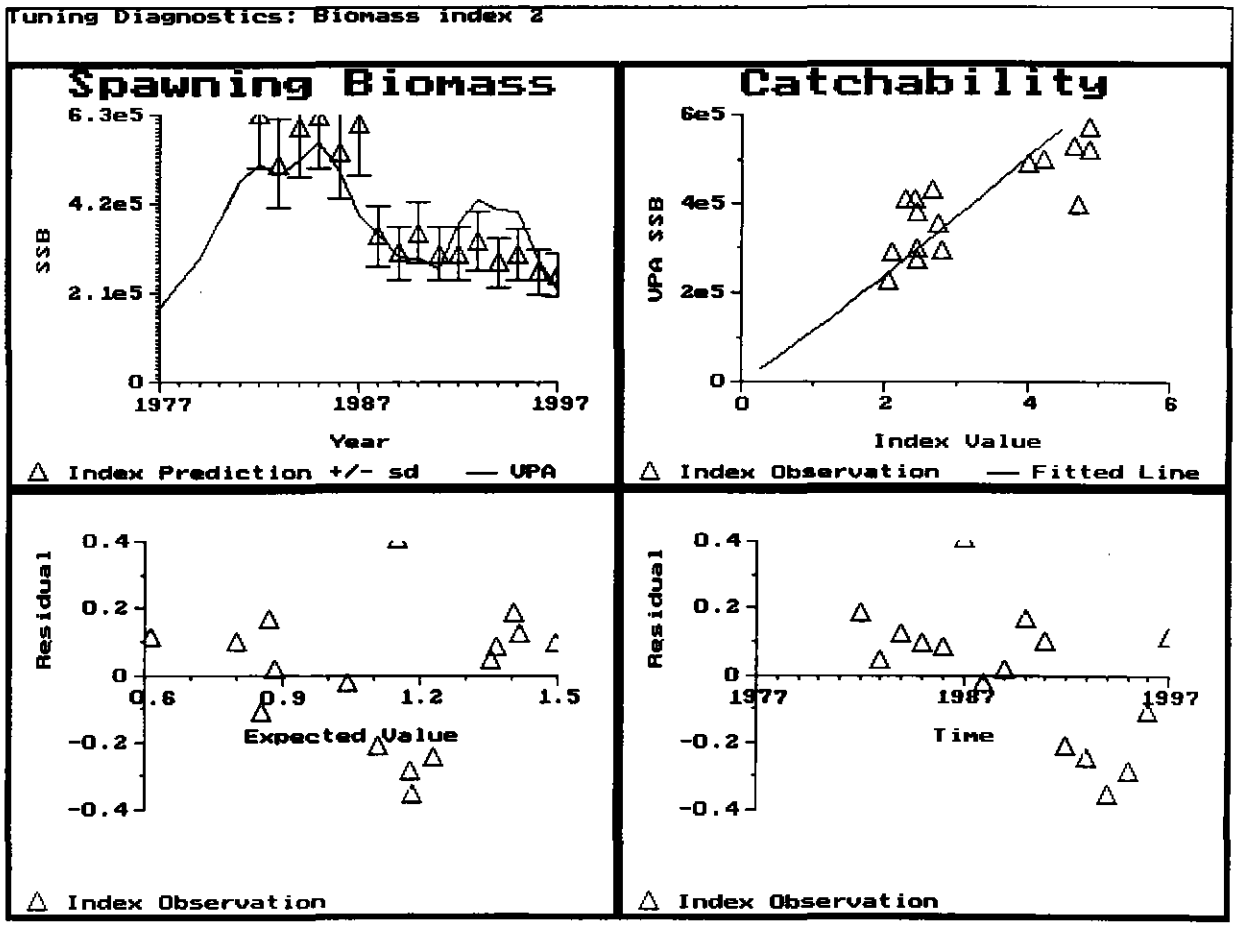

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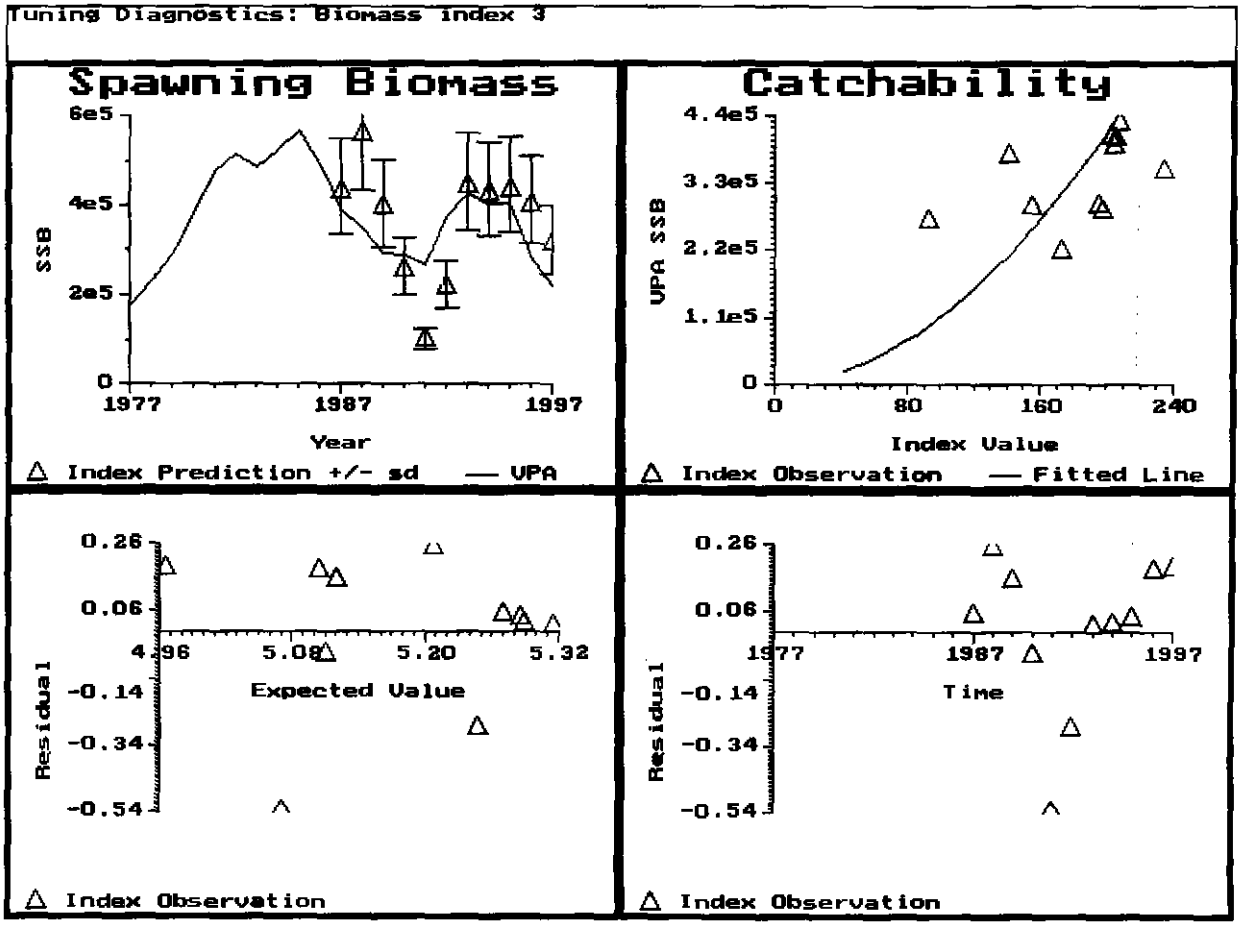

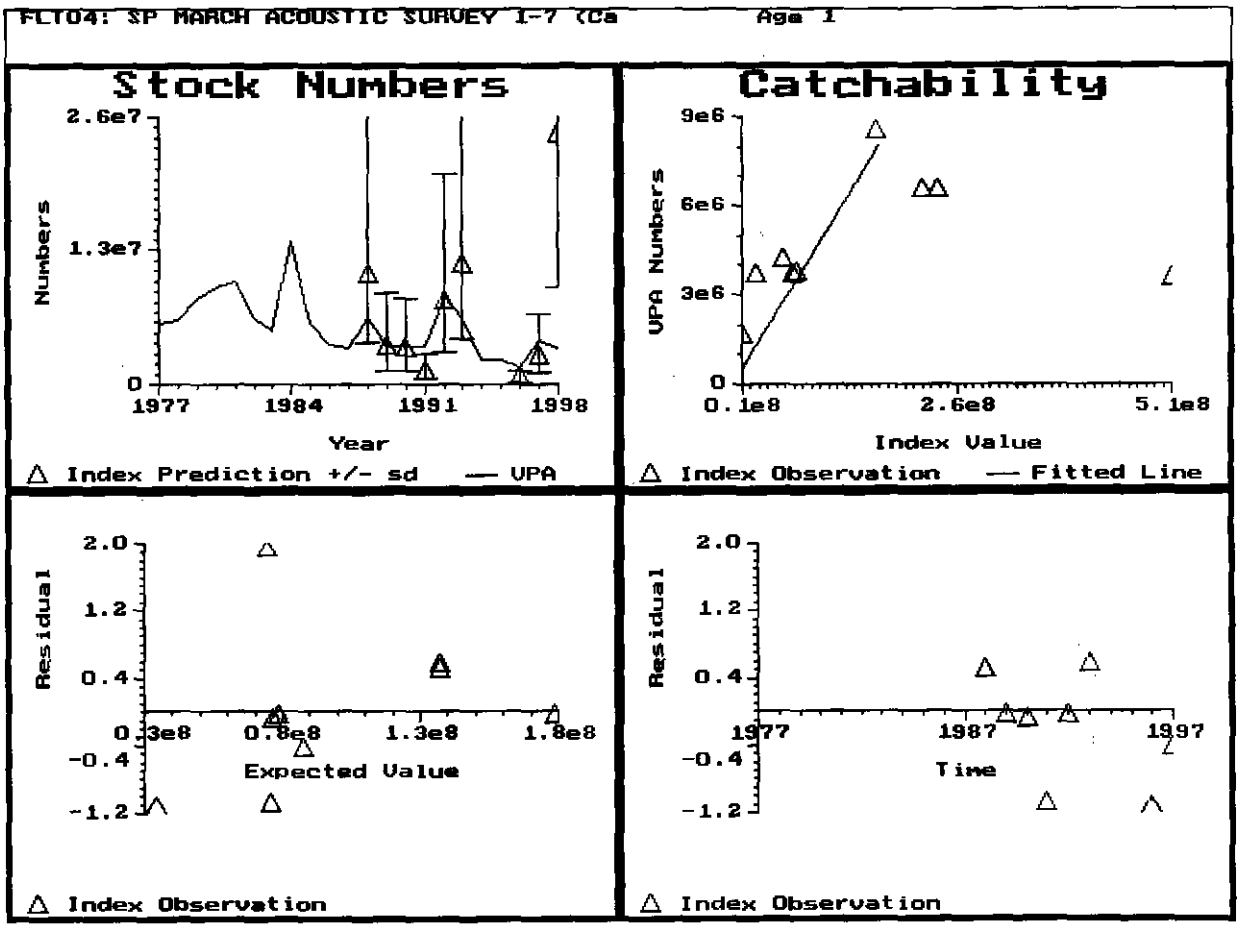

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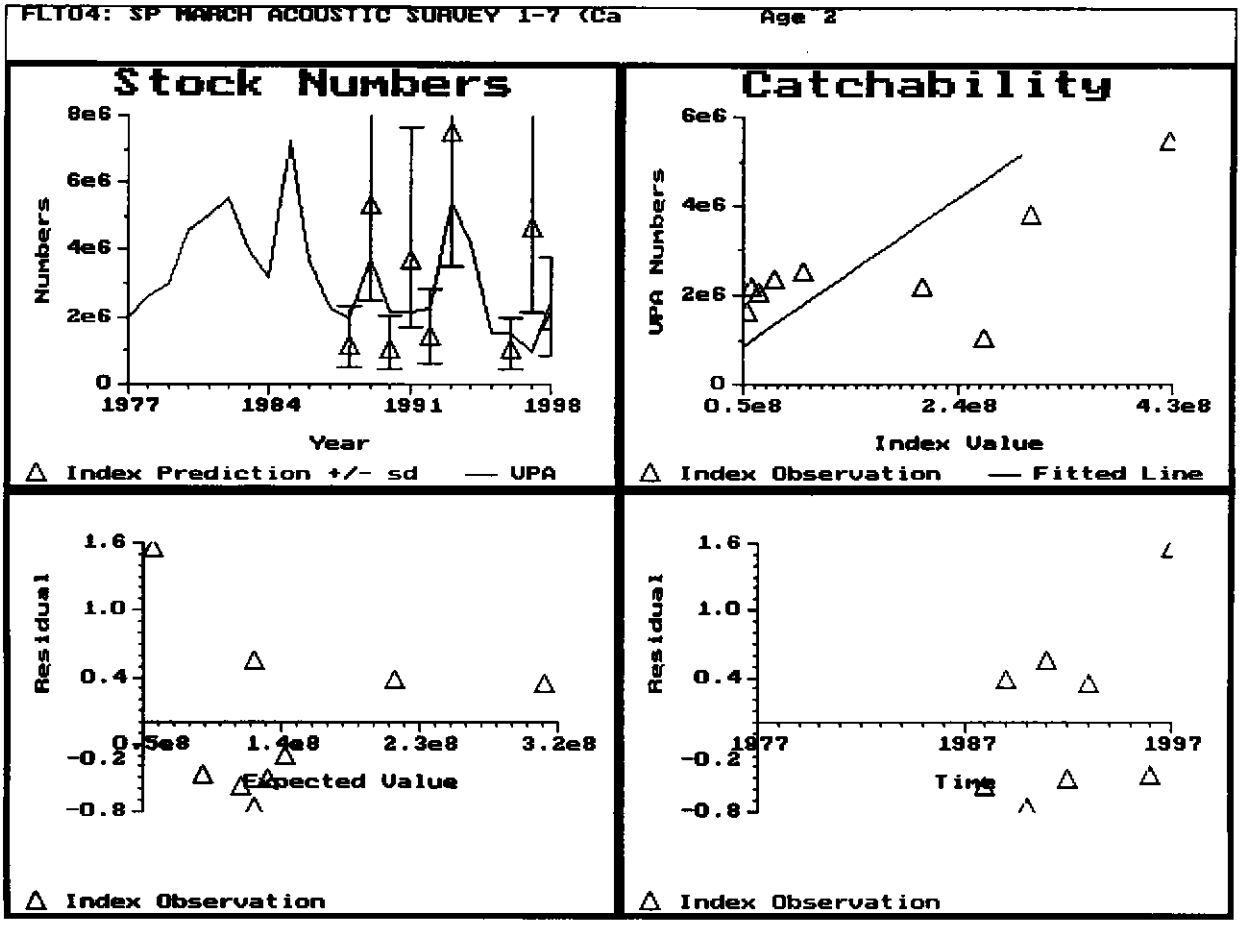

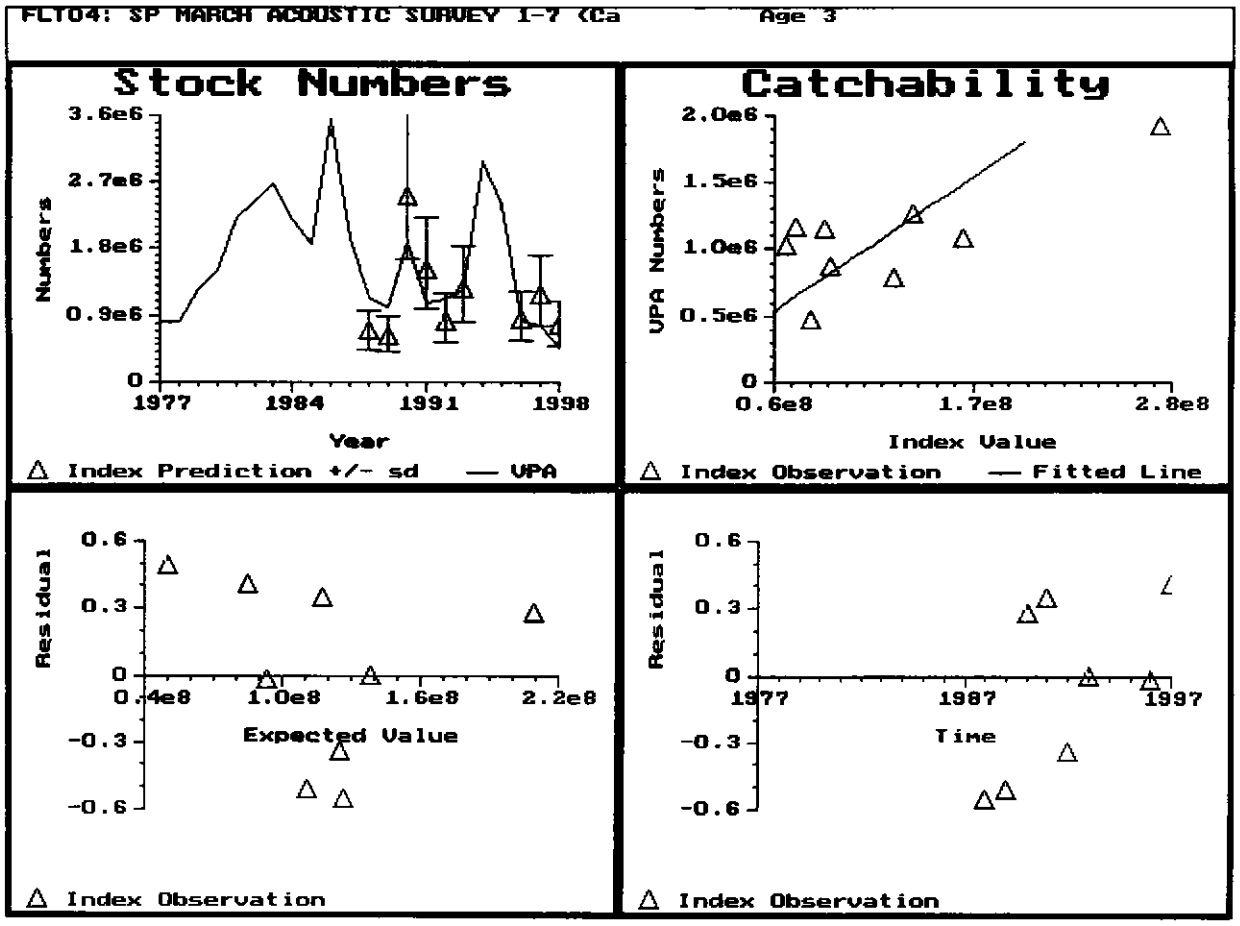

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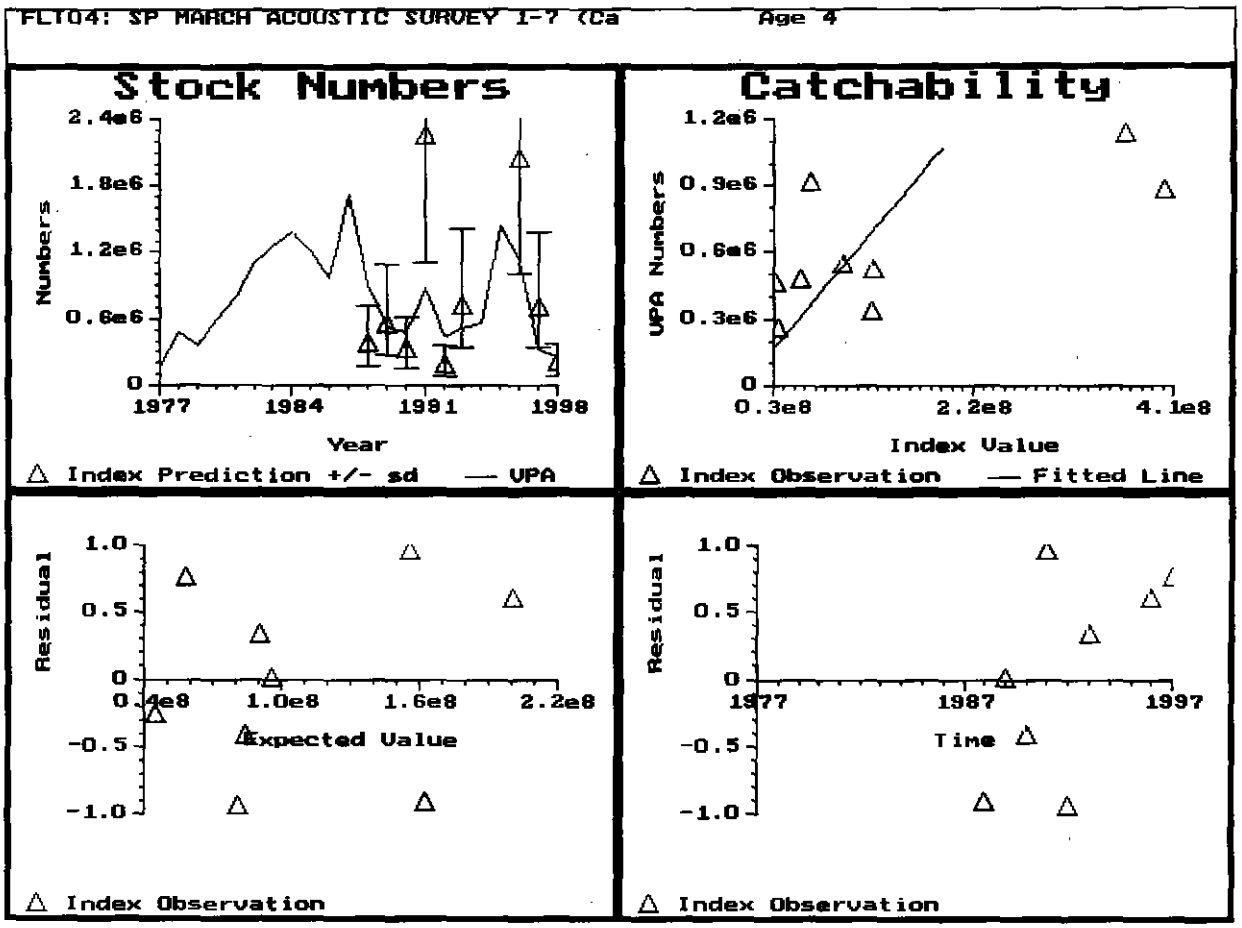

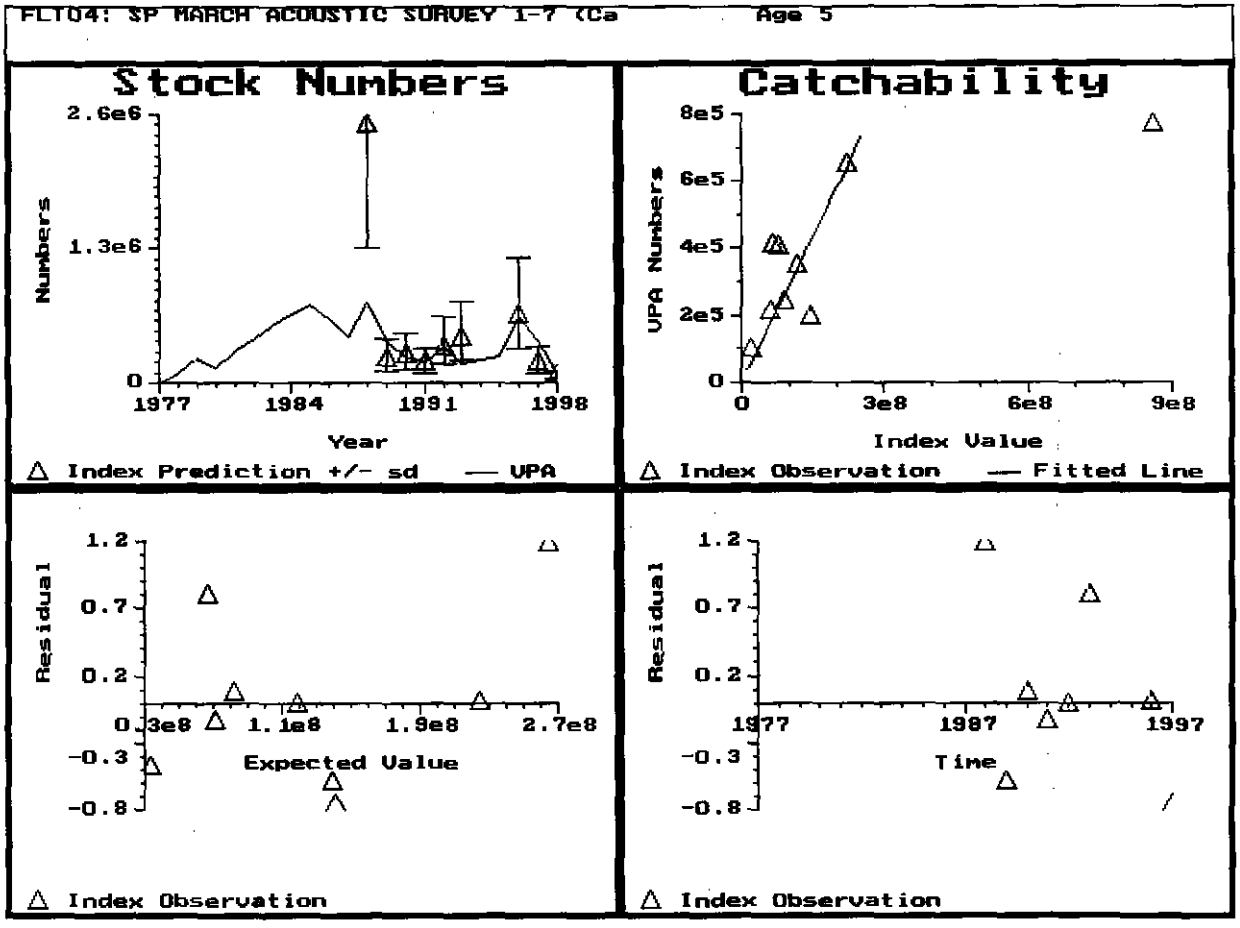

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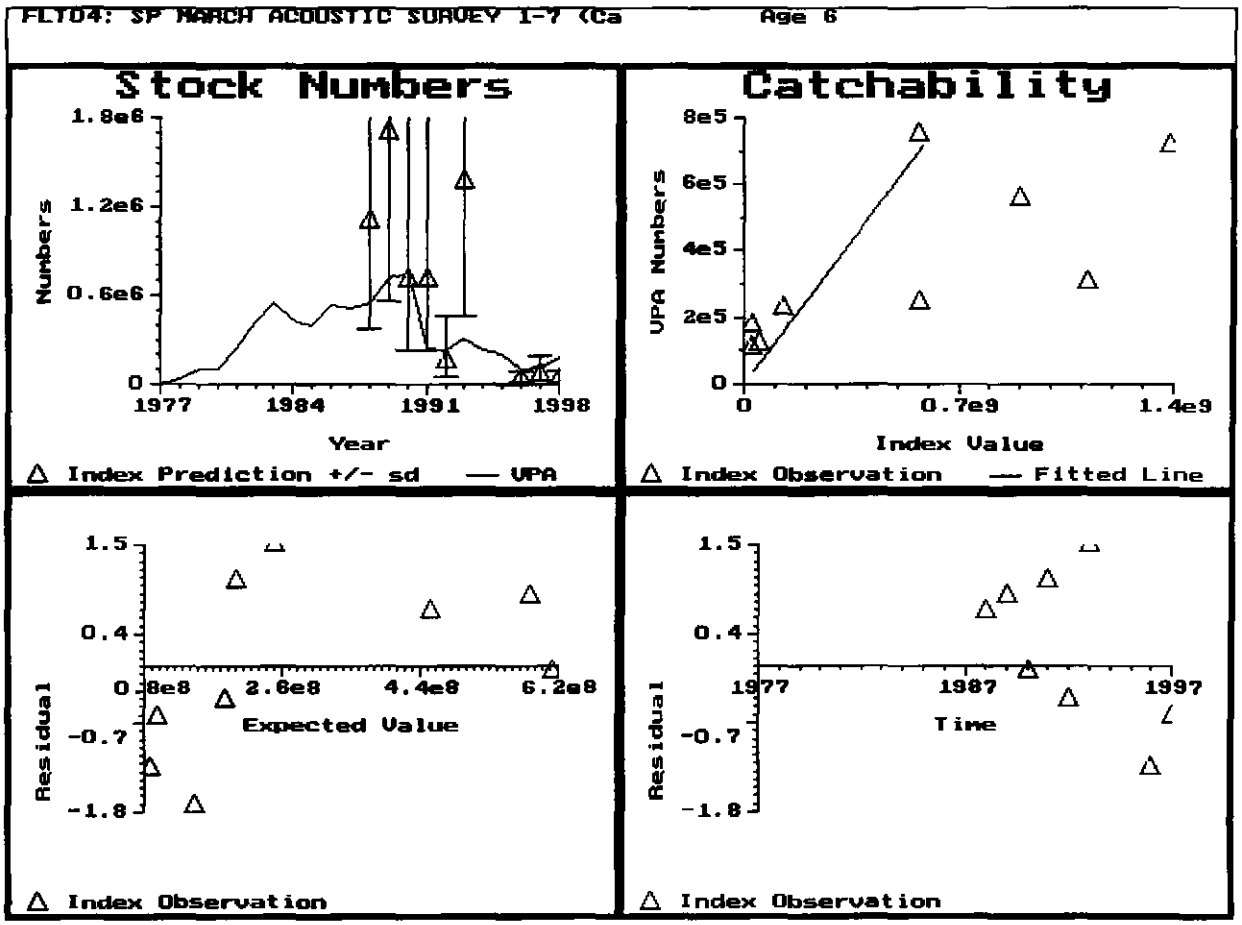


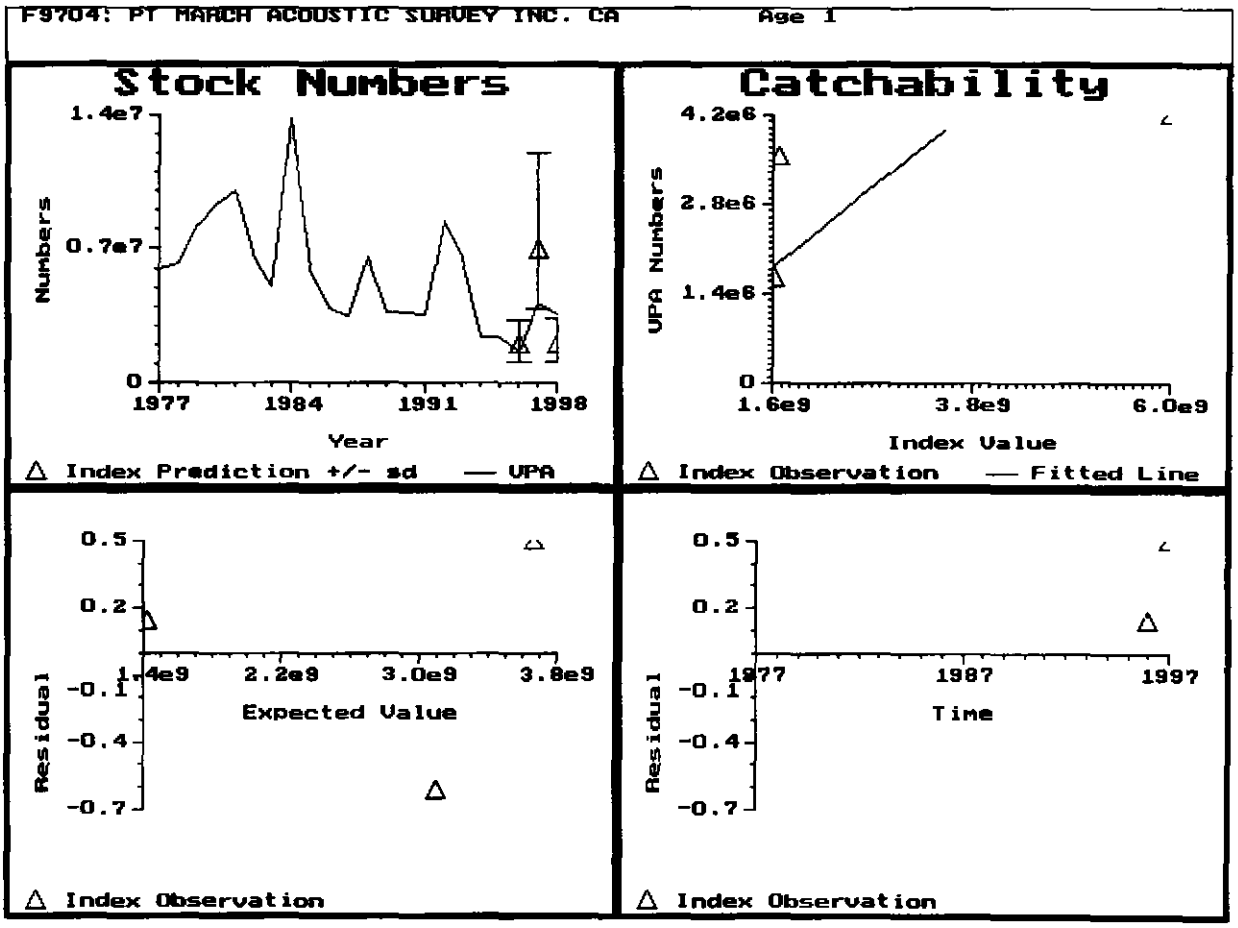
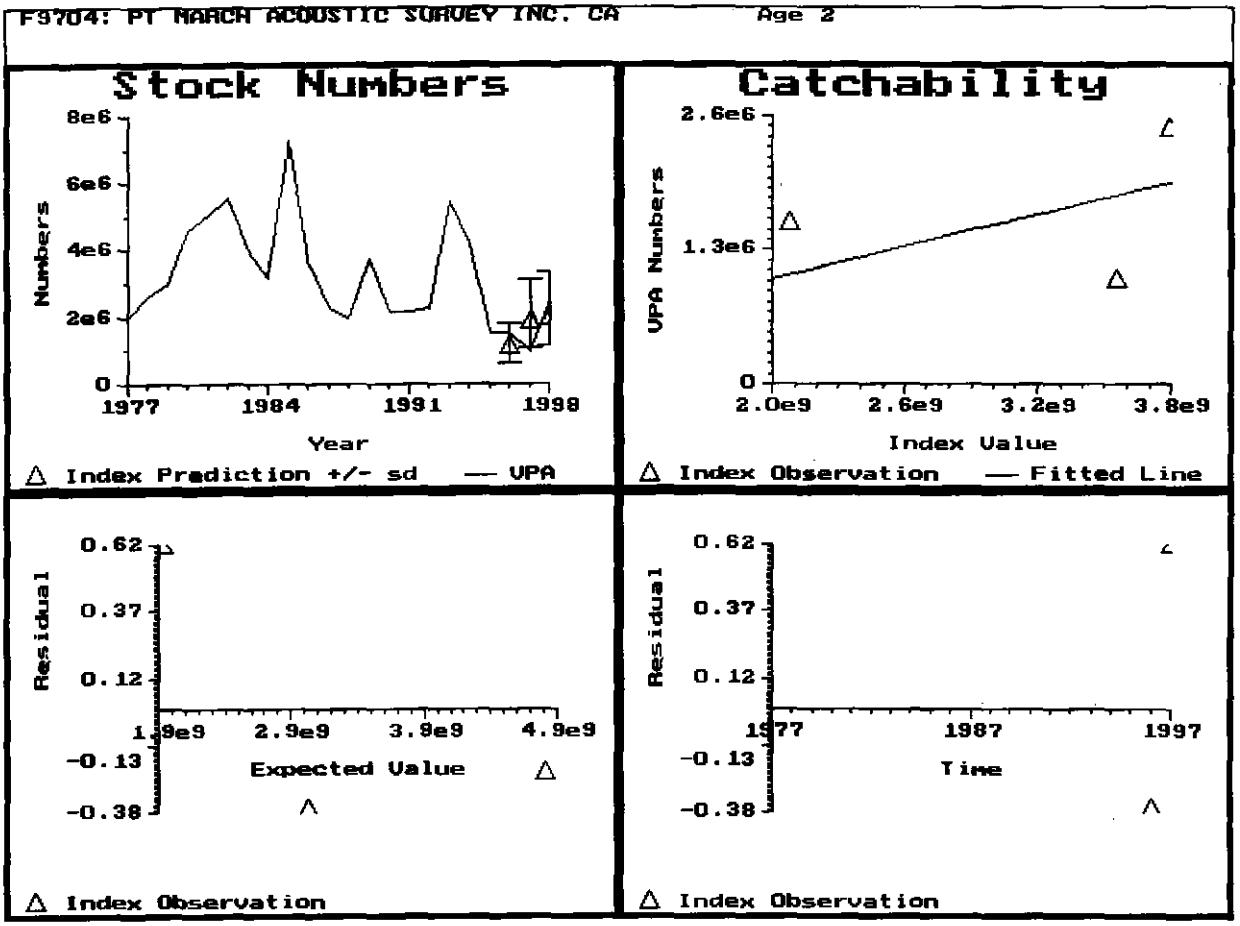
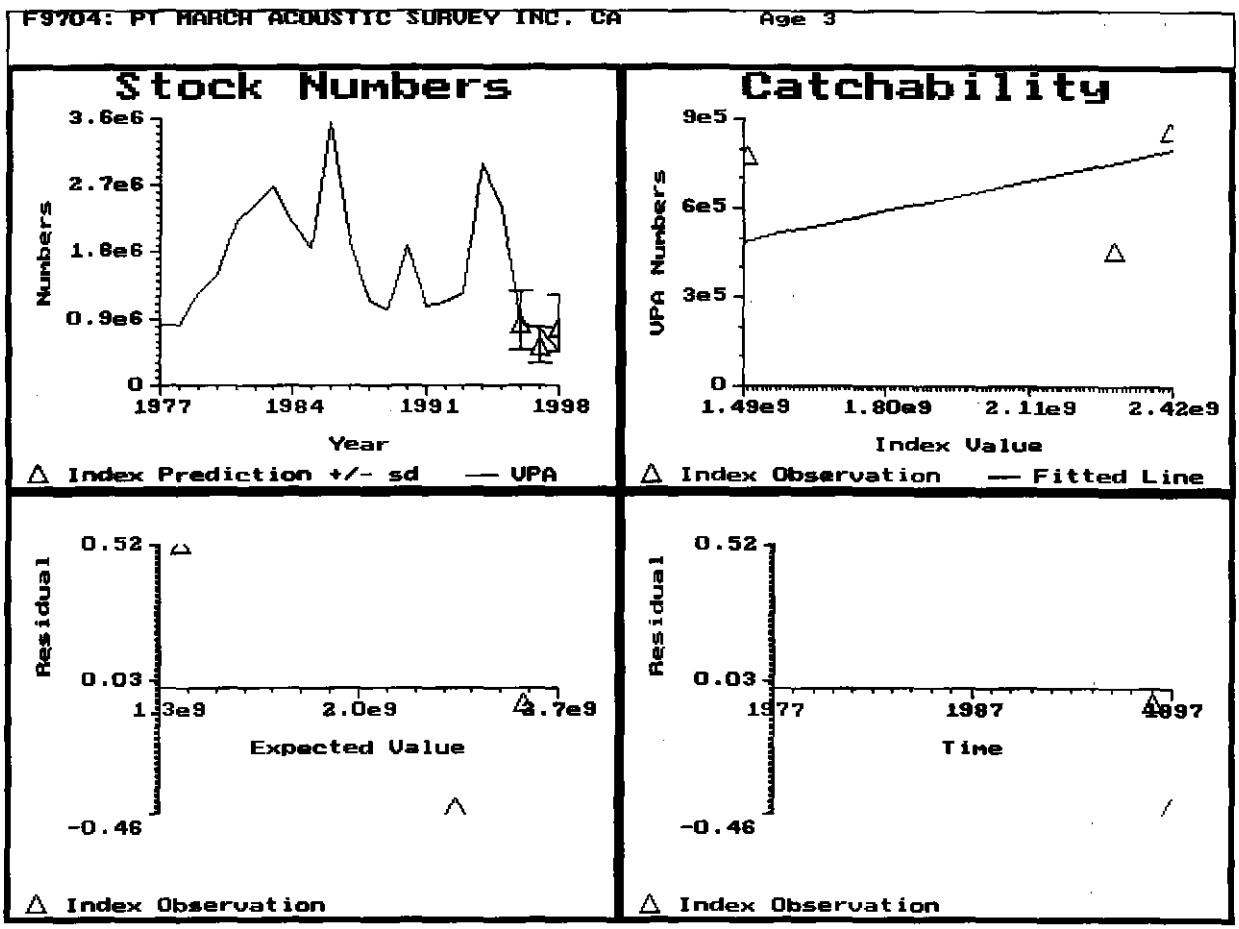


Figure 8.9.2.1 (continued)





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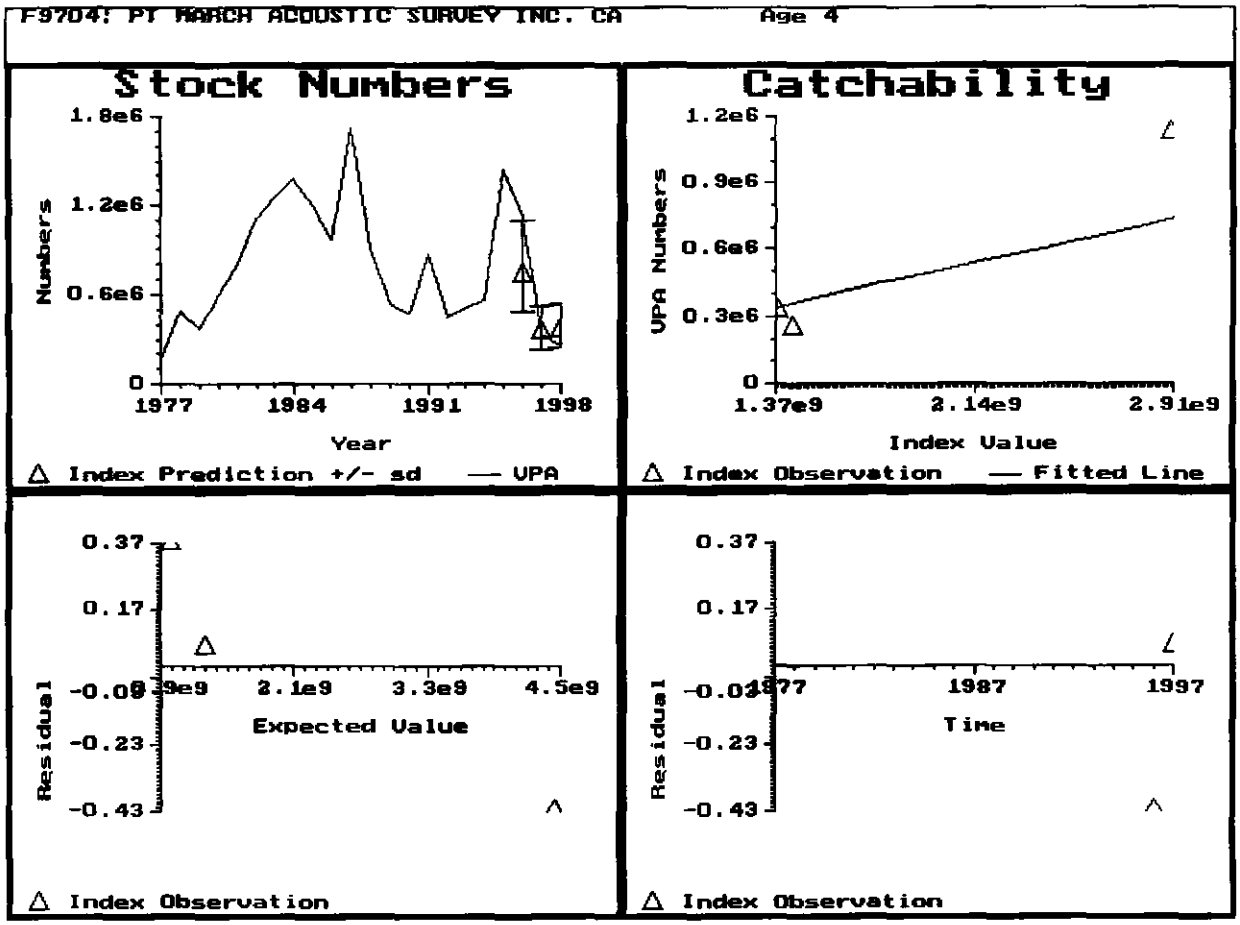


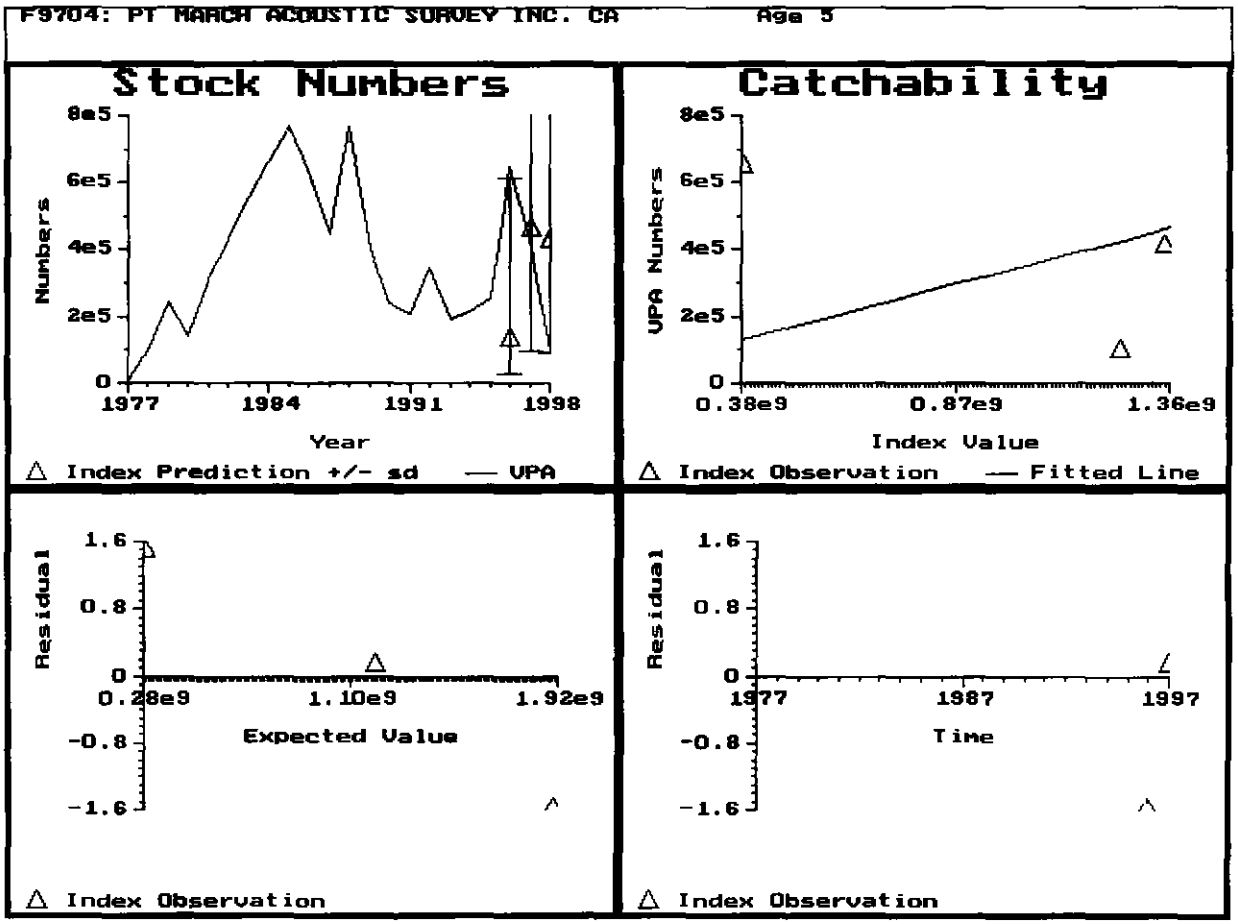
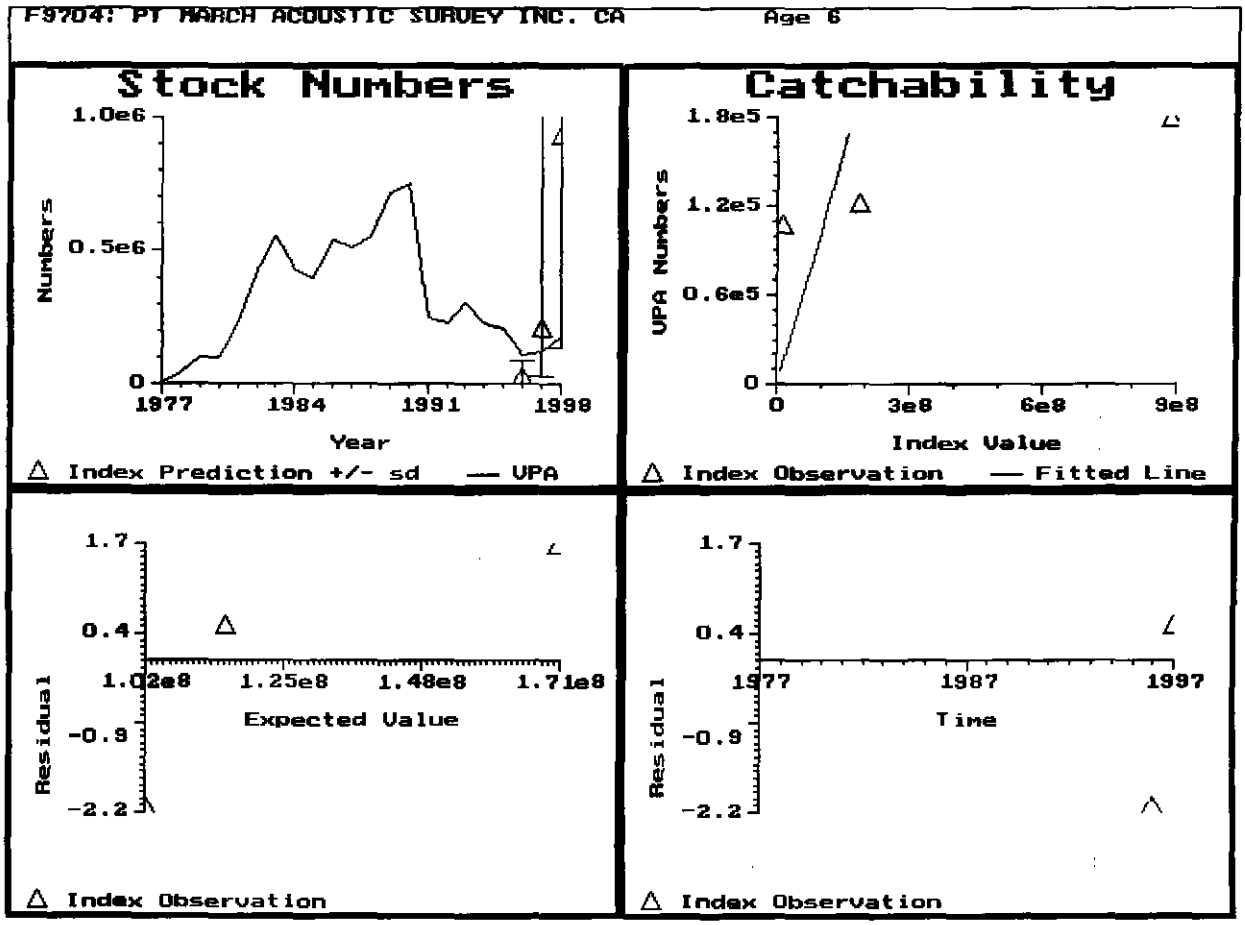


Figure 8.9.2.1 (continued)



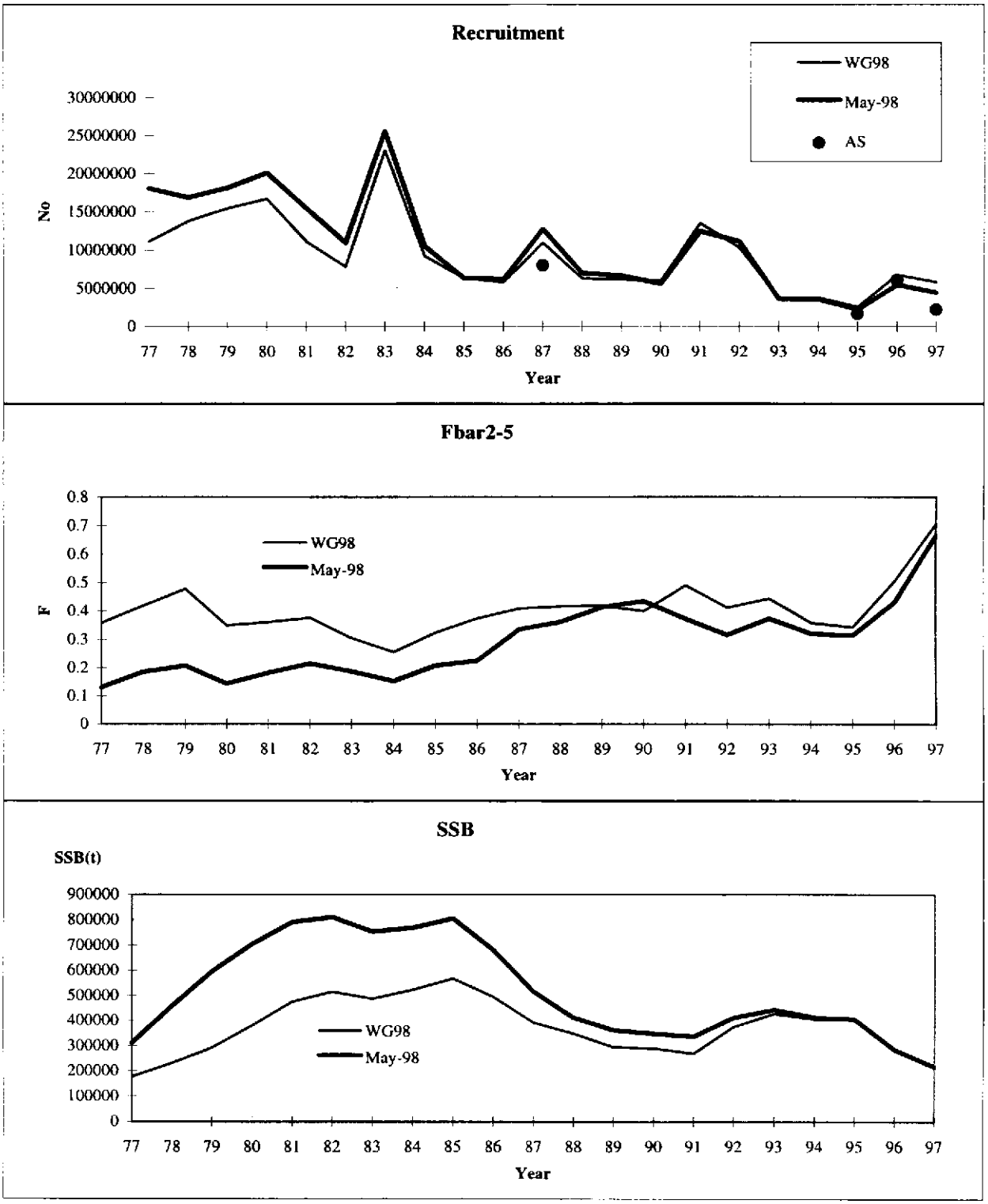
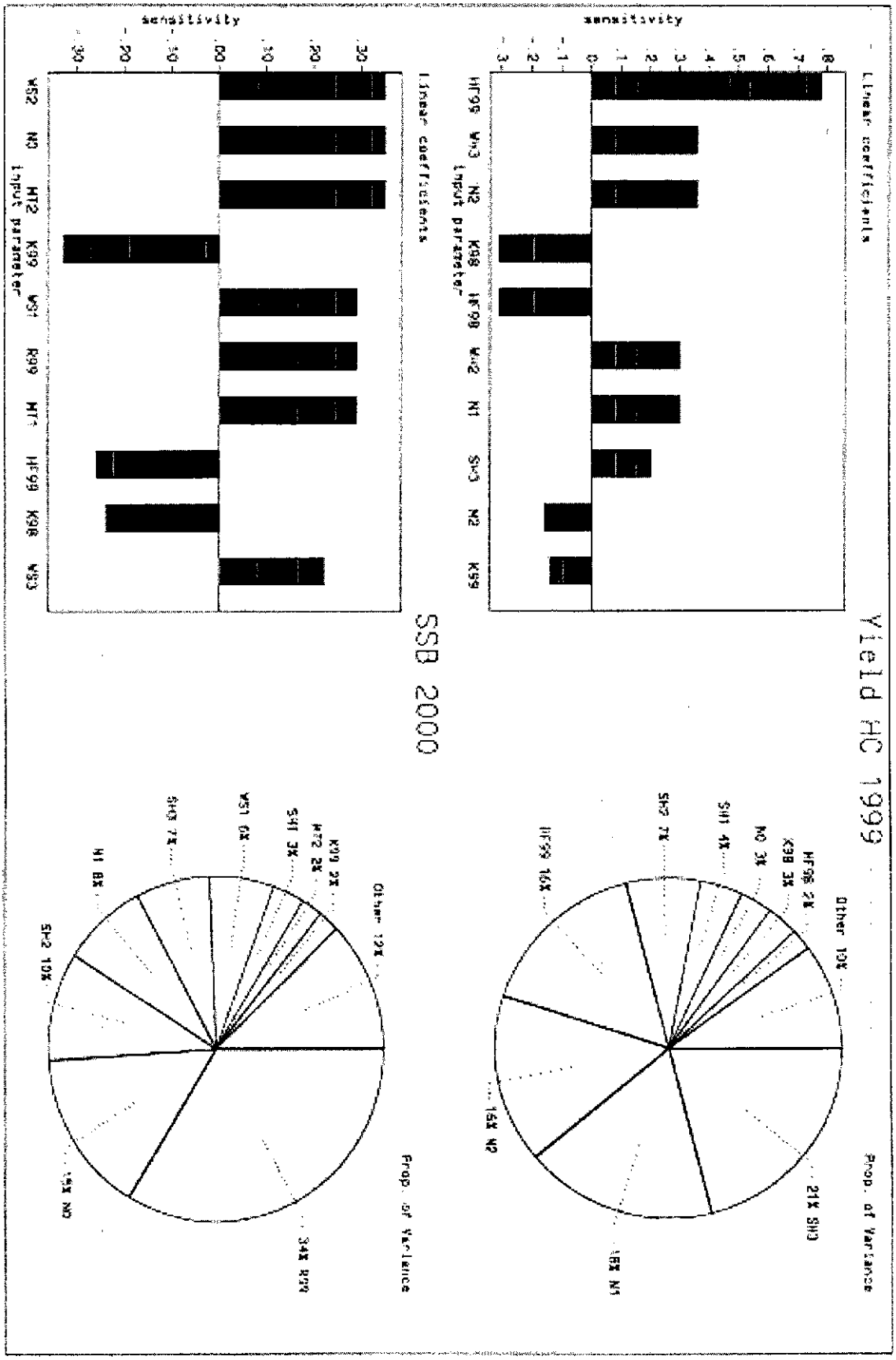


Figure 8.9.2.2 Estimated recruitment, Fbar and SSB .
WG98: Assessment model of Working group
May-98: Assessment made in May.
AS: Estimated recruitment at age 1 in the next year from the acoustic survey

Figure 8.11.1 Sardine, Areas IXa and VIIIc. Sensitivity analysis of short-term forecast.



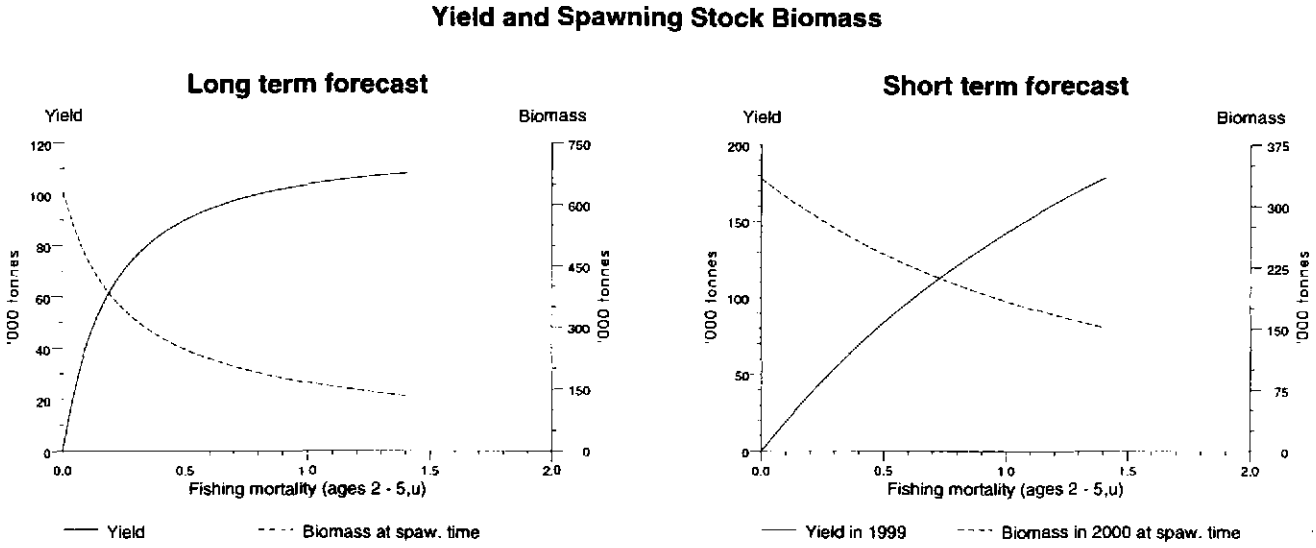


Figure 8.13.1 Short and long term forecast.

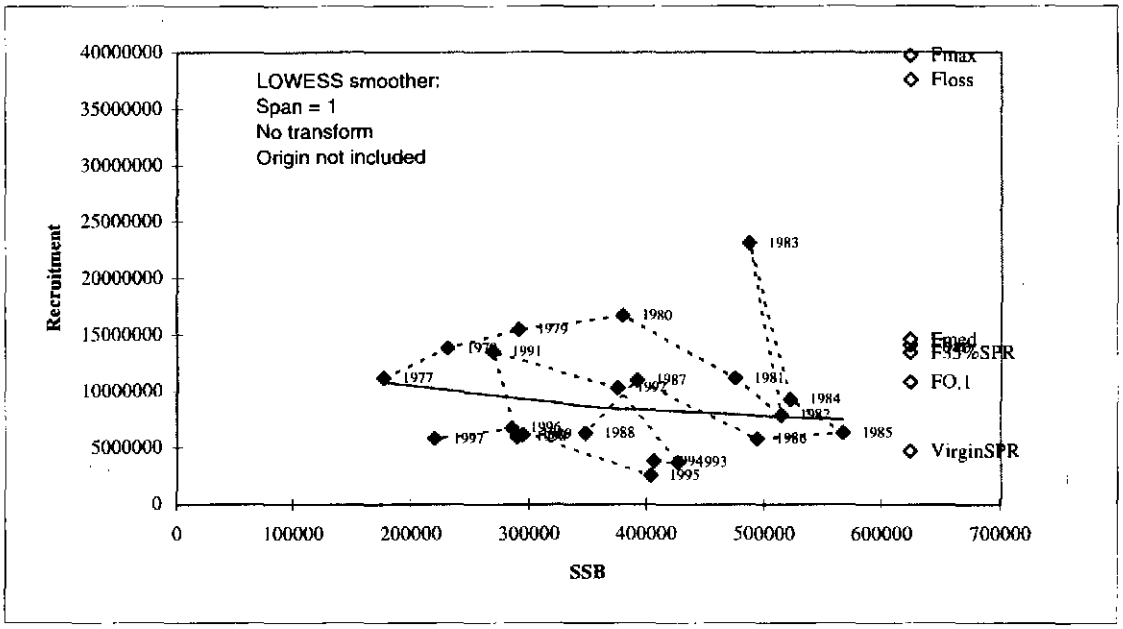
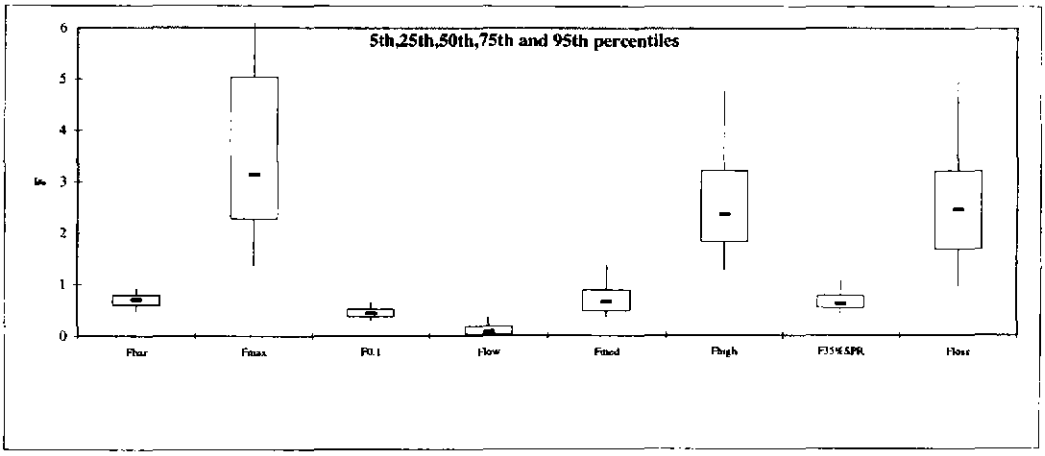


Figure 8.14.1 Recruitment/SSB relationship and reference point for sardine.



Reference point	Deterministic	Median	95th percentile	80th percentile
MedianRecruits	7840000	7840000	11120000	10280000
MBAL	Undefined			
Bloss	176400			
SSB90%R90%Surv	291200	291200	435911	352509
SPR%ofVirgin	33.34	32.92	43.43	39.13
VirginSPR	0.13	0.13	0.18	0.15
SPRloss	0.02	0.02	0.04	0.02

	Deterministic	Median	5th percentile	20th percentile
FBar	0.70	0.70	0.47	0.57
Fmax	3.14	3.13	1.37	1.97
F0.1	0.42	0.44	0.29	0.36
Flow	0.07	0.08	0.00	0.01
Fmed	0.75	0.65	0.34	0.43
Fhigh	2.54	2.34	1.28	1.71
F35%SPR	0.64	0.61	0.41	0.52
Floss	2.95	2.43	0.96	1.53

Figure 8.14.2 Estimates of reference points for sardine.

9 ANCHOVY - GENERAL

9.1 Unit Stocks

The Working Group reviewed the basis for the discrimination of the stocks in Sub-area VIII and Division IXa. No detailed study has been made to discriminate sub-populations along the whole European Atlantic distribution of the anchovy. Morphological studies have shown large variability among samples of anchovies coming from different areas from the central part of the Bay of Biscay to the West of Galicia (Prouzet and Metuzals, 1994, and Junquera, 1993). These authors explain that the variability is reflecting the different environments which surround the development of larvae and juveniles at several recruitment zones in the studied areas. They suggest that the population may be structured by some sub-populations or groups with a certain degree of reproductive isolation. Several considerations, like the well-defined spawning areas of the anchovy at the South-east corner of the Bay of Biscay (Motos *et al.* 1996), and the complementary seasonality of the fisheries along the coasts of the Bay of Biscay (showing a general migration pattern) (Prouzet *et al.* 1991 and 1994), makes the Working Group consider that the anchovy in this area has to be dealt with as a single management unit for assessment purposes.

The connections between the population of the anchovy in the Bay of Biscay and anchovies from other areas, either to the North or to the South is not clear. Junquera (1993) suggested that the anchovy in the Central and Western part of Division VIIIc may be more closely related to the anchovy found off Western Galician coasts than with the anchovy at the South-east corner of the Bay of Biscay (where the major fishery takes place). Morphological studies, as mentioned previously, are influenced by environmental conditions and further investigations, especially on genetic characteristics, are necessary in order to be more certain. The Working Group considers that for assessment and management purposes the anchovy population along the Atlantic Iberian coasts (Division IXa) should be dealt with as a management unit independent of the one in the Bay of Biscay. A further increase in the fisheries in these areas would allow a better study of the dynamics of the anchovy in this area and its connection or not with anchovies from other areas.

9.2 Distribution of the Anchovy Fisheries

Figures 9.2.1a–d give the distributions of the Spanish and French fisheries directed on anchovy in Sub-area VIII and Division IXa for 1997. In Sub-area VIII during the first quarter, the main fishery (predominantly the French fleet) is located around the Gironde estuary from 44°N up to 47°N. During the second quarter, the main landings (predominantly Spanish) were caught off the Southern part of the Bay of Biscay (south of 45°N.), mainly in the Sub-areas VIIIb and VIIIc. During the third quarter, the fishery is spread in the Bay of Biscay: the Spanish one in the Centre and in the South (VIIIb and c) and the French one in the Centre and the North (VIIIb and a). During the fourth quarter, the two fisheries are well separated, the Spanish one in VIIIc (close to the Spanish coast) and the French one in the North and the Centre of the Bay.

In Division IXa, only the Spanish catches are distributed by statistical rectangles and consequently, the catch distribution of the Portuguese catches in 1997 are not represented on these maps. In fact, the Portuguese landings were very low in 1997 and mainly caught during the first and fourth quarter in Sub-divisions Central North. The decrease in catches recorded after the record level of 1995 (7,056 tonnes) is continuing in 1997, especially in IXa North. The Spanish fishery is mainly located in the Bay of Cadiz. During 1997, in the Bay of Cadiz, the principal landings appeared during the first three quarters.

Table 9.2.1 shows the distribution of catches of anchovy by quarters for the period 1991–1997.

The distributions of fisheries in Sub-area VIII is rather constant during this period: the main fishing areas appeared in VIIIc and VIIIb in spring (mainly landings from the Spanish fishery) and in VIIIb and VIIIa during the rest of the year (mainly French fishery). However, we noticed since 1992, after the bilateral agreement between France and Spain (see Section 10.2), an increase of the catches in VIIIa particularly during the second half of the year.

In 1997, the distribution of catches in Division IXa appeared similar to those of the 1991–1994 period. The main fishery area is located in IXa South (Bay of Cadiz) during the first three quarters. The increase of catches recorded in IXa Central North and North in 1995 has not been observed in 1997. As the anchovy tends to be fished as heavily as possible because of its high price at the market, the changes in the landings will probably be reflecting variations in the abundance of the anchovy resources in those areas (Pestana, WD 1996). Historically, catches to the West of the Iberian peninsula (from Sub-divisions IXa Central and North) have shown episodic increases (Junquera 1986, and Pestana WD 1996), probably due to environmental favourable conditions (Uriarte *et al.* 1996).

Table 9.2.1 Catch (t) distribution of ANCHOVY fisheries by quarters and total in the period 1991-1997.

QUARTER 1	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Central	VIIIc East	VIIIb	VIIIa	VIIId
1991	1049	2	6	1	126	0	36	2797	1259	-
1992	1125	0	26	0	0	187	756	3666	958	-
1993	767	0	3	1	0	69	1605	4147	1143	-
1994	690	0	0	0	0	5	62	4601	786	27
1995	185	1	203	12	0	0	35		2380	
1996	41	0	1289	11	116	61	9	2345	0	-
1997	908	6.0	164	2	12	43	58	1548	925	-

QUARTER 2	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Central	VIIIc East	VIIIb	VIIIa	VIIId
1991	3692	0	10	14	90	295	5848	3923	650	-
1992	1368	0	10	0	11	457	17532	2538	275	-
1993	921	0	6	0	25	24	10157	6230	658	-
1994	2055	0	0	0	1	79	11326	6090	163	75
1995	80	7	1989	1233	23	36	14843		6153	
1996	807	1	227	6	1	404	9366	8723	0	-
1997	1110	2	49	4	0	81	4375	3065	598	-

QUARTER 3	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Central	VIIIc East	VIIIb	VIIIa	VIIId
1991	703	0	0	0	24	15	145	386	1744	-
1992	499	0	4	27	192	390	632	191	4108	-
1993	167	0	0	0	1	8	1206	1228	6902	-
1994	210	8	29	1	61	6	1358	2341	3703	15
1995	148	52	1817	4043	1	10	55		3620	
1996	586	0	189	22	134	146	1362	171	6930	-
1997	2007	0	44	2	202	3	735	4189	2651	-

QUARTER 4	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Central	VIIIc East	VIIIb	VIIIa	VIIId
1991	274	0	171	0	205	692	148	91	805	-
1992	4	1	96	6	8	18	204	27	5533	-
1993	105	1	13	0	0	0	574	1005	5106	-
1994	80	0	198	116	6	13	895	341	2520	14
1995	157	271	2716	42	398	148	18		2080	
1996	398	12	1002	5	21	12	158	204	4016	-
1997	589	0	353	54	93	83	530	1225	1354	-

TOTAL	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Central	VIIIc East	VIIIb	VIIIa	VIIId
1991	5717	3	187	15	445	1003	6177	7197	4458	-
1992	2996	1	136	33	211	1053	19122	6422	10874	-
1993	1960	1	22	1	26	101	13542	12609	13809	-
1994	3035	8	227	117	68	103	13641	13373	7172	130
1995	571	331	6725	5329	421	194	14951		14233	
1996	1831	13	2707	44	272	623	10895	11442	10946	-
1997	4614	8	610	62	307	210	5698	10027	5528	-

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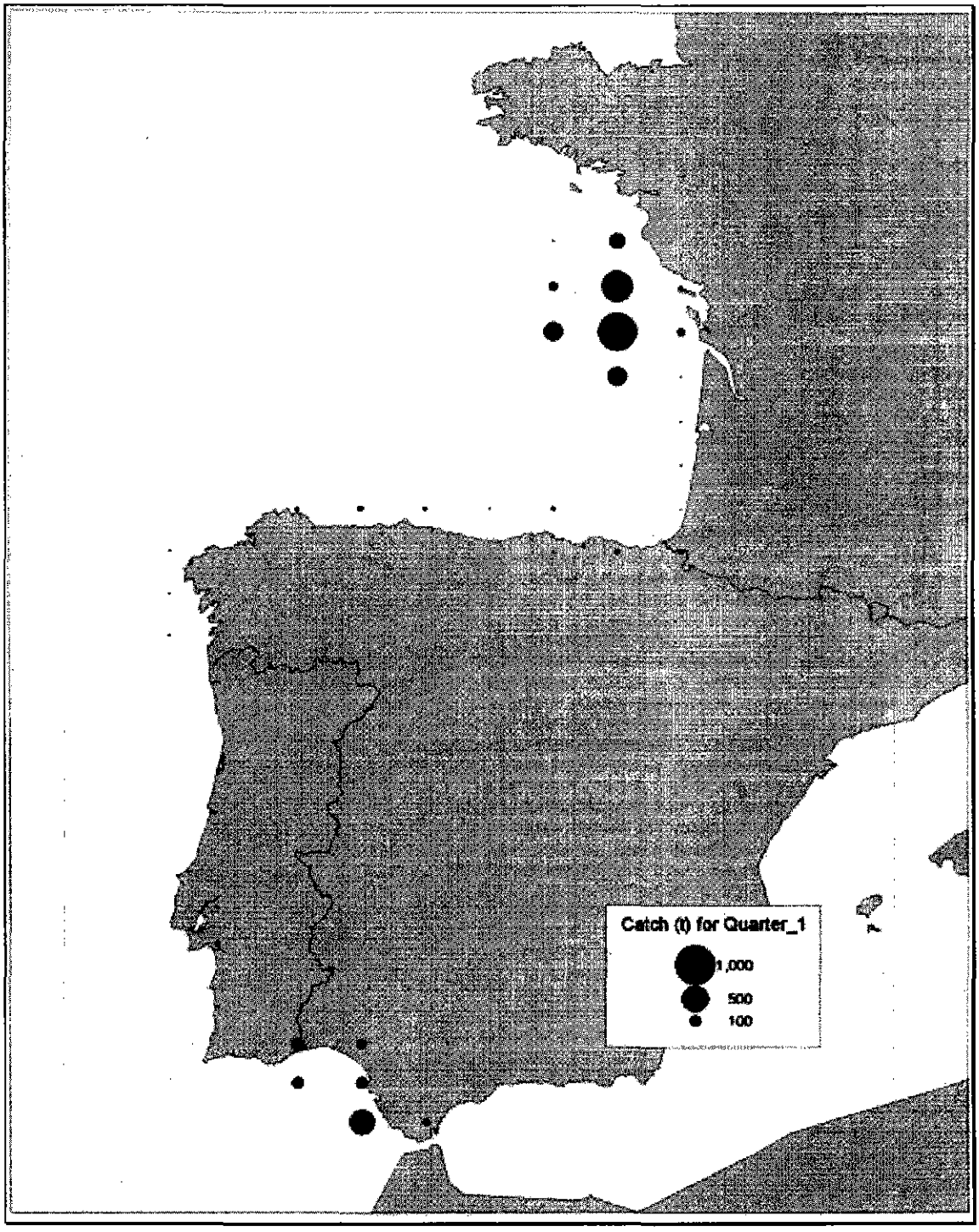


Figure 9.2.1a Distribution of Spanish and French anchovy fisheries for the first quarter.

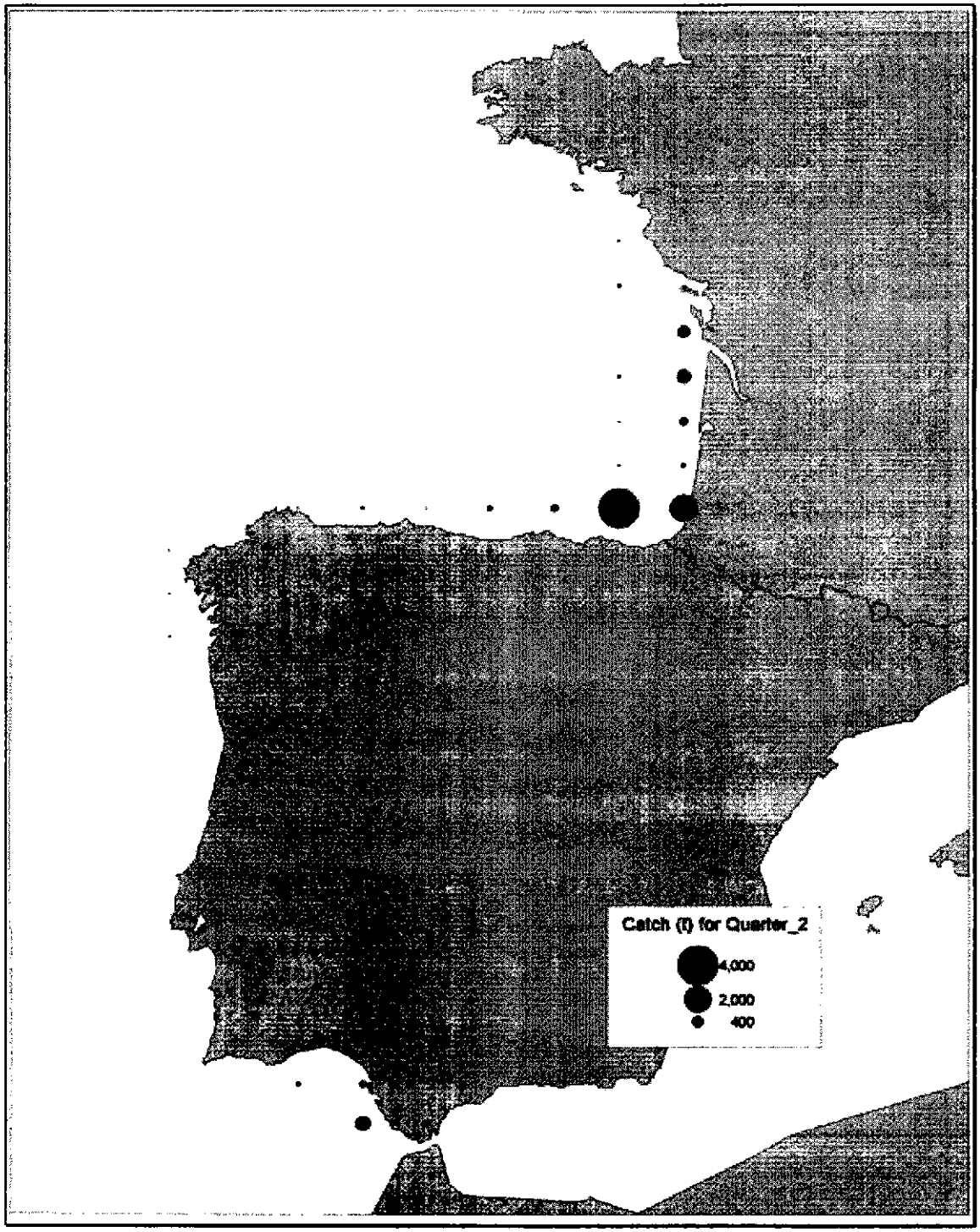


Figure 9.2.1b Distribution of Spanish and French anchovy fisheries for the second quarter.

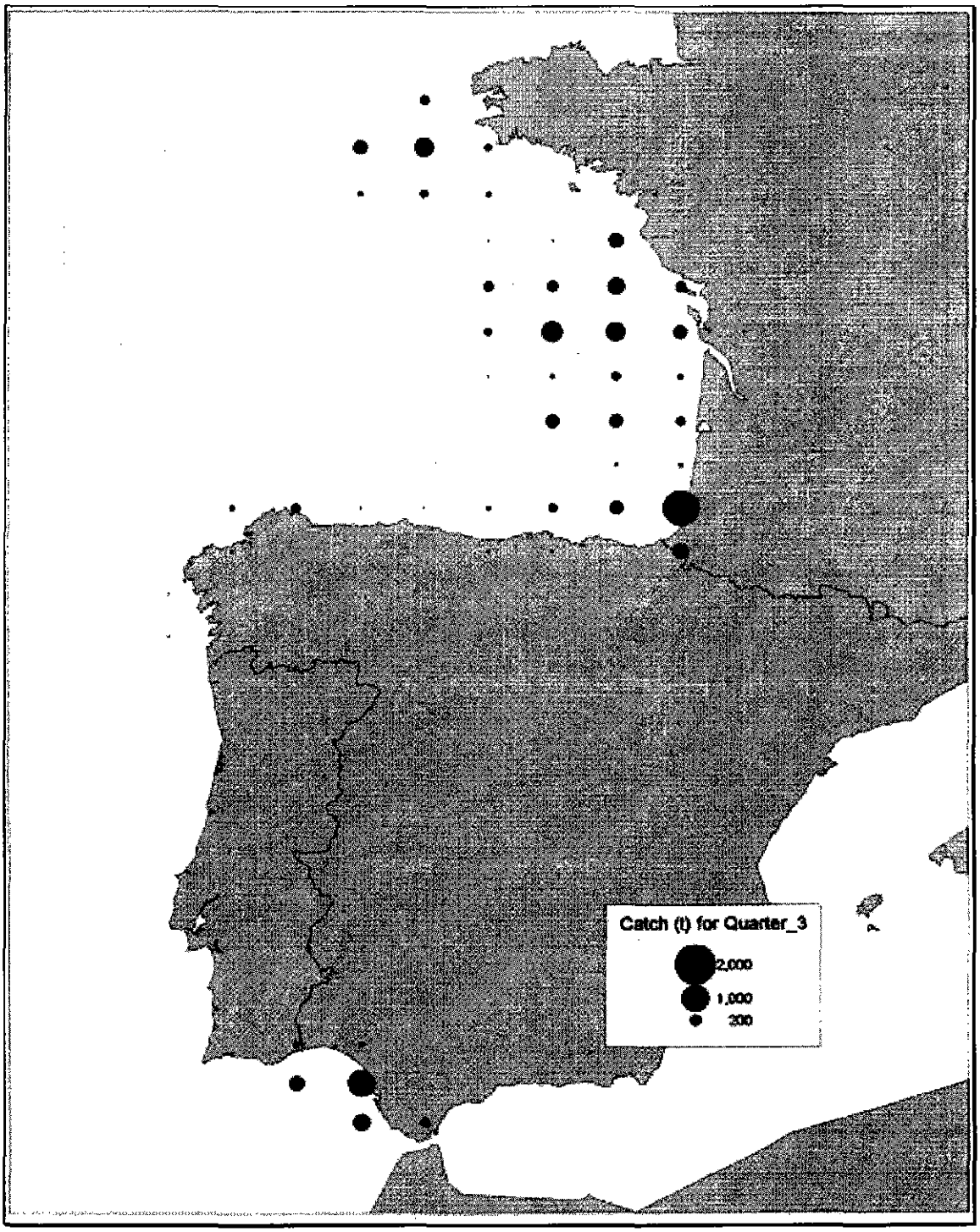


Figure 9.2.1c Distribution of Spanish and French anchovy fisheries for the third quarter.

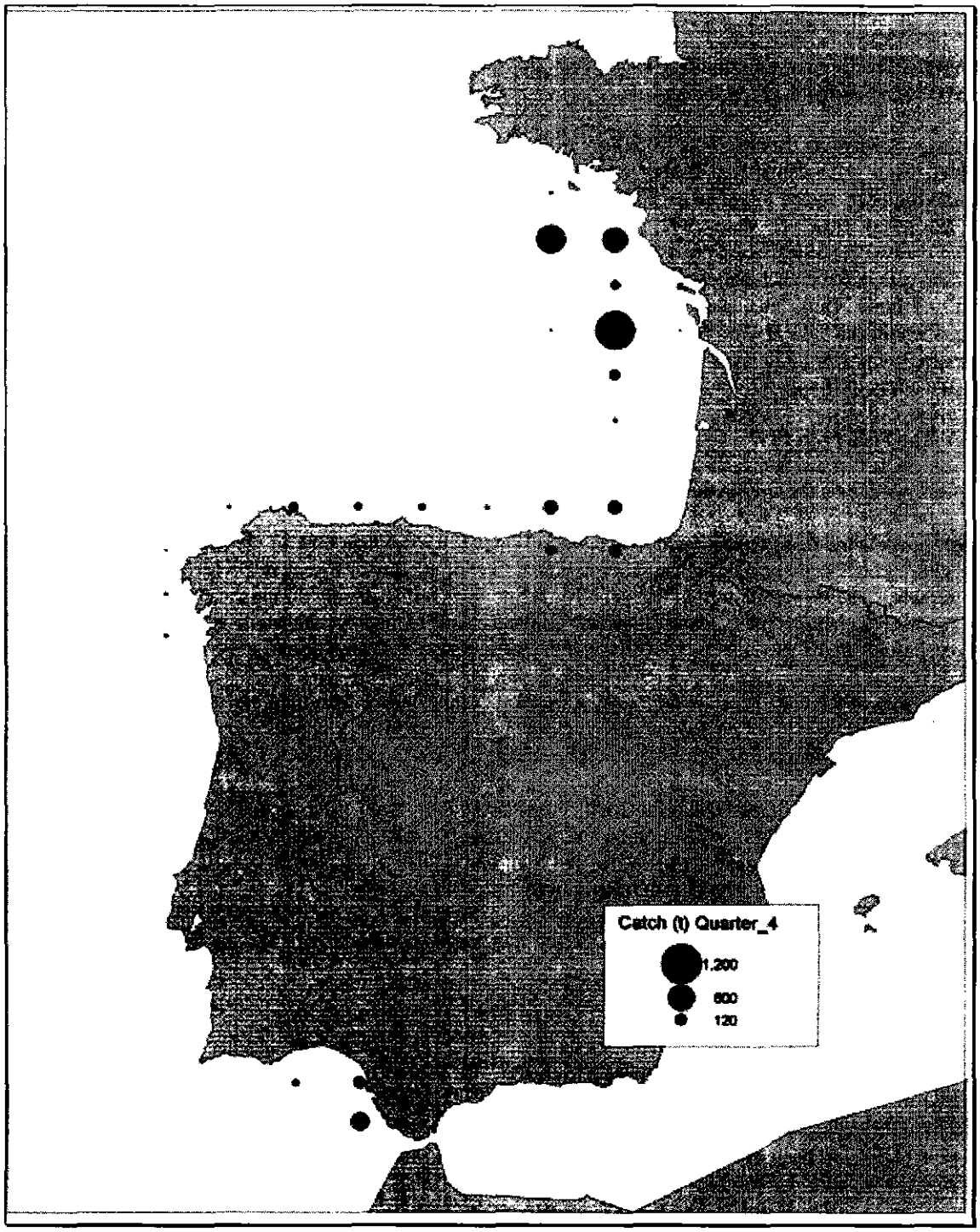


Figure 9.2.1d Distribution of Spanish and French anchovy fisheries for the fourth quarter.

10 ANCHOVY - SUB-AREA VIII

10.1 ACFM Advice Applicable to 1997 and 1998

ACFM reiterates the advice given in 1996 that a reduced fishing mortality on juvenile anchovy will increase the spawning biomass without a major loss in total yield. This may be achieved by closing fishing areas with high abundance of 1-group anchovy. Fishing for anchovy should be prohibited between January and June inclusive within the area defined by the following boundaries:

- from the Spanish coast north along longitude 1.35'W to latitude 44.45'N; west to longitude 1.45W; north to latitude 46.00'N and east to the French mainland.

No decision concerning the closing of fishing areas has been taken. Instead a TAC of 33,000 t was adopted by the managers for 1997, while the international fishery caught 22,337 t. Since the 1980s, the TAC of 30,000 t (33,000 t from 1996 onwards) has been agreed but often exceeded or not reached. The allocation key is 10% for France (3,300 t) and 90% for Spain (29,700 t). However, since 1992, a bilateral agreement between France and Spain modifies every year the quotas between the two countries. More precisely, 6,000 t from the Spanish quota are allocated to the French fleet for the second half of the year, if the French mid-water pelagic activity for anchovy stop during the main Spanish fishery in spring (from 20 March to 1 June). Thus this bilateral agreement between France and Spain allowed some decrease of the fishing effort in Spring when the anchovy is concentrated in the Centre of the Bay of Biscay for spawning. In addition to this, 6,000 t of the Portuguese quota from XIa are exchanged between Portugal and France since 1996, whereas all the French catches are made in the Bay of Biscay (Division VIII) and as such reported to this Working Group.

10.2 The Fishery in 1997

Two fleets operate on anchovy in the Bay of Biscay:

Spanish purse seine fleet: Operative mainly in the spring, when more than 80% of the annual catches of Spain are usually taken. This spring fishery operates at the south-eastern corner of the Bay of Biscay in Divisions VIIIc and b. Until 1995, the Spanish purse-seiners were allowed to fish anchovy in Sub-division VIIIb only during the spring season and under a system of fishing licences (Anon. 1988), while Division VIIIa was closed to them for the whole year. Since 1996, this fleet can fish anchovy throughout the year in Sub-area VIII with the same system of fishing licences.

The major part of this fleet goes for tuna fishing in summer time and by then they use small anchovies as live bait for its fishing. These catches are not landed but the observations collected from logbooks and fishermen interviews indicate that they are supposed to be less than 5 % of the total Spanish catches.

French pelagic trawlers: Operative in summer, autumn and winter. Until 1992, they also operated in the spring season, but due to a bilateral agreement between France and Spain the spring is not presently used as fishing season by the pelagic trawlers. The major fishing areas are the VIIIa and b in the first half of the year and VIIIa mainly during the second half. The VIIIc area is prohibited to the French pelagic fleet.

There are also some French purse-seiners located in the Basque country and in the southern part of Brittany. They fish mainly in the spring season in VIIIb.

10.2.1 Catch estimates for 1997

In 1997 a total of 22,337 tonnes were caught in Sub-area VIII (Table 10.2.1.1 and Figure 10.2.1.1). It is a 35% reduction compared to the level of 1996 catches. These are the lowest catches in the last 5 years. The reason of this drop comes mainly from the decrease of the Spanish catches, which have been halved from 1996 to 1997. The French catches have been reduced by 20%. The main Spanish fishery took place in spring (65%) and the main French fishery in the second half of the year (65%) (Table 10.2.1.2 and Figure 10.2.1.2).

In 1997, as in other years, the Spanish and French fisheries were well separated temporally and spatially. About 61% of the Spanish landings were caught in Division VIIIc and VIIIb in Spring, while the French landings were caught in Divisions VIIIb in winter (21%) or in summer in Divisions VIIIb and VIIIa (64%) (Table 10.2.1.3).

During the first half of 1998, total international catches reached 17,450 t (preliminary data). The Spanish fishery in spring has produced a very low level of catches (6,250 t) similar to the low level of 1997, whereas the French one, during the first half of the year, landed the best production of the series recorded. The strong reduction of the Spanish catches seems to be related to a problem of variation of the catchability (see Section 10.5).

10.2.2 Discards

It is believed than there is no discard in the Spanish fishery and the discards have not been recorded in the French fishery.

10.3 Biological data

10.3.1 Catch in numbers at age

The age composition of the landings of anchovy by countries and for the international total is presented in Table 10.3.1.1. For both countries the 1 age group largely predominates in the catches. For the international catches 1 year-old anchovies make up 75% of the landings, followed by age 2 with 15% The relevance of the one group is rather similar all over the year except for Spain in the fourth quarter where catches at age 0 become predominant. Approximately 25% of the catches of anchovy (in numbers) consists of immature fish prior to their first spawning in May.

The catches of anchovy corresponding to the Spanish live bait fishery for tuna fishing for the period 1987–1996 are given in Table 10.3.1.2. In 1997 catches at age 0 were rather important in comparison to the previous year catches. Live bait catches of anchovy are rather variable depending on the availability of the different small pelagic species which are used as live bait by this tuna fishing.

Table 10.3.1.3 records the age composition of the international catches since 1987, on a half-yearly basis. 1-year-old anchovies predominate in the catches during both halves of most of the years. A few catches of immature 0 age group appeared during the second half of the year. The estimates of the catches at age on an annual basis since 1997 are presented along with the inputs to the assessment in Table 10.8.2.1. The time-series of anchovy catches at age is given in Table 10.3.1.4.

10.3.2 Mean length at age and mean weight at age

Tables 10.3.2.1 and 10.3.2.2 show the length distribution of catches and the variation of mean length and weight by quarters.

For the first quarter, the main fishery which is the French one, fish in the central part of the Bay of Biscay medium size anchovy (grade of 50) Figure 10.3.2.1.

For the second quarter, the length distributions of the French and Spanish fisheries showed a bimodal distribution. For the French landings, the smaller group corresponds mainly to the production of small purse-seiner and pelagic trawlers fishing close to the shore. It is not the case for the Spanish landings. The Spanish fleet caught very small anchovies in spring even in offshore grounds. This year is characterised by an abundance of small size anchovies belonging to age 1 (Figure 10.3.2.2).

For the third quarter, the French and Spanish landings had roughly the same length distributions. We can notice for the French catches a bimodal distribution, the inferior fraction corresponds to the anchovy caught off the coast by the smaller boats (Figure 10.3.2.3)

For the fourth quarter, the size distributions of the French and Spanish landings were very different. That corresponds to productions made on separate geographical areas and characterised by different age compositions. The French landings, mainly 1 year olds, were caught off the north of the Bay of Biscay, whereas the Spanish ones, mainly 0 group, were caught off the VIIIc (Figure 10.3.2.4).

The series of mean weight at age in the fishery on half year from 1987 to 1997 is shown in Table 10.3.2.3. The French mean weights at age in the catches are based on biological sampling from scientific survey and commercial catches. Spanish mean weights at age were calculated from routine biological sampling of commercial catches.

The series of annual mean weight at age in the fishery is shown with the inputs to the assessment in Table 10.8.2.1. These annual values for the fishery represent the weighted averages of the half year values per country, according to their respective catches in numbers at age.

The values of mean weight at age for the stock appear with the inputs to the assessment in Table 10.8.2.1. These values are the ones estimated for the spawners during the DEPM surveys of 1990–1997 (reported in Cendrero ed., 1994 and Motos *et al.* WD 1998 and Uriarte *et al.* WD 1998). For the years when no estimate of mean weight at age for the stock existed (as in 1993 or 1996), the average of the rest of the years has been taken.

10.3.4 Maturity at age

As reported in previous years' reports, anchovies are fully mature as soon as they are 1 year old, at the following spring after they spawn. No differences in specific fecundity (number of eggs per gram of body weight) have been found according to age (Motos 1994).

10.3.5 Natural mortality

The natural mortality for this stock is high and probably variable. In previous Working Group reports, estimates of natural mortality were obtained from consecutive estimates of the population in numbers at age supplied by the DEPM method and the catches taken between surveys (ICES 1992/Assess:17). For the purpose of the assessment applied in the Working Group, a natural mortality of 1.2, fixed value around the historical average, is adopted.

In the framework of an international project between France and Spain (Project 95/018), a statistical approach to get better estimates of natural mortality will be available for next year.

10.4 Fishery-Independent Information

10.4.1 Egg surveys

Egg surveys to estimate the spawning stock biomass (SSB) of the Bay of Biscay anchovy through the Daily Egg Production Method (DEPM) have been implemented from 1987 to 1998, with a gap in 1993 (Table 10.4.1.1). A review of the most recent surveys since 1995 is presented in Motos *et al.* (WD 1998) and Uriarte *et al.* (for the year 1997 in WD 1998). In 1995 and 1997 biomasses of about 60,000 t of anchovy were estimated in the Bay of Biscay. These values are about the middle of the range of estimated spawning biomasses of the DEPM series. From the surveys of 1996 and 1998 only the total egg production is available. In the first case, this is due to the lack of adult sampling and in the second case it is due to the fact that there has not been sufficient time to process the adult samples so as to get the Daily Fecundity estimate. For these two years, a method to estimate the corresponding Spawning Biomass is described here below.

The series of surveys between 1987 and 1997 have shown a positive relationship between spawning area or total daily egg production and biomass (Motos *et al.* WD 1998). Both relationships may be used to obtain estimates of the SSB for the years 1996 and 1998 and this is done in Motos *et al.* (WD 1998). However, a better model for these estimations may be found in taking into account the Daily Egg Production per surface unit and the total positive spawning area:

The formulation of the estimate of the SSB by the DEPM was defined by Parker (1980):

$$SSB = K*P0 * A / DF$$

with SSB (in tonnes); P0 (in number of eggs per 0.5 m^2); A (in km^2) and DF (daily fecundity in number of eggs per g of fish); K is the scale factor.

In last year's report we used the following log linear model (CM 1998/Assess:6):

$$LN(SSB)= a1LN(A) + a2LN(P0) + \xi. \quad (1)$$

In fact, we assumed that the source of variation linked to the daily fecundity was negligible. To take into account this source of error and to diminish the term of residual variance, we have incorporated a constant which represents the ratio of the scaling factor (K) on the daily fecundity (DF).

To extrapolate the biomass from the variables P0 and A, we have linearised this non-linear model with a logarithmic transformation of the variables to have an additive model and to take into account that all these variables are measured with error, thus we have the following statistical model:

$$\mathbf{LN(SSB) = \alpha LN(P0) + \beta LN(A) + cste + \xi}$$

which has a linear form (Y = ax1+bx2 + cste + residuals). The constant term gives us a mean estimate of the daily fecundity.

The regression analysis performed on the data of Table 10.4.1.1 gives a very good explanation of the variance observed multiple $R^2 = 0.987$ (Table 10.4.1.2). The percentage of variance explained is higher than those obtained last year with

the model (1) (R^2=0.91) (see CM 1998/Assess:6, page 305). The values of the coefficient of P0 and (A: spawning area) and the constant term are shown in Table 10.4.1.3 with their standard errors.

The relationship obtained has the following equation:

LN(biomass) = 1.309*LN(spawning area) + 0.684*LN(P0) - 3.927

The 3 parameters used in that model explained the main part of the variance observed (Table 10.4.1.3). No distortion or strong tendencies of the residuals have been observed as we can see in Figures 10.4.1.1 and 10.4.1.2.

The estimates obtained by the loglinear equations of Biomass versus Spawning Area (A) and P0 are very closed to the observed values and the model fits well the variation of the Spawning Biomass according to the parameters used (Figures 10.4.1.3 and 10.4.1.4).

Table 10.4.1.4 gives the estimates from the loglinear model and shows the close fitting obtained. For 1996 and 1998, in using the statistics of the regression line (Table 10.4.1.2), we estimated respectively the biomasses at 34,540 tonnes with a range (-/+ one standard error) of 30,180–39,525 tonnes and 115,114 tonnes with a range of 100,610–131,800 tonnes.

The DEPM surveys are considered to be unbiased and to produce absolute figures of biomass. The composition of the population was derived for the surveys from 1987 to 1997 (except for 1993 and 1996), based on the adult sampling performed during these surveys. However, in 1987 and 1988 the adult sampling did not cover the whole spawning area of anchovy and therefore some assumptions about the composition of the population in the unsampled area had been made. Consequently, the age compositions for the DEPM surveys in 1987 and 1988 are less reliable. The 1995 and 1997 population estimates at age are new inputs for this year's assessment.

The surveys consistently show that the major fraction of the population is always the one year old anchovies and therefore the population is driven year after year by the recruitment at age 1.

10.4.2 Acoustic surveys

The French acoustic surveys aimed estimates available up to now since the 1983 figure in Table 10.4.2.1. The figures for 1991 and 1992 were revised and updated for a FAR programme on anchovy (Cendrero ed. 1994). In 1993, 1994 and 1995, only observations concerning the ecology of anchovy, especially located close to the Gironde estuary (one of the major spawning areas for anchovy in the Bay of Biscay) were made. In 1997, a new acoustic survey was performed for anchovy in the French waters, mainly to study the behaviour of the species in the central part of the Bay (close to the Gironde estuary) and to investigate the relationships between ecology of anchovy and its environment. The values of the estimates of anchovy obtained from that survey are also included in Table 10.4.2.1.

According to the discussion which took place in 1993 (Anon. 1993/Assess:7), the acoustic values are considered to be relative indices of abundance and the values of 1983 and 1984 seem to be underestimated.

The PEGASE98 survey has been carried out on board the R.V. "Thalassa" from 20/5 to 21/6 1998. The objective of the first part of the survey was to study the distribution and the abundance of pelagic species present in the area, associated to environmental conditions. The objective of the second part of the survey was to study the primary and secondary productions associated with environmental conditions in some study areas determined during the first part.

Acoustic data have been stored along 2,500 nautical miles and echo-traces were identified from 34 fishing operations (32 with a mid-water trawl and 2 with a bottom trawl). A first calculation has been done for the area covered by "Thalassa" from 20/5 to 7/6 1998 for anchovy and sardine (Figure 10.4.2.1).

Four areas have been considered according to species assemblage and aggregation types:

	Anchovy	Sardine
Gironde	24,400 t	1,200 t
Arcachon	350 t	0 t
Adour	27,450 t	1,550 t
Offshore	14,800 t	6,400t
Total	67,000 t	9,150 t

The data are not yet processed in totality, but some main conclusions may already noticed in comparison to last year's survey (PEGASE97):

- In front of the Gironde, the community of small anchovy and sprat was well present as every year.
- The total biomass is similar to the one of 1997, but its distribution is much more scattered in a very large geographical area.
- Big anchovy appears continuously from the south of the Bay of Biscay to 45.40'N from about 100 m depth to the shelf break, mixed with mackerel and horse mackerel.
- On one hand, sardine which was omnipresent last year (between 150,000 and 200,000 tonnes) was almost missing this year in the prospected area (about 10,000 tonnes).
- On the other hand, mackerel which was very rare last year, was present this year most of the time with horse-mackerel.

As a preliminary conclusion, anchovy in 1998 occupied a very large area and shared space with horse-mackerel and mackerel instead of sardine last year.

10.5 Effort and Catch per Unit Effort

The evolution of the fishing fleets during recent years is shown in Table 10.5.1. The French mid-water trawlers involved in the anchovy fishery has increased continuously up to 1994. Afterwards, this fleet has been slightly decreasing. Therefore, it seems that after the rapid increase of the French fishing effort since 1984, we observe a certain reduction of the fishing effort for the last years, according to the slight decrease in the number of vessels involved in the fishery. The main fishing effort is concentrated in the central and north part of the Bay of Biscay in the second half of the year for the French fishery, whereas for the Spanish one, the main fishing season takes place during the first half of the year in the south-eastern part of the Bay.

The fishing effort developed by the two countries is nowadays similar although the fishing pattern is different. The current effort may be at the level that existed in this fishery at the beginning of the 1970s (Anon. 1996/Assess:2).

The CPUE of the Spanish purse-seiners during the spring fishery for anchovy is shown in Table 10.5.2. This index is spatially linked with the anchovy abundance in the southern area of the Bay of Biscay and also, although less closely, to the evolution of the biomass of the whole population in the Bay of Biscay, as measured by the daily egg production method (Uriarte and Villamor, WD 1993). The indices for the first half of 1997 and 1998 showed strong decreases of CPUE for the total catch, suggesting a decrease of the population in these two recent years. The DEPM estimates of biomass showed, however, that this is not the case and therefore such a decrease must come from other reasons. In 1997, the small size of anchovy caught has interfered with the normal development of the fishery because the Spanish markets are not interested in buying anchovies of small sizes (only for fresh consumption). This and the bad weather conditions largely reduced the potential of catching (and selling) of the fleet. In 1998 the DEPM survey has shown that anchovy concentrations at the south of the Bay of Biscay were weaker than in other years. This area is the one where the Spanish purse seiners mainly operate. Thus, the vulnerability of the anchovy population to this fleet may have been reduced. Therefore in these last two years the catchability of the Spanish purse seine fleet has probably been reduced.

10.6 Distribution of Anchovy

See Section 9.2.

10.7 Recruitment Forecasting and Environment

The anchovy spawning population heavily depends upon the strength of the recruitment at age 1 produced every year. This means that the dynamics of the population directly follow those of the recruitment with very small buffer. The forecast of the fishery and the population therefore depends on the provision of an estimate of next year's anchovies at age 1. Given the absence of quantitative recruitment surveys, the only information presently available is that concerning the influence of the natural environment on the recruitment of anchovy.

Borja *et al.* (1996a and *in press*) have noted that oceanographic environment produced by northern and eastern winds of medium and low intensity blowing in spring and early summer in the Bay of Biscay seems to induce good levels of recruitment at age 1 for the next year to the anchovy population. This result was initially established for the period 1967–1989, relating an Index of Recruitment obtained from the fishery since 1967 (Uriarte 1993) with an upwelling index obtained from wind strength and direction from satellite data over the major spawning areas of the anchovy in the Bay of Biscay. Borja *et al.* (*in press*) have confirmed those results up to 1996. The potential use of this Index of Upwelling for the forecasting of recruitment for the Bay of Biscay anchovy has already been suggested in the previous years. This index explained 51% of the variance of the recruitment from 1986 to 1996 resulting from the assessment of last year's Working

Group (Anon. 1998). The estimates of this Upwelling index since 1986 are reported in Table 10.7.1 (from Borja *et al.* WD 1997) updated with the 1998 estimate.

Since this index is not an observed values but a calculated one, it has been considered that it should only be used to improve the projections of the fishery over 1998 and forecast for 1999 (helping for the estimations of the anchovies at age 0 in both years). Its reliability as a predictor should be evaluated from its fitting to the recruitment estimates of the assessment for the previous years. The *a priori* basis for a relationship between the upwelling index and anchovy recruitment is not well understood. For that reason in the assessment the upwelling index will be entered with a very low weighting factor in such a way as to only influence the estimates of recruitment for the more recent years, when no other or very little information is available.

10.8 State of the Stock

10.8.1 Data exploration and models of assessment

As anchovy is a short living species, no convergence of any VPA can be expected. For that reason, the assessment of the anchovy fishery performed up to now has been based on fitting a separable selection model for fishing mortality with the auxiliary information provided by the direct estimates of biomass and population in numbers at age. The acoustic and egg surveys performed by France and Spain have allowed such an analysis. Although the CPUE of the Spanish purse seiners is available, it has never been included in the assessment because of the likely changes in the catchability of these types of fleets, inversely to the size of the stock (Csirke 1989).

Potentially the current approach could be improved by moving on to a seasonal assessment of the fishery, where the different seasons and fleets could be further studied and described in their fishing patterns. The PSEP programme of R. Cook (1996) which uses a seasonal separable model could be used. Although some work is done in that direction, no result is still available.

Tuning the assessment using the DEPM and acoustic indexes both as aggregated indices of biomass and as aged structured indices was questioned in the ACFM minutes of 1997, because of the double (redundant?) use of the same information in two distinct forms. It is true that the same direct estimate is introduced twice into the assessment but the information contained is really different. The influence that would have on the assessment the use of the survey estimates (acoustic and DEPM surveys) solely as aggregated indexes of biomass or alternatively as aged structured indexes was tested by performing assessment runs for these choices. This was made with the ICA programme and is presented in Table 10.8.1.1 and Figure 10.8.1.1, together with the assessment adopted by the Working Group this year (see below). No major difference appears in terms of recruitment or biomass estimates. However the fishing mortality estimates are smaller when only the indexes of Spawning Biomass tune the assessment. This means that rather different population structures may fit the biomasses equally well, implying rather different fishing mortality estimates by the assessment. Therefore, it was judged preferable to use the aged structured indexes rather than the SSB indexes alone. However, due to the fact that the aggregated SSB indexes are the only figures available for the current year 1998 (and for 1996), the elimination of this type of information reduces the help the survey provides to predict 1998 onwards. For that reason, the Working Group decided to let the information provided by the surveys tune the assessment in both ways as Biomass (t) and age disaggregated (numbers) indexes of the Spawning Population. In order to somehow counterbalance the double use made of the information of each survey in the assessment, the weighting factors have been set to 0.5 for all these inputs so that the information contained in the matrix of catches at age receives about similar weight as each of the surveys tuning indices. Another way of overcoming this situation would be producing a tuning to the biomasses and to the percentages at age in the population obtained from the surveys, provided that the latter information is almost independent of the biomass estimates. However, this would imply modification of the ICA programme and was delayed until this facility is provided by the programme.

10.8.2 Stock assessment

An Integrated Catch at Age analysis, which assumes a separable model of fishing mortality, has been used for the assessment of the anchovy in the Bay of Biscay from 1987 to 1997 (with the ICA package, Patterson and Melvin 1996). The assessment is defined almost similarly to the one implemented in 1997 for the period 1987–1996. Small differences appear in the weighting factors and the inclusion of the Upwelling index. Inputs are summarised in Table 10.8.2.1. The assessment uses as tuning data the DEPM (1987–1997) and the Acoustic (1989–1998) figures as biomass and as population numbers at age estimates. The Acoustic and DEPM estimates are considered as relative and absolute estimates respectively and are downweighted to 0.5. For 1996 and 1998, the DEPM SSB biomasses included in the assessment are the ones obtained from the combined log-linear model of spawning area and daily egg production per unit area explained in Section 10.4.1. The index of upwelling in the Bay of Biscay (see Section 10.7) has been included in the analysis in order to help the assessment in the determination of the most recent recruitments (those of 1997 and 1998). The relative weight given to these tuning data

has been set low (at 0.1) in such a way as not to condition the output of the assessment except for the years where none or little information is available (i.e. the recruitment at age 0 of the most recent years: 1997 and 1998). The tendency observed in the residuals for the relationship among recruitment and upwelling index values is corrected by the use of an exponential model. That allows to have a better fit reducing the variance from 0.16 for the linear mode versus 0.05 for the exponential model.

The assessment assumes a constant natural mortality of 1.2, around the average value estimated earlier at this Working Group (Anon. 1995/Assess:2). The assessment starts in 1987 when the DEPM began to be applied. The separable model of fishing mortality is applied over the whole set of years (1987–97). However the catch data of 1987 and 1988 are downweighted in the analysis because for those years the French catch at age data are considered to be more unreliable than for the rest of the years. In addition, the DEPM population as numbers at age estimates for those years, was not as reliable as for the following ones.

Ages 4 and 5+ are heavily downweighted (to 0.01) due to the small fraction of the catch they represent and to the large imprecision of the estimates. A shift of the age plus from 5+ to 4+ or even 3+ was suggested in the minutes of the ACFM (1997), given the few catches presented in these age groups. This possibility has not been tried for the assessment with the ICA package since moving the age plus to 4+ would imply fixing the selection pattern for age 3. Given that the age 2 which is the reference age for the separable model is already fixed, the only estimate allowed to the assessment would be that of selectivity at age 1 and 0. If the plus group were set at age 3, then no selectivity would be estimated by the assessment except that of age 0. For these reasons the age group plus has not been changed from age 5. The strong downweighting of ages 4 and 5+ should ensure that they do not interfere with the assessment of the other true ages.

The model was fitted to all these inputs by a non linear minimisation of the following objective function:

$$\sum_{a=0}^{a=4}\sum_{y=87}^{y=97}\lambda_{a,y}\left(Ln\left(C_{a,y}\right)-Ln\left(F_y\cdot S_a.N_{a,y}\right)\right)^2$$

$$+\lambda_{DEPM}\sum_{y=87}^{y=98}\left[\ Ln\left(SSB_{DEPM}\right)-Ln\left(\sum_{a=1}^{5}N_{a,y}\cdot O_a\cdot W_{a,y}\cdot\exp\left(-P_F F_Y\cdot S_a-P_M.M\right)\right)\ \right]^2$$

$$+\sum_{y=87}^{97}\sum_{a=1}^{3+}\lambda_{DEPM,a}\left[Ln\left(SP_{DEPM,a,y}\right)-Ln\left(N_{a,y}\cdot\exp\left(-P_F\cdot F_y\cdot S_a-P_M\cdot M\right)\right)\right]^2$$

$$+\lambda_{acoustics}\sum_{y=1989,91,92,97}^{98}\left[Ln\left(SSB_{acoustic}\right)-Ln\left(Q_{acoustic}\sum_{a=1}^{5}N_{a,y}\cdot W_{a,y}\cdot\exp\left(\ -P_F F_Y\cdot S_a-P_M.M\ \right)\right)\right]^2+$$

$$+\sum_{y=89,91,92}^{97}\sum_{a=1}^{2+}\lambda_{acoustics,a}\left[Ln\left(SP_{acoustic}\right)-Ln\left(Q_{a,y}\cdot N_{a,y}\cdot\exp\left(-P_F\cdot F_Y\cdot S_a-P_M\cdot M\right)\right)\right]^2$$

$$+\sum_{y=87}^{98}0.1\cdot\left(Ln\left(U_y\right)-Ln\left(Q_0 {N_0}_y{}^k\right)\right)^2$$

with constraints on : $S_2 = S_4 = 1$ and $F_{98} = F_{97}$

and $\overline{N}$: average exploted abundance over the year.

N : population abundance on the first of January.

N_0 : number of 0 group anchovy.

O : maturity ogive, percentage of maturity.

M : Natural Mortality.

F_Y : Annual fishing mortality for the separable model.

S_a : selection at age for the separable model.

P_F and P_M : respectively proportion of *F* and *M* occurring until mid spawning time.

$C_{a,Y}$: catches at age *a* the year *Y*.

Q_a and $Q_{a,Y}$: catchability coefficients for the acoustic survey.

SSB_{DEPM} and SSB_{acoust} : Spawning Biomass estimates from DEPM and Acoustic methods.

SP_{DEPM} and SP_{acoust} : Spawning populations at age from DEPM and acoustic methods.

U_y is the Upwelling index for year y.

Q_0 catchability coefficient for the upwelling index.

K Coefficient of the power function fitted for the relationship between Upwelling and Recruitment.

$\lambda_{a,Y}$: weighting factor for the catches at age (set respectively to ages 0 to 5 at 0.1, 1, 1, 1, 0.01, 0.01).

Others λ are the weighting factor for the indices and/or ages (see last portion of Table 10.8.2.1).

Results of the assessment are presented in Table 10.8.2.1 and Figure 10.8.2.1.

10.8.3 Reliability of the assessment and uncertainty estimation

In comparison with the results of Anon. (1998) the assessment gets a better definition of the fishing mortality for the last year of the assessment (1997), according to the curve of Residual sum of squares of the model to the tuning indexes according to that fishing mortality (see Figure 10.8.2.1). The assessment is primarily driven by the Spawning Biomass estimates produced by the DEPM; this is the longest and most consistent independent estimate of the population in absolute terms. This index shows a defined minimum at the converged level of fishing mortality in the analysis. The log-variance of the populations estimates from the model versus the tuning indices seems reasonable, but the strong variations in abundance from year to year suggested by the direct DEPM estimates are not followed in parallel by the model (see Figure 10.8.2.1). The separable model presents rather big levels of absolute residuals both across years and ages, performing the best for age 1 (the most important age group in catches).

The severe changes in fishing mortality from 1996 to 1997 will be due to the strong reduction in the catches compared to the increase in biomass from 1996 to 1997. The Spanish purse seine fishery had difficulties in 1997 to find big anchovies suitable for the market, this together with bad weather largely reduced the potential of catching (and selling) of the fleet. It is remarkable as well how the fishing mortality varies according to the size of the stock, so as to increase strongly at low levels of biomass as the case of 1991 and 1996 exemplifies.

Figure 10.8.3.1 compares the series of recruitment, fishing mortality and spawning biomass obtained from the assessments made in 1997 (Anon. 1998) and the one calculated here. The two assessments are rather similar except for the last two years (mainly 1996). The reason for such divergence comes from the new information introduced to the assessment, i.e. the DEPM population at age estimates for 1995 and all the information on biomass and age composition coming for 1997 and 1998 from the acoustic and DEPM surveys. Different trials not presented here have shown that this difference is not due to the different weighting factors given to the fleets neither to the inclusion of the upwelling index. The Working Group considers that this assessment shows reasonably well the recent trends in population abundance and fishing mortality according to the information available. From the output stock summary the only reference about the stock size has to be the spawning biomass and not the total stock size because the latter includes the biomass of the age 0 group at the beginning of every year (when it does not exist). The stock summary of this assessment is presented in Figure 10.8.3.2.

10.9 Catch Prediction

Deterministic catch forecasts are made on the basis of the number of fish at the beginning of 1998 estimated by the ICA, which include the recruitment at age 0 fitted by the assessment according to the Upwelling Index for the Bay of Biscay in 1997. For 1999 onwards the recruitment at age 0 is set equal to the geometric mean of those estimated since 1987 (14,098 millions). Weights in the catches are the average values recorded since 1987 and weights in the stock are the average values input to the assessment since 1990 (when they began to be correctly estimated). Two projections are presented: the first assumes catches at $F_{status\ quo}$ (the mean of the last three years of fishing mortality estimates) in 1998. The second one assumes a catch constraint at 25,000 tonnes in 1998 (Table 10.9.1).

The former suggested catches at 64,000 t in 1998 which is totally impossible due to the TAC regulation and gives an SSB of 30,500 t in 1999 at $F_{status\ quo}$. The latter takes a catch constraint of 25,000 t in 1998, which correspond to a more realistic figure for this year than the one obtained from the previous option. This is due to the strong reduction of F recorded in 1997, probably linked to a temporal reduction of catchability of the Spanish purse seine fleet. In this case, the SSB expected for 1999 at $F_{status\ quo}$ is 40,500 t.

The uncertainties associated to this deterministic projection are strong due to the high variability of natural mortality and of the recruitment itself, before taking into account all the other uncertainties of the values of the parameters estimated by the ICA model.

10.10 Short-Term Risk Analysis

If medium-term projections refer to the period between the assessment and the time when the most recently assessed year classes will not contribute any more to the catches of the fishery, then for the Bay of Biscay anchovy this period is probably two years including the current one. For that reason a probabilistic forecast of the fishery in 1998 and 1999 has been performed in order to check the risk for the spawning stock of falling below the B_{lim} of about 18,000 t in 1998, 1999 and 2000. This has been done with a simulation using the same inputs as the deterministic short-term forecast but using an F multiplier of 1 for 1999 and 2000, whereas for 1998 an F multiplier corresponding to the deterministic catch constraint of 25,000 t has been assumed as starting point (= 0.33).

The method of Cook (1993) was used with the inputs shown in Table 10.10.1. The results, in Figure 10.10.1, show catch probability plots for 1999 and SSB probability plots for 2000. For example, catches above 43,000 t in 1999 will likely be produced by a higher fishing mortality than the one estimated between 1995 and 1997 for the fishery. On the other hand, the probability of the SSB in 2000 of being above B_{pa} (= B_{pre} = 36,000 t) would be about 50%.

The sensitivity analysis of the short-term forecast (Figure 10.10.2) shows a high sensitivity for the yield 1999 to several factors (negatively with natural mortality and positively with abundance of age 1, weight at age 2 in the catch and the effort multiplier in 1999). For the SSB in the year 2000, a high sensitivity to the variation of the 5 first factors is observed (negatively influenced by the natural mortalities in 1999, and positively by the maturity at age 1, the recruitment in 1999 and its mean weight at age 1 in 2000).

10.11 Medium-Term Predictions

As mentioned before, medium-term and short-term approaches to predictions are the same for this species (see Section 10.10).

10.12 Long-Term Yield

Figure 10.12.1 shows the Yield and Spawning Biomass per Recruit (SBR) compared with the virgin state using the mean of the fishing mortalities at age (1–3) estimated for the period 1995–97, increased and decreased by 1 standard deviation. This figure shows that in the current situation the biomass per recruit of the population is close to be reduced (but not yet) to about half of that expected without any fishery. Therefore, the %SBR obtained for this population is slightly above 50%, which satisfies the criteria %SBR of Macer and Sissenwine (1993) for pelagic species. In conclusion, the pattern of fishing mortality of this fishery could be sustainable from a long-term point of view, provided that the risk of overfishing at low levels of abundance is avoided by a close monitoring of the fishery coupled with an adaptive and fast managing system. From Figure 10.12.1 it can be seen that with geometric mean recruitments and current *status quo* F, catches around 30,000 t can theoretically be expected from a long-term point of view (although always subject to the unavoidable recruitment fluctuations).

10.13 Reference Points for Management Purposes

The exploitation of pelagic species should be undertaken with special care, keeping the exploitation of the stock at a moderate level of fishing mortality due to the risks of overfishing at low levels of biomass of this species and taking into account the historical collapses of several of these stocks (Ulltang 1980, Csirke 1988, Pitcher 1995). In this sense, Macer and Sissenwine (1993) state that the higher the natural mortality, the bigger should be kept the percentage of spawning biomass per recruit in relation to the virgin state (the criteria of %SBR). They also indicate that the small pelagic species could be poorly resistant to exploitation and for these species the %SBR corresponding with F_{med} can be as high as 40% or even in some cases 60%. Patterson (1992) suggests that a moderate and sustainable rate of exploitation could be reached at 0.67 M. However, one problem associated with these reviews is that they are based on the knowledge of medium size and not short living species as anchovy. Nevertheless, at the current state of knowledge of this species, they may be taken as an indication of sustainable levels of fishing mortality.

The current levels of fishing mortality (F_{bar} for the ages 1–3 at about 0.82) are below the likely 1.2 value for natural mortality, therefore it meets the criteria of Patterson (1992). The exploitation pattern indicates a negligible exploitation of the 0 group and a moderate fishing pressure on the age 1, far below the one exerted over the two and older years-old anchovies. Although the population consists mainly of 1 year-old anchovies that reach their first maturity in May–June, more than half of the fishing mortality on this age group takes place during and after the spawning season and therefore a high percentage of the population is able to spawn. On the basis of these considerations, it can be said that the current exploitation pattern regarding 1 year old anchovies is generally conservative.

The Study Group on the Precautionary Approach to Fisheries Management (CM 1998/ACFM:10) made some suggestions concerning the Reference Points for Management Purposes made by the Working Group last year. Particularly, it suggested a reference F_{pa} for the anchovy population at the level of 50% of the SPR which corresponds to a value around 1.0 to 1.2 just at or below the natural mortality.

A reference F_{pa} for this population can be suggested at the level of 50%SBR what seems to be, with the current fishing pattern, at an F_{bar} for ages 1–3 at about 1, so just at or below the average natural mortality. The current fishing levels seem to be below the F_{pa} (see Figure 10.12.1) and therefore not at a critical level. However, taking into account a) the likely variability of the natural mortality, b) the uncertainties of the assessment (specially for the latest levels of F) and c) the risk in the fisheries of small pelagics of increasing catchability at low levels of biomass, it seems that it could be difficult to

manage from mortality targets to a given mortality value. In addition, the changes of fishing mortality by changing the fishing effort are hardly to be implemented.

For that reason, the Working Group considers that it is more efficient for the managers to have a clear and simple guideline, from the data given by the direct estimates of the spawning biomass, on the level corresponding to B_{lim} and B_{pa}.

In last year's report (ICES CM 1998/Assess:6:) we estimated the value of B_{lim} equal to 18,000 tonnes of anchovy which corresponds with the minimum biomass below which the stock has a high probability of collapse. This reference was also supported by the Study Group on the Precautionary Approach to Fisheries Management (CM 1998/ACFM:10). The Working Group defines another precautionary level which is the B_{pre}: precautionary biomass. This level was defined as the double of B_{lim} and set at 36,000 tonnes. This can be a level used for B_{pa} but on a short-term period (2 years).

The new observations made in 1997 and in 1998 and the knowledge gathered on this stock since 10 years makes that position stronger. The only way to manage this stock from a concrete point of view is to evaluate the biomass each year, from the direct estimation methods (DEPM or/and acoustic) and to evaluate the strength of the recruitment (environmental indices - see Section 10.7). In any case, the fishery would be closed or strongly reduced if the biomass is around B_{lim}. For convenience these arguments were repeated below.

B_{lim}: For anchovy this level of Biomass should be set at the minimum biomass below which the stock has a high probability of collapse. Preliminarily, it could be defined as the lowest estimated spawning stock biomass (from the assessment) over the past ten years (18,000 tonnes in 1989, see Table 10.8.2.1). Although in this year a good recruitment was produced, this level of spawning biomass is so small that good recruitments at lower biomasses should not be expected. Therefore, this level of spawning biomass should be considered as B_{lim}, below which there is a serious risk of stock collapse. The definition is consistent with the definition of MBAL previously accepted for this stock (set between 15,000 to 20,000 tonnes at the lowest DEPM estimates of biomass in 1989 and 1991, see Table 10.4.1.1).

B_{pre}: A useful reference for the precautionary approach on levels of biomass should be the definition of a precautionary biomass (B_{pre}), slightly different to B_{pa} for management purposes. It is the spawning biomass which allows, under poor recruitment conditions, to obtain a minimum spawning biomass for the following year at the level of B_{lim}. In this way, the management would preserve a minimum SSB in the next year, at least around B_{lim} to prevent as soon as possible the collapse of the fishery. The past experience shows that an SSB between 30,000 tonnes or 40,000 tonnes gives a biomass of 2 year-olds which allows, with a small recruitment, to have in the next spring a biomass at the B_{lim} level. Using the Separable model of the assessment, a fishing mortality *status quo* at the 1995–97 level and the poorest recruitment at age 0 estimated by the model (3,641 millions in 1988), a spawning biomass of about 39,000 t would be required in the year of management to sustain a spawning biomass at B_{lim} in the following year. Taking into account these considerations and given the uncertainties in the assessment and the natural variability of this fishery we suggest to take a B_{pre} at a level doubled of the B_{lim}: 36,000 t.

10.14 Harvest Control Rules

The Study Group on Precautionary Approach to Fisheries Management did not propose any harvest control rules, but for this stock the following suggestions could be considered.

Due to the rapid turnover of this population and the high variation of the natural mortality on the 1 year old, there is no possibility to define practical and useful harvest control rules for that species without direct monitoring of the spawning stock each year. Even in the case of an important population of 1+anchovy, it is very difficult, to be sure to get the year after an SSB sufficiently important to prevent a collapse of the fishery in case of two low consecutive recruitment levels.

In the context of a continuous monitoring of that population, a partial or a total closure of that fishery would be the only practical solution to recommend to managers if the population is around B_{lim} and the environmental signals indicate a weak recruitment strength for next year.

10.15 Management Measures and Considerations

The history of the exploitation of this stock in relation to the proposed precautionary references is shown in Figure 10.15.1. The anchovy occurring in the Bay of Biscay is a short-living species that attains 100% maturity at 1 year old. Although the Bay of Biscay anchovy constitutes a small stock, catches from this resource are economically very valuable. In the last 10 years, there has been a large increase in fishing effort and the catches have been recently exceeding the average level since 1960. The history of the Spanish purse seine fishery shows that a large fleet strongly dependent on anchovy and operating during a long period may not be economically profitable in the long term. Therefore, the need to regulate the fishery is clear.

The above assessment suggests that the current level of fishing mortality could be sustained provided that steps towards a more conservative approach is taken when the stock is at a low level. Therefore, a close monitoring of the fishery coupled with an adaptive and fast reactive managing procedure should be implemented.

According to the possible tools for monitoring the stock (DEPM surveys in May, acoustics at the end or beginning of every year and the upwelling index) the following scenarios for quantitative management are presented for consideration.

2.1 + Submission of Advice on the level of allowable catches within safe biological limits on the basis of the DEPM estimates of biomass and numbers at age. This scenario does not include an estimate of recruitment for the year at the start of the season. Therefore, to reduce the risks of over-exploitation in years of poor recruitment, a more conservative approach to management needs to be taken.

2.2 + Submission of Advice on the level of allowable catches within safe biological limits using a predictor of the new recruitment such as the upwelling index of the year prior to the management, and the survivors expected from the previous year. The DEPM would provide absolute estimates of spawning biomass every year and would serve as starting point to estimate the survivors for the next years. This approach is the one being undertaken by the Working Group.

2.3 + Submission of Advice on the level of allowable catches within safe biological limits making use of an estimate of coming recruitment obtained by means of an acoustic survey. The DEPM would complement the system providing estimates of absolute levels of spawning biomass every year and would be use to forecast the survivors for the next year. The frequency of the DEPM surveys could be relaxed once the management approach has proved to be satisfactory. This strategy would also allow a less conservative approach to be taken.

The benefits and costs of management approaches based on more or less precise information on coming recruitment, as has just been described, should be tested by simulation studies using assessment models. The relative benefits of 2.2 and 2.3 would depend on the precision and accuracy of the upwelling index as a predictor of recruitment, and the recruitment survey. This should also be investigated by simulation studies.

In order to implement a strict management of the Bay of Biscay anchovy, precise information on the abundance of the stock provided on a regular basis is absolutely necessary. The assessment and scientific advice for a species like anchovy rely heavily on this direct method. It is therefore necessary that the countries involved in the fishery guarantee sufficient support to the stock direct monitoring (i.e. by Acoustic or DEPM methods), in order to come out with an optimal management of the fishery.

Table 10.2.1.1 Annual catches (in tonnes) of Bay of Biscay anchovy (Subarea VIII) As estimated by the Working Group members.

COUNTRY	FRANCE	SPAIN	SPAIN	INTERNATIONAL
YEAR	VIIIab	VIIIbc, Landings	Live Bait Catches	VIII
1960	1,085	57,000	n/a	58,085
1961	1,494	74,000	n/a	75,494
1962	1,123	58,000	n/a	59,123
1963	652	48,000	n/a	48,652
1964	1,973	75,000	n/a	76,973
1965	2,615	81,000	n/a	83,615
1966	839	47,519	n/a	48,358
1967	1,812	39,363	n/a	41,175
1968	1,190	38,429	n/a	39,619
1969	2,991	33,092	n/a	36,083
1970	3,665	19,820	n/a	23,485
1971	4,825	23,787	n/a	28,612
1972	6,150	26,917	n/a	33,067
1973	4,395	23,614	n/a	28,009
1974	3,835	27,282	n/a	31,117
1975	2,913	23,389	n/a	26,302
1976	1,095	36,166	n/a	37,261
1977	3,807	44,384	n/a	48,191
1978	3,683	41,536	n/a	45,219
1979	1,349	25,000	n/a	26,349
1980	1,564	20,538	n/a	22,102
1981	1,021	9,794	n/a	10,815
1982	381	4,610	n/a	4,991
1983	1,911	12,242	n/a	14,153
1984	1,711	33,468	n/a	35,179
1985	3,005	8,481	n/a	11,486
1986	2,311	5,612	n/a	7,923
1987	4,899	9,863	546	15,308
1988	6,822	8,266	493	15,581
1989	2,255	8,174	185	10,614
1990	10,598	23,258	416	34,272
1991	9,708	9,573	353	19,634
1992	15,217	22,468	200	37,885
1993	20,914	19,173	306	40,393
1994	16,934	17,554	143	34,631
1995	10,892	18,950	273	30,115
1996	15,238	18,937	198	34,373
1997	12,020	9,939	378	22,337
1998	*11,200*	*6,250*		*17,450* (*)
AVERAGE (1960-97)	4,971	29,058	317	34,121

(*) Preliminary data up to july for the French fishery

Table 10.2.1.2 Monthly catches of the Bay of Biscay anchovy by country (Sub-area VIII) (without live bait catches)

COUNTRY: FRANCE Units: t.

YEAR\MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1987	0	0	0	1113	1560	268	148	582	679	355	107	87	4899
1988	0	0	14	872	1386	776	291	1156	2002	326	0	0	6822
1989	704	71	11	331	648	11	43	56	70	273	9	28	2255
1990	0	0	16	1331	1511	127	269	1905	3275	1447	636	82	10598
1991	1318	2135	603	808	1622	195	124	419	1587	557	54	285	9708
1992	2062	1480	942	783	57	11	335	1202	2786	3165	2395	0	15217
1993	1636	1805	1537	91	343	1439	1315	2640	4057	3277	2727	47	20914
1994	1972	1908	1442	172	770	1730	663	2125	3276	2652	223	0	16934
1995	620	958	807	260	844	1669	389	1089	2150	1231	855	22	10892
1996	1084	630	614	206	150	1568	1243	2377	3352	2666	1349	0	15238
1997	2235	687	24	36	90	1108	1579	1815	1680	2050	718		12022
Average 87-97	1057	879	546	546	816	809	582	1397	2265	1636	825	55	11409
in percentage	9.3%	7.7%	4.8%	4.8%	7.2%	7.1%	5.1%	12.2%	19.9%	14.3%	7.2%	0.5%	100%
Average 92-97	1602	1244	894	258	376	1254	921	1874	2883	2507	1378	14	15203
in percentage	10.5%	8.2%	5.9%	1.7%	2.5%	8.3%	6.1%	12.3%	19.0%	16.5%	9.1%	0.1%	100%

COUNTRY: SPAIN

YEAR\MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1987	0	0	454	4133	3677	514	81	54	28	457	202	265	9864
1988	6	0	28	786	2931	3204	292	98	421	118	136	246	8266
1989	2	2	25	258	4295	795	90	510	116	198	1610	273	8173
1990	79	6	2085	1328	9947	2957	1202	3227	2278	123	16	10	23258
1991	100	40	23	1228	5291	1663	91	60	34	265	184	596	9573
1992	360	384	340	3458	13068	3437	384	286	505	63	94	89	22468
1993	102	59	1825	3169	7564	4488	795	340	198	65	546	23	19173
1994	0	9	149	5569	3991	5501	1133	181	106	643	198	74	17554
1995	0	0	35	5707	11485	1094	50	9	6	152	48	365	18951
1996	48	17	138	1628	9613	5329	1206	298	266	152	225	17	18937
1997	43	1	81	2746	2672	877	316	585	1898	331	203	185	9939
Average 87-97	70	52	510	2726	7186	2898	532	506	396	224	326	196	15622
in percentage	0.4%	0.3%	3.3%	17.5%	46.0%	18.6%	3.4%	3.2%	2.5%	1.4%	2.1%	1.3%	100%
Average 92-97	102	94	497	3906	9144	3970	714	223	216	215	222	114	19417
in percentage	0.5%	0.5%	2.6%	20.1%	47.1%	20.4%	3.7%	1.1%	1.1%	1.1%	1.1%	0.6%	100%

Table 10.2.1.3 ANCHOVY catches in the Bay of Biscay by country and divisions in 1997 (with live bait catches)

COUNTRIES	DIVISIONS	QUARTERS				CATCH (t)	
		1	2	3	4	ANNUAL	%
SPAIN	VIIIa	0	0	0	0	0	0.0%
	VIIIb	12	1839	2015	71	3937	38.2%
	VIIIC	114	4456	1008	803	6381	61.8%
	TOTAL	126	6295	3023	874	10318	100.0%
	%	1.2%	61.0%	29.3%	8.5%	100.0%	
FRANCE	VIIIa	925	598	2651	1354	5528	46.7%
	VIIIb	1536	1226	2329	1211	6302	53.3%
	VIIIC	0	0	0	0	0	0.0%
	TOTAL	2461	1824	4980	2565	11830 (*)	100.0%
	%	20.8%	15.4%	42.1%	21.7%	100.0%	
INTERNATIONAL	VIIIa	925	598	2651	1354	5528	25.0%
	VIIIb	1548	3065	4344	1282	10239	46.2%
	VIIIC	114	4456	1008	803	6381	28.8%
	TOTAL	2587	8119	8003	3439	22148	100.0%
	%	11.7%	36.7%	36.1%	15.5%	100.0%	

(*) 200 tonnes of difference with the total French landings not able to split by quarter

Table 10.3.1.1 ANCHOVY catch at age in thousands for 1997 by country, division and quarter (without the catches from the live bait tuna fishing boats).

units: thousands

SPAIN	QUARTERS / AGE		1 VIIIbc	2 VIIIbc	3 VIIIbc	4 VIIIbc	Annual total VIIIbc
		0	0	0	1,928	56,394	58,321
		1	6,680	289,581	113,264	1,509	411,034
		2	859	73,996	9,363	14	84,233
		3	6	1,922	195	0	2,122
		4	0	0	0	0	0
	TOTAL(n)		7,545	365,499	124,749	57,917	555,711
	W MED.		16.56	17.13	22.01	12.49	17.73
	CATCH. (t)		125.4	6294.9	2799.2	719.4	9,938.8
	SOP		124.9	6260.9	2745.4	723.1	9,854.3
	VAR. %		99.59%	99.46%	98.08%	100.52%	99.15%
FRANCE	**AGE**		**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**
		0	0	0	7,896	33,936	41,832
		1	62,004	113,105	196,012	120,865	491,986
		2	52,327	11,000	18,042	12,537	93,906
		3	3,652	1	0	0	3,653
		4	0	0	0	0	0
	TOTAL(n)		117,983	124,106	221,950	167,338	631,377
	W MED.		20.85	14.70	23.15	16.14	19.20
	CATCH. (t)		2,460.0	1,824.0	4,981.0	2,565.0	11,830.0 (*)
	SOP		2,461.0	1,825.0	5,139.0	2,701.0	12,126.0
	VAR. %		100.04%	100.05%	103.17%	105.30%	102.50%

TOTAL	QUARTERS / AGE		1 VIIIbc	2 VIIIbc	3 VIIIbc	4 VIIIbc	Annual total VIIIbc
Sub-area VIII		0	0	0	9,824	90,330	100,153
		1	68,684	402,686	309,276	122,374	903,020
		2	53,186	84,996	27,405	12,551	178,139
		3	3,658	1,923	195	0	5,775
		4	0	0	0	0	0
	TOTAL(n)		125,528	489,605	346,699	225,255	1,187,088
	W MED.		20.60	16.51	22.74	15.20	18.52
	CATCH. (t)		2,585	8,119	7,780	3,284	21,769
	SOP		2,586	8,086	7,884	3,424	21,980
	VAR. %		100.02%	99.59%	101.34%	104.26%	100.97%

(*) 200 tonnes of difference with the total French landings not able to split by quarter

Table 10.3.1.2 Spanish half - yearly catches of anchovy (2nd semester) by age in ('000) of Bay of Biscay anchovy from the live bait tuna fishing boats. (from ANON 1996 and Uriarte et al. WD1997)

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	10,020	97,581	6,114	11,999	12,716	2,167	3,557	7,872	10,154	8,102	33,078
1	24,675	17,353	6,320	21,540	13,736	14,268	20,160	5,753	10,885	6,100	8,238
2	1,461	203	1,496	139	0	0		477	209	522	58
3	912	3	0	0	0	0		0	0	0	0
Total	37,068	115,140	13,930	33,677	26,452	16,435	23,717	14,102	21,248	14,724	14,724
Catch (t)	546	493	185	416	353	200	306	143.2	273.2	197.5	378
meanW (g)	14.7	4.3	13.3	12.4	13.3	12.1	12.9	10.2	15.8	13.4	9.14

Table 10.3.1.3 Catches at age of anchovy of the fishery in the Bay of Biscay on half year basis as reported up to 1997 to ICES WGs.
Units: Thousands The catches at age are equal to the addition of the age composition of landing and live bait catches of anchovy
(From Uriarte et al., 1997 WD updated for the 1997 data)

INTERNATIONAL

YEAR	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1997	
Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	38,140	0	150,338	0	180,085	0	16,984	0	86,647	0	38,434	0	63,499	0	59,934	0	49,771	0	109,173	0	133,232
1	218,670	120,098	318,181	190,113	152,612	27,085	847,627	517,690	323,877	116,290	1,001,551	440,134	794,056	611,047	494,610	355,663	522,361	189,081	683,009	456,164	471,370	439,888
2	157,665	13,534	92,621	13,334	123,683	10,771	59,482	75,999	310,620	12,581	193,137	31,446	439,655	91,977	493,437	54,867	282,301	21,771	233,095	53,156	138,183	40,014
3	31,362	1,664	9,954	596	18,096	1,986	8,175	4,999	29,179	61	16,960	1	5,336	0	61,667	1,325	76,525	90	31,092	499	5,580	195
4	14,831	58	1,356	0	54	0	0	0	0	0	0	0	0	0	0	0	4,096	7	2,213	42	0	0
5	8,920	0	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	431,448	173,494	398,971	529,130	294,445	219,927	915,283	615,671	663,677	215,579	1,211,647	510,015	1,239,046	766,523	1,049,714	471,789	885,283	260,719	949,408	619,034	615,133	613,329
Internat Catches	11,718	3,590	10,003	5,579	7,153	3,460	19,386	14,886	15,025	4,610	26,381	11,504	24,058	16,334	23,214	11,417	23,479	6,637	21,024	13,349	10,704	11,443 (*)
Var. SOP	100.7%	100.4%	98.3%	101.9%	98.5%	99.3%	100.7%	99.1%	97.6%	98.5%	99.6%	99.9%	101.1%	99.5%	101.0%	100.2%	101.5%	98.2%	99.5%	100.4%	99.7%	102.1%
Annual Catch		15,308		15,581		10,614		34,272		19,635		37,885		40,392		34,631		30,116		34,373		22,147

SPAIN

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	35,452	0	141,918	0	174,803	0	11,999	0	81,536	0	13,121	0	63,499	0	59,022	0	31,101	0	52,238	0	91,400
1	134,390	40,172	210,641	47,480	110,276	13,165	719,678	234,021	210,686	21,113	751,056	72,154	578,219	75,865	257,050	47,065	367,924	17,611	542,127	72,763	296,261	123,011
2	119,503	7,787	61,609	2,690	92,707	9,481	47,266	43,204	139,327	1,715	131,221	5,916	266,612	11,904	315,022	24,971	206,387	1,333	163,010	12,403	74,856	9,435
3	27,336	1,664	7,710	596	8,232	1,986	8,139	4,999	2,657	61	10,067	1	967	0	44,622	1,325	57,214	90	14,461	499	1,927	195
4	14,831	58	1,356	0	54	0	0	0	0	0	0	0	0	0	0	0	4,096	7	2,213	42	0	0
5	8,920	0	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	304,980	85,134	281,414	192,684	211,270	199,435	775,083	294,222	352,670	104,425	892,344	91,192	845,798	151,268	616,694	132,383	635,621	50,142	721,810	137,945	373,044	224,041
Catch Spain	8,777	1,632	6,956	1,804	5,377	2,981	16,401	7,273	8,343	1,583	21,047	1,621	17,206	2,272	15,219	2,478	18,322	902	16,774	2,361	6,420	3,897
Var. SOP	100.7%	99.7%	97.9%	100.6%	97.1%	99.5%	100.9%	99.5%	94.7%	98.2%	99.3%	100.5%	100.8%	100.2%	101.3%	99.6%	102.1%	100.1%	99.5%	100.4%	99.5%	98.7%
Annual Catch		10,409		8,759		8,358		23,674		9,926		22,669		19,479		17,697		19,224		19,135		10,317

FRANCE

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	2,688	0	8,419	0	5,282	0	4,985	0	5,111	0	25,313	0	0	0	912	0	18,670	0	56,936	0	41,832
1	84,280	79,925	107,540	142,634	42,336	13,919	127,949	283,669	113,191	96,177	250,495	367,980	215,836	535,182	237,560	308,598	154,437	171,470	140,882	383,401	175,109	316,877
2	38,162	5,747	31,012	10,644	30,976	1,290	12,216	32,795	171,293	10,866	61,916	25,530	173,043	80,073	178,415	29,896	75,914	20,438	70,085	40,753	63,327	30,579
3	4,026	0	2,245	0	9,863	0	36	0	26,522	0	6,893	0	4,369	0	17,045	0	19,311	0	16,631	0	3,653	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	126,468	88,360	140,797	161,697	83,175	20,492	140,200	321,449	311,007	111,154	319,303	418,823	393,248	615,255	433,020	339,406	249,662	210,578	227,598	481,089	242,089	389,288
Catch France	2,941	1,958	3,048	3,775	1,776	479	2,985	7,613	6,682	3,027	5,334	9,883	6,851	14,062	7,994	8,939	5,157	5,735	4,251	10,987	4,284	7,546 (*)
Var. SOP	100.4%	101.0%	99.0%	102.5%	102.6%	97.8%	99.2%	98.7%	101.3%	98.6%	100.5%	99.8%	101.6%	99.4%	100.3%	100.4%	99.4%	97.9%	102.8%	99.8%	100.0%	103.9%
Annual Catch		4,899		6,822		2,255		10,598		9,708		15,217		20,914		16,934		10,892		15,238		11,830

(*) 200 tonnes of difference with the total French landings not able to split by quarter

Table 10.3.1.4 Catch at age in numbers (millions) of Anchovy in the Bay of Biscay (1).

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	0	0	0	0	0	0	0	0	0	0	0	0
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
Catch	31,117	26,302	37,261	48,191	45,219	26,349	22,102	10,815	4,991	14153	35179	7923

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	0	38.1	150.3	180.1	17.0	86.6	38.4	63.5	59.9	49.8	109.2	133.2
1	52	338.8	508.3	179.7	1365.3	440.2	1441.7	1405.1	850.3	711.4	1139.2	911.3
2	80	171.2	106.0	134.5	135.5	323.2	224.6	531.6	548.3	304.1	286.3	178.2
3	63	33.0	10.6	20.1	13.2	29.2	17.0	5.3	63.0	76.6	31.6	5.8
4	54	14.9	1.4	0.1	0.0	0.0	0.0	0.0	0.0	4.1	2.3	0.0
5+	0	8.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	249	604.9	776.6	514.4	1531.0	879.3	1721.7	2005.6	1521.5	1146.0	1568.4	1228.5
Catch (t)	14762	15,308	15,581	10,614	34,272	19,635	37,885	40,392	34,631	30,116	34,373	22,147

(1) before 1983 some ageing errors could have occurred
(2) Since 1987 the catches of anchovy used as live bait in the Spanish Tuna fishing are included

Table 10.3.2.1 Length distribution ('000) of ANCHOVY in Divisions VIIIa,b,c by country, gear, quarters and Sub-divisions in 1997.

Length (cm)	QUARTER 1 SUB-AREA VIII FRANCE Total VIIIab	QUARTER 1 SUB-AREA VIII SPAIN Seine VIIIabc	Length (cm)	QUARTER 2 SUB-AREA VIII FRANCE Total VIIIab	QUARTER 2 SUB-AREA VIII SPAIN Seine VIIIabc
3.5			3.5		
4			4		
4.5			4.5		
5			5		
5.5			5.5		
6			6		
6.5			6.5		
7			7		
7.5			7.5		
8			8		
8.5			8.5	833	25
9			9	2931	335
9.5	10	35	9.5	3480	636
10	19	199	10	13339	3238
10.5	48	374	10.5	14352	12085
11	105	557	11	15897	29577
11.5	1760	462	11.5	5771	48085
12	2406	362	12	1777	40482
12.5	5164	400	12.5	2391	38868
13	9986	798	13	9631	29403
13.5	11385	585	13.5	11532	23154
14	21448	973	14	9730	21544
14.5	25158	986	14.5	9640	18681
15	16959	955	15	10114	20238
15.5	12832	405	15.5	6028	16244
16	7090	283	16	3603	16620
16.5	3586	69	16.5	1534	17269
17	8	48	17	1265	14878
17.5	7	43	17.5	254	8107
18	5	1	18	1	4178
18.5	4		18.5	1	1027
19	2	10	19		681
19.5			19.5		130
20			20		15
20.5			20.5		2
21			21		
21.5			21.5		
22			22		
22.5			22.5		
Total N	117982	7545	Total N	124104	365502
(*)Catch (t)	2460	125	(*)Catch (t)	1824	6295
L avg (cm)	14.3	13.4	L avg (cm)	12.5	13.4
W avg (g)	20.9	16.6	W avg (g)	14.7	17.2

(*) Total for the Frencch fishery is only 11,830 tonnes: 200 tonnes not allocated by quarter

Table 10.3.2.2 Length distribution ('000) of ANCHOVY in Divisions VIIIa,b,c by country, gear, quarters and Sub-divisions in 1997.

	QUARTER 3	
	SUB-AREA VIII	
Length (cm)	FRANCE Total VIIIab	SPAIN Seine VIIIabc
3.5		
4		
4.5		
5		
5.5		
6		
6.5		
7		
7.5		
8		
8.5		
9		
9.5	1053	
10	402	2
10.5	4404	4
11	3528	108
11.5	5941	200
12	10205	529
12.5	3262	1873
13	18335	4729
13.5	20777	8162
14	24033	18544
14.5	23964	21181
15	24317	26841
15.5	23818	20799
16	23771	10725
16.5	18131	6245
17	9306	3458
17.5	3530	675
18	914	638
18.5	653	13
19	784	12
19.5	392	11
20	131	2
20.5	131	
21	131	
21.5		
22		
22.5		
Total N	221913	124751
(*)Catch (t)	4981	2799
L avg (cm)	14.5	14.9
W avg (g)	22.4	22.4

	QUARTER 4	
	SUB-AREA VIII	
Length (cm)	FRANCE Total VIIIab	SPAIN Seine VIIIabc
3.5		
4		
4.5		
5		
5.5		
6		
6.5		
7		
7.5		162
8		482
8.5		1749
9		1948
9.5		2392
10		934
10.5		1586
11		2815
11.5		4044
12	0	4829
12.5	657	8962
13	7884	8479
13.5	12495	7122
14	9490	5103
14.5	9913	3101
15	9858	1892
15.5	12716	850
16	14498	780
16.5	11657	309
17	7719	160
17.5	3020	72
18	1347	143
18.5	588	
19	417	2
19.5	248	
20	83	
20.5	118	
21	118	
21.5		
22		
22.5		
Total N	102826	57916
(*)Catch (t)	2565	719
L avg (cm)	15.2	12.5
W avg (g)	24.9	12.4

(*) Total for the French fishery is only 11,830 tonnes: 200 tonnes not allocated by quarter

Table 10.3.2.3 Mean weight at age in the national and international catches of anchovy in SubArea VIII on half year basis
Units: grams

INTERNATIONAL

YEAR	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1997	
Sources:	Anon. (1989 & 1991)		Anon. (1989)		Anon. (1991)		Anon. (1991)		Anon. (1992)		Anon. (1993)		Anon. (1995)		Anon. (1996)		Anon. (1997)		Anon. (1997)		Anon. (1998)	
Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0.0	11.7	0.0	5.1	0.0	12.7	0.0	7.4	0.0	14.4	0.0	12.6	0.0	12.3	0.0	14.7	0.0	15.1	0.0	12.0	0.0	11.6
1	21.0	21.9	20.8	23.6	19.5	24.9	20.6	23.8	18.5	25.1	19.6	23.0	15.5	20.9	16.8	25.3	22.5	26.9	19.1	23.2	14.4	20.3
2	32.0	34.2	30.3	30.4	28.5	35.2	28.5	27.7	25.2	29.0	30.9	28.8	27.0	29.4	26.8	28.1	32.3	31.3	29.3	27.7	26.9	30.1
3	37.7	39.2	34.5	44.5	29.7	42.7	44.8	40.8	28.2	39.0	37.7	27.4	30.5	0.0	30.7	30.0	36.4	36.4	35.0	35.7	32.0	29.7
4	41.0	40.0	37.6	0.0	27.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3	29.1	46.1	39.7	0.0	0.0
5	42.0	0.0	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	27.3	20.8	24.6	10.7	23.9	15.6	21.3	24.0	22.1	21.1	21.7	22.5	19.6	21.2	22.3	24.3	26.9	25.0	22.2	21.6	17.3	19.1
SOP	11,795	3,605	9,828	5,685	7,043	3,434	19,515	14,752	14,668	4,538	26,264	11,497	24,314	16,257	23,440	11,442	23,830	6,520	21,066	13,139	10,672	11,687
mean weight 3+	39.3	39.2	35.0	44.5	29.7	42.7	44.8	40.8	28.2	39.0	37.7	27.4	30.5	#DIV/0!	30.7	30.0	36.5	35.9	35.8	36.0	32.0	29.7

SPAIN

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0.0	11.6	0.0	4.7	0.0	12.6	0.0	5.9	0.0	14.3	0.0	13.0	0.0	12.3	0.0	14.7	0.0	16.1	0.0	11.2	0.0	10.8
1	21.4	21.0	21.3	21.7	20.6	25.3	20.6	24.4	18.5	16.4	21.5	18.2	16.4	15.5	18.7	19.6	24.8	20.1	19.9	19.3	14.1	21.1
2	33.0	39.3	32.4	35.7	29.3	36.0	29.0	28.9	28.1	22.4	32.6	24.4	29.5	26.6	29.2	25.4	35.2	33.4	31.9	29.0	28.6	27.4
3	36.0	39.2	34.6	44.5	27.3	42.7	44.9	40.8	34.4	39.0	44.5	27.4	43.3	0.0	32.0	30.0	38.2	36.4	40.2	35.7	41.7	29.7
4	41.0	40.0	37.6	0.0	27.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3	29.1	46.1	39.7	0.0	0.0
5	42.0	0.0	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	29.0	19.1	24.2	9.4	24.7	14.9	21.4	24.6	22.4	14.9	23.4	17.9	20.5	15.0	25.0	18.6	29.4	18.0	23.1	17.6	17.1	17.2
SOP	8,641	1,628	6,811	1,814	5,222	2,966	16,555	7,234	7,900	1,555	20,904	1,629	17,352	2,276	15,424	2,467	18,703	903	16,696	2,170	6,386	3,847
mean weight 3+	39.6	39.2	35.2	44.5	27.3	42.7	44.9	40.8	34.4	39.0	44.5	27.4	43.3	#DIV/0!	32.0	30.0	38.1	35.9	41.0	36.0	41.7	29.7

FRANCE

					Old values		Old values		Old values		Old values		Old values		Old values		Old values		Old values			
Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0.0	13.0	0.0	12.1	0.0	17.0	0.0	11.0	0.0	15.6	0.0	12.3	0.0	0.0	0.0	11.6	0.0	13.5	0.0	12.7	0.0	13.4
1	20.4	22.3	19.8	24.3	16.6	24.5	20.6	23.3	18.7	27.1	13.8	23.9	13.1	21.7	14.8	26.1	17.2	27.6	15.8	23.9	14.9	20.0
2	28.7	27.2	26.1	29.0	26.0	29.6	26.5	26.1	22.9	30.0	27.5	29.8	23.2	29.8	22.6	30.3	24.5	31.1	23.3	27.3	24.9	31.0
3	35.4	0.0	34.0	0.0	31.7	0.0	29.0	0.0	27.6	0.0	27.9	0.0	27.6	0.0	27.3	0.0	31.4	0.0	30.5	0.0	26.8	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	23.4	22.4	21.4	23.9	21.9	22.9	21.1	23.4	21.8	26.8	16.8	23.6	17.7	22.7	18.5	26.4	20.5	26.7	19.2	22.8	17.7	20.1
SOP	2,954	1,977	3,017	3,871	1,821	469	2,961	7,518	6,768	2,984	5,361	9,867	6,962	13,981	8,016	8,975	5,127	5,617	4,370	10,969	4,286	7,840

Table 10.4.1.1 Daily Egg Production Method.: Egg surveys on the Bay of Biscay anchovy.
(from MOTOS & URIARTE WD1993, MOTOS et al. 1995 and MOTOS et al. WD 1997)

YEAR		1987	1988	1989(*)	1990	1991	1992	1993	1994	1995	1996	1997	1998 (Preliminary)
Period of year		2 - 7 June	21 - 28 May	10 - 21 May	4 - 15 May	16May-07Jun	16May-13Jun	No survey	7 May-3June	11 - 25 May	18 - 30 May	9 - 21 May	18 May - 8 June
Positive area (km2)		23850	45384	17546	59757	24264	67796		48735	31189	28448	50133	73131
Surveyed area (km2)		34934	59840	37930	79759	84032	92782		60330	51698	34294	59587	83156
Po (Egg per 0.05 m^2)(A+)		4.6	5.52	2.08	3.78	2.55	4.27		4.39	4.975	4.87	2.69	3.825
Total Daily egg production		2.20	5.01	0.73	5.02	1.24	5.81		4.48	3.09	2.77	2.69	5.59
(* Exp(-12))	C.V.	0.39	0.24	0.4	0.15	0.06	0.14		0.14	0.07	0.16	0.07	0.09
SSB (t)		29365	63500	11861	97239	19276	90720	--	70940	60005	*34540 (***)*	58064	*115114(***)*
	C.V.	0.48	0.31	0.41	0.17	0.14	0.2		0.16	0.10		0.10	
TOTAL #		1129	2675	470	5843	965.6	5797	--	3516	2901		4165.3	
(millions)	C.V.					0.14	0.25		0.18	0.12		0.16	
No/age:	1	656	2349	246	5613	670.5	5571		2457	2477		3576	
	C.V.					0.16	0.26		0.23	0.14		0.18	
(millions)	2	331	258	206	190	290.3	209.3		1005	361		573	
	C.V.					0.17	0.22		0.19	0.23		0.1	
	3+	142	68	18	40	4.8	16.7		54	64		16	
	C.V.					0.42	0.51		0.28	0.30		0.28	

(*) Likely subestimate according to authors (Motos &Santiago,1989)
(**) Estimates based on a log lineal model of biomass as function of positive spawning area and Po (Egg production per unit area)
(***) estimation by a loglinear model

Table 10.4.1.2 Statistics table.

Statistics	
R^2 multiple	0.98710107
R^2 (LN(spawning area)	0.97436853
R^2 (Ln(P0)	0.96582471
Standard error	0.13484319
Number of observ.	9

Table 10.4.1.3 Table of variance analysis and values of the parameters of the regression line.

Variance analysis						
	D.F.	*Sum of squ.*	*Mean square*	*F*	*F critical val.*	
Régression	2	4.14723852	2.07361926	114.043619	1.68392E-05	
Residuals	6	0.10909611	0.01818269			
Total	8	4.25633464				
	Coefficients	*Std Error*	*t statist.*	*Probabilité*	*Lim. inf.(95%)*	*Lim. sup.(95%)*
Constant	-3.92747672	1.0753761	-3.65218897	0.01067841	-6.55882916	-1.296124278
LN(spawning area)	1.30923582	0.10490639	12.4800386	1.6177E-05	1.052538939	1.565932699
LN(P0)	0.68415928	0.13370872	5.11678886	0.0021851	0.356985594	1.011332966

Table 10.4.1.4 : Estimated versus observed biomass.

year	Estimated biomass	Observed biomass
1987	30165	29365
1988	79219	63500
1989	11710	11861
1990	87655	97239
1991	20577	19276
1992	90686	90270
1994	74352	70940
1995	51821	60005
1996	34540	
1997	55192	58064
1998	115114	

Table 10.4.2.1 Evaluation of abundance index from French acoustic surveys

	1983 20/4-25/4	1984 30/4-13/5	1989 (2) 23/4-2/5	1990 12/4-25/4	1991 6/4-29/4	1992 13/4-30/4	1993	1994	1995	1996	1997 6/5-22/5	1998 20/5-7/6
Surveyed area	3,267	3,743	5,112	3,418 (3)	3388 (3)	2440(3)					1726(3)	6376
Density (t/nm(**2))	15.4	10.3	3.0	14.5-32.2 (4)	23.6	32.8					36.5	
Biomass (t)	50,000	38,500	15,500	60-110,000 (4)	64,000	89,000					63000	67000
Number (10**(-6))	2,600	2,000	805	4,300-7,500 (4)	3,173	9,342					3351	
Number of 1-group(10**(-6))	1,800 (1)	600	400	4,100-7,500 (4)	1,873	9,072					2481	

(1) Rough estimation
(2) Assumption of overestimate
(3) Positive area
(4) uncertainty due to technical problems

Table 10.5.1 Evolution of the French and Spanish fleet for ANCHOVY in Subarea VIII (from Working Group members). Units: Numbers of boats.

	France			Spain	
Year	P. seiner	P. trawl	Total	P. seiner	total
1960	52	0 (1)	52	571	623
1972	35	0 (1)	35	492	527
1976	24	0 (1)	24	354	378
1980	14	n/a (1)	14	293	307
1984	n/a	4 (1)	4	306	310
1987	9	36 (1)	45	282	327
1988	10	61 (1)	71	278	349
1989	2	51 (1)	53	215	268
1990	30	80 (2)	110	266	376
1991	30	115 (2)	145	250	395
1992	13	123 (2)	136	244	380
1993	21	138 (2)	159	253	412
1994	26	150 (2)	176	257	433
1995	26	120 (2)	146	257	403
1996	20	100 (2)	120	251	371
1997	15	100 (2)	115	267	299
1998				266	266

(1) Only St. Jean de Luz and Hendaya.
(2) Maximun number of potential boats; the number of pelagic trawling gears is roughly half of this number due to the fishing in pairs of mid-water trawlers.
n/a = Not available.

TABLE 10.5.2 Catch per unit effort of anchovy from the Spanish Spring fishery in the Bay of Biscay
(Average catches per boat and fishing day) (From WG members)

YEAR	87	88	89	90	91	92	93	94	95	96	97 (Provisional)	98
CPUE/PERIOD	03-06	03-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06
CPUE (t)	0.9	0.7	0.8	1.5	1.2	2.5	1.7	1.6	2.6	2.2	0.8	0.8
CPUE 1 (#)	13.8	19.7	16.1	63.4	29.3	86.3	46.7	26.5	52.6	69.6	36.9	27.6
CPUE 2 (#)	12.2	5.8	13.7	4.4	20.2	16.6	29.7	32.6	29.6	21.2	9.4	4.1
CPUE 3 (#)	2.8	0.7	1.2	0.8	0.4	1.3	0.1	4.6	8.2	1.9	0.2	0.2
CPUE 4+ (#)	2.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.0	0.0
CPUE 2+ (#)	17.5	6.6	14.9	5.3	20.6	17.9	29.8	37.2	38.3	23.4	9.7	4.4
CPUE 3+ (#)	5.3	0.9	1.2	0.8	0.4	1.3	0.1	4.6	8.8	2.1	0.2	0.2

in thousands

* CPUE values for the years 1988-89 are updapted acording to the revised catches at age of Spring from Uriarte et al. WD 1997

Table 10.7.1 Upwelling index from Mars to July in the Bay of Biscay as predictor of Recruitment of the anchovy in subarea VIII From Borja et al. (WD 1997, and in press), updated for 1998

years	index value
1987	508.4
1988	473.2
1989	970.9
1990	905.9
1991	1076.3
1992	1128.8
1993	570.9
1994	905.0
1995	1204.0
1996	973.0
1997	1230.5
1998	461.0

Table 10.8.1.1 Comparison of alternative tunings to the Assessment of the anchovy in Subarea VIII

Type of Asses	Run 12.2: Assessment of 1998			Run 11.2: Assessment of 1998			Run 09.2: Assessment of 1998 Downweighting the Tunning Indexes		
Tunning Indexes	Aged Indexes (1) + Upwelling (0.1)			SSB (1) + Upwelling (0.1)			Aged Indexes (0.5)+SSB (0.5)+Upwelling		
Assessment	Age 0	F anual	SSB	Age 0	F anual	SSB	Age 0	F anual	SSB
Year	Aged+Upwel	Aged+Upwel	Aged+Upwel	SSB+Upwell	SSB+Upwell	SSB+Upwell	SSB+Aged+	SSB+Aged+	SSB+Aged+
1987	7,491	0.569	30,024	7,894	0.482	32,510	7,463	0.573	30,017
1988	4,003	0.543	27,663	5,353	0.439	30,944	4,348	0.542	27,610
1989	19,682	0.650	18,336	19,020	0.443	23,857	18,955	0.618	19,272
1990	7,573	0.645	57,182	7,166	0.488	58,004	7,302	0.630	55,415
1991	27,742	1.408	28,929	29,200	0.890	32,289	27,510	1.298	28,567
1992	26,033	0.937	69,561	27,402	0.610	77,414	25,531	0.891	69,413
1993	14,001	0.613	88,827	13,857	0.402	99,669	13,793	0.571	87,927
1994	10,665	0.709	61,003	10,584	0.530	66,813	10,539	0.678	60,584
1995	16,173	0.891	45,675	13,092	0.697	48,480	14,595	0.861	45,292
1996	20,488	1.202	44,825	22,781	0.988	38,237	21,248	1.175	40,824
1997	34,605	0.401	54448	29,867	0.380	56278	29,045	0.414	54409
1998	7,715			7,775			7,513		
Geometmean(10y)	13,193	0.777	42,547	13,503	0.570	46,058	14,025	0.748	42,050
	SSQ	df	Variance	SSQ	df	Variance	SSQ	df	Variance
Tot. WSSQ	7.391	69	0.107	5.137	51	0.101	4.935	74	0.067
Separ CAGE	3.911	26	0.150	2.937	26	0.113	3.357	26	0.129
DEPM SSB	0.000	0	#DIV/0!	1.447	11	0.132	0.384	11	0.035
Acoustic SSB	0.000	0	#DIV/0!	0.735	4	0.184	0.180	4	0.045
DEPM Pop.	2.677	27	0.099	0.000	0	#DIV/0!	0.773	27	0.029
Acoust. Pop.	0.784	6	0.131	0.000	0	#DIV/0!	0.224	6	0.037
Upwelling/Recruitm	0.019	11	0.002	0.018	11	0.002	0.018	11	0.002
Tot USSQ	40.814	69	0.592	43.163	51	0.846	43.614	84	0.519
Separ CAGE	31.467	26	1.210	39.162	26	1.506	31.056	26	1.194
DEPM SSB	0.000	0	#DIV/0!	1.447	11	0.132	1.537	11	0.140
Acoustic SSB	0.000	0	#DIV/0!	0.735	4	0.184	0.718	4	0.180
DEPM Pop.	6.023	27	0.223	0.000	0	#DIV/0!	6.954	27	0.258
Acoust. Pop.	1.394	6	0.232	0.000	0	#DIV/0!	1.593	6	0.266
Upwelling/Recruitm	1.929	11	0.175	1.820	11	0.165	1.756	11	0.160
Weighting factors for the catches at age			**Model**			**Model**			**Model**
Weights 1987	0.5			0.5			0.5		
Weights 1988	0.5			0.5			0.5		
All other years	1			1			1		
Weights age 0	0.1			0.1			0.1		
Weights age 1	1			1			1		
Weights age 2	1			1			1		
Weights age 3	1			1			1		
Weights age 4	0.01			0.01			0.01		
Weights age 5	0.01			0.01			0.01		
Weights DEPM age	0		Absolute	1		Absolute	0.5		Absolute
Weights Acoust age	0		Relative	1		Relative	0.5		Relative
Weight DEPM (SSB	1		Absolute	0		Absolute	0.5		Absolute
Weight Acoustic SS	1		Relative	0		Relative	0.5		Relative
Upwelling/Recruitm	0.1		Linear	0.1		Linear	0.1		Linear

Table 10.8.2.1 Inputs and results of the anchovy assessment (Subarea VIII).

Output Generated by ICA Version 1.4

Anchovy Biscay VIII (run: ICAAND01/I01)

Catch in Number

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	38.1	150.3	180.1	17.0	86.6	38.4	63.5	59.9
1	338.8	508.3	179.7	1365.3	440.2	1441.7	1405.1	850.3
2	171.2	106.0	134.5	135.5	323.2	224.6	531.6	548.3
3	33.0	10.6	20.1	13.2	29.2	17.0	5.3	63.0
4	14.9	1.4	1.0	1.0	1.0	1.0	1.0	1.0
5	8.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0

AGE	1995	1996	1997
0	49.8	109.2	133.2
1	711.4	1139.2	911.3
2	304.1	286.3	178.2
3	76.6	31.6	5.8
4	4.1	2.3	1.0
5	1.0	1.0	1.0

x 10 ^ 6

Weights at age in the catches (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	.012000	.005000	.013000	.007000	.014000	.013000	.012000	.015000
1	.021000	.022000	.020000	.022000	.020000	.021000	.018000	.020000
2	.032000	.030000	.029000	.028000	.025000	.031000	.027000	.027000
3	.038000	.035000	.031000	.043000	.028000	.038000	.031000	.031000
4	.041000	.038000	.027000	.042000	.032000	.038000	.031000	.031000
5	.042000	.049000	.040000	.042000	.032000	.038000	.031000	.031000

AGE	1995	1996	1997
0	.015000	.012000	.012000
1	.024000	.021000	.017000
2	.032000	.029000	.028000
3	.036000	.035000	.032000
4	.037000	.046000	.046000
5	.038000	.046000	.046000

Weights at age in the stock (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	.013000	.013000	.013000	.010000	.015000	.012000	.012000	.015000
1	.016000	.016000	.016000	.016000	.017000	.015000	.016000	.017000
2	.029000	.029000	.029000	.030000	.028000	.032000	.027000	.026000
3	.033000	.033000	.033000	.035000	.034000	.032000	.033000	.032000
4	.037000	.037000	.037000	.037000	.037000	.037000	.037000	.037000
5	.041000	.041000	.041000	.041000	.041000	.041000	.041000	.041000

AGE	1995	1996	1997
0	.012000	.012000	.012000
1	.019000	.016000	.012000
2	.031000	.027000	.027000
3	.034000	.033000	.038000
4	.037000	.037000	.037000
5	.041000	.041000	.041000

Table 10.8.2.1 (continued)

Natural Mortality (per year)

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
1	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
2	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
3	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
4	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
5	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000

AGE	1995	1996	1997
0	1.2000	1.2000	1.2000
1	1.2000	1.2000	1.2000
2	1.2000	1.2000	1.2000
3	1.2000	1.2000	1.2000
4	1.2000	1.2000	1.2000
5	1.2000	1.2000	1.2000

Proportion of fish spawning

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1995	1996	1997
0	.0000	.0000	.0000
1	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000

INDICES OF SPAWNING BIOMASS

INDEX1

	1987	1988	1989	1990	1991	1992	1993	1994
1	29.37	63.50	15.00	97.24	19.28	90.72	*******	70.94

	1995	1996	1997	1998
1	60.00	34.57	58.06	115.11

x 10 ^ 3

INDEX2

	1987	1988	1989	1990	1991	1992	1993	1994
1	999990.	999990.	15500.	999990.	64000.	89000.	999990.	999990.

	1995	1996	1997	1998
1	999990.	999990.	63000.	67000.

Table 10.8.2.1 (continued)

AGE-STRUCTURED INDICES

FLT01: DEPM SURVEYS (Catch: Unknown) (Ef

AGE	1987	1988	1989	1990	1991	1992	1993	1994
1	656.0	2349.0	246.0	5613.0	670.5	5571.0	*******	2457.0
2	331.0	258.0	206.0	190.0	290.3	209.3	*******	1005.0
3	142.0	68.0	18.0	40.0	4.8	16.7	*******	54.0

AGE	1995	1996	1997
1	2477.0	*******	3576.0
2	361.0	*******	573.0
3	64.0	*******	16.0

x 10 ^ 3

FLT02: ACOUSTIC SURVEYS (Catch: Unknown)

AGE	1989	1990	1991	1992	1993	1994	1995	1996
1	400.0	*******	1873.0	9072.0	*******	*******	*******	*******
2	405.0	*******	1300.0	270.0	*******	*******	*******	*******

AGE	1997
1	2481.0
2	870.0

FLT05: Upwelling Index for Recruitment o

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	508.4	473.2	970.9	905.9	1076.3	1128.8	570.9	905.0

AGE	1995	1996	1997	1998
0	1204.0	973.0	1230.5	461.0

Fishing Mortality (per year)

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	.0060	.0056	.0064	.0066	.0136	.0093	.0060	.0071
1	.3123	.2949	.3364	.3428	.7080	.4854	.3125	.3703
2	.8331	.7868	.8975	.9146	1.8889	1.2952	.8338	.9879
3	.5736	.5417	.6179	.6297	1.3004	.8916	.5740	.6801
4	.8331	.7868	.8975	.9146	1.8889	1.2952	.8338	.9879
5	.8331	.7868	.8975	.9146	1.8889	1.2952	.8338	.9879

AGE	1995	1996	1997
0	.0090	.0122	.0043
1	.4696	.6389	.2255
2	1.2528	1.7047	.6017
3	.8625	1.1736	.4142
4	1.2528	1.7047	.6017
5	1.2528	1.7047	.6017

Table 10.8.2.1 (continued)

Population Abundance (1 January)

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	7424.	4294.	19052.	7206.	27767.	25764.	13877.	10454.
1	1941.	2223.	1286.	5702.	2156.	8251.	7688.	4155.
2	515.	428.	498.	277.	1219.	320.	1529.	1694.
3	134.	67.	59.	61.	33.	56.	26.	200.
4	178.	23.	12.	10.	10.	3.	7.	4.
5	25.	3.	3.	3.	2.	2.	3.	2.

AGE	1995	1996	1997	1998
0	14501.	21443.	30950.	3158.
1	3127.	4329.	6380.	9282.
2	864.	589.	688.	1534.
3	190.	74.	32.	114.
4	31.	24.	7.	6.
5	2.	2.	4.	2.

x 10 ^ 6

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 1- 3	SoP (%)
1987	7423860	154548	30027	15308	.5098	.5730	100
1988	4293750	106979	27519	15581	.5662	.5411	99
1989	19052090	285191	19112	10614	.5553	.6173	100
1990	7206170	174188	55649	34272	.6159	.6290	99
1991	27766910	488857	28391	19635	.6916	1.2991	103
1992	25764400	445134	69737	37885	.5432	.8907	98
1993	13876750	332065	88690	40392	.4554	.5735	99
1994	10454320	278162	60978	34631	.5679	.6794	99
1995	14501340	267885	45126	30116	.6674	.8616	98
1996	21443490	345898	40617	34373	.8463	1.1724	98
1997	30950230	468173	54783	22337	.4077	.4138	99

IFAP run code: I01

No of years for separable analysis : 11
Age range in the analysis : 0 . . . 5
Year range in the analysis : 1987 . . . 1997
Number of indices of SSB : 2
Number of age-structured indices : 3

Parameters to estimate : 35
Number of observations : 118

Conventional single selection vector model to be fitted.

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1987	.8331	25	.5083	1.3656	.6475	1.0720	.8600
2	1988	.7868	22	.5038	1.2287	.6267	.9877	.8074
3	1989	.8975	17	.6341	1.2704	.7517	1.0716	.9117
4	1990	.9146	17	.6495	1.2880	.7681	1.0892	.9287
5	1991	1.8889	13	1.4593	2.4449	1.6559	2.1547	1.9053
6	1992	1.2952	17	.9190	1.8253	1.0872	1.5429	1.3152
7	1993	.8338	18	.5759	1.2071	.6904	1.0070	.8488
8	1994	.9879	17	.7028	1.3887	.8303	1.1754	1.0029
9	1995	1.2528	16	.9025	1.7392	1.0598	1.4811	1.2705
10	1996	1.7047	16	1.2423	2.3392	1.4505	2.0034	1.7271
11	1997	.6017	25	.3661	.9891	.4669	.7754	.6214

Table 10.8.2.1 (continued)

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable Model: Selection (S) by age								
12	0	.0072	31	.0039	.0134	.0052	.0099	.0075
13	1	.3748	12	.2921	.4809	.3301	.4256	.3779
	2	1.0000		Fixed : Reference Age				
14	3	.6884	14	.5186	.9139	.5958	.7955	.6957
	4	1.0000		Fixed : Last true age				
Separable model: Populations in year 1997								
15	0	30950231	39	14346866	66768363	20907556	45816776	33425473
16	1	6380095	21	4192641	9708823	5149877	7904192	6528166
17	2	688185	20	462735	1023475	562031	842656	702440
18	3	32245	28	18497	56211	24284	42816	33567
19	4	6925	38	3236	14818	4697	10209	7466
Separable model: Populations at age								
20	1987	177888	108	21029	1504738	59844	528769	321998
21	1988	22794	55	7691	67547	13095	39676	26578
22	1989	11816	34	6014	23217	8372	16677	12539
23	1990	9526	29	5333	17017	7085	12808	9953
24	1991	9818	27	5738	16799	7465	12913	10194
25	1992	2738	34	1404	5339	1948	3850	2902
26	1993	6855	35	3438	13665	4821	9747	7293
27	1994	4476	33	2338	8566	3214	6233	4728
28	1995	30528	29	17040	54690	22673	41104	31909
29	1996	24154	32	12774	45672	17452	33431	25464
Recruitment in year 1998								
30	1997	3158034	291	10518	948187512	171948	58001062	218216622
SSB Index catchabilities								
INDEX1		Absolute estimator. No fitted catchability.						
INDEX2		Linear model fitted. Slopes at age :						
31	2 Q	1.153	21	.9418	2.153	1.153	1.758	1.456
Age-structured index catchabilities								
FLT01: DEPM SURVEYS (Catch: Unknown) Absolute estimator. No fitted catchability.								
FLT02: ACOUSTIC SURVEYS (Catch: Unknown) Linear model fitted. Slopes at age :								
32	1 Q	.9377E-03	26	.7302E-03	.2028E-02	.9377E-03	.1579E-02	.1259E-02
33	2 Q	.1747E-02	26	.1358E-02	.3795E-02	.1747E-02	.2951E-02	.2350E-02
FLT05: Upwelling Index for Recruitment Power model fitted. Slopes (Q) and exponents (K) at age								
34	0 Q	1.518	47	.9656	6.119	1.518	3.893	2.716
35	0 K	.9073	774	.5358E-03	.8187E+10	.9073	.4834E+07	.2209E+17

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1987	1988	1989	1990	1991	1992	1993	1994
0	.390	2.367	.927	-.480	-.924	-1.286	.275	.330
1	.081	.402	-.207	.315	-.437	-.295	.126	.092
2	-.069	-.322	-.330	.253	-.789	.388	-.025	-.214
3	-.089	-.490	.185	-.292	.605	-.199	-.291	.027
4	-1.447	-1.716	-1.490	-1.287	-1.746	-.266	-.893	-.585

Age	1995	1996	1997
0	-.418	-.331	.539
1	-.003	-.105	.173
2	-.283	-.132	-.074
3	.099	-.054	-.133
4	-1.246	-1.762	-.658

Table 10.8.2.1 (continued)

SPAWNING BIOMASS INDEX RESIDUALS

INDEX1

	1987	1988	1989	1990	1991	1992	1993	1994
1	-.0223	.8361	-.2423	.5581	-.3872	.2630	*******	.1513

	1995	1996	1997	1998
1	.2850	-.1612	.0581	.2670

INDEX2

	1987	1988	1989	1990	1991	1992	1993	1994
1	*******	*******	-.3521	*******	.6703	.1013	*******	*******

	1995	1996	1997	1998
1	*******	*******	-.0028	-.4167

AGE-STRUCTURED INDEX RESIDUALS

FLT01: DEPM SURVEYS (Catch: Unknown) (Ef

Age	1987	1988	1989	1990	1991	1992	1993	1994
1	-.3666	.7653	-.9241	.7172	-.2618	.4079	*******	.2206
2	.5235	.4378	.1126	.6286	.0325	.7608	*******	.5171
3	.0500	.5433	-.5139	.2839	-.9840	-.2773	*******	-.4464

Age	1995	1996	1997
1	.5602	*******	.0982
2	.2923	*******	.6726
3	-.2420	*******	-.1950

FLT02: ACOUSTIC SURVEYS (Catch: Unknown)

Age	1989	1990	1991	1992	1993	1994	1995	1996
1	-.6579	*******	.4768	.6480	*******	*******	*******	*******
2	-.3028	*******	.3613	-.1948	*******	*******	*******	*******

Age	1997
1	-.4668
2	.1363

FLT05: Upwelling Index for Recruitment o

Age	1987	1988	1989	1990	1991	1992	1993	1994
0	-.2587	-.1020	-.0049	.3314	-.0589	.0199	-.4037	.1752

Age	1995	1996	1997	1998
0	.3242	-.0520	.0296	.0000

Table 10.8.2.1 (continued)

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1987 to 1997

Variance	.1294
Skewness test stat.	-1.3437
Kurtosis test statistic	1.2933
Partial chi-square	.2966
Significance in fit	.0000
Degrees of freedom	26

PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES

DISTRIBUTION STATISTICS FOR INDEX1
Index used as absolute measure of abundance
Last age is a plus-group

Variance	.0679
Skewness test stat.	1.8350
Kurtosis test statistic	.0697
Partial chi-square	.0712
Significance in fit	.0000
Number of observations	11
Degrees of freedom	11
Weight in the analysis	.5000

DISTRIBUTION STATISTICS FOR INDEX2
Linear catchability relationship assumed
Last age is a plus-group

Variance	.0946
Skewness test stat.	.5767
Kurtosis test statistic	-.3842
Partial chi-square	.0358
Significance in fit	.0000
Number of observations	5
Degrees of freedom	4
Weight in the analysis	.5000

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR FLT01: DEPM SURVEYS (Catch: Unknown) (Ef
Index used as absolute measure of abundance

Age	1	2	3
Variance	.0998	.0837	.0735
Skewness test stat.	.1793	1.4993	-1.3640
Kurtosis test statisti	-.7082	-.8792	-.2240
Partial chi-square	.0643	.0624	.0661
Significance in fit	.0000	.0000	.0000
Number of observations	9	9	9
Degrees of freedom	9	9	9
Weight in the analysis	.3333	.3333	.3333

DISTRIBUTION STATISTICS FOR FLT02: ACOUSTIC SURVEYS (Catch: Unknown)
Linear catchability relationship assumed

Age	1	2
Variance	.1623	.0348
Skewness test stat.	-.0067	.1612
Kurtosis test statisti	-.7761	-.6525
Partial chi-square	.0650	.0161
Significance in fit	.0043	.0005
Number of observations	4	4
Degrees of freedom	3	3
Weight in the analysis	.3750	.3750

Table 10.8.2.1 (continued)

DISTRIBUTION STATISTICS FOR FLT05: Upwelling Index for Recruitment o
Power catchability relationship assumed

Age	0
Variance	.0049
Skewness test stat.	-.1222
Kurtosis test statisti	-.1967
Partial chi-square	.0074
Significance in fit	.0000
Number of observations	12
Degrees of freedom	10
Weight in the analysis	.1000

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	42.3833	118	35	83	.5106
Catches at age	31.1247	55	29	26	1.1971
SSB Indices					
INDEX1	1.4937	11	0	11	.1358
INDEX2	.7571	5	1	4	.1893
Aged Indices					
FLT01: DEPM SURVEYS (Catch: Unknown) (	6.9376	27	0	27	.2569
FLT02: ACOUSTIC SURVEYS (Catch: Unknow	1.5768	8	2	6	.2628
FLT05: Upwelling Index for Recruitment	.4934	12	2	10	.0493

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	4.9247	118	35	83	.0593
Catches at age	3.3645	55	29	26	.1294
SSB Indices					
INDEX1	.3734	11	0	11	.0339
INDEX2	.1893	5	1	4	.0473
Aged Indices					
FLT01: DEPM SURVEYS (Catch: Unknown) (	.7708	27	0	27	.0285
FLT02: ACOUSTIC SURVEYS (Catch: Unknow	.2217	8	2	6	.0370
FLT05: Upwelling Index for Recruitment	.0049	12	2	10	.0005

Table 10.9.1 . Catch predictions

Anchovy in the Bay of Biscay (Fishing Area VIII)

Prediction with management option table: Input data

Year: 1998								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	3158.000	1.2000	0.0000	0.4000	0.3750	12.500	0.0355	11.791
1	9282.000	1.2000	1.0000	0.4000	0.3750	16.051	0.4447	20.536
2	1534.000	1.2000	1.0000	0.4000	0.3750	28.439	1.1864	28.964
3	114.000	1.2000	1.0000	0.4000	0.3750	33.838	0.8168	34.309
4	6.000	1.2000	1.0000	0.4000	0.3750	37.000	1.1864	37.155
5+	2.000	1.2000	1.0000	0.4000	0.3750	41.000	1.1864	39.473
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 1999								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	14098.000	1.2000	0.0000	0.4000	0.3750	12.500	0.0355	11.791
1	.	1.2000	1.0000	0.4000	0.3750	16.051	0.4447	20.536
2	.	1.2000	1.0000	0.4000	0.3750	28.439	1.1864	28.964
3	.	1.2000	1.0000	0.4000	0.3750	33.838	0.8168	34.309
4	.	1.2000	1.0000	0.4000	0.3750	37.000	1.1864	37.155
5+	.	1.2000	1.0000	0.4000	0.3750	41.000	1.1864	39.473
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	14098.000	1.2000	0.0000	0.4000	0.3750	12.500	0.0355	11.791
1	.	1.2000	1.0000	0.4000	0.3750	16.051	0.4447	20.536
2	.	1.2000	1.0000	0.4000	0.3750	28.439	1.1864	28.964
3	.	1.2000	1.0000	0.4000	0.3750	33.838	0.8168	34.309
4	.	1.2000	1.0000	0.4000	0.3750	37.000	1.1864	37.155
5+	.	1.2000	1.0000	0.4000	0.3750	41.000	1.1864	39.473
Unit	Millions	-	-	-	-	Grams	-	Grams

Notes: Run name : MANAND03
Date and time: 05OCT98:09:37

Table 10.9.1 Catch predictions (continued)

The SAS System 09:35 Monday, October 5, 1998

Anchovy in the Bay of Biscay (Fishing Area VIII)

Prediction with management option table

(cont.)

Year: 1998					Year: 1999					Year: 2000	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.8160	236249	98719	63915	0.0000	0.0000	247289	45313	0	272278	61246
.	.	.	.	.	0.2000	0.1632	.	41815	8667	266991	55284
.	.	.	.	.	0.4000	0.3264	.	38611	16087	262623	50395
.	.	.	.	.	0.6000	0.4896	.	35674	22485	258990	46331
.	.	.	.	.	0.8000	0.6528	.	32982	28040	255947	42903
.	.	.	.	.	1.0000	0.8160	.	30512	32900	253377	39972
.	.	.	.	.	1.2000	0.9792	.	28247	37182	251187	37430
.	.	.	.	.	1.4000	1.1424	.	26167	40985	249305	35197
.	.	.	.	.	1.6000	1.3055	.	24257	44385	247670	33212
.	.	.	.	.	1.8000	1.4687	.	22503	47448	246238	31426
.	.	.	.	.	2.0000	1.6319	.	20891	50225	244970	29805
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANAND03
Date and time : 05OCT98:09:37
Computation of ref. F: Simple mean, age 1 - 3
Basis for 1998 : F factors

14:00 Tuesday, October 6, 1998

Anchovy in the Bay of Biscay (Fishing Area VIII)

Prediction with management option table

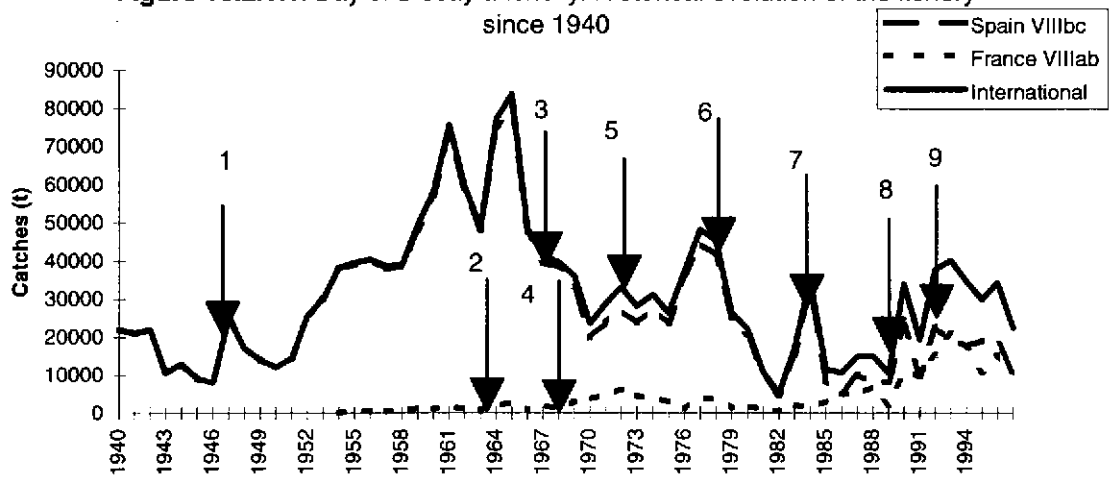
Year: 1998					Year: 1999					Year: 2000	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.3309	0.2700	236249	115716	25000	0.0000	0.0000	271534	60772	0	280849	66711
.	.	.	.	.	0.2000	0.1632	.	55988	11533	273890	59372
.	.	.	.	.	0.4000	0.3264	.	51607	21358	268184	53455
.	.	.	.	.	0.6000	0.4896	.	47593	29784	263480	48622
.	.	.	.	.	0.8000	0.6528	.	43916	37057	259577	44621
.	.	.	.	.	1.0000	0.8160	.	40545	43379	256317	41261
.	.	.	.	.	1.2000	0.9792	.	37454	48913	253573	38398
.	.	.	.	.	1.4000	1.1424	.	34619	53791	251243	35924
.	.	.	.	.	1.6000	1.3055	.	32017	58121	249249	33758
.	.	.	.	.	1.8000	1.4687	.	29630	61991	247526	31838
.	.	.	.	.	2.0000	1.6319	.	27437	65474	246023	30115
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANAND03
Date and time : 06OCT98:14:14
Computation of ref. F: Simple mean, age 1 - 3
Basis for 1998 : TAC constraints

Table 10.10.1 Anchovy (VIII) Input data for the linear sensitivity analysis.

Name	Value	C.V.	Name	Value	C.V.
Population at age in 1998			Exploitation pattern		
N0	3158	0.21	sH0	0.04	0.63
N1	9282	0.21	sH1	0.45	0.25
N2	1534	0.2	sH2	1.19	0.25
N3	114	0.28	sH3	0.82	0.25
N4	6	0.39	sH4	1.19	0.25
N5	2	0.39	sH5	1.19	0.25
Catch weight at age			Stock weight at age		
WH0	0.12	0.13	WS0	0.13	0.22
WH1	0.210	0.17	WS1	0.16	0.22
WH2	0.290	0.07	WS2	0.28	0.08
WH3	0.340	0.06	WS3	0.34	0.08
WH4	0.370	0.12	WS4	0.37	0.08
WH5	0.400	0.11	WS5	0.41	0.08
Natural mortality at age			Maturity		
M0	1.2	0.1	MT0	1.2	0.1
M1	1.2	0.1	MT1	1.2	0.1
M2	1.2	0.1	MT2	1.2	0.1
M3	1.2	0.1	MT3	1.2	0.1
M4	1.2	0.1	MT4	1.2	0.1
M5	1.2	0.1	MT5	1.2	0.1
Effort multiplier in year			Natural mortality multiplier in year		
HF1998	1	0.12	K1998	1	0.1
HF1999	1	0.12	K1999	1	0.1
HF2000	1	0.12	K2000	1	0.1
Recruitment in year					
R1999	3158	0.21			
R2000	3158	0.21			

Figure 10.2.1.1: Bay of Biscay anchovy: Historical evolution of the fishery since 1940



1. Goniometer
2. Echosounder ; anchovy disappeared from the coast of Galicia
3. Minimun landing size: 9 cm
4. Power block
5. 8 tonnes per boat and 5 days per week for the spanish fleet;
   the spanish fleet is not allowed to come into the french 6 nautical miles
6. Radar and sonar
7. 6 tonnes per boat for the spanish fleet
8. Minimun landing size 12 cm: increase of the french pelagic fleet
9. Bilateral agreement between Spain and France in 1992: the pelagic fleet is not allowed to fish anchovy from the end of March to the end of June

Figure 10.2.1.2: Mean monthly catches (1992-1997) for the French and Spanish anchovy fisheries in Sub-area VIII

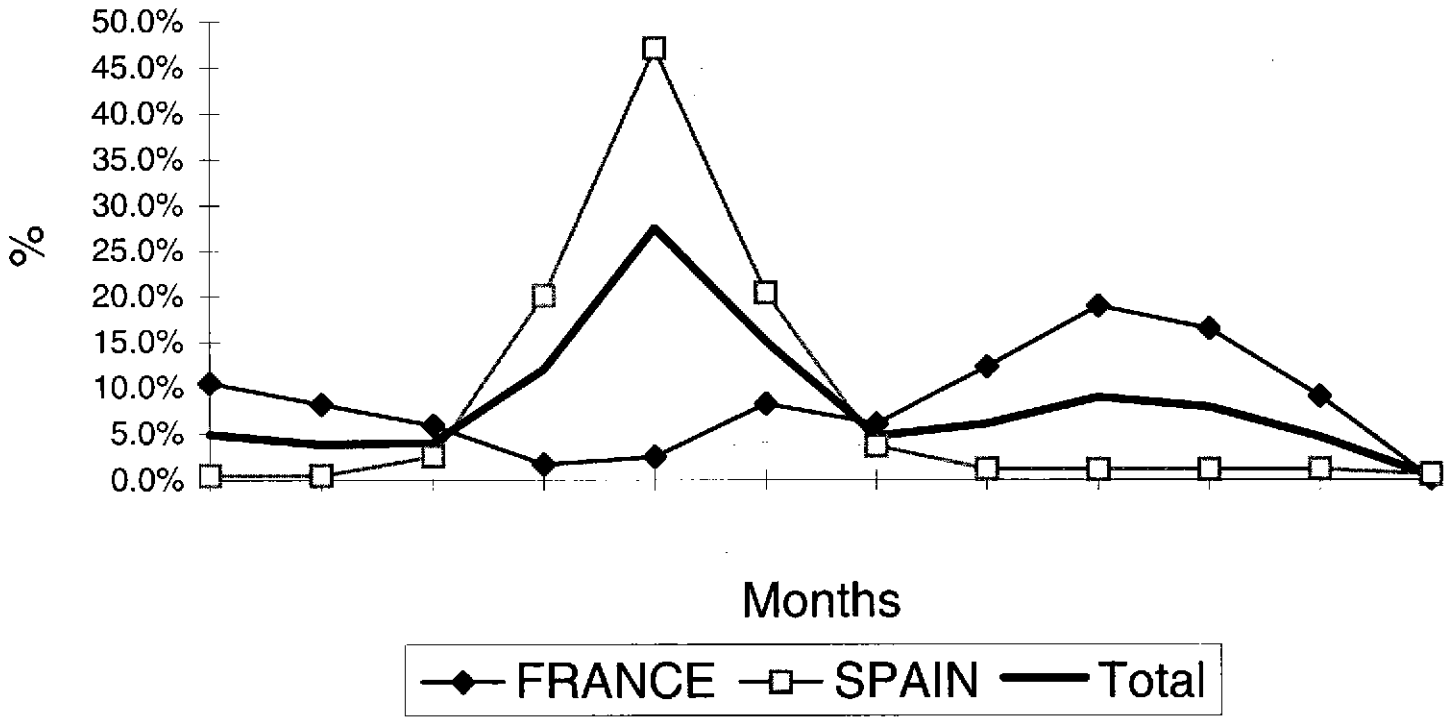


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Figure 10.3.2.1 : Length Distributions of the Spanish and French anchovy catches for the first quarter

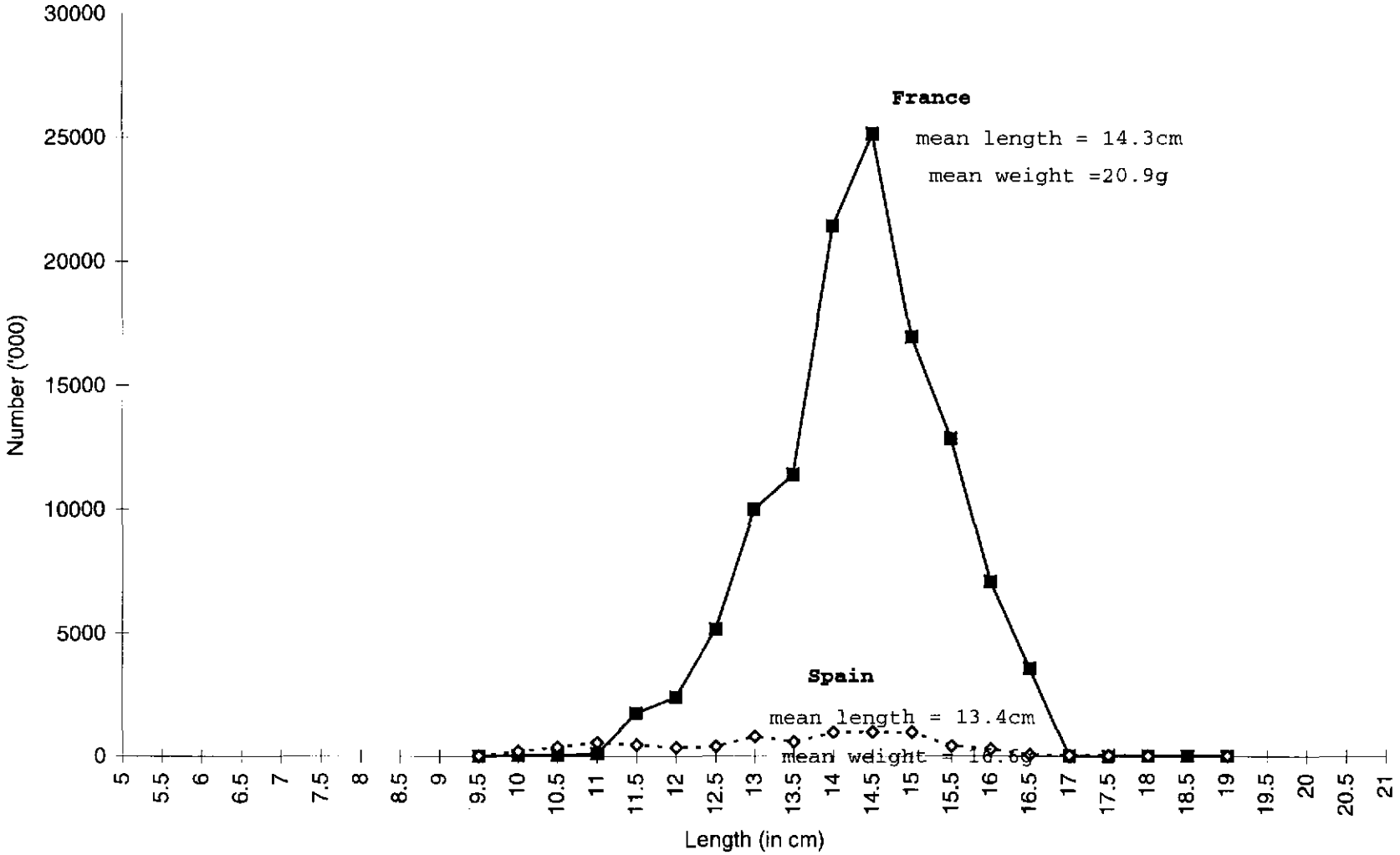

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Figure 10.3.2.2. : Length Distributions of Spanish and French anchovy catches for the second quarter

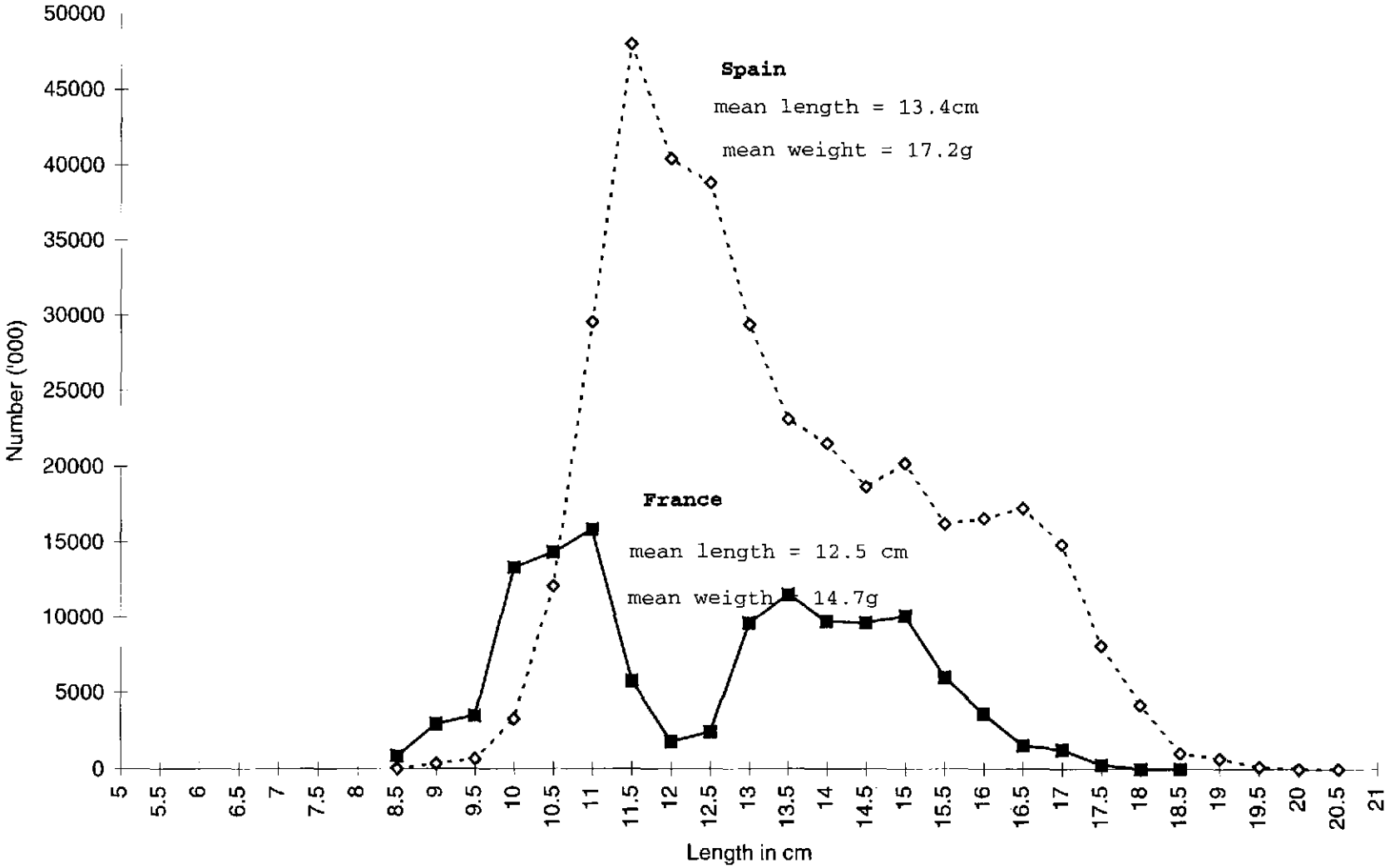

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Figure 10.3.2.3. : Length Distributions of Spanish and French anchovy catches for the third quarter

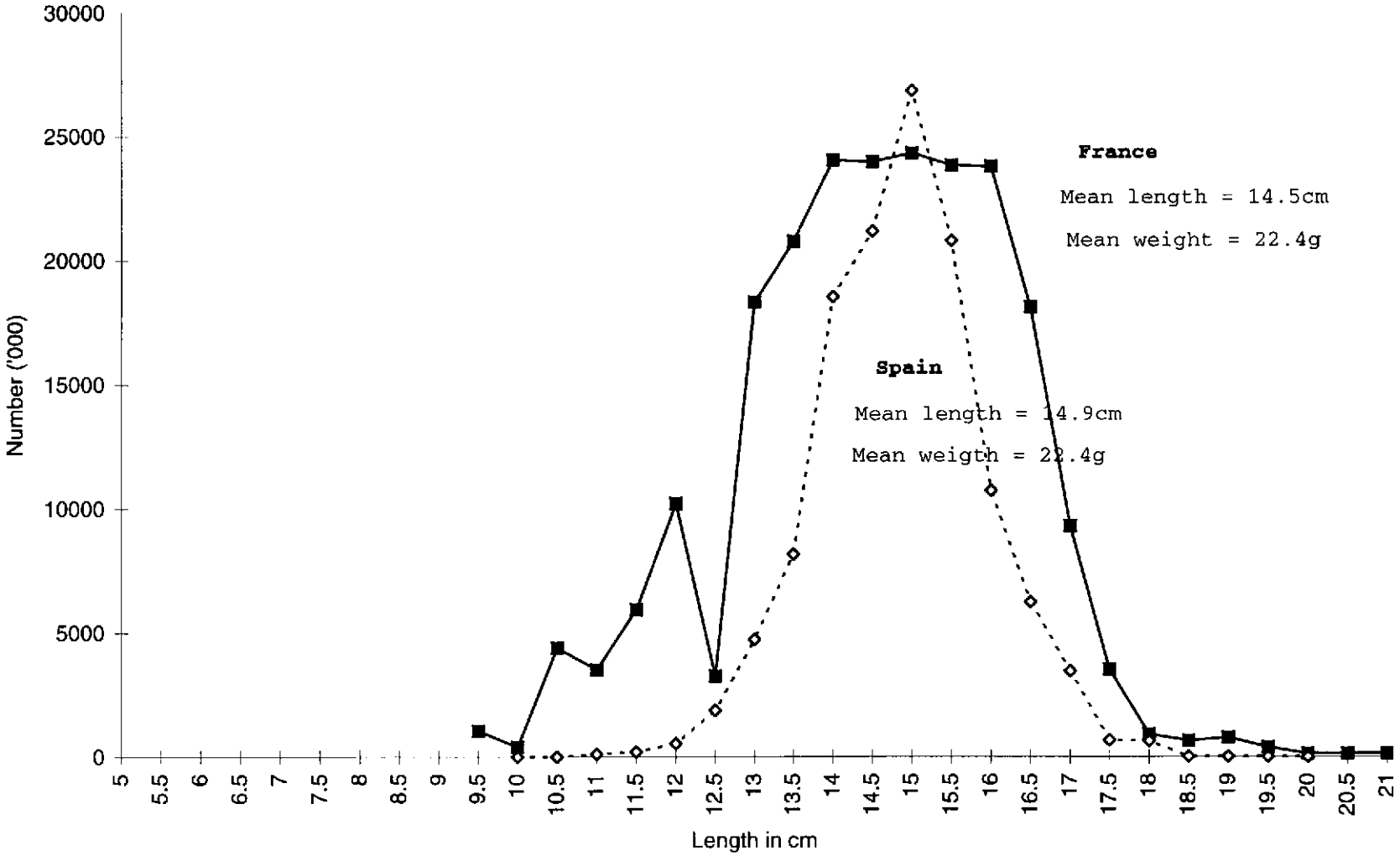

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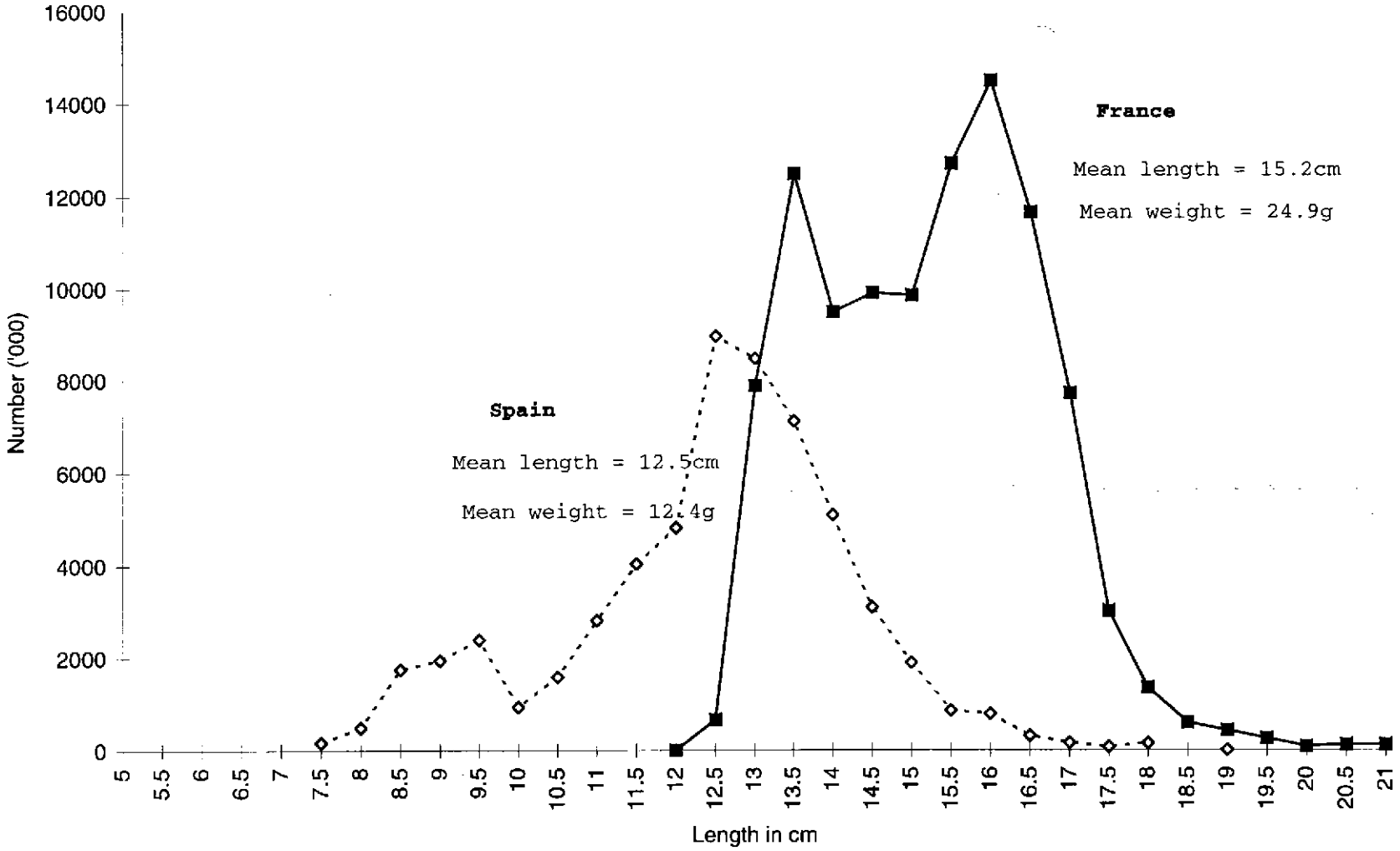
Figure 10.3.2.4. : Length Distributions of Spanish and French anchovy catches for the fourth quarter



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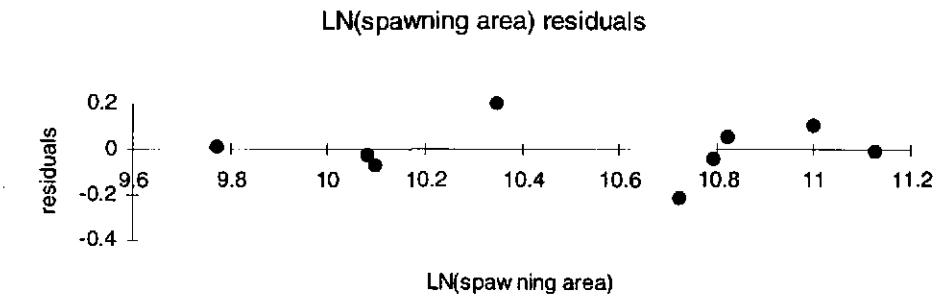


Figure 10.4.1.1 Graphics of the residuals for the first variable (spawning area).

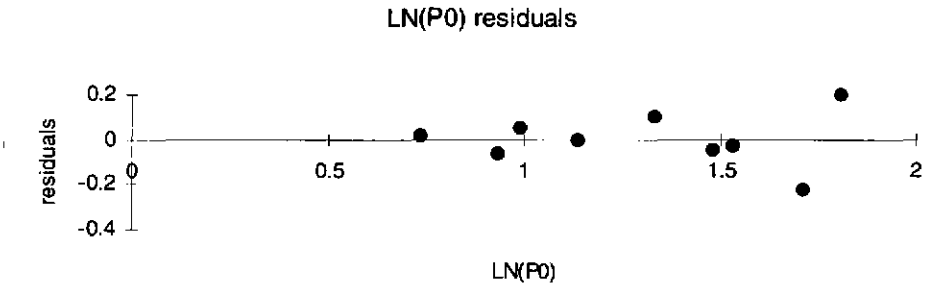


Figure 10.4.1.2 Graphic of the residuals for the second variable (P0).

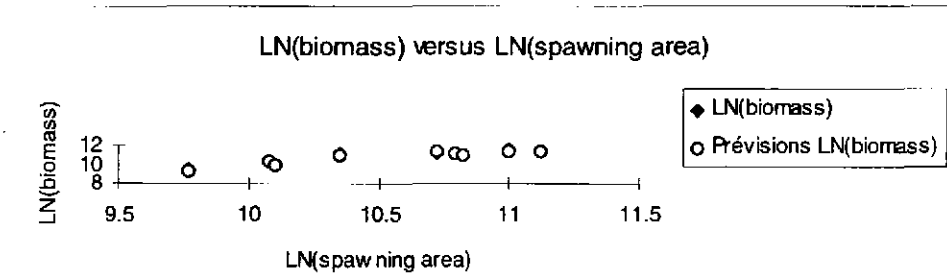


Figure 10.4.1.3 Relationship between biomass and spawning area.

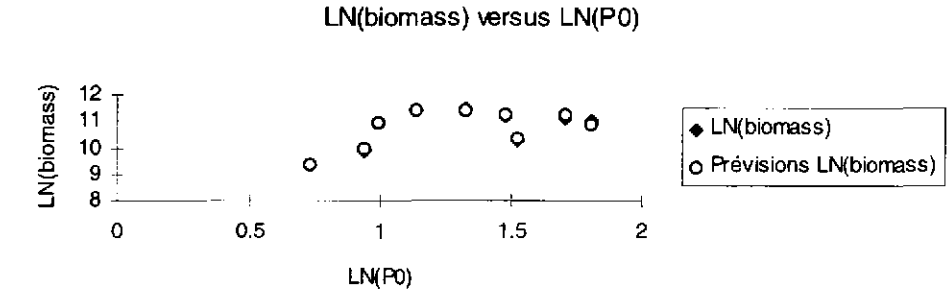


Figure 10.4.1.4 Relationship between biomass and P0.

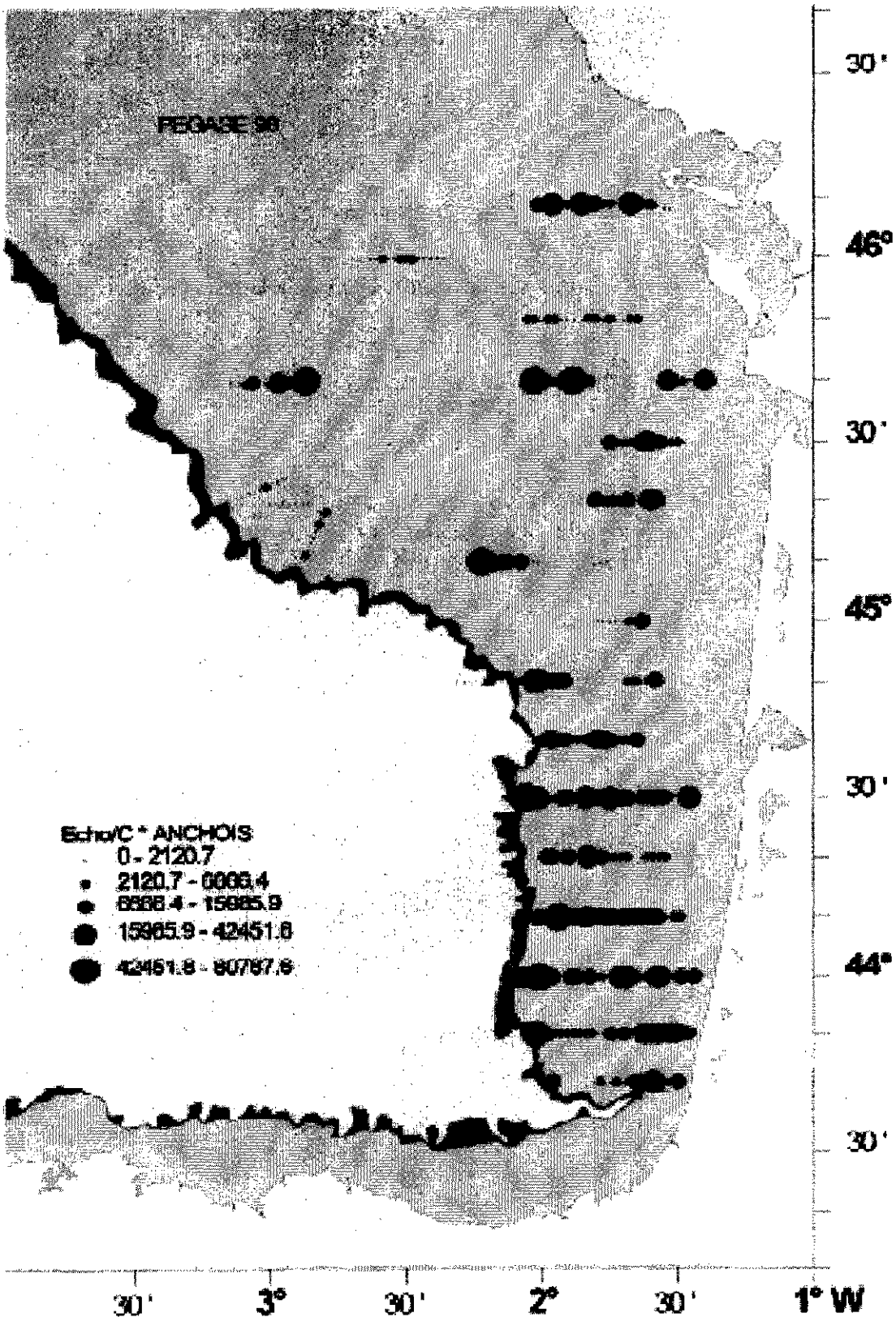


Figure 10.4.2.1 Distribution of echotrace for anchovy in the area sampled during the PEGASE98 survey. (from J. Massé, WD 1998)

Figure 10.8.1.1: Comparison of alternative tunings to the Assessment of the anchovy in Subarea VIII

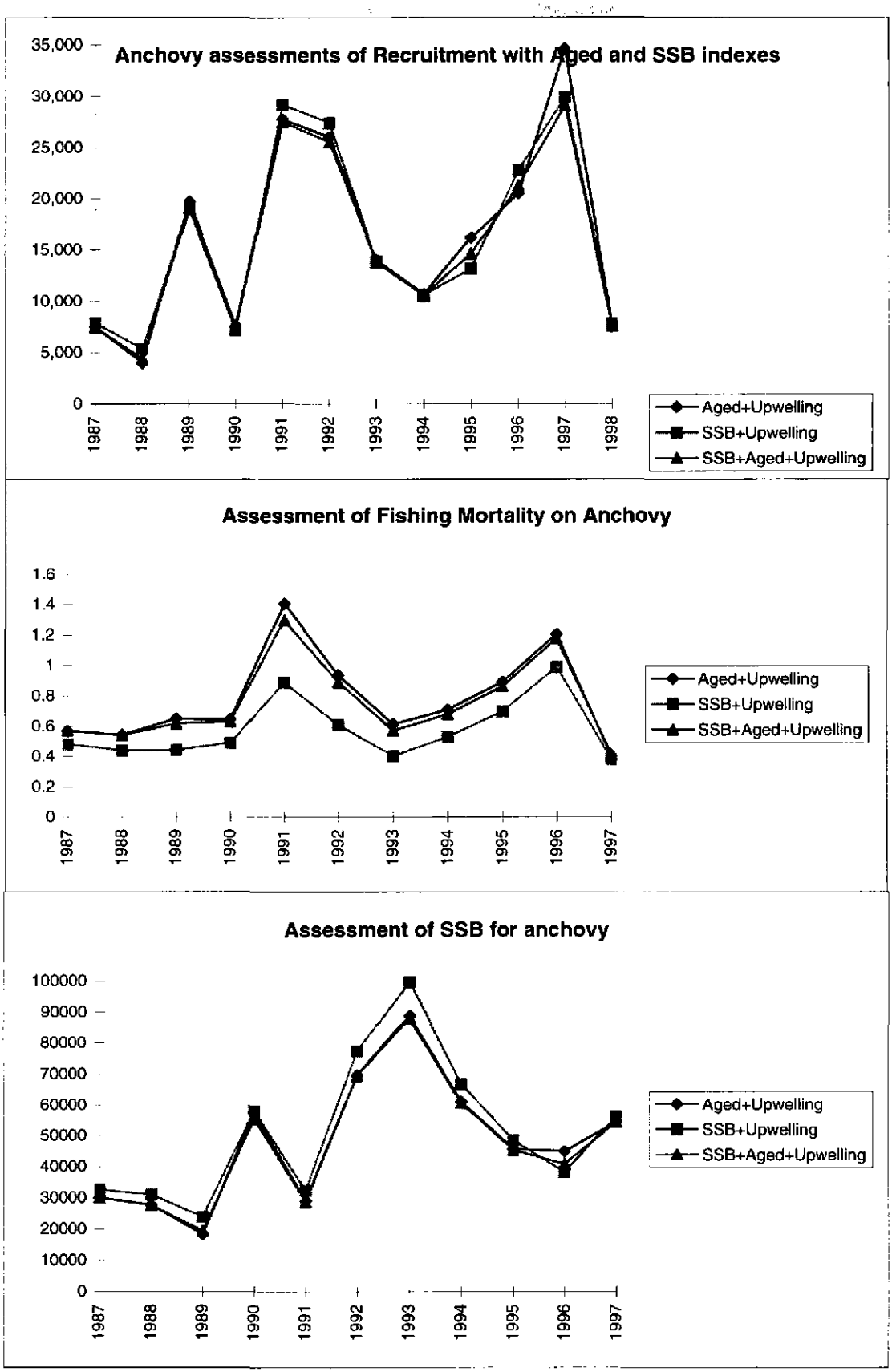
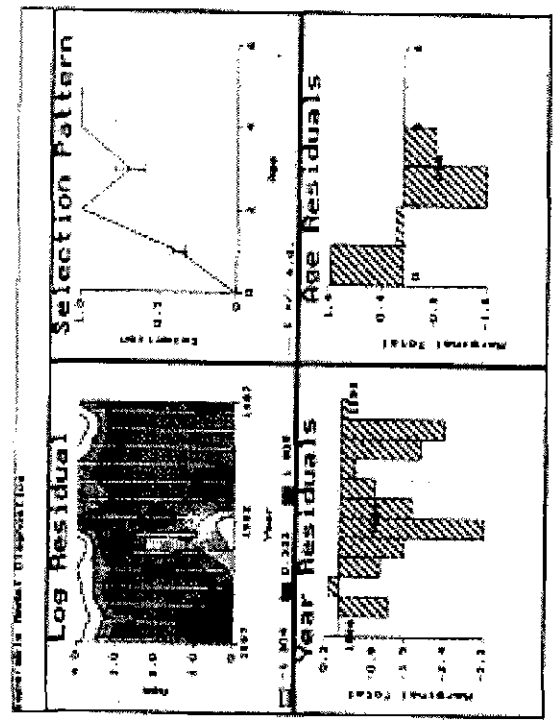
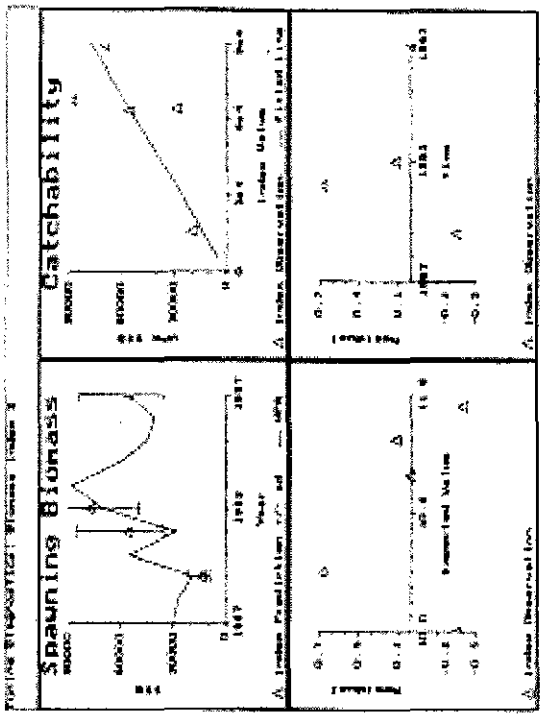
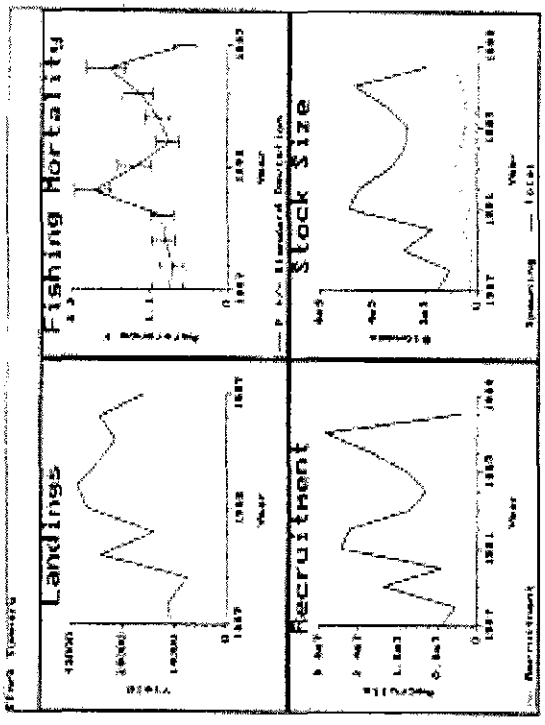


Figure 10.8.2.1 Results for anchovy assessment.







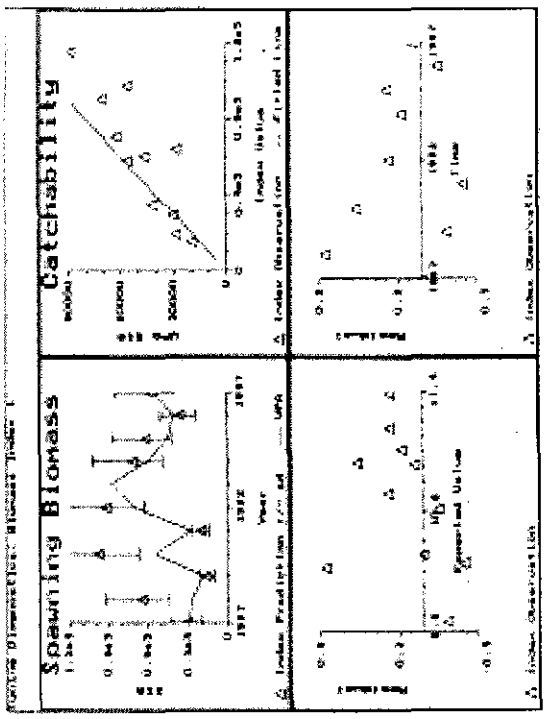
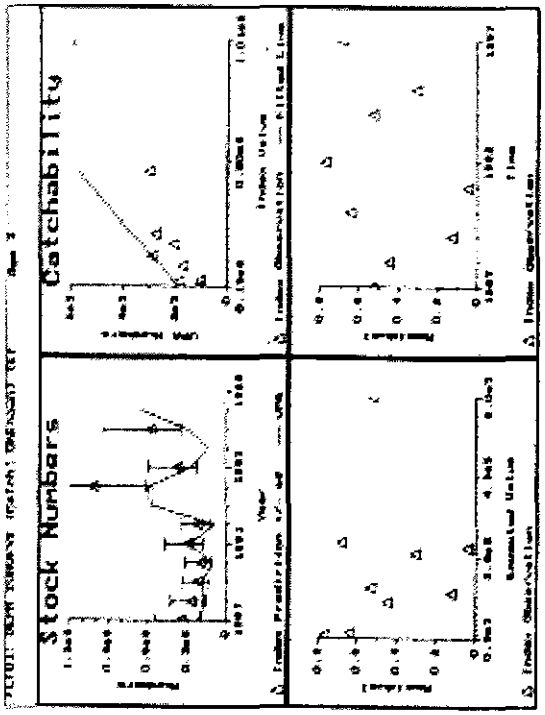
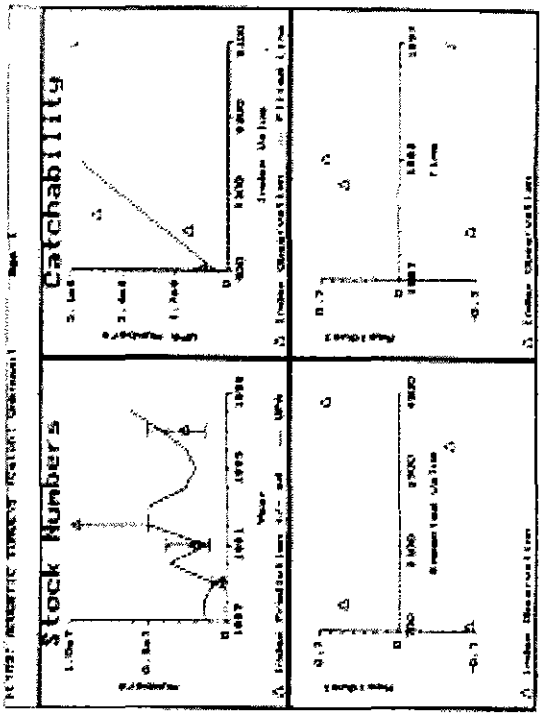
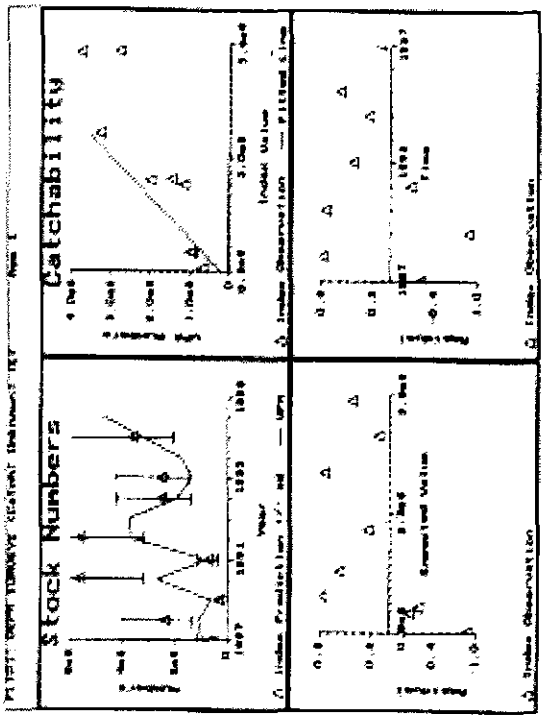


Figure 10.8.2.1 (continued)







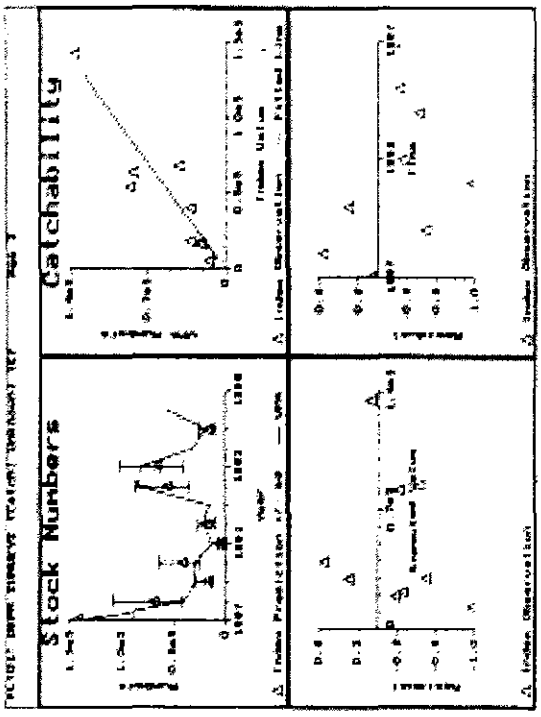
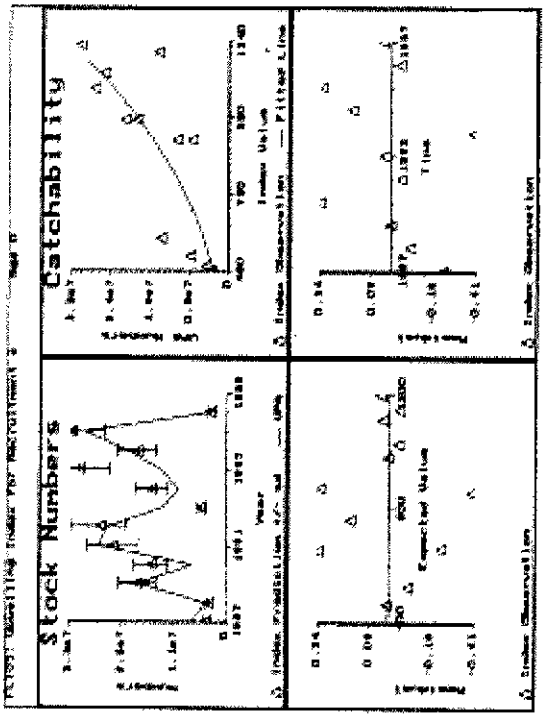


Figure 10.8.2.1 (continued)



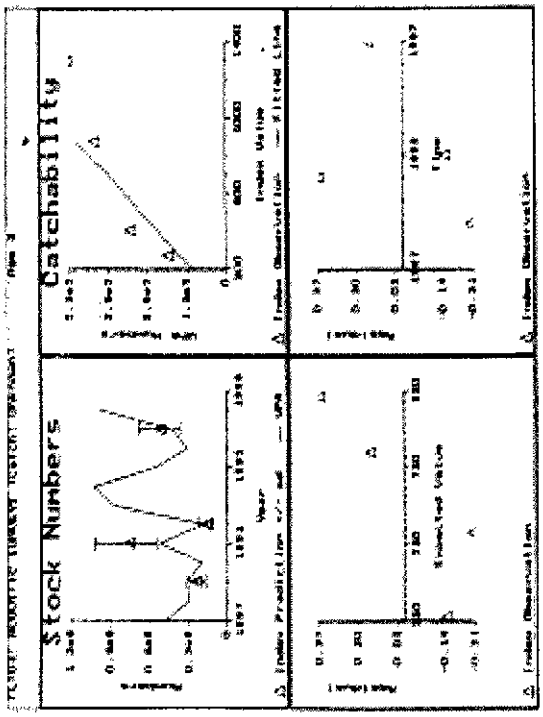


Figure 10.8.3.1 Comparisons between the assessment made in 1997 and 1998.

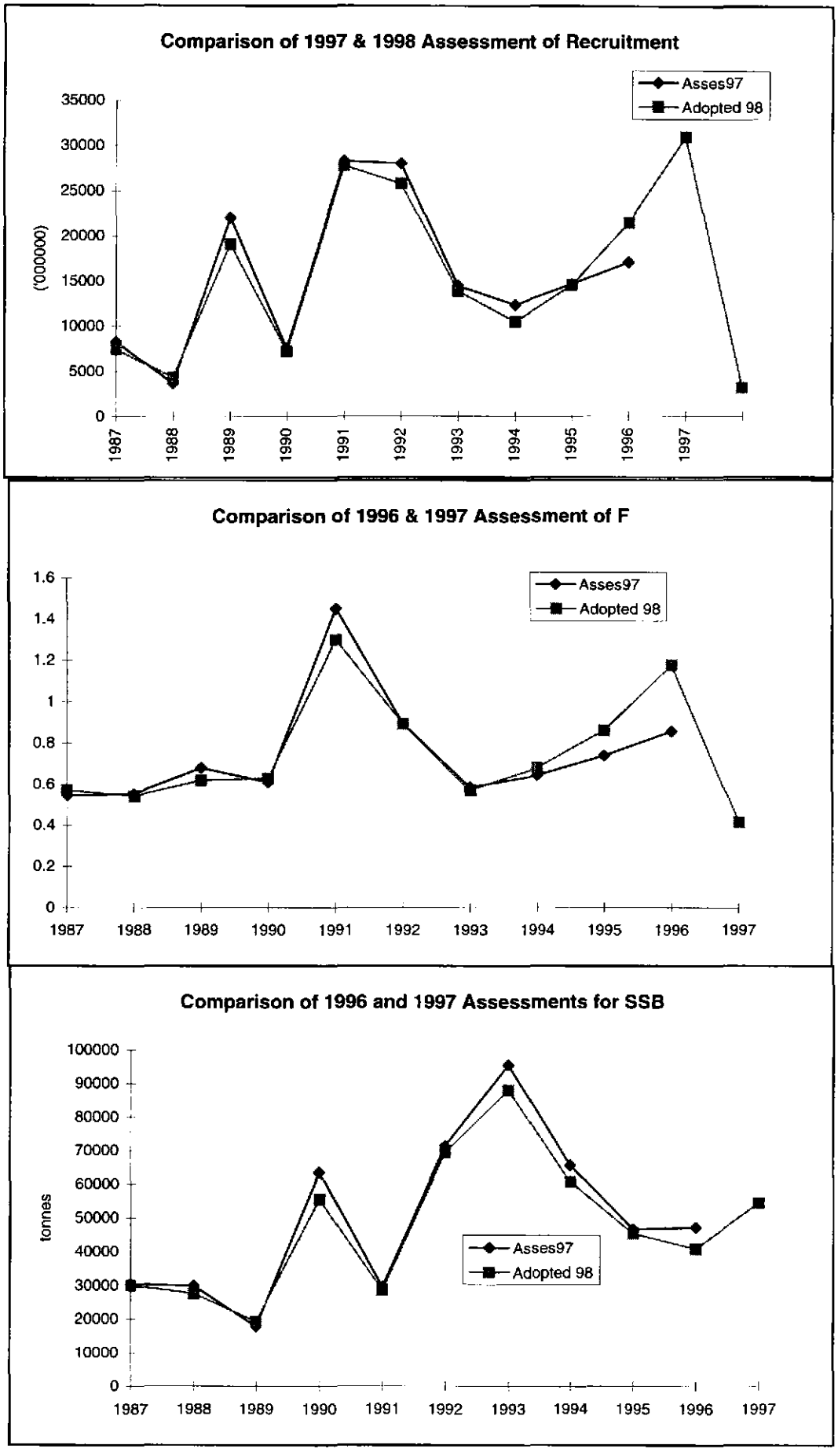


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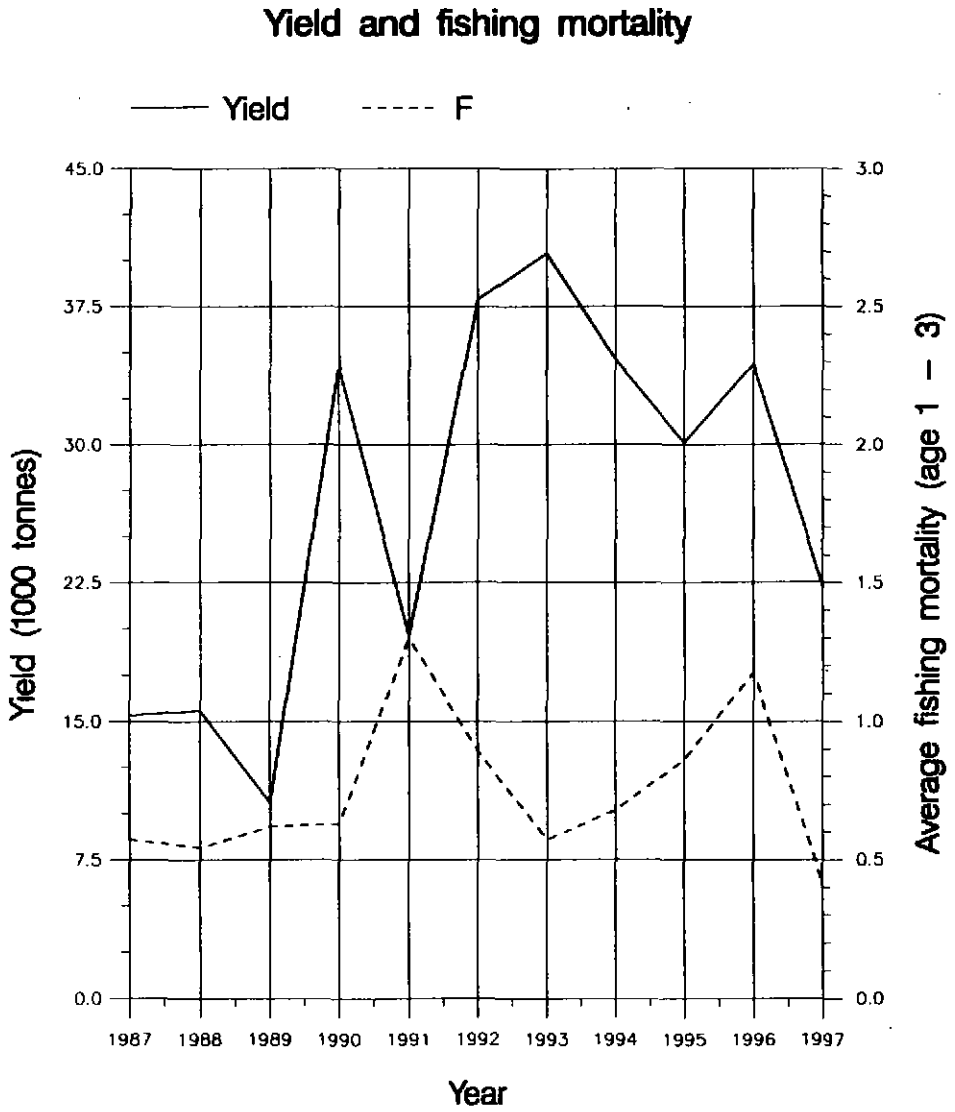
Figure 10. 8.3.2

Fish Stock Summary
Anchovy in the Bay of Biscay (Fishing Area VIII)
4–10–1998



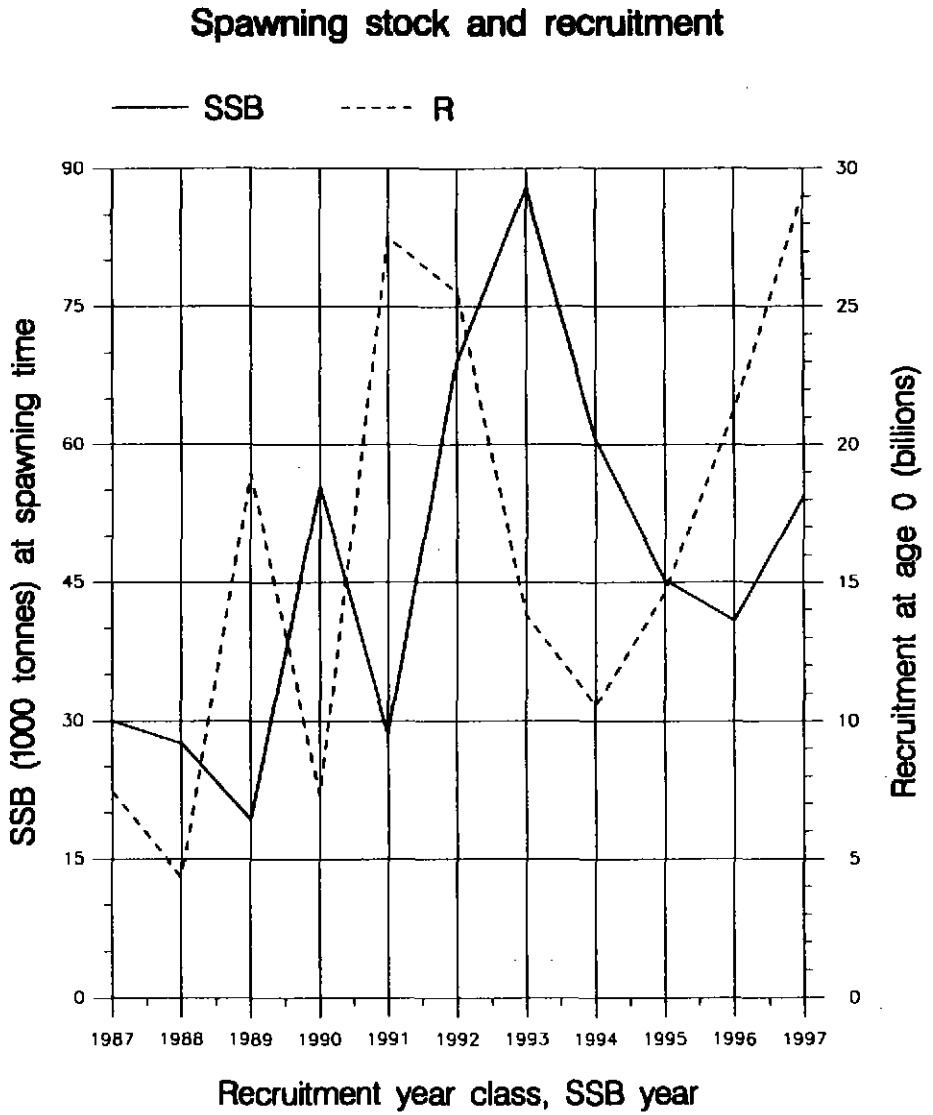
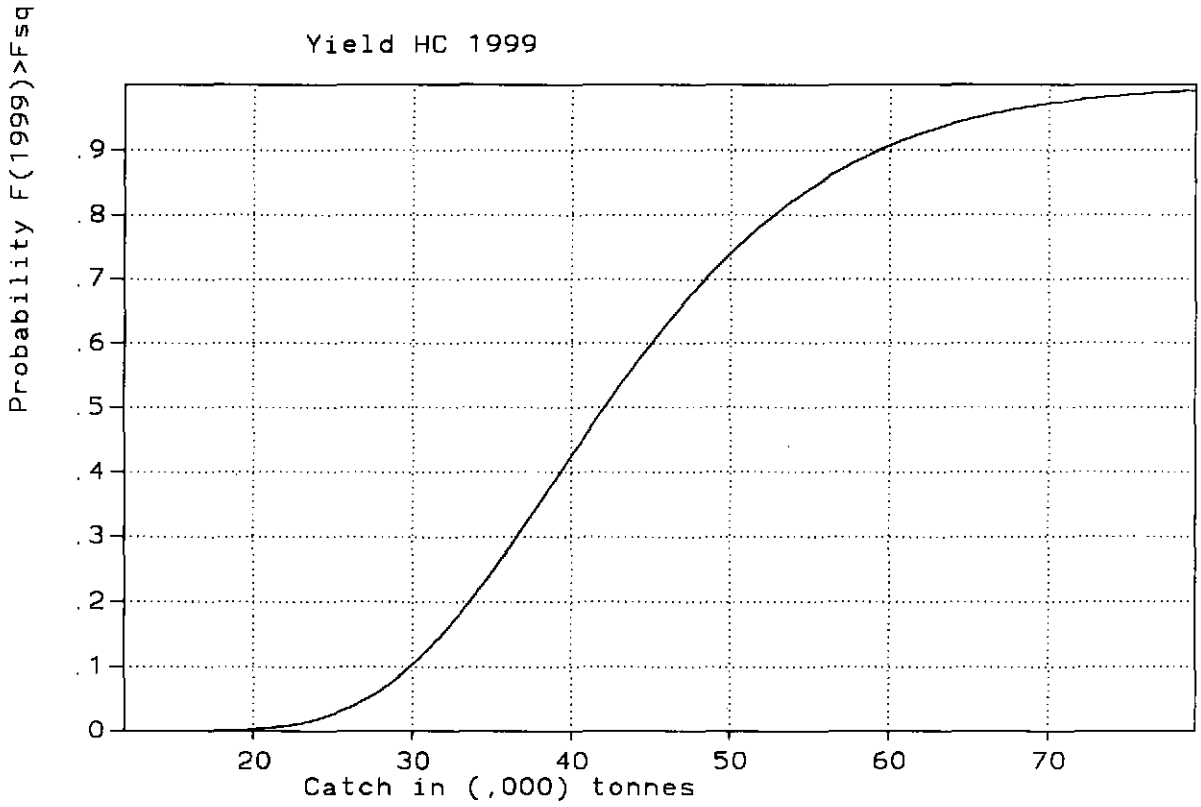


Figure 10.10.1 Anchovy, Area VIII. Probability profiles for short-term forecast.



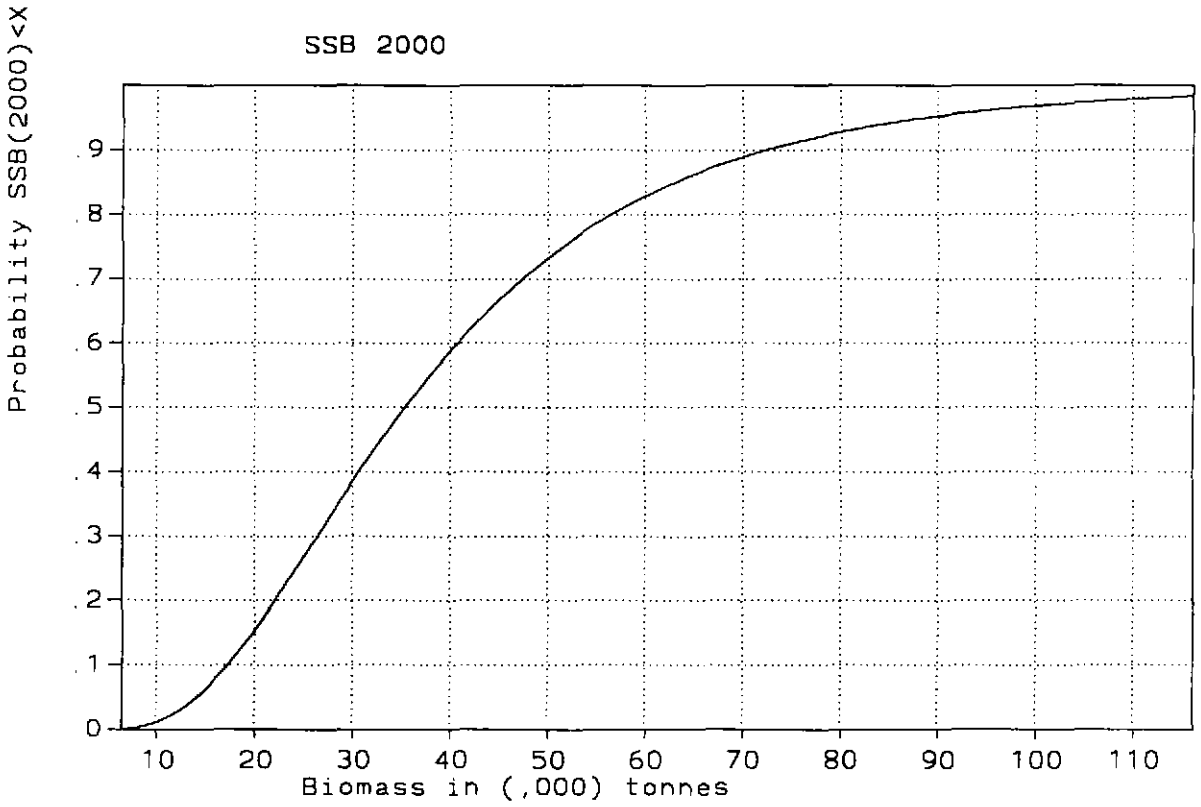


Figure 10.10.2 Anchovy, Area VIII. Sensitivity analysis of short-term forecast.

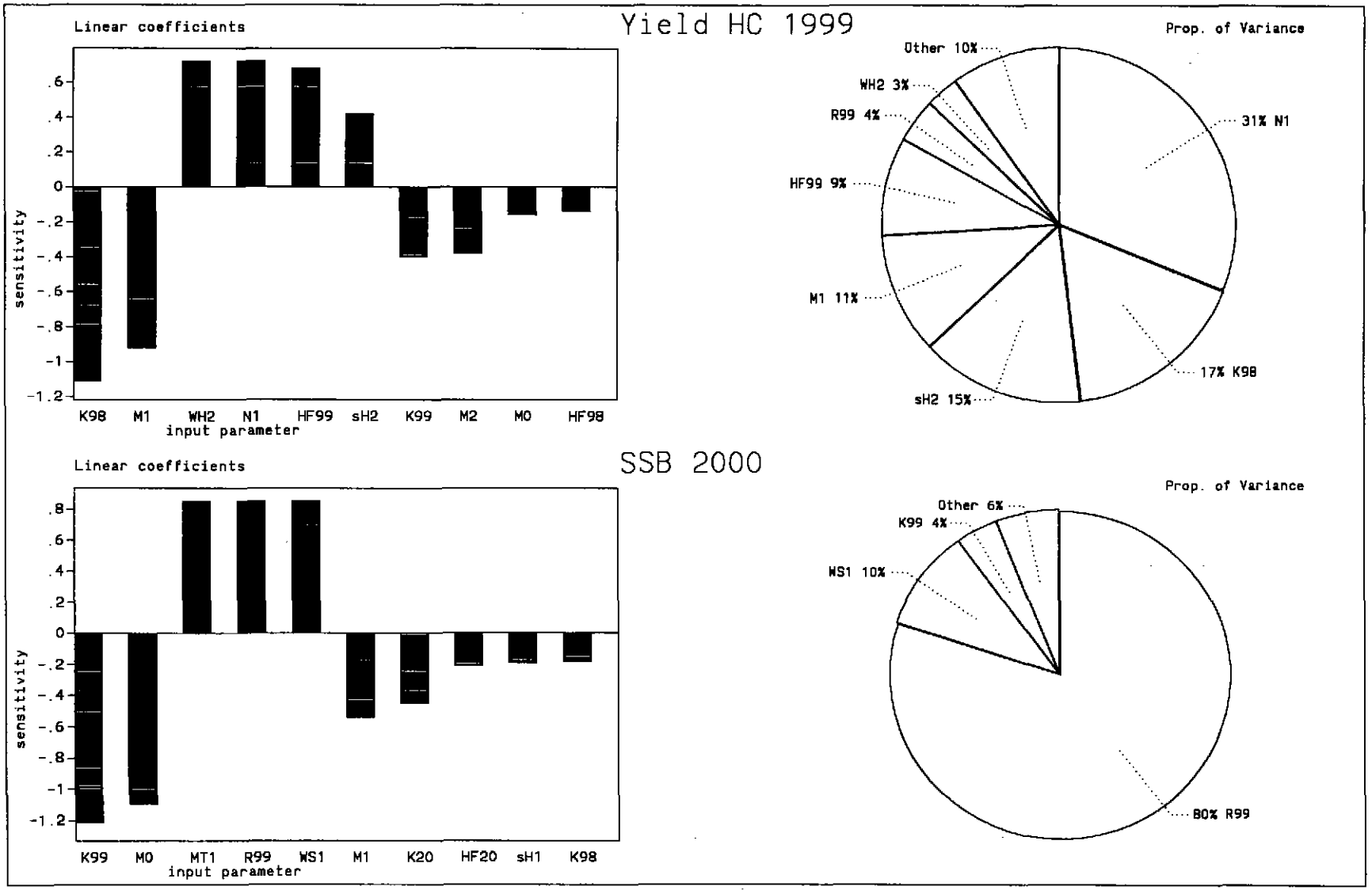


Figure 10.10.3 **Anchovy. Medium term projections. Solid lines show 5, 10, 20, 50 and 95 percentiles**
Parametric bootstrap stock-recruitment relationship
number of simulations 500 Relative Cons. effort = 1.00

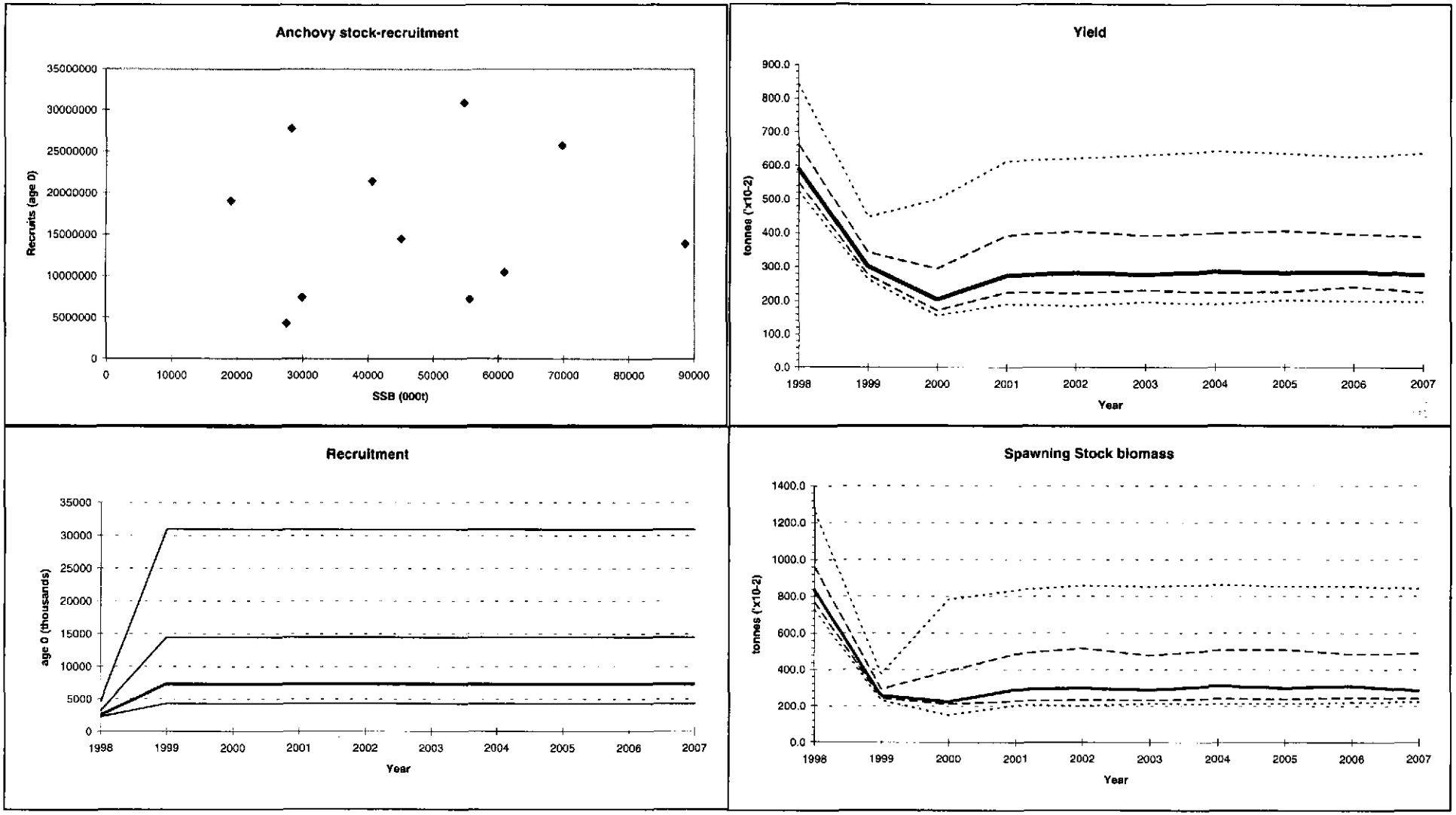


Figure 10.10.4 Anchovy - Medium term predictions showing 5th,10th,20th and 50th percentiles of SSB in 2002 for different F-levels
Parametric bootstrap stock-recruitment relationship. 500 simulations

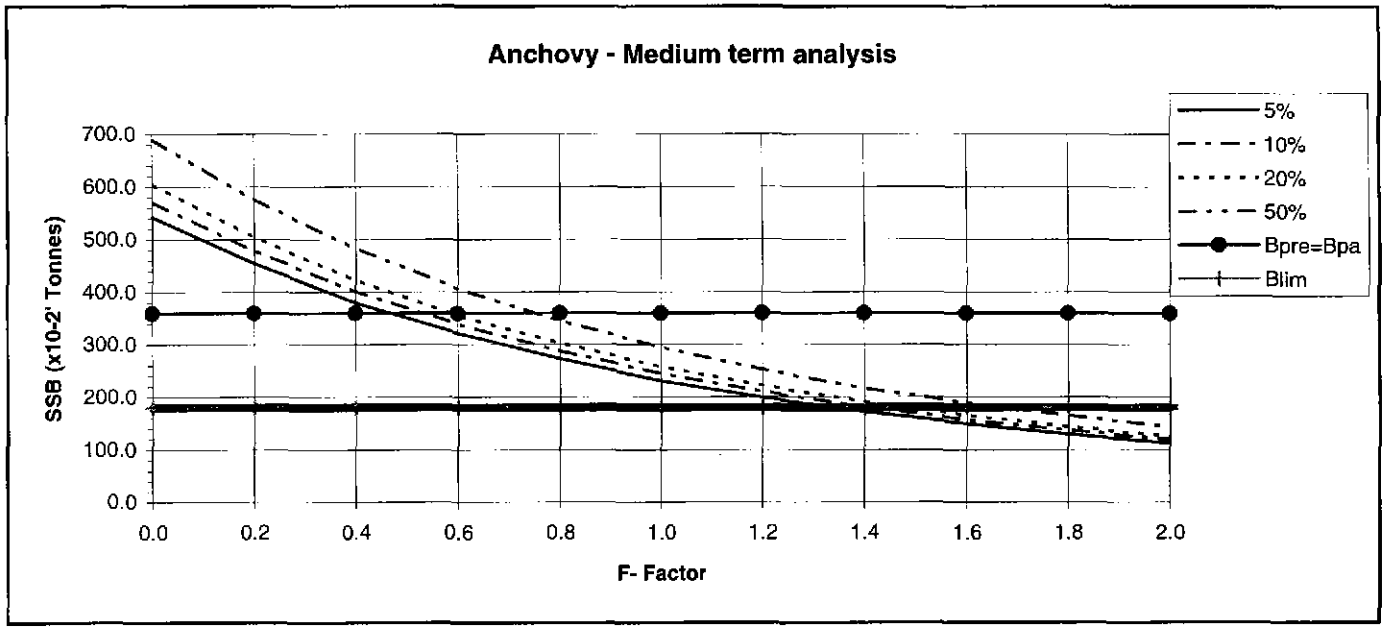


Figure 10. 12.1 Long term yield and %SSBR with R=Geometric mean considering the uncertainties in the estimates of the separable annual F
($F_{statusquo}$ = mean annual $F_{95\text{-}97}$ (+/- 1 s.e.))

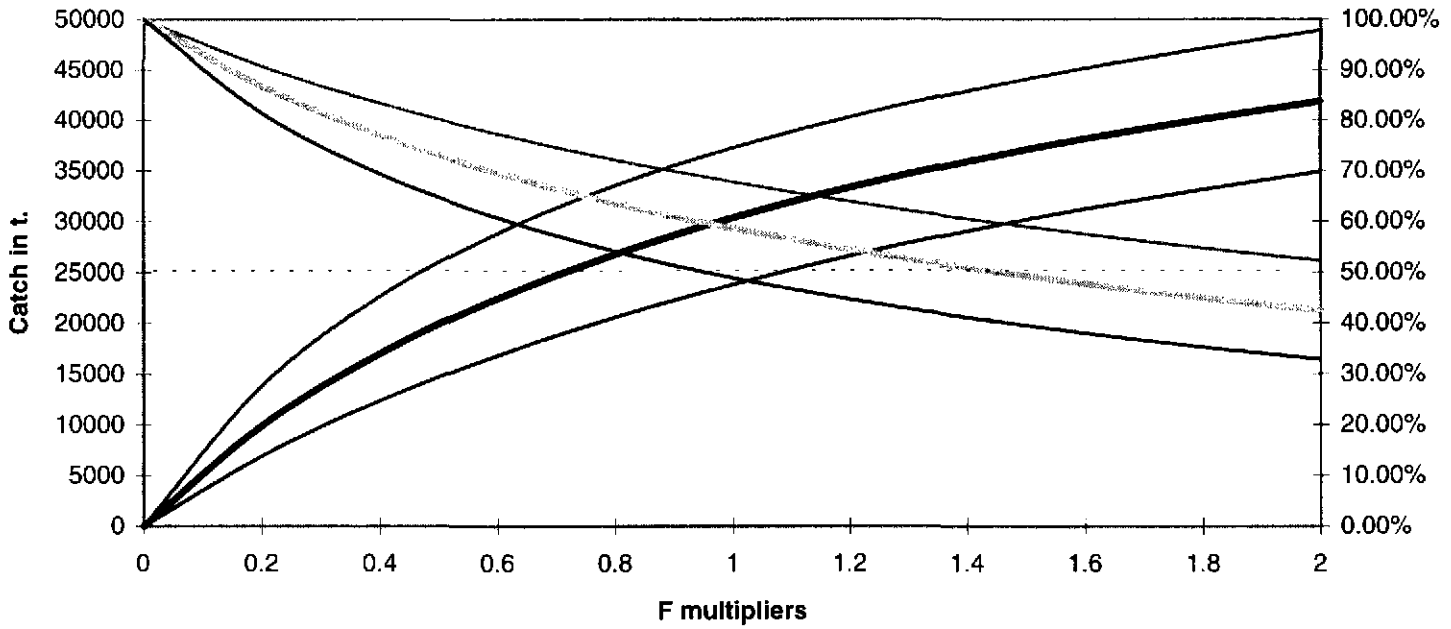
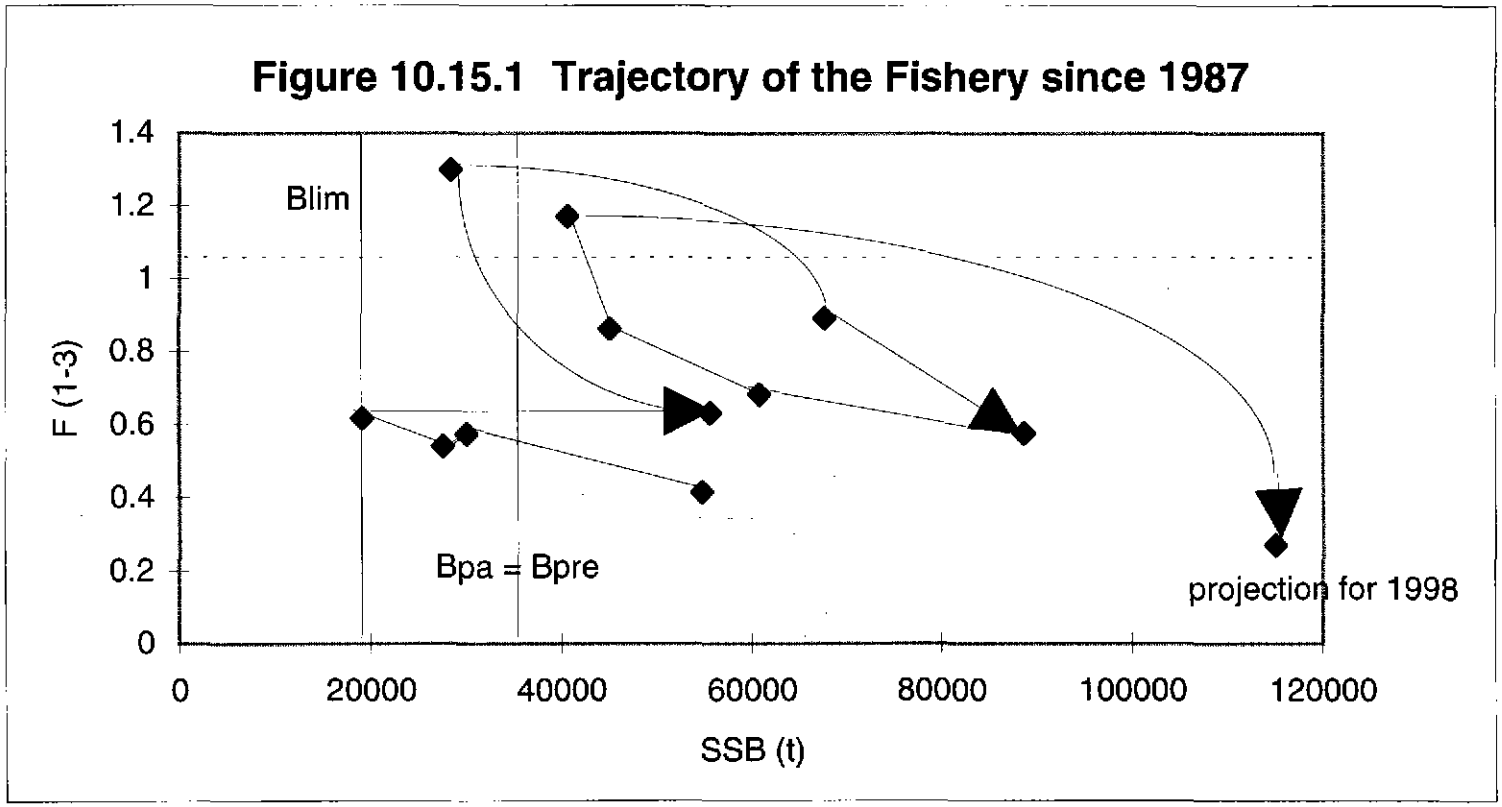


Figure 10.15.1 Trajectory of the Fishery since 1987



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11 ANCHOVY IN DIVISION IXa

11.1 ACFM Advice Applicable to 1997 and 1998

The advice given by ACFM was: If required, precautionary TAC at pre-95 catch level. The agreed TAC for anchovy in Division IXa is 12,000 tonnes.

ACFM advised that no management objectives have been articulated for this stock. The current TAC is believed to exceed the sustainable catch potential. A traditional TAC management system may not be appropriate for this short-lived species, in which variations in recruitment are largely driven by environmental factors. Lack of biological information for this stock hampers the provision of advice on more appropriate management measures. Monitoring of the stock would require regular sampling together with information from a series of acoustic and egg surveys.

11.2 The Fishery in 1997

In 1997 the anchovy fishery in Division IXa was once more situated in the Gulf of Cadiz (Sub-division IXa South) as is usual in this area, except in 1995, when it was mainly found in the northern part of Division IXa. Anchovy is the target species of the Spanish purse-seine fleet in the Gulf of Cadiz. The Spanish and Portuguese purse-seine fleets in the northern part of Division IXa target anchovy when abundance is high, due to high market prices, as occurred in 1995 (ICES 1997/Assess:3). In 1997 anchovy abundance in the northern part of Division IXa was low, as is usual in this area.

The increase in anchovy abundance in the northern part of Division IXa in 1995 may have been due to a variation in thermohaline conditions in the coastal waters northwest of the Iberian Peninsula, less saline and warmer than in preceding years, as noted in the Working Group on Oceanic Hydrography (ICES 1997/C:3), thus creating more favourable conditions for reproduction and larval survival. In 1996 and 1997 a change in the previously described trend came about, with lower temperatures and increased salinity being registered (ICES 1997/C:3, ICES 1998/C:8).

The Spanish fleet in the Gulf of Cadiz is mainly made up of purse-seiners, though there is currently another kind of fleet present in the form of trawlers whose usual target species is the prawn. Some of these trawlers switch to targeting anchovy in years when the yield of prawns is low. The Spanish fleet in the west of Galicia is composed of purse-seiners. (Villamor *et al.*, WD 1998). The Portuguese fleet is mainly made of purse-seiners, with some trawlers and artisanal ships, which catch a very small quantity of anchovies.

11.2.1 Landings in Division IXa

The total catch in 1997 was 5,295 t, somewhat higher than in 1996 (4,595 t), at the same level of catches as in the period 1988–1994. The Spanish catch increased in 1997 (4,664 t) with respect to 1996 (1,824 t) due to the increase in catches in the Gulf of Cadiz (Sub-division IXa South). The catch in 1997 in the Gulf of Cadiz increased to 4,600 t, which is an increase of 258% with respect to 1996, registering the highest catches of the last 6 years. The Spanish catch in Sub-division IXa North remained at the same low levels as in 1996, with a great fall in comparison with 1995. The Portuguese catch in 1997 (632 t) decreased with respect to 1996 (2,771 t) and above all with respect to 1995 (7,056 t). (Table 11.2.1.1 and Figure 11.2.1.1).

Table 11.2.1.2 shows the catch by fishing gear and by country. In both countries the main part of the catch was taken using purse-seine, this gear accounting for 95% in the Spanish and 92% in the Portuguese fisheries.

From 1943 to 1987 catch data were only provided by Portugal, and during this period catches varied between 23 t and 12,610 t (Table 11.2.1.1). The Portuguese annual landings alternate between periods of high catches (1936–1940, 1942–1948, 1955–1957, 1962–1966 and 1995) and periods of very low catch levels (1927–1936, 1966–1976, 1979–1984 and 1987–1994) (Pestana, 1996). Data of Spanish catches in the Bay of Cadiz (Sub-division IXa South) for this period cannot be given since they have been combined with anchovy catches in the area of Morocco, and catches in Galician waters (Sub-division IXa North) are not available.

11.2.2 Landings by Sub-division

Figure 11.2.2.1 shows the percentage of the mean catches for the period 1988–1994 and 1996–1997 and the percentage of the catches in 1995 by Sub-division. Since 1988 the anchovy fishery in Division IXa was situated in the Gulf of Cadiz, except in 1995, when it was mainly found in the northern part of Division IXa.

The distribution of Spanish catches in 1997 was similar to that of 1988–1994 and 1996 (ICES 1992/Assess:17, ICES 1993/Assess:19, ICES 1995/Assess:2, ICES 1996/Assess:7, and ICES 1998/Assess:6) and completely different to that of 1995 (ICES 1997/Assess:3). In 1997, the greatest catches (99%) were found in Sub-division IXa South (Gulf of Cadiz),

and the rest (1%) in Sub-division IXa North (West of Galicia). Catches in the Gulf of Cadiz came about throughout the whole year, increasing in spring and summer. In 1997 the main fishing season was summer (July–September) with almost 44% of the total annual catch. The small catches in Sub-division IXa North came about mainly in the fourth quarter.(Table 11.2.2.1).

The greatest contribution to Portuguese annual landings came from IXa South during the period 1943–1967 (mean value 4,526 t). After this period the landings decreased to 386 t (mean value) from 1968 to 1983 and to 32 t (mean value) from 1984 to 1991. From 1992 to 1995 landings were less than 1 tonne and in 1996 and 1997 they were 32 t (mean value). In Sub-division IXa Central-North there were alternate periods of relatively high and low landings. After 1984 landings of Sub-division IXa Central-North made the greatest contribution to the total annual landings (mean value 1,116 t). The mean percentage of the landings by Sub-division (1970–1995) is 70% of the total in IXa Central-North, 5% in IXa Central-South and 20% in IXa South. The same landing pattern occurs in Sub-divisions IXa Central-North and Central-South during the period from 1970–1994 and in 1995. (Pestana, WD 1996). In 1996 and 1997, catches in Sub-division IXa Central-North and Central-South fell to the same levels as those of the period 1991–1994, but maintained the same pattern of catches as that of the period 1970–1995.

Most of the Portuguese landings were made between May and October (mean 1927–1994). The 1995 landings show a different evolution with two very important periods from April to June and from August to December (Pestana, 1996). In 1997, as in 1996 catches are taken mainly in the first and fourth quarters (Table 11.2.2.1).

11.3 Biological Data

11.3.1 Catch numbers at age

Catches at age of anchovy in Division IXa are not available. Only catches at age were provided in 1995 from the Spanish fishery in Sub-Division IXa North and these catches were made up of age 1 anchovies (ICES 1995/Assess:2).

Catches at age of anchovy in Sub-division IXa North are not available for 1997 as catches were insignificant, thus rendering it impossible to carry out biological sampling of commercial catches. As in previous years, nor are catches at age available for anchovy in the Gulf of Cadiz, due to problems in the interpretation of otolith readings for this area. In 1998 an otolith exchange for anchovy in the Gulf of Cadiz was carried out within the International Project co-funded by the European Commission entitled European Fish Ageing Network (EFAN), to solve the difficulties involved in age reading. The report and conclusions will be presented in the next meeting.

11.3.2 Mean length

Annual length compositions of landings of anchovy in Division IXa were only provided by Spain, from 1988 to 1997 of the Sub-division IXa South and from 1995 to 1997 of the Sub-division IXa North. Portugal has not provided the length distributions of landings in Division IXa.

Table 11.3.2.1 shows the anchovy length distributions in 1997 in Sub-Division IXa South and IXa North by quarter and Table 11.3.2.2 shows the annual length distributions from 1988 to 1997.

In 1997, as in previous years, large number of juveniles are captured (individuals with a length of less than 10 cm) in Sub-division IXa South during the first and second halves of the year (Table 11.3.2.1 and Figure 11.3.2.1). The mean length and weight in the catch in Sub-division IXa South are smaller than those recorded from Sub-division IXa North (Table 11.3.2.2 and Figure 11.3.2.2).

11.3.3 Maturity

In the Gulf of Cadiz (Sub-division IXa South) sexual maturation generally begins in March and reaches a maximum between May and September. Maturity is reached in both sexes at around 11 cm total length. (Millan and Villamor, 1992).

11.3.4 Natural mortality

Natural mortality is not available for this stock. By analogy with the anchovy in Sub-area VIII, natural mortality must be high.

11.4 Fishery Independent Information

11.4.1 Acoustic surveys

A Spanish acoustic survey was carried out in the Gulf of Cadiz (Sub-division IXa South) in 1993 to estimate anchovy abundance. The total biomass estimated was 6,569 t (ICES 1995/Assess:2). Since then, no acoustic surveys have been conducted in this area by Spain. In Sub-division IXa North there is no anchovy data from Spanish acoustic surveys.

Information about anchovy from the Portuguese sardine egg and acoustic surveys relatively in Division IXa is not available because in Portugal there is not any research project for anchovy.

11.5 Effort and Catch per Unit Effort

The data provided of fishing effort and CPUE indices of anchovy in Division IXa refer to the Spanish purse-seine fleet in the Bay of Cadiz from 1988 to 1997 and to the Spanish purse-seine fleet in Sub-division IXa North from 1995 to 1997 (Table 11.5.1 and 11.5.2). No Portuguese data are available.

Effort measured as the number of effective fishing trips made by the five fleets of the Gulf of Cadiz and the CPUE series shows a declining trend to 1995 in all fleets, with a increase in 1996 and 1997. (Figure 11.5.1).

11.6 Recruitment Forecasting

Recruitment forecasting of Anchovy in Division IXa is unknown. By analogy with the anchovy stock in Sub-area VIII, the recruitment may have wide variations driven by environmental factors.

11.7 State of the Stock

The anchovy biomass in the Gulf of Cadiz was estimated by an acoustic survey as 6,569 t in 1993.

The Working Group re-examined the information to see if it was possible to do an assessment based in catch at length, catch and effort. No further progress was made for the following reasons:

- The differences of the length distributions between IXa South and North (Table 11.3.2.2 and Figure 11.3.2.2) suggest that the populations inhabiting these areas may have different dynamics.

- No other estimates either acoustic or from egg sardine surveys are available. Therefore there was no way of scaling any assessment to absolute or relative estimates of anchovy abundance in Division IXa.

Because of the lack of biological information, the state of the stock is unknown. By analogy with the anchovy stock in Sub-area VIII, it seems that this stock will fluctuate widely due to variations in recruitment largely driven by environmental factors.

11.8 Catch Predictions

No catch predictions have been estimated for this stock.

11.9 Medium-Term Predictions

No medium-term predictions have been estimated for this stock.

11.10 Long-Term Yield

No long-term yield predictions have been estimated for this stock.

11.11 Reference Points for Management Purposes

Based on available information it is not possible to determine limit and precautionary reference points.

11.12 Harvest Control Rules

Harvest control rules are not available as reference points are not determined.

11.13 Management Considerations

The regulatory measures were the same as for the previous year and are summarised by Millan and Villamor (WD 1992). It must be pointed out that the purse-seine fleet in the Gulf of Cadiz did not observe the usual voluntary stoppage of three months in this area in 1997 (ICES 1992/Assess:17, ICES 1993/Assess:19, ICES 1995/Assess:2, ICES 1996/Assess:7, ICES 1997/Assess:3, and ICES 1998/Assess:6). The fleet probably went ahead with fishing activity due to the higher anchovy abundance.

Given the reduced knowledge of the biology and dynamics of this population, it is recommended that the precautionary TAC at recent catch level (in the period before the year 1995) would be appropriate to avoid an increase in effort. The current TAC is believed to exceed the sustainable catch potential.

Table 11.2.1.1 Portuguese and Spanish annual landings of ANCHOVY in Division IXa. (From Pestana, 1989 and 1996 and Working Group members).

	Portugal				Spain			
Year	IXa C-N	IXa C-S	IXa South	Total	IXa North	IXa South	Total	TOTAL
1943	7121	355	2499	9975	-	-	-	-
1944	1220	55	5376	6651	-	-	-	-
1945	781	15	7983	8779	-	-	-	-
1946	0	335	5515	5850	-	-	-	-
1947	0	79	3313	3392	-	-	-	-
1948	0	75	4863	4938	-	-	-	-
1949	0	34	2684	2718	-	-	-	-
1950	31	30	3316	3377	-	-	-	-
1951	21	6	3567	3594	-	-	-	-
1952	1537	1	2877	4415	-	-	-	-
1953	1627	15	2710	4352	-	-	-	-
1954	328	18	3573	3919	-	-	-	-
1955	83	53	4387	4523	-	-	-	-
1956	12	164	7722	7898	-	-	-	-
1957	96	13	12501	12610	-	-	-	-
1958	1858	63	1109	3030	-	-	-	-
1959	12	1	3775	3788	-	-	-	-
1960	990	129	8384	9503	-	-	-	-
1961	1351	81	1060	2492	-	-	-	-
1962	542	137	3767	4446	-	-	-	-
1963	140	9	5565	5714	-	-	-	-
1964	0	0	4118	4118	-	-	-	-
1965	7	0	4452	4460	-	-	-	-
1966	23	35	4402	4460	-	-	-	-
1967	153	34	3631	3818	-	-	-	-
1968	518	5	447	970	-	-	-	-
1969	782	10	582	1375	-	-	-	-
1970	323	0	839	1162	-	-	-	-
1971	257	2	67	326	-	-	-	-
1972	-	-	-	-	-	-	-	-
1973	6	0	120	126	-	-	-	-
1974	113	1	124	238	-	-	-	-
1975	8	24	340	372	-	-	-	-
1976	32	38	18	88	-	-	-	-
1977	3027	1	233	3261	-	-	-	-
1978	640	17	354	1011	-	-	-	-
1979	194	8	453	655	-	-	-	-
1980	21	24	935	980	-	-	-	-
1981	426	117	435	978	-	-	-	-
1982	48	96	512	656	-	-	-	-
1983	283	58	332	673	-	-	-	-
1984	214	94	84	392	-	-	-	-
1985	1893	146	83	2122	-	-	-	-
1986	1892	194	95	2181	-	-	-	-
1987	84	17	11	112	-	-	-	-
1988	338	77	43	458	-	4263	4263	4721
1989	389	85	22	496	118	5336	5454	5950
1990	424	93	24	541	220	5726	5946	6487
1991	187	3	20	210	15	5697	5712	5922
1992	92	46	0	138	33	2995	3028	3166
1993	20	3	0	23	1	1960	1961	1984
1994	231	5	0	236	117	3036	3153	3389
1995	6724	332	0	7056	5329	571	5900	12956
1996	2707	13	51	2771	44	1780	1824	4595
1997	610	8	13	632	63	4600	4664	5295

(-) Not available

(0) Less than 1 tonne

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Table 11.2.1.2 ANCHOVY IXa. Catches (t) by gear and by country in 1988-1997.

Country/Quarter	1988*	1989*	1990*	1991*	1992	1993	1994	1995*	1996	1997
SPAIN	4263	5454	5946	5712	3028	1961	3153	5900	1823	4664
Purse seine IXa North		118	220	15	33	1	117	5329	44	63
Purse seine IXa South	4242	5270	5666	5656	2995	1630	2884	496	1556	4410
Trawl IX a South	21.0	66.0	60.0	41.0	0.0	330	152	75	224	190
PORTUGAL	458	496	541	210	275	23	237	7056	2771	632
Trawl					4	9	1		56	46
Purse seine	458	496	541	210	270	14	233	7056	2621	579
Artisanal					1	1	3		94	7
Total	4721	5950	6487	5922	3303	1984	3390	12956	4594	5295

* Portugal data without separate the catch by gear

Table 11.2.2.1 Anchovy catches (t) in Division IXa by country and Subdivisions in 1997.

COUNTRY	SUBDIVISIONS	QUARTER 1 C(t)	%	QUARTER 2 C(t)	%	QUARTER 3 C(t)	%	QUARTER 4 C(t)	%	ANUAL C (t)	%
SPAIN	IXa North	2	3.8	4	7.0	2	3.8	54	85.4	63	1.4
	IXa South	906	19.7	1110	24.1	2006	43.6	578	12.6	4600	98.6
	TOTAL	909	19.5	1114	23.9	2008	43.1	632	13.6	4664	
PORTUGAL	IXa Central North	164	26.9	49	8.0	44	7.2	353	57.9	610	96.6
	IXa Central South	6	72.0	2	20.9	0	4.4	0	2.7	8	1.3
	IXa South	1	9.7	0	2.0	1	6.8	11	81.5	13	2.1
	TOTAL	171	27.1	51	8.0	45	7.2	364	57.7	632	
TOTAL	IXa North	2	3.8	4	7.0	2	3.8	54	85.4	63	1.2
	IXa Central North	164	26.9	49	8.0	44	7.2	353	57.9	610	11.5
	IXa Central South	6	72.0	2	20.9	0	4.4	0	2.7	8	0.2
	IXa South	908	19.7	1110	24.1	2007	43.5	589	12.8	4613	87.1
	TOTAL	1080	20.4	1165	22.0	2054	38.8	997	18.8	5295	

Table 11.3.2.1 Length distribution ('000) of ANCHOVY in Division IXa by country and Sub-divisions in 1997.

	QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4			TOTAL		
Length (cm)	SPAIN IXa North	PORTUGAL IXa C,CN,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa C,CN,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa C,CN,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa C,CN,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa C,CN,S	SPAIN IXa South
3.5	-	-		-	-		-	-			-			-	0
4	-	-		-	-		-	-			-			-	0
4.5	-	-		-	-		-	-	1075		-	355		-	1430
5	-	-	242	-	-		-	-	11111		-	355		-	11709
5.5	-	-	969	-	-	660	-	-	37277		-	355		-	39261
6	-	-	3392	-	-	1320	-	-	43366		-	7455		-	55532
6.5	-	-	7631	-	-	6928	-	-	23494		-	16684		-	54737
7	-	-	6783	-	-	11547	-	-	19526		-	33013		-	70869
7.5	-	-	2544	-	-	10228	-	-	12391		-	22719		-	47881
8	-	-	850	-	-	9238	-	-	28215		-	9584		-	47887
8.5	-	-	244	-	-	4949	-	-	27622		-	4970		-	37785
9	-	-	308	-	-	990	-	-	17975		-	1204		-	20476
9.5	-	-	689	-	-	330	-	-	10951		-	1732		-	13702
10	-	-	1933	-	-	1061	-	-	3937		-	1892		-	8824
10.5	-	-	3742	-	-	2691	-	-	2140		-	3341		-	11914
11	-	-	7043	-	-	5065	-	-	4809		-	5221		-	22139
11.5	-	-	10003	-	-	7692	-	-	3462		-	5643		-	26800
12	-	-	9916	-	-	15802	-	-	6525		-	6248		-	38491
12.5	-	-	9857	-	-	21965	-	-	8696		-	4266		-	44784
13	-	-	9272	-	-	16969	-	-	15587	319	-	4497	374	-	46325
13.5	-	-	9000	-	-	9951	-	-	16422	852	-	2478	997	-	37851
14	-	-	2525	-	-	3726	-	-	10651	1711	-	1982	2004	-	18885
14.5	-	-	2590	-	-	1865	-	-	5597	361	-	1084	422	-	11136
15	-	-	310	-	-	797	-	-	4302	41	-	861	48	-	6269
15.5	-	-	63	-	-	279	-	-	3241	34	-	151	40	-	3734
16	-	-		-	-	186	-	-	1891	28	-	125	33	-	2203
16.5	-	-		-	-		-	-	294	8	-		10	-	294
17	-	-		-	-		-	-		8	-		10	-	
17.5	-	-		-	-		-	-		11	-		13	-	
18	-	-		-	-		-	-			-			-	
18.5	-	-		-	-		-	-			-			-	
19	-	-		-	-		-	-			-			-	
19.5	-	-		-	-		-	-			-			-	
20	-	-		-	-		-	-			-			-	
20.5	-	-		-	-		-	-			-			-	
21	-	-		-	-		-	-			-			-	
21.5	-	-		-	-		-	-			-			-	
22	-	-		-	-		-	-			-			-	
Total N	-	0	89905	-	0	134238	-	0	320558	3374	0	136215	3951	0	680916
Catch (T)	2	171	906	4	51	1110	2	45	2006	54	364	578	63	632	4600
L avg (cm)	-	-	11.1	-	-	11.0	-	-	8.9	14.2	-	8.8	14.2	-	9.6
W avg (g)	-	-	10.1	-	-	8.3	-	-	6.3	16.1	-	4.2	16.1	-	6.8

Table 11.3.2.2 Annual Length distribution ('000) of ANCHOVY in Division IXa from 1988 to 1997.

	1988	1989	1990	1991	1992	1993	1994	1995		1996		1997	
Length (cm)	SPAIN IXa South	SPAIN IXa South	SPAIN IXa South	SPAIN IXa South	SPAIN IXa South	SPAIN IXa South	SPAIN IXa South	SPAIN IXa North	SPAIN IXa South	SPAIN IXa North	SPAIN IXa South	SPAIN IXa North	SPAIN IXa South
3.5											3956		
4			4011	258	1						24394		
4.5		127	16601	3306	26	22					94385		1430
5	128	452	29122	43814	80	22					105300		11709
5.5	170	813	43716	77144	345	66					75573		39261
6		994	39979	43378	921	180					45352		55532
6.5		1207	37909	24724	2337	611	5488				33572		54737
7	255	2391	29592	15470	3567	1862	12009				26691		70869
7.5	351	5764	27140	16574	5993	3561	18391		439		20643		47881
8	3163	24708	24315	16633	12777	4083	23533		439		23701		47887
8.5	8073	62795	33427	15724	18240	2626	22031		447		32814		37785
9	12602	52082	46239	19735	14461	3843	20272		3108		29383		20476
9.5	21594	42387	74823	30742	20684	6848	14835		9805		15933		13702
10	34293	67553	95844	39474	31524	7100	23726		11823		8743		8824
10.5	49922	69793	96132	71062	31870	9496	27521		14966		8435		11914
11	63848	68387	72419	83835	31776	9401	28394		8575		18322		22139
11.5	55186	55528	63427	81931	31150	11636	33602		7105		22440		26800
12	60928	41099	44273	77372	34504	24713	26439	74	4565		18131		38491
12.5	37457	34212	28509	51932	29185	32918	30192	711	3606		10112		44784
13	22608	17989	15263	43309	17040	26293	15732	3049	1855	8	4207	374	46325
13.5	8149	11505	10619	25316	5725	12681	8517	3381	1544	12	1974	997	37851
14	4270	7747	4689	17842	3378	5318	5719	14998	935	258	1385	2004	18885
14.5	474	3190	1206	5211	2180	2535	4763	25944	135	335	967	422	11136
15	3896	2245	605	1987	315	943	3612	46371	138	375	637	48	6269
15.5	2436	1671	318	944	922	510	874	42244	6	226	511	40	3734
16	2126	4676	340	1533	355	56	813	44171		227	165	33	2203
16.5	1690	7271	565	2087	271		368	14369		151		10	294
17	1096	4349	373	1655	95		182	8378		104		10	
17.5	209	1241	199	558	19			778		94		13	
18		571	143	79				236		24			
18.5			19							21			
19										1			
19.5													
20													
20.5													
21													
21.5													
22													
Total N	394923	592750	841818	813628	299743	167322	327014	204705	69491	1835	627727	3951	680916
Catch (T)	4263	5336	5726	5697	2995	1960	3035	5329	571	44	1780	63	4600
L avg (cm)	11.6	10.9	9.6	10.1	10.8	12.0	10.8	15.6	11.0	15.6	7.1	14.2	9.6
W avg (g)	10.8	8.9	6.9	7.0	10.0	11.8	9.3	26.0	9.6	23.7	2.9	16.1	6.8

Table 11.5.1 ANCHOVY in Division IXa. Effort data : Spain IXa South (Bay of Cadiz) and Spain IXa North (Western Galicia) number of fishing trips.

	SUB-DIVISION IXa SOUTH					SUB-DIVISION IXa NORTH	
	PURSE SEINE					PURSE SEINE	
Year	BARBATE Single purpose	BARBATE Multi purpose	SAN LUCAR Multi purpose	I. CRISTINA Single purpose	I.CRISTINA Multi purpose	VIGO	RIVEIRA
	No. fishing trip					No. fishing trip	
1988	3958	17	210	-	-	-	-
1989	4415	39	234	-	-	-	-
1990	4622	92	660	-	-	-	-
1991	3981	40	919	-	-	-	-
1992	3450	116	583	-	-	-	-
1993	2152	5	225	-	-	-	-
1994	1625	69	899	196	28	-	-
1995	528	17	377	22	17	1537	252
1996	1595	89	1659	76	55	32	3
1997	2207	115	1738	75	13	31	23

Table 11.5.2 ANCHOVY in Division IXa. Spain IXa South (Bay of Cadiz) and Spain IXa North (Western Galicia) CPUE series in commercial fisheries.

	SUB-DIVISION IXa SOUTH					SUB-DIVISION IXa NORTH	
	PURSE SEINE					PURSE SEINE	
Year	BARBATE Single purpose	BARBATE Multi purpose	SAN LUCAR Multi purpose	I. CRISTINA Single purpose	I.CRISTINA Multi purpose	VIGO	RIVEIRA
	kg/No. fishing trip					kg/No. fishing trip	
1988	1047	461	420	-	-	-	-
1989	1139	534	943	-	-	-	-
1990	1128	287	643	-	-	-	-
1991	1312	339	456	-	-	-	-
1992	819	173	300	-	-	-	-
1993	641	268	225	-	-	-	-
1994	1326	262	398	204	174	-	-
1995	377	134	166	52	25	2509	2286
1996	497	315	246	137	157	847	4
1997	1580	306	288	134	163	1068	639

Figure 11.2.1.1 Portuguese and Spanish annual landings of Anchovy in Division IXa since 1943.

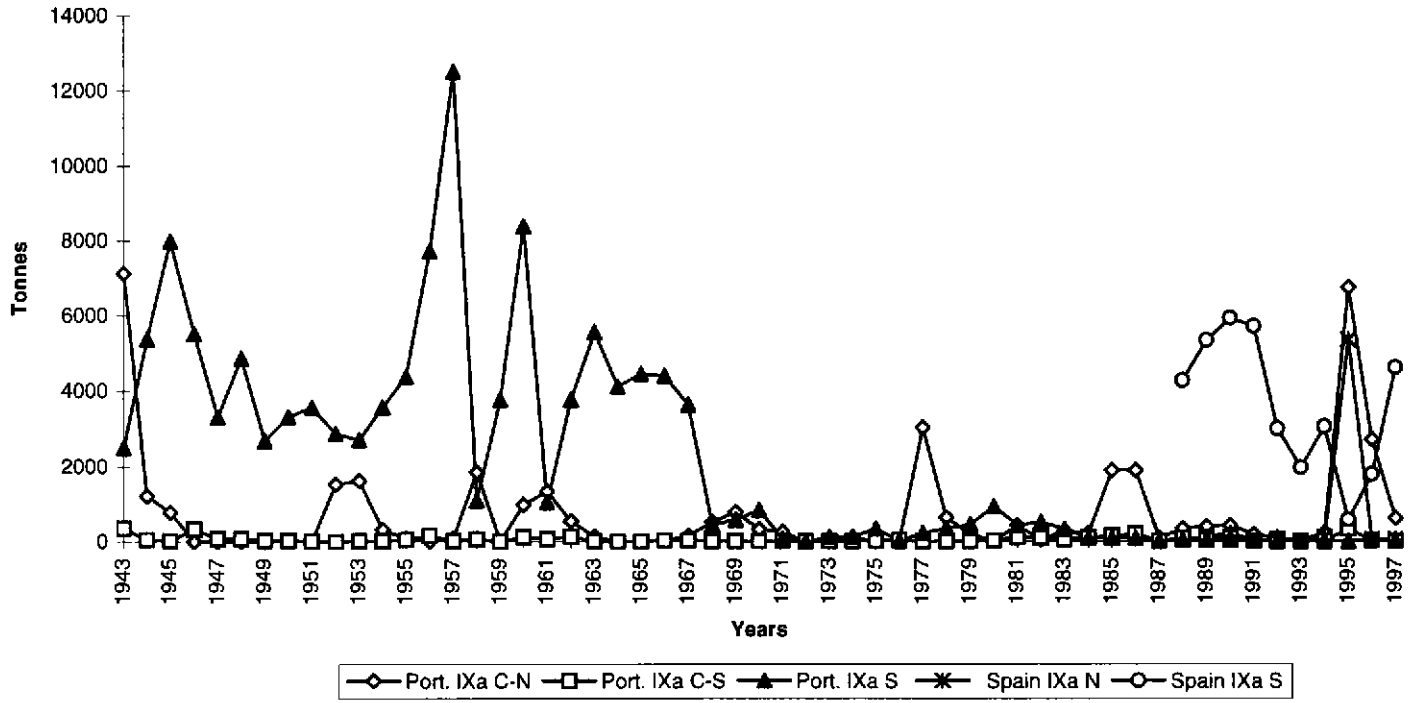


Figure 11.2.2.1 Anchovy in Division IXa. Percentage of the catches by Sub-division for the period 1988–1997.

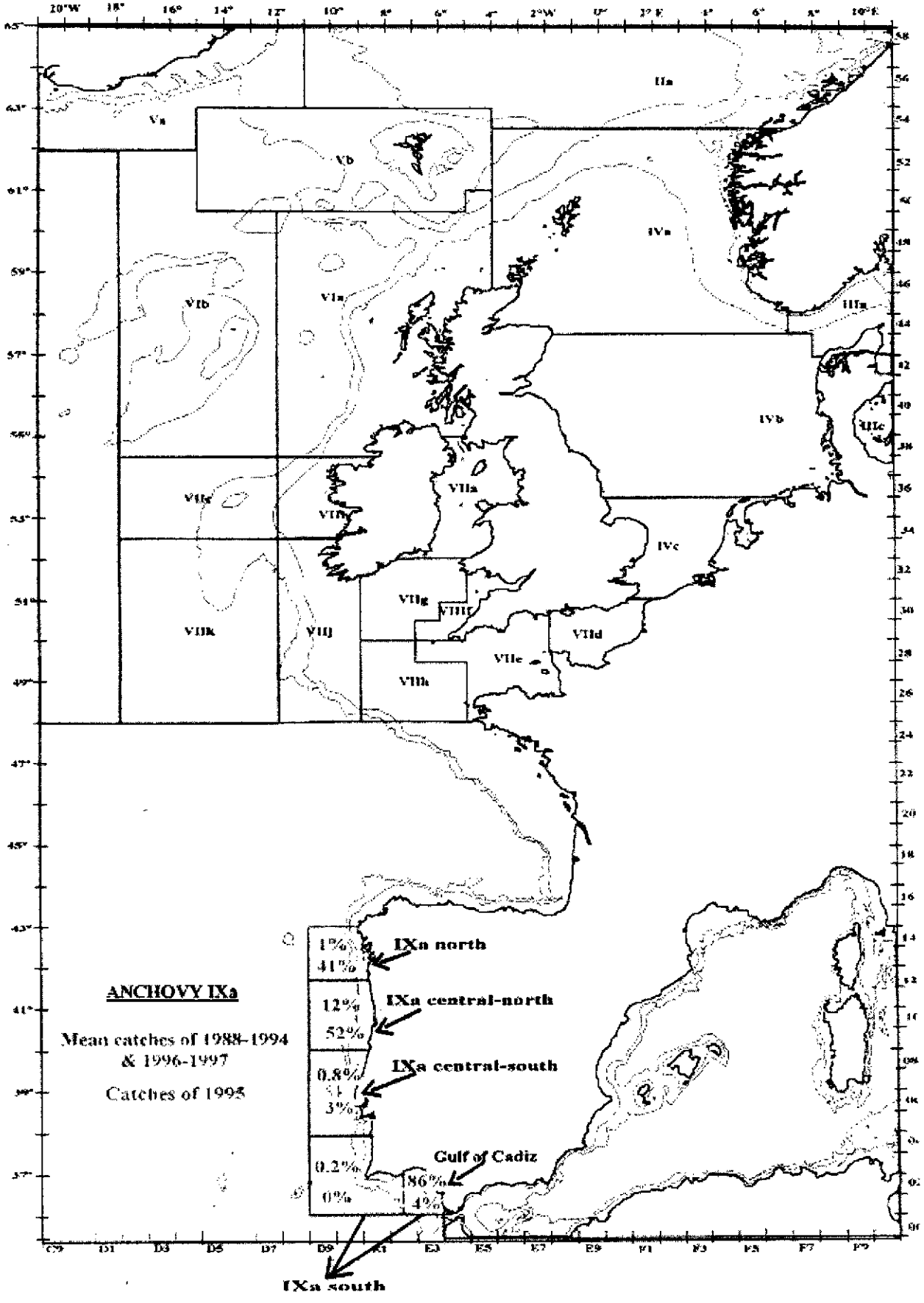
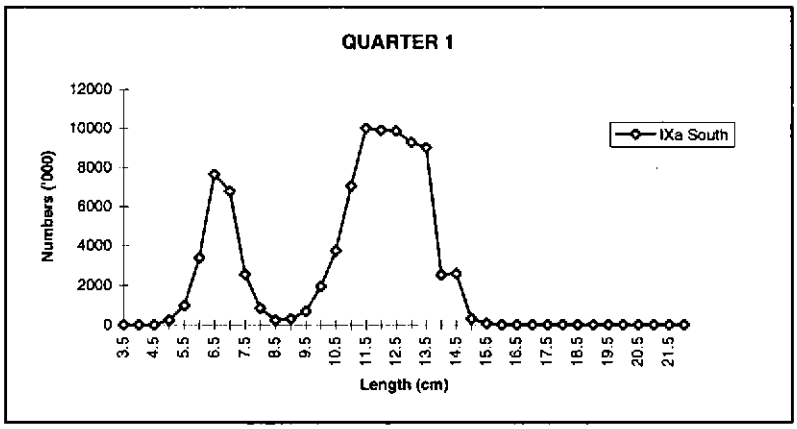
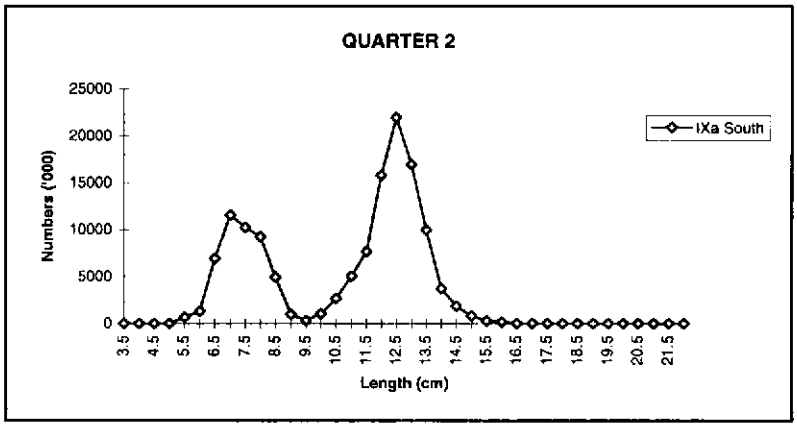
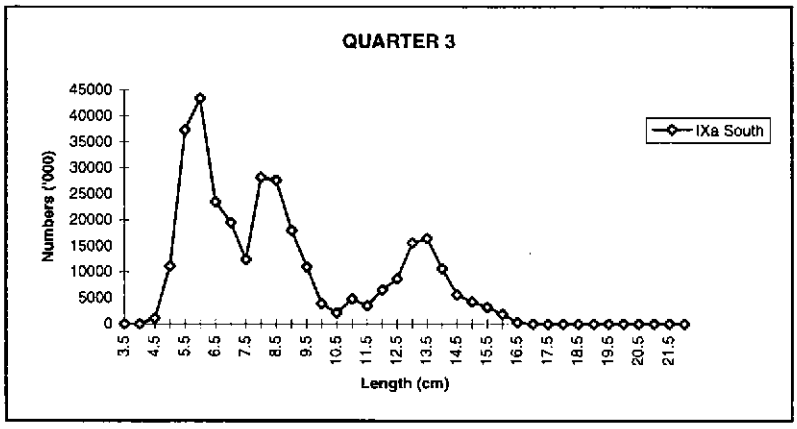


Figure 11.3.2.1 Length distribution ('000) of landings of ANCHOVY in Sub-division IXa South (Gulf of Cadiz) by quarter in 1997.







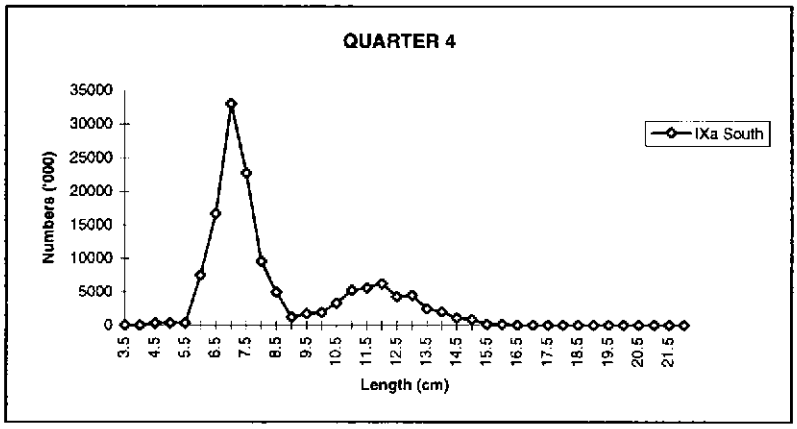


Figure 11.3.2.2 Length distribution ('000) of Anchovy in Sub-division IXa South and IXa North. 1995-1997

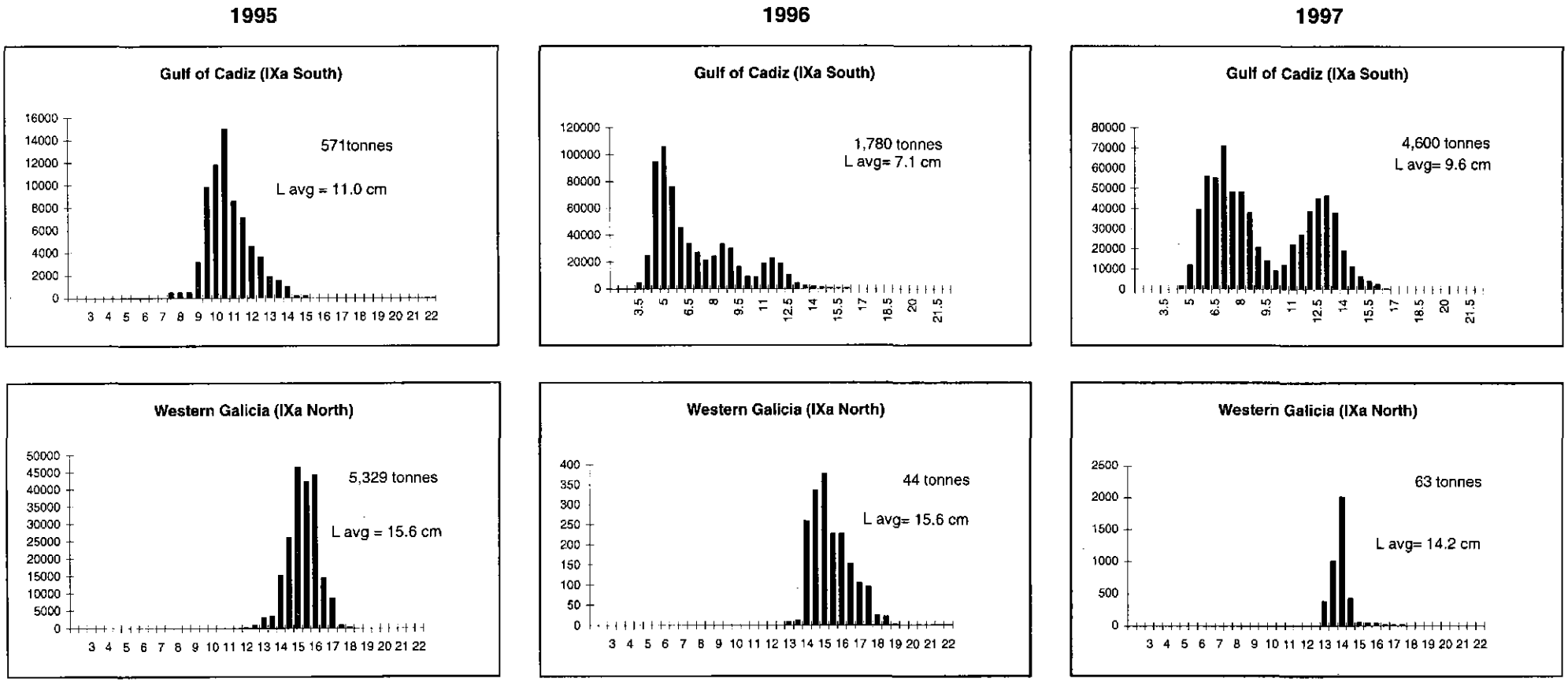
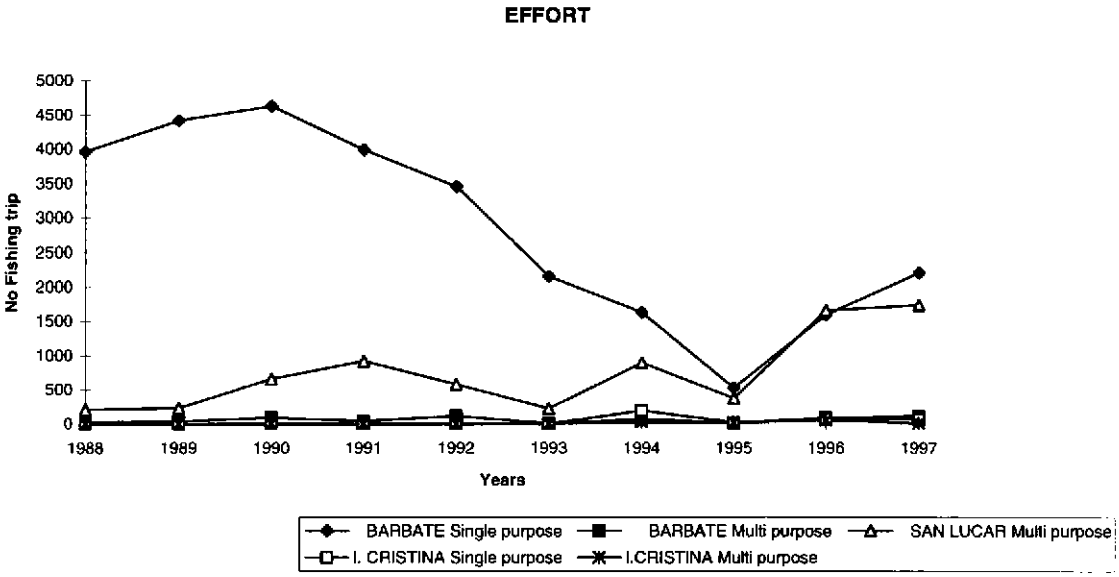
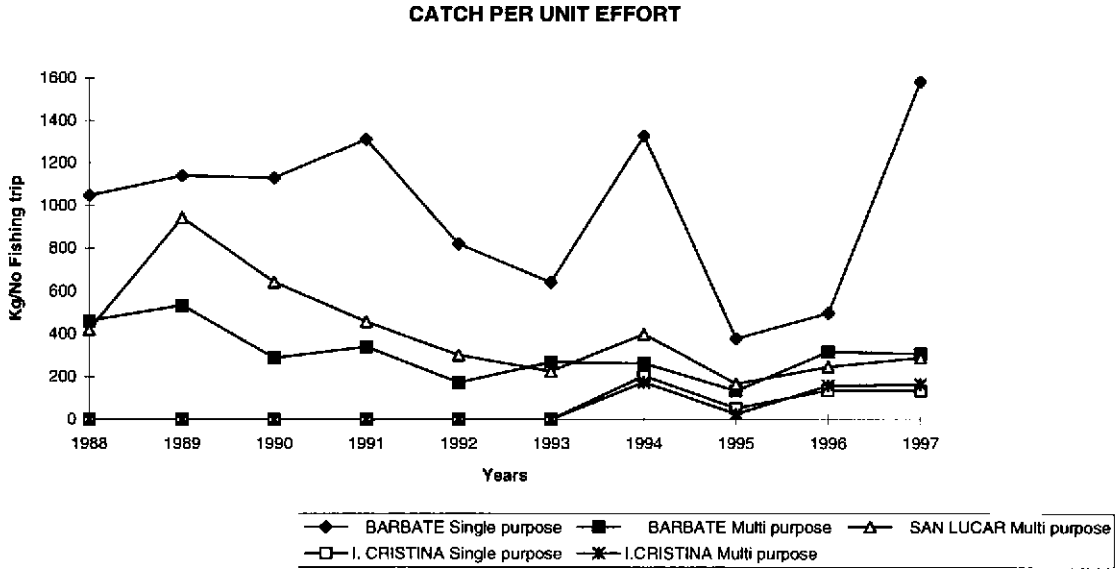


Figure 11.5.1 ANCHOVY in Division IXa. Spain IXa South (Gulf of Cadiz) Effort and CPUE series in commercial fisheries.





12 DATA REQUESTED BY THE MULTI-SPECIES WORKING GROUP

12.1 Mackerel

The catch of mackerel belonging to the North Sea stock has been included in the catches of the western stock since 1987.

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

The Working Group assumes that no new data are available to give catch in number at age by quarter. The total catch of North Sea mackerel of 10,000 tonnes can be assumed.

12.1.2 Weight at age in the stock

No new data are available for the North Sea stock. Data on weight at age in the stock from ICES CM 1998/Assess:6 should be used.

12.1.3 Stock distribution by quarter

Although there appears to be some evidence suggesting a change in the distribution of mackerel in the North Sea, the Working Group did not have sufficient information to justify altering the distributions presented (Table 12.1) in previous reports (Anon. CM 1997/Assess:3).

12.2 Horse Mackerel

12.2.1 Catch in numbers and weight at age by quarter for the North Sea horse mackerel stock

Details of the catch in numbers and the weight at age are given in Table 5.4.1.1.

12.2.2 Stock distribution by quarter

The North Sea Horse Mackerel stock is known to migrate south to the Channel during the 4th quarter and to be back in the North Sea by the 2nd quarter of each year. The Working Group therefore suggests that a value of 50% and 10% of the stock can be assumed to be available in the North Sea during the 4th and 1st quarter respectively.

There is still no information about the numbers of western horse mackerel which migrate into the northern North Sea during the 3rd and 4th quarters of the year. From 1982 to 1986 catches of horse mackerel in Division IVa were low (<1,000 tonnes) indicating very little migration. However, since then catches have increased to a maximum of 113,000 t in 1990, which was about 30% of the total western stock catch. Since 1994 catches have declined and in 1997 the provisional catch in Division IVa was about 64,000 t (Table 4.1.2) or about 17% of the total western stock catch.

In 1997 due to decreasing catches by Norway in Division IVa and a reduction in the modelled inflow of Atlantic water to the North Sea in 1996 (Iversen, *et al.*, WD 1997) the Working Group suggests that a value of 10% of the adult stock of the Western Horse Mackerel can be assumed to be available in Division IVa in the fourth quarter, and 1% in the first quarter of the year.

This year the Working Group suggests that 50% of the adult stock of the Western Horse Mackerel can be assumed to be available in Division IVa in the forth quarter, and 1% in the first quarters of the year (Table 12.2).

Table 12.1 Percentage of each mackerel stock assumed to be present in the North Sea, by quarter, in 1997.

	North Sea Stock (%)				Western Stock (%)[1]			
Quarter	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	90	100	50	70	10	+	50	70

Table 12.2 Percentage of each horse mackerel stock assumed to be present in the North Sea, by quarter, in 1997.

	North Sea Stock (%)				Western Stock (%)			
Quarter	1	2	3	4	1	2	3	4
1-4	10	100	100	50	0	0	0	0
5+	10	100	100	50	1	0	0	50

[1] There is evidence from tagging studies that fish from the southern component also migrate along with western component fish.

13 RESPONSE TO NEAFC REQUEST ON THE SPATIAL DISTRIBUTION OF MACKEREL

13.1 Distribution of Commercial Catches

NEAFC Mackerel commercial catch database

A database of commercial catches by country, month and rectangle from 1977 to 1997 was assembled at the NEAFC Workshop in Aberdeen 14–18 June 1998. As stated in the report from that meeting, the database has been updated at the WGMHSA meeting to include full Norwegian and Faroese data. The data availability to the database otherwise remains as stated in the NEAFC Workshop report.

Evaluation

The database is now substantially complete for the period 1977 to 1997. The main weakness was the missing Norwegian data for years other than ICES triennial mackerel egg survey years, this has now been amended. The database is now able to be queried for any combination of country, month, year, rectangle and ICES Division. Maps are presented of total catch by rectangle for all nations for 1997, 1996 and 1995 (Figures 13.1.1–3). Maps showing mean annual distributions for the early 1990s, late 1980s, early 1980s, and late 1970s are presented in Figures 13.1.4–7. These Figures represent means and so tend to be smoother and of lower amplitude than single year data. The outputs offered in this report only represent the potential of the database and ideally it should be used to answer specific questions pertaining to management. As an example data could be grouped by year to illustrate known changes in the pattern of the fishery, e.g. the development in international waters or the changes in time and space of the pre-spawning migration.

13.2 Distribution of Juveniles

Data on juvenile distributions are mainly derived from the results of bottom trawl surveys in the North Sea and NE Atlantic areas. Some of these data were assembled for the EU-funded Shelf Edge Fisheries and Oceanography Studies Project (SEFOS) and exist as a database held in Aberdeen. This covers the years 1983 to Quarter 1 1997. These surveys are mainly carried out in the first and fourth quarters of the year. Data from small numbers of surveys in the second and third quarters were also included, however, these are far from complete.

Evaluation

The surveys represent a good coverage of the distributions of young mackerel (up to 2 years old) for the North Sea and western shelf in the first and fourth quarters. They do not cover the second and third quarters. They do not cover the shelf off the Norwegian coast, Faroe Islands, Rockall or Iceland, all of which may be important juvenile areas. The other main problem with these data is that of unsampled rectangles. Not all rectangles are sampled in all years, so there are problems in comparing catch rates from one area to another. One solution to this problem would be to use the data as it exists and develop inclusive contoured maps. This would allow more quantitative comparisons to be made. This has not been done to date. Maps are presented for 1990–96 of mean catch rates for ages 0 and 1 in quarter 4 and ages 1 and 2 for Quarter 1 (Figures 13.2.1–4).

13.3 Distribution of Adults

13.3.1 Distributions from egg surveys

Historical information is available on the distribution of stage 1 mackerel eggs from triennial surveys in the western area from 1977 to 1998, the southern area since 1992 and regular surveys in the North Sea since 1967. Stage 1 eggs are less than three days old and their distribution can therefore be used to provide a detailed record of the temporal and spatial distribution of spawning adults.

The data show that spawning occurs along the Portuguese and Spanish coasts, along the Cantabrian Shelf and northwards from southern Biscay through the Celtic Sea to west of Ireland and off the west coast of Scotland. Spawning also occurs in the central North Sea.

Spawning begins in the southern area in late January and extends through to June off the Cantabrian coast. It begins in February in southern Biscay and extends through to July in the western area. In the North Sea spawning is later, beginning in mid May and extending through to the end of July.

Spawning in the southern and western areas tends to be strongly associated with the shelf edge particularly early in the season, but does eventually spread over the shelf. In recent years in the western area there has been a noticeable increase in the spawning off the shelf edge over very deep water.

The time series of surveys in the western area show that there has been a gradual extension of the spawning area northwards although the major egg densities still occur in the vicinity of the Little Sole and Great Sole Banks. Maps of the mean egg distributions by month from the egg surveys 1977 to 1995 are presented in Figures 13.3.1.1–5. A distribution for mackerel spawning in the North Sea is presented in Figure 13.3.1.6.

13.3.2 Distributions from tagging

Between the early 70s and 1997 several tagging experiments on mackerel were conducted in order to clarify the major migration pattern of this species (Eaton 1980, Hamre 1980, Rankine and Walsh 1982, Bakken and Westgard 1986, Iversen and Skagen 1989). A summary of these results was presented by Lockwood 1988 and in ICES 1990/H:5. These tagging experiments demonstrated that in the early eighties western mackerel moved further to the north and east on its feeding migration in summer and autumn time compared to previous years. Since the beginning of the eighties up to present adult mackerel reach Divisions IIa ,IVa and Vb in a larger proportion during the second half of the year than during the seventies and there it mixes with the North Sea stock.

Recent tagging experiments made in the nineties have shown that adult mackerel spawning off the North of the Iberian Peninsula also join the northern migration to Divisions IIa, IVa and Vb during the second half of the year: In 1994 a tagging experiment was carried out within the international project co-funded by the European Commission, entitled *"Shelf Edge Fisheries and Oceanography Studies"* (SEGOS project, AIR92-CT1905), which first showed the connections between the southern and northern mackerel (Figures 13.3.2.1–4). In 1997 an international tagging programme (EU Study Project contract 96-035, Uriarte *et al.* 1998) has confirmed the parallel migration patterns of adult mackerel from the southern or western areas (see more information about this study project in Section 2.3.1).

13.3.3 Distributions from acoustic, trawl and other surveys

The only full scale specific fisheries independent survey for mackerel is the ICES triennial mackerel and horse mackerel egg survey. This can be used to infer adult distributions, in the first half of the year. Smaller scale studies of the distribution of mackerel during their pre and post spawning migrations were carried out as part of the SEGOS project, and these provide valuable data on the distribution of the fish in some parts of the NEA area at some times, but were intended primarily as research and not assessment surveys. The surveys were carried out by Norway, Scotland and the Netherlands. The Scottish and Dutch surveys covered the start of the pre-spawning migration in the northern North Sea and VIa in the winter of 94/95, 95/96 and 96/97. The Norwegian surveys covered the start of the post spawning migration in an area bounded by the Faroes, Tampen Bank and the Scottish west coast in July 1994, 1995 and 1996.

There are also a number of other surveys carried out from which valuable data on mackerel distributions could be extracted. These fall into two main categories: acoustic surveys and trawl surveys. The following sections represent the surveys known to Working Group members which may provide useful data and which should be evaluated.

Acoustic surveys

1. ICES combined Atlanto-Scandian herring survey in the Norwegian Sea. May to August. Iceland, Faroes, Norway, Russia and EU. These surveys are targeted on AS herring but it may be possible to produce mackerel distributions over a large part of the Norwegian Sea from existing acoustic survey data and pelagic trawl haul data.

2. ICES co-ordinated herring acoustic survey of the North Sea and adjacent areas. June to July. Scotland, Ireland, Norway, Denmark, Germany and the Netherlands. These surveys are targeted on herring but it may be possible to produce mackerel distributions over most of the North Sea and Divisions VIa and VIIb from existing acoustic survey data and pelagic trawl haul data.

3. Irish Celtic Sea herring acoustic surveys. October to January. Ireland and Scotland. These surveys are targeted on herring but it may be possible to produce mackerel distributions over parts of the Celtic Sea and Division VII from existing acoustic survey data and pelagic trawl haul data.

4. French pelagic acoustic surveys in Biscay. May. France. These surveys are targeted on all pelagic species including mackerel and produce mackerel distributions over most of the Biscay shelf area off France. These are primarily fisheries ecology surveys but mackerel distributions are available.

5. Spanish acoustic surveys for sardine. March. Spain. These surveys are targeted on sardine but it may be possible to produce mackerel distributions on the Galician coast, Cantabrian Sea and south Biscay from existing acoustic survey data and pelagic trawl haul data.

6. Portuguese acoustic surveys for sardine. March and November. Portugal. These surveys are targeted on sardine but it may be possible to produce mackerel distributions in Division IXa from existing acoustic survey data and pelagic trawl haul data.

Actually extracting usable mackerel data from the historical analyses of these surveys may be impossible, however, the operators are encouraged to at least consider mackerel in the conduct and analysis of these surveys in the future.

Bottom trawl surveys

As mentioned in Section 13.2. there are many bottom trawl surveys carried out across the European shelf. For the purposes of the study of mackerel distribution these are most useful for recruit distributions. However, adult mackerel are also caught in these surveys, and it may be possible to analyse these data to give presence/absence distributions or to apply some simple categorical abundance scale.

Other sources

Pelagic trawl surveys

Only one specific pelagic trawl survey is known of by Working Group members. This is a shorts series of pilot surveys conducted by the Faroes using pair trawls. These surveys provide some data on the distribution of mackerel around the Faroes in August 1996–98 (Belikov *et al.* ICES CM 1998/AA:8).

Aerial surveys

Russian aerial sighting surveys for mackerel and herring conducted in the Norwegian Sea in June–September 1997 (Shatokhin *et al.* WD 1998) and in July–August 1998 (Zabavnikov *et al.* WD 1998) is a promising new method to survey the summer and autumn distribution of mackerel in the Northeast Atlantic. The aerial flights were initially intended to scout large areas of the Norwegian Sea to guide the fishing fleet to the areas where pelagic schools were observed. The flight first revealed the temperature and frontal zones in the sea with high likelihood for concentrations of pelagic species. If schools were observed the fleet was contacted to fish for the observed schools to identify the species (mackerel or herring). A second flight was then undertaken in the area following specific methods in order to get an estimate of the size of the schools and possibly a biomass estimate when the vessels had identified the species in the schools (for more detail, see Shatokhin *et al.* WD 1998 and Zabavnikov *et al.* WD 1998). An overview of the technique and equipment in this monitoring system at PINRO and STC-Complex Systems is shown in Figure 13.3.3.1. A preliminary quantitative rapid biomass estimate of mackerel found in the surveyed area (63°-71°N 10°-06° W) with an allowance for mean size, weight, calculated size of schools discovered was about 400,000 tonnes. However, this method has not been evaluated and so this biomass figure should be treated as preliminary only. Furthermore, information of the distribution and behaviour of mackerel in schools can be obtained from these aerial surveys.

By-catch data

There are at least three current projects on discarding by commercial vessels, which may provide data on mackerel distributions. These are all EU-funded projects and are directed at both pelagic and demersal fisheries. The projects involve Ireland, Spain, Portugal, France, Scotland, Norway and others.

13.4 Advice on Further Research

The current knowledge of mackerel distributions is restricted to the European shelf in quarters 1 and 4 for juveniles. For adults the distribution in the second quarter can be inferred from the egg surveys, and some parts of the distribution in the remainder of the year from commercial data. Commercial data have the drawback that they are restricted spatially and temporally by quotas, management regimes and fleet behaviour, and so can only provide a partial and potentially biased representation of the true adult distribution.

For juveniles, the main research requirements are to establish the distributions in quarters 2 and 3 from other available bottom trawl survey data. The primary source of continuing data collection remains the mackerel recruit and IBTS bottom trawl surveys, and the intensity of these surveys should be returned to historic levels.

For adults, the main requirement is to develop an understanding of the post spawning migration and distribution in the third and fourth quarters. Currently only commercial data are available on a usable scale. As mentioned above these are likely to be biased, A number of attempts have been made to produce a comprehensive appraisal of the post-spawning migration, e.g. the mackerel migration map produced for the SEGOS project and presented in modified form in the report of the June 1998 NEAFC Workshop in Aberdeen, or the migration described from Russian/Faroes data presented

at the Lisbon 1998 ICES ASC (Belikov *et al.* ICES CM 1998/AA:8).Such descriptions invariably result in controversy as they are produced using partial data. It is considered essential by this Working Group that all the potential data sources be evaluated by all interested parties to derive the best possible appraisal of the pattern of migration and the interannual variability in this, and to develop as comprehensive as possible distribution data. It should be emphasised that any interpretation of migration based on incomplete data can only be subjective.

To this end it is proposed that as a first step a workshop should be convened under the joint auspices of ICES and NEAFC to evaluate all the other sources of data (see Section 13.3) not covered in the report of the June 1998 NEAFC Workshop in Aberdeen. Following this a second workshop should assemble all the data from those sources considered useful by the first workshop and produce agreed distributions for all time periods but particularly for the second half of the year and to describe the migration. One possibility is that the first step could be made the subject of an EU Concerted Action. The first workshop could then consider how to support the further work.

The above research all falls into the category of analysis of historical data. It is also clear that understanding would be improved a great deal by extensive study of the distribution of adult mackerel in the second half of the year. This could be by the use of traditional research vessel surveys (combined acoustic, sonar and trawl). However, strong consideration should be given to the type of aerial survey used recently by the Russians to study the mackerel distribution (see Section 13.3). If achievable this would a rapid and cost effective way of acquiring data over an extensive area like the Norwegian Sea. This could be combined with research vessel work.

13.5 Conclusions

The terms of the request from NEAFC to WGMHSA were to collect and evaluate data on the area distribution of mackerel in the NEAFC area for juvenile and parental components and to advise NEAFC on further research to give a comprehensive description of the distribution and possible technical interaction. Little further progress on the collection of data has been made since June with the exception of the updating of the Faroese and Norwegian data. The evaluation of the existing data is presented above. In the absence of requests for specific interrogations of the database, or of responses to the data presented in the report of the June 1998 NEAFC Workshop in Aberdeen, the Working Group has not attempted any further analysis of the data. Problems arose at the Working Group resulting from NEAFC not initially granting ICES use of the database to answer questions from NEAFC. This is clearly undesirable. For the future, matters of access should be addressed as a matter of urgency to prevent a repetition of these problems. The Working Group recommends that NEAFC and ICES agree on mutual access to the data to ease this process.

The advice on research requirements is centred on the need to broaden the temporal and spatial coverage in the existing data sets to cover all parts of the year and all relevant areas. Most importantly the migrations into the Norwegian Sea in the second half of the year, and the juvenile distributions in quarters 2 and 3.

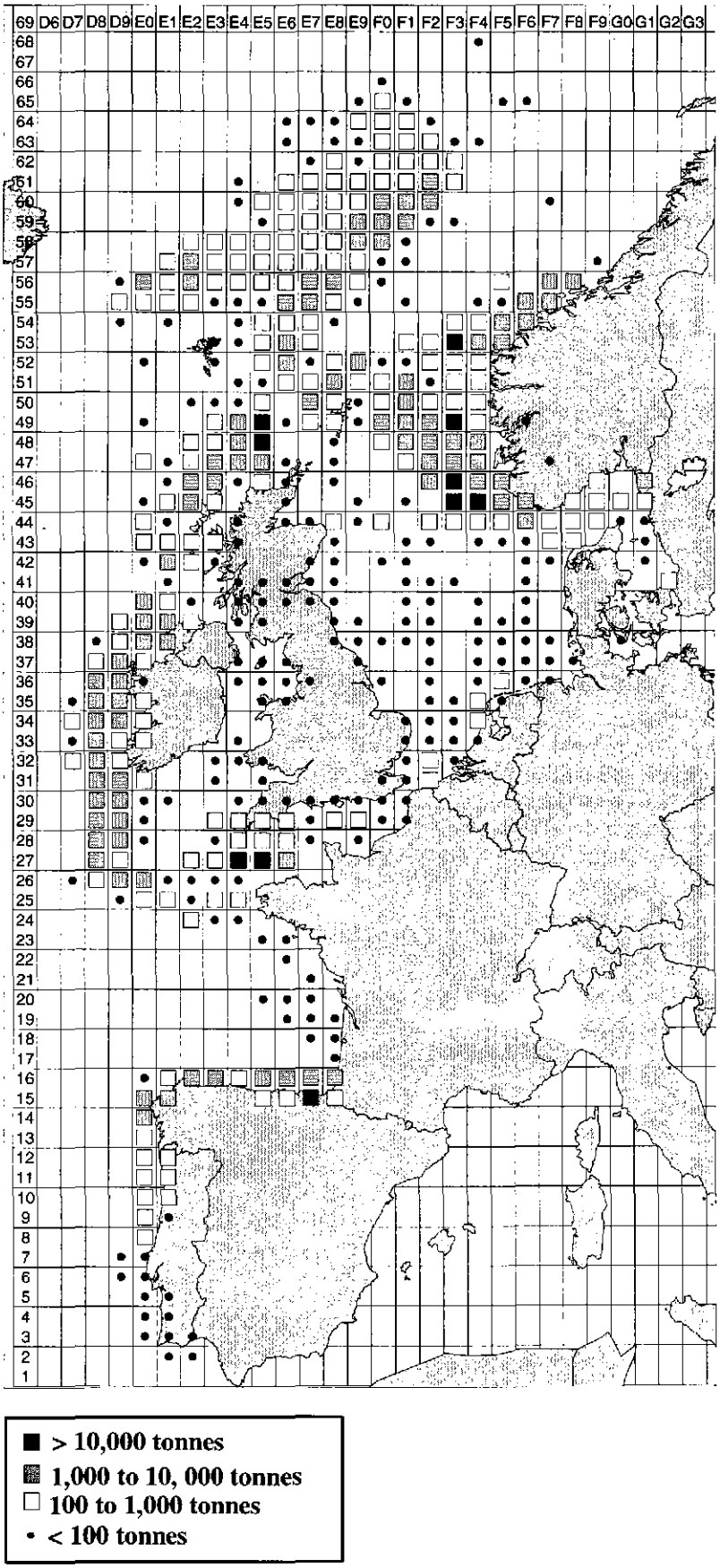


Figure 13.1.1 Distribution of mackerel catches 1997 (WG 1998 data).

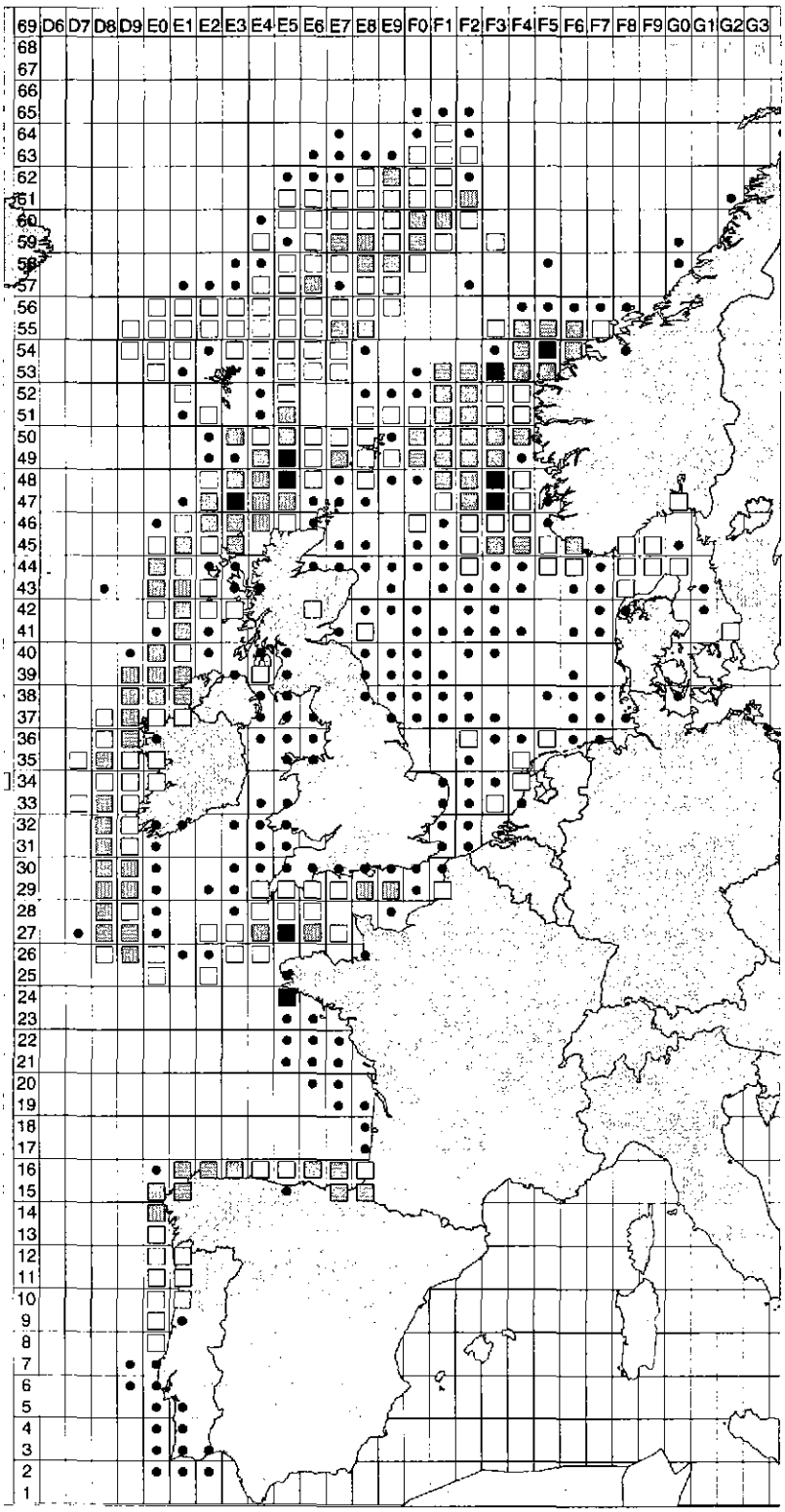
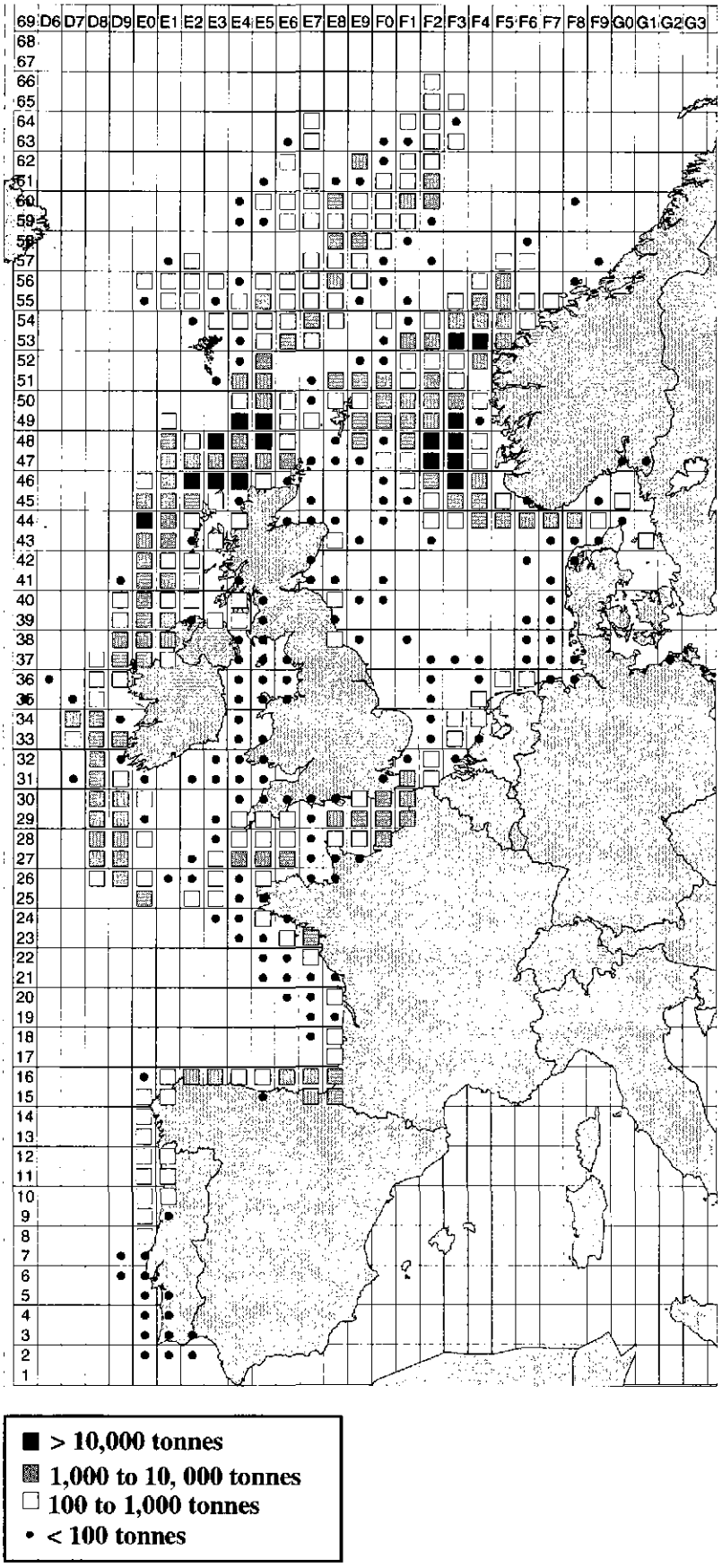
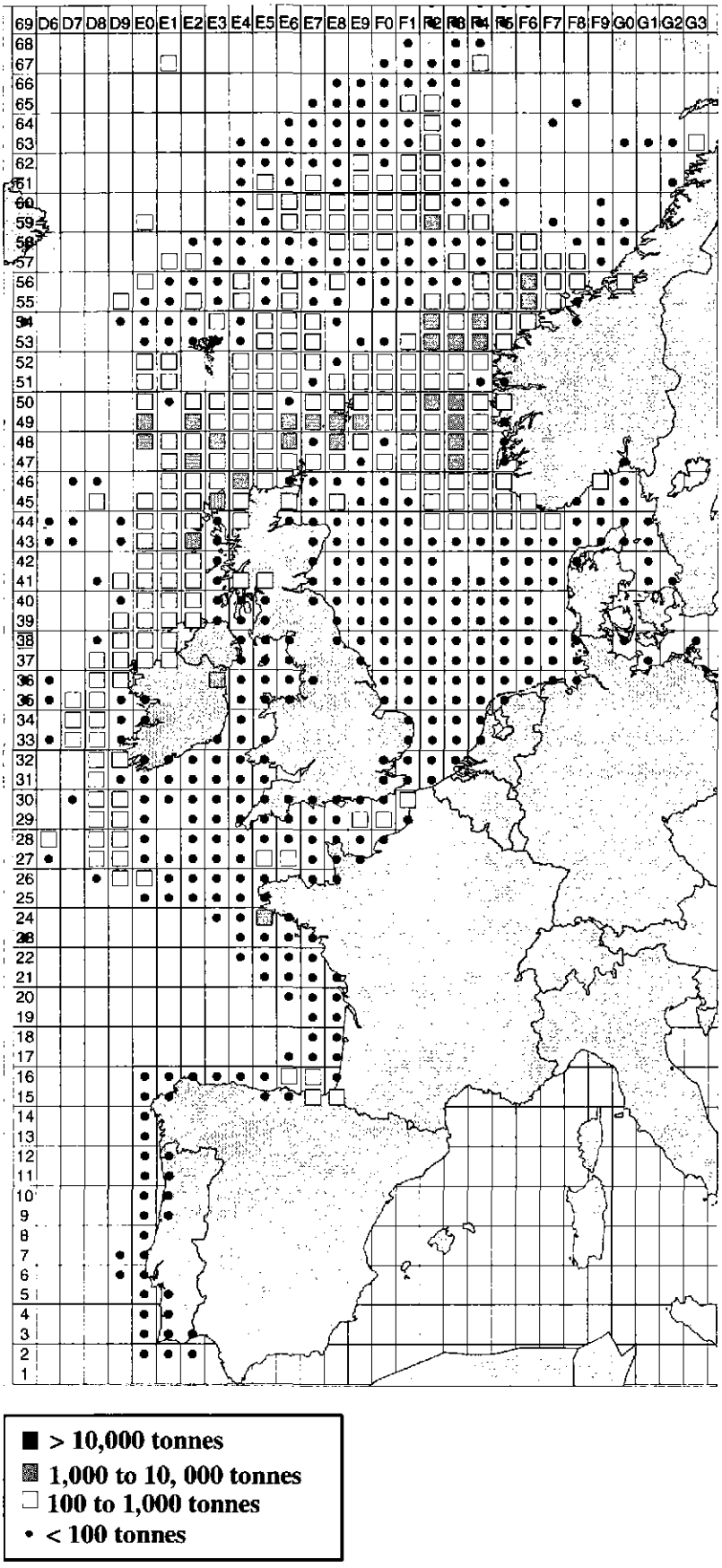


Figure 13.1.2 Distribution of mackerel catches 1996 (NEAFC database data).



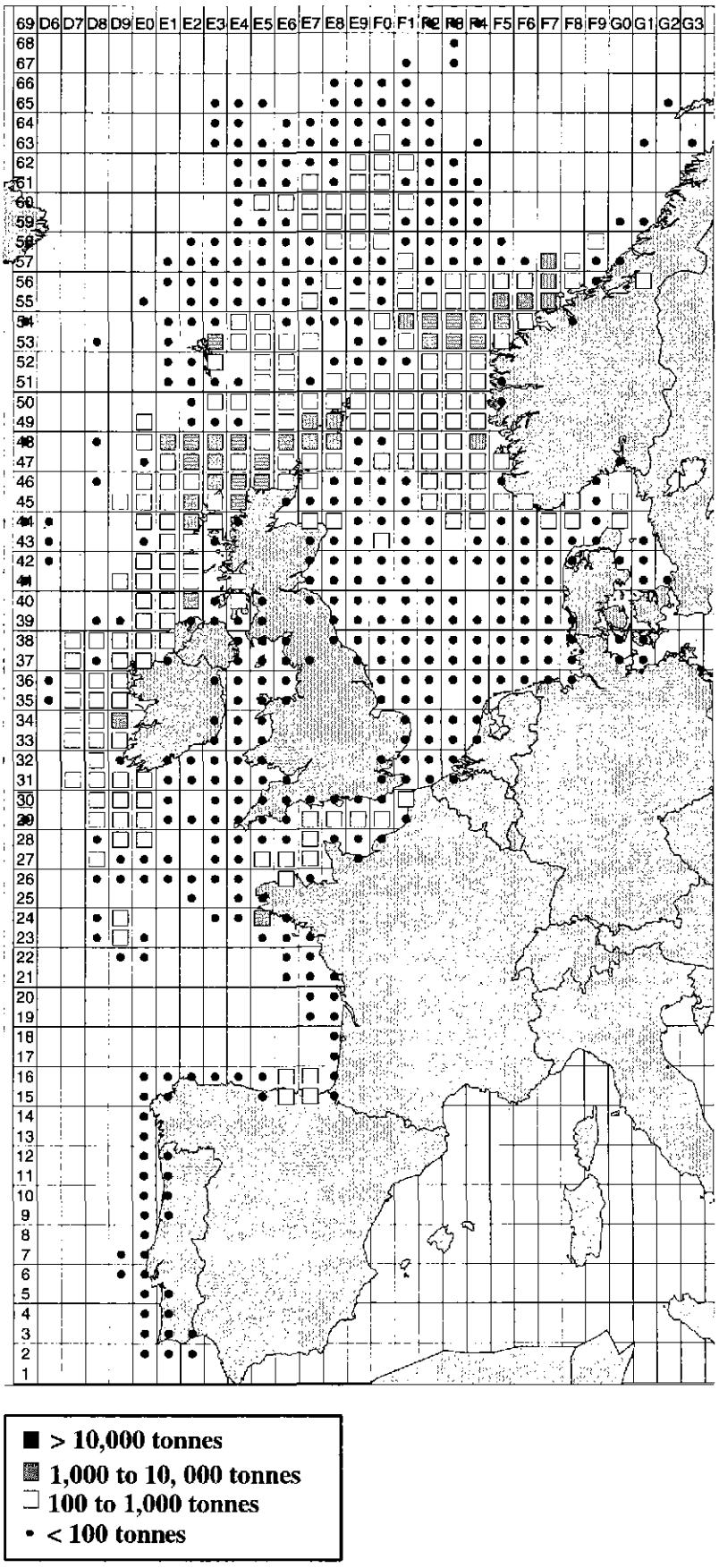
■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 13.1.3 Distribution of mackerel catches 1995 (NEAFC database data).



■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 13.1.4 Mean distribution of mackerel catches 1990 - 94 (NEAFC database data).



■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
❑ 100 to 1,000 tonnes
• < 100 tonnes

Figure 13.1.5 Mean distribution of mackerel catches 1985 - 89 (NEAFC database data).

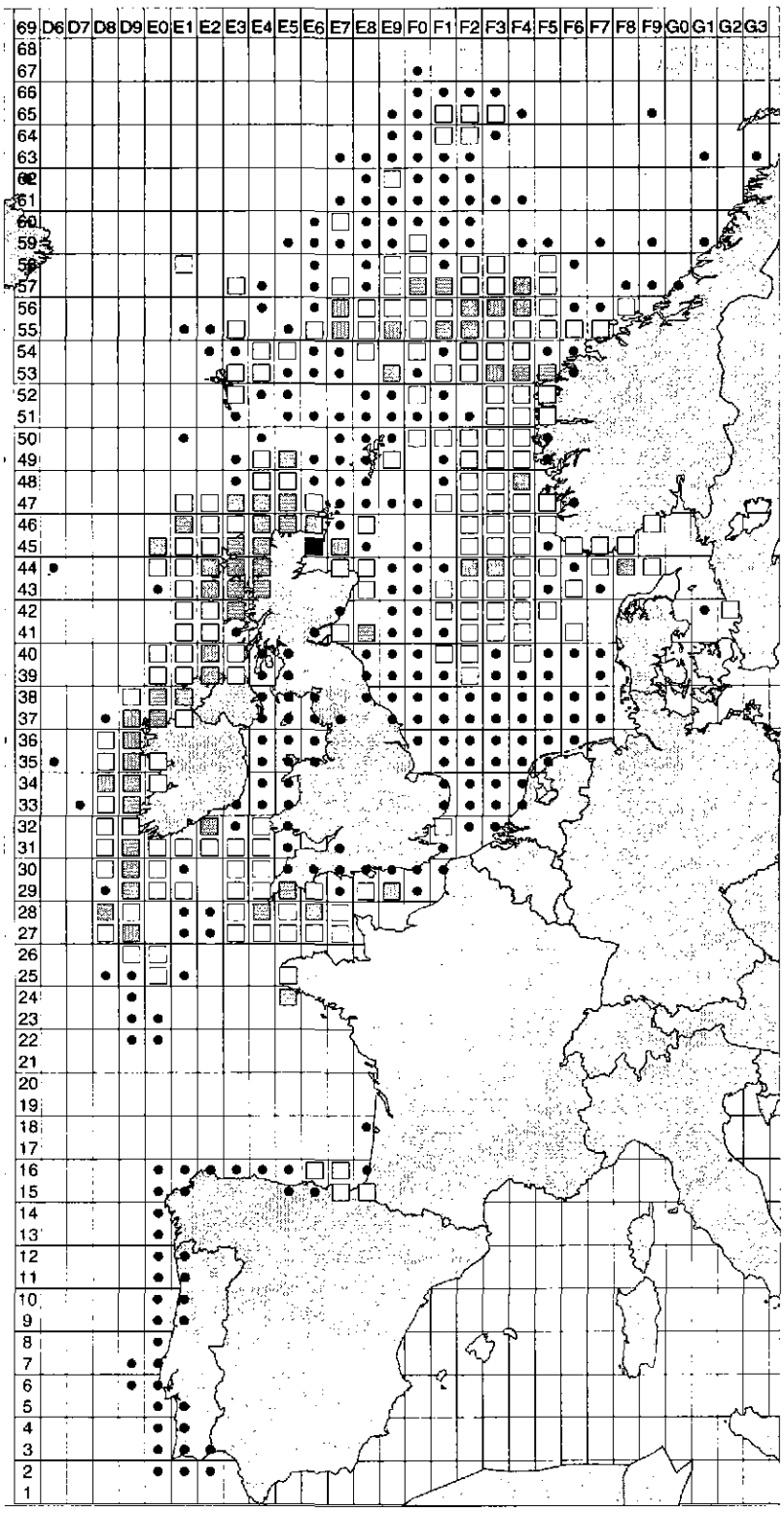


Figure 13.1.6 Mean distribution of mackerel catches 1980 - 84 (NEAFC database data).

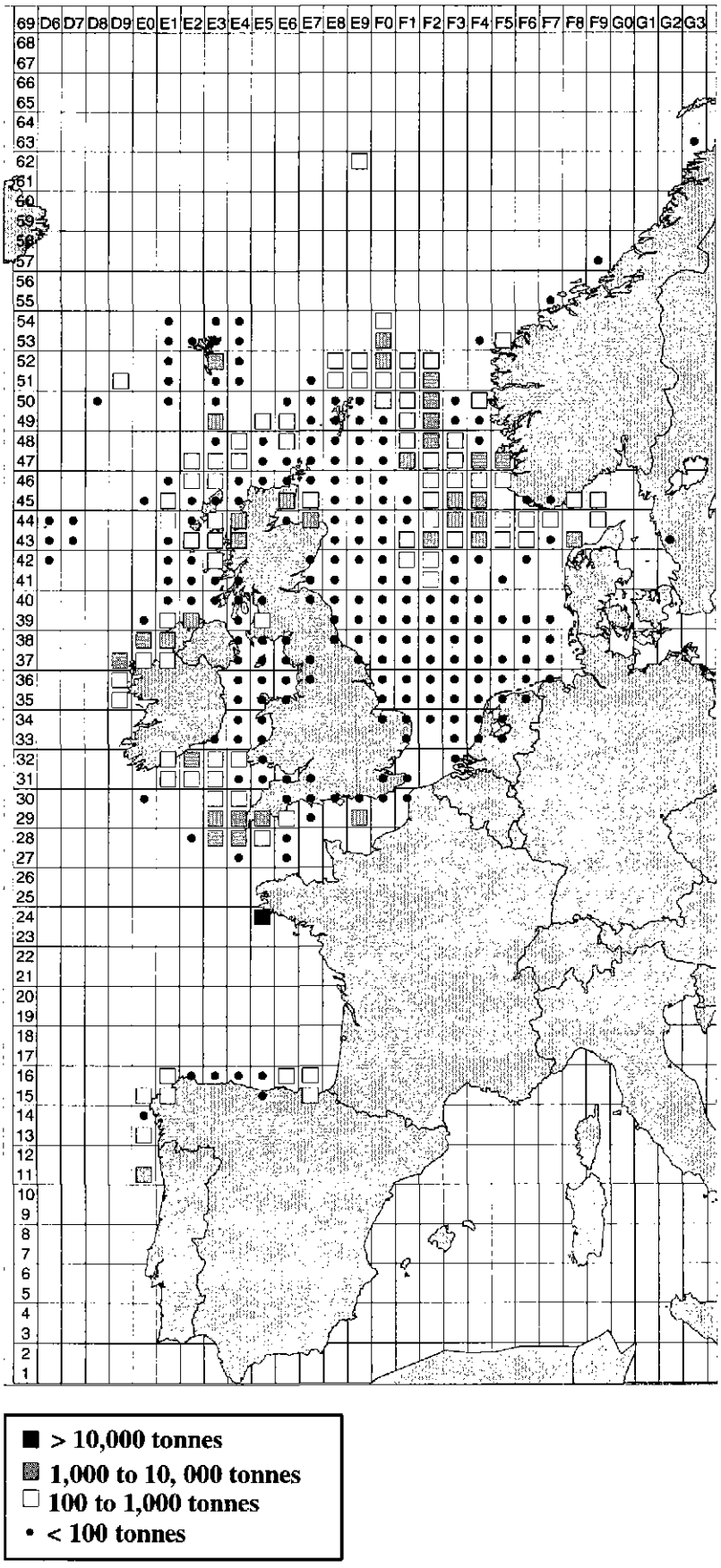


Figure 13.1.7 Mean distribution of mackerel catches 1977 - 79 (NEAFC database data).

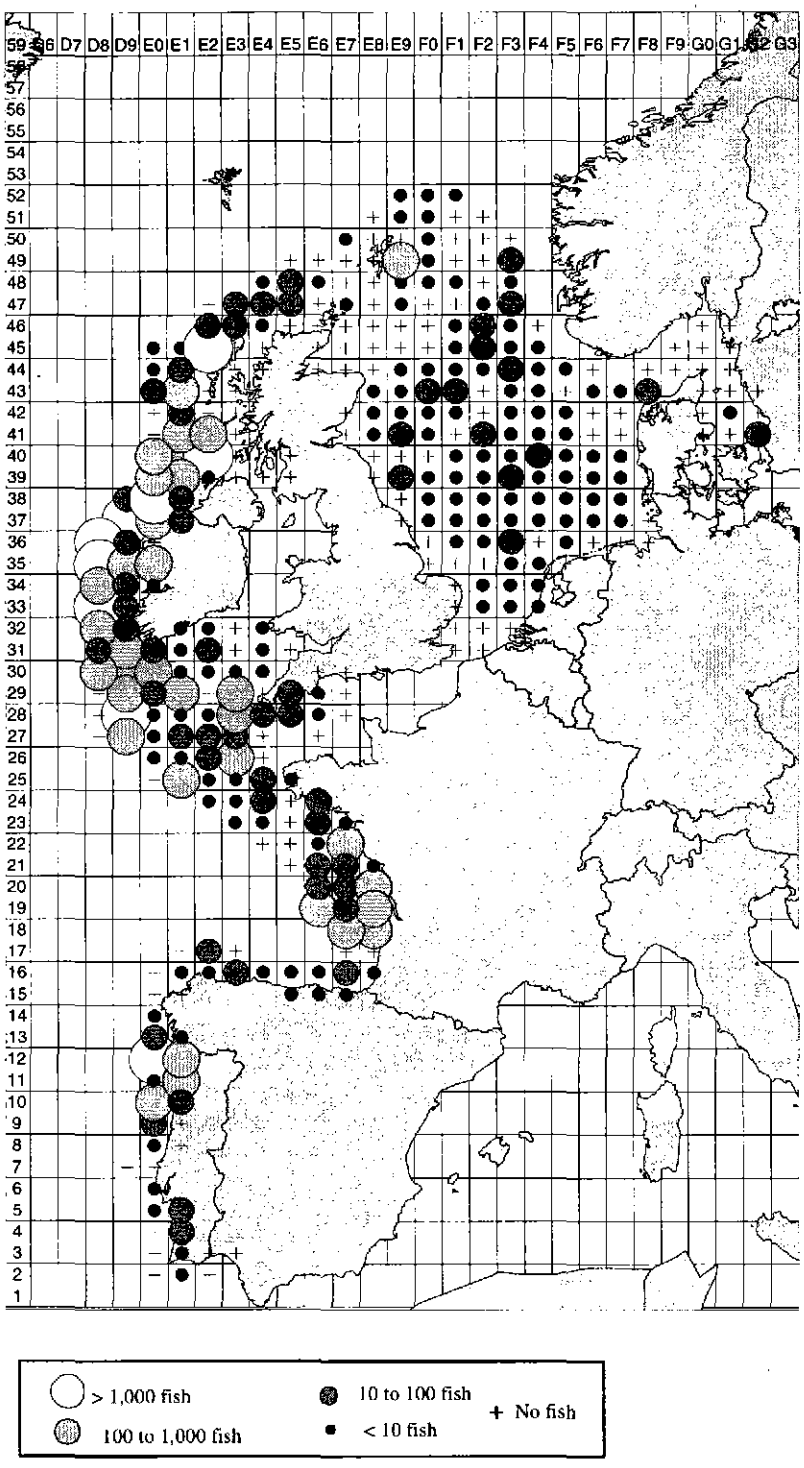


Figure 13.2.1 Mean distribution of mackerel recruits. Quarter 4 – Age 0 1990 - 94 (Catch rates per hour).

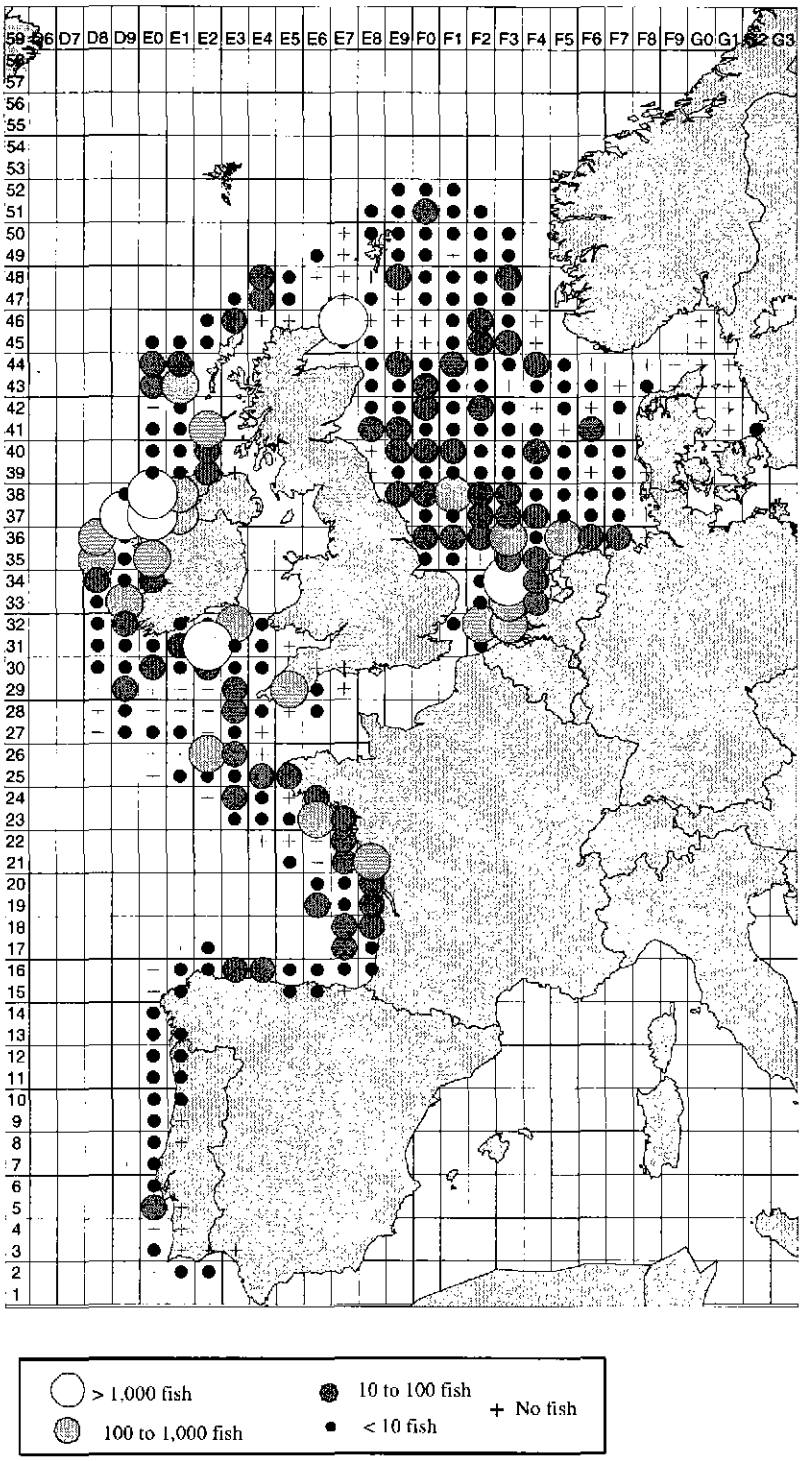


Figure 13.2.2 Mean distribution of mackerel recruits. Quarter 4 – Age 1 1990 - 94 (Catch rates per hour).

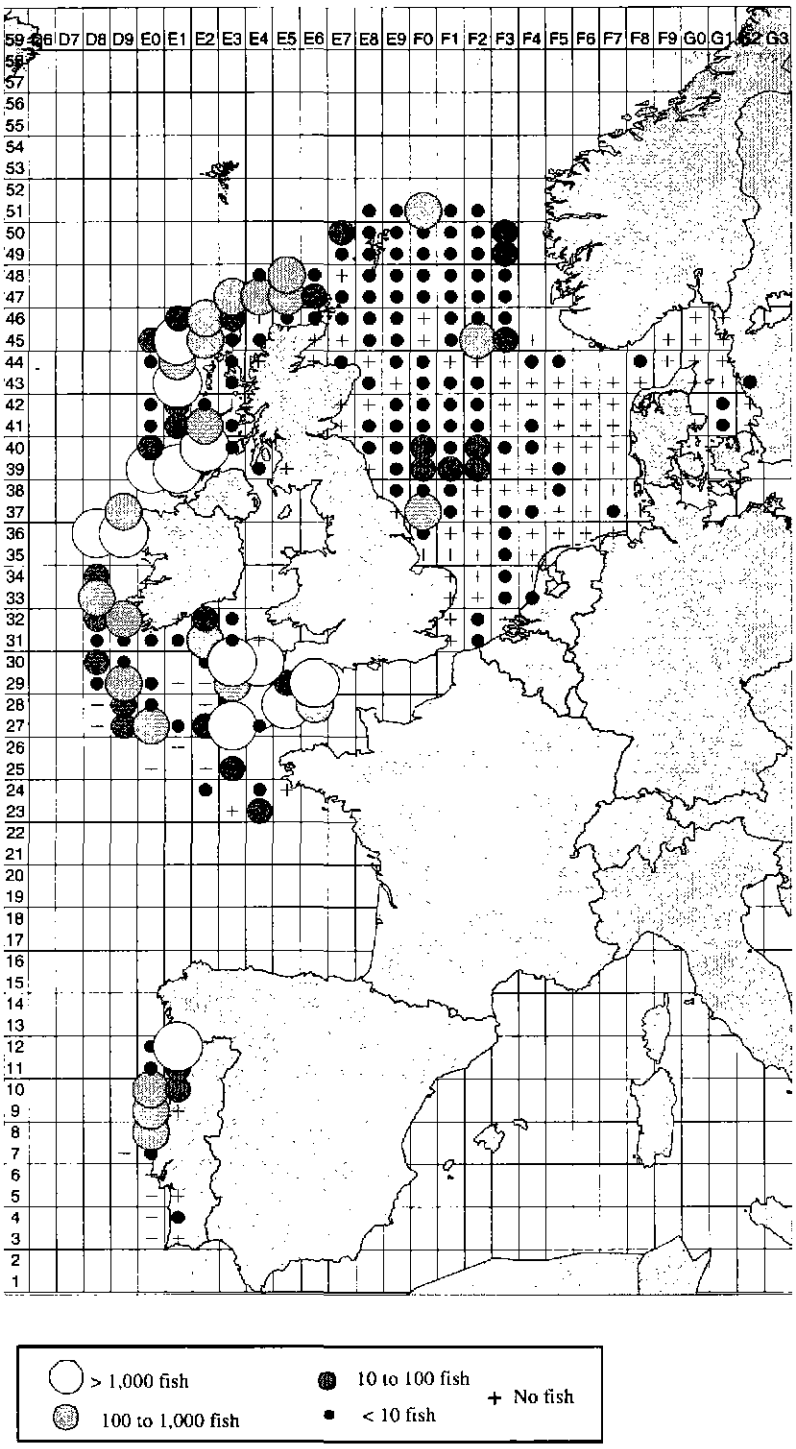


Figure 13.2.3 Mean distribution of mackerel recruits. Quarter 1 – Age 1 1990 - 94 (Catch rates per hour).

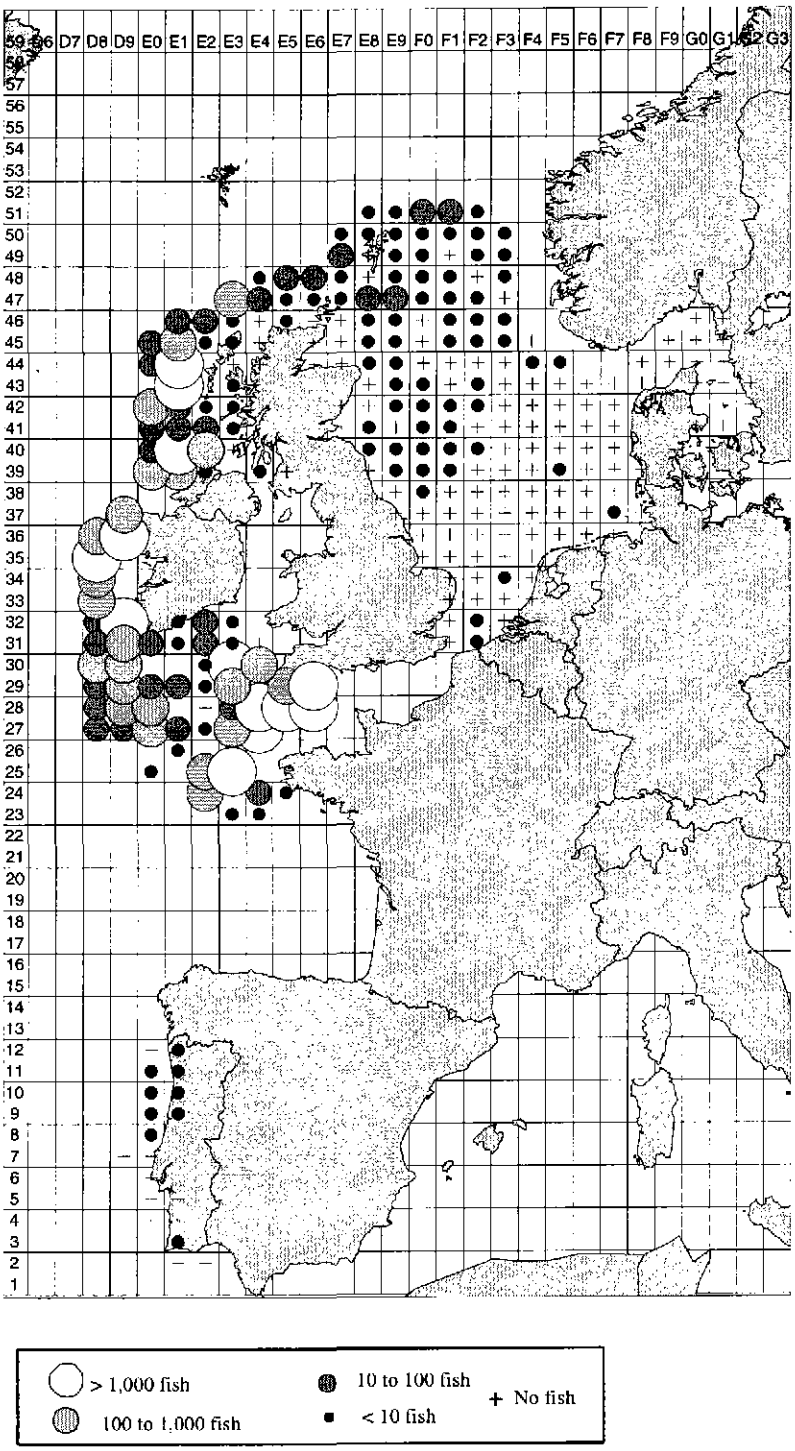


Figure 13.2.4 Mean distribution of mackerel recruits. Quarter 1 – Age 2 1990 - 94 (Catch rates per hour).

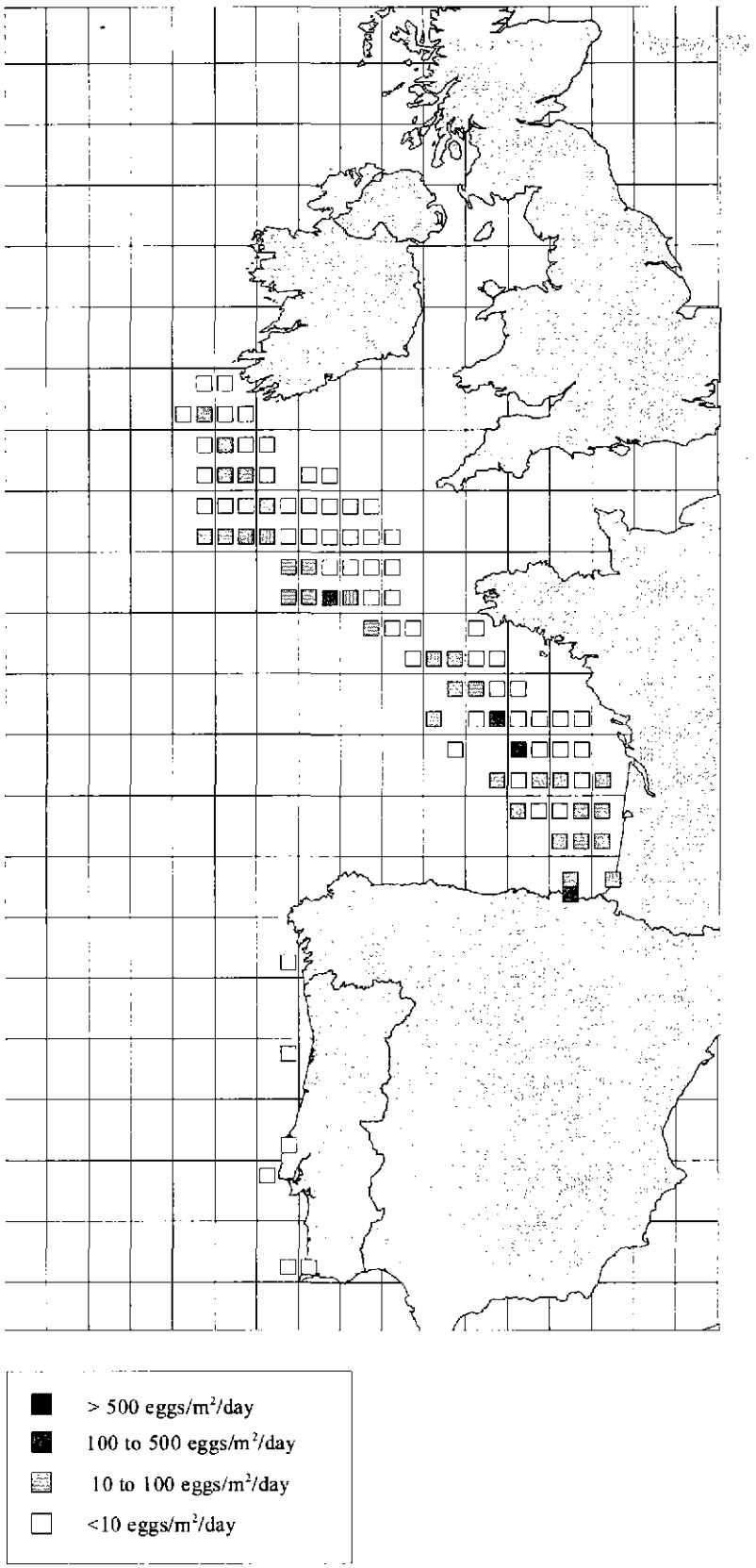


Figure 13.3.1.1 Mean mackerel stage 1 egg distributions from egg surveys. March 1977 to 1995.

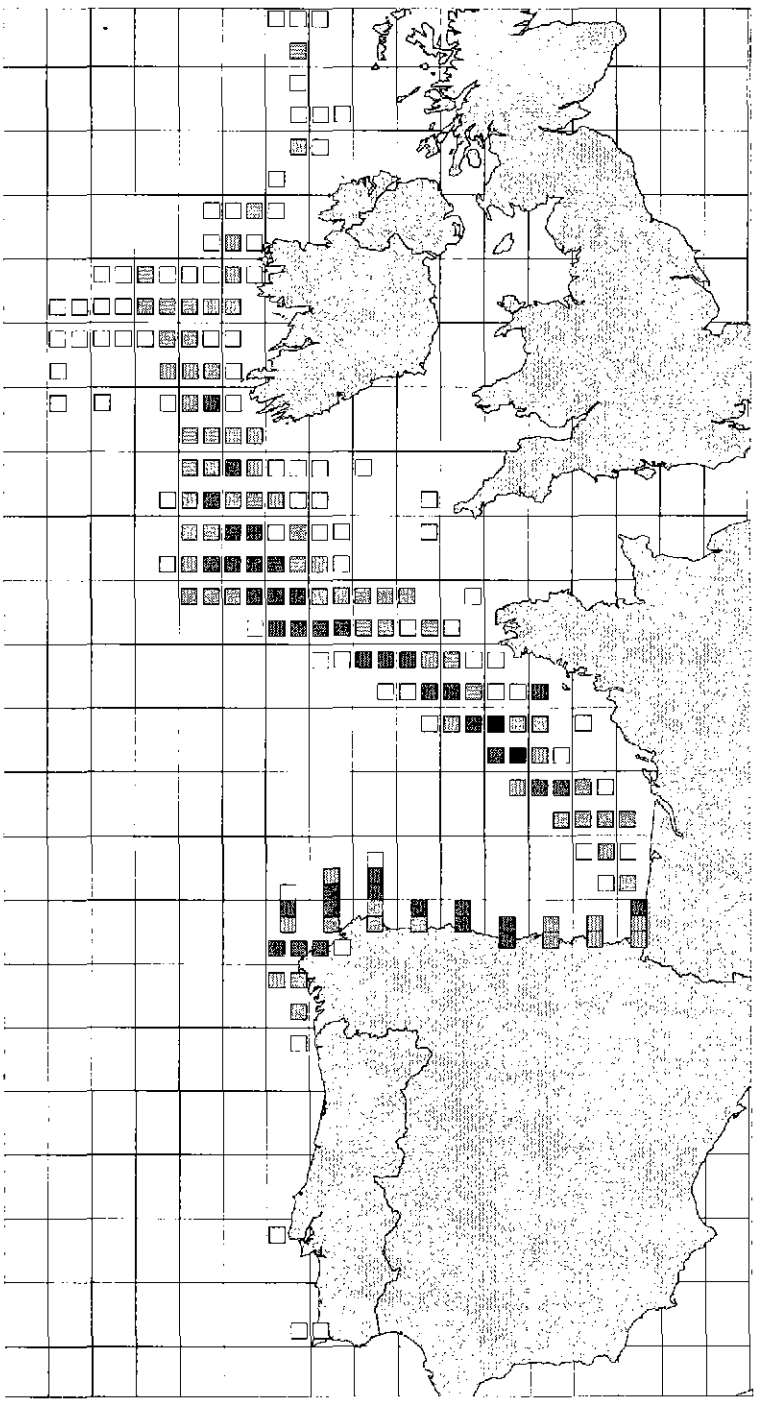


Figure 13.3.1.2 Mean mackerel stage 1 egg distributions from egg surveys. April 1977 to 1995.

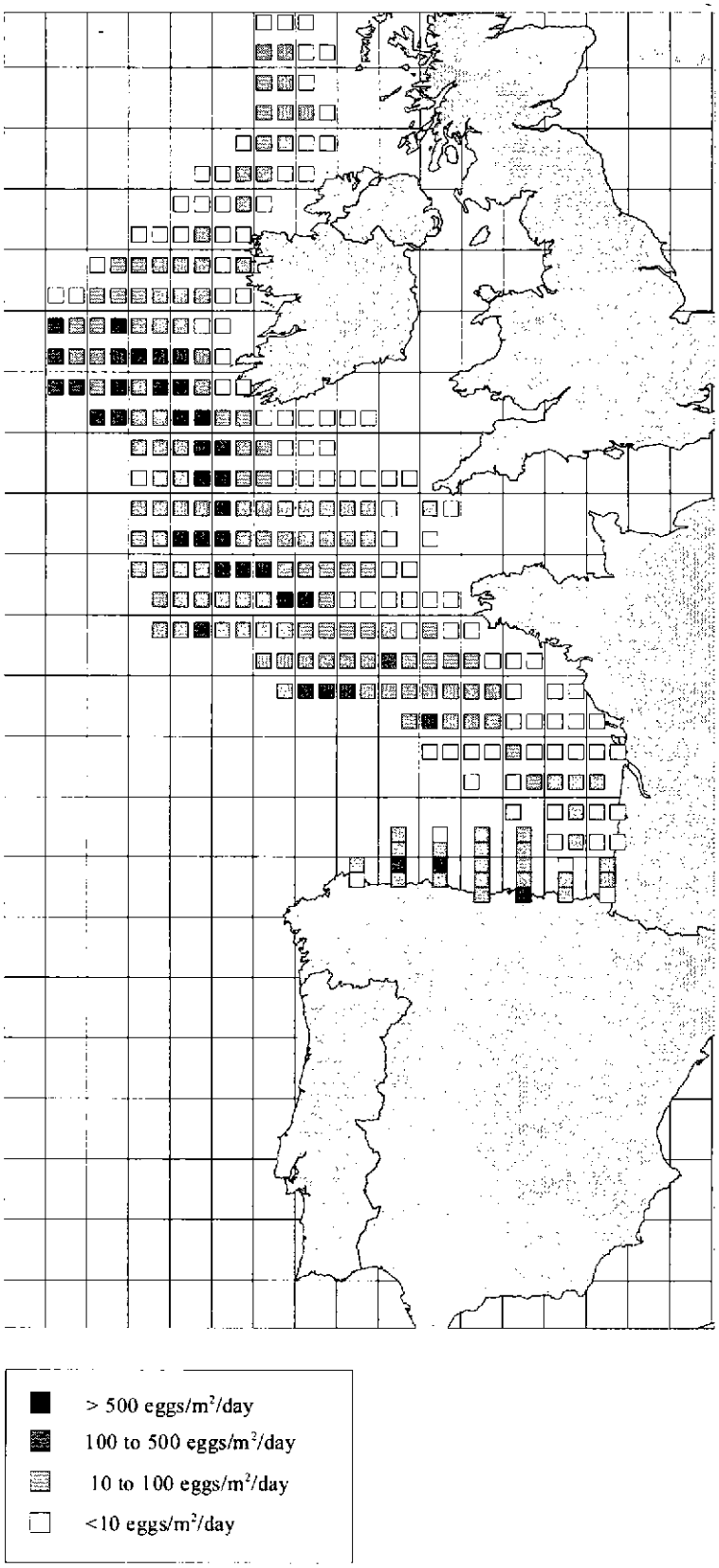


Figure 13.3.1.3 Mean mackerel stage 1 egg distributions from egg surveys. May 1977 to 1995.

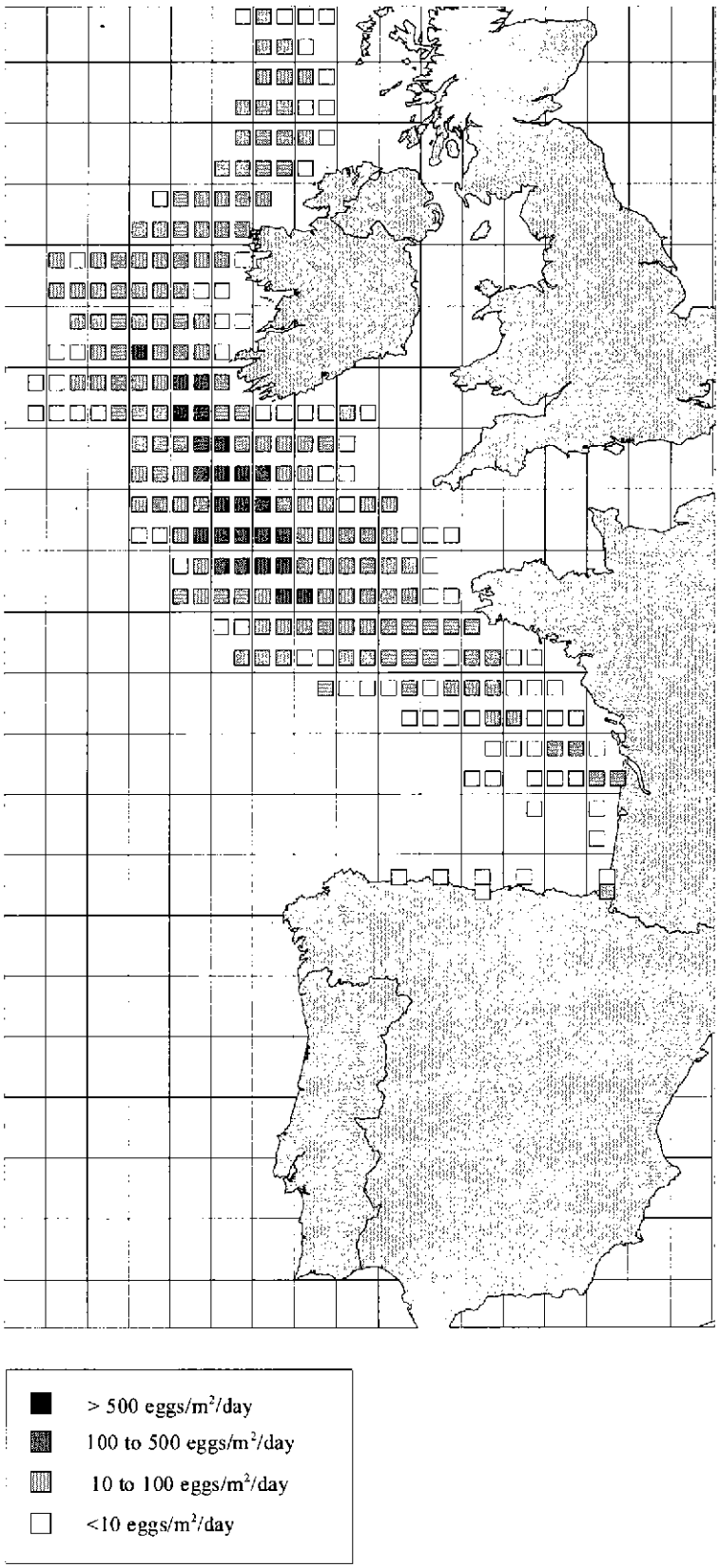


Figure 13.3.1.4 Mean mackerel stage 1 egg distributions from egg surveys. June. 1977 to 1995.

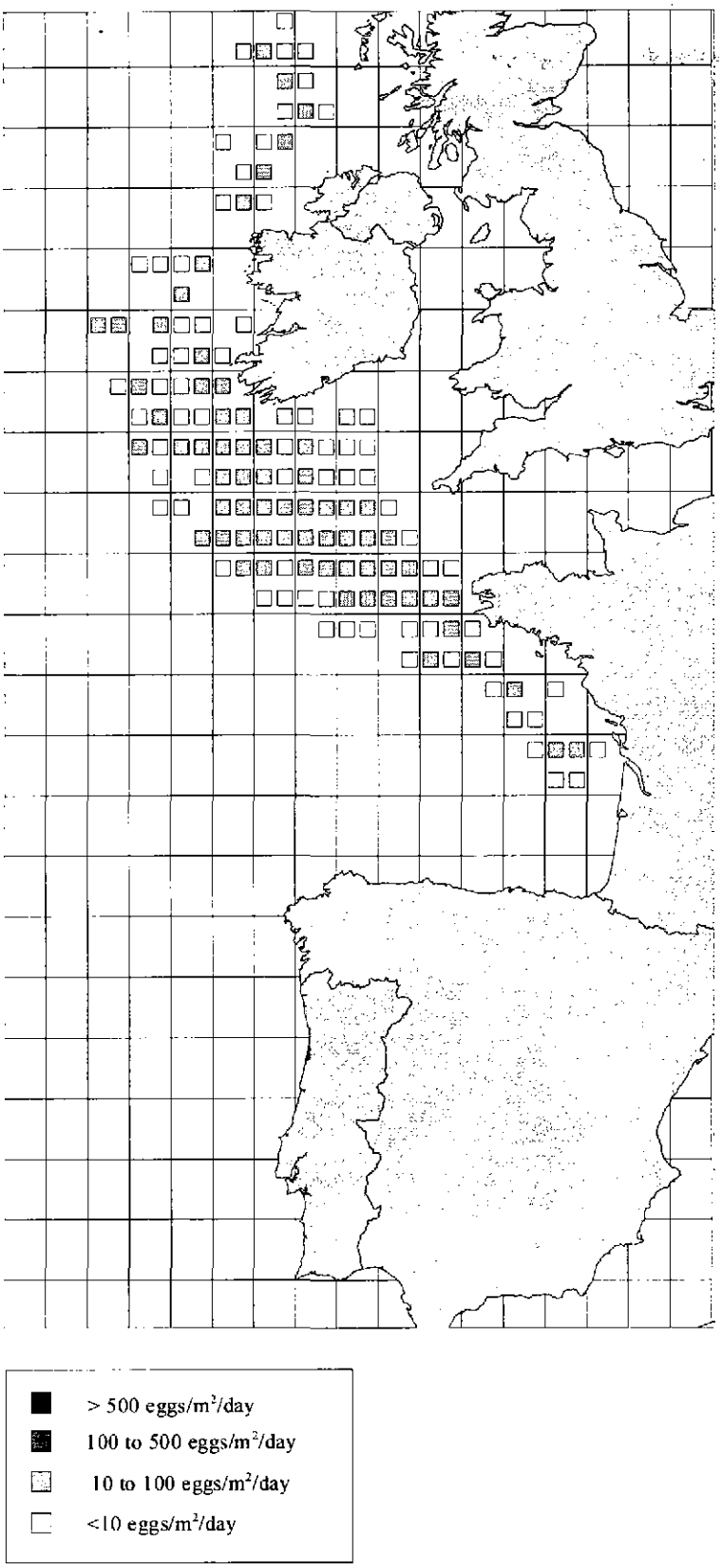


Figure 13.3.1.5 Mean mackerel stage 1 egg distributions from egg surveys, July 1977 to 1995.

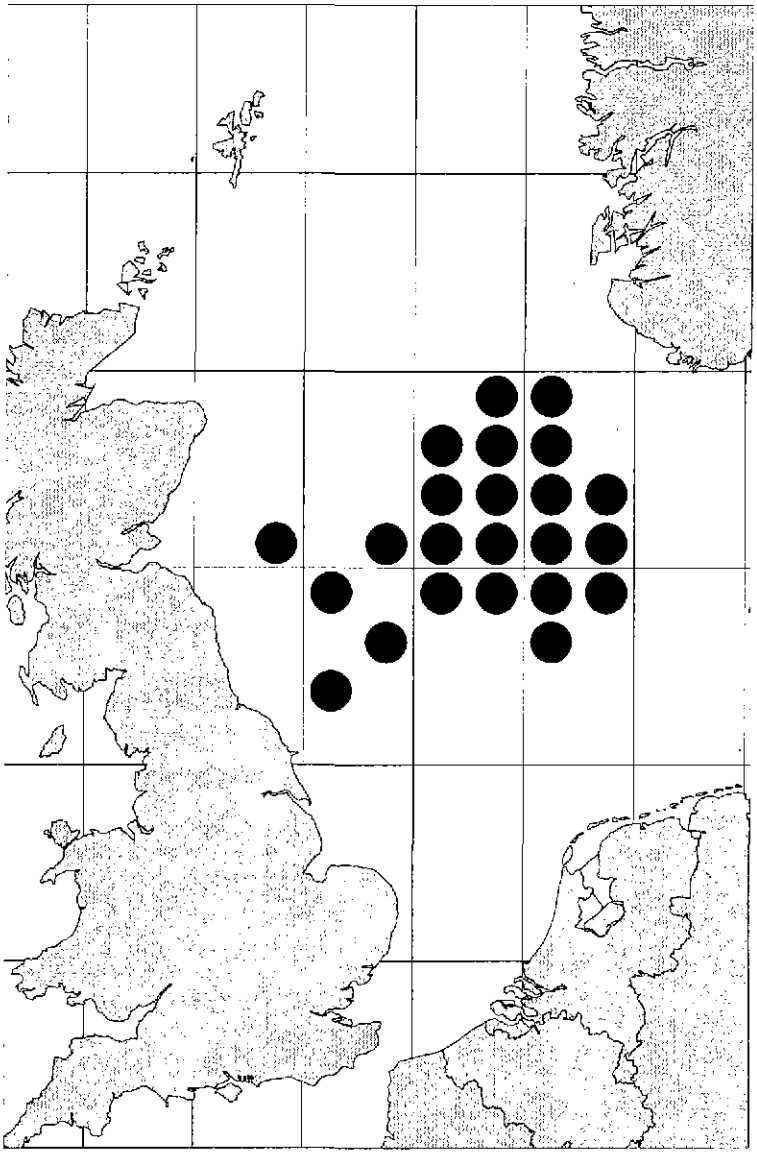


Figure 13.3.1.6 The main mackerel spawning area in the North Sea.

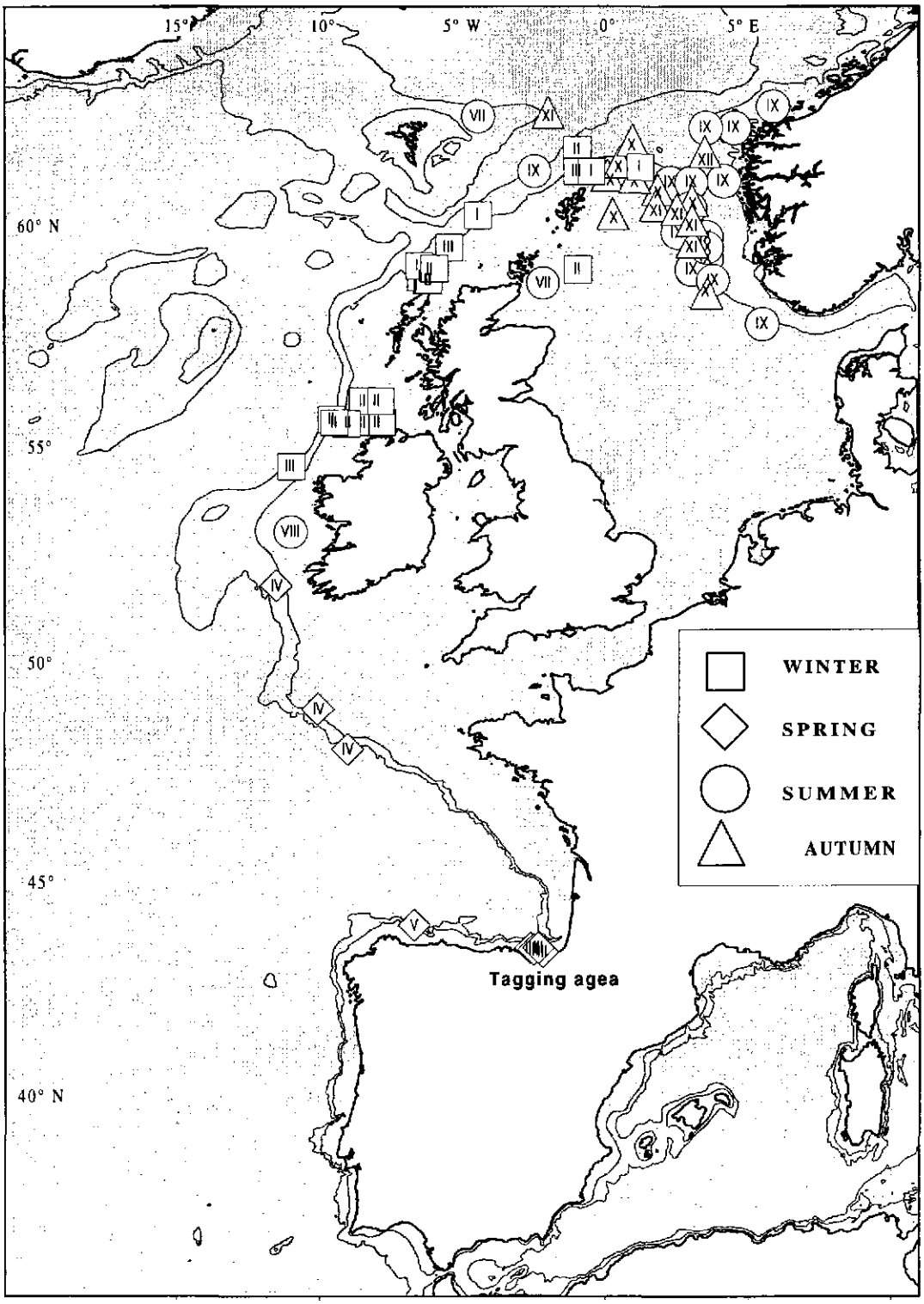


Figure 13.3.2.1 Recaptures obtained from the 1994 tagging survey on mack carried out in the south east corner of the Bay of Biscay. (Uriarte and Lucio, in press).

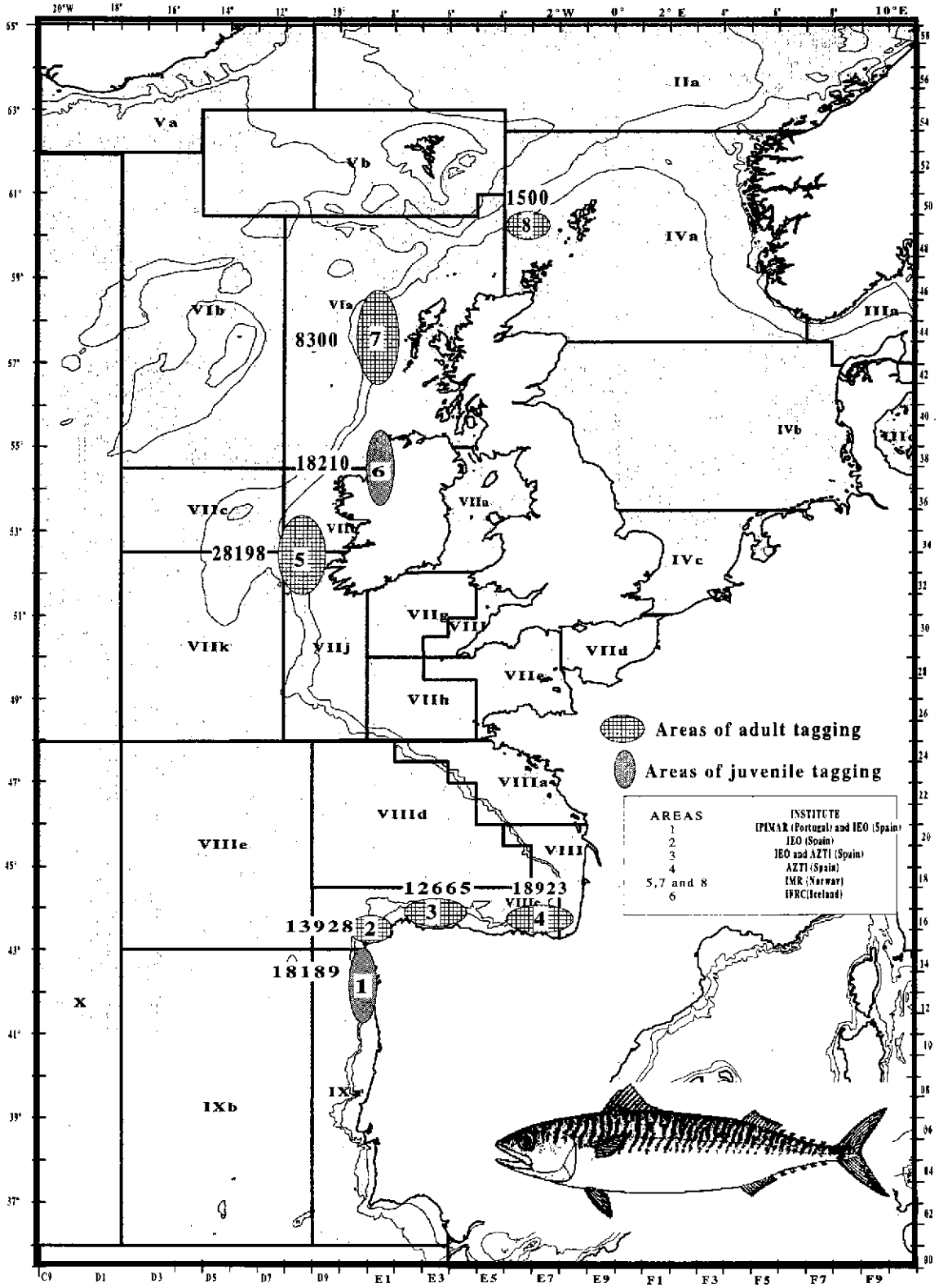


Figure 13.3.2.2: Areas of tagging of adult and juvenile mackerel in 1997 in the east Atlantic within the frame of the project 96-035, with indication of the participant Institutes and total number of mackerel tagged per area.

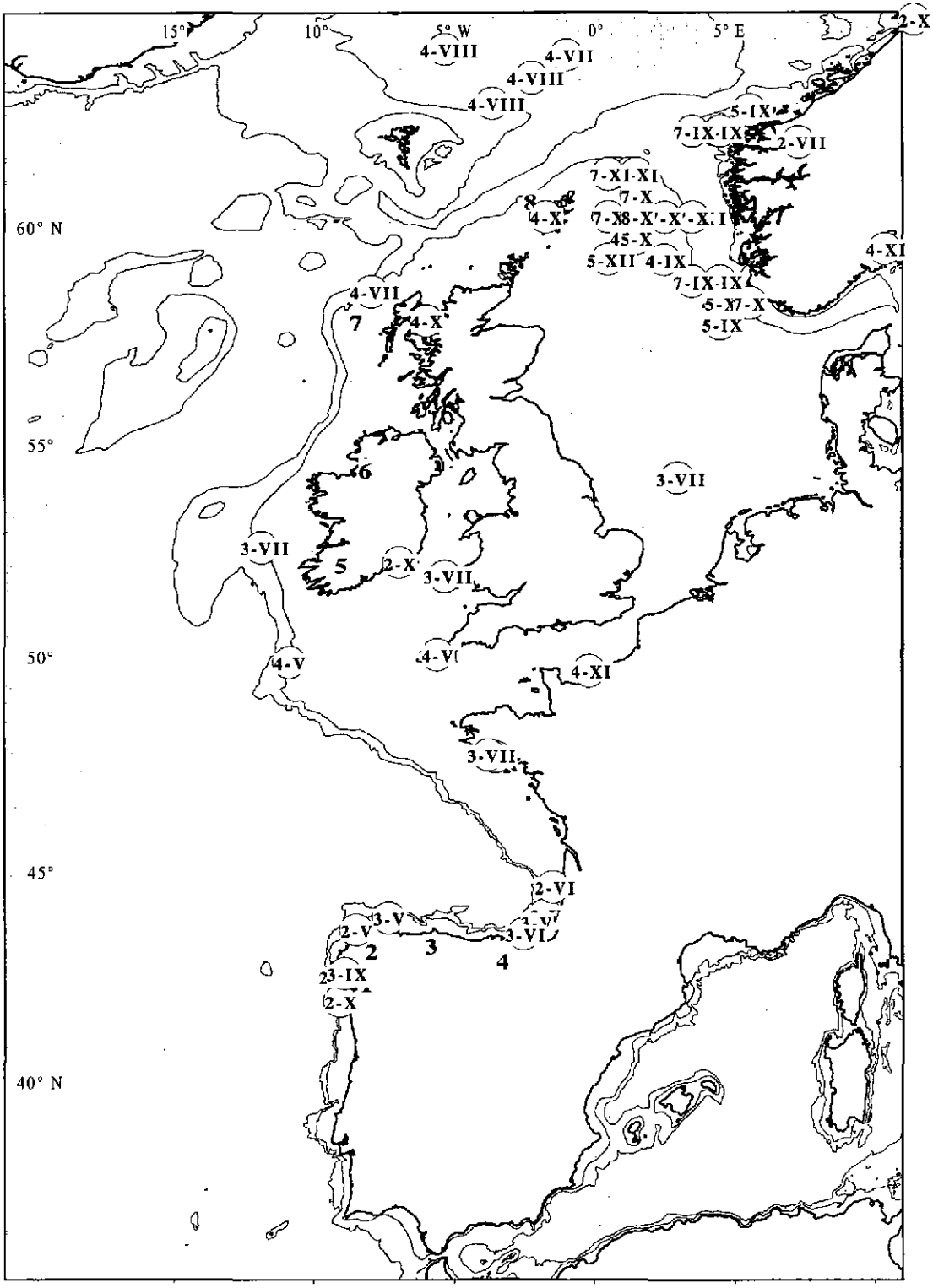


Figure 13.3.2.3: 1997 recaptures of mackerel tagged in adult areas in spring of that year. Numbers inside the circles refer to tagging area (cardinal numbers) and month of the recapture (roman numbers).(EU Study Project 96-035, Uriarte etal. WD 1998)

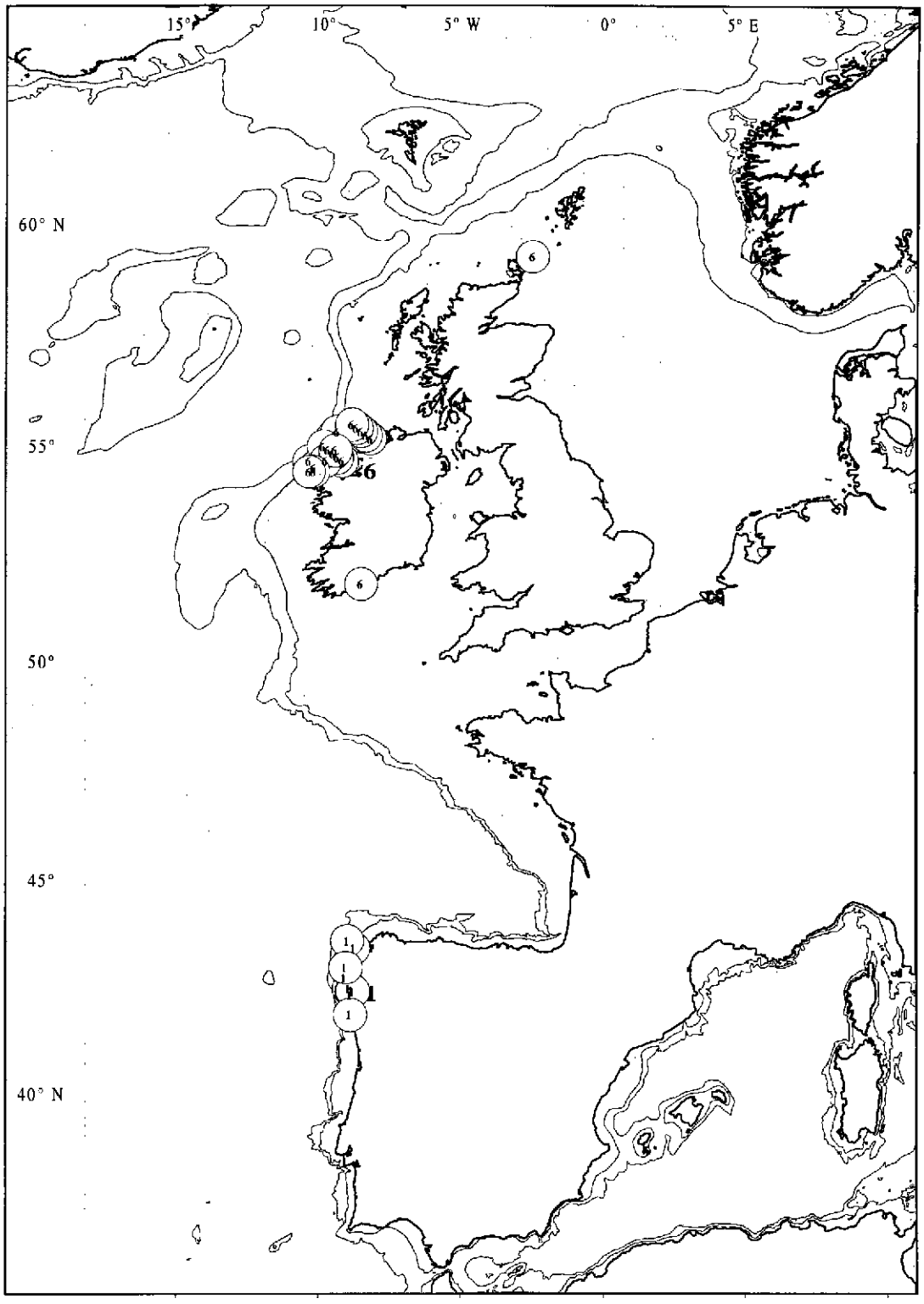


Figure 13.3.2.4: 1997 recaptures of mackerel tagged in juvenile areas in that year. Numbers inside the circles refer to tagging areas (cardinal numbers). (Study Project 96-035, Uriarte et al., WD 1998)

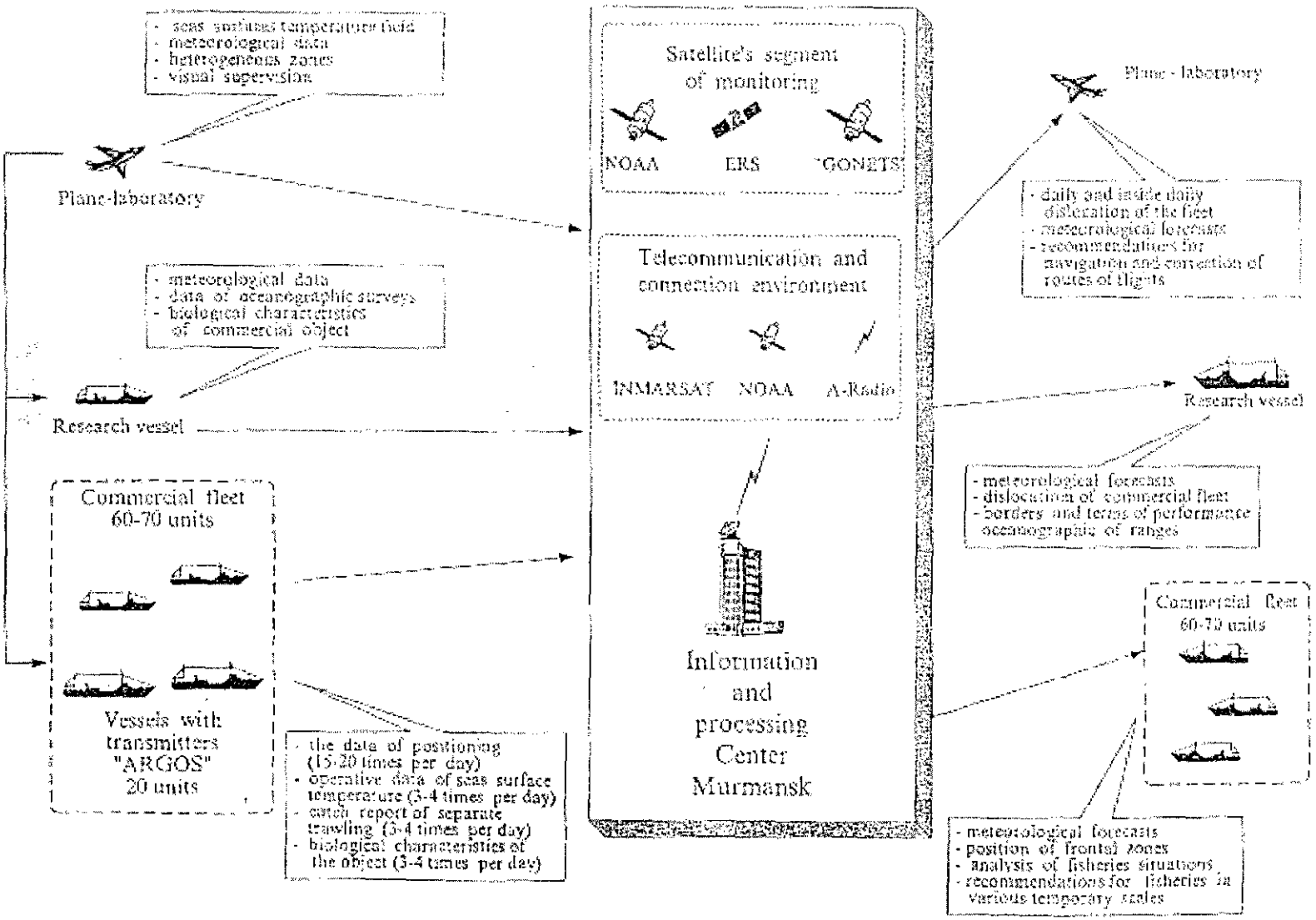


Figure 13.3.3.1 New information technologies of monitoring fisheries of mackerels in the Norwegian Sea (summer 1997 year).

14 RECOMMENDATIONS

The Working Group recommends, that observers should be placed on board vessels in those areas in which discarding may be a problem. This observer programme should be commenced as soon as possible.

ICES is requested to provide a secure long-term electronic data storage facility to allow the Working Group to build a long-term database.

The Working Group recommends that ICES and NEAFC agree on access to the NEAFC data base on mackerel.

The Working Group recommends further studies on the structure of the population of Northeast Atlantic mackerel components, specially those concerning migration pattern (tagging) and spawning components (genetics).

The Working Group, once again, strongly recommends that all countries with relatively high horse mackerel catches should sample for age at an adequate level.

The Working Group recommends, that when a TAC is set for a stock, it should apply to those areas where North Sea horse mackerel are fished, i.e. Divisions IVb,c, VIId, and eastern part of Division IIIa.

The Working Group recommends to carry out surveys using the application of the Daily Egg Production Method (DEPM) in Divisions VIIIc and IXa according to the sardine peak of spawning season in each of these areas. The egg survey (DEPM) should be carried out earlier in the Division IXa than in the VIIIc.

The Working Group recommends that Portugal continues to perform the November acoustic survey which coincides with the spawning aggregation of sardine in the Portuguese area of Division IXa.

The Working Group also recommends the continuation of joint acoustic surveys covering the Divisions VIIIc and IXa each year in March–April. In order to understand the population distribution of sardine these surveys must also investigate the adjacent areas, mainly the French coast.

The Working Group recommends that all the member countries should make available the information on sardine in their waters concerning surveys, catch compositions and eggs and larvae distribution.

The Working Group recommends the implementation of studies on daily increments on age rings of sardine otoliths due to the occurrence of changes in the structure of younger sardine otoliths. This raised problems in allocation in the appropriate age groups.

The Working Group recommends the revision of the maturity at age and weight at age.

The Working Group recommends to collect all anchovy information available from the Portuguese acoustic surveys carried out in Division IXa.

The Working Group recommends the continuation of the direct surveys aimed at the assessment of the stock of anchovy in Division VIII, because this stock requires close monitoring of the population on an annual basis.

15 ABSTRACTS OF WORKING DOCUMENTS

Borges M. F.

Data Exploration and Preliminary Assessments of Sardine *(Sardina pilchardus L.)*. WD 1998. Document available from: Maria de Fatima Borges, Instituto de Investigaçao das Pescas e do Mar, Avenida de Brasília, 1400 Lisboa, Portugal. Email: mfborges@ipimar.pt

The catch matrix used in the assessment during the 97 Working Group was wrongly extended to 11+ by introducing an arbitrary 1000 which was considered by the ICA as a true value. This was found out during the EU Study Group Assessment. Apparently what was necessary would be to introduce missing values in the catch matrix. In this paper are revised the catch matrix, and a preliminary assessment is performed collapsing the plus group 6+.

Dornheim H.

Profile of the German pelagic fleet. WD 1998.

Document available from: Holger Dornheim, Institut fuer Seefischerei, Palmaille 9, 22767 Hamburg, Germany. Email: ish@bfa-fisch.de

This document describes the German pelagic fleet development during the period 1988-1997. The catches of pelagic species per ICES-Division and yearly changes are presented in detail.

Gordo L., Soares E. and Figueiredo I.

Batch fecundity and spawning fraction of sardine off Portuguese coast. WD 1998.

Document available from: Leonel Gordo and Eduardo Soares, Instituto de Investigaçao das Pescas e do Mar, Avenida de Brasília, 1400 Lisboa, Portugal. Email: esoares@ipimar.pt

In March 1997 a survey was carried out off Portuguese coast in order to apply the Daily Egg Production Method to sardine. This working document presents the revised estimates of batch fecundity and spawning fraction of sardine off Portuguese coast in March 1997, which will replace those used by Cunha et al. (1997) that were referred to March 1988.

Holst J. C. and Iversen S. A.

Distribution of mackerel in the Norwegian Sea during Summer, 1991-1998. WD 1998.

Document available from: Jens Christian Holst and Svein A. Iversen, Institute of Marine Research, P.O.Box 1870, Nordnes, 5024 Bergen, Norway. Email: sveini@imr.no.

A short summary of the distribution of mackerel in the Norwegian Sea during the summers 1991-1998 (excl. 1992, 1994) is prented as observed in Norwegian trawl surveys. Mackerel was caught in large parts of the covered areas (60-75°N, 10°W-15°E), with in general decreasing catch rates northwards.

Iversen S. A.

Calculations of catch in numbers, mean weight- and mean length at age in the 1997 catches of Western and North Sea horse mackerel. WD 1998.

Document available from: Svein A. Iversen, Institute of Marine Research, P.O.Box 1870, Nordnes, 5024 Bergen, Norway. Email: sveini@imr.no

Only the Netherlands and Norway provided data on age composition, mean weight- and mean length at age in their catches. These data have been applied for the other catches of North Sea and Western horse mackerel. The documents gives in detail what samples have been applied for differents areas and catches.

Jacobsen J. A.

A short profile of the Faroese fishing fleet for mackerel and changes over the last 10 years. WD 1998.

Document available from: Jan Arge Jacobsen, Fiskirannóknarstovan, P.O.Box 3051, Noatún, FO-110 Tórshavn, Faroe Islands, Denmark. Email: janarge@frs.fo

This document present short summary about the Faroese fleet which fish for pelagic species including mackerel. Presented map of approx. mackerel fishing areas for the Faroese purse-seiner during 1973-1997

López J.M. and Porteiro C.

Relationship of the Gulf index with the Sardine recruitment in NE Atlantic. WD 1998.

Document available from: Carmela Porteiro, Instituto Español de Oceanografía, Apdo. 1552, 36280 Vigo, Spain. Email: carmela.porteiro@vi.ieo.es

The correlation between the Gulf index and the sardine recruitment series is negative. When the Gulf current achieved mean value and it doesn't progress so mush to the north, at the same time if the value of the Gulf index is very low, the recruitment is also bad. Therefore the recruitment of the sardine seems to be favoured by values means of the Gulf stream. According with this analysis 1998 should have a better recruitment that 1997, to be the Gulf index more negative.

Marques V., Morais A., Soares E., Pestana G. and Borges F.
Revision and Update of the Historic Series Results of Sardine Portuguese Acoustic Survey. WD 1998.
Document available from: Vitor Marques and Eduardo Soares, Instituto de Investigaçao das Pescas e do Mar, Avenida de Brasília, 1400 Lisboa, Portugal. Email: esoares@ipimar.pt

This paper presents a review and update of the results of the sardine Portuguese acoustic surveys undertaken during March 1997, November 1997 and March 1998. The consistency analysis of both the design and the results of the three historic series of Portuguese sardine acoustic surveys undertaken since 1984 is also presented.

Massé J.
Preliminary results from PEGASE98 survey. WD 1998.
Document available from: Jacques Massé, Institut Francaise pour la Recherche et l'Explorationdc la Mer. St. Pée-sur-Nivelle, France. Email: jacques.massc@ifremer.fr

This paper present summary results from the anchovy and sardine acoustic surveys on R.V. Thalassa. The PEGASE98 survey has been carried from the 20/5 to 21/6/1998. Some preliminary estimates of biomasses of anchovy and sardine have been made (respectively 67,000 and 9,1500 tonnes). Some indications on the distributions of anchovy schools are given.

Molloy J. and Kelly C.
The Irish Pelagic Fleet that targets mackerel, horse mackerel, atlanto-scandian herring and blue whiting. 1997–1998. WD 1998.
Document available from: John Molloy, Fisheries Research Centre, Abbottstown, Dublin 15, Ireland. Email: molloy@frc.ie

This working document given a short description of the Irish fleet which target mackerel, horse mackerel, blue whiting and atlanto-scandian herring. Some changes that are currently taking place are also described.

Molloy J. and Kelly C.
Some Comments on Sampling Intensity and Compilation of Biological Data. WD 1998.
Document available from: John Molloy, Fisheries Research Centre, Abbottstown, Dublin 15, Ireland. Email: molloy@frc.ie

This working document examined the sampling programmes carried out by the various countries on their catches. In previous years Working Group have not devoted much time to examining the ways in which sampled catches have been used to cover catches which have not been sampled. The main problems have not changed for many years. Some countries which have important fisheries do not carry out any sampling programmes, have no information on distribution of their catches and do not supply information on the gear used by their fleets, and etc. This document identified the areas which are not properly sampled.

Motos L., Uriarte A., Santos M. and Proset P.
Assessment Update for the Bay of Biscay Anchovy *(Engraulis encrasicolus)*. Spawning Biomass in 1995, 1996, 1997 and Preliminary Results of the 1998 Survey. WD 1998.
Document available from: L. Motos and Andres Uriarte, Instituto Tecnológico Pesquero y Alimentario, Avda. Satrústegui n° 8, 20008 San Sebastián, Gipuzkoa, Basque Country, Spain. Email: andres@rp.azti.es

This document revise the results of the 1995-1998 DEPM survey for Bay of Biscay anchovy assessment. Biomass estimates for 1996 and 1988 were derived from the spawning biomass versus spawning area linear relationship using the extension of the spawning area found during the 1996 and 1998 DEPM anchovy surveys, respectively. Further processing of the samples, both egg and adult samples, was achieved afterwards, as to get a full assessment of the 1995 and 1997 spawning biomass following the traditional DEPM procedure was obtained. Since no adult samples were collected in 1996, further processing of egg samples did not allowed us to reach a direct SSB estimate. Furthermore, a new anchovy DEPM survey was carried out in 1998. Provisional results on daily egg production and extension of the spawning area in 1998 are presented in this document as well.

Murta A. and Martins M. M.
Evolution of the Portuguese fleet from 1991 to 1997. WD 1998.
Document available from: Alberto Murta, Instituto de Investigaçao das Pescas e do Mar, Avenida de Brasília, 1400 Lisboa, Portugal. Email: amurta@ipimar.pt

This document present short summary about the Portuguese fleet which catch pelagic species in EU waters. Evolution of the number, types of vessels, gears, and target species.

Nesbø C. L.

Genetic Differentiation of Spawning Stocks of Atlantic Mackerel. WD 1998.

Document available from: Camilla L. Nesbø, Dept. of Biology, Division for General Genetics, University of Oslo, P.O.Box 1031, Blindern, 0316 Oslo. Email: c.l.nesbo@bio.uio.no

Population genetics, 443-bp segment of the mitochondrial cytochrome b gen, and 273-bp of the mitochondrial D-loop region, has been studied. The main conclusions are that the eastern Atlantic mackerel are structured into four genetically different spawning populations; Western-, Southern-, North Sea- and Adriatic (Mediterranean) mackerel. The Southern population seems to be the most differentiated and is the oldest one. Western mackerel show the lowest level of genetic variation, indicating a rapid population size expansion.

Patterson K. R.

A programme for calculating total international catch-at-age and weight at age. WD 1998.

Document available from: Kenneth R. Patterson, Marine Laboratory, P.O.Box 101, Victoria Road, Aberdeen AB11 9DB, Scotland, United Kingdom. Email: k.patterson@marlab.ac.uk

It is argued that use of spreadsheets to assemble international catch and catch sampling data is not ideal because spreadsheet calculations are error-prone, difficult to document, and, in the absence of a well-defined data storage format and interpolation rules, it becomes very difficult to replicate historic calculations. A preferable approach would be to define a country, time-period and area-disaggregated data storage format for this information, and to have available software which assembles a total-international catch-at-age and weight-at-age data set using defined allocation and interpolation rules. Such software should include error-checking routines and should generate tables directly suitable for inclusion in WG report. Approach, implementation, input data formats, data preparation and examples are described in this document.

Reid. D. G.

Report of an acoustic survey for mackerel: Viking bank area of the North Sea in 1995.

Document available from: David G. Reid, Marine Laboratory, P.O.Box 101, Victoria Road, Aberdeen AB11 9DB, Scotland, United Kingdom. Email: reiddg@marlab.ac.uk

This working document presents the mackerel abundance estimate and distribution from acoustic survey in the North Sea in December 1995. The abundance estimate was approximately 1.6 million tonnes and the fish were tightly distributed in the Viking Bank area. It is proposed that this type of survey has considerable potential for providing a biomass index for mackerel for the years between the triennial egg surveys.

Shatokhin B.M, Mishkin V.M., Klochkov D.N. and Chernook V.I.

Advanced information technologies used for mackerel fishery monitoring in the Norwegian Sea.

Document available from: Vladimir I. Chernook, Knipovich Polar Research Institute of Marine fisheries and Oceanography, 6, Knipovich Street, 183763 Murmansk, Russia. Email: inter@pinro.murmansk.ru

In summer 1997, the advanced information technologies were used to support mackerel fishery in the Norwegian Sea. Works were carried out by scientific and technical company "Complex System" jointly with PINRO. Technology, methods, information base and etc. are described in this paper.

Skagen D.W.

Lengths and weights at age for the Western mackerel before 1980, using data from Norwegian tagging surveys. WD 1998.

Document available from: Dankert W. Skagen, Institute of Marine Research, P.O.Box 1870 Nordnes, 5024 Bergen, Norway. Email: dankert@imr.no

For the years prior to 1982, standard values have been used for weight at age in the catch in the assessment of Western mackerel. There are discrepancies between the sum of products of weights and catches in numbers, and the questions has been raised to which extent this is due errors in the catch numbers. This note is an attempt to approach this problem by looking at possible changes in the weights at age for the period 1972-1980, and indicates that the growth has increased in this period.

Tereshchenko E. S. and Shamray E. A.

On estimation of the Atlantic mackerel spawning biomass. WD 1998.

Document available from: Elena S. Tereshchenko, Knipovich Polar Research Institute of Marine fisheries and Oceanography, 6, Knipovich Street, 183763 Murmansk, Russia. Email: belikov@pinro.murmansk.ru

The paper discusses some problems concerning differences in the estimates of spawning stocks. One of the reasons for differences between ICES and Russian based estimates is differences in applied fecundity. This because different threshold diameters of ovocytes which form fecundity of a current season have been applied.

Uriarte A., Motos L., Alvarez P., Santos M., Prouzet P., Massé J.
Population estimates of the Bay of Biscay anchovy in 1997 using the Daily Egg Production method. Annex to the Interim report for the European Commission. WD 1998.
Document available from: Andres Uriarte, Instituto Tecnológico Pesquero y Alimentario, Avda. Satrustegui no.8, 20008 San Sebastián, Gipuzkoa, Basque Country, Spain. Email: andres@rp.azti.es

This document contains the report of the Assessment made of the population of the Bay of Biscay anchovy in 1997 by AZTI and IFREMER using the Daily Egg Production Method (DEPM). The DEPM model, sampling, egg cruise, sample processing and parameter estimates, adult processing and length/age structure of the population, oceanographic conditions are detail described.

Uriarte A. (Coordinator), Alvarez P., Martims M.M., Villamor B., Masó J.M., Iversen S.A., Myklevoll S., Molloy J., Mullins E. and Kennedy D. & Barnewell L.?
Spatial pattern of migration and recruitment of North East Atlantic mackerel. Intermediate report for the European Commission. WD 1998.
Document available from: Andres Uriarte, Instituto Tecnológico Pesquero y Alimentario, Avda. Satrustegui n° 8, 20008 San Sebastián, Gipuzkoa, Basque Country, Spain. Email: andres@rp.azti.es

This document contains the report of the project 96-035. The project entitled:" Spatial pattern of migration and recruitment of North East Atlantic mackerel" aims at clarifying the migration pattern of adult mackerel from the southern areas and western areas and determining the recruitment spatial pattern of juveniles from two nursery areas, different from the Northwest of Ireland and West of Portugal. In the document presented, tables and maps were described, the place of tagging and recaptures of mackerel tagged. Length/age distributions also are described.

Villamor B., Abaunza P., Punzón A., Gancedo R. M., Gonzalez F., Mene L., Millán M., Morlán R., Otero R., Patiño B. and Artetxe I.
Description of the Spanish fleets which catch pelagic species in the ICES area: main changes occurring between 1993 and 1997. WD 1998.
Document available from: Begoña Villamor, Instituto Español de Oceanografía, Apdo. 240, 39080 Santander, Spain. Email: begona.villamor@st.ieo.es

This paper deals with fleets which catch pelagic species (mackerel, horse mackerel, sardine and anchovy), and which operate from Spanish ports on the Atlantic side of the Iberian Peninsula. Fleets targeting these species are considered as well as fleets which catch them as secondary to the target species or as a by-catch. Fleet types, fishing areas and target species are described as well as technical characteristics of these fleets.

Zabavnikov V.B., Troyanovsky F.M., Chernook V.I. and Shatokhin B.M.
Preliminary results from comprehensive air investigations to estimate distribution of mackerel concentrations in the Norwegian Sea in 1998.
Document available from: Vladimir B. Zabavnikov, Knipovich Polar Research Institute of Marine fisheries and Oceanography, 6, Knipovich Street, 183763 Murmansk, Russia. Email: inter@pinro.murmansk.ru.

Air surveys of mackerel feeding migrations in the Norwegian Sea were carried out in July -August onboard the aircraft laboratory AN-26 "Arctica". In that period 15 research flights were done in the area between 63°-71°N 10°-06° W. Preliminary quantitative rapid biomass for mackerel found along the survey route with an allowance for mean size, weight, calculated size of schools discovered and data on distribution and behavior of mackerel in schools.

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