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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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International Council for the Exploration of the Sea

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8 SARDINE

8.1 Otolith exchange

In 1995 the Working Group recommended that a sardine otolith exchange programme should be performed for this year in order to improve otolith readings among the differents readers of both countries, Portugal and Spain.

Prior to this exchange a workshop was held in June 1994 in Lisbon. The main results of this worshop have been reported in a WD at the 1994 WGMHSA and in an IEO internal document. From these documents the main conclusions were a) the good agreement reached among the experienced readers in relation to the poor level reached among the less experienced ones, and b) the problems of interpreting the structure and therefore of ageing those otoliths of sardines greater than 22 cm in length from the Cantabrian sea, the younger sardines caught at the end of the year and the sardines caught in the middle of the year (i.e. end June-to begining of July).

Due to the problems listed above, the exchange was finally organized to cover the whole area of the stock distribution with samples collected throughout the whole year.

A total of 892 pairs of otolith were examined and aged. Details are shown in Table 8.1. At least three samples by each ICES Sub-division (VIIIc East, VIIIc West, IXa North, IXa Central North, IXa Central South and IXa South) caught at the begining of the year (January-March), in June and at the end of the year (November-December), covering the whole length distribution, were analysed. In addition sampling from VIIIb Division has been also included whereas only two samples from Divison IXa South were analysed.

Three Spainsh readers have read separately and individually every sample whereas the Portuguese team gave only one reading obtained by "consensus". Moreover, two of the Spanish readers are beginners.

For these preliminary results a full descriptive analysis has not been done and only a statistical analysis was performed for each sample. A non parametric Wilcoxon Matched-Pair Signed-Rank test over each two paired readers was used to test the degree of agreement between their readings.

Results of the Wilcoxon test are shown in Table 8.2. The agreement is in general low for the inexperienced readers and the same problems found during the last worshop arose in this exchange: there are still problems for ageing sardines over 22 cm in length, sardines caught in the middle of the year and younger sardines caught at the end of the year. Nevertheless a reasonable agreement is reached between the Portuguese reading and the Spanish experienced reader.

Taking into account these results, a workshop should be held in order to clarify and to understand the otolith structure and ageing of those sardines over 22 cm and, especially, younger sardines caught at the end of the year and clarify the ageing criteria for those sardines caught in the middle of the year.

8.2 The fishery in 1995

From Sub-Areas IV, VII, VIII, and IX landings were reported by Denmark, UK (England and Wales), Spain and Portugal (Table 8.3). There are no data available from France. During 1995, 16,846 tonnes were also reported in Sub-Area VII. Since 1992 there is an important increase in catches from Sub-Area VII (about 60% from 1991 to 1995).

Table 8.4 shows the annual landings of sardine by Sub-area (IV–IX) and Division in 1981–1995. There was a decreasing trend from 1981 to 1991. In 1994 the landings increased to about 163 thousand tonnes and by 1995 they reached the same level as in 1991 (around 138 thousand tonnes).

In Sub-Area VII the sardine catches increased from 1,100 tonnes in 1990 to about 23 thousand tonnes and 17 thousand tonnes respectively in 1994 and 1995. In Sub-Area VIII, the catches have decreased since 1988 from 49 thousand tonnes to about 20 thousand tonnes in 1995. Concerning Sub-Area IX, where sardine catches have reached the highest levels in this century, it is noticed that during the 1984–1994 period, they have oscillated between 179 thousand tonnes in 1984 and 102 thousand tonnes in 1995.

Table 8.5 gives the catch by country for the period 1976 to 1995 from the unit stock area (Divisions VIIIc and IXa). Since 1984 the Spanish landings show a sharp decrease from about 108 thousand tonnes to 34 thousand tonnes in 1995. The Portuguese landings have oscillated between 112 thousand tonnes in 1985 and 88 thousand tonnes in 1995. Total landings for 1995 (121,384 tonnes) were lower than in 1994 (132,800 tonnes), both Portugal and Spain have decreased their catches in 1995 in relation to 1994. The Portuguese catch decreased by around 6,700 t and the Spanish by 2,200 t, mainly in Division IXa. As in previous years, about the 98% of the total catch in the stock in 1995 was taken by the purse seine fleets from Spain and Portugal (Table 8.6). About 70% of the total catch of the stock in 1995 comes from catches made by the Portuguese purse seine fleet off the West coast of Portugal within the area between Matosinhos and Sines.

All the available catch data from 1940-1995 for these Divisions are shown in Figure 8.1. After a period of near-stable catches of around 200,000 t during the period 1980–1985, the total catch began to decrease from 1986. The highest landings occurred in 1961 (250,000 t) and the lowest in 1949 (67,000 t), which caused a severe crisis in both the Portuguese purse-seine fishery and Portuguese fishing industry generally. Catches split by country in Divisions VIIIc and IXa are shown in Figure 8.2. The trend in the catches of both Portugal and Spain are quite similar. Nevertheless, after a period of high catches from 1980 to 1985, the Spanish catches show a decreasing trend since 1987, whereas the Portuguese catches have remained quite stable at around 100,000 t per year.

Figure 8.3 shows the Spanish sardine landings by Division (VIIIc and IXa) in 1960–1995. From this figure it can be concluded that the above mentioned decreasing trend in the Spanish landings are due to a decrease in landings in Division IXa, as in Division VIIIc they were quite stable in that period.

During 1995 the seasonal pattern of landings by the two countries was the same as reported in previous years with about 61.5% of the annual catches being landed in the second half of the year (Table 8.6).

8.3 Distribution of the Sardine Fishery

Table 8.7 shows total nominal catches of sardine by quarters and areas in Divisions VIIIc and IXa in 1995. The distribution of catches in 1995 by quarter and area in Divisions VIIIc and IXa was similar to that in recent years, with about 57% of the total catches from Sub-Division IXa Central North and Central South (Table 8.7). As in previous years, the catches in Division VIIIc East were the lowest.

It was presented to this Working Group the sardine catches from 1978 to 1995 (Porteiro *et al.*, 1996) from the Gulf of Cadiz (Division IXa, South of Spain). The highest catches occurred in 1987 (8,870 t) and the lowest in 1981 (2,384 t). Since 1990 the catches decreased, with a slight increase in the last two years.

8.4 Effort and Catch per Unit Effort

Table 8.8 gives the effort in fishing days and the catch per unit effort (tonnes/fishing day) for four different purse seine fleets, from Spain and Portugal.

The CPUE trends for the fleets of Portugal (Division IXa Central+South) and Santonia (VIIIc East) indicate a decrease from 1987 to 1991, with an increase since 1993. In 1995 the CPUE for the Santonia fleet remained at the same level of 1994 (4.08). The CPUE of the fleet of Vigo-Riveira (IXa North) remained at the same level in 1995 as in 1994. In 1995 the Sada fleet (VIIIc West) CPUE remained at the same level of 1994.

In general the fishing effort in all fleets shows a decreasing trend, mainly since 1992.

The effort for the fleets in Division VIIIc in 1995, reached only 50% of the 1987 level like in the year before.

8.5 Fishery-Independent Information

Sardine acoustic surveys have been carried out by Portugal and Spain since 1982 in Divisions VIIIc and IXa. Both countries began to undertake acoustic surveys in the area on a systematic basis since 1984. Portugal performed several surveys per year since 1984, in Spring (March-April), in Summer (August) and in Winter (November-December). Since 1987 Spanish surveys were undertaken in Spring (March-April).

During 1996 three acoustic survey have been carried out, two undertaken by IPIMAR off the Portuguese coast and the Gulf of Cadiz (Spain) in February-March and in June-July and the other by IEO along the Atlantic and Cantabrian Spanish waters in March. These cruises followed the survey strategy, methods and subsequent calculations adopted by the Planning Group for the Acoustic Surveys in ICES Sub-areas VIII and IX (Anon. 1986) and the surveyed area was limited by the 20 m and 200 m isobaths.

February-March Portuguese acoustic survey

The survey was carried out on board R\V "Noruega" from 16th February to 15th March. The total biomass for the whole area was estimated to be 405.3 thousand tonnes, corresponding to 9,426 million fish. In Sub-Divisions IXa Central North, Central South and South (Portuguese coast) a biomass of 251.1 thousand tonnes (5,903 million fish), which was one of the lowest assessed since 1984. This low abundance was mainly due to a remarkable decrease in abundance in Sub-Division IXa Central North in relation to previous years. A Biomass of 154.2 thousand tonnes corresponding to 352.3 million fish was estimated for the area of Gulf of Cadiz.

Table 8.9 and Figure 8.9 shows the number of fish, biomass (tonnes), mean length, mean weight and percentage in number and in weight by age group and area. The highest concentrations of sardine were found in Sub-Divisions IXa Central South and South (Algarve and Cadiz). Young fish (age 1) were mainly distributed in IXa Central North (56% of fish abundance) and, at a lower level, Central South (24% of total fish abundance).

Younger fish were mainly distributed in IXa Central North Sub-division comprising 96% of the abundance in number and 93% of the biomass estimated for this area. Age 4 was the most abundant, in Portugal compared with age 3 in IXa Spain.

Concerning the Portuguese coast, the total estimated biomass of 251 thousand tonnes is significantly lower than the abundance levels of the 1984–1988 period. As it was observed in May 1995, this abundance decrease is due to a remarkable decrease in IXa Central North Sub-division.

The remaining areas off the Portuguese coast do not show any significant change in relation to the previous abundance levels (1984–1988). The same happens to the area of Gulf of Cadiz in relation to the survey undertaken in November 1992 and May 1995.

Sardines were found distributed in shallow waters, with an important decrease in the Northern part of the area (Figure 8.5).

March Spanish acoustic survey

The survey was carried out on board R/V "Cornide de Saavedra" from 11 to 26 March. The survey track consisted of parallel transects perpendicular to the coast line with 12 nautical miles as a mean distance. In addition, extra transects, with a distance of 6 nautical miles apart, were allocated in specific areas.

The total biomass for the Spanish area was estimated to be 53 thousand tonnes, corresponding to 745 million fish. Table 8.10 shows the number of fish , biomass and their %, mean length and its standard deviation and mean weight by age group and ICES Subdivisions. The total assessment of sardines is shown in Table 8.11.

Age groups 4 and 5 were the most abundant comprising 80% of the total abundance and biomass estimated. This is consistent to that found in the last year, when age groups 3 and 4 were also dominant (up to 90% in number in VIIIc West Sub-division, Figure 8.6). The low levels of age groups 1 and 2 (1% and 7% respectively) are also noticeable.

The lack of older ages in Division VIIIc East was attributed to the lack of positive fishing stations in this area and the high abundance of 4 and 5 year olds found in the samples taken in North Galicia, which was the closest one to this area.

As in 1995, the distribution area of the stock was too small, with sardine concentrated in isolated but dense patches along the coast in shallower waters (Figure 8.7). The same distribution was found in the Portuguese waters during the Portuguese acoustic survey. From all the available distribution areas of sardine on the different acoustic surveys carried out by both countries (Anon, 1993, Porteiro *et al,* 1993, Dias *et al,* WD 1993 and

Marques *et al.*, WD 1995), it seems that the area of distribution of the sardine stock along the coast is shrinking. During the first surveys, sardine show a continous distribution along the Atlantic waters of the Iberian Peninsula and were either concentrated close to shallow waters or spread out to the 200 m isobath (Anon. 1993b). Since 1993, large areas, especially in Divisions IXa North and VIIIc, appear to be without sardine or with sardine distributed only in small patches.

June-July Portuguese acoustic survey

The survey was carried out on board R\V "Capricornio" from 15 June to 16 July. The total estimated biomass for the whole surveyed area was 509.6 thousand tonnes corresponding to 10,678 million fish. A biomass of 427.2 thousand tonnes was estimated for the Portuguese coast corresponding to 8,005 million fish. For the Gulf of Cadiz it a biomass of 82.4 thousand tonnes was estimated which corresponds to 2,673 million fish. Table 8.12 shows the number of fish (millions), biomass (tonnes), mean length, mean weight and percentage in number and in weight by age group and area.

The total estimated biomass (509.6 thousand tonnes) is about 26% higher than that previously estimated in February-March. This increase is due to a considerable biomass increase of five times more than that obtained in February-March in the Sub-division IXa Central North. This was partially compensated by a remarkable biomass decrease in the Gulf of Cadiz, 46% less in June-July.

The recruitment (age 1 in July, 2,7 million fish) seems to remain significantly lower than the mean historical level (1976-1995). This age group is mainly distributed in the IXa Central-North Sub-division and in the Gulf of Cadiz (Figure 8.8).

Ages 3 and 4 are the most important, and as in the other surveys, the low number of age 1 and 2, by comparaison, are noticeable.

The 0 age group fish (1996 recruitment) were mainly located in the Gulf of Cadiz and in IXa Central North Sub-division.

Sardine distribution is shown in Figure 8.9. Compared with the previous survey, the recovering of the abundance level in Sub-division IXa Central North is remarkable.

8.6 Length Compositions by Fleet and by Country

In 1995 the quarterly and annual catch length compositions by fleet were provided by Portugal and Spain in Divisions VIIIc and IXa (Table 8.13) and were provided by U.K (England and Wales) in Division VIIe (Table 8.14) for the 1st quarter.

As in previous years, the largest fish were caught in Divisions VIIIc and VIIe.

8.7 Catch in Number at Age

Based on data submitted by Working Group members, the 1995 catch in number at age data were compiled by quarter and sub-divisions of Divisions VIIIc and IXa (Table 8.15).

The Portuguese data (catch in number, length composition, age length/key) were collected on a quaterly basis by sub-division. The Spanish data were collected on a quaterly basis, using the length composition by quarter and the two half year age/length keys.

The 1995 catches of 0 age group fish were notably lower than those in 1994, decreasing from 120.8 million to 30.5 million fish (75% less). The oldest ages (above age group 6) mainly occurred in the catches of Division VIIIc, especially in the Eastern part (Table 8.15).

The annual catch in number at age for the period 1976 to 1995 is presented in Table 8.16 and Figure 8.10 shows the annual catch in number at age from 1981 to 1995.

The catches in number at age for the Gulf of Cadiz (Division IXa South) are available from 1982 to 1995. From the analysis of the acoustic surveys data the distribution of sardine has a continuity between Algarve and the Gulf of Cadiz (Soares, WD 1996, Marques *et al.*, WD 1996). So having neither distribution nor otoliths of the Spanish catch from this area, it seems suitable to use the age-length key from Algarve. From 1982 to 1989 this key was used by half the year, and from 1990 by quarters.

8.8 Mean Length at Age and Mean Weight at Age

The 1995 mean lengths at age in the catches by quarter were provided by Spain (Division VIIIc East, West and Division IXa North) and Portugal (Division IXa Central North, Central -South and South) (Table 8.17).

The mean weights at age in the catch in 1995 were based on Spanish and Portuguese biological sampling. Table 8.18 shows the mean weight at age by sub-division and quarter. The 1995 mean weights at age in the catch are slighty higher than in 1994 and the weights of ages 1 and 2 are higher than those in 1994 (Table 8.19).

Table 8.20 shows the mean weights at age in the stock for the period 1976–1995. The mean weights at age in the stock have been calculated from commercial sampling during the period December 1994–January 1995.

8.9 Maturity at Age

The maturity ogive for 1995 is usually estimated using the first quarter data from Portuguese and Spanish biological sampling (Table 8.21). Of a total of 2,304 individuals examined 2,204 were mature. The percentage of mature at age 1 in 1995 (73%) is higher than for the same age in 1993 (47%), but similar to that of 1992 (79%). For ages older than 1 the percentage of mature is similar to that in recent years.

8.10 Stock Assessment

The available data for tuning the current VPA are given in Table 8.22. As in previous years a value of M=0.33 was used for all ages and all the years and the proportion of M and F before spawning was taken to be 0.25.

This year four sets of fishery independent data are available, Spanish Spring surveys (1988–1996), Portuguese Winter acoustic surveys (1984–1992), Portuguese Summer acoustic surveys (1985–1996) and Portuguese Spring acoustic surveys (1986–1996) (Table 8.23). Only the Portuguese Winter acoustic surveys have no information since 1992. To test whether those indices are consistent, a preliminary assessment was performed using each data set separately.

The model, which was already used and explained in the last assessment Anon. (1996/Assess:7), was constructed using the usual separable model assumptions, but in addition:

- Populations were fitted from ages 0 to 11, with the assumption of negligible catches between ages 6 and 11.
- Age-disaggregated acoustic surveys by Portugal and Spain were included in the fit.
- Catch at age observations from ages 0 to 5 in all years were included in the fit, but also observations at age 6 from 1989 onwards, on account of a change in the age-reading criteria applied.
- Catch at age observations at other loci in the matrix were replaced with arbitrary low values and assigned a very small weight in the analysis.
- Acoustic surveys were assumed to provide a proportionate index of stock abundance.

This model assumes the differential age pattern structure which was already described in Anon. (1996/Assess:7) and provides for the known emigration of fish from the main catching area.

Relative weights Lambda at age were set to 0.5 for age 0 and 1 for age 1 to all real catch-at-age observations. For ages older than the last real age observed in the catch, an arbitrary catch value of 1 million fish was used but was down-weighted by assigning corresponding lambda values to 0.01.

$F_{bar(2-5)}$ 1995 estimates for each run and their confidence intervals were ploted for each survey and are shown in Figure 8.11. From this, both Spanish and Portuguese Spring acoustic surveys give consistent results. Besides, these cruises cover the whole area of the stock distribution simultaneously and therefore, they have been chosen as fishery independent data for tuning the current VPA.

Parameter estimates and fitted populations are given in Table 8.24 and are illustrated in Figures 8.12a), b) and c). Age residuals are low except for age 7 whereas year residuals appear to be higher with positive residuals over the last five years. These residuals may generate uncertainties about the estimations which are reflected in the confidence intervals for both fishing mortality and exploitation pattern. Nevertheless, results obtained last year are compared with those estimated by this assessment and are shown in Figure 8.13. Trends in the overall population are similar and estimates of recruitment area almost the same. Fishing mortality appears to be higher than those estimated the last year; trends for F_{bar} are rather similar untill 1993, but in 1994 there is an increase whereas in the last assessment there was a slight decrease.

As in the last year, the fitted Q(Spanish) and Q(Portuguese) parameters for the two surveys agree well with current perceptions of migrations in the stock (Figure 8.14). Nevertheless, there was a change in the exploitation pattern shown in the catchability for the Portuguese surveys, becoming more important for age groups 3, 4 and 5 than for age group 2 as in the previous year. The catchability of the Spanish surveys remains very similar.

8.11 Recruitment

The recruitment index is shown in Figure 8.12. The estimated recruitments at age 0 show a decreasing trend since 1983 and the low recruitment of 1994 seems to be confirmed, as the lowest recruitment in the time series. In addition, the last three recruitments estimated by the model fit were the lowest in the time series.

8.12 Catch Predictions

Although there are several potential sources of variability in recruitment, especially in pelagic species of short-medium life cycle, such as migration patterns, oceanographic and climatic conditions, an important amount of the variability on recruitment levels appears to be explained by the variability found in the stock size (Figure 8.15). In addition, this relationship would give a more realistic scenario than the assumption of fixed geometric mean recruitment or a fixed low value.

The input data for the deterministic catch forecast are given in Table 8.25, assuming a Beverton and Holt Stock Recruitment Relationship. Besides, the F values were calculated using the mean F for the last three years rescaled to the level of the last year data. A terminal population obtained from the assessment was used as starting population on 1st January 1996. Mean catch weights, stock weights and maturity at age over the period 1992–1994 were used.

Table 8.26 summarises the predicitons carried out for the period 1996-1998. For de F_{bar} the catch predicted will be about 68,000 t in 1996 and 57,000 in 1997. The spawning stock biomass will decrease from 105,000 t in 1996 to 97,000 t in 1997.

8.13 Short-Term and Medium-Term Risk Analysis

Short-term and medium-term stock projecton with variance estimates were computed using ICPROJ version 2.0 and VPRO (Patterson, WD 1995). The analysis was based on the results of the assessment described in Section 8.10. All input data at age were disaggregated up to 11 years old. Forthcomming recruitments were estimated by fitting a Beverton & Holt stock-recruitment relationship with autocorrelated errors:

$$R = \frac{a * SSB}{\left(1 + \frac{SSB}{C}\right)}$$

where a is 0.9737 and C is 3.3685

The projections were performed over ten years under different scenarios of fishing mortality, for 0.001 of the F_{bar} and for increasing exploitation level from 0.1, 0.2 and 1. Percentiles of 5, 25, 75 and 95 of total landings, fishing mortality, recruitment and stock size for each exploitation level are shown in Figure 8.16. All these scenarios gave a low probability of recovery of the stock. Also trends in landings are similar, with an expected decrease in landings for almost all the values of the exploitation pattern. Betweeen the stock sizes predicted for $F=0.1\times F_{bar}$ and $F=0.2\times F_{bar}$ there seems to be a transition stage in which the stock size appears to decrease.

The Beverton & Holt stock-recruitment function relates the recruitment to the declining spawning stock biomass. This is more pessimistic but probably more realistic than assuming constant recruitment which would give a different trend in both stock size and fishing mortality.

8.14 Long-Term Yield

The long-term trends in yield per recruit and spawning stock biomass against the average fishing mortality (ages 2–5) are given in Table 8.27 and Figure 8.17. Because recruitment is likely to be dependant on stock size, manangement considerations should not be dependant on yield per recruit calculation.

8.15 Comments on the Assessment

The principal cause for concern in the assessment of this stock is the declinig of the stock size and the shrinking of the distribution area as it was pointed out in section 8.5. In addition this year there is a change in the exploitation pattern in both Portuguese and Spanish fisheries. Historicaly, Portuguese fishery was supported mainly by young fish (age groups 0, 1 and 2) whereas the Spanish fishery was supported by older fish (Porteiro *et al.*, 1986, Anon. 1989, Porteiro *et al*, 1993, Dias *et al.*, WD 1996). Nevertheless in 1995 the Portuguese fishery was supported by sardines older than 3 years; in addition the proportion of sardines older than 7 years has also decreased in the Spanish catch at age. The same pattern can be observed from the Spanish and Portuguese acoustic surveys carried out in spring. This phenomenon could be the result of a series of low recruitments in recent years whereas the lack of older sardines could be also related to a change in the distribution area.

This last theory arises from the presence of sardine in the northern areas, which was reported in different research vessel surveys. Nevertheless no information about sardine distribution in French waters is available nor length distribution or age structure by quarter is known. Information about sardine in French waters should be requested to demostrate any fish movements from the distribution area into more northerly waters.

Recruitment predictions made using the fitted Beverton & Holt relationship are considered the most appropriate ones for management purposes at present. Although long-term environmental changes may alter perceptions of the dependance of recruitment on the stock size. As is pointed out in section 8.13, this model assumes a further decline in the recruitment due to the declining spawning stock biomass, giving a low probability of recovery. On the other hand, catches of this stock have been fluctuating along the last fifty years, with the lowest reported landing level in 1949 (60,000 t) and the highest in the sixties (Figure 8.1). Considering that this fluctuation is a result of changes in the stock size, it is expected that the Beverton & Holt model, which was only fitted for the last twenty years with a decreasing trend in both stock size and recruitment, would be different if the time series included a complete fluctuating cycle.

8.16 Reference Points for Management Purpose

8.16.1 MBAL

The MBAL of 220,000 tonnes of SSB that was used by last year's Working Group represented the estimated SSB for 1995, which was the lowest on record. Thus, the risk of bringing the SSB below MBAL in the prediction would be equivalent to further reducing the stock. With another weak year class coming in, the stock is now well below this level, which renders this value just an arbitrary low SSB-level.

According to the SSB - recruitment plot (Figure 8.15), a SSB of 450,000–500,000 tonnes seems to represent a level separating mainly high recruitments from mainly low recruitments. There is considerable uncertainties to this level, however. The catches of sardine appear to have long term fluctuations, with a possible period of about 20 years (See Figure 8.1). In addition, the area distribution may change over time (Pastor *et al.*, 1985, 1986, Soares, 1995, Dias *et al.*, WD 1996). If the stock has cyclic variations any target or limit for the SSB will only apply to certain periods. The time span covered by the assessment apparently starts at the peak of a period with high catches. The recruitment dynamics in this period may not be representative of the present situation.

A more appropriate MBAL in the present situation may be the SSB that produced the most recent good year class (1991), which is 230 000 tonnes. It should be kept in mind, however, that this needs to be reviewed regularly.

8.16.2 Target fishing mortalities

Given the steady decline in both SSB and recruitment in the last 20 years, an F_{med} taken from the stock-recruitment plot is not relevant. A possible measure would be the fishing mortality that would sustain an SSB at MBAL with an average recruitment for the recent years. In spite of the Beverton & Holt relationship is the most appropriate for management purposes, the geometric mean of the recruitments since 1988, which is the period with relatively low SSB's gives 3233 millions and an equilibrium fishing mortality of 0.22. This is an appropriate target fishing mortality value once the stock has reached MBAL. This value agrees well with the theoretical one estimated by the relation of 2/3 of natural mortality (M), calculated for pelagic fish species (Patterson, 1992). For this stock M is 0.33 and the expected F value would be 0.22.

In the present situation, where the stock is well below MBAL due to a succession of poor year classes, the stock will remain below MBAL until a better year class appears. In addition to keeping the fishing mortality at the lowest possible level, special care should be taken to protect juveniles in order to take full advantage of a better year class, once it appears.

8.17 Management Considerations

Both the assessment, the fishery independent information and the predictions indicate that this stock is now in a very poor condition. As noted previously, there appear to be cyclic variations in this stock, and over many years the downwards trend in recruitment has been compensated by an increasing fishing mortality. The fishing mortality in recent years has reached a level where even fairly good year classes (e.g. the 1991 year class) only give a minor improvement in the SSB. The decline in SSB over many years and the very poor recruitment the last 3 years all suggest that the stock could be about to collapse.

The recruitment at this low level of SSB is highly uncertain. If the Beverton & Holt recruitment relation is assumed, a further reduction in the recruitment is predicted, due to the decline in the SSB. Even with the far more optimistic assumption of a constant recruitment at the geometric mean over the last 8 years, the fishing mortality will have to be reduced to 0.22 to sustain the stock at the present low MBAL.

Possible actions that can be taken include:

1. Reduce the fishing mortality to the lowest possible level.

2. Consider special measures to maximize the benefical effect on the SSB once a better year class appears. In addition to a general reduction in fishing mortality, this could include special measures to protect juveniles.

3. Although the general picture of a stock in a poor state is well substantiated by the present assessment and the data included in the assessment, better information both on the area distribution of the stock and a better monitoring of the stock through more extensive acoustic surveys would clearly improve the background for proper management of the stock.

Table 8.1 Number of pairs of otoliths and samples by area.

AREA	No of Pair	No of samples
VIIIb	40	1
VIIIc East	116	3
VIIIc West	102	3
IXa North	137	3
IXa Central North	236	7
IXa Central South	238	7
IXa South	62	2

Table 8.2 Results of the Wilcoxon Matched-Pair Singed-Rank Test.

p<0.05 p<0.01

AREA: VIIIb
DATE: 25-III-96

	SPA1	SPA2	SPA3	POR
SPA1		0.2873	0.3978	**0.0481**
SPA2			0.7815	*0.0003*
SPA3				*0.0017*
POR				

AREA: VIIIc East
DATE: 23-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0001*	*0*	*0*
SPA2			0.6354	*0*
SPA3				*0*
POR				

AREA: VIIIc West
DATE: 23-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0*	*0*	*0*
SPA2			**0.0231**	*0*
SPA3				*0*
POR				

AREA: IXa North
DATE: 21-XI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0*	*0*	*0*
SPA2			*0.0024*	*0*
SPA3				*0.0014*
POR				

AREA: IXa Central North
DATE: 20-XII-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0013*	*0*	*0.0004*
SPA2			**0.021**	0.3073
SPA3				0.3555
POR				

AREA: IXa Central North
DATE: 26-III-96

	SPA1	SPA2	SPA3	POR
SPA1		*0.0001*	*0.0016*	0.3196
SPA2			*0.0059*	*0.0066*
SPA3				0.1079
POR				

AREA: IXa Central South
DATE: 12-XII-95

	SPA1	SPA2	SPA3	POR
SPA1		0.1655	0.6171	0.6844
SPA2			0.4054	0.1083
SPA3				0.3711
POR				

AREA: IXa Central South
DATE: 20-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0008*	*0.029*	*0.0002*
SPA2			*0.008*	*0*
SPA3				*0*
POR				

AREA: IXa South
DATE: 27-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		**0.0303**	0.6418	*0.0028*
SPA2			**0.0126**	*0.0001*
SPA3				*0.0003*
POR				

AREA: VIIIc East
DATE: 13-XII-95

	SPA1	SPA2	SPA3	POR
SPA1		*0*	*0*	*0*
SPA2			0.0833	0.8084
SPA3				0.1655
POR				

AREA: VIIIc West
DATE: 19-III-96

	SPA1	SPA2	SPA3	POR
SPA1		0.6287	0.9706	0.1927
SPA2			0.593	0.2482
SPA3				0.1655
POR				

AREA: IXa North
DATE: 18-III-96

	SPA1	SPA2	SPA3	POR
SPA1		**0.0398**	1	0.5637
SPA2			**0.036**	**0.0249**
SPA3				0.8028
POR				

AREA: IXa Central North
DATE: 9-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0013*	*0.0035*	1
SPA2			0.2568	*0.0026*
SPA3				*0.0094*
POR				

AREA: IXa Central North
DATE: 21-XI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0003*	*0.0001*	*0*
SPA2			0.285	0.1176
SPA3				0.3343
POR				

AREA: IXa Central North
DATE: 26-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0014*	0.7763	*0.0005*
SPA2			*0.0003*	*0*
SPA3				*0.0004*
POR				

AREA: IXa Central South
DATE: 14-III-96

	SPA1	SPA2	SPA3	POR
SPA1		**0.0389**	0.1967	**0.0455**
SPA2			0.1573	0.8185
SPA3				0.4054
POR				

AREA: IXa Central South
DATE: 21-XI-95

	SPA1	SPA2	SPA3	POR
SPA1		0.1573	0.4386	0.1573
SPA2			0.3657	**0.0143**
SPA3				0.0598
POR				

AREA: IXa South
DATE: 6-XII-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0001*	*0*	
SPA2			*0.0016*	
SPA3				
POR				

AREA: VIIIc East
DATE: 19-I-96

	SPA1	SPA2	SPA3	POR
SPA1		0.1088		*0.0032*
SPA2				*0.0064*
SPA3				
POR				

AREA: VIIIc West
DATE: 19-XII-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0097*	**0.0113**	**0.0212**
SPA2			0.6374	0.3649
SPA3				0.5724
POR				

AREA: IXa North
DATE: 14-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		*0.0008*	*0.0002*	*0*
SPA2			0.9412	*0*
SPA3				*0*
POR				

AREA: IXa Central North
DATE: 14-XII-95

	SPA1	SPA2	SPA3	POR
SPA1		0.4404	*0*	*0*
SPA2			*0*	*0.0002*
SPA3				*0.0005*
POR				

AREA: IXa Central North
DATE: 23-I-96

	SPA1	SPA2	SPA3	POR
SPA1		0.851	*0.0018*	0.9854
SPA2			*0.0021*	0.6292
SPA3				0.1201
POR				

AREA: IXa Central South
DATE: 6-VI-95

	SPA1	SPA2	SPA3	POR
SPA1		**0.029**	0.6532	*0.0001*
SPA2			**0.0165**	*0*
SPA3				*0.0001*
POR				

AREA: IXa Central South
DATE: 18-I-96

	SPA1	SPA2	SPA3	POR
SPA1		*0.0045*	**0.029**	1
SPA2			0.4795	**0.0116**
SPA3				**0.029**
POR				

AREA: IXa Central South
DATE: 26-III-96

	SPA1	SPA2	SPA3	POR
SPA1		0.1841	0.6722	0.6353
SPA2			0.2482	0.285
SPA3				1
POR				

Table 8.3 Landings (tonnes) of SARDINE by country (Data provided by the Working Group members).

SARDINE VII

COUNTRY	1981	1982	1983	1984	1985	1986	1987	1988
France	1,124	907	803	809	2,089	2,570	965	2,586
Denmark								
UK (Eng.& Wale								

COUNTRY	1989	1990	1991	1992	1993	1994	1995
Denmark				17,843		17,327	10,068
France	1,141	1,107	1,957	1,769	585	272	
UK (Eng.& Wale			3,011	4,494	4,917	2,061	6,852
Netherlands				42			
TOTAL	**1,141**	**1,107**	**4,968**	**24,148**	**5,502**	**19,660**	**16,920**

SARDINE VIII

COUNTRY	1981	1982	1983	1984	1985	1986	1987	1988
France	9,676	5,928	6,467	4,491	8,169	10,229	7,708	7,808
Spain	33,550	31,756	32,374	27,970	25,907	39,195	36,377	40,944
UK (Eng.& Wale								
TOTAL	**43,226**	**37,684**	**38,841**	**32,461**	**34,076**	**49,424**	**44,085**	**48,752**

COUNTRY	1989	1990	1991	1992	1993	1994	1995
France	8,976	8,485	9,637	8,713	5,329	7,283	
Spain	29,856	27,500	20,735	26,160	24,486	22,181	19,538
UK (Eng.& Wale				1		-	-
TOTAL	**38,832**	**35,985**	**30,372**	**34,874**	**29,815**	**29,464**	**19,538**

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
TOTAL	**108,113**	**89,789**	**89,601**	**99,468**	**135,170**	**155,895**	**178,583**	**172,748**

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
TOTAL	**148,765**	**174,716**	**178,200**	**141,411**	**132,448**	**117,596**	**107,270**	**111,657**

COUNTRY	1991	1992	1993	1994	1995
Portugal	92,638	83,315	90,404	94,468	87,818
Spain	14,383	16,579	23,905	16,151	13,928
TOTAL	**107,021**	**99,894**	**114,309**	**110,619**	**101,746**

Table 8.4 Annual landings (tonnes) of SARDINE by Division and Sub-area.

DIVISION	1981	1982	1983	1984	1985	1986	1987	1988
VIId	172	59	211	147	465	512	67	29
VIIe	952	828	590	661	1,624	2,058	682	438
VIIf	-	20	-	-				
VIIg		-	-	1	-			
VIIh			2	-			216	2,119
total VII	**1,124**	**907**	**803**	**809**	**2,089**	**2,570**	**965**	**2,586**
VIIIa	8,482	5,928	6,013	4,472	8,090	10,186	7,631	7,770
VIIIb	1,194		454	19	79	77	77	38
VIIIc	35,550	31,756	32,374	27,970	25,907	39,195	36,377	40,944
VIIId								
total VIII	**45,226**	**37,684**	**38,841**	**32,461**	**34,076**	**49,458**	**44,085**	**48,752**
IXa	178,583	172,748	148,765	174,716	178,200	141,411	132,448	117,596
TOTAL YEAR	**224,933**	**211,339**	**188,409**	**207,986**	**214,365**	**193,439**	**177,498**	**168,934**

DIVISION	1989	1990	1991	1992	1993	1994	1995
IVc			-	8	19		
VIa			-	1	-	-	-
VIb						49	24
VIId	93	64	170	153	127	2,086	1,621
VIIe	91	808	4,687	19,299	5,298	20,985	13,787
VIIf				336	6		
VIIg				0		0	
VIIh	957	235	110	4	71	-	1,439
VIIj				0			
total VII	1,141	1,107	4,968	19,793	5,502	23,071	16,846
VIIIa	8,885	8,381	9,113	8,565	4,703	7,164	
VIIIb	85	104	482	141	548	119	
VIIIc	29,862	27,500	20,735	26,166	24,486	22,181	19,538
VIIId			42	2	78	0	
total VIII	**38,832**	**35,985**	**30,372**	**34,874**	**29,815**	**29,464**	**19,538**
IXa	**107,270**	**111,657**	**107,021**	**99,894**	**114,309**	**110,619**	**101,746**
TOTAL YEAR	**147,243**	**148,749**	**142,361**	**154,569**	**149,645**	**163,154**	**138,130**

Sub-area VII - 1981-1990 only French data was available
(a) - In Div VIIe, 1992 17,507t were caught by Denmark
(-) Unknown catches

Table 8.5 Annual landings (t) of SARDINE in Divisions VIIIc and IXa by country.

Country	1976	1977	1978	1979	1980	1981	1982
Portugal	79,649	79,819	83,553	91,294	106,302	113,253	100,859
Spain	62,041	45,931	56,437	62,147	85,380	100,880	103,645
Total	141,690	125,750	139,990	153,441	191,682	214,133	204,504

	1983	1984	1985	1986	1987	1988	1989
Portugal	85,922	95,110	111,709	103,451	90,214	93,591	91,091
Spain	95,217	107,576	92,398	77,155	78,611	64,949	46,035
Total	181,139	202,686	204,107	180,606	168,825	158,540	137,126

	1990	1991	1992	1993	1994	1995
Portugal	92,404	92,638[1]	83,315	90,404	94,468	87,818
Spain	46,753	35,118	42,739	48,391	38,332	33,566
Total	139,157	127,756	126,054	138,795	132,800	121,384

[1]Discards included.

Table 8.6 SARDINE (VIIIc + IXa) Quarterly catches (t) by gear by country and fleets in 1995 (Provided by the WG members).

Country/Quarter	1st	2nd	3rd	4th	Year
Total	**18138**	**28610**	**43428**	**31208**	**121384**
Spain (VIIIc + IXa):					
Purse-seine	5579	9663	10054	8270	33566
Portugal (IXa):	12559	18947	33374	22938	87818
Purse-seine	11881	18544	32474	22311	85209
Artisanal	331	184	863	523	1900
Trawl	347	219	38	105	709

Table 8.7 SARDINE (VIIIc + IXa). Total nominal catches (t) by quarter and areas of Divisions VIIIc and IXa during 1995.

Area	1st. Q	2nd. Q	3rd. Q	4th. Q	Total 1995
VIIIc East	2354	804	1629	4422	9209
VIIIc West	1553	3264	3738	1774	10329
IXa North	1572	5595	4687	2074	13928
IXa Central-North	2406	9225	17303	12510	41444
IXa Central-South	6667	6433	9419	4751	27270
IXa South (>7°24' W	3486	3289	6653	5677	19104
Total	**18038**	**28610**	**43428**	**31208**	**121284**

Table 8.8 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			3,911	2.43	20,132	4.14	141	590

Table 8.9 Number of fish (thousands) and its %, mean length (cm) and s.d., biomass (tonnes) and its % and mean weight by age group and ICES Subdivision. February - March.

Area: IXa Central North

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
I	600012	57.87	15	13472	48.96	22.5
II	399054	38.49	16.7	12394	45.04	31.1
III	28590	2.76	18.4	1181	4.29	41.3
IV	9148	0.88	19.7	471	1.71	51.5
V						
VI						
Total	1036804			27518		

Area: IXa Central South

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
I	646714	23.79	11.5	7423	6.30	11.5
II	224381	8.25	17.8	8557	7.26	38.1
III	399989	14.72	19.6	20104	17.05	50.3
IV	1185810	43.62	20.2	65601	55.64	55.3
V	256687	9.44	21	15887	13.48	61.9
VI	4646	0.17	21.8	322	0.27	69.2
Total	2718227			117894		

Area: IXa South

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
I	47921	2.23	16.1	1324	1.25	28
II	530280	24.68	18.5	22610	21.39	43
III	504982	23.51	19.4	24826	23.49	49
IV	1018007	47.39	19.9	53969	51.07	53
V	47067	2.19	21.1	2952	2.79	63
VI						
Total	2148257			105681		

Area: IXa Spain

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
I	330338	9.38	16	8960	5.81	27.1
II	928482	26.36	18.1	36705	23.81	39.5
III	1480967	42.04	19.8	66973	43.44	45.2
IV	693043	19.67	19.8	36018	23.36	52.0
V	82722	2.35	20.8	5018	3.25	60.7
VI	7318	0.21	21.7	505	0.33	69.0
Total	3522870			154179		

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Table 8.9 (cont'd)

Area: Portugal

Age Groups	No	%	Mean Length		Biomass	%	Mean weight
I	1294647	21.93		-	22219	8.85	17.2
II	1153715	19.54		-	43561	17.35	37.8
III	933561	15.81		-	46111	18.36	49.4
IV	2212965	37.49		-	120041	47.81	54.2
V	303754	5.15		-	18839	7.50	62.0
VI	4646	0.08		-	322	0.13	69.3
Total	5903288				251093		

Area: Whole area

Age Groups	No	%	Mean Length		Biomass	%	Mean weight
I	1624985	17.24		-	31179	7.69	19.2
II	2082197	22.09		-	80266	19.81	38.5
III	2414528	25.62		-	113084	27.90	46.8
IV	2906008	30.83		-	156059	38.51	53.7
V	386476	4.10		-	23857	5.89	61.7
VI	11964	0.13		-	827	0.20	69.1
Total	9426158				405272		

Table 8.10 Number of fish (thousands) and its %, mean length (cm) and standard deviation, biomass (tonnes) and its % and mean weight by age group and ICES Subdivisions. March.

Area: VIIIc East

Age Goups	No	%	Mean length	(sd)	Biomass	%	Mean weight
I	5245	1.01	16.90	1.96	215.63	0.56	40.25
II	24021	4.62	20.52	1.50	1542.20	4.01	63.66
III	59911	11.53	21.23	1.05	4149.15	10.78	68.98
IV	242950	46.75	21.87	1.20	18066.48	46.95	74.01
V	167414	32.21	22.23	1.12	12924.67	33.59	76.89
VI	12663	2.44	22.76	0.61	1030.43	2.68	81.28
VII	5011	0.96	21.25		346.31	0.90	69.12
VIII	2502	0.48	22.75		203.13	0.53	81.20
Total	519716		21.82	1.34	38478.00		73.59

Area: VIIIc West

Age Goups	No	%	Mean length	(sd)	Biomass	%	Mean weight
I	57	0.37	17.75	1.18	2.62	0.23	45.20
II	831	5.40	20.81	1.32	54.98	4.92	65.75
III	1630	10.60	21.35	0.78	114.12	10.21	69.86
IV	7399	48.10	21.71	0.79	539.33	48.26	72.73
V	4873	31.69	21.90	0.72	362.24	32.42	74.19
VI	330	2.15	22.24	0.56	25.45	2.28	76.95
VII	196	1.27	21.25		13.55	1.21	69.12
VIII	64	0.42	22.75		5.21	0.47	81.20
Total	15381		21.68	0.88	1117.50		72.46

Area: IXa North

Age Goups	No	%	Mean length	(sd)	Biomass	%	Mean weight
I	5337	2.54	18.73	1.17	275.60	2.03	51.31
II	29397	14.01	19.21	1.28	1611.62	11.87	54.43
III	29006	13.83	20.60	0.82	1868.25	13.76	64.25
IV	100476	47.89	20.75	1.08	6593.24	48.56	65.33
V	41555	19.81	21.42	0.85	2933.85	21.61	70.42
VI	1749	0.83	22.31	0.56	135.76	1.00	77.54
VII	2018	0.96	21.25		139.49	1.03	69.12
VIII	246	0.12	22.75		19.99	0.15	81.20
Total	209784		20.61	1.27	13577.80		64.33

Area: Total

Age Goups	No	%	Mean length	(sd)	Biomass	%	Mean weight
I	10639	1.43	17.82	1.85	493.85	0.93	45.64
II	54249	7.28	19.81	1.53	3208.80	6.03	58.59
III	90547	12.16	21.03	1.02	6131.52	11.53	67.46
IV	350824	47.10	21.55	1.26	25199.06	47.39	71.43
V	213842	28.71	22.07	1.11	16220.76	30.51	75.54
VI	14743	1.98	22.69	0.62	1191.63	2.24	80.73
VII	7225	0.97	21.25		499.35	0.94	69.12
VIII	2812	0.38	22.75		228.33	0.43	81.20
Total	744881		21.48	1.42	53173.30		70.89

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Table 8.11 Assessment of sardine. Number in thousands, biomass in tonnes, mean length in cm and mean weight in g. March.

	AGE GROUPS									
Length	I	II	III	IV	V	VI	VII	VIII	Total	Biomass
12										
12.5										
13										
13.5										
14	304								304	8.20
14.5	456								456	13.30
15	1082								1082	34.10
15.5	532								532	18.10
16	380	380							759	27.80
16.5	1049								1049	41.40
17	1292	2584							3877	163.80
17.5	454	2271							2725	123.10
18		10712	1530						12242	590.70
18.5	918	6428							7346	377.70
19		4060		10151					14211	777.90
19.5	4171		4171	33370					41712	2425.20
20			26754	40131	20066				86951	5363.20
20.5		13764	20646	48173	13764				96346	6295.10
21		7225	14450	39737	43349		7225		111985	7740.00
21.5		2721	8162	51693	21766	2721			87062	6357.20
22		4104	4104	45144	41040	4104			98496	7588.60
22.5			2812	30934	28121			2812	64679	5251.60
23			7918	23754	31672	7918			71263	6091.00
23.5				17551	8775				26326	2366.20
24				10187					10187	961.80
24.5					113				113	11.20
25					3451				3451	358.40
25.5					1725				1725	187.70
26										
Total	10639	54249	90547	350824	213842	14743	7225	2812	744881	53173.30
%	1.43	7.28	12.16	47.10	28.71	1.98	0.97	0.38		
M. length	17.82	19.81	21.03	21.55	22.07	22.69	21.25	22.75	21.48	
s.d.	1.85	1.53	1.02	1.26	1.11	0.62			1.42	
Biomass	493.85	3208.80	6131.52	25199.06	16220.76	1191.63	499.35	228.33		
%	0.93	6.03	11.53	47.39	30.51	2.24	0.94	0.43		
M. weight	45.64	58.59	67.46	71.43	75.54	80.73	69.12	81.20	70.89	

Table 8.12 Number of fish (thousands) and its %, mean length (cm) and s.d., biomass (tonnes) and its % and mean weight by age group and ICES Subdivision. June-July.

Area: IXa Central North

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
0	351398	11.32	14.5	8079	5.25	23.0
I	895055	28.83	17.5	36082	23.44	40.3
II	639483	20.60	18.7	31778	20.64	49.7
III	554252	17.85	19.8	32534	21.13	58.7
IV	607384	19.56	20.6	40731	26.45	67.1
V	38859	1.25	22.2	3246	2.11	83.5
VI	18250	0.59	22.1	1515	0.98	83.0
Total	3104681			153965		

Area: IXa Central South

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
0	31423	1.08	15.8	914	0.55	29.1
I	414507	14.22	17.2	15776	9.56	38.1
II	229524	7.88	18.7	11416	6.92	49.7
III	859091	29.48	19.5	48631	29.47	56.6
IV	1178150	40.43	20.2	74139	44.93	62.9
V	201680	6.92	20.9	14118	8.56	70.0
VI						
Total	2914375			164994		

Area: IXa South

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
0	32100	1.62	13.6	604	0.56	18.8
I	132878	6.69	17.4	5248	4.85	39.5
II	265615	13.38	18.5	12611	11.65	47.5
III	808067	40.69	19.2	43232	39.95	53.5
IV	490404	24.69	19.8	29060	26.85	59.3
V	205257	10.34	20.7	13827	12.78	67.4
VI	51539	2.60	21	3641	3.36	70.6
Total	1985860			108223		

Area: IXa Spain

Age Groups	No	%	Mean Length	Biomass	%	Mean weight
0	762086	28.51	12.5	11113	13.49	14.6
I	1242794	46.50	16.2	40091	48.65	32.3
II	580692	21.72	18.2	26378	32.01	45.4
III	87381	3.27	19.4	4827	5.86	55.2
IV						
V						
VI						
Total	2672953			82409		

Table 8.12 (cont'd)

Area: Portugal

Age Groups	No	%	Mean Length		Biomass	%	Mean weight
0	414921	5.18		-	9597	2.25	23.1
I	1442440	18.02		-	57106	13.37	39.6
II	1134622	14.17		-	55805	13.06	49.2
III	2221410	27.75		-	124397	29.12	56.0
IV	2275938	28.43		-	143930	33.69	63.2
V	445796	5.57		-	31191	7.30	70.0
VI	69789	0.87		-	5156	1.21	73.9
Total	8004916				427182		

Area: Whole area

Age Groups	No	%	Mean Length		Biomass	%	Mean weight
0	1177007	11.02		-	20710	4.06	17.6
I	2685189	25.15		-	97197	19.07	36.2
II	1715314	16.06		-	82183	16.13	47.9
III	2308791	21.62		-	129224	25.36	56.0
IV	2275938	21.31		-	143930	28.24	63.2
V	445796	4.17		-	31191	6.12	70.0
VI	69789	0.65		-	5156	1.01	73.9
Total	1.1E+07				509591		

Table 8.13 SARDINE in Divisions VIIIc and IXa. Purse seine catch length distribution ('000 fish) by country, Division and quarter in 1995.

L (cm)	QUARTER 1				QUARTER 2				QUARTER 3				QUARTER 4				YEAR 1995				L (cm)
	Portugal IXa	Spain IXa	Spain VIIIc	TOTAL	Portuga IXa	Spain IXa	Spain VIIIc	TOTAL	Portugal IXa	Spain IXa	Spain VIIIc	TOTAL	Portugal IXa	Spain IXa	Spain VIIIc	TOTAL	Portugal IXa	Spain IXa	Spain VIIIc	TOTAL	
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.5
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.5
8	0	0	0	0	0	3	5	8	0	0	0	0	0	0	0	0	0	3	5	8	8
8.5	0	0	0	0	0	20	27	48	0	0	0	0	0	0	0	0	0	20	27	48	8.5
9	0	0	0	0	0	67	91	158	0	0	0	0	0	0	0	0	0	67	91	158	9
9.5	0	0	0	0	0	151	205	356	0	0	0	0	0	0	0	0	0	151	205	356	9.5
10	0	0	0	0	0	107	146	253	0	0	0	0	0	0	0	0	0	107	146	253	10
10.5	0	0	0	0	0	67	91	158	0	0	0	0	0	0	0	0	0	67	91	158	10.5
11	0	4	18	22	0	24	32	56	14	0	0	14	0	0	0	0	14	28	50	91	11
11.5	183	23	94	301	0	7	9	16	14	0	0	14	255	0	0	255	452	30	104	586	11.5
12	183	21	87	291	0	0	0	0	246	0	0	246	1,038	0	4	1,042	1,467	21	91	1,579	12
12.5	917	6	23	945	0	0	0	0	246	0	0	246	1,611	0	2	1,613	2,773	6	25	2,804	12.5
13	1,466	7	28	1,501	114	0	0	114	279	32	0	311	3,878	0	0	3,878	5,737	39	28	5,804	13
13.5	1,100	1	5	1,106	685	0	0	685	134	57	33	224	5,419	56	47	5,523	7,338	115	85	7,538	13.5
14	4,118	18	5	4,141	1,495	0	0	1,495	117	159	139	415	6,180	46	494	6,721	11,911	223	639	12,773	14
14.5	3,513	22	5	3,541	3,780	0	0	3,780	14	287	152	453	5,319	129	544	5,991	12,626	438	701	13,765	14.5
15	4,828	67	3	4,898	3,767	0	0	3,767	27	269	46	343	3,304	142	165	3,611	11,926	479	214	12,618	15
15.5	6,837	64	3	6,903	3,415	0	0	3,415	422	194	27	643	3,108	140	94	3,342	13,782	398	124	14,303	15.5
16	6,583	221	0	6,804	5,413	130	9	5,551	2,264	243	17	2,523	2,779	238	47	3,064	17,038	831	73	17,943	16
16.5	4,728	178	65	4,972	5,892	53	13	5,957	8,866	84	13	8,964	3,739	200	48	3,987	23,226	516	139	23,880	16.5
17	5,544	449	146	6,139	7,691	655	0	8,346	27,150	229	5	27,385	8,668	226	0	8,894	49,053	1,559	151	50,763	17
17.5	9,690	302	0	9,991	12,732	490	8	13,230	56,717	210	5	56,932	13,707	201	0	13,908	92,845	1,202	14	94,061	17.5
18	16,352	680	4	17,036	26,693	1,857	63	28,613	60,697	1,463	30	62,190	27,011	503	65	27,579	130,753	4,503	162	135,418	18
18.5	32,898	717	144	33,758	52,515	4,415	153	57,083	72,252	2,885	41	75,178	34,014	666	521	35,200	191,679	8,682	858	201,220	18.5
19	39,392	1,755	239	41,386	67,616	10,230	525	78,371	90,447	9,111	107	99,665	44,377	1,695	2,643	48,715	241,831	22,791	3,514	268,136	19
19.5	34,683	1,920	1,233	37,837	61,207	9,914	803	71,924	76,286	8,604	423	85,313	61,165	1,803	4,227	67,196	233,342	22,241	6,687	262,270	19.5
20	24,252	4,698	4,125	33,075	37,374	20,685	4,841	62,900	54,925	13,517	2,258	70,700	40,306	2,867	6,134	49,307	156,856	41,767	17,358	215,981	20
20.5	16,830	3,699	6,817	27,345	17,832	12,630	9,900	40,362	29,368	8,635	7,458	45,461	26,568	3,236	7,710	37,513	90,597	28,199	31,886	150,682	20.5
21	8,776	5,255	9,913	23,943	9,944	13,149	12,881	35,973	19,244	7,837	13,535	40,616	25,068	5,114	12,481	42,663	63,032	31,354	48,809	143,196	21
21.5	5,021	1,493	7,862	14,375	3,891	4,489	10,766	19,146	7,895	3,122	14,520	25,537	16,492	3,339	14,047	33,877	33,299	12,442	47,194	92,936	21.5
22	1,511	2,192	6,298	10,001	1,258	3,498	6,324	11,080	5,017	2,666	9,913	17,597	7,905	3,814	10,862	22,582	15,691	12,170	33,398	61,260	22
22.5	414	490	4,710	5,614	201	978	2,182	3,361	529	859	4,053	5,440	2,117	1,183	6,610	9,910	3,261	3,509	17,555	24,325	22.5
23	87	125	3,817	4,029	76	246	1,717	2,040	119	290	2,073	2,482	919	714	3,275	4,907	1,201	1,375	10,882	13,458	23
23.5	78	40	2,284	2,402	0	0	583	583	1	96	702	800	245	102	1,349	1,695	324	237	4,918	5,479	23.5
24	0	8	1,731	1,739	0	37	390	427	0	0	353	353	7	41	892	940	7	86	3,366	3,458	24
24.5	36	0	717	753	0	32	320	352	0	2	153	156	0	8	422	430	36	43	1,612	1,691	24.5
25	0	2	452	455	0	0	89	89	0	0	5	5	0	14	90	104	0	17	636	653	25
25.5	0	0	52	52	0	0	22	22	0	0	0	0	0	0	14	14	0	0	88	88	25.5
26	0	0	54	54	0	0	8	8	0	0	3	3	0	0	13	13	0	0	78	78	26
26.5	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	26.5
27	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	17	17	27
27.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.5
TOTAL	**230,019**	**24,456**	**50,936**	**305,411**	**323,591**	**83,931**	**52,219**	**459,741**	**513,289**	**60,851**	**56,067**	**630,207**	**345,198**	**26,477**	**72,799**	**444,475**	**1,412,097**	**195,715**	**232,021**	**1,839,833**	**TOTAL**
Fish measured	6,772	3,401	4,363	14,536	9,059	5,531	4,371	18,961	18,645	5,466	5,546	29,657	11,363	3,688	3,968	19,019	45,839	18,086	18,248	82,173	**Fish measured**
No.of samples	57	30	56	143	94	49	57	200	95	49	74	218	95	36	49	180	341	164	236	741	**No.of samples**
no. aged																					**No. aged**
Catch(t)	11,881	1,572	3,907	17,360	18,544	5,595	4,068	28,208	32,474	4,687	5,367	42,528	22,311	2,074	6,196	30,581	85,210	13,929	19,539	118,678	**Catch(t)**

Table 8.14 SARDINE in Division VIIe. Catch length distribution ('000 fish) from trawl fishery (England and Wales) during 1995.

L (cm)	ENGLAND & WALES QUARTER 1	QUARTER 2	QUARTER 1	QUARTER 1	TOTAL
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16				22	22
17	164			51	215
18	268			896	1164
19	537			3243	3780
20	497			4466	4963
21	1710			3339	5048
22	3792			5239	9032
23	4911			5991	10902
24	4399			4707	9106
25	2127			1635	3762
26	557			692	1248
27	249			60	309
28				51	51
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
TOTAL	19210	0	0	30391	49601
Fish measured	349			628	977
No.of samples	3			5	8
No. aged	0			0	0
Catch(t) - VIIe	1988	1.11	5.63	3435	5429

Table 8.15 Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1995.

1995	VIIIc East	VIIIc West	IXa North	Xa Centr-	Xa Centr-	IXa South	All areas
	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q
Age	catch('000	atch('000	catch('000	atch('000	atch('000	atch('000	catch ('000)
0	0	0	0	0	0	0	0
1	26	416	1,015	373	17,068	3,346	22,244
2	527	707	2,168	441	12,026	6,656	22,525
3	7,713	8,039	10,319	7,561	49,797	18,795	102,223
4	8,801	8,289	8,223	16,291	52,011	33,279	126,894
5	3,012	1,653	1,239	2,881	8,428	2,887	20,100
6	3,191	1,066	775	1,008	1,302	198	7,539
7	1,825	698	409	233	45	36	3,246
8	2,585	543	193	0	0	0	3,321
9	363	87	25	0	0	0	475
10	457	113	50	0	0	0	620
11	701	122	40	0	0	0	863
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	29,201	21,733	24,456	28,788	140,676	65,197	310,051
Tonnes	2,354	1,553	1,572	2,406	6,667	3,486	18,038

	VIIIc East	VIIIc West	IXa North	Xa Centr-	Xa Centr-	IXa South	All areas
	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q
Age	catch('000	atch('000	catch('000	atch('000	atch('000	atch('000	catch ('000)
0	0	0	0	0	0	0	0
1	12	674	1,866	15,743	20,601	0	38,895
2	189	1,342	9,092	28,049	15,653	3,938	58,263
3	2,751	16,465	38,661	77,898	42,831	24,119	202,725
4	3,067	17,137	27,740	35,756	34,611	32,831	151,142
5	917	3,089	3,268	1,310	5,203	1,467	15,254
6	876	1,755	1,767	3,345	47	0	7,790
7	518	1,248	864	1,669	0	0	4,299
8	662	695	405	707	0	0	2,469
9	96	90	49	0	0	0	235
10	119	127	78	0	0	0	324
11	198	193	140	0	0	0	531
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	9,405	42,815	83,930	164,477	118,945	62,355	481,927
Tonnes	804	3,264	5,595	9,225	6,433	3,289	28,610

	VIIIc East	VIIIc West	IXa North	Xa Centr-	Xa Centr-	IXa South	All areas
	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q	3'rd Q
Age	catch('000	atch('000)	catch('000	atch('000	atch('000	atch('000	catch ('000)
0	5	440	2,304	1,083	172	0	4,005
1	932	2,753	11,509	54,436	1,148	0	70,778
2	1,449	4,117	11,342	58,230	41,039	21,485	137,662
3	3,996	10,660	17,854	111,211	79,336	82,523	305,579
4	5,492	13,145	12,910	28,809	16,137	5,486	81,978
5	1,441	3,324	2,208	1,797	1,496	238	10,505
6	1,271	1,926	1,224	541	0	0	4,962
7	1,016	1,967	992	2,724	0	0	6,699
8	690	1,219	472	207	0	0	2,588
9	36	26	9	0	0	0	71
10	70	91	29	0	0	0	190
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	16,398	39,668	60,853	259,038	139,328	109,732	625,017
Tonnes	1,629	3,738	4,687	17,303	9,419	6,653	43,429

Table 8.15 (continued)

Age	VIIIc East 4'th Q catch('000	VIIIc West 4'th Q atch('000)	IXa North 4'th Q catch('000	Xa Centr- 4'th Q atch('000	Xa Centr- 4'th Q atch('000	IXa South 4'th Q atch('000	All areas 4'th Q catch ('000)
0	139	1,414	1,380	1,561	22,013	0	26,507
1	4,972	1,114	3,300	25,546	19,298	0	54,230
2	6,398	1,643	3,500	25,221	16,288	1,215	54,265
3	13,874	4,766	6,930	68,690	24,779	68,141	187,180
4	15,279	6,588	7,295	30,119	8,884	11,701	79,865
5	3,645	1,802	1,537	10,416	831	3,118	21,349
6	3,305	1,308	1,024	3,022	7	0	8,665
7	2,450	1,123	906	1,535	0	0	6,014
8	1,760	830	543	0	0	0	3,133
9	79	21	21	0	0	0	121
10	202	86	42	0	0	0	330
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	52,103	20,695	26,478	166,109	92,100	84,174	441,659
Tonnes	4,422	1,774	2,074	12,510	4,751	5,677	31,208

Age	VIIIc East 1-4 Q catch('000	VIIIc West 1-4 Q atch('000)	IXa North 1-4 Q catch('000	Xa Centr- 1-4 Q atch('000	Xa Centr- 1-4 Q atch('000	IXa South 1-4 Q atch('000	All areas 1-4 Q catch ('000)
0	144	1,854	3,684	2,645	22,185	0	30,512
1	5,942	4,957	17,690	96,097	58,115	3,346	186,147
2	8,563	7,809	26,102	111,942	85,006	33,293	272,715
3	28,334	39,930	73,764	265,359	196,743	193,578	797,707
4	32,639	45,159	56,168	110,975	111,642	83,297	439,880
5	9,015	9,868	8,252	16,405	15,958	7,709	67,208
6	8,643	6,055	4,790	7,915	1,356	198	28,956
7	5,809	5,036	3,171	6,162	45	36	20,259
8	5,697	3,287	1,613	913	0	0	11,510
9	574	224	104	0	0	0	902
10	848	417	199	0	0	0	1,464
11	899	315	180	0	0	0	1,394
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	107,107	124,911	195,717	618,412	491,050	321,458	1,858,654
Tonnes	9,209	10,329	13,928	41,444	27,270	19,104	121,284

Table 8.16 Annual catch in number at age for the period 1976–1995.

The SAS System 08:49 Monday, August 19, 1996
: Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

CANUM: Catch in Numbers (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	420	1871	1426	252	71	12	3	0
1977	844	2421	954	110	22	3	1	0
1978	854	2145	913	281	127	40	16	0
1979	643	1479	935	423	187	93	36	0
1980	842	1997	1542	372	155	47	30	0
1981	1021	1920	1720	666	192	102	76	0
1982	60	769	1854	701	350	130	129	0
1983	1061	553	838	795	322	140	139	0
1984	109	3289	470	488	295	176	116	0
1985	258	527	2343	457	290	197	101	0
1986	238	702	987	903	322	194	166	0
1987	1401	512	615	520	521	147	170	0
1988	439	979	525	428	303	291	189	0
1989	244	512	895	381	215	198	183	61
1990	234	562	488	680	275	142	104	142
1991	1574	456	404	380	256	72	26	79
1992	490	985	423	317	175	108	19	61
1993	88	562	1051	502	245	111	66	52
1994	121	61	527	1059	261	107	35	36
1995	31	186	273	798	440	67	29	36

Table 8.17 Length (cm) at age by quarter and by sub-division of SARDINE in 1995.

1995 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	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	19.2	14.2	16.8	16.6	14.5	15.6	14.8
2	20.3	20.2	19.2	17.4	16.7	16.6	17.1
3	21.4	21.1	20.4	18.5	19.0	18.7	19.4
4	21.6	21.3	20.9	19.7	19.9	19.7	20.1
5	22.6	21.8	21.5	20.6	20.7	20.7	21.1
6	23.0	22.4	21.9	21.3	22.3	23.0	22.5
7	22.9	22.3	22.1	21.7	23.2	24.7	22.6
8	23.7	23.1	22.3	0.0	0.0	0.0	23.5
9	23.4	23.5	22.9	0.0	0.0	0.0	23.4
10	24.1	23.6	22.4	0.0	0.0	0.0	23.9
11	24.4	23.5	21.3	0.0	0.0	0.0	24.1
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0-15+	22.2	21.3	20.5	19.5	18.7	18.9	19.5

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	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	19.0	10.9	16.2	17.5	15.6	0.0	16.3
2	20.2	20.4	19.5	19.2	18.8	18.2	19.1
3	21.3	21.1	20.2	19.4	19.6	18.8	19.7
4	21.6	21.3	20.6	19.7	20.0	19.0	20.0
5	22.4	21.7	21.2	21.0	20.7	20.0	21.1
6	22.9	22.2	21.5	20.8	22.7	0.0	21.5
7	22.8	22.1	21.9	21.3	22.7	0.0	21.8
8	23.6	22.6	22.2	21.5	0.0	0.0	22.5
9	23.3	23.1	22.9	0.0	0.0	0.0	23.1
10	24.2	22.6	22.3	0.0	0.0	0.0	23.1
11	24.4	22.8	21.4	0.0	0.0	0.0	23.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0-15+	22.0	21.2	20.3	19.3	19.0	18.9	19.6

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	19.3	14.9	16.7	13.2	15.7	0.0	15.5
1	21.0	21.1	19.6	17.9	16.2	0.0	18.3
2	21.2	21.2	20.0	18.9	18.2	18.0	18.7
3	21.6	21.4	20.4	19.7	19.6	18.8	19.6
4	21.9	21.7	20.8	20.5	20.6	19.1	20.8
5	22.1	21.7	21.2	20.8	21.4	21.2	21.4
6	22.8	22.3	21.3	20.2	23.0	0.0	22.0
7	22.5	21.9	21.6	22.1	0.0	0.0	22.0
8	22.6	22.2	22.1	22.8	0.0	0.0	22.3
9	23.3	23.3	23.3	0.0	0.0	0.0	23.3
10	23.2	22.9	22.8	0.0	0.0	0.0	23.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0-15+	21.9	21.5	20.2	19.2	19.3	18.6	19.4

Table 8.17 (continued)

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	19.3	14.8	16.5	15.3	13.9	0.0	14.2
1	20.3	21.2	19.8	18.2	16.5	0.0	18.0
2	20.6	21.4	20.5	19.0	18.4	18.2	19.2
3	21.1	21.7	21.0	20.4	19.9	19.4	20.1
4	21.6	21.9	21.5	21.0	20.5	19.6	21.0
5	22.0	22.0	21.7	21.7	21.1	20.6	21.6
6	22.7	22.5	22.2	22.2	24.2	0.0	22.4
7	22.5	22.1	21.9	22.4	0.0	0.0	22.3
8	22.8	22.4	22.3	0.0	0.0	0.0	22.6
9	23.4	23.4	23.3	0.0	0.0	0.0	23.4
10	23.2	22.9	22.9	0.0	0.0	0.0	23.1
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0-15+	21.4	21.4	20.8	20.0	17.6	19.5	19.7

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	19.3	14.8	16.6	14.4	13.9	0.0	14.4
1	20.4	19.2	19.1	17.9	15.6	15.6	17.4
2	20.7	21.0	19.8	19.0	18.2	17.7	18.8
3	21.3	21.3	20.4	19.7	19.5	19.0	19.7
4	21.7	21.5	20.8	20.3	20.0	19.4	20.3
5	22.3	21.8	21.3	21.3	20.8	20.5	21.3
6	22.8	22.3	21.7	21.3	22.3	23.0	22.1
7	22.7	22.0	21.8	21.9	23.2	24.7	22.2
8	23.3	22.5	22.2	21.8	0.0	0.0	22.8
9	23.4	23.3	23.0	0.0	0.0	0.0	23.3
10	23.8	23.0	22.5	0.0	0.0	0.0	23.4
11	24.4	23.1	21.4	0.0	0.0	0.0	23.7
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0-15+	21.7	21.3	20.3	19.5	18.7	19.0	19.5

Table 8.18 Weight (g) at age by quarter and by sub-division of SARDINE in 1995.

1995 Age	VIIIc East 1'st Q catch('000)	VIIIc West 1'st Q catch('000)	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	0	0	0	0	0	0	0
1	53	22	36	52	22	30	25
2	62	61	53	61	34	36	38
3	72	69	63	72	48	51	55
4	74	71	67	86	55	59	63
5	84	76	73	98	62	68	73
6	89	82	76	108	76	92	87
7	88	81	79	113	86	114	87
8	97	90	81	0	0	0	95
9	93	94	88	0	0	0	93
10	101	95	82	0	0	0	98
11	105	94	71	0	0	0	102
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
0-15+	80	71	64	84	47	53	58

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	0	0	0	0	0	0	0
1	54	10	33	42	30	0	35
2	65	67	58	55	52	47	54
3	77	75	65	57	58	52	60
4	80	76	69	59	62	54	63
5	90	81	76	71	69	62	73
6	96	87	79	69	89	0	78
7	94	85	83	74	89	0	82
8	105	93	87	76	0	0	90
9	101	98	95	0	0	0	99
10	113	92	89	0	0	0	99
11	117	95	78	0	0	0	99
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
0-15+	85	76	66	56	54	53	59

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	66	28	40	23	37	0	34
1	87	87	69	53	40	0	58
2	90	89	74	63	57	54	62
3	94	92	78	71	71	62	70
4	99	96	84	80	80	66	84
5	102	97	89	82	91	88	92
6	113	104	91	77	110	0	100
7	107	99	95	99	0	0	100
8	110	103	101	109	0	0	105
9	122	120	120	0	0	0	121
10	119	114	112	0	0	0	116
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
0-15+	99	94	76	67	68	61	69

Table 8.18 (continued)

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	60	26	37	31	22	0	24
1	71	81	65	54	40	0	52
2	74	84	73	62	56	54	63
3	80	87	78	78	72	67	74
4	87	90	85	87	80	70	84
5	92	91	87	97	88	81	92
6	101	99	94	103	139	0	101
7	98	93	91	107	0	0	98
8	102	97	96	0	0	0	100
9	111	111	109	0	0	0	111
10	109	104	103	0	0	0	107
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
0-15+	84	85	78	75	52	67	71

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	60	26	39	28	23	0	25
1	73	70	63	52	31	30	47
2	76	82	67	61	53	50	59
3	79	80	69	69	62	61	66
4	85	83	74	76	63	59	71
5	91	87	81	93	68	73	82
6	98	94	85	88	77	92	91
7	96	92	88	95	86	114	93
8	101	97	93	83	0	0	97
9	98	100	99	0	0	0	99
10	106	100	94	0	0	0	103
11	108	95	76	0	0	0	101
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
0-15+	85	82	71	67	56	59	65

Table 8.19

The SAS System 08:49 Monday, August 19, 1996
: Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

WECA: Mean Weight in Catch (Kilograms)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1977	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1978	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1979	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1980	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1981	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1982	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1983	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1984	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1985	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1986	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1987	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1988	0.017	0.034	0.052	0.060	0.068	0.072	0.079	0.093
1989	0.013	0.035	0.052	0.059	0.066	0.071	0.087	0.093
1990	0.024	0.032	0.047	0.057	0.061	0.067	0.070	0.096
1991	0.020	0.031	0.058	0.063	0.073	0.074	0.087	0.097
1992	0.018	0.045	0.055	0.066	0.070	0.079	0.083	0.091
1993	0.017	0.037	0.051	0.058	0.066	0.071	0.081	0.093
1994	0.020	0.036	0.058	0.062	0.070	0.076	0.087	0.093
1995	0.025	0.047	0.059	0.066	0.066	0.071	0.082	0.091

Table 8.20

The SAS System 08:49 Monday, August 19, 1996
: Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

WEST: Mean Weight in Stock (Kilograms)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1977	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1978	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1979	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1980	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1981	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1982	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1983	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1984	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1985	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1986	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1987	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1988	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1989	0.000	0.015	0.038	0.050	0.064	0.067	0.077	0.086
1990	0.000	0.015	0.038	0.050	0.064	0.067	0.079	0.086
1991	0.000	0.019	0.042	0.050	0.064	0.071	0.075	0.088
1992	0.000	0.027	0.036	0.050	0.062	0.069	0.076	0.091
1993	0.000	0.022	0.045	0.057	0.064	0.073	0.076	0.091
1994	0.000	0.031	0.040	0.049	0.060	0.067	0.070	0.085
1995	0.000	0.029	0.050	0.062	0.072	0.079	0.080	0.092

Table 8.21

The SAS System 08:49 Monday, August 19, 1996
: Sardine in the Southern Area (Fishing Areas VIIIc and IXa)

MATPROP: Proportion Mature at Year Start

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1976	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1977	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1978	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1979	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1980	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1981	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1982	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1983	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1984	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1985	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1986	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1987	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1988	0.00	0.65	0.95	1.00	1.00	1.00	1.00	1.00
1989	0.00	0.23	0.83	0.91	0.92	0.94	0.97	1.00
1990	0.00	0.60	0.81	0.88	0.89	0.94	0.97	1.00
1991	0.00	0.74	0.91	0.96	0.97	1.00	1.00	1.00
1992	0.00	0.79	0.91	0.95	0.98	1.00	1.00	1.00
1993	0.00	0.47	0.93	0.94	0.97	0.99	1.00	1.00
1994	0.00	0.80	0.89	0.96	0.96	0.97	1.00	1.00
1995	0.00	0.73	0.98	0.97	0.99	1.00	1.00	1.00

Table 8.22

Sardine in Fishing Areas VIIIc and IXa
102
Spanish Spring AS
1988 1996
1 1 0.25 0.33
1 11
1 221000 63000 72000 64000 858000 175000 310000 342000 53000 18000 -1
1 73000 304000 66000 96000 76000 906000 156000 177000 97000 42000 11000
1 69000 56000 274000 55000 88000 134000 249000 70000 49000 46000 23000
1 25000 150000 126000 314000 51000 79000 56000 345000 29000 71000 6000
1 159000 78000 85000 29000 115000 24000 20000 12000 57000 3000 9000
1 242000 324000 92000 83000 83000 267000 27000 74000 71000 226000 79000
1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
1 18300 16700 97400 80600 19100 8500 5500 -1 -1 -1 -1
1 10639 54249 90547 350824 213842 14743 7225 2812 -1 -1 -1
Portuguese Spring AS
1986 1996
1 1 0.25 0.33
1 6
1 2343866 4024705 1544477 517525 470564 21325 -1
1 -1 -1 -1 -1 -1 -1 -1
1 7742997 2684245 1617241 1446931 804077 425311
1 -1 -1 -1 -1 -1 -1 -1
1 -1 -1 -1 -1 -1 -1 -1
1 -1 -1 -1 -1 -1 -1 -1
1 -1 -1 -1 -1 -1 -1 -1
1 -1 -1 -1 -1 -1 -1 -1
1 -1 -1 -1 -1 -1 -1 -1
1 228435 237092 2110869 2948951 729708 128246 21973
1 294647 1153715 933561 2212965 303754 4646 -1

Table 8.23

Sardine in Fishing Areas VIIIc and IXa

104											
Spanish	Spring	AS									
1988	1996										
1	1	0.25	0.33								
1	11										
1	221000	63000	72000	64000	858000	175000	310000	342000	53000	18000	-1
1	73000	304000	66000	96000	76000	906000	156000	177000	97000	42000	11000
1	69000	56000	274000	55000	88000	134000	249000	70000	49000	46000	23000
1	25000	150000	126000	314000	51000	79000	56000	345000	29000	71000	6000
1	159000	78000	85000	29000	115000	24000	20000	12000	57000	3000	9000
1	242000	324000	92000	83000	83000	267000	27000	74000	71000	226000	79000
1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	18300	16700	97400	80600	19100	8500	5500	-1	-1	-1	-1
1	10639	54249	90547	350824	213842	14743	7225	2812	-1	-1	-1
Portuguese Winter											
1984	1992										
1	1	0.84	0.92								
0	6										
1	2957000	5733000	1152000	1037000	528000	76000	40000				
1	2063000	2744000	4548000	1083000	839000	144000	61000				
1	2493000	1612000	1670000	658000	323000	127000	50000				
1	3715000	2379000	1344000	929000	666000	237000	49000				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	6349072	5480539	1157103	1002580	437424	108224	5663				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
Portuguese Spring		AS									
1986	1996										
1	1	0.25	0.33								
1	6										
1	2343866	4024705	1544477	517525	470564	21325	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	7742997	2684245	1617241	1446931	804077	425311					
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	228435	237092	2110869	2948951	729708	128246	21973				
1	294647	1153715	933561	2212965	303754	4646	-1				
Portuguese Summer		AS									
1985	1996										
1	1	0.75	0.83								
0	6										
1	458169	1184421	4030089	410085	188705	54323	7622				
1	4007382	2702917	2491529	718216	21215	-1	-1				
1	4546428	1203302	1408260	1102317	669649	163138	46283				
1	3139228	1823194	988659	802473	426141	69944	8682				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	-1	-1	-1	-1	-1	-1	-1				
1	414921	1442440	1134622	2221410	2275938	445796	69789				

Table 8.24

CATCH NUMBERS AT AGE (Millions)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	420	844	854	643	842	1021	60	1061	109	258	238	1401	439	244	234	1574	490	88	121	31
1	1871	2421	2145	1479	1997	1920	769	553	3289	527	702	512	979	512	562	456	985	562	61	186
2	1426	954	913	935	1542	1720	1854	838	470	2343	987	615	525	895	488	404	423	1051	527	273
3	252	110	281	423	372	666	701	795	488	457	903	520	428	381	680	380	317	502	1059	798
4	71	22	127	187	155	192	350	322	295	290	322	521	303	215	275	256	175	245	261	440
5	12	3	40	93	47	102	130	140	176	197	194	147	291	198	142	72	108	111	107	67
6	3	1	16	36	30	76	129	139	116	101	166	170	189	183	104	26	19	66	35	29
7	1	1	1	1	1	1	1	1	1	1	1	1	1	61	142	79	61	52	36	36
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

INDICES OF SPAWNING STOCK BIOMASS

0

AGE-STRUCTURED INDICES

INDEX: 1 from 1988 to 1996

	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	2.21E+05	7.30E+04	6.90E+04	2.50E+04	1.59E+05	2.42E+05	-1.00E+00	1.83E+04	1.06E+04
2	6.30E+04	3.04E+05	5.60E+04	1.50E+05	7.80E+04	3.24E+05	-1.00E+00	1.67E+04	5.42E+04
3	7.20E+04	6.60E+04	2.74E+05	1.26E+05	8.50E+04	9.20E+04	-1.00E+00	9.74E+04	9.05E+04
4	6.40E+04	9.60E+04	5.50E+04	3.14E+05	2.90E+04	8.30E+04	-1.00E+00	8.06E+04	3.51E+05
5	8.58E+05	7.60E+04	8.80E+04	5.10E+04	1.15E+05	8.30E+04	-1.00E+00	1.91E+04	2.14E+05
6	1.75E+05	9.06E+05	1.34E+05	7.90E+04	2.40E+04	2.67E+05	-1.00E+00	8.50E+03	1.47E+04
7	3.10E+05	1.56E+05	2.49E+05	5.60E+04	2.00E+04	2.70E+04	-1.00E+00	5.50E+03	7.23E+03
8	3.42E+05	1.77E+05	7.00E+04	3.45E+05	1.20E+04	7.40E+04	-1.00E+00	-1.00E+00	2.81E+03
9	5.30E+04	9.70E+04	4.90E+04	2.90E+04	5.70E+04	7.10E+04	-1.00E+00	-1.00E+00	-1.00E+00
10	1.80E+04	4.20E+04	4.60E+04	7.10E+04	3.00E+03	2.26E+05	-1.00E+00	-1.00E+00	-1.00E+00
11	-1.00E+00	1.10E+04	2.30E+04	6.00E+03	9.00E+03	7.90E+04	-1.00E+00	-1.00E+00	-1.00E+00

INDEX: 2 from 1986 to 1996

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	2.34E+06	-1.00E+00	7.74E+06	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	2.28E+05	2.95E+05
2	4.02E+06	-1.00E+00	2.68E+06	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	2.37E+05	1.15E+06
3	1.54E+06	-1.00E+00	1.62E+06	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	2.11E+06	9.34E+05
4	5.18E+05	-1.00E+00	1.45E+06	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	2.95E+06	2.21E+06
5	4.71E+05	-1.00E+00	8.04E+05	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	7.30E+05	3.04E+05
6	2.13E+04	-1.00E+00	4.25E+05	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	1.28E+05	4.65E+03

FISHING MORTALITY

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	0.0431	0.0889	0.0812	0.054	0.0644	0.1132	0.0087	0.0568	0.0149	0.0494	0.0673	0.0713	0.0843	0.0854	0.1095	0.0845	0.0703	0.0968	0.0949	0.1172
1	0.3196	0.4303	0.3943	0.2269	0.272	0.2359	0.1341	0.1185	0.288	0.1063	0.1318	0.1397	0.1651	0.1673	0.2146	0.1655	0.1378	0.1897	0.1859	0.2296
2	0.4714	0.3108	0.3324	0.3474	0.4574	0.466	0.439	0.2445	0.1609	0.4001	0.25	0.2649	0.3131	0.3172	0.4069	0.3139	0.2613	0.3597	0.3525	0.4354
3	0.1739	0.0676	0.1625	0.2935	0.2619	0.4287	0.4111	0.3992	0.254	0.2683	0.3796	0.4023	0.4755	0.4817	0.6179	0.4766	0.3968	0.5461	0.5353	0.6611
4	0.0858	0.0234	0.1189	0.1782	0.1916	0.2421	0.4953	0.3931	0.2929	0.273	0.4324	0.4582	0.5415	0.5486	0.7038	0.5428	0.452	0.622	0.6096	0.753
5	0.0205	0.0053	0.0618	0.1376	0.0709	0.2147	0.2978	0.4418	0.4549	0.379	0.4578	0.4851	0.5733	0.5808	0.7451	0.5747	0.4785	0.6586	0.6455	0.7972
6	0.0063	0.0024	0.0401	0.0831	0.0686	0.1799	0.5405	0.7139	0.9969	0.6121	0.541	0.5733	0.6776	0.6864	0.8806	0.6792	0.5655	0.7783	0.7628	0.9421
7	0.0026	0.0029	0.0034	0.0036	0.0034	0.0033	0.0036	0.0079	0.0107	0.0213	0.199	0.2109	0.2492	0.2525	0.3239	0.2498	0.208	0.2863	0.2806	0.3465
8	0.004	0.0037	0.0041	0.0047	0.005	0.0047	0.0046	0.0051	0.0111	0.0151	0.0222	0.0236	0.0279	0.0282	0.0362	0.0279	0.0232	0.032	0.0314	0.0387
9	0.0051	0.0056	0.0052	0.0057	0.0066	0.007	0.0066	0.0065	0.0071	0.0187	0.0274	0.029	0.0343	0.0348	0.0446	0.0344	0.0286	0.0394	0.0386	0.0477
10	0.0075	0.0071	0.0078	0.0072	0.008	0.0092	0.0099	0.0092	0.0109	0.01	0.0125	0.0132	0.0157	0.0159	0.0203	0.0157	0.0131	0.018	0.0176	0.0218
11	0.0075	0.0071	0.0078	0.0072	0.008	0.0092	0.0099	0.0092	0.0109	0.01	0.0125	0.0132	0.0157	0.0159	0.0203	0.0157	0.0131	0.018	0.0176	0.0218

Table 8.24 (cont'd)

NUMBERS AT AGE (Millions)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	11667	11623	12825	14347	15813	11163	8124	22537	8637	6278	5189	10516	5402	5187	4940	12967	7508	1283	1581	437	4258
1	7959	8034	7646	8501	9772	10659	7166	5790	15308	6117	4296	3488	7040	3570	3424	3183	8567	5031	837	1034	279
2	4397	4157	3756	3706	4871	5352	6053	4505	3697	8251	3954	2707	2180	4291	2171	1986	1939	5366	2992	500	591
3	1844	1973	2190	1937	1882	2217	2415	2805	2536	2263	3976	2214	1493	1146	2246	1039	1043	1074	2693	1512	233
4	1011	1114	1326	1338	1038	1041	1038	1151	1353	1414	1244	1955	1064	667	509	871	464	504	447	1133	561
5	692	667	783	846	805	616	588	455	558	726	774	580	889	445	277	181	364	212	195	175	384
6	559	488	477	529	530	539	357	314	210	255	357	352	257	360	179	95	73	162	79	73	57
7	445	400	350	329	350	356	324	150	110	56	99	149	143	94	130	53	34	30	53	26	21
8	295	319	286	251	236	251	255	232	107	79	39	59	87	80	52	68	30	20	16	29	13
9	231	211	228	205	179	169	179	183	166	76	56	28	41	61	56	36	47	21	14	11	20
10	157	165	151	163	147	128	121	128	130	118	54	39	19	29	42	38	25	33	15	10	8
11	0	112	198	249	294	314	315	310	312	315	308	257	210	162	135	125	116	100	94	77	61

STOCK SUMMARY

Year	Recruits x10^6	Total B tonnes	Spawn B tonnes	Landings tonnes	Yld/SSB	Ref. F Fbar 2-5
1976	11667	639407	515600	141690	0.2748	0.1879
1977	11623	645770	528731	125750	0.2378	0.1018
1978	12825	657379	537870	139990	0.2603	0.1689
1979	14347	663366	536372	153441	0.2861	0.2392
1980	15813	702715	558018	191682	0.3435	0.2454
1981	11163	740370	577984	214133	0.3705	0.3379
1982	8124	706419	558245	204504	0.3663	0.4108
1983	22537	624738	503641	181139	0.3597	0.3696
1984	8637	718163	546432	202686	0.3709	0.2907
1985	6278	740787	591516	204107	0.3451	0.3301
1986	5189	626695	507173	180606	0.3561	0.3799
1987	10516	508084	409013	168825	0.4128	0.4027
1988	5402	458591	349751	158540	0.4533	0.4759
1989	5187	415407	280642	137126	0.4886	0.4821
1990	4940	351232	241955	139157	0.5751	0.6185
1991	12967	302944	232694	127756	0.549	0.477
1992	7508	437651	329551	126054	0.3825	0.3972
1993	1283	493572	345169	138795	0.4021	0.5466
1994	1581	341366	261151	132800	0.5085	0.5357
1995	437	265085	200170	121384	0.6064	0.6617

PARAMETER ESTIMATES +/- SD

Separable Model: Reference F by year				
1	1986	0.25	0.2117	0.2953
2	1987	0.2649	0.2263	0.3102
3	1988	0.3131	0.2693	0.3641
4	1989	0.3172	0.2734	0.368
5	1990	0.4069	0.3512	0.4716
6	1991	0.3139	0.2685	0.3669
7	1992	0.2613	0.2236	0.3054
8	1993	0.3597	0.3083	0.4196
9	1994	0.3525	0.2972	0.4181
10	1995	0.4354	0.3523	0.538
Separable Model: Selection (S) by age				
11	0	0.2691	0.2273	0.3186
12	1	0.5273	0.4602	0.6043
	2	1	Fixed: Reference Age	
13	3	1.5185	1.3288	1.7353
14	4	1.7294	1.482	2.0181
15	5	1.8311	1.4422	2.3248
16	6	2.164	1.3667	3.4264
17	7	0.7959	0.2691	2.3539
18	8	0.0889	0.026	0.3038

Table 8.24 (cont'd)

19	9	0.1096	0.0318	0.3782
	10	0.05	Fixed: last TRUE age	

Separable Model: Populations in year 1995

20	0	436581	296740	642324
21	1	1033837	803508	1330191
22	2	499834	405231	616522
23	3	1511996	1247861	1832041
24	4	1133376	925451	1388017
25	5	174674	135838	224615
26	6	73394	50063	107597
27	7	26471	12600	55609
28	8	29047	11740	71863
29	9	11254	4674	27097
30	10	9695	3829	24544

Separable Model: Populations at age 10

31	1986	53556.283	2978.6102	962957.64
32	1987	38913.192	4405.7894	343692.43
33	1988	19266.72	5591.0601	66392.863
34	1989	28538.407	9550.4338	85277.871
35	1990	42252.842	16927.929	105464.92
36	1991	38411.2	15427.611	95635.042
37	1992	25229.891	9984.4358	63753.968
38	1993	33112.615	12594.251	87059.186
39	1994	14508.173	5311.1584	39631.104

Age-structured index catchabilities
Age-Structured Index 1

Linear model fitted. Slopes at age:

40	1	Q	2.59E-02	1.82E-02	3.70E-02
41	2	Q	5.89E-02	4.14E-02	8.40E-02
42	3	Q	1.23E-01	8.62E-02	1.77E-01
43	4	Q	1.85E-01	1.27E-01	2.70E-01
44	5	Q	4.26E-01	2.78E-01	6.53E-01
45	6	Q	8.29E-01	4.63E-01	1.49E+00
46	7	Q	1.02E+00	4.40E-01	2.35E+00
47	8	Q	1.68E+00	6.43E-01	4.39E+00
48	9	Q	1.49E+00	5.57E-01	4.00E+00
49	10	Q	1.27E+00	4.67E-01	3.43E+00
50	11	Q	1.42E-01	7.30E-02	2.75E-01

Age-Structured Index 2

Linear model fitted. Slopes at age:

51	1	Q	7.11E-01	4.82E-01	1.05E+00
52	2	Q	1.27E+00	8.66E-01	1.85E+00
53	3	Q	1.60E+00	1.09E+00	2.35E+00
54	4	Q	2.04E+00	1.37E+00	3.06E+00
55	5	Q	1.55E+00	9.79E-01	2.44E+00
56	6	Q	4.76E-01	2.57E-01	8.79E-01

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals
(log(Observed Catch)-log(Expected Catch)
and weights (W) used in the analysis.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
0	-1.91E-01	8.19E-01	1.64E-01	-3.95E-01	-6.26E-01	5.63E-01	1.19E-01	-1.38E-01	-9.73E-03	-2.85E-01	5.00E-01
1	4.37E-01	2.75E-01	6.56E-02	8.46E-02	-8.15E-03	9.32E-02	4.36E-02	-2.81E-01	-6.90E-01	2.29E-02	1.00E+00
2	2.74E-01	1.29E-01	4.17E-02	-1.13E-01	-2.48E-01	-1.29E-01	1.00E-01	-2.83E-01	-3.72E-01	5.85E-01	1.00E+00
3	-1.80E-01	-1.94E-01	-1.30E-01	7.66E-03	-2.77E-01	1.12E-01	7.45E-02	2.51E-01	9.34E-02	2.30E-01	1.00E+00

Table 8.24 (cont'd)

	4	-1.56E-01	-1.74E-01	-2.39E-01	-1.25E-01	2.08E-01	-2.08E-01	1.85E-01	1.91E-01	3.90E-01	-1.69E-01	1.00E+00
	5	-2.34E-01	-2.70E-01	-1.43E-01	1.54E-01	1.15E-01	5.03E-02	-9.99E-02	2.24E-01	2.88E-01	-2.20E-01	1.00E+00
	6	2.52E-01	2.46E-01	5.44E-01	1.64E-01	1.29E-01	-4.42E-01	-3.65E-01	-1.44E-01	-4.57E-02	-2.99E-01	1.00E+00
	7	-2.73E+00	-3.19E+00	-3.30E+00	1.22E+00	1.52E+00	2.06E+00	2.40E+00	2.10E+00	1.16E+00	1.69E+00	1.00E-02
	8	4.90E-01	-1.50E-01	-7.12E-01	-6.40E-01	-4.62E-01	-4.64E-01	5.36E-01	6.16E-01	8.55E-01	6.11E-02	1.00E-02
	9	-2.48E-01	3.96E-01	-1.67E-01	-5.73E-01	-7.32E-01	-4.64E-02	-1.32E-01	3.68E-01	7.92E-01	8.04E-01	1.00E-02
	10	5.68E-01	8.29E-01	1.37E+00	9.61E-01	3.21E-01	6.74E-01	1.28E+00	6.87E-01	1.53E+00	1.73E+00	1.00E-02
Wts		1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	

Aged Index Residuals: log(Observed Index)-log(Expected Index)

Aged Index 1

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	3.35E-01	-9.25E-02	-9.35E-02	-1.05E+00	-1.98E-01	7.69E-01	-1.00E+00	-2.19E-01	5.48E-01
2	-5.26E-01	3.72E-01	-6.13E-01	4.35E-01	-2.11E-01	2.24E-01	-1.00E+00	-3.46E-01	6.65E-01
3	-7.07E-01	-5.28E-01	2.63E-01	2.16E-01	-2.05E-01	-1.11E-01	-1.00E+00	-3.63E-01	1.44E+00
4	-8.72E-01	2.57E-03	-2.39E-01	9.20E-01	-8.59E-01	1.58E-01	-1.00E+00	-6.43E-01	1.53E+00
5	1.08E+00	-6.50E-01	1.83E-02	-1.51E-01	-6.31E-02	2.02E-01	-1.00E+00	-1.03E+00	5.96E-01
6	9.57E-02	1.40E+00	2.48E-01	3.00E-01	-6.69E-01	1.01E+00	-1.00E+00	-1.60E+00	-7.89E-01
7	9.27E-01	6.60E-01	8.20E-01	1.99E-01	-4.06E-01	5.90E-02	-1.00E+00	-1.39E+00	-8.67E-01
8	9.53E-01	3.79E-01	-1.23E-01	1.21E+00	-1.33E+00	8.87E-01	-1.00E+00	-1.00E+00	-1.98E+00
9	-4.04E-02	1.71E-01	-4.23E-01	-5.20E-01	-1.12E-01	9.25E-01	-1.00E+00	-1.00E+00	-1.00E+00
10	-2.03E-01	2.51E-01	-4.87E-02	4.79E-01	-2.27E+00	1.79E+00	-1.00E+00	-1.00E+00	-1.00E+00
11	-1.00E+00	-6.37E-01	2.86E-01	-9.81E-01	-4.99E-01	1.82E+00	-1.00E+00	-1.00E+00	-1.00E+00

Aged Index 2

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-1.31E-01	-1.00E+00	5.80E-01	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.01E+00	5.57E-01
2	-5.10E-02	-1.00E+00	1.57E-01	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-7.61E-01	6.54E-01
3	-1.21E+00	-1.00E+00	-1.55E-01	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	1.53E-01	1.21E+00
4	-1.37E+00	-1.00E+00	-1.55E-01	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	5.55E-01	9.71E-01
5	-7.05E-01	-1.00E+00	-2.74E-01	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	1.32E+00	-3.42E-01
6	-1.82E+00	-1.00E+00	1.54E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00	1.67E+00	-1.39E+00

PARAMETERS OF THE DISTRIBUTION OF ln CATCHES AT AGE

Separable model fitted from 1986 to 1995

Variance :	1.0138
Skewness test statistic:	-2.0216
Kurtosis test statistic:	10.6022
Partial chi square:	8.7014
Probability of chi square:	1
Degrees of freedom:	71

Table 8.24 (cont'd)

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR ln AGED INDEX 1

Linear catchability relationship assumed.

Age:	1	2	3	4	5	6	7	8	9	10	11
Variance:	0.3159	0.2337	0.4489	0.7404	0.4398	0.9682	0.695	1.5004	0.2698	1.7317	1.253
Skewness test stat.:	-0.5159	0.0195	1.4256	0.774	0.0612	-0.1931	-0.54	-0.7084	0.9039	-0.5582	0.8592
Kurtosis test stat.:	-0.1527	-0.8916	0.4226	-0.4414	-0.3649	-0.5186	-0.6137	-0.5914	-0.118	-0.0367	-0.2672
Partial chi square:	0.2029	0.1472	0.2981	0.4526	0.2627	0.6047	0.4607	0.8534	0.1284	0.8341	0.5248
Prob. of chi of	1	1	0.9999	0.9996	0.9999	0.999	0.9996	0.9906	0.9997	0.9748	0.971
Number of data:	8	8	8	8	8	8	8	7	6	6	5
Degrees of freedom:	7	7	7	7	7	7	7	6	5	5	4
Weight in the analysis:	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909

DISTRIBUTION STATISTICS FOR ln AGED INDEX 2

Linear catchability relationship assumed.

Age:	1	2	3	4	5	6
Variance:	0.5589	0.3448	0.9897	1.0518	0.8114	3.4689
Skewness test stat.:	-0.4913	-0.2428	0.0023	-0.4354	0.8149	-0.0201
Kurtosis test stat.:	-0.5071	-0.4327	-0.4339	-0.4836	-0.312	-0.8004
Partial chi square:	0.1249	0.0781	0.2143	0.2217	0.1938	0.9615
Prob. of chi of	0.9887	0.9943	0.9752	0.974	0.9786	0.8106
Number of data:	4	4	4	4	4	4
Degrees of freedom:	3	3	3	3	3	3
Weight in the analysis.	0.1667	0 1667	0.1667	0.1667	0.1667	0.1667

Table 8.25

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

Prediction with management option table: Input data

Year: 1996								
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	4258.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	279.000	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	591.000	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	233.000	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	561.000	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	384.000	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	180.000	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
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	2827.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
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	1340.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANPCL01
Date and time: 20AUG96:12:47

Table 8.26

The SAS System 12:46 Tuesday, August 20, 1996

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

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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	0.6617	138411	104725	67834	0.0000	0.0000	140353	108934	0	205778	172700
.	.	.	.	.	0.1000	0.0662	.	107599	6912	199415	165055
.	.	.	.	.	0.2000	0.1323	.	106286	13503	193365	157893
.	.	.	.	.	0.3000	0.1985	.	104995	19792	187606	151175
.	.	.	.	.	0.4000	0.2647	.	103724	25800	182121	144866
.	.	.	.	.	0.5000	0.3308	.	102473	31543	176892	138933
.	.	.	.	.	0.6000	0.3970	.	101243	37039	171902	133347
.	.	.	.	.	0.7000	0.4632	.	100032	42302	167136	128081
.	.	.	.	.	0.8000	0.5293	.	98841	47346	162580	123111
.	.	.	.	.	0.9000	0.5955	.	97668	52185	158220	118415
.	.	.	.	.	1.0000	0.6617	.	96514	56831	154046	113972
.	.	.	.	.	1.1000	0.7278	.	95378	61296	150046	109764
.	.	.	.	.	1.2000	0.7940	.	94260	65589	146209	105774
.	.	.	.	.	1.3000	0.8602	.	93160	69720	142526	101987
.	.	.	.	.	1.4000	0.9263	.	92077	73699	138987	98388
.	.	.	.	.	1.5000	0.9925	.	91010	77534	135585	94966
.	.	.	.	.	1.6000	1.0587	.	89961	81234	132312	91707
.	.	.	.	.	1.7000	1.1248	.	88927	84804	129161	88602
.	.	.	.	.	1.8000	1.1910	.	87910	88252	126124	85640
.	.	.	.	.	1.9000	1.2572	.	86908	91585	123196	82812
.	.	.	.	.	2.0000	1.3234	.	85922	94808	120370	80110
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL01
Date and time : 20AUG96:12:47
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1996 : F factors

Table 8.27

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	10057768	414712	6613733	394839	6090001	363573
0.0500	0.0331	168400	10942	9552505	374733	6113913	355091	5589436	324265
0.1000	0.0662	304466	19338	9144980	343065	5711721	323648	5186707	293244
0.1500	0.0993	417573	25975	8806809	317261	5378777	298063	4853413	268061
0.2000	0.1323	513718	31350	8519840	295757	5096933	276770	4571386	247156
0.2500	0.1654	596925	35790	8271900	277506	4854021	258726	4328441	229483
0.3000	0.1985	669998	39519	8054503	261781	4641559	243202	4116080	214316
0.3500	0.2316	734957	42696	7861542	248060	4453443	229678	3928187	201134
0.4000	0.2647	793299	45435	7688498	235959	4285158	217768	3760236	189554
0.4500	0.2978	846154	47822	7531952	225187	4133288	207182	3608800	179288
0.5000	0.3308	894399	49921	7389259	215521	3995191	197699	3471230	170112
0.5500	0.3639	938722	51780	7258343	206787	3868794	189143	3345444	161853
0.6000	0.3970	979673	53440	7137544	198846	3752440	181375	3229779	154372
0.6500	0.4301	1017698	54929	7025518	191585	3644787	174285	3122887	147560
0.7000	0.4632	1053161	56274	6921163	184914	3544738	167780	3023664	141326
0.7500	0.4963	1086367	57492	6823568	178758	3451380	161786	2931194	135595
0.8000	0.5293	1117568	58602	6731967	173054	3363954	156241	2844713	130305
0.8500	0.5624	1146980	59615	6645716	167750	3281815	151093	2763572	125405
0.9000	0.5955	1174786	60544	6564265	162801	3204416	146296	2687221	120850
0.9500	0.6286	1201140	61397	6487143	158170	3131288	141814	2615187	116604
1.0000	0.6617	1226180	62184	6413942	153823	3062026	137614	2547061	112634
1.0500	0.6948	1250024	62910	6344309	149733	2996277	133668	2482490	108912
1.1000	0.7278	1272773	63583	6277936	145876	2933734	129952	2421163	105416
1.1500	0.7609	1294519	64206	6214549	142230	2874128	126444	2362808	102124
1.2000	0.7940	1315342	64784	6153909	138777	2817219	123127	2307184	99017
1.2500	0.8271	1335312	65322	6095803	135499	2762796	119983	2254078	96079
1.3000	0.8602	1354494	65823	6040043	132384	2710671	116998	2203300	93298
1.3500	0.8933	1372943	66289	5986457	129417	2660677	114160	2154679	90658
1.4000	0.9263	1390710	66725	5934895	126588	2612662	111457	2108064	88150
1.4500	0.9594	1407842	67131	5885219	123885	2566490	108879	2063317	85764
1.5000	0.9925	1424380	67511	5837305	121300	2522039	106417	2020313	83490
1.5500	1.0256	1440361	67867	5791041	118824	2479197	104061	1978942	81320
1.6000	1.0587	1455819	68199	5746325	116450	2437864	101806	1939099	79247
1.6500	1.0918	1470786	68510	5703065	114171	2397947	99644	1900692	77264
1.7000	1.1248	1485290	68802	5661174	111981	2359364	97568	1863636	75366
1.7500	1.1579	1499358	69075	5620575	109874	2322036	95574	1827853	73546
1.8000	1.1910	1513012	69332	5581198	107845	2285893	93657	1793271	71800
1.8500	1.2241	1526276	69572	5542975	105889	2250871	91811	1759824	70123
1.9000	1.2572	1539170	69797	5505847	104002	2216910	90032	1727451	68511
1.9500	1.2903	1551713	70008	5469757	102180	2183953	88317	1696097	66961
2.0000	1.3234	1563921	70207	5434654	100419	2151951	86662	1665709	65468
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDPCL01
Date and time : 20AUG96:14:51
Computation of ref. F: Simple mean, age 2 - 5
F-0.1 factor : 0.7078
F-max factor : Not found
F-0.1 reference F : 0.4683
F-max reference F : Not found
Recruitment : 2827 (Millions)

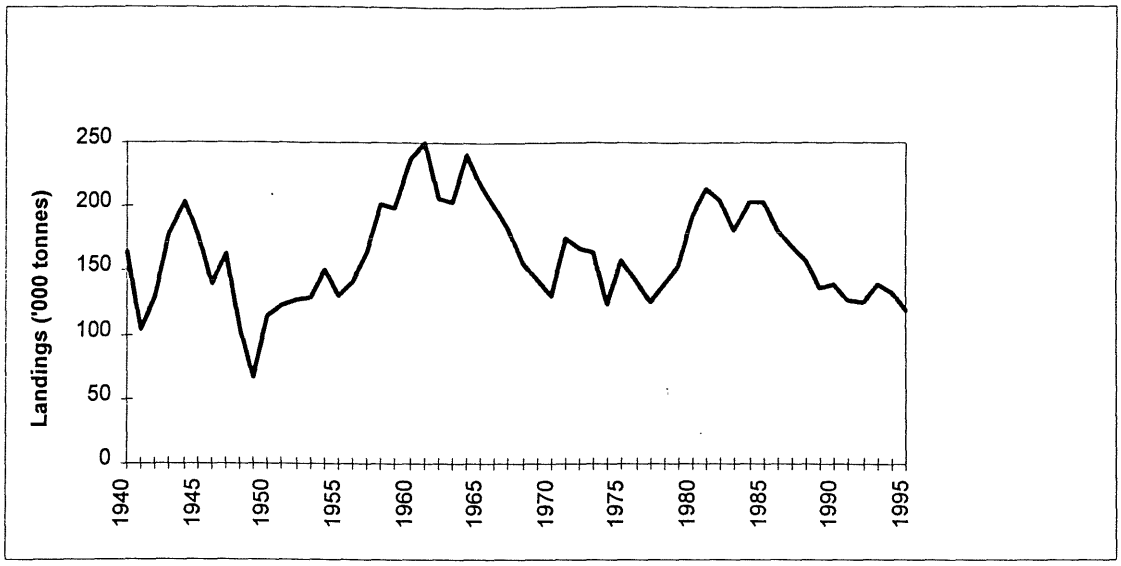


Figure 8.1 Total landings of sardine in Divisions VIIIc and IXa from 1940–1995.

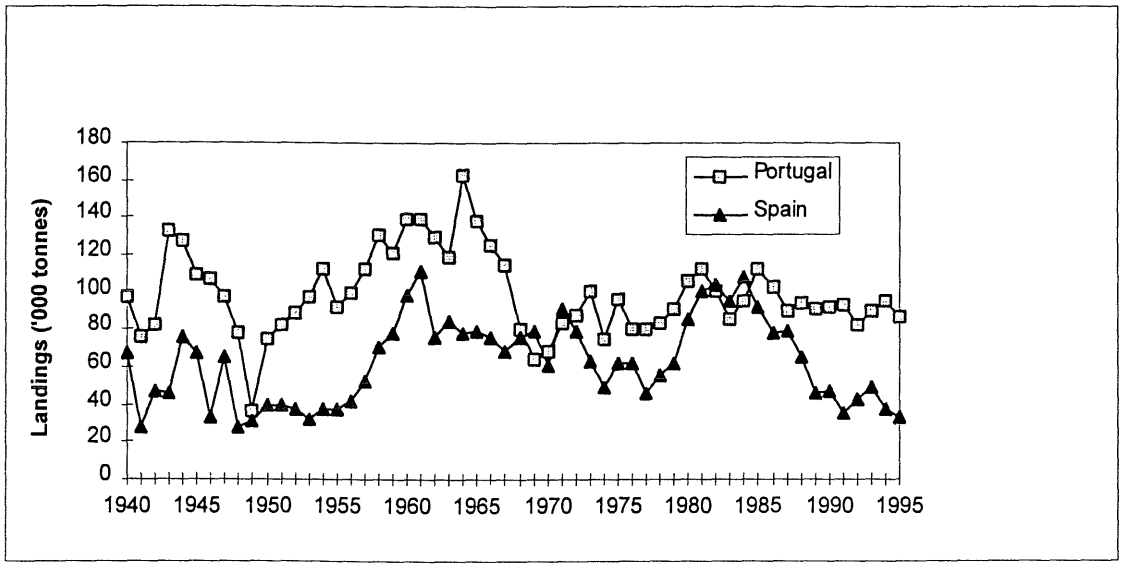


Figure 8.2 Landings of sardine in Divisions VIIIc and IXa by country during 1940–1994.

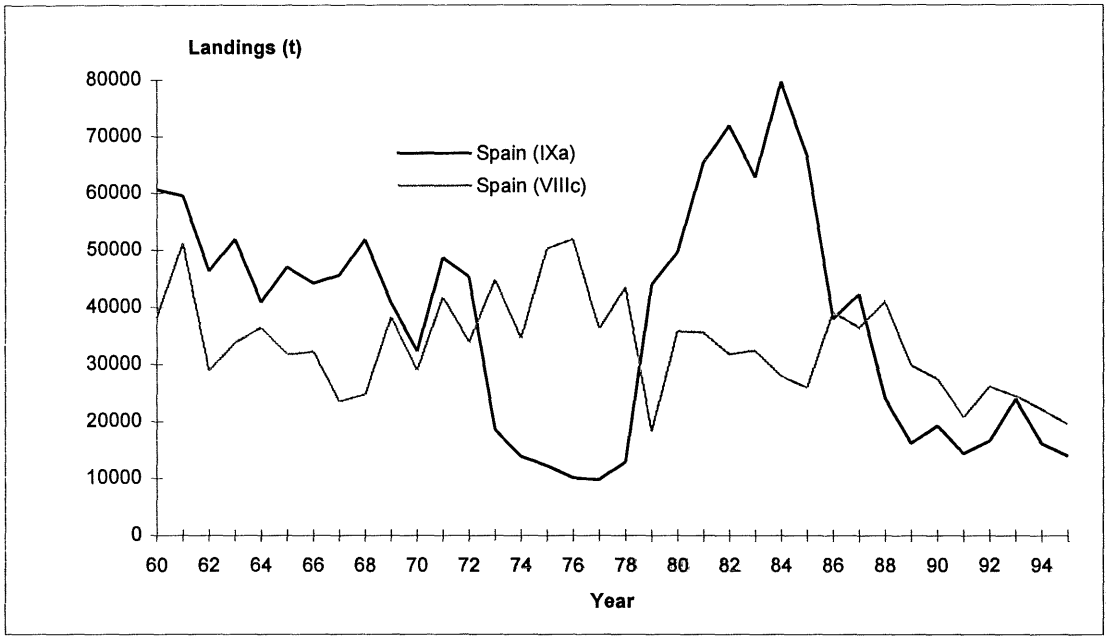


Figure 8.3 Annual Spanish landings by ICES Division.

e:\acfm\wgmhsa97\f-8-3.xls

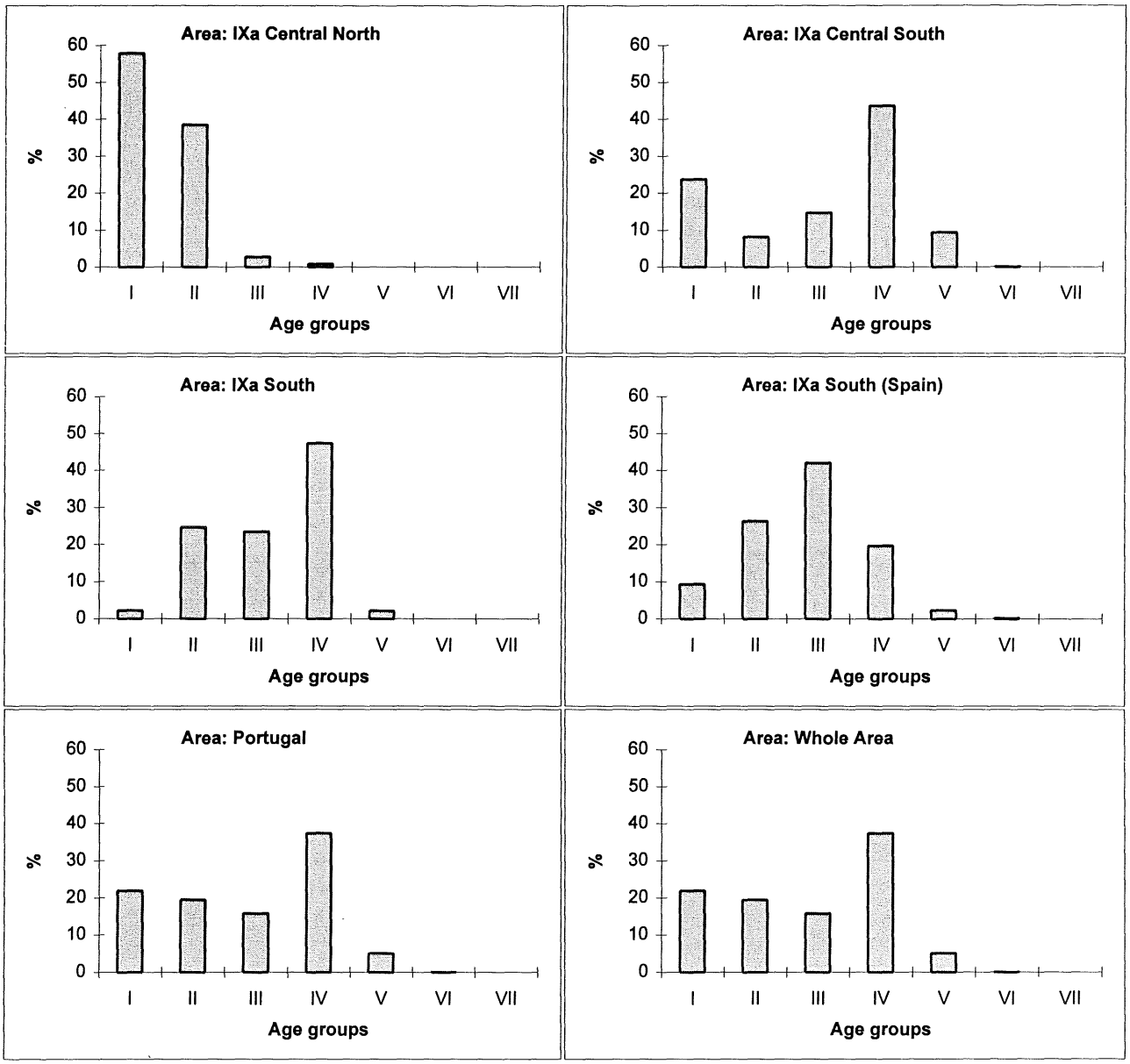


Figure 8.4 Relative abundance in number (%) by age group and area of sardine during the Portuguese February-March survey.

e:\acfm\wgmhsa97\f-8-4.xls

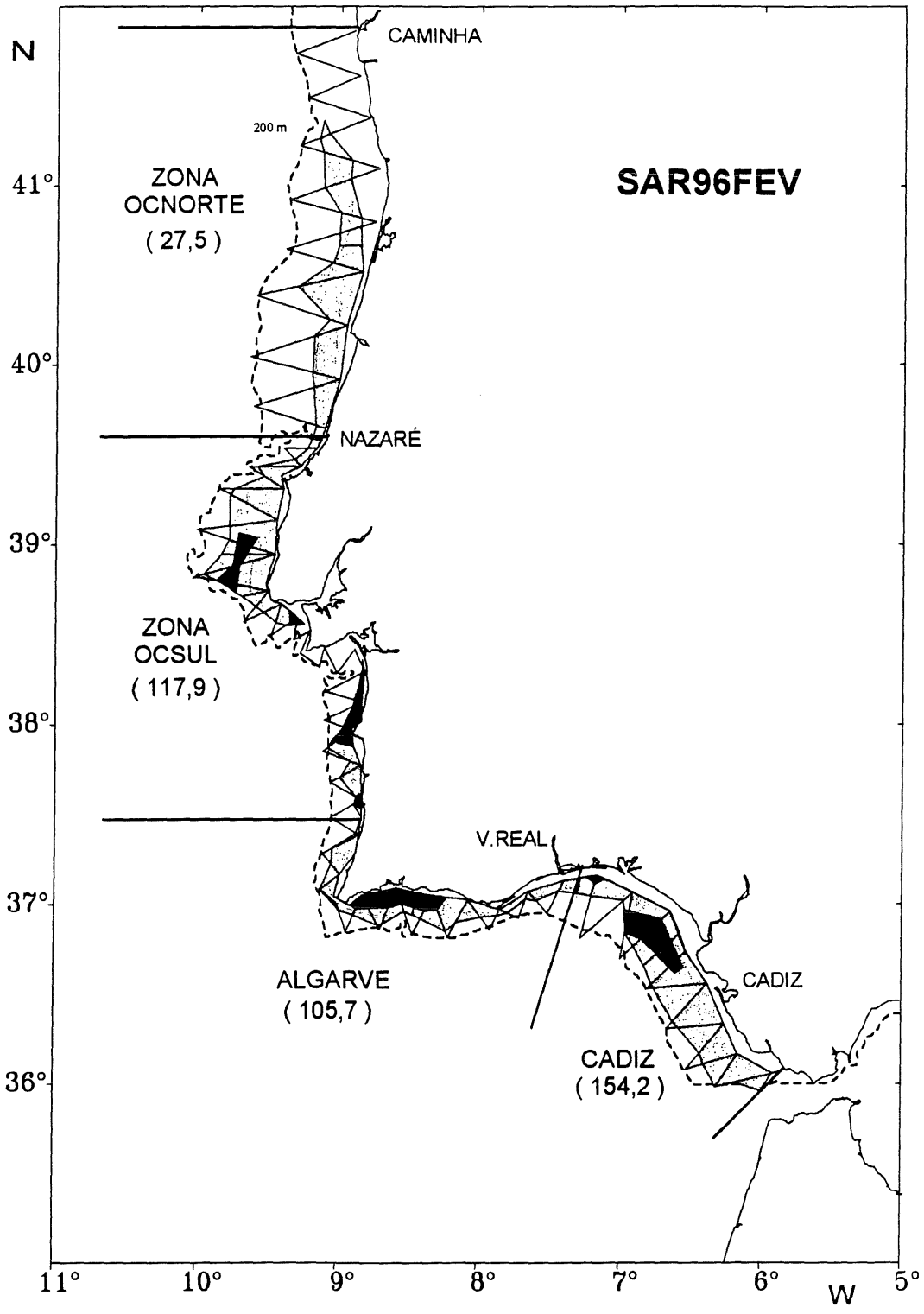


Figure 8.5 February-March Portuguese acoustic survey: survey track, sardine distribution area and coast zones used for abundance estimation purposes. Estimated biomass for each zone ('000 tonnes) is shown between brackets.

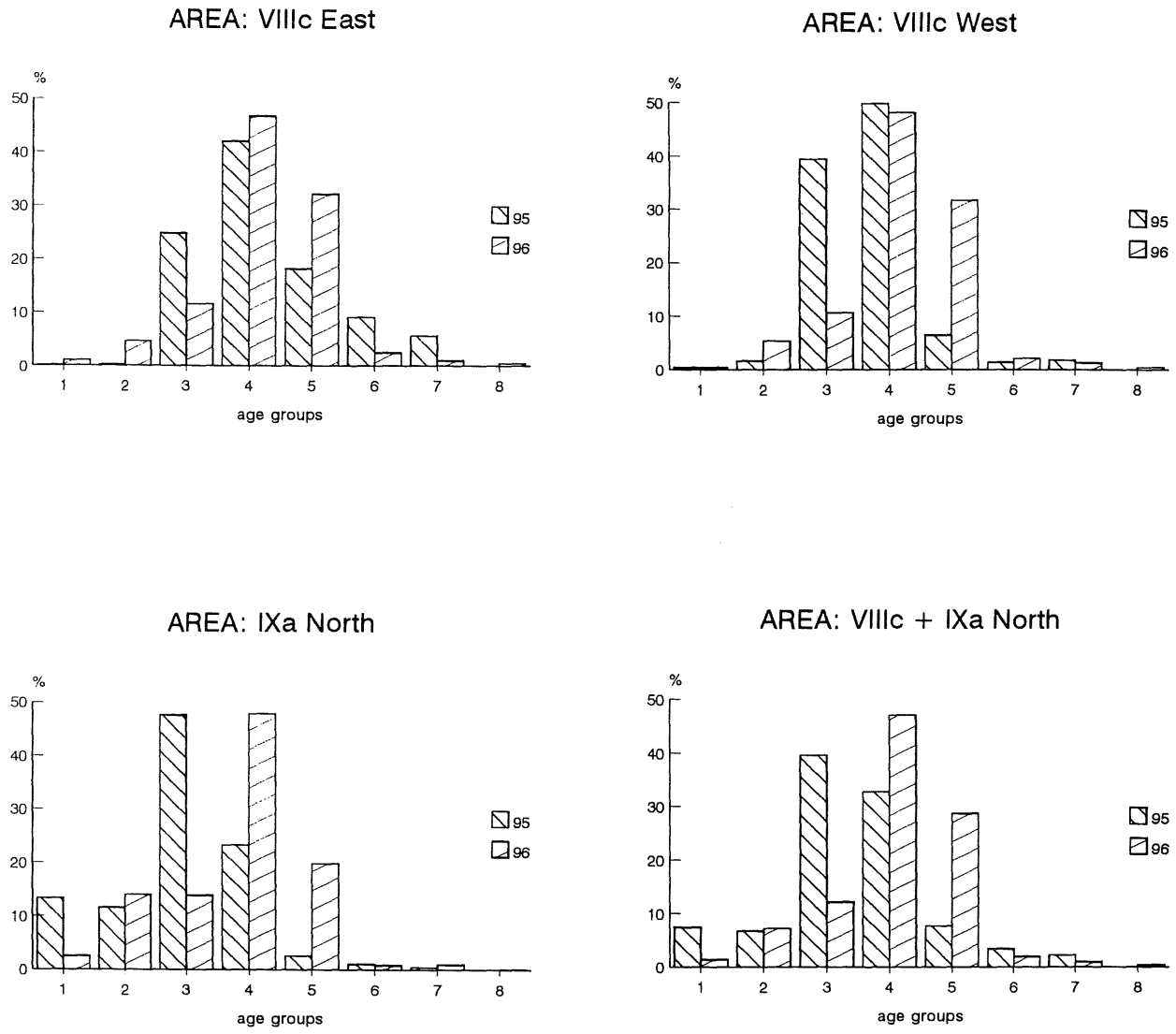


Figure 8.6: Relative abundance in number (%) by age group and area of sardine during IBERSR 95 and SEFOS 96 surveys.

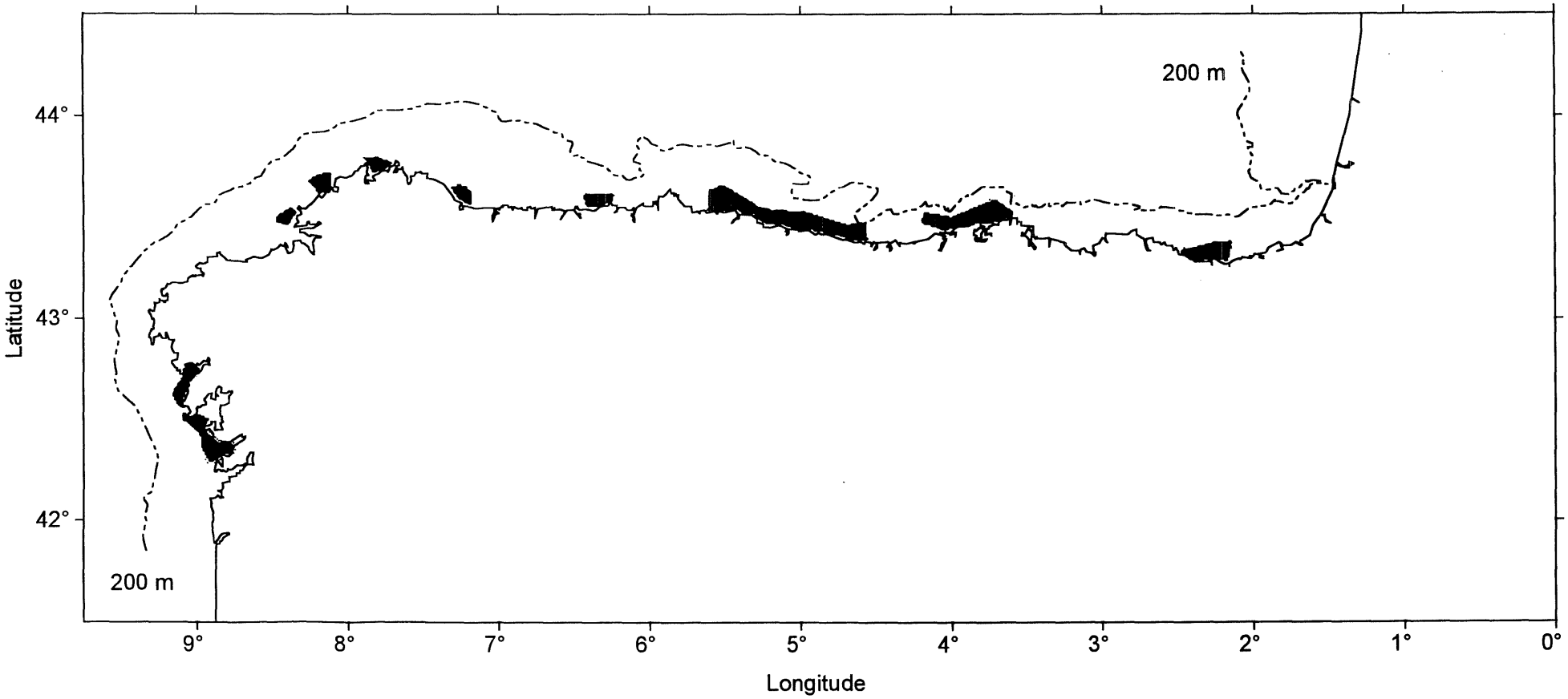


Figure 8.7: SEFOS 0396 (march 1996). Relative abundance of sardine (square meters)

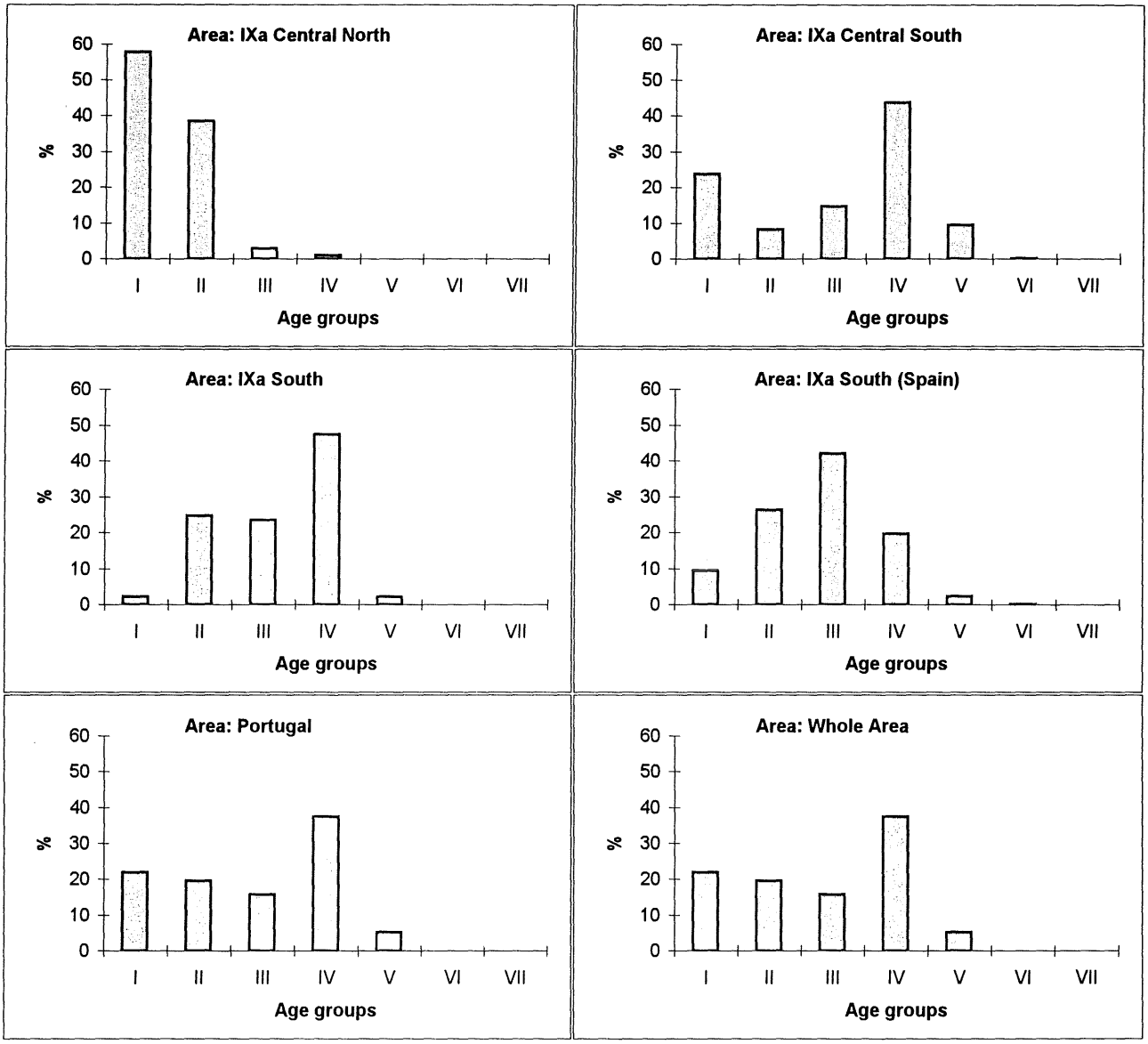


Figure 8.8 Relative abundance in number (%) by age group and area of sardine during the Portuguese June-July survey

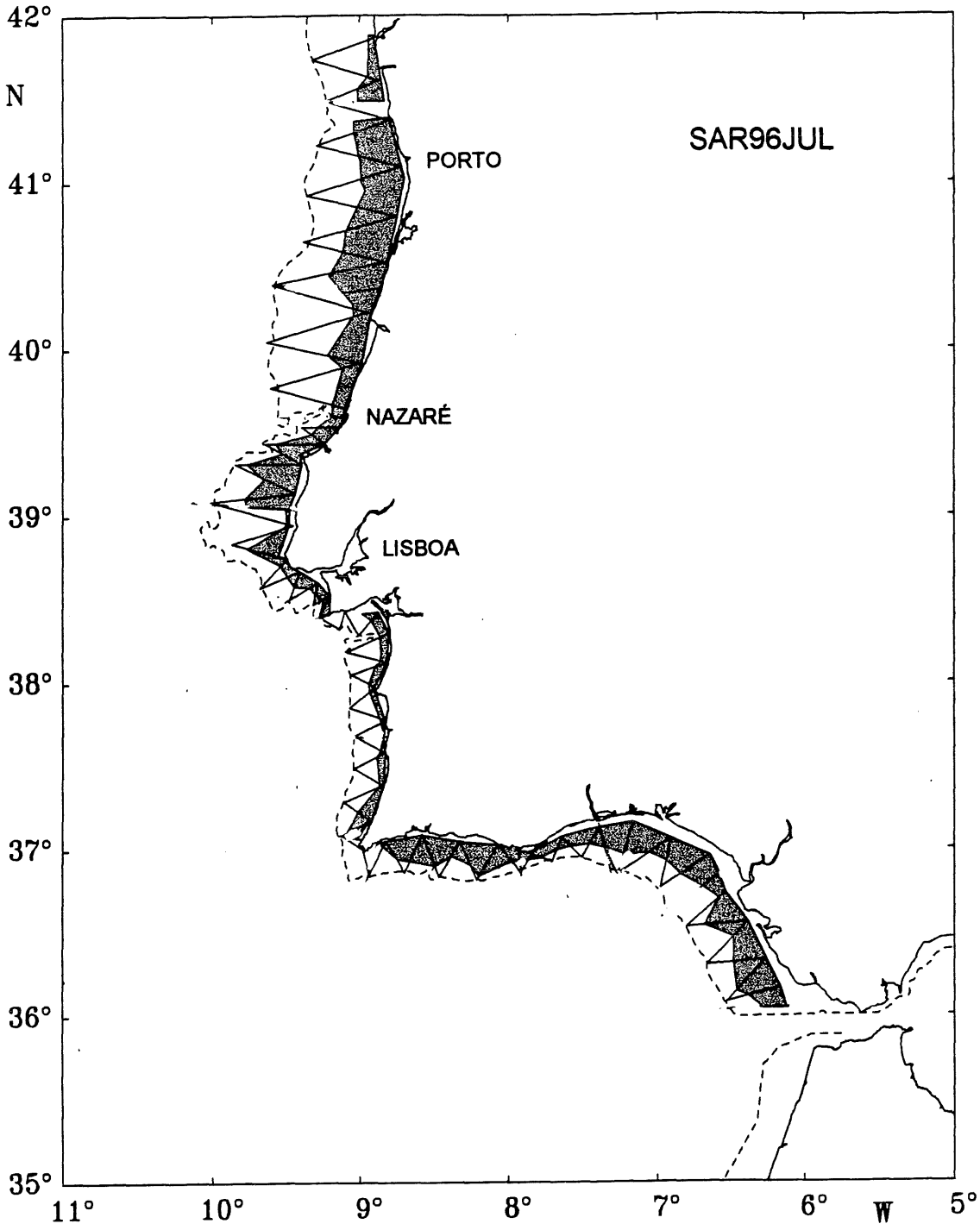


Figure 8.9 June-July Portuguese acoustic survey: survey track and sardine distribution area.

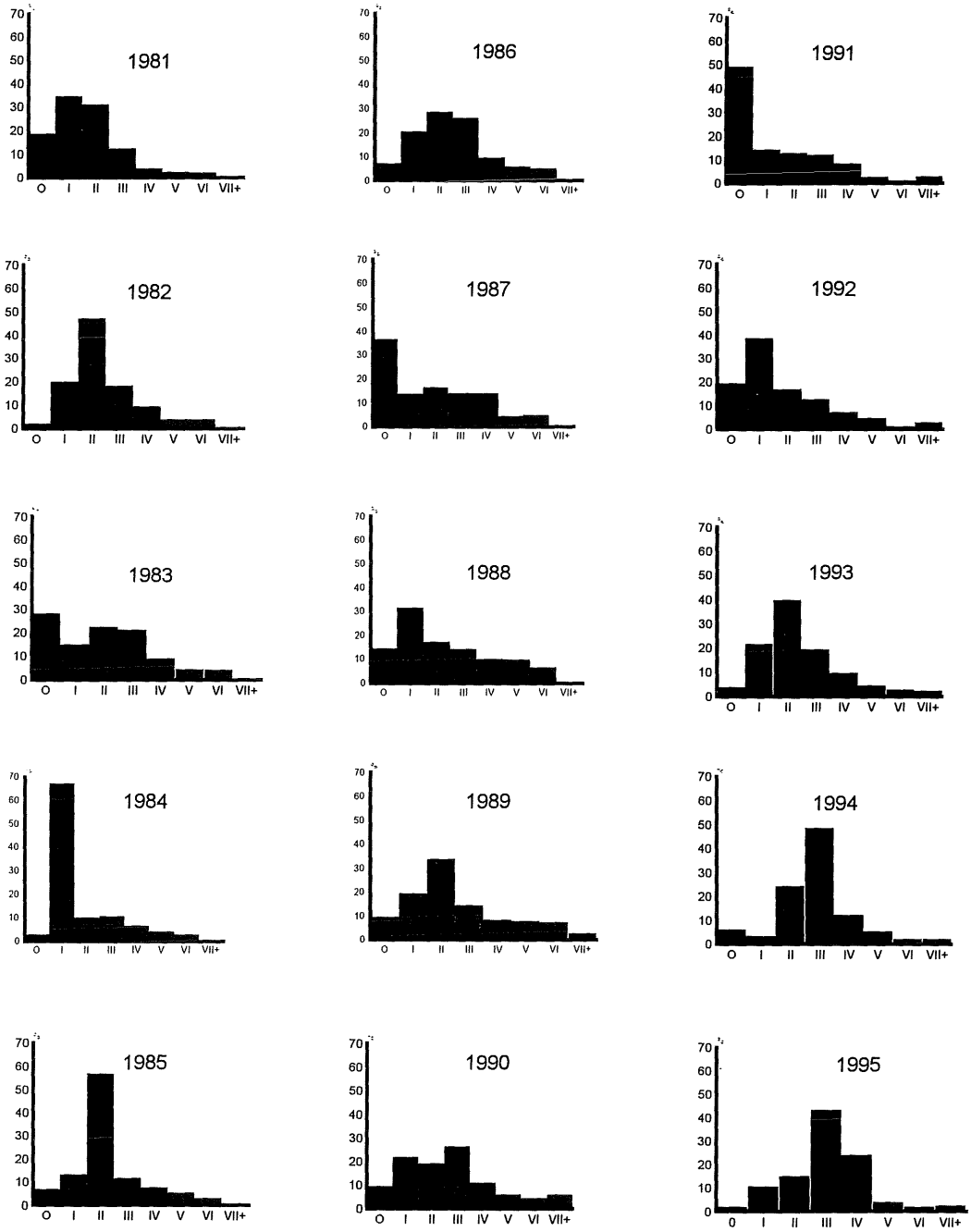


Figure 8.10 Div. VIIIc+IXa - relative annual catch in number at age from 1981 to 1995.

g:\acfm\wgmhsa\sar_soth\fig8_10 21-08-1996 21:31

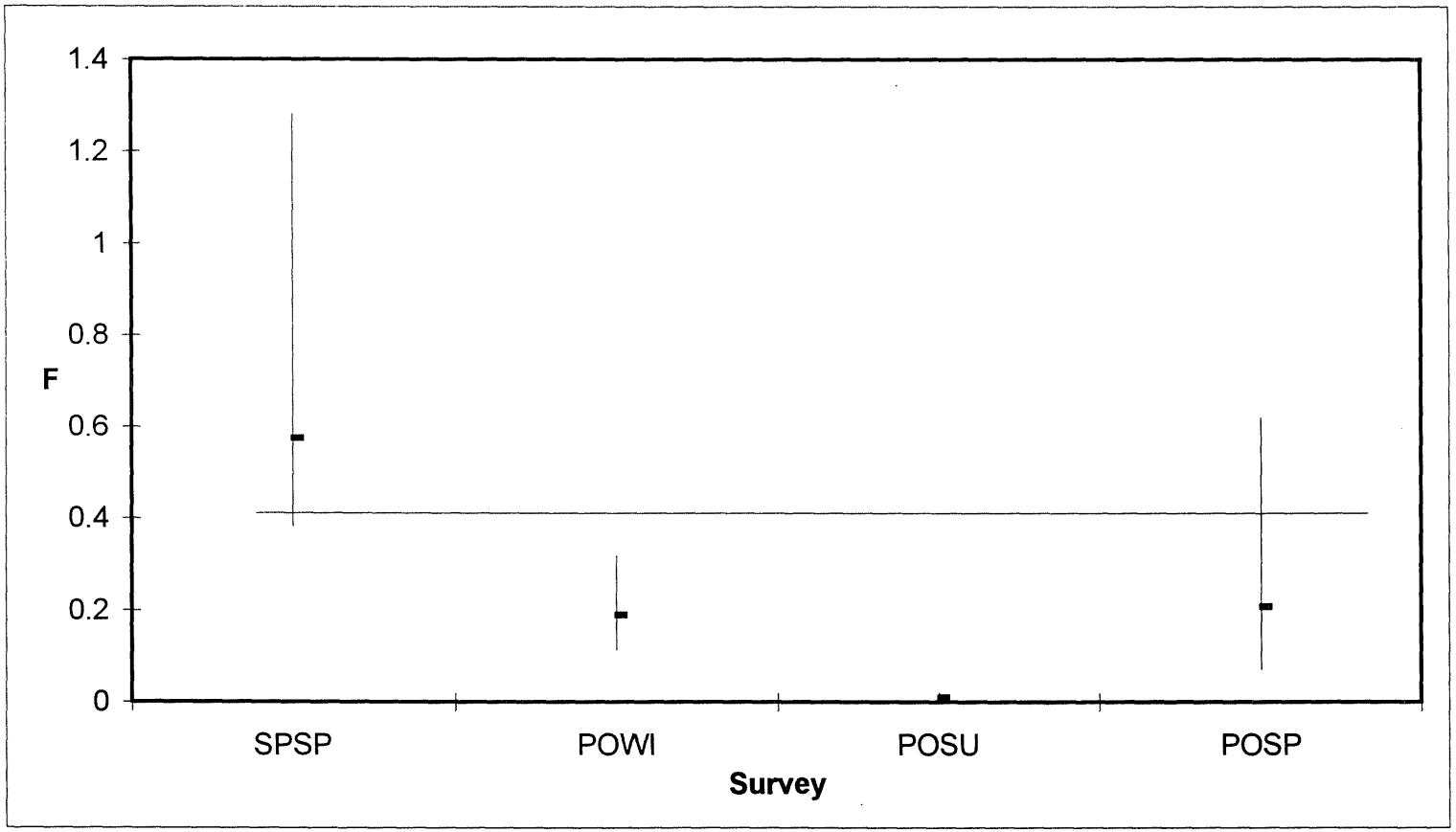
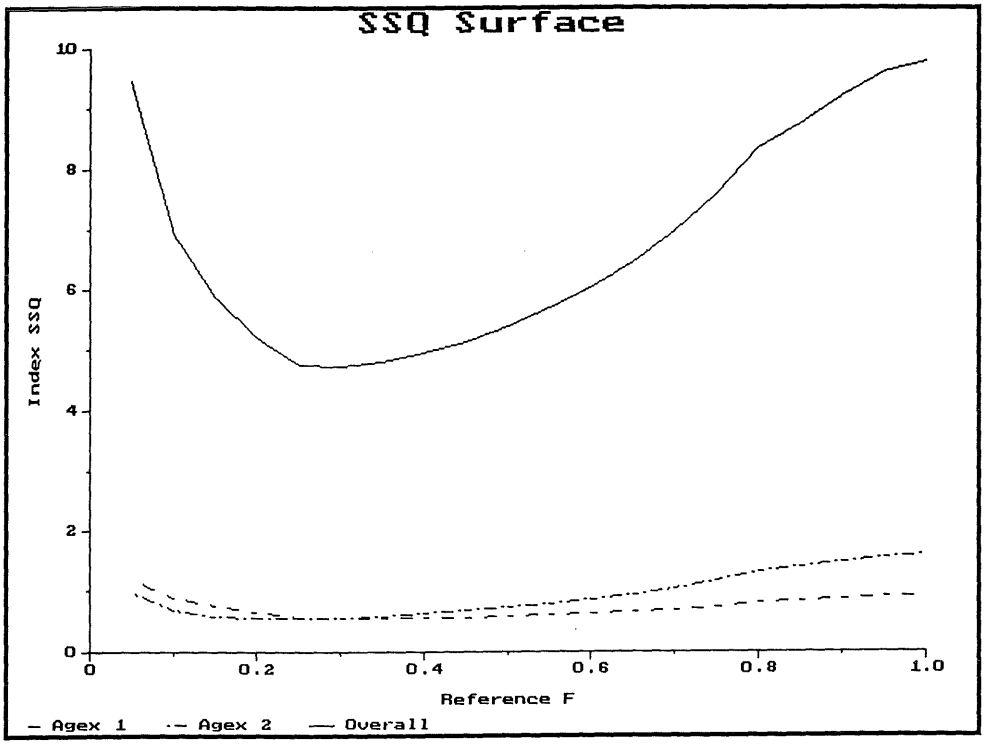


Figure 8.11 Fbar for each survey serie and its confidential interval .



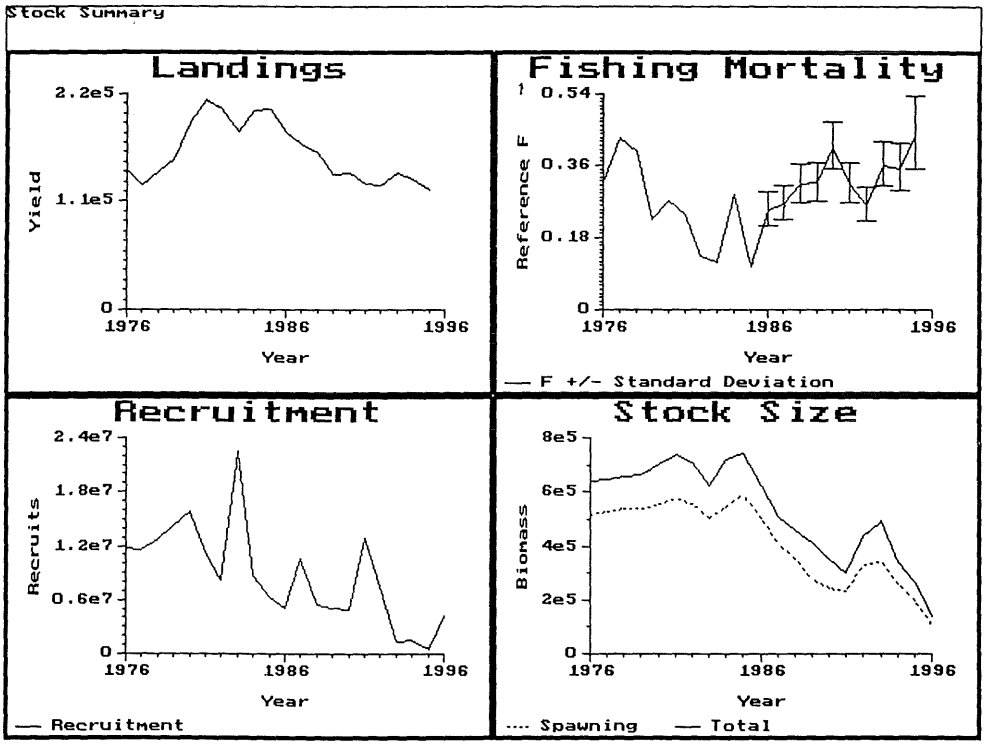


Figure 8.12a Stock summary and separable model diagnostics.

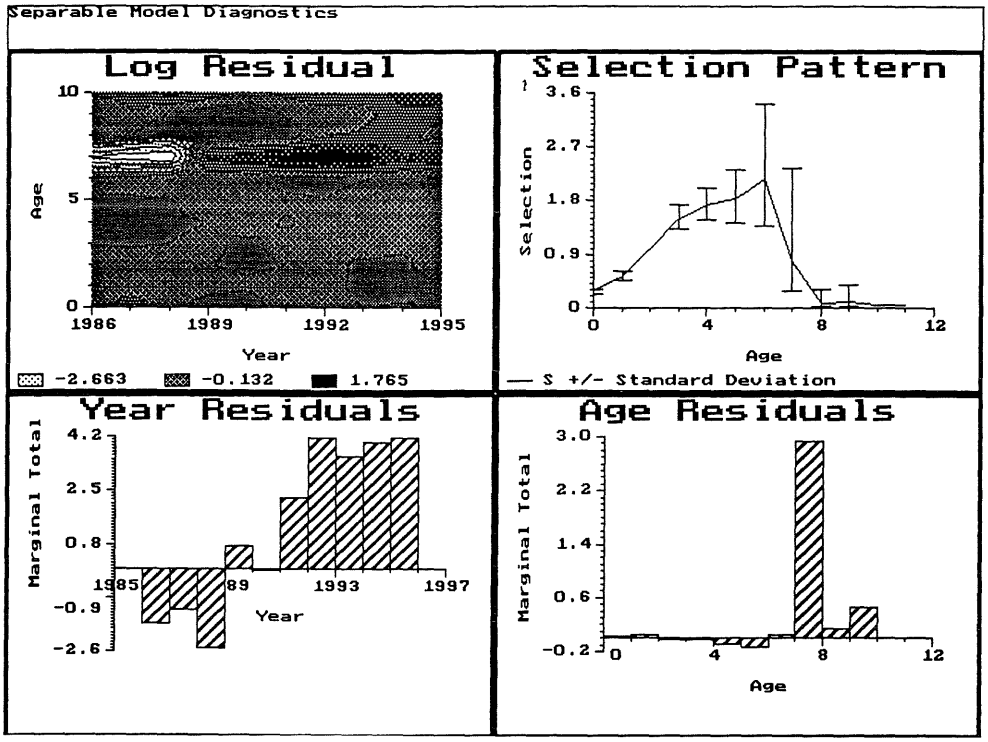


Figure 8.12a (continued).

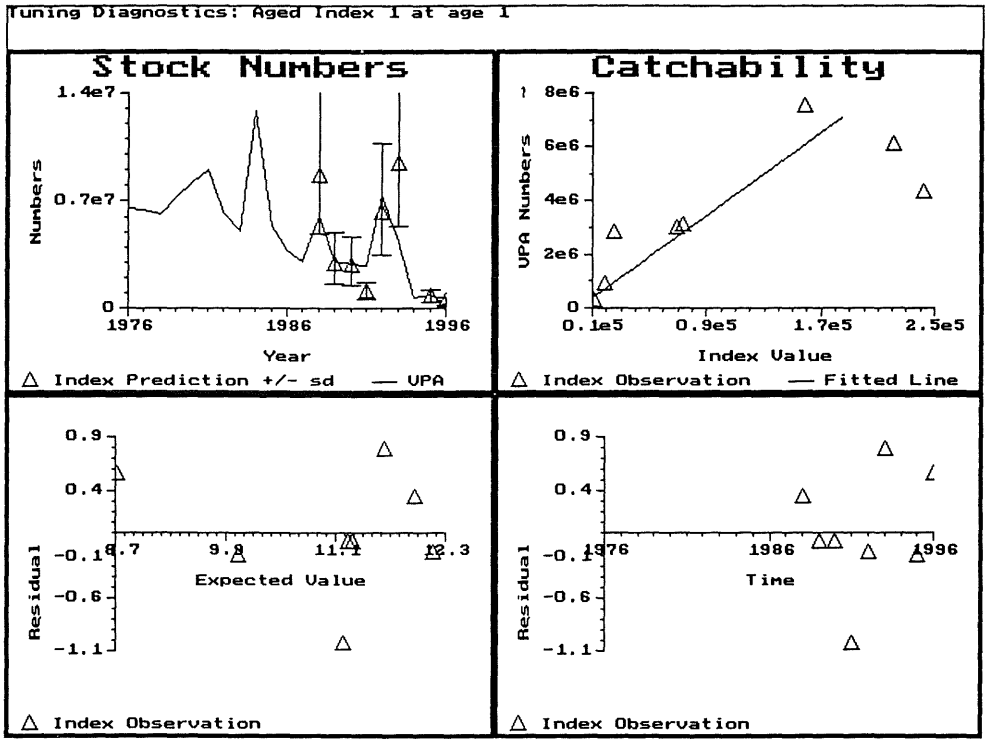
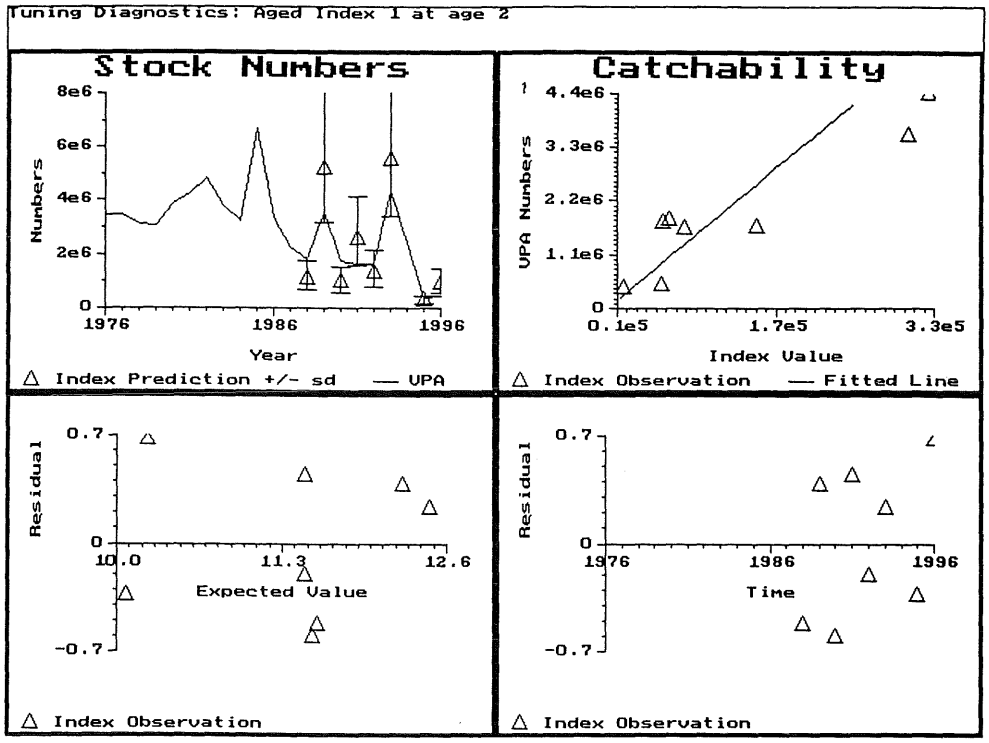


Figure 8.12b Tunning diagnostics: Aged index 1 at ages 1 to 11.



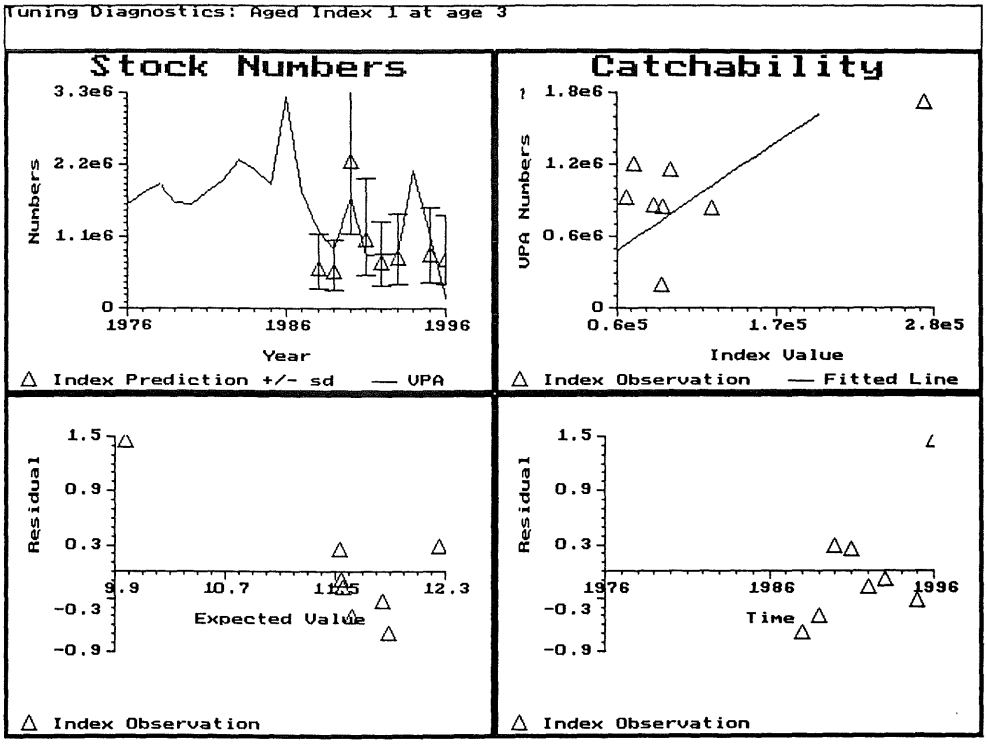
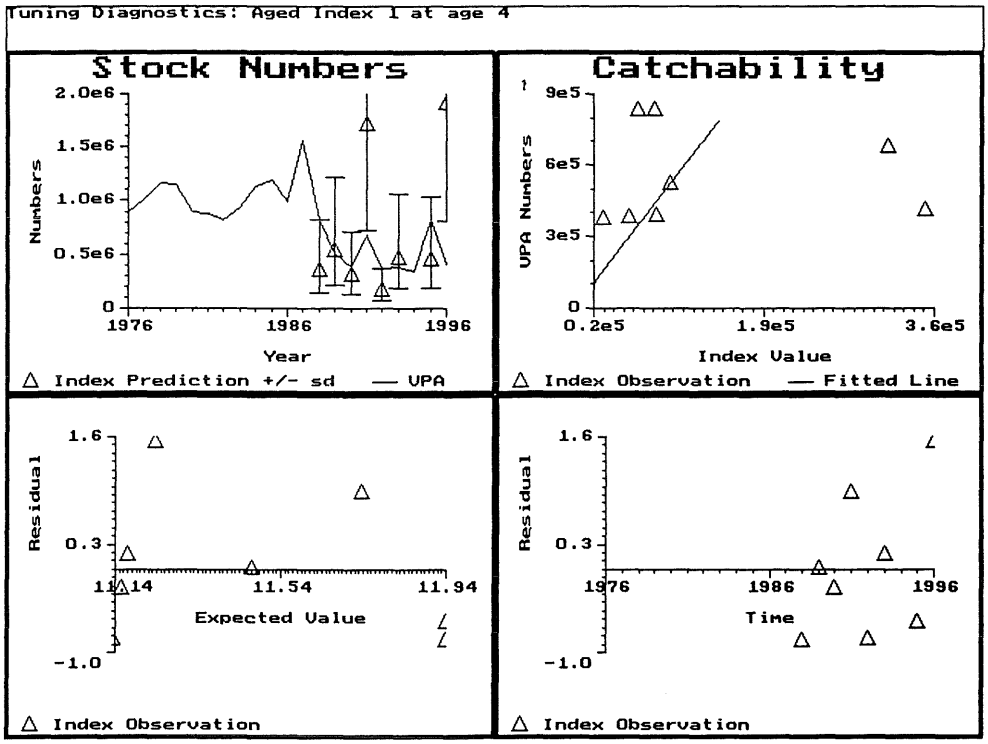


Figure 8.12b (continued)



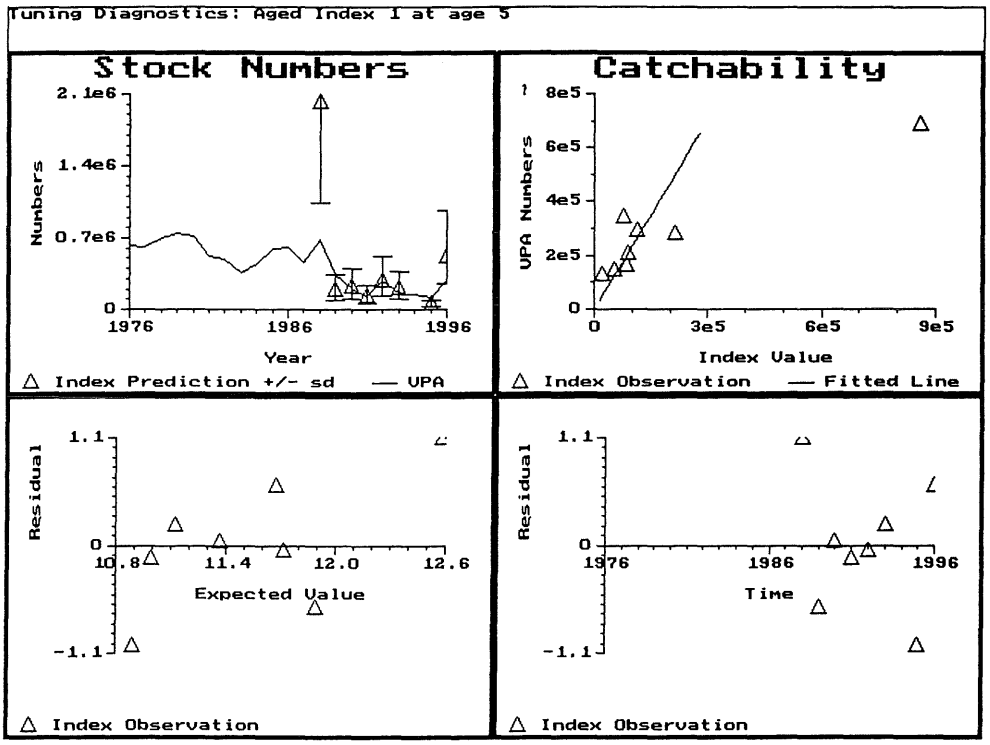
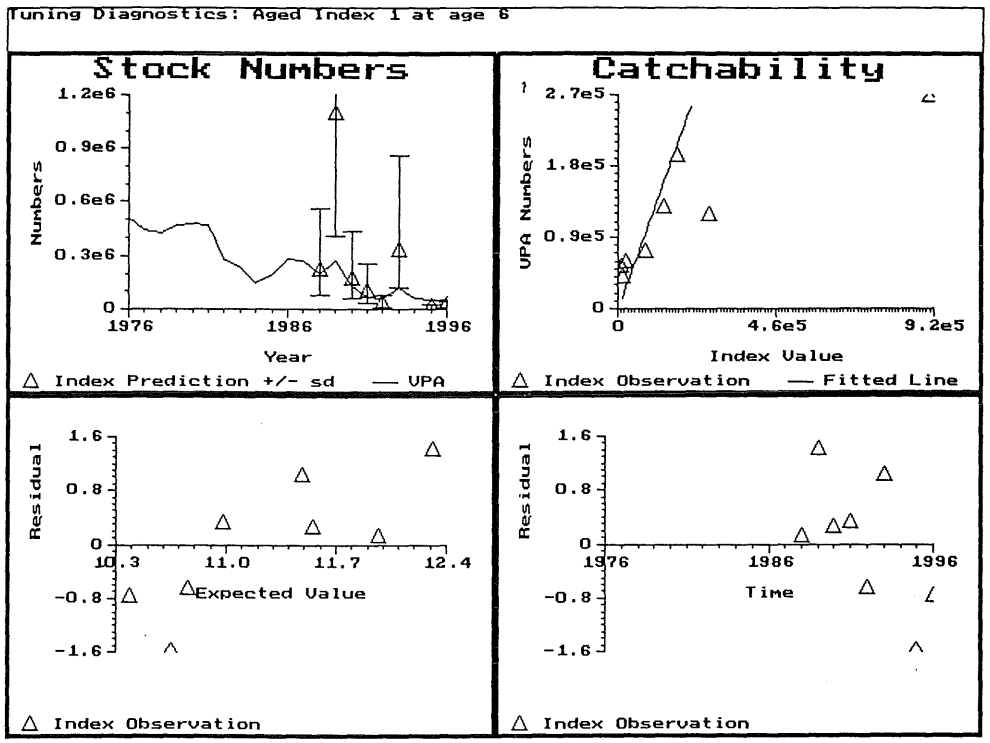


Figure 8.12b (continued)



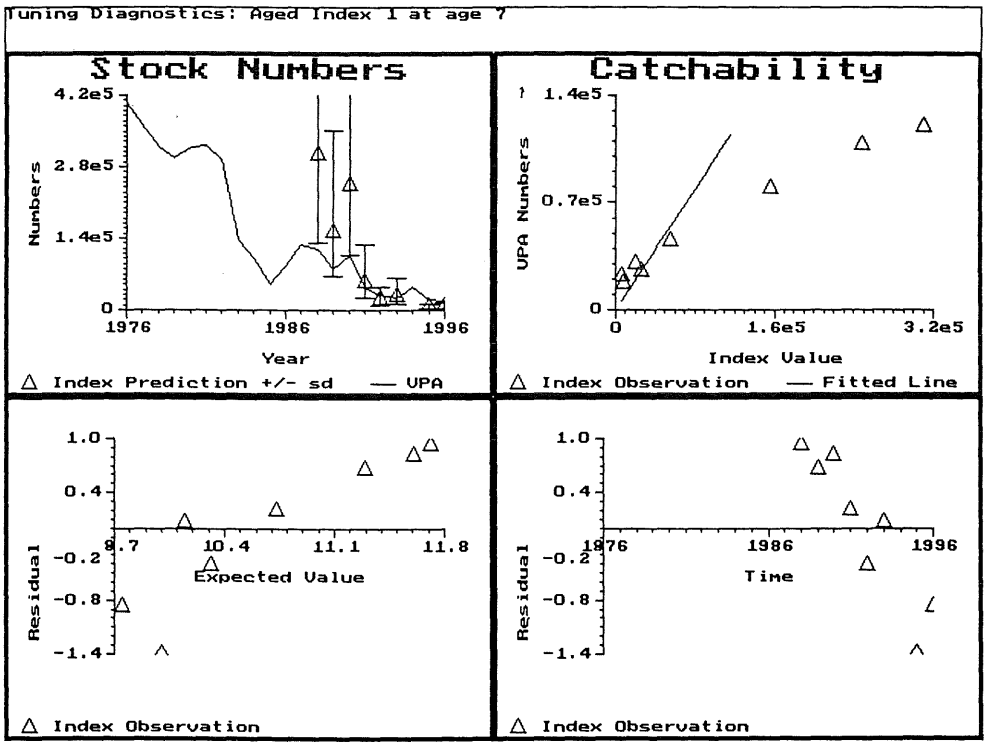
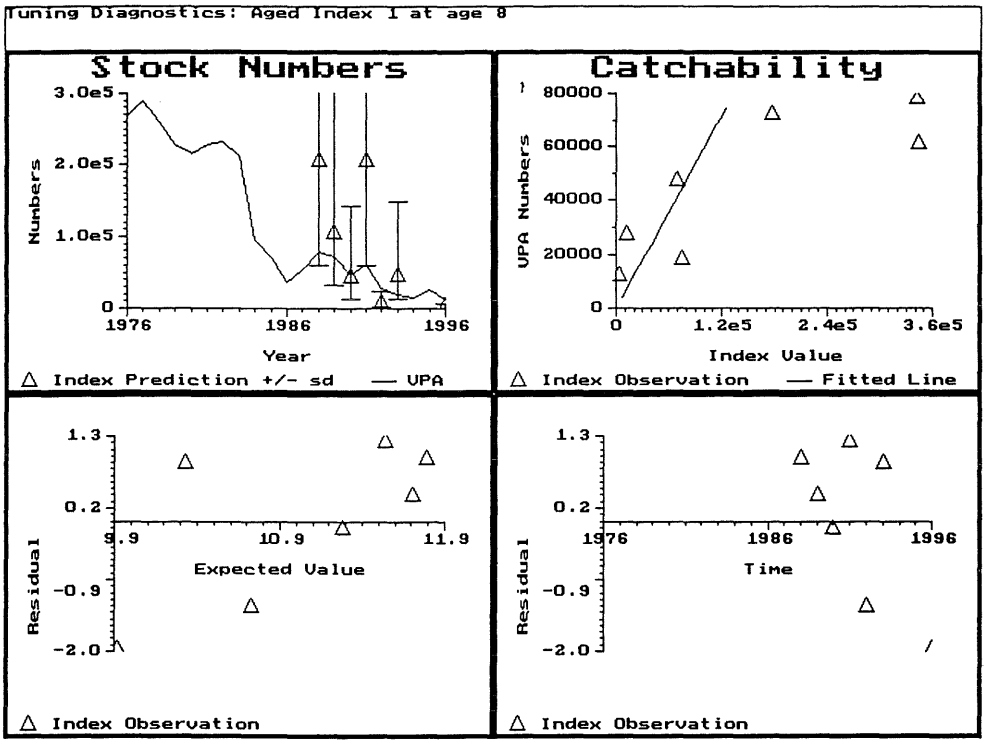


Figure 8.12b (continued)



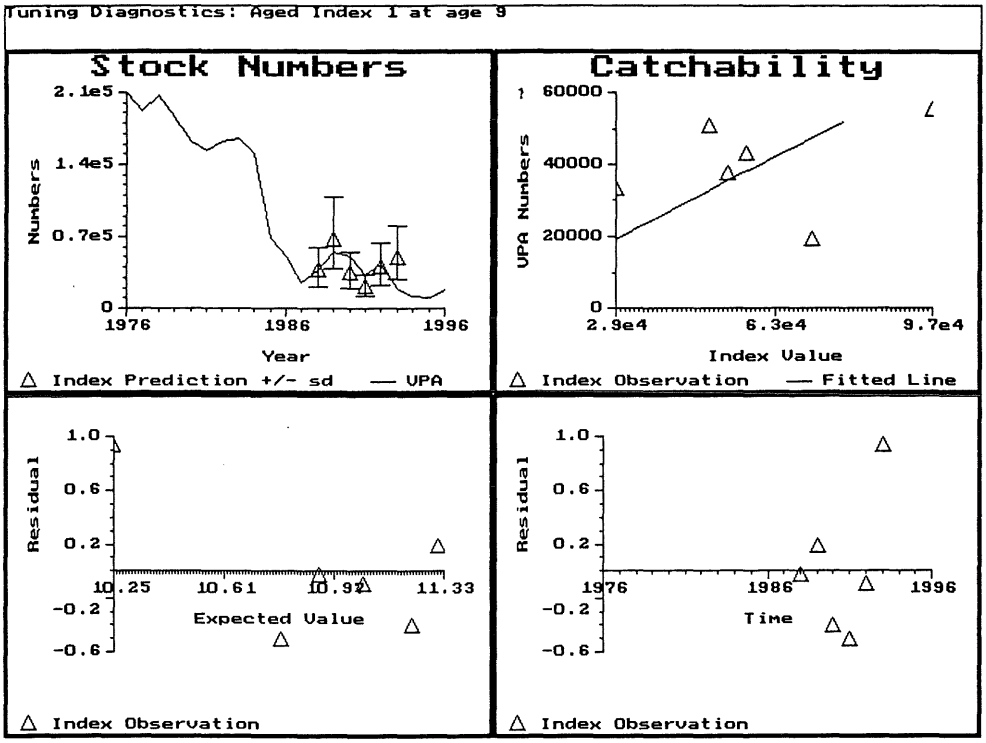
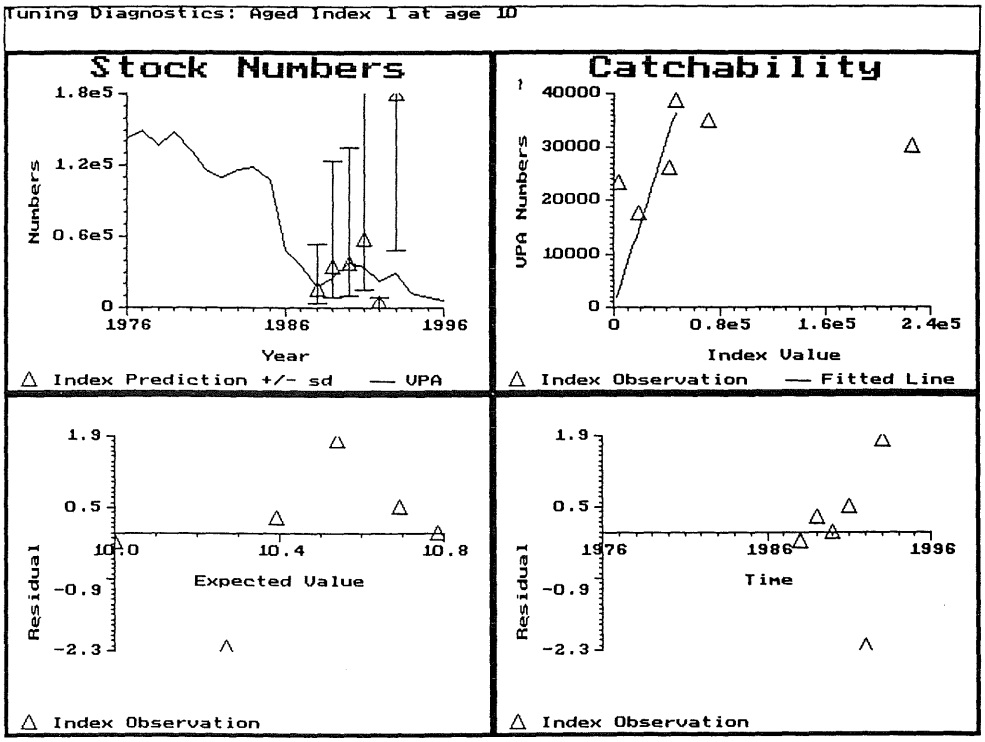


Figure 8.12b (continued)



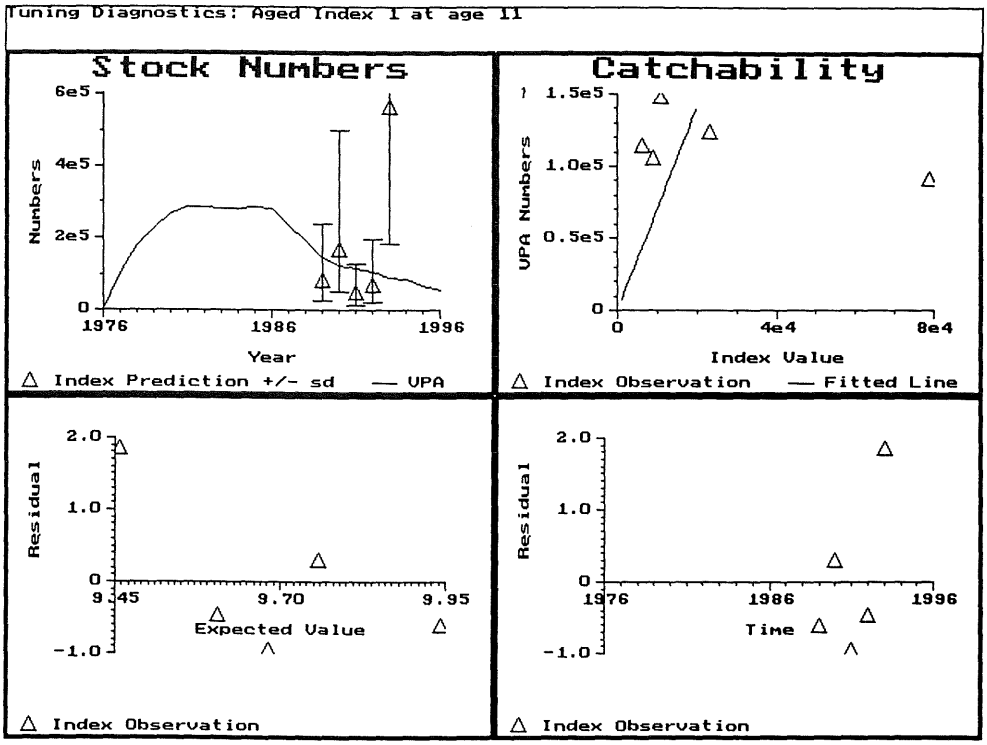
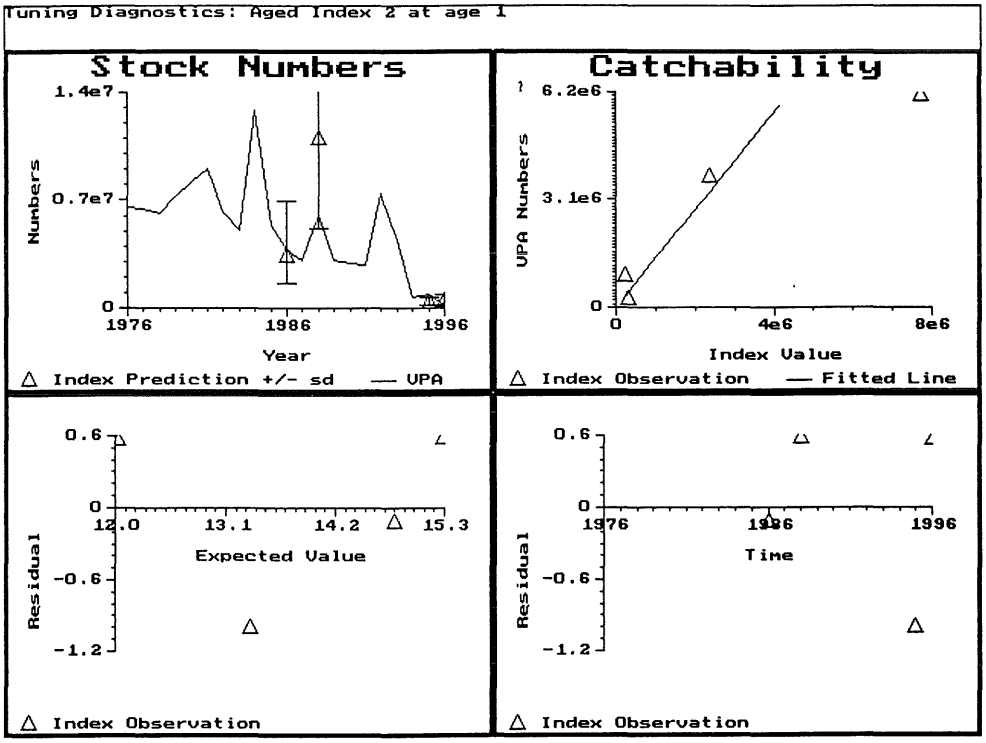


Figure 8.12b (continued)



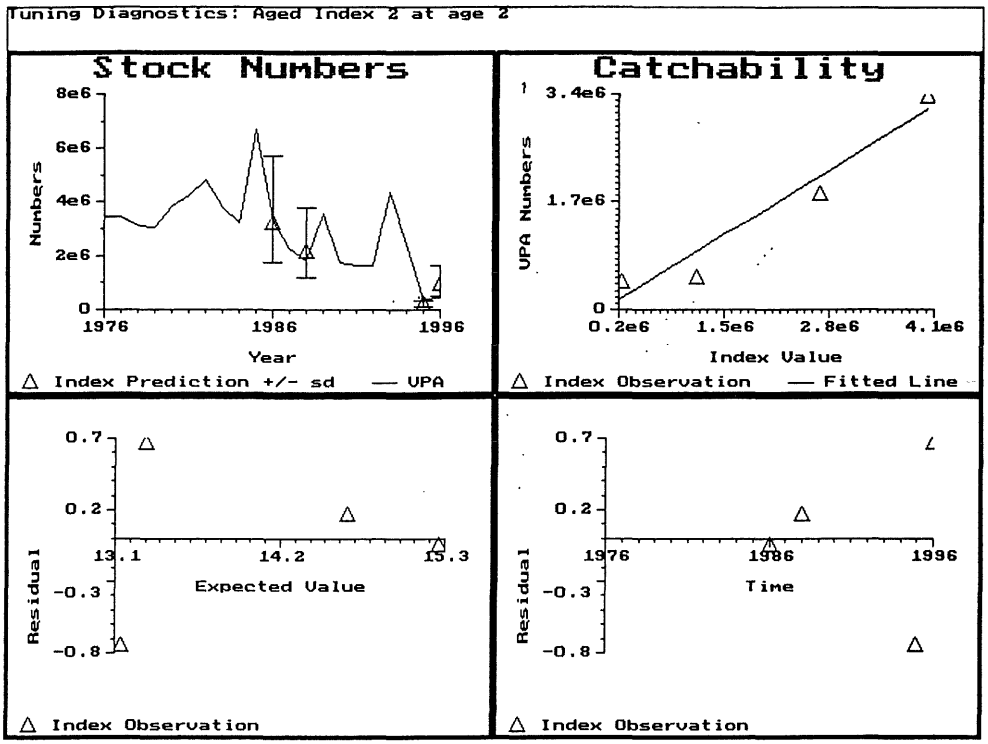
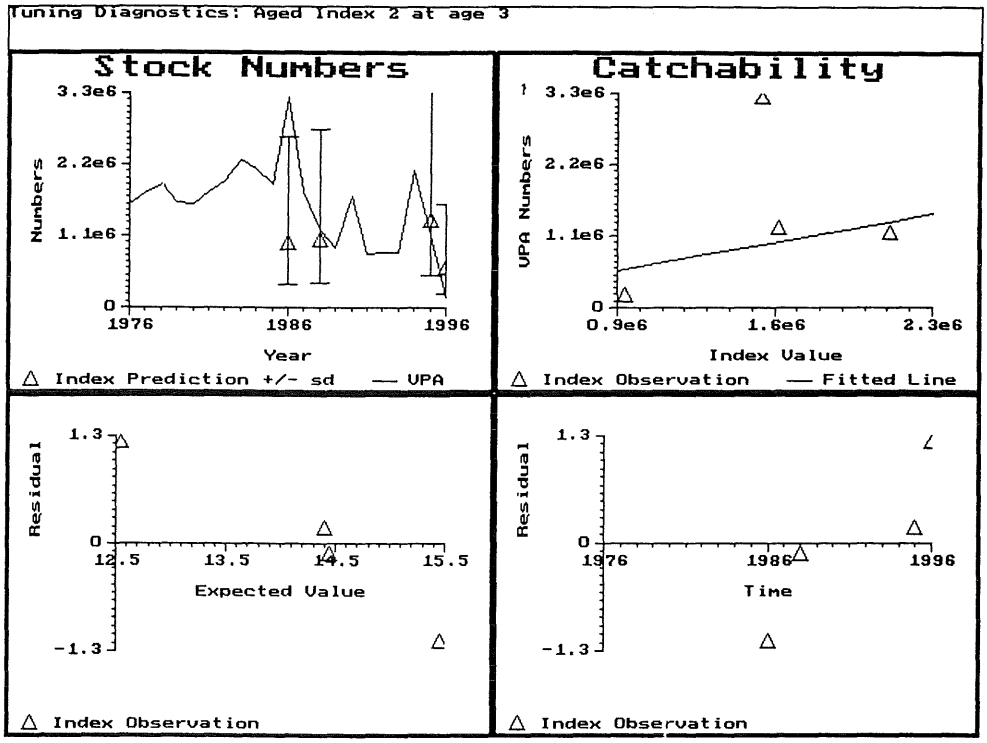


Figure 8.12c Tunning diagnostics: Aged index 2 at ages 1 to 11.



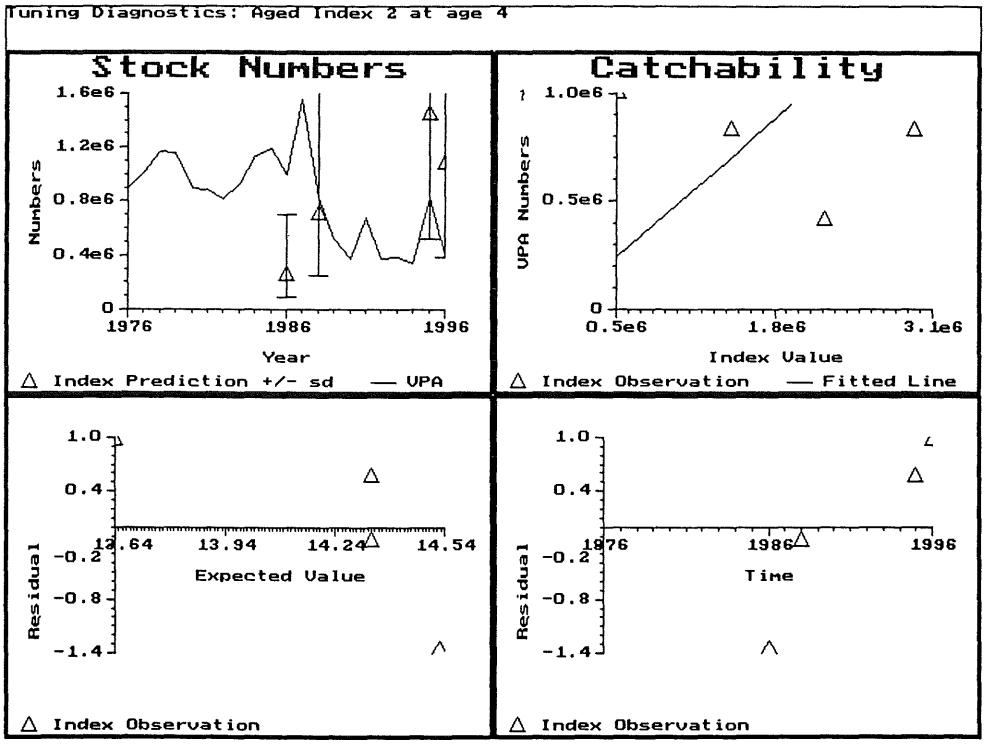
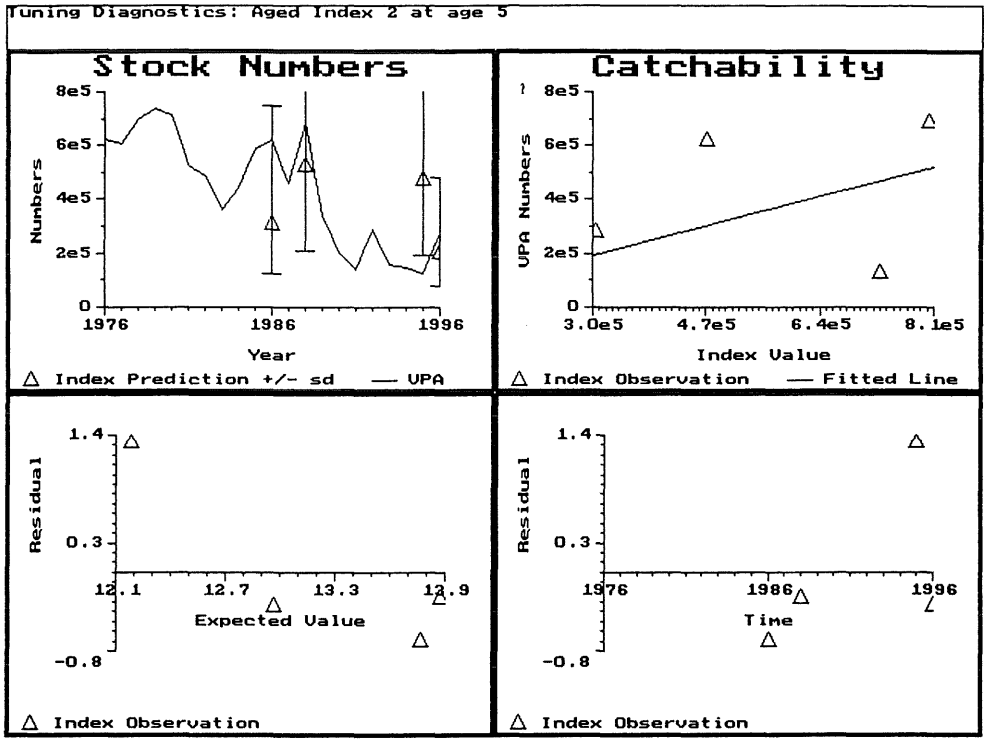


Figure 8.12c (continued)



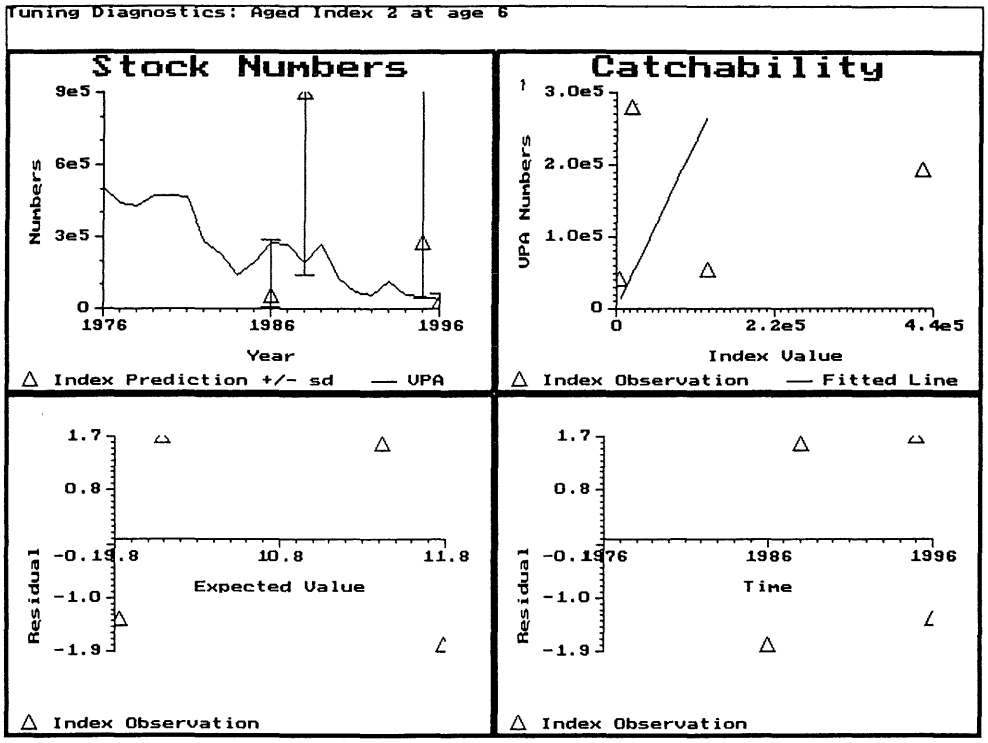


Figure 8.12c (continued)

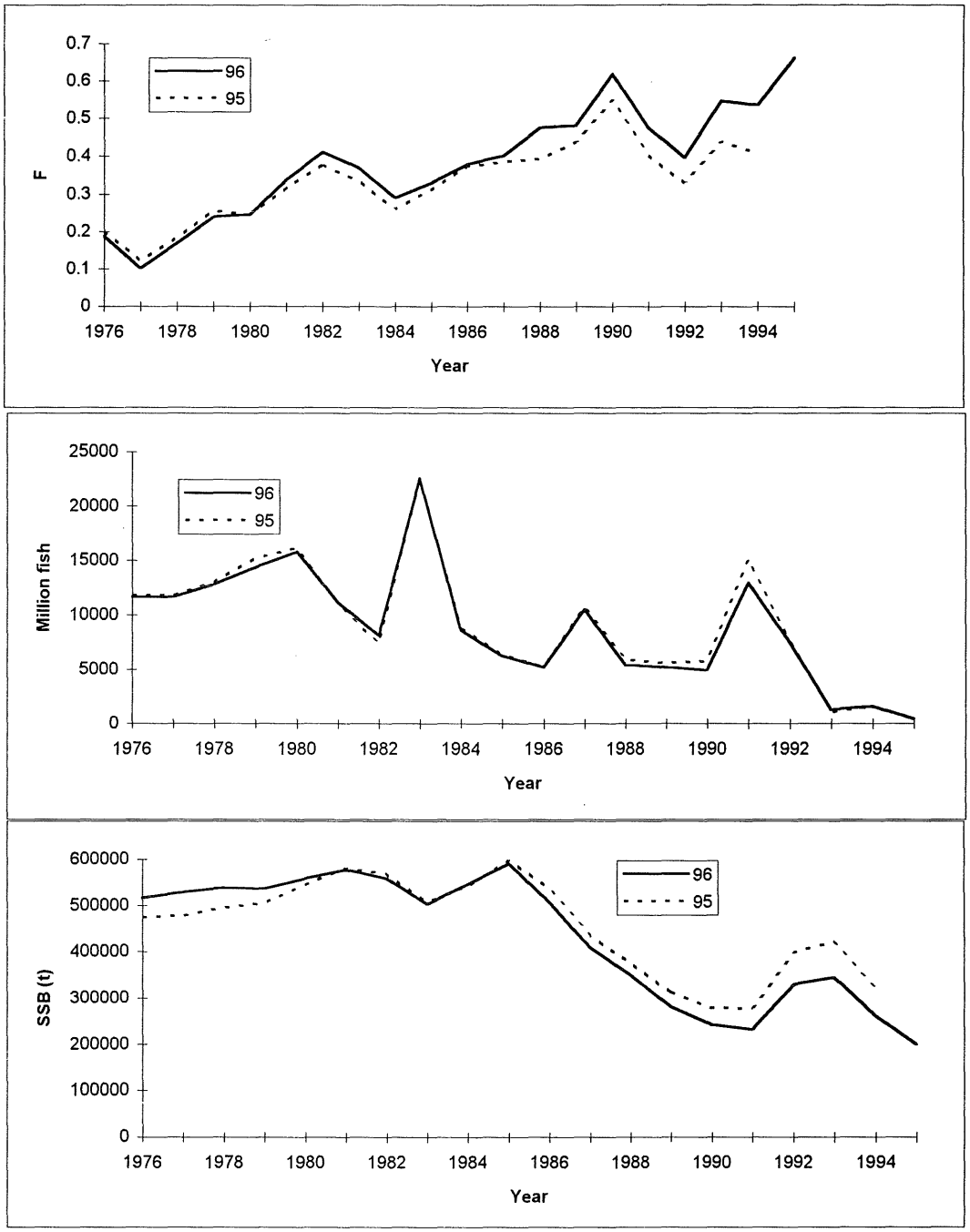


Figure 8.13 Fbar, Recruitment and SSB predictions in 1995 and 1996 assessments.

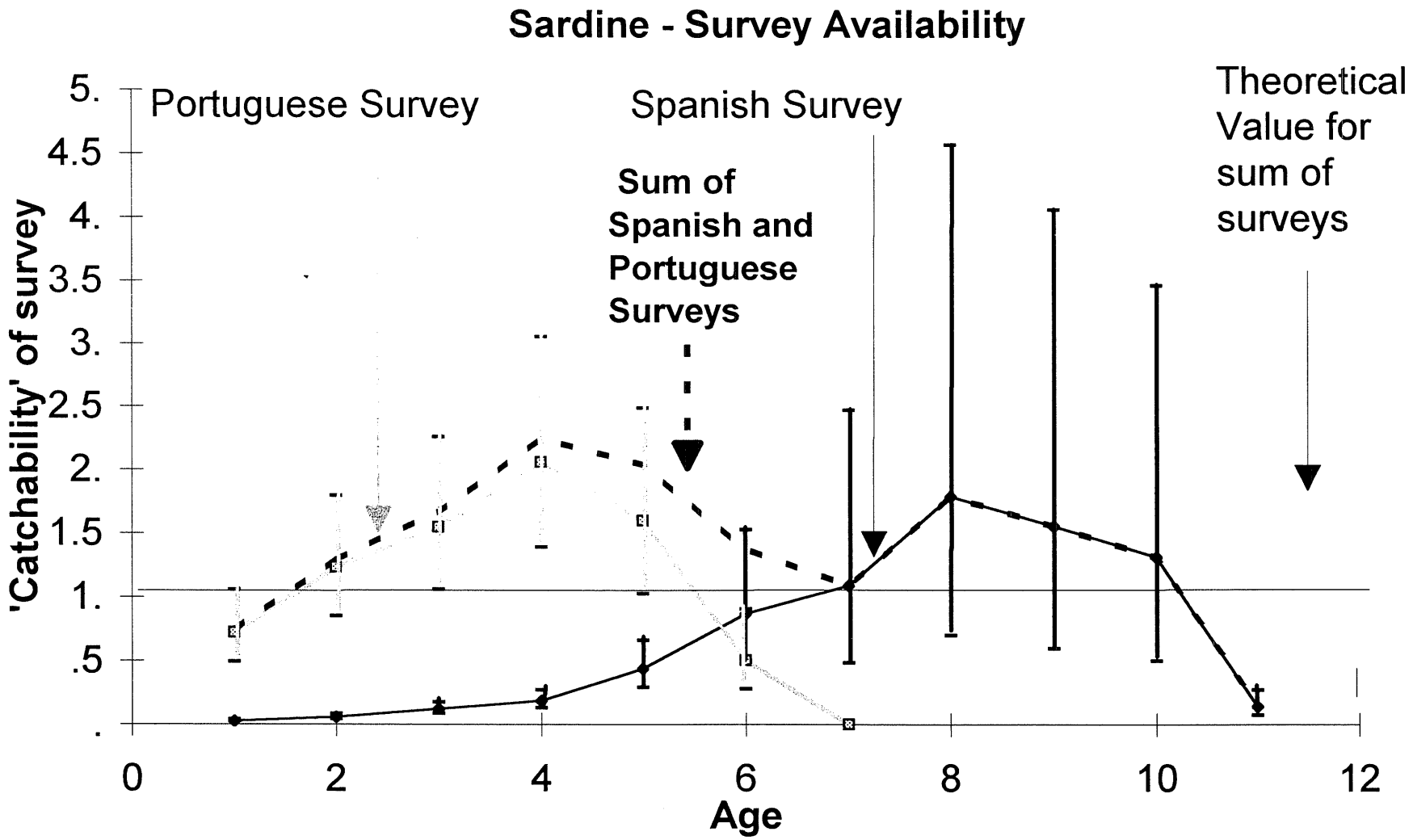

Sardine - Survey Availability
Portuguese Survey
Spanish Survey
Theoretical Value for sum of surveys
Sum of Spanish and Portuguese Surveys
'Catchability' of survey
5.
4.5
4.
3.5
3.
2.5
2.
1.5
1.
.5
.
0
2
4
6
8
10
12
Age

Figure 8.14

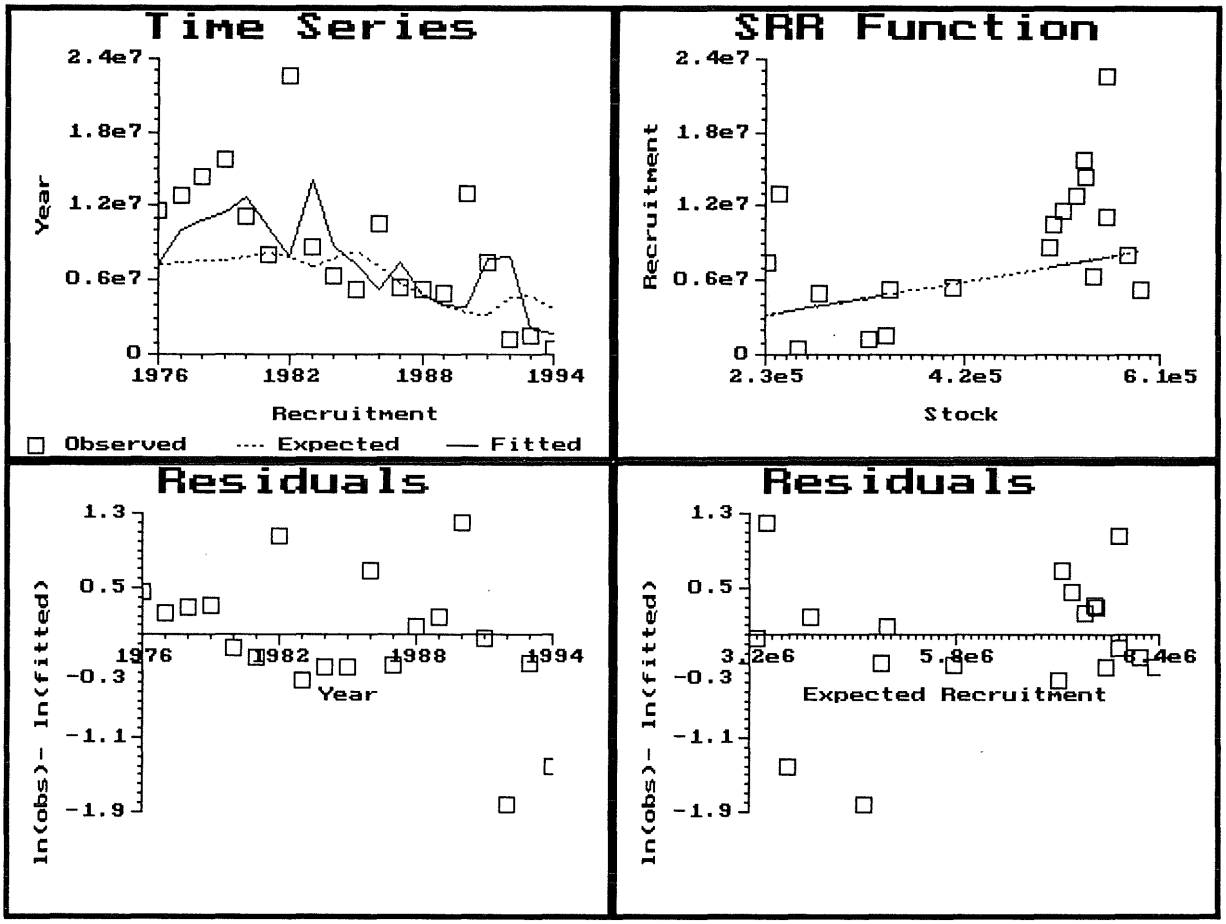
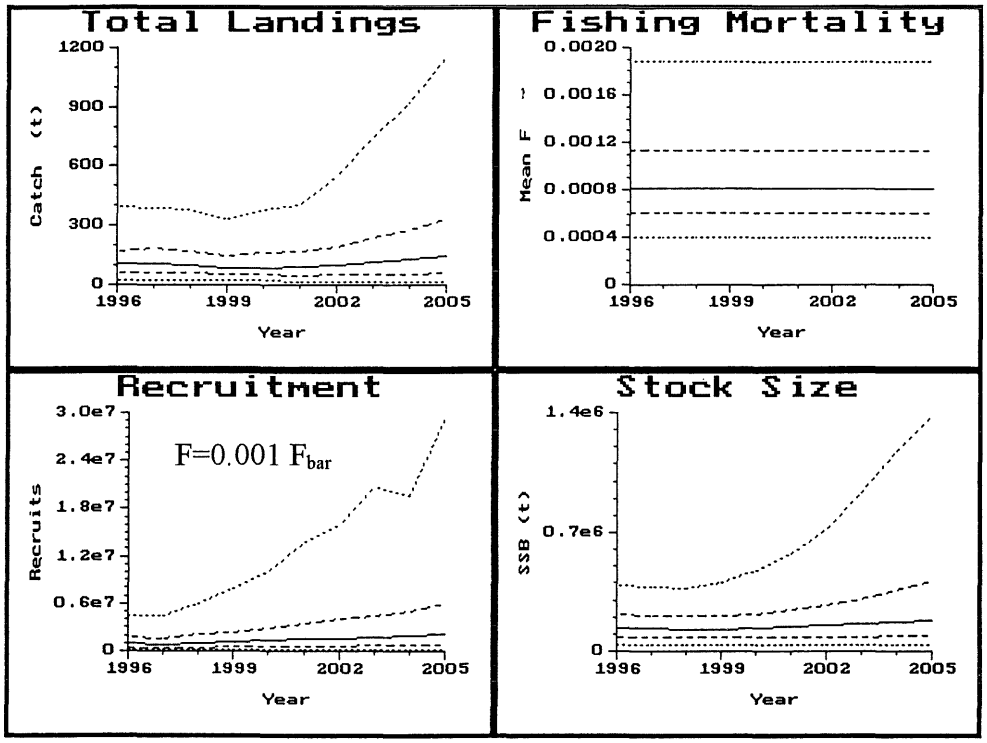

Time Series
2.4e7
1.8e7
1.2e7
0.6e7
0
Year
1976
1982
1988
1994
Recruitment
Observed
Expected
Fitted
SRR Function
2.4e7
1.8e7
1.2e7
0.6e7
0
Recruitment
2.3e5
4.2e5
6.1e5
Stock
Residuals
1.3
0.5
-0.3
-1.1
-1.9
ln(obs)- ln(fitted)
1976
1982
1988
1994
Year
Residuals
1.3
0.5
-0.3
-1.1
-1.9
ln(obs)- ln(fitted)
3.2e6
5.8e6
8.4e6
Expected Recruitment

Figure 8.15



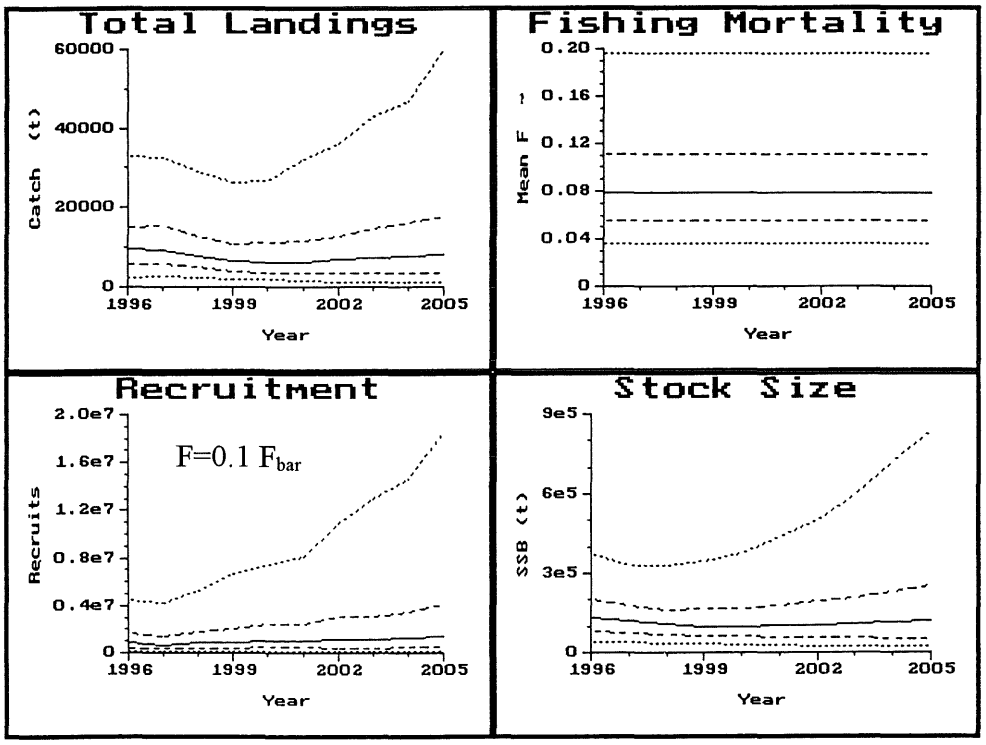
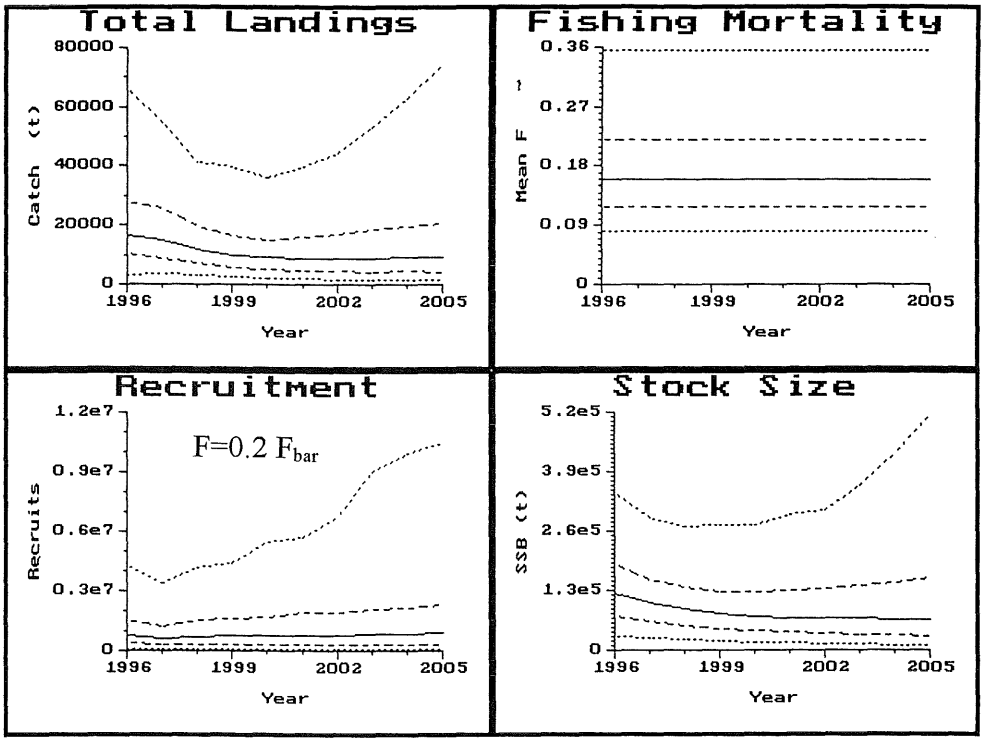


Figure 8.16 Total landings, fishing mortality, recruitment and stock size predicted for increasing exploitation level (F-mult for 0.001 and from 0.1 to 1 step 0.1).



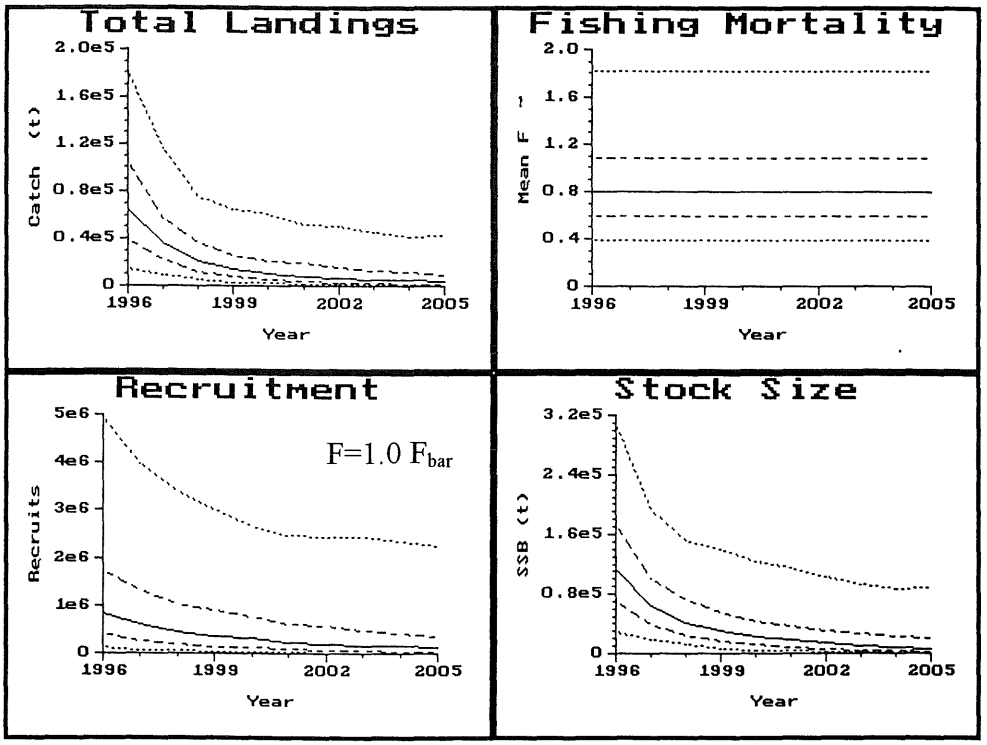
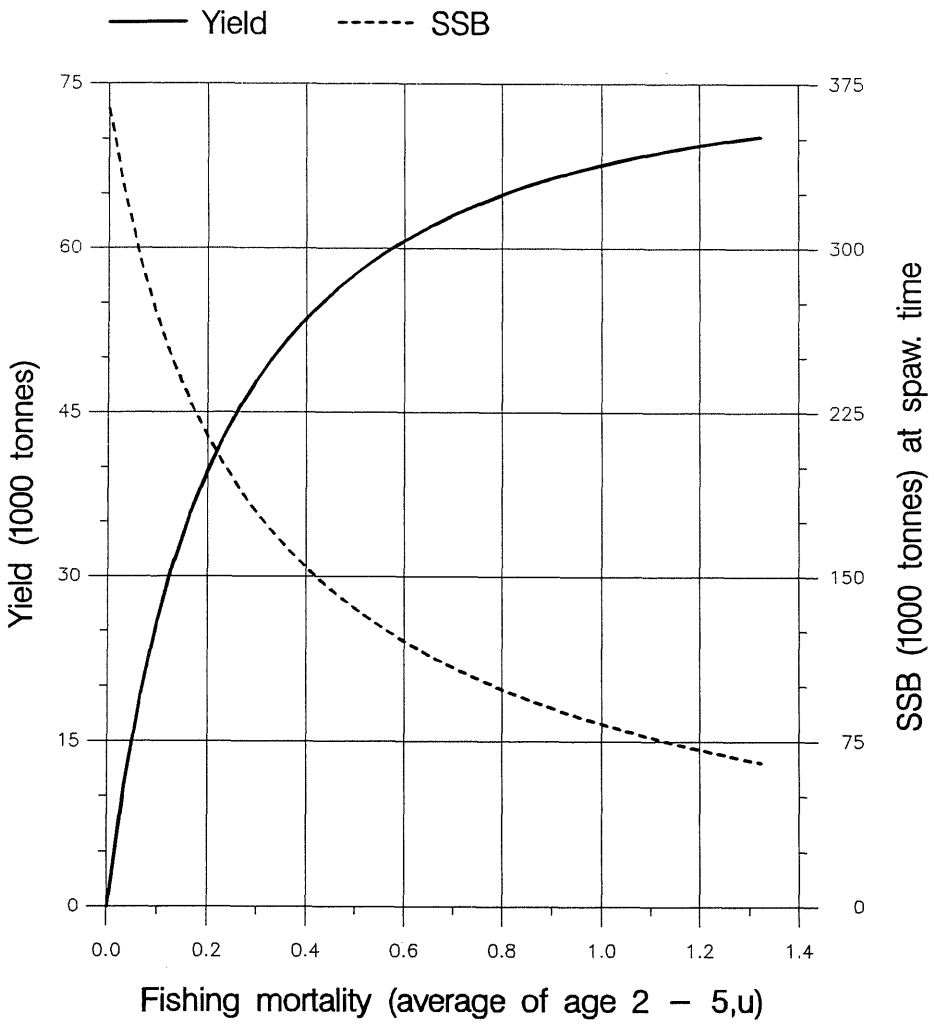


Figure 8.16 (continued).

Figure 8.17

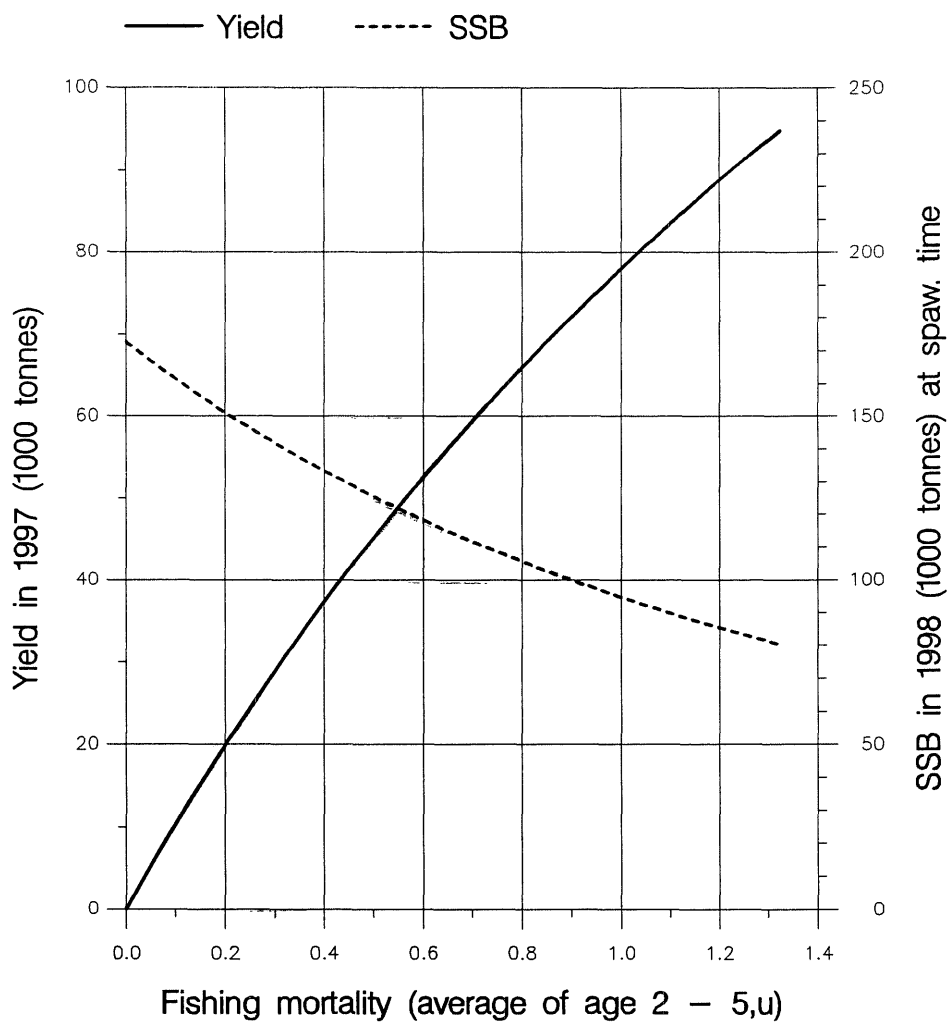
Fish Stock Summary
Sardine in the Southern Area (Fishing Areas VIIIc and IXa)
20 – 8 – 1996

Long term yield and spawning stock biomass



(run: YLDPCL01) C

Short term yield and spawning stock biomass



(run: MANPCL01) D

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 subpopulations 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 that surrounds the development of larvae and juveniles at several recruitment zones in the studied areas, and 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 Southeast 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 to consider that the anchovy in this area has to be dealt for assessment purposes as a single management unit.

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 southeast corner of the Bay of Biscay (where the major fishery takes place), but it is well known that morphological studies are not sufficient to discriminate populations. 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 management unit independent of that existing at the Bay of Biscay. A further increase of 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 9.1a–d give the distribution of the fisheries directed of anchovy in Sub-area VIII and Division IXa for 1995. In Sub-area VIII during the first quarter, the main fishery (predominantly 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 second half of the year , the major fishery is located at the north of the Bay of Biscay (Division VIIIa,b) whereas along the the Spanish coast just small quantities of catches are obtained by the Spanish fleet, with some noticeable catches in December at the west of Division VIIIc.

In Division IXa, in 1995 an increase in catches was observed. Unlike previous years the fishery was situated off North Portugal and West of Galicia. In the first quarter the landings were caught in the central part of Portugal and in the Bay of Cadiz. In the second and third quarter the fishery is located to the north of 40° N (Sub-divisions IXa Central-North and North) and in the fourth quarter the main landings come from Sub-division IXa Central North. Table 9.1 shows the distribution of catches of anchovy by quarters in the period 1991–1995. We can see that the distribution of the Sub-area VIII fishery is constant during this period, but the distribution of catches in Division IXa in 1995 is different from the 1991–1994 period. The total catches in the Division IXa have increased substantially in the central and northern areas of the atlantic coasts (Sub-divisions IXa Central North and IXa North) and catches from Sub-division IXa South have been sharply reduced. Since the anchovy tends to be caught as much as possible by the fishermen due to its high price at market, in both cases the changes in the landings will probably be reflecting changes in the abundance of the anchovy resources in those areas (Pestana WD, 1996). In the first half of 1996, the preliminary data from the fishery, indicates that catches in Sub-division IXa Central North and North have reduced to similar levels to those of the period 1991–1994. Historically, catches to the West of the Iberian peninsula (from Sub-divisions IXa Central and North) have showed episodic increases (Junquera, 1986 and Pestana WD 1996), probably due to favourable environmental conditions.

9.3 Length Compositions by Fleet and by Country

Tables 9.2a and b show the anchovy length distributions in 1995 in Sub-area VIII and in Division IXa by quarter and Sub-divisions.

Annual length compositions of landings of the Bay of Biscay anchovy (Sub-area VIII) are provided by France and Spain and those from Division IXa, only by Spain. Portugal have not provided the 1995 length distributions of landings in Division IXa.

The length distributions in Sub-area VIII is ploted in Figure 9.2. The modal length of the anchovies landed is about 15 cm. France presents some reduction in the size of the anchovies landed in the second quarter compared to the first one. This is due to the fact that pelagic trawlers retired from the fishery and the French catches only correspond to the purse seiners which fish small anchovy close to the shore. On the other hand, the Spanish catches of the second quarter are characterised by bigger anchovies. This is due to the normal pattern of availability of anchovy to the purse seine Spanish fishery according to size over the spring fishing season (Uriarte & Motos, 1993). For the second half of the year , the fleets continued to catch medium size or big anchovies found in spring, except for some Spanish catches from the fourth quarter that are partly based on small anchovy (0 age group).

In Division IXa (Figure 9.3), the mean length and weight in the catch in Sub-division IXa south are smaller than those registered in Sub-division IXa North. As in previous years, a large number of juveniles are captured (individuals with a length of less than 10 cm) in Sub-division IXa South during the firt half of the year. The mean lenghts and weights registered in Sub-division IXa North during the second and third quarters are similar to those registerd in Sub-area VIII (Tables 9.2 a and b). The mode for length composition of anchovy from the 1995 Portuguese autumn trawl surveys in Sub-division IXa Central North and Central South were 16 cm and 13.5 cm respectivaly (Pestana, WD 1996). In general the data from the Portuguese bottom trawl surveys since 1990 suggest that the anchovy along the Portuguesh coast, the more to the South the smaller is.

9.4 Anchovy Otolith Exchange

During 1996, 650 pairs of otoliths were exchanged between three readers from the two countries (France and Spain). The results were presented in Villamor & Uriarte (WD, 1996). Two hundred otoliths were from ICES Division VIIIab, 250 were from ICES Division VIIIc and 200 were from ICES Sub-division Ixa North. The comparison of otolith readings of the three areas was carried out separately.

Taking into account the few ages read, due to the anchovy being a species with a short life-span, the average general agreement between readers was unsatisfactory in Division VIIIab (71%) and VIIIc (80%). In Division IXa North agreement was greater than in the other two areas (96%) owing to the sample of otoliths consisting of specimens of one single age. Agreement between readers varied between 59% and 88% for the Division VIIIab, between 77% and 82% for Division VIIIc and between 94% and 97% for Sub-division IXa North.

The age bias plots of each reader againts the modal age show variability in the samples from Divisions VIIIab (Figure 9.4) and VIIIc (Figure 9.6). The age bias plots for all readers combined show that bias increases with age, and that those from age 2 tend to be underestimated in Division VIIIa,b (Figure 9.5) and that those of age 0 tend to be overestimated in Division VIIIc (Figure 9.7). In Sub-division IXa North the level of bias is very low.

The rate of agreement between the two readers who estimate the largest proportion of the international catches were higher than average (i.e. 80 % in VIIIc and 88 % in the VIIIab otolith samples). This implies that the bias in the age composition of the international catches is lower than the one showed on average in the exchange programme. Nevertheless, considering the importance of age readings in assessment, to continue with exchange programme are needed.

Table 9.1 Catch (t) distribution of ANCHOVY fisheries by quarters and total in the period 1991-1995.

QUARTER 1	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Centra	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	

QUARTER 2	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Centra	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	

QUARTER 3	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Centra	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	

QUARTER 4	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Centra	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	

TOTAL	DIVISION IXa				SUB-AREA VIII					
Year	IXa South	IXa CS	IXa CN	IXa North	VIIIc West	VIIIc Centra	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	

- Not available

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Table 9.2a Length distribution ('000) of ANCHOVY in Divisions VIIIa,b,c and IXa by country, gear quarters and Sub-divisions in 1995.

	QUARTER 1							
	SUB-AREA VIII					DIVISION IXa		
Length (cm)	FRANCE Total VIIIab	SPAIN Seine VIIIb	SPAIN Seine VIIIc East	SPAIN Seine IIIc Centra	SPAIN Seine VIIIc West	SPAIN Seine IXa North	PORTUGAL Total IXa C,CN,S	SPAIN Seine IXa South
7	0	-	0	0	0	-	-	0
7.5	0	-	0	0	0	-	-	51
8	0	-	0	0	0	-	-	51
8.5	0	-	0	0	0	-	-	51
9	0	-	0	0	0	-	-	255
9.5	9	-	0	0	0	-	-	990
10	26	-	0	0	0	-	-	939
10.5	450	-	0	0	0	-	-	1257
11	1252	-	0	0	0	-	-	2526
11.5	3661	-	0	0	0	-	-	3293
12	3589	-	0	0	0	-	-	2871
12.5	4133	-	0	0	0	-	-	2144
13	7417	-	6	0	0	-	-	1020
13.5	8394	-	235	0	0	-	-	674
14	10946	-	269	0	0	-	-	314
14.5	9502	-	275	1	0	-	-	38
15	11216	-	355	1	0	-	-	99
15.5	17472	-	231	1	0	-	-	5
16	14356	-	47	1	0	-	-	0
16.5	7445	-	85	0	0	-	-	0
17	4647	-	29	0	0	-	-	0
17.5	2864	-	0	0	0	-	-	0
18	765	-	0	0	0	-	-	0
18.5	55	-	0	0	0	-	-	0
19	22	-	0	0	0	-	-	0
19.5	0	-	0	0	0	-	-	0
20	0	-	0	0	0	-	-	0
20.5	0	-	0	0	0	-	-	0
21	0	-	0	0	0	-	-	0
21.5	0	-	0	0	0	-	-	0
22	0	-	0	0	0	-	-	0
Total N	108220	0	1532	4	0	-	-	1657
Catch (t)	2380	0	35	0.09	0.01	12	204	172
L avg (cm)	15.0	-	15.0	15.4	15.4	-	-	11.8
W avg (g)	21.6	-	22.9	23.5	23.5	-	-	10.3

	QUARTER 2							
	SUB-AREA VIII					DIVISION IXa		
Length (cm)	FRANCE Total VIIIab	SPAIN Seine VIIIb	SPAIN Seine VIIIc East	SPAIN Seine IIIc Centra	SPAIN Seine VIIIc West	SPAIN Seine IXa North	PORTUGAL Total IXa C,CN,S	SPAIN Seine IXa South
7	0	0	0	0	0	0	-	0
7.5	0	0	0	0	0	0	-	0
8	0	0	0	0	0	0	-	0
8.5	0	0	0	0	0	0	-	8
9	0	0	0	0	0	0	-	40
9.5	40	0	0	0	0	0	-	129
10	176	0	0	0	0	0	-	300
10.5	793	0	0	0	0	0	-	481
11	1783	0	0	0	0	0	-	743
11.5	2997	36	0	0	0	0	-	528
12	7455	117	49	0	0	0	-	567
12.5	7683	339	228	0	0	158	-	1234
13	20654	1557	2077	0	0	632	-	721
13.5	18126	3963	6722	34	22	1265	-	781
14	17332	10320	38127	170	108	7114	-	570
14.5	14956	13187	58145	271	171	11699	-	90
15	21760	19232	91237	268	169	12015	-	30
15.5	12778	16521	78223	251	159	8379	-	0
16	7881	12599	69566	249	158	6798	-	0
16.5	3379	11242	55524	152	96	1739	-	0
17	2777	10862	47388	81	51	790	-	0
17.5	655	9141	35371	11	7	0	-	0
18	101	4469	21867	1	0	158	-	0
18.5	53	2600	7252	0	0	0	-	0
19	35	734	2766	1	0	0	-	0
19.5	11	72	742	1	0	0	-	0
20	6	32	0	0	0	0	-	0
20.5	0	0	13	0	0	0	-	0
21	0	0	0	0	0	0	-	0
21.5	0	0	0	0	0	0	-	0
22	0	0	0	0	0	0	-	0
Total N	141431	117023	515296	1489	942	50747	-	6220
Catch (t)	2768	3385	14843	36	23	1233	1996	76
L avg (cm)	14.3	15.9	16.0	15.5	15.5	15.2	-	12.4
W avg (g)	18.8	28.9	28.8	24.2	24.2	24.3	-	12.3

- Not available

Table 9.2b Length distribution ('000) of ANCHOVY in Divisions VIIIa,b,c and IXa by country, gear quarters and Sub-divisions in 1995.

	QUARTER 3							
	SUB-AREA VIII					DIVISION IXa		
Length (cm)	FRANCE Total VIIIab	SPAIN Seine VIIIb	SPAIN Seine VIIIc East	SPAIN Seine IIIc Centra	SPAIN Seine VIIIc West	SPAIN Seine IXa North	PORTUGAL Total IXa C,CN,S	SPAIN Seine IXa South
7	0	-	0	0	0	0	-	0
7.5	0	-	0	0	0	0	-	0
8	0	-	0	0	0	0	-	0
8.5	0	-	0	0	0	0	-	0
9	0	-	0	0	0	0	-	773
9.5	212	-	0	0	0	0	-	1160
10	99	-	0	0	0	0	-	3865
10.5	899	-	0	0	0	0	-	6184
11	773	-	0	0	0	0	-	3479
11.5	1322	-	0	0	0	0	-	2319
12	2136	-	0	0	0	73	-	773
12.5	469	-	0	0	0	546	-	0
13	1928	-	0	0	0	2386	-	0
13.5	3025	-	41	32	2	2083	-	0
14	6039	-	195	120	7	7738	-	0
14.5	12115	-	282	114	6	13992	-	0
15	15804	-	265	68	4	33894	-	0
15.5	20556	-	148	59	3	33442	-	0
16	23834	-	48	14	1	36929	-	0
16.5	21577	-	23	10	1	12485	-	0
17	11233	-	10	2	0	7503	-	0
17.5	4627	-	5	1	0	770	-	0
18	1670	-	9	9	1	76	-	0
18.5	1193	-	0	0	0	0	-	0
19	1431	-	0	0	0	0	-	0
19.5	716	-	0	0	0	0	-	0
20	239	-	0	0	0	0	-	0
20.5	239	-	0	0	0	0	-	0
21	239	-	0	0	0	0	-	0
21.5	0	-	0	0	0	0	-	0
22	0	-	0	0	0	0	-	0
Total N	132372	0	1027	428	24	151917	-	18552
Catch (t)	3620	0	23	10	1	4043	1869	131
L avg (cm)	15.9	-	15.1	14.9	14.9	15.7	-	10.8
W avg (g)	26.1	-	22.8	23.0	23.0	26.6	-	7.1

	QUARTER 4							
	SUB-AREA VIII					DIVISION IXa		
Length (cm)	FRANCE Total VIIIab	SPAIN Seine VIIIb	SPAIN Seine VIIIc East	SPAIN Seine IIIc Centra	SPAIN Seine VIIIc West	SPAIN Seine IXa North	PORTUGAL Total IXa C,CN,S	SPAIN Seine IXa South
7	0	-	0	0	0	-	-	0
7.5	0	-	0	0	0	-	-	283
8	0	-	0	0	0	-	-	283
8.5	0	-	0	0	0	-	-	283
9	0	-	0	0	0	-	-	1415
9.5	2	-	0	0	0	-	-	5379
10	7	-	5	0	0	-	-	4529
10.5	11	-	3	11	0	-	-	4529
11	27	-	35	121	0	-	-	849
11.5	53	-	32	330	0	-	-	283
12	45	-	11	419	0	-	-	0
12.5	303	-	25	187	763	-	-	0
13	3644	-	50	22	2542	-	-	0
13.5	5495	-	75	11	3050	-	-	0
14	4701	-	47	143	3305	-	-	0
14.5	7714	-	48	620	1271	-	-	0
15	9122	-	131	2434	1543	-	-	0
15.5	11900	-	61	1098	47	-	-	0
16	13921	-	18	334	465	-	-	0
16.5	10266	-	5	95	418	-	-	0
17	7570	-	10	191	816	-	-	0
17.5	2679	-	3	48	1159	-	-	0
18	787	-	3	48	756	-	-	0
18.5	104	-	3	48	448	-	-	0
19	63	-	0	0	122	-	-	0
19.5	643	-	3	48	18	-	-	0
20	214	-	0	0	11	-	-	0
20.5	21	-	0	0	0	-	-	0
21	21	-	0	0	0	-	-	0
21.5	0	-	0	0	0	-	-	0
22	0	-	0	0	0	-	-	0
Total N	79313	0	568	6208	16735	-	-	17834
Catch (t)	2080	0	12	148	398	42	2987	116
L avg (cm)	15.7	-	14.3	14.9	14.9	-	-	10.1
W avg (g)	25.4	-	20.3	23.8	23.8	-	-	6.5

- Not available

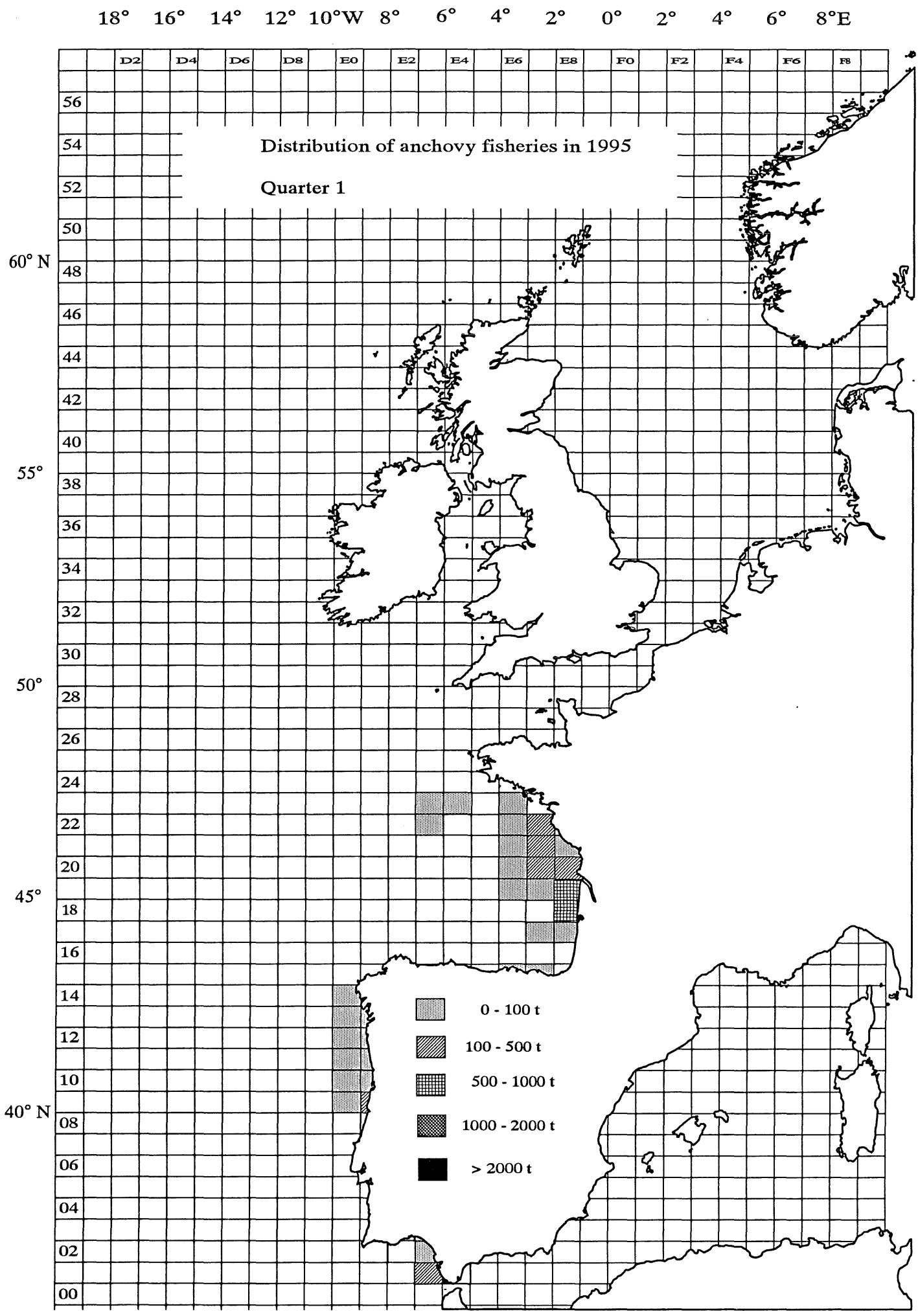
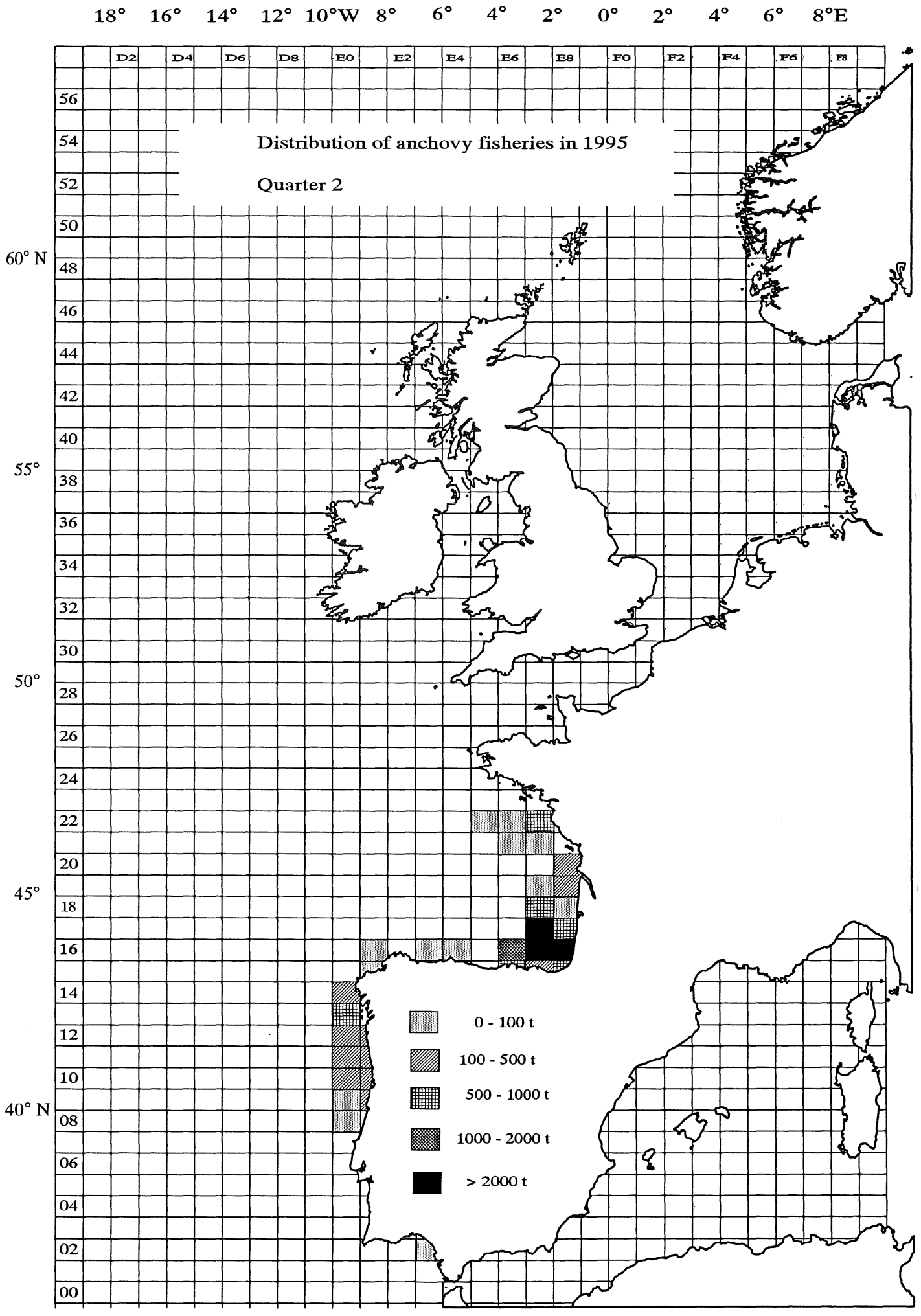

18° 16° 14° 12° 10°W 8° 6° 4° 2° 0° 2° 4° 6° 8°E
D2 D4 D6 D8 E0 E2 E4 E6 E8 F0 F2 F4 F6 F8
56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 08 06 04 02 00
60° N
55°
50°
45°
40° N
Distribution of anchovy fisheries in 1995
Quarter 1
0 - 100 t
100 - 500 t
500 - 1000 t
1000 - 2000 t
> 2000 t

Figure 9.1a


18° 16° 14° 12° 10°W 8° 6° 4° 2° 0° 2° 4° 6° 8°E
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56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 08 06 04 02 00
60° N
55°
50°
45°
40° N
Distribution of anchovy fisheries in 1995
Quarter 2
0 - 100 t
100 - 500 t
500 - 1000 t
1000 - 2000 t
> 2000 t

Figure 9.1b

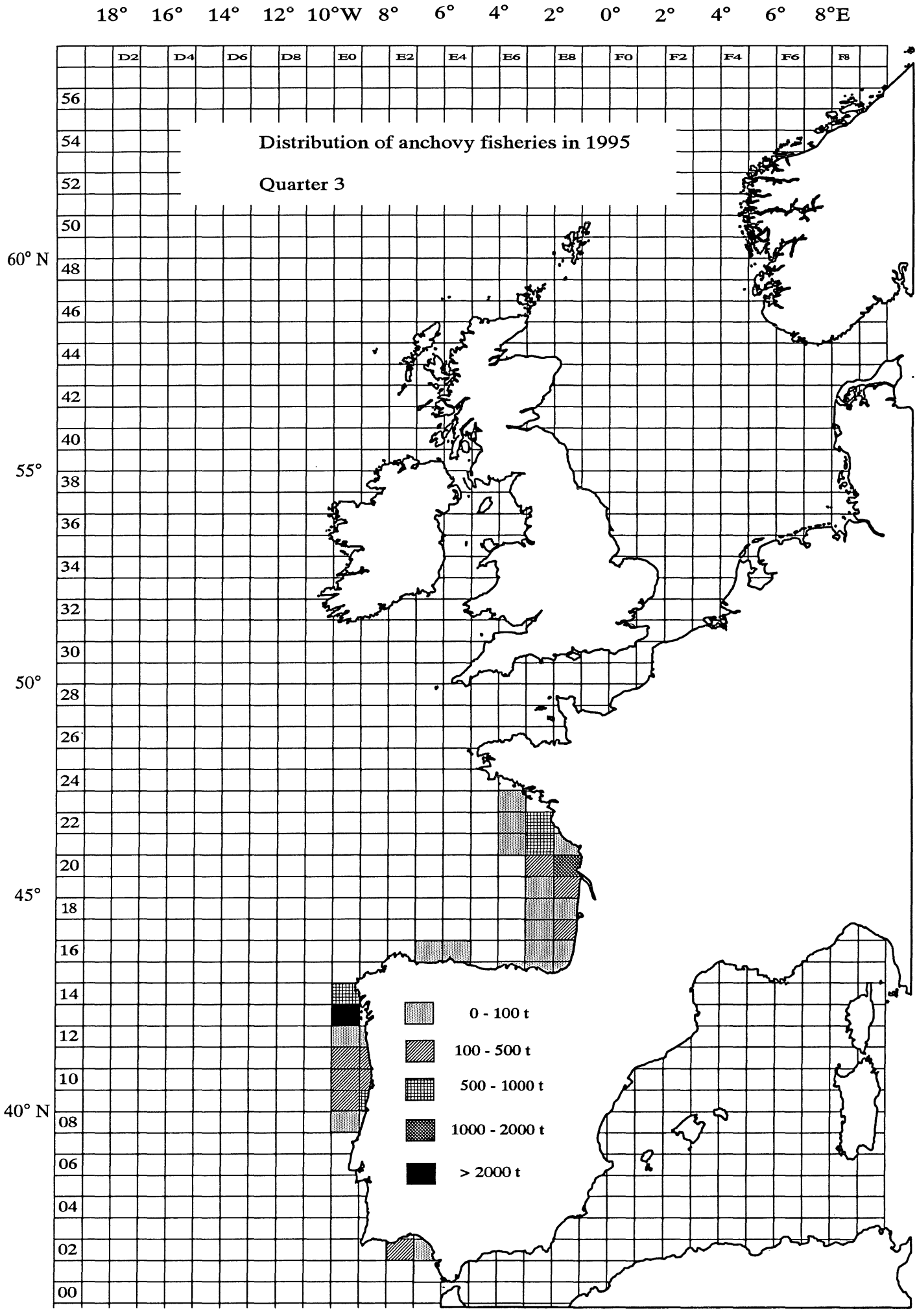
18° 16° 14° 12° 10°W 8° 6° 4° 2° 0° 2° 4° 6° 8°E
D2 D4 D6 D8 E0 E2 E4 E6 E8 F0 F2 F4 F6 F8
56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 08 06 04 02 00
60° N
55°
50°
45°
40° N
Distribution of anchovy fisheries in 1995
Quarter 3
0 - 100 t
100 - 500 t
500 - 1000 t
1000 - 2000 t
> 2000 t

Figure 9.1c

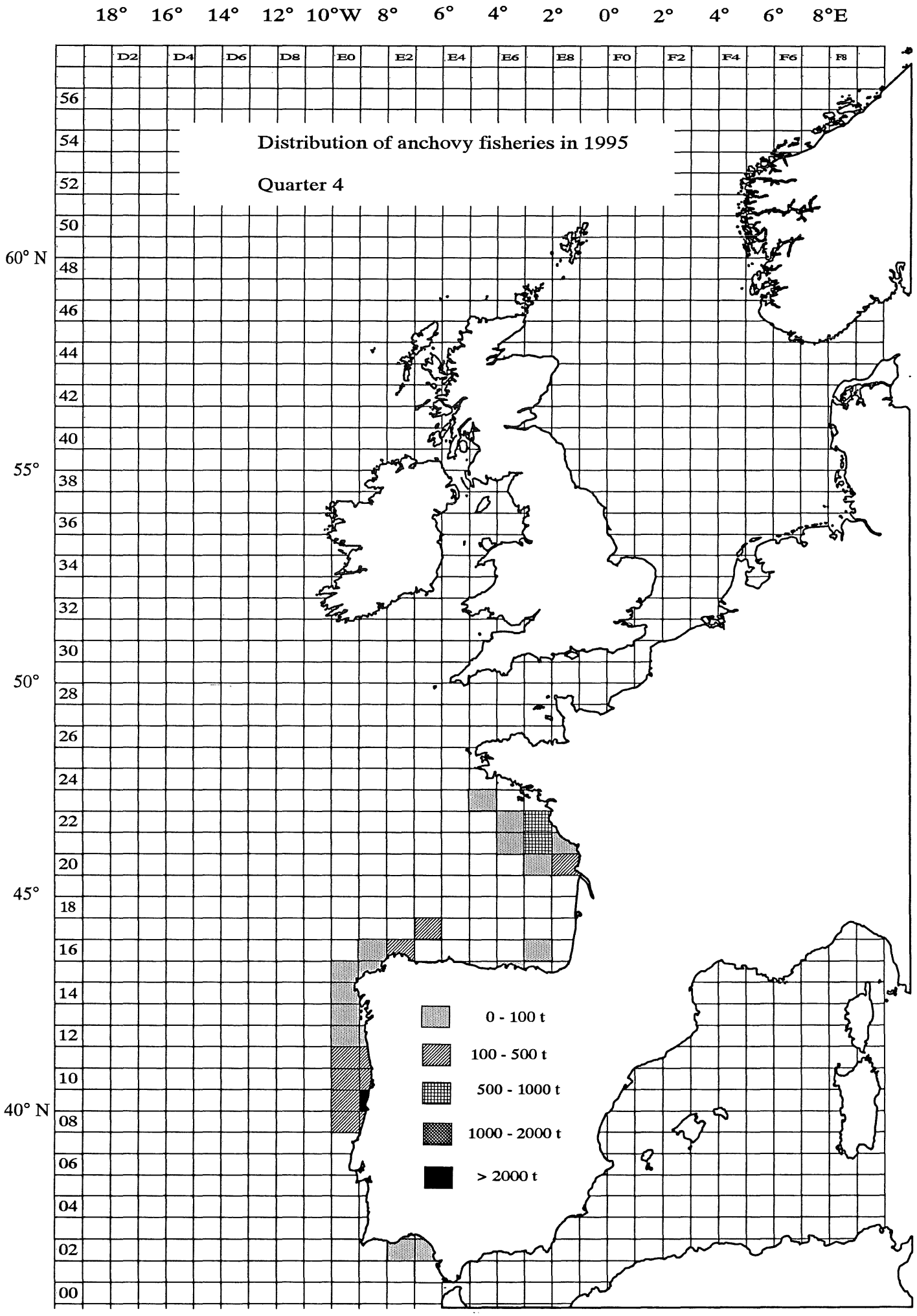
18° 16° 14° 12° 10°W 8° 6° 4° 2° 0° 2° 4° 6° 8°E
D2 D4 D6 D8 E0 E2 E4 E6 E8 F0 F2 F4 F6 F8
56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 08 06 04 02 00
60° N
55°
50°
45°
40° N
Distribution of anchovy fisheries in 1995
Quarter 4
0 - 100 t
100 - 500 t
500 - 1000 t
1000 - 2000 t
> 2000 t

Figure 9.1d

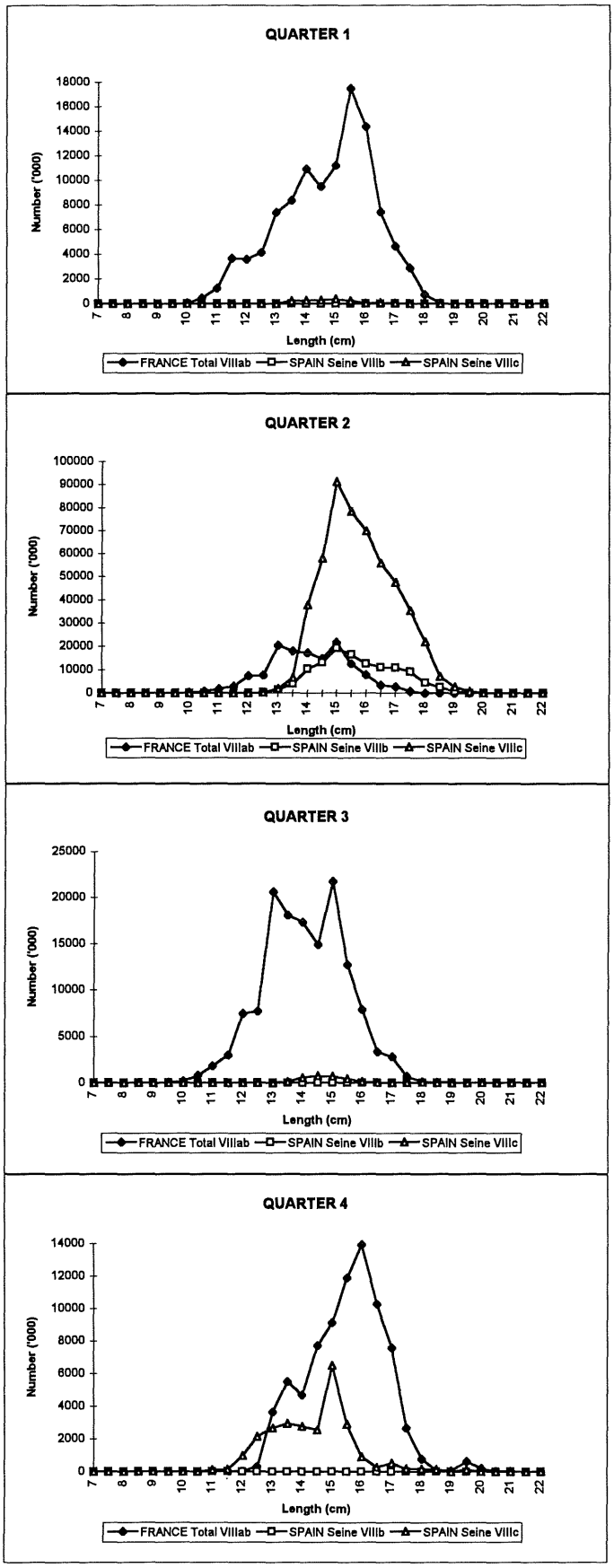

Figure 9.2 Length distributions ('000) of landings of Bay of Biscay ANCHOVY in Divisions VIIIa,b and c by quarters in 1995.

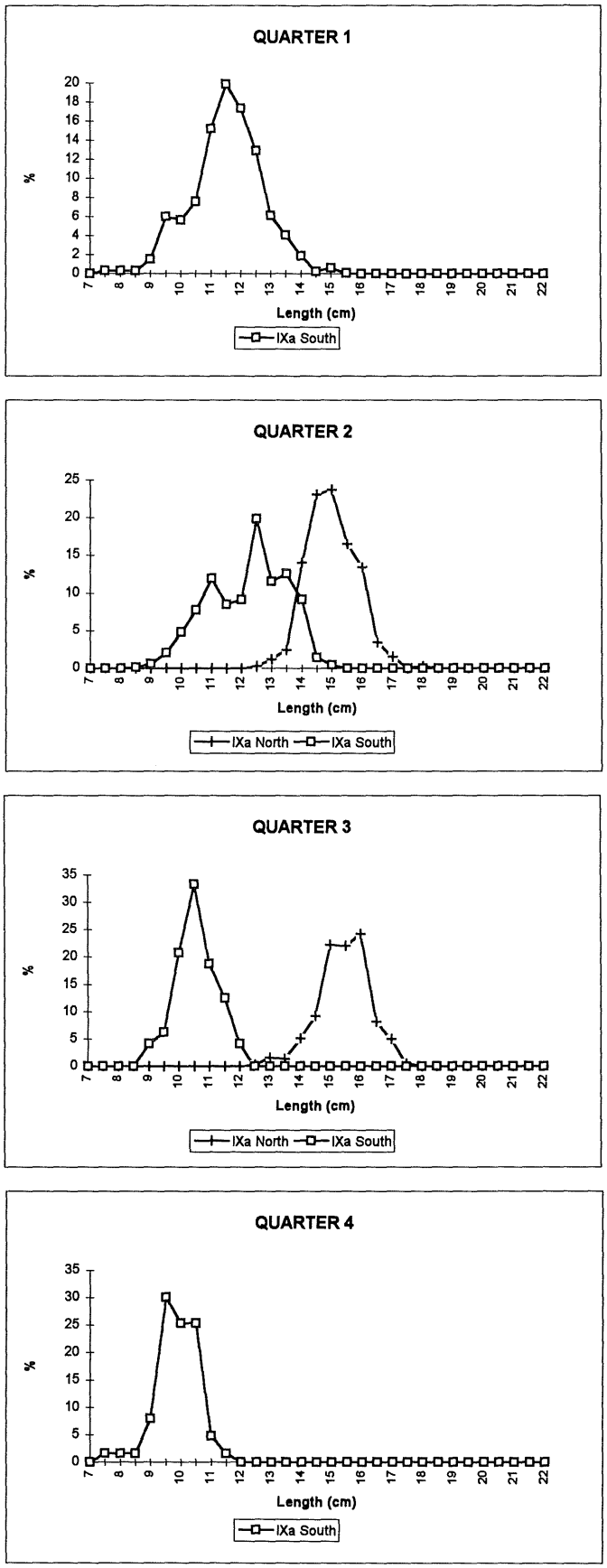

Figure 9.3 Length distributions (%) of landings of ANCHOVY in Division, IXa by quarter and Sub-divisions.

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ANCHOVY (Div. VIIIab) SAMPLE

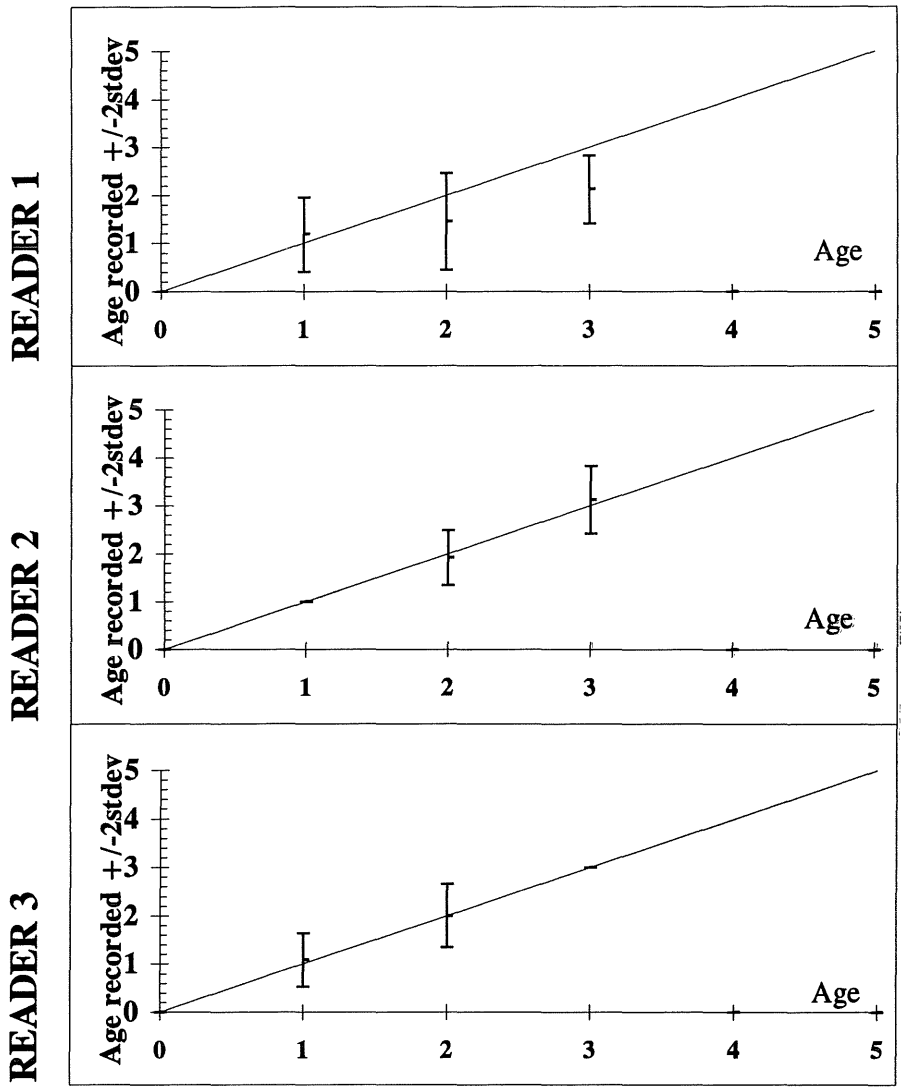

Figure 9.4 In above age bias plots average age +/- 2stdev of each age reader is plotted against modal age.

Modal age	0	1	2	3	4	5
Age recorded	-	1.09	1.79	2.75	-	-
2*stdev	-	0.57	0.90	1.06	-	-

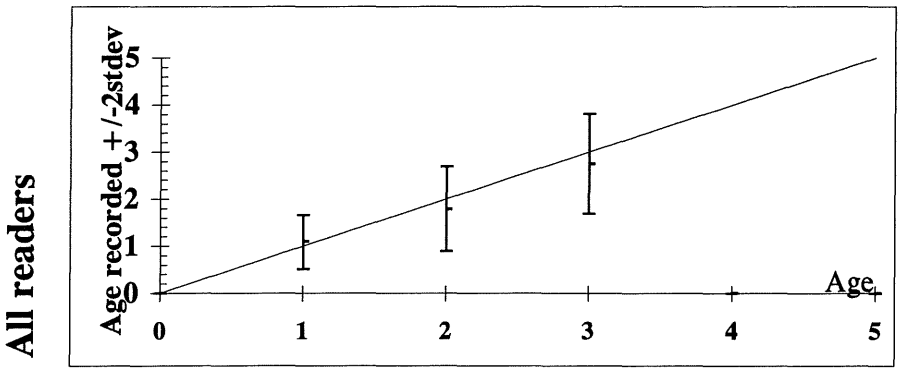

Figure 9.5 In above age bias plot average age +/- 2stdev of all age readers is plotted against modal age.

ANCHOVY (Div. VIIIc) SAMPLE

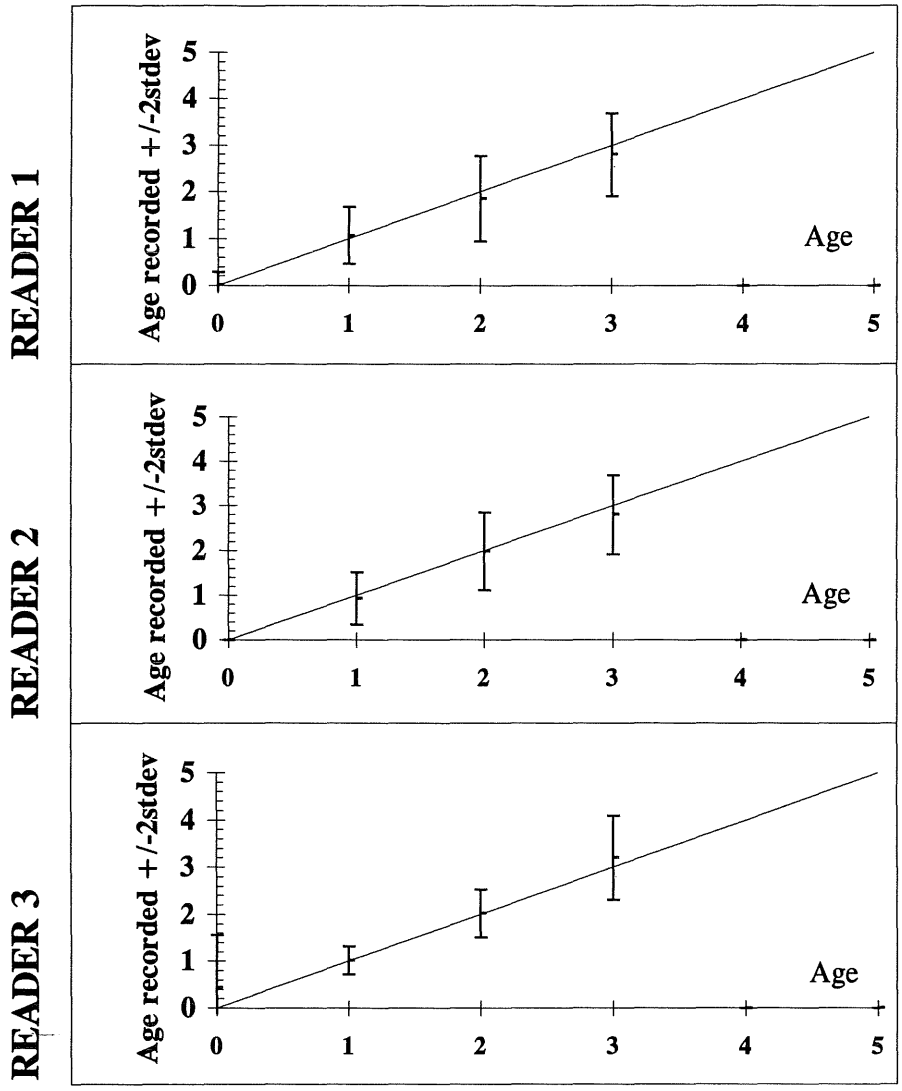

Figure 9.6 In above age bias plots average age +/- 2stdev of of each age reader is plotted against modal age.

Modal age	0	1	2	3	4	5
Age recorded	0.15	1.00	1.95	2.93	-	-
2*stdev	0.78	0.53	0.79	0.92	-	-

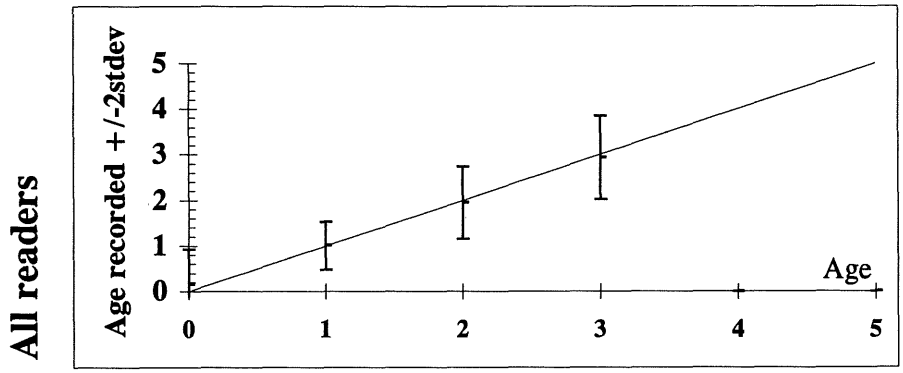

Figure 9.7 In above age bias plot average age +/- 2stdev of all age readers is plotted against modal age.

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10 ANCHOVY - SUB-AREA VIII

10.1 The Anchovy Fishery in 1995

10.1.1 Fleets, scheme of fishing and regulation

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. Untill 1995, the Spanish purse seiners were allowed to fish anchovy in Division VIIIb only during the spring season and under a system of fishing licences (Anon. 1988), while Division VIIIa is closed to them for the whole year. Since 1996 this fleet can fish anchovy all over the year in Sub-area VIII with the same system of fishing licences.

French Pelagic Trawlers: Operative in summer, autumn and winter. Until 1992, it 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 semester and VIIIa, mainly, during the second one. The VIIIc area is prohibited to the French pelagic fleet.

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

Since the 1980s, the TAC of 30,000 t (33,000t in 1995) has been agreed but often exceeded or not reached. The formula for allocation 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 allocation 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 midwater pelagic activity for anchovy stop during the main Spanish fishery in spring (from 20 March to 1 June).

10.1.2 Landings in Sub-area VIII

Under these circumstances, total international landings in Sub-area VIII amounted to 29,798 t in 1995 (Table 10.1 and Figure 10.1), lower than the catch level of the previous years. The French catch fell from 16,993 in 1994 to 10,848 t in 1995 and the Spanish catch slightly increased from 17,554 t in 1994 to 18,950 t in 1995. As in previous years, the main Spanish fishery took place in spring (96.4%) and the main French fishery in the second half of the year (52.4%) (Table 10.2) (Figure 10.2).

No discards were observed in the Spanish fishery and the discards have not been recorded in the French fishery, although the reported French landings includes the catches not sold at harbours.

During the first half of 1996, total international catches reached 18,758 t (preliminary data).

10.1.3 Landings by divisions

In 1995, the Spanish and French fisheries were well separated geographically and in time as in previous years. More than 80% of the Spanish landings were caught in Division VIIIc, mainly in spring, while the French landings were caught in Divisions VIIIab, mainly in summer (Table 10.3).

10.1.4 Landings by EU categories

The distribution of Spanish and French landings by EU market category in Sub-area VIII by quarter for 1995 are given in Table 10.4. As usual, the main landed category is T2 (30–50 fish per kg) for both countries.

10.1.5 Effort and Catch per Unit Effort

The evolution of the fishing fleets during recent years is shown in Table 10.5 and Figure 10.3. The French midwater trawlers involved in the anchovy fishery has increased continuously over these years. Nowadays, the number of pelagic trawlers is roughly about half of the number of the Spanish purse seine boats, although the figures for the French fleet in 1995 are still preliminar. Table 10.5 shows that, during the last 5 years, the number of vessels in the

French fleet in 1995 are still preliminar. Table 10.5 shows that, during the last 5 years, the number of vessels in the French pelagic fleet for anchovy has doubled and at the same time their catches have reached the same level of the Spanish one. These general observations indicate a sharp increase of fishing effort on anchovy in the Bay of Biscay since 1987, despite some decrease in the number of Spanish purse seiners. Although the pelagic trawlers are not allowed to fish anchovy in Division VIIIc, they have opened new fishing periods (autumn and winter mainly) and a new fishing ground in Division VIIIa, especially since 1990 (Prouzet *et al.*, 1994).

A rough evaluation of the Spanish and French efforts in terms of number of gears multiplied by the number of months of activity showed in 1993 a comparable fishing power of around 430 vessel*months for the French fleet and around 500 vessel*months for the Spanish fleet. This observation further indicates that effort developed by the two countries is nowadys similar although the fishing pattern is different. The current effort may be at the level which existed in this fishery at the beginning of the seventies (Anon. 1996/Assess:2).

The CPUE of the Spanish purse seiners during the spring fishery for anchovy is shown in Table 10.6. This index is spatially linked with the anchovy abundance in the southern area of the Bay of Biscay and, 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 preliminary index for the first half of 1996 shows a CPUE for the total catch at a lower level than the one of 1995 (the highest of the series observed). However, the CPUE of the 1-year-old anchovy has increased compared to the indices estimated in the last three years.

10.2 Fishery-Independent Information

10.2.1 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 1994, with a gap in 1993. In the last two years, 1995 and 1996, new egg surveys have been made in the Bay of Biscay, but due to insufficient economic support the whole DEPM was not applied and only approximate biomass indexes have been obtained. The series of surveys between 1987 and 1994 showed a positive relationship between spawning area and biomass (Motos & Uriarte 1994, Motos *et al.* 1995) and, based on this, rough estimates of the spawning biomass of anchovy in the Bay of Biscay in 1995 and 1996 have been produced from the recent egg surveys (Motos *et al.* WD1996, Motos & Uriarte WD1996) (Figure 10.4). In 1995 the spawning area indicated that a biomass of about 45,000 t should be in the surveyed area, whereas the preliminary result from the 1996 survey indicates a biomass about 40,000 t, although this value may be an understimate because some of the positive spawning area was not fully covered by the survey (Motos & Uriarte *op.cit.*). These values are at an intermediate level compared with the whole series of DEPM results (Table 10.7).

The DEPM surveys are considered to be unbiased and to produce absolute figures of biomass whenever the methodology is fully applied. The composition of the population was derived for the surveys from 1987 to 1994, 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 not sampled area were to be made. Because of this the age compositions for the DEPM surveys in 1987 and 1988 are less reliable.

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

10.2.2 Acoustic surveys

The French acoustic surveys aimed at estimating the abundance of the Bay of Biscay anchovy were stopped in 1992. The results of the surveys between 1983 and 1992 appear in Table 10.8. 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.

According to the discussion made in 1993 (Anon. 1993/Assess:7) the acoustic values are considered to be relative indexes of abundance and the values of 1983 and 1984 seems to be underestimated.

10.2.3 Comparison of abundance indices

The general trend in the estimates of anchovy biomass from the acoustic and DEPM methods is comparable between 1989 and 1992 although a large discrepancy was observed in 1991. Both methods however, indicate similar trends in the variations of the population at age 1 (Figure 10.5).

10.3 Recruitment

The recruitment is the major factor driving the dynamics of this population. The estimation of the population at age 1 is therefore very important in order to come up with the variations in the population and the catches. Independent estimates of the 1 year old anchovies recruiting the fishery has been provided by the DEPM and Acoustic surveys. These estimates are the ones used to tune the assessment. This direct estimates of recruits age 1 can be compared in Figure 10.5 *versus* other indices of recruits obtained from the fishery.

10.4 Catch in Numbers at Age

In 1995, the age distribution of the international catches of anchovy (in numbers) in the first semester consisted mainly of 1-year-old anchovies, making up 59% (Table 10.10). This percentage increases during the second half of the year. On annual basis, as in previous years, 1 year old anchovies support more heavily the French catches than the Spanish ones (70.8 % vs. 56 %, respectively). This is mainly due to the different seasonality of these two fisheries. Aproximately 20% of the 1 year old anchovies caught were immatures prior to their first spawning in May.

The catches of anchovy corresponding to the Spanish live bait fishery for tuna fishing for the period 1987-1995 are given in Table 10.11. Live bait catches of anchovy are rather variable depending on the availability of the different small pelagic species and not only on anchovy.

Table 10.12 records the age composition of the international catches since 1989, on a half-yearly basis. In 1995, 1-year-old anchovies predominated in the catches during the two halves of the year. As in previous years, catches of inmatures, 0 age group, appear during the second half of the year.

Table 10.13 contains the available historical series of annual catches by age of Bay of Biscay anchovy. There are some noticeable changes in the age composition of the period 1984–1995 compared with the earlier years which could be related to a higher dependence of catches on recruitment in recent years and a change in the seasonality of this fishery. However, some differences in the age - reading procedure may also be behind the aparent change, because age group 1 is rarely dominant in the landings prior to 1983. A revision of the age composition of the anchovy catches prior to 1983 has been done in the framework of a FAR program and the conclusions suggested that, in some of those past years, different ageing criterias to the ones presently in use seems to have been used (Uriarte 1993).

10.5 Mean Weight at Age

Mean weight at age are shown in Table 10.14. The French mean weights at age in the catches were based on biological sampling from scientific survey and commercial catches. Spanish mean weights at age were calculated from routine biological sampling of commercial catches.

Large differences were observed between the mean weight of age groups caught by the Spanish and the French fleets over the past year 1995. These differences can be explained by the different seasons and fishing grounds of the two fleets. For instance, during the first semester the French landings were made during the first three months while the Spanish ones were made during the last three months. On the other hand, during the second quarter, the French catches are mainly landed by small purse seiners that fish small size anchovies close to the coast, while the Spanish purse seine boats fish bigger anchovies at offshore grounds. In the second half of the year, the French landings were caught in Divisions VIIIa and b, whereas the Spanish ones were mainly caught in VIIIc.

Annual mean weight at age in the fishery and in the stock are shown in Table 10.15 and Table 10.16 respectively. The values for the fishery represent the weighted averages of the half year values per country, according to their respective landed numbers at age. The values for the stock are the ones estimated for the spawners during the DEPM surveys of 1990–1995 (reported in Cendrero ed., 1994 and Motos *et al.* 1995).

10.6 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 were spawned. No differences in specific fecundity (number of eggs per gram of body weight) have been found according to age (Motos 1994).

10.7 Stock Assessment

10.7.1 Integrated Catch at age analysis

The Integrated Catch at Age analysis (ICA package, Patterson WD 1995), 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 1995 (Patterson WD 1995). The assessment is similar to the one implemented in 1995 for the period 1987-1994 in this WG. Inputs are summarised in Table 10.17. CPUE data of the Spanish purse seine fishery, despite of its reasonable behaviour as indicator of abundance (see Section 10.3), was excluded from the analysis because it is presumed that purse seiners can increase the catchability at low levels of abundance (Csirke, 1988, Pitcher 1995). Nevertheless, some previous exploratory runs indicated that the assessment was hardly sensitive to the inclusion of the CPUE into the analysis. The assessment uses as tuning data the DEPM and the Acoustic figures (both, as biomass and population numbers at age estimates). In 1995 the biomass used in the DEPM SSB tuning data is the one obtained from the spawning area and biomass relationship (Figure 10.4, Motos & Uriarte WD 1996). The Acoustic and DEPM estimates are considered as relative and absolute estimates respectively. 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. However, the catch data of years 1987 and 1988 is downweighted in the analysis because in those years French catches at age were estimated from the Spanish ones (Anon.1989/Assess:19).Results are presented in Tables 10.18, 10.19, 10.20 and 10.21 and Figure 10.6.

The results show (as it happened in 1995) that the sum of squares curve has not a well defined minimum when plotted against fishing mortality in the last year of the analysis (Figure 10.6). The logvariance of the populations estimates from the model versus the tunning indices seems reasonable, but the strong variations in abundance suggested by the direct estimates are not followed by the model (Figures 10.6). The separable model shows rather high logvariance regarding the observed catches at age (0.871) (Table 10.19 and 20), due to high residuals both across ages and years. The output levels of fishing mortality although about 10 % higher than those resulting from the past year assessment show similar trends along the period, peacking in 1991 and dropping later on to the same level as inferred for the 1987–1990 period (at a Fbar1-3 between 0.6 and 0.7). The Working Group considers that this assessment reasonably shows the recent trends in population abundance and fishing mortalities acording 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 it 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 10.7.

10.7.2 Production model

A biomass dynamic model (Roel & Cochrane WD 1996) was used to fit the DEPM data and a Bayesian method was applied to estimate key parameters. The biomass was modelled by means of an adult component and a recruitment component, the latter on the basis of the recruitment index described in Borja *et al.* (WD 1996). A reasonable fit to the observed data was attained, although attention was drawn to a negative trend in the residuals (Figure 10.8). The results were viewed as preliminary by the authors and sensitivity tests to alternative model assumptions were suggested. However, this modelling exercise has provided an independent assessment of the anchovy stock from the one obtained by means of ICA, that supports current perceptions about the dynamics and status of the resource.

10.8 Recruitment and environment

The prior assessment, in agreement with the direct estimates of the population, clearly shows that the anchovy spawning population heavily depends upon the strength of the recruitment at age 1 produced every year (see Figure 10.7b). This means that the dynamic of the population directly follow that of recruitment without almost any buffer. Figure 10.5 plots the estimates of the population at age 1 provided by the assessment in comparison with the available indexes of abundance of anchovy at age 1 from the fishery dependent and independent data.. The Egg and Acoustic surveys that have been used to tune the assessment show a strong parallel variation of its estimates of the

population at age 1, although their variations are more intense than that provided by the assessment itself. The concordance of the Year Class Cumulative Catches (YCCC) with the assessed population at age 1 is obviously very high, since the information obtained in that index is the same contained by the Catch at age data used to tune the separable model of the assessment. Cath per Unit Effort of 1 year old anchovies of the Spanish purse seine fleet in spring (CPUE1) shows a rather similar tendencies to the ones produced by the assessment, in spite of not having been included as tunning data. Therefore if this good relationship holds on, in future the CPUE information may be a usefull tool to monitor the population trends when no direct estimation be available. In general the fluctuations of the indexes are rather concordant on the period 1987-1995 and indicate relevant changes between years.

The most recent information indicate that in 1995 there was a medium level of recruitment at age 1. The assessment output for 1996 and the CPUE at age 1 suggest that a new medium recruitment may have appeared in 1996, compared with the previous years. Nevertheless no information from the fishery and no independet direct surveys allow nowadays to forecast the coming recruitment in 1997.

The scatter plot between the spawning biomass and the number of recruits (1-year-olds) obtained from the assessment does not show any defined relationship for this stock, (Figure 10.9a). This is not either shown using the DEPM estimates of biomass and populations at age (Figure 10.9b). However nothing is known about the dynamic of recruitment at very low levels of SSB, when depensatory relationships may appear.

Borja *et al.* (in press) noted that oceanographical environment produced by Northern and Eastern winds of medium and low intensity blowing in spring and early summer in the Bay of Biscay seem to induce good levels of recruitment to the anchovy population. This result was established for the period 1967–1989, relating an Index of Recruitment obtained from the fishery (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. The weak upwelling conditions and the expansion of the areas influenced at surface by the outflows of the major rivers in the region seems to be the major physical implications of these Northern and Eastern winds. In spring, these conditions would enhance the stratification and enrich the surface waters where the eggs and larvae of anchovy develops, assuring a stable and productive environment suitable for its survival.

Borja *et al.* (WD1996) have now confirmed these results extending the indices up to the most recent years of the fishery 1990–1994 (Figure 10.10). The upwelling index explains about 61 % of the interannual variability of the recruitment index in the period 1967–1994 (df. 26). The relationship of this upwelling index with the recruitment estimates provided by the DEPM surveys or by the prior analytical assessment is also highly significant (Figure 10.5, Rsquared =0.784, n=9).

Stock size is at a greatly reduced level compared to the 1950s and 1960s. There is the possibility that the larger fleet which existed in those years could have led to overfishing, but it cannot be proved. The possibility that environmental factors have caused the reduction of the stock has also been considered (Junquera, 1986). The connections between the upwelling index and recruitment seems to endorse the latter hypothesis and connects the dynamics of the anchovy population with that of the environment and climate regimes in the Bay of Biscay. Nevertheless, the likely role of the average level of the parental stock on the recruitment, and thus that of the fishing factor, should not be neglected, but further studied.

10.9 Catch Forecast

No forecast will be available for 1997 because, as mentioned last year, a proper catch forecast has to be based on the results of a direct survey to estimate the strength of the incoming recruitment at the end of the previous season or at the beginning of the management year in question.

The potential use of the above relationship between the upwelling index and subsequent recruitment for the prediction of the recruitment is evident since theoretically it may be estimated after each spawning season (targeted period: March-July). However in the current case the upwelling index for the past 1996 spawning season has not been possible to be obtained yet. This estimate will be available during September or October and an estimate of the forthcoming recruitment could be deduced by then. Nevertheless the Working Group considers convenient checking the performance of such a forecast procedure by making some simulations with retrospective analysis or Monte Carlo simulations before providing a quantitative advice on its basis.

10.10 Comments on Assessment

The estimates of the fishing mortalities provided by the previous assessment are mostly dependent on the accuracy of the direct estimates of biomass of the DEPM, since this is the most complete series of surveys in the period assessed. Improvement of the mortality estimates could be made by taking into account the errors associated with the SSB estimates. Nevertheless the little changes induced by the inclusion of the CPUE values into the assessment gives confidence to the results.

The current levels of fishing mortality (Fbar for the ages 1–3 at about 0.7) are below the likely 1.2 value for natural mortality. The exploitation pattern indicates a negligible explotation of the 0 group and a moderate fishing pressure on the age 1, far below the one exerted over the two and older year old anchovies. Although the population consists mainly of 1 year old anchovy that reaches 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 allowed to spawn. On the basis of this considerations it can be said that the current exploitation pattern regarding 1 year old anchovies is generally conservative. Figure 10.10 shows the yield and spawning biomass per recruit compared with the virgin state using the average figures 1989–1995 of fishing mortality at age, increased and decreased by 1 standard deviation. This figure shows that in the current situation the biomass per recruit of the population is reduced to about half of that expected without any fishery. This fishing preassure could be sustainable from a long term point of view according to some authors (Macer and Sissenwine 1993, see below).

The high fishing mortality recorded in 1991, when the stock was at a very low level may indicate that the catchability of the fleets may increase at decreasing trends in the stock abundance, making the stock susceptibles of overfishing in times of low abundance (Pitcher 1995). This possility should be kept in mind when advising ways of managing the stock.

The analysis of catch data at age shows a decrease of the mean age of anchovies in the catch since 1987. This fact associated with the increasing fishing effort seems to indicate an increase in the fishing mortality in recent years. The prior assessment has shown it up to 1991 but afterwards the fishing mortality drops down to the same level than in 1987–1990. This recent decrease may due to the higher levels of the population recorded in 1992–1994.

10.11 Reference points for management purposes

10.11.1 MBAL

The data available show that spawning biomass of about 15,000–20,000 t produced some of the the highest recruitments in the period 1987-1994 (Figure 10.8). This gives a reference for a minimum precautionary biomass level of about 20,000 t which could be used as a minimun biological level of spawning biomass for this species. However, the result is puzzling since it is below the historical average catches recorded in the fishery since 1960 (Table 10.1) and the period of data used to set this MBAL is too short, exluding any information about the year classes produced in the 1960s when the spawning stock size was probably much larger than at present. Finally it should be mentioned that the adoption of this low MBAL implies that this anchovy population has been in the recent years several times close or even below this threshold value! (like in 1989 or 1991). Therefore if managers would like to choose an MBAL, the value of 20,000 t could serve of reference, although the Working Group express its doubts on the suitability of this estimate for this stock.

10.11.2 Fishing mortality targets

The exploitation of pelagic species should be undertaken with special care, keeping the exploitation of the stock at a moderate level of fishing mortality provided the risks of overfishing at low levels of biomass of this species and taking into account the historical collapses of several anchovy 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 (without fishing) (the criteria of %SBR). They also indicate that the small pelagics could have poor resistance to exploitation and for these species the %SBR corresponding with the Fmed can be as high as 40 % or even in some cases 60 %. Patterson (1992) suggest that a moderate and sustainable rate of exploitation could be reached at 0.67 M. However one problem associated to these reviews is that they are based on the knowledge adquired on medium size and not too short living species compared

with the anchovy. Nevertheless, at the current state of knowledge on this species they may be taken as orientative about sustainable levels of fishing mortalities.

The current assessment suggests that average fishing mortalities on ages 1 to 3 (0.7) meets the criteria of Patterson (1992). In adition, the % SBR obtained for this population is about 50 % (Figure 10.11) what satifies the criteria % SBR of Macer and Sissenwine (1993) for pelagics. Therefore, 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 abundances is avoided by a close monitoring of the fishery coupled with an adaptative and fast managing system.

10.12 Management Measures and Considerations

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 constitute 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 recently been 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 monotoring of the fishery coupled with an adaptative and fast reactive managing procedure should be implemented. At the current state of knowledge two general objectives could be suggested to managers:

1. Fixing the current level of fishing effort and fishing pattern at age. The management of small short living pelagics needs to take into account large levels of uncertainty, particularly the coming recruitment level, and therefore requires a cautious approach. This general idea matches the qualitative management of the fishery suggested in previous years by this WG, via fishing licences and technical measures. The current number of fishing licences could be fixed until a final target is established on the basis of the expected average yield of the stock within safe biological limits. In addition, a possible measure could be to close fishing areas with high abundance of 1-group during the first half of the year in order to maximize survivorship to spawning (see summary sheet).

2. Establishing a management procedure that would involve close monitoring of the fishery and the stock and would regulate fishing mortality according to this information in order to prevent the stock from collapsing. This is particularly relevant in pelagic fish for which increases in catchability associated with low stock levels would be expected. The recent series of population estimates indicate that low levels of abundace are often found in the history of this resource, examples are 1989 and 1991, and therefore it could be extremely dangerous to manage this resource ignoring this possibility. Also, it should be born in mind that the larger the fleet, the more difficult it becomes to regulate or reduce fishing effort. A case of effort reduction would need to be strengthened by a quantitative assessment.

Quantitative management of the fishery is implemented for short-living pelagic species present in other areas such as the South African Anchovy (Butterworth *et al.,* 1993) and the Icelandic Capelin (Anon. 1993/Assess:6). The management of the Bay of Biscay anchovy could be optimized if a reliable estimate of the coming recruitment (for instance by means of acoustics) was available either prior to or at the start of the fishing season. Without an estimate of the coming recruitment the management of the fishery would have to be conservative and as a result the average annual catches obtained from the resource would be substantially lower than the ones that could be obtained if an estimate of recruitment was available early in the season.

The relationship found between the upwelling index at the spring and early summer and the subsequent recruitment in the following year opens interesting possibilities for its utilization as a recruitment predictor in a quantitative management system. The important role apparently played by the environment in the dynamics of the stock does not imply that the management of the fishery is useless or impracticable On the contrary, the above considerations and risks involved in the exploitation of small pelagics stresses the importance of fishery management to prevent high risk situations for the stocks, and encourage the use of reliable forecasts of the coming recruitment.

According to the possible tools for monitoring the stock (DEPM surveys in May, acoustics at the end or begining 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 appoach 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 should allow, with suitable estimates, a less conservative approach to management.

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 rigorous management of the Bay of Biscay Anchovy, precise information on the abundance of the stock provided on regular basis is absolutely necessary. The assessment and scientific advice for a species like anchovy rely heavily on this direct methods. The current lack of support provided by the countries involved on the fishery to the stock direct monitoring (i.e. by Acoustic or DEPM methods), puts at risk the continuity of the assessment of this fishery and precludes the implementation of an optimal management of the fishery.

Finally, it should be mentioned that such a management system can not be implemented within the present ICES/EU institutional structure due to the need of implement management measures very shortly after the surveys. If management of the anchovy stock is required, an institutional framework should be established that would allow management measures to be taken at very short notice. This might be achieved by devolving management responsability to a regional administration.

Table 10.1 Annual catches (in tonnes) of Bay of Biscay anchovy (Subarea VIII) As estimated by the Working Group members.

COUNTRY	FRANCE	SPAIN	INTERNATIONAL
YEAR	VIIIab	VIIIbc	VIII
1960	1085	57000	58085
1961	1494	74000	75494
1962	1123	58000	59123
1963	652	48000	48652
1964	1973	75000	76973
1965	2615	81000	83615
1966	839	47519	48358
1967	1812	39363	41175
1968	1190	38429	39619
1969	2991	33092	36083
1970	3665	19820	23485
1971	4825	23787	28612
1972	6150	26917	33067
1973	4395	23614	28009
1974	3835	27282	31117
1975	2913	23389	26302
1976	1095	36166	37261
1977	3807	44384	48191
1978	3683	41536	45219
1979	1349	25000	26349
1980	1564	20538	22102
1981	1021	9794	10815
1982	381	4610	4991
1983	1911	12242	14153
1984	1711	33468	35179
1985	3005	8481	11486
1986	2311	5612	7923
1987	5061	9863	14924
1988	6743	8266	15009
1989	2200	8174	10374
1990	10598	23258	33856
1991	9708	9573	19281
1992	15207	22468	37675
1993	20914	19173	40087
1994	16993	17554	34547
1995	10848	18950	29798
1996	2630	16128	18758 (*)
AVERAGE (1960-95)	4491	29870	34361

(*) Preliminary data for the first half of the year

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Table 10.2 Monthly catches of the Bay of Biscay anchovy by country (Sub-area VIII)

COUNTRY: **FRANCE** Units: t.

YEAR\MONTH	J	F	M	A	M	J	J	O	S	O	N	D	TOTAL
1987	0.0	0.0	0.0	1225.0	1716.0	283.0	162.0	643.0	749.0	273.0	15.0	1.0	5067.0
1988	0.0	0.4	14.0	784.0	1388.0	781.0	296.0	1154.0	2000.0	324.0	0.2	0.0	6741.6
1989	699.6	81.4	11.0	378.4	763.4	11.0	59.4	8.8	30.8	151.8	4.4	0.0	2200.0
1990	0.4	0.0	15.9	1330.0	1511.3	127.2	269.2	1904.5	3274.8	1446.3	635.9	82.7	10598.1
1991	1318.0	2135.4	603.1	808.0	1622.0	195.2	124.2	419.1	1587.3	556.7	53.7	285.5	9708.2
1992	2062.0	1480.0	941.0	783.0	48.0	10.0	335.0	1202.0	2786.0	3165.0	2395.0	0.4	15207.4
1993	1636.4	1805.3	1536.7	91.2	342.5	1439.2	1314.6	2639.7	4056.6	3277.3	2726.7	47.2	20913.4
1994	1972.4	1907.6	1442.2	171.9	770.1	1730.2	662.7	2125.0	3276.4	2652.3	222.9	0.0	16933.7
1995	618.6	951.5	805.4	258.1	862.4	1662.6	388.6	1083.7	2141.0	1200.3	853.2	22.1	10847.5
Average 87-95	923.0	929.1	596.6	647.7	1002.6	693.3	401.3	1242.2	2211.3	1449.6	767.4	48.8	10913.0
in percentage	8.5%	8.5%	5.5%	5.9%	9.2%	6.4%	3.7%	11.4%	20.3%	13.3%	7.0%	0.4%	100%
Average 91-94	1747.2	1832.1	1130.8	463.5	695.7	843.7	609.1	1596.5	2926.6	2412.8	1349.6	83.3	15690.7
in percentage	11.1%	11.7%	7.2%	3.0%	4.4%	5.4%	3.9%	10.2%	18.7%	15.4%	8.6%	0.5%	100%

COUNTRY: **SPAIN**

YEAR\MONTH	J	F	M	A	M	J	J	O	S	O	N	D	TOTAL
1987	0.0	0.0	453.5	4133.0	3677.0	514.0	80.6	53.5	27.9	456.9	202.1	265.1	9863.6
1988	6.0	0.0	27.9	785.7	2931.4	3203.8	292.1	97.6	421.1	118.3	136.2	245.9	8265.9
1989	1.9	2.3	25.1	257.8	4295.5	794.9	90.0	509.7	115.6	198.4	1609.6	272.7	8173.5
1990	79.2	5.6	2084.7	1327.8	9947.4	2956.7	1202.4	3226.9	2278.3	123.2	16.4	9.5	23258.2
1991	99.6	39.7	23.0	1227.6	5290.8	1662.7	90.5	59.5	34.1	265.3	184.4	596.2	9573.3
1992	360.0	384.0	340.0	3458.0	13068.0	3437.0	384.0	286.0	505.0	63.0	94.0	89.0	22468.0
1993	101.7	59.1	1825.0	3169.0	7563.5	4488.2	794.9	339.7	197.5	64.9	546.3	23.0	19172.8
1994	0.0	9.3	148.7	5569.1	3991.1	5501.2	1133.2	181.4	105.6	642.5	198.0	73.8	17553.9
1995	0.0	0.1	35.1	5707.5	11484.8	1094.4	50.1	8.9	6.0	151.7	47.8	364.5	18950.8
Average 87-95	72.0	55.6	551.4	2848.4	6916.6	2628.1	457.5	529.3	410.1	231.6	337.2	215.5	15253.3
in percentage	0.5%	0.4%	3.6%	18.7%	45.3%	17.2%	3.0%	3.5%	2.7%	1.5%	2.2%	1.4%	100%
Average 91-94	140.3	123.0	584.2	3355.9	7478.4	3772.3	600.6	216.7	210.6	258.9	255.7	195.5	17192.0
in percentage	0.8%	0.7%	3.4%	19.5%	43.5%	21.9%	3.5%	1.3%	1.2%	1.5%	1.5%	1.1%	100%

COUNTRY: FRANCE + SPAIN

Average 91-94	1887.5	1955.1	1714.9	3819.4	8174.0	4615.9	1209.8	1813.1	3137.1	2671.8	1605.3	278.8	32882.7
in percentage	5.7%	5.9%	5.2%	11.6%	24.9%	14.0%	3.7%	5.5%	9.5%	8.1%	4.9%	0.8%	100%

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Table 10.3 ANCHOVY catches in the Bay of Biscay by country and divisions in 1995

COUNTRIES	DIVISIONS	QUARTERS				CATCH (t)	
		1	2	3	4	ANNUAL	%
SPAIN	VIIIb	0.0	3384.7	0.0	0.0	3384.7	17.9%
	VIIIC	35.2	14901.9	65.0	563.9	15566.1	82.1%
	TOTAL	35.2	18286.7	65.0	563.9	18950.8	100.0%
	%	0.2%	96.5%	0.3%	3.0%	100.0%	
FRANCE	VIIIab	2380.0	2768.3	3620.0	2079.5	10847.8	100.0%
	TOTAL	2380.0	2768.3	3620.0	2079.5	10847.8	100.0%
	%	21.9%	25.5%	33.4%	19.2%	100.0%	
INTERNATIONAL	VIIIab	2380.0	6153.0	3620.0	2079.5	14232.5	47.8%
	VIIIC	35.2	14901.9	65.0	563.9	15566.1	52.2%
	TOTAL	2415.2	21055.0	3685.0	2643.4	29798.6	100.0%
	%	8.1%	70.7%	12.4%	8.9%	100.0%	

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Table 10.4 Bay of Biscay ANCHOVY catches (t) by country and EU market categories in 1995

		QUARTERS					
COUNTRY	EEC CAT.	1	2	3	4	ANNUAL	%
SPAIN	T1	0	3681082	1143447	114639	4939168	26.1%
	T2	30118	11161166	1000359	1059913	13251556	69.9%
	T3	30521	150059	203511	372278	756369	4.0%
	T4	1281	0	0	2379	3660	0.0%
	TOTAL	61920	14992307	2347317	1549209	18950753	100.0%
FRANCE	T1	20355	33392	803959	66480	924186	8.5%
	T2	1751804	1252912	2524826	1680383	7209925	66.5%
	T3	613441	1392713	279658	288448	2574260	23.7%
	T4	9105	107336	22027	1517	139985	1.3%
	TOTAL	2394705	2786353	3630470	2036828	10848356	100.0%
INTERN.	T1	20355	3714474	1947406	181119	5863354	19.7%
	T2	1781922	12414078	3525185	2740296	20461481	68.7%
	T3	643962	1542772	483169	660726	3330629	11.2%
	T4	10386	107336	22027	3896	143645	0.5%
	TOTAL	2456625	17778660	5977787	3586037	29799109	100.0%

T1 : < = = 30 anchovies/Kg.
T2 : between 31 and 50 per Kg.
T3 : between 51 and 83 per Kg.
T4 : more than 84 per Kg.

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Table 10.5 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	255	431
1995 (3)	26	150 (2)	176	262	438
1996 (3)	26	150 (2)	176	262	438

(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.
(3) Provisional figures for 1995 and 1996
n/a = Not available.

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TABLE 10.6 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 (Provisional)
CPUE/PERIOD	03-06	03-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06	01-06
CPUE (t)	0.9	0.6	0.8	1.5	1.2	2.5	1.7	1.6	2.6	2.0
CPUE age 1 (#)	13.8	16.7	16.1	63.4	29.3	86.3	46.7	26.7	51.6	66.3
CPUE age 2 (#)	12.2	7.0	13.7	4.4	20.2	16.6	29.7	32.8	29.0	12.9
CPUE age 3 (#)	2.8	1.8	1.2	0.8	0.4	1.3	0.1	4.7	8.0	2.1
CPUE ages 4+ (#)	2.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.3
CPUE ages 2+ (#)	17.5	9.1	14.9	5.3	20.6	17.9	29.8	37.5	37.6	15.2
CPUE ages 3+ (#)	5.3	2.0	1.2	0.8	0.4	1.3	0.1	4.7	8.6	2.3

in thousands

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TABLE 10.7 Daily Egg Production Method.: Egg surveys on the Bay of Biscay anchovy.
(from MOTOS & URIARTE WD1993, MOTOS et al. 1995, 1996 and MOTOS & URIARTE WD1996)

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995 (Prelimnary estimates)	1996 (Prelimnary estimates)
Period of year		2 - 7 June	21 - 28 May	10 - 21 May	4 - 15 May	16May-07June	16May-13June	No survey	17 May-3June	11 - 25 May	18 - 30 May
Positive area (km2)		23850	45384	17546	59757	24264	67796		48735	31189	28448
Surveyed area (km2)		34934	59840	37930	79759	84032	92782		60330	51698	34294
Daily egg production		2.198	5.015	0.73	5.02	1.24	5.81		4.48		
Exp(-12)	C.V.	0.39	0.24	0.4	0.15	0.06	0.14		0.14		
SSB (t)		29365	63500	11861	97239	19276	90720	--	70940	45000	40600
	C.V.	0.48	0.31	0.41	0.17	0.14	0.2		0.16	0.25	0.25
Coastal egg Production Exp(-12)		2.319	5.312	0.328	3.35	0.524	2.97	--	2.74		
TOTAL #		1129	2675	470	5843	965.6	5797	--	3516		
	C.V.					0.14	0.25		0.18		
No/age:	1	656	2349	246	5613	670.5	5571		2457		
	C.V.					0.16	0.26		0.23		
(millions)	2	331	258	206	190	290.3	209.3		1005		
	C.V.					0.17	0.22		0.19		
	3+	142	68	18	40	4.8	16.7		54		
	C.V.					0.42	0.51		0.28		

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Table 10.8 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
Surveyed area	3,267	3,743	5,112	3,418 (3)	3388 (3)	2,440
Density (t/nm(**2))	15.4	10.3	3,0	14.5-32.2 (4)	23.6	32.8
Biomass (t)	50,000	38,500	15,500	60-110,000 (4)	64,000	89,000
Number (10**(-6))	2,600	2,000	805	4,300-7,500 (4)	3,173	9,342
Number of 1-group(10**(-6))	1,800 (1)	600	400	4,100-7,500 (4)	1,873	9,072

(1) Rough estimation
(2) Assumption of overestimate
(3) Positive area
(4) Must be revised

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Table 10.9 Summary of egg and acoustic surveys of Bay of Biscay anchovy

YEARS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Egg survey (million) (1-year-old)					656	2,349	246	5,613	647	5,571		2,457
Acoustic survey (1-year-old) millions	1,800	600					440	n.a.	1,373	9,072		
CPUE 1 (#)							16.1	63.4	29.3	86.3	46.7	26.7
Y.C.C.C.(1)	1,444	352	177	267	340	542	302	1,738	668	2,044	2,034	1150
Assessed age 1					1769	2481	990	6401	2176	8139	8260	4654

(1) Year class cumulative Catches per cohort in numbers

$$\sum_{i=1}^{N} C_{ij}$$

with N = number of years that year class j is fished.
Cij = Catch from year class j in year i

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Table 10.10 ANCHOVY catch at age in thousands for 1995 by country, division and quarter.

QUARTERS AND MAIN DIVISIONS
units: thousands

SPAIN	AGE		1 VIIIbc	2 VIIIbc	3 VIIIbc	4 VIIIbc	Annual total VIIIbc
		0	0	0	0	20,948	20,948
		1	1,135	366,789	2,565	4,161	374,650
		2	325	206,062	215	909	207,511
		3	76	57,138	53	36	57,303
		4	0	4,096	7	0	4,103
	TOTAL(n)		1,536	634,085	2,840	26,054	664,515
	W MED.		23.45	29.43	22.42	21.61	29.08
	CATCH. (t)		35.2	18,286.7	65.0	563.9	18,951
	SOP		36.0	18,678.8	63.6	563.9	19,342
	VAR. %		102.33%	102.14%	97.88%	99.99%	102.07%
FRANCE	**AGE**		**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**
		0	0	0	4,031	13,888	17,919
		1	32,276	121,918	117,012	53,452	324,658
		2	56,558	19,248	11,008	9,404	96,218
		3	19,174	99	0	0	19,273
		4	0	0	0	0	0
	TOTAL(n)		108,008	141,265	132,051	76,744	458,068
	W MED.		21.62	18.80	26.10	25.60	22.71
	CATCH. (t)		2,380	2,768	3,620	2,080	10,848
	SOP		2,543	2,575	3,629	1,957	10,704
	VAR. %		106.85%	93.02%	100.25%	94.11%	98.67%

TOTAL	QUARTERS / AGE		1 VIIIbc	2 VIIIbc	3 VIIIbc	4 VIIIbc	Annual total VIIIbc
Sub-area VIII		0	0	0	4,031	34,836	38,867
		1	33,411	488,707	119,577	57,613	699,308
		2	56,883	225,310	11,223	10,313	303,729
		3	19,250	57,237	53	36	76,576
		4	0	4,096	7	0	4,103
	TOTAL(n)		109,544	775,350	134,891	102,798	1,122,583
	W MED.		21.65	27.49	26.02	24.59	26.48
	CATCH. (t)		2,415	21,055	3,685	2,643	29,799
	SOP		2,579	21,254	3,693	2,521	30,046
	VAR. %		106.78%	100.94%	100.21%	95.36%	100.83%

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Table 10.11
Spanish half - yearly catches of anchovy (2nd semester) by age in ('000)
of Bay of Biscay anchovy from the live bait tuna boats. (from ANON 1996 and WG members)

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	10020	97581	N/A	27993	6098	2167	3557	7872	10154
1	24975	17353	N/A	22238	13736	14268	20160	5753	10885
2	1461	203	N/A	109	0	0		477	209
3	912	3	N/A	0	0	0		0	0
Total	37368	115140	N/A	50340	19834	16435	23717	14102	21248
Catch (t)	546	493		416	353	200	306	143.2	273.2
meanW (g)	14.6	4.3		8.3	17.8	12.1	12.9	10.2	15.8

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Table 10.12 Total catches of anchovy (in millions) by age from 1989 to 1994 on a half-year basis including catches of live bait anchovies for tuna fishing.

Year	1989		1990		1991		1992		1993		1994		1995		1996	
Half year	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Age															Preliminary	
0	0	175	0	33	0	79	0	36	0	64	0	60	0	49	0	
1	157	8	842	541	328	113	998	452	796	613	495	356	522	188	631	
2	130	12	62	58	322	16	197	23	437	90	493	55	282	22	157	
3	14	3	10	5	16	1	17	1	7	0	62	1.3	76	0	21	
4	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	
Total (#)	301	198	914	637	666	209	1212	512	1240	767	1050	472	885	259	810	
Catch (t)	7321	3052	19385	14887	15025	4610	26381	11504	24057	16334	23213	11416	23470	6602	18629	

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Table 10.13 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
0	0	0	0	0	0	0	0	0	0	0	0
1	776	0	156	31	0	1	14	3	0	388	161
2	602	861	1322	1687	1307	405	688	0	25	166	813
3	0	77	262	435	574	535	267	330	133	69	309
4	0	0	0	0	7	7	0	0	0	10	46
5+	0	0	0	0	0	0	0	0	0	0	0
Total	1378	938	1740	2153	1888	948	969	333	158	633	1329

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	0	0	31	128	175	33	79	36	64	60	49
1	53	52	220	385	164	1383	441	1450	1409	850	710
2	105	80	187	128	142	120	338	220	527	548	304
3	177	63	42	29	18	15	18	18	7	63	77
4	4	54	22	3	0	0	0	0	0	0	4
5+	0	0	12	1	0	0	0	0	0	0	0
Total	339	249	514	674	499	1551	876	1724	2007	1521	1144

(1) before 1983 some ageing errors could have occurred

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Table 10.14 Half-year mean weight at age in the catches of the Bay of Biscay anchovy in 1995

Units: g.

Country	Spain	France	Spain	France	Total		
Semester	1	1	2	2	1	2	Annual
Area	VIIIcb	VIIIab	VIIIcb	VIIIab	VIII	VIII	VIII
Age							
0	0.00	0.00	19.19	13.55		16.59	16.59
1	24.76	17.24	26.81	27.62	22.54	27.59	23.82
2	35.18	24.49	36.39	31.14	32.31	31.41	32.25
3	38.02	31.36	36.44		36.34	36.44	36.34
4	37.28		29.15		37.28	29.15	37.27
Total	29.42	20.54	21.69	26.76	26.92	26.14	26.75

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Table 10.15 Weight at age (in grams) in the Total Catch of Anchovy in the Bay of Biscay.

years	0-group	1-group	2-group	3-group
1987	13	21	33	38
1988	13	21	31	35
1989	13	20	29	30
1990	10	22	28	42
1991	15	19	26	32
1992	12	21	31	38
1993	12	18	27	30
1994	16	21	26	29
1995	17	24	32	35

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Table 10.16 Weight at age (in grams) in the stock of Anchovy in the Bay of Biscay.

years	0-group	1-group	2-group	3-group
1987	13	16	29	33
1988	13	16	29	33
1989	13	16	29	33
1990	10	16	29	35
1991	15	17	28	34
1992	12	15	32	32
1994	15	17	26	32
1995	12	16	27	33

from Cendrero 1994

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Table 10.17 Input data and constraints for the assessment of the Bay of Biscay anchovy (Division VIII) with the Integrated Catch at age analysis package.

Range of years for the analysis: 1987-1995:
Relative weight for each year in the analysis: 0.5 / 0.5 / 1 / 1 / 1 / 1 / 1 / 1

Catch Data: Matrix of annual catches at age from the International fishery in Division VIII.
Range of ages: 0-5. Significant range of ages: 1-3 years old.
Relative weights for the reliability of the catches at age: 0.1 / 1 / 1 / 1 / 0.1 / 0.1

Tuning data: Biomass indices:
In.1: DEPM: 8 Observations., 1987-1995 (missing value in 1993), Taken as absolute values.
In.2: Acoustic, 3 values, 1989,1991,1992. Used as relative index

Tuning data: Aged desagregated indices:
In. 1: DEPM Pop. estimates (1987-1994, except for 1993), used as absolute values. Ages: 1-3+
In. 2: Acoustic Population estimates in 1989, 91 & 92. Used as relative figures. Ages: 1,2+

Equal confidence has been set to all the tuning indices. Relative weight for all = 1

Reference age for the separated constraint: 2 y.o.
Selection pattern: Flat. S on last age fixed at 1
Ages used to calculate the reference F : 1-3 y.o.

Table 10.18 ICA. AV file.

```
Total weighted SSQ is :  8.4163358629667

Unweighted Residuals About the Model fit
----------------------------------------
                   Start SSQ     End SSQ   df        Variance     IV
Wt
Separable model:      27.7132      9.7028  20         .4851  2.06125
   Biomass idx 1     2.7667274   1.1261026   8         .1408  3.44652
   Biomass idx 2      .7555241    .3550254   2         .1775  2.73300
   Aged index  1    18.6256450   4.2687818  21         .2033  2.38662
   Aged index  2     2.6410028    .8218924   4         .2055  2.36110

Partition of the weighted residuals
-----------------------------------

 Catch at Age Matrix :    .3473E+01 for   45 observations.

SSB Index  2    1.1261 8
SSB Index  2    .3550254 3

Aged Index  1
Age:              1         2         3
 Wted SSQ: .1071E+01 .1296E+01 .4789E+00
 No data:         7         7         7
Aged Index  2
Age:              1         2
 Wted SSQ: .4678E+00 .1486E+00
 No data:         3         3
```

Table 10.19 ICA Outputs.

CATCH NUMBERS AT AGE (Millions)

	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	31.	128.	175.	33.	79.	36.	64.	60.	49.
1	220.	385.	164.	1383.	441.	1450.	1409.	850.	710.
2	187.	128.	142.	120.	338.	220.	527.	548.	304.
3	42.	29.	18.	15.	18.	18.	7.	63.	77.
4	22.	3.	1.	1.	1.	1.	1.	1.	4.
5	12.	1.	1.	1.	1.	1.	1.	1.	1.

INDICES OF SPAWNING STOCK BIOMASS

	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.294E+05	.635E+05	.150E+05	.972E+05	.193E+05	.907E+05	-.100E+01	.709E+05	.450E+05
2	-.100E+01	-.100E+01	.155E+05	-.100E+01	.640E+05	.890E+05	-.100E+01	-.100E+01	-.100E+01

AGE - STRUCTURED INDICES

INDEX : 1 from 1987 to 1994

	1987	1988	1989	1990	1991	1992	1993	1994
1	.656E+06	.235E+07	.246E+06	.561E+07	.671E+06	.557E+07	-.100E+01	.246E+07
2	.331E+06	.258E+06	.206E+06	.190E+06	.290E+06	.209E+06	-.100E+01	.101E+07
3	.760E+05	.680E+05	.180E+05	.400E+05	.480E+04	.167E+05	-.100E+01	.540E+05

INDEX : 2 from 1989 to 1992

	1989	1990	1991	1992
1	.400E+03	-.100E+01	.187E+04	.907E+04
2	.405E+03	-.100E+01	.130E+04	.270E+03

FISHING MORTALITY

	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	.0048	.0069	.0068	.0068	.0137	.0092	.0063	.0062	.0056
1	.2389	.3425	.3343	.3353	.6755	.4537	.3129	.3045	.2787
2	.7070	1.0137	.9895	.9925	1.9992	1.3427	.9260	.9013	.8248
3	.6493	.9310	.9087	.9116	1.8361	1.2332	.8504	.8278	.7575
4	.7070	1.0137	.9895	.9925	1.9992	1.3427	.9260	.9013	.8248
5	.7070	1.0137	.9895	.9925	1.9992	1.3427	.9260	.9013	.8248

NUMBERS AT AGE (Millions)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	8276.	3310.	21395.	7272.	27393.	27677.	15551.	14273.	14963.	13036.
1	1769.	2481.	990.	6401.	2176.	8139.	8260.	4654.	4273.	4481.
2	663.	420.	530.	213.	1379.	333.	1557.	1819.	1034.	974.
3	128.	98.	46.	59.	24.	56.	26.	186.	223.	136.
4	70.	20.	12.	6.	7.	1.	5.	3.	24.	31.
5	5.	11.	3.	2.	1.	0.	0.	1.	0.	3.

STOCK SUMMARY

Year	Recruits x10^6	Total B tonnes	Spawn B tonnes	Landings tonnes	Yld/SSB	Ref. F Fbar 1- 3
1987	8276.	162141.	29065.	14924.	.5135	.5317

Table 10.19 (cont'd)

1988	3310.	99342.	29178.	15009.	.5144	.7624
1989	21395.	311446.	16356.	10374.	.6342	.7442
1990	7272.	183893.	60886.	33856.	.5561	.7465
1991	27393.	487589.	29395.	19281.	.6559	1.5036
1992	27677.	466726.	69621.	37675.	.5411	1.0099
1993	15551.	361866.	93342.	40087.	.4295	.6964
1994	14273.	346617.	68487.	34547.	.5044	.6779
1995	14963.	284091.	55670.	29798.	.5353	.6203

IFAP run code: I03

PARAMETER ESTIMATES +/- SD

Separable Model: Reference F by year				
1	1987	.7070	.5198	.9616
2	1988	1.0137	.7920	1.2975
3	1989	.9895	.8028	1.2196
4	1990	.9925	.8032	1.2265
5	1991	1.9992	1.7255	2.3164
6	1992	1.3427	1.0923	1.6507
7	1993	.9260	.7361	1.1648
8	1994	.9013	.6887	1.1795
9	1995	.8248	.5549	1.2258
Separable Model: Selection (S) by age				
10	0	.0068	.0042	.0111
11	1	.3379	.2810	.4063
	2	1.0000	Fixed : Reference age	
12	3	.9184	.7650	1.1026
	4	1.0000	Fixed : last true age	
Separable Model: Populations in year 1995				
13	0	14962522.	3737628.	59898164.
14	1	4272511.	2967218.	6152010.
15	2	1033814.	793585.	1346763.
16	3	222517.	161556.	306481.
17	4	24457.	16776.	35656.
Separable Model: Populations at age 4				
18	1987	69818.2799	19812.5856	246035.1372
19	1988	20205.1776	11172.3817	36540.9286
20	1989	11684.6629	7999.9445	17066.5369
21	1990	5564.9526	3959.7294	7820.9126
22	1991	7189.2927	5263.6884	9819.3370
23	1992	1143.3706	757.4875	1725.8324
24	1993	4934.1128	3312.0254	7350.6287
25	1994	3374.0648	2278.2105	4997.0420

SSB Index catchabilities
SSB Index 1 was used as absolute estimator.
No fitted catchability for this index.

26	2	Linear Model : Q	.13816E+01	.10871E+01	.17560E+01

Age-structured index catchabilities
Age-Structured Index 1

Absolute estimator: No fitted catchability.

Table 10.19 (cont'd)

Age-Structured Index 2

Linear model fitted. Slopes at age:

27	1 Q	.11896E-02	.89888E-03	.15743E-02
28	2 Q	.16279E-02	.12316E-02	.21517E-02

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals
(log(Observed Catch)-log(Expected Catch))
and weights (W) used in the analysis.

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	
0	.28814E+00	.22630E+01	.73373E+00	.14143E+00	-.10093E+01	-.14093E+01	.11303E+00	.16118E+00	-.26814E-11	.10000E+00
1	-.17910E-01	-.11754E+00	-.31348E-01	.23177E+00	-.40843E+00	-.21928E+00	.56295E-01	.14840E+00	.13291E+00	.10000E+01
2	-.11219E+00	-.29033E+00	-.40495E+00	.33490E+00	-.89396E+00	.30448E+00	-.12532E+00	-.22311E+00	-.18428E+00	.10000E+01
3	.10026E+00	-.26762E+00	.36152E-01	-.40718E+00	.27154E+00	-.36774E+00	-.30313E+00	-.44485E-01	.40459E-01	.10000E+01
4	-.18074E-02	-.10106E+01	-.15454E+01	-.80575E+00	-.14609E+01	.58559E+00	-.63819E+00	-.23949E+00	-.74628E+00	.10000E+00
Wts	.50000E+00	.50000E+00	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	

Biomass Index Residuals: log(Observed Index) - log(Expected Index)

Idx	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.10280E-01	.77761E+00	-.86572E-01	.46816E+00	-.42198E+00	.26471E+00	-.10000E+01	.35184E-01	-.21278E+00
2	-.10000E+01	-.10000E+01	-.37706E+00	-.10000E+01	.45477E+00	-.77712E-01	-.10000E+01	-.10000E+01	-.10000E+01

Aged Index Residuals: log(Observed Index) - log(Expected Index)

Aged Index 1

Age	1987	1988	1989	1990	1991	1992	1993	1994
1	-.30839E+00	.67816E+00	-.66369E+00	.59798E+00	-.28619E+00	.40644E+00	-.10000E+01	.75814E-01
2	.21158E+00	.56534E+00	.94111E-01	.92497E+00	-.38249E-01	.74198E+00	-.10000E+01	.40455E+00
3	-.96308E-01	.37521E+00	-.20889E+00	.49642E+00	-.43076E+00	-.82913E-01	-.10000E+01	-.29302E+00

Aged Index 2

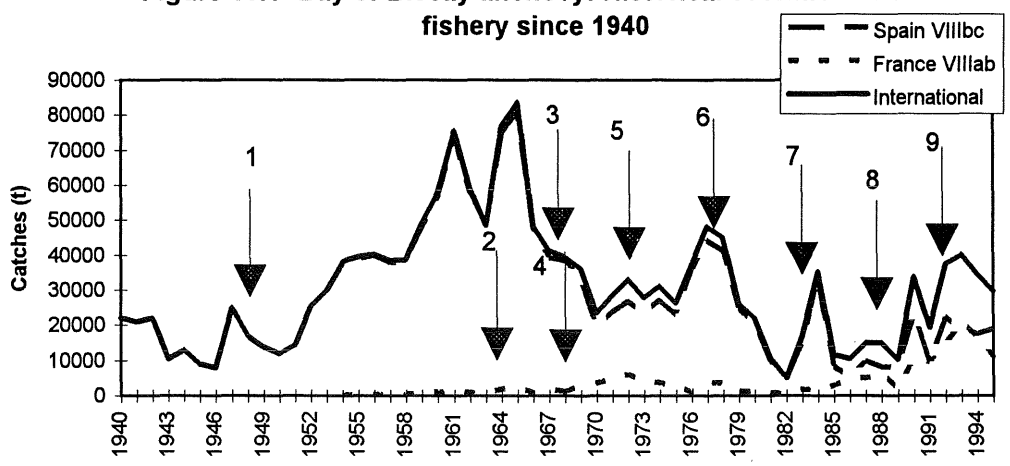
Age	1989	1990	1991	1992
1	-.63502E+00	-.10000E+01	.22050E+00	.41452E+00
2	-.23285E+00	-.10000E+01	.35815E+00	-.12530E+00

PARAMETERS OF THE DISTRIBUTION OF ln CATCHES AT AGE

Table 10.19 (cont'd)

```
 Separable model fitted from 1987 to 1995
Variance                  :     .8705
Skewness test statistic   :    -.3728
Kurtosis test statistic   :    3.8333
Partial chi-square        :    1.9480
Probability of chi-square :    1.0000
Degrees of freedom        :        20


   PARAMETERS OF THE DISTRIBUTION OF THE SSB INDICES
   -------------------------------------------------


     DISTRIBUTION STATISTICS FOR ln SSB INDEX   1


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

Variance                  :     .1299
Skewness test statistic   :    1.3829
Kurtosis test statistic   :    -.0843
Partial chi-square        :     .1073
Probability of chi-square :    1.0000
Number of observations    :         8
Degrees of freedom        :         8
Weight in the analysis    :    1.0000


     DISTRIBUTION STATISTICS FOR ln SSB INDEX   2


 Linear catchability relationship assumed.
 Last age is a plus-group.

Variance                  :     .1775
Skewness test statistic   :     .2315
Kurtosis test statistic   :    -.5303
Partial chi-square        :     .0342
Probability of chi-square :    1.0000
Number of observations    :         3
Degrees of freedom        :         2
Weight in the analysis    :    1.0000


   PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES
   ------------------------------------------------------------


     DISTRIBUTION STATISTICS FOR ln AGED INDEX   1


 Index used as absolute measure of abundance.

Age                       :         1         2         3
Variance                  :     .2243     .1056     .1015
Skewness test stat.       :     .3485    1.5356     .2792
Kurtosis test stat.       :    -.7751    -.4542    -.7091
Partial chi-square        :     .1147     .1675     .0719

Prob. of chi-square       :    1.0000    1.0000    1.0000
Number of data            :         7         7         7
Degrees of freedom        :         7         7         7
Weight in analysis        :     .6667     .6667     .6667


     DISTRIBUTION STATISTICS FOR ln AGED INDEX   2


 Linear catchability relationship assumed.

Age                       :         1         2
Variance                  :     .3118     .0991
Skewness test stat.       :    -.4330     .4352
Kurtosis test stat.       :    -.5303    -.5303
Partial chi-square        :     .0873     .0303
Prob. of chi-square       :     .9573     .9850
Number of data            :         3         3
Degrees of freedom        :         2         2
Weight in analysis        :     .7500     .7500
```

Figure 10.1 Bay of Biscay anchovy: Historical evolution of the fishery since 1940



1. Goniometer
2. Echosounder; anchovy disappear from the coast of Galicia
3. Minimum length 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. Minimum landing size 12 cm : increase of the french pelagic fleet
9. Bilateral agreement between Spain and France : the pelagic fleet is not allowed
   to fish anchovy from the end of March to the end of June

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Figure 10.2 Mean monthly catches (1991-1994) for the French and Spanish anchovy fisheries in Sub-area VIII

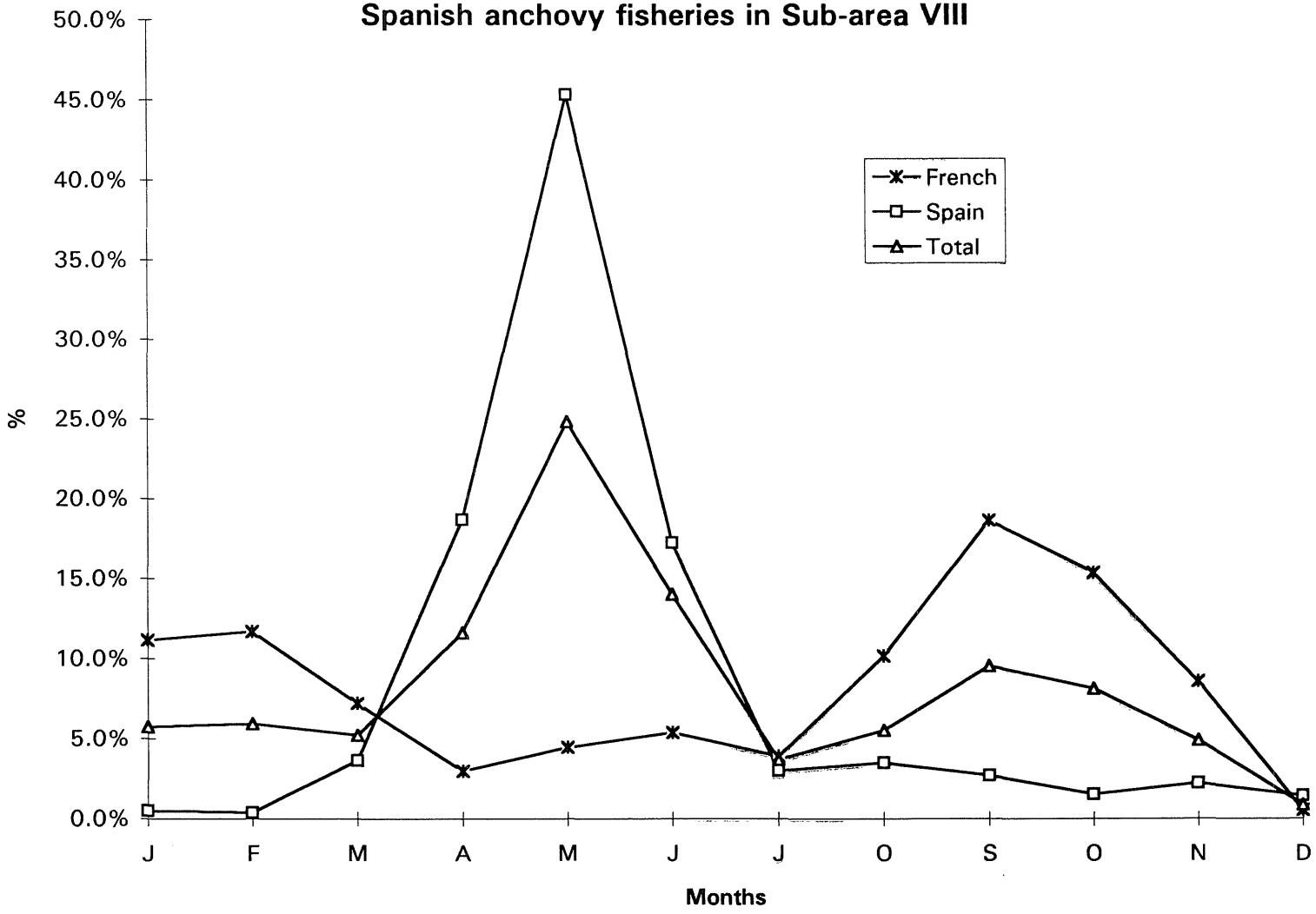

Figure 10.3 Evolution of the fleets fishing for anchovy in the Bay of Biscay

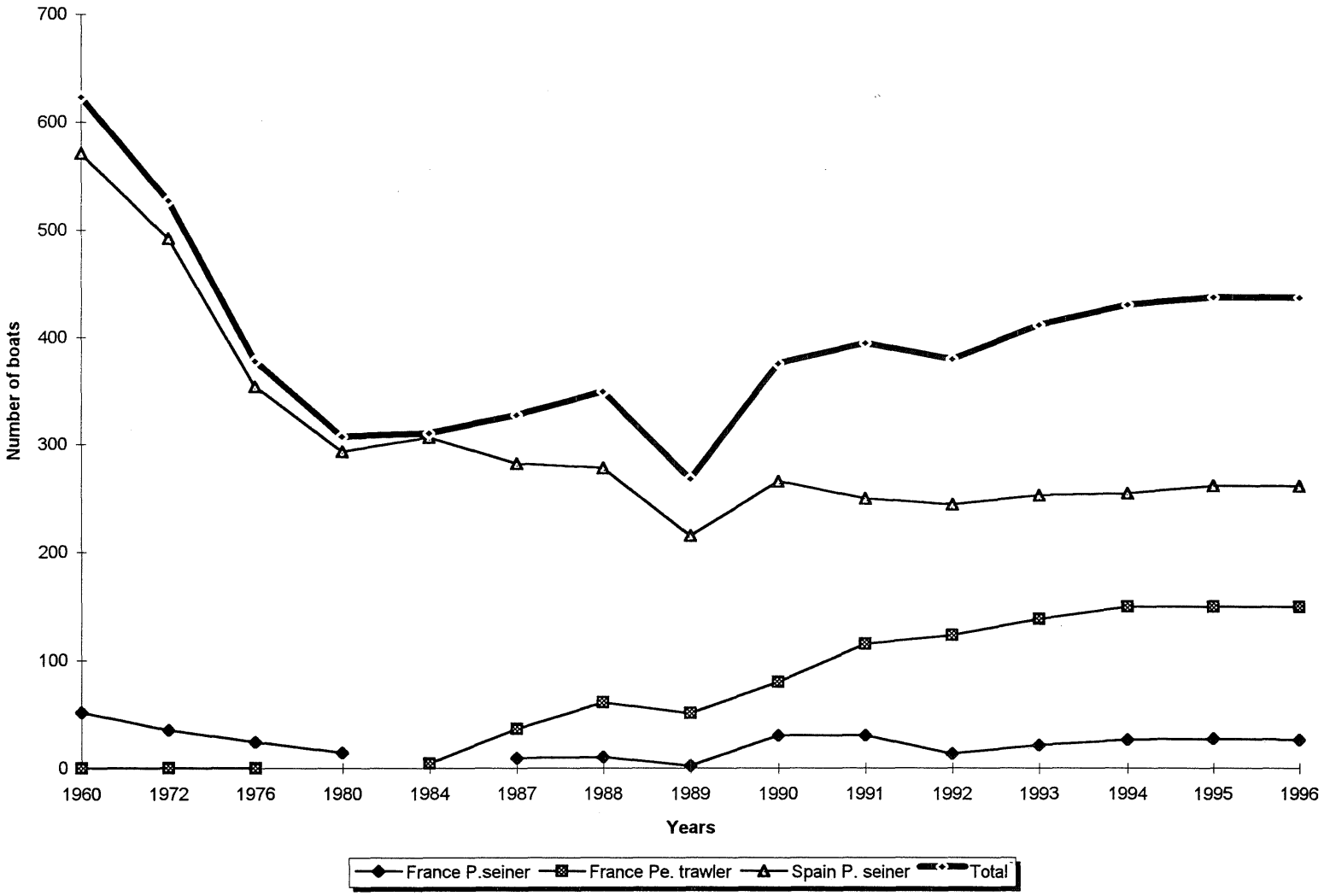

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Figure 10. 4 Relationship between spawning biomass (t) and extension of the spawning area (km^2) for the Bay of Biscay anchovy population. (From Motos et al.WD1996)

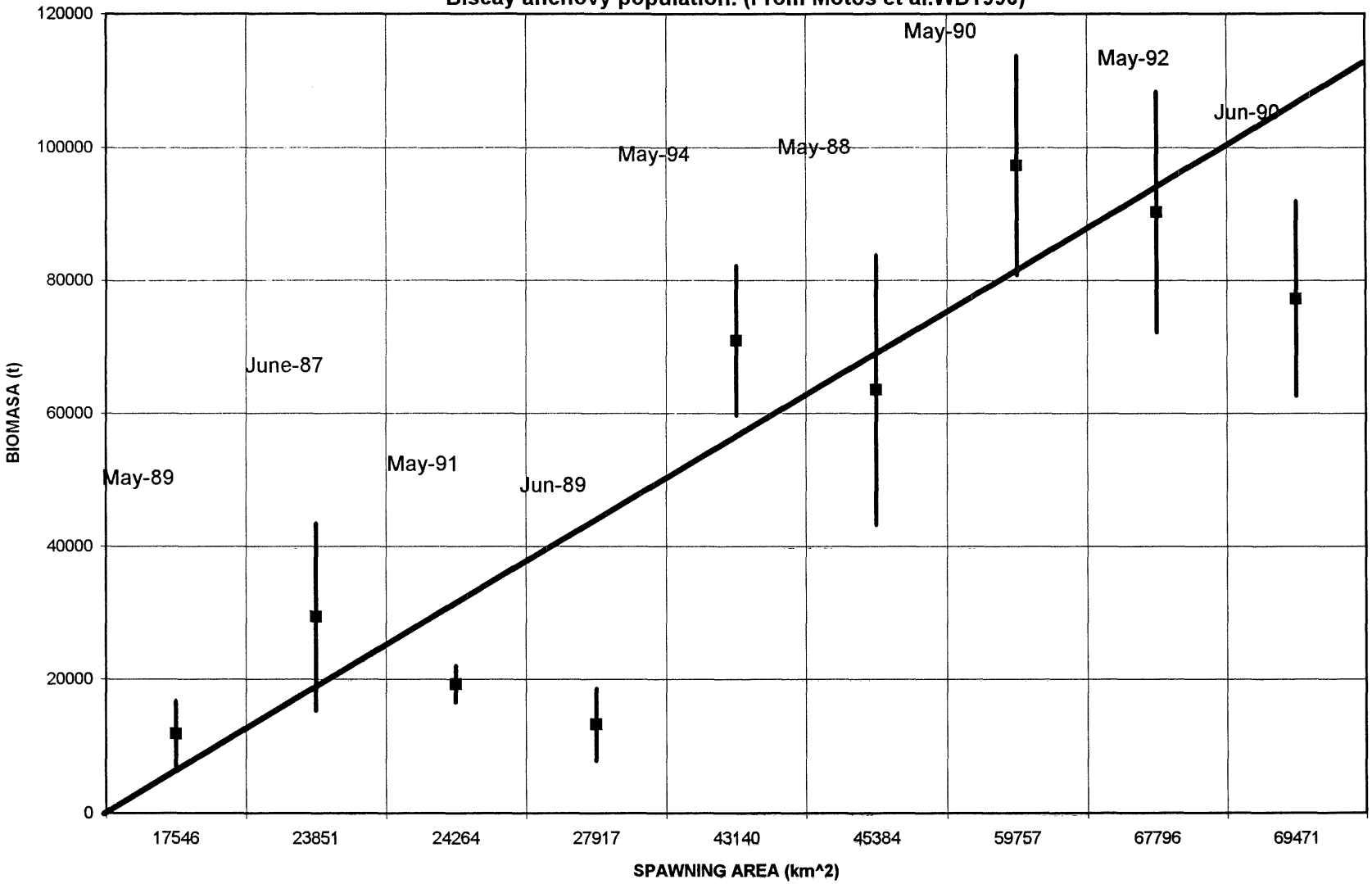

Figure 10.5 Anchovy VIII: Comparison of recruitment indexes at age 1

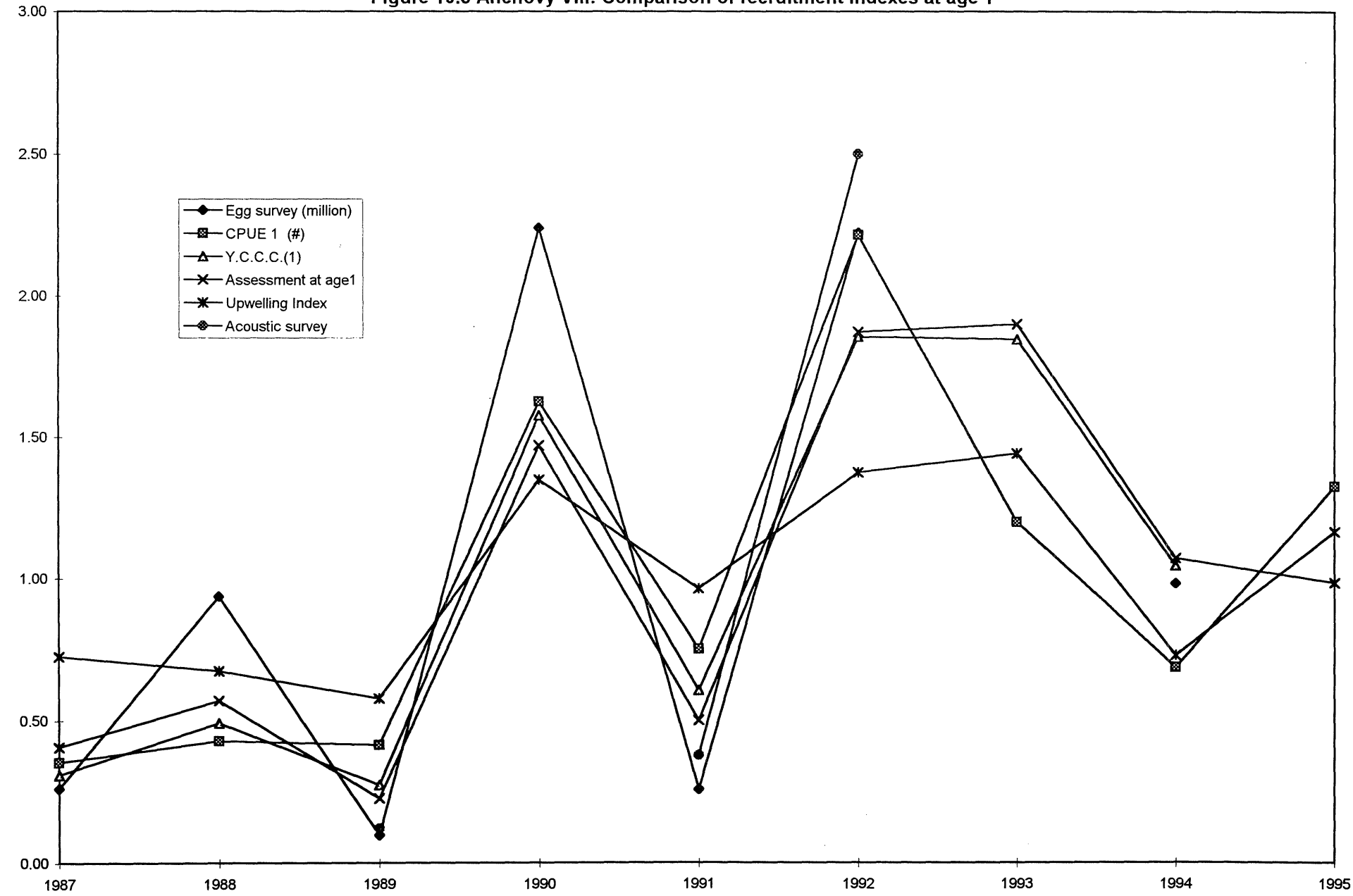

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Figure 10.6 Results of the anchovy assessment in Sub-area VIII.

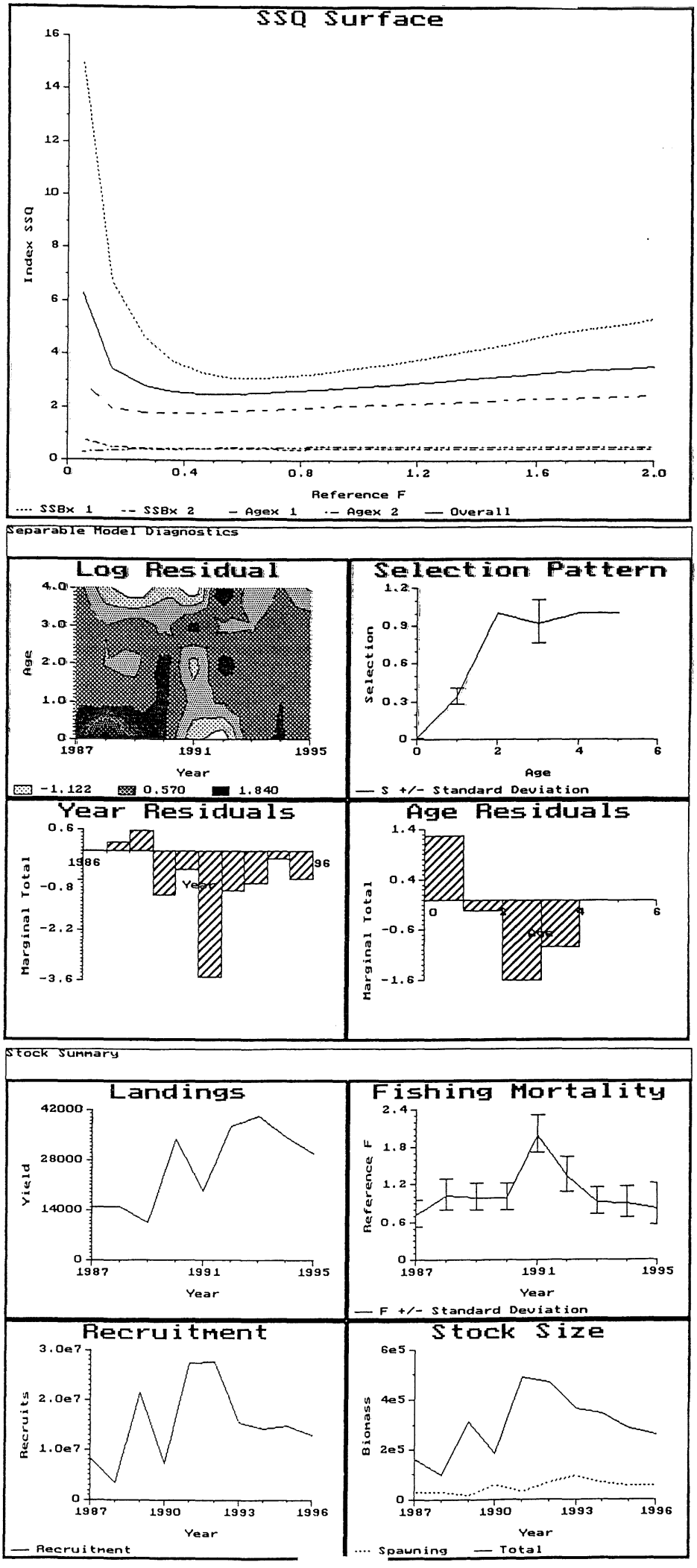
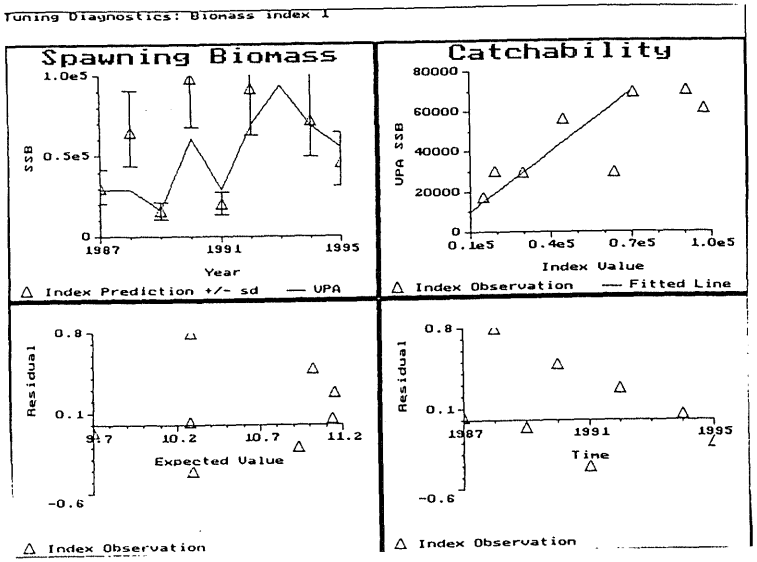
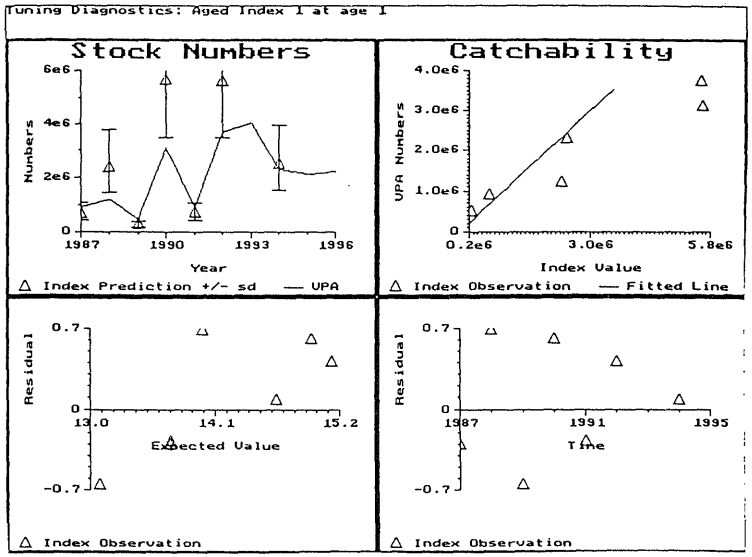
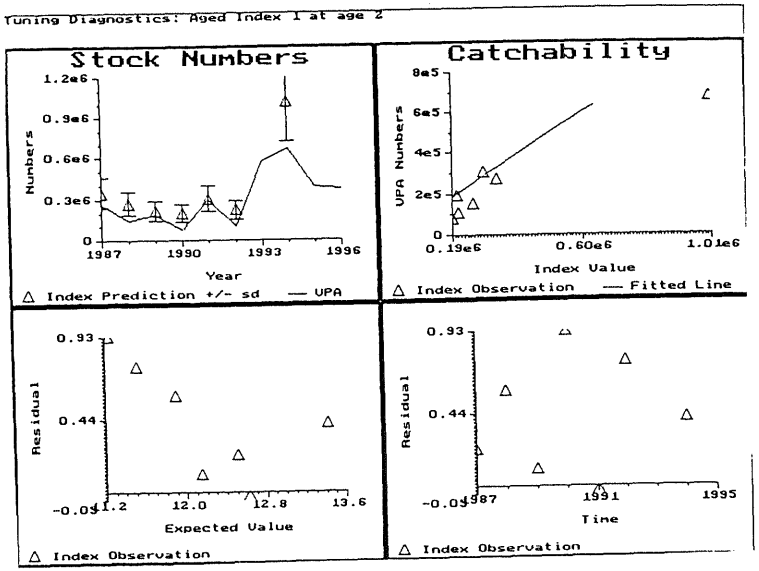


Figure 10.6 (cont'd)







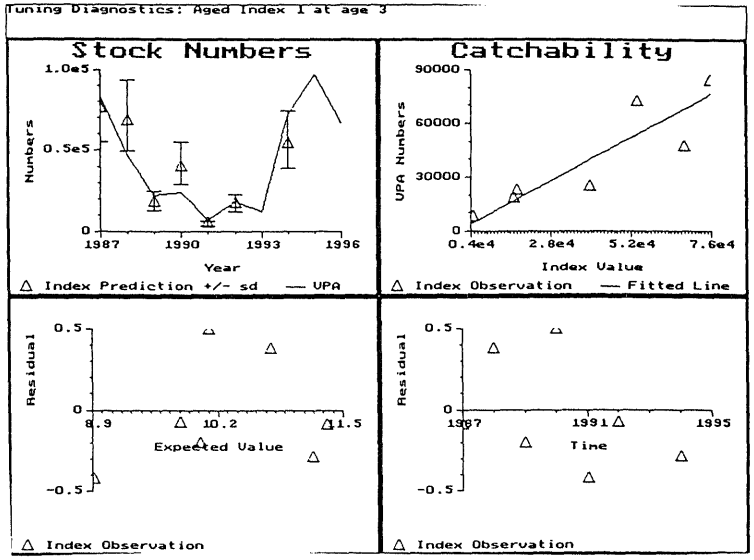
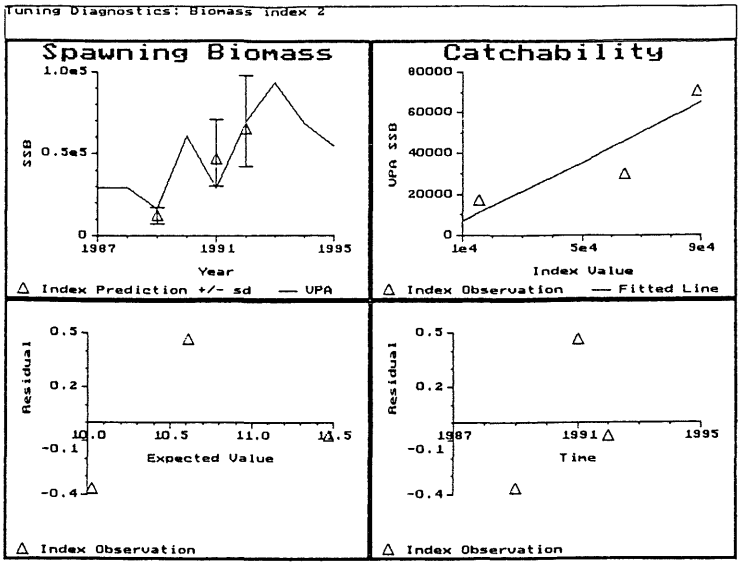
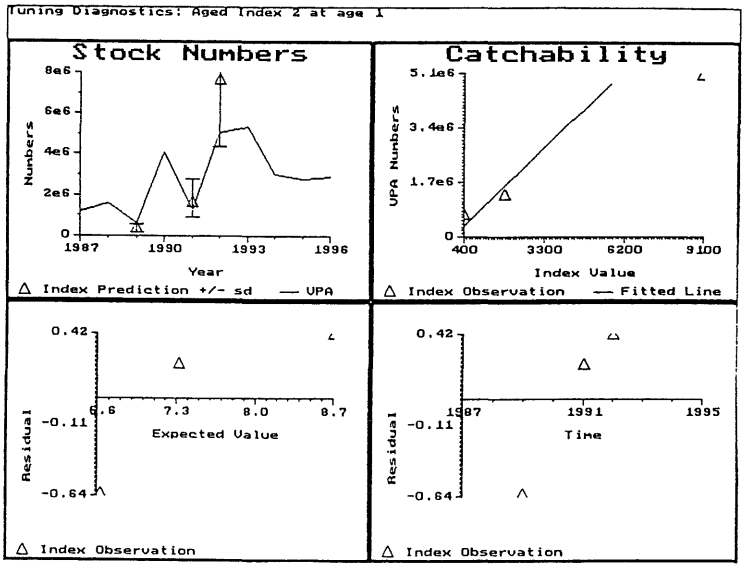


Figure 10.6 (cont'd)





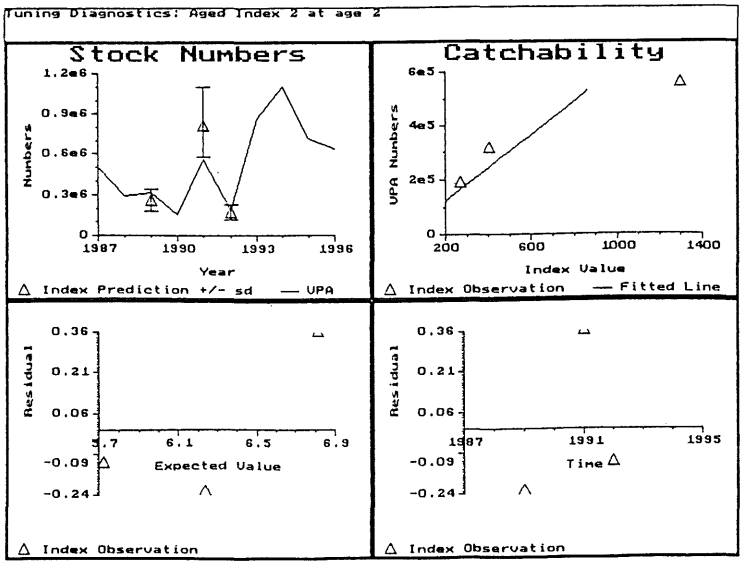
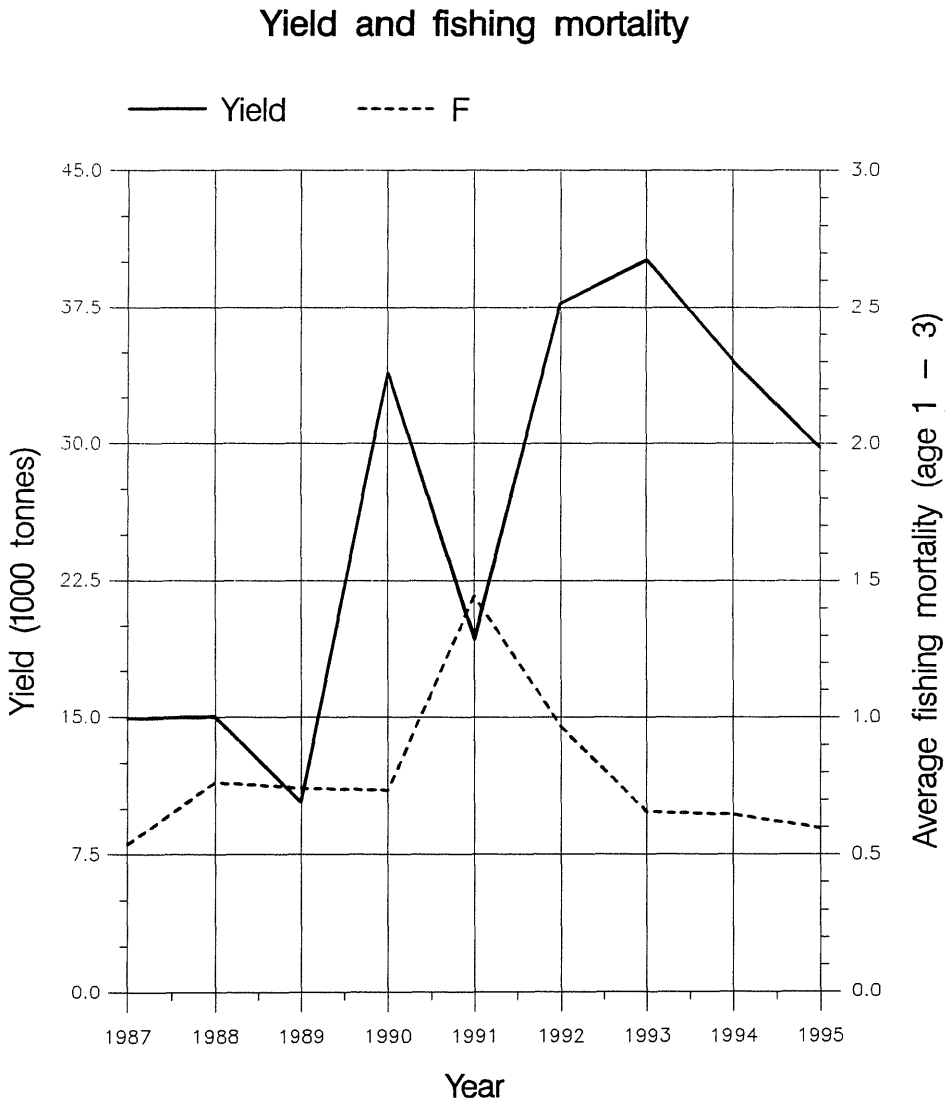
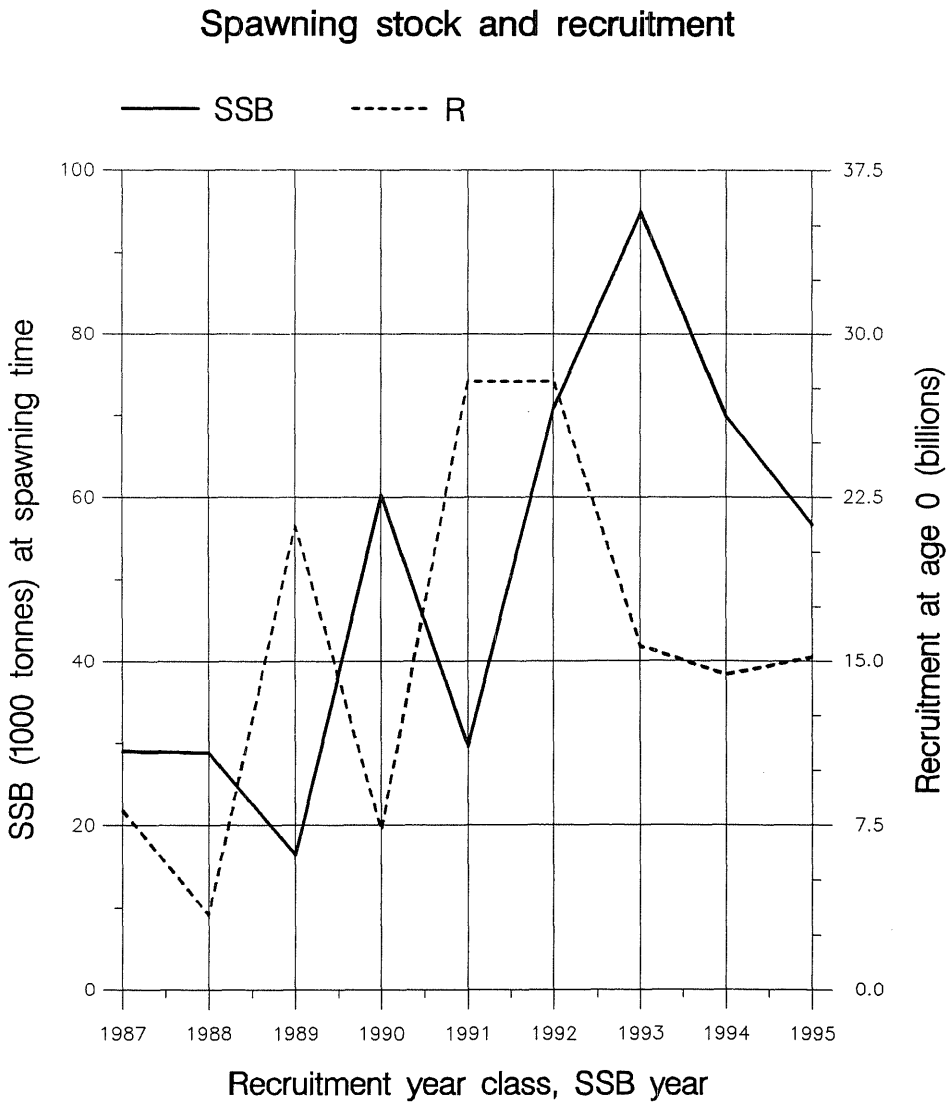


Figure 10.7

Fish Stock Summary
Anchovy in the Bay of Biscay (Fishing Area VIII)
17 – 8 – 1996



(run: ICAAND03) A



(run: ICAAND03) B

Figure 10.9a Relationship between the number of recruits (1 year old anchovies) and the SSB estimated from the assessment.

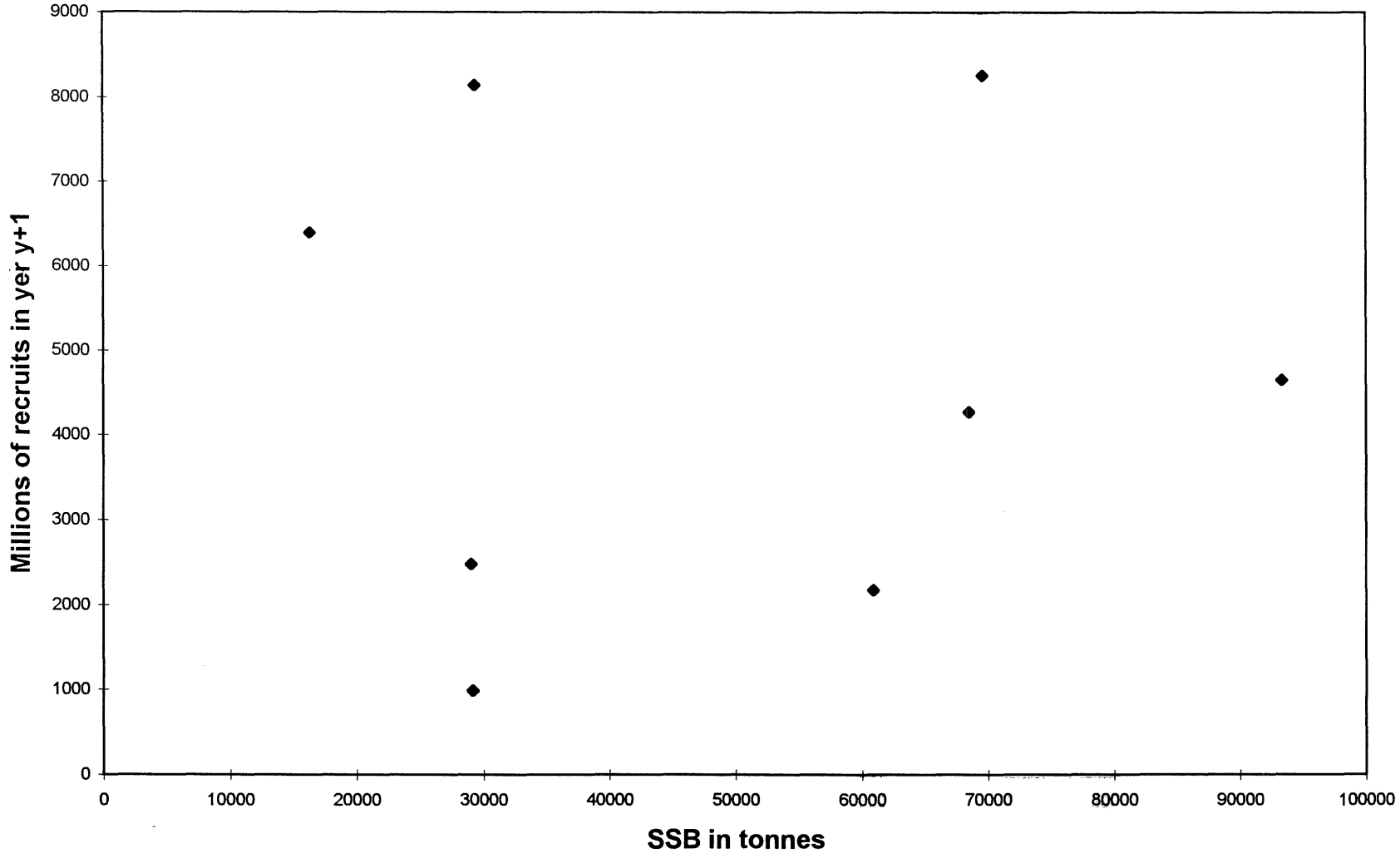


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Figure 10.9b Relationship between the number of recruits (1 year old anchovies) and the SSB estimated from direct estimation method

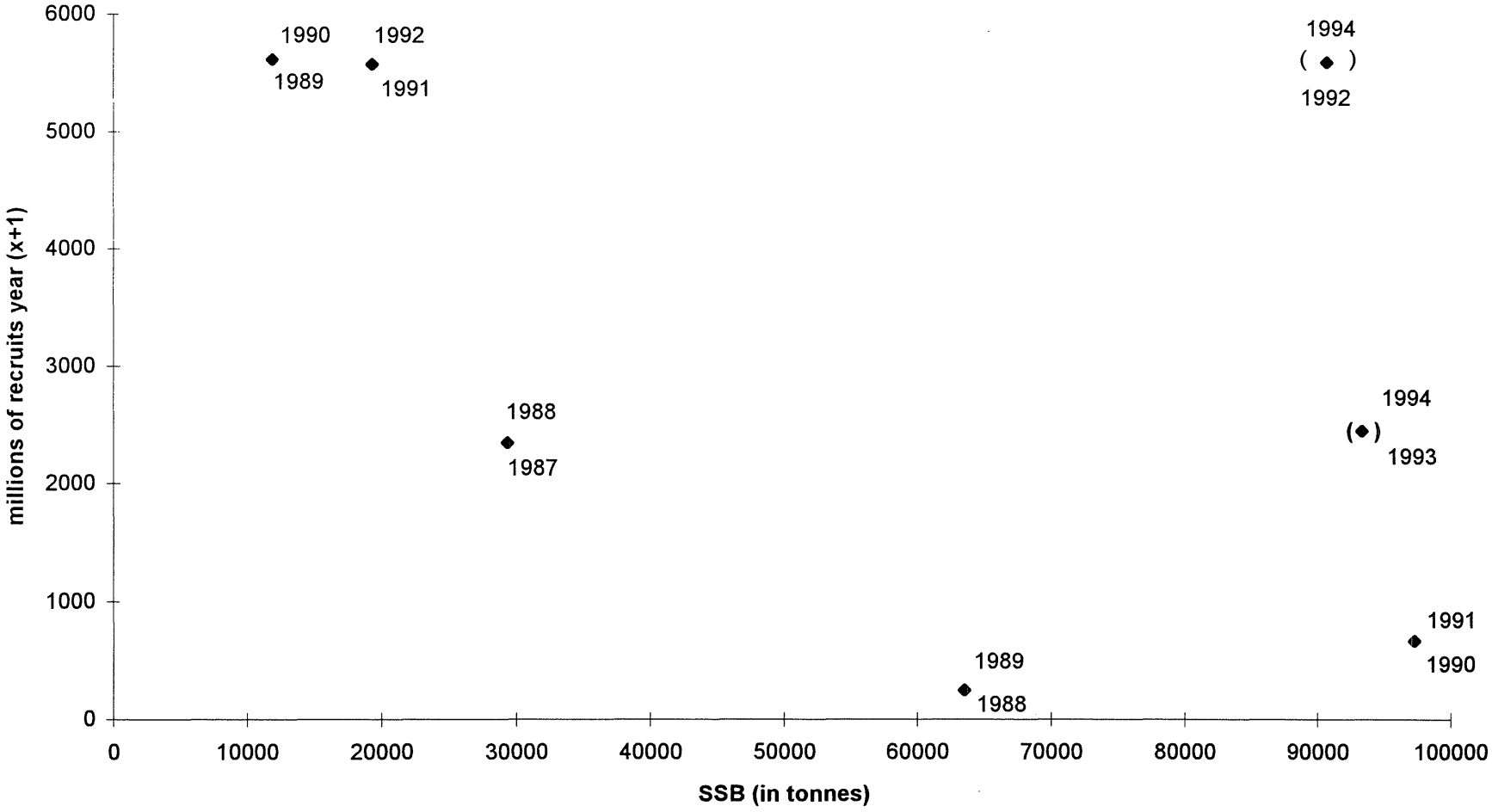

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Figure 10.10 Historical variation of Upwelling and Recruitment indexes (From Borja et al. WD1996)

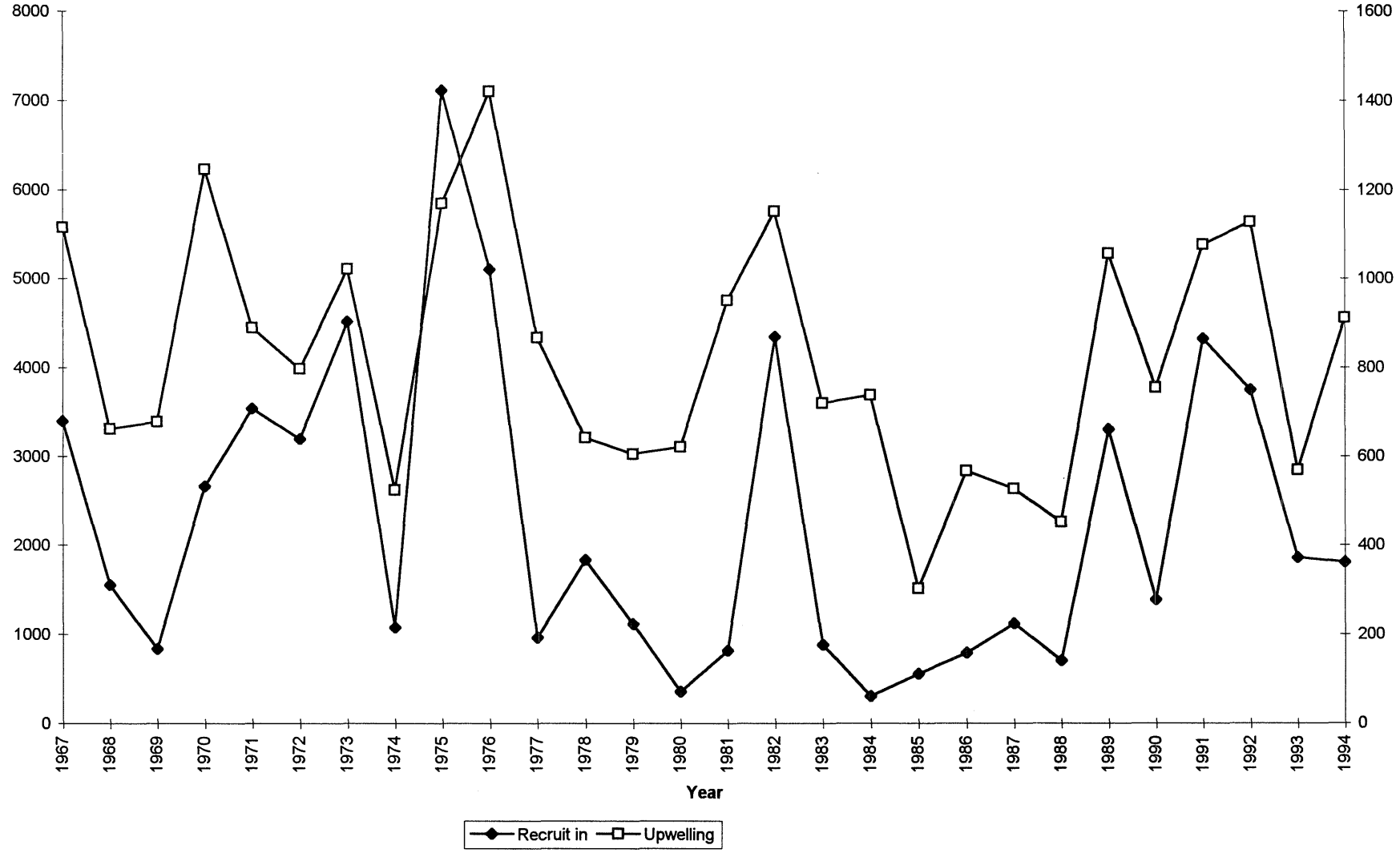


Figure 10.8 DEPM and estimated biomass of the Bay of Biscay Anchovy from the production model.

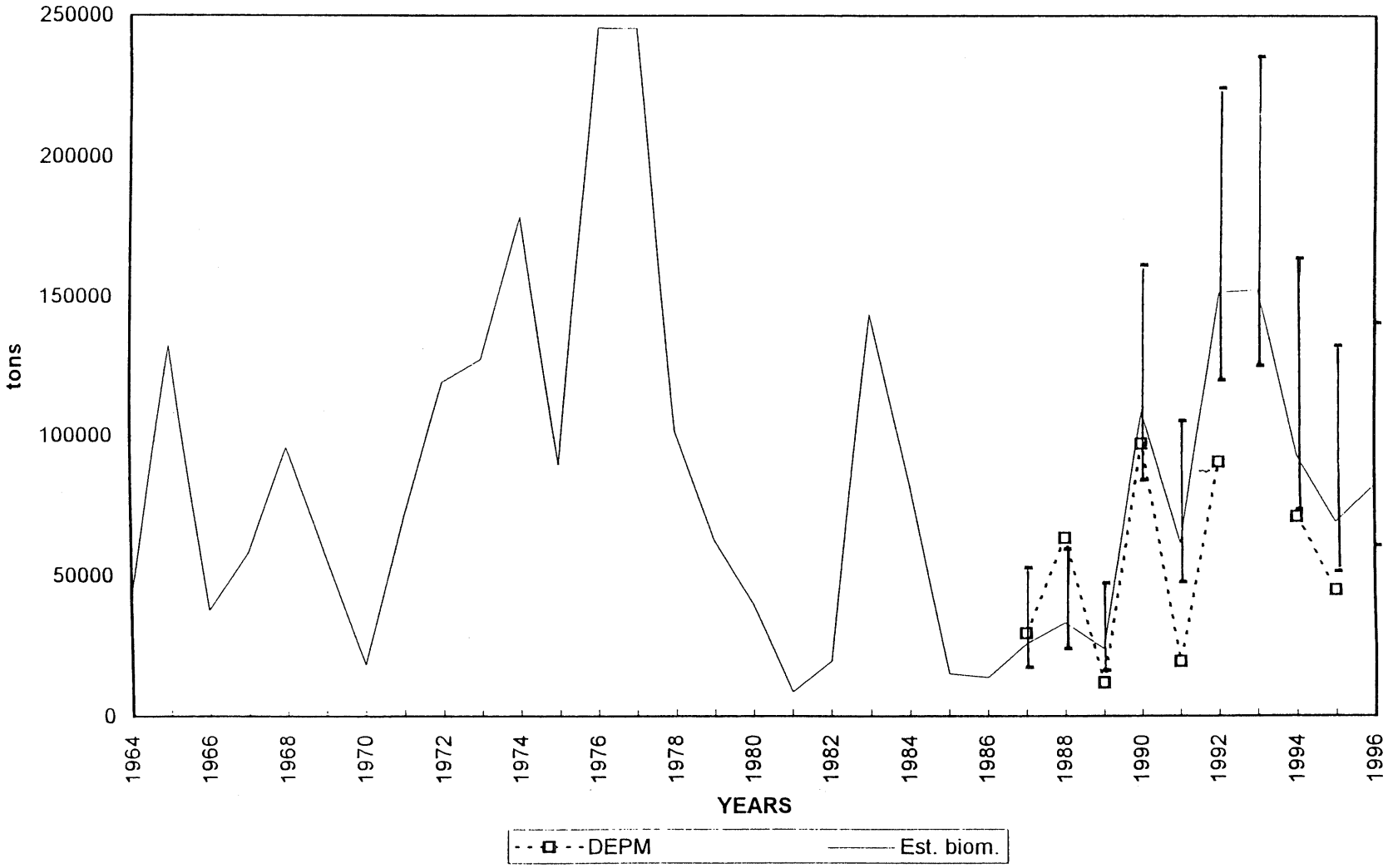
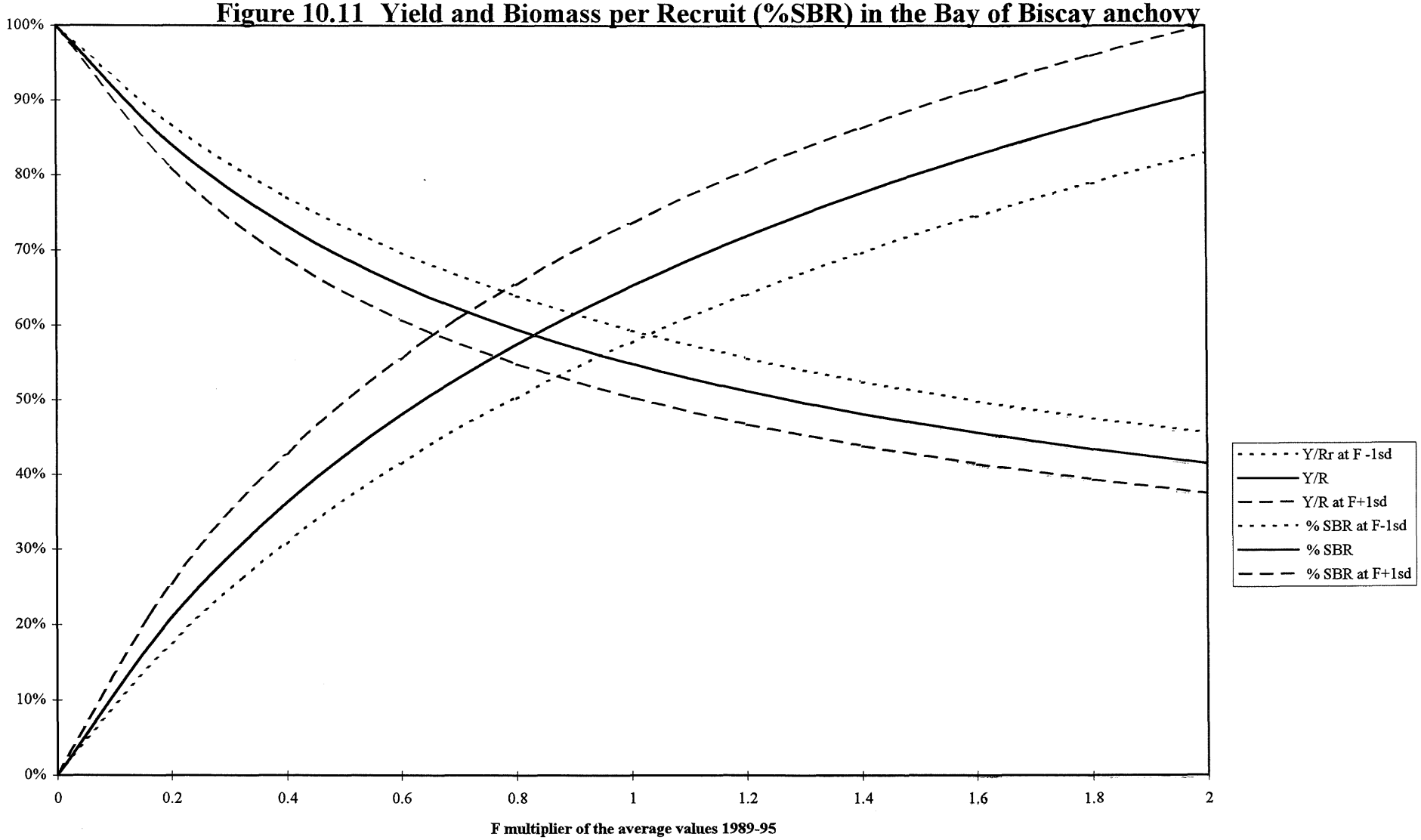


Figure 10.11 Yield and Biomass per Recruit (%SBR) in the Bay of Biscay anchovy



11 ANCHOVY IN DIVISION IXa

11.1 The Fishery in 1995

Unlike previous years, the fishery in 1995 was located to the north of Portugal (Sub-division Central-North) and to the west of Galicia (Sub-division IXa North). Due to the abundance of anchovy in these areas, this was the target species of the Spanish and Portuguese fleets in this year. The fishery is highly dependent of the anchovy abundance in these areas. Nevertheless, the Bay of Cadiz fishery (Sub-division IXa South) was very reduced in 1995.

The Spanish fleet in the Bay of Cadiz is mainly made up of purse-seiners (Anon., 1992/Assess:17) although currently there is another kind of fleet in the form of trawlers, geared for pelagic fishreries, mainly anchovies. The Spanish fleet in the west of Galicia is composed of purse seiners. The Portuguese fleet is made up, mainly, of purse-seiners, some trawlers and artisanal ships, which catch a very small quantity of anchovies.

11.1.1 Landings in Division IXa

The total catch in 1995 was 12,956 t, having increased greatly with respect to previous years (Table 11.1). The catch in 1995 increased in both countries. The Spanish catch in 1995 was 5,900 t and the Portuguese catch was 7,056 t. Portuguese catches in 1995 are at the level observed during the 1960s (Figure 11.1).

From 1943 to 1987 data of catches were only provided by Portugal, and during this period the catches varied between 23 t and 12610 t (Table 11.1). 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 level of catches (1927-1936, 1966-1976, 1979-1984 and 1987-1994) (Pestana, WD 1996). Data of the 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 but Junquera (1986) pointed out that anchovy dissappeared from the west of Galicia at the beginning of the sixties.

The main season of the Spanish fisheries in 1995 was the second half of the year corresponding to the summer months in the IXa North area, in which 74% of the total annual catch was taken. This was unlike previous years in which spring was the main season in IXa South (Table 11.2). Most of the Portuguese landings were caught from May to October (during the period 1927-1994). The 1995 landings show different evolution with two very important periods from April to June and from August to December (Pestana, 1996).

11.1.2 Landings by Sub-division

In 1995, the catches increased substantially in Sub-division IXa North (Galician waters) and in Sub-division IXa Central North (Portuguese waters) compared to previous years. However, in the Bay of Cadiz (Sub-division IXa South) the catch fell from 3,036 t in 1994 to 571 t in 1995 (Table 11.1 and Figure11.1).

The distribution of Spanish catches in 1995 was totally different to those of previous years, with 90% of catches located in Sub-division IXa North (west of Galicia) and the rest (10%) in Sub-division IXa South (Bay of Cadiz) (Anon, 1992/Assess:17, 1993/Assess:19, 1995/Assess:2 and 1996/Assess:7). Catches in Sub-division IXa North occurred mainly in summer (from June to September) and anchovies in this fishery had already spawned. In the Bay of Cadiz catches were very similar throughout the year, without showing any increase in spring, as was observed in previous years, due in part to the fact that part of the fleet stopped operating from May (Table 11.3).

The greatest contribution to the 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. In the last 4 years the landings were less than 1 tonne. In Sub-division IXa Central-North there were alternate periods of relatively high and low landings. After 1984 the landings of the Sub-division IXa Central-North gave the greater 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 landings pattern occurs in Sub-divisons IXa Central-North and Central-South during the period from 1970-1994 and in 1995 (Pestana, WD 1996) (Figure 11.1).

In the first half of 1996, the preliminary data from the fishery, indicates that the catches in Sub-division IXa Central-North and North have reduced to similar levels to those of the period 1991-1994.

11.2 Effort and Catch per Unit Effort

The data provided for 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 1995 and to the Spanish purse-seine fleet in Sub-division IXa North in 1995. No Portuguese data are available.

Effort measured as the number of effective fishing trips made by the five fleets of the Bay of Cadiz shows a decrease in 1995 in all fleets (Table 11.4).

In all of the Bay of Cadiz fleets the CPUE series reflect a declining trend (Table 11.5).

11.3 Acoustic Surveys

An acoustic survey was carried out in the Bay of Cadiz (Sub-division IXa South) in 1993, to estimate anchovy abundance, and the total biomass estimated was 6,569 t (Anon., 1995/Assess:2). Since then, no acoustic surveys have been conducted.

11.4 Catch in Number at Age

Table 11.6 shows the catches in number at age by half years corresponding to the Spanish fishery in Sub-division IXa North. This data mainly corresponds to the months from June to September, when 93% of the total catch in this area was taken. Catches were made up of age 1 anchovies.

11.5 Mean Weight at age and Mean Length at Age

Tables 11.7 and 11.8 show mean lengths and mean weights at age of the Spanish fishery in Sub-division IXa North in 1995. Mean weights at age of Spanish anchovies were calculated from biological sampling of commercial catches.

11.6 Management Measures and Considerations

The regulatory measures in 1995 were the same as for the previous year and are summarised by Millan and Villamor (1992). As in previous years the purse-seine fleet in the Bay of Cadiz stopped operating voluntarily from October to February, and part of the single-purpose purse-seine fleet of the same area stopped from June to December.

Given the reduced knowledge of the biology and dynamic of this population, it is recommended that the precautionary TAC at the level of recent catches would be appropriate to avoid an increase in effort.

Table 11.1 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	5911	6131	6672
1991	187	3	20	210	15	5696	5711	5921
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*	-	-	-	-	116	547	663	-

(-) Not available
(0) Less than 1 tonne
* Preliminary data for the first half of the year

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Table 11.2 **Anchovy cath distribution (t) and porcentage according to half of the year for the period 1988-1995, in Division IXa.**

		1st half year (1)		2nd half year (2)		Anual
Year	**Country**	**Catch (t)**	**%**	**Catch (t)**	**%**	**Catch (t)**
1988	Spain	2534	59.7	1708	40.3	4242
1989	Spain	3876	73.5	1394	26.5	5270
1990	Spain	3806	67.2	1860	32.8	5666
1991	Spain	4736	82.9	975	17.1	5711
1992	Spain	2492	82.3	536	17.7	3028
1993	Spain	1689	86.1	272	13.9	1961
1994	Spain	2745	87.1	408	12.9	3153
1995	Spain	1510	25.6	4390	74.4	5900
1991	Portugal	39	18.5	172	81.5	211
1992	Portugal	38	27.5	100	72.5	138
1993	Portugal	9	40.9	13	59.1	22
1994	Portugal	1	0.3	235	99.7	236
1995	Portugal	2200	31.2	4856	68.8	7056

(1): Corresponds to the spring fishery in Division IXa
(2): Corresponds to the summer and autumn Spanish Fisheries and autumn Portuguese fisheries in Division IXa

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Table 11.3 Anchovy catches (t) in Division IXa by country and Subdivisions in 1995.

COUNTRY	SUBDIVISIONS	QUARTER 1 C(t)	QUARTER 1 %	QUARTER 2 C(t)	QUARTER 2 %	QUARTER 3 C(t)	QUARTER 3 %	QUARTER 4 C(t)	QUARTER 4 %	ANUAL C (t)	ANUAL %
SPAIN	IXa North	12	0.2	1233	23.1	4043	75.9	42	0.8	5329	90.3
	IXa South	185	32.5	80	14.0	148	25.9	157	27.6	571	9.7
	TOTAL	197	3.3	1313	22.3	4191	71.0	199	3.4	5900	
PORTUGAL	IXa Central North	203	3.0	1989	29.6	1817	27.0	2716	40.4	6725	95.3
	IXa Central South	1	0.3	7	2.1	52	15.7	271	81.9	331	4.7
	IXa South	0.00	0.0	0.04	66.7	0.00	0.0	0.02	33.3	0.06	0.0
	TOTAL	204	2.9	1996	28.3	1869	26.5	2987	42.3	7056	
TOTAL	IXa North	12	0.2	1233	23.1	4043	75.9	42	0.8	5329	41.1
	IXa Central North	203	3.0	1989	29.6	1817	27.0	2716	40.4	6725	51.9
	IXa Central South	1	0.3	7	2.1	52	15.7	271	81.9	331	2.6
	IXa South	185	32.5	80	14.0	148	25.9	157	27.6	571	4.4
	TOTAL	401	3.1	3309	25.5	6060	46.8	3186	24.6	12956	

Table 11. 4 ANCHOVY in Division IXa. Effort data : Spain IXa South (Bay of Cadiz) and Spain IXa North (Galician South) 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

Table 11. 5 ANCHOVY in Division IXa. Spain IXa South (Bay of Cadiz) and Spain IXa North (Galician South) 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

Table 11. 6 Catch in numbers ('000) at age by half of the year of ANCHOVY in Sub-division IXa North in 1995.

AGE	1st half year	2nd half year	Total
0	0	0	0
1	51223	153482	204705
2	0	0	0
3	0	0	0
4	0	0	0
5+	0	0	0
0-5+	51223	153482	204705
Tonnes	1245	4084	5329

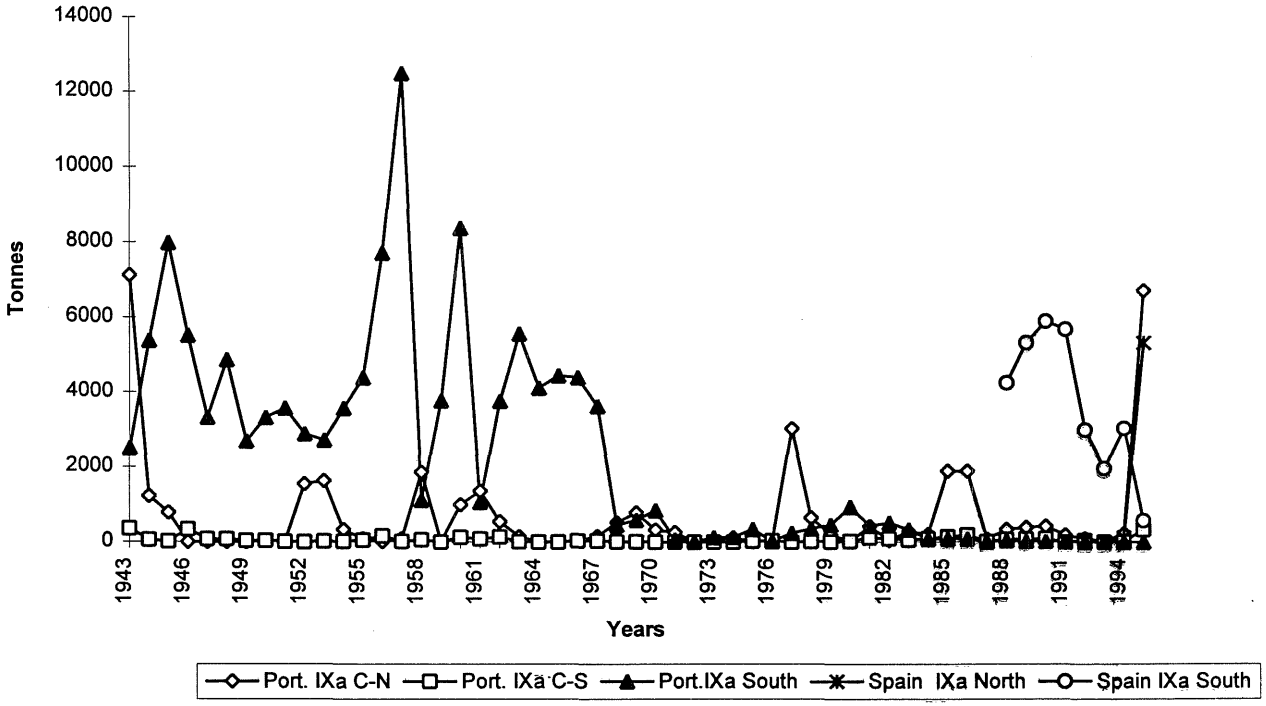
Table 11. 7 Length (cm) at age by half of the year of ANCHOVY in Sub-division IXa North in 1995.

AGE	1st half year	2nd half year	Total
0	0.0	0.0	0.0
1	15.2	15.7	15.6
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5+	0.0	0.0	0.0
0-5+	15.2	15.7	15.6

Table 11. 8 Weight (g) at age by half of the year of ANCHOVY in Sub-division IXa North in 1995.

AGE	1st half year	2nd half year	Total
0	0.0	0.0	0.0
1	24.3	26.6	26.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5+	0.0	0.0	0.0
0-5+	24.3	26.6	26.0

Figure 11.1 Portuguese and Spanish annual landings of ANCHOVY in Division IXa since 1943.



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12 DATA REQUESTED BY THE MULTI-SPECIES WORKING GROUP

12.1 Mackerel

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

The catch of mackerel belonging to the North Sea stock has been included in the catches of the western stock in Sub-area IV since 1987 and in Division IIIa since 1993.

No notable changes have taken place in the fisheries in Sub-area IV or Division IIIa in 1995 compared with 1994. There have been no more egg surveys since the one in 1992 (Anon. 1993/H:4) which confirmed the results of surveys in 1990 and 1991 indicating a very low but stable SSB. Therefore the total catch of North Sea stock mackerel was again assumed to 10,000 tonnes.

There was no data available on the age structure of North Sea stock mackerel in the catch in 1995. The age structure was therefore based on the 1992 data with some additional information from 1993 (Anon. 1996/Asses:7).

The catch in numbers for the whole year was calculated by use of the mean weight in the catch of IV and IIIa for the whole year. The catch in numbers of North Sea mackerel for each quarter of 1995 was calculated using the proportion derived from the total weight of mackerel in Sub-area IV and Division IIIa and the assumed weight of the North Sea stock component, 10,000t. The North Sea stock component formed 3.1% of the total catch. The total number of North Sea stock mackerel in each quarter was then distributed across the ages using the same percentage distribution as for 1993 (Table 12.1).

It should be noted that egg surveys were conducted in 1996 but that the results were not available to the 1996 Working Group.

12.1.2 Weight at age for the North Sea mackerel stock

There were no new observations on weight at age in the stock for any period in 1995. Therefore the data presented (Table 12.2) are the same as those given in 1995 (Anon. 1996/Asses:7).

12.1.3 Stock distribution by quarter

There is no evidence of changes in the distribution in the North Sea therefore the Working Group have assumed the same quarterly distribution of the stocks in 1995 (Table 12.3) as described in the previous report (Anon., 1996/Asses:7).

12.2 Horse Mackerel

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

As explained in the 1994 report of this Working Group (Anon.1995/Asses:5) the available samples from the commercial fishery are not representative of the majority of the catch. Therefore it is still not possible to provide a reliable estimate of the catch in numbers at age.

12.2.2 Weight at age for the North Sea horse mackerel

As the samples weight at age for the North Sea horse mackerel are only taken by division it is not possible to give information on weight at age by statistical rectangles. Weights at age given in Table 12.4 are based on only a few research vessel samples and commercial catches in Division IVb and IVc.

12.2.3 Stock distribution by quarter

The North Sea Horse Mackerel stock are known to migrate south for the Channel during the 4th quarter and to be back in the North Sea in the 2nd quarter. The Working Group therefore considers that 50% and 10 % to be in the North Sea during 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 indicating very little migration. However, since then catches have increased to a maximum of 113,000t in 1990, which is about 30% of the total western stock catch. In 1995 the provisional catch in Division IVa was about 93,000 t (see section 6). This increase in the catch in Division IVa has been attributed to the influence of the large 1982 year class.

With a continued high catch in this area there is no change in the advice about horse mackerel stock distribution by quarter. The Working Group considers that 5% and 65% of the western stock horse mackerel were in the North Sea in the second and third quarters of the year, respectively (Table 12.5).

Some information on the distribution of the earliest age groups, 0 to 2+, may come from the quarterly distributions from the North Sea IBTS once these data become available to the Working Group.

Table 12.1 Estimated catch in numbers ('000) of North Sea mackerel stock in 1988-1995 by quarter.

Year	1988				Sum	1989				Sum	1990				Sum	1991				Sum
Quarter	1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Age %	2.8	0.4	25.5	71.3		5.5	0.6	36.4	57.5		13.2	0.6	22.8	63.4		31.2	0.3	25.2	45.3	
1	81	12	741	2,072	2,906	115	13	746	1,206	2,098	172	8	297	825	1,302	153	1	114	222	489
2	87	12	795	2,224	3,118	449	49	2,969	4,689	8,156	571	26	986	2,740	4,323	3,841	37	2,856	5,077	12,311
3	94	13	859	2,402	3,368	445	49	2,947	4,654	8,095	2,795	127	4,829	13,429	21,180	4,112	40	3,058	5,871	13,180
4	53	8	486	1,358	1,905	129	14	854	1,349	2,346	744	34	1,286	3,576	5,640	1,995	19	1,485	2,896	6,393
5	11	2	99	276	388	73	8	482	760	1,323	216	10	374	1,040	1,640	443	4	330	644	1,421
6	45	6	414	1,158	1,623	16	1	103	162	282	121	6	209	581	917	172	2	128	250	552
7	27	4	243	678	952	62	7	411	649	1,129	26	1	44	123	194	394	4	293	572	1,263
8	30	4	274	768	1,076	37	4	245	387	673	105	5	181	503	794	+	+	+	+	+
9	1	+	9	25	35	41	4	270	426	741	60	3	104	291	458	148	1	110	215	494
10	15	2	139	391	547	2	+	13	20	35	70	3	121	335	529	172	2	128	250	552
11	3	+	31	88	123	21	2	142	223	388	2	+	4	12	18	123	1	92	179	395
12	1	+	5	12	18	5	1	32	51	88	35	2	60	168	265	49	+	37	72	158
13	4	1	36	101	142	1	+	7	10	18	7	+	12	34	53	49	+	37	72	158
14	2	+	22	61	85	3	+	21	36	59	+	+	+	1	1	25	+	18	36	79
15	16	2	146	403	567	27	3	178	280	488	51	2	89	246	388	98	1	93	143	316

Year	1992				Sum	1993				Sum	1994				Sum	1995				Sum	%
Quarter	1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		
Age %	19.8	0.4	16.1	63.7		17.5	0.3	16.5	65.7		21	1	27	51		32.2	0.3	19.7	47.8		
1	747	15	608	2,404	3,775	331	6	312	1,242	1,870	217	6	276	525	1,024	369	4	226	548	1147	5
2	3,005	61	3,443	9,667	15,176	1,323	23	1,247	4,960	7,554	870	23	1,103	2,099	4,095	1475	16	905	2191	4587	20
3	2,444	49	1,987	7,863	12,344	2,315	40	2,183	8,681	13,219	1522	39	1,931	3,674	7,166	2582	27	1584	3835	8028	35
4	573	12	480	1,890	2,982	1,693	29	1,596	6,149	9,669	1092	28	1,384	2,635	5,139	1844	19	1131	2739	5734	25
5	359	7	292	1,154	1,812	562	10	530	2,108	3,210	370	10	469	892	1,741	627	7	385	931	1950	8.5
6	112	2	91	361	566	132	2	125	496	755	87	2	110	210	409	148	2	91	219	459	2.0
7	45	1	37	145	227	40	1	37	149	227	26	1	33	63	123	44	+	27	66	138	0.6
8	22	+	18	72	113	26	+	25	99	151	17	*	22	42	81	30	+	18	44	92	0.4
9	+	+	+	+	+	20	+	19	74	113	13	*	17	31	61	22	+	14	33	69	0.3
10	+	+	+	+	+	+	+	+	+	+	*	*	*	*	0	+	+	+	+	+	+
11	15	+	12	48	76	+	+	+	+	+	4	*	6	10	20	7	+	5	11	23	0.1
12	37	1	30	120	189	7	+	6	25	38	9	*	11	21	41	15	+	9	22	46	0.2
13	15	+	12	48	76	26	+	25	99	151	22	1	28	52	103	37	+	23	55	115	0.5
14	+	+	+	+	+	13	+	12	50	96	13	*	17	31	61	22	+	14	33	69	0.3
15+	82	2	67	264	415	126	2	119	471	718	87	2	110	210	409	148	2	91	219	459	2.0

Table 12.2 Mean weight at age (g) by quarter in the North Sea mackerel stock and mean weight in the catch.

Age	Quarter				Mean weight in catch
	1	2	3	4	
1	180	140	180	180	180
2	210	255	240	210	215
3	240	330	280	240	250
4	260	395	330	260	275
5	300	450	375	300	320
6	325	500	420	325	350
7	355	540	465	355	380
8	380	570	510	380	410
9	410	605	550	410	445
10	435	635	585	435	470
11	465	670	620	465	500
12	500	700	650	500	535
13	530	730	680	530	565
14	560	765	705	560	595
15+	590	790	720	590	620

Table 12.3 Percentage of mackerel present in the North Sea by age, quarter and stock.

Age	North Sea stock				Western stock			
	1	2	3	4	1	2	3	4
1	100	100	100	100	-	20	30	30
2	80	100	100	80	10	10	50	70
>2	90	100	50	70	10	+	50	70

Table 12.4 Mean weight at age (g) by quarter in the catches of North Sea horse mackerel in 1995. The numbers of fish analysed per age group are given in ( ).

Age	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1	no data	no data	no data	no data
2	no data	no data	no data	76 (9)
3	no data	no data	96 (2)	124 (6)
4	no data	no data	145 (14)	124 (9)
5	no data	no data	158 (40)	123 (7)
6	no data	no data	160 (42)	144 (11)
7	no data	no data	181 (44)	160 (14)
8	no data	no data	161 (16)	167 (14)
9	no data	no data	183 (10)	178 (12)
10	no data	no data	174 (2)	174 (10)
11	no data	no data	no data	174 (6)
12	no data	no data	no data	no data
13	no data	no data	232 (3)	221 (15)
14	no data	no data	no data	235 (1)
15+	no data	no data	188 (2)	347 (11)

Table 12.5 Percentage of each horse mackerel stock assumed to be present in the North Sea by quarter in 1995.

	North Sea Stock				Western Stock			
	1	2	3	4	1	2	3	4
Age 1 - 4	10	100	100	50	0	0	0	0
Age 5+	10	100	100	50	0	0	5	65

13 CLOSED AREAS

13.1 Mackerel Box (Protection of Juveniles)

General

It was not possible to prepare a full and comprehensive review of the possible effects of different closed areas to protect juveniles in the time available. The Working Group recommends that if a detailed evaluation of area closures is required, a specialist group should be convened to address the topic and appropriate resources be allocated.

An area off the south-west coast of the UK, commonly known as the SW Mackerel Box, has current restrictions on fishing for mackerel. The area is bounded by the following co-ordinates:

- a point on the south coast of England at 02°00'W.
- latitude 49° 30'N, longitude 02° 00'W.
- latitude 49° 30'N, longitude 07° 00'W.
- latitude 52° 00'N, longitude 07° 00'W.
- a point on the west coast of Wales at latitude 52° 00'N.

The restrictions were imposed in 1989 in order to reduce the fishing effort on juvenile mackerel which were abundant in the area. The only targeted mackerel fishing permitted is for vessels fishing with gill nets or handlines. This fishery is regulated by a quota (1,804 tonnes in 1995). Mackerel may also be taken legally inside the box as a 10% or 15% by-catch in pelagic fisheries targeted at other species. A Dutch human consumption fishery, targeted at horse mackerel, and a Danish industrial fishery for pilchards and horse mackerel, regularly take place inside the box. In 1994 the by-catch of mackerel, from inside the box, in the Dutch and Danish fisheries was an estimated 2,200 tonnes. A further 1000 tonnes was reported from rectangles immediately outside the box.

The UK fishery, in 1994, reported 1,651 tonnes of mackerel from inside the box, taken mainly by handliners. In recent years pilchards have become more abundant in the area. This has led to an increased effort by UK mid-water trawlers and purse seiners which generates a small by-catch of mackerel inside the box. A total of 18,161 tonnes of mackerel was taken by the UK pelagic fleet from the rectangles immediately outside the box.

Mackerel Box Surveys and Sampling

The last surveys, to determine the proportion and abundance of juvenile mackerel inside the restricted area, were carried out in Jan./Feb. 1990 and in Jan. 1991. In addition UK landings from the area have been regularly sampled. A report was presented to the Working Group (Nichols *et al.*, WD 1996) on the results of the most recent survey of mackerel within the SW mackerel Box. The survey was carried out on a commercial mid-water trawler during December 1995 and January 1996. The vessel was permitted to fish commercially and the catches were sampled for length, weight, age and maturity.

The results showed that the percentage immature mackerel, in the catches was over 70% by number and 58 - 60% by weight. These figures compare with 91% immature by number in the 1990 survey and 60% by number in the survey, carried out on the same commercial vessel, in 1991. Commercial landings into the UK from ICES Division VIIe, in the last quarter of 1995 and the first quarter of 1996 showed that the percentage juvenile mackerel by number was still high at 44% in the last quarter 1995 and 56% in the first quarter of 1996. Division VIIe contains the mackerel box and the rectangles immediately outside it. The total international catch from Divisions VIIa,e-h for the first and last quarters of 1994 also show a high percentage of juvenile mackerel, 55% and 48% by number respectively. A summary of the relevant catch data presented in the Working Document is presented in the text table below.

Summary of all catch data for percentages of mackerel mature and immature with the SW Mackerel Box.

Data Source	Percentage by- Numbers Mature	Numbers Immature	Weight Mature	Weight Immature
Marbella Survey Jan/Feb 1990				
(by length)	9.3	90.7		
Silver Harvester Jan. 1991				
(by age)	39.9	60.1		
Commercial catches VIIa, e-h				
(by age) Q1 1994	45	55	58	42
(by age) Q4 1994	52.2	47.8	56.1	43.9
Commercial catches VIIe				
UK landings to E&W				
(by age) Q4 1995	56.5	43.5	61.8	38.2
(by age) Q1 1996	44.4	55.6	50.9	49.1
Silver Harvester 1995/96 Survey				
(by length) Q4 1995	23.6	76.4	39.6	60.4
Q1 1996	23.7	76.3	38.1	61.9
(by age) Q4 1995	26.95	73.05	42.35	57.65
Q1 1996	28.8	71.2	41.5	58.5

The length compositions of the catches of mackerel from the handliner fleet fishing inside the box during the 1995/96 season were also examined. These were compared with the length compositions of the catches of mackerel from commercial pair trawlers fishing immediately outside the mackerel box. These data showed that generally the handliners select significantly larger mackerel than those taken by the pair trawlers.

Present information confirms that large catches of juveniles have consistently been taken in Division VII a, e-h, and that, had fishing been permitted within the SW mackerel box, an even greater number of juvenile fish would most likely have been caught. There is therefore strong justification for retaining the mackerel box.

Information from the North-West Irish Fishery

Additional information was provided to the Working Group on the details of catches of mackerel in Divisions VIa (South) and VIIb. These have increased considerably in recent years from Division VIa South and Division VIIb - mainly during the fourth quarter. In 1995 over 16,000 t of mackerel were recorded from this fishery which takes place close to the Irish coast. Data from the fishery were presented in a working document (Molloy, 1996). The distribution of the catches during the fourth quarter of 1995, according to the log sheets, is shown in Figure 13.1. The distribution is similar to that of previous years. The main catches are taken from Statistical Rectangles 39E1, 38E1,38E0 and 37E0 which together constituted over 12,000 t. Smaller catches of similar mackerel are taken from other squares in these Divisions and also in the adjacent Divisions VIIj and VIIg.

Biological data is available from this fishery since 1986. The age distributions of the catches from 1986, together with the catches in tonnes, are shown in Table 13.1. In general the catches are composed of young mackerel in the age groups 1–4. These age groups have always comprised over 86% of the total catch in numbers from the area. In some years (1993 and 1995) 0-group mackerel were present in the area and were taken in the directed trawl fishery for mackerel. 0-group mackerel, from the very strong 1987 year class, were taken in 1987 as a by-catch in the herring fishery but there was no directed mackerel fishery in that year. The length distribution of the catches indicate that approximately 50% of the fish were under 33 cm.

It is not possible to determine whether the increased catches from this area are a result of a change or an expansion of the area normally inhabited by these small fish or whether they are as a result of an increased effort. Certainly, in 1994 and 1995 a number of large Irish vessels, which normally fish in the North Sea during the fourth quarter, took part in this fishery. Local fishermen report that there has been a notable increase in mackerel shoals in the area in recent years.

The Working Group would be concerned at any continued exploitation of young mackerel in this area particularly at the catch level of 1995. It is important therefore to ensure that this fishery should continue to be closely monitored and that adequate biological information should be collected.

Working Group estimates of catches of juveniles by area

In order to compare the proportions of juvenile mackerel in the landings from other areas the Working Group examined the available information from 1991 to 1995 for Divisions IVa, VIa, VII b,c,j,k, VII a,e,f,g,h, VIII a,b,d, VIIIc and IXa in quarters 1 and 4 when the major fishery takes place. Some data were also available for VIa South. The percentage of 0,1 and 2 year olds in the landings from each of those divisions and the total weight landed, are presented for quarter 1 in Figure 13.2 and for quarter 4 in Figure 13.3.

These show that the main areas and periods when juvenile fish are caught are in Quarters 1 and 4 in Divisions IVa and in Division VIIa,e,f,g,h in both Quarter 1 and Quarter 4, and possibly also in VIa South. A smaller quantity is caught in VIa in both quarters. The IVa fishery catches juvenile fish as a small proportion of the total catch, making it impractical to reduce mortality on juveniles by management measures in this area.

Figure 13.4 shows the landings by year by Division for the period 1991–1995, as numbers and percentage of juveniles (0, 1, 2 years old) and total weight landed, all ages, in tonnes. This shows that there is an increasing trend in the catches of juveniles in Divisions VIIa,e,f,g,h with the highest catches being taken in 1995. These data suggest strongly that management measures intended to protect juvenile mackerel in this Division, should not be relaxed but may rather need to be strengthened.

Catches of juveniles in VIa are also high and have been increasing in the fourth quarter, and have also been high in IXa. In both these areas, the proportion of juveniles in the catches has been high.

Conclusion

Information presented here suggests that it would be unwise to ease any of the existing restrictions which offer some protection to juvenile mackerel. The present mackerel box should therefore be retained, and if possible measures to strengthen its effectiveness should be explored, such as improving policing, reducing the by-catch from industrial fishing, and extending the boundaries. Furthermore, the high proportion of young fish in the catches in Divisions VIa and IXa suggest that improvements in yield per recruit (by reducing the exploitation of younger fish) may be achievable by some restrictive measures in those areas also. Such measures would also be helpful in aiding the recovery of the spawning stock biomass from present historic low levels at a time when a recruitment has been poor. The Working Group was not able to explore such management options.

13.2 Closure of areas to protect juvenile sardine

The Working Group were asked by ACFM to define the data and information requirements for evaluating and, if possible carry out an evaluation of, the effects of an area closure or closures to protect juvenile sardine, taking into account different scenarios of recruitment and fishing mortality levels. The Working Group has pointed out the lack of time necessary to give an adequate consideration for this subject. Therefore, and taking into account further management proposals deriving from this work, this should be considered as a preliminar evaluation and any conclusions must be regarded with caution.

Nevertheless the available information about sardine biology and sardine fisheries has been collected and evaluated.

Distribution of the recruitment areas

The annual recruitment of sardine usually occurs in the Sub-divisions IXa Central North and Central South from the 3rd quarter of each year to the end of the 2nd quarter of the next year with a marked peak from August to November/December and a less marked one from February to March/April (ICES, 1980, 1982, Pestana, 1989). This can also be assumed for the whole Iberian Atlantic stock.

From the percentage of juveniles (0 age-group) in the catch data during the 3rd and 4th quarters in 1992-1995 it can be seen that they mainly occur in Sub-divisions VIIIc West, IXa North, Central-North and Central-South. During the 3rd quarter there is a northward increasing trend of juvenile catch abundance while during the 4th quarter this trend is southwards (Figures. 13.2.1 and 13.2.2).

The results of acoustic surveys carried out since 1984 by Portugal and Spain, mainly those during the recruitment season, also confirm that these are the main juvenile distribution areas of the Iberian Atlantic stock (Pastor *et al.*, 1985, 1986, Dias *et al.*, 1987, 1988, 1989, WD 1996, Soares, 1995, Marques *et al.*, WD 1996, Porteiro *et al*, 1994, 1996).

Off the Portuguese coast sardine juveniles (0 age group) are usually distributed in shallow waters near the coast (≤50m depth) (Dias *et al.*, 1989; Soares, 1995). Sub-division IXa (Minho river-Nazaré) has been identified as a preferential distribution area of sardine juveniles (Dias *et al.*, 1989). Off the Sub-division IXa Central South (Nazaré-Sagres) juveniles were usually detected between the northern boundary of the area and cape Espichel, mainly in the area of Tagus estuary between Capes da Roca and Espichel. In these areas juveniles mainly occur in summer and in winter (Soares, 1995). Unlikely adults, they do not undertake any diel vertical migration remaining in midwater layers.

The Gulf of Cadiz also seems to be an area of occurrence of juvenile sardine. More than 60% of the abundance of juveniles estimated in the acoustic surveys carried out in May-June 1995 and in June-July 1996 were distributed in this area (Marques *et al.*, 1996).

Distribution of the Sardine Fishery

As it was pointed out in Section 8.3, 57% of the total catches comes from Sub-divisons IXa Central North and South. Table 13.2.1a,b,c and d show the catch in numbers at age by quarter and by Sub-division. In addition, quaterly distribution of 0-group in 1991 and 1992 are shown in Figures 13.3a,b and c. In 1992 during the third and fourth quarter, 80% of the 0-group was caught in IXa North and Central North (South of Spain and North of Portugal). In 1993, catches of 0-group mainly occurred in Sub-division VIIIc East during the third quarter and in Sub-division IXa during the fourth quarter. This pattern was similar to that of 1994 whereas in 1995 catches of 0-group occurred in IXa Central South. This information agrees with the information gathered about 0-group during the acoustic surveys carried out for both Portugal and Spain (Figure 13.2.4).

Taking into account this information, it may be concluded that the most important areas of recruitment where the sardine fishery is fully developed seems to be in northern part of Sub-division IXa Central South and IXa Central North and the IXa North.

Medium-term projections

On the basis of the assessment performed in Section 8.10, the deterministic projections were performed over 5 year. The values of fishing mortality chosen were F_{bar},=F_{bar95}, F=0 and F_{bar}=0.22. The last value was selected according to Section 8.17.2. This value is an appropriate target fishing mortality once the stock has reached MBAL. In addition three different scenarios of recruitment were selected, 1) the historical geometric mean as the highest recruitment level (6649 million fish), 2) the geometric mean of the last 8 year (3233 million fish) and 3) recruitments estimated by fitting a Beverton & Holt stock-recruitment The fitted model is described in Section 8.13. Due to the state of this stock, the last two options seem to be more realistic than the historical geometric mean.

Projections were carried out in which fishing mortality for age group 0 was removed. Similar projections were carried out with the normal value of fishing mortality for age group 0.

The input data for the "Beverton & Holt" projection are given in Tables 13.2.1a and b. In Table 13.2.1a the exploitation is set to zero on 0-groups.

Results

A total of 15 projections were performed (Tables 13.2.3a,b,c,d and e). Figure 13.2.5 shows the trends in spawning stock biomass and landings for the different scenarios.

The spawning stock biomass follows almost the same trend when the fitted Beverton & Holt model is applied for all the scenarios. At this level of recruitments, the probability that the stock will recover is low, even for a full fishery closure. Only projections made with a fixed recruitment level shows an increasing trend in spawning stock. Differences between the predicted spawning stock biomasses seem to be important when the recruitments are fixed at levels higher than 3233 million fish (Figure 13.2.6). This plot shows the evolution of the difference between the spawning stock biomass generated as a result of no fishing mortality at age 0 (i.e. full closed area of recruitment) and those which have F=0.1172 for age 0 for the differents scenarios.

In relation to the predicted landings, the same kind of plot was used to shows the trends of the differences between the expected landings when the fishing mortality for age 0 is fixed at 0.1127 and those when the fishing mortality at age 0 is nil. In this case, the projected catches when F=0 at age 0 using the fitted Beverton & Holt model could be higher than those when F=0.1127 for age 0. The other scenarios of recruitment shows the same trend. The difference in landings between the two levels of fishing mortality at age 0 might by lower than 4 thousand tonnes for all the values of reference fishing mortality.

From this it may concluded that:

a) Even if the fishing mortality is reduced to 0, there will be no expected improvement in the situation of the stock. Therefore the imposition of closure areas to protect juvenile sardine is not a sufficient management measure by itself to allow the stock to recover.

b) In a medium term, this management option will produce the same levels of landings which those predicted when the fishing mortality at age 0 is retained at the same level as in 1995.

As it was pointed out in Section 8.17.2, in the present situation, where the stock is well below MBAL due to a succession of poor year classes, the stock will remain below MBAL until a better year class appears. In addition to keeping the fishing mortality at the lowest possible level, special care should be taken to protect juveniles in order to take full advantage of a better year class, once it appears.

Table 13.1 Age distribution of Irish mackerel catches in "local fishery". Quarter 4.

							Age										
Year																	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 +	Tonnes
1977																	
1978																	
1979																	
1980																	
1981																	
1982																	
1983																	
1984																	
1985																	
1986		3.4	88.6	1.9	2.1	1.5			0.3								1200
1987*	100																1000
1988		33.9	29.4	16.1	16.8			1.6	2.1	0.2							5600
1989		6	55.8	16.6	7.6	10.8		1.4		1.8							3600
1990		27	48.7	20.7	2.5		0.6		0.3	0.3							2800
1991	+	19.8	42.9	12.5	8.1	6.3	2.7	3.3	0.2	1	1.3	0.2	0.2	0.5		1	1000
1992	+	54.5	23.7	15.4	3.5	0.7	0.7	0.4	0.4			0.4					700
1993	8.5	11.4	42.1	14.5	13.9	5.1	2.2	0.7	0.8	0.2	0.3						300
1994		36.1	33.7	22.2	4.4	2.4	0.3	0.3	0.3	0.1	0.2						11800
1995	2.6	10.9	46.5	26	10	1.7	1.4	0.5	0.1	0.1	0.1						16000
	* = 0 - group fish taken in estimated by- catch of 1000ts in herring fishery																

Table 13.2.1a Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1992.

1992 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	0	0	0	0	0	0	0
1	6,585	227	9,832	49,255	56,485	618	123,002
2	2,411	1,746	794	2,445	50,285	8,251	65,932
3	4,664	2,792	704	7,187	32,819	18,900	67,066
4	3,309	1,711	307	5,353	27,200	22,168	60,048
5	10,583	4,130	658	841	7,214	7,928	31,354
6	2,405	997	125	63	39	1,197	4,826
7	2,412	943	132	0	0	0	3,487
8	1,305	303	29	0	0	0	1,637
9	6,744	1,405	156	0	0	0	8,305
10	847	241	24	0	0	0	1,112
11	789	132	11	0	0	0	932
12	189	22	1	0	0	0	212
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	42,243	14,649	12,773	65,144	174,042	59,062	367,913
Tonnes	3,004	1,058	421	2,158	6,882	2,981	16,504

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	0	0	0	0	0	0	0
1	1,708	51,781	76,289	105,766	14,575	23,606	273,725
2	2,957	13,812	13,833	26,617	39,790	24,069	121,078
3	2,799	6,727	6,589	14,533	36,163	11,695	78,506
4	1,431	2,300	2,210	19,693	24,190	3,589	53,413
5	3,370	5,001	4,542	6,040	7,982	413	27,348
6	752	1,192	810	267	1,581	84	4,686
7	728	1,102	955	40	0	0	2,825
8	204	334	157	0	0	0	695
9	1,189	1,648	1,052	0	0	0	3,889
10	151	242	128	0	0	0	521
11	132	189	68	0	0	0	389
12	28	67	8	0	0	0	103
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	15,449	84,395	106,641	172,956	124,281	63,456	567,178
Tonnes	1,183	4,676	5,288	8,038	6,573	2,800	28,558

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	10,586	23,053	199,512	60,051	1,163	593	294,958
1	5,029	66,981	40,934	115,475	38,200	38,294	304,913
2	902	6,586	2,825	57,320	56,089	6,719	130,441
3	3,361	10,588	3,788	25,114	49,263	1,636	93,750
4	1,876	5,137	1,796	15,651	8,974	93	33,527
5	6,815	13,161	4,314	2,030	424	0	26,744
6	1,574	2,967	804	287	91	0	5,723
7	1,524	2,171	765	333	0	0	4,793
8	1,029	944	337	0	0	0	2,310
9	4,020	2,865	972	0	0	0	7,857
10	252	150	61	0	0	0	463
11	475	99	26	0	0	0	600
12	107	7	0	0	0	0	114
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	37,550	134,709	256,134	276,261	154,204	47,335	906,193
Tonnes	2,684	7,527	6,618	14,430	9,359	2,196	42,814

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	74	1,096	68,889	124,197	1,024	27	195,307
1	427	25,574	35,489	149,686	60,980	11,060	283,216
2	702	2,268	1,704	44,234	34,138	22,870	105,916
3	3,078	4,262	2,338	30,559	15,833	21,921	77,991
4	1,980	2,144	976	14,964	4,381	3,801	28,246
5	8,188	6,504	2,329	2,984	691	1,790	22,486
6	1,563	1,628	379	1	0	325	3,896
7	2,357	1,358	541	122	0	0	4,378
8	1,852	676	220	0	0	0	2,748
9	7,973	2,549	760	0	0	0	11,282
10	212	152	45	0	0	0	409
11	1,257	245	28	0	0	0	1,530
12	725	124	8	0	0	0	857
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	30,388	48,580	113,706	366,747	117,047	61,794	738,262
Tonnes	2,828	3,200	4,252	17,054	7,154	3,689	38,177

Table 13.2.1b Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1993.

1993 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	0	0	0	0	0	0	0
1	2,982	14,038	24,262	29,455	36,443	481	107,841
2	3,510	3,183	15,024	18,883	36,139	10,898	87,437
3	2,753	2,494	7,438	8,078	34,449	11,872	65,084
4	3,200	1,392	2,482	3,227	15,571	13,440	39,312
5	4,543	1,299	2,092	2,058	10,803	4,624	25,219
6	7,687	1,798	1,888	899	3,482	2,564	18,098
7	1,474	300	410	87	564	663	3,498
8	1,870	329	406	0	0	0	2,605
9	1,617	78	35	0	0	0	1,730
10	6,209	711	421	0	0	0	7,341
11	961	81	49	0	0	0	1,091
12	1,292	102	40	0	0	0	1,434
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15 +	0	0	0	0	0	0	0
Total	38,078	25,805	54,547	60,287	137,231	44,542	360,490
Tonne	3,193	1,039	2,407	2,108	5,935	2,340	17,020

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	0	0	0	0	0	0	0
1	5,125	13,027	89,288	75,397	7,387	3,050	173,274
2	2,221	15,525	74,136	110,118	13,263	27,158	242,421
3	1,205	10,474	31,086	28,109	38,342	24,020	131,236
4	1,178	6,641	6,696	11,211	37,358	11,722	74,804
5	1,233	6,216	5,564	7,378	16,805	3,118	40,314
6	1,740	6,809	3,978	1,149	1,932	1,094	16,702
7	329	1,417	979	38	935	311	4,009
8	347	909	1,263	0	0	0	2,519
9	166	362	12	0	0	0	529
10	863	2,003	240	0	0	0	3,106
11	115	308	45	0	0	0	468
12	170	335	8	0	0	0	513
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15 +	0	0	0	0	0	0	0
Total	14,679	64,026	193,295	231,400	116,022	70,473	689,895
Tonne	890	3,797	9,326	9,426	5,954	3,057	32,450

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	22	37,765	2,921	570	3,618	27	44,923
1	1,602	12,201	41,827	30,391	2,289	5,360	93,670
2	4,974	32,214	52,404	109,711	91,191	58,319	348,813
3	3,819	19,141	19,179	98,540	55,380	14,192	208,251
4	2,649	10,122	5,536	30,476	27,800	2,815	79,198
5	1,710	8,374	2,816	10,563	6,542	170	27,975
6	3,278	8,082	3,537	1,862	1,340	170	18,239
7	501	1,306	269	0	83	0	2,139
8	944	1,432	354	0	40	0	2,770
9	396	563	149	0	0	0	1,108
10	1,037	1,949	374	0	0	0	3,360
11	288	611	76	0	0	0	975
12	230	304	91	0	0	0	625
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15 +	0	0	0	0	0	0	0
Total	21,460	132,044	129,333	280,103	188,263	80,863	832,046
Tonne	1,865	7,437	7,355	15,736	10,044	3,712	46,149

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	88	11,570	2,839	361	27,778	469	42,885
1	3,605	5,961	19,539	86,843	86,540	7,148	187,836
2	7,392	17,521	31,248	220,341	56,162	40,493	372,147
3	4,812	11,058	13,920	30,334	18,906	18,857	97,887
4	2,970	8,040	5,022	17,740	12,677	7,548	51,995
5	2,053	3,946	2,491	7,233	1,289	372	17,383
6	3,279	5,947	3,419	393	93	138	13,269
7	539	927	360	383	0	0	2,209
8	808	1,452	571	0	0	0	2,831
9	342	627	219	0	0	0	1,188
10	1,395	2,438	349	0	0	0	4,182
11	327	671	114	0	0	0	1,112
12	171	301	160	0	0	0	632
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15 +	0	0	0	0	0	0	0
Total	27,781	88,458	80,041	362,638	181,315	75,023	795,236
Tonne	2,013	4,252	4,818	20,015	8,028	4,051	43,179

Table 13.2.1c Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1994.

1994	VIIIc East	VIIIc West	IXa North	Xa Centr-	Xa Centr-	IXa South	All areas
	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q	1'st Q
Age	catch('000	atch('000	catch('000	atch('000	atch('000	atch('000	catch ('000)
0	0	0	0	0	0	0	0
1	157	199	913	0	3,045	337	4,651
2	4,058	8,402	25,499	3,030	13,874	12,053	66,916
3	9,859	14,616	25,384	14,367	55,691	28,439	148,357
4	4,285	3,424	3,061	6,271	32,108	10,051	59,201
5	8,886	3,752	2,182	3,197	19,382	4,672	42,070
6	4,718	1,673	937	2,006	2,320	1,277	12,930
7	6,166	1,851	897	395	1,018	124	10,452
8	1,159	320	163	0	0	0	1,642
9	2,392	448	116	0	0	0	2,956
10	670	104	11	0	0	0	786
11	954	137	18	0	0	0	1,109
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	43,306	34,926	59,183	29,265	127,438	56,953	351,070
onne	3,366	2,191	3,096	1,667	6,252	2,742	19,314

	VIIIc East	VIIIc West	IXa North	Xa Centr-	Xa Centr-	IXa South	All areas
	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q	2'nd Q
Age	catch('000	atch('000	catch('000	atch('000	atch('000	atch('000	catch ('000)
0	0	0	0	0	0	0	0
1	4	85	914	709	17,658	0	19,369
2	745	8,216	35,636	24,353	12,114	8,761	89,826
3	1,695	17,453	35,538	98,497	42,341	51,148	246,672
4	504	3,994	4,029	11,089	17,456	13,122	50,193
5	734	4,166	2,267	2,941	5,852	2,014	17,973
6	351	1,763	893	1,127	789	118	5,040
7	425	1,872	599	185	92	0	3,173
8	63	316	117	211	0	0	706
9	119	381	61	0	0	0	561
10	25	66	4	0	0	0	95
11	37	112	12	0	0	0	161
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	4,701	38,423	80,070	139,110	96,301	75,163	433,768
onne	366	2,800	5,023	7,044	4,753	3,709	23,695

Continued....

Table 13.2.1c Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1994.

Age	VIIIc East 3'rd Q catch('000	VIIIc West 3'rd Q atch('000	IXa North 3'rd Q catch('000	Xa Centr- 3'rd Q atch('000	Xa Centr- 3'rd Q atch('000	IXa South 3'rd Q atch('000	All areas 3'rd Q catch ('000)
0	0	4,505	7,190	393	12,196	0	24,284
1	475	1,547	6,046	743	5,868	0	14,678
2	6,357	22,142	23,471	99,383	54,583	32,264	238,199
3	7,010	24,578	13,260	173,310	82,204	37,668	338,030
4	1,890	5,786	2,513	20,035	24,271	9,489	63,984
5	1,216	2,881	832	5,417	3,642	727	14,714
6	973	2,171	754	2,720	477	0	7,095
7	1,258	2,452	974	155	0	0	4,839
8	109	234	64	155	0	0	561
9	85	228	52	0	0	0	365
10	24	67	36	0	0	0	127
11	45	93	19	0	0	0	157
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	19,440	66,683	55,210	302,313	183,241	80,147	707,035
onne	1,663	5,224	3,464	19,524	9,920	4,978	44,773

Age	VIIIc East 4'th Q catch('000	VIIIc West 4'th Q atch('000	IXa North 4'th Q catch('000	Xa Centr- 4'th Q atch('000	Xa Centr- 4'th Q atch('000	IXa South 4'th Q atch('000	All areas 4'th Q catch ('000)
0	7	12,646	4,812	13,593	65,454	0	96,513
1	284	998	7,354	5,450	7,408	0	21,494
2	6,888	16,336	26,008	31,304	42,646	9,040	132,222
3	9,365	18,955	19,104	201,195	56,877	19,887	325,384
4	2,935	5,038	4,053	55,502	10,766	9,792	88,087
5	2,035	3,030	1,679	6,684	4,202	14,248	31,878
6	1,947	2,319	1,403	1,203	1,874	1,434	10,182
7	2,282	2,805	1,525	0	0	0	6,613
8	202	279	152	0	0	0	633
9	138	191	108	0	0	0	437
10	52	88	87	0	0	0	227
11	89	119	36	0	0	0	245
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	26,226	62,806	66,323	314,931	189,227	54,401	713,914
onne	2,306	4,263	4,567	20,901	9,465	3,513	45,015

Age	VIIIc East 1-4 Q catch('000	VIIIc West 1-4 Q atch('000	IXa North 1-4 Q catch('000	Xa Centr- 1-4 Q atch('000	Xa Centr- 1-4 Q atch('000	IXa South 1-4 Q atch('000	All areas 1-4 Q catch ('000)
0	7	17,151	12,003	13,987	77,650	0	120,797
1	920	2,829	15,228	6,901	33,979	337	60,194
2	18,048	55,096	110,614	158,070	123,217	62,118	527,163
3	27,929	75,603	93,287	487,368	237,114	137,142	1,058,442
4	9,614	18,243	13,656	92,897	84,601	42,454	261,466
5	12,870	13,828	6,960	18,239	33,077	21,660	106,635
6	7,989	7,926	3,988	7,057	5,459	2,828	35,247
7	10,132	8,980	3,995	735	1,110	124	25,076
8	1,533	1,148	495	366	0	0	3,543
9	2,734	1,248	337	0	0	0	4,319
10	771	325	138	0	0	0	1,235
11	1,125	461	85	0	0	0	1,672
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	93,673	202,839	260,786	785,620	596,207	266,664	2,205,787
onne	7,701	14,478	16,150	49,136	30,390	14,942	132,797

Table 13.2.1d Catch in numbers ('000) at age by quarter and by sub-division of SARDINE in 1995.

1995 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	0	0	0	0	0	0	0
1	26	416	1,015	373	17,068	3,346	22,244
2	527	707	2,168	441	12,026	6,656	22,525
3	7,713	8,039	10,319	7,561	49,797	18,795	102,223
4	8,801	8,289	8,223	16,291	52,011	33,279	126,894
5	3,012	1,653	1,239	2,881	8,428	2,887	20,100
6	3,191	1,066	775	1,008	1,302	198	7,539
7	1,825	698	409	233	45	36	3,246
8	2,585	543	193	0	0	0	3,321
9	363	87	25	0	0	0	475
10	457	113	50	0	0	0	620
11	701	122	40	0	0	0	863
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	29,201	21,733	24,456	28,788	140,676	65,197	310,051
Tonne	2,354	1,553	1,572	2,406	6,667	3,486	18,038

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	0	0	0	0	0	0	0
1	12	674	1,866	15,743	20,601	0	38,895
2	189	1,342	9,092	28,049	15,653	3,938	58,263
3	2,751	16,465	38,661	77,898	42,831	24,119	202,725
4	3,067	17,137	27,740	35,756	34,611	32,831	151,142
5	917	3,089	3,268	1,310	5,203	1,467	15,254
6	876	1,755	1,767	3,345	47	0	7,790
7	518	1,248	864	1,669	0	0	4,299
8	662	695	405	707	0	0	2,469
9	96	90	49	0	0	0	235
10	119	127	78	0	0	0	324
11	198	193	140	0	0	0	531
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	9,405	42,815	83,930	164,477	118,945	62,355	481,927
Tonne	804	3,264	5,595	9,225	6,433	3,289	28,610

Age	VIIIc East 3'rd Q catch('000)	VIIIc West 3'rd Q catch('000)	IXa North 3'rd Q catch('000)	IXa Centr-N 3'rd Q catch('000)	IXa Centr-S 3'rd Q catch('000)	IXa South 3'rd Q catch('000)	All areas 3'rd Q catch ('000)
0	5	440	2,304	1,083	172	0	4,005
1	932	2,753	11,509	54,436	1,148	0	70,778
2	1,449	4,117	11,342	58,230	41,039	21,485	137,662
3	3,996	10,660	17,854	111,211	79,336	82,523	305,579
4	5,492	13,145	12,910	28,809	16,137	5,486	81,978
5	1,441	3,324	2,208	1,797	1,496	238	10,505
6	1,271	1,926	1,224	541	0	0	4,962
7	1,016	1,967	992	2,724	0	0	6,699
8	690	1,219	472	207	0	0	2,588
9	36	26	9	0	0	0	71
10	70	91	29	0	0	0	190
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0
Total	16,398	39,668	60,853	259,038	139,328	109,732	625,017
Tonne	1,629	3,738	4,687	17,303	9,419	6,653	43,429

Continued....

Table 13.2.1d (Cont'd)

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	139	1,414	1,380	1,561	22,013	0	26,507
1	4,972	1,114	3,300	25,546	19,298	0	54,230
2	6,398	1,643	3,500	25,221	16,288	1,215	54,265
3	13,874	4,766	6,930	68,690	24,779	68,141	187,180
4	15,279	6,588	7,295	30,119	8,884	11,701	79,865
5	3,645	1,802	1,537	10,416	831	3,118	21,349
6	3,305	1,308	1,024	3,022	7	0	8,665
7	2,450	1,123	906	1,535	0	0	6,014
8	1,760	830	543	0	0	0	3,133
9	79	21	21	0	0	0	121
10	202	86	42	0	0	0	330
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15 +	0	0	0	0	0	0	0
Total	52,103	20,695	26,478	166,109	92,100	84,174	441,659
Tonne	4,422	1,774	2,074	12,510	4,751	5,677	31,208

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	144	1,854	3,684	2,645	22,185	0	30,512
1	5,942	4,957	17,690	96,097	58,115	3,346	186,147
2	8,563	7,809	26,102	111,942	85,006	33,293	272,715
3	28,334	39,930	73,764	265,359	196,743	193,578	797,707
4	32,639	45,159	56,168	110,975	111,642	83,297	439,880
5	9,015	9,868	8,252	16,405	15,958	7,709	67,208
6	8,643	6,055	4,790	7,915	1,356	198	28,956
7	5,809	5,036	3,171	6,162	45	36	20,259
8	5,697	3,287	1,613	913	0	0	11,510
9	574	224	104	0	0	0	902
10	848	417	199	0	0	0	1,464
11	899	315	180	0	0	0	1,394
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15 +	0	0	0	0	0	0	0
Total	107,107	124,911	195,717	618,412	491,050	321,458	1,858,654
Tonne	9,209	10,329	13,928	41,444	27,270	19,104	121,284

Table 13.2.2a

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

Prediction with management option table: Input data

Year: 1996								
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	4258.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0000	0.025
1	279.000	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	591.000	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	233.000	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	561.000	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	384.000	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	180.000	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
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	2827.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0000	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
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	1340.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0000	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Table 13.2.2a (cont'd)

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	980.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0000	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
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	814.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0000	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANPCL04
Date and time: 21AUG96:07:46

Table 13.2.2b

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

Prediction with management option table: Input data

Year: 1996								
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	4258.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	279.000	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	591.000	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	233.000	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	561.000	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	384.000	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	180.000	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
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	2827.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
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	1340.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Table 13.2.2b (cont'd)

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	980.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

(cont.)

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	814.000	0.3300	0.0000	0.2500	0.2500	0.000	0.1172	0.025
1	.	0.3300	0.7300	0.2500	0.2500	0.029	0.2296	0.047
2	.	0.3300	0.9800	0.2500	0.2500	0.050	0.4354	0.059
3	.	0.3300	0.9700	0.2500	0.2500	0.062	0.6611	0.066
4	.	0.3300	0.9900	0.2500	0.2500	0.072	0.7530	0.066
5	.	0.3300	1.0000	0.2500	0.2500	0.079	0.7972	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.087	0.9421	0.087
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANPCL04
Date and time: 21AUG96:22:16

Table 13.2.3a Outputs for projections. Above assuming F=0 and fitted beverton & Holt Stock Recruitment model; below recruitment fixed at 3233 million fish.

The SAS System 08:56 Wednesday, August 21, 1996

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.0000	0.0000	0	0	6486000	138411	2128250	134798	1959717	124124
1997	0.0000	0.0000	0	0	7489939	204201	3817988	179121	3515647	164936
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

The SAS System 08:56 Wednesday, August 21, 1996

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
0.0000	0.0000	259805	222102	0	0.0000	0.0000	267624	235361	0	253086	224774
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

The SAS System 08:56 Wednesday, August 21, 1996

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.0000	0.0000	0	0	6486000	138411	2128250	134798	1959717	124124
1997	0.0000	0.0000	0	0	7895939	204201	3817988	179121	3515647	164936
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

Table 13.2.3a Outputs for projections. Above assuming F=0 and recruitment fixed at 3233 F=0: below recruitment fixed at 6649 million fish.

The SAS System 08:56 Wednesday, August 21, 199

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
0.0000	0.0000	268270	227792	0	0.0000	0.0000	317582	271358	0	358331	308847
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

The SAS System 08:56 Wednesday, August 21, 199

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.0000	0.0000	0	0	6486000	138411	2128250	134798	1959717	124124
1997	0.0000	0.0000	0	0	11311939	204201	3817988	179121	3515647	164936
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

The SAS System 08:56 Wednesday, August 21, 199

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
0.0000	0.0000	339490	275665	0	0.0000	0.0000	477080	398893	0	596526	506674
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

Table 13.2.3b Outputs for projections. Above assuming F=0 for age group 0 and F_{bar}= 0.22 and fitted Beverton & Holt Stock Recruitment model; below recruitment fixed at 3233 million fish.

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.3325	0.2200	349876	23539	6486000	138411	2128250	134798	1859900	117276
1997	0.3325	0.2200	434674	26689	7196463	181891	3526855	156956	3137924	138171
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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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
0.3325	0.2200	218233	176516	31591	0.3325	0.2200	207258	172031	33085	175932	146452
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.3325	0.2200	349876	23539	6486000	138411	2128250	134798	1859900	117276
1997	0.3325	0.2200	434674	26689	7602463	181891	3526855	156956	3137924	138171
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

Table 13.2.3b Outputs for projections. Above assuming F=0 for age group 0 and F_{bar}= 0.22 and recruitment fixed at 3233 F=0: below recruitment fixed at 6649 million fish.

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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
0.3325	0.2200	226697	182098	32452	0.3325	0.2200	256446	206519	38420	275727	223215
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.3325	0.2200	349876	23539	6486000	138411	2128250	134798	1859900	117276
1997	0.3325	0.2200	434674	26689	11018463	181891	3526855	156956	3137924	138171
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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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
0.3325	0.2200	297917	229066	39693	0.3325	0.2200	409455	324670	56784	491821	394700
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

Table 13.2.3c Outputs for projections. Above assuming F=0.1172 for age group 0 and F_{bar}= 0.22 and fitted Beverton & Holt Stock Recruitment model; below recruitment fixed at 3233 million fish.

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.3325	0.2200	488636	27008	6486000	138411	2128250	134798	1859900	117276
1997	0.3325	0.2200	519461	28647	7079466	178499	3441448	154479	3060767	135933
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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
0.3325	0.2200	212083	171639	31924	0.3325	0.2200	200598	166534	32882	169916	141458
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.3325	0.2200	488636	27008	6486000	138411	2128250	134798	1859900	117276
1997	0.3325	0.2200	532691	28978	7485466	178499	3441448	154479	3060767	135933
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

Table 13.2.3c Outputs for projections. Above assuming F=0.1172 for age group 0 and F_{bar}= 0.22 and recruitment fixed at 3233 F=0: below recruitment fixed at 6649 million fish.

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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
0.3325	0.2200	220225	177008	34294	0.3325	0.2200	247906	199704	39848	265896	215287
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	0.3325	0.2200	488636	27008	6486000	138411	2128250	134798	1859900	117276
1997	0.3325	0.2200	644012	31761	10901466	178499	3441448	154479	3060767	135933
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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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
0.3325	0.2200	288722	222181	44041	0.3325	0.2200	395067	313340	60294	473732	380219
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

Table 13.2.3d Outputs for porojections. Above assuming F=0 for age group 0 and F_{bar}=.F_{bar95} and fitted Beverton & Holt Stock Recruitment model: below recruitment fixed at 3233 million fish.

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	1.0000	0.6617	864149	57774	6486000	138411	2128250	134798	1676121	104725
1997	1.0000	0.6617	925867	52950	6773772	150171	3107953	125469	2615895	102745
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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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	0.6617	170237	125937	59466	1.0000	0.6617	144671	109030	55219	105883	79000
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	1.0000	0.6617	864149	57774	6486000	138411	2128250	134798	1676121	104725
1997	1.0000	0.6617	925867	52950	7179772	150171	3107953	125469	2615895	102745
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

Table 13.2.3d Outputs for projections. Above assuming F=0 for age group 0 and $F_{bar}=F_{bar95}$ and recruitment fixed at 3233 F=0: recruitment fixed at 6649 million fish.

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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	0.6617	178702	131310	61878	1.0000	0.6617	192477	140829	69460	196550	143925
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	1.0000	0.6617	864149	57774	6486000	138411	2128250	134798	1676121	104725
1997	1.0000	0.6617	925867	52950	10595772	150171	3107953	125469	2615895	102745
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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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	0.6617	249921	176512	82174	1.0000	0.6617	333865	242820	114948	378409	276558
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:08:57
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

Table 13.2.3e Outputs for projections. Above assuming F=0.1172 for age group 0 and $F_{bar}=F_{bar95}$ and fitted Beverton & Holt Stock Recruitment model; below recruitment fixed at 3233 million fish.

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	1.0000	0.6617	1266531	67834	6486000	138411	2128250	134798	1676121	104725
1997	1.0000	0.6617	1133490	56831	6435228	140353	2860816	118302	2401022	96514
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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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	0.6617	154046	113972	57302	1.0000	0.6617	129580	97647	51857	94471	70482
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	1.0000	0.6617	1266531	67834	6486000	138411	2128250	134798	1676121	104725
1997	1.0000	0.6617	1171857	57791	6841228	140353	2860816	118302	2401022	96514
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

Table 13.2.3e Outputs for projections. Above assuming F=0.1172 for age group 0 and $F_{bar}=F_{bar95}$ and recruitment fixed at 3233 F=0: recruitment fixed at 6649 million fish.

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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	0.6617	161575	118750	63919	1.0000	0.6617	172100	125929	69846	175110	128226
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	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
1996	1.0000	0.6617	1266531	67834	6486000	138411	2128250	134798	1676121	104725
1997	1.0000	0.6617	1494670	65861	10257228	140353	2860816	118302	2401022	96514
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Prediction basis : F factors

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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	0.6617	224918	158954	90041	1.0000	0.6617	297851	216641	118373	336857	246192
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPCL04
Date and time : 21AUG96:22:16
Computation of ref. F: Simple mean, age 2 - 5
Basis for 1998 : F factors

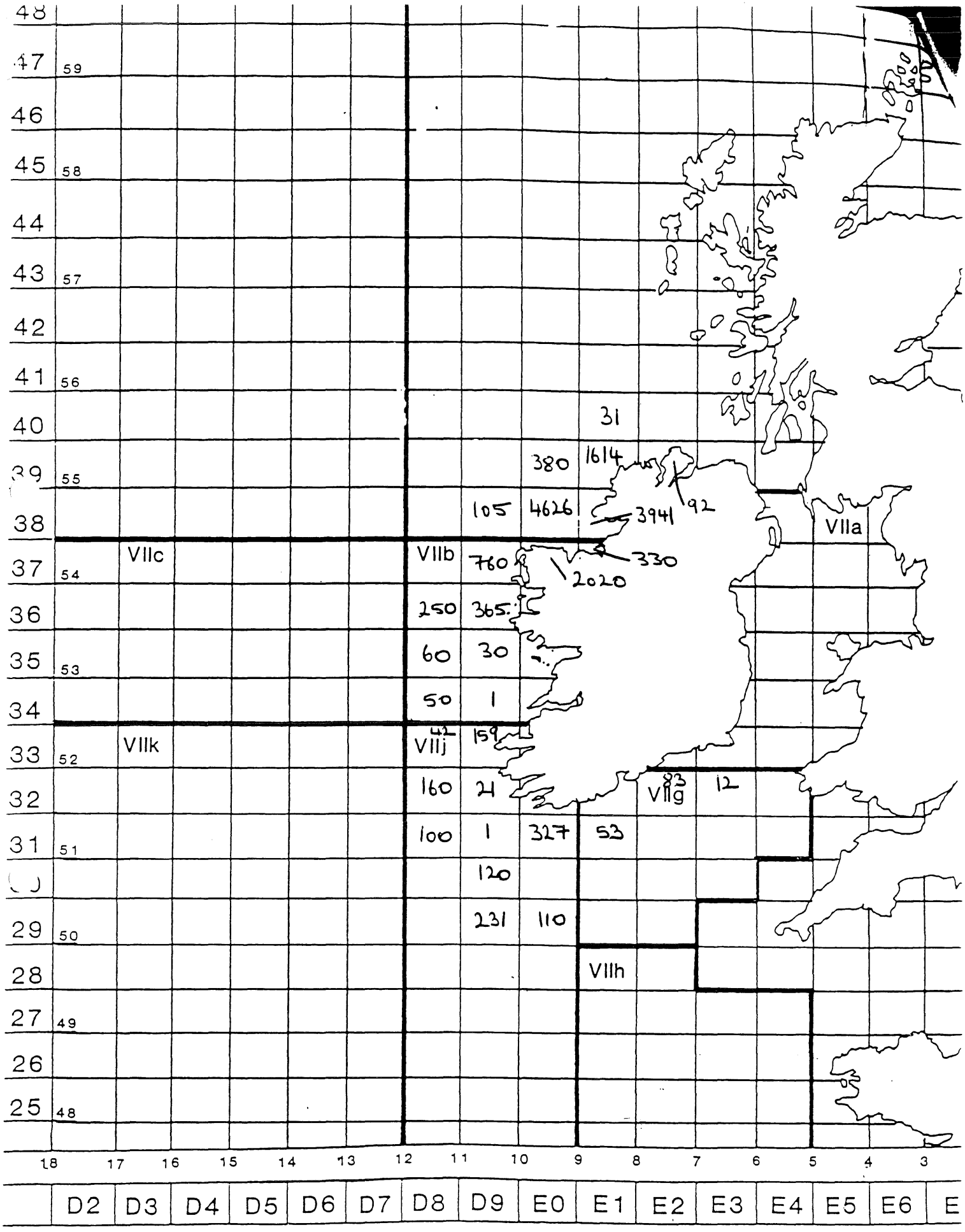
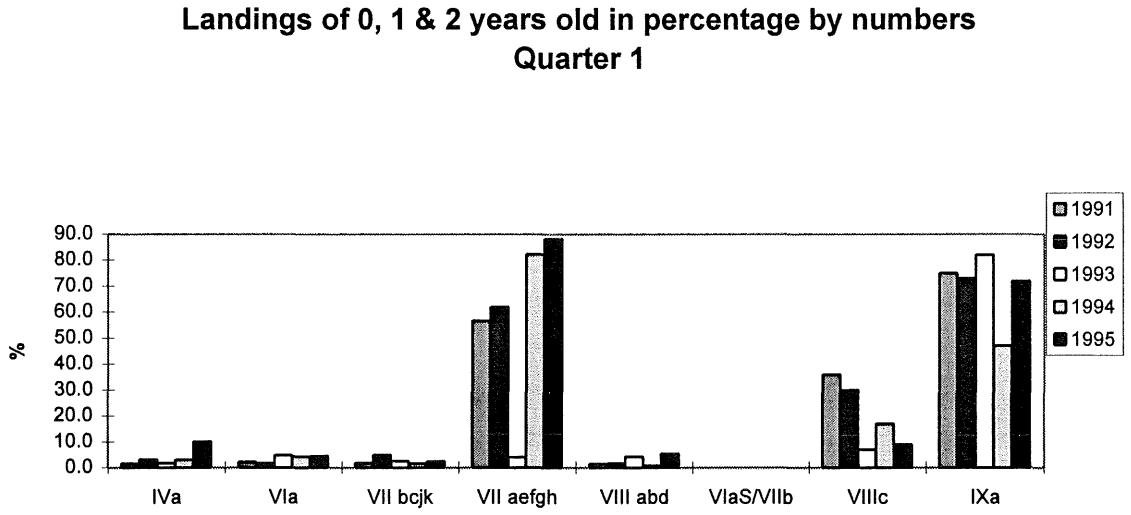
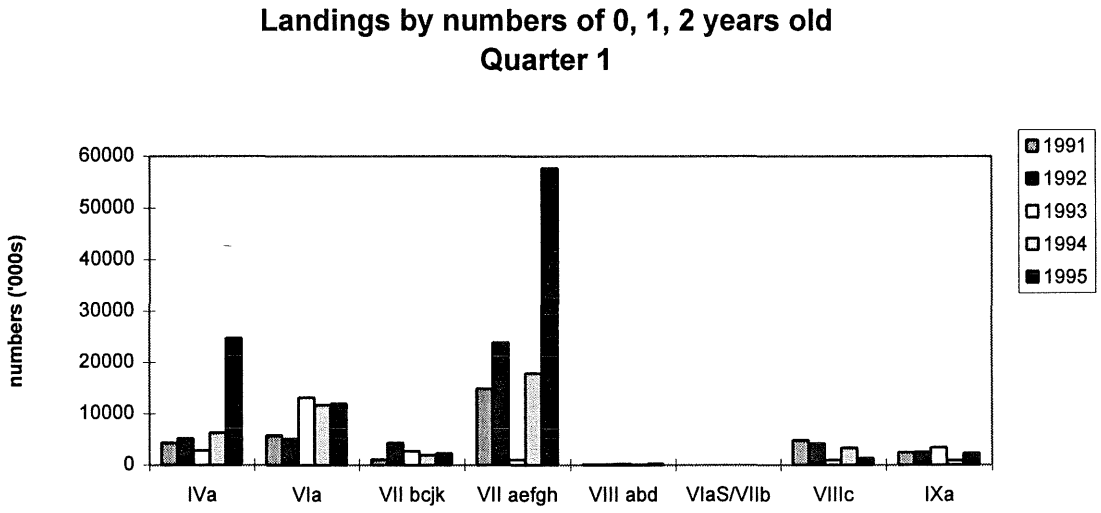
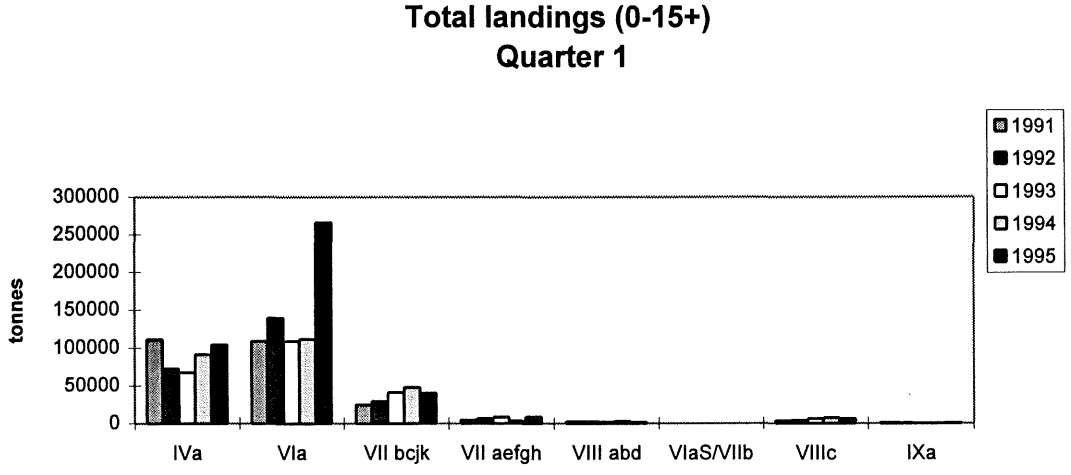


Figure 13.1 Catches by Irish fleet. Quarter 4 1995.

Figure 13.2 Landings of mackerel by Division for the Years 1991 - 1995 in Quarter 1

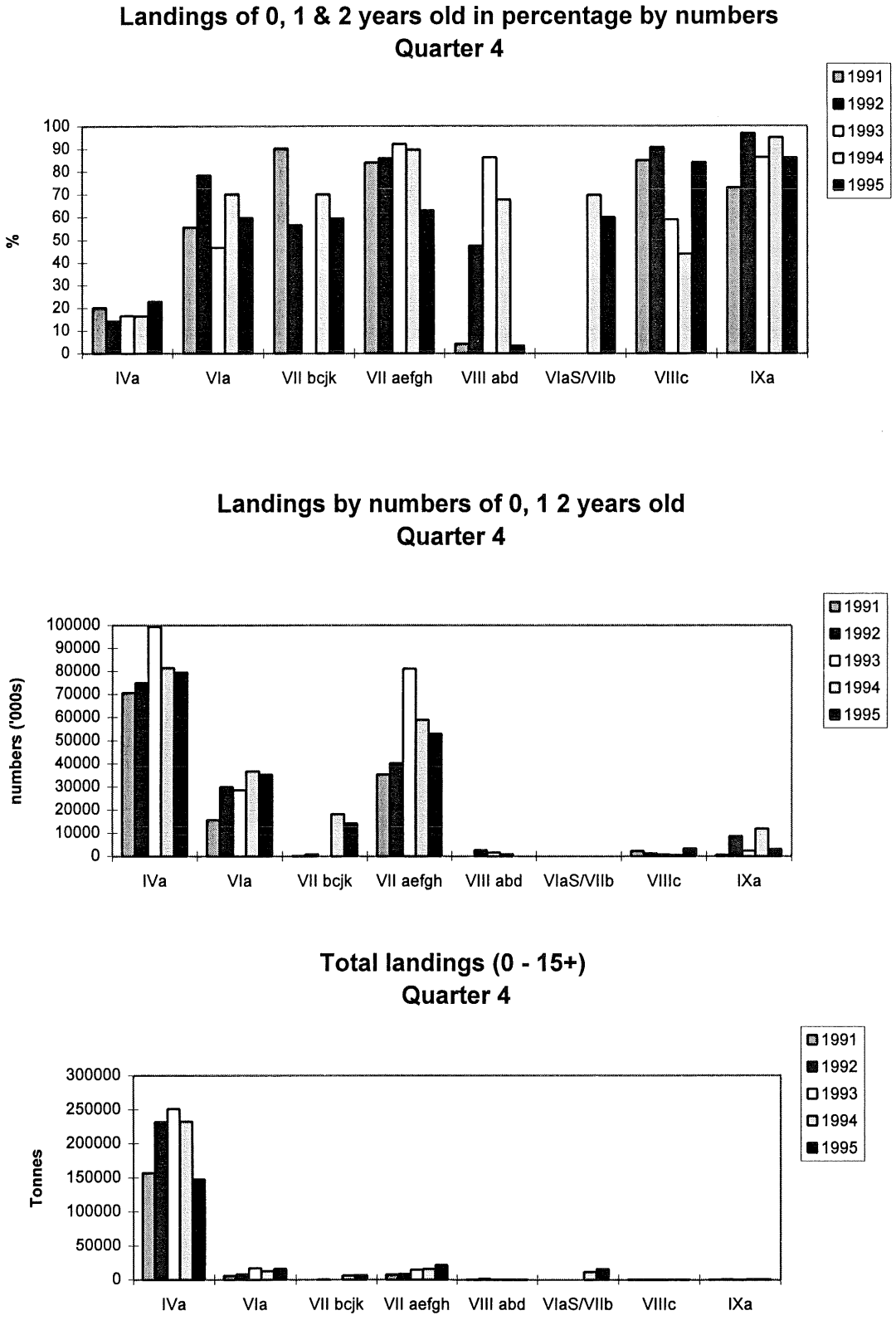






e:\acfm\wgmhsa97\f-13.4.xls

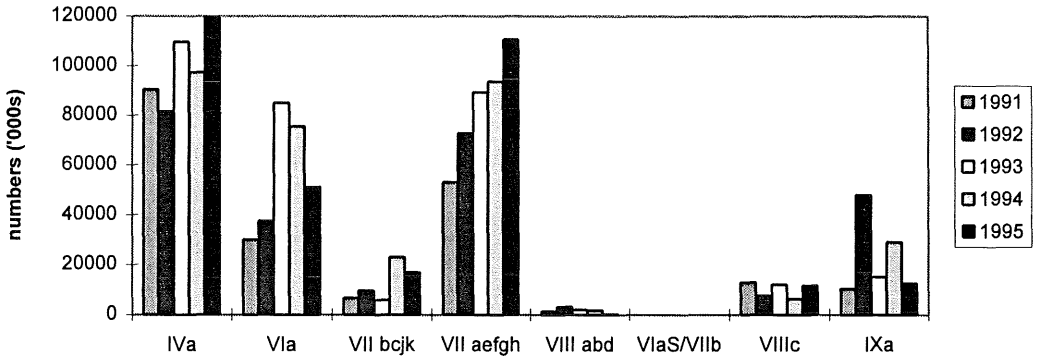
Figure 13.3 Landings of mackerel by Division for the Years 1991 - 1995 in Quarter 4



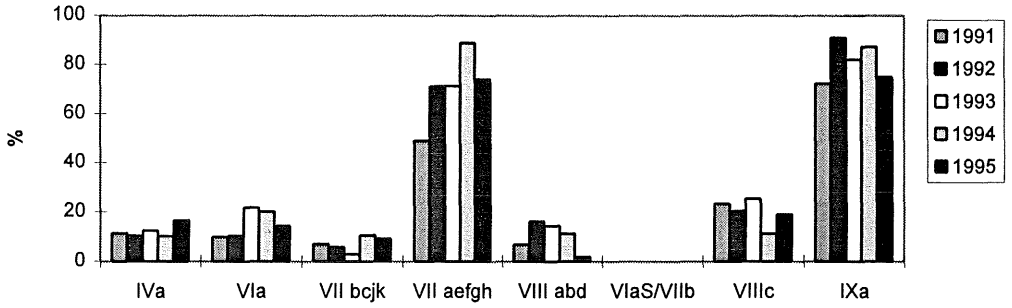
e:\acfm\wgmhsa97\f-13.4.xls

Figure 13.4 Landings of mackerel by Division from 1991 - 1995

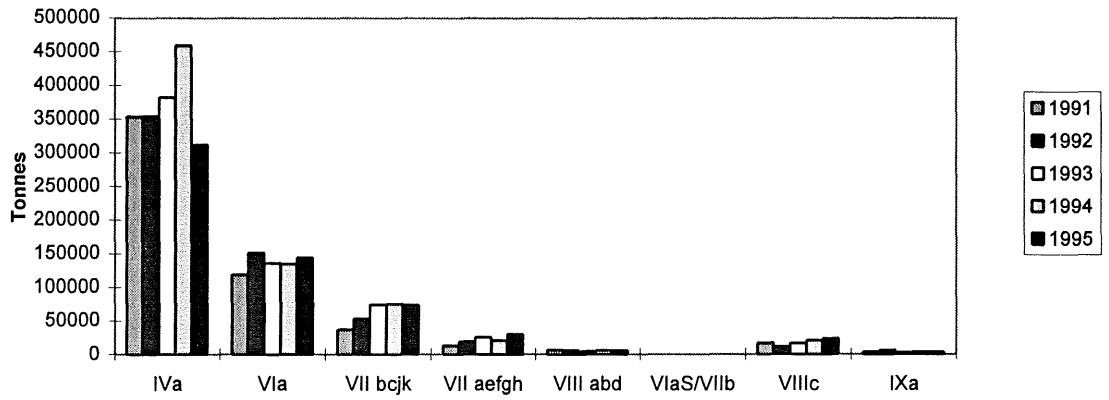
Landings in numbers of 0, 1 & 2 years old by year



Total landings of 0, 1 & 2 years old as % by number for the year



Total landings (0 - 15+) in tonnes by year



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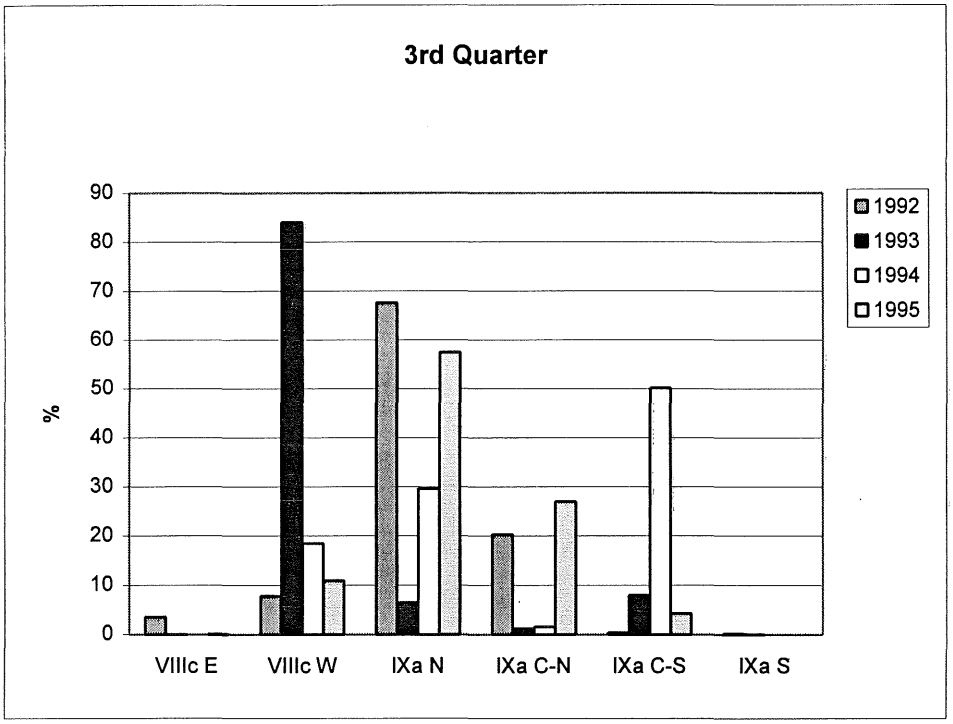


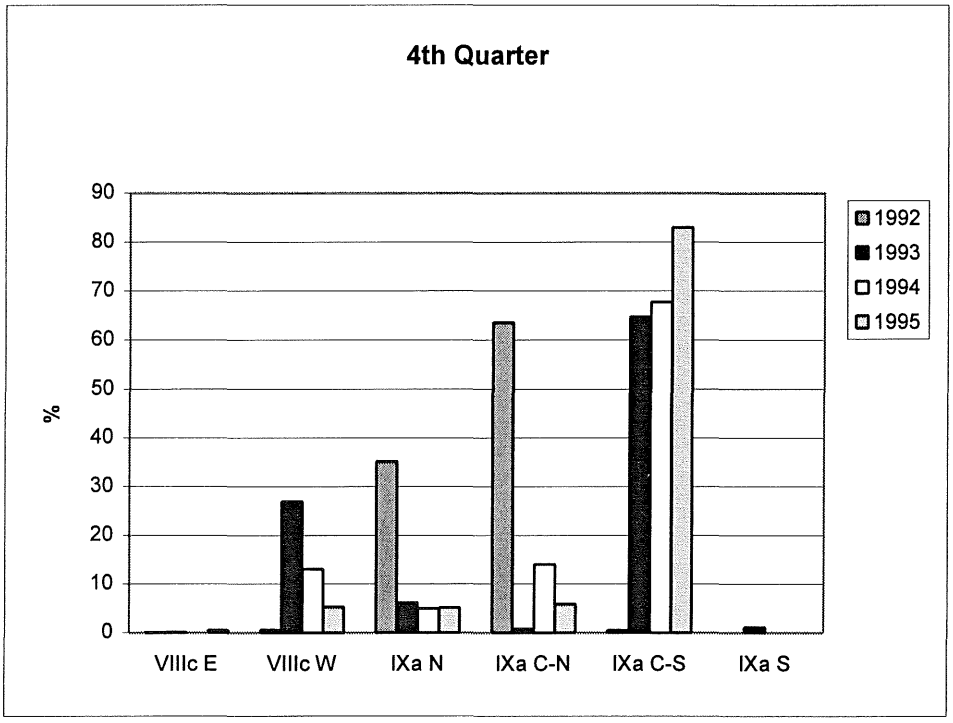


Figure 13.2.1 Distribution of O Age-group sardine (%) during the 3rd and 4th Quarters (Spanish and Portuguese catches)

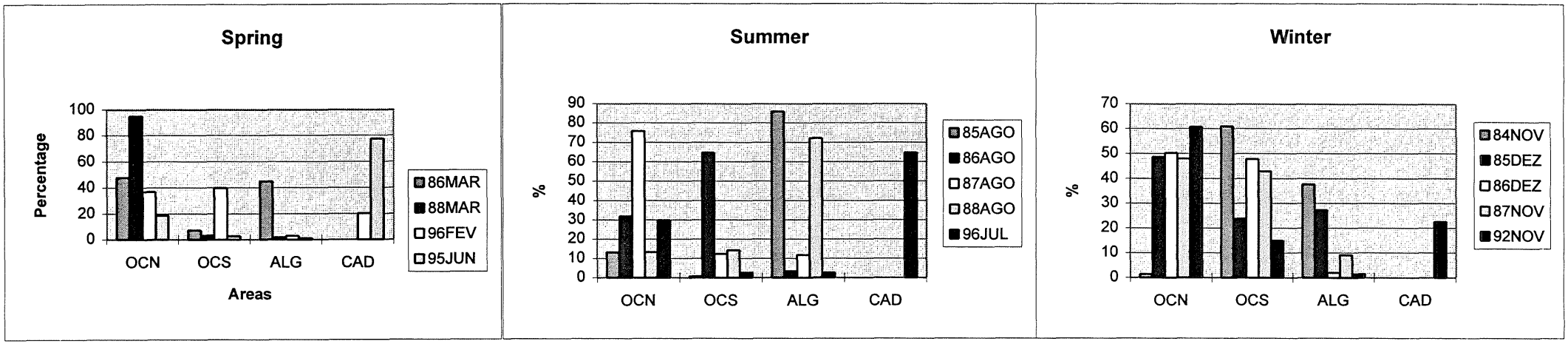


Figure 13.2.2 0 age-group sardine distribution off the Portuguese coast in Spring, Summer and Winter (Portuguese acoustic surveys)

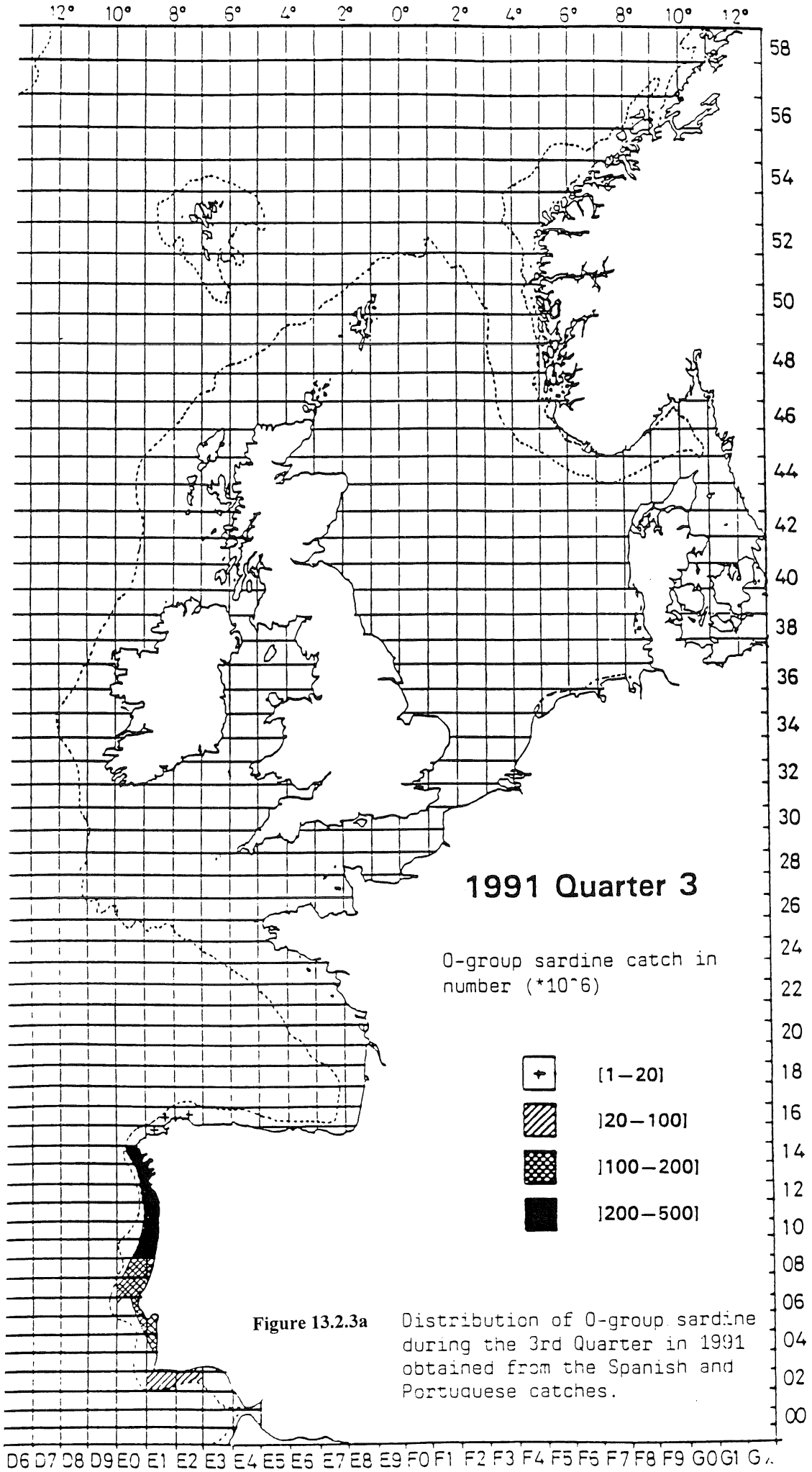


Figure 13.2.3a Distribution of 0-group sardine during the 3rd Quarter in 1991 obtained from the Spanish and Portuguese catches.

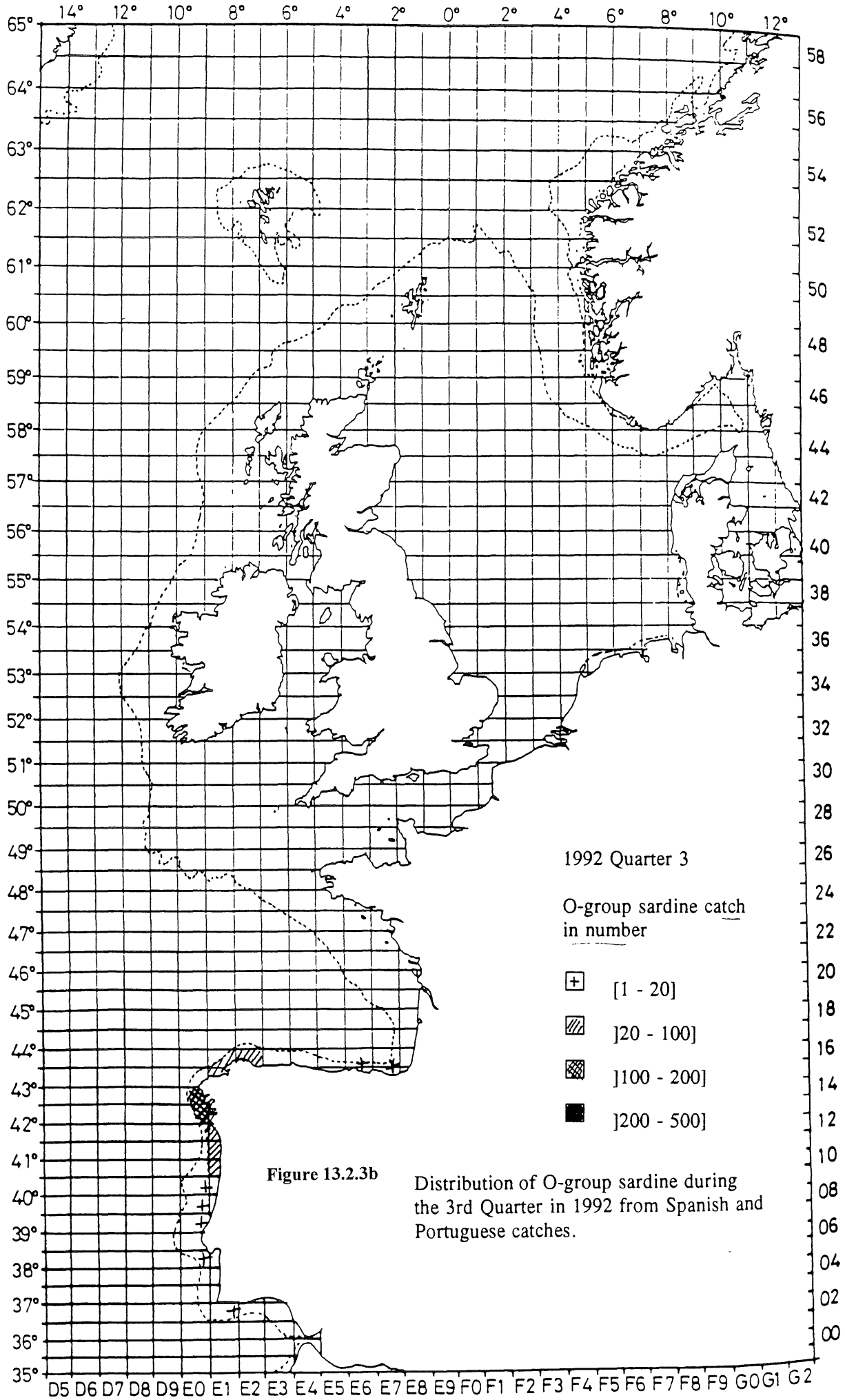


Figure 13.2.3b Distribution of O-group sardine during the 3rd Quarter in 1992 from Spanish and Portuguese catches.

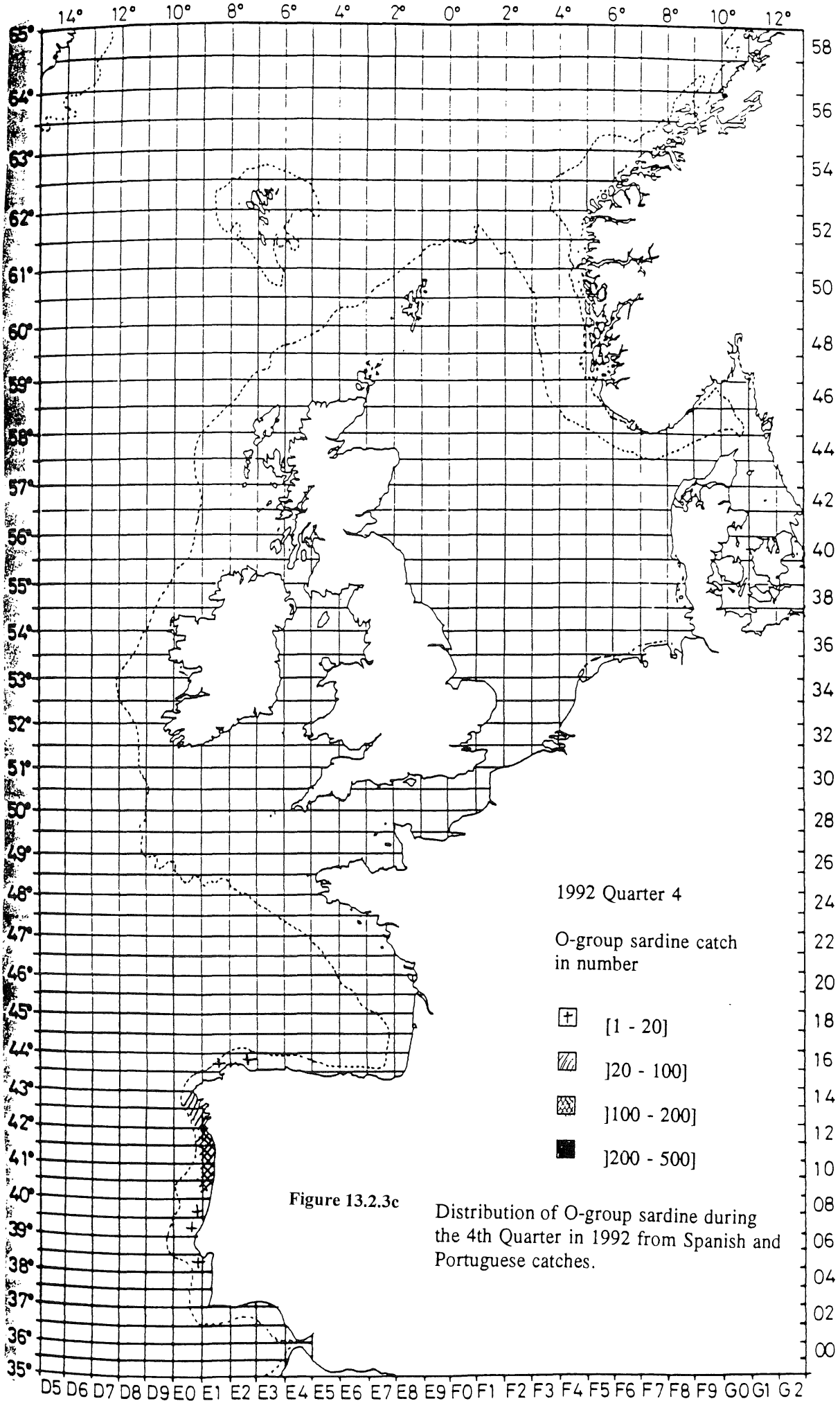
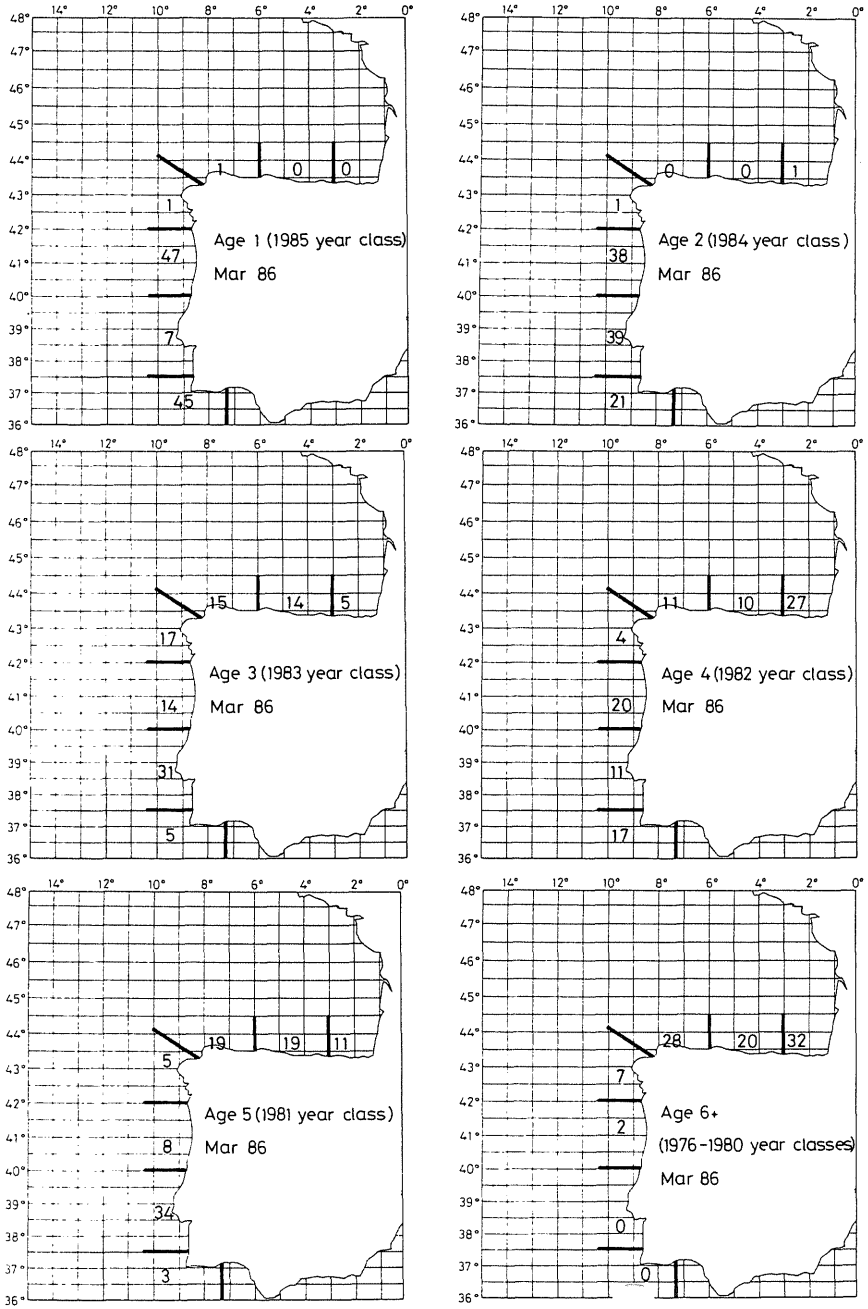
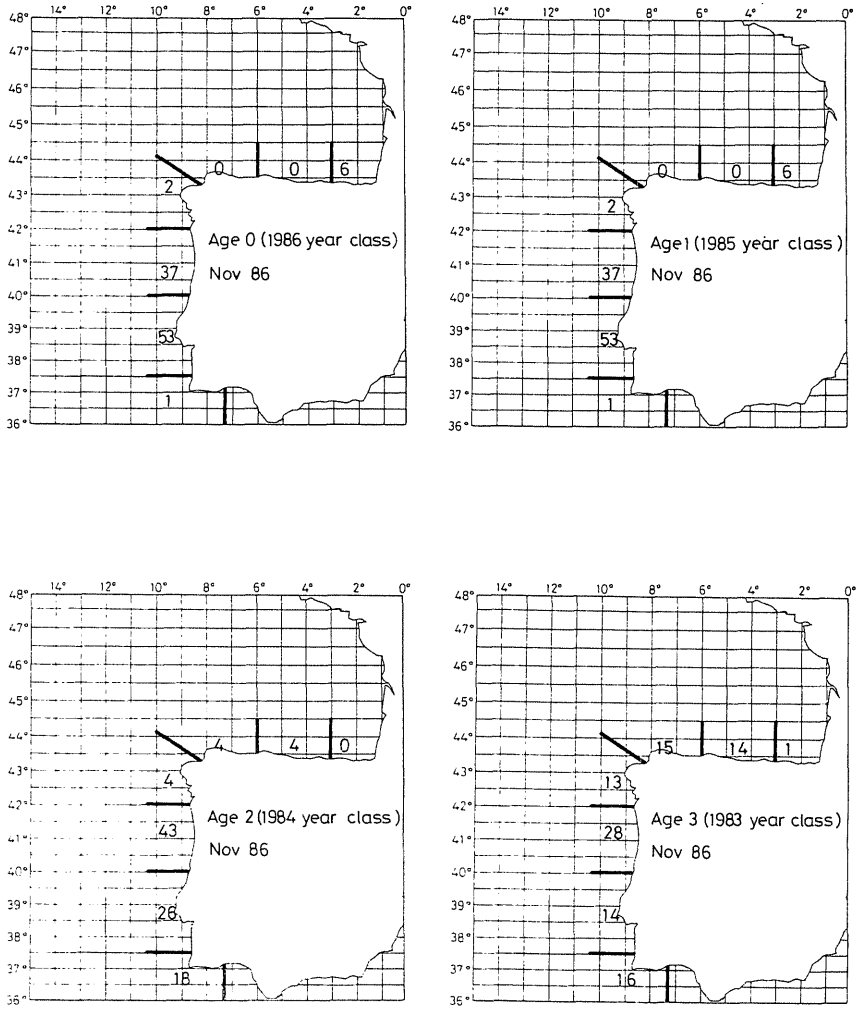


Figure 13.2.3c

Distribution of O-group sardine during the 4th Quarter in 1992 from Spanish and Portuguese catches.

Figure 13.2.4 Sardine. Distribution of age groups (as a percentage of the total numbers in each age group) from the joint Portuguese and Spanish Acoustic Survey - March 1986. From Anon. (1989/Assess:19).





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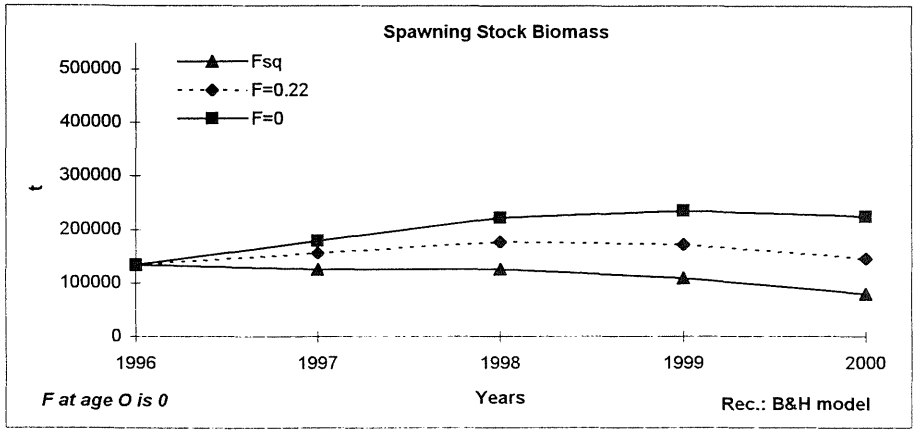
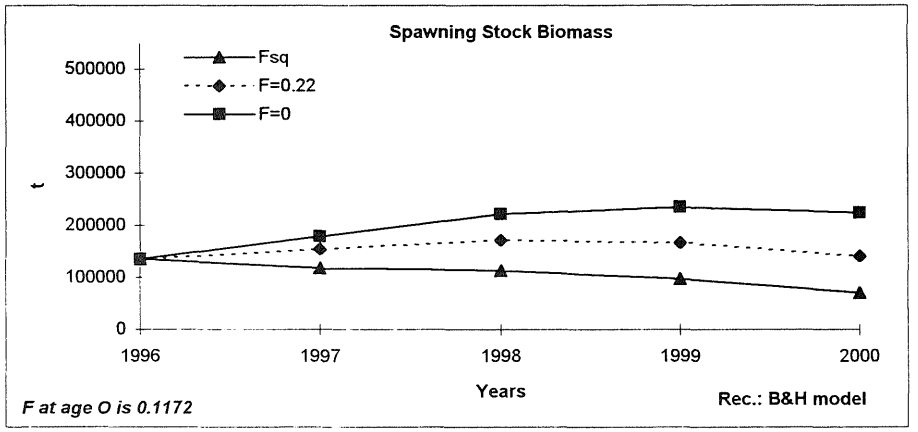
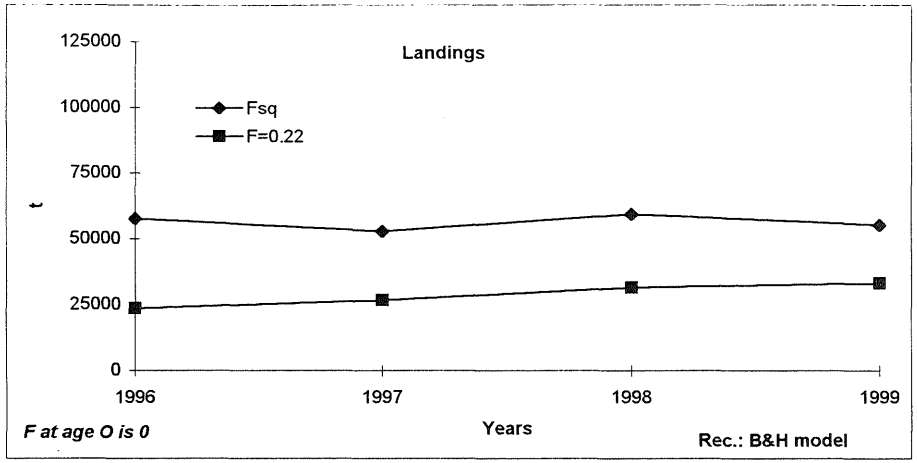






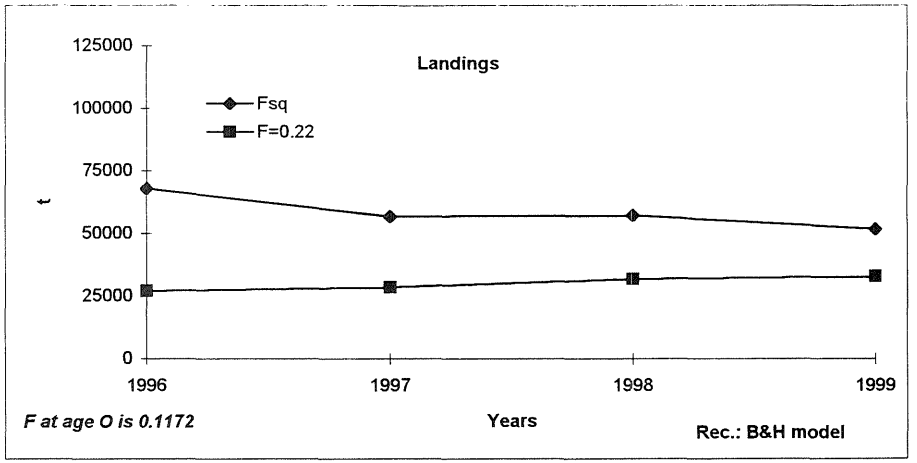
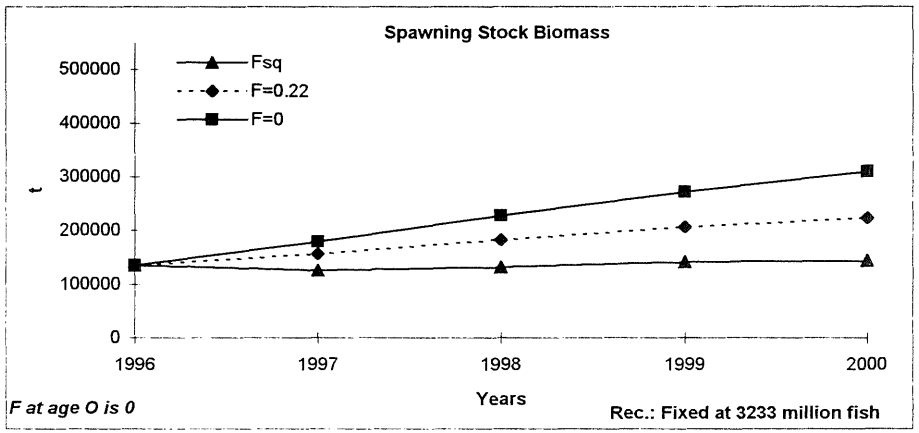
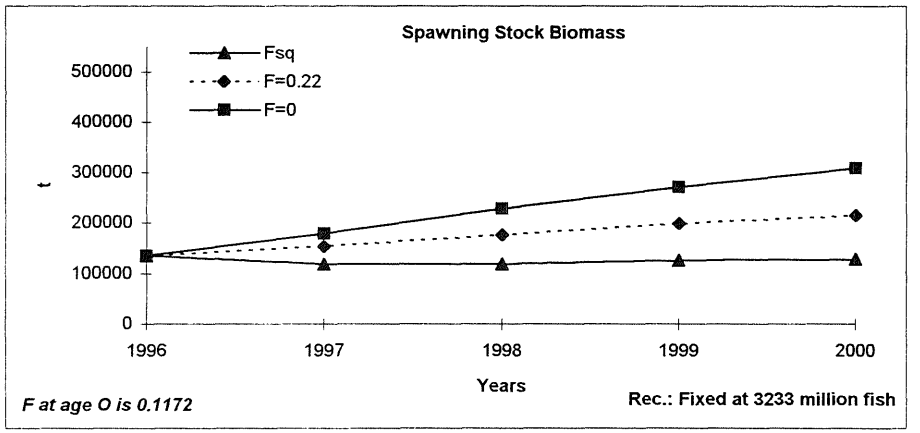
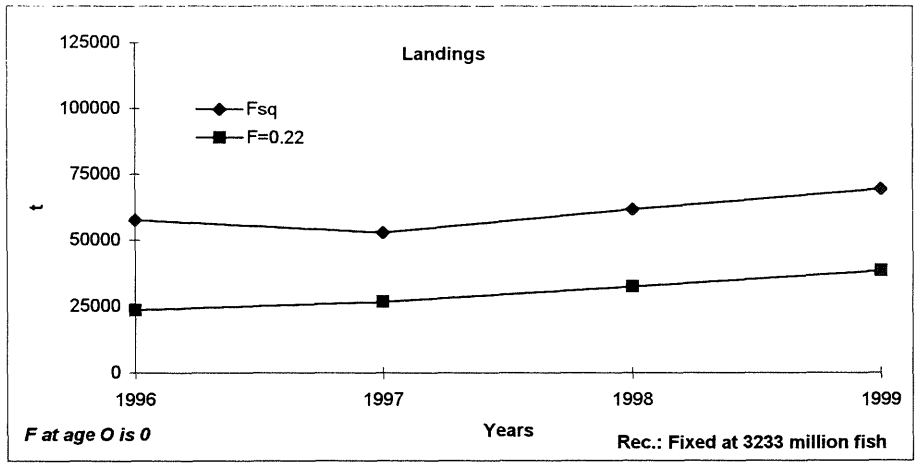


Figure 13.2.5 Annual predicted landings and Spawning Stock Biomass for different Fishing Mortality (F=0; F=0.22; and F=fsq) and Recruitment levels. Left plots show prediction under F=0 at age group 0 and right plots show prediction under F=0.1172.







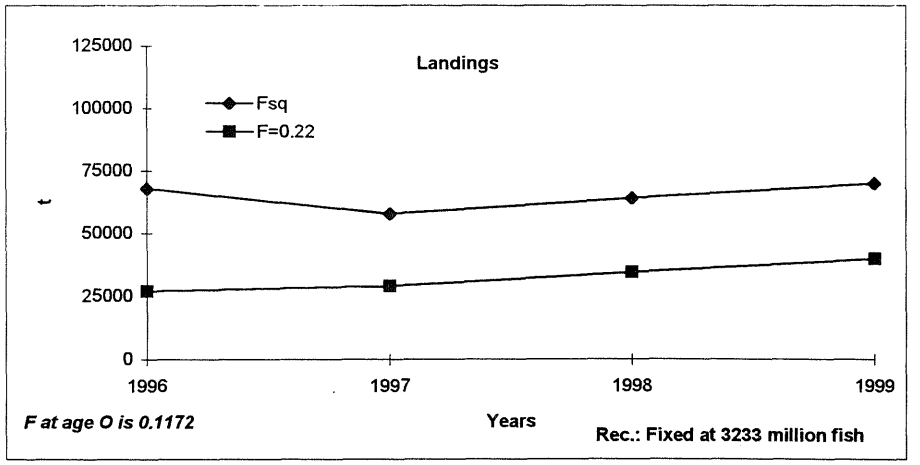
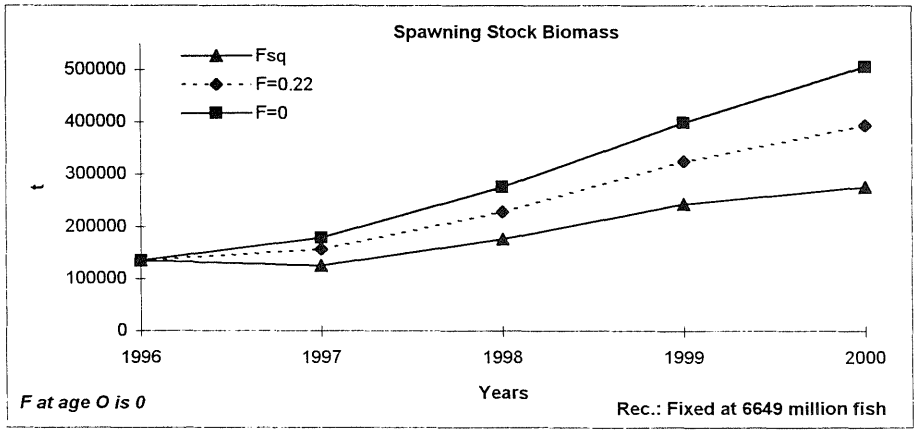
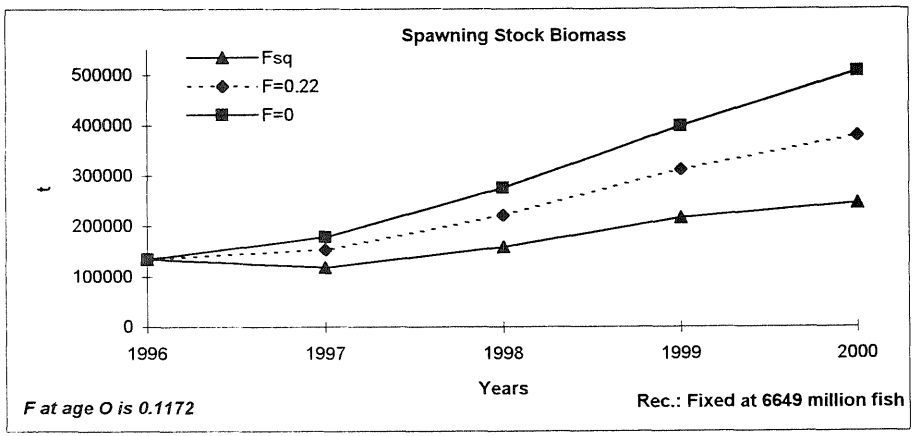
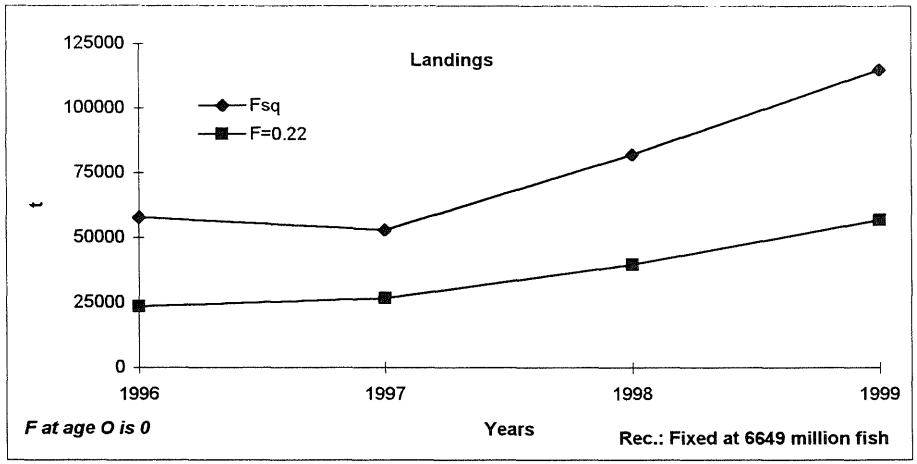


Figure 13.2.5: Continued







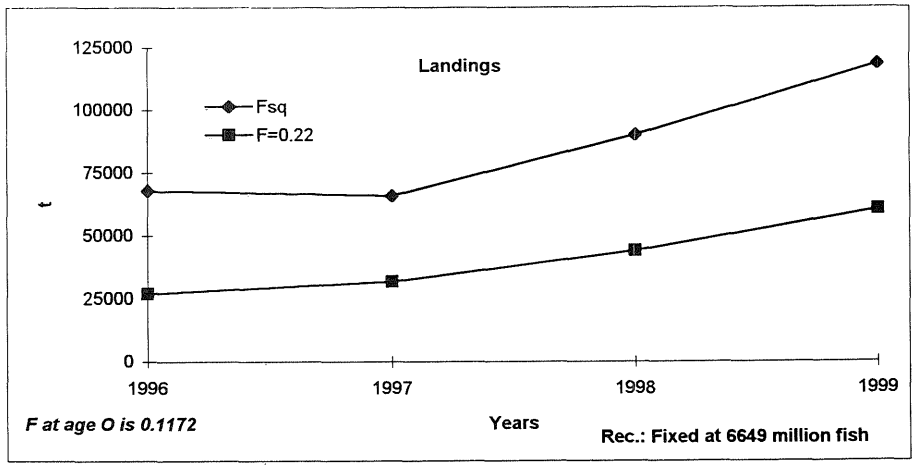


Figure 13.2.5 Continued

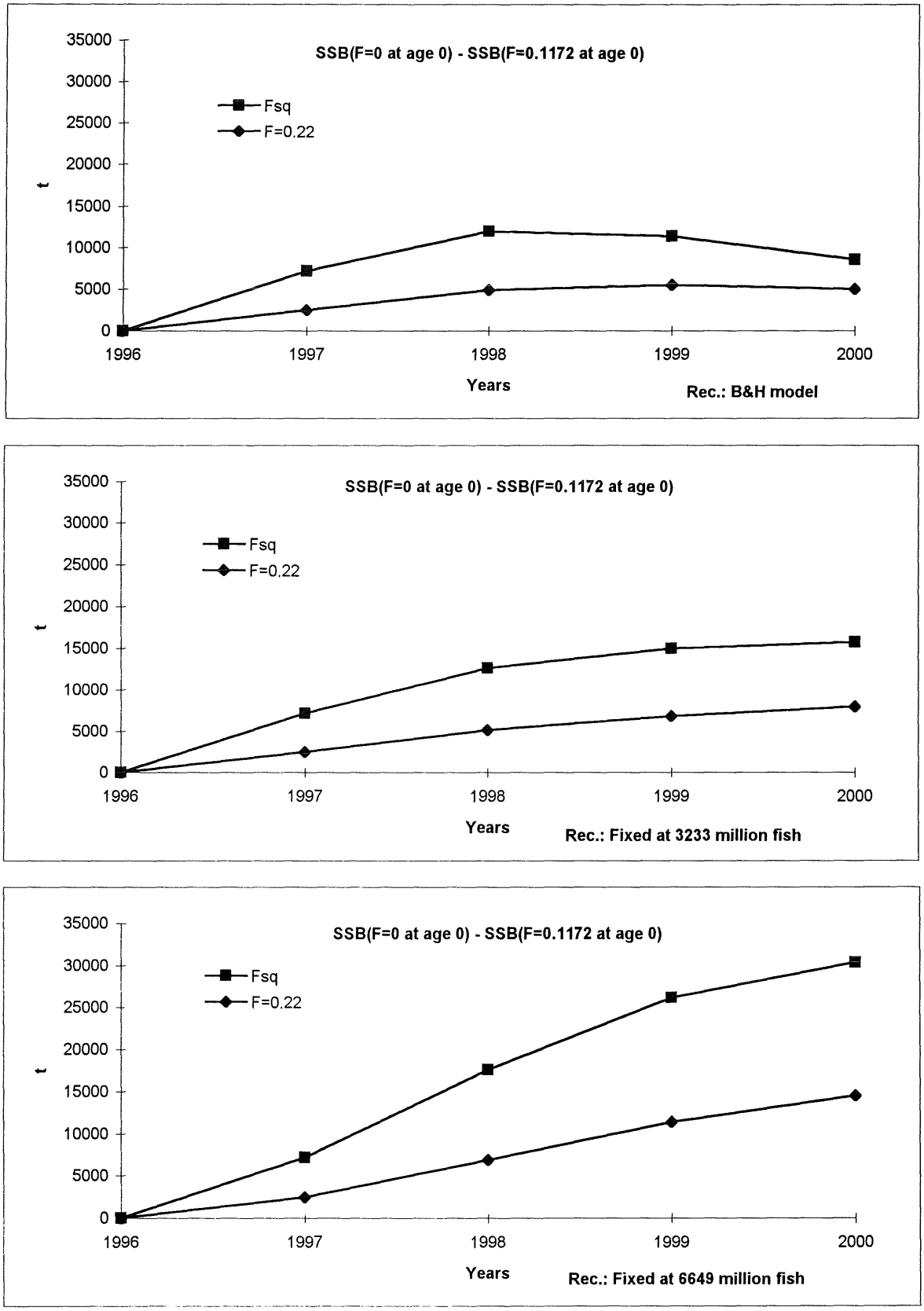
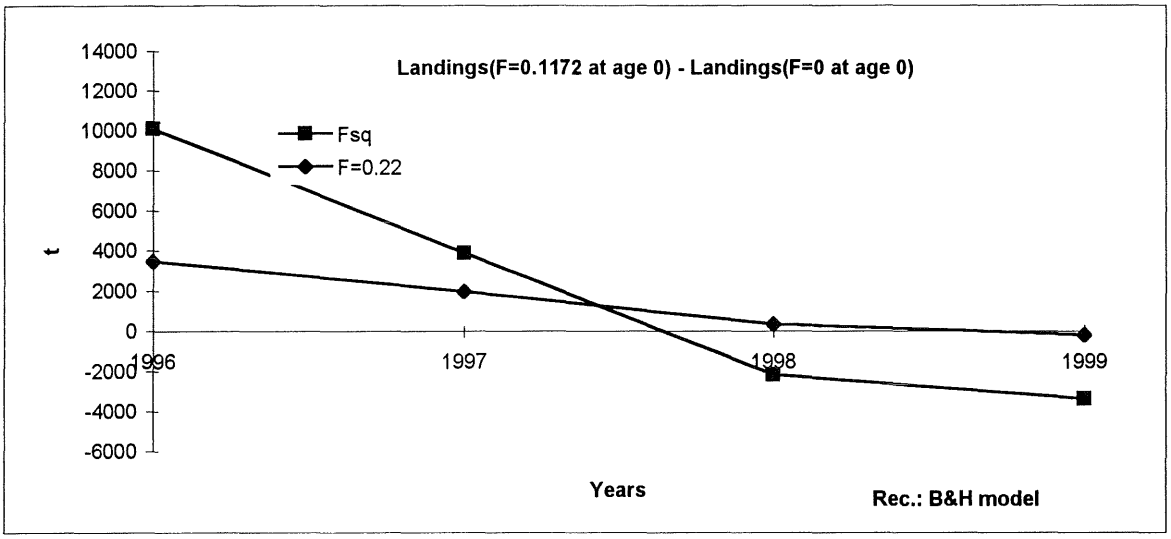
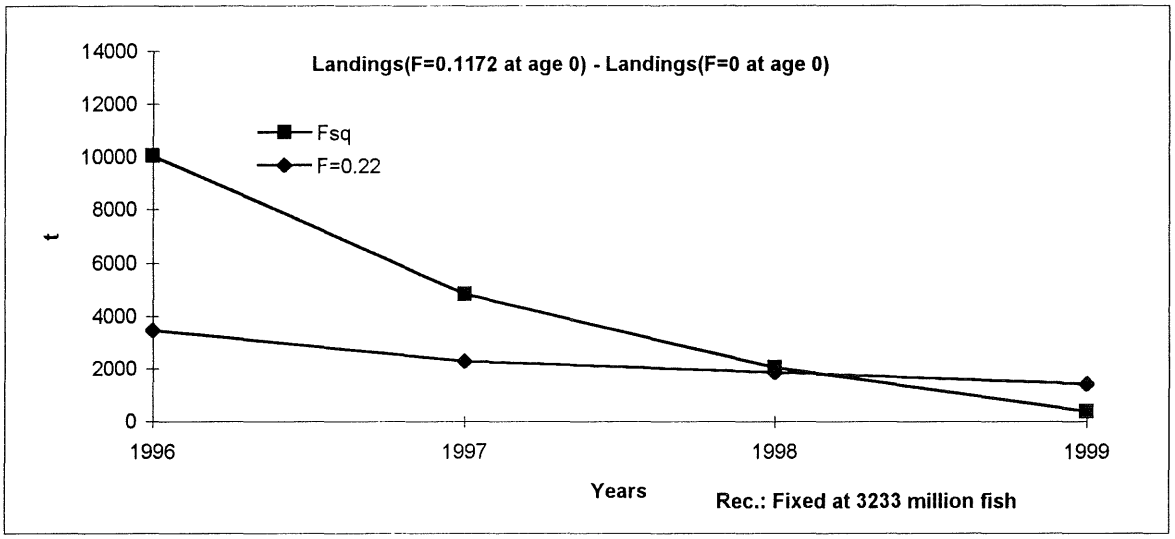


Figure 13.2.6 Differences between SSB for F=0 at age 0 and SSB for F=0.1172 at age 0.





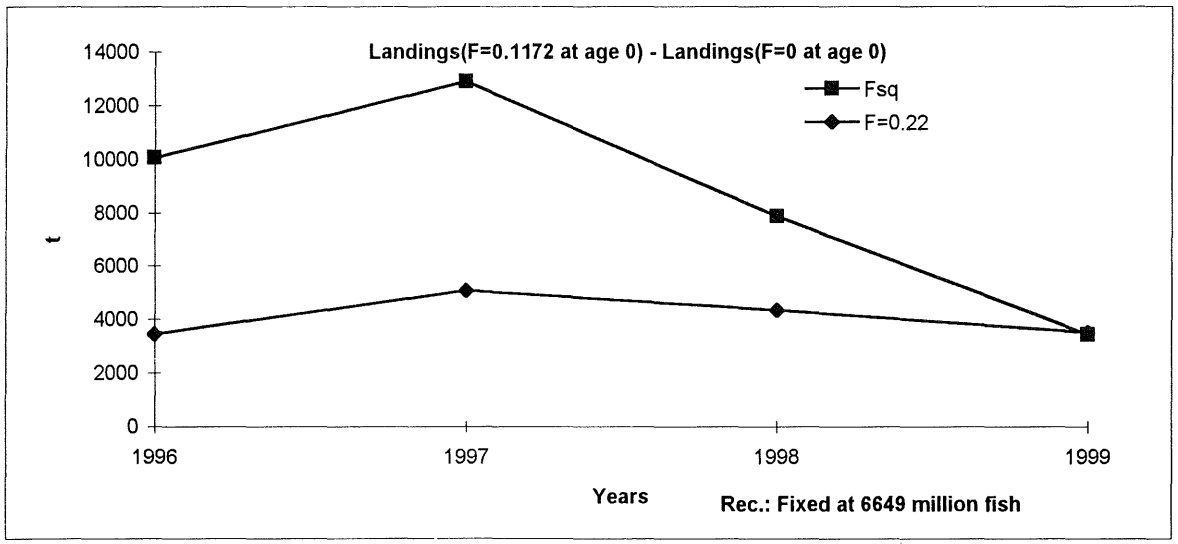


Figure 13.2.7 Differences between landings for F=0.1172 at age 0 and landings for F=0 at age.

14 INVESTIGATIONS ON ENVIRONMENTAL INFLUENCES ON PRODUCTIVITY OF SARDINE AND ANCHOVY. GLOBEC

The Working Group noted the recent establisment of an ICES/GLOBEC office, one of whose purposes is to develop links between the GLOBEC programme and the ICES advisory mechanisms for fishery management. Results presented by Borja *et al.* (WD 1996) served to support their earlier findings which have demonstrated a correlation between anchovy recruitment in the Bay of Biscay and upwelling intensity in the area (Borja *et al.* in press). There results were complementary to earlier conclusions which demostrated a relationship between environmental conditions and recruitment in the sardine stock (Dickson *et al.*, 1988; Chesney, E.J and Alonso Noval, M. 1989; Robles R *et al.*, 1992; Roy, C *et al.* 1993; Dias, C.M.A. *et al.*, 1996).

In view of this strengthening evidence of environmental influences on small pelagic fish in the Bay of Biscay, the Working Group recommend that the ICES/GLOBEC secretary should explore ways to encourage further work on anchovy, sardine and other small pelagic species within the ICES/GLOBEC North Atlantic reginal programme. The Working Group would also request that the ICES Oceanographers should provide data on the provision of rapid and appropiate indices of upwelling to update early indicators of recruitment.

15 RECOMMENDATIONS

15.1 General

The Working Group again strongly recommended that all countries should make effort to provide reliable statistics.

Further evaluate the use of Generalized Additive Modeling in survey planning and analysis of egg survey data with reference to the results of the analysis of the 1989, 1992 and 1995 surveys and the comments of the 1996 MHSA Working Group.

Review all the fecundity and atresia data collected in the western and southern areas for mackerel with particular reference to the significance of any inter-annual differences in the values measured. Advise the MHSA Working Group on any changes which should be made to the values of fecundity and atresia used by them in their analysis of the 1995 egg survey data.

Coordinate the planning of the sampling for maturity of both mackerel and horse mackerel to be used for histological analysis.

Examine the basis for the different mackerel maturity ogive used in 1986. Estimate appropriate maturity ogives from the survey data for use in the calculation of SSB in 1992 and 1995 with an estimate of the CV.

Examine ways of combining the mackerel egg survey data for the western and southern areas to produce a single estimate of mackerel egg production for the combined North East Atlantic Mackerel.

The Working Group recommends and encourages the prosecution environmental studies aimed to understand the connections between the climatic regimes and oceanographic conditions of the waters with the recruitments of the small pelagics assessed by this working groups, like anchovy and sardine.

15.2 Mackerel

The Working Group recommends to investigate the distribution pattern of overwintering mackerel in the North Sea on VIa (N).

The Working Group recommends that during the next egg survey in 1998 both mackerel and horse mackerel ovaries be collected at peak spawning time in both the western and southern area in order to construct maturity ogives based on histological analysis. At the same time additional sampling should be carried out in the juvenile areas.

The Working Group recommends further modeling work should be undertaken in order the explore further the use of distributional models for improving the use of the juvenile surveys for prediction of recruitment. Preliminary work indicates good prospects for deriving a robust index of abundance from the mackerel survey data, and the Working Group recommends that the surveys be continued.

15.3 Horse mackerel

The Working Group strongly recommends that all countries with relatively high horse mackerel catches should sample for age at an adequate level.

The Working Group recommends that during the next egg survey in 1998 both mackerel and horse mackerel ovaries be collected at peak spawning time in both the western and southern area in order to construct maturity ogives based on histological analysis. At the same time additional sampling should be carried out in the juvenile areas.

The Working Group recommends that more research be carried out on North Sea horse mackerel.

The Working Group recommends that at its next meeting results of sensitivity analyses should be presented, which particularly re-examine the biological basis for the current selection of M especially for the *western horse mackerel.*

The Working Group recommends to develop further studies in relation to stock identity problems and/or possible migration patterns especially for the *southern horse mackerel.*

15.4 Sardine

The Working Group recommends to carry out a joint acoustic survey covering the entire distribution area of the sardine stock during the spring (March–April) in 1997. In order to plan the survey and standardize the methodology, it is recommended that a 3 days meeting should take place in Vigo in January 1997 with Pablo Carrera as chairman.

The Working Group recommends a workshop in order to clarify and to understand the otolith structure and ageing those sardines longer than 22 cm and, especially younger sardines caught at the end of the year and clarify the ageing criteria for those sardines caught in the middle of the year.

15.5 Anchovy

The Working Group recommends the continuation of otolith reading exchanges and discussions between the age readers involved with anchovy fisheries in order to improve the consistency among them.

The Working Group recommends the application of simulation studies on the benefits and costs of the management approaches considered in the report, using assessment models.

15.6 ICES

Maps illustrating the quarterly distribution of catches by ICES rectangle are a valuable aid to the interpretation of total fishery and age class spatial distributions. The production of these maps is time consuming and would be spent more productively on other work. With the aim of increasing the efficiency of the Working Group, it is recommended that the ICES Secretariat purchase a software package capable of producing such charts, and provide a standard format for the data to be used within it. Thus allowing data to be prepared before the meeting.

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