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

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PART 2 OF 2

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8 SARDINE GENERAL

Sardine (*Sardina pilchardus*, Walb) has a wide distribution around both North-East Atlantic waters and in the Mediterranean Sea. Its northernmost boundary distribution seems to be likely related with the sea surface temperature and reaches up to the North Sea. Nevertheless, as in other sardine stocks, distribution area and abundance may be related with "regimes" (Lluch-Belda *et al*, 1989) and, hence, changes in both abundance and distribution should be expected.

Most of the studies about distribution and abundance of this fish species were done off the Iberian Peninsula waters, in Moroccan waters and in the Mediterranean Sea (Abad *et al*, 1999, Kifani, 1998, ICES CM 2000/ACFM:5), where sardine is a target species. In northern areas, sardine is not a target species and, is spite catches are routinely reported from this area, they could not reflect the true abundance or distribution of this fish specie.

Under the frame of the EU project PELASSES, a wide area, from Gibraltar to the Celtic Sea was covered in spring 2000 (Marques, 2000 WD and Carrera 2000 WD). Main feature of these surveys was the combination of both acoustic records, provided by 38 and 120 kHz frequencies, and egg samples provided in a continuously way by the CUFES. This device consists on a pump located at 3-5 m depth which provides a water flow of about 600 l/min to a concentrator. From here a smaller water volume (20 l/min) is conducted to a collector.

Acoustic Surveys

In ICES Sub-Division VIIe and in a small part of the VIIh, an acoustic survey was conducted from 19th March to 23rd. The survey, carried out on board R/V Thalassa, mainly covered VIIe. Sardine around the French coast was scarce. Moreover, in this area the presence of any fish specie was scarce. Off the English waters, the occurrence of fish was higher, being sprat the most abundant fish specie. Sardine was found close to the Celtic Sea. Nevertheless, the distribution of the sardine eggs was wider. This could be explained by the currents regime in the English Channel. In VIIe a total of 247 tonnes were estimated, corresponding to 6 million fish, most of the younger (i.e.<18cm length). In the Celtic Sea only a few were steamed, close to the French coast. The bulk of the area was no covered and the outer limit of the distribution is located further than the outer limit of the tracks Total abundance was estimated to be 3283 tonnes corresponding to 56 million fish. Younger specimen were located close to the coast and the adults offshore (Figure 8.1).

From mid April to mid May, VIIIab Divisions were surveyed by the R/V Thalassa. Sardine around VIIIab showed a wide distribution, covering from the coastal waters where the younger were mainly located, to the continental shelf break. Close to the slope large number of spawning adults were detected.

The Fishery

In VII and VIIIab Division catch data area available from France, UK (England and Wales) and Germany (Table 8.1). Germany also provided catch-at-age data from VIIef ICES Division. In VIIIab Division catches were reported by France.

In Division VII reported catches were below 5 thousand tonnes from 1983 to 1991. From 1992 to 1996 catches reached its maximum level, with 23 thousand tonnes reported in 1994. Since 1997, catches are around 4 thousand tonnes. Reported catches in VII for 1999 were 3,711 tonnes, most of then located in VIIef. Total landings in VIIIab were 17730 tonnes, which are similar to that of the last year. Landings in VIIIab presents a stable period from 1983 to 1996 at around 7 thousand tonnes. Since that catches notably increased up to 18 thousand tonnes.

In Division VII, as shown in Table 8.2 most of the catches occurred during the first and the fourth quarter. Length distribution from VIIef are available for the first and fourth quarter (Table 8.3). Mean length were similar for both quarter (12.5 cm).

Acoustic surveys has been performed for anchovy since 1989 in Divisions VIIIab. Some results were also given for sardine. In addition, Spain has also conducted two surveys covering part of VIIIb from 1997 to 1999. From these time series, the sardine biomass estimated was always higher than 200,000 tonnes. The fishing effort in this area for sardine is therefore low and could no reflect the dynamics of sardine.

Although the first acoustic survey in the northern part of this stock was conducted this year, the knowledge about sardine population around VII Area is still scarce. The Working Groups recommends that the study of the sardine in this northern part should be increased and all the member countries should make available the information of sardine in their waters concerning surveys, catch compositions and eggs and larvae distribution.

Table 8.1: Annual catches of sardine by ICES Sub-Division

DIVISION	1983	1984	1985	1986	1987	1988	1989	1990
VIId	211	147	465	512	67	29	93	64
VIIe,f	590	661	1 624	2 058	682	438	91	808
VIIg	-	1	-					
VIIh	2	-			216	2 119	957	235
Total VII	**803**	**809**	**2 089**	**2 570**	**965**	**2 586**	**1 141**	**1 107**
VIIIa	6 013	4 472	8 090	10 186	7 631	7 770	8 885	8 381
VIIIb	454	19	79	77	77	38	85	104
Total VIIIab	**6 467**	**4 491**	**8 169**	**10 263**	**7 708**	**7 808**	**8 970**	**8 485**

DIVISION	1991	1992	1993	1994	1995	1996	1997	1998	1999
VIId	170	153	127	2 086	1 621	179	71	103	247
VIIe,f	4 687	19 635	5 304	20 985	13 787	8 278	2 584	4 223	3 415
VIIg									
VIIh	110	4	71	-	1 439	1 350	1 058	101	11
Total VII	**4 968**	**19 793**	**5 502**	**23 071**	**16 846**	**9 807**	**3 713**	**4 427**	**3 711**
VIIIa	9 113	8 565	4 703	7 164		8 180	11 361	10 674	
VIIIb	482	141	548	119		526	160	7 749	
Total VIIIab	**9 595**	**8 706**	**5 251**	**7 283**		**8 706**	**11 521**	**18 423**	**17 730**

1983-90 only French data was available for Sub-Area VII

Table 8.2: Sardine landings in 1999 by country. Below, quarterly distribution of the German and UK catches.

Division	Germany	UK	France	Year
VIId	62	185		**247**
VIIef	58	3357		**3415**
VIIg				
VIIh	13	25		**38**
VIIj				
VIIIab	11		17730	**17741**
Total	**143**	**3567**	**17730**	**21440**

Country	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Germany			57	87	**143**
UK	2112	2	77	1377	**3568**
Total	**2112**	**2**	**134**	**1463**	**3711**

Table 8.3: Sardine length distribution by quarter in ICES Division VIIef
(1) Provided by UK (England and Wales)
(2) Provided by Germany

	1st Q	2nd Q	3rd Q	4th Q
8				
8.5				
9				
9.5				
10	200			
10.5	200			2
11	1327			17
11.5	1377			47
12	3130			63
12.5	5159			53
13	2805			35
13.5	927			17
14	125			5
14.5	50			1
15	25			
15.5	0			
16				
16.5	100			
17				
17.5				
18				
Total	15426			240
Mean length	12.6			12.5

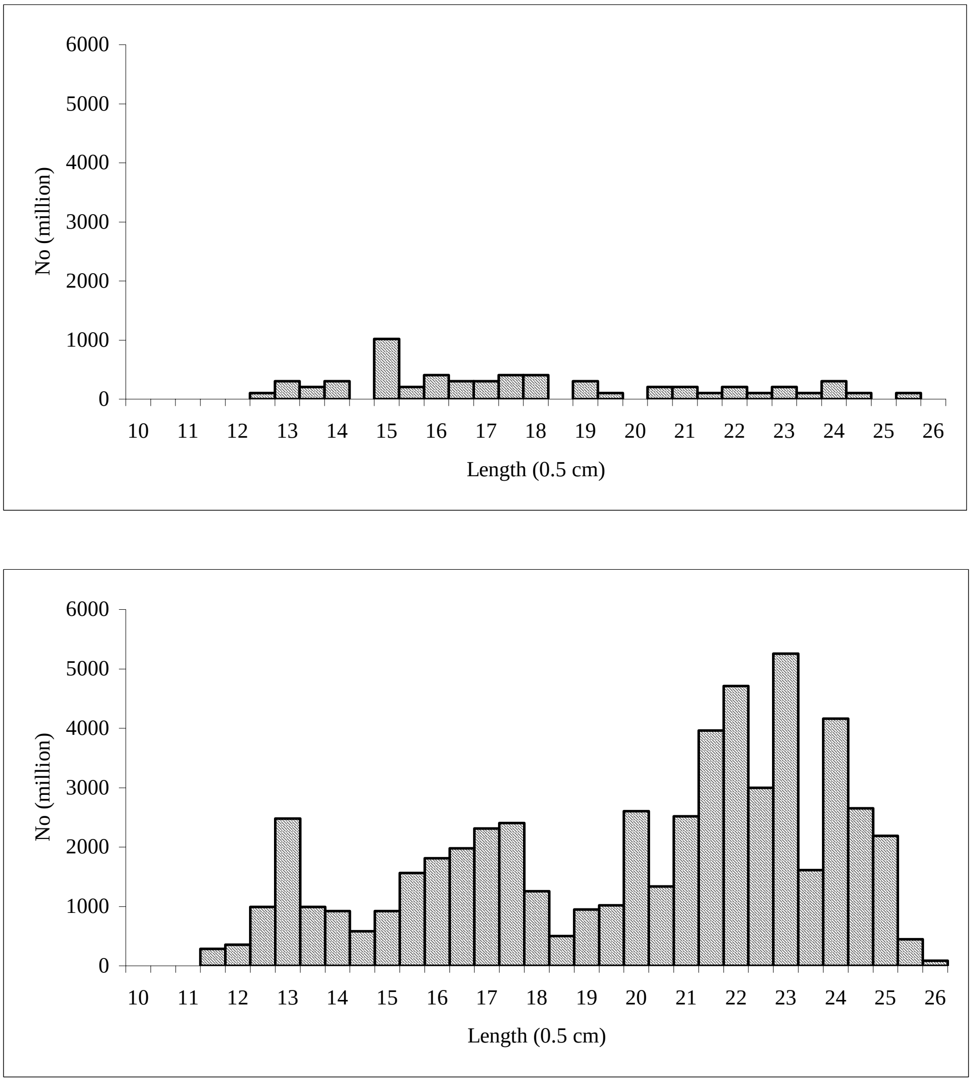

Figure 8.1: Estimated fish abundance by length class (0.5 cm) during PELACUS 0300 acoustic survey. Upper pannel, VIIef; lower pannel VIIh Division

9 SARDINE IN DIVISIONS VIIIC AND IXA

9.1 ACFM Advice Applicable to 1999 and 2000

In October 1998, ACFM recommended a reduction in fishing mortality to a value of F=0.20, corresponding to a predicted catch of 38000 t. If this reduction could not be implemented in 1999, ACFM advised a stepwise reduction in fishing mortality aiming at an increase of 20% in spawning stock biomass in 2000 and corresponding to a 40% decrease in F in 1999.

Based on new data provided by Anon. (1999), ACFM considered that there has been a severe decline in abundance in the northern part of the distribution of the stock whereas abundance in the southern areas has been approximately stable. Spatial changes in distribution and a shift in the exploitation pattern in southern areas towards older ages are perceived. It is unclear whether these changes are due to changes in migration driven by climatic effects, a contraction of the distribution or local depletion of independent units. ACFM considers that “perceptions the overall state of the stock depends on the extent to which reliance is placed on information from the northern and southern areas, and therefore the state of the stock is considered to be uncertain”. For 2000, ACFM recommends that “fishing mortality be reduced below F=0.20, corresponding to a catch of less than 81000 t in order to prevent short-term decline in stock size and promote recovery of the stock”.

9.2 The Fishery in 1999

As estimated by the Working Group, catches in divisions VIIIc and IXa were 94,091 t (22,271 t from Spain and 71,820 t from Portugal). The bulk of the landings (99%) was done by purse seiners. Table 9.2.1 summarises the quarterly landings by ICES Sub-Division.

In March, a ban was imposed to the purse seine fishery off Galician waters (IXa North, VIIIc West and the most western part of VIIIc East). An other management regulation implemented in 1999 was a minimum landing size of 11 cm (EU reg. 850/98). In Spain, a maximum allowable catch of 7,000 Kg per fishing day and a week limitation in the number of fishing days (4 in Galicia, 5 in the rest of Spain) were also implemented. In Portugal, new regulations have been gradually implemented since 1997 and the 1999 measures included: (1) an overall limitation in the number of fishing days (180 days per year, and 48 hours of ban during the weekend), (2) an overall catches reduction of about 10 % of the 1997 catches, (3) a closure of the purse-seine fishery in the northern part of the Portuguese area in February and March and finally, (4) an yearly and daily catches limits for all fishermen organisations. Daily catch limitations have been imposed for the first time in 1999.

In 1999, catches by both countries were lower than those realised in 1998. In Sub-division VIIIc-East, catches were 7,407 t which represented a reduction of 30 % compared to 1998. As previously observed, most of the catches were taken during the first and the fourth quarter, outside the main anchovy and tuna fishing periods. In VIIIc-W, catches were 4,455 t (20 % of reduction) and most of them were made during the second and fourth quarter. In IXa-N, sardine catches were the lowest ever reported (2,563 t, a reduction of 21 %from 1998) due to the absence of fish in the area. Most of the landings from that area occurred during the second and third quarter. In IXa-CN, landings yielded to 31,574 t, which were more or less at the same level than the previous years. However, a large decrease in the catches was observed in the fourth quarter, for which there was no available explanation. Almost 50 % of the catches in this area was obtained during the third quarter. In IX-CS, catches also decreased (21,747 t or a reduction of 26%) and this reduction was equally distributed throughout the year. There is also some mentions that part of the purse-seine’s fleet directed its effort to Spanish mackerel during the first and second quarter of the year. In IXa S, the reduction was 11 % lower (18,499 t), compared to an increase of 19% (7,846 t) in Cadiz.

In 1999, the bulk of the catches for this stock occurred in IXa Central North during the third quarter. The contribution of the catches off Galician waters, which reached up to 90,000 t in the earlier eighties, was almost negligible.

Annual catches from both Spain and Portugal are available since 1940 (Figure 9.2.1 and Table 9.2.2). Declining trends are observed in northern areas (from IXaCN to VIIIc) whereas in the most southern areas, catches have shown a slight increasing trend.

9.3 Fishery Independent Information

9.3.1 Egg surveys

DEPM surveys were carried out in 1999, both in Spain and Portugal (Anon., 2000). An overview of the methodology of these surveys has already been presented in Anon. (2000a) and a detailed description can be found in Anon. (2000b).

The Portuguese survey covered the Portuguese coast and the Gulf of Cádiz from 10th of January to 3rd of February and the Spanish survey was carried out off the North Atlantic Spanish coast from the 16th of March to the 11th of April. Adult parameters are estimated for the entire survey areas (unstratified). Survey timing of the Portuguese survey was changed from March to January, a change which is expected to increase the precision of SSB estimates and also result on a sightly larger estimate due to higher condition of fish in January. Parameters for the Spanish survey were based on samples collected in the Gulf of Biscay due to the small number of adult fish observed in the other areas. Due to inadequate sampling, it was not possible to estimate spawning fraction in the Spanish area and therefore the 1997 estimate was used in the calculation of SSB.

Parameter estimates for the two surveys are presented in Table 9.3.1.1. The total 1999 SSB estimate is 215.5 Ktonnes , with 95% of the biomass coming from the Portuguese survey (Portuguese coast+Gulf of Cadiz), a distribution pattern which is similar to the one observed in 1997. SSB estimates for both areas are well below the corresponding estimates from acoustic surveys. The Portuguese survey gave a much higher SSB than the two previous surveys, mainly due to the combination of a higher egg production and lower spawning fraction. However, the lower spawning fraction is due to very low estimates in the southern region (Algarve+Cadiz) and it is possible that the SSB estimates have been biased by problems related to adult survey design and post-stratification (Tables 9.3.1.1 and 9.3.1.2). An opposite situation was observed in the Spanish surveys. SSB estimates for 1999 where in this case, the lowest of all available estimates. Although the 1999 estimate has to be interpreted with caution, because it uses the 1997 spawning fraction, the SSB series shows a clear decreasing pattern in the Spanish area.

The issue of sampling design and adult parameter estimation has been is addressed by Stratoudakis and Fryer (WD, 2000). This WD demonstrates the impact of post-stratification on the 1999 DEPM estimation of sardine spawning biomass off Portugal, and propose sensible designs for future surveys. Poststratifying the Portuguese 1999 DEPM survey into two strata (western and southern) increases the SSB estimate by at least 100 Kt, nearly 50% more than the original (unstratified) estimate. A series of simulated populations was constructed consisting of the two strata, in which fish abundance and mean spawning fraction in each stratum were allowed to vary widely, and where egg production, sex ratio and batch fecundity were assumed known without error. Then each population was sampled using simple random sampling and various forms of stratified random sampling (allocation proportional to survey area, to fish abundance, and optimal allocation). Ignoring spatial structure in spawning fraction led to very biased and imprecise estimates of fish abundance. In the population scenario that most closely resembles the 1999 Portuguese DEPM survey, the bias was –25%, suggesting that unstratified estimation underestimates the true SSB. Stratified random sampling with allocation proportional to the abundance and optimal allocation outperformed allocation proportional to area and were robust to moderate levels of misallocation. Therefore, the authors believe that future adult surveys for DEPM would benefit by adopting an *a priori* stratified design, in which stratum effort is allocated according to the sardine abundance estimate from the most recent acoustic survey.

In spite of these recent findings, Stratoudakis and Fryer (WD, 2000) do not propose the use of the stratified SSB estimate in current years assessment, the first obvious reason being that new estimates have to be calculated for the previous surveys and the second because there are still doubts whether the large difference in spawning fraction between areas is a real biological phenomena or a temperature related artifact. The working group considers that research in this area should continue within the proposed Study Group on the Estimation of the Spawning Stock Biomass of Sardine and Anchovy by the Daily Egg Production Method and that the approach proposed in this WD should be used in the future.

9.3.2 Acoustic surveys

Acoustic activities undertaken in this area are co-ordinated in the frame of the Planning Group for Pelagic Acoustic Surveys in ICES Divisions IX and VIII (ICES CM 1999/G:13).

Last year, a project called "Direct abundance estimation and distribution of pelagic fish species in north east Atlantic waters: Improving acoustic and daily egg production methods for sardine and anchovy (PELASSES)", was approved by the EU under the frame of the "Common Fisheries Policy". With the objective of improving the precision of the acoustic estimation, this project merges acoustic and ichthyoplankton activities. This combination of different sampling activities has been facilitated by the fact that the surveys currently performed in this area are conducted during the spawning time of two very important pelagic species, sardine and anchovy. Moreover, the recent development of the Continuous Underway Fish Egg Sampler (CUFES) is also an important factor that has contributed largely to the realisation of this objective. This CUFES device consists on a pump located at 3-5 m depth which provides a water flow of about 600 l/min to a concentrator. From there, a small volume of water (20 l/min) is directed to a collector in which plankton with a size greater than 500 µm is retained. CUFES provides continuous records of the plankton present at 3 m depth. An other objective of this project consists in the calibration of this equipment to allow the estimation of the eggs in the whole water column. If such a calibration is successful, both methods will be performed simultaneously on a single R/V.

To summarise, this study will provide the following outcomes:

1. A synoptic coverage from the Gulf of Cadiz to the Celtic Sea to assess by the echo-integration the abundance of sardine and anchovy or other pelagic fish. This will be the first attempt to realise this objective which corresponds also to a recommendation of ICES to cover the entire sardine distribution. New common statistical techniques will be developed to improve the precision of the estimations.

2. The distribution of the main species of pelagic fish at the spawning time.

3. The egg distribution at 5 meters depth and, once CUFES is calibrated, the egg production of the main pelagic fish species.

4. The feasibility of using a single research vessel to get abundance and biomass estimates by echo-integration and egg production methods.

5. Biological samples collected from a wide area will be available to be used for many purposes (i.e. stock identification, otolith exchanges ...).

Portuguese November 1999 Acoustic Survey

This survey was performed in accordance to the standard survey design and strategies which consists in: (1) the calibration of the 38 kHz transducer prior the survey, (2) a distance of 8 nm between parallel transects and, (3) the application of the Nakken and Dommasnes method (1978). Moreover, several CalVET tows were also done during night hours throughout all the surveyed area. The survey was carried out on board R/V Noruega (Marques, WD 2000).

Sardine occurred in two main areas (Figure 9.3.2.1): (1) Off the northern coast, where juveniles are predominant and, (2) in the southern part (Algarve and Cadiz) where the bulk of the population is composed of adult fish (Figure 9.3.2.2, Table 9.3.2.1). Between Cape Roca and Cape San Vicente, sardine abundance was low. Compared with the previous year, there was an important decrease in both biomass and number (from 621,000 t or 21,168 million fish to 272,000 t or 7,866 million fish). This decrease was mainly concentrated in the northern part and Cadiz. In IXa-Central North, juveniles continued to be the dominant age groups (71% in numbers), so the observed decrease seems to be related with an overall decrease of the population. On the contrary in Cadiz, almost no recruits were observed. However, a significant decrease in the absolute number of recruits was also observed. Adults, as it was already mentioned, were mostly concentrated in Algarve and their number remained quite stable (from 95,000 t or 2,019 million fish to 92,000 t or 1,537 million fish, with 99 % belonging to the 1+ age groups in 1999 compared to only 58% in 1998). The egg distribution, as determined by the CalVET tows, matched quite well the acoustic adult distribution (Figure 9.3.2.3).

For this time series, long-term fluctuation in the estimated biomass by area is presented in Figure 9.3.2.11. From this Figure, it can be concluded that:

- An important decrease in the biomass was observed in the north part.

- Large biomass fluctuations in the central part, with the lowest value in 1999

- A stable situation in the south of Portugal where most of the adults are present.

- A poor 1999 year class compared with the previous year, which had more incidence in Cadiz, one of the traditional nursery areas.

Due to the shortness of the time series in Cadiz and giving the influence of the incoming recruitment in the total biomass, no conclusion on the dynamic of sardine in Cadiz could be suggested.

Portuguese March 2000 acoustic survey

This survey conducted in March 2000 has provided for the first time additional information on sardine eggs. Due to the bad weather conditions found in Cadiz, 33% of this area was not covered which however corresponds to the traditional area with less fish abundance.

In comparison to the November survey, sardine were more distributed in the southern parts. On the contrary in IXa-CN, sardine were restricted in a small area, around Porto. Accordingly, the sardine biomass estimated in IXa Central South was higher than that of the November survey (Figures 9.3.2.4 , 9.3.2.5 and Table 9.3.2.1). The number of juveniles increased in northern part and in addition, a large number of fish smaller than 8 cm (modal length of 6 cm) appeared in Cadiz. Taking into consideration the growth pattern of this species, most of these fish were probably hatched in late January 2000 but classified as fish of the age group 1 according to the ageing criteria. These fish notably increased the age group abundance (an increase of 16 % if their abundance is estimated to be about half the age 1 fish abundance in Cadiz). Furthermore, during the second half of the year, these fish will be re-allocated into age group 0. This situation has often happened and might lead to an over-estimation of age group 1 in the Portuguese March surveys.

Comparing with the last March acoustic survey , there was a decrease of 12% in the total biomass. Although this decrease was lower, important changes in the biomass was observed in the different areas. In the northern part, total biomass was estimated at 98,000 t or 3,685 million fish, a decrease of 38 % compared to 1998. Nevertheless in the Central part, which roughly corresponds to IXa Central South, the biomass increased to 150 % (from 35,000 t or 830 million fish in 1999 to 90,000 t or 2,715 millions fish this year). In Algarve (IXa South), the biomass increased by 50 % (from 39,000 t or 862 millions fish estimated last year to 59,000 t or 1,011 millions fish this year). In Cadiz, the biomass decreased by 36% (from 191,000 t or 5,495 millions fish to 122,000 t or 4,463 million fish).

This survey shows a stable situation for the adults, compared with the March and November surveys. On the other hand, the strength of the 1999 year-class could be over-estimated because part of the age 1 fish are presumed to belong the 2000 year-class. The duration of the spawning period for sardine is more than 7 months long, and it occurs from late September to early May. For this species, the recruitment is the result of the temporal and spatial integration of a long hatching process, and takes mainly place from April to October. Thus, this survey was characterised by:

- Stable population of adults mainly concentrated in the Algarve area as it was observed during the previous survey, but distributed northwards as well

- Large amount of sardines recently hatched, specially in Cadiz, which might over-estimate the strength of the 1999 year class.

Figure 9.3.2.10 shows the long-term changes in the estimated biomass from the acoustic survey conducted in March in the region of the Atlantic waters of the Iberian Peninsula (Spanish and Portuguese time series combined). Long-term trends suggest:

- A decrease of the biomass in the north part, after a period of three years of increasing trend (from 1996 with the lowest value in 1998), and a decreasing trend for the last two years.

- A small decreasing trend in the southern areas (from IXa Central South to IXa Cadiz). In IXa Central South, the biomass has been stable up to 1998. But in 1999, it decreased sharply and increased again in 2000. In IXa South, there was a decreasing trend in the biomass from 1995 to 1999 and an increase in 2000. In Cadiz, time series is short and no long-term trends could be observed.

On the other hand, CUFES performance was high and provided a good spatial distribution of the egg distribution. Moreover, the egg distribution provided by CUFES is similar to the adult distribution obtained from the acoustics (Figure 9.3.2.6).

Spanish April 2000 Acoustic Survey

As it was stated in the previous section, the Spanish survey also covered Sub-Division VIIeh during the last days of March 2000, whereas the Spanish area was covered in April. This survey was co-ordinated with those performed by

Portugal and France. (i.e. same methods, and also using CUFES). The survey was conducted on board R/V Thalassa (Carrera, WD 2000).

Figures 9.3.2.7 and 9.3.2.8 show respectively the sardine distribution along the surveyed area and the estimated number of fish at age by Sub-Division.

Off Galician waters, sardine were distributed in small patches without continuity. Only in the northern part of this area, sardine were found in thick and big schools close to the shore. As long as the inner part of the Bay of Biscay was reaching, the sardine distribution became wider. Total biomass notably increased from the previous surveys (from 43,000 t or 726 million fish in 1999 to 96,000 t or 13,121 million fish in 2000). Nevertheless the sardine biomass estimated in IXa-N was lower than that of the previous year (from 4,000 t to 2,000 t). In addition, the small number of fish belonging to age group 1 suggests that a low recruitment occurred in 1999. This situation agreed with the data obtained from the 1999 Portuguese November acoustic survey. In VIIIc-West, the biomass increased from 5,000 t to 31,000 t and in the same way, the biomass in VIIIc-East increased from 35,000 t to the 63,000 t.

To summarise, this survey provided three main conclusions:

- Poor representation of the 1999 year class

- Sardine abundance estimates from this survey time series is still decreasing in IXa-North, which can also be observed in landings from this area.

- The biomass in the Cantabrian sea, where all the fish are mature, notably increased everywhere in all VIIIc Division, the age group 3 being the most important.

Long-term trend in this time series is shown in Figure 9.3.2.10 and can be summarised as follows:

- In the inner part of the Bay of Biscay, the sardine biomass has slowly decreased over time. Nevertheless, short-term trend shows an increasing trend since 1998.

- In the rest of VIIIc Division, sardine shows an important declining trend, specially in the most western part. However, from 1999 to 2000, the biomass increased.

- In IXa North, the estimated biomass was always lower than 20,000 t and since 1993, it shows a declining trend. It should also be noted that this trend is similar to the sardine landings in this Sub-division

As in the case of the Portuguese, CUFES performance was good and the egg distribution obtained with this device, as presented in Figure 9.3.2.9, is similar to the adult distribution described from the acoustic data.

9.4 Biological Data

Biological data were provided by Spain and Portugal. In Spain samples for ALK were pooled on a half year basis for each Sub-Division while length weight relationship were calculated for each quarter. In Portugal both ALK and L/W relationship were compiled on a quarterly and Sub-Division basis. Data from Cadiz were obtained using the length distribution of the Spanish landings and the ALK and L/W from IXa South-Algarve.

9.4.1 Catch numbers at age

Landings were grouped by length classes (0.5 cm) and later applied on a quarterly basis to the ALK of each Sub-Division. Table 9.4.1.1 shows the quarterly length distribution. Mean length from the Cantabrian Sea (VIIIc) and from IXa-CS and South gave higher mean length throughout the year.

The catch-at-age data for 1998 has been revised after that some misallocations in IXa-CN were found. Accordingly, mean weight at age was also changed. This updating caused a decrease in the catch-at-age for age group 1 (19%) and a slight increase in others age groups, except the plus group. The effect of this updating in the assessment model will be explained later.

Table 9.4.1.2 shows the catch-at-age in numbers for each quarter and Sub-Division. In Table 9.4.1.3, the relative contribution of each age group in each Subdivision as well as their relative contribution to the catches.

Total catch was 1,777 millions which represents a decrease of 23 % from the previous year. The most important decrease was observed on age group 0, which represented 14 % of total catch in 1999 compared to 58 % in 1998. The bulk of the catches for this age group was taken in IXa-CN (64 %) as in the previous year. The Portuguese November acoustic survey estimated the 1999 recruitment as half the 1998 one. Therefore, lower catches for this age group were expected. Age groups 1 and 2 were the most represented in the catches (27 % and 20 % respectively), and they were mostly caught in IXa-CN (40 % of the total catches were from these age groups). Older fish (3+) were more represented in IXa CS and IXaS where catches were composed by more that 50% of these age groups.

Since 1978 the contribution of younger fish follows a decreasing trend, with the lowest contribution in 1995. In 1999 the contribution of the younger sardine to the overall catches was 20% higher than the one of the older fish (3+).

9.4.2 Mean length and mean weight at age

Mean length and mean weight at age by quarter and Sub-Division are shown in Tables 9.4.2.1 and 9.4.2.2. As previously observed, higher mean length for each age group and quarter occurred in the Cantabrian Sea (VIIIc) compared with the Northern Portuguese area. In the same way, mean weight at age were consistently higher in VIIIc.

SOP's were all below +/-5 % except for the second quarter in IXa Cadiz which gave a value of 7 % in the first quarter in IXa-N with 12 %. In this case, because only 68 t were landed, overall SOP for this quarter still remained bellow 5 %.

9.4.3 Maturity at age

The maturity ogive for 1999 was based on the biological samples collected during the spawning period (i.e. the fourth quarter of 1998 and the first one of 1999). Age classes from the samples obtained in 1998 were shifted by one year. Samples for each country were weighting according to the results of the acoustic surveys, giving a mean weighted factor for the Portuguese samples of about 90 %. The maturity ogive is presented below:

Age	0	1	2	3	5	5	6+
% mature fish	0	61.9	91.1	98.7	99.5	100	100

In comparison to the previous years, the proportion of fish mature at age 1 is lower whereas for the other age groups, the values are similar.

9.4.4 Natural mortality

According to Pestana (1989), the natural mortality was estimated at 0.33, and considered constant for all ages and years.

9.5 Effort and Catch per Unit Effort

Data on fishing effort and CPUE has been regularly provided in this section both for Portuguese purse-seine fleet and Spanish purse-seine fleets from Sada and Vigo-Riveira. However, it was recognised last year that the effort measure used in these CPUE series did not take into account the searching time, a factor that may influence effort estimates for pelagic fish. Furthermore, there was some indication that the Spanish fleets have gradually changed their target species to other pelagic species (mainly horse mackerel) and there is some indication that this might have also happened in Portugal during a short period in 1999 due to the large abundance of Spanish mackerel in the central area. These changes are probably impossible to evaluate.

Since it was not possible to get new information on fishing effort that enables the improvement of the estimates, effort and CPUE estimates will not be provided for 1999.

9.6 Recruitment Forecasting and Environmental Effects

Previous works have suggested that year class strength of the Iberian sardine is affected by hydroclimatic conditions in the North Atlantic (Borges *et al*., 1997; Santos *et al*., 1997, Cabanas and Porteiro, 1999 in press). The hypothesis of a negative impact of winter upwelling on sardine recruitment has been suggested by Santos *et al*. (1997). A possible mechanism coupling the two phenomena is that upweeling induces the offshore transport of larvae to areas with unfavorable feeding conditions.

The relation of winter upwelling and sardine recruitment off Portugal has been further explored by Borges *et al.* (2000). The authors also showed the relation between winter upwelling indices and the NAO (North Atlantic Oscillation) index. The paper uses a time series of sardine catches (as an index of recruitment 2 years before), indices of winter northern winds and of the NAO for the western Portuguese coast in the period 1945-1991. The results show a significant negative correlation between the mean northern wind index and sardine catches, where the period of high catches observed before 1970 coincides with lower values of the wind index and the period of lower catches after 1970 coincides with higher values of winter northern winds (Figure 9.6.1). Coastal upwelling is non-existent or very weak when the winter northern winds have low strength (left side of the triangle superimposed on Figure 9.6.1) and so do not play an important role in the survival rate of spawning in the area. It is noteworthy that when the winter upwelling overpasses a certain limit and gets stronger, it forces the recruitment or catch to be lower (right side of the triangle). In summary, strong winter north winds appear to have a negative impact on sardine recruitment but when low values are observed other factors become important in recruitment strength. The non-linear relationship implicit in the process needs to be further explored but these results may soon be useful in recruitment monitoring if the mean north wind index can be estimated in time. The working group considered that both the update of the current winter wind series and the availability of these data on time ,will enable its future incorporation in the assessment of sardine stock status.

9.7 State of Stock

9.7.1 Data exploration

Last year the assessment model was checked in order to know the sensitivity to different assumptions and input data (ICES CM 2000/ACFM:5). Several options, including different tuning fleets and input data were used. Finally the Working Group concluded to adopt as tuning data for the model three time series of acoustic surveys (Spanish Spring, Portuguese March and Portuguese November), with linear catchability model and the DEPM time series as an absolute estimator of the fish abundance.

As explained in previous sections catch-at-age and weights-at-age for 1998 were updated according to the new available information. Furthermore, weights in the stock at age for 1998 were reviewed since the last Working Group meeting. DEPM was also updated for 1997 according to the revision made at the Workshop on the Estimation of Spawning Stock Biomass of Sardine (ICES CM 2000/G:07).

In order to check how these changes affected the assessment model, a preliminary run was carried out with the same settings of the previous assessment with corrected historic input data. No major changes occurred in both estimated recruitment and fishing mortality. Nevertheless, SSB estimated for 1998 was 22% lower and that was mainly due to the revision of the weights-at-age in the stocks.

A new run was performed using last year assessment model with historical data revisions and input data updated to 1999 (RUN 1, Figure 9.7.2.2). The inclusion of a new year did no change the perception of the stock and only a small decrease in the recruitment and fishing mortality estimated for 1998 was observed.

In previous years, a difference in the signals given by the different tuning fleets which cover different parts of the stock area has been observed in the assessment. Therefore, it was decided to explore further the separate influence of each tunning fleet in the model fitness and results. Furthermore, it was observed that DEPM estimates, used as absolute indices in the first model, repeatedly gives a lower stock size estimate and that the linear catchability model considered for the Spanish acustic survey provides a poor fit for most ages. The first exploratory model included 14 years of Separable Period divided in two periods, from 1986 to 1990 and from 1991 to 1999, with abrupt change between both. A shift in the pattern of residuals from the separable model was observed from 1990 to 1991 which coincided with the period of change in the selection pattern.

Thus, aiming to explore deeper the assessment model, a series of preliminary analyses were carried out. This exercise consisted in two kinds of trials, i) the effect of the different tuning data in the assessment model and, ii) the effect of the separable period in the assessment model.

Six runs were performed using each of the different fleets as input data and testing different catchability models for DEPM and the Spanish acoustic survey. Table 9.7.1.1 summarises the input data and options for each run. Figures 9.7.1.1a-c show the results in terms of parameter estimates from all exploratory runs.

First model was fitted using only the Spanish March Acoustic survey (RUN-2). SSB estimated by this model give similar results for the most recent history (i.e. from 1989 to 1999). Nevertheless, SSB for years 1989 and backwards is higher than that estimated for the model including all fleets. Fishing mortality give similar trend of that of the test model, but, as in the case of the SSB, estimated $F_{(2-5)}$ for the beginning of the time series is lower and, on the contrary, is higher for the most recent years. Using DEPM alone as absolute estimator (RUN-3) gives a low perception of the stock size for the most recent history, with low SSB and high $F_{(2-5)}$. It should be noted that this series has a single point in the 80's (1988) and two points in the end of the 90's (97 and 99). The Portuguese November Acoustic Survey (RUN-4) gives a contradictory perception of that shown by the previous run, with high SSB for the nineties with low $F_{(2-5)}$ for the same period. The effect of the Portuguese March Acoustic Survey used as the single tunning fleet was not possible to test because the objective function did not converge. Its effect was nevertheless explored in RUN 7 (see below).

Next exploratory analysis investigated changes in the fitted catchability model for different fleets. The observation of the residuals given by the Spanish March Acoustic Survey index, suggested a power relationship rather than a linear one. Thus, RUN-5 shows the effect of such change in the perception of the stock. In spite the power model matched better than the linear, SSQ surface for this index did not reach any minimum and the index prediction gave higher CV than the linear one. Perception of the stock remains similar to the test model, and no major changes can be observed in the SSB estimated in the most recent years, with a small difference for the period 1988-1992. $F_{(2-5)}$ is similar to the test model for the period 1993-99. Nevertheless, this model present a marked peak in 1990 and from this year backwards, the estimated $F_{(2-5)}$ is higher than the test model. RUN-6 shows the perception of the stock when DEPM is treated as relative estimator with linear catchability. This model scales SSB upwards throughout the assessment period giving a more optimistic perception of the stock. $F_{(2-5)}$ is always lower than the test model and the estimated SSB higher. In recent years, SSB estimates are close to those provided by the model constructed with the Portuguese November acoustic survey alone. The exclusion of the Portuguese March Acoustic Survey (RUN-7) provides no change in the perception of the stock.

Overall, the sensitivity analysis indicates:

- The model is sensitive to which tuning fleets are included
- The exclusion of the Portuguese March Acoustic Survey does not give any change in the perception of the stock
- The model constructed with the Spanish Acoustic Survey alone as tuning fleet gives a perception close to that of the model made with all the fleets
- Compared with the test model the Portuguese November Acoustic Survey provides a more optimistic perception of the stock for the most recent years. Moreover, this perception is contradictory to that given by the model with DEPM alone as an absolute index.
- Similar perception of the stock is obtained for the models constructed with the Portuguese November AS or when DEPM is used as linear estimator in the general model.
- Although a power model could be suggested for the Spanish March Acoustic Survey, the CV of this model is lower than with the linear one.

Previous to check the sensitive to the selection pattern, catch-at-age data was analysed in order to know whether the selection pattern has changed. Figure 9.7.1.2 shows the relative differences between catches of the younger fish (age groups 0, 1 and 2) and the older (age groups 3+). The contribution of the younger fish to the overall catches shows a decreasing trend from 1978 to 1995 and an increasing trend since this year to 1998. This trend is affected by the strength of the incoming recruitment. Nevertheless, in spite the trend for the most recent years is positive, the contribution of the younger fish is the lowest of the time series, both relative and absolute terms. This plot suggests that since 1993 the fishing pattern has changed and the contribution of the younger fish to the catch became lower. The explanation for this change seems to be related with poor recruitment occurred from 1993 to 1995. The 1997 and 1998 year classes have been estimated to be above the mean recruitment of the last years but unexpectedly, they had little reflex on the catches.

Terminal numbers at age in the separable model are used to perform a VPA back in time. The chose of the appropriate selection pattern is important to increase the accuracy and precision of the parameters estimation.

Different options concerning the separable period were tested. The results of the parameters estimation are given in figure 9.7.1.3. First model (RUN-8) was performed with two separable periods similar to those used in last year assessment, from 1987 to 1991 and from 1992 to 1999, assuming abrupt change in the selection pattern. This model give similar results to that of the test model, but the estimated $F_{(2\text{-}5)}$ was lower for year 1991. Residuals from the separable period shown a shift at the period change, as in the test model. Same behaviour in the residuals was observed when the model was constructed with two periods, from 1987 to 1990 and 1991 to 1999.

Taking into account the analysis of the catch-at-age matrix, it seems that the major change occurred from 1993 to 1994. Therefore, a new model (RUN-9) was constructed with two separable periods, from 1987 to 1993 and from 1994 to 1999. This model yields lower SSB for the period 1993-1996. Also estimated $F_{(2\text{-}5)}$ for the same period was slightly lower than that of the test model. Another model was performed with a lower separable period, from 1991 to 1993 for the first period and from 1994 to 1999 for the second. This model gives a different perception of the stock, with lower SSB for the whole period (1978-1999) and higher $F_{(2\text{-}5)}$, specially for 1990.

The analysis of the influence of the choice the separable period gives:

- Less sensitivity in the parameter estimates than the choice of the tuning fleet.

- A shift in the pattern of residuals of the separable model in those models in which the two periods were not properly chosen.

- Less abrupt change in the trend of residuals when the change in the separable period is set in 1993.

A trial run was also made with the AMCI model (Assessment Model Combining Information from various sources AMCI, Skagen, 2000, see also Section 2). This model has a population model with a fishing mortality model that basically is separable, as has ICA, but it can relax the assumption that the fishing mortalities are separable by allowing for recursive updating of the fishing mortalities, by which the selection pattern can change slowly. In spite the model has not been deeply tested, and it was never used for this stock, a preliminary run was made mainly to analyse further the changes in selection pattern throughout the assessment period. Figure 9.7.1.4 shows the selection pattern by year, normalised to the average F2-5, estimated by the model. It is clear that a pattern where higher selection of younger fish prevailed in the eighties while an opposite pattern is observed in the 90´s, with 1989-1993 as a transition period. The change in the proportion of younger/older fish along the nineties does not allow to fit a single appropriate selection pattern for this period.

On the basis of the above exploration, the Working Group stresses that the dynamic of this stock, which might include changes in both distribution area, changes in the age pattern distribution along the Iberian Peninsula (Azevedo, WD 1999) and large recruitment variability, makes difficult to get an appropriate model for the whole time series. Therefore, uncertainties about the true dynamics and absolute values still remain. The exploratory analysis showed a large sensitivity of the assessment to the different tuning series. Although improvement of the assessment by changing options regarding tuning were considered, the Working Group considers that the uncertainty currently prevailing advises for caution before significant knowledge is added. Nevertheless a model constructed with 13 years of separable period divided from 1987 to 1993 and from 1994 to 1999 including all the available tuning fleets and DEPM spawning biomass as an absolute estimator, gives lower residuals without noticeable trends. The Working Group decided to adopt such model as the most appropriate to represent the dynamic of this stock.

9.7.2 Stock assessment

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

$$\sum_{0}^{6+}\sum_{1987}^{1993}\lambda_a\left[\ln\left(C_{a,y}\right)-\ln\left(F_y\cdot S_{1,a}\cdot\overline{N}_{ay}\right)\right]^2+\sum_{0}^{6+}\sum_{1994}^{1999}\lambda_a\left[\ln\left(C_{a,y}\right)-\ln\left(F_y\cdot S_{2,a}\cdot\overline{N}_{ay}\right)\right]^2+$$

$$+\sum_{1987}^{1993}\left[\ln\left(DEPM_y\right)-\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{1,a}-PM\cdot M)\right)\right]^2+$$

$$\sum_{1994}^{1999}\left[\ln\left(DEPM_y\right)-\ln\left(\sum_a Na,y\cdot Oa,y\cdot Way\cdot\exp(-PF\cdot F_y\cdot S_{2,a}-PM\cdot M)\right)\right]^2+$$

$$+\sum_{1987}^{1993}\sum_{1}^{6}\left[\ln(ANP_{a,y})-\ln\left(Q_{ANPa}\cdot\overline{N}\cdot\exp\left(-F_y\cdot S_{1,a}-M\right)\right)\right]^2+\sum_{1994}^{1999}\sum_{1}^{6}\left[\ln(ANP_{a,y})-\ln\left(Q_{ANPa}\cdot\overline{N}\cdot\exp\left(-F_y\cdot S_{2,a}-M\right)\right)\right]^2+$$

$$+\sum_{1987}^{1993}\sum_{1}^{6}\left[\ln(ASS_{a,y})-\ln\left(Q_{ASSa}\cdot\overline{N}\cdot\exp\left(-F_y\cdot S_{1,a}-M\right)\right)\right]^2+\sum_{1994}^{1999}\sum_{1}^{6}\left[\ln(ASS_{a,y})-\ln\left(Q_{ASSa}\cdot\overline{N}\cdot\exp\left(-F_y\cdot S_{2,a}-M\right)\right)\right]^2$$

$$+\sum_{1987}^{1993}\sum_{0}^{6}\left[\ln(ASP_{a,y})-\ln\left(Q_{ASPa}\cdot\overline{N}\cdot\exp\left(-F_y\cdot S_{1,a}-M\right)\right)\right]^2+\sum_{1994}^{1999}\sum_{0}^{6}\left[\ln(ASP_{a,y})-\ln\left(Q_{ASPa}\cdot\overline{N}\cdot\exp\left(-F_y\cdot S_{2,a}-M\right)\right)\right]^2$$

with constrains on $S_{13} = S_{15} = S_{23} = S_{25}=1.0$

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

N: population abundance on 1st January
Oa,y: maturity ogive
M: Natural mortality
PM and PF: Proportion of M and F before spawning
S_{1a}, S_{2a}: Selection patterns at age for the separable model in the time periods 1987–1993 and 1994–1999 respectively
DEPM: SSB estimation from the daily egg production method
Q_{ANP}, Q_{ASP}, Q_{ASS}: Catchability of the linear indices from Portuguese (P) March, November (N) and Spanish (S) March surveys
λ a,y: weighting factors for the catches at age (0.5 for age group 0 and 1.0 for the others)

Results of the assessment are shown in Table 9.7.2.1 and Figure 9.7.2.1. The inclusion of two selection patterns reflect the change found in the catch at age matrix. SSB indices from the DEPM are below the estimated SSB in the three years.

As in last years assessment, a negative trend in residuals with time is observed for age groups 4-6 in the Spanish March acoustic survey and an opposite trend in the November Portuguese acoustic survey. These patterns indicate that the Spanish survey overestimates the population given by the model in the 80’s and the Portuguese November survey is overestimating it in the 90’s. Furthermore, a high residual corresponding to 1983 year-class is evident in the Spanish survey. Separable model residuals are similar to those observed from last year’s assessment with values higher than ±0.5 for age group 0 in 1991, 1993 and 1995 and on age group 5 in 1998 . However, the abrupt change in the residual pattern from 1990 to 1991 observed in last years assessment is now smoothed due the change in the limits of the two separable periods. CV’s expressed in % of the parameter estimates are similar to previous assessments and are mainly in the range 15-30%.

Figure 9.7.2.2 shows the estimated recruitment, F2–5 and SSB for the whole time series provided by the models fitted this year and in the last years assessment. Estimated recruitments are similar to those in the last years assessment. This years assessment confirms that the 1998 year-class has been well above those in the previous six years. Recruitment estimated for 1999 represents a 16% decrease relatively to that in 1998. Strong year-classes are observed in 1983, 1991 and 1998 but with decreasing strength in that order. Fishing mortality shows a similar pattern as in last year except for the period 1991-1994 where lower values were estimated, coinciding with the transition between the two selection patterns. F(2-5) for 1999 shows a 25% decrease relatively to that in 1998, what seems to reflect in part a decrease in fishing effort due to fishery regulations. The SSB time series estimated this year is comparable to that observed in the last years assessment. Estimated SSB again shows two clear periods of higher abundance (1982–86 and 1993–95), the second one with slighlty relative importance. After a declining period up to 1997, SSB seems to be stable in the last two years. At present the stock is considered to be at a low level, similar to that observed in 1990.

9.7.3 Reliability of the assessment model

As it was stated last year from various working documents (Azevedo, 1999 WD; Bernal 1999 WD; Carrera *et al*, 1999 WD; Morais *et al*, 1999 WD; Stratoudakis, 1999;WD) important changes in both sardine distribution and abundance has been detected since earlier nineties. A change of the sardine distribution towards southern areas and a reduction of the overall sardine distribution area, leads to a different perception of the stock depending on the area considered. Both the catch distribution by areas and the age composition of the catches in each area have gradually changed. Population abundance and catches are dependent of the strength of the incoming recruitment which shows low to average values in recent years and a short-term impact on catches and population abundance. As a consequence of this dynamics, neither the selection pattern nor the overall dynamic of the stock can be properly modelled if areal/temporal differences are not considered.

The assessment model presently available to the Working Group improved the precision in the parameters estimation. Nevertheless, uncertainties about accuracy still remain. Taking into account the similar trends observed from the different assessment models explored and the lack of a more appropriate model in which an area perception of the evolution of this stock can be observed, the Working Group concludes that the parameters estimated by the model should be regarded as relative.

9.8 Catch Predictions

9.8.1 Divisions VIIIc and IXa combined

Input values for short term catch predictions (until 2002) are presented in Table 9.8.1. Numbers at age for ages 2-6+ were based on the population numbers estimated by the assessment model at the beginning of 2000. There is indication that the 1999 recruitment is poorly estimated by this model (CV=0.41). The number of age 1 fish for projections was calculated by replacing the 1999 recruitment estimated by the model with the geometric mean recruitment for the last six years and projecting forward one year using the F at age 0 estimated by the model. Input value for recruitment in 2000 was fixed at 7831 million fish, which corresponds to the geometric mean of the period 1994-1999. Large variations in recruitment are observed in the time series. The lowest recruitments have been observed in the more recent period and the strongest recruitments in this period are still lower than most of the recruitments in the 80's. Therefore, the mean value used for projections is considered to be representative of the recent years.

As in the assessment model, input value for natural mortality was 0.33 and input values for the proportion of F and M before spawning were 0.25. Stock and catch weights at age were calculated as mean values for the last three years. The use of these mean values is expected to smooth the interannual variability in these parameters. Due to the decrease in the fishing mortality in the last year input values for the exploitation pattern were those estimated by the assessment model for 1999. The 1999 maturity ogive was used in projections.

Results of the predictions are shown in Table 9.8.2 and Table 9.8.2.1. At F *status* quo (F2-5 in 1999 equal to 0.30) these predictions indicate about 23% increase in the catches and a 27% increase in the SSB comparatively to 1999. Preliminary information on catches for the first semester of 2000 indicate a level of catches similar to that in 1999, both off the Portuguese coast and off the Northern Spanish coast. The effort for these fisheries in 2000 is not expected to increased due to fisheries regulations limiting both fishing effort and catches.

However, keeping F at Fstatus quo indicates a decrease in SSB in 2002. A reduction of 20% of current fishing mortality provides a increase in SSB until 2002 while maintaining the catch level. The predicted SSB value for 2002 is comparable to the SSB level observed in 94-95.

9.8.2 Catch predictions by area for Divisions VIIIc and IXa

Table 9.8.2 presents the input data. The stock size, natural mortality, maturity ogive, proportion of F and M before spawning and also mean weight at age in the stock were the same as used for the catch predictions for Division VIIIc+IXa. Partial exploitation patterns for each area were calculated by splitting the exploitation pattern estimated for the areas combined in 1999 according to the proportion of catches in each area. Input values for the mean weight at age in the catch by sub-division was taken as the average of 1997–1999.

Catch forecasts for each Division are shown in Table 9.8.2.2. At F *status quo*, catches are expected to increase in both areas in 2000 and 2001 and SSB is expected to increase until 2001 and then decrease slightly. Considering a 20% reduction of fishing mortality SSB will maintain the increasing trend along the projection period and catches in each area will be similar to those in 1999.

Catch prediction by area were calculated on the basis of the estimated parameters in the assessment model for 1999 and partial catches by areas. It should be clearly stated that this forecast is based on the assumption of no changes in the spatial distribution of the population and stable partial fishing mortality levels. Partial Fs for each area were calculated, using the average ratio of the fleets catch at age and the total catch at each age for the years 1997–1999. There is no any scientific evidence to forecast catches according to ICES Divisions. This split by area should only be regarded as an example, because the split could also be based on other criteria. If necessary, advise on other criteria on how to split the catches between “Northern” and “Southern” areas should become available from the management bodies outside ICES.

9.9 Short Term Risk Analysis

Not considered to be relevant.

9.10 Medium Term Projections

Not considered to be relevant.

9.11 Long-term Yield

Input data for yield per recruit analysis is shown in Table 9.11.1. As for the short term catch predictions, input value for natural mortality was 0.33 and input values for the proportion of F and M before spawning were 0.25. Maturity ogive, stock and catch weights at age were calculated as mean values for the last three years. Population numbers used in the projection are those used for short term predictions. Results are shown in Table 9.11.2 and Figure 9.11.1.

9.12 Uncertainty in Assessment

Not considered to be relevant.

9.13 Reference Points for Management Purposes

The Study Group on the Precautionary Approach to Fisheries Management (ICES 1998/ACFM:10) did not consider any reference points for sardine. In addition, ACFM concluded that since the state of the stock in relation to precautionary reference points is considered to be unknown, no precautionary approach reference points are proposed.

Absolute size of this stock still remains uncertain. Nevertheless, as it was already stated, the perception of this stock from the different assessment models analysed gave similar fluctuations in SSB, $\mathrm{Fbar}_{(2\text{-}5)}$ and recruitment.

The state of the stock in earlier part of the time series remains unclear. Therefore the Working Group concluded that no reference points for management purposes should be suggested.

9.14 Harvest Control Rules

No harvest control rules were proposed for sardine by the Study Group on the Precautionary Approach to Fisheries Management (ICES 1998/ACFM:10).

The lack of stability in the assessment model makes difficult to adopt a harvest control rule. Nevertheless, given the similar trends observed in the different models, some form of rule adapted to the most recent assessment could be suggested. Accordingly, to prevent further decrease of the stock in short term, a harvest control rule in which the estimation of the last assessment is observed as relative could be adopted. As it was stated last year, the fishing mortality for this stock should be adapted according to the perception of the stock size.

9.15 Management Considerations

The distribution and abundance of the Iberian sardine stock has changed. Since earlier nineties, the distribution pattern is changing with an overall decrease in the distribution area and a reduction in abundance in the north part and a stable situation in the south. Thus the perception of this stock is heavily dependent of the area. On the other hand, the proportion of younger fish (i.e. age groups 0, 1 and 2) in the catches show a decreasing trend since 1978, being lower than the contribution of the older fish (age groups 3+) from 1993 to 1995. As a consequence, neither the selection pattern nor the overall dynamic of the stock can be properly modelled if stationarity has to be assumed along the time series.

Exploratory analysis performed this year, in which the sensitivity to different options for tuning fleets and for the separable period and selection pattern was studied, resulted in an improvement of the assessment model. Although the precision of the model increased, uncertainties about the true level of the parameters estimated by the model still remain. Nevertheless, the perception of this stock obtained from the different models gave similar trends in recruitment, stock size and fishing mortality.

At present the Spawning Stock Biomass of this stock is considered to be lower, similar to that observed in 1990. The estimated 1998 year class is above the geometric mean of the time series. Because of the high CV (41%) in the estimation of the 1999 year class and given the relative low catches of this age group during 1999 compared with those obtained in 1998, the strength of the 1999 recruitment is unknown. Fishing mortality increased from 1995 to 1998 when reached its highest value since 1980. Nevertheless, fishing mortality shows a sharp decrease last year. Management measures undertaken by both countries Spain and Portugal to reduce the fishing effort (i.e. closure periods, limitation of the fishing days) and the overall catches (daily and/or annual allowable catches per boat or per fisherman organisation) as well as the strength of the 1998 year class contributed to such diminution in the fishing mortality.

The differences in the evolution of the stock abundance in different areas remains a matter of concern. The biological relationship between the different areas is still unclear. This may imply a vulnerability of the fishery at both a local and a global level.. Therefore, close monitoring of this stock is still needed.

9.16 Stock Identification, Composition, Distribution And Migration In Relation To Climatic Effects

Last year, a considerable amount of progress has been made regarding the knowledge of sardine dynamics within the current stock unit. An overall reduction of the distribution area and a shift in the distribution pattern to the southern areas were important changes observed between the 80’s and the 90’s. These changes were accompanied by weak year-classes in the recent years and introduced considerable changes in the fishery distribution and in the fishing pattern along the area. Possible explanations to these changes include changes in upwelling patterns affecting larval survival. Although different perceptions of the stock are apparent from the northern and southern areas, no basis for a change in the assessment unit currently defined was advanced. Furthermore, the need of a better knowledge of the dynamics of the population to the north and south of the current stock was identified. It was also evident that the assessment model currently used is not able to describe properly these temporal and spatial changes.

During 1999, research has continued in several areas to try to answer these questions but the need of an integrated approach was recognised. A proposal for a new Project has been prepared and will be submitted to the EU-Quality of Life Program in October 2000. The main objectives of the project are to describe the stock structure and dynamics of sardine in the Northeast Atlantic in order to propose alternatives for analytical assessment. The study area goes from the French coast to the Spanish Mediterranean and the Morrocan coast. The studies planned include the identification of spawning areas and seasons and description of spawning dynamics, stock identification using complementary techniques (genetics, morphometrics, otolith chemistry, life history properties), direct and indirect evidence of fish movements, links between sardine distribution and abundance with primary and secondary productivity, analysis of possible mechanisms of larval drift and development of appropriate assessment models.

Table 9.2.1 Quarterly distribution of sardine landings (t) by ICES Sub-Division. Above, absolute values; below, relative numbers.

Sub-Div	1st	2nd	3rd	4th	Total
VIIIc-E	2401	1199	1141	2666	**7407**
VIIIc-W	209	1885	986	1375	**4455**
IXa-N	68	1080	1249	167	**2563**
IXa-CN	932	6109	15464	9068	**31574**
IXa-CS	4806	3670	6262	7009	**21747**
IXa-S (A)	2890	5164	5980	4466	**18499**
IXa-S (C)	2458	1312	2158	1917	**7846**
Total	**13764**	**20419**	**33240**	**26668**	**94091**

Sub-Div	1st	2nd	3rd	4th	Total
VIIIc-E	2.55	1.27	1.21	2.83	**7.87**
VIIIc-W	0.22	2.00	1.05	1.46	**4.73**
IXa-N	0.07	1.15	1.33	0.18	**2.72**
IXa-CN	0.99	6.49	16.44	9.64	**33.56**
IXa-CS	5.11	3.90	6.66	7.45	**23.11**
IXa-S (A)	3.07	5.49	6.36	4.75	**19.66**
IXa-S (C)	2.61	1.39	2.29	2.04	**8.34**
Total	**14.63**	**21.70**	**35.33**	**28.34**	

Table 9.2.2: Iberian Sardine Landings (tonnes) by sub-area and total for the period 1940-1998.

Year	Sub-area VIIIc	IXa North	IXa Central North	IXa Central South	IXa South Algarve	IXa South Cadiz	All sub-areas	Div. IXa	Portugal	Spain (excl.Cadiz)	Spain (incl.Cadiz)
1940	66816		42132	33275	23724		**165947**	**99131**	**99131**	**66816**	**66816**
1941	27801		26599	34423	9391		**98214**	**70413**	**70413**	**27801**	**27801**
1942	47208		40969	31957	8739		**128873**	**81665**	**81665**	**47208**	**47208**
1943	46348		85692	31362	15871		**179273**	**132925**	**132925**	**46348**	**46348**
1944	76147		88643	31135	8450		**204375**	**128228**	**128228**	**76147**	**76147**
1945	67998		64313	37289	7426		**177026**	**109028**	**109028**	**67998**	**67998**
1946	32280		68787	26430	12237		**139734**	**107454**	**107454**	**32280**	**32280**
1947	43459	21855	55407	25003	15667		**161391**	**117932**	**96077**	**65314**	**65314**
1948	10945	17320	50288	17060	10674		**106287**	**95342**	**78022**	**28265**	**28265**
1949	11519	19504	37868	12077	8952		**89920**	**78401**	**58897**	**31023**	**31023**
1950	13201	27121	47388	17025	17963		**122698**	**109497**	**82376**	**40322**	**40322**
1951	12713	27959	43906	15056	19269		**118903**	**106190**	**78231**	**40672**	**40672**
1952	7765	30485	40938	22687	25331		**127206**	**119441**	**88956**	**38250**	**38250**
1953	4969	27569	68145	16969	12051		**129703**	**124734**	**97165**	**32538**	**32538**
1954	8836	28816	62467	25736	24084		**149939**	**141103**	**112287**	**37652**	**37652**
1955	6851	30804	55618	15191	21150		**129614**	**122763**	**91959**	**37655**	**37655**
1956	12074	29614	58128	24069	14475		**138360**	**126286**	**96672**	**41688**	**41688**
1957	15624	37170	75896	20231	15010		**163931**	**148307**	**111137**	**52794**	**52794**
1958	29743	41143	92790	33937	12554		**210167**	**180424**	**139281**	**70886**	**70886**
1959	42005	36055	87845	23754	11680		**201339**	**159334**	**123279**	**78060**	**78060**
1960	38244	60713	83331	24384	24062		**230734**	**192490**	**131777**	**98957**	**98957**
1961	51212	59570	96105	22872	16528		**246287**	**195075**	**135505**	**110782**	**110782**
1962	28891	46381	77701	29643	23528		**206144**	**177253**	**130872**	**75272**	**75272**
1963	33796	51979	86859	17595	12397		**202626**	**168830**	**116851**	**85775**	**85775**
1964	36390	40897	108065	27636	22035		**235023**	**198633**	**157736**	**77287**	**77287**
1965	31732	47036	82354	35003	18797		**214922**	**183190**	**136154**	**78768**	**78768**
1966	32196	44154	66929	34153	20855		**198287**	**166091**	**121937**	**76350**	**76350**
1967	23480	45595	64210	31576	16635		**181496**	**158016**	**112421**	**69075**	**69075**
1968	24690	51828	46215	16671	14993		**154397**	**129707**	**77879**	**76518**	**76518**
1969	38254	40732	37782	13852	9350		**139970**	**101716**	**60984**	**78986**	**78986**
1970	28934	32306	37608	12989	14257		**126094**	**97160**	**64854**	**61240**	**61240**
1971	41691	48637	36728	16917	16534		**160507**	**118816**	**70179**	**90328**	**90328**
1972	33800	45275	34889	18007	19200		**151171**	**117371**	**72096**	**79075**	**79075**
1973	44768	18523	46984	27688	19570		**157533**	**112765**	**94242**	**63291**	**63291**
1974	34536	13894	36339	18717	14244		**117730**	**83194**	**69300**	**48430**	**48430**
1975	50260	12236	54819	19295	16714		**153324**	**103064**	**90828**	**62496**	**62496**
1976	51901	10140	43435	16548	12538		**134562**	**82661**	**72521**	**62041**	**62041**
1977	36149	9782	37064	17496	20745		**121236**	**85087**	**75305**	**45931**	**45931**
1978	43522	12915	34246	25974	23333	5619	**145609**	**102087**	**83553**	**56437**	**62056**
1979	18271	43876	39651	27532	24111	3800	**157241**	**138970**	**91294**	**62147**	**65947**
1980	35787	49593	59290	29433	17579	3120	**194802**	**159015**	**106302**	**85380**	**88500**
1981	35550	65330	61150	37054	15048	2384	**216517**	**180967**	**113253**	**100880**	**103264**
1982	31756	71889	45865	38082	16912	2442	**206946**	**175190**	**100859**	**103645**	**106087**
1983	32374	62843	33163	31163	21607	2688	**183837**	**151463**	**85932**	**95217**	**97905**
1984	27970	79606	42798	35032	17280	3319	**206005**	**178035**	**95110**	**107576**	**110895**
1985	25907	66491	61755	31535	18418	4333	**208439**	**182532**	**111709**	**92398**	**96731**
1986	39195	37960	57360	31737	14354	6757	**187363**	**148168**	**103451**	**77155**	**83912**
1987	36377	42234	44806	27795	17613	8870	**177696**	**141319**	**90214**	**78611**	**87481**
1988	40944	24005	52779	27420	13393	2990	**161531**	**120587**	**93591**	**64949**	**67939**
1989	29856	16179	52585	26783	11723	3835	**140961**	**111105**	**91091**	**46035**	**49870**
1990	27500	19253	52212	24723	19238	6503	**149429**	**121929**	**96173**	**46753**	**53256**
1991	20735	14383	44379	26150	22106	4834	**132587**	**111852**	**92635**	**35118**	**39952**
1992	26160	16579	41681	29968	11666	4196	**130250**	**104090**	**83315**	**42739**	**46935**
1993	24486	23905	47284	29995	13160	3664	**142495**	**118009**	**90440**	**48391**	**52055**
1994	22181	16151	49136	30390	14942	3782	**136582**	**114401**	**94468**	**38332**	**42114**
1995	19538	13928	41444	27270	19104	3996	**125280**	**105742**	**87818**	**33466**	**37462**
1996	14423	11251	34761	31117	19880	5304	**116736**	**102313**	**85758**	**25674**	**30978**
1997	15587	12291	34156	25863	21137	6780	**115814**	**100227**	**81156**	**27878**	**34658**
1998	16177	3263	32584	29564	20743	6594	**108924**	**92747**	**82890**	**19440**	**26034**
1999	11862	2563	31574	21747	18499	7846	**94091**	**82229**	**71820**	**14425**	**22271**

Div. IXa = IXa North + IXa Central-North + IXa Central-South + IXa South-Algarve + IXa South-Cadiz

Table 9.3.1.1 Parameter estimates for the 1999 Portuguese and Spanish DEPM surveys.

	Portugal	Spain	Total
Parameters	January 1999	April 1999*	
Egg production (eggs10^{-12})	5.24 (35)	0.34 (44)	
Female weight (g)	44.42 (5)	66.03 (41)	
Sex ratio	0.61 (5)	0.55 (45)	
Batch fecundity	18416 (5)	21800 (12)	
Spawning fraction	0.101 (15)	-	
Spawning biomass (Kt)	**205.1** (39)	**10.4** (77)**	**215.5** (86)

* Adult parameters correspond to the values obtained in Gulf of Biscay region
** Estimated with spawning fraction obtained in 1997

Table 9.3.1.2 Comparison of SSB estimates (CV's within brackets) by survey and for the total area obtained with DEPM.

Year	Portugal	Spain	Total
1988	115.1 (34)	180.2 (50)	295.3 (33)
1997	127.2 (57)	20.7 (84)	147.9 (51)
1999	205.1 (39)	10.4 (77)	215.5 (39)

Table 9.3.2.1.a. Sardine assessment during the Portuguese 1999 Fall Acoustic survey. Number in thousand fish and Biomass in tonnes

AREA			1	2	3	4	5	6	7+	Total
Oc. Norte	**Biomass**	46726	24332	15157	2887	152		68		**89323**
	%	52.31	27.24	16.97	3.23	0.17		0.08		
	Mean Weight	19.5	37.7	49.2	60.7	66.9		72.1		
	No fish	2396691	646062	308149	47588	2279		944		**3401712**
	%	70.46	18.99	9.06	1.40	0.07		0.03		
	Mean Length	13.9	17.3	18.8	20.1	20.8		21.3		
Oc. Sul	**Biomass**	12787	1410	3905	5030	5461	2516	1251		32360
	%	39.51	4.36	12.07	15.54	16.88	7.78	3.87		
	Mean Weight	10.1	39.5	51.4	58.6	65.8	69.5	73.4		
	No fish	1265134	35656	75996	85837	83046	36213	17049		**1598932**
	%	79.12	2.23	4.75	5.37	5.19	2.26	1.07		
	Mean Length	11.1	17.5	19	19.9	20.6	20.9	21.3		
Algarve	**Biomass**	1204	5630	13648	14850	23272	23035	7633	2878	92151
	%	1.31	6.11	14.81	16.11	25.25	25.00	8.28	3.12	
	Mean Weight	34.5	48.5	52.1	57.6	62.2	66.5	70.2	76	
	No fish	34937	116064	261777	257656	373976	346213	108751	37863	1537236
	%	2.27	7.55	17.03	16.76	24.33	22.52	7.07	2.46	
	Mean Length	16.8	18.7	19.2	19.8	20.3	20.7	21.1	21.6	
Cadiz	**Biomass**	3953	20741	9648	10551	10046	1880	1418	232	58468
	%	6.76	35.47	16.50	18.05	17.18	3.22	2.43	0.40	
	Mean Weight	31.1	39.8	44.1	49.7	52.2	64.1	63.4	61.9	
	No fish	127204	521275	218721	212487	192545	29347	22377	3752	1327708
	%	9.58	39.26	16.47	16.00	14.50	2.21	1.69	0.28	
	Mean Length	16.2	17.6	18.1	18.8	19.1	20.4	20.4	20.3	
Portugal	**Biomass**	60747	31449	32811	22886	29018	25621	9098	2878	213834
	%	28.41	14.71	15.34	10.70	13.57	11.98	4.25	1.35	
	Mean Weight	21.4	41.9	50.9	59.0	65.0	45.3	71.9	76.0	
	No fish	3696787	797816.8	645959.8	391121	459342.4	382446.9	126786.6	37863	6537880
	%	56.54	12.20	9.88	5.98	7.03	5.85	1.94	0.58	
	Mean Length	13.9	17.8	19.0	19.9	20.6	13.9	21.2	21.6	
Whole Area	**Biomass**	64731	52230	42503	33487	39116	27565	10579	3172	272302
	%	23.77	19.18	15.61	12.30	14.36	10.12	3.88	1.16	
	Mean Weight	23.8	41.4	49.2	56.7	61.8	50.0	69.8	69.0	
	No fish	3824007	1319109	864699	603627	651907	411814	149184	41635	7865588
	%	48.62	16.77	10.99	7.67	8.29	5.24	1.90	0.53	
	Mean Length	14.7	17.9	18.8	19.5	20.1	19.4	21.0	21.0	

Table 9.3.2.1.b. Sardine assessment during the Portuguese 2000 Spring Acoustic Survey. Number in thousand fish and Biomass in tonnes.

AREA		1	2	3	4	5	6	7+	Total
Oc. Norte	**Biomass**	52427	12754	15442	9625	3510	2646	1299	**97704**
	%	53.66	13.05	15.80	9.85	3.59	2.71	1.33	
	Mean Weight	18.7	42.2	49.4	60.3	65	71	74.4	
	No fish	2802193	302069	312436	159507	54044	37249	17448	**3684945**
	%	76.04	8.20	8.48	4.33	1.47	1.01	0.47	
	Mean Length	13.9	18.1	19.1	20.3	20.8	21.4	21.7	
Oc. Sul	**Biomass**	34833	20844	15365	12362	4831	1452	641	**90328**
	%	38.56	23.08	17.01	13.69	5.35	1.61	0.71	
	Mean Weight	21.6	40.8	53.8	60.1	65.7	74.2	81.2	
	No fish	1611902	511258	285429	205721	73488	19565	7896	**2715259**
	%	59.36	18.83	10.51	7.58	2.71	0.72	0.29	
	Mean Length	14.4	17.9	19.6	20.3	20.9	21.7	22.3	
Algarve	**Biomass**	79	5489	7749	8322	10473	13677	13484	**59272**
	%	0.13	9.26	13.07	14.04	17.67	23.07	22.75	
	Mean Weight	32.8	42.3	49.3	54.1	61.8	63.7	73.2	
	No fish	2407	129778	157150	153772	169467	214544	184210	**1011328**
	%	0.24	12.83	15.54	15.20	16.76	21.21	18.21	
	Mean Length	16.8	18.1	19	19.6	20.5	20.7	21.6	
Cadiz	**Biomass**	17457	48713	22171	12309	13180	3523	5105	**122458**
	%	14.26	39.78	18.10	10.05	10.76	2.88	4.17	
	Mean Weight	8.1	39.7	47.5	51.8	56.1	63.8	66.3	
	No fish	2164952	1226822	466663	237681	234946	55264	77048	**4463375**
	%	48.50	27.49	10.46	5.33	5.26	1.24	1.73	
	Mean Length	9.1	17.8	18.8	19.4	19.9	20.7	20.9	
Portugal	**Biomass**	87339	39087	38556	30309	18814	17775	15424	**247304**
	%	35.32	15.81	15.59	12.26	7.61	7.19	6.24	
	Mean Weight	24.4	41.8	50.8	58.2	64.2	69.6	76.3	
	No fish	4416502	943105	755015	519000	296999	271358	209554	**7411532**
	%	59.59	12.72	10.19	7.00	4.01	3.66	2.83	
	Mean Length	15.0	18.0	19.2	20.1	20.7	21.3	21.9	
Whole	**Biomass**	104796	87800	60727	42618	31994	21298	20529	**369762**
Area	**%**	28.34	23.75	16.42	11.53	8.65	5.76	5.55	
	Mean Weight	20.3	41.3	50.0	56.6	62.2	68.2	73.8	
	No fish	6581454	2169927	1221678	756681	531945	326622	286602	**11874907**
	%	55.42	18.27	10.29	6.37	4.48	2.75	2.41	
	Mean Length	13.6	18.0	19.1	19.9	20.5	21.1	21.6	

Table 9.3.2.1.c. Sardine assessment during the Spanish 2000 Acoustic survey. Number in thousand fish and Biomass in tonnes.

AREA		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
VIIIc-Ee	**Biomass**	2866	8786	7585	4085	2612	648	346	129		**27057**
(>3°30')	**%**	10.6	32.5	28.0	15.1	9.7	2.4	1.3	0.5		
	Mean Weight	45.0	59.3	70.8	79.1	85.1	92.9	101.2	98.9		
	No fish	63307	147507	106827	51469	30598	6956	3420	1305		**411390**
	%	15.4	35.9	26.0	12.5	7.4	1.7	0.8	0.3		
	Mean Length	17.7	19.6	20.9	21.8	22.4	23.1	23.8	23.6		
VIIIc-Ew	**Biomass**	294	6819	11783	7515	7457	1348	201	431	67	**35917**
(<3°30')	**%**	0.8	19.0	32.8	20.9	20.8	3.8	0.6	1.2	0.2	
	Mean Weight	53.6	66.0	74.0	80.4	83.5	91.8	100.6	89.3	100.6	
	No fish	5454	102998	158898	93236	89114	14646	2002	4807	667	**471823**
	%	1.2	21.8	33.7	19.8	18.9	3.1	0.4	1.0	0.1	
	Mean Length	18.9	20.4	21.3	21.9	22.2	23.0	23.8	22.7	23.8	
VIIIc-W	**Biomass**		1435	12726	8069	6089	2114	852	142		**31427**
	%		4.6	40.5	25.7	19.4	6.7	2.7	0.5		
	Mean Weight		78.3	76.7	83.2	88.0	88.0	96.1	106.6		
	No fish		18316	165628	96701	69061	23928	8853	1328		**383815**
	%		4.8	43.2	25.2	18.0	6.2	2.3	0.3		
	Mean Length		21.7	21.5	22.2	22.6	22.6	23.4	24.3		
IXa-N	**Biomass**	878	764	222	50	9	13	8			**1944**
	%	45.2	39.3	11.4	2.6	0.5	0.6	0.4			
	Mean Weight	38.1	44.5	53.7	59.4	84.0	89.3	106.6			
	No fish	22894	16987	4086	843	106	141	71			**45127**
	%	50.7	37.6	9.1	1.9	0.2	0.3	0.2			
	Mean Length	16.7	17.7	18.9	19.6	22.3	22.8	24.3			
Spain	**Biomass**	4038	17805	32316	19719	16167	4123	1407	702	67	**96345**
	%	4.2	18.5	33.5	20.5	16.8	4.3	1.5	0.7	0.1	
	Mean Weight	43.6	61.8	74.0	81.1	85.4	90.0	98.0	93.9	100.6	
	No fish	91656	285808	435440	242249	188879	45671	14346	7440	667	**1312155**
	%	7.0	21.8	33.2	18.5	14.4	3.5	1.1	0.6	0.1	
	Mean Length	17.6	19.9	21.3	22.0	22.4	22.8	23.5	23.2	23.8	

Table 9.4.1.1 Length composition (thousands) by quarter and ICES Sub-Division.

				First Quarter				
Length	**VIIIc-E**	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Total**
7								
7.5								
8								
8.5								
9								
9.5			0					0
10			1					1
10.5	11		3					14
11	11		11	18			389	429
11.5	33		25	66			991	1115
12	57	1	58	144	94		2530	2884
12.5	92	8	67	281	281		4342	5071
13	82	53	32	555	172		8599	9493
13.5	9	120	20	508	187		10425	11269
14	39	293	9	734	313		10216	11604
14.5	80	176	18	871	529	108	8798	10581
15	209	109	32	978	751	331	7067	9478
15.5	157	95	44	935	1366	709	3959	7265
16	320	84	88	1246	2313	1660	2799	8509
16.5	523	59	105	1335	3581	2317	2599	10520
17	539	46	103	708	3522	2801	4632	12351
17.5	722	31	78	1162	4948	3723	4442	15109
18	629	50	63	1888	11590	4526	3969	22714
18.5	741	73	56	2420	13619	6407	2788	26104
19	1045	146	45	2216	20239	8936	2429	35057
19.5	1223	220	59	1293	15116	9580	1870	29362
20	1517	359	51	777	7567	8622	1269	20163
20.5	2340	456	59	661	4921	4060	640	13138
21	4048	433	58	272	3121	1896	183	10011
21.5	3774	290	60	263	1215	1058		6659
22	4664	207	58	116	261	170		5477
22.5	2584	116	35	43	188	26		2993
23	2764	50	20	1				2834
23.5	1287	27		9		20		1341
24	636	15						651
24.5	297	2				2		302
25	123							123
25.5	137	1						138
26	38							38
Total	30733	3521	1260	19500	95895	56953	84938	292800
Mean l	21.2	19.1	17.7	17.5	18.9	19.1	15.4	18.1
sd	2.14	2.98	3.16	2.25	1.43	1.37	2.16	2.65
Catch	**2401**	**209**	**68**	**932**	**4806**	**2890**	**2458**	**13764**

Table 9.4.1.1: Cont'd

Length	VIIIc-E	VIIIc-W	IXa-N	IXa-CN	IXa-CS	IXa-S	IXa-Ca	Total
				Second Quarter				
7								
7.5								
8								
8.5								
9								
9.5								
10	1							1
10.5	1						25	26
11	1						50	51
11.5					224		50	274
12	9			26	559		99	694
12.5	5		54	163	1715		395	2332
13	24		31	419	2151		397	3023
13.5	35		72	892	2925		819	4743
14	156		76	1345	5470		668	7715
14.5	297	9	211	1274	5434		1149	8374
15	523	38	273	1205	6398		2747	11184
15.5	477	25	979	3301	3160		5900	13842
16	775	90	896	5276	2793	2	9632	19464
16.5	798	41	1731	8357	3296	12	8137	22371
17	890	84	1924	12913	3435	916	3781	23943
17.5	818	102	2430	18265	2301	4828	2318	31061
18	699	134	2486	18229	4347	8872	1326	36093
18.5	390	207	2104	13296	6927	10992	655	34570
19	171	307	2147	11525	8523	11180	655	34508
19.5	442	696	1837	8802	6733	11844	255	30609
20	896	978	1323	7016	6533	15244	73	32063
20.5	1857	2491	997	2528	4129	9225		21227
21	2395	2632	597	1484	3317	5089		15514
21.5	2322	3184	297	501	1130	2283		9718
22	2078	3596	131	157	562	565		7089
22.5	1050	3473	55	51	85	211		4926
23	541	1983	31		5	46		2605
23.5	201	964	43		7	97		1312
24	51	435	1		18			505
24.5	94	132						226
25		54			12			67
25.5	0							0
26								
Total	17997	21655	20725	117027	82191	81406	39130	380130
Mean l	20.0	21.8	18.4	18.1	17.5	19.6	16.4	18.4
sd	2.50	1.37	1.68	1.49	2.56	1.10	1.21	2.19
Catch	**1199**	**1885**	**1080**	**6109**	**3670**	**5164**	**1312**	**20419**

Table 9.4.1.1: Cont'd

	Third Quarter							
Length	**VIIIc-E**	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Total**
7								
7.5		6						6
8		6						6
8.5		52						52
9		65						65
9.5		91						91
10		98						98
10.5		176		24			278	478
11		52	199	845			742	1837
11.5		39	247	2959			1761	5006
12		52	366	5206			2873	8497
12.5	61	98	412	5457			2430	8458
13	138	104	577	5664	34		1877	8395
13.5	247	91	278	9361	17		1912	11906
14	144	78	268	8229			2107	10825
14.5	3	98	198	6656	50		4322	11328
15	24	63	281	4795	211		6210	11585
15.5	59	38	296	4212	347		6868	11822
16	35	14	440	5237	407	39	7043	13214
16.5	45	24	555	7094	1222	45	7300	16285
17	186	91	915	10173	1331	238	4276	17211
17.5	315	141	867	16709	2383	1788	3498	25700
18	430	260	1464	25455	4234	6728	3058	41630
18.5	407	340	1890	31377	9508	13121	1252	57895
19	422	546	2296	27813	22595	17391	1561	72623
19.5	276	646	2691	33005	21550	19743	520	78431
20	228	955	2421	27273	17338	18845	173	67233
20.5	618	1563	1996	18171	8196	8277	87	38908
21	1269	1607	1126	8097	3401	3603		19103
21.5	2224	1541	500	2143	760	1135		8302
22	2928	1323	221	400	224	232		5328
22.5	1610	998	154	100	12	31		2905
23	854	519	19		34			1426
23.5	328	160			5			492
24	68	164			5			237
24.5	14	27						41
25	8	19						27
25.5		1						1
26								
Total	12940	12146	20676	266456	93863	91218	60149	557447
Mean l	21.1	20.3	18.5	18.1	19.5	19.6	15.7	18.4
sd	2.29	3.11	2.54	2.46	1.00	0.87	1.97	2.40
Catch	**1141**	**986**	**1249**	**15464**	**6262**	**5980**	**2158**	**33240**

Table 9.4.1.1: Cont'd

	Fourth Quarter							
Length	**VIIIc-E**	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Total**
7								
7.5								
8								
8.5								
9								
9.5			17		66			83
10			86	13	49			148
10.5			233	30	214			476
11		57	774	848	49			1727
11.5		99	812	3412	721			5043
12		311	797	8760	868			10736
12.5		396	469	12381	779			14026
13	107	212	326	11121	1546		22	13335
13.5	124	127	201	9145	709		44	10350
14	215	49	161	10254	1267	47	110	12102
14.5	68	37	125	7984	646	26	619	9505
15	93	29	73	7786	616		993	9591
15.5	81	67	119	8096	702	55	1105	10225
16	260	164	135	7651	1239	204	2222	11876
16.5	265	573	198	7512	2454	253	3131	14386
17	386	693	217	9718	4541	113	5027	20695
17.5	1274	923	171	17342	4765	803	4994	30273
18	2253	846	132	18704	9325	2808	5498	39566
18.5	2319	688	78	21595	14677	6100	3720	49177
19	4385	688	80	13263	19216	11473	4668	53773
19.5	4594	832	113	10454	21207	13869	2758	53827
20	4950	708	125	8055	15404	14840	1544	45625
20.5	4079	1107	95	2741	8334	8868	580	25804
21	3942	1528	64	1678	4113	5762	536	17621
21.5	3422	2526	83	546	1786	2267		10629
22	2235	1827	95	200	833	479		5669
22.5	1081	1894	55	81	254	127		3493
23	710	832	34	12	116	107		1811
23.5	389	598	13	5				1005
24	233	245	1	1				480
24.5	37	70						107
25	42	25						67
25.5	5	6						11
26								
Total	37551	18157	5882	199386	116496	68201	37571	483243
Mean l	20.2	20.2	14.3	16.6	19.0	19.9	18.0	18.1
sd	1.70	2.87	3.37	2.60	1.90	0.98	1.40	2.63
Catch	**2666**	**1375**	**167**	**9068**	**7009**	**4466**	**1917**	**26668**

Table 9.4.1.2

Table 9.4.1 Catch in numbers ('000) at age by quarter and by SubDivision in 1999

	VIIIc-E	VIIIc-W	IXa-N	IXa-CN	IXa-CS	IXa-S	IXa-Ca	Tot
First Quarter								
0								
1	4255	1274	749	8374	8689	3262	61523	88125
2	3728	678	214	4514	23150	11776	12348	56409
3	6779	626	116	6885	39790	9189	3919	67303
4	7868	678	71	1563	15745	15531	4141	45598
5	3789	152	56	806	5788	9795	2078	22465
6	2048	75	27	668	4006	4767	793	12384
7	1756	30	18	121	618	1221	136	3900
8	127		9	19	98	121		374
9	163	4						167
10	219	4		15				
11								
Total	30733	3521	1260	22964	97883	55664	84938	296725
Catch	2401	209	68	932	4806	2890	2458	13764
Second Quarter								
0								
1	5900	920	11055	55464	38011	3054	23990	138395
2	1731	2488	6311	35422	14268	9776	11296	81293
3	3880	5184	2007	31050	15829	14496	2829	75275
4	3872	7448	912	4282	6757	18415	594	42280
5	1372	2971	247	2074	3826	16891	222	27602
6	695	1568	96	1582	3447	14509	183	22080
7	466	858	85		508	4074	15	6006
8	18		14		126	196		355
9	36	109				196		341
10	26	109						
11								
Total	17997	21655	20725	129874	82773	81607	39130	393627
Catch	1199	1885	1080	6109	3670	5164	1312	20419
Third Quarter								
0	1347	1802	5448	52662	782		44933	106973.837
1	2527	3730	8475	90361	12770	3998	6818	128679
2	2249	1938	4021	58793	27477	16249	3833	114560
3	2597	2079	1888	61625	35533	13320	2711	119752
4	2079	1345	655	11306	10892	22485	930	49693
5	1123	624	144	1732	4032	25359	737	33751
6	870	493		1419	2344	6592	172	11891
7	147	134	44		57	1099	8	1490
8						508	5	514
9								
10								
11								
Total	12940	12146	20676	277897	93887	89610	60149	567304
Catch	1141	986	1249	15464	6262	5980	2158	33240
Fourth Quarter								
0	3556	4667	4713	104449	11076	690	9891	139042.323
1	19029	4154	627	64371	18981	5114	7751	120027
2	5685	2338	279	47984	26898	15256	10806	109247
3	4491	2611	145	15566	35508	14221	4820	77361
4	2624	2339	73	1494	12233	18195	2643	39599
5	1022	1061	14	148	6380	12005	1070	21699
6	904	743		156	2958	5141	559	10462
7	240	243	33		800	608	32	1956
8					102	147		249
9								
10								
11								
Total	37551	18157	5882	234169	114935	71378	37571	519642
Catch	2666	1375	167	9068	7009	4466	1917	26668
Whole Year								
0	4903	6469	10162	157111	11857	690	54824	246016
1	31712	10078	20906	218570	78450	15428	100082	475225
2	13394	7442	10824	146713	91794	53058	38283	361509
3	17748	10500	4156	115125	126660	51225	14278	339691
4	16442	11810	1712	18646	45628	74626	8308	177170
5	7306	4809	461	4759	20026	64050	4107	105518
6	4519	2880	122	3824	12755	31010	1707	56817
7	2608	1266	179	121	1982	7002	192	13351
8	145		23	19	326	973	5	1492
9	199	113				196		508
10	245	113		15				
11								
Total	99220	55478	48544	664905	389478	298259	221786	1777297
Catch	7407	4455	2563	31574	21747	18499	7846	94091

Table 9.4.1.3: Relative distribution of sardine catches. Upper pannel, relative contribution of each age group within each Sul
Lower pannel, relative contribution of each Sub-Division within each Age Group.

Age	VIIIc-E	VIIIc-W	IXa-N	IXa-CN	IXa-CS	IXa-S	IXa-Ca	Tot
0	4.94	11.66	20.93	23.63	3.04	0.23	24.72	13.84
1	**31.96**	18.17	**43.07**	**32.87**	20.14	5.17	**45.13**	**26.74**
2	13.50	13.42	22.30	22.07	23.57	17.79	17.26	20.34
3	17.89	18.93	8.56	17.31	**32.52**	17.17	6.44	19.11
4	16.57	**21.29**	3.53	2.80	11.72	**25.02**	3.75	9.97
5	7.36	8.67	0.95	0.72	5.14	21.47	1.85	5.94
6+	7.78	7.88	0.67	0.60	3.87	13.14	0.86	4.06

Age	VIIIc-E	VIIIc-W	IXa-N	IXa-CN	IXa-CS	IXa-S	IXa-Ca
0	1.99	2.63	4.13	**63.86**	4.82	0.28	22.28
1	6.67	2.12	4.40	**45.99**	16.51	3.25	21.06
2	3.70	2.06	2.99	**40.58**	25.39	14.68	10.59
3	5.22	3.09	1.22	33.89	**37.29**	15.08	4.20
4	9.28	6.67	0.97	10.52	25.75	**42.12**	4.69
5	6.92	4.56	0.44	4.51	18.98	**60.70**	3.89
6+	10.69	6.06	0.45	5.51	20.87	**54.29**	2.64

Table 9.4.2.1: Mean length at age by quarter and ICES Sub-Division

	First Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0								
1	17.1	15.6	15.6	15.2	16.2	16.4	14.2	14.8
2	20.3	20.2	19.6	17.5	18.1	17.8	17.5	18.0
3	21.3	21.1	20.8	19.0	19.2	19.0	18.6	19.3
4	22.0	21.5	21.4	19.9	19.9	19.6	19.3	20.1
5	22.7	22.1	22.0	20.3	20.5	20.1	19.8	20.7
6	22.8	22.2	22.5	21.0	20.9	20.4	20.1	21.0
7	23.3	23.2	22.2	21.4	21.1	20.9	19.7	22.0
8	23.9		22.8	20.3	21.7	22.2		22.6
9	23.6	24.3						23.6
10	24.3	24.3		22.3				
11								
Total	21.2	19.1	17.7	17.5	18.9	19.1	15.4	18.1

	Second Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0								
1	16.8	18.0	17.2	17.0	15.1	18.0	15.8	16.3
2	20.6	20.4	19.3	18.2	18.6	18.5	16.8	18.3
3	21.3	21.7	20.0	19.4	19.6	18.7	17.9	19.5
4	21.7	22.0	20.3	20.3	20.1	19.7	19.1	20.4
5	22.4	22.6	21.9	20.3	20.8	20.3	19.4	20.8
6	22.3	22.9	22.0	21.0	20.9	20.4	19.5	20.8
7	22.6	23.5	22.0		22.1	20.8	20.0	21.4
8	23.8		22.8		21.8	21.3		21.6
9	23.7	24.3				21.3		22.5
10	24.5	24.3						
11								
Total	20.0	21.8	18.4	18.1	17.5	19.6	16.4	18.4

	Third Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	15.7	14.1	15.1	13.7	15.6		14.9	14.4
1	19.9	20.2	19.2	17.9	18.2	18.3	17.1	18.1
2	21.8	21.5	20.3	19.2	19.4	19.0	18.2	19.3
3	22.1	21.7	20.6	20.2	19.8	19.1	18.3	20.0
4	22.4	22.4	20.9	20.9	20.1	19.9	19.2	20.4
5	22.6	22.8	21.4	20.9	20.6	20.1	19.5	20.3
6	22.5	22.4		20.5	20.8	20.2	19.6	20.6
7	23.2	23.7	22.3		22.1	20.8	20.4	21.4
8						20.8	20.8	20.8
9								
10								
11								
Total	21.1	20.3	18.5	18.1	19.5	19.6	15.7	18.4

	Fourth Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	17.1	16.2	12.9	14.0	14.4	16.9	16.4	14.4
1	19.7	20.1	18.8	18.0	18.2	18.6	17.8	18.4
2	21.1	21.7	20.8	18.9	19.1	19.3	18.5	19.1
3	21.5	21.9	21.4	20.1	19.8	19.9	18.9	20.0
4	22.1	22.6	21.6	21.0	20.3	20.2	19.9	20.5
5	22.7	22.9	21.6	21.5	20.4	20.6	20.2	20.8
6	22.4	22.6		21.5	21.0	20.8	20.3	21.1
7	23.9	23.8	22.9		21.0	21.1	20.3	21.8
8					20.8	21.8		21.4
9								
10								
11								
Total	20.2	20.2	14.3	16.6	19.0	19.9	18.0	18.0

	Whole Year							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	16.7	15.6	14.1	13.9	14	17	15.2	14.4
1	18.8	19.4	18.0	17.6	16.5	18.0	15.1	17.0
2	20.9	21.1	19.7	18.8	18.8	18.7	17.7	18.8
3	21.5	21.7	20.3	19.9	19.6	19.2	18.5	19.7
4	22.0	22.2	20.7	20.7	20.1	19.9	19.4	20.3
5	22.6	22.7	21.7	20.6	20.6	20.3	19.8	20.6
6	22.6	22.7	22.1	20.8	20.9	20.4	20.0	20.8
7	23.3	23.6	22.3	21.4	21.3	20.8	19.9	21.7
8	23.9		22.8	20.3	21.4	21.2	20.8	21.5
9	23.6	24.3				21.3		22.8
10	24.3	24.3		22.3				
11								
Total	20.6	20.8	17.9	17.5	18.8	19.6	16.1	18.3

Table 9.4.2.2: Mean weight at age by quarter and ICES Sub-Division

	First Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0								
1	0.040	0.030	0.031	0.026	0.030	0.033	0.022	0.025
2	0.067	0.066	0.060	0.039	0.042	0.042	0.042	0.044
3	0.078	0.075	0.073	0.050	0.050	0.050	0.051	0.053
4	0.087	0.080	0.080	0.057	0.057	0.055	0.057	0.062
5	0.095	0.088	0.086	0.062	0.062	0.060	0.061	0.067
6	0.097	0.089	0.092	0.067	0.066	0.062	0.065	0.070
7	0.104	0.102	0.088	0.072	0.068	0.067	0.061	0.084
8	0.112		0.095	0.060	0.074	0.080		0.089
9	0.107	0.116						0.107
10	0.118	0.116		0.080				
11								
Total	0.079	0.059	0.048	0.041	0.049	0.052	0.030	0.047

	Second Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0								
1	0.039	0.049	0.042	0.039	0.027	0.049	0.033	0.035
2	0.073	0.071	0.059	0.047	0.050	0.053	0.039	0.049
3	0.080	0.085	0.067	0.057	0.059	0.055	0.047	0.060
4	0.085	0.089	0.070	0.066	0.064	0.063	0.058	0.070
5	0.093	0.097	0.087	0.066	0.070	0.070	0.060	0.074
6	0.093	0.100	0.089	0.074	0.072	0.070	0.061	0.073
7	0.097	0.109	0.089		0.085	0.074	0.066	0.082
8	0.112		0.098		0.081	0.079		0.082
9	0.112	0.119				0.079		0.095
10	0.122	0.119						
11								
Total	0.069	0.087	0.052	0.047	0.044	0.063	0.036	0.052

	Third Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0.036	0.028	0.032	0.023	0.033		0.030	0.027
1	0.073	0.076	0.064	0.052	0.054	0.054	0.045	0.054
2	0.095	0.091	0.076	0.064	0.065	0.060	0.054	0.065
3	0.099	0.095	0.080	0.075	0.070	0.061	0.055	0.072
4	0.104	0.105	0.084	0.082	0.073	0.069	0.064	0.076
5	0.107	0.110	0.090	0.083	0.078	0.071	0.067	0.074
6	0.106	0.105		0.078	0.081	0.073	0.068	0.079
7	0.116	0.125	0.102		0.098	0.079	0.077	0.088
8						0.078	0.082	0.078
9								
10								
11								
Total	0.089	0.081	0.061	0.056	0.067	0.067	0.035	0.059

	Fourth Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0.043	0.038	0.019	0.021	0.027	0.040	0.037	0.024
1	0.066	0.071	0.058	0.047	0.052	0.052	0.048	0.052
2	0.082	0.089	0.079	0.056	0.061	0.057	0.055	0.059
3	0.087	0.092	0.086	0.068	0.068	0.062	0.058	0.068
4	0.094	0.102	0.088	0.080	0.073	0.065	0.068	0.072
5	0.102	0.105	0.087	0.086	0.075	0.069	0.071	0.074
6	0.098	0.102		0.086	0.081	0.070	0.072	0.078
7	0.121	0.119	0.105		0.081	0.073	0.072	0.089
8					0.078	0.080		0.079
9								
10								
11								
Total	0.073	0.076	0.029	0.039	0.061	0.063	0.051	0.051

	Whole Year							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0.041	0.035	0.026	0.022	0.028	0.040	0.031	0.025
1	0.058	0.065	0.051	0.046	0.038	0.048	0.028	0.042
2	0.079	0.081	0.066	0.057	0.055	0.054	0.046	0.056
3	0.084	0.088	0.073	0.067	0.062	0.058	0.053	0.065
4	0.090	0.093	0.077	0.076	0.066	0.064	0.061	0.070
5	0.098	0.100	0.088	0.072	0.071	0.069	0.065	0.073
6	0.098	0.101	0.090	0.075	0.074	0.069	0.067	0.075
7	0.105	0.112	0.095	0.072	0.079	0.074	0.064	0.084
8	0.112		0.097	0.060	0.078	0.079	0.082	0.082
9	0.108	0.119				0.079		0.099
10	0.118	0.119		0.080				
11								
Total	0.076	0.080	0.053	0.047	0.056	0.062	0.036	0.053

Table 9.7.1.1: Input values and main results on the stock perception for the different models explored

	Year range	Age Range	Sep constraint	Ref. Age	Sel. Pattern	SSB index	AS indices	Index weights	Age weights
Test Model **(RUN 1)**	1978-1999	0-6+	14 years 1986-1999	3	1986-90; 1991-99	DEPM, absolute	Sp. March (86-88;90-93;96-00) Pt March, incl. Cadiz (96-99) Pt Fall (84-87; 92; 97-99)	Equal weights	0.5 for Age 0 1 for 1+

		SSB index	AS indices	COMMENTS
TUNING EFFECT	**RUN-2**		Sp. March (86-88;90-93;96-00)	SSB higher in 80's, Fbar, higher in 90's,lower in 80's
	RUN-3	DEPM, absolute		SSB lower in 90's; Fbar higher, specially since 96
	RUN-4		Pt Fall (84-87; 92; 97-99)	SSB higher in 90's, lower in 80's; Fbar lower in 90's, higher in 80's
	RUN-5	DEPM, absolute	All, Sp. March with power model	SSB lower in 80's; Fbar higher in 80's, peak in 1990
	RUN-6	DEPM, linear model	All	SSB scaled upward, Fbar scale downward
	RUN-7	DEPM, absolute	Without Pt March	No noticeable effects

		SEP. CONSTRAINT	SELECTION PATTERN	COMMENTS
Sep. Const. and Sel. Pattern	**RUN-8**	1987-1999	1987-1991; 1992-1999	Small changes in SSB, Fbar diferent for 1991. Shift in residual
	RUN-9	1987-1999	1987-1993; 1994-1999	SSB lower mid 90's, Fbar lower mid 90's. No shift in residuals

Table 9.7.2.1a: Input values for the assessment model.

Output Generated by ICA Version 1.4

Sardine VIIIc+IXa

Catch in Number

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	869.4	674.5	856.7	1026.0	62.0	1070.0	118.0	268.0
1	2296.6	1535.6	2037.4	1934.8	795.0	577.0	3312.0	564.0
2	946.7	956.1	1562.0	1733.7	1869.0	857.0	487.0	2371.0
3	295.4	431.5	378.8	679.0	709.0	803.0	502.0	469.0
4	136.7	189.1	156.9	195.3	353.0	324.0	301.0	294.0
5	41.7	93.2	47.3	104.5	131.0	141.0	179.0	201.0
6	16.5	36.0	30.0	76.5	129.0	139.0	117.0	103.0

x 10 ^ 6

Catch in Number

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	304.0	1437.0	521.0	248.0	258.0	1580.6	498.3	87.8
1	755.0	543.0	990.0	566.0	602.0	477.4	1001.9	566.2
2	1027.0	667.0	535.0	909.0	517.0	436.1	451.4	1081.8
3	919.0	569.0	439.0	389.0	707.0	406.9	340.3	521.5
4	333.0	535.0	304.0	221.0	295.0	265.8	186.2	257.2
5	196.0	154.0	292.0	200.0	151.0	74.7	110.9	113.9
6	167.0	171.0	189.0	245.0	248.0	105.2	80.6	120.3

x 10 ^ 6

Catch in Number

AGE	1994	1995	1996	1997	1998	1999
0	120.8	30.5	277.1	208.6	449.1	246.0
1	60.2	189.1	101.3	548.6	366.2	475.2
2	542.2	280.7	347.7	453.3	501.6	361.5
3	1094.4	829.7	514.7	391.1	352.5	339.7
4	272.5	472.9	652.7	337.3	233.7	177.2
5	112.6	70.2	197.2	225.2	178.7	105.5
6	72.1	64.5	46.6	70.3	105.9	72.2

x 10 ^ 6

Weights at age in the catches (Kg)

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	0.01700	0.01700	0.01700	0.01700	0.01700	0.01700	0.01700	0.01700
1	0.03400	0.03400	0.03400	0.03400	0.03400	0.03400	0.03400	0.03400
2	0.05200	0.05200	0.05200	0.05200	0.05200	0.05200	0.05200	0.05200
3	0.06000	0.06000	0.06000	0.06000	0.06000	0.06000	0.06000	0.06000
4	0.06800	0.06800	0.06800	0.06800	0.06800	0.06800	0.06800	0.06800
5	0.07200	0.07200	0.07200	0.07200	0.07200	0.07200	0.07200	0.07200
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Table 9.7.2.1a (cont): Input values for the assessment model.

Weights at age in the catches (Kg)

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.01700	0.01700	0.01700	0.01300	0.02400	0.02000	0.01800	0.01700
1	0.03400	0.03400	0.03400	0.03500	0.03200	0.03100	0.04500	0.03700
2	0.05200	0.05200	0.05200	0.05200	0.04700	0.05800	0.05500	0.05100
3	0.06000	0.06000	0.06000	0.05900	0.05700	0.06300	0.06600	0.05800
4	0.06800	0.06800	0.06800	0.06600	0.06100	0.07300	0.07000	0.06600
5	0.07200	0.07200	0.07200	0.07100	0.06700	0.07400	0.07900	0.07100
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the catches (Kg)

AGE	1994	1995	1996	1997	1998	1999
0	0.02000	0.02500	0.01900	0.02200	0.02400	0.02500
1	0.03600	0.04700	0.03800	0.03300	0.04000	0.04200
2	0.05800	0.05900	0.05100	0.05200	0.05500	0.05600
3	0.06200	0.06600	0.05800	0.06200	0.06100	0.06500
4	0.07000	0.07100	0.06100	0.06900	0.06400	0.07000
5	0.07600	0.08200	0.07100	0.07300	0.06700	0.07300
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the stock (Kg)

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500
2	0.03800	0.03800	0.03800	0.03800	0.03800	0.03800	0.03800	0.03800
3	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000
4	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400
5	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the stock (Kg)

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.01500	0.01500	0.01500	0.01500	0.01500	0.01900	0.02700	0.02200
2	0.03800	0.03800	0.03800	0.03800	0.03800	0.04200	0.03600	0.04500
3	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05700
4	0.06400	0.06400	0.06400	0.06400	0.06400	0.06400	0.06200	0.06400
5	0.06700	0.06700	0.06700	0.06700	0.06700	0.07100	0.06900	0.07300
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Table 9.7.2.1a (cont): Input values for the assessment model.

Weights at age in the stock (Kg)

AGE	1994	1995	1996	1997	1998	1999
0	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.03100	0.02900	0.03600	0.02500	0.02300	0.02000
2	0.04000	0.05000	0.04700	0.05000	0.04100	0.03900
3	0.04900	0.06200	0.06100	0.05800	0.05300	0.05400
4	0.06000	0.07200	0.06900	0.06800	0.06100	0.06200
5	0.06700	0.07900	0.07500	0.07400	0.06700	0.06800
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Natural Mortality (per year)

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
1	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
2	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
3	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
4	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
5	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
6	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000

Natural Mortality (per year)

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
1	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
2	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
3	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
4	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
5	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
6	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000

Natural Mortality (per year)

AGE	1994	1995	1996	1997	1998	1999
0	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
1	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
2	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
3	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
4	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
5	0.33000	0.33000	0.33000	0.33000	0.33000	0.33000
6	0.33000	0.33000	0.33000	0.33000	0.33000	0.30000

Table 9.7.2.1a (cont): Input values for the assessment model.

Proportion of fish spawning

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.6500	0.6500	0.6500	0.6500	0.6500	0.6500	0.6500	0.6500
2	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Proportion of fish spawning

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.6500	0.6500	0.6500	0.2300	0.6000	0.7400	0.7900	0.4700
2	0.9500	0.9500	0.9500	0.8300	0.8100	0.9100	0.9100	0.9300
3	1.0000	1.0000	1.0000	0.9100	0.8800	0.9600	0.9500	0.9400
4	1.0000	1.0000	1.0000	0.9200	0.8900	0.9700	0.9800	0.9700
5	1.0000	1.0000	1.0000	0.9400	0.9400	1.0000	1.0000	0.9900
6	1.0000	1.0000	1.0000	0.9770	0.9870	1.0000	1.0000	1.0000

Proportion of fish spawning

AGE	1994	1995	1996	1997	1998	1999
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.8000	0.7300	0.8300	0.7270	0.7200	0.6190
2	0.8900	0.9800	0.8900	0.9180	0.9240	0.9110
3	0.9600	0.9700	0.9200	0.9500	0.9560	0.9870
4	0.9600	0.9900	0.9600	0.9720	0.9870	0.9950
5	0.9700	1.0000	1.0000	0.9930	0.9950	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

INDICES OF SPAWNING BIOMASS

INDEX1

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

x 10 ^ 3

INDEX1

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	147.90

x 10 ^ 3

Table 9.7.2.1a (cont): Input values for the assessment model

INDEX1

	1998	1999
1	*******	215.50

x 10 ^ 3

AGE-STRUCTURED INDICES

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

AGE	1986	1987	1988	1989	1990	1991	1992	1993
1	55.1	632.0	224.1	*******	69.1	25.4	168.0	238.6
2	20.6	256.5	63.8	*******	56.0	208.1	77.5	427.3
3	1040.7	27.4	73.6	*******	272.9	163.7	88.4	135.9
4	215.3	2390.4	64.2	*******	53.3	401.0	31.0	126.1
5	408.8	586.2	848.3	*******	87.5	62.4	116.9	145.8
6	571.7	1259.1	885.7	*******	582.3	574.3	122.8	1117.9

x 10 ^ 3

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

AGE	1994	1995	1996	1997	1998	1999	2000
1	*******	*******	10.6	56.5	509.8	214.5	91.7
2	*******	*******	54.2	263.1	103.1	160.4	285.8
3	*******	*******	90.5	125.7	80.4	134.6	435.4
4	*******	*******	350.8	123.3	33.8	124.3	242.2
5	*******	*******	213.8	65.7	20.6	28.4	188.9
6	*******	*******	24.8	61.0	25.4	64.0	68.1

x 10 ^ 3

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CAD

AGE	1996	1997	1998	1999	2000
1	1625.0	6344.1	1636.2	5711.7	6581.5
2	2082.2	3238.1	4015.0	2552.6	2169.9
3	2414.5	1551.8	2190.9	1460.7	1221.7
4	2906.0	1260.2	1434.0	844.4	756.7
5	386.5	1360.1	1185.0	595.7	531.9
6	12.0	202.8	980.0	469.1	613.2

x 10 ^ 6

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

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

x 10 ^ 6

Table 9.7.2.1a (cont): Input values for the assessment model.

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	6349.1	*******	*******	*******	*******	2424.7	8680.4	3696.8
1	5480.5	*******	*******	*******	*******	1961.2	1809.4	798.0
2	1157.1	*******	*******	*******	*******	906.4	1214.6	646.0
3	1002.6	*******	*******	*******	*******	728.9	823.3	391.1
4	437.4	*******	*******	*******	*******	1040.6	396.2	459.3
5	108.2	*******	*******	*******	*******	771.8	367.1	382.4
6	18.8	*******	*******	*******	*******	322.4	220.4	164.6

x 10 ^ 6

Table 9.7.2.1.b: Ouput values from the assessment model.

Fishing Mortality (per year)

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	0.07728	0.05314	0.06273	0.11495	0.00832	0.05312	0.01537	0.04080
1	0.45261	0.21893	0.25880	0.22625	0.14065	0.11413	0.26593	0.10838
2	0.45111	0.40334	0.42218	0.42774	0.41461	0.25584	0.15290	0.36037
3	0.46137	0.44848	0.32074	0.38266	0.36266	0.36735	0.27108	0.24940
4	0.37770	0.73055	0.33849	0.31640	0.41076	0.32593	0.26410	0.29238
5	0.64843	0.56748	0.47325	0.46525	0.42498	0.33244	0.35084	0.32886
6	0.64843	0.56748	0.47325	0.46525	0.42498	0.33244	0.35084	0.32886

Fishing Mortality (per year)

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.05358	0.06651	0.06630	0.06694	0.07282	0.05673	0.05053	0.04930
1	0.17744	0.14612	0.14566	0.14706	0.15997	0.12463	0.11101	0.10830
2	0.33983	0.25269	0.25190	0.25431	0.27665	0.21553	0.19198	0.18729
3	0.26723	0.36269	0.36155	0.36502	0.39708	0.30936	0.27556	0.26883
4	0.32732	0.37901	0.37781	0.38144	0.41494	0.32328	0.28795	0.28092
5	0.37716	0.36269	0.36155	0.36502	0.39708	0.30936	0.27556	0.26883
6	0.37716	0.36269	0.36155	0.36502	0.39708	0.30936	0.27556	0.26883

Fishing Mortality (per year)

AGE	1994	1995	1996	1997	1998	1999
0	0.02170	0.02062	0.02960	0.03437	0.03555	0.02641
1	0.04545	0.04319	0.06201	0.07200	0.07446	0.05533
2	0.12983	0.12338	0.17714	0.20569	0.21273	0.15805
3	0.26597	0.25276	0.36289	0.42137	0.43580	0.32379
4	0.33012	0.31373	0.45041	0.52300	0.54091	0.40188
5	0.26597	0.25276	0.36289	0.42137	0.43580	0.32379
6	0.26597	0.25276	0.36289	0.42137	0.43580	0.32379

Population Abundance (1 January)

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	13696.	15279.	16513.	11058.	8782.	24249.	9079.	7861.
1	7316.	9114.	10416.	11149.	7087.	6261.	16532.	6428.
2	3024.	3345.	5264.	5781.	6393.	4426.	4016.	9110.
3	927.	1385.	1607.	2481.	2710.	3036.	2464.	2478.
4	505.	420.	636.	838.	1217.	1355.	1512.	1351.
5	101.	249.	145.	326.	439.	580.	703.	835.
6	40.	96.	92.	238.	432.	572.	460.	428.

x 10 ^ 6

Table 9.7.2.1b (cont): Ouput values from the assessment model.

Population Abundance (1 January)

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	6831.	11604.	7171.	7201.	6741.	15880.	12052.	5323.
1	5425.	4655.	7806.	4825.	4842.	4506.	10787.	8238.
2	4146.	3266.	2892.	4851.	2994.	2966.	2860.	6940.
3	4568.	2122.	1824.	1616.	2704.	1632.	1719.	1697.
4	1388.	2514.	1062.	913.	806.	1307.	861.	938.
5	725.	719.	1237.	523.	448.	383.	680.	464.
6	618.	653.	724.	931.	879.	460.	390.	595.

x 10 ^ 6

Population Abundance (1 January)

AGE	1994	1995	1996	1997	1998	1999	2000
0	5492.	4233.	7170.	7289.	12383.	10421.	8714.
1	3642.	3863.	2981.	5004.	5063.	8591.	7296.
2	5314.	2502.	2660.	2014.	3348.	3379.	5844.
3	4137.	3355.	1590.	1602.	1179.	1946.	2074.
4	932.	2280.	1874.	795.	756.	548.	1012.
5	509.	482.	1198.	858.	339.	316.	264.
6	360.	337.	178.	237.	348.	300.	325.

x 10 ^ 6

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 2- 5	SoP (%)
1978	13696210	314031	227020	145609	0.6414	0.4847	83
1979	15279370	386221	282170	157241	0.5573	0.5375	96
1980	16512580	496260	369887	194802	0.5267	0.3887	95
1981	11057950	610270	462565	216517	0.4681	0.3980	89
1982	8781680	635223	500969	206946	0.4131	0.4033	96
1983	24249390	596704	482201	183837	0.3812	0.3204	104
1984	9079300	713617	542075	206005	0.3800	0.2597	95
1985	7860890	751590	606911	208440	0.3434	0.3077	94
1986	6831300	666490	545965	187363	0.3432	0.3279	97
1987	11604270	574469	469240	177695	0.3787	0.3393	100
1988	7171390	541402	428614	161530	0.3769	0.3382	102
1989	7200580	524140	363683	140962	0.3876	0.3414	96
1990	6741300	491178	357095	149430	0.4185	0.3714	104
1991	15879750	448676	358115	132587	0.3702	0.2894	99
1992	12052280	619464	481746	130249	0.2704	0.2578	99
1993	5322550	743659	545570	142495	0.2612	0.2515	98
1994	5491650	654256	528695	136581	0.2583	0.2480	98
1995	4232910	681058	564793	125280	0.2218	0.2357	98
1996	7170140	566235	452914	116736	0.2577	0.3383	101
1997	7289440	460062	356030	115814	0.3253	0.3929	98
1998	12382800	419781	324417	108925	0.3358	0.4063	97
1999	10420760	494127	366815	94091	0.2565	0.3019	98

No of years for separable analysis : 13
Age range in the analysis : 0 . . . 6
Year range in the analysis : 1978 . . . 1999
Number of indices of SSB : 1
Number of age-structured indices : 3

Parameters to estimate : 58
Number of observations : 239

Two selection vectors to be fitted.
Selection assumed constant up to and including : 1993
Abrupt change in selection specified.

Table 9.7.2.1b (cont): Ouput values from the assessment model.

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1987	0.3627	22	0.2355	0.5585	0.2910	0.4520	0.3716
2	1988	0.3615	22	0.2317	0.5642	0.2881	0.4537	0.3710
3	1989	0.3650	23	0.2310	0.5769	0.2890	0.4610	0.3751
4	1990	0.3971	22	0.2534	0.6222	0.3158	0.4993	0.4076
5	1991	0.3094	22	0.1974	0.4848	0.2460	0.3890	0.3176
6	1992	0.2756	22	0.1784	0.4257	0.2207	0.3440	0.2824
7	1993	0.2688	22	0.1736	0.4162	0.2151	0.3360	0.2756
8	1994	0.2660	24	0.1658	0.4266	0.2090	0.3385	0.2738
9	1995	0.2528	23	0.1602	0.3989	0.2003	0.3190	0.2597
10	1996	0.3629	22	0.2353	0.5597	0.2909	0.4527	0.3719
11	1997	0.4214	21	0.2774	0.6401	0.3404	0.5216	0.4311
12	1998	0.4358	21	0.2839	0.6690	0.3502	0.5423	0.4463
13	1999	0.3238	23	0.2057	0.5096	0.2569	0.4081	0.3326
Separable Model: Selection (S1) by age 1987 1993								
14	0	0.1834	23	0.1147	0.2932	0.1443	0.2330	0.1887
15	1	0.4029	19	0.2749	0.5904	0.3315	0.4896	0.4106
16	2	0.6967	18	0.4848	1.0012	0.5790	0.8383	0.7087
	3	1.0000		Fixed : Reference Age				
17	4	1.0450	16	0.7627	1.4317	0.8899	1.2271	1.0586
	5	1.0000		Fixed : Last true age				
Separable Model: Selection (S2) by age from 1994 to 1999								
18	0	0.0816	27	0.0472	0.1411	0.0617	0.1079	0.0848
19	1	0.1709	22	0.1104	0.2644	0.1368	0.2135	0.1752
20	2	0.4881	20	0.3255	0.7320	0.3970	0.6002	0.4987
	3	1.0000		Fixed : Reference Age				
21	4	1.2412	17	0.8837	1.7432	1.0437	1.4760	1.2600
	5	1.0000		Fixed : Last true age				
Separable model: Populations in year 1999								
22	0	10420764	41	4598139	23616580	6864599	15819180	11369352
23	1	8591389	27	5054494	14603236	6554199	11261782	8911899
24	2	3379036	21	2203172	5182476	2716597	4203010	3460449
25	3	1945652	19	1324796	2857469	1599204	2367154	1983421
26	4	548142	20	364601	824078	445193	674897	560132
27	5	316296	24	194746	513709	246963	405093	326128
Separable model: Populations at age								
28	1987	719348	34	363332	1424210	507685	1019256	764380
29	1988	1237060	28	709980	2155435	931876	1642190	1287709
30	1989	523047	28	301975	905963	395204	692246	543999
31	1990	448420	26	267220	752491	344337	583966	464336
32	1991	382876	25	230935	634785	295825	495545	395828
33	1992	680134	24	420403	1100331	532106	869342	700933
34	1993	464300	24	289700	744132	364992	590629	477942
35	1994	509278	23	318316	814800	400704	647270	524129
36	1995	481849	25	293937	789891	374449	620054	497416
37	1996	1197589	25	728727	1968117	929469	1543053	1236679
38	1997	858487	24	531454	1386764	672163	1096461	884572
39	1998	338895	24	209804	547415	265347	432829	349191

SSB Index catchabilities
INDEX1
Absolute estimator. No fitted catchability.

Age-structured index catchabilities
FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

Linear model fitted. Slopes at age :

40	1	Q	.2050E-01	26	.1592E-01	.4472E-01	.2050E-01	.3472E-01	.2762E-01
41	2	Q	.3947E-01	26	.3070E-01	.8565E-01	.3947E-01	.6662E-01	.5307E-01
42	3	Q	.8377E-01	26	.6494E-01	.1836	.8377E-01	.1423	.1131
43	4	Q	.1641	27	.1256	.3735	.1641	.2860	.2251
44	5	Q	.2716	29	.2040	.6563	.2716	.4930	.3825
45	6	Q	.5451	28	.4157	1.258	.5451	.9590	.7524

Table 9.7.2.1b (cont): Ouput values from the assessment model.

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CAD

Linear model fitted. Slopes at age :

46	1	Q	726.6	41	486.4	2504.	726.6	1676.	1204.
47	2	Q	937.7	40	634.1	3132.	937.7	2118.	1531.
48	3	Q	1204.	40	814.5	4018.	1204.	2718.	1965.
49	4	Q	1654.	41	1107.	5697.	1654.	3814.	2741.
50	5	Q	1700.	44	1112.	6306.	1700.	4122.	2920.
51	6	Q	997.7	42	662.1	3533.	997.7	2344.	1676.

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Linear model fitted. Slopes at age :

52	0	Q	542.4	34	390.2	1496.	542.4	1077.	810.4
53	1	Q	515.0	33	372.0	1404.	515.0	1014.	765.4
54	2	Q	623.6	33	450.5	1699.	623.6	1228.	926.5
55	3	Q	712.9	34	513.2	1964.	712.9	1414.	1064.
56	4	Q	985.9	34	704.7	2777.	985.9	1985.	1487.
57	5	Q	669.7	35	474.0	1943.	669.7	1375.	1024.
58	6	Q	397.3	35	283.7	1122.	397.3	801.4	600.1

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1987	1988	1989	1990	1991	1992	1993	1994
0	0.8133	0.2831	-0.4726	-0.4486	0.7493	-0.0165	-0.9110	0.1845
1	0.0034	0.0900	0.0031	-0.0170	0.0562	0.0340	-0.2435	-0.8297
2	0.0642	-0.0317	-0.0274	-0.1834	-0.1221	0.0537	0.0639	-0.0199
3	0.0243	-0.0809	-0.0888	-0.0764	0.0866	-0.0431	0.4183	0.2778
4	-0.2434	0.0560	-0.1205	0.2234	-0.1548	0.0066	0.2656	0.1900
5	-0.2008	-0.1005	0.3739	0.1768	-0.1579	-0.2369	0.1927	0.0988

Separable Model Residuals

Age	1995	1996	1997	1998	1999
0	-0.8807	0.4409	-0.0067	0.1973	0.0607
1	0.3062	-0.4121	0.6146	0.1662	0.1863
2	0.1230	-0.0611	0.3459	-0.0914	-0.1561
3	0.2553	0.2123	-0.1934	-0.0182	-0.3085
4	-0.1091	0.1081	0.1868	-0.1551	0.1259
5	-0.2736	-0.4635	-0.1218	0.5494	0.3390

SPAWNING BIOMASS INDEX RESIDUALS

INDEX1

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	-0.3736	*******

INDEX1

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	-0.8785

Table 9.7.2.1b (cont): Ouput values from the assessment model.

INDEX1

	1998	1999
1	*******	-0.5319

AGE-STRUCTURED INDEX RESIDUALS

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	-0.596	1.991	0.437	*******	-0.260	-1.195	-0.182	0.438
2	-1.934	0.810	-0.459	*******	-0.619	0.690	-0.267	0.553
3	1.126	-1.724	-0.585	*******	0.339	0.314	-0.361	0.081
4	0.082	1.906	-0.850	*******	-0.752	0.763	-1.389	-0.071
5	0.879	1.244	1.072	*******	-0.177	-0.377	-0.330	0.271
6	0.678	1.408	0.953	*******	0.348	0.962	-0.421	1.364

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

Age	1994	1995	1996	1997	1998	1999	2000
1	*******	*******	-1.666	-0.512	1.677	0.278	-0.409
2	*******	*******	-0.554	1.309	-0.134	0.287	0.317
3	*******	*******	-0.240	0.092	-0.045	-0.054	1.056
4	*******	*******	0.296	0.123	-1.118	0.478	0.532
5	*******	*******	-0.274	-1.109	-1.336	-0.971	1.107
6	*******	*******	-1.220	-0.593	-1.849	-0.806	-0.825

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CAD

Age	1996	1997	1998	1999	2000
1	-0.205	0.641	-0.725	-0.008	0.297
2	-0.074	0.652	0.360	-0.114	-0.824
3	0.378	-0.060	0.595	-0.335	-0.578
4	0.100	0.137	0.321	0.083	-0.640
5	-1.516	0.087	0.882	0.239	0.308
6	-2.552	0.003	1.199	0.582	0.768

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Age	1984	1985	1986	1987	1988	1989	1990	1991
0	-0.179	-0.370	-0.028	-0.147	*******	*******	*******	*******
1	0.177	0.233	-0.063	0.450	*******	*******	*******	*******
2	-0.313	0.440	0.206	0.143	*******	*******	*******	*******
3	0.050	0.068	-1.025	0.177	*******	*******	*******	*******
4	-0.467	0.136	-0.813	-0.634	*******	*******	*******	*******
5	-1.165	-0.725	-0.660	-0.047	*******	*******	*******	*******
6	-0.862	-0.255	-0.919	-0.514	*******	*******	*******	*******

Table 9.7.2.1b (cont): Ouput values from the assessment model.

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Age	1992	1993	1994	1995	1996	1997	1998	1999
0	0.336	*******	*******	*******	*******	-0.139	0.608	-0.082
1	0.410	*******	*******	*******	*******	0.113	0.023	-1.343
2	0.069	*******	*******	*******	*******	0.188	-0.021	-0.714
3	0.381	*******	*******	*******	*******	0.272	0.715	-0.638
4	-0.070	*******	*******	*******	*******	1.102	0.205	0.540
5	-0.856	*******	*******	*******	*******	1.016	1.216	1.219
6	-1.529	*******	*******	*******	*******	1.951	1.202	0.923

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1987 to 1999	
Variance	0.1398
Skewness test stat.	-0.8008
Kurtosis test statistic	1.5674
Partial chi-square	0.4425
Significance in fit	0.0000
Degrees of freedom	43

PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES

DISTRIBUTION STATISTICS FOR INDEX1

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

Variance	0.3981
Skewness test stat.	-0.8264
Kurtosis test statistic	-0.5437
Partial chi-square	0.0932
Significance in fit	0.0074
Number of observations	3
Degrees of freedom	3
Weight in the analysis	1.0000

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	0.1867	0.1222	0.0927	0.1410	0.1376	0.1973
Skewness test stat.	0.6822	-0.9477	-0.8766	0.4389	0.0778	-0.2149
Kurtosis test statisti	-0.2406	0.2251	0.5632	-0.1816	-0.9440	-0.9088
Partial chi-square	0.1814	0.1154	0.0844	0.1279	0.1292	0.1784
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	12	12	12	12	12	12
Degrees of freedom	11	11	11	11	11	11
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

Table 9.7.2.1b (cont): Ouput values from the assessment model.

DISTRIBUTION STATISTICS FOR FLT05: PT MARCH ACOUSTIC SURVEY INCL.CAD

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	0.0445	0.0521	0.0394	0.0228	0.1349	0.3700
Skewness test stat.	-0.1861	-0.3469	0.0748	-1.1328	-0.9666	-1.0993
Kurtosis test statisti	-0.4576	-0.4103	-0.6819	-0.0098	-0.0832	-0.0681
Partial chi-square	0.0081	0.0095	0.0074	0.0043	0.0258	0.0778
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0001	0.0007
Number of observations	5	5	5	5	5	5
Degrees of freedom	4	4	4	4	4	4
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

DISTRIBUTION STATISTICS FOR FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Linear catchability relationship assumed

Age	0	1	2	3	4	5	6
Variance	0.0143	0.0465	0.0185	0.0454	0.0582	0.1439	0.2114
Skewness test stat.	1.1146	-2.1325	-1.1014	-0.8759	0.4152	0.3105	0.4710
Kurtosis test statisti	-0.1296	1.2320	0.0190	-0.2797	-0.4784	-0.9603	-0.6941
Partial chi-square	0.0045	0.0149	0.0061	0.0154	0.0203	0.0530	0.0821
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	8	8	8	8	8	8	8
Degrees of freedom	7	7	7	7	7	7	7
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	108.6666	239	58	181	0.6004
Catches at age	7.2539	78	39	39	0.1860
SSB Indices					
INDEX1	1.1942	3	0	3	0.3981
Aged Indices					
FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+	57.9221	72	6	66	0.8776
FLT05: PT MARCH ACOUSTIC SURVEY INCL.C	15.9296	30	6	24	0.6637
FLT06: PT NOVEMBER AC.SURVEY EXCL.CADI	26.3668	56	7	49	0.5381

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	9.2353	239	58	181	0.0510
Catches at age	5.4516	78	39	39	0.1398
SSB Indices					
INDEX1	1.1942	3	0	3	0.3981
Aged Indices					
FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+	1.6089	72	6	66	0.0244
FLT05: PT MARCH ACOUSTIC SURVEY INCL.C	0.4425	30	6	24	0.0184
FLT06: PT NOVEMBER AC.SURVEY EXCL.CADI	0.5381	56	7	49	0.0110

Table 9.8.1 – Sardine: input data for short-term predictions.

10:23 Friday, September 22, 2000
Sardine in Divisions VIIIc and IXa

Prediction with management option table: Input data

Year: 2000

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	7831.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0264	0.024
1	5483.000	0.3300	0.6190	0.2500	0.2500	0.023	0.0553	0.038
2	5844.000	0.3300	0.9110	0.2500	0.2500	0.043	0.1581	0.054
3	2074.000	0.3300	0.9870	0.2500	0.2500	0.055	0.3238	0.063
4	1012.000	0.3300	0.9950	0.2500	0.2500	0.064	0.4019	0.068
5	264.000	0.3300	1.0000	0.2500	0.2500	0.070	0.3238	0.071
6+	325.000	0.3300	1.0000	0.2500	0.2500	0.100	0.3238	0.100
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

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	7831.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0264	0.024
1	.	0.3300	0.6190	0.2500	0.2500	0.023	0.0553	0.038
2	.	0.3300	0.9110	0.2500	0.2500	0.043	0.1581	0.054
3	.	0.3300	0.9870	0.2500	0.2500	0.055	0.3238	0.063
4	.	0.3300	0.9950	0.2500	0.2500	0.064	0.4019	0.068
5	.	0.3300	1.0000	0.2500	0.2500	0.070	0.3238	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.100	0.3238	0.100
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

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	7831.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0264	0.024
1	.	0.3300	0.6190	0.2500	0.2500	0.023	0.0553	0.038
2	.	0.3300	0.9110	0.2500	0.2500	0.043	0.1581	0.054
3	.	0.3300	0.9870	0.2500	0.2500	0.055	0.3238	0.063
4	.	0.3300	0.9950	0.2500	0.2500	0.064	0.4019	0.068
5	.	0.3300	1.0000	0.2500	0.2500	0.070	0.3238	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.100	0.3238	0.100
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANXAN04
Date and time: 22SEP00:12:59

Table 9.8.2 – Sardine:Results of short-term predictions.

10:23 Friday, September 22, 2000
Sardine in Divisions VIIIc and IXa

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002		F
Reference Factor	Stock F	Sp.stock biomass	Catch in biomass	F weight	Reference Factor	Stock F	Sp.stock biomass	Catch in biomass	Stock weight	Sp.stock biomass	biomass	
1.0000	0.3019	607	466	116	0.0000	0.0000	618	509	0	723	604	
.	.	.	.	.	0.0500	0.0151	.	507	7	716	596	
.	.	.	.	.	0.1000	0.0302	.	505	14	710	588	
.	.	.	.	.	0.1500	0.0453	.	504	22	704	581	
.	.	.	.	.	0.2000	0.0604	.	502	29	698	573	
.	.	.	.	.	0.2500	0.0755	.	501	35	691	566	
.	.	.	.	.	0.3000	0.0906	.	499	42	685	559	
.	.	.	.	.	0.3500	0.1057	.	497	49	680	552	
.	.	.	.	.	0.4000	0.1208	.	496	56	674	545	
.	.	.	.	.	0.4500	0.1359	.	494	62	668	538	
.	.	.	.	.	0.5000	0.1509	.	493	69	662	531	
.	.	.	.	.	0.5500	0.1660	.	491	75	657	525	
.	.	.	.	.	0.6000	0.1811	.	490	81	651	518	
.	.	.	.	.	0.6500	0.1962	.	488	88	646	512	
.	.	.	.	.	0.7000	0.2113	.	487	94	640	506	
.	.	.	.	.	0.7500	0.2264	.	485	100	635	500	
.	.	.	.	.	0.8000	0.2415	.	484	106	630	494	
.	.	.	.	.	0.8500	0.2566	.	482	112	624	488	
.	.	.	.	.	0.9000	0.2717	.	481	118	619	482	
.	.	.	.	.	0.9500	0.2868	.	479	123	614	476	
.	.	.	.	.	1.0000	0.3019	.	478	129	609	471	
.	.	.	.	.	1.0500	0.3170	.	476	135	604	465	
.	.	.	.	.	1.1000	0.3321	.	475	140	600	460	
.	.	.	.	.	1.1500	0.3472	.	473	146	595	454	
.	.	.	.	.	1.2000	0.3623	.	472	151	590	449	
.	.	.	.	.	1.2500	0.3774	.	470	156	585	444	
.	.	.	.	.	1.3000	0.3925	.	469	162	581	439	
.	.	.	.	.	1.3500	0.4076	.	467	167	576	434	
.	.	.	.	.	1.4000	0.4227	.	466	172	572	429	
.	.	.	.	.	1.4500	0.4378	.	465	177	567	424	
.	.	.	.	.	1.5000	0.4529	.	463	182	563	419	
.	.	.	.	.	1.5500	0.4679	.	462	187	559	415	
.	.	.	.	.	1.6000	0.4830	.	460	192	555	410	
.	.	.	.	.	1.6500	0.4981	.	459	197	550	406	
.	.	.	.	.	1.7000	0.5132	.	457	202	546	401	
.	.	.	.	.	1.7500	0.5283	.	456	207	542	397	
.	.	.	.	.	1.8000	0.5434	.	455	211	538	392	
.	.	.	.	.	1.8500	0.5585	.	453	216	534	388	
.	.	.	.	.	1.9000	0.5736	.	452	220	530	384	
.	.	.	.	.	1.9500	0.5887	.	451	225	526	380	
.	.	.	.	.	2.0000	0.6038	.	449	229	523	376	
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	

Notes: Run name : MANXAN04
Date and time : 22SEP00:12:59
Computation of ref. F: Simple mean, age 2 - 5
Basis for 2000 : F factors

Table 9.8.2.1 – Sardine: Input data for short-term predictions for Divisions VIIIc and IXa.

.10:23 Friday, September 22, 2000
Sardine in Divisions VIIIc and IXa

Multi fleet prediction with mangement option table: Input data

2000	Division IXa		Division VIIIc							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0252	0.024	0.0012	0.038	7831.000	0.3300	0.0000	0.2500	0.2500	0.000
1	0.0505	0.041	0.0049	0.060	5483.000	0.3300	0.6190	0.2500	0.2500	0.023
2	0.1489	0.055	0.0091	0.080	5844.000	0.3300	0.9110	0.2500	0.2500	0.043
3	0.2969	0.063	0.0269	0.085	2074.000	0.3300	0.9870	0.2500	0.2500	0.055
4	0.3378	0.066	0.0641	0.091	1012.000	0.3300	0.9950	0.2500	0.2500	0.064
5	0.2866	0.069	0.0372	0.099	264.000	0.3300	1.0000	0.2500	0.2500	0.070
6+	0.2698	0.100	0.0540	0.100	325.000	0.3300	1.0000	0.2500	0.2500	0.100
Unit	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

2001	Division IXa		Division VIIIc							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0252	0.024	0.0012	0.038	7831.000	0.3300	0.0000	0.2500	0.2500	0.000
1	0.0505	0.041	0.0049	0.060	.	0.3300	0.6190	0.2500	0.2500	0.023
2	0.1489	0.055	0.0091	0.080	.	0.3300	0.9110	0.2500	0.2500	0.043
3	0.2969	0.063	0.0269	0.085	.	0.3300	0.9870	0.2500	0.2500	0.055
4	0.3378	0.066	0.0641	0.091	.	0.3300	0.9950	0.2500	0.2500	0.064
5	0.2866	0.069	0.0372	0.099	.	0.3300	1.0000	0.2500	0.2500	0.070
6+	0.2698	0.100	0.0540	0.100	.	0.3300	1.0000	0.2500	0.2500	0.100
Unit	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

2002	Division IXa		Division VIIIc							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0252	0.024	0.0012	0.038	7831.000	0.3300	0.0000	0.2500	0.2500	0.000
1	0.0505	0.041	0.0049	0.060	.	0.3300	0.6190	0.2500	0.2500	0.023
2	0.1489	0.055	0.0091	0.080	.	0.3300	0.9110	0.2500	0.2500	0.043
3	0.2969	0.063	0.0269	0.085	.	0.3300	0.9870	0.2500	0.2500	0.055
4	0.3378	0.066	0.0641	0.091	.	0.3300	0.9950	0.2500	0.2500	0.064
5	0.2866	0.069	0.0372	0.099	.	0.3300	1.0000	0.2500	0.2500	0.070
6+	0.2698	0.100	0.0540	0.100	.	0.3300	1.0000	0.2500	0.2500	0.100
Unit	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

Notes: Run name : MANXAN05
Date and time: 22SEP00:18:05

Table 9.8.2.2 – Sardine: Results of short-term predictions for Divisions VIIIc and IXa.

10:23 Friday, September 22, 2000
Sardine in Divisions VIIIc and IXa

Multi fleet prediction with mangement option table

Year: 2000

Division IXa			Division VIIIc			Total		
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.2676	106	1.0000	0.0343	15	121	607	466
-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes

Year: 2001									Year: 2002	
Division IXa			Division VIIIc			Total				
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	Stock biomass	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	0	618	509	723	604
0.0500	0.0134	7	0.0500	0.0017	1	8	.	507	716	596
0.1000	0.0268	13	0.1000	0.0034	2	15	.	505	710	588
0.1500	0.0401	20	0.1500	0.0051	3	22	.	504	704	581
0.2000	0.0535	26	0.2000	0.0069	4	30	.	502	698	573
0.2500	0.0669	32	0.2500	0.0086	5	37	.	501	691	566
0.3000	0.0803	38	0.3000	0.0103	6	44	.	499	685	559
0.3500	0.0936	44	0.3500	0.0120	6	51	.	498	680	552
0.4000	0.1070	50	0.4000	0.0137	7	58	.	496	674	545
0.4500	0.1204	56	0.4500	0.0154	8	64	.	494	668	538
0.5000	0.1338	62	0.5000	0.0172	9	71	.	493	662	531
0.5500	0.1472	68	0.5500	0.0189	10	78	.	491	657	525
0.6000	0.1605	74	0.6000	0.0206	11	84	.	490	651	518
0.6500	0.1739	79	0.6500	0.0223	11	91	.	488	646	512
0.7000	0.1873	85	0.7000	0.0240	12	97	.	487	640	506
0.7500	0.2007	90	0.7500	0.0257	13	103	.	485	635	500
0.8000	0.2140	96	0.8000	0.0275	14	110	.	484	630	494
0.8500	0.2274	101	0.8500	0.0292	15	116	.	482	624	488
0.9000	0.2408	107	0.9000	0.0309	15	122	.	481	619	482
0.9500	0.2542	112	0.9500	0.0326	16	128	.	479	614	476
1.0000	0.2676	117	1.0000	0.0343	17	134	.	478	609	471
1.0500	0.2809	122	1.0500	0.0360	18	140	.	476	604	465
1.1000	0.2943	127	1.1000	0.0378	18	145	.	475	600	460
1.1500	0.3077	132	1.1500	0.0395	19	151	.	473	595	454
1.2000	0.3211	137	1.2000	0.0412	20	157	.	472	590	449
1.2500	0.3344	142	1.2500	0.0429	20	162	.	470	585	444
1.3000	0.3478	147	1.3000	0.0446	21	168	.	469	581	439
1.3500	0.3612	152	1.3500	0.0463	22	173	.	467	576	434
1.4000	0.3746	156	1.4000	0.0481	22	179	.	466	572	429
1.4500	0.3880	161	1.4500	0.0498	23	184	.	465	568	424
1.5000	0.4013	165	1.5000	0.0515	24	189	.	463	563	419
1.5500	0.4147	170	1.5500	0.0532	24	194	.	462	559	415
1.6000	0.4281	174	1.6000	0.0549	25	199	.	460	555	410
1.6500	0.4415	179	1.6500	0.0566	25	204	.	459	550	406
1.7000	0.4548	183	1.7000	0.0583	26	209	.	458	546	401
1.7500	0.4682	188	1.7500	0.0601	27	214	.	456	542	397
1.8000	0.4816	192	1.8000	0.0618	27	219	.	455	538	392
1.8500	0.4950	196	1.8500	0.0635	28	224	.	453	534	388
1.9000	0.5084	200	1.9000	0.0652	28	229	.	452	530	384
1.9500	0.5217	204	1.9500	0.0669	29	233	.	451	526	380
2.0000	0.5351	208	2.0000	0.0686	30	238	.	449	523	376
-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

```
----------------------------------------------------------------------------------------------------------
 Notes: Run name            : MANXAN05
        Date and time       : 22SEP00:18:05
        Computation of ref. F: Division IXa:   Simple mean, age 2 - 5
                              Division VIIIc: Simple mean, age 2 - 5
        Basis for 2000      : F factors
```

Table 9.11.1 – Sardine: input data for long term predictions.

Sardine in Divisions VIIIc and IXa

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	7831.000	0.3300	0.0000	0.2500	0.2500	0.000	0.0264	0.024
1	.	0.3300	0.6190	0.2500	0.2500	0.023	0.0553	0.038
2	.	0.3300	0.9110	0.2500	0.2500	0.043	0.1581	0.054
3	.	0.3300	0.9870	0.2500	0.2500	0.055	0.3238	0.063
4	.	0.3300	0.9950	0.2500	0.2500	0.064	0.4019	0.068
5	.	0.3300	1.0000	0.2500	0.2500	0.070	0.3238	0.071
6+	.	0.3300	1.0000	0.2500	0.2500	0.100	0.3238	0.100
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDXAN04
Date and time: 23SEP00:17:36

Table 9.11.2 – Sardine: results of yield per recruit analysis.

The SAS System 17:35 Saturday, September 23, 2000

Sardine in Divisions 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	27861	1087	17476	1020	16092	939
0.0500	0.0151	190	13	27291	1038	16911	970	15525	890
0.1000	0.0302	363	25	26771	993	16396	926	15008	846
0.1500	0.0453	522	35	26295	952	15925	885	14535	806
0.2000	0.0604	668	45	25857	915	15492	848	14100	770
0.2500	0.0755	803	53	25453	881	15093	815	13699	737
0.3000	0.0906	929	61	25079	850	14724	784	13327	707
0.3500	0.1057	1045	68	24731	822	14381	755	12982	679
0.4000	0.1208	1154	74	24407	796	14062	729	12661	654
0.4500	0.1359	1255	80	24104	771	13764	705	12361	630
0.5000	0.1509	1350	85	23820	749	13485	683	12081	608
0.5500	0.1660	1440	90	23554	728	13224	662	11817	588
0.6000	0.1811	1524	95	23303	708	12978	643	11569	569
0.6500	0.1962	1604	99	23066	690	12746	625	11336	552
0.7000	0.2113	1679	103	22843	673	12527	608	11115	535
0.7500	0.2264	1751	106	22631	657	12320	592	10906	520
0.8000	0.2415	1818	110	22430	642	12123	577	10708	505
0.8500	0.2566	1883	113	22239	628	11937	564	10520	492
0.9000	0.2717	1944	115	22057	615	11760	550	10342	479
0.9500	0.2868	2003	118	21883	603	11591	538	10171	467
1.0000	0.3019	2059	121	21717	591	11430	526	10009	456
1.0500	0.3170	2113	123	21559	580	11276	515	9854	445
1.1000	0.3321	2164	125	21407	569	11129	505	9705	435
1.1500	0.3472	2214	127	21262	559	10988	495	9563	425
1.2000	0.3623	2261	129	21122	549	10852	486	9427	416
1.2500	0.3774	2307	131	20988	540	10723	477	9296	407
1.3000	0.3925	2351	133	20858	531	10598	468	9170	399
1.3500	0.4076	2393	135	20734	523	10478	460	9049	391
1.4000	0.4227	2434	136	20614	515	10362	452	8932	384
1.4500	0.4378	2474	138	20498	508	10251	445	8820	376
1.5000	0.4529	2512	139	20386	500	10143	438	8711	369
1.5500	0.4679	2549	141	20277	493	10039	431	8606	363
1.6000	0.4830	2585	142	20172	487	9939	424	8505	357
1.6500	0.4981	2619	143	20071	480	9842	418	8407	350
1.7000	0.5132	2653	144	19972	474	9748	412	8312	345
1.7500	0.5283	2686	146	19877	468	9656	406	8220	339
1.8000	0.5434	2718	147	19784	462	9568	400	8131	334
1.8500	0.5585	2749	148	19693	457	9482	395	8044	328
1.9000	0.5736	2779	149	19606	452	9399	390	7960	323
1.9500	0.5887	2808	150	19520	446	9318	385	7879	319
2.0000	0.6038	2836	151	19437	441	9239	380	7799	314
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

```
Notes: Run name             : YLDXAN04
       Date and time        : 23SEP00:17:36
       Computation of ref. F: Simple mean, age 2 - 5
       F-0.1 factor         : 1.5072
       F-max factor         : Not found
       F-0.1 reference F    : 0.4550
       F-max reference F    : Not found
       Recruitment          : 7831 (Thousands)
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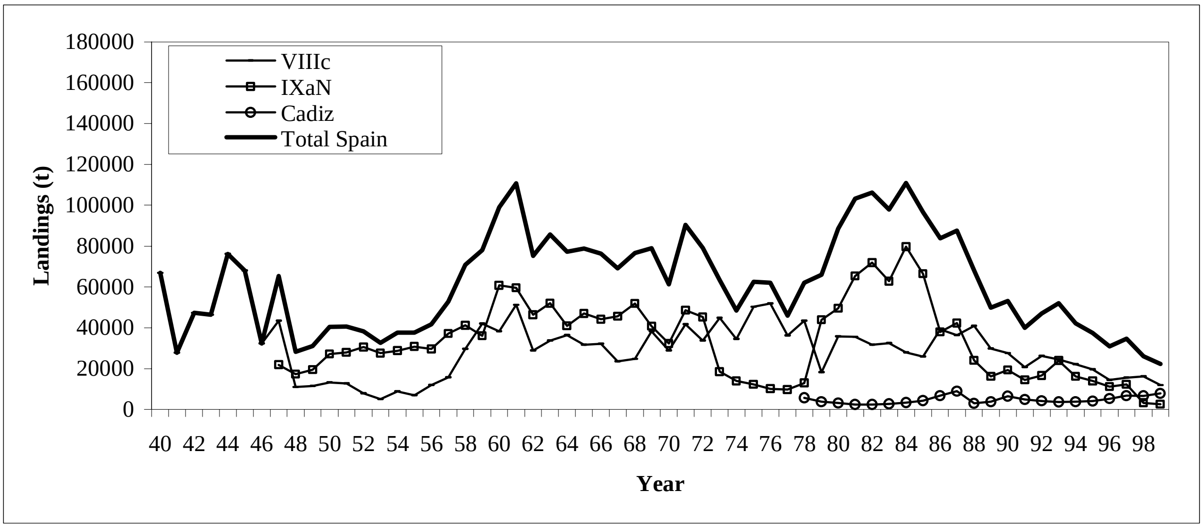


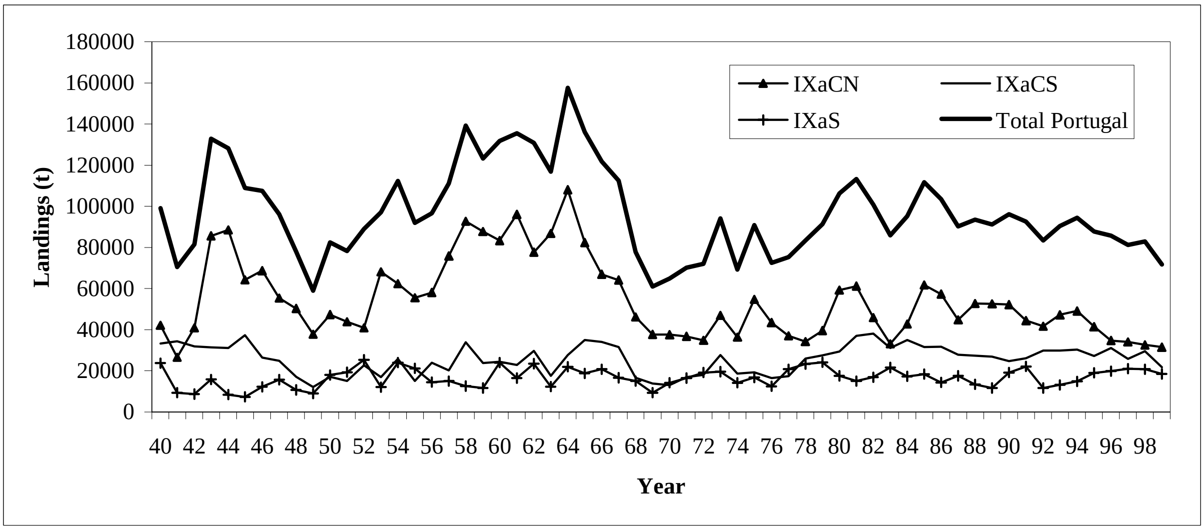


Figure 9.2.1: Annual landings of sardine, by country (upper pannel) and by ICES Sub-Division and country

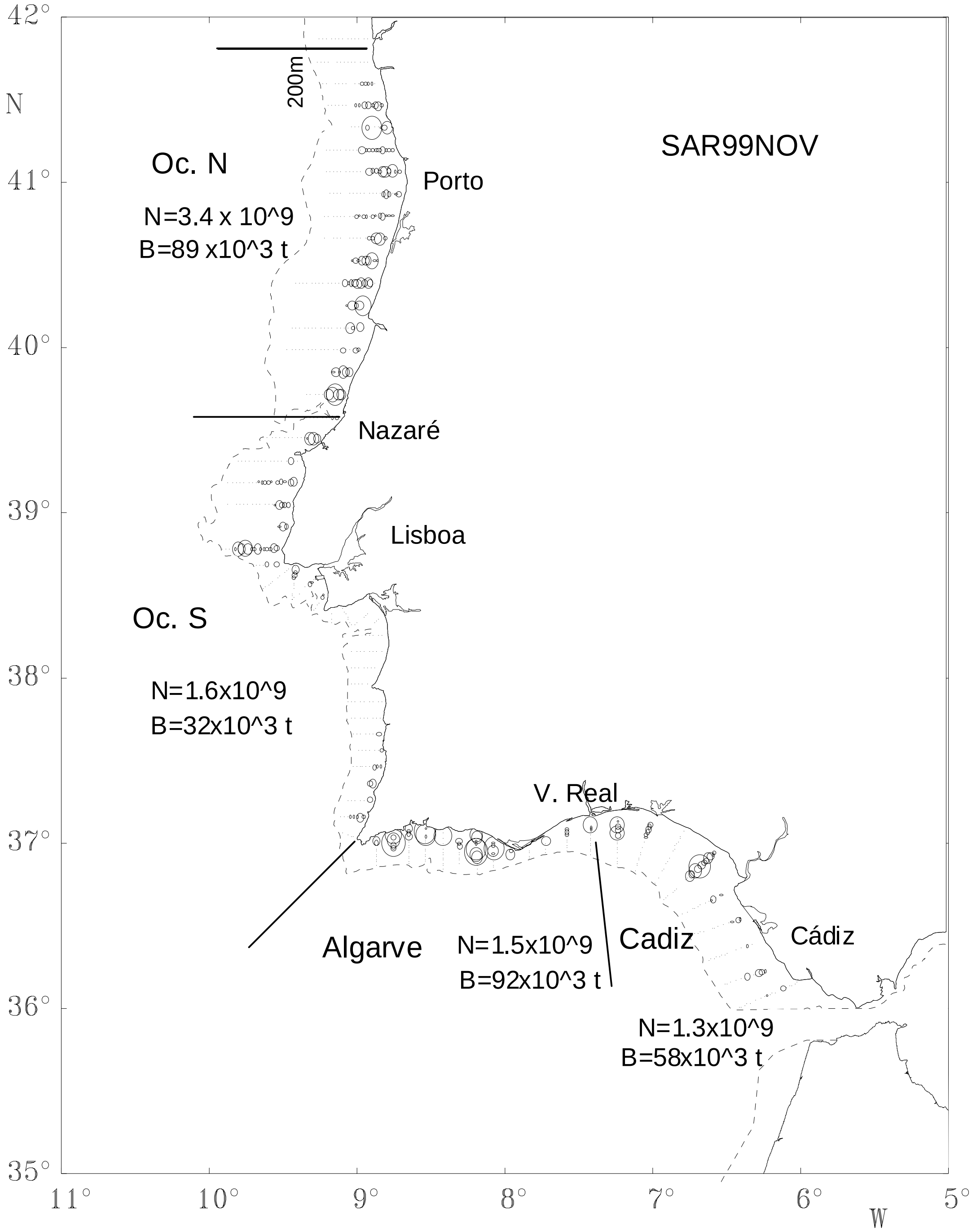


Figure 9.3.2.1 – SAR99NOV: acoustic energy distribution per nautical mile and abundance in number and biomass for sardine in each zone. Circle diameter is proportional to the square root of the acoustic energy (SA).

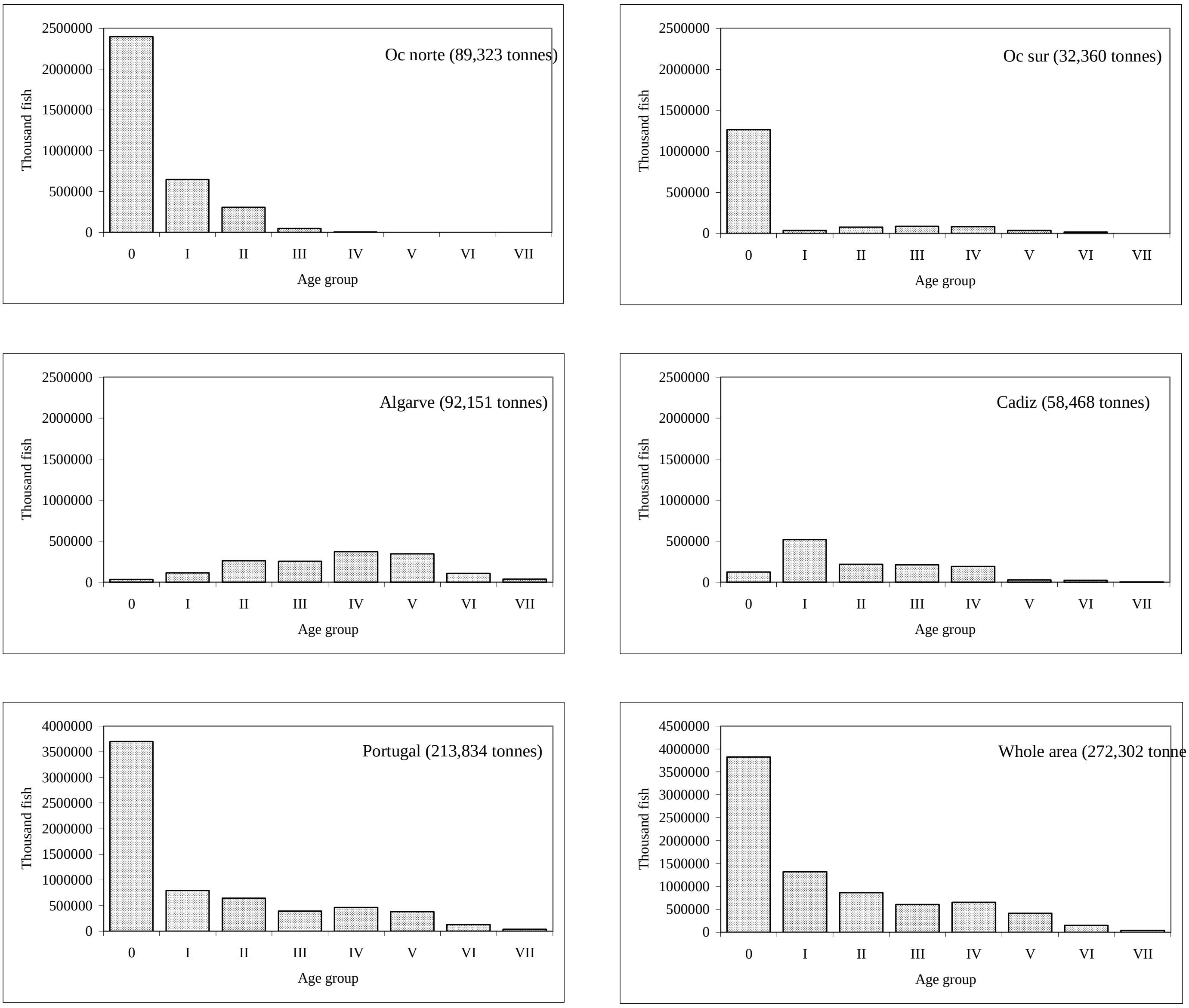


Figure 9.3.2.2: Estimated fish number of sardine (thousands) by area for the Portuguese Fall Acoustic survey 1999.

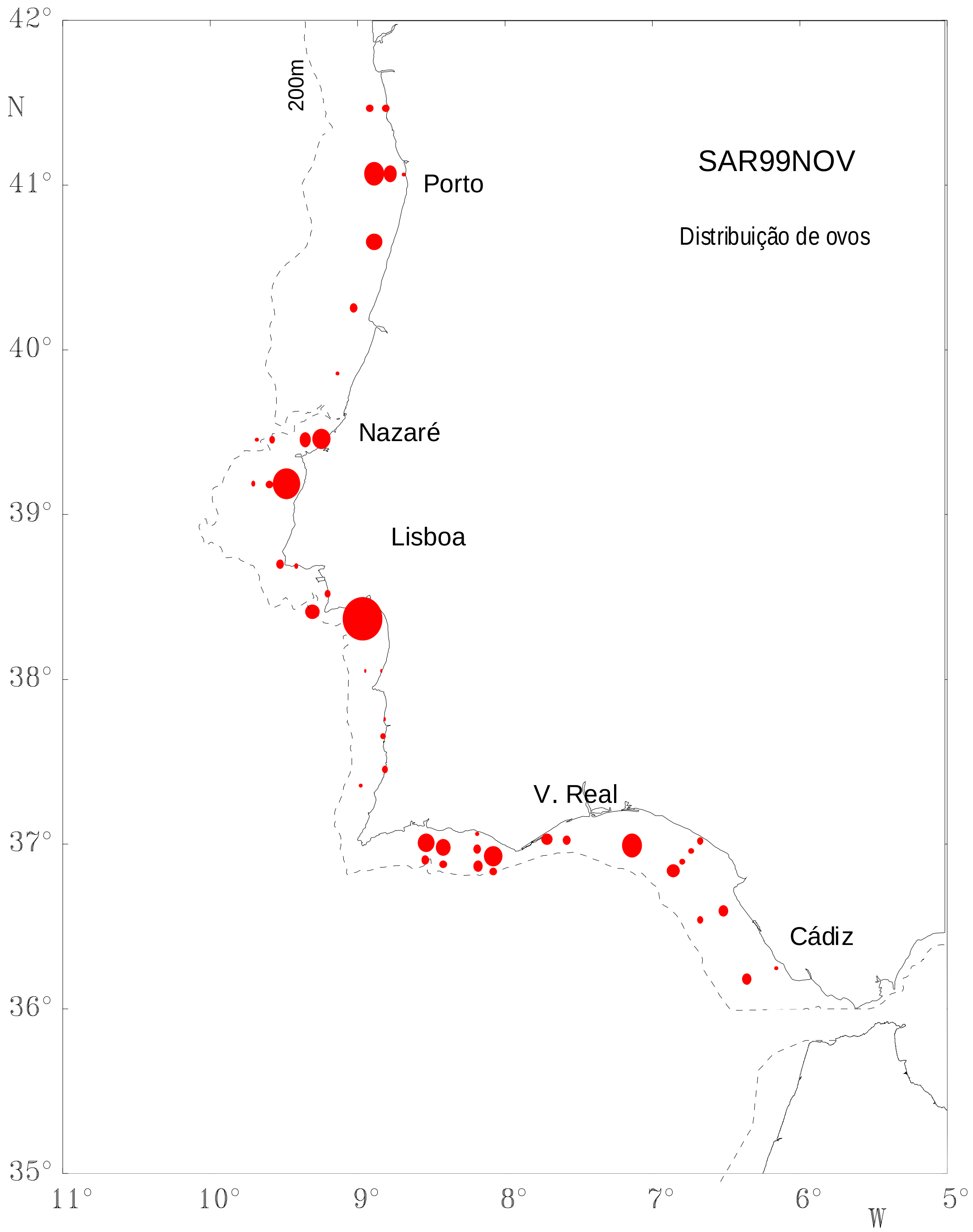


Figure 9.3.2.3: Egg numbers from CalVET tows during the Portuguese Fall Acoustic survey 1999.

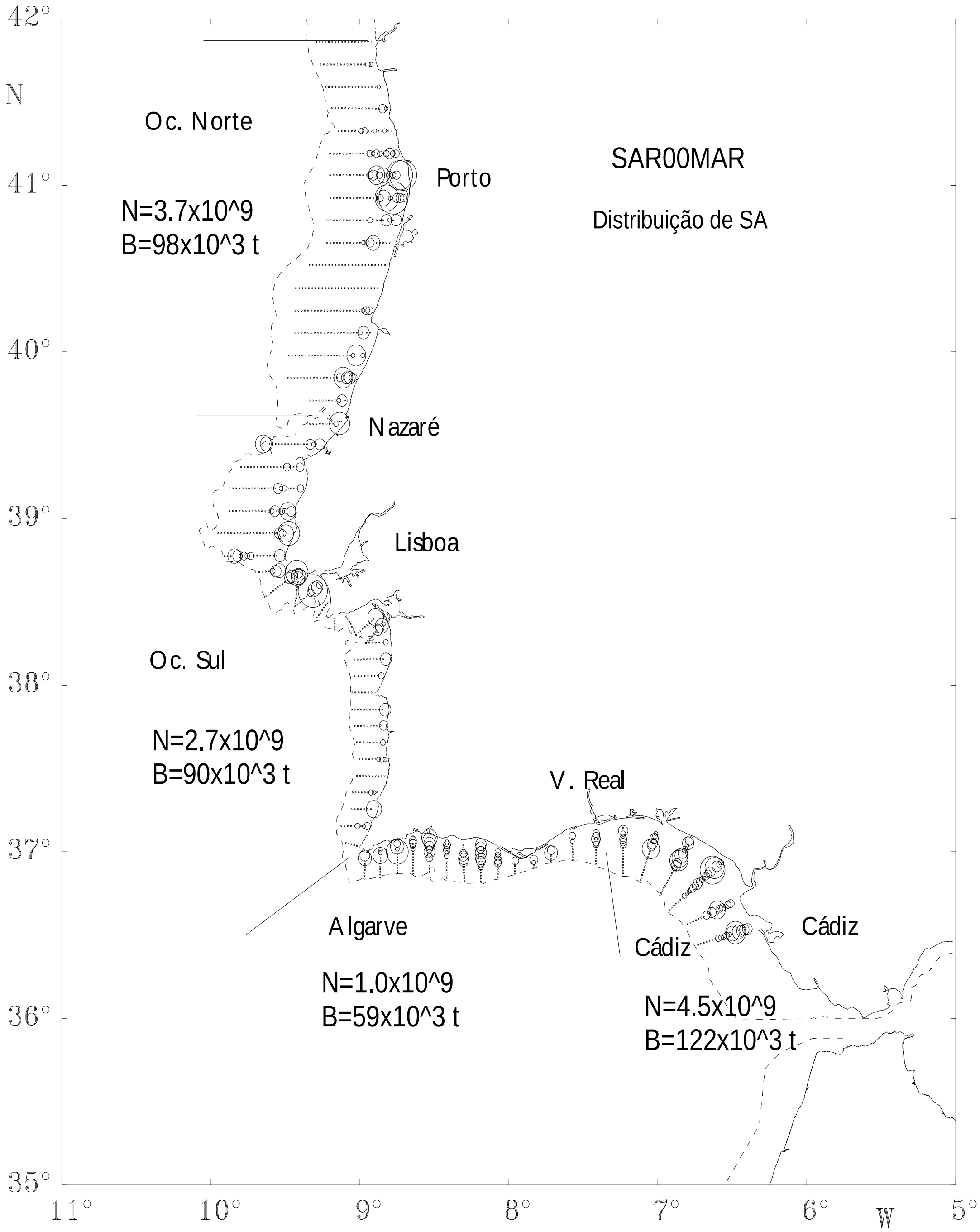


Figure 9.3.2.4 – SAR00MAR: acoustic energy distribution per nautical mile and abundance in number and biomass for sardine, in each zone. Circle diameter is proportional to the square root of the acoustic energy (SA). Note that 35% of the Cadiz area was not covered.

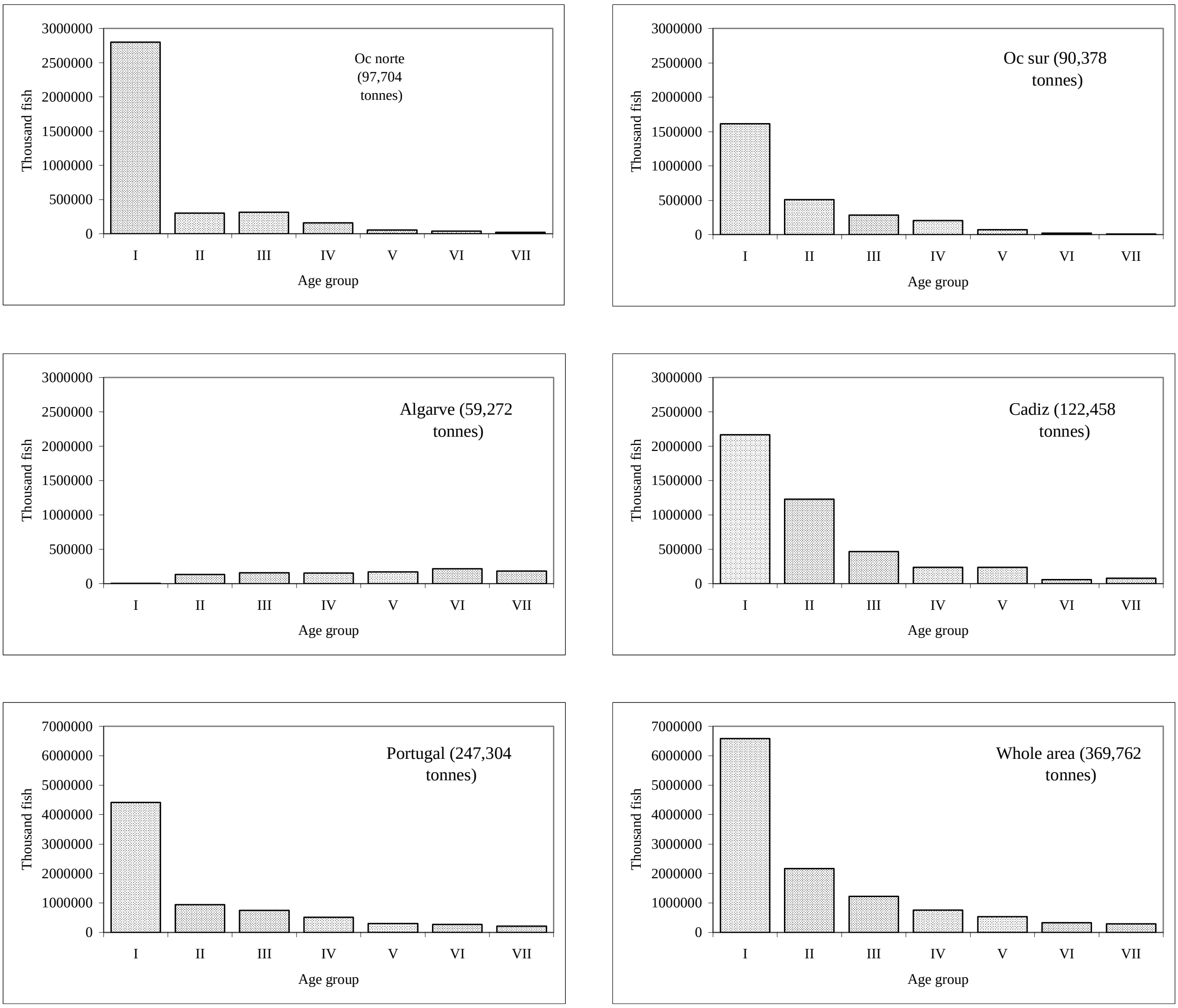


Figure 9.3.2.5: Estimated fish number of sardine (thousands) by area for the Portuguese Spring Acoustic survey 2000.

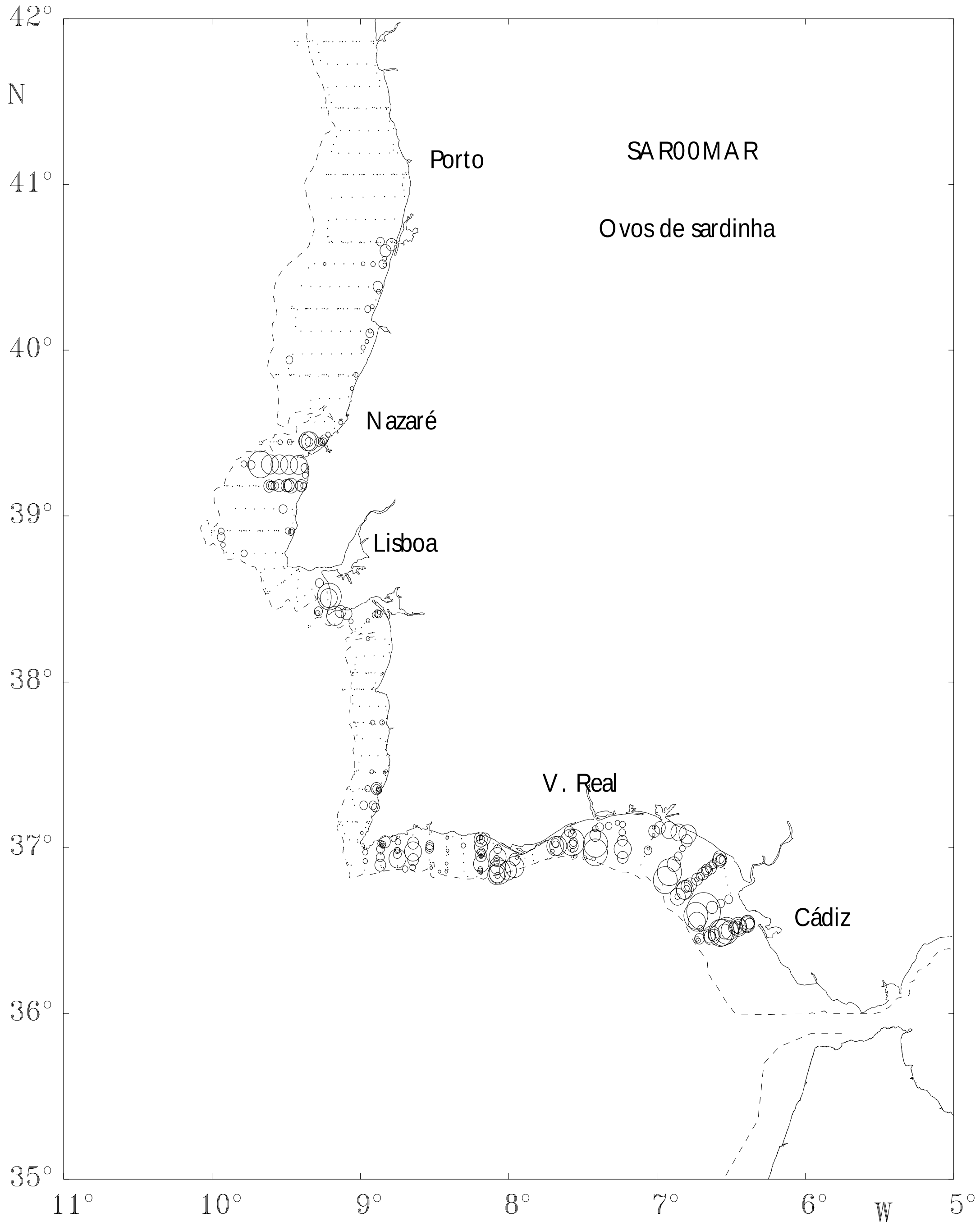


Figure 9.3.2.6 – Egg numbers from CUFES during the Portuguese Spring Acoustic Survey 2000.

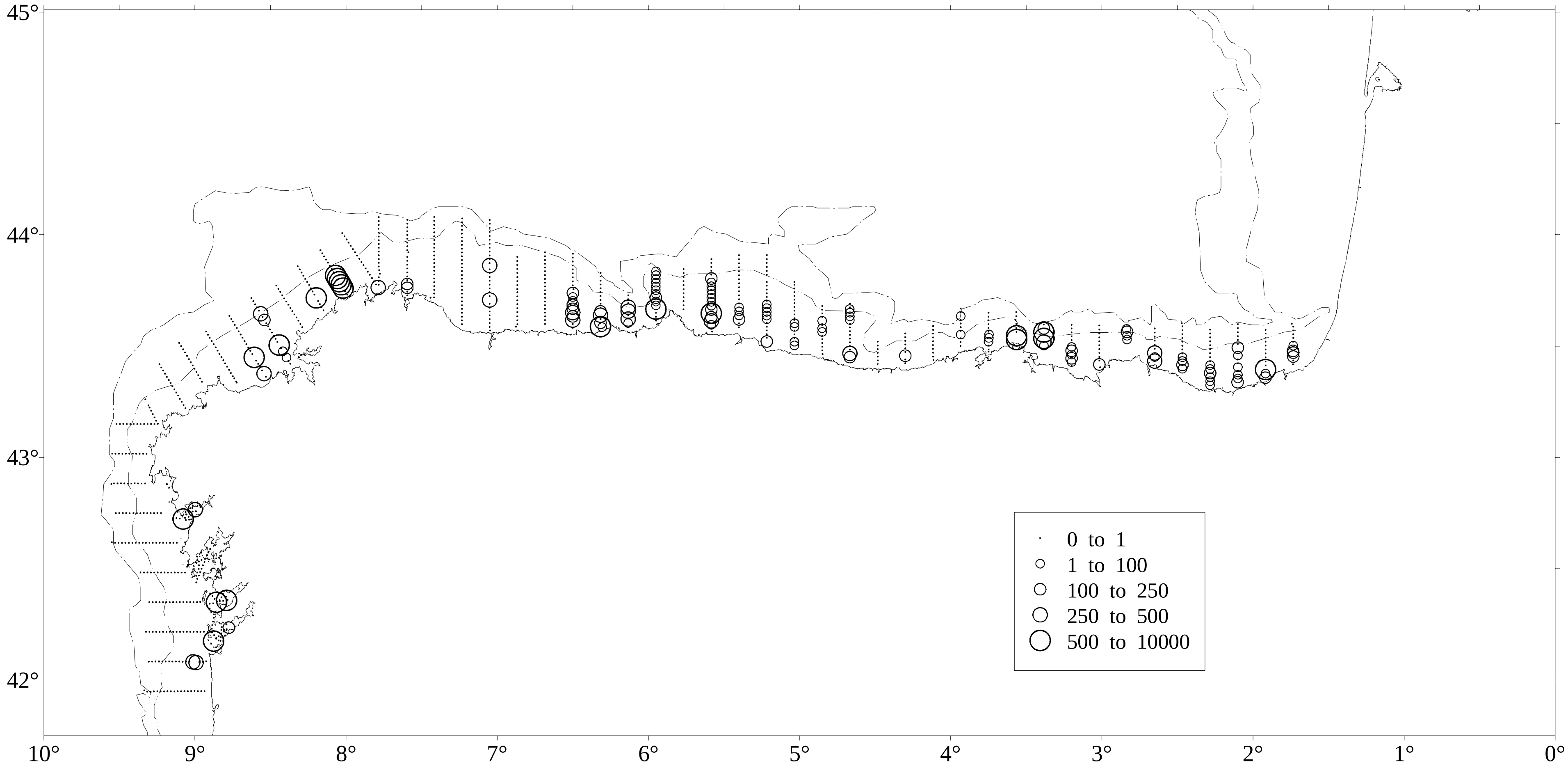


Figure 9.3.2.7 – Classed acoustic energy distribution per nautical mile for sardine during the Spanish Spring Acoustic Survey 2000.

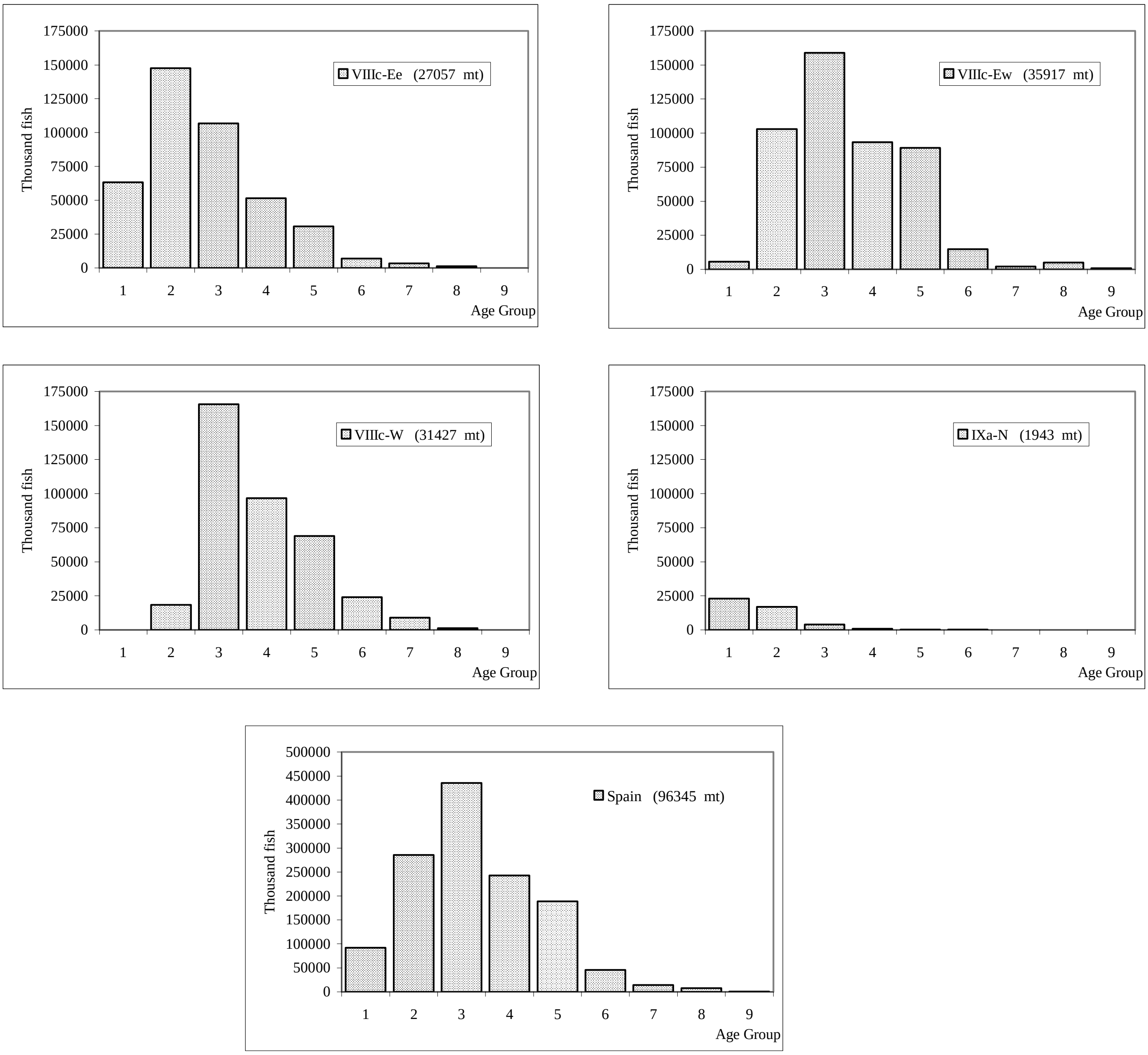


Figure 9.3.2.8: Estimated fish number of sardine (thousands) by area for the Spanish Spring Acoustic survey 2000.

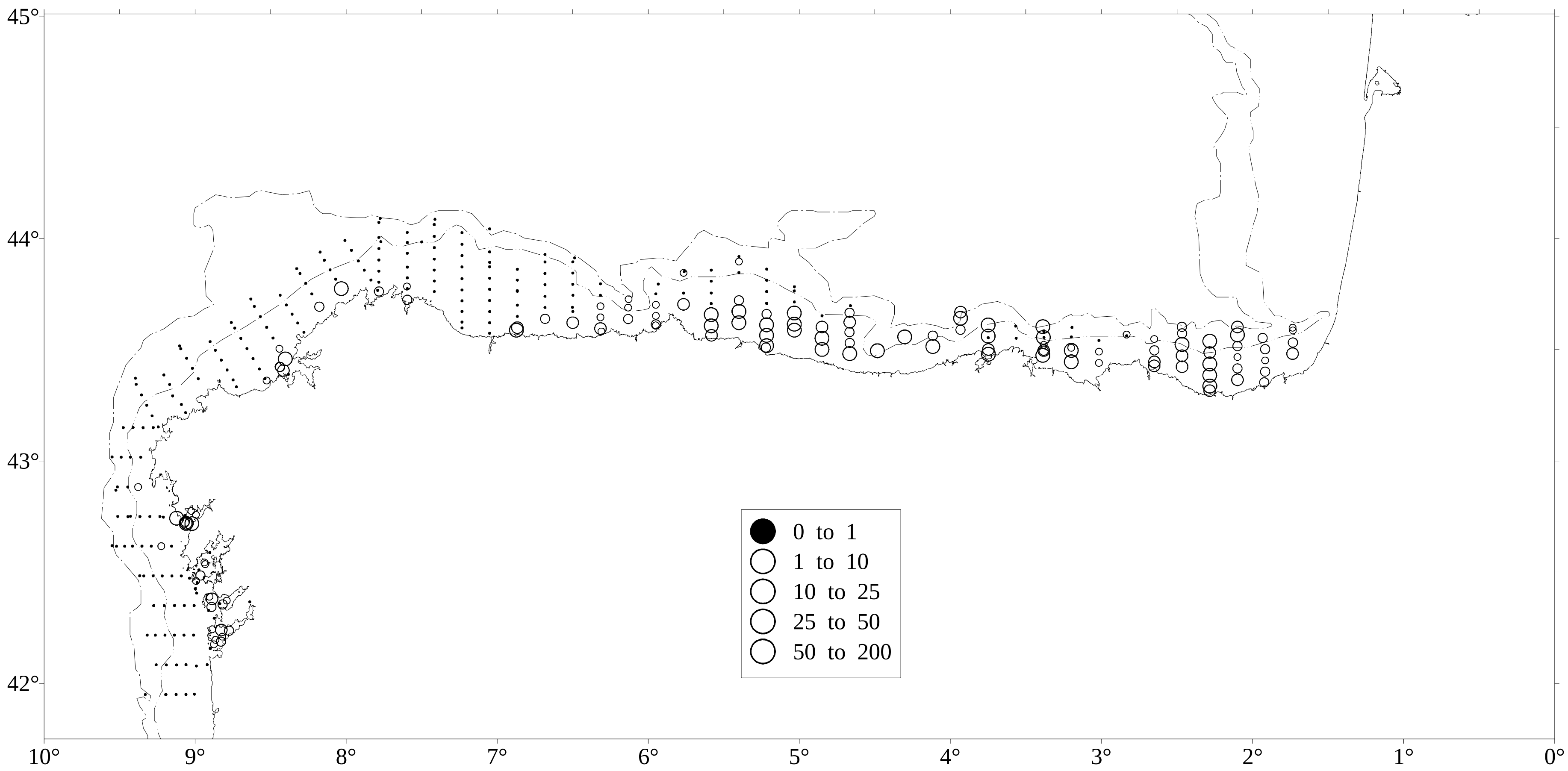


Figure 9.3.2.9 Egg numbers from CUFES during the Spanish Spring Acoustic Survey 2000.

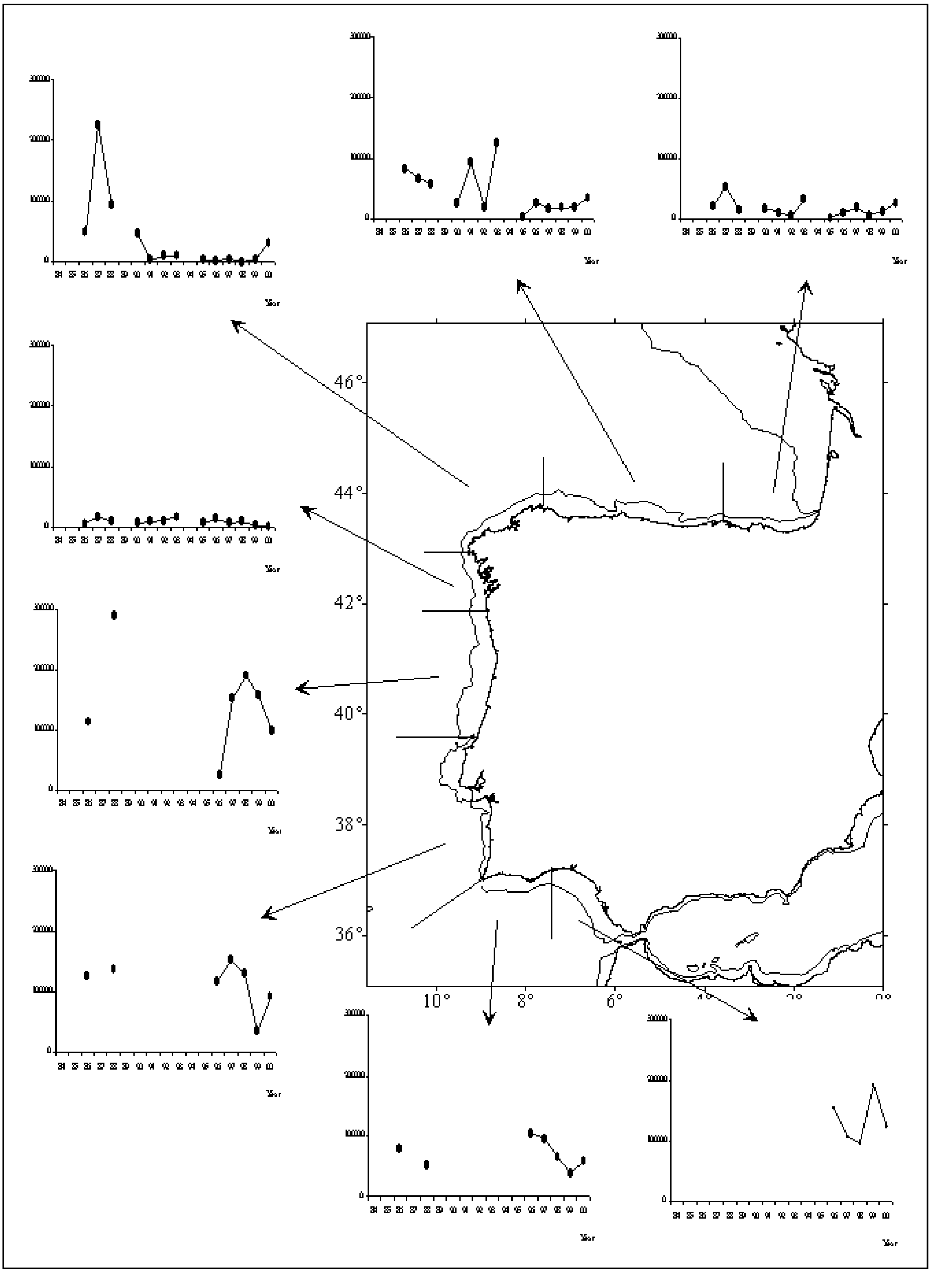


Figure 9.3.2.10: Estimated total biomass by area for sardine during the March acoustic surveys time series along the Iberian Peninsula (Spanish and Portuguese time series combined). Series starts in 1984. Maximum biomass value set at 300,000 tonnes.

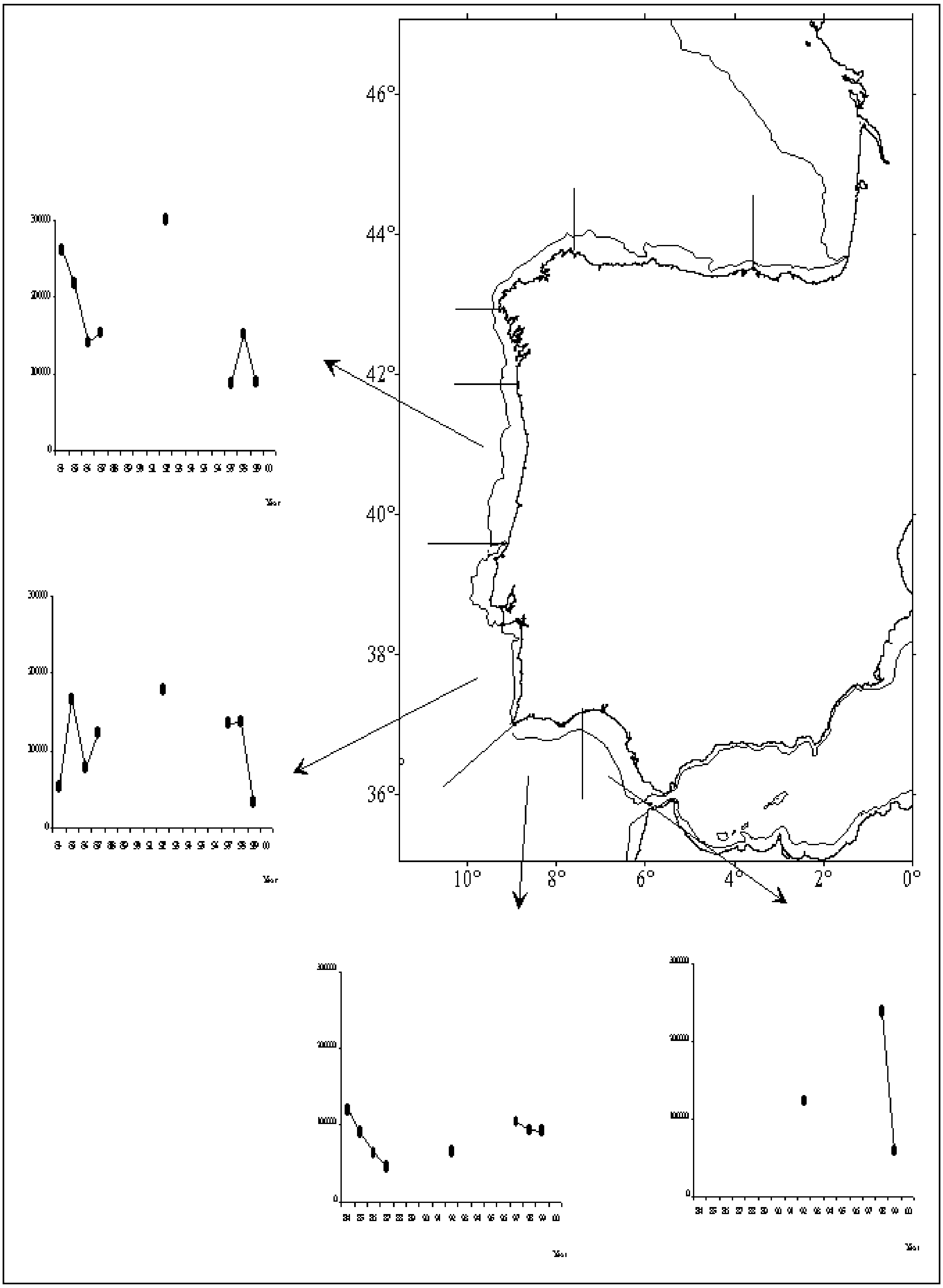


Figure 9.3.2.11: Estimated total biomass by area for sardine from the Portuguese November acoustic surveys time series. Series starts in 1984. Maximum biomass value set at 300,000 tonnes.

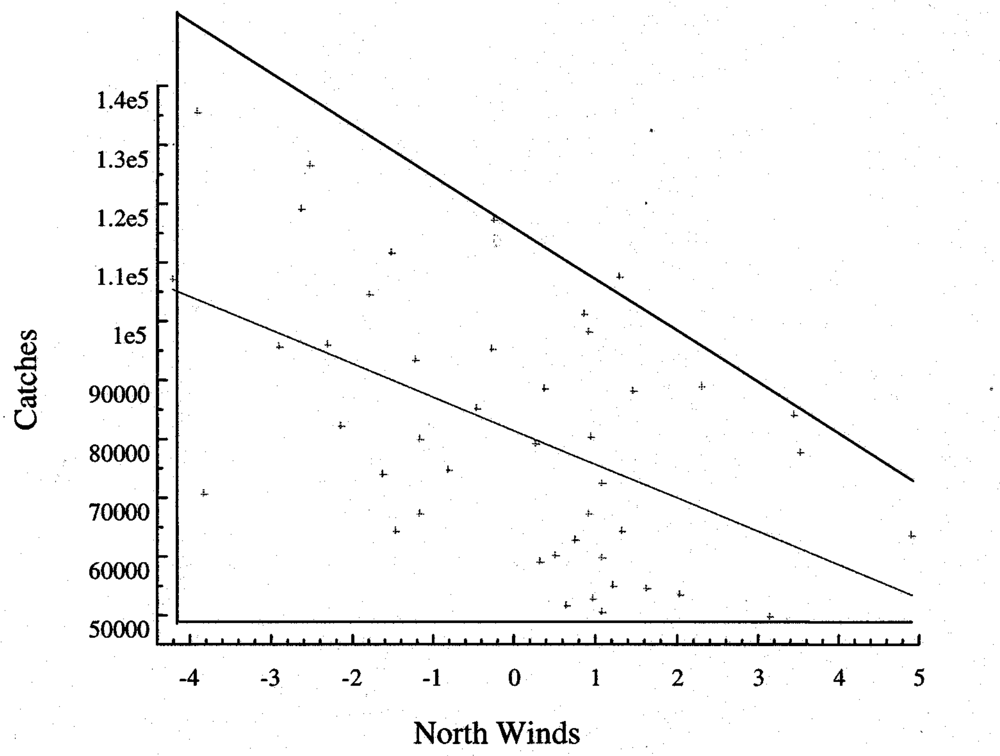
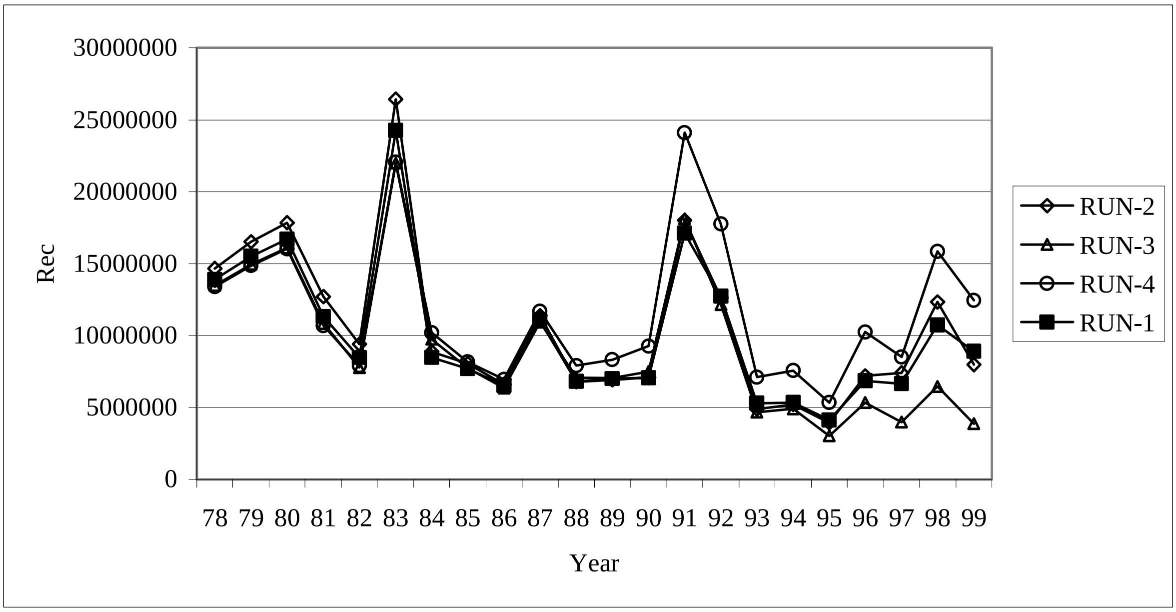
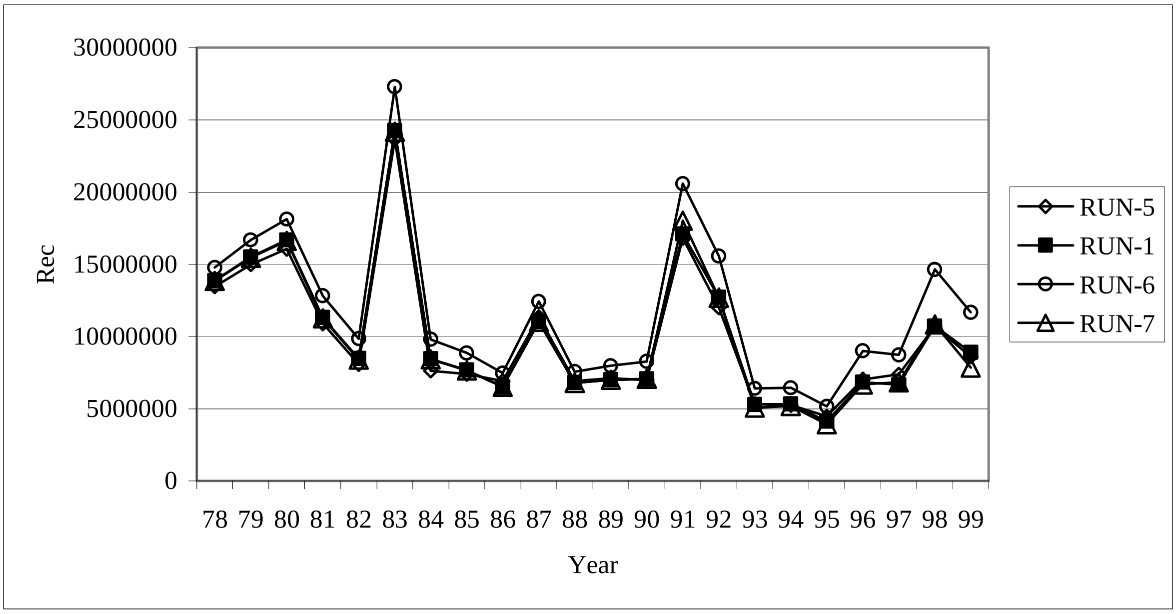


Figure 9.6.1 Correlation between sardine catches and the mean north wind index in the western Iberian coast (1947-1991). The superimposed triangle is intended to emphasise the decrease in the varaibility of catches with increasing northern winds.



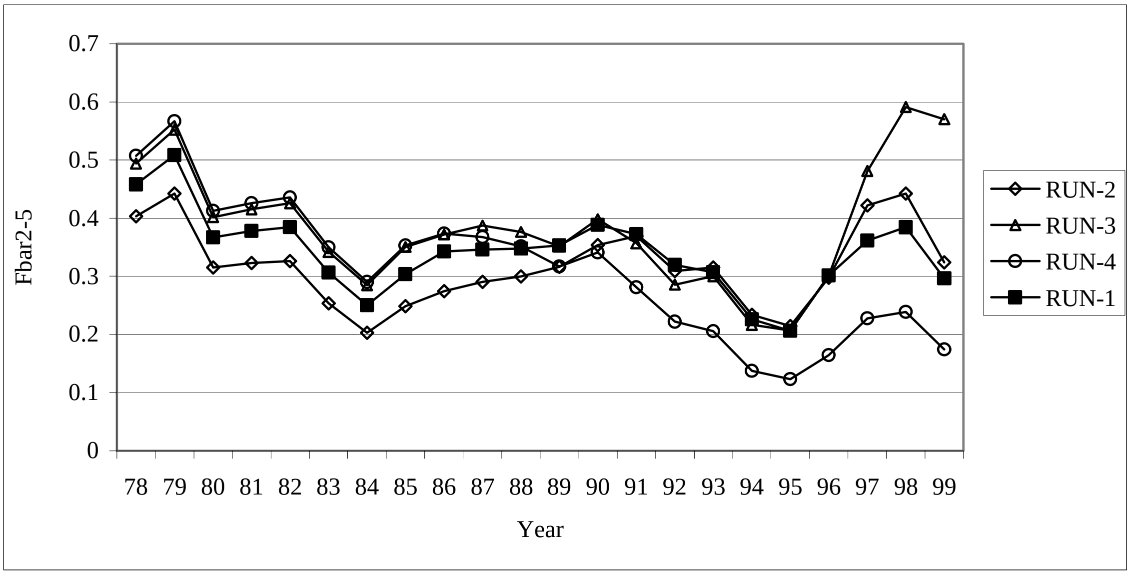


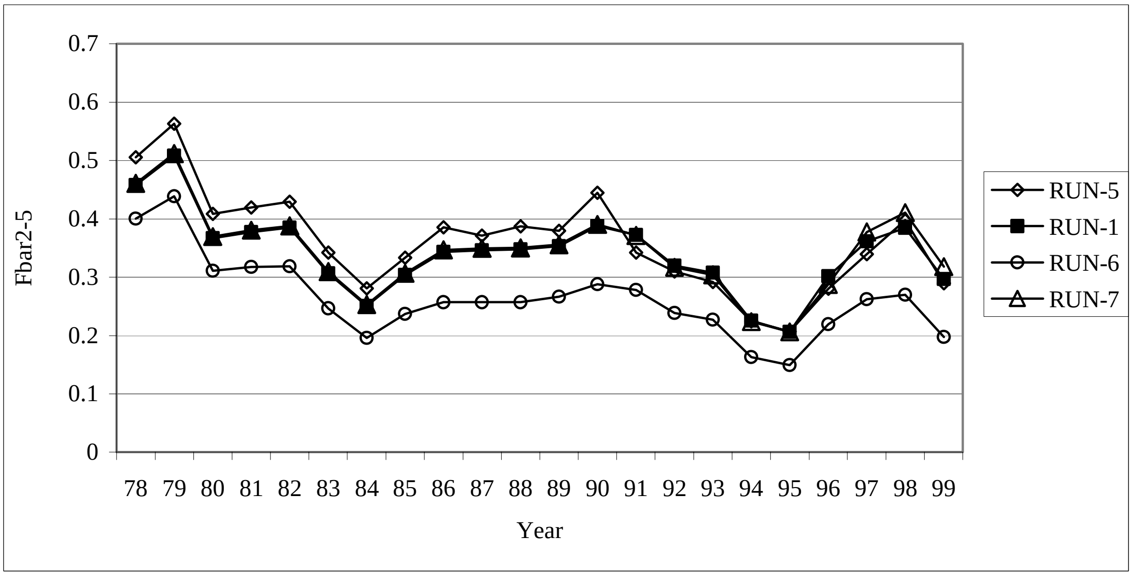
RUN-2	Fitted model with only Spanish Spring Acoustic Survey
RUN-3	Fitted model with only DEPM time series as absolute estimator
RUN-4	Fitted model with only Portuguese Fall Acoustic Survey
RUN-1	**Fitted model with all the fleets (Reference run)**
RUN-5	Fitted model with all the fleets as in WG98,but Spanish AS as power
RUN-6	Fitted model with all the fleets as in WG98 but DEPM as Linear
RUN-7	Fitted model with all the fleets as in WG98 without Portuguese Spring AS

Figure 9.7.1.1a: Estimated Iberian sardine recruitment from various assessment model options (ICA)

RUN-2	Fitted model with only Spanish Spring Acoustic Survey
RUN-3	Fitted model with only DEPM time series as absolute estimator
RUN-4	Fitted model with only Portuguese Fall Acoustic Survey
RUN-1	**Fitted model with all the fleets (Reference run)**
RUN-5	Fitted model with all the fleets as in WG98,but Spanish AS as power
RUN-6	Fitted model with all the fleets as in WG98 but DEPM as Linear
RUN-7	Fitted model with all the fleets as in WG98 without Portuguese Spring AS

Figure 9.7.1.1b: Estimated Iberian sardine SSB from various assessment models





RUN-2	Fitted model with only Spanish Spring Acoustic Survey
RUN-3	Fitted model with only DEPM time series as absolute estimator
RUN-4	Fitted model with only Portuguese Fall Acoustic Survey
RUN-1	**Fitted model with all the fleets (Reference Run)**
RUN-5	Fitted model with all the fleets as in WG98,but Spanish AS as power
RUN-6	Fitted model with all the fleets as in WG98 but DEPM as Linear
RUN-7	Fitted model with all the fleets as in WG98 without Portuguese Spring AS

Figure 9.7.1.1c Estimated Iberian sardine F(2-5) from various assessment models

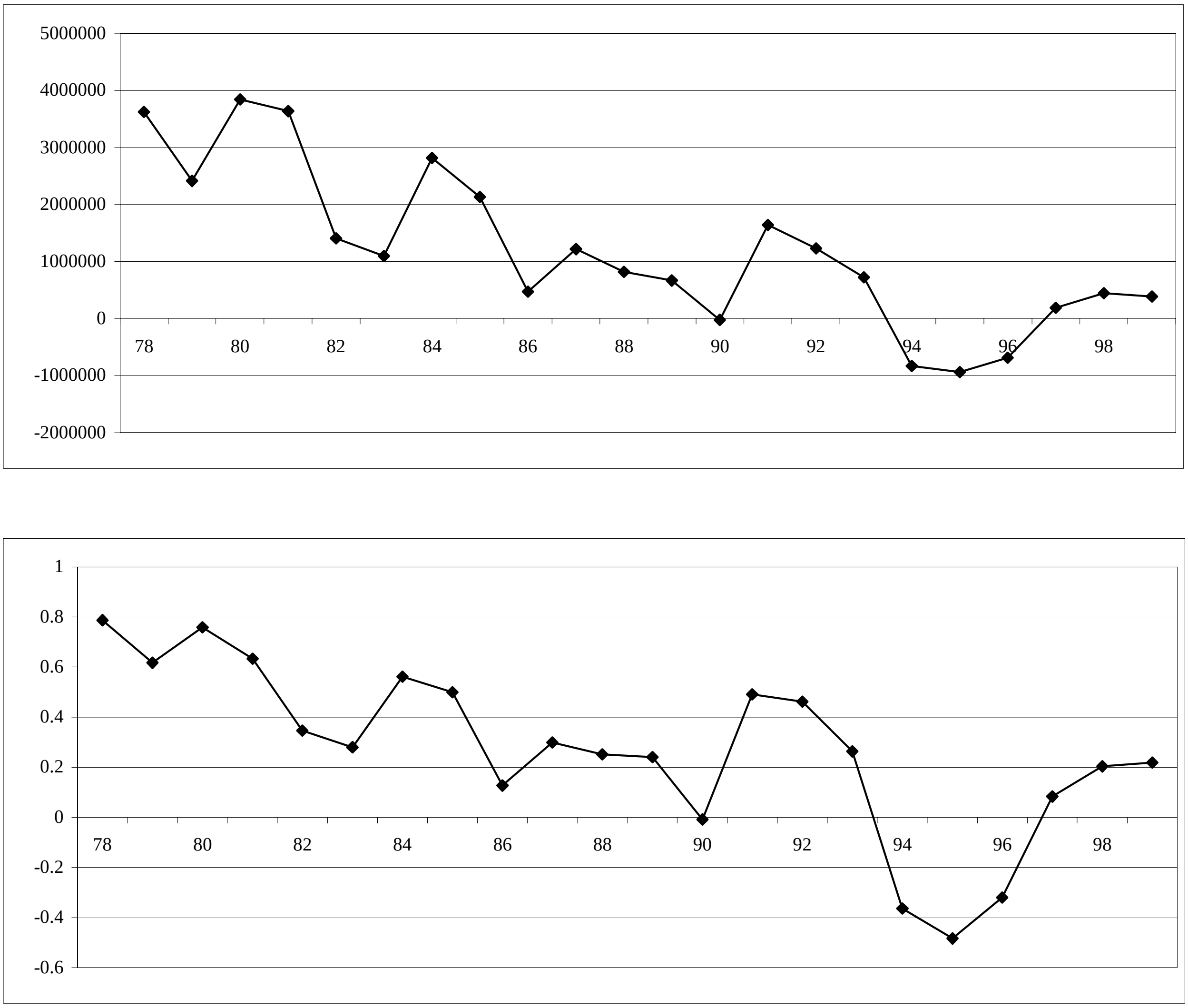
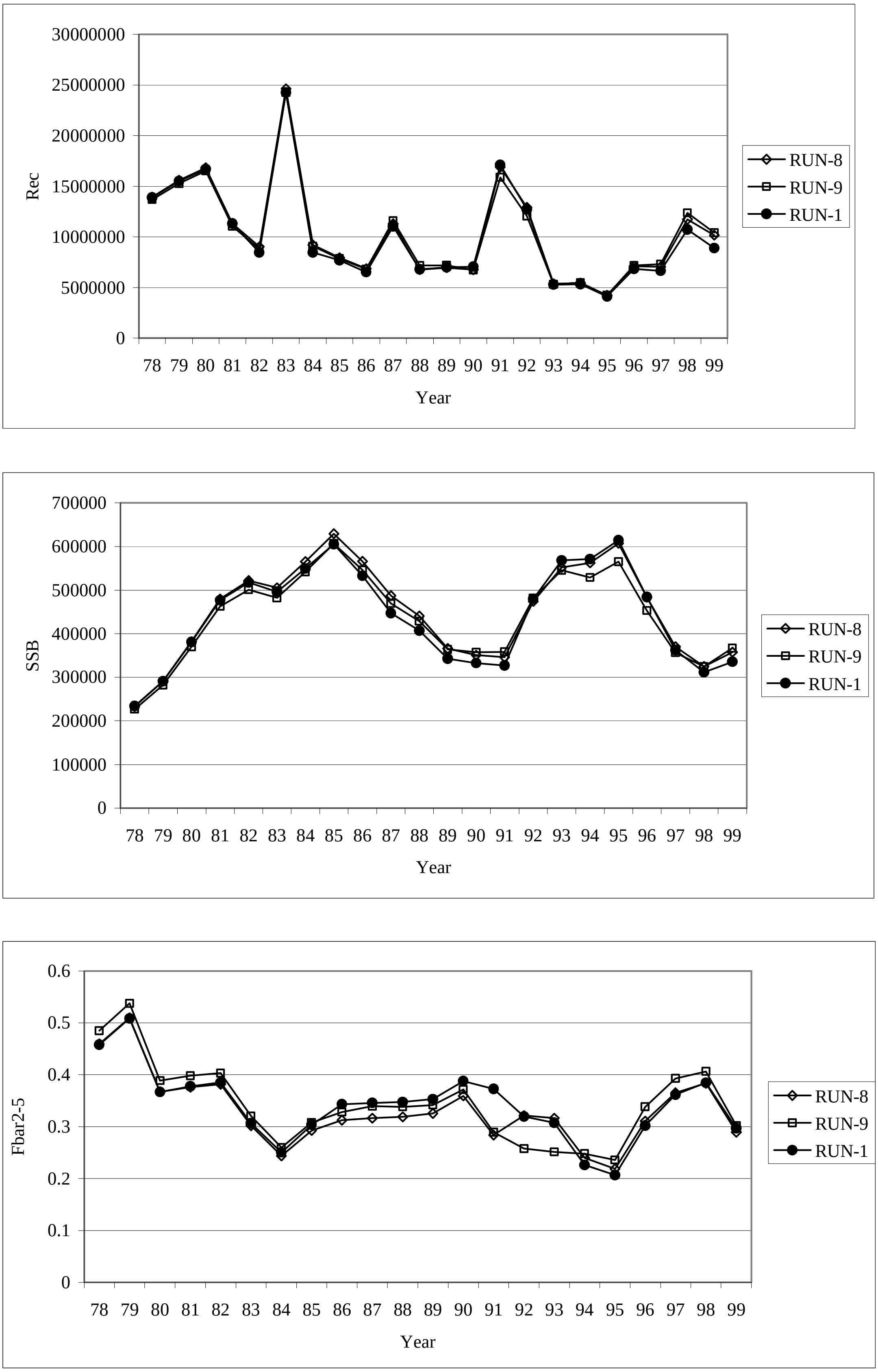


Figure 9.7.1.2: Differences in catches between younger fish (ages groups 0, 1 and 2) and older fish (3+). Upper pannel absolute numbers, lower pannel relative numbers.



RUN-8	Fitted model with Separable periods 1987-91 and 1992-99. Abrupt change assumed
RUN-9	Fitted model with Separable periods 1987-93 and 1994-99. Abrupt change assumed
RUN-1	**Fitted model with all the fleets (Reference Run)**

Figure 9.7.1.3: Estimated Iberian sardine recruitment, SSB, F(2-5) for different models with different separable periods.

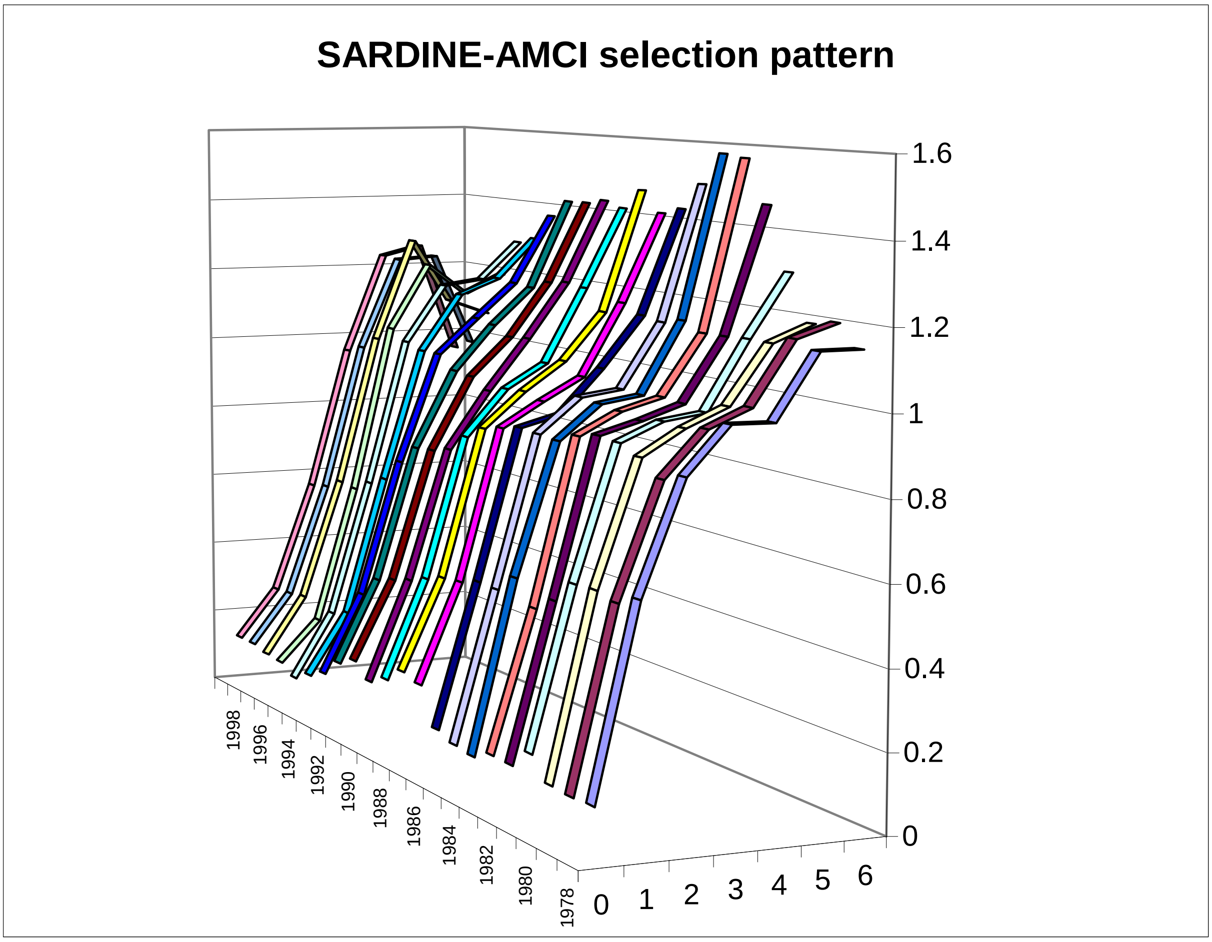


Figure 9.7.1.4: Fitted selection pattern for each year along the time series from AMCI model

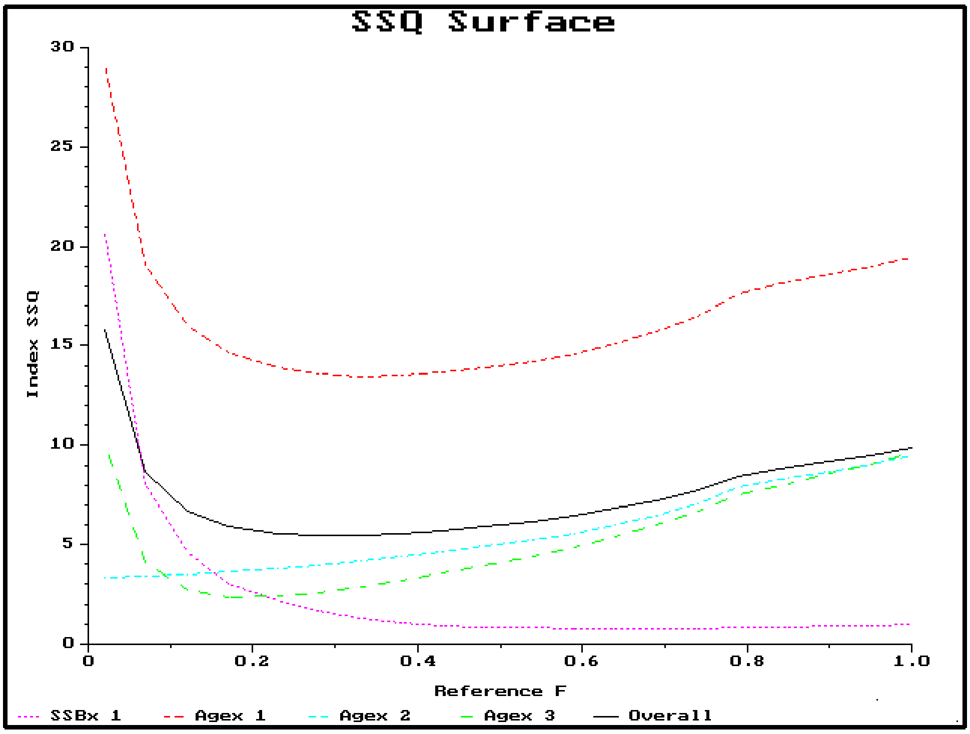
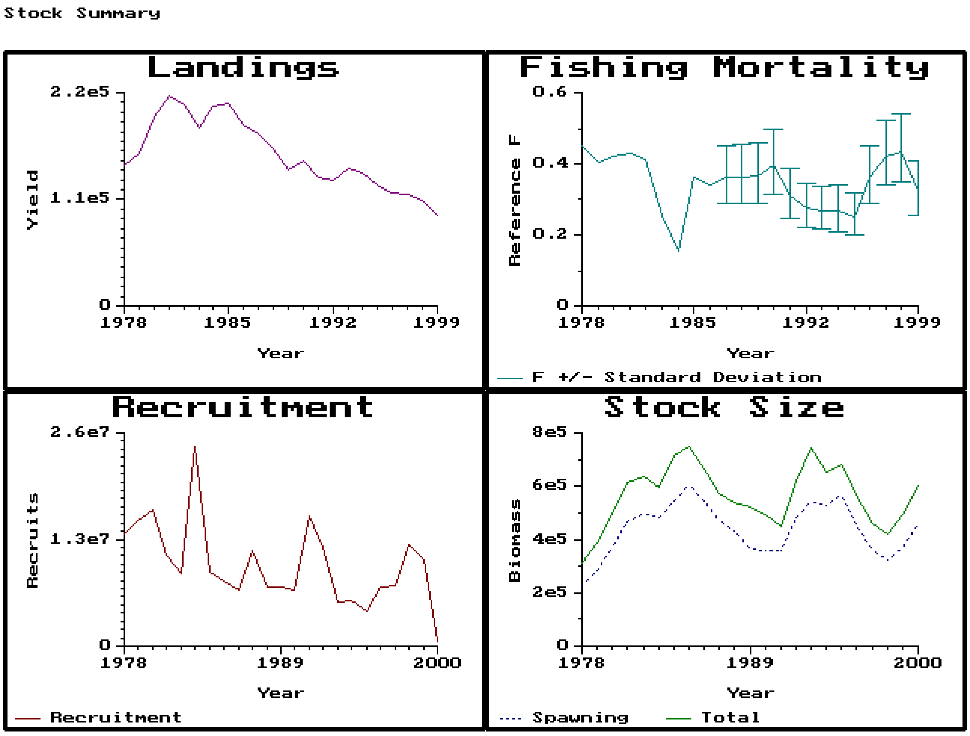


Figure 9.7.2.1 Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model. (SSBx1 is DEPM –absolute estimator-; Agex 1 is the Spanish Spring Acoustic survey time series –linear estimator-; Agex 2 is the Portuguese Spring Acoustic survey time series –linear estimator-; Agex 3 is the Portuguese Fall Acoustic survey time series –linear estimator-)



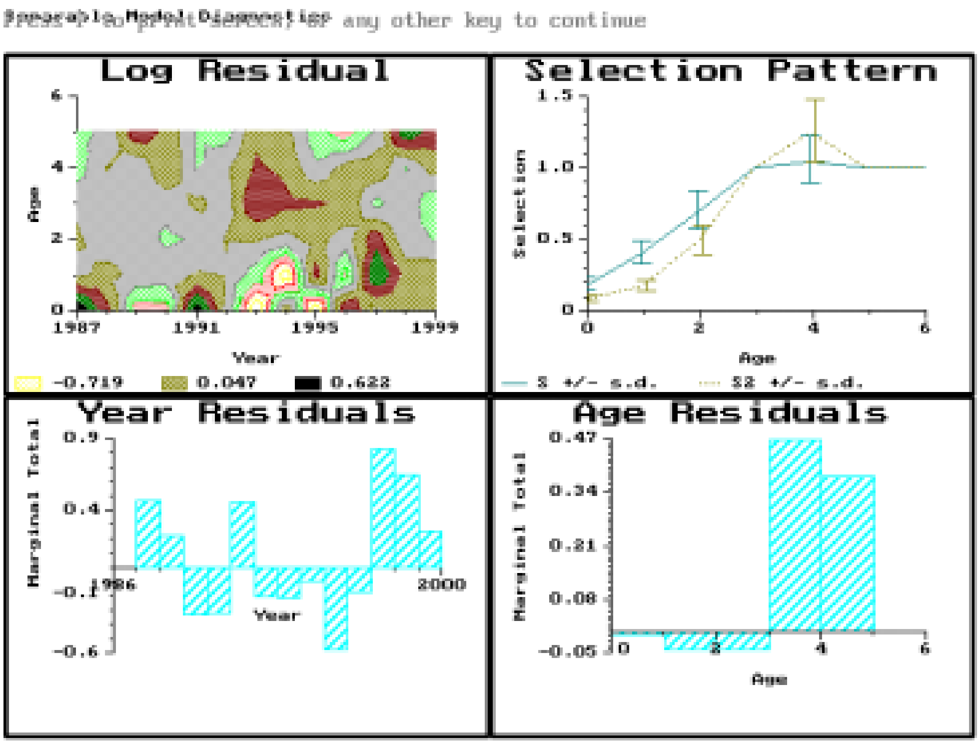
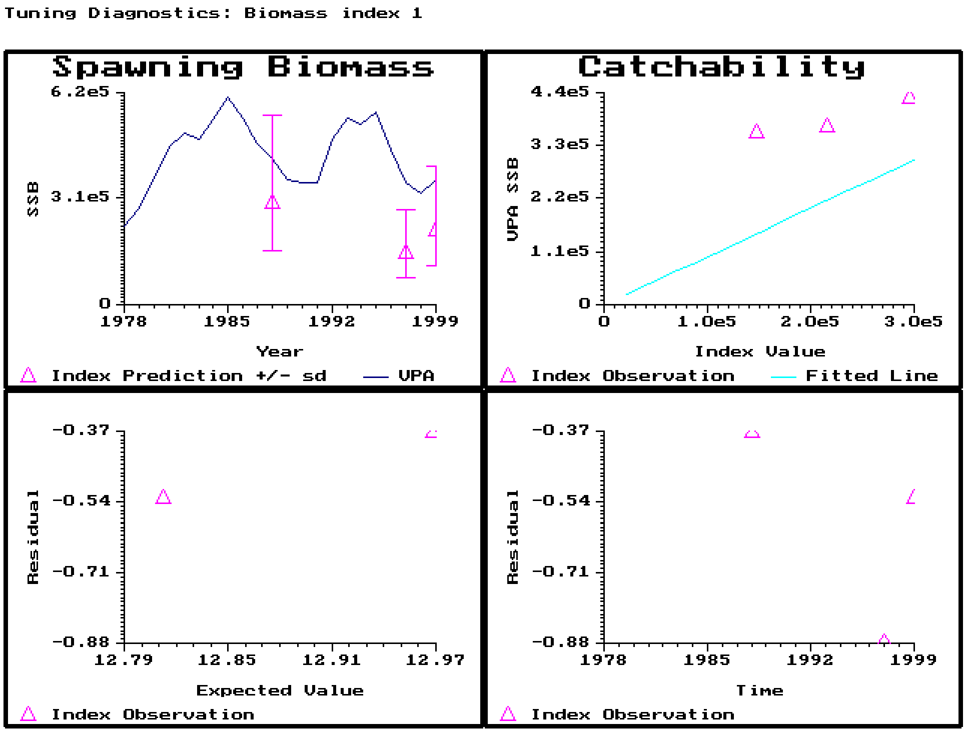


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.



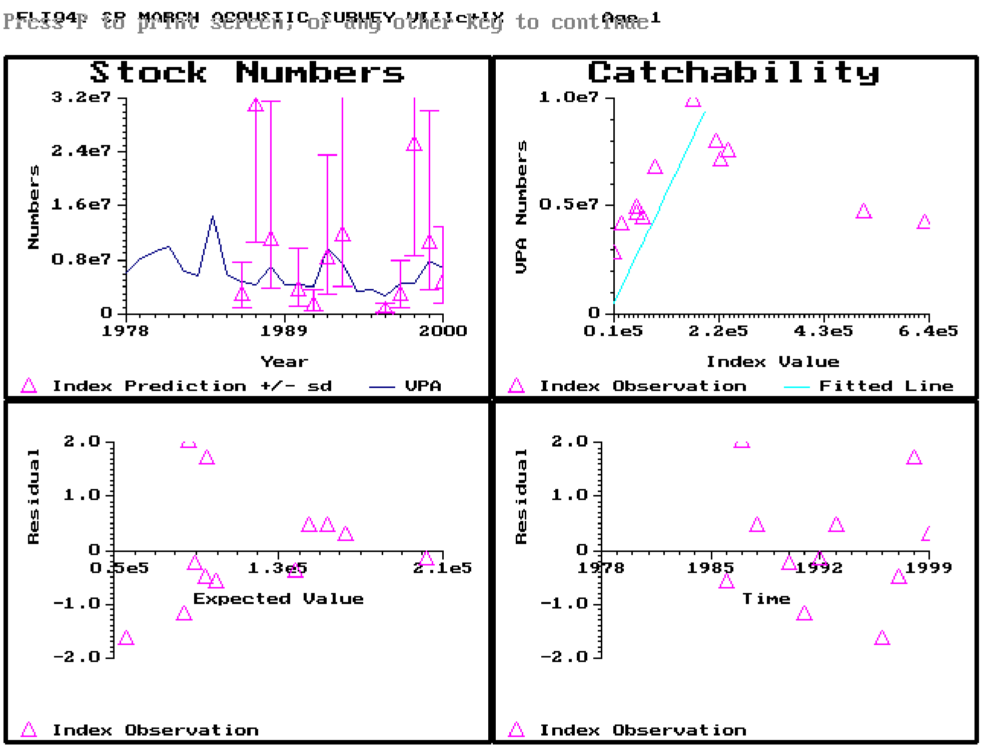
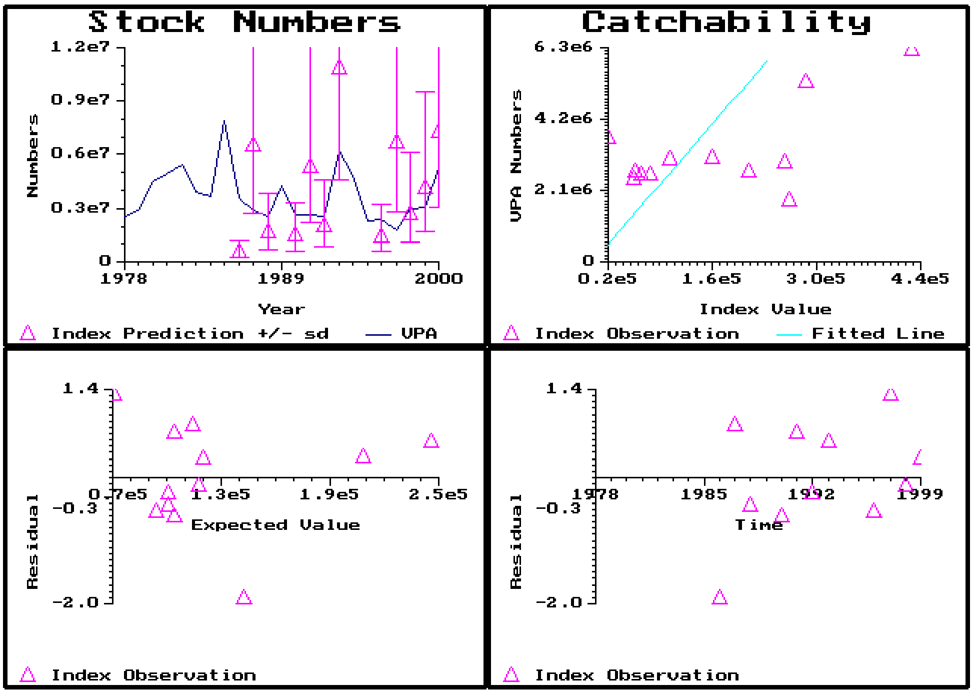


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX Age 2



FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX Age 3

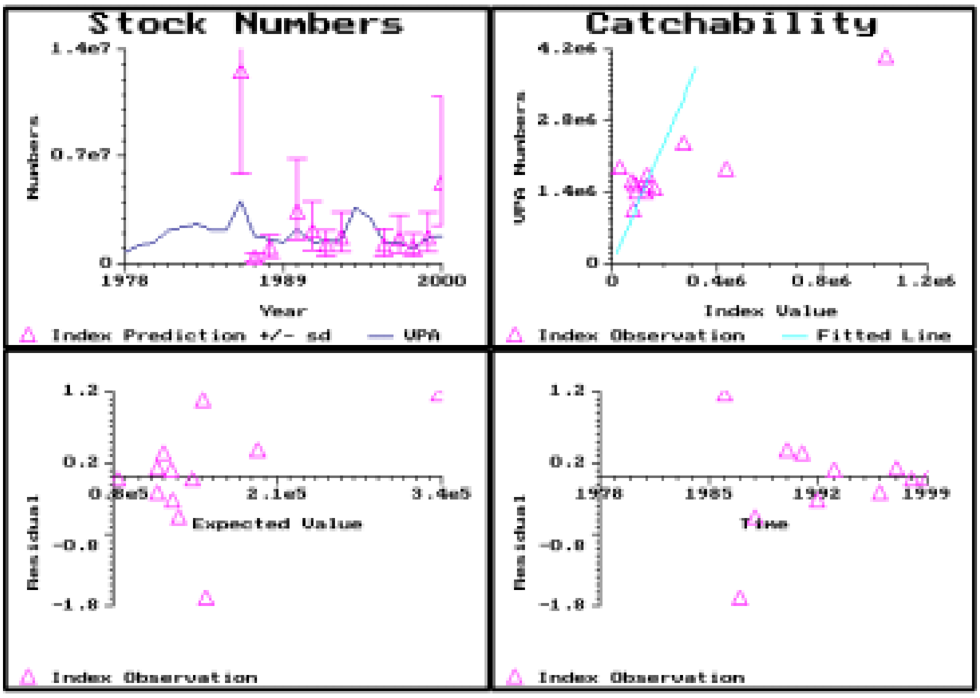
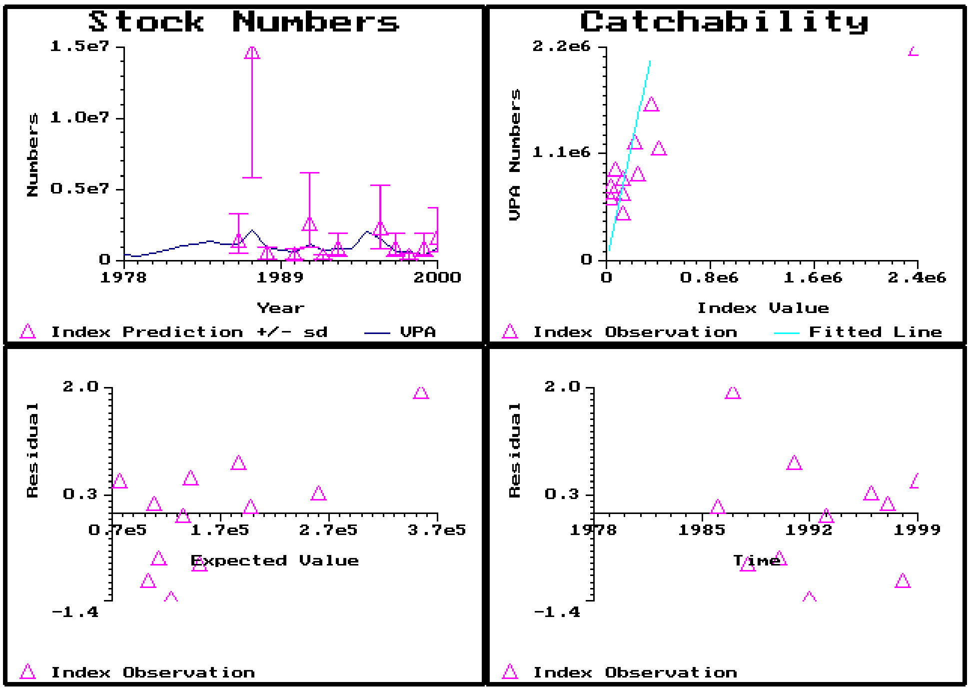


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX Age 4



Press 'P' to print screen, or any other key to continue

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX Age 5

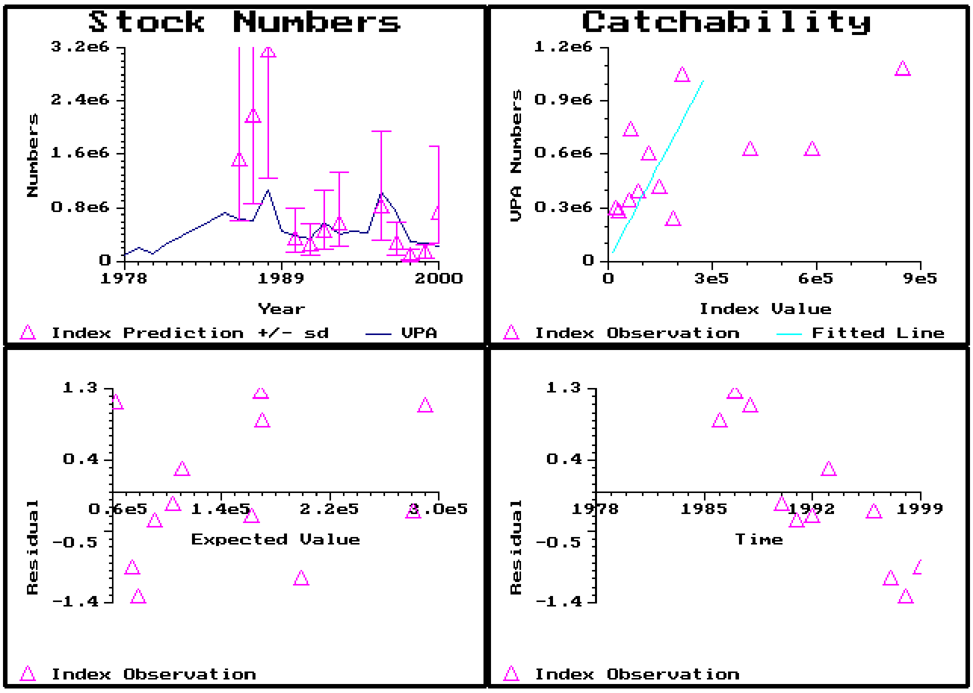
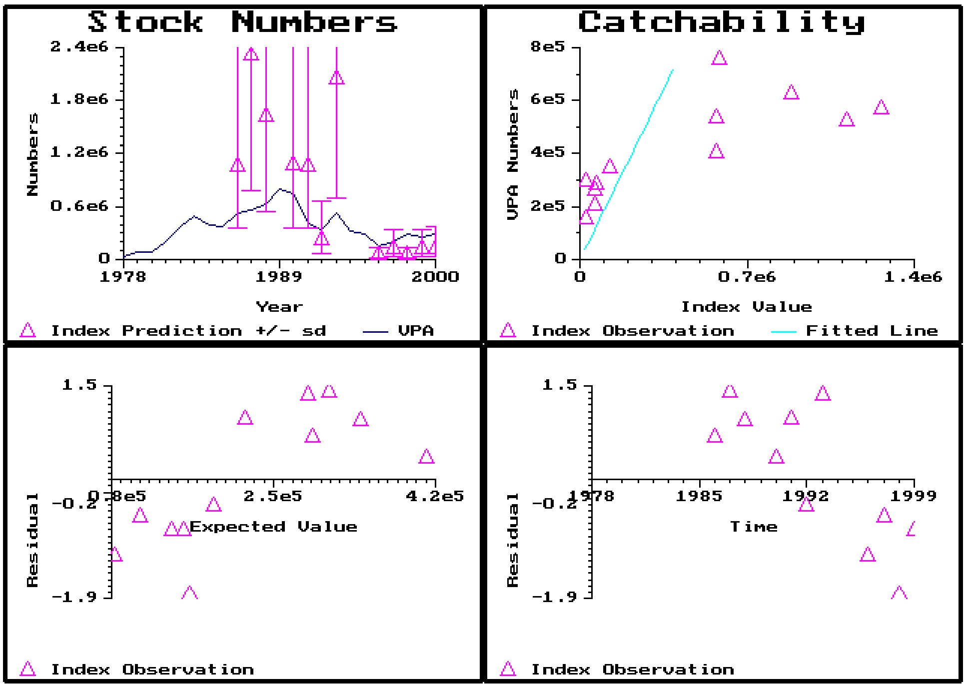


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX Age 6



FLT05P PT MARCH ACOUSTIC SURVEY INCL.CAD Age 1

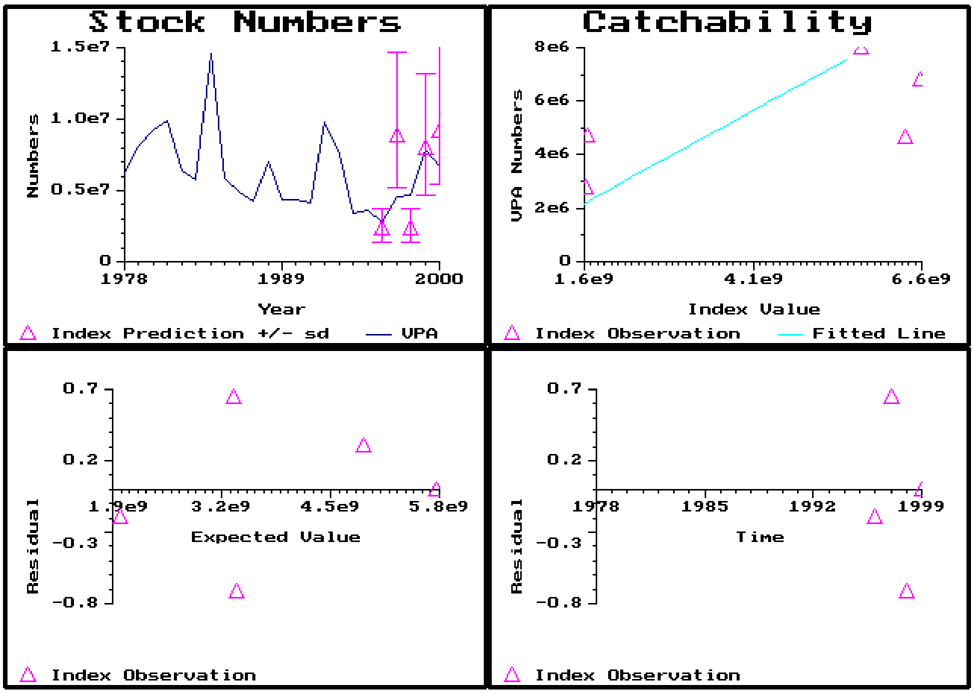
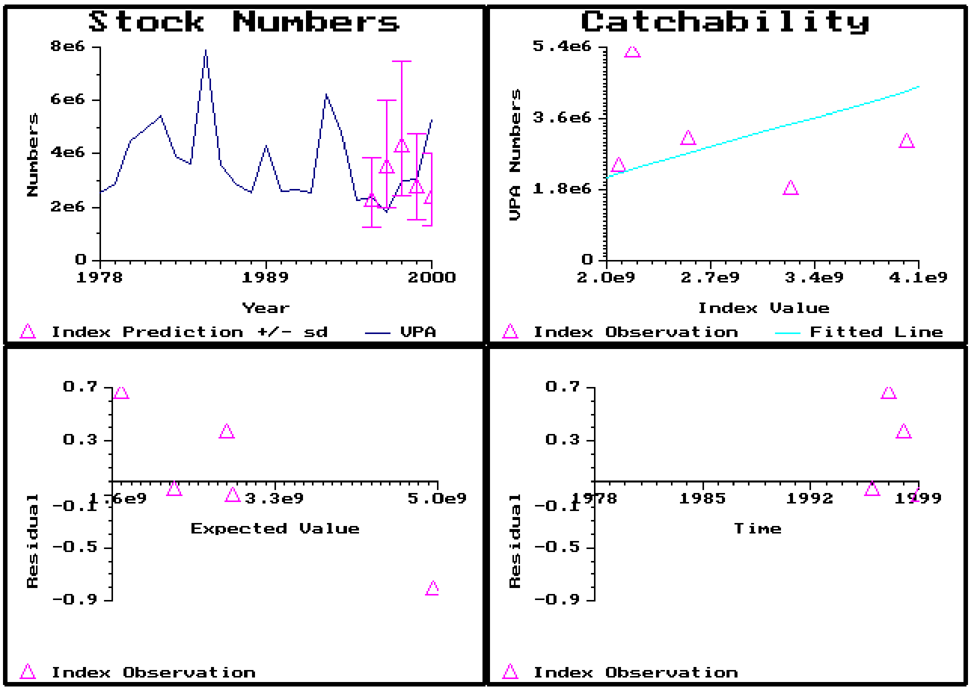


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CAD Age 2



FLT05: PT MARCH ACOUSTIC SURVEY INCL.CAD Age 3

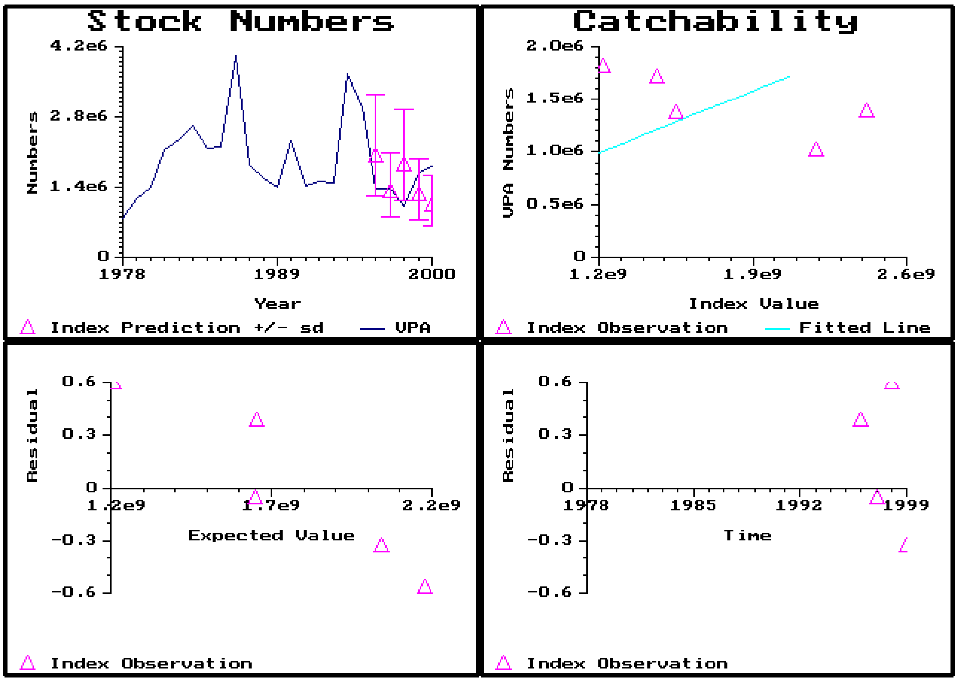
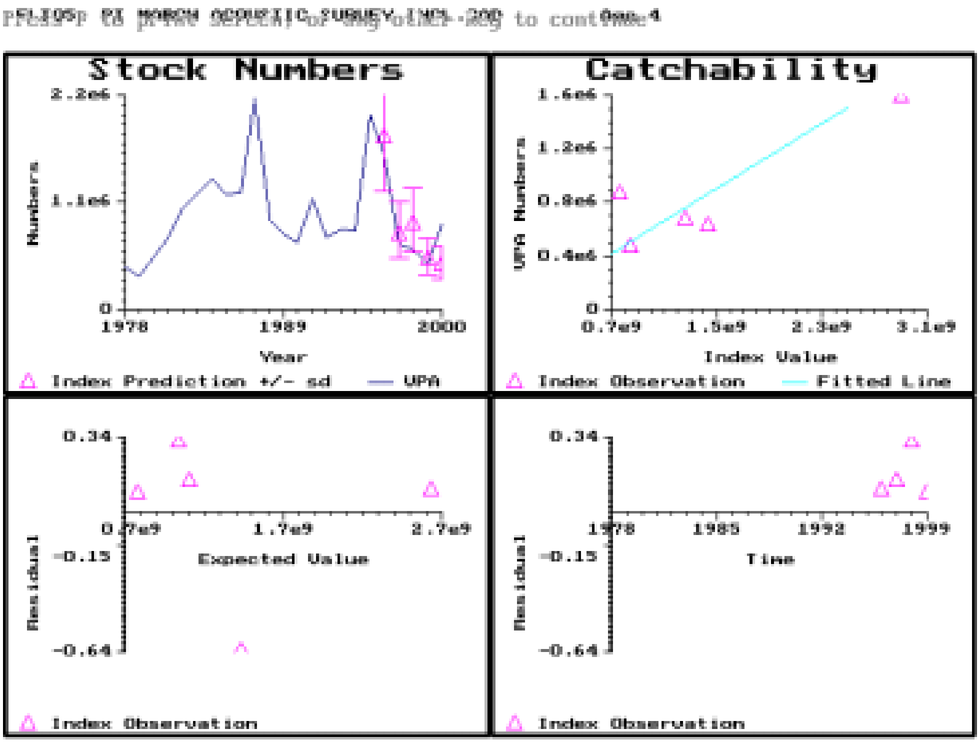


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.



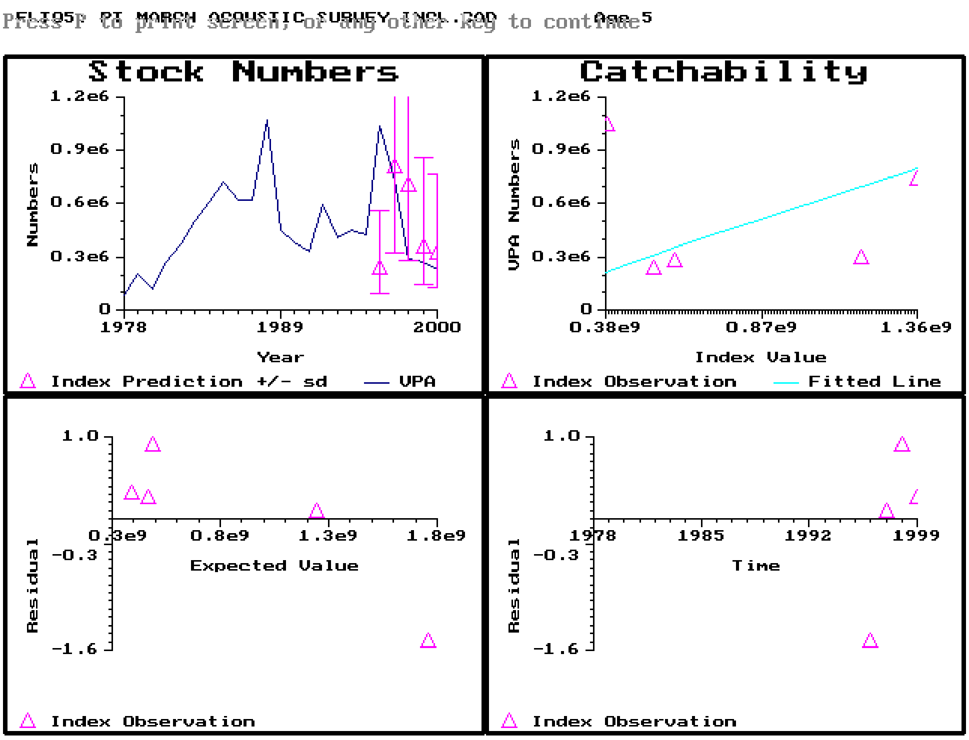
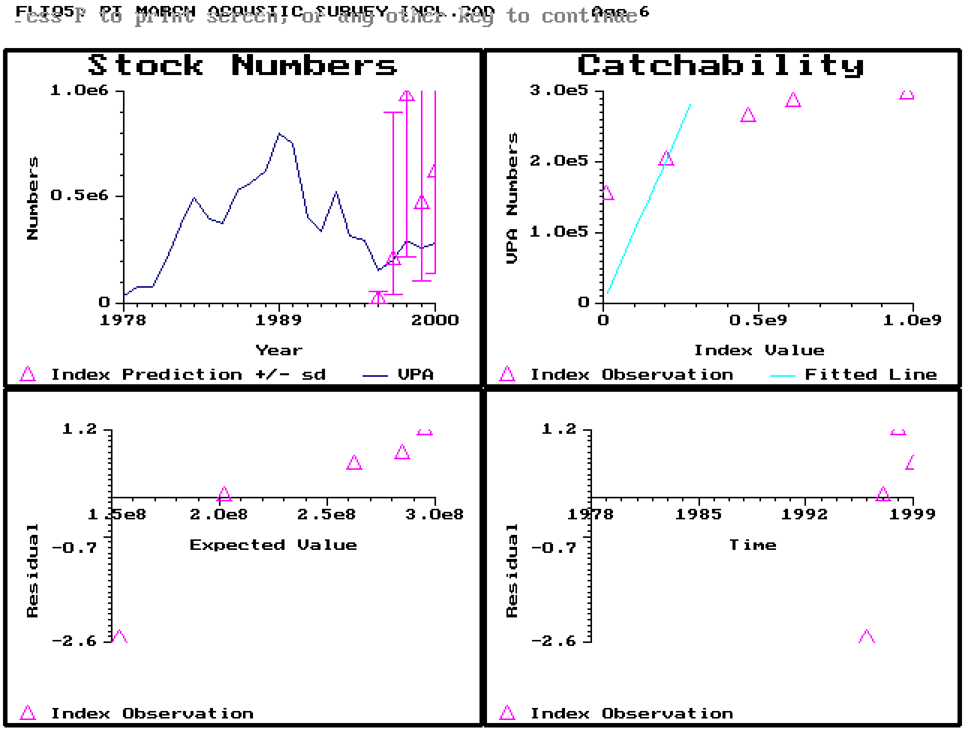


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.



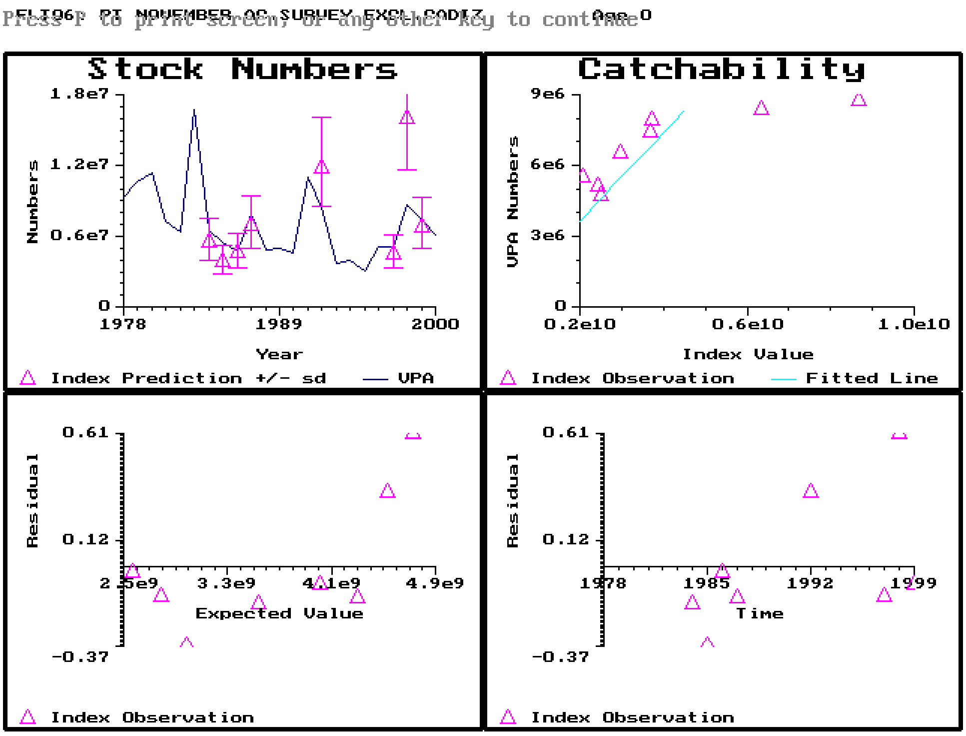
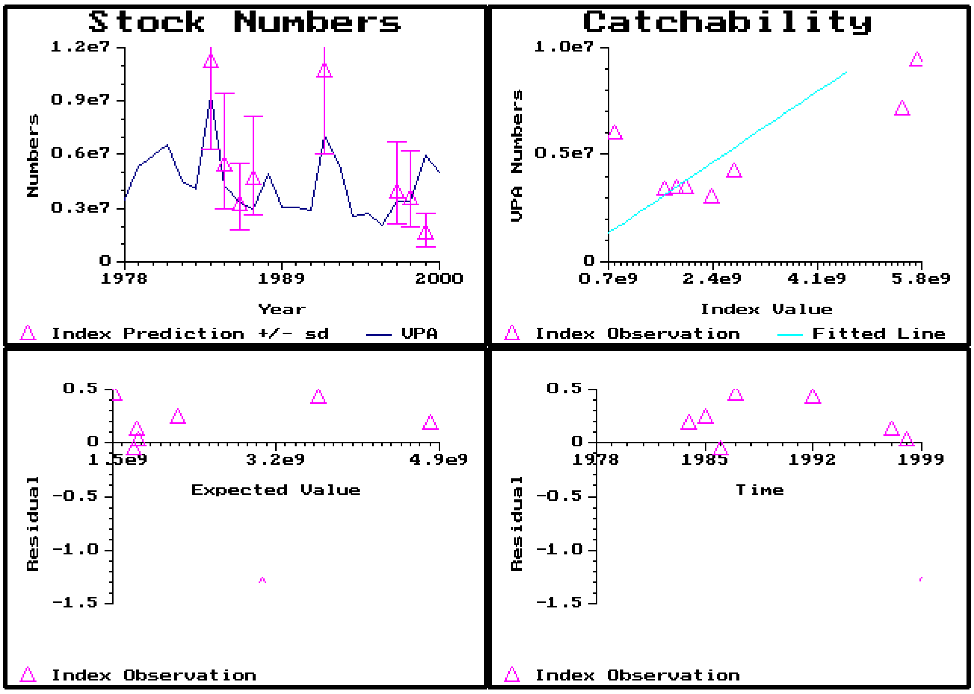


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Age 1



FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Age 2

Press P to print screen, or any other key to continue

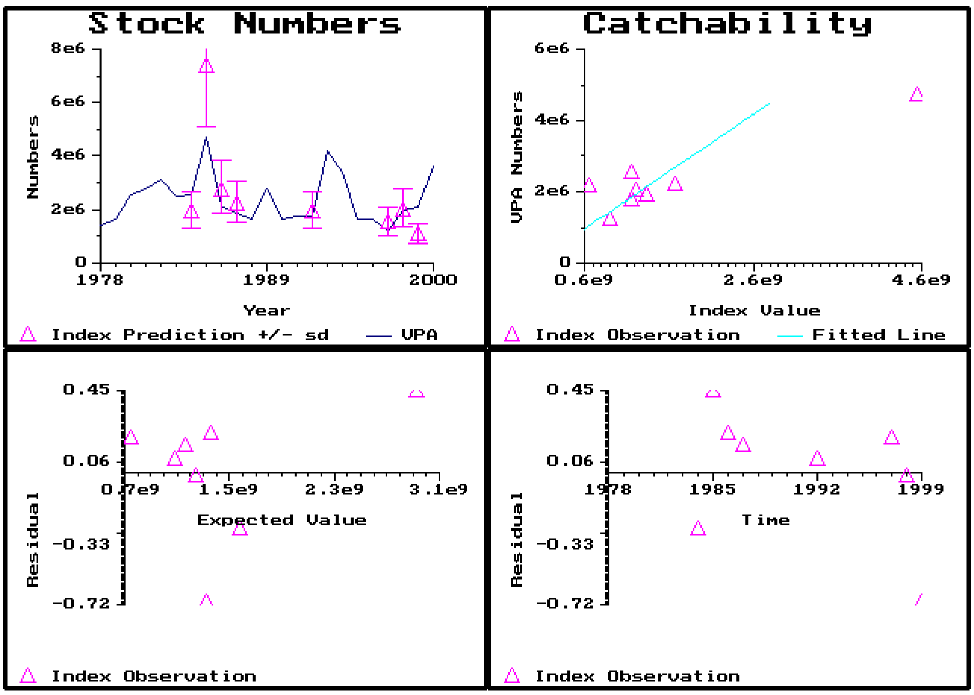
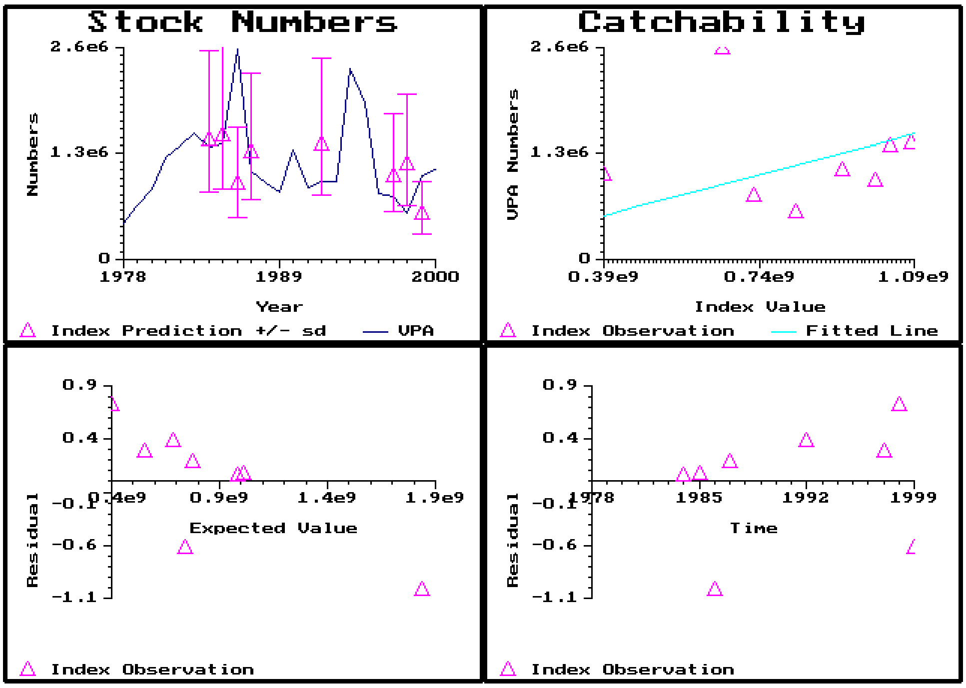


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Age 3



FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Age 4

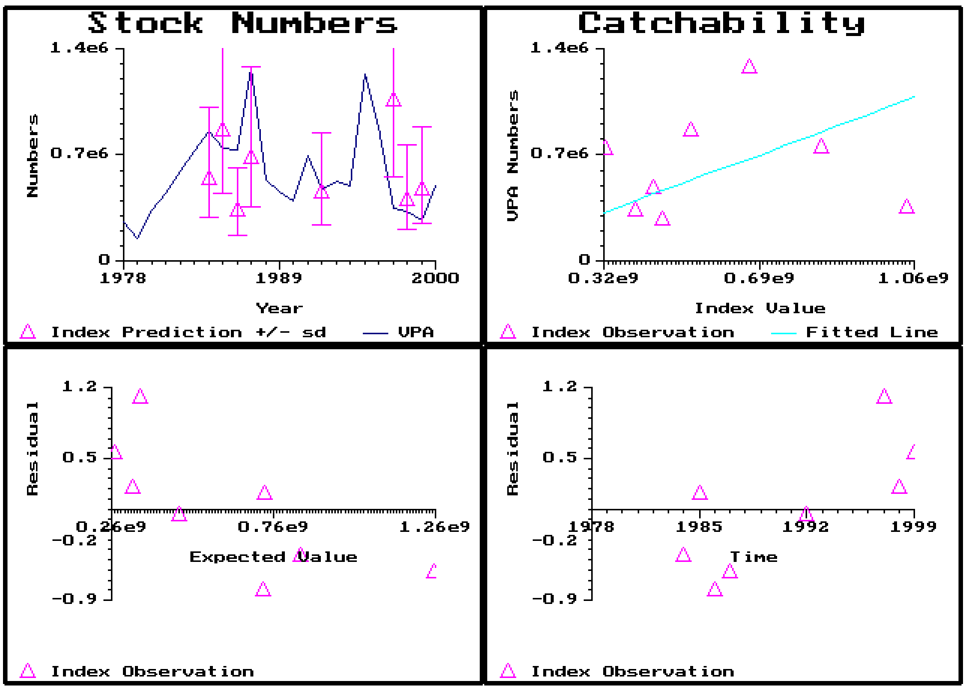
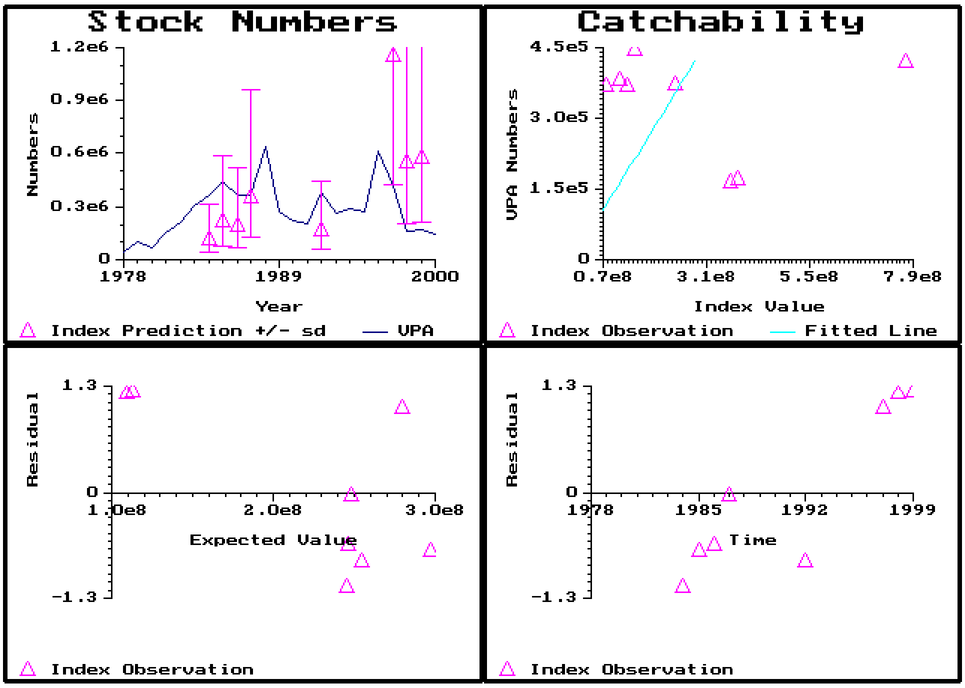


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ   Age 5



FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ   Age 6

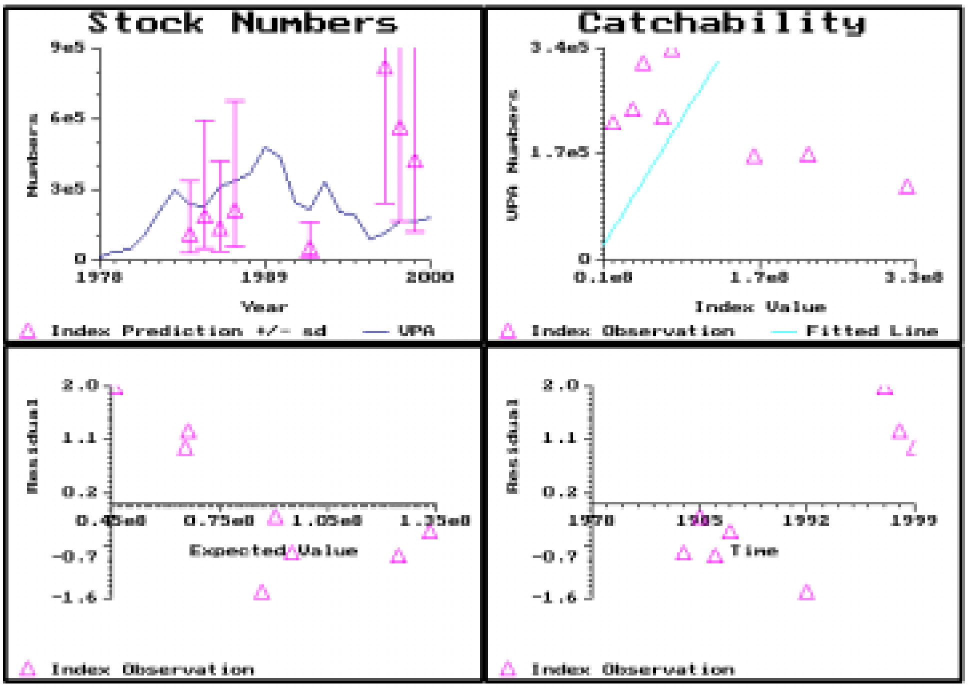


Figure 9.7.2.1 (cont): Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model.

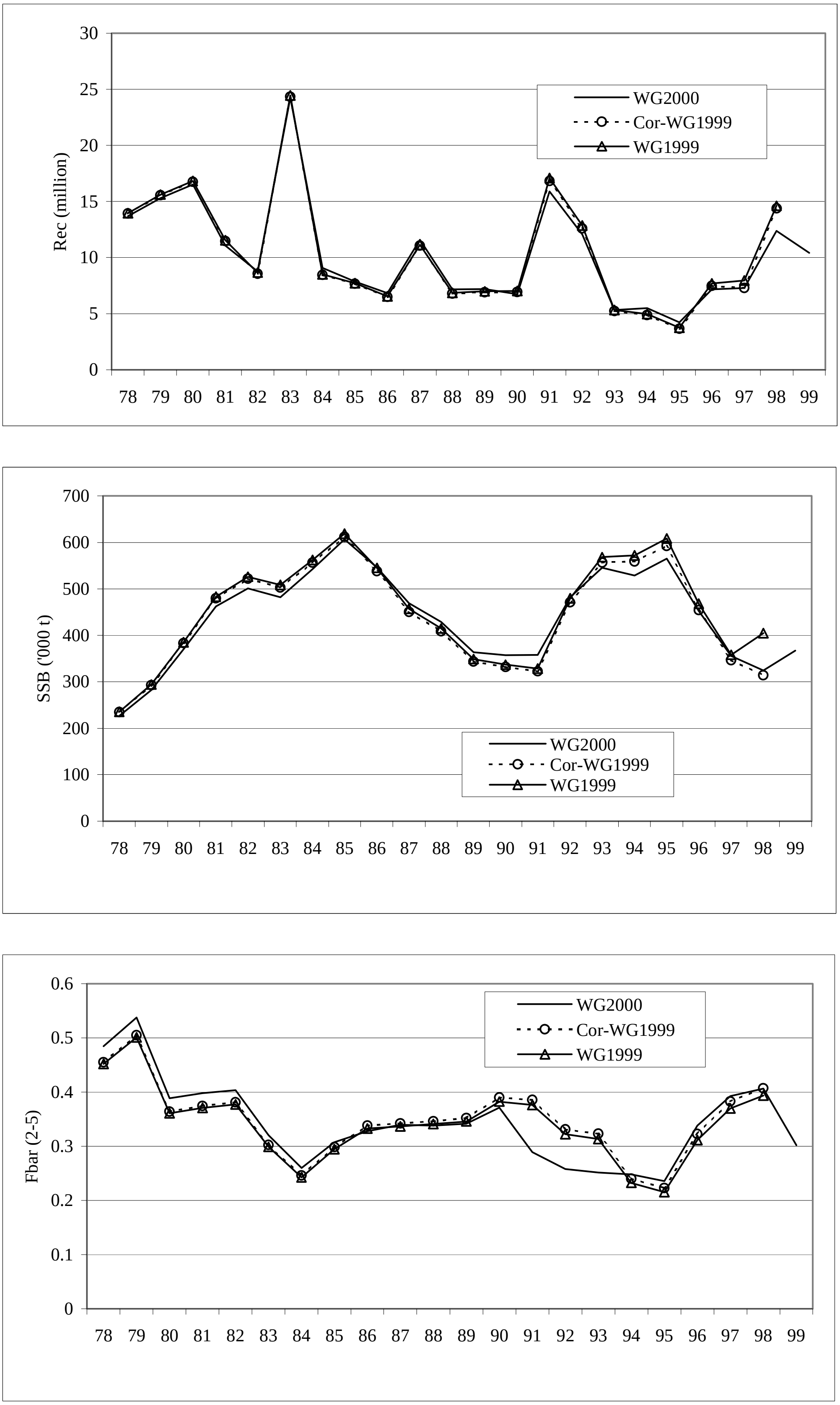


Figure 9.7.2.2: Comparative analysis of the assessment model. Dashed line corresponds to the estimation of the assessment model (with updated values for 1998 catch-at-age, 1998 weight-at-age in both stock catch). Line with triangle corresponds to the estimation of the last assessment.

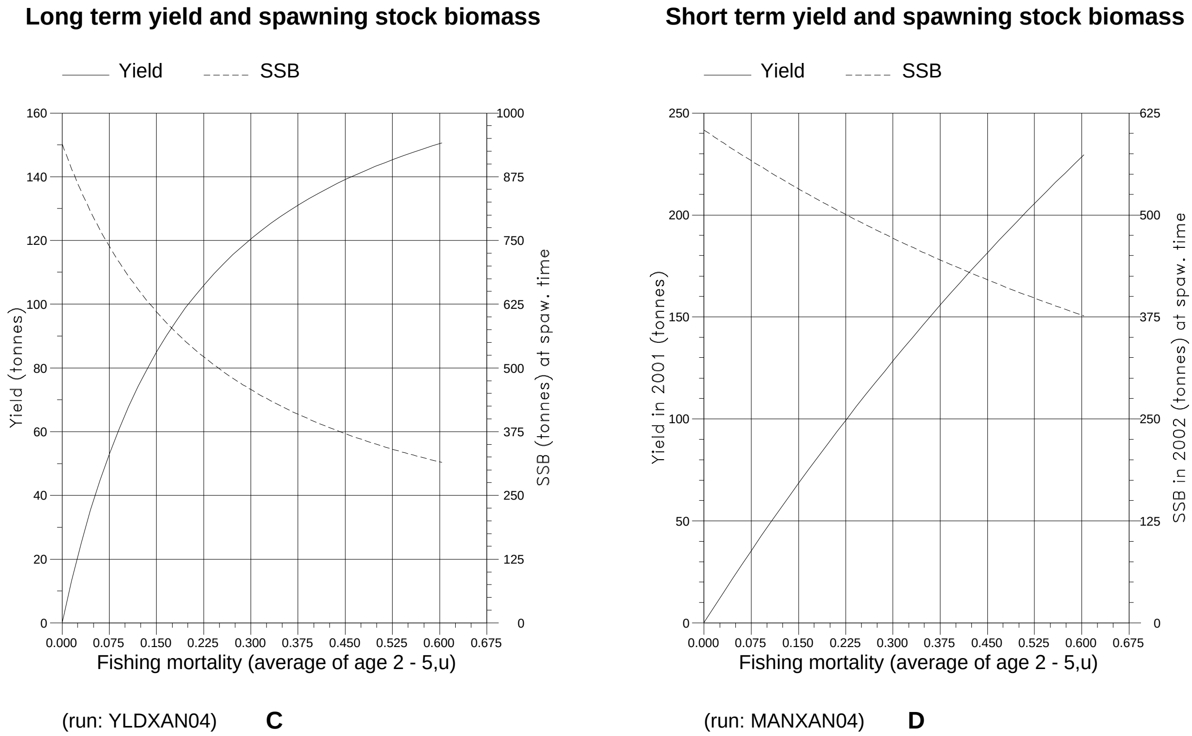

Long term yield and spawning stock biomass
Yield
SSB
Yield (tonnes)
SSB (tonnes) at spaw. time
0
20
40
60
80
100
120
140
160
125
250
375
500
625
750
875
1000
0.000
0.075
0.150
0.225
0.300
0.375
0.450
0.525
0.600
0.675
Fishing mortality (average of age 2 - 5,u)
(run: YLDXAN04)
C
Short term yield and spawning stock biomass
Yield
SSB
Yield in 2001 (tonnes)
SSB in 2002 (tonnes) at spaw. time
0
50
100
150
200
250
125
250
375
500
625
Fishing mortality (average of age 2 - 5,u)
(run: MANXAN04)
D

Figure 9.11.1

10 ANCHOVY – GENERAL

10.1 Stock Units

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

Some new observations made in 2000 during the Pelasses survey in winter suggest the presence of anchovy in the Celtic Sea (Carrera,2000). However, these informations are presently too scarce to change our opinion on the possibility to find a different stock unit in the North of the Bay of Biscay. This small stock is probably linked to the population of anchovy found in the Channel in spring by the professional fisheries.

Junquera (1993) suggested that anchovy in the Central and Western part of Division VIIIc may be more closely related to the anchovy found off the Western Galician coasts than with the anchovy at the South-east corner of the Bay of Biscay (where the major fishery takes place). Morphological studies, as mentioned previously, are influenced by environmental conditions and further investigations, especially on genetic characteristics, are necessary in order to be more certain. The Working Group considers that for assessment and management purposes the anchovy population along the Atlantic Iberian coasts (Division IXa) should be dealt with as a management unit independent of the one in the Bay of Biscay. There is a need for further studies on the dynamic on the anchovy in IXa and its possible connection with anchovies from other areas.

10.2 Distribution of the Anchovy Fisheries

The observations collected by the members of the Working group allowed to define the principal areas of fishing according to quarters. Table 10.2.1 shows the distribution of catches of anchovy by quarters for the period 1991-1999. In Sub-area VIII during the first quarter, the main fishery (predominantly by the French fleet) was located around the Gironde estuary from 44°N up to 47°N. During the second quarter, the main landings (predominantly Spanish) were caught in the Southern part of the Bay of Biscay (south of 45°N.), mainly in Sub-areas VIIIb and VIIIc. During the third quarter, the fishery was spread in the Bay of Biscay: the Spanish one in the Center and in the South and for the first time in the North (VIIIa,b and c) and the French one in the Center and the North (VIIIa mainly). During the fourth quarter, the main fishery is located in the North of the Bay of Biscay and some Spanish purse seiners stayed to fish in the North, but the main production remained the French one.

In Division IXa, the Portuguese landings in 1999 were low and most of the fish was caught as usually during the first and fourth quarter in Sub-division Central North. The Portuguese catches peaked 1995 (7056 tonnes) and since then they remained low. The Spanish fishery in 1999 was mainly located in the Bay of Cadiz. During 1999, in that area, the landings decreased reaching a lower level than the historical maximum for this area (8977 t) observed in 1998 and are relatively stable throughout the year without undergoing any significant rise in spring-summer as it was usual. The decrease of Spanish catches in IXa North since the maximum level in 1995 (5,329 t) is continuing in 1999.

The distribution of fisheries in the Sub-area VIII is rather constant during this period: the main fishing areas appeared in VIIIc and VIIIb in Spring (mainly landings from the Spanish fishery) and in the VIIIb and VIIIa during the rest of the year (mainly French fishery). Since the bilateral agreement between France and Spain in 1992 (see chapter 10.2), there is an increase of the catches in the VIIIa, particularly during the second half of the year.

Since 1998, the distribution of fisheries in Division IXa was situated in the Gulf of Cadiz (Sub-Division IXa South, except in 1995, when it was mainly found in the northern part of Division Ixa (Sub-Division Ixa North and Central North).

Historically, catches to the West of the Iberian Peninsula (from Subdivisions IXa Central and North) have shown episodic increases (Junquera, 1986 and Pestana WD 1996), probably due to environmental favourable conditions (Uriarte *et al*., 1996).

Table 10.2.1: Catch (t) distribution of ANCHOVY fisheries by quarters and total in the period 1991-1999.

Q 1	DIVISION IXa				SUB-AREA VIII					
Year	**IXa South**	**IXa CS**	**IXa CN**	**IXa North**	**VIIIc West**	**VIIIc Central**	**VIIIc East**	**VIIIb**	**VIIIa**	**VIIId**
1991	1049	2	6	1	126	0	36	2797	1259	-
1992	1125	0	26	0	0	187	756	3666	958	-
1993	767	0	3	1	0	69	1605	4147	1143	-
1994	690	0	0	0	0	5	62	4601	786	27
1995	185	1	203	12	0	0	35		2380	
1996	41	0	1289	11	116	61	9	2345	0	-
1997	908	6.0	164	2	12	43	58	1548	925	-
1998	1782	109	424	192	472			4725	0	
1999	1638	65	91	76	65			4008	0	0

Q 2	DIVISION IXa				SUB-AREA VIII					
Year	**IXa South**	**IXa CS**	**IXa CN**	**IXa North**	**VIIIc West**	**VIIIc Central**	**VIIIc East**	**VIIIb**	**VIIIa**	**VIIId**
1991	3692	0	10	14	90	295	5848	3923	650	-
1992	1368	0	10	0	11	457	17532	2538	275	-
1993	921	0	6	0	25	24	10157	6230	658	-
1994	2055	0	0	0	1	79	11326	6090	163	75
1995	80	7	1989	1233	23	36	14843		6153	
1996	807	1	227	6	1	404	9366	8723	0	-
1997	1110	2	49	4	0	81	4375	3065	598	-
1998	2175	0	191	51	2215			5505	0	
1999	1995	0	4	7	7138			4169	0	0

Q 3	DIVISION IXa				SUB-AREA VIII					
Year	**IXa South**	**IXa CS**	**IXa CN**	**IXa North**	**VIIIc West**	**VIIIc Central**	**VIIIc East**	**VIIIb**	**VIIIa**	**VIIId**
1991	703	0	0	0	24	15	145	386	1744	-
1992	499	0	4	27	192	390	632	191	4108	-
1993	167	0	0	0	1	8	1206	1228	6902	-
1994	210	8	29	1	61	6	1358	2341	3703	15
1995	148	52	1817	4043	1	10	55		3620	
1996	586	0	189	22	134	146	1362	171	6930	-
1997	2007	0	44	2	202	3	735	4189	2651	-
1998	2877	12	49	5	1579			205	11671	
1999	1617	0	139	318	949			351	5750	0

Q 4	DIVISION IXa				SUB-AREA VIII					
Year	**IXa South**	**IXa CS**	**IXa CN**	**IXa North**	**VIIIc West**	**VIIIc Central**	**VIIIc East**	**VIIIb**	**VIIIa**	**VIIId**
1991	274	0	171	0	205	692	148	91	805	-
1992	4	1	96	6	8	18	204	27	5533	-
1993	105	1	13	0	0	0	574	1005	5106	-
1994	80	0	198	116	6	13	895	341	2520	14
1995	157	271	2716	42	398	148	18		2080	
1996	398	12	1002	5	21	12	158	204	4016	-
1997	589	0	353	54	93	83	530	1225	1354	-
1998	2710	32	231	123	27			1	5217	
1999	692	30	723	12	98			0	4266	0

TOTAL	DIVISION IXa				SUB-AREA VIII					
Year	**IXa South**	**IXa CS**	**IXa CN**	**IXa North**	**VIIIc West**	**VIIIc Central**	**VIIIc East**	**VIIIb**	**VIIIa**	**VIIId**
1991	5717	3	187	15	445	1003	6177	7197	4458	-
1992	2996	1	136	33	211	1053	19122	6422	10874	-
1993	1960	1	22	1	26	101	13542	12609	13809	-
1994	3035	8	227	117	68	103	13641	13373	7172	130
1995	571	331	6725	5329	421	194	14951		14233	
1996	1831	13	2707	44	272	623	10895	11442	10946	-
1997	4614	8	610	62	307	210	5698	10027	5528	-
1998	9543	153	894	371	4294			10436	16888	
1999	5942	96	957	413	8249			8529	10016	0

Not available

11 ANCHOVY - SUB-AREA VIII

11.1 ACFM Advice Applicable to 1999 and 2000

ICES advice from ACFM in November 1999 states: "ICES recommends that there be no fishing of anchovy until there is evidence of recruitment which would bring SSB above B_{pa}. The 1998 year class is known to be weak while the 1999 year class is predicted to be weak based on environmental conditions. SSB is expected to decrease to unacceptable levels due to poor recruitment. A survey in April 2000 will provide additional information on the strength of the 1999 year class and this information will be reviewed by ICES when available."

As relevant factors to be considered in management, ICES further pointed out: "A strong reduction of the spawning biomass in 2000, linked to adverse environmental conditions, is expected to bring the stock below B_{pa}, even under conditions of no catches. For this reason, ICES advises that there should be no fishery. It is recognized that the state of the resource can change quickly, and therefore in-year monitoring and management could be appropriate."

The values of reference points proposed by ICES are B_{pa} = 36,000 t and B_{lim} = 18,000 t.

This approach to management is intended by ICES to be "consistent with the precautionary approach" in that it seeks to achieve a low probability of falling below the B_{lim} reference point, in accordance with international agreements on the precautionary approach to fisheries.

STECF endorsed the ICES advice. However, STECF also pointed out that at least two management options were possible for 2000:

Option A: Closure of the fishery and opening, if there is evidence that SSB is estimated to be above B_{pa} in 2000.

A closure of the fishery will give the maximum protection to the spawning stock biomass. The fishery can be opened if after the April survey there is sufficient evidence that the then fully mature 1999 year class will result in bringing the spawning stock biomass above B_{pa} in 2000. However, the fishery season will be quite advanced by then and a very fast decision should therefore be taken. In order to guarantee this, STECF recommends that a decision process is set allowing the possible reopening of the fishery on the 1st of May based on the preliminary spawning stock biomass estimate available at the end of April. If the preliminary spawning stock biomass estimate is above $B_{pa,}$ then a TAC for 2000 can be adopted for the remainder of the year.

Option B: No closure of the fishery in 2000 until survey data confirm that spawning stock biomass is expected to fall below $B_{pa.}$

Maintaining the fishery at a low level until the verification of the level of spawning biomass would be an option to consider. This would imply the setting of a low TAC for 2000. Then, if the spawning stock biomass at the end of April is confirmed to be above B_{pa}, the TAC could be revised upwards. Otherwise, the fishery would be closed. The level of the TAC should be set at a lower value than the expected catches at status quo fishing mortality corresponding to a period up to 30 April. In view of the observed seasonal pattern of fishing, about 24% of the catch is taken by that date. A TAC of 3000 t would guarantee that there is a decrease in fishing mortality of 80% while it is also close to the expected catches by 30 April (about 24% of the status quo catch forecast).

Considering these advices and the necessity to protect as much as possible the future of the stock and the fishery economy of the Bay of Biscay, the fishery council adopted a provisional TAC fixed at 16,000 tonnes, the half of the usual precautionary TAC, for 2000.

The Commission also acknowledged the need to enhance scientific and technical knowledge in order to define precautionary reference points for the management of the stock of anchovy in the Bay of Biscay. So, a scientific meeting conducted by STECF was held at Brussels to analyze from a managerial point of view the risk analysis.

The principal conclusions of workshop (STECF-SGRST report, 2000) are based on the comparison of revenue and biological risk in both a high-risk scenario (B1 = 36 000t, intermediate harvest model) and a low-risk scenario (B1 = 9000t, recent historic harvest model), both being considered plausible.

The comparison indicated:

Under conditions of high underlying biological risk, imposing closures is effective at avoiding stock collapses and in maintaining revenue. The calculation is fairly robust to the choice of value at which to close the fishery, in the range 18000 to 36000 t. Average revenue in the longer term, is roughly doubled by adopting a policy of closing the fishery at low stock sizes.

Under conditions of low underlying biological risk, imposing closures at low stock sizes does not, in the longer term, have a large impact on revenue (max. about 10% reduction) compared with the unregulated case.

However, data do not permit a view as to whether the 'high risk' or 'low risk' situation is closer to reality and the range of high-risk scenarios has not been explored fully.

In order to secure and updated decision of the anchovy TAC for 2000, the Commission convened at Brussels a meeting (29-31 May) under the auspices of STECF in order to analyze:

- The results of the acoustic and egg surveys conducted in April and May;
- The commercial catch rates observed during the first months of 2000;
- As far as possible, any physical and oceanographic features, such as upwelling index, allowing a forecast of the strength of the 2000 year class.

The re-assessment of the state of the stock by STECF in May 2000 with the new information gathered (DEPM and Acoustic surveys and catch data) resulted in a substantial increase in the perceived stock size: about 50,000 t at spawning time in May compared with previous ICES estimates of 25,000 t.

Finally, the managers decided to revise the provisional TAC and to bring the level to the usual precautionary level: 33,000 tonnes.

11.2 The Fishery in 1999

Two fleets operate on anchovy in the Bay of Biscay and the pattern of each fishery has not changed in recent years, however the relative amount of their catches have changed:

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

The major part of this fleet goes for tuna fishing in summer time and by then they use small anchovies as live bait for its fishing. These catches are not landed but the observations collected from logbooks and fisherman interview indicate that they are supposed to be less than 5 % of the total Spanish catches. For the first time in 1999, a part of the fleet came to fish in the VIIIa during summer and autumn and landed significant amounts of fish (see Table 11.2.1.3).

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

There are also some French purse-seiners located in the Basque country and in the southern part of Brittany. They fish mainly in the spring season in VIIIb and for a part of them in autumn in the north of the Bay of Biscay.

11.2.1 Catch estimates for 1999

In 1999 a total of 27,259 tonnes were caught in Subarea VIII (Table 11.2.1.1 and Figure 11.2.1.1). It is a 15.6% decrease compared to the level of 1998 catches. This decrease is due to the French fishery that had a 60 % decrease of these landings. At the contrary, the Spanish catches had a 55% increase. As usual, the main Spanish fishery took place in Spring (79%) and the main French fishery in the second half of the year (63 %) (Table 11.2.1.2 and Figure 11.2.1.2).

In 1999, as in other years, Spanish and French fisheries were well separated temporally and spatially. About 79% of the Spanish landings were caught in divisions VIIIc and VIIIb in Spring, while the French landings were caught in divisions

VIIIb in Winter (29.2 %) or in Summer and autumn in division VIIIa (63%) (Table 11.2.1.3). However, as mentioned previously, for the first time a significant number of Spanish purse seiners went in the North of the Bay of Biscay to catch anchovy during the summer and the beginning of autumn.

During the first half of 2000, total international catches reached 24,061 t (preliminary data) which is a higher level than the one reached for the same period in 1999. This increase is especially due to a good fishing season for the Spanish purse seiners. There has also been some increase in the level of French catches for the first semester. (see Tables 11.2.1.1 & 2).

11.2.2 Discard

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

11.3 Biological Data

11.3.1 Catch in numbers at age

The age composition of the landings of anchovy by countries and for the international total production are presented in Table 11.3.1.1. For both countries, the 2 age group largely predominates in the catches during the first semester. For the international catches, 2 year-old anchovies make up 51.2 % of the landings (61.5% for the first semester), followed by age 1 with 43.5%. As usually, the 0 and 3 age groups represented respectively a low proportion of the catches in 1999, respectively 3.6 and 1.8% for each category. Approximately 17% of the catches of anchovy (in numbers) consisted of immature fish prior to their first spawning in May.

The catches of anchovy corresponding to the Spanish live bait fishery for tuna fishing for the period 1987-1999 are given in Table 11.3.1.2. In 1999, catches at age 0 were higher than those of the previous year. Live bait catches of anchovy are rather variable depending on the availability of the different small pelagic species which are used as live bait by this tuna fishing.

Table 11.3.1.3 records the age composition of the international catches since 1987, on a half-yearly basis. 1-year-old anchovies predominate largely in the catches during the both halves of most of the years (except for the years 1991, 1994 and 1999). A few catches of immature, 0 age group, appeared during the second half of the year. The estimates of the catches at age on annual basis since 1987 is presented along with the inputs to the assessment in Table 11.7.2.1.

11.3.2 Mean length at age and mean weight at age

Table 11.3.2.1 shows the distribution of length catches and the variation of mean length and weight by quarters.

For the first quarter, the main fishery that is the French one, fish, medium size anchovy (grade of 50), in the central part of the Bay of Biscay (Figure 11.3.2.1).

For the second quarter, the length distribution of the Spanish fishery, the main one showed a bimodal distribution. For the French landings, the smaller group corresponds mainly to the production of small purse-seine and pelagic trawlers fishing close to the shore. (Figure 11.3.2.2).

For the third quarter, the French and Spanish landings had some different length distributions. This is probably due to the fact that the major part of the Spanish catches was made in the South of the Bay of Biscay whereas the French catches were made in the North. We can notice for the French catches a bimodal distribution, the inferior fraction corresponds to the anchovy caught off the coast by the smaller boats. (Figure 11.3.2.3)

For the fourth quarter, the size distribution of the French and Spanish landings were similar. That corresponds to productions caught off the North of the Bay of Biscay by the two fisheries. (Figure 11.3.2.4).

The series of mean weight at age in the fishery by half year, from 1987 to 1999, is shown in Table 11.3.2.2. The French mean weights at age in the catches are based on biological sampling from scientific survey and commercial catches. Spanish mean weights at age were calculated from routine biological sampling of commercial catches.

The series of annual mean weight at age in the fishery is shown with the inputs to the assessment in Table 11.7.2.1. These annual values for the fishery represent the weighted averages of the half-year values per country, according to their respective catches in numbers at age.

The values of mean weight at age for the stock appear with the inputs to the assessment in Table 11.7.2.1. These values are the ones estimated for the spawners during the DEPM surveys of 1990-1998 (reported in Cendrero ed., 1994 and Motos et al., WD 1998 and Uriarte et al., WD 1999). For the years 1993 and 1996, when no estimate of mean weight at age for the stock existed, the average of the rest of the years has been taken.

11.3.3 Maturity at Age

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

11.3.4 Natural Mortality

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

In the framework of an international project between France and Spain (Project 95/018), a statistical approach to get better estimates of natural mortality has been carried out. This approach used DEPM information and trends in CPUE of some French pelagic trawler fleet chosen as reference. In that study, we use as inputs the estimates given by the DEPM for the level of abundance of SSB. Given that level, we use as a decreasing trends the Z estimates calculated from the CPUE values of the French reference fleets. Finally, we try to appreciate the degree of convergence among the level of abundance in June of the next year calculated as indicated above and the level of SSB given by the DEPM for the next year. The main results are shown in the following table (after Prouzet *et al*, 1999).

Cohort	Z est.	Confidence interval of Z (90%)		F est.	Confidence interval of F (90%)		M est.	Confidence interval of M (90%)	
1986	1.16	0.75	1.57	0.59	0.34	0.97	0.57	0.13	0.98
1987	4.56	3.41	5.70	0.98	0.58	1.67	3.59	2.69	4.61
1988	1.93	1.70	2.17	0.63	0.50	0.78	1.30	1.05	1.54
1989	3.76	2.90	4.62	0.71	0.43	1.14	3.01	2.15	3.73
1990	1.94	1.68	2.21	1.2	0.87	1.67	0.74	0.36	1.05
1991	1.92	1.58	2.25	0.43	0.27	0.74	1.48	1.12	1.82
1993	2.67	2.18	3.16	1.01	0.68	1.54	1.65	1.07	2.14

From the results obtained, M (natural mortality) can vary widely among years and it seems that the assumption of a constant M use for the current management procedure is a strong simplification of the actual population dynamic.

11.4 Fishery-Independent Information

11.4.1 Egg surveys

Egg surveys to estimate the spawning stock biomass (SSB) of the Bay of Biscay anchovy through the Daily Egg Production Method (DEPM) have been implemented from 1987 to 2000, with a gap in 1993 (Table 11.4.1.1). A review of the most recent surveys since 1995 was presented in Uriarte *et al*. (WD1999) (for the years 1995, 1997, 1998 and 1999. This year a new WD (Uriarte *et al*., 2000) provides the final estimate of the Spawning Biomass in year 2000 according to the positive spawning area and the total egg production.

Besides, this document revises as well the results of the 1994 DEPM survey for Bay of Biscay anchovy assessment (Motos et al., 1995), according to the revision of the Spawning frequency AZTI is making of the whole set of DEPM surveys and the revision of the ageing procedures of the eggs and egg production estimates (Uriarte et al. 2000WD). The biomass estimate for that year turned out to be 60,062 t, which is as expected smaller (by about 10,000 t) than the one originally estimated by Motos et al.(op. cit.). This is mainly due to the drop in the egg production estimate.

The spawning area, and total egg production estimated from the survey in 2000 is presented in Table 11.4.1.1. The map of egg abundance and the positive spawning area is shown in Figure 11.4.1.1.

With the new estimate of biomass for 1994, the set of the DEPM biomass (SSB), spawning area (A) and egg production per surface unit (P0) was revisited to establish the best multiple relationship of the two latter to predict the SSB. This relationship was used to update the estimates for the 1996 and 1999 and produce the figure for the current year 2000. In all these years only the total Egg production is available, due to the lack of adult sampling. The model is similar to the one defined by Uriarte et al., 1999 (WD 1999) and similar to the one used in the previous year working group (ICES CM1999/ACFM:6). The model is such as:

$LN(SSB) = \alpha LN(P0) + \beta LN(A) + cste + \xi$,

With P0: daily egg production per 0.05 m^2 and A: positive spawning area. The constant term give us a mean estimate of the inverse of the daily fecundity. The parameters were fitted to the complete set of surveys (excluding the repeated June estimates of 1989 and 1990, for which there are other estimates produced by surveys in May) (Uriarte *et al*. WD2000):

Dependent variable: Ln BIOMASS

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	-2,8227	1,01948	-2,76878	0,0277
Ln po	0,707834	0,159838	4,42845	0,0030
Ln sa	1,19684	0,102478	11,679	0,0000

R-squared = 97 %   R-squared (adjusted for d.f.) = 96 %, Standard Error of Est. = 0,137639
Mean absolute error = 0,0860291

The spawning area and the egg production estimates arising from the DEPM surveys are in Table 11.4.1.1.

That allows defining the following biomasses:

BIOMASS(tons)	1996	CV(%)	1999	CV(%)	1999+	CV(%)	2000	CV(%)
F(Po,SA)May	39,545	16.0	63,115	14.8	69,074	15.1	44,973	14.5

Summary of the Predictions for the SSB according to the different analysis. The log predictions were transformed to original scale including a biass correction factor as $SSB = \exp(\hat{y} + \frac{1}{2}\sigma^2)$. The estimate selected for 1999 is 1999+, which includes the addition for an extra area corresponding to a radial to the north of the surveying area because it was presumed that the northern edge of the spawning was not fully covered by the survey (Uriarte et al., WD2000).

These estimates turn out to be almost identical to the ones already provided to previous working groups and, in the case of 2000, almost identical to the one provided in May to the European Commission (ad hoc STECF meeting).

The 2000 estimate confirms a decreasing trend in the Biomass since 1998, similar to the one recorded during 1992-1996 (Figure 11.4.1.2). The drop of biomass is however not so sharp as the one predicted by ICES (2000/ACFM:5), and this is certainly due to a lesser decrease of recruitments (specially for 1999) than foreseen last year. The spatial distribution of the eggs production is not fully concordant with the biomass distribution obtained in the acoustic survey, while the egg survey suggest a stronger biomass in the south (young and old anchovies), the acoustic suggest a stronger biomass to the north mainly of one year old anchovies.

Since the beginning of the use of the DEPM survey to assess the status of the Bay of Biscay anchovy, the estimates provided for 1989 have been considered downward biased as suggested by their authors (Motos and Santiago, 1989). For these reasons, there have always been raised by 1 standard deviation of that estimate for the purposes of the assessment.

11.4.2 Acoustic surveys

The French acoustic surveys estimates that are available up to now (since 1983) are in Table 11.4.2.1 The figures for 1991 and 1992 were revised and updated for a FAR programme on anchovy (Cendrero ed., 1994). In 1993, 1994 and 1995, only observations concerning the ecology of anchovy, especially located close to the Gironde estuary (one of the major spawning areas for anchovy in the Bay of Biscay) were made. In 1997, a new acoustic survey was performed for anchovy in the French waters, mainly to study the behaviour of the species in the central part of the Bay (close to the Gironde estuary) and to investigate the relationships between ecology of anchovy and its environment.

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

In 2000, within the frame of the EU Study Project PELASSES, a series of co-ordinated acoustic surveys have been planned covering the continental shelf of south-western part of Europe (from Gibraltar to the English Channel).

The main objective of these cruises was the abundance estimation using the echo-integration method of the pelagic fish species present off the Portuguese, Spanish and French coast.

Surveys were conducted in spring, using two research vessels: R/V Noruega for the southern area (from Gibraltar to Miño river) and R/V Thalassa for the northern area (North Spain and France).

The first survey (PELACUS 0300) was organised by the Spain (IEO). The survey track is shown in Figure 9.3.2 (see chapter 9.3 on the Sardine).

The survey was divided in two phases. First part from 17th March to 25th covering the most northern area (ICES Division VII) and from 28th March to 13th April covering the Spanish area. Data analysis is described in Porteiro *et al*. (1996). Basically echo-integrated energy (back-scattered energy expressed in m^2/nmi^2) is allocated into fish species by scrutinising of the echo-traces and/or according to the fish proportion found at the fishing stations weighted by a TS/length relationship.

Anchovy was found in the northern part of the Bay of Biscay (off the Brittany coasts). In addition a scarce distribution was also located in the English area. In the Spanish area anchovy was found in a low density in the inner part of the Bay of Biscay. On the contrary, few isolated echo-traces with high density were found close to Cape Peñas (5°30’W) as shown in Figure 11.4.2.1.

Anchovy eggs from CUFES were only found in the inner part of the Bay of Biscay (Figure 11.4.2.1). Both the acoustic and the egg distributions were similar.

For assessment purposes, two different weight/length relationships were calculated.

A total of 4 949 tonnes corresponding to 262 millions fish were estimated in the French area. Figure 11.4.2.2 shows the length distributions from three different areas. In the inner part of the Bay of Biscay, only 574 tonnes, corresponding to 29 million fish were estimated.

Concerning those fish of the western part, in spite the smaller distribution area, the high density led an estimation of 5,853 t.

A second survey (PEL2000) was conducted from 18th April to 14th May 2000 and, following the previous one, covered from the Spanish/French border to Brest. The methodology was similar to that used in the previous survey.

Acoustic energy allocated to anchovy is shown in Figure 11.4.2.3. According to that, main output for the acoustic assessment is shown in the text table below:

Zone	Area (milles²)	Biomass (t)	Coef. Var.
Gironde	1460	22600	9.8 %
Offshore of Gironde	2300	16100	32.8 %
Centre	750	400	32.8 %
South	2180	8600	33.7 %
Total	**6690**	**47700**	

The Biomass is estimated to 47700 t but probably underestimated (Jacques Massé, pers.comm.).

Most of the fish belonged to age group 1. Figure 11.4.2.4. shows the length distributions of anchovies sampled during the scientific survey. As usually, the smallest fish have been caught close to the Gironde estuary.

11.5 Effort and Catch per Unit Effort

The evolution of the fishing fleets during recent years is shown in Table 11.5.1. The French mid-water trawlers involved in the anchovy fishery has increased continuously up to 1994. Afterwards this fleet has been slightly decreasing. Therefore, it seems that after the rapid increase of the French fishing effort since 1984, we observe a certain reduction of the fishing effort for the last years, according to the decrease in the number of vessels involved in the fishery. That is confirmed in 1999. The main French fishing effort is concentrated in the central and northern part of the Bay of Biscay in the second half of the year, whereas for the Spanish fishery, the main fishing season takes place during the first half of the year in the south-eastern part of the Bay.

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

The CPUE of the Spanish purse-seiners during the spring fishery for anchovy is shown in Table 11.5.2. This index is spatially linked with the anchovy abundance in the southern area of the Bay of Biscay and also with its catchability (availability of the anchovy close to the surface in Spring). It seems less closely related 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). As an example, the indices for the first half of 1997 and 1998 showed strong decreases of CPUE for the total catch, suggesting a decrease of the population in these two recent years. The DEPM estimates of biomass showed, however, that this was not the case. For 1999, we noticed an increase of the global CPUE (in tons per boat per day) and particularly a large increase of the catch per unit of effort for the 2 years old, which is one of the highest, recorded on the 1987-1999 period. These levels are in agreement with the DEPM estimates made in 1998 and confirm the presence of a relevant population of 2 years old in the Bay of Biscay during the first part of the year 1999. On the other hand, the CPUE at age 1 is at a low level.

In 2000 the preliminary CPUE of Spanish purse seines reveal a strong increase in the catch per boat of anchovies at age 1, and a rather relevant presence of the two years old. In general for this spring fishery the catchability seems to have increased in this year due to the general good weather that prevail over late April, May and June. This made that only a single day of fishing were lost due to bad weather along the fishing season.

Some observations have been made on the variation of landing per trip during the first quarter for the French pelagic fleet from 1988 to 1998 in order to see if the variation of that index followed the fluctuation of the biomass estimates by the DEPM method. The methodology to validate and to treat the data is given in Prouzet and Lissardy (2000). Table 11.5.3. gives the catch per trip in number of 1 year old anchovy for three different harbours, located in the South (Bayonne), in the Center (Saint-Gilles Croix de Vie) and in the Central-North (La Turballe) of the Bay of Biscay. Two fleets were chosen as reference: Saint-Gilles-Croix-de-Vie (LS), La Turballe (SN) fishing harbours because their fishing behaviour correspond to that observed during the first quarter 2000.

A deviance analysis made on the following model: $DEPMbiomass \approx a * \log(meancpue) + b + \varepsilon$ in using as dependant variable the series of DEPM biomass of age 1 (see Table 10.4.1.1) and as independent variables the series of mean cpue of age 1 for the first quarter from La Turballe and Saint-Gilles Croix de Vie fishing harbours weighted by their number of observations (Table 11.5.3) showed that 81% of the deviance of the DEPM biomass is explained by the variation of mean catch per trip. The results are shown in Table 11.5.4.

In 2000, from information gathered on the location of anchovy catches[1], we estimated the main fishing areas for anchovy during the first quarter. As generally observed, the fishing zone was centred on the Gironde estuary between 46°15 North down to the latitude of the Bassin d'Arcachon: 44°45 North. Figure 11.5.1., shows the fluctuation of the catches according to the day of fishing. This fluctuation can be strong some days. Figure 11.5.2 shows the trends of the mean catch per trip for these 2 fleets. We can notice a decrease of catches per trip through January with the lowest levels in February then followed by a significant increase in March. The trend of the catch fluctuations is the same for the two fishing fleets: Saint-Gilles Croix de Vie (LS) and La Turballe (SN).

Table 11.5.5. gives the statistic summary of the data collected on these CPUE. The catch per trip were very high even when we applied a correction factor of 71% for the percentage of 1 year old anchovy in the catches. This is difficult presently to know if the high level of catch per trip is due to a strong abundance of anchovy in winter or mainly to a change in the behaviour of the fishing fleet in 2000 (change of behaviour due to a possible closure of the fishery at the end of June 2000).

11.6 Recruitment Forecasting and Environment

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

Two environmental indexes are available to this Working Group:

One is the Upwelling index of Borja *et al*. (1996; 1998), which was mainly based on last years prediction. This index shows the positive influence of the northern and eastern winds of medium and low intensity blowing in Spring and early Summer in the Bay of Biscay for the on set of good levels of recruitment at age 1 for the next year for the anchovy population. This index was built up with a long series of Recruitment based on CPUE data for the period 1967-1996 and the most recent assessments of this Working Group confirmed that relationship. The estimates of this Upwelling since 1986 are reported in Table 11.6.1, updated with the 2000 estimate). That Upwelling index was used for the first time in 1999 to predict the Recruitment of the Bay of Biscay anchovy in 2000, given the indications of a very weak recruitment entering the fishery with the potential reduction of the Biomass below 36,000 t. From the assessment performed in 1999, the variation of the index explained about 57.5 % (Adjusted R2 for d.f) of the variance of the Recruitment estimated from 1986 to 1997 (by a multiplicative model). The direct linear comparison between the upwelling Index and the anchovy population at age 1 estimates of DEPM surveys show that Upwelling explained about 54 % of recruitment variation (R = 0.734). The prediction made in 1999 turned to be far below the recruitment now is being estimated to have entered the fishery in 2000, but figure is not outside the confidence limits of the predictions made by the model as fitted last year (Figure 11.6.1). Assuming that the current estimate of recruitment at age 0 occurring in 1999 is close to reality (as provided in the assessment adopted below -section 12.8-), we have updated the above relationships with the new estimates for recruitment at ages 0 and 1 in 1998 and 1999. The coefficient of determination R^2 (adjusted for d.f.=12) of the multiplicative model for age 0 drops to 43.1%, being still significant. But now the best model turned out to be a linear model, not on the log scale but on the linear scale, for which the coefficient of determination (adjusted) reaches the value of 51.7%. Table 11.6.2. shows the fitted model to the recruitment at age 0. In practice the fitting to the multiplicative or linear models do not have major implications in the result of any forecast.

The second index relating environment with the recruitment of anchovy is provided by Petitgas et al. (WD2000). They used a 3D hydrodynamic physical model (IFREMER Brest) that simulates processes occurring over the Biscay French continental shelf to construct environmental variables that relate directly to the physical processes that occur in the sea. Many variables were constructed to describe the variations of Gironde river plume, coastal upwelling and stratification / turbulence processes. A hierarchical procedure was implemented to test for the best regression model (Allain et al. 1999). Linear regressions with each set of 1, 2…7 variables are adjusted to the recruitment index. Among the "best" regressions according to the R^2 criterion (highest R^2 for a fixed number of parameters), they selected the models which variables are all significant according to a Student's t test. The fit was made on the series of abundance 1986-1998.

The variables and corresponding physical processes selected by this procedure for the period 1986-1998 are, in order of their explanatory power:

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[1] Professional fishermen indicated the precise locations of their catches for each fishing trip. So it was possible to define the main fishing zones for anchovy during the first quarter.

1. Upwelling index (UPW), which is the summed positive "vertical speed" over the period March-July along the Landes coast (SW France). Vertical speed corresponds to the weekly mean vertical current from the bottom to the surface (tide effects have been filtered). These upwelling events are caused by moderate and intermittent easterly to north-easterly winds. Their influence appears always positive and especially crucial in March-May (before the peak spawning), according to the examples of the 2 best recruitment years 1992 and 1998. This variable is therefore rather similar to the one produced by Borja et al. (1996, 1998) on the sole basis of wind data.

2. Stratification breakdown index (SBD), which is a binary variable describing stratification breakdown events in June or July concerning the waters above the whole continental shelf. These events are linked with periods of strong westerly winds (>15 m/s) in June or July which last sereral and could have caused important larvae mortality (after the peak spawning) responsible for the bad recruitments in 1987, 1988 and 1990.

In comparison to Borja et al. (1998) which did not identify turbulence (monthly average of the cube of the wind) as a significative factor on recruitment, Allain et al. (1999) were able to evidence a stratification breakdown at the scale of the whole shelf in July under major westerly gales and at a time scale of the week.

The environmental indexes were regressed by these authors on the ICES estimates at age 1 of anchovy on January 1 of year y, as reported in the ICES report. Petitgas et al. considered the period 1986-1998, given in the 1998 ICES report. Values are in numbers of fish (the unit being 10^6). The series of values was regressed on environmental indices constructed for spring of year y-1. The relationship built upon the two retained variables explained above turned out to be highly significant for the period 1986-1998 (R^2 =75.2%). However the inclusion of the two most recent recruitment estimates up to age 1 in 2000 dropped down the R^2 to 65.5% (and to 59.5 when adjusted for d.f.).

Because the model has 2 covariates, UPW with a positive effect and SBD with a negative one, low R is mainly due to SDB and not so much to UPW. Since 1998, summers have shown low UPW and no SBD and therefore, Petitgas' model tend to predict average recruitment values.

The Working Group examined this new index and pointed out the risks of using a binary variable which was selected from the available data of the short series of years 1986-98. It was considered that it might be too soon to make a direct use of this new index as had been done with the other. In any case, the ecological explanation given by this model to the occurrence of strong failure in the recruitment, when de-stratification takes place in early summer, fits well with the most recent recruitment that entered in the fishery and gives an explanation to the strong deviance of the forecast recruitment in 1999 by Borja's model and the actual recruitment estimated.

Table 11.6.1 gives the environmental indexes supplied by Petitgas et al. since 1986 and presents the coefficient of determination of their upwelling and predictions on this Working Group assessment estimates. It is interesting to note that the upwelling index arising from the hydrodynamic model of IFREMER gives a rather different perception of this phenomena during summer 2000 than the one describing Borja`s index. Figure 11.6.2 presents the general fitting of the environmental versus the population at age 0 estimates produced by the assessment performed this year. Table 11.6.2 gives the parameters fitted for linear simple or multiple models on age 0 from the assessment and their associated forecasts.

In last year working groups it was agreed that, since the environmental indexes do not estimate recruitment abundance directly (as surveys indexes do) but are just descriptors of the environment, they should not used as tuning data for the assessment and might only be considered to improve the projections of the fishery in next future. Their reliability as predictors should thus be re-evaluated every year from its fitting to the recruitment estimates provided by the assessment.

11.7 State of the Stock

11.7.1 Data exploration and Models of assessment

In this stock, natural mortality is believed to be high (but variable) and close to or higher than fishing mortality. For that reason, in a VPA the strength of the year classes will be conditional on the assumed natural mortality. The assessment of the anchovy fishery performed up to now has been based on fitting a separable selection model for fishing mortality with the auxiliary information provided by the direct estimates of biomass and population in numbers at age. The acoustic and egg surveys performed by France and Spain have allowed such analysis. Although the CPUE of the Spanish purse seiners is available, it has never been included in the assessment because of the likely changes in the catchability of these types of fleets, possibly inversely to the size of the stock (Csirke 1989).

The first step to assess the anchovy population in Subarea VIII was the comparison between the last year assessment and the one produced in a similar way (same tuning indexes and weighting factors) after adding the most recent fishery and survey indexes. This is shown in Figure 11.7.1.1, both assessments are very consistent. This assessment is an Integrated Catch at Age analysis, with a separable model of fishing mortality from 1987 to 1997 (with the ICA package, Patterson and Melvin 1996). This assessment, as those made in the previous years, reveals several puzzling results that deserve some analysis and considerations: there are large standard deviations between the catches at age and the separable model estimates (0.452) and between the auxiliary information to the population at age estimates (see table 11.7.1.1). This result in a poor Coefficient of determination of catches (in tonnes), which only attains 67%, and moderate fitting to the DEPM absolute estimates of spawning biomass (Coeff R2=67%).

In addition the data, as pointed out by ACFM, might be partly in contradiction: On one hand, the residuals to the DEPM are often positive specially for age 2 (indicating an estimate of the population at age 2 higher than the one modelled. On the other, the residuals from the catches at age 2 to the separable model are often negative (being caught less than expected by the separable model). These two sources of information (DEPM and Catches at age) might be partly in contradiction. The major problem of this summarised in Table 11.7.1.1.

In order to solve the problems that the current assessment implies, the Working Group explored the following approaches:

Analysis of individual residuals to search for potential outliers in the catches at age: The analysis consist on checking the statistical significance of the reduction in WSSQ that the elimination (strong down weighting) of a single catch at age produces in the total fitting of the separable model. This is made with an F test for the ratio between the reduction achieved in the WSSQ versus the residual variance remaining after the new fitting under the assumption of normal residuals (implicit in ICA). This is similar to the F tests in stepwise regressions (Wonnacott & Wonnacott 1981, Drapper & Smith 1981).

Sensitivity analysis of the weighting factors for the catches at age: In Table 11.7.1.2 three sets of catch at age weighting factors are presented. The first one is the weighting so far applied in the previous years, medium down weighting of age 0 and strong down weighting of ages 4 and 5 due to their scarce abundance in the catches. The first alternative try a stronger down weighting of age 0, because of the scarce separability of the catches of that age group. Catches at age 0 are made in different periods, areas and by different fleets and purposes than the rest of the anchovy catches. Half of those catches are made as live bait for the Spanish tuna boats and they catch only the amount required for tuna fishing, which depend as well upon the availability of other small pelagics, therefore this catch may be misleading sensu separable.

The second alternative weighting reduces the weight at age 3 to 0.1, this because of the fact that this age group supposes, on average for the last 13 years, less than 5% of the total international catch (both in numbers and tonnes, Table 11.7.1.2) and is mainly caught only during the first half of the year. The idea is increasing the precision of the separable model on ages 1 and 2 at the expenses of age 3.

Setting the selectivity of age 4 (the last true age in the catches) equal to the one calculated for age 3: This should reduce strongly the residuals at age 4, although due to the weighting factors the residuals in this age do not affect significantly the assessment.

Searching for residuals in the matrix of catches at age

Table 11.7.1.3 show the reduction in WSSQ of the assessment of reference achieved by the alternate omission of the catches at age 1 to 3 in the whole set of cage analysis of the assessment of reference (by a strong down weighting to 0.0001). Several residuals produce significant reduction in the total WSSQ and the most important comes from the catches at age 3 in 1991. This catches at age 3 as the rest of the 1998 cohort were revised upward in the revision of the catches at age made in 1997 (Uriarte et al. WD1997). By then they were already put in doubt because they were in strong contradiction with the DEPM population estimates. The current analysis also shows that they are as well in contradiction with the separable fishing pattern model. The benefits of omitting the catch at age 3 in 1991 can be seen in Table 11.7.1.4 (Column B): The log standard residual of the catches at age to the separable model are significantly reduced and the coefficient of determination of catches at age improves greatly. Figure 11.7.1.1 compared the results of this assessment with the two former ones.

Changing the weighting factors at age 0 and 3 and the selectivity at age 4

The two most trivial next changes are setting weighting factor at age 0 equal to 0.01 and letting S4 be equal to the convergence value of S3. Those two changes appear in columns C and D of Table 11.7.1.4. The reduction in the weighting factor produces a significant reduction of the WSSQ. This factor has changed from 0.1 (in the previous assessments) to 0.01. On the other hand, setting the selectivity at age 4 (the last true age group) equal to the selectivity to age 3 is not significant, which might be already expected since the weighting factor of this age group is already very low 0.01. The selectivity selected for age 4 such that it equal the one at age 3 was established by direct minimization in an excel workbook. The reduction so far achieved is only due to the down-weighting of the age 0 residuals and the reduction of the residuals to age 4, but the fitting of the other ages do not improve (see Table 11.7.1.5), neither to the DEPM.

Next step was down weighting the age 3 in the analysis. This is shown in Table 11.7.1.4 (columns E and F). Although the reduction in WSSQ necessarily significant (due to the smaller weighting): There is some improvement in the residuals for the separable model. The improvement is shown in Table 11.7.1.5 in the sense that catches at age 1 and 2 improve their fitting to the separable model at the expenses mainly of age 3. There is also some improvements in the fitting to the DEPM population estimates at age 3 and 2 (including a small reduction of the biass) and in the fitting to the acoustic (Table 11.7.1.4).

In this way this exploratory analysis show that the fitting to the separable model can be improved at the expenses of the ages 0 and 3, which can be considered marginal ages (in %) of the catch. Therefore the Working Group adopted the assessment based on considering age 3 in 1991 as an outlier and down weighting ages 0 and 3 to 0.01 and 0.1.

On the use of the auxiliary variables

Tuning the assessment using the DEPM and acoustic indexes both as aggregated indices of biomass and as aged structured indices was already discussed in previous years (ICES CM1999). Although the age structured index turn out to contain the most valuable information, the Working Group decided to let the information provided by the surveys tune the assessment in both ways as Biomass (in tons) and as age disaggregated indexes (in number) of the Spawning Population.

This year the Working Group decided to revisit this use of the auxiliary information. Figures 11.7.1.3 and 4 show the sensitivity of the assessment to the isolated use of acoustic or DEPM auxiliary information for the assessment. The use of the relative acoustic indexes as the sole source for the assessment drops down the SSB estimates and increases the fishing mortality. The use of the DEPM surveys alone (as absolute estimators) produce biomass and recruitments rather similar to the assessment of reference mentioned above (as last year but with down weighting factors for ages 0 and 1). This result simply evidence that the assessment is being driven by the use of the DEPM surveys as absolute estimates of Biomass and Population at age. In last year Working Group it was shown that when the DEPM series are taken entirely as relative then recruitment and biomasses decrease and fishing mortality increases substantially, as happens with the acoustic index. It suffices to consider a few years of the DEPM surveys as absolute to scale the whole assessment. Given the fact that the most recent years of the DEPM surveys are fully updated and revised for this Working Group)(since the 1994 estimate), those years taken as absolute estimations suffice to “anchor” the assessment on its current result. The other conclusion arising from Figure 11.7.1.4 is that the population at age estimates and SSB values from the DEPM surveys do not contain exactly the same information concerning the fishing mortality. Therefore its double use (as numbers and SSB) is justified.

Much of the above results and analysis are based on the idea that the DEPM surveys are usually unbiased and absolute estimators of biomass and its value and robustness should prevail over the assumption of separable fishing model. In fact we attribute the bad fitting of ages 1 and 2 to the non separability of fishing mortality for ages 0 and 3 and not to errors in the DEPM. All the assessment must be admitted rely on the confidence given to each source of data. Since the short living species has no covergence property via VPA to their true values, this means that only the auxiliary information supports the assessment. Therefore in no case we can escape to the subjective judgement of the robustness of the surveys, and so it will be in future. Therefore the Working Group concluded, as in previous years, to make use of all the auxiliary information available.

11.7.2 Stock assessment

An Integrated Catch at Age analysis, which assumes a separable model of fishing mortality, has been used for the assessment of the anchovy in the Bay of Biscay from 1987 to 1999 (with the ICA package, Patterson and Melvin 1996).

Inputs for the final assessment are summarised in Table 11.7.2.1. The assessment uses as tuning data the DEPM (1987-2000) and the Acoustic (1989-2000) figures as biomass and as population numbers at age estimates. The Acoustic and DEPM estimates are considered as relative and absolute estimates respectively and are down-weighted to 0.5 (because of the double use made of the indexes). For 1996 and 1999, the DEPM SSB biomasses included in the assessment are the ones obtained from the combined log-linear model of spawning area and Daily egg production per unit area explained in section 11.4.1.

The assessment assumes a constant natural mortality of 1.2, around the average value estimated earlier at this working group (Anon., 1995/Assess:2). The assessment starts in 1987 when the DEPM began to be applied. The separable model of fishing mortality is applied over the whole set of years (1987-99) (13 years). However the catch data of 1987 and 1988 are down-weighted in the analysis because for those years, the French catch at age data are considered to be more unreliable than for the rest of the years. In addition, the DEPM population as numbers at age estimates for those years, were not as reliable as for the following ones.

Ages 0, 4 and 5+ are heavily down-weighted (to 0.01) due to the small fraction of the catch they represent and to the large imprecision of the estimates. Age 3 is also down weighted to 0.1 again due to is low percentage in the catch and the improvement get through this in the fitting of the separable model to ages 1 and 2 (see previous section). The strong down weighting of ages 0, 4 and 5+ should assure that they do not interfere with the assessment of the other true ages.

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

$$\sum_{a=0}^{a=4}\sum_{y=87}^{y=99}\lambda_{a,y}\left(Ln\left(C_{a,y}\right)-Ln\left(F_y\cdot S_a.\overline{N}_{a,y}\right)\right)^2$$

$$+\lambda_{DEPM}\sum_{y=1987}^{y=2000}\left[Ln\left(SSB_{DEPM}\right)-Ln\left(\sum_{a=1}^{5}N_{a,y}\cdot O_a\cdot W_{a,y}\cdot\exp\left(-P_F F_Y\cdot S_a-P_M.M\right)\right)\right]^2$$

$$+\sum_{y=87}^{98}\sum_{a=1}^{3+}\lambda_{DEPM,a}\left[Ln\left(SP_{DEPM,a,y}\right)-Ln\left(N_{a,y}\cdot\exp\left(-P_F\cdot F_y\cdot S_a-P_M\cdot M\right)\right)\right]^2$$

$$+\lambda_{acoustics}\sum_{y=1989,91,92,97}^{98,2000}\left[Ln\left(SSB_{acoustic}\right)-Ln\left(Q_{acoustic}\sum_{a=1}^{5}N_{a,y}\cdot W_{a,y}\cdot\exp\left(-P_F F_Y\cdot S_a-P_M.M\right)\right)\right]^2+$$

$$+\sum_{y=89,91,92}^{97,2000}\sum_{a=1}^{2+}\lambda_{acoustics,a}\left[Ln\left(SP_{acoustic}\right)-Ln\left(Q_{a,y}\cdot N_{a,y}\cdot\exp\left(-P_F\cdot F_Y\cdot S_a-P_M\cdot M\right)\right)\right]^2$$

with constraints on : $S_2 = S_4 = 0.7923$ and $F_{2000} = F_{1999}$

and $\overline{N}$: average exploited abundance over the year
N : population abundance on the first of January
N_0 : number of 0 group anchovy
O : maturity ogive, percentage of maturity
M : Natural Mortality
F_Y : Annual fishing mortality for the separable model
S_a : selection at age for the separable model
P_F and P_M : respectively proportion of *F* and *M* occurring until mid spawning time
$C_{a,Y}$: catches at age *a* the year *Y*
Q_a and $Q_{a,Y}$: catchability coefficients for the acoustic survey
SSB_{DEPM} and SSB_{acoust} : Spawning Biomass estimates from DEPM and Acoustic methods
SP_{DEPM} and SP_{acoust} : Spawning populations at age from DEPM and acoustic methods
$\lambda_{a,Y}$: weighting factor for the catches at age (set respectively to ages 0 to 5 at 0.01, 1, 1, 0.1, 0.01, 0.01)

Other λ are the weighting factor for the indices and/or ages (all equal a priori to 0.5)(see last portion of table 10.8.2.1)

Results of the assessment are presented in Table 11.7.2.2 and Figure 11.7.2.1.

The assessment thus defined is rather similar to the one implemented in 1999 for the period 1987-1998, with the exception of the severe down weighting of ages 0 and 3.

Comparison of results with the assessment and projections made last year.

Table 11.7.2.3 shows that anchovy assessments for the Bay of Biscay have been closely consistent in recent years. However small changes have happened between the previous and the current year assessment (Table 11.7.2.4 and

Figure 11.7.2.2). ICES forecasted a continuous decrease of biomass from 1998 to 2000. The current assessment confirms the decrease of biomass from 1998 to 1999, but results in a comparable figure for 2000. The estimate of biomass for 1998 decreases in comparison with the last years assessment (by about 26%), whereas the current perception of the biomass in 2000 (46750) greatly exceeds (by 86%) the forecasted biomass for this year (of 25000t). This is due to a different perception of the strength of the most recent year classes. The 1997 year class, although still very strong, is reduced by about 25%, whereas the predicted very weak 1998 and 1999 year classes are now perceived as low and at medium recruitment levels respectively. These estimates have increased 64% for the 1998 year class and 186% for the 1999 year class. This led to an underestimate of the expected biomass for 2000 from the last year assessment. According to the ICES forecast the spawning stock biomass was expected to be between 11 000 and 45 000 t with 95% probability. The new estimate is just in excess of the upper range of this expected range. The change in the perception of the stock size is marginally outside of the estimated range of precision of the survey and assessment methods currently used to provide advice on this stock, as calculated by ICES, therefore significantly different.

The ICA estimate of biomass in year 2000 is 46750 t, that is mainly due to the tuning biomass indexes used as inputs for this year in the assessment. This estimate of biomass for 2000 is based on a projection of the fishery during the current year with a fishing mortality equal to the one estimated for 1999 so that the indexes of biomasses from the surveys are fitted.

11.7.3 Reliability of the assessment and uncertainty of the estimation

The assessment is primarily driven by the Spawning Biomass estimates produced by the DEPM, this is the longest and most consistent independent estimate of the population in absolute terms. As shown in the exploratory analysis the adoption of the DEPM estimates as absolute figures allows scaling the whole analysis in the definition of recruitment, biomass and fishing mortality. The assessment shows a well-defined minimum at the converged level of fishing mortality for the most recent year in the analysis (1999). The log-variance of the populations estimates from the model versus the tuning indices seems reasonable, but the strong variations in abundance from year to year suggested by the direct DEPM estimates are not followed in parallel by the model (see Figure 11.7.2.1). The model tends to smooth annual variability in biomass. The separable model presents rather high level of absolute residuals both across years and ages, performing the best for age 1 and 2 (the most important age group in catches). These two ages have improved their fitting in comparison to the last year assessment.

There are changes in the fishing mortality in 1991 and 1992 mainly due to the down weighting of age 3 in 1991 what has lead to an improvement of the separable model.

The Working Group considers that this assessment shows reasonably well the recent trends in population abundance and fishing mortality according to the information available. From the output stock summary the only reference about the stock size has to be the spawning biomass and not the total stock size because the latter includes the biomass of the age 0 group at the beginning of every year (when it does not exist). The stock summary of this assessment is presented in Figure 11.7.3.1.

Table 11.7.2.3 shows that anchovy assessments for the Bay of Biscay have been closely consistent in recent years. However the reliability of recruitment estimates based on catches at age 0 for the last year are not reliable.

11.8 Catch Prediction

Predictions for catch and population for anchovy can be very problematic. This is due to three major factors:

- The predicted population is heavily dependent on new recruitment
- There is no discernible stock recruit relationship
- The fishery is principally on age 1 fish

These factors should be borne in mind in considering the two projections (2000 and 2001) detailed below.

Projection for 2000 made in 1999

The forecast for 2000 (made at the 1999 Working Group) was based on predictions for ages 0 and 1 in 1999. The prediction for age 1 was based on averaging the estimates provided for this age group by the assessment model and the estimate predicted using the upwelling index (Borja et al 1996 & 1998). Predictions for age 1 fish in 1999 from ICA were based on the catches of the 1998 year class at age 0. These were extremely low compared to historical values, leading to the perception that this year class (1998) was very weak. The inclusion of the upwelling index in the calculation indicated that this was an underestimate, but did not bring the estimate up to the level calculated in 2000. The current assessment gave a 64% greater abundance of that year class, and showed a strong negative residual for age 0 in 1998.

The underestimate may be due to the nature of the fishery for age 0 fish. The market demand for this size of fish is generally very low. Additionally, this age group is implicated in catches taken for live bait for the tuna fishery. These live bait catches are not specifically targeted on anchovy but cover all small pelagics. While this does not explain the unusually low catch level of 0 group anchovy in this year, it does indicate why such low levels may not necessarily indicate a low level of recruitment. Therefore, it was decided not to use these catch data in the context of the separable model to forecast year class strengths in the current assessment.

The prediction of the 1999 year class at age 0 was entirely based on the upwelling index. The new estimate of this year class made in 2000 was approximately 186 % higher than this prediction. This discrepancy was, however, within the 95% probability range of the prediction (see Figure 11.6.2). The combined effect of the two consecutive underestimates of consecutive recruitments resulted in the poor prediction in comparison to the current estimate of the SSB in 2000.

It is clear from the above that the upwelling index has limited value in the prediction of absolute recruitment levels. This is, at least in part, due to the relatively short time series of SSB estimates available to parameterise the index model. The standard error around the index will be greater following the inclusion of the data point for this year, however, the relationship remains statistically significant. One solution may be to use the index as a qualitative rather than an absolute measure.

Projection for 2001 made in 2000

Given all the above information it is possible to define the problems and requirements for stock prediction in anchovy:

- The fishery and the population are largely dependent on the number of age 1 fish in the population.

- But the fishery for age 0 in the previous year provides very little information about the abundance of age 1 in the present year. This means that prediction of stock abundance is dependent on the prediction of the level of recruitment.

- As there is no valid stock recruit relationship it is impossible to predict recruitment from the current SSB. So some other indicator for predicted recruitment is required.

- One possible indicator would be one using environmental information. Two possible candidates would be the upwelling index described by Borja (Borja et al. 1996, 1998, WD2000) or the slightly more complex stratification/upwelling index proposed by Petitgas et al (Allain 1999, WD 2000). Neither of these indices are currently fully reliable indicators of recruitment. The Borja index worked well for recruitment in 1998 but was much less accurate in 1999. Conversely, the Petitgas index worked well in 1999 but was less accurate in 1998.

- There are protocols for combining more than one, imperfect recruitment indices. For instance, Shepherd (1997) proposed combination using inverse variance weighting. However, such a combined index is untested on this stock, and the two indices are also measures of the same environmental phenomena, and there may be correlation problems. For these reasons it was not felt that such a combined index could be proposed at present.

- This leads to the conclusion that it would be incautious to rely on these environmental indices for the time being. However, the Working Group recognises that in the case of the stock scenario presented by anchovy, a reliable environmental index would be invaluable. Investigations should definitely be continued into these indices with the aim of improving their reliability and forecasting power.

Given the inability to predict recruitment from catches, stock or environmental indices the Working Group felt that any prediction of future abundance would have to be based on some calculation from historical recruitment. The Working Group also agreed that in the face of this uncertainty, management should be conducted in a two-stage process. In the first stage a prediction would be made based on the most recent estimate of stock biomass and on a mean calculated from the recruitment time series 1986 – 1999. This could then be used by managers to set TACs for the first half of the coming year. A second assessment would be carried out following the completion of the acoustic and DEPM surveys in that year and a modified TAC set for the second half of that year.

The Working Group considered a variety of ways of calculating the mean recruitment to be used in the first stage of this process. The Working Group felt that, for the time being until more information becomes available, this calculated mean should be conservative, as the managers would have the ability to update TACs at the second stage. It was agreed that the most appropriate value, for the time being, would be a mean of the recruitments lower than arithmetic mean over the time series (8,653 million). This effectively means that the calculated value will tend to be an underestimate in 75% of cases. The chances of getting a lower recruitment than this value would therefore be 25%. The inputs and outputs of this project are in Tables 11.8.1 and 2. For prediction purposes, the recruitment at age 0 in the subsequent years would be set equal to the geometric mean 1986 to 1999 (12,175 million) and the status quo fishing mortality is set equal to the latest 5 years (1995-1999) instead of only the latest 3 years, due to the pronounced interannual fluctuations of the fishing mortality of this fishery.

An additional prediction is also presented, in which the conventional assumption of a recruitment at the geometric mean is applied. The short life span of the anchovy, implies that the development of the stock and its tolerance to exploitation is heavily dependent on the recruitment. The recruitment is poorly known and can vary over a large range. For the time being the working group does not consider the use of the geometric mean recruitment in the short term prediction to be compatible with the precautionary approach. The Working Group recommends further examination of plausible harvest control rules and that this should be made available to this Working Group in 2001. The inputs and outputs for this second projection are in Tables 11.8.3 and 4.

Weights at age in the catches would be set at the average values recorded since 1987 and weights in the stock are the average value input to the assessment since 1990 (the first year of accurate assessment of this parameter. A total catch constraint of 35,000 t for 2000 is assumed, consistent with the development of the fishery in 1999 (Table 11.2.1.3).

11.9 (Short-term risk analysis)

11.10 Medium term predictions

The analysis of the last year was not repeated. The fishing mortality is still considered to be within safe biological limits.

11.11 (Long-Term Yield)

11.12 Uncertainty in assessment

See 11.7.3

11.13 Reference points for management purposes

Reference points (B_{pa} & B_{lim}) have been defined in previous Working Group reports (ICES CM 1998/ Assess 6:). In view of the Working Group proposal for two stage management it is felt that these may not be entirely appropriate in this context. The following text describes the reference points as they are presently defined. It should be recognised that these may require modification in the future.

In the last year report (ICES CM 1998/ Assess 6:), the Working Group estimated the value of B_{lim} equal to 18,000 tonnes of anchovy which correspond to the minimum biomass below which no observations and no considerations on the dynamic of that stock have been made. The Working Group defined another precautionary level that was the B_{pre}: precautionary biomass. This level was defined as the double of B_{lim} and set at 36,000 tonnes.

B_{lim}: which is the level of biomass below which the stock has a high probability of collapse. Preliminary, it could be defined as the lowest estimated spawning stock biomass (from the assessment) over the past ten years (18,000 tonnes in 1989 according to Table 10.1.6 in Working Group report CM1998/Assess: 6).

That definition was consistent with the definition of MBAL previously accepted for this stock (set between 15,000 and 20,000 tonnes corresponding to the lowest DEPM estimates of the historical series observed in 1989 and 1991 during the period 1987-1998).

Bpa: Management of this stock has been guided by the need to withstand two successive years of poor recruitment, implying that catches may have to be reduced if the SSB reaches 36000 t. This value was adopted by ACFM as Bpa. However, in last years advise, ACFM interpreted this values as a limit point triggering closure of the fishery, rather than as a Bpa. The Working Group considers that SSB below 36000 t and above Blim should trigger a reduction in the fishery if there is indications of another poor year class, rather than its closure.

For the future, a harvest control rule as outlined in Section 11.14 should complement the precautionary framework.

11.14 Harvest Control Rules

One of the major problem for the fishery management of the Bay of Biscay anchovy is the long and short term fluctuation in biomass linked to variability in recruitment mainly driven by environmental factors.

The Working Group considered the possibility of making a concrete proposal of harvest control rules for the management of the fishery, but it was judged to be premature for several reasons. The basics for Harvest control rules on the Bay of Biscay anchovy were agreed by the Working Group, but the election of some concrete formulation was believed to be out of the scope of the Working Group. Instead a broad frame HCR could be proposed to managers for them to select those which can best reconcile the interests of fishermen subject to the management with the sustainability of the population from a biological point of view.

The Bay of Biscay anchovy is a small population, exploited by seasonal fisheries from two countries. The strong dependency of these fishermen on that resource means that whichever of the many harvest control rules envisaged, they will have a great impact on the different fisheries and communities. Because of this, the Working Group considers that its role must be to build up a general frame for the simulation of Harvest Control rules. This will then allow the different parties; fishermen and managers involved in the fishery, to make informed decisions for future management.

In these conditions, the Working Group considers that a real and effective management of that stock can be attained by using the scientific surveys to monitor the level of biomass and the recruitment indices to predict low recruitment level.

So, in order to avoid relying too much on the recruitment prediction based on an environmental index, the Working Group proposes that the annual TAC will be set in two steps. The idea of reviewing the management advice for short-lived species on the basis of information obtained during the fishing season is not new (as for south African anchovy COCHRANE 1998, or Capelin ICES CM ACFM:18). In South Africa a two stages TAC recommendation has been used to manage the local anchovy resource since the early 1990s (Cochrane *et al.* 1998). The approach taken is to provide an initial TAC based on a biomass estimate obtained by means of acoustics and to review this TAC when an estimate of recruitment becomes available in the middle of the season. Both the TAC initial and the TAC revised are computed by applying simple formulae to the survey estimates of biomass and recruitment. However, those apparently simple formulae are the result of a long process, which involved scientists and managers. The formulae are part of a management procedure (Butterworth et al. 1993) tested by means of computer simulations and finalised in consultation with industry and public representatives.

In the case of the Bay of Biscay anchovy the general proposed two stages are the following:

- a preliminary TAC for the year operative for the first part of the year (n+1) from January to June (until its update, see revised TAC). This TAC should be based on the biomass estimates of the year (n) called $B1_{(n)}$ and the qualitative level of recruitment in September the year (n) called Rsept(n). So the preliminary TAC call TACprelim is defined as Tacprelim= f(B1(n),Rsept(n)). The qualitative level of Rsept is based either on the value of the environmental index after Borja et al (WD 2000) (Called upindex(1)),or the best of the two available environmental indexes (upwelling iupindex(1) and upindex(2), the latter corresponding to the environmental index after Petitgas et al (WD 2000).

- a revised final TAC operative over the second part of the year from June to December and based on the biomass assessed the year (n+1) called $B2_{(n+1)}$. So this final TAC called revised TAC is defined as $TAC_{revised} = TAC2 = f[B2_{(n+1)}]$.

A working document (Prouzet, WD 2000) giving an example of a detailed harvest rules and retrospective analysis on recent history of the fishery, is presented and the Working Group thinks that it is a useful approach.

11.15 Management Measures and Considerations

The general framework of the anchovy management in the Bay of Biscay has been defined in the last working group report and this general framework remains presently valid. (See ICES CM1999\Assess: 6, for more details). As mentioned then, the assessment suggests that the current level of fishing mortality could be sustained in the long term provided that a step towards a more conservative approach is taken when the stock is at a low level. This seems presently to be the case according to the current assessment (mean $F_{(97-99)} = 0.49$, largely inferior to F_{pa}). However, the large variability of abundance due to the fluctuation of environmental factors makes the stock difficult to manage as the prediction of this recruitment is still uncertain. This implies the monitoring of the stock each year from direct estimation methods to validate our prediction on the recruitment and to correct if, necessary, our perception on the trend of the population. This suggests that it is necessary for the short-term management to be more active and to define the outlines of the fishery regulation as we proposed in section 11.14. These outlines have to be discussed inside an ad hoc study group in the framework of the ICES and EU community and consider not only the biological problems, but also the economical ones. That means some discussions not only among scientists but also with the fishery managers.

The history of the exploitation of this stock in relation to the proposed precautionary reference points is shown at Figure 11.15.1. The Bay of Biscay anchovy is a short-living species that is totally mature at 1 year old. Although the Bay of Biscay anchovy constitute a small stock, catches from this resource are economically very valuable. The Figure 11.15.1 shows two rapid variations of the abundance at constant F during two periods: 1991 to 1995 and 1997 up to now. Presently the mean F is lower than the mean F observed during the 1990-1996 period and the abundance estimated in 2000 is higher than B_{pa}.

For 2001, the estimates from the upwelling index give a large possibility of biomass. It seems difficult to give an accurate figure for the moment. It is the reason why a two step management plan seems the only solution for a positive management of that very valuable resource in the Bay of Biscay.

Table 11.2.1.1: Annual catches (in tonnes) of Bay of Biscay anchovy (Subarea VIII) As estimated by the Working Group members.

COUNTRY	**FRANCE**	**SPAIN**	**SPAIN**	**INTERNATIONAL**
YEAR	VIIIab	VIIIbc, Landings	Live Bait Catches	VIII
1960	1,085	57,000	n/a	58,085
1961	1,494	74,000	n/a	75,494
1962	1,123	58,000	n/a	59,123
1963	652	48,000	n/a	48,652
1964	1,973	75,000	n/a	76,973
1965	2,615	81,000	n/a	83,615
1966	839	47,519	n/a	48,358
1967	1,812	39,363	n/a	41,175
1968	1,190	38,429	n/a	39,619
1969	2,991	33,092	n/a	36,083
1970	3,665	19,820	n/a	23,485
1971	4,825	23,787	n/a	28,612
1972	6,150	26,917	n/a	33,067
1973	4,395	23,614	n/a	28,009
1974	3,835	27,282	n/a	31,117
1975	2,913	23,389	n/a	26,302
1976	1,095	36,166	n/a	37,261
1977	3,807	44,384	n/a	48,191
1978	3,683	41,536	n/a	45,219
1979	1,349	25,000	n/a	26,349
1980	1,564	20,538	n/a	22,102
1981	1,021	9,794	n/a	10,815
1982	381	4,610	n/a	4,991
1983	1,911	12,242	n/a	14,153
1984	1,711	33,468	n/a	35,179
1985	3,005	8,481	n/a	11,486
1986	2,311	5,612	n/a	7,923
1987	4,899	9,863	546	15,308
1988	6,822	8,266	493	15,581
1989	2,255	8,174	185	10,614
1990	10,598	23,258	416	34,272
1991	9,708	9,573	353	19,634
1992	15,217	22,468	200	37,885
1993	20,914	19,173	306	40,393
1994	16,934	17,554	143	34,631
1995	10,892	18,950	273	30,115
1996	15,238	18,937	198	34,373
1997	12,020	9,939	378	22,337
1998	22,987	8,455	176	31,617
1999	13,649	13,145	465	27,259
2000	7,000	17,061		24,061 (*)
AVERAGE (1960-99)	5,638	28,145	318	33,886

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

Table 11.2.1.2. Monthly catches of the Bay of Biscay anchovy by country (Sub-area VIII) (without live bait catches)

COUNTRY: **FRANCE** 1000 Units: t.

YEAR\ MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1987	0	0	0	1113	1560	268	148	582	679	355	107	87	4899
1988	0	0	14	872	1386	776	291	1156	2002	326	0	0	6822
1989	704	71	11	331	648	11	43	56	70	273	9	28	2255
1990	0	0	16	1331	1511	127	269	1905	3275	1447	636	82	10598
1991	1318	2135	603	808	1622	195	124	419	1587	557	54	285	9708
1992	2062	1480	942	783	57	11	335	1202	2786	3165	2395	0	15217
1993	1636	1805	1537	91	343	1439	1315	2640	4057	3277	2727	47	20914
1994	1972	1908	1442	172	770	1730	663	2125	3276	2652	223	0	16934
1995	620	958	807	260	844	1669	389	1089	2150	1231	855	22	10892
1996	1084	630	614	206	150	1568	1243	2377	3352	2666	1349	0	15238
1997	2235	687	24	36	90	1108	1579	1815	1680	2050	718		12022
1998	1523	2128	783	0	237	1427	2425	4995	4250	2637	2477	103	22987
1999	2080	1333	574	55	68	948	1015	922	3138	1923	1592	0	13649
Average 87-99	1172	1010	567	466	714	867	757	1637	2485	1735	1011	55	12472
in percentage	9.4%	8.1%	4.5%	3.7%	5.7%	7.0%	6.1%	13.1%	19.9%	13.9%	8.1%	0.4%	100%
Average 92-99	1652	1366	840	200	320	1238	1121	2146	3086	2450	1542	25	15982
in percentage	10.3%	8.5%	5.3%	1.3%	2.0%	7.7%	7.0%	13.4%	19.3%	15.3%	9.6%	0.2%	100%

COUNTRY: **SPAIN**

YEAR\ MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1987	0	0	454	4133	3677	514	81	54	28	457	202	265	9864
1988	6	0	28	786	2931	3204	292	98	421	118	136	246	8266
1989	2	2	25	258	4295	795	90	510	116	198	1610	273	8173
1990	79	6	2085	1328	9947	2957	1202	3227	2278	123	16	10	23258
1991	100	40	23	1228	5291	1663	91	60	34	265	184	596	9573
1992	360	384	340	3458	13068	3437	384	286	505	63	94	89	22468
1993	102	59	1825	3169	7564	4488	795	340	198	65	546	23	19173
1994	0	9	149	5569	3991	5501	1133	181	106	643	198	74	17554
1995	0	0	35	5707	11485	1094	50	9	6	152	48	365	18951
1996	48	17	138	1628	9613	5329	1206	298	266	152	225	17	18937
1997	43	1	81	2746	2672	877	316	585	1898	331	203	185	9939
1998	35	235	493	371	4602	1083	1518	44	47	3	22	1	8455
1999	8	26	52	4626	4214	1396	1037	26	911	207	615	27	13144
Average 87-99	60	60	441	2693	6412	2488	630	440	524	214	315	167	14443
in percentage	0.4%	0.4%	3.1%	18.6%	44.4%	17.2%	4.4%	3.0%	3.6%	1.5%	2.2%	1.2%	100%
Average 92-99	75	92	389	3409	7151	2901	805	221	492	202	244	98	16078
in percentage	0.5%	0.6%	2.4%	21.2%	44.5%	18.0%	5.0%	1.4%	3.1%	1.3%	1.5%	0.6%	100%

Table 11.2.1.3: ANCHOVY catches in the Bay of Biscay by country and divisions in 1999 (with live bait catches)

COUNTRIES	DIVISIONS	QUARTERS				CATCH (t)	
		1	2	3	4	ANNUAL	%
SPAIN	VIIIa	0	0	674	751	1425	10.8%
	VIIIb	21	3098	351	0	3471	26.4%
	VIIIc	65	7138	949	98	8249	62.8%
	TOTAL	87	10236	1974	849	13145	100
	%	0.7%	77.9%	15.0%	6.5%	100.0%	
FRANCE	VIIIa	0	0	5076	3515	8591	62.9%
	VIIIb	3987	1071	0	0	5058	37.1%
	VIIIc	0	0	0	0	0	0.0%
	TOTAL	3987	1071	5076	3515	13649	100.0%
	%	29.2%	7.8%	37.2%	25.8%	100.0%	
INTERNATIONAL	VIIIa	0	0	5750	4266	10016	37.4%
	VIIIb	4008	4169	351	0	8529	31.8%
	VIIIc	65	7138	949	98	8249	30.8%
	TOTAL	4074	11307	7050	4364	26794	100.0%
	%	15.2%	42.2%	26.3%	16.3%	100.0%	

Table 11.3.1.1: ANCHOVY catch at age in thousands for 1999 by country, division and quarter (without the catches from the live bait tuna fishing boats).

units: thousands

	QUARTERS		1	2	3	4	Annual total
SPAIN	**AGE**		**VIIIbc**	**VIIIbc**	**VIIIabc**	**VIIIabc**	**VIIIbc**
		0	0	0	7,596	4,230	11,826
		1	6,556	127,855	51,208	15,199	200,818
		2	843	230,541	26,782	10,052	268,217
		3	18	10,034	525	0	10,577
		4	0	108	0	0	108
	TOTAL(n)		7,416	368,538	86,111	29,481	491,546
	W MED.		11.91	28.37	23.53	28.92	27.31
	CATCH. (t)		86.5	10236.2	1973.6	848.2	13,144.5
	SOP		88.4	10456.1	2026.3	852.6	13,423.4
	VAR. %		102.13%	102.15%	102.67%	100.52%	102.12%
FRANCE	**AGE**		**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**
		0	0	0	3,108	22,192	25,300
		1	51,345	34,311	85,355	70,761	241,771
		2	127,443	21,185	80,391	24,869	253,888
		3	7,710	0	0	0	7,710
		4	0	0	0	0	0
	TOTAL(n)		186,498	55,496	168,854	117,822	528,669
	W MED.		21.60	20.05	29.67	32.89	26.53
	CATCH. (t)		3,987.2	1,070.7	5,075.8	3,515.5	13,649.2
	SOP		4,028.8	1,112.7	5,009.4	3,875.2	14,026.0
	VAR. %		101.04%	103.92%	98.69%	110.23%	102.76%

	QUARTERS		1	2	3	4	Annual total
TOTAL	**AGE**		**VIIIbc**	**VIIIbc**	**VIIIbc**	**VIIIbc**	**VIIIbc**
Sub-area VIII		0	0	0	10,704	26,422	37,127
		1	57,900	162,167	136,562	85,960	442,589
		2	128,286	251,726	107,173	34,921	522,105
		3	7,727	10,034	525	0	18,286
		4	0	108	0	0	108
	TOTAL(n)		193,914	424,034	254,965	147,303	1,020,215
	W MED.		21.23	27.28	27.60	32.10	26.91
	CATCH. (t)		4,074	11,307	7,049	4,364	26,794
	SOP		4,117	11,569	7,036	4,728	27,449
	VAR. %		101.07%	102.32%	99.81%	108.34%	102.45%

Table 11.3.1.2. Spanish half - yearly catches of anchovy (2nd semester) by age in ('000) of Bay of Biscay anchovy from the live bait tuna fishing boats. (from ANON 1996 and Uriarte et al. WD1997)

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	10,020	97,581	6,114	11,999	12,716	2,167	3,557	7,872	10,154	8,102	33,078	1,032	17,230
1	24,675	17,353	6,320	21,540	13,736	14,268	20,160	5,753	10,885	6,100	8,238	15,136	20,784
2	1,461	203	1,496	139	0	0		477	209	522	58	0	810
3	912	3	0	0	0	0		0	0	0	0	0	0
Total	37,068	115,140	13,930	33,677	26,452	16,435	23,717	14,102	21,248	14,724	41,375	16,169	38,825
Catch (t)	546	493	185	416	353	200	306	143.2	273.2	197.5	378	175.5	465.126
meanW (g)	14.7	4.3	13.3	12.4	13.3	12.1	12.9	10.2	15.8	13.4	9.14	10.85	11.98

Table 11.3.1.3 : Catches at age of anchovy of the fishery in the Bay of Biscay on half year basis as reported up to 1990 to ICES WGs and updated since then.

Units: Thousands The catches at age are equal to the addition of the age composition of landing and live bait catches of anchovy

(From Uriarte et al., 1997 WD updated for the 1997 AND 1998 data)

INTERNATIONAL

YEAR	1987		1988		1989		1990		1991		1992		1993	
Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	30,140	0	150,338	0	100,005	0	16,904	0	86,647	0	30,434	0	63,489
1	210,670	120,098	310,181	180,113	152,612	27,005	847,627	517,890	323,877	116,290	1,801,551	440,134	794,055	611,047
2	157,665	13,534	82,621	13,334	123,603	18,771	58,402	75,899	318,620	12,501	190,137	31,446	439,695	91,977
3	31,362	1,664	9,954	596	18,056	1,906	8,175	4,899	28,179	61	16,860	1	5,336	0
4	14,031	58	1,356	0	54	0	0	0	0	0	0	0	0	0
5	0,920	0	98	0	0	0	0	0	0	0	0	0	0	0
Total #	431,448	173,464	389,971	529,138	294,445	218,927	915,203	615,671	693,677	215,579	1,211,647	510,015	1,239,046	766,523
Interest Catches	11,719	3,590	10,003	5,579	7,153	3,468	18,306	14,006	15,825	4,610	26,381	11,504	24,050	16,334
Var. SOP	100.7%	100.4%	90.3%	101.9%	90.5%	89.3%	100.7%	99.1%	97.6%	98.5%	98.6%	98.9%	101.1%	98.5%
Annual Catch		15,300		15,581		10,614		34,272		19,626		37,805		40,392

YEAR	1994		1995		1996		1997		1998		1999	
Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	59,934	0	49,771	0	109,173	0	133,232	0	4,076	0	54,357
1	494,618	355,663	522,361	109,081	603,008	456,164	471,378	439,080	443,018	590,139	228,067	243,306
2	493,437	54,867	282,301	21,771	233,096	53,156	138,103	40,014	128,054	123,225	388,012	142,904
3	61,667	1,325	76,525	80	31,092	489	5,508	195	5,596	3,390	17,761	525
4	0	0	4,096	7	2,213	42	0	0	155	0	108	0
5	0	0	0	0	0	0	0	0	0	0	0	0
Total #	1,048,714	471,789	885,283	260,719	948,408	619,034	615,133	613,329	578,423	720,837	617,948	441,092
Interest Catches	23,214	11,417	23,479	6,637	21,024	13,349	18,704	11,443	12,918	10,700	15,301	11,870
Var. SOP	101.0%	100.2%	101.5%	98.2%	99.5%	100.4%	99.7%	102.1%	100.6%	94.8%	102.0%	103.8%
Annual Catch		34,631		30,116		34,373		22,147		31,617		27,259

SPAIN

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	35,452	0	141,918	0	174,003	0	11,899	0	81,536	0	13,121	0	63,489
1	134,380	40,172	210,641	47,408	110,276	13,165	718,678	234,821	218,606	21,113	761,856	72,154	570,219	75,885
2	119,583	7,787	61,609	2,698	92,707	8,401	47,266	43,204	138,327	1,715	131,221	5,916	266,612	11,984
3	27,336	1,664	7,710	596	8,232	1,906	8,138	4,899	2,657	61	10,867	1	967	0
4	14,031	58	1,356	0	54	0	0	0	0	0	0	0	0	0
5	0,920	0	98	0	0	0	0	0	0	0	0	0	0	0
Total #	384,980	85,134	281,414	192,604	211,270	198,436	775,083	294,222	352,670	104,425	892,344	91,192	845,790	151,260
Catch Spain	8,777	1,632	6,965	1,804	5,377	2,981	16,401	7,273	8,340	1,593	21,847	1,621	17,206	2,272
Var. SOP	100.7%	99.7%	97.9%	100.6%	97.1%	99.5%	100.9%	99.5%	94.7%	98.2%	98.3%	108.5%	108.8%	100.2%
Annual Catch		10,409		8,769		8,358		23,674		9,926		22,668		19,479

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	59,022	0	31,181	0	52,230	0	91,480	0	4,076	0	29,057
1	267,058	47,085	367,924	17,611	542,127	72,763	296,261	123,011	217,711	57,847	134,411	87,181
2	315,022	24,971	206,307	1,333	163,018	12,483	74,056	9,435	41,171	9,515	231,304	37,644
3	44,622	1,325	57,214	80	14,461	489	1,327	195	4,002	9	18,051	525
4	0	0	4,096	7	2,213	42	0	0	155	0	108	0
5	0	0	0	0	0	0	0	0				
Total #	616,604	132,383	635,621	50,142	721,818	137,946	373,044	224,041	263,039	71,446	375,954	154,416
Catch Spain	15,219	2,470	18,322	982	16,774	2,361	6,428	3,887	6,918	1,812	18,323	3,287
Var. SOP	101.3%	99.6%	102.1%	100.1%	99.5%	100.4%	99.5%	98.7%	99.9%	98.8%	102.1%	101.7%
Annual Catch		17,687		19,224		19,135		10,317		8,630		13,610

FRANCE

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	2,688	0	8,419	0	5,202	0	4,905	0	5,111	0	25,313	0	0
1	84,280	79,925	187,540	142,634	42,336	13,918	127,948	203,669	113,191	95,177	250,495	367,980	215,836	535,182
2	38,162	5,747	31,012	10,644	38,976	1,298	12,216	32,795	171,293	10,866	61,816	25,530	173,043	80,073
3	4,026	0	2,245	0	9,863	0	36	0	26,522	0	6,893	0	4,369	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	126,468	88,360	140,797	161,697	83,175	20,492	140,200	321,449	311,007	111,154	319,203	410,823	393,248	615,255
Catch France	2,941	1,958	3,048	3,775	1,776	479	2,905	7,613	6,602	3,827	5,334	9,883	6,851	14,062
Var. SOP	100.4%	101.0%	99.0%	102.5%	102.6%	87.0%	99.2%	98.7%	101.3%	98.6%	108.5%	98.8%	101.6%	98.4%
Annual Catch		4,899		6,822		2,255		10,598		9,708		15,217		20,914

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0	912	0	10,670	0	56,936	0	41,832	0	0	0	25,300
1	237,568	300,580	154,437	171,470	148,002	303,481	175,108	316,077	226,107	540,293	85,656	156,115
2	178,415	29,096	75,914	20,430	79,005	40,753	63,327	30,579	87,603	113,710	148,628	105,260
3	17,045	0	18,311	0	16,631	0	3,653	0	1,594	3,389	7,718	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
Total #	433,028	339,486	248,662	210,570	227,598	401,089	242,009	389,280	315,304	657,392	241,994	286,676
Catch France	7,994	8,939	5,157	5,735	4,251	10,987	4,204	7,546	6,098	16,080	5,058	8,591
Var. SOP	100.3%	100.4%	99.4%	97.8%	102.0%	98.8%	100.0%	103.8%	102.5%	94.3%	101.7%	103.4%
Annual Catch		16,934		10,082		15,230		11,030		22,987		13,649

Table 11.3.2.1. Length distribution ('000) of anchovy in Divisions VIIIa,b,c by country, by year, quarters and Sub-divisions in 1999.

Length (half cm)	QUARTER 1 France VIIIab	QUARTER 1 Spain VIIIbc	QUARTER 2 France VIIIab	QUARTER 2 Spain VIIIbc	QUARTER 3 France VIIIab	QUARTER 3 Spain VIIIbc	QUARTER 4 France VIIIab	QUARTER 4 Spain VIIIbc
3.5				0		0		0
4				0		0		0
4.5				0		0		0
5				0		0		0
5.5				0		0		0
6				0		0		0
6.5				0		0		0
7			0	0	0	0	0	0
7.5			0	0	0	0	0	0
8		115	0	0	0	0	0	0
8.5		287	0	0	0	0	0	0
9		747	0	0	0	0	0	0
9.5	0	460	60	0	0	47	0	0
10	0	750	302	0	130	173	0	0
10.5	867	474	1368	1	529	337	0	0
11	2601	120	2506	314	2711	313	0	24
11.5	7803	482	3582	1128	4303	785	0	28
12	7802	456	6062	6356	4600	1109	0	219
12.5	8777	648	2824	11887	2912	1921	82	209
13	15818	714	3903	20201	1750	6995	1043	987
13.5	16906	600	4313	25484	3464	9447	1952	1577
14	22215	506	3943	32107	7725	12155	1894	2139
14.5	15088	313	4271	26520	7463	10201	6088	2898
15	17181	245	7442	27316	18157	9557	8875	2953
15.5	26033	172	5137	27302	16198	9585	14928	2904
16	21412	141	3476	36240	17030	8887	22986	3491
16.5	11271	131	2219	36990	21575	4882	22407	2971
17	7255	32	2251	44327	15597	4770	16542	3879
17.5	4329	10	901	30947	11437	2624	12032	1997
18	1317	9	468	22841	10147	1471	5641	1928
18.5	261	1	213	12065	8346	545	2488	653
19	104	4	128	4805	4536	263	573	622
19.5	0	0	85	1298	3460	39	0	172
20	0	0	43	293	3140	0	0	0
20.5	0	0	0	114	3140	0	0	0
21	0	0	0	0	756	0	0	0
21.5	0		0		0		0	
22	0		0		0		0	
22.5								
23								
23.5								
24								
24.5								
25								
25.5								
26								
Number ('000)	187041	7416	55496	368538	169108	86108	117531	29653
Catch (t)	87	3987	1071	10236	5076	1074	3515	849
Mean Length (cm)	14.51	11.88	13.98	15.63	16.05	14.82	16.23	15.82
Mean Weight (g)	21.6	11.91	20.05	28.37	29.67	23.53	32.89	28.92

Table 11.3.2.2. Mean weight at age in the national and international catches of anchovy in SubArea VIII on half year basis

Units: grams

INTERNATIONAL

YEAR	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1997		1998		1999	
Sources	Anon. (1989 & 1991)		Anon. (1989)		Anon. (1991)		Anon. (1991)		Anon. (1992)		Anon. (1993)		Anon. (1995)		Anon. (1996)		Anon. (1997)		Anon. (1998)		Anon. (1999)		Anon (2000)		WG data	
Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0.0	11.7	0.0	5.1	0.0	12.7	0.0	7.4	0.0	14.4	0.0	12.6	0.0	12.3	0.0	14.7	0.0	15.1	0.0	12.0	0.0	11.6	0.0	10.2	0.0	15.7
1	21.0	21.9	20.8	23.6	19.5	24.9	20.6	23.8	18.5	25.1	19.6	23.0	15.5	20.9	16.8	25.3	22.5	26.9	19.1	23.2	14.4	20.3	21.8	23.7	17.1	27.0
2	32.0	34.2	30.3	30.4	28.5	36.2	28.5	27.7	25.2	29.0	30.9	28.8	27.0	29.4	26.8	28.1	32.3	31.3	29.3	27.7	26.9	30.1	24.3	27.7	29.6	33.5
3	37.7	39.2	34.5	44.5	29.7	42.7	44.8	40.8	28.2	39.0	37.7	27.4	30.5	0.0	30.7	30.0	36.4	36.4	35.0	35.7	32.0	29.7	31.9	28.7	34.7	38.9
4	41.0	40.0	37.6	0.0	27.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3	29.1	46.1	39.7	0.0	0.0	31.9	0.0	55.9	0.0
5	42.0	0.0	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	27.3	20.8	24.6	10.7	23.9	15.6	21.3	24.0	22.1	21.1	21.7	22.5	19.6	21.2	22.3	24.3	26.9	25.0	22.2	21.6	17.3	19.1	22.5	24.3	25.4	27.7
SOP	11,796	3,606	9,828	5,686	7,043	3,434	19,610	14,752	14,608	4,536	26,264	11,497	24,314	16,257	23,440	11,442	23,830	6,620	21,066	13,139	10,672	11,687	12,996	17,727	15,686	12,229
mean weight 3+	39.3	39.2	35.0	44.5	29.7	42.7	44.8	40.8	28.2	39.0	37.7	27.4	30.5	30.5	30.7	30.0	36.5	35.9	35.8	36.0	32.0	29.7	31.9	28.7	34.9	38.9

SPAIN

Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0.0	11.6	0.0	4.7	0.0	12.8	0.0	5.9	0.0	14.5	0.0	13.0	0.0	12.3	0.0	14.7	0.0	16.1	0.0	11.2	0.0	10.8	0.0	10.2	0.0	10.4
1	21.4	21.0	21.3	21.7	20.6	25.3	20.6	24.4	18.5	16.4	21.5	18.2	16.4	15.5	18.7	19.6	24.8	20.1	19.9	19.3	14.1	21.1	24.2	24.7	18.6	21.3
2	33.0	39.3	32.4	36.7	29.3	36.0	29.0	28.9	28.1	22.4	32.6	24.4	29.5	26.6	29.2	35.4	35.2	33.4	31.9	29.0	28.6	27.4	32.3	35.3	33.0	31.0
3	38.0	39.2	34.6	44.5	27.3	42.7	44.9	40.8	34.4	39.0	44.5	27.4	43.3	0.0	32.0	30.0	38.2	36.4	40.2	35.7	41.7	29.7	35.3	52.1	40.6	38.9
4	41.0	40.0	37.6	0.0	27.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3	29.1	46.1	39.7	0.0	0.0	31.9	0.0	55.9	0.0
5	42.0	0.0	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	29.0	19.1	34.2	9.4	24.7	14.9	31.4	24.6	22.4	14.9	23.4	17.8	20.6	15.0	26.0	18.6	29.4	18.0	23.1	17.6	17.1	17.2	26.6	26.3	26.0	21.7
SOP	8,841	1,628	6,811	1,814	5,222	2,966	16,565	7,234	7,930	1,565	20,904	1,629	17,352	2,276	15,424	2,487	18,703	903	16,896	2,170	6,386	3,847	6,746	1,809	10,544	3,344
mean weight 3+	39.6	39.2	36.2	44.5	27.3	42.7	44.9	40.8	34.4	39.0	44.5	27.4	43.3	43.3	32.0	30.0	38.1	35.9	41.0	36.0	41.7	29.7	36.2	52.1	40.7	38.9

FRANCE

					Old values		Old values		Old values		Old values		Old values		Old values		Old values		Old values							
Periods	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Age 0	0.0	13.0	0.0	12.1	0.0	17.0	0.0	11.0	0.0	15.6	0.0	12.3	0.0	0.0	0.0	11.6	0.0	13.6	0.0	12.7	0.0	13.4	0.0	0.0	0.0	21.8
1	20.4	22.3	19.8	24.3	16.6	24.5	20.6	23.3	18.7	27.1	13.8	23.9	13.1	21.7	14.8	26.1	17.2	27.6	15.8	23.9	14.9	20.0	19.5	23.6	14.6	30.2
2	28.7	27.2	26.1	29.0	26.0	29.6	26.5	26.1	22.9	30.0	27.5	29.8	23.2	29.8	22.6	30.3	24.6	31.1	23.3	27.3	24.9	31.0	20.6	27.1	24.8	34.3
3	35.4	0.0	34.0	0.0	31.7	0.0	29.0	0.0	27.6	0.0	27.9	0.0	27.6	0.0	27.3	0.0	31.4	0.0	30.5	0.0	26.8	0.0	23.2	28.6	27.1	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	23.4	22.4	21.4	22.9	21.9	22.9	21.1	23.4	21.6	26.8	16.8	23.6	17.7	22.7	19.5	26.4	20.6	26.7	19.2	22.8	17.7	20.1	19.8	24.2	21.2	31.0
SOP	2,954	1,377	3,017	3,871	1,821	469	2,961	7,518	6,708	2,984	5,361	9,867	6,962	13,981	8,016	8,975	5,127	5,617	4,370	10,969	4,286	7,840	6,250	15,918	5,142	8,885

TABLE 11.4.1.1 Daily Egg Production Method.: Egg surveys on the Bay of Biscay anchovy.
(from MOTOS & URIARTE WD1993, MOTOS et al. 1995 ; URIARTE et al. WD 1999; URIARTE et al WD 2000)

YEAR		1987	1988	1989(*)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (prelimina
Period of year		2 - 7 June	21 - 28 Ma	10 - 21 Ma	4 - 15 May	6May-07Ju	6May-13Ju	No survey	May-3Jun	11 - 25 Ma	18 - 30 May	9 - 21 May	18 May - 8	22 May - 5 June	
Positive area (km2)		23850	45384	17546	59757	24264	67796		48735	31189	28448	50133	73131	51019	37883
Surveyed area (km2)		34934	59840	37930	79759	84032	92782		60330	51698	34294	59587	83156	61533	63192
Po (Egg per 0.05 m^2)(A+)		4.6	5.52	2.08	3.78	2.55	4.27		3.93	4.975	4.87	2.69	3.825	3.65	3.45
Total Daily egg production		2.20	5.01	0.73	5.02	1.24	5.81		3.83	3.09	2.77	2.70	5.6	3.72	2.61
(* Exp(-12))	C.V.	0.39	0.24	0.4	0.15	0.06	0.14		0.14	0.07	0.16	0.07	0.05	0.09	0.19
SSB (t)		29365	63500	11861	97239	19276	90720	--	60062	54700	39545	51176	101976	69074	44973
	C.V.	0.48	0.31	0.41	0.17	0.14	0.2		0.17	0.09	0.16	0.10	0.09	0.15	0.15
TOTAL #		1129	2675	470	5843	965.6	5797	--	2954	2644		3737.7	6282.4		
(millions)	C.V.					0.14	0.25		0.19	0.11		0.16	0.13		
No/age:	1	656	2349	246	5613	670.5	5571		2030	2257		3242.6	5466.7		
	C.V.					0.16	0.26		0.23	0.13		0.17	0.15		
(millions)	2	331	258	206	190	290.3	209.3		874	329		482.1	759.5		
	C.V.					0.17	0.22		0.19	0.23		0.1	0.14		
	3+	142	68	18	40	4.8	16.7		49.3	58		13.1	56.3		
	C.V.					0.42	0.51		0.3	0.30		0.27	0.36		

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

Table 11.4.2.1. Evaluation of Anchovy abundance index from French acoustic surveys in the Bay of Biscay.

	1983 20/4-25/4	1984 30/4-13/5	1989 (2) 23/4-2/5	1990 12/4-25/4	1991 6/4-29/4	1992 13/4-30/4	1993	1994 15/5-27/5	1995	1996	1997 6/5-22/5	1998 20/5-7/6	1999	2000 18/04 - 14/
Surveyed area	3,267	3,743	5,112	3,418 (3)	3388 (3)	2440(3)	*na*	2300(3)	*na*	*na*	1726(3)	9400 5600 (3)	*na*	6690(*)
Density (t/nm(**2))	15.4	10.3	3,0	4.5-32.2 (4	23.6	32.8	*na*	14.5	*na*	*na*	36.5	10.2	*na*	
Biomass (t)	50,000	38,500	15,500	)-110,000 (	64,000	89,000	*na*	35,000	*na*	*na*	63000	57000	*na*	47700(**)
Number (10**(-6))	2,600	2,000	805	300-7,500 (	3,173	9,342	*na*	*na*	*na*	*na*	3351	*na*	*na*	
Number of 1-group (10**(-6	1,800 (1)	600	400	100-7,500 (	1,873	9,072	*na*	*na*	*na*	*na*	2481	*na*	*na*	
Number of age 2-group (1(	800	1,400	405	0 -200 (4)	1,300	270	*na*	*na*	*na*	*na*	870	*na*	*na*	
Anchovy mean weight	19.2	19.3	19.3	*na*	20.2	9.5	*na*	*na*	*na*	*na*	18.8	*na*	*na*	

(1) Rough estimation
(2) Assumption of overestimate
(3) Positive area
(4) uncertainty due to technical problems
(*) area where anchovy shools have been detected
(**) underestimation
last version July 2000 by Jacques Masse

Table 11.5.1: Evolution of the French and Spanish fleets for ANCHOVY in Subarea VIII (from Working Group members). Units: Numbers of boats.

Year	France			Spain	total
	P. seiner	P. trawl	Total	P. seiner	
1960	52	0 (1)	52	571	623
1972	35	0 (1)	35	492	527
1976	24	0 (1)	24	354	378
1980	14	n/a (1)	14	293	307
1984	n/a	4 (1)	4	306	310
1987	9	36 (1)	45	282	327
1988	10	61 (1)	71	278	349
1989	2	51 (1)	53	215	268
1990	30	80 (2)	110	266	376
1991	30	115 (2)	145	250	395
1992	13	123 (2)	136	244	380
1993	21	138 (2)	159	253	412
1994	26	150 (2)	176	257	433
1995	26	120 (2)	146	257	403
1996	20	100 (2)	120	251	371
1997	26	136 (2)	162	267	429
1998	26	100 (2)	126	266	392
1999	26	100 *	126	250	376

* provisional

(1) Only St. Jean de Luz and Hendaya.

(2) Maximun number of potential boats; the number of pelagic trawling gears is rough of this number due to the fishing in pairs of mid-water trawlers.

n/a = Not available.

TABLE 11.5.2 Catch per unit effort of anchovy from the Spanish Spring fishery in the Bay of Biscay
(Average catches per boat and fishing day) (From WG members)

YEAR	87	88	89	90	91	92	93	94	95	96	97	98	99	2000 (Provisional)
CPUE/PERIOD	03-06	03-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06	04-06	03-06	03-06	04-06
CPUE (t)	0.9	0.7	0.8	1.5	1.2	2.5	1.7	1.6	2.6	2.2	0.8	0.9	1.4	2.1
CPUE 1 (#)	13.8	19.7	16.1	63.4	29.3	86.3	46.7	26.5	52.6	69.6	36.9	28.8	17.8	44.9
CPUE 2 (#)	12.2	5.8	13.7	4.4	20.2	16.6	29.7	32.6	29.6	21.2	9.4	5.7	31.0	27.1
CPUE 3 (#)	2.8	0.7	1.2	0.8	0.4	1.3	0.1	4.6	8.2	1.9	0.2	0.6	1.6	7.6
CPUE 4+ (#)	2.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.0	0.0	0.0	0.0
CPUE 2+ (#)	17.5	6.6	14.9	5.3	20.6	17.9	29.8	37.2	38.3	23.4	9.7	4.4	32.6	34.7
CPUE 3+ (#)	5.3	0.9	1.2	0.8	0.4	1.3	0.1	4.6	8.8	2.1	0.2	0.2	1.6	7.6

in thousands

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

Table 11.5.3.: Statistics summary for the catch per trip during the first quarter for Saint-Gilles Croix de Vie, La Turballe and Bayonne fishing harbours from 1988 to 1998.(From Prouzet and Lissardy,2000)

Bayonne fishing harbour (BA)

Toutes zones	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
lb observation	3	1	4	101	307	224	176	5	3	2	7
Nb marées	3	1	4	101	315	224	212	18	9	15	13
Minimum	5040	13090	141079	26478	20343	6477	11351	8496	13297	9185	15725
1° Quartile	11138		145225	108697	170212	40463	52656	21706	18111		46161
Moyenne	52072		185322	265726	329483	65424	117989	39505	32772	10249	110352
Médiane	17237		179388	225872	280067	60382	97755	44575	22924		80654
3° Quartile	75587		219485	401054	456634	82008	173160	45839	42509		184209
Maximum	133938	13090	241435	876198	1369256	172592	428951	76912	62094	11312	215347
SE moyenne	41084		24708	18664	12724	2464	6213	11712	14922	1063	31502
LCL moyenne				228698	304444	60569	105727				
UCL moyenne				302754	354521	70279	130251				

Saint-Gilles Croix de Vie fishing harbour (LS)

Toutes zones	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
lb Observation	2	21	3	21	18	14	17	16	11	10	23
Nb marées	12	29	9	172	107	170	135	103	81	83	257
Minimum	2743	7549	11051	1031	1696	2233	2454	14046	4613	2262	27716
1° Quartile		38448	12608	15368	19510	11224	101296	50020	15526	12344	135986
Moyenne	7042	109189	15209	37251	221004	17849	119441	69305	75749	57879	192023
Médiane		93076	14165	23931	153455	18731	124098	71246	41279	32776	179322
3° Quartile		162644	17287	63069	318251	24032	148050	77707	106957	108244	237372
Maximum	11340	333806	20410	102458	950032	38023	243986	160709	252730	159851	468924
SE moyenne	4298	20195	2752	7143	60653	2820	13980	9223	24594	18052	22230
LCL moyenne		67063.96	3369.291	22351.449	93038.191	11755.509	89804.97	49646.98	20951.53	17043.73	145921.12
UCL moyenne		151314.51	27047.959	52150.815	348970.135	23941.788	149076.33	88962.93	130547.18	98714.61	238124.77

La Turballe fishing harbour (SN)

Toutes Zones	1991	1992	1993	1994	1995	1996	1997	1998
lb Observation	91	78	196	315	206	254	214	220
Nb marées	149	117	227	347	241	256	241	230
Minimum	523	4100	1580	6362	128	1385	3337	21341
1° Quartile	33347	38233	6631	21063	2645	11902	41815	120807
Moyenne	40733	161715	17503	35491	39854	38423	94139	195335
Médiane	44570	76166	11273	33575	26575	22046	78844	202944
3° Quartile	50310	255727	25006	42559	58401	56213	136274	270592
Maximum	70950	777248	109547	123849	202164	314029	414559	389314
SE moyenne	1511	20303	1155	1118	2999	2454	4685	5799
LCL moyenne	37731	121286	15225	33292	33941	33589	84905	183906
UCL moyenne	43735	202144	19781	37690	45768	43257	103373	206764

Table 11.5.4. Percentage of DEPMbiomass deviance explained by the variation of the mean catch per trip of the French pelagic fleet in using a semi-logarithmic model. (From Prouzet and Lissardy, 2000).

Equation coefficients

	Values	Standard Error
Origin (b)	-22964.1	3426.1
log(Moy) (a)	2310.4	305.5

model equation : $biom = 2310.4 \times log(Moy) - 22964.1 + \varepsilon$

Results from deviance analysis.

	ddl	Residual Deviance	Residuals ddl	Deviance	Pseudo F	Proba ($F<F_{crit}$)	R^2
NULL			14	3624459722			0.81
log(Moy)	1	2953100247	13	671359475	57.18	4.1×10^{-6}	

Table 11.5.5: Statistics summary of the landings per trip for the two French main pelagic trawler fleets (LS and SN) operating during the first quarter 2000 for anchovy in the Bay of Biscay (after Prouzet and Lissardy, 2000).

	Saint-Gilles Croix de Vie (LS)	La Turballe (SN)	Whole fleet
Mean Weight (kg)	6436.9	5314.7	5791.3
SE mean (95% C.I.)	303.8 (5836.3 – 7037.4)	189.6 (4940.8 – 5688.6)	171.4 (5454.3 – 6128.4)
Mean number	332880	256976	282706
SE mean (95% C.I.)	17930(297302 – 368458)	8994 (239236 - 274714)	8739 (265506 – 299905)
Median weight (kg)	6165	5000	5410
1st Quartile	3567.5	3300	3350
3rd Quartile	9862.5	8400	8400
Median number	365000	242105	282380
1st Quartile	187732	157519	162202
3rd Quartile	485357	400000	400000

Tabla 11.6.1: Series of Upwelling indexes from Borja et al. (1996,98 6 WD2000) and Allain et al. (1999) & Petitgas et al (WD2000) including the Destratification variable

	WD2000	**WD2000**		**Results from previous WG Reports**					**Assessm**	**WD2000**		**DEPM estimates**
	Borja's et al. (1996,	**Petitgas et al. (WD2000)**		Age 0 in the assessment				**WG2000**	in year Y+	Prediction of P.Petitgas		in year Y+1
									WG2000	Fitted for the period 86-97		**WG2000**
Year	Upwelling	Upwelling	SBD	1,996	1,997	1,998	1,999	2,000	Age_1 Serie	Adjusted		Age 1 Series
1986	617.5	20.49	0	5,901	6,164	6,483	6,461	5845.1	1756.1	3268.7		656.0
1987	508.4	47.25	1	8,276	8,267	7,424	7,447	8702.5	2597.6	2065.9		2349.0
1988	473.2	35.88	1	3,310	3,641	4,294	4,387	3473.2	1038.0	1363.2		346.9
1989	970.9	45.45	0	21,395	21,990	19,052	19,082	19651.7	5889.1	4811.4		5613.0
1990	905.9	50	1	7,272	7,506	7,206	7,319	7586.5	2266.8	2235.9		670.5
1991	1,076.3	110.74	0	27,393	28,271	27,767	28,402	27632.0	8223.5	8845.9		5571.0
1992	1,128.8	47.16	0	27,677	28,003	25,764	25,305	24102.8	7182.3	4917.2		
1993	570.9	53.03	0	15,551	14,455	13,877	13,334	12789.1	3827.0	5279.9		2030.1
1994	905.0	29.2	0	14,273	12,335	10,454	10,275	10405.3	3111.4	3807.5		2257.0
1995	1,204.0	74.99	0	14,963	14,650	14,051	13,397	14513.7	4336.7	6636.6		
1996	973.0	50.17	0		17,065	21,443	20,231	18197.0	5432.6	5102.9		3242.6
1997	1,230.5	100.04	0			30,950	34,648	25830.1	7742.4	8184.7		5466.7
1998	461.0	58.49	0				2,977	7841.4	2357.6	*5617.3*	Predicition	
1999	402.0	32.68	0					12582.4	3822.3	*4022.5*	Prediction	
2000	391.0	51.21	0							*5167.4*	Prediction	
								Age 0	Age 1			Age 1
							Geometric Mean:	12174	3645		Geometric Mean:	
							Arithmetic mean:	14225	4256		Arithmetic mean:	
							CV	54.4%	54.2%		CV	

Retrospective analysis of the Upwelling index performances

Coeff.Determination for age 0:	1986-96	1986-97	1986-98	1986-99	1986-00
with Borja's Upwelling index	51.5%	51.5%	58.6%	62.6%	55.4%
Petiga`'s Upwelling index	34.0%	36.0%	53.0%	47.7%	49.7%

Coeff.Determination for age 1:

Borja's Inc	Petitga's Multiple Index	
60.3%	75.2%	1986-1997
61.9%	65.5%	1986-1998
55.1%	65.5%	1986-1999

FORECA	Linear models on assessment estimates			
(Actual fitting)	Borja's Inc	Petitga's Multiple Index		
Age 0	Upwelling	Upwelling	Multiple index	
1986-1999	55.4%	49.7%	65.0%	1986-1999
Adjusted for d.f.	51.7%	45.5%	59.5%	Adjusted for d.f.
ction for age 0 2000	*6034*	*13634*	*15298*	Prediction
CV for prediction	98.7%	43.4%	33.7%	CV for prediction

Linear models on assessment estimates			**FORECASTS**
Borja's Inc	Petitga's Multiple Index		(Actual fitting)
Upwelling	Multiple index		**Age 1**
55.3%	65.8%	1986-1999	1986-1999
51.6%	59.5%	Adjusted for d.f.	Adjusted for d.f.
1809	*4577*	Prediction	Prediction for age 1 2001
98.6%	33.6%	CV for prediction	CV for prediction

Table 11.6.2: Linear models fitted to age 0 between the environmental indexes and the assessment adopted by this Working Group in Sept.2000. (14 pairs of data)

a) Boja's et al. Upwelling Index (1986,1998)

Regression Analysis - Linear model: Y = a + b*X

Dependent variable: Age_0
Independent variable: UpwellingAZTI (Borja's et al Index

Parameter	Estimate	Standard Error	T Statistic	P-Value
Intercept	-1497.37	4317.4	-0.346823	0.7347
Slope	19.2621	4.98788	3.86179	0.0023

Correlation Coefficient = 0.744396   R-squared = 55.4125 percent
R-squared (adjusted for d.f.) = 51.6969 percent Standard Error of Est. = 5375.88

Forecast Year	Fitted Value	Stnd. Error for Forecast	Lower 95.0% CL for Forecast	Upper 95.0% CL for Forecast
200	6034.12	5955.1	-6940.96	19009.2

b) Petitgas et al Upwelling Index (WD2000)

Multiple Regression Analysis

Dependent variable: Age_0

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	2732.51	3672.62	0.744023	0.4712
UpwelIfremer	212.949	61.8924	3.44063	0.0049

R-squared = 49.66 percent   R-squared (adjusted for d.f.) = 45.465 percent
Standard Error of Est. = 5712.15   Mean absolute error = 4400.9

Forecast: Row	Fitted Value	Stnd. Error for Forecast	Lower 95.0% CL for Forecast	Upper 95.0% CL for Forecast
15	13637.6	5915.1	749.691	26525.5

c) Petitgas et al Upwelling and destratification Multiple model (WD2000)

Multiple Regression Analysis

Dependent variable: Age_1

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	1699.38	1022.49	1.662	0.1247
UpwelIfremer	56.1941	16.2808	3.45157	0.0054
Destratif	-2222.16	978.687	-2.27055	0.0443

R-squared = 65.757 percent   R-squared (adjusted for d.f.) = 59.531 percent
Standard Error of Est. = 1471.26   Mean absolute error = 980.34

Forecast Row	Fitted Value	Stnd. Error for Forecast	Lower 95.0% CL for Forecast	Upper 95.0% CL for Forecast
15	4577.09	1539.17	1189.38	7964.79

Table 11.7.1.1: Log Residuals to the Separable Model and DEPM from the Assessment of Reference (see text)

As made in the last year WG.

A) Catch at age

ln(x)-ln(y)

Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	Total
1987	0.495	0.050	-0.025	-0.068	-0.928	0.000	-0.5
1988	2.516	0.383	-0.261	-0.340	-1.940	0.000	0.4
1989	1.054	-0.235	-0.315	0.282	-1.641	0.000	-0.9
1990	-0.409	0.256	0.259	-0.245	-1.500	0.000	-1.6
1991	-0.805	-0.484	-0.759	0.691	-1.950	0.000	-3.3
1992	-1.122	-0.315	0.417	-0.153	-0.554	0.000	-1.7
1993	0.429	0.096	-0.014	-0.256	-1.202	0.000	-0.9
1994	0.428	0.086	-0.169	0.125	-0.807	0.000	-0.3
1995	-0.280	-0.041	-0.186	0.253	-1.391	0.000	-1.6
1996	-0.051	-0.160	-0.109	0.076	-1.919	0.000	-2.2
1997	0.387	0.085	-0.156	-0.104	-0.956	0.000	-0.7
1998	-1.402	0.127	0.011	-0.263	-0.207	0.000	-1.7
1999	0.278	0.322	-0.030	-0.526	-1.536	0.000	-1.5
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
Totales	1.5	0.2	-1.3	-0.5	-16.5	0.0	-16.7
Observaciones	13	13	13	13	13		65
Unweighted Squared log residuals of ...					Wy*(ln(x)-ln(y))^2		
Total USQR	12.40	0.77	1.08	1.27	24.71	0.00	40.24
Weighted Squared log residuals of ...					Wa*Wy*Wty*(ln(x)-ln(y))^2		
Total WSQR	0.91	0.70	1.05	1.21	0.22	0.00	4.09390

B) Log residuals for the fitting to the DEPM surveys.

Year\ ages	**1**	**2**	**3 +**	**Total**	**SSB**
1987	-0.390	0.477	0.103	0.1894	-0.2658
1988	0.723	0.376	0.351	1.4493	0.5132
1989	-0.606	0.375	-0.350	-0.5813	-0.3545
1990	0.704	0.585	0.100	1.3882	0.5276
1991	-0.292	-0.036	-1.197	-1.5243	-0.4242
1992	0.392	0.687	-0.511	0.5680	0.2179
1993	0.000	0.000	0.000	0.0000	0.0000
1994	0.100	0.404	-0.637	-0.1332	0.0288
1995	0.502	0.273	-0.406	0.3691	0.2257
1996	0.000	0.000	0.000	0.0000	0.0321
1997	0.332	0.766	-0.216	0.8817	0.2488
1998	0.245	0.496	0.289	1.0298	0.1300
1999	0.000	0.000	0.000	0.0000	0.1880
2000	0.000	0.000	0.000	0.0000	-0.0986
Total	1.7088	4.4020	-2.4741	3.6368	0.9691
TOTAL USSQ	2.20716	2.39512	2.66103	7.26331	1.14219
Total WSSQ	0.7357	0.7984	0.8870	2.4211	0.5711
Observaciones	10	10	10	30	13
Parámetros	0	0	0	0	0
DF	10	10	10	30	13
Variance	0.0736	0.0798	0.0887	0.0807	0.0439
Poderac.media	0.3333	0.3333	0.3333	0.3333	0.50
Variance 2	0.2207	0.2395	0.2661	0.2421	0.0879
Coefficient R2	86.8%	88.6%	74.8%		77.8%

Table 11.7.1.2: Weighting factors for the catches at age percentages of those ages in the Catch

Catch in weight	age 0	age 1	age 2	age 3	age 4	age 5
Average 87-99	4.4%	60.0%	31.1%	3.6%	0.5%	0.3%

Weighting factors	Wf0	Wf1	Wf2	Wf3	Wf4	Wf5
Previous	0.1	1	1	1	0.01	0.01
Alternative 1	0.01	1	1	1	0.01	0.01
Alternative 2	0.01	1	1	0.1	0.01	0.01

Table 11.7.1.3: Reduction in WSSQ by eliminating Year/Age Cage Observation and F ratio test

Initial WSSQ: 8.8218

Sensitivity Analysis of the catch at age matrix

a) Reduction in WSSQ by eliminating Year/Age Cage Observation

	Edad 1	Edad 2	Edad 3
1987	0.0006	0.0003	0.0257
1988	0.1160	0.0570	0.1199
1989	0.1433	0.1800	0.2351
1990	0.1041	0.1351	0.1172
1991	0.4177	1.0130	1.1720
1992	0.0394	0.4053	0.0144
1993	0.0276	0.0007	0.2737
1994	0.0010	0.0567	0.0052
1995	0.0008	0.0403	0.1469
1996	0.0562	0.0094	0.0174
1997	0.0052	0.0351	0.0275
1998	0.0264	0.0058	0.1623
1999	0.7183	0.0139	0.6718

b) Probability of the reductions in WSSQ (F.ratio test)

	Edad 1	Edad 2	Edad 3
1987	0.939	0.956	0.615
1988	0.284	0.454	0.276
1989	0.234	0.182	0.126
1990	0.311	0.248	0.282
1991	0.040	0.001	0.000
1992	0.535	0.044	0.706
1993	0.602	0.934	0.099
1994	0.921	0.455	0.821
1995	0.927	0.529	0.228
1996	0.457	0.761	0.679
1997	0.821	0.557	0.603
1998	0.610	0.811	0.205
1999	0.007	0.712	0.009

Table 11.7.1.4: Summary results of assessments of anchovy, changing the weighting factors at age 0 and 3 and the selectivity at age 4.
A- Assessment of reference similar to the one produced in last year, updating data, B- Down-weighting age 3 in 1991 to 0.0001
C- as B down-weighting age 0 to 0.01, D- as C but selectivity at 4 equal to age 3, E and F as D down weighting age 3 to 0.2 and to 0.1 respectively

RUN	**A**	**B**	**C**	**D**	**E**	**F**
Natural Mortality	1.20	1.20	1.20	1.20	1.20	1.20
NMM2+ (factor)	1.00	1.00	1.00	1.00	1.00	1.00
Slectivity at age 4	1.00	1.00	1.00	=Sel_3	=Sel_3	=Sel_3
Fitting summary						
Total Weighted squared residuals	8.8220	7.6497	6.7485	6.6921	5.5543	5.3491
Catches (Cages)	4.095	2.984	2.051	1.886	1.358	1.392
DEPM SSB (t)	0.571	0.581	0.581	0.588	0.645	0.600
DEPM SPages (1-3+)	2.421	2.557	2.551	2.655	2.231	2.054
Acoustic SSB (t)	0.751	0.688	0.673	0.671	0.571	0.562
Acoust. SPages (1-2+)	0.984	0.839	0.891	0.892	0.749	0.742
SSQ Total	*8.822*	*7.650*	*6.748*	*6.692*	*5.554*	*5.349*
SSQ Catches	*4.095*	*2.984*	*2.051*	*1.886*	*1.358*	*1.392*
SSQ tunning indices	*4.727*	*4.665*	*4.698*	*4.806*	*4.196*	*3.957*
Residual Variance	*0.0991*	*0.0860*	*0.0758*	*0.0752*	*0.0631*	*0.0601*
Observaciones	*125*	*125*	*125*	*125*	*125*	*125*
Parámetros	*36*	*36*	*36*	*36*	*37*	*36*
Degrees of freedom (d.f.)	*89*	*89*	*89*	*89*	*89*	*89*
Reducction in d.f.		*0*	*0*	*0*	*0*	*0*
Reducction in SSQ		*1.17*	*0.90*	*0.06*	*1.14*	*0.21*
F ratio for Red_SSQ		*13.64*	*11.89*	*0.75*	*18.03*	*3.41*
Probability of F		*0.0004*	*0.0009*	*0.3888*	*0.0001*	*0.0680*
Another fitting statics						
Coeficiente R2 Catch in tonnes	70.2%	89.3%	89.0%	89.2%	93.0%	91.8%
Coeficiente R2 Biomas DEPM	77.7%	72.5%	71.9%	71.6%	74.6%	75.4%
Coeficiente R2 Biomas Acustic	20.2%	24.3%	25.4%	25.5%	29.7%	29.6%
Log error estandard Cages	*0.4721*	*0.4030*	*0.3390*	*0.3251*	*0.3218*	*0.3333*
Log error estandard DEPM SSB	*0.2964*	*0.2991*	*0.2991*	*0.3007*	*0.3150*	*0.3039*
Log error estandard DEPM Pop. Age 1	*0.4698*	*0.4607*	*0.4643*	*0.4672*	*0.4287*	*0.4472*
Log error estandard DEPM Pop. Age 2	*0.4893*	*0.5417*	*0.5427*	*0.5488*	*0.5395*	*0.4960*
Log error estandard DEPM Pop. Age 3+	*0.5160*	*0.5111*	*0.5053*	*0.5263*	*0.4614*	*0.4126*
Log error estandard Acustic SSB	*0.5004*	*0.4790*	*0.4738*	*0.4731*	*0.4364*	*0.4326*
Log error estandard Acústica Pop. Age 1	*0.5190*	*0.4301*	*0.4138*	*0.4134*	*0.4425*	*0.4563*
Log error estandard Acústica Pop. Age 2+	*0.6218*	*0.6119*	*0.6504*	*0.6512*	*0.5508*	*0.5350*
Total Marginal residuals of age 2 in DEPM	4.4017	4.65	4.61	4.67	4.64	4.13
Weighting factos age 0	0.1000	0.1000	0.0100	0.0100	0.0100	0.0100
Weighting factos age 1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Weighting factos age 2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Weighting factos age 3	1.0000	1.0000	1.0000	1.0000	0.2000	0.1000
Weighting factos age 4	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Weighting age3 in 1991	1.0000	0.0001	0.0001	0.0001	0.0001	0.0001
Weighting factor DEPM	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
Weighting factor DEPM age 1	0.5	0.5	0.5	0.5	0.5	0.5
Weighting factor DEPM age 2	0.5	0.5	0.5	0.5	0.5	0.5
Weighting factor DEPM age 3+	0.5	0.5	0.5	0.5	0.5	0.5
Weighting factor Acoustic	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
Weighting factor Acoustic age 1	0.5	0.5	0.5	0.5	0.5	0.5
Weighting factor Acoustic age 2+	0.5	0.5	0.5	0.5	0.5	0.5

Table 11.7.1.5: Residuals to the Separable Model and to the DEPM of the assessments cases where catches at age 0 and 3 and increasingly down weighted.

Case B: Update of last year working group, down weighting age 3(1991) to 0.0001

W3=W2=W1=1

Catch at age log Residuals

Year\ ages	0	1	2	3	4	5	Total
1987	0.457	-0.023	-0.087	-0.061	-0.652	0.000	-0.4
1988	2.701	0.329	-0.307	-0.220	-2.162	0.000	0.3
1989	0.926	-0.145	-0.404	0.338	-1.805	0.000	-1.1
1990	-0.771	-0.077	0.281	-0.272	-1.766	0.000	-2.6
1991	-0.546	-0.246	-0.412	1.742	-1.542	0.000	-1.0
1992	-1.099	-0.292	0.330	-0.174	-0.178	0.000	-1.4
1993	0.466	0.097	-0.009	-0.236	-1.530	0.000	-1.2
1994	0.415	0.055	-0.218	0.204	-1.097	0.000	-0.6
1995	-0.262	-0.043	-0.185	0.372	-1.561	0.000	-1.7
1996	-0.028	-0.165	-0.123	0.168	-2.104	0.000	-2.3
1997	0.423	0.068	-0.185	-0.027	-1.226	0.000	-0.9
1998	-1.377	0.111	-0.027	-0.162	-0.413	0.000	-1.9
1999	0.212	0.292	-0.059	-0.424	-1.686	0.000	-1.7
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
Totales	1.5	0.0	-1.4	1.2	-17.7	0.0	-16.4
Observacione	13	13	13	13	13		65
Unweighted Squared log residuals of ...				Wy*(ln(x)-ln(y))^2			
Total USQR	13.04	0.42	0.76	3.78	28.78	0.00	46.78
Weighted Squared log residuals of ...				Wa*Wy*Wty*(ln(x)-ln(y))^2			
Total WSQR	0.93	0.37	0.71	0.72	0.26	0.00	2.98425

DEPM Log residuals

Year\ ages	1	2	3 +	Total	SSB
1987	-0.412	0.455	0.103	0.1459	-0.2837
1988	0.727	0.377	0.281	1.3845	0.5110
1989	-0.352	0.448	-0.340	-0.2432	-0.1780
1990	0.806	1.075	0.306	2.1862	0.6392
1991	-0.329	-0.034	-0.803	-1.1660	-0.4201
1992	0.367	0.532	-0.775	0.1244	0.1832
1993	0.000	0.000	0.000	0.0000	0.0000
1994	0.077	0.360	-0.769	-0.3412	-0.0103
1995	0.477	0.232	-0.541	0.1678	0.1992
1996	0.000	0.000	0.000	0.0000	-0.0036
1997	0.318	0.726	-0.370	0.6748	0.2279
1998	0.272	0.490	0.222	0.9848	0.1490
1999	0.000	0.000	0.000	0.0000	0.2386
2000	0.000	0.000	0.000	0.0000	-0.0608
Total	1.9508	4.6526	-2.6853	3.9181	1.1818
OTAL USSQ	2.12280	2.93444	2.61274	7.66998	1.16272
Total WSSQ	0.7076	0.9781	0.8709	2.5567	0.5814
bservaciones	10	10	10	30	13
Parámetros	0	0	0	0	0
DF	10	10	10	30	13
Variance	0.0708	0.0978	0.0871	0.0852	0.0447
oderac. media	0.3333	0.3333	0.3333	0.3333	0.50
Variance 2	0.2123	0.2934	0.2613	0.2557	0.0894
ard deviations	0.460738	0.541706	0.51115	0.505634	0.299066

Case D: as B but down weighting Cage 0 to 0.01 and Se4=Se(3=0.4769

W3=W2=W1=1

Catch at age

Year\ ages	0	1	2	3	4	5	Total
1987	0.560	0.064	-0.037	-0.031	0.160	0.000	0.7
1988	2.825	0.436	-0.252	-0.190	-1.552	0.000	1.3
1989	0.944	-0.105	-0.406	0.284	-1.318	0.000	-0.6
1990	-0.826	-0.069	0.289	-0.287	-1.343	0.000	-2.3
1991	-0.542	-0.256	-0.379	1.845	-0.997	0.000	-0.3
1992	-1.148	-0.324	0.275	-0.169	0.418	0.000	-0.9
1993	0.496	0.090	-0.004	-0.212	-0.885	0.000	-0.5
1994	0.438	0.080	-0.247	0.207	-0.529	0.000	-0.1
1995	-0.249	-0.029	-0.183	0.340	-1.036	0.000	-1.2
1996	-0.023	-0.152	-0.120	0.183	-1.689	0.000	-1.8
1997	0.469	0.080	-0.181	-0.004	-0.628	0.000	-0.3
1998	-1.548	0.091	-0.080	-0.207	0.183	0.000	-1.6
1999	0.299	0.197	-0.012	-0.374	-1.036	0.000	-0.9
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
Totales	1.7	0.1	-1.3	1.4	-10.3	0.0	-8.4
Observacione	13	13	13	13	13		65
Unweighted Squared log residuals of ...				Wy*(ln(x)-ln(y))^2			
Total USQR	14.67	0.48	0.68	4.05	13.63	0.00	33.52
Weighted Squared log residuals of ...				Wa*Wy*Wty*(ln(x)-ln(y))^2			
Total WSQR	0.11	0.38	0.65	0.63	0.12	0.00	1.88610

DEPM Log residuals

Year\ ages	1	2	3 +	Total	SSB
1987	-0.402	0.437	0.058	0.0940	-0.2842
1988	0.744	0.360	0.163	1.2569	0.5149
1989	-0.317	0.456	-0.437	-0.2979	-0.1622
1990	0.828	1.137	0.270	2.2354	0.6803
1991	-0.357	-0.005	-0.839	-1.2004	-0.4274
1992	0.360	0.519	-0.747	0.1317	0.1753
1993	0.000	0.000	0.000	0.0000	0.0000
1994	0.085	0.317	-0.786	-0.3838	-0.0170
1995	0.483	0.239	-0.619	0.1034	0.1879
1996	0.000	0.000	0.000	0.0000	-0.0046
1997	0.312	0.725	-0.406	0.6308	0.2226
1998	0.295	0.495	0.218	1.0084	0.1668
1999	0.000	0.000	0.000	0.0000	0.1936
2000	0.000	0.000	0.000	0.0000	-0.0583
Total	2.0323	4.6702	-3.1239	3.5785	1.1679
TOTAL USSQ	2.18233	3.01145	2.76981	7.96360	1.17651
Total WSSQ	0.7274	1.0038	0.9233	2.6545	0.5878
Observaciones	10	10	10	30	13
Parámetros	0	0	0	0	0
DF	10	10	10	30	13
Variance	0.0727	0.1004	0.0923	0.0885	0.0452
Poderac. media	0.3333	0.3333	0.3333	0.3333	0.50
Variance 2	0.2182	0.3011	0.2770	0.2655	0.0904
Log standard deviations	0.46715	0.54877	0.52629	0.51522	0.30071

Case F: as D but down weighting W3=0.1

W3=0.1

Catch at age

Year\ ages	0	1	2	3	4	5	Total
1987	0.442	0.205	-0.118	-0.439	-0.469	0.000	-0.4
1988	2.648	0.138	-0.205	-0.966	-1.768	0.000	-0.2
1989	1.206	0.114	-0.255	0.279	-1.287	0.000	0.1
1990	-0.887	-0.170	0.172	-1.079	-1.341	0.000	-3.3
1991	-0.376	-0.204	-0.292	1.387	-1.081	0.000	-0.6
1992	-1.067	-0.323	0.196	-0.823	0.275	0.000	-1.7
1993	0.311	-0.010	-0.069	-0.942	-1.195	0.000	-1.9
1994	0.358	0.034	-0.078	-0.074	-0.610	0.000	-0.4
1995	-0.268	-0.027	-0.084	0.172	-0.727	0.000	-0.9
1996	-0.033	-0.147	-0.061	-0.129	-1.292	0.000	-1.7
1997	0.651	0.105	-0.126	-0.556	-0.356	0.000	-0.3
1998	-1.349	0.149	-0.150	-0.901	-0.196	0.000	-2.4
1999	-0.064	0.098	-0.154	-1.255	-1.706	0.000	-3.1
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
Totales	1.6	0.0	-1.2	-5.3	-11.8	0.0	-16.8
Observacione	13	13	13	13	13		65
Unweighted Squared log residuals of ...				Wy*(ln(x)-ln(y))^2			
Total USQR	13.27	0.32	0.36	8.61	15.12	0.00	37.67
Weighted Squared log residuals of ...				Wa*Wy*Wty*(ln(x)-ln(y))^2			
Total WSQR	0.10	0.28	0.33	0.61	0.13	0.00	1.4551

DEPM Log residuals

Year\ ages	1	2	3 +	Total	SSB
1987	-0.268	0.285	0.112	0.1286	-0.2340
1988	0.623	0.522	0.282	1.4261	0.4481
1989	-0.388	0.231	-0.190	-0.3458	-0.2542
1990	0.802	1.011	0.250	2.0626	0.6267
1991	-0.412	-0.110	-0.731	-1.2521	-0.4901
1992	0.415	0.433	-0.727	0.1200	0.2178
1993	0.000	0.000	0.000	0.0000	0.0000
1994	0.143	0.532	-0.364	0.3104	0.1068
1995	0.479	0.283	-0.135	0.6271	0.2336
1996	0.000	0.000	0.000	0.0000	-0.0547
1997	0.194	0.565	-0.403	0.3559	0.1036
1998	0.325	0.332	0.082	0.7388	0.1541
1999	0.000	0.000	0.000	0.0000	0.3113
2000	0.000	0.000	0.000	0.0000	-0.0168
Total	1.9118	4.0848	-1.8251	4.1715	1.1521
TOTAL USSQ	1.98691	2.42122	1.57296	5.98109	1.20110
Total WSSQ	0.6623	0.8071	0.5243	1.9937	0.6006
Observaciones	10	10	10	30	13
Parámetros	0	0	0	0	0
DF	10	10	10	30	13
Variance	0.0662	0.0807	0.0524	0.0665	0.0462
Poderac. media	0.3333	0.3333	0.3333	0.3333	0.50
Variance 2	0.1987	0.2421	0.1573	0.1994	0.0924
Log standard deviations	0.44575	0.49206	0.39661	0.44651	0.30396

Table 11.7.2.1.: Inputs for the anchovy assessment (subarea VIII)

Output Generated by ICA Version 1.4 **Assesssment downweighting W0=0.01 and W3=0.1**

Anchovy in subarea VIII - Bay of Biscay

Catch in Number

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	38.1	150.3	180.1	17.0	86.6	38.4	63.5	59.9	49.8	109.2	133.2	4.1	35.5
1	338.8	508.3	179.7	1365.3	440.2	1441.7	1405.1	850.3	711.4	1139.2	911.3	1042.0	433.9
2	171.2	106.0	134.5	135.5	323.2	224.6	531.6	548.3	304.1	286.3	178.2	252.1	531.6
3	33.0	10.6	20.1	13.2	29.2	17.0	5.3	63.0	76.6	31.6	5.8	9.0	19.1
4	14.9	1.4	1.0	1.0	1.0	1.0	1.0	1.0	4.1	2.3	1.0	1.0	1.0
5	8.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Predicted Catch in Number

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	24.5	10.7	54.0	41.4	126.4	111.9	46.6	42.0	65.2	113.1	69.7	15.7	37.8
1	276.0	443.0	160.3	1617.7	539.6	1992.1	1419.6	821.8	731.2	1319.5	820.9	897.5	392.4
2	192.7	130.2	173.6	114.1	432.9	184.6	569.5	592.8	324.3	304.2	202.1	292.9	618.4
3	51.3	27.8	15.2	38.8	7.3	38.7	13.6	67.9	64.5	36.0	10.1	22.1	66.7
4	23.9	8.2	3.6	3.8	2.9	0.8	3.3	1.8	8.5	8.4	1.4	1.2	5.5

Weights at age in the catches (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	.011700	.005100	.012700	.007400	.014400	.012600	.012300	.014700	.015100	.011900	.011600	.010200	.018500
1	.021300	.021900	.020300	.021800	.020300	.020600	.017800	.020300	.023700	.019900	.017200	.022900	.021900
2	.032100	.030300	.029000	.028100	.025400	.030600	.027400	.026900	.032200	.031100	.027600	.026000	.030500
3	.037700	.035000	.031000	.043300	.028200	.037700	.030500	.030700	.036400	.040100	.031900	.030700	.034800
4	.041000	.037600	.027100	.040500	.040500	.040500	.040500	.040500	.037300	.046000	.040500	.031900	.055900
5	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000

Weights at age in the stock (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	.013000	.013000	.013000	.010000	.015000	.012000	.012000	.015000	.012000	.012000	.012000	.012000	.012000
1	.021700	.022600	.021000	.016200	.016800	.015400	.016000	.017100	.019000	.016400	.011900	.014600	.016400
2	.033000	.029800	.029000	.029500	.028000	.031700	.027000	.025800	.031100	.028700	.026600	.029900	.028700
3	.038000	.034100	.033000	.034600	.034000	.031700	.033000	.032300	.034100	.033600	.037400	.036900	.033500
4	.041000	.042500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500
5	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.040000

Natural Mortality (per year)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
1	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
2	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
3	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
4	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000
5	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000	1.2000

Proportion of fish spawning

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 11.7.2.1 (Cont'd)

INDICES OF SPAWNING BIOMASS

DEPM

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	29.36	63.50	16.72	97.24	19.28	90.72	*******	60.06	54.70	39.55	51.18	101.98	69.07	44.97

x 10 ^ 3

Acoustic

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	999990.	999990.	15500.	999990.	64000.	89000.	999990.	35000.	999990.	999990.	63000.	57000.	999990.	47700.

AGE-STRUCTURED INDICES

DEPM SUVEYS (Ages 1 to 3+)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	656.0	2349.0	346.9	5613.0	670.5	5571.0	*******	2030.1	2257.0	*******	3242.6	5466.7
2	331.0	258.0	290.5	190.0	290.3	209.3	*******	874.3	329.0	*******	482.1	759.5
3	142.0	68.0	25.4	40.0	4.8	16.7	*******	49.3	58.0	*******	13.1	56.3

x 10 ^ 3

ACOUSTIC SURVEYS (ages 1 to 2+)

AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	400.0	*******	1873.0	9072.0	*******	*******	*******	*******	2481.0	*******	*******	2517.0
2	405.0	*******	1300.0	270.0	*******	*******	*******	*******	870.0	*******	*******	331.0

x 10 ^ 3

Fishing Mortality (per year)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.0049	0.0053	0.0047	0.0094	0.0079	0.0080	0.0063	0.0069	0.0077	0.0107	0.0046	0.0035	0.0052
1	0.3046	0.3319	0.2971	0.5901	0.4949	0.5022	0.3943	0.4362	0.4862	0.6733	0.2913	0.2168	0.3250
2	0.7014	0.7642	0.6840	1.3586	1.1395	1.1563	0.9079	1.0044	1.1194	1.5501	0.6708	0.4991	0.7483
3	0.6166	0.6719	0.6013	1.1944	1.0018	1.0166	0.7982	0.8830	0.9841	1.3628	0.5897	0.4388	0.6578
4	0.5557	0.6055	0.5419	1.0764	0.9028	0.9161	0.7193	0.7958	0.8869	1.2282	0.5315	0.3954	0.5929
5	0.5557	0.6055	0.5419	1.0764	0.9028	0.9161	0.7193	0.7958	0.8869	1.2282	0.5315	0.3954	0.5929

Population Abundance (1 January)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	8703.	3473.	19652.	7587.	27632.	24103.	12789.	10405.	14514.	18197.	25830.	7841.	12582.	11469.
1	1752.	2608.	1041.	5891.	2264.	8257.	7202.	3828.	3112.	4338.	5422.	7744.	2354.	3770.
2	614.	389.	564.	233.	983.	416.	1505.	1462.	745.	576.	666.	1220.	1878.	512.
3	180.	92.	55.	86.	18.	95.	39.	183.	161.	73.	37.	103.	223.	268.
4	91.	29.	14.	9.	8.	2.	10.	5.	23.	18.	6.	6.	20.	35.
5	34.	4.	4.	2.	3.	3.	3.	3.	3.	2.	4.	5.	4.	4.

x 10 ^ 6

Weighting factors for the catches in number

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.0050	0.0050	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
1	0.5000	0.5000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.5000	0.5000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	0.0500	0.0500	0.1000	0.1000	0.0001	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
4	0.0050	0.0050	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100

Table 11.7.2.1 (Cont'd)

Predicted SSB Index Values

DEPM

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	37280.	40585.	21582.	51967.	31477.	72976.	999990.	53953.	43317.	41559.	46158.	87437.	51230.	46750.

Acoustic

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	999990.	999990.	21730.	999990.	31692.	73475.	999990.	54322.	999990.	999990.	46474.	88034.	999990.	47070.

Predicted Age-Structured Index Values

DEPM SURVEYS (Ages 1 to 3+) Predicted

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	857.4	1260.0	511.0	2517.2	1012.0	3678.6	*******	1759.6	1397.2	*******	2670.2	3950.9
2	248.8	153.1	230.4	69.1	323.7	135.7	*******	513.2	247.7	*******	274.0	544.5
3	130.6	51.6	31.1	31.3	10.2	34.8	*******	71.2	66.6	*******	20.0	52.4

ACOUSTIC SURVEYS (ages 1 to 2+) Predicted

AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	681.8	*******	1400.5	5097.9	*******	*******	*******	*******	3558.8	*******	*******	2450.4
2	492.7	*******	685.4	349.5	*******	*******	*******	*******	553.3	*******	*******	626.9

x 10 ^ 3

Fitted Selection Pattern

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069
1	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343	0.4343
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791	0.8791
4	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923
5	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923	0.7923

Table 11.7.2.2. Results for the anchovy assessment (Sub area VIII)

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 1- 3	SoP (%)
1987	8702500	183447	37279	15308	0.4106	0.5409	99
1988	3473190	120223	40585	15581	0.3839	0.5893	100
1989	19651690	296209	21582	10614	0.4918	0.5274	100
1990	7586510	181598	51966	34272	0.6595	1.0477	99
1991	27631950	481087	31476	19634	0.6238	0.8787	101
1992	24102750	432766	72975	37885	0.5191	0.8917	100
1993	12789070	311185	81638	40293	0.4936	0.7001	99
1994	10405300	265507	53953	34631	0.6419	0.7745	99
1995	14513690	263014	43316	30115	0.6952	0.8632	99
1996	18196970	309336	41558	34373	0.8271	1.1954	100
1997	25830090	393986	46158	22337	0.4839	0.5173	99
1998	7841350	247896	87436	31617	0.3616	0.3849	102
1999	12582420	251910	51230	26794	0.5230	0.5770	98

No of years for separable analysis : 13
Age range in the analysis : 0 . . . 5
Year range in the analysis : 1987 . . . 1999
Number of indices of SSB : 2
Number of age-structured indices : 2
Parameters to estimate : 36
Number of observations : 125
Conventional single selection vector model to be fitted.

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1987	0.7014	24	0.4347	1.1319	0.5495	0.8954	0.7226
2	1988	0.7642	23	0.4868	1.1998	0.6072	0.9620	0.7848
3	1989	0.6840	18	0.4717	0.9917	0.5659	0.8267	0.6964
4	1990	1.3586	17	0.9663	1.9103	1.1418	1.6166	1.3793
5	1991	1.1395	16	0.8172	1.5889	0.9617	1.3501	1.1560
6	1992	1.1563	18	0.7969	1.6779	0.9563	1.3982	1.1774
7	1993	0.9079	18	0.6271	1.3145	0.7517	1.0966	0.9242
8	1994	1.0044	17	0.7081	1.4248	0.8403	1.2005	1.0205
9	1995	1.1194	19	0.7713	1.6247	0.9256	1.3537	1.1398
10	1996	1.5501	16	1.1315	2.1236	1.3201	1.8202	1.5703
11	1997	0.6708	19	0.4593	0.9795	0.5529	0.8137	0.6834
12	1998	0.4991	21	0.3282	0.7590	0.4030	0.6181	0.5107
13	1999	0.7483	24	0.4642	1.2062	0.5865	0.9547	0.7708
Separable Model: Selection (S) by age								
14	0	0.0069	71	0.0017	0.0279	0.0034	0.0141	0.0089
15	1	0.4343	10	0.3559	0.5300	0.3924	0.4807	0.4366
	2	1.0000	Fixed : Reference Age					
16	3	0.8791	25	0.5338	1.4478	0.6816	1.1339	0.9081
	4	0.7923	Fixed : Last true age					
Separable model: Populations in year 1999								
17	0	12582421	28	7156914	22120891	9435059	16779685	13114713
18	1	2353631	26	1407091	3936900	1810300	3060033	2436112
19	2	1877847	17	1339633	2632297	1580616	2230973	1905933
20	3	223149	20	147916	336646	180918	275237	228114
21	4	19930	24	12220	32503	15528	25579	20560
Separable model: Populations at age								
22	1987	91401	188	2290	3646870	13935	599477	535907
23	1988	29329	85	5520	155836	12509	68768	42168
24	1989	14105	33	7276	27341	10062	19771	14932
25	1990	9010	28	5185	15655	6797	11943	9375
26	1991	7815	32	4113	14849	5632	10843	8245
27	1992	1992	32	1046	3795	1434	2768	2103
28	1993	10328	33	5306	20105	7353	14509	10942
29	1994	5339	34	2692	10589	3765	7572	5675
30	1995	22775	31	12316	42115	16644	31165	23923
31	1996	18160	34	9240	35687	12865	25633	19271
32	1997	5649	44	2367	13481	3624	8804	6233
33	1998	6152	32	3234	11703	4432	8541	6493

SSB Index catchabilities

DEPM

Table 11.7.2.2 (Cont'd)

Absolute estimator. No fitted catchability.
Acoustic
Linear model fitted. Slopes at age :
34 2 Q 1.007 14 .8761 1.546 1.007 1.345 1.176
Age-structured index catchabilities
DEPM SUVEYS (Ages 1 to 3+)
Absolute estimator. No fitted catchability.
ACOUSTIC SURVEYS (ages 1 to 2+)
Linear model fitted. Slopes at age :
35 1 Q 1.011 19 .8359 1.821 1.011 1.505 1.258
36 2 Q 1.333 20 1.096 2.435 1.333 2.002 1.668

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.440	2.645	1.204	-0.889	-0.378	-1.069	0.308	0.356	-0.270	-0.035	0.649	-1.351	-0.063
1	0.205	0.137	0.114	-0.170	-0.204	-0.323	-0.010	0.034	-0.027	-0.147	0.104	0.149	0.101
2	-0.118	-0.205	-0.255	0.172	-0.292	0.196	-0.069	-0.078	-0.064	-0.061	-0.126	-0.150	-0.151
3	-0.441	-0.966	0.279	-1.079	1.387	-0.823	-0.942	-0.074	0.172	-0.130	-0.560	-0.901	-1.252
4	-0.474	-1.770	-1.286	-1.341	-1.080	0.275	-1.195	-0.610	-0.727	-1.292	-0.356	-0.196	-1.704

SPAWNING BIOMASS INDEX RESIDUALS
DEPM

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	-0.2386	0.4476	-0.2550	0.6266	-0.4904	0.2176	*******	0.1073	0.2333	-0.0497	0.1032	0.1538	0.2988	-0.0388

Acoustic

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	*****	******	-0.3378	*****	0.7028	0.1917	*****	-0.4396	****	*****	0.3043	-0.4347	*****	0.0133

AGE-STRUCTURED INDEX RESIDUALS
DEPM SUVEYS (Ages 1 to 3+)

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-0.268	0.623	-0.388	0.802	-0.412	0.415	*******	0.143	0.480	*******	0.194	0.325
2	0.285	0.522	0.232	1.012	-0.109	0.433	*******	0.533	0.284	*******	0.565	0.333
3	0.084	0.275	-0.202	0.244	-0.753	-0.733	*******	-0.367	-0.138	*******	-0.422	0.072

ACOUSTIC SURVEYS (ages 1 to 2+)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	-0.5333	*******	0.2907	0.5764	*******	*******	*******	*******	-0.3608	*******	*******	0.0268
2	-0.1961	*******	0.6401	-0.2581	*******	*******	*******	*******	0.4526	*******	*******	-0.6386

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)
Separable model fitted from 1987 to 1999

Variance	0.0455
Skewness test stat.	-4.2352
Kurtosis test statistic	-0.0847
Partial chi-square	0.1317
Significance in fit	0.0000
Degrees of freedom	32

PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES
DISTRIBUTION STATISTICS FOR DEPM
Index used as absolute measure of abundance
Last age is a plus-group

Variance	0.0460
Skewness test stat.	0.9859
Kurtosis test statistic	-0.3791
Partial chi-square	0.0561
Significance in fit	0.0000
Number of observations	13
Degrees of freedom	13

Table 11.7.2.2 (Cont'd)

```
Weight in the analysis               0.5000
   DISTRIBUTION STATISTICS FOR   Acoustic
 Linear catchability relationship assumed
 Last age is a plus-group
 Variance                            0.0933
Skewness test stat.                  0.4263
Kurtosis test statistic             -0.5951
Partial chi-square                   0.0527
Significance in fit                  0.0000
Number of observations                    7
Degrees of freedom                        6
Weight in the analysis               0.5000

 PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES
   DISTRIBUTION STATISTICS FOR DEPM SUVEYS (Ages 1 to 3+)
 Index used as absolute measure of abundance
 Age                        1         2         3
 Variance              0.0663    0.0808    0.0542
Skewness test stat.    1.2182    1.8214   -1.8134
Kurtosis test statisti -0.7673   -0.4346   -0.2947
Partial chi-square     0.0462    0.0681    0.0541
Significance in fit    0.0000    0.0000    0.0000
Number of observations     10        10        10
Degrees of freedom         10        10        10
Weight in the analysis 0.3333    0.3333    0.3333


  DISTRIBUTION STATISTICS FOR ACOUSTIC SURVEYS (ages 1 to 2+)
 Linear catchability relationship assumed
 Age                        1         2
 Variance              0.0780    0.1057
Skewness test stat.    0.0469    0.1190
Kurtosis test statisti -0.6594   -0.6834
Partial chi-square     0.0215    0.0318
Significance in fit    0.0001    0.0001
Number of observations      5         5
Degrees of freedom          4         4
Weight in the analysis 0.3750    0.3750

 ANALYSIS OF VARIANCE
 Unweighted Statistics
Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                        47.9750     125          36   89   0.5390
Catches at age                         37.6610      65          33   32   1.1769
  SSB Indices
  DEPM                                  1.1964      13           0   13   0.0920
  Acoustic                              1.1198       7           1    6   0.1866
   Aged Indices
DEPM SUVEYS (Ages 1 to 3+)              6.0384      30           0   30   0.2013
ACOUSTIC SURVEYS (ages 1 to 2+)         1.9595      10           2    8   0.2449
 Weighted Statistics
Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                         2.9804     125          36   89   0.0335
Catches at age                          1.4549      65          33   32   0.0455
  SSB Indices
  DEPM                                  0.2991      13           0   13   0.0230
  Acoustic                              0.2799       7           1    6   0.0467
   Aged Indices
DEPM SUVEYS (Ages 1 to 3+)              0.6709      30           0   30   0.0224
ACOUSTIC SURVEYS (ages 1 to 2+)         0.2756      10           2    8   0.0344
```

Table 11.7.2.3a. -Stock: Anchovy Sub-area VIII

Assessment Quality Control Diagram 1

Average F(1-3,u)													
Date of assessment	Year												
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1989													
1990													
1991													
1992													
1993													
1994													
1995													
1996	0.707	1.014	0.990	0.993	1.992	1.343	0.926	0.901	0.825				
1997	0.546	0.554	0.678	0.610	1.449	0.892	0.585	0.643	0.738	0.855			
1998	0.573	0.541	0.617	0.629	1.299	0.891	0.574	0.679	0.862	1.172	0.414		
1999	0.549	0.501	0.581	0.615	1.258	0.863	0.565	0.679	0.861	1.238	0.486	0.251	
2000	0.541	0.589	0.527	1.048	0.8787	0.892	0.700	0.775	0.863	1.195	0.517	0.385	0.577

Remarks: Assessments of 1996-2000 performed using ICA.

Table 11.7.2.3b. - Stock: Anchovy Sub-area VIII

Assessment Quality Control Diagram 2

Recruitment (age 0) Unit: millions													
Date of assessment	Year class												
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1989													
1990													
1991													
1992													
1993													
1994													
1995													
1996	8276	3310	21395	7272	27393	27677	15551	14273	14963				
1997	8267	3641	21990	7506	28271	28003	14455	12335	14650	17065			
1998	7424	4294	19052	7206	27767	25764	13877	10454	14051	210443	30950		
1999	7447	4387	19082	7319	28402	25305	13334	10275	13397	20231	34647	2977	
2000	8703	3473	19652	7587	27632	24103	12789	10405	14514	18197	25830	7841	12582

Remarks: Assessments of 1996-2000 performed using ICA.

Table 11.7.2.3c. - Stock: Anchovy Sub-area VIII

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)														
Date of assessment	Year													
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1989														
1990														
1991														
1992														
1993														
1994														
1995														
1996	29178	16356	60886	29395	69621	93342	68487	55670						
1997	29905	17782	63438	29569	71261	95497	65521	46671	47188	(53503)				
1998	27519	19112	55649	28391	69737	88690	60978	45126	40617	54783	(88135)			
1999	37070	23389	55844	28794	71236	87618	58755	43727	37098	49641	118593	(59477)		
2000	40585	21582	51966	31476	72975	81638	53953	43316	41558	46158	87436	51230	(46750)	

Remarks: Assessments of 1996-2000 performed using ICA. In brackets the SSB estimate for the year of the assessment is presented.

Table 11.7.2.4: Comparisons between the assessment made in 1999 and in 2000 by this WG

Type of Assesmet	Assessment from ICES (2000)			Updated assessment Similar to 1999 assessment with a new year of data and down weighting ages 0 to 0.01 and age 3 to 0.1		
Assessment Year	**Age 0**	**F anual**	**SSB**	**Age 0**	**F anual**	**SSB**
1987	7,447	0.5496	37,813	8,703	0.541	37,279
1988	4,387	0.5007	37,070	3,473	0.589	40,585
1989	19,082	0.5807	23,389	19,652	0.527	21,582
1990	7,319	0.6146	55,844	7,587	1.048	51,966
1991	28,402	1.2581	28,794	27,632	0.879	31,476
1992	25,305	0.8625	71,236	24,103	0.892	72,975
1993	13,334	0.5659	87,618	12,789	0.700	81,638
1994	10,275	0.6792	58,755	10,405	0.775	53,953
1995	13,397	0.8612	43,727	14,514	0.863	43,316
1996	20,231	1.2382	37,098	18,197	1.195	41,558
1997	34,648	0.4856	49641	25,830	0.517	46,158
1998	4,774	0.2511	118593	7,841	0.385	87,436
1999	4,394	0.251	59484	12,582	0.579	51,230
2000			25178		0.579	46,750
Geomet. mean(10y)	12,843	0.704	48,849	12,906	0.743	47,512

Table 11.8.1 Inputs for the Catch option Predictions for the Anchovy in Sub Area VIII. Fishing Mortality pattern as the average of the last five years (1995-1999). Case of average recruitment below the arithmetic mean of the total series (1986-1999, as shown in table 11.6.1) (resulting in 8653 millions at age 0).

The SAS System 12:27 Saturday, September 23, 2000

Anchovy in Sub-area VIII (Bay of Biscay)

Prediction with management option table: Input data

Year: 2000

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	8653.000	1.2000	0.0000	0.4000	0.3750	12.444	0.0063	12.200
1	3770.000	1.2000	1.0000	0.4000	0.3750	15.922	0.3987	20.800
2	512.000	1.2000	1.0000	0.4000	0.3750	28.703	0.9180	29.000
3	268.000	1.2000	1.0000	0.4000	0.3750	34.178	0.8071	34.500
4	35.000	1.2000	1.0000	0.4000	0.3750	40.500	0.7274	40.000
5+	4.000	1.2000	1.0000	0.4000	0.3750	42.000	0.9180	42.000
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 2001 & 2002

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	12174.000	1.2000	0.0000	0.4000	0.3750	12.444	0.0063	12.200
1	.	1.2000	1.0000	0.4000	0.3750	15.922	0.3987	20.800
2	.	1.2000	1.0000	0.4000	0.3750	28.703	0.9180	29.000
3	.	1.2000	1.0000	0.4000	0.3750	34.178	0.8071	34.500
4	.	1.2000	1.0000	0.4000	0.3750	40.500	0.7274	40.000
5+	.	1.2000	1.0000	0.4000	0.3750	42.000	0.9180	42.000
Unit	Millions	-	-	-	-	Grams	-	Grams

Notes: Run name : MANAND04
Date and time: 23SEP00:12:30

Table 11.8.2 Catch option Predictions for the Anchovy in Sub Area VIII. Case of average recruitment below the arithmetic mean of the total series (1986-1999, as shown in table 11.6.1) (resulting in 8653 millions at age 0).

The SAS System   12:27 Saturday, September 23, 2000

Anchovy in Sub-area VIII (Bay of Biscay)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
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
1.5253	1.0798	193150	39573	35000	0.0000	0.0000	212754	39058	0	239306	56023
.	.	.	.	.	0.1000	0.0708	.	38188	2312	237778	53834
.	.	.	.	.	0.2000	0.1416	.	37341	4513	236337	51794
.	.	.	.	.	0.3000	0.2124	.	36516	6611	234978	49889
.	.	.	.	.	0.4000	0.2832	.	35712	8612	233696	48108
.	.	.	.	.	0.5000	0.3540	.	34929	10522	232484	46440
.	.	.	.	.	0.6000	0.4248	.	34166	12346	231339	44876
.	.	.	.	.	0.7000	0.4956	.	33423	14089	230256	43407
.	.	.	.	.	0.8000	0.5663	.	32698	15757	229231	42024
.	.	.	.	.	0.9000	0.6371	.	31993	17353	228260	40722
.	.	.	.	.	1.0000	0.7079	.	31305	18883	227340	39494
.	.	.	.	.	1.1000	0.7787	.	30634	20349	226468	38333
.	.	.	.	.	1.2000	0.8495	.	29980	21755	225640	37234
.	.	.	.	.	1.3000	0.9203	.	29343	23104	224853	36193
.	.	.	.	.	1.4000	0.9911	.	28721	24401	224106	35205
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANAND04
Date and time : 23SEP00:12:30
Computation of ref. F: Simple mean, age 1 - 3
Basis for 2000 : TAC constraints

Table 11.8.3 Inputs for the Catch option Predictions for the Anchovy in Sub Area VIII.

Case of Geometric mean Recruitment (1986-1999) at 12174 millions.

The SAS System 11:10 Saturday, September 23, 2000

Anchovy in Sub-area VIII (Bay of Biscay)

Prediction with management option table: Input data

Year: 2000

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	12174.000	1.2000	0.0000	0.4000	0.3750	12.444	0.0063	12.200
1	3770.000	1.2000	1.0000	0.4000	0.3750	15.922	0.3987	20.800
2	512.000	1.2000	1.0000	0.4000	0.3750	28.703	0.9180	29.000
3	268.000	1.2000	1.0000	0.4000	0.3750	34.178	0.8071	34.500
4	35.000	1.2000	1.0000	0.4000	0.3750	40.500	0.7274	40.000
5+	4.000	1.2000	1.0000	0.4000	0.3750	42.000	0.9180	42.000
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 2001 & 2002

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	12174.000	1.2000	0.0000	0.4000	0.3750	12.444	0.0063	12.200
1	.	1.2000	1.0000	0.4000	0.3750	15.922	0.3987	20.800
2	.	1.2000	1.0000	0.4000	0.3750	28.703	0.9180	29.000
3	.	1.2000	1.0000	0.4000	0.3750	34.178	0.8071	34.500
4	.	1.2000	1.0000	0.4000	0.3750	40.500	0.7274	40.000
5+	.	1.2000	1.0000	0.4000	0.3750	42.000	0.9180	42.000
Unit	Millions	-	-	-	-	Grams	-	Grams

Notes: Run name : MANAND02

Date and time: 23SEP00:11:11

Table 11.8.4 Catch option Predictions for the Anchovy in Sub Area VIII. Case of Geometric mean Recruitment (1986-1999) at 12174 millions.

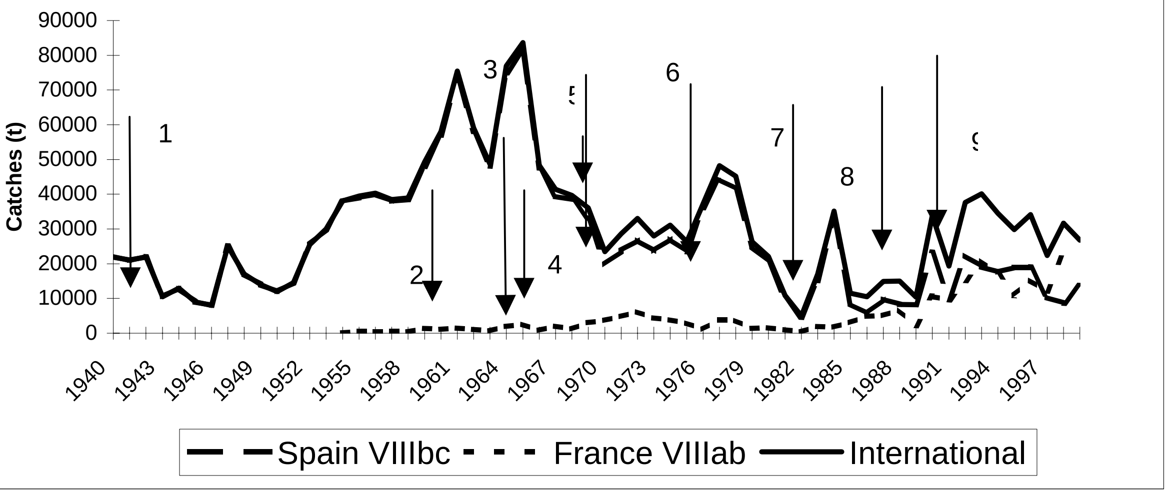
The SAS System 11:10 Saturday, September 23, 2000

Anchovy in Sub-area VIII (Bay of Biscay) Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
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
1.5110	1.0697	236967	39689	35000	0.0000	0.0000	229615	49809	0	248435	61844
.	.	.	.	.	0.1000	0.0708	.	48767	2818	246548	59225
.	.	.	.	.	0.2000	0.1416	.	47751	5509	244763	56786
.	.	.	.	.	0.3000	0.2124	.	46760	8081	243073	54512
.	.	.	.	.	0.4000	0.2832	.	45793	10541	241472	52389
.	.	.	.	.	0.5000	0.3540	.	44849	12896	239955	50405
.	.	.	.	.	0.6000	0.4248	.	43928	15151	238517	48548
.	.	.	.	.	0.7000	0.4956	.	43029	17311	237152	46807
.	.	.	.	.	0.8000	0.5663	.	42151	19383	235856	45174
.	.	.	.	.	0.9000	0.6371	.	41294	21372	234625	43639
.	.	.	.	.	1.0000	0.7079	.	40458	23281	233455	42195
.	.	.	.	.	1.1000	0.7787	.	39641	25115	232343	40834
.	.	.	.	.	1.2000	0.8495	.	38844	26877	231284	39551
.	.	.	.	.	1.3000	0.9203	.	38065	28573	230277	38339
.	.	.	.	.	1.4000	0.9911	.	37305	30205	229317	37192
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANAND02
Date and time : 23SEP00:11:11
Computation of ref. F: Simple mean, age 1 - 3
Basis for 2000 : TAC constraints

Figure 11.2.1.1: Bay of Biscay anchovy: Historical evolution of the fishery since 1940



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

Figure 11.2.1.2: Mean monthly catches (1992-1999) for the French and Spanish anchovy fisheries in Sub-area VIII

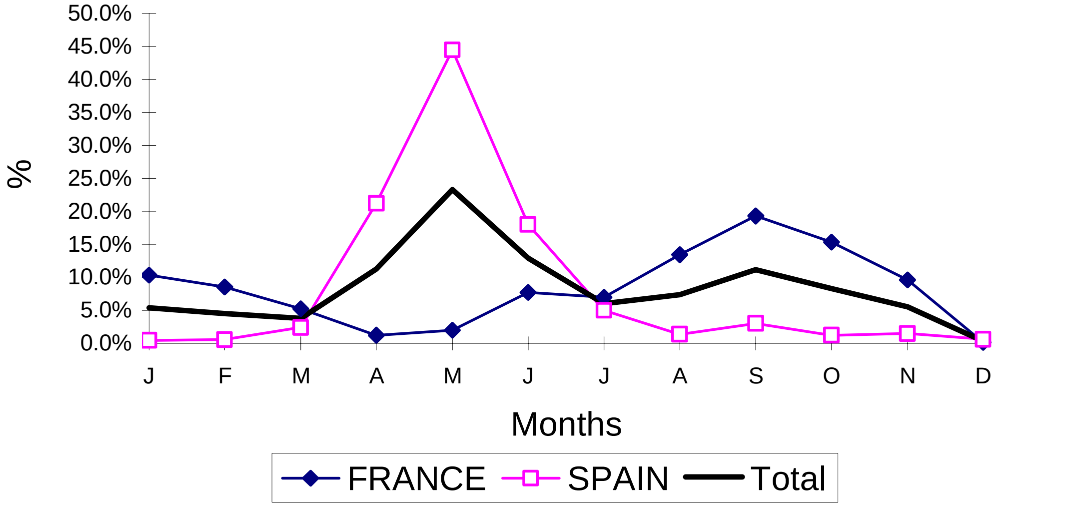


Figure 11.3.2.1 -First Quarter-

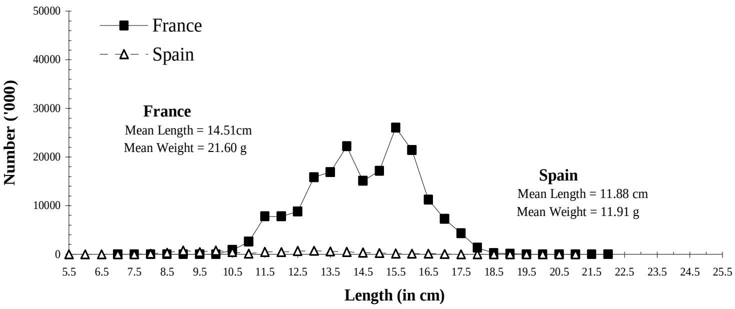


Figure 11.3.2.2 - Second Quarter

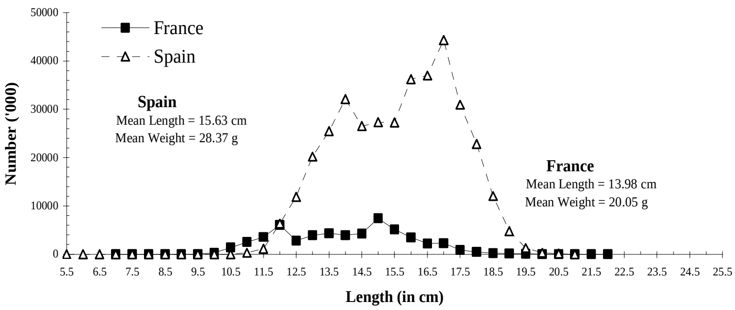


Figure 11.3.2.3 -Third Quarter-

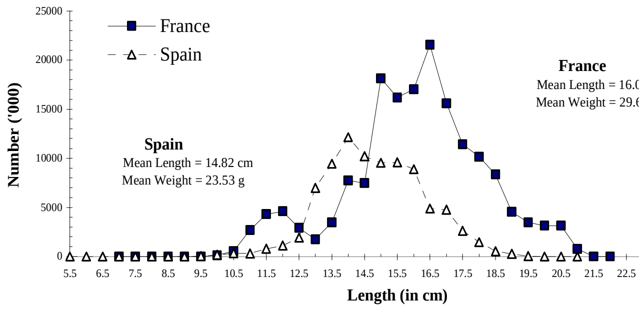
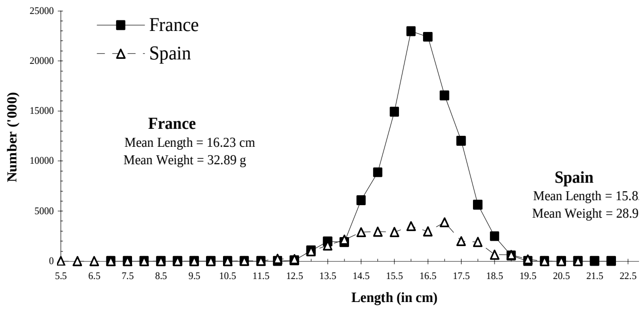


Figure 11.3.2.4 -Fourth Quarter-



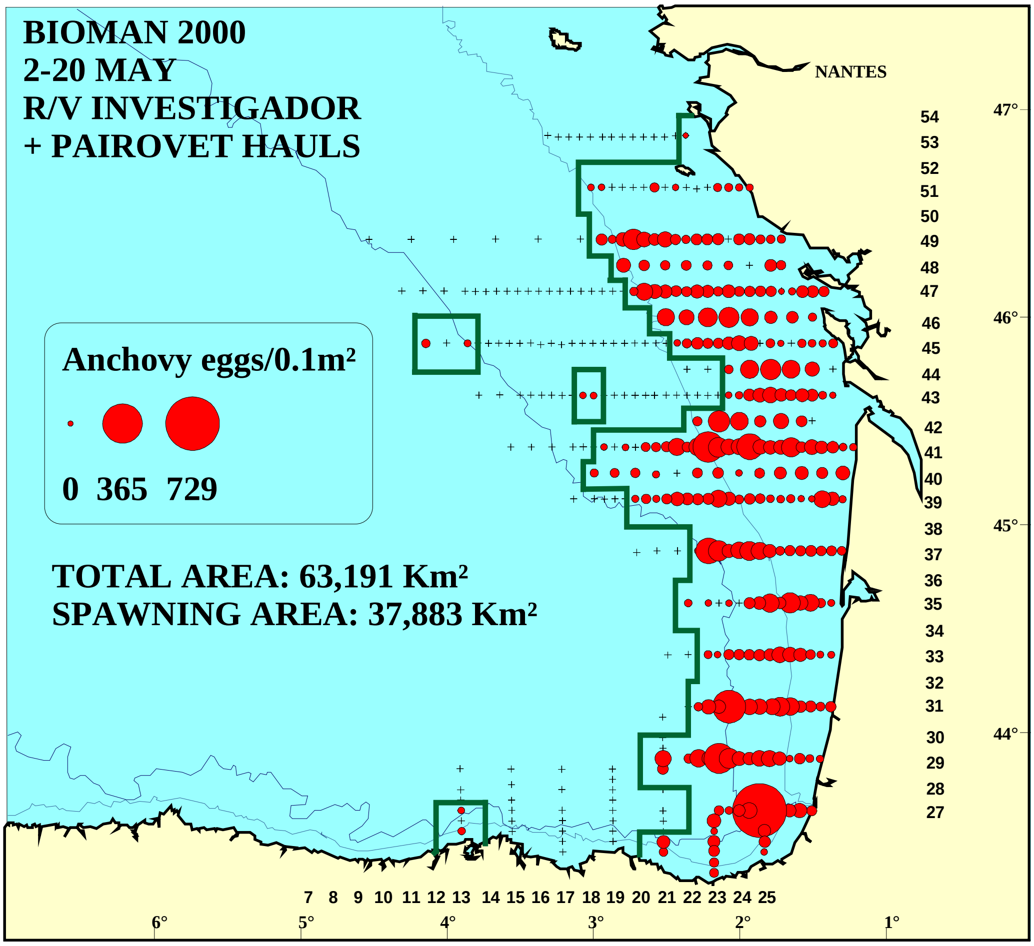


Figure 11.4.1.1: Anchovy Egg/0.1m² distribution found during BIOMAN 2000.
Solid line encloses the positive spawning area

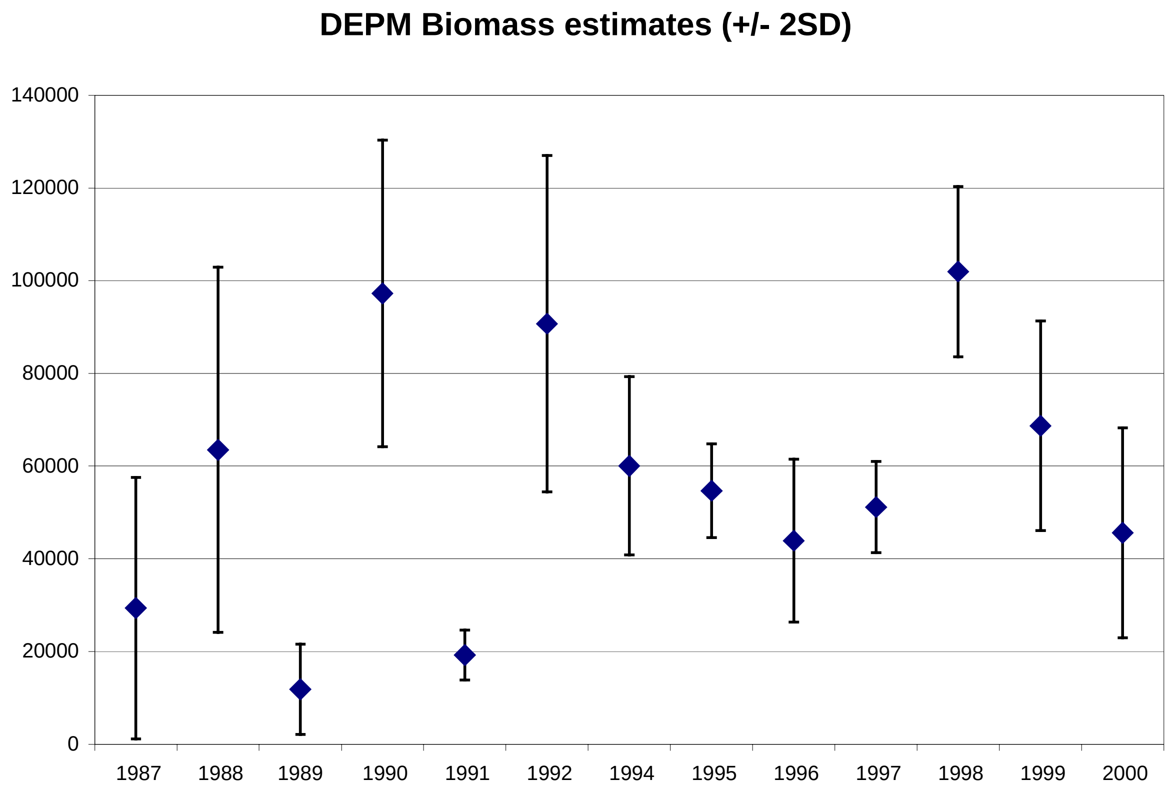


Figure 11.4.1.2: Series of Biomass estimates obtained from the Egg surveys since 1987 Uriarte et al WD2000. Most of them are full DEPM estimates, except in 1996, 1999 and 2000 which were deduced indirectly from the relationship of biomass with the spawning area and daily egg production per surface unit (P0).

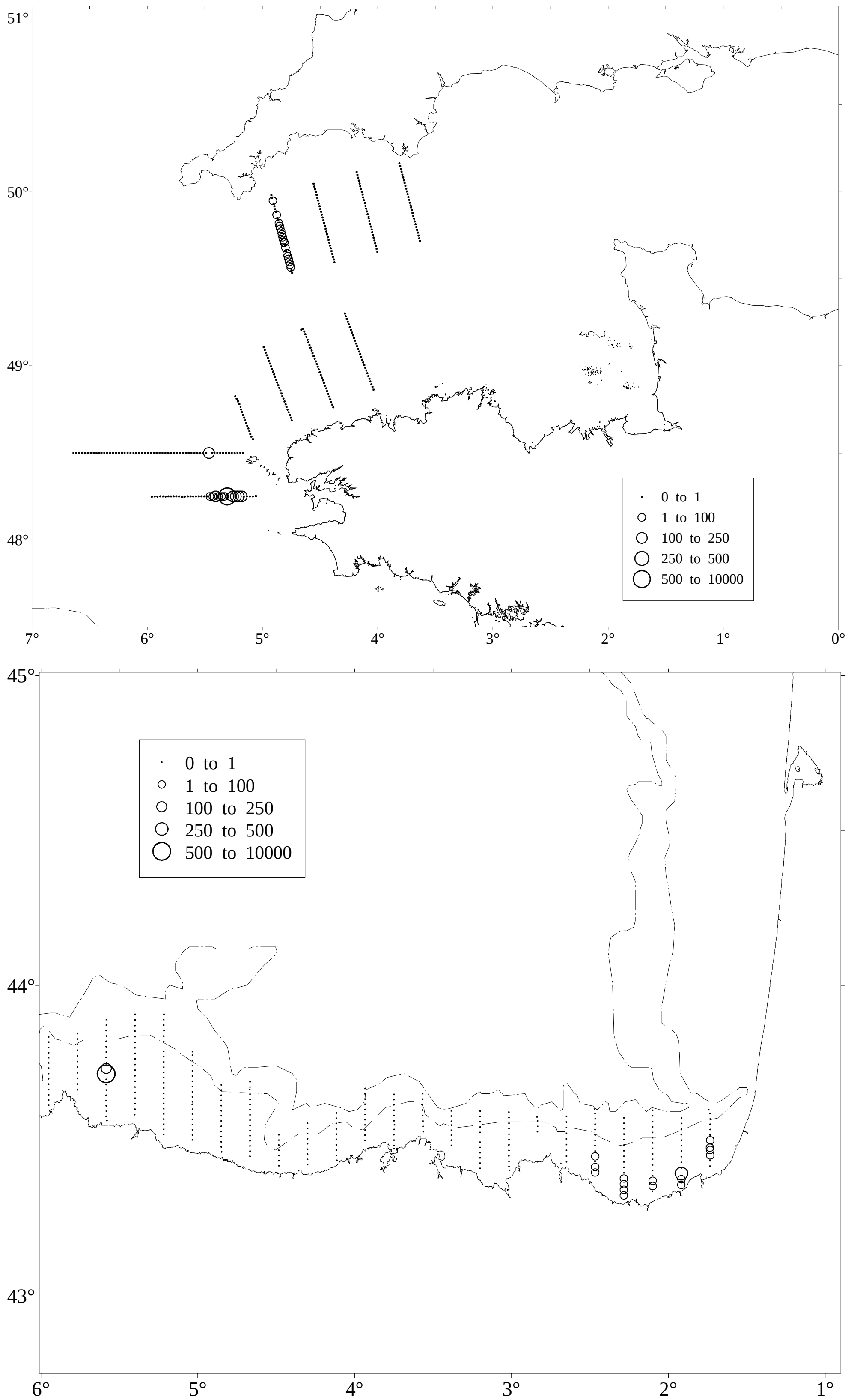
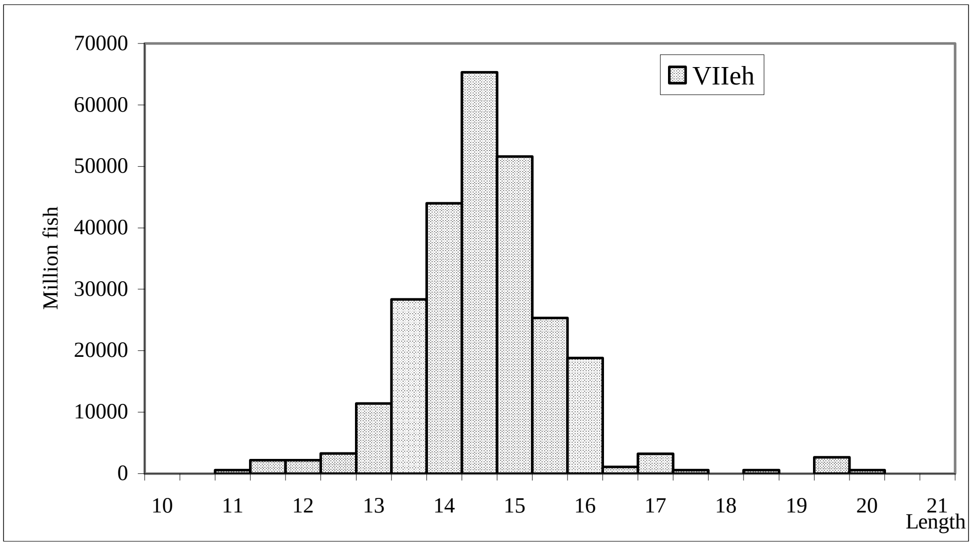
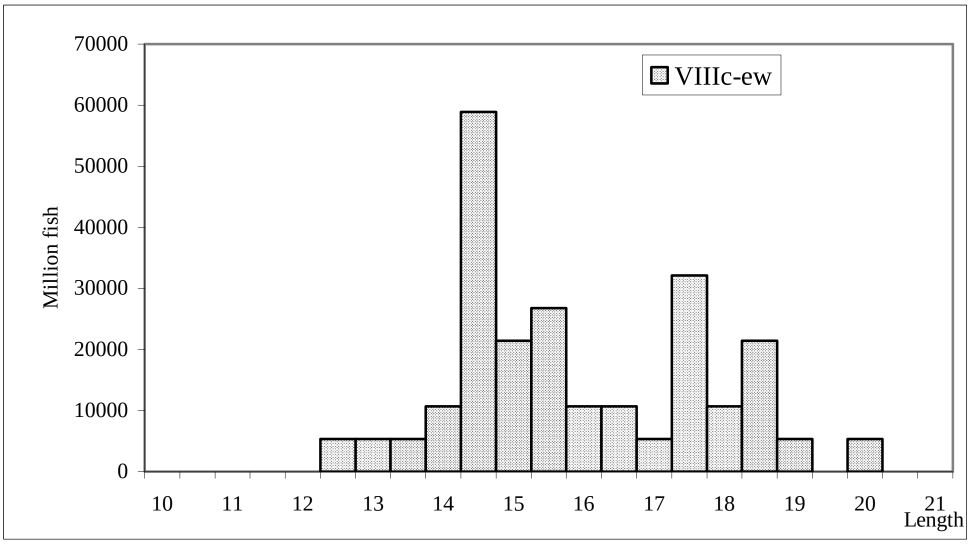


Figure 11.4.2.1: Acoustic energy allocated to anchovy during the acoustic survey PELACUS 0300





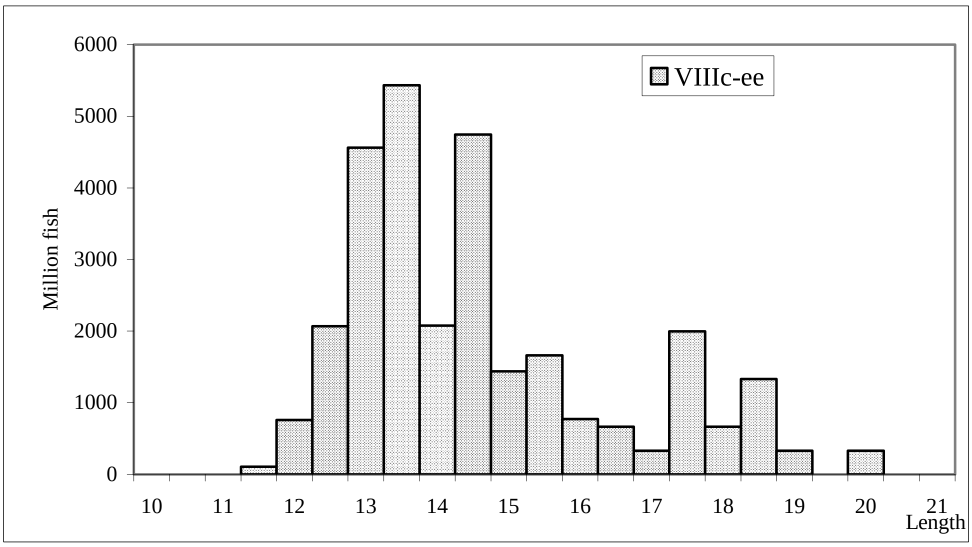


Figure 11.4.2.2: Estimated fish number at length class by ICES Sub-Division during the survey Pelacus 0300

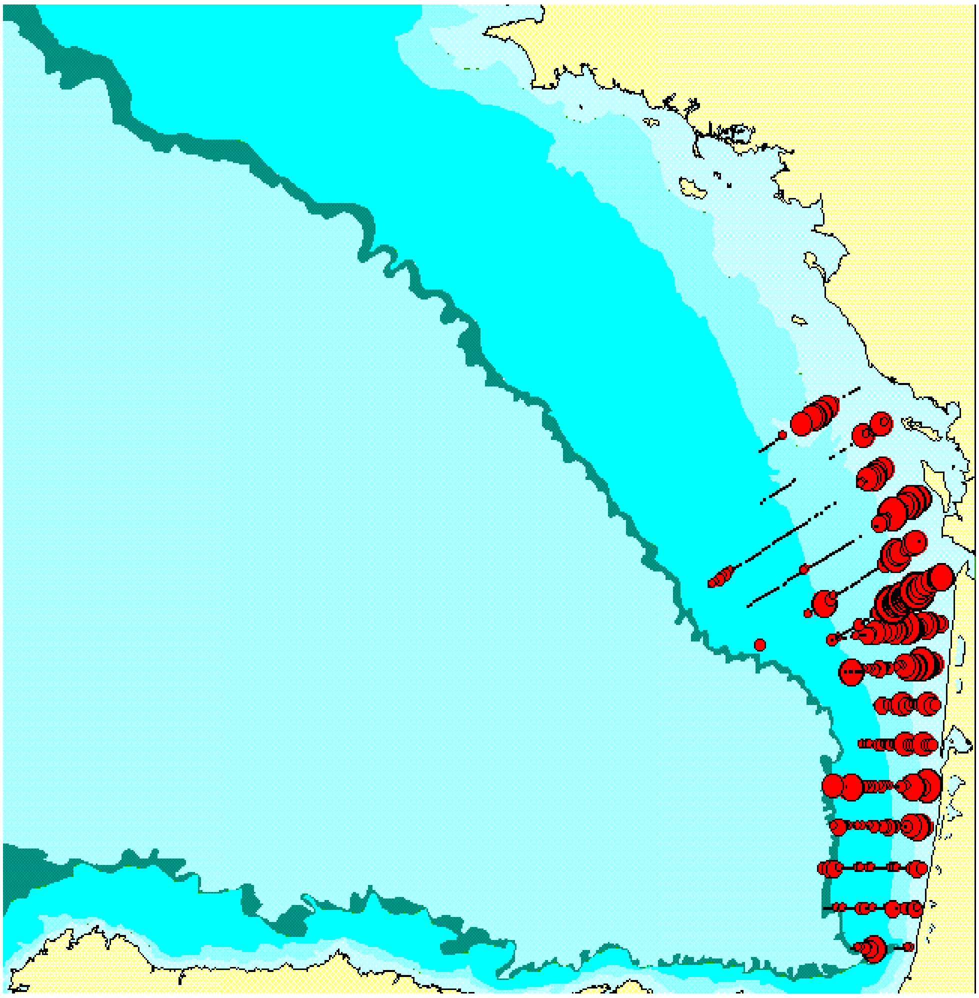


Figure 11.4.2.3. : Anchovy energies distribution during the survey PELASSES 2000 (after Massé, 2000).

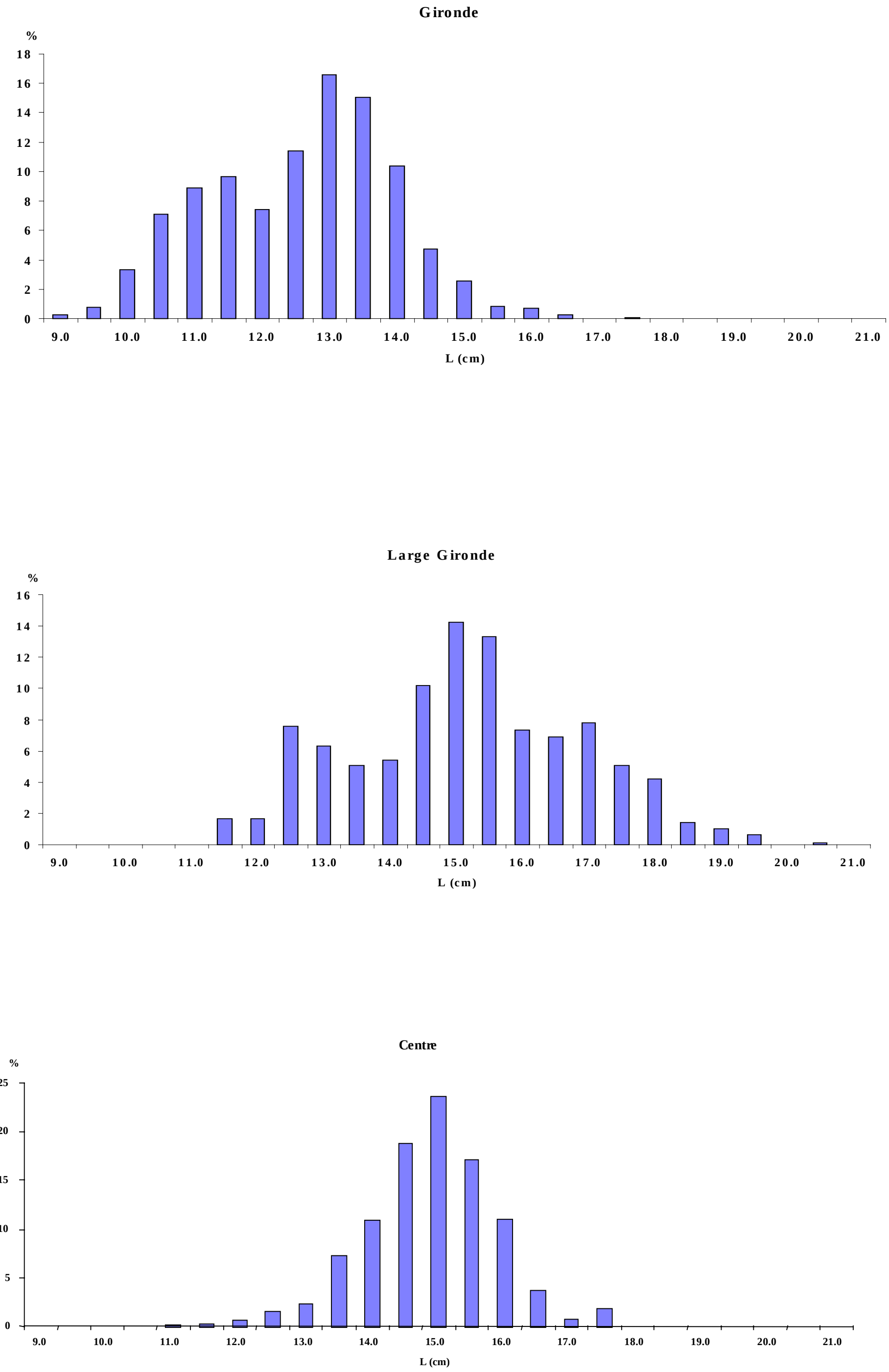


Figure 11.4.2.4. : Length distributions of anchovy sampled during the survey PELASSES 2000 in the Bay of Biscay (after Masse, WD 2000).

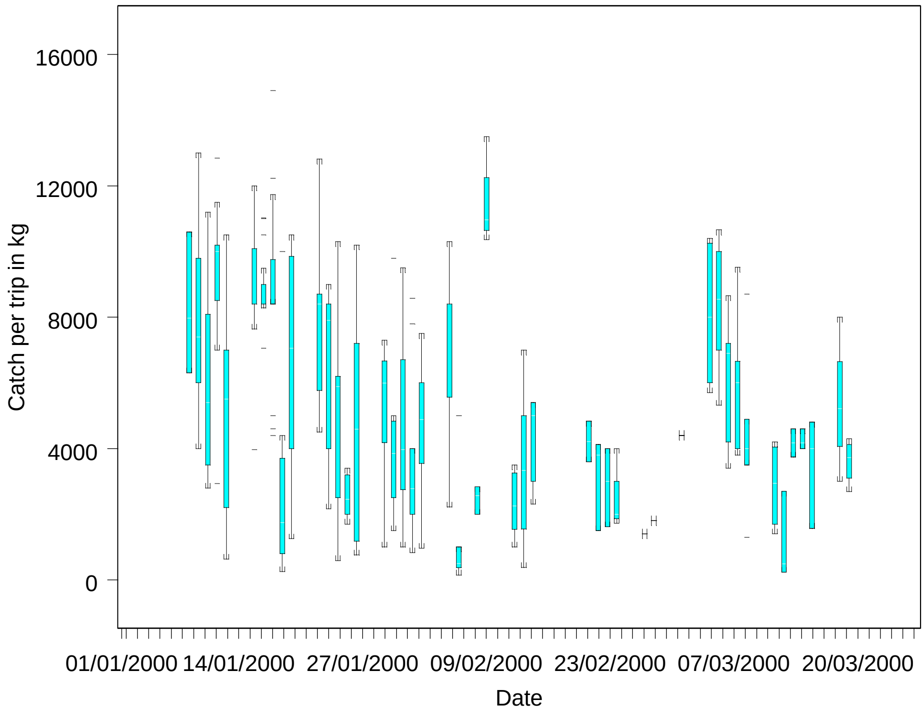


Figure 11.5.1: boxplots showing the daily variation of anchovy catch per trip (in kg) of the French pelagic fleet during the first quarter in 2000

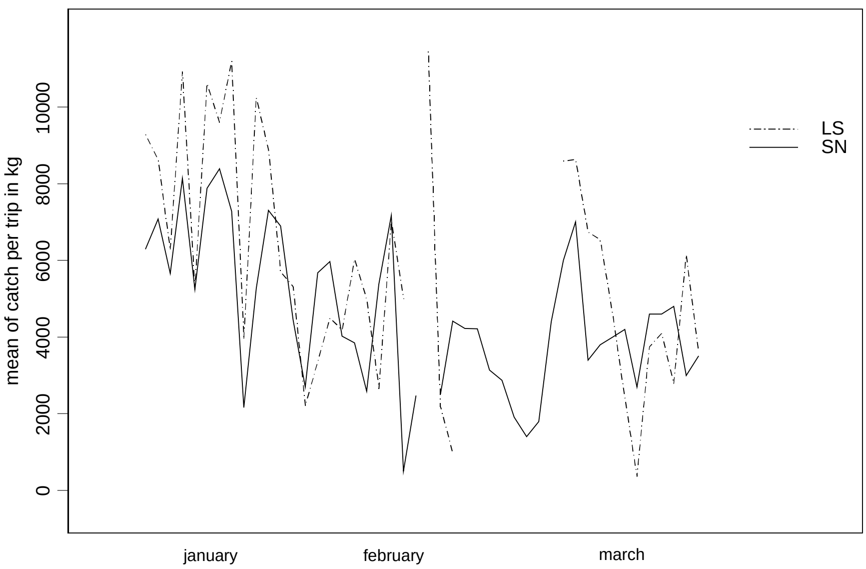
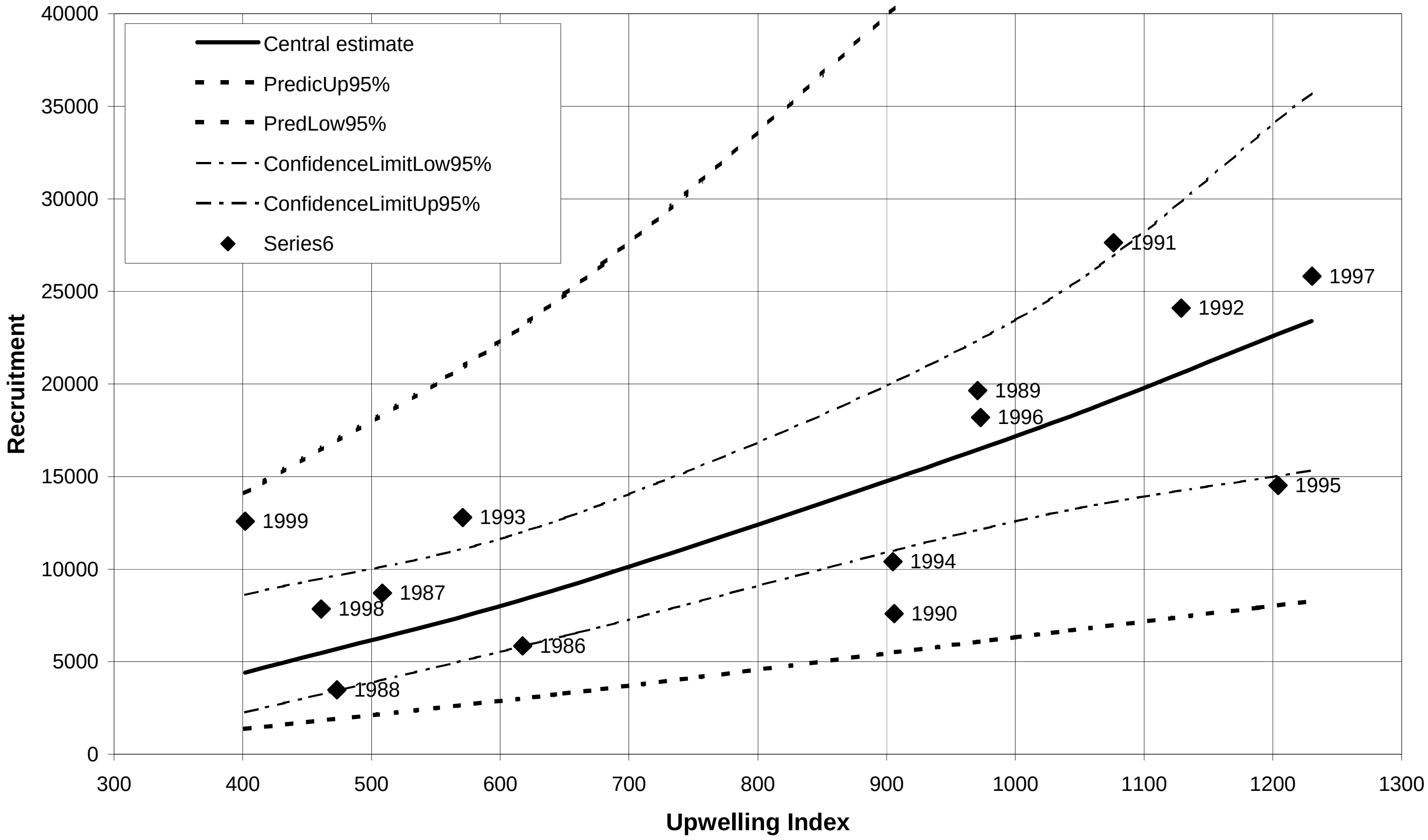
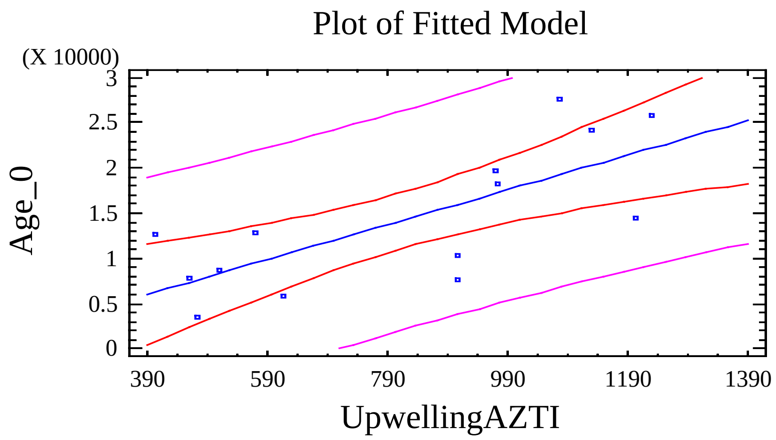


Figure 11.5.2: mean daily variation of the anchovy catch per trip for the French pelagic fleet during the winter fishing season in 2000 LS (Saint-Gilles Croix de Vie) and SN (La Turballe)

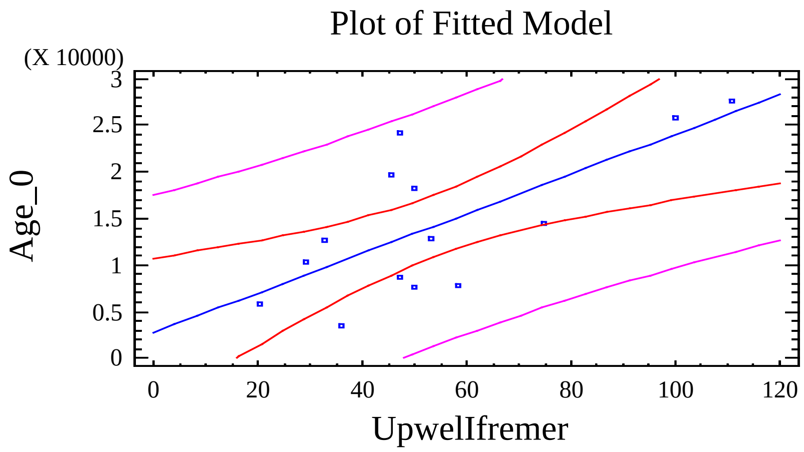
Figure 11.6.1: Predictive model in 1999 in comparison with the actual assessment



a) Borja's *et al*. Upwelling Index (1986,1998)



b) Use of Upwelling Index defined in Petitgas et al (WD2000)



c) Petitgas et al Upwelling and destratification Multiple model (WD2000)

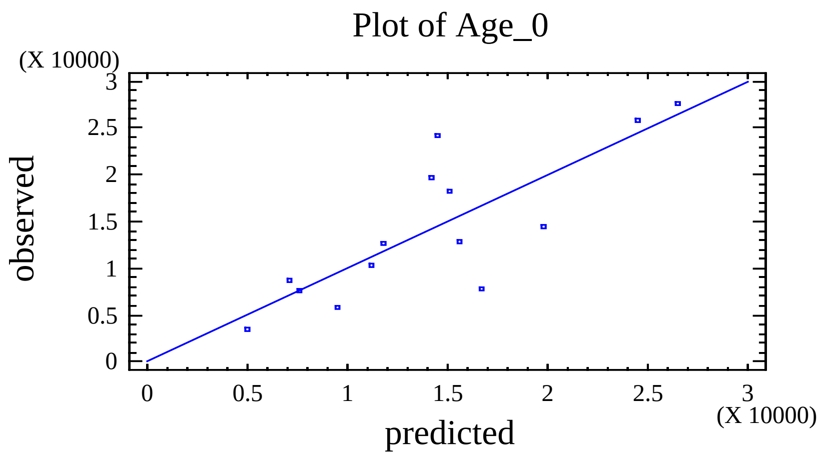


Figure 11.6.2: Linear models fitted to age 0 between the environmental indexes and the assessment adopted by this Working Group in Sept.2000. (14 pairs of data).

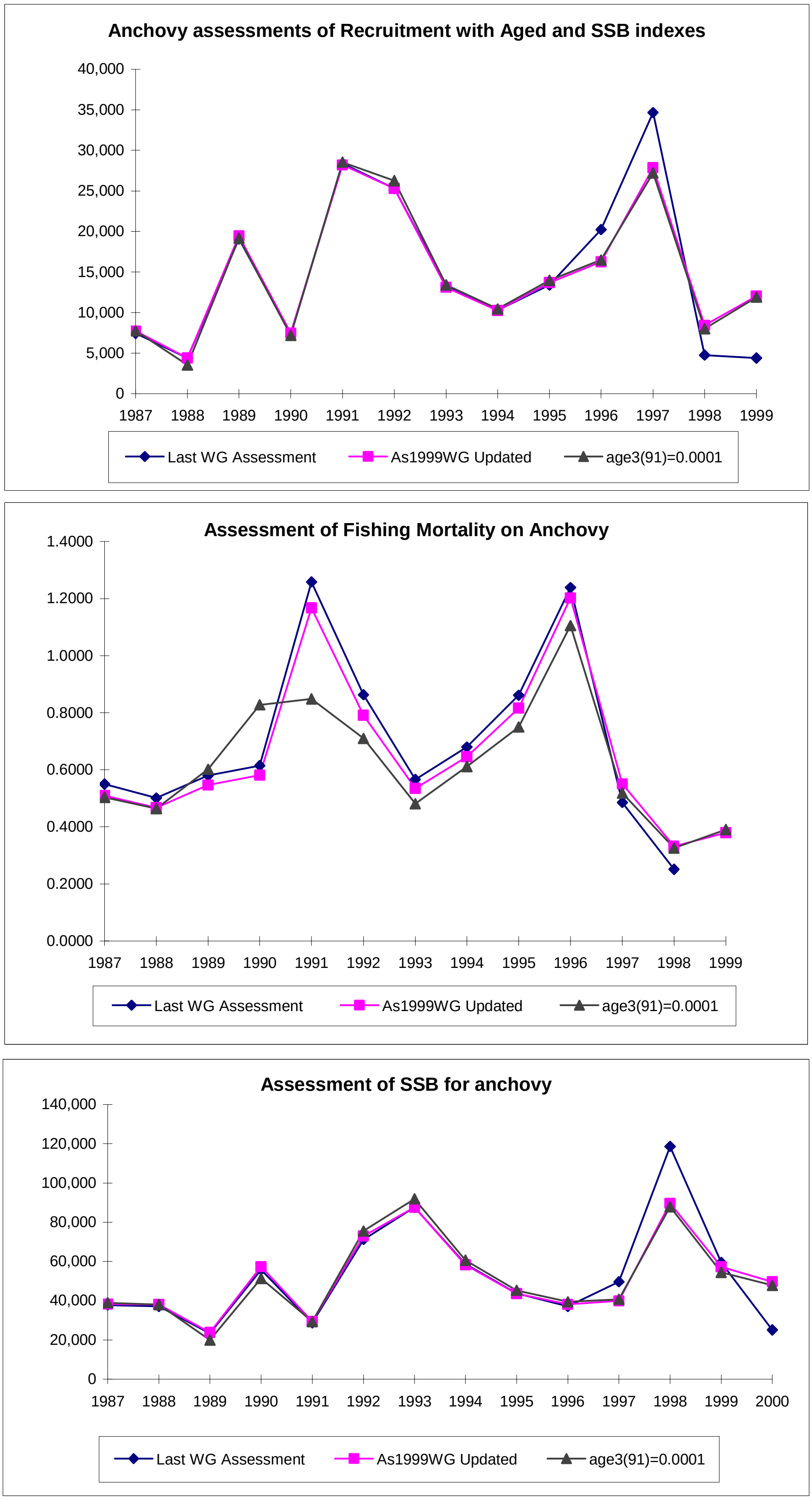
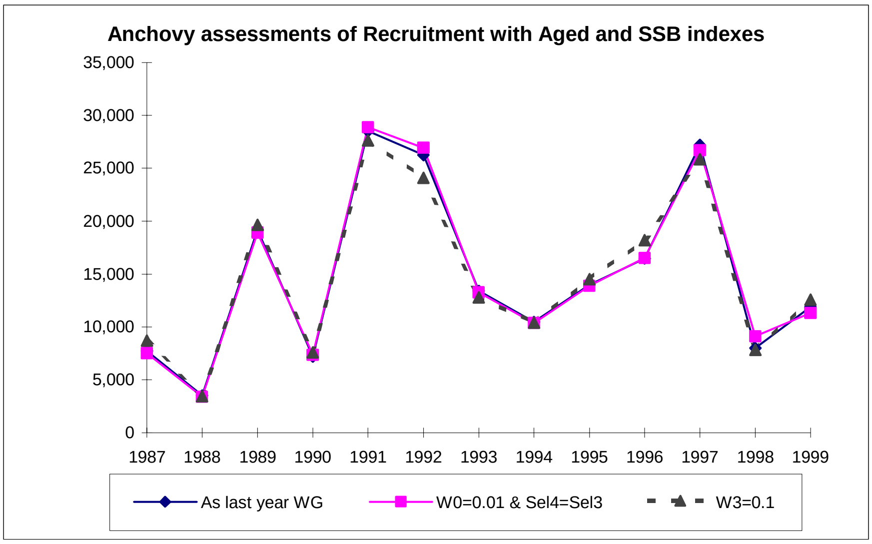
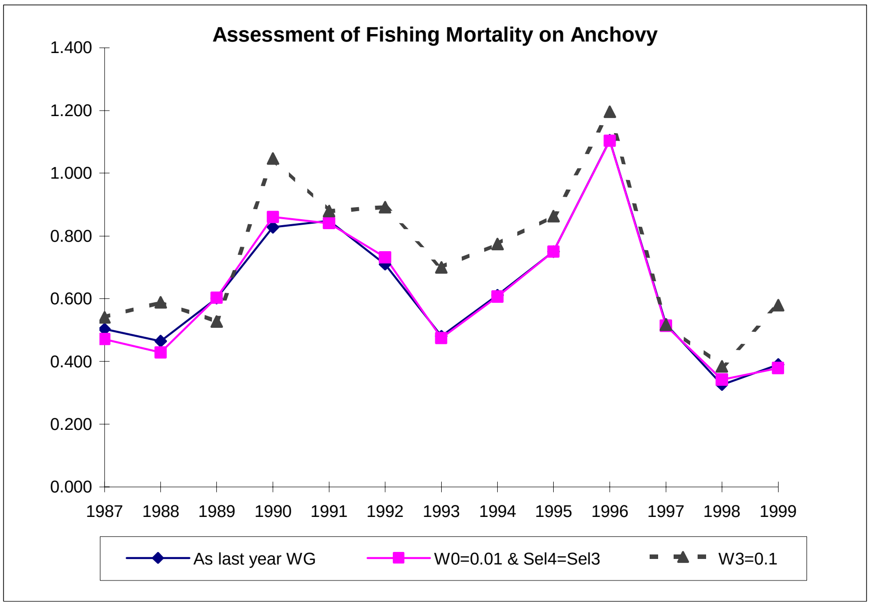


Figure 11.7.1.1: Comparison of Last year assessment versus the new updated data for the anchovy Concerning New the new information available and down weighting age 3 in 1991.





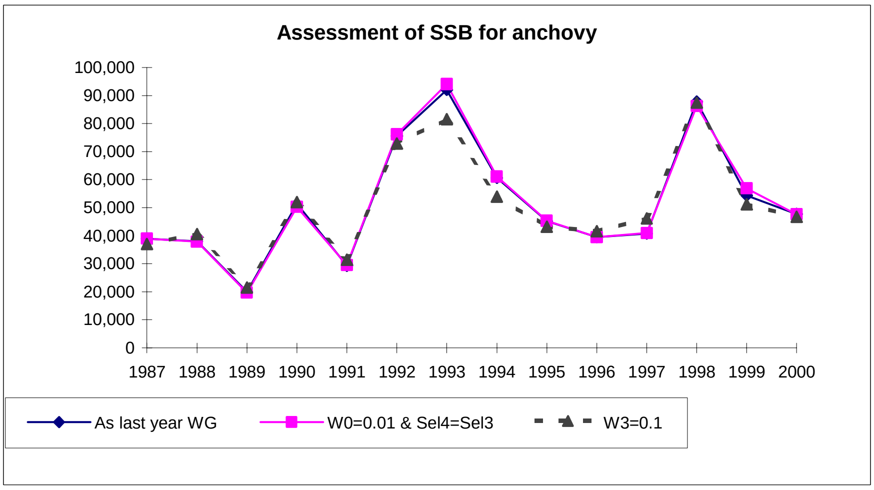


Figure 11.7.1.2: Comparison of alternative tunings to the Assessment of the anchovy in Subarea VIII Concerning different weighting factors

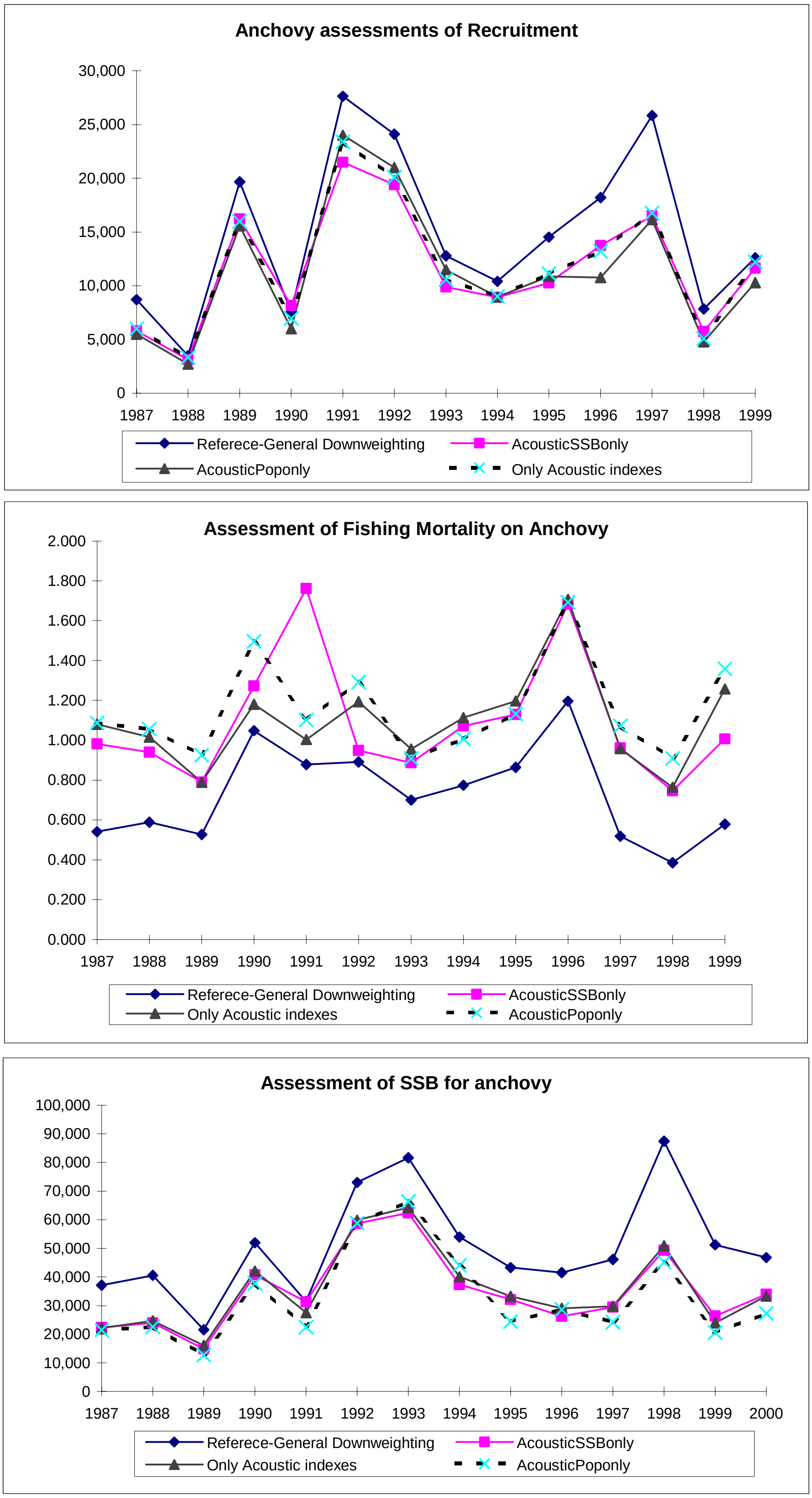
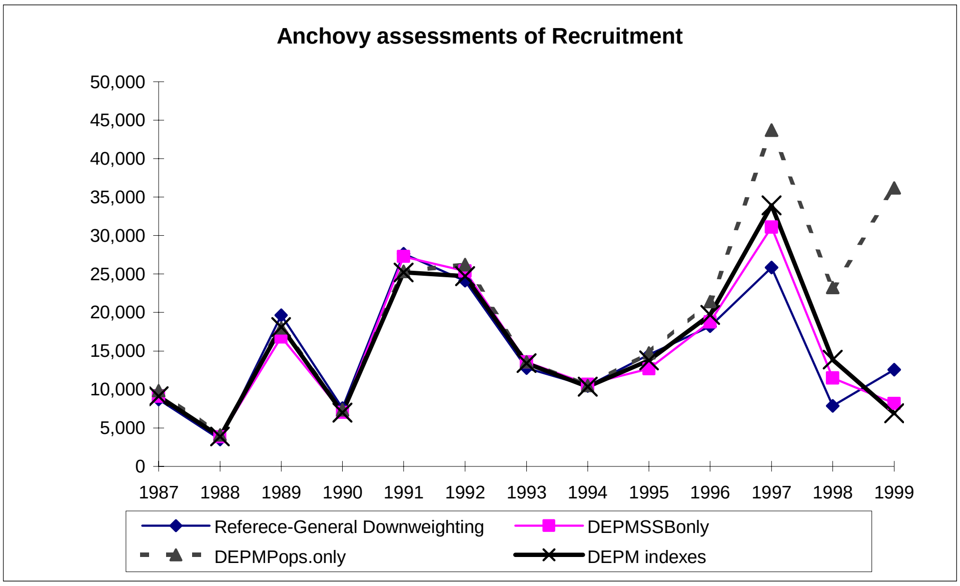
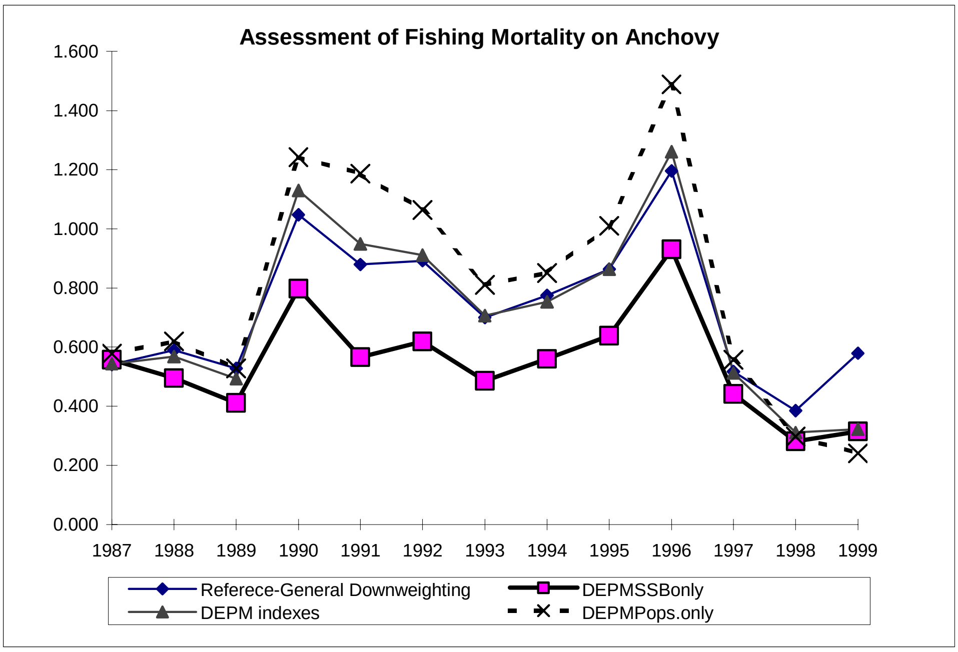


Figure 11.7.1.3: Comparison of alternative tunings to the Assessment of the anchovy in Subarea VIII Concerning The sole use of Acoustic index in comparison with the standard assesment of reference





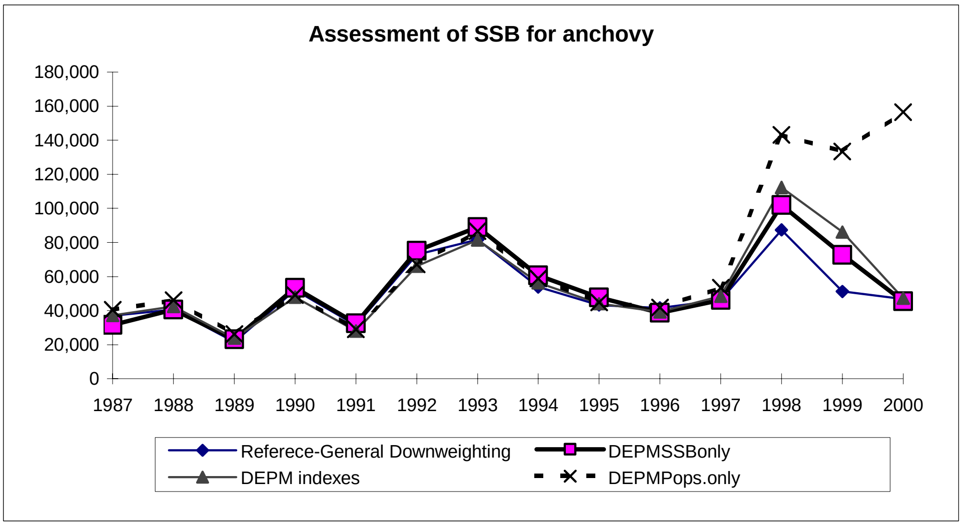
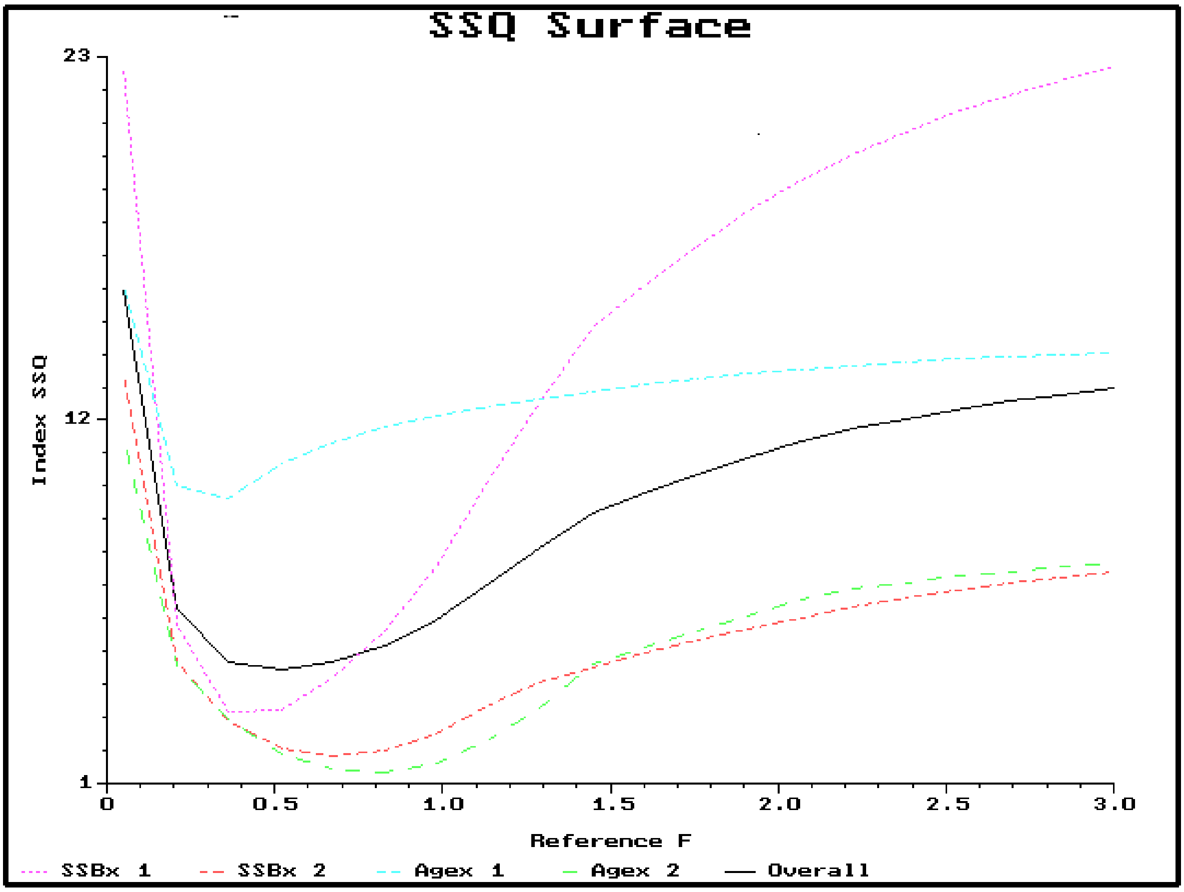
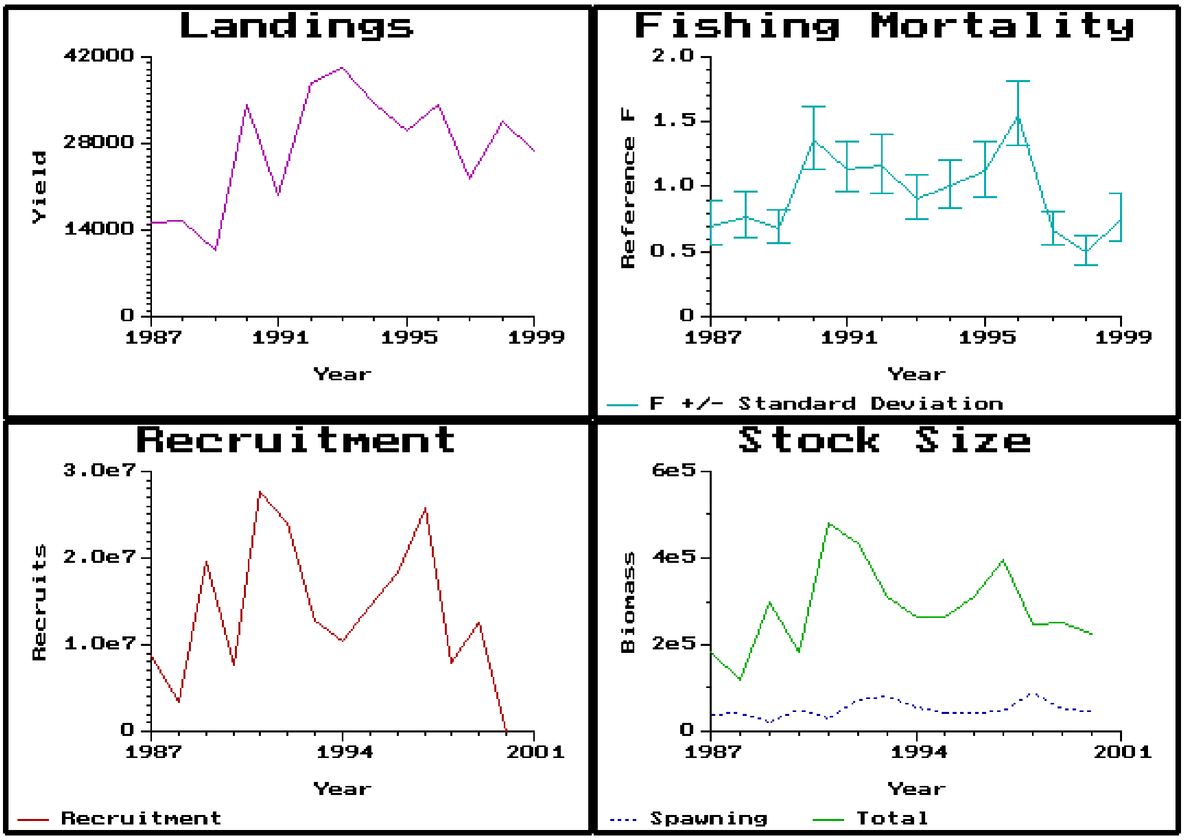


Figure 11.7.1.4: Comparison of alternative tunings to the Assessment of the anchovy in Subarea VIII Concerning The sole use of DEPM index in comparison with the standard assesment of reference

Figure 11.7.2.1 Output figures from the assessment of the Anchovy in Subarea VIII

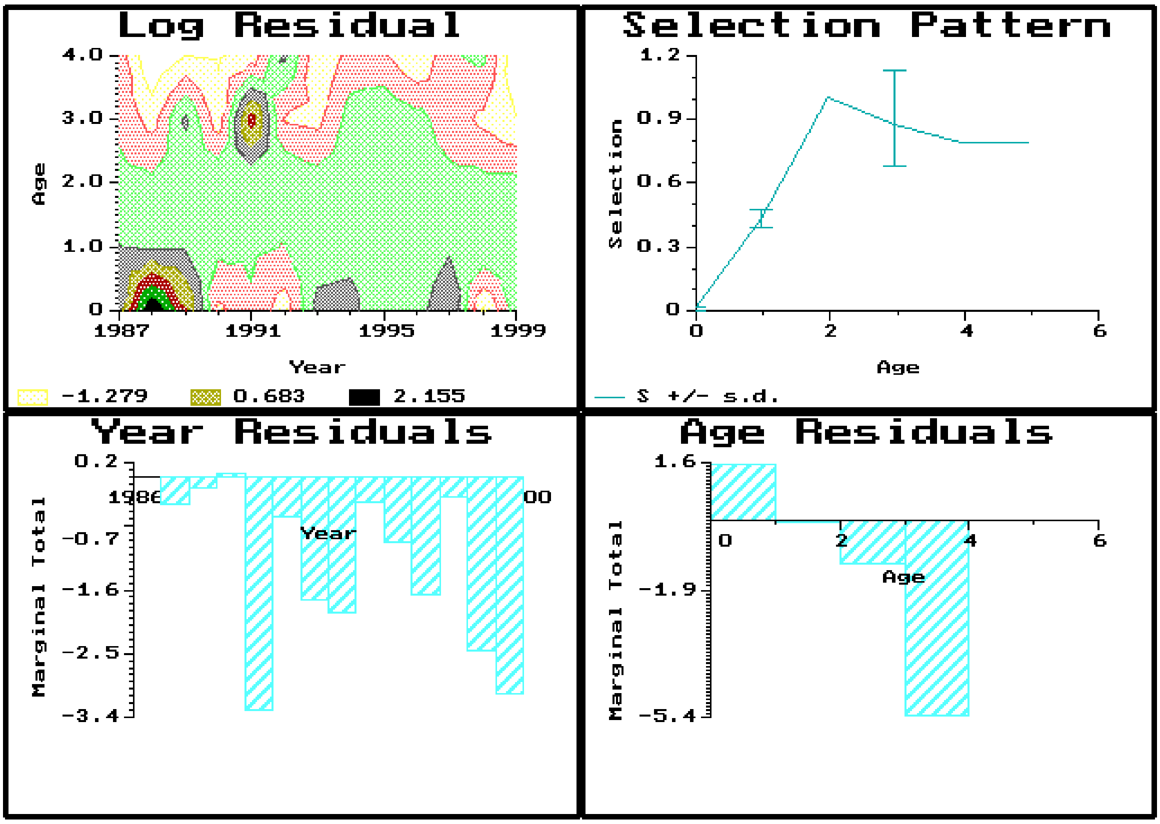


Stock Summary
Press F to print screen, or any other key to continue

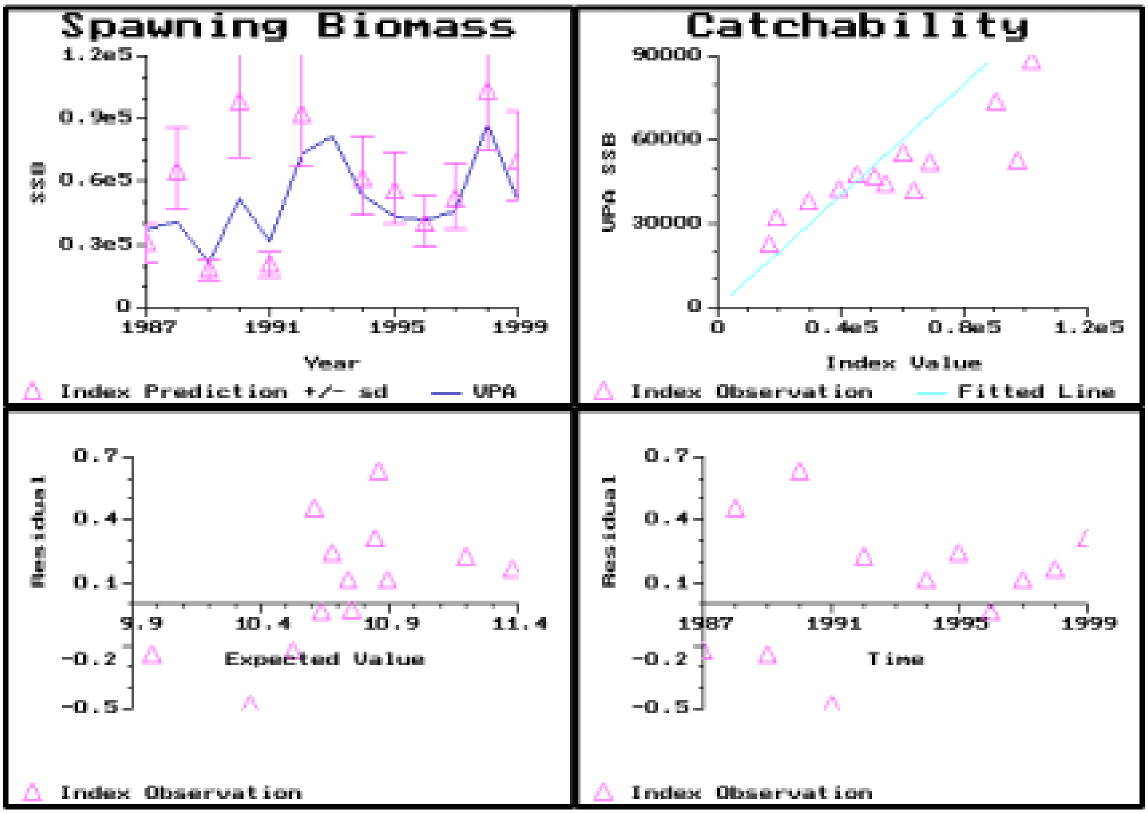


Figures 11.7.2.1 (Cont….)

Separable Model Diagnostics
Press P to print screen, or any other key to continue

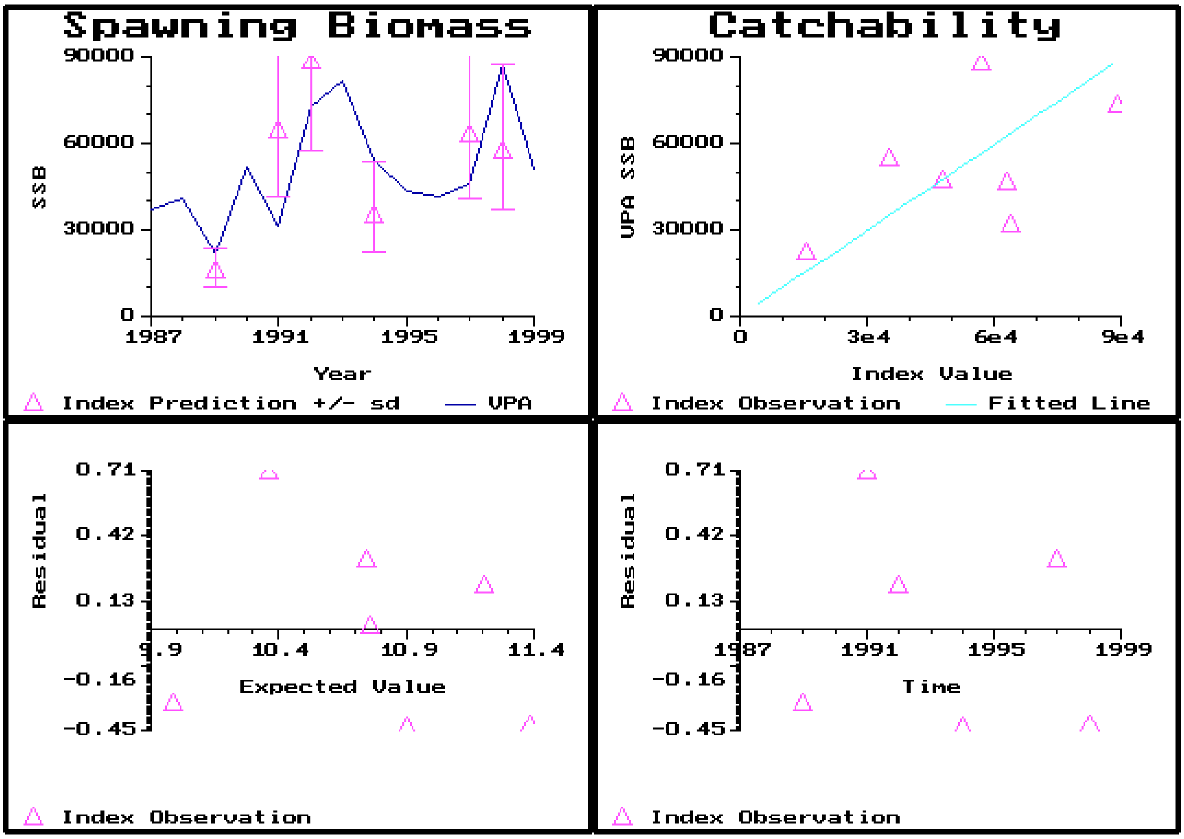


Tuning Diagnostics: Biomass index 1
Press P to print sd



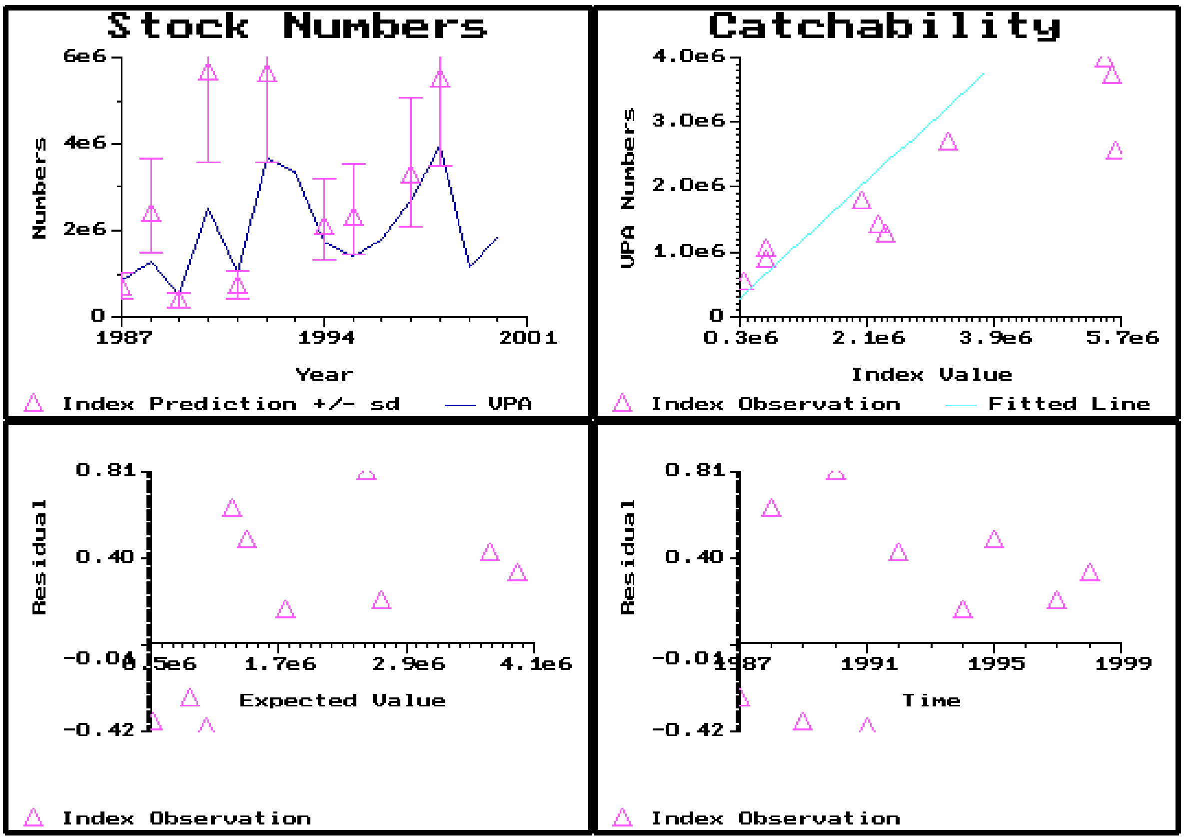
Figures 11.7.2.1 (Cont….)

Tuning Diagnostics: Biomass index 2



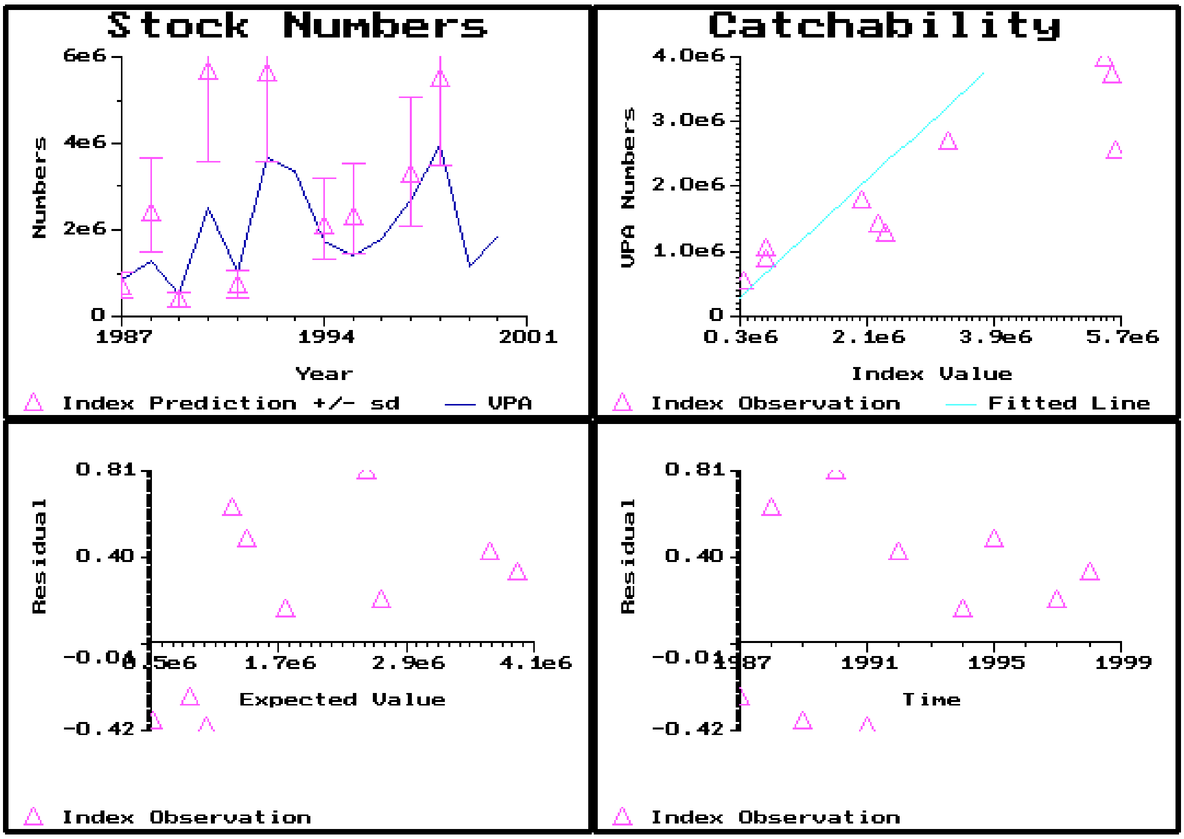
DEPM SUVEYS (Ages 1 to 3+)

Age 1

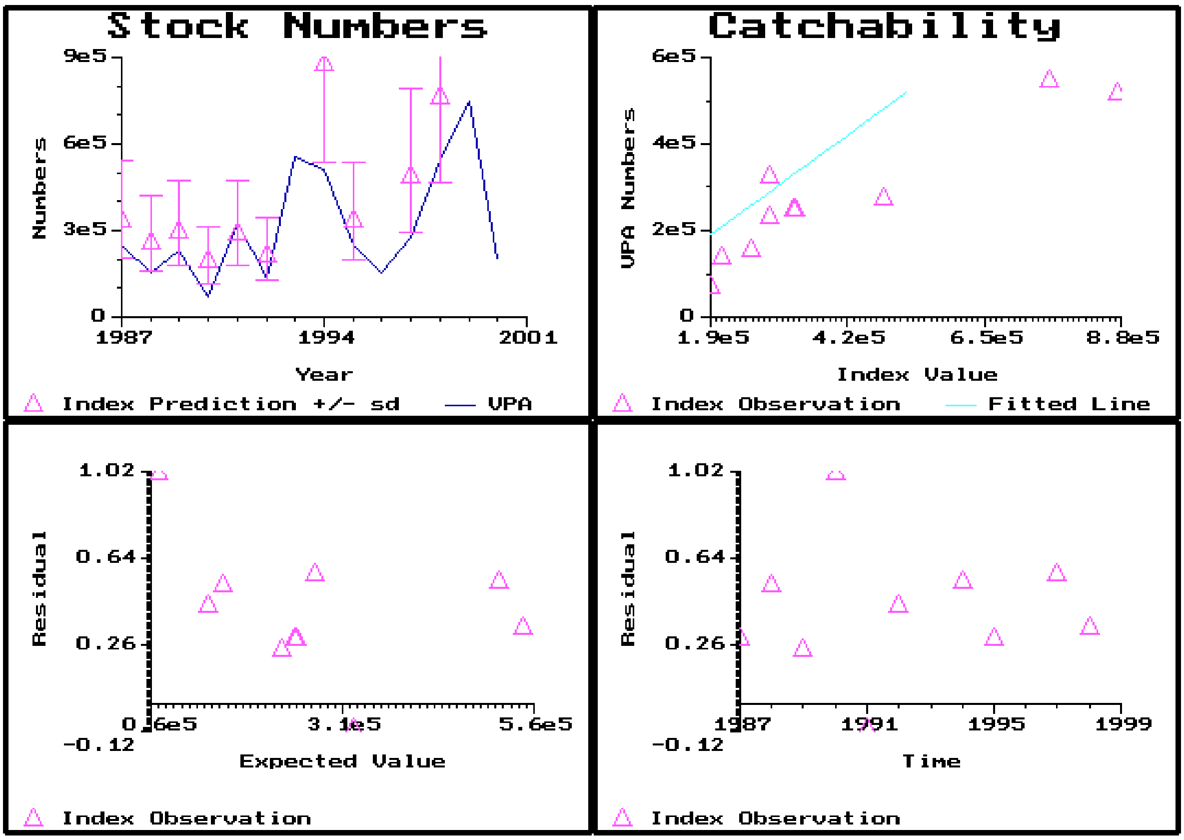


Figures 11.7.2.1 (Cont….)

DEPM SUVEYS (Ages 1 to 3+) Age 1

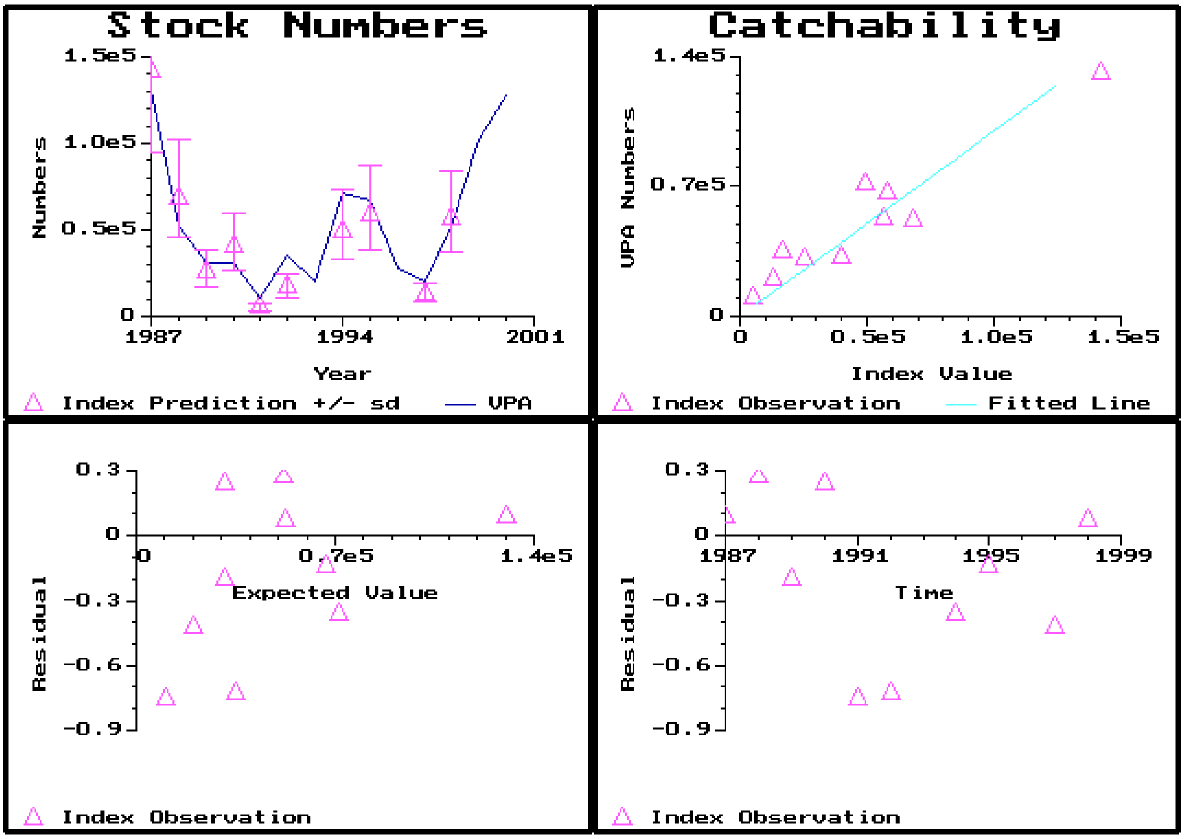


DEPM SUVEYS (Ages 1 to 3+) Age 2

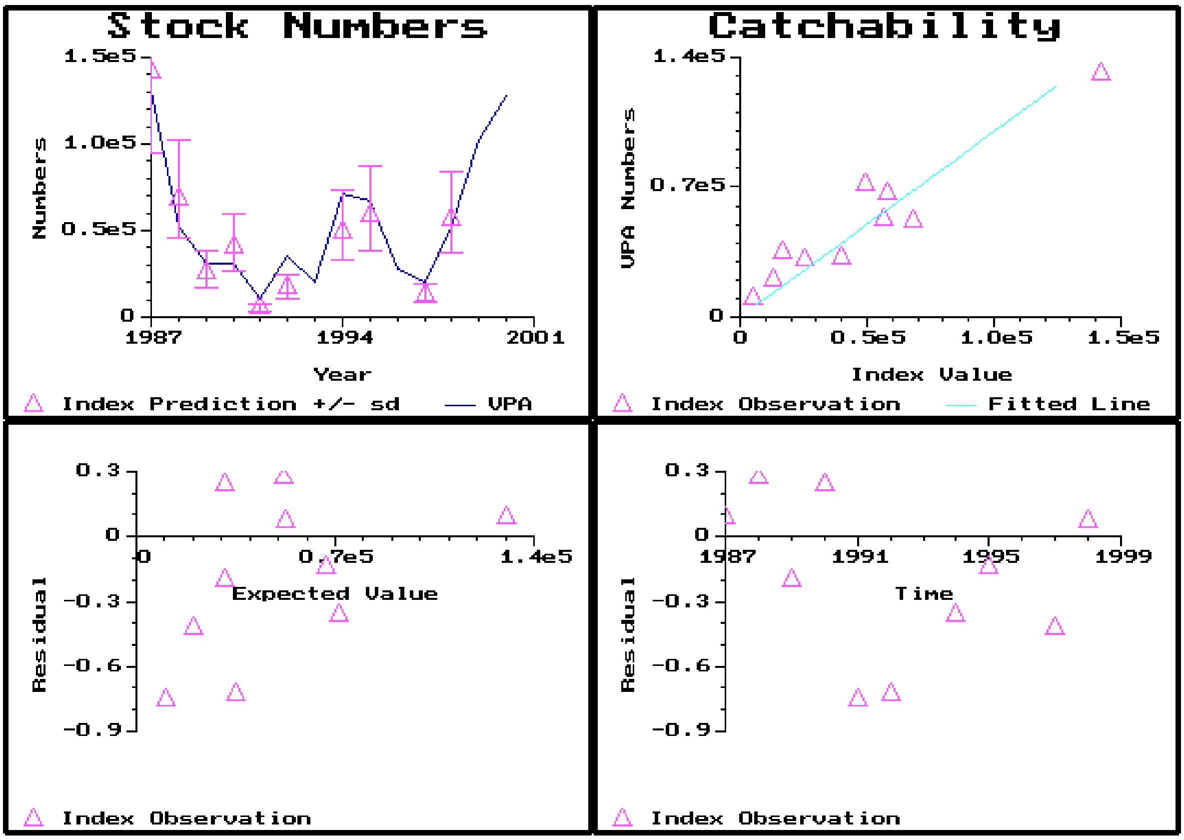


Figures 11.7.2.1 (Cont….)

DEPM SUVEYS (Ages 1 to 3+)   Age 3

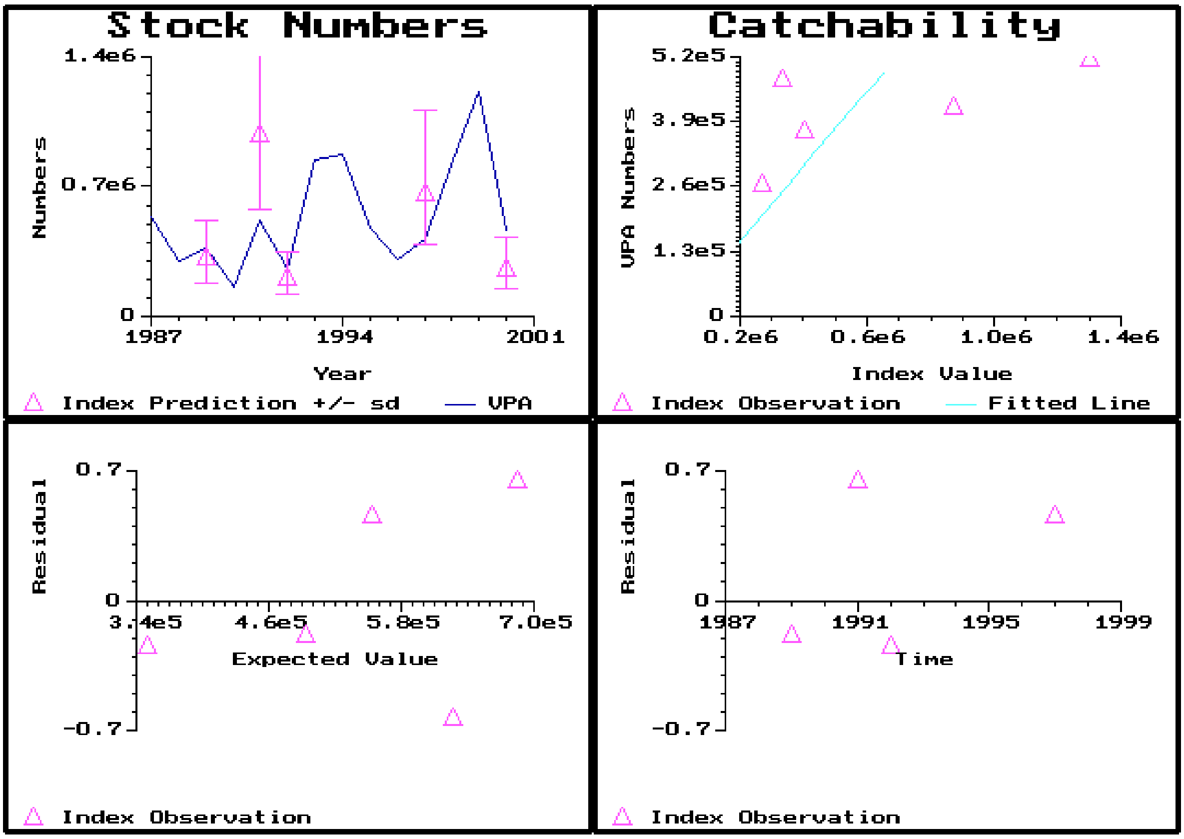


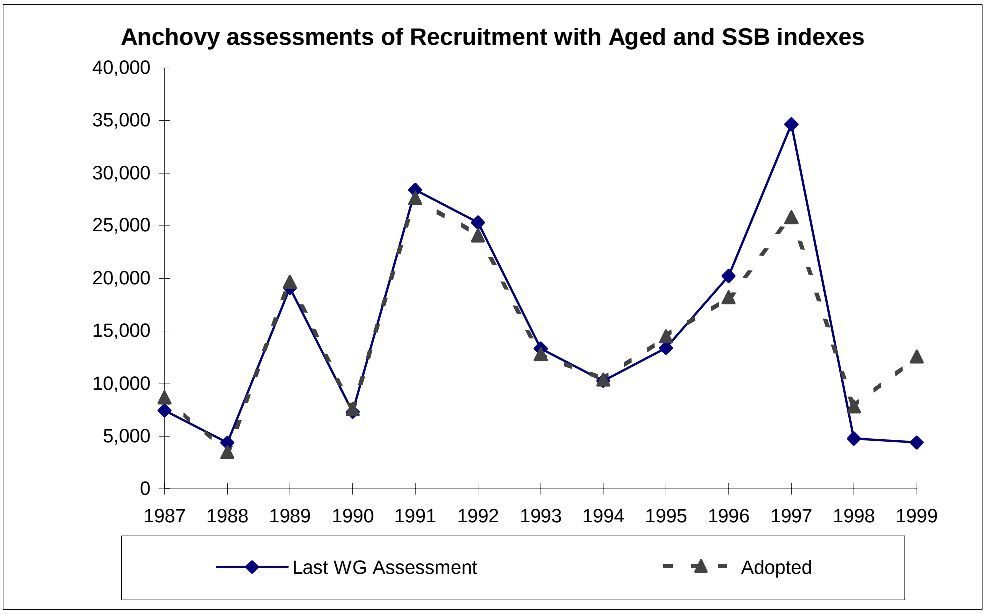
DEPM SUVEYS (Ages 1 to 3+)   Age 3

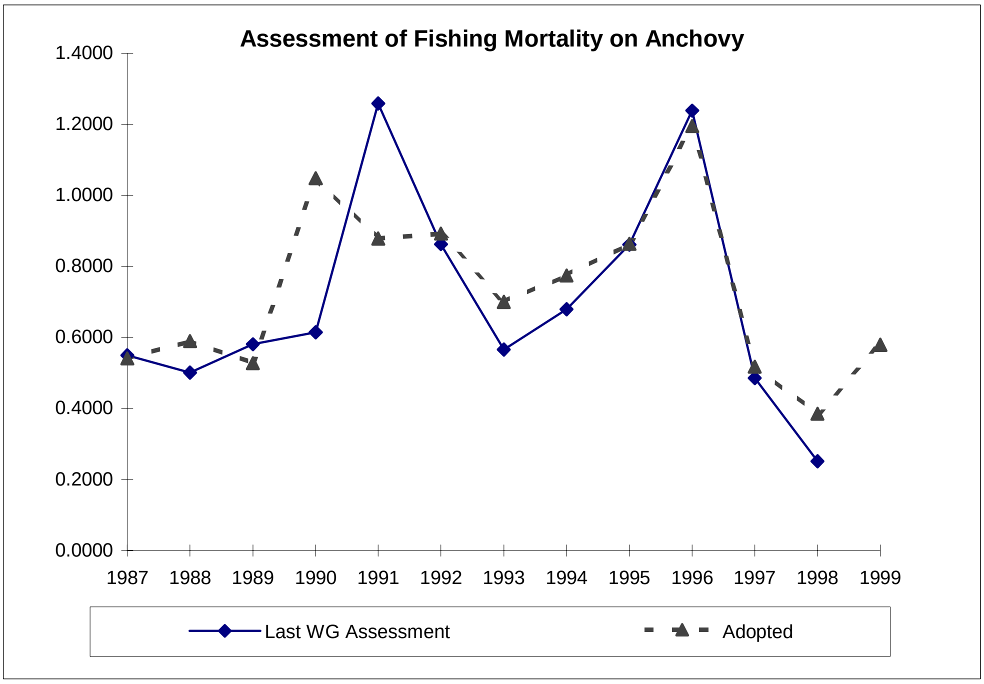


Figures 11.7.2.1 (Cont….)

ACOUSTIC SURVEYS (ages 1 to 2+) Age 2







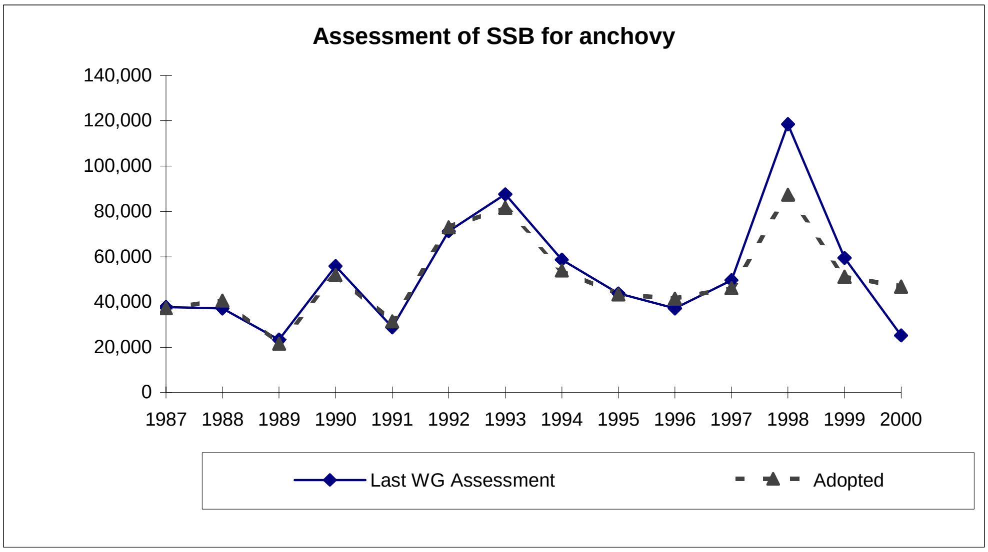


Figure 11.7.2.2: Comparison of last year assessment with the adopted one this year Concerning Anchovy in Subarea VIIII

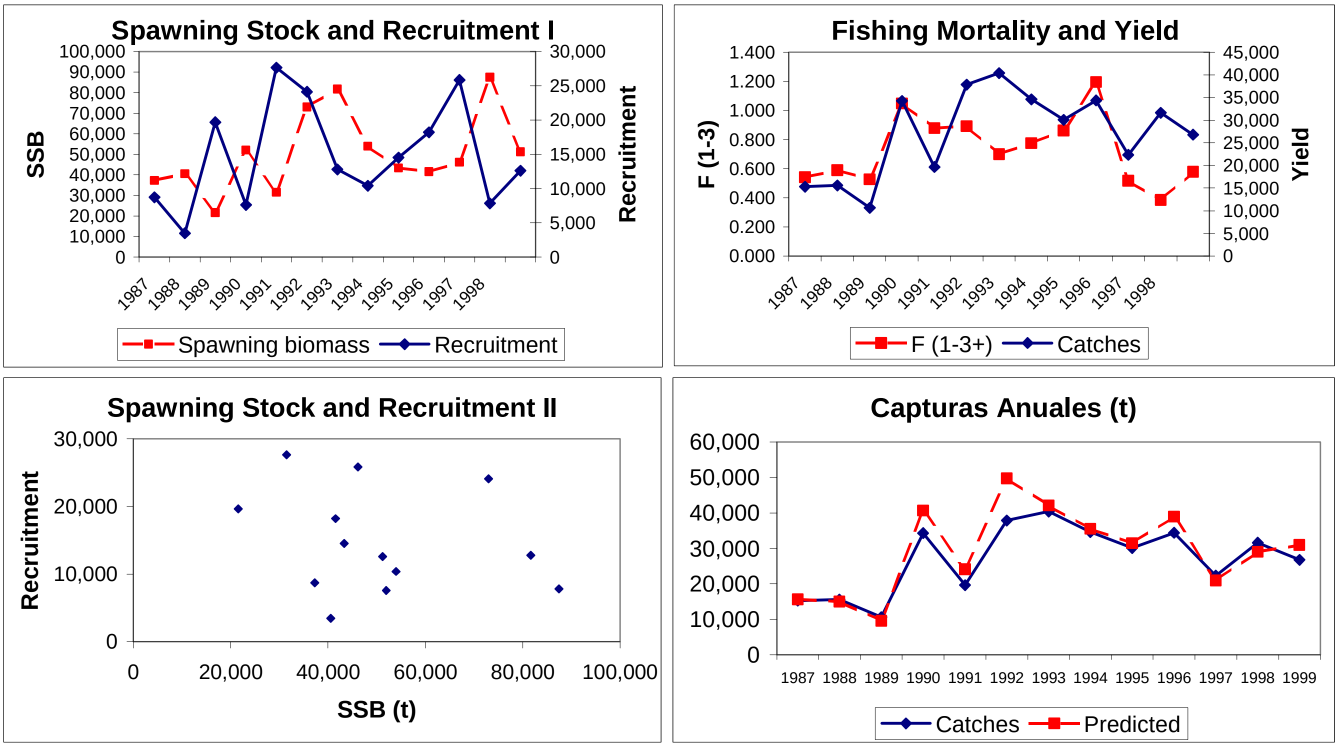


Figure 11. 7.3.1. Fish stock Summary - Anchovy in Sub-area VIII (Bay of Biscay).

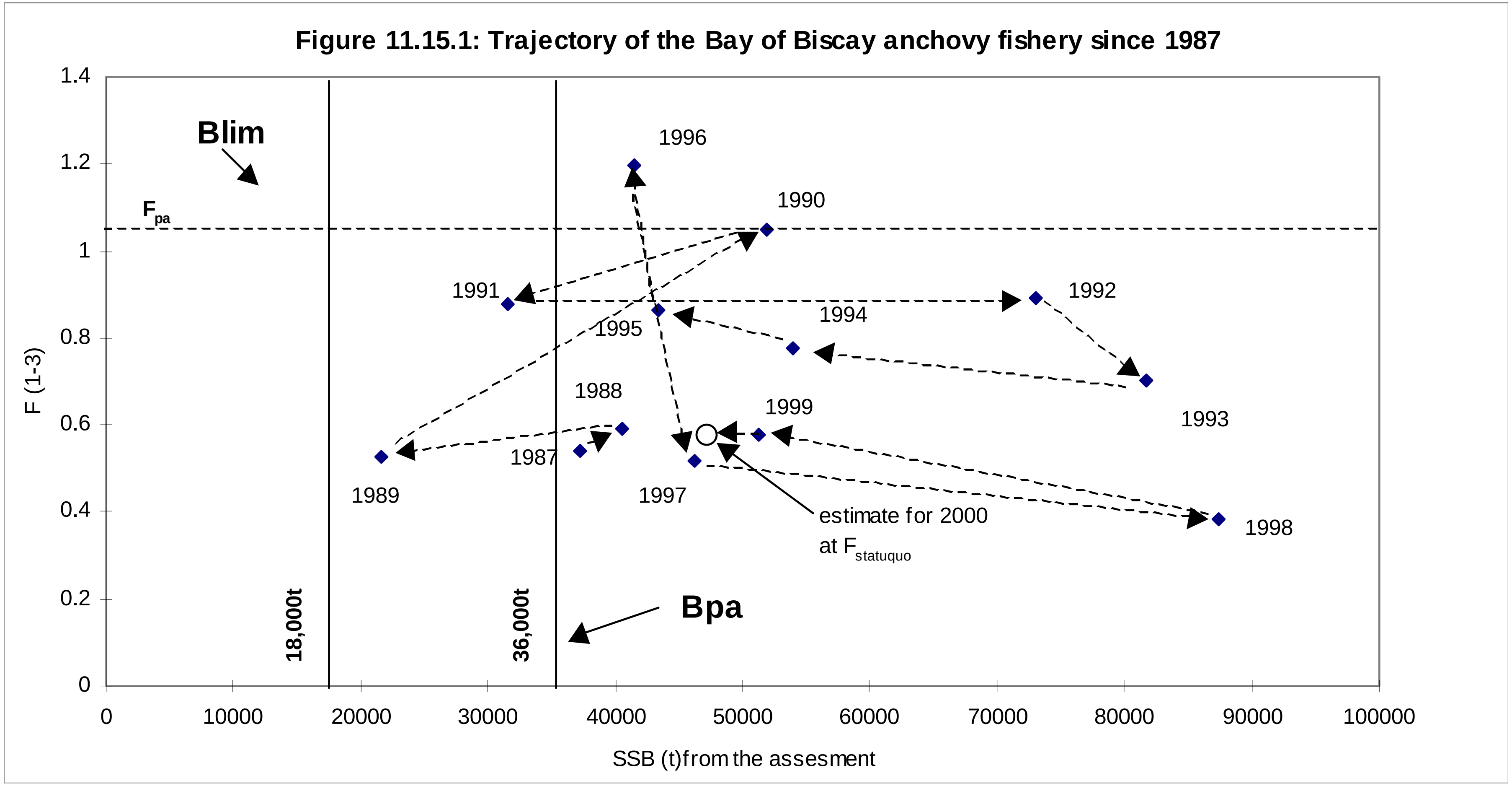


Figure 11.15.1: Trajectory of the Bay of Biscay anchovy fishery since 1987
Blim
F_{pa}
1996
1990
1991
1992
1994
1995
1993
1988
1999
1987
1989
1997
estimate for 2000
at $F_{statuquo}$
1998
18,000t
36,000t
Bpa
F (1-3)
SSB (t) from the assesment
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000

12 ANCHOVY IN DIVISION IXA

12.1 ACFM Advice Applicable to 1999 and 2000

The advice given by ACFM was the following: If a traditional TAC is required it should be set at the average landings since 1988, excluding 1995, that is, 4,600 t in 1999 and 2000. For 2000, ACFM recommended that a management plan, including monitoring of the development of the stock and of the fishery with corresponding regulations, should be developed and implemented. The agreed TAC for anchovy in Division IXa was 13,000 tonnes for 1999 and 10,000 tonnes for 2000.

No management objectives have been articulated for this stock. The current TAC is almost three times higher than the average of catches of recent years (excluding 1995 and 1998), which is 4,600 t. In 1998, the catch of 11,000 t was over twice this level. It is recognised that the state of the resource can change quickly, and therefore an in-year monitoring and management would be appropiate. Lack of biological information for this stock hampers the provision of advice on more appropriate management measures. Monitoring of the stock would require regular sampling together with information from a series of acoustic and egg surveys.

12.2 The Fishery in 1999

In 1999 the anchovy fishery in Division IXa was once more situated in the Gulf of Cadiz (Sub-division IXa South) as is usual in this area, except in 1995, when it was mainly found in the northern part of Division IXa (Figure 12.2.1.1). Anchovy is the target species of the Spanish purse-seine fleet in the Gulf of Cadiz. The Spanish and Portuguese purse-seine fleets in the northern part of Division IXa target anchovy when abundance is high, due to high market prices, as occurred in 1995 (ICES 1997/ Assess:3). In 1999, the anchovy fishery in the northern part of Division IXa was low, as is usual in this area.

The increase in anchovy abundance in the northern part of Division IXa in 1995 may have been due to a variation in thermohaline conditions in the coastal waters northwest of the Iberian Peninsula, less saline and warmer than in preceding years (Diaz del Río et al., 1996 and ICES 1997/C:3), thus creating more favourable conditions for reproduction and larval survival. Before 1995 and since 1996 a change in the previously described trend occurred, with lower temperatures and increased salinity being registered (ICES 1997/C:3, ICES 1998/C:8 and ICES 1999/C:8).

The Spanish fleet in the Gulf of Cadiz is mainly made up of purse-seiners, though there is currently another kind of fleet present in the form of trawlers, whose usual target species is the deep-sea rose shrimp (*Parapenaeus longirostris*). Some of these trawlers switch to targeting anchovy in years when the yield of shrimps is low. The Spanish fleet in the west of Galicia is composed of purse-seiners. The Portuguese fleet is mainly made up of purse-seiners, with some trawlers and artisanal ships fishing a very small quantity of anchovies (Table 12.2.1.2).

12.2.1 Landings in Division IXa

The total catch in 1999 was 7,408 t (Table 12.2.1.1 and Figure 12.2.1.1), which represents a 32.4% decrease compared to the level of 1998 catches (10,962 t). Nevertheless, the catch in 1999 is still higher than the average catch levels registered in this area since 1988 (excluding 1995 and 1998). The decreased catches in 1999 are explained by the decrease experienced by the Spanish catches in the Gulf of Cadiz (Sub-division IXa South), where the anchovy fishery mainly takes place.

The Spanish catches also decreased in 1999 (6,000 t) with respect to 1998 (9,349 t) due to the aforementioned decrease in catches in the Gulf of Cadiz (Sub-division IXa South). Thus, Gulf of Cadiz catches decreased to 5,587 t in 1999, breaking the increasing trend which started since 1996 and culminated in the historical maximum for this area in 1998 (8,977 t). The average catch in the Gulf of Cadiz between 1988 and 1998 is about 4,200 t. The Spanish catches in Sub-division IXa North (413 t) have showed a slight increase with respect to those recorded in 1998 (371 t). However, these catches are still lower than those in 1995 (5,329 t), remaining at the low levels usually found in the area. The Portuguese catch in 1999 (1,408 t) slightly decreased with respect to 1998 (1,613 t) and fell respect to 1995 (7,056 t), (Table 12.2.1.1 and Figure 12.2.1.1).

Table 12.2.1.2 shows the catch by fishing gear and by country. In both countries the main part of the catch was taken using purse-seine, this gear accounting for 84% in the Spanish fishery and 96% in the Portuguese one. Spanish trawl catches of anchovy from the Gulf of Cadiz decreased from 1,148 t in 1998 to 993 t in 1999, although their relative importance in the whole anchovy fishery in this area has increased up to 18% in 1999 (13% in 1998).

From 1943 to 1987, catch data were only provided by Portugal, which varied between 88 t and 12,610 t (Table 12.2.1.1). The Portuguese annual landings alternate between periods of high catches (1936-1940, 1942-1948, 1955-1957, 1962-1966 and 1995) and periods of very low catch levels (1927-1936, 1966-1976, 1979-1984 and 1987-1994) (Pestana, 1996). For this same period, the Spanish catch data from the Gulf of Cadiz (Sub-division IXa South) cannot be provided since they have been combined with anchovy catches in the area of Morocco, whereas catches in Galician waters (Sub-division IXa North) are not available. The historical series of Spanish catches started in 1988 for the Gulf of Cadiz, and in 1989 for the Galician waters. Total Spanish catches from Division IXa ranged between 1,824 t (1996) and 9,349 t (1998).

12.2.2 Landings by Sub-division

Since 1988, the anchovy fishery in Division IXa was situated in the Gulf of Cadiz (Sub-division IXa South), except in 1995, when it was mainly found in the northern part of Division IXa (Sub-division IXa North and Central-North).

The distribution of Spanish catches in 1999 was similar to that of the years 1988-1994 and 1996-1998 (ICES 1992/Assess:17, ICES 1993/Assess: 19, ICES 1995/Assess: 2, ICES 1996/Assess: 7, ICES 1998/Assess: 6, ICES 1999/ACFM:6 and ICES 2000/ACFM:5) and completely different to that of 1995 (ICES 1997/Assess: 3). In 1999, the greatest catches (93%) were found in Sub-division IXa South (Gulf of Cadiz), and the rest (7%) in Sub-division IXa North (West of Galicia). Catches in the Gulf of Cadiz take place throughout the year, usually increasing in spring and summer. In 1998, however, catches were relatively stable throughout the year without undergoing any significant rise in spring-summer. This seasonal pattern was also evidenced in 1999, although autumn catches showed a lesser relative importance than in the precedent year. The small catches in Sub-division IXa North occurred mainly in the first and third quarters.(Table 12.2.2.1).

The greatest contribution to Portuguese annual landings came from IXa South during the period 1943-1967 (mean value 4,526 t).Thereafter, landings decreased to 386 t (mean value) from 1968 to 1983, and to 32 t (mean value) from 1984 to 1991. From 1992 to 1995, landings were less than 1 tonne, in 1996-1997 they were 32 t (mean value). In 1998, Portuguese landings from IXa South increased to 566 t, then decreasing to 355 t in 1999. In Sub-division IXa Central-North there were alternate periods of relatively high and low landings. After 1984, landings of Sub-division IXa Central-North made the greatest contribution to total annual landings (mean value 1,116 t). The mean percentage of landings by Sub-division (1970-1995) is 70% of the total in IXa Central-North, 5% in IXa Central-South and 20% in IXa South. The same landing pattern occurs in Sub-divisons IXa Central-North and Central-South during the period from 1970-1994 and in 1995 (Pestana, WD 1996). In 1996-1999, catches in Sub-division IXa Central-North and Central-South fell, but maintained the same pattern of catches as in the period 1970-1995.

Most of the Portuguese landings were made between May and October (mean 1927-1994). The 1995 landings show a different evolution with two very important periods, from April to June and from August to December. (Pestana, 1996). In 1996-1999, catches are taken mainly in the first and fourth quarters (Table 12.2.2.1).

12.3 Fishery-Independent Information

12.3.1 Acoustic surveys

In 1993, a Spanish acoustic survey to estimate anchovy abundance was carried out off the Spanish waters of the Gulf of Cadiz (Sub-division IXa South). The total biomass estimated was 6,569 t (ICES 1995/Assess:2). Since then, no acoustic surveys have been conducted in this area by Spain. In Sub-division IXa North, Spain has been conducting acoustic surveys aimed at sardine since 1983, but no anchovy schools were detected (Carrera et al., WD 1999; Carrera, WD 2000).

In previous years, information on anchovy from the Portuguese sardine egg- and acoustic surveys in Division IXa was not available as there is no research project for anchovy in Portugal. Nevertheless, the updated information provided by IPIMAR from the November 1998 and March 1999 acoustic surveys for sardine has provided data about anchovy distribution and abundance (Morais, WD 2000). The surveyed area in these surveys included the waters of the Portuguese continental shelf and those of Spanish Gulf of Cadiz (Sub-divisions IXa Central-North, Central-South and South), between 20 and 200 m depth (Figure 12.3.1.1 and 12.3.1.2).

The estimates of anchovy biomass for the total surveyed area were 32,959 t in November 1998, and 25,359 t in March 1999 (Table 12.3.1.1, Figure 12.3.1.3 and 12.3.1.4). The biggest concentrations of anchovy occurred in the Gulf of Cadiz (Spanish waters of the Sub-division IXa South), which accounted for 90% of total estimated biomass in both surveys (30,092 t and 24,763 t, respectively). As deduced from the integration values, large portions of such concentrations were composed by very dense schools located near the bottom and in depths between 50 and 90 m. Nevertheless, other surveys should be analysed to confirm whether this behavior is exceptional or not.

Off the Portuguese shelf, large concentrations of anchovy were found only in the area in front of Lisbon (Sub-division IXa Central-South), rendering biomass estimates of 1,951 t (November 1998) and 406 t (March 1999). Only low anchovy concentrations were found in small areas in the rest of the shelf(Table 12.3.1.1, Figure 12.3.1.3 and 12.3.1.4).

The anchovy size composition in the Sub-division IXa Central-North was clearly dominated by smaller anchovies (≤12.5 cm TL) than the ones found in Sub-division IXa Central-South, where anchovies larger than 13 cm TL were predominant. These differences were more noticeable during the November 1998 survey (Figure 12.3.1.5).

In the Sub-division IXa South, 71% (November 1998) and 59% (March 1999) of the Gulf of Cadiz anchovies were between 12 and 14 cm TL, although juveniles (5.5-8.0 cm TL) were also present (5% of total numbers) in the November 1998 survey. The size composition of the Algarvian anchovy was only available from the November 1998 survey, where 91% of the anchovies were between 11-14 cm TL (Figure 12.3.1.5).

12.4 Biological Data

12.4.1 Catch numbers at age

Catches at age of anchovy for the whole Division IXa are not available. The only available estimates were provided by Spain for anchovy catches in the Gulf of Cadiz (Sub-division IXa South) for the period 1996-1999. These data have been presented for the first time in this Working Group (Millán and Ramos, WD 2000).

Portugal has not provided estimates of length or age composition of anchovy landings in Sub-divisions IXa Central (north and south) and South (Algarve). Catches at age were only provided for the Spanish fishery in Sub-division IXa North in 1995, and these catches consisted of age 1 anchovies (ICES 1997/Assess:3). Catches at age of anchovy from this Sub-division are not normally available since commercial landings used to be insignificant, making very difficult the biological sampling of commercial catches. A few otolith samples were also collected in 1999, following the same procedure as in 1998. However, catches at age estimates are not presented owing to the small number of sampled otoliths and their failure to cover the whole length range. They were not considered representative of the population. Further, samples did not cover all quarters in the year. In the 1999 sample, 58.8% of anchovies were found to be age 1, 40.0% age 2 and 1.2% age 3 (B. Villamor, pers. comm.).

Difficulties experienced in recent years in age determination of the Gulf of Cadiz anchovy using otolith examination has also prevented from providing catch at age estimates of the Spanish landings in this area. In 1997 and 1998, an otolith exchange for the Gulf of Cadiz anchovy was carried out within the International Project co-funded by the European Commission entitled European Fish Ageing Network (EFAN), which aims at solving the difficulties involved in age reading. The conclusions reported from this exercise confirmed the existence of problems in the interpretation of both the otolith edge and the annual rings, which led to state the need for establishing more standarised ageing criteria for the species in this area (García Santamaría, 1998). Bearing in mind these problems, Millán and Ramos (WD 2000) have presented estimates of the age composition of Gulf of Cadiz anchovy landings from 1996 to 1999. The authors have corroborated the above problems in anchovy ageing and, therefore, such estimates must be considered as preliminary.

The age composition of the Gulf of Cadiz anchovy landings from 1996 to 1999 is presented in Table 12.4.1.1 and Figures 12.4.1.1 and 12.4.1.2. The Gulf of Cadiz anchovy fishery is supported by the 0, 1 and 2 age-groups. These results differ from those obtained from the EFAN exercise, in which older anchovies of 3 and 4 years old were also identified. By applying length frequency analysis methods to the 1989-1993 data series, Bellido *et al*. (2000) also conclude that the fishery is mainly supported by the 0, 1 and 2 age-groups, 2 year-old fish making up for only 3% of the fishery (pooled data for the whole series).

Following the estimates given in the WD, the contribution of the 0 and 1 age groups in 1996 and 1997 was different to that observed in 1998 and 1999 (Figure 12.4.1.1). In the first two years, the percentage composition of both age groups in landings was similar, with percentages around 50% each, whereas in the two following years 1 year-old anchovies largely dominated the landings, representing 69% and 73%, respectively.

Recruits showed a decreasing trend in relative numbers and weights during the period analysed, the lowest percentage (22%) being recorded in 1999. However, the highest catches in number and weight at age 0 in absolute terms were landed in 1998 and the lowest ones in 1999.

The success of the Gulf of Cadiz anchovy fishery is mainly related to the high abundance of the 1 year-old anchovies (Figure 12.4.1.2). This fact became apparent in 1998 and 1999, when 1 year-old anchovies (1997 and 1998 year classes) made up for 78% and 81% of the landings.

The 2 year-old anchovies were poorly represented in the landings, ranging between 1% (1996 and 1998) and 8% (1997). In 1999, this age group made up for about 5% of the total catch in numbers.

Landings of the 0 age-group anchovies were restricted to the second half in the year, whereas those of 1 and 2 year-old anchovies were present throughout the year, although they were lower in the fourth quarter (Table 12.4.1.1).

12.4.2 Mean length- and mean weight at age

Length Distributions by fleet

Annual length compositions of anchovy landings in Division IXa are provided only by Spain, from 1988 to 1999 for Sub-division IXa South, and from 1995 to 1999 for Sub-division IXa North. Portugal has not provided length distributions of landings in Division IXa.

Anchovy length distributions in 1999 in Division IXa by quarter and Sub-division are shown in Table 12.4.2.1 and Figure 12.4.2.1. Table 12.4.2.2 shows annual length distributions from 1988 to 1999. Figure 12.4.2.2 compares length distributions in Sub-divisions IXa South and IXa North from 1995 to 1999.

In 1999, as in previous years, a large number of juveniles were captured (individuals less than 10 cm long) in Sub-division IXa South during the first and second halves of the year (Table 12.4.2.1 and Figure 12.4.2.1). The mean length and mean weight in the catch in Sub-division IXa South are smaller than those recorded from Sub-division IXa North (Table 12.4.2.2 and Figures 12.4.2.1 and 12.4.2.2).

Mean Length- and Mean Weight at Age in Landings

Mean length- and mean weight at age data for the whole Division IXa are not available for 1999 for the same reasons as explained previously (see Section 12.4.1).

Mean length and mean weight at age for 1 year-old fish in the catch of Sub-division IXa North in 1995 were 15.6 cm and 26.0 g respectively (ICES 1997/Assess:3). From the small samples of otoliths obtained in Sub-division IXa North in 1999, mean lengths were 15.5 cm, 17.6 cm and 17.9 cm for ages 1, 2 and 3 respectively (B. Villamor, pers. comm.). These mean lengths at age were almost identical to those estimated from the 1998 otolith sample (ICES 2000/ACFM: 5)

Mean lengths were estimated at 9.3 cm for age 0, 12.4 cm for age 1, 13.7 cm for age 2, 15.0 cm for age 3 and 15.5 for age 4 from the sample of otoliths of the Gulf of Cadiz anchovies (Sub-division IXa South) used in the EFAN otolith exchange (García Santamaría, 1999). As previously cited, Millán and Ramos (WD 2000) only recorded anchovies not older than 2 years. The annual and quarterly estimates of mean length- and mean weight at age in the 1996-1999 Spanish landings are showed in Tables 12.4.2.3 and 12.4.2.4. The smallest annual mean length- and mean weight at ages 0 and 1 were recorded in 1996 (6.3 cm and 6.9 cm; 2 g and 3 g).

An increase in the mean length (from 7.6 cm to 8.3 cm) was observed in the 0 age group between 1997 and 1998. A decrease to 7.4 cm was noted in 1999. The mean weight of this age group after 1996 varied between 3g (1997, 1999) and 4 g (1998).

Since 1997 onwards, the mean length at age 1 was mantained at around 10 cm, its mean weight ranging between 7 g (1998) and 9 g (1999). The mean length of the two year-old anchovies ranged between 13.6 cm and 14.3 cm, showing a stable inter-annual trend throughout the four-year period. Conversely, annual mean weights at age 2 showed a decreasing trend, from 19 g in 1996 to 16 g in 1998, but then increasing up to 18 g in 1999.

Seasonally, 0 age-group anchovies are larger and heavier in the fourth quarter. The 1 and 2 year-old anchovies showed a clear and persistent pattern through the years, showing the larger mean length and heavier mean weight in the second half in the year.

12.4.3 Maturity at age

Results from a study undertaken over a four-year period (1989-1992) in the Spanish waters of the Gulf of Cadiz (Sub-division IXa South) show that the anchovy spawning season extends from late winter to early autumn (Millán, 1999). Peak spawning time for the whole population occurs from June to August. Maturity is reached at a total length of 11.09 cm in males and 11.20 cm in females. However, size at maturity varies between years, suggesting a high plasticity in the reproductive process in response to environmental changes (Millán, 1999).

Recent data from the Portuguese acoustic surveys in November 1998 and March 1999 (Morais, pers. comm.) indicated that 45% of anchovies in November 1998 and 78% in March 1999 were mature in the Algarve-Gulf of Cádiz area. In the Sub-division IXa Central percentages of mature fish found in both surveys were 1% and 79%, respectively. Estimates of length at maturity were also available from these Portuguese acoustic surveys (see section 12.3.1 and Morais, WD 2000). For the whole Sub-division IXa South (Algarve and Gulf of Cadiz), length at first maturity in November 1998 was estimated at 12,90 cm TL in both sexes, whereas in March 1999 this size was attained at 11,32 cm in males and at 11,57 cm in females. For the Sub-division IXa Central (northern and southern areas combined) those estimates were only calculated for the March 1999 survey. The estimates were 14,93 cm TL in males and 14,22 cm TL in females, contrasting with the smaller values described above for the southernmost anchovies.

12.4.4 Natural mortality

Natural mortality is unknown for this stock. By analogy with anchovy in Sub-area VIII, natural mortality is probably high.

12.5 Effort and Catch per Unit Effort

Data provided on fishing effort (number of effective fishing trips) and CPUE indices of anchovy in Division IXa correspond to the Spanish purse-seine fleet in the Gulf of Cadiz from 1988 to 1999, and to the Spanish purse-seine fleet in Sub-division IXa North from 1995 to 1999 (Table 12.5.1 and 12.5.2). No Portuguese data are available.

The effort and CPUE series of the Barbate single-purpose fleet in the Gulf of Cadiz experienced a strong declining trend from 1991 to 1995, this last year registering the lowest values for both variables. The decrease in fishing effort was not evident in the remaining Spanish fleets which showed fluctuating effort levels. However, their CPUE series also exhibited decreasing trends. Since 1996 onwards, an increase in effort is observed in the Barbate single-purpose and Sanlucar fleets, with a considerable increase in CPUE in the Barbate single-purpose fleet (Figure 12.5.1).

In Sub-division IXa North, very high effort and CPUE levels were recorded in 1995 when there was a high abundance of anchovy in this area. A sharp decline in effort and CPUE was observed in 1996, suggesting low anchovy abundance. A slight recovery in effort levels and CPUE has been observed since 1997 (Figure 12.5.2).

12.6 Recruitment Forecasting

Recruitment forecasts of anchovy in Division IXa are not available. By analogy with the anchovy stock in Sub-area VIII, recruitment may be driven by environmental factors and may be highly variable as a result.

12.7 State of the Stock

Despite new biological information presented this year, no assessment of this stock can be made for the following reasons:

Catch-at-age data are only available for one part of the stock (Spanish Gulf of Cadiz), and this data series is still short (1996-1999).

The series of biomass estimates from acoustic surveys is also very short.

The differences found between areas in length distributions, mean length- and mean weight at age, and maturity-length ogives, which were estimated from both fishery data and acoustic surveys (see Sections 12.3 and 12.4), support the view that the populations inhabiting these areas may have different biological characteristics and dynamics.

Anchovy biomass in Division IXa was estimated at 32,959 t in November 1998 and at 25,359 t in March 1999 from acoustic surveys, 90% of these estimated biomass corresponded to the Gulf of Cadiz in both surveys (30,092 t and 24,763 t respectively). Anchovy biomass in the Gulf of Cadiz was estimated as 6,569 t in an acoustic survey in 1993.

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

12.8 Catch Preditions

No catch preditions have been estimated for this stock

12.9 Medium-Term Predictions

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

12.10 Long-Term Yield

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

12.11 Reference Points for Management Purposes

It is not possible to determine limit and precautionary reference points based on the available information.

12.12 Harvest Control Rules

Harvest control rules cannot be provided as reference points are not determined.

12.13 Management Considerations

The regulatory measures in place were the same as for the previous year and are summarised by Millan and Villamor (WD 1992). It must be pointed out that the purse-seine fleet in the Gulf of Cadiz did not observe the normal voluntary closure of three months in 1997, 1998 and 1999 (ICES 1992/Assess:17, ICES 1993/Assess:19, ICES 1995/Assess: 2, ICES 1996/Assess: 7, ICES 1997/Assess: 3 and ICES 1998/Assess: 6). The fleet probably continued fishing because of higher anchovy abundance.

Given the limited knowledge of the biology and dynamics of this population and to avoid an increase in effort, a precautionary TAC at the level of recent catches (excluding 1995 and 1998) is recommended. The mean catches from the period 1988-1999 (excluding 1995 and 1998) are about 4,900 t.

Table 12.2.1.1 Portuguese and Spanish annual landings of ANCHOVY in Division IXa.
(From Pestana, 1989 and 1996 and Working Group members).

	Portugal				Spain			
Year	**IXa C-N**	**IXa C-S**	**IXa South**	**Total**	**IXa North**	**IXa South**	**Total**	**TOTAL**
1943	7121	355	2499	9975	-	-	-	-
1944	1220	55	5376	6651	-	-	-	-
1945	781	15	7983	8779	-	-	-	-
1946	0	335	5515	5850	-	-	-	-
1947	0	79	3313	3392	-	-	-	-
1948	0	75	4863	4938	-	-	-	-
1949	0	34	2684	2718	-	-	-	-
1950	31	30	3316	3377	-	-	-	-
1951	21	6	3567	3594	-	-	-	-
1952	1537	1	2877	4415	-	-	-	-
1953	1627	15	2710	4352	-	-	-	-
1954	328	18	3573	3919	-	-	-	-
1955	83	53	4387	4523	-	-	-	-
1956	12	164	7722	7898	-	-	-	-
1957	96	13	12501	12610	-	-	-	-
1958	1858	63	1109	3030	-	-	-	-
1959	12	1	3775	3788	-	-	-	-
1960	990	129	8384	9503	-	-	-	-
1961	1351	81	1060	2492	-	-	-	-
1962	542	137	3767	4446	-	-	-	-
1963	140	9	5565	5714	-	-	-	-
1964	0	0	4118	4118	-	-	-	-
1965	7	0	4452	4460	-	-	-	-
1966	23	35	4402	4460	-	-	-	-
1967	153	34	3631	3818	-	-	-	-
1968	518	5	447	970	-	-	-	-
1969	782	10	582	1375	-	-	-	-
1970	323	0	839	1162	-	-	-	-
1971	257	2	67	326	-	-	-	-
1972	-	-	-	-	-	-	-	-
1973	6	0	120	126	-	-	-	-
1974	113	1	124	238	-	-	-	-
1975	8	24	340	372	-	-	-	-
1976	32	38	18	88	-	-	-	-
1977	3027	1	233	3261	-	-	-	-
1978	640	17	354	1011	-	-	-	-
1979	194	8	453	655	-	-	-	-
1980	21	24	935	980	-	-	-	-
1981	426	117	435	978	-	-	-	-
1982	48	96	512	656	-	-	-	-
1983	283	58	332	673	-	-	-	-
1984	214	94	84	392	-	-	-	-
1985	1893	146	83	2122	-	-	-	-
1986	1892	194	95	2181	-	-	-	-
1987	84	17	11	112	-	-	-	-
1988	338	77	43	458	-	4263	4263	4721
1989	389	85	22	496	118	5336	5454	5950
1990	424	93	24	541	220	5726	5946	6487
1991	187	3	20	210	15	5697	5712	5922
1992	92	46	0	138	33	2995	3028	3166
1993	20	3	0	23	1	1960	1961	1984
1994	231	5	0	236	117	3036	3153	3389
1995	6724	332	0	7056	5329	571	5900	12956
1996	2707	13	51	2771	44	1780	1824	4595
1997	610	8	13	632	63	4600	4664	5295
1998	894	153	566	1613	371	8977	9349	10962
1999	957	96	355	1408	413	5587	6000	7408

(-) Not available
(0) Less than 1 tonne

Table 12.2. 1.2 ANCHOVY IXa. Catches (t) by gear and by country in 1988-1999.

Country/Quarter	1988*	1989*	1990*	1991*	1992	1993	1994	1995*	1996	1997	1998	1999
SPAIN	4263	5454	6131	5711	3028	1961	3153	5900	1823	4664	9349	6000
Purse seine IXa North		118	220	15	33	1	117	5329	44	63	371	413
Purse seine IXa South	4263	5336	5911	5696	2995	1630	2884	496	1556	4410	7830	4594
Trawl IX a South	0.0	0.0	0.0	0.0	0.0	330	152	75	224	190	1148	993
PORTUGAL	458	496	541	210	275	23	237	7056	2771	632	1613	1408
Trawl					4	9	1		56	46	37	43
Purse seine	458	496	541	210	270	14	233	7056	2621	579	1541	1346
Artisanal					1	1	3		94	7	35	20
Total	4721	5950	6672	5921	3303	1984	3390	12956	4594	5295	10962	7409

* Portugal data without separate the catch by gear

Table 12.2.2.1 Anchovy catches (t) in Division IXa by country and Subdivisions in 1999.

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	76	18.4	7	1.8	318	76.9	12	2.9	413	6.9
	IXa South	1335	23.9	1982	35.5	1582	28.3	687	12.3	5587	93.1
	TOTAL	1411	23.5	1990	33.2	1900	31.7	699	11.6	6000	
PORTUGAL	IXa Central North	91	9.5	4	0.4	139	14.5	723	75.5	957	68.0
	IXa Central South	65	68.2	0	0.2	0	0.2	30	31.3	96	6.8
	IXa South	303	85.3	13	3.5	35	9.8	5	1.3	355	25.2
	TOTAL	460	32.6	17	1.2	174	12.4	758	53.8	1408	
TOTAL	IXa North	76	18.4	7	1.8	318	76.9	12	2.9	413	5.6
	IXa Central North	91	9.5	4	0.4	139	14.5	723	75.5	957	12.9
	IXa Central South	65	68.2	0	0.2	0	0.2	30	31.3	96	1.3
	IXa South	1638	27.6	1995	33.6	1617	27.2	692	11.6	5942	80.2
	TOTAL	1871	25.3	2006	27.1	2074	28.0	1457	19.7	7408	

Table 12.3.1.1. Estimated abundance in number (millions) and biomass (tonnes) from the Portuguese acoustic surveys by area and total.

		Portugal				Spain	TOTAL
		Central-North	Central-South	South (Algarve)	Total	South (Cadiz)	
November 1998	Number	30	122	50	203	2346	2549
	Biomass (t)	313	1951	603	2867	30092	32959
March 1999	Number	22	15	*	37	2079	2116
	Biomass (t)	190	406	*	596	24763	25359

* Due to the distribution observed during the survey, the last transect (near the border with Spain) that normally belongs to sub-area Algarve was included in Cadiz.

Table 12.4.1.1. Spanish catches in numbers at age (in thousands) of Gulf of Cadiz anchovy for 1996-1999, by year and quarter.

YEAR		QUARTERS				
1996	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0	0	0	413465	71074	317216
	1	12772	130880	11550	7281	327614
	2	13	882	826	333	4249
	Total (n)	12785	131761	425842	78688	649078
	Catch (t)	41	807	585	348	1780
	SOP	36	742	619	299	1680
	VAR.%	88.11	92.06	105.87	85.97	94.36
1997	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0	0	0	237283	96475	273842
	1	67055	123878	69278	19430	330348
	2	22601	9828	11649	745	53737
	Total (n)	89656	133706	318211	116650	657927
	Catch (t)	906	1110	2006	578	4600
	SOP	844	1273	1923	596	4590
	VAR.%	93.07	114.71	95.88	103.07	99.78
1998	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0	0	0	75708	360599	432554
	1	325407	384529	220869	84729	1017658
	2	11066	879	1316	0	14889
	Total (n)	336473	385408	297893	445329	1465102
	Catch (t)	1773	2113	2514	2579	8977
	SOP	1923	2128	2599	2655	9299
	VAR.%	108.46	100.72	103.41	102.95	103.59
1999	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0	0	0	40549	84234	140055
	1	249922	115218	86931	20276	458099
	2	10982	18701	2450	146	30085
	Total (n)	260904	133919	129931	104656	628239
	Catch (t)	1335	1983	1582	687	5587
	SOP	1330	1756	1391	673	5111
	VAR.%	99.61	88.60	87.90	98.02	91.48

Table 12.4.2.1: Length distribution ('000) of ANCHOVY in Division IXa by country and Sub-divisions in 1999.

	QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4			TOTAL		
Length (cm)	**SPAIN IXa North**	**PORTUGAL IXa C,CN,S**	**SPAIN IXa South**	**SPAIN IXa North**	**PORTUGAL IXa C,CN,S**	**SPAIN IXa South**	**SPAIN IXa North**	**PORTUGAL IXa C,CN,S**	**SPAIN IXa South**	**SPAIN IXa North**	**PORTUGAL IXa C,CN,S**	**SPAIN IXa South**	**SPAIN IXa North**	**PORTUGAL IXa C,CN,S**	**SPAIN IXa South**
3.5	0	-	0	0	-	0	0	-	0	0	-	0	0	-	0
4	0	-	1831	0	-	0	0	-	0	0	-	0	0	-	1831
4.5	0	-	15819	0	-	0	0	-	1236	0	-	0	0	-	17055
5	0	-	38804	0	-	0	0	-	2296	0	-	0	0	-	41100
5.5	0	-	34062	0	-	0	0	-	2119	0	-	0	0	-	36181
6	0	-	17339	0	-	0	0	-	1854	0	-	173	0	-	19366
6.5	0	-	16299	0	-	0	0	-	2914	0	-	1208	0	-	20421
7	0	-	11705	0	-	0	0	-	3974	0	-	2070	0	-	17749
7.5	0	-	5577	0	-	0	0	-	7647	0	-	5865	0	-	19089
8	0	-	1862	0	-	134	0	-	7363	0	-	11475	0	-	20835
8.5	0	-	1603	0	-	554	0	-	4464	0	-	9103	0	-	15724
9	0	-	2350	0	-	1072	0	-	2501	0	-	9015	0	-	14937
9.5	0	-	3593	0	-	2005	0	-	1498	0	-	10390	0	-	17487
10	0	-	5977	0	-	4585	0	-	2176	0	-	10792	0	-	23530
10.5	0	-	8935	0	-	5913	0	-	3478	0	-	13156	0	-	31482
11	0	-	9936	0	-	8294	0	-	7644	0	-	7719	0	-	33593
11.5	0	-	15791	0	-	11202	0	-	8584	0	-	4427	0	-	40004
12	0	-	21447	0	-	20221	0	-	8678	0	-	5267	0	-	55614
12.5	0	-	22351	0	-	25349	0	-	11085	0	-	7599	0	-	66384
13	0	-	14835	0	-	17713	0	-	16058	0	-	4020	0	-	52625
13.5	76	-	6386	0	-	16773	16	-	14220	1	-	1340	92	-	38719
14	218	-	2432	0	-	10084	27	-	9776	1	-	670	246	-	22962
14.5	360	-	1453	0	-	5626	133	-	5985	5	-	184	497	-	13247
15	839	-	400	20	-	2830	208	-	3397	8	-	184	1075	-	6811
15.5	339	-	118	71	-	1564	721	-	741	28	-		1160	-	2422
16	196	-		92	-	659	1320	-	229	51	-		1658	-	889
16.5	90	-		71	-	227	2185	-	18	84	-		2430	-	246
17	45	-		10	-		2086	-		80	-		2221	-	0
17.5	178	-		0	-		1482	-		57	-		1717	-	0
18	134	-		0	-		878	-		34	-		1045	-	0
18.5	59	-		0	-		325	-		12	-		397	-	0
19	164	-		0	-		147	-		6	-		317	-	0
19.5	89	-		0	-		46	-		2	-		138	-	0
20	0	-		0	-		0	-		0	-		0	-	0
20.5	0	-		0	-		0	-		0	-		0	-	0
21	0	-		0	-		0	-		0	-		0	-	0
21.5	0	-		0	-		0	-		0	-		0	-	0
22	0	-		0	-		0	-		0	-		0	-	0
Total N	2787	-	260904	265	-	134805	9574	-	129938	367	-	104656	12993	-	630304
Catch (T)	76	460	1335	7	17	1983	318	174	1582	12	758	687	413	1408	5587
L avg (cm)	16.0	-	8.7	16.2	-	12.7	17.1	-	11.4	17.1	-	10.2	16.8	-	10.4
W avg (g)	27.3	-	5.1	27.3	-	14.7	33.2	-	12.2	33.2	-	6.6	31.8	-	8.9

Table 12.4.2.2: Annual Length distribution ('000) of ANCHOVY in Division IXa from 1988 to 1999.

	1988	1989	1990	1991	1992	1993	1994	1995		1996		1997		1998		1999	
Length (cm)	**SPAIN IXa South**	**SPAIN IXa South**	**SPAIN IXa South**	**SPAIN IXa South**	**SPAIN IXa South**	**SPAIN IXa South**	**SPAIN IXa South**	**SPAIN IXa North**	**SPAIN IXa South**	**SPAIN IXa North**	**SPAIN IXa South**	**SPAIN IXa North**	**SPAIN IXa South**	**SPAIN IXa North**	**SPAIN IXa South**	**SPAIN IXa North**	**SPAIN IXa South**
3.5											1349						
4			4011	258	1						12677						1831
4.5		127	16601	3306	26	22					67819		1333		4656		17055
5	128	452	29122	43814	80	22					160894		11492		25825		41100
5.5	170	813	43716	77144	345	66					129791		38722		57086		36181
6		994	39979	43378	921	180					52812		53185		82442		19366
6.5		1207	37909	24724	2337	611	5488				33640		50275		76694		20421
7	255	2391	29592	15470	3567	1862	12009				32469		62492		68074		17749
7.5	351	5764	27140	16574	5993	3561	18391		439		19088		42120		43197		19089
8	3163	24708	24315	16633	12777	4083	23533		439		8949		45120		32964		20835
8.5	8073	62795	33427	15724	18240	2626	22031		447		11776		36200		47796		15724
9	12602	52082	46239	19735	14461	3843	20272		3108		12007		20009	156	78561		14937
9.5	21594	42387	74823	30742	20684	6848	14835		9805		6844		13611	367	106350		17487
10	34293	67553	95844	39474	31524	7100	23726		11823		4887		8951	754	132106		23530
10.5	49922	69793	96132	71062	31870	9496	27521		14966		7156		12231	1486	150718		31482
11	63848	68387	72419	83835	31776	9401	28394		8575		17343		22647	2047	158806		33604
11.5	55186	55528	63427	81931	31150	11636	33602		7105		21738		27353	1477	133585		40004
12	60928	41099	44273	77372	34504	24713	26439	74	4565		17855		39131	1267	99586		55614
12.5	37457	34212	28509	51932	29185	32918	30192	711	3606		11544		45267	1178	76285		66384
13	22608	17989	15263	43309	17040	26293	15732	3049	1855	8	6450	374	46852	2737	44979		52625
13.5	8149	11505	10619	25316	5725	12681	8517	3381	1544	12	4468	997	38183	2403	25038	92	38719
14	4270	7747	4689	17842	3378	5318	5719	14998	935	258	3880	2004	19127	3038	11847	246	22962
14.5	474	3190	1206	5211	2180	2535	4763	25944	135	335	1990	422	11268	2813	5712	497	13247
15	3896	2245	605	1987	315	943	3612	46371	138	375	790	48	6370	1976	2080	1075	6811
15.5	2436	1671	318	944	922	510	874	42244	6	226	703	40	3764	890	579	1160	2422
16	2126	4676	340	1533	355	56	813	44171		227	159	33	2224	560	138	1658	889
16.5	1690	7271	565	2087	271		368	14369		151		10	296	330		2430	246
17	1096	4349	373	1655	95		182	8378		104		10		438		2221	
17.5	209	1241	199	558	19			778		94		13		311		1717	
18		571	143	79				236		24						1045	
18.5			19							21						397	
19										1						317	
19.5																138	
20																	
20.5																	
21																	
21.5																	
22																	
Total N	394923	592750	841818	813628	299743	167322	327014	204705	69491	1835	649078	3951	658223	24231	1465102	12993	630315
Catch (T)	4263	5336	5726	5697	2995	1960	3035	5329	571	44	1780	63	4600	371	8977	413	5587
L avg (cm)	11.6	10.9	9.6	10.1	10.8	12.0	10.8	15.6	11.0	15.6	6.6	14.2	9.4	13.4	9.7	16.8	10.1
W avg (g)	10.8	8.9	6.9	7.0	10.0	11.8	9.3	26.0	9.6	23.7	2.6	16.1	7.0	15.3	6.3	31.8	8.1

Table 12.4.2.3. Mean length (±SD) at age (TL, in cm) in the Spanish catches of Gulf of Cadiz anchovy on a yearly and quarterly basis (1996-1999).

YEAR		QUARTERS				
1996	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			5.6 (0,8)	7.3 (1,9)	6.3 (1,9)
	1	7.4 (1,9)	8.5 (3,5)	12.9 (1,0)	13.7 (0,6)	6.9 (2,8)
	2	14.0 (0,4)	13.9 (0,4)	15.2 (0,5)	15.6 (0,2)	14.3 (0,7)
	Total	7.4 (1,9)	8.5 (3,5)	5.8 (1,5)	7.9 (2,7)	6.6 (2,5)
1997	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			7.1 (1,4)	8.1 (1,8)	7.6 (1,6)
	1	10.0 (2,5)	10.5 (2,5)	13.1 (1,0)	13.0 (0,9)	10.2 (3,0)
	2	13.4 (0,6)	14.0 (0,6)	15.0 (0,8)	15.1 (0,4)	13.8 (0,9)
	Total	10.9 (2,6)	10.8 (2,6)	8.7 (3,0)	8.9 (2,5)	9.4 (3,0)
1998	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			7.1 (1,9)	8.8 (2,1)	8.3 (2,2)
	1	9.5 (1,8)	9.2 (2,2)	11.9 (1,1)	12.2 (0,9)	10.2 (2,1)
	2	13.23 (0,6)	14.0 (0,4)	15.0 (0,5)		13.6 (0,8)
	Total	9.6 (1,9)	9.2 (2,2)	10.7 (2,5)	9.5 (2,3)	9.7 (2,3)
1999	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			7.7 (1,6)	9.3 (1,3)	7.4 (2,2)
	1	8.2 (3,1)	12.2 (1,2)	12.7 (1,3)	12.5 (0,7)	10.7 (2,8)
	2	13.4 (0,7)	14.1 (0,7)	15.2 (0,4)	14.9 (0,2)	14.0 (0,9)
	Total	8.4 (3,3)	12.5 (1,3)	11.2 (2,8)	10.0 (1,7)	10.1 (3,1)

Table 12.4.2.4. Mean weight (±SD) at age (in g) in the Spanish catches of Gulf of Cadiz anchovy on a yearly and quarterly basis (1996-1999).

YEAR		**QUARTERS**				
1996	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			1.1 (0,6)	2.6 (2,0)	1.9 (2,4)
	1	2.8 (2,0)	5.6 (4,7)	14.2 (3,4)	15.3 (2,2)	3.1 (4,3)
	2	17.6 (1,5)	17.0 (1,5)	23.1 (2,2)	22.8 (0,9)	18.9 (3,2)
	Total	2.8 (2,1)	5.6 (4,8)	1.5 (2,5)	3.9 (4,4)	2.6 (3,8)
1997	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			2.6 (1,6)	3.4 (2,7)	3.1 (2,3)
	1	7.3 (4,5)	8.8 (5,2)	15.1 (3,5)	13.1 (3,0)	8.5 (5,8)
	2	15.6 (2,5)	18.6 (2,7)	22.8 (3,6)	21.3 (1,9)	17.5 (3,7)
	Total	9.4 (5,4)	9.5 (5,6)	6.0 (6,5)	5.1 (4,7)	7.0 (6,1)
1998	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			2.6 (2,3)	4.7 (2,9)	4.1 (2,9)
	1	5.44 (2,8)	5.5 (3,6)	10.7 (3,0)	11.2 (2,7)	7.2 (3,9)
	2	13.78 (1,9)	18.7 (1,8)	21.6 (2,2)		16.1 (3,1)
	Total	5.7 (3,2)	5.5 (3,7)	8.7 (4,6)	6.0 (3,9)	6.3 (4,0)
1999	**AGE**	**1**	**2**	**3**	**4**	**Annual total**
	0			3.2 (2,2)	5.1 (2,0)	3.1 (2,8)
	1	4.7 (4,7)	12.1 (3,7)	13.9 (4,0)	11.7 (2,1)	9.0 (5,3)
	2	14.6 (2,7)	19.5 (3,5)	23.5 (1,9)	19.9 (0,8)	17.8 (3,6)
	Total	5.1 (5,0)	13.1 (4,5)	10.7 (6,3)	6.4 (3,3)	8.1 (2,8)

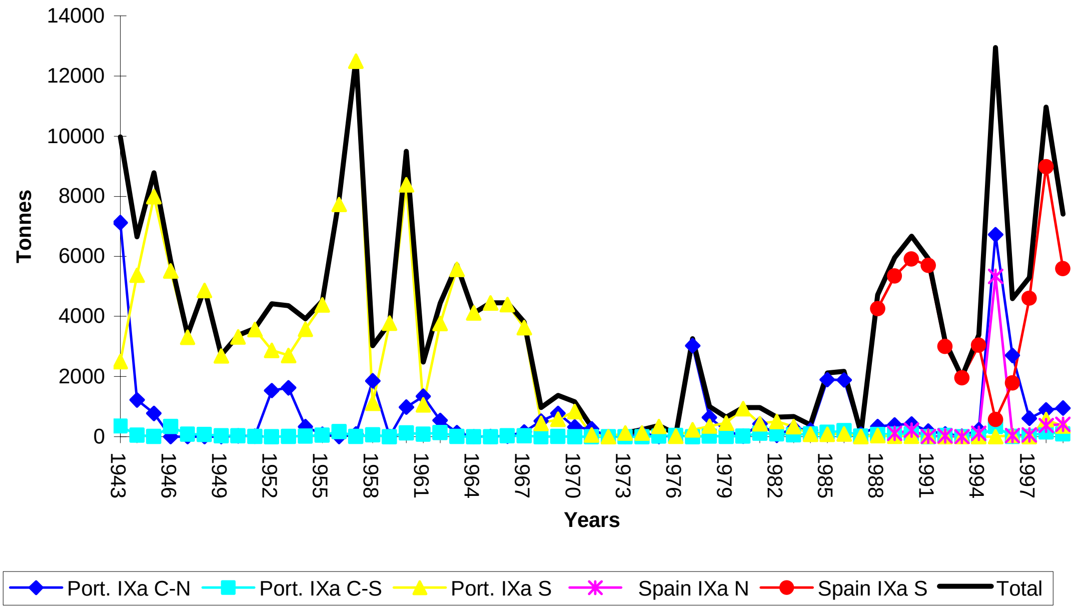
Table 12.5.1 ANCHOVY in Division IXa. Effort data : Spain IXa South (Bay of Cadiz) and Spain IXa North (Galician South) number of fishing trips.

	SUB-DIVISION IXa SOUTH					SUB-DIVISION IXa NORTH	
	PURSE SEINE					PURSE SEINE	
	BARBATE	BARBATE	SAN LUCAR	I. CRISTINA	I.CRISTINA	VIGO	RIVEIRA
Year	Single purpose	Multi purpose	Multi purpose	Single purpose	Multi purpose		
	No. fishing trip					No. fishing trip	
1988	3958	17	210	-	-	-	-
1989	4415	39	234	-	-	-	-
1990	4622	92	660	-	-	-	-
1991	3981	40	919	-	-	-	-
1992	3450	116	583	-	-	-	-
1993	2152	5	225	-	-	-	-
1994	1625	69	899	196	28	-	-
1995	528	17	377	22	17	1537	252
1996	1595	89	1659	76	55	32	3
1997	2207	115	1738	75	13	31	23
1998	2153	-	2234	177	30	134	269
1999	1762	9	2167	330	257	51	85

Table 12.5.2 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	
	BARBATE	BARBATE	SAN LUCAR	I. CRISTINA	I.CRISTINA	VIGO	RIVEIRA
Year	Single purpose	Multi purpose	Multi purpose	Single purpose	Multi purpose		
	kg/No. fishing trip					kg/No. fishing trip	
1988	1047	461	420	-	-	-	-
1989	1139	534	943	-	-	-	-
1990	1128	287	643	-	-	-	-
1991	1312	339	456	-	-	-	-
1992	819	173	300	-	-	-	-
1993	641	268	225	-	-	-	-
1994	1326	262	398	204	174	-	-
1995	377	134	166	52	25	2509	2286
1996	497	315	246	137	157	847	4
1997	1580	306	288	134	163	1068	639
1998	3144	-	221	242	197	1489	512
1999	2162	219	241	134	150	1088	1585

Figure 12.2.1.1: Portuguese and Spanish annual landings of Anchovy in Division IXa since 1943



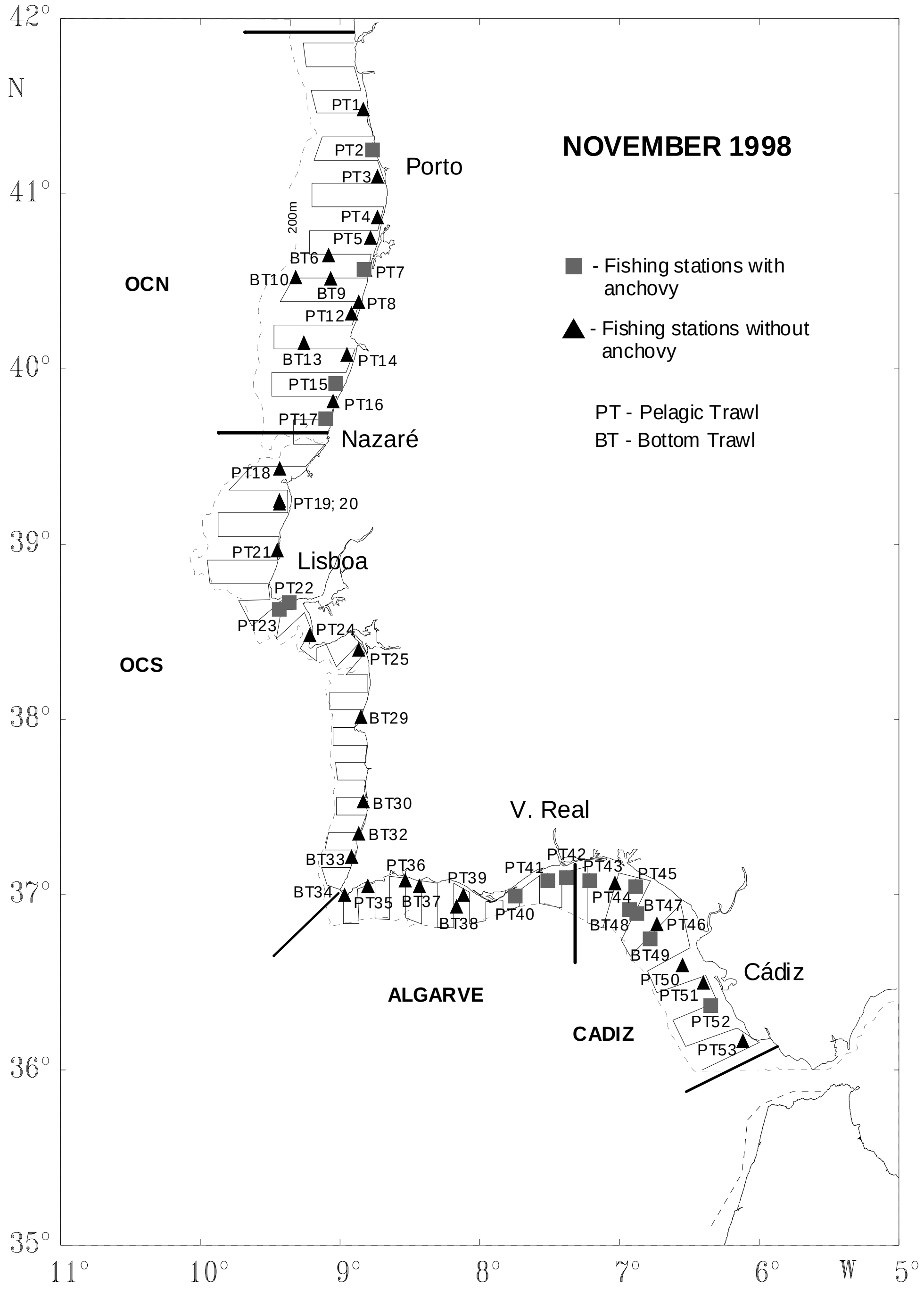


Figure 12.3.1.1. Survey track design and location of trawl stations (with and without anchovy) in November 1998 acoustic survey.

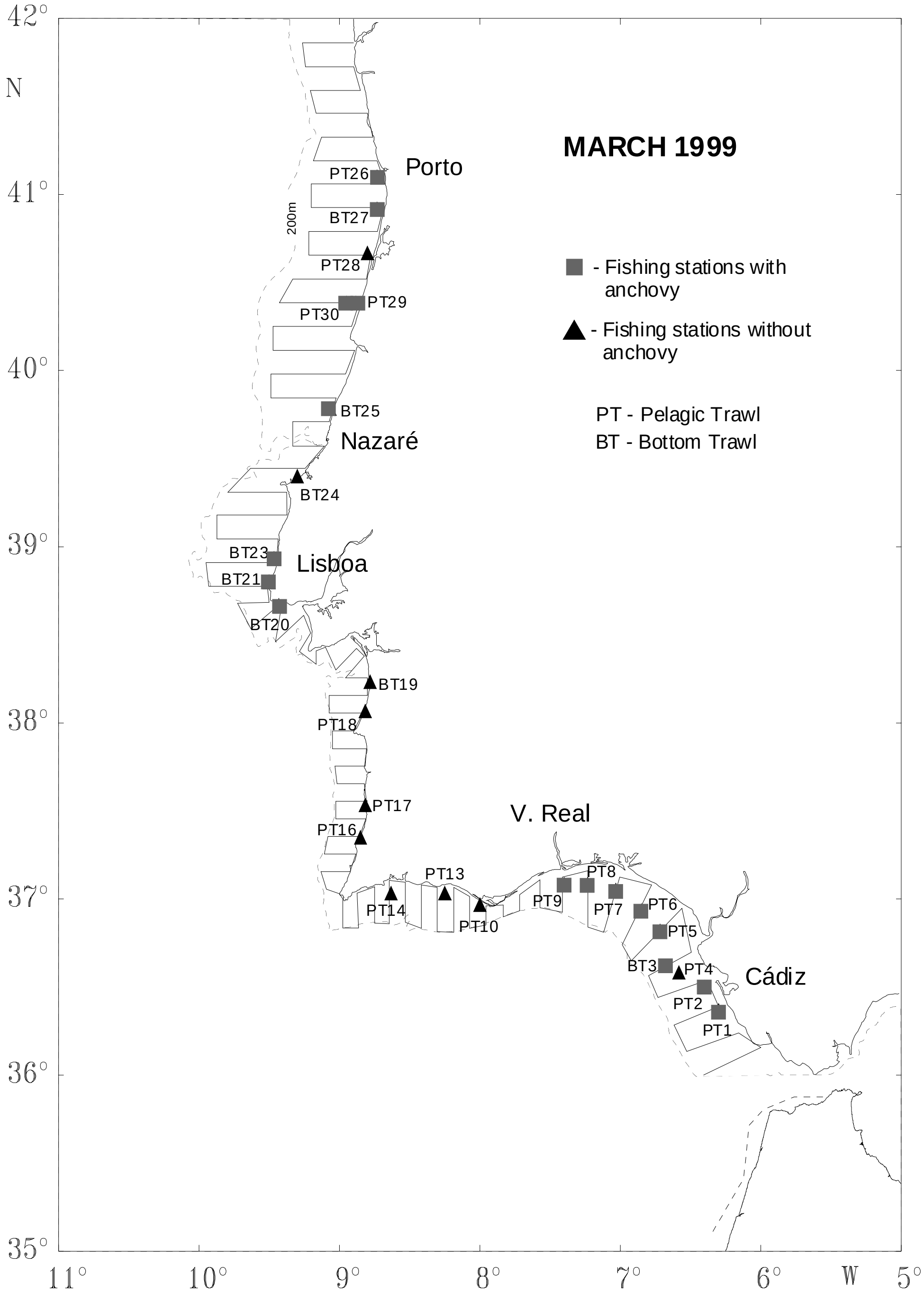


Figure 12.3.1.2 - Survey track design and location of trawl stations (with and without anchovy) in March 1999 acoustic survey.

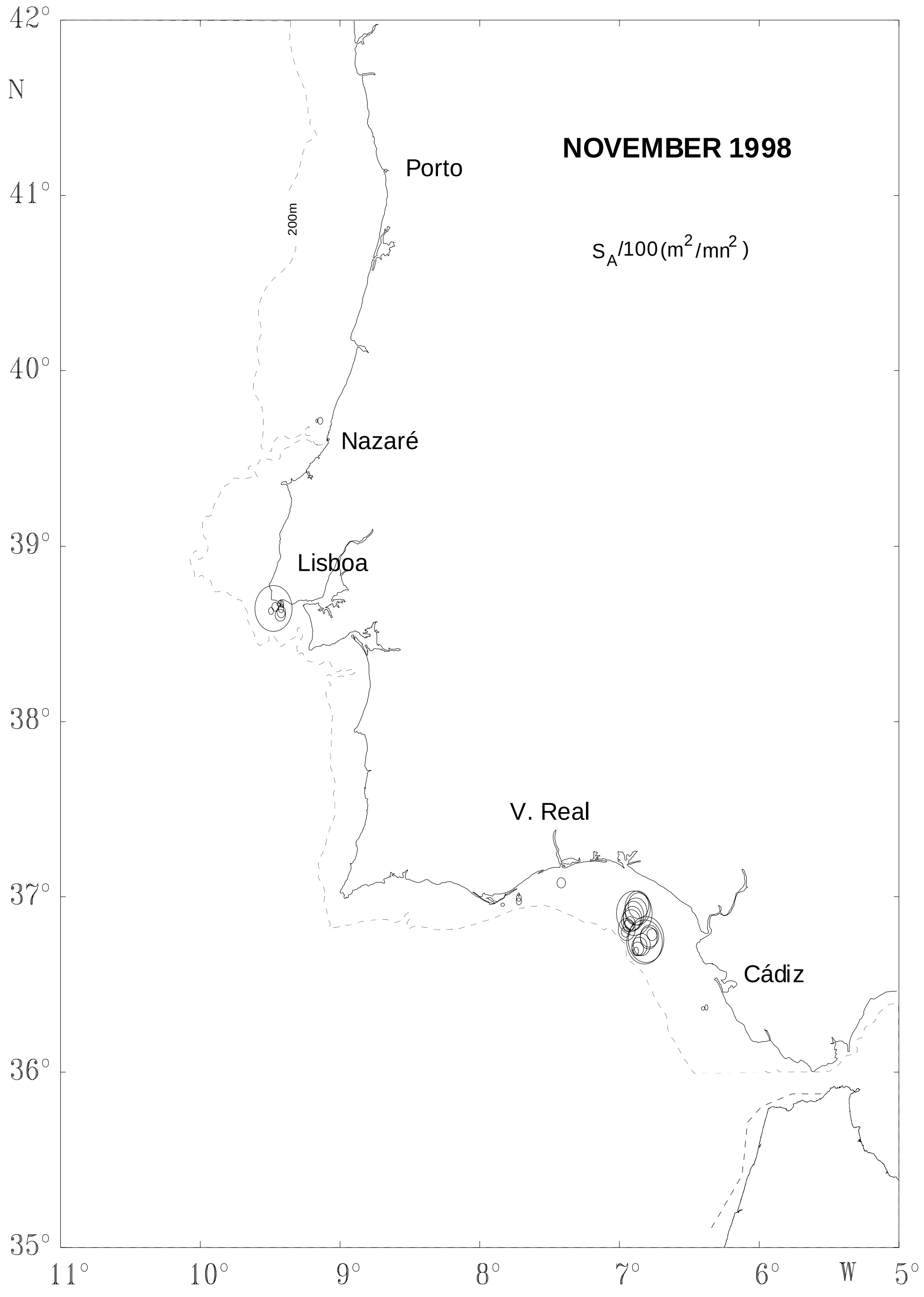


Figure 12.3.1.3 – Acoustic energy distribution per nautical mile during the November 1998 survey. Circle diameter is propocional to the square root of the acoustic energy (S_A).

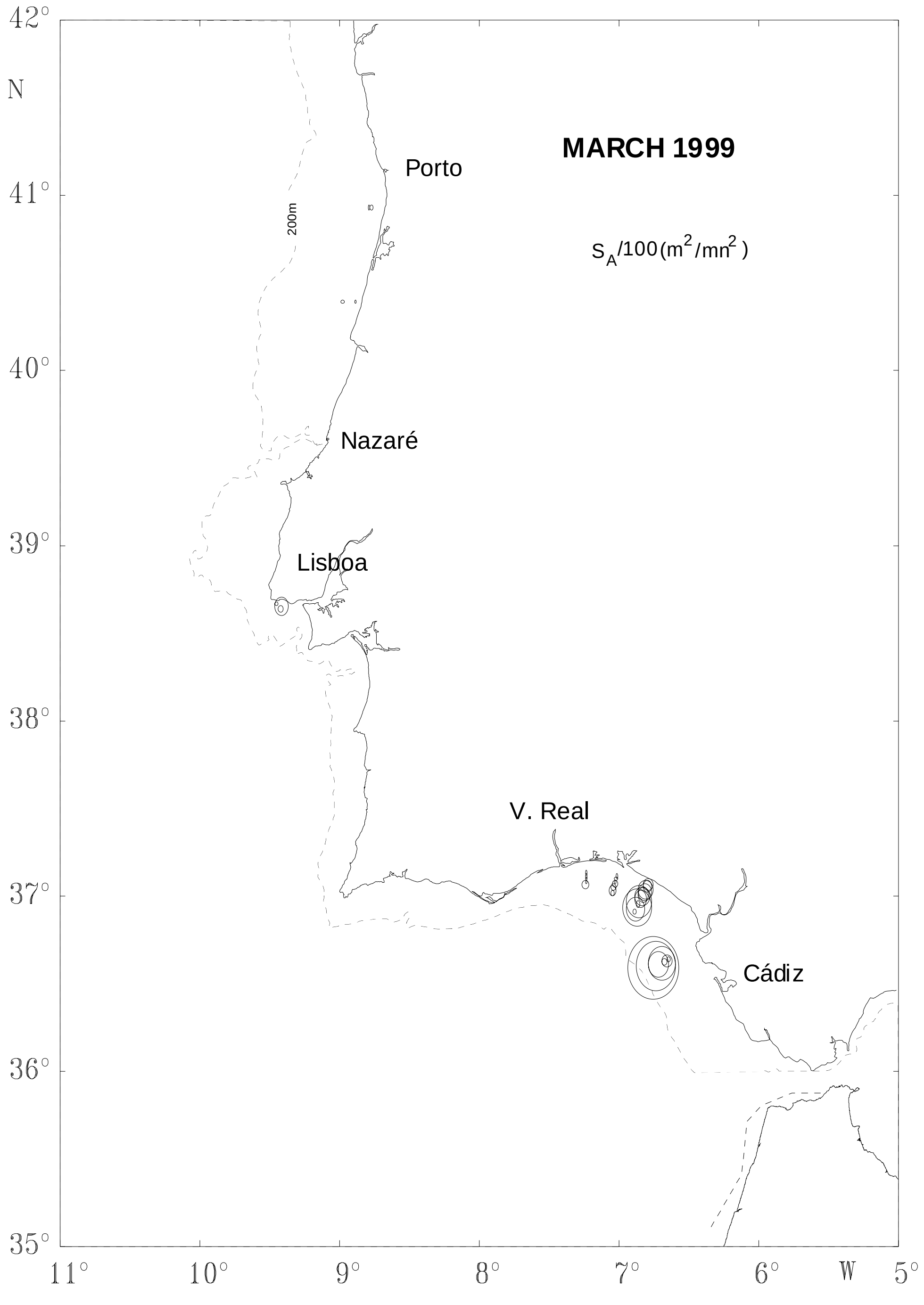


Figure 12.3.1.4 – Acoustic energy distribution per nautical mile during the March 1999 survey. Circle diameter is propocional to the square root of the acoustic energy (S_A).

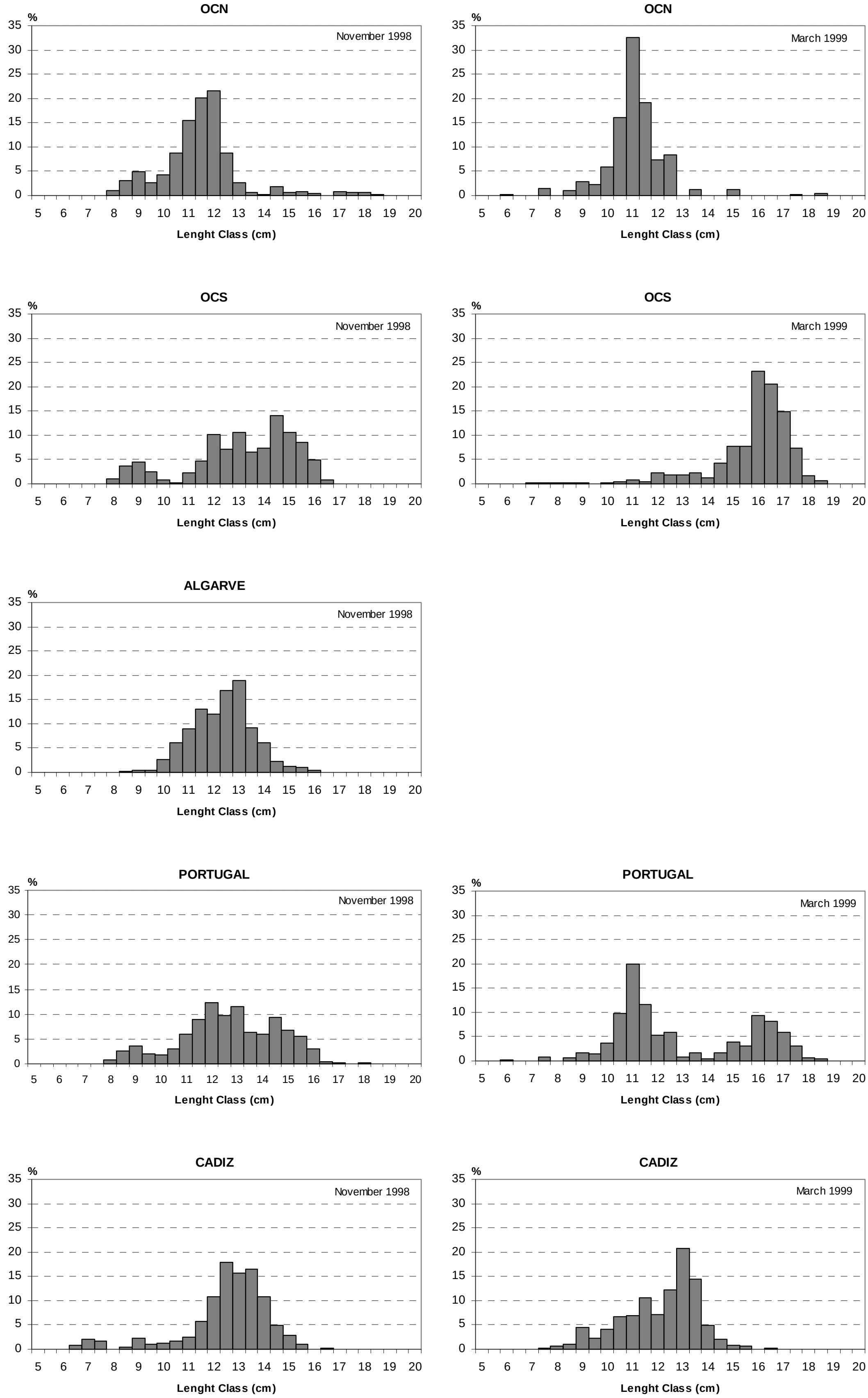


Figure 12.3.1.5 – Distribution of length class frequency (%) by region during the November 1998 and March 1999 acoustic surveys.

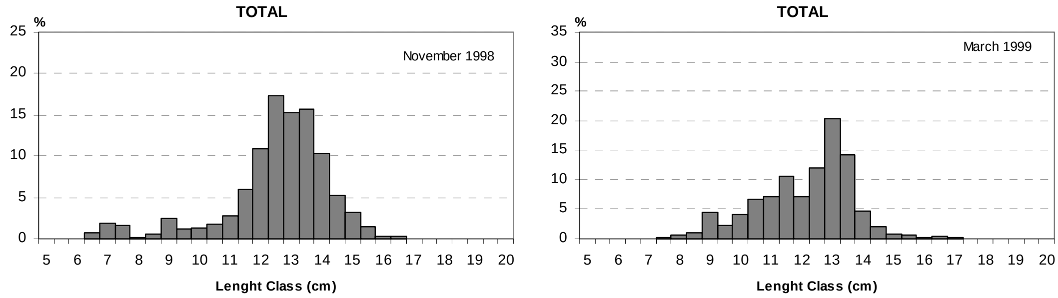


Figure 12.3.1.5 (cont.) – Distribution of length class frequency (%) for the total area during the November 1998 and March 1999 surveys.

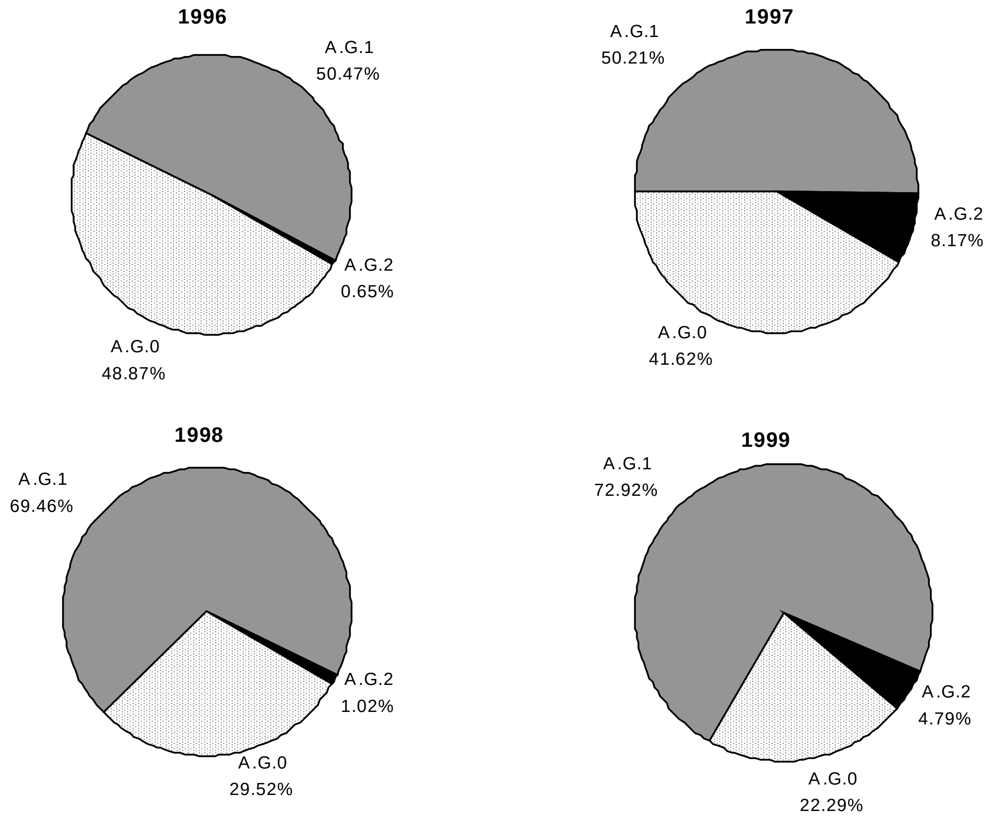


Figure 12.4.1.1. Annual relative numbers at age in the catches of Gulf of Cadiz anchovy (1996-1999).

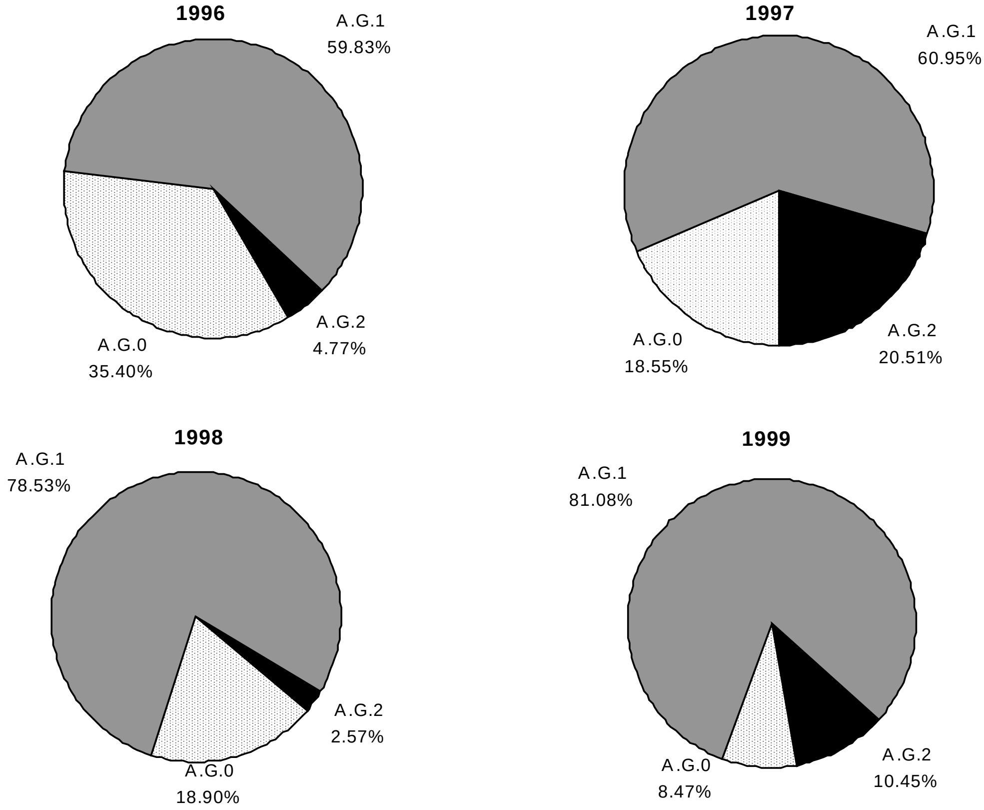


Figure 12.4.1.2. Annual relative weights at age in the Spanish catches of Gulf of Cadiz anchovy (1996-1999).

Figure 12.4.2.1: Length distribution ('000) of landings of ANCHOVY in Sub-divisions IXa South(Gulf of Cadiz) and IXa North (Western Galicia) by quarter in 1999

SUB-DIVISION IXa SOUTH | **SUB-DIVISION IXa NORTH**

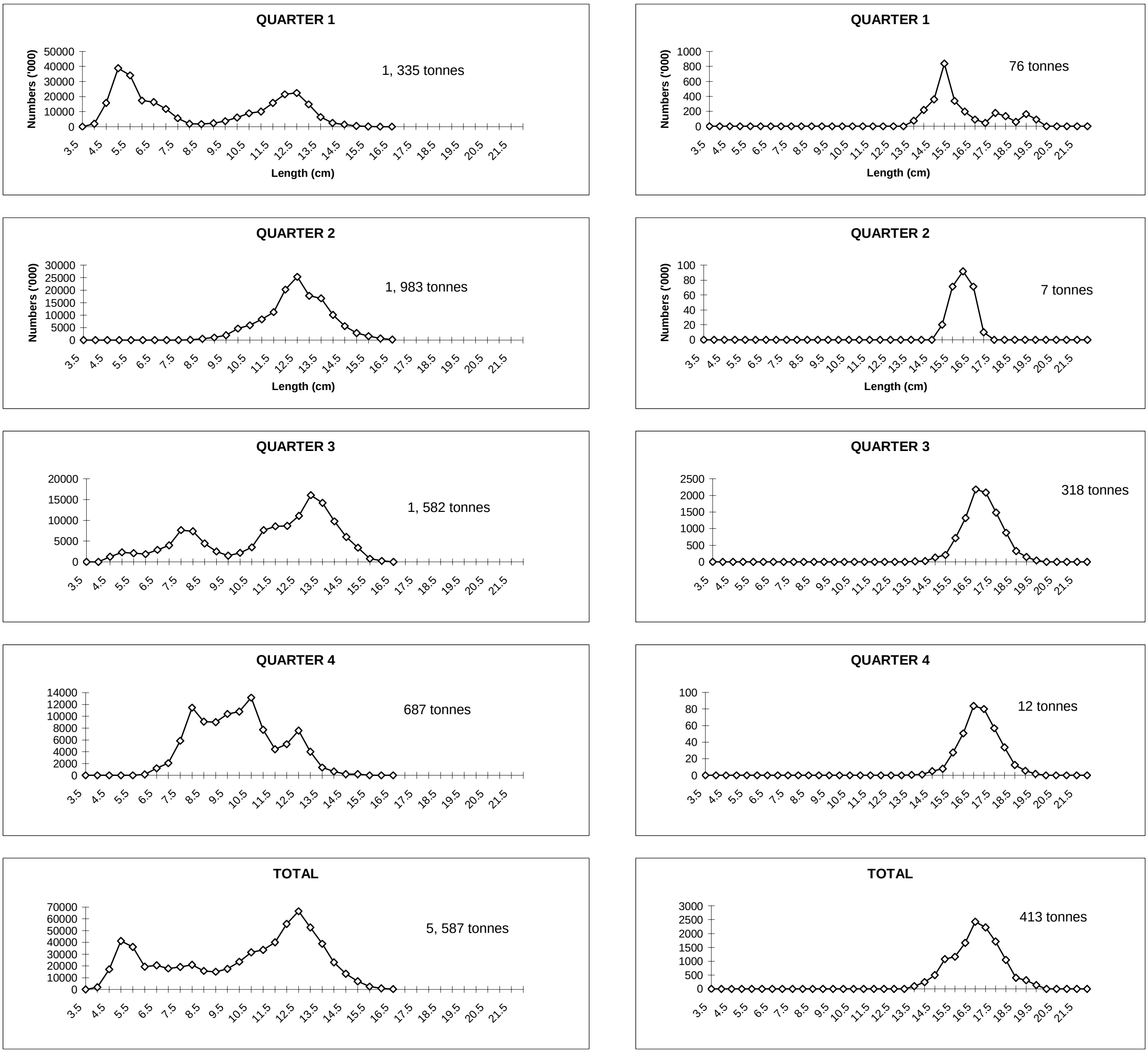
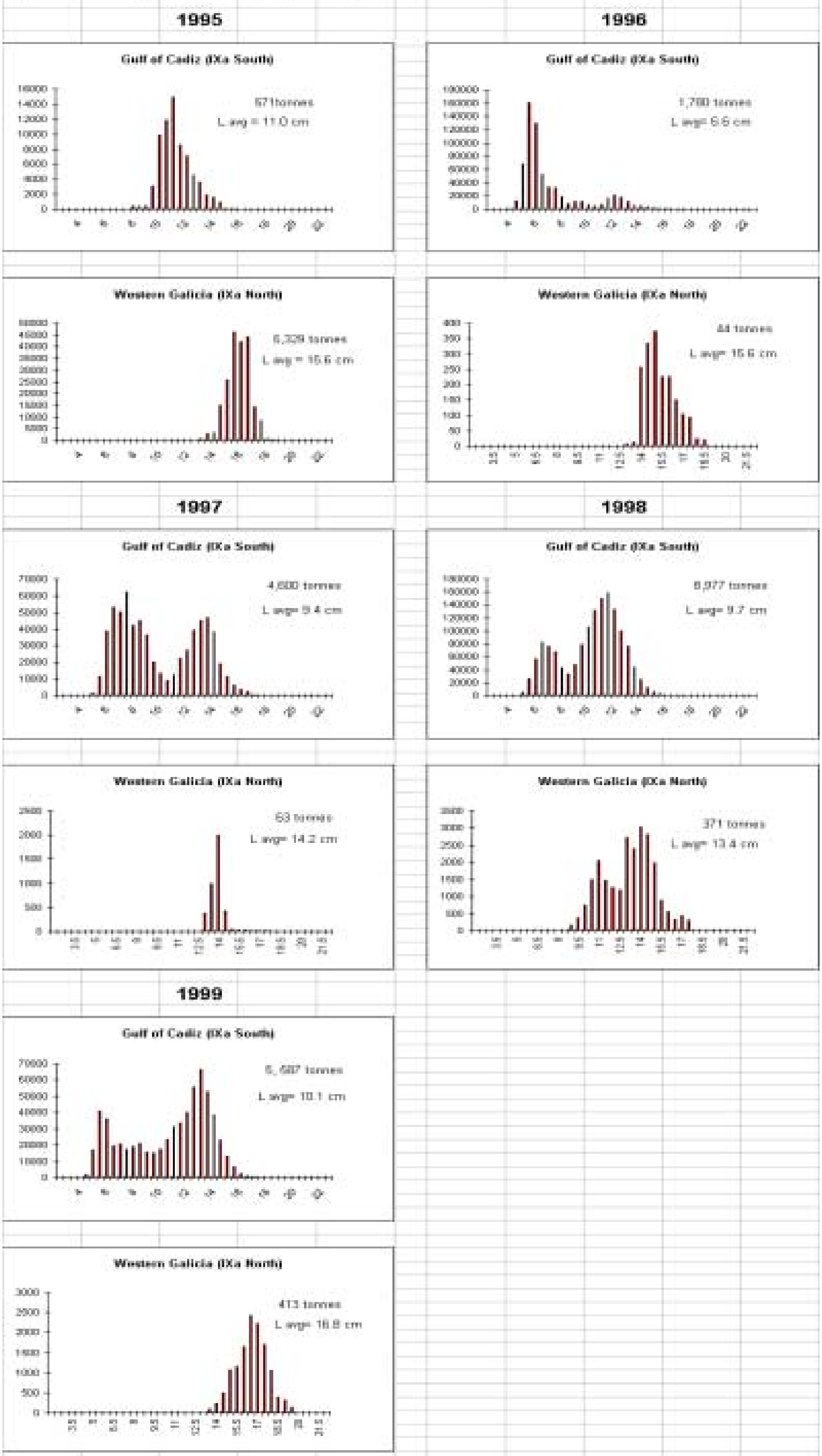
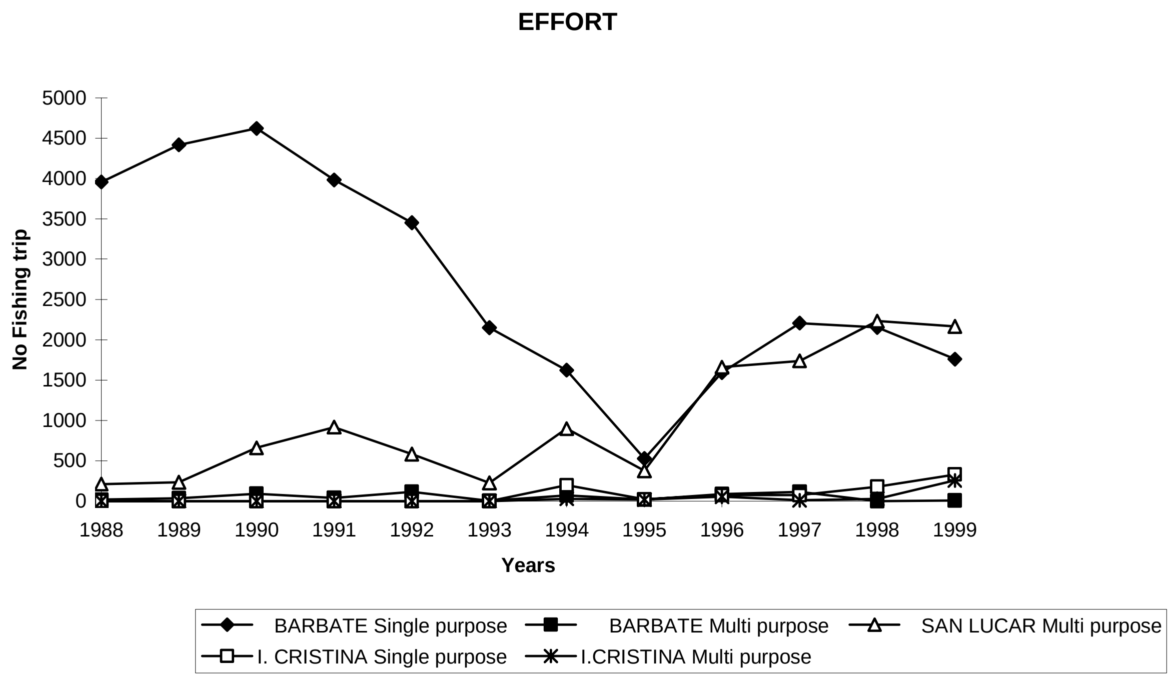


Figure 12.4.2.2 Length distribution ('000) of Anchovy in Sub-division IXa South and IXa North. 1995-1999





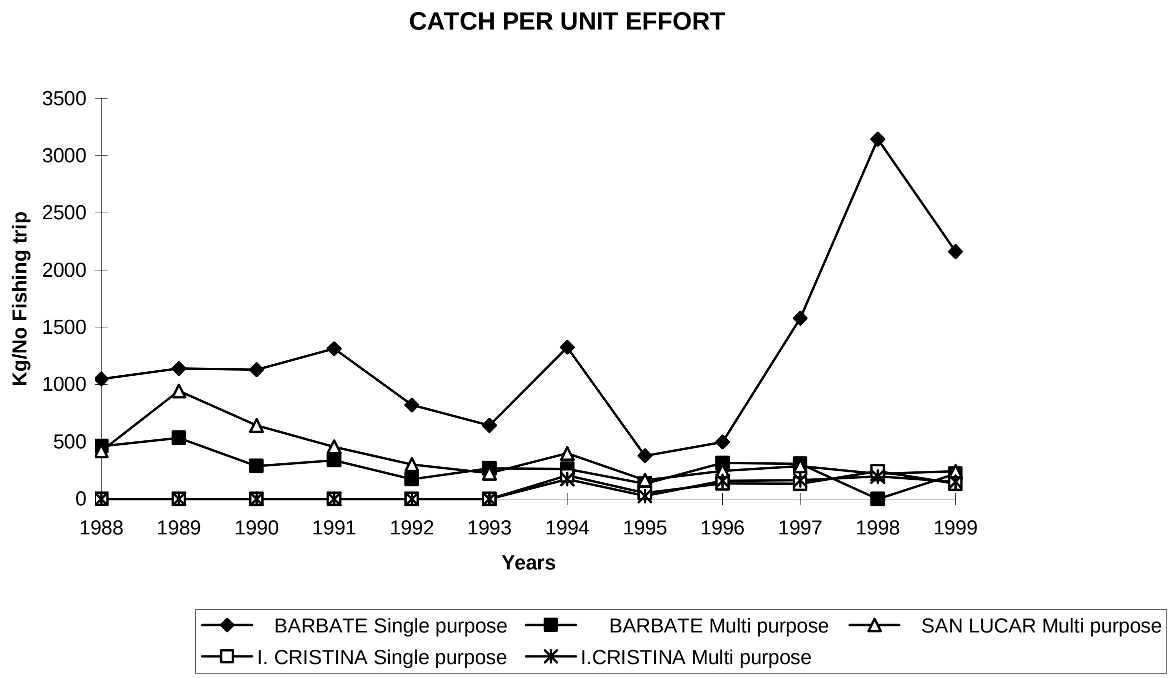
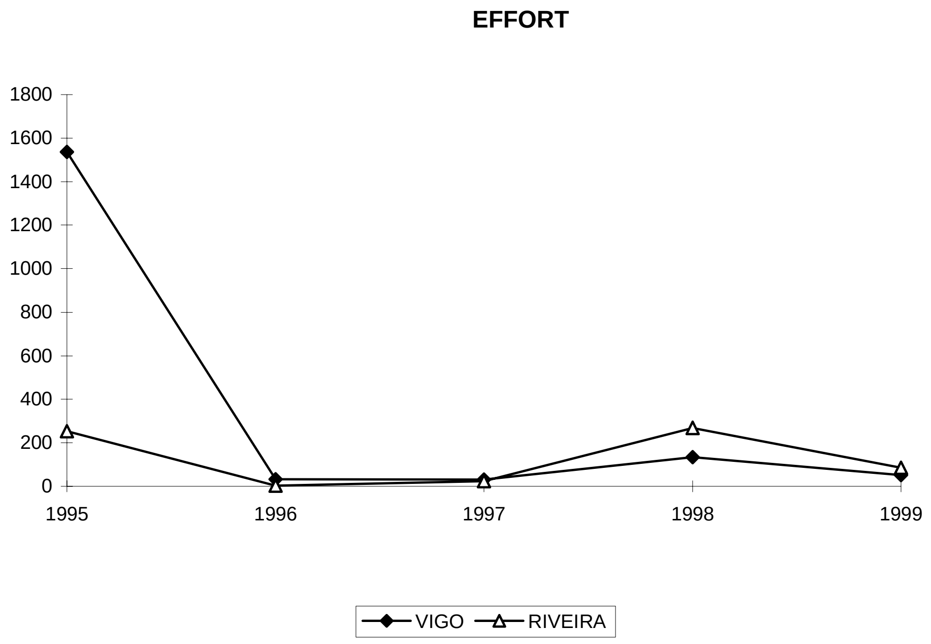


Figure12.5.1 ANCHOVY in Division IXa. Spain IXa South (Bay of Cadiz) Effort and CPUE series in comercial fisheries.



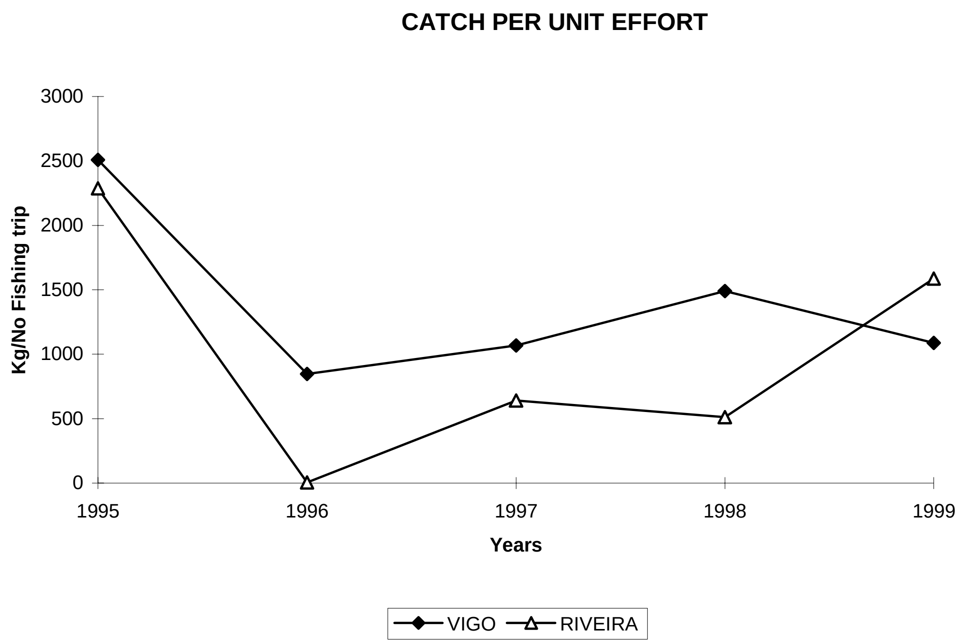


Figure12.5.2 ANCHOVY in Division IXa. Spain IXa North (Galician West) Effort and CPUE series in commercial fisheries.

13 RECOMMENDATIONS

General

The Working Group recommended that Dankert Skagen, who was only appointed for a term of one year, be appointed as chairman of the Mackerel, Horse Mackerel, Sardine and Anchovy Working Group for a new term of 3 years.

The Working Group strongly recommends that the collection programme outlined by Working Group on Mackerel and Horse Mackerel Egg Surveys in response to T.o.R. c) (see above) be carried out in full. Furthermore the Working Group recommends that the collection of data on primary adult parametrs – fecundity and atresia – be carried out on an annual basis. To this end all institutes which are in a position to collect adult fish in the western spawning area in the first quater are encouraged to do, following preservation protocols designated by CEFAS.

The Working Group recommends that a directory be allocated on the ICES server to store relevant documentation and the most recent version of exchange sheets and programmes used to aggregate the data, and that these items be available over the ICES web server.

Mackerel & Horse Mackerel

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

The Working Group recommends to combine the horse mackerel fecundity estimates from Division IXa with those already presented for Division VIIIc, to obtain, as soon as possible, an estimation of the southern horse mackerel SSB from 1998 egg survey.

The Working Group recommends that the assessment data be prepared before next years Working Group meeting in order to be able to do an assessment fot the North East Atlantic Mackerel over the period 1972-2000 at it next meeting.

Sardine

The Working Group recommends that observers should be placed on vessels in order estimate discards in fisheries where mackerel discarding is perceived to be a problem.

The Working Group strongly recommends the creation of a Study Group on the Estimation of Sardine and Anchovy Spawning Stock Biomass by the Daily Egg Production Method, in order to carry on the studies already started in this area in a context profiting of the different experiences in the two species.

The Working Group recommends that studies for sardine stock identification should be continued in order to clarify the population structure within the current stock limits and the relationships with adjacent areas.

Considering current uncertainty in stock assessment and the inadequacy of the current model to explain all variability in the stock dynamics, the Working Group recommends the exploration of alternative assessment methods.

The Working Group recommends to carry on the application of the Daily Egg Production Method (DEPM) in Divisions VIIIc and IXa according to the sardine peak of spawning season in each of these areas.

The Working Group recommends that Portugal continues to perform the November acoustic survey which coincides with the spawning aggregation of sardine in the Portuguese area of Division IXa.

The Working Group also recommends to the continuation of joint acoustic surveys covering the in Divisions VIIIc and IXa each year in March-April. In order to understand the population distribution of sardine these surveys also must investigate the adjacent areas, mainly the French coast.

The Working Group recommends that all the member countries should make available the information of sardine in their waters concerning surveys, catch compositions and eggs and larvae distribution.

The Working Group recommends the implementation of studies on daily increments on age rings of sardine otoliths due to the occurrence of changes in the structure of younger sardine otoliths. This raised problems in allocation in the appropriate age groups.

The Working Group recommends the revision of the maturity at age and the adoption of a common definition of mature fish for DEPM estimation and for the calculation of stock maturity ogives.

The Working Group recommends the revision of the weights at age in the stock.

The Working Group recommends that an Workshop on Sardine Biological Sampling procedures for maturity at-age and weight-at age be held.

The Working Group recommends that an exchange of sardine otoliths be carried out routinely each year.

Anchovy

The Working Group again recommends that observers should be placed on board vessels in those areas in which discarding may be a problem. Existing observer programmes should be continued.

Bay of Biscay anchovy should be monitoring with the DEPM and acoustic surveys.

The Working Group recommends further examination of plausible harvest control rules and that this should be made available to this Working Group in 2001.

The management of the Bay of Biscay anchovy requires an ad hoc process between scientists and managers to define and simulate a range of harvest control rules, so as that managers and interested bodies can make a proper discussion about the implications of those harvest control rules which lead ultimately to the adoption of an agreed management for future.

The Working Group recommends to extend backwards the catch at age data series for the Gulf of Cadiz anchovy (Sub-division IXa South, Spain) as far as possible, and to recover all the information available on the anchovy fishery and biology off Portuguese waters.

The Working Group recommends to undertake studies on the past history of the fishery on the Bay of Biscay anchovy, in order to build up a linger time series of anchovy catch at age and effort data to permit a fuller understanding of the stock dynamics and under varying environmental and fishery conditions.

The Working Group recommends to continue with the recovery and provision of all the information available (past and present) on anchovy from the Portuguese acoustic surveys carried out in Division IXa.

Since anchovy seems to exhibit biological differences along the Division IXa, the Working Group also recommends, if possible, to make available the results from the genetic studies which are currently in progress. Biological samples from this area have been provided by the 2000 acoustic surveys carried out under the PELASSES Project.

14 REFERENCES

Anon. 1990. Report on the Assessment of the Stock of Sardine, Horse Mackerel and Anchovy. ICES, C.M. 1990/Assess:24, 169 pp. (mimeo).

Anon. 1991. Report on the Assessment of the Stock of Sardine, Horse Mackerel and Anchovy. ICES, C.M. 1991/Assess:22, 138pp. (mimeo).

Anon. 1991. Report of the study group on coordination of bottom trawl surveys in Sub-areas VI, VII, VIII and Division IXa. ICES, C.M. 1991/G:13.

Anon. 1992. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1992/Assess: 17, 207 pp.

Anon. 1993. Report of the Working Group on Long-Term Management Measures. ICES, C.M. 1993/Assess:7.

Anon. 1993. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1993/Assess:19.

Anon. 1995. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1995/Assess:2.

Anon. 1996. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1996/Assess:7.

Anon.1996. Report of the Mackerel/Horse Mackerel Egg Production Working Group. ICES, C.M. 1996/H:2.

Anon. 1997. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Ssardine and Anchovy. ICES, C.M. 1997/ Assess: 3.

Anon. 1997. Report on the meeting of the ICES Working Group on Oceanic Hydrography.ICES, C.M. 1997/C:3.

Anon. 1998. Report of the precautionary approach to fishery management. ICES, C.M. 1998/ACFM:10.

Anon. 1998. Working Group on the Assessment of Mackerel Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1998/Assess:6.

Anon. 1998. Report on the meeting of the ICES Working Group on Oceanic Hydrography.ICES, C.M. 1998/C:8.

Anon. 1999. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1999/ACFM: 6.

Anon. 1999. Report on the meeting of the ICES Working Group on Oceanic Hydrography.ICES, C.M. 1999/C:8.

Anon. 1999. Report of the Working Group on Mackerel and Horse Mackerel Egg Surveys. ICES, C.M. 1999/G:5.

Anon. 1999. Report of the Horse Mackerel Otolith Workshop. ICES, C.M. 1999/G:16.

Anon. 1999. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1999/Assess: 6. 468pp.

Anon. 2000. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Anon. 2000. Report of the Working Group on Mackerel and Horse Mackerel Egg Surveys. ICES, C.M. 2000/G:01.

Anon. 2000. Report of the Workshop on the Estimation of Spawning Stock Bopmass of Sardine. ICES, C.M. 2000/G:07.

Azevedo M. 1999. Exploratory data analysis for Iberian Sardine (Sardina pilchardus). WD for the ICES Working Group Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Bellido, J.M., Pierce, G.J., Romero, J.L., Millán, M. 2000. Use of frequency analysis methods to estimate growth of anchovy (Engraulis encrasicolus L. 1758) in the Gulf of Cadiz (SW Spain). Fish. Res., 1057:1-9.

Bernal M. 1999. Preliminary results on a two stage modelling of sardine (Sardina pilchardus, Walb.) egg presence and abundance off the Spanish coast and its implication for stock assessment. WD for the ICES Working Group Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Bernal, M., Buckland, S.T., Lago de Lanzos, A., Valdes, L. 1999 – A new procedure for assigning ages to eggs of synchronous spawning fish. ICES CM 1999/T:5.

Bernal , M. Stratoudakis, Y., Cunha, M.E., Lago de Lanzos, A., Franco, C., Valdez, L., Lopez, P.C. 2000 – Temporal changes in the spawning area and distribution of Atlanto-Iberian Sardine (sardina pilchardus Walb) eggs. Euroconferencia Vigo 2000)

Borges, M.F., Silva, A., Porteiro, C., Abaunza, P., Eltink, A., Walsh, M., Poulard, J.C., Iversen, S. 1995. Distribution and migration of horse mackerel. ICES, C.M. 1995/H: 19 Poster.

Borja, A., A. Uriarte, L. Motos and V. Valencia, 1996. Relationship between anchovy (Engraulis encrasicolus L.) recruitment and the environment in the Bay of Biscay. Sci., Mar., 60 (Supl. 2): 179-192.

Borges, M.F., Santos, A.M., Pestana, G. Groom, Steve. 1997. Is the decreasing recruitment of pelagic fish (sardine and horse mackerel) induced by a change of the environmental conditions? ICES C.M 1997T:25.

Butterworth, D. S., De Oliveira, J. A. A. and Cochrane, K. L. 1993. Current initiatives in refining the management procedure for the South African anchovy resource. In Proceedings of the International Symposium on Management Strategies for Exploited Fish Populations, Anchorage, October 1992. Kruse, G., Eggers, D. M., Marasco, R. J., Pautzke, C. and T. J. Quinn (Eds). Fairbanks, Alaska; Sea Grant College Program: 439-473 (Alaska Sea Grant College Report 93-102).

Carrera P. 1999. Acoustic survey JUVESU 0899: preliminary results. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Carrera P. 1999. Short note on the maturity ogive of sardine fitted logistic models during PELACUS 0399 acoustic survey. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Carrera P., Villamor B. and Abaunza P. 1999. Report of the acoustic survey PELACUS 0399: results on sardine, mackerel, horse mackerel and anchovy. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Cendrero, O. 1994. Improvment of stock assessment by direct methods, in application to the anchovy (Engraulis encrasicholus) in the Bay of Biscay. Final report of the EC-FAR Project 1991-1993, Contract N MA 2495 EF (mimeo).

Cochrane, K. L., Butterworth, D. S., De Oliveira, J. A. A. and Roel, B. A. 1998. Management procedures in a fishery based on highly variable stocks and with conflicting objectives: experiences in the South African pelagic fishery. Revs Fish Biol. Fish. 8: 177-214.

Díaz del Río, G., Lavín, A., Alonso, J., Cabanas, J.M., Moreno-Ventas, X. 1996. Hydrographic variability in Bay of Biscay shelf and slope waters in spring 1994, 1995, 1996 and relation to biological drifting material. ICES, C.M. 1996/S:18.

Eltink, A. Horse Mackerel egg production and spawning stock size in the North Sea in 1992. ICES, C.M. 1992/H:21.

García Santamaría, M.T. 1998. Anchovy (Engraulis encrasicolus) Otolith Exchange (1997-1998). European Fish Ageing Network (EFAN). Report 4-98, 33 pp (mimeo).

Gavaris, S. 1989. An adaptive framework for the estimation of population size. *Canadian Atlantic Fisheries Scientific Advisory Committee Research Document*, 88/29.

Hamre, J. 1978. The effect of recent changes in the North sea mackerel fishery on stock and yield. Rapp. P.-v. Reun. Cons. Int. Explor. Mer., 172:197-210.

ICES CM 1999: Report of the Northern pelagic and Blue Whiting fisheries Working Group. ICES CM 1999/ACFM :28.

Iversen, S. A., Skogen, M. D. and Svedsen E. 1998. Influx of Atlantic waters and feeding migration of horse mackerel. ICES, C.M. 1998/R:18.

Iversen S. A. and Eltink A. 1999. Egg production and spawning stock size of mackerel in the North Sea in 1999. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Junquera, S. 1986. Peche de l anchois (Engraulis engrasicholus L.) dans le Golfe de Gascogne et sur le Littoral Atlantique dela Galice depuis 1920, variations quantitatives. Rev. Trav. Inst. Peches Marit. , 48 (3 et 4): 133-142.

Junquera, S. and Perez-Gandaras, G. 1993. Population diversity in Bay of Biscay anchovy (Engraulis engrasicholus, L. 1758) as revealed by multivariate analisis of morphometric and meristic characters. ICES J. mar. Sci. , 50:383:396.

Kizner Z.I. and D.Vasilyev. 1997. Instantaneous Separable VPA (ISVPA). ICES journal of Marine Science, 54, N 3: 399-411.

Millán, M., 1999. Reproductive characteristics and condition status of anchovy Engraulis encrasicolus L. from the Bay of Cádiz (SW Spain). Fish. Res., 41:73-86.

Millán, M., Villamor, B., 1992. The fishery of Anchovy in the Bay of Cádiz (IXa ICES Division) during 1988-1991. WD to the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1992/Assess:17.

Morais A., Borges M.F. and Marques, V. 1999. Changes on Sardine Distribution Pattern and Trends of Recruitment, Spawning Stock Abundance in the Portuguese Area as Directly Estimated by Acoustic Surveys from 1984-1999. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Motos, l. 1994. Estimación de la biomasa desovante de la población de anchoa del golfo de Vizcaya, engraulis encrasicolus, a partir de su producción de huevos. Bases metodológicas y aplicación. Memoria presentada para defensa de la Tesis Doctoral. Universidad del País Vasco, 1994.

Motos, L., Metuzals, K.., Uriarte, A. and Prouzet, P. 1995. Evalucion de la biomasa de anchoa (Engraulis engrasicholus) en el golfo de Vizcaya. Campana BIOMAN 94. Informe Tecnico IMA /AZTI/IFREMER, 32 pp. + 2 anexos, (mimeo).

Motos L., Uriarte A., Santos M. and Proset P. Assessment Update for the Bay of Biscay Anchovy (Engraulis encrasicolus). Spawning Biomass in 1995, 1996, 1997 and Preliminary Results of the 1998 Survey. 1998. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1999/ACFM:6.

Panterne P., Sánchez F., Fernández A. and Abaunza P. 1999. Horse mackerel and mackerel conversion coefficients between RV Thalassa using GOV 36/47 gear and RV Cornide de Saavedra using Baka 44/60 gear from overlapping experiments. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Patterson, K. R. and G. D. Melvin. 1996. Integrated catch at age analysis version 1.2. *Scottish Fisheries Research Report*, 56. Aberdeen: FRS.

Patterson, K.R. 1997. Evaluation of uncertainty in stock assessment, biological reference points and outcome of a harvest control law where model structure is uncertain using a Bayesian method: Norwegian Spring-Spawning Herring. ICES C.M. 1997/DD:8

Patterson, K.R. 1999. A programme for calculating total international catch at age and weight at age. WD to the Working Group ICES, C.M. 1999/ACFM: 6.

Perez, N., Pereda, P.,Uriarte, A.,Trujillo, V., Olaso, I. and Lens, S. 1994. Discards of the Spanish Fleet in the ICES Divisiona.Study Contract D6 X1V, Ref.N:PEM/93/005.

Perez J.R., Villamor B. and Abaunza P. 1999. Maturity ogive of the Northeast Atlantic mackerel (Scomber scombrus L.) from the southern area using histological and macroscopic methods. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Pestana, G. 1989. Manancial Ibero-Atlântico de Sardinha (Sardina pilchardus, Walb.) sua Avaliação e Medidas de Gestão. Dissertação original apresentada para provas de acesso à categoria de Investigador Auxiliar. Área Científica de Dinâmica de Populações. INIP, 192pp. 1 Anexo.

Pestana, G. 1996. Anchovy in Portuguese waters (IXa): landings and length distribution in surveys. WD to the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1996/Assess:7.

Prouzet, P. and Metuzals, K. 1994. Phenotypic and genetic studies on the Bay of Biscay anchovy. InCendrero (Eds) 1994. Final report of the EC FAR project (1991-1993).

Prouzet P., A. Uriarte, B. Villamor, M. Artzrouni, O. Gavart, E. Albert and E. Biritxinaga, 1999. Estimations de la mortalite par peche (F) et naturelle (M) a partir des methodes directes d'evaluation de l'abondance chez les petits pelagiques – Precision de ces estimateurs. Rapport final contrat UE – DG XIV 95/018, 67 pages.

Prouzet P. and M. Lissardy, 2000. An attempt to estimate the anchovy biomass in the Bay of Biscay in 2000 from the catch per trip of the French pelagic fleet during the first quarter. Working Document for the STECF sub-group on anchovy. Brussels 29 to 31 of May 2000.

Shepherd, J. G. 1997: Prediction of year class strength by calibration regression of multiple recruit index series. ICES J. Mar. Sci., 54: 741-752.

Soriano, M. and Sanjuan, A. 1998. Preliminary results on allozyme differentiation in Trachurus trachurus (Osteichthyes,Perciformes,Carangide) on the NE Atlantic waters. WD to the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1998/Assess:6.

Stratoudakis, Y. 1999. Temporal changes in estimated spawning area and distribution of sardine (Sardina pilchardus) eggs off Portugal. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Stratoudakis , Y., Cunha, E., Borges, F. Soares, E., Vendrel, C. 2000 – Thoughts on the planning of future DEPM surveys for Atlant0-Iberian sardine. WD to the Workshop on the estimation of spawning stock biomass of sardine (Vigo, 2000).

Uriarte, A., Motos, L., Santos, M., Alvarez, P. and Prouzet, P. 1999. Assessment update for the Bay of Biscay Anchovy (Engraulis encrasicolus). Spawning biomass in 1995, 1996, 1997, 1998 and preliminary results of the 1999 survey. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 2000/ACFM:5.

Uriarte, A., Prouzet, P. and Villamor, B. 1996. Bay of Biscay and Ibero Atlantic anchovy populations and their fisheries. Sci. Mar., 60 (Supl. 2): 237-255.

Uriarte, A. and Villamor, B. 1993. Effort and CPUE of the Spanish purse-seine fisheries of Anchovy in spring. WD for the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES, C.M. 1993/ Assess:19.

Vasilyev D.A. 1998. Separable Methods of Catch-at-age Analysis From Point of View of Precautionary Approach. ICES Study Group on the Precautionary Approach to Fishery Management (Copenhagen, 3-6 February 1998). Working Paper N 11. 7 pp.

Vasilyev D. 1998a. Separable cohort procedures with internal property of unbiasness of the solution. ICES C.M. 1998 / BB:3, 11 pp.

Vasilyev D. 2000. Actual problems of analysis of fish stock and fishery parameters. VNIRO Publishing, 2000. 265 p. (in Russian)

15 ABSTRACTS OF WORKING DOCUMENTS

Abaunza, P., Fariña, A. C., Murta, A.

Applying Biomass Dynamic Models to the southern horse mackerel stock (Atlantic waters of Iberian Peninsula). A comparison with VPA-based methods. WD 2000.

Document available from: Pablo Abaunza, Instituto Español de Oceanografía. Apdo: 240, 39080 Santander, Spain. Email: pablo.abaunza@st.ieo.es

The horse mackerel, an important target species in the fisheries of the Northeast Atlantic, is currently subject to assessment and management programmes in the ICES area. The current method used in the stock assessment of the Southern horse mackerel is based on VPA, using time series of catch-at-age data and CPUE from 1985 to present. The application of biomass-dynamic models to the assessment and catch prediction of this stock was never attempted before. In this paper, a production model was applied to the Southern horse mackerel stock. To quantify uncertainty in parameter estimates bootstrap confidence intervals were computed, which showed that estimates could be looked as reliable. The bootstrap standard deviations of Ft, r, q, MSY and F_{MSY} were not very high, despite the lack of trends in the effort series available. The current level of fishing mortality for 1998 was estimated inadequate for the sustainability of the resource, being well above F_{MSY} according to the biomass-dynamic models, and above F_{pa} according to the age-structured model. Both models showed a good agreement in the evolution of fishing mortality and in the perception of the state of the stock. Differences existed in the evolution of biomass estimates especially through the last years, in which the age-structured model showed an increasing trend. The estimates of MSY and F_{MSY} were in accordance with the precautionary approach philosophy. The biomass-dynamic model used here proved useful to be applied to the Southern horse mackerel stock, giving complementary information to the age-structured model, both in the perception of the state of the stock and in the definition of management targets.

Abaunza, P., Murta, A., Teia, A., Molloy, J., Nascetti, G., Mattiucci, S., Cimmaruta, R., Magoulas, A., Sanjuan, A., MacKenzie, K., Iversen, S., Dahle, G., Gordo, L., Zimmermann, C., Stransky, C., Santamaria, M.T., Ramos, P., Quinta, R.

HOMSIR: An international project on horse mackerel stock identification research in the ICES area and in the Mediterranean Sea. WD 2000.

Document available from: Pablo Abaunza, Instituto Español de Oceanografía. Apdo: 240, 39080 Santander, Spain. Email: pablo.abaunza@st.ieo.es

The aim of this project is to assess the stock structure of the horse mackerel, which is an important target species in many north-east Atlantic and Mediterranean fisheries. The project will provide information currently lacking for an effective definition of horse mackerel stock boundaries, and will evaluate the status of the horse mackerel populations. The overall objective will be achieved integrating the results from several techniques such as genetic markers, other biological tags like morphometric studies and the use of parasites, physical tagging and life history traits (growth, reproduction and distribution). The genetic stock assessment will be performed by means of five different genetic approaches comprising the analysis of allozymes, the mitochondiral DNA and the microsatellite DNA. The proposed research will therefore set-up and improved multi-disciplinary tool for fish stock identification, and an exhaustive knowledge of horse mackerel stock structure, in order to allow an enhanced management of horse mackerel resource in European Union waters in short, medium and long term.

Borges, M.F., Santos, A. M. P., Crato, N., Mendes, H. and Mota, B.

Sardine catches and climatic changes off Portugal in the last decades. WD 2000.

Document available from: Maria F. Borges, Instituto de Investigação das Pescas e do Mar (IPIMAR), Av. Brasília, 1449-006 Lisboa, Portugal. Email: mfborges@ipimar.pt

Decades changes have been observed in the annual catch of sardine. Long-term changes have also been observed in alongshore winds off Portugal in the last decades. During sardine spawning season, north winds that favour upwelling lead to unfavourable conditions for egg and larval survival.

By using time series analysis, we investigated the effect of NAO conditions on the recruitment strength of sardine population in the period from 1946-1991. We also investigated the time lag between recruitment strength and its turnout in catches.

Our time series retrospective analysis lead to the possibility of forecasting sardine recruitment by using key environmental variables – the winter wind conditions during winter. We conclude that when winter north wind overpasses a certain limit, then resulting recruitment is forced to a lower bound.

Borja, A.

Report on anchovy recruitment in the Bay of Biscay. WD 2000.

Document available from: Angel Borja, AZTI, Avda. Satrustegui nº8, 20008 San Sebastián, Basque Country, Spain. Email: aborja@azti.es

Recruitment of anchovy in the Bay of Biscay is related primarily with the March-July upwelling in the southern corner of the area and potentially with turbulence.

In this document are presents results used these assuming to derive an upwelling index and turbulence data, giving a consistent result for long time-series data from 1967 to 2000, when compared with recruitment series based on CPUE.

For the series between 1967 and 1995 the correlation between recruitment and upwelling explains about 59-63% of the variance. However when including the last three years, the explained variance falls to 50-56%.

Has tried to incorporate new data about turbulence from other areas and has found that the turbulence in 44ºN 4ºW has significant values in a multiple regression, increasing the explained variance in 11% for the long time series 1967-2000.

The new upwelling data obtained for year 2000 is 391, after two years of very low upwelling. This makes possible that the recruitment at age 0 for this year 2000 will be low.

Borja, A., Uriarte, A. and Egaña, J.

Environmental factors affecting recruitment of the mackerel, *Scomber scombrus L. 1758*, along the North-eastern Atlantic coasts of Europe. WD 2000.

Document available from: Angel Borja, AZTI, Avda. Satrustegui nº8, 20008 San Sebastián, Basque Country, Spain. Email: aborja@azti.es

Research group has studied successfully the relationships between some environmental processes (turbulence, upwelling, the North Atlantic Oscillation): and the recruitment of some Atlantic species, such as the anchovy, the bluefin or the albacore.

Results show that the southern pre-spawning migration pattern of the Atlantic mackerel is directed towards areas with low turbulence mixing at spawning time, providing a “stable environment”, for egg and larvae survival. In the southern areas, where the spawning starts, the turbulence conditions of pre-spawning and spawning periods has the largest influence on the success of recruitment; this is probably related to the more ‘stable’ weather in the subsequent months and for the remainder of the year. In contrast, in the northern areas, the role of turbulence over the whole of the year becomes increasingly more relevant; this is probably related to the high levels of turbulence during autumn and winter, which may become limiting to the survival of juveniles.

At least 48% of the variability in the Atlantic mackerel recruitment may be explained by means of environmental variables, such as turbulence and NAO. Other variables, such as upwelling, are not statistically significant; however, they are potential future areas of research.

Good recruitments are related with environmental conditions (mainly low turbulence) in the spawning areas and periods; similarly, with conditions during the subsequent months, up to the start of the following year.

Carrera P.

Acoustic survey PELACUS 0300 within the frame of pelasses: sardine abundance estimates. WD 2000.

Document available from: Pablo Carrera, Instituto Español de Oceanografía. P.O. Box 130, 15080 A Coruña, Spain. Email: pablo.carrera@co.ieo.es

This survey was the main activity of the PELASSES project. Part of the information got from this survey is still under treatment. Next steps will be the set up of the CUFES system and their calibration against the PairoVet tows; if this calibration was successful, DEPM would use CUFES as egg sampler, allowing a better coverage of the egg distribution area. As well as this calibration, new attempts for assessment aiming to improve the precision will be done by incorporating auxiliary variables such us Primary Production, egg distribution, etc.

First analysis of the available information revealed that:

a) The performance of the CUFES as anchovy and sardine egg sampler was good.
b) Sardine biomass increased but only in VIIIc.
c) No indication of a good 1999 year class was achieved
d) Sardine in VII was scarce, but the egg distribution was wider than that of the adults
e) In spring, anchovy is also present in VII Division
f) When mackerel is found with zooplankton masses, its biomass estimation could be over estimated.
g) 1999 mackerel year class seems to be good

In 2000, CUFES provided sardine and egg information from Gibraltar to the English Channel. Nevertheless, the spawning period of anchovy is narrower compared to that of sardine and it stars in mid May. Thus the number of anchovy eggs collected during this survey was low.

In VII, the most important fish species was sprat which was caught in almost of the fishing station. In this area sardine was scarce, in spite the wider but low density distribution of the eggs.

Mackerel use to be find associated with plankton layers. It seems to be possible distinguish the thick plankton layers from the mackerel, the problem arises when both are mixing in a single layer. It seems that the mackerel abundance was higher.

Chernook, V.I., Zabavnikov, V.B., Troyanovsky F.M. and Shamray E.A.

Preliminary Results of Complex Airborne Research Conducted by PINRO on Distribution and Biomass Estimation of Mackerel in 2000. WD 2000.

Document available from: Vladimir I. Chernook, Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, 183763, Murmansk, Russia. Email: inter@pinro.murmansk.ru

This working document presents the preliminary results of the Russian annual aierborne research carried out during summer 2000. These surveys covered the southern part of Norwegian Sea from 62° up to 72° N and between 18° W and 10° E.

Thermal, hydrodynamic and bioproductive processes in the Norwegian Sea were characterised by the late beginning of spring and summer processes.

Feeding migration of mackerel to the southern Norwegian Sea began by 7-12 days later compared to the usual pattern and was mainly of eastern.

Number of feeding "surface mackerel" reduced in the total abundance of the registered schools and the number of "deeper schools" in 5-20 m increased.

Costa, A. M.

Working Document. WD 2000.

Document available from: Ana Maria Costa, Instituto de Investigação das Pescas e do Mar, Avenida de Brasília, 1400, Lisboa, Portugal. Email: eamcosta@ipimar.pt

FILE NOT AVAILABLE

In this working document the final results of total fecundity and atresia of horse mackerel of the portuguese coast in 1998, determined with the histometric method are presents. Only tables and pictures are available.

Eltink, A., de Boois, I. and Wiegerinck, H.

Preliminary estimates of horse mackerel fecundity in 2000 and the planning of the fecundity sampling in 2001. WD 2000.

Document available from: Guus Eltink, RIVO-DLO, P.O.Box 68, 1970 AB IJmuiden, Netherlands. Email: guus@rivo.dlo.nl

Up to now horse mackerel has been assumed to be a determinate spawner.

In 1998 the horse mackerel fecundity was estimated much lower compared to earlier years. This was expected be due to exceptional early spawning in 1998 and it was assumed that spawning fish had been used for the fecundity estimation. An important fact is that horse mackerel can not easily be recognised in histological slides of the ovaries as having spawned in the current season. This is caused by the long time interval between two batches of spawning. It is that long that the post-ovulatory-follicles (POF's) can have disappeared before other stages of spawning activity (migrating nucleus stage, hyaline oocyte stage) appear. Therefore, fecundity sampling should be carried out before any spawning takes place, because as soon as spawning starts individual fish can not be identified any more as not having spawned yet.

In 2000 a small scale test sampling for fecundity was carried out as a test case for the sampling in 2001, which is the year in which the extensive international egg surveys will be carried out. The aim was to follow the changes in fecundity over time until the beginning of spawning season in order to estimate the most appropriate time for fecundity sampling. Results showed that fecundity was still low in March when spawning started, indicating that horse mackerel might an indeterminate spawner.

A sampling scheme for fecundity estimation has been proposed for the 2001 egg surveys based on the results of this test sampling in 2000.

Iversen S. A., Skogen M. and Svendsen E.

A prediction of the Norwegian catch level of horse mackerel in 2000. WD 2000.

Document available from: Svein A. Iversen, Institute of Marine Research, P.O.Box 1870, Nordnes, 5817 Bergen, Norway. Email: sveini@imr.no

Norway has since 1987 been the main fishing nation for horse mackerel in the northern part of the North Sea and Norwegian Sea. This fishery is carried out in the Norwegian economical zone in the second half of the year. This fishery is considered to exploit the western stock. It is shown that there is good correlation between the modelled winter influx of Atlantic water to the North Sea and the catch levels of horse mackerel in The Norwegian purse seine fishery the following autumn. The modelled inflow in 1999 was calculated at 2.22 Sverdrup corresponding to a predicted catch of 42,000 t. The actual Norwegian catch in 1999 was 46,600 t. The modelled inflow of Atlantic water the first quarter of 2000 was 2.4 Sverdrup corresponding to a predicted catch of 60,000 t.

Marques V.

Sintesis of the Portuguese Acoustic Surveys in the ICES Sub-Area IXa, carried out in November 1999 and March 2000. WD 2000.

Document available from: Vítor Marques, Instituto de Investigção das Pescas e do Mar, Avenida de Brasília, 1449-006, Lisboa, Portugal. Email: vmarques@ipimar.pt

This paper presents the main results of the Portuguese acoustic surveys carried out during November 1999 and March 2000. These surveys covered the Portuguese continental shelf and the Gulf of Cadiz waters.

About 35 % of the Gulf of Cadiz area were not covered, in March 2000 survey, due to bad weather.

Sardines juveniles were predominant between Caminha and Nazaré (OCNorte zone). Between Nazaré and Cabo da Roca adults were predominant. In front of Lisbon, between Cabo da Roca and Cabo Espichel, mainly juveniles were fished. From South of Cabo Espichel and V. Real de Santo António, only sardine adults were captured. In Gulf of Cadiz the fishing samples are bimodal with a class of little juveniles and another adults class.

Millan, M. and Ramos, F.

Preliminary estimates of catch in numbers, mean weight- and mean length at age in the 1996-1999 Spanish landings of Gulf of Gadiz anchovy (Sub-division IXa South). WD 2000.

Document available from: Milagros Millán, Instituto Español de Oceanografía. Unidad de Cádiz. Puerto pesquero, Muelle de Levante s/n, P.O. Box 2609, 11006 Cádiz, Spain. Email: milagros.millan@cd.ieo.es

This working document reports preliminary estimates of the age composition and mean length- and mean weight at age of the Spanish total landings of Gulf of Cadiz anchovy for 1996-1999. Age readings were carried out on 4 754 otoliths, which were monthly collected throughout the 4-year period, and assuming 1 January as birthday. As previously stated (EFAN otolith exchange exercise), the identification of true annual rings showed specially difficult due to the presence of many false marks, which are laid down with some degree of periodicity (spring and/or summer hyaline rings). During the analysed period, the Gulf of Cadiz anchovy fishery was based on the fishing of 0, 1 and 2 age-group anchovies, the 1-year-old ones being the better represented and the 2 year-old fish the less. The success of the Gulf of Cadiz anchovy fishery largely depends on the strength of the year class. Thus, the data support that the historical maximum of landings reached in 1998 is explained by a probable exceptional strength of the 1997 year class and the good recruitment to the fishery in that year. Intra- and inter-annual variations of both the mean length- and weight at age are also documented.

Morais A.

Abundance Estimation, Biological Aspects and Distribution of Anchovy (Engraulis encrasicholus) in Portuguese Continental Waters and the Bay of. WD 2000.

Document available from: Alexandre Morais, Instituto de Investigação das Pescas e do Mar (IPIMAR), Av. Brasília, 1449-006, Lisboa, Portugal, Email: amorais@ipimar.pt

This work presents results from two acoustic surveys in the Portuguese area and Bay of Cadiz carried out in November 1998 and March 1999 with R. V. "Noruega". This working document provides abundance estimates of anchovy (Engraulis encrasicholus) by length classes and its distribution in the survey area. It also describes some aspects of anchovy biology (Length-weight relationships and maturity-length ogives) in that area. Anchovy total estimated abundance was 33 thousand tonnes (2.5 x 106 individuals) in November 1998 and 25.5 thousand tonnes (2.1 x 106 individuals) in March 1999. In both surveys, more than 90% of the total biomass estimated was present in Cadiz. The maturity data obtained during the November 1998 survey shows significant differences between the Portuguese Occidental shelf and the area of Algarve and Bay of Cadiz. Finally, in both surveys rare demersal formations of dense anchovy concentrations were observed at moderate depths (50-90 m) in the Bay of Cadiz.

Murta, A. and Abaunza, P.

Has horse mackerel been more abundant than it is now in Iberian waters? WD 2000.

Document available from: Alberto Murta, Instituto de Investigação das Pescas e do Mar, Avenida de Brasília, 1449-006, Lisboa, Portugal. Email: amurta@ipimar.pt

According to the assessments carried out by this working group, the horse mackerel biomass in the Atlantic waters of Portugal and Spain attained a maximum in 1998. From 1985 to 1998 the estimated biomass presents an increasing trend. Nevertheless, historical catches around 2.5 times the current catch level were recorded between 1962 and 1978. This took us to suspect that in a broader time scale the biomass variation estimated from the assessment may have little meaning. Also, given the current catches, which are very low as compared with those from 1962 to 1978 there is the possibility of the stock to be severely depleted.

It is clear from the catch data, that the current catch level is not abnormally low when compared with the catches from the 1st half of the 20th century. The catches from 1962-1978 appear exceptionally high when looking to the whole time series.

Petitgas, P., Allain, G., Lazure, P.

A recruitment index for anchovy in 2001 in Biscay. WD 2000.

Document available from: Pierre Petitgas, IFREMER, BP 21105, F- 44311, Nantes, France, Email: Pierre.Petitgas@ifremer.fr

The IFREMER recruitment index is based on a multi-linear regression of the anchovy abundance on environmental indices. The anchovy abundance considered is the abundance at age 1 on january 1 of year y, as estimated by the ICES Working Group with the procedure ICA. The environmental indices are extracted from the hydrodynamic model of IFREMER for the french part of the continental shelf of Biscay. The period considered for constructing the environmental indices is march 1 to july 31 of year y-1.The regression model was adjusted using the values given in the 1998 report of the ICES Working Group. For predicting anchovy abundance at age1 for 1999, 2000 and 2001, environmental indices have been extracted from the hydrodynamic model and the regression model used in extrapolation mode. The prediction for 2001 is an average recruitment.

Prouzet, P.

An example of determination of harvest rules for the management of anchovy in the Bay of Biscay. WD 2000.

Document available from: Patrick Prouzet, Institute Français de Recherche pour l'Exploration de la Mer B.P. 3, 64310 St-Pée-sur-Nivelle, France. Email: prouzet@st-pee.inra.fr

A preliminary annual TAC (TAC1) applied on the first part of the year (n+1) from January to June and set to zero when the revised one is defined. This TAC should be based on the biomass estimates of the year (n) called B1(n) and the qualitative level of recruitment in September the year (n) called Rsept(n). So the preliminary TAC, call TACprelim is defined as Tacprelim= f(B1(n),Rsept(n)). The qualitative level of Rsept is based either on the value of the environmental index after Borja et al (WD 2000) (called upindex(1)),or the best of the two available environmental indexes {upindex(1) and upindex(2), the latter corresponding to the environmental index after Petitgas et al (WD 2000)}.

A revised final TAC operative over the second part of the year from June to December and based on the biomass assessed the year (n+1) called B2(n+1). So this TAC called revised TAC is defined as TACrevised = TAC2 = f[B2(n+1)].

Reid D.

Documenting changes in western mackerel migtration timing 1997-2000. WD 1999.

Document available from: David G. Reid, Marine Laboratory, P.O.Box 101, Victoria Road, Aberdeen AB11 9DB, Scotland, United Kingdom. Email: reiddg@marlab.ac.uk

The western mackerel undertakes a pre-spawning migration from the eastern North Sea, in the vicinity of the Viking Bank, to their spawning areas west of the British Isles and in the Bay of Biscay. In the 1970s and 1980s this migration occurred initially in the months of August and September. During this period the migration has been later and more off-shore. But 1997 the migration could be shown to start as late as the middle to the end of February. This WD presents evidence from an acoustic survey in January 2000 and assembled commercial data from 1997-2000 from a number of EU countries that the timing of migration is again changing. The main conclusion is that in 2000 the migration started much earlier than in previous years and that this may be part of a general ternd to earlier migrations.

It seems likely that there has been a major change in some aspect of the ocean climate to stimulate this change, although to date no obvious candidate has been implicated. This will be investigated.

Skagen D. W.

Trial assessment for NEA mackerel using ICA and AMCI. WD 2000.

Document available from: Dankert W. Skagen, Institute of Marine Research, P.O.Box 1870, Nordnes, 5817 Bergen, Norway. Email: dankert@imr.no

Assessment of the NEA mackerel has at times been problematic, since the only data available apart from catches at age are SSB measurements every third years. In last years Working Group a new programme AMCI was presented, which can make use of tag return data in addition to catches and SSB measurements. The program has been exxtended since then, and now offers a range of options for combining different kinds of information from different sources, into an assessment of a fish stock. The program includes a self contained parametric model for the population, functions for describing the relations between the population and the observations, and a selection of measures of the deviations of modelled data from the observations. The document gives a short description of the program and the options that are possible. Some trial runs are presented, showing that in general, the assessment is quite robust to model formulations.

Stratoudakis, Y. And Fryer, R.

Adult survey design and implications for sardine (Sardina pilchardus) DEPM estimation off Portugal. WD 2000.

Document available from: Yorgos Stratoudakis, Instituto de Investigção das Pescas e do Mar, Avenida de Brasília, 1449-006, Lisboa, Portugal. Email: yorgos@ipimar.pt

In the absence of adequate model-based estimators, estimation of spawning biomass from the Daily Egg Production Method (DEPM) is entirely based on the selected survey design, using design-based estimators. Judgement sampling and survey post-stratification have been recommended as ways of achieving sampling proportional to local fish densities and reliable estimation of spawning biomass when there are spatial differences in the DEPM adult parameters. Here, we discuss these concepts, demonstrate the impact of post-stratification on the DEPM estimation of sardine (Sardina pilchardus) spawning biomass off Portugal, and propose sensible designs for future surveys. Post-stratifying the Portuguese 1999 DEPM survey into two strata (western and southern) increases the SSB estimate by at least 100 Kt, nearly 50% more than the original (unstratified) estimate. This large difference led us to explore the impact of adult survey design and estimation in a simulation exercise. We constructed a series of populations consisting of two strata, in which fish abundance and mean spawning fraction in each stratum were allowed to vary widely, and where egg production, sex ratio and batch fecundity were assumed known without error. We then sampled each population using simple random sampling and various forms of stratified random sampling (allocation proportional to survey area, to fish abundance, and optimal allocation). Ignoring spatial structure in spawning fraction led to very biased and imprecise estimates of fish abundance. In the population scenario that most closely resembles the 1999 Portuguese DEPM survey, the bias was –25%, suggesting that unstratified estimation underestimates the true SSB. Stratified random sampling with allocation proportional and optimal allocation outperformed allocation proportional to area and were robust to moderate levels of misallocation. We believe that future adult surveys for DEPM would benefit by adopting an a priori stratified design, in which stratum effort is allocated according to the sardine abundance estimate from the most recent acoustic survey.

Uriarte A., Motos L., Santos M., Ibaibarriaga, L. and Prouzet P.

Estimates of spawning biomass of the Bay of Biscay Anchovy (Engraulis encrasicolus, L.) in 2000 and review of the assessment of biomass in 1994 and estimates in 1996 and 1999. WD 2000.

Document available from: Andres Uriarte, Instituto Tecnológico Pesquero y Alimentario, Avda. Satrustegui no.8, 20008 San Sebastián, Gipuskoa, Basque Country, Spain. Email: andres@rp.azti.es

This document includes the estimates arising from the 2000 May survey. Biomass estimate for this year was derived in May from the spawning area/biomass relationship using the extension of the spawning area found in survey and it was reported to STECF. Now the estimate of the SSB is based on its relationship with the spawning area (SA) and Daily egg production per surface unit (Po) which is the best model to estimate SSB. (EU project 96/034, ANNEX 5) and it is presented in this document.

Biomass estimates for 1996 and 1999 were derived from the spawning area/biomass relationship using the extension of the spawning area found during the 1996 and 1999 DEPM anchovy surveys, respectively. Additioally, SSN as a function of Po and Sa is presented. Changes on the results for 1994 involves modification for 1996 and 1999.

Uriarte, A., Villamor, B. and Martins, M.

Estimates of Catches at age of mackerel for the southern fleets between 1972 and 1983 and comparison of alternative procedures. WD 2000.

Document available from: Andres Uriarte, Instituto Tecnológico Pesquero y Alimentario, Avda. Satrustegui no.8, 20008 San Sebastián, Gipuskoa, Basque Country, Spain. Email: andres@rp.azti.es

Since 1995, ICES has acknowledged the necessity of carrying out a single assessment of mackerel for a population unit called Northeast Atlantic mackerel, putting together all European Atlantic mackerel (ICES CM 1996). The catches at age of mackerel caught in the western area are known since 1972, however the catches at age from the southern area are only known since 1984 and for this area total landings in tonnes are only known since 1977. Partly due to these reasons, so far the assessment of NEAM starts in 1984, whereas the assessment of the so called “western” mackerel goes back to 1972. ICES seeks for a complete historical perspective of the whole NEAM similar to the one produced for the western mackerel.

The current paper presents:

a) a recovery of statistical data since 1972 of the catches in tonnes produced by the southern fleets and landed in Spain and Portugal which have not previously been reported to the ICES Working Group.
b) An estimate of the catches at age of mackerel landed in the southern area covering the period 1972-1984, which is based on the fitting of separable models for the Divisions VIIIBC and IXa and
c) A comparison of the separable catch estimates with other simpler methods of estimating the corresponding catches at age for the southern area.

The aim of this effort is allowing for a complete historical perspective of the whole NEAM starting back in 1972, similar to the one produced for the western mackerel.

The idea of obtaining the unknown catches at age of mackerel from the southern fleets by a separable model comes from the procedures used by Cook and Reeves in 1993 to estimate unknown catches at age for certain years of the industrial fishery catches of Norway pout.

Vasilyev, D., Belikov, S. and Shamray E.

Tuning of natural mortality for Northeast Atlantic Mackerel. WD 2000.

Document available from: Dimitri Vasilyev, Federal Research Institute of Fisheries and Oceanography (VNIRO), 17 Verhne Krasnoselskaya, 107140, Moscow, Russia.

FAX: +7 095 264 9187

Spawning stock size estimates based on catch-at-age analysis for Northeast Atlantic Mackerel in recent years were generally lower than estimates based on egg surveys. The purpose of the this paper was to test the hypothesis that the above mentioned discrepancy may be caused by underestimated value of natural mortality (0.15), traditionally used in the assessment. Since it is always difficult to estimate the value of natural mortality together with other parameters of separable model it was decided to split the available information into two parts and to use catch-at-age data only for estimating of parameters of separable model (on this stage different values of M are taken as “known”). The estimates of SSB, based on egg survey, are used afterwards to choose the “best” value of M. A separable model named ISVPA was chosen for analysis of catch-at-age data because its minimization procedure, based on some principles of robust statistics, in some cases helps to produce unique solution using the catch-at-age data of real quality (high level of noise) without auxiliary information. The ISVPA-derived estimates of total biomass, SSB and recruitment are rather similar to results of ICA. The best fit with respect to egg survey SSB estimates was achieved for M=0.19.

Villamor, B. and Lucio, P.

A short note on the historical allocation by stocks of mackerel catches from divisions VIIIc and IXa. WD 2000.

Document available from: Begoña Villamor, Instituto Español de Oceanografía. Apdo: 240, 39080 Santander, Spain. Email: begona.villamor@st.ieo.es

This paper describes the cases of misreporting of the official Spanish catches from Division VIIIc in the early years of the western mackerel assessment. This note is an extract of the reports of the Mackerel Working Groups (1974-1995), Sardine Working Group and Pelagics in Division VIIIc and IXa and Horse Mackerel Working Group (1985-1988).

Zimmermann C.

Western Horse Mackerel: Short and Medium-Term Predictions by ADAPT 2000-2005. WD 2000.

Document available from: Christopher Zimmermann, Inst. Seefischerei, Palmaille 9, 22767 Hamburg, Germany. Email: zimmermann.ish@bfa-fisch.de

The aim of this working document is to document the short and medium term projections for this stock using the ADAPT-method, as these data are not included in the Working Group report. The same was done in the last two years (WD Sparre & Zimmermann, Working Group MHSA 1998, WD Zimmermann, Working Group MHSA 1999). The agreed predictions for the Western Horse Mackerel were calculated using diferent approaches and are given in Sec. 6.5 of the Working Group report.

Zimmermann, C., Kelly, C., Abaunza, P., Carrera, P., Eltink, A., Iversen, S., Murta, A., Reid, D., Silva, A., Uriarte, A., Villamor, B.

Whitelist on the functionality and properties of an input application for the submission and processing of commercial catch and sampling data within the ICES enviroment. WD 2000.

Document available from: Christopher Zimmermann, Inst. Seefischerei, Palmaille 9, 22767 Hamburg, Germany. Email: zimmermann.ish@bfa-fisch.de

Historic data on catches and sampling of commercial catches at a disaggregated level and the subjective decisions to fill in missing information by the species co-ordinators have not been well documented by the different ICES Working Groups in the past. There was also no consistent storage of the disaggregated data at ICES. The need for changing this was stated by several ICES groups and defined in the ICES Code of Practice for Data Handling.

HAWorking Group and MHSA strongly recommended to ICES since 1998 that a standard application should be developed, preferably as a database-standalone, to ease data input, evaluation and documentation. This should be possibly used by all Working Groups, starting with the pelagics as soon as possible.

In late 2000, ICES stated that it intends to implement a standard system for data submission and storage, and asked the MHSA do produce a detailed list of the needed functionality of such an input application. The list presented here is the first attempt to support ICES in its effort to start with the development.