Advisory Committee on Fishery Management ICES CM 2003/ACFM:07

REPORT OF THE

Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy

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TECHNICAL MINUTES

Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy

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The assessments, made by WGMHSA were reviewed by a subgroup of ACFM members and the chair of the working group, who also presented the assessments. The working group is complemented for its effort to explore new methods, to discuss the ongoing scientific work and to document progress. Also the intention of the working group to improve the archiving of basic data is supported. A few general comments were made.

The report is quite large. This is in principle not a problem. However, the working group must be realise that, because of the timing of meetings of the working group and ACFM, the report is only a few days before the ACFM meeting available for reviewing. This means that there is ample time for the reviewers to consider the report.

Therefore, it would be very much appreciated if more attention would be given to standardisation of the lay out and presentation. For example, it would be very helpful to have for each stock a (text)table comparing this en last years assessments settings rather than a whole page explaining that the same or a different choice was made. Also standard graphs comparing the results with this years assessment with previous years would be helpful. For some stock this information was presented. It could also be considered to present the information, which is not required to come to the annual advice, to a different section in the report.

The check tables in section 1 are very useful and should be extended to all stocks assessed by the working group. It would be preferable to standardize these tables as much as possible.

The reviewers worked with a draft version of the report. In this version a number of graphs were missing. Other graphs were presented more than once (sardines ICA output). Also, especially in the western horse mackerel section, there was a mismatch in the table and figure numbering with the text.

NE Atlantic mackerel

The ICA assessment presented by the WG differs in a number of ways from the previous ones. Previously the egg surveys were used.

There was considerable discussion on the way the WG had used the result of the 2001 egg survey in the assessment. The increasing trend in the present ICA assessment has not changed compared to the previous assessment but is on a lower level now. It was questioned whether the use of absolute SSB from the egg survey in the tuning was the right procedure. The chair of the WG replied that there was too little contrast in the data to use the relative trend in the egg surveys. It was noted that most of the egg survey SSB estimates were above those estimated by ICA. This may be related to the arbitrary assumption of natural mortality in the assessment. Also it was noted that the SSB estimated by the ICA assessment does not follow the point estimates by the egg survey. It seems that the present assessment tries to adjust its SSB estimate to the most recent egg survey. Over the longer time period the stock has remained rather stable and the variation in the point estimates of SSB in the egg surveys is small (noise). If any significance would have been given to the different SSB estimates by the egg surveys the present increase in biomass in the ICA assessment is in contradiction with the decrease indicated by the latest egg survey. Other exploratory assessments were presented by the WG, largely confirming the main conclusions from the ICA assessment but also showing that a different trend in the more recent year might be possible. Although with reservations ACFM accepted the ICA assessment by the working group.

The three different methods appeared to give very similar results to the ICA assessment and gave some support to the treatment of the egg survey in the final. However, there were some subtle differences and a comparative plot of the results would have been very useful.

Presently, the egg survey is the only fishery independent information in the assessment. ACFM is of the opinion that a multi-annual management strategy should be developed. This stock is an suitable candidate for a multi-annual TAC (stable SSB, stable recruitment, well above Bpa and many age groups in the stock), however ACFM did not give a multi-annual advice this year because the associated risks were unknown. The WG is asked to come up with a proposal in 2003.

Other comments were that the map indicated that there was no sampling for mackerel by Portugal. It was also mentioned that underreporting may have been more significant than has been assumed.

In the plenary session of ACFM it was noted that the results of an assessment, using the same configuration accepted last year, were not presented in the report. This should be standard procedure, also when another model or configuration is preferred now. From a run, using the WG2001 configuration, available in the archives, ACFM noted that this would have lead to a different perception of development stock and fishing mortality. In comparison with 1998, SSB estimated by the egg surveys in 2001 decreased by 23%. SSB from the assessment using last years setting show a negligible change over the same time period, while the SSB in the assessment preferred by the WG shows an increase by 17% over the same period. The fishing mortality in 2001 by the assessment using last years configuration is estimated to be 0.3, which is 50% higher than in the accepted assessment. Although this seems to be high compared to other estimates in recent years, this is not impossible and observed before in pelagic stocks when large catches have been taken from a declining stock.

<u>Western horse mackerel (*Trachurus trachurus*) in Divisions IIa, IVa, Vb VIa, VIIa-c, e-k, NIIIa,b,d,e</u>

Given all the handicaps this assessment has experienced, this was considered to be a good assessment. Although the trend in SSB remains unchanged compared to previous assessments, the level of biomass estimates and fishing mortality change up and down every year, which leads to an unstable TAC advice. Although this assessment looks consistent with last year, the biomass estimates in recent year were about 25% higher resulting in a higher TAC advice than last year despite the stock is declining. The assessment uses the results of a triennial egg survey. Evidence is increasing that horse mackerel is an indeterminate spawner. The uncertainty about this puts extra doubt on the assessment. If horse mackerel is an indeterminate spawner, the choice by the WG to use of egg production as an index, instead of SSB biomasses derived from it, in the ICA assessment is possible the best to do. ACFM were not in a position to fully evaluate if the type if linear extrapolation used in this assessment was statistical sound approach. This approach remains a cause for serious concern to ACFM. The WG expressed a preference to re-establish the old Bpa of 500 000 tonnes. ACFM apologies to the WG for overlooking the reasoning for withdrawing the Bpa last year. This was because the point was made in ACFM plenary that there may have been two very different productivity regimes for this stock. Since the 82 year class entered the fishery recruitment may have been impaired in some way by the presence of this large year class. Now this year class has disappeared the stock may be in a very different productivity regime and recruitment to the stock could be very different. The arguments given as support were not all convincing. The estimate of the SSB of 500 kt by the egg survey in 1983 around the time the famous 1982 year class was spawned becomes doubtful when horse mackerel appears not to be a determinate spawner. Also the fact that the assessment is this year is close to this value is not convincing since the assessment was made up to do so. It was considered that the use of a precautionary fishery mortality reference point would probably be better.

Southern horse mackerel (*Trachurus trachurus*) in Divisions VIIIc and IXa

The XSA assessment is very problematic. The data are of poor quality. It was questioned whether bottom trawl cpue indices are representative for population abundance for pelagic stocks and whether XSA is the appropriate assessment tool for this stock. It was also noted that the information from the egg surveys has not been used in the assessment. The tuning series in the assessment show contradictory trends. This was noted by the WG. ACFM was of the opinion that a number of tuning series should not have been used because either they contain very little information (Spanish 8c east fleet) or had strong negative slopes (both Portuguese survey fleets). Also the basis for the use of the power model for age 0 and 1 was questioned. In this case a plot of the cpue numbers against the population indices would be useful to inspect. ACFM did not accept the assessment and recommends that the WG to improve the data and explore alternative models. Since the available information, including the egg survey, indicated that the stock is rather stable, the advice by ACFM was based on the average catches in recent years.

<u>North Sea horse mackerel (*Trachurus trachurus*) in Division IIIa eastern part, Divisions IVbc and VIId.</u>

No assessment is possible because of insufficient data. Also fishery independent is lacking. It was noted that the increase in juvenile fish in the catch in recent years may be cause by a relative strong year class 1998. Also the relative large catch numbers of the year classes around the 1998 year class may indicate that there are ageing problems.

Sardine in Divisions VIIIc and IXa

Although very technical this section was well written. ACFM appreciates the working group for the extensive exploration for of the data using different models and data sources. It was felt that a step forward was made in understanding some of the complex problems that are related to different signals in the data and the complex biology of this species. The use of different assessment models resulted in differences in the perception of historical evaluation of the stock. Last year the ICA assessment was accepted. Although the results of this years ICA assessment were quite similar to those of last year, the exploration of data, using AMCI has strengthen ACFMs doubt on the results of the ICA assessment. Although it was also uncertain about AMCI (little experience with the method, residuals not available) ACFM did not accept both assessments. The predictions following both assessments both indicated that the advised TAC by ACFM would not lead to a reduction in the estimated stock size.

Anchovy in VIII

The assessment is consistent with last years and was accepted. ACFM appreciates the use of alternative models like the Biomass Production Model in different configurations and of which the results support the ICA assessment. It was considered that the results of the Biomass Production Model is just as good as ICA and may be probably better. The environmental indices are not good enough to be used to predict incoming year classes. The catch predictions are very dependent on year class strength and since there is no information on the recruiting year class in the fishery in 2003, no meaningful prediction prediction could be made. The terms of reference of WGMHSA request for the evaluation of harvest control rules for anchovy fishing. This work is essential in order to be able to provide meaningful advice. Not much progress on the development of harvest control rules has been made in recent years. ACFM asks the working group to take this work op with priority. Time constraints prevented a discussion on reference points.

Anchovy in IXa

The available data are limited. Despite the working Group made an attempt to use the available data in a meaningful way. ACFM encourages the Working Group to continue to do this. The collection of additional supplementary data would be very valuable. In particular acoustic data, egg surveys and extending the short time series of data. Because of the short time span of anchovy and catches mostly consist of age 0-1, future assessments of the stock are not likely to be used for TAC predictions.

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1 INTRODUCTION

1.1 Terms of Reference

The **Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy** [WGMHSA] met at ICES Headquarters from 10–19 September 2002 to address the following terms of reference, as decided by the 89th Statutory Meeting:

a) assess the status of and provide catch options for 2003 for the stocks of mackerel and horse mackerel (defining stocks as appropriate);
b) assess the status of and provide catch options for 2003 for the sardine stock in Divisions VIIIc and IXa;
c) assess the status of and provide catch options for 2003 for the anchovy stocks in Sub-area VIII and Division IXa;
d) review progress in determining precautionary reference points;
e) for sardine update information on the stock identification, composition, distribution and migration in relation to oceanographic effects.
f) evaluate the conservation benefit of the western mackerel box, and the likely consequences for the western stock if the box were to be opened
g) continue the evaluation of harvest control rule for anchovy fishing.
h) provide specific information on possible deficiencies in the assessments including at least: Major inadequacies in the data on catches, effort or discards; major inadequacies if any in research vessel surveys data and major difficulties if any in model formulation; including inadequacies in available software. The Group should clarify the consequences from these deficiencies for a) assessment of the status of the stocks and b) for the projection;
i) for stocks for which a full analytical assessment is presented, comment on this meeting's assessments compared to the last assessment of the same stock;
j) consider the results presented in the reports of the WGMG and the SGPA with a view to apply these in the assessments;
k) review the draft Quality Handbook.

Terms of reference a – e, h and i are considered under the respective stocks. Given the ongoing process on revision of reference points in ICES, the WG has restricted itself to update calculations of the values of candidate reference points where possible, and where relevant, indicated to which extent the WG considers a need for revising the current reference points or establishing reference points. T.o.R f) is treated in Section 2.16. T.o.R g) would require intersessional work that had not been possible to perform for this meeting. T.o.R j) is not considered specifically in the report text. However, the WG put considerable effort into applying the experience from *i.a*. the WGMG and the SGPA, not the least through analysing the structural assumptions in the assessments. T.o.R k is considered in Section 1.5

The Working Group made a large number of trial assessment runs in its effort to find the most appropriate analysis of its data. The detailed outputs of these trial runs are in general not included in the report, but are documented in a separate folder in the WG files.

This year, an extensive revision of historic catch data for mackerel back to 1972 was made by a sub-group of the WG which met in conjunction with the WGMEGS, according to a recommendation by WGMHSA. Since this was an ad hoc initiative by the WG without a formal status as an ICES working group, its report is published as an annex to the present WG report, together with two Working Documents, which are an integral part of the documentation of the data revision.

Each year, a large number of Working Documents are presented to the Working Group. These documents are an important part of the background material for the work by the Working Group. Since there is no natural forum for presenting this information to the wider public, the intention by the Working Group is to include these documents on the electronic version of the report, which will be available on a CD-rom.

1.2 Participants

Pablo Abaunza	Spain
Bo Andersen	Denmark
Sergei Belikov	Russia
Miguel Bernal	Spain
Carryn Cunningham (part time)	UK (England and Wales)
Chris Darby	UK (England and Wales)
Leoni Dransfield	Ireland
Guus Eltink	Netherlands
Emma Hatfield	UK (Scotland)
Leire Ibaibarriaga	Spain
Svein A. Iversen	Norway
Jan Arge Jacobsen	Faroe Islands
Ciarán Kelly	Ireland
Alberto Murta	Portugal
Francois Poisson	France
Fernando Ramos	Spain
David Reid	UK (Scotland)
Beatriz Roel	UK (England and Wales)
Eugeny Shamrai	Russia
Alexandra Silva	Portugal
Per Sparre (part time)	Denmark
Dankert Skagen (Chair)	Norway
Andres Uriarte	Spain
Dimitri Vasilyev	Russia
Sieto Verver	Netherlands
Begoña Villamor	Spain
Christopher Zimmermann	Germany

1.3 Quality and Adequacy of Fishery and Sampling Data

1.3.1 Sampling data from commercial fishery

The Working Group again carried out a brief review of the sampling data and the level of sampling on the commercial fisheries. Sampling levels have increased for mackerel (to 83%) and are now back to the long-term average. The proportion of the horse mackerel catch which was sampled has increased this year but is still inadequate at 65%. Sardine stocks continue to be well sampled. Anchovy sampling has been inadequate for the past 2 years. A short summary of the data, similar to that presented in the most recent Working Group report is shown for each stock. Sampling programmes by EU countries have been partially funded under the new EU sampling directive (Council Regulation EEC N° 1543/2000) in 2001 and it is hoped that this will continue to improve sampling levels.

The sampling programmes on the various species are summarised as follows.

__Mackerel__

Year	Total catch t	% Catch covered by sampling programme	Samples	Measured	Aged
1992	760,000	85	920	77,000	11,800
1993	825,000	83	890	80,411	12,922
1994	822,000	80	807	72,541	13,360
1995	755,000	85	1,008	102,383	14,481
1996	563,600	79	1,492	171,830	14,130
1997	569,600	83	1,067	138,845	16,355
1998	666,700	80	1,252	130,011	19,371
1999	608,928	86	1,109	116,978	17,432
2000	667,158	76	1,182	122,769	15,923
2001	677,708	83	1,419	142,517	19,824

In 2001 83% of the total catch was covered by the sampling programmes. This represents an increase since last year with Russian catches now being sampled. The number of sampled, aged, and measured fish has increased since 1997. Spain and Portugal continue to carry out an extremely intensive programme on their catches. Germany decreased the proportion of the catch sampled from 2000 and currently samples only 36% of the catch; in addition there were small decreases in the proportion of the catch sampled in Denmark, England, and Ireland. Norway, Portugal, Scotland, Spain, and the Netherlands continue to sample the entire catch thoroughly. The countries with significant catches which did not carry out any sampling programmes in 2001 again included France, Faroes, and Sweden (these countries accounted for almost 50,000 t of unsampled catches).

There were more areas than in previous years which do not appear to be adequately sampled:

- Subarea III, in which 1,561 t are taken but where no sampling is carried out
- Div. VIIIa, where 1,703 t are taken but where no sampling is carried out
- Div. Vb, where 1,647 t are taken but inadequately sampled
- Div. IVb, where 2,038 t are taken but inadequately sampled
- Div. IVc, where 2,321 t are taken but inadequately sampled
- Div. VIIc, where 1,957 t are taken but inadequately sampled
- Div. VIId, where 6,446 t are taken but inadequately sampled
- Div. VIIe, where 15,618 t are taken but inadequately sampled
- Div. VIIh, where 3,576 t are taken but inadequately sampled
- Div. VIIj, where 42,512 t are taken but inadequately sampled

See Figures 1.3.1.1 and 1.3.1.2 for a map of sampling levels relative to catch.

The summarised details of the more important mackerel catching countries are shown in the following table.

Country	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
Belgium	98	0%	0	0	0
Denmark	22,522	75%	9	471	471
England & Wales	25,868	28%	31	3,924	978
Estonia	219	0%	0	0	0
Faroe Islands	24,005	0%	0	0	0
France	20,956	0%	0	0	0
Germany	25,307	36%	23	11,000	597
Ireland	70,452	72%	56	6,638	2,217
NORWAY	180,595	100%	150	15,395	1,603
Portugal	3,119	100%	339	30,415	650
Russia	41,568	100%	238	21,901	1,201
Scotland	163,940	98%	138	22,929	6,567
Spain*	44,142	100%	325	21,039	2,797
Sweden	5,098	0%	0	0	0
The Netherlands	36,096	100%	110	8,805	2,743
Total	663,986	83	1,419	142,517	19,824

*Unoffical catches

Horse Mackerel

The following table shows a summary of the overall sampling intensity on horse mackerel catches in recent years.

Year	Total catch t	% Catch covered by sampling programme	Samples	Measured	Aged
1992	436,500	45	1,803	158,447	5,797
1993	504,190	75	1,178	158,954	7,476
1994	447,153	61	1,453	134,269	6,571
1995	580,000	48	2,041	177,803	5,885
1996	460,200	63	2,498	208,416	4,719
1997	518,900	75	2,572	247,207	6,391
1998	399,700	62	2,539	245,220	6,416
1999	363,033	51	2,158	208,387	7,954
2000	272,496	56	1,610	186,825	5,874
2001	283,331	64	1,502	204,400	8,117

The overall sampling levels on horse mackerel appear to have remained at about the same intensity in recent years. The large numbers of samples and measured fish are due mainly to intensive length measurement programs in the southern areas. In 2001, 68% of the horse mackerel measured were from Division IXa.

Countries that carried out comprehensive sampling programmes in 2001 were Netherlands, Portugal, and Spain. Sampling intensity from Ireland was slightly higher than last year (66%). In 2001, Germany decreased their sampling intensity to 2% and UK (England and Wales) stopped sampling altogether. France, Denmark, and Scotland continue to take considerable catches but do not carry out any sampling programmes whatsoever. The lack of sampling data for large portions of the horse mackerel catch continues to have a serious effect on the accuracy and reliability of the assessment and the Working Group remains concerned about the low number of fish that are aged.

The following table shows the most important horse mackerel catching countries and the summarised details of their sampling programme in 2001.

Horse mackerel sampling

Country	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
Belgium	19	0.0	0	0	0
Denmark	23,424	0.0	0	0	0
UK (England+Wales)	10,429	0.0	0	0	0
France	16,841	0.0	0	0	0
Germany	12,461	2.0	7	654	193
Ireland	52,212	66.2	23	4,191	1,040
Norway	7,992	97.4	18	1,786	345
Portugal	13,760	96.3	992	138,749	1,198
Russia	16	0.0	0	0	0
UK (Scotland)	8,029	0.0	0	0	0
Spain	31,979	93.7	334	37,355	1,641
Sweden	114	0.0	0	0	0
The Netherlands	87,306	89.2	128	21,665	3,700
Total	264,582	64	1,502	204,400	8,117

∗ Unofficial catches

In spite of the improvement 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 horse mackerel sampling intensity for the western fisheries was as follows:

Country	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
Belgium	19				
Denmark	6,108	0			
England & Wales	7,096	0			
France	15,145	0			
Germany	12,231	2	7	654	193
Ireland	51,542	67	23	4,191	1,040
Norway	7,956	98	18	1,786	345
Russia	16	0			
Scotland	8,029	0			
Spain*	2,710	19	24	12,138	282
Sweden	68	0			
The Netherlands	73,439	86	79	15,889	2,475
Total	180,911	59	151	34,658	4,335

∗ Unofficial catches

The horse mackerel sampling intensity for the North Sea (IVbc, VIId, and the eastern part of IIIa) fishery was as follows:

Country	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
Belgium	19	0	0	0	0
Denmark	17,316	0	0	0	0
England & Wales	3,333	0	0	0	0
France	1,696	0	0	0	0
Germany	968	0	0	0	0
Ireland	670	0	0	0	0
Norway	36	0	0	0	0
Sweden	46	0	0	0	0
The Netherlands	13,867	100	49	5,776	1,225
Total	37,951	50	49	5,776	1,225

The sampling intensity for the Southern fishery was as follows:

Country	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
Portugal	13,760	96	992	138,749	1,198
Spain*	31,979	100	310	25,217	1,359
Total	45,739	99	1,302	163,966	2,557

∗ Unofficial catches

Sardines

The sampling programmes on sardines are summarised as follows:

Year	Total catch t	% Catch covered by sampling programme	Samples	Measured	Aged
1992	164,000	79	788	66,346	4,086
1993	149,600	96	813	68,225	4,821
1994	162,900	83	748	63,788	4,253
1995	138,200	88	716	59,444	4,991
1996	126,900	90	833	73,220	4,830
1997	134,800	97	796	79,969	5,133
1998	209,422	92	1,372	123,754	12,163
1999	101,302	93	849	91,060	8,399
2000	91,718	94	777	92,517	7,753
2001	110,276	92	874	115,738	8,058

The proportion of the catch covered by the sampling programme decreased slightly in 2001.

The summarised details of individual sampling programmes in 2001 are shown below. These catches cover area VII, VIII, and IXa.

Country	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
Spain*	30,262	100	*14,378*	*272,688*	2,520
Portugal	71,695	100	441	71,395	5,538
**England &Wales	0	0	0	0	0
Ireland	7,856	0	0	0	0
Germany	463	0	0	0	0
Total	110,276		*14,789*	*344,083*	8,058

* Unofficial catches
** This data needs to be checked

The overall sampling levels for sardine are adequate for areas VIIIc and IXa. Catches of sardine in VII should be sampled. There may also be catches of sardine by France in area VII which are not reported to the WG.

Anchovy

The sampling programmes carried out on anchovy in 2001 are summarised below. The programmes are shown separately for Subarea VIII and for Div. IXa. Sampling throughout Div's. VIIIa+b and VIIIc appears to be unsatisfactory. The second semester (42% of the international catch) is not sampled. A full sampling programme will be carried out by France in 2002 on catches in Div. VIII; however, this was not done in 2001.

The overall sampling levels for recent years are shown below:

Year	Total catch t	% Catch covered by sampling programme	Samples	Measured	Aged
1992	40,800	92	289	17,112	3,805
1993	39,700	100	323	21,113	6,563
1994	34,600	99	281	17,111	2,923
1995	42,104	83	?	?	?
1996	38,773	93	214	17,800	4,029
1997	27,440	76	258	18,850	5,194
1998	31,617	100	268	15,520	5,181
1999	40,156	100	397	33,778	10,227
2000	39,497	99	209	18,023	4,713
2001	49.247	58	317	28,615	4,683

The sampling programmes for France and Spain are summarised below.

Country	Division	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
France	VIII a, b	17,097	8	32	4461	500
Spain∗	VIII a	1,194	0	9	730	0
Spain∗	VIII b	6448	100	57	3607	899
Spain∗	VIII c east	15,410	95	154	10,590	1,928
Total	VIII	40,149	56	252	19,388	3,327

∗ Unofficial catches

The level of sampling for VIIIa catches by France should be improved in the future.

The sampling programmes for the fisheries in Div. IXa are summarised below.

Country	Division	Official catch t	% Catch covered by sampling programme	Samples	Measured	Aged
Spain∗	IXa	8,243	100	65	9,227	1,356
Portugal	IXa	855	0	0	0	0
Total	IXa	9,098	100	65	9,227	1,356

∗ Unofficial catches

No catches from Portugal were sampled for length and age in Division IXa in 2001.

1.3.2 Catch data

Recent working groups have on a number of occasions discussed the accuracy of the catch statistics and the possibility of large-scale underreporting or species and area misreporting. These discussions applied particularly to mackerel and horse mackerel in the northern areas.

For mackerel and horse mackerel it was concluded that in the southern areas the catch statistics appear to be satisfactory. In the northern areas it was concluded that since 1996 there has been a considerable improvement in the accuracy of the total landing figures, and this continues to be the case. The reasons for the improvement in catch statistics are given as tighter enforcement of the management measures in respect of the national quota and increasing awareness of the importance of accurate catch figures for possible zonal attachment of some stocks. In 2001 the misreporting of catches particularly from Division IVa into VIa appears to have increased again. The reason for this is unclear as the area is now open until 14th of February and the stock appears to be migrating to the western spawning area before this. Underreporting of catches because of transhipping of catches at sea has decreased in recent years because most of the catches are now landed to factories ashore.

In France there remains a problem in relation to the collection of all fishery statistics, particularly for mackerel and horse mackerel and sardine. The figures provided to this Working Group may be inaccurate.

Discarding information was reported to the WG this year (See Section 1.3.3. below).

1.3.3 Discards

Mackerel

Discarding of small mackerel has historically been a major problem in the mackerel fishery and was largely responsible for the introduction of the southwest mackerel box. In the years prior to 1994 there was evidence of large-scale discarding and slipping of small mackerel in the fisheries in Division IIa and Subarea IV, mainly because of the very high prices paid for larger mackerel (>600 g) in Norway for the Japanese market. This factor was put forward as a possible reason for the very low abundance of the 1991 year class in the 1993 catches in numbers-at-age. In these areas the difference in prices has decreased since 1994 and the Working Group assumed that discarding may have been reduced in these areas.

In some fisheries, e.g. those in Subareas VI and VII, mackerel is taken as a by-catch in the directed fisheries for horse mackerel. Reports from these fisheries have suggested that discarding may be significant because of the low mackerel quota relative to the high horse mackerel quota – particularly in those fisheries carried out by freezer trawlers. The level of discards is greatly influenced by the market prices and by quota. The Working Group would like to highlight the possibility that discarding of small mackerel may again become a problem in all areas, particularly if a strong year class enters the fishery.

As a result of an EU study on discard information from Norwegian and Scottish purse seine fisheries (completed in 1999) some age disaggregated data from the fisheries in the fourth quarter in area IVa was available to the Working Group from Scotland. This data was incorporated in the catch numbers-at-age and weight in the stock. Discard data is treated confidentially by the Working Group and is only shown by area in the report. Further studies on discards, funded under the PESCA programme and the CFP Study programme, are now being performed, and a small amount of information was made available in 2001 WG from Scotland. There is no final report from this study available yet.

An EU programme carried out by Spain studied the rate of discards of all species taken by the Spanish bottom trawl fleets, fishing in Sub-areas VI, VII, VIIIc, and IXa. The results of this study (Perez *et. al.* 1994) showed that the discard rates varied by species and by area and fishing fleet. The observed levels of discards were between 0.2% - 25.7% for horse mackerel, between 0.1% and 8.1% for mackerel, and less than 1% for sardine.

No updated discard information on discarding was available for 2001.

Horse Mackerel

Discarding of adult horse mackerel by the twin rig fleet in the North Sea may be a problem, but there is no information on the level of discarding.

Because of the potential importance of significant discards levels on the mackerel and horse mackerel assessments the **Working Group again recommends that observers should be placed onboard vessels in those areas in which discarding may be a problem. Existing observer programmes should be continued.**

Sardine

A paper was presented to the Working group on sardine slipping off Northern Portugal (Stratoudakis & Marçalo, in press). Observations onboard purse seiners demonstrated that the deliberate lowering of the net to allow pelagic fish to escape ("slip") was frequent off northern Portugal during the second semester of 2001. Some slipping occurred in 25 of the 30 trips observed, and the quantities slipped were significantly higher when the net was set on dense echo-sounder marks. During the 12 weeks of the study, the sampled fleet (9 vessels) landed 2196 tonnes and deliberately released an estimated 4979 tonnes (CV = 33.6 %). More than 95% of the total catch was sardine. Data provided by the skippers in the absence of onboard observers led to considerably lower estimates of slipped quantities. The main reason for slipping was daily quota limitations, although illegal size and mixture with unmarketable by-catch were also reported. These results alert to the existence and potential magnitude of slipping, although indications of large seasonal and regional variations make extrapolations to the entire fishery inappropriate.

Anchovy

As in the sardine fishery there are no estimates of discards in the anchovy fishery.

1.3.4 Age reading

Reliable age data are an important pre-requisite in the stock assessment process. The accuracy and precision of these data, for the various species, is kept under constant review by the Working Group.

Mackerel

The last ICES mackerel otolith reading workshop took place in 1995 (Anon., 1995), which showed (after re-analysing the age reading results in a new spreadsheet) an overall percentage agreement to modal age of 63% (range 52%-70%) and an overall precision (CV) of 9.5% (range 7.5% - 14.9%). The higher the CV, the greater the imprecision. Bias did not appear to be a problem (being relative bias because comparisons were made to modal age).

The 2001 otolith exchange (EU-contract SAMFISH 2000/2001) only included age readers from Spain, Portugal, the Netherlands, England and Scotland. The results showed a slight improvement with an overall percentage agreement of 67% (range 56%-79%). One would not expect this improvement in agreement, because the mean age in the 2001 sample was higher (7.5 years) compared to the 1995 sample (5.4 years). However, the overall precision was considerably worse in 2001 (CV=13.0%, range 12.0% - 19.5%) compared to 1995 (CV=9.5%, range 7.5% - 14.9%).

What did cause this much lower precision (higher CV) in the 2001 exchange? The otoliths of this exchange set were prepared in different ways, because each institute supplied 25 otoliths which were prepared according to the institutes standard otolith preparation technique. The age reading results were also examined by group of otoliths prepared by an institute in order to evaluate the different otolith processing techniques. The text table below shows the results based on the age readings of all readers reading all otoliths of all institutes:

Institute that prepared the otoliths	Percentage agreement to modal age	Precision CV (%)
RIVO	75.8	7.5
CEFAS	75.6	7.3
AZTI	66.7	14.8
IEO	66.6	10.2
IPIMAR	61.4	18.6
MARLAB	54.1	21.0

From the table above it is apparent that the otolith preparation method determines to a large extend the accuracy and precision of the age readings. It appears that the achieved precision might even have improved compared to the results of the 1995 workshop, if all otoliths for the 2001 otolith exchange had been prepared by CEFAS or RIVO.

Unfortunately this otolith exchange did not include all countries that are supplying age reading results to the assessment Working Group. Therefore, a more extensive otolith exchange is needed. This provides then also the possibility that the improved otolith processing techniques of some countries can be evaluated. It might be useful to give some institutes the possibility to provide 2 sets of 25 otoliths to be included in the otolith exchange, if they want two otolith processing methods to be compared.

The Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy recommends that institutes examine their otolith preparation technique for mackerel and that a new mackerel otolith exchange be carried out to evaluate the otolith processing techniques of all institutes that are providing age data to this Working Group.

Horse mackerel

The otolith exchange, carried out in 1996, showed a considerable bias in the age readings of the older ages. As a consequence an otolith workshop was held in Lowestoft in January 1999 (ICES 1999/G:16). Following discussion and comparisons there was improvement in the precision of age reading during the workshop. However, the underestimation of older age groups (bias), which is an accuracy error, could not be significantly improved on. The problem of underestimating the age of older fish was thoroughly investigated by an estimation of the effect of age-reading errors on the assessment (addendum of ICES 1999/G:16). It was concluded that the accuracy errors (bias) should be improved first before the precision would be improved, because both age-reading errors have an opposite effect on the estimates of fishing mortality and spawning stock biomass. The Workshop recommended to slice the whole otoliths of set K (last set used at workshop) according to the transverse-sectioned otolith processing technique and to stain these with the most suitable stain before an otolith exchange would take place among the most experienced readers. The Workshop regarded that this new processing technique might increase the visibility of the outer annual rings compared to the traditional broken/burnt technique and it might therefore reduce the bias in the older ages.

Improvements in the quality of the basic horse mackerel age data within the ICES area over the last 20 years is given in Eltink (2001) This document presented new results on age-reading comparisons from otoliths treated according the traditional broken/burnt otolith processing technique and according to the stained sliced transeverse-sectioned otolith processing technique. The results from the experienced age readers demonstrated that the processing technique of the sliced transverse sectioned otoliths could considerably reduce the bias in age reading and at the same time improve precision, when these were stained with a light woodstain called "Honey Pine Light Fast Stain"[1]. Reading stained sliced otoliths seems to be a major step forward in the process of getting good quality basic horse mackerel age data.

The Working Group encourages the further use of this promising otolith processing method. Age readers who start to apply this new processing method should first read a reference set of otoliths of known age processed according to this new method in order to estimate their precision and accuracy (bias) in the age reading before they read large quantities of otoliths of which the ageings are used for assessment purposes. In the future when more age readers apply this technique, otolith exchange will be needed.

Sardine

An otolith exchange for sardine was carried out in July 2000 within the framework of EU Project PELASSES to standardise age-reading criteria between project participants (Soares *et al*., 2002). A total of 359 otolith pairs were analysed from sardine samples collected in the spring acoustic surveys covering the area from the English Channel to the Gulf of Cadiz. Disagreement in age readings of young (age groups 1 and 2) and old fishes (from age group 4 onwards) and on otoliths from the southern areas (Algarve and Cadiz) were the main problems identified during the exchange and later discussed in a workshop. The consistency within readers was also checked during the workshop. Identification of the first annual ring was the main problem on younger ages and the study of first ring diameter in several cohorts and areas was recommended to minimise this problem. In older fish, discrimination of rings near the otolith edge caused most of the disagreements and the ability to distinguish these rings can be improved using a higher optical magnification. These difficulties are complicated in otoliths from the southern areas, due to the less clear structure and to the frequent occurrence of false rings. Since false rings are more evident in the antirostrum, readers are advised to use the rostrum for age assignment. A poor consistency within readers was observed and to minimise this problem, it is recommended that each reader regularly calibrates his age readings with a reference collection of otoliths. The present workshop outlined an improvement in sardine age-reading performance since the last otolith exchange with acceptable levels of agreement, precision, and accuracy for young individuals (age groups one to three). However, ageing older individuals with otoliths from the southern area and within reader consistency are still a matter of concern. Otolith exchanges should be carried out and complemented by the regular calibration of readings compared to a reference collection covering different areas and seasons.

Anchovy

During 2001 and 2002 and within the EU study project PELASSES (99/010) an exchange of otoliths and a workshop on age reading of anchovy otoliths from Subareas VIII and IXa took place coordinated by AZTI. The otolith exchange programme took place during Summer and Autumn 2001, based on which the precision of current ageing procedures was assessed and served as a starting point for the analysis and discussions of the workshop. The workshop was organised to standardise the age readings of anchovy and discuss the problems and difficulties for the age readings. The workshop took place in January 2002 in AZTI with participants from Portugal, France, and Spain (Uriarte *et al*., WD2002).

The precision of current ageing procedures was assessed through the exchange of otoliths. The sets of otoliths examined in the exercise were otoliths arising from the most recent monitoring of the fishery landings and from recent surveys, mostly during 2000 and 2001. Otoliths older than 3 years did not appear for Subarea VIII, and ages older than 2 seemed not to appear for Subdivision IXa. For the Bay of Biscay the average percentage of agreement across ages and readers (83%) and the average Coefficient of Variation (CV=30%) were rather low for a three-year-old fish. The major disagreements arise from the ageing of the oldest age groups (2 and 3). Ages 0 and 1 seem to be much better determined.

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[1] Supplier: Morrels Woodfinishes, UK; www.morrells-woodfinishes.com

For the Atlantic coasts and Bay of Cadiz anchovy otoliths a rather similar low precision has arisen: The average percentage of agreement across ages and readers was 84 % and the average CV was 40.8%. Otoliths in Division IXa are known to be rather difficult for age determination.

The major goal of the workshop was to identify major difficulties in age determination and standardise anchovy otolith ageing criteria for the Bay of Biscay and for Division IXa. For the former case AZTI's methodology for age determination was discussed and adopted by the workshop. For the second area suggestions on age-reading methodology and on further research were agreed.

After the workshop the general agreement achieved for the Bay of Biscay and Division IXa attained about 92 and 88% respectively.

A more complete description of the results of the exchange programme and workshop on anchovy otoliths is found in Section 10.3.

1.3.5 Biological data

The main problems in relation to other biological data, identified by the Working Group are listed by species.

Mackerel

The revision of the catch data by the SGDRAMA (see annex) necessitated a revision of the maturity ogive for NEA mackerel. This is because the maturity ogive for NEA mackerel is based on a weighting by the SSB's from the three components. Details of the changes in relative weighting and subsequent revision of the maturity ogive are given in the 2002 WD by Eltink, Villamor, and Uriarte. In addition the mean weights in the stock for NEA mackerel are based on the relative proportion of each component in the NEA SSB. Thus, the mean stock weights were revised also. Details of revisions to the NEA mean stock weights can also be found in the 2002 WD by Eltink, Villamor, and Uriarte.

Horse Mackerel

There is no new information on horse mackerel maturity. Information on the spawning nature of horse mackerel is now urgently required. This is a consequence of discussions at WGMEGS (2002) whereby it is now uncertain if horse mackerel is a determinate spawner. If this is the case SSB indices from the egg surveys will no longer be valid, and a different method will be needed to provide a fishery-independent index for this species (this is further discussed in Section 6.3.1).

Sardine

Work on a different definition of mature fish for the Daily Egg Production Method and the calculation of maturity ogives for analytical assessment, was presented to the 2000 WG. This work was done because of the persistence of doubts regarding the correspondence between the macroscopic and the microscopic maturity stage and also regarding the first development stage that should be considered in the definition of mature fish in each area. It was agreed at the 2000 WG that an intercalibration of the two maturity scales be carried out and that this serve as a basis for a common definition of mature fish. Some preliminary results were presented in the SGSBSA meeting held in Lisbon 2001, although more results from ongoing analysis are still expected and a common definition of mature fish was not still agreed.

1.3.6 Quality control and data archiving

Current methods of compiling fisheries assessment data. Information on official, area misreported, unallocated, discarded and sampled catches are currently recorded by the national laboratories on the WG-data exchange sheet (MS Excel; for definitions see text table below) and sent to the species co-ordinators. Co-ordinators collate data using the latest version of *sallocl* (Patterson, 1999) which produces a standard output file (*Sam.out*). However only sampled, official, WG and discards are available in this file.

There are at present no defined criteria on how to allocate samples of catch numbers, mean length and mean weight at age to unsampled catches, but the following general process is implemented by the species co-ordinators. Searches are made for appropriate samples by gear (fleet), area, and quarter, if an exact match is not available the search will move to a neighbouring area, if the fishery extends to this area in the same quarter. More than one sample may be allocated to an unsampled catch, in this case a straight mean or weighted mean of the observations may be used. If there are no samples available the search will move to the closest non adjacent area by gear (fleet) and quarter, but not in all cases. For example in the case of NEA mackerel samples from the southern area are not allocated to unsampled catches in the western area. It would be very difficult to formulate an absolute definition of allocation of samples to unsampled catches which was generic to all stocks, however full documentation of any allocations made are stored each year in the data archives (see below). It was noted that when samples are allocated the quality of the samples may not be examined (i.e. numbers aged) and that allocations may be made notwithstanding this. The Working Group again encourages national data submitters to provide an indication of what data could be used as representative of their unsampled catches.

Definitions of the different catch categories as used by the MHMSA WG

Official Catch	Catches as reported by the official statistics to ICES
Unallocated Catch	Adjustments to the official catches made for any special knowledge about the fishery, such as under- or over-reporting for which there is firm external evidence. (can be negative)
Area misreported Catch	To be used only to adjust official catches which have been reported from the wrong area. (can be negative). For any country the sum of all the area misreported catches should be zero.
Discarded Catch	Catch which is discarded
WG Catch	The sum of the 4 categories above
Sampled Catch	The catch corresponding to the age distribution

Quality of the Input data. Primary responsibility for the accuracy of national biological data lies with the national laboratories that submit such data. Each species co-ordinator is responsible for combining, collating, and interpolating the national data where necessary to produce the input data for the assessments. A number of validation checks are already incorporated in the data submission spreadsheet currently in use, and these are checked by the co-ordinators who in the first instance report anomalies to the laboratory which provided the data.

The working group acknowledges the effort some members have made to provide "corrected" data, which in some cases differ significantly from the officially reported catches. Most of this valuable information is gathered on the basis of personal knowledge of the fishery and good relations between the responsible scientist and the fishermen. The WG is aware of the problem that this knowledge might be lost if the scientist resigns, and asks the national laboratories to ensure continuity in data provision. In addition the working group recognises and would like to highlight the inherent conflict of interest in obtaining details of unallocated catches by country and increasing the transparency of data handling by the Working Group. This issue will have to be carefully considered in light of any future development by ICES of a standard platform to store all fisheries aggregated data.

The quality and format of input data provided to the species co-ordinators is still highly variable. Table 1.3.6.1 gives an overview of possible problems by nation. From this it can be seen that some nations have not or inadequately aged samples, others have not used the data input spreadsheet provided or not even submitted any data. This is regarded to be problematic for Denmark, England, the Faroes, France and Germany in the case of Mackerel; Denmark, England, France, Germany, Scotland and Sweden in the case of Horse Mackerel; and France and Portugal in the case of Anchovy. It has to be noted that in this respect the quality of input data has again slightly deteriorated as compared to last year. For Sardine, Ireland and Germany reported catches in the northern area (VIIIa, VII and VI) but did not sample their catch. There are indications that France and England & Wales may have significant catches in that area but do neither report nor sample these. This might become problematic if catches in this currently unregulated fishery continue to rise. This table will be updated again next year to continue to track improvements. For anchovy, a complex method of catch sampling based on stratifying by commercial size-categories is used. Although a documented programme such as *sallocl* is not used to combine these data it was felt that such a programme would not improve the quality of this data.

The Working Group documents sampling coverage of the catches in two ways. Sampling effort will be tabulated against official catches by species (as in this Section). Further, maps showing total catch in relation to numbers of aged and measured fish by area give a picture of the quality of the overall sampling programme in relation to where the fisheries are taking place (Figures 1.3.1.1 and 1.3.1.2).

Transparency of data handling by the Working Group and archiving past data. The current practice of data handling by the working group is unchanged since last year. Data received by the co-ordinators which is not reproduced in the report is available in a folder called "archives" under the working group and year directory structure. This archived data contains the disaggregated dataset, the allocations of samples to unsampled catches, the aggregated dataset and (in some cases) a document describing any problems with the data in that year.

Prior to 1997, most of the data was handled in multiple spreadsheet systems in different formats. These are now stored in the original format, separately for each stock and catch year. Table 1.3.6.2 gives an overview on data collected by Sept. 2002. It is the intention of the Working group that in the interim period until the proposed standard database is developed (see below) the previous years archived data will be copied over to the current year directory and updated at the working group. Thus the archive for each year will contain the complete dataset available. Further, it should be backed up on Compact Disk. The request by the WG for ICES to provide an archive folder was again not carried out, therefore the WG continues to create an archive by manually copying over all previously stored disaggregated and input data to the current WG folder. **The WG recommends again that archives folder should be given access only to designated members of the MHSA WG**, as it contains sensitive data.

The WG continues to ask members to provide any kind of national data reported to previous working groups (official catches, working group catches, catch-at-age and biological sampling data), to fill in missing historical disaggregated data. However, there was little response from the national institutes. **The WG recommends that national institutes increase national efforts to gain historic data, aiming to provide an overview which data are stored where, in which format and for what time frame.** The working Group still sees a need to raise funds (possibly in the framework of a EU-study) for completing the collection of historic data, for verification and transfer into digital format.

Review of recommended progress and future developments. During the last two years WGMHSA has pressed for the urgent need for a database-based input application for the handling of commercial catch and catch at age data. WGMHSA stated that this should preferably be developed under the auspices of ICES and meet the requirements of more than the pelagic groups in the ICES environment. It was the WG's opinion that this database could solve not only the immediate data handling problems, but also most of the quality control issues at the data input level, as raised by ICES in the draft of a Quality Control handbook (see section 1.5).

As ICES indicated its readiness to facilitate the development of this database, the WG decided to put only little effort in further improvements of the input spreadsheet and *sallocl* program. Work on the exchange spreadsheet used by the species co-ordinators included correction to cell formulas which calculate SOP comparison, the implementation of validation checks at the value entry point, and crosschecks on the data reported by sampled areas and disaggregated by statistical rectangle. It was noted again that considerable difficulties were encountered with the combination of the input spreadsheet and *sallocl*. These problems were due to non printing characters which are generated when csv files are produced by MS office localised to non-english versions, and non-printing characters created from the export of data to the exchange spreadsheet from database applications. In spite of the two previous WG's recommendations, ICES has not provided a facility to store relevant documentation and the most recent version of exchange sheets and programmes used to aggregate the data, allowing to download these items over the ICES web server.

This year, ICES announced that the issue of developing an input application for the handling of commercial data would be forwarded to the delegates (at ASC 2002) in this year to facilitate the long-awaited progress. The WG expresses its satisfaction with the steps now undertaken and, as it regards this as being still a matter of highest priority, offers any possible support. To speed up the development process, WGMHSA recommends to seek input of a number of different species co-ordinators early in the developmental process, and to make use of information and applications already available, such as the database developed within the EU project EMAS ("*VPAbase*", see ICES CM 2002/ACFM:6, Sec. 1.3.6, and Sparre *et al.* 2001). The database should also provide a solution to the archiving problem when stored on the ICES system, for example data could be submitted by each country over a web-enabled version, which would overcome the problem of users working off different versions of the application. However, given the confidential nature of some of this data, the security implications of such a solution would have to be addressed.

Table 1.3.6.1. Overview of the availability and format of data provided to the species co-ordinators and possible problems (e.g. inconsistencies, missing data) Grey fields in the last column indicate poor sampling level.

A. Mackerel

Country	Data supplied	Data exchange sheet	Aged Samples	Problems
Belgium	NO	-	-	NO
Denmark	YES	YES	YES	YES
England	YES	YES	YES	YES
Estonia	NO	-	-	NO
Faroes	YES	YES	NO	YES
France	NO	-	-	YES
Germany	YES	YES	YES	YES
Ireland	YES	YES	YES	NO
Netherlands	YES	YES	YES	NO
Norway	YES	YES	YES	NO
Portugal	YES	YES	YES	NO
Russia	YES	YES	YES	NO
Scotland	YES	YES	YES	NO
Spain	YES	YES	YES	NO
Sweden	YES	YES	NO	NO

B. Horse Mackerel

Country	Data supplied	Data exchange sheet	Aged Samples	Problems
Belgium	NO	-	-	NO
Denmark	YES	NO	NO	YES
England	YES	YES	NO	YES
France	NO	-	-	YES
Germany	YES	YES	YES	YES
Ireland	YES	YES	YES	NO
Netherlands	YES	YES	YES	NO
Norway	YES	YES	YES	NO
Portugal	YES	YES	YES	NO
Russia	NO	-	-	NO
Scotland	YES	YES	NO	YES
Spain	YES	YES	YES	NO
Sweden	NO	-	-	YES

C. Sardine

Country	Data supplied	Data exchange sheet	Aged Samples	Problems
France	NO	-	-	YES
England	NO	-	-	YES
Ireland	YES	YES	NO	YES
Germany	YES	YES	NO	NO
Portugal	YES	YES	YES	NO
Spain	YES	YES	YES	NO

C. Anchovy

Country	Data supplied	Data exchange sheet	Aged Samples	Problems
France	YES	-	YES	YES
Portugal	YES	-	NO	YES
Spain	YES	-	YES	NO

Table 1.3.6.2: Available disaggregated data for the WG MHSA per Sept. 2002
X: Multiple spreadsheets(usually xls); W: WG-data national input spreadsheets (xls);
D: Disfad and Alloc-outputs (ascii/txt)

Stock		Catchyear	Format			Comments
			X	W	D	
Horse Mackerel: Western and North Sea						
	HOM_NS+W	1991	X			Files from Svein Iversen, April 1999
		1992	X			Files from Svein Iversen, April 1999
		1993	X			Files from Svein Iversen, April 1999
		1994	X			Files from Svein Iversen, April 1999
		1995	X			Files from Svein Iversen, April 1999
		1996	X			Files from Svein Iversen, April 1999
		1997	X	W	D	Files from Svein Iversen, April 1999
		1998		W	D	Files provided by Pablo Abaunza Sept 1999
		1999		W	D	Files provided by Svein Iversen Sept 2000
		2000	X	W	D	Files provided by Svein Iversen Sept 2001
		2001	X	W	D	Files provided by Svein Iversen Sept 2002
Horse Mackerel: Southern						
	HOM_S	1992	X			WG Files on ICES system [Database.92], March 1999
		1996	X			Source?
		1997		(W)	D	WG Files on ICES system [WGFILES\HOM_SOTH], March 1999
		1998		W	D	Files provided by Pablo Abaunza Sept 1999
		1999		W	D	Files provided by Pablo Abaunza Sept 2000
		2000	X	W		Files provided by Pablo Abaunza Sept 2001
		2001	X	W		Files provided by Pablo Abaunza Sept 2002
North East Atlantic Mackerel						
	NEAM	1991	X			North Sea +Western WG Files on ICES system [Database.91], March 199
		1992	X			North Sea +Western WG Files on ICES system [Database.92], March 199
		1993	X			North Sea +Western WG Files on ICES system [Database.93], March 199
		1997		W	D	Files from Ciaran Kelly, April 1999
		1998		W	D	Files from Ciaran Kelly, Sept 1999
		1999		W	D	Files provided by Ciaran Kelly, Sept 2000
		2000		W	D	Files provided by Ciaran Kelly, Sept 2001
		2001		W	D	Files provided by Ciaran Kelly, Sept 2002
	Western Mackerel subset					
		1997		(W)	D	Files from Ciaran Kelly, April 1999; (W) contained in NEAM
		1998		(W)	D	Files from Ciaran Kelly, Sept 1999; (W) contained in NEAM
		1999		(W)	D	Files provided by Ciaran Kelly, Sept 2000; (W) contained in NEAM
		2000	X	(W)		Files provided by Guus Eltink, Sept 2001; (W) contained in NEAM
		2001	X	(W)		Files provided by Guus Eltink, Sept 2002; (W) contained in NEAM
	Southern Mackerel subset					
		1991	X			WG Files on ICES system [Database.91], March 1999
		1992	X			WG Files on ICES system [Database.92], March 1999
		1993	X			WG Files on ICES system [Database.93], March 1999
		1994	X			WG Files on ICES system [Database.94], March 1999
		1995	X			WG Files on ICES system [Database.95], March 1999
		1996	X			WG Files on ICES system [Database.96], March 1999
		1997	X	(W)		WG Files on ICES system [WGFILES\MAC_SOTH], March 1999
		1998	X	(W)		Files provided by Mane Martins; (W) contained in NEAM
		1999	X	(W)		Files provided by Begoña Villamor, Sept 2000; (W) contained in NEAM
		2000	X	(W)		Files provided by Begoña Villamor, Sept 2001; (W) contained in NEAM
		2001	X	(W)		Files provided by Guus Eltink, Sept 2002; (W) contained in NEAM
Sardine						
		1992	X			WG Files on ICES system [Database.92], March 1999
		1993	X			WG Files on ICES system [Database.93], March 1999
		1995	X			files provided by Pablo Carrera Sept 2001
		1996	X			files provided by Pablo Carrera Sept 2001
		1997		W	D	W for Portugal only, files provided by Pablo Carrera and Kenneth Patters
		1998		W	D	files provided by Pablo Carrera Sept 1999
		1999		W		files provided by Pablo Carrera Sept 2000
		2000		W	D	files provided by Pablo Carrera Sept 2001
		2001		W	D	files provided by Alexandra Silva, Sept. 2002
Anchovy						
	Anchovy in VIII	1987-95	X			revised data, all in one spreadsheet, provided by Andres Uriarte Sept 199
		1996	X			file provided by Andres Uriarte Sept 1999
		1997	X	W	D	files provided by Andres Uriarte Sept 1999
		1998	X	W		files provided by Andres Uriarte Sept 1999
		1999	X	W		files provided by Andres Uriarte Sept 2000
		2000	X	W		files provided by Andres Uriarte Sept 2001
		2001	X	W		files provided by Andres Uriarte Sept 2002
	Anchovy in IX					
		1992	X			files in WK3-format provided by Begoña Villamor Sept 1999
		1993	X			files in WK3-format provided by Begoña Villamor Sept 1999
		1994	X			files provided by Begoña Villamor Sept 1999
		1995	X			files provided by Begoña Villamor Sept 1999
		1996	X			files provided by Begoña Villamor Sept 1999
		1997	X	W		W for Spain only, files provided by Begoña Villamor Sept 1999
		1998	X	W		W for Spain only, files provided by Begoña Villamor Sept 1999
		1999	X	W		W for Spain only, files provided by Begoña Villamor Sept 2000
		2000	X	W		W for Spain only, files provided by Begoña Villamor Sept 2001
		2001	X	W		W for Spain only, files provided by Begoña Villamor Sept 2002

1.4 Checklists for quality of assessments

As a step in the direction of systematic documentation of the assessment procedures and quality, checklists as suggested by the HAWG (ICES 2000) were made for some of the stocks since 2000 and updated again this year (Tables 1.4.1-1.4.5).

1.5 Comments on the ICES quality control handbook

The WG was again asked to comment on the ICES quality control handbook (see Terms of reference: k). Last year, the WG elaborated extensively on its view to this initiative and has nothing substantially new to add to this (ICES CM 2002/ACFM:06). In the light of the little development the QC handbook has undergone in the last year, and that ACFM has been unable to review the comments of the different working groups, MHSA decided not to comment on this issue again. However, the group is prepared to revisit the topic whenever significant progress is visible.

Table 1.4.1. Checklist for North-East Atlantic mackerel assessments.

1. General

step	*Item*	*Considerations*
1.1	Stock definition	Assessments are now performed for mackerel *(Scomber scombrus)* over the whole distribution area. Stock components are separated on the basis of catch distribution, which reflects management considerations and different historical information for the components rather than on any biological evidence: Western component: spawning in Sub-areas and Div. VI, VII, VIIIabde, distributed also in IIa, Vb, XII, XIV; North Sea component: spawning in IV and IIIa (but as the North Sea component is almost non-existent, most of the catches in IVa and IIIa are considered as belonging to the Western component); Southern component: spawning in VIIIc and IXa. Possible problems with species mixing *(S. japonicus)* in the Southern part of the area.
1.2	Stock structure	
1.3	Single-/multi-species	Single-species assessments.

2. Data

step	*Item*	*Considerations*
2.1	Removals: catch, discarding, misreporting	Catch estimation based on official landings statistics and augmented by national collected additional information on misreporting and discarding. Discard information was only available for the Netherlands until 2001 when Scotland also provided information. Discarding is considered as a problem in the fishery. Misreporting is corrected by re-allocating catches from official reported areas to areas where catches were taken, based on additional information. Separation of the different mackerel stock components is on the basis of the spatial and temporal distribution of catches (see above).
2.2	Indices of abundance	
	Catch per unit effort	cpue (at age) information for the Southern area only.
	Gear surveys (trawl, longline)	Trawl surveys for juvenile mackerel gives recruit indices and distribution, currently not used for the assessment.
	Acoustic surveys	Experimental surveys in 1999 to 2002 by Norway, Scotland, Spain, Portugal, and France. These are not currently used in the assessment.
	Egg surveys	The triennial egg survey for mackerel and horse mackerel currently provides the only fishery-independent SSB estimate used in the assessment. The survey has been conducted in the western area since 1977, and in the southern area since 1992. In its present form the survey aims at covering the whole spawning time (January - July) and area (South of Portugal to West of Scotland) for both components since 1995. Applied method: Annual Egg Production Method. Similar egg surveys are also carried out on a roughly triennial basis in the North Sea, but these have only a partial spatio-temporal coverage and are not currently used in the assessment.
	Larvae surveys	None.
	Other surveys	Russian aerial surveys have been conducted annually in July since 1997 in international waters in the Norwegian Sea and in part of the Norwegian and Faroese waters (Div. IIa). This gives distribution and biomass estimates, not currently used in the assessment. The arial surveys now include Norwegian & Faroese participation.

Table 1.4.1 (Cont'd)

2.3	Age, size, and sex-structure: catch-at-age, weight-at-age, maturity-at-age, size-at-age, age-specific reproductive information	Catch-at-age: derived from national sampling programmes. Sampling programmes differ largely by country and sometimes by fishery. Sampling procedures applied are either separate length and age sampling or representative age sampling. Total number of samples taken (2001): 1,419; total number of fish aged: 19,824; total number of fish measured: 142,517. Weight-at-age in the stock: Western component; derived from the Dutch and Irish national sampling program (catches in March-May from Div. VIIj). Presented as point estimates without variances. Southern component: based on Spanish samples in the first half of the year in Div. VIIIc. North Sea components: constant value since 1984 (start of data series). Weighted by the relative proportion of the egg production estimates of SSB for the respective components (Western / Southern / North Sea: 61-85% / 13-21% / 2-21%, in 2001 85% / 12% / 3%). Weight-at-age in the catch: derived from the total international catch-at-age data weighted by catch in numbers. In some countries, weight-at-age is derived from general length-weight relationships, others use direct measurements. Maturity-at-age: based on biological samples from commercial and research vessels; weighted maturity ogive according to the SSB biomass in the three components (see above).
2.4	Tagging information	Used as indicator for the mixing of the Southern and Western components; used to estimate total mortality; for exploratory assessment runs (AMCI).
2.5	Environmental data	Not used.
2.6	Fishery information	Several scientists involved in the assessment of this stock are familiar with the fishery. Most major mackerel fishing nations have placed observers aboard the fishing vessels. Anecdotal information on the fishery may be used in the judgement of the assessment.

3. Assessment model

step	*Item*	*Considerations*
3.1	Age, size, length, or sex-structured model	*Current assessment model: ICA* *Exploratory analyses: AMCI & ISVPA*
3.2	Spatially explicit or not	No
3.3	Key model parameters: natural mortality, vulnerability, fishing mortality, catchability	Natural mortality: fixed parameter over years and ages (M=0.15) based on tagging data. Selection-at-age: Reference age 5 for which selection is set at 1. Selection at final age set to 1.2. One period of 10 years of separable constraint (including the egg survey biomass estimates from 1992 onwards). Population in final year: 13 parameters. Population at final age for separable years: 9 parameters. Recruitment for survivors year: Total number of parameters: 40 Total number of observations: 111 Number of observations per parameter: 2.8
	Recruitment	No recruitment relationship fitted.
3.4	Statistical formulation: - what process errors - what observation errors - what likelihood distr.	Model is in the form of a weighted sum of squares. Terms are weighted by manually set weights. Index for biomass from egg surveys gets a weight of 5 and each catch-at-age observation in the separable period contributes a weight of 1 except 0-group, which is down-weighted to 0.01. The survey biomass estimate was treated as absolute up to 1998. From 1999 to 2001 it was treated as an index. In 2002 it was again treated as absolute.
3.5	Evaluation of uncertainty: - asymptotic estimates of variance, - likelihood profile - bootstrapping - bayes posteriors	Maximum likelihood estimates of parameters and 95% confidence limits are given. Total variance for the model and model components are given, both weighted and unweighted (weighted is currently incorrectly calculated in the model). Several test statistics are given (skewness, kurtosis, partial chi-square). Historic uncertainty analysis based on Monte-Carlo evaluation of the parameter distributions.

Table 1.4.1 (Cont'd)

3.6	Retrospective evaluation	Currently no retrospective analysis is carried out. Two reasons: because it is not directly available within ICA and because the assumptions concerning the separable period have been very variable over recent years. It is recognised that the retrospective analysis would be useful. Historic realisations of assessments are routinely presented and form a direct overview on the changes in the perception of the state of the stock. These are presented for SSB, fishing mortality, and recruitment.
3.7	Major deficiencies	• reference age not well determined • selection at final age not well determined • separable period changes often • weighting for catch data much higher than for survey data (41 to 5) • weighting for survey indices and catch data are not related to variability in the data • correlation structure of parameters not properly assessed and presented • catchability of surveys is assumed constant over the years • area misreporting of catch is a minor problem • relationship between number of parameters, number of data points and total SSQ not addressed • simpler assessment models currently not evaluated • Assessment is over sensitive to recent survey SSBs

4. Prediction model(s) – SHORT TERM

step	*Item*	*Considerations*
4.1	Age, size, sex, or fleet-structured prediction model	Age-structured model, by fleet and area fished.
4.2	Spatially explicit or not	Not.
4.3	Key model (input) parameters	Stock weights-at-age: average from last 3 years Natural mortality-at-age: average from last 3 years Maturity-at-age: average from last 3 years Catch weights-at-age BY FLEET: average from last 3 years Proportion of M and F before spawning: 0.4 Fishing mortalities by age: From ICA Numbers-at-age: from ICA, final year in assessment; ages 2 to 12+ 0-group is GM recruitment whole period except last 3 years 1-group is GM recruitment applying mortality-at-age 0 Fishing mortalities by area (and age): *The exploitation pattern used in the prediction was the separable ICA F's for the final year and then re-scaled according to the ratio status quo F (last 3 years) and reference F ($F_{4\text{-}8}$). This exploitation pattern is subdivided into partial F's for each fleet using the average ratio of the fleet catch at each age for the last 3 years.*
4.4	Recruitment	Geometric mean over whole period except last 3 years.
4.5	Evaluation of uncertainty	Uncertainty in model parameters is NOT incorporated, though sometimes a limited number of sensitivity analyses may be performed, usually with regard to recruitment level.
4.6	Evaluation of predictions	Predictions are not evaluated retrospectively (this is tricky to do in terms of catches, but some evaluation in terms of population numbers-at-age should be done).
4.7	Major Deficiencies	*SSB estimates from egg surveys are only available every 3 years.* *Assessment/Prediction mismatch: The prediction model contains more detail (by fleet) than the assessment model (not by fleet). In particular, stock estimates are based on a separable model which is then treated in a non-separable way in the short-term predictions.* *Catch options: no unique solution for catches by fleet when management objectives are stated in terms of F_{adult} and $F_{juvenile}$. Need to impose further constraints (eg maintain proportions of catches between fleets), to find unique solution.* *No stochasticity/uncertainty reflected in short-term predictions.* Intermediate year: general problem – whether to use *status quo* F or a TAC constraint for intermediate year. Software: MFDP programme.

5. Prediction model(s) – MEDIUM TERM

step	*Item*	*Considerations*
5.1	Age, size, sex, or fleet-structured prediction model	Age structured.
5.2	Spatially explicit or not	No.
5.3	Key model parameters	*Model parameters as in short-term predictions. Exploitation pattern, numbers-at-age and corresponding CVs as estimated by ICA in the previous year assessment. Expected recruitments are based on the geometric mean computed from the time-series of estimated recruitments and its CV.*
5.4	Recruitment	An Occam stock recruitment relationship is fitted.
5.5	Evaluation of uncertainty	Stochastic forward projections are based on the Baranov catch equation incorporating uncertainty in the starting population numbers and recruitment as noted in point 2, 5.3.
5.6	Evaluation of predictions	Predictions are not evaluated post-hoc.
5.7	Major Deficiencies	The upper ranges of recruitments predicted are higher than any in historical record. This leads to over-optimistic trajectories of both SSB and catches in the medium term, with consequent under-estimation of the risks associated with the various management options. In 2002 the WG decided not to present results of medium-term projections until these problems have been solved.

Table 1.4.2. Checklist Southern Horse Mackerel Assessment

1. General

step	*Item*	*Considerations*
1.1	Stock definition	The southern stock is distributed in Divisions VIIIc an IXa. There are still uncertainties in the delineation of horse mackerel stocks in the Northeast Atlantic. The limit line for the separation between Southern and Western horse mackerel stocks is not clear and it is supported by scarce biological information. With the ongoing project on horse mackerel stock identification research (HOMSIR), it is expected to clarify the horse mackerel stock structure in the Northeast Atlantic.
1.2	Stock structure	
1.3	Single/multi-species	A single-speciessingle-species assessment is carried out

2. Data

step	*Item*	*Considerations*
2.1	Removals: catch, discarding, fishery induced mortality	Catches are included in the assessment. Catch reports are quite good and mis-reported catches and discards are negligible. During the assessment period the level of catches has never reached the TAC of 73 000 proposed for *Trachurus spp*. until 1999 (68 000 t in 2000 and 2001 and 2002). The lack of target species for the purse seiners, like anchovy and sardine, can produce an increase in the fishing mortality of the horse mackerel, as it happened in 1997, 1998 and 1999.
2.2	Indices of abundance	The following series of age-disaggregated indices are available: two series of bottom trawl surveys from 1985 onwards. Another series of bottom trawl surveys from 1989 onwards. The relationship between the indices and abundance is considered to be linear. There is also a three-year series (1995, 1998, 2001) of SSB estimates based on egg surveys.
	Catch per unit effort	Three series of cpue corresponding to three different bottom trawl fishing fleets are available. One from 1979 to 1990 and the other two from 1984 onwards. Data disaggregated by age are available from the two last ones.
	Gear surveys (trawl, longline)	Three series of Bottom trawl surveys are carried out in the distribution area (see Indices of abundance). Two of them cover the entire stock distribution area during the recruitment season (fourth quarter).
	Acoustic surveys	Information is available from acoustic surveys but not used in the assessment. Biomass estimates are considered to be underestimated, because the horse mackerel is also found close to the bottom blind area of the acoustic transducer.
	Egg surveys	Egg surveys have been carried out on a triannual basis since 1995.
	Larvae surveys	Some information from the egg surveys, but not used in the assessment.
2.3	Age, size and sex-structure: catch-at-age, weight-at-age, Maturity-at-age, Size-at-age, age-specific reproductive information	Biological sampling of the catches is considered to be good. Catch at age matrix is available from 1985. Age assignment is validated until age 12. There are no significative trends in the weight-at-age in the catch over the assessment period. Weight at age in the stock is considered to be constant over the assessment period, as it is also the case of the maturity ogive.
2.4	Tagging information	At the moment there is no available information from tagging.
2.5	Environmental data	Enviromental information is available from acoustic surveys and bottom trawl surveys. Satellite images can provide useful information on the dynamics of the aquatic systems based mainly in the estimation of the sea surface temperature. Preliminar multivariate analysis have shown a good fit among the recruitment strength and some enviromental conditions.
2.6	Fishery information	Horse mackerel is mainly caught by purse seiners and bottom trawlers. The catches are relatively uniform over the year, although the second and third quarter show relatively higher catches.

3. Assessment model

step	*Item*	*Considerations*
3.1	Age, size, length or sex-structured model	XSA. The model is tuned with two series of commercial fishing fleets and three series of bottom trawl surveys. In 2002 the WG revised some of the tuning fleets. The assessment period is from 1985 onwards.
3.2	spatially explicit or not	No.
3.3	key model parameters: natural mortality, vulnerability, fishing mortality, catchability	Fishing mortality and catchability. Natural mortality is set to a constant value.
	recruitment	No stock recruitment relationship is assumed. Recruitment estimates from XSA.
3.4	Statistical formulation: - what process errors - what observation errors - what likelihood distr.	No statistical formulation. Catch data is supposed error-free.
3.5	Evaluation of uncertainty: - asymptotic estimates of variance, - likelihood profile - bootstrapping - bayes posteriors	No evaluation of assessment uncertainty.
3.6	Retrospective evaluation	Yes.

4. Prediction model(s)

step	*Item*	*Considerations*
5.1	Age, size, sex or fleet-structured prediction model	Age. Using the short-term forecast and Y/R routines available in ICES. In 2001 WG and 2002 WG, the software MFDP and MFYPR was used for both purposes respectively.
5.2	Spatially explicit or not	No.
5.3	Key model parameters	Fishing mortality.
5.4	Recruitment	Geometric mean over the XSA model estimates at age 0 in the assessment period.
5.5	Evaluation of uncertainty	No.
5.6	Evaluation of predictions	No.

Table 1.4.3: Checklist - ANCHOVY VIII

1. General

step	Item	*Considerations*
1.1	Stock definition	The stock is distributed in the Bay of Biscay. It is considered to be isolated from a small population in the English Channel and from the population(s) in the IXa.
1.2	Stock structure	No subpopulations have been defined although morfometrics and meristic studies suggest some heterogeneity, at least in morfotipes.
1.3	Single/multi-species	A single-species assessment is carried out.

2. Data

step	*Item*	*Considerations*
2.1	Removals: catch, discarding, fishery induced mortality	Discards are not included but considered not relevant for the two fleets. The fishing statistics are considered accurate and the fishery is well known.
2.2	Indices of abundance	Series of surveys for DEPM and acoustic since 1987 (with a gap in 1993). Acoustic surveys since 1983 (although not covering all the years).
	Catch per unit effort	Series of catch per unit effort exist for the French trawlers and Spanish purse seine fleets (although not standardized) and are not used in assessment.
	Gear surveys (trawl, longline)	Surveys use pelagic trawls to sample the population mainly during the spawning period and in some cases (opportunistically) purse seining.
	Acoustic surveys	Series since 1989 (used in the assessment), there are several indexes available since 1983 but before the period of the assessment.
	Egg surveys	Daily Egg Production Method applied to estimate the SSB. Series since 1987-2002 with a gap in 1993. Estimates in 1996, 99 & 2002 are based on regression models of previous DEPM SSB on P0 and SA.
	Larvae surveys	Some sampling exists to know the larvae condition. And there are some experimental surveys on juveniles in 1999 and 2000.
2.3	Age, size and sex-structure: catch-at-age, weight-at-age, Maturity-at-age, Size-at-age, age-specific reproductive information	Biological sampling of the catches has been generally sufficient, except for 2000 and 2001. An increase of the sampling effort seems useful to have a better knowledge of the age structure of the catches during the second semester in the North of the Bay of Biscay. Age reading is considered accurate and cross reading exchanges and workshops have taken place recently between Spain and France (Uriarte WD2002). Otolith typology is made. Indirect validation with the fluctuation of the stock (2-year-old validation) is being prepared.
2.4	Tagging information	No tagging program.
2.5	Environmental data	Much information exists, particularly on the temperature, water stratification, upwelling index, etc. (Motos et al. 1996, Borja et al. 1996, 98, Allain et al. 2001). Currently a 3-Dimensional Hydrodynamic model is used to monitor the Bay of Biscay environment affecting anchovy recruitment (Allain et al. 2001) .
2.6	Fishery information	Two main fisheries. A Spanish purse seine fishery operating mainly in Spring and a French one using mainly pelagic trawling and operating mainly in winter, summer and autumn. A small fleet of French purse seiner fishery operates in the South of the Bay of Biscay (Spring) and in the North (2^{nd} half of the year).

Table 1.4.3 (Cont'd)

3. Assessment model

step	*Item*	*Considerations*
3.1	Age, size, length or sex-structured model	ICA is used with DEPM, Acoustic and age structure of the catches and the population.
3.2	Spatially explicit or not	No.
3.3	Key model parameters: natural mortality, vulnerability, fishing mortality, catchability	Natural mortality is set at 1.2. It is considered variable. Catchability for the DEPM index is set to 1 because it is assumed to be an absolute indicator of Biomass. Catchability of the acoustic survey is estimated. Separability of the fishing mortality by ages is assumed and fishing pattern is estimated.
	Recruitment	No stock recruitment relationship is assumed. However, below 18,000 tonnes a link between recruitment and spawning abundance is assumed.
3.4	Statistical formulation: - what process errors - what observation errors - what likelihood distr.	Accuracy of the data is not taken into account (No observation error). But a weighting factor allows the translation of the validity of the information so it can be used in the tuning of the assessment. Log normal errors assumed. Maximum likelihood estimates.
3.5	Evaluation of uncertainty: - asymptotic estimates of variance, - likelihood profile – bootstrapping - bayes posteriors	Asymptotic estimates of variances, by the inverse of the Hessian matrix. No explicit bootstrapping evaluation of the uncertainty.
3.6	Retrospective evaluation	Not done so far (2002).

4. Prediction model(s)

Step	*Item*	*Considerations*
4.1	Age, size, sex or fleet-structured prediction model	Deterministic age prediction models (too simplistic for this highly variable population) based on CEFAS deterministic projections (MFDP).
4.2	Spatially explicit or not	No.
4.3	Key model parameters	Recruitment at age 0 in the assessment year. Separable fishing mortality, Catch constraint for the assessment year.
4.4	Recruitment	Geometric mean or more precautionary levels, according to the complementary information that might be available to the WG. The use of environmental indices is in a state of refinement for future use.
4.5	Evaluation of uncertainty	Short term sensitivity analysis (Cook 1993) was used in 1999.
4.6	Evaluation of predictions	Not properly.

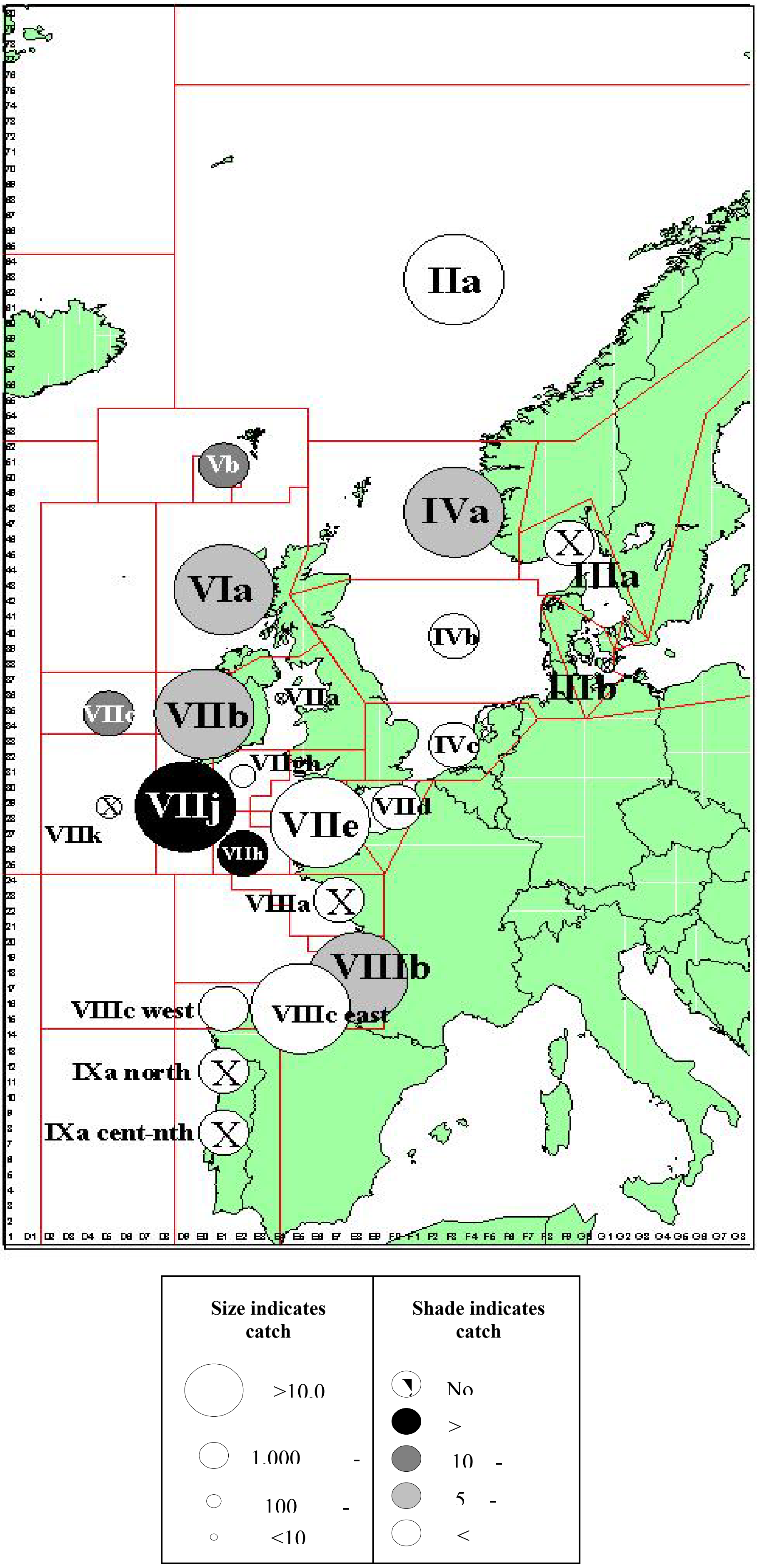


Figure 1.3.1.1 Sampling of mackerel for length in relation to tonnage landed by ICES Subdivision. Circle size indicates catch tonnage and shading indicates sampling level.

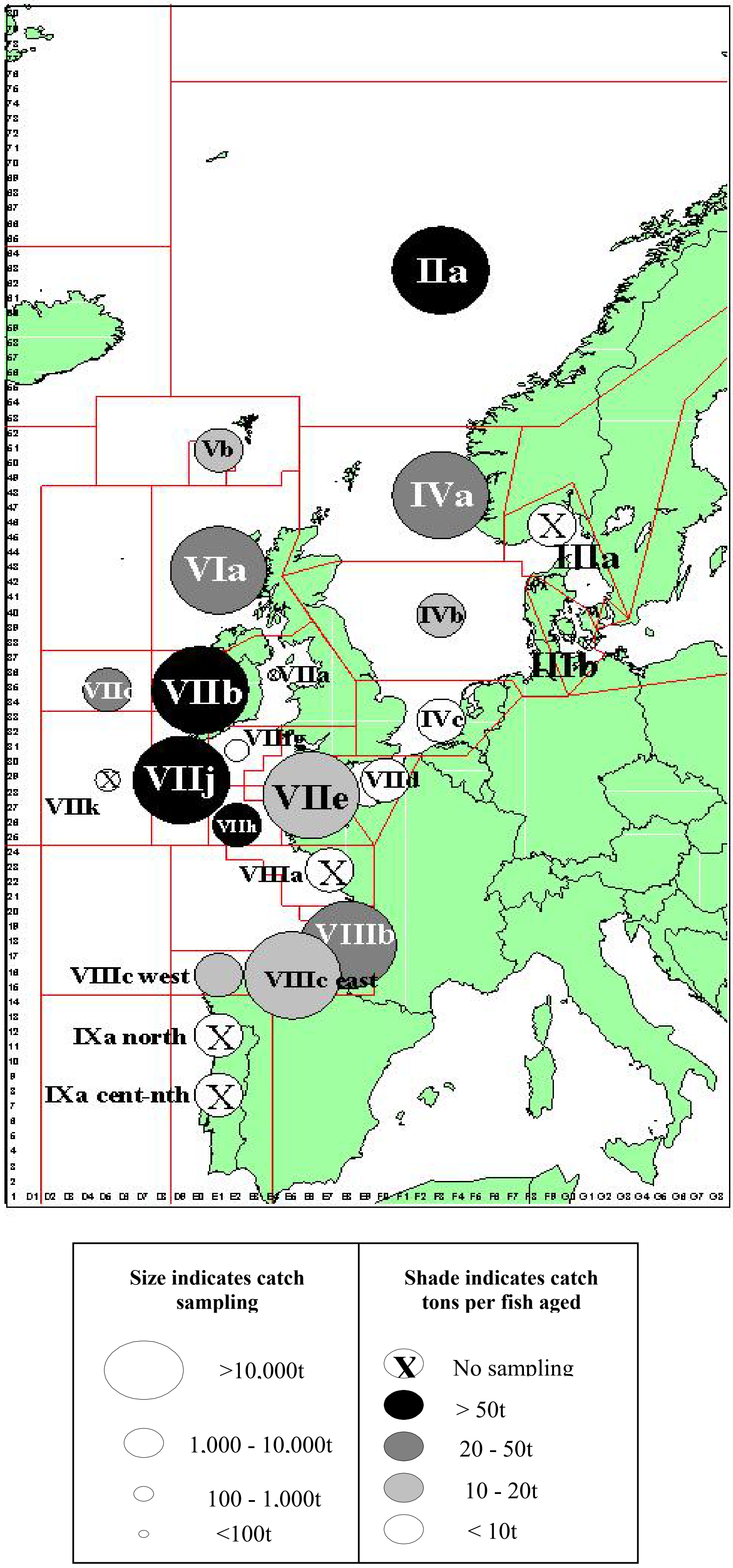


Figure 1.3.1.2 Sampling of mackerel for age in relation to tonnage landed by ICES Subdivision. Circle size indicates catch tonnage and shading indicates sampling level.

2 NORTHEAST ATLANTIC MACKEREL

2.1 ICES advice applicable to 2001 and 2002

For the second time (in 2001 and 2002) the international agreed TAC's cover the total distribution area of the Northeast Atlantic mackerel stock. The advice for this stock includes the three stock components: Southern, Western and North Sea mackerel. In parts of the year these components mix in the distribution area. The advised TAC is split into a Northern (IIa, IIIa,b,d, IV, Vb, VI, VII, VIIIa,b,d,e, XII, XIV) and a Southern (VIIIc, IXa) part on the basis of the catches the previous three years in the respective areas (Figure 2.1.1). The three components have overlapping distributions and part of the Southern component is fished in the northern area.

The different agreements cover the total distribution area of Northeast Atlantic mackerel, while each agreement in some cases covers different parts of the same ICES Divisions and Subareas. The agreements also provide flexibility of where the catches can be taken.

The TACs agreed by the various management authorities and the advice given by ACFM for 2001 and 2002 are given in the text table below.

Agreement	Areas and Divisions	TACs in 2001	TACs in 2002
Coastal states agreement (EU, Faroes, Norway)	IIa, IIIa, IV, Vb, VI, VII, VIII, XII, XIV	574,000	586,500
NEAFC agreement	International waters of IIa, IV, Vb, VI, VII, XII, XIV	54,050[1)]	53,900[2)]
EU-NO agreement[3)]	IIIa, IVa,b	1,865	1,865
EU autonomous[4)]	VIIIc, IXa	40,180	41,100
Total		669,995	683,365

Stock components	ACFM advice 2001	ACFM advice 2002	Areas used for allocations	Prediction basis	Catch in 2001
North Sea	Lowest possible level	Lowest possible level	IIa, IIIa, IV, Vb, VI, VII, VIIIa,b,d,e, XII, XIV	Northern	634,510
Western	Reduce F below F_{pa} = 0.17	Reduce F below F_{pa} = 0.17			
Southern			VIIIc, IXa	Southern[5)]	43,198
Total					677,708

1) NEAFC agreement was 65,000 t including 11,050 t not fished by any party.
2) NEAFC agreement was 66,400 t including 12,500 t not fished by any party.
3) Quota to Sweden.
4) Includes 3,000 t of the Spanish quota that can be taken in Spanish waters VIIIb.
5) Does not include the 3,000 t of Spanish catches taken in Spanish waters of VIIIb under the southern TAC.

The TAC for the Southern area applies to Division VIIIc and IXa, although 3,000 t of this TAC could be taken from Division VIIIb (Spanish waters), which is included in the Northern area. These catches (3,000 t) have always been included by the Working Group in the western component and are therefore included in the assessment for the Western area and the provision of catch options for that area.

For the years 1999–2002 a fishing mortality not exceeding $\mathbf{F}_{pa}$ = 0.17 was recommended, which in 2002 corresponds to a catch of less than 694,000 t.

In addition to the TACs and the national quota the following are some of the more important additional management measures which have been in force since 1998, and are again in force in 2001. These measures are mainly designed to afford maximum protection to the North Sea stock while it remains in its present depleted state, while at the same time allowing fishing on the western stock when it is present in the North Sea, as well as to protect juvenile mackerel.

1. Prohibition of fishing in Division IVa from 1 February to 30 June, and of a directed mackerel fishery in Divisions IVb and IVc throughout the year;
2. Prohibition of a directed mackerel fishery in the “Mackerel Box”;
3. Minimum landing size of 30 cm for Subarea IV, Division IIIa and 20 cm for Divisions VIIIc and IXa.

Various national measures such as closed seasons and boat quotas are also in operation in most of the major mackerel catching countries.

2.2 The Fishery in 2001

2.2.1 Catch Estimates

The total estimated catch in 2001 was about 678,000 t, which was about 10,000 t higher than the catch taken in 2000. The combined TAC's for 2001 amounted to 669,995 t (See Section 2.1.). The combined TAC for 2000 was 611,745 t. For the second time the TAC's set for 2002 covered all areas where mackerel is caught. The combined TAC's as best ascertained by the Working Group (Section 2.1) and agreed for 2002 amount to 683,365 t.

The total catch estimated by the Working Group to have been taken from the various areas is shown in Table 2.2.1.1. Revisions to the historical data series are shown in italics, these changes are further discussed in Section 2.5. This table shows the development of the fisheries since 1969. The historical catches reported in this table have been re-examined intersessionally (See Section 1.3). The highest catches (over 300,000 t) were again taken in Division IVa, where the total has increased by over 40,000 t since 2000. The catches, taken from Div. Vb and Subarea II (67,097 t), were over 20,000 t lower than recorded in 2000, and at a similar level to 1999. This decrease was mainly due to reduced Norwegian catches from IIa (-10,000 t), and reduced Russian catches in the Faroese zone (Vb, -7,500 t). The catch taken in Subarea VI decreased by almost 40,000 t to around 110,000 t, which is similar to 1998. Catches in Area VIII outside the southern area (VIIIc) increased by about 10,000 t, and the bulk of the catch was taken in VIIIb. This represents a shift in the fishery here where the catch was mainly taken in VIIIa last year. The catch in Subarea VII increased again by almost 17,000 t to about 117,000 t.

The catches taken in Divisions VIIIc and IXa increased from about 36,000 t to about 43,000 t, which is similar to the catch in 1998 & 1999 and higher than average catches in the period before 1998.

The total area misreported catch during 2001 as best ascertained by the WG was about 40,000 t, this is similar to the situation before 1999.

The quarterly distributions of the catches since 1990 are shown in the text table below. The distribution of the catches in 2001 is similar to the catch by quarter in 2000. There was a greater proportion of this catch taken the western area in the first quarter.

Percentage distribution of the total catches from 1990 - 2001

Year	Q1	Q2	Q3	Q4
1990	28	6	26	40
1991	38	5	25	32
1992	34	5	24	37
1993	29	7	25	39
1994	32	6	28	34
1995	37	8	27	28
1996	37	8	32	23
1997	34	11	33	22
1998	38	12	24	27
1999	34	9	30	27
2000	39	4	23	33
2001	38	7	25	30

The catches per quarter by Subarea and Division are shown in Table 2.2.1.6. These catches are shown per statistical rectangle in Figures 2.8.1.1 to 2.8.1.4 and are discussed in more detail in Section 2.8. It should be noted that these figures are based on details submitted in the official log books and may not indicate the true location of the stock. 38% of the total catch was taken during the 1st quarter as the shoals migrate from Div.IVa through Subarea VI to the main spawning areas in Subarea VII. The proportion of the total catch taken in Quarter 2 increased slightly to 7%. 25% of the total catch was taken during Quarter 3, this is a similar pattern as in 2000. The main catches in the second quarter were taken from the summer feeding areas in Division IIa and IVa. During Quarter 4, 30% of the total catch was taken mainly from Division IVa. The main catches of southern mackerel are taken in VIIIc (83%) and these are mainly taken in the first quarter. Catches from IXa, which comprise 17% of southern mackerel catches, are mainly taken in the first and third quarters.

National catches

The national catches recorded by the various countries for the different areas are shown in Table 2.2.1.2 - 2.2.1.5. As has been stated in previous reports these figures should not be used to study trends in national figures. This is because of the high degree of misreporting and "unallocated" catches recorded in some years due to some countries exceeding their quota. The main mackerel catching countries in recent years continue to be Norway, Scotland, Ireland, Russia, Netherlands and Spain. Significant catches also taken by Denmark, Germany, France, England, and Faroe Islands (combined catch 118,658 t), of these only Denmark, England, and Germany provide sampled catch data covering 32,766 t of this catch. France and the Faroe Islands take almost 45,000 t, but do not sample any catches.

The total catch recorded from Subarea II and Vb (Table 2.2.1.2) in 2001 was about 67,000 t, which was over 20,000 t less than in 2000. This reduction was due to reduced Norwegian catches in IIa and reduced Russian catches in the Faroese zone. The Russian catch from the international zone remained at a similar level. Again the WG was unaware of any misreporting of catches from IIa into IVa.

The total catch recorded from the North Sea (Subarea IV and Division IIIa) (Table 2.2.1.3) in 2001 was 312,004 t, which is about 40,000 t more than in 2000. Misreporting of catches taken in this area into VIa appears to have increased again. This misreporting does not appear to be caused by the presence of mackerel in IVa after the area closure on the 14th February. The main catches were recorded by Norway (158,401 t), while substantial catches were also recorded by the United Kingdom (50,165 t) and Denmark (21,680 t), the Faroese catch increased significantly to 18,571 t. Discards were again reported this year, but data on the age structure of the discarded catch was not available. The volume of discarded mackerel in the North Sea appears to have decreased sharply since 1998. The report on EU study (No. 99/071) should be reviewed to elaborate further on this. There were very small reported catches from IIIa.

The total catch estimated to have been taken from the Western areas (Table 2.2.1.4) was over 255,000 t. This is similar to the WG catch taken last year. However, the misreported catches from IVa appeared to have increased. The main catches continue to be taken by United Kingdom (139,589 t) and Ireland (60,168 t). The Netherlands (33,654 t), Germany (20,793 t), and France (18,975 t) continue to have important fisheries in this area.

The total catch recorded from Divisions VIIIc and IXa (Table 2.2.1.5) in 2001 was 43,198 t; this is similar to the catches in 1998 & 1999, but is about 7,000 t higher than the catches last year. The increase in the southern mackerel catches compared to 2000 was due to a return to normal effort from the main targeting fleet (handline), which did not encounter bad weather in April as in 2000.

Table 2.2.1.1 Catches of MACKEREL by area. Discards not estimated prior to 1978. (Data submitted by Working Group members.)

Year	Subarea VI			Subarea VII and Divisions VIIIa,b,d,e			Subarea IV and III			Subarea I,II & Divs.Vb[1]	Divs. VIIIc, IXa	Total		
	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Landings	Landings	Discards	Catch
1969	4,800		4,800	47,404		47,404	739,175		739,175	7	42,526	833,912	0	833,912
1970	3,900		3,900	72,822		72,822	322,451		322,451	163	70,172	469,508	0	469,508
1971	10,200		10,200	89,745		89,745	243,673		243,673	358	32,942	376,918	0	376,918
1972	13,000		13,000	130,280		130,280	188,599		188,599	88	29,262	361,229	0	361,229
1973	52,200		52,200	144,807		144,807	326,519		326,519	21,600	25,967	571,093	0	571,093
1974	64,100		64,100	207,665		207,665	298,391		298,391	6,800	30,630	607,586	0	607,586
1975	64,800		64,800	395,995		395,995	263,062		263,062	34,700	25,457	784,014	0	784,014
1976	67,800		67,800	420,920		420,920	305,709		305,709	10,500	23,306	828,235	0	828,235
1977	74,800		74,800	259,100		259,100	259,531		259,531	1,400	25,416	620,247	0	620,247
1978	151,700	15,100	166,800	355,500	35,500	391,000	148,817		148,817	4,200	25,909	686,126	50600	736,726
1979	203,300	20,300	223,600	398,000	39,800	437,800	152,323	500	152,823	7,000	21,932	782,555	60600	843,155
1980	218,700	6,000	224,700	386,100	15,600	401,700	87,931		87,931	8,300	12,280	713,311	21600	734,911
1981	335,100	2,500	337,600	274,300	39,800	314,100	64,172	3,216	67,388	18,700	16,688	708,960	45516	754,476
1982	340,400	4,100	344,500	257,800	20,800	278,600	35,033	450	35,483	37,600	21,076	691,909	25350	717,259
1983	320,500	2,300	322,800	235,000	9,000	244,000	40,889	96	40,985	49,000	14,853	660,242	11396	671,638
1984	306,100	1,600	307,700	161,400	10,500	171,900	43,696	202	43,898	98,222	20,208	629,626	12302	641,928
1985	388,140	2,735	390,875	75,043	1,800	76,843	46,790	3,656	50,446	78,000	18,111	606,084	8191	614,275
1986	104,100		104,100	128,499		128,499	236,309	7,431	243,740	101,000	24,789	594,697	7431	602,128
1987	183,700		183,700	100,300		100,300	290,829	10,789	301,618	47,000	22,187	644,016	10789	654,805
1988	115,600	3,100	118,700	75,600	2,700	78,300	308,550	29,766	338,316	120,404	24,772	644,926	35566	680,492
1989	121,300	2,600	123,900	72,900	2,300	75,200	279,410	2,190	281,600	90,488	18,321	582,419	7090	589,509
1990	114,800	5,800	120,600	56,300	5,500	61,800	300,800	4,300	305,100	118,700	21,311	611,911	15600	627,511
1991	109,500	10,700	120,200	50,500	12,800	63,300	358,700	7,200	365,900	97,800	20,683	637,183	30700	667,883
1992	141,906	9,620	151,526	72,153	12,400	84,553	364,184	2,980	367,164	139,062	18,046	735,351	25000	760,351
1993	133,497	2,670	136,167	99,828	12,790	112,618	387,838	2,720	390,558	165,973	19,720	806,856	18180	825,036
1994	134,338	1,390	135,728	113,088	2,830	115,918	471,247	1,150	472,397	72,309	25,043	816,025	5370	821,395
1995	145,626	74	145,700	117,883	6,917	124,800	321,474	730	322,204	135,496	27,600	748,079	7721	755,800
1996	129,895	255	130,150	73,351	9,773	83,124	211,451	1,387	212,838	103,376	34,123	552,196	11415	563,611
1997	65,044	2,240	67,284	114,719	13,817	128,536	226,680	2,807	229,487	103,598	40,708	550,749	18864	569,613
1998	110141	71	110,212	105,181	3,206	108,387	264,947	4,735	269,682	134,219	44,164	658,652	8012	666,664
1999§	98,666		98,666	93,821		93,821	299,798		299,798	72,848	43,796	608,929	0	608,929
2000*	150,927	1	150,928	113,520	1,918	115,438	271,997	165	272,162	92,557	36,074	665,075	2084	667,159
2001*	113,234	83	113,317	141,012	1,081	142,093	311,979	24	312,003	67,097	43,198	676,520	1,188	677,708

*Preliminary.

[1]For 1976–1985 only Division IIa. Subarea I, and Division IIb included in 2000 only

§ Discards reported as part of unallocated catches

NB Figures in gray are revised, the revisions are documented in the SGDRAMA Annex to this report

Table 2.2.1.2 Catches (t) of MACKEREL in the Norwegian Sea (Division IIa) and off the Faroes (Division Vb). (Data submitted by Working Group members.)

Country	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Denmark	11,787	7,610	1,653	3,133	4,265	6,433	6,800
Faroe Islands	137				22	1,247	3,100
France		16				11	
Germany, Fed. Rep.			99		380		
German Dem. Rep.			16	292		2,409	
Norway	82,005	61,065	85,400	25,000	86,400	68,300	77,200
Poland							
United Kingdom			2,131	157	1,413		400
USSR	4,293	9,405	11,813	18,604	27,924	12,088	28,900
Discards							2,300
Total	98,222	78,096	101,112	47,186	120,404	90,488	118,700

Country	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Denmark	1,098	251			4,746	3,198	37	2,090	106	1,375	7
Estonia		216		3,302	1,925	3,741	4,422	7,356	3,595	2,673	219
Faroe Islands	5,793	3,347	1,167	6,258	9,032	2,965	5,777**	2,716	3,011	5,546	3,272
France	23	6	6	5	5	0	270				
Germany						1					
Iceland						92	925	357			
Ireland									100		
Latvia		100	4,700	1,508	389	233					
Lithuania										2,085	
Netherlands						561			661		
Norway	76,760	91,900	110,500	141,114	93,315	47,992	41,000	54,477	53,821	31,778	21,971
Russia		42,440	49,600	28,041	44,537	44,545	50,207	67,201	51,003	49,100*	41,566
United Kingdom	514	802		1,706	194	48	938	199	662		54
USSR[2]	13,631[2]										
Poland							22				
Sweden											8
Misreported (IVa)				-109,625	-18,647			-177	-40,011		
Misreported (VIa)									-100		
Discards											
Total	97,819	139,062	165,973	72,309	135,496	103,376	103,598	134,219	72,848	92,557	67,097

[2]Russia.
*Includes small bycatches in Sub area I & IIb
** Faroese catch revised from previously reported 7,628

Table 2.2.1.3 Catch (t) of MACKEREL in the North Sea, Skagerrak, and Kattegat (Subarea IV and III). (Data submitted by Working Group members).

Country	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	49	14	20	37		125	102	191
Denmark	23,368	28,217	32,588	26,831	29,000	38,834	41,719	42,502
Estonia							400	
Faroe Islands				2,685	5,900	5,338		11,408
France	1,200	2,146	1,806	2,200	1,600	2,362	956	1,480
Germany, Fed. Rep.	1,853	474	177	6,312	3,500	4,173	4,610	4,940
Iceland								
Ireland				8,880	12,800	13,000	13,136	13,206
Latvia							211	
Netherlands	1,949	2,761	2,564	7,343	13,700	4,591	6,547	7,770
Norway	50,600	108,250	59,750	81,400	74,500	102,350	115,700	112,700
Sweden	1,300	3,162	1,003	6,601	6,400	4,227	5,100	5,934
United Kingdom	559	19857	1,002	38,660	30,800	36,917	35,137	41,010
USSR (Russia from 1990)								
Romania								
Misreported (IIa)								
Misreported (VIa)	148,000	117,000	180,000	92,000	126,000	130,000	127,000	146,697
Unallocated	7,391	8,948	29,630	6,461	-3,400	16,758	13,566	-
Discards	7,431	10,789	29,776	2,190	4,300	7,200	2,980	2,720
Total	243,700	301,618	338,316	281,600	305,100	365,875	367,164	390,558

Country	1994	1995	1996	1997	1998	1999	2000[1]	2001
Belgium	351	106	62	114	125	177	146	97
Denmark	47,852	30,891	24,057	21,934	25,326	29,353	27,720	21,680
Estonia				-	-			
Faroe Islands	11,027	17,883	13,886	3,288[2]	4,832	4,370	10,614	18,571
France	1,570	1,599	1,316	1,532	1,908	2,056	1,588	1,981
Germany, Fed. Rep.	1,479	712	542	213	423	473	78	4,514
Iceland						357		
Ireland	9,032	5,607	5,280	280	145	11,293	9,956	10,284
Latvia				-	-			
Netherlands	3,637	1,275	1,996	951	1,373	2,819	2,262	2,441
Norway	114,428	108,890	88,444	96,300	103,700	106,917	142,320	158,401
Sweden	7,099	6,285	5,307	4,714	5,146	5,233	4,994	5,090
United Kingdom	27,479	21,609	18,545	19,204	19,755	31,578	57,110	50,165
Russia				3,525	635	345	1,672	2
Romania	2,903			-	-			
Misreported (IIa)	109,625	18,647	-	-	-	40,000		
Misreported (VIa)	134,765	106,987	51,781	73,523	98,432	59,882	8,591	39,024
Unallocated	-	983	236	1,102	3,147	4,946	3,197	-272
Discards	1,150	730	1,387	2,807	4,753		1,912	24
Total	472,397	322,204	212,839	229,487	269,700	299,799	272,160	312,004

[1]Includes small catches in IIIb & IIId

[2]Faroese catches revised from previously reported 1,367

Table 2.2.1.4 Catch (t) of MACKEREL in the Western area (Subareas VI and VII and Divisions VIIIa,b,d,e). (Data submitted by Working Group members).

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992
Denmark	200	400	300	100		1,000		1,573	194
Faroe Islands	9,200	9,900	1,400	7,100	2,600	1,100	1,000		
France	12,500	7,400	11,200	11,100	8,900	12,700	17,400	4,095	
Germany	11,200	11,800	7,700	13,300	15,900	16,200	18,100	10,364	9,109
Ireland	84,100	91,400	74,500	89,500	85,800	61,100	61,500	17,138	21,952
Netherlands	99,000	37,000	58,900	31,700	26,100	24,000	24,500	64,827	76,313
Norway	34,700	24,300	21,000	21,600	17,300	700		29,156	32,365
Poland									
Spain	100				1,500	1,400	400	4,020	2,764
United Kingdom	198,300	205,900	156,300	200,700	208,400	149,100	162,700	162,588	196,890
USSR	200								
Unallocated	18000	75100	49299	26000	4700	18900	11,500	-3,802	1,472
Misreported (Iva)			-148,000	-117,000	-180,000	-92,000	-126,000	-130,000	-127,000
Discards	12,100	4,500			5,800	4,900	11,300	23,550	22,020
Grand Total	479,600	467,700	232,599	284,100	197,000	199,100	182,400	183,509	236,079

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001
Denmark		2,239	1,443	1,271	-	-	552	82	835
Estonia			361		-	-			
Faroe Islands	2,350	4,283	4,248	-	2,448[1]	3,681	4,239	4,863	2,161
France	8,296	9,998	10,178	14,347	19,114	15,927	14,311	17,857	18,975
Germany	23,776	25,011	23,703	15,685	15,161	20,989	19,476	22,901	20,793
Ireland	81,773	79,996	72,927	49,033	52,849	66,505	48,282	61,277	60,168
Netherlands	44,600	40,698	34,514	34,203	22,749	28,790	25,141	30,123	33,654
Norway	600	2,552			-	-			223
Spain	3,162	4,126	4,509	2,271	7,842	3,340	4,120	4,500	4,063
United Kingdom	215,265	208,656	190,344	127,612	128,836	165,994	127,094	126,620	139,589
USSR									
Unallocated	0	4,632	28,245	10,603	4,577	8,351	9,254	0	12,807
Misreported (IVa)	-146,697	-134,765	-106,987	-51,781	-73,523	-98,255	-59,982	-3,775	-39,024
Discards	15,660	4,220	6,991	10,028	16,057	3,277		1,920	1,164
Grand Total	248,785	251,646	270,476	213,272	196,110	218,599	192,486	266,367	255,408

[1]Faroese catches revised from 2,158

Table 2.2.1.5 Landings (tonnes) of mackerel in Divisions VIIIc and IXa, 1977–2001. Data submitted by Working Group members.

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Spain[1]	19,852	18,543	15,013	11,316	12,834	15,621	10,390	13,852	11,810	16,533	15,982	16,844
Portugal[2]	1,743	1,555	1,071	1,929	3,108	3,018	2,239	2,250	4,178	6,419	5,714	4,388
Spain[2]	2,935	6,221	6,280	2,719	2,111	2,437	2,224	4,206	2,123	1,837	491	3,540
Poland[2]	8	-	-	-	-	-	-	-	-	-	-	-
USSR[2]	2,879	189	111	-	-	-	-	-	-	-	-	-
Total[2]	7,565	7,965	7,462	4,648	5,219	5,455	4,463	6,456	6,301	8,256	6,205	7,928
TOTAL	27,417	26,508	22,475	15,964	18,053	21,076	14,853	20,308	18,111	24,789	22,187	24,772

[1]Division VIIIc.

[2]Division IXa.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Spain[1]	13,446	16,086	16,940	12,043	16,675	21,146	23,631	28,386	35,015	36,174	37,631	30,061	38,205
Portugal[2]	3,112	3,819	2,789	3,576	2,015	2,158	2,893	3,023	2,080	2,897	2,002	2,253	3,119
Spain[2]	1,763	1,406	1,051	2,427	1,027	1,741	1,025	2,714	3,613	5,093	4,164	3,760	1,874
Total[2]	4,875	5,225	3,840	6,003	3,042	3,899	3,918	6,737	5,693	7,990	6,165	6,013	4,993
TOTAL	18,321	21,311	20,780	18,046	19,719	25,045	27,549	34,123	40,708	44,164	43,796	36,074	43,198

[1]Division VIIIc.

[2]Division IXa.

Table 2.2.1.6 Catches of mackerel by Division and Subarea in 2001.
(Data submitted by Working Group members.)

	Quarter				
Area	1	2	3	4	Grand Total
II Vb	680	2,869	60,879	2,669	67,097
IIIabd	485	157	613	307	1,561
IVa	46,904	216	100,338	158,626	306,084
IVbc	0	582	2,993	783	4,359
VI	96,768	6,393	492	9,664	113,317
VII	86,804	13,478	965	15,727	116,973
VIIIabde	4,575	6,711	8	13,826	25,120
VIIIc	20,025	15,957	683	1,539	38,205
IXa	1,721	914	1,798	561	4,993
Grand Total	257,962	47,276	168,768	203,702	677,708

2.2.2 Species Mixing

Scomber sp.

As in previous years, there was both a Spanish and a Portuguese fishery for Spanish mackerel, *Scomber japonicus*, in the south of Division VIIIb, in Division VIIIc and Division IXa. Figure 2.2.2.1 shows the annual landings by ICES Divisions since 1982. The greatest catches came from Division IXa for the whole period.

Table 2.2.2.1 shows the Spanish landings by Subdivision in the period 1982–2001. The total Spanish landings of *S. japonicus* in 2001 was 2,475 t, showing a decreasing trend since 1994 on. In 2001 the catch in Division VIIIb and Sub-VIIIc East was 426 t and 1,442 t respectively, slightly increasing in relation to the 2000 catches. In Subdivision VIIIc West the catch was only 54 t in 2001. In Subdivision IXa North the catch was only 1 t in 2001, showing a strong decreasing trend since 1995. More than 95% of the catches were obtained by purse seiners and the main catches were taken in the second half of the year, mainly in autumn (80%), when the *S. scombrus* catches were lowest. *S. japonicus* is not a target species to the Spanish purse seine fleet in these areas.

Data of monthly landings by gear and area were obtained from fishing vessel owner's associations and fishermen's associations through the existing information network of the IEO and AZTI (Advisory Organisations to Fisheries and Oceanography Administration) in all Cantabrian and Galician ports. In the ports of Cantabria and Northern Galicia (Subdivision VIIIc West) catches of *S. scombrus* and *S. japonicus* are separated by species, since each of them is important in a certain season of the year. In the ports of Southern Galicia (Subdivision IXa North) the separation of the catch of the two species is not registered at all ports, for which reason the total separation of the catch is based on the monthly percentages of the ports in which they are separated and on the samplings carried out in the ports of this area. There is no problem in the mackerel species identification in the Spanish fishery in Divisions VIIIb,c and Subdivision IXa North.

In Subdivision IXa South, the Gulf of Cadiz, there is a small Spanish fishery for mixed mackerel species which had a catch of 552 t of *Scomber japonicus* in 2001. In the bottom trawl surveys carried out in the Gulf of Cadiz in 2001, catches of *S. japonicus* made up 51% and *S. scombrus* 49% of the total catch in weight of both species (M. Millán, pers. comm). From 1992 to 1997 the catch of *S. scombrus* in bottom trawl surveys was scarce or even non-existent (about 1% of the total catch of both species). Since then, this proportion of the *S. scombrus* has progressively increased, accounting for 61 % in 2000 and 49% in 2001. Due to the uncertainties in the proportion of *S. scombrus* in landings, these catches have never been included in the mackerel catches reported to this Working Group by Spain.

Portuguese landings of *S. japonicus* from Division IXa (CN, CS and S) were 4,228 t, showing a strong decrease in comparison to the 1999 (13,877 t) and 2000 (10,520 t) catch levels, the highest ones since 1982. The distribution of the catches is similar during the whole period, catches being higher in the southern areas than in the northern ones (Table 2.2.2.1). These species are landed by all fleets, but the purse seiners accounted for 73% of the total weight. *S. japonicus* is not a main target species to the Portuguese fleet. Landing data are collected from the auction market system and sent to the General Directorate for Fisheries where they are compiled. This includes information on the landings per species by day and vessel. There is no probably no mixed identification of mackerel species in the Portuguese fishery in Division IXa.

Unless stated otherwise, references to mackerel in this report refer to *Scomber scombrus* only. As stated in a paragraph above, the catches from the Gulf of Cadiz have never been included in this report.

A working paper by Martins and Skagen (WD, 2002) on *S. japonicus* in Iberian waters was presented. The paper summarises the biological data available for the years until 1998. Some attempts to perform an assessment have been made. The lack of reliable tuning data severely limits the inferences that can be made, but there were indications of an increasing trend in the fishing mortality that appeared to be relatively robust across assumptions. In the view of the Working Group, the validity of this study is crucially dependent on the data being representative of a distinct stock unit, and it is by no means clear if this is the case or if the *S. japonicus* in the area just is part of a larger, migrating stock complex. Further clarification of this question was recommended.

Table 2.2.2.1: Catches in tonnes of Scomber japonicus in Divisions VIIIb, VIIIc and IXa in the period 1982–2001.

Country	Subdivisions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	Division VIIIb	0	0	0	0	0	0	0	0	0	487	7	4	427	247	778	362	1218	632	344	426
	VIIIc East	322	254	656	513	750	1150	1214	3091	1923	1502	859	1892	1903.2	2558	2633	4416	1753	414	1279	1442
	VIIIc west															47	610	12	3	626	54
Spain	Total	322	254	656	513	750	1150	1214	3091	1923	1502	859	1892	1903.2	2558	2679	5026	1765	418	1905	1496
	IXa North												2557	7560.2	4705	5066	1727	412	104	531	1
	IXa South											895	800	1012.7	364	370	613	969	879	470	552
	Total	0	0	0	0	0	0	0	0	0	0	895	3357	8572.9	5068	5437	2340	1381	983	1001	553
	Total Spain	322	254	656	513	750	1150	1214	3091	1923	1989	1761	5253	10903	7872	8894	7729	4364	2033	3250	2475
	IXa Central-North	-	0	236	229	223	168	165	281	228	137	914	543	378	913	785	521	481	296	146	60
Portugal	IXa Central-South	-	244	3924	4777	3784	5299	838	2105	5792	6925	5264	5019	2474	1544	2224	2109	3414	10407	7450	2202
	IXa South	-	129	3899	4113	4177	3409	2813	4061	2547	3080	2803	1779	1578	1427	1749	2778	2796	3173	2924	1966
	Total Portugal	664	373	8059	9118	8184	8876	3816	6447	8568	10142	8981	7341	4430	3884	4759	5408	6690	13877	10520	4228
	Division VIIIb										487	7	4	427	247	778	362	1218	632	344	426
	VIIIc East	322	254	656	513	750	1150	1214	3091	1923	1502	859	1892	1903	2558	2633	4416	1753	414	1279	1442
	VIIIc west															47	610	12	3	626	54
	Division VIIIc	322	254	656	513	750	1150	1214	3091	1923	1502	859	1892	1903	2558	2679	5026	1765	418	1905	1496
TOTAL																					
	IXa North												2557	7560	4705	5066	1727	412	104	531	1
	IXa Central-North		0	236	229	223	168	165	281	228	137	914	543	378	913	785	521	481	296	146	60
	IXa Central-South		244	3924	4777	3784	5299	838	2105	5792	6925	5264	5019	2474	1544	2224	2109	3414	10407	7450	2202
	IXa South		129	3899	4113	4177	3409	2813	4061	2547	3080	3698	2579	2591	1790	2120	3391	3764	4052	3395	2518
	Division IXa	664	373	8059	9118	8184	8876	3816	6447	8568	10142	9876	10698	13003	8952	10195	7748	8071	14860	11521	4781
	Total	986	627	8715	9631	8934	10026	5030	9538	10491	12131	10742	12594	15333	11756	13653	13137	11054	15909	13770	6703

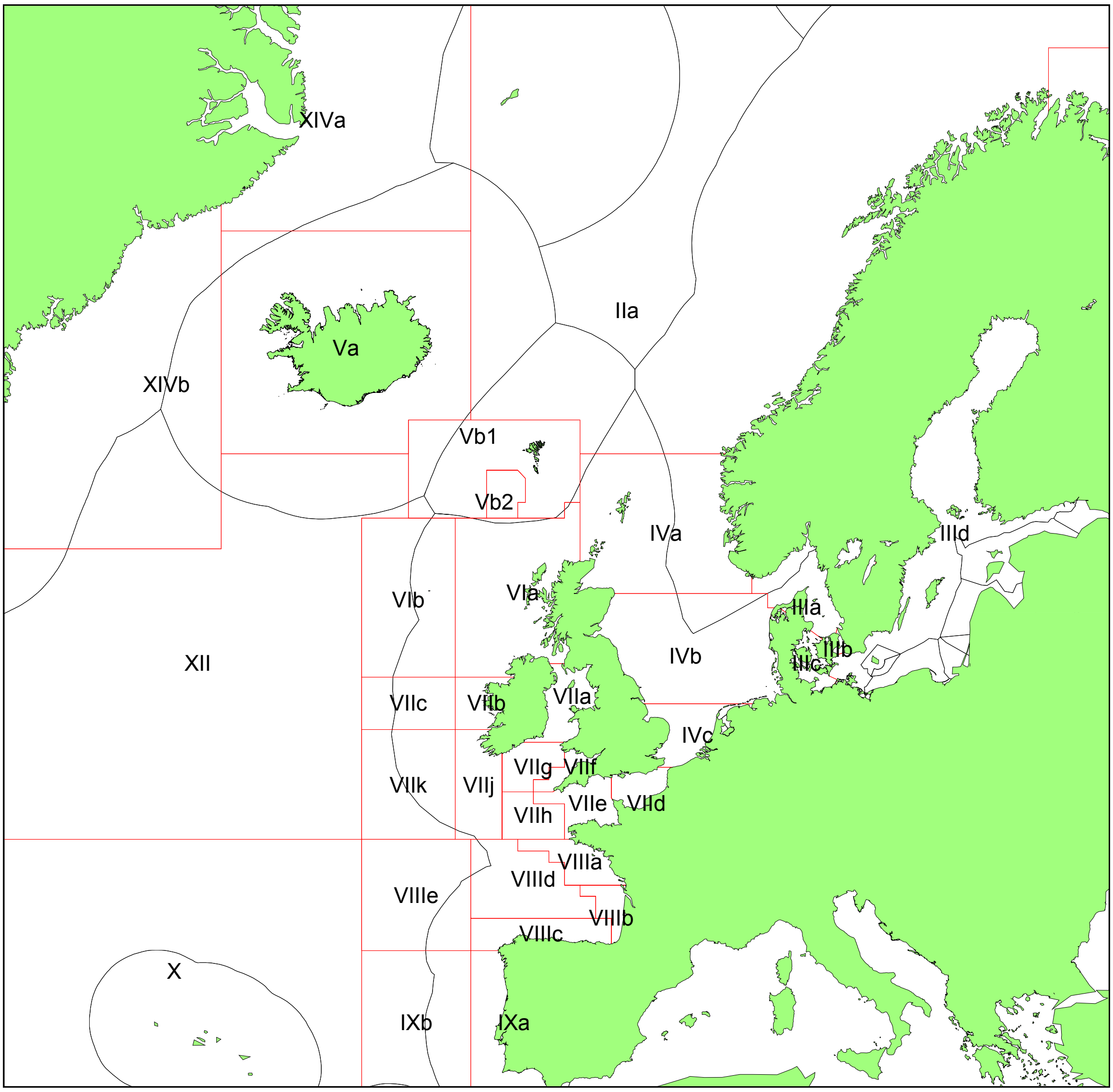


Figure 2.1.1. Map of approximate national zones and ICES Divisions and Subareas. Note that EU region is considered as one zone in this map.

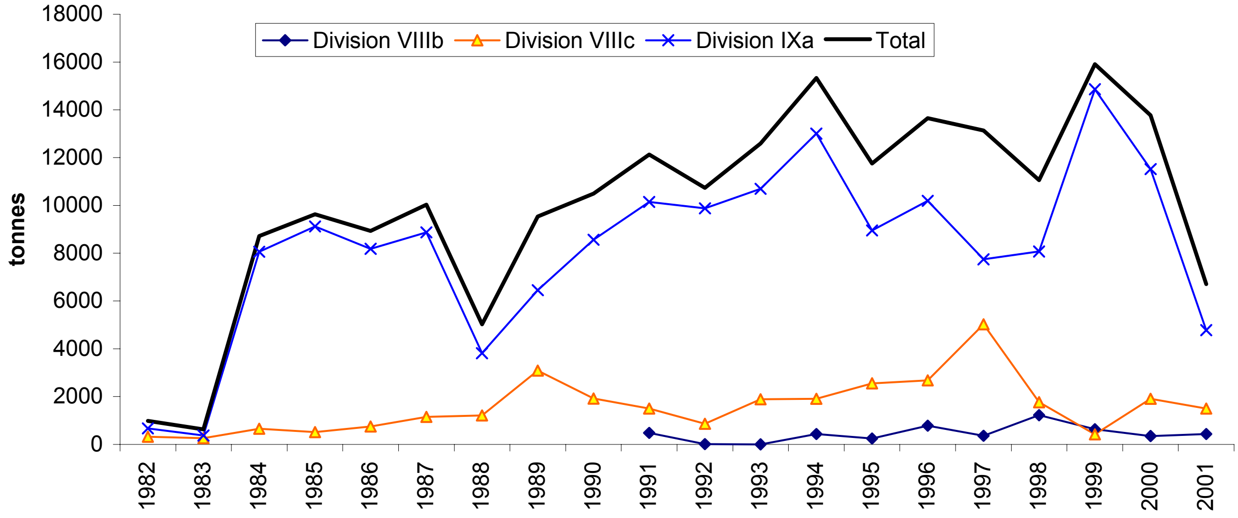


Figure 2.2.2.1: Annual landings of *Scomber japonicus* by ICES divisions from 1982 to 2001.

2.3 Stock Components

2.3.1 Biological evidence for stock components

No new biological evidence has been presented to assist in stock component definition for mackerel.

2.3.2 Allocation of catches to component

Since 1987 all catches taken in the North Sea and Division IIIa have been assumed to belong to the Western stock. This assumption also applies to all the catches taken in the international waters. It has not been possible to calculate the total catch taken from the North Sea stock component separately, but it has been assumed to be 10,000 t for a number of years. This is because of the very low stock size and because of the low catches taken from Divisions IVb,c. This figure was originally based on a comparison of the age compositions of the spawning stock calculated at the time of the North Sea egg surveys. This assumption has been continued for the catches taken in 2001. It should be pointed out that if the North Sea stock increases, which the most recent egg survey may suggest, this figure might need to be reviewed. An international egg survey carried out in the North Sea during June 1999 again provided a very low index of stock size in the area (<100,000 t) (ICES 2002, G:06)). A new egg survey in the North Sea carried out during June 2002 and the SSB adopted at 210,000 t indicating an increase SSB from 70,000 t in 1999 (See Section 2.6.2).

Prior to 1995 catches from Divisions VIIIc and IXa were all considered belonging to the southern mackerel stock, although no separate assessment had been carried out on the stock. In 1995 a combined assessment was carried out in which all catches from all areas were combined, i.e. the catches from the southern stock were combined with those from the western stock. The same procedure was carried out by the 1997 - 2001Working Groups and again by the present Working Group, - the new population unit again being called the Northeast Atlantic (NEA) mackerel unit. This year, the data series for the NEA mackerel was extended backwards to 1972 (See Section 2.5).

The TAC for the Southern area applies to Divisions VIIIc and IXa. Since 1990, 3,000 t of this TAC, which has been around 40,000 t, have been permitted to be taken from Division VIIIb in Spanish waters. This area is included in the "Western management area". These catches (3,000 t) have always been included by the Working Group in the western component and are therefore included in the assessment for the Western area and the provision of catch options for that area.

2.4 Biological Data

2.4.1 Catch in numbers-at-age

The 2001 catches in numbers at age by quarter for NE Atlantic mackerel (Areas II, III, IV, V, VI, VII, VIII and IX) are shown in Table 2.4.1.1. These catch in numbers relate to a tonnage of 677,708t, which is the best estimate of the WG of total removals from the stock in 2001. The percentage catch by numbers at age is given in Table 2.4.1.2.

The age structure of the 2001 catches of NE Atlantic mackerel is predominantly 2-8 year old fish. These age groups constitute 86% of the total catches which is very similar to 2000 & 1999. There was an even spread of ages 3 to 7 in catches, which target mackerel in the northern areas. In the southern North Sea and eastern English Channel (IVb,c and VIId), where mackerel is caught as a bycatch in fisheries for horsemackerel, the age distribution is predominantly juvenile fish (age group 1 and 2 fish). In the western English Channel and northern Biscay (VIIe,f and VIIIa,b) the catch is predominated by juvenile fish (age 1-4). In the southern areas the catches were mainly comprised of juvenile fish (age 0, 1 and 2) with VIIIc east having a catch at age distribution similar to targeted mackerel catches in the northern areas.

Age distributions of catches were provided by Denmark, England, Ireland, Netherlands, Norway, Portugal, Russia, Scotland, Spain and Germany. There are still gaps in the overall sampling for age from countries which take substantial catches notably France, Faroes and Sweden (combined catch of 50,059t) and the UK (England & Wales) and Germany who provide aged data for less than 35% of their catches. In addition there were no aged samples to cover the entire catch from sub area III, (total catch 1,562t) and division VIIIa (total catch 1,703t) and some minor catches in divisions VIIa VIIg and VIIk and VIIIb. As in 2000 catches for which there were no sampling data were converted into numbers at age using data from the most appropriate fleets. This is obviously undesirable where the only aged samples available are from a different type of gear.

Sampling data is further discussed in Section 1.3.1.

2.4.2 Length composition by fleet and country

Length distributions of some of the 2001 catches by some of the fleets were provided by England, Ireland, Netherlands, Norway, Portugal, Russia, Scotland, Spain and Germany. The length distributions were available from most of the fishing fleets and account for 74% of the catches. These distributions are only intended to give a very rough indication of the size of mackerel by the various fleets and do not reflect the seasonal variations, which occur in many of the landings. More detailed information on a quarterly basis is available for some fleets on the working group files. The length distributions by country and fleet for 2001 are shown in Table 2.4.2.1.

2.4.3 Mean lengths at age and mean weights at age

Mean lengths

The mean lengths at age per quarter for 2001 for the NE Atlantic mackerel is shown in Table 2.4.3.1. These data continue the long time series and may be useful in investigating changes in relation to stock size.

Mean weights

The mean weights at age in the catch per quarter and ICES Division for NE Atlantic mackerel in 2001 are shown in Table 2.4.3.2. Mean weights at age in the stock at spawning time for NE Atlantic mackerel are based on a weighted mean of the stock weights for the Western, Southern and North Sea stock components. The stock weights for NE Atlantic mackerel and the Western, Southern and North Sea components are given in Table 2.4.3.3. In the period 1998-2001 the stock weights of NE Atlantic mackerel are based on a relative weighting of the North Sea, Western and Southern mackerel components based on the proportion of egg production in each area from the egg surveys. Due to the revision of the catch data by SGDRAMA (see annex and section 2.5) the stock weights for the period from 1972 to 1997 have been revised. These revisions are further detailed in the WD by Eltink, Villamor and Uriarte (2002),(see annex). For the Western component the stock weights were based on Dutch mean weights at age from commercial catch data from Division VIIj over the period March to May. From the 1997 WG onwards the stock weights for the Western component are based on mean weights at age in the catch from Irish and Dutch commercial catch data (from Division VIIb, & VIIj over the spawning period March to May) which is weighted by the number of observations from each country. For the southern component stock weights are based on samples taken in VIIIc in the first quarter.

2.4.4 Maturity Ogive

The revision of the catch data by the SGDRAMA (see annex) necessitated a revision of the maturity ogive for NEA mackerel. This is because the maturity ogive for NEA mackerel is based on a weighting of the SSB's from the three components. Details of the changes in relative weighting and subsequent revision of the maturity ogive are given in the 2002 WD by Eltink, Villamor and Uriarte (also in annex)

2.4.5 Natural Mortality and Proportion of F and M

The value for natural mortality used by the WG for all components of the NE Atlantic mackerel stock is 0.15. This estimate is based the value obtained from Norwegian tagging studies carried out in the North Sea (Hamre, 1978). The proportion of F and M before spawning for NE Atlantic mackerel is taken as 0.4.

Table 2.4.1.1 Catch in numbers-at-age (000's) for NE Atlantic mackerel

Quarters 1 to 4

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc-east	VIIIc-west	Ixa central	Ixa north	Total
0	0	0	0	3	0	286	0	0	0	0	0	341	4,322	0	0	4	0	0	1	6	981	5,801	4,101	10,187	26,033
1	0	1	0	1,379	4,020	2,040	0	2,924	21	437	3	2,841	6,187	57	11	547	332	0	687	6,236	1,645	2,867	7,449	408	40,093
2	7,114	148	0	38,865	3,720	3,527	5	16,718	75	6,843	194	9,305	29,004	1,252	48	2,310	4,658	1	1,734	15,124	4,354	3,044	3,654	1,002	152,695
3	21,545	385	0	80,216	681	1,287	351	35,603	19	20,125	854	5,158	10,656	659	94	1,954	11,789	152	972	10,336	9,515	3,059	681	1,177	217,268
4	32,266	524	0	103,737	393	679	525	50,221	10	21,120	881	2,927	6,411	281	99	1,637	13,527	182	1,383	15,912	17,041	3,122	458	940	274,277
5	32,671	653	0	120,278	126	241	698	53,172	3	23,733	1,084	1,417	3,536	127	132	2,137	18,321	243	391	7,337	14,915	1,540	282	430	283,467
6	20,828	476	0	84,828	77	214	687	40,586	2	16,133	730	980	1,996	65	99	1,574	17,854	183	186	5,700	15,879	1,257	146	406	210,888
7	12,558	388	0	83,273	61	188	850	30,208	1	16,281	597	583	1,903	16	0	15	15,364	2	170	4,588	8,848	436	76	217	176,623
8	4,914	282	0	52,407	45	63	509	21,325	0	6,011	295	363	894	22	0	9	8,844	1	251	4,547	7,961	307	52	190	109,291
9	1,983	181	0	34,784	41	59	173	10,843	0	5,486	234	360	278	1	0	3	4,646	1	41	1,618	4,186	129	13	111	65,171
10	669	124	0	21,087	4	4	4	6,756	0	4,487	222	203	2	0	0	0	2,567	0	20	672	928	30	5	23	37,806
11	563	48	0	9,742	3	0	335	2,642	0	1,024	38	44	209	0	0	0	2,084	0	18	843	1,048	25	4	31	18,702
12	699	75	0	11,653	6	0	335	3,263	0	1,041	86	41	0	0	0	0	1,552	0	1	148	838	28	2	16	19,785
13	59	12	0	3,473	3	0	0	1,594	0	930	32	157	0	0	0	0	628	0	6	208	421	12	1	10	7,546
14	132	11	0	2,353	0	4	0	861	0	354	16	0	0	0	0	0	163	0	0	74	393	12	0	5	4,381
15	79	9	0	2,297	0	0	0	1,451	0	761	28	58	0	0	0	0	636	0	1	39	393	15	0	5	5,773
SOP	65,449	1,570	0	306,399	2,040	2,322	1,647	113,916	30	45,584	1,957	6,443	15,609	687	192	3,578	43,004	330	1,703	23,429	33,412	4,747	3,120	1,874	679,041
Catch	65,450	1,561	1	306,084	2,038	2,321	1,647	113,317	29	45,625	1,957	6,446	15,618	687	192	3,576	42,512	330	1,703	23,417	33,456	4,748	3,119	1,874	677,708
SOP%	100%	99%	100%	100%	100%	100%	100%	99%	99%	100%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%

Quarter 1

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc-east	VIIIc-west	Ixa central	Ixa north	Total
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
1	0	0	0	1	0	0	0	92	0	75	3	0	6	0	0	0	0	0	0	4	122	131	1,181	14	1,629
2	38	80	0	4,981	0	0	5	8,486	0	5,174	177	3,992	9,635	25	0	144	3,247	1	155	295	2,579	817	1,664	688	42,182
3	129	206	0	16,666	0	0	18	26,529	0	17,716	815	1,638	6,160	25	72	1,450	10,453	152	64	1,180	6,597	1,955	224	1,033	93,083
4	315	251	0	22,402	0	0	25	42,887	0	18,405	824	1,232	3,899	10	87	1,620	10,568	182	48	2,560	10,547	2,260	126	800	119,047
5	277	276	0	27,182	0	0	31	47,262	0	20,798	1,016	394	1,747	7	116	2,130	15,111	243	15	2,053	8,059	994	122	320	128,153
6	236	174	0	17,801	0	0	21	37,410	0	15,432	713	298	365	1	87	1,570	13,924	183	12	2,205	8,409	823	44	306	100,013
7	119	138	0	14,172	0	0	17	27,125	0	13,699	533	261	309	2	0	14	11,895	2	10	1,511	4,527	270	52	158	74,814
8	62	73	0	7,801	0	0	9	18,812	0	4,340	254	143	475	2	0	9	7,312	1	6	1,057	3,955	172	25	135	44,643
9	6	49	0	5,320	0	0	6	9,299	0	4,656	214	274	68	1	0	3	3,871	1	11	574	2,006	66	6	79	26,508
10	8	34	0	3,629	0	0	4	5,903	0	4,076	211	119	0	0	0	0	2,022	0	5	219	433	15	3	17	16,699
11	0	17	0	1,810	0	0	2	2,315	0	939	36	12	0	0	0	0	1,713	0	0	256	467	11	3	22	7,603
12	1	10	0	1,130	0	0	1	2,993	0	941	83	12	0	0	0	0	1,272	0	0	118	384	10	2	11	6,969
13	0	3	0	369	0	0	0	1,376	0	838	30	0	0	0	0	0	554	0	0	65	181	4	0	7	3,429
14	3	3	0	348	0	0	0	747	0	354	16	0	0	0	0	0	163	0	0	60	155	4	0	3	1,858
15	4	2	0	193	0	0	0	1,284	0	605	24	0	0	0	0	0	636	0	0	35	155	7	0	3	2,948
SOP	626	494	0	47,095	0	0	54	97,299	0	40,207	1,842	2,069	4,628	16	156	2,900	34,899	330	80	4,494	17,798	2,191	692	1,030	258,914
Catch	626	485	0	46,904	0	0	54	96,768	0	40,247	1,842	2,069	4,631	16	156	2,900	34,613	330	80	4,495	17,834	2,191	692	1,030	257,962
SOP%	100%	98%		100%	102%		100%	99%		100%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%

Table 2.4.1.1 Catch in numbers at age (000's) for NE Atlantic mackerel

Quarter 2

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc-east	VIIIc-west	Ixa central	Ixa north	Total
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
1	0	0	0	8	794	3	0	3	0	0	0	50	6	17	0	0	0	0	3	49	794	434	2,214	143	4,520
2	175	13	0	81	1,123	124	0	548	3	687	17	1,789	57	178	1	0	0	0	122	1,891	1,151	699	1,388	148	10,195
3	592	28	0	78	113	23	0	1,874	1	1,563	39	1,654	13	40	9	2	1,004	0	131	2,277	2,635	451	157	75	12,758
4	1,443	36	0	79	4	3	0	2,583	1	2,300	58	722	14	43	11	3	2,959	0	81	2,198	6,330	511	101	87	19,566
5	1,267	56	0	88	33	0	0	3,131	0	2,733	68	288	6	19	14	4	3,210	0	84	2,708	6,762	339	67	75	20,952
6	1,081	46	0	55	5	10	0	2,229	1	685	17	263	11	34	11	3	3,930	0	77	2,636	7,424	323	28	85	18,951
7	543	41	0	45	4	0	0	1,838	0	2,549	64	79	0	1	0	0	3,470	0	63	2,219	4,309	140	16	55	15,435
8	284	29	0	29	3	0	0	1,410	0	1,656	41	88	2	6	0	0	1,532	0	52	1,776	3,998	117	13	53	11,089
9	26	23	0	20	2	0	0	695	0	827	21	26	0	0	0	0	775	0	30	1,044	2,176	56	3	31	5,756
10	38	10	0	10	1	0	0	409	0	410	10	54	0	0	0	0	545	0	15	453	494	13	1	6	2,470
11	0	4	0	4	0	0	0	171	0	85	2	0	0	0	0	0	371	0	17	586	580	14	0	8	1,843
12	7	7	0	6	1	0	0	193	0	100	3	0	0	0	0	0	280	0	0	30	453	18	0	5	1,102
13	0	2	0	2	0	0	0	127	0	91	2	28	0	0	0	0	74	0	5	144	240	7	0	3	726
14	13	2	0	2	0	0	0	82	0	0	0	0	0	0	0	0	0	0	0	15	238	8	0	2	361
15	20	2	0	1	0	0	0	167	0	156	4	28	0	0	0	0	0	0	1	4	238	8	0	2	632
SOP	2,869	157	0	223	557	26	0	6,457	1	4,600	115	1,178	22	68	19	5	7,672	0	221	6,504	15,078	868	681	232	47,552
Catch	2,869	157	0	216	556	26	0	6,393	1	4,600	115	1,179	22	68	19	5	7,469	0	221	6,490	15,089	868	681	232	47,276
SOP%	100%	100%		97%	100%	100%	105%	99%	100%	100%	100%	100%	100%	100%	100%	100%	97%		100%	100%	100%	100%	100%	100%	99%

Quarter 3

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc-east	VIIIc-west	Ixa central	Ixa north	Total
0	0	0	0	0	0	176	0	0	0	0	0	2	97	0	0	4	0	0	0	0	321	0	2,321	9,646	12,566
1	0	1	0	652	1,494	1,813	0	180	0	0	0	32	1,397	1	2	54	12	0	0	1	38	1,006	3,177	233	10,093
2	6,739	40	0	9,479	2,110	3,100	0	496	0	2	0	45	1,963	13	8	76	53	0	0	6	67	685	462	107	25,450
3	20,473	107	0	18,304	206	1,053	58	463	0	4	0	5	240	71	3	9	12	0	0	10	38	304	234	37	41,631
4	29,935	167	0	24,066	0	526	86	273	0	6	0	5	237	95	1	9	0	0	0	11	32	214	177	20	55,862
5	30,400	248	0	36,908	52	176	115	146	0	7	0	1	57	59	2	2	0	0	0	3	21	149	59	12	68,416
6	19,064	173	0	29,068	0	176	115	40	0	2	0	0	11	22	1	0	0	0	0	2	13	88	44	6	48,826
7	11,630	146	0	25,443	0	176	144	32	0	7	0	0	8	9	0	0	0	0	0	1	5	21	4	2	37,627
8	4,443	98	0	18,013	0	59	86	21	0	4	0	0	2	14	0	0	0	0	0	0	4	14	8	2	22,768
9	1,905	70	0	13,775	0	59	29	11	0	2	0	0	2	0	0	0	0	0	0	0	2	5	3	1	15,863
10	603	33	0	6,020	0	0	0	6	0	1	0	0	2	0	0	0	0	0	0	0	0	1	0	0	6,667
11	549	13	0	2,276	0	0	58	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2,900
12	685	21	0	4,127	0	0	58	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4,893
13	57	6	0	1,291	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,356
14	112	6	0	1,252	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,371
15	53	5	0	1,162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,221
SOP	60,603	612	0	100,426	1,021	1,975	275	489	0	12	0	18	781	103	5	30	16	0	0	8	83	600	1,272	525	168,853
Catch	60,604	612	1	100,338	1,019	1,974	275	492	0	12	0	18	781	103	5	30	16	0	0	8	83	600	1,272	525	168,768
SOP%	100%	100%	100%	100%	100%	100%	100%	101%		100%		100%	100%	100%	99%	100%	100%			100%	100%	100%	100%	100%	100%

Table 2.4.1.1 Catch in numbers at age (000's) for NE Atlantic mackerel

Quarter 4

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc-east	VIIIc-west	Ixa central	Ixa north	Total
0	0	0	0	3	0	111	0	0	0	0	0	339	4,224	0	0	0	0	0	1	6	660	5,801	1,780	541	13,467
1	0	0	0	717	1,732	224	0	2,649	21	362	0	2,759	4,778	39	9	493	320	0	684	6,183	692	1,295	876	19	23,852
2	162	14	0	24,324	487	303	0	7,187	73	980	0	3,479	17,350	1,036	39	2,090	1,359	0	1,457	12,931	557	843	140	58	74,869
3	351	44	0	45,167	362	212	276	6,737	18	842	0	1,861	4,244	522	9	492	320	0	777	6,869	245	349	66	32	69,796
4	573	70	0	57,190	389	150	414	4,477	9	409	0	967	2,262	134	0	5	0	0	1,255	11,142	132	136	54	33	79,801
5	728	74	0	56,099	41	66	551	2,633	2	195	0	734	1,726	41	0	1	0	0	292	2,573	74	59	34	23	65,946
6	447	82	0	37,904	72	29	551	908	2	14	0	419	1,609	9	0	1	0	0	98	857	34	23	30	9	43,098
7	268	63	0	43,613	57	12	689	1,213	0	27	0	243	1,586	4	0	0	0	0	97	857	7	5	3	2	48,747
8	126	81	0	26,564	42	4	414	1,083	0	10	0	131	415	0	0	0	0	0	193	1,714	5	3	6	1	30,793
9	46	39	0	15,669	39	0	138	838	0	1	0	59	208	0	0	0	0	0	0	0	2	2	1	0	17,043
10	19	48	0	11,427	3	4	0	438	0	1	0	30	0	0	0	0	0	0	0	0	0	0	1	0	11,971
11	14	15	0	5,652	3	0	276	154	0	0	0	32	208	0	0	0	0	0	0	0	0	0	0	0	6,356
12	6	37	0	6,390	5	0	276	77	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	6,821
13	2	0	0	1,811	3	0	0	90	0	0	0	129	0	0	0	0	0	0	1	0	0	0	0	0	2,036
14	4	0	0	751	0	4	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	791
15	2	0	0	941	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	972
SOP	1,351	307	0	158,648	463	321	1,318	9,671	28	766	0	3,179	10,178	500	12	642	415	0	1,402	12,425	451	1,089	474	87	203,720
Catch	1,351	307	0	158,626	462	321	1,318	9,664	28	765	0	3,181	10,186	500	12	641	414	0	1,402	12,424	450	1,089	474	87	203,702
SOP%	100%	100%		100%	100%	100%	100%	100%	99%	100%		100%	100%	100%	100%	100%	100%		100%	100%	100%	100%	100%	100%	100%

Table 2.4.1.2 Percentage catch numbers-at-age for NE Atlantic mackerel

Quarters 1–4

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	1%	7%	0%	0%	0%	0%	0%	0%	0%	1%	27%	24%	67%	2%
1	0%	0%	0%	0%	44%	24%	0%	1%	16%	0%	0%	11%	9%	2%	2%	5%	0%	0%	12%	8%	2%	13%	44%	3%	2%
2	5%	4%	4%	6%	41%	41%	0%	6%	58%	5%	4%	38%	44%	51%	10%	23%	5%	0%	30%	21%	5%	14%	22%	7%	9%
3	16%	12%	9%	12%	7%	15%	8%	13%	14%	16%	16%	21%	16%	27%	19%	19%	11%	20%	17%	14%	11%	14%	4%	8%	13%
4	24%	16%	12%	16%	4%	8%	12%	18%	7%	17%	17%	12%	10%	11%	21%	16%	13%	24%	24%	22%	19%	14%	3%	6%	17%
5	24%	20%	19%	18%	1%	3%	16%	19%	2%	19%	20%	6%	5%	5%	27%	21%	18%	32%	7%	10%	17%	7%	2%	3%	17%
6	15%	14%	16%	13%	1%	2%	15%	15%	2%	13%	14%	4%	3%	3%	20%	15%	17%	24%	3%	8%	18%	6%	1%	3%	13%
7	9%	12%	14%	13%	1%	2%	19%	11%	0%	13%	11%	2%	3%	1%	0%	0%	15%	0%	3%	6%	10%	2%	0%	1%	11%
8	4%	8%	9%	8%	0%	1%	11%	8%	0%	5%	6%	1%	1%	1%	0%	0%	9%	0%	4%	6%	9%	1%	0%	1%	7%
9	1%	5%	7%	5%	0%	1%	4%	4%	0%	4%	4%	1%	0%	0%	0%	0%	5%	0%	1%	2%	5%	1%	0%	1%	4%
10	0%	4%	3%	3%	0%	0%	0%	2%	0%	4%	4%	1%	0%	0%	0%	0%	2%	0%	0%	1%	1%	0%	0%	0%	2%
11	0%	1%	1%	1%	0%	0%	7%	1%	0%	1%	1%	0%	0%	0%	0%	0%	2%	0%	0%	1%	1%	0%	0%	0%	1%
12	1%	2%	2%	2%	0%	0%	7%	1%	0%	1%	2%	0%	0%	0%	0%	0%	2%	0%	0%	0%	1%	0%	0%	0%	1%
13	0%	0%	1%	1%	0%	0%	0%	1%	0%	1%	1%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%
14	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
15	0%	0%	1%	0%	0%	0%	0%	1%	0%	1%	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%

Table 2.4.2.1 Mackerel length distribution in 2001 catches by country and various fleets.

Length	Portugal	Spain			Netherlands	Ireland	Norway	Scotland	England			Russia	Denmark	Germany
(cm)	all gears	artisanal	purse seine	trawl	pel. trawl	pel. trawl	purse seine	pel. trawl	hand lines	pel. trawl	bottom trawl	pel. trawl	pel. trawl	all gears
13														
14														
15			0%											
16			1%											
17			8%											
18			13%	0%										
19	0%		3%	0%	0%					0%				
20	2%		1%	0%	0%	0%				0%				
21	3%	0%	4%	1%	0%	0%								
22	3%		9%	0%	0%	0%		0%	0%	0%				
23	4%	0%	3%	0%	0%	0%			0%	0%				
24	13%	0%	1%	0%	0%				0%	0%				
25	7%	0%	0%	0%	0%	0%			1%	1%				
26	4%	0%	1%	0%	1%	1%		0%	2%	2%				0%
27	4%	0%	2%	1%	3%	2%	0%	0%	5%	6%		0%		1%
28	6%	0%	3%	4%	4%	2%	0%	2%	6%	12%	3%	0%		3%
29	11%	1%	4%	7%	9%	3%	0%	3%	13%	22%	10%	1%		4%
30	15%	1%	4%	10%	5%	4%	1%	3%	11%	15%	12%	2%	0%	5%
31	11%	2%	5%	16%	5%	7%	1%	4%	12%	12%	7%	2%	1%	5%
32	7%	3%	5%	16%	6%	10%	2%	6%	15%	10%	22%	3%	3%	7%
33	4%	4%	5%	12%	5%	12%	3%	8%	13%	8%	23%	6%	3%	9%
34	3%	5%	5%	8%	7%	12%	4%	9%	9%	6%	8%	10%	4%	10%
35	2%	8%	6%	7%	10%	11%	6%	11%	7%	3%	10%	13%	5%	12%
36	1%	10%	7%	5%	9%	10%	8%	12%	3%	1%	6%	15%	11%	12%
37	1%	13%	7%	5%	8%	9%	9%	12%	2%	1%		14%	16%	11%
38	0%	16%	7%	3%	9%	6%	45%	11%	1%	0%		12%	15%	9%
39	0%	15%	7%	3%	7%	5%	8%	9%	0%	0%		8%	17%	6%
40	0%	12%	5%	1%	5%	3%	6%	6%	0%	0%		6%	14%	3%
41	0%	6%	3%	1%	3%	2%	4%	3%	0%	0%		3%	7%	1%
42	0%	3%	1%	0%	2%	1%	2%	1%	0%			1%	3%	1%
43	0%	1%	1%	0%	1%	0%	1%	1%	0%			1%	2%	0%
44		0%	0%	0%	0%	0%	0%	0%				0%	0%	0%
45		0%	0%	0%	0%	0%	0%	0%				0%		0%
46		0%		0%			0%	0%				0%		
47				0%			0%	0%				0%		
48												0%		
49														
50														

Table 2.4.3.1 Mean length (cm) at age for NE Atlantic mackerel

Quarters 1–4

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0				22.5		23.7			25.1			25.1	21.2			19.5			25.1	22.5	21.2	22.7	24.2	18.4	21.0
1		31.8		29.5	29.7	29.1	29.5	26.7	28.8	26.0	22.8	29.5	28.0	28.5	29.2	29.1	29.3		29.5	29.4	27.9	28.9	28.8	28.4	28.8
2	30.8	30.5	31.4	31.5	31.8	31.4	29.5	30.6	30.5	29.8	29.3	29.9	29.8	31.3	29.7	29.6	29.2	29.0	29.7	29.7	30.5	30.8	31.1	30.3	30.5
3	33.5	33.4	34.2	33.7	34.3	33.5	34.4	32.6	32.6	32.2	32.4	33.0	32.2	33.0	35.9	35.0	33.3	36.3	33.6	33.4	33.0	32.4	33.6	31.7	33.2
4	35.5	35.1	35.6	35.3	36.6	35.7	35.0	35.0	33.7	34.4	34.3	34.9	33.9	34.5	36.8	36.7	35.2	36.8	35.2	35.2	35.4	34.2	34.7	33.7	35.2
5	36.5	36.5	36.7	36.5	37.1	35.1	34.8	36.1	34.8	35.5	35.4	35.8	35.7	34.9	38.6	38.5	37.1	38.6	36.3	36.6	37.4	36.2	35.6	36.5	36.4
6	37.6	37.7	37.8	37.6	38.1	36.4	38.0	37.8	34.6	37.3	37.0	36.2	37.2	35.4	38.8	38.8	38.1	38.8	37.0	37.6	38.1	36.8	36.8	37.5	37.7
7	38.1	38.3	38.5	38.1	39.3	36.0	38.4	38.2	37.9	37.3	37.2	38.5	39.5	35.7	36.3	34.4	38.8	39.2	37.6	38.3	39.3	38.0	37.6	39.0	38.2
8	39.8	39.2	39.4	39.0	38.8	34.6	40.0	39.2	36.4	38.2	38.4	37.8	37.6	35.8	36.0	34.4	40.1	40.3	37.2	38.4	40.0	39.1	38.7	40.0	39.2
9	40.6	40.1	40.1	40.0	39.2	38.5	40.0	39.7	38.9	39.2	39.4	40.1	40.5	37.5		37.5	40.9	41.7	40.8	40.4	40.6	40.1	40.0	40.6	40.0
10	40.9	40.5	40.9	40.4	43.1	38.5	39.8	40.5	37.9	39.6	39.8	41.9	36.6			36.6	41.9	41.6	42.0	40.8	40.8	40.5	40.7	40.8	40.5
11	41.4	39.8	40.5	40.5	42.2		41.5	40.9	41.5	40.9	41.0	38.5	40.5				42.2	42.5	42.9	41.9	42.0	42.1	41.6	41.8	41.0
12	41.7	40.8	41.5	41.3	43.0		41.5	41.1	38.5	41.0	42.3	42.2					41.7	42.3	41.7	41.5	42.1	42.6	42.6	41.4	41.3
13	42.7	42.2	42.4	42.2	42.5		42.0	41.2	43.5	41.4	41.7	40.9					43.8	44.0	43.4	42.8	42.3	43.0	45.3	41.8	42.1
14	43.3	42.8	43.2	42.7	43.0	44.5	41.8	41.3		42.4	42.4						40.5			42.0	43.0	43.4	45.1	42.6	42.4
15	43.5	43.0	43.5	43.2	43.3		40.9	42.0	42.9	43.1	43.0	44.7					43.2	43.5	46.5	43.4	43.0	44.1		42.6	42.9

Quarter1

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0																									
1		29.5		29.5	29.5		29.5	28.2		22.8	22.8	21.1	21.1	21.1		21.1				28.0	28.0	26.3	26.3	28.8	26.4
2	32.7	29.5		29.5	29.5		29.5	29.4		29.2	29.1	29.0	28.0	27.7		27.7	29.0	29.0	29.0	30.5	30.5	30.6	31.0	30.3	29.2
3	33.6	32.3		32.3	32.3		32.3	32.4		32.2	32.4	32.6	31.7	31.0	36.3	35.8	33.3	36.3	32.6	33.2	32.9	32.5	33.5	31.7	32.5
4	35.6	34.1		34.1	34.1		34.1	35.0		34.3	34.3	34.8	33.8	34.1	36.8	36.7	35.3	36.8	34.8	35.1	35.1	34.1	34.5	33.5	34.7
5	37.0	35.4		35.2	35.2		35.2	36.2		35.5	35.4	35.0	34.2	33.0	38.6	38.5	37.2	38.6	35.0	36.5	37.3	36.0	35.4	36.4	36.1
6	37.8	36.5		36.4	36.4		36.4	37.8		37.2	37.0	35.7	33.8	34.7	38.8	38.8	38.2	38.8	35.7	37.4	38.0	36.5	36.5	37.3	37.5
7	38.7	37.5		37.2	37.1		37.1	38.2		37.4	37.3	38.8	34.3	34.3		34.3	38.9	39.2	38.8	38.1	39.2	37.5	37.5	38.8	38.0
8	40.0	38.6		38.2	38.1		38.1	39.3		38.8	38.6	37.8	35.0	34.4		34.4	40.2	40.3	37.8	39.3	39.9	38.7	38.6	40.0	39.2
9	40.0	39.6		39.4	39.3		39.3	39.6		39.3	39.5	40.1	37.5	37.5		37.5	41.1	41.7	40.1	39.7	40.5	39.8	39.8	40.5	39.8
10	39.0	40.1		39.9	39.8		39.8	40.5		39.8	39.9	42.8					41.7	41.6	42.8	39.8	40.7	40.0	40.5	40.8	40.3
11		39.4		39.4	39.4		39.4	40.8		40.8	41.0	38.5					42.3	42.5	38.5	40.3	41.9	41.8	41.5	41.8	40.9
12	46.0	41.0		41.0	41.0		41.0	41.1		41.3	42.5	41.5					42.0	42.3	41.5	41.7	42.0	41.8	42.5	41.4	41.4
13		42.0		42.0	42.0		42.0	41.1		41.2	41.5						44.0	44.0		41.8	42.2	42.6	43.5	41.8	41.8
14	43.0	41.8		41.8	41.8		41.8	41.3		42.4	42.4						40.5			42.2	42.9	43.1	45.1	42.5	41.7
15	43.3	40.9		40.9	40.9		40.9	42.0		43.2	43.0						43.2	43.5		43.4	42.9	44.7		42.5	42.5

Table 2.4.3.1 (Continued)

Quarter 2

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0																									
1		32.5		32.0	29.6	24.5		28.2	25.1			23.8	25.1	25.1	25.1				22.3	22.0	25.9	26.1	27.2	26.5	27.1
2	32.7	31.4		31.2	31.8	27.5		29.8	27.8	31.2	31.2	28.4	27.8	27.8	27.8				28.2	28.0	29.8	28.9	30.7	28.7	29.6
3	33.6	34.2		33.7	34.0	30.6	34.5	32.7	30.6	32.1	32.1	32.1	30.5	30.5	36.2	36.3	33.0		32.1	32.1	33.5	31.9	33.5	31.9	32.6
4	35.6	35.6		35.4	35.0	35.5	35.0	35.0	33.7	35.2	35.2	34.8	33.5	33.5	36.8	36.8	35.1		35.1	35.3	36.0	34.7	34.5	35.0	35.4
5	37.0	36.8		36.6	37.3		34.8	36.3	34.7	36.1	36.1	35.2	34.2	34.2	38.6	38.6	36.6		36.9	37.1	37.7	36.9	35.4	37.7	36.9
6	37.8	37.8		37.7	37.4	38.8	38.0	37.9	35.0	38.2	38.2	35.7	34.9	34.9	38.8	38.8	37.9		37.9	38.1	38.3	37.5	36.5	38.4	38.0
7	38.7	38.5		38.3	38.1		38.4	38.2	36.8	36.7	36.7	37.5	37.5	37.5	37.5		38.4		39.1	39.0	39.5	38.8	37.5	39.6	38.5
8	40.0	39.4		39.2	39.1		40.0	39.2	36.3	36.7	36.7	39.1	36.0	36.0	36.0		39.3		39.8	39.8	40.1	39.7	38.6	40.2	39.3
9	40.0	40.1		40.2	39.9		40.0	39.7	38.9	38.9	38.9	40.5					39.7		41.1	40.9	40.7	40.5	39.6	40.7	40.2
10	39.0	40.9		41.0	40.6			40.6	37.9	37.9	37.9	43.0					42.6		41.8	41.3	40.9	41.1	40.5	40.8	40.8
11	43.0	40.5		40.4	40.1		41.5	41.1	41.5	41.5	41.5						41.6		43.0	42.7	42.0	42.3	41.5	41.7	42.0
12	46.0	41.5		41.6	41.4		41.5	41.2	38.5	38.5	38.5						40.1			41.0	42.2	43.1	42.5	41.5	41.1
13		42.4		42.4	42.3			41.3	43.5	43.5	43.5	44.6					42.3		43.7	43.2	42.4	43.2	43.5	41.9	42.6
14	43.0	43.2		43.1	43.0			41.1												41.3	43.2	43.6		42.9	42.6
15	43.3	43.5		43.4	43.3			42.1	42.9	42.9	42.9	47.0							47.0	43.2	43.2	43.6		42.9	43.0

Quarter 3

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0						24.2						19.5	19.5			19.5					21.2		24.7	18.3	19.6
1		32.5		30.1	29.6	29.0		26.9				27.7	27.7	32.5	29.3	27.7	29.3			27.0	30.6	29.9	30.4	29.4	29.5
2	30.8	31.6	31.4	31.4	31.8	31.5		31.6	31.2	31.2		29.8	29.8	33.2	29.7	29.8	29.7			30.1	32.3	31.8	32.0	31.4	31.2
3	33.5	34.7	34.2	34.3	34.0	33.3	34.5	33.2	32.1	32.1		31.6	31.6	34.7	34.4	31.6	32.5			31.7	32.9	32.6	33.6	32.4	33.8
4	35.5	36.3	35.6	35.8	33.9	35.7	35.0	34.8	35.2	35.2		33.3	33.4	35.3	36.7	33.3				32.6	34.6	34.9	34.8	34.5	35.6
5	36.5	37.5	36.7	36.9	37.5	35.2	34.8	35.0	36.1	36.1		32.8	32.9	36.0	38.5	32.8				33.7	35.9	36.0	35.8	35.7	36.7
6	37.6	38.3	37.8	37.9	38.0	36.2	38.0	36.6	38.2	38.2		35.6	35.9	35.9	38.8	35.6				33.9	37.3	36.9	37.1	37.2	37.8
7	38.1	38.9	38.5	38.6	38.1	35.8	38.4	37.4	36.7	36.7		36.1	36.6	35.8	35.8	36.1				34.4	38.8	38.0	38.5	38.8	38.4
8	39.8	39.6	39.4	39.4	40.1	34.5	40.0	38.5	36.7	36.7		33.5	34.3	35.9	35.9	33.5				35.8	39.5	38.5	38.9	39.4	39.5
9	40.6	40.2	40.1	40.1	40.2	38.5	40.0	41.1	38.9	38.9		35.5	36.0			35.5				36.3	40.1	39.2	40.5	40.1	40.2
10	41.0	41.2	40.9	41.0	40.8			40.7	37.9	37.9		36.6	36.6			36.6				40.2	40.2	39.8	41.5	40.6	41.0
11	41.4	40.6	40.5	40.5	42.4		41.5	41.7	41.5	41.5			40.5							37.6	41.7	41.8	42.5	41.9	40.7
12	41.6	41.7	41.5	41.5	43.5		41.5	41.2	38.5	38.5										41.7	41.5	42.0		42.0	41.5
13	42.7	42.4	42.4	42.4	42.0			42.8	43.5	43.5										41.6	41.9	42.8	47.0	42.2	42.4
14	43.3	43.2	43.2	43.2	43.3			42.4												41.9	42.5	43.5		42.9	43.2
15	43.6	43.5	43.5	43.5	42.8			42.1	42.9	42.9										43.6	42.5	43.5		42.9	43.5

Table 2.4.3.1 (Continued)

Quarter 4

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0				22.5		22.9			25.1			25.1	21.3						25.1	22.5	21.2	22.7	23.6	20.9	22.3
1		28.9		29.0	29.9	30.0		26.7	28.8	26.6		29.7	28.1	30.0	29.3	29.2	29.3		29.5	29.5	30.1	29.4	30.4	30.7	28.9
2	30.6	32.2		31.9	31.8	32.0		31.9	30.6	31.9		31.5	30.8	32.0	29.7	29.7	29.7		29.9	29.9	31.9	31.7	32.1	33.1	31.2
3	33.6	34.7		34.1	34.5	34.5	34.5	33.3	32.6	33.2		34.1	33.0	33.0	32.5	32.5	32.5		33.9	33.9	32.6	32.4	33.6	33.4	33.9
4	35.3	35.5		35.6	36.6	35.5	35.0	35.0	33.7	34.5		35.3	34.0	34.2		33.4			35.2	35.2	34.4	33.8	34.9	34.8	35.4
5	36.3	37.4		36.8	36.4	35.1	34.8	35.6	34.7	34.3		36.5	37.3	34.0		35.6			36.2	36.2	35.4	35.1	36.0	35.4	36.7
6	37.6	38.6		38.0	38.1	36.6	38.0	37.9	34.3	35.9		36.9	38.0	35.8		35.7			36.5	36.5	36.6	36.6	37.0	36.4	37.9
7	38.4	38.4		38.1	39.4	38.5	38.4	38.4	38.5	36.7		38.6	40.5	35.9		38.5			36.5	36.5	37.8	38.0	38.5	37.4	38.2
8	39.8	39.2		39.0	38.8	35.5	40.0	38.8	37.0	38.0		37.0	40.5	37.5					36.5	36.5	38.5	39.1	38.9	38.2	38.9
9	40.8	40.5		40.1	39.2		40.0	40.4	40.0	40.4		40.0	41.5						40.0	40.1	38.7	39.2	40.5	38.9	40.1
10	40.9	40.2		40.2	44.0	38.5		40.5	36.5	40.5		36.5							36.5	40.0	39.9	40.4	41.5	40.8	40.2
11	40.9	39.3		40.8	42.5		41.5	42.5	38.5	42.5		38.5	40.5						38.5	40.4	41.3	41.9	42.5	41.8	40.9
12	42.3	40.2		41.2	43.2		41.5	41.3	42.5	41.3		42.5							42.5	40.6	40.7	41.9	43.5	41.9	41.2
13	42.7	40.9		42.2	42.5			43.0	40.1	43.0		40.1							40.1	41.4	42.0	42.2		42.0	42.1
14	43.3	44.2		42.4		44.5		42.5		42.5										41.1	42.7	42.9		42.9	42.4
15	43.6	43.0		43.3					42.5			42.5							42.5	42.5	42.7	42.9		42.9	43.3

Table 2.4.3.2 Mean weight (kg) at age for NE Atlantic mackerel

Quarters 1–4

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0				0.087		0.102			0.130			0.129	0.064			0.046			0.130	0.076	0.068	0.086	0.103	0.046	0.069
1		0.281		0.218	0.125	0.202	0.206	0.143	0.172	0.130	0.085	0.197	0.167	0.182	0.180	0.178	0.180		0.185	0.184	0.156	0.177	0.177	0.167	0.172
2	0.271	0.238	0.270	0.270	0.250	0.255	0.203	0.225	0.213	0.189	0.179	0.187	0.197	0.248	0.196	0.195	0.170	0.158	0.188	0.189	0.202	0.212	0.215	0.201	0.223
3	0.370	0.326	0.372	0.345	0.332	0.320	0.360	0.277	0.266	0.249	0.254	0.263	0.245	0.291	0.352	0.331	0.264	0.361	0.298	0.289	0.261	0.246	0.296	0.231	0.307
4	0.454	0.393	0.435	0.404	0.459	0.397	0.385	0.357	0.297	0.318	0.314	0.321	0.295	0.334	0.398	0.394	0.335	0.397	0.369	0.357	0.324	0.292	0.336	0.280	0.378
5	0.499	0.450	0.480	0.450	0.505	0.366	0.366	0.401	0.333	0.354	0.351	0.363	0.374	0.349	0.458	0.454	0.398	0.457	0.375	0.370	0.385	0.347	0.365	0.359	0.427
6	0.548	0.508	0.536	0.507	0.523	0.395	0.494	0.460	0.322	0.427	0.409	0.366	0.470	0.351	0.484	0.483	0.441	0.484	0.377	0.390	0.407	0.366	0.417	0.389	0.477
7	0.565	0.531	0.568	0.524	0.582	0.371	0.366	0.484	0.447	0.424	0.421	0.475	0.582	0.375	0.387	0.318	0.475	0.490	0.441	0.424	0.448	0.403	0.449	0.438	0.499
8	0.651	0.586	0.613	0.577	0.559	0.348	0.298	0.527	0.352	0.453	0.447	0.437	0.455	0.370	0.363	0.310	0.529	0.539	0.441	0.449	0.473	0.440	0.503	0.472	0.543
9	0.674	0.621	0.649	0.614	0.581	0.548	0.489	0.549	0.430	0.501	0.501	0.507	0.686	0.418		0.417	0.568	0.605	0.502	0.483	0.493	0.474	0.568	0.491	0.580
10	0.702	0.647	0.694	0.637	0.790	0.469	0.541	0.589	0.386	0.521	0.546	0.656	0.414			0.414	0.620	0.609	0.579	0.495	0.504	0.491	0.613	0.501	0.608
11	0.690	0.599	0.661	0.636	0.731		0.247	0.614	0.514	0.572	0.583	0.420	0.620				0.616	0.626	0.600	0.557	0.547	0.550	0.669	0.537	0.612
12	0.706	0.661	0.708	0.686	0.777		0.267	0.616	0.404	0.580	0.646	0.651					0.578	0.591	0.630	0.533	0.557	0.574	0.733	0.524	0.647
13	0.722	0.729	0.765	0.723	0.747		0.653	0.622	0.597	0.597	0.612	0.595					0.713	0.732	0.621	0.563	0.563	0.587	0.900	0.539	0.668
14	0.788	0.753	0.804	0.753	0.778	0.706	0.626	0.630		0.657	0.657						0.565			0.552	0.594	0.606	0.932	0.573	0.696
15	0.758	0.776	0.824	0.782	0.801		0.577	0.679	0.575	0.683	0.683	0.691					0.670	0.679	0.796	0.609	0.594	0.637		0.573	0.715

Quarter 1

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0																									
1		0.206		0.206	0.206		0.206	0.183		0.085	0.085	0.057	0.057	0.057		0.057				0.151	0.154	0.129	0.114	0.169	0.121
2	0.358	0.202		0.203	0.203		0.203	0.199		0.174	0.176	0.160	0.140	0.148		0.148	0.158	0.158	0.160	0.200	0.201	0.205	0.210	0.198	0.177
3	0.391	0.274		0.275	0.276		0.276	0.272		0.248	0.255	0.244	0.217	0.218	0.362	0.349	0.263	0.361	0.244	0.264	0.256	0.248	0.282	0.229	0.262
4	0.469	0.330		0.330	0.330		0.330	0.357		0.320	0.315	0.307	0.274	0.300	0.398	0.395	0.333	0.397	0.307	0.316	0.315	0.288	0.319	0.275	0.335
5	0.543	0.370		0.365	0.364		0.364	0.402		0.358	0.353	0.332	0.283	0.270	0.458	0.454	0.400	0.457	0.332	0.356	0.379	0.342	0.353	0.355	0.383
6	0.575	0.415		0.410	0.409		0.409	0.459		0.429	0.410	0.334	0.274	0.321	0.484	0.483	0.444	0.484	0.334	0.385	0.402	0.358	0.398	0.382	0.435
7	0.601	0.451		0.437	0.433		0.433	0.482		0.438	0.429	0.473	0.311	0.311		0.311	0.483	0.490	0.473	0.408	0.444	0.389	0.443	0.431	0.460
8	0.663	0.498		0.478	0.473		0.473	0.526		0.491	0.462	0.428	0.329	0.310		0.310	0.536	0.539	0.428	0.448	0.470	0.428	0.496	0.471	0.506
9	0.650	0.540		0.524	0.521		0.521	0.542		0.514	0.508	0.497	0.418	0.418		0.418	0.581	0.605	0.497	0.462	0.490	0.464	0.561	0.490	0.532
10	0.647	0.563		0.545	0.541		0.541	0.585		0.535	0.554	0.727					0.614	0.609	0.727	0.467	0.500	0.472	0.602	0.501	0.564
11		0.531		0.531	0.531		0.531	0.604		0.577	0.587	0.446					0.624	0.626	0.446	0.485	0.547	0.539	0.664	0.538	0.580
12	0.944	0.603		0.603	0.603		0.603	0.614		0.599	0.654	0.622					0.588	0.591	0.622	0.538	0.553	0.542	0.730	0.521	0.601
13		0.653		0.653	0.653		0.653	0.612		0.597	0.613						0.732	0.732		0.542	0.558	0.571	0.804	0.537	0.628
14	0.812	0.626		0.626	0.626		0.626	0.626		0.657	0.657						0.565			0.559	0.587	0.594	0.932	0.567	0.622
15	0.820	0.577		0.577	0.577		0.577	0.681		0.711	0.700						0.670	0.679		0.610	0.587	0.666		0.567	0.672

Table 2.4.3.2 Mean weight (kg) at age (continued)

Quarter 2

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0																									
1		0.302		0.287	0.220	0.100		0.183	0.108			0.094	0.108	0.108	0.108				0.078	0.076	0.120	0.126	0.125	0.132	0.140
2	0.358	0.271		0.268	0.284	0.131		0.199	0.152	0.211	0.211	0.146	0.151	0.151	0.151				0.147	0.150	0.188	0.172	0.200	0.168	0.188
3	0.391	0.374		0.345	0.316	0.195	0.364	0.275	0.207	0.228	0.228	0.220	0.205	0.205	0.359	0.362	0.275		0.221	0.226	0.273	0.237	0.282	0.235	0.257
4	0.469	0.437		0.404	0.393	0.329	0.388	0.348	0.282	0.305	0.305	0.288	0.279	0.279	0.396	0.398	0.341		0.295	0.307	0.341	0.306	0.319	0.316	0.340
5	0.543	0.483		0.460	0.518		0.366	0.393	0.306	0.332	0.332	0.308	0.298	0.298	0.457	0.458	0.387		0.363	0.370	0.392	0.368	0.352	0.393	0.388
6	0.575	0.537		0.514	0.499	0.426	0.496	0.462	0.321	0.396	0.396	0.316	0.318	0.318	0.482	0.484	0.431		0.395	0.402	0.413	0.387	0.396	0.418	0.428
7	0.601	0.569		0.542	0.532		0.365	0.472	0.357	0.350	0.350	0.413	0.398	0.398	0.398		0.448		0.428	0.426	0.452	0.430	0.443	0.458	0.438
8	0.663	0.614		0.593	0.583		0.295	0.518	0.352	0.353	0.353	0.457	0.351	0.351	0.351		0.492		0.466	0.463	0.475	0.461	0.499	0.478	0.467
9	0.650	0.649		0.636	0.624		0.487	0.537	0.430	0.430	0.430	0.579					0.502		0.504	0.495	0.496	0.490	0.550	0.494	0.494
10	0.647	0.695		0.666	0.651			0.589	0.386	0.386	0.386	0.641					0.639		0.535	0.508	0.508	0.514	0.602	0.501	0.536
11	0.700	0.661		0.637	0.617		0.245	0.614	0.514	0.514	0.514						0.577		0.605	0.588	0.548	0.560	0.664	0.533	0.572
12	0.942	0.709		0.709	0.693		0.266	0.618	0.404	0.404	0.404						0.536			0.511	0.560	0.593	0.730	0.529	0.552
13		0.765		0.754	0.748			0.614	0.597	0.597	0.597	0.811					0.572		0.628	0.573	0.567	0.599	0.802	0.542	0.592
14	0.812	0.804		0.788	0.778			0.618												0.523	0.599	0.613		0.583	0.610
15	0.820	0.824		0.810	0.801			0.670	0.575	0.575	0.575	0.820							0.820	0.601	0.599	0.615		0.583	0.630

Quarter 3

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0						0.110						0.046	0.047			0.046					0.069		0.109	0.045	0.059
1		0.302		0.236	0.220	0.199		0.148				0.160	0.160	0.272	0.180	0.160	0.180			0.135	0.208	0.194	0.223	0.185	0.205
2	0.268	0.280	0.270	0.272	0.284	0.258		0.250	0.211	0.211		0.202	0.202	0.294	0.197	0.202	0.197			0.191	0.246	0.235	0.266	0.226	0.263
3	0.369	0.397	0.372	0.378	0.315	0.318	0.364	0.296	0.228	0.228		0.247	0.247	0.341	0.321	0.247	0.280			0.226	0.257	0.253	0.313	0.247	0.368
4	0.453	0.467	0.435	0.444	0.356	0.402	0.388	0.346	0.305	0.305		0.298	0.299	0.362	0.396	0.298				0.247	0.301	0.310	0.351	0.298	0.446
5	0.497	0.521	0.480	0.492	0.535	0.369	0.366	0.357	0.332	0.332		0.283	0.287	0.391	0.456	0.283				0.277	0.338	0.339	0.388	0.332	0.493
6	0.546	0.563	0.536	0.543	0.524	0.386	0.496	0.411	0.396	0.396		0.376	0.390	0.386	0.483	0.376				0.283	0.378	0.365	0.438	0.374	0.543
7	0.563	0.586	0.568	0.572	0.535	0.362	0.365	0.445	0.350	0.350		0.398	0.427	0.382	0.382	0.398				0.294	0.426	0.398	0.498	0.424	0.567
8	0.650	0.627	0.613	0.616	0.627	0.348	0.295	0.490	0.353	0.353		0.302	0.336	0.384	0.384	0.302				0.335	0.448	0.413	0.518	0.444	0.620
9	0.674	0.648	0.649	0.649	0.628	0.548	0.487	0.661	0.430	0.430		0.369	0.402			0.369				0.351	0.469	0.439	0.593	0.469	0.651
10	0.706	0.713	0.694	0.698	0.657			0.637	0.386	0.386		0.414	0.414			0.414				0.480	0.472	0.459	0.644	0.486	0.699
11	0.690	0.661	0.661	0.661	0.746		0.245	0.692	0.514	0.514			0.620							0.392	0.530	0.527	0.699	0.533	0.658
12	0.703	0.721	0.708	0.711	0.811		0.266	0.667	0.404	0.404										0.541	0.520	0.539		0.535	0.705
13	0.722	0.765	0.765	0.765	0.722			0.774	0.597	0.597										0.536	0.535	0.566	0.989	0.544	0.763
14	0.784	0.804	0.804	0.804	0.800			0.735												0.549	0.558	0.595		0.572	0.802
15	0.729	0.824	0.824	0.824	0.770			0.684	0.575	0.575										0.619	0.558	0.595		0.572	0.820

Table 2.4.3.2 Mean weight (kg) at age (continued)

Quarter 4

Ages	IIa	IIIa	IIIb	IVa	IVb	IVc	Vb	VIa	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc east	VIIIc west	Ixa central	Ixa north	Total
0				0.087		0.088			0.130			0.130	0.064						0.130	0.076	0.067	0.086	0.095	0.067	0.080
1		0.200		0.200	0.000	0.225		0.141	0.173	0.140		0.199	0.169	0.214	0.180	0.180	0.180		0.185	0.185	0.195	0.186	0.223	0.210	0.167
2	0.270	0.291		0.284	0.023	0.274		0.255	0.216	0.254		0.239	0.227	0.266	0.197	0.198	0.197		0.194	0.194	0.233	0.232	0.267	0.264	0.241
3	0.376	0.370		0.358	0.347	0.344	0.364	0.297	0.268	0.291		0.318	0.287	0.294	0.280	0.280	0.280		0.315	0.315	0.249	0.247	0.312	0.271	0.339
4	0.457	0.424		0.416	0.460	0.382	0.388	0.366	0.298	0.329		0.364	0.331	0.334		0.309			0.376	0.376	0.294	0.282	0.356	0.307	0.403
5	0.496	0.482		0.463	0.457	0.357	0.366	0.397	0.337	0.324		0.401	0.469	0.326		0.389			0.381	0.381	0.323	0.315	0.394	0.321	0.455
6	0.555	0.576		0.525	0.525	0.437	0.496	0.509	0.321	0.376		0.420	0.516	0.389		0.383			0.367	0.366	0.357	0.355	0.434	0.349	0.520
7	0.583	0.557		0.525	0.585	0.497	0.365	0.532	0.498	0.408		0.498	0.636	0.394		0.498			0.446	0.445	0.396	0.400	0.498	0.381	0.525
8	0.652	0.607		0.580	0.558	0.350	0.295	0.553	0.433	0.458		0.433	0.600	0.453					0.435	0.435	0.419	0.435	0.517	0.404	0.566
9	0.686	0.657		0.614	0.579		0.487	0.634	0.521	0.634		0.521	0.776						0.521	0.476	0.427	0.440	0.593	0.430	0.616
10	0.709	0.651		0.635	0.837	0.469		0.641	0.399	0.641		0.399							0.399	0.474	0.465	0.480	0.644	0.492	0.634
11	0.687	0.604		0.660	0.747		0.245	0.750	0.410	0.750		0.410	0.620						0.410	0.489	0.513	0.532	0.699	0.527	0.641
12	0.730	0.635		0.684	0.786		0.266	0.683	0.662	0.683		0.662							0.662	0.496	0.494	0.534	0.758	0.533	0.667
13	0.722	0.622		0.707	0.747			0.789	0.548	0.789		0.548							0.548	0.526	0.538	0.544		0.535	0.701
14	0.784	0.795		0.726		0.706		0.747		0.747										0.513	0.564	0.572		0.572	0.727
15	0.729	0.760		0.772					0.568			0.568							0.568	0.571	0.564	0.572		0.572	0.766

Table 2.4.3.3 Calculation of mean weights in the stock for NEA for the past 3 years

YEAR **1999**

weighting according egg prod. by area in 1998

AGE	WESTERN stock weight	WESTERN stock number	SOUTHERN stock weight	SOUTHERN stock number	North S. stock weight	North S. stock number	AGE	NORTH EAST ATLANTIC MACKEREL weighted mean weight	number
1	0.070	0.73	0.161	0.25	0.138	0.02	1	**0.094**	1
2	0.195	0.73	0.248	0.25	0.23	0.02	2	**0.209**	1
3	0.237	0.73	0.305	0.25	0.314	0.02	3	**0.256**	1
4	0.301	0.73	0.354	0.25	0.357	0.02	4	**0.315**	1
5	0.350	0.73	0.385	0.25	0.438	0.02	5	**0.361**	1
6	0.401	0.73	0.427	0.25	0.464	0.02	6	**0.409**	1
7	0.360	0.73	0.455	0.25	0.418	0.02	7	**0.385**	1
8	0.446	0.73	0.493	0.25	0.471	0.02	8	**0.459**	1
9	0.491	0.73	0.511	0.25	0.529	0.02	9	**0.497**	1
10	0.503	0.73	0.545	0.25	0.545	0.02	10	**0.514**	1
11	0.452	0.73	0.548	0.25	0.55	0.02	11	**0.478**	1
12	0.565	0.73	0.617	0.25	0.63	0.02	12	**0.579**	1
13	0.567	0.73	0.622	0.25	0.66	0.02	13	**0.583**	1
14	0.585	0.73	0.656	0.25	0.68	0.02	14	**0.605**	1
15+	0.611	0.73	0.716	0.25	0.69	0.02	15+	**0.639**	1
			Constant 1984-NOW		**1991/H:11** constant 1984-now		12+	0.601	

YEAR **2000**

weighting according egg prod. by area in 1998

AGE	WESTERN stock weight	WESTERN stock number	SOUTHERN stock weight	SOUTHERN stock number	North S. stock weight	North S. stock number	AGE	NORTH EAST ATLANTIC MACKEREL weighted mean weight	number
1	0.070	0.73	0.161	0.25	0.138	0.02	1	**0.094**	1
2	0.187	0.73	0.248	0.25	0.23	0.02	2	**0.203**	1
3	0.236	0.73	0.305	0.25	0.314	0.02	3	**0.255**	1
4	0.282	0.73	0.354	0.25	0.357	0.02	4	**0.301**	1
5	0.350	0.73	0.385	0.25	0.438	0.02	5	**0.360**	1
6	0.385	0.73	0.427	0.25	0.464	0.02	6	**0.397**	1
7	0.392	0.73	0.455	0.25	0.418	0.02	7	**0.408**	1
8	0.448	0.73	0.493	0.25	0.471	0.02	8	**0.460**	1
9	0.494	0.73	0.511	0.25	0.529	0.02	9	**0.499**	1
10	0.489	0.73	0.545	0.25	0.545	0.02	10	**0.504**	1
11	0.539	0.73	0.548	0.25	0.55	0.02	11	**0.542**	1
12	0.518	0.73	0.617	0.25	0.63	0.02	12	**0.545**	1
13	0.524	0.73	0.622	0.25	0.66	0.02	13	**0.551**	1
14	0.552	0.73	0.656	0.25	0.68	0.02	14	**0.580**	1
15+	0.574	0.73	0.716	0.25	0.69	0.02	15+	**0.612**	1
			Constant 1984-NOW		**1991/H:11** constant		12+	0.572	

YEAR **2001**

weighting according egg prod. by area in 2001

AGE	WESTERN stock weight	WESTERN stock number	SOUTHERN stock weight	SOUTHERN stock number	North S. stock weight	North S. stock number	AGE	NORTH EAST ATLANTIC MACKEREL weighted mean weight	number
1	0.070	0.85	0.127	0.12	0.12	0.03	1	**0.078**	1
2	0.158	0.85	0.196	0.12	0.209	0.03	2	**0.164**	1
3	0.237	0.85	0.259	0.12	0.295	0.03	3	**0.241**	1
4	0.345	0.85	0.320	0.12	0.342	0.03	4	**0.342**	1
5	0.392	0.85	0.382	0.12	0.364	0.03	5	**0.390**	1
6	0.452	0.85	0.404	0.12	0.437	0.03	6	**0.446**	1
7	0.461	0.85	0.445	0.12	0.444	0.03	7	**0.459**	1
8	0.506	0.85	0.470	0.12	0.429	0.03	8	**0.499**	1
9	0.535	0.85	0.491	0.12	0.509	0.03	9	**0.529**	1
10	0.586	0.85	0.502	0.12	0.606	0.03	10	**0.576**	1
11	0.610	0.85	0.545	0.12	0.643	0.03	11	**0.603**	1
12	0.589	0.85	0.570	0.12	0.55	0.03	12	**0.586**	1
13	0.524	0.85	0.622	0.12	0.66	0.03	13	**0.540**	1
14	0.552	0.85	0.656	0.12	0.68	0.03	14	**0.568**	1
15+	0.574	0.85	0.716	0.12	0.69	0.03	15+	**0.595**	1
			Constant 1984-NOW		**1991/H:11** constant		12+	0.586	

2.5 Extension of the Assessment Input Data Set: SGDRAMA

At the 2000 WG meeting, a method for extending the catch data set for the Southern area back to 1972 was presented to the WG (WD Uriarte *et al.* 2000, reproduced in the Annex 3 to this year's report) and adopted. However, it became clear that a major revision of the Western and North Sea catch data was also needed before the different data sets could be combined. Therefore, the WG recommended last year to form a Study Group verifying total catch and catch-at-age data for North-East Atlantic mackerel for the early period (back to 1972) in the Western and North Sea area. This *ad hoc* Study Group on Data Revision and Archaeology for the NEA Mackerel Assessment (SGDRAMA) met in April 2002 in conjunction with WGMEGS in Dublin, Ireland.

The purpose of this *ad hoc* study group was threefold: (i) to provide validated input data for the assessment of the North-East Atlantic (NEA) mackerel stock to the WGMHSA; (ii) to document clearly problems identified in the historical dataset; and (iii) to provide a record of the decisions made during the preparation of the updated, combined dataset for 1972–2000 (catch data 1963–2000). A comparative assessment using previous and updated input data gave very similar results. The main reason for the extension of the data set was the need for a longer time series for the calculation of geometric mean recruitment. So far, the recruitment has been calculated separately for the Western stock component and then raised to the total stock. The recruitment calculated by both methods within SGDRAMA differed only by 3.2%, if the same settings were used in the assessment. Therefore, the SG recommended to use the new dataset also for the estimation of long-term geometric mean recruitment and to skip the laborious separate assessment for the Western mackerel component at future WGMHSA meetings. A detailed description of the procedures followed by SGDRAMA can be found in the study group's report, which is printed as Annex 1 to this WGMHSA's report.

A working document by Eltink *et al.* (WD 2002) presented a revision of mean weights-at-age in the stock and proportion mature-at-age for the Southern mackerel to this year's WG. The update required a further recalculation of the combined WEST and MATPROP data for the NEA mackerel. This Working Document is also reproduced as an Annex 3 to this year's WGMHSA report.

2.6 Fishery-independent Information

2.6.1 Egg survey estimates of spawning biomass in 2001

2.6.1.1 Description

The ICES Triennial Mackerel and Horse Mackerel Egg Survey was carried out from January to July 2001. The results of the survey were presented at WGMEGS in Dublin April 2002. The WGMEGS meeting was responsible for the completion of the analysis of the egg survey and the provision of spawning stock biomass estimates to WGMHSA. The report is available as ICES CM 2002/G:06. The conclusions from this report are presented here in summary. The previous report of WGMHSA included preliminary data and maps. These have been updated and completed for this report.

The survey has been analysed using seven contiguous periods – see table below

Period	Dates
1	21 January – 10 February
2	11 February – 10 March
3	11 March – 8 April
4	9 April – 13 May
5	14 May – 10 June
6	11 June – 1 July
7	2 July – 23 July

The analysis protocols followed those described in the report of WGMEGS (ICES 2000/G:01). Interpolation into unsampled rectangles was carried out manually according to the rules set down in that report. Arithmetic means were used where more than one sample per rectangle per period were collected.

Conversion to biomass was carried out using PreSSB-SSB ratio, fecundity and sex ratio as in 1998.

2.6.1.2 Results

Figures 2.6.1.1 – 7 show the mean daily egg production for mackerel by rectangle by period. Post plots of daily egg production values were square root scaled to the maximum at a single station of 600 eggs m^{-2} d^{-1}.

- Period 1 (Fig 2.6.1.1) – Only the Division IXa was surveyed during this period. Very little production was seen in this period, with the main concentrations off the Galician coast.
- Period 2 (Fig 2.6.1.2) – In this period both the Portuguese and Spanish coast were surveyed. Again, production was very low. The highest production was again off the Galician coast. Low levels of production were observed along both coasts.
- Period 3 (Fig 2.6.1.3) – This was the first period with full coverage. Little interpolation was required. High levels of production were seen along the Spanish coast, the Celtic Sea and on Porcupine Bank. Outside edges were well defined except between 48 & 49°N and at 53° 45N.
- Period 4 (Fig. 2.6.1.4) – There was good coverage in this period with well defined edges and little interpolation. Main concentrations were in the east of the Cantabrian Sea and west of Ireland.
- Period 5 (Fig. 2.6.1.5) – Again, there was good coverage and edge definition, except at SW edge of Porcupine Bank at 51°N. Production was found in a wide band from Biscay to the Hebrides.
- Period 6 (Fig 2.6.1.6) – There was a considerable amount of interpolation in this period mainly due to occupation of alternate transects, but coverage and edges were good. Again production was concentrated in the Celtic Sea, Porcupine Bank and north and west of Ireland.
- Period 7 (Fig 2.6.1.7) – As in period 6 the survey was based on alternate transects. However, the interpolation was sound in all areas except on the southern edge, where there were large values on the southern border. The potential for missed production south of this must be considered.

2.6.1.3 Fecundity and atresia

A total of 227 fecundity samples were taken from 15 different locations between 44 and 59°N and between weeks 7 and 16. This allowed an understanding of latitudinal variation in fecundity – this is discussed more extensively in Section 2.6.1.6. For the western area, the calculated potential fecundity was 1097 and the realised fecundity (after atresia) was 1033 eggs per gram female. Atresia was calculated as 46 eggs per gram female (similar to 1998) with an intensity of 20% (down from 55% in 1998). For the southern area the calculated potential fecundity was 1689 and the realised fecundity (after atresia) was 1647 eggs per gram female. Atresia was calculated as 68 eggs per gram female (similar to 1998) with an intensity of 8% (down from 15% in 1998).

This represents the best sampling to date for fecundity.

2.6.1.4 Egg production and SSB estimates

The total annual egg production in the west was 1.21 x 10^{15}. The egg production curve was well behaved, in contrast to 1998. The egg production curve is presented in Figure 2.6.1.8. This translates to an SSB estimate of 2.53 million tonnes.

The total annual egg production in the south was 0.28 x 10^{15}. The egg production curve was also well behaved, in contrast to 1998. The egg production curve is presented in Figure 2.6.1.9. This translates to an SSB estimate of 370,000 tonnes.

2.6.1.5 Supplementary surveys outside the standard area in 2002

In 2002 a further mackerel and horse mackerel egg survey was carried out by the Irish Marine Institute to investigate whether significant spawning occurs outside the ICES standard area. 173 ICES rectangles were sampled on the Porcupine, Rockall and Hatton Banks, the Rockall Trough and Faroese waters. Stage 1 Mackerel eggs were found south and east of the Rockall Bank and south of the Faroes Bank extending eastwards to the Scottish Shelf. Daily egg production per ICES rectangles outside the standard area was however less than 1% of egg production measured inside the standard area in the same sampling period in 2001 suggesting that mackerel spawning outside the standard area does not significantly contribute to the egg production estimate. Further details are given in the WD: Dransfeld, *et al.,* 2002.

2.6.1.6 Problems with the estimates

It should first be stated that the 2001 survey was probably the best that has been carried out to date. The survey itself had full coverage over the complete spawning season. There was little problem with interpolation or with spatio-temporal confusion, which had affected previous surveys. The egg production curves were well behaved with the first and last periods being relatively low. A very important increase in the number of samples for fecundity was achieved, and although many of these had to be rejected, the spatial and temporal range was considerably improved. However there were a small number of areas which require further development. A detailed appraisal of these are included below and should be passed to the WGMEGS for consideration at their next meeting in April 2003.

Three key areas were identified for examination; Fecundity measurement, species ID and staging; and variance estimation. Each area of work has been detailed along with the logistical implications.

Fecundity measurement

Four major areas for development were identified for fecundity measurement: Temporal resolution/variability, spatial resolution/variability, interaction of fecundity estimation with migration patterns and validation of recently observed changes in fecundity .

- **Temporal resolution and variability** – The 1998 and 2001 surveys have clearly shown evidence of a drop in potential fecundity after 1995. When this was first observed in 1998 it was treated with some scepticism as it was the first major deviation in measured fecundity in the time series. This was exacerbated by the fact that egg production dropped to 1998 but when combined with the realised fecundity gave a sharply increased biomass 1995-98. The 2001 survey showed a similar level to 1998, and could be considered as substantiating that figure. This shows the need to track fecundity at a higher temporal resolution than the current 3 year cycle. Annual sampling would give a better understanding of inter year variability and would avoid surprises caused by changes in the historical pattern such as was seen in 1998.

  Logistics: Samples could be collected by commercial vessels working in the first quarter fishery on the western shelf edge – these would be mainly Scottish and Irish vessels. Additionally opportunistic sampling could be carried out on appropriate RVs. For this to work, the Gilson Free fixing method developed by Peter Withames at CEFAS would need to validated and available. WGMEGS should define sample sizes and preferred locations. The best option would be to charter a commercial vessel but it is recognized that this would be an expensive option.

- **Spatial resolution and variability –** The relatively high fecundity sampling carried out in 2001 allowed, for the first time, an analysis of the spatial variability in measured fecundity. The preliminary analysis of these data indicated a latitudinal effect, with fish sampled in the south of the western area showing a higher fecundity than further north. Historically we have used these data to generate a single eggs per gram female fecundity figure which is then applied globally. If the latitudinal effect is confirmed it should be possible to develop geographically stratified fecundity values which can then be applied to egg production estimates by region. A special case in this context is the fecundity samples collected in the southern area, and this is considered in the following section. In addition to this, samples for fecundity estimation should be collected throughout the spawning period, particularly in the main spawning areas. This would allow examination of the evolution of fecundity in the different areas over time.

  Logistics: As a minimum, the level of sampling carried out in 2001 should be maintained in 2004 and beyond. Sample collection from commercial vessels (see above) in the fishery should probably be maintained in survey years. It is probably better to have more samples than we can analyse rather than the reverse.

- **Interaction of fecundity estimation with migration patterns** – Fecundity samples are, by necessity, collected prior to the actual spawning season. In the southern area, in particular, this means that samples are collected from a population dominated by very young fish. These are also probably resident, or at least migrate only short distances. By the time of peak spawning the population is dominated by older fish which have migrated in from the north, these probably have a fecundity better indicated by sampling in the western area. In 2001 the measured fecundity in the southern area was 1647 eggs per gram female, while in the west it was 1033. So the question is what fecundity should be used in the southern area? There is also probably a migration interaction in the western area as well. If we plan to use geographical fecundity strata, the fish will be migrating through these, so again, samples taken prior to the spawning season may not be completely representative of the actual spawning population.

Logistics: WGMEGS should consider the validity of continuing to use small fish samples collected in the Southern area to convert the egg production to biomass. 2001 samples as well as those from previous years should be re-examined to determine how well these fit with western samples. The relationships between observed fecundity and condition factor should also be examined. This should represent a desk study requiring little extra resources. The examination of latitudinal variation should be completed and it's implications wrt. migration considered by WGMEGS

- **Validation of recently observed changes in fecundity** – Until the 1998 egg survey measured mackerel fecundity levels had been relatively stable –1400 to 1600 (potential fecundity), 1200 to 1400 (realised fecundity). Potential fecundity in 1998 was 1206, and 1097 in 2001. For realised fecundity the figures were 1002 and 1033 respectively. So there would appear to be a step change in fecundity prior to the 1998 survey. The quality of data particularly in 2001, and to a lesser extent in 1998 was better than in previous years. We can conclude that these figures were valid observations. This leaves the question of why we see a step change prior to 1998. Was there an actual change in the biology of the fish or were there problems in the analysis. It is probably impossible to prove the latter, but there a number of lines of investigation to answer the former. One possibility is to re-examine the data used in the fecundity estimates for other correlated changes. Three solutions could be examined

a) Systematic differences in condition factor in the fish samples – can we explain low fecundity by poor condition factor.

b) Systematic differences in the gonado-somatic index (GSI)– can we explain low fecundity by female fish having smaller ovaries. GSI data on routine sampling in 2003/4

c) Given the latitudinal effect observed in 2001 – where were the earlier samples taken, and could the step change be explained by the location of sampling.

Logistics: If the data are still available, this work should be a relatively small scale desk study. Initial work can be done using the relatively small sample sizes used in the fecundity estimation. The extraction of other relevant data from landings or research surveys, to give information on cf in the previous year may be slightly greater. Decisions on this should await the results of the first stage using the survey samples. In the interim institutes should encouraged to collect GSI data from routine mackerel samples collected in 2004.

Species ID and staging

- Identification of eggs to species and stage remains one of the core requirements for the conduct of egg surveys. Recent exchange programmes have given mixed messages as to how wide a range of variability is introduced in this step in the process. In the short term, the problem can be minimised with the use of regular workshops and exchange programmes. These should become a regular part of the survey process. It is proposed that an egg ID and staging workshop be held prior to the 2004 egg survey (possibly autumn 2003) and at 3 year intervals after that. A standard set of photographs of stages in mackerel and horse mackerel should be prepared for this workshop and circulated to all participants in the surveys.

  Logistics: An ID and staging workshop should be proposed for autumn 2003. ToR should be set by WGMHSA September 2002.

- In the longer term, more reliable methods, particularly for species ID should be developed. The most promising approach would seem to be the use of DNA probes. Some progress has been made on this at CEFAS and a new project is proposed at FRS-MLA. There are also reports of an EU project entitled MarineEggs which may be able to provide assistance in this area.

  Logistics:. Any proposed studies e.g. DNA probes, should be positively encouraged – as these are likely to be expensive these should either be major funded national or international programmes.

Variance estimation

The estimation of variance for the egg surveys is currently carried out using the approach developed by Fryer (ICES 1996). There are two requirements here, firstly to clarify the current methodology and present it to all practitioners and secondly to examine the adequacy of current variance estimators in the light of new statistical methods.

- **Clarification of current methodology** – The methods and approach currently used are complex and incorporate several steps and a bootstrap estimator. The estimation of variance in the fecundity estimates and its combination with the survey estimator are also unclear in some cases. The best approach to this is to have the relevant people present the methods used to all current practitioners. The aim would be to ensure the method is understood and applied in a uniform fashion for all surveys and components.

  Logistics: This should probably be a component of the meeting of WGMEGS in April 2003. Another possibility is to address this requirement along with the second requirement – this could probably be best done at a joint workshop for WGMEGS/SGSBSA (see below)

- **New variance estimators** – The methodology for the estimation of variance in these surveys is now relatively dated. It uses Fortran routines that are over 15 years old and for which compilers are difficult to obtain. Many new methods are now available for estimating variance e.g. Geostatistics or GAM. Further the current estimator includes only some of the known components of variance e.g. it does not include ID and staging variability, or sampler variability. A study of sources and scale of variance has been carried out at Imperial College, London as part of the GBMAF project. A new, simpler and more inclusive tool for estimating variance would be very useful

  Logistics: The problems here are not unique to the mackerel egg surveys. This aspect would be best covered at a joint workshop with WGMEGS and SGSBSA. Other aspects for this workshop could include ID and staging, as well as survey design etc. The workshop might best be held in conjunction with either WGMEGS or SGSBSA.

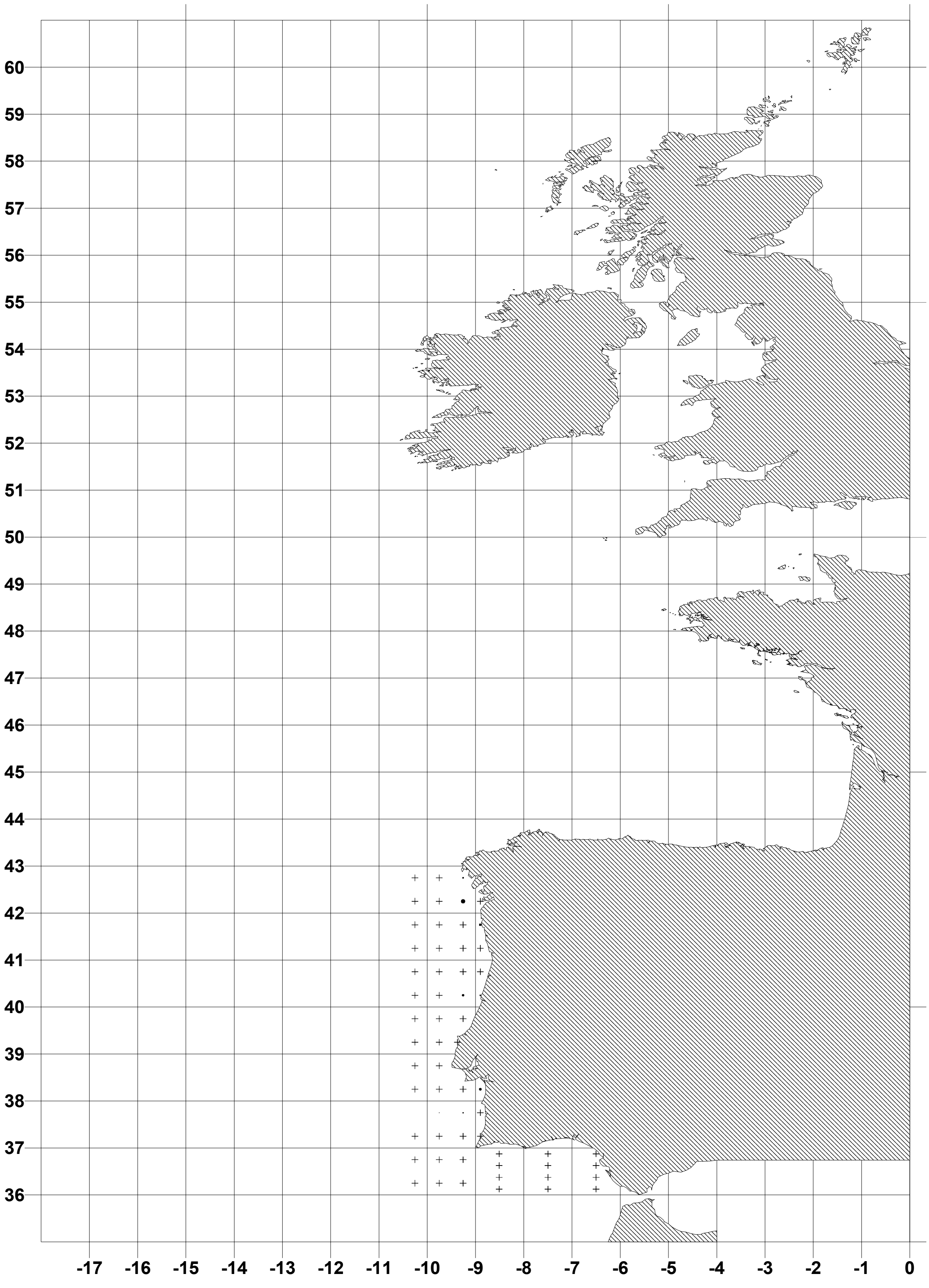


Figure 2.6.1.1. Mackerel egg production by rectangle for period 1 (21 January – 10 February). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 800 eggs m^{-2} day^{-1}.

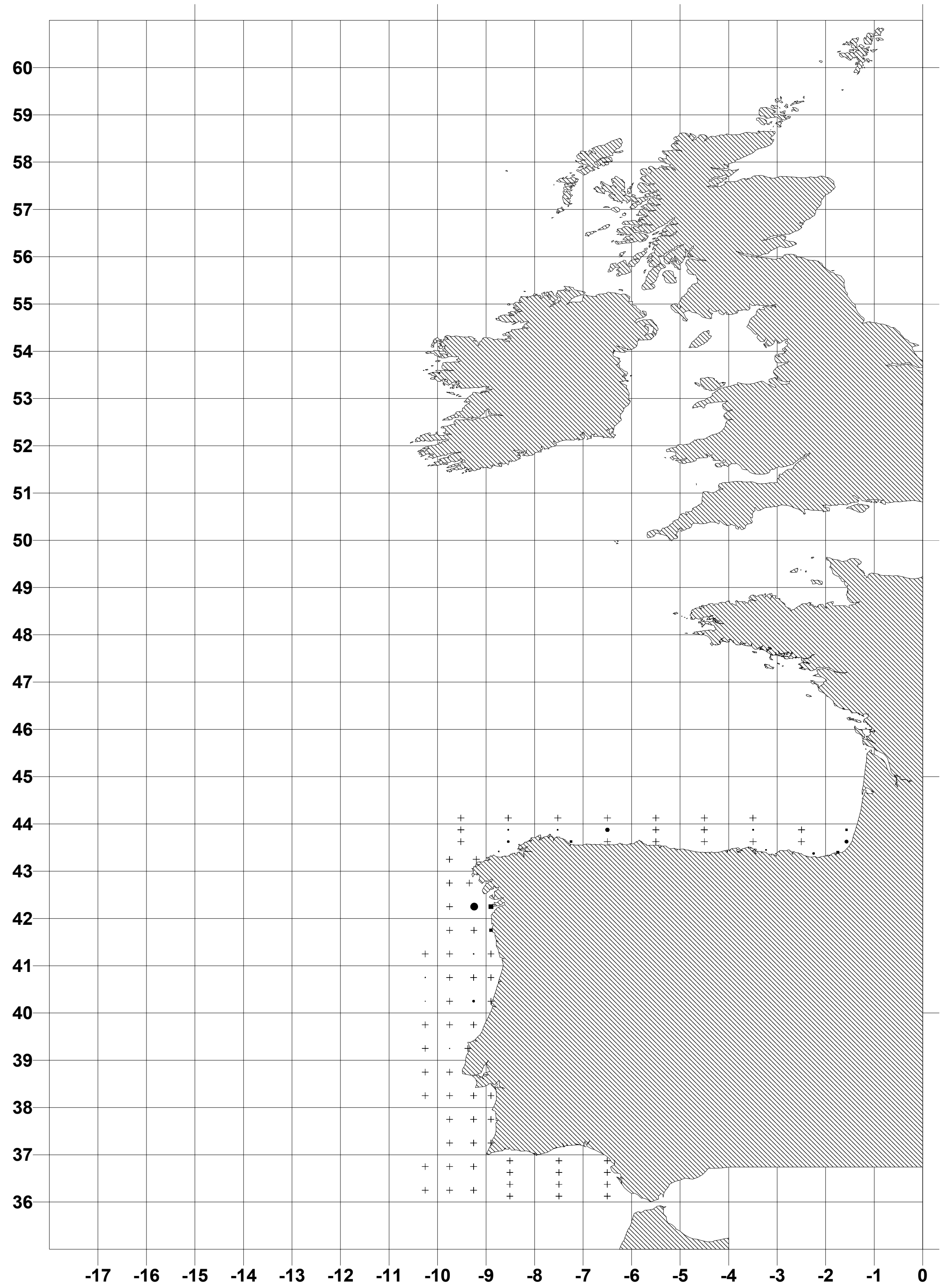


Figure 2.6.1.2. Mackerel egg production by rectangle for period 2 (11 February – 11 March). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 800 eggs m^{-2} day^{-1}.

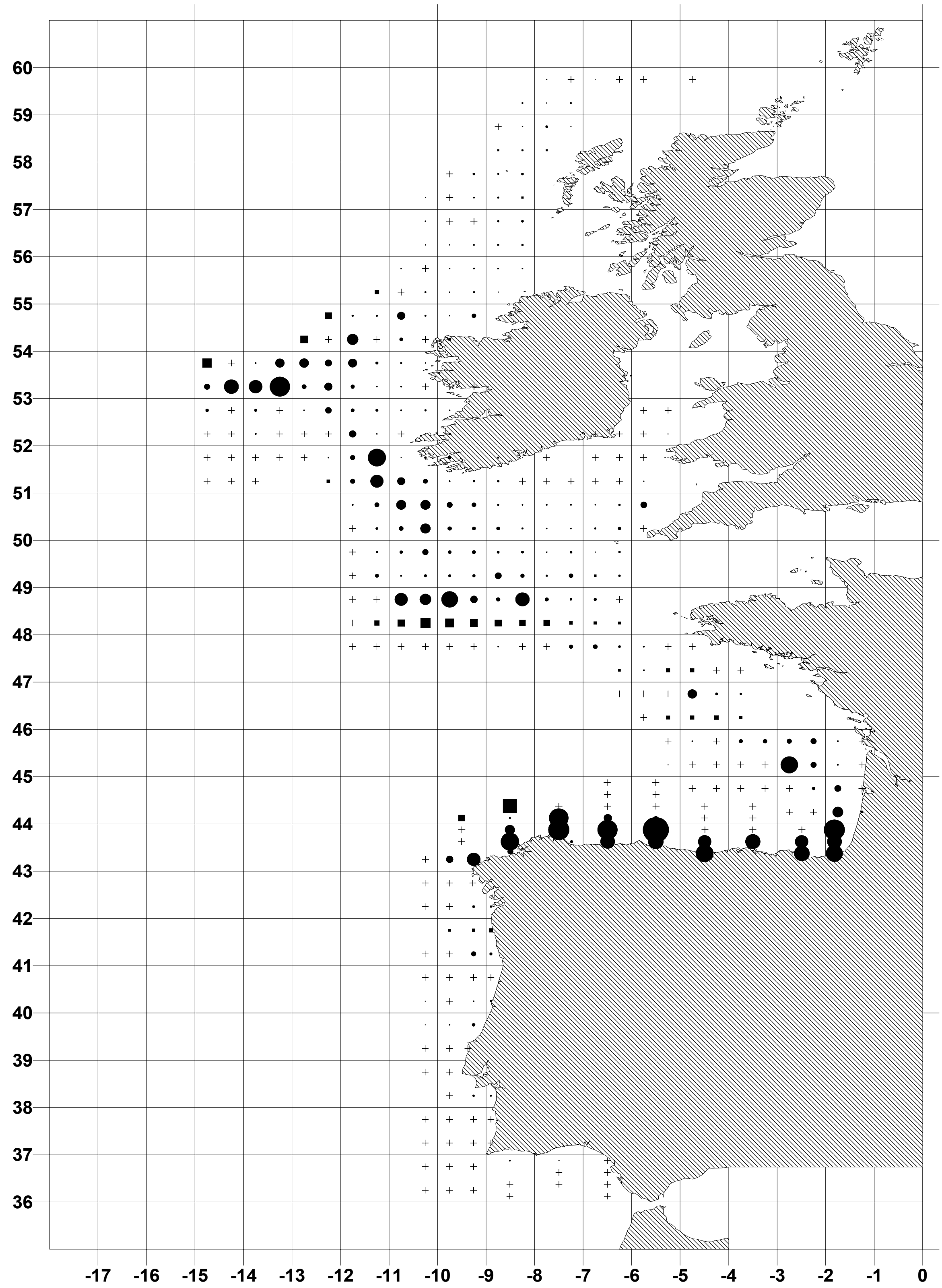


Figure 2.6.1.3. Mackerel egg production by rectangle for period 3 (12 March – 8 April). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 800 eggs m^{-2} day^{-1}.

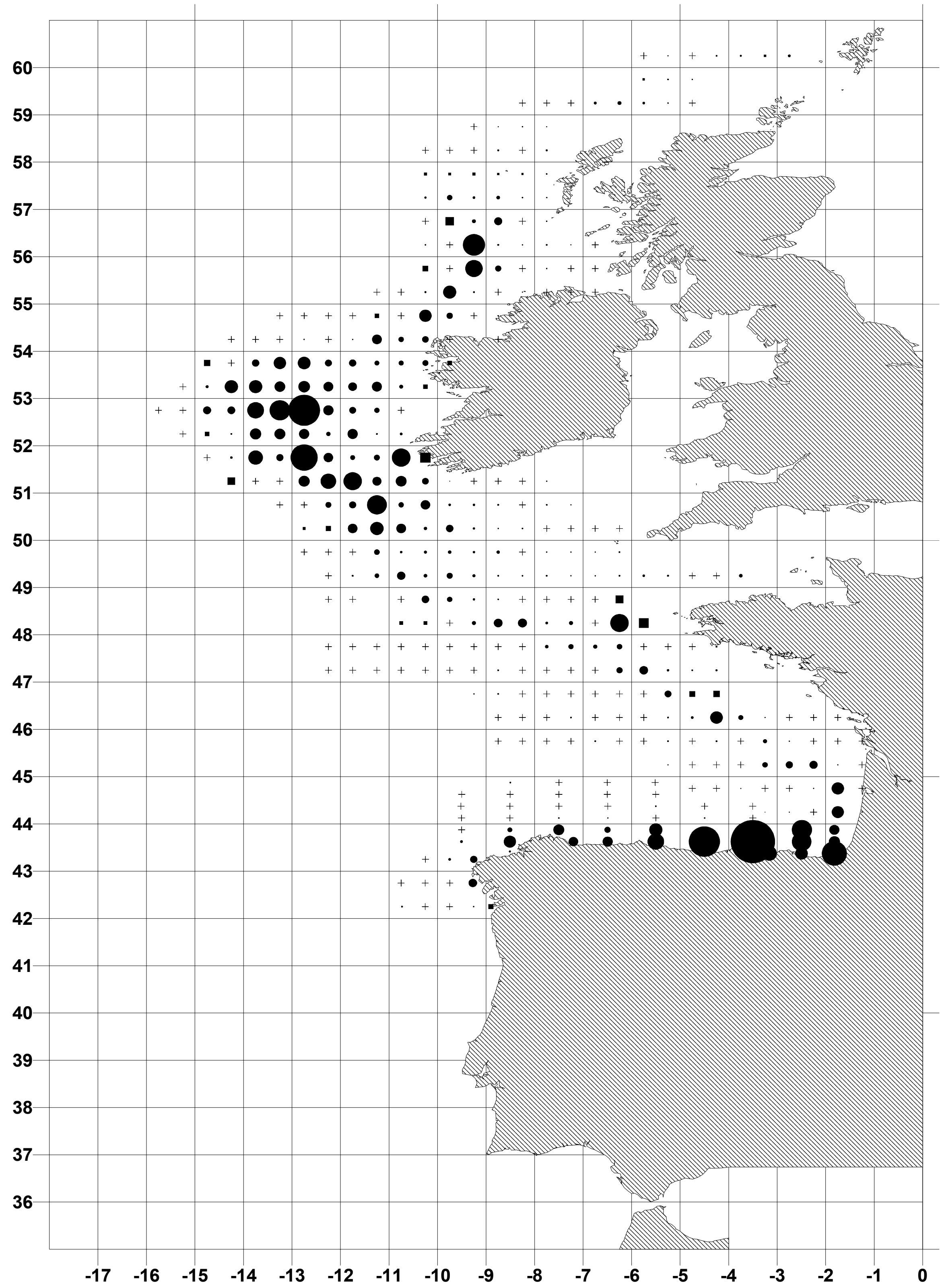


Figure 2.6.1.4. Mackerel egg production by rectangle for period 4 (9 April – 13 May). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 800 eggs m^{-2} day^{-1}.

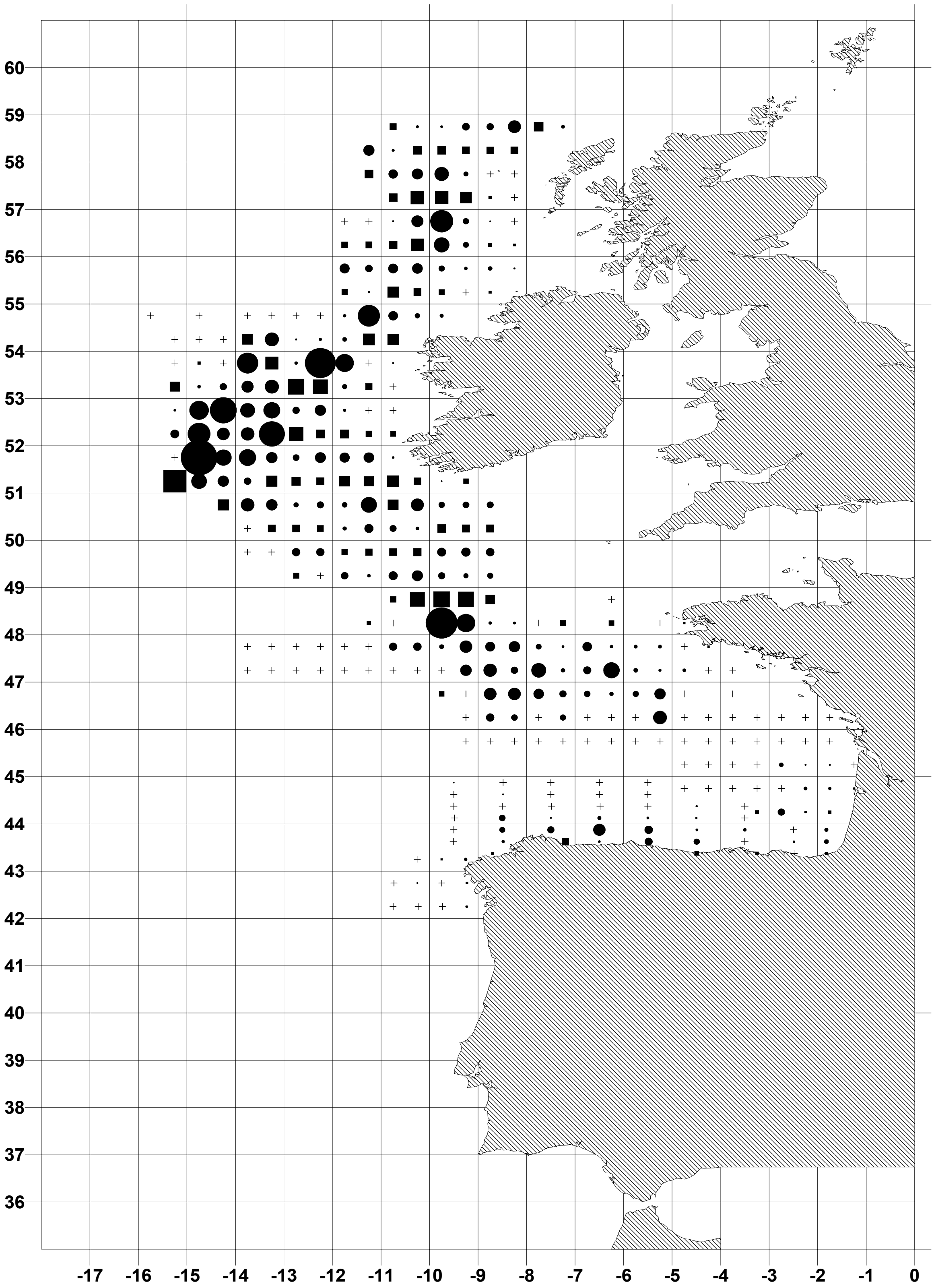


Figure 2.6.1.5. Mackerel egg production by rectangle for period 5 (14 May – 10 June). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 800 eggs m^{-2} day^{-1}.

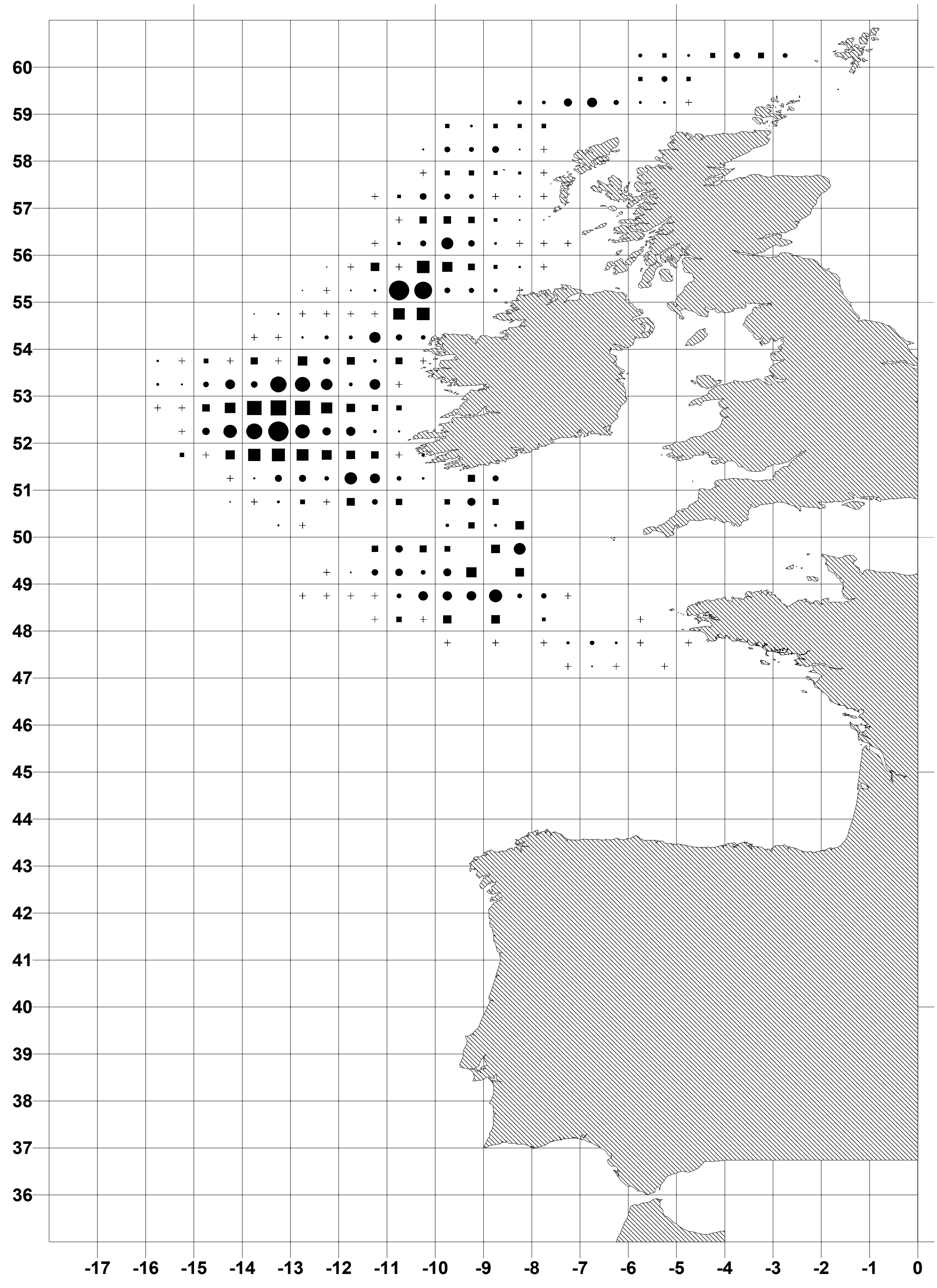


Figure 2.6.1.6. Mackerel egg production by rectangle for period 6 (11 June – 1 July). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 800 eggs m^{-2} day^{-1}.

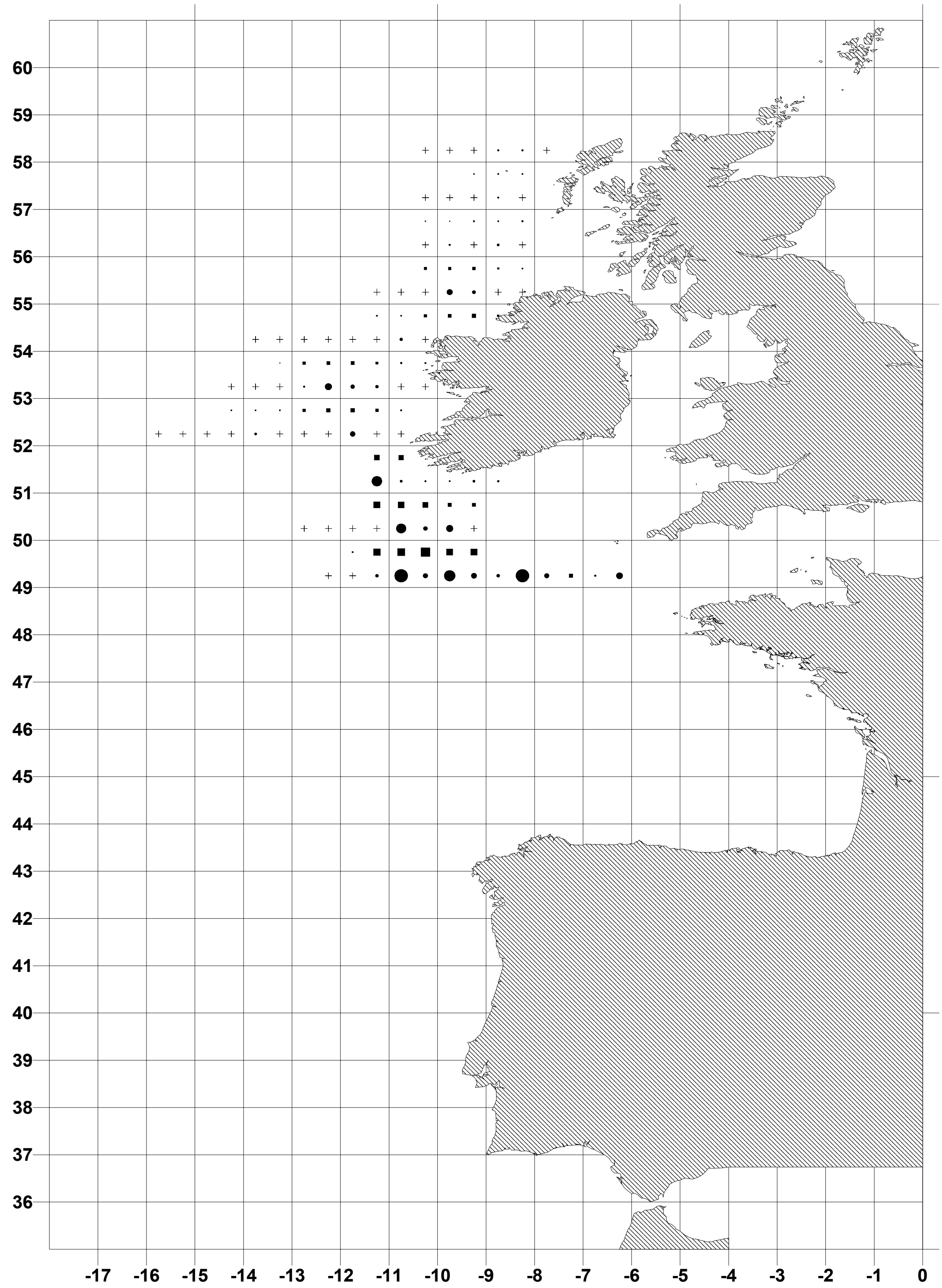


Figure 2.6.1.7. Mackerel egg production by rectangle for period 7 (2 July – 1 August). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 800 eggs m^{-2} day^{-1}.

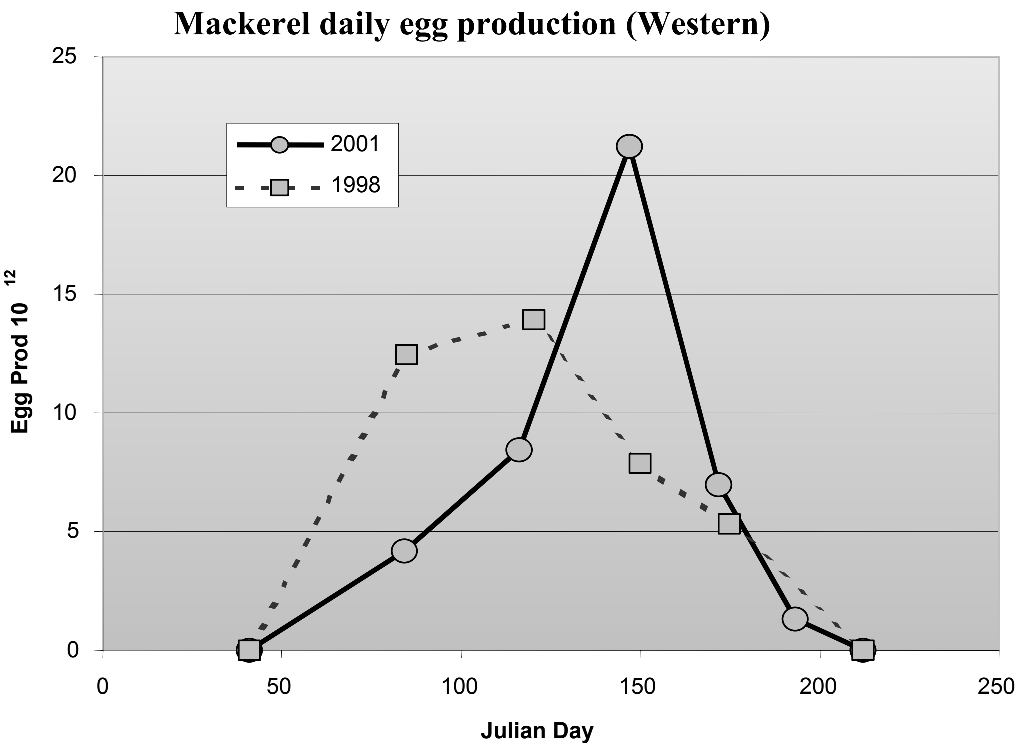


Figure 2.6.1.8. Mackerel daily egg production curve for the western area. 1998 data are included for comparison.

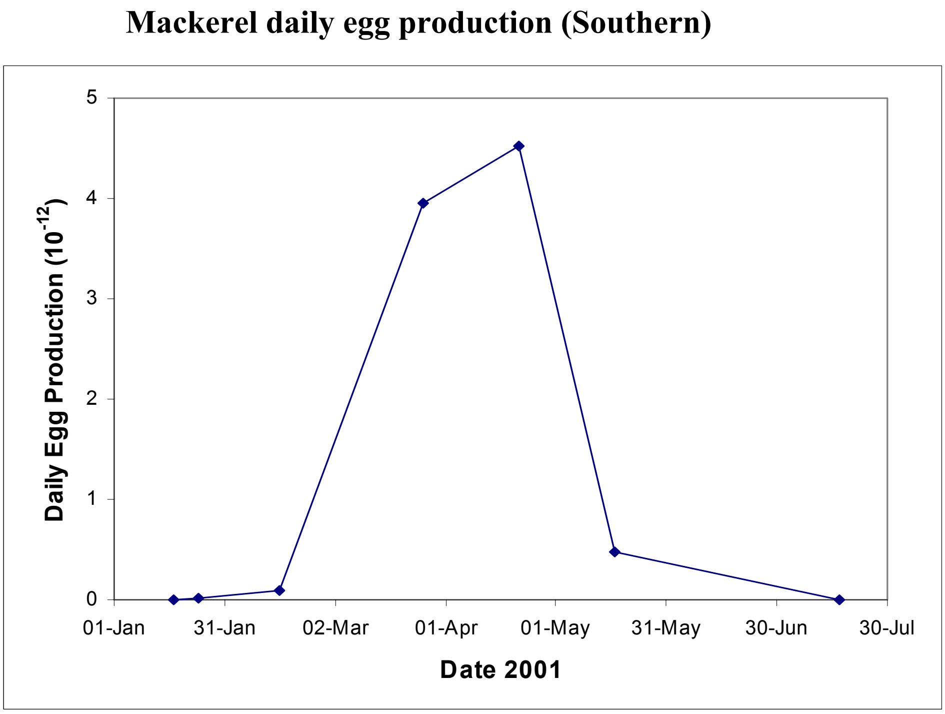


Figure 2.6.1.9. Mackerel daily egg production curve for the southern area.

2.6.2 Egg survey estimate of the North Sea spawning biomass in 2002

During the period 3–24 June 2002 the Netherlands and Norway carried out egg surveys in the North Sea to estimate the spawning stock biomass (SSB) of mackerel (Iversen and Eltink WD 2002). During this period the assumed spawning area was covered three times. The last time the North Sea was covered several times during the spawning season was in 1999 and 1996.

The data collecting and the handling of the samples were according to ICES (1997/H:4). The timing and the results of the surveys are given in Table 2.6.2.1. The "G.O. Sars" and "Tridens" worked respectively mainly the area north and south of 56^o N.

The eggs were sorted from each of the sampled stations and their age were estimated according to development stage and the observed temperature at 5 m. The development stages used in the calculations are eggs without visible embryo (i.e. stage 1A+1B, Lockwood *et.al*. (1981)). The average number of eggs produced per day per m^2 was calculated for each statistical rectangle of 0.5^o latitude * 0.5^o longitude (Figures 2.6.2.1–3). The samples were obtained in the middle of each of the rectangles. The egg production was calculated for the total investigated area for each of the three periods (Table 2.6.2.1). During all three coverages a very high egg production (197–753 eggs/m^2) was observed in one and two of the same rectangles in the western part of the spawning area. About 20, 30 and 40% of the total egg production during the three respective coverages came from these rectangles.

The surveys did not cover the total spawning area and period. Some of the unsampled rectangles are given interpolated values, indicated as shadowed rectangles in Figures 2.6.2.1–3. The part of the interpolated egg production was about 10% of the total production estimates during the two first coverages and about 5% during the third coverage. Based on the three production estimates the spawning curve was drawn (Figure 2.6.2.4). The three production estimates are considered minimum estimates since the sampling was not carried out until zero values were obtained in all directions.

The last coverage gave the highest egg production. If the third survey was carried out previous to the peak of spawning in 2002, the egg production may be seriously underestimated. In years with adequate sampling for defining peak spawning, this period occurred within 12–24 June (Table 2.6.2.1). Therefore it is unlikely that the egg production obtained during the third coverage in 2002 is a serious underestimate of the peak production. The egg production curve might be drawn as a straight line from this point to the end of spawning or as a steeper line as indicated in Figure 2.6.2.4.

By integrating the maximum egg production curve in Figure 2.6.2.4 the total egg production was estimated at $147*10^{12}$ eggs. By applying the weight fecundity relationship 1401 eggs/g/female (Iversen and Adoff, 1983) this corresponds to a SSB of 210,000 tons. However by applying the alternative line from peak of spawning (Figure 2.6.2.4) the egg production and the SSB is reduced by 20% ($118*10^{12}$ eggs and 168,000 tons).

There are no new fecundity data from the North Sea since 1982 (Iversen and Adoff, 1983). So far atresia in ovaries from North Sea spawners have not been studied. For mackerel spawning in the western area such data are available from several years. Both in 1998 and 2001 the realized fecundity in the western area was rather low (about 1000 eggs per g female) (ICES 2002/G:6). If the same weight fecundity relation is applied for the North Sea survey the SSB estimate will increase by about 40%.

Due to the uncertainties in the SSB estimate in 2002 (limited temporal and spatial coverage of the spawning area, no information of fecundity of North Sea mackerel since 1982) the working group for the time being considers 210,000 tonnes as an approximate estimate of the SSB of North Sea mackerel in 2002.

Table 2.6.2.2 gives the estimated egg production in the North Sea for the years with multiple surveys of the spawning area. The corresponding SSBs given in the table are based on a standard fecundity of 1401 eggs/g/female (Iversen and Adoff, 1983).

Table 2.6.2.1. Mackerel egg surveys in the North Sea in 2002.

Coverage	1	2	3
"Tridens"	3–6 June	10–14 June	17–21 June
"G.O. Sars"	3–9 June	9–14 June	15–24 June
Midpoint of survey Julian day	6 June 157	12 June 163	19 June 170
Total daily egg x 10^{-12}	2.72	2.50	4.26
Interpolated daily egg x 10^{-12}	0.27	0.24	0.20

Table 2.6.2.2. Egg production estimates from egg surveys in the North Sea and corresponding SSB based on a standard fecundity of 1401 eggs/g/female.

Year	Egg prod $*10^{-12}$	SSB$*10^{-3}$ tons	Observed peak of spawning (midpoint of survey)
1980	60	86	(25 June?)[1]
1981	40	57	17 June
1982	126	180	23 June
1983	160	228	13 June
1984	78	111	12 June
1986	30	43	23 June
1988	25	36	20 June
1990	53	76	24 June
1996	77	110	19 June
1999	48	68	-
2002	147 (118)	210 (168)	-

[1]This was the first coverage in 1980.

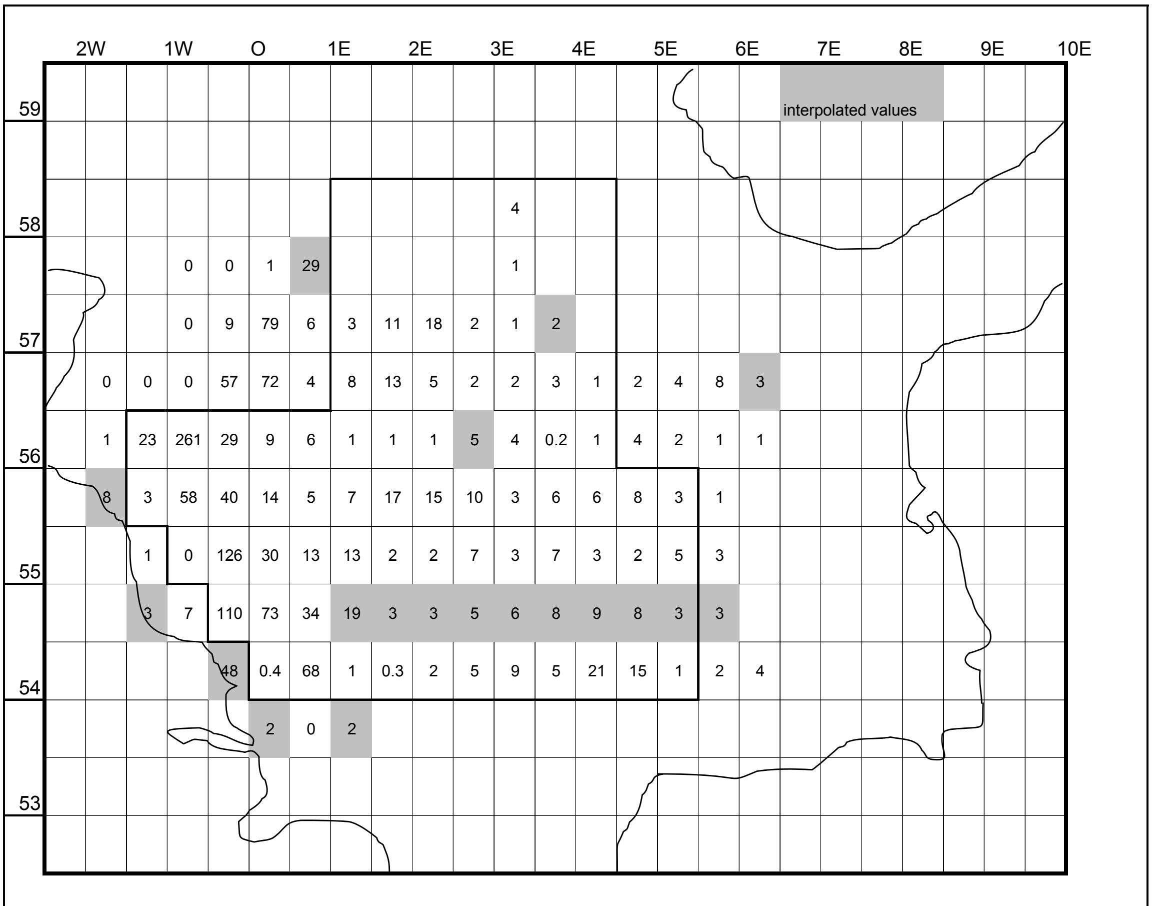


Figure 2.6.2.1. Daily production of mackerel eggs per m2 per rectangle during the first coverage, 3-9 June 2002

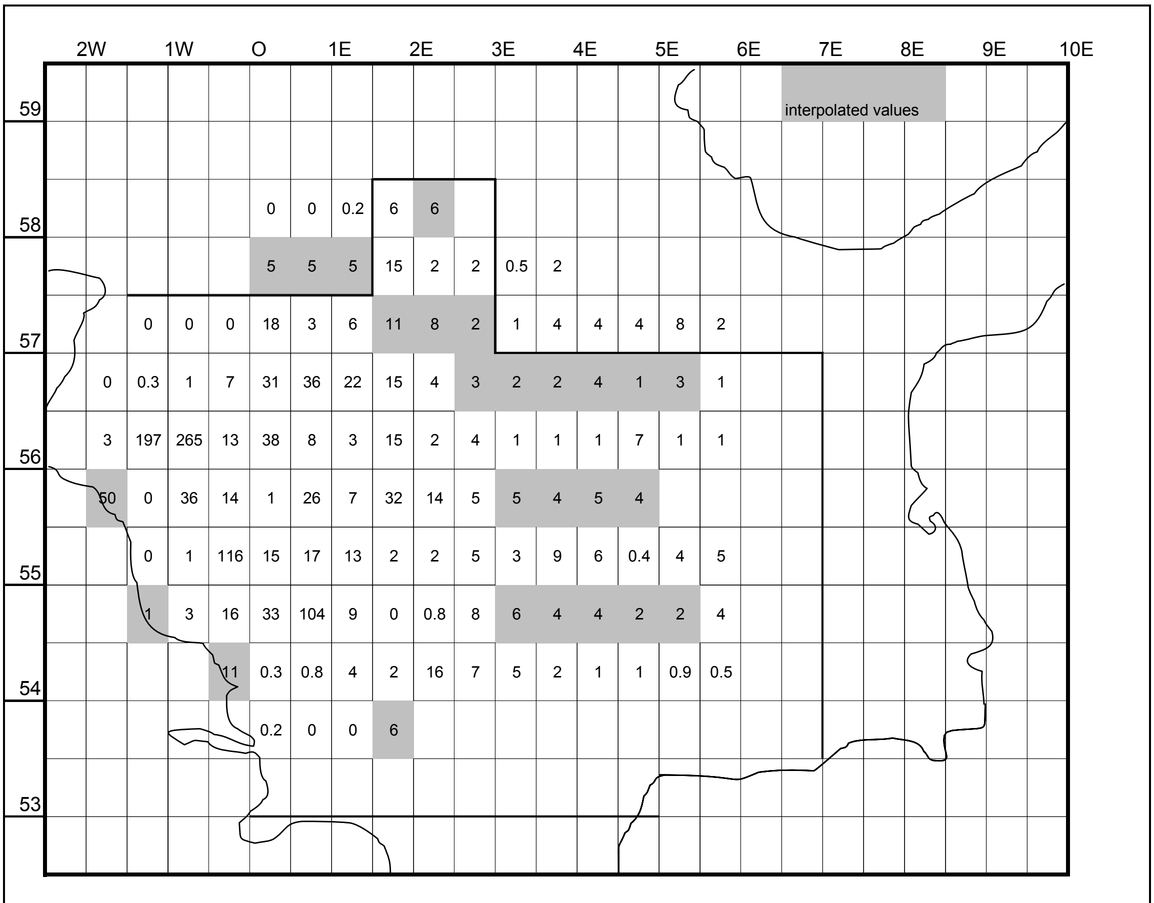


Figure 2.6.2.2. Daily production of mackerel eggs per m2 per rectangle during the second coverage, 9-14 June 2002.

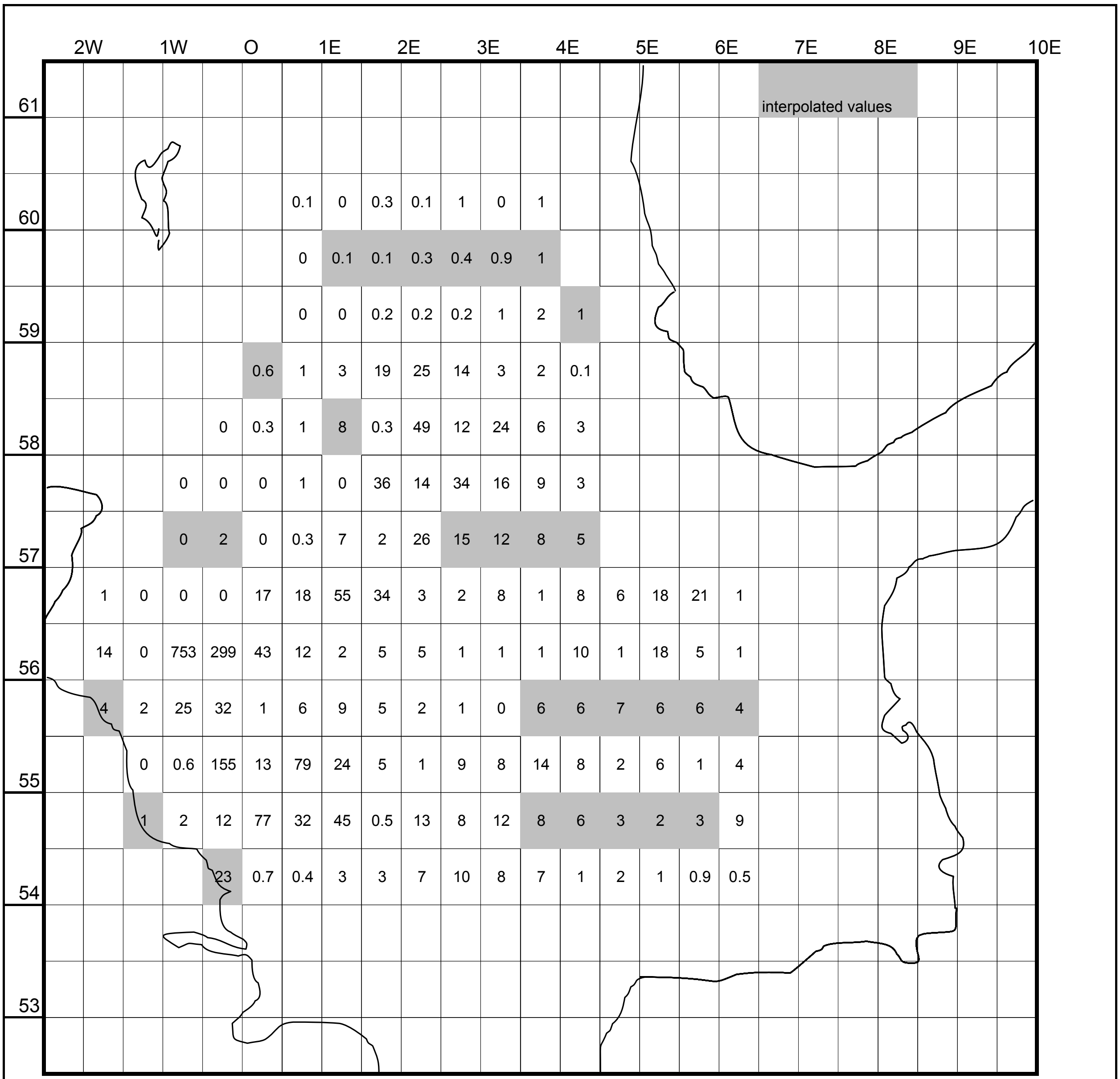


Figure 2.6.2.3. Daily production of mackerel eggs per m2 per rectangle during the third coverage, 15-24 June 2002

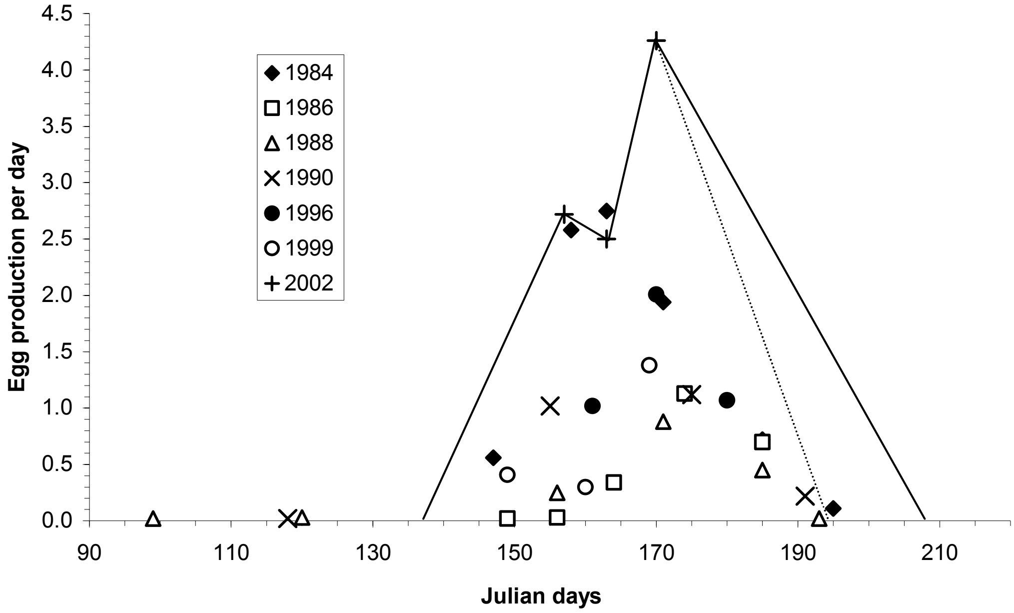


Figure 2.6.2.4. Daily egg production (eggs x 10^{-12}) of North Sea mackerel during the different surveys since 1984. The production curve for 2002 is given as two alternatives.

2.7 Effort and Catch per Unit Effort

The effort and catch-per-unit-effort from the commercial fleets is only provided for the southern area.

Table 2.7.1 and Figure 2.7.1 show the fishing effort data from Spanish and Portuguese commercial fleets. The table includes Spanish effort of the hand-line fleets from Santona and Santander (Subdivision VIIIc East) from 1989 to 2001 and from 1990 to 2001 respectively, for which mackerel is the target species from March to May. The Figure also shows the effort of the Aviles and A Coruna trawl fleets (Subdivision VIIIc East and VIIIc West) from 1983 to 2001. The Spanish trawl fleet effort corresponds to the total annual effort of the fleet for which demersal species is the main target. The Vigo purse-seine fleet (Subdivision IXa North) from 1983 to 1992 for which mackerel is a by-catch is also presented. The effort of the Santoña hand-line fleet showed an increasing trend since 1994, although in 2000 it showed a small decrease. The effort of the Santander hand-line fleet increased from 1995 to 1997; since then the effort has remained stable at the 1997-level. The effort of the trawl fleets remained rather stable during the whole period. The purse-seine fleet effort fluctuated during the available period.

Portuguese mackerel effort from the trawl fleet (Subdivision IXa Central-North, Central-South, and South) during 1988 - 2001 is also included and, as in Spain mackerel is a by-catch. The effort for this fleet increased in 1998 compared to the previous years. Since 1999 to 2001, the effort decreased compared to 1998.

Figure 2.7.2 and Table 2.7.2 show the CPUE corresponding to the fleets referred to in Table 2.7.1. The CPUE trend of the Spanish hand-line fleets shows an increase since 1994 to 1999, decreasing in 2000 and increasing in 2001 at the 1999 level. The CPUE for the Aviles trawl fleet has increased since 1994, in particular in 2000, but this figure is not reliable because catches of this fleet are estimated from 1994 onwards. The A Coruña trawl fleet has been rather stable during the whole period. The CPUE of the Portuguese trawl fleet shows a decrease from 1992 to 1998, increasing since 1999.

Catch-per-unit-effort for the hand-line and trawl fleets, expressed as the numbers of fish at each age group, is shown in Table 2.7.3.

Table 2.7.1 SOUTHERN MACKEREL. Effort data by fleets.

	SPAIN					PORTUGAL
	TRAWL		HOOCK (HAND-LINE)		PURSE SEINE	TRAWL
	AVILES Subdiv.VIIIc East (HP*fishing days*10^-2)	A CORUÑA Subdiv.VIIIc West (Av. HP*fishing days*10^-2)	SANTANDER Subdiv.VIIIc East (Nº fishing trips)	SANTOÑA Subdiv.VIIIc East (Nº fishing trips)	VIGO Subdiv.IXa North (Nº fishing trips)	Subdiv.IXa CN,CS &S (Fishing hours)
YEAR	ANUAL	ANUAL	MARCH to MAY	MARCH to MAY	ANUAL	ANUAL
1983	12568	33999	-	-	20	-
1984	10815	32427	-	-	700	-
1985	9856	30255	-	-	215	-
1986	10845	26540	-	-	157	-
1987	8309	23122	-	-	92	-
1988	9047	28119	-	-	374	55178
1989	8063	29628	-	605	153	52514
1990	8492	29578	322	509	161	49968
1991	7677	26959	209	724	66	44061
1992	12693	26199	70	698	286	74666
1993	7635	29670	151	1216	-	47822
1994	9620	39590	130	1926	-	38719
1995	6146	41452	217	1696	-	42090
1996	4525	35728	560	2007	-	43633
1997	4699	35211	736	2095	-	42043
1998	5929	-	754	3022	-	86020
1999	6829	30232	739	2602	-	55311
2000	4453	30073	719	1709	-	69846
2001	2385	29923	700	2479	-	74684

- Not available

Table 2.7.2 SOUTHERN MACKEREL. CPUE series in commercial fisheries.

	SPAIN					PORTUGAL
	TRAWL		HOOCK (HAND-LINE)		PURSE SEINE	TRAWL
	AVILES Subdiv.VIIIc East (Kg/HP*fishing days*10^-2)	A CORUÑA Subdiv.VIIIc West (Kg/Av. HP*fishing days*10^-2)	SANTANDER Subdiv.VIIIc East (Kg/Nº fishing trips)	SANTOÑA Subdiv.VIIIc East (Kg/Nº fishing trips)	VIGO Subdiv.IXa North (t/Nº fishing trips)	Subdiv.IXa CN,CS &S (Kg/Fishing hours)
YEAR	ANUAL	ANUAL	MARCH to MAY	MARCH to MAY	ANUAL	ANUAL
1983	14.2	34.2	-	-	1.3	-
1984	24.1	40.1	-	-	5.6	-
1985	17.6	38.1	-	-	4.2	-
1986	41.1	34.2	-	-	5.0	-
1987	13.0	36.5	-	-	2.1	-
1988	15.9	48.0	-	-	3.7	36.4
1989	19.0	43.0	-	1427.5	2.1	26.8
1990	82.7	59.0	739.6	1924.4	2.7	39.2
1991	68.2	54.6	632.9	1394.4	2.0	39.9
1992	35.1	19.7	905.6	856.4	3.9	21.2
1993	12.8	19.2	613.3	1790.9	-	16.9
1994	57.2	41.4	2388.5	1590.6	-	20.9
1995	94.9	34.0	3136.1	1987.9	-	24.5
1996	124.5	29.1	1165.7	1508.9	-	23.8
1997	133.2	35.7	2137.9	1867.8	-	18.5
1998	142.1	-	2361.5	2128.0	-	15.4
1999	136.4	42.9	2438.0	2084.7	-	23.9
2000	311.6	65.1	1795.5	1879.7	-	24.7
2001	222.9	61.1	2323.2	2401.0	-	26.4

- Not available

Table 2.7.3. SOUTHERN MACKEREL. CPUE at age from fleets.

VIIIc East handline fleet (Spain:Santoña) (Catch thousands)

Year	Effort	Catch age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10	age 11	age 12	age 13	age 14	age 15+
1989	605	0	0	3	74	142	299	197	309	441	134	67	27	23	19	7	27
1990	509	0	0	0	17	71	210	465	177	384	378	127	40	51	2	7	5
1991	724	0	0	52	435	785	473	309	323	100	98	150	29	3	7	7	18
1992	698	0	0	35	568	442	477	139	69	77	20	15	17	4	4	0	1
1993	1216	0	0	40	65	1043	621	1487	771	345	339	215	126	59	66	30	52
1994	1926	0	23	168	526	1060	2005	1443	1003	406	360	176	98	54	24	24	9
1995	1696	0	41	83	793	1001	789	1092	998	928	519	339	300	159	83	81	63
1996	2007	0	0	28	401	1234	865	701	1361	802	773	330	288	105	13	28	18
1997	2095	0	7	255	709	3475	2591	894	880	693	471	248	146	98	24	11	11
1998	3022	0	1	100	1580	2017	4456	3461	1496	1015	1006	594	428	443	155	114	296
1999	2602	0	1	230	1435	3151	2900	3697	1956	758	424	317	233	131	75	21	18
2000	1709	0	1	34	619	877	2098	1297	1822	913	282	125	122	62	42	26	9
2001	2479	0	8	208	1230	2978	2859	3030	1654	1477	783	177	196	157	75	74	74

VIIIc East handline fleet (Spain:Santander) (Catch thousands)

Year	Effort	Catch age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10	age 11	age 12	age 13	age 14	age 15+
1990	322	0	0	0	6	25	66	132	41	86	83	28	8	11	0	2	2
1991	209	0	0	5	45	96	60	39	43	14	14	23	4	1	1	1	4
1992	70	0	0	4	60	47	51	15	7	8	2	2	2	0	0	0	0
1993	151	0	0	1	2	43	26	63	33	15	15	9	5	3	3	1	2
1994	130	0	2	18	56	110	205	146	101	40	36	18	10	5	2	2	1
1995	217	0	3	33	171	168	144	225	227	222	107	70	56	22	9	11	9
1996	560	0	0	6	89	276	191	152	293	171	164	70	60	22	3	6	4
1997	736	0	0	22	170	963	754	368	472	398	328	170	100	74	18	8	10
1998	754	0	391	86	486	644	1419	1035	403	250	232	127	96	82	19	9	9
1999	739	0	24	211	668	1541	1006	1174	496	183	83	65	44	23	13	4	1
2000	719	0	0	2	110	285	781	534	777	388	133	62	58	35	21	13	3
2001	700	0	133	97	283	857	945	966	438	342	151	35	24	17	8	3	3

VIIIc East trawl fleet (Spain:Aviles) (Catch thousands)

Year	Effort	Catch age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10	age 11	age 12	age 13	age 14	age 15+
1988	9047	0	333	25	78	126	28	34	31	15	6	1	0	1	2	0	1
1989	8063	0	535	201	66	38	53	17	23	29	7	3	2	2	2	0	4
1990	8492	1834	6690	145	123	147	158	181	21	24	17	6	1	2	3	5	24
1991	7677	95	2419	592	205	108	99	57	55	16	14	26	4	3	2	1	13
1992	12693	236	1495	329	122	65	115	56	38	52	16	19	27	13	4	0	2
1993	7635	3	31	48	8	49	20	37	20	11	13	7	6	9	5	3	9
1994	9620	0	83	317	299	180	302	204	144	56	45	21	12	7	3	4	1
1995	6146	0	9	139	261	168	125	177	156	147	74	50	44	20	10	11	9
1996	4525	0	327	126	274	527	149	81	134	70	63	27	21	8	1	2	3
1997	4699	368	786	934	183	391	167	48	49	43	37	22	14	13	3	2	5
1998	5929	0	537	1442	868	237	341	221	74	34	29	15	10	9	1	0	1
1999	6829	2	601	746	685	730	262	284	117	41	15	10	6	2	2	0	0
2000	4453	1	380	594	1889	629	878	268	297	128	41	16	12	10	4	2	0
2001	2385	0	139	475	573	536	166	131	45	24	10	2	1	1	0	0	0

Table 2.7.3. (Cont'd)

VIIIc West trawl fleet (Spain:La Coruña) (Catch thousands)

		Catch															
Year	**Effort**	**age 0**	**age 1**	**age 2**	**age 3**	**age 4**	**age 5**	**age 6**	**age 7**	**age 8**	**age 9**	**age 10**	**age 11**	**age 12**	**age 13**	**age 14**	**age 15+**
1988	28119	0	6095	584	625	594	167	239	444	195	53	12	8	21	26	0	7
1989	29628	462	482	719	345	289	541	231	355	444	117	63	24	22	22	6	15
1990	29578	27	4535	939	175	235	370	624	184	409	405	145	45	69	5	9	5
1991	26959	1	39	454	573	839	551	445	504	165	165	266	53	4	10	11	23
1992	26199	1	154	102	298	251	355	128	61	84	25	32	38	14	6	0	2
1993	29670	0	307	440	118	528	188	265	98	41	33	21	11	3	4	2	3
1994	39590	0	237	1531	1085	821	1156	575	264	63	40	17	6	1	1	1	0
1995	41452	735	249	400	624	324	251	381	376	402	175	116	104	44	17	19	20
1996	35728	54	5865	104	562	695	148	77	127	65	59	27	20	8	1	2	2
1997	35211	13	626	1347	531	1234	493	136	140	114	88	49	32	25	6	3	6
1998	-	3	6745	2965	2547	641	678	451	144	80	72	49	36	38	13	8	18
1999	30232	4461	444	292	409	512	314	399	220	112	85	74	59	34	20	6	17
2000	30073	40	9283	902	1932	642	781	170	158	79	24	12	11	9	5	4	3
2001	29923	0	184	886	1615	1799	814	648	201	128	48	11	7	9	4	4	6.813

IXa trawl fleet (Portugal) (Catch thousands)

		Catch															
Year	**Effort**	**age 0**	**age 1**	**age 2**	**age 3**	**age 4**	**age 5**	**age 6**	**age 7**	**age 8**	**age 9**	**age 10**	**age 11**	**age 12**	**age 13**	**age 14**	**age 15+**
1988	55178	8076	4510	536	457	76	14	3	0	1	5	0	0	0	0	0	0
1989	52514	6092	6468	1080	572	185	51	15	4	7	4	3	0	0	0	0	0
1990	49968	2840	5729	1967	137	36	11	4	4	0	0	0	0	0	0	0	0
1991	44061	1695	2397	1904	1090	138	85	65	24	3	5	0	0	0	0	0	0
1992	74666	498	2211	1015	664	263	100	45	22	17	10	70	0	0	0	0	0
1993	47822	1010	2365	442	172	155	32	8	5	1	0	1	0	0	0	0	0
1994	38719	650	1128	1447	342	125	94	65	21	4	1	2	0	1	0	0	0
1995	42090	1001	2690	983	295	99	59	46	40	25	17	16	8	5	0	0	1
1996	43633	423	1293	778	490	269	86	88	129	98	109	66	34	17	6	0	1
1997	42043	318	885	1763	181	98	125	95	59	47	20	20	6	10	0	0	0
1998	86020	1873	3950	1265	171	47	39	40	56	23	14	19	51	32	13	0	5
1999	55311	2311	3615	1384	316	94	55	32	13	2	2	1	1	1	0	0	0
2000	67112	2730	6318	1328	424	226	135	71	40	20	9	13	4	11	0	0	0
2001*	74684	3030	5539	1665	382	195	149	65	42	24	3	2	0	0	0	0	0

(-) Not available

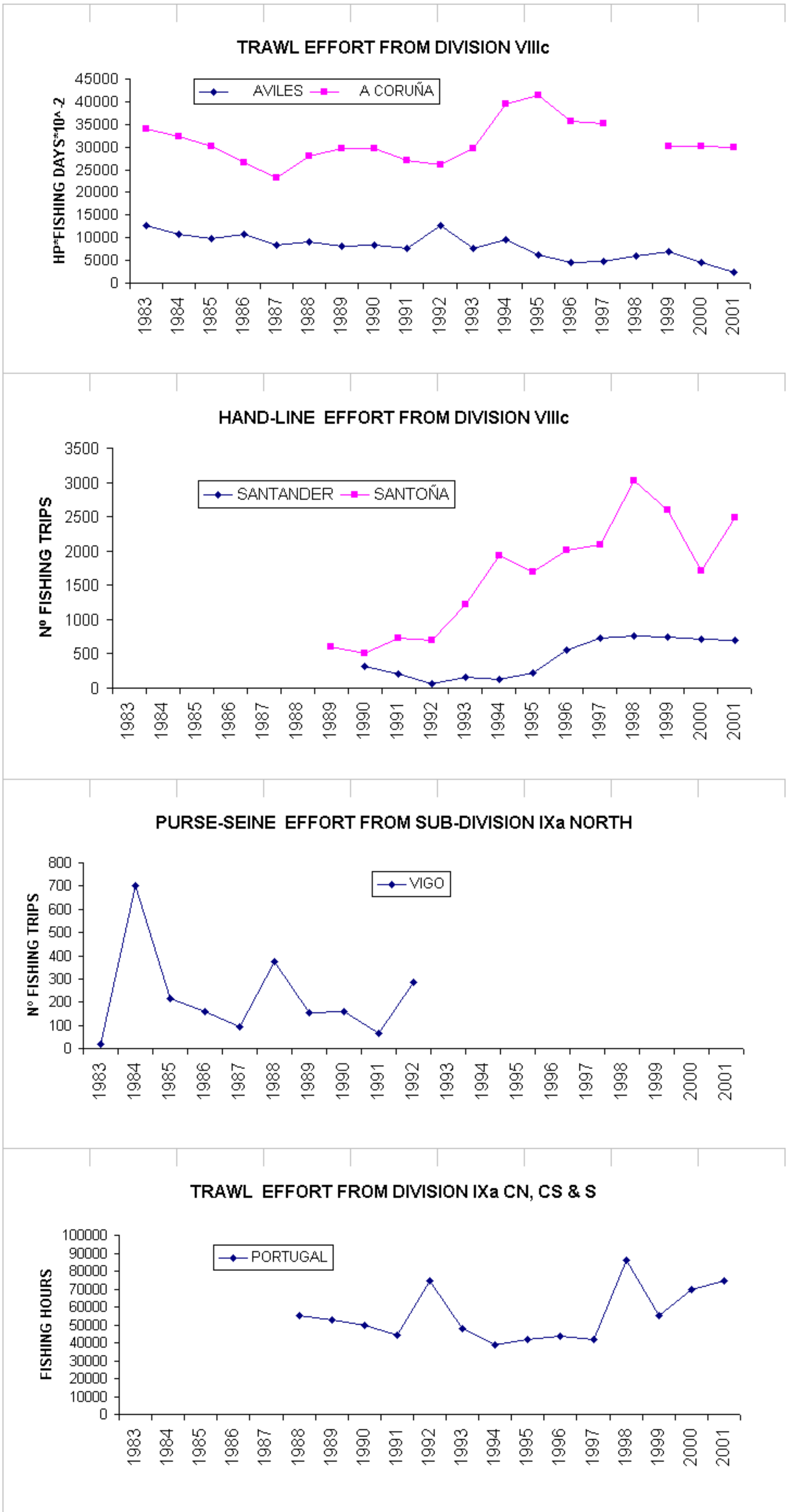


Figure 2.7.1 : SOUTHERN MACKEREL. Effort data by fleets and area

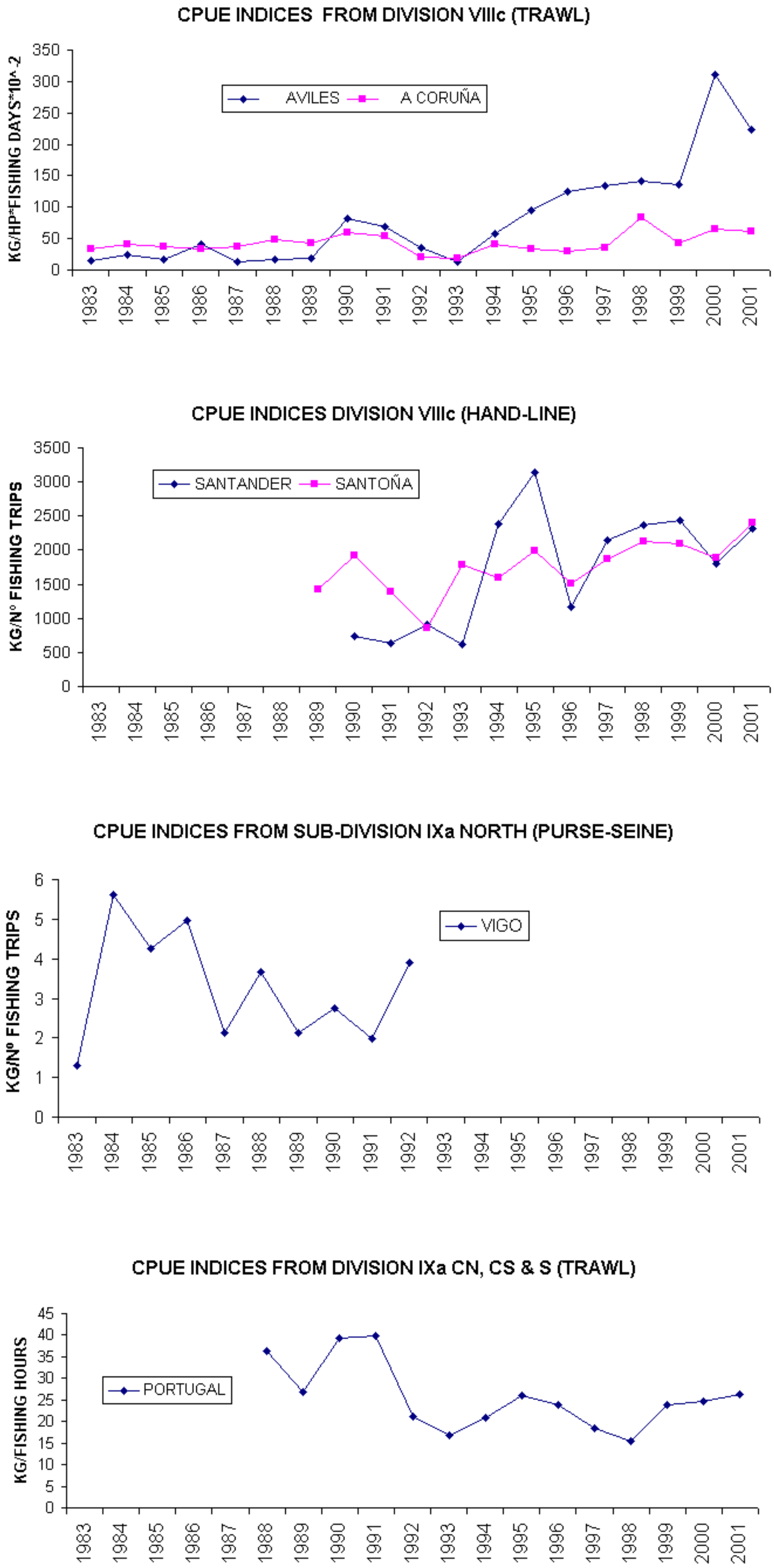


Figure 2.7.2 : SOUTHERN MACKEREL. CPUE indices by fleets and area

2.8 Distribution of Mackerel in 2001-2002

2.8.1 Distribution of commercial catches in 2001

The distribution of the mackerel catches taken in 2001 is shown by quarter and rectangle in Figures 2.8.1.1–4. These data are based on catches reported by Portugal, Spain, Netherlands, Germany, Norway, Russia, Faroes, UK, Ireland, and Sweden. In these data the Spanish catches are not based on official data. Not all official catches are included in these data. The total catches reported by rectangle were approximately 589,200 tonnes including Spanish WG data; the total working group catches were 677,708 tonnes. The main data missing from these data are from France, who do not report by rectangle, and Denmark, which has not reported this year for the first time.

First Quarter 2001

Catches reported by rectangle during this quarter totalled about 221,400 tonnes, down by about 5% from 2000. The perennial problem of mis-reporting between Divisions IVa and VIa, which gave large catches just west of 4^{o} W, seemed to remain at a high level. The relaxation of fishing regulations in IVa in the first quarter may still have reduced the pressure to misreport. Otherwise, the general distribution of catches was similar to 1995 to 2000, with the bulk of the catches along the western shelf edge between Shetland and the Celtic Sea, but mainly in the north of this area. Again, this suggests that the pattern and timing of the pre-spawning migration has remained relatively constant. The catch distribution is shown in Figure 2.8.1.1.

Second Quarter 2001

Catches during this quarter totalled about 37,140 tonnes; almost double that of 2000, although this figure was a drop from 1999. The general distribution of catches was similar to 2000, with the main catch area being along the western shelf edge between the Hebrides and the Celtic Sea. The catches taken in international waters east and north of the Faroe Islands were increased in 2001 over 2000 following a reduction 1998–2000. Similar fishing patterns to 2000 were apparent around the Iberian Peninsula. The catch distribution is shown in Figure 2.8.1.2.

Third Quarter 2001

Catches during this quarter totalled about 153,108 tonnes, up slightly from 2000. The general distribution of catches was similar to 2001, with the main catches being taken in international waters and off the Norwegian coast. There was a slight increase in catches around the Shetland Islands in 2000, but this was not continued in 2001. The scattered catches on the western side of the British Isles were quite similar to 2000. Catches in the Iberian area were very similar to 2000. The catch distribution is shown in Figure 2.8.1.3.

Fourth Quarter 2001

Catches during this quarter totalled about 177,500 tonnes, down by 30,000 tonnes from 2000. The general distribution of catches was very similar to 2000. The main catches were taken in the area west of Norway across to Shetland. There was less evidence of mis-reported catches west of 4^{o}W, and west of 8^{o}W near the Faroes. Again, only small catches were taken west of Scotland, but catches west of Ireland were similar to 1999 and 2000. The pattern of catches seen in the English Channel, which increased in 1999, remained similar to 2000. The catch distribution is shown in Figure 2.8.1.4.

The catch totals by quarter represent only catches from those countries, which provided data by ICES rectangle. They do not include those countries, which provide catch by larger area units.

2.8.2 Distribution of juvenile mackerel

Surveys in winter 2001/2002

As the recruit database was fully completed at this year's and last year's meetings of WGMHSA only the latest data are presented here. However, comparisons with 2000/2001 are presented below.

Fourth Quarter 2001

Age 0 fish in quarter 4 2001 (Figure 2.8.2.1)

- Catch rates in NW Ireland have recovered from the very low values in 2000 – catches are slightly less than prior to 2000

- There were very high catch rates in central Biscay – this was the only area to show reasonable catch rates in 2000, and is much higher in 2001.

- The hot spot in north Portugal which had been declining in recent years and was largely absent in 2000 appears to be strong again in 2001

- Two good catches in the Celtic Sea – but closer to the coast than in 2000

- Weak catches in the Hebrides as in 2000, but one good catch off the north coast of Scotland

The overall major reduction in age 0 fish seen in the 2000 surveys was not repeated in 2001. The major nursery areas in NW Ireland and Biscay were strong and the Portuguese area was much better than most recent years. The only traditional area not having good catches was the Hebrides, which has been weak for some years. The conclusion from these surveys 1999 – 2001 would seem to be that 2000 was a very bad year for recruitment. This is supported by early indications from the commercial landings and the ICA output. The surveys indicate that this will not be repeated in 2001.

Age 1 fish (Figure 2.8.2.2.) were weak across most of the area, although reasonably abundant in Biscay. This would be the 2000 year class mentioned above, and so would be expected to be weak.

First quarter 2002

Age 1 fish in quarter 1 2002 (Figure 2.8.2.3)

- High catch rates recorded off NW Ireland and the Hebrides as in all previous years except 2001.
- Similar well distributed high catch rates in the Celtic Sea as in all previous years except 2001
- High catch rates in the north part of the North Sea – similar to 2000 and 2001
- Well distributed and reasonably strong catch rates in central North Sea of putative North Sea component juveniles
- Catch rates in the Cornish Box remained low as in 2000 and 2001

Age 2 fish in quarter 1 2002 (Figure 2.8.2.4)

- Low catch rates in NW Ireland/Hebrides area and in the northern North Sea
- Good catch rates in Cornish box area
- Very good catch rates in the Celtic Sea. These high catch rates are surprising given the likely weakness of the 2000 year class. These data should be treated with some caution as the catches were split into age using length and not otolith readings. There were very substantial survey catches of larger fish (>20 cm) in this area, and given the lack of age data, the data cannot be treated as definite.
- Very little caught in central North Sea

Distribution maps of mackerel recruits in their first and second winters

One problem with the current timing of bottom trawl surveys in the winter period is that the best coverage of the western area is in the fourth quarter while the North Sea is not covered at all. In the first quarter, the western area surveys are restricted to the area north of the Celtic Sea while there is full coverage of the North Sea. Recent tagging studies (Uriarte et al ICES CM 2001:O17) have shown that juvenile mackerel are most likely to remain in the same place prior to recruitment to the adult stock. Other work (Reid in progress) also suggests that average catch rates remain stable in the northern part of the western area between quarters 4 and the following quarter 1. Potentially this should allow the combination of surveys in both quarters to provide a single complete area coverage for all areas for a given winter. These were provided in the previous WG report and are continued here. The maps are for first winter fish in

Figure 2.8.2.5 and second winter fish in Figure 2.8.2.6. for the winter of 2001–2002. The same trends reported above can be seen in these maps:

For first winter fish (Figure. 2.8.2.5.)

- Strong catches from Portugal up to the northern North Sea.
- Increased catch rates in the central North Sea

For second winter fish (Figure. 2.8.2.6.)

- Generally low catch rates from NW Ireland to the northern North Sea
- Better catch rates in the Celtic Sea and Biscay. NB. Both areas are length split not age split.
- Very low catch rates in the central North Sea

It should be noted that not all these surveys use the same survey gears. Most surveys in the western area use an IBTS GOV trawl (although with various non-standard modifications). The Irish surveys use a smaller version of the GOV. The Portuguese gear is quite similar to the GOV. The Spanish surveys in the Cantabrian Sea use the *Baka* trawl. This is towed slower and has a much lower headline height, and has a very low catchabilty for young mackerel. The conversion factor calculated in the EU SESITS project for this gear, against the GOV was 8.45. This correction has not been applied to date for the data used here, but will be considered for future use.

The catch rates plotted here for the Biscay area in quarter 4 2001, and the Celtic Sea in quarter 1 2002 are length split and not age split, and so should be treated with more caution.

As noted in previous reports, the coverage of the western area in the fourth quarter remains reasonably good. There are gaps in the area west of Ireland and in the inner part of the Celtic Sea/Western Approaches. However, the Irish Marine Institute conducted a survey in the inner part of the Celtic Sea in quarter 4 2001, and although the data were not available for this WG this improvement is to be commended. The working group noted with approval the intention of CEFAS to start up a western fourth quarter bottom trawl survey.

This should fill most of the unsampled areas in the Celtic Sea area. A new bottom trawl survey series in the area of the Porcupine Bank was carried out by IEO in 2001, however, the data have not yet been made available to the WG. It is to be hoped that, together with the advent of the new Irish research vessel in 2003, this will allow complete coverage west of Ireland.

The analysis of the surveys 1999–2002 have clearly shown a major dip in recruitment of the 2000 year class. This is provisionally confirmed by the landings and ICA recruitment output. The surveys may, therefore, indicate such a recruitment failure at least a year earlier than the landings. The pattern in recent years should be investigated and if possible a new recruitment index calculated.

2.8.3 Distribution and migration of adult mackerel

Acoustic surveys

Four relevant acoustic surveys were carried out on mackerel and reported to this WG. These were:

- An acoustic survey by the Institute of Marine Research, Bergen in October 2001. This mainly covered the area between the Viking and Tampen Banks, but scouting surveys covered a wider area (approx 58–62°N and 5°E to 0°W).
- An acoustic survey by IEO in ICES Subdivisions VIIIc and IXa, in March and April 2002.
- An acoustic survey by IFREMER in April to June 2001. The survey covered the Biscay shelf from 43° 30 to 48°N.
- An acoustic survey for pelagic species by PINRO in June – July 2002. The survey covered the Norwegian Sea from 63° N to 71° 30' N and between 11° W - 15° E.

The IMR survey showed that in the latter part of 2001, there were substantial concentrations of mackerel spread across the platform up to 30 nm from the shelf break between the Viking and Tampen Banks (approx 60°N 3°E to 61°30N 2°E). A provisional estimate of approximately 600,000 t of mackerel was made, which was very similar to that of 2000. The fish were also in a similar location to the previous year's survey. However, there were significant observations of mackerel west of Tampen Bank (bounded 60° 45'N, 2°E and 61° 30'N, 0°E). These were mixed with herring and species splits were uncertain. These registrations may be evidence of an early migration movement.

The IEO survey was primarily targeted on sardine and anchovy, however, substantial amounts of mackerel were observed. As in 1999 and 2000, mackerel were ubiquitous throughout the Cantabrian Sea, but the major concentrations were seen in the central part and extending to the west. This area was dominated by young fish of around 22–23cm in length. The fish in the eastern part of the Cantabrian Sea were generally older with a mean length of around 33cm. Almost no mackerel were seen in the north of IXa, along the Galician coast. Further good observations were made in the northern part of the Portuguese coast around 41°N. This area was dominated by young fish around 22cm in length. The high abundance of early juveniles is in contrast to the previous year and confirms the findings of trawl surveys. A provisional abundance estimate of 1,400,000 tonnes was made. This should be contrasted to the 399,000 tonnes estimated in 2000.

The IFREMER survey was targeted at all pelagic fish resources in the French Biscay area. Analysis to date has been concentrated on sardine and anchovy, however abundance estimates for mackerel will be made available. Mackerel was common in the catches throughout the area, and particularly in the north.

The PINRO survey was carried out by the Russian RV "Fridtjof Nansen" in the southern and central Norwegian Sea. This survey was part of the international survey for the Atlanto-Scandian herring in the Norwegian Sea in summer 2002, however, attention was given to collection of any available information on mackerel, both biological and acoustic. For the estimation of mackerel abundance and biomass three TS to length relationships were investigated. As in previous surveys, the survey covered only a part of the mackerel feeding area in the Norwegian Sea. Thus, areas to the south of 63°N in June and to the south of 66° N in July where mackerel are traditionally distributed in this season were not surveyed. The mackerel biomass was estimated as being between 1.6 to 2.5 million tonnes in June between 63° -67° N and 11°W - 09°E. 1.8 million tonnes were found in July between 66° 40' - 71° 30' N and 07°W - 15°E. Notwithstanding the large differences in abundance and biomass estimates derived from different TS to length relationships, it is safe to say that in summer not less than 2–2.5 million tonnes of mackerel migrate to the Norwegian Sea for feeding. 1.8 million tonnes of which are distributed to the north of 66° N. Identification of mackerel in summer was handicapped by the presence of larval and young herring distributed in the same depths. However, multi-frequency data collected within the EU SIMFAMI project, as well as new data on the mackerel target strength, will make it possible to design an identification algorithm to compensate for this problem. See Kryssov *et. al.* WD 2002.

Aerial Surveys

Two aerial surveys were carried out in the summer of 2002:

- A Russian survey in the Norwegian Sea in July/August from 61 to 74°N in which the Faroese participated during August 2002.
- A joint Russian/Norwegian survey in the Norwegian Sea in July from 61° 45'N to 71°N.

As the surveys were essentially part of a single programme, they are considered together.

A new Russian annual aerial survey for mackerel in the Norwegian Sea was carried out during 19 July – 17 August 2002. As in previous years the survey was targeted on the spatial distribution of mackerel aggregations in the Norwegian Sea, as well as the thermal and hydrodynamic status of the sea surface, distribution of locations of increased bio-productivity and the availability and distribution of other marine organisms (sea mammals and birds).

Several Russian commercial vessels worked/fished in the International waters at the same time to identify observations made by the Russian research aircraft and two research vessels carried out pelagic fish surveys (See Shamray and Belikov WD 2002) which have been performed annually for several years. The Faroes operated in the Faroese EEZ in early August with one research vessel and one commercial trawler to identify aerial observations (see Jacobsen WD 2002).

As a follow up to the recommendation given by the ICES WGMHSA (WGMHSA (ICES 2002 CM/ACFM:06) the new ICES Planning Group on Aerial and Acoustic Surveys for Mackerel (PGAAM) was established and met for the first time in A Coruña (Spain) from 18–20 February 2002.

During the PGAAM meeting it was planned that two aircraft (Russian and Norwegian) would work in the Norwegian Sea in July 2002 together with commercial and research vessels (ICES 2002 CM/G:03). The Russian research aircraft, AN-26 "Arktika", carried out flights in the international waters and inside different national EEZs during 20 – 25 July while the Norwegian flights were mainly in the Norwegian economical zone during 15–25 July (See Zabavnikov *et. al.* WD 2002).

The Russian aircraft were equipped with several different remote-sensing sensors like IR-radiometer and scanner, LIDAR, microwave radiometer, digital photo- and video cameras. The Norwegian aircraft was equipped only with a LIDAR hired from NOAA Environmental Technical Laboratory (NOAA ETL), including hardware and software.

Two Norwegian commercial purse seiners worked the same tracks as covered by the Norwegian aircraft. Along these tracks CTD- and pelagic trawl stations were carried out at prefixed positions. All vessels of both countries collected biological samples and investigated the distribution and abundance of mackerel by sonars, echo sounders and surface trawling.

The Russian team used the LIDAR system for the second year while Norway tried it for the first time. The LIDAR data have not yet been processed.

The tracks and areas of the joint Russian-Norwegian survey are shown in Figure 2.8.3.1.

Combined distribution from acoustic, aerial, and commercial data

Russia in collaboration with Norway and the Faroes, carried out complex investigations on mackerel in the Norwegian Sea during June – August 2002. These investigations include research vessels, numbers of observers onboard commercial vessels and the aircraft-laboratory. The main goal was to map mackerel abundance distribution and migration in summer and to produce a biomass estimate.

As in previous years mackerel was widely distributed in the Norwegian Sea during summer (Figure 2.8.3.2–4). However, in July no concentrations were found in that area due to an increased influence of the cold East Icelandic Current resulting in an more easterly distribution of mackerel (Figure 2.8.3.3–4). In July and August high concentrations were found in the central Norwegian Sea, within a wider area of distribution (Figure 2.8.3.3–4).

The major feeding migration of mackerel into the Norwegian Sea started earlier than in 2001. The migration of mackerel into the international waters of the Norwegian Sea came mainly from the Norwegian EEZ. This appeared to occur earlier and last longer than in 1999–2001.

The investigations do not provide a full coverage of the mackerel distribution in summer as in some areas the limit of distribution was not reached. The most obvious example would be in the eastern part of the Norwegian EEZ, where Norwegian research and commercial vessels confirmed large numbers of mackerel distributed close to the coast. However, the combined data from all research and commercial vessels as well as the aircraft-laboratory appear to be capable of providing the most complete estimation of distribution of the feeding mackerel at this time of year (Figure 2.8.3.5). It should be stressed that these data cannot therefore be used for zonal attachment purposes.

Inferences on migration from commercial data

No new data were available to the working group on detailed catch location and timings of commercial mackerel fishing activity. Some data has been collected at a number of institutes, but this has not as yet been collated and reported. It was hoped that this data series could be updated in 2002, but this has not proved possible.

2.8.4 The development of surveys for mackerel under the aegis of the Planning Group for Aerial and Acoustic surveys for Mackerel (PGAAM)

As mentioned in the previous WG report (ICES CM 2002/ ACFM:06), the only fishery-independent data for mackerel come from the triennial mackerel egg surveys. This makes the annual assessments increasingly vulnerable with distance from the last egg survey year, and also tends to cause substantial fluctuations in the assessment when a new survey becomes available. In this context, it was noted that a number of uncoordinated surveys for mackerel were being carried out by a number of different countries every year. For this reason a new Planning Group on the Aerial and Acoustic Surveys (PGAAM) was established to provide coordination for these additional surveys.

PGAAM met for the first time in February 2002 to:

- Coordinate vessels from appropriate countries to collaborate with the Russian aerial surveys in the Norwegian Sea and seek other nations willing to participate in aerial surveys.
- Coordinate Scottish and Norwegian acoustic surveys in the Viking Bank area to ensure full coverage and appropriate areas and timings.
- Coordinate Spanish, Portuguese and French acoustic surveys and seek potential collaborators for northern extension of these surveys.
- Utilise the findings of the EU SIMFAMI project to provide a universally applicable mackerel target strength to length relationship for use in all acoustic surveys for mackerel.

During the first PGAAM meeting it was possible to provide coordination for some of these surveys (Anon. 2002b). The results of these surveys will be reported at the next meeting (Lisbon, April 2003) and will be presented to WGMHSA at their meeting in 2003.

Aerial Surveys

The Working Group recommended that the aerial surveys should continue and that vessel collaboration should be provided in all the survey areas. Such collaboration was successfully carried out with Russian, Icelandic and Norwegian research/commercial vessels in 2001 and with Russian and Norwegian vessels in 2002. Due to the weather conditions, collaboration with Faroese and Icelandic vessels was not successful but it is encouraging that both countries were able and ready to cooperate; the Faroese had two vessels at sea in early August as part of the joint Russian-Faroese survey.

The results of the aerial surveys are presented in Section 2.8.3.

North Sea acoustic surveys

In October - November 2002, Scotland and Norway will conduct a co-coordinated acoustic survey for mackerel in the North Sea and its western approaches. The Scottish research vessel will survey the western approaches along the continental shelf west of Shetland and east to the Tampen Bank area. The Norwegian survey will cover the North Sea between 58^o and 60^{o}N. Both vessels will then survey the area between Tampen and Viking Banks in the northern North Sea using an interlaced parallel transect design with a minimum intertransect spacing of 15 n.m. In the area around Viking Bank transects will be placed closer at 7.5 – 15 n.mi. to achieve a higher density concentration (Anon. 2002b).

The results of this joint survey will be presented during the next PGAAM and WGMHSA meetings in 2003.

Southern area acoustic surveys

A series of coordinated acoustic surveys have been carried out in Spanish, Portuguese and French waters for a number of years. They extend from the Gulf of Cadiz in the south to Brittany in the north. The surveys are carried out between March and May, usually earlier in the south and later in the north. They are targeted principally at sardine and anchovy. However, they cover a large part of the mackerel distribution at this time and produced mackerel abundance estimation.

Unfortunately France and Portugal were not able to participate in the PGAAM meeting in 2002. WGMHSA would support the recommendation by PGAAM that Portugal and France should participate in the next PGAAM meeting for effective co-ordination of surveys to provide mackerel data in the southern area.

Next steps

WGMHSA supports the suggestion of PGAAM that data from surveys not necessarily targeted at mackerel should be monitored for potential use in the estimation of mackerel abundance or in the provision of biological samples. For this reason, any countries that have such data available should, if possible participate in the PGAAM meeting 2003.

PGAAM plans to meet again in Lisbon in April 2003 immediately after WGMEGS. WGMHSA supports this intention and encourages the group to continue its work.

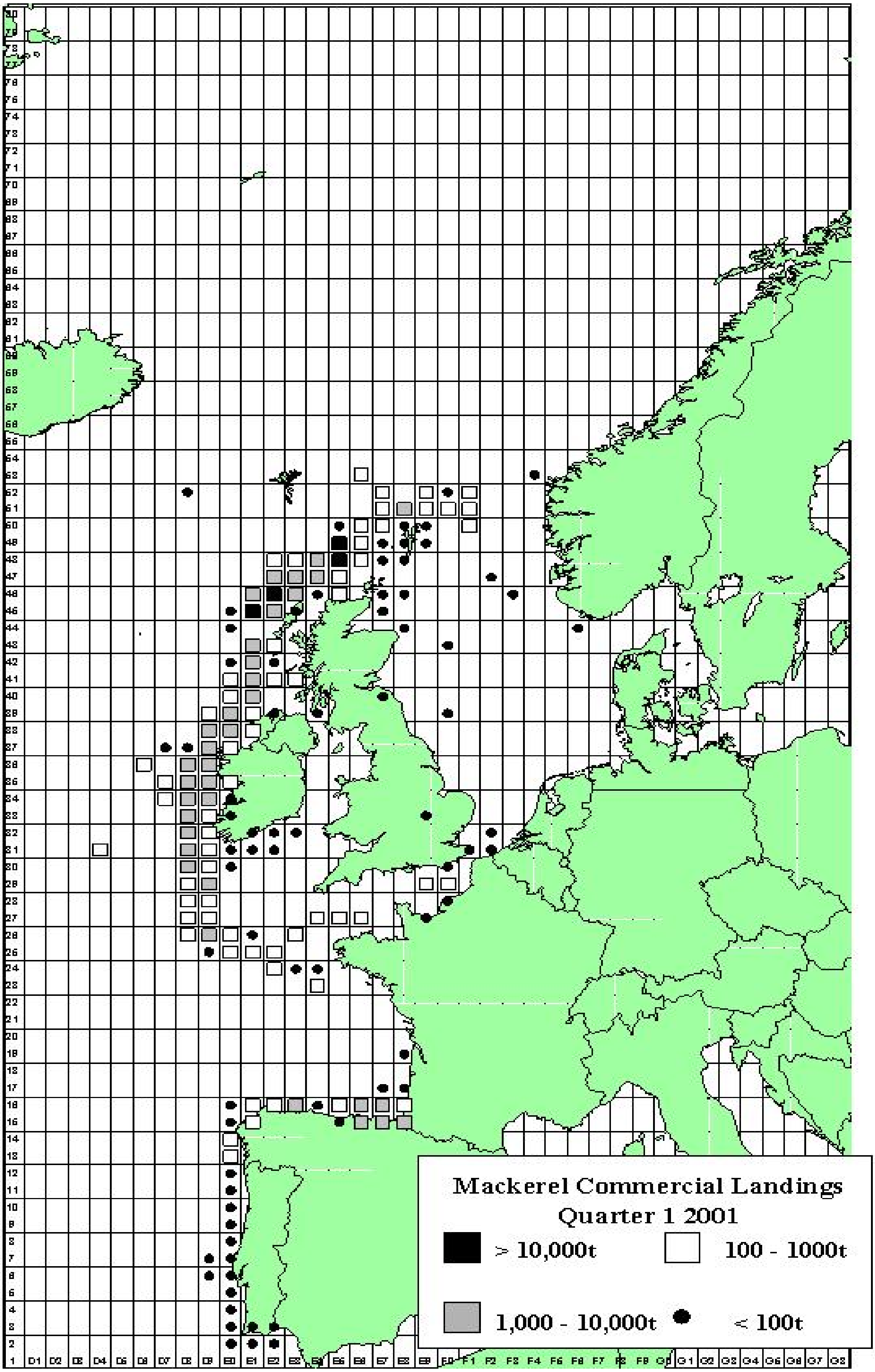


Figure 2.8.1.1. Mackerel commercial catches in quarter 1 2001.

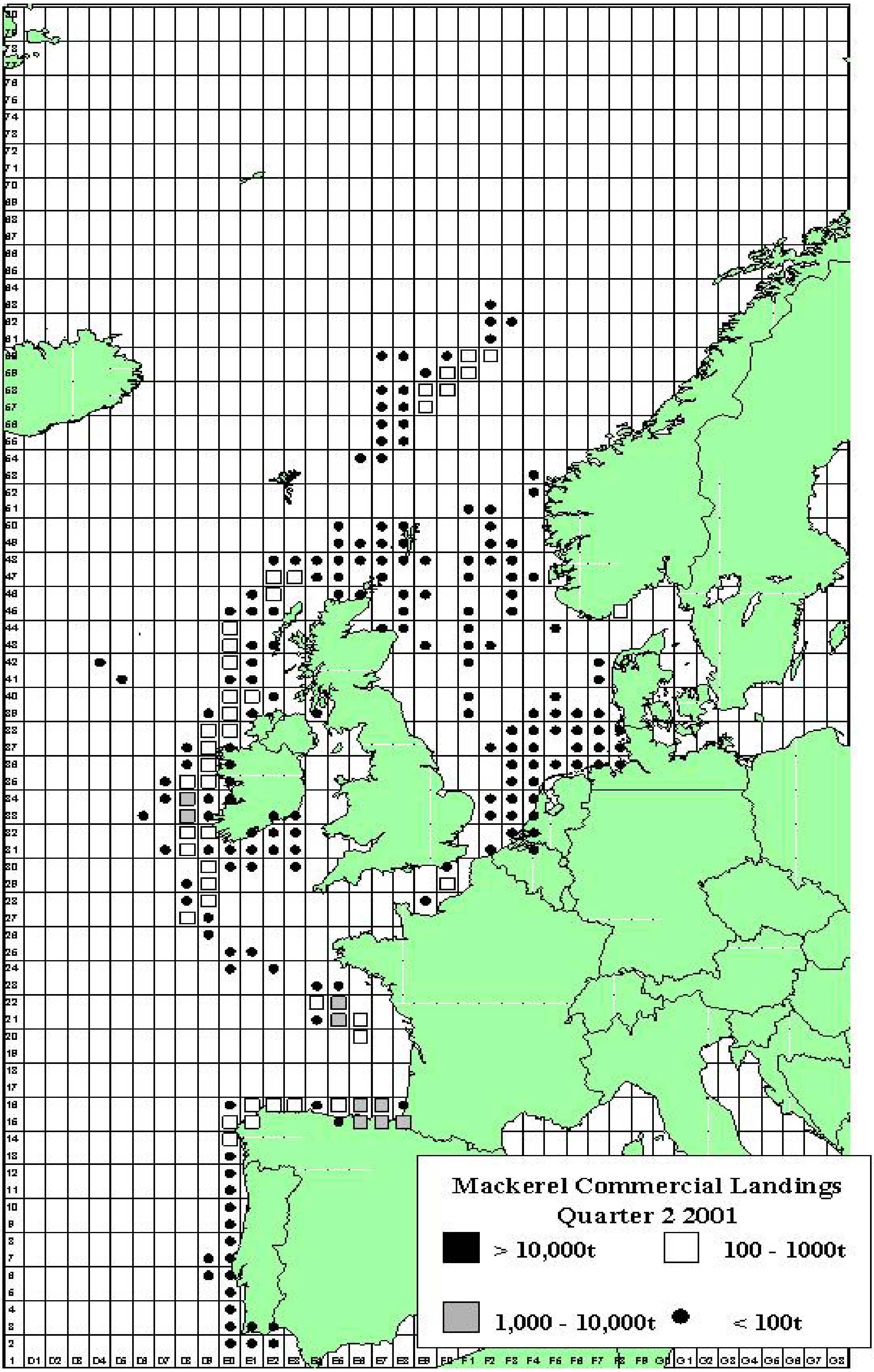


Figure 2.8.1.2. Mackerel commercial catches in quarter 2 2001.

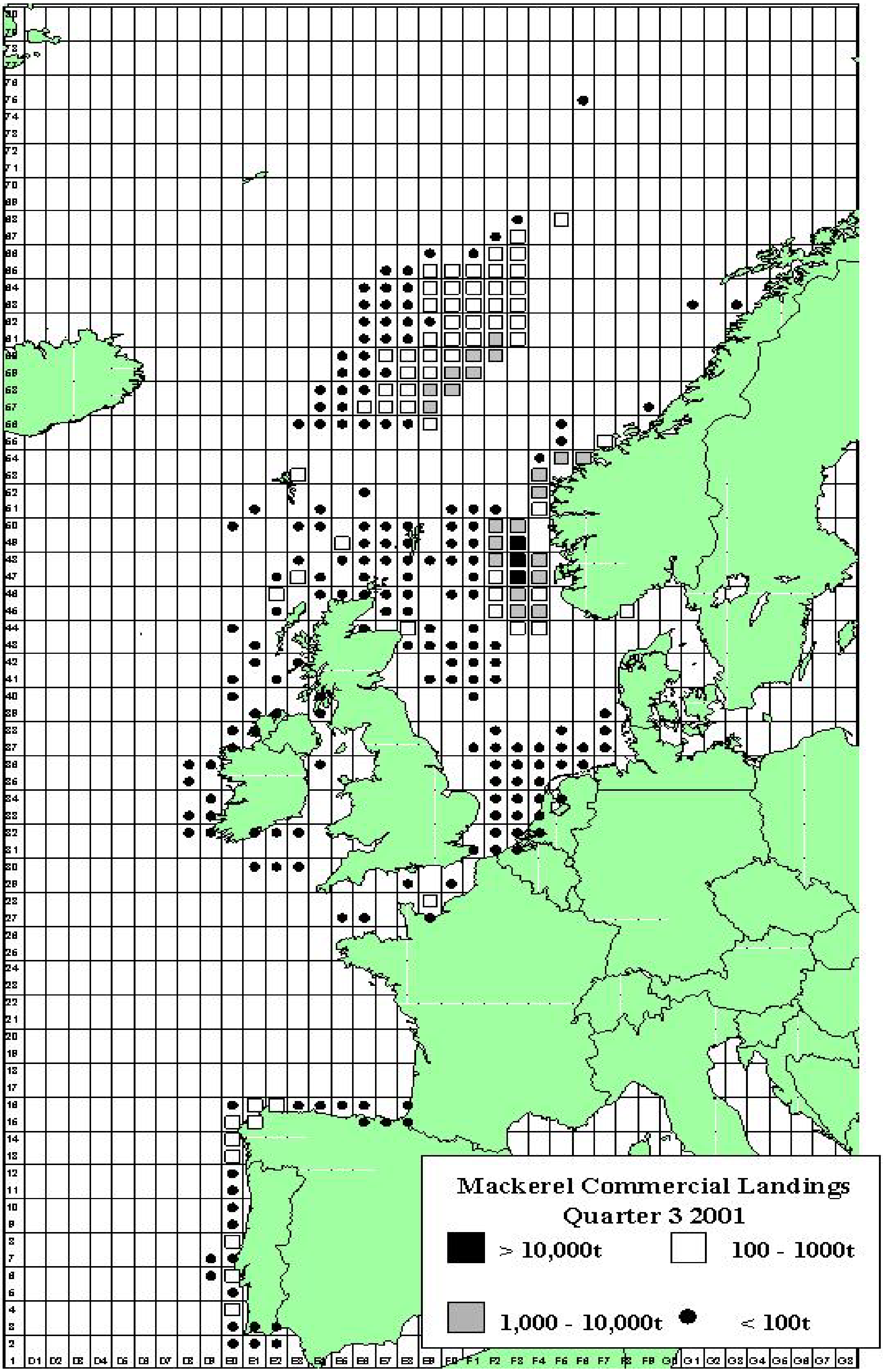


Figure 2.8.1.3. Mackerel commercial catches in quarter 3 2001.

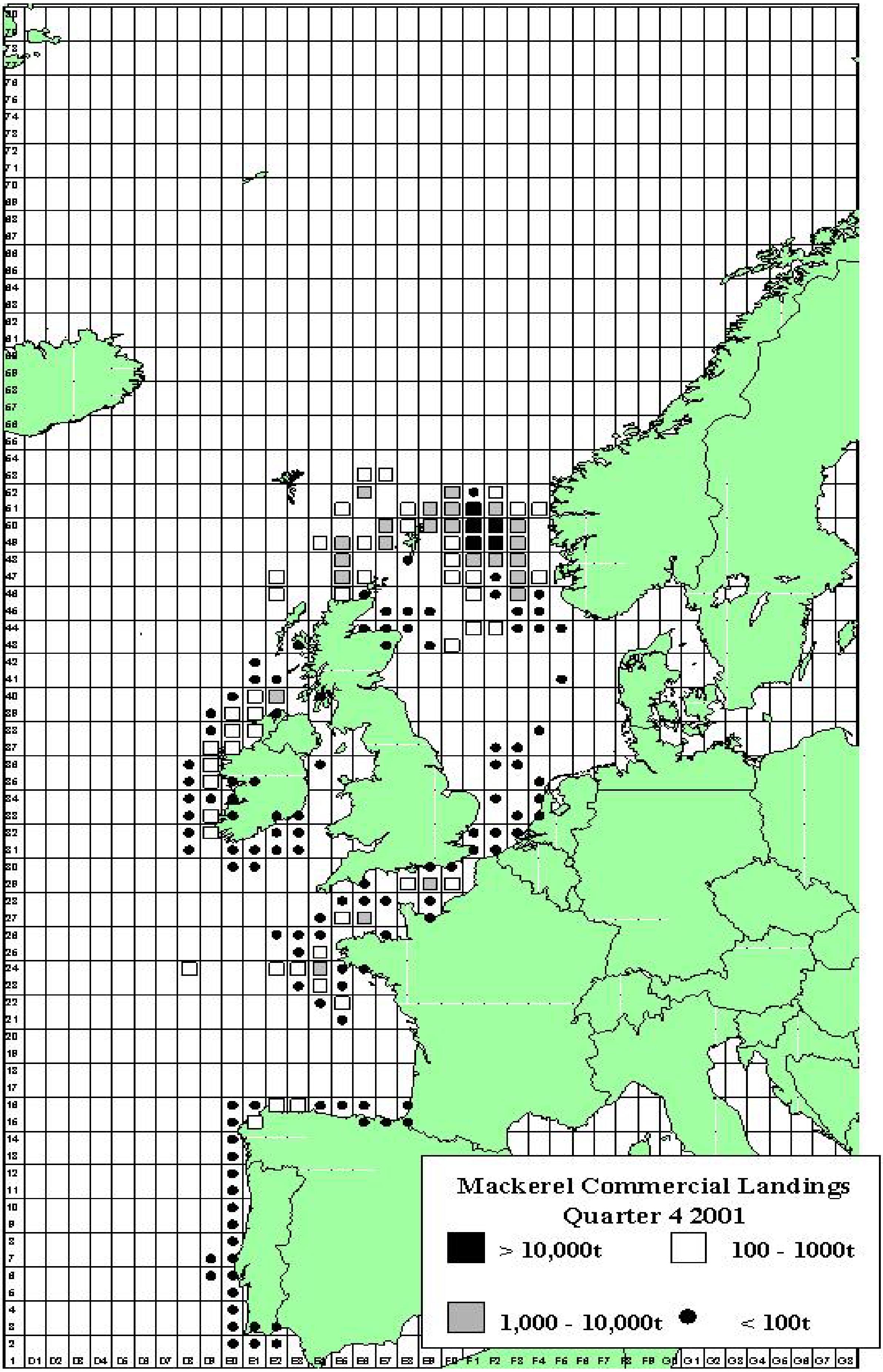


Figure 2.8.1.4. Mackerel commercial catches in quarter 4 2001.

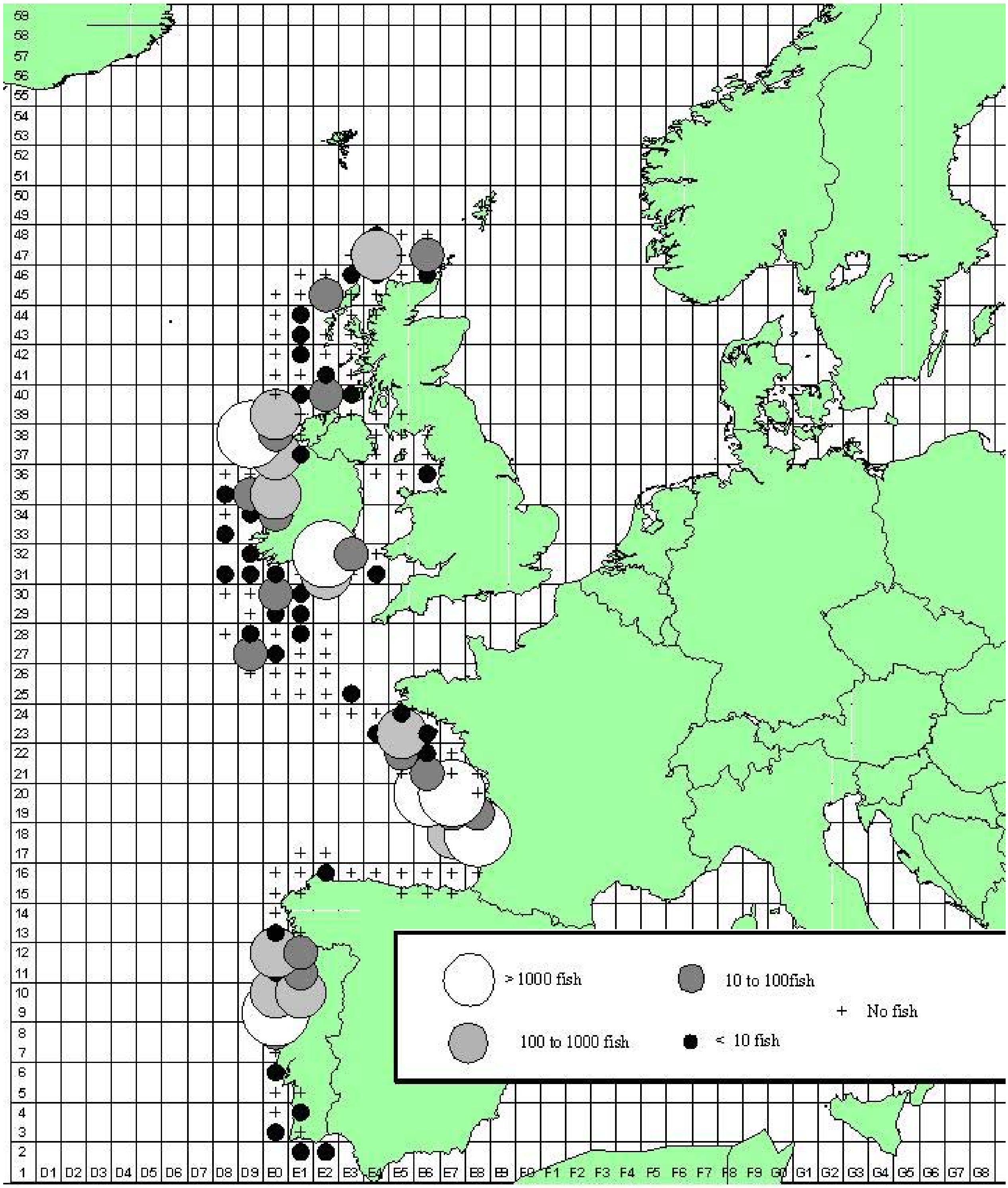


Figure 2.8.2.1. Distribution of mackerel recruits. 2001 year class age 0 in quarter 4 2001.

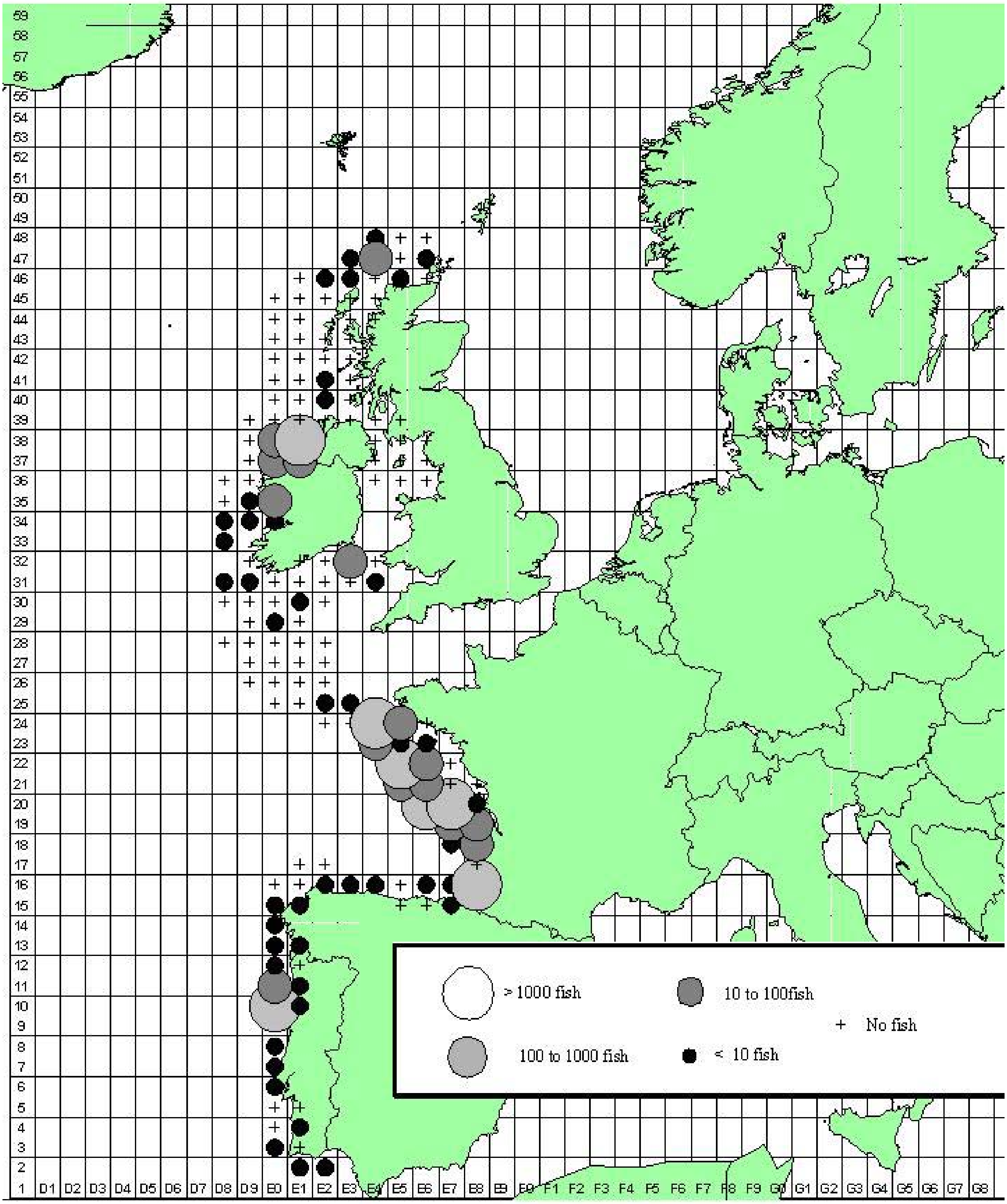


Figure 2.8.2.2. Distribution of mackerel recruits. 2000 year class age 1 in quarter 4 2001.

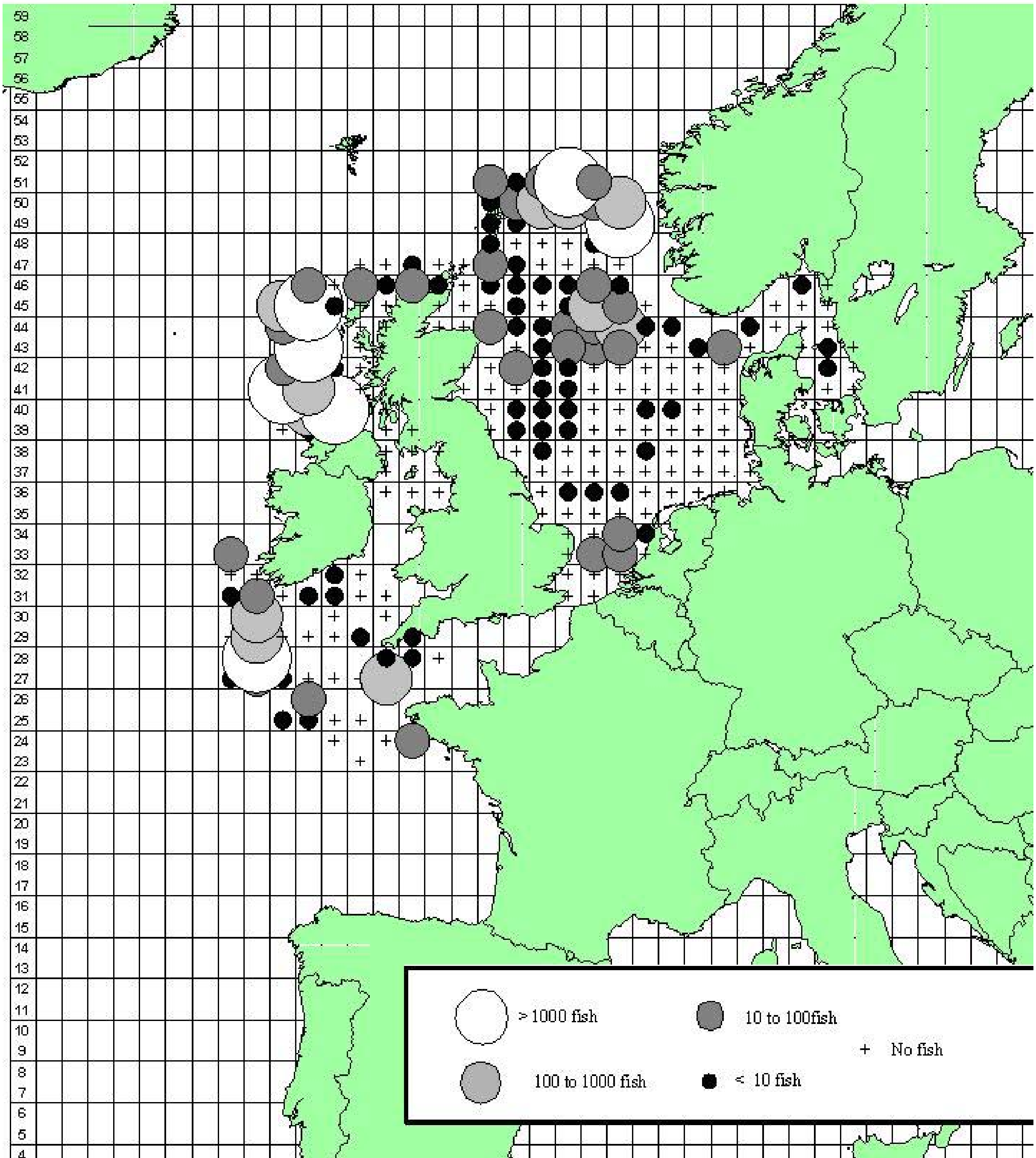


Figure 2.8.2.3. Distribution of mackerel recruits. 2001 year class age 1 in quarter 1 2002.

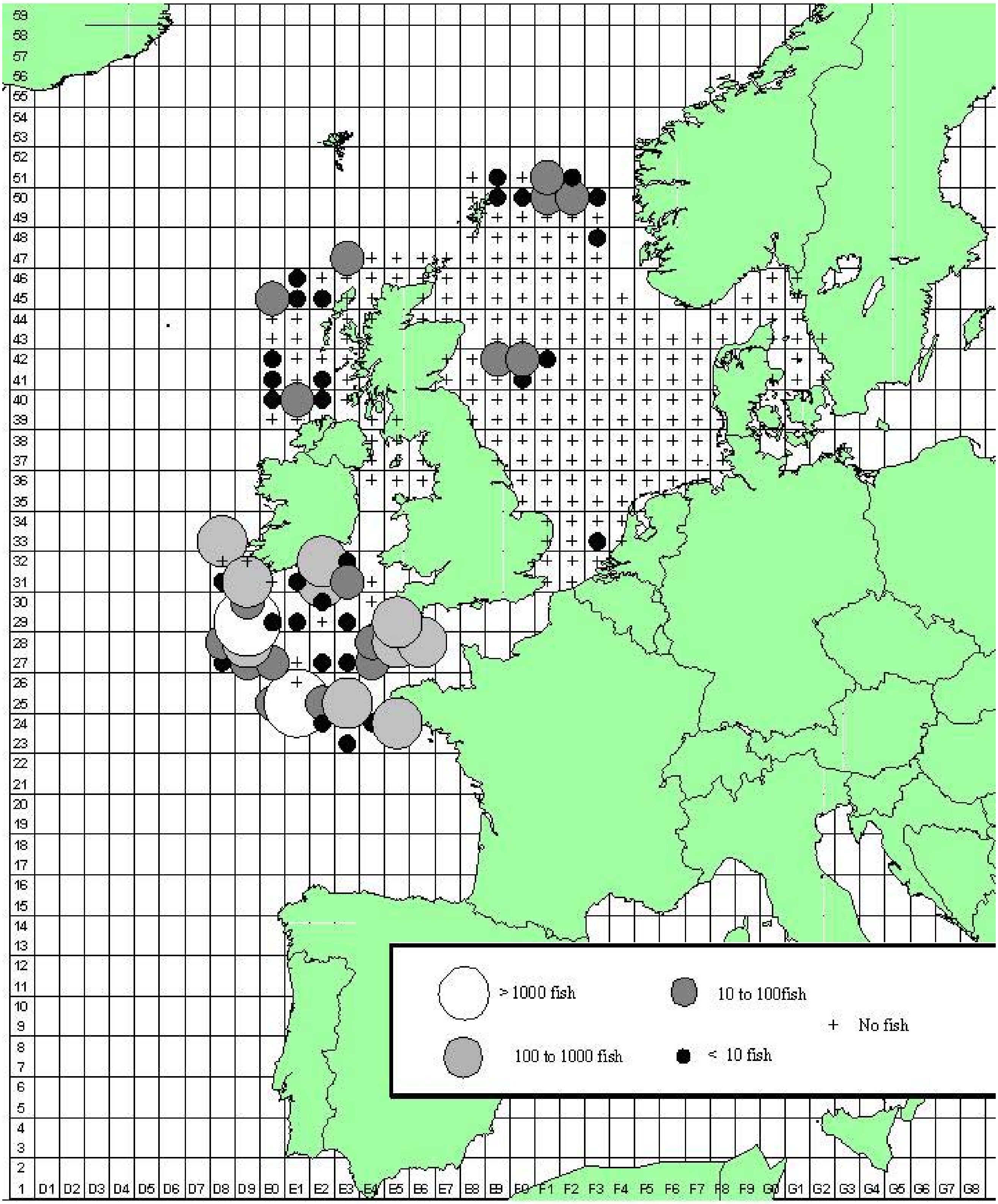


Figure 2.8.2.4. Distribution of mackerel recruits. 2000 year class age 2 in quarter 1 2002.

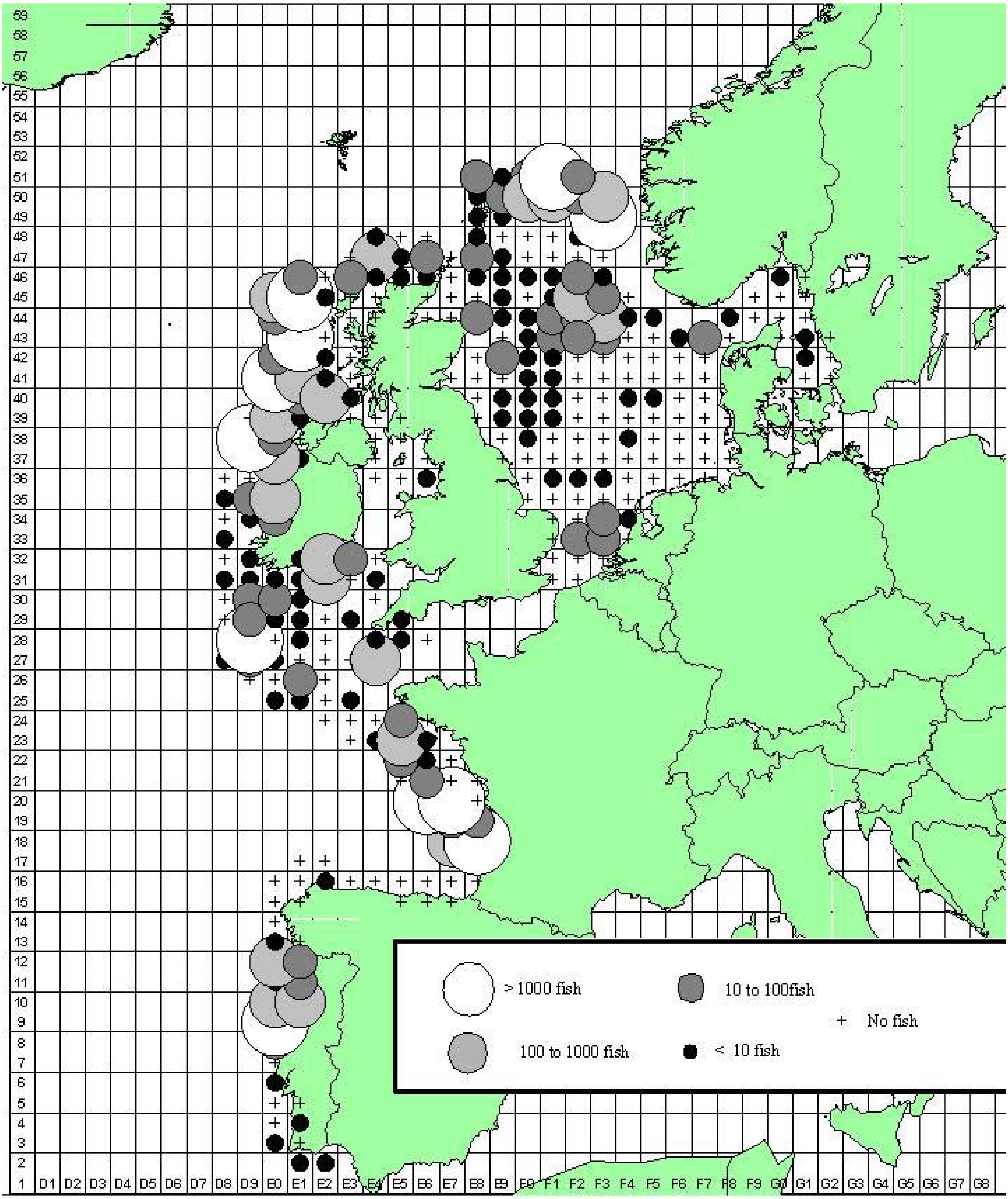


Figure 2.8.2.5. Distribution of mackerel recruits. 2001 year class in 1st winter (2001/2002).

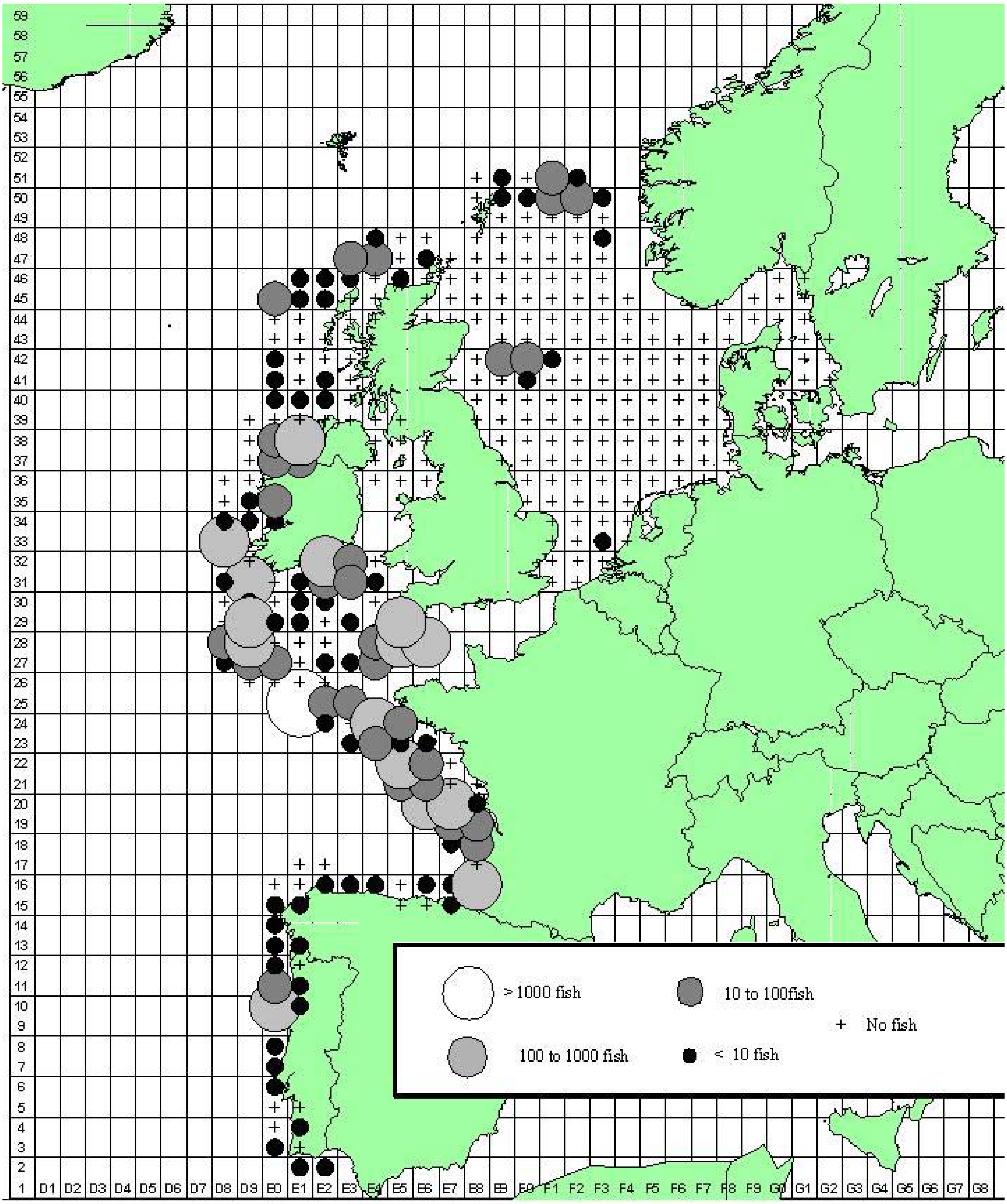


Figure 2.8.2.6. Distribution of mackerel recruits. 2000 year class in 2nd winter (2001/2002).

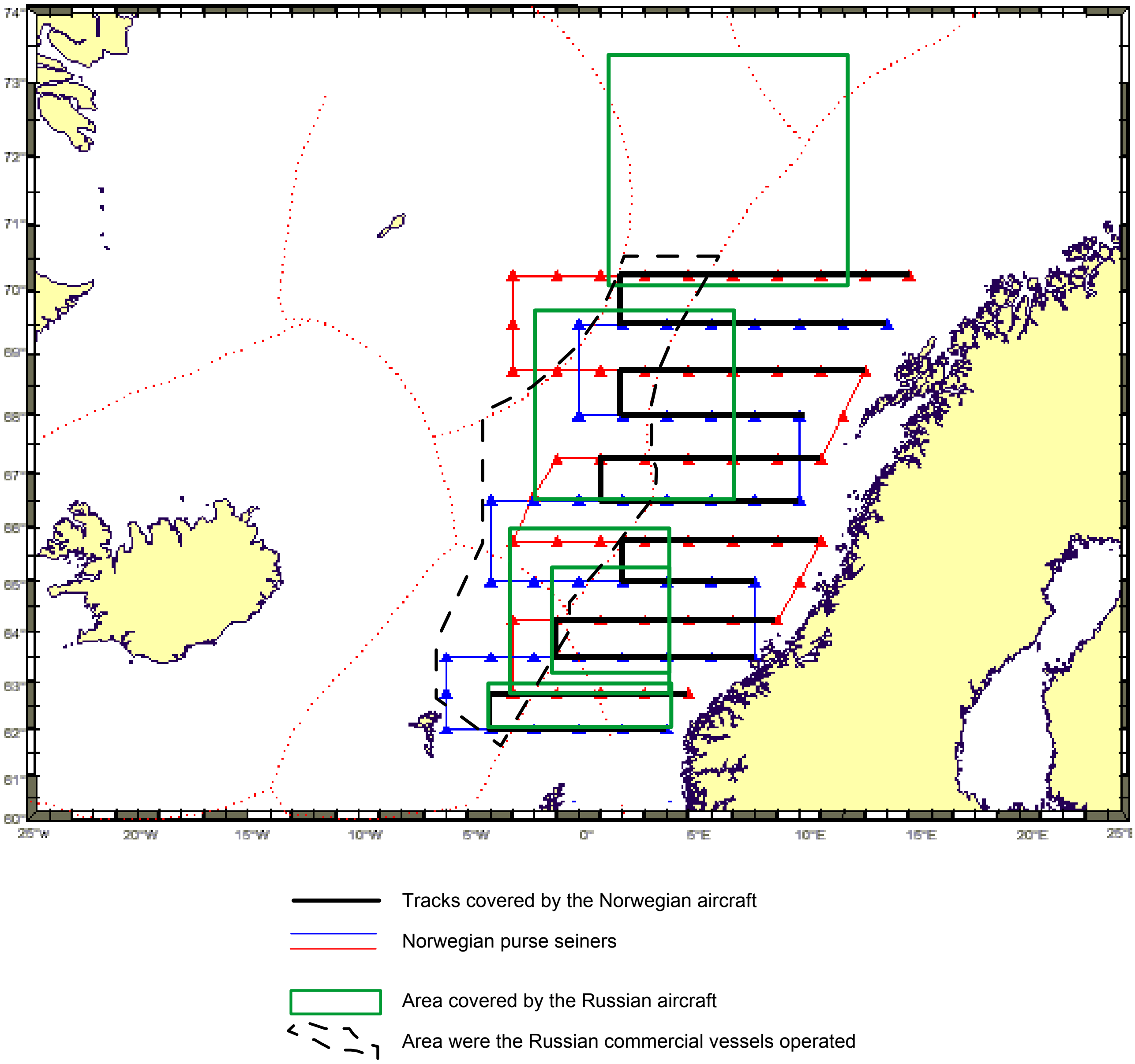


Figure 2.8.3.1. Tracks by the Norwegian purse seiners and airplane, and areas covered by the Russian airplane and commercial vessels July 2002.

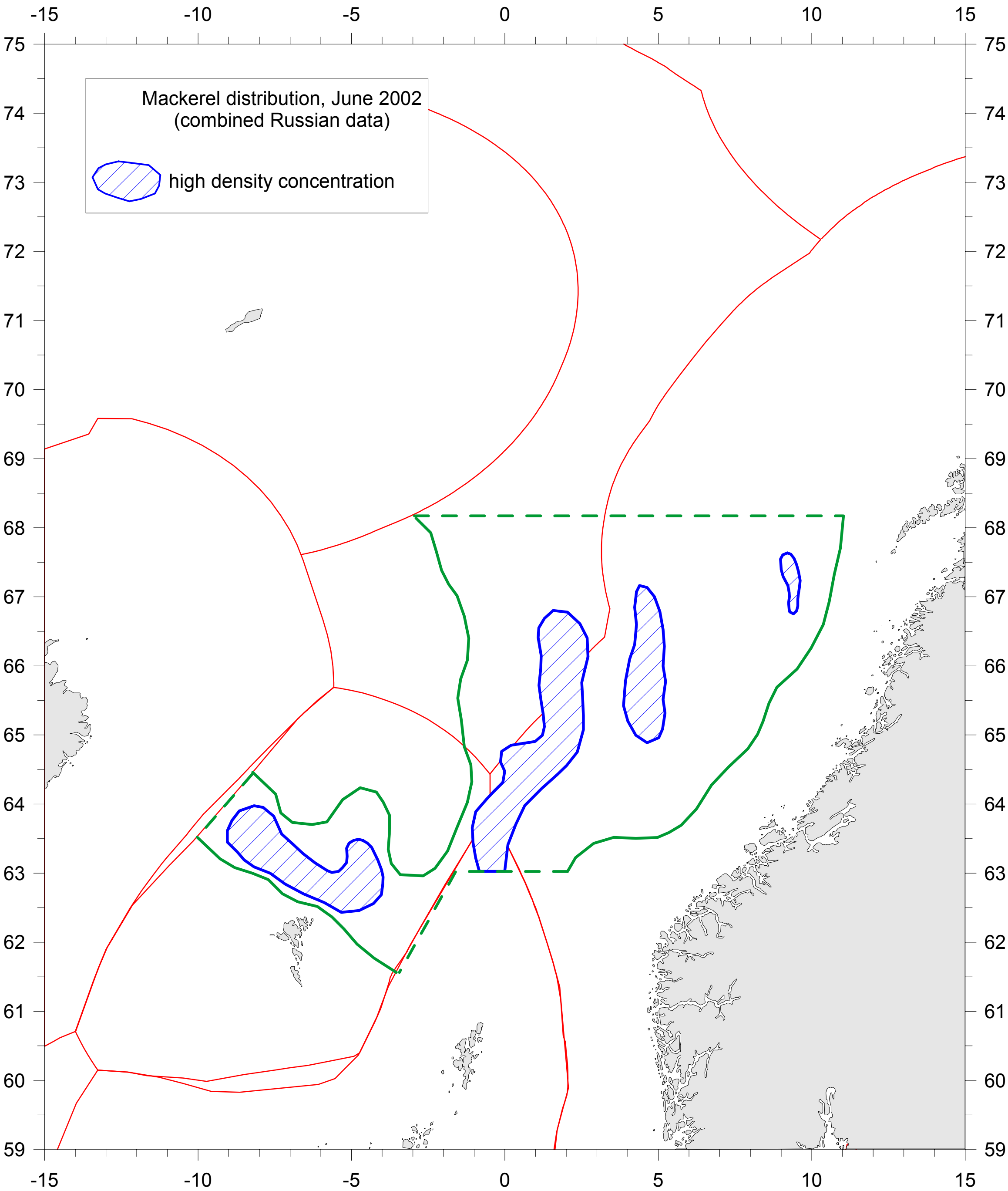


Figure 2.8.3.2. Mackerel distribution during June 2002. Combined Russian data.

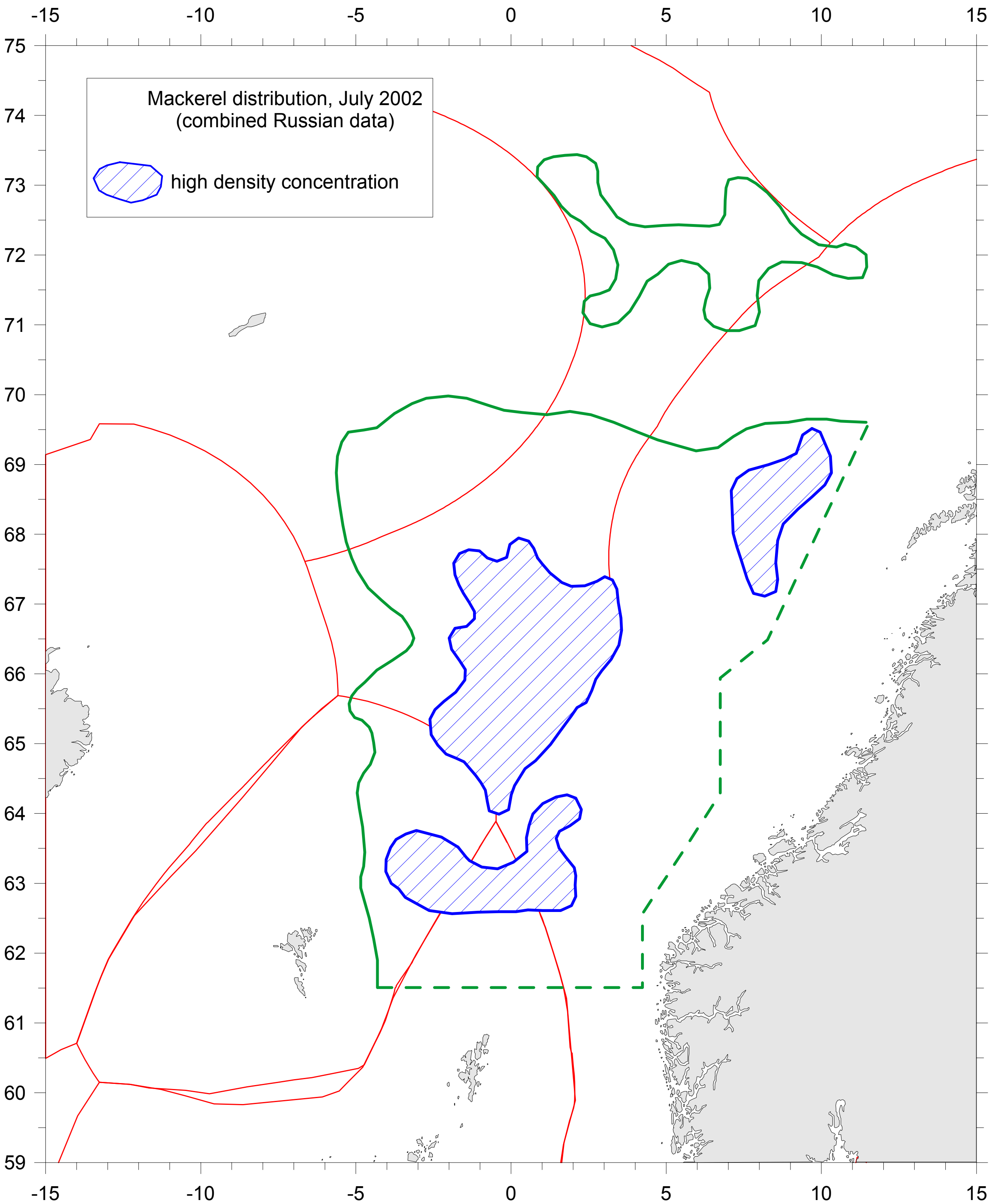


Figure 2.8.3.3. Mackerel distribution during July 2002. Combined Russian data.

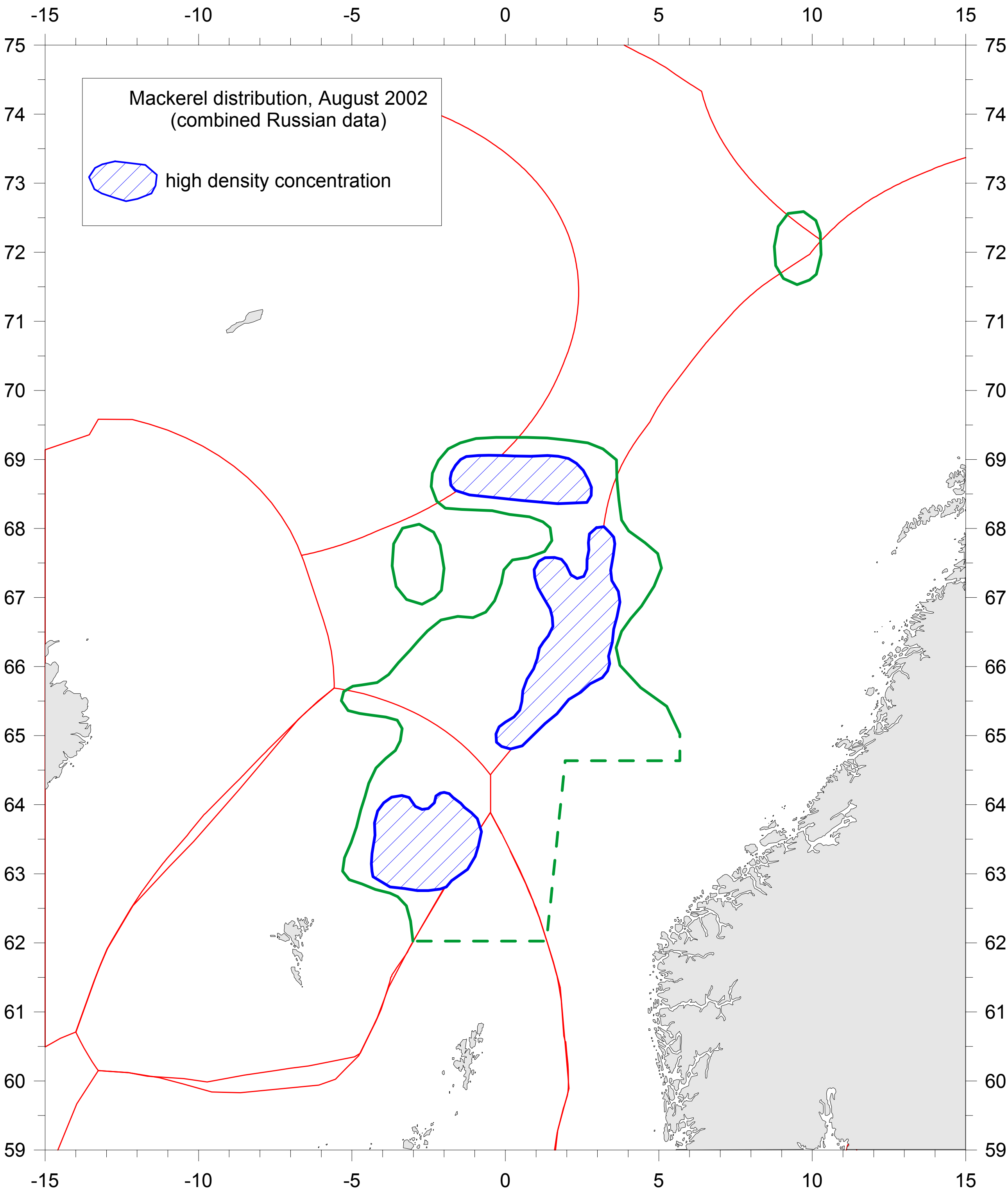


Figure 2.8.3.4. Mackerel distribution during August 2002. Combined Russian data.

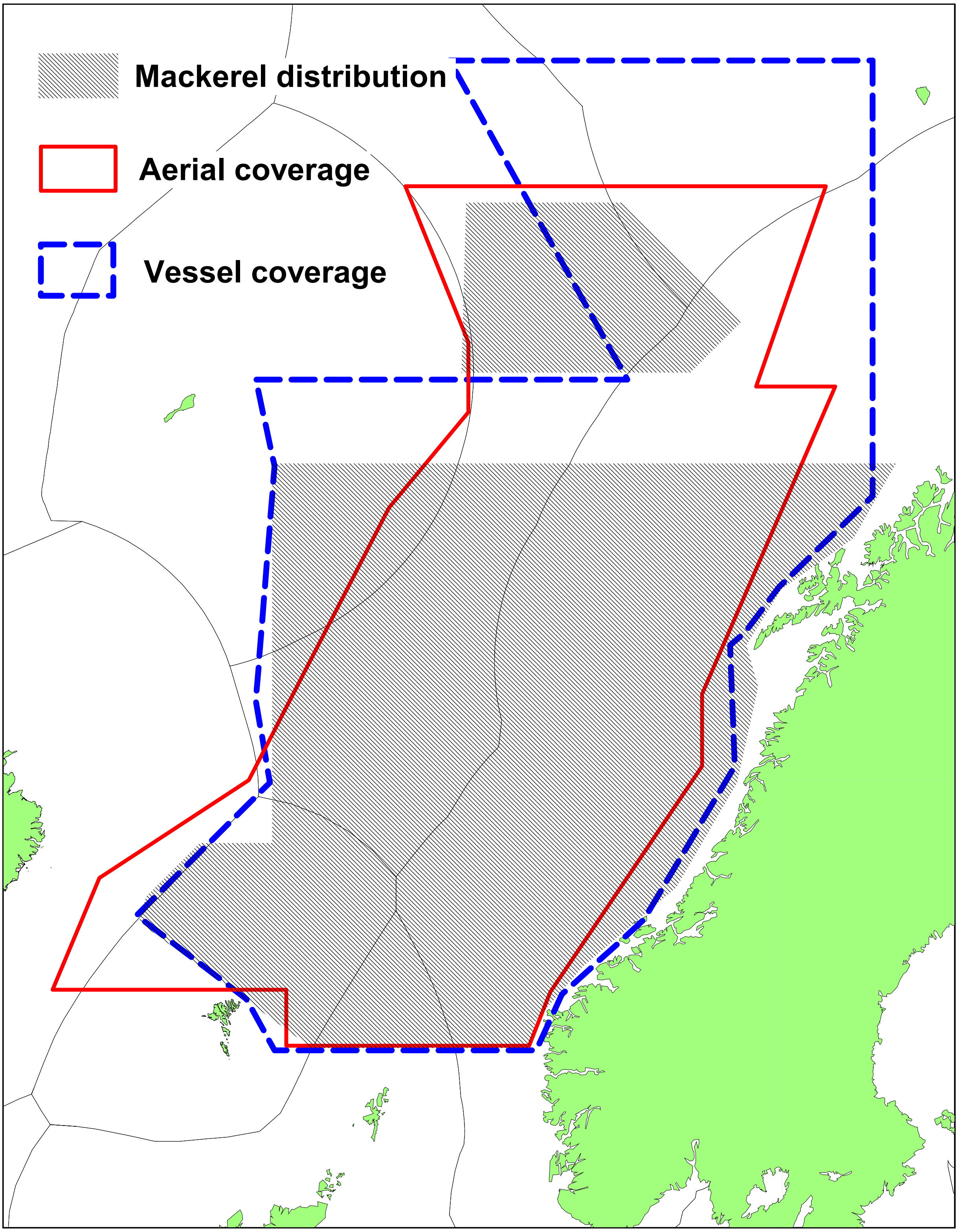


Figure 2.8.3.5. Map of approximate summer distribution (June, July and August) of mackerel (hatched) in the Norwegian Sea as observed by joint aerial/survey and commercial vessels in 2002. Coverage of one Russian and one Norwegian aircraft (solid red line) during July and August, and coverage of research and commercial vessels participating in the joint surveys (broken blue line). No coverage south of 61°30'N.

2.9 Data Exploration and Preliminary Modelling

ISVPA trial runs

This year a modified version of ISVPA was applied. The current version of the model provides possibilities to include SSB estimates from the egg surveys into the assessment, to estimate two different selection patterns for two different periods, bootstrap (conditional parametric, assuming lognormal error distribution in catch-at-age). These are now built-in options. Details of the ISVPA model are given in Vasilyev (WD 2002).

In last year's ISVPA assessment the 0 age group was excluded from the analysis because of very high residuals in the effort-controlled version of the model. This gave more confidence to the stability of the fishery selectivity. In this year's mixed version of the model, an unstable selectivity of fishing on 0 age group is less problematic, because the model does not consider either catch-at-age data or separability assumption to be absolutely true.

Preliminary runs revealed high instability of results if the time interval for the estimation of any of the two selection patterns in the model was chosen too narrow. That is why finally the whole period 1984–2001 was divided into two equal parts to supply maximum informational support for estimation of each of them, despite this is not in agreement with the year of expected change in the NEA mackerel selection pattern (1989).

Profiles of the ISVPA loss function, when the model was fitted on catch-at-age data only (median of distribution of squared residuals in logarithmic catches (MDN)) and when the model was fitted on SSB estimates from egg surveys (sum of squared residuals between logarithms of ISVPA-derived SSB estimates and logarithms of SSB estimates from egg surveys (SSE)) with respect to the terminal effort factor when using such setting of the time intervals revealed good coincidence of the minima, indicating that the signals from the catch-at-age data and from egg surveys are similar (Figure 2.9.1a). Results on the stock assessment produced by ISVPA using catch-at-age data only and using tuning on SSB surveys (4 points of the survey data were used) are also very close to each other (Figure 2.9.1d).

Since the catch-at-age data and the surveys gave quite similar estimates, the catch-at-age- and SSB-derived terms were included with equal weights in the loss function in the final ISVPA run (after the magnitudes of MDN (catch-at-age) and SSE(SSB) were drawn into the same scale). The estimates of F(4–8) and selection patterns for the two periods are shown in Figure 2.9.2. The results indicate a slight increase in stock biomass, despite that the SSB estimate from the 2001 egg surveys is lower in comparison to surveys of 1998.

The ISVPA results are in line with the other methods.

AMCI trial runs

The AMCI software was used to explore some structural assumptions that are different from what ICA allows for. Some of the work was done prior to the meeting (Skagen, WD 2002), and a final key run with data as used by the WG for the assessment was made during the meeting.

The runs prior to the meeting were set up allowing a modest year-to-year change in selection, except for the first 4 years, where it was assumed to be stable. The objective function was log sums of squares on the catch numbers-at-age for 1984 - 2001, on the yearly yields and the SSB, and a Poisson likelihood function on the number of tags returned for each release year and age. Catch numbers-at-age 0 were down-weighted by a factor of 0.01 and those at age 1 by a factor of 0.1. In the preliminary runs, three years of egg surveys (1995, 1998, 2001) were included, and treated as either relative or absolute measures of the spawning biomass.

The key run in this exercise showed stable fishing mortality in the last years at approximately 0.2 if the SSB was treated as relative and a slight increasing trend in the fishing mortality if it was treated as absolute, or if a very high weight was given to the egg survey data. The catchability estimated for the egg surveys with these data was 1.07. By not using the egg survey data, a lower fishing mortality around 0.14 in the last years was obtained. By leaving out the tagging data the recent fishing mortality was estimated slightly higher than in the key run, at approximately 0.23.

Thus, it appeared that the information in the SSB data indicated a somewhat higher fishing mortality, while the tags return data indicate a lower fishing mortality in the recent years.

In subsequent runs, the catch data were extended to 1980, the 1992 egg survey estimate was included, and the updated weights and maturities were used, in accordance with the final ICA run. Using the egg survey data as relative estimates of SSB, the catchability was now estimated at 1.14.

In all runs, the selection appeared to be stable and relatively flat at fully recruited ages, except for a period in the early 1990ies where the selection was higher at old ages (Figure 2.9.3). This can be taken as a justification of the use of separable models like ICA and ISVPA. However, some of the early year classes generate trends in the catch residuals (Figure 2.9.4), suggesting that there may be some year class effects. The overall results with AMCI, shown in Figure 2.9.5, are well in line with those by the other methods.

ICA trial runs

Table 2.9.1 shows for comparison the different input parameters of the final ICA assessment on NEA mackerel for the years 1997–2002.

The sensitivity of the ICA model was tested with preliminary data files by applying different weightings to the relative index of SSB's from egg surveys, weightings of 1 and 10 compared to a traditional weighting of 5 and using the SSB index as relative. ICA did not appear to be very sensitive to changes in weighting between 1 and 10, because the difference in F ranged only from -8% to +1% and the SSB changed only from -1% to +8% compared to the standard value of 5 for weighting. ICA appeared to be much more sensitive to changes in the periods of separable constraint ranging from 3 to 10 years, because the difference in F in the final year ranged from -39% to -9% and the SSB ranged from -17% to +68% compared to the period of separable constraint of 7 years.

A run was made with the final assessment files using a period of separable constraint of 10 years covering all available SSB's from the 1992, 1995, 1998 and 2001 egg surveys, while using this SSB index as an relative index. This period of separable constraint of 10 years was chosen, because both ICA and AMCI did not indicate large changes in the exploitation pattern over this period. In the diagnostic output of ICA this resulted in a catchability of 1.272 (run 10), while in earlier years a catchability was achieved close to 1. The key to this difference in this year's and last year's assessments from ICA is in the catchability plots of the diagnostics (Figure 2.9.6). In last year's plots there is sufficient range and contrast for the model to be able to estimate q = 1.092 (Figure 2.9.6). For comparison an ICA run for western mackerel was carried out with the same input parameters as last year except the period of separable constraint was changed to 13 years (15 years is the maximum for ICA and two periods of separable constraint of 2+13 years resulted in very different SSB's for the early period). The obtained catchabilities from this year's assessment of the western mackerel and last year's assessment were respectively 1.106 and 1.098 (Figure 2.9.6). Adding the 2001 SSB from the egg survey and adding an extra year of catch-at-age data in the western mackerel assessment did not change q significantly, which is due to the much larger number of SSB estimates from egg surveys.

The WG felt that relative tuning to the short NEA mackerel SSB time-series (1992, 1995, 1998, and 2001) was inappropriate. This was due substantially to the low signal contrast in these data, and that the bulk of the observed variability could be attributed to variance in the surveys, rather than major shifts in the SSB. SSB's from egg surveys prior to 1992 were not used in the assessment because they were carried out in the western area only. They were then raised to a NEA value using a 15% ratio based on surveys in 1992 and 1995. The validity of this ratio is suspect; as the 1998 survey gave a ratio closer to 25%, thus only complete NEA mackerel survey indices have been used.

The sensitivity of the ICA model was tested with the final data files by applying weightings of 1, 5 and 10 to the absolute index of SSB's from egg surveys (Figure 2.9.7). This exercise showed only slight differences in the estimated SSB, F and recruitment in the final year. The 2001 SSB from the egg surveys was regarded to be more reliable than the 1998 SSB and therefore the WG decided to use an arbitrary weighting of 5.

The WG decided to use ICA in the assessment, to use the SSB values from the egg surveys as an absolute index with a weighting of 5 and with a period of separable constraint of 10 years.

Table 2.9.1 Input parameters of the final ICA assessments of NEA-Mackerel for the years 1997–2002.

Assessment year	2002	2001	2000	1999	1998 ###	1997
First data year	1972	1984	1984	1984	1984	1984
Final data year	2001	2000	1999	1998	1997	1996
No of years for separable constraint ?	10	9	8	7	12	11
Constant selection pattern model (Y/N)	S1(1992–2001)	S1(1992–2000)	S1(1992–1999)	S1(1992–1998)	S1(86–88); S2(89–97)	S1(86–88); S2(89–96)
S to be fixed on last age	1.2	1.2	1.2	1.2	1.2 / 1.2	1.2 / 1.2
Reference age for separable constraint	5	5	5	5	5	5
First age for calculation of reference F	4	4	4	4	4	4
Last age for calculation of reference F	8	8	8	8	8	8
Shrink the final populations	No	No	No	No	No	No
Tuning indices						
SSB from egg surveys Years	1992+1995+1998+2001	1992+1995+1998	1992+1995+1998	1992+1995+1998	86 + 89 + 92 + 95 + 98	86 + 89 + 92 + 95
Abundance index	absolute index	relative index: linear	relative index: linear	relative index: linear	absolute index	absolute index
Model weighting						
Relative weights in catch-at-age matrix	all 1, except 0-gr 0.01	all 1, except 0-gr 0.01	all 1, except 0-gr 0.01	all 1, except 0-gr 0.01	all 1, except 0-gr 0.01	all 1, except 0-gr 0.01
Survey indices weighting Egg surveys	5.0	5.0	5.0	5.0	1.0	1.0
Stock recruitment relationship fitted?	No	No	No	No	No	No
Parameters to be estimated	41	40	38	36	55	53
Number of observations	124	111	99	87	149	136

At the 1998 Working Group meeting only a provisional assessment was carried out (the 1997 assessment was regarded to be more reliable)

Figure 2.9.1 North East Atlantic Mackerel. Results of stock assessment by means of ISVPA options: Mixed version (residuals are distributed between catch-at-age and separable representation of fishing mortality)
Two selection patterns: (1984-1992 and 1993-2001) to supply equation number of years for each
SSB survey results are treated as absolute

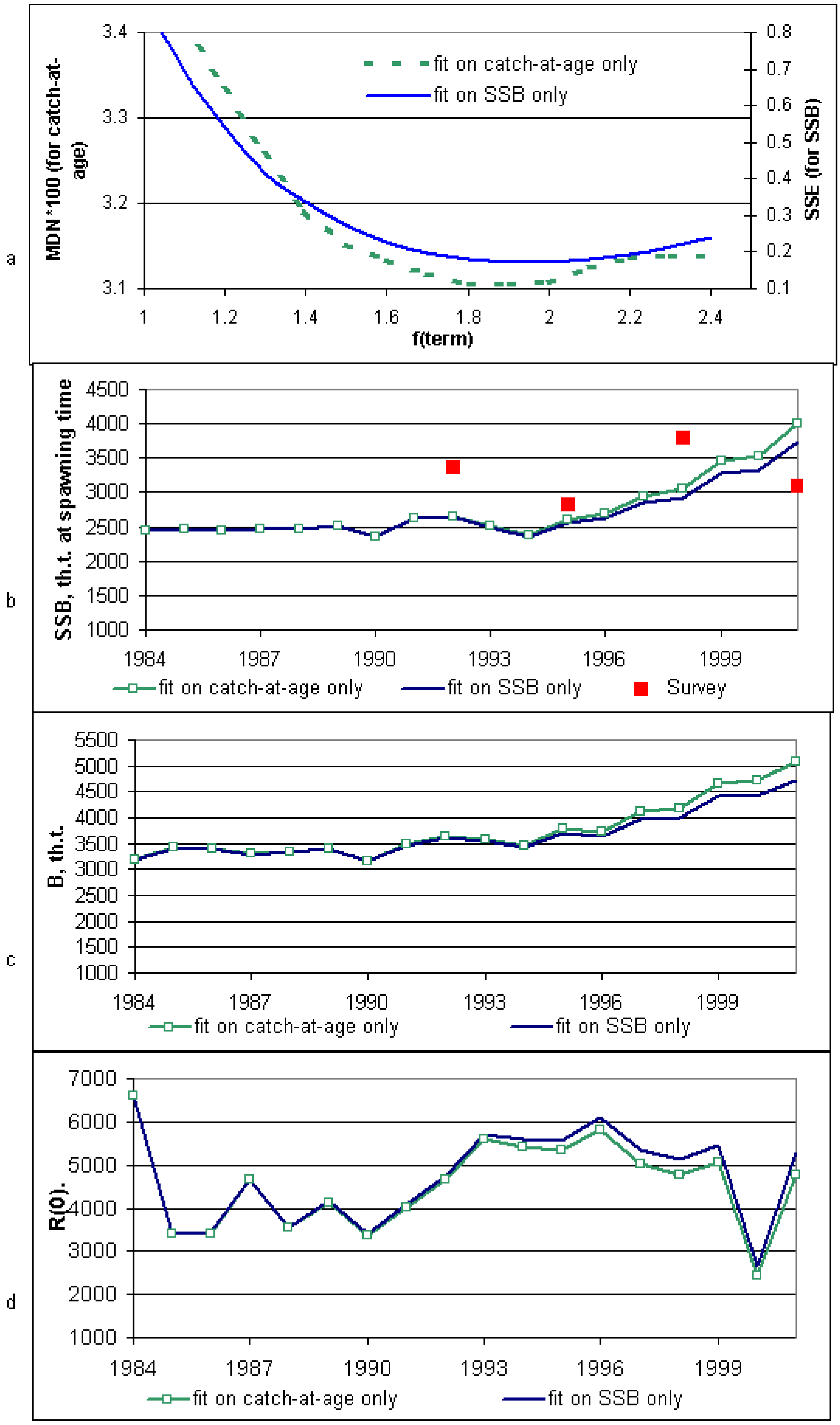


Figure 2.9.2 North East Atlantic Mackerel. Results of stock assessment by means of ISVPA
tuned both on catch-at-age and SSB with equal weights (after rescaling)
S1(a): 1984-1992
S2(a): 1993-2001

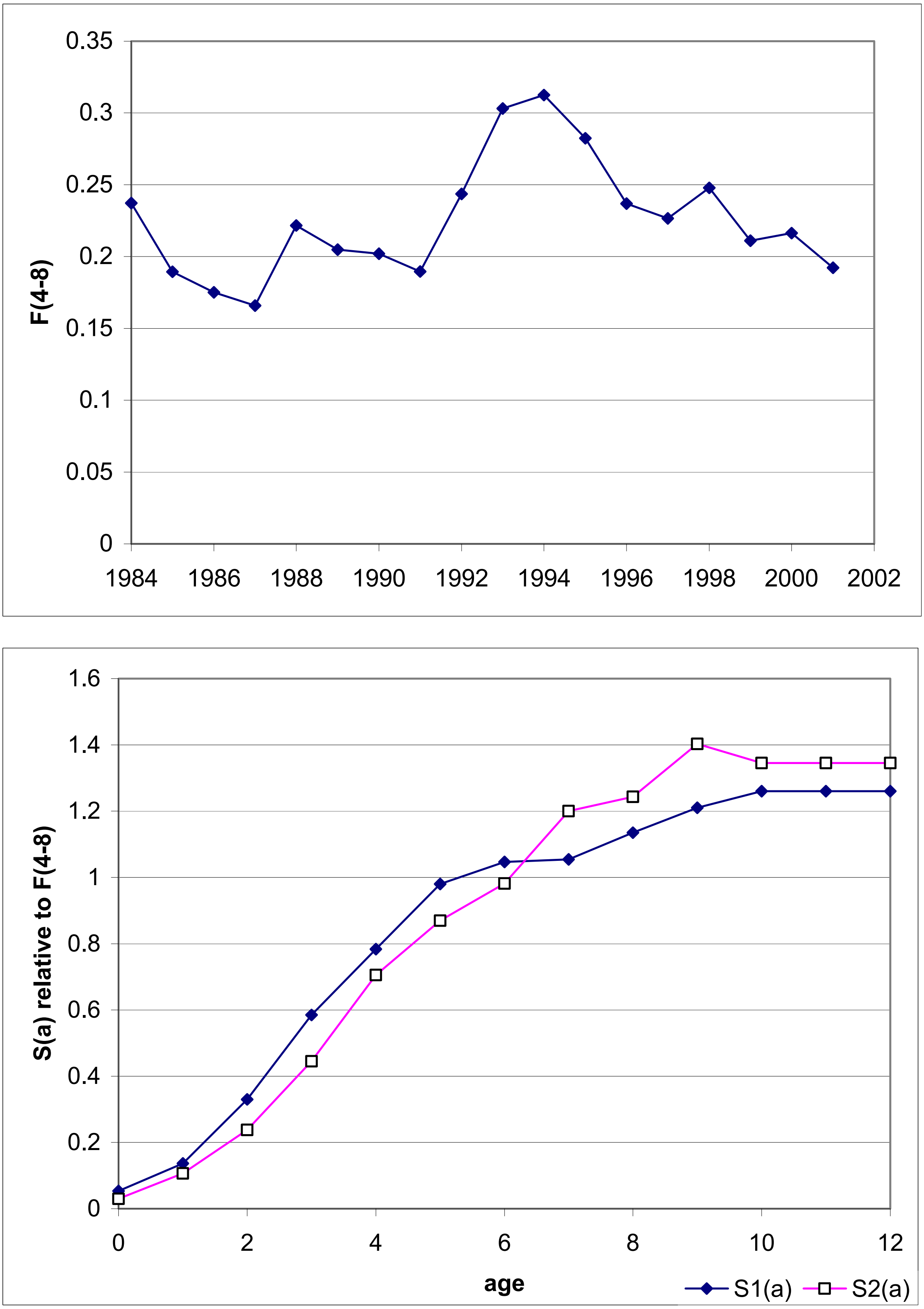


Figure 2.9.3 North East Atlantic Mackerel. Results of AMCI assessment
Fishing mortality at age and gear (SSB absolute)

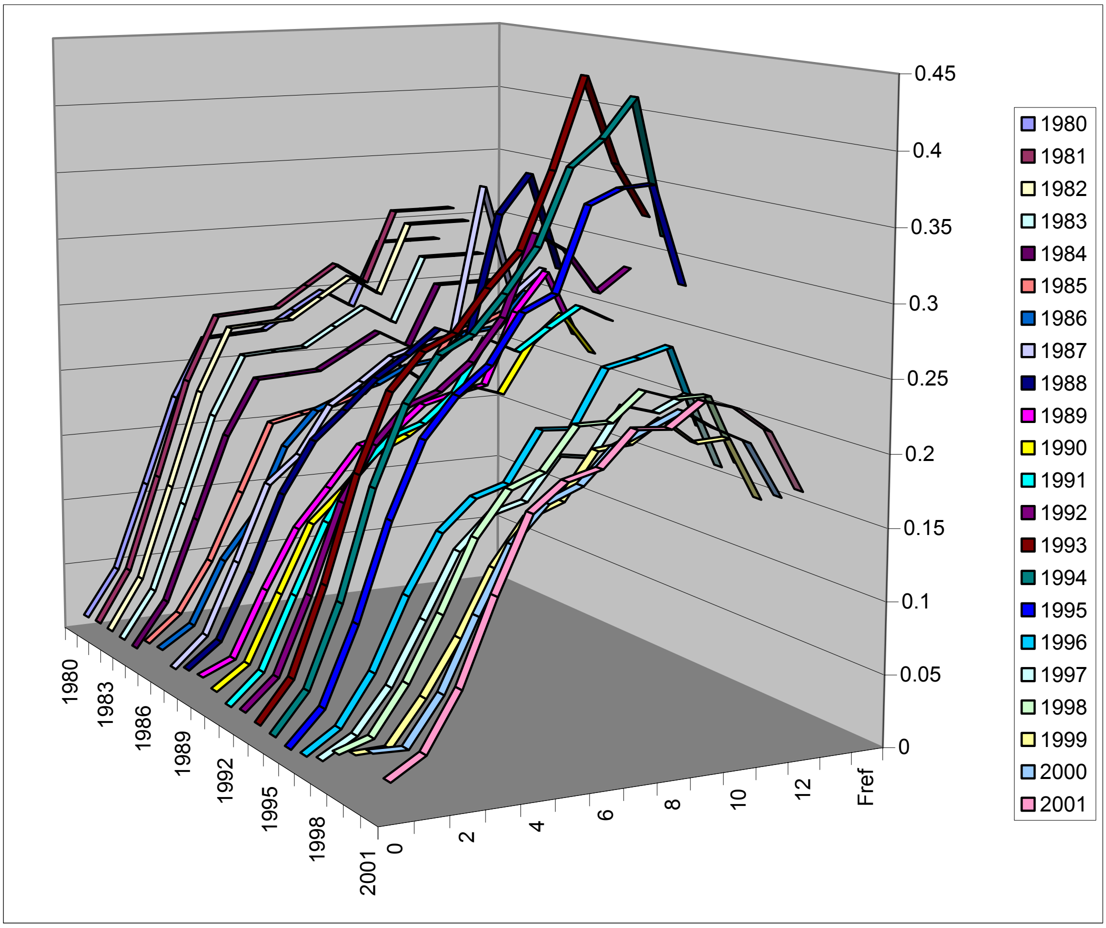


Figure 2.9.4 North East Atlantic Mackerel. Results of AMCI assessment
Unweighted log catch residuals

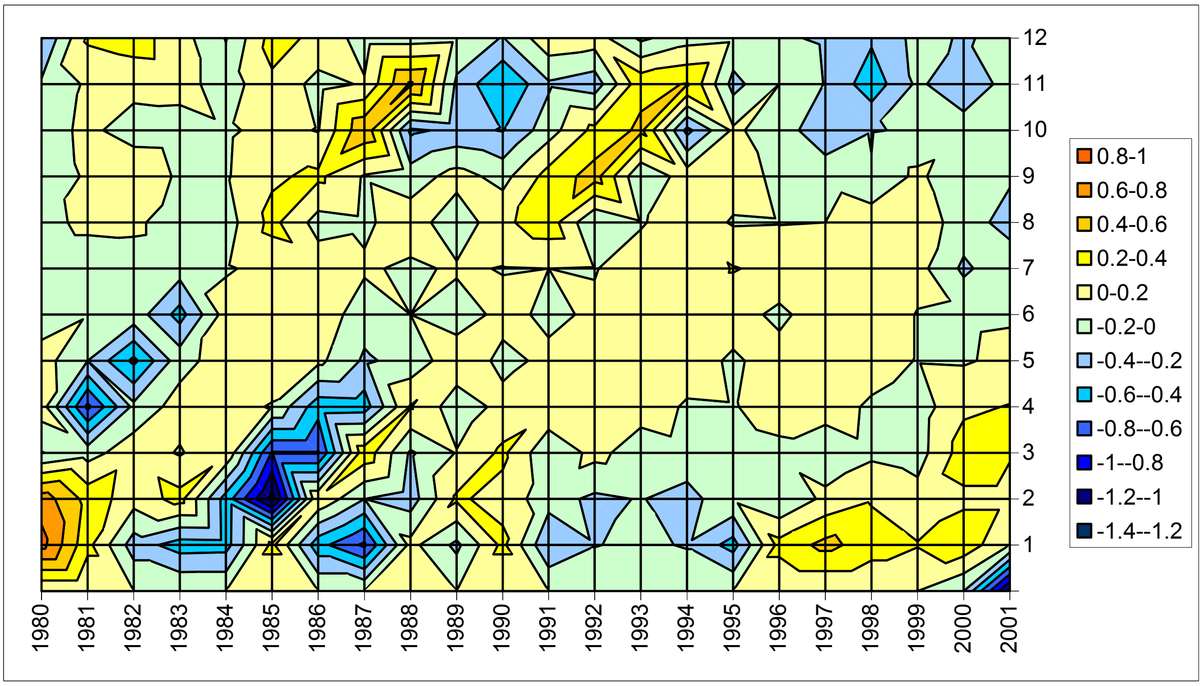
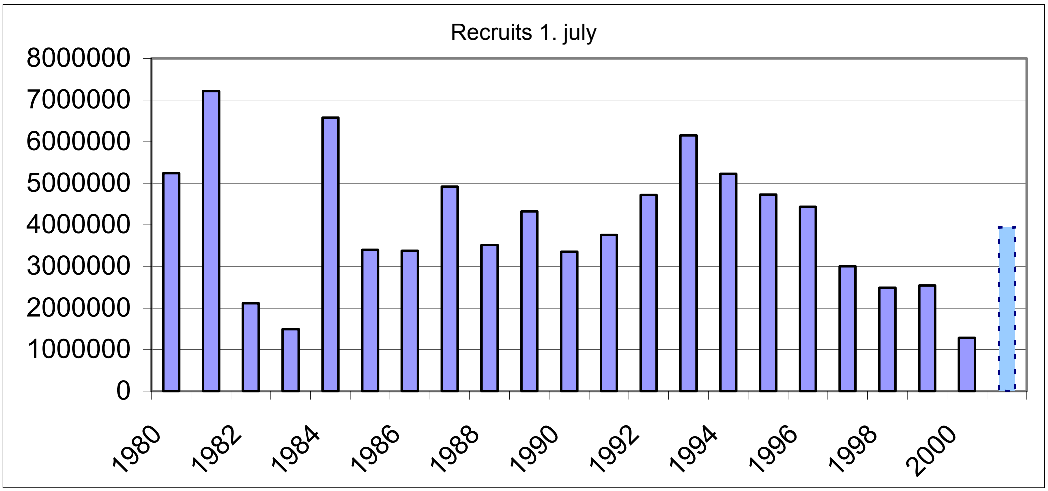
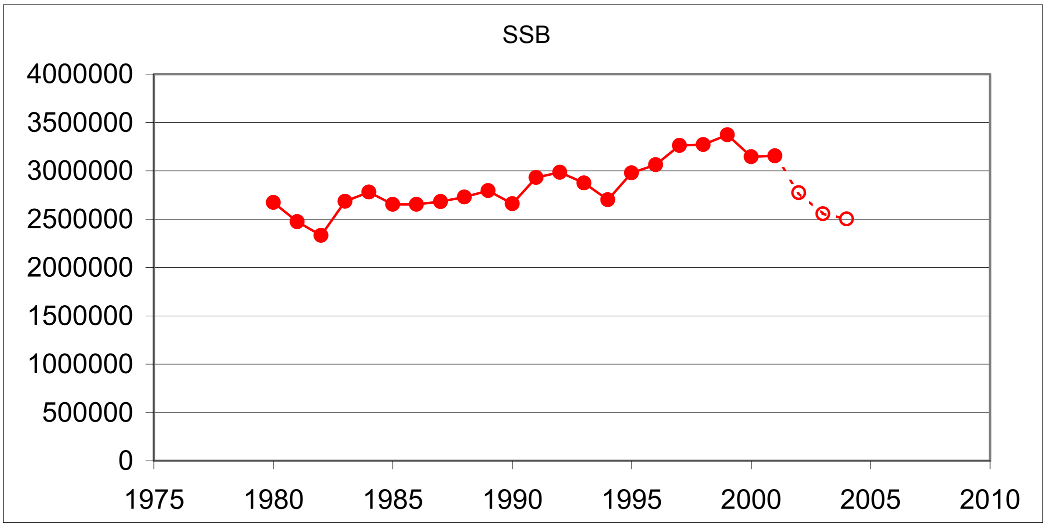
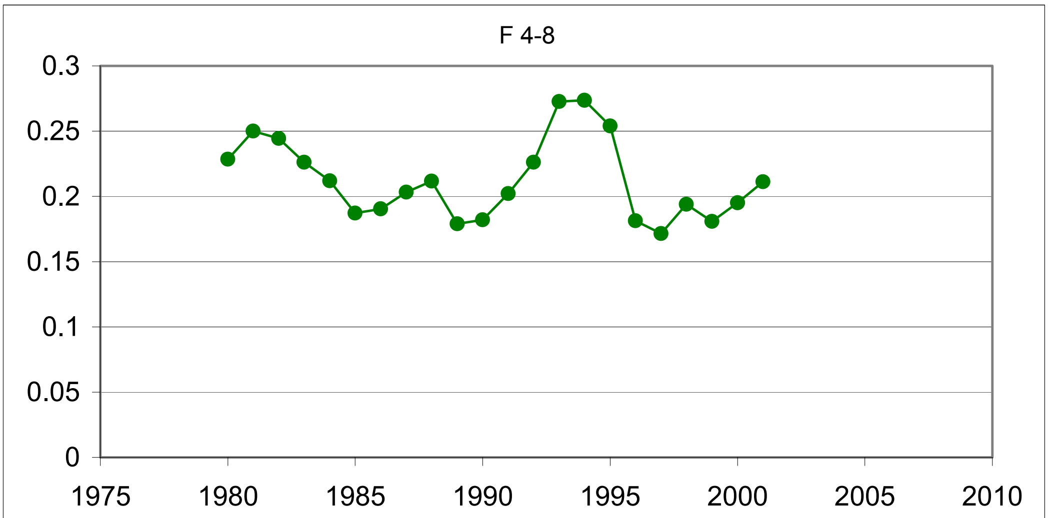


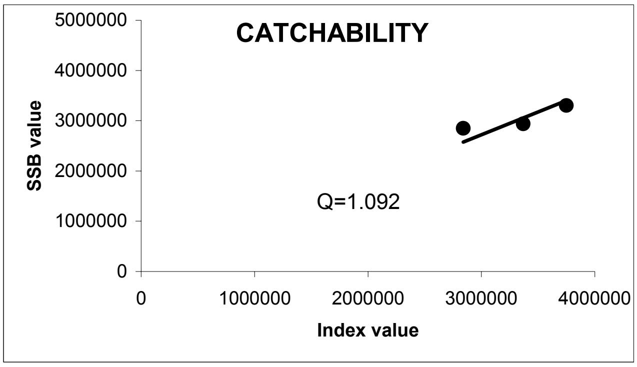
Figure 2.9.5 North East Atlantic Mackerel. Results of AMCI assessment



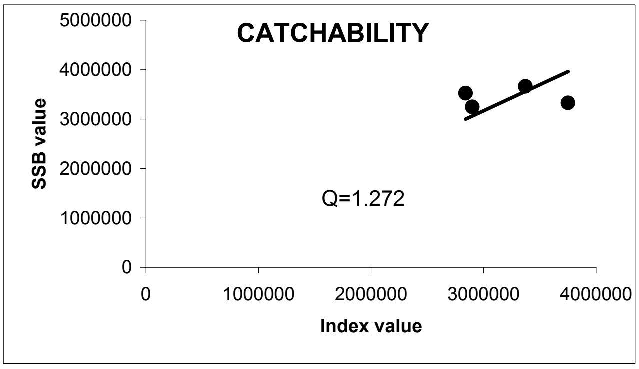




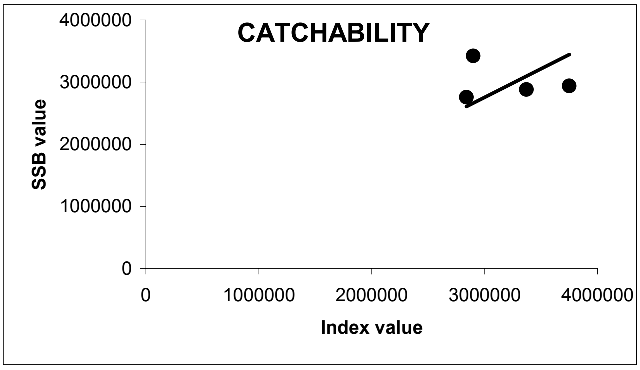
NEA mackerel



Last years assessment Relative index of SSB

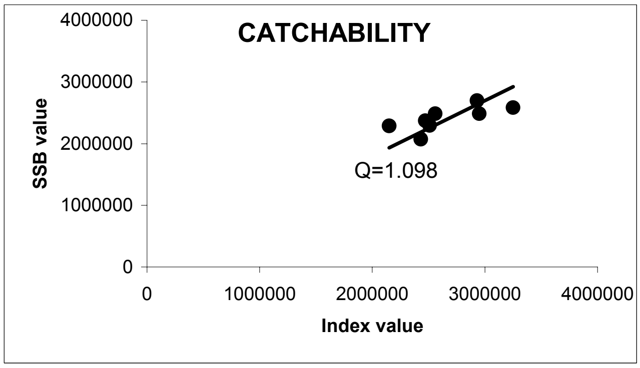


This years assessment Relative index of SSB

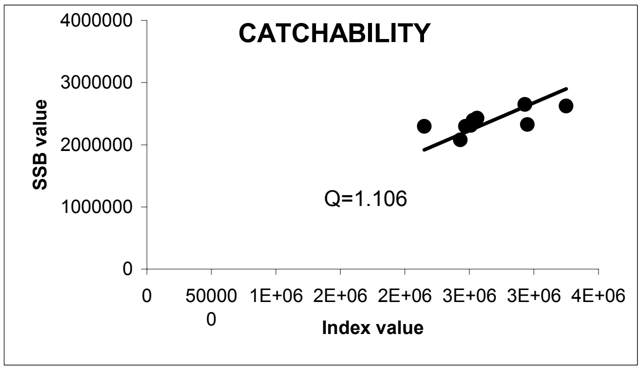


This years assessment Absolute index of SSB

Western mackerel



Last years assessment Relative index of SSB



This years assessment Relative index of SSB

Figure 2.9.6 The plots of catchability for both NEA and western mackerel. Top figures show the catchability plots of last years assessments. The middle figures show the catchability plots of this years assessment when using the input parameters as much as possible as last year. The lower figure shows the catchability plot for NEA mackerel when using the biomass index as absolute.

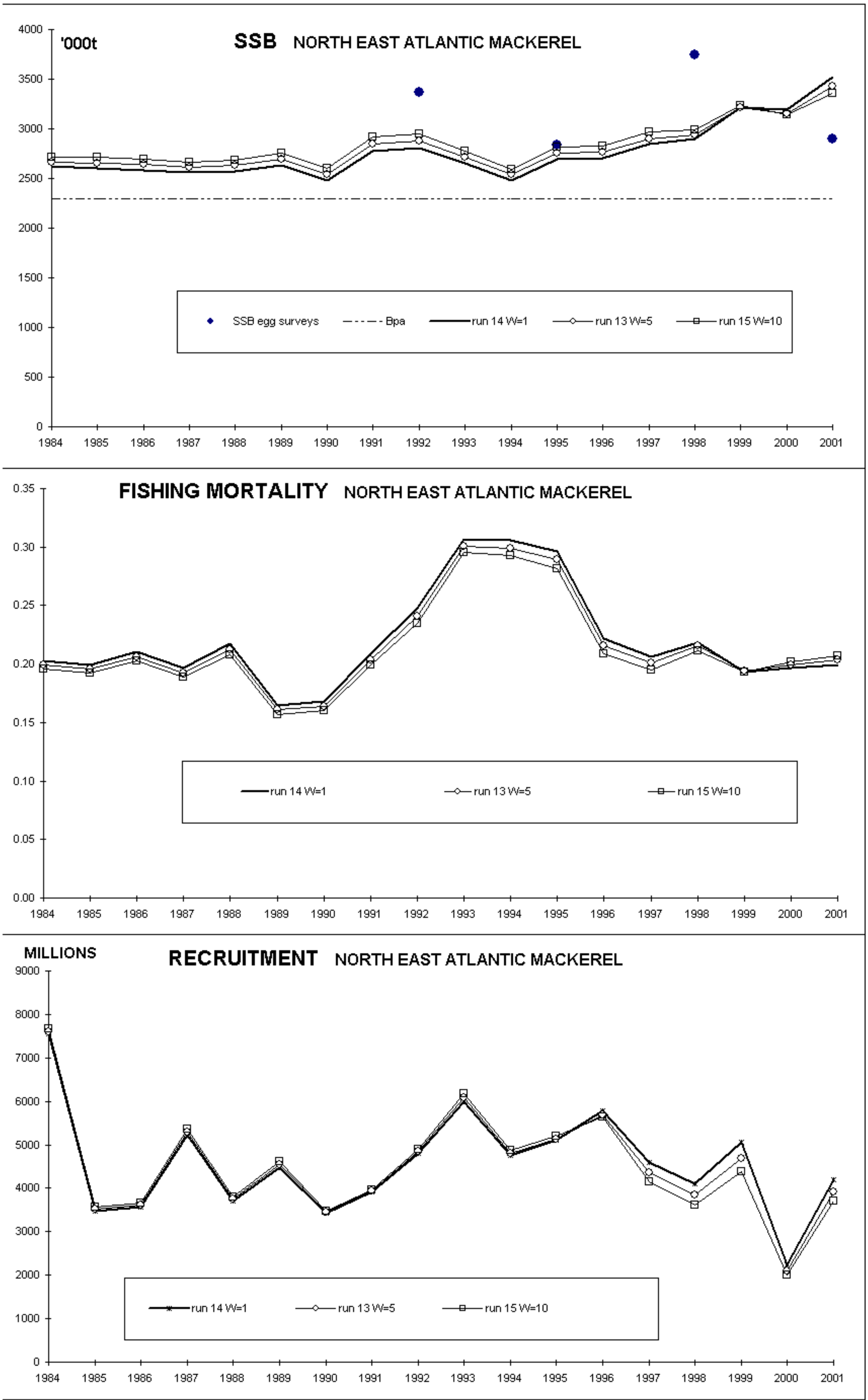


Figure 2.9.7 **Comparison of SSB, F and recruitment estimates (ICA) obtained at various assessment working group meetings. Biomass estimates from egg surveys in 1992, 1995, 1998 and 2001 are also shown. At the 1999 - 2001 working groups the 1992, 1995 and 1998 egg survey SSB's and at the 2002 working group the 1992, 1995, 1998 and 2001 egg survey SSB's were used. At the 1998 working group meeting the new assessment was rejected and in stead the 1997 assessment was projected one year forward.The recruitment figure shows also the geometric mean (GM) recruitment from 1994 onwards.**

2.10 State of the Stock

2.10.1 Stock assessment

In this year the time-series for assessment was extended. It starts now in 1972 instead of 1984 as in earlier years (see Section 2.5).

Table's 2.10.1.1–6 show the catches in number, the mean weights-at-age in the catch, the mean weights-at-age in the stock, the natural mortality, the proportion of fish spawning, and the SSB index values used in the assessment.

ICA fits to the catch-at-age data, and the egg production estimates were used to examine the relationship between the indices and the catch-at-age data as estimated by a separable VPA. The WG decided to use a weighting of 5 for the SSB index and used the index series as an absolute index of abundance as was done prior to 1998. The argumentation for this is given in Section 2.9. The WG decided to use the 4 most recent SSB estimates from the egg surveys in the analysis. This is because the egg surveys prior to 1992 were only carried out in the western area and were raised to give retrospective SSB for the NEA stock assuming that the proportion of the NEA stock in the western area was 0.85. This proportion was estimated as 0.75 from the 1998 egg survey and this cast doubt on the validity of using a fixed value to raise the western SSB estimates for years prior to 1992. In this year's assessment the separable constraint was changed to one period of 10 years to include the SSB index time-series over the period 1992–2001. A terminal selection of 1.2 was used for the period of separable constraint. The selection pattern was calculated relative to the reference fishing mortality at age 5. The changes in the inputs used in ICA this year relative to other years is given in Table 2.9.1.

The model was fitted by a non-linear minimisation of:

$$\sum_{a=0}^{a=11} \sum_{y=1992}^{y=2001} \lambda_a (\ln(C_{a,y}) - \ln(F_y . S_a \cdot \overline{N}_{a,y}))^2 +$$
$$\sum_{y=1992}^{y=2001} \sum(\ln(EPB_y) - \ln(Q \sum_a N_{a,y} \cdot O_{a,y} \cdot W_{a,y} \cdot \exp(-PF . F_y . S_a - PM . M)))^2$$

subject to the constraints

$S_5 = 1.0$
$S_{11} = 1.2$

where:

- . - mean exploited population abundance over the year.
- N - population abundance on 1 January.
- O - percentage maturity.
- M - natural mortality.
- F - fishing mortality at age 5.
- S - selection at age over the time period 1992–2001, referenced to age 5.
- λ - weighting factor set to 0.01 for age 0, 1.0 for all other ages.
- a,y - age and year subscripts.
- PF, PM - proportion of fishing and natural mortality occurring before spawning.
- EPB - Egg production estimates of mackerel spawning biomass.
- C - Catches in number-at-age and year.
- Q - the ratio between egg estimates of biomass and the assessment model of biomass.

Table's 2.10.1.7 and 2.10.1.8 present the estimated fishing mortalities and population numbers-at-age. Table's 2.10.1.9 and Figures 2.10.1.1–2.10.1.4 present the ICA diagnostic output. The stock summary is presented in Table 2.10.1.10. Figure 2.10.1.5 shows the catches, F, recruitment, and SSB for the extended period 1972–2001.

2.10.2 Reliability of the assessment and uncertainty estimation

Assessment

The relatively poor sampling of some parts of the fishery, which may lead to quite large errors in the catch at age data, was pointed out in previous years as a problem in the assessment. In 2000 the proportion sampled of the total catch of the north east Atlantic mackerel was the lowest since 1992 (see Section 1.3). However, in 2001 the percentage of catch covered by sampling increased from 76% to 83% and the numbers aged by 24% compared to 2000.

The problem of assessing the stock with very little supplementary data remains serious, as has been pointed out previously. Four years ago, the WG found that the main problem was to obtain a stable stock estimate when the last independent information was far back in time. In the three years prior to this WG meeting the problem related more to the over-dependence of the estimate on the last data point (the egg survey biomass in 1998). In this years assessment the 1998 and 2001 egg survey biomass estimates did not fit to the SSB estimates from ICA. The WG considers the egg survey estimates of SSB to be quite reliable information. In recent years the coverage in area and time of the egg surveys as well as the collection of biological data improved.

At last years WG the most serious concern was that an increase in SSB following from the high egg survey SSB estimate measured in 1998, could only be explained by recent strong year classes coming into the spawning stock. There was no clear evidence from landings or other sources that this was the case. The inclusion of the 2001 egg survey SSB in this years assessment then reduced the modelled recent recruitment to around the average level.

Data exploration in 2002using different weighting factors for the SSB of 1, 5 and 10 as an absolute index appeared to have no significant effect on the predicted SSB in the last year.

The AMCI model is able to use the large data set of Norwegian tag material as an additional source of information about mortality. It is reassuring that the AMCI model gives results that are in line with the ICA assessment, although the trends in SSB and F variate. Similar results were also obtained using the ISVPA model. In each case these models were set up to use the same SSB estimates, and as absolute values. The AMCI and ISVPA models were also run with and without the biomass estimates from the egg surveys and again this had no substantial effect on the stock trajectories. In summary, these results suggests that the ICA estimate as presented here is relatively robust and provides a valid perception of the stock situation. (see sections 2.9 and 2.10.1).

Uncertainty

The variances estimated by ICA express how well the parameters, including the present population numbers, can be estimated with the present data and model assumptions. The CV's of the stock number estimates are in the order of 9-13%, which is slightly better than in the last assessment done in 2001 (11 - 17%). The 2000 and 2001 year classes, for which there is little information in the data, have higher CV's.

The SSB, F and recruitment estimates as obtained by previous Working Groups (1995 - 2002), are shown in Figure 2.10.2.1. Although the long term trend in biomass is consistent, the levels of variability reflect switches between the use of SSB as a relative or an absolute index. The SSB estimates calculated at this years Working Group differ considerably from the three earlier Working Groups, because the lower SSB estimate from the 2001 egg survey was included in this years assessment. From 1994 until data from the next egg survey in 1998 became available, the model tried to fit to the relatively low SSB estimate from the 1995 egg survey, leading to the low SSB assessments in those years. From then onwards the model appeared to be trying to fit an increasing trend driven by the low 1995 and high 1998 SSB estimates based on the egg surveys. The inclusion of the 2001 estimate then changes the perception again, suggesting a more median stock trajectory. The last three WG's treated the egg survey biomass estimates as relative indices, but this WG decided to use them as an absolute index, as was the standard practice up to 1999. Until the 2002 WG, the catchability cooefficient for the SSB estimates was found to be close to 1 suggesting that an absolute biomass figure should be acceptable. When tuning the ICA to the egg survey SSB as a relative index in 2002 the catchability plots showed too little range and contrast for the model to be able to estimate q. Therefore, the western mackerel and NEA mackerel assessments of the past years of assessment were used as a prior for q. In the past q was estimated as being close to 1 both for western and NEA mackerel and therefore it was decided to return to the use of the SSB as an absolute index.

The WG feels strongly that the current use of the ICA model appears to be too sensitive to variability in the SSB estimates from egg surveys. The variability in the survey SSB estimates at around 30% is not exceptional for surveys in general. The problem appears to lie mainly in the three year interval between survey estimates becoming available. The model attempts to fit to the last survey estimate, which has the greatest influence. Large corrections in the modelled

SSB then have to be made when a new estimate becomes available that differs to any substantial degree from the previous one, as happened with the 1995 and 1998 survey estimates and again for the 2001 estimates. It could be suggested that the model is actually attempting to fit to the noise in the survey data rather than the signal. Examination of the full egg survey time series in the western area suggests that the stock is relatively stable. (Figure 2.10.1.5 shows that the SSB of the NEA mackerel remained rather constant from 1980 onwards).

In summary the fundamental problem is the sparcity of fishery independent data, specifically the three year cycle in the availability of egg survey SSB estimates, which, additionally is not age disaggregated. Possible ways to improve this situation are:

– More fishery independent data - e.g. more frequent egg surveys, or some other index
– Improved assessment modelling methodology -
– Design a management regime adapted to the uncertainty in the assessment process

Fishery independent data - There is currently ongoing work on the development of acoustic surveys for provision of a stock estimate for mackerel. Bottom trawl surveys in both the western area and the North Sea have the potential to provide information on year classes prior to their appearance in the fishery. More extensive tagging programmes, e.g. in the juvenile areas, would provide additional supporting data. It should be recognized that none of these approaches will provide an instant fix and will require varying degrees of development and validation work.

Modelling - Although there is scope for improvement in the models it must be recognized that models cannot compensate for lack of real data, and so model developments can only partly address the problem.

Management - The management regime needs to take into account these problems in providing an accurate assessment of the state of the stock. This implies a moderate fishing mortality allowing a buffer stock which is sufficiently large to sustain year to year variations in recruitment and extraction. In a strategy like this, the long term yield would be nearly independent of the fishing mortality over a wide range of fishing mortalities. So such moderate fishing mortalities can be applied without any significant loss in long term yield. The current management regime is appropriate to this approach and should be continued. However, managers should understand that fluctuations in SSB estimates are likely and that any management regime should be robust to such fluctuations on at least a three year cycle. As such it could be suggested that the NEA mackerel stock would be an ideal candidate for a multi-annual management regime.

Table 2.10.1.1 North East Atlantic Mackerel. Catch in numbers-at-age.

Output Generated by ICA Version 1.4

Mackerel NE Atlantic WG2002

Catch in Number

AGE	1972	1973	1974	1975	1976	1977	1978	1979
0	10.71	17.00	29.28	36.17	62.51	6.08	34.62	114.53
1	34.98	46.27	108.08	62.91	282.82	175.22	34.51	360.70
2	51.65	74.54	47.41	92.39	249.29	328.73	560.74	62.91
3	194.46	109.02	155.39	84.51	374.25	226.56	449.34	609.52
4	650.98	415.01	148.54	265.13	176.79	236.12	279.24	385.58
5	0.00	814.52	424.46	164.67	314.26	67.76	282.16	250.75
6	0.00	0.00	673.32	251.42	133.82	186.62	78.88	248.10
7	0.00	0.00	0.00	991.63	379.79	105.00	172.21	92.66
8	0.00	0.00	0.00	0.00	478.93	229.80	73.93	169.60
9	0.00	0.00	0.00	0.00	0.00	236.97	127.97	73.90
10	0.00	0.00	0.00	0.00	0.00	0.00	243.33	102.36
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	204.29
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

x 10 ^ 6

AGE	1980	1981	1982	1983	1984	1985	1986	1987
0	33.10	56.68	11.18	7.33	287.29	81.80	49.98	7.40
1	411.33	276.23	213.94	47.91	31.90	268.96	58.13	40.13
2	393.02	502.37	432.87	668.91	86.06	20.89	424.56	156.67
3	64.55	231.81	472.46	433.74	682.49	58.35	38.39	663.38
4	328.21	32.81	184.58	373.26	387.58	445.36	76.55	56.68
5	254.17	184.87	26.54	126.53	251.50	252.22	364.12	89.00
6	142.98	173.35	138.97	20.18	98.06	165.22	208.02	244.57
7	145.38	116.33	112.48	90.15	22.09	62.36	126.17	150.59
8	54.78	125.55	89.67	72.03	61.81	19.56	42.57	85.86
9	130.77	41.19	88.73	48.67	47.92	47.56	13.53	34.80
10	39.92	146.19	27.55	49.25	37.48	37.61	32.79	19.66
11	56.21	31.64	91.74	19.75	30.11	26.96	22.97	25.75
12	104.93	199.62	156.12	132.04	69.18	97.65	81.15	63.15

x 10 ^ 6

AGE	1988	1989	1990	1991	1992	1993	1994	1995
0	57.64	65.40	24.25	10.01	43.45	19.35	25.37	14.76
1	152.66	64.26	140.53	58.46	83.58	128.14	147.31	81.53
2	137.63	312.74	209.85	212.52	156.29	210.32	221.49	340.90
3	190.40	207.69	410.75	206.42	356.21	266.68	306.98	340.21
4	538.39	167.59	208.15	375.45	266.59	398.24	267.42	275.03
5	72.91	362.47	156.74	188.62	306.14	244.28	301.35	186.85
6	87.32	48.70	254.01	129.15	156.07	255.47	184.93	197.86
7	201.02	58.12	42.55	197.89	113.90	149.93	189.85	142.34
8	122.50	111.25	49.70	51.08	138.46	97.75	106.11	113.41
9	55.91	68.24	85.45	43.41	51.21	121.40	80.05	69.19
10	20.71	32.23	33.04	70.84	36.61	38.79	57.62	42.44
11	13.18	13.90	16.59	29.74	40.96	29.07	20.41	37.96
12	57.49	35.81	27.91	52.99	68.20	68.22	57.55	39.75

x 10 ^ 6

AGE	1996	1997	1998	1999	2000	2001
0	37.96	36.01	61.13	67.00	36.34	26.03
1	119.85	144.39	99.35	73.52	102.15	40.09
2	168.88	186.48	229.77	131.32	133.59	152.69
3	333.37	238.43	264.57	212.65	254.13	217.27
4	279.18	378.88	323.19	249.96	345.21	274.28
5	177.67	246.78	361.94	267.01	262.17	283.47
6	96.30	135.06	207.62	228.68	215.42	210.89
7	119.83	84.38	118.39	149.11	156.34	176.62
8	55.81	66.50	72.75	81.45	95.29	109.29
9	59.80	39.45	47.35	47.00	46.55	65.17
10	25.80	26.73	24.39	28.50	27.79	37.81
11	18.35	13.95	16.55	15.79	16.75	18.70
12	30.65	24.97	22.93	30.59	30.09	37.48

x 10 ^ 6

Table 2.10.1.2 North East Atlantic Mackerel. Catch weights-at-age.

Weights-at-age in the catches (Kg)

AGE	1972	1973	1974	1975	1976	1977	1978	1979
0	0.05200	0.05000	0.05100	0.05000	0.05900	0.05600	0.03600	0.01600
1	0.13500	0.14500	0.13600	0.14800	0.13700	0.13600	0.13500	0.13700
2	0.27700	0.19400	0.22900	0.17700	0.20700	0.16900	0.16100	0.16100
3	0.34100	0.28500	0.26100	0.25900	0.26300	0.27500	0.25000	0.24300
4	0.42300	0.36800	0.33400	0.32300	0.32000	0.33300	0.32500	0.31800
5	0.00000	0.44800	0.39200	0.34800	0.34600	0.35200	0.34500	0.34800
6	0.00000	0.00000	0.48100	0.43000	0.40600	0.40700	0.40300	0.40100
7	0.00000	0.00000	0.00000	0.48800	0.44300	0.44600	0.42100	0.41600
8	0.00000	0.00000	0.00000	0.00000	0.51800	0.54600	0.51800	0.50600
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.53700	0.53600	0.51300
10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.52900	0.53700
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.52200
12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

AGE	1980	1981	1982	1983	1984	1985	1986	1987
0	0.05700	0.06000	0.05300	0.05000	0.03100	0.05500	0.03900	0.07600
1	0.13100	0.13200	0.13100	0.16800	0.10200	0.14400	0.14600	0.17900
2	0.24900	0.24800	0.24900	0.21900	0.18400	0.26200	0.24500	0.22300
3	0.28500	0.28700	0.28500	0.27600	0.29500	0.35700	0.33500	0.31800
4	0.34500	0.34400	0.34500	0.31000	0.32600	0.41800	0.42300	0.39900
5	0.37800	0.37700	0.37800	0.38600	0.34400	0.41700	0.47100	0.47400
6	0.45400	0.45400	0.45400	0.42500	0.43100	0.43600	0.44400	0.51200
7	0.49800	0.49900	0.49600	0.43500	0.54200	0.52100	0.45700	0.49300
8	0.52000	0.51300	0.51300	0.49800	0.48000	0.55500	0.54300	0.49800
9	0.54200	0.54300	0.54100	0.54500	0.56900	0.56400	0.59100	0.58000
10	0.57400	0.57300	0.57400	0.60600	0.62800	0.62900	0.55200	0.63400
11	0.59000	0.57600	0.57400	0.60800	0.63600	0.67900	0.69400	0.63500
12	0.58000	0.58400	0.58200	0.61400	0.66300	0.71000	0.68800	0.71800

AGE	1988	1989	1990	1991	1992	1993	1994	1995
0	0.05500	0.04900	0.08500	0.06800	0.05100	0.06100	0.04600	0.07200
1	0.13300	0.13600	0.15600	0.15600	0.16700	0.13400	0.13600	0.14300
2	0.25900	0.23700	0.23300	0.25300	0.23900	0.24000	0.25500	0.23400
3	0.32300	0.32000	0.33600	0.32700	0.33300	0.31700	0.33900	0.33300
4	0.38800	0.37700	0.37900	0.39400	0.39700	0.37600	0.39000	0.39000
5	0.45600	0.43300	0.42300	0.42300	0.46000	0.43600	0.44800	0.45200
6	0.52400	0.45600	0.46700	0.46900	0.49500	0.48300	0.51200	0.50100
7	0.55500	0.54300	0.52800	0.50600	0.53200	0.52700	0.54300	0.53900
8	0.55500	0.59200	0.55200	0.55400	0.55500	0.54800	0.59000	0.57700
9	0.56200	0.57800	0.60600	0.60900	0.59700	0.58300	0.58300	0.59400
10	0.61300	0.58100	0.60600	0.63000	0.65100	0.59500	0.62700	0.60600
11	0.62400	0.64800	0.59100	0.64900	0.66300	0.64700	0.67800	0.63100
12	0.69700	0.73900	0.71300	0.70800	0.66900	0.67900	0.71300	0.67200

AGE	1996	1997	1998	1999	2000	2001
0	0.05800	0.07600	0.06500	0.06200	0.06300	0.06900
1	0.14300	0.14300	0.15700	0.17600	0.13500	0.17100
2	0.22600	0.23000	0.22700	0.23600	0.22900	0.22300
3	0.31300	0.29500	0.31000	0.30700	0.30800	0.30700
4	0.37700	0.35900	0.35400	0.36100	0.36700	0.37800
5	0.42500	0.41500	0.40800	0.40600	0.42900	0.42600
6	0.48400	0.45300	0.45200	0.45400	0.46700	0.47700
7	0.51800	0.48100	0.46200	0.50100	0.50400	0.49900
8	0.55100	0.52400	0.51800	0.53700	0.53700	0.54300
9	0.57600	0.55300	0.55000	0.56900	0.57000	0.58000
10	0.59600	0.57700	0.57300	0.58700	0.58800	0.60800
11	0.60300	0.59100	0.59100	0.60900	0.59700	0.61200
12	0.67000	0.63600	0.63100	0.68800	0.64900	0.66700

Table 2.10.1.3 North East Atlantic Mackerel. Stock weights-at-age.

Weights-at-age in the stock (Kg)

AGE	1972	1973	1974	1975	1976	1977	1978	1979
0	0.00800	0.00800	0.00800	0.00800	0.00800	0.00800	0.00800	0.00800
1	0.13200	0.13200	0.13000	0.12900	0.12800	0.12700	0.11100	0.11000
2	0.17800	0.17700	0.17300	0.17100	0.17000	0.16700	0.17500	0.17400
3	0.24300	0.24200	0.23800	0.23600	0.23600	0.23300	0.23800	0.23700
4	0.41100	0.30100	0.29600	0.29400	0.29300	0.28900	0.30000	0.29900
5	0.00000	0.43800	0.32200	0.31800	0.31800	0.31300	0.34600	0.34500
6	0.00000	0.00000	0.46900	0.36500	0.36500	0.36100	0.38200	0.38000
7	0.00000	0.00000	0.00000	0.49700	0.41900	0.41600	0.41000	0.40800
8	0.00000	0.00000	0.00000	0.00000	0.51200	0.44600	0.43200	0.43000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.53000	0.45100	0.44900
10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.51400	0.50400
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.51600
12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

AGE	1980	1981	1982	1983	1984	1985	1986	1987
0	0.00800	0.00800	0.00800	0.00800	0.00000	0.00000	0.00000	0.00000
1	0.10900	0.08700	0.08600	0.08600	0.08100	0.08500	0.07700	0.07800
2	0.17300	0.18600	0.13500	0.17200	0.19400	0.16500	0.17900	0.14800
3	0.23600	0.25200	0.22100	0.23500	0.25300	0.29300	0.26700	0.24000
4	0.29700	0.31300	0.28000	0.28000	0.29500	0.30600	0.30400	0.28600
5	0.34300	0.32300	0.38500	0.33900	0.32400	0.34100	0.35600	0.37400
6	0.37900	0.37800	0.35300	0.37700	0.39300	0.38400	0.35100	0.38600
7	0.40700	0.41900	0.40800	0.40400	0.43600	0.43000	0.41600	0.41100
8	0.42900	0.43400	0.43700	0.43900	0.44100	0.45900	0.47300	0.42900
9	0.44800	0.44900	0.44600	0.50300	0.47900	0.46800	0.44300	0.48200
10	0.50300	0.44300	0.47900	0.47300	0.52000	0.55900	0.46800	0.49900
11	0.50800	0.52300	0.52600	0.55500	0.51000	0.57900	0.49700	0.47000
12	0.51800	0.53100	0.53400	0.56300	0.55000	0.60700	0.57500	0.54900

AGE	1988	1989	1990	1991	1992	1993	1994	1995
0	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.07200	0.07600	0.07400	0.07500	0.07800	0.07800	0.07900	0.08100
2	0.15600	0.17700	0.13800	0.15500	0.21200	0.19700	0.17800	0.16400
3	0.23700	0.24400	0.22200	0.23000	0.25900	0.26800	0.23700	0.26700
4	0.30100	0.30600	0.28700	0.30700	0.31000	0.31500	0.30100	0.32600
5	0.32900	0.35200	0.33900	0.35700	0.36200	0.36000	0.36100	0.39800
6	0.42300	0.38000	0.37300	0.40900	0.40200	0.41600	0.41300	0.44800
7	0.44500	0.42900	0.41400	0.43200	0.42400	0.45400	0.46600	0.49100
8	0.43200	0.47400	0.40900	0.50200	0.46200	0.46500	0.47000	0.50800
9	0.45500	0.45700	0.43700	0.54100	0.48700	0.48400	0.48300	0.54600
10	0.52200	0.46600	0.51400	0.56600	0.52200	0.51100	0.55000	0.51400
11	0.58900	0.51000	0.52300	0.56600	0.55200	0.58500	0.60800	0.61900
12	0.63200	0.59500	0.52900	0.59400	0.58300	0.57700	0.58400	0.63900

AGE	1996	1997	1998	1999	2000	2001
0	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0.07600	0.07600	0.07700	0.08100	0.07400	0.07800
2	0.13300	0.18600	0.14900	0.19400	0.18500	0.16400
3	0.25100	0.22800	0.22300	0.24200	0.23500	0.24100
4	0.31700	0.29600	0.28500	0.30100	0.28900	0.34200
5	0.36600	0.36100	0.34200	0.35300	0.35000	0.39000
6	0.44400	0.40200	0.40000	0.39600	0.39000	0.44600
7	0.46200	0.44500	0.42600	0.42300	0.42600	0.45900
8	0.50100	0.47800	0.46600	0.44000	0.44700	0.49900
9	0.56500	0.51900	0.50200	0.48500	0.48500	0.52900
10	0.57300	0.53700	0.54900	0.49800	0.49200	0.57600
11	0.61100	0.53200	0.52400	0.46500	0.53200	0.60300
12	0.63200	0.58500	0.58000	0.56500	0.54400	0.58600

Table 2.10.1.4 North East Atlantic Mackerel. Natural mortality at age.

Natural Mortality (per year)

AGE	1972	1973	1974	1975	1976	1977	1978	1979
0	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
1	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
2	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
3	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
4	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
5	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
6	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
7	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
8	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
9	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
10	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
11	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
12	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000

AGE	1980	1981	1982	1983	1984	1985	1986	1987
0	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
1	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
2	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
3	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
4	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
5	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
6	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
7	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
8	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
9	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
10	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
11	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
12	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000

AGE	1988	1989	1990	1991	1992	1993	1994	1995
0	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
1	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
2	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
3	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
4	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
5	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
6	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
7	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
8	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
9	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
10	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
11	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
12	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000

AGE	1996	1997	1998	1999	2000	2001
0	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
1	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
2	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
3	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
4	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
5	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
6	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
7	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
8	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
9	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
10	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
11	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000
12	0.15000	0.15000	0.15000	0.15000	0.15000	0.15000

Table 2.10.1.5 North East Atlantic Mackerel. Proportion of fish spawning.

Proportion of fish spawning

AGE	1972	1973	1974	1975	1976	1977	1978	1979
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0500	0.0500	0.0500	0.0600	0.0600	0.0600	0.0600	0.0600
2	0.5300	0.5400	0.5400	0.5500	0.5500	0.5500	0.5600	0.5600
3	0.9000	0.9000	0.9000	0.8900	0.8900	0.8900	0.8900	0.8900
4	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800
5	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800
6	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1980	1981	1982	1983	1984	1985	1986	1987
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0600	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700
2	0.5700	0.5700	0.5700	0.5800	0.5800	0.5800	0.5800	0.5800
3	0.8900	0.8800	0.8800	0.8800	0.8800	0.8800	0.8800	0.8800
4	0.9800	0.9800	0.9800	0.9800	0.9700	0.9700	0.9700	0.9700
5	0.9800	0.9800	0.9800	0.9800	0.9700	0.9700	0.9700	0.9700
6	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1988	1989	1990	1991	1992	1993	1994	1995
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700
2	0.5800	0.5800	0.5800	0.5800	0.5800	0.5800	0.5800	0.5800
3	0.8800	0.8800	0.8800	0.8800	0.8800	0.8800	0.8800	0.8800
4	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
5	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
6	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1996	1997	1998	1999	2000	2001
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700
2	0.5800	0.5800	0.5800	0.5800	0.5800	0.5900
3	0.8800	0.8800	0.8600	0.8600	0.8600	0.8800
4	0.9700	0.9700	0.9800	0.9800	0.9800	0.9700
5	0.9700	0.9700	0.9800	0.9800	0.9800	0.9700
6	0.9900	0.9900	0.9900	0.9900	0.9900	0.9900
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.10.1.6 North East Atlantic Mackerel. Biomass estimates from egg surveys

INDICES OF SPAWNING BIOMASS

INDEX1

	1972	1973	1974	1975	1976	1977	1978	1979
1	*******	*******	*******	*******	*******	*******	*******	*******

x 10 ^ 3

INDEX1

	1980	1981	1982	1983	1984	1985	1986	1987
1	*******	*******	*******	*******	*******	*******	*******	*******

x 10 ^ 3

INDEX1

	1988	1989	1990	1991	1992	1993	1994	1995
1	*******	*******	*******	*******	3370.0	*******	*******	2840.0

x 10 ^ 3

INDEX1

	1996	1997	1998	1999	2000	2001
1	*******	*******	3750.0	*******	*******	2900.0

x 10 ^ 3

Table 2.10.1.7 North East Atlantic Mackerel. Fishing mortality at age.

Fishing Mortality (per year)

AGE	1972	1973	1974	1975	1976	1977	1978	1979
0	0.00514	0.00368	0.00750	0.00766	0.01322	0.00619	0.01122	0.02297
1	0.00663	0.02620	0.02764	0.01898	0.07238	0.04429	0.04181	0.14656
2	0.02518	0.01662	0.03212	0.02823	0.09228	0.10683	0.18400	0.09471
3	0.04950	0.06453	0.04141	0.06995	0.14453	0.10764	0.19705	0.29408
4	0.08807	0.13431	0.11145	0.08749	0.19339	0.12105	0.17746	0.24464
5	0.00000	0.14357	0.18718	0.16459	0.13449	0.09995	0.19662	0.22623
6	0.00000	0.16305	0.16046	0.15282	0.18497	0.10465	0.15323	0.25080
7	0.00000	0.18861	0.24589	0.35256	0.34124	0.20480	0.12584	0.25581
8	0.00000	0.18713	0.24397	0.21452	0.27106	0.33676	0.20570	0.16649
9	0.00000	0.20398	0.26593	0.23383	0.19108	0.19741	0.30001	0.30773
10	0.00000	0.18155	0.23669	0.20812	0.17007	0.12638	0.30116	0.39269
11	0.00000	0.17229	0.22461	0.19750	0.16139	0.11993	0.23594	0.41899
12	0.00000	0.17229	0.22461	0.19750	0.16139	0.11993	0.23594	0.41899

AGE	1980	1981	1982	1983	1984	1985	1986	1987
0	0.00619	0.00813	0.00554	0.00467	0.04149	0.02537	0.01498	0.00151
1	0.10188	0.06202	0.03644	0.02802	0.02395	0.04718	0.02144	0.01417
2	0.22268	0.16495	0.12374	0.14460	0.06112	0.01861	0.09271	0.07023
3	0.12599	0.18753	0.21794	0.16637	0.20369	0.05092	0.04092	0.19374
4	0.24084	0.08267	0.21167	0.25286	0.20805	0.18791	0.08294	0.07432
5	0.23862	0.19639	0.08446	0.20796	0.25518	0.19224	0.21852	0.12416
6	0.18424	0.24022	0.21010	0.08103	0.23329	0.25088	0.22692	0.21148
7	0.21587	0.21217	0.22906	0.19389	0.11351	0.21590	0.29153	0.24106
8	0.22353	0.27648	0.23776	0.21266	0.18688	0.13201	0.21210	0.31135
9	0.17704	0.24685	0.30302	0.18556	0.20237	0.20292	0.12041	0.25394
10	0.25656	0.28929	0.24541	0.25928	0.20139	0.22869	0.19869	0.24286
11	0.36665	0.31352	0.28056	0.26337	0.23606	0.20636	0.20140	0.22375
12	0.36665	0.31352	0.28056	0.26337	0.23606	0.20636	0.20140	0.22375

AGE	1988	1989	1990	1991	1992	1993	1994	1995
0	0.01668	0.01559	0.00760	0.00274	0.00848	0.01059	0.01053	0.01018
1	0.03676	0.02203	0.04000	0.02161	0.02891	0.03612	0.03592	0.03470
2	0.05854	0.09329	0.08820	0.07437	0.06463	0.08073	0.08030	0.07757
3	0.10835	0.11162	0.16143	0.11132	0.12316	0.15384	0.15303	0.14783
4	0.22503	0.12443	0.14785	0.20573	0.18537	0.23155	0.23033	0.22250
5	0.12245	0.21990	0.15540	0.18355	0.21431	0.26770	0.26628	0.25723
6	0.16325	0.10657	0.22346	0.17543	0.24338	0.30401	0.30240	0.29212
7	0.25460	0.14751	0.12120	0.25688	0.28153	0.35167	0.34980	0.33791
8	0.29767	0.20647	0.17182	0.19789	0.27933	0.34892	0.34707	0.33527
9	0.32339	0.25429	0.22889	0.21094	0.30447	0.38033	0.37832	0.36546
10	0.22313	0.29541	0.17797	0.28444	0.27100	0.33851	0.33672	0.32527
11	0.24093	0.21693	0.23026	0.22765	0.25717	0.32124	0.31954	0.30868
12	0.24093	0.21693	0.23026	0.22765	0.25717	0.32124	0.31954	0.30868

AGE	1996	1997	1998	1999	2000	2001
0	0.00760	0.00707	0.00758	0.00682	0.00703	0.00717
1	0.02592	0.02411	0.02586	0.02326	0.02396	0.02446
2	0.05794	0.05388	0.05781	0.05199	0.05356	0.05468
3	0.11041	0.10268	0.11017	0.09907	0.10207	0.10420
4	0.16619	0.15455	0.16581	0.14911	0.15363	0.15683
5	0.19213	0.17868	0.19170	0.17239	0.17762	0.18131
6	0.21819	0.20292	0.21770	0.19577	0.20171	0.20590
7	0.25239	0.23472	0.25182	0.22646	0.23333	0.23818
8	0.25042	0.23289	0.24986	0.22469	0.23151	0.23632
9	0.27297	0.25385	0.27235	0.24492	0.25235	0.25759
10	0.24295	0.22594	0.24241	0.21799	0.22460	0.22927
11	0.23056	0.21441	0.23004	0.20687	0.21314	0.21757
12	0.23056	0.21441	0.23004	0.20687	0.21314	0.21757

Table 2.10.1.8 North East Atlantic Mackerel. Population numbers-at-age.

Population Abundance (1 January)

AGE	1972	1973	1974	1975	1976	1977	1978	1979
0	2249.0	4976.1	4216.5	5102.4	5125.2	1060.5	3341.6	5429.5
1	5695.9	1925.8	4267.2	3602.0	4358.1	4353.3	907.2	2844.1
2	2236.4	4870.1	1614.7	3572.7	3042.0	3489.2	3584.6	748.8
3	4333.7	1877.0	4122.6	1345.9	2989.4	2387.5	2698.9	2566.8
4	8306.4	3549.9	1514.6	3404.4	1080.1	2226.8	1845.2	1907.5
5	0.0	6546.7	2671.4	1166.1	2684.8	766.2	1698.1	1330.0
6	0.0	0.0	4881.2	1906.8	851.4	2020.0	596.8	1200.7
7	0.0	0.0	0.0	3578.4	1408.6	609.0	1565.9	440.7
8	0.0	0.0	0.0	0.0	2164.9	861.9	427.1	1188.4
9	0.0	0.0	0.0	0.0	0.0	1420.9	529.7	299.3
10	0.0	0.0	0.0	0.0	0.0	0.0	1003.9	337.8
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	639.4
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

x 10 ^ 6

AGE	1980	1981	1982	1983	1984	1985	1986	1987
0	5778.7	7538.0	2180.5	1694.2	7607.7	3515.7	3620.3	5297.0
1	4567.1	4943.1	6435.5	1866.4	1451.4	6281.8	2950.2	3069.7
2	2114.2	3550.2	3998.7	5340.9	1562.1	1219.7	5157.7	2485.4
3	586.3	1456.5	2591.0	3041.1	3978.1	1264.8	1030.4	4046.2
4	1646.4	444.9	1039.2	1793.4	2216.3	2793.0	1034.5	851.3
5	1285.5	1113.7	352.5	723.8	1198.7	1549.3	1992.1	819.6
6	912.9	871.6	787.7	278.9	506.0	799.4	1100.3	1378.1
7	804.2	653.6	590.0	549.5	221.3	344.9	535.4	754.8
8	293.7	557.8	455.0	403.8	389.6	170.1	239.2	344.3
9	866.0	202.1	364.1	308.7	281.0	278.2	128.3	166.6
10	189.4	624.4	135.9	231.5	220.7	197.5	195.5	97.9
11	196.3	126.1	402.4	91.5	153.7	155.3	135.3	137.9
12	366.4	795.6	684.8	612.1	353.3	562.5	477.9	338.2

x 10 ^ 6

AGE	1988	1989	1990	1991	1992	1993	1994	1995
0	3751.9	4552.7	3446.6	3940.5	4858.9	6084.5	4805.9	5139.7
1	4552.3	3175.8	3857.9	2944.1	3382.3	4146.8	5181.8	4093.1
2	2604.9	3776.8	2673.9	3190.4	2479.8	2828.2	3442.6	4302.6
3	1994.1	2114.6	2961.2	2107.2	2549.2	2000.8	2245.5	2734.4
4	2869.2	1540.1	1627.8	2168.8	1622.6	1939.8	1476.6	1658.5
5	680.3	1971.9	1170.5	1208.5	1519.6	1160.3	1324.5	1009.4
6	623.0	518.0	1362.2	862.4	865.7	1055.6	764.1	873.5
7	960.0	455.5	400.8	937.7	622.9	584.2	670.4	486.1
8	510.5	640.6	338.3	305.6	624.2	404.6	353.7	406.7
9	217.0	326.3	448.5	245.2	215.8	406.3	245.6	215.2
10	111.2	135.2	217.8	307.0	170.9	137.0	239.1	144.8
11	66.1	76.6	86.6	156.9	198.9	112.2	84.0	147.0
12	288.3	197.2	145.7	279.5	322.9	266.3	225.7	160.6

x 10 ^ 6

AGE	1996	1997	1998	1999	2000	2001	2002
0	5697.3	4353.1	3839.6	4679.7	2105.8	3922.0	(4084.2)
1	4379.0	4866.6	3720.4	3279.8	4000.4	1799.8	3351.6
2	3402.8	3672.6	4088.9	3120.4	2758.0	3361.7	1511.6
3	3426.9	2764.0	2995.2	3321.7	2549.7	2250.1	2739.5
4	2030.1	2641.2	2146.8	2309.1	2589.3	1981.6	1745.0
5	1142.7	1479.8	1947.8	1565.4	1712.1	1911.3	1458.0
6	671.8	811.6	1065.3	1384.0	1134.0	1233.8	1372.3
7	561.4	464.9	570.3	737.5	979.4	797.8	864.4
8	298.4	375.4	316.4	381.6	506.1	667.6	541.1
9	250.3	199.9	256.0	212.1	262.3	345.6	453.6
10	128.5	164.0	133.5	167.8	142.9	175.4	229.9
11	90.0	86.8	112.6	90.2	116.1	98.3	120.1
12	159.8	139.0	119.8	175.8	168.4	205.9	210.6

x 10 ^ 6

Table 2.10.1.9 North East Atlantic Mackerel. Diagnostic output.

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	1992	0.2143	7	0.1858	0.2471	0.1993	0.2305	0.2149
2	1993	0.2677	7	0.2326	0.3081	0.2492	0.2876	0.2684
3	1994	0.2663	7	0.2315	0.3063	0.2479	0.2860	0.2670
4	1995	0.2572	7	0.2232	0.2965	0.2393	0.2766	0.2579
5	1996	0.1921	7	0.1662	0.2221	0.1784	0.2069	0.1927
6	1997	0.1787	7	0.1545	0.2066	0.1659	0.1924	0.1792
7	1998	0.1917	7	0.1655	0.2221	0.1778	0.2066	0.1922
8	1999	0.1724	7	0.1482	0.2005	0.1596	0.1862	0.1729
9	2000	0.1776	7	0.1520	0.2076	0.1640	0.1923	0.1782
10	2001	0.1813	8	0.1529	0.2150	0.1662	0.1978	0.1820
Separable Model: Selection (S) by age								
11	0	0.0396	52	0.0140	0.1115	0.0233	0.0671	0.0455
12	1	0.1349	8	0.1149	0.1584	0.1243	0.1464	0.1354
13	2	0.3016	7	0.2592	0.3508	0.2792	0.3258	0.3025
14	3	0.5747	7	0.4971	0.6644	0.5337	0.6189	0.5763
15	4	0.8650	7	0.7521	0.9947	0.8054	0.9289	0.8672
	5	1.0000	Fixed : Reference Age					
16	6	1.1357	6	0.9955	1.2956	1.0618	1.2146	1.1382
17	7	1.3137	6	1.1575	1.4909	1.2315	1.4013	1.3164
18	8	1.3034	6	1.1538	1.4724	1.2248	1.3870	1.3059
19	9	1.4207	6	1.2614	1.6002	1.3371	1.5096	1.4234
20	10	1.2645	6	1.1176	1.4307	1.1873	1.3468	1.2670
	11	1.2000	Fixed : Last true age					
Separable model: Populations in year 2001								
21	0	3921992	166	149535	102865131	740711	20766561	15730761
22	1	1799756	18	1240994	2610104	1488827	2175620	1832420
23	2	3361683	13	2593016	4358212	2944628	3837807	3391304
24	3	2250056	10	1818902	2783411	2018639	2508003	2263347
25	4	1981601	9	1647821	2382991	1803623	2177142	1990395
26	5	1911266	8	1621223	2253199	1757327	2078690	1918016
27	6	1233835	7	1054952	1443050	1139071	1336483	1237781
28	7	797770	7	682887	931980	736926	863637	800284
29	8	667567	7	572622	778254	617307	721918	669615
30	9	345608	8	295264	404537	318933	374515	346725
31	10	175430	8	148364	207433	161055	191088	176072
32	11	98259	9	82047	117674	89623	107727	98676
Separable model: Populations at age								
33	1992	198850	16	142704	277085	167884	235526	201719
34	1993	112178	13	86935	144749	98497	127759	113130
35	1994	84047	11	67008	105419	74872	94346	84610
36	1995	146957	10	119095	181336	132011	163594	147804
37	1996	90043	10	73490	110325	81178	99876	90528
38	1997	86752	9	71610	105096	78664	95671	87168
39	1998	112603	9	93396	135760	102355	123876	113116
40	1999	90171	9	75058	108326	82114	99018	90567
41	2000	116137	9	97153	138830	106029	127209	116619

SSB Index catchabilities

INDEX1

Absolute estimator. No fitted catchability.

Table 2.10.1.10 North East Atlantic Mackerel. Stock summary table.

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 4- 8	SoP (%)
1972	2248990	5634943	4148849	361204	0.0871	0.1060	99
1973	4976080	5546224	4255845	571011	0.1342	0.1633	100
1974	4216500	5446784	4118121	607632	0.1476	0.1898	100
1975	5102370	5280231	3875290	784070	0.2023	0.1944	99
1976	5125150	5001108	3554524	828239	0.2330	0.2250	99
1977	1060540	4703769	3388656	620276	0.1830	0.1734	100
1978	3341640	4347582	3352920	736832	0.2198	0.1718	100
1979	5429540	3905670	2899829	843227	0.2908	0.2288	100
1980	5778680	3550112	2444369	734951	0.3007	0.2206	100
1981	7538030	3717872	2508240	754438	0.3008	0.2016	100
1982	2180520	3632518	2407086	717267	0.2980	0.1946	100
1983	1694210	3719488	2671034	671588	0.2514	0.1897	99
1984	7607650	3458517	2664191	637606	0.2393	0.1994	99
1985	3515670	3694073	2654424	614371	0.2315	0.1958	100
1986	3620300	3661590	2637758	602200	0.2283	0.2064	99
1987	5297020	3497826	2607755	654991	0.2512	0.1925	99
1988	3751860	3583395	2627656	680492	0.2590	0.2126	100
1989	4552690	3655597	2694023	589509	0.2188	0.1610	100
1990	3446630	3418518	2542161	627511	0.2468	0.1639	100
1991	3940490	3769663	2851443	667886	0.2342	0.2039	98
1992	4858890	3895705	2881514	760351	0.2639	0.2408	99
1993	6084460	3824024	2717108	825036	0.3036	0.3008	100
1994	4805880	3704213	2537184	821395	0.3237	0.2992	100
1995	5139740	3931771	2757892	755776	0.2740	0.2890	99
1996	5697260	3785525	2768540	563612	0.2036	0.2159	100
1997	4353140	4031012	2902304	569613	0.1963	0.2008	99
1998	3839570	3988418	2937605	666682	0.2269	0.2154	100
1999	4679650	4278132	3215136	608930	0.1894	0.1937	100
2000	2105760	4189694	3156635	667159	0.2114	0.1996	100
2001	(4084200)	4370426	3423557	677708	0.1980	0.2037	99

No of years for separable analysis : 10
Age range in the analysis : 0 . . . 12
Year range in the analysis : 1972 . . . 2001
Number of indices of SSB : 1
Number of age-structured indices : 0

Parameters to estimate : 41
Number of observations : 124

Conventional single selection vector model to be fitted.

Figure 2.10.1.1 The sum of squares surface for the ICA separable VPA fit to the North East Atlantic mackerel egg survey biomass estimates (1992-2001).SSB estimates from egg surveys covering the range 1992-1998 in the biomass index were used and there is only on period of separable constraint (1992-2001).

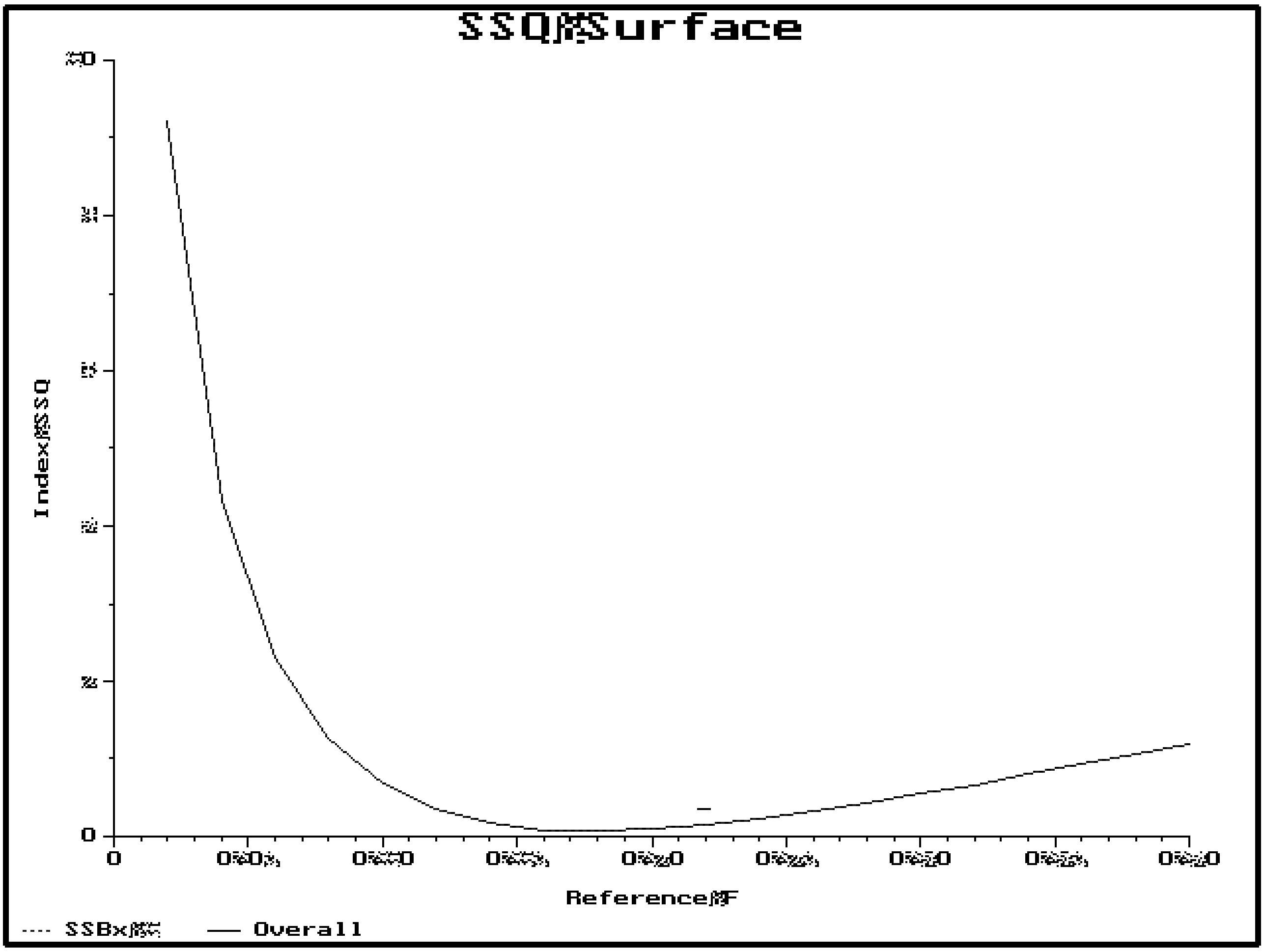


Figure 2.10.1.2 The long term trends in stock parameters for North East Atlantic mackerel.
SSB estimates from egg surveys covering the range 1992-1998 in the biomass index were used and there is only on period of separable constraint (1992-2001).

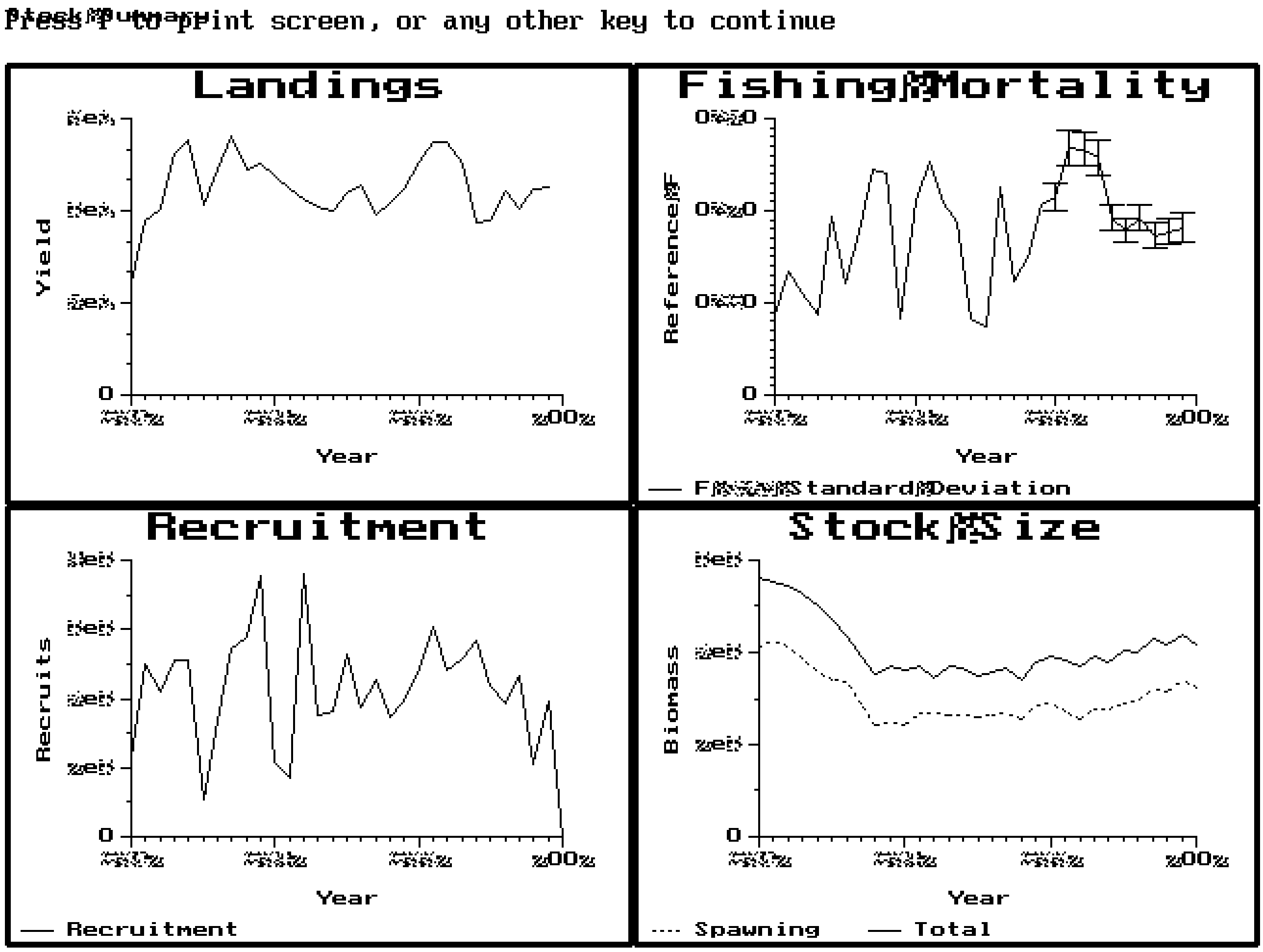


Figure 2.10.1.3 The catch at age residuals and ages fitted by ICA to the North East Atlantic Mackerel data. SSB estimates from egg surveys covering the range 1992-1998 in the biomass index were used and there is only one period of separable constraint (1992-2001)

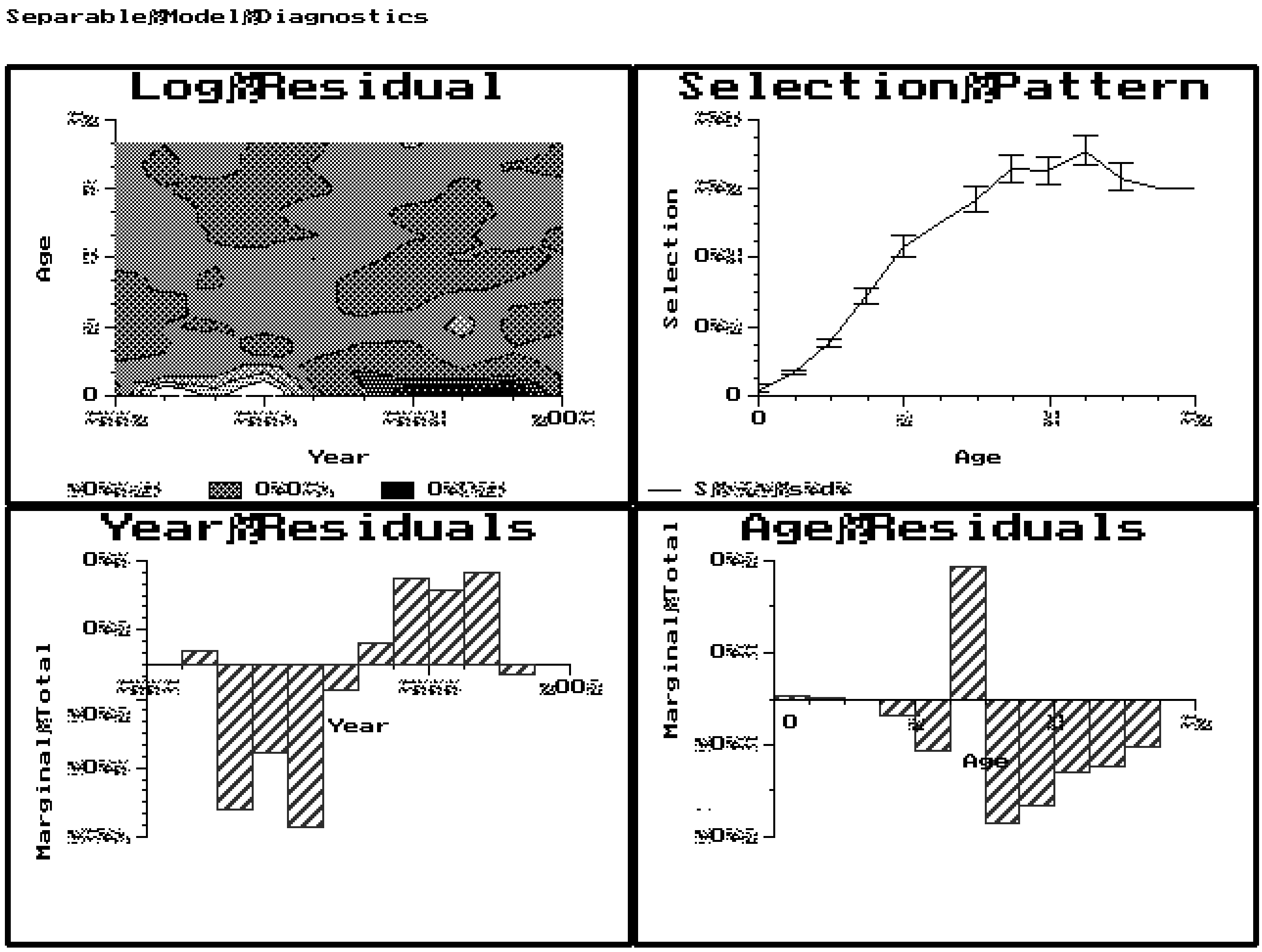
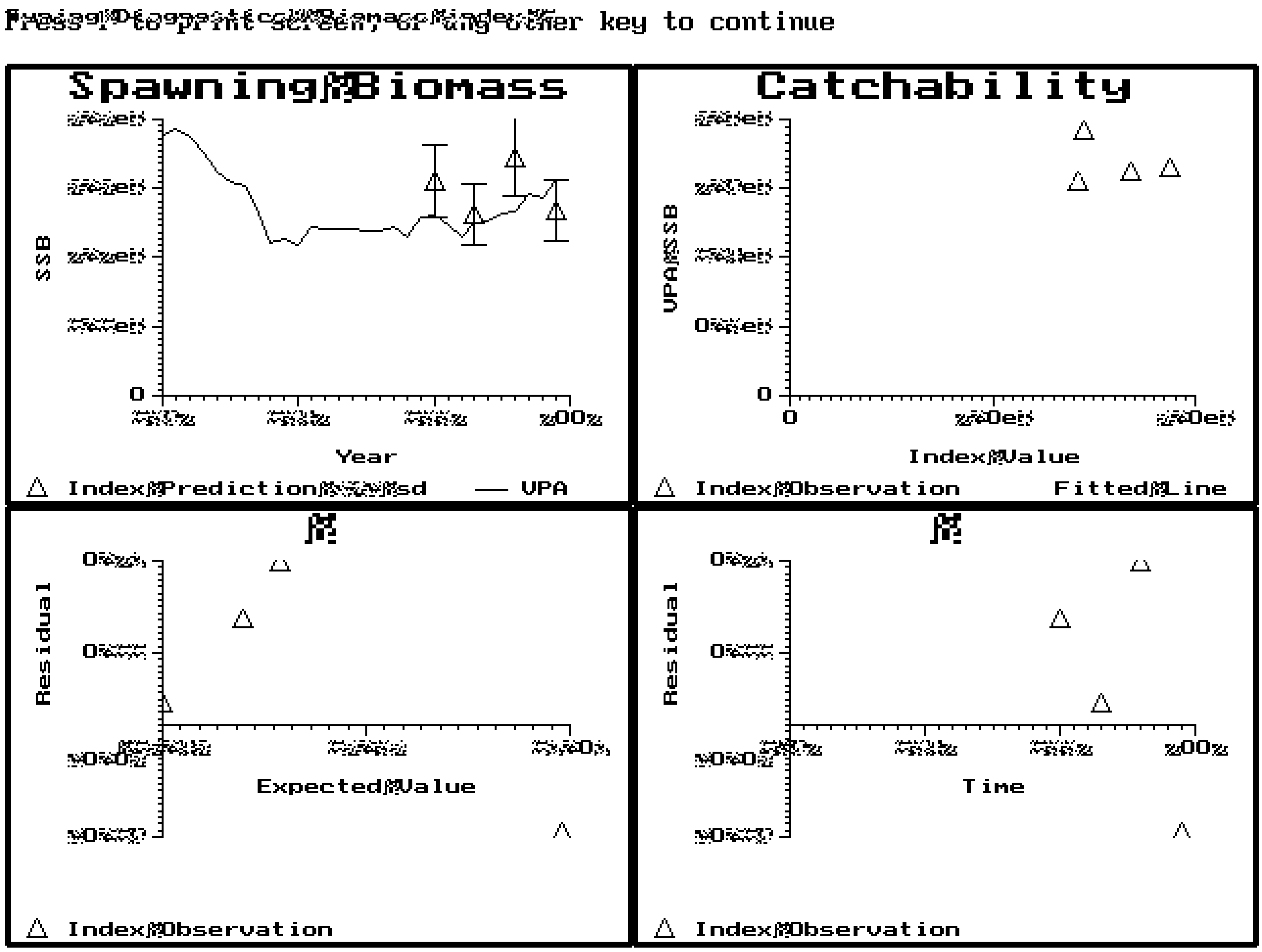


Figure 2.10.1.4 The diagnostics for the egg production index as fitted by ICA to the North East Atlantic Mackerel. SSB estimates from egg surveys covering the range 1992-1998 in the biomass index were used and there is only one period of separable constraint (1992-2001).



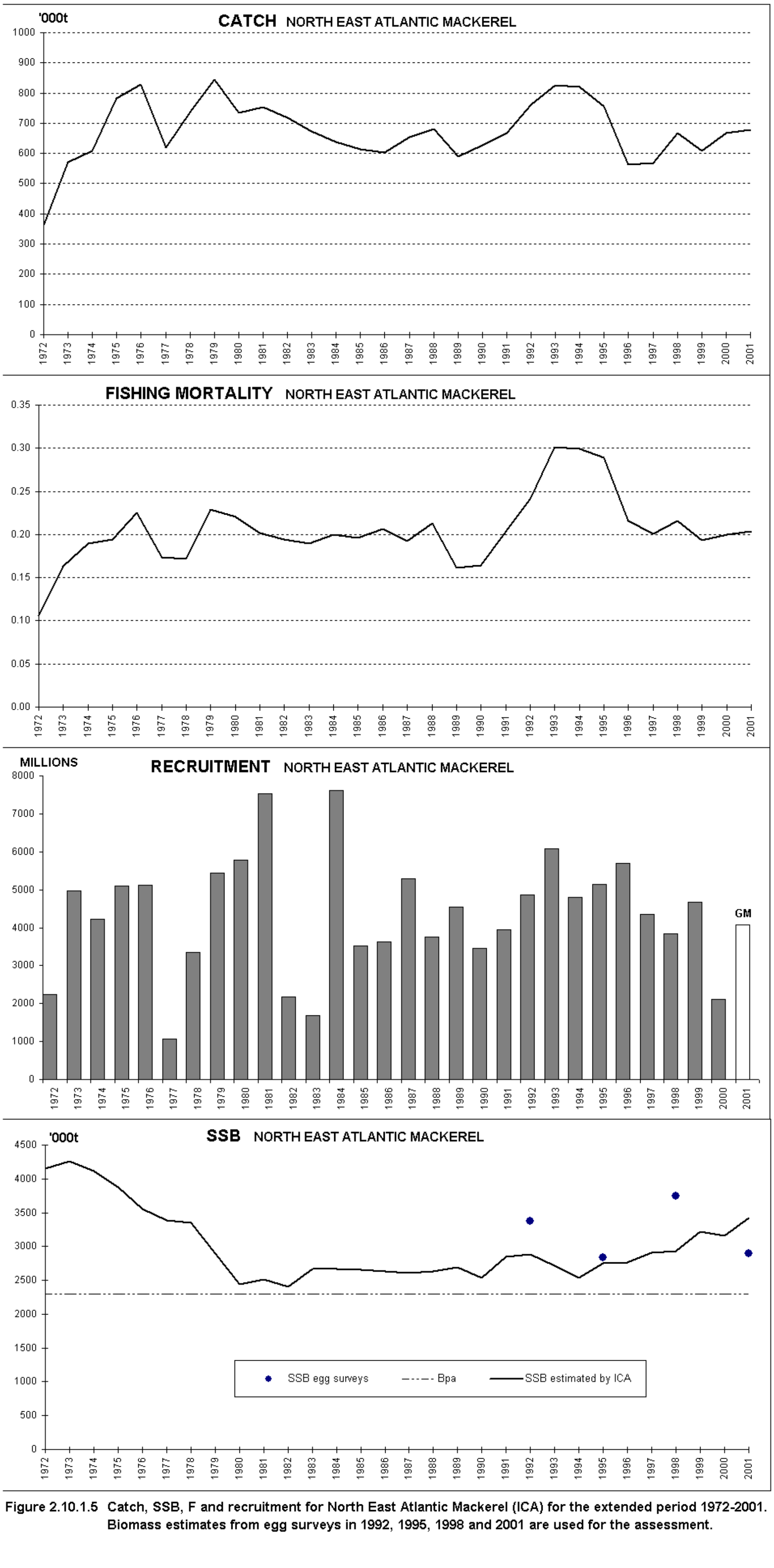


Figure 2.10.1.5 Catch, SSB, F and recruitment for North East Atlantic Mackerel (ICA) for the extended period 1972-2001. Biomass estimates from egg surveys in 1992, 1995, 1998 and 2001 are used for the assessment.

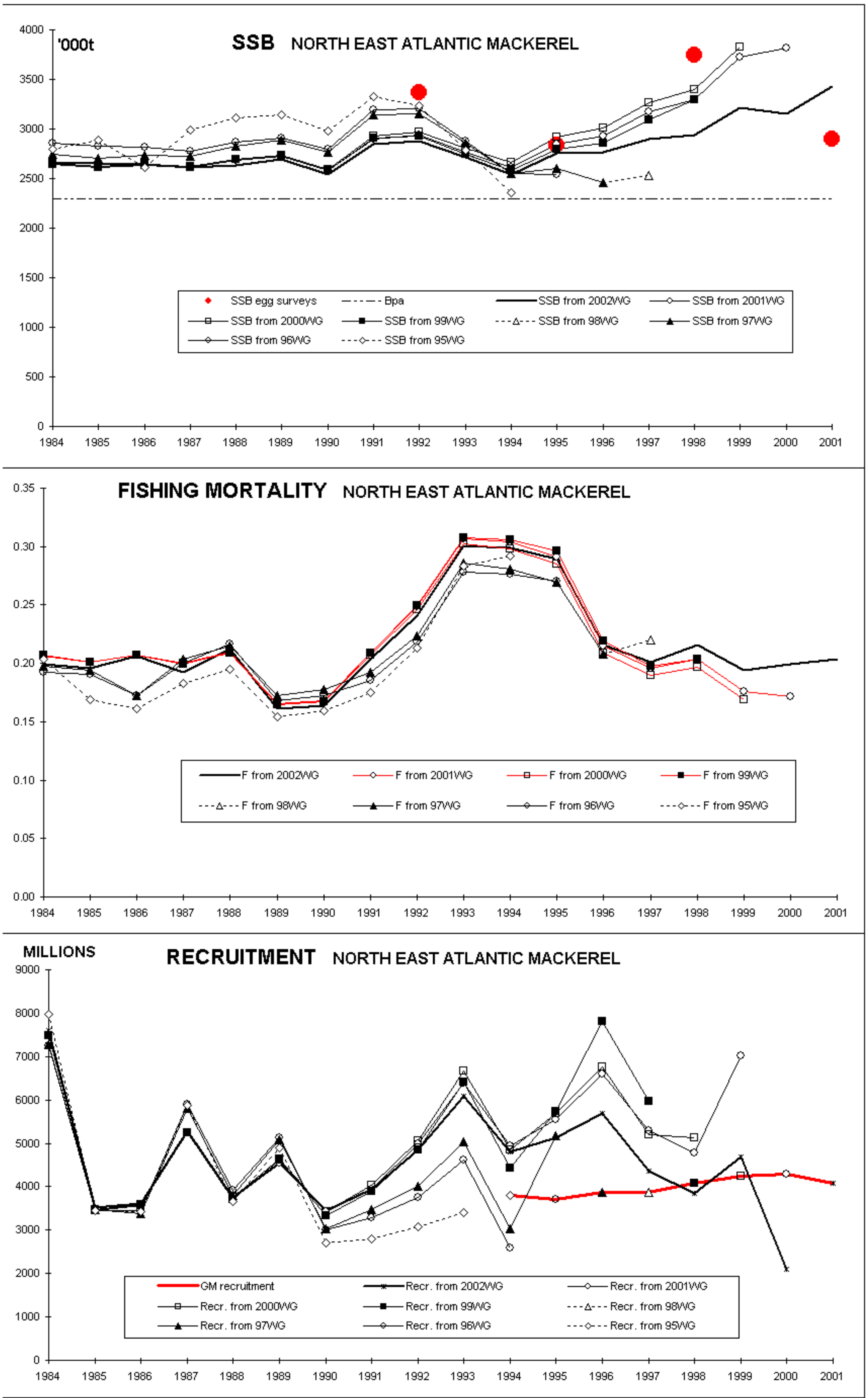


Figure 2.10.2 **Comparison of SSB, F and recruitment estimates (ICA) obtained at various assessment working group meetings. Biomass estimates from egg surveys in 1992, 1995, 1998 and 2001 are also shown. At the 1999 - 2001 working groups the 1992, 1995 and 1998 egg survey SSB's and at the 2002 working group the 1992, 1995, 1998 and 2001 egg survey SSB's were used. At the 1998 working group meeting the new assessment was rejected and in stead the 1997 assessment was projected one year forward.The recruitment figure shows also the geometric mean (GM) recruitment from 1994 onwards.**

2.11 Catch predictions

Table 2.11.1 and Table 2.11.2 present the calculations for the input values for the catch forecasts and the input data for the predictions.

Apart from the recruitment of year class 2002 (age 0) and year class 2001 (age 1), the ICA-estimated abundances in 2002 (ages 2 – 12+) were used as the starting populations in the prediction. No correction was made to the low ICA-estimated abundance in 2002 of age group 2 (year class 2000), because of its low abundance in the recruitment surveys (see Section 2.8).

The following assumptions were made regarding recruitment at age 0 and age 1 in 2002:

Age 0: No recruitment indices are available for the 2002 year class. The geometric mean was used for the 2002 recruitment. The value of 4084.2 million fish is calculated from the geometric mean of the North East Atlantic mackerel recruitments for the period 1972–1998. In earlier years this was done by calculating the geometric mean recruitment of western mackerel over the period 1972-present, raised by the ratio of the estimated western and North East Atlantic mackerel recruitment for the period 1984-present. This method is now replaced by calculating the geometric mean recruitment directly from the North East Atlantic mackerel, because the time-series for North East Atlantic mackerel is now extended back to 1972 and because both procedures were not significantly different based on last year's assessments of western mackerel and the extended North East Atlantic mackerel (see Section 2.5). The difference between both methods was only 3% and therefore a direct estimation of the geometric mean recruitment from the extended assessment of the North East Atlantic mackerel was carried out at this year's Working Group meeting.

Age 1 The recruitment at age 1 is taken to be the geometric mean recruitment (4084.2 million fish) brought forward 1 year by the total mortality at age 0 in that year (see Table 2.11.1).

Recruitment at age 0 in 2003 and 2004 was also assumed to be 4084.2 million fish.

Catch forecasts have been calculated for the provision of area-based TACs. Two "fleets" have been defined:

1. "Northern" area corresponding to the exploitation of the western area, including the North Sea and Division I, IIa and IIIa; "Northern" area reflects all areas except Divisions VIIIc and IXa;

2. "Southern" area including Div. VIIIc and IXa ("Southern").

The exploitation pattern used in the prediction was the separable ICA F's for the final year and then re-scaled according to the ratio *status quo* F (1999–2001) and reference F ($F_{4–8}$). This exploitation pattern was subdivided into partial F's for each fleet using the average ratio of the fleet catch at each age for the years 1999–2001.

Weight-at-age in the catch was taken as an average of the values for the period 1999–2001 for each area. Weight-at-age in the stock was calculated from an average (1999–2001) of weights-at-age for the NEA mackerel stock.

The catch for 2002 is assumed to be 683,000 t, which corresponds to the TAC in 2001 (see Section 2.1).

Predictions were calculated by the MFDP program.

Six single option summary tables are presented and summarised in the text tables below. In addition Tables 2.11.3 and 2.11.4 refer to 3 options with a catch constraint of 683 kt in 2002 and to 3 options with *status quo* fishing mortality ($\mathbf{F}_{sq}$ = 0.20) in 2002. Each of these two options for 2002 are then followed by:

F2003 = F2004 = 0.15 lower level of F in the F-range 0.15–0.20 as agreed by EU, Norway, and Faroes in 1999;
F2003 = F2004 = 0.17 corresponding to $\mathbf{F}_{pa}$;
F2003 = F2004 = 0.20 upper level of F in the F-range 0.15–0.20 as agreed by EU, Norway, and Faroes in 1999 and equal to $\mathbf{F}_{sq}$ (1999–2001);

UNITS: ‘000 t

	Catch 2002 = 683 kt F=0.15 2003,2004			Catch 2002 = 683 kt F= $\mathbf{F}_{pa}$ = 0.17 2003,2004			Catch 2002 = 683 kt $\mathbf{F}_{sq}$= 0.20 2003,2004		
Year	Ref F	Catch	SSB	Ref F	Catch	SSB	Ref F	Catch	SSB
2002	0.21	683	3068	0.21	683	3068	0.21	683	3068
2003	0.15	478	2981	0.17	536	2960	0.20	623	2929
2004	0.15	480	3016	0.17	530	2950	0.20	601	2856

UNITS: ‘000 t

	Status quo (F1999–2001=0.20) F=0.15 2003,2004			*Status quo* (F1999–2001=0.20) F= $\mathbf{F}_{pa}$ = 0.17 2003,2004			*Status quo* (F1999–2001=0.20) $\mathbf{F}_{sq}$= 0.20 2003,2004		
Year	Ref F	Catch	SSB	Ref F	Catch	SSB	Ref F	Catch	SSB
2002	0.20	649	3080	0.20	649	3080	0.20	649	3080
2003	0.15	482	3007	0.17	542	2986	0.20	629	2954
2004	0.15	483	3037	0.17	534	2976	0.20	605	2875

For options F = 0.15 and F = 0.17 the forecasts for 2003 and 2004 predict that SSB will remain rather stable compared to 2002.

For options F = 0.20 = $F_{\text{status quo}}$ = 0.20 the forecasts predict that SSB will decrease in 2003 and further decrease in 2004 compared to 2004.

The MFDP programme could not produce a two multi-fleet management option table for the options *status quo* F in 2001 or a catch constraint of 683 kt in 2002. Therefore, this was carried out by a spreadsheet, which was checked last year by comparing its results to the IFAP prediction programme results. The results of both were exactly the same including the decimals. At this meeting this spreadsheet was used again, but differed slightly due to rounding differences of the input. A detailed multi-fleet prediction table is presented in Table 2.11.5 for the $F_{\text{status quo}}$ =0.20 in 2002–2004.

Table 2.11.6 presents the two fleet management option table for the option of *status quo* F in 2002 and a range of F's for 2003. Table 2.11.7 presents the two fleet management option table for the option of 683 kt in 2002 and a range of F's for 2003.

The forecasts of SSB in 2002 and 2003 for the two scenarios are much lower compared to the predicted SSB values for 2002 and 2003 carried out last year. This is because of a downward revision of the last five years of SSB values when the SSB from the 2001 egg survey was used in the assessment in 2002. As a consequence of this, the population-at-age in 2002 has been scaled down in this year’s assessment. In addition the 2000 year class is indicated to be weak. This year class will appear as age 3 and 4 in the catches of 2003 and 2004 and thus will have a significant effect on the predicted SSB's.

Figure 2.11.1 shows that the catch assumed by the WG in the first year of the prediction (catch constraint option) is closer to the actual catches (obtained one year later) than the catch corresponding to $\mathbf{F}_{sq}$ in the first year of the prediction.

The Working Group recommends that the MFDP program be improved in order to be able to produce a suitable multi-management option table for two fleets at next year’s meeting.

Table 2.11.1 CALCULATION OF INPUTS FOR SHORT-TERM PREDICTIONS FOR NEA MACKEREL

UNIT: millions

Version: 22/Sep/2002 13:18

Year class	AGE	Stock in numbers at 1st January 2002	
2002	0	4084.2	<--- geometric mean over period 1972-1998
2001	1	3490.2	<--- corrected 1-year olds ----------------->
2000	2	1511.6	<-- from ICA
1999	3	2739.5	<-- from ICA
1998	4	1745.0	<-- from ICA
1997	5	1458.0	<-- from ICA
1996	6	1372.3	<-- from ICA
1995	7	864.4	<-- from ICA
1994	8	541.1	<-- from ICA
1993	9	453.6	<-- from ICA
1992	10	229.9	<-- from ICA
1991	11	120.1	<-- from ICA
	12+	210.6	<-- from ICA

CALCULATION OF RECRUITMENT AT AGE 1	
Numbers at age **1**	3351.6
At age **0** one year earlier	3922.0
CORRECTED **1**-YEAR OLDS	3490.2

(N_age_1_in_2001 / N_age_0_in 2000) x GM recruitment

Calculation of status quo F and fishery pattern by fleet

	MAC-south catch at age			MAC-northern catch at age			MAC-northern fraction		
AGE	1999	2000	2001	1999	2000	2001	1999	2000	2001
0	66972	29314	21070	31	7032	4963	0.0005	0.1935	0.1906
1	13109	36657	12369	60411	65496	27725	0.8217	0.6412	0.6915
2	8634	10186	12053	122685	123401	140642	0.9343	0.9237	0.9211
3	12828	20928	14432	199824	233205	202836	0.9397	0.9176	0.9336
4	22031	9629	21560	227933	335582	252717	0.9119	0.9721	0.9214
5	17387	17322	17167	249626	244852	266300	0.9349	0.9339	0.9394
6	21849	8773	17688	206833	206646	193200	0.9045	0.9593	0.9161
7	11407	11973	9577	137701	144366	167046	0.9235	0.9234	0.9458
8	4667	6237	8510	76786	89049	100782	0.9427	0.9345	0.9221
9	2882	2018	4438	44122	44528	60732	0.9387	0.9566	0.9319
10	2330	1076	986	26175	26711	36821	0.9183	0.9613	0.9739
11	1788	1014	1108	13998	15733	17594	0.8867	0.9394	0.9408
12	991	636	884	28634	28694	35333	0.9362	0.9535	0.9426
13	585	394	444						
14	203	269	411						
15+	172	100	413						

	F's of WG2002 (from ICA)			Mean F(4-8)	Rescaling factor mean over three years		Rescaled	Rescaled fishery pattern for the prediction		Mean fractions last 3 years	
					1.0000						
AGE	1999	2000	2001	1999-2001		AGE	F-values	SOUTH	NORTH	SOUTH	NORTH
0	0.00682	0.00703	0.00717	0.00701		0	0.00701	**0.0061**	**0.0009**	0.8718	0.1282
1	0.02326	0.02396	0.02446	0.02389		1	0.02389	**0.0067**	**0.0172**	0.2819	0.7181
2	0.05199	0.05356	0.05468	0.05341		2	0.05341	**0.0039**	**0.0495**	0.0736	0.9264
3	0.09907	0.10207	0.10420	0.10178		3	0.10178	**0.0071**	**0.0947**	0.0697	0.9303
4	0.14911	0.15363	0.15683	0.15319		4	0.15319	**0.0099**	**0.1433**	0.0649	0.9351
5	0.17239	0.17762	0.18131	0.17711		5	0.17711	**0.0113**	**0.1658**	0.0639	0.9361
6	0.19577	0.20171	0.20590	0.20113		6	0.20113	**0.0148**	**0.1864**	0.0734	0.9266
7	0.22646	0.23333	0.23818	0.23266		7	0.23266	**0.0161**	**0.2166**	0.0691	0.9309
8	0.22469	0.23151	0.23632	0.23084		8	0.23084	**0.0154**	**0.2154**	0.0669	0.9331
9	0.24492	0.25235	0.25759	0.25162		9	0.25162	**0.0145**	**0.2371**	0.0576	0.9424
10	0.21799	0.2246	0.22927	0.22395		10	0.22395	**0.0109**	**0.2130**	0.0488	0.9512
11	0.20687	0.21314	0.21757	0.21253		11	0.21253	**0.0165**	**0.1960**	0.0777	0.9223
12+	0.20687	0.21314	0.21757	0.21253		12+	0.21253	**0.0119**	**0.2006**	0.0559	0.9441
	0.1937	**0.1996**	**0.2037**	**0.1990**			**0.1990**				
	Mean F(4-8)	Mean F(4-8)	Mean F(4-8)	Mean F(4-8)			Mean F(4-8)				

Proportion of F and M before spawing	
F	M
0.4	0.4

Table 2.11.1 (Continued)

AGE	Proportion MATURE		1999	2000	2001
0	0.00		0.00	0.00	0.00
1	0.07	NEA	0.07	0.07	0.07
2	0.58		0.58	0.58	0.59
3	0.87		0.86	0.86	0.88
4	0.98		0.98	0.98	0.97
5	0.98		0.98	0.98	0.97
6	0.99		0.99	0.99	0.99
7	1.00		1.00	1.00	1.00
8	1.00		1.00	1.00	1.00
9	1.00		1.00	1.00	1.00
10	1.00		1.00	1.00	1.00
11	1.00		1.00	1.00	1.00
12+	1.00		1.00	1.00	1.00

AGE	NEA Mean weight at age in the STOCK		1999	2000	2001
0	0.000		0.000	0.000	0.000
1	0.078	NEA	0.081	0.074	0.078
2	0.181		0.194	0.185	0.164
3	0.240		0.242	0.235	0.241
4	0.310		0.301	0.289	0.342
5	0.364		0.353	0.350	0.390
6	0.410		0.396	0.390	0.446
7	0.436		0.423	0.426	0.459
8	0.462		0.440	0.447	0.499
9	0.500		0.485	0.485	0.529
10	0.522		0.498	0.492	0.576
11	0.533		0.465	0.532	0.603
12+	0.565		0.565	0.544	0.586

AGE	NORTHERN Mean weight at age in the CATCH		1999	2000	2001
0	0.073		0.092	0.056	0.070
1	0.168	NORTHERN	0.184	0.150	0.171
2	0.231		0.237	0.231	0.224
3	0.312		0.310	0.314	0.310
4	0.373		0.367	0.368	0.383
5	0.424		0.408	0.435	0.429
6	0.471		0.461	0.470	0.483
7	0.507		0.509	0.511	0.502
8	0.545		0.544	0.543	0.549
9	0.579		0.575	0.575	0.586
10	0.599		0.595	0.591	0.611
11	0.612		0.619	0.602	0.616
12+	0.675		0.698	0.653	0.673

AGE	SOUTHERN Mean weight at age in the CATCH		1999	2000	2001
0	0.065		0.062	0.064	0.069
1	0.140	SOUTHERN	0.137	0.110	0.174
2	0.202		0.202	0.196	0.208
3	0.250		0.261	0.233	0.257
4	0.310		0.302	0.311	0.318
5	0.366		0.371	0.348	0.380
6	0.399		0.385	0.408	0.404
7	0.427		0.407	0.429	0.446
8	0.450		0.433	0.447	0.472
9	0.478		0.481	0.459	0.493
10	0.505		0.503	0.509	0.504
11	0.531		0.531	0.516	0.547
12+	0.557	weighted mean weight!	0.528	0.536	0.557
			0.549	0.543	0.564
			0.572	0.571	0.594
			0.594	0.614	0.595

AGE	NEA Mean weight at age in the CATCH		1999	2000	2001
0	0.065		0.062	0.063	0.069
1	0.161	NEA	0.176	0.135	0.171
2	0.229		0.236	0.229	0.223
3	0.307		0.307	0.308	0.307
4	0.369		0.361	0.367	0.378
5	0.420		0.406	0.429	0.426
6	0.466		0.454	0.467	0.477
7	0.501		0.501	0.504	0.499
8	0.539		0.537	0.537	0.543
9	0.573		0.569	0.570	0.580
10	0.594		0.587	0.588	0.608
11	0.606		0.609	0.597	0.612
12+	0.668		0.688	0.649	0.667

Table 2.11.2 North East Atlantic Mackerel. Multifleet prediction: INPUT DATA

2002

	NORTHERN		SOUTHERN							
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 the stock
0	0.0009	0.073	0.0061	0.065	**4084**	0.15	0.00	0.4	0.4	0.000
1	0.0172	0.168	0.0067	0.140	**3490**	0.15	0.07	0.4	0.4	0.078
2	0.0495	0.231	0.0039	0.202	1512	0.15	0.58	0.4	0.4	0.181
3	0.0947	0.312	0.0071	0.250	2740	0.15	0.87	0.4	0.4	0.240
4	0.1433	0.373	0.0099	0.310	1745	0.15	0.98	0.4	0.4	0.310
5	0.1658	0.424	0.0113	0.366	1458	0.15	0.98	0.4	0.4	0.364
6	0.1864	0.471	0.0148	0.399	1372	0.15	0.99	0.4	0.4	0.410
7	0.2166	0.507	0.0161	0.427	864	0.15	1.00	0.4	0.4	0.436
8	0.2154	0.545	0.0154	0.450	541	0.15	1.00	0.4	0.4	0.462
9	0.2371	0.579	0.0145	0.478	454	0.15	1.00	0.4	0.4	0.500
10	0.2130	0.599	0.0109	0.505	230	0.15	1.00	0.4	0.4	0.522
11	0.1960	0.612	0.0165	0.531	120	0.15	1.00	0.4	0.4	0.533
12+	0.2006	0.675	0.0119	0.557	211	0.15	1.00	0.4	0.4	0.565
UNIT:		(kg)		(kg)	(millions)					(kg)

2003

	NORTHERN		SOUTHERN							
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 the stock
0	0.0009	0.073	0.0061	0.065	4084.2	0.15	0.00	0.4	0.4	0.000
1	0.0172	0.168	0.0067	0.140	-	0.15	0.07	0.4	0.4	0.078
2	0.0495	0.231	0.0039	0.202	-	0.15	0.58	0.4	0.4	0.181
3	0.0947	0.312	0.0071	0.250	-	0.15	0.87	0.4	0.4	0.240
4	0.1433	0.373	0.0099	0.310	-	0.15	0.98	0.4	0.4	0.310
5	0.1658	0.424	0.0113	0.366	-	0.15	0.98	0.4	0.4	0.364
6	0.1864	0.471	0.0148	0.399	-	0.15	0.99	0.4	0.4	0.410
7	0.2166	0.507	0.0161	0.427	-	0.15	1.00	0.4	0.4	0.436
8	0.2154	0.545	0.0154	0.450	-	0.15	1.00	0.4	0.4	0.462
9	0.2371	0.579	0.0145	0.478	-	0.15	1.00	0.4	0.4	0.500
10	0.2130	0.599	0.0109	0.505	-	0.15	1.00	0.4	0.4	0.522
11	0.1960	0.612	0.0165	0.531	-	0.15	1.00	0.4	0.4	0.533
12+	0.2006	0.675	0.0119	0.557	-	0.15	1.00	0.4	0.4	0.565
UNIT:		(kg)		(kg)	(millions)					(kg)

2004

	NORTHERN		SOUTHERN							
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 the stock
0	0.0009	0.073	0.0061	0.065	4084.2	0.15	0.00	0.4	0.4	0.000
1	0.0172	0.168	0.0067	0.140	-	0.15	0.07	0.4	0.4	0.078
2	0.0495	0.231	0.0039	0.202	-	0.15	0.58	0.4	0.4	0.181
3	0.0947	0.312	0.0071	0.250	-	0.15	0.87	0.4	0.4	0.240
4	0.1433	0.373	0.0099	0.310	-	0.15	0.98	0.4	0.4	0.310
5	0.1658	0.424	0.0113	0.366	-	0.15	0.98	0.4	0.4	0.364
6	0.1864	0.471	0.0148	0.399	-	0.15	0.99	0.4	0.4	0.410
7	0.2166	0.507	0.0161	0.427	-	0.15	1.00	0.4	0.4	0.436
8	0.2154	0.545	0.0154	0.450	-	0.15	1.00	0.4	0.4	0.462
9	0.2371	0.579	0.0145	0.478	-	0.15	1.00	0.4	0.4	0.500
10	0.2130	0.599	0.0109	0.505	-	0.15	1.00	0.4	0.4	0.522
11	0.1960	0.612	0.0165	0.531	-	0.15	1.00	0.4	0.4	0.533
12+	0.2006	0.675	0.0119	0.557	-	0.15	1.00	0.4	0.4	0.565
UNIT:		(kg)		(kg)	(millions)					(kg)

Table 2.11.3 NORTH EAST ATLANTIC MACKEREL. Two area prediction summary table with Fsq=0.20 in 2002
(Data obtained from the MFDP programm)

Fsq=0.20 in 2002 and F=0.15 in 2003-2004

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		1st of January		Spawning time	
Year	F Factor	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
2002	1.0000	0.19	1430	609	0.01	143	40	0.20	1573	649	18821	3994	10407	3510	9204	3080
2003	0.7538	0.14	1056	452	0.01	106	30	0.15	1162	482	18828	3911	10021	3368	9006	3007
2004	0.7538	0.14	1059	453	0.01	107	30	0.15	1166	483	19214	3975	10254	3398	9229	3037
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Fsq=0.20 in 2002 and F=0.17 in 2003-2004

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		1st of January		Spawning time	
Year	F Factor	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
2002	1.0000	0.19	1430	609	0.01	143	40	0.20	1573	649	18821	3994	10407	3510	9204	3080
2003	0.8543	0.16	1188	508	0.01	120	34	0.17	1308	542	18828	3911	10034	3368	8963	2986
2004	0.8543	0.16	1174	501	0.01	119	33	0.17	1293	534	19080	3923	10129	3347	9062	2971
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Fsq=0.20 in 2002-2004

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		1st of January		Spawning time	
Year	F Factor	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
2002	1.0000	0.19	1430	609	0.01	143	40	0.20	1573	649	18821	3994	10407	3510	9204	3080
2003	1.0000	0.19	1380	590	0.01	139	39	0.20	1519	629	18828	3911	10021	3368	8867	2954
2004	1.0000	0.19	1336	567	0.01	137	38	0.20	1473	605	18884	3846	9944	3272	8821	2875
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Table 2.11.4 NORTH EAST ATLANTIC MACKEREL. Two area prediction summary table with catch constraint of 683kt in 2002
(Data obtained from the MFDP programm)

Catch constraint of 683 kt in 2002 and F=0.15 in 2003-2004

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		1st of January		Spawning time	
Year	F Factor	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
2002	1.0318	0.1959	1504	641	0.0143	151	42	0.2102	1655	683	18821	3994	10407	3510	9171	3068
2003	0.7363	0.1398	1048	448	0.0102	105	30	0.1500	1153	478	18753	3882	9950	3339	8943	2981
2004	0.7363	0.1398	1052	450	0.0102	106	30	0.1500	1158	480	19158	3952	10199	3374	9180	3016
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Catch constraint of 683 kt in 2002 and F=0.17 in 2003-2004

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		1st of January		Spawning time	
Year	F Factor	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
2002	1.0318	0.1959	1504	641	0.0143	151	42	0.2102	1655	683	18821	3994	10407	3510	9171	3068
2003	0.8345	0.1585	1178	503	0.0115	119	33	0.1700	1297	536	18753	3882	9950	3339	8887	2960
2004	0.8345	0.1585	1166	497	0.0115	118	33	0.1700	1284	530	19025	3900	10075	3324	9015	2950
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Catch constraint of 683 kt in 2002 and Fsq=0.20 in 2003-2004

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		1st of January		Spawning time	
Year	F Factor	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
2002	1.0318	0.1959	1504	641	0.0143	151	42	0.2102	1655	683	18821	3994	10407	3510	9171	3068
2003	0.9818	0.1864	1369	584	0.0136	139	39	0.2000	1508	623	18753	3882	9950	3339	8805	2929
2004	0.9818	0.1864	1327	563	0.0136	136	38	0.2000	1463	601	18830	3824	9892	3250	8775	2856
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Table 2.11.5 NORTH EAST ATLANTIC MACKEREL. Two area prediction detailed table.

data obtained from MFDP output

Rundate :16/09/2002

Fsq = 0.20 constraint for each fleet in 2002 and F=0.17 (2003-2004)

YEAR 2002 F-factor **1.0000**

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		Spawning time	
Year class	Age	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass
2002	0	0.00	3	0	0.01	23	1	0.01	26	1	4084	0	0	0
2001	1	0.02	55	9	0.01	22	3	0.02	77	12	3490	271	228	18
2000	2	0.05	68	16	0.00	5	1	0.05	73	17	1512	274	813	147
1999	3	0.09	229	71	0.01	17	4	0.10	246	75	2740	656	2147	514
1998	4	0.14	216	80	0.01	15	5	0.15	231	85	1745	542	1510	469
1997	5	0.17	206	87	0.01	14	5	0.18	220	92	1458	531	1249	455
1996	6	0.19	216	102	0.01	17	7	0.20	233	109	1372	564	1181	485
1995	7	0.22	156	79	0.02	12	5	0.23	168	84	864	377	742	323
1994	8	0.22	97	53	0.02	7	3	0.23	104	56	541	250	465	215
1993	9	0.24	89	51	0.01	5	3	0.25	94	54	454	227	386	193
1992	10	0.21	41	24	0.01	2	1	0.22	43	25	230	120	198	103
1991	11	0.20	20	12	0.02	2	1	0.21	22	13	120	64	104	55
1990	12+	0.20	35	24	0.01	2	1	0.21	37	25	211	119	182	103
		0.19	1430	609	0.01	143	40	**0.20**	1574	**649**	18821	3994	9204	**3080**
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

YEAR 2003 F-factor: **1.0000**

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		Spawning time	
Year class	Age	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass
2003	0	0.00	3	0	0.01	20	1	0.01	23	1	4084	0	0	0
2002	1	0.01	47	8	0.01	19	3	0.02	66	11	3491	271	228	18
2001	2	0.04	113	26	0.00	9	2	0.05	122	28	2933	531	1582	286
2000	3	0.08	89	28	0.01	7	2	0.09	96	30	1233	295	972	233
1999	4	0.12	227	85	0.01	16	5	0.13	243	90	2130	662	1859	578
1998	5	0.14	158	67	0.01	11	4	0.15	169	71	1289	469	1116	406
1997	6	0.16	143	67	0.01	11	5	0.17	154	72	1051	432	915	376
1996	7	0.19	151	77	0.01	11	5	0.20	162	82	966	421	840	366
1995	8	0.18	92	50	0.01	7	3	0.20	99	53	590	272	513	237
1994	9	0.20	63	36	0.01	4	2	0.22	67	38	370	185	320	160
1993	10	0.18	47	28	0.01	2	1	0.19	49	29	304	158	265	138
1992	11	0.17	23	14	0.01	2	1	0.18	25	15	158	84	139	74
1991	12+	0.17	34	23	0.01	2	1	0.18	36	24	230	130	202	114
		0.16	1188	508	0.01	120	34	**0.17**	1311	**542**	18828	3911	8950	**2986**
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

YEAR 2004 F-factor: **1.0000**

		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			1st of January		Spawning time	
Year class	Age	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	Stock size	Stock biomass	SP. ST. size	SP. ST. biomass
2004	0	0.00	3	0	0.01	20	1	0.01	23	1	4084	0	0	0
2003	1	0.01	47	8	0.01	19	3	0.02	66	11	3494	271	228	18
2002	2	0.04	113	26	0.00	9	2	0.05	122	28	2944	533	1588	287
2001	3	0.08	174	54	0.01	13	3	0.09	187	57	2412	577	1901	455
2000	4	0.12	104	39	0.01	7	2	0.13	111	41	973	302	849	264
1999	5	0.14	197	83	0.01	13	5	0.15	210	88	1608	586	1392	507
1998	6	0.16	130	61	0.01	10	4	0.17	140	65	953	392	830	341
1997	7	0.19	119	60	0.01	9	4	0.20	128	64	762	332	663	289
1996	8	0.18	106	58	0.01	8	3	0.20	114	61	682	315	593	274
1995	9	0.20	71	41	0.01	4	2	0.22	75	43	417	208	360	180
1994	10	0.18	40	24	0.01	2	1	0.19	42	25	257	134	224	117
1993	11	0.17	31	19	0.01	3	1	0.18	34	20	216	115	189	101
1992	12+	0.17	41	27	0.01	2	1	0.18	43	28	279	157	244	138
		0.19	1174	501	0.01	119	33	**0.17**	1295	**534**	19080	3923	9062	**2971**
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Table 2.11.6 NORTH EAST ATLANTIC MACKEREL. Two area management option table.

Fsq = 0.20 in 2002

Data from 2002-2007.xls

		YEAR 2002										
		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			Spawning time	
F factor	Reference F	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	SP. ST. size	SP. ST. biomass
1	0.20	0.19	1430	609	0.01	143	40	0.20	1573	649	9196	3079
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)

		YEAR 2003											2004	
		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			Spawning time		Spawning time	
F factor	Reference F	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
0.00	0.0000	0.0000	0	0	0.0000	0	0	0.0000	0	0	9431	3170	10606	3589
0.05	0.0100	0.0093	74	32	0.0007	7	2	0.0099	82	34	9401	3159	10506	3549
0.10	0.0200	0.0185	148	64	0.0014	15	4	0.0199	163	68	9372	3148	10407	3509
0.15	0.0300	0.0278	221	95	0.0020	22	6	0.0298	243	101	9343	3137	10310	3470
0.20	0.0400	0.0371	293	126	0.0027	29	8	0.0398	322	134	9314	3126	10213	3431
0.25	0.0500	0.0464	365	157	0.0034	36	10	0.0497	401	167	9285	3115	10118	3393
0.30	0.0600	0.0556	436	188	0.0041	43	12	0.0597	480	200	9256	3104	10024	3356
0.35	0.0700	0.0649	507	218	0.0047	50	14	0.0696	557	232	9227	3093	9931	3318
0.40	0.0800	0.0742	577	248	0.0054	58	16	0.0796	635	264	9199	3082	9840	3282
0.45	0.0900	0.0835	646	277	0.0061	65	18	0.0895	711	296	9170	3071	9749	3246
0.50	0.1000	0.0927	715	307	0.0068	71	20	0.0995	787	327	9142	3060	9659	3210
0.55	0.1100	0.1020	784	336	0.0074	78	22	0.1094	862	358	9114	3049	9571	3175
0.60	0.1200	0.1113	851	365	0.0081	85	24	0.1194	937	389	9085	3038	9484	3140
0.65	0.1300	0.1206	919	394	0.0088	92	26	0.1293	1011	420	9057	3028	9397	3106
0.70	0.1400	0.1298	985	422	0.0095	99	28	0.1393	1084	450	9029	3017	9312	3072
0.75	0.1500	0.1391	1051	450	0.0101	106	30	0.1492	1157	480	9001	3006	9228	3038
0.80	0.1600	0.1484	1117	478	0.0108	112	32	0.1592	1229	510	8974	2996	9145	3005
0.85	0.1700	0.1577	1182	506	0.0115	119	33	0.1691	1301	539	8946	2985	9062	2973
0.90	0.1800	0.1669	1246	533	0.0122	126	35	0.1791	1372	568	8918	2975	8981	2941
0.95	0.1900	0.1762	1310	560	0.0128	132	37	0.1890	1443	597	8891	2964	8901	2909
1.00	0.2000	0.1855	1374	587	0.0135	139	39	0.1990	1513	626	8863	2954	8821	2878
1.05	0.2100	0.1948	1437	614	0.0142	145	41	0.2089	1582	654	8836	2943	8743	2847
1.10	0.2200	0.2040	1499	640	0.0149	152	42	0.2189	1651	683	8809	2933	8666	2816
1.15	0.2300	0.2133	1561	666	0.0155	158	44	0.2288	1719	711	8782	2923	8589	2786
1.20	0.2400	0.2226	1623	692	0.0162	165	46	0.2388	1787	738	8755	2912	8513	2756
1.25	0.2500	0.2318	1683	718	0.0169	171	48	0.2487	1854	766	8728	2902	8439	2727
1.30	0.2600	0.2411	1744	743	0.0176	177	49	0.2587	1921	793	8701	2892	8365	2698
1.35	0.2700	0.2504	1804	769	0.0182	184	51	0.2686	1987	820	8675	2882	8292	2669
1.40	0.2800	0.2597	1863	794	0.0189	190	53	0.2786	2053	846	8648	2872	8220	2641
1.45	0.2900	0.2689	1922	819	0.0196	196	54	0.2885	2118	873	8621	2862	8148	2613
1.50	0.3000	0.2782	1981	843	0.0203	202	56	0.2985	2183	899	8595	2852	8078	2586
1.55	0.3100	0.2875	2039	867	0.0209	208	58	0.3084	2247	925	8569	2842	8008	2559
1.60	0.3200	0.2968	2096	892	0.0216	215	59	0.3184	2311	951	8543	2832	7940	2532
1.65	0.3300	0.3060	2153	916	0.0223	221	61	0.3283	2374	977	8516	2822	7872	2505
1.70	0.3400	0.3153	2210	939	0.0230	227	63	0.3383	2437	1002	8490	2812	7804	2479
1.75	0.3500	0.3246	2266	963	0.0236	233	64	0.3482	2499	1027	8464	2802	7738	2453
1.80	0.3600	0.3339	2322	986	0.0243	239	66	0.3582	2561	1052	8439	2792	7672	2428
1.85	0.3700	0.3431	2377	1009	0.0250	245	67	0.3681	2622	1076	8413	2783	7608	2403
1.90	0.3800	0.3524	2432	1032	0.0257	251	69	0.3781	2683	1101	8387	2773	7543	2378
1.95	0.3900	0.3617	2487	1055	0.0263	256	70	0.3880	2743	1125	8362	2763	7480	2353
2.00	0.4000	0.3710	2541	1077	0.0270	262	72	0.3980	2803	1149	8336	2754	7417	2329
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

Table 2.11.7 NORTH EAST ATLANTIC MACKEREL. Two area management option table.

Catch contstraint 683kt in 2002

data from predictions 2002-2007.xls

		YEAR 2002										
		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			Spawning time	
F factor	Reference F	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	SP. ST. size	SP. ST. biomass
1	**1.056221**	0.1959	1503.554	640.633	0.0143	150.658	42.367	0.2102	1654	683	9163	3067
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)

		YEAR 2003											2004	
		NORTHERN AREA			SOUTHERN AREA			TOTAL AREA			Spawning time		Spawning time	
F factor	Reference F	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	F	Catch in numbers	Catch in weight	SP. ST. size	SP. ST. biomass	SP. ST. size	SP. ST. biomass
0.00	**0.0000**	0.0000	0	0	0.0000	0	0	0.0000	0	0	9364	3143	10546	3563
0.05	**0.0528**	0.0093	74	32	0.0007	7	2	**0.0099**	81	**34**	9335	**3132**	10447	3523
0.10	**0.1056**	0.0185	147	63	0.0014	15	4	**0.0199**	161	**67**	9306	**3121**	10349	3484
0.15	**0.1584**	0.0278	219	94	0.0020	22	6	**0.0298**	241	**100**	9277	**3110**	10253	3445
0.20	**0.2112**	0.0371	291	125	0.0027	29	8	**0.0398**	320	**133**	9248	**3099**	10157	3407
0.25	**0.2641**	0.0464	362	156	0.0034	36	10	**0.0497**	398	**166**	9219	**3088**	10063	3369
0.30	**0.3169**	0.0556	433	186	0.0041	43	12	**0.0597**	476	**198**	9191	**3077**	9969	3332
0.35	**0.3697**	0.0649	503	216	0.0047	50	14	**0.0696**	553	**230**	9162	**3066**	9877	3295
0.40	**0.4225**	0.0742	572	245	0.0054	57	16	**0.0796**	630	**262**	9134	**3056**	9786	3259
0.45	**0.4753**	0.0835	641	275	0.0061	64	18	**0.0895**	705	**293**	9106	**3045**	9696	3223
0.50	**0.5281**	0.0927	710	304	0.0068	71	20	**0.0995**	781	**324**	9078	**3034**	9608	3188
0.55	**0.5809**	0.1020	777	333	0.0074	78	22	**0.1094**	855	**355**	9050	**3023**	9520	3153
0.60	**0.6337**	0.1113	845	362	0.0081	85	24	**0.1194**	929	**386**	9022	**3013**	9433	3118
0.65	**0.6865**	0.1206	911	390	0.0088	92	26	**0.1293**	1003	**416**	8994	**3002**	9347	3084
0.70	**0.7394**	0.1298	977	418	0.0095	98	28	**0.1393**	1076	**446**	8966	**2992**	9263	3051
0.75	**0.7922**	0.1391	1043	446	0.0101	105	30	**0.1492**	1148	**476**	8938	**2981**	9179	3017
0.80	**0.8450**	0.1484	1108	474	0.0108	112	31	**0.1592**	1220	**505**	8911	**2971**	9097	2985
0.85	**0.8978**	0.1577	1172	501	0.0115	118	33	**0.1691**	1291	**534**	8883	**2960**	9015	2952
0.90	**0.9506**	0.1669	1236	528	0.0122	125	35	**0.1791**	1361	**563**	8856	**2950**	8934	2921
0.95	**1.0034**	0.1762	1300	555	0.0128	131	37	**0.1890**	1431	**592**	8829	**2939**	8855	2889
1.00	**1.0562**	0.1855	1363	582	0.0135	138	39	**0.1990**	1501	**620**	8802	**2929**	8776	2858
1.05	**1.1090**	0.1948	1425	608	0.0142	144	40	**0.2089**	1570	**649**	8775	**2919**	8698	2827
1.10	**1.1618**	0.2040	1487	634	0.0149	151	42	**0.2189**	1638	**676**	8748	**2908**	8621	2797
1.15	**1.2147**	0.2133	1549	660	0.0155	157	44	**0.2288**	1706	**704**	8721	**2898**	8545	2767
1.20	**1.2675**	0.2226	1610	686	0.0162	164	46	**0.2388**	1773	**732**	8694	**2888**	8470	2738
1.25	**1.3203**	0.2318	1670	711	0.0169	170	47	**0.2487**	1840	**759**	8667	**2878**	8396	2709
1.30	**1.3731**	0.2411	1730	737	0.0176	176	49	**0.2587**	1906	**786**	8641	**2868**	8323	2680
1.35	**1.4259**	0.2504	1789	762	0.0182	183	51	**0.2686**	1972	**812**	8614	**2858**	8251	2652
1.40	**1.4787**	0.2597	1848	786	0.0189	189	52	**0.2786**	2037	**839**	8588	**2848**	8179	2624
1.45	**1.5315**	0.2689	1907	811	0.0196	195	54	**0.2885**	2102	**865**	8562	**2838**	8108	2596
1.50	**1.5843**	0.2782	1965	835	0.0203	201	56	**0.2985**	2166	**891**	8536	**2828**	8038	2569
1.55	**1.6371**	0.2875	2023	860	0.0209	207	57	**0.3084**	2230	**917**	8510	**2818**	7969	2542
1.60	**1.6900**	0.2968	2080	883	0.0216	213	59	**0.3184**	2293	**942**	8484	**2808**	7901	2515
1.65	**1.7428**	0.3060	2136	907	0.0223	219	61	**0.3283**	2356	**968**	8458	**2798**	7833	2489
1.70	**1.7956**	0.3153	2193	931	0.0230	225	62	**0.3383**	2418	**993**	8432	**2789**	7767	2463
1.75	**1.8484**	0.3246	2248	954	0.0236	231	64	**0.3482**	2480	**1018**	8406	**2779**	7701	2438
1.80	**1.9012**	0.3339	2304	977	0.0243	237	65	**0.3582**	2541	**1042**	8381	**2769**	7636	2412
1.85	**1.9540**	0.3431	2359	1000	0.0250	243	67	**0.3681**	2602	**1067**	8355	**2759**	7571	2388
1.90	**2.0068**	0.3524	2413	1023	0.0257	249	68	**0.3781**	2662	**1091**	8330	**2750**	7508	2363
1.95	**2.0596**	0.3617	2467	1045	0.0263	255	70	**0.3880**	2722	**1115**	8304	**2740**	7445	2339
2.00	**2.1124**	0.3710	2521	1067	0.0270	261	71	**0.3980**	2782	**1139**	8279	**2731**	7382	2315
	UNIT:	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	F(4-8)	(millions)	(kt)	(millions)	(kt)	(millions)	(kt)

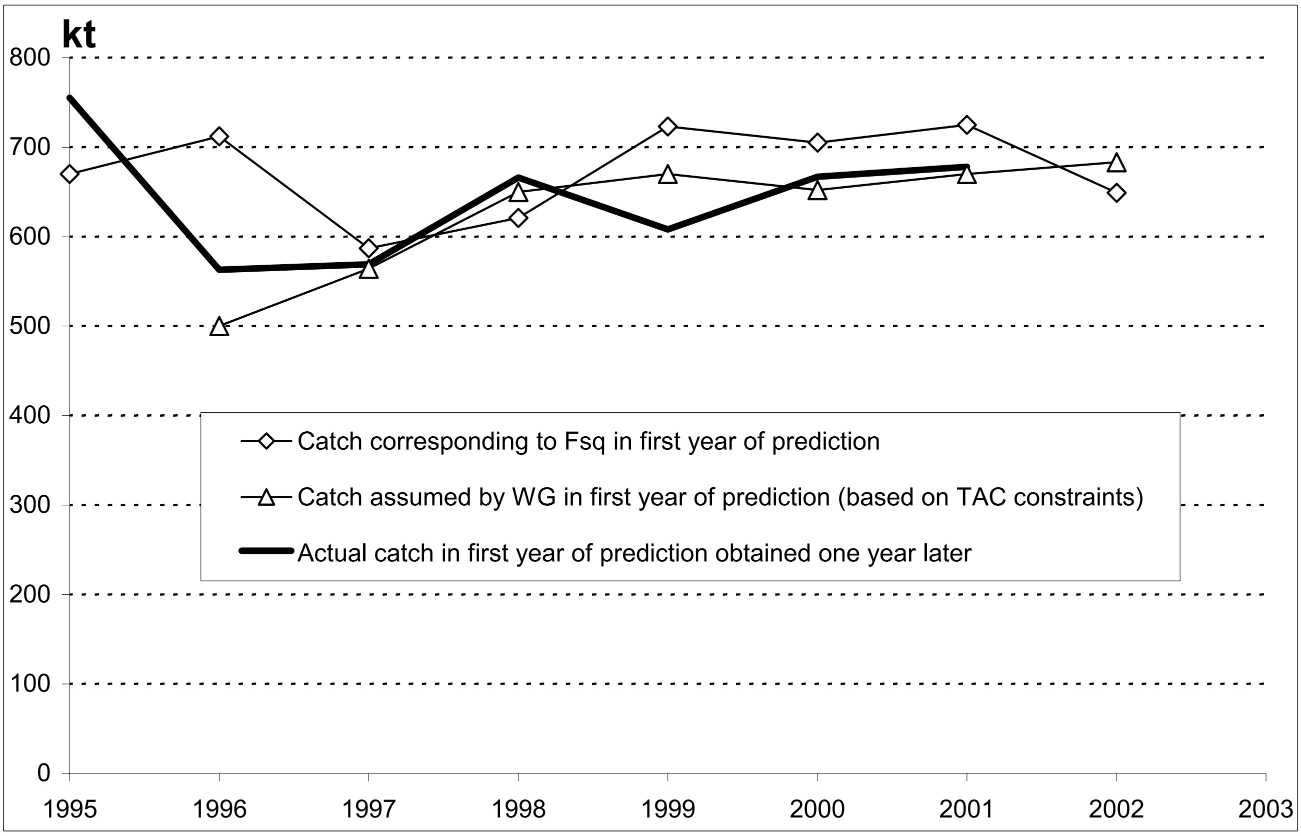


Figure 2.11.1 The catch in the first year of prediction (obtained one year later) compared to the catch corresponding to Fsq and as assumed by the WG (catch constraint option based on TAC's) in the first year of the prediction.

2.12 Medium-term Predictions

Three stochastic medium-term projections for the period 2002–2011 were carried out on the basis of exploitation at F=0.2, $\mathbf{F}_{pa}$=0.17 and F=0.15 with a catch constraint of the 2002 TAC. These projections encompass the range of F values agreed by managers for the NEA mackerel stock. The method used to calculate medium-term projections was that described in ICES (1996/Assess:10); a Monte-Carlo method was used, with a conventional stock projection being used for each iteration. Population parameters (vector of abundance-at-age in 2002, fishing mortality at reference age in 2002, selection-at-age) were drawn from a multivariate normal distribution with means equal to the values estimated in the stock assessment model, and with covariance as estimated in the same model fit. Weights-at-age in the catch were calculated as the mean weights-at-age from 1999–2001. Weights-at-age in the stock, maturity ogives and natural mortality were as given in Table 2.11.1. The procedure was implemented using the ICP program.

Examination of the results of the ICP prompted the realisation that the upper ranges of recruitment were higher than any observed in the historical record, which led to over-optimistic trajectories of both SSB and catches in the medium term. The main reason for this is the distribution of future recruitments assumed by ICA and ICP. This is shown in Figure 2.12.1 where the cumulative distribution of historic recruitment is compared with the percentiles in the recruitment drawn by ICP. The consequence of this over-estimation of stock size is an under-estimation of the risks associated with the various management options. The WG decided not to present results of medium-term projections until these problems have been solved.

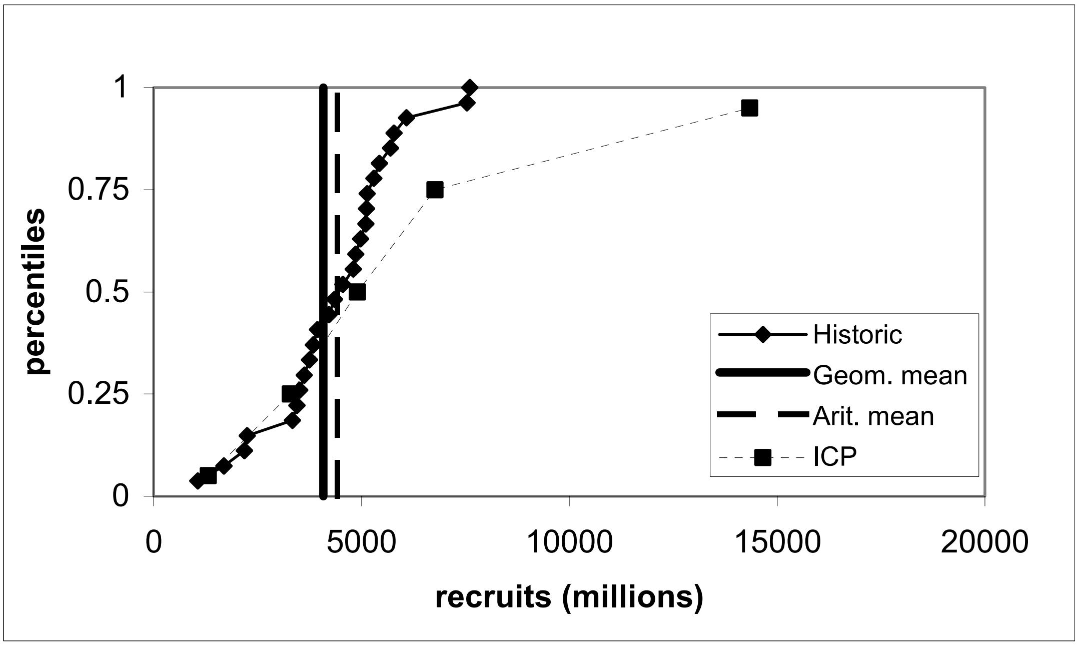


Figure 2.12.1. NEA mackerel. Cumulative probability of recruitment numbers comparing output from the ICA assessment (historical recruitment, geometric and arithmetic mean) and the distribution of recruitments produced by the stochastic medium term projection by ICP.

2.13 Long-term Yield

Table 2.13.1 presents the yield per recruit forecasts for the combined North East Atlantic Mackerel stock. The multifleet yield per recruit programme (MFYPR) was not able to carry out the yield per recruit forecasts for both the Northern and Southern area as was done at earlier working group meetings. Therefore, yield per recruit forecast was carried out for the combined areas. The input values for $\mathbf{F}_{low}$, $\mathbf{F}_{med}$ and $\mathbf{F}_{high}$ were obtained from the PA run in next Section (2.14).

$\mathbf{F}_{max}$ is poorly defined at a combined reference F of about 0.66. However, for pelagic species $\mathbf{F}_{max}$ is generally estimated to be at levels of F well beyond sustainable levels and should not be used as a fishing mortality target. $\mathbf{F}_{0.1}$ was estimated to be 0.19.

Table 2.13.1 One area yield per recruit table for North East Atlantic Mackerel (Single recruit)

MFYPR version 1, Run: run1b, Time and date: 18:37 18/09/02, Yield per results

FMult	F(4-8)	CatchNos Numbers	Yield kg	StockNos Numbers	Biomass kg	SpwnNosJan Numbers	SSBJan kg	SpwnNosSpwn Numbers	SSBSpwn kg
0	0.0000	0.0000	0.0000	7.1792	2.1738	4.9571	2.0257	4.6684	1.9077
0.1	0.0199	0.0766	0.0376	6.6696	1.9077	4.4506	1.7603	4.1622	1.6450
0.2	0.0398	0.1365	0.0651	6.2714	1.7032	4.0554	1.5565	3.7675	1.4438
0.3	0.0597	0.1846	0.0859	5.9513	1.5417	3.7382	1.3956	3.4507	1.2851
0.4	0.0796	0.2243	0.1018	5.6878	1.4110	3.4777	1.2656	3.1905	1.1572
0.5	0.0995	0.2576	0.1143	5.4667	1.3033	3.2595	1.1585	2.9728	1.0521
0.6	0.1194	0.2860	0.1242	5.2782	1.2131	3.0738	1.0689	2.7876	0.9644
0.7	0.1393	0.3106	0.1321	5.1152	1.1364	2.9137	0.9929	2.6279	0.8901
0.8	0.1592	0.3321	0.1386	4.9726	1.0706	2.7739	0.9276	2.4887	0.8264
0.9	0.1791	0.3512	0.1439	4.8466	1.0133	2.6507	0.8710	2.3660	0.7713
1.0	0.1990	0.3681	0.1482	4.7343	0.9631	2.5411	0.8214	2.2569	0.7231
1.1	0.2189	0.3834	0.1519	4.6333	0.9188	2.4428	0.7776	2.1592	0.6807
1.2	0.2388	0.3972	0.1549	4.5418	0.8792	2.3540	0.7386	2.0710	0.6430
1.3	0.2587	0.4099	0.1575	4.4585	0.8438	2.2734	0.7037	1.9909	0.6093
1.4	0.2786	0.4214	0.1597	4.3822	0.8118	2.1997	0.6723	1.9178	0.5791
1.5	0.2985	0.4321	0.1615	4.3119	0.7828	2.1320	0.6438	1.8508	0.5517
1.6	0.3184	0.4419	0.1630	4.2469	0.7563	2.0696	0.6178	1.7889	0.5268
1.7	0.3383	0.4511	0.1644	4.1865	0.7320	2.0118	0.5941	1.7317	0.5041
1.8	0.3582	0.4596	0.1655	4.1302	0.7097	1.9580	0.5723	1.6786	0.4833
1.9	0.3781	0.4676	0.1665	4.0775	0.6891	1.9078	0.5522	1.6290	0.4641
2.0	0.3980	0.4751	0.1673	4.0280	0.6700	1.8608	0.5336	1.5827	0.4464

Reference point	F multiplier	Absolute F
Fbar(4-8)	1.00	0.20
FMax	3.30	0.66
F0.1	0.94	0.19
F35%SPR	1.13	0.23
Flow	0.15	0.03
Fmed	1.01	0.20
Fhigh	2.01	0.40

2.14 Reference Points for Management Purposes

In the 1997 Working Group Report (ICES 1998/Assess:6) an extensive and detailed analysis on potential candidates for reference points for the precautionary approach were given. The reference points suggested by SGPAFM were largely based on this analysis and are in line with the suggestions from the 1997 Working Group, and were consequently adopted in the 1998 Working Group Report (ICES 1998/ACFM:6). These values have been used by ACFM since 1998.

Since the full catch at age time series of the North East Atlantic Mackerel stock back to 1972 became available this year as well as the 2001 egg survey results were incorporated in the assessment, the WG decided to calculate reference points based on this new information. The PA software was used to calculate various precautionary reference points of spawning stock biomass and fishing mortality.

The input to the PA is the .sum and the .sen files from ICA. However, these need extensive modifications before any use. The stock numbers in the .sen file are from the last years with data and not the stock sizes at the end of the current year (i.e. 2002, where stock sizes at age 0 and 1 are replaced with appropriate (GM) estimates of recruitment, see sec. 2.11.1). Furthermore the selection-pattern from the ICA output has to be changed to the mean F at age for the last three years (same as used for prediction, Table 2.11.1). At the end of the new input file, some additional values have to be added manually (Human factor multipliers, recruitments and natural mortality multipliers). In addition the CV for age 0 (2002 year class) was taken from the GM estimate while the CVs for older ages were the same as for the stock size number from 2001 (ICA output). Table 2.14.1 give a list of input parameters to the PA run.

The results are shown in Table 2.14.2 and Figs 2.14.1-5. $\mathbf{F}_{0.1}$ was estimated to be 0.19 in the present assessment, the same as in the previous three years.

The Working Group noted that recent updates have not significantly changed the basis for the present references points. The WG also noted that the lowest observed SSB was 2.4 million tonnes, slightly higher than the current $\mathbf{B}_{pa}$ (Table 2.14.2).

Table 2.14.1. NEA mackerel: Input variables to the PA software.

Age	N	M	CWt	SWt	Mat	F	FPreSpwn	MPreSpwn	NCV
0	4084.2	0.15	0.064802	0	0	0.00701	0.4	0.4	0.44
1	3490.2	0.15	0.160833	0.078039	0.06745	0.02389			0.18966
2	1511.6	0.15	0.229411	0.180747	0.58429	0.05341			0.13246
3	2739.5	0.15	0.307201	0.239625	0.86588	0.10178			0.10853
4	1745	0.15	0.36856	0.310318	0.97606	0.15319			0.09411
5	1458	0.15	0.420487	0.364436	0.97606	0.17711			0.08397
6	1372.3	0.15	0.465875	0.410355	0.99202	0.20113			0.07991
7	864.4	0.15	0.501315	0.435732	1	0.23266			0.07933
8	541.1	0.15	0.538897	0.461944	1	0.23084			0.07827
9	453.6	0.15	0.572897	0.499716	1	0.25162			0.08032
10	229.9	0.15	0.594417	0.522119	1	0.22395			0.08549
11	120.1	0.15	0.605973	0.5332	1	0.21253			0.092
12	210.6	0.15	0.668076	0.564882	1	0.21253			0.092

FbarMinAge	4
FbarMaxAge	8
M year CV	0.1

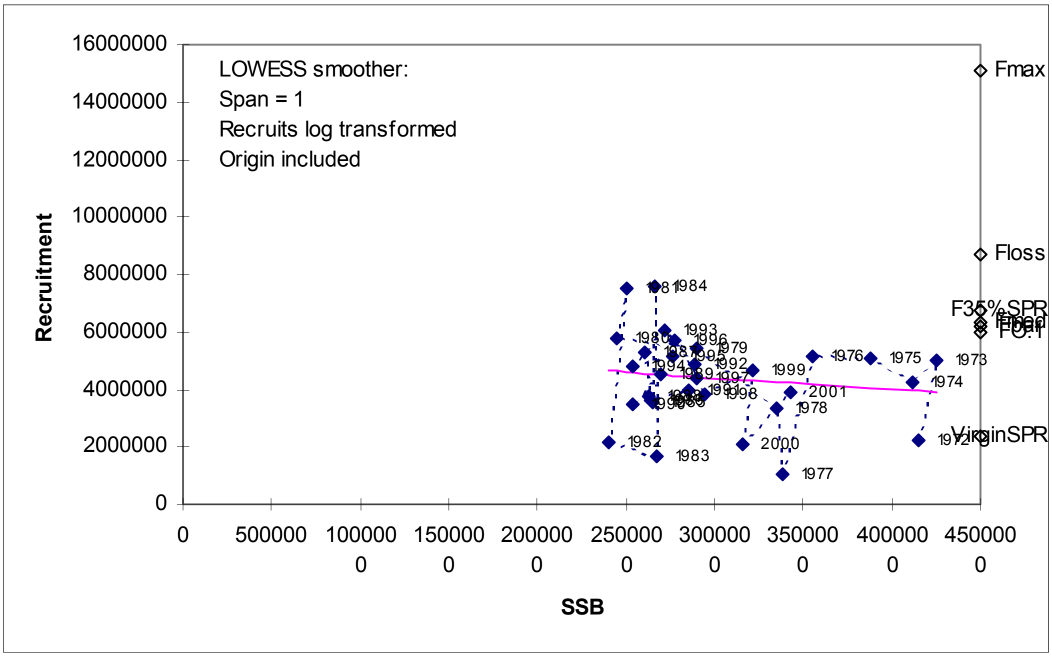


Figure 2.14.1 NAE mackerel stock-recruitment plot with a LOWESS smoother as a possible stock recruitment relationship. Some reference points are also indicated (PA output).

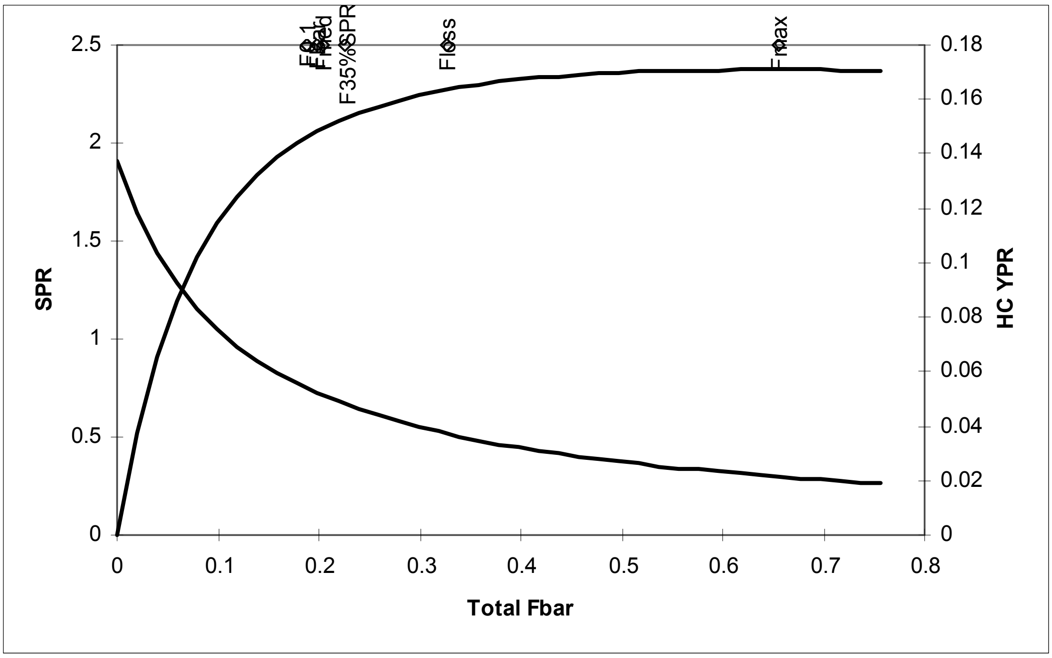


Figure 2.14.2 Plot of YPR and SPR curves with some reference points indicated for NAE mackerel.

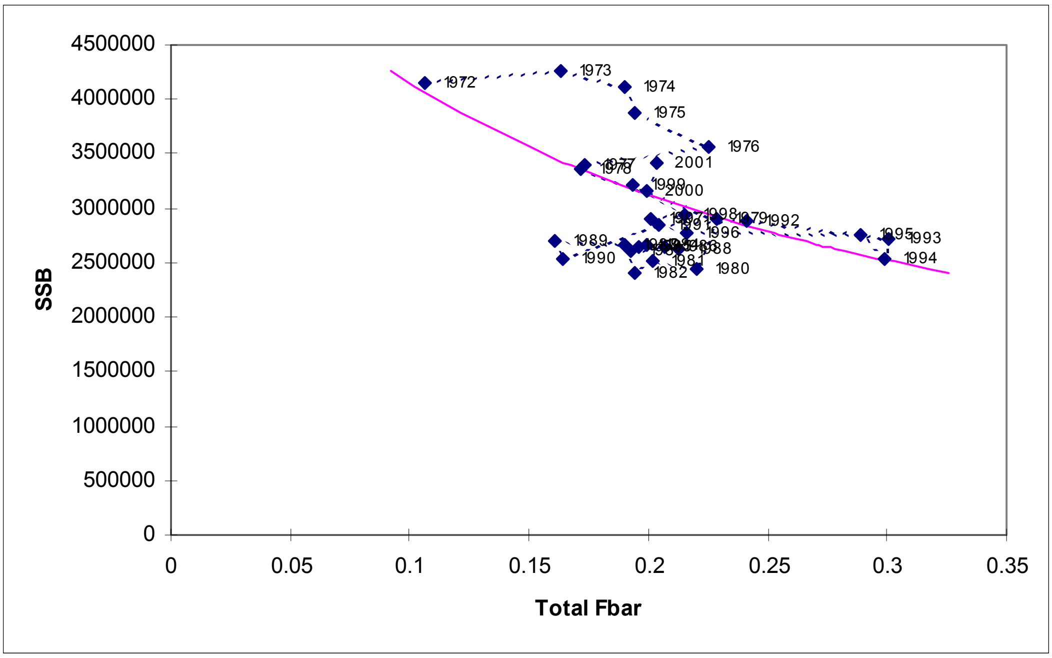


Figure 2.14.3 Plot of historical SSB against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship for NAE mackerel.

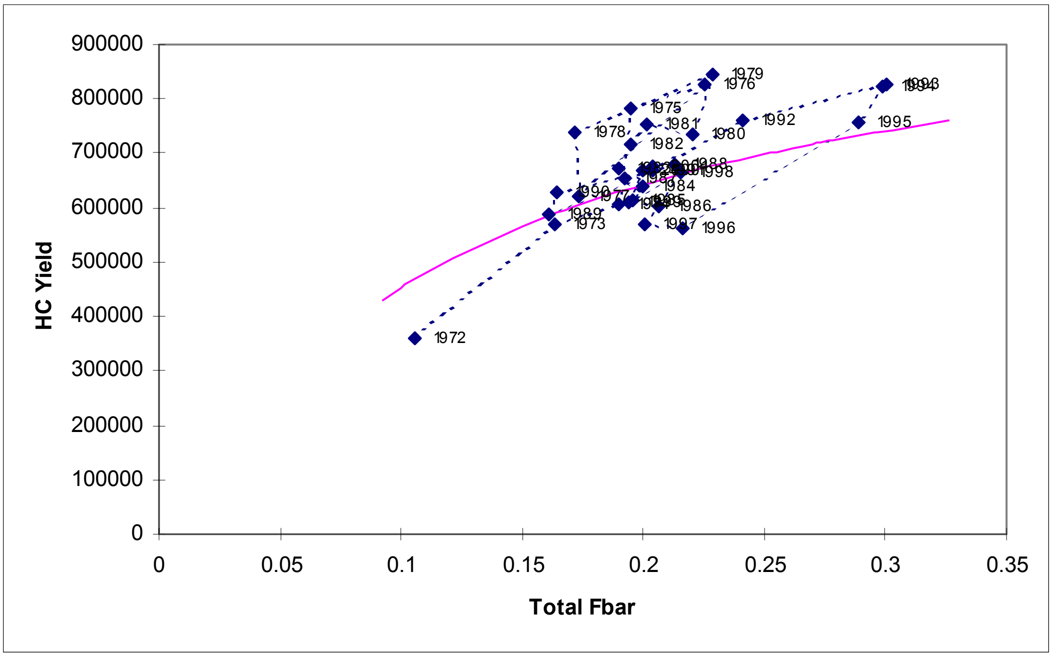


Figure 2.14.4 Plot of historical yield against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship for NAE mackerel.

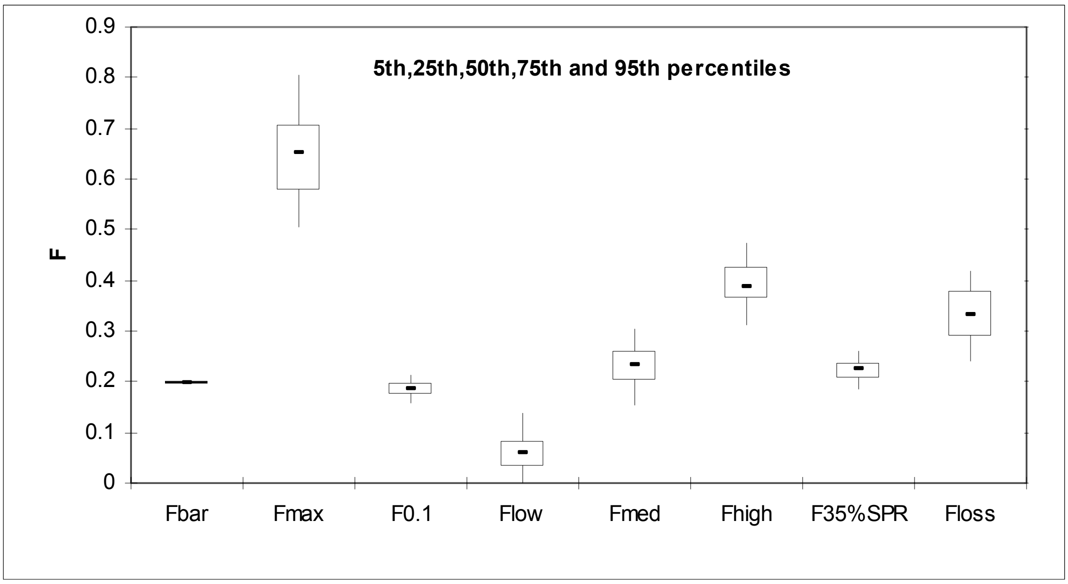


Figure 2.14.5 Various Reference points and their uncertainties calculated for NAE mackerel.

2.15 Management Measures and Considerations

The perception of the NEA mackerel stock has changed from the previous assessment; however, the mackerel stock is still in a healthy state. The results from the latest (2001) egg survey indicated a lower biomass than that perceived during the last two years, which was a result of the high biomass estimate from the 1998 egg survey.

The assessment model is considered as unreliable at estimating the most recent year classes prior to their appearance in the fishery. Given this, and the over-sensitivity of the model to the most recent SSB estimate leading to fluctuations in the stock assessment, a management regime is needed which is capable of incorporating this uncertainty in their advice. Specifically the regime should consider the possibility that poor year classes are not recognised until several years later, and that the recent perception of the stock is subject to variability and allow for this uncertainty in the advice. See Section 2.10.2 for a detailed discussion of the reliability of the assessment and its implications for management.

In 1999 Norway, Faroes, and EU have agreed on: "For 1999 and subsequent years, the parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality in the range of 0.15–0.20 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of the fishing mortality rate." The Working Group sees no reason to deviate from the strategy to maintain a fishing mortality of 0.17. Medium- and long-term predictions made in previous Working Groups have indicated that a long-term harvesting strategy with a fixed F near $\mathbf{F}_{0.1}$ would be optimal with respect to long-term yield and low risk. ACFM has recommended F= 0.17 as $\mathbf{F}_{pa}$.

The North Sea spawning component still needs the maximum possible protection, although the indications from the egg survey in 2002 the stock show some signs of recovery.

Little is known about discards in the mackerel fishery. Information on discards has not improved in the last years.

The WG would again put forward the possibility of introducing a Harvest Control Rule (HCR) for the period between the results from the egg surveys. The risks and advantages of a multi-annual HCR could be studied by a retrospective analysis of the stock assessments in the years between each egg survey estimate, noting a relatively large shift in the stock estimates after each egg survey.

2.16 The Mackerel Box

WGHMSA Term of reference (f): "evaluate the conservation benefit of the western mackerel box, and the likely consequences for the western stock if the box were to be opened; a Study Group will be formed to address the problem.

2.16.1 General

The restrictions on fishing for mackerel inside the regulated area known as the 'Mackerel Box' are described in Council Regulation (EC) No 894/97 Article 9.

The Mackerel Box (Figure 2.16.1) is defined by the area bounded by the following co-ordinates:

- a point on the south coast of the UK at longitude 02 00' W
- latitude 49 30' N longitude 02 00' W
- latitude 49 30' N longitude 07 00' W
- latitude 52 00' N longitude 07 00' W
- a point on the West coast of the UK at latitude 52 00' W

The restrictions were introduced in order to reduce the fishing effort on juvenile mackerel (defined as ages 1, 2 and 3 in quarters 1 and 2 and 0, 1 and 2 in quarters 3 and 4), which are considered to be concentrated in the area and vulnerable to targeted exploitation. A seasonal closure was imposed from 1980 and the area was permanently closed in 1985 to all methods of mackerel fishing except quota-regulated vessels using gill nets or handlines. Mackerel may also be taken legally inside the Box as a by-catch in the Danish industrial fishery for horse mackerel and pilchards and the Dutch human consumption fisheries targeted at horse mackerel.

The mackerel box is not the only area in which there are restrictions on the fishing of mackerel. The North Sea, in which large numbers of juvenile mackerel from the western area occur in the south during the third quarter of the year, is closed to a targeted mackerel fishery throughout the year. A conservation measure introduced after the North Sea stock had been severely over fished.

The fishery in the area of the mackerel box

ICES Divisions VIIefg and h include parts of the mackerel box. In order to examine the dynamics of the fishery in the area of the box, the working group therefore examined commercial landings data for those divisions.

Landings by ICES area are illustrated for the year 2001 in Figure 2.8.1.1 - 4. The average yearly total landing for the last 10 years from Divisions VIIefgh is 25kt, with a range 18 – 40kt. The majority of the catches are reported from divisions VIIe and f.

The age compositions of the commercial catch in number at age recorded within Divisions VIIefgh in the years 1988 – 2001 are illustrated Figure 2.16.2. Juvenile fish constitute the greatest proportion of the catch in numbers, with a range from 70 – 85%.

The total catch in number at age, by reported ICES divisions are presented in Table 2.4.1.1. The values can be used to calculate the proportion of the catch, and hence fishing mortality that results from the fishery in each division. In recent years, 38% of the total 1 year old and 26% of 2 year old mackerel catches, and accordingly the fishing mortality at those ages, resulted from catches in Division VIIefgh.

Research surveys inside the mackerel box

The commercial catch proportions are in agreement with survey information collected by CEFAS from within the mackerel box. Nichols and Warnes (1999) reported the proportional number of immature fish within samples taken from the mackerel box at 91% in 1990, 60% in 1991, 76% in the winter of 1995/6 and 69% in 1998.

The potential yield and biomass contribution from mackerel taken in the area of the mackerel box.

Weight at age estimates for mackerel are recorded by ICES division in Table 2.4.3.2. The mean values for Divisions VIIefgh and for the total North East Atlantic mackerel catches are illustrated in Figure 2.16.3. The Figure illustrates that the average weight of a fish caught in the divisions is lower than other areas.

Yield per recruit was calculated using the partial fishing mortality vector for catch in number recorded in Division VIIefgh and the average weight at age for the divisions. The results are compared with the yield per recruit for the total North East atlantic fishery in Figure 2.16.4. The percentage loss of yield when taking a fish in VIIefgh compared to the remainder of the areas in which mackerel are distributed, at increasing levels of fishing mortality, is presented in Figure 2.16.5. At the current fishing mortality rate of 0.2, 15% in yield is lost by catching fish in VIIefgh. The loss is due to the low weight of fish taken in divisions VIIegfh and the low modal age of capture. The result is consistent with previous studies (Lockwood and Shepherd 1984).

In an extension of the yield per recruit analysis the loss of yield to the total North East Atlantic fishery was calculated for a range of fishing mortality levels. The results are presented in Figure 2.16.6. For example there is a loss to the overall fishery of 18% of any unit of catch removed from VIIefgh at a target fishing mortality of 0.2, the current level of F. The loss is greater if the target fishing mortality is the biological reference point $\mathbf{F}_{0.1}$. Reducing the age of first capture by allowing a fishery on juveniles, lowers the fishing mortality at which $\mathbf{F}_{0.1}$ occurs and there is a 25% loss of yield per unit of catch if $\mathbf{F}_{0.1}$ is used as a precautionary F target.

Figures 2.16.7 and 2.16.8 present the contribution to SSB of each recruit to the stock and the percentage loss of SSB per recruit from removing fish in Divisions VIIefgh. At the current fishing mortality rate of 0.2 the loss of SSB per recruit from fish taken in the Box area is 20%.

Both the yield and SSB per recruit analyses assume that the fish taken within the mackerel Box are of similar age composition and weight to the commercial samples from VIIefgh. The mackerel box is known to have large schools of 1 and two year old fish. Directed fishing at these schools may result in higher local fishing mortalities and result in even greater losses than those calculated at the status quo levels.

The effect of increasing effort in VIIefgh on the risk to the NEA mackerel spawning stock

The consequence of management scenarios for the North east Atlantic, in terms of levels of fishing mortality, are evaluated using stochastic medium term projections in section x.x.x. The simulations have shown that at the current level of exploitation there is a 12% probability that SSB will fall below the $\mathbf{B}_{pa}$ of 2.3 million tonnes in the medium term. Although Patterson et al (2000) have shown that in general the method used under estimates the risk to the stock, they concluded that the results could be used to illustrate the consequences of management actions.

In a series of stochastic projections the result of increasing fishing mortality in the mackerel box on the SSB of the NEA stock was examined by raising the partial F contribution of the catches from VIIefgh to the total level of fishing mortality. The results are presented in terms of the risk of SSB falling below $\mathbf{B}_{pa}$ at increasing levels of effort in the mackerel box and in terms of the median level of catch in VIIefgh. Figure 2.16.9 presents the development of the risk probability of the stock falling below $\mathbf{B}_{pa}$ in the next 20 years at increasing levels of effort multiplier for VIIefgh in the range 0.1 to 3.0. The figure shows that the probability of the stock falling below $\mathbf{B}_{pa}$ increases from 13% to 18% over the range of effort factors examined. Figure 2.16.10 illustrates the level of risk in the last 5 years of the simulation against the average landing from VIIefgh.

Recent studies of the methods for generating stochastic medium term projections and work carried out at the working group have established that these probabilities are likely to be under estimates of the risk to the stock. As with the yield per recruit calculations the results are conditional on a fishery inside the mackerel box having the same characteristics as that in VIIefgh. Targeting of the juvenile schools within the box could result in even greater potential risk.

2.16.2 Conclusions

Whilst the Working Group appreciates that the way in which the fishery is prosecuted is a decision for the stock managers, it considers that the loss of potential yield and the increased risk to the spawning stock of the NEAC mackerel should be avoided. The mackerel box should remain closed to targeted mackerel fishing. This advice is consistent with previous studies by this Working Group and the EU Scientific Technical Committee for Fisheries.

The working group is aware that juvenile fish are sometimes taken in large quantities in other areas of the NEA mackerel stock distribution (ICES CM1997/Assess:3). The group is continually monitoring the situation and will recommend management measures for those areas if appropriate.

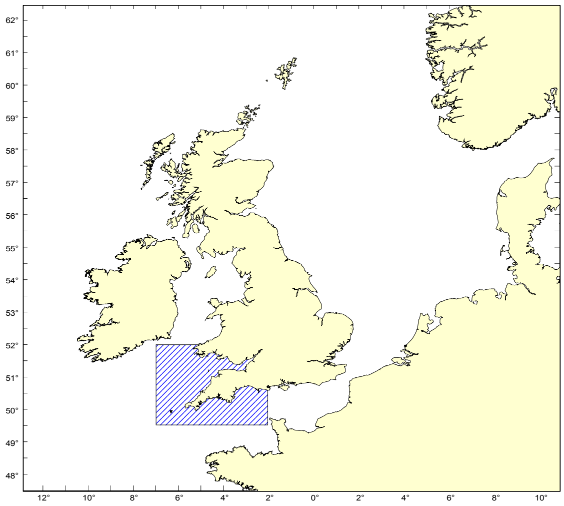


Figure 2.16.1. The Mackerel Box.

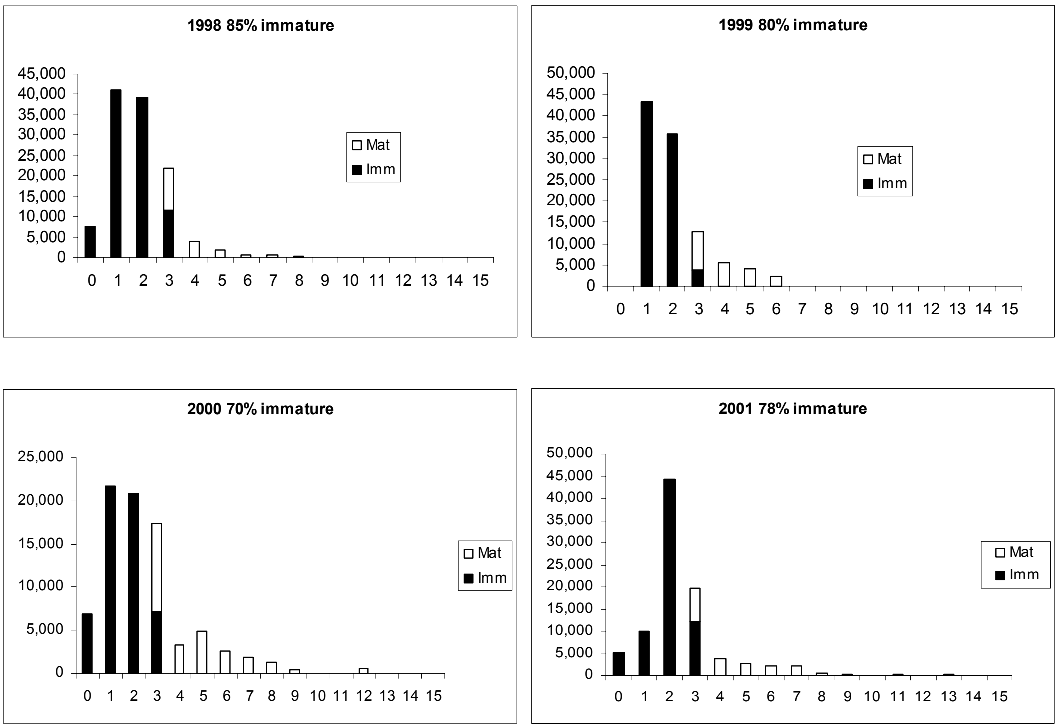


Figure 2.16.2. The percentage of mature and immature fish recorded in commercial catches from ICES Divisions VIIe,f,g,h for the years 1998– 2001. Ages 0–2 are assumed to be immature, age 3 is assumed to be immature in quarters 1 and 2 and mature in quarters 3 and 4.

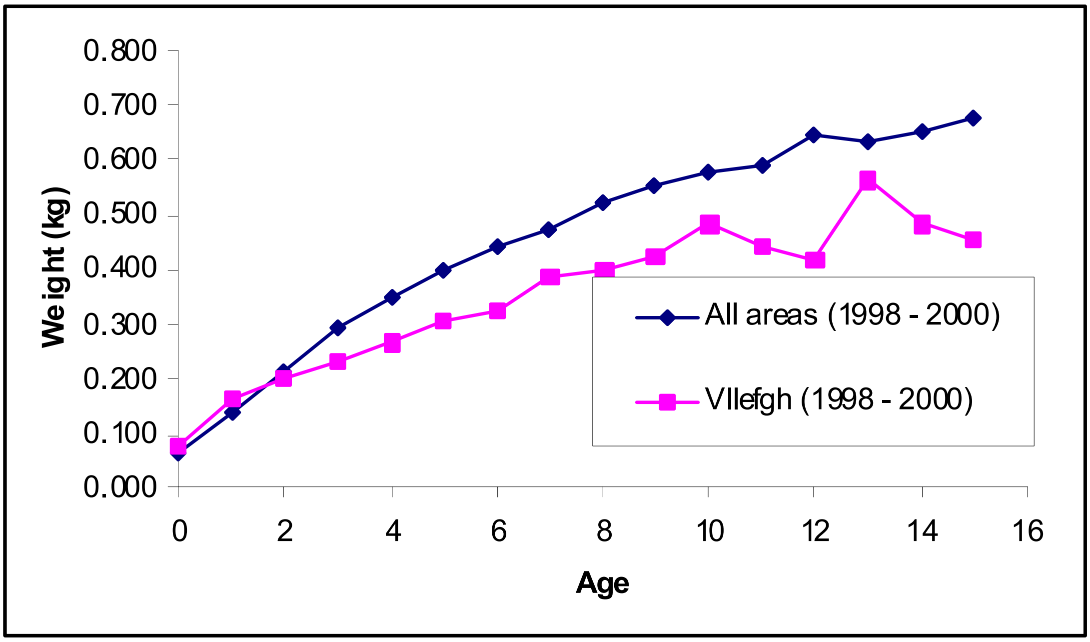


Figure 2.16.3 The average weight-at-age of mackerel caught in ICES Division VIIe,f,g,h and in all ICES Divisions, illustrating the relatively low weight-at-age of fish taken from Divisions VIIe,f,g,h.

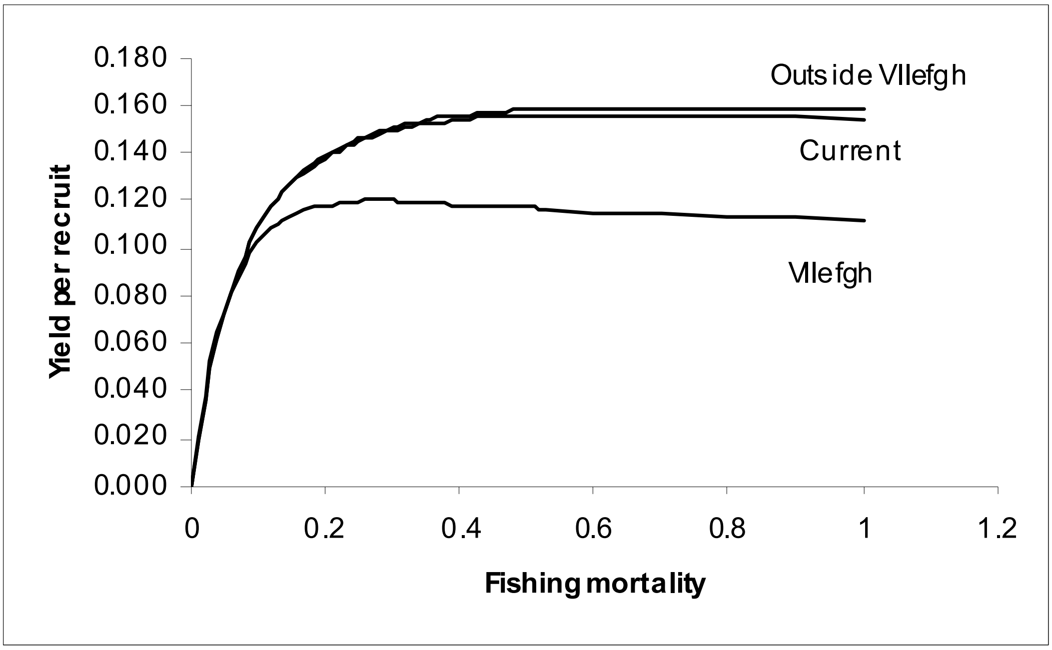


Figure 2.16.4. Yield per recruit estimated using input data collated from ICES Divisions VIIe,f,g,h for the years 1998–2000, all other ICES Divisions, and the whole North East Atlantic fishery (Current).

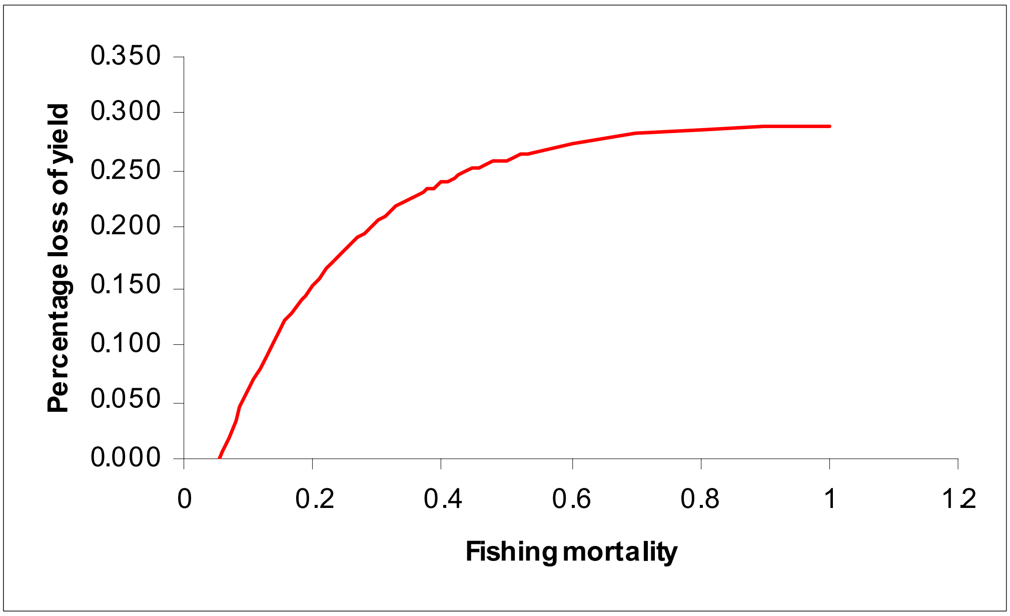


Figure 2.16.5. The percentage loss of yield per recruit at increasing levels of fishing mortality, as estimated using input data collated from ICES Divisions VIIe,f,g,h for the years 1998–2000. The percentage loss is calculated as (Yield (outside) – Yield (Inside)) / Yield (outside)

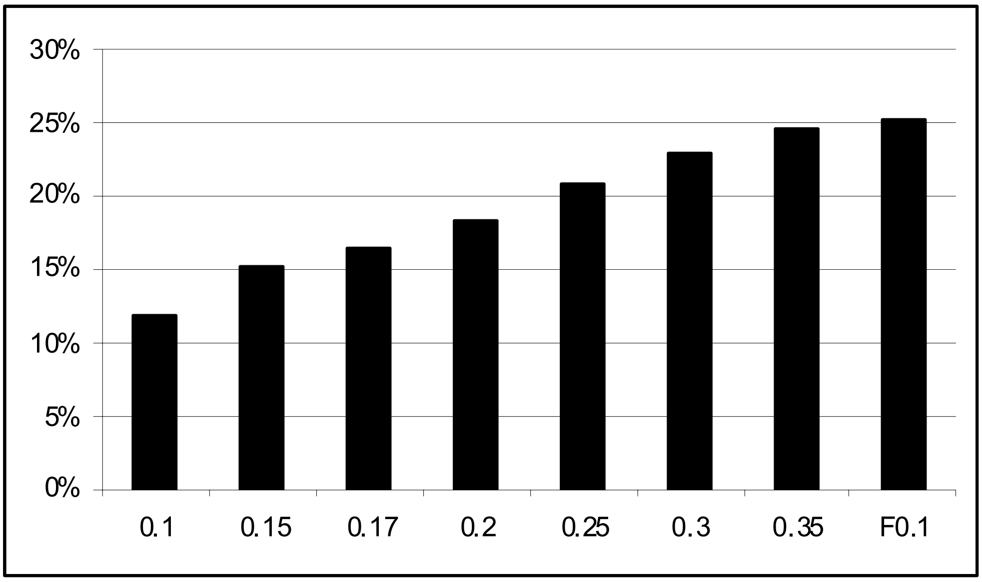


Figure 2.16.6. The percentage loss of yield from the overall North East Atlantic mackerel stock for each unit of fish removed from within ICES area VIIaefgh at a range of constant fishing mortality targets. For example 100 tonnes of fish removed from the VIIe,f,g,h would require a 121 tonnes (21% extra) reduction in yield from the overall NEA fishery in order to compensate and maintain a constant fishing mortality of F = 0.25.

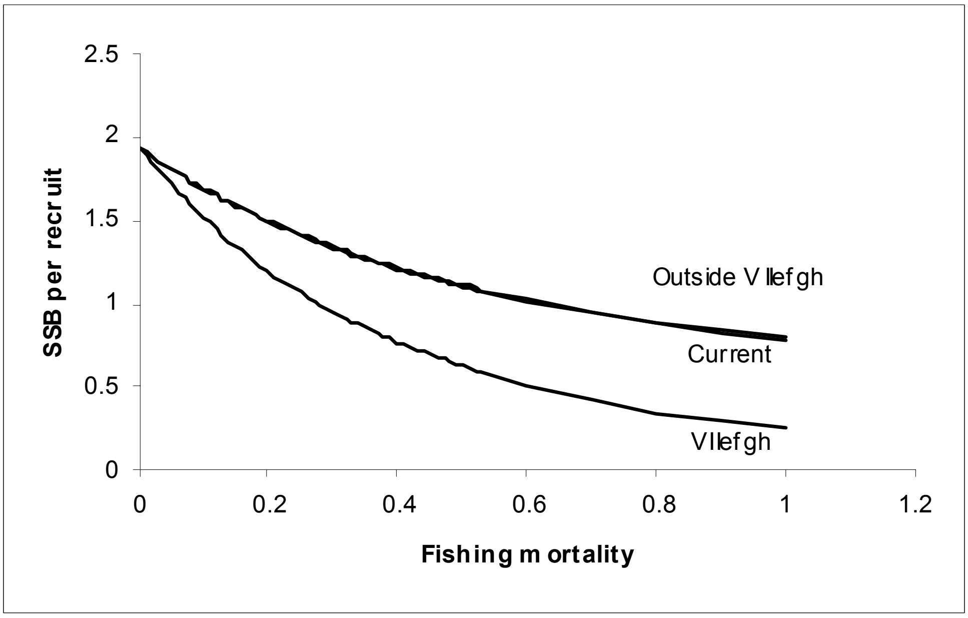


Figure 2.16.7. SSB-per-recruit estimated using input data collated from ICES Divisions VIIefgh for the years 1998–2000 (VIIe,f,g,h), all other ICES Divisions (Outside), and the whole North East Atlantic fishery (Current).

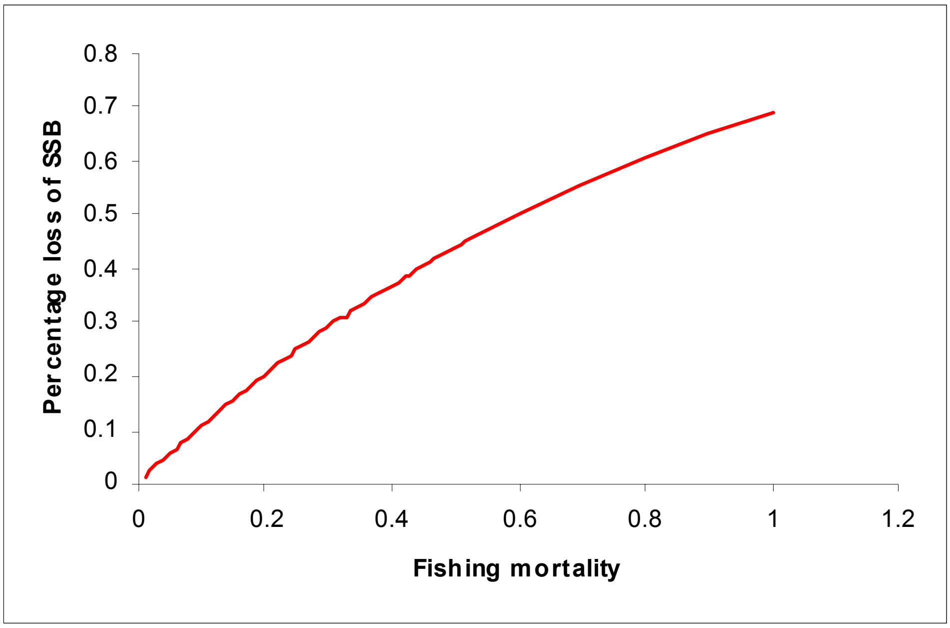


Figure 2.16.8. The percentage loss of SSB-per-recruit at increasing levels of fishing mortality, as estimated using input data collated from ICES Divisions VIIefgh for the years 1998– 2000 (VIIe,f,g,h), all other ICES Divisions (Outside). The percentage loss is calculated as (SSBR (outside) – SSBR (VIIe,f,g,h)) / SSBR (outside)

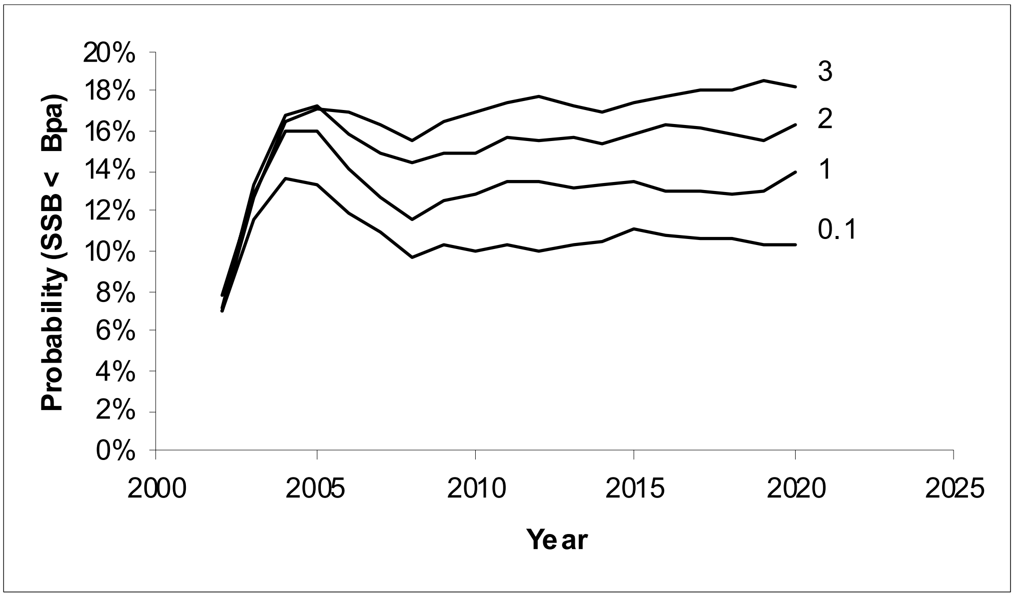


Figure 2.16.9. The risk that the NEA mackerel SSB will fall below $\mathbf{B}_{pa}$ at a range of fishing effort multipliers inside ICES Division VIIe,f,g,h. *Status quo* is represented by 1.0.

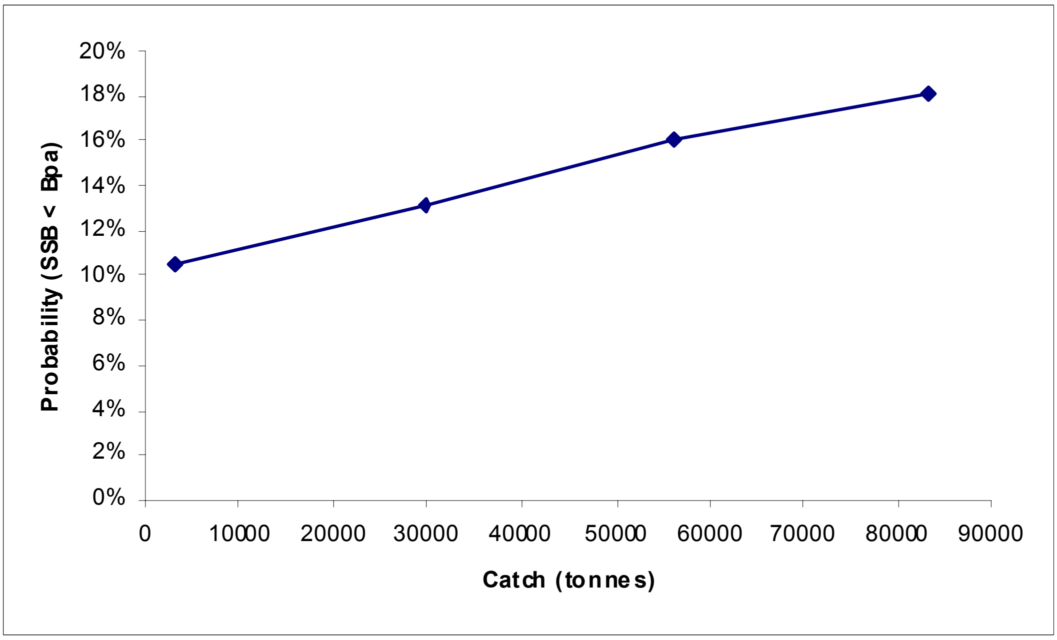


Figure 2.16.10. The risk that the NEA mackerel SSB will fall below $\mathbf{B}_{pa}$ at a range of catch levels (medians of the stochastic distribution) inside ICES Division VIIe,f,g,h. *Status quo* is represented by 20,000 t.

2.17 Fishery Management System Modeling

Two working papers (Cunningham & al: WD 2002) were presented. In the first document, the North East Atlantic mackerel population was modelled using a Bayesian state-space model, fitted to abundance indices of the spawning stocks and catch-at-age data by division and quarter from 1965 to 2000 (the 2001 data were not available for this analysis). The population was assumed to consist of three distinct spawning stocks (the Western, Southern and North Sea spawning components). The migration of these spawning stocks between their separate spawning grounds and joint feeding grounds, is modelled by quarter using fixed migration vectors. These vectors are based on expert advice, using information obtained from past tagging studies and commercial catch-at-age by division and quarter data. The results indicate that the current state of the population is insensitive to uncertainty surrounding the northerly migration of the Southern spawning stock. However, uncertainty surrounding the extent to which juveniles are subject to fishing mortality, without being landed, results in large differences in the marginal posterior distributions of key model parameters.

In the second document this population dynamics model was then used together with a fishery management system to explore the effect of alternative management options under the alternative hypotheses considered in the historic fit of the model to the data. Implementation uncertainty was included, taking into account the difference between the agreed TAC and the actual catch, as well as catch in international waters (which were assumed to fall outside of the agreed TAC). A harvest control model was used to simulate the decision process followed by the WGMHSA, ICES, and the NEAFC when recommending and setting quotas in future years. This includes the annual assessment of the model using the ICA program and a three-year deterministic projection program. The catch-at-age and abundance data projected by the population dynamics model was subject to further observation uncertainty before this data was used in the assessment model.

The results of this study are dependent on the assumptions of the underlying population dynamics model, and the fact that this model did not include the 2001 data, and in particular, the lower 2001 abundance indices in the Western and Southern spawning stocks, compared to 1998 indices.

The WGMHSA agreed that the use of a fishery management system would be a way forward in the future. This would require discussions and agreement on the sources of uncertainty, both in implementation and observation, that need to be incorporated, and the extent of this uncertainty. The population dynamics model used in a fishery management system is normally more detailed and realistic than that used in the assessment model and would again require agreement. The management options looked at here involved changes in the catch biomass by division, and thus a model that includes the movement of the mackerel by division was needed. Finally, the modelling of a decision rule assumed to be followed by ICES in this study may be perceived to be incorrect and agreement on a decision rule to apply in all future years (particularly in situations when, for example, one spawning component is projected to decline sharply) must be agreed upon.

3 MACKEREL STOCK COMPONENTS: NORTH SEA, WESTERN AND SOUTHERN AREAS

3.1 North Sea Mackerel Component

3.1.1 Fishery-independent information

During the egg survey carried out in the North Sea in June (Iversen and Eltink, WD 2002) three vessels trawled to obtain the age composition of the North Sea spawners. The trawl hauls were carried out by the research vessels "Tridens" and "G.O. Sars" and a Norwegian commercial purse seiner "Endre Dyrøy" equipped for trawling. All the hauls were carried out in areas were mackerel eggs were observed.

The age distributions obtained by the three vessels are given in Table 3.1.1.1. It is interesting to see that the three age distributions are rather similar with a dominating 1999 year class. If the age distribution of the North Sea mackerel is set as an average of the three distributions, it is possible to calculate the numbers of North Sea spawners by year class (Table 3.1.1.1). The calculations are based on a spawning stock of 210,000 tons (Section 2.6.2).

3.1.2 State of the stock

The size of the spawning component in the North Sea is estimated at 210,000 tons (Section 2.6.2) and is based on the egg survey carried out in June (Iversen and Eltink, WD 2002). Due to the relatively rich 1999 year class the stock has increased since the last time an egg survey was carried out in the North Sea in 1999 (Table 2.6.2.2). However, the stock is still considered to be at a low level compared to a stock size of about 3.5 mill tons in the early 1960s.

3.2 Western Mackerel Component

3.2.1 Biological data

The Westerm mackerel component is regarded as a subset of the NEA Mackerel, which is considered in Section 2. In previous years, a separate calculation of the historic stock abundance was made for the Western component, in order to get a longer time-series of stock-recruitment data. This year, data for the whole NEA stock were available back to 1972, as described in Section 2.5. Accordingly, the WG no longer found it necessary to do a separate assessment on the Western stock.

For the previous assessments on the Western component catches from Divisions VIIIa and b, Subareas VII, VI, V, IV, III and II were allocated to that component. These data can be found in Tables 2.2.1.1 (landings), 2.4.1.1 (catch in numbers), 2.4.3.1 (lengths-at-age) and 2.4.3.3 (weights-at-age). According to the present perception of migrations (Section 2.3), it is likely that some of these catches come from fish spawning in other areas than the Western spawning area.

3.2.2 Fishery-independent information

Egg surveys

The total annual egg production in the Western area was 1.21 x 10^{15} (see Section 2.6.1 for details). This translates to an SSB estimate of 2.53 million tonnes. The text table below shows the time-series of egg survey estimates for the Western area.

	1977	1980	1983	1986	1989	1992	1995	1998	2001
Egg production $*10^{-15}$	1.98	1.48	1.53	1.24	1.52	1.94	1.49	1.37	1.21
SSB (million tonnes)	3.25	2.43	2.51	2.15	2.56	2.93	2.47	2.95	2.53

3.3 Southern Mackerel Component

3.3.1 Biological Data

Catch in numbers-at-age

The 2001 catches in numbers at age for Divisions VIIIc and IXa are discussed in Section 2.4.1 (Table 2.4.1.1 and 2.4.1.2 NEA mackerel).

Mean lengths at age and mean weights at age

The mean lengths at age and mean weigths at age for Divisions VIIIc and IXa are discussed in Section 2.4.3 (Tables 2.4.3.1 and 2.4.3.2 - NEA mackerel).

The mean weights at age in the stock for the Southern mackerel are presented in Section 2.4.3 (Table 2.4.3.3- NEA Mackerel). As recomended by the Working Group the last year (ICES CM 2002/ACFM:06), the data set on the mean weigths at age in the stock for the southern mackerel has been revised for the period 1984-recent. The mean of the weigths at age in the catch based on Spanish sampling during the first half of the year in Division VIIIc for the years 1984-2001 is taken as the mean weigths at age in the stock. This method is evaluated in Eltink et al., (WD 2002). The data for the period 1972-1983 were estimated by Uriarte et al. (WD 2000)

Maturity ogive

No new information became available on maturity ogive since the 1999 meeting of this Working Group (ICES, 2000). In 1999 the WG changed the southern maturity ogive used in the assessment by the maturity ogive based on histological analysis and this ogive was also used for the subsequent years. In the present WG, this ogive had been used in the assessment for the period 1972-recent.

Natural Mortality

The value for natural mortality used by the WG for the Southern component as well as for all the others of the NE Atlantic mackerel stock is 0.15. (see section 2.4.5).

3.3.2 Fishery- independent information

Egg Surveys

The 2001 egg production data was estimated by the Working Group on mackerel and horse mackerel egg surveys (ICES CM 2002/G:06). The egg production estimate of the southern spawning component was 28.31 x 10^{13} eggs with a CV of 16.53%. Spawning season coverage in the southern area during 2001 (from 11 January to 21 May) was less extended than in 1998 (from 17 January to 21 June), not allowing full coverage of the spawning season. The fecundity estimated was 1647 eggs/g with a CV of 12.6%. The 2001 fecundity is 41% higher than in 1998. This is related to a difference in the potential fecundity (24%) and in the percentage prevalence of atresia in 2001, which was 8%, compared to 15% in 1998.

The SSB estimated in 2001 was 371 279 t with a CV of 20.7%. This estimation is 53% lower than the SSB estimated in 1998 (800 000 t). With the increase of the fecundity, the total annual egg production in 2001 (34% lower than in 1998) resulted in a sharp reduction in SSB. However, the SSB estimated in 2001 is similar to the one in 1995 (378 450 t).

Further information is given in Section 2.6.1- NEA Mackerel.

Bottom trawl surveys

There are two surveys series: The Spanish September-October survey and the Portuguese October survey. The two sets of Autumn surveys covered Sub-divisions VIIIc East, VIIIc West and IXa North (Spain) from 20-500 m depth, using Baka 44/60 gear and Subdivisions IXa Central North, Central South and South (Portugal), from 20-750 m depth, using a Norwegian Campelen Trawl (NCT), that is a trawl net having a 14 m horizontal opening, rollers on the ground-rope and fitted with a 20 mm mesh size cod end. The same sampling methodology is used in both surveys but there were differences in the gear design. The Spanish survey used a bottom trawl (similar to the gear normally used in these waters by the commercial trawl fleet) aimed at benthic and demersal species. Therefore the scope of the survey must be borne in mind, regarding the validity of the abundance indices obtained for pelagic species. In addition, no work is carried out at less than 80 m depth, which results in an imcomplete coverage of the whole area of mackerel juvenile distribution. Comparative data analysis of Baka and GOV gears are described in Section 2.8.2.

Table 3.3.2.1 shows the numbers at age per half hour trawl from the Spanish bottom trawl surveys from 1984 to 2001 in September-October and the numbers at age per hour trawl from the Portuguese bottom trawl Autumn surveys from 1986 to 2001. Both are carried out during the fourth quarter when the recruits have entered the area and the adults are very scarce in this area. The historical series of abundance indices from the Spanish trawl surveys indicates that 1992 and the period from 1996 to 2000 were those with the highest values of juvenile presence (0 and 1). The series of the Portuguese October survey shows a very high values of recruitment (age 0) in 1988, 1992, the period 1995 to 1999 and 2001.

Acoustic surveys

Since 1999, an Spanish acoustic survey was carried out in spring to estimate the stock abundance of mackerel off the Galician and Cantabrian Sea (Subdivision IXa North and Division VIIIc). The mackerel biomass was estimated to be 320,000 t in 1999, 706,000 t in 2000 and 399,000 t in 2001. In 2002, the acoustic survey took place in March in Sub-division IXa Central North (Portuguese waters), Sub-division IXa North (Spanish waters) and Division VIIIc. The total biomass was estimated to be 1,382,995 t (55,000 t in Division IXa and 1,327,497 t in Division VIIIc) in 2002. In the 2002 survey the target strength changed for mackerel as recommended by the Planing Group on Aerial and Acoustic Surveys for Mackerel (ICES CM 2002/G:03).

The biomass assessed in 2000 is considered to be an overestimated due to high plankton abundance in the area (Carrera, WD 2000). In comparison whith the previous years, the number of juvenile fish estimated in 2001 was lower than that observed last year, most of the fish found (90%) were higher than 33 cm. During 2001 the number of adult mackerel estimated in the Spanish area remain quite stable. There were no indication of a strong 2000 year class, and therefore the total biomass estimated in 2001 was lower than that estimated in 2000 (Carrera, WD 2001). In 2001 the biomass estimated for mackerel (399,000 t) was very similar to the value estimated by means of the egg production method (371,279 t). The number of juvenile fish estimated in 2002 was higher than the observed in 2001. Fish measuring less than 25 cm accounted for more than 80% in Portuguese waters, 38% in the west and central of Cantabrian Sea and a negligible proportion in the east of Cantabrian Sea (Figure 3.3.2.1)

In 1999 another Spanish acoustic survey was carried out in August only in Division IXa North within the JUVESU Project (FAIR CT 97 3374), mackerel was the most fished species in this area and most of the mackerel fish belonged to age 0 (80%) (Carrera WD, 1999).

Further information is given in Section 2.8.3.- NEA Mackerel.

Table 3.1.1.1. Age compositions obtained by the different vessels, the suggested age distribution and the estimated numbers of North Sea spawners per age group.

	G. O. SARS		ENDRE DYRØY		TRIDENS		TOTAL		Mat.	SPAWNING STOCK	
Age	%	W (g)	%	W (g)	%	W (g)	%	W (g)	ogive	W (g)	N (millions)
0	0		0		0	0	0	0	0		0.00
1	10.60	116.8	0.50	128.3	6.00	122.0	5.78	119.8	0.00	119.8	0.00
2	12.60	234.0	7.80	247.0	12.00	184.0	11.10	209.3	0.37	209.3	29.76
3	51.20	310.4	47.10	248.4	48.00	310.6	48.58	295.5	1.00	295.5	351.98
4	10.20	360.0	13.10	288.0	8.00	373.5	9.83	341.5	1.00	341.5	71.19
5	10.60	396.0	16.40	383.0	12.00	336.3	12.75	363.7	1.00	363.7	92.39
6	2.60	373.0	6.50	341.0	8.00	486.5	6.28	437.1	1.00	437.1	45.47
7	0.30	397.0	1.80	411.0	2.00	462.0	1.53	443.8	1.00	443.8	11.05
8	0.90	410.0	2.00	437.0	0.00	-	0.73	428.6	1.00	428.6	5.25
9	0.80	454.0	1.30	543.0	0.00	-	0.53	509.1	1.00	509.1	3.80
10	0.00	-	1.20	541.0	2.00	626.0	1.30	606.4	1.00	606.4	9.42
11	0.00	-	1.30	643.0	0.00	-	0.33	643.0	1.00	643.0	2.35
12	0.00	-	1.00	643.0	0.00	-	0.25	643.0	1.00	643.0	1.81
13	0.24	899.0	0.00	-	0.00	-	0.06	899.0	1.00	899.0	0.43
14	0.00	-	0.20	665.0	2.00	500.0	1.05	507.9	1.00	507.9	7.61
12+							1.36	550.0	1.00	550.0	9.85
Total		299.7		304.80		319.00		310.80		332.00	632.53

Table 3. 3.2.1 SOUTHERN MACKEREL. CPUE at age from surveys.

October Spain Survey, Bottom trawl survey (Catch: numbers)

							Catch					
Year	**Effort**	**age 0**	**age 1**	**age 2**	**age 3**	**age 4**	**age 5**	**age 6**	**age 7**	**age 8**	**age 9**	**age 10+**
1984	1	1.47	0.20	0.11	0.37	0.15	0.21	0.04	0.01	0.03	0.02	0.07
1985	1	2.65	1.60	0.02	0.06	0.37	0.14	0.09	0.03	0.02	0.03	0.08
1986	1	0.03	0.17	0.14	0.02	0.03	0.06	0.03	0.00	0.00	0.00	0.03
1987												
1988	1	0.29	0.03	0.03	0.01	0.02	0.01	0.01	0.01	0.00	0.00	0.00
1989	1	0.51	0.00	0.02	0.00	0.04	0.02	0.00	0.01	0.00	0.00	0.00
1990	1	0.40	0.94	0.04	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00
1991	1	0.13	0.27	0.22	0.27	0.34	0.07	0.03	0.01	0.03	0.00	0.01
1992	1	19.90	0.48	0.16	0.15	0.09	0.03	0.01	0.00	0.00	0.00	0.00
1993	1	0.07	1.26	0.79	0.03	0.06	0.02	0.01	0.00	0.00	0.00	0.01
1994	1	0.47	0.11	0.12	0.15	0.04	0.04	0.01	0.01	0.00	0.00	0.00
1995	1	0.92	0.03	0.19	0.16	0.05	0.01	0.01	0.00	0.00	0.00	0.00
1996	1	46.09	6.40	1.32	0.07	0.10	0.02	0.00	0.01	0.01	0.00	0.00
1997	1	5.73	27.11	6.28	0.67	0.39	0.00	0.00	0.00	0.00	0.00	0.00
1998	1	0.46	3.82	0.97	0.24	0.05	0.09	0.06	0.02	0.02	0.00	0.01
1999	1	3.93	0.98	2.42	0.53	0.12	0.01	0.00	0.00	0.00	0.00	0.00
2000	1	26.78	1.90	0.87	0.20	0.10	0.02	0.03	0.00	0.00	0.00	0.00
2001	1	0.31	1.21	1.07	0.32	0.15	0.08	0.00	0.00	0.00	0.00	0.00

October Portugal Survey, Bottom trawl survey (Catch: numbers)

							Catch					
Year	**Effort**	**age 0**	**age 1**	**age 2**	**age 3**	**age 4**	**age 5**	**age 6**	**age 7**	**age 8**	**age 9**	**age 10+**
1986	1	0.52	2.76	1.00	0.51	0.04	0.01	0.01	0.00	0.00	0.00	0.00
1987	1	1.03	23.28	14.79	2.94	0.55	0.00	0.00	0.00	0.00	0.00	0.00
1988	1	86.47	24.55	0.35	0.33	0.04	0.01	0.00	0.00	0.00	0.00	0.00
1989	1	11.64	28.43	4.71	3.45	0.02	0.01	0.00	0.00	0.00	0.00	0.00
1990	1	1.34	2.99	1.75	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00
1991	1	0.31	0.37	0.29	0.19	0.03	0.02	0.02	0.01	0.00	0.00	0.00
1992	1	123.55	2.74	0.66	0.30	0.06	0.01	0.01	0.00	0.00	0.00	0.00
1993	1	52.32	0.39	0.12	0.05	0.08	0.00	0.00	0.00	0.00	0.00	0.00
1994	1	12.21	0.77	0.30	0.11	0.04	0.05	0.02	0.01	0.00	0.00	0.00
1995	1	318.60	9.08	0.28	0.11	0.03	0.01	0.01	0.00	0.00	0.00	0.00
1996*	1	235.26	2.16	0.22	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1997	1	772.03	39.40	7.66	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1998	1	226.59	11.58	0.31	0.00	0.04	0.02	0.00	0.00	0.02	0.00	0.00
1999*	1	209.11	2.62	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000	1	23.23	2.26	0.03	0.04	0.14	0.07	0.00	0.02	0.00	0.00	0.00
2001	1	299.04	12.19	3.89	1.70	0.19	0.05	0.02	0.00	0.01	0.01	0.01

* DIFFERENT SHIP

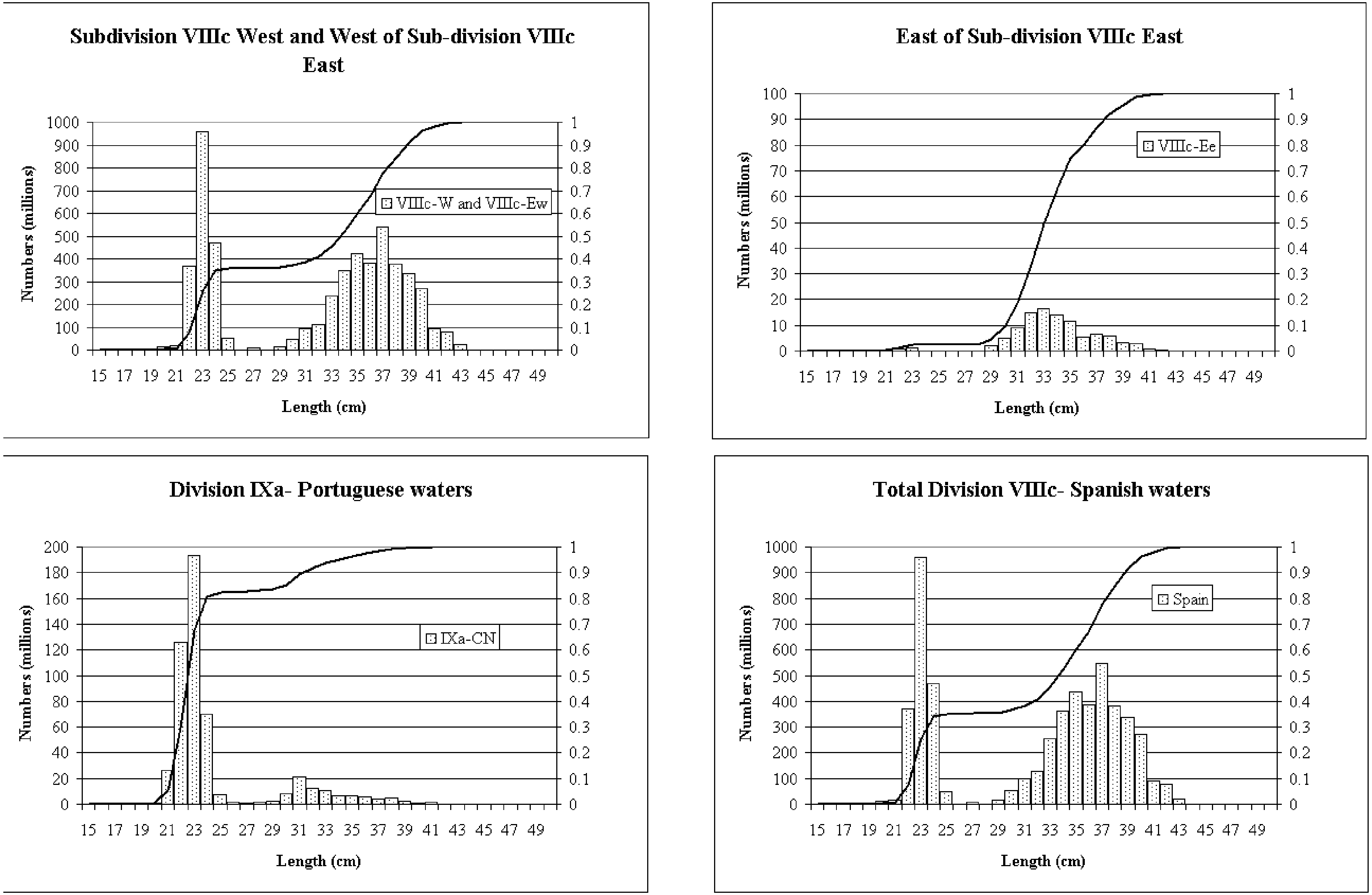


Figure 3.3.2.1: Mackerel length distribution by area for the Spanish acoustic survey during 2002. The line denotes the cumulative frecuency

4 HORSE MACKEREL

4.1 Fisheries in 2001

The total international catches of horse mackerel in the North East Atlantic are shown in Table 4.1.1 and Figure 4.3.1. The total catch from all areas in 2001 was 283,300 tons which is 11,000 tons more than in 2000 which was the lowest catch since 1988. Ireland, Denmark, Scotland, England and Wales, Germany and the Netherlands have a directed trawl fishery and Norway a directed purse seine fishery for horse mackerel. Spain and Portugal have a directed trawl and purse seine fishery.

The quarterly catches of horse mackerel by Division and Sub-division in 2001 are given in Table 4.1.2 and the distribution of the fisheries are given in Figure 4.1.1.a–d. The figures are based on data provided by Denmark, England and Wales, Scotland, Ireland, Northern Ireland, Germany, Netherlands, Norway, Portugal and Spain representing 90 % of the total catches.

First quarter: 79,500 tons. This is 3,000 tons more than in 2000. The catches this quarter (Figure 4.1.1.a) are mainly distributed in the western and southern areas as in previous years.

Second quarter: 43,500 tons. This is 1,700 tons less than in 2000. As usual, rather low catches were taken during the second quarter and the catches are distributed as in previous years (Figure 4.1.1.b).

Third quarter: 31,600 tons. This is 13,200 tons less than in 2000, and the catches were distributed as in previous years (Figure 4.1.1.c). As in the two previous years some catches were taken rather far north.

Fourth quarter: 128,700 tons. This is 22,300 tons more than in 2000 and the distribution of the catches were mainly as in previous years (Figure 4.1.1.d). Also during this quarter some catches were taken rather far north. The Norwegian fishery in the North Sea have since 1987 been carried out during this quarter. These catches have varied between 2,000 and 128,000 tons. In 2001 Norway caught about 8,000 tons. During this quarter rather large numbers of juvenile horse mackerel have been caught particularly in subareas VII and VIII (Eltink, WD 2002).

4.2 Stock Units

For many years the Working Group has considered the horse mackerel in the north east Atlantic as separated into three management stocks: the North Sea, The Southern and the Western stocks (ICES 1990/Assess: 24, ICES 1991/Assess: 22). Since little information from research surveys is available, this separation is based on the observed egg distributions and the temporal and spatial distribution of the fishery. Western horse mackerel are thought to have similar migration patterns as Western mackerel. As for mackerel, the egg surveys have demonstrated that it is difficult to determine a realistic border between a western and southern spawning area.

There is no new information at hand to evaluate the perception of stock units and migration pattern as adopted and applied by this working group for many years. A study of stock structures of horse mackerel within the western, the southern, the North Sea and the Mediterranean areas are carried out in an ongoing EU funded project (HOMSIR) which will present results next year. The working group will then have information to evaluate the present stock perception.

4.3 Allocation of Catches to Stocks

Based on spatial and temporal distribution of the horse mackerel fishery the catches were as in previous years allocated to the three management stocks as follows:

Western stock: Divisions IIa, IIIa (western part), Vb, IVa, VIa, VIIa–c,e–k and VIIIa,b,d,e. It seems strange that only catches from western part of Division IIIa are allocated to this stock. The reason for this is that the catches in the western part of this Division taken in the fourth quarter usually are taken in neighbouring area of catches of western fish in Division IVa. In 2000 there were no information about where and when the Swedish catches were taken in Division IIIa .

At present there is only set a TAC for the western stock in EU waters. The present management area for this stock is therefore restricted to Divisions VIa, VIIa–c,e–k and VIIIa,b,d,e and western part of Division IVa, which do not cover the total distribution area. If TACs are set by stocks, they should apply to all areas where the different stocks are distributed.

North Sea stock: Divisions IIIa (eastern part), IVb,c and VIId. . Denmark reported some small quantities from Division IIIb and they were allocated to the North Sea stock.

Southern stock: Divisions VIIIc and IXa. All catches from these areas are allocated to the southern stock.

The catches by stock are given in Table 4.3.1 and Figure 4.3.1. Over the years only one country have provided data about discard and the amount of discards given in Table 4.3.1 are therefore not representative for the total fishery. Since 1998 there are no data about discard available for the Working Group.

4.4 Estimates of discards

No estimates of discards are available for horse mackerel. An unknown proportion of discards is included in the unreported landings.

4.5 Species Mixing

Trachurus spp.

Three species of *Trachurus* genus, *T. trachurus*, *T. mediterraneus* and *T. picturatus* are found together and are commercially exploited in the NE Atlantic waters. Studies on genetic differentiation showed three clear groups corresponding to each species of *Trachurus* with no intermediate principal component scores, excluding the possibility of hybrids between species (Soriano, M. and Sanjuan, WD 1997).

Following the Working Group recommendation (ICES 2002/ACFM: 06), special care was again taken to ensure that catch and length distributions and numbers at age of *T. trachurus* supplied to the Working Group did not include *T. mediterraneus* and *T. picturatus*. Spain provided data on *T. mediterraneus* and Portugal on *T. picturatus*.

Table 4.5.1 shows the catch of *T. mediterraneus* by Sub-divisions since 1989. In Divisions VIIIab and Subdivision VIIIc East , the total catch of *T. mediterraneus* was 1820 t in 2001, being the lowest catches since 1989. In Sub-division VIIIc West and Division IXa North there are no catches of this species. In 2000 and 2001 there were a small catches of *T.mediterraneus* in Sub-area VII.

As in previous years in both areas, more than 95% of the catches were obtained by purse seiners and the main catches were taken in the second half of the year, mainly in autumn, when the *T. trachurus* catches were lowest. *T. mediterraneus* catches were lowest in spring.

Catches and length distributions of *T. mediterraneus* in the Spanish fishery in Divisions VIIIa,b and c were reported separately from the catches and length distributions of *T. Trachurus*. Data of monthly landings by gear and area were obtained from fishing vessel owner's associations and fishermen's associations through the existing information network of the IEO and AZTI (Advisory Organisations to Fisheries and Oceanography Administration) in all of the Cantabrian and Galician ports. *T. mediterraneus* is only landed in ports of the Basque country, Cantabria and Asturias. In ports of the Basque country the catches of *T. mediterraneus* and *T. trachurus* appear separately, except some small categories, in which the separation is made on the basis of samplings carried out in ports and information reported by fishermen. In the ports of Cantabria and Asturias the separation of the catch of the two species is not registered in all the ports, for which reason the total separation of the catch is made based on the monthly percentages of the ports in which these catches are separated and based on samplings made in the ports of this area.

A fishery for *T. picturatus* only occurred in the southern part of Division IXa, as in previous years. Data on *T. picturatus* in the Portuguese fishery for the period 1986-2001 are also given in Table 4.5.1 . Catches and length distributions of *T. trachurus* for the Portuguese fishery in Division IXa do not include data for *T. picturatus*. Landings data are collected from the auction market system and sent to the General Directorate for Fisheries to be compiled. This includes information on landings per species by day and vessel.

As information is available on the amounts and distribution of catches of T. *mediterraneus* and *T. picturatus* for at least 13 years (ICES 1990/Assess:24, ICES 1991/Assess:22, ICES 1992/Assess:17, ICES 1993/Assess: 19, ICES 1995/ Assess:2, ICES 1996/Assess:7, ICES 1997/Assess:3, ICES 1998/ Assess:6, ICES 1999/ ACFM:6, ICES 2000/ACFM:5; ICES 2001/ACFM:06; ICES 2002/ACFM:06), and as the evaluations and assessments are only made for *T. trachurus*, the Working Group recommends that the TACs and any other management regulations which might be established in the future should be related only to *T. trachurus* and not to *Trachurus spp*. in general, as is the case at present . It would then be appropriate to set TACs for the other species as well.

4.6 Length Distribution by Fleet and by Country:

England and Wales, Netherlands, Norway, Germany, Ireland, Portugal and Spain provided length distribution data for parts or the total of their catches in 2001. These length distributions cover 51 % of the total landings and are shown in Table 4.6.1.

Table 4.1.1 Landings (t) of HORSE MACKEREL by Sub-area. Data as submitted by Working Group members.

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

Sub-area	1985	1986	1987	1988	1989	1990
II	79	214	3,311	6,818	4,809	11,414
IV + IIIa	24,238	20,746	20,895	62,892	112,047	145,062
VI	33,025	20,455	35,157	45,842	34,870	20,904
VII	39,034	77,628	100,734	90,253	138,890	192,196
VIII	27,740	43,405	37,703	34,177	38,686	46,302
IX	20,237	31,159	24,540	29,763	29,231	24,023
Total	144,353	193,607	222,340	269,745	358,533	439,901

Sub-area	1991	1992	1993	1994	1995	1996	1997
II + Vb	4,487	13,457	3,168	759	13,133	3,366	2,617
IV + IIIa	77,994	113,141	140,383	112,580	98,745	27,782	81,198
VI	34,455	40,921	53,822	69,616	83,595	81,259	40,145
VII	201,326	188,135	221,120	200,256	330,705	279,109	326,415
VIII	49,426	54,186	53,753	35,500	28,709	48,269	40,806
IX	21,778	26,713	31,944	28,442	25,147	20,400	27,642
Total	389,466	436,553	504,190	447,153	580,034	460,185	518,882

Sub-area	1998	1999	2000	2001[1]
II + Vb	2,538	2,557	1,169	60
IV + IIIa	31,295	58,746	31,583	19,839
VI	35,073	40,381	20,657	24,636
VII	250,656	186,604	137,716	138,790
VIII	38,562	47,012	54,211	75,120
IX	41,574	27,733	27,160	24,912
Total	399,698	363,033	272,496	283,357

[1]Preliminary.

Table 4.1.2 Quarterly catches of HORSE MACKEREL by Division and Subdivision in 2001.

Division	1Q	2Q	3Q	4Q	TOTAL
IIa+Vb	0	60	0	0	60
IIIa	0	11	96	50	157
IVa	69	0	1,436	10,020	11,525
IVbc	2,405	24	3,623	2,105	8,157
VIId	23,724	3,229	29	11,132	38,114
VIa,b	3,386	3,044	7,434	10,772	24,636
VIIa–c,e–k	39,128	6,061	3,320	52,167	100,676
VIIIa,b,d,e	2,804	18,993	2,731	29,765	54,293
VIIIc	3,768	6,265	5,879	4,915	20,827
IXa	4,208	5,882	7,086	7,736	24,912
Sum	79,492	43,569	31,634	128,662	283,357

Table 4.3.1 Landings and discards of HORSE MACKEREL (t) by year and division, for the North Sea, Western and Southern horse mackerel. (Data submitted by Working Group members.)

Year	North Sea horse mackerel					Western horse mackerel							Southern horse mackerel			Total
	IIIa	IVb,c	Discards	VIId	Total	IIa	IVa	VIa,b	VIIa-c,e-k	VIIIa,b,d,e	Discards	Total	VIIIc	IXa	Total	All stocks
1982	- 2,788[3]	-		1,247	4,035	-	-	6,283	32,231	3,073	-	41,587	19,610	39,726	59,336	104,958
1983	- 4,420[3]	-		3,600	8,020	412	-	24,881	36,926	2,643	-	64,862	25,580	48,733	74,313	147,195
1984	- 25,893[3]	-		3,585	29,478	23	94	31,716	38,782	2,510	500	73,625	23,119	23,178	46,297	149,400
1985	1,138	22,897		2,715	26,750	79	203	33,025	35,296	4,448	7,500	80,551	23,292	20,237	43,529	150,830
1986	396	19,496		4,756	24,648	214	776	20,343	72,761	3,071	8,500	105,665	40,334	31,159	71,493	201,806
1987	436	9,477		1,721	11,634	3,311	11,185	35,197	99,942	7,605	-	157,240	30,098	24,540	54,638	223,512
1988	2,261	18,290		3,120	23,671	6,818	42,174	45,842	81,978	7,548	3,740	188,100	26,629	29,763	56,392	268,163
1989	913	25,830		6,522	33,265	4,809	85,304[2]	34,870	131,218	11,516	1,150	268,867	27,170	29,231	56,401	358,533
1990	14,872[1]	17,437		1,325	18,762	11,414	112,753[2]	20,794	182,580	21,120	9,930	373,463	25,182	24,023	49,205	441,430
1991	2,725[1]	11,400		600	12,000	4,487	63,869[2]	34,415	196,926	25,693	5,440	333,555	23,733	21,778	45,511	391,066
1992	2,374[1]	13,955	400	688	15,043	13,457	101,752	40,881	180,937	29,329	1,820	370,550	24,243	26,713	50,955	436,548
1993	850[1]	3,895	930	8,792	13,617	3,168	134,908	53,782	204,318	27,519	8,600	433,145	25,483	31,945	57,428	504,190
1994	2,492[1]	2,496	630	2,503	5,689	759	106,911	69,546	194,188	11,044	3,935	388,875	24,147	28,442	52,589	447,153
1995	240	7,948	30	8,666	16,756	13,133	90,527	83,486	320,102	1,175	2,046	510,597	27,534	25,147	52,681	580,034
1996	1,657	7,558	212	9,416	18,843	3,366	18,356	81,259	252,823	23,978	16,870	396,652	24,290	20,400	44,690	460,185
1997	2,037[4]	15,504[5]	10	5,452	19,540	2,617	63,647	40,145	318,101	11,677	2,921	442,571	29,129	27,642	56,771	518,882
1998	3,693	10,530	83	16,194	30,500	2,540[6]	17,011	35,043	232,451	15,662	830	303,543	22,906	41,574	64,480	398,523
1999	2,095[4]	9,335		27,889	37,224	2,557[7]	47,316	40,381	158,715	22,824		273,888	24,188	27,733	51,921	363,033
2000	1,105[4]	25,954		22,471	48,425	1,169[8]	4,524	20,657	115,245	32,227		174,927	21,984	27,160	49,144	272,496
2001	157[9]	8,157		38,114	46,425	60	11,525[10]	24,636	100,676	54,293		191,193	20,828	24,911	45,739	283,357

[1]Norwegian and Danish catches are included in the Western horse mackerel.
[2]Norwegian catches in Division IVb included in the Western horse mackerel.
[3]Divisions IIIa and IVb,c combined.
[4]Included in Western horse mackerel
[5]Norwegian catches in IVb (1,426 t) included in Western horse mackerel.
[6]Includes 1937 t from Vb
[7]Includes 132 t from Vb
[8]Includes 250 t from Vb
[9]Includes 72 t allocated to western horse mackerel
[10]Includes 69 t allocated to North Sea horse mackerel

Table 4.5.1 Catches (t) of *Trachurus mediterraneus* in Divisions VIIIab, VIIIc and IXa and Subarea VII in the period 1989-2001 and *Trachurus picturatus* in División IXa, Subarea X and in CECAF Division 34.1.1 in the period 1986-2001.

	Divisions	Subdivisions	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
T. mediterraneus	**VII**		**-**	**-**	**-**	0	0	0	0	0	0	0	0	0	0	0	59	1
	VIIIab		**-**	**-**	**-**	23	298	2122	1123	649	1573	2271	1175	557	740	1100	988	525
	VIIIc	VIIIc East	-	-	-	3903	2943	5020	4804	5576	3344	4585	3443	3264	3755	1592	808	1293
		VIIIc west	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
		Total	-	-	-	3903	2943	5020	4804	5576	3344	4585	3443	3264	3755	1592	808	1293
	IXa	IXa North	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
		IXa C, N & S	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
		Total	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL		**-**	**-**	**-**	**3926**	**3241**	**7142**	**5927**	**6225**	**4917**	**6856**	**4618**	**3821**	**4495**	**2692**	**1854**	**1820**
T. picturatus	**IXa**		367	181	2370	2394	2012	1700	1035	1028	1045	728	1009	834.01	526	320	464	420
	X Azorean Area		3331	3020	3079	2866	2510	1274	1255	1732	1778	1822	1715	1920	1473	690	563	1089
	34.1.1 Madeira's area		2006	1533	1687	1564	1863	1161	792	530	297	206	393	762	657	344	646	385
	TOTAL		**5704**	**4734**	**7136**	**6824**	**6385**	**4135**	**3082**	**3290**	**3120**	**2756**	**3117**	**3516**	**2657**	**1354**	**1672**	**1894**

(-) Not available

Table 4.6.1 Length distributions (%) of HORSE MACKEREL catches by fleet and country in 2001 (0.00=<0.005%)

	Engl. & Wales	Netherlands	Germany	Norway	Ireland	Spain				Portugal		
	P. trawl	Pel.trawl	Pel. trawl	P.seine	Pel.	P.seine	Dem.	Gill	Hook	Trawl	P. Seine	Artisanal
cm	Div. VIIe		Div Via	Divs IIa, IVa	trawl		trawl	net				
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.15	0.11	0.11
11	0.00	0.00	0.00	0.00	0.00	3.86	0.25	0.00	0.00	0.28	6.50	2.15
12	0.00	0.00	0.00	0.00	0.00	14.30	0.11	0.00	0.02	7.03	16.51	13.01
13	0.00	0.00	0.00	0.00	0.00	6.34	0.67	0.01	0.01	17.94	31.49	4.46
14	0.00	0.00	0.00	0.00	0.00	4.25	1.48	0.06	0.01	14.81	14.25	0.76
15	0.00	0.00	0.00	0.00	0.00	5.10	5.95	0.52	0.07	8.01	7.22	0.18
16	0.00	0.04	0.00	0.00	0.00	3.82	7.39	0.67	0.12	3.88	2.62	0.06
17	0.00	0.58	0.00	0.00	0.00	3.26	3.64	0.41	0.30	4.26	1.27	0.07
18	0.00	1.19	0.00	0.00	0.00	4.72	1.26	0.85	0.59	6.16	0.61	0.13
19	0.00	1.78	0.00	0.00	0.00	7.69	0.70	1.38	0.34	4.54	0.66	0.28
20	0.64	3.78	0.00	0.00	0.00	7.86	0.40	1.93	0.09	4.01	1.26	0.58
21	1.10	6.29	0.00	0.00	0.00	5.88	0.20	1.28	0.02	2.59	1.63	1.28
22	2.19	9.41	0.00	0.00	0.02	3.95	0.33	0.86	0.03	2.54	1.16	3.33
23	5.02	15.05	0.00	0.00	0.05	2.53	0.87	0.67	0.06	2.62	5.10	3.65
24	11.14	15.98	0.00	0.00	0.12	2.62	2.02	1.18	1.14	2.02	3.93	7.09
25	18.36	12.14	0.00	0.00	2.00	4.31	4.68	4.26	0.49	2.33	3.14	8.96
26	21.38	9.23	0.00	0.00	8.03	5.72	5.33	8.07	6.02	3.65	1.81	11.76
27	13.07	8.44	0.00	0.00	25.91	4.23	7.20	9.57	8.54	4.15	0.53	13.24
28	8.65	5.84	0.18	0.11	27.57	2.94	8.72	8.54	8.87	3.05	0.13	10.86
29	6.92	3.48	0.15	0.95	18.16	2.22	10.48	8.63	19.23	2.03	0.04	5.27
30	1.70	2.68	1.76	3.42	8.67	1.65	9.68	8.91	22.69	1.57	0.02	4.15
31	4.05	1.50	4.08	8.84	2.98	0.96	9.73	6.72	14.94	1.04	0.02	3.25
32	1.12	0.92	12.46	15.34	2.03	0.50	7.74	5.70	7.95	0.64	0.00	2.03
33	1.60	0.59	17.71	22.11	1.43	0.17	4.81	4.39	6.74	0.36	0.00	1.32
34	0.19	0.63	22.41	19.65	1.41	0.21	2.89	4.35	0.67	0.19	0.00	0.86
35	0.48	0.22	19.44	14.45	0.71	0.13	1.59	2.55	0.15	0.08	0.00	0.56
36	0.67	0.17	13.87	8.68	0.52	0.13	0.66	1.96	0.68	0.05	0.00	0.33
37	0.93	0.05	5.80	3.81	0.17	0.04	0.57	1.36	0.10	0.01	0.00	0.14
38	0.00	0.01	1.03	2.02	0.17	0.03	0.29	1.37	0.00	0.00	0.00	0.07
39	0.38	0.01	0.94	0.56	0.02	0.00	0.24	2.53	0.08	0.00	0.00	0.04
40	0.29	0.00	0.09	0.06	0.02	0.00	0.07	5.44	0.00	0.00	0.00	0.01
41	0.10	0.00	0.09	0.00	0.00	0.00	0.03	4.99	0.04	0.00	0.00	0.02
42+	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.86	0.00	0.01	0.00	0.01
Sum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

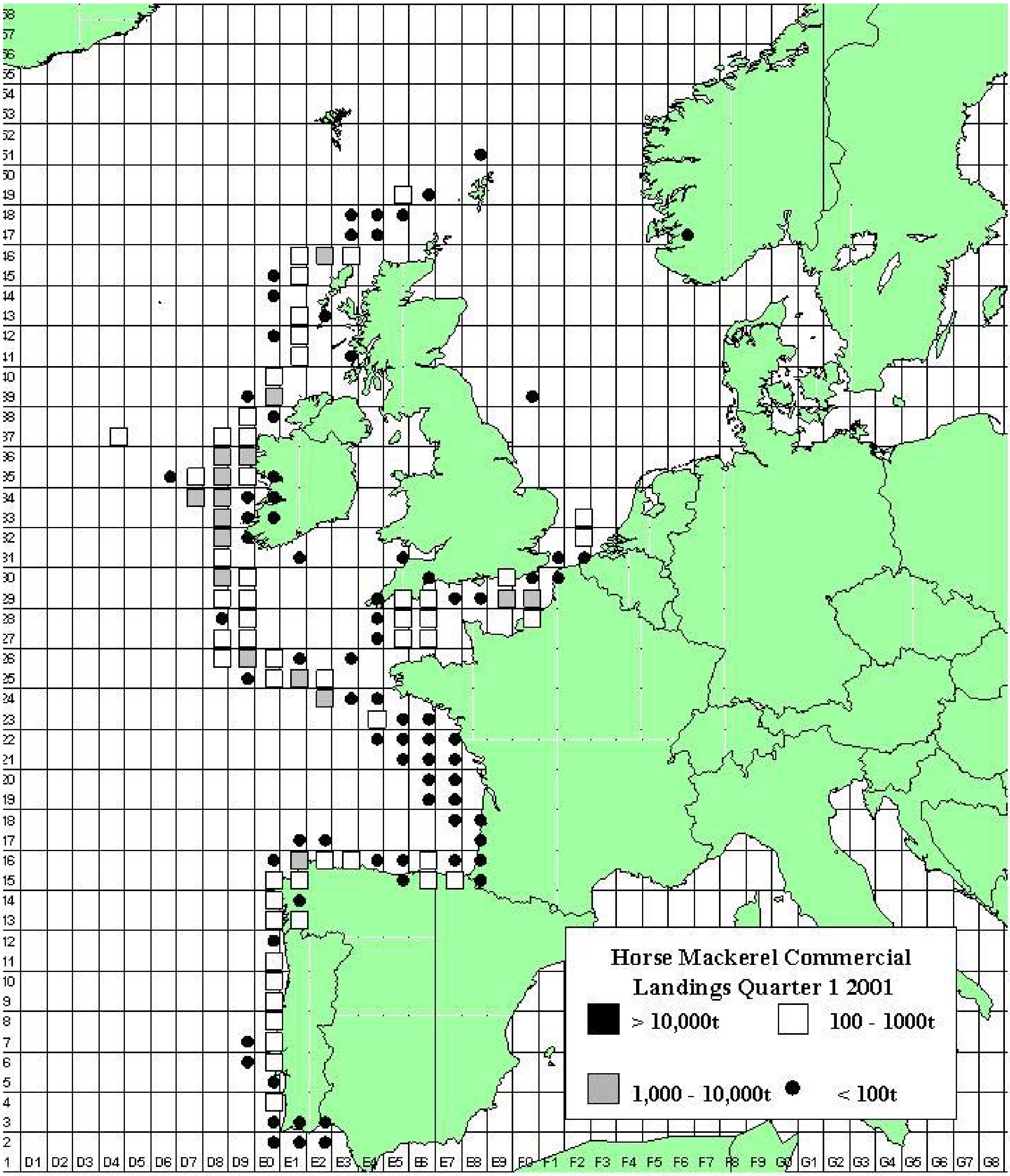


Figure 4.1.1a. Horse Mackerel commercial catches in quarter 1 2001.

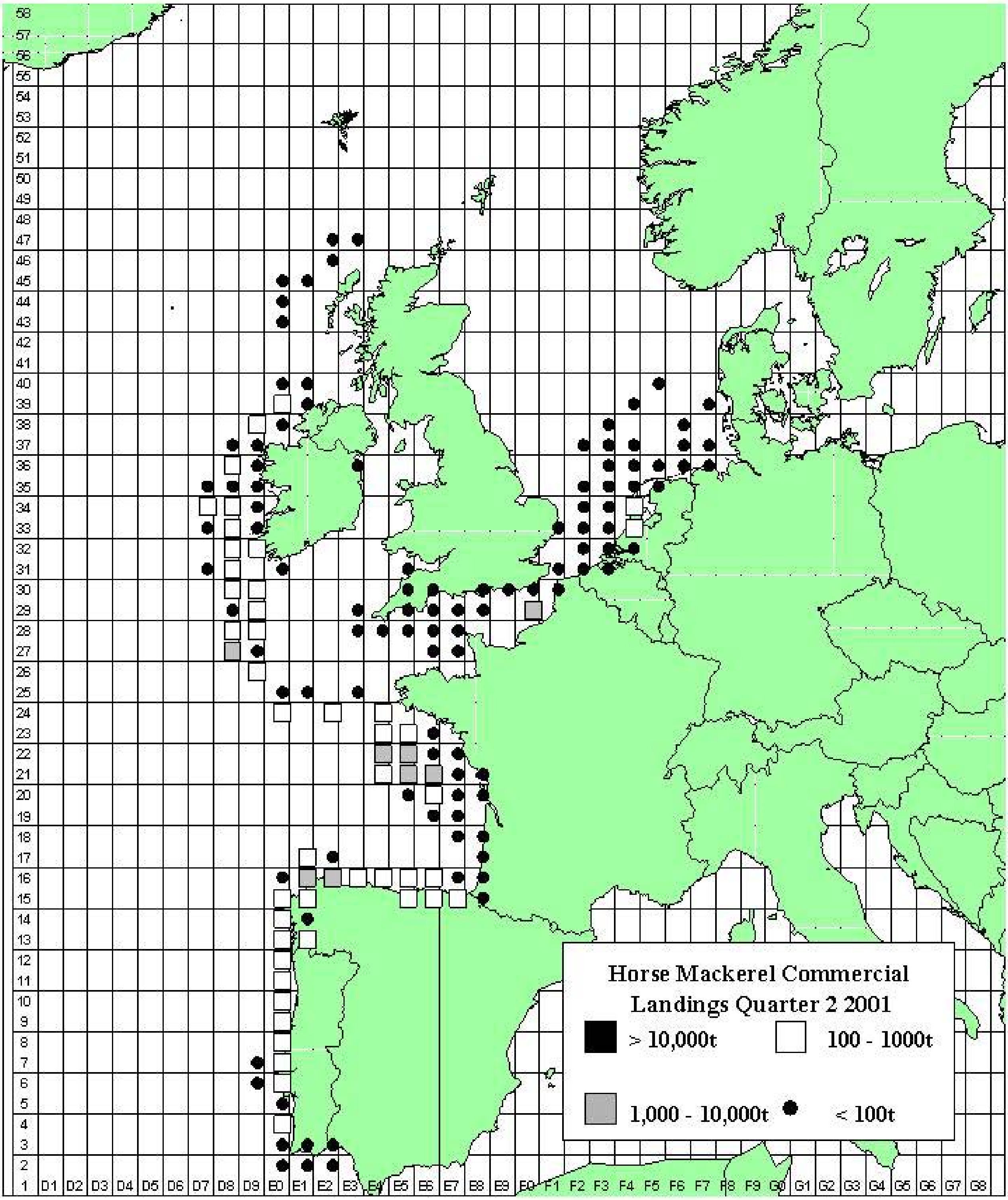


Figure 4.1.1.b. Horse Mackerel commercial catches in quarter 2 2001.

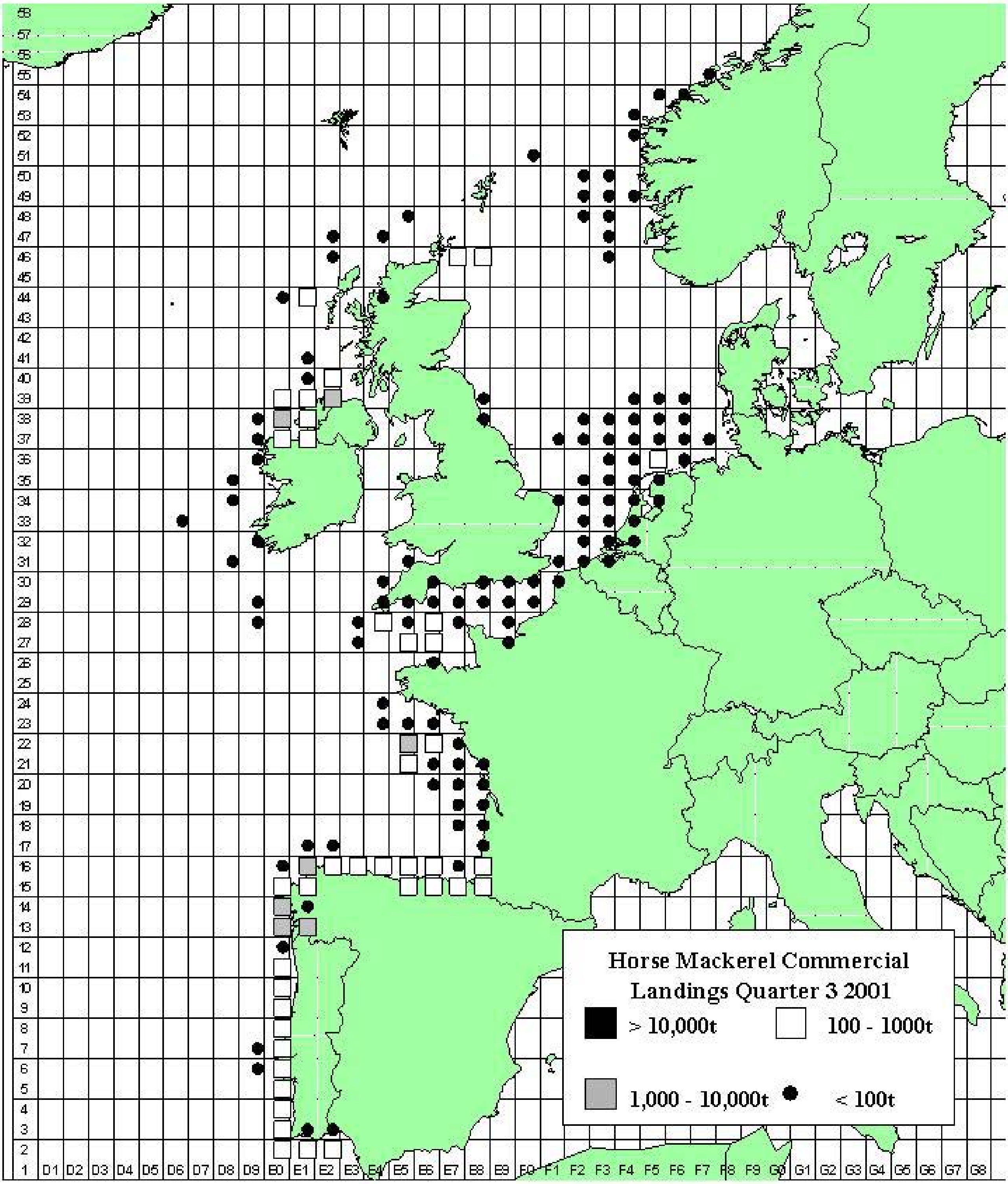


Figure 4.1.1.c. Horse Mackerel commercial catches in quarter 3 2001.

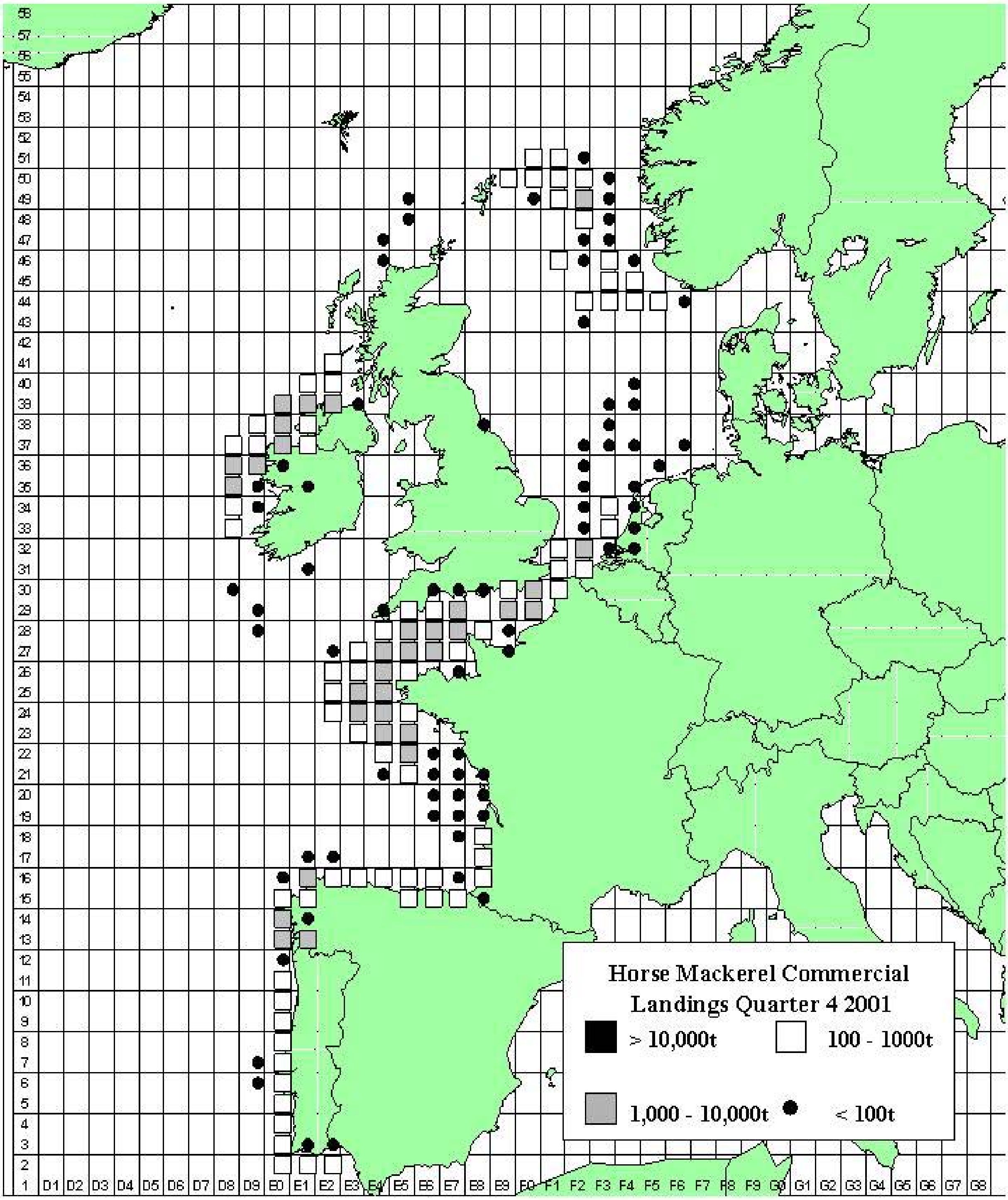


Figure 4.1.1.d. Horse Mackerel commercial catches in quarter 4 2001.

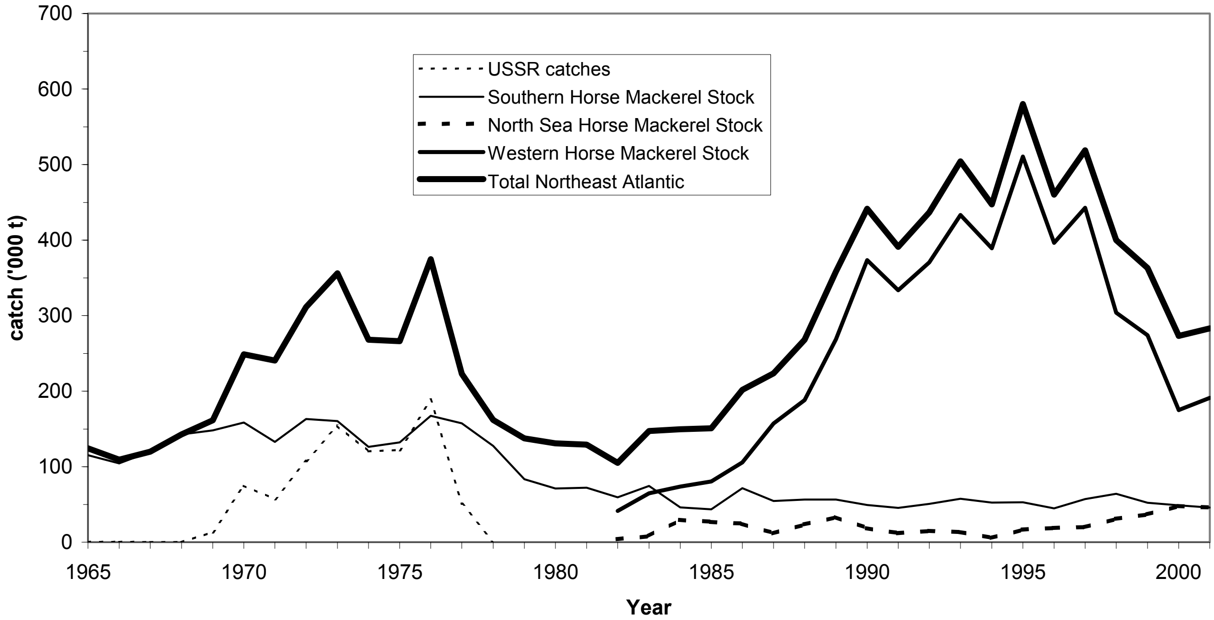


Figure 4.3.1 Total catches of horse mackerel in the northeast Atlantic during the period 1965 - 2001. The catches taken by the USSR and catches taken from the southern, western and North Sea horse mackerel stocks are shown in relation to the total catches in the northeast Atlantic.

5 NORTH SEA HORSE MACKEREL (DIVISIONS IIIA (EXCLUDING WESTERN SKAGERRAK), IVBC AND VIID

5.1 ACFM Advice Applicable to 2001 and 2002

State of stock/exploitation: Pointing out that the sate of the stock is not known, the ACFM recommended a precautionary TAC not above the long term average of 18000 tonnes.

EU has since 1987 set a TAC for EU waters in Division IIa and Sub-area IV, which is a wider area than the North Sea stock is distributed in. This TAC has been fixed at 60,000 t for 1993-1999. In 2000 the TAC was reduced to 51 000 a value which was kept for 2001.

5.2 The Fishery in 2001 on the North Sea stock

Catches taken in Divisions IVb, c and VIId are regarded as belonging to the North Sea horse mackerel and in some years also catches from Division IIIa - except the western part of Skagerrak (see Sections 4.2 and 4.3). Table 4.3.1 shows the catches of this stock from 1982–2000. The total catch taken from this stock in 2001 was 46,425 (2000 tonnes less than year 2000, which was the largest catch on record). In previous years most of the catches from the North Sea stock were taken as a by-catch in the small mesh industrial fisheries in the fourth quarter carried out mainly in Divisions IVb and VIId, but in recent years a large part of the catch was taken in a directed horse mackerel fishery for human consumption.

5.3 Fishery-independent Information

5.3.1 Egg Surveys

No egg surveys for horse mackerel have been carried out in the North Sea since 1991. Such surveys were carried out during the period 1988-1991 and the SSB was estimated between 217 and 255 thousand tonnes the last three survey years (Eltink, 1992).

5.3.2 Bottom trawl surveys

This year, the WG did not have access to the IBTS data on horse mackerel.

5.4 Biological Data

5.4.1 Catch in Numbers at Age

Catch in numbers at age by quarter and annual values were calculated according to Dutch samples collected in Divisions IVb and IVc from the third and fourth quarter, and in VIId from the first, third and fourth quarter. Annual catch numbers at age are given in Table 5.4.1.1 and by area for 2001 in Table 5.4.1.2. Table 5.4.1.3 shows catch number by quarter and by area in 2001. Figure 5.4.1.3 shows that the age distribution in 2001 is very different from that of year 2000.

The allocations of samples to calculate catch in numbers by age for the different Divisions are available in the Working Group archive. For the earlier years age compositions were presented based on samples taken from smaller Dutch commercial catches and research vessel catches. These are available for the period 1987–1995, and cover only a small proportion of the total catch, but give a rough indication of the age composition of the stock (Figure 5.4.1.1).

At present the sampling intensity is rather low and the quality of the catch at age data may be questionable. If a dependable analytical assessment is to be done in the future the sampling needs to be improved. Last year (2001) however, a preliminary assessment was made based on data from 1995-2000. From 1995 the proportion of the catch taken for human consumption has been high (around 70% in 1995 and 96). The Dutch samples after 1996 covered all their catches, and as this catch is the largest part, the coverage has been around 70 % in recent years The coverage for 1995-6 is not known. In 2001 the coverage was only 50% as shown in the text table below.

	1995	1996	1997	1998	1999	2000	2001
% of landings covered	62	55	57	66	77	71	50
Samples from	RV	RV+FV	FV	FV	FV	FV	FV

(RV = Research Vessel, FV = Commercial fishing Vessels)

5.4.2 Mean weight at age and mean length at age

Table 5.4.2.1 shows weight by quarter and by area in 2001. Table 5.4.2.2 shows length by quarter and by area in 2001. The annual average values are shown in Table 5.3.2.1. The weight-at-age for 2000 and 2001 are compared in Figure 5.4.1.3. As can be seen, the weight-at-age in 2001 does not follow the expected curve for growth for age 1 to 5.

5.4.3 Maturity at age

No data have been made available for this Working Group.

5.4.4 Natural mortality

There is no specific information available about natural mortality of this stock.

5.5 State of the Stock

Estimates of total age composition are available since 1995 based on Dutch samples (Table 5.4.1.1). Estimates of age composition prior to 1995 are considered unreliable, that is, not representative for the entire fishery, and should not be used for analytical assessment. During the period the catches were relatively low with an average of 18,000 t. The catch, however, has gone up considerably in recent years, and the state of the stock is unknown. In 2000 the catch level increased to the highest on record and remained at the high level in 2001. The egg surveys in later years for mackerel in the North Sea do not cover the spawning area of horse mackerel. The present stock level is uncertain since the last SSB estimate was made in 1991. Since allocation of catches to the stock is based on the temporal and spatial distribution of the fishery it is important that catches are reported by ICES rectangle and quarters. Since there is no information of the SSB since 1991 it is not known if this stock is still exploited moderately. Last year (2001), however, it was attempted to make a first preliminary analytical assessment based on data from 1995 to 2000. It was attempted to analyse the IBTS data to obtain an index of biomass. Two preliminary assessments were made in 2001 for the North Sea Horse Mackerel: (1) ISVPA (2) Ad Hoc Spread Sheet – (a method with a smaller number of parameters).

The catch-at-age appears to have changed during the period from 1995 to 2000, with a large reduction in mean age, mean length and mean weight. Whether this is caused by a real change in the fishing pattern, or is caused by biased samples is unknown. In years 1995 and 1996 a certain number of commercial catches were converted into age distributions by research vessel samples, which may not be representative for the commercial fishery. In recent years, however, a fishery for human consumption fishery has developed. This fishery targets at small size horse mackerel for the Japanese market (Eltink, pers. Com.). It appears that fishing mortality has shown a pronounced increasing trend during the period 1995-2000. Because of the lack of survey data, the assessment could not be updated this year.

As appears from Figure 5.4.1.3, there a big differences between 2000 and 2001 in age distribution and weight-at-age were observed.

5.6 Reference Points for Management Purposes

At present there is not sufficient information to estimate appropriate reference points.

5.7 Harvest Control Rules

No harvest control rules were considered since no assessment was carried out.

5.8 Management Measures and Considerations

EU has since 1987 set a TAC for EU waters in Division IIa and Sub-area IV. This TAC has been 60,000 t from 1993 to 1999 and 51000 in 2000. However, this TAC is set for a wider area than the North Sea horse mackerel is distributed in. This TAC area also covers parts of the distribution area of western horse mackerel in EU waters of Divisions IVa and

IIa. The Working Group recommends that if a TAC is set for this stock, it should apply to those areas where the North Sea horse mackerel are fished, i.e. Divisions IVb,c, VIId and eastern part of Division IIIa.

No forecast for the North Sea stock has been made for 2003.

The data were insufficient to define a management plan for this stock.

5.9 Recommendation

The Working Group recommends that the IBTS collects age composition samples from horse mackerel in third quarter in the area of the North Sea horse mackerel (IVbc, VIId and IIIa), to improve the fishery independent abundance indices. It is also recommended that more age composition samples be collected, covering all major components of the North Sea horse mackerel fisheries.

Table 5.3.2.1.a. Weight at age (kg), 1995-2001, for the North Sea horse mackerel stock

Age	1995	1996	1997	1998	1999	2000	2001
1	0.076	0.107	0.063	0.063	0.063	0.075	0.055
2	0.126	0.123	0.102	0.102	0.102	0.101	0.072
3	0.125	0.143	0.126	0.126	0.126	0.136	0.071
4	0.133	0.156	0.142	0.142	0.142	0.152	0.082
5	0.146	0.177	0.160	0.160	0.160	0.166	0.120
6	0.164	0.187	0.175	0.175	0.175	0.194	0.183
7	0.161	0.203	0.199	0.199	0.199	0.198	0.197
8	0.178	0.195	0.231	0.231	0.231	0.213	0.201
9	0.165	0.218	0.250	0.250	0.250	0.247	0.235
10	0.173	0.241	0.259	0.259	0.259	0.280	0.246
11	0.317	0.307	0.300	0.300	0.300	0.279	0.260
12	0.233	0.211	0.329	0.329	0.329	0.342	0.286
13	0.241	0.258	0.367	0.367	0.367	0.318	0.287
14	0.348	0.277	0.299	0.299	0.299	0.325	0.295
15+	0.348	0.277	0.360	0.360	0.360	0.332	0.336

Table 5.3.2.1.b. Length at age (cm) 1995-2001, for the North Sea horse mackerel stock

Age	1995	1996	1997	1998	1999	2000	2001
1	19.2	19.2	19.2	19.2	19.2	19.0	18.7
2	22.0	22.0	22.0	22.0	22.0	21.5	20.4
3	23.5	23.5	23.5	23.5	23.5	23.9	20.6
4	24.8	24.8	24.8	24.8	24.8	24.9	21.3
5	25.5	25.5	25.5	25.5	25.5	26.0	25.0
6	26.4	26.4	26.4	26.4	26.4	27.8	27.4
7	27.2	27.2	27.2	27.2	27.2	28.3	28.0
8	29.2	29.2	29.2	29.2	29.2	28.6	28.4
9	29.5	29.5	29.5	29.5	29.5	30.0	29.7
10	29.5	29.5	29.5	29.5	29.5	31.3	30.2
11	30.6	30.6	30.6	30.6	30.6	31.4	30.7
12	32.1	32.1	32.1	32.1	32.1	33.7	32.0
13	33.3	33.3	33.3	33.3	33.3	33.5	31.7
14	31.1	31.1	31.1	31.1	31.1	33.4	32.1
15+	32.5	32.5	32.5	32.5	32.5	33.4	33.4

Table 5.4.1.1. Catch in numbers (millions), 1995-2001, for the North Sea horse mackerel stock

Age	1995	1996	1997	1998	1999	2000	2001
1	1.76	4.58	12.56	2.30	12.42	70.23	12.81
2	3.12	13.78	27.24	22.13	31.45	77.98	36.36
3	7.19	11.04	14.07	36.69	23.13	28.41	174.34
4	10.32	11.87	14.93	38.82	17.59	21.42	87.81
5	12.08	9.64	14.58	20.79	23.12	31.27	18.51
6	13.16	12.49	12.38	12.10	26.19	19.64	11.49
7	11.43	7.96	10.12	13.99	20.64	19.47	18.25
8	12.64	6.60	8.64	10.79	21.75	9.00	14.70
9	7.25	1.48	2.45	8.26	12.91	11.50	10.22
10	5.87	5.31	0.75	4.01	8.21	8.96	9.98
11	0.01	0.29	0.34	2.72	2.14	6.98	9.58
12	8.84	1.28	0.25	0.71	0.43	3.07	5.35
13	0.20	8.92	0.00	1.81	1.40	1.61	3.73
14	4.37	8.01	1.38	0.31	3.78	0.00	1.95
15+	0.00	0.00	0.00	5.11	4.03	12.22	5.81

Table 5.4.1.2 Catch number, annual mean length and annual mean weight North Sea horse mackerel stock by area in 2001

Catch number (Total 2001)

Ages	IIIb	IVa	IVb	IVc	IVbc	VIId	Total
1	4	42	370	1283	24	11085	12807
2	26	83	997	3209	65	31981	36361
3	125	582	6697	22619	415	143900	174338
4	110	291	4832	10961	225	71395	87814
5	19	42	777	3034	48	14595	18514
6	43	0	1041	1899	40	8469	11492
7	66	0	988	1773	57	15367	18250
8	98	0	2310	1439	64	10789	14699
9	36	0	1010	997	26	8147	10217
10	6	0	196	1346	16	8419	9982
11	6	0	196	1034	12	8332	9580
12	6	0	196	450	7	4689	5347
13	0	0	0	361	4	3369	3733
14	0	0	0	0	0	1954	1954
15+	6	0	196	213	5	5395	5814

Mean Weight-at-age (kg)

Ages	IIIb	IVa	IVb	IVc	Ivbc	VIId	Total
0							
1	0.052	0.052	0.052	0.054	0.053	0.055	0.055
2	0.081	0.056	0.060	0.060	0.063	0.073	0.072
3	0.095	0.065	0.075	0.080	0.077	0.070	0.071
4	0.124	0.072	0.102	0.089	0.092	0.079	0.082
5	0.158	0.086	0.133	0.135	0.131	0.116	0.120
6	0.179		0.179	0.183	0.181	0.184	0.183
7	0.190		0.191	0.202	0.195	0.197	0.197
8	0.202		0.202	0.217	0.208	0.198	0.201
9	0.210		0.213	0.250	0.226	0.236	0.235
10	0.233		0.233	0.247	0.247	0.246	0.246
11	0.244		0.244	0.262	0.256	0.261	0.260
12	0.262		0.262	0.266	0.264	0.289	0.286
13				0.281	0.281	0.287	0.287
14						0.295	0.295
15+	0.366		0.366	0.318	0.344	0.335	0.336

Mean Length-at-age (cm)

Ages	IIIb	IVa	IVb	IVc	Ivbc	VIId	Total
0							
1	18.5	18.5	18.5	18.5	18.5	18.7	18.7
2	20.6	19.5	19.5	19.5	19.7	20.5	20.4
3	21.8	20.2	20.7	20.9	20.8	20.5	20.6
4	23.6	20.8	22.4	21.8	21.9	21.2	21.3
5	25.7	23.5	25.1	26.5	25.5	24.6	25.0
6	26.6		26.7	27.2	26.9	27.6	27.4
7	27.3		27.3	27.9	27.5	28.0	28.0
8	28.1		28.1	28.8	28.4	28.4	28.4
9	28.2		28.3	29.8	28.8	29.9	29.7
10	29.5		29.5	30.0	30.0	30.2	30.2
11	30.5		30.5	30.2	30.3	30.8	30.7
12	30.5		30.5	30.6	30.6	32.2	32.0
13				31.2	31.2	31.8	31.7
14						32.1	32.1
15+	30.5		30.5	32.3	32.3	33.5	33.4

Table 5.4.1.3 Catch number of North Sea horse mackerel stock by quarter and by area in 2001

Quarter 1

Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Sum
1	0	42	370	1061	22	9035	10529
2	0	83	737	2115	43	19215	22193
3	0	582	5161	14813	304	126474	147334
4	0	291	2581	7406	152	63298	73727
5	0	42	370	1061	22	10680	12174
6	0	0	0	0	0	4600	4600
7	0	0	0	0	0	5132	5132
8	0	0	0	0	0	4808	4808
9	0	0	0	0	0	3532	3532
10	0	0	0	0	0	4528	4528
11	0	0	0	0	0	3524	3524
12	0	0	0	0	0	2679	2679
13	0	0	0	0	0	1860	1860
14	0	0	0	0	0	1079	1079
15+	0	0	0	0	0	3385	3385

Quarter 2

Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Sum
1	4	0	1	17	0	85	106
2	7	0	1	34	0	437	480
3	51	0	9	235	0	1556	1851
4	25	0	4	118	0	1057	1205
5	4	0	1	17	0	1287	1308
6	0	0	0	0	0	459	459
7	0	0	0	0	0	2212	2212
8	0	0	0	0	0	2036	2036
9	0	0	0	0	0	896	896
10	0	0	0	0	0	1753	1753
11	0	0	0	0	0	2036	2036
12	0	0	0	0	0	1470	1470
13	0	0	0	0	0	582	582
14	0	0	0	0	0	582	582
15+	0	0	0	0	0	589	589

Quarter 3

Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Sum
1	0	0	0	116	1	6	123
2	6	0	196	926	11	34	1174
3	42	0	1369	6948	83	42	8484
4	66	0	2152	2779	53	19	5069
5	12	0	391	1274	17	7	1701
6	30	0	978	1158	23	8	2198
7	24	0	783	232	12	17	1067
8	66	0	2152	347	30	7	2602
9	30	0	978	232	14	10	1265
10	6	0	196	116	4	6	327
11	6	0	196	347	6	8	563
12	6	0	196	0	2	2	206
13	0	0	0	0	0	3	3
14	0	0	0	0	0	1	1
15+	6	0	196	0	2	4	208

Quarter 4

Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Sum
1	0	0	0	89	1	1960	2050
2	13	0	63	134	10	12294	12514
3	32	0	158	624	29	15827	16669
4	20	0	95	658	20	7021	7814
5	3	0	16	683	9	2620	3331
6	13	0	63	741	16	3401	4235
7	42	0	205	1542	45	8005	9839
8	32	0	158	1092	34	3938	5253
9	6	0	32	766	12	3709	4525
10	0	0	0	1230	12	2131	3373
11	0	0	0	687	7	2763	3456
12	0	0	0	450	4	539	993
13	0	0	0	361	4	924	1288
14	0	0	0	0	0	292	292
15+	0	0	0	213	2	1417	1631

Table 5.4.2.1 Weight-at-age of North Sea horse mackerel stock by quarter and by area in 2001

W			Quarter 1				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Mean
1	0.000	0.052	0.052	0.052	0.052	0.052	0.052
2	0.000	0.056	0.056	0.056	0.056	0.057	0.057
3	0.000	0.065	0.065	0.065	0.065	0.065	0.065
4	0.000	0.072	0.072	0.072	0.072	0.072	0.072
5	0.000	0.086	0.086	0.086	0.086	0.098	0.096
6	0.000	0.000	0.000	0.000	0.000	0.189	0.189
7	0.000	0.000	0.000	0.000	0.000	0.202	0.202
8	0.000	0.000	0.000	0.000	0.000	0.204	0.204
9	0.000	0.000	0.000	0.000	0.000	0.240	0.240
10	0.000	0.000	0.000	0.000	0.000	0.245	0.245
11	0.000	0.000	0.000	0.000	0.000	0.265	0.265
12	0.000	0.000	0.000	0.000	0.000	0.285	0.285
13	0.000	0.000	0.000	0.000	0.000	0.239	0.239
14	0.000	0.000	0.000	0.000	0.000	0.275	0.275
15+	0.000	0.000	0.000	0.000	0.000	0.316	0.316

W			Quarter 2				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Mean
1	0.052	0.000	0.052	0.052	0.000	0.052	0.052
2	0.056	0.000	0.056	0.056	0.000	0.075	0.073
3	0.065	0.000	0.065	0.065	0.000	0.072	0.071
4	0.072	0.000	0.072	0.072	0.000	0.086	0.084
5	0.086	0.000	0.086	0.086	0.000	0.132	0.132
6	0.000	0.000	0.000	0.000	0.000	0.135	0.135
7	0.000	0.000	0.000	0.000	0.000	0.166	0.166
8	0.000	0.000	0.000	0.000	0.000	0.191	0.191
9	0.000	0.000	0.000	0.000	0.000	0.204	0.204
10	0.000	0.000	0.000	0.000	0.000	0.207	0.207
11	0.000	0.000	0.000	0.000	0.000	0.240	0.240
12	0.000	0.000	0.000	0.000	0.000	0.279	0.279
13	0.000	0.000	0.000	0.000	0.000	0.336	0.336
14	0.000	0.000	0.000	0.000	0.000	0.330	0.330
15+	0.000	0.000	0.000	0.000	0.000	0.286	0.286

W			Quarter 3				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Mean
1	0.000	0.000	0.000	0.070	0.070	0.071	0.070
2	0.062	0.000	0.062	0.065	0.063	0.099	0.065
3	0.108	0.000	0.108	0.108	0.108	0.102	0.108
4	0.136	0.000	0.136	0.123	0.130	0.134	0.129
5	0.176	0.000	0.176	0.159	0.168	0.179	0.163
6	0.179	0.000	0.179	0.179	0.179	0.184	0.179
7	0.191	0.000	0.191	0.181	0.187	0.207	0.189
8	0.202	0.000	0.202	0.212	0.207	0.191	0.203
9	0.214	0.000	0.214	0.250	0.230	0.245	0.221
10	0.233	0.000	0.233	0.309	0.268	0.279	0.261
11	0.244	0.000	0.244	0.274	0.258	0.270	0.263
12	0.262	0.000	0.262	0.000	0.262	0.327	0.263
13	0.000	0.000	0.000	0.000	0.000	0.354	0.354
14	0.000	0.000	0.000	0.000	0.000	0.299	0.299
15+	0.366	0.000	0.366	0.000	0.366	0.400	0.367

W			Quarter 4				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Mean
1	0.000	0.000	0.000	0.062	0.062	0.071	0.071
2	0.104	0.000	0.104	0.084	0.094	0.100	0.099
3	0.126	0.000	0.126	0.114	0.120	0.105	0.105
4	0.153	0.000	0.153	0.136	0.145	0.137	0.137
5	0.173	0.000	0.173	0.168	0.170	0.179	0.177
6	0.178	0.000	0.178	0.188	0.183	0.183	0.184
7	0.189	0.000	0.189	0.205	0.197	0.202	0.202
8	0.201	0.000	0.201	0.218	0.210	0.195	0.200
9	0.192	0.000	0.192	0.250	0.221	0.241	0.242
10	0.000	0.000	0.000	0.241	0.241	0.280	0.265
11	0.000	0.000	0.000	0.255	0.255	0.271	0.267
12	0.000	0.000	0.000	0.266	0.266	0.332	0.302
13	0.000	0.000	0.000	0.281	0.281	0.354	0.333
14	0.000	0.000	0.000	0.000	0.000	0.299	0.299
15+	0.000	0.000	0.000	0.318	0.318	0.401	0.390

Table 5.4.2.2 Length at age of North Sea horse mackerel stock by quarter and by area in 2001

Length			Quarter 1				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Mean
1	0.00	18.50	18.50	18.50	18.50	18.50	18.50
2	0.00	19.50	19.50	19.50	19.50	19.54	19.53
3	0.00	20.21	20.21	20.21	20.21	20.21	20.21
4	0.00	20.79	20.79	20.79	20.79	20.81	20.81
5	0.00	23.50	23.50	23.50	23.50	23.96	23.90
6	0.00	0.00	0.00	0.00	0.00	28.01	28.01
7	0.00	0.00	0.00	0.00	0.00	28.62	28.62
8	0.00	0.00	0.00	0.00	0.00	28.81	28.81
9	0.00	0.00	0.00	0.00	0.00	30.37	30.37
10	0.00	0.00	0.00	0.00	0.00	30.44	30.44
11	0.00	0.00	0.00	0.00	0.00	31.06	31.06
12	0.00	0.00	0.00	0.00	0.00	32.17	32.17
13	0.00	0.00	0.00	0.00	0.00	30.61	30.61
14	0.00	0.00	0.00	0.00	0.00	31.63	31.63
15+	0.00	0.00	0.00	0.00	0.00	33.20	33.20

Length			Quarter 2				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Mean
1	18.50	0.00	18.50	18.50	0.00	18.50	18.50
2	19.50	0.00	19.50	19.50	0.00	20.89	20.76
3	20.21	0.00	20.21	20.21	0.00	20.67	20.60
4	20.79	0.00	20.79	20.79	0.00	21.88	21.75
5	23.50	0.00	23.50	23.50	0.00	25.26	25.23
6	0.00	0.00	0.00	0.00	0.00	25.53	25.53
7	0.00	0.00	0.00	0.00	0.00	26.99	26.99
8	0.00	0.00	0.00	0.00	0.00	28.14	28.14
9	0.00	0.00	0.00	0.00	0.00	29.15	29.15
10	0.00	0.00	0.00	0.00	0.00	29.08	29.08
11	0.00	0.00	0.00	0.00	0.00	30.57	30.57
12	0.00	0.00	0.00	0.00	0.00	31.99	31.99
13	0.00	0.00	0.00	0.00	0.00	34.25	34.25
14	0.00	0.00	0.00	0.00	0.00	33.50	33.50
15+	0.00	0.00	0.00	0.00	0.00	32.00	32.00

Length			Quarter 3				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Sum
1	0.00	0.00	0.00	18.50	18.50	19.89	18.56
2	18.50	0.00	18.50	19.25	18.84	22.03	19.20
3	22.36	0.00	22.36	22.37	22.36	22.49	22.37
4	24.14	0.00	24.14	23.88	24.02	24.59	24.00
5	26.50	0.00	26.50	25.77	26.17	27.25	25.95
6	26.70	0.00	26.70	27.00	26.84	27.38	26.86
7	27.25	0.00	27.25	27.00	27.14	28.19	27.21
8	28.14	0.00	28.14	28.83	28.45	28.21	28.24
9	28.30	0.00	28.30	29.50	28.85	29.82	28.54
10	29.50	0.00	29.50	31.50	30.41	30.64	30.24
11	30.50	0.00	30.50	30.83	30.65	30.62	30.71
12	30.50	0.00	30.50	0.00	30.50	32.80	30.52
13	0.00	0.00	0.00	0.00	0.00	32.53	32.53
14	0.00	0.00	0.00	0.00	0.00	31.34	31.34
15+	30.5		30.5		32.3	32.3	30.6

Length			Quarter 4				
Ages	IIIb	IVa	Ivb	IVc	Ivbc	VIId	Sum
1	0.00	0.00	0.00	18.50	18.50	19.89	19.82
2	22.25	0.00	22.25	20.50	21.38	22.05	22.04
3	23.60	0.00	23.60	22.64	23.12	22.63	22.64
4	25.17	0.00	25.17	24.37	24.77	24.71	24.69
5	25.50	0.00	25.50	32.66	29.08	27.14	28.27
6	26.50	0.00	26.50	27.44	26.97	27.22	27.24
7	27.27	0.00	27.27	28.00	27.63	27.91	27.91
8	28.00	0.00	28.00	28.82	28.41	28.11	28.26
9	27.50	0.00	27.50	29.94	28.72	29.65	29.68
10	0.00	0.00	0.00	29.82	29.82	30.66	30.35
11	0.00	0.00	0.00	29.93	29.93	30.62	30.48
12	0.00	0.00	0.00	30.63	30.63	32.96	31.89
13	0.00	0.00	0.00	31.16	31.16	32.53	32.14
14	0.00	0.00	0.00	0.00	0.00	31.34	31.34
15+	0.00	0.00	0.00	32.3	32.3	34.7	34.4

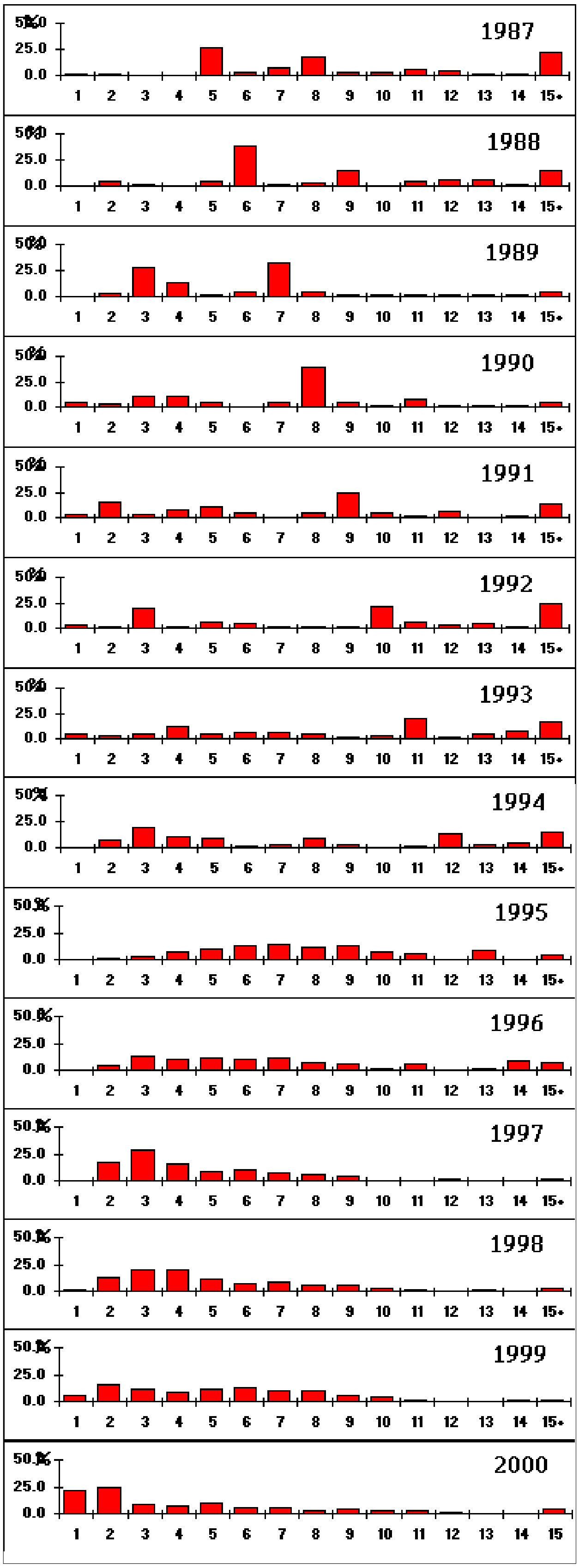


Figure 5.4.1.1. Age composition North Sea horse mackerel stock from commercial and research vessel samples, 1987-2000 (Survey data not yet processed for 2001).

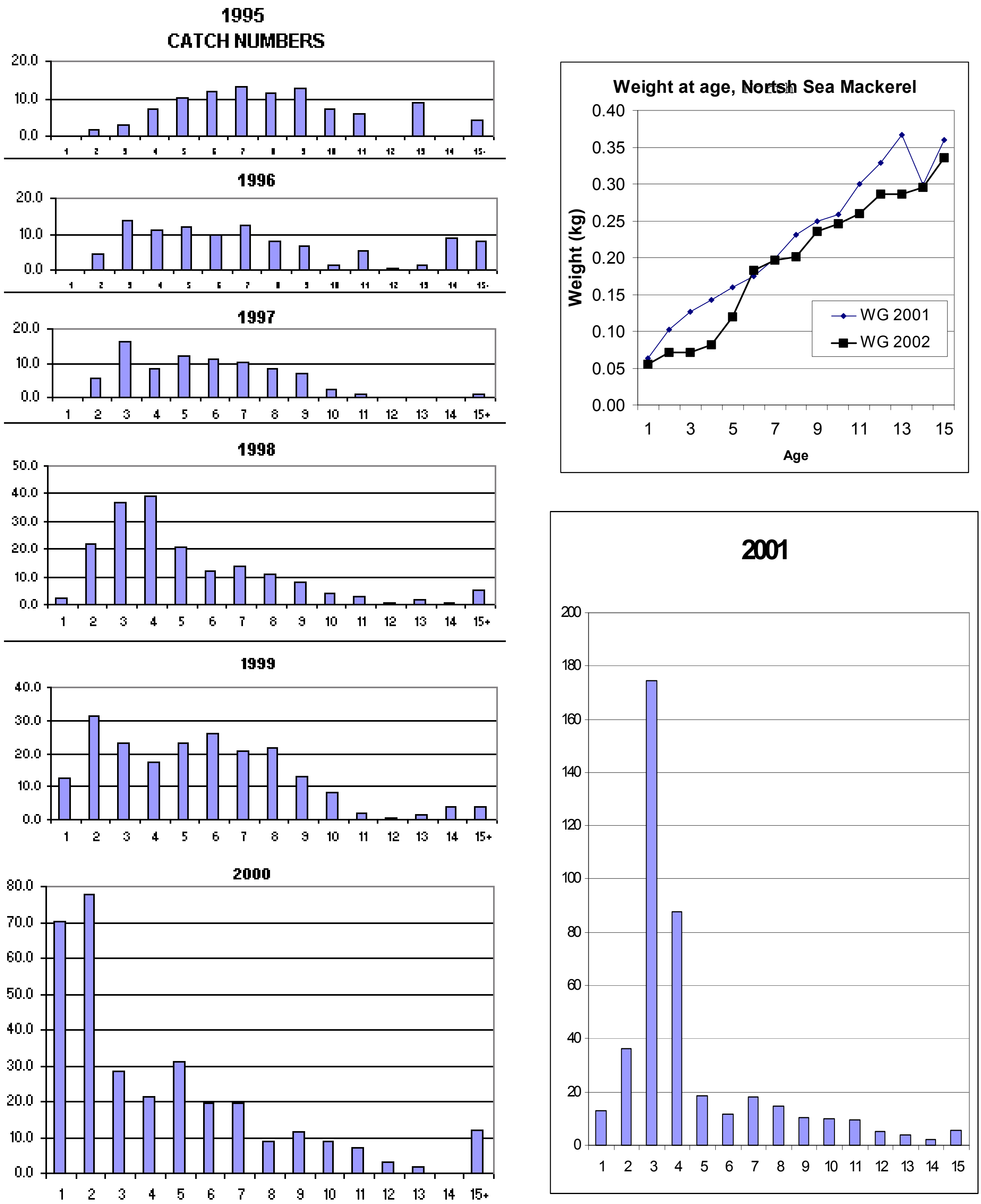


Figure 5.4.1.3 North Sea horse mackerel. Catch at age (000'), 1995-2001. Comparison of weight-at-age in 2001 and 2002 working group meetings.

6 WESTERN HORSE MACKEREL (DIVISIONS IIA, IIIA (WESTERN PART), IVA, VB, VIA, VIIA–C, VIIE–K, AND VIIIA,B,D,E

6.1 ACFM Advice Applicable to 2001 and 2002

For 2001 ICES advised to limit the catches to less than 224,000 t which corresponds to $\mathbf{F}_{0.1}$=0.15.

This was aimed at maintaining the SSB above that which produced the 1982 year class. For 2002 ICES advised that the catches should be limited to less than 98,000 tons. As for the two previous years ICES also for 2002 advised to close the directed trawl fishery for horse mackerel and the industrial fisheries in Divisions VIIe,f due to relatively large catches of juvenile horse mackerel.

EU has set TACs for horse mackerel since 1987 covering Division Vb (EU waters only), Sub areas VI and VII, Divisions VIIIa,b,d,e. These areas do not correspond to the total distribution area of western horse mackerel. The TAC should apply to all areas where western horse mackerel are fished. The TAC set by EU was reduced from 320,000 tons in 1998 to 150.000 tons in 2001.

The catches of western horse mackerel in 2001 were 191,000 tons which is about 40,000 tons less than the internal TAC set by EU. It is also the second time the catch level did not exceed the catch level recommended by ICES. The first time was in 2000 (Figure 6.11.4).

6.2 The Fishery in 2000 of the Western Stock

The fishery for western horse mackerel is carried out in Divisions IIa, IIIa (western part) IVa, VIa, VIIa–c,e–k and VIIIa,b,d,e. The national catches taken by the countries fishing in these areas are shown in Tables 6.2.1–6.2.5, while information on the development of the fisheries by quarter and division is shown in Table 4.1.2 and in Figures 4.1.1.a–d.

The total catch allocated to western horse mackerel in 2001 was 191,000 t (Table 4.3.1) which is 16,000 tons more than in 2000.

Divisions IIa and Vb

The national catches in this area are shown in Table 6.2.1. The catches in this area have varied from year to year. The catches dropped from the record high catch of 14,000 tons in 1995 to 3,400 tons 1996. Since then the catches have been about 2,500 tons until they dropped to 1,100 tons in 2000. In 2001 only 60 tons were reported caught in this area.

Sub-area IV and Division IIIa

Except for some minor Danish catches reported from Division IIIb and some small catches the first quarter in Division IVa all catches from Divisions IVa and IIIa in 2001 were allocated to the western stock. The catches of the western stock in Division IVa has fluctuated between 4,500 -135,000 tons during the period 1987-2001. These fluctuations are mainly due to the availability of western horse mackerel for the Norwegian fleet in October –November. In 2001 this availability was relatively poor and about 7,000 tons were taken by the Norwegian fleet.

The total catches of horse mackerel in Sub area IV and Division IIIa are shown in Table 6.2.2.

Sub-area VI

The catches in this area increased from 21,000 tons in 1990 to a historical high level of 84,000 tons in 1995 and 81,000 tons in 1996 (Table 6.2.3). After a reduction in the catches of more than 50% in 1997 and 1998 the catches increased to 65,300 tons in 1999. In 2000 and 2001 the catches were reduced a similar low level as in 1990. The main part of the catches is taken in a directed Irish trawl fishery for horse mackerel.

Sub-area VII

All catches from Sub area VII except Division VIId were allocated to the western stock. The catches from this area are mainly taken in directed Dutch and Irish trawl fisheries in Divisions VIIb,e,h,j. The catches of western horse mackerel increased from below 100,000 tons prior 1989 to about 320,000 tons in 1995 and 1997 (Table 4.3.1). Since than the catches have dropped and 101,000 tons were reported from this area in 2001.

The total catches of horse mackerel in Sub area VII are shown in Table 6.2.4.

Sub-area VIII

All catches from this Sub area except VIIIc are allocated to the western stock. The catches of western horse mackerel in these areas were less than 10,000 t in the period 1982-1988. Since then the catches have usually fluctuated between 10,000-32,000 tons (Table 4.3.1) and in 2001 the catches were 54,200 tons which is the highest 0n record.

The total catches of horse mackerel in Sub-area VIII are given in Table 6.2.5

6.3 Fishery Independent information

6.3.1 Egg survey estimates of spawning biomass

The ICES Triennial Mackerel and Horse Mackerel Egg Survey was carried out from January to July 2001. The results of the survey were presented WGMEGS in Dublin April 2002. This meeting was responsible for the completion of the analysis of the egg survey and the provision of spawning stock biomass estimates to WGMHSA. The report is available as ICES CM 2002/G:06. The conclusions from this report are presented here in summary. The previous report of WGMHSA included preliminary data and maps. These have been updated and completed for this report.

The survey has been analysed using seven contiguous periods – see table below

Period	Dates
1	21 January – 10 February
2	11 February – 10 March
3	11 March – 8 April
4	9 April – 13 May
5	14 May – 10 June
6	11 June – 1 July
7	2 July – 23 July

The analysis protocols followed those described in the report of WGMEGS (ICES 2000/G:01). Interpolation into unsampled rectangles was carried out manually according to the rules set down in that report. Arithmetic means were used where more than one sample per rectangle per period were collected.

6.3.1.1 Results

Figures 2.6.1 – 5 show the mean daily egg production for horse mackerel by rectangle by period. Post plots of daily egg production values were square root scaled to the maximum at a single station of 500 eggs m^{-2} d^{-1}.

- Period 3 (Fig 6.3.1.1) – Only low levels of egg production were recorded in this period. The main areas of production were in the corner of Biscay with small amounts west of Brittany. Little interpolation was required.
- Period 4 (Fig. 6.3.1.2.) – There was good coverage in this period with well defined edges and little interpolation. Again production was low and confined to a few small patches in Biscay and west of Ireland.
- Period 5 (Fig. 6.3.1.3) – Again, there was good coverage and edge definition, except at SW edge of Porcupine Bank at 51^{o}N. There was a high number of interpolated values but this was mainly due to alternate transect occupation. Production was much higher than in period 4 and was found in a wide band from Biscay to the SW of Ireland.
- Period 6 (Fig 6.3.1.4) – There was a considerable amount of interpolation in this period again mainly due to occupation of alternate transects, but coverage and edges were good. The area of production was similar to period 5 but much lower in the inner part of Biscay. Production levels were relatively high.
- Period 7 (Fig 6.3.1.5) – As in period 6 the survey was based on alternate transects. However, the interpolation was sound in all areas except on the southern edge, where there were large values on the southern border. The potential for missed production south of this must be considered. Production was reduced and was confined to areas to the SW, west and NW of Ireland.

6.3.1.2 Fecundity and atresia

A total of 225 fecundity samples were taken from a number of different locations between 44 and 59°N and between periods 1 to 6. There was almost zero atresia estimated during the 1998 survey, however, there was a distinct trend in fecundity with time (see fig 6.3.6). Fecundity ranged from 183 eggs per gram female at the beginning of the spawning season to 1361 by period 6. This pattern was confirmed from the samples taken in 1998 and supplementary sampling in 2000. After a great deal of discussion WGMEGS agreed that the best figure to use was a mean value for samples from day 100 onwards – representing the period of peak spawning. This value was 994 eggs per gram female, and was substantially different from the previously used long term mean value of 1557 (1504 corrected for atresia). The WG also considered that the improved observations in 2001 could be considered as substantiating those in 1998, and so the same fecundity calculation method be used for that year also. This gave a fecundity of 1002 eggs per gram female in 1998 which resulted in a biomass of 2 million tonnes. No correction factor was used as the fecundity was measured at peak spawning and not prior to the spawning season. The increase in fecundity across the spawning season was considered as possible evidence that horse mackerel was an indeterminate spawner. This matter is discussed in detail below.

6.3.1.3 Egg production and SSB estimates

The total annual egg production was 0.684 x 10^{15}. The egg production curve was well behaved, in contrast to 1998. The egg production curve is presented in Figure 6.3.1.7. This translates to an SSB estimate of 1.38 million tonnes. WGMEGS recommended that this value be treated with caution, due to the problems estimating fecundity, and should be used as a relative measure of the SSB.

6.3.1.4 Supplementary surveys outside the standard area in 2002

An egg survey conducted in 2002 by the Irish Marine Institute has shown that horse mackerel spawning outside the standard survey did not contribute significantly to the egg production estimate. Further details are given in the WD: Dransfeld, *et al.,* 2002.

6.3.1.5 Problems with the estimates

WGMEGS in 2002 identified a number of major problems in the use of these surveys and the AEPM for the horse mackerel assessment. The most important of these were whether horse mackerel was a determinate spawner and if so what was the most appropriate way to collect and analyse fecundity data. In each case the questions and problems are described and the logistical implications of the work proposed are discussed. The following sections represent a proposed work programme for WGMEGS in the context of their next meeting in April 2003 and of the survey in 2004.

Determinate or indeterminate?

The observations of fecundity in 2001 (supported by data collected in 2000 and 1998) showed that potential fecundity appeared to increase throughout the early part of the spawning season until at least day 100. The final sample collected also showed the highest fecundity in the western area. This is suggestive that this species is an indeterminate spawner, and that *de novo* vitellogenesis occurs during the spawning season. The relatively low atresia c.f mackerel may also suggest this. There is an urgent need to decide whether this is the case or not. The evolution in potential fecundity through the spawning season should be confirmed by limited sampling throughout the spawning season in 2004 coupled with histological examination. However, empirically, the best approach would be to design cage or other studies that would confirm one way or the other. The designs for such studies are not obvious at present. WGMEGS felt that this problem MUST be resolved prior to the next SSB estimation in 2004/05.

Logistics: Until this question is resolved there should be a limited fecundity sampling programme in 2004. The resources freed by this should be directed towards resolving the determinacy question.

It is proposed that a workshop be held immediately prior to the WGMEGS meeting in April. This workshop should be tasked to define the research programme and data required to definitively answer this question. Ideally the workshop should include experts from beyond WGMEGS/WGMHSA

Fecundity sampling

Assuming determinacy, we need to establish an appropriate methodology for collecting fecundity data. This should encompass geographical and, critically, temporal variation. The methodology will also need to include an understanding on the migrations of female horse mackerel during the spawning period.

Logistics: This should probably wait until we have solved the determinacy question. Limited fecundity sampling in 2004 should be sufficient to confirm that the pattern observed in 1998, 2000 and 2001 has been maintained.

In the case of indeterminacy

It looks increasingly likely that horse mackerel may be an indeterminate spawner. If this is the case we need to investigate the best continued use of the triennial egg surveys. One approach would be to use a DEPM approach. This has been tested for horse mackerel and a number of major problems identified.

- The spawning fraction is low with a high CV due to high spatial variability
- Stage durations for POFs, hydrated oocytes and migratory nucleii are unknown
- Spawning season is at least five months while individual fish may span for only 2 or 3 months, and may migrate in our out of the area during the 5 months.
- Additionally, resources for conducting a DEPM solely for horse mackerel are unlikely to be forthcoming

A second approach may be more promising. The current survey provides a total annual egg production. This includes both eggs laid down prior to the spawning season AND the result of de novo vitellogenesis in season. This could then be used as an index without attempting to convert to biomass using the very dubious fecundity figures. This would allow the retention of the Total Annual Egg Production (TAEP) time series in the assessment. The assessment for 2002 was carried out using TAEP only, and appeared to perform well. This use of TAEP assumes that the egg production is largely dependent on adult fish weight. *De novo* vitellogenenesis is believed to be largely the result of feeding in season and condition factor may be a suitable proxy for this. High condition factor would then link to a high level of *de novo* vitellogenenesis. It should be possible to do retrospective analyses of this relationship or at least for variation in condition factor. An additional aspect might be to determine what horse mackerel feeds on in this period and look at the variability in the abundance of these from the plankton samples we collect on the survey. So the initial approach would be to:

a) Investigate use of TAEP in assessment models

b) Investigate spatio-temporal variability in condition factor and gonado-somatic index. This should include as much data from RV and landings as is feasible.

More advanced studies, with significant resource implications, would be:

c) Investigate feeding in horse mackerel, prey etc

d) Analysis of egg survey plankton data for food availability at spawning time and place.

Logistics: The investigation of TAEP as an index should be relatively simple, and from initial use at WGMHSA in 2002 appears promising. Condition factor and GSI could be investigated from historical data and from new data collected from RV and landings. This work will require a high level analyst to collate and analyse the data.

Feeding studies would involve collection of adult samples during the survey for stomach content analysis. Combined with the need for extended adult fecundity data for mackerel and horse mackerel suggests that the use of a commercial vessel would be really VERY desirable. It is proposed that there should be workshop on the horse mackerel: problems and solutions, PRIOR to the WGMEGS meeting in April 2003.

6.3.2 Use of bottom trawl survey data in the assessment of western horse mackerel

One of the perennial problems of the assessment of this species is the long period between fisheries independent stock estimates from the egg surveys. One possible solution to this would be to use an index calculated from the bottom trawl surveys carried out in the western area in the fourth quarter. This is an attractive option due to the fact that the surveys are already in operation, and a new horse mackerel index would be a relatively simple task to calculate. However there are a number of problems with this approach;

- The CPUE data from these surveys are currently not compiled into a database. This should be solved in the near future when the EU funded DATRAS programme completes it's work.

- There is no current standardisation of survey gear in the west as is the case in the North Sea. Again this may be solved in the future as the IBTS Working Group is investigating the development of a new standard gear for these surveys.
- The bottom trawl data set was examined for evidence of the very large 1982 year class in the years following 1982. No evidence of any exceptional year class was seen until these fish turned up in the fishery.
- Horse mackerel is a pelagic fish, and while bottom trawl surveys have been shown to work well for the production of indices for young pelagics e.g. herring in the North Sea or mackerel in the western area, there is little evidence that they work for older fish.

In summary, the WG feels that while the approach has promise, it should wait at least until the western IBTS database is operational.

6.4 Biological Data

6.4.1 Catch in numbers

Since 1998 there has been an increase in age readings compared with previous years. This has improved the quality of the catch at age matrix of the western horse mackerel. In 2001 the Netherlands (Division VIa, Subareas IV, VII and VIII) and Norway (Division IVa), Ireland (Division VIa and Sub area VII) and Germany (Division VIa) and Spain (Sub area VIII) provided catch in numbers at age. The catch sampled for age readings in 2000 provided 59% of the total catch. Still the number of age readings are considered to low to be satisfactory.

Catches from other countries were converted to numbers at age using adequate data provided by the countries quoted above. The procedure has been carried out using the specific software for calculating international catch at age (Patterson, WD 1999).

The total annual and quarterly catches in numbers for western horse mackerel in 2001 are shown in Table 6.4.1.1. The sampling intensity is discussed in Section 1.3. The catch at age matrix shows the predominance and the dominance of the 1982 year class (see Figure 6.4.1.1). Currently this cohort has been included in the plus group since 1996. There is no sign of a new abundant year class in the catches of 2001.

6.4.2 Mean length at age and mean weight at age

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

The same countries providing data for catch in numbers by age also provide data for mean weight and length in catches by quarter and area. These data were applied to the catches from other countries using the specific software for calculating international catch at age, mean weight and mean length at age in the catches (Patterson, WD 1999). The mean weight and mean length at age in the catches by year and quarters of 2001 are shown in Tables 6.4.2.1 and 6.4.2.2.

Mean weight at age in the stock

As for previous years the mean weight at age for the two years old was given a constant weight while the weight for the older ages is based on all mature fish sampled from Dutch freezer trawlers the first and second quarter in Divisions VIIj,k (Table 6.5.1.1d). Both the mean weight by age groups in the stock and in the catches are lower than in 2000.

6.4.3 Maturity ogive

There are no new data on maturity for the western horse mackerel since 1988. In 1999 the working group applied a maturity ogive based on the estimated maturity ogive from the Cantabrian Sea (southern area), which is close to the western area for assessment purposes of the western horse mackerel (ICES, 2000/ACFM:5). The difference between the maturity ogive as used for the years 1987-1997 and the new maturity ogive applied since 1998 is shown in Table 6.5.1.b.

6.4.4 Natural mortality

The natural mortalities applied in previous assessments of western horse mackerel are summarised and discussed in ICES (1998/Assess:6) and the Working Group admitted uncertainties in M in the range of 0.05 to 0.15. As in 2000 the Working Group applied M=0.15.

Table 6.2.1 Landings (t) of HORSE MACKEREL in Subarea II. (Data as submitted by Working Group members.)

Country	1980	1981	1982	1983	1984	1985	1986	1987
Denmark	-	-	-	-	-	-	-	39
France	-	-	-	-	1	1	-[2]	-[2]
Germany, Fed.Rep	-	+	-	-	-	-	-	-
Norway	-	-	-	412	22	78	214	3,272
USSR	-	-	-	-	-	-	-	-
Total	-	+	-	412	23	79	214	3,311

	1988	1989	1990	1991	1992	1993	1994	1995
Faroe Islands	-	-	964[3]	1,115	9,157[3]	1,068	-	950
Denmark	-	-	-	-	-	-	-	200
France	-[2]	-	-	-	-	-	55	-
Germany, Fed. Rep.	64	12	+	-	-	-	-	-
Norway	6,285	4,770	9,135	3,200	4,300	2,100	4	11,300
USSR / Russia (1992 -)	469	27	1,298	172	-	-	700	1,633
UK (England + Wales)	-	-	17		-	-	-	-
Total	6,818	4,809	11,414	4,487	13,457	3,168	759	14,083

	1996	1997	1998	1999	2000	2001[1]
Faroe Islands	1,598	799[3]	188[3]	132[3]	250[3]	-
Denmark	-	-	1,755[3]			-
France	-	-	-			-
Germany	-	-	-			-
Norway	887	1,170	234	2304	841	44
Russia	881	648	345	121	84[3]	16
UK (England + Wales)	-	-	-			-
Estonia	-	-	22			
Total	3,366	2,617	2,544	2557	1175	60

[1]Preliminary.
[2]Included in Sub-area IV.
[3]Includes catches in Division Vb.

Table 6.2.2 Landings (t) of HORSE MACKEREL in Sub-area IV and Division IIIa by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	8	34	7	55	20	13	13	9	10
Denmark	199	3,576	1,612	1,590	23,730	22,495	18,652	7,290	20,323
Faroe Islands	260	-	-	-	-	-	-	-	-
France	292	421	567	366	827	298	231[2]	189[2]	784[2]
Germany, Fed.Rep.	+	139	30	52	+	+	-	3	153
Ireland	1,161	412	-	-	-	-	-	-	-
Netherlands	101	355	559	2,029[3]	824	160[3]	600[3]	850[4]	1,060[3]
Norway[2]	119	2,292	7	322	[3]	203	776	11,728[4]	34,425[4]
Poland	-	-	-	2	94	-	-	-	-
Sweden	-	-	-	-	-	-	2	-	-
UK (Engl. + Wales)	11	15	6	4	-	71	3	339	373
UK (Scotland)	-	-	-	-	3	998	531	487	5,749
USSR	-	-	-	-	489	-	-	-	-
Total	2,151	7,253	2,788	4,420	25,987	24,238	20,808	20,895	62,877

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	10	13	-	+	74	57	51	28	-
Denmark	23,329	20,605	6,982	7,755	6,120	3,921	2,432	1,433	648
Estonia	-	-	-	293	-		17	-	-
Faroe Islands	-	942	340	-	360	275	-	-	296
France	248	220	174	162	302		-	-	-
Germany, Fed.Rep.	506	2,469[5]	5,995	2,801	1,570	1,014	1,600	7	7,603
Ireland	-	687	2,657	2,600	4,086	415	220	1,100	8,152
Netherlands	14,172	1,970	3,852	3,000	2,470	1,329	5,285	6,205	37,778
Norway	84,161	117,903	50,000	96,000	126,800	94,000	84,747	14,639	45,314
Poland	-	-	-	-	-	-	-	-	-
Sweden	-	102	953	800	697	2,087	-	95	232
UK (Engl. + Wales)	10	10	132	4	115	389	478	40	242
UK (N. Ireland)	-	-	350	-	-		-	-	-
UK (Scotland)	2,093	458	7,309	996	1,059	7,582	3,650	2,442	10,511
USSR / Russia (1992 -)	-	-	-						
Unallocated + discards	12,482[4]	-317[4]	-750[4]	-278[6]	-3,270	1,511	-28	136	-31,615
Total	112,047	145,062	77,904	114,133	140,383	112,580	98,452	26,125	79,161

Country	1998	1999	2000	2001[1]
Belgium	19	21	19	19
Denmark	2,048	8,006	4,409	2,288
Estonia	22	-	-	
Faroe Islands	28	908	24	-
France	379	60	49	48
Germany	4,620	4,071	3,115	230
Ireland	-	404	103	375
Netherlands	3,811	3,610	3,382	4,685
Norway	13,129	44,344	1,246	7,948
Russia	-	-	2	-
Sweden	3,411	1,957	1,141	119
UK (Engl. + Wales)	2	11	15	317
UK (Scotland)	3,041	1,658	3,465	3,161
Unallocated + discards	737	-325	14613	649
Total	31,247	64,725	31583	19,839

[1]-Preliminary. [2] Includes Division IIa. [3] Estimated from biological sampling. [4] Assumed to be misreported. [5] Includes 13 t from the German Democratic Republic. [6] Includes a negative unallocated catch of -4,000 t.

Table 6.2.3 Landings (t) of HORSE MACKEREL in Sub-area VI by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Denmark	734	341	2,785	7	-	-	-	769	1,655
Faroe Islands	-	-	1,248	-	-	4,014	1,992	4,450[3]	4,000[3]
France	45	454	4	10	14	13	12	20	10
Germany, Fed. Rep.	5,550	10,212	2,113	4,146	130	191	354	174	615
Ireland	-	-	-	15,086	13,858	27,102	28,125	29,743	27,872
Netherlands	2,385	100	50	94	17,500	18,450	3,450	5,750	3,340
Norway	-	5	-	-	-		83	75	41
Spain	-	-	-	-	-		-[2]	-[2]	-[2]
UK (Engl. + Wales)	9	5	+	38	+	996	198	404	475
UK (N. Ireland)						-	-	-	-
UK (Scotland)	1	17	83	-	214	1,427	138	1,027	7,834
USSR	-	-	-		-	-	-	-	-
Unallocated + disc.						-19,168	-13,897	-7,255	-
Total	8,724	11,134	6,283	19,381	31,716	33,025	20,455	35,157	45,842

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	973	615	-	42	-	294	106	114	780
Faroe Islands	3,059	628	255	-	820	80	-	-	-
France	2	17	4	3	+	-	-	-	52
Germany, Fed. Rep.	1,162	2,474	2,500	6,281	10,023	1,430	1,368	943	229
Ireland	19,493	15,911	24,766	32,994	44,802	65,564	120,124	87,872	22,474
Netherlands	1,907	660	3,369	2,150	590	341	2,326	572	498
Norway	-	-	-	-	-	-	-	-	-
Spain	-[2]	-[2]	1	3	-	-	-	-	-
UK (Engl. + Wales)	44	145	1,229	577	144	109	208	612	56
UK (N.Ireland)	-	-	1,970	273	-	-	-	-	767
UK (Scotland)	1,737	267	1,640	86	4,523	1,760	789	2,669	14,452
USSR / Russia (1992 -)	-	44	-	-	-	-	-	-	-
Unallocated + disc.	6,493	143	-1,278	-1,940	-6,960[4]	-51	-41,326	-11,523	837
Total	34,870	20,904	34,456	40,469	53,942	69,527	83,595	81,259	40,145

Country	1998	1999	2000	2001[1]
Denmark	-	-	-	-
Faroe Islands	-	-	-	-
France	221	25,007	-	428
Germany	414	1,031	209	265
Ireland	21,608	31,736	15,843	20,162
Netherlands	885	1,139	687	600
Spain	-	-	-	-
UK (Engl. + Wales)	10	344	41	91
UK (N.Ireland)	1,132	-	-	
UK (Scotland)	10,447	4,544	1,839	3,111
Unallocated +disc.	98	1,507	2,038	-21
Total	34,815	65,308	20,657	24,636

[1]Preliminary.
[2]Included in Sub-area VII.
[3]Includes Divisions IIIa, IVa,b and VIb.
[4]Includes a negative unallocated catch of -7,000 t.

Table 6.2.4 Landings (t) of HORSE MACKEREL in Sub-area VII by country. Data submitted by the Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	-	1	1	-	-	+	+	2	-
Denmark	5,045	3,099	877	993	732	1,477[2]	30,408[2]	27,368	33,202
France	1,983	2,800	2,314	1,834	2,387	1,881	3,801	2,197	1,523
Germany, Fed.Rep.	2,289	1,079	12	1,977	228	-	5	374	4,705
Ireland	-	16	-	-	65	100	703	15	481
Netherlands	23,002	25,000	27,500[2]	34,350	38,700	33,550	40,750	69,400	43,560
Norway	394	-	-	-	-	-	-	-	-
Spain	50	234	104	142	560	275	137	148	150
UK (Engl. + Wales)	12,933	2,520	2,670	1,230	279	1,630	1,824	1,228	3,759
UK (Scotland)	1	-	-	-	1	1	+	2	2,873
USSR	-	-	-	-	-	120	-	-	-
Total	45,697	34,749	33,478	40,526	42,952	39,034	77,628	100,734	90,253

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Faroe Islands	-	28	-	-	-	-	-	-	-
Belgium	-	+	-	-	-	1	-	-	18
Denmark	34,474	30,594	28,888	18,984	16,978	41,605	28,300	43,330	60,412
France	4,576	2,538	1,230	1,198	1,001	-	-	-	27,201
Germany, Fed.Rep.	7,743	8,109	12,919	12,951	15,684	14,828	17,436	15,949	28,549
Ireland	12,645	17,887	19,074	15,568	16,363	15,281	58,011	38,455	43,624
Netherlands	43,582	111,900	104,107	109,197	157,110	92,903	116,126	114,692	81,464
Norway	-	-	-	-	-	-	-	-	-
Spain	14	16	113	106	54	29	25	33	-
UK (Engl. + Wales)	4,488	13,371	6,436	7,870	6,090	12,418	31,641	28,605	17,464
UK (N.Ireland)	-	-	2,026	1,690	587	119	-	-	1,093
UK (Scotland)	+	139	1,992	5,008	3,123	9,015	10,522	11,241	7,931
USSR / Russia (1992-)	-	-	-	-	-	-	-	-	-
Unallocated + discards	28,368	7,614	24,541	15,563	4,0103	14,057	68,644	26,795	58,718
Total	135,890	192,196	201,326	188,135	221,000	200,256	330,705	279,100	326,474

Country	1998	1999	2000	2001[1]
Faroe Islands	-	-	550	-
Belgium	18	-	-	-
Denmark	25,492	19,223	13,946	20,574
France	24,223	-	20,401	11,049
Germany	25,414	15,247	9,692	8,320
Ireland	51,720	25,843	32,999	30,192
Netherlands	91,946	56,223	50,120	46,196
Spain	-	-	50	7
UK (Engl. + Wales)	12,832	8,885	2,972	8,901
UK (N.Ireland)	-	-	-	-
UK (Scotland)	5,095	4,994	5,152	1,757
Unallocated + discards	12,706	31,239	1,884	11,046
Total	249,446	161,654	137,766	138,042

[1]Provisional.
[2]Includes Sub-area VI.

Table 6.2.5 Landings (t) of HORSE MACKEREL in Sub-area VIII by country.
(Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Denmark	-	-	-	-	-	-	446	3,283	2,793
France	3,361	3,711	3.073	2,643	2,489	4,305	3,534	3,983	4,502
Netherlands	-	-	-	-	-[2]	-[2]	-[2]	-[2]	-
Spain	34,134	36,362	19,610	25,580	23,119	23,292	40,334	30,098	26,629
UK (Engl. + Wales)	-	+	1	-	1	143	392	339	253
USSR	-	-	-	-	20	-	656	-	-
Total	37,495	40,073	22,684	28,223	25,629	27,740	45,362	37,703	34,177

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	6,729	5,726	1,349	5,778	1,955	-	340	140	729
France	4,719	5,082	6,164	6,220	4,010	28	-	7	8,690
Germany, Fed. Rep.	-	-	80	62	-		-	-	-
Netherlands	-	6,000	12,437	9,339	19,000	7,272	-	14,187	2,944
Spain	27,170	25,182	23,733	27,688	27,921	25,409	28,349	29,428	31,081
UK (Engl. + Wales)	68	6	70	88	123	753	20	924	430
USSR/Russia (1992 -)	-	-	-	-	-	-	-	-	-
Unallocated + discards	-	1,500	2,563	5,011	700	2,038	-	3,583	-2,944
Total	38,686	43,496	46,396	54,186	53,709	35,500	28,709	48,269	40,930

Country	1998	1999	2000	2001[1]
Denmark	1,728	4,818	2,584	582
France	1,844	74	7	5,316
Germany	3,268	3,197	3,760	3,645
Ireland	-	-	6,485	1,483
Netherlands	6,604	22,479	11,768	36,106
Russia	-	-	-	-
Spain	23,599	24,190	24,154	23,531
UK (Engl. + Wales)	9	29	112	1,092
UK (Scotland)	-	-	249	-
Unallocated + discards	1,884	-8658	5,093	4,365
Total	38,936	46,129	54,212	76,120

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

Table 6.4.1.1 Western horse mackerel catch in numbers (1000) at age by quarter and area in 2001

1.Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	4783	2533	20	0	0	35	506	4398	531	2009	14816
2	0	0	0	0	0	0	0	3939	2086	17	0	887	367	5228	45448	5488	1893	65352
3	0	0	0	0	0	0	0	1125	596	5	0	0	16	232	2013	243	473	4702
4	0	0	0	0	52	355	75	844	447	4	0	86	15	217	1890	228	493	4706
5	0	0	0	0	842	1263	323	2532	1341	11	59	1145	12	170	1475	178	1873	11224
6	0	0	0	0	3058	2129	678	3095	1639	17	2546	7496	8	107	930	112	4699	26514
7	0	0	0	319	6244	909	651	2251	1192	21	7845	18653	2	25	219	26	7970	46327
8	0	0	0	713	16535	1973	1499	1125	596	22	12168	7496	1	10	85	10	6087	48319
9	0	0	0	1335	7884	2271	950	563	298	7	3405	5610	0	1	10	1	3448	25784
10	0	0	0	942	3666	298	311	0	0	2	1273	1633	0	1	9	1	1014	9150
11	0	0	0	1615	3028	99	247	0	0	2	1273	1575	0	1	7	1	941	8789
12	0	0	0	2292	971	355	130	281	149	1	59	516	0	1	6	1	435	5197
13	0	0	0	3781	1187	99	91	0	0	0	59	1575	0	1	5	1	534	7333
14	0	0	0	2338	2893	653	306	563	298	2	59	1661	0	0	2	0	1070	9844
15+	0	0	0	4186	8387	951	711	0	0	0	118	13197	0	1	8	1	4408	31969

2. Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	114	13	0	183
1	0	0	0	0	0	0	0	0	0	0	0	0	1	4897	2575	1177	0	8649
2	0	0	0	0	0	0	0	0	0	0	0	0	6	50363	14535	12109	0	77013
3	0	0	0	0	0	0	0	0	0	0	0	0	2	13673	11367	3288	0	28330
4	1	0	0	19	19	24	1	0	0	0	0	0	1	9030	14918	2171	0	26184
5	2	0	0	53	133	175	9	0	0	0	0	0	1	6674	10675	1605	0	19326
6	6	0	0	186	230	304	15	0	3	0	18	1492	1	6738	12293	1620	1	22907
7	11	0	0	354	456	603	31	0	8	0	49	3979	1	7938	15306	1909	3	30647
8	16	0	0	496	865	1144	58	0	10	0	61	4973	1	5231	10195	1258	3	24310
9	8	0	0	245	374	494	25	0	12	0	73	5968	0	3292	6450	791	4	17736
10	2	0	0	66	145	192	10	0	5	0	27	2238	0	1308	2492	314	1	6801
11	2	0	0	72	111	146	7	0	2	0	12	995	0	105	89	25	1	1567
12	3	0	0	105	48	63	3	0	1	0	3	249	0	105	104	25	0	709
13	5	0	0	164	39	51	3	0	2	0	9	746	0	54	6	13	0	1091
14	3	0	0	99	72	95	5	0	0	0	0	0	0	30	19	7	0	329
15+	6	0	0	194	243	321	16	0	9	0	52	4227	0	71	39	17	3	5197

3. Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
1	0	0	0	0	0	0	0	6	89	0	0	0	0	0	0	58	0	153
2	0	0	0	0	0	0	0	88	1414	0	0	0	0	7	0	258	0	1767
3	0	0	0	11	0	0	0	152	2432	0	0	1	0	345	217	286	0	3444
4	0	0	0	641	121	0	0	78	1248	0	0	0	0	6	0	392	27	2512
5	0	0	6	1566	403	0	1	54	865	0	0	0	0	1004	652	302	168	5022
6	2	2	49	5870	882	0	1	59	952	0	0	0	0	338	217	332	221	8927
7	7	7	169	10660	1558	0	1	80	1280	0	0	0	0	3007	1957	474	449	19649
8	10	10	263	13365	2504	0	2	54	870	0	0	0	0	2338	1522	323	737	22001
9	17	17	422	4374	817	0	1	29	466	0	0	0	0	1002	652	194	312	8303
10	13	13	334	933	164	0	0	10	166	0	0	0	0	1	0	66	88	1790
11	4	4	98	142	98	0	0	7	114	0	0	0	0	334	217	10	48	1076
12	11	11	276	314	70	0	0	2	28	0	0	0	0	0	0	3	42	757
13	3	3	86	199	95	0	0	2	28	0	0	0	0	0	0	0	21	439
14	6	6	157	35	80	0	0	2	28	0	0	0	0	0	0	0	18	332
15+	43	43	1068	653	312	0	0	11	171	0	0	0	0	1	0	1	95	2397

4. Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	8023	175	0	824	0	0	1494	1953	258	421	13149
2	0	0	0	0	0	0	0	24360	2786	0	6180	0	0	14449	21395	2830	6045	78046
3	0	0	0	0	291	0	0	33825	4793	0	6592	0	0	4321	40881	5408	10106	106217
4	0	0	0	1497	555	0	0	17739	2460	0	5030	0	0	3098	18777	2484	5434	57073
5	0	0	56	3559	1444	0	0	15084	1705	0	6848	0	0	3789	18777	2484	4305	58051
6	0	1	457	5517	4788	0	0	17043	1877	0	2146	0	0	1406	10343	1368	5066	50013
7	0	4	1591	14223	7382	0	0	20175	2523	0	12958	0	0	6550	36266	4798	7930	114399
8	0	5	2468	16030	11179	0	0	13138	1715	0	12958	0	0	6173	21329	2822	7242	95061
9	0	9	3958	7179	7641	0	0	6983	919	0	5200	0	0	2392	5149	681	4176	44287
10	0	7	3139	1489	2502	0	0	2193	326	0	0	0	0	17	644	85	1265	11667
11	0	2	919	629	700	0	0	1509	225	0	0	0	0	47	1953	258	609	6850
12	0	6	2591	0	419	0	0	780	56	0	1734	0	0	759	0	0	365	6708
13	0	2	810	690	473	0	0	377	56	0	0	0	0	16	644	85	227	3380
14	0	3	1474	107	538	0	0	1182	56	0	0	0	0	0	0	0	245	3606
15+	0	22	10024	2613	3780	0	0	2263	337	0	3467	0	0	1516	0	0	1934	25955

Total year 2001

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	114	17	0	186
1	0	0	0	0	0	0	0	12811	2798	20	824	0	36	6897	8926	2024	2430	36767
2	0	0	0	0	0	0	0	28387	6286	17	6180	887	373	70046	81379	20685	7938	222178
3	0	0	0	12	291	0	0	35101	7821	5	6592	1	18	18571	54479	9224	10579	142694
4	1	0	0	2157	746	379	77	18661	4155	4	5030	86	16	12352	35584	5275	5954	90475
5	2	0	62	5178	2821	1439	333	17670	3912	11	6908	1145	13	11637	31578	4569	6346	93623
6	8	3	506	11573	8958	2433	694	20198	4472	17	4710	8988	8	8589	23783	3433	9987	108360
7	18	10	1760	25556	15641	1512	683	22505	5003	21	20852	22632	3	17520	53747	7206	16352	211022
8	27	16	2731	30604	31083	3116	1559	14317	3192	22	25187	12470	1	13751	33132	4413	14069	189691
9	25	26	4380	13133	16716	2765	976	7575	1696	7	8678	11578	1	6687	12261	1668	7940	96110
10	15	20	3473	3430	6477	490	321	2204	496	2	1300	3871	0	1327	3145	467	2370	29408
11	6	6	1017	2457	3937	245	255	1516	340	2	1285	2569	0	487	2266	294	1599	18282
12	14	17	2867	2712	1508	418	134	1063	234	1	1796	764	0	865	110	29	842	13372
13	9	5	896	4834	1793	150	94	379	86	0	68	2321	0	71	655	99	782	12243
14	9	10	1631	2577	3582	748	311	1747	383	2	59	1661	0	30	21	8	1332	14111
15+	49	65	11092	7646	12721	1272	728	2274	516	0	3637	17424	0	1588	46	19	6439	65517

Table 6.4.2.1 Western horse mackerel mean weight (Kg) at age in catch by quarter and area in 2001

1.Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0																		
1								0.048	0.048	0.048			0.023	0.023	0.023	0.023	0.048	0.039
2								0.064	0.064	0.064		0.065	0.039	0.039	0.039	0.039	0.065	0.042
3								0.089	0.089	0.089			0.073	0.073	0.073	0.073	0.089	0.081
4					0.096	0.101	0.098	0.103	0.103	0.103		0.119	0.113	0.113	0.113	0.113	0.112	0.109
5					0.149	0.132	0.131	0.113	0.113	0.116	0.121	0.118	0.126	0.126	0.126	0.126	0.122	0.123
6					0.126	0.137	0.133	0.119	0.119	0.124	0.130	0.133	0.135	0.135	0.135	0.135	0.130	0.129
7				0.266	0.145	0.152	0.153	0.125	0.125	0.127	0.130	0.139	0.135	0.135	0.135	0.135	0.139	0.139
8				0.295	0.190	0.160	0.180	0.148	0.148	0.149	0.149	0.171	0.167	0.167	0.167	0.167	0.167	0.172
9				0.311	0.211	0.179	0.194	0.237	0.237	0.205	0.158	0.181	0.234	0.234	0.234	0.234	0.189	0.197
10				0.330	0.234	0.199	0.226			0.183	0.183	0.197	0.259	0.259	0.259	0.259	0.202	0.225
11				0.314	0.206	0.178	0.218			0.200	0.200	0.188	0.269	0.269	0.269	0.269	0.195	0.221
12				0.351	0.352	0.164	0.277	0.286	0.286	0.253	0.204	0.245	0.288	0.288	0.288	0.288	0.250	0.310
13				0.350	0.292	0.259	0.279			0.193	0.193	0.193	0.306	0.306	0.306	0.306	0.214	0.294
14				0.363	0.281	0.196	0.247	0.204	0.204	0.218	0.238	0.209	0.312	0.312	0.312	0.312	0.217	0.268
15+				0.397	0.302	0.231	0.261			0.184	0.184	0.266	0.378	0.378	0.378	0.378	0.251	0.289

2. Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0													0.041	0.041	0.041	0.041		0.041
1													0.040	0.040	0.048	0.040		0.042
2													0.061	0.061	0.064	0.061		0.061
3	0.138			0.138									0.071	0.071	0.073	0.071		0.072
4	0.167			0.167	0.134	0.134	0.134						0.095	0.095	0.082	0.095		0.088
5	0.169			0.169	0.148	0.148	0.148						0.109	0.109	0.099	0.109		0.105
6	0.175			0.175	0.151	0.151	0.151		0.144		0.144	0.144	0.121	0.121	0.111	0.121	0.144	0.118
7	0.225			0.225	0.166	0.166	0.166		0.169		0.169	0.169	0.125	0.125	0.114	0.125	0.169	0.128
8	0.244			0.244	0.191	0.191	0.191		0.151		0.151	0.151	0.141	0.141	0.116	0.141	0.151	0.139
9	0.255			0.255	0.195	0.195	0.195		0.184		0.184	0.184	0.168	0.168	0.129	0.168	0.184	0.162
10	0.277			0.277	0.227	0.227	0.227		0.213		0.213	0.213	0.196	0.196	0.154	0.196	0.213	0.188
11	0.274			0.274	0.222	0.222	0.222		0.216		0.216	0.216	0.261	0.261	0.259	0.261	0.216	0.226
12	0.283			0.283	0.264	0.264	0.264		0.210		0.210	0.210	0.286	0.286	0.283	0.286	0.210	0.255
13	0.296			0.296	0.255	0.255	0.255		0.211		0.211	0.211	0.306	0.306	0.306	0.306	0.211	0.234
14	0.326			0.326	0.265	0.265	0.265						0.320	0.320	0.314	0.320		0.292
15+	0.316			0.316	0.247	0.247	0.247		0.256		0.256	0.256	0.485	0.485	0.544	0.485	0.256	0.263

3. Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0																0.041		0.041
1								0.074	0.074		0.074	0.074		0.074		0.051		0.065
2								0.097	0.097		0.097	0.097		0.097		0.069		0.093
3				0.138				0.110	0.110		0.110	0.110		0.085	0.084	0.074		0.103
4				0.167	0.171		0.171	0.128	0.128		0.128	0.128		0.128		0.081	0.171	0.133
5	0.273	0.273	0.273	0.170	0.174		0.166	0.143	0.143		0.143	0.143		0.103	0.103	0.099	0.166	0.139
6	0.328	0.328	0.328	0.179	0.179		0.172	0.159	0.159		0.159	0.159		0.109	0.108	0.110	0.172	0.170
7	0.305	0.305	0.305	0.189	0.188		0.179	0.163	0.163		0.163	0.163		0.104	0.104	0.113	0.179	0.164
8	0.317	0.317	0.317	0.197	0.199		0.192	0.160	0.160		0.160	0.160		0.127	0.127	0.116	0.192	0.183
9	0.347	0.347	0.347	0.203	0.205		0.189	0.199	0.199		0.199	0.199		0.138	0.138	0.129	0.189	0.196
10	0.366	0.366	0.366	0.215	0.236		0.215	0.200	0.200		0.200	0.200		0.200		0.153	0.215	0.244
11	0.358	0.358	0.358	0.227	0.228		0.205	0.241	0.241		0.241	0.241		0.114	0.114	0.247	0.205	0.183
12	0.394	0.394	0.394	0.204	0.207		0.198	0.417	0.417		0.417	0.417		0.417		0.283	0.198	0.288
13	0.360	0.360	0.360	0.232	0.218		0.218	0.224	0.224		0.224	0.224		0.224		0.000	0.218	0.255
14	0.385	0.385	0.385	0.282	0.248		0.248	0.285	0.285		0.285	0.285		0.285		0.312	0.248	0.325
15+	0.418	0.418	0.418	0.221	0.234		0.217	0.319	0.319		0.319	0.319		0.319		0.570	0.217	0.325

4. Quarter

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0																		
1								0.052	0.074		0.081			0.038	0.060	0.060	0.075	0.055
2								0.089	0.097		0.097			0.052	0.098	0.098	0.097	0.086
3					0.158			0.109	0.110		0.107			0.104	0.112	0.112	0.122	0.112
4				0.174	0.170			0.126	0.128		0.127			0.124	0.119	0.119	0.138	0.126
5		0.273	0.273	0.182	0.173			0.136	0.143		0.164	0.121		0.156	0.126	0.126	0.153	0.142
6		0.328	0.328	0.183	0.181			0.149	0.159		0.175	0.130		0.162	0.133	0.133	0.166	0.157
7		0.305	0.305	0.194	0.190			0.157	0.163		0.176	0.130		0.171	0.137	0.137	0.171	0.163
8		0.317	0.317	0.197	0.204			0.159	0.160		0.177	0.149		0.174	0.143	0.143	0.173	0.175
9		0.347	0.347	0.211	0.213			0.204	0.199		0.187	0.158		0.185	0.144	0.144	0.202	0.208
10		0.366	0.366	0.216	0.236			0.200	0.200			0.183		0.156	0.140	0.140	0.210	0.252
11		0.358	0.358	0.264	0.258			0.241	0.241			0.200		0.139	0.134	0.134	0.247	0.226
12		0.394	0.394	0.000	0.255			0.349	0.417		0.191	0.204		0.191			0.354	0.303
13		0.360	0.360	0.280	0.260			0.224	0.224			0.193		0.175	0.163	0.163	0.235	0.260
14		0.385	0.385	0.235	0.302			0.230	0.285			0.238		0.312			0.290	0.309
15+		0.418	0.418	0.275	0.276			0.319	0.319		0.197	0.184		0.197			0.296	0.321

tal year 2001

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
0													0.041	0.041	0.041	0.041		0.041
1								0.050	0.050	0.048	0.081	0.074	0.024	0.038	0.038	0.038	0.053	0.045
2								0.086	0.086	0.064	0.097	0.065	0.039	0.057	0.059	0.060	0.089	0.065
3	0.138			0.138	0.158			0.109	0.109	0.089	0.107	0.110	0.073	0.079	0.103	0.096	0.120	0.103
4	0.167			0.172	0.164	0.103	0.099	0.125	0.125	0.103	0.127	0.119	0.111	0.102	0.103	0.106	0.136	0.114
5	0.182	0.273	0.273	0.178	0.165	0.134	0.131	0.133	0.133	0.116	0.164	0.118	0.125	0.124	0.117	0.118	0.144	0.132
6	0.213	0.328	0.328	0.181	0.161	0.139	0.133	0.144	0.144	0.124	0.151	0.134	0.134	0.128	0.122	0.126	0.149	0.143
7	0.255	0.305	0.305	0.193	0.171	0.158	0.154	0.153	0.154	0.127	0.159	0.144	0.131	0.139	0.129	0.132	0.156	0.152
8	0.273	0.317	0.317	0.200	0.196	0.171	0.180	0.158	0.158	0.149	0.164	0.163	0.154	0.154	0.134	0.141	0.171	0.171
9	0.317	0.347	0.347	0.219	0.211	0.182	0.194	0.206	0.206	0.205	0.176	0.182	0.178	0.170	0.136	0.154	0.196	0.196
10	0.354	0.366	0.366	0.248	0.235	0.210	0.226	0.200	0.200	0.183	0.184	0.206	0.215	0.195	0.151	0.180	0.207	0.228
11	0.326	0.358	0.358	0.295	0.216	0.204	0.218	0.241	0.241	0.200	0.200	0.199	0.268	0.149	0.137	0.149	0.215	0.221
12	0.368	0.394	0.394	0.331	0.316	0.179	0.276	0.333	0.333	0.253	0.192	0.234	0.287	0.203	0.284	0.286	0.292	0.302
13	0.321	0.360	0.360	0.333	0.279	0.258	0.278	0.224	0.224	0.193	0.195	0.199	0.306	0.276	0.166	0.183	0.220	0.278
14	0.365	0.385	0.385	0.355	0.283	0.205	0.247	0.222	0.222	0.218	0.238	0.209	0.314	0.320	0.314	0.320	0.231	0.280
15+	0.405	0.418	0.418	0.338	0.292	0.235	0.261	0.319	0.318	0.184	0.197	0.263	0.391	0.210	0.516	0.484	0.264	0.301

Table 6.4.2.2 Western horse mackerel mean length (cm) at age in catch by quarter and area in 2001

Ages	IIa	IIIa	IVa	VIa	VIIb	VIIc	VIIbc	VIIe	VIIef	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIab	VIIa-c e-k	Total
1.Quarter																		
0																		
1								18.6	18.6	18.6			13.7	13.7	13.7	13.7	18.6	16.8
2								20.4	20.4	20.4		21.5	16.5	16.5	16.5	16.5	21.3	17.1
3								22.8	22.8	22.8			20.6	20.6	20.6	20.6	22.8	21.6
4					23.5	24.5	23.9	23.8	23.8	23.8		24.5	24.0	24.0	24.0	24.0	24.3	24.0
5					26.7	25.9	25.8	25.1	25.1	25.2	25.5	25.5	25.0	25.0	25.0	25.0	25.5	25.4
6					26.0	26.7	26.2	25.6	25.6	26.0	26.5	26.6	25.6	25.6	25.6	25.6	26.3	26.2
7				31.2	26.8	27.8	27.4	25.8	25.8	26.0	26.4	27.0	25.5	25.5	25.5	25.5	26.8	26.8
8				32.5	29.2	28.3	28.9	26.8	26.8	26.9	27.2	28.7	27.5	27.5	27.5	27.5	28.3	28.4
9				33.1	30.0	29.3	29.6	31.5	31.5	29.9	27.6	29.2	31.0	31.0	31.0	31.0	29.4	29.6
10				34.0	31.2	30.2	31.0			29.5	29.5	30.3	32.1	32.1	32.1	32.1	30.3	31.0
11				33.2	30.1	28.5	30.3			30.4	30.4	29.7	32.6	32.6	32.6	32.6	29.8	30.6
12				34.7	35.1	28.5	32.5	31.5	31.5	31.1	30.5	31.7	33.3	33.3	33.3	33.3	31.5	33.4
13				34.7	33.0	32.5	32.8			30.5	30.5	30.0	34.1	34.1	34.1	34.1	30.8	33.0
14				35.2	32.7	30.4	31.8	29.5	29.5	30.7	32.5	30.8	34.3	34.3	34.3	34.3	30.9	32.3
15+				36.5	33.4	31.5	32.4			30.0	30.0	32.5	36.6	36.6	36.6	36.6	32.1	33.1
2. Quarter																		
Ages	**IIa**	**IIIa**	**IVa**	**VIa**	**VIIb**	**VIIc**	**VIIbc**	**VIIe**	**VIIef**	**VIIg**	**VIIh**	**VIIj**	**VIIk**	**VIIIa**	**VIIIb**	**VIIIab**	**VIIa-c e-k**	**Total**
0													18.5	18.5	18.5	18.5		18.5
1													16.7	16.7	18.0	16.7		17.1
2													19.4	19.4	19.8	19.4		19.5
3	24.5			24.5									20.8	20.8	21.1	20.8		20.9
4	26.6			26.6	25.2	25.2	25.2						22.8	22.8	21.8	22.8		22.2
5	26.9			26.9	26.3	26.3	26.3						23.9	23.9	23.3	23.9		23.6
6	27.3			27.3	26.5	26.5	26.5		26.5		26.5	26.5	25.0	25.0	24.5	25.0	26.5	24.9
7	29.6			29.6	27.4	27.4	27.4		27.7		27.7	27.7	25.1	25.1	24.6	25.1	27.7	25.3
8	30.4			30.4	28.8	28.8	28.8		27.4		27.4	27.4	26.0	26.0	24.6	26.0	27.4	26.0
9	31.0			31.0	29.3	29.3	29.3		28.8		28.8	28.8	27.4	27.4	25.2	27.4	28.8	27.2
10	32.0			32.0	30.8	30.8	30.8		30.1		30.1	30.1	28.9	28.9	26.8	28.9	30.1	28.6
11	32.0			32.0	30.6	30.6	30.6		30.5		30.5	30.5	31.5	31.5	31.0	31.5	30.5	30.7
12	32.1			32.1	31.8	31.8	31.8		30.5		30.5	30.5	32.9	32.9	32.6	32.9	30.5	31.7
13	32.9			32.9	31.4	31.4	31.4		30.2		30.2	30.2	34.1	34.1	34.1	34.1	30.2	30.9
14	34.4			34.4	32.1	32.1	32.1						32.3	32.3	31.0	32.3		32.7
15+	33.5			33.5	31.2	31.2	31.2		32.3		32.3	32.3	39.0	39.0	40.4	39.0	32.3	32.4
3. Quarter																		
Ages	**IIa**	**IIIa**	**IVa**	**VIa**	**VIIb**	**VIIc**	**VIIbc**	**VIIe**	**VIIef**	**VIIg**	**VIIh**	**VIIj**	**VIIk**	**VIIIa**	**VIIIb**	**VIIIab**	**VIIa-c e-k**	**Total**
0																18.5		18.5
1								20.3	20.3		20.3	20.3		20.3		18.7		19.7
2								22.1	22.1		22.1	22.1		22.1		20.6		21.9
3				24.5				23.2	23.2		23.2	23.2		21.6	21.5	21.2		22.7
4				26.6	26.9		26.9	24.4	24.4		24.4	24.4		24.4		21.8	26.9	24.7
5	29.5	29.5	29.5	26.8	27.2		26.9	25.4	25.4		25.4	25.4		23.2	23.2	23.3	26.9	25.2
6	31.5	31.5	31.5	27.5	27.4		26.9	26.2	26.2		26.2	26.2		22.5	22.5	24.3	26.9	26.9
7	31.3	31.3	31.3	28.1	27.9		27.6	26.7	26.7		26.7	26.7		23.5	23.5	24.5	27.6	26.7
8	31.7	31.7	31.7	28.6	28.7		28.3	26.4	26.4		26.4	26.4		24.5	24.5	24.5	28.3	27.8
9	32.6	32.6	32.6	29.1	29.1		28.8	28.1	28.1		28.1	28.1		25.2	25.2	25.1	28.8	28.3
10	33.4	33.4	33.4	29.7	30.9		30.2	28.9	28.9		28.9	28.9		28.9		26.7	30.2	30.4
11	32.8	32.8	32.8	30.5	30.5		30.1	29.8	29.8		29.8	29.8		24.5	24.5	30.4	30.1	27.6
12	33.7	33.7	33.7	29.0	29.3		29.4	35.5	35.5		35.5	35.5		35.5		32.5	29.4	31.2
13	33.1	33.1	33.1	30.8	29.7		29.7	30.5	30.5		30.5	30.5		30.5			29.7	31.0
14	34.0	34.0	34.0	33.5	31.4		31.4	31.5	31.5		31.5	31.5		31.5		30.5	31.4	33.0
15+	34.9	34.9	34.9	30.1	30.7		29.7	32.3	32.3		32.3	32.3		32.3		41.0	29.7	32.6
4. Quarter																		
Ages	**IIa**	**IIIa**	**IVa**	**VIa**	**VIIb**	**VIIc**	**VIIbc**	**VIIe**	**VIIef**	**VIIg**	**VIIh**	**VIIj**	**VIIk**	**VIIIa**	**VIIIb**	**VIIIab**	**VIIa-c e-k**	**Total**
0																		
1								18.9	20.3		20.5			15.5	19.5	19.5	20.3	18.8
2								21.7	22.1		22.3			17.8	22.5	22.5	22.2	21.3
3					26.7			23.2	23.2		23.3			23.0	23.6	23.6	24.1	23.4
4				27.4	27.4			24.4	24.4		24.5			24.4	24.3	24.3	25.2	24.5
5		29.5	29.5	27.8	27.5			25.3	25.4		26.6	25.5		26.2	24.4	24.4	26.1	25.4
6		31.5	31.5	27.9	27.9			26.1	26.2		26.9	26.5		26.3	24.8	24.8	26.8	26.3
7		31.3	31.3	28.5	28.4			26.5	26.7		27.0	26.4		26.8	25.4	25.4	27.2	26.7
8		31.7	31.7	28.6	29.2			26.4	26.4		27.3	27.2		27.1	25.6	25.6	27.2	27.3
9		32.6	32.6	29.3	29.7			28.5	28.1		28.5	27.6		28.4	26.0	26.0	28.5	28.8
10		33.4	33.4	29.6	30.8			28.9	28.9			29.5		26.4	25.5	25.5	29.4	30.4
11		32.8	32.8	31.6	31.8			29.8	29.8			30.4		25.8	25.5	25.5	30.4	29.2
12		33.7	33.7		31.4			33.4	35.5		27.5	30.5		27.5			33.7	31.2
13		33.1	33.1	31.6	31.8			30.5	30.5			30.5		27.1	26.5	26.5	30.9	30.7
14		34.0	34.0	30.5	33.5			30.1	31.5			32.5		34.3			32.1	32.4
15+		34.9	34.9	31.5	32.4			32.3	32.3		28.5	30.0		28.5			32.0	32.5
year 2001																		
Ages	**IIa**	**IIIa**	**IVa**	**VIa**	**VIIb**	**VIIc**	**VIIbc**	**VIIe**	**VIIef**	**VIIg**	**VIIh**	**VIIj**	**VIIk**	**VIIIa**	**VIIIb**	**VIIIab**	**VIIa-c e-k**	**Total**
0													18.5	18.5	18.5	18.5		18.5
1								18.8	18.8	18.6	20.5	20.3	13.8	16.2	16.2	16.3	18.9	17.6
2								21.6	21.6	20.4	22.3	21.5	16.5	18.9	18.7	19.1	22.0	19.4
3	24.5			24.5	26.7			23.1	23.1	22.8	23.3	23.2	20.6	21.3	22.9	22.4	24.0	22.8
4	26.6			27.2	27.0	24.5	23.9	24.4	24.4	23.8	24.5	24.5	23.9	23.2	23.2	23.4	25.1	23.8
5	27.2	29.5	29.5	27.5	27.2	25.9	25.8	25.3	25.3	25.2	26.6	25.5	24.9	24.6	24.0	24.2	25.9	25.1
6	28.3	31.5	31.5	27.7	27.2	26.6	26.2	26.0	26.0	26.0	26.7	26.5	25.5	25.1	24.7	24.9	26.6	26.0
7	30.2	31.3	31.3	28.4	27.7	27.6	27.4	26.5	26.5	26.0	26.8	27.1	25.4	25.5	25.1	25.3	27.0	26.5
8	30.9	31.7	31.7	28.7	29.1	28.5	28.9	26.5	26.5	26.9	27.2	28.2	26.8	26.3	25.3	25.7	27.7	27.5
9	32.1	32.6	32.6	29.6	29.8	29.3	29.6	28.7	28.7	29.9	28.1	29.0	27.9	27.4	25.5	26.5	28.9	28.7
10	33.2	33.4	33.4	30.9	31.0	30.4	31.0	28.9	28.9	29.5	29.5	30.2	29.9	28.9	26.5	28.0	29.8	30.2
11	32.5	32.8	32.8	32.6	30.4	29.8	30.3	29.8	29.8	30.4	30.4	30.0	32.4	26.2	25.6	26.2	30.0	29.9
12	33.3	33.7	33.7	34.0	33.7	29.0	32.4	32.9	32.9	31.1	27.6	31.3	33.2	28.2	32.6	32.9	32.4	32.1
13	33.0	33.1	33.1	34.0	32.5	32.1	32.8	30.5	30.5	30.5	30.5	30.1	34.1	32.5	26.6	27.5	30.8	32.1
14	34.1	34.0	34.0	34.9	32.8	30.6	31.8	29.9	29.9	30.7	32.5	30.8	33.9	32.4	31.3	32.3	31.1	32.4
15+	34.7	34.9	34.9	34.1	33.0	31.5	32.4	32.3	32.3	30.0	28.6	32.4	36.9	29.0	39.8	39.0	32.0	32.8

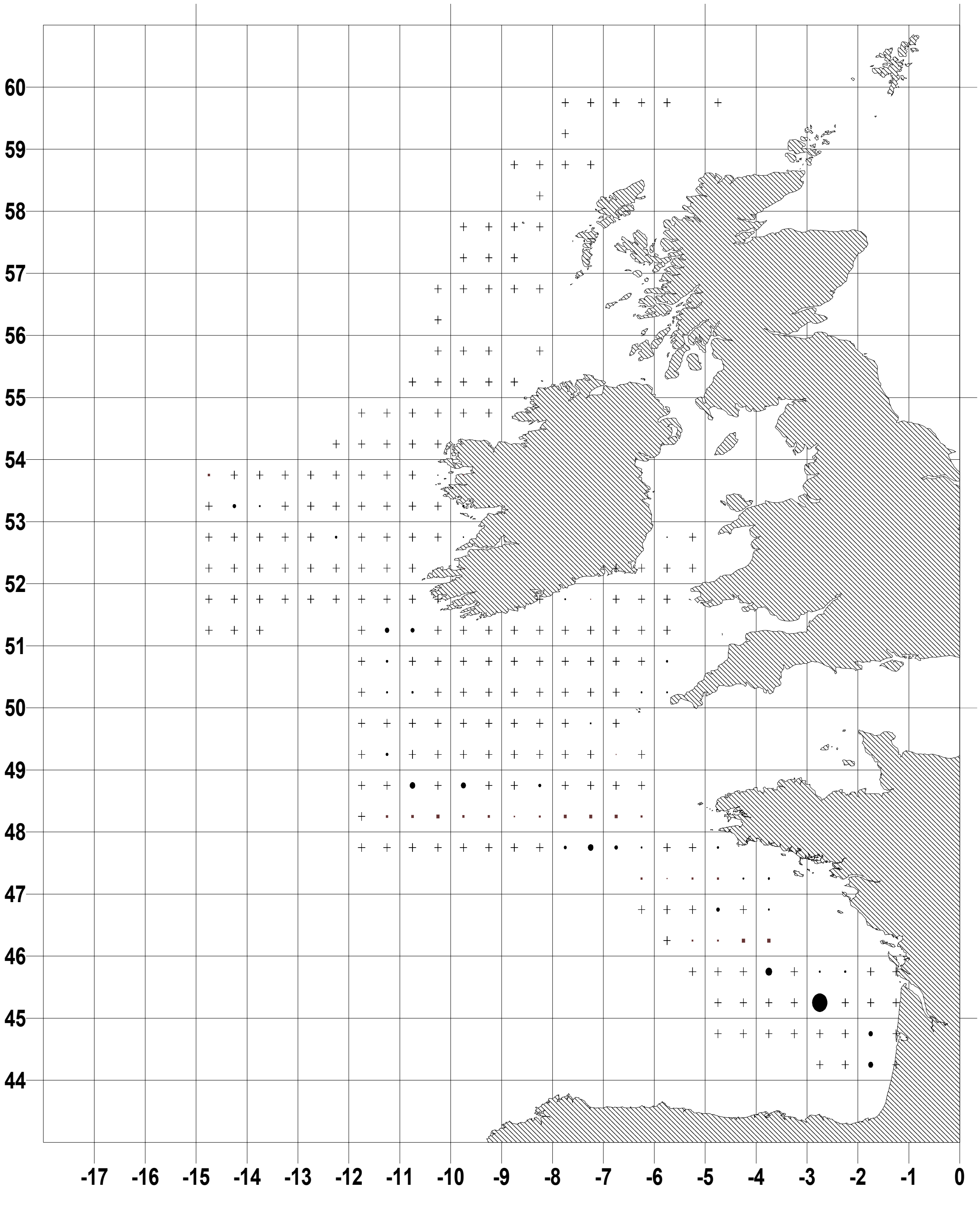


Figure 6.3.1.1. Horse mackerel egg production by rectangle for period 3 (12 March – 8 April). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 500 eggs $m^{-2}.day^{-1}$.

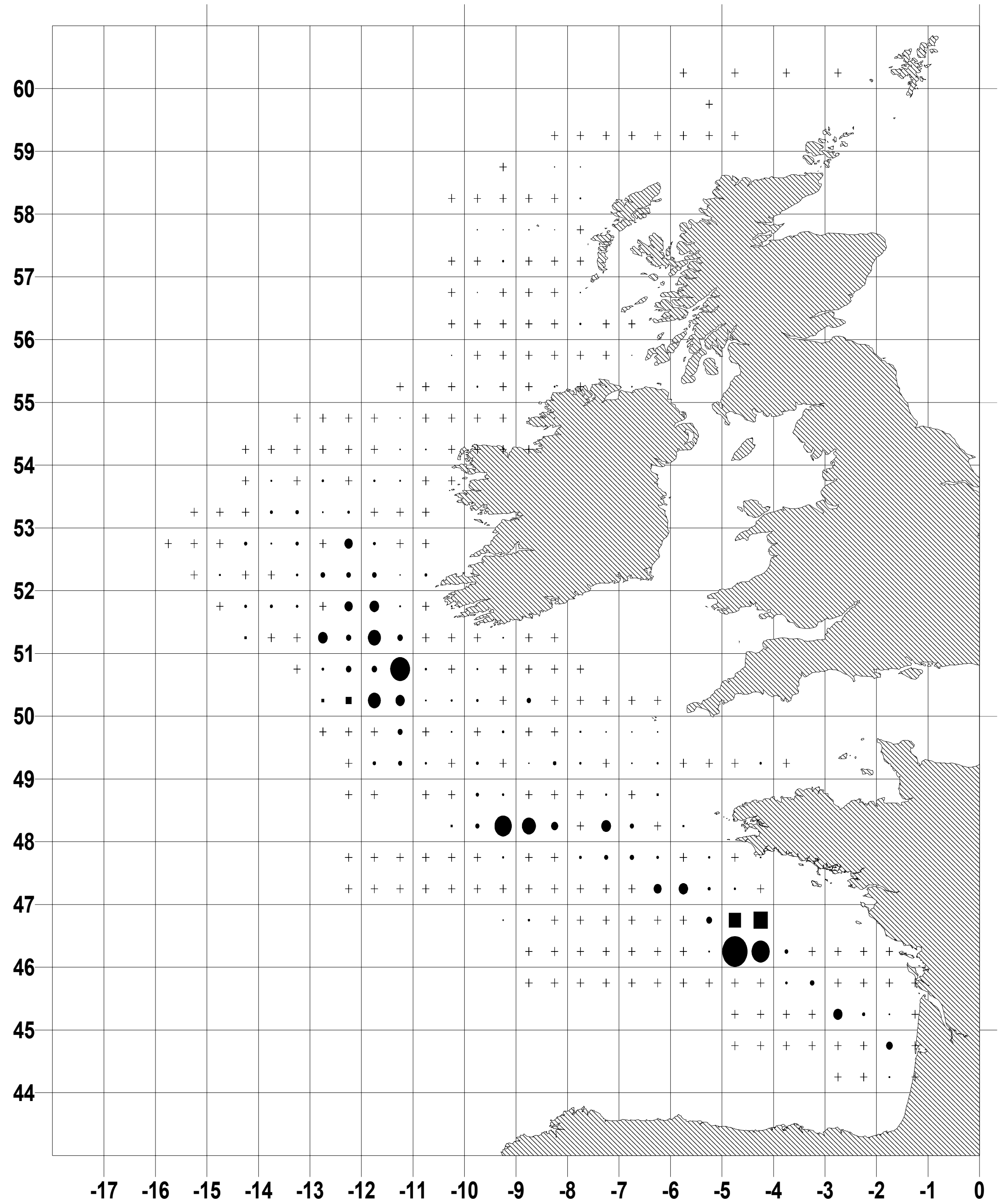


Figure 6.3.1.2. Horse mackerel egg production by rectangle for period 4 (9 April – 13 May). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 500 eggs $m^{-2}.day^{-1}$.

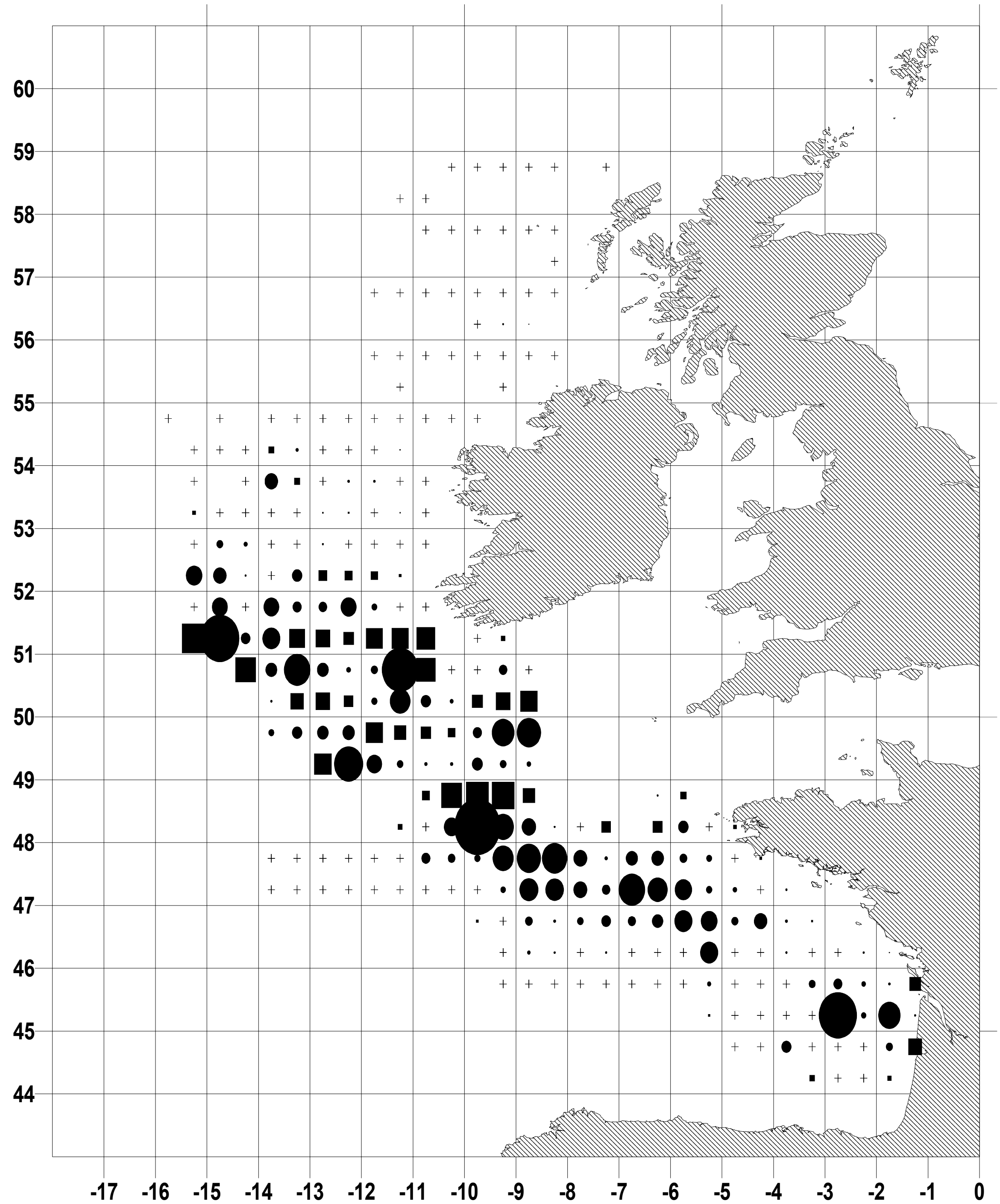


Figure 6.3.1.3. Horse mackerel egg production by rectangle for period 5 (14 May – 10 June). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 500 eggs $m^{-2}.day^{-1}$.

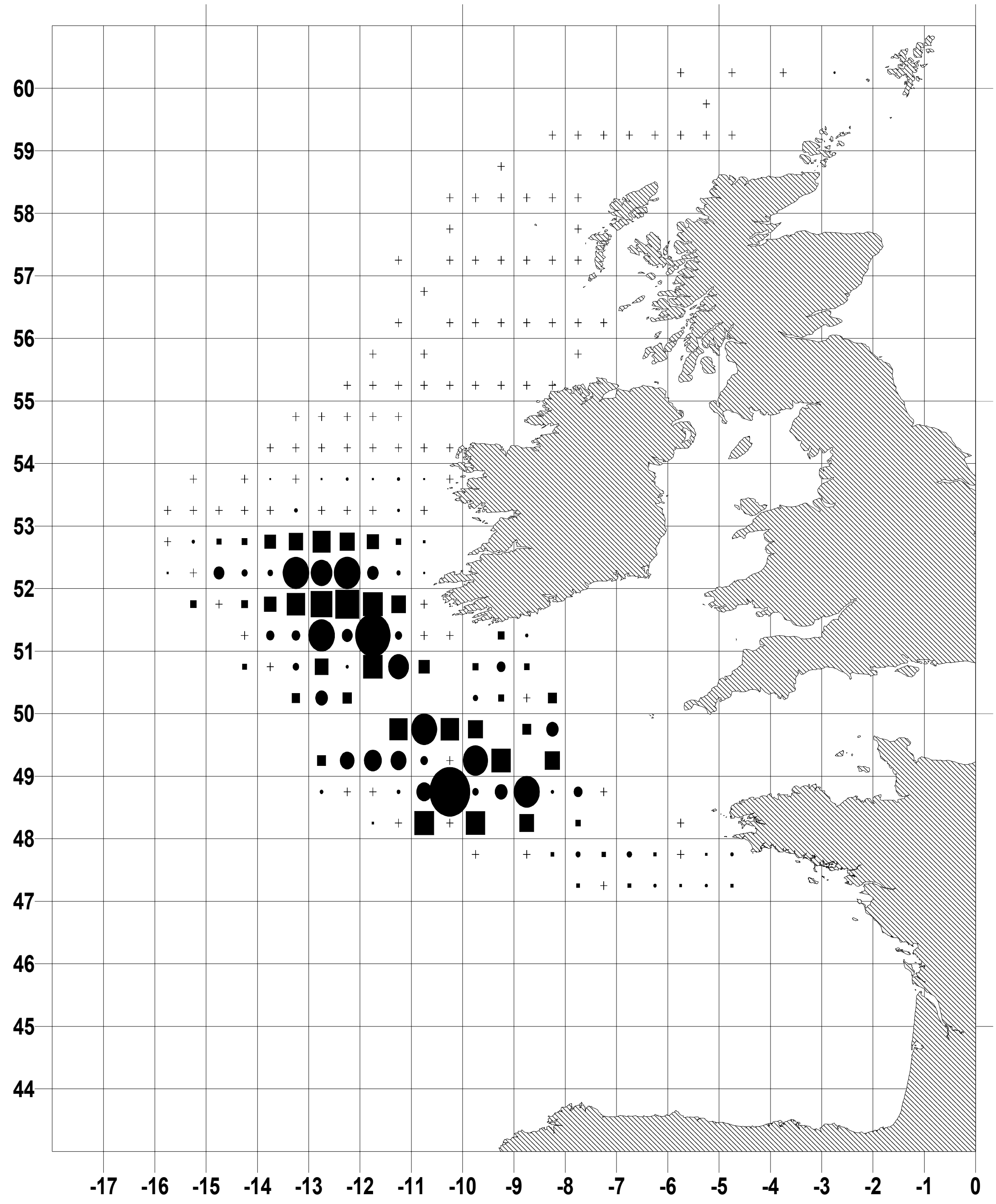


Figure 6.3.1.4. Horse mackerel egg production by rectangle for period 6 (11 June – 1 July). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 500 eggs $m^{-2}.day^{-1}$.

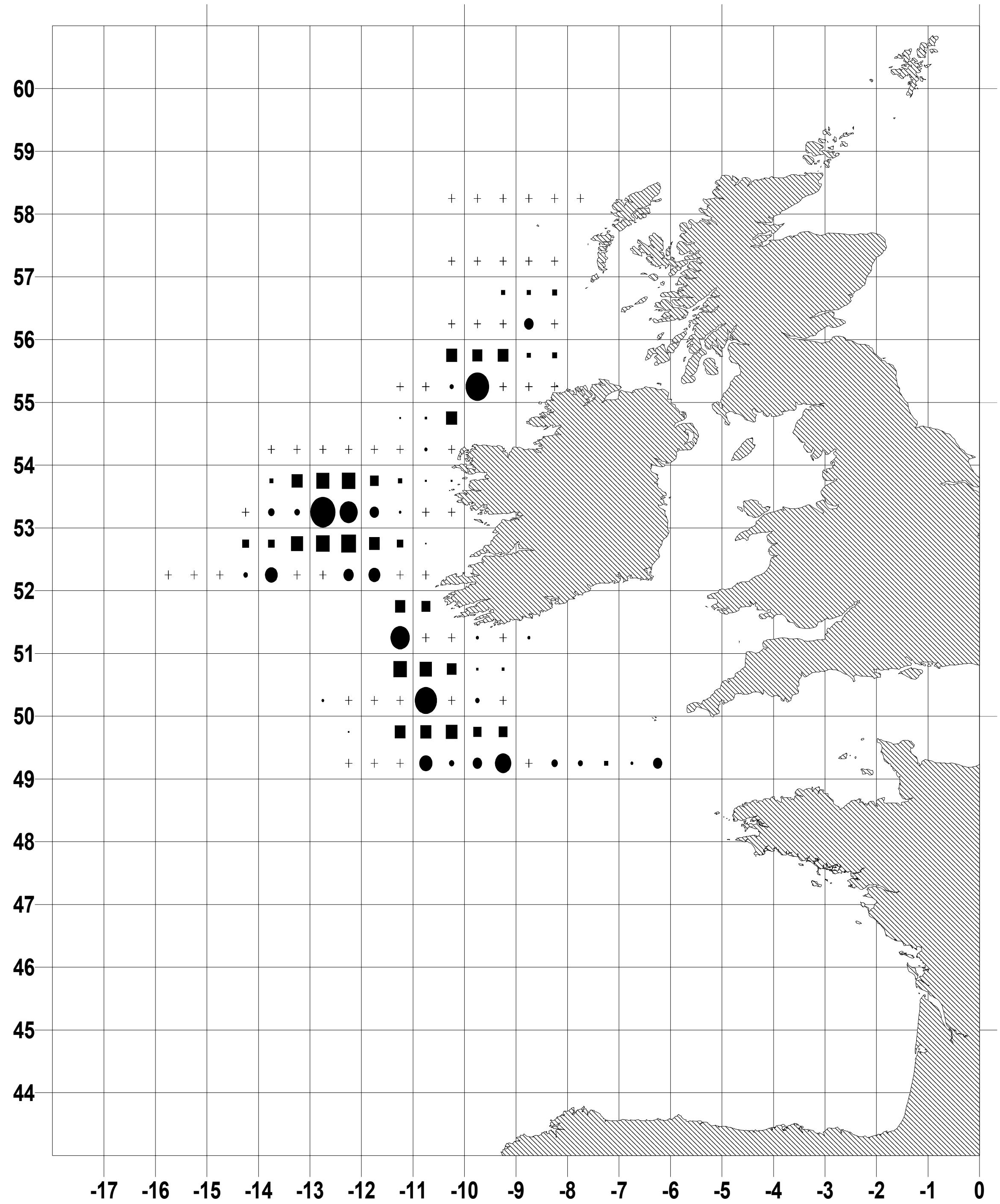


Figure 6.3.1.5. Horse mackerel egg production by rectangle for period 7 (2 July – 1 August). Filled circles represent observed values, filled squares represent interpolated values, crosses represent observed zeroes. Interpolated zeroes are not included. Circles and squares are square root scaled to a maximum of 500 eggs $m^{-2}.day^{-1}$.

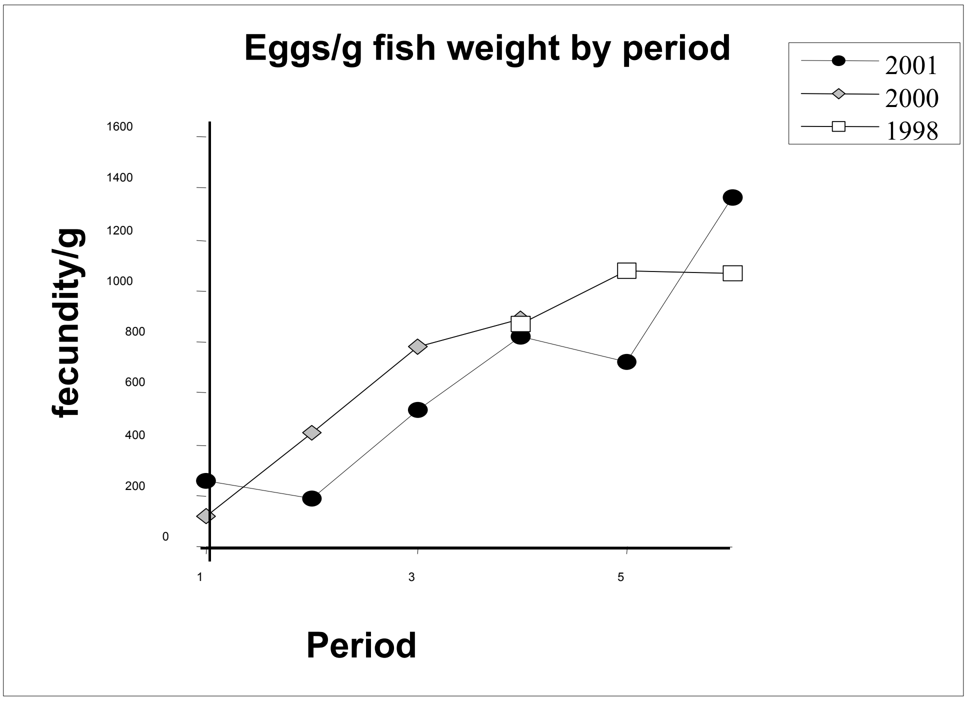


Figure 6.3.1.6. Horse mackerel fecundity over the spawning period as observed in 1998, 2000 and 2001.

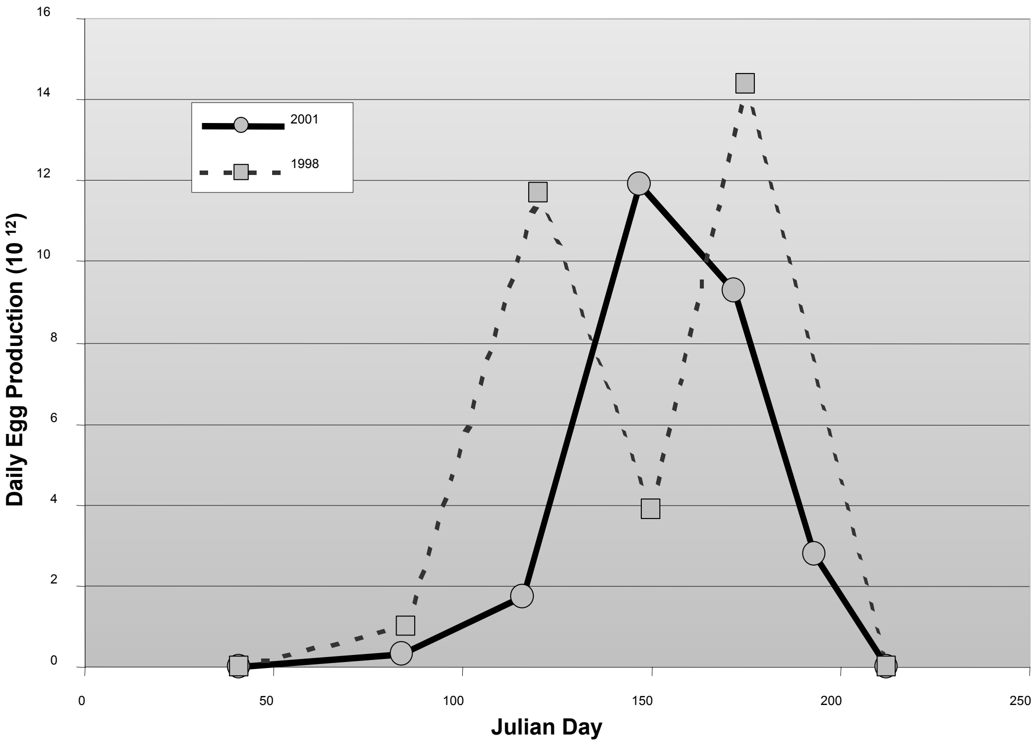


Figure 6.3.1.7. Western Horse Mackerel egg production curves for 2001 and 1998

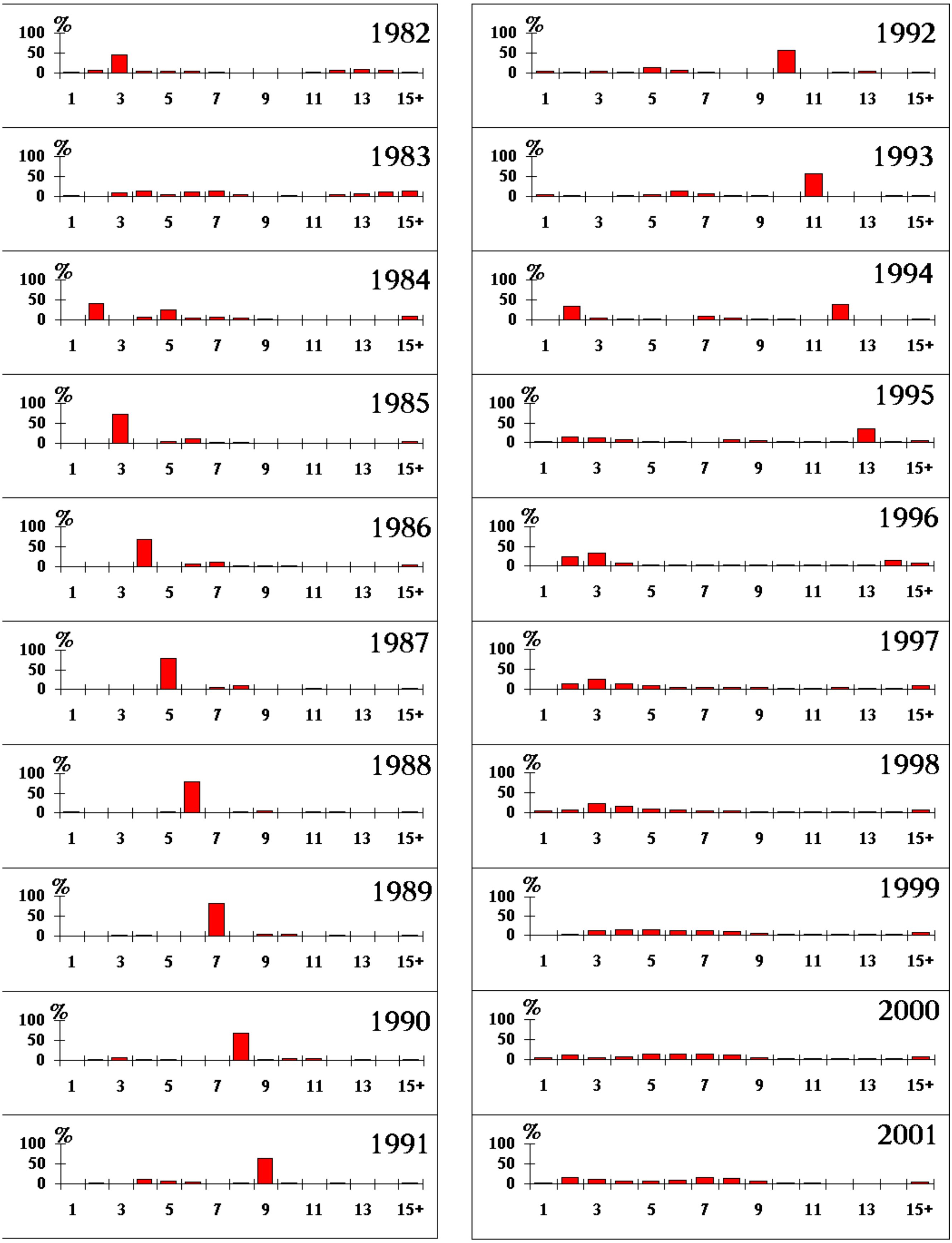


Figure 6.4.1.1 The age composition of the WESTERN HORSE MACKEREL in the international catches during 1982-2001.

6.5 State of the Stock

6.5.1 Data exploration and preliminary modelling

During the 2000 working group (ICES CM2001/ACFM:06), data exploration and preliminary modelling were conducted using three model structures, a VPA based 'ADAPT'-type method (Gavaris, 1988), Instantaneous Separable VPA (Kizner and Vasilyev 1997) and the SAD assessment method which combines a Separable VPA and an 'ADAPT' model structure. The Working Group reviewed the time series of population estimates from the fitted SAD model and the limited set of diagnostics and sensitivity analyses that were available at the meeting. Although the SAD model was still under development, the Working Group considered that the assessment structure is a more realistic representation of the dynamics of the Western Horse mackerel stock, than the estimates from the ADAPT and Bayesian models. The Working Group recommended that the State of the Stock should be based on the estimates derived from the SAD assessment method. ACFM concurred with the working group recommendation and based its advice on the results from the assessment method.

At the 2001 meeting (ICES CM2002/ACFM:06), the SAD and the ISVPA models were again used to estimate the stock dynamics. It was shown, using profiling, that the estimates from the SAD model were dependent on the assumption of selection at the oldest age and the Working Group presented catch options that reflected the uncertainty. At high fishing mortalities the forecast catches showed a relatively wide range of values but, at the low fishing mortality values required for stabilising the stock decline, the range was narrow. ISVPA was also fitted to the stock data and showed close agreement in the recent period of stock decline. Despite the agreement of the ISVPA and SAD stock trajectories, ACFM decided that the state of the stock was uncertain and rejected the assessment.

At this years meeting the SAD and ISVPA models were used to model the stock dynamics.

A Separable VPA /ADAPT (SAD) assessment of the Western Horse mackerel

Assessment models constructed for the Western Horse mackerel should take into account the particular characteristics of the catch at age data set. As has been noted in previous Assessment Working Group Reports (ICES 1996/H:2, ICES 1997/Assess:3) the stock has been dominated by a series of strong cohorts, the extremely strong 1982 and the much less abundant 1987 year classes comprising the bulk of the historic catches. In recent years there has been a change in the selection pattern towards increasing exploitation of younger fish, as the 1982 year class diminishes in importance (Figure 6.4.1.1).

The only fishery independent information currently available for calibration of the population model was a time-series of egg survey estimates of spawning biomass (ICES 2002/G:06). However the WGMEGS (Section 6.3.1) has suggested that the Horse mackerel may be an indeterminate spawner and that the current estimates of fecundity are highly uncertain. The Working Group discussed the implications of the WGMEGS findings and concluded that the most simple approach to the assessment of the stock was to assume that the series of egg production estimates was based on a constant but unknown fecundity and to attempt to estimate a catchability (fecundity) parameter within the SAD assessment.

As no age disaggregated information is available for model calibration by means of age independent catchability; an assumption of constant selection at age is required. The assumption is valid for recent years in which there are no dominant cohorts. However, the selective nature of the fishery for the abundant 1982 year class ensures that selection at age is not constant in many of the historic years. In the SAD model, the requirement for different structural models for recent and historic periods has been met by the fitting of linked Separable VPA and ADAPT VPA-based models. The structure is a modification of the ICA model developed by Patterson and Melvin (1996) in which a separable model is applied to recent data and linked to a VPA transformation of historic catch. In the SAD model, separable VPA derived population abundance at age is used to initiate the VPA transformation of the cohorts currently surviving in the population and an ADAPT type model structure is used to estimate the historic non-separable fishing mortalities of the earlier year classes.

Figure 6.5.1.1 presents an illustration of the model structure and the parameters estimated within the non-linear minimisation. The age structure of the assessment, 1 to 11+, aggregates the 1982 year class within the plus group for the years 1993 - 2001, removing its influence on the selection pattern estimated for the cohorts currently dominating the catches. The separable model is fitted to the catch data for the years 1998 - 2001. This time period is extended one year from last years model. A four period was chosen in order to cover the last two egg survey estimates of biomass and after consideration of the recent changes in selection, away from the oldest ages towards young age classes (ICES 2000/ACFM:5, ICES 2002/ACFM:06). The separable model estimates of the 1998 population abundance at age initiate a historic VPA for the cohorts exploited in that year. Apart from 1992, population abundance at the oldest age for the years 1997 and earlier is derived from the catch at age data at the oldest age and the average (un-weighted) fishing mortality at ages 7 - 9, in the same year, scaled by a ratio multiplier. The ratio is estimated within the model as a parameter. Fishing mortality on the plus group is taken to be equal to that on the oldest age. The ratio parameter allows the model to increase selection at the oldest age and for the plus group, compared to the mid range ages, allowing for directed fishing of older, larger fish. In order to model the directed fishing of the dominant 1982 year class, fishing mortality on this year class at age 10 in 1992 was also estimated as a parameter within the model.

The sum of squares objective function for the model is:

$$SSQ = \lambda * \sum_{\substack{y=1983,1989,\ 1992,\\ 1995,1998,\ 2001}} \Big[ln(q\ EP_y) - ln\left(\Sigma_a N_{a,y} \cdot O_{a,y} \cdot W_{a,y}.exp(-PF.\ F_y.S_a - PM.M)\right) \Big]^2$$

$$+ \sum_{y=1998}^{2001} \Big[ln(C_{(y,a)}) - ln(C_{(y+1,a+1)}) - ln\left(\frac{F_{(y+1,a+1)} \cdot S_{(y+1,a+1)}.Z_{(y,a)}\,(1 - e^{-Z(y+1,a+1)})\,e^{-Z(y,a)}}{F_y \cdot S_a\ Z_{(y+1,a+1)}\ (1 - e^{-Z(y,a)})} \right) \Big]^2$$

Where : N - represents the population abundance estimated by a separable VPA for the years 1998 - 2000 and from the VPA transformation for the years 1982 – 1997;

F – the separable model annual fishing mortality factor;

S – the separable model selection at age factor;

M – natural mortality;

Z – total fishing mortality (F + M);

W – weights at age;

O – maturity at age;

C – reported catch at age

EP – the egg production estimates from surveys;

q - the catchability parameter linking egg production to SSB;

PF – the proportion of fishing mortality exerted before spawning;

PM – the proportion of natural mortality exerted before spawning;

a,y - denote age and year respectively.

λ - a weighting factor allows the components of the objective function to be given

different relative weights.

The objective function does not include the residual for the egg production estimate of 1986. Sensitivity tests of model estimates to the presence or absence of the survey observations (ICES CM2001/ACFM:06) established that the greatest reduction in the objective function is obtained by excluding the 1986 survey from the analysis. The effect of including this observation in the time series is to lower the trajectory of SSB such that the egg survey SSB in the years 1989 and 1992 are under estimated by the model. The over-estimation of spawning stock size by the model in the years 1986 - 1990, is consistent with the known growth pattern of the 1982 year class and has been comprehensively discussed in ICES (1998/Assess:6). There were density dependent reductions in growth and maturity within this year class and imposed by it on contemporary year classes. No data was available for the estimation of the reduced maturity at age during that period and the constant values used within the models are considered to be too high. Given the doubts about the maturity during the early years of when the 1982 year class was present in the stock, the decision was taken to exclude the 1986 survey from the data set to which the model was fitted.

The parameters, estimated by a non-linear minimisation of the sum of squares, are:

1) Fishing mortality on the reference age for the separable model (age 7) in 2001.
2) The selection at the oldest age relative to that at the reference age in 2001.
3) The scaling of the fishing mortality for age 10 and the plus group relative to the average of ages 7 - 9.
4) Fishing mortality on the 1982 year class at age 10 and the corresponding plus group in 1992.
5) Catchability linking the egg production estimates and the SSB estimates from the model.

Input data for the model were as presented in Tables 6.5.1.1 and 6.5.1.2. Natural mortality (constant at age and by year at 0.15), maturity at age and stock weights at age and the proportions of F and M before spawning (0.45), are assumed to be known precisely. Table 6.5.1.3 presents the Egg production estimates taken from ICES (2000:G06).

In order to investigate the precision of the parameter estimates derived from the fitted model, the profile of the sum of squares surface was examined. This was carried out by constraining the parameter for which the profile was required at a range of values covering the value estimated at the optimum solution and then searching for the constrained minimum with the remaining four parameters. Plots of the objective function value at the constrained minima against the range of parameter values are presented in Figure 6.5.1.2; they illustrate the curvature of the five dimensional sum of squares surface in the direction of each parameter.

During the initial fitting of the SAD model to the catch at age and survey data it was established that there appeared to be insufficient information in the model to determine the magnitude of the catchability parameter. Figure 6.5.1.2a presents two sum of squares profiles for catchability. The lower of the curves is derived from the initial specification of the model and data structure as described previously. The profile shows that there is only information that the value of catchability is greater than ~1.

The new model structure is over parameterised in that there is insufficient data to obtain an estimate of the parameters. A reduction in the number of estimated parameters by the introduction of additional model constraints or an increase in the amount of available data are required in order to estimate the parameters. The former approach was taken last year when the fecundity was assumed known and the spawning stock biomass estimates assumed to be absolute. With the doubts concerning the spawning biology of horse mackerel an alternative assumption was required.

It was noted that at higher estimates of catchability the model could find a lower sum of squares by inducing large year to year fluctuations in the estimates of SSB. Given the recent history of the stock, which is based on the decline of the 1982 year class, sudden increases in the stock abundance are highly unlikely and a model which has a more constrained change in SSB is required. Given the time constraints available at the meeting it was not possible to explore alternative model structures. Therefore a relatively simple assumption was introduced that the egg production has followed a linear decline since 1992 after the SSB of the 1982 year class had passed its peak biomass. This is consistent with the known development of the stock based on the catch at age data.

A regression model was fitted to the last four egg production estimates (R^2 = 0.99) and estimates calculated for the intermediate years. The assumption provided six more "data" points, which were then used in the model fit resulting in the upper sum of squares profile illustrated in Figure 6.5.1.2a. The minimum of the new catchability surface is well defined but at a marginal value of the original surface. Damping the severe variation in SSB between years has marginally increased the contribution to the sum of squares from the true data points but provides a more realistic model for the biomass development in time.

Last year, during the fitting of the SAD model it was noted that the search algorithm converged to objective function minima with values similar to the optimal solution, but at different parameter combinations. These resulted from a correlation between the effects of the parameters and in order to examine the response surface a grid search was carried out over a range of fishing mortality and selection parameter values. The exercise was repeated this year for all combinations of parameters and the results are illustrated in Figure 6.5.1.3. The contour maps and marginal profiles show that all of the parameters estimated within the model have well defined minima. There is some correlation between the estimates of catchability and fishing mortality at age 10 in 1992 and the F multiplier at the oldest age but the marginal profiles show that they are in fact well defined. In comparison with last years assessment, the addition of an extra years egg production data and the assumption of the linear decline in egg production has reduced the parameter correlation and produced well defined minima.

Table 6.5.1.4 presents the log catchability residuals from the fit of the separable model to the catch at age data for ages 1 – 10. Table 6.5.1.5 presents the log catchability residuals from the fit of the SAD model to the time series of egg production estimates scaled by the catchability estimate. Figures 6.5.1.4 and 6.5.1.5 plot the SSB residuals against time and expected value.

In an analysis of the consistency of assessments carried out with the SAD model methodology, the time series of estimates from the last three assessment Working groups were compared. The results for the SSB time series are presented in Figures 6.5.2.6, recruits in Figure 6.5.2.7 and for fishing mortality in Figure 6.5.2.8 and 6.5.2.9, in which the egg production estimates are presented for comparison. The model fits have been consistent between years showing a robust solution for the estimates of the stock dynamics.

An ISVPA assessment of the Western horse mackerel

This year the ISVPA model (see section 2.9 of this Report and Vasilyev, WD 2002) was used to compare signals coming from catch-at-age data and from data on egg production. Historical changes in selection pattern were investigated by splitting the whole period of separable constraint (equal to the whole interval of years used in the assessment) into two parts. Similar to what was done in NEA mackerel stock assessment by means of ISVPA, equal periods (1982-1991 and 1992-2001) were chosen in order to supply maximum information support for each of the selection patterns. Since the selection pattern for this stock is strongly unstable because of the extremely abundant 1982 year class, the catch-controlled version of the model (attributing the model residuals to violations of the separability assumption) was used. By the same reason the stabilising condition of "unbiasedness" (zero year- and age sums of residuals) was imposed not on residuals in logarithmic catch-at-age, but on the separable representation of fishing mortality.

Separate fitting of the model on catch-at-age data only and on egg production data (by minimisation of sum of squared residuals between logarithms of ISVPA-derived SSB estimates of egg production) gave fairly similar results, both in terms of optimal fit (Figure 6.5.2.10), and of final results (Figure 6.5.2.12). They are also in good agreement with the results of stock assessment by means of the SAD model, except for the somewhat higher stock level in 1982-1984.

Estimated selection patterns revealed higher fishery pressure on young ages for the second period of fishery (see Figure 6.5.2.11) which is in agreement with the known dynamics of the recent fishery.

A comparison of the two assessment models

The time series of SSB fishing mortality and recruitment estimates from the ISVPA and the SAD models are presented in Figures 6.5.2.12a,b,c,d. There is good agreement between the models in the estimates of SSB for during the decline of the dominant 1982 year classes. In 2001there is very close agreement. ISVPA estimates higher recruitment in recent years associated with lower juvenile mortality (ages 2 –4). The selection pattern estimated for the period 1992 – 2001 by ISVA is lower than that estimated by SAD. This results from the longer period of the separable constraint within the ISVPA model which averages over a longer time series with years in which juvenile mortality was lower. SAD has a shorter separable period during which it is known that the fleets have increased the targeting of juveniles has been substantial.

6.5.2 Stock assessment

The sensitivity analyses carried out in Section 6.5.1 have shown that solution space for parameter estimates from the SAD model is well defined. The SAD assessment model was therefore adopted as the final assessment for this stock. It was fitted to the catch at age and egg production data sets with the structure described previously. The assessment results for fishing mortality, population abundance at age and the stock summary time series are presented in Tables 6.5.2.1. - 6.5.2.3. The stock summary plots are presented in Figures 6.5.2.1 a - e.

The SAD estimates of SSB increased to a peak value of 2,700,000 t in 1988 following the recruitment of the 1982 year class. With the lack of recruitments of equivalent magnitude, SSB has declined steadily until 2001 (Figure 6.5.2.1e). The 2001 estimate of SSB, at 760,000t, is estimated to be above the historic low that gave rise to the 1982 year class.

Average fishing mortality (Fbar 4-10) is estimated by the model to have fluctuated within the range 0.1 - 0.3 throughout the history of the fishery. An increase in fishing mortality at the youngest ages has occurred progressively since 1991 reflecting a known shift in the selection pattern towards younger fish (Figure 6.5.2.1).

Apart from the strong 1982 year class, recruitment to the stock showed an increasing trend between 1991 and 1994 and is then estimated to have declined. However, the age of full recruitment to the fishery is 5 and catch at age data at the youngest ages is subject to higher relative errors so that the level of the most recent recruitment is uncertain.

6.5.3 Reliability of the Assessment

The SAD model has been adapted to the changing situation in the understanding of the reproductive biology of the Western horse mackerel stock. The model structure was modified at the Working Group due to the uncertainty in the estimates of fecundity in order to allow the estimation of catchability. An assumption of a linear decline in egg production has reduced the uncertainty in parameter considerably. The time series of estimates agree well with those from the ISVPA model illustrating robustness of the recent SSB estimates to model structure, and show a consistent retrospective pattern when compared with assessment carried out during the last three working groups.

Figure 6.5.3.1 illustrates the consistency of the recent SAD estimates of SSB and compares them with the estimates from the historic egg survey estimates and the previously applied Adapt and Bayesian models.

6.6 Catch Prediction

A calculation of the consequences of different short-term catch options was made from the results of the SAD assessment. The biological input data for the catch predictions are given in Table 6.6.1. The following assumptions were made:

1. Recruitment in 2000 and the following years was taken as the geometric mean of the years 1983 - 1999, excluding the strong 1982 year class.

2. Exploitation in 2001 and later was assumed to follow the selection pattern estimated for the period 1998 – 2000, scaled to the average of the years 1999 - 2001.

3. Weights at age in the stock and in the catch, and maturity were taken as the average of the years 1999 to 2001.

In addition to the deterministic forecast two fishing mortality management reference points ($\mathbf{F}_{0.1}$, F 35% SPR) were calculated using the results from each assessment, allowing comparison with the estimated average fishing mortality.

Two deterministic forecasts were made for the Western horse mackerel. A status quo fishing mortality and a catch constrained forecast. The results of the deterministic catch prediction are presented in Table 6.6.2 ($\mathbf{F}_{sq}$) and 6.6.3 (catch constraint). At current fishing mortality levels the stock decline continues. Fishing mortality rates below 0.17 will maintain the SSB at the level of $\mathbf{B}_{pa}$, or higher. No exploitation options will maintain the SSB levels at the level of 2002.

6.7 Short and medium term risk analysis

The assessment of this stock is currently under development. At this stage in the analysis estimates of the uncertainty associated with parameters has not been fully tested and therefore short and medium term risks have not been evaluated.

6.8 Long-Term Yield

Table 6.8.1 and Figure 6.8.1 present the yield per recruit forecasts calculated from the selection pattern estimated within the separable model and catch and stock weight, maturity and natural mortality at age averaged over the last three years of the assessment.

$\mathbf{F}_{max}$ is poorly defined at a combined reference F of about 0.45. However, for pelagic species $\mathbf{F}_{max}$ is generally estimated to be at levels of F well beyond sustainable levels and should not be used as a fishing mortality target.

The time series of stock and recruitment estimates for this management unit are short. The estimates of $\mathbf{F}_{med}$, $\mathbf{F}_{high}$ and $\mathbf{F}_{low}$ for short time series will be unreliable.

6.9 Reference Points for Management Purposes

Biomass reference points

At its last meeting ACFM rejected the $\mathbf{B}_{pa}$ established by this working group and declared the status of the stock uncertain. The working group is not in agreement with this decision and is of the opinion that the reference point should be reinstated.

The basis for the working groups acceptance of a $\mathbf{B}_{pa}$ at 500kt is :

This stock is characterised by infrequent, extremely large recruitments. As only a short time series of data are available, it is not possible to quantify stock-recruit relationships, but one may make the precautionary assumption that the likelihood of a strong year class appearing would decline if stock size were to fall lower than the stock size at which the only such event has been observed. The basis for the level of $\mathbf{B}_{pa}$ is the stock size in 1983 (as estimated by an egg survey and the assessment), which is used as a proxy for the stock size present in 1982; that which produced the strong 1982 year class. The egg survey biomass estimate based on the old fecundity estimate was 1983 was 530,000 t.

A time series of egg survey production estimates is available from 1977, which show a stable stock until the arrival of the 1982 year class within the SSB in 1986. There is therefore a series for egg production estimates which agree with the 1982 observation showing the stock was stable at around 500kt based on either the previous estimate of fecundity or the SAD estimate of catchability.

The current SAD assessment estimate for 1982 is 641,000. Conventionally this has been rounded to 500,000 t.

An 35% SPR of 485kt was established from an equilibrium prediction based on an average mean weak recruitment to the stock from 1983 onwards (Eltink 2002 WD).

Fishing mortality reference points

Model development for the assessment of this stock is incomplete. Two fishing mortality reference points have been calculated from the current implementation, they are $\mathbf{F}_{0.1}$ 0.18 and F35%SPR 0.15. Both are close to the previous years estimates and the current estimate of F2001 at 0.24 is above both.

ACFM has not defined any fishing mortality reference points for this stock but in its advice it has used $\mathbf{F}_{0.1}$ as the highest F that is consistent with the Precautionary Approach.

6.10 Harvest control rules

The stock is at present in a transition from harvesting the large 1982 year class to the fishing of younger ages. Further development work for the estimation of uncertainty and on the sensitivity of the model to the imposed structural constraints, will allow an evaluation of Harvest control rules in the near future.

6.11 Management Considerations

If the fishing mortality in 2002 is the same as in 2001 the catch will decrease below the 190 000 t recorded for 2001. Fishing at the level estimated for 2001 will result in a further reduction of catch in 2003. The decline in SSB is estimated to continue to decline throughout 2003 and 2004 unless the fishing mortality is reduced to level near to $\mathbf{F}_{0.1}$.

This stock has been dependent on the abundant 1982 year class for many years and there have been no equivalent year classes of this magnitude. Recently however fisheries in Divisions VIId and VIIe,f have taken large catches of mainly juvenile horse mackerel from both the North Sea and western stocks. For example in 1998 over 13,400 t of horse mackerel were taken in the third and fourth quarter from Division VIId in which between 54% to 68% of the catch was between 1-4 years old. Similarly in Divisions VIIe-f over 42,600 t of horse mackerel were taken the third and fourth quarter in which between 63% to 96% of the catches were between 1-4 years old. Figure 6.4.1.1 and Table 6.5.1.1 show a clear change in the age-structure of the catches from older to younger fish since 1996.

The Working Group expresses concern about this high exploitation rate of juvenile fish at a time when the TAC is considered too high for the long-term exploitation of the stock. Juvenile fisheries are common in many pelagic stocks and harvesting strategies have been developed that allow a balance of competing market demands (Herring WG 1999). In general the TAC for fisheries which heavily exploit juveniles, is lower than an adult fishery, to account for the inherent variability in the targeted year classes and the loss of potential yield. If the current increase in targeted juvenile mortality continues, landings will have to be reduced at a faster rate than that for an adult fishery. The Working Group recommends that a management strategy similar to that for North Sea Herring, in which both adult and juvenile mortality are independently restricted, be explored for this stock.

Eltink (2002WD) presented a working document on the biological evaluation of the juvenile and adult western horse mackerel fisheries. In the western horse mackerel fisheries the periods 1982-1984 and 1994-2001 are characterized by high percentages of juveniles in the annual international catches (fluctuating between 14% and 55% in numbers). In the period in between this was not the case because the extremely strong 1982 was targeted by the fishery. In recent years the fishery pattern has again reverted to the exploitation on juvenile fish.

Figures 6.11.1 and 6.11.2 show for 2000 the international catch in tonnes, the mean age and the percentage of 0-3 group for western horse mackerel respectively by year and by quarter. The catches of all three horse mackerel stock stocks contain high proportions of 0-3 group fish. In fact the only area where only adult fish are caught is from southwest of Ireland up to the Norwegian Sea.

The catch of western horse mackerel in 2000 consisted mainly out of:

- adults during the whole year: Divisions IIIa (west), IVa, VIab, VIIbcjk
- juveniles during the whole year: Divisions VIIIabd
- adults during the first half of the year Divisions VIIefgh
- juveniles during the second half of the year: Divisions VIIefgh

Eltink (WD2002) evaluated the fishery on juvenile and adult western horse mackerel based on biological criteria by means of long-term equilibrium predictions of catch and stock and by studying the effect of area/period closures. Effort reductions in 5 steps in the juvenile areas/periods up to a total closure and effort reductions in 5 steps in the adult areas/periods also up to a total closure were carried out for three options in the equilibrium predictions: a) fishing mortality constant at F(1-10)=M=0.15, b) catch constraint of 100 kt and c) spawning stock biomass constant at 500 kt.

In the equilibrium situation of no fishery the maximum biomass at age in the stock is reached between ages 3 to 6. This implies that on biological arguments the fishery should take place from age 3 onwards, because the biomass at age approximately stops to increase at ages 3-6 and decreases from age 7 onwards. Therefore, a closure of juvenile areas/periods should be considered in order to avoid a fishery on ages 0-2.

Figure 6.11.3 show the results from the equilibrium predictions for 5 steps in effort reduction in the adult areas/periods and for 5 steps of effort reduction in the juvenile areas/periods for the following three management options: 1) Fishing mortality constant at F=M=0.15 2) Catch constraint of 100 kt and 3) SSB constraint at 500 kt. In the middle of the table and figure is the current situation at A(1.0) J(1.0). The changes in SSB, catch, fishing mortality, mean weight at age in the catch, mean age and Y/R can be observed due to the different steps in effort reductions and due to the three management options. For all three management options the catch ranges from 80 to 100 kt, the fishing mortality from 0.11 to 0.2 and the SSB from 234 to 500 kt. A fishery on juveniles reduces the SSB and the catch, but increases the fishing mortality.

A transfer of effort from the juvenile areas/periods to the adult areas/periods up to even a total closure of the juvenile areas/periods will increase the spawning stock biomass compared to the recent level. This increase in SSB reaches its maximum in the case of only a fishery in the adult areas/periods and corresponds then to 22% for the option of F=0.15 and also 22% for the option of a catch constraint of 100 kt. For the option F(1-10)=0.15 the catch remains rather constant for a more directed fishery towards adults.

A transfer of effort from the adult areas/periods to the juvenile areas/periods up to even a total closure of the adult areas/periods will decrease the spawning stock biomass compared to the recent level. This decrease in SSB reaches its maximum in the case of only a fishery in the juvenile areas/periods and corresponds then to 10% for the option of F=0.15 and 39% for the option of a catch constraint of 100 kt. For the option F(1-10)=0.15 the catch is reduced, if the fishery is more directed towards juveniles (up to 8% in the case of closure of the adult areas/periods).

A strong warning should be given in case of a fishery in which a large proportion of the catch are juvenile fish, because the stock can be depleted rapidly, if recruitment falls to a low level. From 1994 onwards there has been an increasing trend to fish in the juvenile areas/periods. The percentages caught (in weight) in the juvenile area/periods in 1998 and 2000 were respectively 30% and 36% and even increased in 2001 up to 52%. To stop a further increase of catches in the juvenile areas/periods a maximum proportion of catch to be caught in the juvenile areas/periods could be considered or a closure of juvenile areas/periods could be considered in order to avoid a fishery on ages 0-2

A recent meeting between European POs and scientists has indicated that the fishing industry is aware of the problem of increased fishing on juveniles, and have proposed a series of measures including closed areas to ameliorate this situation. The WG would support the principle of such initiatives.

The TAC has only been given for parts of the distribution and fishing areas (EU waters). The Working Group advises that if a TAC is set for this stock, it should apply to all areas where western horse mackerel are caught, i.e. Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa–c, VIIe–k and VIIIa,b,d,e.

The TAC has been overshot considerably between 1988 and 1997 (Figure 6.11.4). In recent years this trend has reversed and the fishery has not achieved the TAC. It is worth noting that at the meeting between European POs and scientists the fishing industry reported that it was having great difficult catching sufficient horse mackerel.

Table 6.5.1.1. Western Horse Mackerel: Input to SAD

a. Catch in numbers (thousands)

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0	0	0	0	0	0	767	0	0	3230	12420	0	2315	0	0	0	123	0	181	186
1	2523	5668	0	1267	0	83	23975	0	19117	19570	83830	94250	15324	50843	4036	3726	71802	11551	57665	36767
2	14320	1627	183682	3802	0	414	5354	0	42191	47240	24040	49520	796606	411412	615759	417131	153811	51232	113043	222178
3	91566	23595	3378	467741	1120	0	1839	18860	130153	13980	66180	7700	104631	382838	841304	703245	464537	166912	41346	142694
4	7825	38374	27621	3462	489397	2476	3856	16604	57561	187410	50210	52870	49463	198181	157053	390131	340241	221663	62114	90475
5	8968	11005	114001	32441	6316	748405	16616	4821	31195	126310	243720	83770	40466	52812	67924	231570	206255	233540	132496	93623
6	7979	31942	17009	77862	47149	1730	824940	13169	9883	68330	110620	307370	26961	85565	45939	112433	141961	198856	140014	108360
7	6013	37775	29105	9808	79428	34886	10613	1159554	19305	19000	42840	124050	205842	26425	48597	120131	111607	175297	153776	211022
8	1122	12854	25890	12545	18609	76224	34963	10940	1297370	21090	14202	65790	87767	230028	49091	122121	74827	136735	119389	189691
9	281	2360	11230	4809	15328	9854	59452	53909	34673	1173940	17930	25250	37045	107838	44193	103944	64746	72017	54766	96110
10	1122	3948	3121	7155	11052	8015	8531	75496	66058	21140	1063910	3250	40453	95799	48439	95516	47935	33058	15337	29408
11+	55306	92614	44421	31785	41126	52690	66659	71705	211999	132370	149030	1285690	992582	1354115	718074	585684	378334	247613	157285	123525

b. Proportion of fish mature at start of year

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.4	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.05	0.05
3	0.8	0.7	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.25	0.25	0.25	0.25
4	1	1	0.85	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7
5	1	1	1	0.95	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.95	0.95	0.95	0.95
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 6.5.1.2 Western Horse Mackerel: Input to SAD

a. Mean weight at age in the catch (kg)

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.012	0.015	0.012	0.008	0.010	0.021	0.015	0.015	0.017	0.014	0.000	0.023	0.041
1	0.054	0.039	0.034	0.029	0.029	0.068	0.031	0.050	0.032	0.031	0.014	0.033	0.037	0.038	0.059	0.039	0.041	0.057	0.059	0.045
2	0.090	0.113	0.073	0.045	0.045	0.067	0.075	0.075	0.031	0.046	0.092	0.083	0.052	0.052	0.078	0.075	0.087	0.094	0.083	0.065
3	0.142	0.124	0.089	0.087	0.110	0.110	0.114	0.149	0.090	0.113	0.117	0.120	0.106	0.073	0.090	0.093	0.102	0.110	0.097	0.103
4	0.178	0.168	0.130	0.150	0.107	0.155	0.132	0.142	0.124	0.125	0.139	0.126	0.124	0.089	0.125	0.109	0.113	0.122	0.128	0.114
5	0.227	0.229	0.176	0.156	0.171	0.143	0.147	0.142	0.126	0.148	0.143	0.142	0.158	0.126	0.141	0.142	0.140	0.142	0.141	0.132
6	0.273	0.247	0.216	0.199	0.196	0.174	0.157	0.220	0.129	0.141	0.157	0.154	0.153	0.130	0.155	0.179	0.162	0.164	0.157	0.143
7	0.276	0.282	0.245	0.243	0.223	0.198	0.240	0.166	0.202	0.144	0.163	0.163	0.167	0.170	0.166	0.189	0.172	0.188	0.161	0.152
8	0.292	0.281	0.278	0.256	0.251	0.249	0.304	0.258	0.183	0.187	0.172	0.183	0.194	0.176	0.177	0.199	0.183	0.207	0.195	0.171
9	0.305	0.254	0.262	0.294	0.296	0.264	0.335	0.327	0.227	0.185	0.235	0.199	0.199	0.200	0.191	0.209	0.192	0.216	0.212	0.196
10	0.369	0.260	0.259	0.257	0.280	0.321	0.386	0.330	0.320	0.215	0.222	0.177	0.280	0.204	0.206	0.234	0.213	0.225	0.243	0.228
11+	0.352	0.319	0.306	0.319	0.356	0.342	0.413	0.432	0.358	0.329	0.357	0.250	0.249	0.249	0.277	0.270	0.250	0.316	0.295	0.285

b. Mean weight at age in the stock (kg)

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.070
3	0.080	0.080	0.077	0.081	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.066	0.095	0.080	0.090	0.110	0.087	0.074
4	0.207	0.171	0.122	0.148	0.105	0.105	0.105	0.105	0.105	0.121	0.105	0.105	0.105	0.119	0.118	0.112	0.108	0.120	0.108	0.082
5	0.232	0.227	0.155	0.140	0.134	0.126	0.126	0.103	0.127	0.137	0.133	0.153	0.147	0.096	0.129	0.124	0.129	0.130	0.148	0.100
6	0.269	0.257	0.201	0.193	0.169	0.150	0.141	0.131	0.135	0.143	0.151	0.166	0.185	0.152	0.148	0.162	0.142	0.160	0.170	0.121
7	0.280	0.276	0.223	0.236	0.195	0.171	0.143	0.159	0.124	0.144	0.150	0.173	0.169	0.166	0.172	0.169	0.151	0.170	0.173	0.131
8	0.292	0.270	0.253	0.242	0.242	0.218	0.217	0.127	0.154	0.150	0.158	0.172	0.191	0.178	0.183	0.184	0.162	0.180	0.193	0.142
9	0.305	0.243	0.246	0.289	0.292	0.254	0.274	0.210	0.174	0.182	0.160	0.170	0.191	0.187	0.185	0.188	0.174	0.190	0.202	0.161
10	0.369	0.390	0.338	0.247	0.262	0.281	0.305	0.252	0.282	0.189	0.182	0.206	0.190	0.197	0.202	0.208	0.191	0.210	0.257	0.187
11+	0.352	0.311	0.287	0.306	0.342	0.317	0.366	0.336	0.345	0.333	0.287	0.222	0.235	0.233	0.238	0.238	0.215	0.222	0.260	0.260

Table 6.5.1.3 The time series of egg production estimates for the western horse mackerel as reported in ICES (2002/G:06).

Year	Egg Production
1977	5.33E+14
1980	6.35E+14
1983	3.81E+14
1986	5.08E+14
1989	1.63E+15
1992	1.58E+15
1995	1.23E+15
1998	1.00E+15
2001	6.84E+14

Table 6.5.1.4 The Log catch ratio residuals from the fit of the SAD separable VPA model to the catch at age data for ages 1 – 10 and years 1999 – 2001.

Ln(C/Cest)	1998	1999	2000	2001
1	0.36	-0.39	0.02	0.00
2	0.02	-0.23	0.23	-0.02
3	0.16	0.08	-0.23	0.16
4	0.05	0.02	-0.10	0.10
5	-0.06	-0.01	-0.03	0.00
6	-0.01	0.08	-0.01	-0.16
7	-0.03	0.07	0.02	-0.03
8	-0.09	0.10	0.01	-0.04
9	-0.08	0.12	-0.02	-0.07
10	0.00	0.08	-0.03	-0.04

Table 6.5.1.5 The time series of log residuals from the SAD model fit to the Western horse mackerel egg production estimates. A true value of 1 indicates real data a 0 value indicates interpolated estimates of data points.

	1983	1989	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
True data	1	1	1	0	0	1	0	0	1	0	0	1
Log Resid	-0.03	0.08	-0.06	0.04	-0.03	-0.03	0.08	-0.10	-0.02	0.05	0.06	-0.05

Table 6.5.2.1 The fishing mortality at age estimated by the SAD assessment model for the Western Horse mackerel

F	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1	0.005	0.000	0.000	0.001	0.000	0.000	0.006	0.000	0.011	0.013
2	0.012	0.004	0.006	0.015	0.000	0.000	0.002	0.000	0.026	0.031
3	0.045	0.023	0.009	0.018	0.005	0.000	0.001	0.010	0.047	0.010
4	0.029	0.023	0.032	0.011	0.022	0.013	0.007	0.015	0.035	0.084
5	0.037	0.049	0.082	0.045	0.025	0.041	0.111	0.010	0.034	0.096
6	0.045	0.171	0.095	0.071	0.081	0.008	0.054	0.115	0.025	0.092
7	0.053	0.288	0.220	0.069	0.091	0.076	0.059	0.096	0.232	0.058
8	0.066	0.144	0.309	0.131	0.173	0.112	0.096	0.075	0.140	0.402
9	0.017	0.184	0.171	0.081	0.222	0.123	0.114	0.199	0.338	0.172
10	0.072	0.324	0.368	0.148	0.255	0.163	0.141	0.195	0.373	0.333
+gp	0.072	0.324	0.368	0.148	0.255	0.163	0.141	0.195	0.373	0.333

F	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.034	0.021	0.003	0.010	0.001	0.003	0.052	0.047	0.035	0.047
2	0.018	0.024	0.237	0.095	0.148	0.148	0.176	0.159	0.119	0.161
3	0.053	0.007	0.061	0.162	0.272	0.238	0.223	0.201	0.150	0.204
4	0.044	0.052	0.053	0.149	0.087	0.184	0.201	0.181	0.135	0.184
5	0.142	0.092	0.049	0.070	0.066	0.170	0.209	0.189	0.141	0.191
6	0.108	0.253	0.037	0.130	0.076	0.141	0.199	0.180	0.134	0.182
7	0.073	0.161	0.253	0.043	0.096	0.273	0.284	0.256	0.191	0.259
8	0.054	0.145	0.155	0.469	0.100	0.351	0.389	0.351	0.261	0.355
9	0.672	0.121	0.107	0.274	0.144	0.300	0.375	0.338	0.252	0.343
10	0.220	0.224	0.271	0.414	0.179	0.486	0.191	0.172	0.129	0.175
+gp	0.220	0.224	0.271	0.414	0.179	0.486	0.191	0.172	0.129	0.175

Table 6.5.2.2 The population numbers at age estimated by the SAD assessment model for the Western Horse mackerel

N	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	44985281	372425	1079073	2167673	3302153	4820702	2369846	2255342	1961674	3163768
1	526602	38719190	320549	928767	1865733	2842189	4149217	2039034	1941191	1688428
2	1325361	450909	33320657	275899	798222	1605851	2446218	3549021	1755013	1653063
3	2242875	1127463	386592	28508946	233941	687036	1381785	2100512	3054671	1471411
4	294101	1845510	948527	329609	24103933	200316	591337	1187607	1790430	2508431
5	264245	245876	1552844	790779	280485	20292413	170117	505391	1006779	1487636
6	197593	219117	201417	1230782	650533	235556	16771514	131005	430522	837602
7	126343	162667	158962	157581	987108	516177	201140	13670043	100540	361384
8	18821	103166	104964	109818	126532	775923	411912	163277	10690146	68625
9	18077	15158	76870	66324	82883	91643	597126	322099	130384	7997468
10	17488	15299	10858	55744	52624	57117	69736	458795	227220	80055
+gp	862016	358880	154534	247636	195820	375485	544898	435757	729213	501271

N	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	5628871	6594782	6569173	4421001	1779823	1022526	1010870	2176244	924030		
1	2720084	4833292	5676181	5651992	3805191	1531907	880096	869950	1873111	795152	
2	1435088	2263425	4072613	4871318	4817545	3271414	1315068	690892	738056	1558703	652748.2
3	1378978	1212889	1902206	2766284	3811097	3575233	2428741	989193	547126	530376	1141780
4	1253486	1125499	1036799	1540173	2025788	2499728	2424801	1659466	696554	432557	372289.1
5	1985158	1032303	919676	846492	1141778	1597907	1789594	1771389	1222669	541904	309866.4
6	1163237	1482532	810794	754031	679587	919722	1160493	1348966	1307983	929439	385189.2
7	657538	898580	990867	672844	569618	542306	687303	867143	976578	995894	666693.9
8	293419	526203	658329	661878	554607	445189	355317	488024	583726	697884	661429.7
9	39500	239373	391871	485203	356277	431811	269881	236404	293191	391655	420974.4
10	5794369	17364	182604	302918	317572	265651	275230	172221	136661	201543	239194.4
+gp	811662	6869052	4480504	4281740	4707787	1628913	2333703	2333703	1679617	1401816	1158578

Table 6.5.2.3 The population summary time series age estimated by the SAD assessment model for the Western Horse mackerel

YEAR	RECRUITS Age 0	Biomass (tonnes)	SSB (tonnes)	TOTAL INT. LANDINGS(tonnes)	Fbar (4 - 10)	Fbar (2 - 6)
1982	44985281	777647	640531	41587	0.05	0.03
1983	372425	734285	615757	64862	0.17	0.05
1984	1079073	2221694	621662	73625	0.18	0.05
1985	2167673	2892431	1358069	80551	0.08	0.03
1986	3302153	3065072	1833334	105665	0.12	0.03
1987	4820702	3164352	2318144	157240	0.08	0.01
1988	2369846	3183407	2704530	188100	0.08	0.04
1989	2255342	3063440	2449473	268867	0.10	0.03
1990	1961674	2702827	2071798	373463	0.17	0.03
1991	3163768	2527245	1929564	333555	0.18	0.06
1992	5628871	2192359	1687143	370550	0.19	0.07
1993	6594782	2550331	1974281	433145	0.15	0.09
1994	6569173	2206414	1585283	388875	0.13	0.09
1995	4421001	2183285	1428589	510597	0.22	0.12
1996	1779823	2541707	1726865	396652	0.11	0.13
1997	1022526	1774213	1062891	442571	0.27	0.18
1998	1010870	1705185	1176572	303543	0.26	0.20
1999	2176244	1621864	1226129	273888	0.24	0.18
2000	924030	1376316	1109617	174927	0.18	0.14
2001		1045656	761520	191193	0.24	0.18

'DP version 1a

WHM 2001 WG

date: 20:45 18/09/02

age range: 4-10

Table 6.6.1 The input data for the Western Horse mackerel deterministic short term forecast

2002								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	2346726	0.15	0.00	0.45	0.45	0.000	0.000	0.021
1	2019846	0.15	0.00	0.45	0.45	0.000	0.043	0.054
2	652748	0.15	0.05	0.45	0.45	0.057	0.146	0.080
3	1141780	0.15	0.25	0.45	0.45	0.090	0.185	0.103
4	372289	0.15	0.70	0.45	0.45	0.103	0.167	0.121
5	309866	0.15	0.95	0.45	0.45	0.126	0.174	0.138
6	385189	0.15	1.00	0.45	0.45	0.150	0.165	0.155
7	666694	0.15	1.00	0.45	0.45	0.158	0.235	0.167
8	661430	0.15	1.00	0.45	0.45	0.172	0.322	0.191
9	420974	0.15	1.00	0.45	0.45	0.184	0.311	0.208
10	239194	0.15	1.00	0.45	0.45	0.218	0.159	0.232
11	1158578	0.15	1.00	0.45	0.45	0.247	0.159	0.299

2002								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	2346726	0.15	0.00	0.45	0.45	0.000	0.000	0.021
1	2019846	0.15	0.00	0.45	0.45	0.000	0.043	0.054
2	652748	0.15	0.05	0.45	0.45	0.057	0.146	0.080
3	1141780	0.15	0.25	0.45	0.45	0.090	0.185	0.103
4	372289	0.15	0.70	0.45	0.45	0.103	0.167	0.121
5	309866	0.15	0.95	0.45	0.45	0.126	0.174	0.138
6	385189	0.15	1.00	0.45	0.45	0.150	0.165	0.155
7	666694	0.15	1.00	0.45	0.45	0.158	0.235	0.167
8	661430	0.15	1.00	0.45	0.45	0.172	0.322	0.191
9	420974	0.15	1.00	0.45	0.45	0.184	0.311	0.208
10	239194	0.15	1.00	0.45	0.45	0.218	0.159	0.232
11	1158578	0.15	1.00	0.45	0.45	0.247	0.159	0.299

2002								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	2346726	0.15	0.00	0.45	0.45	0.000	0.000	0.021
1	2019846	0.15	0.00	0.45	0.45	0.000	0.043	0.054
2	652748	0.15	0.05	0.45	0.45	0.057	0.146	0.080
3	1141780	0.15	0.25	0.45	0.45	0.090	0.185	0.103
4	372289	0.15	0.70	0.45	0.45	0.103	0.167	0.121
5	309866	0.15	0.95	0.45	0.45	0.126	0.174	0.138
6	385189	0.15	1.00	0.45	0.45	0.150	0.165	0.155
7	666694	0.15	1.00	0.45	0.45	0.158	0.235	0.167
8	661430	0.15	1.00	0.45	0.45	0.172	0.322	0.191
9	420974	0.15	1.00	0.45	0.45	0.184	0.311	0.208
10	239194	0.15	1.00	0.45	0.45	0.218	0.159	0.232
11	1158578	0.15	1.00	0.45	0.45	0.247	0.159	0.299

Input units are thousands and kg - output in tonnes

MFDP version 1a
Run: WHM 2001 WG
Western Horse Mackerel 2001 W.G.
Time and date: 20:45 18/09/02
Fbar age range: 4-10

Table 6.6.2 The status quo catch option forecast table for the Western horse mackerel stock.

2002 Biomass	SSB	FMult	FBar	Landings
910762	667731	1.0000	0.2190	181470

2003 Biomass	SSB	FMult	FBar	Landings	2004 Biomass	SSB
800547	608586	0.0000	0.0000	0	891262	638692
.	603043	0.1000	0.0219	17126	875652	620711
.	597555	0.2000	0.0438	33909	860363	603278
.	592123	0.3000	0.0657	50356	845389	586373
.	586746	0.4000	0.0876	66476	830723	569981
.	581422	0.5000	0.1095	82277	816356	554083
.	576151	0.6000	0.1314	97764	802283	538663
.	570934	0.7000	0.1533	112946	788496	523707
.	565768	0.8000	0.1752	127829	774989	509199
.	560654	0.9000	0.1971	142420	761755	495124
.	555591	1.0000	0.2190	156726	748789	481468
.	550578	1.1000	0.2409	170752	736083	468219
.	545616	1.2000	0.2628	184506	723633	455362
.	540702	1.3000	0.2847	197993	711432	442885
.	535838	1.4000	0.3066	211219	699475	430776
.	531021	1.5000	0.3284	224190	687756	419023
.	526253	1.6000	0.3503	236911	676269	407616
.	521531	1.7000	0.3722	249389	665010	396542
.	516856	1.8000	0.3941	261628	653974	385791
.	512228	1.9000	0.4160	273634	643155	375353
.	507645	2.0000	0.4379	285411	632549	365219

Input units are thousands and kg - output in tonnes

MFDP version 1a
Run: WHMSA 2002 WG Catch const
Western Horse Mackerel 2001 W.G.
Time and date: 21:26 18/09/02
Fbar age range: 4-10

Table 6.6.3 The catch constrained option forecast table for the Western horse mackerel stock.

2002 Biomass	SSB	FMult	FBar	Landings
910762	679671	0.8109	0.1776	150000

2003 Biomass	SSB	FMult	FBar	Landings	2004 Biomass	SSB
828747	632506	0.0000	0.0000	0	918368	662800
.	626732	0.1000	0.0219	17748	902189	644106
.	621016	0.2000	0.0438	35139	886346	625981
.	615358	0.3000	0.0657	52181	870830	608407
.	609756	0.4000	0.0876	68883	855634	591367
.	604211	0.5000	0.1095	85252	840750	574841
.	598722	0.6000	0.1314	101295	826171	558814
.	593287	0.7000	0.1533	117021	811891	543270
.	587907	0.8000	0.1752	132435	797901	528192
.	582581	0.9000	0.1971	147546	784196	513565
.	577308	1.0000	0.2190	162361	770769	499375
.	572088	1.1000	0.2409	176884	757613	485607
.	566920	1.2000	0.2628	191125	744722	472249
.	561803	1.3000	0.2847	205087	732091	459286
.	556738	1.4000	0.3066	218779	719713	446706
.	551722	1.5000	0.3284	232206	707583	434496
.	546757	1.6000	0.3503	245373	695695	422646
.	541840	1.7000	0.3722	258287	684044	411144
.	536973	1.8000	0.3941	270953	672623	399977
.	532153	1.9000	0.4160	283376	661429	389137
.	527382	2.0000	0.4379	295562	650455	378612

Input units are thousands and kg - output in tonnes

(a)

2001			2002			2003
F = F2001	**Catch**	**SSB**	**F**	**Catch**	**SSB**	**SSB**
0.219	181470	667731	0.10	75423	583731	560979
			0.15	112946	570934	523707
			0.18	131027	564647	506114
			0.20	142420	560654	495124
			0.25	176467	548516	462877
			F2001	156726	555591	481468

(b)

2001			2002			2003
F = F2000	**Catch**	**SSB**	**F**	**Catch**	**SSB**	**SSB**
0.178	150000	679671	0.10	78151	606616	582010
			0.15	117021	593287	543270
			0.18	135747	586740	524986
			0.20	147546	582581	513565
			0.25	182801	569941	480056
			F2001	162361	577308	499375

F0.1	0.179
F35%SPR	0.149

Table 6.6.4 Summary catch option tables for the Western horse mackerel stock (a) Status quo fishing mortality (b) catch constrained.

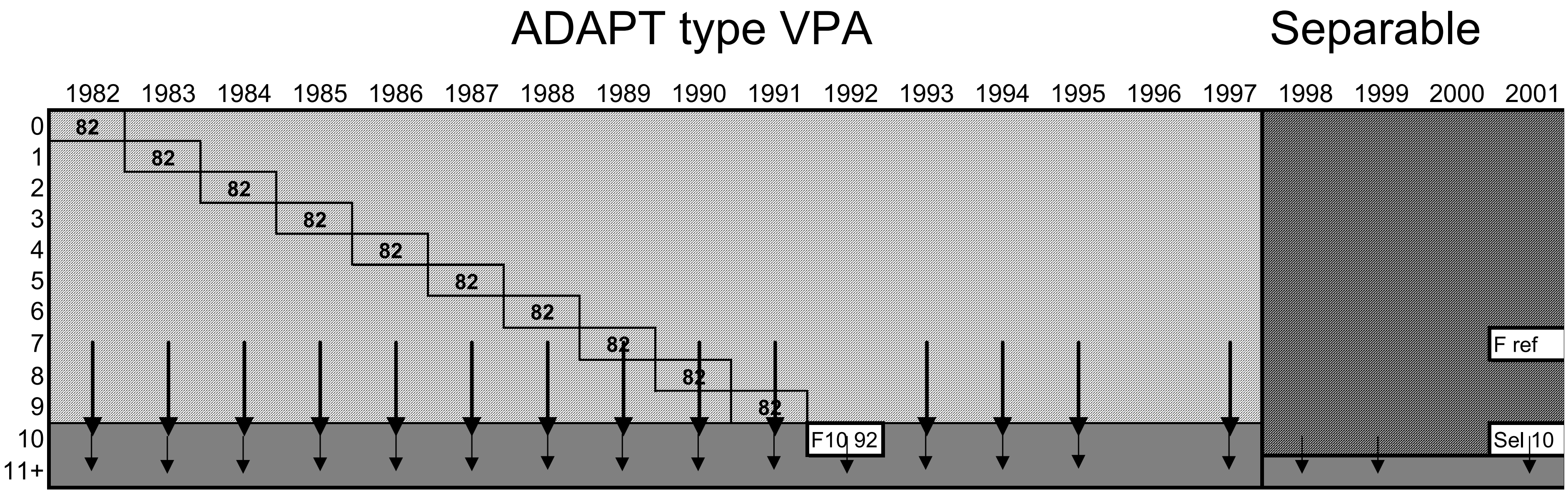
Table 6.8.1 The yield per recruit calculations for the Western horse mackerel stock

MFYPR version 2a
Run: WHM 2002 WG
Time and date: 20:51 18/09/02
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	7.1792	0.8214	3.9482	0.7184	3.6905	0.6715
0.1000	0.0219	0.0842	0.0141	6.6189	0.7022	3.4072	0.6010	3.1572	0.5569
0.2000	0.0438	0.1517	0.0244	6.1703	0.6092	2.9774	0.5097	2.7349	0.4682
0.3000	0.0657	0.2068	0.0320	5.8042	0.5354	2.6296	0.4375	2.3942	0.3983
0.4000	0.0876	0.2525	0.0377	5.5004	0.4757	2.3437	0.3795	2.1151	0.3424
0.5000	0.1095	0.2911	0.0420	5.2446	0.4269	2.1054	0.3322	1.8834	0.2971
0.6000	0.1314	0.3240	0.0453	5.0264	0.3864	1.9043	0.2933	1.6887	0.2600
0.7000	0.1533	0.3524	0.0478	4.8381	0.3525	1.7327	0.2608	1.5233	0.2291
0.8000	0.1752	0.3771	0.0498	4.6741	0.3237	1.5849	0.2335	1.3814	0.2033
0.9000	0.1971	0.3990	0.0513	4.5297	0.2991	1.4565	0.2103	1.2587	0.1815
1.0000	0.2190	0.4183	0.0525	4.4016	0.2778	1.3439	0.1905	1.1517	0.1629
1.1000	0.2409	0.4357	0.0535	4.2872	0.2593	1.2447	0.1733	1.0578	0.1469
1.2000	0.2628	0.4513	0.0542	4.1841	0.2430	1.1565	0.1584	0.9748	0.1331
1.3000	0.2847	0.4654	0.0548	4.0909	0.2287	1.0777	0.1453	0.9010	0.1211
1.4000	0.3066	0.4783	0.0553	4.0060	0.2159	1.0070	0.1338	0.8351	0.1106
1.5000	0.3284	0.4901	0.0557	3.9282	0.2045	0.9432	0.1236	0.7760	0.1013
1.6000	0.3503	0.5009	0.0560	3.8568	0.1942	0.8853	0.1145	0.7227	0.0931
1.7000	0.3722	0.5110	0.0562	3.7909	0.1849	0.8327	0.1064	0.6744	0.0858
1.8000	0.3941	0.5203	0.0564	3.7298	0.1765	0.7846	0.0991	0.6305	0.0793
1.9000	0.4160	0.5289	0.0566	3.6730	0.1688	0.7405	0.0925	0.5905	0.0734
2.0000	0.4379	0.5370	0.0567	3.6200	0.1617	0.7000	0.0865	0.5540	0.0681

Reference point	F multiplier	Absolute F
Fbar(4-10)	1.0000	0.219
FMax	2.5455	0.5574
F0.1	0.8181	0.1791
F35%SPR	0.6794	0.1488

Weights in kilograms



Model estimated parameters

1	F10 92	Fishing mortality on the 1982 year class at age 10 in 1992
2	F ref	Fishing mortality on the reference age in 1999
3		The raising factor which scales fishing mortality at age 10 relative to the avererage of ages 7 - 9
4	Sel 10	Selection at age 10 in the separable model
5		Catchability of the estimated SSB relative to the Western horse mackerel egg production time series

Figure 6.8.1 An illustration of the SAD model structure used for the assessment of the Western horse mackerel stock. and the parameters estimated within the least squares minimisation.

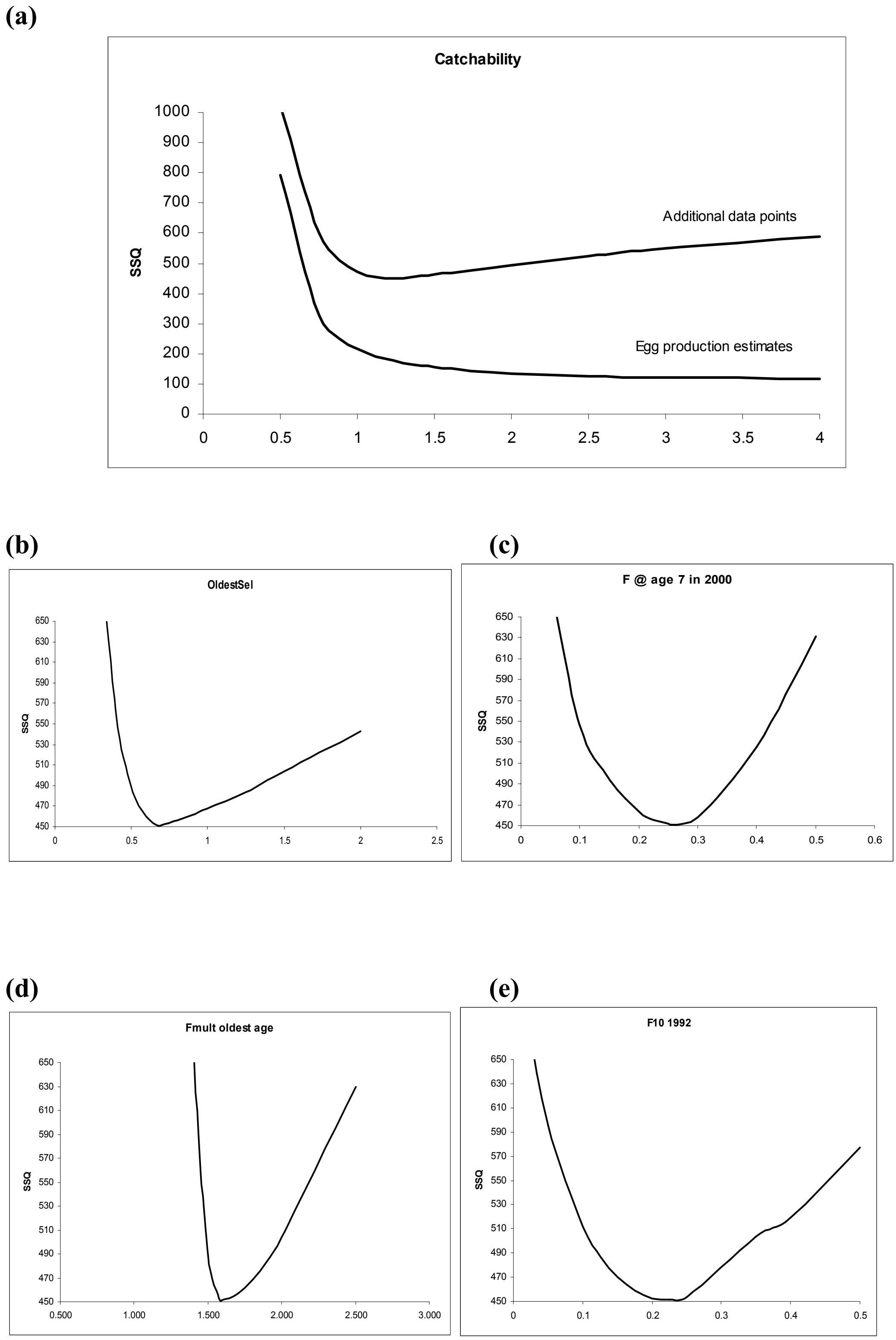
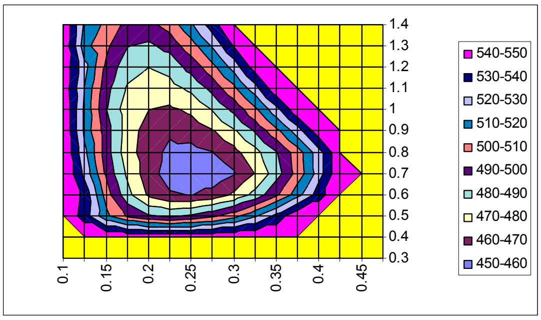
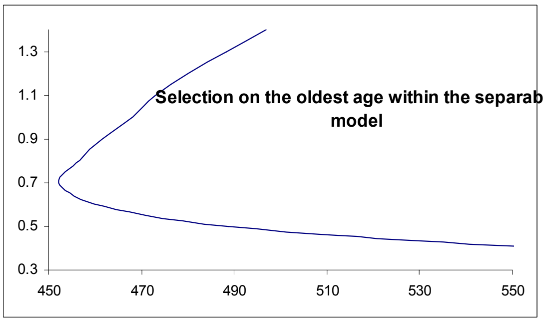


Figure 6.5.1.2 The single parameter sum of squares profiles for each of the five parameters estimated within the SAD assesment model.





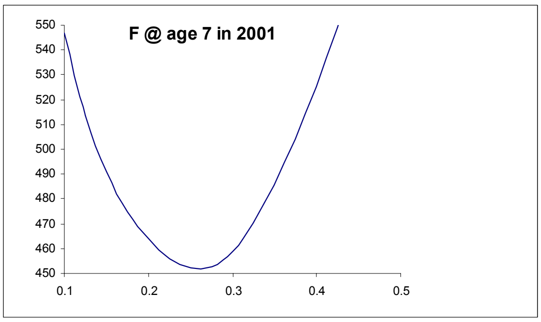
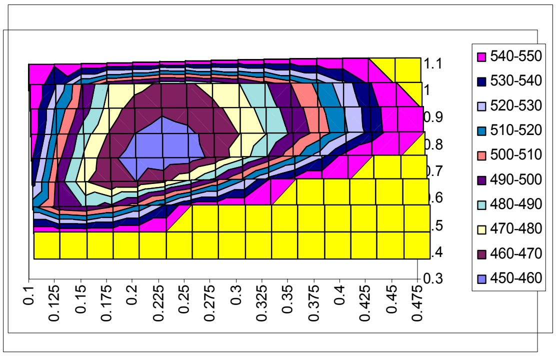
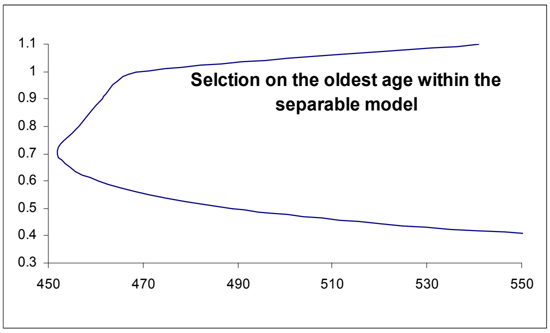


Figure 6.5.1.3a The two dimensional sum of squares profile for the fishing mortality at age 7 in the final assessment year and selection at the oldest age in the separable model.





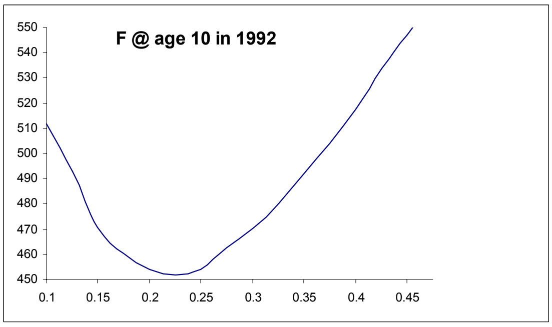


Figure 6.5.1.3b. The two dimensional sum of squares profile for the fishing mortality at age 10 in 1992 and selection at the oldest age in the separable model.

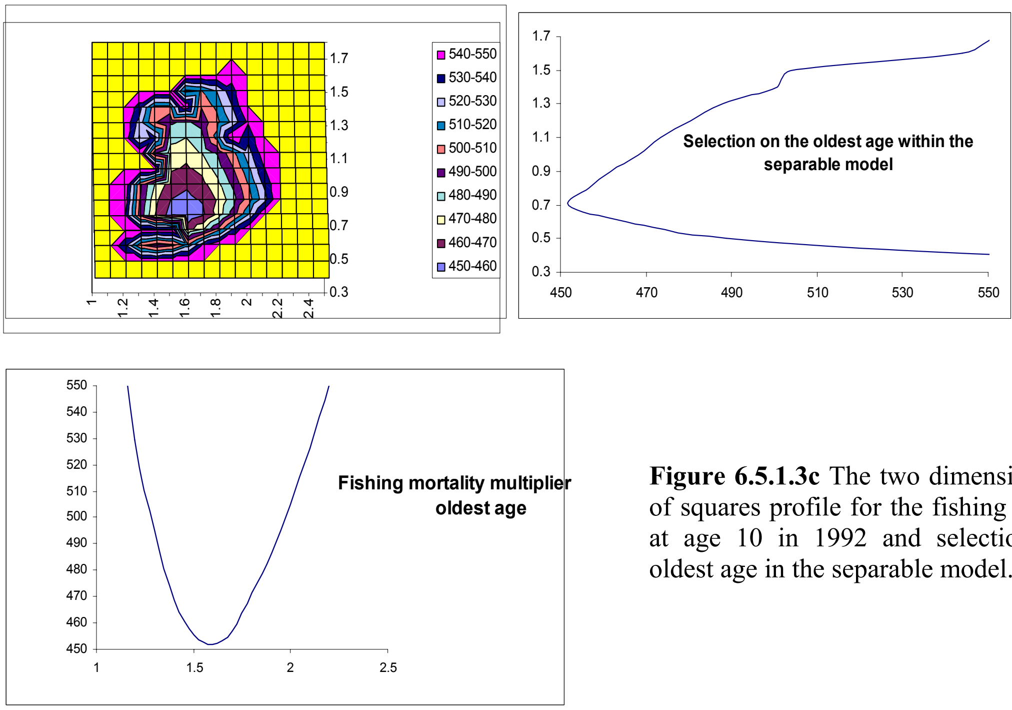


Figure 6.5.1.3c The two dimensional sum of squares profile for the fishing mortality at age 10 in 1992 and selection at the oldest age in the separable model.

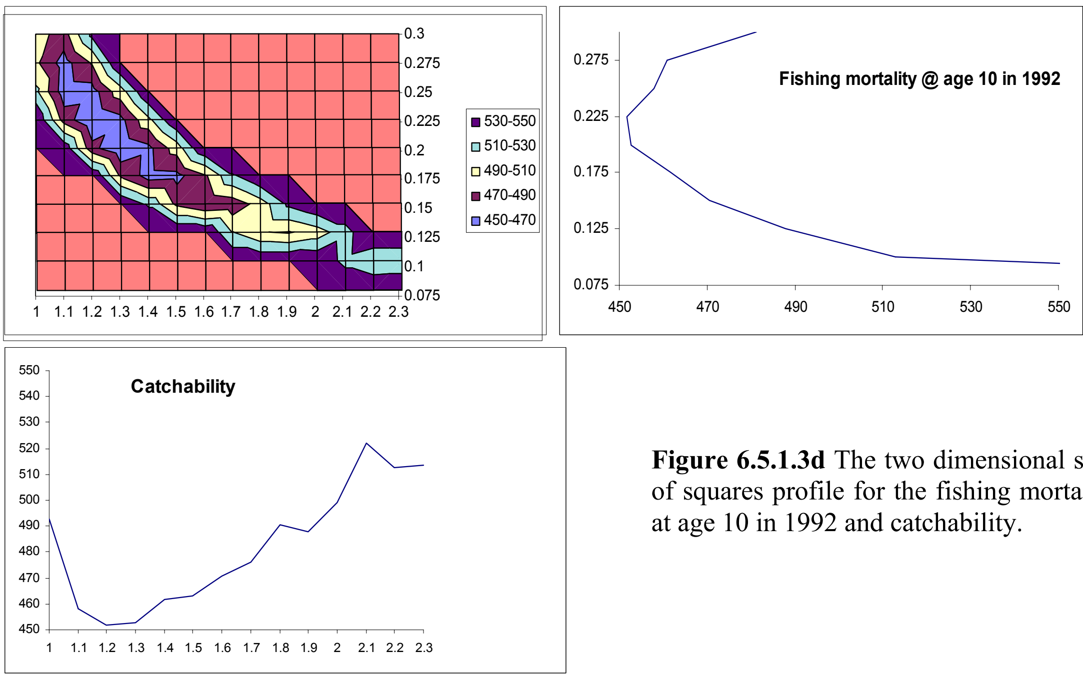


Figure 6.5.1.3d The two dimensional sum of squares profile for the fishing mortality at age 10 in 1992 and catchability.

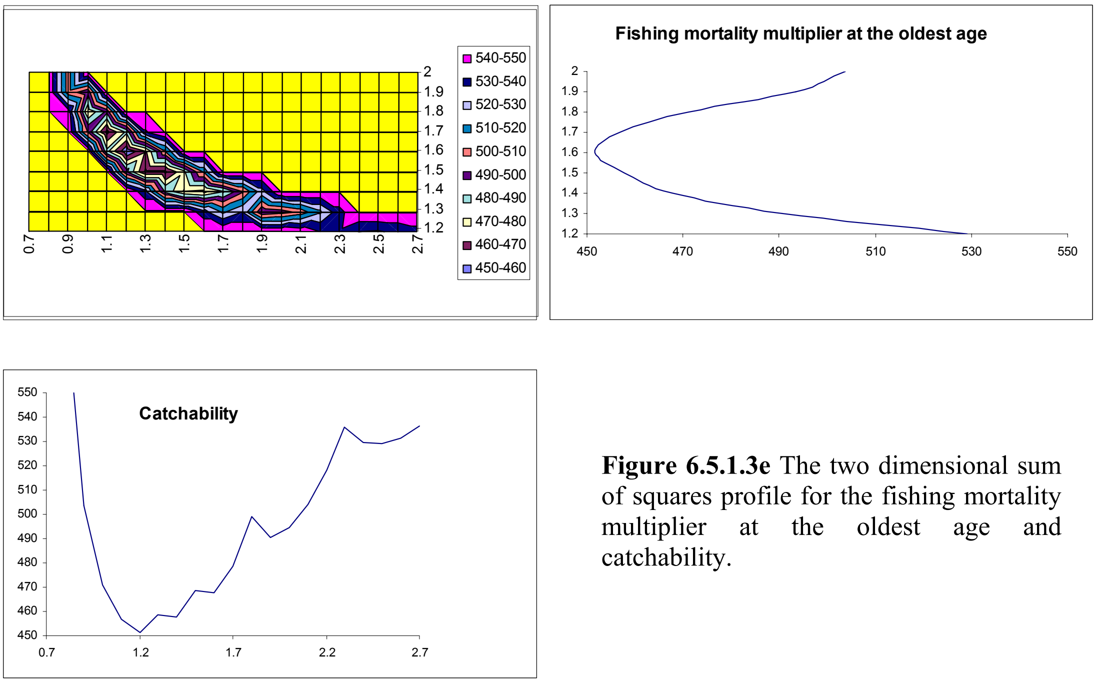


Figure 6.5.1.3e The two dimensional sum of squares profile for the fishing mortality multiplier at the oldest age and catchability.

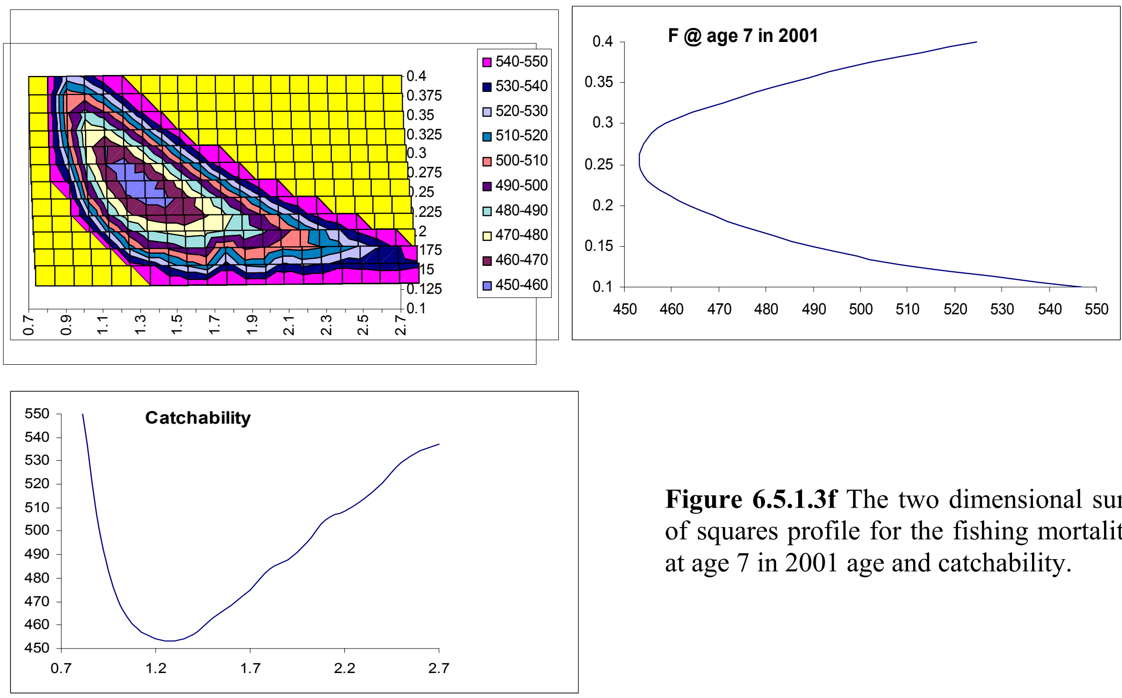
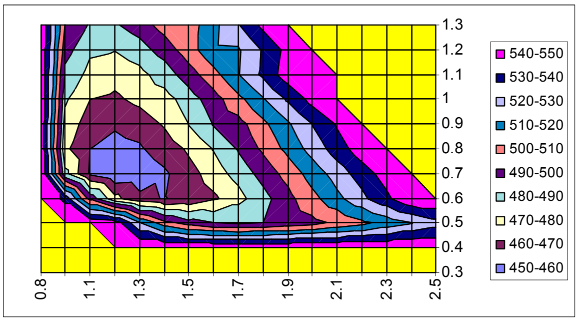
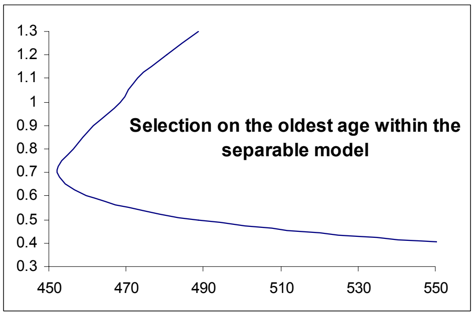


Figure 6.5.1.3f The two dimensional sum of squares profile for the fishing mortality at age 7 in 2001 age and catchability.





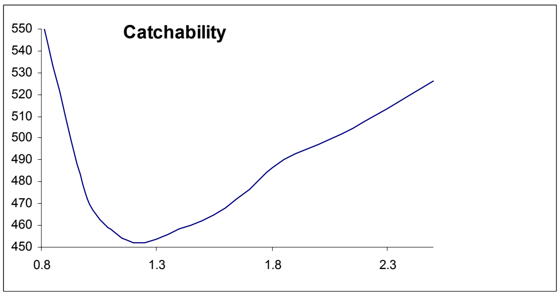
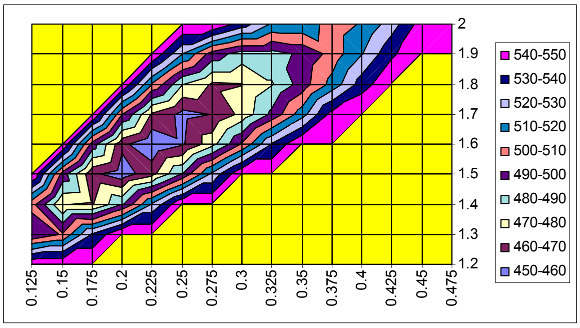
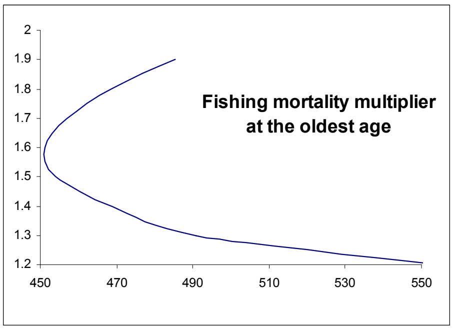


Figure 6.5.1.3g The two dimensional sum of squares profile for the selection at the oldest age in the separable model and catchability.





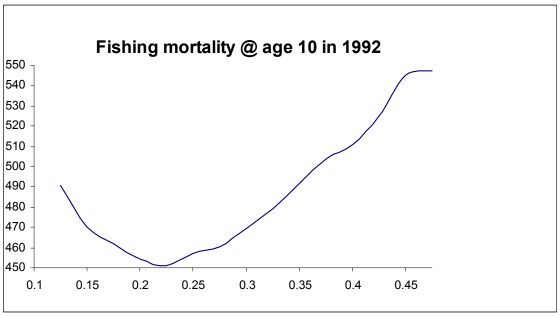


Figure 6.5.1.3h The two dimensional sum of squares profile for the fishing mortality multiplier at the oldest age and fishing mortality at age 10 in 1992.

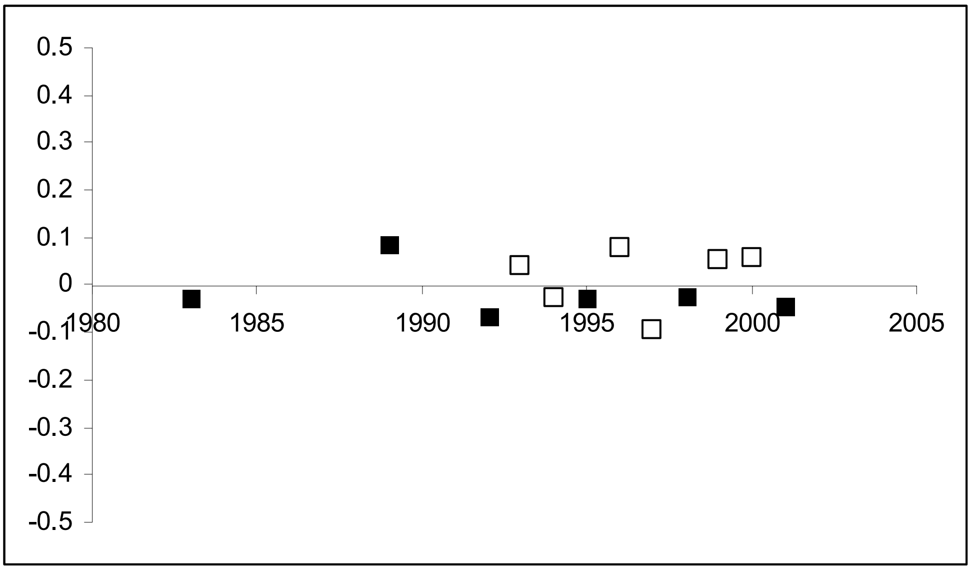


Figure 6.5.1.4 The time series of log residuals from the SAD model fit to the Western horse mackerel egg production estimates. Solid points illustrate real data hollow point interpolated estimates of data points.

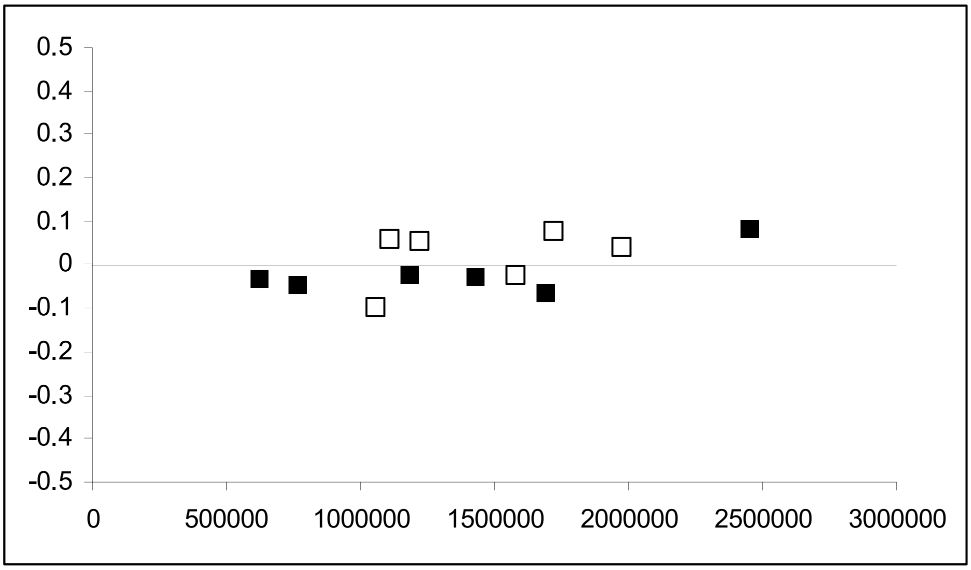


Figure 6.5.1.5 The log residuals from the SAD model fit to the Western horse mackerel egg production estimates plotted against estimated SSB. Solid points illustrate real data hollow point interpolated estimates of data points.

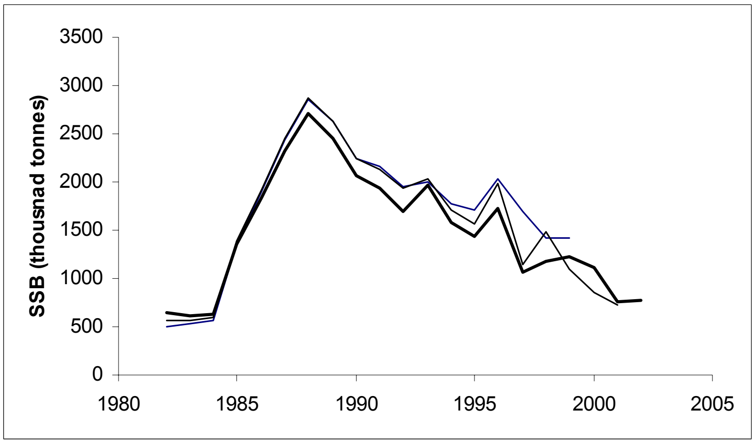


Figure 6.5.1.6 A comparison of the SAD model estimates of spawning stock biomass from assessments carried out in 2000 and 2001 thin lines and 2002 thick line.

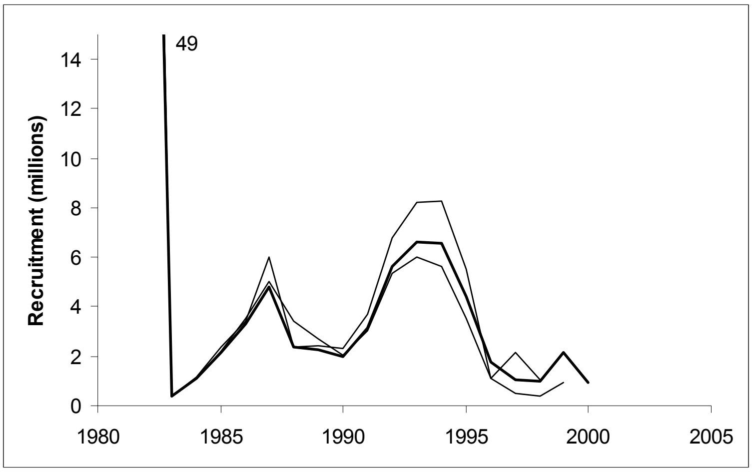


Figure 6.5.1.7 A comparison of the SAD model estimates of recruitment from assessments carried out in 2000 and 2001 thin lines and 2002 thick line.

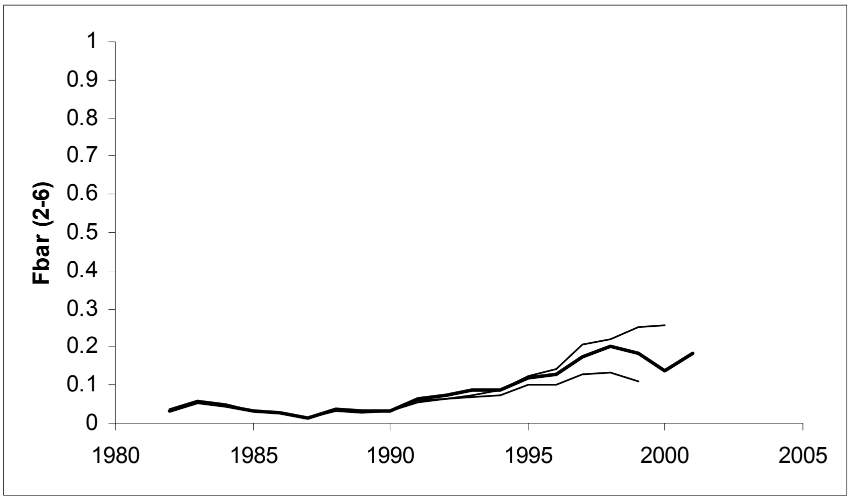


Figure 6.5.1.8 A comparison of the SAD model estimates of Fbar(2-6) from assessments carried out in 2000 and 2001 thin lines and 2002 thick line.

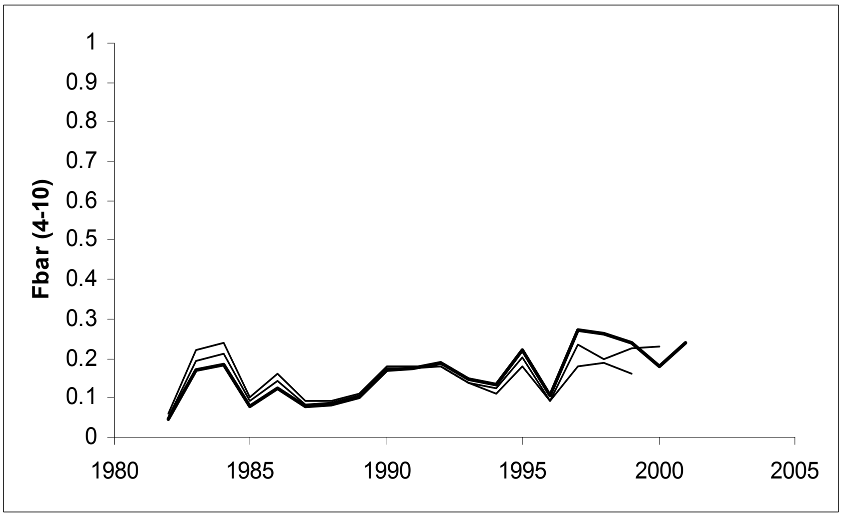


Figure 6.5.1.9 A comparison of the SAD model estimates of Fbar(4-10) from assessments carried out in 2000 and 2001 thin lines and 2002 thick line.

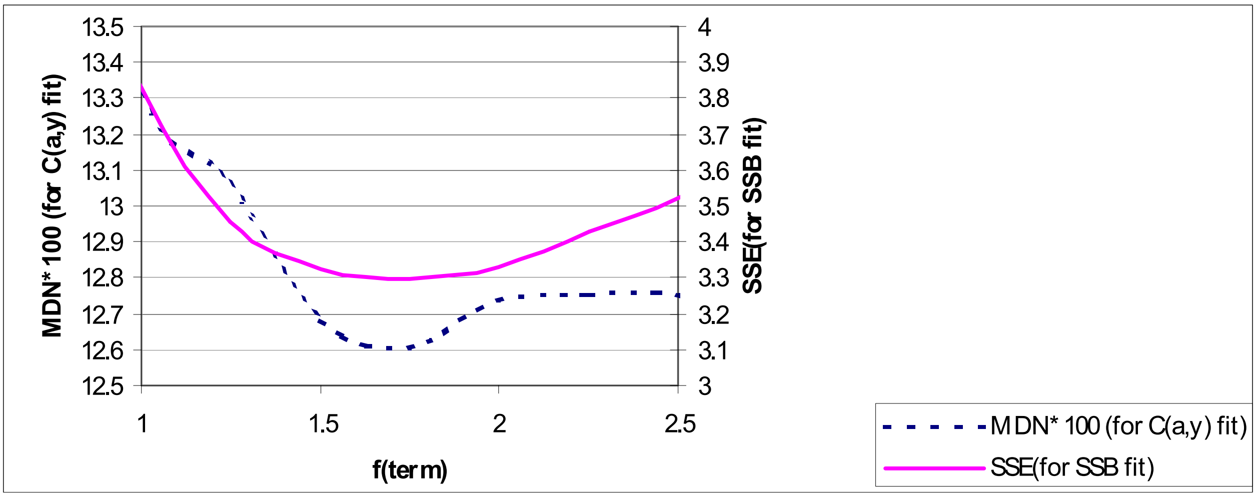


Figure 6.5.1.10. Model fit with ISVPA, with and without fitting to the SSB series

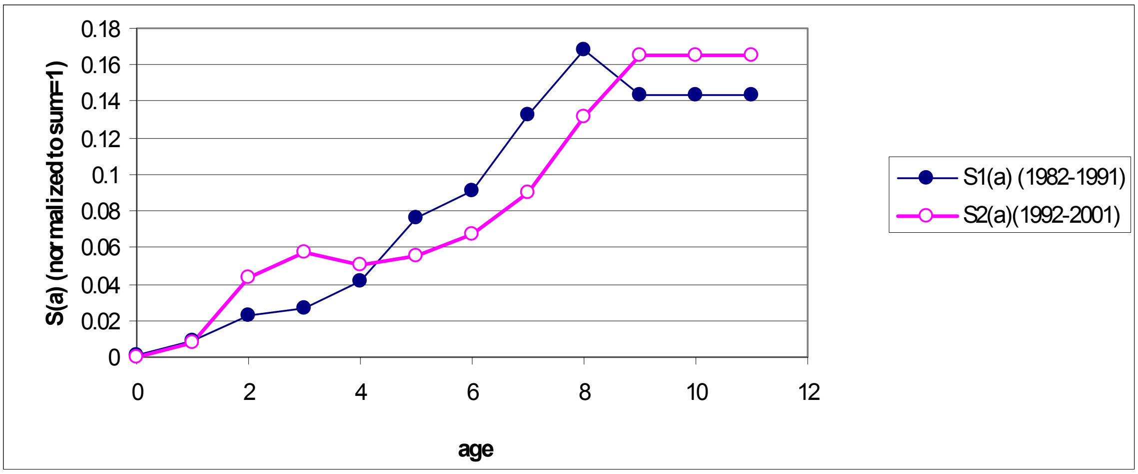


Figure 6.5.1.11. Selection at age according to ISVPA for the early and late period

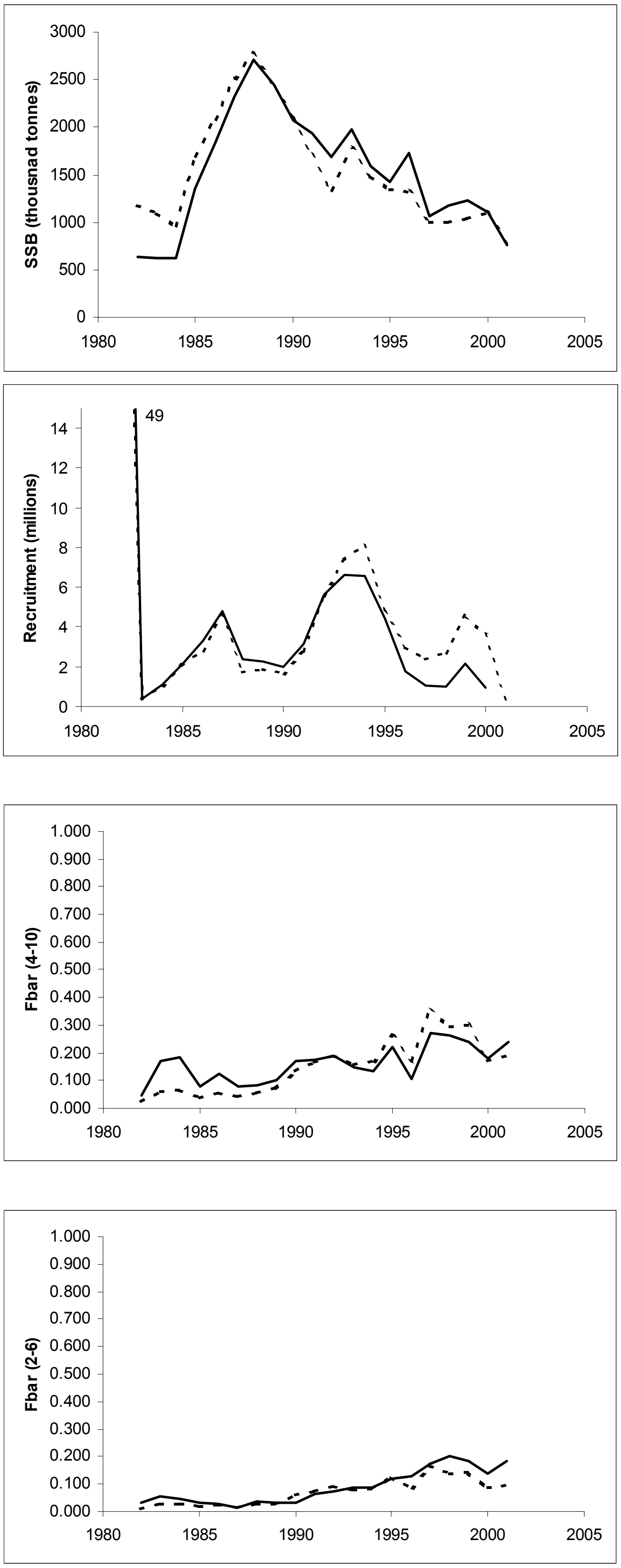


Figure 6.5.1.12 A comparison of the model estimates of (a) SSB (b) recruitment (c) Fbar (4 – 10) and (d) Fbar (2-6). Broken line: ISVPA. Whole line: SAD.

Western horse mackerel

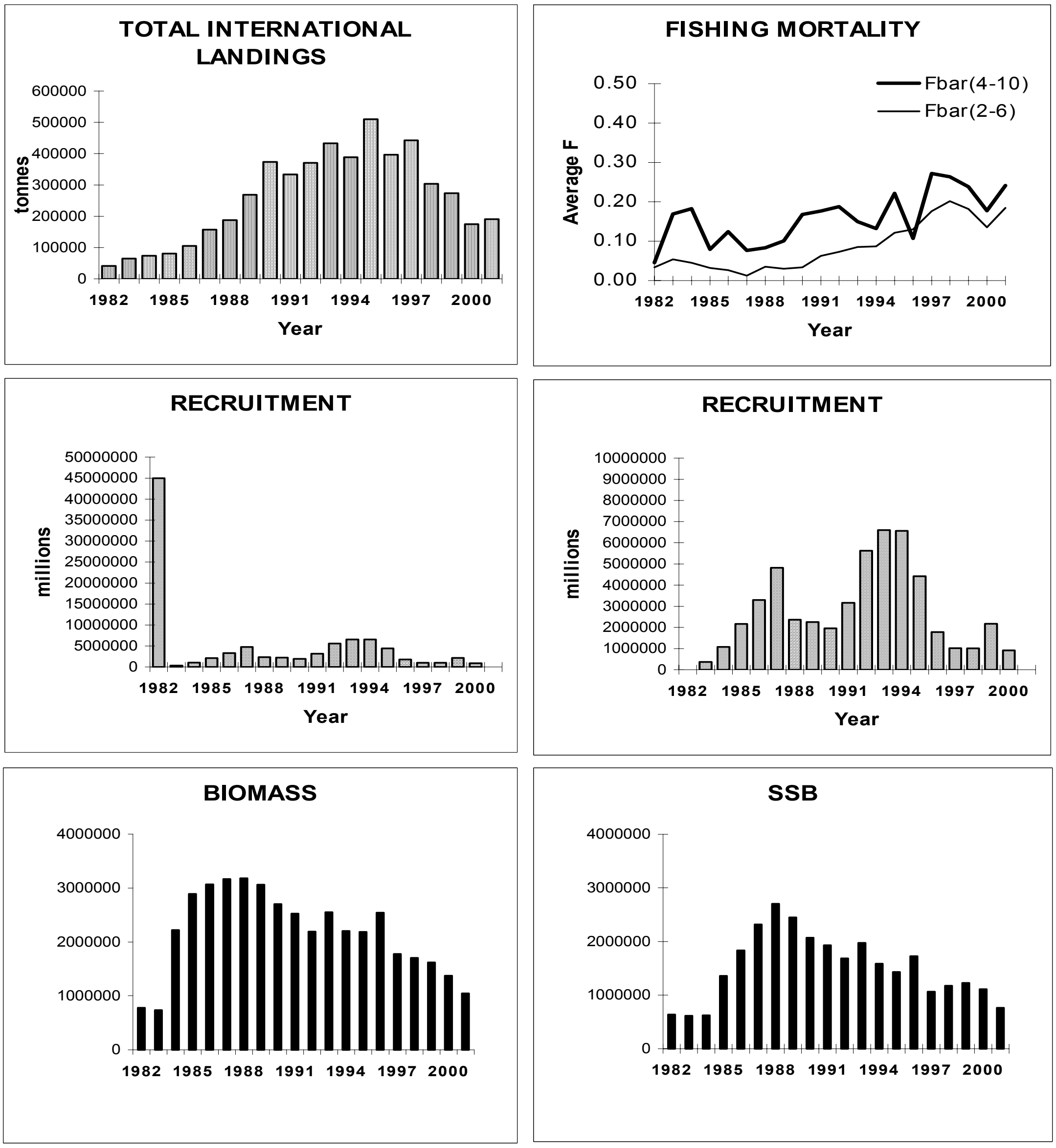
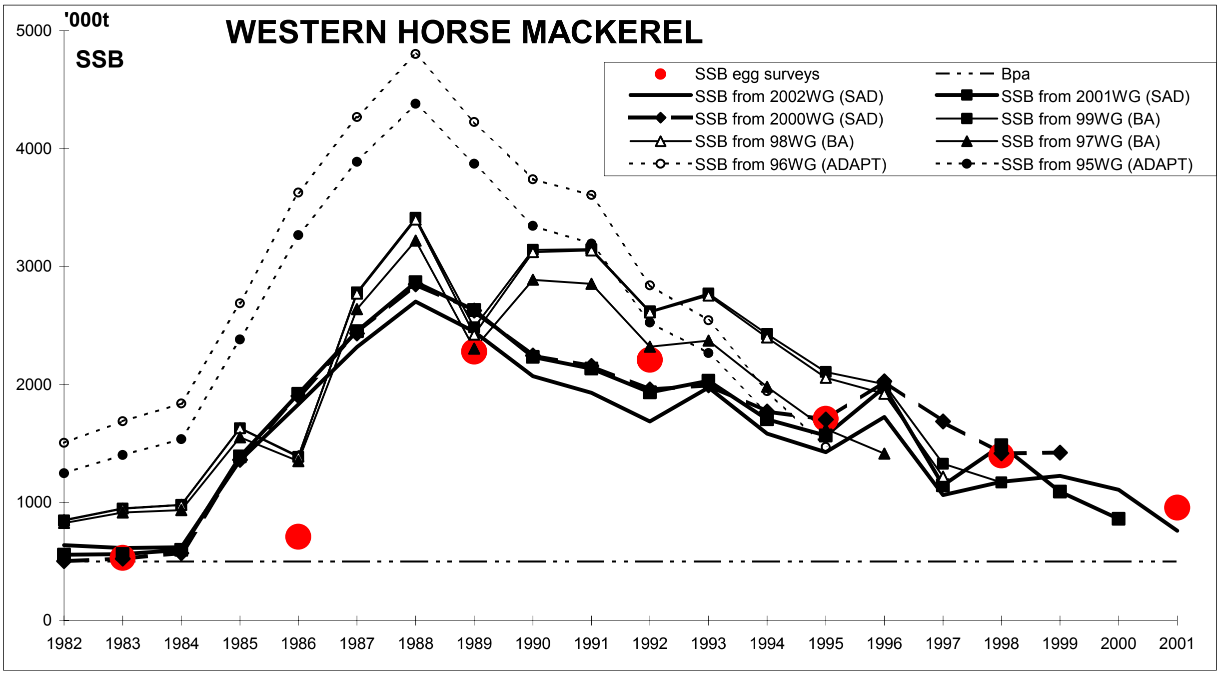


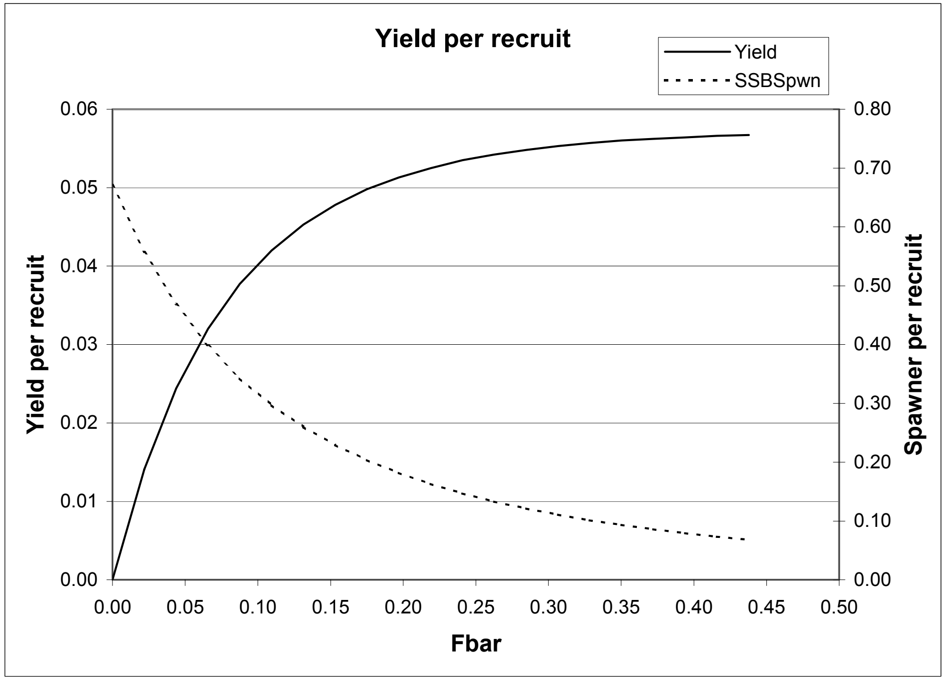
Figure 6.5.2.1. Stock summary plots for Western Horse mackerel

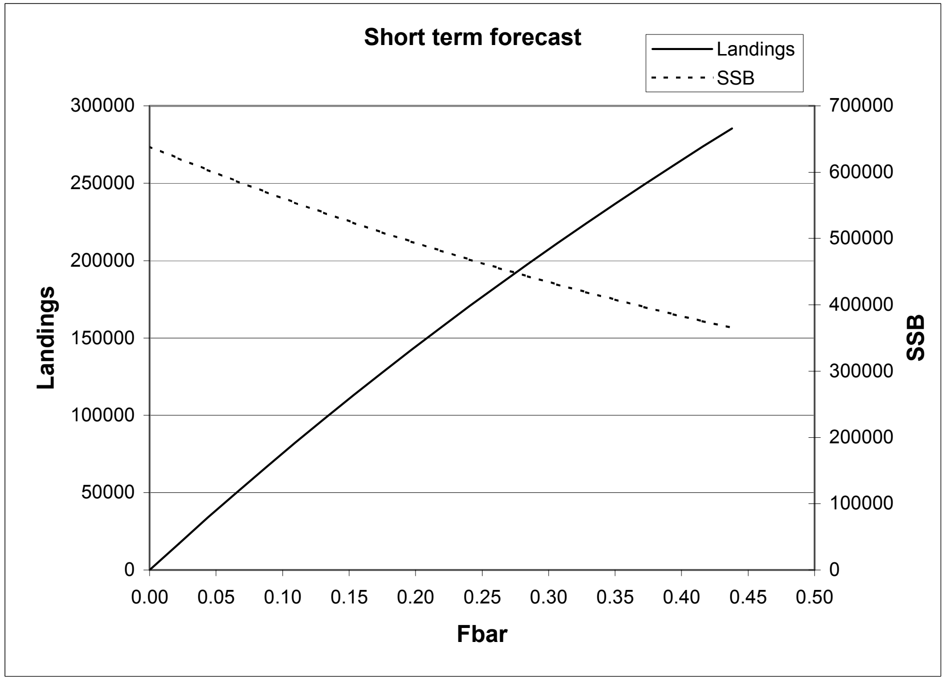
a) Landings b) Avrage fishing mortality ages 4-10 and 2-5
c) Recruitment 1982-1999 d) Recruitment 1983-1999
e). Stock biomass f) Spawning stock biomass



Comparison of SSB estimates as calculated at different ICES Working Group meetings. Biomass estimates of the egg surveys in 1983, 1986, 1989, 1992, 1995, 1998 and 2001 are also shown. Three different types of assessment have been carried out:

1: **ADAPT assessments in 1995 and 1996;**
2: **BAYESIAN assessments in 1997-1999;**
3: **SAD assessment in 2000, 2001 and 2002.**





MFYPR version 2a
Run: WHM 2002 WG
Time and date: 20:51 18/09/02

Reference point	F multiplier	Absolute F
Fbar(4-10)	1.0000	0.2190
FMax	2.5455	0.5574
F0.1	0.8181	0.1791
F35%SPR	0.6794	0.1488

Weights in kilograms

MFDP version 1a
Run: WHM 2001 WG
Western Horse Mackerel 2001 W.G.
Time and date: 20:45 18/09/02
Fbar age range: 4-10

Input units are thousands and kg - output in tonnes

Figure 6.8.1a,b The results of the deterministic catch prediction and yield per recruit for the Western Horse mackerel stock.

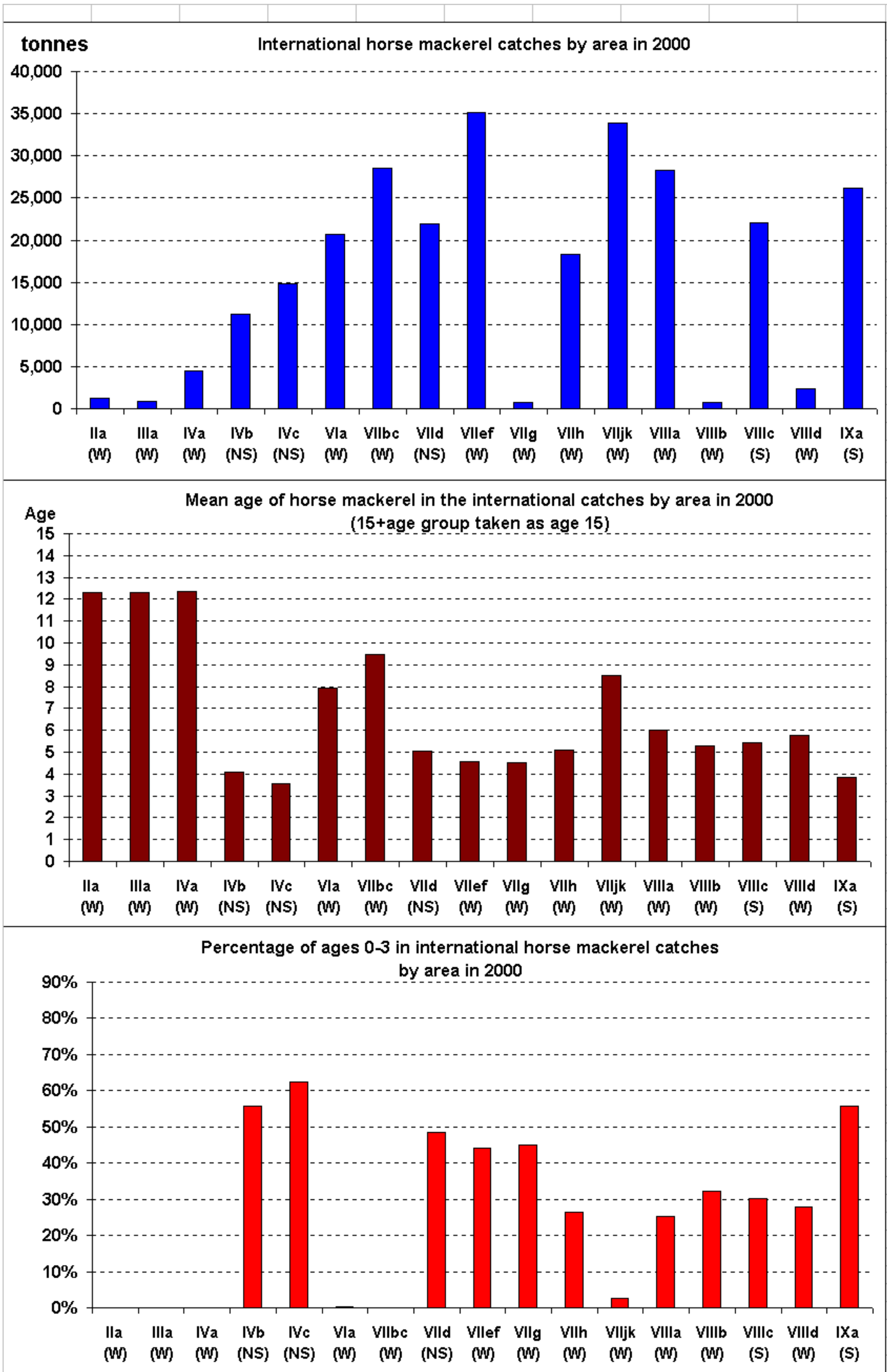


Fig. 6.11.1 Upper pannel: The international catch in tonnes of horse mackerel by area in 2000.
Middle pannel: The mean age of horse mackerel in the international catches by area in 2000.
Lower pannel: The proportion of ages 0-3 in the international catches by area in 2000.
NS = North Sea horse mackerel; W = western horse mackerel; S = Southern horse mackerel

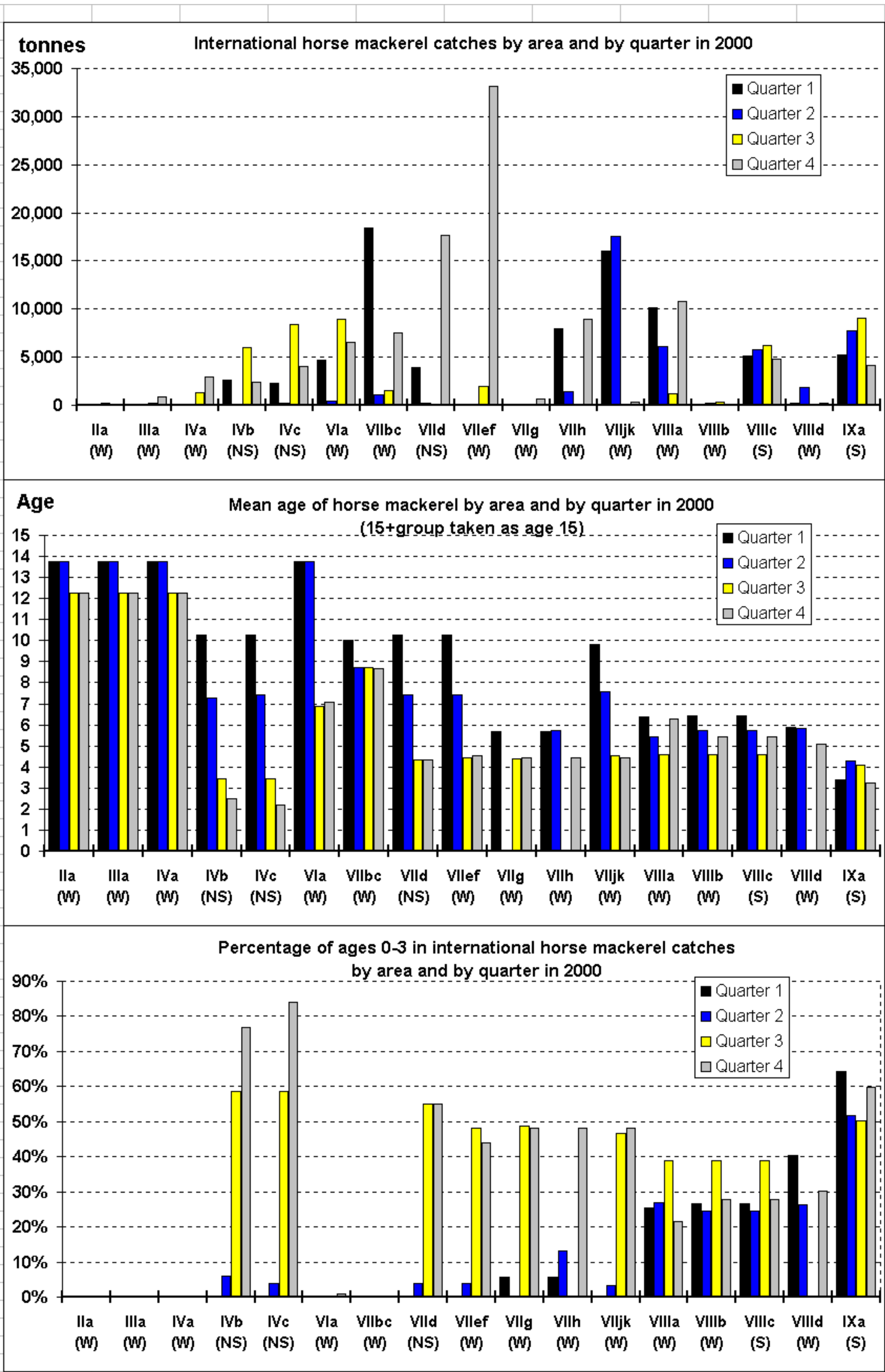


Fig. 6.11.2	Upper pannel: The international catch in tonnes of horse mackerel by area and by quarter in 2000.
	Middle pannel: The mean age of horse mackerel in the international catches by area and by quarter in 2000.
	Lower pannel: The proportion of ages 0-3 in the international catches by area and by quarter in 2000.
	NS = North Sea horse mackerel; W = western horse mackerel; S = Southern horse mackerel

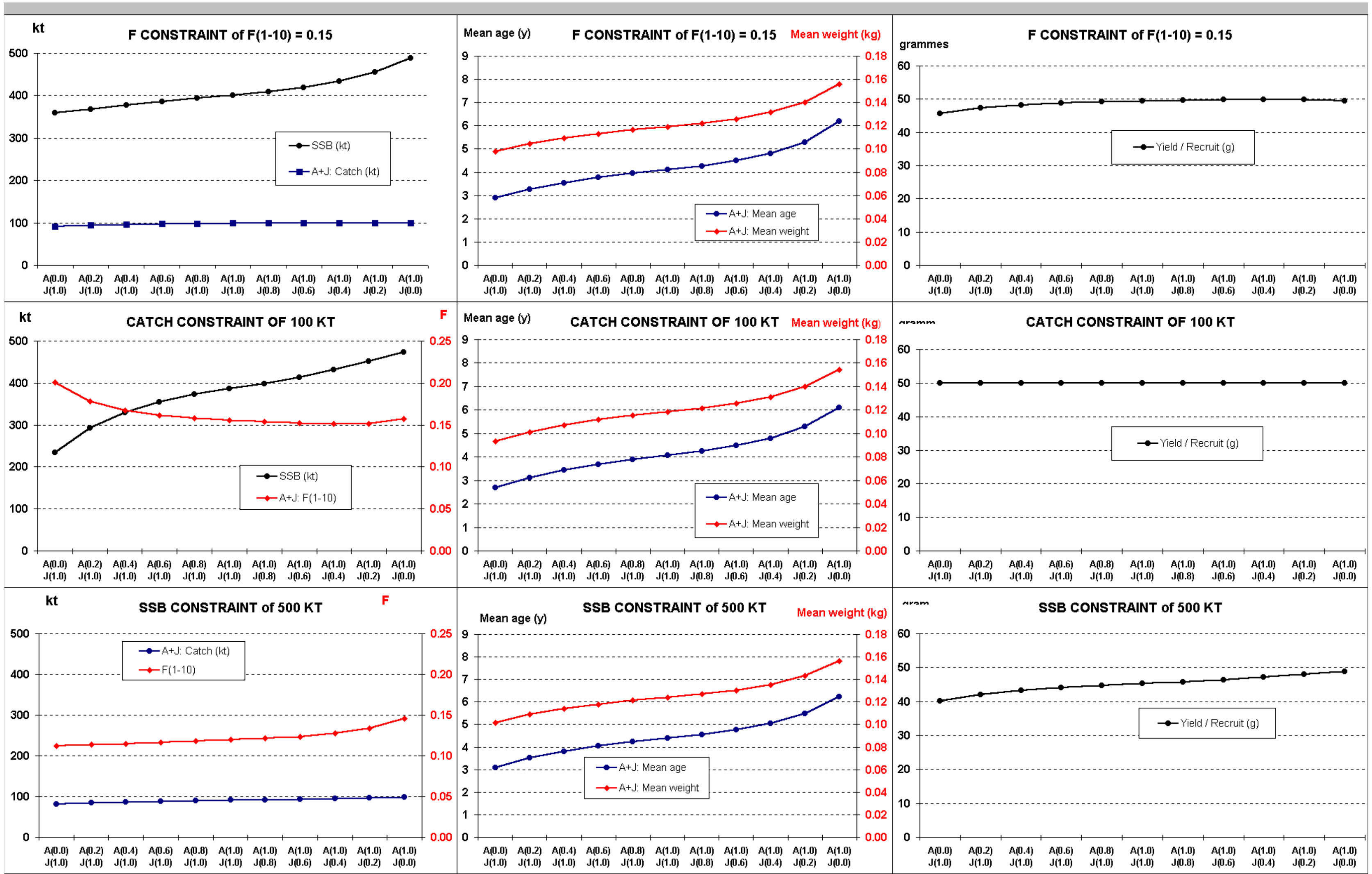


Figure 6.11.3 The effect on spawning stock biomass, fishing mortality, catch in tonnes, mean weight, mean age and yield/recruit caused by stepwise changes in the exploitation pattern by fishing relatively less in the adult areas/periods or less in the juvenile areas/periods compared to the current situation, which is indicated as A(1.0), J(1.0).
These results from the equilibrium predictions are presented for three different options: a) F constraint of F(1-10)=M=0.15 b) Catch constraint of 100 kt and c) SSB constraint of 500 kt.

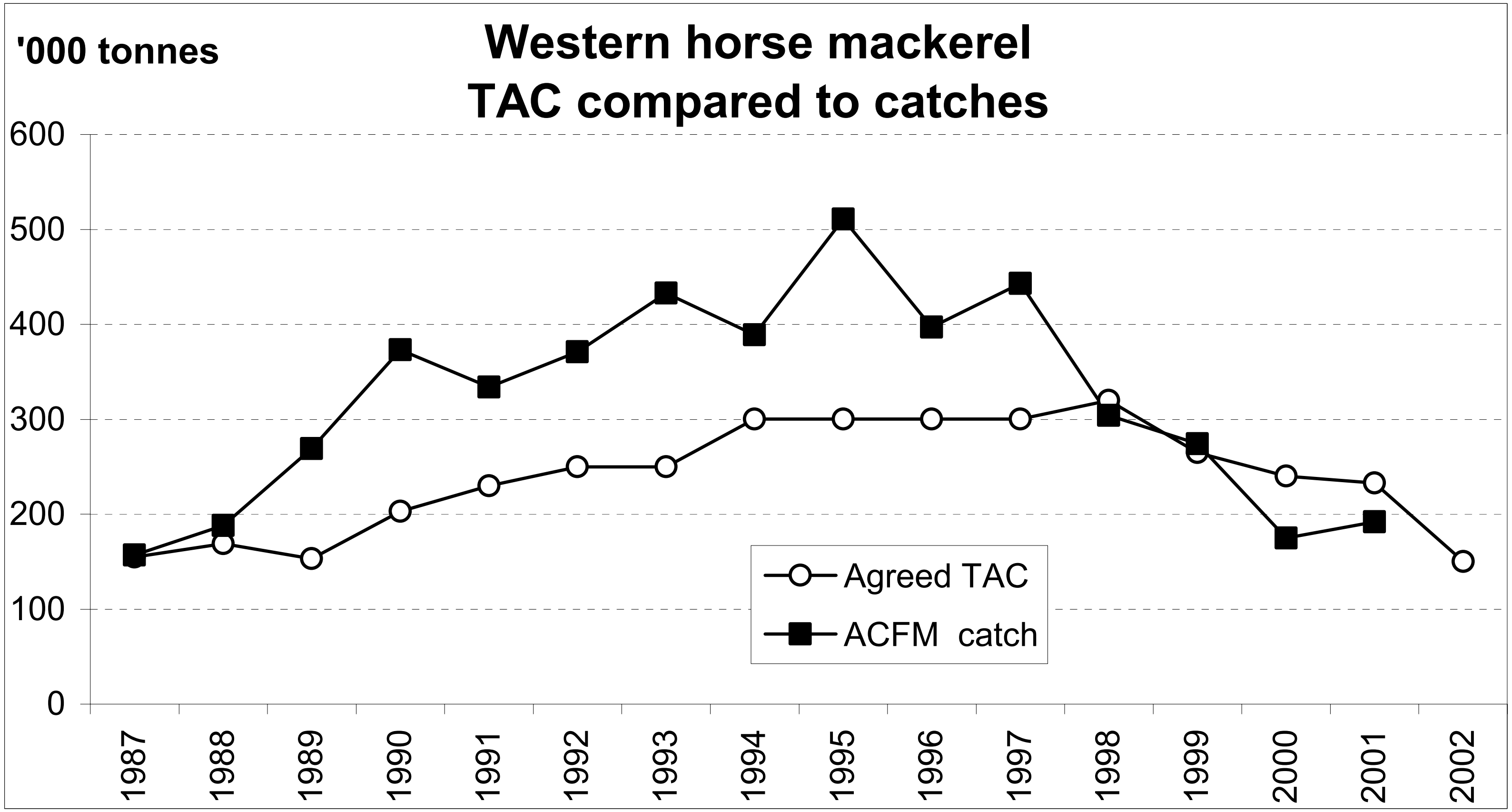


Figure 6.11.4 The agreed TAC for western horse mackerel compared to the actual catches.

7 SOUTHERN HORSE MACKEREL (DIVISIONS VIIIC AND IXA)

7.1 ICES advice Applicable to 2001 and 2002

ICES stated that fishing mortality should be below 0.113, ($\mathbf{F}_{pa}$ = 0.17), corresponding to landings of less than 34,000 t in 2002. This would keep SSB above $\mathbf{B}_{pa}$ in 2003. ICES recommended that the TAC for this stock should only apply to *Trachurus trachurus.* The TAC for all *Trachurus* species up to 1999 was 73,000 t, and 68, 000 t in 2000 and 2001.

7.2 The Fishery

7.2.1 The Fishery in 2001

Total catches from Divisions VIIIc and IXa were estimated by the Working Group to be 45,739 t in 2001 which represents a decrease of 6.9 % compared to the 2000 catches. This level of catch is slightly below the interval of mean level of catches obtained during the period 1990-2000: 52,306 t (± 5,660). The catch by country and gear is shown in Table 7.2.1.1. The Portuguese catches show a decrease of 10.3% compared with the catches in 2000, being the lowest value since 1985. This decrease was mainly due to the drop of the artisanal catches (-61.7%). In the Spain the decrease in catches compared to 2000 is of 5.3%, due to the significant reduction in purse seiners catches (- 13.9 %). The high level of Spanish catches reached on this stock during 1997, 1998 and 1999 was due to the higher catches obtained by the purse seiners. The falls in abundance of other target species, like sardine in the Spanish area, forced the purse seine fisheries to target other species like horse mackerel (ICES CM 1999/ACFM: 6). The 2001 proportion of the catches by gear presents a similar pattern than in 1997-2000 period, being the purse seiners catches the most important ones in the Spanish area (62.9% of the catches) whereas in the Portuguese waters, the trawler's catches are the majority (55.9 % of the catches).

In this area the catches of horse mackerel are relatively uniform over the year (Borges *et al.*, 1995; Villamor *et al.*, 1997), although the second and the third quarter show relatively higher catches (see Table 7.2.1.2).

ICES officially reported catches are requested for "horse mackerel" whose designation includes all the species of the genus *Trachurus* in the area (*T. trachurus, T. mediterraneous and T. picturatus*), thus not only *Trachurus trachurus* L., which is the species at present moment under assessment by this Working Group. The reported catch therefore always has to be revised by the Working Group in order to eliminate species of horse mackerel other than *T. trachurus* (see Section 4.5).

7.2.2 The fishery in earlier years

ACFM asked to review the present perception of the state of the stock in the light of the very high catches reported in the period 1962-1978. To investigate further this question historical catches were recovered covering the period between 1927-1998 for Portugal and 1939-1998 for Spain (WD Murta & Abaunza, 2000). An attempt was also made to obtain a rough measure of abundance of stock estimating CPUE indices. Therefore, it was obtained a CPUE series from Portuguese trawl fleet, covering the periods 1938-1955 and 1990-98. 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. Instead, the catches from 1962-1978 appear exceptionally high when looking to the whole time series. More work is needed, in particular getting better effort indices and investigating the probability of the existence of one or more strong year-classes. The working Group recommends that the work should be completed to examine effort data in the years prior to 1985, in order to understand the large fluctuations in the catches in previous years.

7.3 Biological Data

7.3.1 Catch in numbers at age

The catch in numbers at age from all gears for 2001 are presented by quarter and area, and disaggregated by Sub-division: VIIIc East, VIIIc West, IXa North, IXa Central North, IXa Central South and IXa South (Table 7.3.1.1a and 7.3.1.1b). Table 7.3.1.2 and Figure 7.3.1.1 present the catch in numbers by year. The 1982 yearclass is well represented in the catch in numbers at age matrix, but has almost dissappeared in the most recent years. The 1986 and 1987 year classes are strong but do not reach the extreme high level of the 1982 year-class. In 2001 the catches on age 0 were high representing the 30% of the total catch in numbers. The catches on intermediate ages (7 and 8) are also noticeable as they were in 1999 and 2000 on 4 to 7 ages. In general, juveniles (ages up to three years old) dominate the catch at age matrix. The sampling scheme is believed to achieve good coverage of the fishery. The number of fish aged seems also to be appropriate, with a total of 2,968 fish aged distributed by quarters. Catch in numbers at age have been obtained by applying a quarterly ALK to each of the catch length distribution estimated from the samples of each Sub-division. The sampling intensity is discussed in Section 1.3. The data before 1985 have not yet been revised according to the approved ageing methodology. So, they have been considered inappropriate for a VPA and have not been included in the analytical assessment.

7.3.2 Mean length and mean weight at age

Tables 7.3.2.1a,b and 7.3.2.2a,b show the 2001 mean weights and mean lengths at age in the catch by quarter and Sub-division for the Spanish and Portuguese data. Table 7.3.2.3 presents the weight at age in the stock and in the catch. The old fishes in 2001 presented low mean weight at age values but higher than the extremely low values found in 2000. The scarcity of big fishes in the catches taken in 2000 and 2001 (specimens greater than 37 cm), comparing with other years could explain partially this fact. Constant mean weights at age in the stock have been used for the whole period based on data from 1985 to 1991. The matrix of mean weights at age in the stock was calculated in the following way: for each age, the mean weight in the catch in the fourth quarter of each year, was averaged with the mean weight in the catch in the first quarter of the following year. Then an overall average over the years was calculated for the final mean weight estimate for each age. The working Group recommends that the weights-at-age in the stock should be revised to provide weights on an annual basis.

7.3.3 Maturity at age

The proportions of fish mature at each age (see text table below) have been considered to be constant over the assessment period. The maturity ogive used before to the 1992 assessment (ICES 1993/Assess:7) presented low estimates at the age range 5 to 8 due to lower availability of this range of fish on the catches (ICES 1993/Assess: 7; ICES 1998/Assess:6). As ACFM requested in 1992 the maturity ogive was smoothed as follows. New information on maturity ogives based on samples from Sub-divisions VIIIc East, VIIIc West and IXa North was presented to the 1999 Working Group (ICES 2000/ACFM: 5). As no new information has been presented in 2002 from Sub-divisions IXa Central-North, IXa Central-South and IXa South, it has not been possible to estimate a new maturity ogive for the whole stock, consequently changes in the maturity ogive have not been proposed. The Working Group recommends that new information on maturity at age from Division IXa be analysed and presented at the next meeting.

Age Group												
0	1	2	3	4	5	6	7	8	9	10	11	12
0.00	0.00	0.04	0.27	0.63	0.81	0.90	0.95	0.97	0.98	0.99	1.0	1.0

7.3.4 Natural mortality

According to the ageing methodology established in the ICES area (Eltink and Kuiper, 1989; ICES 1991/H: 59) the life span for the southern horse mackerel was considered to be longer than thought before (up to 40 years old). Therefore the natural mortality was revised (ICES 1992/Assess: 17), changing the previous level from 0.20 to the present 0.15. The analytical assessments performed since 1992 have not shown any inconsistency due to this level of natural mortality.

7.4 Fishery Independent Information and CPUE Indices of Stock Size

7.4.1 Trawl surveys

There are three survey series: The Portuguese July survey, the Portuguese October survey and the Spanish October survey. The two October surveys covered Sub-divisions VIIIc East, VIIIc West, IXa North (Spain) from 20–500 m depth and Sub-divisions IXa Central North, Central South and South, in Portugal, from 20–750 m depth. The same sampling methodology was used in both surveys but there were differences in the gear design, as described in ICES (1991/G: 13). The Portuguese October and July survey indices and the Spanish September/October survey indices are estimated by strata for the range of distribution of horse mackerel in the area, which has been consistently sampled over the years. This corresponds to the 20–500 m strata boundaries. It was demonstrated that horse mackerel off the Portuguese shelf are stratified by length according to the depth and spawning time (ICES 1993/Assess: 19). This explains the special characteristics of the composition of the catches, the lower availability of fish after first maturing which creates a peculiar selection pattern.

Table 7.4.1.1 indicates the catch rates from research vessel surveys in Kg per tow, for comparison with the total biomass trend. In 1999 the two Portuguese surveys (July and October surveys) were carried out by the research vessel

“Capricornio” which is very different from the one previously used, both in terms of the vessel basic performance and gear type used. There is no estimation of the calibration factor to compare the Portuguese indices obtained in 1999 from “Capricornio”, with the rest of the series and then the 1999 data were not used for the assessment. The same explanation should to be applied in 1994 to the July Portuguese survey and in 1996 for the Portuguese October survey. Likewise, it was not also considered the year 1996 in the July Portuguese survey because it was carried out with a different gear and no calibration factor is available at the moment. Portuguese surveys show similar catch rates and variability in the data, showing the following mean and standard deviation in the time series: 22.58 (±19.2) and 22.2 (±17.5) for July and October surveys respectively. Both surveys present similar trends for the 1995-2000 period, but in 2001 they are in opposite directions. The Spanish October survey biomass index shows a decrease of 29.9% compared with the index obtained in 2000, although it is still inside the range of the levels obtained since 1992. This series has less variability than the observed in the Portuguese series giving a mean yield of 21.1(±10.9), and it is especially stable since 1992. Spanish surveys shows a closer agreement in yield trends with the Portuguese July surveys, excepting in the 1995-1998 period.

Table 7.4.1.2 shows the number at age from the October surveys and from the Portuguese July survey. Age disaggregated data is only available from 1985. The Spanish September/October survey and the Portuguese October survey are carried out during the fourth quarter when the recruits have entered the area. As it was explained above, in 1999 the indices obtained from the Portuguese surveys are not comparable with the rest of the series. In this survey there have been during in 2001 an increase in yields of intermediate ages (4 to 9 years old). In the Spanish October survey in 2001 the yields of ages 7 and 8 years old were noticeable. The high yields on intermediate ages (4 to 9 years old) have also been characteristic during the recent years, from 1998 to 2000, changing the pattern observed in 1997 (Table 7.4.1.2). In this survey the 1982 superabundant yearclass is the most conspicuous and the 1994 yearclass is shown as a strong one. In the Portuguese July survey there is a strong fall in the observed 1995 abundance indices comparing with those obtained in 1993. Since 1995 the indices are similar (except for the groups 0 and 1 which present high variability). In this survey, in 2000 and 2001, there is also an increase in the strength of the intermediate ages (5 to 8) comparing with the indices obtained since 1995.

7.4.2 Egg surveys

Some problems have been detected in the research work related with egg surveys, which produce important SSB indeces for tuning the assessment of some stocks. As it is stated in ICES (2000/G: 01 Ref: D, 2000/ACFM: 5) more research work is needed for the adult parameters estimation (e.g. if it is a determinate or indeterminate species and therefore the fecundity estimates, atresia and maturity) and egg identification. In this sense new information has been presented to the Working Group on egg staging for Daily Egg Production Method (WD Vendrel et al., 2002).

The MHMEGGS WG (ICES 2002/G: 06 Ref: D) provided the estimate of the 2001 fecundity, which was of 1578 eggs/g with a CV of 19.4%. This fecundity estimate is 27% higher than the value obtained in 1998 (1245 eggs/g, CV=26.8%). The SSB estimated in 2001 was 227,966 t with a CV of 40.9%, which is lower than the SSB estimated in 1998 (301, 084 t, with a CV of 50%). The SSB estimated in 2001 from the egg surveys was very close to the 2001 SSB estimate from the analytical assessment (ICES 2002/ACFM: 6).

In 2002 Portugal applied the Daily Egg Production Method (DEPM) to horse mackerel in ICES Division IXa (WD Costa et al., 2002). The preliminary results showed that the estimate for: a) the estimates of adult parameters have a very high coefficient of variation; b) the value of spawning fraction is higher when compared with previous values; c) the application of the egg mortality model of the standard method produces a much lower total daily egg production compared with the ICES methodology, and d) the interpolation for the adjacent non sampled half ICES rectangles in the spawning area, has strong influence on the estimated SSB (more 51% than without interpolation).

7.5 Effort and Catch per Unit Effort

Figure 7.5.1 shows the evolution of the commercial effort series from the Spanish trawl fleets fishing in Sub-division VIIIc West (A Coruña) and in Sub-division VIIIc East (Avilés) from 1984 to 2001. A Coruña bottom trawl fleet in 2001 reached the lowest level of effort in the series, continuing with the decreasing trend that started in 1996. In 1998 there was no reliable estimation on the A Coruña bottom trawl fleet effort. The effort in Avilés bottom trawl fleet has decreased by 43.6%, comparing with the 2000 observed effort, being, as in the case of A Coruña trawl fleet, the lowest level of effort in the series. There is no estimation of effort from the purse seine fleets, which is the fleet that catches the majority of Spanish catches (63% in 2001).

Table 7.5.1 presents the commercial catch rates from the trawl fleet fishing in Sub-divisions IXa Central North, IXa Central South and South (Portugal) from 1979 to 1990 and trawl fleets from Spain fishing in Sub-division VIIIc West (A Coruña) and in Sub-division VIIIc East (Avilés) from 1983 to 2001. In 2001 both fleets show significant increases in catch rates comparing with the values obtained in 2000 (6.9% and –53.1% respectively), which is just the opposite pattern to that observed in 2000. In 1998 there was no effort estimation from A Coruña bottom trawl fleet. Since 1994 the obtaining of catch and effort information from Avilés trawl fleet is becoming very difficult and the data are not fully accessible from the local fishermen association. Thus the catch and effort data are estimated (with information available and through observers at fishing port). The Avilés trawl fleet catches estimates are more uncertain than theeffort estimates (Punzón, A and Gancedo, R., com. pers., IEO, Santander, Spain). Furthermore, there is a hypothesis of this fleet being catching fish form different populations than the the fleets operating in Subdivision VIIIc West and Division IXa. This later hypothesis is under investigation within the EU funded project HOMSIR (Horse Mackerel Stock Identification Research). Horse mackerel trawl catch rates from the Portuguese trawl fleet fishing in Division IXa are yet not available since 1991, and the whole series needs to be revised.

Catch per unit effort at age

CPUE at age from the Galician (A Coruña) bottom trawl fleet (Sub-division VIIIc West) and from the Cantabrian (Avilés) trawl fleet fishing in Sub-division VIIIc East are available from 1984 to 2001 (Table 7.5.2).

As it has been observed since 1997, the catch rates of juveniles (up to age 3) in 2001 from the both fleets were at the similar low levels. Since 1999, in both surveys, the indeces of intermediate ages (5 to 12) are noticeable. There is no estimation of effort in 1998 for A Coruña bottom trawl fleet.

7.6 Recruitment Forecasting

Figure 7.6.1 shows the evolution of these indices from 1985 to 2001. Both surveys present a high variability, especially in recent years. The variability in the Portuguese survey is higher than in the Spanish one, and no clear trends are evident over the whole Portuguese survey series. The abundance indices of the Spanish survey present a slight decreasing trend over the years. From 1996 to 2001 the recruitment indices from the Portuguese survey were higher than the ones from the Spanish one, except in 2000 when the Spanish survey provided higher indices. In general it seems that there exists no good agreement in trends between these surveys in the abundance index for the 0 group.

7.7 State of the Stock

7.7.1 Data exploration and preliminary modelling

The southern horse mackerel stock assessment has been tuned using 5 CPUE index series, coming from the following fleets:

Fleet 1: Catch per unit of effort of the trawl fleet from A Coruna (VIIIc West - North Galicia) (1985-2001)

Fleet 2: Catch per unit of effort of the trawl fleet from Avilés (VIIIc East - Cantabrian Sea) (1985-1993)

Fleet 3: Portuguese October Trawl Survey during the recruitment season (Division IXa) (1985-2001)

Fleet 4: Spanish October trawl Survey during the recruitment season (Sub-division IXa North and Division VIIIc) (1985-2001)

Fleet 5: Portuguese July Trawl Survey end of spawning season in Division IXa (1985-2001)

In previous years assessments it was noticed contradictory information coming from the different fleets used to tune the assessment (see for example Figure 7.7.1.3 in last year's report ICES CM 2002/ACFM: 6). In preliminary runs using each fleet at a time, fleet 2 showed a steep increase of SSB in recent years, as opposite to the trends revealed by the other fleets, having a great influence in the assessment. Given the uncertainty in the catches of the Avilés fleet explained in section 7.5, the indices from this fleet from 1994 to 2001 were removed from the assessment. It is therefore recommended that the Avilés fishermen association should provide reliable catch data from 1994 to present, as it was usual in earlier years.

The CPUE indices from surveys, in particular fleets 3 and 5, also showed high residuals in preliminary assessments, thus having low weight in the final result. The methodology to obtain CPUE indices from those surveys is currently being revised. There are some indications that part of the noise in the data may be due to a conjunction of the sampling design and of a decrease in recent years of the survey duration, which lead to an insufficient area coverage. This assumption seems to be confirmed by the fact that the biggest residuals in the preliminary assessments corresponded to the survey years with least stations carried out.

As a preliminary solution to decrease the high variability of these data, the surveys presenting high residuals and a lower sampling effort were removed from the tuning data sets. Those were the years 1992, 1993, 1997 and 2001 from fleet 3 and 1993 from fleet 5. The year 1994 was also removed from fleet 5 because during the revision of the data it was discovered that the survey had been carried out with a different gear. At the same time, the indices from fleets 3 and 5 were calculated using a simple mean instead of a stratified one, allowing a higher coherence in the data and a much lower variance. A comparison of these surveys indices calculated in both ways is shown in Figure 7.7.1.1. The October surveys in that figure show essentially a strong year-effect, which is not surprising given that those surveys catch mostly recruits. The July surveys also showed a strong year-effect when the stratified mean was used, whereas with the simple mean a more coherent pattern was visible, with some well-marked cohorts. Common to both surveys and methodologies is the apparent lack of older fish in recent years, as compared with the years before 1995.

Even after changing the tuning data as described above, a discrepancy between the information provided by the commercial fleets and the surveys was apparent in the preliminary assessment residuals. This is clearly shown in Figure 7.7.1.2 where it is clear that although the trends are the same in both assessments, the SSB level from 1994 to present is much lower in the assessment with the surveys than in the one with the commercial fleets. The assessment using all fleets seems a compromise between the other two, presenting the same trends and a SSB level from 1994-2001 identical to that of earlier years.

7.7.2 Stock assessment

As in last year's assessment, XSA parameters were set at catchability independent of age for ages equal or greater than 9 years old, and the plus group at 12. A minimum standard errors of the mean to which the survivors are shrunk of 1.0 was used. This weak shrinkage ensures that the estimates are primarily derived from the data.

The final stock assessment was performed following the conclusions of the preliminary modelling (Section 7.7.1). The final option was to consider the assessment with all fleets as the one that best represents the actual condition of the stock.

Figure 7.7.2.1 presents F and SSB estimates from a retrospective analysis carried out with the same data and options as the final assessment, along with the SSB estimates from the annual egg production method (AEPM). It is clear that for the reference Fbar (1-11) the retrospective estimates show an extremely close agreement, especially from 1997 backwards, and a remarkable absence of bias. All AEPM estimates are higher than the XSA ones, however, given the large variance of the AEPM estimates, XSA estimates are within 1 standard deviation range from the AEPM estimates. The AEPM SSB estimate for 2001 is close to the estimate of the assessment carried out with just the commercial fleets (Figure 7.7.1.2). The tuning diagnostics and final results are given in Tables 7.7.2.1-7.7.2.4. Figure 7.7.2.2 shows the fish stock summary trends over the period 1985-2001 according to the final assessment.

7.7.3 Reliability of the assessment and uncertainty estimation

The option for an assessment with just tuning data from surveys would probably be too pessimistic. The decrease in SSB level coincides with a decrease in sampling effort of fleets 3 and 5, which can decrease the probability of having hauls with large catches when sampling schooling species such as horse mackerel. On the other hand, the increase of CPUE from the commercial fleets, especially fleet 1, coincides with a period in which hake catches decreased steeply and the fleet started targeting mainly horse mackerel, which was previously a secondary species. Therefore, the option for an assessment with just commercial fleets would probably give a too optimistic view of the stock.

At first sight this assessment seems consistent, given the retrospective pattern and the SSB trajectory parallel to the AEPM estimates. However, during the preliminary modelling, there were evident discrepancies in the information given by the different tuning fleets. The current assessment gives a perception of the state of the stock that is different from previous year's assessments, namely a decreasing trend and an overall lower level of SSB. This was mainly caused by the removal of recent data from the Avilés fleet and from some noisy data from surveys, which gave surveys a bigger weight in the assessment. The divergent trends in tuning fleet data are a source of uncertainty about the state of the stock. If the perception given by the survey data happens to correspond better to reality, the assessment presented here may be giving a too optimistic view of the stock.

In last year's report it was stated that an increase in the reliability of the assessment would take place after the revisions of the input data and of the stock boundaries. This latter task is expected to be finished next year within project

HOMSIR. As for the former one, this working group recommends that a workshop take place before the next working group to revise basic biological data, survey data and methodology to calculate CPUE indices from surveys.

7.8 Catch Predictions

The terminal population in 2001 from the final VPA was used as input to the catch forecast for age groups 1 and older. Recruitment at age 0 was assumed to be the geometric mean of the period 1985-1999. The exploitation pattern was taken as the arithmetic mean of the last three years, without scaling to the last year, which is assumed to correspond to the most likely exploitation in the short term. Table 7.8.1 gives the input parameters and Tables 7.8.2.a-d show the results of the short-term predictions of the catch and spawning stock biomass at Fstatus-quo and TAC constraints.

At F status-quo (Fbar 1999-2001) the predicted catch in weight for 2002 is 48,830 t. In 2003, assuming the same recruitment level, the catch at Fstatus quo is predicted to be 50,030 t. The spawning stock biomass is predicted to decrease from 163,743 t at the beginning of 2002 to 152,217 t in 2003 (Table 7.8.2.a) at Fstatus-quo. Assuming Fstatus-quo in 2003, the spawning stock biomass is predicted to decrease in 2004 to 146,562 t.

7.9 Long-Term Yield

The long-term yield per recruit and spawning biomass-per-recruit curves, against F, derived using the input data in Table 7.8.1 are shown in Figure 7.9.1. Table 7.9.1 presents the yield per recruit summary table. $\mathbf{F}_{0.1}$ is estimated to be 0.10, and $\mathbf{F}_{max}$ to be 0.19 at the reference age (1-11).

7.10 Reference Points for Management Purpose

The stock SSB trend seems to be well defined and insensitive to different options in the assessment; however, the level of SSB estimates for recent years is dependent on the weight given to each tuning fleet in the assessment. Reference points calculated previously were based on an assessment done with different data and may not fit so well the current perception of the stock. Moreover, the perception of the state of the stock is likely to change after the revision of stock boundaries and assessment data, and the reference points will need to be recalculated if that is the case.

7.11 Harvest Control Rules

No harvest control rules were yet proposed neither by the Study Group on the Precautionary Approach to Fisheries Management (ICES 2002/ACFM: 10) nor by this Working Group.

7.12 Management Considerations

In the year 2000 the TAC was revised to 68000 tonnes, which was in close agreement with the recommendations from this working group to decrease the previous TAC of 73000 tonnes. This TAC has never been reached during the assessment period and still seems dangerously high. Given the uncertainty on the state of the stock, and taking into account that southern horse mackerel is caught in multispecies fisheries, a reduction of effort should be put in practice until the decreasing trend in SSB is inverted.

Table 7.2.1.1 Annual catches (tonnes) of SOUTHERN HORSE MACKEREL by countries by gear in Divisions VIIIc and IXa. Data from 1984–2001 are Working Group estimates.

Year	Portugal (Division IXa)				Spain (Divisions IXa + VIIIc)					Total VIIIc+IXa
	Trawl	Seine	Artisanal	Total	Trawl	Seine	Hook	Gillnet	Total	
1963	6,593	54,267	3,900	64,760	-	-	-	-	53,420	118,180
1964	8,983	55,693	4,100	68,776	-	-	-	-	57,365	126,141
1965	4,033	54,327	4,745	63,105	-	-	-	-	52,282	115,387
1966	5,582	44,725	7,118	57,425	-	-	-	-	47,000	104,425
1967	6,726	52,643	7,279	66,648	-	-	-	-	53,351	119,999
1968	11,427	61,985	7,252	80,664	-	-	-	-	62,326	142,990
1969	19,839	36,373	6,275	62,487	-	-	-	-	85,781	148,268
1970	32,475	29,392	7,079	59,946	-	-	-	-	98,418	158,364
1971	32,309	19,050	6,108	57,467	-	-	-	-	75,349	132,816
1972	45,452	28,515	7,066	81,033	-	-	-	-	82,247	163,280
1973	28,354	10,737	6,406	45,497	-	-	-	-	114,878	160,375
1974	29,916	14,962	3,227	48,105	-	-	-	-	78,105	126,210
1975	26,786	10,149	9,486	46,421	-	-	-	-	85,688	132,109
1976	26,850	16,833	7,805	51,488	89,197	26,291	376[1]	-	115,864	167,352
1977	26,441	16,847	7,790	51,078	74,469	31,431	376[1]	-	106,276	157,354
1978	23,411	4,561	4,071	32,043	80,121	14,945	376[1]	-	95,442	127,485
1979	19,331	2,906	4,680	26,917	48,518	7,428	376[1]	-	56,322	83,239
1980	14,646	4,575	6,003	25,224	36,489	8,948	376[1]	-	45,813	71,037
1981	11,917	5,194	6,642	23,733	28,776	19,330	376[1]	-	48,482	72,235
1982	12,676	9,906	8,304	30,886	-[2]	-[2]	-[2]	-	28,450	59,336
1983	16,768	6,442	7,741	30,951	8,511	34,054	797	-	43,362	74,313
1984	8,603	3,732	4,972	17,307	12,772	15,334	884	-	28,990	46,297
1985	3,579	2,143	3,698	9,420	16,612	16,555	949	-	34,109	43,529
1986	-[2]	-[2]	-[2]	28,526	9,464	32,878	481	143	42,967	71,493
1987	11,457	6,744	3,244	21,445	-[2]	-[2]	-[2]	-[2]	33,193	54,648
1988	11,621	9,067	4,941	25,629	-[2]	-[2]	-[2]	-[2]	30,763	56,392
1989	12,517	8,203	4,511	25,231	-[2]	-[2]	-[2]	-[2]	31,170	56,401
1990	10,060	5,985	3,913	19,958	10,876	17,951	262	158	29,247	49,205
1991	9,437	5,003	3,056	17,497	9,681	18,019	187	127	28,014	45,511
1992	12,189	7,027	3,438	22,654	11,146	16,972	81	103	28,302	50,956
1993	14,706	4,679	6,363	25,747	14,506	16,897	124	154	31,681	57,428
1994	10,494	5,366	3,201	19,061	10,864	22,382	145	136	33,527	52,588
1995	12,620	2,945	2,133	17,698	11,589	23,125	162	107	34,983	52,681
1996	7,583	2,085	4,385	14,053	10,360	19,917	214	146	30,637	44,690
1997	9,446	5,332	1,958	16,736	8,140	31,582	169	143	40,034	56,770
1998	13,221	5,906	2,217	21,334	13,150	29,805	63	118	43,136	64,480
1999	6,866	5,705	1,849	14,420	10,015	27,332	29	126	37,502	51,922
2000	7,971	4,209	2,168	15,348	10,144	23,373	59	214	33,790	49,138
2001	7,692	4,787	831	13,760	11,222	20,122	45	590	31,979	45,739

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

Table 7.2.1.2.- Southern horse mackerel catches by quarter and area.

Country/Sub-division	Spain VIIIc-E, VIIIc-W, IXa-N		Unit:tonnes		Total
Quarter/ Year	1	2	3	4	
1984	-	-	-	-	28990
1985	-	-	-	-	34109
1986	-	-	-	-	42967
1987	5179	8678	11067	8269	33193
1988	6445	7936	7918	8464	30763
1989	7824	7480	8011	7855	31170
1990	6827	7871	7766	6783	29247
1991	5369	7220	8741	6686	28016
1992	4065	8750	10042	5445	28302
1993	5546	9227	9823	7085	31681
1994	6486	8966	9732	8343	33527
1995	6050	10328	10969	7636	34983
1996	7188	8045	8211	7193	30637
1997	6638	11132	13854	8410	40034
1998	8244	10696	13089	11107	43135
1999	7715	9589	12027	8170	37502
2000	7405	8694	11012	6679	33790
2001	5682	8481	9179	8637	31979

Country/ Sub-division	Portugal IXa-CN, IXa-CS, IXa-S		Unit:tonnes		Total
Quarter/Year	1	2	3	4	
1984	4669	6506	3577	2358	17110
1985	1226	3055	2946	2192	9419
1986	4627	8093	7542	8264	28526
1987	3902	5474	6654	3524	19554
1988	3069	7402	7554	7100	25125
1989	4074	9096	8543	3513	25226
1990	3341	5753	5873	4992	19959
1991	3101	5630	5094	3672	17497
1992	2516	5661	7196	7281	22654
1993	5455	6401	8384	5507	25747
1994	4418	5051	6386	3206	19061
1995	3240	4618	6038	3802	17698
1996	2649	3830	4068	3506	14053
1997	4449	5370	4218	2699	16736
1998	5498	5846	6005	3995	21344
1999	3479	3991	4023	2927	14420
2000	3000	4849	4258	2241	14348
2001	2294	3666	3787	4013	13760

Table 7.3.1.1a.- Southern horse mackerel catch in numbers at age (in thousands) by quarter and area in 2001

QUARTER 1

AGE	AREA IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	549.884	321.660	10575.653	724.805	4.523	1672.828	13299.468
2	2371.498	552.349	3820.353	209.857	9.045	402.413	4994.016
3	1648.610	1255.145	1050.126	728.031	406.304	164.342	3603.948
4	433.381	1393.254	1091.805	825.159	658.707	523.146	4492.071
5	111.356	415.208	967.277	854.667	1194.187	1033.948	4465.288
6	139.575	454.092	1149.870	987.434	1914.260	1400.566	5906.223
7	49.181	131.458	337.671	1583.610	2542.701	1289.823	5885.263
8	58.081	125.480	328.196	1268.005	1784.147	636.459	4142.286
9	7.067	26.695	46.083	1407.340	2016.653	294.625	3791.394
10	14.967	84.942	153.226	933.266	1357.695	119.865	2648.993
11	9.338	68.955	122.252	582.247	915.246	57.032	1745.732
12	4.333	37.761	59.706	455.867	735.669	51.185	1340.188
13	2.300	20.849	29.615	198.094	341.903	13.949	604.411
14	1.130	13.693	19.624	280.465	518.749	8.754	841.285
15+	0.377	8.783	20.834	172.935	340.086	11.853	554.491
Total	5401.078	4910.324	19772.290	11211.782	14739.874	7680.789	58315.059

QUARTER 2	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	509.782	154.245	18345.591	3646.900	8268.275	5915.151	36330.163
2	380.724	610.042	2016.739	1384.055	3933.946	1732.132	9676.914
3	1452.560	4078.353	2010.493	281.514	2548.441	280.321	9199.121
4	369.828	2499.089	152.870	155.527	1537.776	366.252	4711.515
5	406.142	2595.179	567.316	259.812	2024.727	908.227	6355.262
6	266.766	650.307	1125.072	477.218	3036.899	1767.258	7056.754
7	414.813	697.848	2405.750	942.691	3620.486	2647.883	10314.657
8	210.459	376.374	1527.827	1002.746	2357.181	2250.466	7514.594
9	12.584	59.163	280.693	1524.200	1837.415	2231.674	5933.145
10	4.379	40.199	214.497	1126.700	1027.848	1362.732	3771.975
11	2.374	15.821	136.756	715.460	579.975	756.530	2204.543
12	1.815	5.035	74.580	578.306	430.228	575.889	1664.039
13	1.100	1.493	34.149	248.491	166.945	217.755	668.834
14	0.880	0.559	17.417	760.713	169.034	242.241	1189.964
15+	1.320	0.012	8.004	544.784	149.138	167.318	869.255
Total	4035.527	11783.719	28917.754	13649.118	31688.315	21421.829	107460.735

QUARTER 3	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.074	467.162	6.339	2826.306	20.623	121.731	3442.161
1	19179.492	13922.327	3261.663	5418.229	1679.049	5322.384	29603.653
2	849.336	90.763	1998.717	11803.834	4208.773	2462.446	20564.532
3	693.170	545.826	1475.710	1259.350	3081.517	621.738	6984.141
4	597.284	1836.518	344.968	666.840	2499.978	884.506	6232.809
5	450.811	3116.888	655.170	362.321	1184.558	598.550	5917.487
6	378.057	2091.577	1163.914	148.805	100.297	150.863	3655.456
7	328.609	1141.582	1254.752	2563.233	4749.413	4304.042	14013.022
8	144.075	264.530	723.606	1720.007	1354.755	3137.936	7200.833
9	77.954	122.880	428.471	554.853	380.263	540.260	2026.727
10	45.866	70.710	276.682	910.230	950.363	886.103	3094.087
11	18.523	25.565	127.926	696.411	512.111	451.414	1813.427
12	11.429	15.392	71.264	149.749	141.651	69.971	448.028
13	6.530	10.154	63.840	165.465	113.944	57.884	411.286
14	0.480	1.298	17.847	106.153	122.072	53.007	300.376
15+	2.713	2.034	34.357	241.022	244.992	73.305	595.711
Total	22784.404	23725.205	11905.226	29592.806	21344.358	19736.141	106303.736

QUARTER 4	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	13665.676	35570.774	49296.272	8426.492	52148.481	6207.247	151649.266
1	3094.054	87.687	1559.055	9510.076	7880.605	1920.053	20957.476
2	377.468	151.913	1417.233	14540.739	6369.595	5228.201	27707.681
3	191.389	1342.078	205.126	1669.530	634.391	1276.722	5127.847
4	253.916	3185.274	158.274	581.949	616.872	891.942	5434.310
5	199.808	1612.142	178.235	375.365	390.980	386.299	2943.022
6	192.782	784.371	330.528	183.102	174.455	47.356	1519.811
7	191.258	586.298	561.355	2585.782	2457.267	2198.091	8388.794
8	77.211	199.702	273.540	2070.699	1604.570	1006.697	5155.209
9	21.375	62.727	101.190	528.806	362.957	194.144	1249.824
10	13.515	45.211	71.582	791.281	613.681	349.423	1871.178
11	4.934	17.613	27.912	475.963	341.898	207.274	1070.660
12	1.067	5.553	10.565	96.280	53.869	31.626	197.894
13	0.346	4.431	11.194	103.509	72.146	37.258	228.538
14	0.756	6.450	12.341	106.580	8.620	40.128	174.119
15+	0.000	3.700	3.905	217.708	40.303	57.213	322.829
Total	18285.555	43665.925	54218.309	42263.860	73770.688	20079.674	233998.456

Table 7.3.1.1.b.- Total catch in numbers at age (in thousands) in 2001.

AGES	AREA IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	13665.749	36037.936	49302.611	11252.798	52169.104	6328.978	168757.176
1	23333.212	14485.919	33741.963	19300.010	17832.452	14830.416	123523.972
2	3979.026	1405.067	9253.041	27938.485	14521.359	9825.192	66922.170
3	3985.729	7221.402	4741.455	3938.424	6670.652	2343.124	28900.786
4	1654.408	8914.135	1747.916	2229.476	5313.333	2665.846	22525.114
5	1168.117	7739.417	2367.999	1852.165	4794.453	2927.025	20849.175
6	977.182	3980.347	3769.384	1796.559	5225.910	3366.043	19115.425
7	983.862	2557.186	4559.527	7675.315	13369.867	10439.840	39585.597
8	489.826	966.085	2853.169	6061.457	7100.652	7031.558	24502.747
9	118.981	271.465	856.437	4015.199	4597.288	3260.702	13120.071
10	78.727	241.061	715.987	3761.476	3949.587	2718.122	11464.960
11	35.169	127.954	414.846	2470.081	2349.230	1472.250	6869.530
12	18.644	63.742	216.116	1280.202	1361.418	728.672	3668.793
13	10.276	36.927	138.798	715.559	694.938	326.847	1923.345
14	3.246	22.001	67.229	1253.912	818.475	344.129	2508.991
15+	4.411	14.529	67.100	1176.448	774.520	309.689	2346.698
Total	50506.565	84085.173	114813.578	96717.565	141543.236	68918.433	556584.551

Table 7.3.1.2.- Southern horse mackerel. Catch in numbers at age by year (in thousands).

	AGES															
YEAR	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1985	393697	297486	84887	79849	26197	14665	7075	7363	3981	6270	4614	3214	2702	1699	864	4334
1986	615298	425659	96999	64701	122560	27584	13610	24346	12080	6694	8198	6349	5838	3244	2023	2963
1987	53320	618570	170015	66303	28789	81020	21825	10485	5042	3795	2337	1999	1666	951	1029	1906
1988	121951	271052	94945	39364	22598	20507	92897	17212	11669	10279	7042	4523	6050	2514	1379	3717
1989	242537	158646	70438	93590	37363	25474	22839	52657	11308	14892	11182	2728	2243	4266	1456	3791
1990	48100	164206	100833	60289	35931	14307	11786	12913	76713	9463	6562	3481	2568	2017	2430	4409
1991	31786	69544	71451	24222	33833	28678	13952	14578	11948	64501	8641	5671	3933	1970	2113	2164
1992	45629	285197	107761	51971	21596	23308	24973	14167	11384	12496	52251	4989	4043	2480	1815	4045
1993	10719	101326	262637	95182	35647	23159	22311	35258	11881	15094	5813	36062	1653	879	823	2304
1994	9435	113345	264744	93214	23624	11374	18612	22740	26587	8207	5142	2546	10266	1291	1001	1210
1995	3512	161142	124731	93349	47507	15997	11235	13608	19931	16763	8550	5664	4846	11717	2367	2809
1996	38345	35453	57096	41157	53002	27873	11580	11378	8384	19061	14339	6302	5896	3923	9571	4317
1997	8553	376888	157423	58132	34944	22297	11403	11704	17014	9206	19672	13436	4009	2045	906	7297
1998	15247	247786	149900	88318	45496	30161	32271	27189	15454	8733	7280	7682	6901	3238	3310	10426
1999	51940	120035	65577	80854	85370	37711	24491	20852	18187	10835	6802	3655	2879	1046	728	3182
2000	12652	86609	45129	48398	39134	34836	50409	40822	23393	13036	5664	6756	4147	3273	3781	4764
2001	168757	123524	66922	28901	22525	20849	19115	39586	24503	13120	11465	6870	3669	1923	2509	2347

Table 7.3.2.1a.- Southern horse mackerel mean weight at age (in kg) by quarter and area in 2001

QUARTER 1

AGE	AREA IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.040	0.039	0.031	0.032	0.062	0.039	0.034
2	0.063	0.060	0.053	0.040	0.062	0.037	0.082
3	0.081	0.090	0.087	0.086	0.089	0.106	0.126
4	0.110	0.111	0.113	0.107	0.120	0.124	0.124
5	0.138	0.139	0.141	0.124	0.134	0.131	0.137
6	0.164	0.163	0.162	0.153	0.148	0.142	0.155
7	0.177	0.175	0.174	0.170	0.167	0.155	0.167
8	0.199	0.200	0.199	0.186	0.185	0.169	0.187
9	0.220	0.220	0.220	0.221	0.226	0.192	0.222
10	0.235	0.241	0.240	0.237	0.242	0.209	0.240
11	0.254	0.257	0.254	0.245	0.252	0.215	0.250
12	0.282	0.279	0.280	0.252	0.263	0.223	0.260
13	0.301	0.309	0.307	0.263	0.271	0.231	0.271
14	0.333	0.341	0.338	0.286	0.290	0.289	0.291
15+	0.365	0.358	0.412	0.276	0.283	0.254	0.286
Total	0.078	0.114	0.066	0.171	0.194	0.119	0.137

QUARTER 2	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.040	0.054	0.025	0.038	0.032	0.038	0.031
2	0.063	0.075	0.049	0.037	0.032	0.037	0.043
3	0.077	0.082	0.064	0.074	0.080	0.084	0.089
4	0.110	0.111	0.117	0.116	0.110	0.131	0.121
5	0.128	0.125	0.136	0.136	0.132	0.140	0.139
6	0.153	0.150	0.155	0.159	0.147	0.152	0.156
7	0.179	0.179	0.186	0.180	0.162	0.168	0.179
8	0.193	0.202	0.205	0.196	0.179	0.186	0.195
9	0.240	0.257	0.258	0.227	0.209	0.212	0.218
10	0.283	0.277	0.284	0.243	0.226	0.226	0.235
11	0.310	0.299	0.306	0.249	0.233	0.234	0.244
12	0.334	0.328	0.333	0.257	0.233	0.233	0.247
13	0.373	0.355	0.359	0.265	0.245	0.242	0.258
14	0.397	0.374	0.388	0.359	0.270	0.275	0.330
15+	0.474	0.405	0.448	0.411	0.305	0.255	0.364
Total	0.102	0.112	0.067	0.162	0.109	0.134	0.114

QUARTER 3	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.014	0.013	0.013	0.019	0.045	0.043	0.019
1	0.029	0.019	0.025	0.052	0.055	0.049	0.052
2	0.063	0.076	0.067	0.082	0.094	0.078	0.085
3	0.086	0.098	0.078	0.116	0.127	0.131	0.121
4	0.108	0.116	0.106	0.143	0.138	0.154	0.143
5	0.132	0.132	0.145	0.160	0.147	0.167	0.152
6	0.155	0.147	0.160	0.244	0.244	0.244	0.178
7	0.172	0.159	0.177	0.193	0.167	0.184	0.181
8	0.193	0.189	0.197	0.215	0.206	0.200	0.208
9	0.213	0.213	0.216	0.270	0.280	0.232	0.255
10	0.229	0.228	0.228	0.254	0.221	0.216	0.233
11	0.264	0.265	0.277	0.289	0.290	0.248	0.281
12	0.265	0.266	0.272	0.305	0.342	0.333	0.321
13	0.264	0.269	0.289	0.294	0.302	0.268	0.295
14	0.291	0.306	0.320	0.361	0.386	0.379	0.372
15+	0.494	0.371	0.362	0.354	0.378	0.370	0.369
Total	0.043	0.065	0.106	0.112	0.149	0.139	0.122

QUARTER 4	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.031	0.020	0.023	0.022	0.017	0.018	0.023
1	0.041	0.033	0.045	0.038	0.039	0.042	0.045
2	0.063	0.074	0.062	0.085	0.078	0.084	0.083
3	0.095	0.104	0.087	0.111	0.125	0.123	0.117
4	0.109	0.108	0.107	0.144	0.147	0.139	0.127
5	0.127	0.117	0.136	0.171	0.159	0.152	0.144
6	0.143	0.138	0.156	0.244	0.244	0.244	0.188
7	0.166	0.161	0.174	0.194	0.188	0.173	0.187
8	0.182	0.182	0.189	0.209	0.209	0.201	0.208
9	0.218	0.222	0.220	0.250	0.236	0.247	0.245
10	0.238	0.242	0.241	0.235	0.228	0.218	0.232
11	0.245	0.248	0.247	0.273	0.246	0.265	0.263
12	0.277	0.280	0.282	0.340	0.291	0.306	0.318
13	0.291	0.305	0.307	0.305	0.270	0.289	0.292
14	0.272	0.309	0.307	0.372	0.421	0.362	0.366
15+	0.000	0.419	0.420	0.377	0.470	0.350	0.385
Total	0.040	0.038	0.030	0.088	0.043	0.090	0.054

Table 7.3.2.1b.- Total mean weight at age (in kg) in 2001.

	AREA						
AGES	**IXaS**	**IXaCS**	**IXaCN**	**IXaN**	**VIIIcW**	**VIIIcE**	**Total**
0	0.031	0.020	0.023	0.021	0.017	0.019	0.021
1	0.031	0.020	0.028	0.042	0.038	0.042	0.033
2	0.063	0.069	0.057	0.081	0.070	0.072	0.073
3	0.081	0.089	0.075	0.105	0.107	0.119	0.094
4	0.109	0.111	0.111	0.128	0.129	0.140	0.120
5	0.130	0.127	0.140	0.142	0.138	0.144	0.135
6	0.154	0.147	0.159	0.171	0.153	0.153	0.155
7	0.174	0.166	0.181	0.187	0.169	0.174	0.175
8	0.192	0.194	0.201	0.204	0.192	0.193	0.196
9	0.217	0.225	0.231	0.234	0.224	0.216	0.225
10	0.235	0.243	0.249	0.243	0.230	0.221	0.234
11	0.262	0.262	0.278	0.264	0.255	0.242	0.257
12	0.277	0.280	0.296	0.267	0.263	0.245	0.263
13	0.285	0.300	0.312	0.277	0.270	0.252	0.273
14	0.330	0.331	0.340	0.344	0.302	0.301	0.324
15+	0.000	0.000	0.391	0.373	0.327	0.300	0.349
Total	0.050	0.061	0.053	0.115	0.089	0.121	0.082

Table 7.3.2.2a.- Southern horse mackerel mean length at age (in cm) by quarter and area in 2001

QUARTER 1

AGE	AREA IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	16.6	16.5	15.1	15.2	19.5	16.4	16.0
2	19.5	19.1	18.4	16.6	19.5	16.2	27.5
3	21.2	22.0	21.8	21.8	22.0	23.4	31.7
4	23.6	23.7	23.8	23.5	24.5	24.8	26.2
5	25.5	25.6	25.7	24.8	25.5	25.3	26.0
6	27.1	27.0	27.0	26.7	26.4	26.0	27.2
7	27.8	27.7	27.7	27.6	27.5	26.8	27.6
8	29.0	29.0	29.0	28.6	28.5	27.6	28.8
9	30.0	30.0	30.0	30.3	30.6	28.9	30.4
10	30.7	30.9	30.9	31.1	31.3	29.8	31.3
11	31.5	31.6	31.5	31.5	31.8	30.1	31.8
12	32.7	32.6	32.6	31.8	32.2	30.4	32.1
13	33.4	33.7	33.7	32.2	32.6	30.8	32.6
14	34.6	34.9	34.8	33.2	33.4	33.3	33.4
15+	35.7	35.5	37.1	32.8	33.1	31.8	33.2
Total	20.6	23.4	18.6	27.0	28.7	23.7	25.8

QUARTER 2	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	16.4	18.4	13.9	16.3	15.4	16.4	15.1
2	19.4	20.6	17.8	16.1	15.4	16.2	17.3
3	20.8	21.3	19.6	20.7	21.2	21.5	24.2
4	23.6	23.7	24.1	24.2	23.7	25.3	25.7
5	24.9	24.7	25.4	25.6	25.3	25.8	26.7
6	26.5	26.3	26.6	27.0	26.3	26.6	27.5
7	27.9	27.9	28.3	28.2	27.2	27.6	28.8
8	28.7	29.1	29.2	29.1	28.2	28.6	29.5
9	30.9	31.6	31.7	30.6	29.7	29.9	30.2
10	32.7	32.5	32.7	31.4	30.6	30.6	31.0
11	33.8	33.3	33.6	31.7	30.9	31.0	31.4
12	34.6	34.4	34.6	32.0	30.9	30.9	31.5
13	36.0	35.4	35.5	32.3	31.5	31.4	32.0
14	36.8	36.0	36.5	35.8	32.5	32.7	34.8
15+	39.0	37.0	38.3	37.4	33.6	31.9	35.7
Total	22.4	23.5	17.8	25.3	22.3	24.2	22.8

QUARTER 3	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	11.0	10.7	10.6	12.8	17.4	17.1	12.7
1	14.4	12.2	13.4	18.2	18.6	17.9	24.1
2	19.0	20.4	19.4	21.4	22.3	20.9	22.1
3	21.3	22.3	20.6	24.2	25.0	25.3	25.9
4	23.2	23.7	23.0	26.1	25.8	26.7	27.4
5	24.9	24.9	25.7	27.1	26.3	27.5	27.6
6	26.4	25.9	26.7	31.5	31.5	31.5	29.5
7	27.3	26.6	27.6	28.8	27.4	28.4	28.6
8	28.5	28.3	28.7	30.0	29.5	29.3	30.0
9	29.5	29.5	29.7	32.5	32.9	30.9	32.5
10	30.3	30.3	30.3	31.7	30.0	30.0	31.0
11	31.9	32.0	32.5	33.3	33.4	31.6	33.1
12	32.0	32.0	32.3	34.0	35.3	34.9	35.0
13	31.9	32.1	33.0	33.5	33.8	32.5	33.9
14	33.1	33.7	34.2	36.1	36.9	36.7	36.5
15+	39.9	36.0	35.7	35.8	36.6	36.4	36.4
Total	15.8	17.3	21.5	22.6	25.9	24.8	25.7

QUARTER 4	IXaS	IXaCS	IXaCN	IXaN	VIIIcW	VIIIcE	Total
0	14.7	12.6	13.2	13.4	12.4	12.7	14.1
1	16.2	15.1	16.8	16.1	16.2	16.5	18.6
2	19.0	20.2	18.9	21.7	21.1	21.6	21.6
3	22.1	22.9	21.4	23.8	24.9	24.7	24.7
4	23.2	23.2	23.1	26.1	26.4	25.8	25.4
5	24.6	23.8	25.1	27.7	27.0	26.6	26.8
6	25.6	25.3	26.4	31.5	31.5	31.5	30.4
7	27.0	26.7	27.4	28.9	28.6	27.8	28.9
8	27.9	27.9	28.3	29.8	29.7	29.3	29.9
9	29.8	30.0	29.9	31.6	31.1	31.5	31.7
10	30.7	30.9	30.8	30.9	30.5	30.0	30.8
11	31.1	31.2	31.1	32.6	31.5	32.3	32.3
12	32.5	32.6	32.7	35.2	33.4	34.0	34.5
13	33.0	33.6	33.7	33.9	32.6	33.3	33.5
14	32.3	33.7	33.6	36.5	38.1	36.1	36.3
15+	0.0	37.6	37.6	36.6	39.4	35.7	36.8
Total	15.7	14.7	13.9	20.5	15.2	20.4	17.4

Table 7.3.2.2b.- Total southern horse mackerel mean length (cm) at age in 2001.

	AREA						
AGES	**IXaS**	**IXaCS**	**IXaCN**	**IXaN**	**VIIIcW**	**VIIIcE**	**Total**
0	14.7	12.6	13.2	13.2	12.4	12.8	**12.9**
1	14.7	12.4	14.3	16.7	16.1	16.9	**15.1**
2	19.3	20.0	18.6	21.2	19.9	20.2	**20.3**
3	21.1	21.8	20.5	23.4	23.4	24.4	**22.3**
4	23.4	23.5	23.6	25.0	25.1	25.8	**24.3**
5	24.9	24.6	25.6	25.9	25.7	26.1	**25.3**
6	26.4	25.9	26.7	27.7	26.6	26.7	**26.6**
7	27.5	27.0	27.9	28.5	27.6	27.9	**27.9**
8	28.5	28.6	29.0	29.5	28.9	28.9	**29.0**
9	29.7	30.1	30.4	30.9	30.5	30.1	**30.5**
10	30.6	31.0	31.2	31.3	30.7	30.3	**30.8**
11	31.8	31.9	32.5	32.3	31.9	31.3	**31.9**
12	32.4	32.6	33.2	32.4	32.2	31.4	**32.2**
13	32.7	33.3	33.8	32.8	32.5	31.8	**32.6**
14	34.4	34.5	34.8	35.3	33.8	33.8	**34.6**
15+	0.0	0.0	36.6	36.2	34.6	33.7	**35.4**
Total	**16.8**	**17.1**	**16.5**	**22.6**	**19.8**	**23.2**	**19.3**

Table 7.3.2.3.- Southern horse mackerel mean weight at age in the stock and in the catch by year.

Mean weight at age in the stock

YEAR	AGES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1985	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1986	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1987	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1988	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1989	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1990	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1991	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1992	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1993	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1994	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1995	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1996	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1997	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1998	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
1999	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
2000	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381
2001	0.000	0.032	0.055	0.075	0.105	0.127	0.154	0.176	0.213	0.240	0.269	0.304	0.318	0.348	0.355	0.381

Mean weight at age in the catch

YEAR	AGES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1985	0.014	0.027	0.070	0.091	0.117	0.132	0.152	0.182	0.249	0.264	0.284	0.312	0.320	0.344	0.357	0.378
1986	0.016	0.029	0.055	0.076	0.104	0.137	0.185	0.194	0.209	0.290	0.301	0.319	0.329	0.339	0.349	0.349
1987	0.024	0.031	0.049	0.058	0.096	0.106	0.131	0.161	0.198	0.211	0.246	0.302	0.288	0.352	0.361	0.358
1988	0.027	0.036	0.066	0.082	0.111	0.126	0.156	0.156	0.202	0.239	0.249	0.275	0.314	0.333	0.327	0.355
1989	0.016	0.041	0.062	0.089	0.109	0.132	0.152	0.189	0.200	0.203	0.248	0.320	0.345	0.359	0.375	0.389
1990	0.016	0.035	0.047	0.076	0.124	0.130	0.155	0.170	0.182	0.214	0.260	0.272	0.316	0.345	0.368	0.388
1991	0.016	0.033	0.063	0.102	0.133	0.151	0.168	0.173	0.193	0.196	0.233	0.236	0.280	0.304	0.323	0.372
1992	0.018	0.029	0.048	0.078	0.105	0.141	0.162	0.173	0.182	0.191	0.214	0.240	0.278	0.313	0.341	0.387
1993	0.015	0.034	0.040	0.064	0.109	0.155	0.171	0.202	0.225	0.225	0.255	0.250	0.321	0.364	0.397	0.461
1994	0.021	0.036	0.058	0.069	0.097	0.142	0.182	0.205	0.226	0.250	0.276	0.299	0.295	0.343	0.363	0.391
1995	0.029	0.036	0.058	0.091	0.110	0.139	0.173	0.189	0.218	0.235	0.273	0.291	0.305	0.290	0.362	0.392
1996	0.013	0.029	0.066	0.104	0.130	0.154	0.181	0.206	0.212	0.226	0.257	0.279	0.260	0.313	0.310	0.441
1997	0.022	0.033	0.054	0.091	0.123	0.149	0.171	0.202	0.209	0.246	0.233	0.265	0.313	0.350	0.390	0.347
1998	0.025	0.038	0.062	0.093	0.122	0.152	0.173	0.195	0.208	0.226	0.257	0.260	0.266	0.306	0.335	0.387
1999	0.021	0.033	0.055	0.086	0.122	0.143	0.167	0.201	0.221	0.238	0.275	0.305	0.293	0.401	0.471	0.501
2000	0.023	0.037	0.059	0.089	0.116	0.139	0.152	0.169	0.181	0.215	0.222	0.224	0.240	0.225	0.243	0.279
2001	0.021	0.033	0.073	0.094	0.120	0.135	0.155	0.175	0.196	0.225	0.234	0.257	0.263	0.273	0.324	0.349

Table 7.4.1.1 SOUTHERN HORSE MACKEREL. CPUE indices from research surveys.

	Portugal IXa (20-500 m depth)			Spain VIIIc & IXa North (20-500m depth)
	Bottom trawl (20-mm codend)			
Year	Kg/h March	kg/h Jun-Jul	kg/h Oct	kg/30 minutes Sept-Oct
1979		12.2	5.5	-
1980		20.6	2.5	-
1981		11.6	1.8	-
1982		42.1	36.9	-
1983		79.1	24.6	37.97
1984		-	-	51.98
1985		9.5	3.8	20.93
1986		4.8	23.5	10.14
1987		-	6.9	-
1988		-	26.0	12.05
1989		14.9	11.7	15.48
1990		14.4	21.5	9.62
1991		11.8	16.9	4.92
1992	17.5	38.0	40.8	20.30
1993	100.24	35.6	57.6[1]	18.11
1994	_	49.3[3]	12.4	21.61
1995	_	9.8	18.9	21.99
1996	_	_	23.25[2]	26.75
1997	_	21.0	59.6	14.43
1998	_	14.3	15.4	27.99
1999	_	3.1[2]	10.1[2]	21.26
2000	_	9.4	6.7	25.60
2001	_	8.0	48.8	17.95

1.- Revised
2.- In 1996 and 1999 the surveys was carried out with a different vessel and different gear. There is no estimation of the calibration factor.
3.- In 1994 this survey was carried out with a different gear. There is no estimation of the calibration factor.

Table 7.4.1.2.- Southern horse mackerel. CPUE at age from surveys.

Portuguese October Survey

YEAR	AGES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1985	70.580	60.151	2.837	1.144	0.618	0.240	0.096	0.025	0.001	0.006	0.004	0.015	0.003	0.003	0.006	0.003
1986	706.196	123.479	82.500	70.046	12.621	2.445	0.313	0.552	0.370	0.238	0.189	0.286	0.181	0.126	0.051	0.115
1987	95.243	24.377	29.541	12.419	9.802	5.673	1.163	0.519	0.487	0.368	0.225	0.165	0.248	0.047	0.022	0.019
1988	29.416	704.046	54.984	20.207	13.920	6.472	21.741	8.294	1.834	0.878	0.298	0.030	0.001	0.001	0.001	0.001
1989	377.665	93.538	40.406	20.064	6.196	3.956	3.847	2.395	0.662	0.320	0.430	0.398	0.162	0.139	0.012	0.004
1990	508.494	269.582	28.907	16.472	17.014	9.822	1.794	1.187	3.577	2.600	1.532	0.624	0.770	0.266	0.239	0.179
1991	336.245	97.414	14.704	13.411	14.272	6.571	3.895	2.275	2.331	1.951	1.006	0.405	0.350	0.238	0.220	0.185
1992	677.806	500.049	184.896	34.300	15.932	8.153	6.113	6.745	4.196	3.251	3.805	0.497	0.702	0.178	0.082	0.086
1993	1733.340	214.230	328.440	111.630	37.010	2.160	0.950	0.950	0.670	0.860	0.570	1.340	0.370	0.220	0.070	0.050
1994	4.217	9.499	75.879	44.908	19.693	5.142	2.013	1.022	0.850	0.534	0.234	0.189	0.126	0.089	0.053	0.030
1995	6.972	9.386	148.650	56.402	26.310	8.156	3.383	0.709	0.527	0.383	0.260	0.219	0.227	0.228	0.221	0.215
1996*	1225.000	5.750	6.979	16.342	19.530	8.052	2.129	0.592	0.209	0.135	0.106	0.062	0.047	0.031	0.005	0.005
1997	2832.548	21.619	110.750	18.102	51.410	67.224	19.203	14.257	5.914	6.939	2.386	0.109	0.028	0.126	0.079	0.054
1998	90.534	33.609	182.002	4.166	1.937	1.448	1.071	1.289	0.270	0.032	0.012	0.011	0.012	0.000	0.000	0.041
1999*	178.196	21.004	32.750	36.685	3.029	1.058	0.573	0.156	0.036	0.054	0.046	0.010	0.010	0.000	0.000	0.000
2000	3.246	15.197	15.150	21.096	11.822	6.430	3.013	1.169	0.445	0.147	0.147	0.084	0.059	0.005	0.004	0.000
2001	1762.378	2.247	9.080	6.399	7.670	14.301	17.732	20.479	9.295	3.918	2.068	0.821	0.116	0.101	0.088	0.018

Spanish October Survey

YEAR	AGES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1985	182.630	84.360	322.510	467.600	7.090	6.500	4.710	4.050	4.840	5.390	3.580	0.880	0.840	0.260	0.770	5.010
1986	289.420	44.600	12.640	7.000	41.810	4.920	5.150	11.110	4.680	7.200	8.540	3.050	1.310	0.800	0.980	3.840
1987	217.665	64.153	20.035	8.053	18.482	16.448	5.100	7.979	5.662	5.879	4.712	4.630	1.470	1.389	4.147	0.001
1988	145.910	14.650	14.220	9.000	5.130	8.170	54.990	5.050	5.730	6.850	4.800	2.600	7.030	1.650	2.410	17.550
1989	115.000	6.540	1.900	21.300	4.680	17.500	15.620	65.040	7.680	10.470	26.160	0.570	0.410	4.770	0.400	5.440
1990	26.620	17.790	2.730	2.680	15.920	5.680	7.630	6.090	73.350	3.050	4.730	0.860	0.810	0.600	0.770	1.670
1991	48.470	15.370	5.100	0.150	1.440	1.820	0.710	0.640	2.170	28.900	6.420	6.520	2.220	1.070	2.780	0.640
1992	85.470	44.810	0.740	1.050	0.350	2.080	4.470	4.360	5.730	5.090	47.600	5.060	1.620	0.600	0.180	3.550
1993	138.619	31.848	3.447	0.630	2.199	4.546	13.762	17.072	4.513	4.422	3.881	22.057	0.235	0.041	0.228	0.256
1994	937.761	64.849	20.936	1.332	1.510	2.535	4.887	9.632	11.578	2.473	1.530	0.911	4.512	0.361	0.194	0.433
1995	38.308	172.564	12.492	6.941	5.806	3.845	6.311	9.659	14.481	11.868	3.503	1.930	0.340	8.609	0.101	0.049
1996	43.288	47.240	26.844	19.573	35.014	19.058	6.602	11.004	2.733	21.892	7.012	1.079	1.723	0.033	3.657	0.078
1997	13.866	21.891	6.529	9.419	7.730	6.327	3.911	3.995	12.424	3.947	10.330	7.708	0.506	0.350	0.109	2.585
1998	22.701	7.359	20.450	26.250	54.150	28.340	19.390	11.049	4.552	2.623	0.897	2.132	2.238	0.491	0.259	2.493
1999	30.744	50.190	17.429	3.930	19.331	18.302	10.964	13.575	11.888	8.618	4.186	0.924	1.198	0.068	0.054	0.103
2000	82.066	15.513	4.885	10.151	22.200	32.770	50.779	19.532	6.091	6.497	1.262	0.402	0.844	0.849	3.983	1.049
2001	100.998	33.875	23.985	12.557	6.815	4.238	1.308	30.670	18.740	3.667	6.075	3.411	0.470	0.571	0.187	0.439

July Portuguese Survey

YEAR	AGES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1985																
1986																
1987																
1988																
1989	81.913	38.356	45.522	60.648	26.998	5.846	3.164	6.634	3.042	3.716	1.440	0.793	0.613	0.214	0.157	0.244
1990	82.175	51.605	69.397	26.157	12.393	5.588	3.670	3.515	7.745	3.001	1.363	0.695	0.758	0.445	0.356	0.470
1991	17.429	53.094	19.479	3.507	3.906	3.978	2.495	3.128	3.566	7.637	3.537	3.574	2.288	2.491	0.508	0.413
1992	109.178	1822.950	39.701	21.081	7.980	5.013	3.427	3.348	3.879	5.616	9.998	3.988	5.772	3.205	1.038	0.481
1993	1.810	263.390	263.800	150.040	20.840	39.560	89.150	31.340	22.690	9.530	0.520	0.640	0.050	0.020	0.000	0.000
1994*	54.981	408.262	232.995	110.935	49.988	34.724	38.438	20.985	5.725	3.905	3.550	3.193	5.485	1.883	1.057	0.867
1995	5.410	38.571	16.132	23.071	26.699	12.233	5.577	2.071	0.540	0.270	0.223	0.158	0.263	0.115	0.091	0.103
1996*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	29.139	330.305	71.131	8.199	11.932	4.993	1.969	1.371	0.249	0.169	0.170	0.462	0.054	0.000	0.000	0.012
1998	116.243	166.298	74.108	7.292	4.740	2.509	1.276	0.648	0.212	0.151	0.121	0.009	0.081	0.017	0.033	0.019
1999*	0.000	0.863	9.697	15.993	3.576	0.864	0.560	0.317	0.240	0.199	0.085	0.068	0.035	0.000	0.000	0.000
2000	0.842	53.711	7.391	5.146	5.572	5.044	9.953	5.577	2.210	0.784	0.122	0.122	0.041	0.070	0.056	0.056
2001	1.251	4.100	9.008	9.405	7.712	8.899	9.041	6.901	2.717	1.338	0.768	0.293	0.178	0.136	0.028	0.024

* These values are not considered in the assessment, because the surveys were carried out with a different gear (1994), and with a different vessel and gear (1996 and 1999)

Table 7.5.1.- SOUTHERN HORSE MACKEREL. CPUE series in commercial fisheries.

Year	Division IXa (Portugal)	Division VIIIc (Spain)	
	Trawl	Trawl	
		Sub-div. VIIIc East Aviles	Sub-div. VIIIc West A Coruña
	kg/h	kg/Hp.day. 10^{-2}	kg/Hp.day.10^{-2}
1979	87.7	-	-
1980	69.3	-	-
1981	59.1	-	-
1982	56.2	-	-
1983	98.0	123.46	90.4
1984	55.9	142.94	135.87
1985	24.4	131.22	118.00
1986	41.6	116.90	130.84
1987	71.0	109.02	176.65
1988	91.1	88.96	146.63
1989	69.5	98.24	172.84
1990	98.9	125.35	146.27
1991	n.a.	106.42	145.09
1992	n.a.	73.70	163.12
1993	n.a.	71.47	200.50
1994	n.a.	137.56	136.75
1995	n.a.	130.44	124.11
1996	n.a.	145.64	156.50
1997	n.a.	89.56	117.39
1998	n.a.	93.28	n.a.
1999	n.a.	91.05	121.75
2000	n.a.	72.07	107.60
2001	n.a.	110.37	115.07

Table 7.5.2.- Southern horse mackerel. CPUE at age from fleets.

Effort unit: Fishing trips/100 * mean HP

A Coruña bottom trawl fleet

YEAR	Effort	AGES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1985	30255	3	12	134	399	19	42	39	25	27	43	22	8	3	1	3	27
1986	26540	3	79	58	118	400	40	31	22	15	15	41	16	6	10	2	33
1987	23122	1	33	113	92	143	672	76	61	13	22	20	16	8	2	1	13
1988	28119	5	167	258	58	58	51	408	40	29	22	11	11	16	4	2	9
1989	29628	23	152	48	115	56	57	38	299	40	103	78	6	2	23	2	16
1990	29578	1	84	128	37	71	17	27	39	394	21	27	5	6	6	7	15
1991	26959	1	1	41	2	20	39	27	65	49	376	37	17	12	2	9	5
1992	26199	0	191	60	10	9	54	99	48	46	51	361	12	6	3	0	8
1993	29670	0	34	467	39	51	95	87	210	56	79	16	209	1	0	1	1
1994	26393	2	79	270	12	8	20	92	146	165	34	18	4	45	1	0	1
1995	28000	0	7	122	84	37	25	36	64	129	102	33	12	2	47	1	1
1996	23818	0	1	29	14	65	89	51	62	41	125	108	36	15	14	59	3
1997	23668	0	2	3	2	6	13	14	32	52	49	86	80	34	18	6	40
1998		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1999	20154	0	0	2	5	35	46	65	99	118	65	37	23	17	5	3	14
2000	20048	0	0	3	6	15	49	87	96	71	55	22	34	26	17	20	26
2001	19958	0	0	0	1	7	17	41	90	87	97	69	45	32	15	19	14

Effort unit: Fishing days/100 * mean HP

Avilés bottom trawl fleet

YEAR	Effort	AGES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1985	9856	1	167	613	574	13	18	16	13	17	21	14	4	4	1	4	19
1986	11000	36	223	271	174	527	42	19	14	10	8	9	2	1	1	0	2
1987	8309	1	244	350	166	48	396	40	19	7	9	6	5	3	1	1	4
1988	9047	181	264	53	23	18	19	148	14	17	22	15	12	22	6	5	27
1989	8063	65	275	62	105	50	42	18	100	13	38	35	1	1	18	2	15
1990	8492	1	726	373	257	72	19	21	24	192	10	13	3	4	4	4	9
1991	7677	39	495	882	41	85	51	10	12	9	67	3	2	1	1	1	1
1992	13000	2	35	21	65	34	60	63	20	16	19	114	3	1	1	0	7
1993	7635	0	215	462	77	44	23	18	42	6	14	2	35	1	0	0	1
1994	9620	1	47	632	12	6	17	69	118	135	25	14	3	38	1	0	0
1995	6146	1	182	441	141	70	32	25	39	89	71	31	12	4	37	1	1
1996	4525	0	225	608	129	230	128	32	24	22	49	32	10	4	4	17	0
1997	5061	0	48	10	15	34	43	36	49	83	34	76	42	8	2	0	14
1998	5032	0	0	2	34	34	63	93	102	63	28	16	16	11	3	4	5
1999	6829	0	0	4	17	101	139	86	74	78	39	13	5	5	0	0	0
2000	4347	0	9	6	7	15	54	82	80	56	31	14	17	12	10	12	13
2001	2450	0	0	11	35	60	79	100	170	98	54	29	15	12	4	6	3

Table 7.7.2.1

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Horse mackerel south

CPUE data from file hom9atunfin.dat

Catch data for 17 years. 1985 to 2001. Ages 0 to 12.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
8c West trawl fleet ,	1985,	2001,	0,	11,	.000,	1.000
8c East trawl fleet ,	1985,	2001,	0,	11,	.000,	1.000
Oct Pt Survey ,	1985,	2001,	0,	11,	.800,	.900
Oct Sp. survey ,	1985,	2001,	0,	11,	.790,	.880
Jul Pt. survey ,	1989,	2001,	0,	11,	.540,	.630

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 2

Catchability independent of age for ages >= 9

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00816

Final year F values

Age ,	0,	1,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 29,	.1227,	.2233,	.2083,	.1450,	.1254,	.1464,	.1165,	.2224,	.1966,	.1838
Iteration 30,	.1225,	.2228,	.2079,	.1445,	.1251,	.1460,	.1161,	.2216,	.1958,	.1828

Age ,	10,	11
Iteration 29,	.1907,	.3006
Iteration 30,	.1896,	.2988

Table 7.7.2.1 (Cont'd)

Regression weights

.751	.820	.877	.921	.954	.976	.990	.997	1.000	1.000

Fishing mortalities

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	.035	.009	.008	.003	.032	.011	.028	.086	.017	.123
1	.251	.096	.124	.168	.040	.472	.445	.301	.190	.223
2	.237	.365	.366	.185	.078	.236	.327	.189	.166	.208
3	.188	.320	.200	.199	.081	.101	.191	.278	.197	.145
4	.114	.180	.115	.141	.157	.087	.102	.270	.198	.125
5	.081	.162	.076	.101	.109	.087	.096	.109	.159	.146
6	.091	.099	.180	.095	.094	.056	.166	.100	.197	.116
7	.182	.171	.132	.183	.124	.122	.174	.145	.227	.222
8	.193	.216	.178	.155	.155	.261	.223	.160	.228	.196
9	.430	.398	.215	.154	.205	.241	.196	.227	.156	.183
10	.231	.343	.215	.343	.181	.319	.288	.218	.168	.190
11	.316	.233	.234	.366	.432	.243	.187	.217	.330	.299

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XSA population numbers (Thousands)

	AGE									
YEAR	0	1	2	3	4	5	6	7	8	9
1992	1.43E+06	1.38E+06	5.51E+05	3.28E+05	2.17E+05	3.21E+05	3.08E+05	9.18E+04	6.99E+04	3.85E+04
1993	1.23E+06	1.19E+06	9.26E+05	3.75E+05	2.34E+05	1.67E+05	2.55E+05	2.42E+05	6.59E+04	4.96E+04
1994	1.32E+06	1.05E+06	9.32E+05	5.54E+05	2.34E+05	1.68E+05	1.22E+05	1.99E+05	1.76E+05	4.57E+04
1995	1.14E+06	1.12E+06	7.94E+05	5.57E+05	3.90E+05	1.80E+05	1.34E+05	8.77E+04	1.50E+05	1.27E+05
1996	1.30E+06	9.75E+05	8.18E+05	5.68E+05	3.92E+05	2.92E+05	1.40E+05	1.05E+05	6.28E+04	1.11E+05
1997	8.73E+05	1.08E+06	8.06E+05	6.51E+05	4.51E+05	2.89E+05	2.25E+05	1.10E+05	7.98E+04	4.63E+04
1998	5.95E+05	7.43E+05	5.79E+05	5.48E+05	5.06E+05	3.55E+05	2.28E+05	1.83E+05	8.34E+04	5.29E+04
1999	6.83E+05	4.98E+05	4.10E+05	3.59E+05	3.89E+05	3.94E+05	2.78E+05	1.66E+05	1.33E+05	5.75E+04
2000	7.88E+05	5.40E+05	3.18E+05	2.92E+05	2.34E+05	2.56E+05	3.04E+05	2.17E+05	1.24E+05	9.72E+04
2001	1.58E+06	6.67E+05	3.84E+05	2.31E+05	2.07E+05	1.65E+05	1.88E+05	2.15E+05	1.48E+05	8.46E+04

Estimated population abundance at 1st Jan 2002

0.00E+00	1.20E+06	4.60E+05	2.69E+05	1.73E+05	1.57E+05	1.23E+05	1.45E+05	1.49E+05	1.06E+05

Taper weighted geometric mean of the VPA populations:

1.07E+06	8.57E+05	5.89E+05	4.24E+05	3.21E+05	2.48E+05	1.96E+05	1.47E+05	1.02E+05	6.84E+04

Standard error of the weighted Log(VPA populations) :

.3477	.3385	.3723	.3833	.3986	.4291	.4627	.5159	.5604	.6047

	AGE	
YEAR	10	11
1992	2.73E+05	1.99E+04
1993	2.16E+04	1.87E+05
1994	2.87E+04	1.32E+04
1995	3.17E+04	1.99E+04
1996	9.34E+04	1.94E+04
1997	7.76E+04	6.71E+04
1998	3.13E+04	4.85E+04
1999	3.75E+04	2.02E+04
2000	3.94E+04	2.59E+04
2001	7.16E+04	2.87E+04

Estimated population abundance at 1st Jan 2002

6.10E+04	5.13E+04

Taper weighted geometric mean of the VPA populations:

4.46E+04	2.74E+04

Table 7.7.2.1 (Cont'd)

Standard error of the weighted Log(VPA populations) :

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   ,        .6763,    .7336,
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Log catchability residuals.

Fleet : 8c West trawl fleet

Age	1985	1986	1987	1988	1989	1990	1991
0	-.66	-1.32	1.08	-.89	-3.54	1.89	1.15
1	-.04	.92	.05	1.21	1.63	1.25	-1.23
2	1.50	.75	1.55	1.54	.03	1.58	.43
3	1.73	2.42	2.28	1.68	1.51	.58	-1.59
4	-.30	1.12	2.14	.98	.95	.34	-.65
5	.12	.19	1.33	.53	.52	-.62	-.62
6	-.08	-.35	.75	.34	-.03	-.48	-.35
7	-.43	-.85	.07	-.40	-.44	-.30	.12
8	-.38	-.67	-1.14	-.86	-.37	-.15	.12
9	-.28	-.83	-.03	-.78	.42	-.95	-.09
10	-.55	.18	-.08	-.42	.97	-.51	.14
11	-1.10	-.34	-.27	-.50	-.44	-1.21	-.50

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	99.99	99.99	.23	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	1.09	.17	.84	-.60	-1.49	-1.09	99.99	99.99	99.99	99.99
2	.68	2.15	1.71	.93	-.42	-2.60	-.55	-2.19	-1.53	99.99
3	-.08	1.09	-.42	1.46	-.25	-2.31	1.27	-.56	-.20	-1.78
4	-.77	.79	-.97	.00	.73	-1.82	.89	.34	-.03	-.70
5	-.07	1.06	-.43	-.32	.63	-1.28	.45	-.16	.36	-.26
6	.03	-.03	.92	-.21	.26	-1.52	.75	-.02	.24	-.07
7	-.10	.28	.21	.17	.09	-.61	.43	.28	.02	-.04
8	-.14	.00	.20	.04	-.07	-.01	.54	.41	.01	.02
9	.36	.41	-.32	-.33	.19	.15	.16	.37	-.35	.37
10	.27	-.38	-.49	.01	.21	.23	.54	.23	-.36	.20
11	-.48	-.02	-1.21	-.52	.80	.27	.21	.37	.57	.74

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9	10	11
Mean Log q	-19.7901	-20.3303	-19.3613	-18.6797	-18.1315	-17.4675	-17.1954	-16.8848	-16.8848	-16.8848
S.E(Log q)	1.5877	1.3662	.9357	.6627	.6162	.3213	.3510	.4162	.3957	.6629

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0	-1.61	-.556	-.86	.03	8	2.52	-23.29
1	.56	.235	17.87	.04	13	1.23	-21.07

Table 7.7.2.1 (Cont'd)

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2,	.37,	1.299,	15.69,	.32,	16,	.56,	-19.79,
3,	.54,	.762,	16.97,	.22,	17,	.76,	-20.33,
4,	.82,	.296,	18.16,	.21,	17,	.80,	-19.36,
5,	.86,	.347,	17.78,	.37,	17,	.59,	-18.68,
6,	1.00,	.002,	18.13,	.36,	17,	.65,	-18.13,
7,	.90,	.563,	16.92,	.77,	17,	.30,	-17.47,
8,	.88,	.716,	16.51,	.78,	17,	.32,	-17.20,
9,	1.03,	-.139,	17.06,	.67,	17,	.45,	-16.88,
10,	.84,	1.088,	15.86,	.82,	17,	.33,	-16.84,
11,	.77,	1.141,	15.37,	.70,	17,	.50,	-16.94,

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Fleet : 8c East trawl fleet

Age	1985	1986	1987	1988	1989	1990	1991
0	-8.01	3.85	-7.61	11.03	7.85	-7.23	5.37
1	.23	-.06	-.65	-.19	.25	-.18	-.04
2	1.36	.40	.93	-1.69	-1.20	1.12	1.97
3	.25	.75	.92	-1.08	-.24	.80	-.28
4	.95	.51	.28	-.85	.34	-.19	.26
5	-.58	.15	.84	-.31	.54	-.24	-.07
6	-.10	-.19	.89	.21	.28	.27	-.33
7	.14	-.30	.02	-.21	-.13	.57	-.21
8	.62	.16	-.39	.08	.15	.72	.02
9	.15	-.54	.12	.38	.75	-.42	-.53
10	.14	-.42	-.23	1.05	1.50	.04	-1.09
11	-.65	-1.50	-.38	.74	-.90	-.45	-1.36

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	-6.73	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	.57	-.21	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	-2.43	.71	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	-.42	.16	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	-.48	.21	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	-.22	.02	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	.06	-.49	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	-.15	.13	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	-.13	-.53	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	.12	.06	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	-.14	-1.08	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
11	-1.11	-.43	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5,	6,	7,	8,	9,	10,	11
Mean Log q,	-17.0066,	-17.3637,	-17.5679,	-17.6973,	-17.8858,	-17.5702,	-17.5383,	-16.9109,	-16.9109,	-16.9109,
S.E(Log q),	1.7855,	.6548,	.4899,	.3890,	.4295,	.2975,	.4445,	.4607,	1.0057,	1.0413,

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0,	3.53,	-.122,	38.04,	.00,	8,	11.31,	-20.86,
1,	-.41,	-1.981,	12.36,	.46,	9,	.46,	-17.31,

Table 7.7.2.1 (Cont'd)

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2,	-1.55,	-.484,	7.60,	.02,	9,	3.16,	-17.01,
3,	.68,	.486,	15.94,	.51,	9,	.51,	-17.36,
4,	.80,	.413,	16.59,	.66,	9,	.46,	-17.57,
5,	.79,	.683,	16.60,	.83,	9,	.34,	-17.70,
6,	1.05,	-.111,	18.16,	.70,	9,	.54,	-17.89,
7,	1.04,	-.164,	17.81,	.87,	9,	.37,	-17.57,
8,	.74,	1.411,	15.91,	.93,	9,	.29,	-17.54,
9,	1.30,	-.808,	18.70,	.76,	9,	.64,	-16.91,
10,	.99,	.010,	17.03,	.53,	9,	1.18,	-17.07,
11,	.93,	.196,	17.07,	.76,	9,	.74,	-17.61,

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Fleet : Oct Pt Survey

Age	1985	1986	1987	1988	1989	1990	1991
0	.37	1.38	.19	.27	1.37	1.68	.72
1	1.63	1.39	-1.10	2.54	.84	.92	-2.31
2	-1.17	2.23	-.25	.71	-.70	-.54	-.17
3	-3.19	.04	-.39	1.56	-1.04	-1.15	.13
4	-1.17	-1.11	-.82	1.26	-.30	-.36	-.12
5	-1.49	.33	-3.83	1.68	-.43	-.17	.34
6	-1.20	-.45	-.56	1.11	-1.13	2.03	1.40
7	-1.39	.39	-.70	2.00	-1.98	2.16	.69
8	-1.80	.66	.07	1.01	-1.58	-.35	2.89
9	99.99	1.88	.79	-1.91	99.99	2.60	-.23
10	99.99	.37	-.86	99.99	99.99	2.65	2.43
11	-.36	1.78	.27	99.99	99.99	3.09	.80

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	99.99	99.99	-1.43	-.79	99.99	99.99	.61	99.99	-1.22	99.99
1	99.99	99.99	-1.97	.65	99.99	99.99	.89	99.99	-.26	99.99
2	99.99	99.99	-.47	.14	99.99	99.99	.86	99.99	-.30	99.99
3	99.99	99.99	.70	.06	99.99	99.99	-.27	99.99	.56	99.99
4	99.99	99.99	1.20	.93	99.99	99.99	-1.20	99.99	-.18	99.99
5	99.99	99.99	.33	.25	99.99	99.99	-.76	99.99	.87	99.99
6	99.99	99.99	-.54	-.41	99.99	99.99	.67	99.99	-1.42	99.99
7	99.99	99.99	-.35	-.51	99.99	99.99	.48	99.99	-.93	99.99
8	99.99	99.99	-.13	-.54	99.99	99.99	.37	99.99	-1.05	99.99
9	99.99	99.99	.84	.35	99.99	99.99	-.53	99.99	-1.74	99.99
10	99.99	99.99	-1.12	.70	99.99	99.99	-1.24	99.99	-.36	99.99
11	99.99	99.99	-.51	1.73	99.99	99.99	99.99	99.99	-1.89	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9	10	11
Mean Log q	-9.0996	-9.4213	-9.8347	-10.3122	-10.5796	-11.0567	-12.2192	-12.1326	-12.1326	-12.1326
S.E(Log q)	.7123	.8820	.9376	1.1448	1.2036	1.2263	1.2958	1.4485	1.5927	1.9017

Table 7.7.2.1 (Cont'd)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0,	.52,	.337,	12.03,	.10,	11,	1.29,	-10.33,
1,	1.01,	-.004,	9.13,	.04,	11,	1.67,	-9.17,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2,	.84,	.215,	9.75,	.30,	11,	.66,	-9.10,
3,	-2.48,	-1.750,	21.90,	.05,	11,	1.86,	-9.42,
4,	13.52,	-1.076,	-26.33,	.00,	11,	12.50,	-9.83,
5,	-2.09,	-1.838,	16.71,	.07,	11,	1.99,	-10.31,
6,	1.03,	-.033,	10.53,	.18,	11,	1.37,	-10.58,
7,	-5.18,	-1.659,	16.32,	.02,	11,	5.53,	-11.06,
8,	2.78,	-.770,	13.25,	.04,	11,	3.75,	-12.22,
9,	2.00,	-.568,	13.02,	.08,	9,	3.12,	-12.13,
10,	.20,	.801,	10.70,	.22,	8,	.33,	-11.94,
11,	-1.32,	-.493,	7.51,	.02,	8,	2.73,	-11.71,

Fleet : Oct Sp. survey

Age	1985	1986	1987	1988	1989	1990	1991
0	.25,	.07,	.45,	.66,	.41,	-.34,	-.63
1	1.10,	.39,	.25,	-.90,	-1.17,	-.28,	-.57
2	3.80,	.53,	1.06,	-.04,	-1.83,	-.83,	-.35
3	3.00,	.65,	.76,	.89,	.96,	-.92,	-3.17
4	.38,	.38,	1.50,	.14,	.14,	.47,	-1.74
5	.33,	.06,	-.58,	.72,	1.42,	.33,	-1.73
6	.23,	.17,	.26,	.71,	1.55,	.68,	-1.65
7	.27,	.92,	.27,	.00,	.51,	.35,	-2.09
8	.27,	.50,	.13,	-.16,	.37,	.54,	-.69
9	.17,	.86,	.91,	.55,	.70,	-.35,	-.23
10	.16,	1.05,	.72,	1.35,	2.52,	.27,	.87
11	-.77,	.47,	.73,	.57,	-.20,	-.42,	.99

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	-.16,	.27,	1.31,	-.41,	-.45,	-.73,	-.05,	.02,	.41,	-.11
1	-.09,	-.39,	.44,	1.33,	.14,	-.35,	-1.04,	1.07,	-.21,	.35
2	-2.43,	-1.30,	.50,	-.01,	.64,	-.63,	.92,	.99,	-.05,	1.39
3	-1.31,	-1.84,	-1.59,	.06,	.98,	.13,	1.40,	-.01,	1.08,	1.48
4	-2.50,	-.69,	-1.12,	-.26,	1.55,	-.16,	1.68,	1.05,	-.66,	.52
5	-1.41,	.10,	-.56,	-.19,	.93,	-.18,	1.12,	.59,	-.66,	.02
6	-.77,	.55,	.32,	.41,	.41,	-.62,	1.06,	.24,	-.54,	-1.49
7	-.12,	.27,	-.14,	.73,	.63,	-.43,	.12,	.40,	-1.74,	1.02
8	.04,	-.12,	-.19,	.17,	-.62,	.74,	-.34,	.10,	-.44,	.48
9	.54,	.12,	-.53,	-.04,	.75,	-.06,	-.64,	.49,	-.37,	-.78
10	.65,	.77,	-.55,	.29,	-.24,	.45,	-1.11,	.19,	-1.10,	-.11
11	1.10,	.26,	-.27,	.18,	-.32,	.24,	-.77,	-.70,	-1.69,	.32

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5,	6,	7,	8,	9,	10,	11
Mean Log q,	-3.8638,	-4.1514,	-3.7056,	-3.4412,	-3.2595,	-2.6556,	-2.2570,	-2.0774,	-2.0774,	-2.0774,
S.E(Log q),	1.1565,	1.4073,	1.2076,	.8544,	.8852,	.8889,	.4415,	.5446,	.8815,	.7639,

Table 7.7.2.1 (Cont'd)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0,	.58,	.846,	7.34,	.29,	17,	.57,	-2.61,
1,	.95,	.068,	3.52,	.18,	17,	.77,	-3.02,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2,	4.72,	-.829,	-31.16,	.00,	17,	5.53,	-3.86,
3,	.69,	.393,	6.90,	.14,	17,	1.01,	-4.15,
4,	.46,	1.349,	8.58,	.38,	17,	.53,	-3.71,
5,	1.37,	-.429,	.16,	.12,	17,	1.21,	-3.44,
6,	1.11,	-.169,	2.24,	.18,	17,	1.03,	-3.26,
7,	.94,	.116,	3.20,	.28,	17,	.88,	-2.66,
8,	.80,	1.091,	4.15,	.74,	17,	.35,	-2.26,
9,	1.19,	-.576,	.33,	.47,	17,	.67,	-2.08,
10,	1.07,	-.155,	1.33,	.35,	17,	.97,	-1.92,
11,	.91,	.310,	2.91,	.53,	17,	.72,	-2.18,

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Fleet : Jul Pt. survey

Age	1985	1986	1987	1988	1989	1990	1991
0	99.99	99.99	99.99	99.99	-.39	.08	-.52
1	99.99	99.99	99.99	99.99	.13	-.04	-.08
2	99.99	99.99	99.99	99.99	.75	1.67	-.50
3	99.99	99.99	99.99	99.99	.69	-.34	-1.48
4	99.99	99.99	99.99	99.99	.48	.18	-1.87
5	99.99	99.99	99.99	99.99	.35	.07	-1.70
6	99.99	99.99	99.99	99.99	.47	.89	.85
7	99.99	99.99	99.99	99.99	-1.62	1.05	.41
8	99.99	99.99	99.99	99.99	.13	-1.06	2.36
9	99.99	99.99	99.99	99.99	-1.52	2.00	-.34
10	99.99	99.99	99.99	99.99	99.99	1.33	2.61
11	99.99	99.99	99.99	99.99	99.99	1.77	1.86

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	99.99	99.99	99.99	-.15	99.99	.16	.04	99.99	-.09	.52
1	.11	99.99	99.99	-.39	99.99	.18	.39	99.99	-.02	-.24
2	.24	99.99	99.99	-.14	99.99	.55	-.85	99.99	-.44	-.30
3	.07	99.99	99.99	.40	99.99	-.29	.92	99.99	-.62	.42
4	-.11	99.99	99.99	1.31	99.99	-.01	1.11	99.99	-1.04	-.27
5	.37	99.99	99.99	.15	99.99	-.39	-.55	99.99	.32	1.12
6	.00	99.99	99.99	-.25	99.99	-1.17	.12	99.99	-.34	.28
7	1.38	99.99	99.99	.06	99.99	-.63	-.26	99.99	-.30	-.03
8	1.40	99.99	99.99	-.74	99.99	-.47	.18	99.99	-.59	-.53
9	2.86	99.99	99.99	-.21	99.99	-1.20	-.54	99.99	-.20	-.24
10	.35	99.99	99.99	-.34	99.99	-2.14	-.33	99.99	.90	-.05
11	3.11	99.99	99.99	-.78	99.99	-4.12	99.99	99.99	-.42	-.81

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5,	6,	7,	8,	9,	10,	11
Mean Log q,	-9.7388,	-10.0749,	-10.4117,	-10.2338,	-10.3552,	-10.1488,	-10.9561,	-11.0953,	-11.0953,	-11.0953,
S.E(Log q),	.7316,	.7293,	1.0036,	.7851,	.6436,	.7917,	1.0643,	1.3425,	1.3789,	2.4479,

Table 7.7.2.1 (Cont'd)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0,	-.37,	-3.307,	15.09,	.56,	8,	.36,	-10.36,
1,	.21,	2.318,	12.75,	.61,	9,	.27,	-9.44,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2,	.67,	.558,	10.87,	.35,	9,	.52,	-9.74,
3,	.62,	.893,	11.18,	.50,	9,	.46,	-10.07,
4,	.53,	.858,	11.49,	.38,	9,	.54,	-10.41,
5,	-1.62,	-2.412,	15.92,	.14,	9,	.96,	-10.23,
6,	11.64,	-1.472,	-8.90,	.00,	9,	6.89,	-10.36,
7,	23.03,	-2.426,	-28.33,	.00,	9,	13.72,	-10.15,
8,	-4.90,	-2.198,	14.82,	.03,	9,	4.12,	-10.96,
9,	2.20,	-.666,	10.89,	.05,	9,	3.09,	-11.10,
10,	1.86,	-.557,	11.03,	.08,	8,	2.72,	-10.96,
11,	-.32,	-2.813,	9.85,	.54,	7,	.51,	-11.33,

1

Terminal year survivor and F summaries :

Age 0 Catchability dependent on age and year class strength

Year class = 2001

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Sp. survey ,	1072743.,	.599,	.000,	.00,	1,	.155,	.000
Jul Pt. survey ,	2018390.,	.487,	.000,	.00,	1,	.234,	.000
P shrinkage mean ,	857011.,	.34,,,,				.548,	.168
F shrinkage mean ,	4414982.,	1.00,,,,				.063,	.035

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1202239.,	.24,	.32,	4,	1.302,	.123

Age 1 Catchability dependent on age and year class strength

Year class = 2000

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	136136.,	1.541,	.000,	.00,	1,	.013,	.611
Oct Sp. survey ,	675915.,	.478,	.030,	.06,	2,	.138,	.157
Jul Pt. survey ,	382806.,	.246,	.076,	.31,	2,	.522,	.262
P shrinkage mean ,	588870.,	.37,,,,				.287,	.178
F shrinkage mean ,	339666.,	1.00,,,,				.040,	.291

Table 7.7.2.1 (Cont'd)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
460047.,	.19,	.12,	7,	.660,	.223

1

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1999

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	207550.,	1.823,	.000,	.00,	1,	.016,	.262
Oct Sp. survey ,	322776.,	.455,	.397,	.87,	3,	.257,	.176
Jul Pt. survey ,	250818.,	.292,	.102,	.35,	2,	.647,	.221
F shrinkage mean ,	280339.,	1.00,,,,				.080,	.200

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
269174.,	.24,	.13,	7,	.544,	.208

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1998

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	31990.,	1.083,	.121,	.11,	2,	.058,	.609
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	150553.,	.677,	.346,	.51,	2,	.126,	.164
Oct Sp. survey ,	269729.,	.444,	.362,	.82,	4,	.256,	.095
Jul Pt. survey ,	178721.,	.337,	.204,	.61,	3,	.478,	.140
F shrinkage mean ,	144633.,	1.00,,,,				.083,	.170

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
172963.,	.24,	.19,	12,	.776,	.145

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	70859.,	.731,	.430,	.59,	3,	.102,	.258
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	286987.,	.861,	.109,	.13,	2,	.062,	.070
Oct Sp. survey ,	150624.,	.455,	.426,	.94,	5,	.183,	.130
Jul Pt. survey ,	177481.,	.234,	.203,	.87,	4,	.586,	.111
F shrinkage mean ,	117761.,	1.00,,,,				.068,	.163

Table 7.7.2.1 (Cont'd)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
157223.,	.20,	.16,	15,	.799,	.125

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	93226.,	.493,	.113,	.23,	5,	.232,	.189
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	169744.,	.639,	.517,	.81,	2,	.102,	.108
Oct Sp. survey ,	106465.,	.432,	.186,	.43,	6,	.228,	.167
Jul Pt. survey ,	139890.,	.315,	.429,	1.36,	4,	.363,	.130
F shrinkage mean ,	163062.,	1.00,,,,				.075,	.112

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
123396.,	.21,	.14,	18,	.646,	.146

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	154177.,	.393,	.280,	.71,	6,	.272,	.109
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	165501.,	.697,	.457,	.66,	3,	.066,	.102
Oct Sp. survey ,	91510.,	.375,	.338,	.90,	7,	.239,	.177
Jul Pt. survey ,	182491.,	.298,	.172,	.58,	5,	.368,	.093
F shrinkage mean ,	135775.,	1.00,,,,				.055,	.123

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
144525.,	.19,	.14,	22,	.733,	.116

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	143636.,	.254,	.156,	.61,	8,	.442,	.228
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	47197.,	.682,	.326,	.48,	4,	.046,	.576
Oct Sp. survey ,	303681.,	.364,	.262,	.72,	8,	.172,	.114
Jul Pt. survey ,	118036.,	.259,	.181,	.70,	5,	.301,	.271
F shrinkage mean ,	212943.,	1.00,,,,				.040,	.159

Table 7.7.2.1 (Cont'd)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
148577.,	.16,	.12,	26,	.779,	.222

1

Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	105126.,	.211,	.140,	.67,	8,	.533,	.196
8c East trawl fleet ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Oct Pt Survey ,	64313.,	.592,	.346,	.58,	4,	.048,	.303
Oct Sp. survey ,	134704.,	.287,	.248,	.87,	9,	.272,	.156
Jul Pt. survey ,	75035.,	.423,	.098,	.23,	5,	.113,	.265
F shrinkage mean ,	99311.,	1.00,,,,				.034,	.206

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
105518.,	.15,	.10,	27,	.673,	.196

Age 9 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	74038.,	.193,	.152,	.79,	9,	.542,	.152
8c East trawl fleet ,	48940.,	.559,	.222,	.40,	2,	.020,	.222
Oct Pt Survey ,	47906.,	.575,	.364,	.63,	4,	.040,	.226
Oct Sp. survey ,	46145.,	.269,	.194,	.72,	10,	.272,	.234
Jul Pt. survey ,	54500.,	.416,	.171,	.41,	5,	.095,	.202
F shrinkage mean ,	53269.,	1.00,,,,				.031,	.206

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
61013.,	.14,	.09,	31,	.676,	.183

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1991

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	57395.,	.177,	.162,	.92,	11,	.562,	.170
8c East trawl fleet ,	92914.,	.732,	.148,	.20,	3,	.009,	.108
Oct Pt Survey ,	59387.,	.601,	.522,	.87,	5,	.035,	.165
Oct Sp. survey ,	45198.,	.261,	.134,	.51,	11,	.240,	.211
Jul Pt. survey ,	38242.,	.295,	.255,	.86,	7,	.126,	.245
F shrinkage mean ,	40000.,	1.00,,,,				.028,	.236

Table 7.7.2.1 (Cont'd)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
51259.,	.13,	.09,	38,	.710,	.190

Age 11   Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
8c West trawl fleet ,	18757.,	.175,	.156,	.89,	12,	.550,	.292
8c East trawl fleet ,	17223.,	.503,	.319,	.63,	4,	.022,	.315
Oct Pt Survey ,	26455.,	.663,	.327,	.49,	6,	.030,	.216
Oct Sp. survey ,	15841.,	.258,	.182,	.70,	12,	.248,	.338
Jul Pt. survey ,	18199.,	.290,	.154,	.53,	8,	.114,	.300
F shrinkage mean ,	31977.,	1.00,,,,				.035,	.182

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
18421.,	.13,	.08,	43,	.663,	.299

Table.- 7.7.2.2

Run title : Horse mackerel south

At 17/09/2002 10:05

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR		1985	1986	1987	1988	1989	1990	1991
AGE								
	0	0.2918	0.2908	0.0436	0.1555	0.2758	0.0605	0.0211
	1	0.4455	0.5544	0.5012	0.3051	0.2933	0.2874	0.1107
	2	0.219	0.239	0.4214	0.1233	0.114	0.29	0.1843
	3	0.0506	0.2444	0.2413	0.152	0.1629	0.1279	0.0986
	4	0.1213	0.0971	0.1545	0.1144	0.1996	0.0822	0.0932
	5	0.0925	0.1718	0.0815	0.1488	0.1728	0.1035	0.0828
	6	0.0676	0.1103	0.1891	0.1201	0.2327	0.1069	0.1318
	7	0.1512	0.3281	0.1103	0.2116	0.0878	0.1888	0.177
	8	0.1037	0.3727	0.0981	0.1634	0.1983	0.1688	0.2529
	9	0.1559	0.2401	0.1802	0.2799	0.3055	0.2398	0.1979
	10	0.17	0.2961	0.1166	0.5544	0.5246	0.202	0.339
	11	0.1881	0.3513	0.1027	0.3258	0.4057	0.287	0.2546
+gp		0.1881	0.3513	0.1027	0.3258	0.4057	0.287	0.2546
0 FBAR 1- 3		0.2384	0.346	0.388	0.1935	0.1901	0.2351	0.1312
FBAR 7-11		0.1538	0.3176	0.1216	0.307	0.3044	0.2173	0.2443
FBAR 1-11		0.1605	0.2732	0.1997	0.2272	0.2452	0.1895	0.1748

Table 8 Fishing mortality (F) at age

YEAR		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	FBAR 99-**
AGE												
	0	0.0349	0.0095	0.0078	0.0033	0.0324	0.0106	0.028	0.0855	0.0175	0.1225	0.0752
	1	0.2512	0.0961	0.1243	0.1679	0.04	0.4723	0.4451	0.3006	0.1899	0.2228	0.2378
	2	0.2365	0.3647	0.3656	0.1854	0.0782	0.2364	0.3271	0.1892	0.1662	0.2079	0.1878
	3	0.1876	0.32	0.2002	0.1994	0.0813	0.1012	0.191	0.2777	0.1967	0.1445	0.2063
	4	0.1136	0.1796	0.1151	0.1407	0.1574	0.0873	0.1019	0.2696	0.1984	0.1251	0.1977
	5	0.0814	0.1623	0.0757	0.1009	0.1087	0.087	0.0959	0.109	0.1587	0.146	0.1379
	6	0.0914	0.099	0.1798	0.0946	0.0936	0.0561	0.1658	0.0998	0.1971	0.1161	0.1377
	7	0.1818	0.1707	0.1316	0.1831	0.1242	0.1224	0.1742	0.1455	0.2272	0.2216	0.1981
	8	0.1931	0.216	0.178	0.1545	0.1553	0.261	0.2227	0.1601	0.2283	0.1958	0.1947
	9	0.4301	0.3978	0.2151	0.154	0.2054	0.2412	0.1958	0.2272	0.1562	0.1828	0.1887
	10	0.2307	0.3432	0.2149	0.3431	0.1809	0.3194	0.2885	0.2178	0.1683	0.1896	0.1919
	11	0.3157	0.2333	0.2336	0.3664	0.4317	0.2432	0.1872	0.217	0.3297	0.2988	0.2818
+gp		0.3157	0.2333	0.2336	0.3664	0.4317	0.2432	0.1872	0.217	0.3297	0.2988	
0 FBAR 1- 3		0.2251	0.2603	0.23	0.1843	0.0665	0.27	0.321	0.2558	0.1843	0.1918	
FBAR 7-11		0.2703	0.2722	0.1946	0.2402	0.2195	0.2374	0.2137	0.1935	0.2219	0.2177	
FBAR 1-11		0.2103	0.2348	0.1849	0.19	0.1506	0.2025	0.2177	0.2012	0.2015	0.1865	

Table 7.7.2.3.-

Run title : Horse mackerel south

At 17/09/2002 10:05

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR		1985	1986	1987	1988	1989	1990	1991
AGE								
	0	1676828	2628439	1348322	912927	1084739	883266	1641987
	1	892024	1078009	1691480	1111045	672624	708631	715609
	2	465181	491781	532949	881996	704818	431750	457583
	3	1745148	321632	333290	300983	671056	541294	278064
	4	247110	1427983	216805	225353	222539	490756	409963
	5	178943	188386	1115372	159897	172998	156878	389063
	6	116629	140412	136554	884844	118599	125267	121753
	7	56557	93820	108227	97285	675408	80891	96884
	8	43570	41848	58165	83425	67766	532477	57643
	9	46820	33808	24812	45385	60978	47836	387137
	10	31816	34481	22888	17835	29527	38669	32393
	11	20199	23104	22072	17532	8818	15040	27195
+gp		60130	50922	61168	52685	37772	49137	48616
0 TOTAL		5580956	6554625	5672106	4791192	4527643	4101891	4663891

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

YEAR		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	GMST 85-99	AMST 85-
AGE														
	0	1434048	1225709	1315737	1136045	1295151	873036	595475	683107	788071	1577262	0	1168320	1248988
	1	1383782	1191965	1045033	1123712	974545	1079173	743494	498385	539769	666561	1202239	950271	993967
	2	551412	926442	931929	794313	817689	805907	579197	410049	317602	384232	460047	625896	652200
	3	327557	374630	553737	556504	567953	650821	547603	359451	292094	231495	269174	478221	541982
	4	216860	233716	234142	390127	392384	450659	506235	389390	234370	206507	172963	346492	403601
	5	321470	166617	168090	179611	291711	288556	355466	393512	255949	165418	157223	254383	301771
	6	308264	255068	121923	134124	139752	225219	227676	277971	303713	187979	123396	183717	222270
	7	91850	242156	198841	87673	105018	109542	183269	166024	216531	214642	144525	127909	159563
	8	69864	65912	175716	150047	62836	79834	83426	132516	123552	148498	148577	87004	113670
	9	38529	49571	45709	126574	110656	46305	52929	57468	97185	84640	105518	58793	78301
	10	273371	21570	28663	31728	93391	77558	31315	37455	39411	71555	61013	39070	53511
	11	19865	186817	13172	19900	19376	67080	48505	20199	25927	28666	51259	24762	35258
+gp		49066	29204	70957	75960	72432	70897	150255	43141	60956	43400	46128		
TOTAL		5085938	4969378	4903648	4806318	4942895	4824588	4104845	3468668	3295130	4010855	2942062		

Table 7.7.2.4

Run title : Horse mackerel south

At 17/09/2002 10:05

Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 0	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	FBAR 1- 3	FBAR 7-11	FBAR 1-11
1985	1676828	325735	146356	43535	0.2975	1.0238	0.2384	0.1538	0.1605
1986	2628439	355119	193987	71258	0.3673	1.019	0.346	0.3176	0.2732
1987	1348322	361336	209417	52747	0.2519	0.9882	0.388	0.1216	0.1997
1988	912927	353066	211807	55888	0.2639	0.9782	0.1935	0.307	0.2272
1989	1084739	341297	208547	56396	0.2704	0.986	0.1901	0.3044	0.2452
1990	883266	351336	227842	49207	0.216	1.0057	0.2351	0.2173	0.1895
1991	1641987	340244	227406	45511	0.2001	1.0123	0.1312	0.2443	0.1748
1992	1434048	345020	212739	50956	0.2395	0.9935	0.2251	0.2703	0.2103
1993	1225709	343691	197896	57428	0.2902	1.0001	0.2603	0.2722	0.2348
1994	1315737	309499	164595	52588	0.3195	1.0003	0.23	0.1946	0.1849
1995	1136045	324371	176431	52681	0.2986	0.9997	0.1843	0.2402	0.19
1996	1295151	335761	186438	44690	0.2397	1.0075	0.0665	0.2195	0.1506
1997	873036	358120	200155	56770	0.2836	0.994	0.27	0.2374	0.2025
1998	595475	364353	228610	64480	0.2821	0.9867	0.321	0.2137	0.2177
1999	683107	298493	194528	51922	0.2669	0.9893	0.2558	0.1935	0.2012
2000	788071	294308	200449	49138	0.2451	1.0212	0.1843	0.2219	0.2015
2001	1577262	262948	175135	45739	0.2612	0.9953	0.1918	0.2177	0.1865
Arith. Mean	1241185	333217	197785	52996	.2702	0	0.2029		
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)					

Table 7.8.1.- Input data for predictions

MFDP version 1
Run: hom-soth
Time and date: 10:04 19/09/02
Fbar age range: 0-12

2002

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	1168320	0.15	0	0.25	0.25	0.000	0.075	0.021
1	1202239	0.15	0	0.25	0.25	0.032	0.238	0.033
2	460047	0.15	0.04	0.25	0.25	0.055	0.188	0.073
3	269174	0.15	0.27	0.25	0.25	0.075	0.206	0.094
4	172963	0.15	0.63	0.25	0.25	0.105	0.198	0.120
5	157223	0.15	0.81	0.25	0.25	0.127	0.138	0.135
6	123396	0.15	0.9	0.25	0.25	0.154	0.138	0.155
7	144525	0.15	0.95	0.25	0.25	0.176	0.198	0.175
8	148577	0.15	0.97	0.25	0.25	0.213	0.195	0.196
9	105518	0.15	0.98	0.25	0.25	0.240	0.189	0.225
10	61013	0.15	0.99	0.25	0.25	0.269	0.192	0.234
11	51259	0.15	1	0.25	0.25	0.304	0.282	0.257
12	46128	0.15	1	0.25	0.25	0.347	0.282	0.299

2003

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	1168320	0.15	0	0.25	0.25	0.000	0.075	0.021
1	.	0.15	0	0.25	0.25	0.032	0.238	0.033
2	.	0.15	0.04	0.25	0.25	0.055	0.188	0.073
3	.	0.15	0.27	0.25	0.25	0.075	0.206	0.094
4	.	0.15	0.63	0.25	0.25	0.105	0.198	0.120
5	.	0.15	0.81	0.25	0.25	0.127	0.138	0.135
6	.	0.15	0.9	0.25	0.25	0.154	0.138	0.155
7	.	0.15	0.95	0.25	0.25	0.176	0.198	0.175
8	.	0.15	0.97	0.25	0.25	0.213	0.195	0.196
9	.	0.15	0.98	0.25	0.25	0.240	0.189	0.225
10	.	0.15	0.99	0.25	0.25	0.269	0.192	0.234
11	.	0.15	1	0.25	0.25	0.304	0.282	0.257
12	.	0.15	1	0.25	0.25	0.347	0.282	0.299

2004

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	1168320	0.15	0	0.25	0.25	0.000	0.075	0.021
1	.	0.15	0	0.25	0.25	0.032	0.238	0.033
2	.	0.15	0.04	0.25	0.25	0.055	0.188	0.073
3	.	0.15	0.27	0.25	0.25	0.075	0.206	0.094
4	.	0.15	0.63	0.25	0.25	0.105	0.198	0.120
5	.	0.15	0.81	0.25	0.25	0.127	0.138	0.135
6	.	0.15	0.9	0.25	0.25	0.154	0.138	0.155
7	.	0.15	0.95	0.25	0.25	0.176	0.198	0.175
8	.	0.15	0.97	0.25	0.25	0.213	0.195	0.196
9	.	0.15	0.98	0.25	0.25	0.240	0.189	0.225
10	.	0.15	0.99	0.25	0.25	0.269	0.192	0.234
11	.	0.15	1	0.25	0.25	0.304	0.282	0.257
12	.	0.15	1	0.25	0.25	0.347	0.282	0.299

Input units are thousands and kg - output in tonnes

Table 7.8.2a.- Prediction with management option table

MFDP version 1
Run: hom-soth
Horse mackerel south
Time and date: 10:04 19/09/02
Fbar age range: 0-12

2002				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
271483	163743	1	0.1936	48830

2003					2004	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
271397	160127	0	0	0	327195	188408
.	159317	0.1	0.0194	5460	321009	183713
.	158511	0.2	0.0387	10813	314949	179141
.	157710	0.3	0.0581	16061	309013	174687
.	156913	0.4	0.0775	21206	303196	170347
.	156120	0.5	0.0968	26250	297497	166120
.	155331	0.6	0.1162	31195	291914	162002
.	154546	0.7	0.1356	36044	286443	157990
.	153766	0.8	0.1549	40798	281082	154081
.	152989	0.9	0.1743	45459	275830	150273
.	152217	1	0.1936	50030	270684	146562
.	151449	1.1	0.213	54512	265640	142946
.	150685	1.2	0.2324	58907	260699	139424
.	149925	1.3	0.2517	63216	255856	135991
.	149169	1.4	0.2711	67442	251111	132646
.	148417	1.5	0.2905	71587	246461	129387
.	147669	1.6	0.3098	75651	241903	126210
.	146925	1.7	0.3292	79637	237437	123115
.	146185	1.8	0.3486	83546	233060	120099
.	145449	1.9	0.3679	87379	228770	117159
.	144717	2	0.3873	91139	224566	114294

Input units are thousands and kg - output in tonnes

Table 7.8.2b.- Prediction with management option table

MFDP version 1
Run: hom-soth
Time and date: 10:43 19/09/02
Fbar age range: 0-12

Year:	2002	F multiplier:	1	Fbar:	0.1936				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
0	0.0752	78634	1651	1168320	0	0	0	0	0
1	0.2378	236950	7819	1202239	38472	0	0	0	0
2	0.1878	73306	5351	460047	25303	18402	1012	16912	930
3	0.2063	46715	4391	269174	20188	72677	5451	66483	4986
4	0.1977	28883	3466	172963	18161	108967	11442	99895	10489
5	0.1379	18839	2543	157223	19967	127351	16174	118507	15050
6	0.1377	14763	2288	123396	19003	111056	17103	103350	15916
7	0.1981	24178	4231	144525	25436	137299	24165	125855	22151
8	0.1947	24473	4797	148577	31647	144120	30697	132219	28163
9	0.1887	16893	3801	105518	25324	103408	24818	95011	22803
10	0.1919	9917	2321	61013	16412	60403	16248	55454	14917
11	0.2818	11732	3015	51259	15583	51259	15583	46013	13988
12	0.2818	10557	3155	46128	15986	46128	15986	41407	14350
Total		595839	48830	4110382	271483	981069	178678	901108	163743

Year:	2003	F multiplier:	1	Fbar:	0.1936				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
0	0.0752	78634	1651	1168320	0	0	0	0	0
1	0.2378	183840	6067	932767	29849	0	0	0	0
2	0.1878	129994	9490	815804	44869	32632	1795	29990	1649
3	0.2063	56956	5354	328180	24613	88609	6646	81057	6079
4	0.1977	31476	3777	188492	19792	118750	12469	108864	11431
5	0.1379	14638	1976	122166	15515	98954	12567	92082	11694
6	0.1377	14104	2186	117892	18155	106102	16340	98740	15206
7	0.1981	15483	2710	92548	16289	87921	15474	80593	14184
8	0.1947	16807	3294	102039	21734	98978	21082	90805	19341
9	0.1887	16850	3791	105253	25261	103148	24756	94773	22746
10	0.1919	12223	2860	75200	20229	74448	20026	68349	18386
11	0.2818	9920	2550	43345	13177	43345	13177	38909	11828
12	0.2818	14473	4325	63235	21915	63235	21915	56764	19672
Total		595397	50030	4155241	271397	916122	166246	840925	152217

Year:	2004	F multiplier:	1	Fbar:	0.1936				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
0	0.0752	78634	1651	1168320	0	0	0	0	0
1	0.2378	183840	6067	932767	29849	0	0	0	0
2	0.1878	100857	7363	632948	34812	25318	1392	23268	1280
3	0.2063	101000	9494	581963	43647	157130	11785	143739	10780
4	0.1977	38376	4605	229812	24130	144782	15202	132728	13936
5	0.1379	15953	2154	133134	16908	107839	13696	100350	12744
6	0.1377	10959	1699	91604	14107	82444	12696	76723	11815
7	0.1981	14792	2589	88420	15562	83999	14784	76998	13552
8	0.1947	10763	2109	65342	13918	63382	13500	58148	12385
9	0.1887	11572	2604	72285	17348	70839	17001	65088	15621
10	0.1919	12192	2853	75011	20178	74261	19976	68177	18340
11	0.2818	12227	3142	53423	16241	53423	16241	47956	14579
12	0.2818	15839	4733	69204	23983	69204	23983	62122	21529
Total		607003	51062	4194235	270684	932621	160257	855297	146562

Input units are thousands and kg - output in tonnes

Table 7_8_2c.- Prediction with management option table. TAC constraint

MFDP version 1
Run: hom-sothTAC
Horse mackerel south
Time and date: 10:46 19/09/02
Fbar age range: 0-12

2002				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
271483	159608	1.5147	0.2933	68000

2003					2004	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
217672	144787	0	0	0	226082	168765
.	144057	0.1	0.0194	4152	221667	164574
.	143330	0.2	0.0387	8222	217342	160491
.	142608	0.3	0.0581	12213	213104	156514
.	141889	0.4	0.0775	16126	208952	152639
.	141174	0.5	0.0968	19962	204883	148864
.	140463	0.6	0.1162	23723	200896	145185
.	139756	0.7	0.1356	27411	196990	141602
.	139052	0.8	0.1549	31027	193162	138110
.	138353	0.9	0.1743	34573	189412	134707
.	137656	1	0.1936	38049	185737	131392
.	136964	1.1	0.213	41458	182135	128161
.	136275	1.2	0.2324	44801	178606	125013
.	135590	1.3	0.2517	48079	175147	121945
.	134909	1.4	0.2711	51294	171758	118956
.	134231	1.5	0.2905	54446	168437	116042
.	133556	1.6	0.3098	57538	165182	113203
.	132886	1.7	0.3292	60569	161992	110436
.	132218	1.8	0.3486	63543	158866	107739
.	131555	1.9	0.3679	66459	155803	105110
.	130894	2	0.3873	69318	152800	102548

Input units are thousands and kg - output in tonnes

Table 7.8.2d. Precdiction with the management option tables. TAC constraint.

MFDP version 1
Run: hom-sothTAC
Time and date: 10:46 19/09/02
Fbar age range: 0-12

Year:	2002	F multiplier:	1.5147	Fbar:	0.2933				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
0	0.1139	0	0	0	0	0	0	0	0
1	0.3602	339155	11192	1202239	38472	0	0	0	0
2	0.2844	106129	7747	460047	25303	18402	1012	16508	908
3	0.3125	67345	6330	269174	20188	72677	5451	64742	4856
4	0.2995	41720	5006	172963	18161	108967	11442	97385	10225
5	0.2089	27594	3725	157223	19967	127351	16174	116422	14786
6	0.2085	21624	3352	123396	19003	111056	17103	101535	15636
7	0.3001	34921	6111	144525	25436	137299	24165	122688	21593
8	0.295	35374	6933	148577	31647	144120	30697	128947	27466
9	0.2859	24451	5501	105518	25324	103408	24818	92732	22256
10	0.2907	14343	3356	61013	16412	60403	16248	54102	14553
11	0.4269	16628	4273	51259	15583	51259	15583	44375	13490
12	0.4269	14963	4471	46128	15986	46128	15986	39933	13839
Total		744246	68000	2942062	271483	981069	178678	879368	159608

Year:	2003	F multiplier:	1	Fbar:	0.1936				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
0	0.0752	0	0	0	0	0	0	0	0
1	0.2378	0	0	0	0	0	0	0	0
2	0.1878	115019	8396	721829	39701	28873	1588	26535	1459
3	0.2063	51709	4861	297946	22346	80445	6033	73590	5519
4	0.1977	28305	3397	169503	17798	106787	11213	97896	10279
5	0.1379	13222	1785	110345	14014	89380	11351	83173	10563
6	0.1377	13138	2036	109814	16911	98832	15220	91974	14164
7	0.1981	14424	2524	86217	15174	81906	14416	75080	13214
8	0.1947	15178	2975	92147	19627	89383	19038	82002	17466
9	0.1887	15243	3430	95215	22852	93310	22395	85734	20576
10	0.1919	11091	2595	68238	18356	67556	18172	62021	16684
11	0.2818	8987	2310	39268	11937	39268	11937	35250	10716
12	0.2818	12518	3741	54696	18955	54696	18955	49099	17016
Total		298834	38049	1845218	217672	830437	150319	762353	137656

Year:	2004	F multiplier:	1	Fbar:	0.1936				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
0	0.0752	0	0	0	0	0	0	0	0
1	0.2378	0	0	0	0	0	0	0	0
2	0.1878	0	0	0	0	0	0	0	0
3	0.2063	89365	8400	514925	38619	139030	10427	127181	9539
4	0.1977	34841	4181	208641	21907	131444	13802	120500	12653
5	0.1379	14346	1937	119722	15205	96975	12316	90240	11460
6	0.1377	9899	1534	82741	12742	74467	11468	69300	10672
7	0.1981	13779	2411	82361	14496	78243	13771	71722	12623
8	0.1947	10026	1965	60872	12966	59046	12577	54170	11538
9	0.1887	10450	2351	65278	15667	63972	15353	58778	14107
10	0.1919	11029	2581	67857	18254	67178	18071	61675	16591
11	0.2818	11095	2851	48478	14737	48478	14737	43517	13229
12	0.2818	13964	4173	61013	21144	61013	21144	54769	18981
Total		218794	32385	1311887	185737	819845	143666	751852	131392

Input units are thousands and kg - output in tonnes

Table 7_9_1.- Yield per recruit summary table

MFYPR version 1
Run: hom-soth
Time and date: 10:26 19/09/02
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	7.1792	1.014	3.7744	0.8666	3.6355	0.8347
0.1	0.0194	0.1114	0.0162	6.4378	0.82	3.114	0.6797	2.9836	0.6509
0.2	0.0387	0.197	0.0264	5.8692	0.6805	2.622	0.5467	2.4997	0.5207
0.3	0.0581	0.2653	0.033	5.4152	0.5758	2.2405	0.4481	2.1257	0.4246
0.4	0.0775	0.3215	0.0374	5.042	0.4946	1.9359	0.3727	1.8282	0.3514
0.5	0.0968	0.3688	0.0402	4.7283	0.4301	1.6874	0.3136	1.5862	0.2942
0.6	0.1162	0.4092	0.0421	4.4602	0.3779	1.4812	0.2664	1.3861	0.2488
0.7	0.1356	0.4443	0.0433	4.2279	0.335	1.3077	0.2281	1.2183	0.212
0.8	0.1549	0.475	0.044	4.0246	0.2991	1.1602	0.1967	1.0761	0.182
0.9	0.1743	0.5022	0.0443	3.8448	0.2689	1.0337	0.1706	0.9546	0.1572
1	0.1936	0.5264	0.0444	3.6848	0.2431	0.9243	0.1487	0.8499	0.1364
1.1	0.213	0.5481	0.0443	3.5414	0.221	0.8292	0.1302	0.7591	0.119
1.2	0.2324	0.5677	0.0441	3.4122	0.2018	0.746	0.1145	0.68	0.1042
1.3	0.2517	0.5855	0.0438	3.2951	0.1852	0.673	0.1011	0.6107	0.0915
1.4	0.2711	0.6017	0.0435	3.1887	0.1705	0.6085	0.0895	0.5498	0.0807
1.5	0.2905	0.6165	0.0431	3.0914	0.1576	0.5514	0.0795	0.496	0.0714
1.6	0.3098	0.6301	0.0426	3.0022	0.1462	0.5006	0.0708	0.4484	0.0634
1.7	0.3292	0.6426	0.0421	2.9203	0.136	0.4554	0.0633	0.406	0.0563
1.8	0.3486	0.6541	0.0417	2.8446	0.1269	0.415	0.0566	0.3684	0.0502
1.9	0.3679	0.6648	0.0412	2.7747	0.1188	0.3788	0.0508	0.3347	0.0449
2	0.3873	0.6748	0.0407	2.7098	0.1115	0.3462	0.0457	0.3046	0.0402

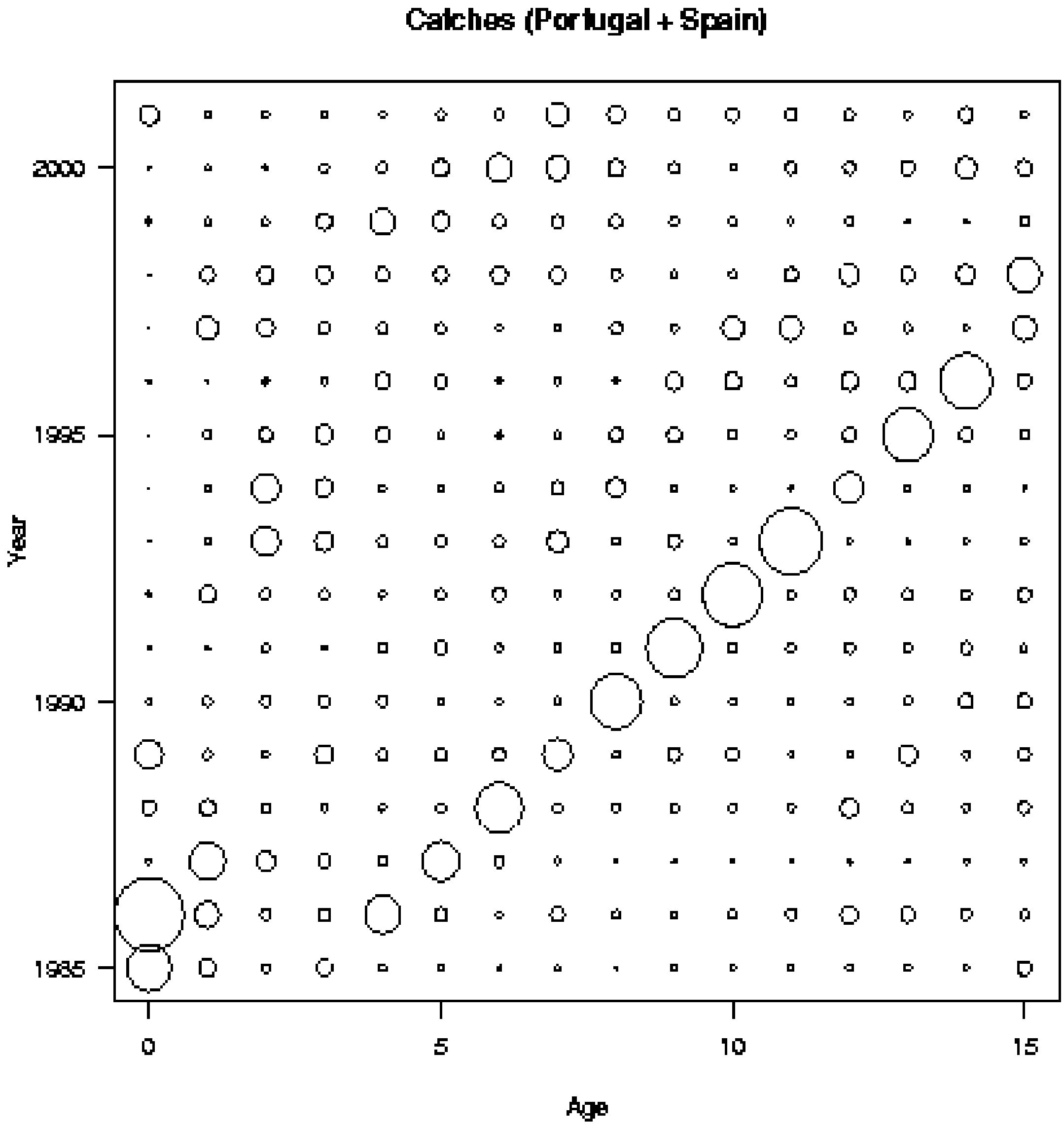


Figure 7.3.1.1. The age composition of southern horse mackerel in the international catches from 1985 to 2001. The circles are proportional to the total catches of each age through the whole period, in order to look for the relative strength of each age in each year.

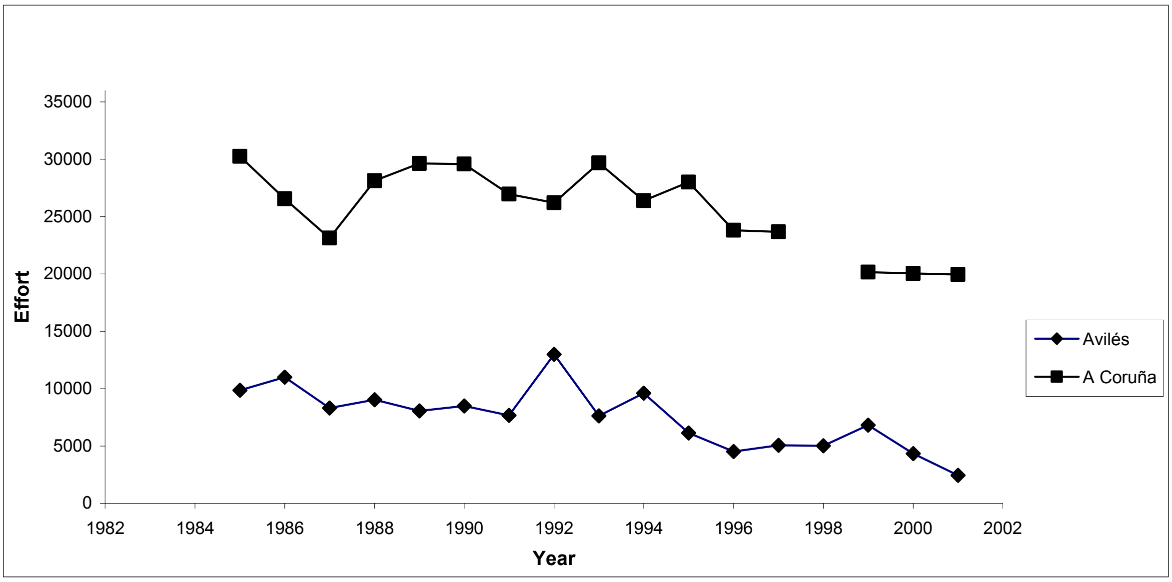


Figure 7.5.1 Effort series from two Spanish commercial bottom trawl fleets

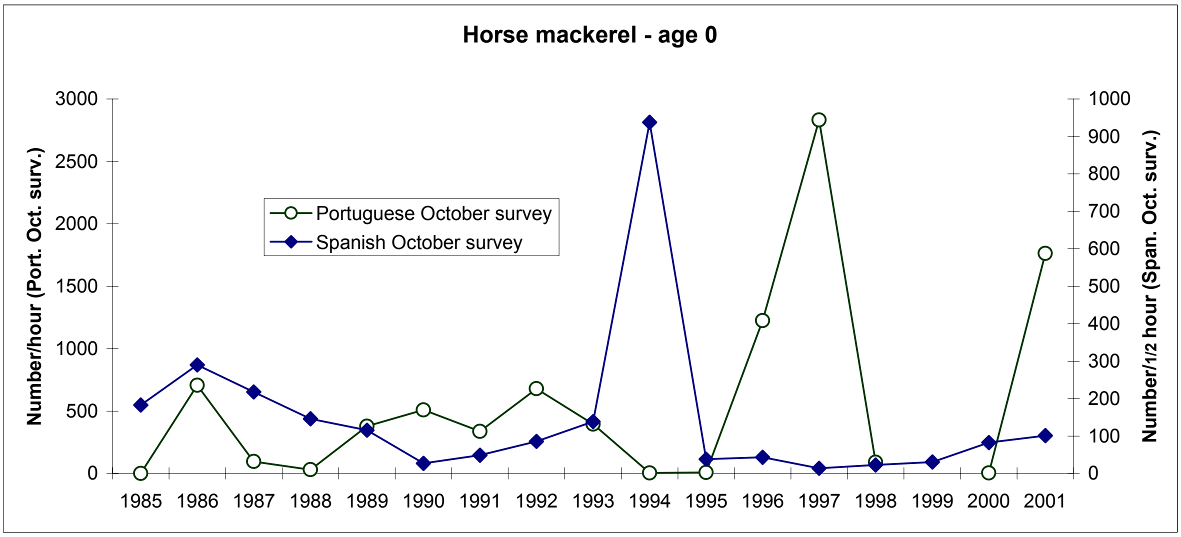


Figure 7.6.1 - Catches of age 0 horse mackerel in bottom trawl surveys used in the tuning of the VPA.

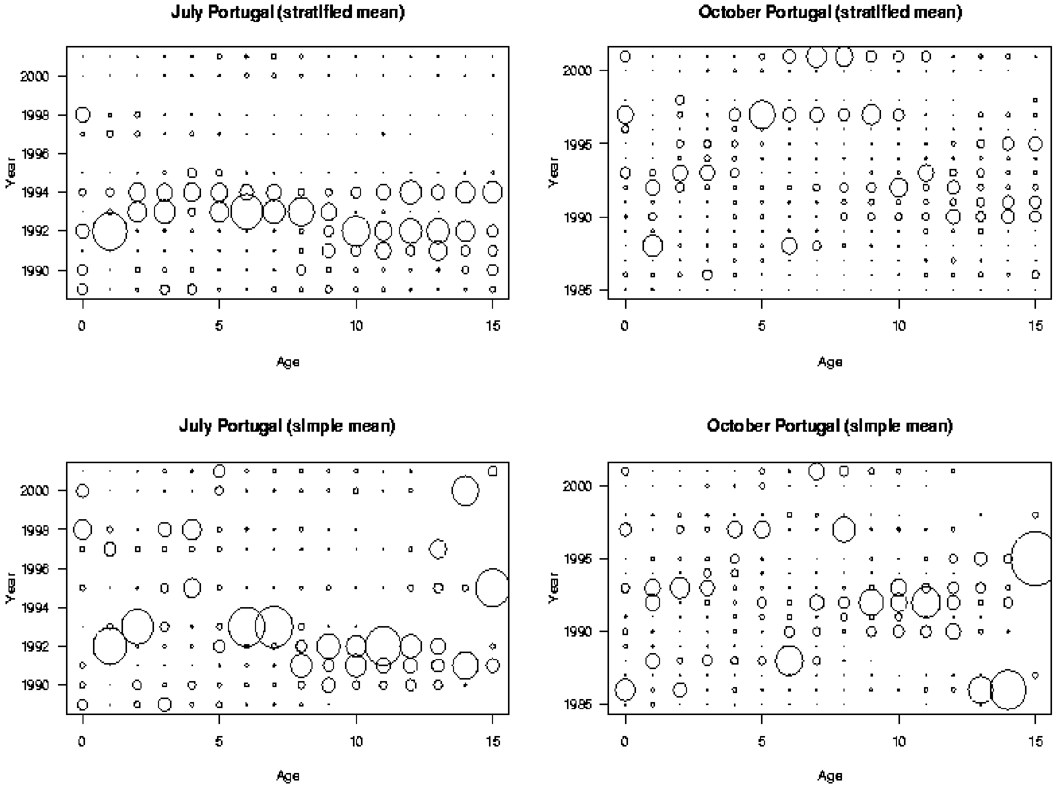


Figure. 7.7.1.1. Comparison of different methodologies, stratified mean and simple mean, to obtain CPUE at age indeces from July and October Portuguese surveys. The circles are proportional to the total catches of each age through the whole period, in order to look for the relative strength of each age in each year.

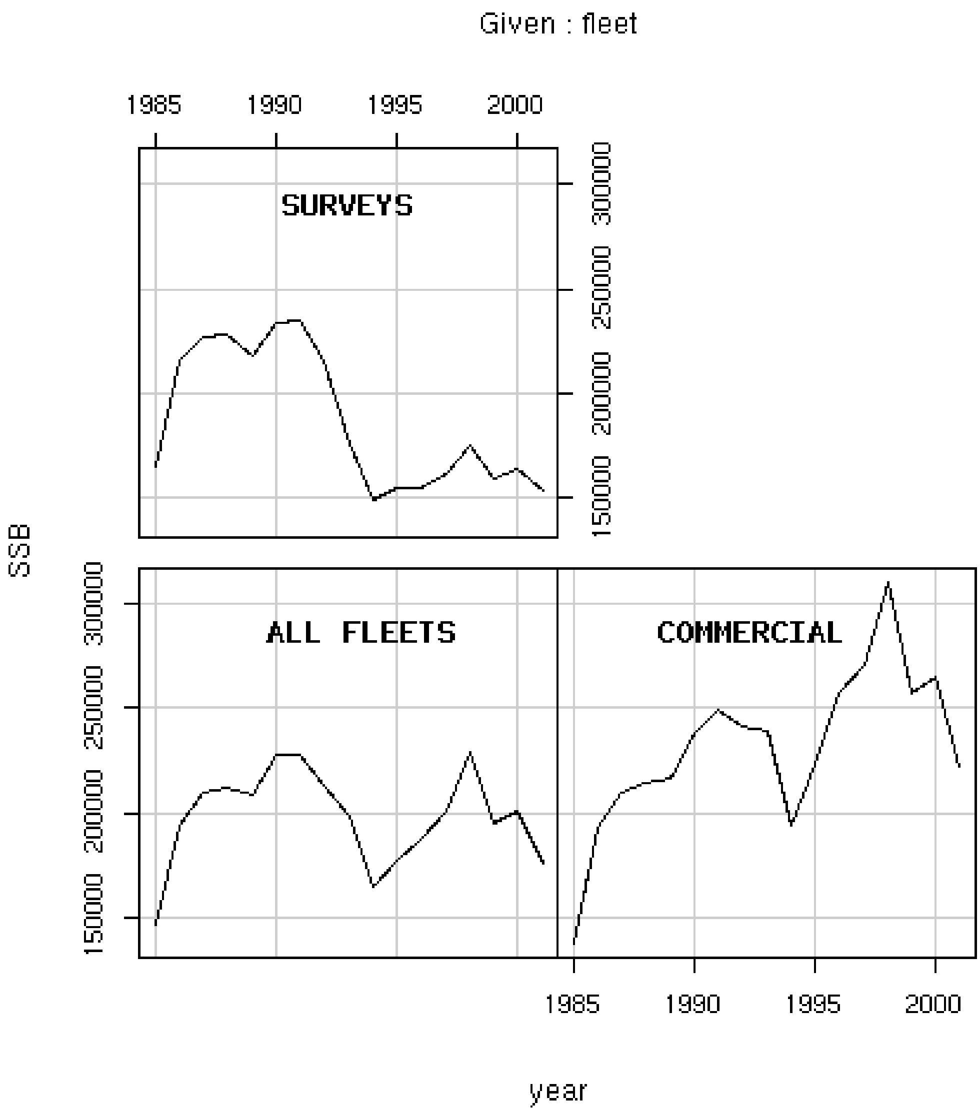
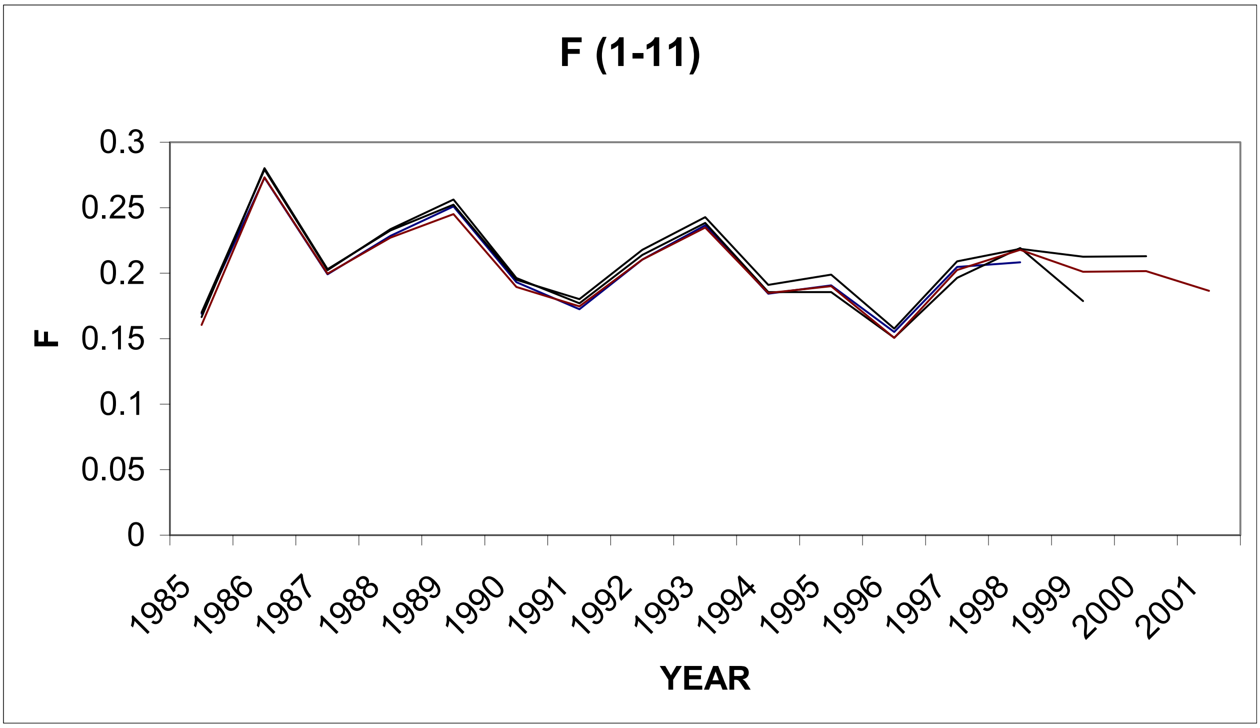


Figure 7.7.1.2. Comparison of SSB trends from XSA outputs using different fleets for tunning: upper panel XSA tunned with survey fleets; bottom to the right panel: XSA tunned with commercial fleets; bottom to the left: XSA tunned with all fleets (surveys and commercial fleets).



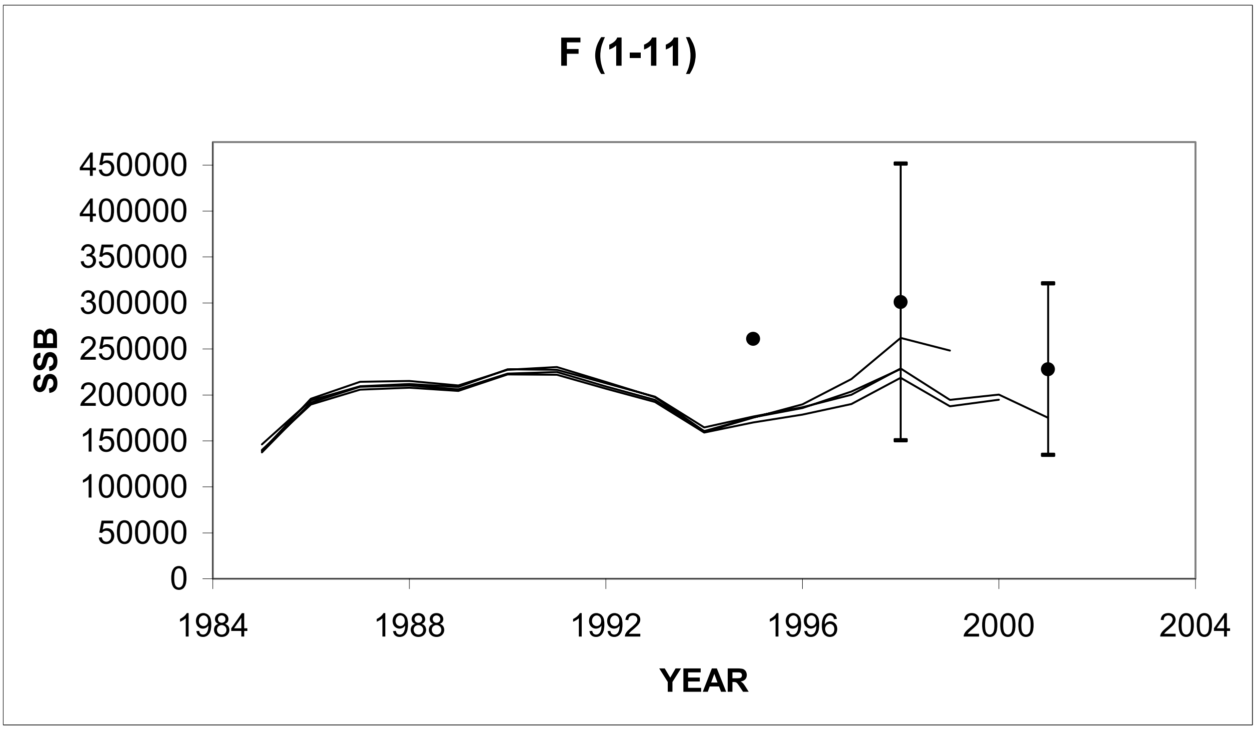


Figure 7.7.2.1.- Retrospective analysis (1998-2001) of the southern horse mackerel stock using XSA tunining outputs (F and SSB)
In the bottom panel it is also showed the SSB estimates (+/- the standard deviation) from egg surveys carried out in 1995, 1998 an
It is not available the standard deviation of the SSB estimate from the 1995 egg survey

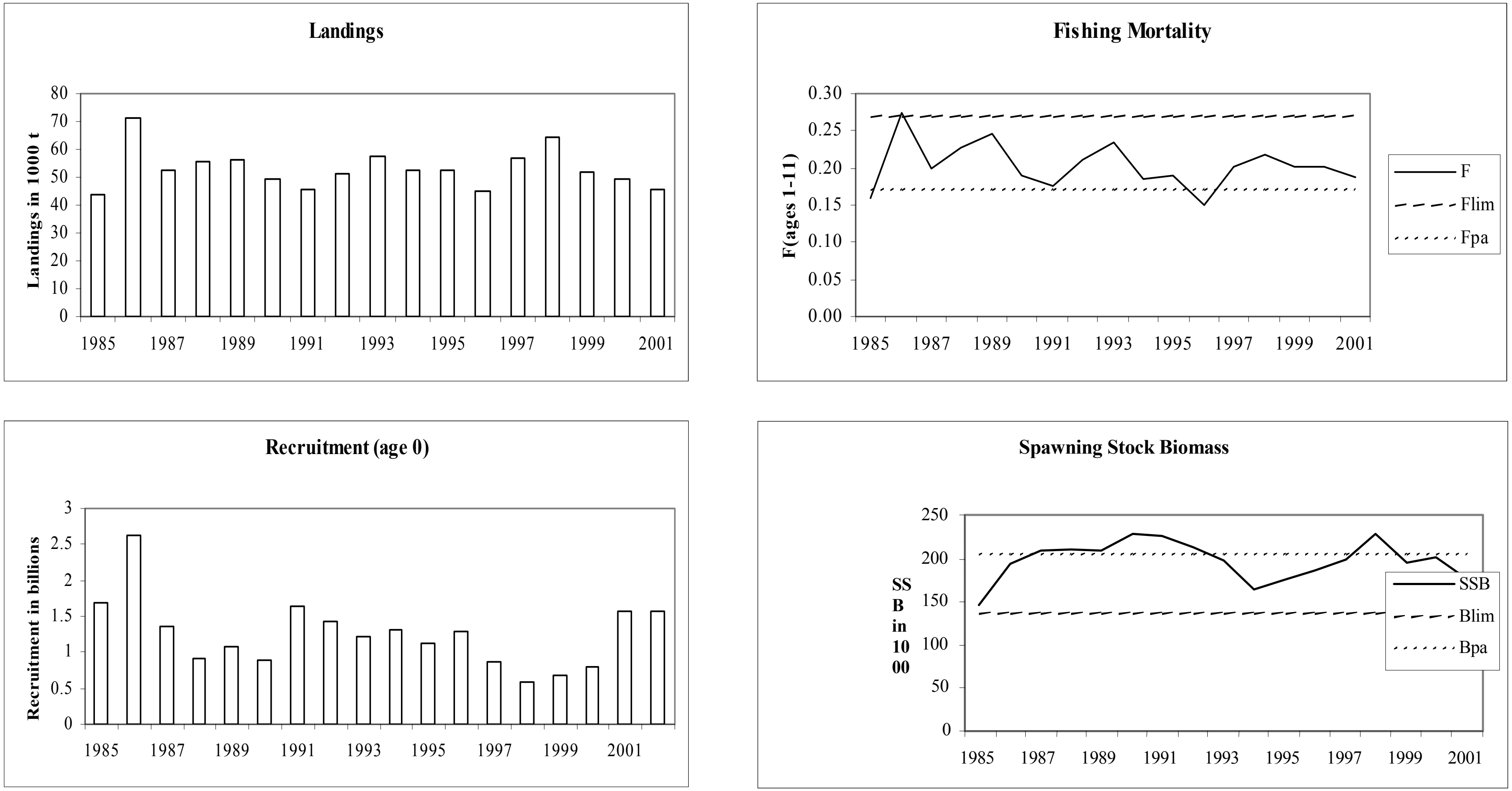


Figure 7.7.2.2. Southern Horse Mackerel Stock Summary.

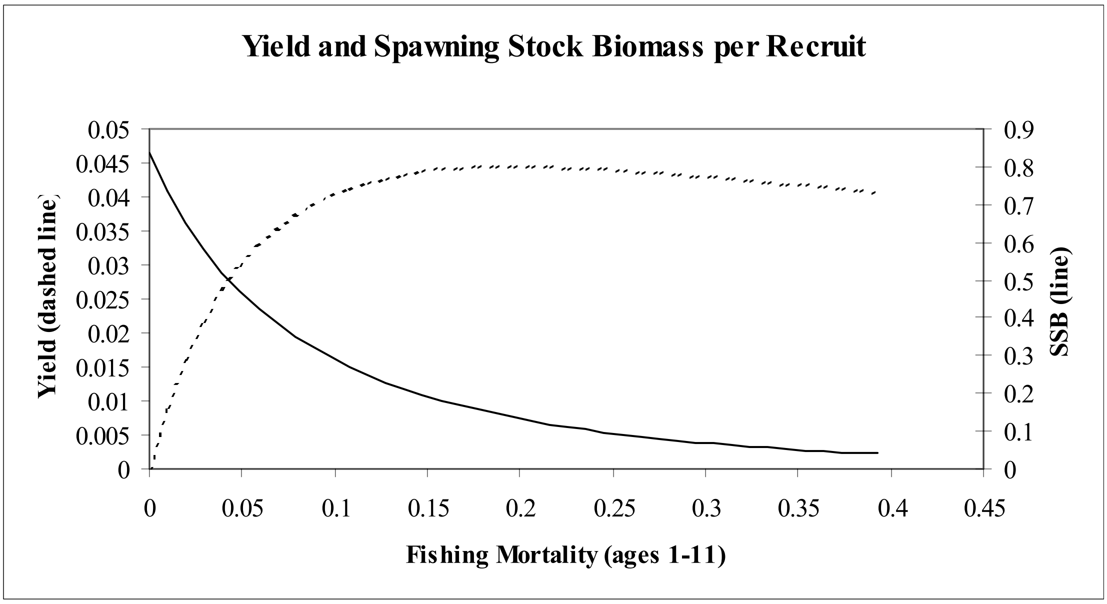
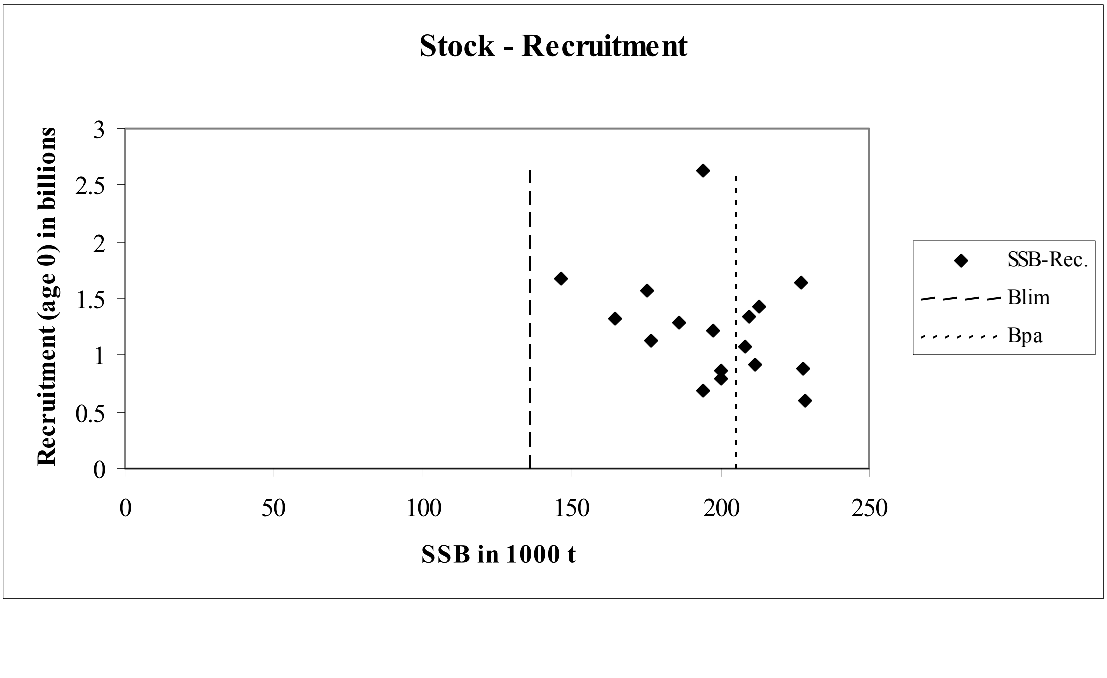


Figure 7.9.1.- Yield and Spawning Stock Biomass per Recruit



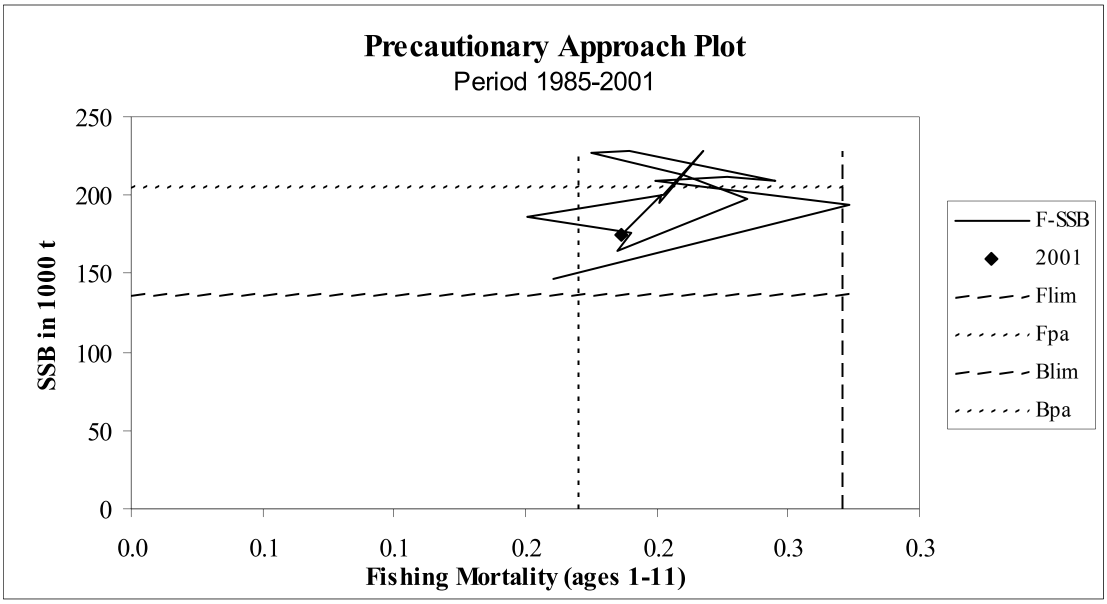


Figure 7.10.1. Southern horse mackerel stock / recruitment (upper panel) and PA (bottom) plots

8 SARDINE GENERAL

Sardine (*Sardina pilchardus*, Walb 1792) is an important pelagic fish species with a wide distribution area in NE Atlantic waters and adjacent areas (i.e. to the Black Sea in the east and to the Açores in the west). Northern and southern limits seem to be related to the average water temperature, being located within 10ºC and 20ºC isotherme (Furnestin, 1945). Nevertheless, several authors have hypothesised that sardine distribution and abundance are dependent on the oceanographic regime (Barkova *et al*., 2001; Kifani, 1998; Carrera and Porteiro, in press). High abundance, wide geographic distributions, feeding/spawning migrations and high catches in the commercial fishery are all associated with favourable “regimes” (Lluch-Belda *et al*. 1992, Schwartzlose *et al.* 1999).

In the **Morocco area** off the African coast, the fishery started in the 1950s. Landings peaked in the 1970s, declined in the 1980s and rose again in the 1990s to about 1 Mill. t per year (Kifani 1998). Sardine was earlier separated into three stocks units in this area, however, recent studies stated that only two populations are distributed in Moroccan waters, which can be distinguished by different growth rates and longevity and meristic characters (Barkova *et al*., 2001).

North of the Iberian peninsula there is currently no directed fishery on sardine, and no total allowable catch is set. However, reported catch from these areas increased in the last year. Apart from some studies on sardine and ichthyoplankton distribution undertaken in ICES Divisions VIIIab and VIIefh, very little information is available on the distribution, biology and stock structure of sardine in this area.

Acoustic surveys in Division VIIIa, b

During May and June 2002, an acoustic survey was carried out off the French coast within the framework of the EU Study PELASSES (Poisson & Massé WD 2002). This survey, targeted mainly on anchovy, also covered the distribution area of other pelagic fish species like sardine. It was co-ordinated with the Portuguese and Spanish surveys to cover the southern part of the European Atlantic waters. In contrast to previous years, the sardine biomass for the area covered has not yet been calculated and was thus not available to this year’s WG.

The fishery

No information on sardine catch in the Moroccan area was available to the WG.

Commercial catch data for 2001 from the northern areas (VIIIabde, VII and VI) was provided by Ireland and Germany. The UK (England and Wales) and France did not report any catches, however, there are indications that these nations catch a significant amount of sardine. The total reported catch in 2001 was 8,319 t and thus more than doubled compared to last year (3,341 t, Table 8.1). None of the catch was sampled for age or length. 90% of the reported catches were taken in Sub-area VII (7,472 t, whereof 6,531 t were taken in Div. VIIe). 714 t were reported from as far north as Div. VIa (see Table below). As in previous years, the fishery mainly took place in the 4th quarter (7,328 t; 88 % of the total catch).

Reported catch of sardine in the northern areas (VIIIabde, VII and VI) in 2001

Area/quarter	1	3	4	Grand Total
VIa		714		**714**
VIIa			47	**47**
VIIb		140	38	**178**
VIId			73	**73**
VIIe	88		6443	**6531**
VIIg			353	**353**
VIIh	41		125	**166**
VIIj			123	**123**
VIIIa		8	125	**133**
Grand Total	129	862	7327	**8318**

Table 8.1: Annual catches of sardine in the northern areas by ICES Sub-Division. Note that these figures are likely to be underestimates as not all nations catching sardine in these areas report their catch.

DIVISION	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
VIId	211	147	465	512	67	29	93	64	170	153
VIIe,f	590	661	1624	2058	682	438	91	808	4687	19635
VIIg	-	1	-							
VIIh	2	-			216	2119	957	235	110	4
Total VII	*803*	*809*	*2089*	*2570*	*965*	*2586*	*1141*	*1107*	*4967*	*19792*
VIIIa	6013	4472	8090	10186	7631	7770	8885	8381	9113	8565
VIIIb	454	19	79	77	77	38	85	104	482	141
Total VIIIab	*6467*	*4491*	*8169*	*10263*	*7708*	*7808*	*8970*	*8485*	*9595*	*8706*
Total northern	**7270**	**5300**	**10258**	**12833**	**8673**	**10394**	**10111**	**9592**	**14562**	**28498**

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

DIVISION	1993	1994	1995	1996	1997	1998	1999	2000	2001
IVc								5	
VIa									714
Total IV and VI								*5*	*714*
VIIa,b									225
VIId	127	2086	1621	179	71	103	247	209	73
VIIe,f	5304	20985	13787	8278	2584	4223	3415	2916	6531
VIIg									353
VIIh*	71	-	1439	1350	1058	101	11	173	289
Total VII	*5502*	*23071*	*16847*	*9807*	*3713*	*4427*	*3711*	*3298*	*7471*
VIIIa	4703	7164		8180	11361	10674		38	133
VIIIb	548	119		526	160	7749			
Total VIIIab	*5251*	*7283*		*8706*	*11521*	*18423*	*17730*	*38*	*133*
Total northern	**10753**	**30354**	**16847**	**18513**	**15234**	**22850**	**21441**	**3341**	**8318**

* includes VIIj in 2001

9 SARDINE IN VIIIC AND IXA

9.1 ACFM Advice Applicable to 2002

Based on new data provided by ICES CM 2002/ACFM:06, ACFM considered that the perception of the state of the stock depends on the relative contributions from the northern and the southern areas. The biomass of this stock has remained at a low level and fishing mortality has decreased since 1998. National management measures, closed periods and limitation of fishing days and catches, continued to be enforced in both Portugal and Spain. Acoustic surveys indicate a strong 2000 year class with a restricted distribution and the size is still uncertain. Since the actual stock biomass is close to the lowest historical level and both its distribution among different areas and the relationships between the areas are poorly known, ACFM recommended that "fishing mortality be reduced below F=0.25 in 2002, corresponding to a catch of less than 95 000 t in order to prevent short-term decline in stock size".

9.2 The fishery in 2001

Management measures implemented in each country since 1997 continued to be enforced in 2001. In Spain, from 1th February to 31st March there was a ban for the purse seine fishery and sardine catches were not allowed. Also, a maximum allowable catch of 7,000 Kg per fishing day of >15cm sardines, and a maximum allowable catch of between 11 and 15 cm sardines was set, as well as a per week limitation in the number of fishing days (4 in Galicia, 5 in the rest of Spain). In Portugal, a closure of the purse-seine fishery took place in the northern part (north of the 39º42" north) of the Portuguese coast from the 10th of February to 8th of April and the yearly quota for the Producers Organization was limited to 68.5 thousand tons.

As estimated by the Working Group, catches in divisions VIIIc and IXa were 101,957 t (30,262 t from Spain and 71,695 t from Portugal) representing an increase of 19% relative to 2000, mainly due to the 50% rise in the Spanish catches. The bulk of the landings (99%) were made by purse seiners. Table 9.2.1 summarises the quarterly landings and their relative distribution by ICES Subdivision. Landings increased considerably in the North and Northwest Iberian Peninsula (almost tripled in area IXaN and increased 40% in area IXaCN), and showed a sharp decrease in area IXaS-Algarve (30%), being approximately stable in the remaining areas. Most of the landings (36%) occurred in the third quarter and were lowest on the first quarter due to fishery bans that take place in both countries. As in previous years, sardine is mainly landed in the west Portuguese coast (57% in sub-areas IXaCN and IXaCS).

The series of annual catches from both Spain and Portugal are available from 1940 (Figure 9.2.1 and Table 9.2.2). Landings in 2001 inverted the declining trend observed since 1993 mainly in the northern areas of the stock (from IXa-CN to VIIIc).

9.3 Fishery independent information

9.3.1 Egg surveys

During 2002, both Portugal and Spain carried out a DEPM survey, on 7th January - 8th February and 18th March -16th April respectively. The Portuguese survey covered the area from Cadiz to the Galician border, while the Spanish survey covered from the Galician border to the inner part of the Bay of Biscay, with some stations covering the French waters up to 45 º North. Two egg sampling gears were used in both surveys, a CUFES sampler and CalVET nets. CUFES was used in both surveys to identify the limits of the spawning area and to adaptatively allocate more sampling effort in areas of high egg density, while CalVET was used as the main sampling gear to estimate daily egg production rates. Sampling grid consisted of 6nmi separated transects in the Spanish survey and 8 nmi separated transects in Portugal. CUFES samples were obtained each 3 nmi along the transects, while CalVET samples were obtained either each 3nmi on areas of high egg densities, or each 6 nmi on areas of low egg densities, both in the Portuguese and Spanish survey.

A total number of 639 and 575 CUFES samples were obtained in the Spanish and Portuguese survey respectively, together with 296 and 484 CalVET stations sampled in the Spanish and Portuguese surveys respectively. The position of the sampling stations, together with the sampled abundance of eggs in both the Spanish and Portuguese surveys are shown in Figure 9.3.1.1 and 9.3.1.2. Egg production estimates for the time series of DEPM surveys updated up to 2002 both in Portugal and Spain are shown in Table 9.3.1.1. Egg production estimate in 2002 is lower in Spain than in Portugal, following the same pattern as from 1997 onwards. In Spain there is a clear temporal trend in egg production estimates, with high values in the 1988 and 1990 surveys and lower and approximately constant values in 1997, 1999 and 2002. In Portugal, the egg production estimates does not show any consistent temporal trend, although the 2002 estimate seems to be lower than any of the other later 90´s surveys (1997 and 1999).

Modifications on egg production estimation methods has been proposed in previous workshops (WKSBS; ICES 2000a) and study groups (SGSBSA; ICES 2002), and this results in the time series estimates being obtained using different methods. An update of the time series using a common methodology is expected to be carried after the SGSBSA meeting in 2003, but for comparative purposes different estimates for the Spanish egg production time series are shown in Table 9.3.1.2. Conclusions from this table are that point estimates of egg production seems to be robust to the different methods used, while variance estimates are affected by the estimation method used.

SSB estimates from the 2002 DEPM surveys are not yet available due to the laboratory preparation of adult samples, as has been the case in previous years, and as it was expected by the SGSBSA. Final estimates of SSB from the DEPM surveys are expected to be reported in the 2003 SGSBSA meeting.

9.3.2 Acoustic surveys

Acoustic activities undertaken in this area are co-ordinated within the framework of the Planning Group for Pelagic Acoustic Surveys in ICES Divisions IX and VIII (ICES CM 1999/G:13). Spring surveys were undertaken within the framework of the EU DG XIV project 99/010 PELASSES. Within this project, the French survey was carried out using the same methodology. This consists of the use of two acoustic frequencies (38 and 120 kHz) and a continuous sampling of pelagic eggs at 3-5 m depth using CUFES among other common systems.

Portuguese Acoustic Surveys

The Portuguese surveys covered the Portuguese coast and the Gulf of Cadiz in November 2001 and March 2002. The main results from these surveys are presented in Marques and Morais (WD 2002). For the first time in the Portuguese surveys, Movies+ software (IFREMER) was used to assist in the acoustic energy extraction in problematic situations.

Two situations may occur:

- Echo sounder draws the bottom line inside dense schools lying near the bottom. The abundance is underestimated.

- Echo sounder bottom pulse fails, on soft sediment bottom. The bottom is integrated as fish and there is an abundance overestimation.

Sardine abundance was estimated using both the usual method and the bottom correction with Movies+ and a comparison of the results for each area in the two surveys is shown in Table 9.3.2.1. Overall differences were small, being 3% when the total area is considered. Major discrepancies are observed in the Algarve area in November 2001 and in Cadiz in March 2002, where sardine is observed more frequently in dense schools close to the bottom. The WG agreed that this problem affects all surveys and the methodologies for bottom correction should be discussed within the FAST WG and decided to use this year the estimates which were not corrected with Movies.

Sardine was observed on an almost continuous distribution along the Occidental North area on both surveys (Figure 9.3.2.1 and 9.3.2.2). Unlike in previous surveys, significant amounts of sardine were found outside the 50 meters depth contour. Estimates of abundance and biomass by age and area are shown on Tables 9.3.2.2 and 9.3.2.3. Sardine abundance decreased in the north Portuguese coast from November 2000 to November 2001, remaining stable from this date up to March 2002 (Figure 9.3.2.3). There are no signs of an above average recruitment in this area. On the Occidental South area there is a slight recovery in sardine abundance in the March 2002 survey. The southern Portuguese area shows an increase of sardine abundance since the March 2001 survey. There were large amounts of sardine juveniles, near Lisbon while Cadiz also showed an abundance in juveniles in November 2001 (Tables 9.3.2.2 and 9.3.2.3). The abundance of juveniles suggests that the 2001 recruitment may be above the average, however it is not distributed in the north coast, one of the traditional recruitment areas. The strong 2000 year class is still dominant in the Northern area and also detected in the Occidental south coast suggesting a slight spread to the south.

Spanish April 2002 Acoustic Survey

In April 2002 the Spanish acoustic survey, carried out on board R/V 'Thalassa', covered i) an area in north Portugal; ii) the Spanish area; and iii) a small area in south France. Together with the acoustic and CUFES sampling, extensive studies on plankton and primary production were undertaken along the surveyed area. Data from the 2002 survey was used for the 2002 assessment, but no working document with main results from the acoustic survey was presented to the WG.

Table 9.3.2.4 and Figure 9.3.2.4 show the sardine acoustic estimate. The abundance estimated in 2002 in the Spanish area is about 34% larger than in 2001. Age 1 group is no longer the most abundance age class group, as opposite to the situation in 2001. In area IXa-N, age group 2 is the most abundance group, which probably comes from the large recruitment class in the Northern Portuguese area in 2000.

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 the length/weight relationship was calculated for each quarter. In Portugal both ALK and L/W relationship were compiled on a quarterly and Sub-Division basis. This year, an ALK and L/W relationship from the Cádiz area were computed from Cádiz data by the first time.

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) is the highest in the area, as it has been observed in last year WG. As in previous years, the smallest fish were caught in IXa-CN.

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 Sub-Division is shown as well as their relative contribution to the catches.

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.

9.4.3 Maturity at age

The maturity ogive for 2001 was based on biological samples collected during the spawning period. In the Portuguese area samples were taken during the acoustic survey undertaken in November 1999. Age groups were shifted one year. In the Spanish area, samples were also collected during the acoustic survey performed in 2001. Samples for each country were weighted 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	39.1	90.2	96.2	98.9	100	100

Maturity of the age group 1 is larger than in 2000, which was considered to be very low, but remains still low in the time series. A revision of the time series of the maturity ogive and the possible effects of changes in methodology may have in its estimation is on progress.

9.4.4 Natural mortality

Natural mortality was estimated at 0.33 by Pestana (1989), and is considered constant for all ages and years.

9.5 Effort and catch per unit effort

Data on fishing effort and CPUE have been regularly provided in this section both for the Portuguese purse-seine fleet and Spanish purse-seine fleets from Sada and Vigo-Ribeira. Concerns about the effort measurements have been expressed in previous WG, and it has prevented this data to be used in the assessment. No new information on fishing effort review has been presented, and thus the situation remains the same.

9.6 Recruitment forecasting and Environmental effects

Different WD has been presented in previous WG treating the relationship between sardine recruitment and environmental effects (Borges *et al*., 1997; Santos *et al*., 1997, Cabanas and Porteiro, 1999 in press, Borges *et al*., 2000, Porteiro *et al*., WD 2001, Carrera *et al* 2001). Main conclusion from these works is that year class strength of the Iberian sardine is affected by hydroclimatic conditions in the North Atlantic. The recruitment process in sardine is the outcome of a large time/spatial integral that accounts for different oceanographic regimes along the Atlantic waters of the Iberian peninsula, and thus the year class strength relationships with environmental effects will possibly have to be analysed at a finer spatial scale than the whole stock area to obtain adequate results.

No new WD were presented to this year WG, but some feedback from an forthcoming EU project SARDYN is expected in next WG´s.

9.7 State of the stock

9.7.1 Data exploration

Last year, there were no attempts to change the sardine assessment model established in the 2000 WG (ICES CM 2000/ACFM:5, ICES CM 2001/ACFM:6), as it was considered that the model was extensively checked for sensitivity in its parameters and assumptions. Nevertheless, although the WG considered that previous exploratory analysis improved the fit of the model, uncertainties about the accuracy of estimates and therefore of absolute stock levels still remain. Concerns about the effect that recent changes in sardine distribution, abundance and population structure (Stratoudakis *et al*, WD2001, Porteiro *et al*, WD2001) may have on the model were raised and the WG considered that the dynamics of the stock could not be properly modeled if geographic/temporal differences are not taken into account. An attempt to combine the Spanish and Portuguese March acoustic survey was explored as a way to reduce the noise introduced by the different signals given by the Spanish and Portuguese data. That approach was not pursued because 6 years of Spanish acoustic survey would have had to have been discarded.

This year a WD (Silva et al. WD2002) describing the exploration of area based sardine assessment using a recent model/software (AMCI, Skagen 2002) was presented. The main purpose of this exploration was to see to which extent assessing the stock on an area basis can account for the local nature of some of the data. However, there is sparse catch-independent information about the area distribution of the stock and attempts so far to estimate the area distribution as part of the assessment lead to over-parametrisation. In order to do the assessment of sardine on an area basis with the present AMCI software, there is a need for independent information on the area distribution of the stock, and the results will be conditional on this information. This WD also explored several options in single-area AMCI runs and their comparison with the assessment software currently used (ICA). The two models provided different perspectives of the stock and possible explanations were highlighted, as the treatment of the plus group, the weighting of the DEPM survey and assumptions on the selection pattern.

Based on the results from Silva et al (WD2002), the WG decided to use AMCI to explore further the data on Iberian sardine, to evaluate some assumptions underlying the current sardine assessment and to compare the results of this exploratory analysis with ICA standard runs. A total of 6 runs of AMCI and 3 runs of ICA were designed to test several assumptions regarding the selectivity pattern and to explore further the differences between the two models regarding the weighting of the DEPM survey and of the plus group. The different runs and their assumptions are described in Table 9.7.1.1 below.

Table 9.7.1.1 Different runs with both the AMCI and the ICA software and their main assumptions.

	AMCI Runs	ICA runs	Run names
Standard Run	• No fixed selectivity periods • Gradual changes in selectivity pattern for ages and years • Default AMCI weights for DEPM and other sources • No spatial component	• Default ICA run as described in the 2000 WG (ICES CM 2000/ACFM:5, ICES CM 2001/ACFM:6)	• **Run 0**
Treatment of 6+ group	• Downweight of 6+ group and flat selectivity pattern from age 3 onwards • Flat selection from age 3 onwards	---	• **6+Down** • **Flat**
Selectivity pattern	• 2 periods of Fixed selectivity (as in ICA) + flat selection from age 3 onwards	---	• **Fixed**
DEPM relative weight	• DEPM weight =0.1 • DEPM weight = 10	• DEPM weight =0.1 • DEPM weight = 10	• **DEPM01** • **DEPM10**

Figure 9.7.1.1 shows the estimated recruitment, SSB and F2-5 for all AMCI runs tried in the exploratory analysis. Most AMCI runs show very similar output of SSB, Recruitment and F2-5, except for the AMCI 6+Down run. Assumptions in this run are not natural for this software, as generally AMCI does allow the selectivity to change across ages and also treats the 6+ group as a dynamic group that affects the estimation of the abundance in the rest of the groups. As in this run the model downweight the residuals of 6+ group, it is allowed to fit any kind of selectivity pattern to this group. This led to convergence problems and produced results which were out of range, so the selectivity pattern was forced to be fixed from age 3 onwards. The result of this run show a different pattern of both mortality and SSB than the rest of the runs, with fishing mortality being regarded as very high up to the early 90´s and SSB estimates being lower than in any other run for the same period.

Figure 9.7.1.2 shows the estimated selectivity pattern from AMCI-Run0. The figure show a relatively constant selectivity pattern up to the early 90´s, and a gradual change in selectivity afterwards. Selectivity after the 90´s increases in ages 4 and 5, and decreases in the 6+ group. This pattern gets very steep in recent years with a sharp peak of selectivity in age 5 and a sharp decrease in the 6+ group. That sharp selectivity pattern does not seem to be biologically plausible and rather seem to be related to insufficient data to provide reliable estimates of mortality in recent years. A natural assumption in this case is to force the selection pattern to be flat after a certain age.

Figure 9.7.1.3 shows a comparative of the selection patterns from the initial AMCI run (AMCI-Run0) with both the one in which the selectivity pattern has been forced flat from age 3 onwards (AMCI-Flat) and the one in which two separable periods and flat selectivity from age 3 onwards was forced (AMCI-fixed). The steep increase in selectivity of age 5 and the decrease in selectivity of group 6+ (already shown in Figure 9.7.1.2 using a different perspective) is evident in Figure 9.7.1.3a. Collapsing the age groups 3 onwards produced a smoother selectivity pattern of group 3+, but forces ages 0, 1 and 2 to show some increase in selectivity from 1996 onwards (Figure 9.7.1.3b). Figure 9.7.1.3c shows the selection pattern for the model with the 3+ group aggregated but with the assumption of two separable periods of fixed selection across years. The cutting years for those periods are the ones used in the ICA-Run0. The selection pattern for the 3+ group estimated by the AMCI-Fixed run is very similar to the one produced in the AMCI-Flat run, but selection patterns in ages 0, 1 and 2 does not show the upwards trend from 1996 that was apparent in the AMCI-Flat run. The average mortality for those ages will be thus higher in AMCI-Flat than in AMCI-Fixed. Figure 9.7.1.3c also shows that when the periods are fixed, the variability of the mortality values in the years previous to the fixed periods is large, and difficult to explain on biological or fishery grounds.

DEPM relative weight in the estimation procedure (AMCI-DEPM01, and AMCI-DEPM10 runs) does not affect very much the absolute values of SSB, Recruitment or F2-5 time series (Figure 9.7.1.1). This suggest that the AMCI model seems to estimate levels of biomass which are to some extent consistent with the DEPM based SSB estimates. However, using it as a relative index was shown to have a large influence on results (Silva et al. WD 2002), highlighting the need of further exploration.

Figure 9.7.1.4 shows the estimated recruitment , SSB and F2-5 for all ICA runs tried in the exploratory analysis. ICA output on both SSB and F2-5 is very sensitive to the choices of the DEPM weight. As DEPM based SSB estimates are below the ICA estimates, upweighting the DEPM time series produces a reduction in SSB and an increase in mortality.

The DEPM upweighting also produced a decrease in the recruitment series, specially on the last recruitment peak in 2000, which is reduced around 21 %. Reducing the DEPM weight in ICA (ICA-DEPM01) produces the opposite effect, although the changes are smaller, specially in the 2000 recruitment peak. This effect suggest that, opposite to AMCI, the ICA is not able to fit the DEPM based SSB estimates, unless the model is forced to do so.

Figure 9.7.1.5 shows the ICA-Run0 selection pattern. Due to the model assumptions, selection on ages 3, 5 and 6 overlap on the fixed periods, while age 4 shows a slightly larger value in the last period than in the 1987 to 1995 period. The pattern of the ages 3 onwards is then very similar to the 3+ selection pattern in the AMCI-fixed run (Figure 9.7.1.3c). The pattern of decreasing relative mortality in the recent period in ages 0, 1 and 2 is also similar to the pattern estimated by the AMCI-Fixed run, although the mortality level of age 1, and specially age 2, is higher in the later period of the ICA-Run0 than in the AMCI-Fixed run for the same period (about 0.4 in AMCI-Fixed run age 1 and 0.6 for the same age in the same period in ICA-Run0). The variability of fishing mortality before the start of the first separable period (1987) is even larger in the ICA-Run0 than in the AMCI-Fixed run, with the starting F values given to the VPA for age 2 seeming to be in-adequate.

Figure 9.7.1.6 shows the comparative estimates of SSB, recruits and F2-5 between selected runs of ICA and AMCI. AMCI-Flat is regarded as the AMCI model that more appropriately fit the data, as it overcomes the problem of a too steep selection pattern in recent years. The ICA base run (ICA-Run0) is regarded as the more appropriate ICA model to fit the data in accordance to previous WG exploratory analysis and in lack of new evidence to challenge this model. AMCI-6+Down and ICA-DEPM10 are shown because they are the ones that make the shape of both the ICA and the AMCI models more similar to each other. AMCI models show a lower SSB level than the ICA models. Also, the AMCI-Flat run shows a general decreasing trend along the time series, with the later SSB peak around the mid 90´s being lower than the early peak in SSB around mid 80´s. A similar trend to the ICA-Run0 model can only be attained in AMCI if the 6+ group is downweighted (and the selection pattern on age 3 onwards is made flat), but then the biomass levels are very different and also the F values you obtain are out of range. For ICA models, the only way to obtain a similar trend to the AMCI-Flat run is to upweight the DEPM survey on the fitting procedures (ICA-DEPM10). In lack of external evidence, both options, downweighting the 6+ group in AMCI or upweighting the DEPM survey in ICA are regarded as not natural for those models, and not proved supported by biological or fishery information.

9.7.2 Stock assessment

Results from the exploratory analysis indicate substantial differences in the output between the AMCI models and the ICA runs, and the reason for this difference is not fully understood. The WG could not decide which model structure was more appropriate to evaluate the Iberian sardine stock, for the reason described in section 9.7.3, and thus both an ICA and an AMCI based assessment are presented for this stock.

The same input data was used in the ICA and AMCI assessment models and is presented in Table 9.7.2.1a.

ICA Assessment

The ICA model selected from the exploratory analysis was comparable to the model accepted in 2001. Model options comprise:

- two separable periods, 1987-1993, 1994-2001 with an abrupt change in selection
- selection constrained to one on age groups 3 and five
- catchability relative for acoustic surveys and absolute for the DEPM surveys
- catchability constant with time
- 0-group catches with weigth=0.1 relative to older ages

Results of the model are presented in Table 9.7.2.1b and Figure 9.7.2.1. Both the stock perspective and the model fit are comparable to those of last year assessment. Catch residuals are generally low (below 0.5) except for the 0-group, however this age group is downweighted and will have little influence in the model fit. Survey residuals show some large values, sometimes associated with specific yearclasses (as the negative band in the 1983 and the positive band in the 1998 yearclass in the Spanish survey or the negative residuals in most non-recruit ages in 2000 in the Portuguese surveys). SSB estimates from the DEPM survey are always below the values estimated by the model.

Figure 9.7.2.2 shows the estimated recruitment, F2–5 and SSB for the whole time series showing a general similarity in the trajectories provided by the models fitted this year and in the assessment made in 2001. The historical perspective of the SSB suggests similar stock levels in the mid-eighties and the mid-nineties and a decreasing trend in the fishing mortality along the period (however, landings declined continuously since 1985 with a reverse trend in 2001). Strong year classes are observed in 1983 and 1991/1992 with decreasing strength in that order and alternate with periods of poor recruitment. The 2000 recruitment is estimated as the largest recruitment of the series (1.4 times higher than the 1983 recruitment). The model also indicates that recruitment in 2001 will be comparable to that in 1991, the second highest of the series, however with a large associated CV (40%). According to this model, the SSB increased 62% in the last year, due to the contribution of the 2000 recruitment (which makes half of the population numbers and 34% of the SSB in 2001).

AMCI Assessment

Initial parameter estimates required by AMCI were those of the final ICA assessment model from 2001. The AMCI model selected from the exploratory analysis has the following options:

- smooth selection model for the whole period (changes in selection are gradual and continuous with time)
- flat selection from age 3 to age 6+ estimated by the model
- catchability relative for acoustic surveys and absolute for the DEPM survey
- smooth catchability pattern for surveys (gradual and continuous changes with time)
- 0-group catches with weight=0.1 relative to the older ages

Table 9.7.2.2 presents the parameter values and CV's estimated by the model. All catchability values show low precision and both the recruitment and the mortality in the last year of the assessment have larger CV's than estimates for previous years. The CV's for the initial F-selection is not properly estimated by the current algorithm. The pattern of residuals in catch-at-age data for the period 1987-2001 (age groups 0-5) is comparable to that estimated from ICA, however AMCI generates slightly lower levels of residuals in the period 1987-1993 than in the period 1994-2001 (the two selection periods defined on ICA) while the opposite is observed with ICA (Figure 9.7.2.3). Both the level and the pattern of acoustic survey residuals are similar in the two models (Figure 9.7.2.4). The AMCI model biomass is, however closer to the SSB estimated by the DEPM than the ICA model (Figure 9.7.2.2). Catchability-at-age for the Portuguese November and the Spanish March acoustic surveys is presented in Figure 9.7.2.5. The opposite trends in catchability with age observed in the two surveys possibly highlight differences in the age structure of the population in the areas covered by each of the survey. There is an indication of a catchability change with time in the Portuguese November survey.

Table 9.7.2.3 is the summary table for the assessment. This assessment model provides a different perspective of the stock in the most recent years when compared to the ICA assessment, indicating a biomass level ranging from 50-75% of that estimated by ICA and a higher level and increasing fishing mortality (Figure 9.7.2.2). The SSB trends are comparable in the two assessments, indicating two periods of higher biomass levels, mid-eighties and mid-nineties, however the second peak is estimated by AMCI as 30% lower than the first. Lower recruitments are estimated throughout the whole period and the strong 2000 recruitment is confirmed although with a lower level than the 1983 yearclass.

Overall, the two assessment models indicate that the sardine stock is recovering from a low level of abundance due to the contribution of the strong 2000 yearclass. The historical trends are however quite different with ICA providing a more optimistic perspective of the last 10 years. A large divergence between the two assessments is also found on the level of the 2000 yearclass, which is estimated as strong by both models but considered extraordinary by ICA. Differences in the goodness of fit of each model are apparently negligible based on the qualitative analysis of residuals carried out by the WG, although AMCI fits closer to the SSB estimates from the DEPM.

9.7.3 Reliability of the assessment

Differences on the stock assessment using an AMCI model and the 2001 ICA model were large, especially in the perception of the stock on the 90´s . The WG was unable to decide which of these models was appropriate to assess the sardine stock, due to the following reasons:

- The adequacy of some differences in the estimation approach/assumptions of the ICA and AMCI model were impossible to test in biological/fishery grounds. This mainly refers to:

    - How the selectivity pattern is estimated/assumed in both models and the fact that no conclusive independent data on possible changes in selectivity patterns across years, areas and/or age classes was available to the working group.

    - How the plus group age class is treated in each model and the lack of independent data on how important the 6+ group is in the stock.

- It was difficult to asses which of the models were assigning more appropriate relative weights to the sources of information used in the assessment

- Limited experience in the comparison between the ICA and AMCI software.

- Difficulties in comparing the goodness of fit of the ICA and AMCI models.

In order to overcome this problems, the Working Group recommends that further investigation on the differences between AMCI and ICA are carried out, specially for this stock, and that the results of those investigations are presented to next WG meeting in 2003. Also, a revision of the independent sources of information used to fit the assessment models will be desirable.

A revision of the DEPM based SSB estimates is due by the SGSBSA in 2003, in which a new DEPM based estimate of SSB for 2002 will be also presented. To complete the revision of the independent sources of information, the WG recommends that a revision of the acoustic based SSB estimate time series is also carried out, and if possible, presented to the 2003 WG. This revision should deal with changes in methodology in acoustic surveys, and its possible effects in the survey catchability. Taking into account this expected new information/knowledge that will be available to the next meeting in 2003, the WG anticipate that most of the difficulties in deciding which model is more appropriate for describing the Iberian sardine stock can be overcome, and a decision on which model to adopt to carry out the assessment may be taken.

Also, the WG expect feedback from a dedicated EU project SARDYN, in which questions regarding sardine distribution, migration and biology will be studied. The ultimate output of that project (expected to be finished in 2005) is to determine the limits of the sardine stock in the EU waters, and to produce a better assessment model for the stock, which will be made available to the WG.

The actual situation in which the WG was unable to decide which of the available models is appropriate to describe Iberian sardine stock is seen by the WG as a transition position. On one hand, problems highlighted by previous WG, related to the application of the ICA model in this stock, together with the ones found in this year exploratory analysis made the WG suspicious of how well the ICA model explains the actual situation of the stock. A new promising tool was made available to the group and it made possible a more extensive analysis of the data from the fishery and from its external sources of information. Nevertheless, both the lack of experience on using this new tool and the lack of specific data to validate some of the assumptions of the new method prevent the group from accepting the assessment carried out with it. The WG expects that new available data together with further training in the new method will make possible for the WG to make a decision about which model is appropriate to describe the Iberian sardine stock.

9.8 Catch predictions

Catch predictions were carried out using results from both assessment models (ICA and AMCI) with similar input data except stock numbers at age and selection pattern and the same assumptions regarding fishing mortality and recruitment. The WG agreed that value of the 2000 recruitment estimated by ICA is not consistent with the strength and geographic spread observed for that cohort as seen in both surveys and catches in 2001 and 2002. In the forecasts, this estimate was replaced by the geometric mean of the recruitments laying above the average recruitment (geometric) for the whole time series (1978-2001) (this will be called the above average recruitment). A similar procedure was done with AMCI predictions. The new 2001 populations were projected one year ahead assuming the fishing mortality estimated by the each assessment model. Since little confidence can be attached to the 2001 recruitment estimated by the assessment models, this value was replaced by the geometric mean of the whole series (average recruitment). This option takes into account the indications provided by the catches and by the most recent acoustic surveys for the recruitment in 2001. Recruitments assumed for 2002-2003 are below average values, corresponding to the geometric mean of the recruitments laying below the average recruitment for the whole time series.

Weights at age in the stock and in the catch were calculated as the arithmetic mean value of the three last years (1999-2001). The maturity ogive and the exploitation pattern corresponded to the 2001 values. As in the assessment, input value for natural mortality was 0.33 and input values for the proportion of F and M before spawning were 0.25.

Input values and results for each assessment are shown in Tables 9.8.1.1 and 9.8.1.2. At F_{sq} , equal to $F_{(2-5)}$ = 0.19 in the case of ICA and to $F_{(2-5)}$ = 0.38 in the case of AMCI , both models predict 2002 yield close to that observed in 2001 (98426 Kt and 107493 Kt in ICA and AMCI respectively). However, using the AMCI model, the biomass is expected to grow 5% in 2003 compared to a 10% increase as predicted when using ICA results. Catches in 2003 are expected to have a small increase in 2003, according to both models, however, biomass will decline in the following year if fishing mortality remains stable and below average recruitments occur.

Taking into account the uncertainty in the assessment and the results of these analyses, the WG decided to adopt the lowest possible risk in order to prevent decline in SSB in short term. A reduction of 10% of current fishing mortality will provide, according to both models the short term stability of SSB (up to 2004) while maintaining the catch level similar to that observed in 2001.

9.9 Uncertainty of assessment

There are several sources of uncertainty in this year assessment. Most obvious source of uncertainty is the structural uncertainty caused by the impossibility to choose between two alternative models to assess the Iberian sardine. This situation is new because it is the first time the group tries a different model to ICA. Nevertheless, the worries about whether ICA was an appropriate model to describe the Iberian sardine fishery are not new. Also, although exploratory analysis of the robustness of the ICA model were carried out in previous WG, proper model uncertainty analysis has never been carried out for this stock. This is due to the difficulties of introducing the different uncertainty in all assumptions and data used through all the modelling processing in the model uncertainty analysis. This year, tentative uncertainty analysis of both ICA and AMCI models were carried out, but because a proper uncertainty analysis including structural uncertainty in the assessment was impossible to carry out, an analysis of the uncertainty of the assessment is not presented. Nevertheless, the WG recommends that an extra effort to carry out an uncertainty analysis in next years is carried out.

9.10 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.

The absolute size of this stock still remains uncertain. In addition to this, this year WG was unable to find the appropriate model to describe the stock. This situation is regarded as transitory by the WG, and it is expected that the perception of the stock can be improved in next years. Therefore the Working Group concluded that no reference points for management purposes should be suggested.

9.11 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 it 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 the 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.

9.12 Management considerations

At present the Spawning Stock Biomass of this stock is considered to be low, but there are indications that the SSB has increased in the last year. Both tentative assessment indicate a SSB in 2001 lower than that observed in 1990. Fishing mortality increased from 1995 to 1998 where it reached the highest value since 1980. Nevertheless, fishing mortality shows a decrease in the last two years. Management measures undertaken by Spain and Portugal to reduce the fishing effort and the overall catches may have contributed to this decrease.

The 2000 yearclass has been confirmed as a good year class, although its strength still remains unknown. ICA assessment model still identify the 2000 recruitment as by far the largest recruitment in the Iberian sardine stock time series, while AMCI assessment model identify the 2000 recruitment as a good recruitment, but an average one of the good recruitment years seen in the time series. Independent sources as the 2001 and 2002 acoustic surveys have identified the 2000 year class as a good year class, but gave the perception of a smaller year-class than other year-class in the time series (like the one in 1988), and with less spread than in previous good year-classes (the 2001 and 2002 acoustic surveys only identify the effects of the 2000 year class in northern Portugal and Galicia areas). Also the 2002 egg production estimates are on the order of magnitude of the later years, and in Spain still well below the levels of the 1988 and 1990 estimates, suggesting that the DEPM-based estimate SSB will be of the order of that of 1999, which was low in the short DEPM series available. Both the uncertainties as to the state of the stock, and the perception that the stock is still in a lower level in relation to the time series recommends that close monitoring of this stock is still needed, even if the 2002 assessments shows an increasing trend.

9.13 Stock identification, composition, distribution and migration in relation to climatic effects

No new information on stock identification, composition, distribution or migration was presented in this WG. Nevertheless, there is an important amount of ongoing work in relation to this issues which are expected to report to the WG in soon. Also the WG expects to get an important feedback from the EU project SARDYN, which main objectives include sardine stock identification, dynamics and the development of sardine specific assessment models.

Table 9.2.1: Quaterly distribution of sardine landings (t) in 2001 by ICES Sub-Division. Above absolute values; below, relative numbers

Sub-Div	1st	2nd	3rd	4th	Total
VIIIc-E	1687	2247	1274	3890	**9098**
VIIIc-W	112	2054	3610	1924	**7700**
IXa-N	32	2294	4599	1473	**8398**
IXa-CN	938	6849	14396	10543	**32726**
IXa-CS	4656	6435	7070	7458	**25619**
IXa-S (A)	1831	5108	4384	2027	**13350**
IXa-S (C)	1245	848	1467	1506	**5066**
Total	**10501**	**25835**	**36800**	**28821**	**101957**

Sub-Div	1st	2nd	3rd	4th	Total
VIIIc-E	1.65	2.20	1.25	3.82	**8.92**
VIIIc-W	0.11	2.01	3.54	1.89	**7.55**
IXa-N	0.03	2.25	4.51	1.44	**8.24**
IXa-CN	0.92	6.72	14.12	10.34	**32.10**
IXa-CS	4.57	6.31	6.93	7.32	**25.13**
IXa-S (A)	1.80	5.01	4.30	1.99	**13.09**
IXa-S (C)	1.22	0.83	1.44	1.48	**4.97**
Total	**10.30**	**25.34**	**36.09**	**28.27**	

Table 9.2.2: Iberian Sardine Landings (tonnes) by sub-area and total for the period 1940-2001.

Year	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)
	Sub-area										
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**
2000	11697	2866	23311	23701	19129	5081	**85786**	**74089**	**66141**	**14563**	**19644**
2001	16798	8398	32726	25619	13350	5066	**101957**	**85159**	**71695**	**25196**	**30262**

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

Table 9.3.1.1 Egg production estimates both in Spain and in Portugal from 1988 onwards. † Estimate does not include Cádiz area. †† Estimated using GLM to fit the mortality curve. * Estimated using transects as the sampling unit and GLM to fit the mortality curve (Standard method since SGSBSA 2001).

Year	Portugal Egg production [cv]	Spain Egg production [cv]
1988	**2.87 x 10^{12} [22] †**	**3.58 x 10^{12} [--]**
1990	**------**	**1.78 x 10^{12} [28]**
1997	**4.40 x 10^{12} [49]**	**6.99 x 10^{11} [40] † †**
1999	**5.24 x 10^{12} [30]**	**4.53 x 10^{11} [27] ***
2002	**2.07 x 10^{12} [33]**	**5.19 x 10^{11} [33] ***

Table 9.3.1.2 Differences between egg production estimates in Spain due to the different methods used. CV in 1988 using the traditional method is only approximate.

Year	Traditional [cv]	Transects [cv]	GAM + newageing [cv]
1988	**3.58 x 10^{12} [~30]**	**--**	**2.78 x 10^{12} [17]**
1990	**1.78 x 10^{12} [28]**	**--**	**3.13 x 10^{12} [54]**
1997	**6.99 x 10^{11} [40]**	**--**	**5.66 x 10^{11} [25]**
1999	**3.42 x 10^{11} [21]**	**4.53 x 10^{11} [27]**	**--**
2002	**--**	**5.19 x 10^{11} [33]**	**--**

Table 9.3.2.1 Estimates of sardine abundance and relative error, in the Portuguese November 2001 and March 2002 surveys, using the usual method and the bottom correction with Movies+.

Number (10^6)	**OCN**	**OCS**	**Algarve**	**Cadiz**	**Portugal**	**Total**
November 2001 (without bottom correction)	7918	6391	1548	9400	15857	25256
November 2001 (with bottom correction)	7918	6542	1751	9765	16210	25976
Error (%)	0	2	11	4	2	3
MARCH 2002 (without bottom correction)	7931	3587	2897	5714	14415	20129
MARCH 2002 (with bottom correction)	7963	3631	2871	6263	14466	20728
Error(%)	0.4	1	-0.9	8.7	0.3	3

Table 9.3.2.2: Sardine Assessment from the 2001 Portuguese November acoustic survey. Number of fish in thousands and biomass in tons.

AREA		0	1	2	3	4	5	6	7+	Total
Oc. Norte	**Biomass**	63678	189689	19616	5826	1067	1067	0	0	**280943**
	%	22.67	67.52	6.98	2.07	0.38	0.38	0.00		
	Mean Weight	22.2	41.4	57.1	64.9	61.3	61.3	0	0	
	No fish	2865167	4584247	343629	89794	17399	17399	0	0	**7917635**
	%	36.19	57.90	4.34	1.13	0.22	0.22	0.00		
	Mean Length	14.1	17.4	19.3	20.1	19.8	19.8	0	0	
Oc. Sul	**Biomass**	60144	27668	17334	26086	5507	5984	2130	621	**145474**
	%	41.34	19.02	11.92	17.93	3.79	4.11	1.46	0.43	
	Mean Weight	12.2	45.9	59.9	66	76.7	77.7	86.3	85.5	
	No fish	4923450	602408	289242	395294	71778	77040	24684	7260	**6391156**
	%	77.04	9.43	4.53	6.19	1.12	1.21	0.39	0.11	
	Mean Length	10.9	17.9	19.6	20.2	21.2	21.3	22	22	
Algarve	**Biomass**	27905	8629	3546	2228	1837	2064	1089	250	**47548**
	%	58.69	18.15	7.46	4.69	3.86	4.34	2.29	0.53	
	Mean Weight	23.9	41.5	57.3	61	67.8	68.4	76.5	79	
	No fish	1166648	208076	61911	36538	27083	30176	14232	3160	**1547824**
	%	75.37	13.44	4.00	2.36	1.75	1.95	0.92	0.20	
	Mean Length	14.8	17.7	19.6	20	20.7	20.7	21.5	21.7	
Cadiz	**Biomass**	128398	79459	26142	22063	16725	6349	1344	416	**280896**
	%	45.71	28.29	9.31	7.85	5.95	2.26	0.48	0.15	
	Mean Weight	20	44.7	53.1	60.8	66.9	73	76.1	92.7	
	No fish	6407455	1778257	491999	362730	250142	86985	17658	4489	**9399715**
	%	68.17	18.92	5.23	3.86	2.66	0.93	0.19	0.05	
	Mean Length	14.3	18	18.9	19.7	20.2	20.8	21	22.3	
Portugal	**Biomass**	151727	225986	40496	34140	8411	9115	3219	871	**473965**
	%	32.01	47.68	8.54	7.20	1.77	1.92	0.68	0.18	
	Mean Weight	17.8	42.1	57.9	65.5	72.6	74.7	82.8	87.6	
	No fish	8955265	5394731	694782	521626	116260	124615	38916	10420	**15856615**
	%	56.48	34.02	4.38	3.29	0.73	0.79	0.25	0.07	
	Mean Length	12.4	17.5	19.4	20.1	20.8	21.0	21.6	22.1	
Whole Area	**Biomass**	280125	305445	66638	56203	25136	15464	4563	1287	**754861**
	%	37.11	40.46	8.83	7.45	3.33	2.05	0.60	0.17	
	Mean Weight	18.8	42.8	56.0	63.6	68.8	74.0	80.9	89.2	
	No fish	15362720	7172988	1186781	884356	366402	211600	56574	14909	**25256330**
	%	60.83	28.40	4.70	3.50	1.45	0.84	0.22	0.06	
	Mean Length	13.2	17.6	19.2	20.0	20.4	20.9	21.4	22.2	

Table 9.3.2.3: Sardine Assessment from the 2001 Portuguese Spring acoustic survey. Numbers in thousands and biomass in tons.

AREA		1	2	3	4	5	6	7+	Total
Oc. Norte	Biomass	85469	140928	1572	2106	1117	1157	521	**232870**
	%	36.70	60.52	0.68	0.90	0.48	0.50		
	Mean Weight	21.5	36.4	53.1	54.8	69	70.5	71.2	
	No fish	3978480	3876760	29624	38436	16191	16406	7319	**7963216**
	%	49.96	48.68	0.37	0.48	0.20	0.21		
	Mean Length	14.6	17.6	19.9	20.1	21.8	21.9	22	
Oc. Sul	Biomass	57107	11878	2815	7790	6281	5117	5197	**96185**
	%	59.37	12.35	2.93	8.10	6.53	5.32	5.40	
	Mean Weight	19.4	42.9	54.8	63	69	70.2	77.8	
	No fish	2948752	277049	51358	123695	91020	72890	66759	**3631523**
	%	81.20	7.63	1.41	3.41	2.51	2.01	1.84	
	Mean Length	14	18.3	19.7	20.6	21.2	21.3	22	
Algarve	Biomass	45962	36687	9648	3457	4617	3250	1414	**105035**
	%	43.76	34.93	9.19	3.29	4.40	3.09	1.35	
	Mean Weight	30.2	39.6	47.4	56.9	56.7	60.7	59.9	
	No fish	1521316	926625	203682	60729	81425	53546	23598	**2870921**
	%	52.99	32.28	7.09	2.12	2.84	1.87	0.82	
	Mean Length	16.1	17.8	19	20.3	20.2	20.7	20.6	
Cadiz	Biomass	100875	42967	19273	12667	3565	2126	0	**181473**
	%	55.59	23.68	10.62	6.98	1.96	1.17	0.00	
	Mean Weight	23.3	37.1	44.7	49.4	61.1	55.6	0	
	No fish	4321613	1157438	430845	256459	58320	38223	0	**6262898**
	%	69.00	18.48	6.88	4.09	0.93	0.61	0.00	
	Mean Length	15	17.5	18.6	19.2	20.6	20	0	
Portugal	Biomass	188538	189493	14035	13353	12015	9524	7132	**434090**
	%	43.43	43.65	3.23	3.08	2.77	2.19	1.64	
	Mean Weight	21.3	36.9	47.7	58.2	66.0	65.3	61.9	
	No fish	8448548	5080434	284664	222860	188636	142842	97676	**14465660**
	%	58.40	35.12	1.97	1.54	1.30	0.99	0.68	
	Mean Length	14.5	17.6	18.9	20.1	21.0	20.9	16.7	
Whole Area	Biomass	289413	232460	33308	26020	15580	11650	7132	**615563**
	%	47.02	37.76	5.41	4.23	2.53	1.89	1.16	
	Mean Weight	22.0	37.0	46.0	53.9	64.9	63.5	61.9	
	No fish	12770161	6237872	715509	479319	246956	181065	97676	**20728558**
	%	61.61	30.09	3.45	2.31	1.19	0.87	0.47	
	Mean Length	14.6	17.6	18.7	19.6	20.9	20.7	16.7	

Table 9.3.2.4: Sardine assessment from the 2002 Spanish Spring Acoustic Survey

Area		1	2	3	4	5	6	7	8	9	10	Total
VIIIc-Ee	Biomass	4136	12217	15480	22366	13357	5688	977	342	0	0	74562
(>3º 30')	%	5.55	16.38	20.76	30.00	17.91	7.63	1.31	0.46			
	M. weight	33.28	59.12	69.36	78.51	85.13	87.11	97.07	88.23			67.85
	No Fish	123001	205641	222636	283854	156390	65122	10058	3856	0	0	1070558
	%	11.49	19.21	20.80	26.51	14.61	6.08	0.94	0.36			0.00
	M. length	16.70	20.10	21.16	22.02	22.60	22.77	23.57	22.86			21.01
VIIIc-Ew	Biomass	1536	5524	10911	24123	13074	5827	1322	332	40	0	62689
(<3º 30')	%	2.45	8.81	17.41	38.48	20.86	9.29	2.11	0.53	0.06		
	M. weight	33.75	59.94	74.89	79.87	87.29	93.20	94.95	88.89	120.17		75.81
	No Fish	45079	91515	144974	300324	149070	62304	13863	3722	332	0	811181
	%	5.56	11.28	17.87	37.02	18.38	7.68	1.71	0.46	0.04		0.00
	M. length	16.78	20.18	21.68	22.14	22.78	23.27	23.41	22.91	25.25		21.77
VIIIc-W	Biomass	223	1886	1619	2623	1115	204	126	29	12	0	7837
	%	2.85	24.06	20.66	33.47	14.23	2.60	1.61	0.37	0.15		
	M. weight	36.25	63.08	71.75	77.72	84.62	91.48	89.88	98.91	99.35		70.74
	No Fish	6143	29743	22450	33551	13131	2225	1398	290	120	0	109051
	%	5.63	27.27	20.59	30.77	12.04	2.04	1.28	0.27	0.11		0.00
	M. length	17.17	20.52	21.39	21.94	22.55	23.13	23.00	23.72	23.75		21.29
Xia-N	Biomass	3108	20438	3385	2339	0	0	0	0	0	0	29270
	%	10.62	69.83	11.56	7.99							
	M. weight	31.80	46.63	58.01	69.49							46.11
	No Fish	96174	433304	58539	33929	0	0	0	0	0	0	621946
	%	15.46	69.67	9.41	5.46							0.00
	M. length	16.46	18.62	19.97	21.17							18.55
XIa-CN	Biomass	53390	158131	3944	2119	413	23	457	0	0	0	218478
	%	24.44	72.38	1.81	0.97	0.19	0.01	0.21				
	M. weight	21.35	35.06	54.68	67.79	67.75	75.60	81.34				30.03
	No Fish	2473207	4463659	71931	31090	6091	302	5619	0	0	0	7051899
	%	35.07	63.30	1.02	0.44	0.09	0.00	0.08				0.00
	M. length	14.48	16.98	19.60	21.00	21.00	21.75	22.27				16.16
Spain	Biomass	9003	40065	31395	51451	27546	11719	2425	703	52	0	174358
	%	5.16	22.98	18.01	29.51	15.80	6.72	1.39	0.40	0.03		
	M. weight	32.89	51.98	69.65	78.60	86.12	90.08	95.50	88.92	114.37		64.54
	No Fish	270396	760202	448599	651658	318591	129651	25318	7868	452	0	2612736
	%	10.35	29.10	17.17	24.94	12.19	4.96	0.97	0.30	0.02		0.00
	M. length	16.64	19.28	21.18	22.02	22.68	23.01	23.45	22.92	24.85		20.67

Table 9.4.1.1a: Sardine length composition (thousands) by ICES Sub-Division in the first quarter 2001

				First Quarter				
Length	**VIIIc-E**	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Total**
7								
7.5								
8								
8.5	106							106
9	425							425
9.5	743							743
10	637							637
10.5	106			23				129
11	106			23	194	2		325
11.5	850			93	199	2		1143
12	212			284	396	2		895
12.5	224			1733	523	8	46	2533
13	188	9		3685	783	6	209	4880
13.5	238			7190	1002	3	483	8917
14	541	12	3	9169	958	34	1921	12638
14.5	524	6	6	7341	1217	13	2286	11393
15	1204	9	7	5394	1996	64	1348	10023
15.5	525		120	1804	1230	103	2535	6317
16	262		128	1237	2569	453	2351	7000
16.5	312		101	827	2336	621	1202	5399
17	225		99	421	3199	1462	2315	7723
17.5	57	8	50	364	4619	2065	3519	10681
18	237		44	397	6596	2159	3416	12848
18.5	530	19	34	310	7644	3077	3473	15087
19	1012	6	14	443	9858	4154	3186	18674
19.5	1807	9	13	550	12022	5133	1198	20732
20	1037	60	19	283	12566	6368	739	21072
20.5	1585	89	14	189	9582	3848	289	15596
21	2655	188	27	109	8203	1838	147	13167
21.5	3030	223	23	35	2694	684	23	6712
22	2721	236	14	11	1069	173		4223
22.5	2511	184	14	4	263	53		3029
23	1166	146	4	5	27	37		1385
23.5	323	48		2				373
24	158	30				6		193
24.5	52	3		0	8			63
25	19					14		33
25.5								
26								
Total	26328	1286	734	41927	91754	32382	30687	225098
Mean l	19.1	21.8	17.6	14.7	19.0	19.5	17.3	18.1
sd	4.11	1.69	1.96	1.53	2.05	1.31	1.81	2.81
Catch	**1687**	**112**	**32**	**938**	**4656**	**1831**	**1245**	**10500**

Table 9.4.1.1b: Sardine length composition (thousands) by ICES Sub-Division in the second quarter 2001

	Second Quarter							
Length	**VIIIc-E**	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Total**
7								
7.5								
8								
8.5	3							3
9	66		20					87
9.5	24		61					86
10	21		276			30		326
10.5	3		347					351
11	3		691	21	13	59		788
11.5	28		686	233	13	207		1167
12	7		928	341		414		1691
12.5	7		593	915	28	592		2135
13			704	2104	13	616	53	3490
13.5			1168	3163	147	557	210	5245
14			1584	6530	332	355	698	9500
14.5		47	2653	11303	1728	355	1291	17378
15	109	215	6222	21336	4863	200	1560	34507
15.5	126	336	8933	23153	6613	171	1217	40549
16	70	1196	9727	29037	8401	668	1145	50243
16.5	252	741	7129	28124	7985	2078	950	47260
17	15	1426	6146	25445	9258	5909	1538	49738
17.5	230	3974	4518	18118	6960	10637	1298	45735
18	396	9222	5073	11462	7212	13309	1675	48350
18.5	584	7116	3066	6977	8548	13186	1469	40945
19	1309	4230	1679	4516	11176	10706	1628	35245
19.5	1748	1609	830	2324	12617	10491	1296	30915
20	2892	941	484	1443	14075	8913	1723	30471
20.5	2192	746	460	1420	10178	5540	622	21159
21	3300	970	277	770	6535	3018	173	15043
21.5	3671	787	113	349	2024	893		7836
22	4014	954	138	64	615	183	86	6053
22.5	3162	931	97	7	41	124		4363
23	1641	710		3	61			2415
23.5	1087	401	13	1		28		1530
24	428	130						558
24.5	117	57						174
25	67	69						136
25.5	24							24
26	7							7
Total	27606	36808	64618	199157	119439	89240	18632	555500
Mean l	21.3	19.0	16.4	16.6	18.6	18.8	17.6	17.8
sd	1.81	1.69	1.89	1.48	1.89	1.61	1.99	2.14
Catch	**2247**	**2054**	**2294**	**6849**	**6435**	**5108**	**848**	**25835**

Table 9.4.1.1c: Sardine length composition (thousands) by ICES Sub-Division in the third quarter 2001

	Third Quarter							
Length	**VIIIc-E**	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Total**
7								
7.5								
8								
8.5								
9				47				47
9.5		8	42	468				518
10		9	1060	1504				2572
10.5		76	2285	2101		45	50	4557
11		466	4266	3327		150	184	8393
11.5		856	3095	3996		500	234	8682
12	44	863	932	4533		1324	636	8332
12.5	162	277	906	5215		1615	990	9164
13	638	82	804	4924		2029	645	9122
13.5	635	17	907	3836		1428	1107	7931
14	475	6	2753	2542		3484	1366	10626
14.5	293		3738	3332		4839	2526	14728
15	272	6	10331	6012	218	5665	3920	26423
15.5	46		9142	8466	766	5368	4642	28430
16	70	6	12999	16850	1515	2716	2553	36710
16.5	77	31	6286	28159	2569	1522	2593	41237
17	5	368	7839	49831	4706	1292	2886	66927
17.5	66	1322	6699	49812	8743	2177	3430	72249
18	28	5290	9657	48803	16396	4125	3522	87821
18.5	51	7332	7563	29843	17877	5687	2954	71307
19	84	10389	8300	20453	18506	7963	931	66626
19.5	571	9901	5788	11669	13754	7863	1062	50606
20	759	6173	3730	6961	10699	8895	802	38019
20.5	1417	5087	2038	3785	6707	5157	247	24439
21	2337	1881	1043	2113	5211	3013	92	15689
21.5	2572	778	334	670	1834	1114		7302
22	2073	706	149	220	696	154		3997
22.5	2099	819	60	13	202	34		3227
23	507	1049	19	36	28			1639
23.5	380	385						764
24	24	560				5		589
24.5	50	12						62
25	1							1
25.5		123						123
26								
Total	15734	54876	112765	319523	110426	78165	37374	728862
Mean l	20.4	19.4	16.6	17.3	19.1	17.7	16.5	17.7
sd	3.06	2.12	2.55	2.04	1.24	2.63	1.97	2.35
Catch	**1274**	**3610**	**4599**	**14396**	**7070**	**4384**	**1467**	**36799**

Table 9.4.1.1d: Sardine length composition (thousands) by ICES Sub-Division in the fourth quarter 2001

			Fourth Quarter				
Length	**VIIIc-E**	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Total**
7								
7.5								
8								
8.5				15				15
9				45				45
9.5			3	295				297
10			83	620	130			833
10.5			207	2580	389			3176
11		2	453	4302	750			5508
11.5		100	236	4249	1720	11		6317
12		325	109	3567	2502	140		6643
12.5	95	418	153	3108	2636	180		6589
13	331	269	263	2910	2192	214	247	6425
13.5	474	128	239	3480	1690	477	376	6864
14	460	59	1253	2578	1829	2548	619	9347
14.5	2845	38	1412	2640	1617	4953	1013	14518
15	10593	21	1799	4602	1326	6061	984	25386
15.5	7016	19	1861	11634	742	4624	396	26291
16	7817	34	1278	21770	1726	2895	979	36499
16.5	882	50	761	33468	2313	2070	2199	41744
17	8	60	835	44193	6433	3268	1584	56382
17.5		49	784	39236	12004	1511	2092	55676
18		195	1002	31937	14293	903	2588	50918
18.5	6	592	2272	17310	13765	863	4330	39139
19	2866	3175	3150	10458	14237	1388	3271	38545
19.5	2484	6740	4011	5498	12478	2341	3471	37024
20	2313	6971	2440	4166	15260	3350	2088	36589
20.5	3115	4475	1786	1883	12106	2625	1383	27373
21	5522	1485	952	1393	7994	1954	538	19839
21.5	5869	806	318	462	4185	693	77	12411
22	4543	549	398	219	1367	342		7419
22.5	3337	395	388	120	310	105		4656
23	1734	305	44	0	65	26		2174
23.5	812	167		29				1007
24	527	61			23			611
24.5	25	17						43
25	40	0						40
25.5	24				24			47
26								
Total	63739	27507	28488	258767	136109	43543	28234	586387
Mean l	18.6	19.9	17.9	17.0	18.5	17.2	18.2	17.8
sd	3.11	1.86	2.66	2.01	2.44	2.41	1.82	2.46
Catch	**3890**	**1924**	**1473**	**10543**	**7458**	**2027**	**1506**	**28820**

Table 9.4.1.2: Catch in numbers ('000) at age by quarter and by SubDivision in 2001

								First Quarter
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0	0	0	0	0	0	0	0
1	7,435	113	597	37,581	19,620	3,552	14,674	83,572
2	3,666	128	53	2,415	20,192	6,948	6,115	39,517
3	5,063	311	35	887	23,139	5,612	7,141	42,186
4	4,201	530	41	571	16,346	6,337	2,326	30,353
5	3,679	179	7	420	9,066	6,342	250	19,944
6	1,250	24	0	45	2,934	2,088	106	6,447
7	862	0	0	4	160	967	75	2,068
8	86	0	0	1	298	379	0	764
9	72	0	0	2	0	102	0	177
10	14	0	0	0	0	0	0	14
11	0	0	0	0	0	0	0	0
Total	26,328	1,286	734	41,927	91,754	32,325	30,687	225,041
Catch	1,687	112	32	938	4,656	1,831	1,245	10,501

								Second Quarter
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0	0	0	0	0	0	0	0
1	957	27,800	61,165	178,651	49,706	21,654	8,248	348,180
2	5,144	3,638	2,200	13,502	20,735	19,057	3,712	67,988
3	7,149	1,635	675	4,736	17,963	17,997	4,199	54,354
4	5,476	2,749	444	1,588	16,135	11,181	1,879	39,452
5	5,286	787	134	128	11,075	6,557	267	24,235
6	1,838	200	0	550	3,040	6,424	246	12,298
7	1,386	0	0	0	697	4,014	81	6,178
8	177	0	0	0	88	1,293	0	1,558
9	137	0	0	0	0	1,062	0	1,200
10	55	0	0	0	0	0	0	55
11	0	0	0	0	0	0	0	0
Total	27,606	36,808	64,618	199,156	119,439	89,240	18,632	555,499
Catch	2,247	2,054	2,294	6,849	6,435	5,108	848	25,835

								Third Quarter
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	2,425	2,666	30,298	41,024	0	30,277	17,884	124,573
1	1,455	38,838	68,246	230,857	44,449	7,929	14,123	405,897
2	3,729	7,579	8,740	34,226	22,802	9,040	3,709	89,826
3	4,762	2,529	3,773	9,601	23,254	12,018	1,402	57,339
4	2,388	1,716	1,265	2,841	10,256	6,415	160	25,040
5	454	976	366	906	6,497	5,358	95	14,653
6	521	330	76	68	2,771	4,390	0	8,155
7	0	130	0	0	398	2,055	0	2,583
8	0	0	0	0	0	579	0	579
9	0	0	0	0	0	105	0	105
10	0	112	0	0	0	0	0	112
11	0	0	0	0	0	0	0	0
Total	15,734	54,876	112,765	319,523	110,426	78,165	37,374	728,862
Catch	1,274	3,610	4,599	14,396	7,070	4,384	1,467	36,800

								Fourth Quarter
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	12,576	1,363	6,067	31,334	17,881	20,571	5,607	95,400
1	23,893	17,474	13,030	207,606	51,687	9,392	11,570	334,652
2	9,323	4,998	4,728	12,732	18,542	1,841	6,638	58,802
3	10,404	2,024	2,669	4,755	15,954	2,673	3,539	42,018
4	5,102	960	1,529	2,209	17,269	3,894	581	31,544
5	1,427	529	357	104	10,988	2,608	299	16,313
6	1,014	116	107	13	1,851	846	0	3,947
7	0	31	0	0	1,075	858	0	1,964
8	0	0	0	13	459	617	0	1,090
9	0	0	0	0	0	242	0	242
10	0	12	0	0	0	0	0	12
11	0	0	0	0	0	0	0	0
Total	63,739	27,507	28,488	258,767	135,706	43,543	28,234	585,983
Catch	3,890	1,924	1,473	10,543	7,458	2,027	1,506	28,821

								Whole Year
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	15001.81	4028.745	36365	72358.06	17880.9	50847.9	23490.73	219973.1
1	33740.51	84225.04	143037.4	654695	165462.1	42525.93	48614.7	1172301
2	21861.01	16343.1	15721.23	62875.27	82271.2	36886.37	20175.15	256133.3
3	27377.29	6498.195	7152.405	19978.71	80309.51	38300.49	16280.7	195897.3
4	17166.27	5954.95	3279.495	7209.85	60005.8	27826.26	4945.949	126388.6
5	10846.6	2471.683	865.6525	1558.66	37626.1	20865.43	910.9763	75145.1
6	4624.002	669.6299	183.1411	676.9	10594.87	13747.16	351.7294	30847.43
7	2247.68	161.778	0	3.75	2329.78	7894.7	155.9153	12793.6
8	262.9543	0	0	13.95	844.84	2867.93	0	3989.674
9	209.6086	0	0	2.22	0	1511.2	0	1723.029
10	69.24633	124.0758	0	0	0	0	0	193.3221
11	0	0	0	0	0	0	0	0
Total	133,407	120,477	206,604	819,372	457,325	243,273	114,926	2,095,385
Catch	9,098	7,700	8,398	32,726	25,619	13,350	5,066	101,957

Table 9.4.1.3: Relative distribution of sardine catches. Upper pannel, relative contribution of each age group within each Sub-Division 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	11%	3%	18%	9%	4%	21%	20%	10%
1	25%	70%	69%	80%	36%	17%	42%	56%
2	16%	14%	8%	8%	18%	15%	18%	12%
3	21%	5%	3%	2%	18%	16%	14%	9%
4	13%	5%	2%	1%	13%	11%	4%	6%
5	8%	2%	0%	0%	8%	9%	1%	4%
6+	6%	1%	0%	0%	3%	11%	0%	2%
	100%	100%	100%	100%	100%	100%	100%	100%

Age	VIIIc-E	VIIIc-W	IXa-N	IXa-CN	IXa-CS	IXa-S	IXa-Ca	
0	7%	2%	17%	33%	8%	23%	11%	100%
1	3%	7%	12%	56%	14%	4%	4%	100%
2	9%	6%	6%	25%	32%	14%	8%	100%
3	14%	3%	4%	10%	41%	20%	8%	100%
4	14%	5%	3%	6%	47%	22%	4%	100%
5	14%	3%	1%	2%	50%	28%	1%	100%
6+	15%	2%	0%	1%	28%	53%	1%	100%

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	13.17	17.93	16.85	14.33	16.03	17.12	15.85	14.67
2	19.77	20.97	19.99	17.19	18.54	18.54	18.34	18.83
3	20.96	21.44	21.11	19.18	19.76	19.35	18.43	19.94
4	21.88	22.68	21.78	19.95	20.56	20.03	19.10	20.96
5	22.23	22.42	22.21	20.11	21.10	20.48	19.61	21.53
6	22.71	23.75		20.78	21.61	20.80	20.25	22.01
7	22.87			22.00	22.25	21.15	19.75	22.46
8	23.41			23.37	22.85	21.74		22.66
9	23.35			21.25		22.27		23.08
10	23.75							23.75
11								
Total	21.41	21.53	20.39	19.80	20.34	20.16	18.76	20.99

	Second Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0								
1	15.67	18.29	16.23	16.29	16.69	16.87	15.91	16.85
2	19.86	19.34	18.94	18.54	18.80	18.39	18.65	18.90
3	20.95	21.13	20.55	19.45	19.73	18.94	18.76	19.79
4	21.93	22.75	21.10	20.45	20.42	19.70	19.65	21.02
5	22.39	22.45	20.28	21.25	20.86	20.09	19.86	21.40
6	22.82	23.75		21.71	21.24	20.41	20.25	21.45
7	23.06				22.16	20.87	19.75	21.82
8	23.52				21.75	21.21		21.77
9	23.57					21.75		22.18
10	24.04							24.04
11								
Total	21.78	21.28	19.42	19.62	20.21	19.80	18.98	20.92

	Third Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	13.86	11.96	13.48	13.00		14.75	15.03	14.12
1	19.00	19.35	17.37	17.60	18.15	18.07	17.42	18.01
2	20.99	20.08	19.60	19.12	18.93	18.99	18.76	19.33
3	21.95	21.35	20.23	20.34	19.61	19.48	19.37	20.10
4	22.55	22.64	21.02	20.72	20.54	20.21	20.03	21.08
5	23.89	22.62	20.42	21.25	21.00	20.40	19.64	21.17
6	22.85	23.69	21.53	22.65	21.11	20.80		21.40
7		23.90			22.27	21.16		21.72
8						21.44		21.44
9						22.20		22.20
10		24.25						24.25
11								
Total	20.73	21.09	19.09	19.24	20.23	19.75	18.37	20.44

	Fourth Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	15.08	12.92	14.07	12.65	13.35	15.41	15.60	14.16
1	16.82	19.97	17.99	17.38	18.19	16.56	18.20	17.80
2	20.88	20.34	19.96	19.41	19.26	18.74	19.46	19.97
3	21.91	21.10	20.38	20.33	19.98	19.73	19.73	20.89
4	22.58	21.92	21.57	20.21	20.69	20.25	20.22	21.33
5	24.03	22.02	20.90	22.27	20.97	20.93	19.57	21.59
6	22.92	23.48	21.78	22.25	21.44	21.09		22.20
7		22.72			21.41	21.43		21.49
8				22.26	21.89	21.79		21.84
9						21.35		21.35
10		24.25						24.25
11								
Total	20.60	20.97	19.52	19.60	19.69	19.73	18.80	20.62

	Whole Year							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	14.99	12.29	13.57	12.85	13.35	15.02	15.09	14.14
1	15.59	19.05	16.94	16.99	17.47	17.05	16.98	17.36
2	20.35	19.95	19.61	18.98	18.88	18.58	18.82	19.30
3	21.38	21.21	20.32	20.08	19.75	19.22	18.93	20.16
4	22.12	22.60	21.29	20.44	20.56	19.97	19.54	21.09
5	22.51	22.42	20.60	21.01	20.97	20.39	19.70	21.44
6	22.79	23.68	21.67	21.75	21.34	20.64	20.25	21.69
7	22.96	23.66		22.00	21.84	21.04	19.75	21.95
8	23.47			22.33	22.21	21.45		21.96
9	23.46			21.25		21.75		22.27
10	23.94	24.25						24.15
11								
Total	21.23	21.01	19.14	19.77	19.60	19.51	18.63	20.50

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	0.018	0.048	0.036	0.020	0.029	0.040	0.030	0.023
2	0.063	0.076	0.067	0.035	0.045	0.049	0.048	0.051
3	0.077	0.082	0.078	0.050	0.055	0.055	0.049	0.062
4	0.088	0.100	0.087	0.056	0.063	0.061	0.056	0.073
5	0.093	0.096	0.094	0.057	0.068	0.065	0.060	0.080
6	0.101	0.117		0.063	0.074	0.067	0.067	0.086
7	0.103			0.076	0.081	0.071	0.062	0.095
8	0.111			0.092	0.089	0.076		0.092
9	0.110			0.068		0.081		0.103
10	0.117							0.117
11								
Total	0.088	0.087	0.072	0.057	0.063	0.063	0.053	0.078
	Second Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0								
1	0.033	0.050	0.035	0.032	0.037	0.042	0.032	0.038
2	0.065	0.060	0.057	0.049	0.054	0.053	0.053	0.056
3	0.077	0.079	0.072	0.059	0.064	0.058	0.054	0.065
4	0.089	0.100	0.079	0.069	0.071	0.065	0.063	0.079
5	0.095	0.095	0.070	0.078	0.077	0.069	0.064	0.083
6	0.101	0.114		0.084	0.082	0.073	0.068	0.085
7	0.104				0.094	0.078	0.063	0.089
8	0.111				0.088	0.082		0.089
9	0.112					0.089		0.094
10	0.119							0.119
11								
Total	0.090	0.083	0.062	0.062	0.071	0.067	0.057	0.080
	Third Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0.021	0.013	0.020	0.019		0.031	0.028	0.024
1	0.062	0.064	0.045	0.046	0.055	0.056	0.046	0.051
2	0.084	0.073	0.067	0.059	0.062	0.065	0.058	0.065
3	0.098	0.090	0.075	0.072	0.069	0.070	0.065	0.074
4	0.108	0.111	0.085	0.076	0.079	0.078	0.072	0.087
5	0.131	0.110	0.077	0.082	0.084	0.081	0.067	0.089
6	0.112	0.127	0.092	0.101	0.085	0.085		0.092
7		0.132			0.100	0.090		0.097
8						0.093		0.093
9						0.104		0.104
10		0.138						0.138
11								
Total	0.077	0.086	0.058	0.057	0.067	0.069	0.048	0.076
	Fourth Quarter							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0.027	0.016	0.022	0.016	0.021	0.030	0.031	0.023
1	0.041	0.070	0.051	0.042	0.050	0.039	0.052	0.048
2	0.082	0.075	0.070	0.060	0.059	0.058	0.065	0.070
3	0.096	0.085	0.075	0.070	0.065	0.069	0.068	0.081
4	0.107	0.097	0.092	0.069	0.072	0.076	0.074	0.086
5	0.132	0.099	0.083	0.094	0.075	0.085	0.066	0.089
6	0.112	0.122	0.094	0.093	0.080	0.087		0.099
7		0.110			0.080	0.092		0.087
8				0.093	0.085	0.097		0.092
9						0.090		0.090
10		0.136						0.136
11								
Total	0.085	0.090	0.070	0.067	0.065	0.072	0.059	0.082
	Whole Year							
	VIIIc-E	**VIIIc-W**	**IXa-N**	**IXa-CN**	**IXa-CS**	**IXa-S**	**IXa-Ca**	**Tot**
0	0.027	0.014	0.021	0.017	0.021	0.031	0.028	0.024
1	0.033	0.060	0.041	0.040	0.045	0.044	0.041	0.044
2	0.073	0.070	0.067	0.056	0.055	0.055	0.057	0.061
3	0.086	0.085	0.075	0.067	0.063	0.062	0.057	0.071
4	0.095	0.102	0.087	0.071	0.071	0.069	0.062	0.081
5	0.099	0.101	0.079	0.076	0.076	0.073	0.065	0.084
6	0.103	0.121	0.093	0.084	0.080	0.077	0.068	0.089
7	0.103	0.127		0.076	0.088	0.082	0.063	0.092
8	0.111			0.093	0.087	0.087		0.091
9	0.111			0.068		0.089		0.096
10	0.118	0.137						0.131
11								
Total	0.087	0.091	0.066	0.065	0.065	0.067	0.055	0.078

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	2000	2001
0	120.8	30.5	277.1	208.6	449.1	246.0	489.8	220.0
1	60.2	189.1	101.3	548.6	366.2	475.2	354.8	1172.3
2	542.2	280.7	347.7	453.3	501.6	361.5	314.0	256.1
3	1094.4	829.7	514.7	391.1	352.5	339.7	255.5	195.9
4	272.5	472.9	652.7	337.3	233.7	177.2	194.2	126.4
5	112.6	70.2	197.2	225.2	178.7	105.5	97.7	75.1
6	72.1	64.5	46.6	70.3	105.9	72.5	64.4	49.5

x 10 ^ 6

Predicted Catch in Number

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	630.4	395.4	405.1	414.9	760.5	500.6	208.3	102.2
1	533.3	894.4	565.3	613.6	456.7	972.7	705.3	163.5
2	618.4	543.8	918.8	613.0	487.6	428.2	1010.2	542.7
3	549.3	472.6	418.6	743.9	366.3	350.4	343.2	771.5
4	685.3	288.1	249.7	232.4	304.0	182.9	196.5	202.7
5	189.0	325.6	137.9	125.6	85.8	137.5	93.0	95.3

x 10 ^ 6

Table 9.7.2.1a (Continued)

Predicted Catch in Number

AGE	1995	1996	1997	1998	1999	2000	2001
0	80.1	168.6	170.3	238.3	213.3	833.7	257.5
1	161.1	194.1	335.7	306.8	327.7	293.0	919.1
2	233.6	349.3	340.2	526.4	369.1	398.9	291.5
3	583.7	374.5	439.2	375.1	447.7	324.9	295.8
4	485.8	545.5	266.1	267.9	175.2	221.2	138.4
5	92.4	331.4	281.6	117.5	89.7	62.2	67.6

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

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	2000	2001
0	0.02000	0.02500	0.01900	0.02200	0.02400	0.02500	0.02500	0.02300
1	0.03600	0.04700	0.03800	0.03300	0.04000	0.04200	0.03700	0.04200
2	0.05800	0.05900	0.05100	0.05200	0.05500	0.05600	0.05600	0.05900
3	0.06200	0.06600	0.05800	0.06200	0.06100	0.06500	0.06600	0.06700
4	0.07000	0.07100	0.06100	0.06900	0.06400	0.07000	0.07100	0.07500
5	0.07600	0.08200	0.07100	0.07300	0.06700	0.07300	0.07400	0.07900
6	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000	0.10000

Weights at age in the 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

Table 9.7.2.1a (Continued)

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

Weights at age in the stock (Kg)

AGE	1994	1995	1996	1997	1998	1999	2000	2001
0	0.00000	0.00000	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	0.01700	0.01700
2	0.04000	0.05000	0.04700	0.05000	0.04100	0.03900	0.04300	0.04200
3	0.04900	0.06200	0.06100	0.05800	0.05300	0.05400	0.05900	0.05800
4	0.06000	0.07200	0.06900	0.06800	0.06100	0.06200	0.06400	0.07500
5	0.06700	0.07900	0.07500	0.07400	0.06700	0.06800	0.06700	0.08000
6	0.10000	0.10000	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	2000	2001
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	0.30000

Table 9.7.2.1a (Continued)

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	2000	2001
0	0.0000	0.0000	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	0.2570	0.3910
2	0.8900	0.9800	0.8900	0.9180	0.9240	0.9110	0.9100	0.9020
3	0.9600	0.9700	0.9200	0.9500	0.9560	0.9870	0.9470	0.9620
4	0.9600	0.9900	0.9600	0.9720	0.9870	0.9950	0.9500	0.9890
5	0.9700	1.0000	1.0000	0.9930	0.9950	1.0000	1.0000	1.0000
6	1.0000	1.0000	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

INDEX1

	1998	1999
1	*******	215.50

x 10 ^ 3

Table 9.7.2.1a (Continued)

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 ^ 6

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

AGE	1994	1995	1996	1997	1998	1999	2000	2001
1	*******	*******	10.6	56.5	509.8	214.5	91.7	975.6
2	*******	*******	54.2	263.1	103.1	160.4	285.8	262.9
3	*******	*******	90.5	125.7	80.4	134.6	435.4	186.5
4	*******	*******	350.8	123.3	33.8	124.3	242.2	142.9
5	*******	*******	213.8	65.7	20.6	28.4	188.9	98.9
6	*******	*******	24.8	61.0	25.4	64.0	68.1	66.1

x 10 ^ 6

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IX

AGE	2002
1	270.4
2	760.2
3	448.6
4	651.7
5	318.6
6	163.3

x 10 ^ 6

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CAD

AGE	1996	1997	1998	1999	2000	2001	2002
1	1625.	6344.	1636.	5712.	6581.	18684.	12408.
2	2082.	3238.	4015.	2553.	2170.	774.	6131.
3	2415.	1552.	2191.	1461.	1222.	515.	656.
4	2906.	1260.	1434.	844.	757.	337.	437.
5	386.	1360.	1185.	596.	532.	276.	232.
6	12.	203.	980.	469.	613.	184.	266.

x 10 ^ 6

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	2957.	2063.	2493.	3715.	999990.	999990.	999990.	999990.
1	5733.	2744.	1612.	2379.	999990.	999990.	999990.	999990.
2	1152.	4548.	1670.	1344.	999990.	999990.	999990.	999990.
3	1037.	1083.	658.	929.	999990.	999990.	999990.	999990.
4	528.	839.	323.	666.	999990.	999990.	999990.	999990.
5	76.	144.	127.	236.	999990.	999990.	999990.	999990.
6	40.	70.	50.	80.	999990.	999990.	999990.	999990.

x 10 ^ 6

Table 9.7.2.1a (Continued)

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	6349.	999990.	999990.	999990.	999990.	2425.	8680.	3697.
1	5481.	999990.	999990.	999990.	999990.	1961.	1809.	798.
2	1157.	999990.	999990.	999990.	999990.	906.	1215.	646.
3	1003.	999990.	999990.	999990.	999990.	729.	823.	391.
4	437.	999990.	999990.	999990.	999990.	1041.	396.	459.
5	108.	999990.	999990.	999990.	999990.	772.	367.	382.
6	19.	999990.	999990.	999990.	999990.	322.	220.	165.

x 10 ^ 6

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

AGE	2000	2001
0	30871.	8955.
1	1616.	5395.
2	247.	695.
3	90.	522.
4	122.	116.
5	94.	125.
6	66.	49.

x 10 ^ 6

Table 9.7.2.1b: Output values for the ICA assessment model

Fishing Mortality (per year)

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	0.07709	0.05297	0.06252	0.11443	0.00824	0.05272	0.01530	0.04063
1	0.45150	0.21831	0.25785	0.22535	0.13993	0.11297	0.26361	0.10784
2	0.44982	0.40184	0.42053	0.42555	0.41235	0.25426	0.15112	0.35608
3	0.46004	0.44650	0.31903	0.38044	0.35991	0.36441	0.26892	0.24586
4	0.37571	0.72678	0.33628	0.31410	0.40724	0.32247	0.26121	0.28930
5	0.64312	0.56273	0.46888	0.46075	0.42053	0.32834	0.34565	0.32406
6	0.64312	0.56273	0.46888	0.46075	0.42053	0.32834	0.34565	0.32406

Fishing Mortality (per year)

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.05370	0.06589	0.06580	0.06624	0.07101	0.05454	0.04793	0.04615
1	0.17662	0.14422	0.14402	0.14498	0.15542	0.11938	0.10490	0.10101
2	0.33772	0.24804	0.24770	0.24936	0.26730	0.20532	0.18042	0.17374
3	0.26291	0.35486	0.35437	0.35675	0.38242	0.29375	0.25812	0.24856
4	0.32119	0.37249	0.37197	0.37447	0.40141	0.30834	0.27094	0.26090
5	0.37166	0.35486	0.35437	0.35675	0.38242	0.29375	0.25812	0.24856
6	0.37166	0.35486	0.35437	0.35675	0.38242	0.29375	0.25812	0.24856

Fishing Mortality (per year)

AGE	1994	1995	1996	1997	1998	1999	2000	2001
0	0.02204	0.02084	0.03061	0.03742	0.04175	0.03537	0.02964	0.01965
1	0.05294	0.05006	0.07352	0.08990	0.10028	0.08496	0.07120	0.04720
2	0.12068	0.11412	0.16761	0.20493	0.22861	0.19368	0.16231	0.10761
3	0.22473	0.21250	0.31210	0.38161	0.42570	0.36065	0.30225	0.20038
4	0.26354	0.24920	0.36601	0.44751	0.49922	0.42293	0.35445	0.23499
5	0.22473	0.21250	0.31210	0.38161	0.42570	0.36065	0.30225	0.20038
6	0.22473	0.21250	0.31210	0.38161	0.42570	0.36065	0.30225	0.20038

Population Abundance (1 January)

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	13729.	15326.	16568.	11105.	8867.	24428.	9122.	7893.
1	7331.	9138.	10450.	11189.	7120.	6322.	16660.	6458.
2	3031.	3355.	5281.	5805.	6421.	4450.	4060.	9202.
3	929.	1390.	1614.	2493.	2727.	3056.	2481.	2509.
4	507.	421.	639.	843.	1225.	1368.	1526.	1363.
5	102.	250.	146.	328.	443.	586.	712.	845.
6	40.	97.	93.	240.	436.	578.	466.	433.

x 10 ^ 6

Population Abundance (1 January)

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	6816.	11586.	7276.	7407.	7092.	16796.	12543.	5416.
1	5449.	4644.	7798.	4898.	4984.	4749.	11434.	8595.
2	4168.	3283.	2890.	4854.	3046.	3067.	3030.	7402.
3	4634.	2138.	1842.	1622.	2720.	1676.	1796.	1819.
4	1411.	2561.	1078.	929.	816.	1334.	898.	997.
5	734.	736.	1269.	534.	459.	393.	705.	493.
6	625.	666.	736.	949.	907.	481.	413.	637.

x 10 ^ 6

Table 9.7.2.1b (Continued)

Population Abundance (1 January)

AGE	1994	1995	1996	1997	1998	1999	2000	2001
0	5501.	4558.	6559.	5436.	6834.	7198.	33488.	15527.
1	3718.	3869.	3209.	4574.	3765.	4712.	4995.	23372.
2	5586.	2535.	2646.	2144.	3005.	2448.	3112.	3344.
3	4473.	3559.	1626.	1608.	1256.	1719.	1450.	1902.
4	1020.	2568.	2069.	856.	790.	590.	862.	771.
5	552.	563.	1439.	1031.	393.	345.	278.	435.
6	418.	393.	202.	257.	354.	279.	287.	314.

x 10 ^ 6

Population Abundance (1 January)

AGE	2002
0	8879.
1	10946.
2	16028.
3	2159.
4	1119.
5	438.
6	446.

x 10 ^ 6

Weighting factors for the catches in number

AGE	1987	1988	1989	1990	1991	1992	1993	1994
0	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Weighting factors for the catches in number

AGE	1995	1996	1997	1998	1999	2000	2001
0	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	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
4	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

Predicted SSB Index Values

INDEX1

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	433.50	*******

x 10 ^ 3

Table 9.7.2.1b (Continued)

INDEX1

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	371.99

x 10 ^ 3

INDEX1

	1998	1999
1	*******	283.08

x 10 ^ 3

Predicted Age-Structured Index Values

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I Predicted

AGE	1986	1987	1988	1989	1990	1991	1992	1993
1	117.35	100.70	169.10	*******	107.81	103.52	249.99	188.08
2	163.50	131.22	115.54	*******	121.25	123.70	122.84	300.50
3	380.62	172.26	148.41	*******	217.87	136.79	147.66	149.85
4	220.69	396.34	166.82	*******	125.55	209.22	142.01	158.00
5	173.70	174.73	301.38	*******	108.46	94.51	170.78	119.64
6	265.26	283.36	313.59	*******	383.80	207.55	179.40	277.47

x 10 ^ 6

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I Predicted

AGE	1994	1995	1996	1997	1998	1999	2000	2001
1	*******	*******	70.63	100.31	82.39	103.46	109.99	517.23
2	*******	*******	107.54	86.46	120.62	98.99	126.64	137.68
3	*******	*******	132.20	128.87	99.67	138.34	118.15	158.30
4	*******	*******	320.61	130.34	118.97	90.30	133.86	122.76
5	*******	*******	344.93	243.65	92.02	81.74	66.71	106.64
6	*******	*******	86.93	108.95	148.67	118.44	123.70	139.08

x 10 ^ 6

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I Predicted

AGE	2002
1	242.23
2	659.82
3	179.70
4	178.26
5	107.48
6	197.49

x 10 ^ 6

Table 9.7.2.1b (Continued)

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CA Predicted

AGE	1996	1997	1998	1999	2000	2001	2002
1	2856.	4056.	3331.	4183.	4447.	20913.	9794.
2	1910.	1536.	2142.	1758.	2249.	2445.	11719.
3	1237.	1206.	932.	1294.	1105.	1481.	1681.
4	2007.	816.	745.	565.	838.	768.	1116.
5	1474.	1041.	393.	349.	285.	456.	459.
6	156.	195.	266.	212.	221.	249.	354.

x 10 ^ 6

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Predicted

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	4561.	3852.	3285.	5518.	999990.	999990.	999990.	999990.
1	5079.	2286.	1806.	1588.	999990.	999990.	999990.	999990.
2	1311.	2441.	1125.	966.	999990.	999990.	999990.	999990.
3	787.	813.	1478.	624.	999990.	999990.	999990.	999990.
4	630.	548.	550.	950.	999990.	999990.	999990.	999990.
5	226.	274.	227.	232.	999990.	999990.	999990.	999990.
6	92.	87.	120.	130.	999990.	999990.	999990.	999990.

x 10 ^ 6

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Predicted

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	6078.	999990.	999990.	999990.	999990.	2661.	3331.	3531.
1	4059.	999990.	999990.	999990.	999990.	1647.	1342.	1705.
2	951.	999990.	999990.	999990.	999990.	657.	901.	759.
3	575.	999990.	999990.	999990.	999990.	458.	342.	499.
4	367.	999990.	999990.	999990.	999990.	295.	259.	208.
5	243.	999990.	999990.	999990.	999990.	316.	116.	108.
6	88.	999990.	999990.	999990.	999990.	49.	65.	54.

x 10 ^ 6

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Predicted

AGE	2000	2001
0	16515.	7731.
1	1832.	8770.
2	994.	1126.
3	445.	644.
4	325.	326.
5	92.	159.
6	59.	73.

x 10 ^ 6

Fitted Selection Pattern

AGE	1978	1979	1980	1981	1982	1983	1984	1985
0	0.1676	0.1186	0.1960	0.3008	0.0229	0.1447	0.0569	0.1653
1	0.9814	0.4889	0.8082	0.5924	0.3888	0.3100	0.9802	0.4386
2	0.9778	0.9000	1.3181	1.1186	1.1457	0.6977	0.5620	1.4483
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	0.8167	1.6277	1.0541	0.8256	1.1315	0.8849	0.9714	1.1767
5	1.3980	1.2603	1.4697	1.2111	1.1684	0.9010	1.2853	1.3181
6	1.3980	1.2603	1.4697	1.2111	1.1684	0.9010	1.2853	1.3181

Table 9.7.2.1b (Continued)

Fitted Selection Pattern

AGE	1986	1987	1988	1989	1990	1991	1992	1993
0	0.2043	0.1857	0.1857	0.1857	0.1857	0.1857	0.1857	0.1857
1	0.6718	0.4064	0.4064	0.4064	0.4064	0.4064	0.4064	0.4064
2	1.2845	0.6990	0.6990	0.6990	0.6990	0.6990	0.6990	0.6990
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.2217	1.0497	1.0497	1.0497	1.0497	1.0497	1.0497	1.0497
5	1.4136	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.4136	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Fitted Selection Pattern

AGE	1994	1995	1996	1997	1998	1999	2000	2001
0	0.0981	0.0981	0.0981	0.0981	0.0981	0.0981	0.0981	0.0981
1	0.2356	0.2356	0.2356	0.2356	0.2356	0.2356	0.2356	0.2356
2	0.5370	0.5370	0.5370	0.5370	0.5370	0.5370	0.5370	0.5370
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.1727	1.1727	1.1727	1.1727	1.1727	1.1727	1.1727	1.1727
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

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	13728830	314823	227679	145609	0.6395	0.4822	83
1979	15326420	387476	283212	157241	0.5552	0.5345	96
1980	16568120	498143	371443	194802	0.5244	0.3862	95
1981	11104870	613086	464951	216517	0.4657	0.3952	89
1982	8866740	638865	504145	206946	0.4105	0.4000	96
1983	24428060	601386	486203	183837	0.3781	0.3174	104
1984	9121840	720203	547471	206005	0.3763	0.2567	95
1985	7893150	759175	613639	208440	0.3397	0.3038	94
1986	6816160	673787	552583	187363	0.3391	0.3234	97
1987	11585680	581057	475495	177695	0.3737	0.3326	100
1988	7275920	546518	433503	161530	0.3726	0.3321	102
1989	7406880	529210	367617	140962	0.3834	0.3343	96
1990	7091890	500160	364464	149430	0.4100	0.3584	104
1991	16796010	464244	371183	132587	0.3572	0.2753	99
1992	12542670	653185	508893	130249	0.2559	0.2419	99
1993	5415970	789351	582205	142495	0.2448	0.2329	98
1994	5501170	697828	567666	136581	0.2406	0.2084	98
1995	4557910	728349	609705	125280	0.2055	0.1971	98
1996	6559460	609982	492653	116736	0.2370	0.2895	101
1997	5436460	475057	371988	115814	0.3113	0.3539	98
1998	6833950	386303	301970	108925	0.3607	0.3948	97
1999	7198420	370404	283081	94091	0.3324	0.3345	98
2000	33487970	406785	284568	85786	0.3015	0.2803	98
2001	15527250	772100	458759	101957	0.2222	0.1858	99

No of years for separable analysis : 15
Age range in the analysis : 0 . . . 6
Year range in the analysis : 1978 . . . 2001
Number of indices of SSB : 1
Number of age-structured indices : 3

Parameters to estimate : 62
Number of observations : 289

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

Table 9.7.2.1b (Continued)

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	0.3549	21	0.2309	0.5455	0.2850	0.4419	0.3635
2	1988	0.3544	22	0.2274	0.5522	0.2826	0.4444	0.3636
3	1989	0.3567	23	0.2259	0.5635	0.2825	0.4504	0.3666
4	1990	0.3824	22	0.2440	0.5993	0.3041	0.4809	0.3926
5	1991	0.2937	22	0.1873	0.4606	0.2335	0.3695	0.3016
6	1992	0.2581	22	0.1669	0.3993	0.2066	0.3225	0.2646
7	1993	0.2486	22	0.1603	0.3855	0.1987	0.3109	0.2549
8	1994	0.2247	23	0.1423	0.3550	0.1780	0.2838	0.2309
9	1995	0.2125	22	0.1368	0.3301	0.1697	0.2660	0.2179
10	1996	0.3121	21	0.2060	0.4728	0.2525	0.3858	0.3192
11	1997	0.3816	20	0.2556	0.5697	0.3110	0.4682	0.3897
12	1998	0.4257	20	0.2838	0.6386	0.3461	0.5236	0.4349
13	1999	0.3606	21	0.2367	0.5495	0.2909	0.4471	0.3691
14	2000	0.3022	22	0.1945	0.4697	0.2414	0.3785	0.3100
15	2001	0.2004	23	0.1268	0.3166	0.1587	0.2531	0.2059
Separable Model: Selection (S1) by age 1987 1993								
16	0	0.1857	23	0.1165	0.2958	0.1464	0.2355	0.1910
17	1	0.4064	19	0.2783	0.5935	0.3350	0.4930	0.4141
18	2	0.6990	18	0.4879	1.0013	0.5819	0.8397	0.7108
	3	1.0000		Fixed : Reference Age				
19	4	1.0497	16	0.7669	1.4367	0.8944	1.2320	1.0632
	5	1.0000		Fixed : Last true age				
Separable Model: Selection (S2) by age from 1994 to 2001								
20	0	0.0981	23	0.0618	0.1556	0.0775	0.1241	0.1008
21	1	0.2356	18	0.1630	0.3404	0.1952	0.2842	0.2398
22	2	0.5370	17	0.3810	0.7569	0.4508	0.6398	0.5453
	3	1.0000		Fixed : Reference Age				
23	4	1.1727	14	0.8753	1.5712	1.0101	1.3615	1.1858
	5	1.0000		Fixed : Last true age				
Separable model: Populations in year 2001								
24	0	15527251	40	6964910	34615737	10314596	23374209	16882069
25	1	23372146	27	13538033	40349822	17689162	30880899	24296978
26	2	3344415	22	2138112	5231303	2661906	4201918	3432678
27	3	1901954	20	1277071	2832599	1552181	2330546	1941637
28	4	770664	20	514360	1154684	627010	947231	787238
29	5	434611	23	276855	682258	345286	547045	446268
Separable model: Populations at age								
30	1987	735594	34	372865	1451194	520096	1040382	781150
31	1988	1268615	28	730593	2202847	957320	1681135	1319905
32	1989	534181	27	309290	922595	404209	705946	555351
33	1990	459259	26	274272	769014	353049	597421	475421
34	1991	392788	25	237516	649568	303876	507716	405940
35	1992	704508	24	436626	1136740	551922	899277	725811
36	1993	492526	23	308031	787525	387643	625788	506852
37	1994	552338	23	346211	881186	435214	700981	568248
38	1995	563292	24	349498	907867	441544	718610	580244
39	1996	1439118	24	897289	2308132	1130891	1831353	1481532
40	1997	1031489	23	656505	1620656	819122	1298913	1059263
41	1998	393185	22	250613	616866	312467	494755	403703
42	1999	344530	23	218284	543793	272962	434864	353998
43	2000	277741	23	175811	438768	219946	350723	285404

SSB Index catchabilities
INDEX1
Absolute estimator. No fitted catchability.

Table 9.7.2.1b (Continued)

Age-structured index catchabilities

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I

Linear model fitted. Slopes at age :

44	1	Q	23.95	24	18.93	49.48	23.95	39.11	31.54
45	2	Q	45.13	24	35.70	92.93	45.13	73.52	59.34
46	3	Q	93.04	24	73.37	193.5	93.04	152.6	122.8
47	4	Q	179.4	25	139.8	386.7	179.4	301.4	240.5
48	5	Q	274.3	27	210.0	625.2	274.3	478.6	376.6
49	6	Q	491.6	26	381.7	1073.	491.6	833.0	662.5

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CA

Linear model fitted. Slopes at age :

50	1	Q	968.5	35	691.2	2741.	968.5	1956.	1464.
51	2	Q	801.5	34	575.2	2230.	801.5	1600.	1202.
52	3	Q	870.3	34	624.2	2425.	870.3	1739.	1306.
53	4	Q	1123.	35	797.0	3226.	1123.	2291.	1709.
54	5	Q	1172.	37	815.8	3585.	1172.	2495.	1837.
55	6	Q	880.0	36	620.6	2584.	880.0	1822.	1353.

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Linear model fitted. Slopes at age :

56	0	Q	696.5	30	518.3	1733.	696.5	1289.	993.6
57	1	Q	539.0	30	402.3	1328.	539.0	991.4	765.7
58	2	Q	512.5	30	382.6	1262.	512.5	942.1	727.8
59	3	Q	563.4	30	418.8	1407.	563.4	1045.	805.0
60	4	Q	728.4	31	536.8	1866.	728.4	1376.	1053.
61	5	Q	607.5	32	442.7	1612.	607.5	1175.	892.0
62	6	Q	376.4	31	276.9	970.1	376.4	713.6	545.5

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1987	1988	1989	1990	1991	1992	1993	1994
0	0.8239	0.2759	-0.4907	-0.4750	0.7315	-0.0047	-0.8640	0.1672
1	0.0179	0.1016	0.0013	-0.0191	0.0443	0.0296	-0.2197	-0.9994
2	0.0756	-0.0163	-0.0107	-0.1703	-0.1118	0.0528	0.0685	-0.0009
3	0.0353	-0.0738	-0.0733	-0.0508	0.1050	-0.0293	0.4182	0.3497
4	-0.2476	0.0538	-0.1220	0.2386	-0.1344	0.0178	0.2694	0.2959
5	-0.2047	-0.1088	0.3721	0.1841	-0.1387	-0.2146	0.2030	0.1674

Separable Model Residuals

Age	1995	1996	1997	1998	1999	2000	2001
0	-0.9653	0.4969	0.2029	0.6338	0.1428	-0.5318	-0.1575
1	0.1604	-0.6509	0.4910	0.1769	0.3718	0.1915	0.2434
2	0.1837	-0.0047	0.2870	-0.0483	-0.0209	-0.2393	-0.1293
3	0.3516	0.3181	-0.1158	-0.0621	-0.2761	-0.2402	-0.4120
4	-0.0270	0.1794	0.2369	-0.1367	0.0110	-0.1303	-0.0904
5	-0.2745	-0.5190	-0.2237	0.4198	0.1621	0.4512	0.1060

Table 9.7.2.1b (Continued)

SPAWNING BIOMASS INDEX RESIDUALS

INDEX1

	1982	1983	1984	1985	1986	1987	1988	1989
1	*******	*******	*******	*******	*******	*******	-0.3849	*******

INDEX1

	1990	1991	1992	1993	1994	1995	1996	1997
1	*******	*******	*******	*******	*******	*******	*******	-0.9223

INDEX1

	1998	1999
1	*******	-0.2728

AGE-STRUCTURED INDEX RESIDUALS

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	-0.757	1.837	0.281	*******	-0.445	-1.404	-0.398	0.238
2	-2.074	0.670	-0.593	*******	-0.772	0.520	-0.461	0.352
3	1.006	-1.838	-0.701	*******	0.225	0.180	-0.513	-0.098
4	-0.025	1.797	-0.956	*******	-0.856	0.651	-1.523	-0.226
5	0.856	1.210	1.035	*******	-0.214	-0.416	-0.379	0.198
6	0.768	1.491	1.038	*******	0.417	1.018	-0.379	1.394

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I

Age	1994	1995	1996	1997	1998	1999	2000	2001
1	*******	*******	-1.893	-0.574	1.823	0.729	-0.182	0.635
2	*******	*******	-0.684	1.113	-0.157	0.483	0.814	0.647
3	*******	*******	-0.378	-0.025	-0.215	-0.027	1.304	0.164
4	*******	*******	0.090	-0.055	-1.260	0.320	0.593	0.152
5	*******	*******	-0.478	-1.310	-1.497	-1.059	1.041	-0.075
6	*******	*******	-1.255	-0.580	-1.767	-0.615	-0.597	-0.744

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I

Age	2002
1	0.110
2	0.142
3	0.915
4	1.296
5	1.087
6	-0.190

Table 9.7.2.1b (Continued)

FLT05: PT MARCH ACOUSTIC SURVEY INCL.CA

Age	1996	1997	1998	1999	2000	2001	2002
1	-0.564	0.447	-0.711	0.311	0.392	-0.113	0.237
2	0.086	0.746	0.628	0.373	-0.036	-1.150	-0.648
3	0.669	0.252	0.854	0.121	0.100	-1.055	-0.942
4	0.370	0.435	0.655	0.402	-0.102	-0.823	-0.937
5	-1.339	0.267	1.103	0.534	0.624	-0.503	-0.685
6	-2.566	0.039	1.303	0.794	1.019	-0.304	-0.285

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Age	1984	1985	1986	1987	1988	1989	1990	1991
0	-0.433	-0.624	-0.276	-0.396	*******	*******	*******	*******
1	0.121	0.182	-0.113	0.405	*******	*******	*******	*******
2	-0.129	0.622	0.395	0.330	*******	*******	*******	*******
3	0.276	0.287	-0.808	0.397	*******	*******	*******	*******
4	-0.176	0.426	-0.532	-0.356	*******	*******	*******	*******
5	-1.085	-0.645	-0.580	0.021	*******	*******	*******	*******
6	-0.825	-0.218	-0.883	-0.485	*******	*******	*******	*******

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Age	1992	1993	1994	1995	1996	1997	1998	1999
0	0.044	*******	*******	*******	*******	-0.093	0.958	0.046
1	0.300	*******	*******	*******	*******	0.174	0.298	-0.759
2	0.196	*******	*******	*******	*******	0.321	0.299	-0.161
3	0.555	*******	*******	*******	*******	0.465	0.877	-0.244
4	0.174	*******	*******	*******	*******	1.259	0.424	0.790
5	-0.810	*******	*******	*******	*******	0.892	1.155	1.266
6	-1.549	*******	*******	*******	*******	1.886	1.228	1.114

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ

Age	2000	2001
0	0.626	0.147
1	-0.125	-0.486
2	-1.394	-0.483
3	-1.600	-0.211
4	-0.982	-1.032
5	0.022	-0.242
6	0.120	-0.394

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1987 to 2001	
Variance	0.1488
Skewness test stat.	-2.1555
Kurtosis test statistic	2.1703
Partial chi-square	0.5653
Significance in fit	0.0000
Degrees of freedom	51

Table 9.7.2.1b (Continued)

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	0.3578
Skewness test stat.	-0.9494
Kurtosis test statistic	-0.3690
Partial chi-square	0.0837
Significance in fit	0.0063
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+I

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	0.1875	0.1201	0.1025	0.1465	0.1442	0.1737
Skewness test stat.	0.2657	-1.4391	-0.6904	0.2154	-0.1684	0.0135
Kurtosis test statisti	-0.2866	0.3555	0.4483	-0.4206	-0.9615	-0.8770
Partial chi-square	0.1328	0.0834	0.0703	0.0998	0.1001	0.1185
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	14	14	14	14	14	14
Degrees of freedom	13	13	13	13	13	13
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

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

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	0.0373	0.0789	0.0907	0.0690	0.1243	0.2812
Skewness test stat.	-0.6369	-0.6424	-0.5173	-0.6592	-0.3299	-1.1678
Kurtosis test statisti	-0.7125	-0.4918	-0.6408	-0.7032	-0.6364	0.1389
Partial chi-square	0.0102	0.0218	0.0259	0.0201	0.0367	0.0887
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	7	7	7	7	7	7
Degrees of freedom	6	6	6	6	6	6
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	0.0342	0.0200	0.0492	0.0782	0.0805	0.1012	0.1685
Skewness test stat.	0.9277	-1.2171	-1.8096	-1.3408	0.1432	0.5047	0.5647
Kurtosis test statisti	-0.2483	-0.1802	0.7721	0.1251	-0.6490	-0.8116	-0.5984
Partial chi-square	0.0138	0.0084	0.0213	0.0351	0.0370	0.0481	0.0842
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	10	10	10	10	10	10	10
Degrees of freedom	9	9	9	9	9	9	9
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

Table 9.7.2.1b (Continued)

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	136.5637	289	62	227	0.6016
Catches at age	9.2352	90	43	47	0.1965
SSB Indices					
INDEX1	1.0733	3	0	3	0.3578
Aged Indices					
FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+	68.2086	84	6	78	0.8745
FLT05: PT MARCH ACOUSTIC SURVEY INCL.C	24.5349	42	6	36	0.6815
FLT06: PT NOVEMBER AC.SURVEY EXCL.CADI	33.5117	70	7	63	0.5319

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	11.3282	289	62	227	0.0499
Catches at age	6.9949	90	43	47	0.1488
SSB Indices					
INDEX1	1.0733	3	0	3	0.3578
Aged Indices					
FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+	1.8947	84	6	78	0.0243
FLT05: PT MARCH ACOUSTIC SURVEY INCL.C	0.6815	42	6	36	0.0189
FLT06: PT NOVEMBER AC.SURVEY EXCL.CADI	0.6839	70	7	63	0.0109

Table 9.7.2.2 Parameter values and CV's as estimated by the AMCI assessment model

Run id 2E+07 90845

Coefficients of variation are derived from the Hessian

Parameter						Value	CV
1	Initial	number	1978	age1		7409712	0.1122
2	Initial	number	1978	age2		3441888	0.1271
3	Initial	number	1978	age3		1218801	0.1458
4	Initial	number	1978	age4		567402.1	0.1671
5	Initial	number	1978	age5		170270.5	0.2201
6	Initial	number	1978	age6		65081.5	0.2741
7	Recruitment	age0	1978			10808557	0.1082
8	Recruitment	age0	1979			12360225	0.1031
9	Recruitment	age0	1980			14198976	0.1
10	Recruitment	age0	1981			9990000	0.0992
11	Recruitment	age0	1982			7219334	0.1081
12	Recruitment	age0	1983			18492600	0.0921
13	Recruitment	age0	1984			7347560	0.1021
14	Recruitment	age0	1985			5939755	0.1
15	Recruitment	age0	1986			5104620	0.0993
16	Recruitment	age0	1987			8816572	0.0923
17	Recruitment	age0	1988			5438944	0.0956
18	Recruitment	age0	1989			5084052	0.0976
19	Recruitment	age0	1990			4761592	0.0967
20	Recruitment	age0	1991			11441252	0.087
21	Recruitment	age0	1992			9622387	0.0938
22	Recruitment	age0	1993			4233690	0.1033
23	Recruitment	age0	1994			4183380	0.098
24	Recruitment	age0	1995			3446700	0.0973
25	Recruitment	age0	1996			4372834	0.0963
26	Recruitment	age0	1997			3333776	0.1169
27	Recruitment	age0	1998			3424839	0.1434
28	Recruitment	age0	1999			3242947	0.1983
29	Recruitment	age0	2000			13161504	0.276
30	Recruitment	age0	2001			7097802	0.4643
31	F-select	year	1978	age	0	0.1385	47.6839
32	F-select	year	1978	age	1	0.7956	47.685
33	F-select	year	1978	age	2	1.0635	47.7816
34	F-select	year	1978	age	3	0.8759	47.7489
35	F	year	1978			0.3753	0.1251
36	F	year	1979			0.3879	0.1222
37	F	year	1980			0.2837	0.1223
38	F	year	1981			0.354	0.1169
39	F	year	1982			0.3582	0.1164
40	F	year	1983			0.3167	0.1174
41	F	year	1984			0.2766	0.1167
42	F	year	1985			0.2777	0.1145
43	F	year	1986			0.34	0.1092
44	F	year	1987			0.3452	0.1082
45	F	year	1988			0.3679	0.1064
46	F	year	1989			0.4083	0.1049
47	F	year	1990			0.5175	0.1006
48	F	year	1991			0.4056	0.1064
49	F	year	1992			0.3783	0.1067
50	F	year	1993			0.5021	0.1042
51	F	year	1994			0.4025	0.113
52	F	year	1995			0.4085	0.11
53	F	year	1996			0.4261	0.1043
54	F	year	1997			0.4752	0.1003
55	F	year	1998			0.5028	0.1024
56	F	year	1999			0.4691	0.1228
57	F	year	2000			0.4731	0.1554

Table 9.7.2.2 Parameter values and CV's as estimated by the AMCI assessment model (Cont'd)

58	F	year		2001		0.3767	0.2059
59	Pt.	November	Acoustic	age	0	0.0006	0.4278
60	Pt.	November	Acoustic	age	1	0.0007	0.4097
61	Pt.	November	Acoustic	age	2	0.0006	0.4291
62	Pt.	November	Acoustic	age	3	0.0006	0.466
63	Pt.	November	Acoustic	age	4	0.0007	0.5222
64	Pt.	November	Acoustic	age	5	0.0004	0.7318
65	Pt.	November	Acoustic	age	6	0.0002	1.0511
66	Sp.	March	Acoustic	age	1	0.0132	0.6689
67	Sp.	March	Acoustic	age	2	0.0282	0.6114
68	Sp.	March	Acoustic	age	3	0.0994	0.4192
69	Sp.	March	Acoustic	age	4	0.1705	0.5273
70	Sp.	March	Acoustic	age	5	0.4043	0.4347
71	Sp.	March	Acoustic	age	6	0.5572	0.4718
72	Pt.	March	Acoustic	age	1	0.0013	0.3756
73	Pt.	March	Acoustic	age	2	0.0013	0.3582
74	Pt.	March	Acoustic	age	3	0.0015	0.3433
75	Pt.	March	Acoustic	age	4	0.0021	0.3532
76	Pt.	March	Acoustic	age	5	0.0018	0.4462
77	Pt.	March	Acoustic	age	6	0.0011	0.5274
78	Pt.	March	Acoustic	age	4	0.0021	0.3765
79	Pt.	March	Acoustic	age	5	0.0018	0.5004
80	Pt.	March	Acoustic	age	6	0.0008	0.6126

Table 9.7.2.3 Summary of AMCI assessment

Run id 20020918 090845.471

SUMMARY TABLE

Year	Recruits age 0	SSB	F 2 - 5	Catch SOP
1978	10808556	285612	0.3753	173761
1979	12360225	342946	0.3879	162454
1980	14198976	410070	0.2837	204861
1981	9990000	505508	0.3540	242574
1982	7219334	534834	0.3582	214148
1983	18492600	496516	0.3167	176636
1984	7347559	542978	0.2766	215114
1985	5939755	617478	0.2777	219928
1986	5104620	556239	0.3400	192838
1987	8816571	455638	0.3452	176283
1988	5438944	390415	0.3679	157273
1989	5084052	318300	0.4083	146539
1990	4761592	276185	0.5175	142966
1991	11441252	264450	0.4056	132785
1992	9622386	356334	0.3783	131196
1993	4233689	394271	0.5021	144949
1994	4183380	392991	0.4025	138725
1995	3446699	413913	0.4085	126755
1996	4372833	348892	0.4261	115179
1997	3333776	296121	0.4752	117250
1998	3424839	236268	0.5028	112033
1999	3242946	194019	0.4691	95793
2000	13161504	159852	0.4731	87272
2001	7097801	202934	0.3767	102903
2002	9000000	336911	0.3767	0

Table 9.8.1.1 - Input values and results for short term predictions based on the ICA assessment model output.

2002

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	6595000	0.33	0	0.25	0.25	0.000	0.020	0.024
1	6834000	0.33	0.391	0.25	0.25	0.018	0.047	0.040
2	7315000	0.33	0.902	0.25	0.25	0.041	0.108	0.057
3	2158000	0.33	0.962	0.25	0.25	0.057	0.200	0.066
4	1119000	0.33	0.989	0.25	0.25	0.067	0.235	0.072
5	438000	0.33	1	0.25	0.25	0.072	0.200	0.075
6	440000	0.33	1	0.25	0.25	0.100	0.200	0.100

2003

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	6595000	0.33	0	0.25	0.25	0.000	0.020	0.024
1	.	0.33	0.391	0.25	0.25	0.018	0.047	0.040
2	.	0.33	0.902	0.25	0.25	0.041	0.108	0.057
3	.	0.33	0.962	0.25	0.25	0.057	0.200	0.066
4	.	0.33	0.989	0.25	0.25	0.067	0.235	0.072
5	.	0.33	1	0.25	0.25	0.072	0.200	0.075
6	.	0.33	1	0.25	0.25	0.100	0.200	0.100

2004

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	6595000	0.33	0	0.25	0.25	0.000	0.020	0.024
1	.	0.33	0.391	0.25	0.25	0.018	0.047	0.040
2	.	0.33	0.902	0.25	0.25	0.041	0.108	0.057
3	.	0.33	0.962	0.25	0.25	0.057	0.200	0.066
4	.	0.33	0.989	0.25	0.25	0.067	0.235	0.072
5	.	0.33	1	0.25	0.25	0.072	0.200	0.075
6	.	0.33	1	0.25	0.25	0.100	0.200	0.100

Input units are thousands and kg - output in tonnes

Table 9.8.1.1 (cont) - Input values and results for short term predictions based on the ICA assessment model output.

Year:		2002	F multiplier		1	Fbar:	0.1858				
Age		F	CatchNos	Yield		StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	0	0.0197	109366	2661		6595000	0	0	0	0	0
	1	0.0472	268730	10839		6834000	123012	2672094	48098	2431629	43769
	2	0.1076	637531	36339		7315000	302353	6598130	272723	5914363	244460
	3	0.2004	335594	22149		2158000	123006	2075996	118332	1818198	103637
	4	0.235	200888	14464		1119000	74973	1106691	74148	960911	64381
	5	0.2004	68114	5131		438000	31390	438000	31390	383609	27492
	6	0.2004	68425	6843		440000	44000	440000	44000	385361	38536
Total			1688648	98426		24899000	698734	13330911	588690	11894071	522276

Year:		2003	F multiplier		1	Fbar:	0.1858				
Age		F	CatchNos	Yield		StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	0	0.0197	109366	2661		6595000	0	0	0	0	0
	1	0.0472	182812	7373		4649040	83683	1817775	32720	1654191	29775
	2	0.1076	408455	23282		4686594	193713	4227308	174729	3789230	156622
	3	0.2004	734387	48470		4722399	269177	4542948	258948	3978804	226792
	4	0.235	227947	16412		1269727	85072	1255760	84136	1090344	73053
	5	0.2004	98905	7451		636001	45580	636001	45580	557023	39920
	6	0.2004	80337	8034		516599	51660	516599	51660	452447	45245
Total			1842210	113683		23075361	728884	12996391	647773	11522039	571407

Year:		2004	F multiplier		1	Fbar:	0.1858				
Age		F	CatchNos	Yield		StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	0	0.0197	109366	2661		6595000	0	0	0	0	0
	1.00	0.0472	182812	7373		4649040	83683	1817775	32720	1654191	29775
	2.00	0.1076	277864	15838		3188201	131779	2875757	118865	2577741	106547
	3.00	0.2004	470509	31054		3025560	172457	2910589	165904	2549151	145302
	4.00	0.235	498823	35915		2778572	186164	2748007	184116	2386024	159864
	5.00	0.2004	112228	8454		721669	51720	721669	51720	632052	45297
	6.00	0.2004	105463	10546		678168	67817	678168	67817	593953	59395
Total			1757065	111843		21636211	693619	11751966	621141	10393113	546180

Input units are thousands and kg - output in tonnes

Table 9.8.1.1 (cont) - Input values and results for short term predictions based on the ICA assessment model output.

2002				
Biomass	SSB	FMult	FBar	Landings
698734	522276	1	0.1858	98426

2003					2004	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
728884	596476	0	0	0	791294	659283
.	593916	0.1	0.0186	12219	780744	646798
.	591367	0.2	0.0372	24240	770377	634591
.	588831	0.3	0.0558	36065	760190	622656
.	586306	0.4	0.0743	47700	750178	610985
.	583794	0.5	0.0929	59147	740339	599573
.	581293	0.6	0.1115	70409	730669	588413
.	578804	0.7	0.1301	81491	721166	577500
.	576326	0.8	0.1487	92395	711825	566827
.	573861	0.9	0.1673	103124	702644	556389
.	571407	1	0.1858	113683	693619	546180
.	568964	1.1	0.2044	124074	684749	536194
.	566533	1.2	0.223	134300	676029	526428
.	564113	1.3	0.2416	144364	667457	516874
.	561704	1.4	0.2602	154269	659031	507528
.	559307	1.5	0.2788	164018	650747	498386
.	556922	1.6	0.2973	173615	642603	489442
.	554547	1.7	0.3159	183061	634596	480692
.	552183	1.8	0.3345	192359	626723	472131
.	549831	1.9	0.3531	201513	618982	463755
.	547489	2	0.3717	210524	611371	455559

Input units are thousands and kg - output in tonnes

Table 9.8.1.2 - Input values and results for short term predictions based on the AMCI assessment model output.

2002

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	4295000	0.33	0	0.25	0.25	0	0.0872	2.43E-02
1	4410000	0.33	0.391	0.25	0.25	0.018	0.1662	4.03E-02
2	4030000	0.33	0.902	0.25	0.25	4.13E-02	0.2624	0.057
3	764000	0.33	0.962	0.25	0.25	0.057	0.4148	0.066
4	364000	0.33	0.989	0.25	0.25	0.067	0.4148	0.072
5	169000	0.33	1	0.25	0.25	7.17E-02	0.4148	7.53E-02
6	175000	0.33	1	0.25	0.25	0.1	0.4148	0.1

2003

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	4295000	0.33	0	0.25	0.25	0	0.0872	2.43E-02
1	.	0.33	0.391	0.25	0.25	0.018	0.1662	4.03E-02
2	.	0.33	0.902	0.25	0.25	4.13E-02	0.2624	0.057
3	.	0.33	0.962	0.25	0.25	0.057	0.4148	0.066
4	.	0.33	0.989	0.25	0.25	0.067	0.4148	0.072
5	.	0.33	1	0.25	0.25	7.17E-02	0.4148	7.53E-02
6	.	0.33	1	0.25	0.25	0.1	0.4148	0.1

2004

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	4295000	0.33	0	0.25	0.25	0	0.0872	2.43E-02
1	.	0.33	0.391	0.25	0.25	0.018	0.1662	4.03E-02
2	.	0.33	0.902	0.25	0.25	4.13E-02	0.2624	0.057
3	.	0.33	0.962	0.25	0.25	0.057	0.4148	0.066
4	.	0.33	0.989	0.25	0.25	0.067	0.4148	0.072
5	.	0.33	1	0.25	0.25	7.17E-02	0.4148	7.53E-02
6	.	0.33	1	0.25	0.25	0.1	0.4148	0.1

Input units are thousands and kg - output in tonnes

Table 9.8.1.2(cont.) Input values and results for short term predictions based on the AMCI assessment model output.

Year:	2002	F multiplier	1	Fbar:	0.3767				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0872	306218	7451	4295000	0	0	0	0	0
1	0.1662	577787	23304	4410000	79380	1724310	31038	1523145	27417
2	0.2624	797926	45482	4030000	166573	3635060	150249	3134675	129567
3	0.4148	223456	14748	764000	43548	734968	41893	610102	34776
4	0.4148	106464	7665	364000	24388	359996	24120	298835	20022
5	0.4148	49430	3724	169000	12112	169000	12112	140288	10054
6	0.4148	51184	5118	175000	17500	175000	17500	145269	14527
Total		2112465	107493	14207000	343501	6798334	276911	5852315	236362

Year:	2003	F multiplier	1	Fbar:	0.3767				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0872	306218	7451	4295000	0	0	0	0	0
1	0.1662	370770	14954	2829929	50939	1106502	19917	977413	17593
2	0.2624	531618	30302	2684984	110979	2421855	100103	2088475	86324
3	0.4148	651821	43020	2228584	127029	2143898	122202	1779666	101441
4	0.4148	106104	7639	362770	24306	358779	24038	297825	19954
5	0.4148	50552	3808	172838	12387	172838	12387	143474	10282
6	0.4148	47774	4777	163341	16334	163341	16334	135591	13559
Total		2064857	111953	12737445	341974	6367213	294982	5422443	249154

Year:	2004	F multiplier	1	Fbar:	0.3767				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0872	306218	7451	4295000	0	0	0	0	0
1	0.1662	370770	14954	2829929	50939	1106502	19917	977413	17593
2	0.2624	341143	19445	1722973	71216	1554122	64237	1340189	55394
3	0.4148	434275	28662	1484792	84633	1428370	81417	1185701	67585
4	0.4148	309504	22284	1058197	70899	1046557	70119	868755	58207
5	0.4148	50381	3795	172254	12345	172254	12345	142989	10248
6	0.4148	46688	4669	159628	15963	159628	15963	132508	13251
Total		1858980	101261	11722772	305995	5467432	263998	4647554	222278

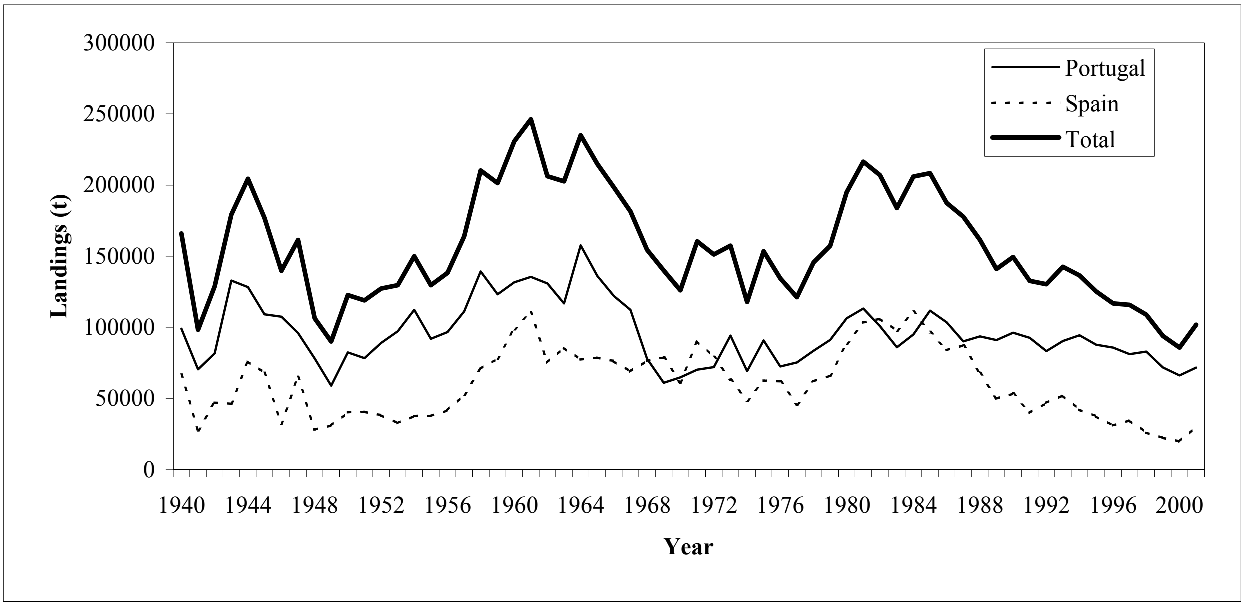
Input units are thousands and kg - output in tonnes

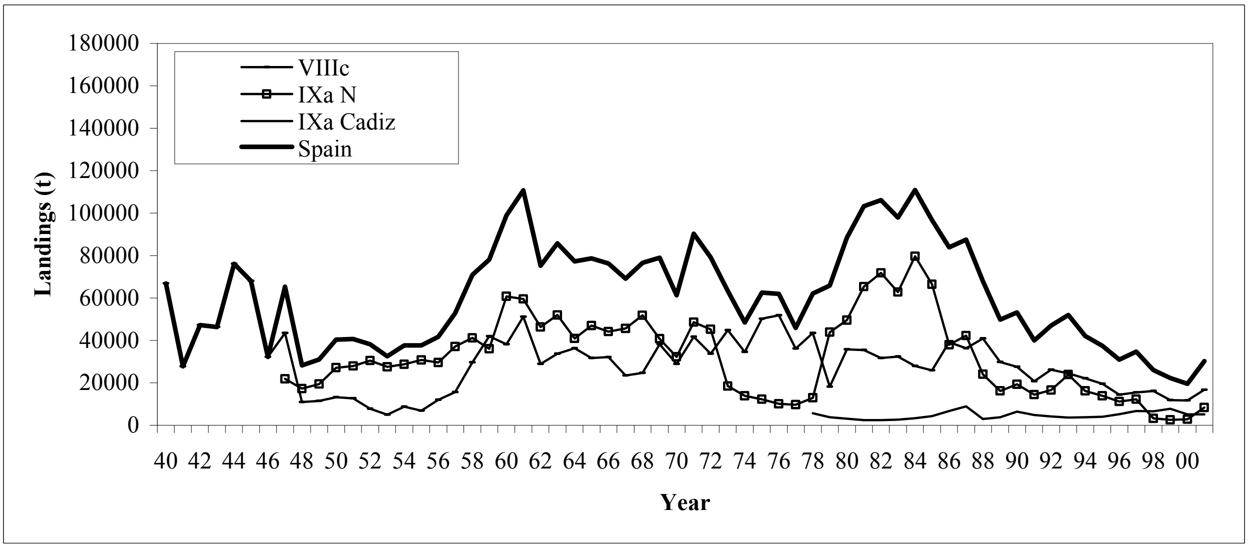
Table 9.8.1.2(cont.) Input values and results for short term predictions based on the AMCI assessment model output.

2002				
Biomass	SSB	FMult	FBar	Landings
343501	236362	1	0.3767	107493

2003					2004	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
341974	271622	0	0	0	399906	324544
.	269282	0.1	0.0377	12773	389084	312250
.	266962	0.2	0.0753	25162	378612	300473
.	264664	0.3	0.113	37181	368476	289188
.	262387	0.4	0.1507	48842	358664	278375
.	260131	0.5	0.1884	60158	349166	268012
.	257895	0.6	0.226	71140	339969	258079
.	255679	0.7	0.2637	81800	331064	248557
.	253484	0.8	0.3014	92149	322439	239427
.	251309	0.9	0.339	102196	314086	230673
.	249154	1	0.3767	111953	305995	222278
.	247018	1.1	0.4144	121429	298156	214225
.	244902	1.2	0.452	130634	290561	206501
.	242805	1.3	0.4897	139576	283201	199090
.	240727	1.4	0.5274	148264	276068	191979
.	238668	1.5	0.5651	156708	269155	185155
.	236628	1.6	0.6027	164914	262453	178604
.	234606	1.7	0.6404	172891	255955	172317
.	232602	1.8	0.6781	180646	249655	166280
.	230617	1.9	0.7157	188187	243545	160483
.	228650	2	0.7534	195520	237620	154915

Input units are thousands and kg - output in tonnes





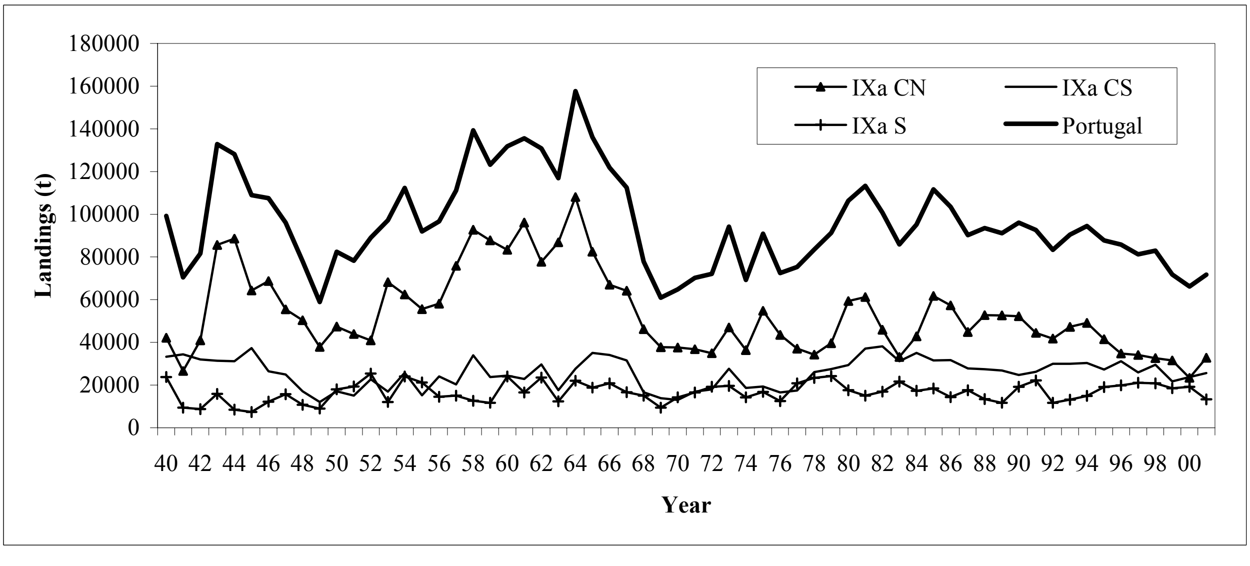


Figure 9.2.1: Annual landings of sardine, by country (upper pannel) and by ICES Sub-Division and country

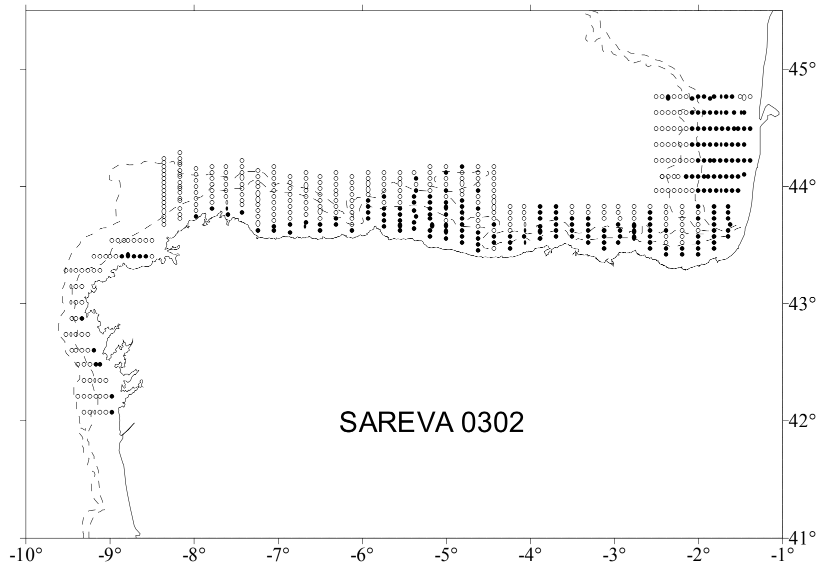


Figure 1. Location of CUFES stations.Presence (•) and absence (◦) of sardine eggs.

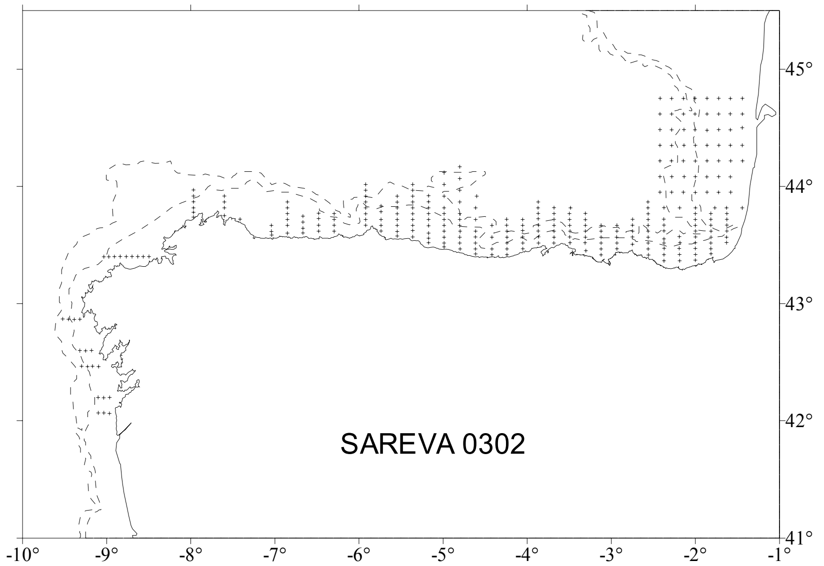
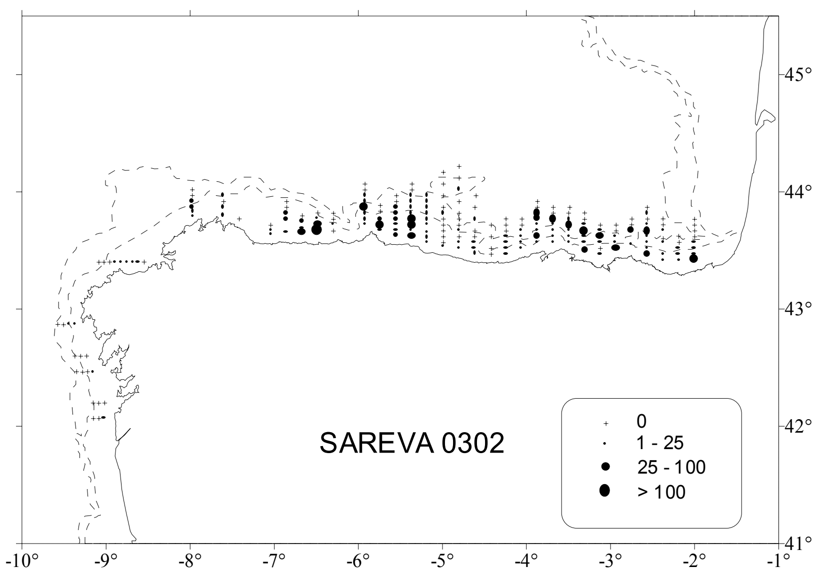


Figure 2. Stations sampled with the CalVET net



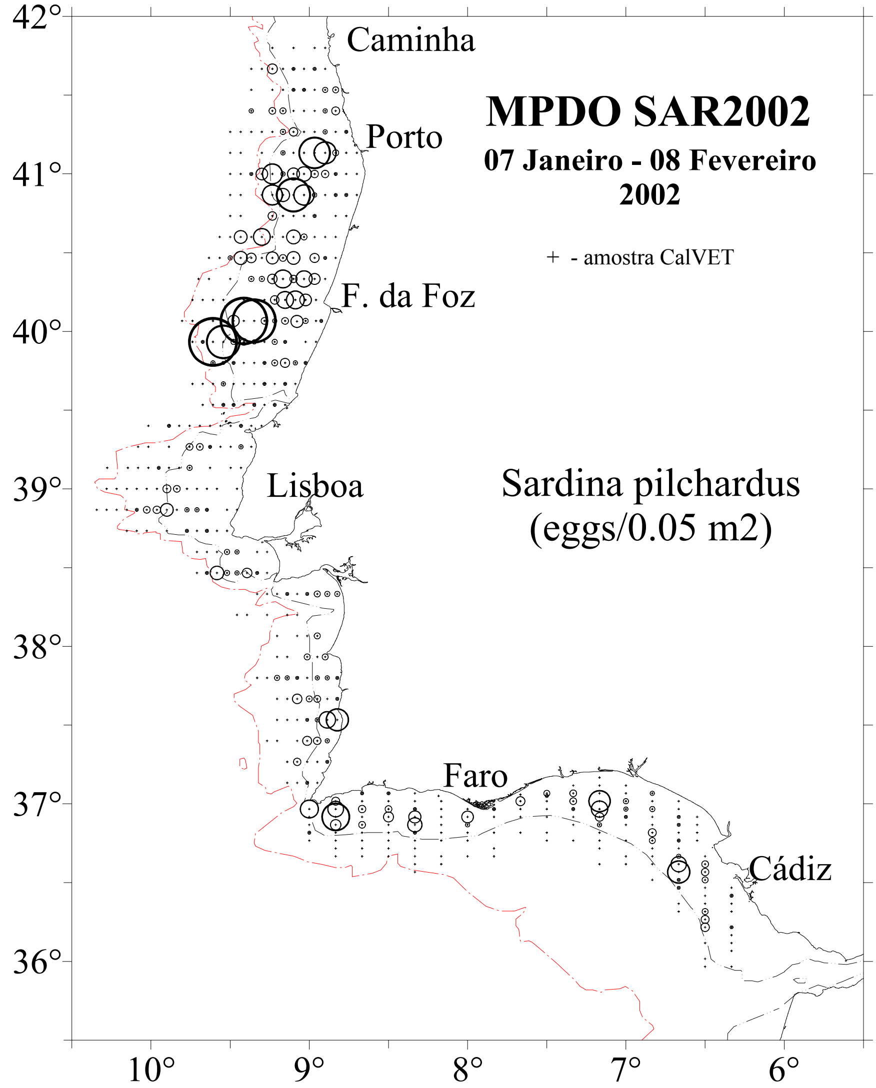


Figure 9.3.1.2. Portuguese DEPM sampling stations and sampled abundance of eggs

.

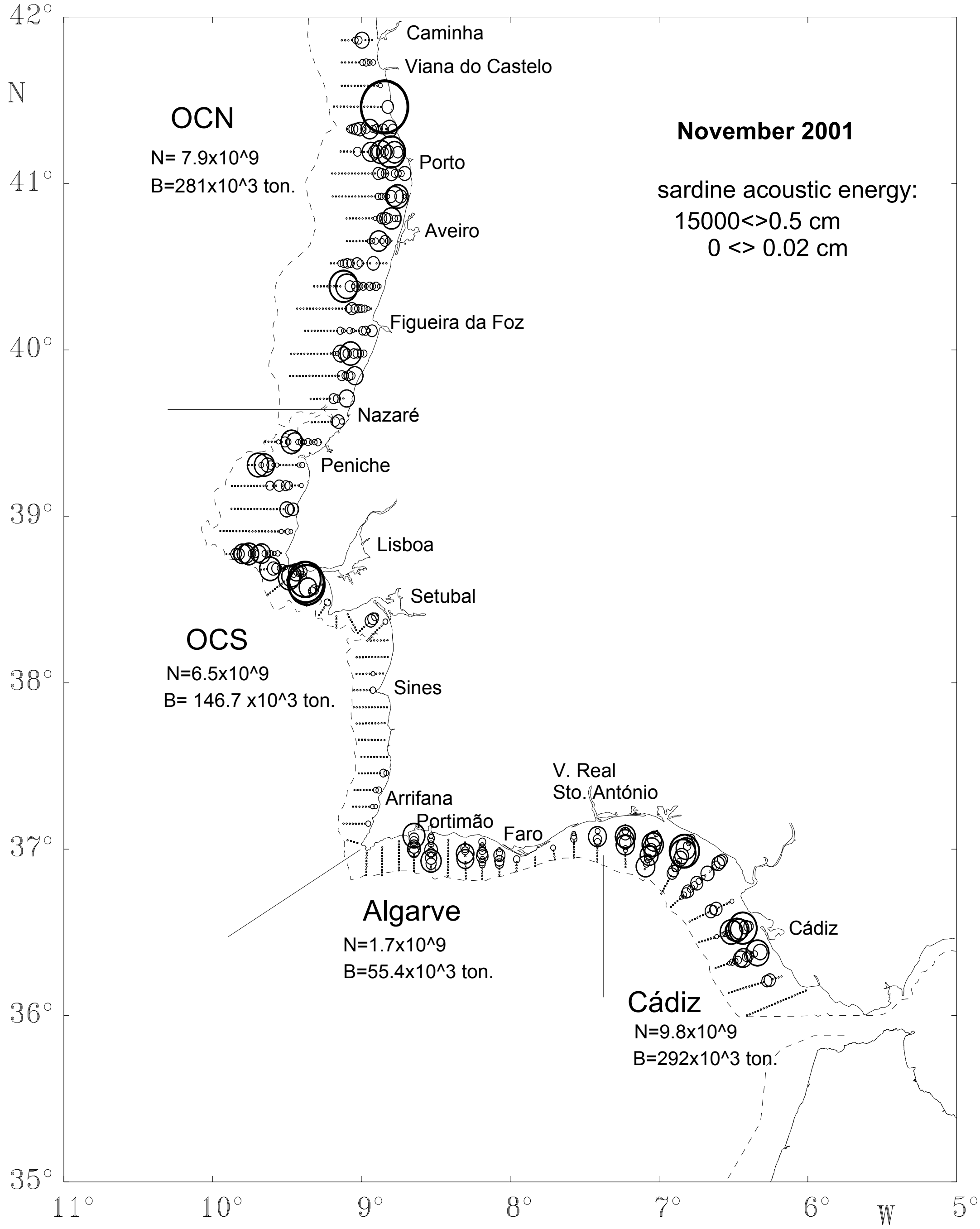


Figure 9.3.2.1 – Portuguese November acoustic survey in 2001: sardine acoustic energy per nautical mile and abundance, in number and biomass, for each zone. Circle diameter is proportional to the square root of the acoustic energy (SA m^2/nm^2).

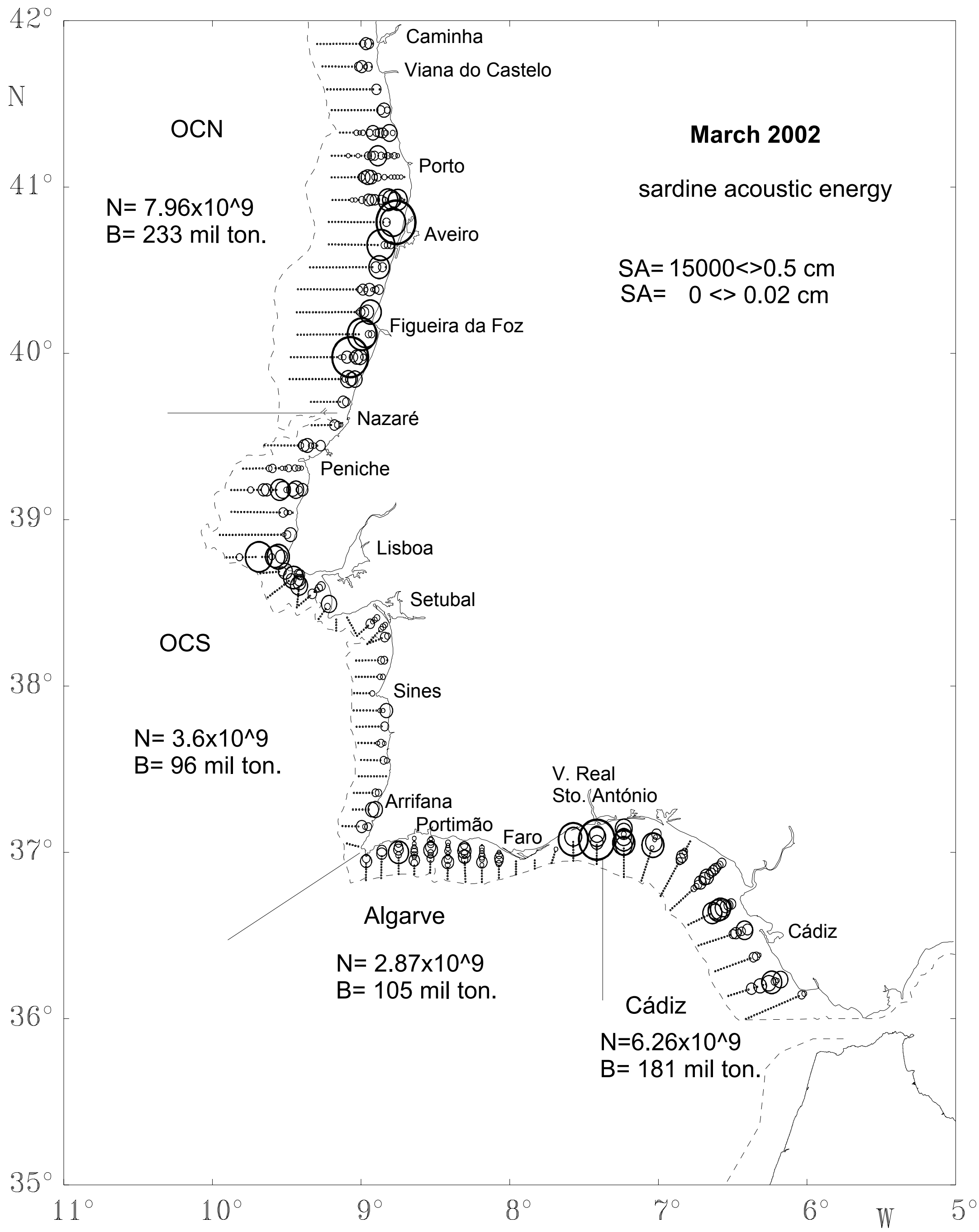
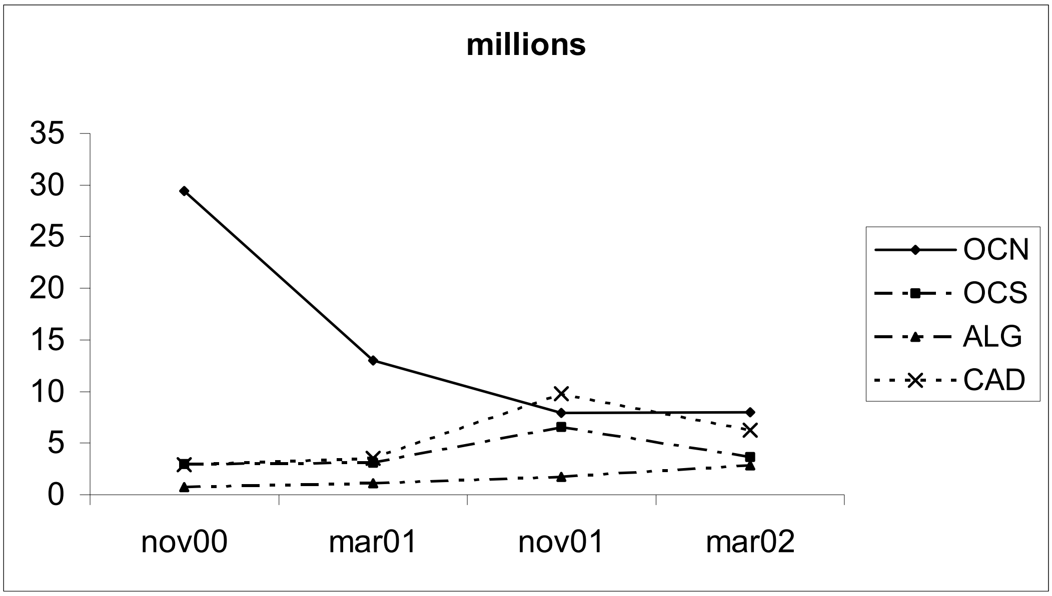


Figure 9.3.2.2 – Portuguese March acoustic survey in 2002: sardine acoustic energy per nautical mile and abundance, in number and biomass, for each zone. Circle diameter is proportional to the square root of the acoustic energy (SA m^2/nm^2).



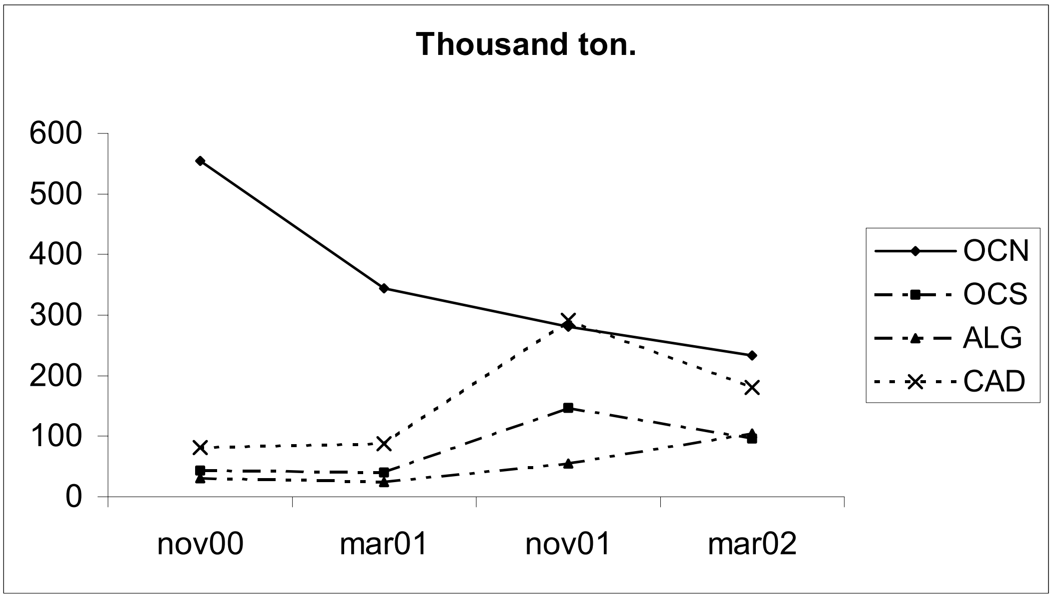


Figure 9.3.2.3 – Sardine abundance evolution, in numbers (top) and in biomass (bottom) in the Portuguese acoustic surveys from November 2000 to March 2002, in each sub-area.

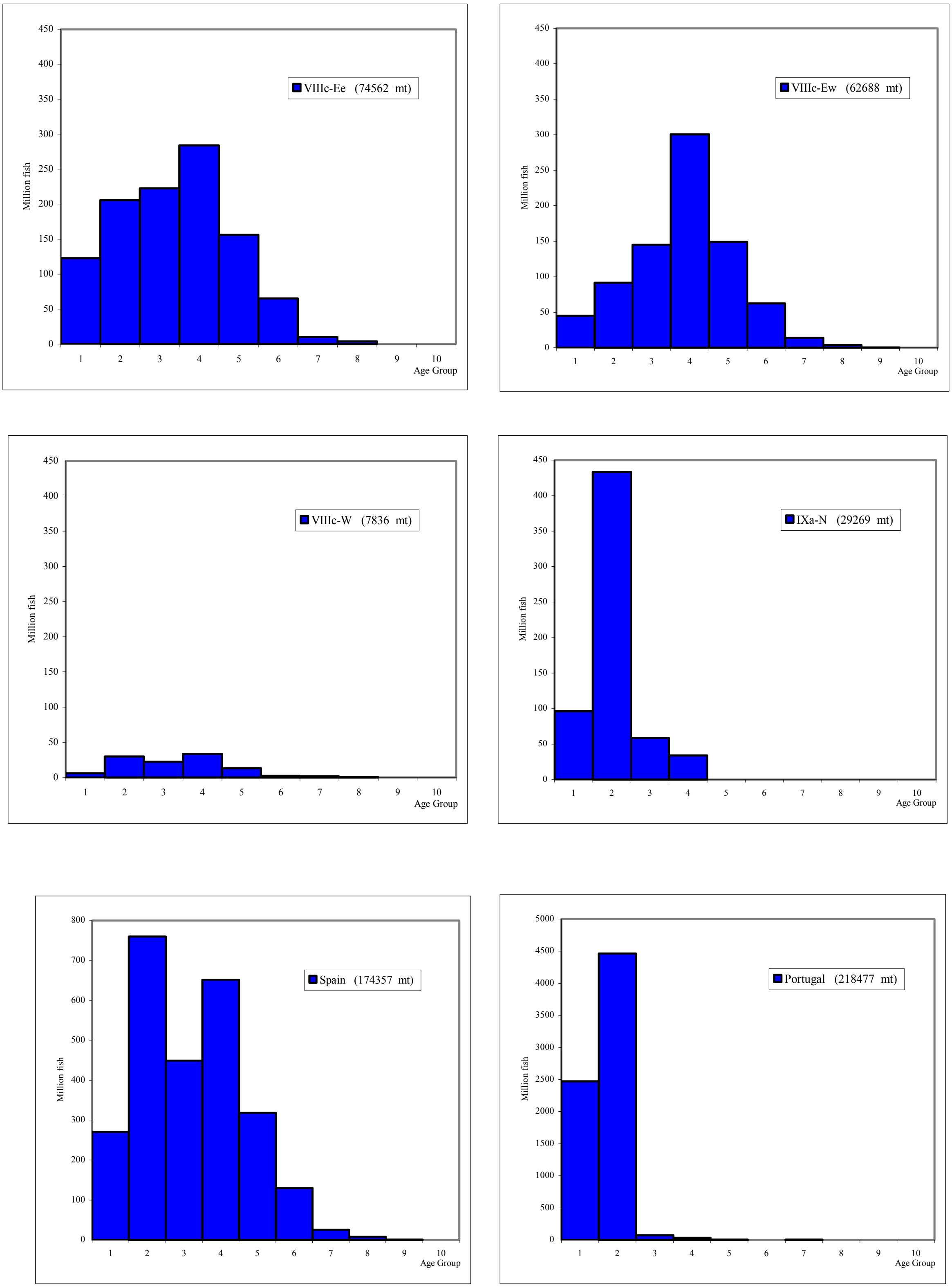


Figure 9.3.2.4: Estimated fish number of sardine(millions) for the Spanish Spring Acoustic survey 2002.

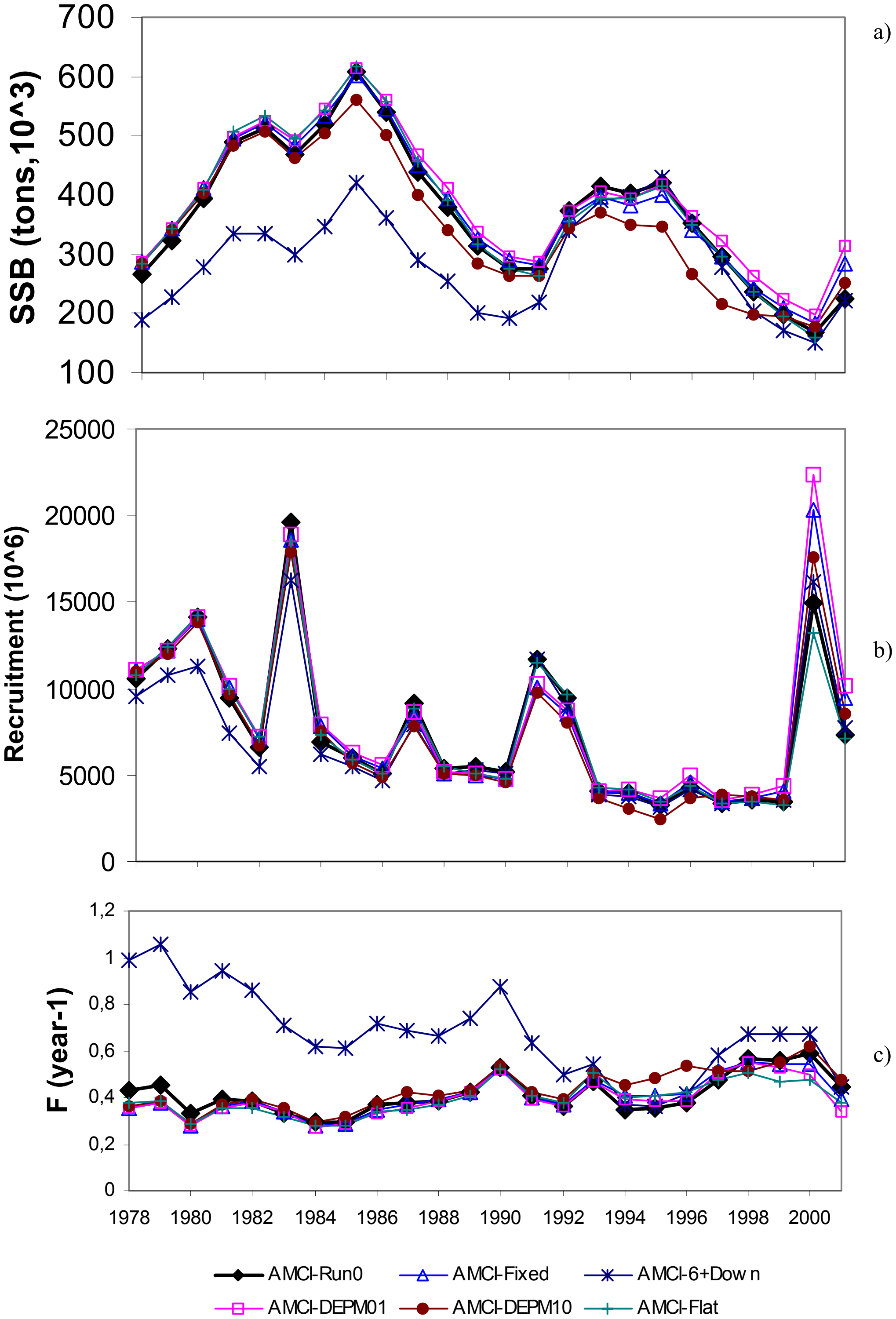


Figure 9.7.1.1: a) SSB, b) Recruits and c) F2-5 estimates from the different runs using AMCI.

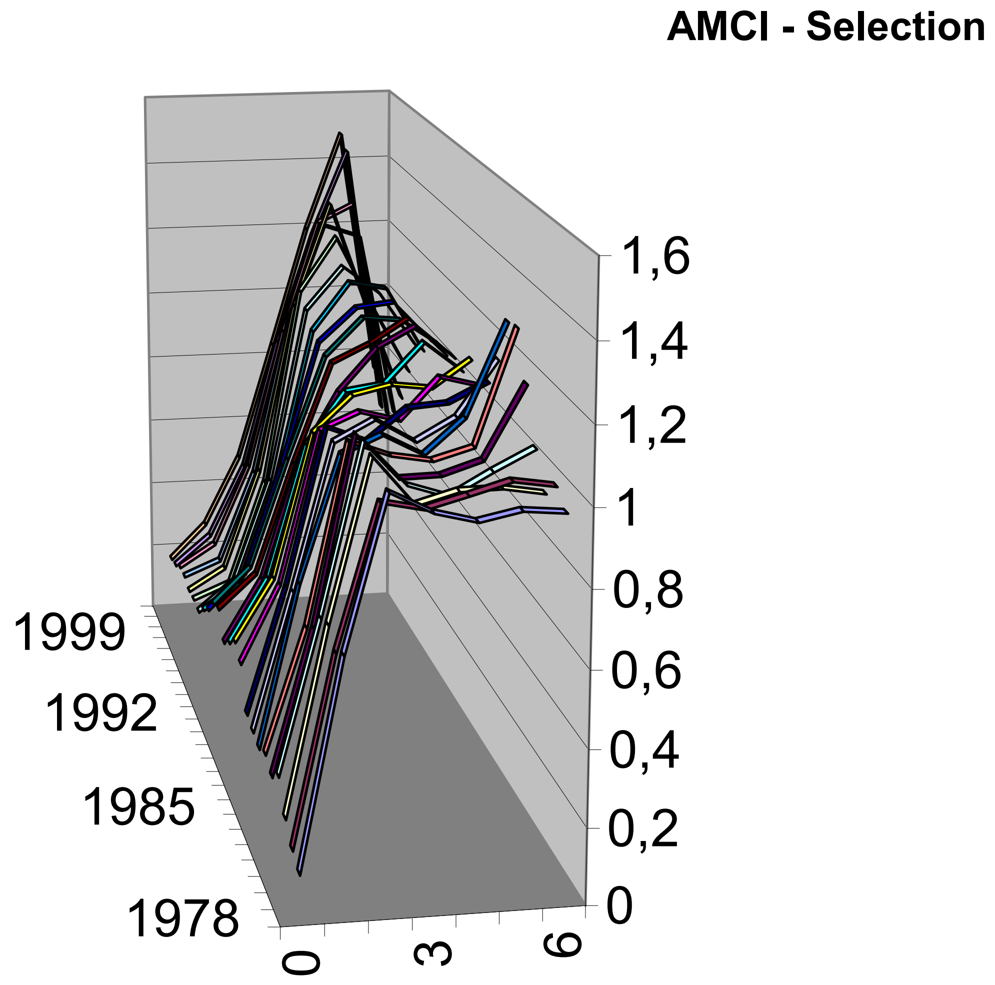
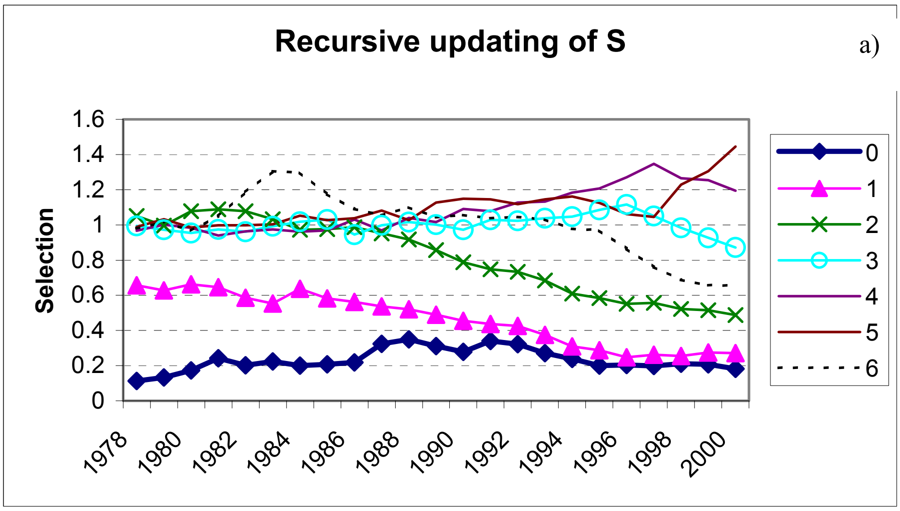
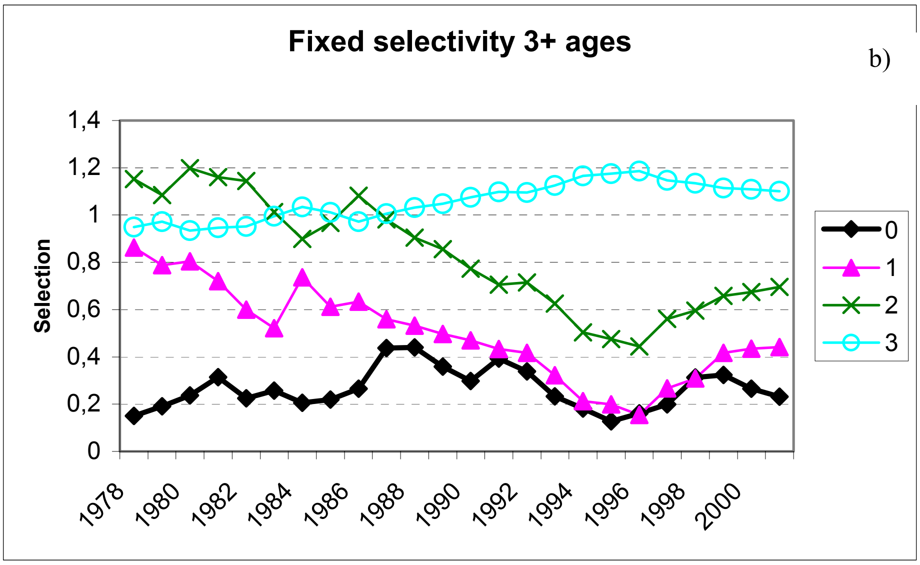


Figure 9.7.1.2: AMCI Run 0 selectivity pattern for all ages and years.





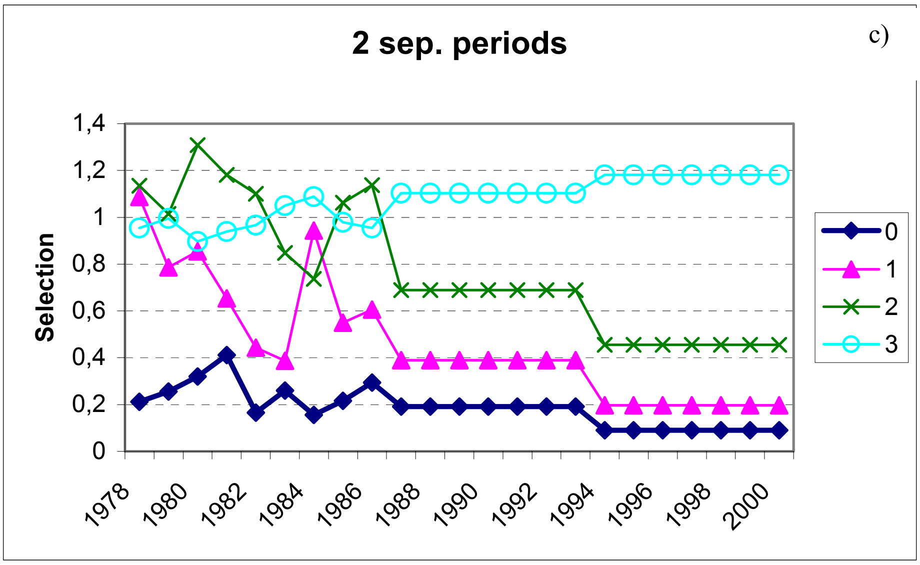


Figure 9.7.1.3. Selectivity patterns of a) AMCI-Run0 , b) AMCI – Flat and c) AMCI - Fixed runs

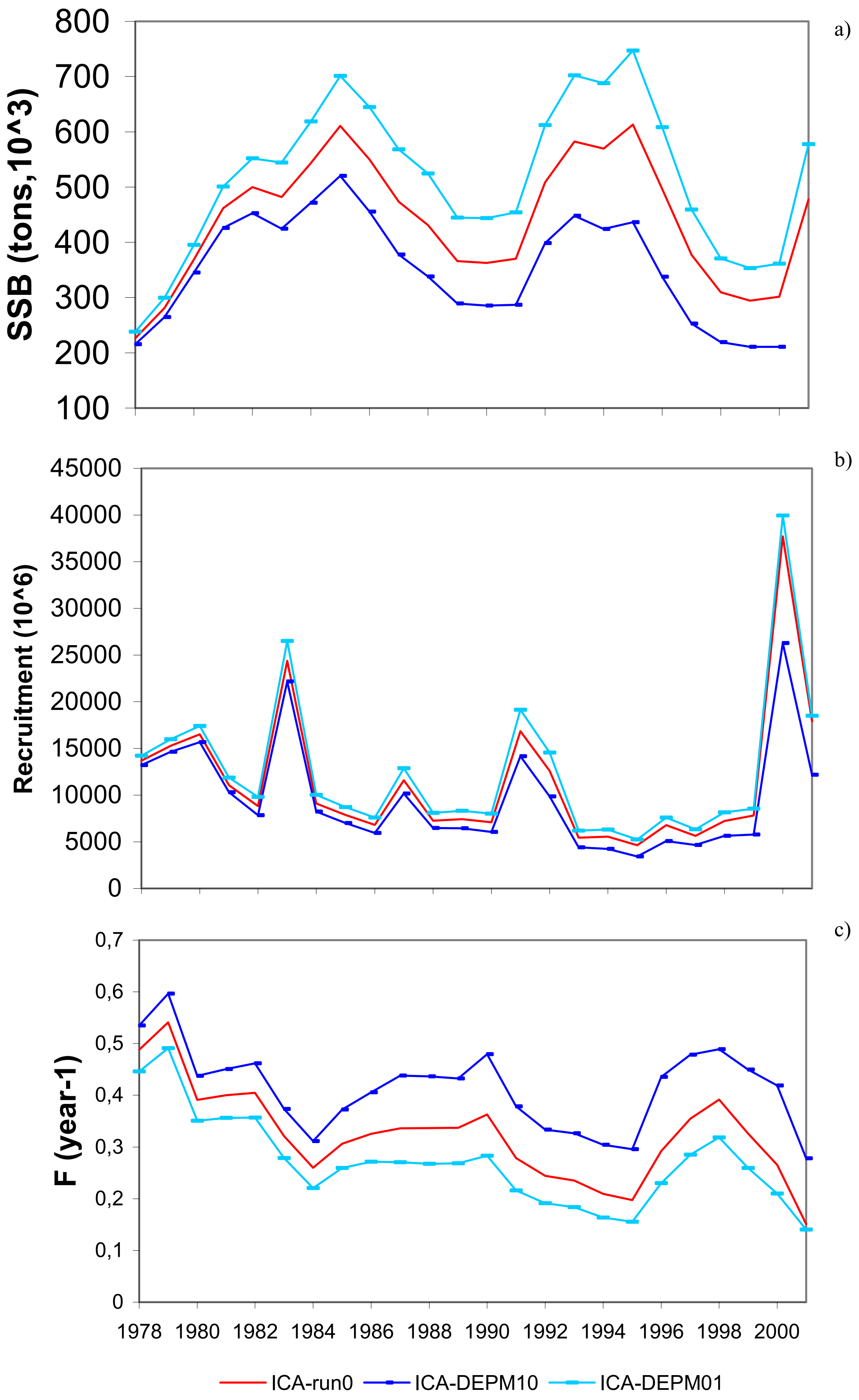


Figure 9.7.1.4: a) SSB, b) recruits and c) F2-5 estimates from the different runs using ICA.

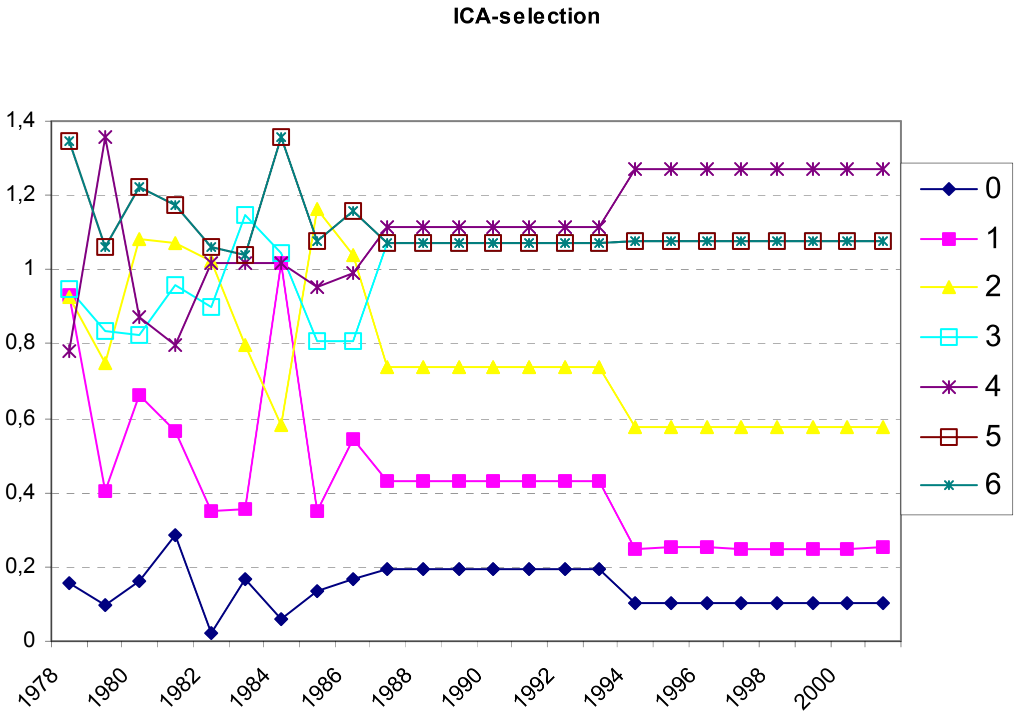


Figure 9.1.7.5: ICA selection pattern.

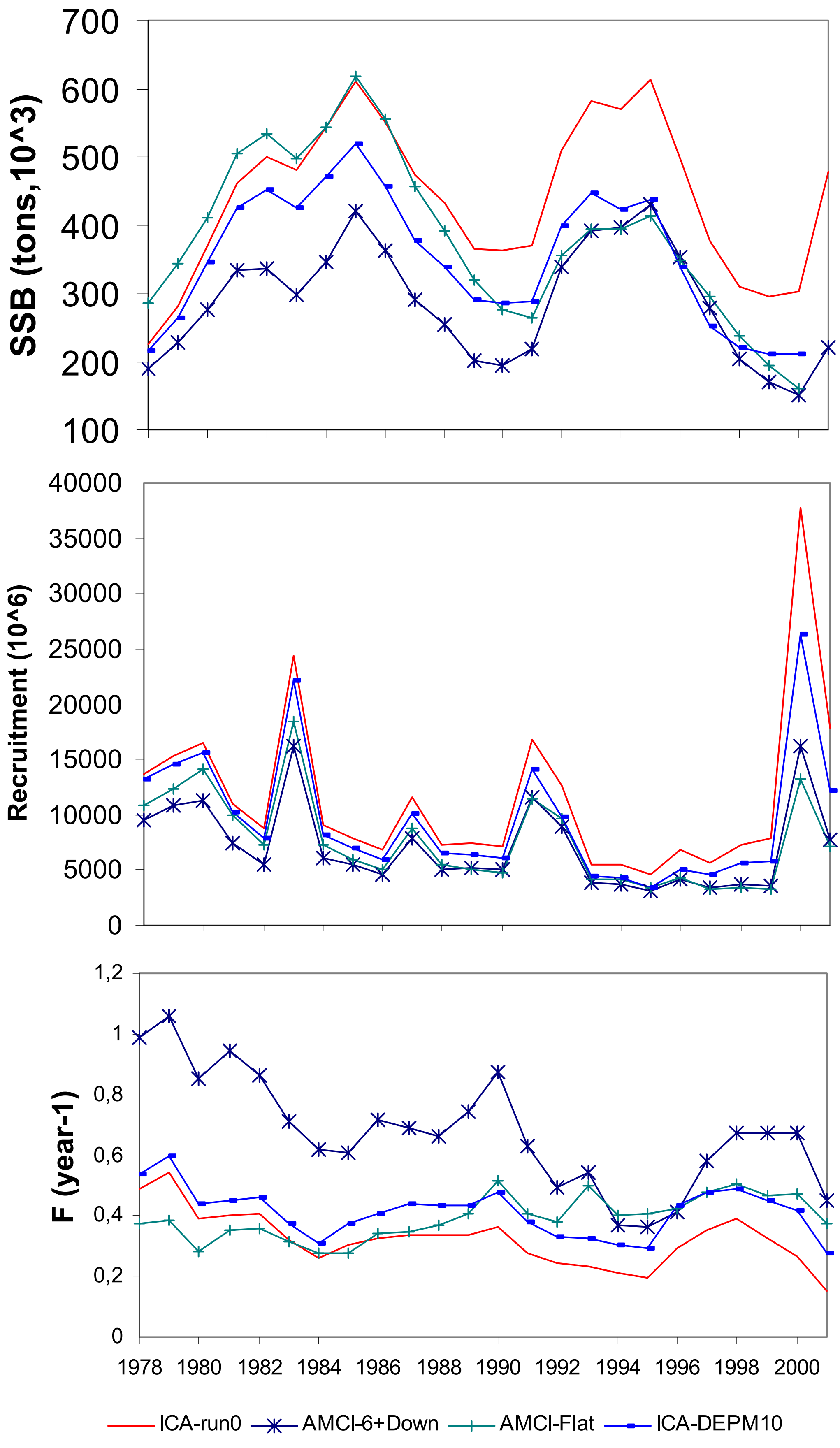


Figure 9.7.1.6: SSB, recruits and F2-5 estimates from representative runs of both AMCI and ICA runs.

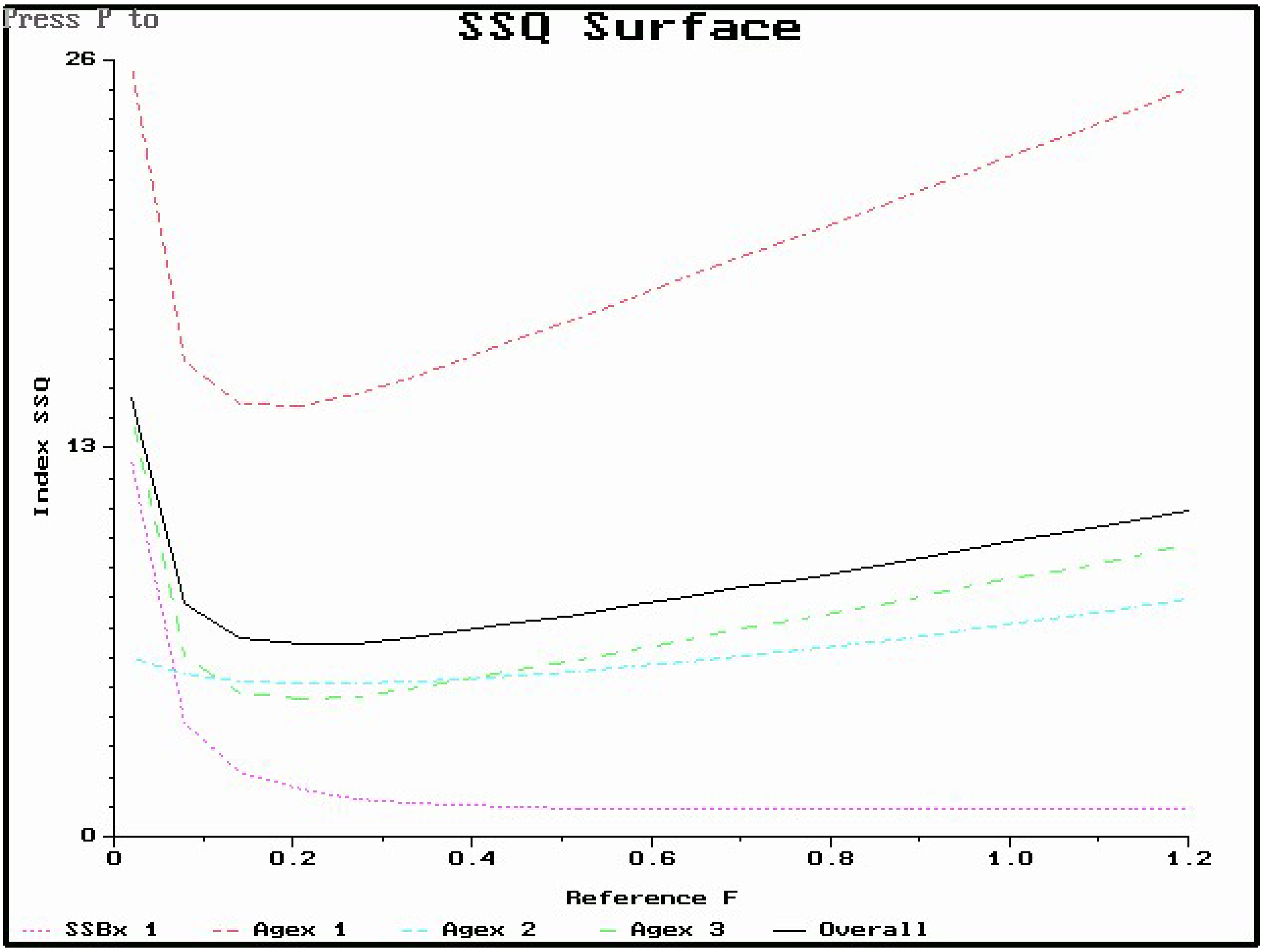


Figure 9.7.2.1 Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model. (SSBx1 is DEPM –absolute estimator-; Agex 1 is the Spanish Spring Acoustic survey time series –linear estimator-; Agex 2 is the Portuguese Spring Acoustic survey time series –linear estimator-; Agex 3 is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

Stock Summary

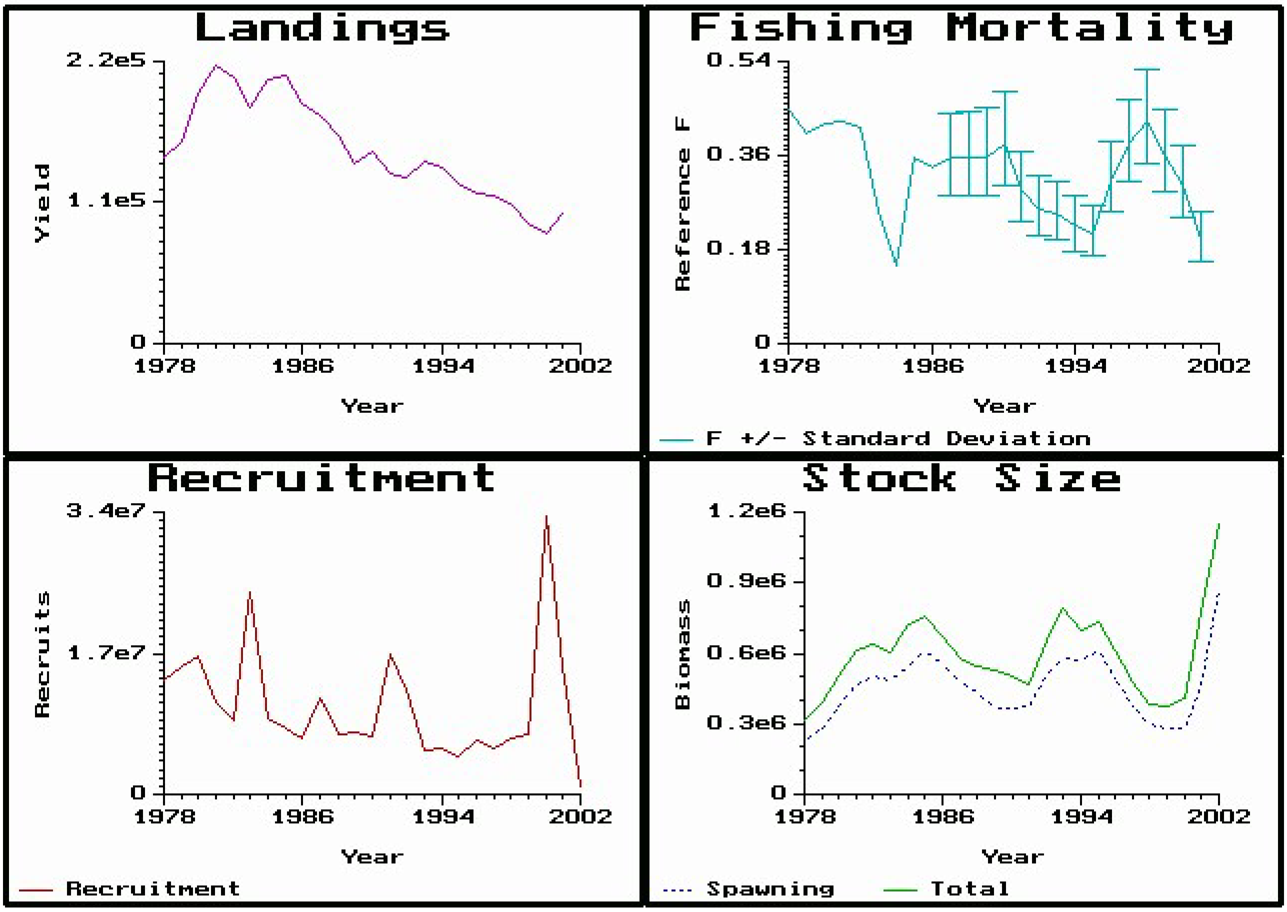
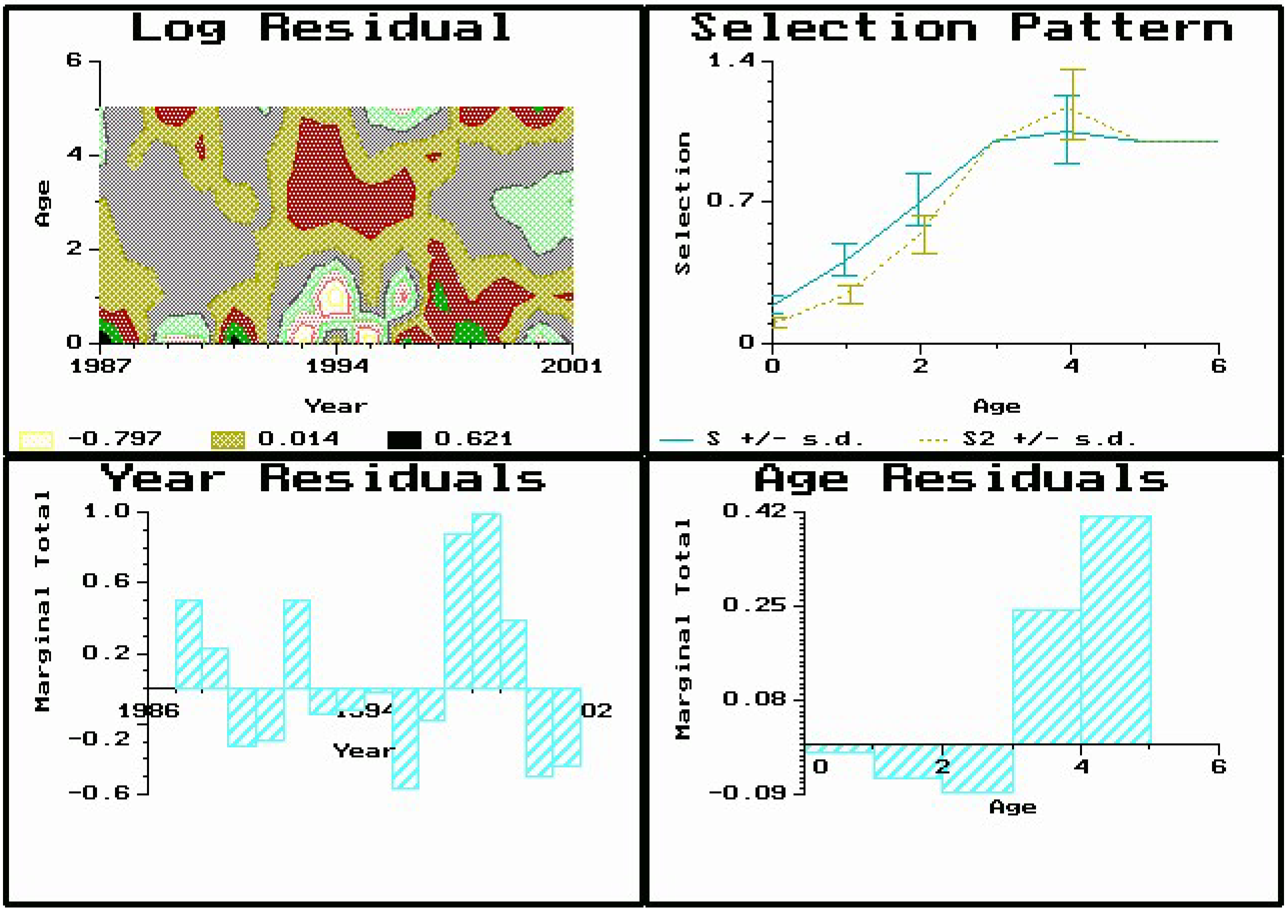


Figure 9.7.2.1 (Cont'd)

Separable Model Diagnostics



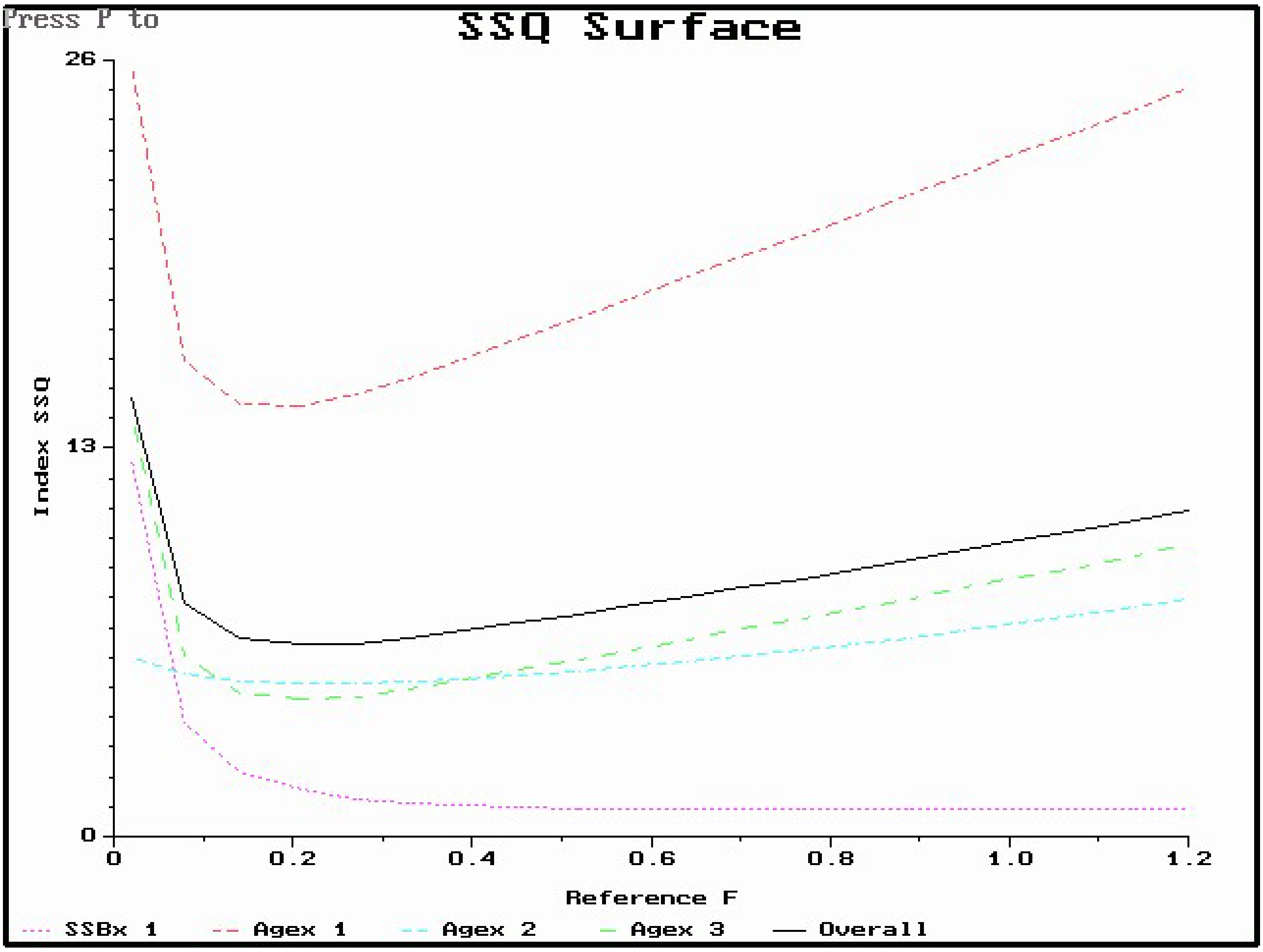
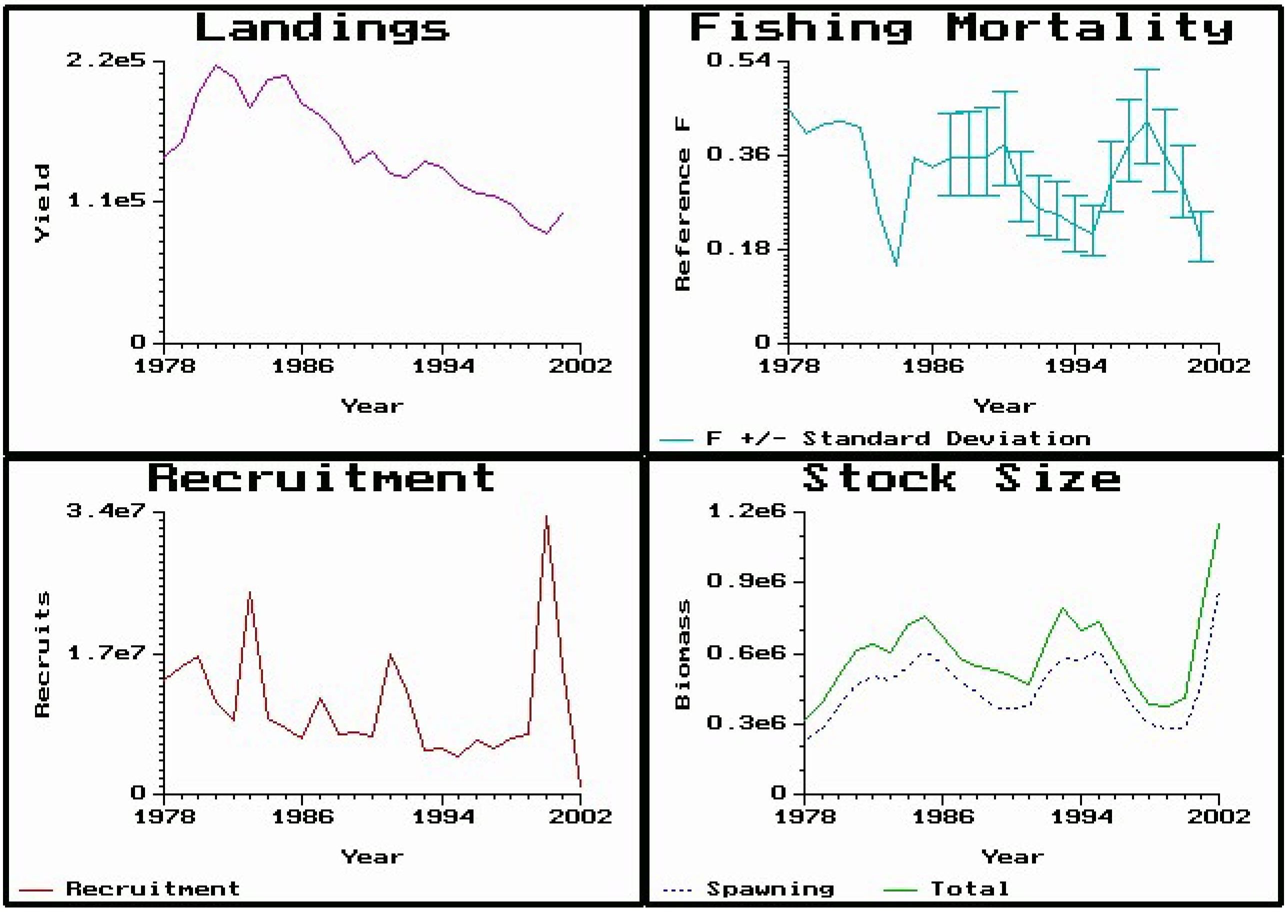
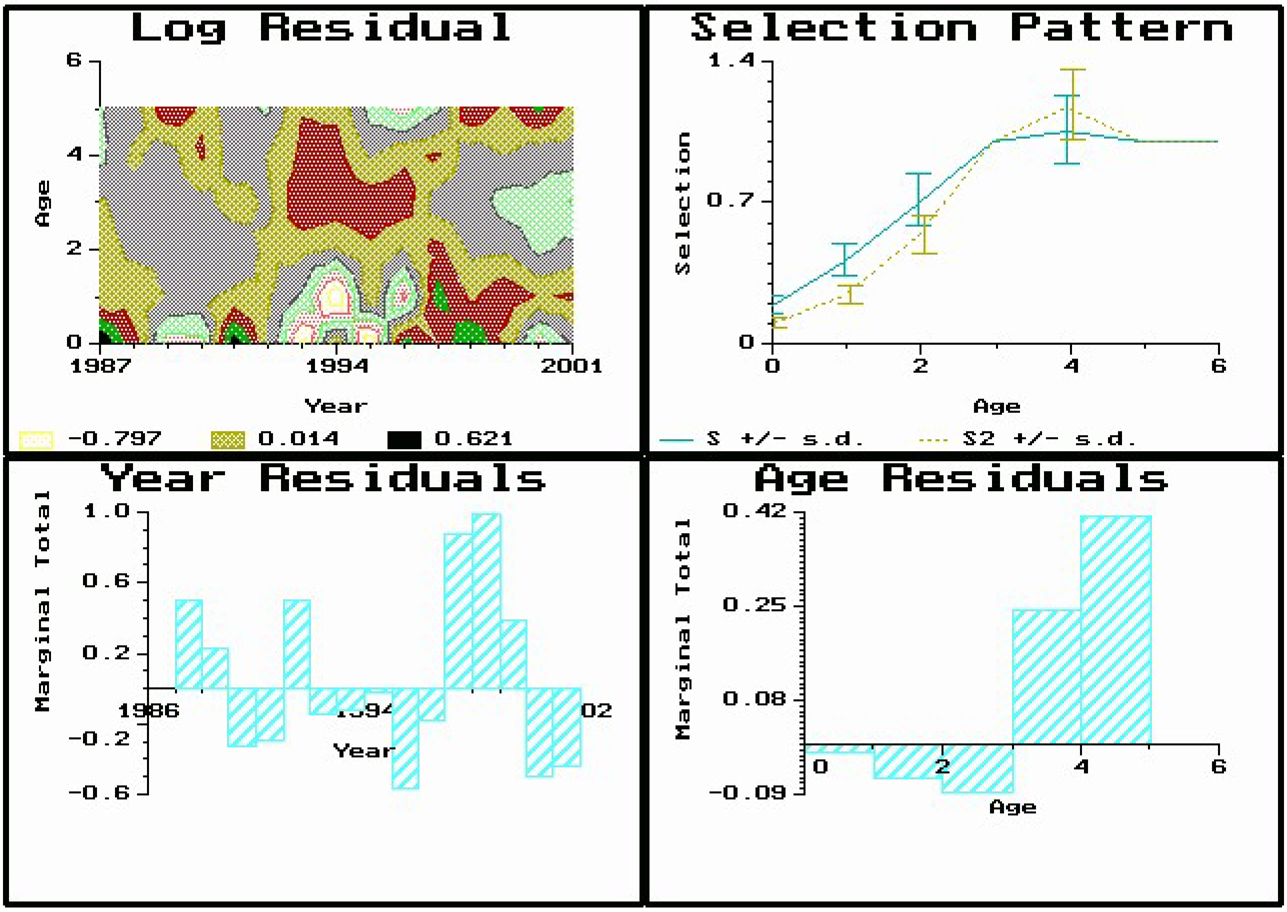


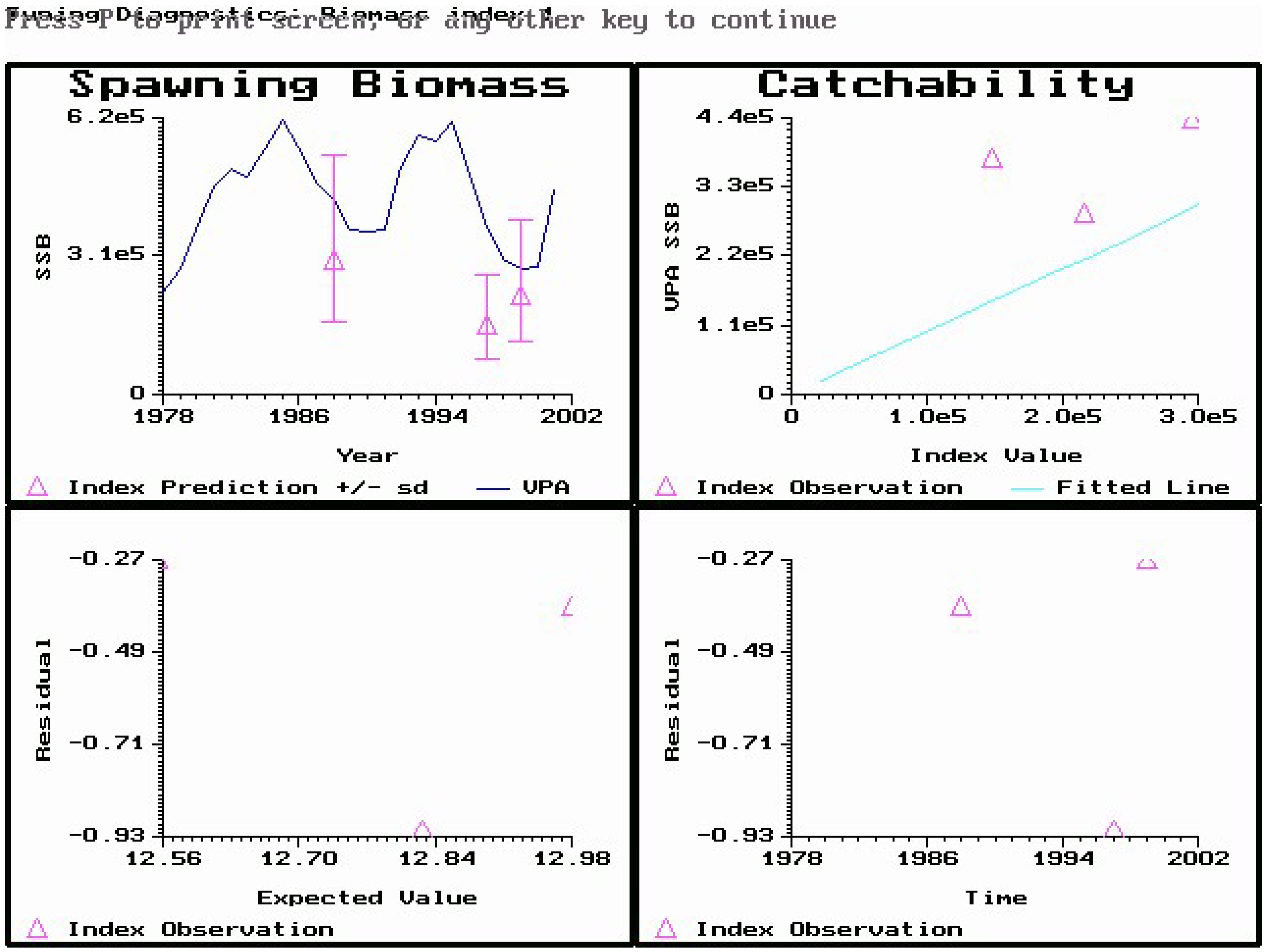
Figure 9.7.2.1 Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model. (SSBx1 is DEPM –absolute estimator-; Agex 1 is the Spanish Spring Acoustic survey time series –linear estimator-; Agex 2 is the Portuguese Spring Acoustic survey time series –linear estimator-; Agex 3 is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

Stock Summary



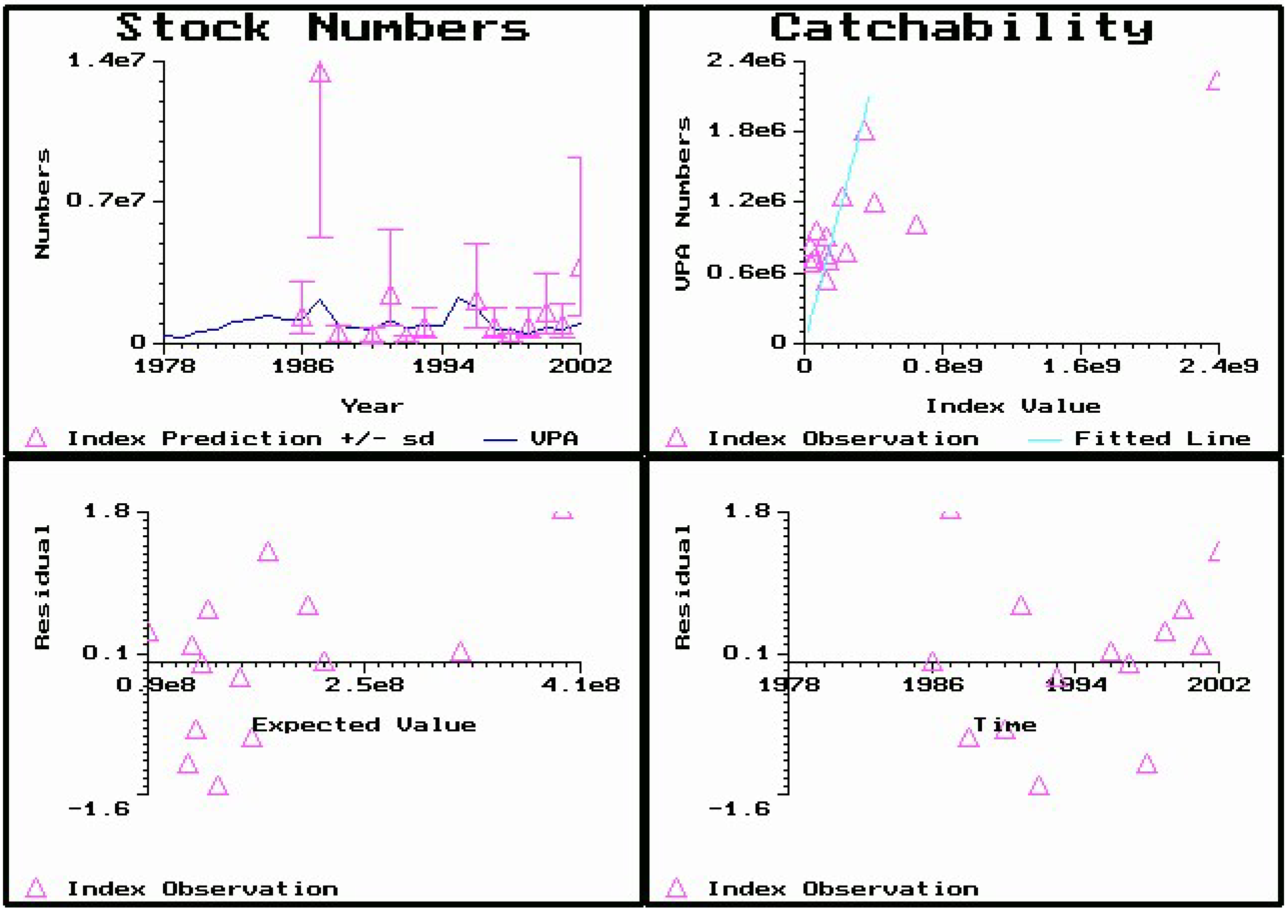
Separable Model Diagnostics



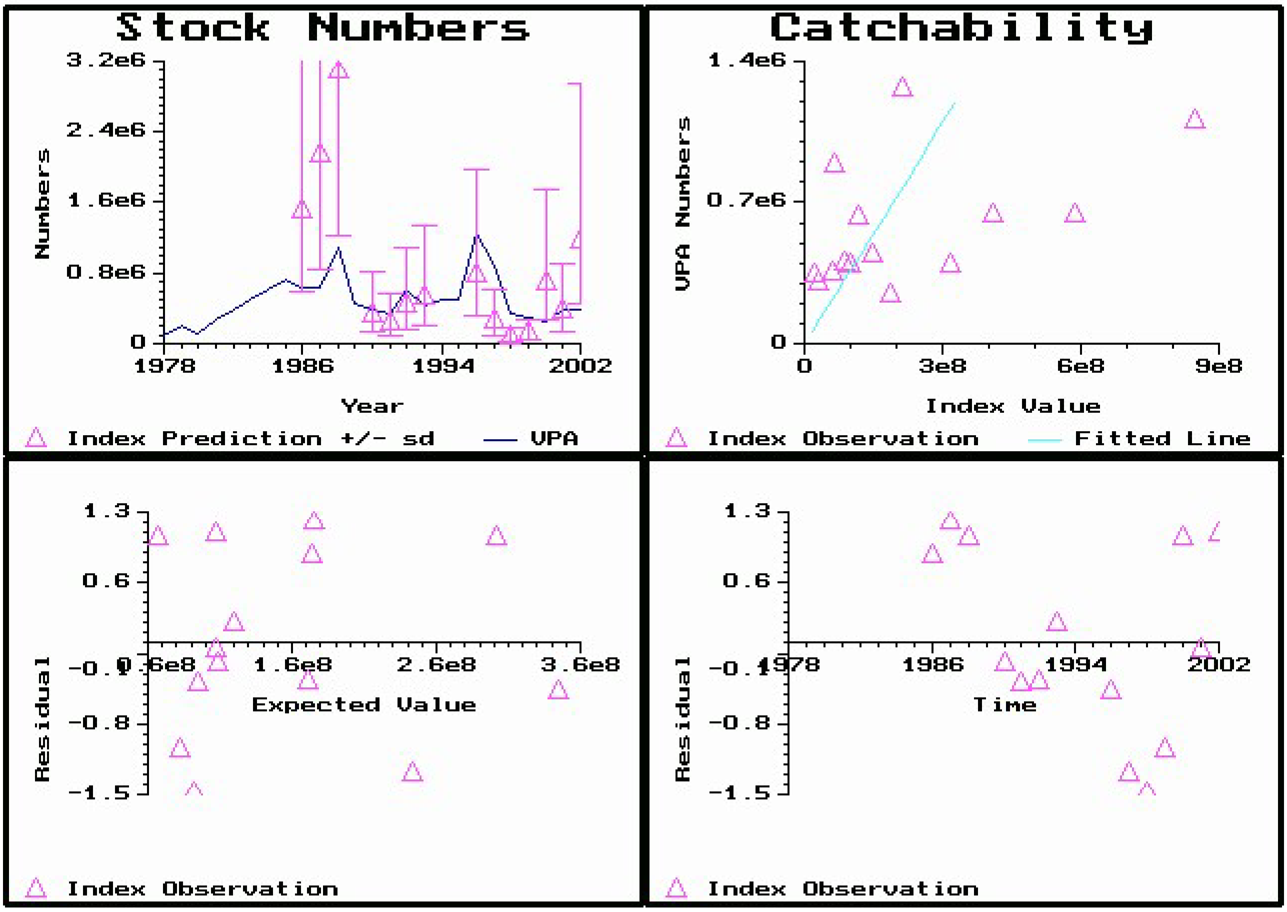


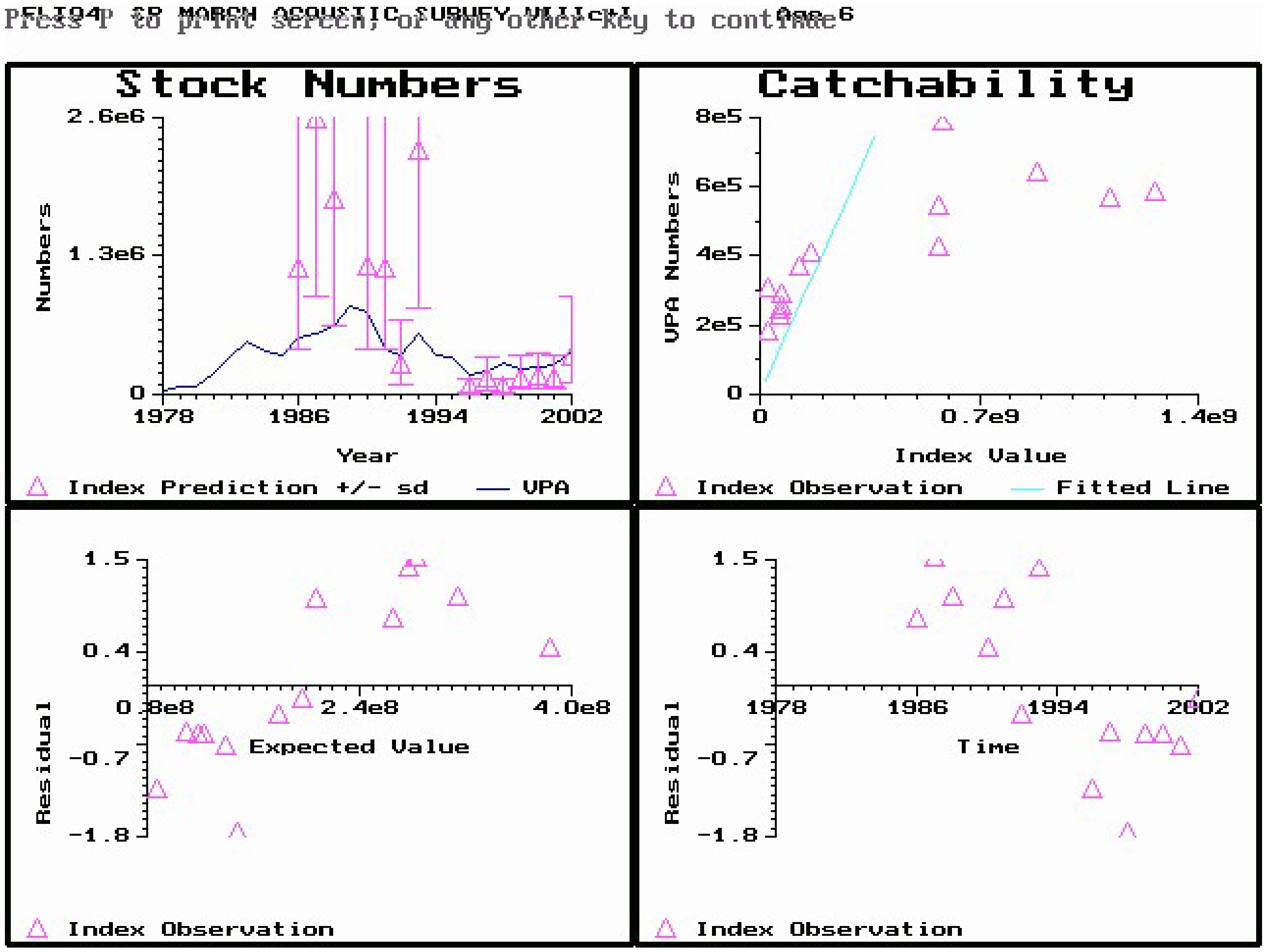
Press P to print screen, or any other key to continue
Spawning Biomass
6.2e5
3.1e5
0
SSB
1978
1986
1994
2002
Year
Index Prediction +/- sd
VPA
Catchability
4.4e5
3.3e5
2.2e5
1.1e5
0
VPA SSB
0
1.0e5
2.0e5
3.0e5
Index Value
Index Observation
Fitted Line
-0.27
-0.49
-0.71
-0.93
Residual
12.56
12.70
12.84
12.98
Expected Value
Index Observation
-0.27
-0.49
-0.71
-0.93
Residual
1978
1986
1994
2002
Time
Index Observation

FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+IXa Age 4

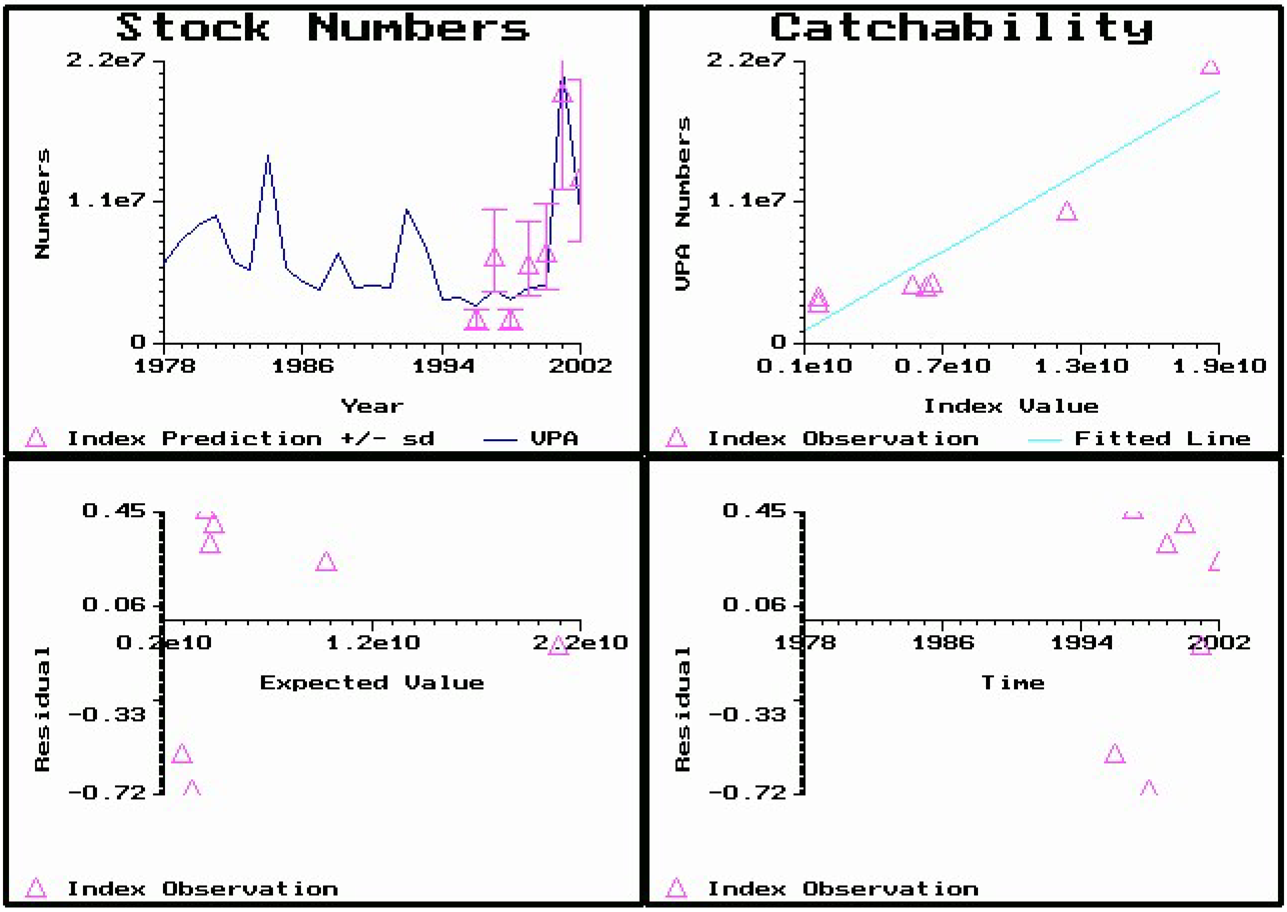


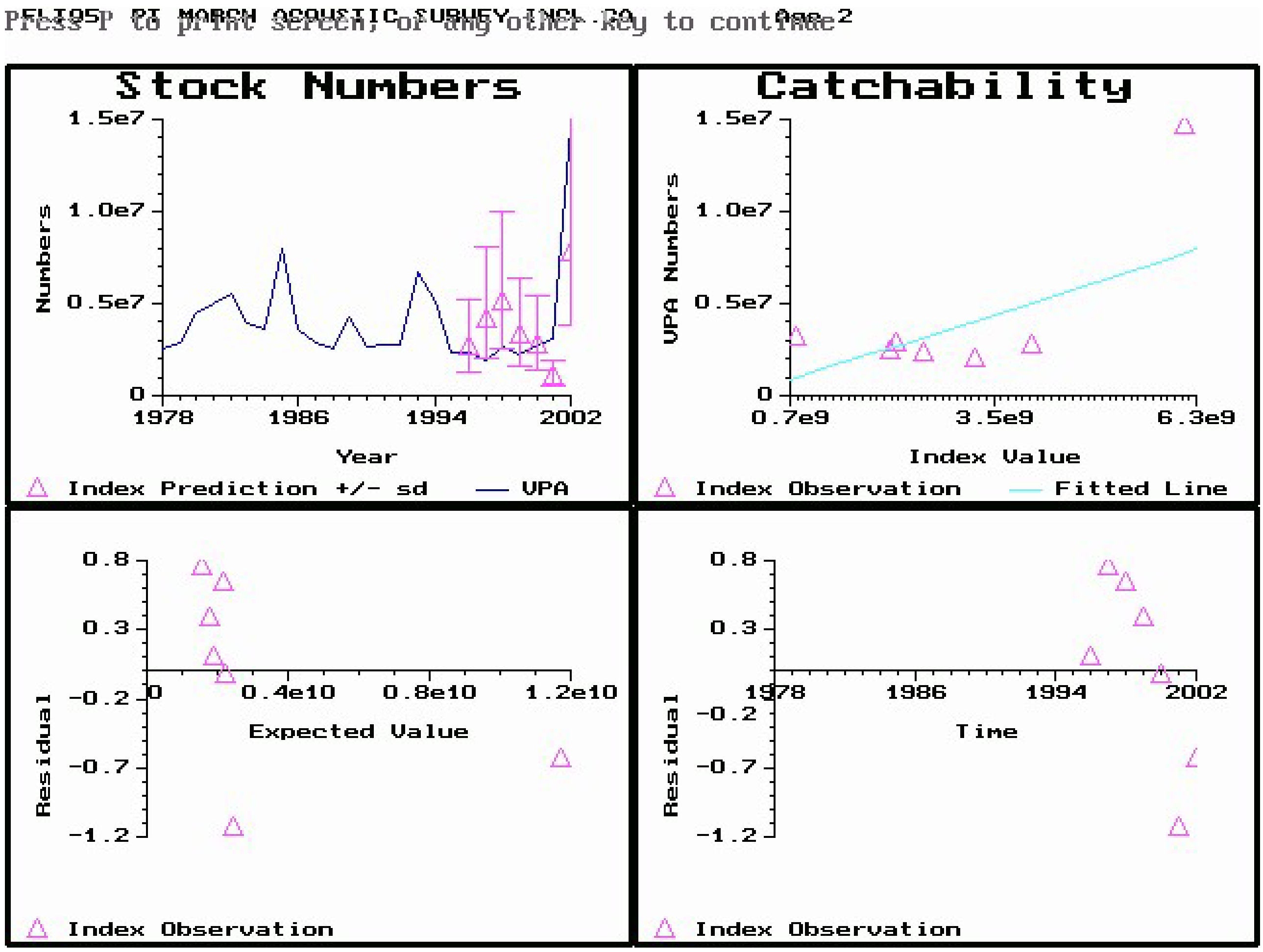
FLT04: SP MARCH ACOUSTIC SURVEY VIIIc+I Age 5



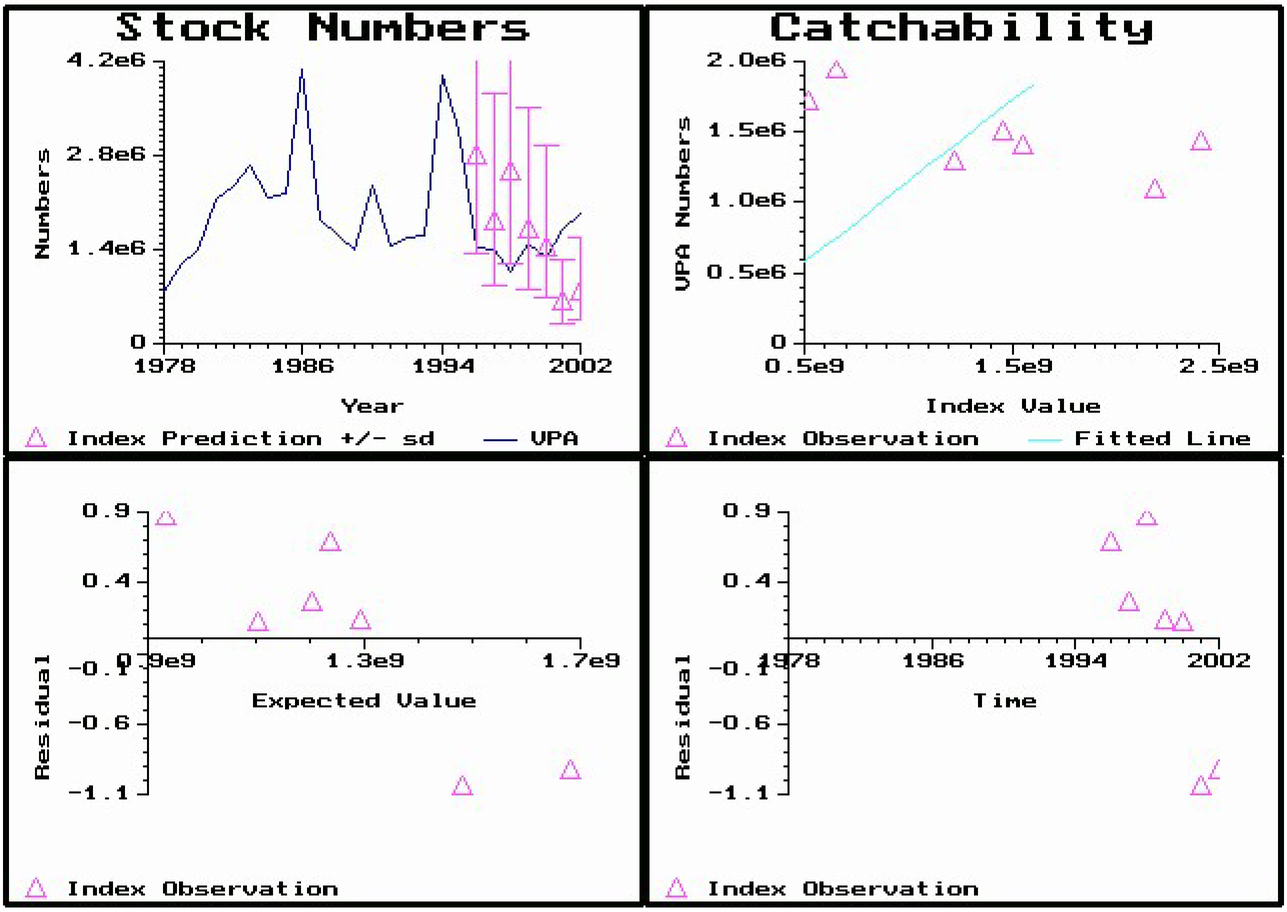

PELI94P SP MARCH ACOUSTIC SURVEY VIIIc+I Age 6
Press P to print screen, or any other key to continue
Stock Numbers
Numbers
Year
Index Prediction +/- sd
VPA
Catchability
VPA Numbers
Index Value
Index Observation
Fitted Line
Residual
Expected Value
Index Observation
Residual
Time
Index Observation

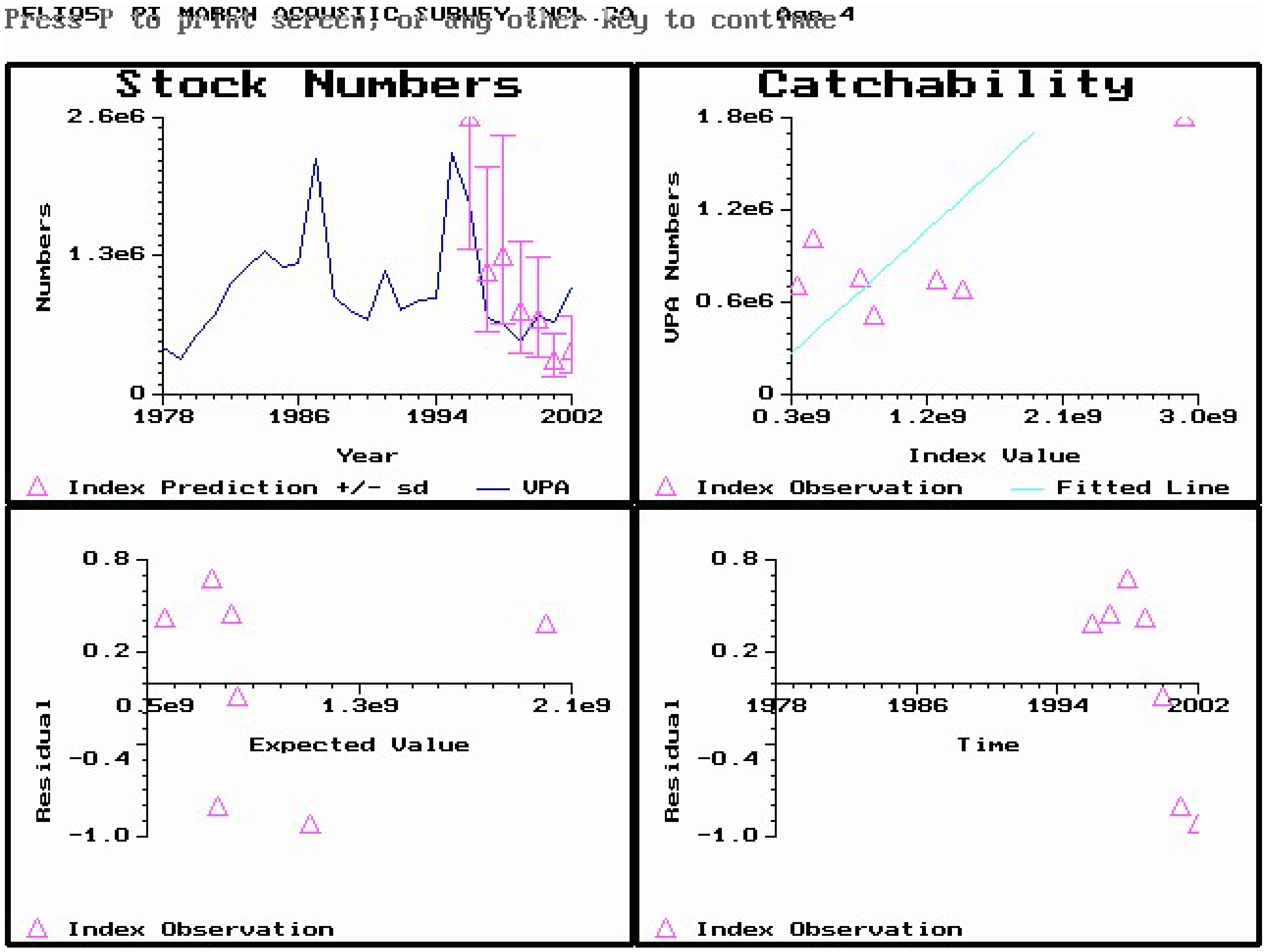
FLT05: PT MARCH ACOUSTIC SURVEY INCL.CA Age 1




PELI95P PT MARCH ACOUSTIC SURVEY INCL CA
Age 2
Press P to print screen, or any other key to continue
Stock Numbers
1.5e7
1.0e7
0.5e7
0
Numbers
1978
1986
1994
2002
Year
Index Prediction +/- sd
VPA
Catchability
1.5e7
1.0e7
0.5e7
0
VPA Numbers
0.7e9
3.5e9
6.3e9
Index Value
Index Observation
Fitted Line
0.8
0.3
-0.2
-0.7
-1.2
Residual
0
0.4e10
0.8e10
1.2e10
Expected Value
Index Observation
0.8
0.3
-0.2
-0.7
-1.2
Residual
1978
1986
1994
2002
Time
Index Observation

FLI95P PT MARCH ACOUSTIC SURVEY INCL CA Age 3




PELI95P PT MARCH ACOUSTIC SURVEY INCL 2Q Age 4
Press P to print screen, or any other key to continue
Stock Numbers
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1.3e6
0
Numbers
1978
1986
1994
2002
Year
Index Prediction +/- sd
VPA
Catchability
1.8e6
1.2e6
0.6e6
0
VPA Numbers
0.3e9
1.2e9
2.1e9
3.0e9
Index Value
Index Observation
Fitted Line
0.8
0.2
-0.4
-1.0
Residual
0.5e9
1.3e9
2.1e9
Expected Value
Index Observation
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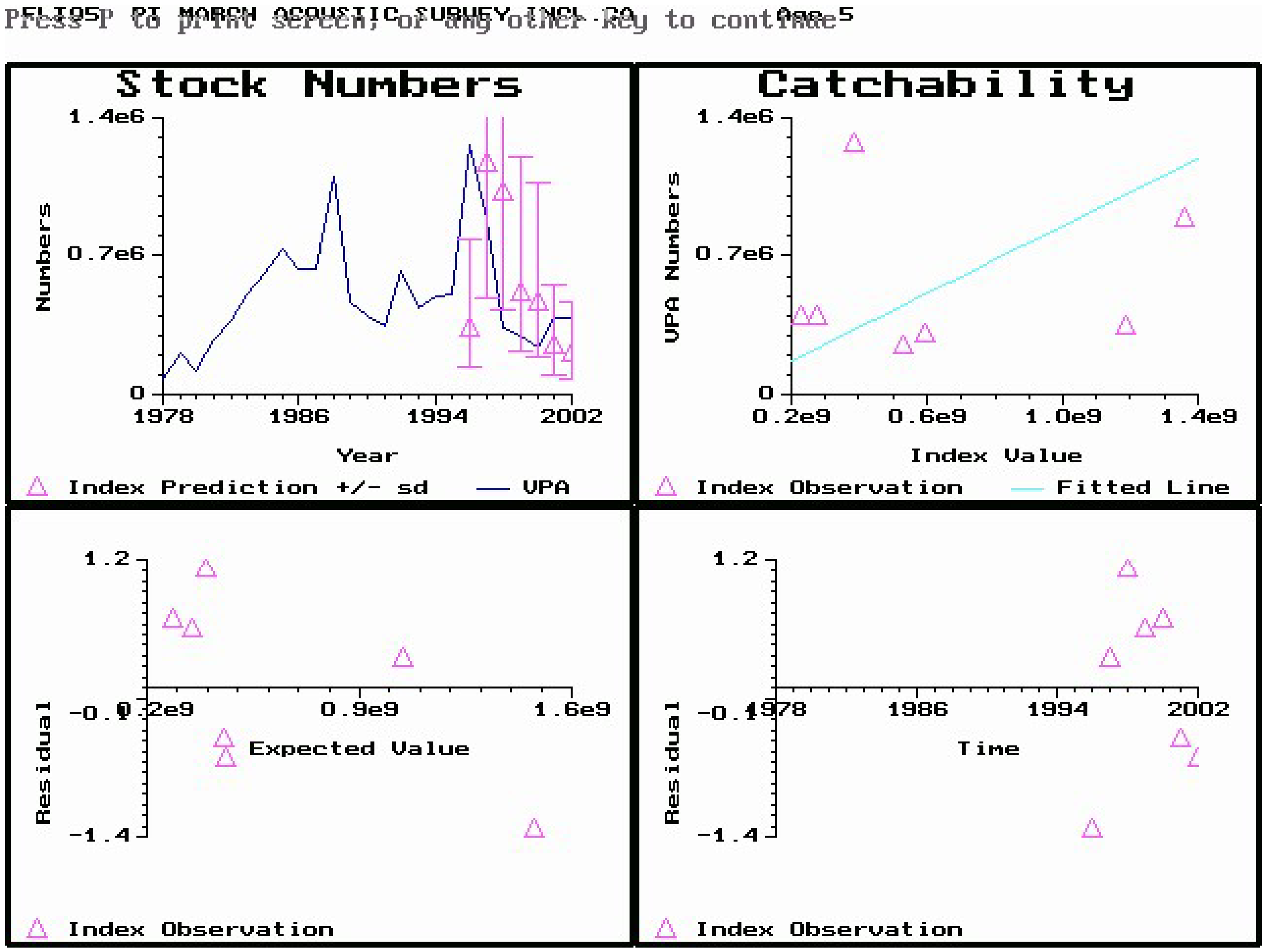
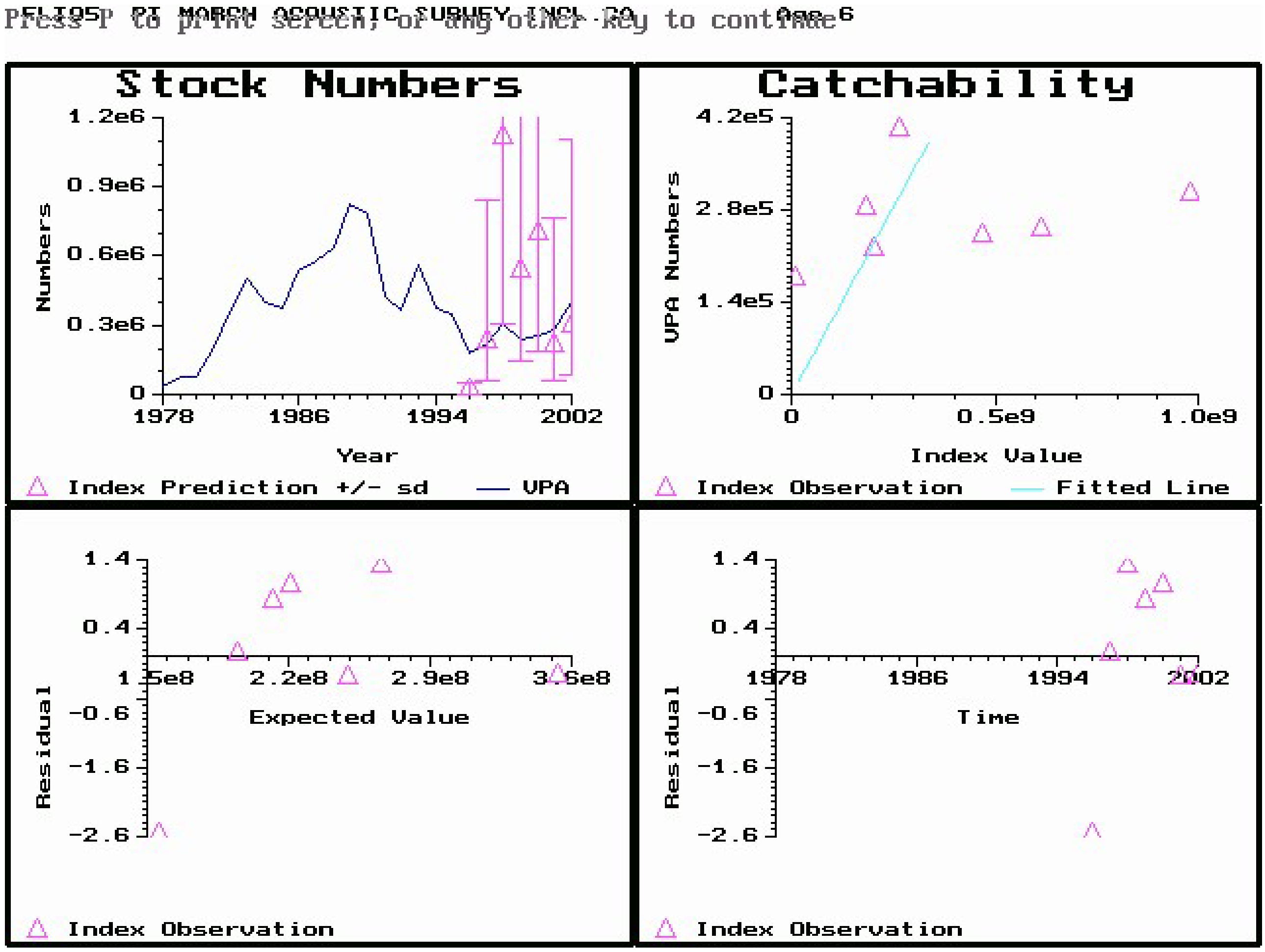
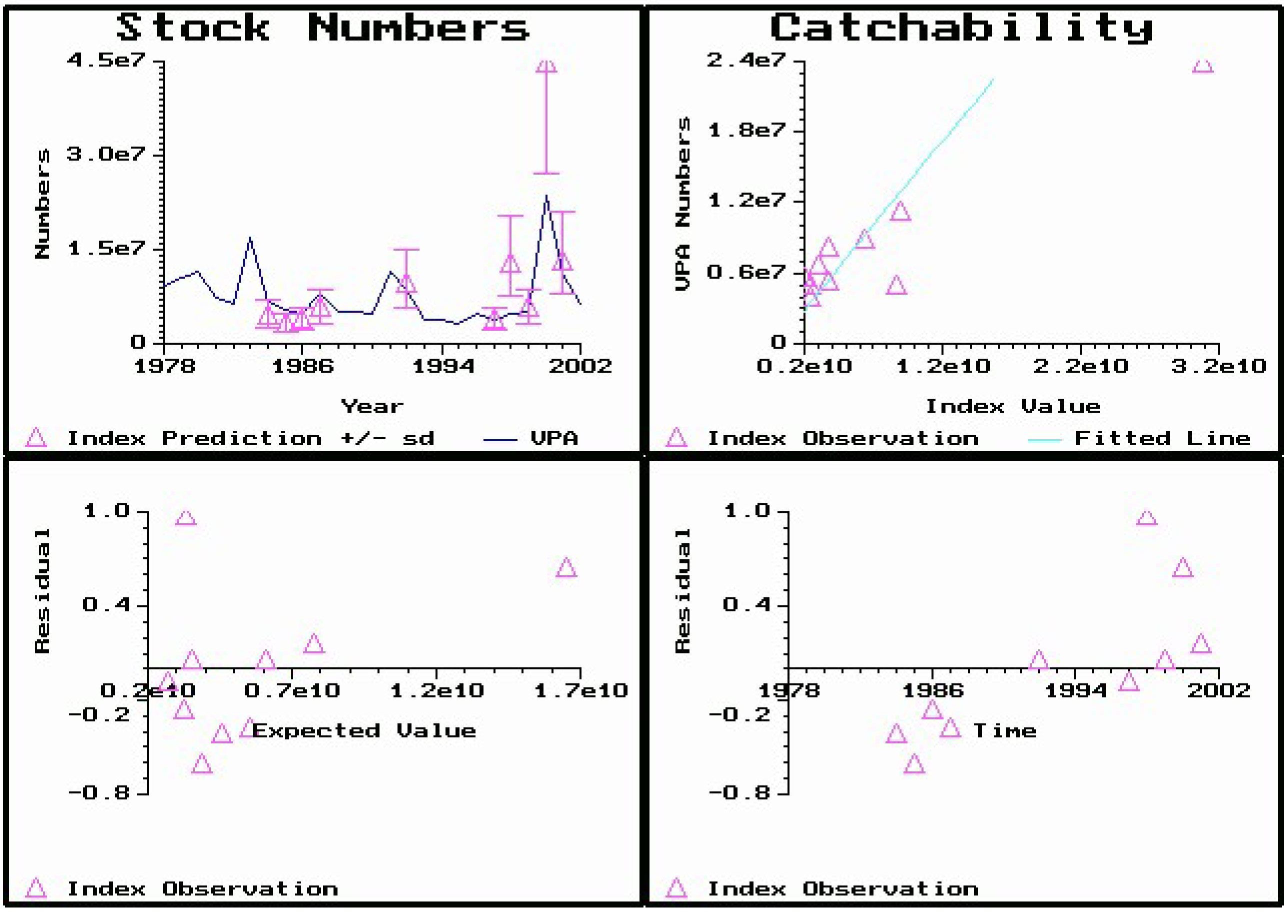
0.2
-0.4
-1.0
Residual
1978
1986
1994
2002
Time
Index Observation

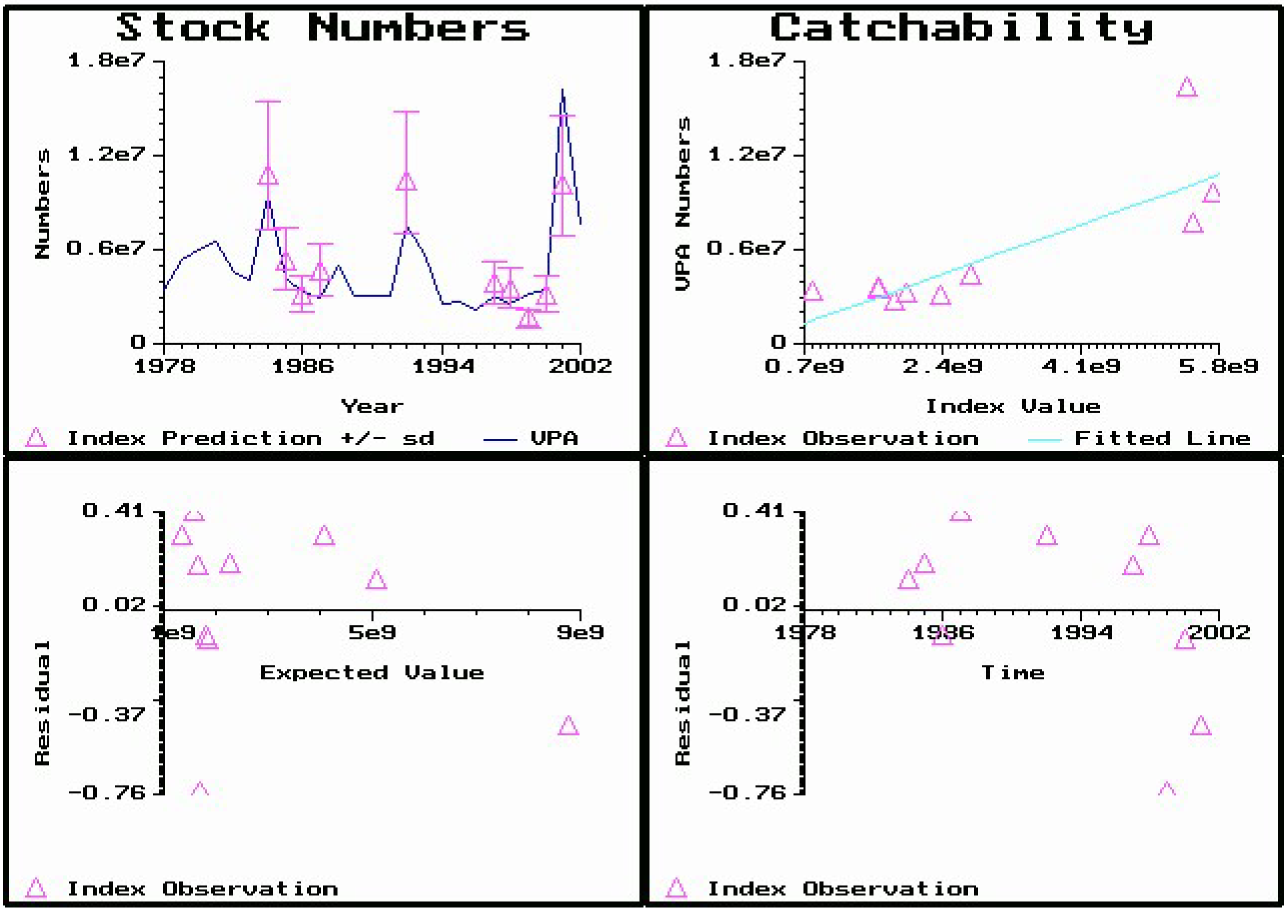

PELI95P PT MARCH ACOUSTIC SURVEY INCL CA Age 5
Press P to print screen, or any other key to continue
Stock Numbers
Numbers
1.4e6
0.7e6
0
1978
1986
1994
2002
Year
Index Prediction +/- sd
VPA
Catchability
VPA Numbers
1.4e6
0.7e6
0
0.2e9
0.6e9
1.0e9
1.4e9
Index Value
Index Observation
Fitted Line
Residual
1.2
-0.1
-1.4
0.2e9
0.9e9
1.6e9
Expected Value
Index Observation
Residual
1.2
-0.1
-1.4
1978
1986
1994
2002
Time
Index Observation

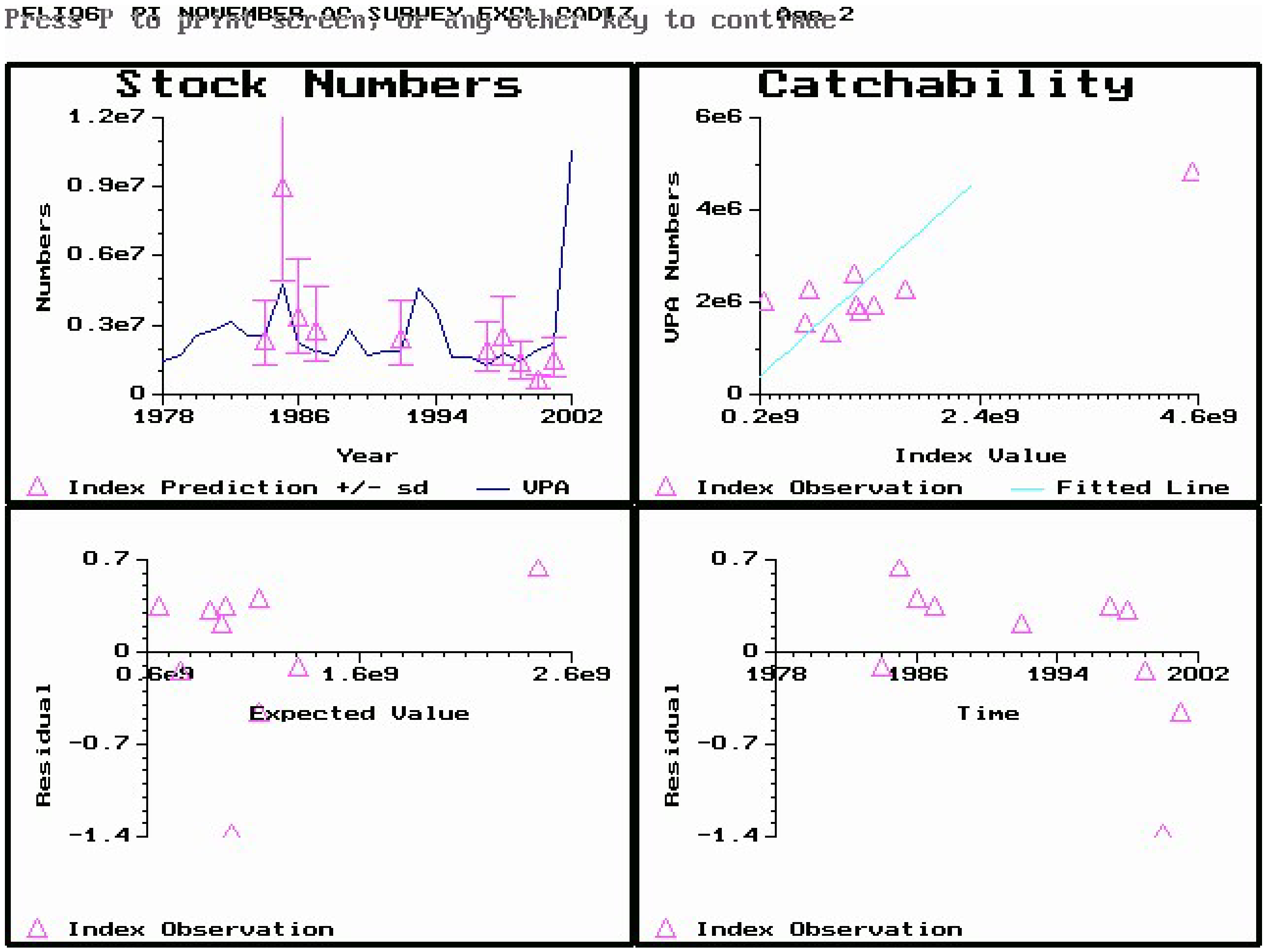

PELI95P PT MARCH ACOUSTIC SURVEY INCL CA Age 6
Press P to print screen, or any other key to continue
Stock Numbers
Numbers
1.2e6
0.9e6
0.6e6
0.3e6
0
1978
1986
1994
2002
Year
Index Prediction +/- sd
VPA
Catchability
VPA Numbers
4.2e5
2.8e5
1.4e5
0
0
0.5e9
1.0e9
Index Value
Index Observation
Fitted Line
Residual
1.4
0.4
-0.6
-1.6
-2.6
1.5e8
2.2e8
2.9e8
3.6e8
Expected Value
Index Observation
Residual
1.4
0.4
-0.6
-1.6
-2.6
1978
1986
1994
2002
Time
Index Observation

FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ Age 0



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




PELI96P PT NOVEMBER AC SURVEY EXCL CADIZ Age 2
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Stock Numbers
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Year
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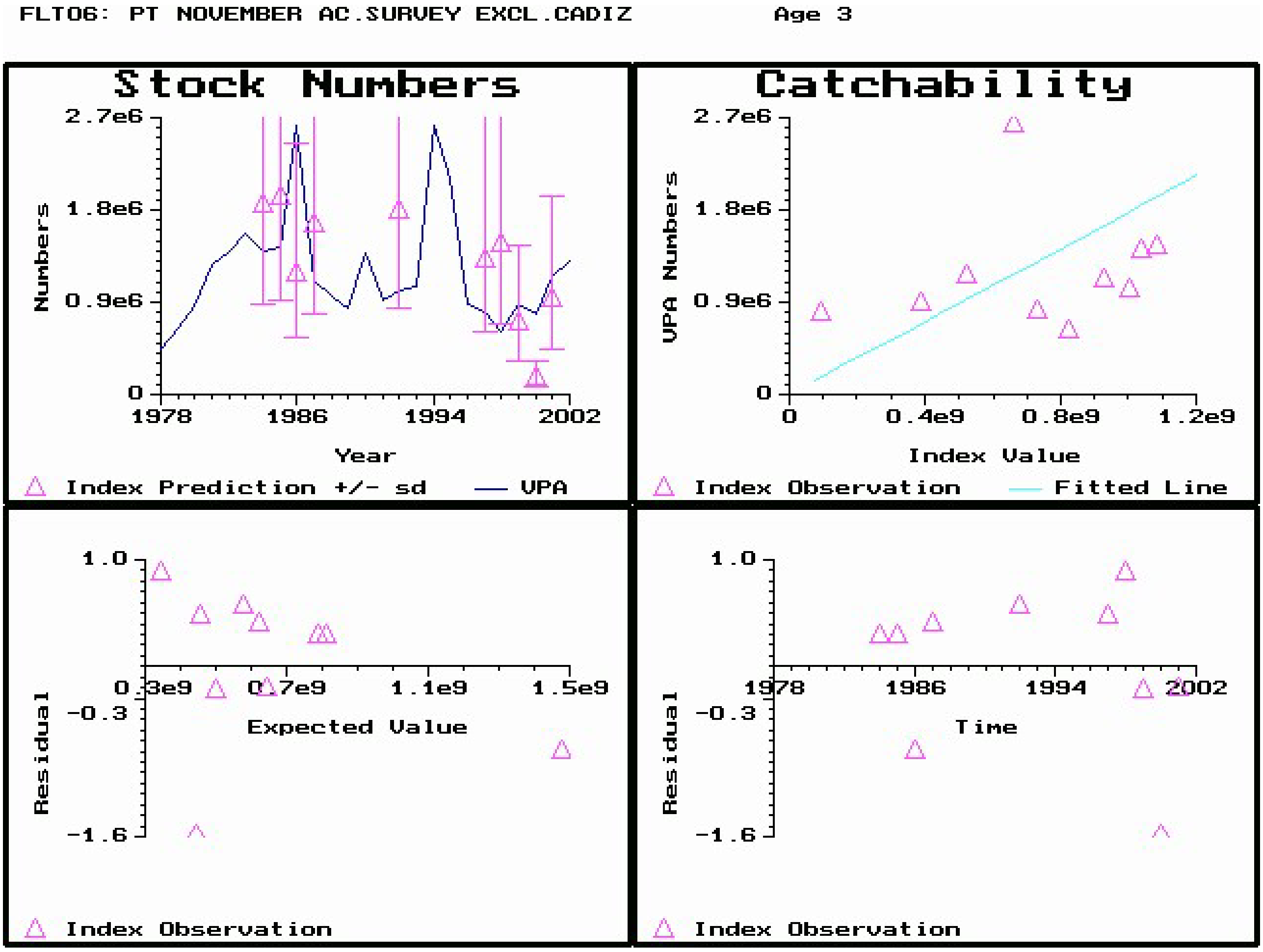
FLT06: PT NOVEMBER AC.SURVEY EXCL.CADIZ
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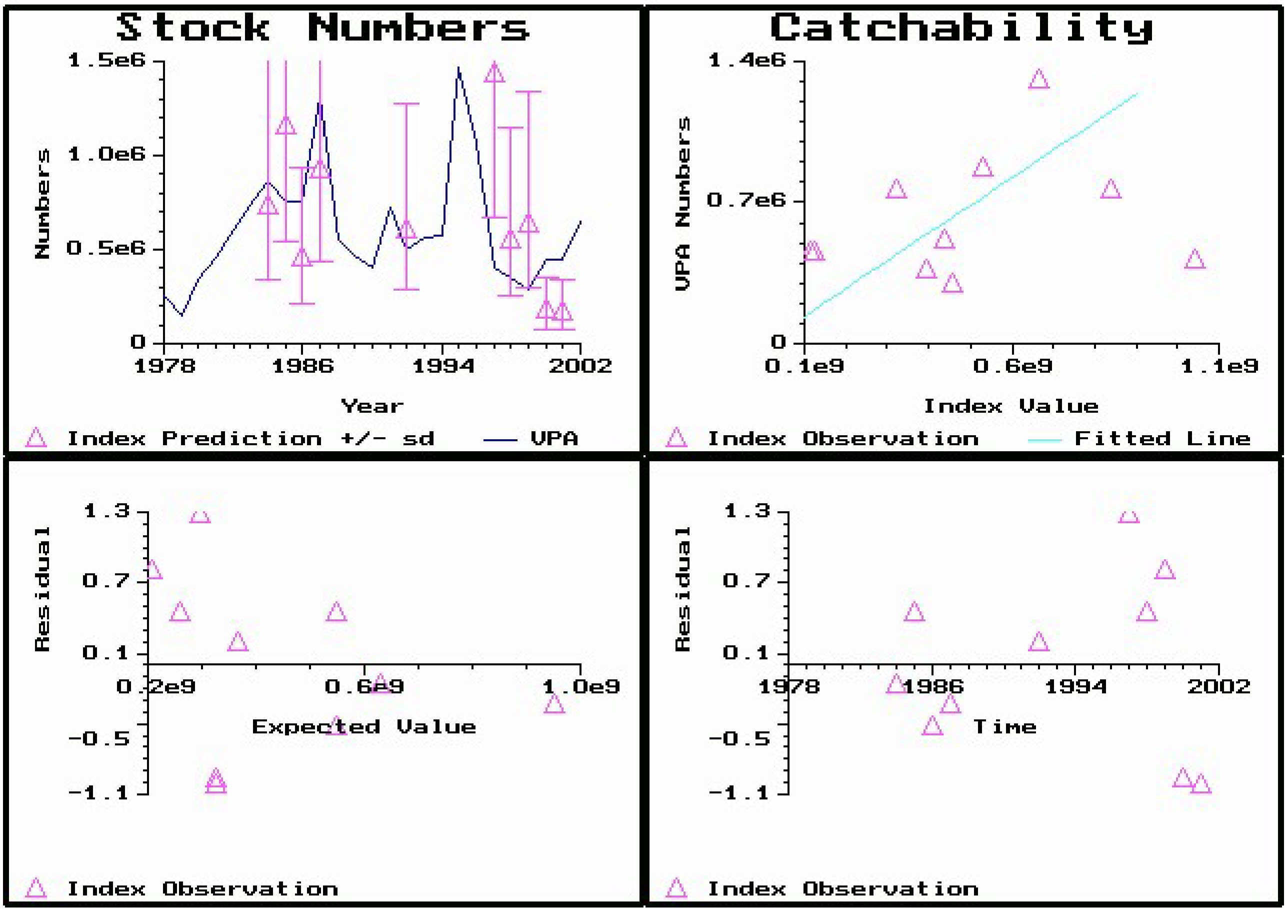


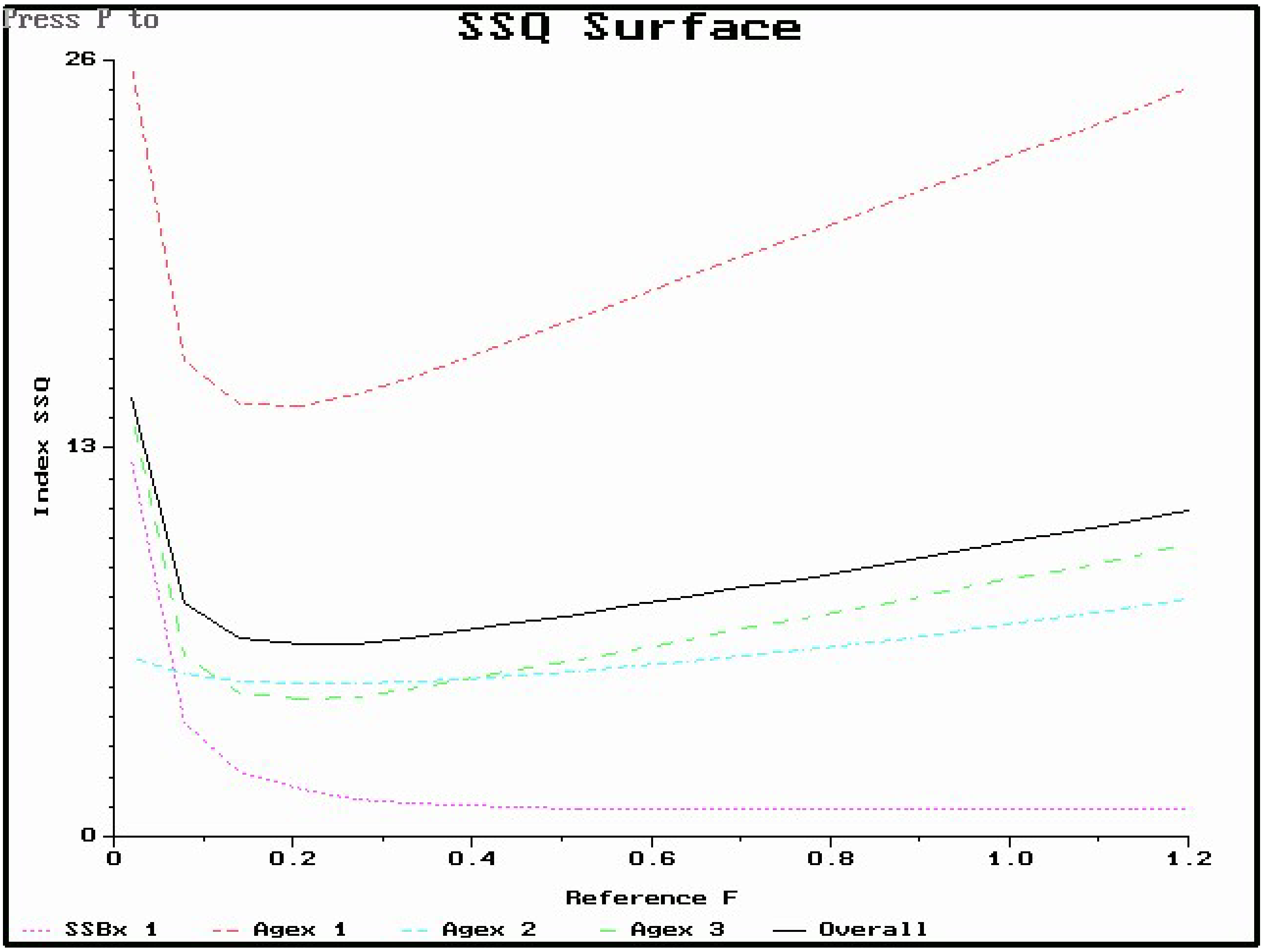


Figure 9.7.2.1 Sardine in Divisions VIIIc and IXa. ICA diagnostic plots for the assessment model. (SSBx1 is DEPM –absolute estimator-; Agex 1 is the Spanish Spring Acoustic survey time series –linear estimator-; Agex 2 is the Portuguese Spring Acoustic survey time series –linear estimator-; Agex 3 is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

Stock Summary

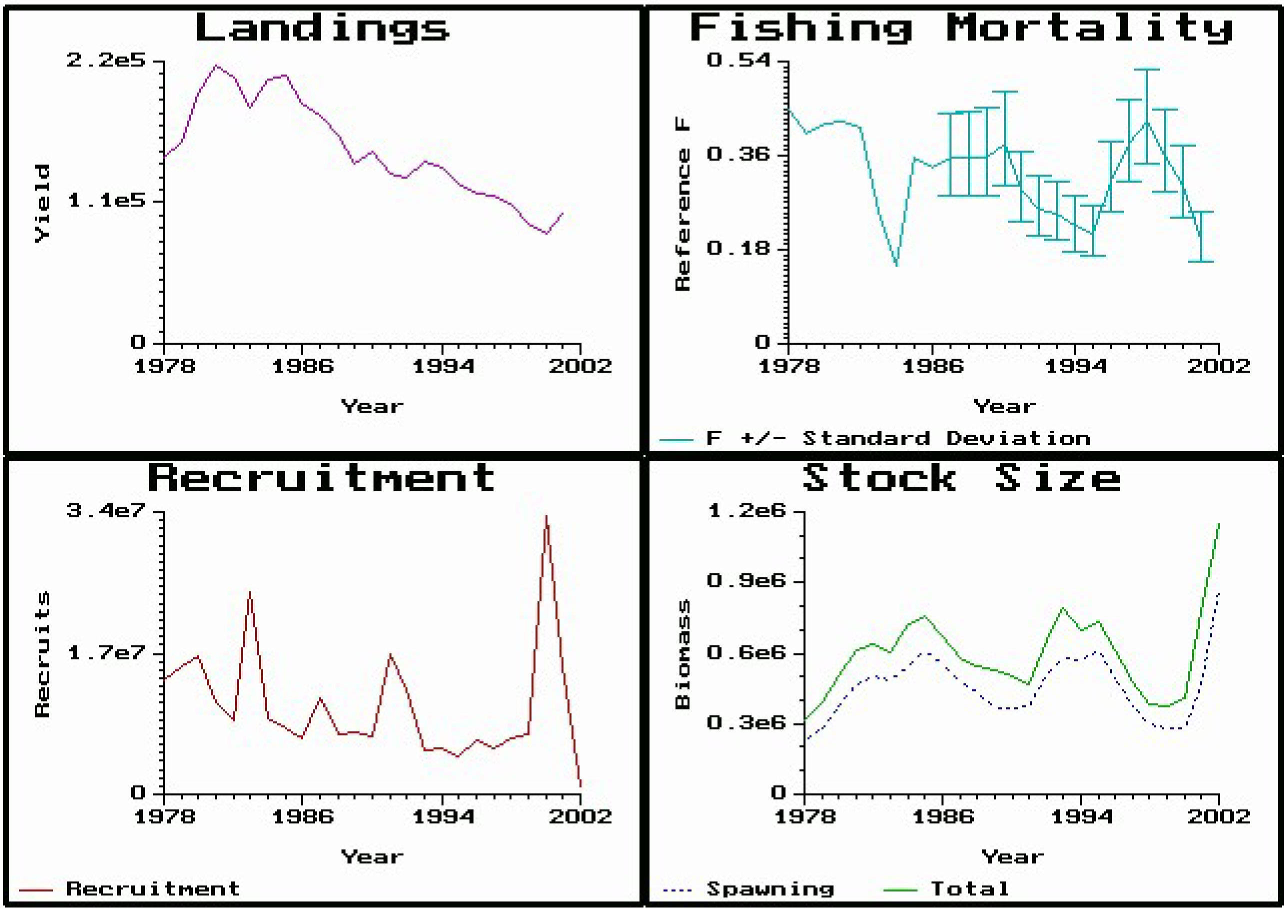


Figure 9.7.2.1 (Cont'd)

Separable Model Diagnostics

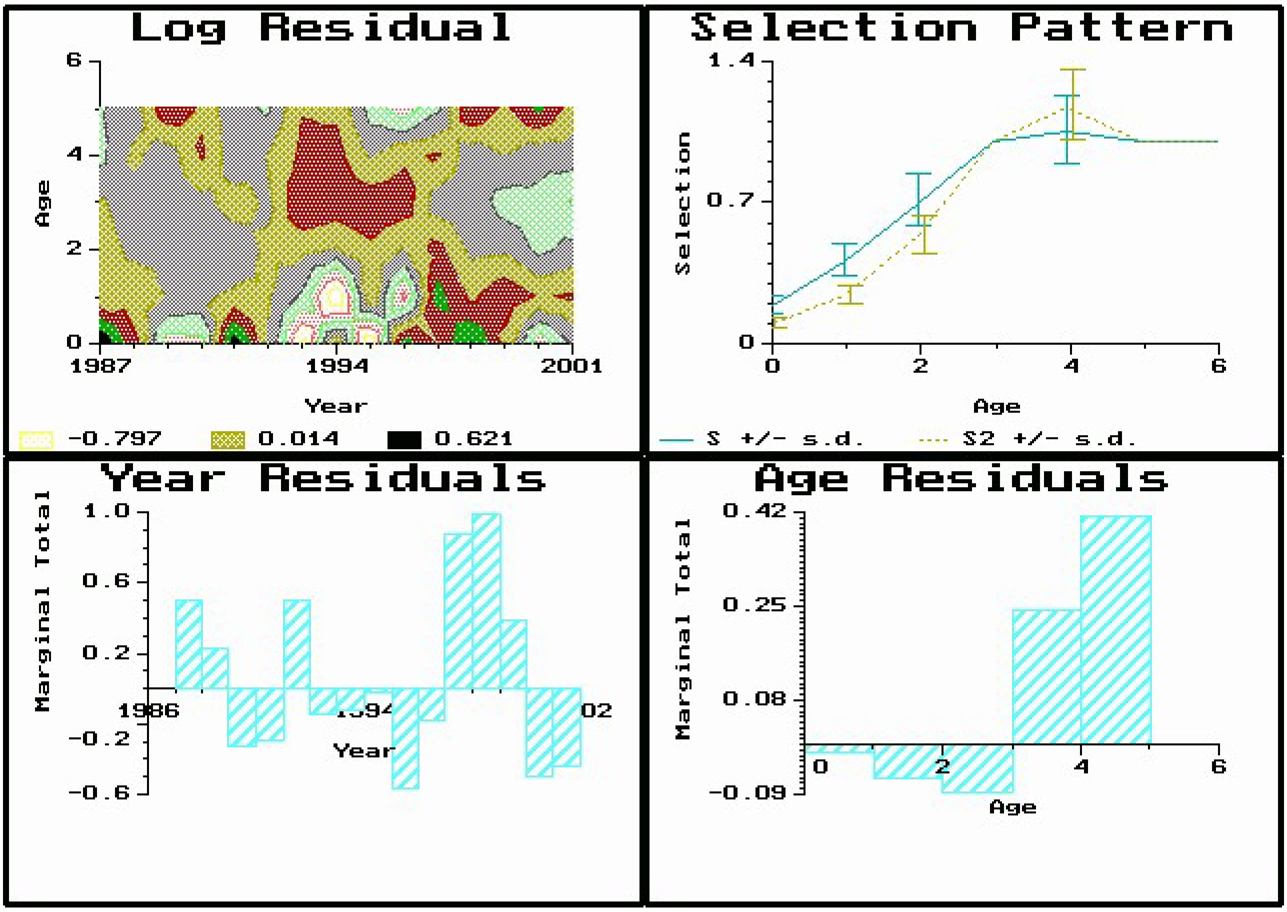


Figure 9.7.2.1 (Cont'd)

Separable Model Diagnostics

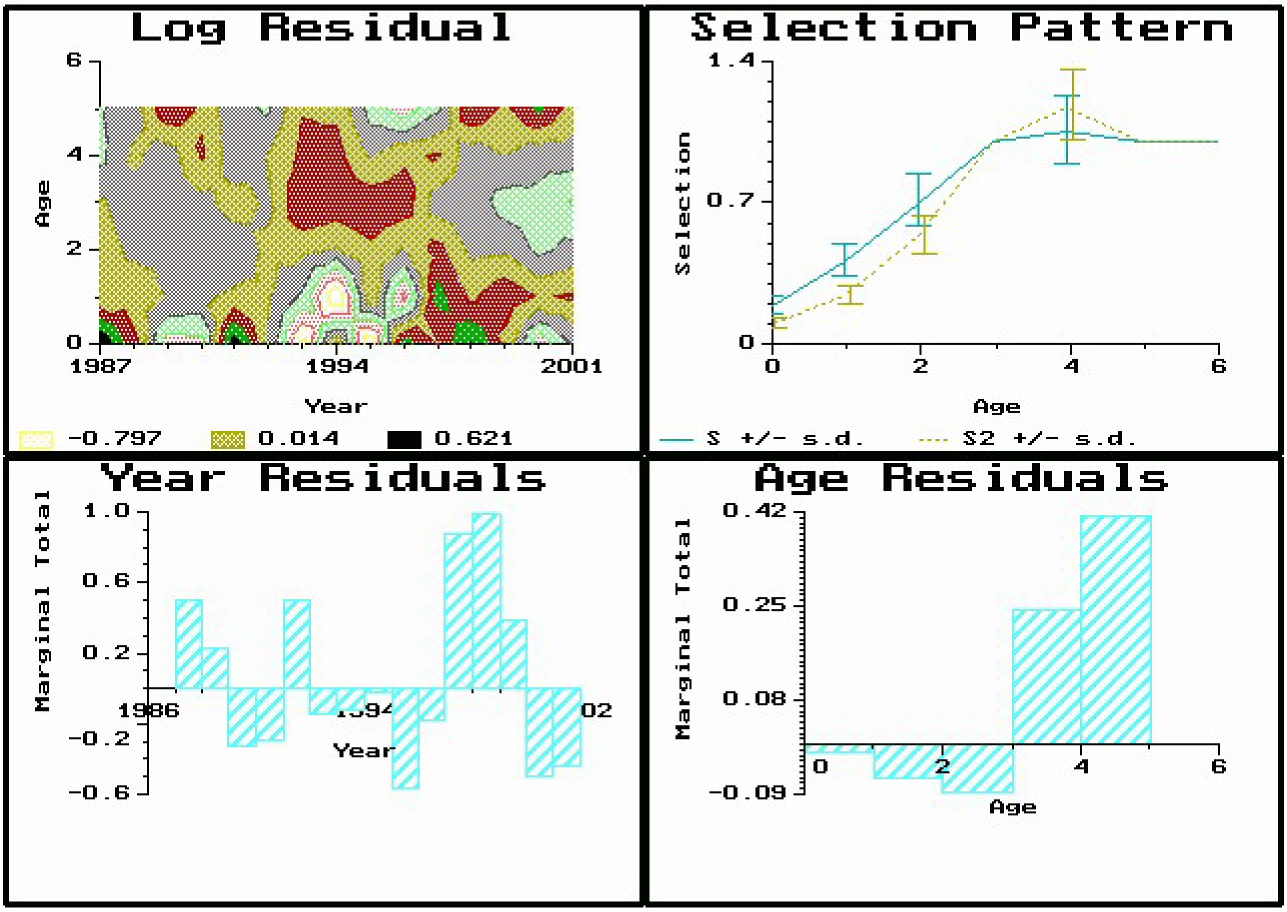
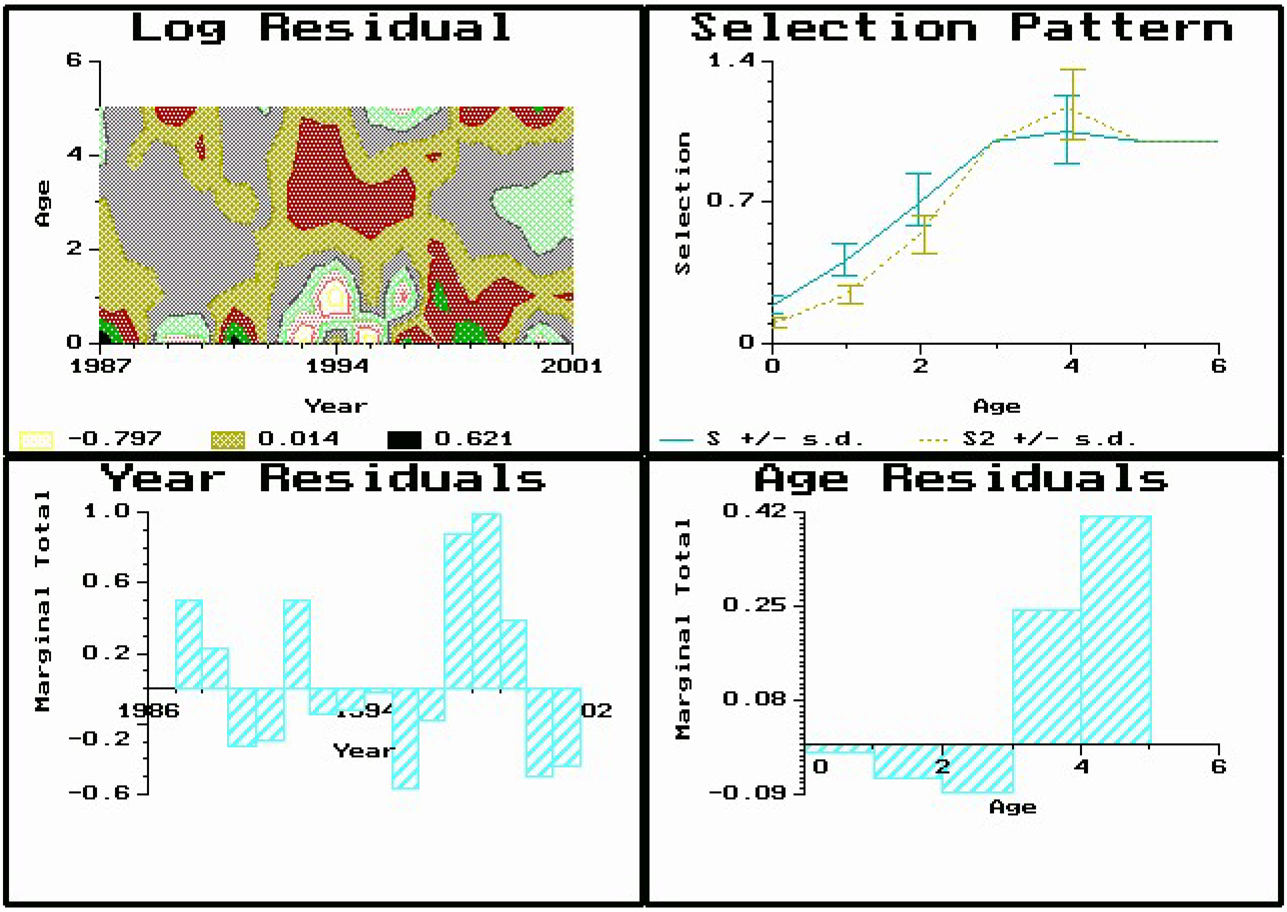


Figure 9.7.2.1 (Cont'd)

Separable Model Diagnostics



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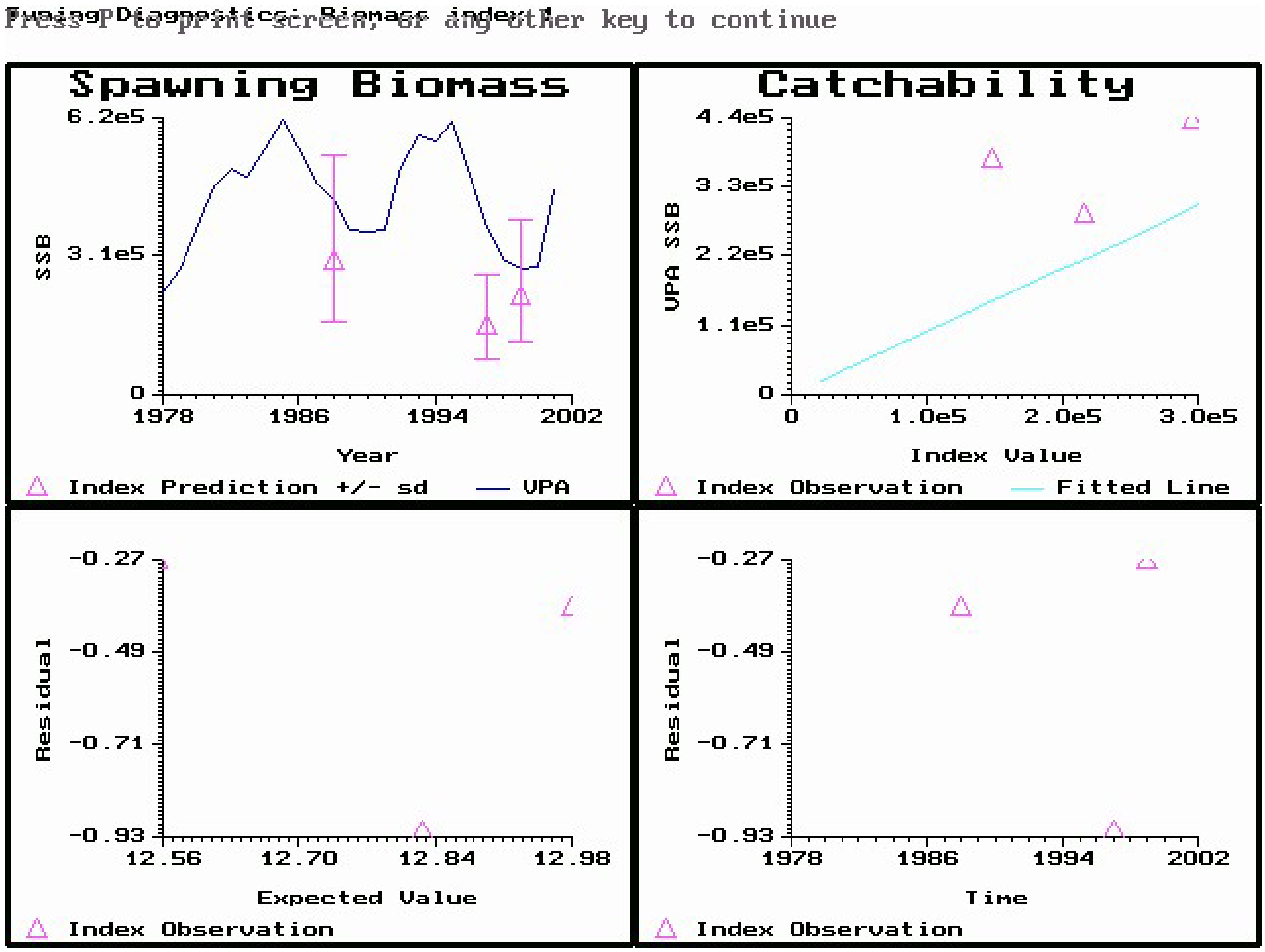

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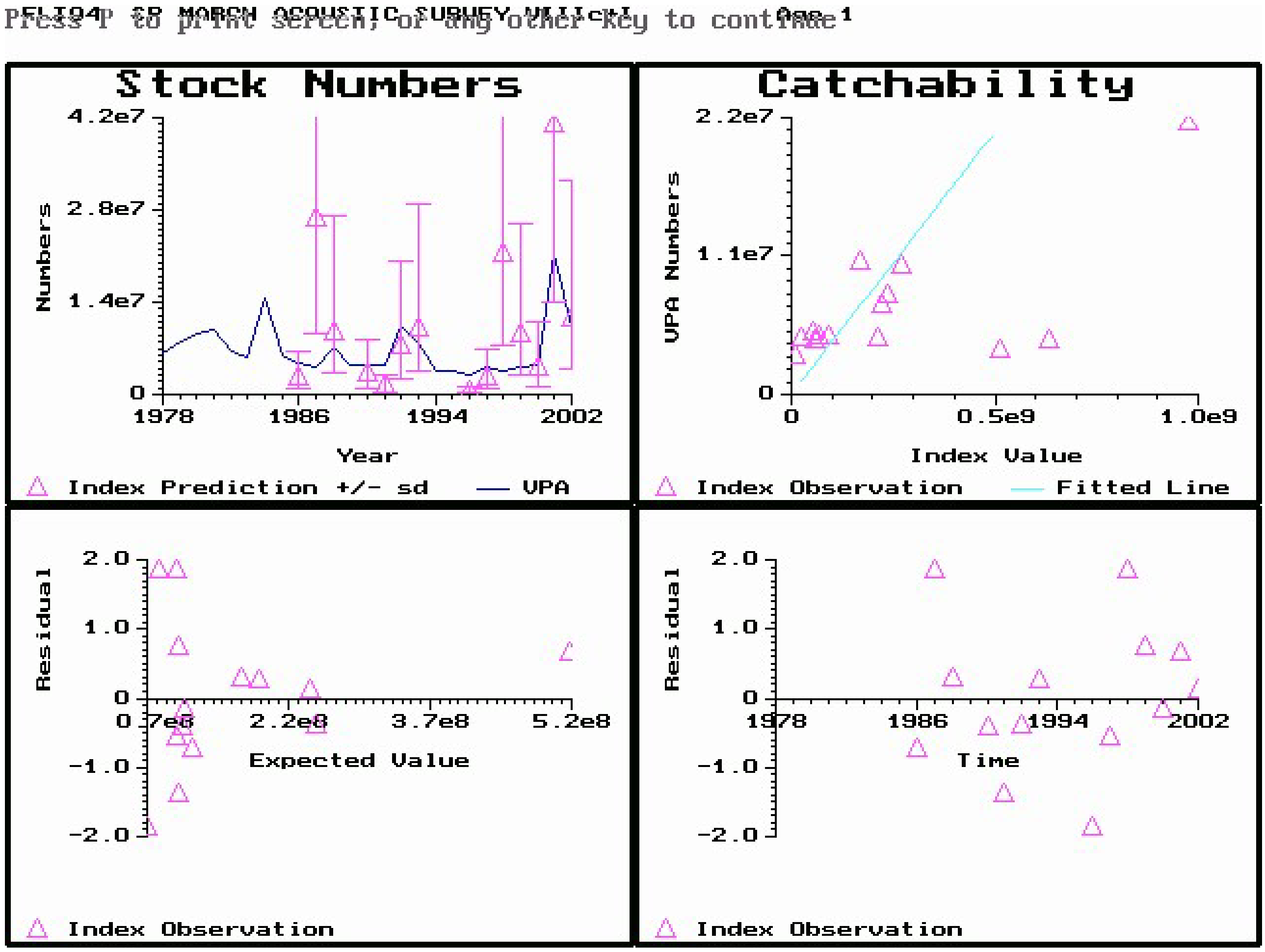

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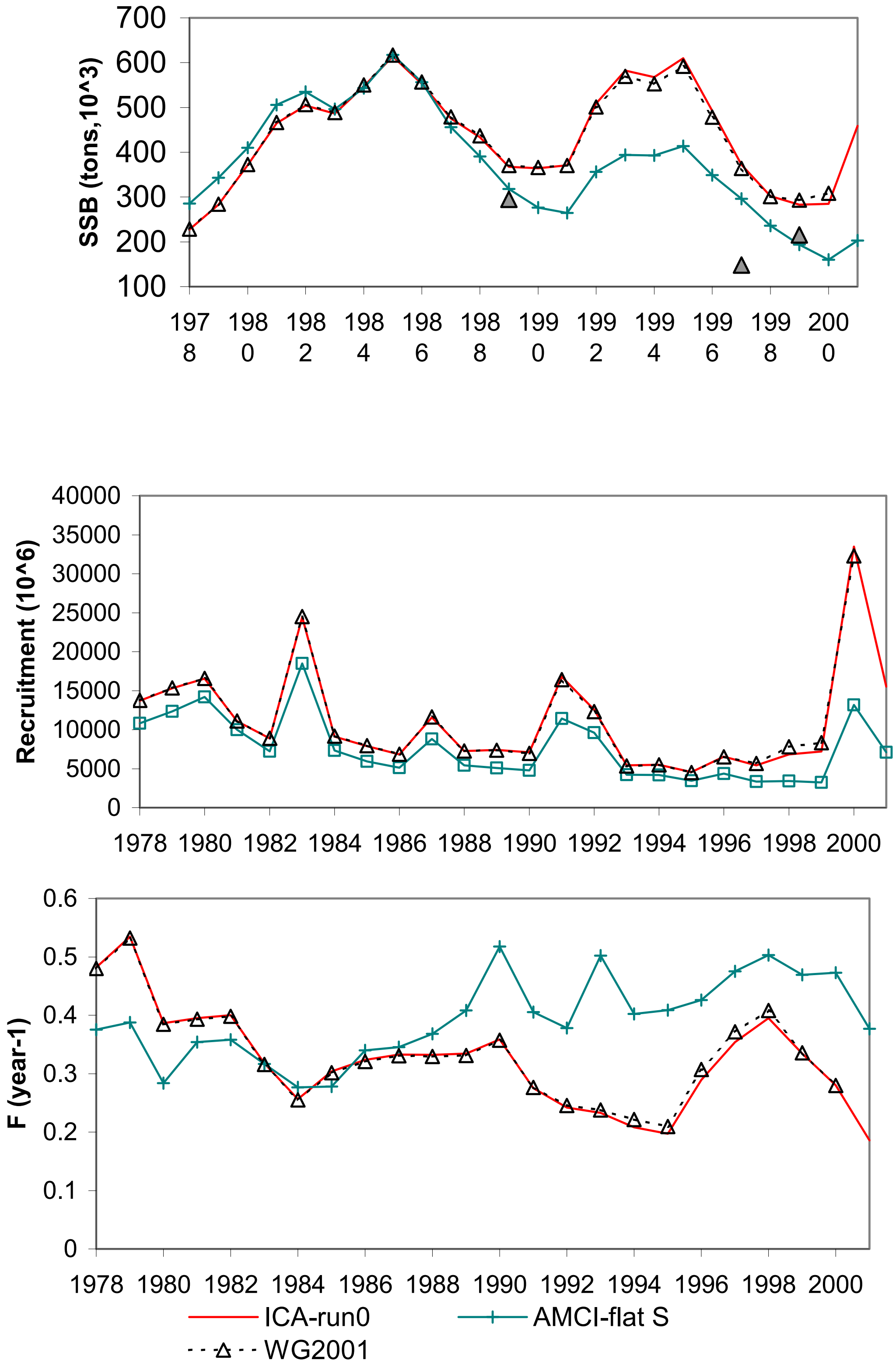


Figure 9.7.2.2 SSB, recruitment and Fbar(2-5) estimated by the ICA and the AMCI models selected for this years assessment and comparison with the final assessment from last year (WG2001). Spawning biomass estimates from the DEPM are represented on the SSB plot (top).

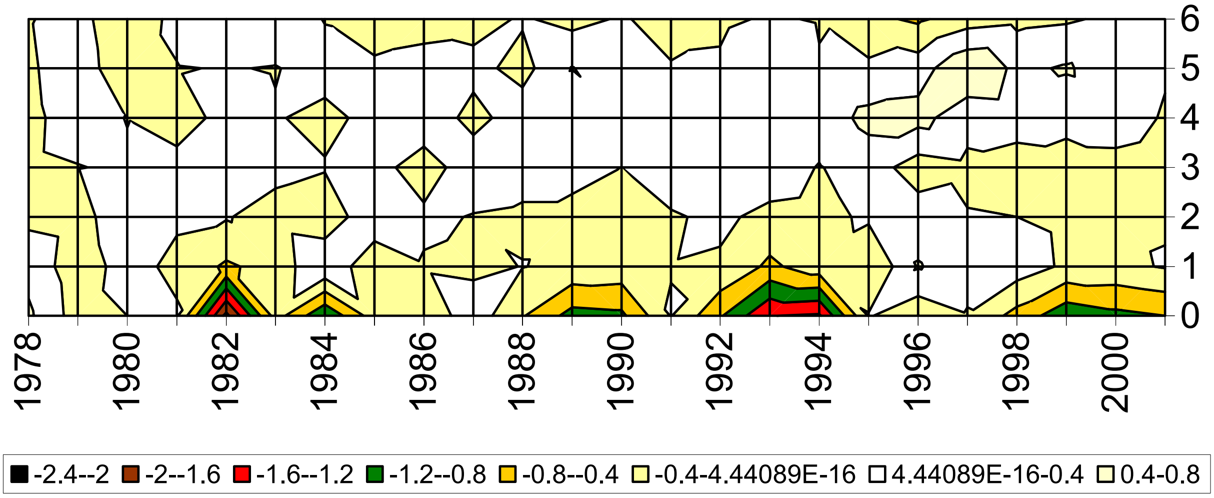


Figure 9.7.2.3 Catch-at-age residuals of the AMCI assessment model

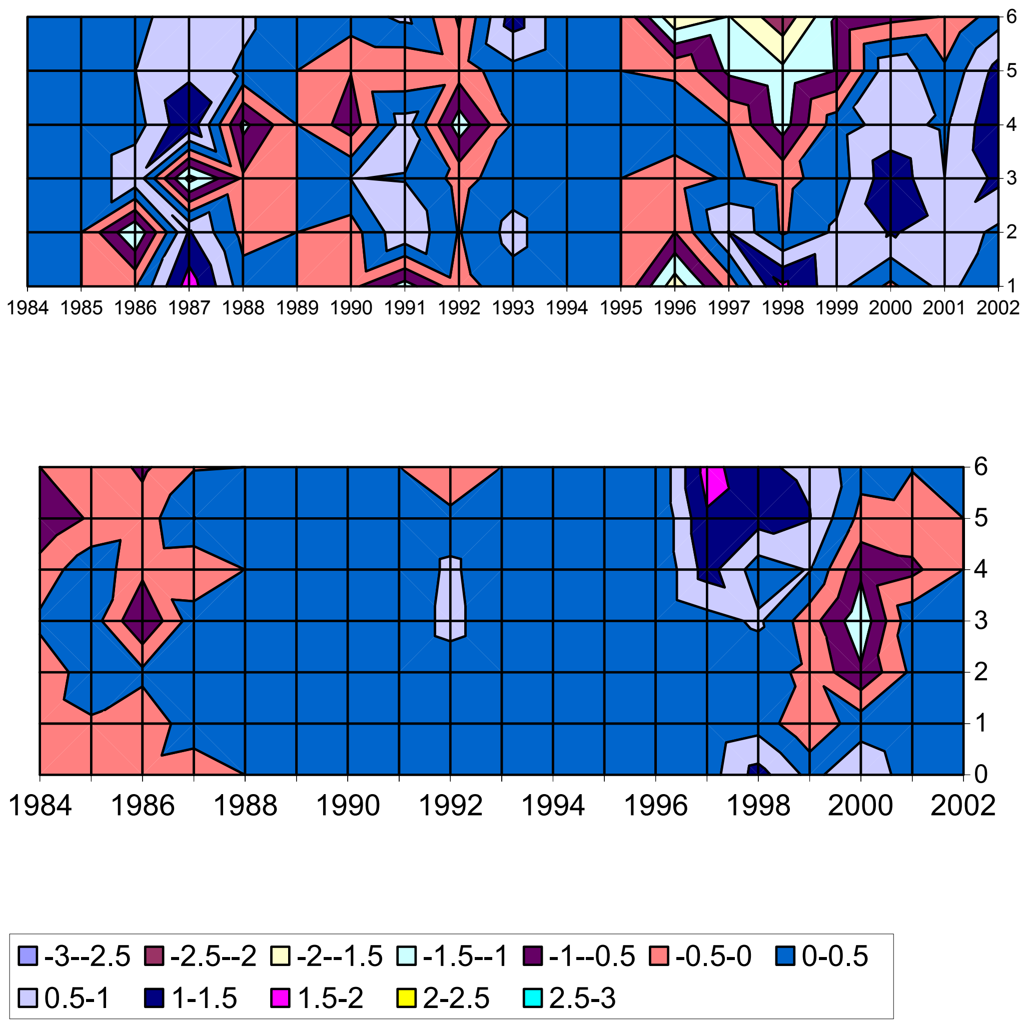


Figure 9.7.2.4 Residuals from the AMCI assessment model for the Spanish March and the Portuguese November acoustic surveys.

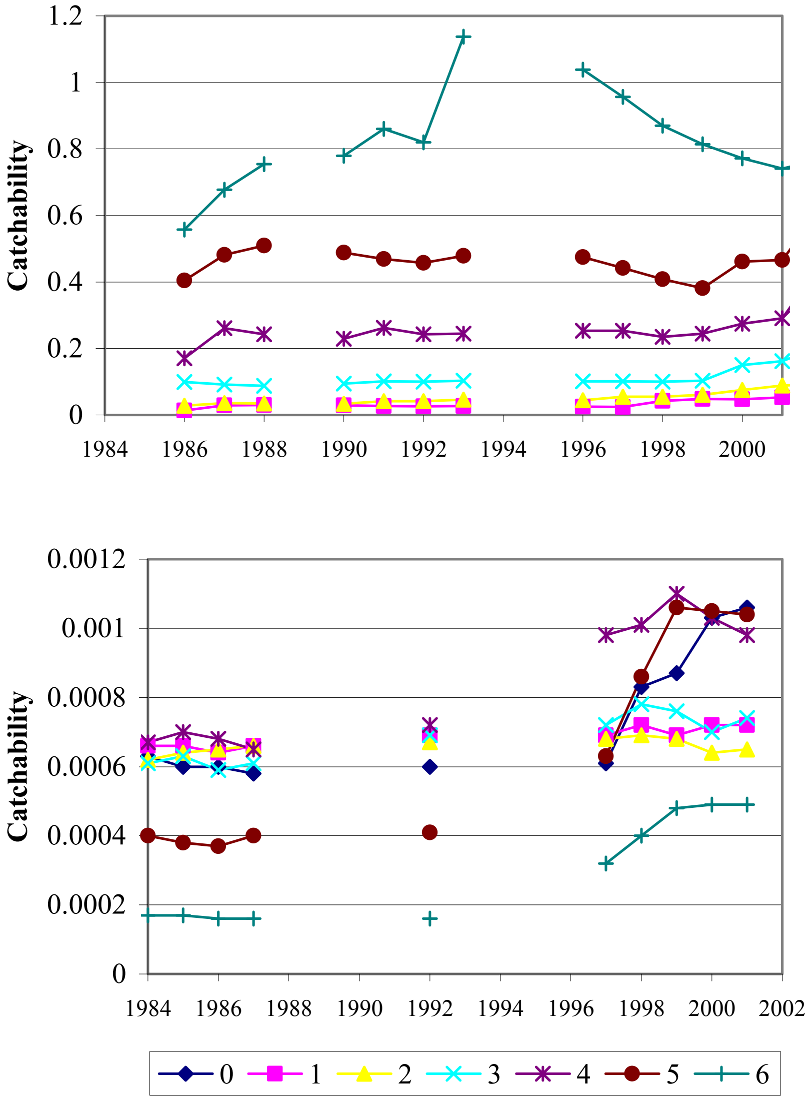


Figure 9.7.2.5 Catchability-at-age estimated by the AMCI model for Spanish March (top) and Portuguese November (bottom) acoustic surveys.

10 ANCHOVY – GENERAL

10.1 Stock Units

The WG reviewed the basis for the discrimination of the stocks in Subarea 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; Junquera, 1993). These authors explained that the variability is reflecting the different environments in the recruitment zones where the development of larvae and juveniles took place. They suggested 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.,* 1994), the WG 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). So far, these observations not affect our perception of one stock in the Bay of Biscay area. Anchovy found in the Celtic sea area 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 WG 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. 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, support the view that the populations inhabiting IXa may be not enterely homogeneus, showing different biological characteristics and dynamics (ICES 2001/ACFM:06). The recent catch distribution of anchovy along Division IXa confirms that anchovy fishery is mainly concentrated in the Spanish waters of the Gulf of Cadiz (more than 80% of total landings), which is also corroborated by direct estimates of the stock biomass (about 90% of total biomass). Such data seem to suggest the existence of an anchovy stable population in the Gulf of Cadiz which may be relatively independent of the remaining populations in Division IXa. These others populations seem to be latent ones, which only develop when suitable environmental conditions take place, as occurred in 1995. (See section 12 and Ramos *et al*., 2001)

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 1991-2001.

In Subarea VIII during the first quarter in 2001, 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 (VIIIb) and in the South (VIIIc), whereas the French fishery is located in the North (VIIIa). During the fourth quarter, the main fishery is located in the North of the Bay of Biscay (VIIIa) and some Spanish purse seiners stayed to fish in the North, but the main production corresponded to the French fleets.

Anchovy fishery in Division IXa in 2001 was again located in the Gulf of Cadiz area (Spanish part of the Sub-division IXa South) throughout the year as observed in recent years. Highest landings this year from this Division occurred during the second and third quarters, which were mainly caught by the Spanish fleets fishing in the Gulf of Cadiz. Spanish catches from the Sub-division IXa North were negligible. Portuguese anchovy landings from Division IXa in 2001 were relatively low as compared with the Spanish ones, although they also occurred throughout the year. Most of the Portuguese anchovy was caught in the Sub-division IXa Central North and South (Algarve area) between the second and fourth quarter.

10.3 Workshop on anchovy otoliths from Subarea VIII and Division IXa in 2002

During 2001 and 2002 and within the EU study project PELASSES (99/010) an exchange of otoliths and a workshop on age reading of anchovy otoliths from subareas VIII and IXa took place coordinated by AZTI. The otoliths exchange programme took place during Summer and Autumn 2001 based on which precision of current ageing procedures was assessed and served as starting point for analysis and discussions of the workshop. The workshop was organized to standardize the age readings of anchovy and discuss the problems and difficulties for the age readings. The workshop took place in January 2002 in AZTI (Uriarte et al. WD2002). A total of 7 readers from AZTI, IEO, IFREMER and IPIMAR took place in both activities.

The major goal of the workshop was to identify major difficulties in age determination and standardize anchovy otolith ageing criteria for the Bay of Biscay and for division IXa. For the former case AZTI's methodology for age determination was discussed and adopted by the Workshop. For the second area suggestions on age reading methodology and on further research were agreed.

From the exchange of otoliths precision of current ageing procedures was assessed. For the Bay of Biscay the average percentage of agreement across ages and readers (83 %) and the average Coefficient of Variation (CV=30%) were rather low for a three year living fish. The major disagreements arise from the ageing of the oldest age groups (2 and 3). Ages 0 and 1 seem to be much better determined.

For the Atlantic coasts and Gulf of Cadiz anchovy otoliths a rather similar low precision arisen: The average percentage of agreement across ages and readers was 84 % and the average CV was 40.8%. Otoliths in division IXa are known to be rather difficult for age determination.

After the workshop the general agreement achieved for the Bay of Biscay and Division IXa attained about 92 and 88 % respectively. The results of the Workshop are described in Uriarte et al. (WD, 2002).

During the workshop it was recognised that otoliths from Division IXa show a higher complexity (presence of checks and strong differences in the individual growth pattern) than those from the Bay of Biscay. The adoption for the Gulf of Cadiz otoliths of the standardised age reading criteria followed in the Bay of Biscay resulted in an improvement in the precision of age determinations and an increase in the level of readings agreement among participants. Furthermore, results from this workshop lead to the realizing the presence of some fish of age 3 and a probable higher abundance of 2-years old anchovies than previously detected. From such observations it was advised that age determinations performed during the last years were revised, although further research is still needed in order to develop a standard *ad hoc* methodology for determining the age of the Gulf of Cadiz population (see below).

At present Gulf of Cadiz otolith collections from 1995-2001 are under revision following the above recommendations and the standards adopted for the Bay of Biscay anchovy. Revision of the remaining years with available collections (1988-1993) will be attempted throughout the next year. It is expected that in the next year's WGMHSA the results from this revision be presented. Nevertheless, some problems related with the correct allocation of small fish either into the 0- or 1-age groups still persist. Additionally, use of maturity data (macroscopic scale) as auxiliary information to allocate otoliths into these age groups showed some inconsistencies because the difficulties found in the correct differentiation of developing and partial post-spawning stages.

Major conclusions of the Workshop were:

- A standard procedure has been proposed and adopted for the Bay of Biscay (Uriarte 2002) and a CD with the validation, the method and large set of didactic photos produced at AZTI will be delivered to every participant of the workshop.
- For the otoliths from Division IXa the workshop has recommended following the general rules applied in the Bay of Biscay (adapted with some particularities of the area as the existence of several fishes with none or poorly marked first winter ring).
- Assurance of future quality is being devised by free collaboration and exchange among the institutes with rutinary samples in order to check and assure as much as possible consistency among readers.
- Quality commitments: An exchange can be organised in 3 years in 2005, to check the consistency and precision of age readings.
- For division IXa, following of length mode cohorts and otolith development of the edge throught out the year and for several years if possible is advisable.

Research for solving doubts on conflicting otoliths was encouraged making use of studies on daily growth of otoliths.

The Working Group supports the conclusions of the Workshop.

Table 10.2.1: Catch (t) distribution of ANCHOVY fisheries by quarters and total in the period 1991-2001.

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
2000	416	61	41	0		88		4003	0	0
2001	1052	13	27	0		598		1406	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
2000	668	0	5	1		14690		3755	0	0
2001	3233	3	30	4		13462		7629	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	0
1999	1617	0	139	318		949		351	5750	0
2000	673	0	0	7		1238		211	8804	0
2001	3278	3	107	13		1314		249	8788	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	0
1999	692	30	723	12		98		0	4266	0
2000	603	0	25	2		98		266	3843	0
2001	1091	0	234	11		36		624	6042	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	0
1999	5942	96	957	413		8249		8529	10016	0
2000	2360	61	71	10		16113		8235	12647	0
2001	8655	19	397	27		15410		9908	14831	0

Not available

11 ANCHOVY - SUB-AREA VIII

11.1 ACFM Advice and STECF recommendations applicable to 2002

ICES advice from ACFM in November 2001 states: "ICES recommends that a preliminary TAC for 2002 is set to 33 000 t. This is based on the conservative assumption that recruitment in 2001 and beyond is 8.5 billion (mean of the below mean year classes in the historical series), and that the fishing mortality is the average of that of recent years (F=0.65). This TAC should be revised in the middle of the year 2002, based on the results of the fishery and of acoustic and egg surveys in May-June."

STECF in November 2001 recommends that "it is not necessary to set a preliminary TAC and an annual TAC of 33,000 t could be set for 2002. STECF also recommends that the Commission may wish to request ICES to propose harvest control rules that would allow managers to automatically revise a preliminary TAC in the middle of the year".

The European Fishery Commission decided to set an annual TAC at a precautionary level of 33,000t, as traditionally had been done.

11.2 The fishery in 2001

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 (up to 1999) indicate that they are supposed to be less than 5 % of the total Spanish catches. Since 1999, a part of the Spanish fleet came to fish in the VIIIa during summer and autumn and landed significant amounts of fish. In 2001 this fleet also operated during autumn in the VIIIa area. (**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 2001

In 2001 a total of 40 149 tonnes were caught in Subarea VIII (**Table 11.2.1.1** and **Figure 11.2.1.1**). It is a 8.5% increase compared to the level of 2000 catches. The Spanish fishery increased their landings while the catches of France showed a small decrease. As usual, the main Spanish fishery took place in the second quarter (85.4%) and the main French fishery in the second half of the year (83.7%) (**Table 11.2.1.2** and **Figure 11.2.1.2**).

In 2001, as in other years, Spanish and French fisheries were well separated temporally and spatially. About 86 % of the Spanish landings were caught in divisions VIIIc and VIIIb in Spring, while the French landings were caught in divisions VIIIb in Winter (16 %) or in Summer and autumn in division VIIIa (83.7 %) (**Table 11.2.1.3**). As in 1999 and 2000 some Spanish purse seines went to fish for anchovy in VIIIa during the second half of the years, although catches were low (2.2 %).

During the first half of 2002, total international catches reached 10,919 t (preliminary data) which showed a strong decreasing compared with the same period in the previous years. It is due to small landings of the Spanish fleet in Spring (of only about 4.500 t) which were the lowest recorded since 1986 (**see Tables 11.2.1.1 & 2**). This failure of the spring Spanish catches in 2002 may be indicative of low recruitment (age 0) in 2001.

11.2.2 Discards

As in the sardine fishery there are no estimates of discards in the anchovy fishery but there does not appear to be any significant problem.

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 catch are presented in **Table 11.3.1.1**. The quality of age composition in 2001 is poor, since there was no otolith sampling during the second half of the year, when 83% of the French fishery, 12% of the Spanish fishery and 42 % of the international catches took place (see quality of data section 1.3). The second semester age composition of catches was based on previous years grade age relationships (being grade the number of fishes per kilogram). Age otolith sampling in 2002 is expected to have improved the second semester of 2002.

For France, the 1 age group largely predominates in the catches, except during the second quarter. For Spain the ages 1 and 2 are both well represented in catches in 2001. For the international catches, 1 year-old anchovies make up 65.8 % of the landings followed by age 2 with 32.12%. As usually, the 0 and 3 age groups represented respectively a low proportion of the catches in 2001, respectively 0.1 and 1.7% for each category. Approximately 5% 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 have not been provided since 2000. The Table 11.3.1.2 gives the data available for the period 1987 – 1999. These are traditionally catches of small anchovy mainly of 0 and 1 year old groups amounting about 5 hundred tonnes or less. Nevertheless in 2001 live bait catches were minima if any, since according to fishermen it was impossible to find any juveniles in the Bay of Biscay. This certainly suggest a failure of age 0 recruits in 2001.

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, appear 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 in 2001.

For the first quarter, the French and the Spanish fishery show the same length distribution, corresponding with anchovy of the medium size, (**Figure 11.3.2.1).**

For the second quarter, the length distribution of the Spanish fishery, the main one showed a unimodal distribution. For the French landings, we observed a bimodal distribution for the catches; the smaller group corresponds mainly to the catch by small purse-seiners and pelagic trawlers fishing close to the shore. On average, the anchovies landed by the French fleet are smaller than those caught by the Spanish one in the second quarter (**Figure 11.3.2.2**).

For the third quarter, the main fishery is the French one. On average the French anchovy catches had a mean size higher than the Spanish ones. (**Figure 11.3.2.3**). For the fourth quarter, the size distribution of the French and Spanish landings were similar. (**Figure 11.3.2.4**).

The series of mean weight at age in the fishery by half year, from 1987 to 2001, 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. However for both countries these estimates in 2001 were not based on any biological sampling but on analogies the grade-age relationships of previous years.

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 1990-2001. For the years 1993, 1996,1999 and 2000, when no estimate of mean weight at age for the stock existed, the average of the rest of the years is taken.

11.3.3 Maturity at Age

As reported in previous years' reports, anchovies are fully mature as soon as they reach 1 year old, at the following Spring after they hatched. 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.

For the purpose of the assessment applied in the WG, a constant natural mortality of 1.2 is used. However, the natural mortality for this stock is high and probably variable. Natural mortality estimates after Prouzet et al, 1999 suggest that this parameter could vary between 0.5 to 3. From the results obtained, M (natural mortality) can vary widely among years and it seems that the assumption of a constant M used 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 2002, with a gap in 1993 **(Table 11.4.1.1)**. The map of egg abundance and the positive spawning area for 2002 is shown in **Figure 11.4.1.1**.

The largest spawning area of the whole series of DEPM surveys was recorded in 2001. As no estimate of Daily Fecundity was available in 2001, the biomass estimate used in the past year working group was initially based on a regression of past SSB estimates on Daily Egg production (P0) and Spawning Area (SA) and the Julian day of the middle of the survey dates (ICES CM2002/ACFM02). This gave a figure of about 127,800 tonnes for 2001. An update is available for 2001 (Uriarte et al. 2002WD), which makes of proper fecundity estimates for this year and gives a figure of about 124,100 t (with a CV of 20%) **(Table 11.4.1.1)**, almost identical to the one predicted. This confirms the good performance of this simple relationship. The whole application of the DEPM has now led to provide estimates of the population in numbers at age as well **(Table 11.4.1.1)**. A summary of the results from the **2001 DEPM survey** follow below:

Parameter	Estimate	Est. Error	CV
DEP	8.48E+12	7.38E+11	0.0870
R'	0.5316	0.0023	0.0044
S	0.2882	0.0510	0.1770
F	11335.5	802.1	0.0708
Wf	24.60	1.2647	0.0514
DF	70.59	12.7909	0.1812
Biomass	124,132	24951.01	0.2010
Wt	20.71147	1.741611	0.0841
Population #	6047.6	1379.2	0.2281
Pa 1	0.7162	0.0533	0.0745
Pa 2	0.2630	0.0485	0.1845
Pa 3	0.0208	0.0073	0.3510
Nage 1	4362.2	1173.3	0.2690
Nage 2	1562.0	345.9	0.2214
Nage 3	123.5	45.2	0.3660
Wage_1	16.78	0.636	0.038
Wage_2	28.52	4.394	0.154
Wage_3+	34.844	11.068	0.3176

For the estimation of the Spawning Biomass in 2002 after the Daily Egg production estimate of the survey, the same regression model has been applied in Santos and Uriarte (WD2002):

$LN(SSB) = Constant + \alpha LN(P0) + \beta LN(SA) + \delta Julian\text{-}day + \xi$

where *P0* is the daily egg production per 0.05 m2 and *SA* is the positive spawning area.

The regression statistics and the forecast for 2001 are presented the working document. The log predictions were transformed to the original scale including a bias correction factor for the

$$SSB = \exp(\hat{y} + \frac{1}{2}\sigma^2)\ .$$

Based on this model, the DEPM estimate for 2002 is about 51,000 t, with a CV=13%. As Po and SA are taken as predictors without their measurement error, the CV above is probably an underestimate. The current preliminary estimate is below the acoustic preliminary estimate of biomass for 2002 of about 97,700 t. This DEPM 2002 estimate indicates a substantial decrease in Biomass most likely related to a poor presence of age 1 in 2002 (poor recruitment occurring in 2001).

The whole series of DEPM biomass estimates since 1987 are presented in **Figure 11.4.1.2**. A total of 15 years of SSB estimates and 11 years of population at ages estimates are now available for the assessment of this anchovy and this values are taken as absolute estimator of the biomass and population of anchovy in the bay of Biscay.

11.4.2 Acoustic surveys

The French acoustic surveys estimates available from 1983 to date are shown 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, 1998, 99 and 2000 new acoustic surveys were performed for anchovy in the French waters. The acoustic values are considered to be relative indices of abundance (Anon. 1993/ Assess:7).

Within the frame of the EU Study Project PELASSES, a series of co-ordinated acoustic surveys were planned in 2000, 2001 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).

Another acoustic survey took place in May 2002 (PEL2002) from 6th of May to 8th of June, along systematic parallel transects perpendicular to the French coast see **Figure 11.4.2.1.** A total of 5000 nautical miles were covered and 61 hauls were performed (Poisson et Masse WD, 2002). The survey area was stratified according to coherent multi-species communities, depth, strata and latitude (Figure **11.4.2.1**) resulting in 4 strata.

The main results from the acoustic assessment is shown in the text table below:

	Area prospected (nM²)	**Biomass(tons)**
Gironde	1317	**52 756**
Centre	5305	**5 521**
South (Adour)	1379	**35 642**
Offshore (Fer à cheval)	2666	**3 132**
TOTAL	10667	**97 051**

The above table points out to a total biomass of 97,051. The biomass estimated by acoustics is close to 2000 estimate but lower than 2001. Compared to the apparent low catches by professional both in France and Spain, this estimate could appear as to be over-estimated. Nevertheless, anchovy was well present during the whole acoustic survey (fig. 1); echo-traces were well present and anchovy was well represented in a lot of hauls. The situation was not that much different from the 2000 one.

For each haul where anchovy was present, a sample of about 200 fish was measured. A global length distribution was obtained according to each area defined by gathering the individual observations in this area weighted by the acoustic energy attributed to the species (Xai , Massé 1995). The **figure 11.4.2.2** gives the length distributions of the anchovy sampled in the main areas.

From these distributions we can infer that at least 18 % of the spawning stock biomass consists of 1 year old. This very low and unusual proportion for the Group 1 (less than 20 %), but it is coherent with the observation of big fish all along the survey. Small fishes (mean length 12 cm) were only observed in a single haul (Gironde) and medium size fish (14 cm) in only 4 hauls upon the 27 fishing operations.

This estimate is also coherent with the preliminary results of CUFES sampling during PELGAS02 which show a distribution of anchovy eggs quite similar to the one observed in 2000 with a density is even higher.

According to the length distributions per area and global age/length key, the number of individuals (10**6) per age and area during PELGAS02 was estimated as following.

	G1	**G2**	**G3**	**Total**
Gironde	485.6	1 263.3	246.9	1 995.8
Centre	21.5	120.6	34.1	176.2
Adour	322.2	800.7	187.2	1 310.1
Fer à cheval	1.7	63.4	21.8	86.9
Total	830.9	2 248.0	490.1	3 569.0
%	**23.3%**	**63.0%**	**13.7%**	

A total of 97 051 tonnes corresponding to 3 569 million of fish were estimated during the survey. The 2 age group largely predominates (63%).

An hypothesis could be advanced by the fact that in opposition to previous years, very few schools were observed close to the surface and most of the detections were close to the bottom, mixed with horse mackerel in the southern part (Adour) and sprat in the Northern (Gironde). This particular spatial distribution could be an explanation of the low catches in the commercial fishery induced to a low accessibility more than to a low availability.

Extension of previous data (PEL2001)

The Biomass estimate and the Estimate number of individuals (10**6) per age and area in the Bay of Biscay in 2001 (PEL2001 acoustic survey) are shown in the two following text tables.

	Area prospected (nM²)	**Biomass(tons)**
Northern Coastal area (2)	2 200	**20 400**
Centre offshore area (3)	3 900	**500**
Centre Coastal area (4)	3 100	**2 100**
South offshore(5)(Cap Breton?)	3 300	**4 100**
South Coast (Gironde) (6)	4 600	**105 200**
Southern area (Adour?) (7)	700	**4 900**
TOTAL	**21 300**	**137 200**

	G1	G2	total
Northern Coastal area (2)	1 501.5	85.3	1 586.8
Centre Coastal area (4)	139.2	11.8	151.0
Southern area (Adour?) (7)	90.3	105.3	195.6
South Coast (Gironde) (6)	4 432.4	1 526.3	5 958.8
Total	6 163.5	1 728.7	7 892.1
%	**78.1%**	**21.9%**	

The estimates of the population in numbers at age were not available in the previous year and therefore they constitute new inputs for the assessment.

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 number of French mid-water trawlers involved in the anchovy fishery 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. However for the recent years (since 1999) the number of vessels involved in that fishery has not been updated.

The fishing effort developed by the two countries is nowadays similar although the fishing pattern is different,mainly since 1992 when the Pelagic French Fleet stop the Fishery in Spring during the spawning season of anchovy in the Bay of Biscay. The current effort may be at the level that existed in this fishery at the beginning of the 1970's (Anon. 1996/Assess:2), but the stop of the French pelagic fleet in Spring allows to prevent a catch of a too large number of fish before their first spawning.

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). 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 results given in a STECF WD (Prouzet and Lissardy, 2000) from a regression analysis using a Generalized Linear Model and summarised in a previous report (ICES CM2001/ACFM:06)) showed that 81% of the deviance of the DEPM biomass is explained by the variation of the mean catch per trip.

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 a 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 prior to the fishery, the only information presently available is the one concerning the influence of the environment on the recruitment of anchovy.

Two environmental indices are available to this WG (Borja's upwelling index –pers. comm..-, Petitgas et al. WD2002) (**Table 11.6.1**) and a review of the role of these environmental indices in setting the anchovy recruitment in the Bay of Biscay is made in Uriarte et al. (2002) and by Petitgas et al. (WD2002).

The Upwelling index of. Borja *et al*. (1996; 1998) on which the prediction made in 1999 was based showed 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 onset of good levels of recruitment at age 1 for the anchovy population in the next year. 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 recruitment up to that from 1999 confirmed that relationship. However the two latest recruitment estimates, and particularly the recruitment from 2000, rendered not statistically significant the role of this index (Uriarte et al. 2002). The estimates of this Upwelling index since 1986 are reported in **Table 11.6.1,** updated with the 2002 value.

The second index relating environment with the recruitment of anchovy is provided by Petitgas et al. (WD2002). 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. According to R^2 criterion, the best linear regression is built from 2 physical factors (Allain et al., 1999):

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). This variable is therefore rather similar to the one produced by Borja et al. (1996, 1998) on the sole basis of wind data and has also a positive effect

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 several days and could have caused important larvae mortality (after the peak spawning).

In comparison to Borja et al. (1998) which did not identify turbulence (monthly average of the cube of the wind) as a significant 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.

These two variables explained about 70 % of the recruitment inter-annual variability between 1986-1999. However, Uriarte et al. (2002) showed that the recruitments in the most recent years have led Borja's upwelling index to be not significant over the period 1987-2001 and have dropped the coefficient of determination of Allain's index to about 50%, worsening its predictive power. Nevertheless, the spring-summer upwelling still seems to favour recruitment, while the negative role of the stratification breakdown seems to be corroborated by the likely bad recruitment occurring in 2001.

Allain's model has 2 covariates, Upwelling (UPW)) with a positive effect and SBD with a negative one, therefore low R is mainly due to SDB . In the summer periods of 1998-2000 UPW was low and no SBD appeared, therefore, Petitgas' model predicted average recruitment values. For year 2001 UPW was still below average and in addition an SBD event took place. A breakdown in stratification was observed in July 2001. The SBD corresponded to strong winds in July (17 to 19 July) as was the case in 1987. The breakdown in july 2001 was comparable to SBD events in other years (Petitgas et al., 2001). So SBD was attributed the value of 1 and a low recruitment (age-1) was predicted for 2002 (at about 1850 millions of age 1, or about 6170 millions recruiting at age 0 in 2001, among the 4 lowest previous recruitment estimates of the series). Nevertheless Petitgas et al. (WD2001) commented that due to the higher than normal spawning surface area, the recruitment may not be so conditioned by the SDB events which, were only recorded in the southern half of the Bay of Biscay. The acoustic survey performed by IFREMER with R/V "Thalassa" in may 2002 estimated a low recruitment in 2002 with age-1 fish representing only approx. 18 thousand tonnes (18% of total biomass) (Poisson and Massé, 2002). Low recruitment for 2002 (age-0 fish in 2001) was also considered very likely by Uriarte et al. (2002). And according to this year assessment results (see next sections), a low recruitment is estimated in 2001 (poor age 1 in 2002). This suggests that the recruitment prediction performed last year is validated. In the series 1986-2002, the model adjusted and predicted well the low recruitment and this was due to the SBD negative effect. In contrast, the model has a worse performance in predicting high recruitment (Petitgas WD2002).

The very high age-1 recruitment in 2001 appears as an outlier in the series (more than 11 billions individuals at age 1 in 2001). The model was not able to predict (model fit 1987-1998) the very high recruitment observed in 2001 (upwelling was medium and no stratification breakdown occurred) nor was it able to adjust to the value (model fit 1987-2001). This made the variance explained by the model drop to 48.5 % (70 % without this year) (Petitgas et al. WD2002). Environment processes that are not included in the indices may have enhanced anchovy recruitment. The hydrology of the Bay of Biscay was very particular during autumn 2000 and winter 2001 with very important westerly winds and freshwater outFlows resulting in exceptionally low salinities in the Bay. This may also have resulted in a particular circulation pattern. It is possibly that survival in the juvenile stage was enhanced more than for other years. To the credit of this interpretation is the distribution of the age-1 fish found during the spring 2001 acoustic survey. In spring 2001, the spatial distribution of spawning age-1 fish was different than that of other years: anchovy spawned in June north of 46°30N, outside of the usual spatial may-june spawning box. The SBD which occurred in july 2001 would not have allowed the important spawning of spring 2001 to recruit into an important age-1 class in 2002 ((Petitgas WD2002).

For 2003, the model predicts a medium recruitment value (no SBD and medium UPW): recruitment can either be medium or high (Petitgas et al. 2002WD).

In summary, the negative role on the onset of anchovy recruitment arising from the stratification breakdown events in June or July is being confirmed (SBD binary variable in Allain's 3-D model). Therefore this variable could be useful to identify bad recruitments scenarios for forecasting purposes. However the predictive power of this relationship may be still low, as was the case for the unexpected high 2000 year class. For this reasons the WG considers that it would not be advisable to rely already on these environmental indices to forecast recruitment. However, the WG recognises that in the case of the anchovy fishery, 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, until a better modelling and/or understanding of the precision for forecasting is obtained.

11.7 State of the stock

11.7.1 Data exploration and Models of assessment

Exploratory runs with ICA

The assessment of the anchovy fishery performed up to now has been based on fitting a separable selection model for fishing mortality, assuming a constant natural 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 and for the current year new estimates of biomass in 2002 are again available from both methods. 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 assumption of constant Natural mortality, fixed in the assessment to 1.2, may not be correct however for this stock since it is suspected to be highly variable (Prouzet et al. 1999).

A careful selection of the appropriate weighting factors for the catches at age in the estimation process for the assessment was undertaken in 2000 (ICES CM2001/ACFM:06). It showed that the fitting to the separable model can be improved by down weighting ages 0 and 3, which can be considered marginal ages in terms of their percentage in the catch. Therefore the WG adopted the same weighting factors for this year's assessment i.e., down weighting ages 0 and 3 to 0.01 and 0.1 respectively. In addition catch at age 3 in 1991 was found to be an outlier and was strongly down-weighted to 0.0001.

This year the WG has started with an assessment similar and with the same settings as the one produced in the last year, just including the new input data available: the catches at age in 2001, the population at age estimates for the DEPM and acoustic surveys in 2002 and the estimates from both surveys corresponding to 2002. The results can be compared with those from the last year in **Figure 11.7.1.1**. Both are very close one to the other; the only difference being that recruitment in 2000 raises up.

Next a two separate period for the fitting of the separable period was checked in order to see if the first years of the assessment period from 1987 to 1991 (when the winter fishery barely existed and the summer fishery was developing) may have different fishing pattern than the latter's ones. The **Figure 11.7.1.1** show the little differences arising from that exercise, so no major changes in the fishing pattern are evidenced for the current period 1987-2001.

Tuning the assessment using the DEPM and acoustic indexes both as aggregated indices of biomass and as aged structured indices was already discussed and accepted in previous years (ICES CM1999, ICES CM 2001). In addition the assessment uses the DEPM indexes as absolute estimators of the population abundance, which strongly influences the levels of Biomass and Fishing mortalities resulting from the assessment. This year the sensitivities of this decisions into the assessment were tested once more: **Figure 11.7.1.2** shows the influence of taking out from the assessment all the age structure information arising from the surveys. Little differences appear from this exercise, what reflects that the bulk of the population dynamics is already reflected in the biomass estimates, since the frequent and intense oscillations of recruitment are directly reflected in parallel oscillation of next year biomasses. Alternatively keeping all the information from the surveys but dealing the DEPM estimates as relative instead as absolute lead to drastic change in the perception of the population, reducing the average level of biomasses by about 30-35% all over the historical series and conversely increasing the average level of fishing mortality. This neat effect over the whole period is certainly due to the poor convergence properties of VPAs like assessment towards their true values for this short living species. Therefore the scaling role of a biomass index can not be substituted by any VPA assessment in these species. The working group considers that the assumption that the DEPM surveys are unbiased and absolute estimators of biomass is valid given the long series of daily fecundity estimates at the peak spawning available for this population (Motos 1996, Santos et al. 2002 WD).

Finally an alternative assessment of the anchovy population has been devised

Biomass Dynamic Model for anchovy

Following an approach already applied to squids biomass based (delay-difference) model (Schnute 1987, Roel & Butterworth 2000).was essayed for this anchovy. The model seeks to estimate recruitment at age 1 at the beginning of each year (in mass) accounting for the signals of inter-annual Biomass variations obtained from the direct surveys on this anchovy and the level of total catches (in tonnes) produced each year. This is only feasible because the series of surveys cover the whole period of the assessment with the exception of the 1993 and in several years more the two surveys were available.

The model does not make use of the age structure of catches except for the first months of each year when catches (in tonnes) are used splitted in age 1 and 2+ (this supposes about 37% of catches being splitted into two age classes). Catches are therefore dealt in majority as total tonnes not by ages. And the contribution of the age 0 to the catches has been removed to eliminate noise in the data, despite of their small contribution to the data.

The model differentiates two seasons for fitting purposes: the first one goes from the 1st January to 15th May and serves to obtain intermediate estimates within the year at peak spawning time, when the surveys have usually been made, so that fitting to them is made for that period. The second period just lead the total biomass (as survivors) to the beginning of the next year when estimates of the new Recruitment biomass at age 1 are produced by the model (*B(y,1,1*).

Denoting by *B(y,s,a)* the population biomass (in tonnes) at the beginning of the period *s* of year *y* of the *a* age class, the Biomass dynamic model can be formulated as follows:

First period: the Total biomass is equal to the new Recruitment (in mass) and the biomass surviving from the previous year

$$B(y,1,1+) = B(y,1,1) + B(y,1,2+) =$$

$$= B(y,1,1) + B(y_{-1},2,1+)\exp(-gf_2) - C(y_{-1},2,1+)\exp(-g(f_2 - h_2))$$

where *Y-1* denotes the previous year and a=1+ denotes all age groups being one or more years old.

Second period: the total biomass equals to that surviving since the beginning of the year which arises from the recruitment and the survivors from previous year:

$$B(y,2,1+) = B(y,2,1) + B(y,2,2+)$$

with $B(y,2,1) = B(y,1,1)\exp(-gf_1) - C(y,1,1)\exp(-g(f_1 - h_1))$

and $B(y,2,2+) = B(y,1,2+)\exp(-gf_1) - C(y,1,2+)\exp(-g(f_1 - h_1))$

In both periods ***g*** is a biomass decreasing rate accounting for growth G and the natural mortality M rates. The value for growth G by age was computed from the series of mean weights at age in the population coming from the DEPM (**Table 11.7.2.1**). AN average G rate for all ages in the population was produced from the weighting average of the G values by age and the average age composition of the population from the previous year assessment. This resulted in 0.52 for G. After subtraction of the natural mortality of 1.2, ***g*** results in a value of -0.68 (but ***g*** enters the above formulation in absolute terms as 0.68). In addition

f_1 and f_2 are fractions of the year corresponding to each period,

h_1 and h_2 are fractions within each period corresponding to the elapsed time from the beginning of the period to the date when catches were taken on average. This fractions are used to project the observed catches to the end of the period.

Input data (**Table 11.7.1.1**) : The DEPM and acoustics total biomass (with 15 and 8 data respectively) and the biomass at age 1 estimates from those surveys, when available (with 11 and 8 data respectively) are the indexes to be fitted at the beginning of the second period.

Catches in mass for age 1 and 2+ from January to mid May each year and total catches in tonnes for the rest of the year are taken into account by the model.

The parameters values for g f1 and f2 and h1 and h2 are also shown in **Table 11.7.1.1**.

Unknown Parameters: In this model the only parameters to be estimated are the Survivors at the beginning of 1987 and Recruitment in mass at the beginning of each year 1987-2002.

Parameter estimation: The model was fitted in an Excell workbook by a non linear minimization of the following objective function:

$$\sum_y \left(\ln(B_{depm}(y,2,1)) - \ln(q_{depm}\hat{B}(y,2,1))\right)^2 + \sum_y \left(\ln(B_{depm}(y,2,1+)) - \ln(q_{depm}\hat{B}(y,2,1+))\right)^2$$

$$+\sum_y \left(\ln(B_{acoustics}(y,2,1)) - \ln(q_{acoustics}\hat{B}(y,2,1))\right)^2 + \sum_y \left(\ln(B_{acoustics}(y,2,1+)) - \ln(q_{acoustics}\hat{B}(y,2,1+))\right)^2$$

where the recruitment at the beginning of the year $B(y,1,1)$ is constrained to be greater than 3000 tonnes. This is made just to avoid any negative recruitment value.

Catches themselves are not fitted by the model: they only act as subtracting offsets so that they are constraining the Recruitment and biomass levels, so that survivors arriving to mid spawning period can never be negative.

Two alternative model fitting were devised: The first one takes the DEPM index as absolute (q_{depm} fixed to 1) and the Acoustics as relative as for the ICA standard setting, The second fitting was made to both survey indices but taking them as relative. In all cases different initial parameters were essayed in order to be assure that a single minima was attained. The initial parameters for the final runs were taken from the last year ICA assessment (ICES CM 2002/ACFM:06). However, the different attempts with different initial values showed that the results were not dependent on the initial values.

Results for the first and second runs are shown in **Table 11.7.1.2** along with the fitted values for the standard and adopted ICA results. **Figures 11.7.1.3** and **5** show the fitted values and a comparison with the ICA results for both runs. The residuals are shown in **Figures 11.7.1.4** and **6**.

This Biomass dynamic model gives a rather similar and consistent results with those arising from ICA, with a tendency towards a bit smaller biomasses and recruitment in the recent years. In both runs the final biomass in 2002 is set at about 50,000-60,000 tonnes, coincident with the one provided by ICA. The high consistency between both types of assessment reflects on the one hand that the catches at age data do not contain very contrasting information versus the survey data. On the other hand that ICA is basically driven by the Surveys which by themselves they contained sufficient information as to point out the basic changes in recruitment. As mentioned above a catch at age analysis for this short living species can not converge to the true population levels and this makes absolutely dependent of the survey indices the result of the assessment.

This is a kind of simple model which seem to perform pretty similar to the more complex and heavily parameterised ICA assessment model, but this biomass dynamic model, as ICA, certainly can only be fitted if the current monitoring of the anchovy population is sustained. This assessment is of thetype that can be easily applied just after the surveys in order to give advice to managers.

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 for the period from 1987 to 2001 (with the ICA package, Patterson and Melvin 1996), as in previous years.

Inputs for the final assessment are summarised in **Table 11.7.2.1**. The assessment uses as tuning data the DEPM (1987-2002, 15 surveys) and the Acoustic (1989-2001, 8 surveys available) estimates both as biomass and as population numbers at age indices. The Acoustic estimates are treated as relative and DEPM as absolute and both are down-weighted to 0.5 (because of the double use made of the indices). For 1996, 1999, 2000 and 2002 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 and for the later year with the Julian day (see section 11.4.1). Catch-at-age data on an annual basis are presented in the **table 11.7.2.1.**

The assessment performed used similar settings to the ones chosen for the 2001 assessment. The assessment assumes a constant natural mortality of 1.2, around the average value estimated earlier (Anon., 1995/Assess:2, Prouzet et al. 1999). The separable model of fishing mortality is applied over the period of 15 years considered (1987-2001). However the catch data of 1987 and 1988 are down-weighted in the analysis because the French 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 based on reliable information, therefore those years are down-weighted.

Catches for ages 0 and 4 are down-weighted to 0.01 in the assessment because they represent about 3% for age 0 and less than 1% for age 4 of the total catch . Age 3 is down-weighted to 0.1 because it also represents a small percentage in the catch around 3% and down-weighting results in an improvement in the fitting of the separable model to ages 1 and 2 (ICES CM2002)

The assessment was achieved by a non-linear minimisation of the following objective function:

$$\sum_{a=0}^{a=4}\sum_{y=87}^{y=01}\lambda_{a,y}\left(Ln\left(C_{a,y}\right)-Ln\left(F_y\cdot S_a.\overline{N}_{a,y}\right)\right)^2$$

$$+\lambda_{DEPM}\sum_{y=1987}^{y=2002}\left[Ln\left(SSB_{DEPM}\right)-Ln\left(\sum_{a=1}^{5}N_{a,y}\cdot O_a\cdot W_{a,y}\cdot\exp\left(-P_F F_Y\cdot S_a-P_M.M\right)\right)\right]^2$$

$$+\sum_{y=87}^{2001}\sum_{a=1}^{3+}\lambda_{DEPM,a}\left[Ln\left(SP_{DEPM,a,y}\right)-Ln\left(N_{a,y}\cdot\exp\left(-P_F\cdot F_y\cdot S_a-P_M\cdot M\right)\right)\right]^2$$

$$+\lambda_{acoustics}\sum_{y=1989}^{2002}\left[Ln\left(SSB_{acoustic}\right)-Ln\left(Q_{acoustic}\sum_{a=1}^{5}N_{a,y}\cdot W_{a,y}\cdot\exp\left(-P_F F_Y\cdot S_a-P_M.M\right)\right)\right]^2+$$

$$+\sum_{y=1989}^{2002}\sum_{a=1}^{2+}\lambda_{acoustics,a}\left[Ln\left(SP_{acoustic}\right)-Ln\left(Q_{a,y}\cdot N_{a,y}\cdot\exp\left(-P_F\cdot F_Y\cdot S_a-P_M\cdot M\right)\right)\right]^2$$

with constraints on : $S_2 = S_4 = 0.79$ and $F_{2002} = F_{2001}$

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

N : population abundance on the first of January

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)

Others 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 stock summary of this assessment is presented in **Figure 11.7.2.2.**

11.7.3 Reliability of the assessment and uncertainty of the estimation

The assessment is heavily influenced by the surveys, the Spawning Biomass estimates produced by the DEPM (which is the longest series) and the acoustics. The use of DEPM as absolute estimate of biomass scales the SSB estimates of the assessment. The model fits well the aggregated indices of biomass (DEPM and acoustic) , without any skewness or kurtosis and no clear trends in the log-residuals (Table 11.7.2.2 and Figure 11.7.2.1). Some uncertainties in the DEPM SSB estimates arise from the use of regression methods in 1996, 1999 and 2002. The assessment shows a well-defined minimum at the converged level of fishing mortality for the most recent year in the analysis (2001). The absolute residuals from the separable model are high both across years and ages, particularly for ages 0 and 3, which are the ones down-weighted in the assessment. The best fit is achieved for ages 1 and 2 which are the most important age groups in the catches.

Table 11.7.3.1 shows that some changes arise between the output of the assessment performed in year 2000 and the current assessment (**Figure 11.7.1.1)**. The biomass for year 2000 estimated that year at about 70,000 t. is being now estimated at about 97,000 t. This change results from the high levels of anchovy at age 2 resulting from the population estimates in 2001 both in the acoustics and DEPM. The ICA estimate of biomass in year 2001 is 126,300 t., consistent with the estimate of the surveys. This increase in biomass is related to the large recruitment at age 1 in 2001. And the Biomass in 2002 is reduced to about 58,000 t., due to a low recruitment in 2001 as noticed by the surveys in 2002. The recruitment in 2001 is estimated to be close to lowest ones in the series. This estimate is obtained by the model fit to the survey population estimates for 2002, by projecting the biomass under fishing mortality equal to the one estimated for 2001.

Due to the high levels of Biomasses estimated to since 1998, the current levels of fishing mortality are far below those at the beginning of the nineties.

The WG considers that this assessment reflects current perceptions regarding trends in population abundance and fishing mortality. The close estimates of population trends arising from the Biomass dynamic model, which so little use of the age structure of catches, gives additional confidence to the current perception of the anchovy population, but above all indicates that the major information of the state of the stock is being directly obtained from the surveys. So the reliability of the assessment depends directly upon the reliability of the surveys

11.8 Catch Prediction

The population and the fishery in the prediction year depends largely on the incoming recruitment, which takes place in the interim year of the assessment. As the level of recruitment is unknown, two scenarios have been defined by the WG for the fishery projections in 2003:

- a precautionary approach, assuming for recruitment (age 0) in year 2002 the geometric mean of those below the median of the historical series .
- standard approach, taking the geometric mean recruitment of the historical series.

Both catch predictions are possible and the Working Group considered that it is difficult to propose to the managers a choice owing to the fact that in case of a low recruitment, the first scenario will be more appropriate.

The inputs for these two scenarios for projections are given in **Tables 11.8.1** and **11.8.3**. The population at age in 2002 has been taken directly from the ICA assessment output despite of being dependent on the preliminary biomass estimates from the surveys. For scenario A, the geometric mean for years, 1987, 88, 90, 93, 94, 95 and 2001 was chosen, resulting in 7,828 millions of 0 year-olds in 2002. For scenario B, the recruitment at age 0 in the subsequent years would be the geometric mean 1987 to 2001 (13,919 millions of age 0).

Weights at age in the catch correspond to the average values recorded since 1987 (15 years). Weights at age in the stock correspond to the average from 1990 (the first year of accurate assessment of this parameter, 12 years in total) as in the assessment input.

For each of the two scenarios A and B, projections were performed with a catch constraint for 2001 of 25,000 tonnes, which is a likely estimate given the low catches obtained during the first semester of 2002. The *status quo* fishing mortality was set equal to the average of the last 7 years (1995-2001) instead of only the last 3 years, due to the significant inter-annual fluctuations of the fishing mortality in this fishery.

The outputs for these two scenarios for projections are given in **Tables 11.8.2** and **11.8.4**. The results differ largely between the two scenarios: In the scenario A (low recruitment values in 2002), and under status quo exploitation, the predicted catch for 2003 would be about 17,000 t with a Biomass of about 34,241 t. For all the range of F multipliers biomass would remain still above the $\mathbf{B}_{lim}$ of 18,000 t and duplicating F would led Biomass to 28,563t for a catch level of 28,545 t. In the case of geometric mean recruitment in 2002, catches at F status quo would be at about 30,000 t for a spawning biomass of about 66,862 t. For higher catches spawning biomass would still remain above 55,000 t.

The little information available about recruitment comes only from fishermen information about the catching efficiency of juveniles for live bait fishing of tuna, they state that in comparison with the previous year juveniles are being detected in several places, so that a failure of recruitment as the one happening in 2001 can not be inferred from their comments. ON the other hand the environmental recruitment model of IFREMER (Petitgas WD2002) suggest that average recruitment may be occurring in year 2002. Therefore no strong indication of a relevant failure of recruitment is suspected. However as noticed earlier the WG is not in the position of forecast this year recruitment of 2002.

11.9 Reference points for management purposes

Reference points, $\mathbf{B}_{pa}$ and $\mathbf{B}_{lim}$, have been defined for this stock by ACFM (ICES CM 1998/ Assess 6:).

$\mathbf{B}_{lim}$ was defined as the level of biomass below which the stock has a high probability of collapse. The Working Group estimated a value of $\mathbf{B}_{lim}$ equal to 18,000 tonnes for anchovy (ICES CM 1998/ Assess 6:), which corresponded to the minimum spawning biomass estimated by the assessment model over the previous ten years (Table 10.1.6 in WG report CM1998/Assess: 6). The lowest Spawning Biomass estimated in this year assessment is 21,300 t.

$\mathbf{B}_{pa}$**:** defined as a biomass level at which some management action to protect the stock needs to be taken. Originally, a $\mathbf{B}_{pa}$ = 36,000 t of anchovy was estimated and defined as the SSB level which could withstand two successive poor recruitments. Although that $\mathbf{B}_{pa}$ level was not thoroughly evaluated it was adopted by ACFM. Simulation work presented at last year meeting (Uriarte & Rueda WD01) tested the validity of this reference limit for the interim year (assessment year) to prevent the stock to fall below $\mathbf{B}_{lim}$ the prediction year (the next one) under an F status quo strategy. The conclusion of that work was that 36,000 t may not be an appropriate value for $\mathbf{B}_{pa}$ as it is not robust under all feasible recruitment scenarios. On that basis and taking into account the difficulties in managing a stock with such a short life-span, the WG recommended further simulation work on this issue to estimate appropriate reference points for this stock. However no further work has been made on this issue in the mean while and the WG members considered that there was not time enough to go ahead on this issue during the WG.

11.10 Harvest Control Rules

One of the major problems for the fishery management of the Bay of Biscay anchovy is the strong and short-term fluctuations in biomass linked to variability in recruitment strongly influenced by environmental factors. The Spawning Stock Biomass is determined by the abundance level of the incoming year class which cannot be determined with sufficient accuracy to recommend an annual TAC at the beginning of the fishing season (January). For that reason the WG believes that a two stages management is the best solution if the fishery was to be regulated by TAC. The two stages may consist of a provisional annual TAC which would be revised in the middle of next year once a new survey estimate is available.

The Working Group considered this approach useful and in 2001 proposed a simulation study to be undertaken in the course of 2002 to evaluate alternative management regimes. However such work has not been undertaken. Guidelines for such study follow:

An age structured operating model may be used to project forward the population for a fixed period (i.e. 20 years). An annual assessment, the TAC recommendation and implementation processes should also be included in the simulation framework. Management scenarios to be compared should include:

1) Single stage TAC regime resulting in an annual TAC recommended at the beginning or at the middle of the season. TAC options considered:

- fixed TAC
- TAC estimated based on $\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$ considerations (current approach).

2) Two stages TAC regime consisting of an initial TAC at the beginning of the season and a revised TAC after the survey. Options:

- The 2 stages regime is only applied under exceptional circumstances (i.e. when the biomass is below a certain threshold);
- always applied: initial TAC is fixed from year to year and then revised after the survey by applying a pre-agreed harvest control rule;
- always applied: inital TAC is set as a conservative proportion of the estimated biomass and then revised upwards by applying a harvest control rule if the survey estimates a good spawning biomass.

Performance of the various management regimes considered should be compared by estimating key statistics such as: risk for the stock of falling a certain level, expected average catches and biomass level at the end of the simulation period.

The WG considers that this type of simulations could well be done within a Bayesian simulation framework analogue to the one proposed for mackerel by Cunningham et al. WD2002.

Although the above research has not been performed during 2002, some parallel research is ongoing: a simulation framework to evaluate the benefits of using environmentally linked recruitment predictors in the management of anchovy like stocks is being devised for 2002 within the frame of the SPACC/IOC Study Group on the Use of Environmental Indices in the Management of Pelagic Populations (Barange M (Ed.) 2001).

11.11 Management Measures and Considerations

The population dynamics of anchovy, characterised by a very short life and with the spawning stock and catch consisting mainly of ages 1 and 2, makes this stock difficult to manage. In particular, management by annual TACs is not appropriate because most of the stock (in some years over 90%) in the TAC year consists of year classes that are unknown at the time of the advise . This is illustrated in Figure 11.11.1, which shows the age composition of the catches in recent years. In 2002 the population is within safe biological limits (Figure 11.11.2) but dependence on recruitment results in rapid population changes.

ACFM proposed in 2000 a two-stages advisory scheme, with a provisional TAC set at the start of the year based on an assumption of future recruitment, which could be revised when the results from the surveys (DEPM and acoustic surveys) became available. To avoid the possibility of advising a TAC that could turn out to be too high resulting in excessive fishing mortality, the incoming recruitment will have to be assumed at a relatively low level. This would result in a cautious primary advise, but would allow an increase in the TAC in the second half of the year if a mid-year revision showed that the stock could sustain it. This would be in accordance with the precautionary approach, but would lead to under-utilisation, and sometimes to unduly restrictive advise if the initial TAC was too conservative.

Scientific advice for the management of the fishery through TACs will have to rely in assumptions about future recruitment unless recruitment estimates (through direct surveys) or some indirect forecasts of the recruitment are timeously available. A two-stages regime, which would be less dependent on a recruitment forecast than annual TACs, appears to be problematic from a management point of view for a variety of reasons. STECF in November 2000 (STCEF2000) suggested that a two stage regime might be implemented only if the spawning biomass was below some threshold value. The Working Group considers that a full operative model to evaluate alternative management regimes, including the one proposed by STEFC, needs to be developed (see 11.10 above). However such task could not be performed by the Working Group during this meeting, but is recommended that is undertaken in the near future.

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

COUNTRY **YEAR**	**FRANCE** VIIIab	**SPAIN** VIIIbc, Landings	**SPAIN** Live Bait Catches	**INTERNATIONAL** 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	17,765	19,230	n/a	36,994
2001	17,097	23,052	n/a	40,149
2002	*6,419*	*4,500*	n/a	10,919
AVERAGE (1960-01)	6,200	27,811	318	33,962

Provisional estimate for the first half of the year

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

COUNTRY: FRANCE Units: t.

YEAR\MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1987	0	0	0	1113	1560	268	148	582	679	355	107	87	4899
1988	0	0	14	872	1386	776	291	1156	2002	326	0	0	6822
1989	704	71	11	331	648	11	43	56	70	273	9	28	2255
1990	0	0	16	1331	1511	127	269	1905	3275	1447	636	82	10598
1991	1318	2135	603	808	1622	195	124	419	1587	557	54	285	9708
1992	2062	1480	942	783	57	11	335	1202	2786	3165	2395	0	15217
1993	1636	1805	1537	91	343	1439	1315	2640	4057	3277	2727	47	20914
1994	1972	1908	1442	172	770	1730	663	2125	3276	2652	223	0	16934
1995	620	958	807	260	844	1669	389	1089	2150	1231	855	22	10892
1996	1084	630	614	206	150	1568	1243	2377	3352	2666	1349	0	15238
1997	2235	687	24	36	90	1108	1579	1815	1680	2050	718		12022
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
2000	2200	948	825	5	58	1412	2190	2720	3629	2649	1127	0	17765
2001	717	517	143	46	47	1311	1078	3401	4309	2795	2732	0	17097
Average 87-01	1210	973	556	407	626	933	874	1827	2683	1867	1133	47	12850
in percentage	9.4%	7.6%	4.3%	3.2%	4.9%	7.3%	6.8%	14.2%	20.9%	14.5%	8.8%	0.4%	100%
Average 92-01	1613	1239	769	165	266	1262	1223	2329	3263	2505	1620	19	16180
in percentage	10.0%	7.7%	4.8%	1.0%	1.6%	7.8%	7.6%	14.4%	20.2%	15.5%	10.0%	0.1%	100%

COUNTRY: SPAIN

YEAR\MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1987	0	0	454	4133	3677	514	81	54	28	457	202	265	9864
1988	6	0	28	786	2931	3204	292	98	421	118	136	246	8266
1989	2	2	25	258	4295	795	90	510	116	198	1610	273	8173
1990	79	6	2085	1328	9947	2957	1202	3227	2278	123	16	10	23258
1991	100	40	23	1228	5291	1663	91	60	34	265	184	596	9573
1992	360	384	340	3458	13068	3437	384	286	505	63	94	89	22468
1993	102	59	1825	3169	7564	4488	795	340	198	65	546	23	19173
1994	0	9	149	5569	3991	5501	1133	181	106	643	198	74	17554
1995	0	0	35	5707	11485	1094	50	9	6	152	48	365	18951
1996	48	17	138	1628	9613	5329	1206	298	266	152	225	17	18937
1997	43	1	81	2746	2672	877	316	585	1898	331	203	185	9939
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
2000	18	0	99	1952	11864	3153	958	342	413	346	83	0	19230
2001	243	48	337	2,203	14,381	3,102	1,436	1	126	1,055	120	1	23052
Average 87-01	70	55	411	2611	7306	2573	706	404	490	279	287	145	14785
in percentage	0.5%	0.4%	2.8%	17.7%	49.4%	17.4%	4.8%	2.7%	3.3%	1.9%	1.9%	1.0%	100%
Average 92-01	86	78	355	3143	8345	2946	883	211	448	302	215	78	16428
in percentage	0.5%	0.5%	2.2%	19.1%	50.8%	17.9%	5.4%	1.3%	2.7%	1.8%	1.3%	0.5%	104%

COUNTRY: Total FRANCE + SPAIN

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Average 92-01	1,698.7	1,317.4	1,123.9	3,308.3	8,611.7	4,208.5	2,106.5	2,539.8	3,710.3	2,806.1	1,835.0	97.4	32,607.5
in percentage	5.2%	4.0%	3.4%	10.1%	26.4%	12.9%	6.5%	7.8%	11.4%	8.6%	5.6%	0.3%	102%

Table 11.2.1.3: ANCHOVY catches in the Bay of Biscay by country and divisions in 2001 (without live bait catches)

COUNTRIES	DIVISIONS	QUARTERS				CATCH (t)	
		1	2	3	4	ANNUAL	%
SPAIN	VIIIa	0	0	0	515	515	2.2%
	VIIIb	29	6224	249	624	7127	30.9%
	VIIIc	598	13462	1314	36	15410	66.8%
	TOTAL	627	19686	1563	1176	23052	100
	%	2.7%	85.4%	6.8%	5.1%	100.0%	
FRANCE	VIIIa	0	0	8788	5527	14316	83.7%
	VIIIb	1377	1404	0	0	2782	16.3%
	VIIIc	0	0	0	0	0	0.0%
	TOTAL	1377	1404	8788	5527	17097	100.0%
	%	8.1%	8.2%	51.4%	32.3%	100.0%	
INTERNATIONAL	VIIIa	0	0	8788	6042	14831	36.9%
	VIIIb	1406	7629	249	624	9908	24.7%
	VIIIc	598	13462	1314	36	15410	38.4%
	TOTAL	2004	21091	10351	6703	40149	100.0%
	%	5.0%	52.5%	25.8%	16.7%	100.0%	

The separation of Spanish catches during the second half of the year between VIIIa and VIIIb are only approximate estimations

Table 11.3.1.1: ANCHOVY catch at age in thousands for 2001 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**	**VIIIbc**	**VIIIbc**	**VIIIbc**
		0	0	0	272	476	748
		1	29,753	348,383	35,899	18,252	432,288
		2	2,311	324,779	23,769	19,718	370,577
		3	128	18,726	464	0	19,318
		4	1	4,947	0	0	4,948
	TOTAL(n)		32,194	696,835	60,404	38,446	827,879
	W MED.		19.67	28.48	26.18	30.14	28.04
	CATCH. (t)		627.3	19686.3	1562.9	1175.5	23,052.1
	SOP		633.3	19843.5	1581.1	1182.2	23,240.1
	VAR. %		100.95%	100.80%	101.16%	100.56%	100.82%
FRANCE	**AGE**		**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**	**VIIIab**
		0	0	0	0	1	1
		1	49,620	32,590	287,768	165,758	535,737
		2	14,738	32,597	36,212	18,418	101,964
		3	844	0	4,631	0	5,476
		4	0	0	0	0	0
	TOTAL(n)		65,202	65,186	328,612	184,177	643,177
	W MED.		20.42	22.46	28.36	28.18	26.90
	CATCH. (t)		1,331.1	1,464.0	9,318.2	5,189.3	17,303
	SOP		1,377.0	1,404.0	8,788.0	5,527.0	17,096
	VAR. %		103.45%	95.90%	94.31%	106.51%	98.81%
	QUARTERS		**1**	**2**	**3**	**4**	**Annual total**
TOTAL	**AGE**		**VIIIabc**	**VIIIabc**	**VIIIabc**	**VIIIabc**	**VIIIabc**
Sub-area VIII		0	0	0	272	477	749
		1	79,374	380,973	323,667	184,011	968,024
		2	17,049	357,376	59,981	38,135	472,541
		3	972	18,726	5,095	0	24,794
		4	1	4,947	0	0	4,948
	TOTAL(n)		97,396	762,021	389,016	222,623	1,471,057
	W MED.		20.17	27.96	28.02	28.51	27.54
	CATCH. (t)		1,958	21,150	10,881	6,365	40,355
	SOP		2,010	21,248	10,369	6,709	40,336
	VAR. %		102.65%	100.46%	95.29%	105.41%	99.95%

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)

Since 1999 onwards are not being estimated.

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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	n/a	n/a
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	n/a	n/a
2	1,461	203	1,496	139	0	0		477	209	522	58	0	810	n/a	n/a
3	912	3	0	0	0	0		0	0	0	0	0	0	n/a	n/a
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	n/a	n/a
Catch (t)	546	493	185	416	353	200	306	143.2	273.2	197.5	378	175.5	465.13	n/a	n/a
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	n/a	n/a

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 1998 to ICES WGs and updated since then. The catches at age are equal to the addition of the age composition of landing and without live bait catches of anchovy. (From Uriarte et al., 1997 WD updated for the 1997 AND 1998 data)

Units: Thousands

INTERNATIONAL

YEAR	1987		1988		1989		1990		1991		1992		1993		1994	
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
Age 0	0	38,140	0	150,338	0	180,085	0	16,984	0	86,647	0	38,434	0	63,499	0	59,934
1	218,670	120,098	318,181	190,113	152,612	27,085	847,627	517,690	323,877	116,290	1,001,551	440,134	794,055	611,047	494,610	355,663
2	157,665	13,534	92,621	13,334	123,683	10,771	59,482	75,999	310,620	12,581	193,137	31,446	439,655	91,977	493,437	54,867
3	31,362	1,664	9,954	596	18,096	1,986	8,175	4,999	29,179	61	16,960	1	5,336	0	61,667	1,325
4	14,831	58	1,356	0	54	0	0	0	0	0	0	0	0	0	0	0
5	8,920	0	99	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	431,448	173,494	398,971	529,130	294,445	219,927	915,283	615,671	663,677	215,579	1,211,647	510,015	1,239,046	766,523	1,049,714	471,789
Internat Catches	11,718	3,590	10,003	5,579	7,153	3,460	19,386	14,886	15,025	4,610	26,381	11,504	24,058	16,334	23,214	11,417
Var. SOP	100.7%	100.4%	98.3%	101.9%	98.5%	99.3%	100.7%	99.1%	97.6%	98.5%	99.6%	99.9%	101.1%	99.5%	101.0%	100.2%
Annual Catch		15,308		15,581		10,614		34,272		19,635		37,885		40,392		34,631

YEAR	1995		1996		1997		1998		1999		2000		2001	
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	49,771	0	109,173	0	133,232	0	4,075	0	54,357	0	5,298	0	749
1	522,361	189,081	683,009	456,164	471,370	439,888	443,818	598,139	220,067	243,306	559,934	396,961	460,346	507,678
2	282,301	21,771	233,095	53,156	138,183	40,014	128,854	123,225	380,012	142,904	268,354	64,712	374,424	98,117
3	76,525	90	31,092	499	5,580	195	5,596	3,398	17,761	525	84,437	18,613	19,698	5,095
4	4,096	7	2,213	42	0	0	155	0	108	0	0	0	4,948	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	885,283	260,719	949,408	619,034	615,133	613,329	578,423	728,837	617,948	441,092	912,725	485,584	859,417	611,639
Internat Catches	23,479	6,637	21,024	13,349	10,704	11,443	12,918	18,700	15,381	11,878	22,536	14,458	23,095	17,054
Var. SOP	101.5%	98.2%	99.5%	100.4%	99.7%	102.1%	100.6%	94.8%	102.0%	103.0%	100.8%	97.6%	100.8%	101.1%
Annual Catch		30,116		34,373		22,147		31,617		27,259		36,994		40,149

SPAIN

YEAR	1987		1988		1989		1990		1991		1992		1993		1994	
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
Age 0	0	35,452	0	141,918	0	174,803	0	11,999	0	81,536	0	13,121	0	63,499	0	59,022
1	134,390	40,172	210,641	47,480	110,276	13,165	719,678	234,021	210,686	21,113	751,056	72,154	578,219	75,865	257,050	47,065
2	119,503	7,787	61,609	2,690	92,707	9,481	47,266	43,204	139,327	1,715	131,221	5,916	266,612	11,904	315,022	24,971
3	27,336	1,664	7,710	596	8,232	1,986	8,139	4,999	2,657	61	10,067	1	967	0	44,622	1,325
4	14,831	58	1,356	0	54	0	0	0	0	0	0	0	0	0	0	0
5	8,920	0	99	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	304,980	85,134	281,414	192,684	211,270	199,435	775,083	294,222	352,670	104,425	892,344	91,192	845,798	151,268	616,694	132,383
Catch Spain	8,777	1,632	6,955	1,804	5,377	2,981	16,401	7,273	8,343	1,583	21,047	1,621	17,206	2,272	15,219	2,478
Var. SOP	100.7%	99.7%	97.9%	100.6%	97.1%	99.5%	100.9%	99.5%	94.7%	98.2%	99.3%	100.5%	100.8%	100.2%	101.3%	99.6%
Annual Catch		10,409		8,759		8,358		23,674		9,926		22,669		19,479		17,697

YEAR	1995		1996		1997		1998		1999		2000		2001	
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	31,101	0	52,238	0	91,400	0	4,075	0	29,057	0	439	0	748
1	367,924	17,611	542,127	72,763	296,261	123,011	217,711	57,847	134,411	87,191	389,515	71,547	378,136	54,151
2	206,387	1,333	163,010	12,403	74,856	9,435	41,171	9,515	231,384	37,644	199,233	8,640	327,090	43,487
3	57,214	90	14,461	499	1,927	195	4,002	9	10,051	525	50,834	2,085	18,854	464
4	4,096	7	2,213	42	0	0	155	0	108	0	0	0	4,948	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total #	635,621	50,142	721,810	137,945	373,044	224,041	263,039	71,445	375,954	154,416	639,583	82,711	729,029	98,851
Catch Spain	18,322	902	16,774	2,361	6,420	3,897	6,818	1,812	10,323	3,287	17,087	2,143	20,314	2,738
Var. SOP	102.1%	100.1%	99.5%	100.4%	99.5%	98.7%	98.9%	99.8%	102.1%	101.7%	101.1%	100.7%	102.1%	101.7%
Annual Catch		19,224		19,135		10,317		8,630		13,610		19,230		23,052

FRANCE

YEAR	1987		1988		1989		1990		1991		1992		1993		1994	
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
Age 0	0	2,688	0	8,419	0	5,282	0	4,985	0	5,111	0	25,313	0	0	0	912
1	84,280	79,925	107,540	142,634	42,336	13,919	127,949	283,669	113,191	95,177	250,495	367,980	215,836	535,182	237,560	308,598
2	38,162	5,747	31,012	10,644	30,976	1,290	12,216	32,795	171,293	10,866	61,916	25,530	173,043	80,073	178,415	29,896
3	4,026	0	2,245	0	9,863	0	36	0	26,522	0	6,893	0	4,369	0	17,045	0
4	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
Total #	126,468	88,360	140,797	161,697	83,175	20,492	140,200	321,449	311,007	111,154	319,303	418,823	393,248	615,255	433,020	339,406
Catch France	2,941	1,958	3,048	3,775	1,776	479	2,985	7,613	6,682	3,027	5,334	9,883	6,851	14,062	7,994	8,939
Var. SOP	100.4%	101.0%	99.0%	102.5%	102.6%	97.8%	99.2%	98.7%	101.3%	98.6%	100.5%	99.8%	101.6%	99.4%	100.3%	100.4%
Annual Catch		4,899		6,822		2,255		10,598		9,708		15,217		20,914		16,934

YEAR	1995		1996		1997		1998		1999		2000		2001	
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	18,670	0	56,936	0	41,832	0	0	0	25,300	0	4,859	0	1
1	154,437	171,470	140,882	383,401	175,109	316,877	226,107	540,293	85,656	156,115	170,418	325,413	82,210	453,527
2	75,914	20,438	70,085	40,753	63,327	30,579	87,683	113,710	148,628	105,260	69,121	56,072	47,334	54,630
3	19,311	0	16,631	0	3,653	0	1,594	3,389	7,710	0	33,603	16,528	844	4,631
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 #	249,662	210,578	227,598	481,089	242,089	389,288	315,384	657,392	241,994	286,676	273,142	402,873	130,388	512,789
Catch France	5,157	5,735	4,251	10,987	4,284	7,546	6,099	16,888	5,058	8,591	5,449	12,316	2,782	14,316
Var. SOP	99.4%	97.9%	102.8%	99.8%	100.0%	103.9%	102.5%	94.3%	101.7%	103.4%	99.8%	97.0%	100.5%	101.3%
Annual Catch		10,892		15,238		11,830		22,987		13,649		17,765		17,097

Table 11.3.2.1. Length distribution ('000) of anchovy in Divisions VIIIa,b,c by country and quarters in 2001.

	QUARTER 1		QUARTER 2		QUARTER 3		QUARTER 4	
Length (half cm)	France VIIIab	Spain VIIIbc	France VIIIab	Spain VIIIbc	France VIIIab	Spain VIIIbc	France VIIIab	Spain VIIIbc
3.5								
4								
4.5								
5								
5.5								
6								
6.5								
7								
7.5								
8								
8.5	0		0					
9	0		8					
9.5	31		15					
10	93	18	77		0		0	
10.5	378	254	261	16	13	2	0	9
11	944	638	707	46	50	2	0	10
11.5	2521	1128	1063	241	2344	19	0	16
12	3360	1600	3757	581	2779	244	0	35
12.5	3617	2037	4027	3257	2945	468	0	22
13	4561	2887	3417	9688	5555	2537	0	389
13.5	6891	2901	4586	23592	8157	3605	600	379
14	7883	5150	4875	54002	20556	5626	1473	1310
14.5	7089	4475	5559	78119	21374	8330	10427	2275
15	5515	4827	6443	107534	29392	9217	16718	4960
15.5	6333	2612	7505	85184	44123	7817	23506	4515
16	6826	2401	7903	89518	50209	7308	31004	6759
16.5	4795	627	6051	69498	49664	5707	30450	5318
17	1947	315	3952	69560	33533	4639	26835	5456
17.5	1973	195	2966	47372	25919	2438	22645	2903
18	361	63	1984	33667	21400	1201	13848	2465
18.5	70	42	515	14764	8752	834	5082	1464
19	15	16	10	7915	792	254	1190	91
19.5	0	7	5	2067	370	113	0	70
20	0		0	951	297	79	0	
20.5	0				297		0	
21	0				89		0	
21.5					0		0	
22					0		0	
22.5								
23								
23.5								
24								
24.5								
25								
25.5								
26								
Number ('000)	65202	32194	65687	697572	328608	60439	183779	38446
Catch (t)	1377	627.3416	1404	19686.278	8788	1562.9369	5527	1175.543
Mean Length (cm)	14.67	14.35	15.14	16.01	16.17	15.60	16.64	16.40
Mean weight (g)	21.12	19.49	21.37	28.22	26.74	25.86	30.07	30.58

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	
Sources:	Anon. (1989 & 1991)		Anon. (1989)		Anon. (1991)		Anon. (1991)		Anon. (1992)		Anon. (1993)		Anon. (1995)		Anon. (1996)	
Periods	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf
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
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
2	32.0	34.2	30.3	30.4	28.5	35.2	28.5	27.7	25.2	29.0	30.9	28.8	27.0	29.4	26.8	28.1
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
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
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
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
SOP	11,795	3,605	9,828	5,685	7,043	3,434	19,515	14,752	14,668	4,538	26,264	11,497	24,314	16,257	23,440	11,442
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

YEAR	1995		1996		1997		1998		1999		2000		2001	
Sources:	Anon. (1997)		Anon. (1998)		Anon. (1999)		Anon (2000)		WG data		WG data		WG data	
Periods	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf
Age 0	0.0	15.1	0.0	12.0	0.0	11.6	0.0	10.2	0.0	15.7	0.0	19.3	0.0	14.3
1	22.5	26.9	19.1	23.2	14.4	20.3	21.8	23.7	17.1	27.0	21.7	28.2	22.7	27.5
2	32.3	31.3	29.3	27.7	26.9	30.1	24.3	27.7	29.8	33.5	29.1	33.0	31.8	31.1
3	36.4	36.4	35.0	35.7	32.0	29.7	31.9	28.7	34.7	38.9	32.8	36.9	36.3	38.6
4	37.3	29.1	46.1	39.7	0.0	0.0	31.9	0.0	55.9	0.0	0.0	0.0	40.7	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
Total	26.9	25.0	22.2	21.6	17.3	19.1	22.5	24.3	25.4	27.7	24.9	29.0	27.1	28.2
SOP	23,830	6,520	21,066	13,139	10,672	11,687	12,996	17,727	15,686	12,229	22,715	14,106	23,272	17,247
mean weight 3+	30.3	36.2	36.3	35.7	31.8	29.7	31.9	28.7	34.7	38.9	32.8	36.9	36.3	38.6

SPAIN

Year	1987		1988		1989		1990		1991		1992		1993		1994	
Periods	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf
Age 0	0.0	11.6	0.0	4.7	0.0	12.6	0.0	5.9	0.0	14.3	0.0	13.0	0.0	12.3	0.0	14.7
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
2	33.0	39.3	32.4	35.7	29.3	36.0	29.0	28.9	28.1	22.4	32.6	24.4	29.5	26.6	29.2	25.4
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
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
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
Total	29.0	19.1	24.2	9.4	24.7	14.9	21.4	24.6	22.4	14.9	23.4	17.9	20.5	15.0	25.0	18.6
SOP	8,841	1,628	6,811	1,814	5,222	2,966	16,555	7,234	7,900	1,555	20,904	1,629	17,352	2,276	15,424	2,467
mean weight 3+	39.6	39.2	35.2	44.5	27.3	42.7	44.9	40.8	34.4	39.0	44.5	27.4	43.3	43.3	32.0	30.0

Year	1995		1996		1997		1998		1999		2000		2001	
Periods	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf
Age 0	0.0	16.1	0.0	11.2	0.0	10.8	0.0	10.2	0.0	10.4	0.0	14.0	0.0	14.3
1	24.8	20.1	19.9	19.3	14.1	21.1	24.2	24.7	18.6	21.3	23.6	25.8	23.6	25.2
2	35.2	33.4	31.9	29.0	28.6	27.4	32.3	35.3	33.0	31.0	31.2	28.2	32.5	30.9
3	38.2	36.4	40.2	35.7	41.7	29.7	35.3	52.1	40.6	38.9	36.8	28.2	36.6	44.7
4	37.3	29.1	46.1	39.7	0.0	0.0	31.9	0.0	55.9	0.0	0.0	0.0	40.7	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
Total	29.4	18.0	23.1	17.6	17.1	17.2	25.6	25.3	28.0	21.7	27.0	26.1	28.1	27.7
SOP	18,703	903	16,696	2,170	6,386	3,847	6,746	1,809	10,544	3,344	17,278	2,157	20,477	2,740
mean weight 3+	38.1	36.4	40.6	35.7	31.7	29.7	35.3	52.1	40.6	38.9	31.9	28.2	37.0	44.7

FRANCE

Year	1987		1988		1989*		1990*		1991*		1992*		1993*		1994*	
Periods	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf
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
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
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
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
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
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
Total	23.4	22.4	21.4	23.9	21.9	22.9	21.1	23.4	21.8	26.8	16.8	23.6	17.7	22.7	18.5	26.4
SOP	2,954	1,977	3,017	3,871	1,821	469	2,961	7,518	6,768	2,984	5,361	9,867	6,962	13,981	8,016	8,975

FRANCE	1995*		1996*		1997		1998		1999		2000		2001	
Periods	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf	1st half	2nd haf
Age 0	0.0	13.5	0.0	12.7	0.0	13.4	0.0	0.0	0.0	21.8	0.0	19.8		20.4
1	17.2	27.6	15.8	23.9	14.9	20.0	19.5	23.6	14.6	30.2	17.2	28.7	18.5	27.8
2	24.5	31.1	23.3	27.3	24.9	31.0	20.6	27.1	24.8	34.3	23.2	33.6	26.5	31.5
3	31.4	0.0	30.5	0.0	26.8	0.0	23.2	28.6	27.1	0.0	26.8	38.0	30.0	38.0
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
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
Total	20.5	26.7	19.2	22.8	17.7	20.1	19.8	24.2	21.2	31.0	19.9	29.7	20.8	28.4
SOP	5,127	5,617	4,370	10,969	4,286	7,840	6,250	15,918	5,142	8,885	5,437	11,949	2,795	14,508

* Old values

TABLE 11.4.1.1 Daily Egg Production Method.: Egg surveys on the Bay of Biscay anchovy.
(From ICES2001/ACFM06 updated for the 2001 from Uriarte et a. Working Document 2002) and for 2002 from Santos& Uriarte Working Document 2002 (preliminary estimate))

YEAR		1987	1988	1989(*)	1989(*)	1990	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 (provisional **
Period of year		2 - 7 June	21 - 28 May	10 - 21 May	14-24 June	4 - 15 May	29 May-15 June	16May-07Jun	16May-13Jun	No survey	17 May-3June.	11 - 25 May	18 - 30 May	9 - 21 May	18 May - 8 June	22 May - 5 June	2 May - 20 May	14 May - 8 June	6-21 May
Julian Mid Day		155	145	136	171	130	158	148	151		146	138	144	135	149	149	131	147	134
Positive area (km2)		23850	45384	17546	27917	59757	69471	24264	67796		48735	31189	28448	50133	73131	51019	37883	72022	35980
Surveyed area (km2)		34934	59840	37930	-	79759	-	84032	92782		60330	51698	34294	59587	83156	61533	63192	92376	56176
Po (Egg per 0.05 m^2)(A+)		4.6	5.52	2.08	1.50	3.78	5.21	2.55	4.27		3.93	4.975	4.87	2.69	3.825	3.65	3.45	5.885	3.885
Total Daily egg production		2.20	5.01	0.73	0.83	5.02	7.24	1.24	5.81		3.83	3.09	2.77	2.70	5.6	3.72	2.61	8.48	2.77
(* 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	0.087	0.076
SSB (t)		29,365	63,500	11,861	10,058	97,239	77,254	19,276	90,720	--	60,062	54,700	39,545	51,176	101,976	69,074	44,973	124,132	51000
	C.V.	0.48	0.31	0.41	-	0.17	-	0.14	0.20		0.17	0.09	0.16	0.10	0.09	0.15	0.15	0.20	0.16
TOTAL #		1129	2675	470		5843		965.6	5797	--	2954	2644		3737.7	6282.4			6047.6	
(millions)	C.V.							0.14	0.25		0.19	0.11		0.16	0.13			0.23	
No/age:	1	**656.0**	**2,349.0**	**246.0**		**5,613.0**		**670.5**	**5,571.0**		**2,030.0**	**2,257.0**		**3,242.6**	**5,466.7**			**4,362.2**	
	C.V.							0.16	0.26		0.23	0.13		0.17	0.15			0.27	
(millions)	2	**331.0**	**258.0**	**206.0**		**190.0**		**290.3**	**209.3**		**874.0**	**329.0**		**482.1**	**759.5**			**1,562.0**	
	C.V.							0.17	0.22		0.19	0.23		0.10	0.14			0.22	
	3+	**142.0**	**68.0**	**18.0**		**40.0**		**4.8**	**16.7**		**49.3**	**58.0**		**13.1**	**56.3**			**123.5**	
	C.V.							0.42	0.51		0.30	0.30		0.27	0.36			0.37	

(*) 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)
(***) Estimates based on a log lineal model of biomass as function of positive spawning area and Po (Egg production per unit area) and Julian day of the mid day of the survey

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	1994 15/5-27/5	1997 6/5-22/5	1998 20/5-7/6	2000 18/04 - 14/05	2001 27/04 - 6/06	2002 6/05 - 6/06
Surveyed area	3,267	3,743	5,112	3,418 (3)	3388 (3)	2440(3)	2300(3)	1726(3)	9400 5600 (3)	6781	21300	10667
Density (t/nm(**2))	15.4	10.3	3,0	14.5-32.2 (4)	23.6	32.8	14.5	36.5	10.2			
Biomass (t)	50,000	38,500	15,500	60-110,000 (4)	64,000	89,000	35,000	63000	57000	98,484	137200 (5)	97051
Number (10**(-6))	2,600	2,000	805	4,300-7,500 (4)	3,173	9,342	*na*	3351	*na*		7892 (6)	3,569
Number of 1-group(10**(-6))	1,800 (1)	600	400	4,100-7,500 (4)	1,873	9,072	*na*	2481	*na*		6163 (6)	831
Number of age 2-group(10**(-6))	800	1,400	405	0 -200 (4)	1,300	270	*na*	870	*na*		1728 (6)	2,738
Anchovy mean weight	19.2	19.3	19.3	*na*	20.2	9.5	*na*	18.8	*na*		16.8 (6)	27.2

(1) Rough estimation
(2) Assumption of overestimate
(3) Positive area
(4) uncertainty due to technical problems
(*) area where anchovy shools have been detected
(5) For the assessment performed in the WG of year 2001 the value used for 2001 biomass was 132800t becouse the definitive figure from the survey arrived too late to the WG
(6) based on the biomass estimate of areas 2, 4, 6 and 7 (13 2600 t)

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

	France				Spain		
Year	P. seiner	P. trawl		Total	P. seiner		total
1960	52	0	(1)	52	571		623
1972	35	0	(1)	35	492		527
1976	24	0	(1)	24	354		378
1980	14	n/a	(1)	14	293		307
1984	n/a	4	(1)	4	306		310
1987	9	36	(1)	45	282		327
1988	10	61	(1)	71	278		349
1989	2	51	(1)	53	215		268
1990	30	80 (2)		110	266		376
1991	30	115 (2)		145	250		395
1992	13	123 (2)		136	244		380
1993	21	138 (2)		159	253		412
1994	26	150 (2)		176	257		433
1995	26	120 (2)		146	257		403
1996	20	100 (2)		120	251		371
1997	26	136 (2)		162	267		429
1998	26	100 (2)		126	266		392
1999	26	100 *		126	250		376
2000	26	100 *		126	238	(3, 4)	364
2001	n/a	n/a		n/a	220	(3,4)	
2002	n/a	n/a		n/a	215	(3, 4)	

* provisional
(1) Only St. Jean de Luz and Hendaya.
(2) Maximun number of potential boats; the number of pelagic trawling gears is roughly half of this number due to the fishing in pairs of mid-water trawlers.
n/a = Not available.
(3) Provisional figure according to the number of licences for purse seining in European Community Waters
(4) Provisional estimate

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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (Provisional)	2001	2002
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	04-06	04-06
CPUE (t)	0.9	0.7	0.8	1.5	1.2	2.5	1.7	1.6	2.6	2.2	0.8	0.9	1.4	2.1	n/a	n/a
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	n/a	n/a
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	n/a	n/a
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	n/a	n/a
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	n/a	n/a
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	n/a	n/a
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	n/a	n/a

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

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

											Assessment	Updated from WD2001	
	WD2000	**WD2000**		**Results from previous WG Reports**							in year Y+1	Prediction of P.Petitgas	
	Borja's et al. (1996,00)	**Petitgas et al. (WD2000)**		Age 0 in the assessment				**WG2000**	**WG2001**	**WG2002**	**WG2001**	Fitted for the period 86-99	
Year	Upwelling	Upwelling	SBD	1,996	1,997	1,998	1,999	2,000	2,001	2,002	Age_1 Serie	Adjusted Age 1	
1986	617.5	20.49	0	5,901	6,164	6,483	6,461	5,845	5,837	5,847	1751.0	3237	
1987	508.4	47.25	1	8,276	8,267	7,424	7,447	8702.5	8,507	8,497	2553.0	2101	
1988	473.2	35.88	1	3,310	3,641	4,294	4,387	3473.2	3,461	3,466	1038.0	1465	
1989	970.9	45.45	0	21,395	21,990	19,052	19,082	19651.7	19,288	19,309	5788.0	4631	
1990	905.9	50	1	7,272	7,506	7,206	7,319	7586.5	7,456	7,468	2229.0	2254	
1991	1,076.3	110.74	0	27,393	28,271	27,767	28,402	27632.0	27,443	27,379	8213.0	8279	
1992	1,128.8	47.16	0	27,677	28,003	25,764	25,305	24102.8	24,011	23,986	7186.0	4727	
1993	570.9	53.03	0	15,551	14,455	13,877	13,334	12789.1	12,717	12,681	3811.0	5055	
1994	905.0	29.2	0	14,273	12,335	10,454	10,275	10405.3	10,405	10,412	3117.0	3724	
1995	1,204.0	74.99	0	14,963	14,650	14,051	13,397	14513.7	14,254	14,232	4267.0	6282	
1996	973.0	50.17	0		17,065	21,443	20,231	18197.0	18,262	18,220	5454.0	4895	
1997	1,230.5	100.04	0			30,950	34,648	25830.1	28,812	28,780	8647.0	7681	
1998	461.0	58.49	0				2,977	7841.4	13,387	14,269	4022.0	5360	
1999	402.0	32.68	0					12582.4	18,419	25,531	5533.0	3918	
2000	391.0	51.21	0						38,397	32,709	11518	*4953*	*Prediction*
2001	418.0	42.63	1							4,356		*1842*	*Prediction*
2002	642	63.52	0										
Average	**757.6**	**53.7**											
			Observations	10	11	12	13	14	15	16			

Retrospective analysis of the Upwelling index performances

Coeff.Determination for age 0:	1986-95	1986-96	1986-97	1986-98	1986-99	1986-00	1986-01
with Borja's Upwelling index	51.5%	51.5%	58.6%	62.6%	55.4%	5.5%	23.8%
Correlation Coefficient	0.72	0.72	0.77	0.79	0.74	0.24	0.23
Corrlation.Probability	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?
Petiga`'s Upwelling index	34.0%	36.0%	53.0%	47.7%	49.7%	28.3%	27.1%
Correlation Coefficient	0.58	0.60	0.73	0.69	0.70	0.53	0.52
Corrlation.Probability	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?

Coeff.Determination for age 1:

Borja's Index	Petitga's Multiple Index	
38.3%	70.4%	1986-1999
5.5%	47.9%	1986-2000

Table 11.7.1.1: Input data for the biomass dynamic model for the Bay of Biscay anchovy.

g	0.680
f1s	0.375
f2s	0.625

						DEPM		ACOUSTICS	
year	**h1**	**h2**	**C(y, 1, 1)**	**C(y, 1, 2+)**	**C(y, 2, 1+)**	**B(y,2,1)**	**B(y,2,1+)**	**B(y,2,1)**	**B(y,2,1+)**
1987	0.31	0.19	2,711	5,607	6,543	14,235	29,365		
1988	0.33	0.18	2,602	1,262	10,954	53,087	63,500		
1989	0.28	0.23	1,723	2,152	4,442	5,166	11,861		
1990	0.31	0.21	9,314	1,259	23,574	90,650	97,239		
1991	0.23	0.20	3,903	6,288	8,196	11,271	19,276	28,322	64,000
1992	0.25	0.22	11,933	4,433	21,026	85,571	90,720	84,439	89,000
1993	0.24	0.24	6,414	7,763	25,431				
1994	0.23	0.21	3,795	9,807	20,150	34,674	60,062		35,000
1995	0.29	0.18	5,718	8,832	14,815	42,906	54,700		
1996	0.28	0.20	4,570	4,675	23,833		39,545		
1997	0.21	0.26	4,323	2,912	13,256	38,536	51,176	38,498	63,000
1998	0.20	0.26	5,898	2,089	23,588	80,357	101,976		57,000
1999	0.23	0.26	2,067	8,828	15,511		69,074		
2000	0.26	0.20	6,298	5,712	24,882		44,973		98,484
2001	0.30	0.22	5,481	5,986	28,671	73,198	124,132	90,928	137,200
2002	0.26	0.22	1,930	5,791			51,000	17,723	97,051

Table 11.7.1.2: Recruitment and spawning biomass estimates from ICA and biomass dynamic model assessments.

	ICA		BIOMASS DYNAMIC MODEL			BIOMASS DYNAMIC MODEL		
			DEPM absolute and acoustics relative			DEPM relative and acoustics relative		
year	**B(y,1,1)**	**B(y,2,1+)**	**B(y,1,1)**	**B(y,2,1)**	**B(y,2,1+)**	**B(y,1,1)**	**B(y,2,1)**	**B(y,2,1+)**
1987	38,062	37,164	21,710	14,233	26,440	20,711	13,458	25,075
1988	57,653	39,877	53,650	39,052	47,440	51,299	37,231	44,928
1989	21,840	21,306	7,966	4,554	20,298	7,660	4,317	18,789
1990	93,911	51,291	109,363	75,840	82,282	105,641	72,957	78,634
1991	37,548	30,791	24,353	15,321	37,541	23,407	14,588	34,961
1992	126,295	72,368	111,426	75,340	85,517	106,637	71,630	80,500
1993	114,960	82,507	59,180	40,014	63,901	61,727	41,987	63,333
1994	65,031	53,563	49,206	34,679	42,994	46,761	32,784	40,812
1995	59,299	43,363	68,318	47,530	49,225	65,664	45,473	46,063
1996	68,224	40,128	47,007	32,149	44,255	46,549	31,794	42,300
1997	64,819	46,182	55,194	38,906	44,910	52,971	37,183	42,198
1998	126,159	96,087	91,736	65,843	78,707	87,597	62,636	74,126
1999	68,608	77,885	68,806	51,437	69,069	66,946	49,996	65,308
2000	128,906	97,971	67,733	46,667	66,981	65,927	45,268	63,677
2001	157,200	126,033	133,260	98,046	111,847	128,421	94,296	106,424
2002	22,436	58,129	24,569	17,248	51,664	23,697	16,572	48,242

Table 11.7.2.1: INPUTs for the Bay of Biscay anchovy assessment

Output Generated by ICA Version 1.4 — ASSESSMENT AS THE ONE MADE IN 2001 (but with the new inputs)

Anchovy in subarea VIII WG2002- Bay of

Catch in Number

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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	54.4	5.3	0.7
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	463.4	956.9	968.0
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	522.9	333.1	472.5
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	18.3	103.0	24.8
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	1.1	1.0	4.9
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	1.0	1.0

x 10 ^ 6

Weights at age in the catches (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	.011700	.005100	.012700	.007400	.014400	.012600	.012300	.014700	.015100	.011900	.011600	.010200	.015700	.019300	.014300
1	.021300	.021900	.020300	.021800	.020300	.020600	.017800	.020300	.023700	.019900	.017200	.022900	.022300	.024400	.025200
2	.032100	.030300	.029000	.028100	.025400	.030600	.027400	.026900	.032200	.031100	.027600	.026000	.030800	.029900	.031600
3	.037700	.035000	.031000	.043300	.028200	.037700	.030500	.030700	.036400	.040100	.031900	.030700	.034800	.033600	.036800
4	.041000	.037600	.027100	.040500	.040500	.040500	.040500	.040500	.037300	.046000	.040500	.031900	.055900	.040500	.040700
5	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000

Table 11.7.2.1. (cont'd)

Weights at age in the stock (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	.013000	.013000	.013000	.010000	.015000	.012000	.012000	.015000	.012000	.012000	.012000	.012000	.012000	.012000	.012000
1	.021700	.022600	.021000	.016200	.016800	.015400	.016000	.017100	.019000	.016000	.011900	.014600	.016000	.016800	.016000
2	.033000	.029800	.029000	.029500	.028000	.031700	.028900	.025800	.031100	.028900	.026600	.029900	.028900	.028500	.028900
3	.038000	.034100	.033000	.034600	.034000	.031700	.034500	.032300	.034100	.034500	.037400	.036900	.034500	.034800	.034500
4	.041000	.042500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500	.040500
5	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000	.042000

Natural Mortality (per year)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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	1.2000	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	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	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	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	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	1.2000	1.2000

Proportion of fish spawning

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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	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	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	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	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	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	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	2001
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	124.13

x 10 ^ 3

DEPM

	2002
1	51.00

x 10 ^ 3

Acoustic

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	*******	*******	15.50	*******	64.00	89.00	*******	35.00	*******	*******	63.00	57.00	*******	98.48	137.20

x 10 ^ 3

Acoustic

	2002
1	97.05

x 10 ^ 3

Table 11.7.2.1. (cont'd)

AGE-STRUCTURED INDICES

DEPM SUVEYS (Ages 1 to 3+)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	656.0	2349.0	346.9	5613.0	670.5	5571.0	*******	2030.1	2257.0	*******	3242.6	5466.7	*******	*******	4362.2
2	331.0	258.0	290.5	190.0	290.3	209.3	*******	874.3	329.0	*******	482.1	759.5	*******	*******	1562.0
3	142.0	68.0	25.4	40.0	4.8	16.7	*******	49.3	58.0	*******	13.1	56.3	*******	*******	123.5

x 10 ^ 3

ACOUSTIC SURVEYS (ages 1 to 2+)

AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	400.0	*******	1873.0	9072.0	*******	*******	*******	*******	2481.0	*******	*******	*******	6163.0	831.0
2	405.0	*******	1300.0	270.0	*******	*******	*******	*******	870.0	*******	*******	*******	1728.0	2738.0

x 10 ^ 3

Table 11.7.2.2: Outputs for the Bay of Biscay anchovy assessment:

Fishing Mortality (per year)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.0033	0.0036	0.0033	0.0064	0.0055	0.0055	0.0043	0.0047	0.0052	0.0074	0.0032	0.0022	0.0022	0.0027	0.0020
1	0.2975	0.3277	0.2939	0.5795	0.4965	0.4970	0.3885	0.4265	0.4742	0.6680	0.2848	0.1949	0.1968	0.2466	0.1835
2	0.7289	0.8027	0.7201	1.4197	1.2164	1.2175	0.9518	1.0449	1.1616	1.6365	0.6977	0.4774	0.4822	0.6040	0.4495
3	0.5939	0.6540	0.5867	1.1567	0.9910	0.9919	0.7755	0.8513	0.9464	1.3333	0.5685	0.3890	0.3928	0.4921	0.3663
4	0.5758	0.6341	0.5689	1.1216	0.9609	0.9618	0.7519	0.8255	0.9176	1.2928	0.5512	0.3772	0.3809	0.4772	0.3551
5	0.5758	0.6341	0.5689	1.1216	0.9609	0.9618	0.7519	0.8255	0.9176	1.2928	0.5512	0.3772	0.3809	0.4772	0.3551

Population Abundance (1 January)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	8497.	3466.	19309.	7468.	27379.	23986.	12681.	10412.	14232.	18220.	28780.	14269.	25531.	32709.	4356.
1	1754.	2551.	1040.	5797.	2235.	8201.	7185.	3803.	3121.	4264.	5447.	8641.	4288.	7673.	9825.
2	609.	392.	554.	234.	978.	410.	1503.	1467.	748.	585.	659.	1234.	2142.	1061.	1806.
3	193.	88.	53.	81.	17.	87.	37.	175.	155.	70.	34.	99.	231.	398.	175.
4	80.	32.	14.	9.	8.	2.	10.	5.	22.	18.	6.	6.	20.	47.	73.
5	33.	3.	4.	2.	3.	3.	3.	3.	3.	2.	4.	5.	5.	4.	6.

x 10 ^ 6

Population Abundance (1 January)

AGE	2002
0	12825.
1	1309.
2	2463.
3	347.
4	36.
5	17.

Table 11.7.2.2. (cont'd)

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	8497490	180615	37164	15308	0.4119	0.5401	99
1988	3466470	118929	39877	15581	0.3907	0.5948	100
1989	19308810	291383	21306	10614	0.4982	0.5336	100
1990	7467920	178740	51291	34272	0.6682	1.0520	99
1991	27378880	476610	30791	19634	0.6376	0.9013	101
1992	23985640	430063	72368	37885	0.5235	0.9021	100
1993	12681140	312340	82507	40293	0.4884	0.7053	99
1994	10411890	265034	53563	34631	0.6465	0.7742	99
1995	14232120	259664	43363	30115	0.6945	0.8607	99
1996	18220110	307034	40128	34373	0.8566	1.2126	100
1997	28780120	429372	46182	22337	0.4837	0.5170	99
1998	14268800	338385	96087	31617	0.3290	0.3538	102
1999	25530960	445875	77885	27259	0.3500	0.3573	97
2000	32708580	567587	97971	36994	0.3776	0.4475	100
2001	4356450	270899	126033	40564	0.3218	0.3331	100

No of years for separable analysis : 15
Age range in the analysis : 0 . . . 5
Year range in the analysis : 1987 . . . 2001
Number of indices of SSB : 2
Number of age-structured indices : 2

Parameters to estimate : 40
Number of observations : 144

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	0.7289	23	0.4609	1.1528	0.5769	0.9210	0.7491
2	1988	0.8027	21	0.5226	1.2329	0.6448	0.9992	0.8222
3	1989	0.7201	17	0.5062	1.0243	0.6016	0.8619	0.7318
4	1990	1.4197	16	1.0282	1.9603	1.2042	1.6738	1.4391
5	1991	1.2164	15	0.8898	1.6627	1.0371	1.4267	1.2319
6	1992	1.2175	18	0.8551	1.7334	1.0166	1.4580	1.2374
7	1993	0.9518	17	0.6705	1.3513	0.7960	1.1382	0.9672
8	1994	1.0449	16	0.7499	1.4560	0.8822	1.2376	1.0599
9	1995	1.1616	18	0.8141	1.6574	0.9689	1.3925	1.1808
10	1996	1.6365	15	1.2179	2.1990	1.4075	1.9027	1.6552
11	1997	0.6977	18	0.4863	1.0011	0.5803	0.8388	0.7097
12	1998	0.4774	20	0.3191	0.7143	0.3887	0.5864	0.4876
13	1999	0.4822	21	0.3182	0.7305	0.3901	0.5960	0.4931
14	2000	0.6040	20	0.4081	0.8940	0.4945	0.7378	0.6162
15	2001	0.4495	19	0.3044	0.6638	0.3685	0.5485	0.4585
Separable Model: Selection (S) by age								
16	0	0.0045	63	0.0013	0.0157	0.0024	0.0085	0.0055
17	1	0.4082	8	0.3426	0.4864	0.3733	0.4464	0.4098
	2	1.0000		Fixed : Reference Age				
18	3	0.8147	22	0.5236	1.2677	0.6502	1.0209	0.8357
	4	0.7900		Fixed : Last true age				

Table 11.7.2.2. (cont'd)

Separable model: Populations in year 2001

19	0	4356454	39	1998524	9496352	2927305	6483332	4714731
20	1	9824782	14	7327370	13173394	8459326	11410641	9935396
21	2	1806080	16	1318928	2473163	1538459	2120254	1829457
22	3	174661	24	107237	284477	136179	224019	180155
23	4	73341	26	43497	123661	56181	95743	75993

Separable model: Populations at age

24	1987	80238	203	1483	4338522	10476	614531	637380
25	1988	32046	77	7058	145496	14809	69345	43168
26	1989	13854	32	7342	26143	10020	19155	14601
27	1990	8868	26	5224	15053	6770	11616	9197
28	1991	7688	30	4254	13893	5684	10397	8046
29	1992	1900	31	1029	3509	1389	2598	1995
30	1993	9748	31	5227	18182	7093	13398	10254
31	1994	5064	33	2637	9726	3630	7065	5353
32	1995	22463	29	12612	40007	16733	30155	23458
33	1996	18171	32	9679	34114	13177	25058	19134
34	1997	5595	41	2499	12527	3709	8441	6089
35	1998	5851	31	3150	10869	4266	8025	6151
36	1999	20150	23	12744	31862	15950	25457	20708
37	2000	46889	23	29317	74993	36899	59584	48255

SSB Index catchabilities

DEPM

Absolute estimator. No fitted catchability.

Acoustic

Linear model fitted. Slopes at age :

38	2	Q	1.067	12	.9469	1.544	1.067	1.369	1.218

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 :

39	1	Q	.9853	18	.8284	1.682	.9853	1.414	1.200
40	2	Q	1.552	17	1.313	2.598	1.552	2.198	1.875

Table 11.7.2.2. (cont'd)

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.850	3.023	1.595	-0.493	-0.010	-0.692	0.694	0.740	0.137	0.334	0.926	-1.481	0.518	-2.283	-1.928
1	0.225	0.171	0.124	-0.139	-0.194	-0.308	0.005	0.059	-0.010	-0.124	0.120	0.138	0.019	-0.044	-0.009
2	-0.139	-0.249	-0.276	0.144	-0.327	0.178	-0.100	-0.108	-0.091	-0.104	-0.144	-0.125	0.045	0.116	0.173
3	-0.477	-0.909	0.328	-1.005	1.453	-0.725	-0.846	-0.003	0.236	-0.078	-0.460	-0.760	-0.907	0.087	-0.265
4	-0.372	-1.895	-1.307	-1.352	-1.107	0.290	-1.170	-0.583	-0.737	-1.324	-0.376	-0.105	-1.274	-2.384	-0.982

SPAWNING BIOMASS INDEX RESIDUALS

DEPM

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	-0.2356	0.4652	-0.2422	0.6396	-0.4684	0.2260	*******	0.1145	0.2323	-0.0146	0.1027	0.0595	-0.1201	-0.7786	-0.0152

	2002
1	-0.1308

Acoustic

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	*******	*******	-0.3833	*******	0.6665	0.1418	*******	-0.4906	*******	*******	0.2455	-0.5873	*******	-0.0599	0.0198

	2002
1	0.4475

Table 11.7.2.2. (cont'd)

AGE-STRUCTURED INDEX RESIDUALS

DEPM SUVEYS (Ages 1 to 3+)

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	-0.272	0.643	-0.389	0.813	-0.398	0.419	*******	0.145	0.471	*******	0.187	0.205	*******	*******	-0.155
2	0.307	0.532	0.267	1.038	-0.067	0.477	*******	0.549	0.301	*******	0.590	0.311	*******	*******	0.638
3	0.081	0.277	-0.176	0.281	-0.701	-0.663	*******	-0.336	-0.118	*******	-0.368	0.086	*******	*******	0.023

ACOUSTIC SURVEYS (ages 1 to 2+)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	-0.5078	*******	0.3301	0.6078	*******	*******	*******	*******	-0.3411	*******	*******	*******	-0.0503	-0.0387
2	-0.3199	*******	0.5164	-0.3699	*******	*******	*******	*******	0.3226	*******	*******	*******	-0.1399	-0.0093

Table 11.7.2.2. (cont'd)

```
 PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)
 -----------------------------------------------------

 Separable model fitted from 1987  to 2001
 Variance                            0.0403
Skewness test stat.                 -3.7815
Kurtosis test statistic             -0.8954
Partial chi-square                   0.1409
Significance in fit                  0.0000
Degrees of freedom                       38

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                            0.0577
Skewness test stat.                 -0.5836
Kurtosis test statistic              0.1763
Partial chi-square                   0.0791
Significance in fit                  0.0000
Number of observations                   15
Degrees of freedom                       15
Weight in the analysis               0.5000

   DISTRIBUTION STATISTICS FOR   Acoustic

 Linear catchability relationship assumed
 Last age is a plus-group

 Variance                            0.0913
Skewness test stat.                  0.0545
Kurtosis test statistic             -0.7016
Partial chi-square                   0.0675
Significance in fit                  0.0000
Number of observations                    9
Degrees of freedom                        8
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                0.0599    0.0909    0.0422
Skewness test stat.      1.3793    1.8248   -1.8707
Kurtosis test statisti  -0.6112   -0.6239   -0.1957
Partial chi-square       0.0461    0.0830    0.0466
Significance in fit      0.0000    0.0000    0.0000
Number of observations       11        11        11
Degrees of freedom           11        11        11
Weight in the analysis   0.3333    0.3333    0.3333
```

Table 11.7.2.2. (cont'd)

DISTRIBUTION STATISTICS FOR ACOUSTIC SURVEYS (ages 1 to 2+)

Linear catchability relationship assumed

Age	1	2
Variance	0.0642	0.0472
Skewness test stat.	0.2773	0.4178
Kurtosis test statisti	-0.5663	-0.6558
Partial chi-square	0.0221	0.0177
Significance in fit	0.0000	0.0000
Number of observations	6	6
Degrees of freedom	5	5
Weight in the analysis	0.3750	0.3750

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	66.6000	144	40	104	0.6404
Catches at age	55.5507	75	37	38	1.4619
SSB Indices					
DEPM	1.7295	15	0	15	0.1153
Acoustic	1.4613	9	1	8	0.1827
Aged Indices					
DEPM SUVEYS (Ages 1 to 3+)	6.3723	33	0	33	0.1931
ACOUSTIC SURVEYS (ages 1 to 2+)	1.4862	12	2	10	0.1486

Weighted Statistics

	SSQ	Data	Parameters	d.f.	Variance Variance
Total for model	3.2465	144	40	104	0.0312
Catches at age	1.5317	75	37	38	0.0403
SSB Indices					
DEPM	0.4324	15	0	15	0.0288
Acoustic	0.3653	9	1	8	0.0457
Aged Indices					
DEPM SUVEYS (Ages 1 to 3+)	0.7080	33	0	33	0.0215
ACOUSTIC SURVEYS (ages 1 to 2+)	0.2090	12	2	10	0.0209

Table 11.7.3.1: Stock: Anchovy Sub-area VIII. Historical quality of the assessment.
Assessment Quality Control Diagram 1

Average F(1-3,u)															
Date of assessment	Year														
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1989															
1990															
1991															
1992															
1993															
1994															
1995															
1996	1.014	0.990	0.993	1.992	1.343	0.926	0.901	0.825							
1997	0.554	0.678	0.610	1.449	0.892	0.585	0.643	0.738	0.855						
1998	0.541	0.617	0.629	1.299	0.891	0.574	0.679	0.862	1.172	0.414					
1999	0.501	0.581	0.615	1.258	0.863	0.565	0.679	0.861	1.238	0.486	0.251				
2000	0.589	0.527	1.048	0.8787	0.892	0.700	0.775	0.863	1.195	0.517	0.385	0.577			
2001	0.596	0.533	1.053	0.901	0.902	0.702	0.772	0.859	1.210	0.517	0.353	0.370	0.574		
2002	0.594	0.533	1.052	0.901	0.902	0.705	0.774	0.860	1.212	0.517	0.353	0.357	0.447	0.333	
2003															

Remarks: Assessments of 1996-1999 performed using ICA.

Table 11.7.3.1 (cont'd)

Assessment Quality Control Diagram 2

Recruitment (age 0) Unit: millions														
Date of assessment	Year class													
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1989														
1990														
1991														
1992														
1993														
1994														
1995														
1996	3310	21395	7272	27393	27677	15551	14273	14963						
1997	3641	21990	7506	28271	28003	14455	12335	14650	17065					
1998	4294	19052	7206	27767	25764	13877	10454	14051	210443	30950				
1999	4387	19082	7319	28402	25305	13334	10275	13397	20231	34647	2977			
2000	3473	19652	7587	27632	24103	12789	10405	14514	18197	25830	7841	12582		
2001	3461	19288	7456	27443	24011	12717	10405	14254	18262	28812	13387	18419	38397	
2002	3466	19308	7467	27378	23985	12681	10411	14232	18220	28780	14268	25530	32708	4356

Remarks: Assessments of 1996-1999 performed using ICA.

Table 11.7.3.1 (cont'd)

Assessment Quality Control Diagram 3

Date of assessment	Spawning stock biomass ('000 t) – Year														
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1989															
1990															
1991															
1992															
1993															
1994															
1995															
1996	16356	60886	29395	69621	93342	68487	55670								
1997	17782	63438	29569	71261	95497	65521	46671	47188							
1998	19112	55649	28391	69737	88690	60978	45126	40617	54783						
1999	23389	55844	28794	71236	87618	58755	43727	37098	49641	118593					
2000	21582	51966	31476	72975	81638	53953	43316	41558	46158	87436	51230	(46750)			
2001	21265	51031	30641	72241	81905	53638	43310	39816	46136	96063	74552	70323	(95352)		
2002	21306	51291	30791	72368	82507	53563	43363	40128	46182	96087	77885	97971	126033		

Remarks: Assessments of 1996-1999 performed using ICA.

Table 11.8.1 CATCH PREDICTION FOR THE ANCHOVY IN DIVISION VIII FOR 2002

PRECAUTIONARY APPROACH Geometric mean of recruitments below median 1987-2001

Fishery mortality pattern is the average of the period 1995-2001

INPUTS FOR PREDICTIONS TO 2001 AND 2002

MFDP version 1a

Run: PrecautionaryRecruitment

Time and date: 18:29 18/09/02

Fbar age range: 1-3

2002

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	7,827,774	1.2	0	0.4	0.375	0.0123	0.0036	0.0126
1	1,309,500	1.2	1	0.4	0.375	0.0160	0.3213	0.0213
2	2,463,100	1.2	1	0.4	0.375	0.0289	0.7870	0.0293
3	347,010	1.2	1	0.4	0.375	0.0345	0.6412	0.0346
4	36,474	1.2	1	0.4	0.375	0.0405	0.6217	0.0401
5	16,659	1.2	1	0.4	0.375	0.0420	0.6217	0.0420

2003

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	7,827,774	1.2	0	0.4	0.375	0.0123	0.0036	0.0126
1	.	1.2	1	0.4	0.375	0.0160	0.3213	0.0213
2	.	1.2	1	0.4	0.375	0.0289	0.7870	0.0293
3	.	1.2	1	0.4	0.375	0.0345	0.6412	0.0346
4	.	1.2	1	0.4	0.375	0.0405	0.6217	0.0401
5	.	1.2	1	0.4	0.375	0.0420	0.6217	0.0420

Input units are thousands and kg - output in tonnes

Table 11.8.2 –Catch option prediction for the anchovy fishery in SubArea VIII in 2002. Precautionary Option
Geometric mean of recruitments below median 1987-2001
Fishery mortality pattern is the average of the period 1995-2001

MFDP version 1a
Run: PrecautionaryRecruitment
Anchovy in subarea VIII WG2001- Bay of Biscay anchovy Exploratory run
Time and date: 18:29 18/09/02
Fbar age range: 1-3

2002				
Biomass	SSB	FMult	FBar	Landings
202,779	56,309	0.6888	0.4017	25,000

2003					2004	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
161304	41,293	0	0	0	164,220	43,153
.	40,517	0.1	0.0583	2,011	162,925	41,489
.	39,758	0.2	0.1166	3,941	161,694	39,927
.	39,015	0.3	0.1749	5,793	160,521	38,460
.	38,288	0.4	0.2333	7,573	159,405	37,082
.	37,576	0.5	0.2916	9,283	158,343	35,786
.	36,880	0.6	0.3499	10,928	157,330	34,566
.	36,199	0.7	0.4082	12,509	156,365	33,416
.	35,532	0.8	0.4665	14,032	155,445	32,332
.	34,880	0.9	0.5248	15,497	154,567	31,309
.	34,241	1	0.5831	16,909	153,729	30,342
.	33,616	1.1	0.6415	18,269	152,929	29,428
.	33,003	1.2	0.6998	19,580	152,166	28,562
.	32,404	1.3	0.7581	20,845	151,436	27,743
.	31,817	1.4	0.8164	22,065	150,739	26,965
.	31,243	1.5	0.8747	23,243	150,072	26,227
.	30,680	1.6	0.933	24,381	149,435	25,526
.	30,130	1.7	0.9913	25,480	148,825	24,860
.	29,590	1.8	1.0497	26,542	148,241	24,225
.	29,062	1.9	1.108	27,569	147,682	23,620
.	28,545	2	1.1663	28,563	147,147	23,044
.	28,038	2.1	1.2246	29,524	146,634	22,493
.	27,542	2.2	1.2829	30,454	146,143	21,967
.	27,055	2.3	1.3412	31,356	145,672	21,464
.	26,579	2.4	1.3995	32,229	145,220	20,982
.	26,112	2.5	1.4579	33,075	144,786	20,521
.	25,655	2.6	1.5162	33,895	144,370	20,078
.	25,207	2.7	1.5745	34,690	143,970	19,653
.	24,768	2.8	1.6328	35,462	143,587	19,245
.	24,338	2.9	1.6911	36,211	143,218	18,852
.	23,917	3	1.7494	36,938	142,864	18,474

Input units are thousands and kg - output in tonnes

Table 11.8.3 CATCH PREDICTION FOR THE ANCHOVY IN DIVISION VIII FOR 2003

GEOMETRIC MEAN Geometric mean of recruitments below average

Fishery mortality pattern is the average of the period 1995-2001

MFDP version 1a
Run: GeometricMean_Pro
Time and date: 18:12 18/09/02
Fbar age range: 1-3

2002

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	19,919,491	1.2	0	0.4	0.375	0.0123	0.0036	0.0126
1	1,309,500	1.2	1	0.4	0.375	0.0160	0.3213	0.0213
2	2,463,100	1.2	1	0.4	0.375	0.0289	0.7870	0.0293
3	347,010	1.2	1	0.4	0.375	0.0345	0.6412	0.0346
4	36,474	1.2	1	0.4	0.375	0.0405	0.6217	0.0401
5	16,659	1.2	1	0.4	0.375	0.0420	0.6217	0.0420

2003

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	19,919,491	1.2	0	0.4	0.375	0.0123	0.0036	0.0126
1 .		1.2	1	0.4	0.375	0.0160	0.3213	0.0213
2 .		1.2	1	0.4	0.375	0.0289	0.7870	0.0293
3 .		1.2	1	0.4	0.375	0.0345	0.6412	0.0346
4 .		1.2	1	0.4	0.375	0.0405	0.6217	0.0401
5 .		1.2	1	0.4	0.375	0.0420	0.6217	0.0420

Table 11.8.4 –Catch option prediction for the anchovy fishery in SubArea VIII in 2002. Geometric Mean
Geometric mean of recruitments below average
Fishery mortality pattern is the average of the period 1995-2000

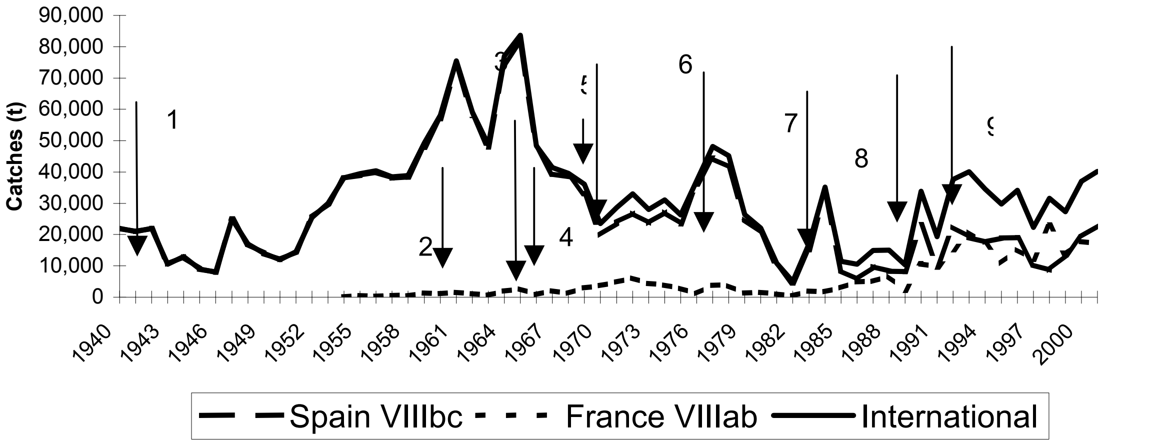
MFDP version 1a
Run: GeometricMean_Pro
Anchovy in subarea VIII WG2001- Bay of Biscay anchovy Exploratory run
Time and date: 18:12 18/09/02
Fbar age range: 1-3

2002				
Biomass	SSB	FMult	FBar	Landings
351,910	56,417	0.6816	0.3975	25,000

2003					2004	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
368625	78,397	0	0	0	403,220	100,456
.	77,146	0.1	0.0583	3,478	400,902	97,060
.	75,918	0.2	0.1166	6,838	398,679	93,849
.	74,713	0.3	0.1749	10,086	396,547	90,813
.	73,529	0.4	0.2333	13,225	394,500	87,938
.	72,367	0.5	0.2916	16,262	392,536	85,216
.	71,225	0.6	0.3499	19,200	390,649	82,634
.	70,105	0.7	0.4082	22,044	388,837	80,185
.	69,004	0.8	0.4665	24,798	387,096	77,860
.	67,923	0.9	0.5248	27,465	385,423	75,651
.	66,862	1	0.5831	30,048	383,815	73,550
.	65,819	1.1	0.6415	32,552	382,268	71,550
.	64,795	1.2	0.6998	34,980	380,781	69,646
.	63,789	1.3	0.7581	37,334	379,350	67,830
.	62,801	1.4	0.8164	39,618	377,973	66,099
.	61,830	1.5	0.8747	41,834	376,647	64,446
.	60,877	1.6	0.933	43,985	375,370	62,866
.	59,940	1.7	0.9913	46,074	374,141	61,356
.	59,019	1.8	1.0497	48,103	372,957	59,910
.	58,114	1.9	1.108	50,074	371,816	58,526
.	57,225	2	1.1663	51,989	370,717	57,199

Input units are thousands and kg - output in tonnes

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 (1992-2001) for the French and Spanish fisheries in Sub-area VIII

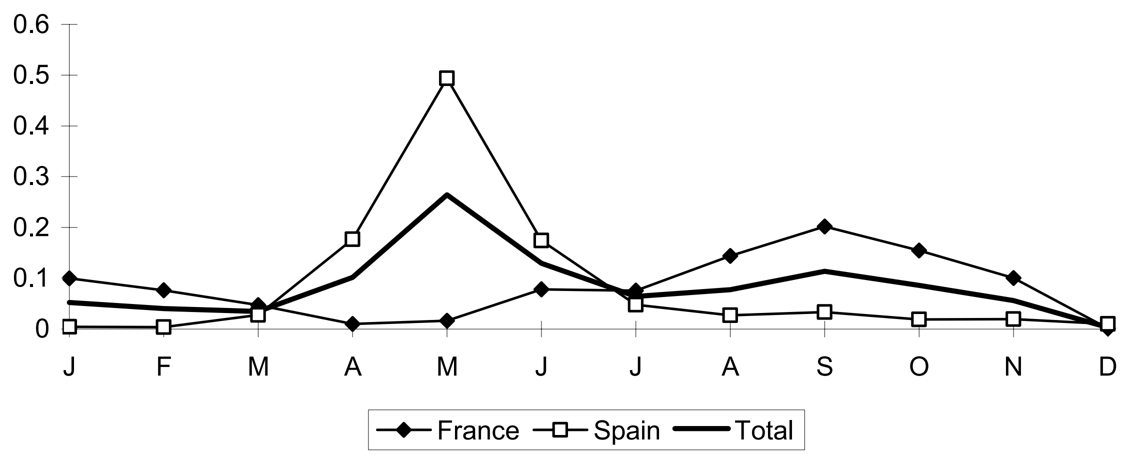


Figure 11.3.2.1 Size distribution-First Quarter-

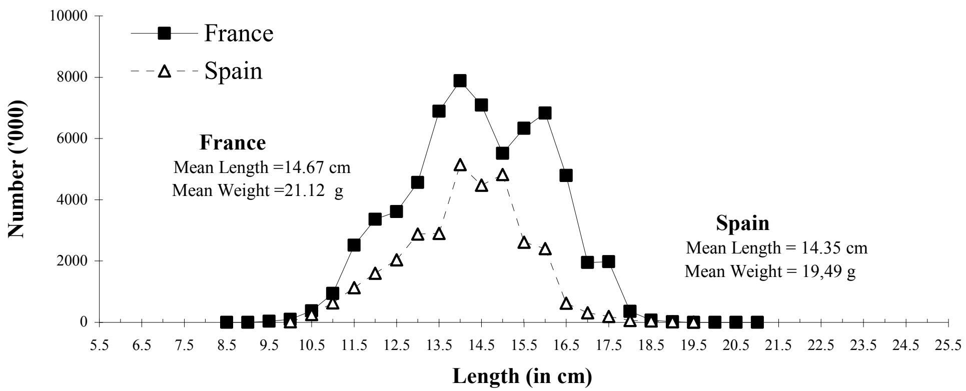


Figure 11.3.2.3 Size distribution-Third Quarter-

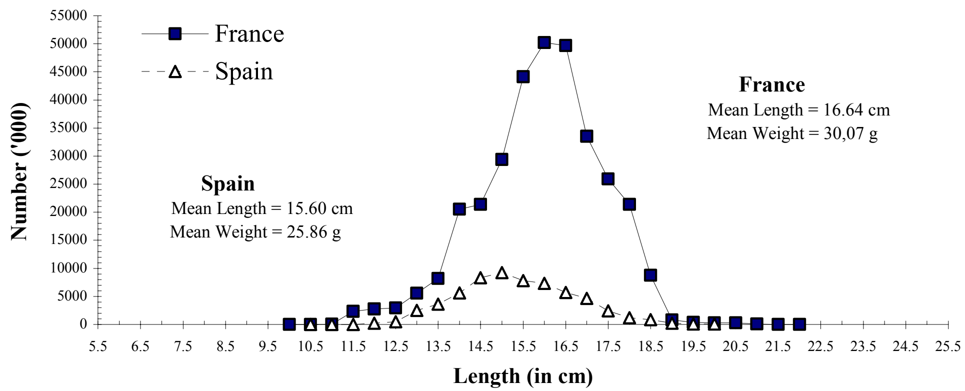


Figure 11.3.2.2 Size distribution - Second Quarter

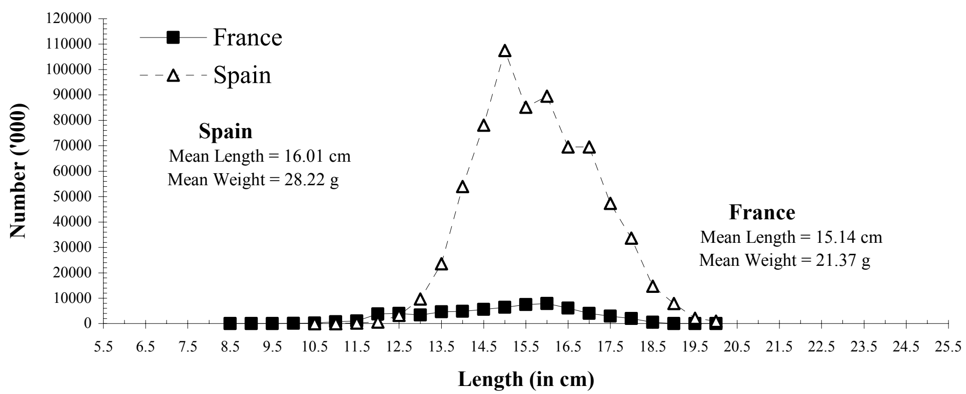
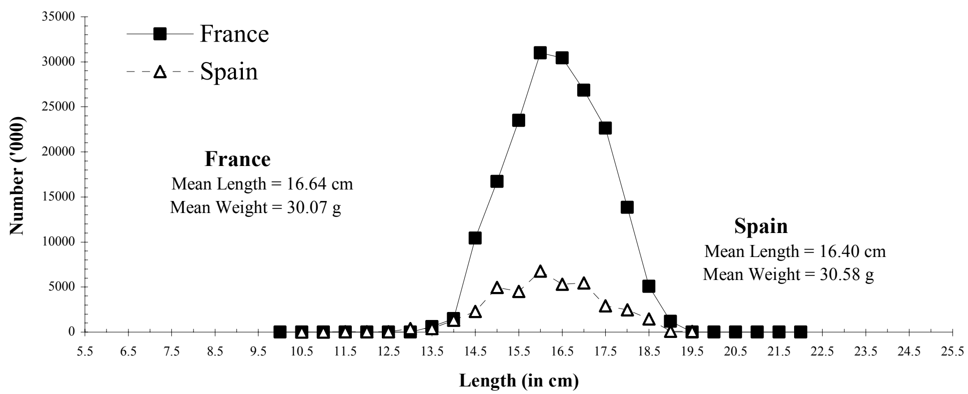


Figure 11.3.2.4 Size distribution -Fourth Quarter-



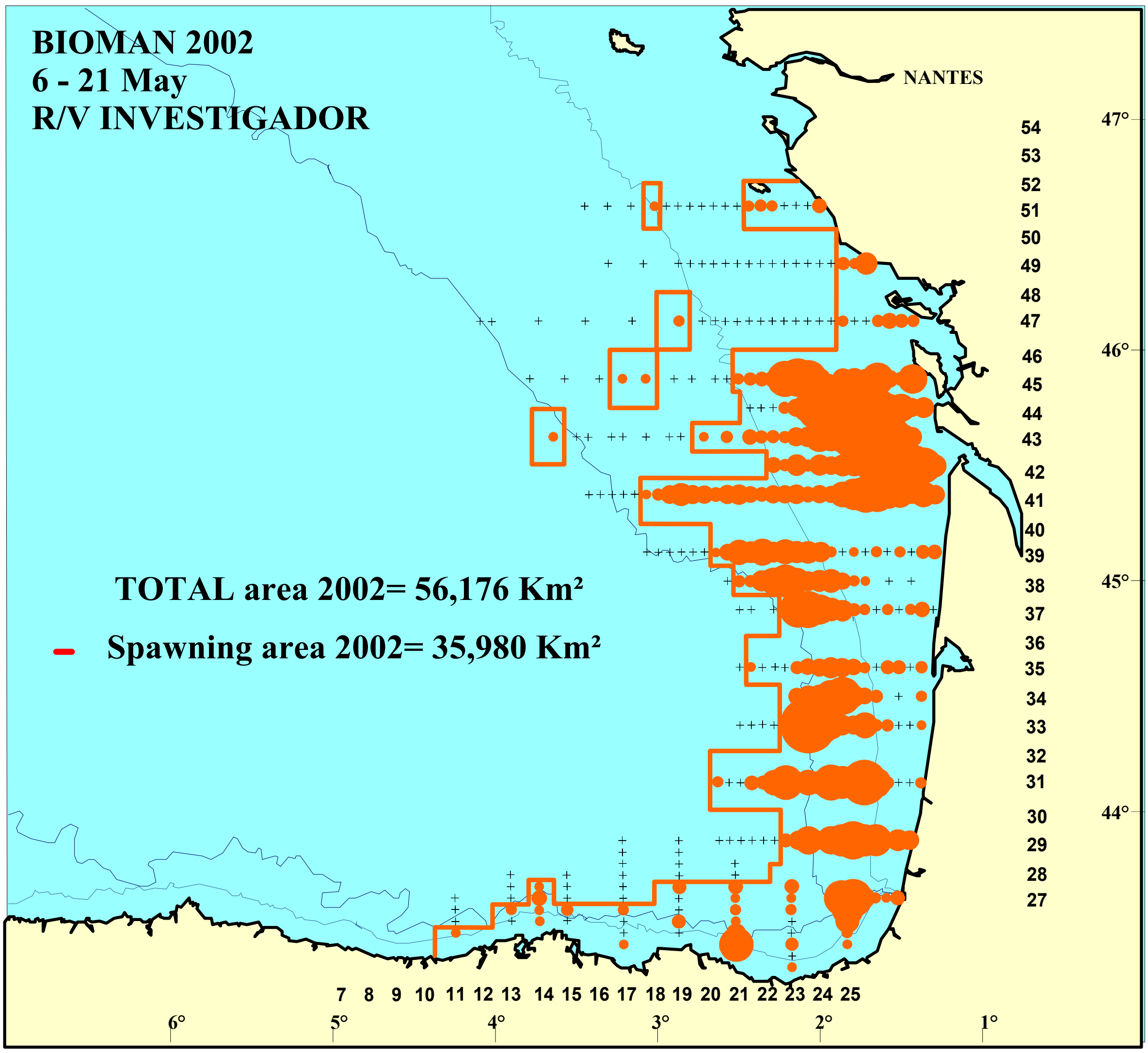


Figure 11.4.1.1: Anchovy Egg/0.1m² distribution found during BIOMAN 2002. Solid line encloses the positive spawning area.

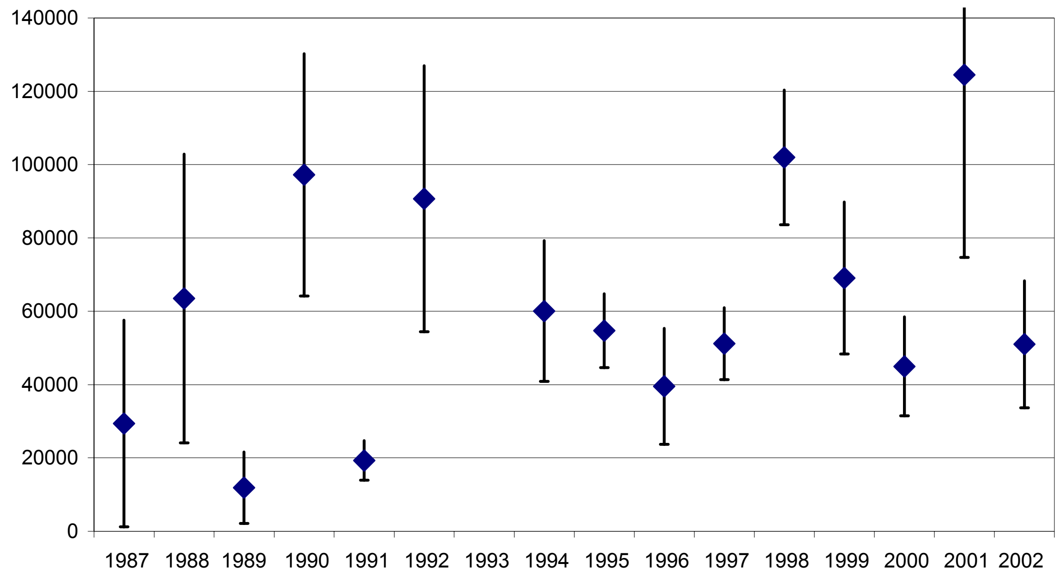


Figure 11.4.1.2: Series of Biomass obtained for the Bay of Biscay anchovy by the Daily Egg Production Method since 1987, bounded by ±2 s.e. of the estimate.

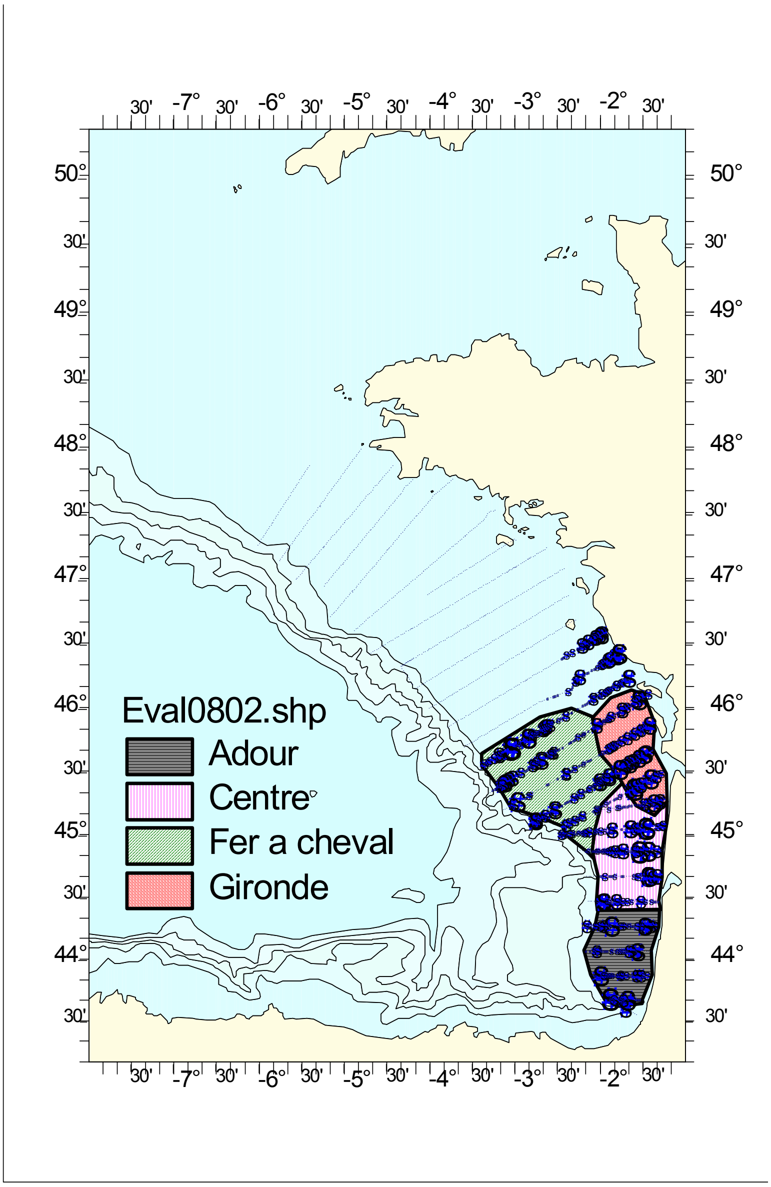


Figure 11.4.2.1 Distribution of energies and areas taken into consideration for biomass estimate from acoustic survey in 2002.

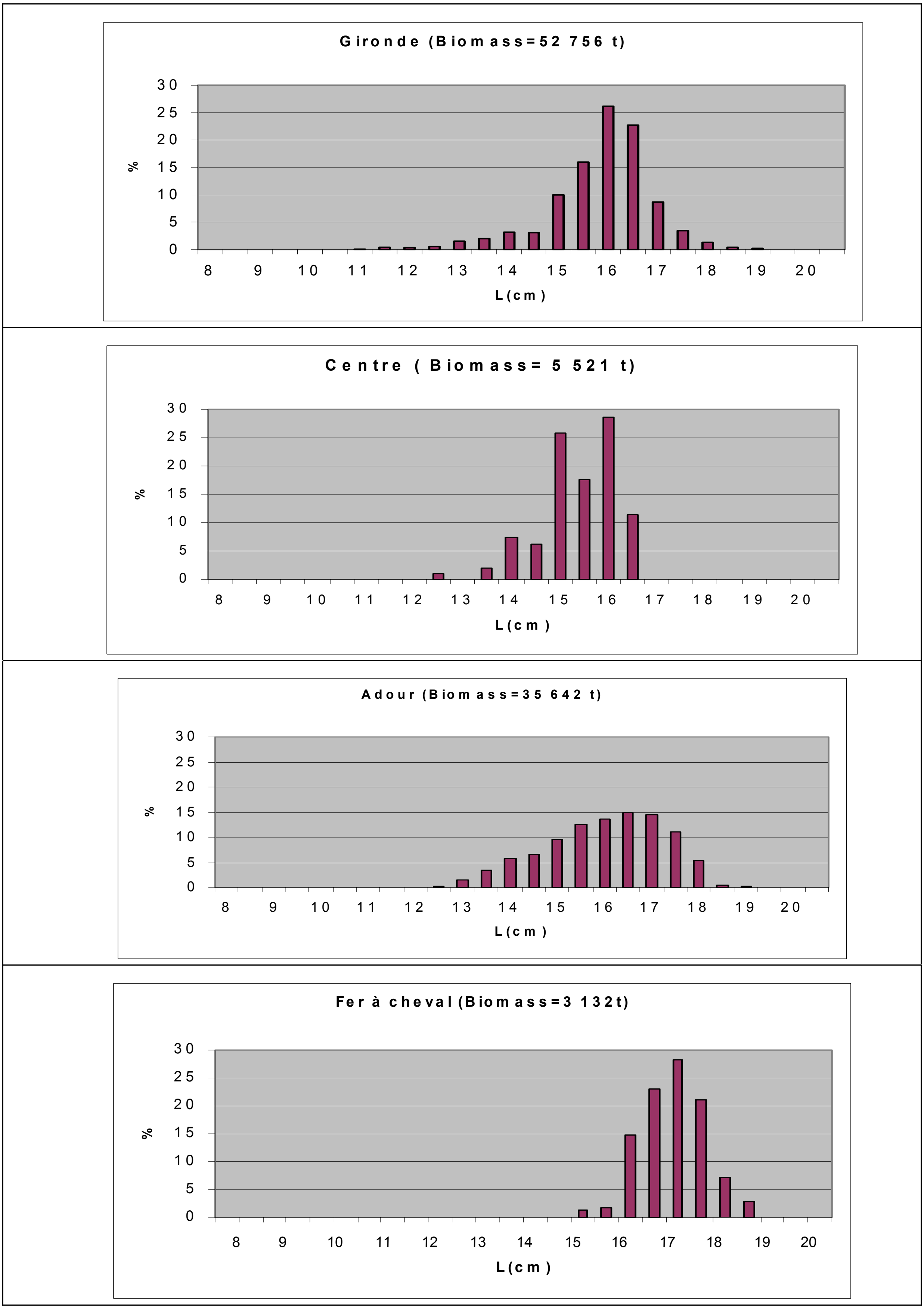


Figure 11.4.2.2 Anchovy length distribution by area for the PEL2002 survey and approximate estimates of biomasses.

Figure 11.7.1.1: Review of the current assessment in comparison with the one made in 2001.

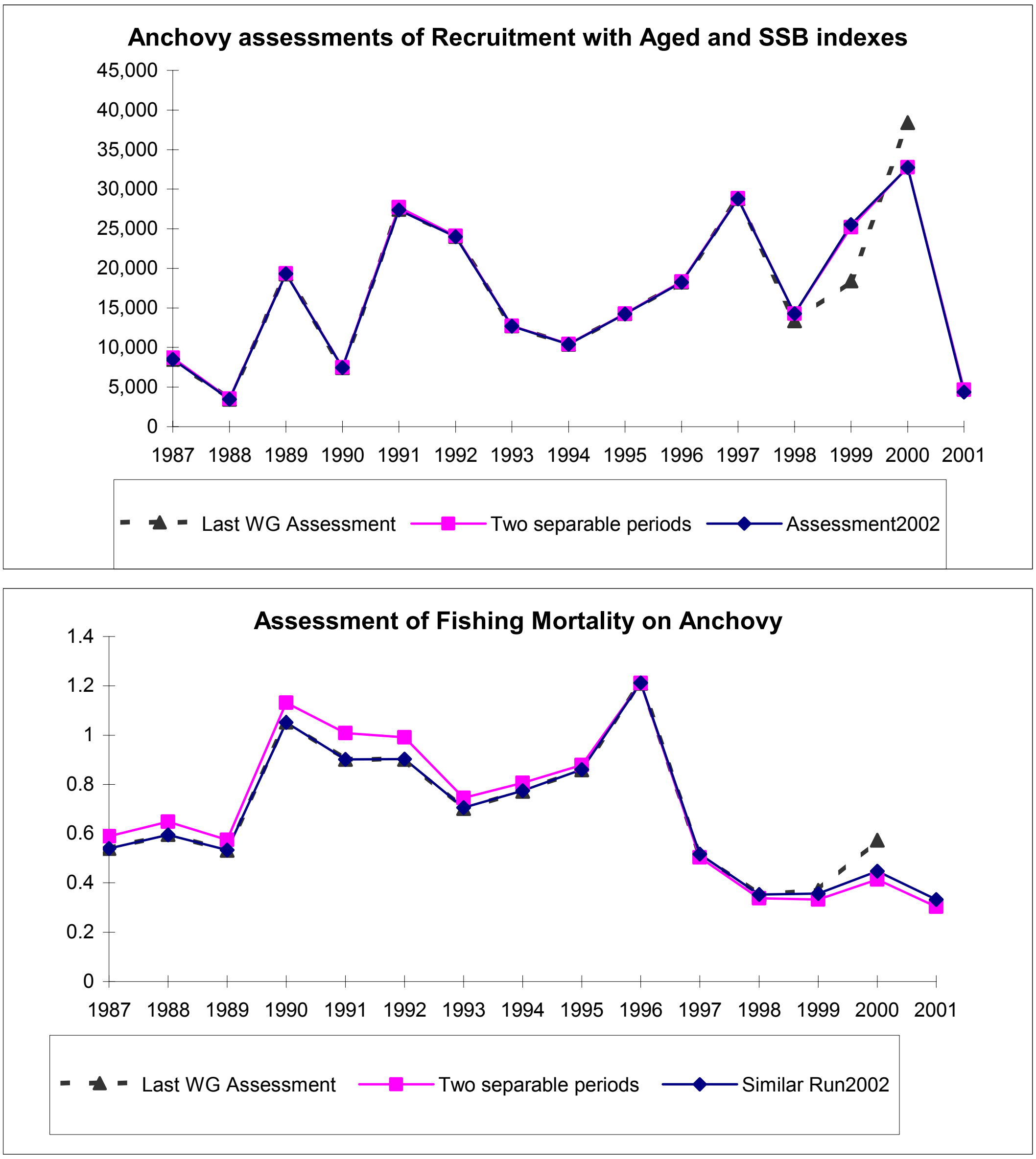


Figure 11.7.1.2: Current assessment (2002) and comparison with two alternative ones.

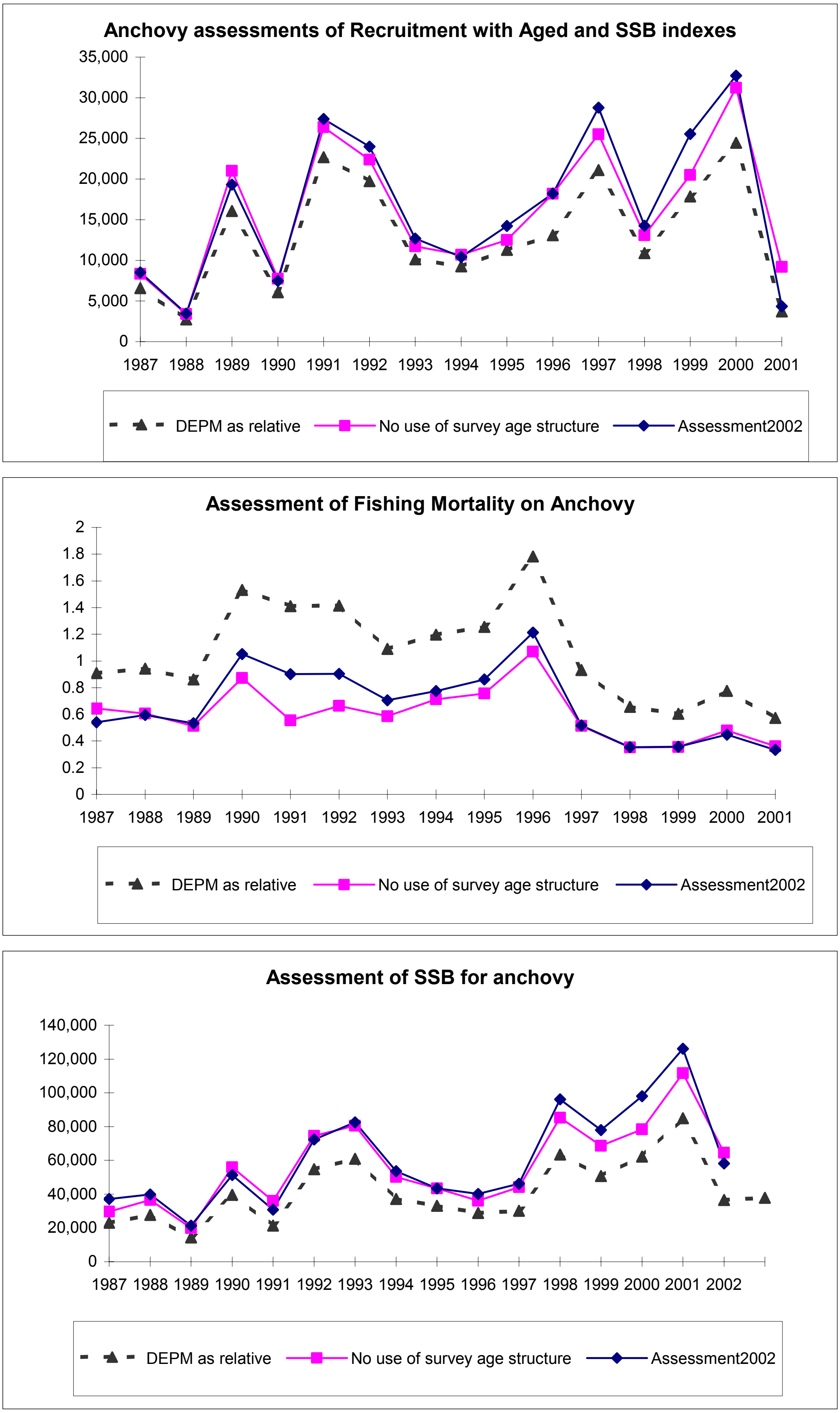


Figure 11.7.1.3: Assessment of the Bay of Biscay anchovy recruitment and spawning biomasses from the biomass dynamic model with DEPM as absolute and acoustics as relative indexes; Comparison with ICA outputs and survey data.

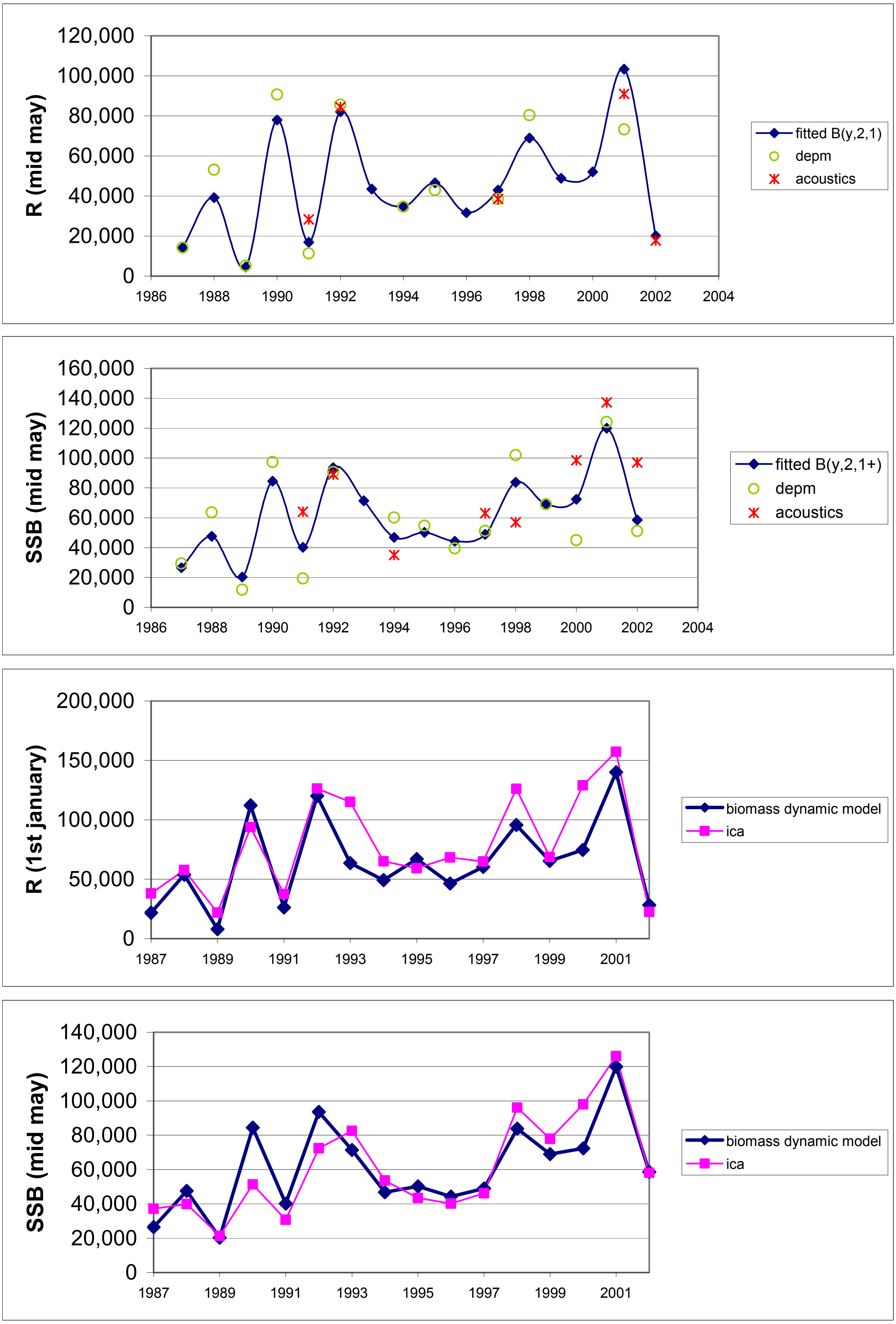


Figure 11.7.1.4: Biomass dynamic model fitting and residuals to the survey observations (DEPM as absolute and acoustics as relative indexes).

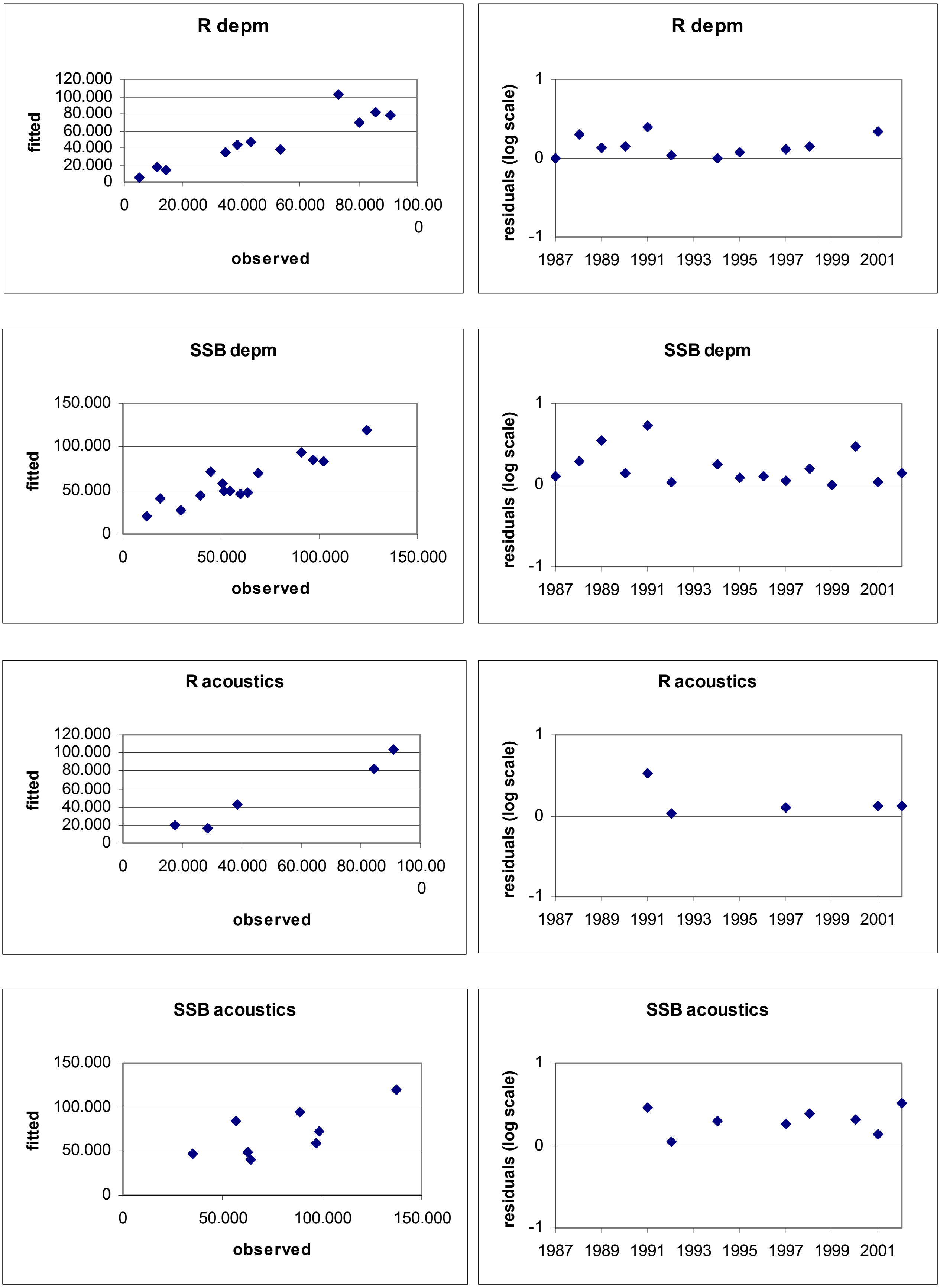


Figure 11.7.1.5: Assessment of the Bay of Biscay anchovy recruitment and spawning biomasses from the biomass dynamic model with DEPM and acoustics as relative indexes; Comparison with ICA outputs and survey data.

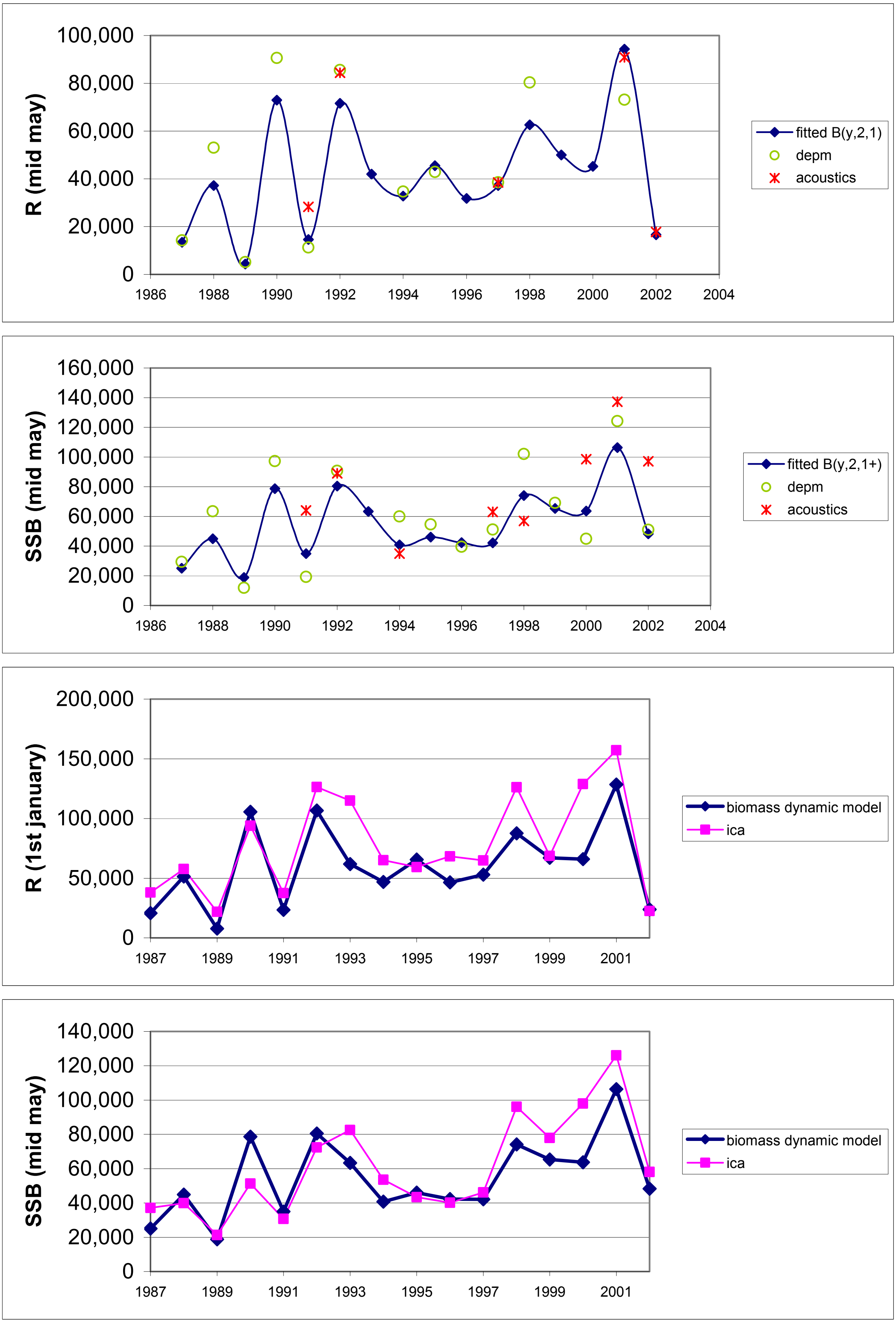


Figure 11.7.1.6: Biomass dynamic model fitting and residuals to the survey observations (DEPM and acoustics as relative indexes).

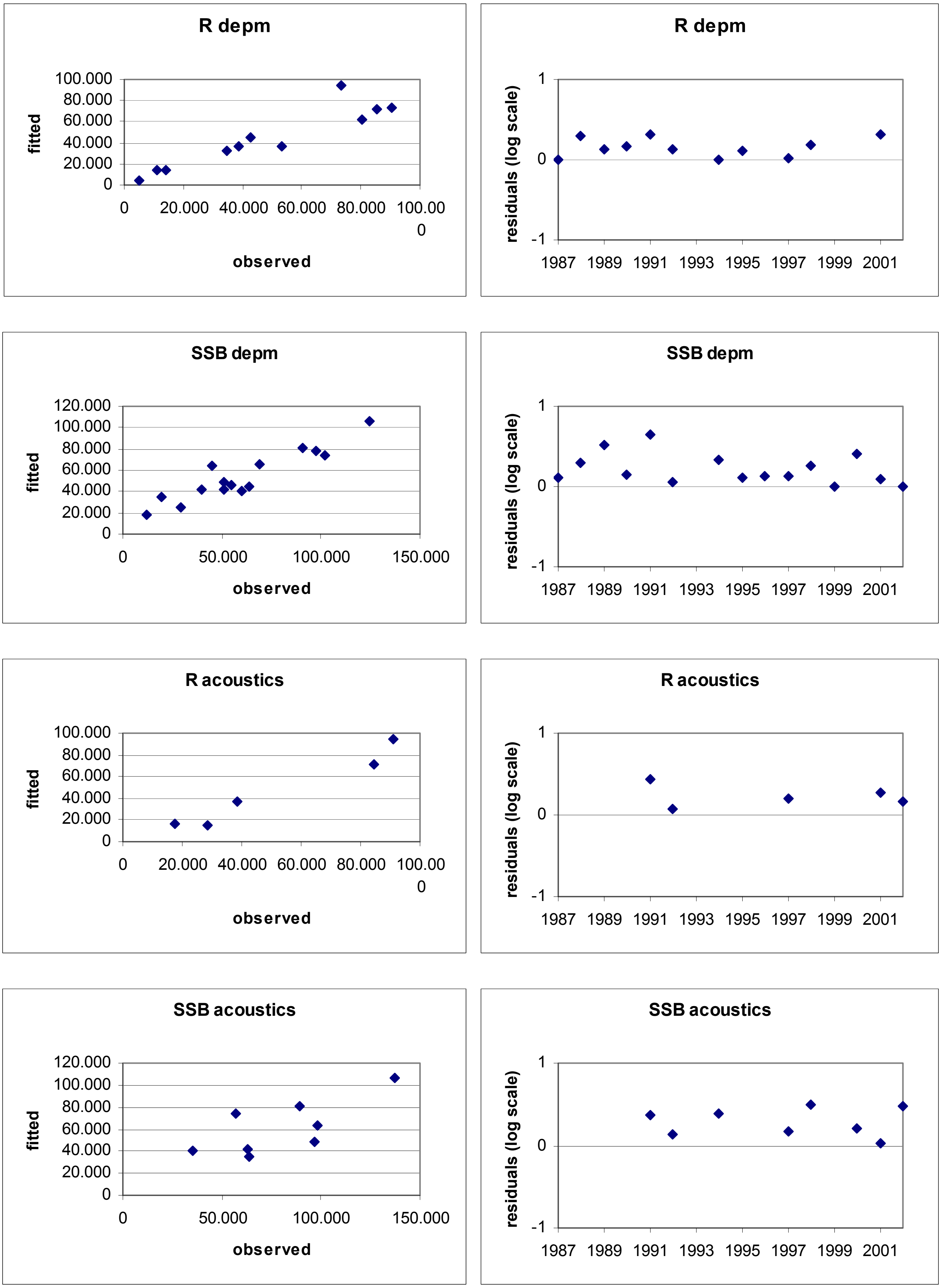
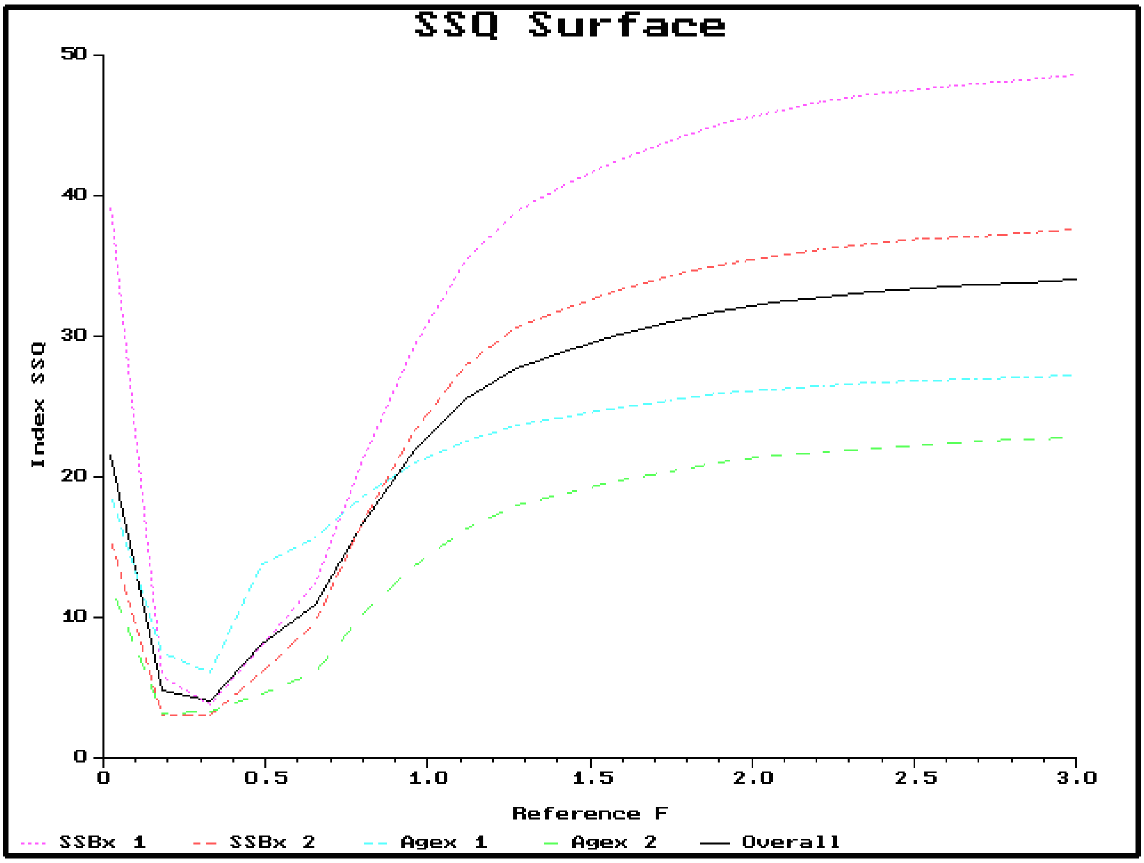


Figure 11.7.2.1: Fitting graphics of the assessment of the Bay of Biscay anchovy.



Stock Summary

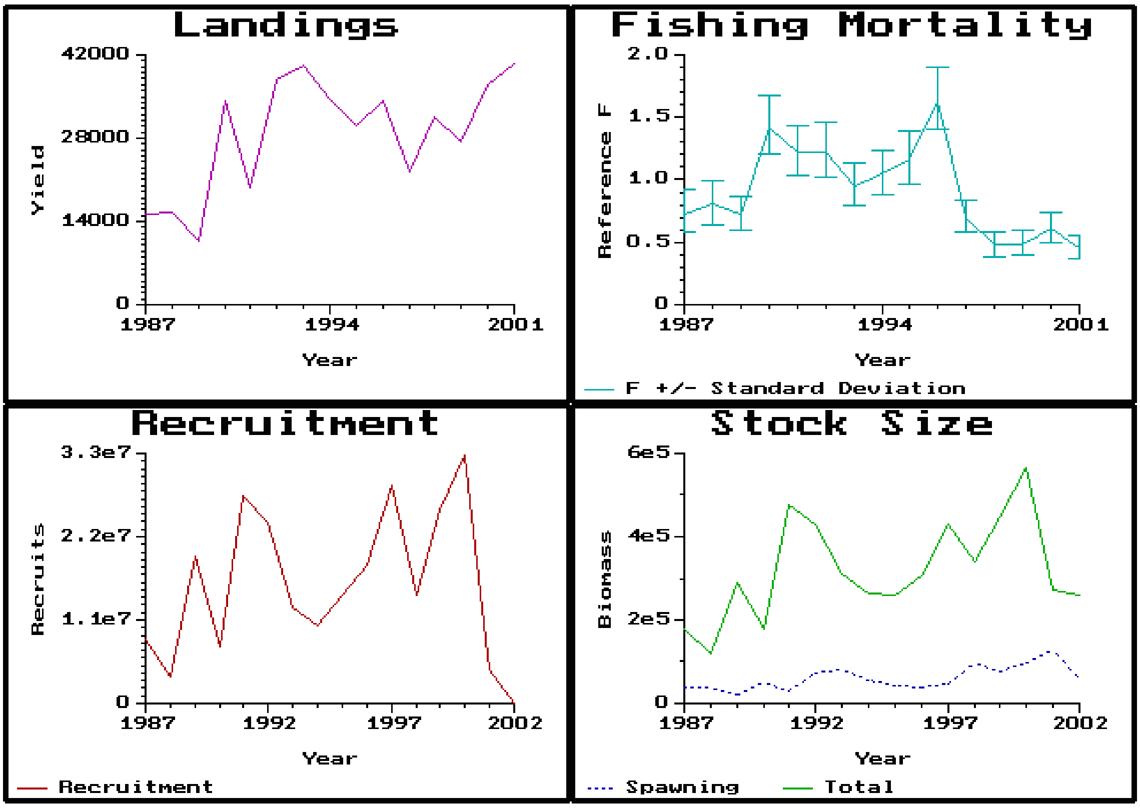
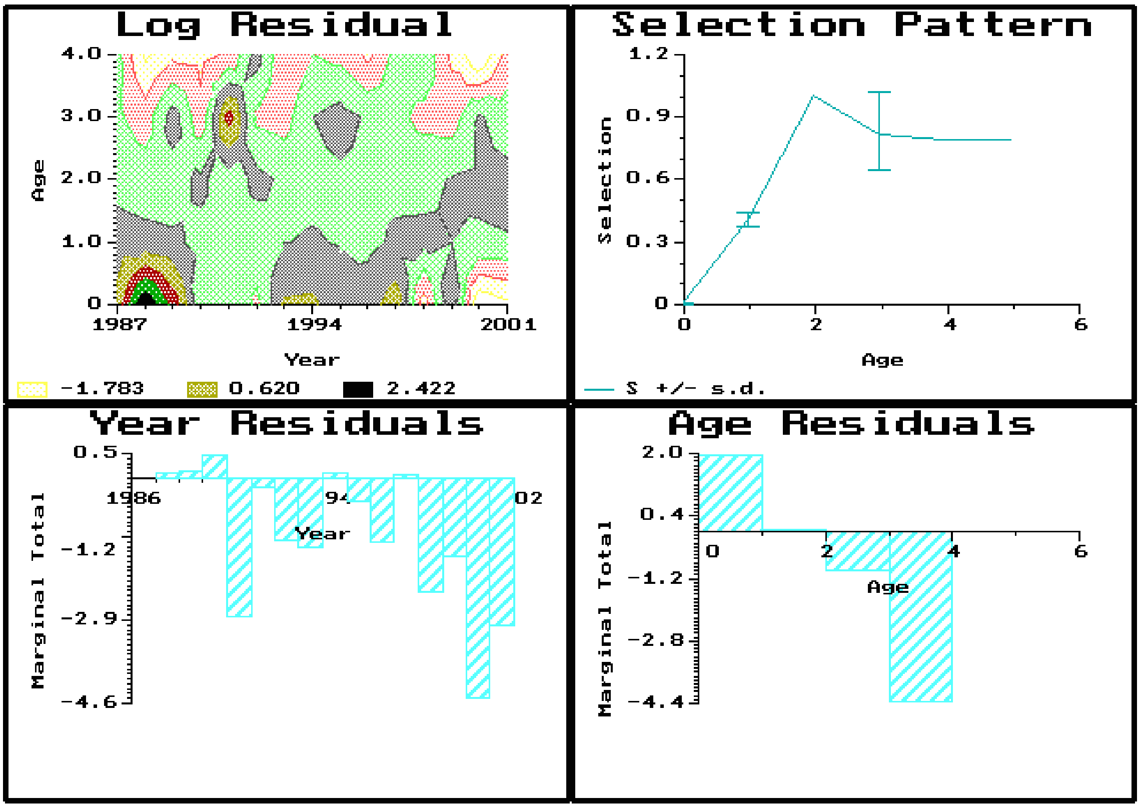


Figure 11.7.2.1 (cont'd)

Separable Model Diagnostics



Tuning Diagnostics: Biomass index 1

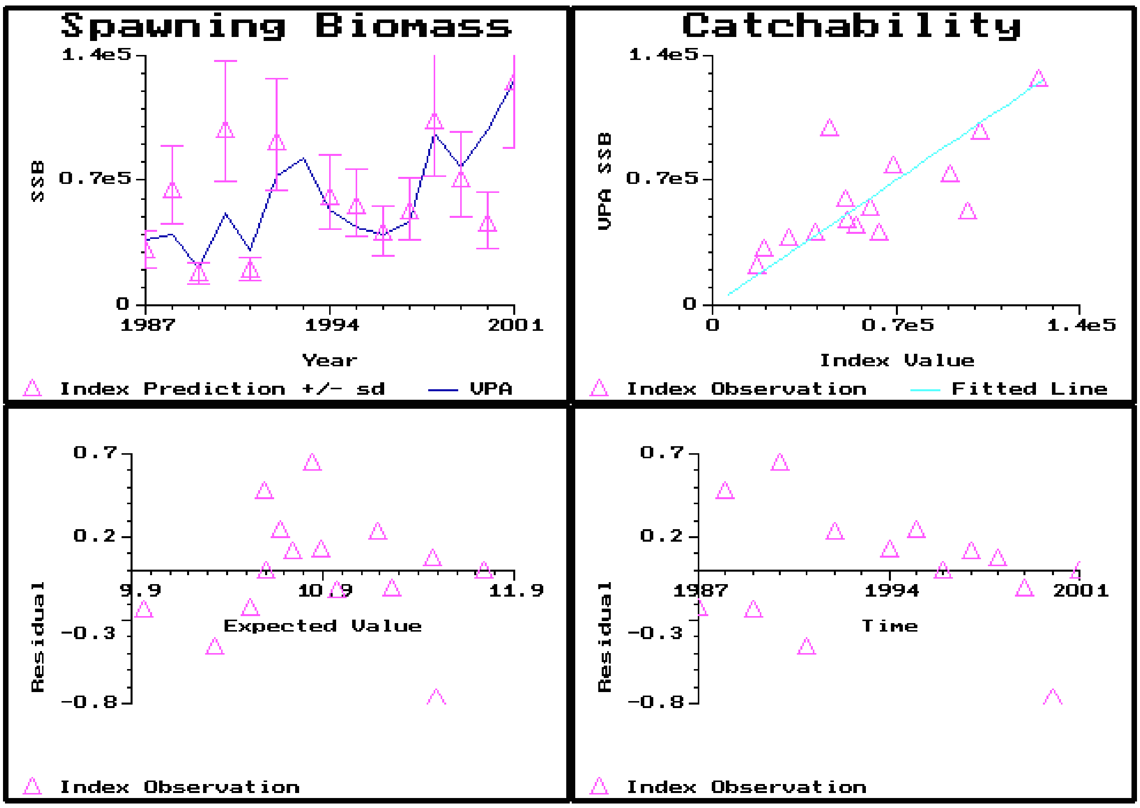
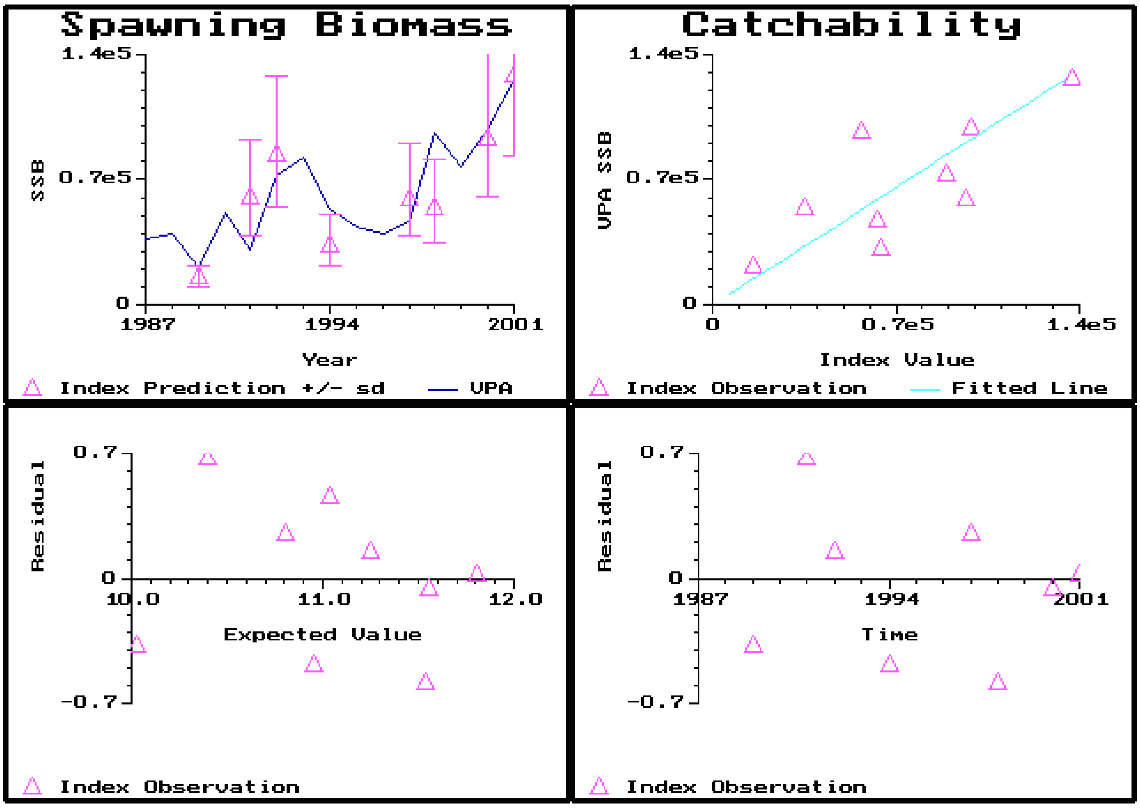


Figure 11.7.2.1 (cont'd)

Tuning Diagnostics: Biomass index 2



DEPM SUVEYS (Ages 1 to 3+) Age 1

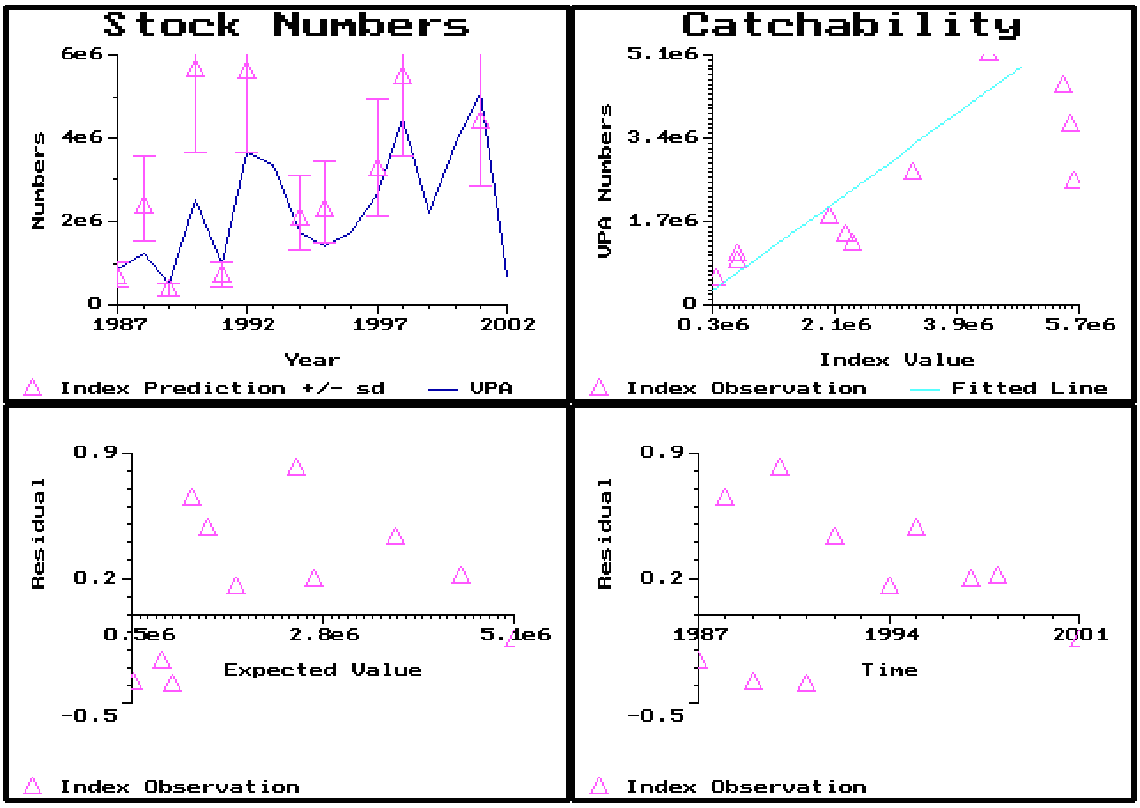
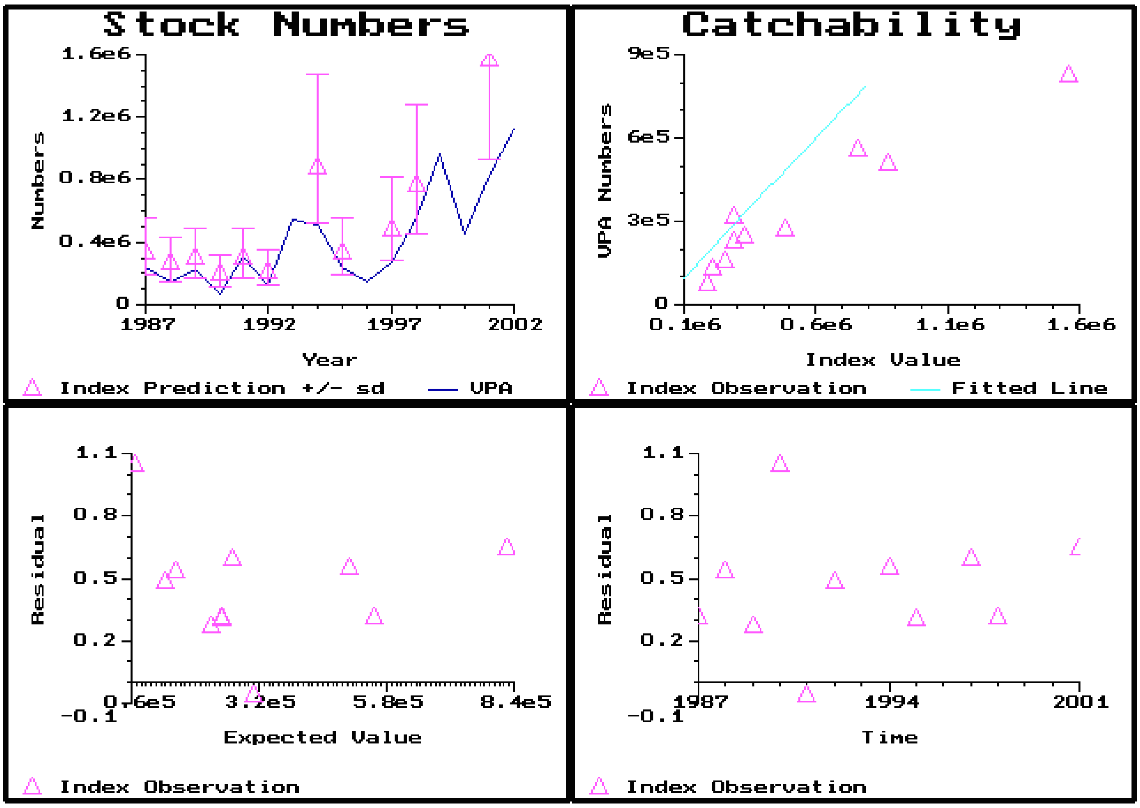


Figure 11.7.2.1 (cont'd)

DEPM SUVEYS (Ages 1 to 3+) Age 2



DEPM SUVEYS (Ages 1 to 3+) Age 3

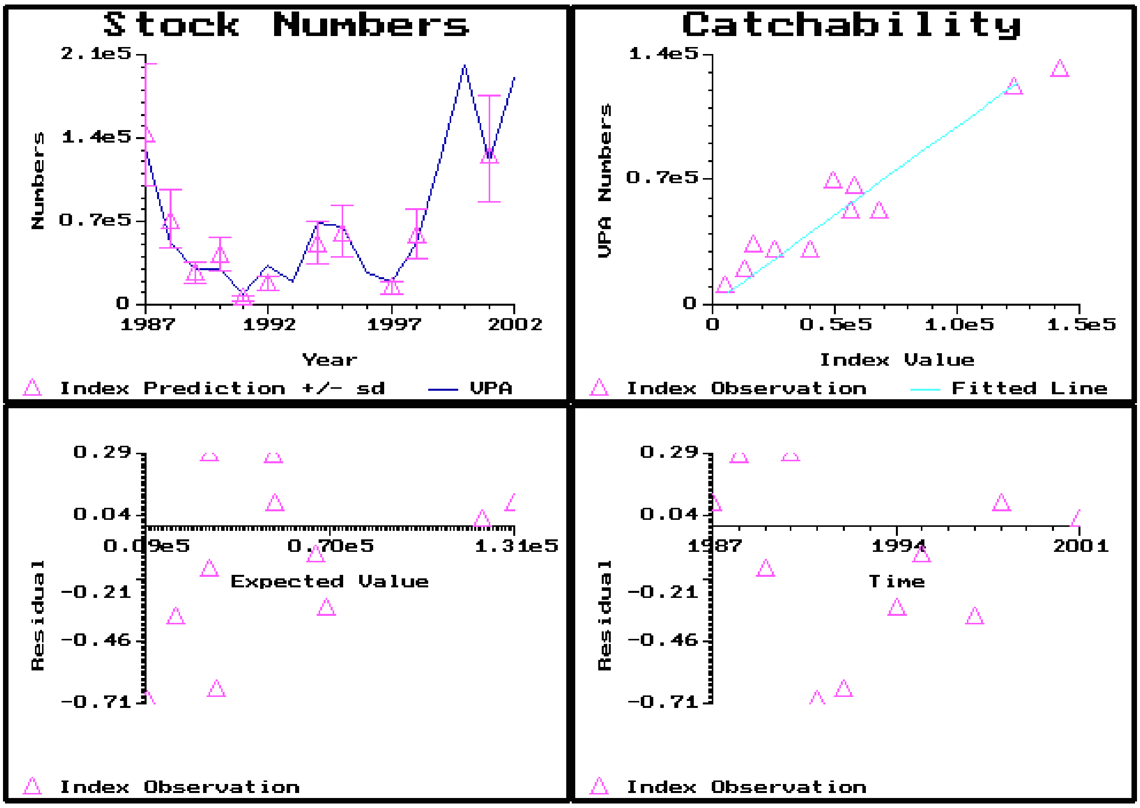
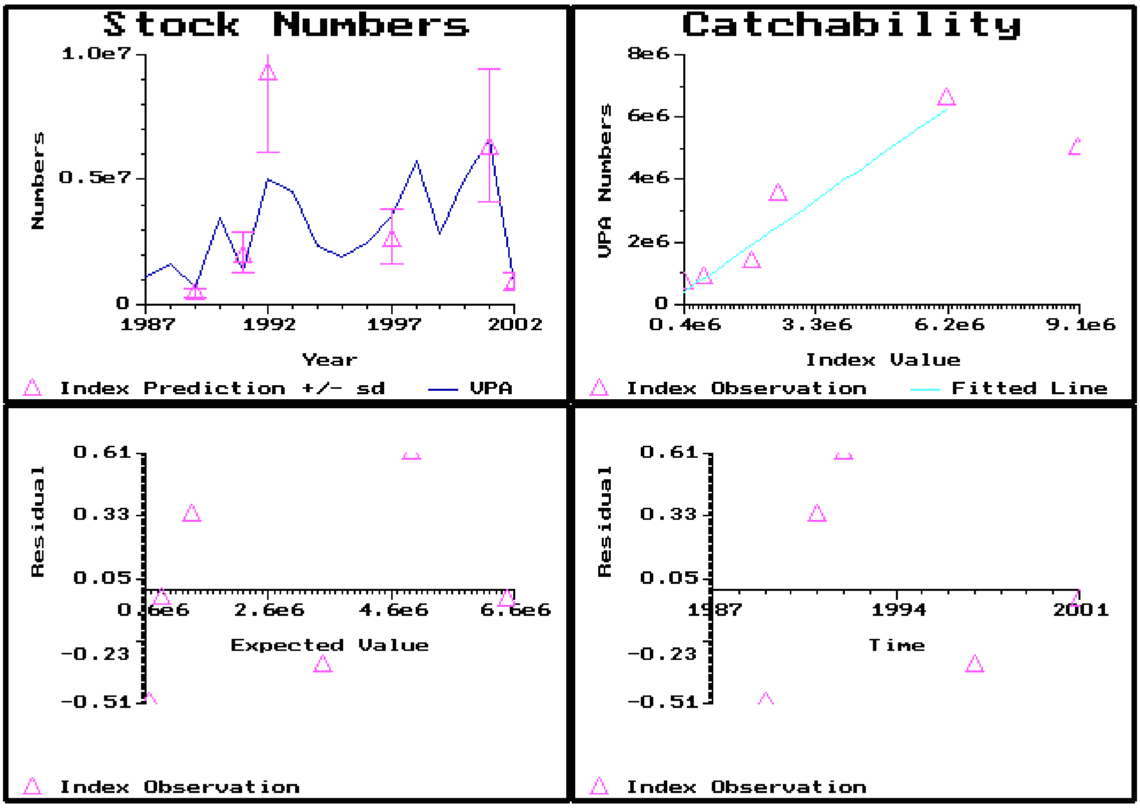


Figure 11.7.2.1 (cont'd)

ACOUSTIC SURVEYS (ages 1 to 2+) Age 1



ACOUSTIC SURVEYS (ages 1 to 2+) Age 2

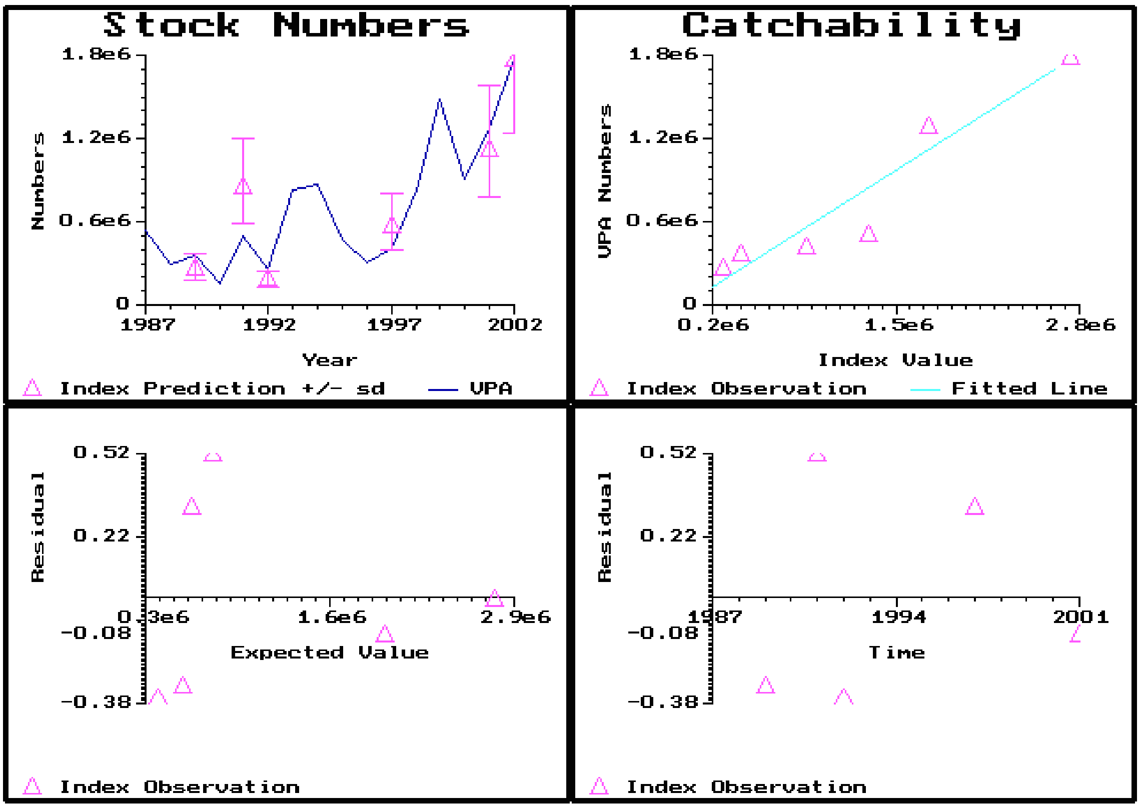


Figure 11.7.2.2: Summary of the assessment of the Bay of Biscay anchovy.

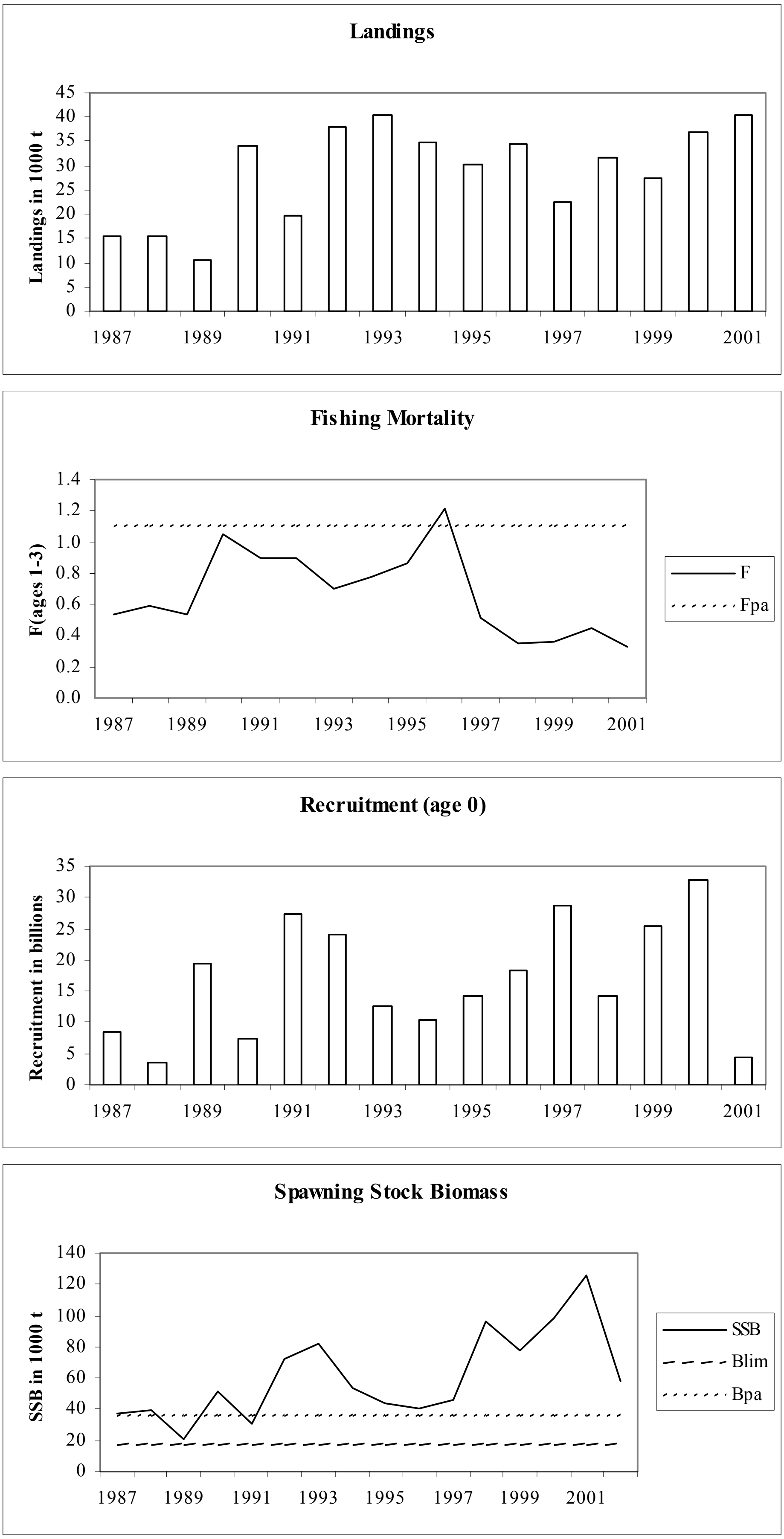


Figure 11.11.1 - mean age distribution of anchovy catches during the period 1987-2000 and elements of knowledge for their forecast

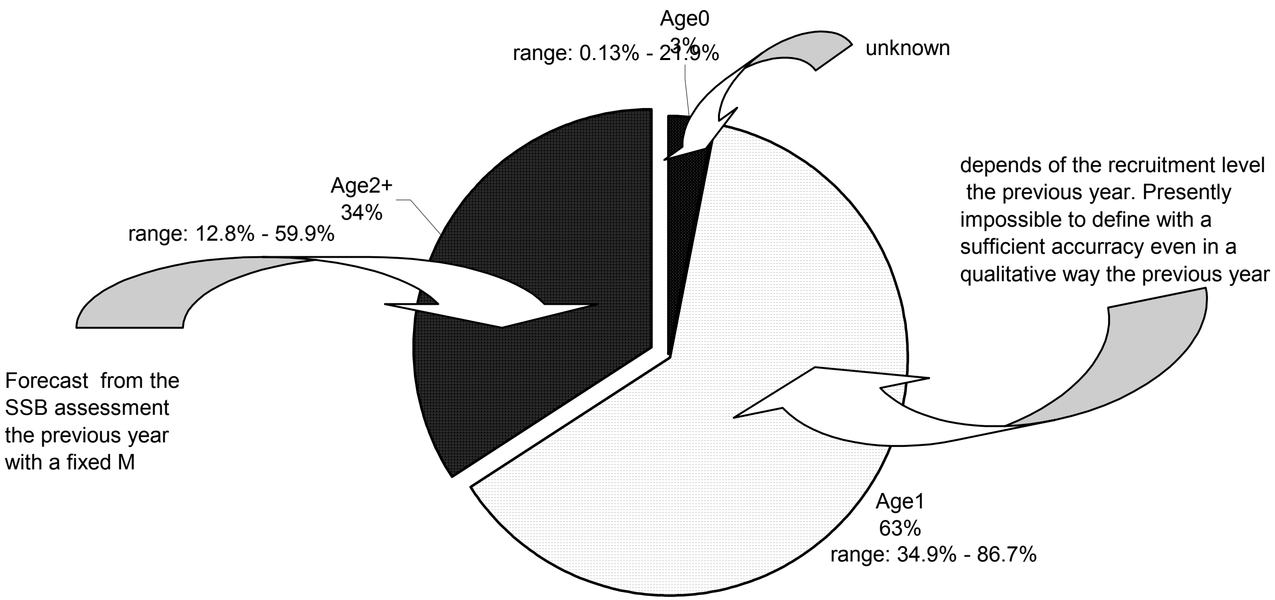
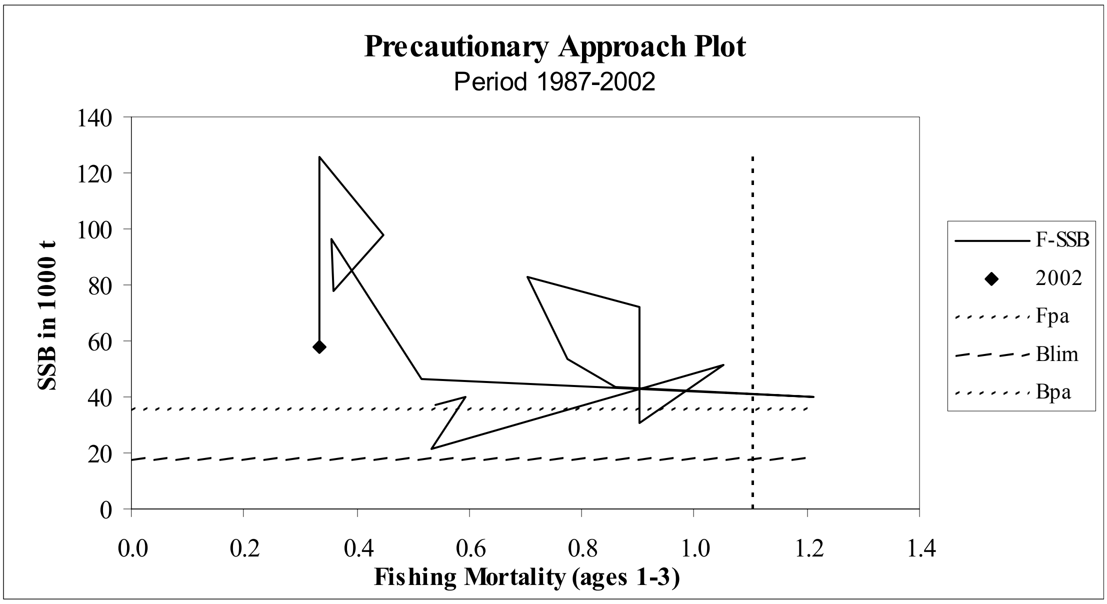


Figure 11.11.2: Trajectory of the Bay of Biscay fishery since 1987.



12 ANCHOVY IN DIVISION IXA

12.1 ACFM Advice Applicable to 2002

From ICES recommendations (ICES, C.M. 2002/ACFM:06), the ACFM advice on management for 2001 and 2002 states that catches in these years be restricted to 4,900 t, which correspond to the level of mean catches from the period 1988-1999, excluding 1995 and 1998. This level should be kept until the response of the stock to the fishery is known. ACFM is aware that the state of this resource can change quickly, and therefore it considered appropriate the development and implementation of a management plan including an in-year monitoring of both the stock and the fishery with corresponding regulations.

The agreed TAC for anchovy (for Sub-areas IX and X and CECAF 34.1.1) was 10,000 t for 2000 and 2001. Anchovy catches in Division IXa in 2000 and 2001 were 2,502 t and 9,098 t respectively. For 2002 this TAC has been agreed to be 8,000 t.

12.2 The Fishery in 2001

12.2.1 Landings in Division IXa

Anchovy total catches in 2001 were 9,098 t (Table 12.2.1.1, Figure 12.2.1.1). These catches not only represented a considerable increase in relation to the very low catches recorded in 2000 (2,502 t) but also they were close to the highest records in the historical series with complete data for the whole Division (12,956 t in 1995 and 10,962 t in 1998). Overall, this increasing trend in catches was observed in all Sub-divisions, although it was more remarkable in the Spanish part of the Sub-division IXa South (Gulf of Cadiz). Only catches from the Sub-division IXa Central-South still declined (19 t) in relation to those recorded in 2000 (61 t).

As usual, the anchovy fishery in 2001 was mainly harvested by purse seine fleets (99% of total catches). Portuguese and Spanish purse-seine landings accounted for 94% and 99% of their respective national total catches (Table 12.2.1.2). However, unlike the Spanish Gulf of Cadiz fleet, the remaining purse-seine fleets only target on anchovy when its abundance is high. Trawl (both Spanish and Portuguese) and Portuguese artisanal landings showed a low relative importance within the context of the whole anchovy fishery in the Division.

12.2.2 Landings by Subdivision

The anchovy fishery was located in 2001 in the Sub-division IXa South (8,655 t, *i.e*., 95% of total catch in the whole Division, Table 12.2.2.1, Figure 12.2.1.1). As observed in recent years, the bulk of these catches was fished again in the Spanish Gulf of Cadiz (8,216 t against 439 t landed in the Algarve). Excepting catches from IXa Central-North (397 t, only 4% of total catch), the relative importance of the remaining Sub-divisions was negligible.

The distribution pattern of the Spanish fishery in 2001 followed the one observed in recent years, with almost the whole of anchovy being fished in the Gulf of Cadiz waters (only 27 t in Subdivision IXa North, *i.e*., southern Galician waters). This usual distribution pattern of the Spanish fishery only shifted in 1995, when favourable environmental conditions in the northwestern coastal waters of the Iberian Peninsula favoured an increased level of anchovy abundance in Sub-division IXa North as well as in the Portuguese IXa Central-North.

The Portuguese anchovy fishery in 2001 was mainly distributed between Subdivisions IXa South (Algarve, 439 t, 51% of total Portuguese catches) and IXa Central-North (397 t, 46%). Anchovy catches in IXa Central-South were almost negligible (19 t, 2%). Historically, each of these Sub-divisions has shown alternate periods of relatively high and low landings, anchovy fishery being located either in the IXa Central-South (before 1984) or in the IXa Central-North (after 1984) (see Table 12.2.1.1 and Pestana, 1996).

Seasonal distribution of catches by country and Sub-divisions in 2001 is shown in Table 12.2.2.1. Anchovy catches were recorded throughout the year in all Sub-divisions but in IXa North, where no catches were recorded for the first quarter. In the northernmost Sub-divisions catches occurred mainly in the second half in the year whereas those from Portuguese waters of the IXa Central-South and South (Algarve) occurred in the first half. Spanish catches from the Gulf of Cadiz attained higher levels in second and third quarters.

12.3 Fishery-Independent Information

12.3.1 Acoustic Surveys

Spanish Surveys

Spanish acoustic surveys aimed at sardine have been conducted in Subdivision IXa North and Division VIIIc since 1983. Results from these surveys for the Sub-division IXa North have evidenced the scarce presence or even the absence of anchovy in this area (Carrera *et al*., 1999; Carrera, 1999 and 2001). Spain acoustically surveyed for the first time the Gulf of Cadiz anchovy (Sub-division IXa South) in June 1993. The total biomass estimated in this survey was 6,569 t (ICES, C.M. 1995/Assess:02).

An inter-calibration acoustic survey (SIGNOISE) between the R/V 'Cornide de Saavedra' and 'Vizconde de Eza' was conducted in the Gulf of Cadiz waters in February 2002. Sampled depths included those comprised between 20 and 500 m. This survey also included the conduction of some experiments aimed at knowing the acoustic noise of both vessels and to obtain their respective 'acoustic signs'. Besides acoustic sampling by both vessels, CUFES (in continuous) and PAIROVET (in fixed stations) sampling were also carried out by the R/V 'Cornide'. Results from this survey are at present under revision and the only available information on anchovy is of a descriptive type (Pablo Carrera, pers. comm.). From this information it is worthy to be mentioned that denser anchovy schools were mainly located in inner-shelf waters (40-100 m depth) close to the Guadalquivir River mouth. Anchovy schools exhibited a semi-demersal behavior in the water column during this survey. The repetition of some acoustic tracks in different days also allowed to evidence noticeable changes in the anchovy distribution pattern mainly driven by contrasting weather conditions (calm versus strong western winds). Few anchovy eggs occurred in the survey area probably because the survey took place well before the spring peak spawning period. The WG regards this survey as a positive development and encourages their continuation.

Portuguese Surveys

Results on anchovy distribution and abundance from Portuguese acoustic surveys in November 2001 and March 2002 have been provided to this WG (Marques and Morais, WD 2002). 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).

Acoustic fish densities in IPIMAR surveys are provided by the EK500 sounder. However, it has been sometimes observed that such values are not correct because the inability of the sounder bottom detector to follow the real bottom. This is particularly true when there are dense schools near the bottom (leading to a biomass underestimation) or when the bottom is very soft (overestimation). Both problems seem to be more evident for both sardine and anchovy in the Algarve-Gulf of Cadiz area. For the above reasons, corrections of the acoustic fish densities for sardine and anchovy in the November 2001 and March 2002 acoustic surveys were performed by using the IFREMER software MOVIES+ (Marques and Morais, WD 2002). This software was only used to solve situations like those described above because of the differences found between the average vessel speed per mile as computed by MOVIES+ and the one corresponding to the echo-sounder.

Anchovy biomass for the total surveyed area was estimated at 28,884 t (3,451 million fish) in November 2001 (Table 12.3.1.1). Although a generalised increase in biomass was recorded in the Portuguese sub-divisions Central North and Central South, the above overall estimate entailed a decrease of 5,364 t in relation to the estimated biomass in the precedent year (34,248 t). A decreased estimated biomass for the Spanish Gulf of Cadiz anchovy (25,580 t in November 2001 against 34,248 t in November 2000) was the main responsible for this overall decrease. Nevertheless, biggest concentrations of anchovy during this survey occurred in the Gulf of Cadiz (89% of the total estimated biomass, Figure 12.3.1.3). Some smaller concentrations were also found near Lisbon.

In the March 2002 survey anchovy total biomass was estimated at 25,431 t (4,530 million fish), and it was at the same level that the attained in March 2001 (25,281 t, Table 12.3.1.1). By sub-divisions, the Central North and Central South showed increased biomass levels (mainly the latter) in relation to the precedent year whereas the southernmost areas showed decreased levels (more evident in the Algarve area). Again, the bulk of the anchovy resource in the surveyed area was concentrated in the Spanish Gulf of Cadiz (87% of the total estimated biomass, Figure 12.3.1.4) with smaller concentrations near Lisbon.

Large differences in population size composition were detected in the November 2000 survey, smaller size classes being more apparent in the Gulf of Cadiz (Figure 12.3.1.5). Mean lengths in the population were estimated at 16.4 and 15.3 cm in the sub-divisions Central North and Central South, and at 10.9 cm in the Gulf of Cadiz. About 89% of the total number of individuals estimated in the Gulf of Cadiz were ≤12.5 cm total length (Figure 12.3.1.6).

The March 2002 survey showed two different population structures. While in Gulf of Cadiz and Central South areas the smaller fishes clearly dominated, in the Algarve and Central North zones the bigger fishes prevailed (Figures 12.3.1.5 and 12.3.1.6). The Central North area presented a wide length range (between 7.5 and 19 cm), two well defined modal classes (11.5 and 16.5 cm) and a mean length of 14.7 cm. Anchovy off the Central South showed a similar length range to that observed in the Central North but with a very different demographic structure featured by the absolute dominance of the younger fishes (93% of fish measuring ≤12 cm), and a mean length of 10.4 cm. Gulf of Cadiz anchovy showed an unimodal length distribution with length classes between 8.5 and 10.5 cm representing 87% of the total number estimated for this sub-area. Mean length in this area was estimated at 9.7 cm. Anchovy lengths in Algarve ranged from 11 and 16.5 cm and the mean length was 14.4 cm. The above pattern suggests either a southernmost (along the Atlantic wall of the Iberian Peninsula) or easternmost (in the Gulf of Cadiz) location of smaller anchovies during this season in this year.

12.4 Biological Data

12.4.1 Catch Numbers at Age

Catch-at-age data from the whole Division IXa are only available from the Spanish Gulf of Cadiz fishery (Sub-division IXa South). In the present year, this catch-at-age series has been extended backwards to 1988, the starting year of the historical series of Gulf of Cadiz catches. Catch-at-age data from the Spanish fishery in Sub-division IXa North were not available since commercial landings were negligible.

As for Gulf of Cadiz data the information gaps described in the last year's report for the whole 1994 and second half in 1995 (only the size composition in catches is available) have been filled from an iterated age-length key (IALK) by applying the Kimura and Chikuni's (1987) algorithm (Millán, WD 2002). For this purpose, overall empirical ALK's were firstly constructed on a quarterly and annual basis by combining the corresponding ALK's from the whole available series (1988-2001). Weighted mean lengths at age 0, 1, 2, and 3 (7.16 cm, 10.82 cm, 14.55 cm, and 16.80 cm) estimated from this 'annual' ALK and a constant $L\infty$=18.14 cm (maximum length in biological samples) were used as input data to estimate the (non-seasonal) VBGF parameters by using the FISHPARM package (Saila *et al*., 1988). The resulting VBGF parameters (K=0.689 per year, t_0=-0.747 years, $L\infty$=18.14 cm), quarterly catches and empirical length frequency distributions, and overall 'quarterly' ALK's were used as input data to run the Kimura and Chikuni's algorithm and to obtain the IALK estimates.

The age composition of the Gulf of Cadiz anchovy landings from 1988 to 2001 is presented in Table 12.4.1.1 and Figure 12.4.1.1. The catch-at-age series shows that 0, 1 and 2 age groups support the Gulf of Cadiz anchovy fishery and that the success of this fishery largely depends on the abundance of 1 year-old anchovies. However, the contribution of age-2 anchovies usually accounts for less than 1% of the total annual catch (excepting 1997, 1999, and 2001, with contributions of 7%, 5%, and 3%, respectively). Likewise, age-3 anchovies only occurred in the first quarter in 1992 but their importance in the total annual catch that year was insignificant. The relative importance of 0- and 1-age groups in the fishery has experienced some changes through the series. Thus, 1 year-old anchovies constituted almost the whole of anchovy landed in the period 1988-1994 (with percentages higher than 80%). Between 1995 and 1997 the contribution of this age group decreased down to between 25% (1996) and 50% (1995), whereas since 1998 onwards the relative importance of 1 year-old anchovies was increased again, although up to percentages between 60-75%. The contribution of the 0-age group was relatively low in the 1988-1994 catches, although its importance was considerably increased since 1995 onwards (mainly in the 1995-1997 period).

Total catch in the Gulf of Cadiz in 2001 was 723 millions fish which represents an overall increase of 56% compared to the previous year (320 millions). The most important increases were observed in age groups 1 (64% increase) and 2 (84%).

Landings of the 0 age-group anchovies are generally restricted to the second half of the year, whereas 1 and 2 year-old catches are present throughout the year (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 only provided by Spain, from 1988 to 2001 for Subdivision 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 2001 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 since 1988. Length frequency distributions of Gulf of Cadiz anchovy (Sub-division IXa South) from 1988 to 1995 in this table have been revised and corrected after detecting some errors in the tabulated data in previous reports. Such corrections do not affect to the previously submitted data under the WG-data exchange sheet format ('lenght data' spreadsheets). Figure 12.4.2.2 compares length distributions in Subdivisions IXa South and IXa North since 1995. Note that, with the exception of 1998, the fish caught in the North are larger than 12.5 cm.

In 2001, as in previous years, smaller mean sizes and weights in Subdivision IXa South (Gulf of Cadiz) were recorded in the first and fourth quarters as a consequence of the large number of juveniles captured. Thus, individuals measuring less than 10.5 cm accounted for 52% and 65% of total fish landed in each of these quarters (Table 12.4.2.1 and Figure 12.4.2.1). Conversely, spring-summer catches were dominated by larger fish, showing modes at 12.5-13 cm. Mean length and weight in the annual catch (11.4 cm and 11.3 g) showed a relative increase in relation to the values recorded in 2000 and they are the highest ones in the whole analysed series (Table 12.4.2.2, Figures 12.4.2.1 and 12.4.2.2).

Mean Length- and Mean Weight at Age in Landings

In 2001, mean length- and mean weight-at-age data are only available for Gulf of Cadiz anchovy catches. Furthermore, the Spanish data series for these estimates have been completed until 1988 (Tables 12.4.2.3 and 12.4.2.4). The analysis of small samples of otoliths from Sub-division IXa North in 1998 and 1999 rendered estimates of mean sizes at ages 1, 2 and 3 of 15.5 cm, 17.6 cm and 17.9 cm respectively (ICES, C.M. 2000/ACFM:05 and ICES, C.M. 2001/ACFM:06). Comparisons of these estimates with those ones from the Gulf of Cadiz anchovy indicate that southern anchovies attain smaller sizes at age.

Seasonally, 0 age-group anchovies off the Gulf of Cadiz are larger and heavier in the fourth quarter. The 1 and 2 year-old anchovies exhibit 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

Previous biological studies based on commercial samples of Gulf of Cadiz anchovy (Millán, 1999) indicate that its spawning season extends from late winter to early autumn with a peak spawning time for the whole population occurring from June to August. Length at maturity was estimated at 11.09 cm in males and 11.20 cm in females. However, it was evidenced that size at maturity may vary between years, suggesting a high plasticity in the reproductive process in response to environmental changes.

Annual maturity ogives for Gulf of Cadiz anchovy during the period 1991-2000 were presented in the last year's WGMHSA report (ICES, C.M. 2002/ACFM:06). These ogives were directly based on the proportion of mature fish at age from size-stratified monthly biological samples collected from commercial catches during the spawning period (*i.e.*, second and third quarters). In the present report, these ogives have been revised and completed with those calculated for the years 1988-1990 and 2001 (Table 12.4.3). For this purpose, the ratio of mature-at-age by size class in these monthly samples were firstly extrapolated to the monthly catch numbers-at-age by size class. New and revised annual maturity ogives were then calculated as the proportion of mature fish at age in the total catch for the considered period.

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 (M=1.2 is used for the data exploration, see Section 12.7.1).

12.5 Effort and Catch per Unit Effort

Data on fishing effort (number of effective fishing trips) and CPUE indices of anchovy in Division IXa correspond to the Spanish purse-seine fleets both in the Gulf of Cadiz (since 1988) and in Sub-division IXa North (since 1995), (Tables 12.5.1 and 12.5.2; Figures 12.5.1- 12.5.3). No data are available for the Portuguese fleets. Neither effort nor CPUE data for Spanish fleets in IXa North in 2000 and 2001 are available because of the low catches in those years.

As described in the last year's WG report, the dynamics of the Spanish fleets in the Gulf of Cadiz has experienced the following changes since 1998 onwards:

- A drastic reduction of the fishing effort by the Barbate single-purpose purse-seine fleet since 2000 onwards. Most of these vessels (the main responsible for anchovy exploitation in both the Moroccan and Gulf of Cadiz fishing grounds in previous years) accepted a tie-up scheme in 2000 and 2001 because the EU-Morocco Fishery Agreement was not renewed. In 2001, only one of these vessels was still fishing in Gulf of Cadiz waters.

- A remarkable increase of the fishing effort of the remaining single-purpose purse seine fleets, both as a result of the high anchovy yields recorded in 1998 and the void left by the Barbate fleet in successive years. Additionally, the situation have resulted in a large portion of the multi-purpose fleet (trawlers and artisanal vessels) seasonally fishing anchovy to operate exclusively as purse-seiners. The increasing trend in fishing effort by the single-purpose fleets continued in 2001 because given high anchovy yields.

- High yields also resulted in Mediterranean purse-seiners (at least 7 vessels recorded) fishing and landing anchovy in the Gulf of Cadiz ports during 2001, with the consequent conflicts with the local fleets. Awaiting a more detailed data revision, preliminary information on this subject seems to indicate that most of these Mediterranean-based vessels stopped fishing in Gulf of Cadiz in 2002.

In Subdivision 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, but it is unknown if this trend still occurs in 2000 and 2001 because the absence of effort data for these years (Figure 12.5.3).

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 Data Exploration

For lack of more consistent biological data (*e.g.* morphometrics/genetics-based studies), the similar recent anchovy catch trajectories of the Algarve and Gulf of Cadiz anchovy, the acoustic surveys data and some biological evidences were considered sufficient in the last year's WG to justify a separate data exploration of anchovy in Sub-division IXa South (Ramos *et al*., 2001; Anon., 2002).

A first trial ICA analysis with annual data (1996-2000) was attempted just before last year WG but it proved unfeasible because of the catch-at-age data structure (only the 0,1, and 2 age classes are present in the fishery) and the shortness of the tuning index series (Ramos *et al*., 2001). As an alternative, an *ad hoc* separable model implemented and run on a spread-sheet was used in the last WG for data exploration of anchovy in Sub-division IXa South (Algarve+Gulf of Cadiz, years 1995-2000). This same model has been fit this year to catch-at-age data from the period 1995 to 2001. The CPUE-based tuning index also covered the same period, and the acoustic estimates of biomass included those ones from the years 1998 to 2001. For the purpose of the data exploration the seasonal and annual catch-at-age data for the Algarvian anchovy were compiled by applying ALKs from the Gulf of Cadiz. Weights at age in the catches were estimated as usual, whereas weights at age in the stock correspond to yearly estimates calculated as the weighted mean weights-at-age in the catches for the second and third quarters. The maturity ogive was the same used as input data in the last year (Table 12.7.1).

Data in this model were analysed by half-year-periods (Table 12.7.1). The separable model was fit to half-year catch-at-age data and to two biomass indices: an aggregated CPUE from the Barbate single-purpose purse-seine fleet, and acoustic estimates of biomass from Portuguese surveys. Catches at age were assumed to be linked by the usual catch equations; the relationship between the index series and the stock sizes was assumed linear. A constant selection pattern was assumed for the whole period. Parameters estimated are selectivity at age for both half-year-periods in relation to the reference age (age 1), recruitment, survey catchability (k1) and CPUE catchability (k2) and annual F values per half-year-period. Parameters are estimated by minimising the sum of squares of the log-residuals from the catch-at-age, the CPUE and the acoustics biomass data.. F values for 1995 were computed as an average of the Fs in subsequent years.

Catches in the year 2000 were low as only a small fraction of the Barbate purse-seine fleet operated in that year (Fig. 12.7.1.a). As a result, the CPUE in year 2000 as an index of resource abundance may contain additional uncertainty, therefore fitting the model to both the CPUE and the acoustic survey time-series seemed sensible. The model fits the catch at age and the CPUE data reasonably well (Fig. 12.7.1.c). The acoustic estimates of biomass, the average biomass and the biomass at the time of the acoustic survey as estimated by the model were plotted in Figure 12.7.1.d, showing that the fit to the acoustic data was poor. This is likely to be related to the facts that the two biomass indices show conflicting trends but the CPUE time-series has more information than the acoustic one so, the former will be more powerful in any regression. It was noticed that Fs in year 2001 are about half of the estimated Fs for year 1998 while both the catches in tons and the estimated CPUEs are similar.

Residuals from the model fit to the catch at age data were plotted in Figures 12.7.2.a and b suggesting that they broadly conform to assumptions of normality. The SSQ profile shown in Figure 12.7.2.c suggests that the confidence intervals around the estimate of k1 are probably wide. The point estimate (k1= 4.4) seemed high and similar considerations to the ones made by the Working Group in 2000 still apply (see ICES, C.M. 2002/ACFM:06).

According to the model, fishing mortality seemed to have been increasing until 1999 and then gone down in 2000, remaining relatively low in 2001 (Fig. 12.7.1.b). Although catches in tonnes in 1998 and 2001 are similar, the numbers caught in 2001 were far less because the weights at age in 2001 were close to double the 1998 ones. In addition, the model estimates for 2001 the highest CPUE in the period which, linked to a high estimate of average biomass, results in a comparatively low fishing mortality. Given the catch data and the level of natural mortality adopted, the estimated selectivity for age 2 ($S_{2,1st\ S}$ = 1.27 and $S_{2,2nd\ S}$ = 1.5) is now, compared to last year, more in agreement with the perception of the impact of the fishery on the stock.

Although the assessment presented here is considered preliminary and for the purpose of data exploration, the results suggest that the capacity in the fishery prior to 2000 may result in relatively high fishing mortality even when the stock is at an average biomass level as, for example, in 1997 and 1999 (Fig. 12.7.1.c). By analogy with the anchovy stock in Sub-area VIII, this stock may fluctuate widely due to variations in recruitment largely driven by environmental factors. Given current uncertainty in stock status, the Working Group considered unwise to allow further increases in fishing capacity if sustainable utilisation is to be ensured.

Also for purposes of data exploration, the anchovy dynamics from division IXa was modelled by means of a biomass based (delay-difference) model (Schnute, 1987; Roel and Butterworth, 2000). Deterministically, the general form of the model is the following:

$$B_{y+1} = B_y e^{-g} + R_y - C_y \,, \qquad (1)$$

where B_y is the biomass at the start of July of year y,

R_y is the recruitment in year y, which the model takes to occur as a pulse at the start of July,

g is a composite parameter, treated as an annual rate, which accounts for natural mortality, emigration and somatic growth (g is taken to be zero for the recruitment term R_y), and

C_y is the catch for a 12 month period commencing on July of year y.

Given the fact that this is a short-lived species and that recruitment apparently takes place in the second half of the year, the model was further refined by dividing the year in two six-month periods. The model parameters are the entire time-series of recruitment, the catchabilities for the abundance indices, g and the biomass at the start of the first year of the biomass projections *Binit*, where the year $y = 0$ corresponds to 1988.

The abundance indices (S^i), which include both the catch per unit effort indices and the biomass estimates from scientific surveys, are assumed for the former to be proportional to the average biomass during the corresponding period:

$$S_y^i = q_i \overline{B}_y e^{\xi_y^i} \,, \qquad (2)$$

where $\overline{B}_y$ is the average biomass during the pertinent period in year y (taken to be equal to the arithmetic average of the biomass at the start and the end of that period),

q_i is the catchability coefficient associated with the index i, and

ξ_y^i is the observation error for index i in year y.

The biomass time-series is estimated by projecting the biomass (B_{init}) at the start of the catch series forward under the historic annual catches. Assuming that the errors in Equation (2) are log-normally distributed with a constant coefficient of variation (i.e., $S_y^i = q^i \overline{B}_y e^{\xi_y^i}$, ξ^i from N(0; σ_i^2)), the estimates of the model parameters for recruitment (R_y), the biomass at the start of the catch data series (B_{init}) and the standard deviation of the residuals (σ_i) for each log-abundance index are obtained by maximizing the appropriate likelihood function. Ignoring constants, this corresponds to minimizing:

$$-\ln L = -\sum_{i=1}^{m} \ln L_i \ , \tag{3}$$

where m is the number of abundance indices and L_i is the likelihood corresponding to the index of abundance S^i:

$$-\ln L_i = n \ln \sigma_i + \frac{1}{2\sigma_i^2} \sum_{y=1}^{n_i} [\ln S_y^i - \ln \hat{S}_y^i]^2 \ . \tag{4}$$

Here σ_i is the standard deviation of the residuals, estimated by:

$$\hat{\sigma}_i^{\,2} = \frac{1}{n_i} \sum_{y_i^{init}}^{y_i^{final}} (\ln S_y^i - \ln \hat{S}_y^i)^2 \ , \tag{5}$$

and n_i is the number of data points for abundance index i. The catchability coefficient estimates (q_i) are obtained from the following equation:

$$\hat{q}_i = \exp\left[{}^{1}\!/_{n_i} \sum (\ln S_y^i - \ln \overline{B}_y) \right], \tag{6}$$

where $\overline{B}_y$ is the average biomass during the corresponding period in year y.

Experimentation using this estimation procedure indicated that the data were not sufficiently informative to allow estimation of all the parameters, so g was fixed externally, with results being evaluated for $g = 0.8$ based on the value computed for the Bay of Biscay anchovy. It was necessary to introduce the additional constraint that the resource biomass was at its pristine equilibrium level at the start of the first year of the biomass projections to estimate *Binit*.

Data fitted were two time-series of half-year CPUEs from the Barbate purse-seine fleet and the March and November surveys. The Barbate fleet's CPUE, as in the separable model, is taken to be representative of the stock biomass in the area. An aggregated CPUE of the Sanlucar fleet for the period including the fourth quarter in the year and the first quarter in the next year (CPUE $_{Q4y+Q1y+1}$) was estimated as a fishery-based recruitment index. The fishing area for this fleet is traditionally located in the nearness of the Guadalquivir river mouth, one of the most important recruitment areas in the Gulf. Landings from this fleet are usually characterised by a high proportion of small-sized anchovies, which is noticeably increased during first and fourth quarters in the year. The Sanlucar CPUE, although shown in the model output, was however not fitted because it shows a trend which is in conflict with the one of the Barbate fleet's CPUE and the model did not converge if this series was included.

The output from the model and plots of the estimated time-series of recruitment and plots illustrating the model fit to the data are shown in Table 12.7.2 and Figure 12.7.3. The CPUE data show a declining trend from 1988 to 1995 and then an increase in the most recent period. These fluctuations in CPUE could be the result of either changes in catchability or real changes in biomass. Examination of Figure 12.4.1.1 suggests that a change in catchability around 1996 is a possibility. The model assumes constant catchability so the only way that could fit the fluctuations was by varying recruitment. The model estimated the recruitment time-series but required several trials changing the starting parameter values fed to the minimisation routine to find the global minimum. This suggests that additional information, *i.e.* on recruitment, could result in better performance. Sensitivity of the results to the starting parameter values was not fully tested.

Further, the assumption of recruitment taking place in the second half of the year is not reflected in the corresponding CPUE. If recruitment takes place some time within the last three months of the year it should reflect primarily in the biomass of the second half of the year y and then in the first half of the year y+1. However, examination of the CPUE data suggests a similar signal in both time-series for a given year therefore some refinement of the model may be indicated.

Finally, comparison of the point estimates of the surveys catchabilities show large differences between the two analyses undertaken: while the separable approach estimates a biomass that is on average about 25% of the survey estimates, the biomass model estimates a biomass which is about double the survey estimate. The biomass model is fitting the data by raising the biomass level and this is probably the result of conflict between the trends in CPUE and the surveys. Further examination of the model performance and the data available will be carried out intersessionally, results to be presented to the WG in 2003.

12.8 Reference Points for Management Purposes

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

12.9 Harvest Control Rules

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

12.10 Management Considerations

The regulatory measures in place for the anchovy purse-seine fishing were the same as for the previous years and are summarised as follows:

- Minimum landing size: 10 cm total length.
- Minimum vessel tonnage of 20 GRT with temporary exemption.
- Maximum engine power: 450 h.p.
- Purse-seine maximum length: 450 m.
- Purse-seine maximum depth: 80 m.
- Fishing time limited to 5 days per week, from Monday to Friday.
- Cessation of fishing activities from Saturday 00:00 h to Sunday 12:00 h.
- Fishing prohibition inside bays and estuaries.

It must be pointed out that the Spanish purse-seine fleet in the Gulf of Cadiz does not observe the normal voluntary closure of three months (December to February) since 1997.

The WG recommends that effective effort should not increase above recent levels. Further, WG recommends that the fishery should not be allowed to further expand until the stock is assessed and there is evidence that the stock could support higher fishing pressure. 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 average catches for 1988 - 2001 (but excluding the high values corresponding to 1995,1998, and 2001) is recommended. This recommended catch level corresponds to 4,674 tonnes.

Table 12.2.1.1. Portuguese and Spanish annual landings (tonnes) 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	5330	5448	5944
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	3035	3152	3388
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	7409
2000	71	61	178	310	10	2182	2191	2502
2001	397	19	439	855	27	8216	8244	9098

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

Table 12.2.1.2. Anchovy catches (tonnes) by gear and country in Division IXa in 1988-2001.

Country/Quarter	1988*	1989*	1990*	1991*	1992	1993	1994	1995*	1996	1997	1998	1999	2000	2001
SPAIN	4263	5454	6131	5711	3028	1961	3153	5900	1823	4664	9349	6000	2191	8244
Purse seine IXa North		118	220	15	33	1	117	5329	44	63	371	413	10	27
Purse seine IXa South	4263	5336	5911	5696	2995	1630	2884	496	1556	4410	7830	4594	2078	8180
Trawl IX a South						330	152	75	224	190	1148	993	104	36
PORTUGAL	458	496	541	210	275	23	237	7056	2771	632	1613	1408	310	855
Trawl					4	9	1		56	46	37	43	6	16
Purse seine	458	496	541	210	270	14	233	7056	2621	579	1541	1346	297	806
Artisanal					1	1	3		94	7	35	20	7	32
Total	4721	5950	6672	5921	3303	1984	3390	12956	4594	5295	10962	7409	2502	9098

* Portuguese catches not differentiated by gear

Table 12.2.2.1. Quarterly anchovy catches (tonnes) in Division IXa by country and Subdivision in 2001.

COUNTRY	SUBDIVISIONS	QUARTER 1		QUARTER 2		QUARTER 3		QUARTER 4		ANUAL	
		C(t)	%	C(t)	%	C(t)	%	C(t)	%	C (t)	%
SPAIN	IXa North	0	0.0	4	15.2	13	46.0	11	38.8	27	0.3
	IXa South	924	11.2	3031	36.9	3195	38.9	1066	13.0	8216	99.7
	TOTAL	924	11.2	3035	36.8	3208	38.9	1077	13.1	8244	
PORTUGAL	IXa Central North	27	6.7	30	7.5	107	26.8	234	59.0	397	46.5
	IXa Central South	13	66.7	3	18.0	3	13.8	0	1.6	19	2.2
	IXa South	128	29.1	203	46.2	83	18.9	25	5.8	439	51.3
	TOTAL	167	19.5	236	27.6	192	22.5	260	30.4	855	
TOTAL	IXa North	0	0.0	4	15.2	13	46.0	11	38.8	27	0.3
	IXa Central North	27	6.7	30	7.5	107	26.8	234	59.0	397	4.4
	IXa Central South	13	66.7	3	18.0	3	13.8	0	1.6	19	0.2
	IXa South	1052	12.2	3233	37.4	3278	37.9	1091	12.6	8655	95.1
	TOTAL	1091	12.0	3271	35.9	3400	37.4	1337	14.7	9098	

Table 12.3.1.1. Estimated abundance in number (millions) and biomass (tonnes) from 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	313	1951	603	2867	30092	32959
March 1999	**Number**	22	15	*	37	2079	2116
	Biomass	190	406	*	596	24763	25359
November 2000	**Number**	4	20	*	23	4970	4994
	Biomass	98	241	*	339	33909	34248
March 2001	**Number**	25	13	285	324	2415	2738
	Biomass	281	87	2561	2929	22352	25281
November 2001	**Number**	35	94	-	129	3322	3451
	Biomass	1028	2276	-	3304	25580	28884
March 2002	**Number**	22	156	92	270	4261	4530
	Biomass	472	1070	1706	3248	22183	25431

* 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 catch in numbers ('000) at age of Gulf of Cadiz anchovy (Sub-division IXa-South, 1988-2001) on a quarterly(Q), half-year (HY) and annual basis. Data for 1994 and second half in 1995 estimated from an iterated ALK by applying the Kimura and Chikuni's (1987) algorithm .

1988	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	13204	55286	0	68490	68490
	1	89197	188073	87183	18794	277269	105976	383245
	2	0	0	1928	0	0	1928	1928
	3	0	0	0	0	0	0	0
	Total (n)	89197	188073	102315	74080	277269	176394	453663
	Catch (t)	730	1815	1164	553	2545	1718	4263
	SOP	728	1810	1164	552	2537	1716	4253
	VAR.%	100	100	100	100	100	100	100

1989	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	2652	7981	0	10633	10633
	1	199286	302223	69570	3471	501509	73042	574551
	2	0	0	5747	0	0	5747	5747
	3	0	0	0	0	0	0	0
	Total (n)	199286	302223	77969	11452	501509	89421	590930
	Catch (t)	1314	2579	1327	110	3892	1437	5330
	SOP	1311	2563	1322	110	3874	1432	5306
	VAR.%	100	101	100	100	100	100	100

1990	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	18313	316191	0	334504	334504
	1	341850	206863	99526	5373	548713	104900	653612
	2	185	0	929	0	185	929	1114
	3	0	0	0	0	0	0	0
	Total (n)	342035	206863	118768	321565	548897	440333	989230
	Catch (t)	2273	1544	1169	740	3816	1909	5726
	SOP	2271	1543	1166	739	3814	1905	5719
	VAR.%	100	100	100	100	100	100	100

1991	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	11537	45411	0	56948	56948
	1	351314	334722	36156	1189	686036	37345	723381
	2	0	4053	1591	376	4053	1968	6021
	3	0	0	0	0	0	0	0
	Total (n)	351314	338775	49284	46977	690089	96261	786350
	Catch (t)	1049	3673	701	273	4722	975	5697
	SOP	1035	3638	696	271	4672	968	5640
	VAR.%	101	101	101	101	101	101	101

1992	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	2415	0	0	2415	2415
	1	159677	147523	42707	86	307200	42793	349993
	2	182	0	861	41	182	902	1084
	3	63	0	0	0	63	0	63
	Total (n)	159922	147523	45983	127	307445	46110	353555
	Catch (t)	1125	1367	499	4	2492	503	2995
	SOP	1120	1364	498	4	2484	502	2986
	VAR.%	100	100	100	100	100	100	100

1993	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	13797	23517	0	37314	37314
	1	73104	81486	12120	2025	154590	14145	168735
	2	576	649	0	12	1225	12	1237
	3	0	0	0	0	0	0	0
	Total (n)	73680	82135	25917	25555	155815	51472	207287
	Catch (t)	767	921	167	105	1688	272	1960
	SOP	761	914	166	105	1675	271	1946
	VAR.%	101	101	100	100	101	100	101

1994	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	1794	960	0	2755	2755
	1	130013	217610	5150	3512	347622	8662	356285
	2	1	31	4576	691	32	5267	5299
	3	0	0	0	0	0	0	0
	Total (n)	130014	217641	11521	5163	347655	16684	364339
	Catch (t)	690	2055	210	80	2745	290	3035
	SOP	687	2045	210	80	2732	290	3022
	VAR.%	100	100	100	101	100	100	100

1995	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	11256	23241	0	34497	34497
	1	19579	6928	6851	602	26508	7453	33961
	2	189	0	0	0	189	0	189
	3	0	0	0	0	0	0	0
	Total (n)	19769	6928	18107	23843	26697	41950	68647
	Catch (t)	185	80	148	157	265	305	571
	SOP	184	79	148	157	264	305	568
	VAR.%	101	101	100	100	101	100	100

1996	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	413465	71074	0	484540	484540
	1	12772	130880	11550	7281	143652	18832	162483
	2	13	882	826	333	894	1159	2053
	3	0	0	0	0	0	0	0
	Total (n)	12785	131761	425842	78688	144546	504530	649076
	Catch (t)	41	807	585	348	848	933	1780
	SOP	36	743	621	306	779	926	1706
	VAR.%	114	109	94	113	109	101	104

1997	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	237283	96475	0	333758	333758
	1	67055	123878	69278	19430	190933	88708	279641
	2	22601	9828	11649	745	32429	12394	44823
	3	0	0	0	0	0	0	0
	Total (n)	89656	133706	318211	116650	223362	434860	658223
	Catch (t)	906	1110	2006	578	2016	2584	4600
	SOP	844	1273	1923	596	2117	2519	4635
	VAR.%	107	87	104	97	95	103	99

1998	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	75708	360599	0	436307	436307
	1	325407	384529	220869	84729	709936	305599	1015535
	2	11066	879	1316	0	11944	1316	13260
	3	0	0	0	0	0	0	0
	Total (n)	336473	385408	297893	445329	721881	743221	1465102
	Catch (t)	1773	2113	2514	2579	3885	5092	8977
	SOP	1923	2127	2599	2654	4050	5254	9304
	VAR.%	92	99	97	97	96	97	96

1999	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	40549	84234	0	124784	124784
	1	249922	115218	86931	20276	365140	107207	472348
	2	10982	18701	2450	146	29683	2596	32279
	3	0	0	0	0	0	0	0
	Total (n)	260904	133919	129931	104656	394823	234587	629410
	Catch (t)	1335	1983	1582	687	3318	2269	5587
	SOP	1330	1756	1391	673	3087	2064	5150
	VAR.%	100	113	114	102	107	110	108

2000	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	41028	77780	0	118808	118808
	1	75141	65947	46460	9949	141088	56409	197497
	2	638	2670	523	14	3307	537	3844
	3	0	0	0	0	0	0	0
	Total (n)	75779	68617	88011	87743	144395	175755	320150
	Catch (t)	329	660	655	537	989	1193	2182
	SOP	327	659	666	535	986	1201	2187
	VAR.%	101	100	98	100	100	99	100

2001	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	30987	127140	0	158126	158126
	1	98687	227388	177264	37992	326075	215256	541331
	2	4155	14028	4535	624	18183	5159	23342
	3	0	0	0	0	0	0	0
	Total (n)	102842	241416	212785	165756	344258	378541	722800
	Catch (t)	924	3031	3195	1066	3955	4261	8216
	SOP	908	3014	3145	1065	3922	4210	8132
	VAR.%	102	101	102	100	101	101	101

Table 12.4.2.1. Length distribution ('000) of Anchovy in Division IXa by country and Sub-divisions in 2001.

	QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4			TOTAL		
Length (cm)	SPAIN IXa North	PORTUGAL IXa CN,CS,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa CN,CS,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa CN,CS,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa CN,CS,S	SPAIN IXa South	SPAIN IXa North	PORTUGAL IXa CN,CS,S	SPAIN IXa South
3.5	-	-	0	-	-	0	-	-	0	-	-	266	-	-	266
4	-	-	0	-	-	38	-	-	0	-	-	162	-	-	200
4.5	-	-	0	-	-	75	-	-	0	-	-	1574	-	-	1649
5	-	-	23	-	-	801	-	-	0	-	-	4664	-	-	5489
5.5	-	-	37	-	-	1297	-	-	0	-	-	7968	-	-	9301
6	-	-	100	-	-	3434	-	-	33	-	-	8265	-	-	11832
6.5	-	-	150	-	-	5189	-	-	33	-	-	9680	-	-	15051
7	-	-	97	-	-	3357	-	-	303	-	-	12154	-	-	15911
7.5	-	-	270	-	-	5112	-	-	417	-	-	4885	-	-	10684
8	-	-	1269	-	-	8138	-	-	1725	-	-	5857	-	-	16989
8.5	-	-	3826	-	-	6620	-	-	2676	-	-	6304	-	-	19426
9	-	-	9471	-	-	2964	-	-	2949	-	-	7540	-	-	22924
9.5	-	-	13691	-	-	4038	-	-	3800	-	-	8090	-	-	29620
10	-	-	13923	-	-	3970	-	-	6351	-	-	11653	-	-	35897
10.5	-	-	10330	-	-	12676	-	-	6797	-	-	13343	-	-	43145
11	-	-	10821	-	-	19420	-	-	10019	-	-	10412	-	-	50672
11.5	-	-	10362	-	-	27754	-	-	13182	-	-	7733	-	-	59031
12	-	-	8435	-	-	27261	-	-	22600	-	-	8578	-	-	66873
12.5	-	-	6090	-	-	29006	-	-	26587	-	-	6965	-	-	68648
13	-	-	4006	-	-	20283	-	-	29944	-	-	5708	-	-	59942
13.5	-	-	2495	-	-	14557	-	-	28700	-	-	5212	-	-	50964
14	-	-	2123	-	-	10460	-	-	23359	-	-	3444	-	-	39385
14.5	-	-	1633	-	-	6100	-	-	12846	-	-	2795	-	-	23375
15	-	-	1475	-	-	5016	-	-	8038	-	-	1506	-	-	16035
15.5	-	-	842	-	-	2556	-	-	5413	-	-	591	-	-	9402
16	-	-	456	-	-	3330	-	-	3971	-	-	548	-	-	8305
16.5	-	-	415	-	-	2518	-	-	1787	-	-	315	-	-	5034
17	-	-	447	-	-	1527	-	-	975	-	-	116	-	-	3065
17.5	-	-	56	-	-	2349	-	-	281	-	-	45	-	-	2731
18	-	-	0	-	-	38	-	-	0	-	-	0	-	-	38
18.5	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0
19	-	-	0	-	-	38	-	-	0	-	-	0	-	-	38
19.5	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0
20	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0
20.5	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0
21	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0
21.5	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0
22	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0
Total N	-	-	102842	-	-	229920	-	-	212785	-	-	156374	-	-	701921
Catch (T)	0	167	924	4	236	3031	13	192	3195	11	260	1066	27	855	8216
L avg (cm)	-	-	10.9	-	-	11.7	-	-	12.8	-	-	9.5	-	-	11.4
W avg (g)	-	-	8.8	-	-	12.5	-	-	14.8	-	-	6.4	-	-	11.3

Table 12.4.2.2: Annual Length distribution ('000) of Anchovy in Division IXa from 1988 to 2001.

	1988	1989	1990	1991	1992	1993	1994	1995		1996		1997		1998		1999		2000	2001
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	SPAIN IXa South	SPAIN IXa South
3.5											1349								266
4			4281	172	2	49					12677						1831	114	200
4.5			18371	3937	29	707					67819		1333		4656		17055	856	1649
5	65		32251	54991	90	1832					160894		11492		25825		41100	5006	5489
5.5	86		46584	80537	369	3247					129791		38722		57086		36181	9391	9301
6			45810	43303	983	5031					52812		53185		82442		19366	12961	11832
6.5		1185	44454	28102	2685	6463	6092				33640		50275		76694		20421	11446	15051
7	226	3906	37065	17847	4094	6169	13330				32469		62492		68074		17749	11754	15911
7.5	347	5609	34614	20448	7178	7507	20415		402		19088		42120		43197		19089	20386	10684
8	1871	15959	32562	20037	15632	8325	26136		402		8949		45120		32964		20835	19704	16989
8.5	7892	36001	43081	17916	22442	7748	24497		454		11776		36200		47796		15724	18590	19426
9	13492	31905	53016	19745	16924	7820	22586		2799		12007		20009	156	78561		14937	19435	22924
9.5	26090	36222	88097	34408	23280	8612	16520		9153		6844		13611	367	106350		17487	27397	29620
10	42791	69717	115050	40656	37450	7320	26383		10743		4887		8951	754	132106		23530	34049	35897
10.5	60760	82715	108001	59678	38310	9199	30570		13282		7156		12231	1486	150718		31482	26203	43145
11	73499	82718	86757	67113	39426	8500	31536		8408		17343		22647	2047	158806		33604	21814	50672
11.5	61624	64599	72875	63013	36883	10154	37310		7340		21738		27353	1477	133585		40004	18846	59031
12	66239	50823	50592	65983	39500	24246	29363	74	5279		17855		39131	1267	99586		55614	18734	66873
12.5	42651	42791	34023	54033	33181	33555	33560	711	4502		11544		45267	1178	76285		66384	14738	68648
13	26053	20237	19022	45191	19867	27543	17543	3049	2299	8	6450	374	46852	2737	44979		52625	11841	59942
13.5	9415	11846	12683	21333	7003	13059	9602	3381	1957	12	4468	997	38183	2403	25038	92	38719	9197	50964
14	4954	8397	5779	13684	3785	5710	6493	14998	1205	258	3880	2004	19127	3038	11847	246	22962	6860	39385
14.5	561	3048	1671	4097	2293	2793	5495	25944	194	335	1990	422	11268	2813	5712	497	13247	3713	23375
15	6102	2147	817	2391	521	1082	4217	46371	219	375	790	48	6370	1976	2080	1075	6811	2812	16035
15.5	2985	1757	402	1194	1045	525	1054	42244	8	226	703	40	3764	890	579	1160	2422	983	9402
16	2995	4975	370	1943	271	75	977	44171		227	159	33	2224	560	138	1658	889	294	8305
16.5	2621	7842	489	2406	225	17	443	14369		151		10	296	330		2430	246	4	5034
17	252	4584	275	1767	75		216	8378		104		10		438		2221		97	3065
17.5	109	1325	133	595	12			778		94		13		311		1717			2731
18		621	95	75				236		24						1045			38
18.5			10							21						397			
19										1						317			38
19.5																138			
20																			
20.5																			
21																			
21.5																			
22																			
Total N	453679	590930	989230	786595	353555	207287	364339	204705	68647	1835	649078	3951	658223	24231	1465102	12993	630315	327225	701921
Catch (T)	4263	5330	5726	5697	2995	1960	3035	5329	571	44	1780	63	4600	371	8977	413	5587	2182	8216
L avg (cm)	11.3	11.0	9.3	9.6	10.7	10.9	10.5	15.6	10.9	15.6	6.6	14.2	9.4	13.4	9.7	16.8	10.1	9.8	11.4
W avg (g)	9.4	9.0	5.8	7.2	8.4	9.4	8.3	26.0	8.3	23.7	2.6	16.1	7.0	15.3	6.3	31.8	8.1	6.8	11.3

Table 12.4.2.3. Mean length (TL, in cm) at age in the Spanish catches of Gulf of Cadiz anchovy (Sub-division IXa-South, 1988-2001) on a quarterly (Q), half-year (HY) and annual basis. Data for 1994 and second half in 1995 estimated from an iterated ALK by applying the Kimura and Chikuni's (1987) algorithm.

1988	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0			9.4	10.2		10.0	10.0
	1	10.9	11.4	12.3	12.2	11.3	12.3	11.6
	2			16.4			16.4	16.4
	3							
	Total	10.9	11.4	12.0	10.7	11.3	11.5	11.3
1989	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			9.1	10.9		10.5	10.5
	1	10.1	10.8	13.3	13.3	10.5	13.3	10.9
	2			16.9			16.9	16.9
	3							
	Total	10.1	10.8	13.4	11.6	10.5	13.2	11.0
1990	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			9.4	6.9		7.1	7.1
	1	10.1	10.4	11.8	11.5	10.2	11.8	10.5
	2	15.2		16.9		15.2	16.9	16.6
	3							
	Total	10.1	10.4	11.5	7.0	10.2	8.2	9.3
1991	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			10.7	9.4		9.7	9.7
	1	7.2	11.5	13.1	16.1	9.3	13.2	9.5
	2		14.9	17.1	17.1	14.9	17.1	15.6
	3							
	Total	7.2	11.5	12.7	9.7	9.3	11.2	9.6
1992	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			9.5			9.5	9.5
	1	10.0	11.1	12.0	15.9	10.5	12.0	10.7
	2	16.3		15.7	16.7	16.3	15.7	15.8
	3	16.9				16.9		16.9
	Total	10.0	11.1	12.0	16.2	10.5	12.0	10.7
1993	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			6.3	7.7		7.2	7.2
	1	11.5	11.7	12.2	13.8	11.6	12.4	11.7
	2	14.7	14.9		16.5	14.8	16.5	14.8
	3							
	Total	11.5	11.8	9.1	8.2	11.6	8.6	10.9
1994	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			9.2	9.2		9.2	9.2
	1	9.3	11.0	13.3	13.9	10.4	13.5	10.5
	2	12.8	14.3	15.3	15.4	14.3	15.3	15.3
	3							
	Total	9.3	11.0	13.4	13.2	10.4	13.4	10.5
1995	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			10.3	10.2		10.2	10.2
	1	11.3	11.8	11.4	13.0	11.5	11.6	11.5
	2	14.7				14.7		14.7
	3							
	Total	11.4	11.8	10.7	10.2	11.5	10.4	10.9

1996	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0			5.6	7.3		5.8	5.8
	1	7.4	8.5	12.9	13.7	8.4	13.2	8.9
	2	14.0	13.9	15.2	15.6	13.9	15.3	14.7
	3							
	Total	7.4	8.5	5.8	7.9	8.4	6.1	6.6
1997	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			7.1	8.1		7.4	7.4
	1	10.0	10.5	13.1	13.0	10.3	13.0	11.2
	2	13.4	14.0	15.0	15.1	13.6	15.0	14.0
	3							
	Total	10.9	10.8	8.7	8.9	10.8	8.8	9.5
1998	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			7.1	8.8		8.5	8.5
	1	9.5	9.2	11.9	12.2	9.3	12.0	10.1
	2	13.2	14.0	15.0		13.3	15.0	13.5
	3							
	Total	9.6	9.2	10.7	9.5	9.4	10.0	9.7
1999	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			7.7	9.3		8.8	8.8
	1	8.2	12.2	12.7	12.5	9.5	12.7	10.2
	2	13.4	14.1	15.2	14.9	13.8	15.2	13.9
	3							
	Total	8.4	12.5	11.2	10.0	9.8	10.6	10.1
2000	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			7.7	9.5		8.9	8.9
	1	8.2	10.9	11.9	12.5	9.4	12.0	10.2
	2	14.1	15.0	15.4	16.1	14.9	15.5	15.0
	3							
	Total	8.2	11.1	10.0	9.8	9.6	9.9	9.8
2001	**AGE**	**Q1**	**Q2**	**Q3**	**Q4**	**HY1**	**HY2**	**ANNUAL**
	0			9.9	8.4		8.7	8.7
	1	10.7	11.4	13.2	13.0	11.2	13.1	12.0
	2	15.5	16.2	16.3	16.2	16.0	16.3	16.1
	3							
	Total	10.9	11.7	12.8	9.5	11.4	11.3	11.4

Table 12.4.2.4. Mean weight (in kg) at age in the Spanish catches of Gulf of Cadiz anchovy (Sub-division IXa-South, 1988-2001) on a quarterly (Q), half-year (HY) and annual basis. Data for 1994 and second half in 1995 estimated from an iterated ALK by applying the Kimura and Chikuni's (1987) algorithm.

1988 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.005	0.006		0.006	0.006
1	0.008	0.010	0.012	0.011	0.009	0.012	0.010
2			0.028			0.028	0.028
3							
Total	0.008	0.010	0.011	0.007	0.009	0.010	0.009

1989 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.004	0.008		0.007	0.007
1	0.007	0.008	0.016	0.014	0.008	0.016	0.009
2			0.034			0.034	0.034
3							
Total	0.007	0.008	0.017	0.010	0.008	0.016	0.009

1990 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.005	0.002		0.002	0.002
1	0.007	0.007	0.010	0.009	0.007	0.010	0.008
2	0.023		0.032		0.023	0.032	0.031
3							
Total	0.007	0.007	0.010	0.002	0.007	0.004	0.006

1991 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.008	0.005		0.006	0.006
1	0.003	0.011	0.015	0.027	0.007	0.016	0.007
2		0.024	0.036	0.033	0.024	0.035	0.028
3							
Total	0.003	0.011	0.014	0.006	0.007	0.010	0.007

1992 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.005			0.005	0.005
1	0.007	0.009	0.011	0.029	0.008	0.011	0.008
2	0.027		0.024	0.033	0.027	0.024	0.025
3	0.030				0.030		0.030
Total	0.007	0.009	0.011	0.030	0.008	0.011	0.008

1993 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.002	0.003		0.003	0.003
1	0.010	0.011	0.012	0.016	0.011	0.012	0.011
2	0.021	0.021		0.028	0.021	0.028	0.021
3							
Total	0.010	0.011	0.006	0.004	0.011	0.005	0.009

1994 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.005	0.005		0.005	0.005
1	0.005	0.009	0.017	0.017	0.008	0.017	0.008
2	0.013	0.020	0.025	0.023	0.020	0.025	0.025
3							
Total	0.005	0.009	0.018	0.015	0.008	0.017	0.008

1995 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.007	0.006		0.007	0.007
1	0.009	0.011	0.010	0.014	0.010	0.010	0.010
2	0.021				0.021		0.021
3							
Total	0.009	0.011	0.008	0.007	0.010	0.007	0.008

1996 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.001	0.003		0.001	0.001
1	0.003	0.006	0.014	0.015	0.005	0.015	0.006
2	0.018	0.017	0.023	0.023	0.017	0.023	0.020
3							
Total	0.003	0.006	0.001	0.004	0.005	0.002	0.003

1997 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.003	0.003		0.003	0.003
1	0.007	0.009	0.015	0.013	0.008	0.015	0.010
2	0.016	0.019	0.023	0.021	0.017	0.023	0.018
3							
Total	0.009	0.010	0.006	0.005	0.009	0.006	0.007

1998 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.003	0.005		0.004	0.004
1	0.005	0.005	0.011	0.011	0.005	0.011	0.007
2	0.014	0.019	0.022		0.014	0.022	0.015
3							
Total	0.006	0.006	0.009	0.006	0.006	0.007	0.006

1999 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.003	0.005		0.005	0.004
1	0.005	0.012	0.014	0.012	0.007	0.013	0.008
2	0.015	0.020	0.023	0.020	0.018	0.023	0.018
3							
Total	0.005	0.013	0.011	0.006	0.008	0.009	0.008

2000 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.003	0.005		0.005	0.005
1	0.004	0.009	0.011	0.012	0.006	0.011	0.008
2	0.018	0.024	0.025	0.027	0.023	0.025	0.023
3							
Total	0.004	0.010	0.008	0.006	0.007	0.007	0.007

2001 AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
0			0.006	0.004		0.005	0.005
1	0.008	0.011	0.016	0.014	0.010	0.015	0.012
2	0.025	0.032	0.031	0.028	0.030	0.031	0.030
3							
Total	0.009	0.012	0.015	0.006	0.011	0.011	0.011

Table 12.4.3. Maturity ogives (ratio of mature fish at age) for Gulf of Cadiz anchovy (Sub-division IXa South), based on biological samples collected during the spawning period (second+third quarters).

Year	**Age**		
	0	**1**	**2+**
1988	0	0.82	1
1989	0	0.53	1
1990	0	0.65	1
1991	0	0.76	1
1992	0	0.53	1
1993	0	0.77	1
1994	0	0.60	1
1995	0	0.76	1
1996	0	0.49	1
1997	0	0.63	1
1998	0	0.55	1
1999	0	0.74	1
2000	0	0.70	1
2001	0	0.76	1

Table 12.5.1. Anchovy in Division IXa. Effort data (no. of fishing trips) for Spanish fleets in Sub-divisions IXa-South (Gulf of Cadiz) and IXa-North (Southern Galicia).(SP: single purpose; MP: multi purpose).

	SUB-DIVISION IXa SOUTH									SUB-DIVISION IXa NORTH	
	PURSE SEINE									PURSE SEINE	
Year	BARBATE (SP)	BARBATE (MP)	SANLÚCAR (SP)	SANLÚCAR (MP)	P.UMBRÍA (SP)	P.UMBRÍA (MP)	I. CRISTINA (SP)	I. CRISTINA (MP)	MEDIT. (SP)	VIGO	RIVEIRA
	No. fishing trips									No. fishing trips	
1988	3958	17	-	210	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1989	4415	39	-	234	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1990	4622	92	-	660	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1991	3981	40	-	919	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1992	3450	116	-	583	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1993	2152	5	-	225	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1994	1625	69	-	899	*n.a.*	*n.a.*	196	28	-	*n.a.*	*n.a.*
1995	528	17	-	377	*n.a.*	*n.a.*	22	17	-	1537	252
1996	1595	89	-	1659	*n.a.*	*n.a.*	76	55	-	32	3
1997	2207	115	-	1738	*n.a.*	*n.a.*	75	13	-	31	23
1998	2153	-	2234	-	*n.a.*	*n.a.*	177	30	-	134	269
1999	1762	9	2167	-	660	595	330	257	-	51	85
2000	785	2	2196	-	1776	169	572	-	-	*n.a.*	*n.a.*
2001	1281	89	1331	-	2367	22	1254	4	271	*n.a.*	*n.a.*

Table 12.5.2. Anchovy in Division IXa. CPUE data (Kg/fishing trip) for Spanish fleets in Sub-divisions IXa-South (Gulf of Cadiz) and IXa-North (Southern Galicia). (SP: single purpose; MP: multi purpose).

	SUB-DIVISION IXa SOUTH									SUB-DIVISION IXa NORTH	
	PURSE SEINE									PURSE SEINE	
Year	BARBATE (SP)	BARBATE (MP)	SANLÚCAR (SP)	SANLÚCAR (MP)	P.UMBRÍA (SP)	P.UMBRÍA (MP)	I. CRISTINA (SP)	I. CRISTINA (MP)	MEDIT. (SP)	VIGO	RIVEIRA
	Kg/fishing trip									Kg/fishing trip	
1988	1047	461	-	420	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1989	1139	534	-	943	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1990	1128	287	-	643	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1991	1312	339	-	456	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1992	819	173	-	300	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1993	641	268	-	225	*n.a.*	*n.a.*	*n.a.*	*n.a.*	-	*n.a.*	*n.a.*
1994	1326	262	-	398	*n.a.*	*n.a.*	204	174	-	*n.a.*	*n.a.*
1995	377	134	-	166	*n.a.*	*n.a.*	52	25	-	2509	2286
1996	497	315	-	246	*n.a.*	*n.a.*	137	157	-	847	4
1997	1580	306	-	288	*n.a.*	*n.a.*	105	126	-	1068	639
1998	3144	-	221	-	*n.a.*	*n.a.*	242	197	-	1489	512
1999	2162	219	241	-	142	143	134	150	-	1088	1585
2000	1365	77	208	-	169	142	391	-	-	*n.a.*	*n.a.*
2001	2327	1507	249	-	948	337	1539	805	2025	*n.a.*	*n.a.*

Table 12.7.1. Anchovy in Sub-division IXa South (Algarve+Gulf of Cadiz) . Input values for the seasonal separable assessment model.

Anchovy IXa-South (Algarve+Golfo de Cádiz)
Years: 1995-2001
Fleets: All

Half-year Catch in number (in millions) at age (1995-2001)

	1995		1996		1997		1998		1999		2000		2001	
AGE	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
0	0	34.50	0	495.13	0	335.67	0	465.60	0	126.26	0	129.46	0	161.95
1	26.51	7.45	143.75	19.89	191.06	89.10	722.99	341.82	422.57	109.26	161.65	58.89	354.92	220.76
2	0.19	0.00	0.90	1.21	32.46	12.41	12.03	1.51	32.29	2.65	3.51	0.55	19.70	5.29
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Mean weight at age in the stock (in g), maturity ogive (average estimate) and natural mortality (half-year) estimates

AGE	Mean weight							Maturity	Natural mortality
	1995	1996	1997	1998	1999	2000	2001		
0	7	1	3	3	3	3	6	0	0.6
1	11	6	11	7	13	10	13	0.79	0.6
2	23	20	21	20	20	24	32	1	0.6

Acoustic Biomass estimates (tonnes) in Sub-division IXa South (Algarve+Gulf of Cadiz)

Nov. 1998	Mar. 1999	Nov. 2000	Mar. 2001	Nov. 2001
30695	24763	33909	24913	25580

Annual anchovy CPUE (kg/fishing trip) of the Barbate single-purpose purse-seine fleet

1995	1996	1997	1998	1999	2000	2001
377	497	1580	3144	2162	1365	2327

Table 12.7.2. Anchovy in Sub-division IXa South: outputs from the biomass based (delay-difference) model.

```
 A N C H O V Y   I X A
 OUTPUT FROM FITTING FOUR TIME-SERIES
******************************
 INITIAL BIOMASS:   57246.150000GE=   8.000000E-01
 **************************************
ESTIMATED RECRUITMENT
 1988   31913.5
 1989   28196.0
 1990   30572.8
 1991   27289.1
 1992   13968.7
 1993   28509.3
 1994    9190.1
 1995   25735.3
 1996   31004.0
 1997   79022.4
 1998   28150.6
 1999   37005.7
 2000   38487.9
 2001   32287.7
 MINUS LOG-LIKELIHOOD =      -52.933790

 SIGMA SQ Barbate's CPUE1:   9.055660E-02
 SIGMA SQ Barbate's CPUE2:   3.104724E-01
 SIGMA SQ Sanlucar's CPUE:    3.533321E-01
 SIGMA SQ NOV SURV:    9.539511E-03
 SIGMA SQ MARCH SURV:   3.110452E-15

 CPUE 1ST SEM    OBSERVED         ESTIMATED
       1988        1.274358        1.512191
       1989        1.297476        1.407345
       1990        1.373725        1.253667
       1991        1.580606        1.222560
       1992    9.930572E-01        1.171514
       1993    6.422869E-01    8.373508E-01
       1994        1.440592        1.079838
       1995    3.773106E-01    6.925958E-01
       1996    6.275000E-01    9.848985E-01
       1997        1.477521        1.215513
       1998        2.849056        2.534696
       1999        2.468905        1.649318
       2000        1.554558        1.625842
       2001        2.560499        1.659309
  CPUE 2ND SEM
       1988    8.294799E-01    9.669336E-01
       1989    8.592428E-01    8.692742E-01
       1990    7.970412E-01    8.224237E-01
       1991    7.429153E-01    7.736983E-01
       1992    4.510108E-01    6.371588E-01
       1993    3.053457E-01    6.564564E-01
       1994    5.434783E-01    5.447561E-01
       1996    2.226477E-01    7.500426E-01
       1997        1.707130        1.338403
       1998        3.415983        1.323405
       1999        1.742877        1.064850
       2000        1.217229        1.108875
       2001        2.173959    9.894234E-01
```

Table 12.7.2. (cont'd)

CPUE SANLUCAR	OBSERVED	ESTIMATED
1988	7.231000E-01	3.340715E-01
1989	5.278646E-01	2.951567E-01
1990	5.528734E-01	3.200367E-01
1991	3.451235E-01	2.856632E-01
1992	2.344304E-01	1.462241E-01
1993	4.416388E-01	2.984359E-01
1994	2.142857E-01	9.620185E-02
1995	1.639091E-01	2.693979E-01
1996	2.160982E-01	3.245507E-01
1997	2.352237E-01	8.272082E-01
1998	2.243015E-01	2.946805E-01
1999	2.293661E-01	3.873758E-01
2000	2.743496E-01	4.028924E-01
2001	2.239100E-01	3.379878E-01
MARCH SURVEY		
1999	24763.000000	24763.000000
2001	24913.000000	24913.000000
NOVEMBER SURVEY		
1998	30695.000000	33534.630000
2000	33909.000000	29594.340000
2001	25580.000000	26827.550000

Estimate of curr. biomass: 53661.770000

ESTIMATES OF Q AND SIGMA
CPUE 1S Q= 3.250629E-05 SGM= 9.055660E-02

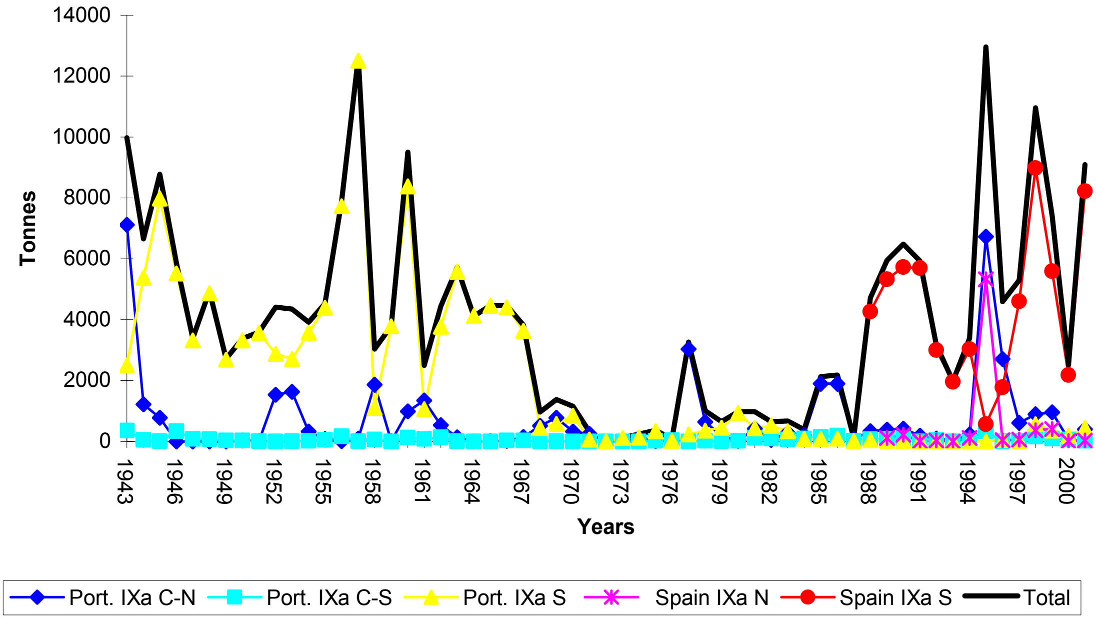
ESTIMATES OF Q AND SIGMA
CPUE 2S Q= 2.149356E-05 SGM= 3.104724E-01

ESTIMATES OF Q AND SIGMA
CPUE SL Q= 1.046802E-05 SGM= 3.533321E-01

ESTIMATES OF Q AND SIGMA
MARCH SURVEY Q= 4.880520E-01 SGM= 3.110452E-15

ESTIMATES OF Q AND SIGMA
NOV SURVEY Q= 3.794946E-01 SGM= 9.539511E-03

Figure 12.2.1.1. Historical series of Portuguese and Spanish anchovy landings in Division IXa (1943-2001).



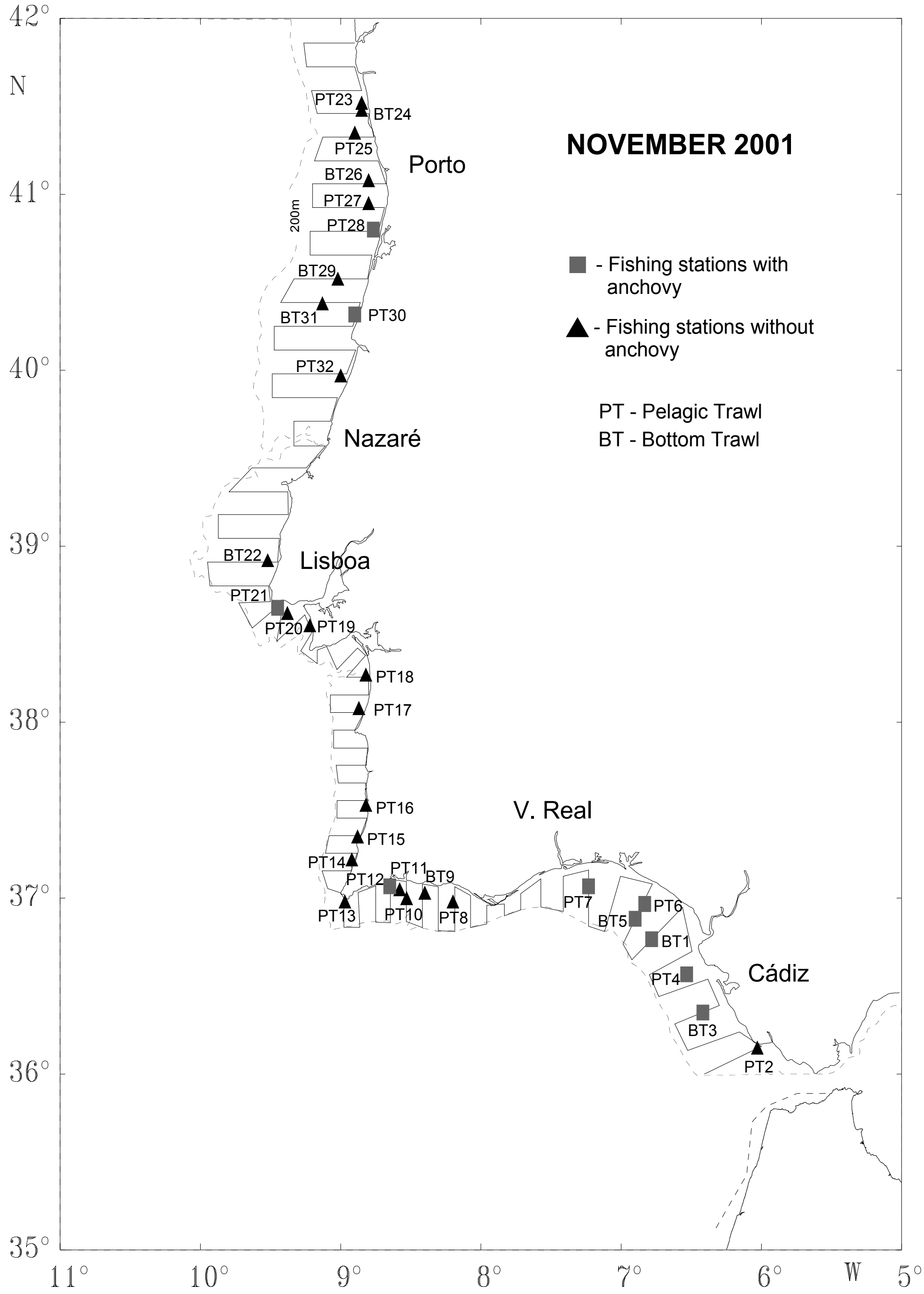


Figure 12.3.1.1. Survey track design and location of trawl stations (with and without anchovy) in November 2001 Portuguese acoustic survey.

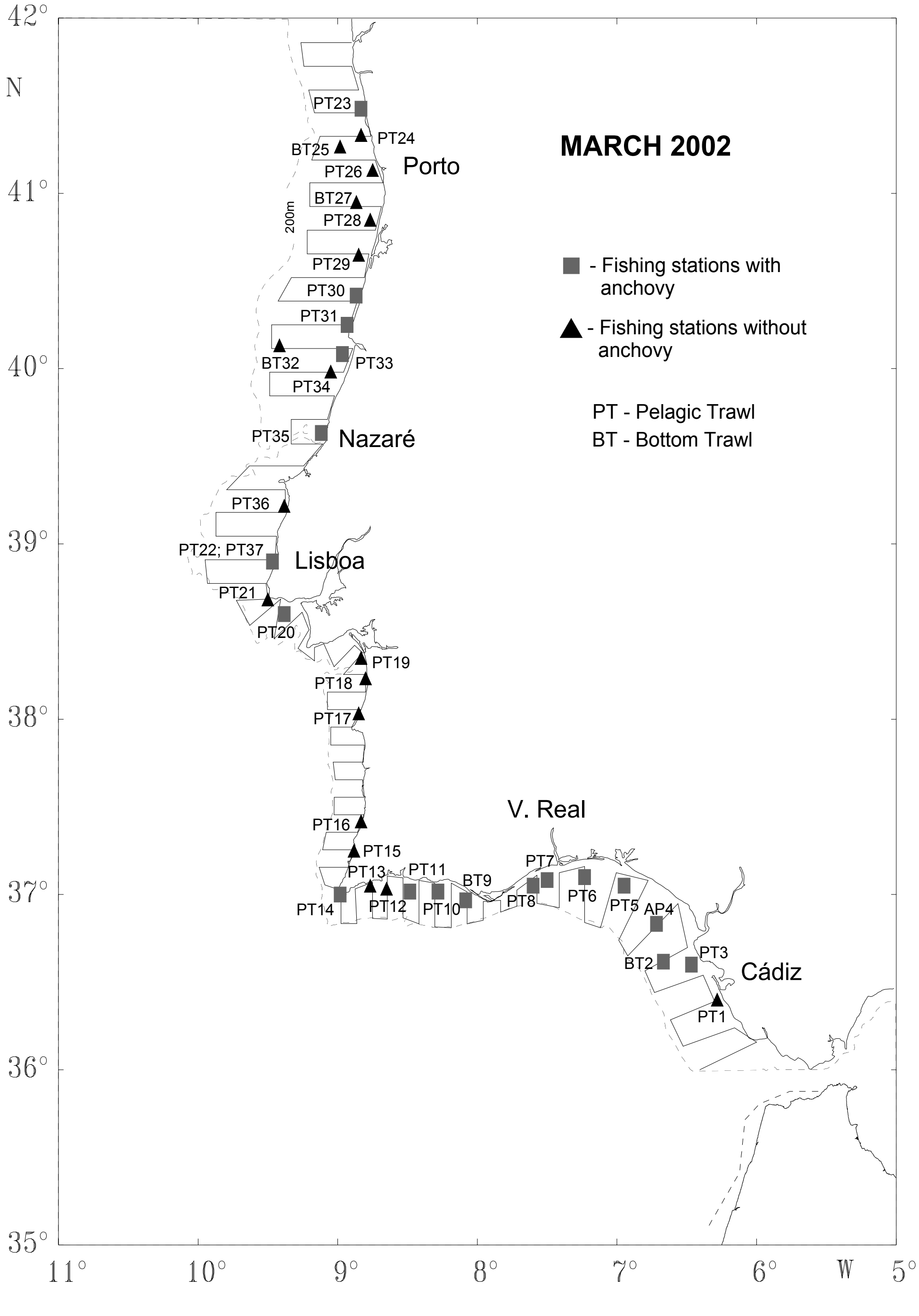


Figure 12.3.1.2. Survey track design and location of trawl stations (with and without anchovy) in March 2002 Portuguese acoustic survey.

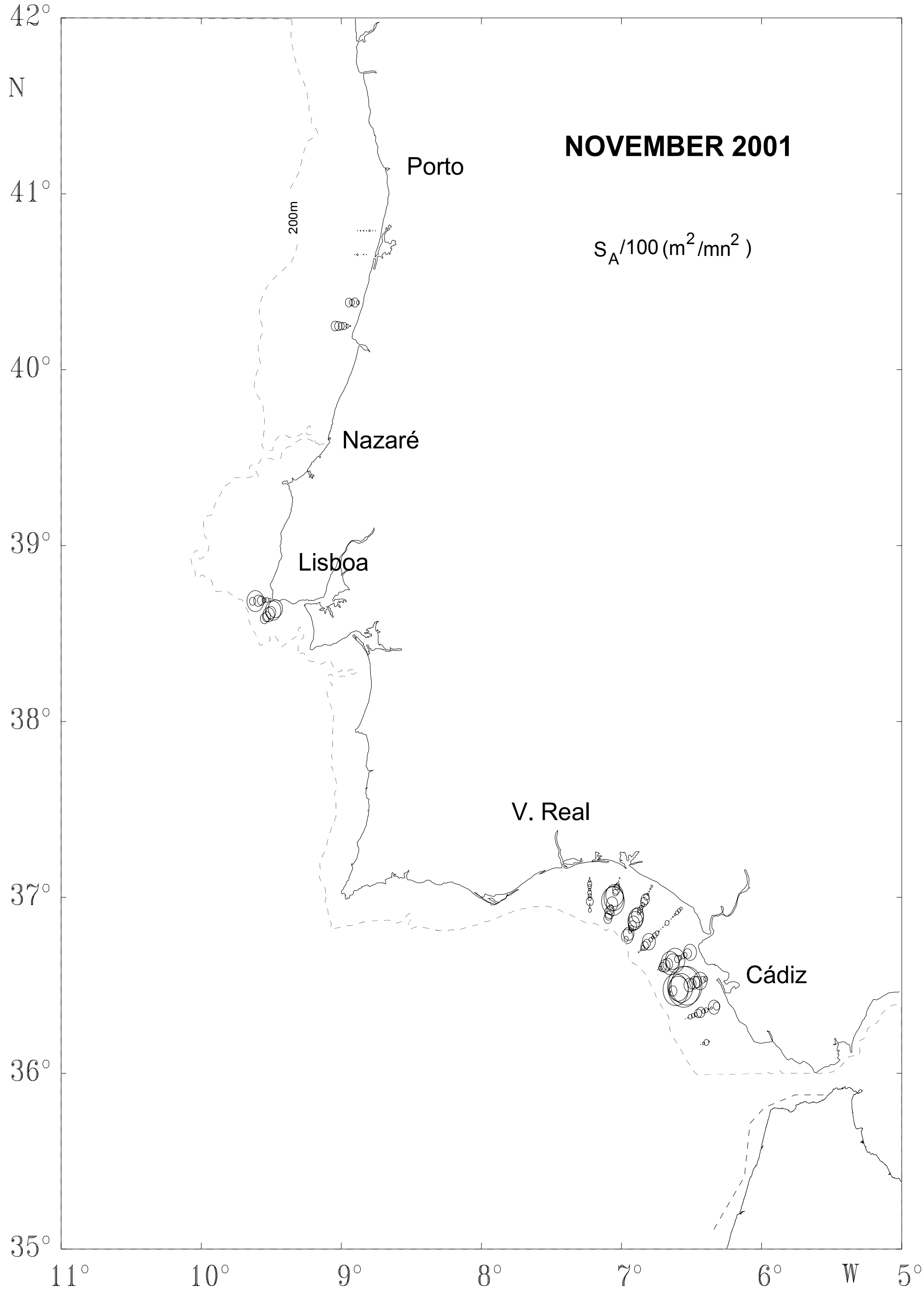


Figure 12.3.1.3. Anchovy in Division IXa: Acoustic energy distribution per nautical mile during the November 2001 Portuguese survey**.** Circle diameter is proportional to the square root of the acoustic energy (S_A).

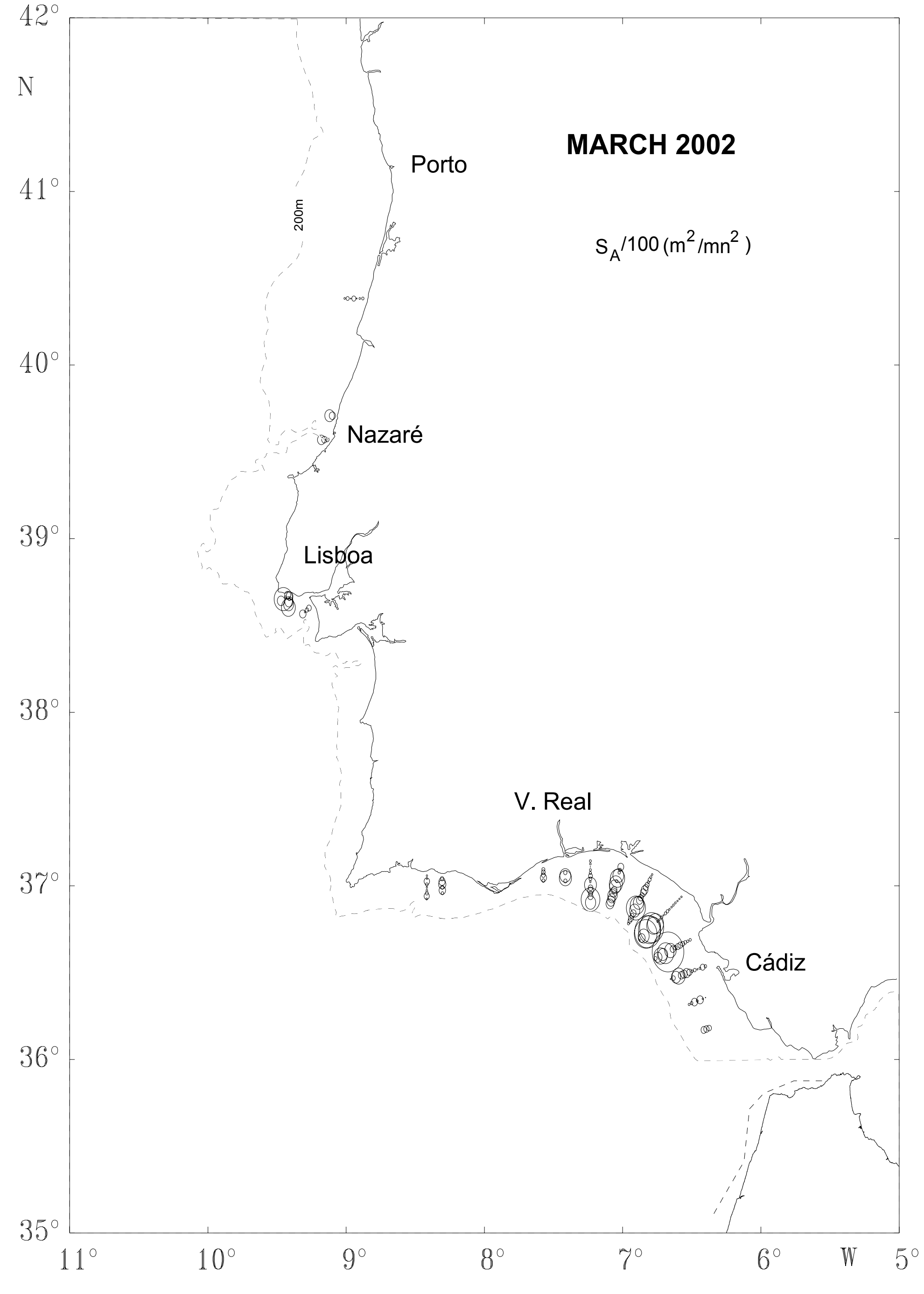


Figure 12.3.1.4. Anchovy in Division IXa: Acoustic energy distribution per nautical mile during the March 2002 Portuguese survey. Circle diameter is proportional to the square root of the acoustic energy (S_A).

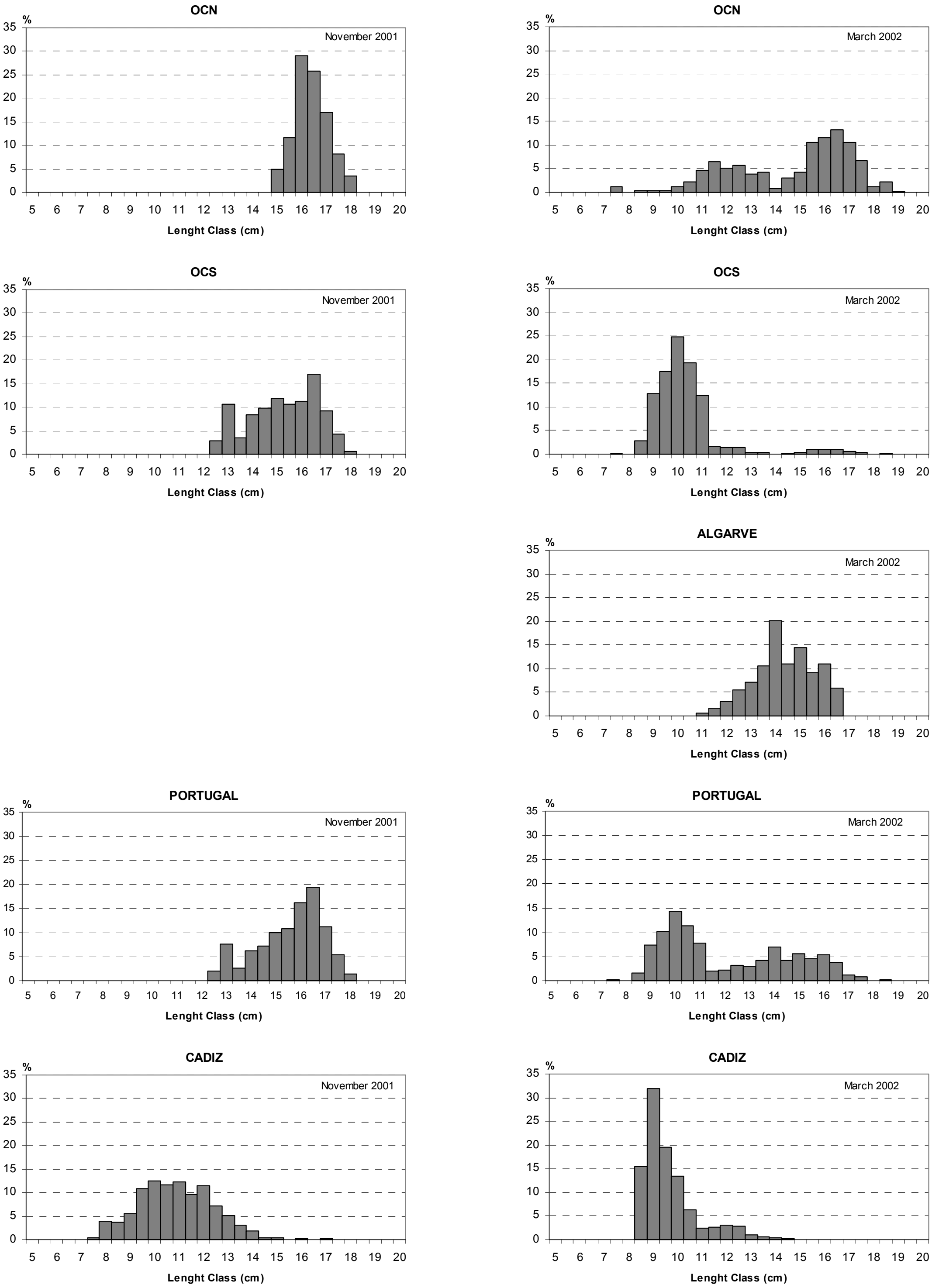


Figure 12.3.1.5. Anchovy in Division IXa: Distribution of length class frequency (%) by region during the November 2001 and March 2002 acoustic surveys.

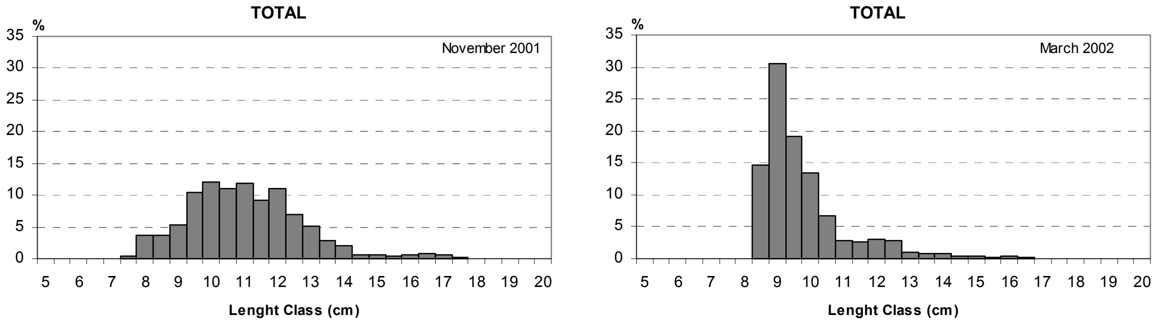


Figure 12.3.1.5. (cont'd.). Anchovy in Division IXa: Distribution of length class frequency (%) for the total area during the November 2001 and March 2002 surveys.

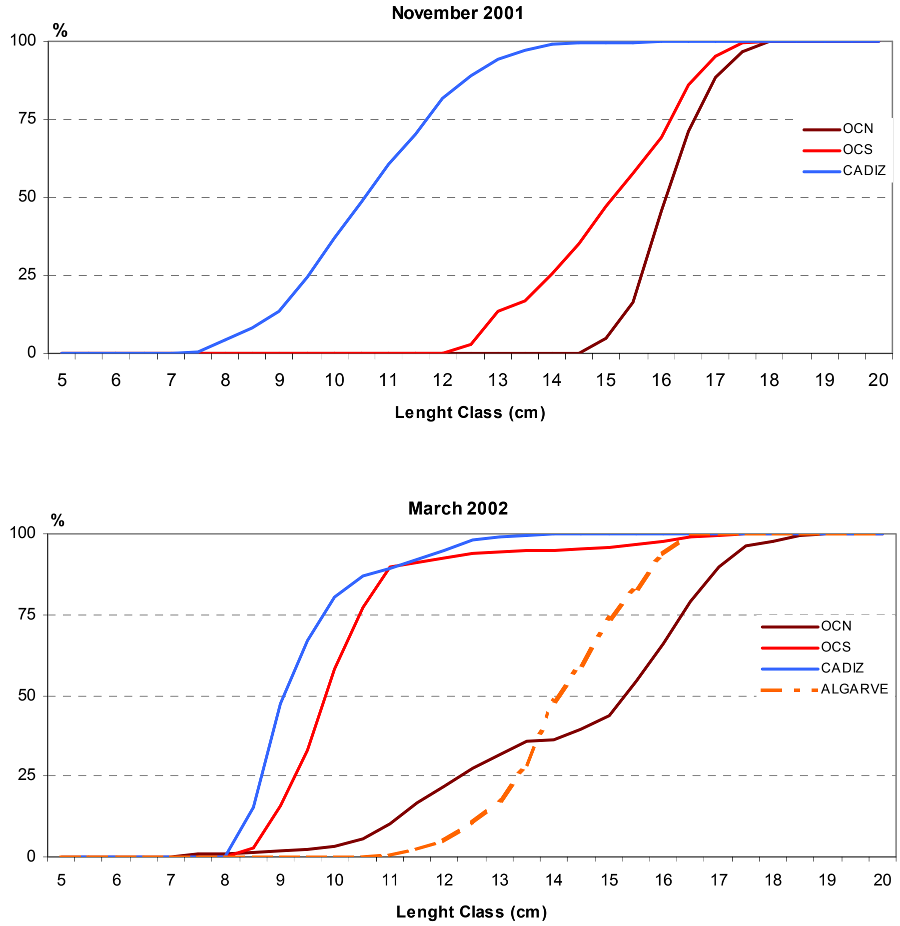


Figure 12.3.1.6. Anchovy in Division IXa: cumulative frequency (%) by length class and region during the November 2001 and March 2002 Portuguese acoustic surveys.

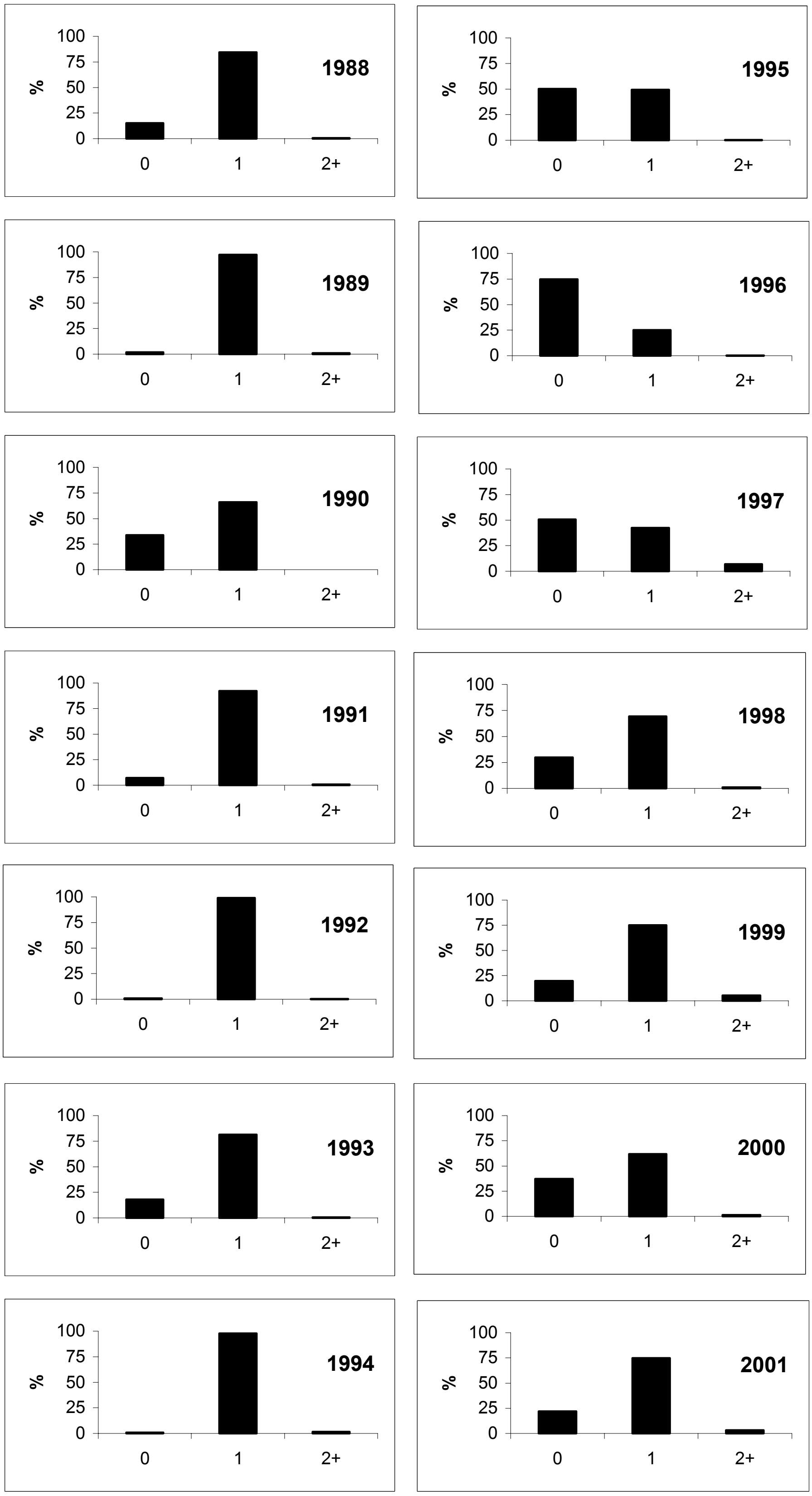


Figure 12.4.1.1. Age composition of Spanish catches of Gulf of Cadiz anchovy (Sub-division IXa-South; 1988-2001). Data for 1994 and second half in 1995 estimated from an iterated ALK by applying the Kimura and Chikuni's (1987) algorithm.

Figure 12.4.2.1. Length distribution ('000) of anchovy landings in Sub-division IXa South (Gulf of Cadiz) by quarter in 2001. Without data for Sub-division IXa North (Western Galicia).

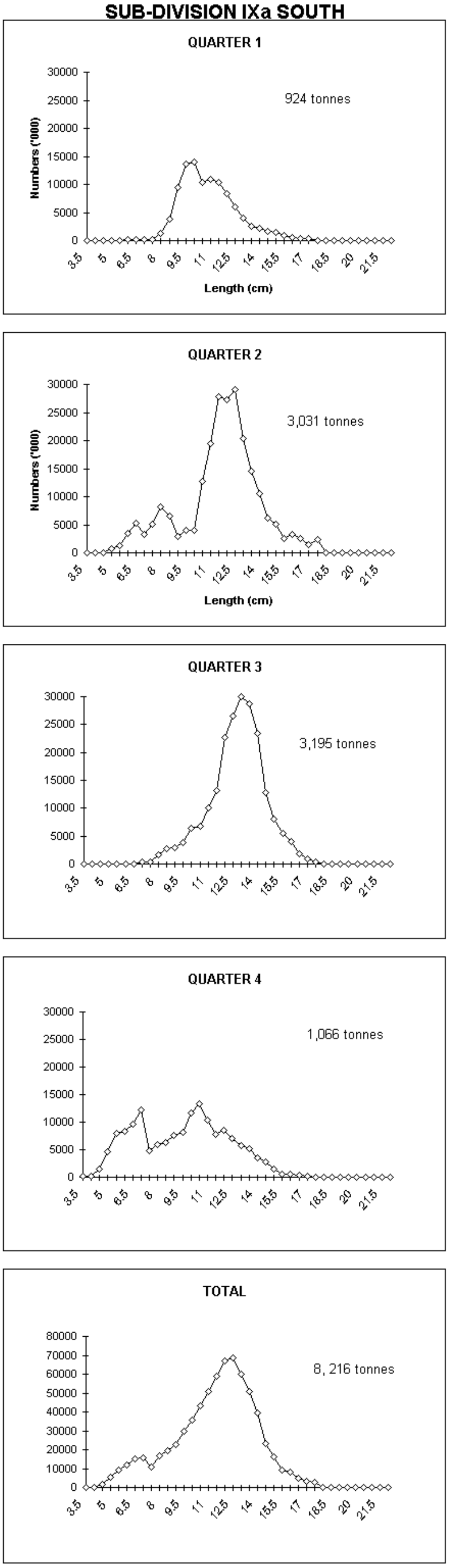
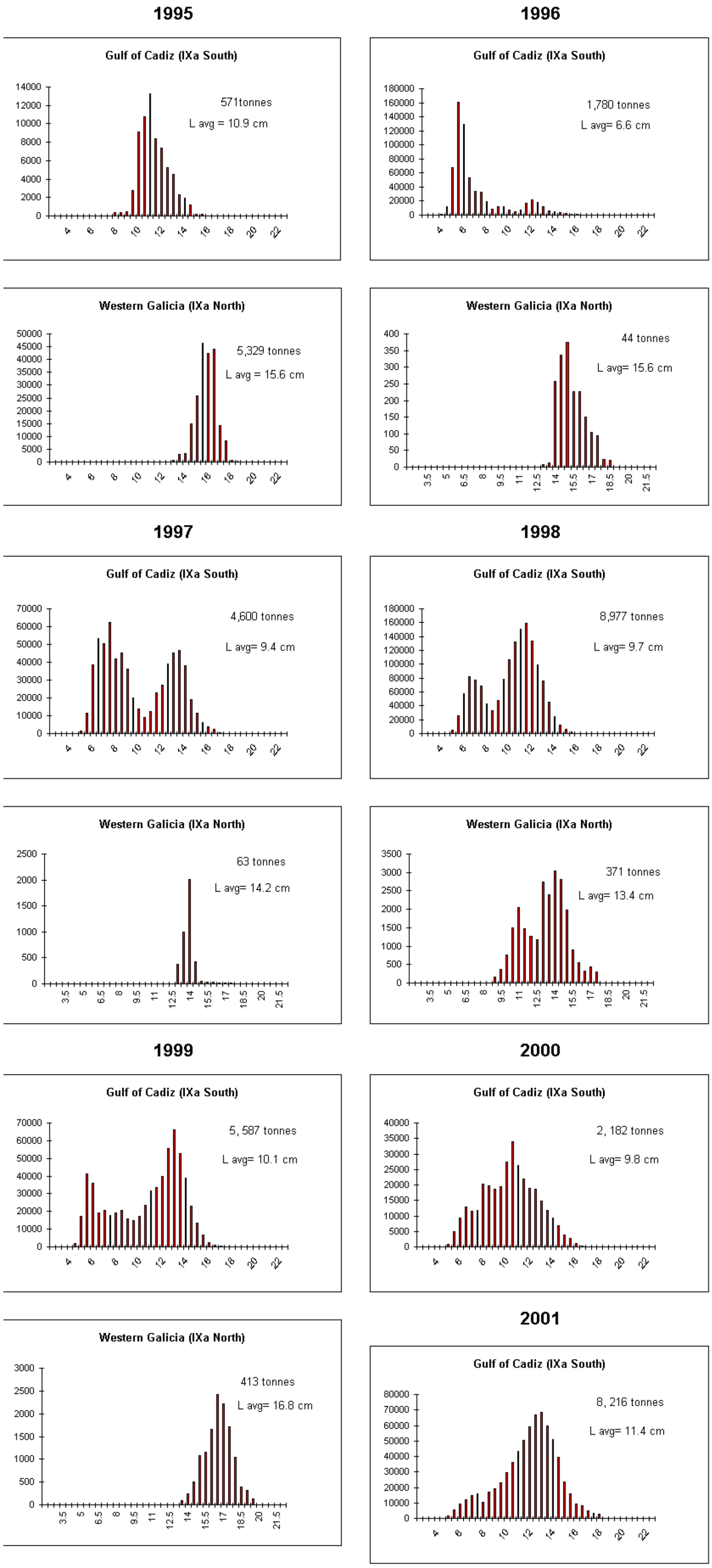


Figure 12.4.2.2. Length distribution ('000) of anchovy in Sub-divisions IXa South and IXa North (1995-2001).



Fishing effort (no of effective fishing trips)

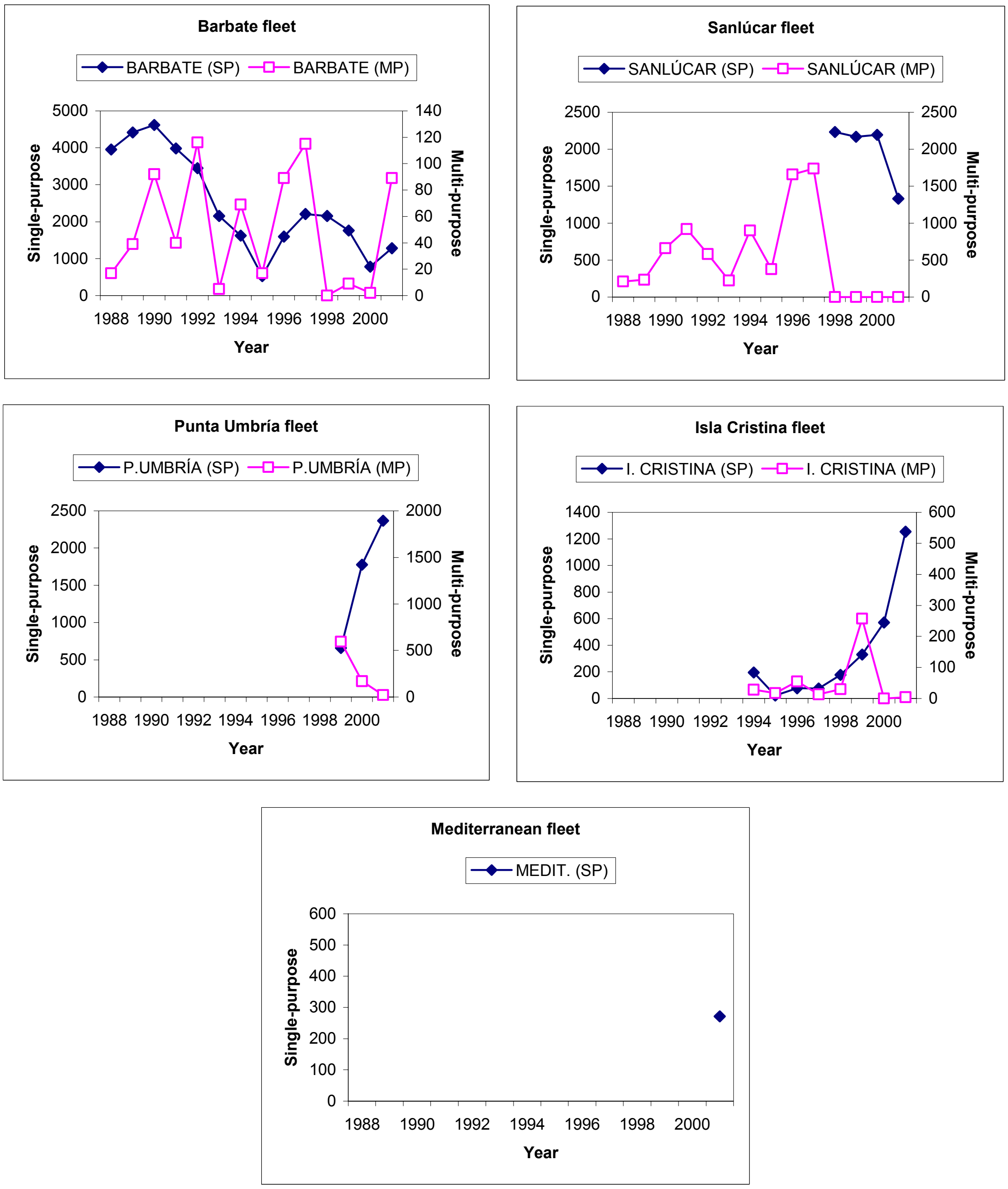


Figure 12.5.1. **Anchovy in Division IXa. Spanish Effort series in commercial fisheries in Gulf of Cadiz (Sub-division IXa South). SP: Single-purpose purse-seine fleets; MP: Multi-purpose purse-seine fleets.**

CPUE (Kg/fishing trip)

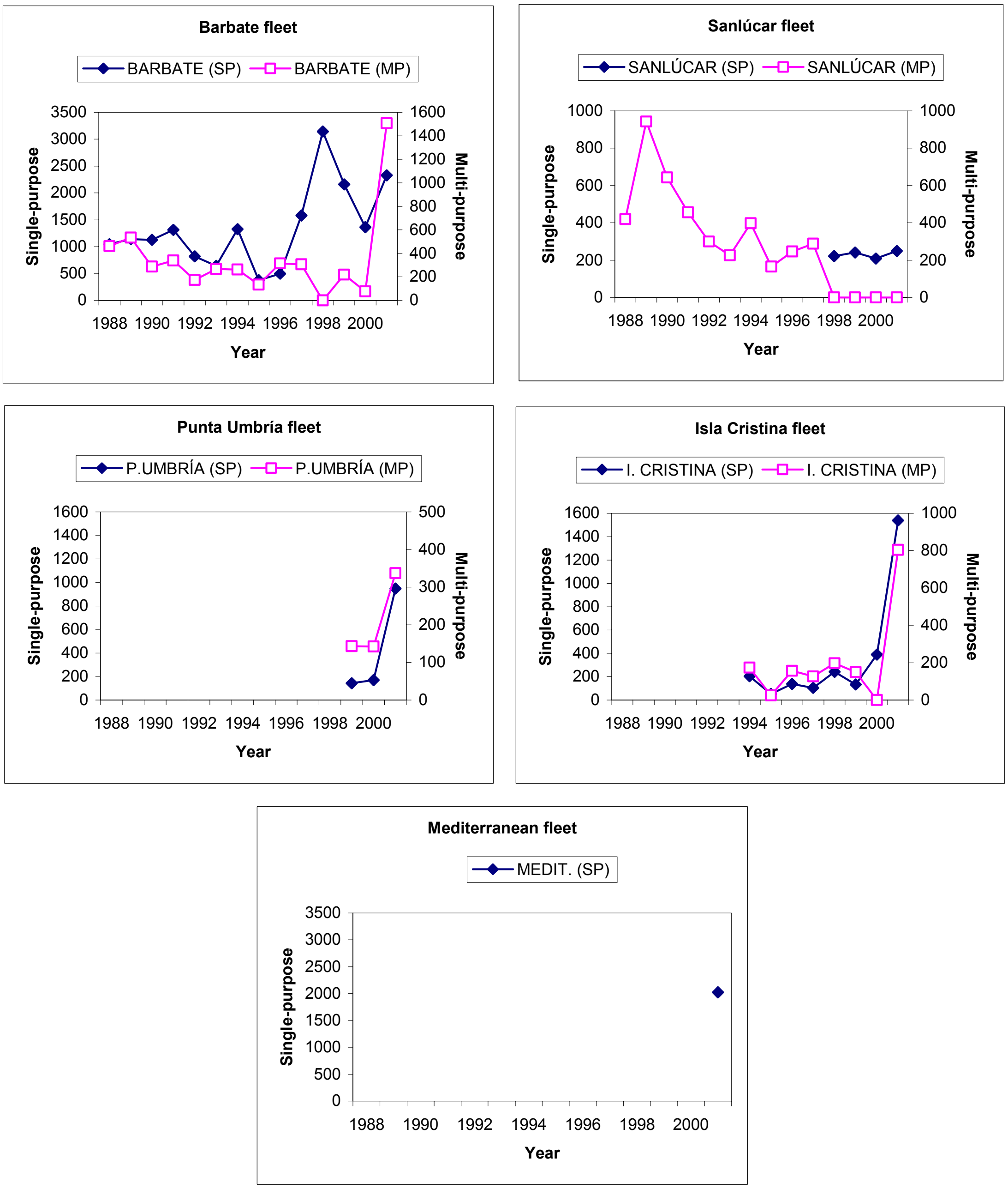
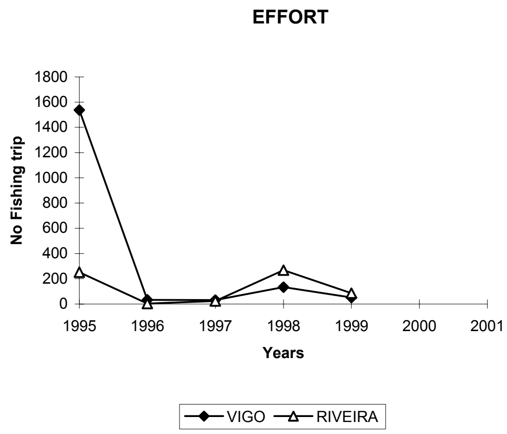


Figure 12.5.2. Anchovy in Division IXa. Spanish CPUE series in commercial fisheries in Gulf of Cadiz (Sub-division IXa South). SP: Single-purpose purse-seine fleets; MP: Multi-purpose purse-seine fleets.



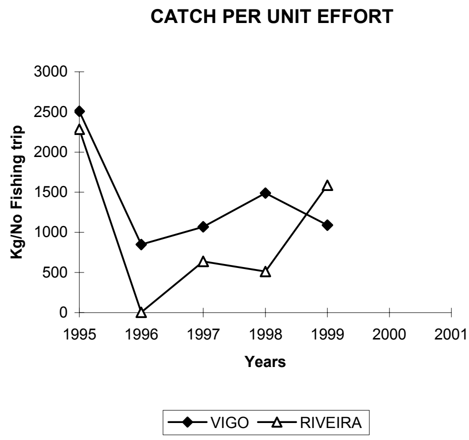


Figure 12.5.3. Anchovy in Division IXa. Spanish Effort and CPUE series in commercial fisheries in Western Galicia (Sub-division IXa North). Not available data for 2000 and 2001.

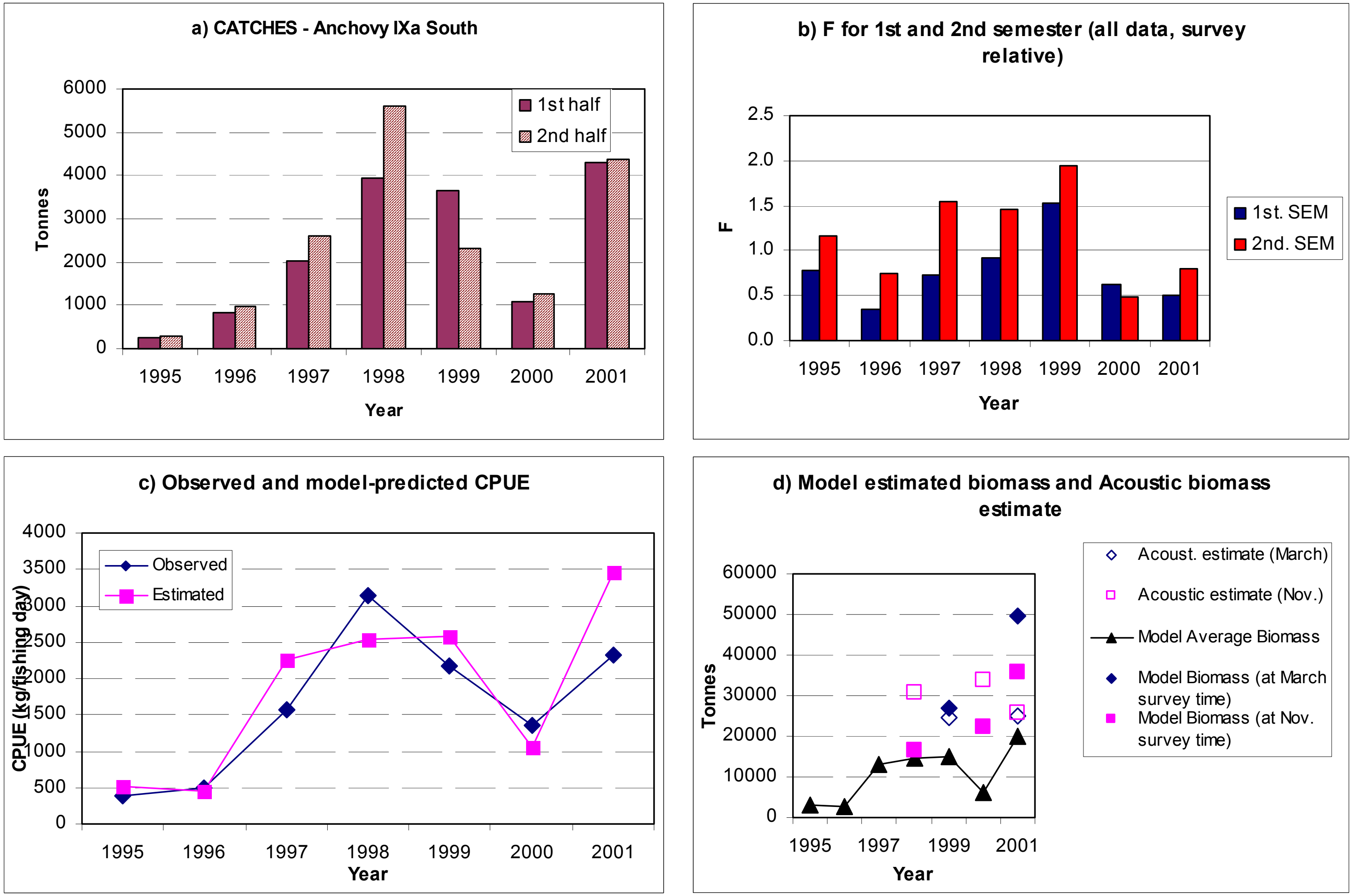


Figure 12.7.1. Anchovy in Sub-division IXa South: (a) catches on a half-year basis (1995-2001), (b) estimated fishing mortality (F) by the separable model, (c) observed and model predicted CPUE for the Barbate single-purpose purse-seine fleet, (d) model estimated biomass and acoustic biomass estimates.

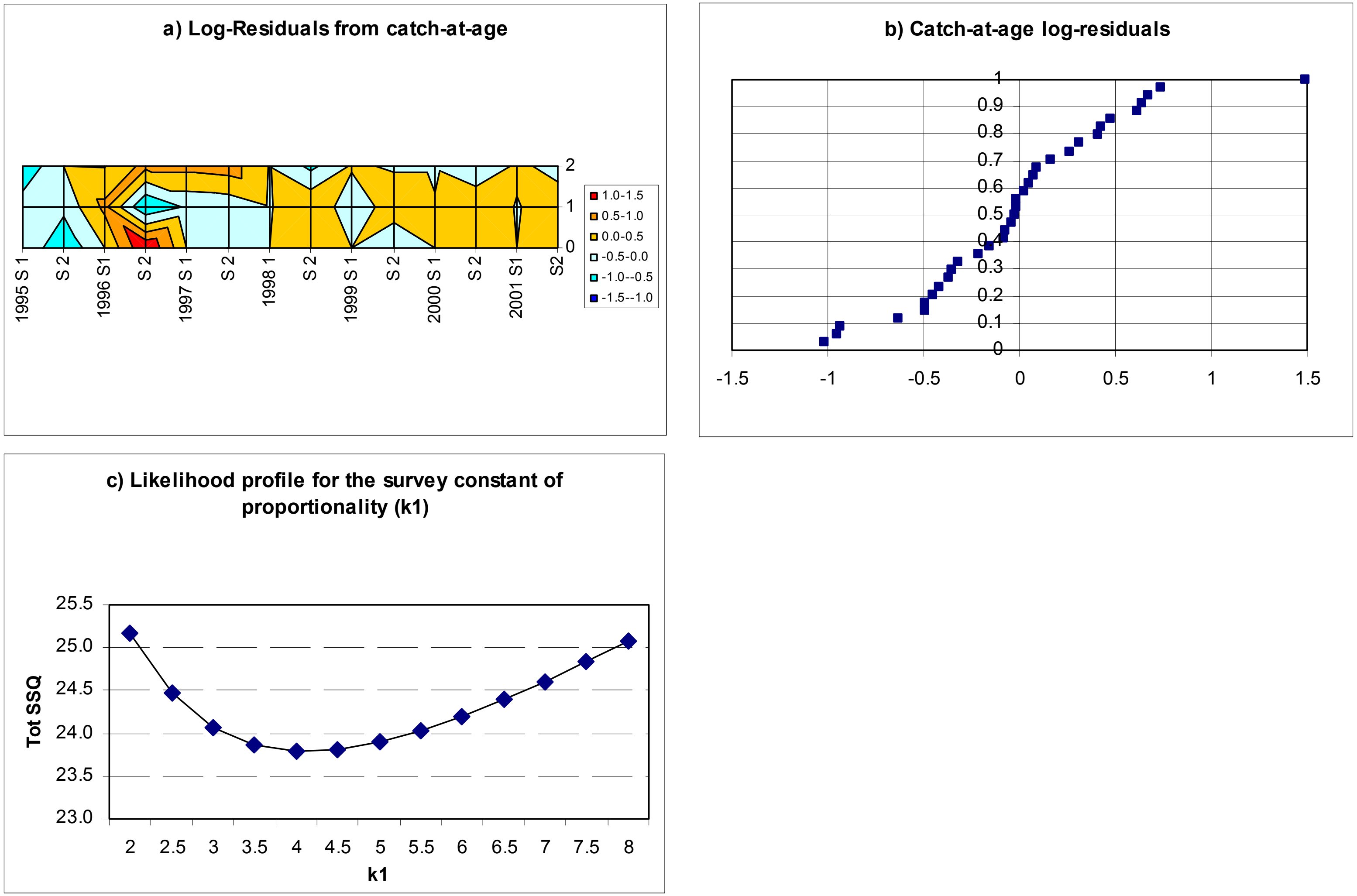


Figure 12.7.2. Anchovy in Subdivision IXa South: (a) log-residuals from catch at age, (b) sorted log-residuals from fit to catch-at-age data, (c) likelihood profile for the survey constant of proportionality (k1).

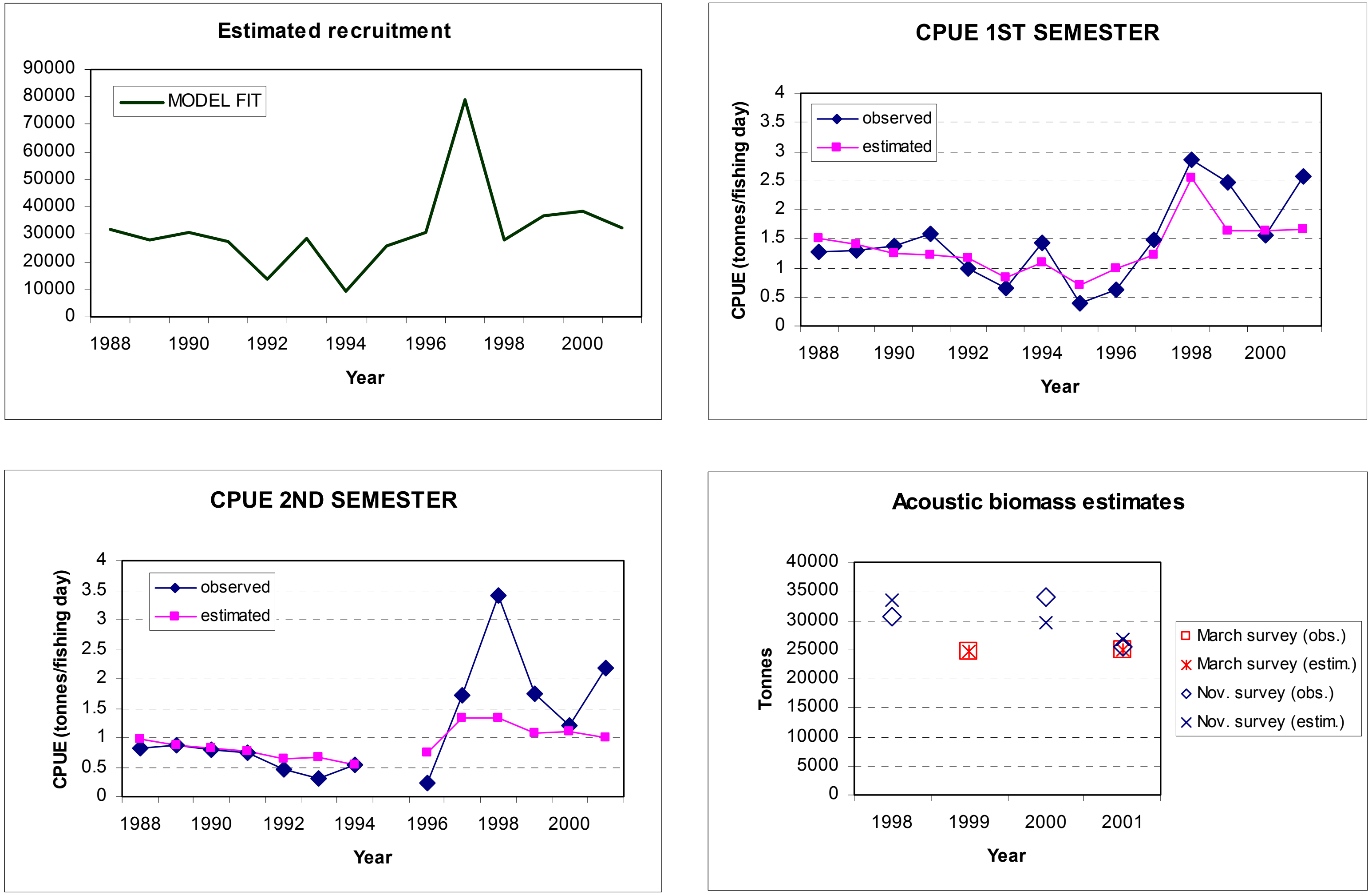


Figure 12.7.3. Anchovy in Sub-division IXa South: outputs from the biomass delay-difference model. Estimated recruitment, observed and estimated Barbate fleet's CPUEs and acoustic biomasses.

13 RECOMMENDATIONS

GENERAL

The Working Group recommends that national institutes increase national efforts to gain historic data, aiming to provide an overview which data are stored where, in which format and for what time frame.

The Working Group recommends again that the archives folder should be given access only to designated members of the WGMHSA.

EGG SURVEYS

The Working Group recommends that:

1. A workshop on mackerel and horse mackerel egg: species ID and staging – should be held in Lowestoft October 2003 (Chair S. Milligan CEFAS). ToR to be set by WGMEGS in April 2003.
2. A short workshop on defining research and analysis requirements for resolving the question of determinacy in horse mackerel should be held immediately prior to the meeting of WGMEGS in Lisbon April 2003. The workshop will be chaired by Guus Eltink, RIVO, Netherlands). The workshop should include invited outside experts.
3. WGMEGS should be asked to investigate the historical time series of mackerel fecundity and biological data with the aim of identifying possible factors in the change in fecundity 1995-98. This should include investigation of condition factor and GSI from survey and other sampling programmes.

MACKEREL

The Working Group recommends that the MFDP program be improved, in collaboration with representatives from the WG, in order to be able to produce a suitable multi-management option table for two fleets at next years meeting.

The Working Group recommends that institutes examine their otolith preparation technique for mackerel and that a new mackerel otolith exchange be carried out to evaluate the otolith processing techniques of all institutes that are providing age data to this Working Group.

The mackerel box should remain closed to targeted mackerel fishing.

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 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.

North Sea horse mackerel

The Working Group recommends that the IBTS collects age composition samples from horse mackerel in third quarter in the area of the North Sea horse mackerel (IVbc, VIId and IIIa), to improve the fishery independent abundance indices. It is also recommended that more age composition samples be collected, covering all major components of the North Sea horse mackerel fisheries.

The Working Group recommends that if a TAC is set for this stock, it should apply to those areas where the North Sea horse mackerel are fished, i.e. Divisions IVb,c, VIId and eastern part of Division IIIa.

Western horse mackerel

The Working Group recommends that a management strategy similar to that for North Sea Herring, in which both adult and juvenile mortality are independently restricted, be explored for this stock.

Southern horse mackerel

The Working Group recommends that the work should be completed to examine effort data in the years prior to 1985, in order to understand the large fluctuations in the catches in previous years.

The Working Group recommended that the Avilés fishermen association should be encouraged to provide reliable catch data from 1994 to present, as it was usual in earlier years.

The Working Group recommends that the weights-at-age in the stock should be revised to provide weights on an annual basis.

The Working Group recommends that new information on maturity at age from Division IXa be analysed and presented at the next meeting.

The Working Group recommends that a workshop take place before the next working group to revise basic biological data, survey data and methodology to calculate CPUE indices from surveys.

The Working Group recommends that bottom trawl surveys used to tune the assessment should have an appropriate sampling effort and be carried out in a regular basis.

The Working Group recommends that the TACs and any other management regulations which might be established in the future should be related only to *T. trachurus* and not to *Trachurus spp*. in general, as is the case at present . It would then be appropriate to set TACs for the other species as well.

SARDINE

The Working Group recommends that further investigations on the uncertainties of the sardine assessment, in particular on the differences between AMCI and ICA are carried out, and that the results of those investigations are presented to next WG meeting in 2003.

The Working Group recommends that a revision of the acoustic based SSB estimate time series is carried out, and if possible, presented to the 2003 WG. This revision will complement the revision of the DEPM based SSB estimates which is due by the next SGSBSA in 2003.

The Working Group recommends that further work on the maturity ogive should be carried out and that conclusions about the impact of changes in methodology in the estimates are presented to the WG.

ANCHOVY

The Working Group recommends that direct surveying of the Bay of Biscay by the Egg (DEPM) and acoustics surveys are pursued given that it is impossible to carry out a reliable assessment of this population without this information, particularly by the scaling role of the absolute estimates.

The Working Group endorsed the conclusions of the Workshop on Anchovy otoliths age reading concerning procedures for the Bay of Biscay anchovy and that in IXa. Given the uncertainties risen from age readings in the Gulf of Cadiz anchovy, the WG recommends that previous and new age determinations be revised as far as possible according to the recommendations proposed in that Workshop.

The Working Group recommends that the studies about the relationship between the oceanographic environment and the Bay of Biscay anchovy recruitment should be continued and enhance in next years in order to help to provision of scientific advice.

The Working Group recommends to carry out a simulation study to evaluate alternative management regimes for the Bay of Biscay anchovy.

The Working Group regards the Spanish acoustic survey recently conducted in Gulf of Cadiz (Sub-division IXa South) as a positive development and recommends its continuation in next years.

The Working Group recommends to recover all the information available on the anchovy fishery and biology (including information on age structure by Subdivision if available) off Portuguese waters.

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.

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15 ABSTRACTS OF WORKING DOCUMENTS

Cunha, M. E., Costa, A.M., Vendrell, C., Farinha, A. and Pissarra, J.

Horse Mackerel *(Trachurus trachurus)* evaluation by the Daily Egg Production Method (DEPM) in ICES Division IXa (Portugal and Gulf of Cadiz): Preliminary results.

Document available from: Manuela E. Cunha, Instituto de Investigação das Pescas e do Mar (IPIMAR), Av. Brasília, 1400 Lisboa, Portugal

Email: micunha@ipimar.pt

Spatial distribution and abundance estimates of horse mackerel eggs off the Portuguese coast and Gulf of Cadiz during January/February 2002 were obtained during a cruise of the R/V "Noruega" in order to apply the Daily Egg Production Method (DEPM) to evaluate the horse mackerel biomass in the area. This document presents an adaptation of the standard daily egg production method described in Lasker (1985) to horse-mackerel, discusses the daily egg production parameters and spawning biomass estimate, and gives the equivalent result given by the ICES daily egg production method described in Anon. (1993) and used in 1992 by the ICES Working Group on Mackerel/Horse Mackerel Egg Production.

Cunha, M. E., Varela, F., Vedrell, C. and Stratoudakis, Y.

Preliminary Results from Sardine *(Sardina pilchardus)* Daily Egg Production in ICES Division IXa (Lat. 41º 50'N, 36º 00'N) During January/February 2002.

Document available from: Manuela E. Cunha, Instituto de Investigação das Pescas e do Mar (IPIMAR), Av. Brasília, 1400 Lisboa, Portugal

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Spatial distribution and abundance estimates of sardine eggs off the Portuguese coast and Gulf of Cadiz during January/February 2002 were obtained during a cruise of the R/V "Noruega" in order to apply the Daily Egg Production Method (DEPM) to evaluate the sardine biomass in the area. This paper presents the preliminary results from the sardine DEPM surveys in the ICES Division IXa.

Cunningham, C. L., Darby, C. D., Reid, D. G., Kirkwood G. P. and McAllister, M. K.

Alternative Management Options for the North East Atlantic Mackerel Population.

Document available from: Carryn Cunningham, Renewable Resources Assessment Group., Department of Environmental Science and Technology., Imperial College of Science, Technology and Medicine., Prince Consort Road, London, SW7 2BP, Great Britain.

Email: c.l.cunningham@ic.ac.uk

In this working document a fishery management system is used to explore the effect of alternative management options for the North East Atlantic mackerel fishery under alternative hypotheses of the state of the North East Atlantic mackerel population. This system includes implementation and observation uncertainty and projects the population into the future, assuming that the TAC is set in a similar manner to that currently used by ICES. The alternative management options considered include the protection of juveniles through closed areas, and changes in the fishing effort by division. Thus the population dynamics model used incorporates the movement of this population by division and season.

Cunningham, C. L., Reid, D. G., Darby, C. .D., Kirkwood G. P. snd McAllister, M. K.

A Bayesian State-Space Model of the North East Atlantic Mackerel Population: Modelling Separate Spawning Stocks Using Fixed Migration Vectors.

Document available from: Carryn Cunningham, Renewable Resources Assessment Group., Department of Environmental Science and Technology., Imperial College of Science, Technology and Medicine., Prince Consort Road, London, SW7 2BP, Great Britain.

Email: c.l.cunningham@ic.ac.uk

In this working document a Bayesian state-space model is used to model the North East Atlantic mackerel population, which is assumed to consist of three distinct spawning stocks. The migration of these spawning stocks between their separate spawning grounds and joint feeding grounds is modelled using fixed migration vectors. Results indicate that the current state of the population is insensitive to uncertainty surrounding the northerly migration of the Southern spawning stock. However, uncertainty surrounding the extent to which juveniles are subject to fishing mortality, without being landed, results in large differences in the marginal posterior distributions of key model parameters.

Dransfeld, L., Dwane, O., Molloy, J., Kelly, C., and Reid, D.

Assessment of Mackerel and Horse Mackerel Daily Egg Production outside the ICES Standard Survey Area

Document available from: Leonie Dransfeld, Marine Institute, Abbotstown Laboratory, Snugboro Road, Dublin 15, Ireland.

Email: leonie.dransfeld@marine.ie

One year after the ICES triennial mackerel and horse mackerel egg survey, a further egg survey was carried out to assess whether significant spawning occurs outside the ICES standard area. 173 ICES rectangles were sampled on the Porcupine, Rockall and Hatton Banks, the Rockall Trough and the Faroes waters using standard methodology for the collection of mackerel and horse mackerel eggs. Data were analysed to obtain distribution of stage 1 mackerel and horse mackerel eggs and daily egg production in 41 control rectangles inside the standard area and 132 rectangles outside the standard area. In 2002 daily egg production of mackerel was elevated inside the standard area, with rates decreasing off the shelf edge. Some spawning activity took place south and east of the Rockall Bank and south east of the Faroes Bank extending to west of the Scottish Shelf edge. Low levels of horse mackerel egg production were found west of the Rockall bank and south of the Faroes Bank. The combined daily egg production per ICES rectangles outside the standard area in 2002 for mackerel and horse mackerel was less than 1% of egg production measured inside the standard area in period 5 and 6, 2001. This indicated that spawning of both species outside the standard area was insignificant. The northern peripheries of the standard area should however be further explored for possible spawning activities and surveys should extend sampling to higher latitudes during the ICES survey program.

Eltink, A. T. G. W.

Biological Evaluation of the fishery on juvenile and adult Western Horse Mackerel (*Trachurus trachurus L.*).

Document available from: Guus Eltink, RIVO, P.O. box 68, 1970 AB IJmuiden, Netherlands.

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Since 1994 the western horse mackerel fisheries are characterized by high percentages of juveniles in the annual international catches (fluctuating between 17% and 48% in numbers).

In this study the fishery on juvenile and adult western horse mackerel is evaluated based on biological criteria by means of long-term equilibrium predictions of catch and stock and by studying the effect of area/period closures. Effort reductions in 5 steps in the juvenile areas/periods up to a total closure and effort reductions in 5 steps in the adult areas/periods also up to a total closure were carried out for three options in the equilibrium predictions.

In the equilibrium situation of no fishery the maximum biomass at age in the stock is reached between age 3-6. This implies that on biological arguments the fishery should take place from age 3 onwards, because the biomass at age approximately stops to increase at ages 3-6 and decreases from age 7 onwards. Therefore, a closure of the juvenile areas/periods should be considered in order to avoid a fishery on ages 0-2.

A transfer of effort from the juvenile areas/periods to the adult areas/periods up to even a total closure of the juvenile areas/periods will increase the spawning stock biomass compared to the recent level. This increase in SSB reaches its maximum in the case of only a fishery in the adult areas/periods.

A transfer of effort from the adult areas/periods to the juvenile areas/periods up to even a total closure of the adult areas/periods will decrease the spawning stock biomass compared to the recent level. This decrease in SSB reaches its maximum in the case of only a fishery in the juvenile areas/periods.

Eltink, A., Villamor, B. and Uriarte, A.

Revision of the mean weights at age in the stock (WEST) and the proportion mature at age (MATPROP) of NEA Mackerel over the period 1972-2001.

Document available from: Guus Eltink, RIVO, P.O. box 68, 1970 AB IJmuiden, Netherlands.

Email: a.t.g.w.eltink@rivo.wag-ur.nl

The mean weights at age in the stock and the proportions mature at age are calculated for the NEA mackerel by weighting this information by mackerel component according to the spawning stock biomass estimates from the southern, western and North Sea mackerel components. SG DRAMA provided a complete data set for mean weights at age in the stock and for the proportions mature at age for the NEA mackerel over the whole time series 1972-2000. However, it is already necessary to revise this data set, because the data set on the mean weights at age in the stock for the southern mackerel component is revised for the period 1984-recent. The areas and periods of sampling for the collection of these mean weights at age in the stock have been evaluated. Furthermore, this additional revision is necessary because the weighting factors for calculation of the mean weights at age in the stock and the proportion mature at age for NEA mackerel were not correct for the period 1984-2000. It was necessary to create a data base from which it is evident how the mean weights at age in the stock and the proportions mature are achieved for the NEA mackerel based on the information by mackerel component.

The total SSB's for NEA mackerel were not correct in the SSB assessment file for NEA mackerel, because the SSB's of the North Sea component were not included. Therefore a table was prepared that shows clearly the SSB estimates from the egg surveys by mackerel component; how the total SSB's for NEA mackerel are achieved and how the weighting factors are achieved for the calculation of mean weights at age in stock and the proportions mature of the NEA mackerel from these data by the mackerel component. The inclusion of the SSB's from the North Sea egg surveys is becoming more important now, because the SSB of the North Sea mackerel component has increased in 2002.

Iversen, S. A. and Eltink, A.

Egg production and spawning stock size of mackerel in the North Sea in 2002.

Document available from: Svein A. Iversen, Institute of Marine Research, P.O Box 1870 Nordnes, 5817 Bergen, Norway.

E-mail: svein.iversen@imr.no

During the period 3-24 June 2002 Netherlands and Norway carried out egg surveys in the North Sea to estimate the spawning stock biomass of mackerel. The spawning area was covered three times and the egg production was calculated for the total investigated area for each of the three periods. During all three coverage’s a very high egg production was observed in one and two of the same rectangles in the western part of the spawning area. About 20, 30 and 40% of the total egg production during the three respective coverage’s came from these rectangles. The surveys did not cover the total spawning area and period. Based on the three production estimates the spawning curve was drawn. The egg production estimates are considered minimum estimates since the sampling were not carried out until zero values were obtained in all directions. During the surveys in 2002 ovaries were collected to study fecundity and atresia. However, at present it is not decided if these ovaries will be analyzed. The SSB was estimated at 210,000 tons, and the 1999 year class dominated (50%) the spawning stock.

Jacobsen, J. A.

Mackerel survey north of the Faroes 2-8 August 2002

Document available from: Jan Arge Jacobsen, Faroese Fisheries Laboratory, Nóatún, P.O. Box 3051, FO-110 Tórshavn, Faroe Islands.

Email: janarge@frs.fo

A short note about the joint Russian-Faroese aerial/research vessel investigations on mackerel distribution during August 2002 in the Faroese EEZ.

Kryssov, A., Sentjabov, E. and Sergeeva, T.

Some Results from Russian Investigations on Mackerel in the Norwegian Sea during June-July 2002.

Document available from: Evgeny Shamray, Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, 183763, Murmansk, Russia.

Email: inter@pinro.murmansk.ru

Russian RV "Fridtjof Nansen" carried out whithin the international survey for the Atlanto-Scandian herring in the Norwegian Sea in summer 2002, however, much attention was given to collection of any available information on mackerel. When estimating mackerel abundance and biomass three relationships between reflectivity and length of an individual were used. Like in previous surveys, this year investigations covered only a part of the mackerel feeding area in the Norwegian Sea. Thus, areas to the south of 63°N in June and to the south of 66° N in July where mackerel are traditionally distributed in this season were not surveyed. However, a mackerel biomass was estimate from 1.6 to 2.5 million tones in June between 63° -67° N and 11°W - 09°E while 1.8 million tones in July were found between 66° 40' - 71° 30' N and 07°W - 15°E. Identification of mackerel in summer is much handicapped by the presence of larval and young herring distributed in the same depths. However, data collected within the frames of the SIMFAMI project as well as new data on the mackerel target strength will make it possible to elaborate an identification algorithm taking into account such the case.

Lago de Lanzós, A., Franco, C., Bernal, M., Hernández, C. and Cubero, P.

Preliminary results of sardine *(Sardina pilchardus, Walb.)* daily egg production off the northern coast of Spain (Cantabrian Sea) in March-April 2002.

Document available from: Ana Lago de Lanzós, Instituto Español de Oceanografía, Avda Brasil 31 28020 Madrid, Spain

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Following the recommendations of the Study Group on the Estimation of Spawning Stock Biomass of Sardine and Anchovy celebrated in Lisbon, it was decided to carry out a sardine daily egg production method DEPM survey in order to provide an estimate of the spawning stock biomass of the Atlanto-Iberian Sardine in 2002 in the area comprising from the Gulf of Cadiz to the inner part of the Bay of Biscay.

The region from the Gulf of Cadiz to the Miño border was covered by Portugal's IPIMAR, while Spain's IEO covered the north and north-western Iberian Peninsula and the Bay of Biscay (to 45°N). The Spanish ichthyoplankton survey was conducted on the B/O *Cornide de Saavedra* (SAREVA0302), and that of adults on the B/O *Thalassa* (PELACUS 0302).

The present paper present preliminary results on sardine egg distribution obtained from the survey conducted to the north and north-west of the Iberian Peninsula, as well as an estimate of the daily egg production in the sampled area.

Marques, V. and Morais, A.

Abundance Estimation and Distribution of Sardine *(Sardina pilchardus)* and Anchovy (*Engraulis encrasicholus)* in Portuguese Continental Waters and the Gulf of Cadiz (November 2001/March 2002).

Document available from: Vítor Marques, Instituto de Investigção das Pescas e do Mar, Avenida de Brasília, 1449-006, Lisboa, Portugal.

E-mail: vmarques@ipimar.pt

This paper presents the main results of the Portuguese acoustic surveys carried out during November 2001 and March 2002 with R. V. "Noruega". These surveys covered the Portuguese continental shelf and the Gulf of Cadiz. The working document provides abundance estimates of sardine (*Sardina pilchardus*) by age classes and anchovy (*Engraulis encrasicholus*) by length classes and its distribution in the surveyed area. The total abundance estimated for sardine was 775 thousand tonnes (26 x 10^9 individuals) for the November 2001 survey and 615 thousand tonnes (20.7 x 10^9 individuals) for the March 2002 survey. Anchovy total estimated abundance was 28.9 thousand tonnes (3451 x 10^6 individuals) in November 2001 and 25.4 thousand tonnes (4530 x 10^6 individuals) in March 2002. The Portuguese quarterly landings, for anchovy, by Sub-Divisions and by gear, are also presented.

Martins, M. M. and Skagen, D. W.

Exploring the state of the stock of *Scomber japonicus* from ICES Divisions VIIIc and IXa.

Document available from: Maria M. Martins, Instituto de Investigação das Pescas e do Mar (IPIMAR), Av. Brasília, 1400 Lisboa, Portugal.

E-mail: mmmartins@ipimar.pt

This working paper aims to inform what kind of data is available on Spanish Mackerel from the Iberian Peninsula and what has been done about this stock so far. Estimates of the state of the stock that have been made over the years using XSA are presented, as well as some recent exploratory analysis with separable models.

Millán, M.

A short note on the estimation of catch-at-age data for the Gulf of Cadiz anchovy (Sub-division IXa South) in 1994 and second half in 1995 from an iterated age-at-length key.

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;

In the present WGMHSA the catch-at-age series from the Spanish Gulf of Cadiz anchovy fishery (Sub-division IXa South) has been extended backwards to 1988, the starting year of the available historical series of Gulf of Cadiz catches. Information gaps on catch-at-age data described in the last year's report for the whole 1994 and second half in 1995 (only the size composition in catches is available) have been attempted to fill in from an iterated age-at-length key (IALK) by applying the Kimura and Chikuni's (1987) algorithm. The present WD summarises the results obtained after applying the resulting IALK to data.

Petitgas, P., Allain, G. and Lazure, P.

A recruitment index for anchovy in 2003 in Biscay.

Document available from: Pierre Petitgas, IFREMER, BP 21105, F- 44311, Nantes, France.

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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 WG 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 and 2002 reports of the ICES WG. For predicting anchovy abundance at age1 in 2003, environmental indices have been extracted from the hydrodynamic model for the period march-july 2002, and the regression model fitted on the historical series used in extrapolation mode.

During 1999, we revisited the pioneer work performed by AZTI on predicting a recruitment index for anchovy in Biscay and proposed a new index (Allain et al., 1999 and 2001). Borja et al. (1996, 1998) have evidenced a relationship between anchovy recruitment (age 1 in year y+1) and the wind regime during spring and summer in the previous year (year y). In particular, they estimated an upwelling index based on the wind regime. Because meteorological variables (wind, temperature, river discards) are forcing events on the sea but not the effective meso-scale processes that govern the production in the sea, they do not relate directly to the survival of larvae and to recruitment. Therefore we 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.

Poisson, F. and Massé, J.

Report of the acoustic survey PELGAS02.

Document available from: Francois Poisson, , Institute Français de Recherche pour l'Exploration de la Mer B.P., 8 rue François Toullec, 56100 Lorient, France

Email: francois.poisson@ifremer.fr

The French acoustic survey PELGAS02 was carried out in the Bay of Biscay from 6 May to 8 June 2002 on board the French research vessel Thalassa. The area has been prospected by acoustics and CUFES sampling (1009 surface samples for eggs counting).

The strategy was the identical to 2000 and 2001 surveys :

- acoustic data were collected along systematic parallel transects perpendicular to the French coast. The length of the ESDU (Elementary Sampling Distance Unit) was 1 mile and the transects were uniformly spaced by 12 nautical miles covering the continental shelf from 25 m depth to the shelf break.

- acoustic data were collected only during the day because of anchovy behaviour in this area. This species is usually grouped very close to the surface during night and so "disappear" in the blind layer for the echo sounder between the surface and 10 m depth

The biomass estimated by acoustics is close to 2000 estimate but lower than 2001. Compared to the apparent low catches by professional both in France and Spain, this estimate could appear as to be over-estimated. Nevertheless, anchovy was well present during the whole acoustic survey in the southern area, echo-traces were well present and anchovy was well represented in a lot of hauls. The situation was not that much different of 2000 one.

This estimate is also coherent with the preliminary results of CUFES sampling during PELGAS02 which show a distribution of anchovy eggs quite similar to the one observed in 2000 with a density even upper.

An hypothesis could be advanced by the fact that in opposition to previous years, very few schools were observed close to the surface and most of the detections were close to the bottom, mixed with horse mackerel in the southern part (Adour) and sprat in the Northern (Gironde). This particular spatial distribution could be an explanation of the low commercial catches induced to a low accessibility (or poor valorisation) more than to a low availability.

Santos, M. and Uriarte, A.

Preliminary estimates of the Spawning Stock Biomass of the Bay of Biscay anchovy *(Engraulis encrasicolus, L.)* in 2002.

Document available from: Maria Santos, AZTI, Instituto Tecnológico Pesquero y Alimentario, San Sebastián, País Vasco, España.

Email: msantos@pas.azti.es

The assessment and scientific advice on the Bay of Biscay anchovy, entirely depends upon the availability of population direct estimates. An application of the Daily Egg Production Method (DEPM) to estimate the Biomass and population of anchovy in the Bay of Biscay has been carried out in 2002 by AZTI within the frame of the Spanish Fishery Monitoring National Programme contracted with the European Commission. The survey covered southeast of the Bay of Biscay in May 2002 for estimating egg abundance and Daily egg production. In parallel and acoustic survey was carried out by the IFREMER to assess the anchovy population biomass, which was coordinated and simultaneous in time with the former survey to supply the adult samples required for the estimation of adult fecundity parameters for the DEPM implementation.

Within this international context the current survey contributes to its main objective, which is to provide biomass, and population estimates of the anchovy in the Bay of Biscay on a yearly basis for its submission to the ICES working group on the assessment of this species.

This document describes the preliminary estimate of the Spawning Stock Biomass based on its relationship with the spawning area (SA) and Daily egg production per surface unit (Po) and other covariates as Temperature or Julian day of the median day of the survey development.

Shamray, E. and Belikov, S.

Russian Investigations on Mackerel distribution in the Norwegian Sea during summer season 2002.

Document available from: Evgeny Shamray, Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, 183763, Murmansk, Russia.

Email: inter@pinro.murmansk.ru

Russia made complex investigations on mackerel in the Norwegian Sea during June – August 2002. These investigations include research vessels, number of observers' onboard commercial vessels and aircraft-laboratory. The main goal was to make map mackerel summer distribution, migration and biomass assessment. As usually mackerel was widely distributed in the Norwegian Sea during summer. The major feeding migration of mackerel into Norwegian Sea started some early compared to the year 2001. Migration of mackerel to the international waters of the Norwegian Sea took place mainly from the Norwegian EEZ, on the whole, was early and longer than in 1999-2001. The combined, data from all research/commercial vessels as well as from aircraft-laboratory can provide the most complete estimation of distribution of the feeding mackerel.

Silva, A., Skagen, D. W. and Stratoudakis, Y.

Exploring area based sardine assessment with AMCI.

Document available from: Alexandra Silva, Instituto de Investigção das Pescas e do Mar, Avenida de Brasília, 1449-006, Lisboa, Portugal.

E-mail: asilva@ipimar.pt

This document presents an exploratory assessment of the sardine stock using AMCI with area desegregated data. The analyses proceeded in three steps:

- exploration of several options in a single-area AMCI run
- set up of an area based AMCI run to be compared with the single area run
- explore area based runs, in particular with regard to specification of area distributions.

The main purpose of this exploration was to see to which extent assessing the stock on an area basis can account for the local nature of some of the data. The problems that one may hope to solve are due to the local nature of the surveys, and the hypothesis that the stock concentrates in a smaller area if it is reduced. However, the independent information of the area distribution is sparse. Thus, some of the information in the data is spent on estimating area distribution, and the question is if the remaining information is sufficient to estimate the stock and the mortalities.

The conclusion is that the results in terms of local abundance and fishing mortalities will be conditional on what is assumed about area distribution, and that the area distribution hardly can be estimated with the existing data.

Skagen, D. W.

AMCI, Version 2.2 May 2002: Assessment model combining information from various sources,Versions 2x: Area disaggregated: Model description Instructions for installation and running File formats.

Document available from: Dankert W. Skagen, Institute of Marine Research, P.O Box 1870 Nordnes, 5817 Bergen, Norway

Email: dankert@imr.no

Description and Manual for AMCI

Skagen, D. W.

Mortality of NEA mackerel estimated from tag recaptures.

Document available from: Dankert W. Skagen, Institute of Marine Research, P.O Box 1870 Nordnes, 5817 Bergen, Norway

Email: dankert@imr.no

This note considers estimation of total mortality in the NEA mackerel using tag recapture data.

Skagen, D. W.

Preliminary exploration of the 2002 data for NEA mackerel using AMCI.

Document available from: Dankert W. Skagen, Institute of Marine Research, P.O Box 1870 Nordnes, 5817 Bergen, Norway

Email: dankert@imr.no

This document describes preliminary runs on the NEA mackerel data set. The main findings were: The SSB estimates indicate that the stock has been considerably reduced since 1998, and that the fishing mortality has increased correspondingly. How this is reflected in the assessment depend on how much weight one gives to the SSB data. The catchability of the egg survey data is only slightly above 1, which is reassuring since great effort is made to make these measurements absolute. Without the egg survey data, the fishing mortality has a downward trend in recent years, which comes from the tag return data. However, since the tag return data by their nature contain little information about the mortality in the most recent years, one should hesitate to rely on an assessment using just these data.

The details of the method are described in the manual for AMCI, which is included in the Working Documents.

Stratoudakis, Y. and Marçalo, A.

Sardine slipping during purse seining off northern Portugal (MS submitted to: ICES Journal of Marine Science).

Document available from: Yorgos Stratoudakis, Instituto de Investigação das Pescas e do Mar, Avenida de Brasília, 1449-006, Lisboa, Portugal.

E-mail: yorgos@ipimar.pt

Observations onboard purse seiners demonstrated that the deliberate lowering of the net to allow pelagic fish to escape (”slip”) was frequent off northern Portugal during the second semester of 2001. Some slipping occurred in 25 of the 30 trips observed, and the quantities slipped were significantly higher when the net was set on dense echo-sounder marks. During the 12 weeks of the study, the sampled fleet (9 vessels) landed 2196 tonnes and deliberately released an estimated 4979 tonnes (CV = 33.6 %). More than 95% of the total catch was sardine. Data provided by the skippers in the absence of onboard observers led to considerably lower estimates of slipped quantities. The main reason for slipping was daily quota limitations, although illegal size and mixture with unmarketable bycatch were also reported. These results alert to the existence and potential magnitude of slipping, although indications of large seasonal and regional variations turn extrapolations for the entire fishery impractical.

Uriarte, A., Santos, M., Motos, L. and Petitgas, P.

Population estimate of the bay of Biscay anchovy bt the daily egg production method for 2001.

Document available from: Andres Uriarte, Instituto Tecnológico Pesquero y Alimentario, Avda. Satrustegui no.8, 20008 San Sebastián, Gipuskoa, Basque Country, Spain.
E-mail: andres@pas.azti.es

The project 00/013 entitled "*Population estimates of the bay of Biscay anchovy by the daily egg production method for 2001*" presented an International project of collaboration between Spain and France to evaluate in 2001 the biomass of this anchovy by the Daily Egg Production Method (DEPM). The fist purpose of these evaluations was to assists with them to ICES in the assessment of this species. Two surveys were conducted in May 2001 to implement the DEPM on this anchovy: The egg cruise “BIOMAN 01” was conducted on board the R/V "INVESTIGADOR" by AZTI and the specific adult cruise (called PEL2001) was conducted on board the R/V "THALASSA" by IFREMER, which was at the same time an acoustic survey on pelagics in this area. Preliminary estimates of the spawning stock biomass of anchovy were submitted to ICES in September 2001 and more completed estimates are provided in this report. The full DEPM methodology has been applied, including the estimation of the spawning frequency on a subset of 36 samples. The total spawning biomass of the Bay of Biscay anchovy estimated for the cruise time in May 2001 is about 124,132 t (CV = 0.199). From an historical perspective, these biomass is the highest ever recorded. This is due to two reasons: first a strong recruitment to the spawning population of anchovies at age 1 is recorded, and second there has been a strong presence of two year old anchovies in the population (the highest estimate of the series). The spawning population was basically composed of 1 year old anchovy (4,362 millions, CV= 27 %), mainly located in the coastal area and more secondarily in the remainder regions, and 2 year old anchovy (about 1,562 millions, CV 22 %), followed by a small amount of three or older age groups (123.5 millions CV= 36.6 %). The 2 and 3 years old anchovy was mainly placed at the mid south and/or offshore areas.

Uriarte, A., Blanco, M., Cendrero, O., Grellier, P., Millán, M., Morais, A. and Rico, I.

Workshop on anchovy otoliths from Subarea VIII and Division IXa.

Document available from: Andrés Uriarte, AZTI, Herrera kaia, Portualde z/g, 20110 PASAIA, Gipuzkoa, País Vasco, España.

E-mail: auriarte@pas.azti.es

Within PELASSES project, in subtask 2.3 it was established that at least one workshop will be organized to standardize the age readings of sardine and anchovy. In our February meeting in Lisbon, it was decided that a workshop on anchovy otoliths age reading would be carried out during the rest of the project life, coordinated by AZTI, preferably before summer 2001, although finally this has taken place in January 2002.

The major GOAL of this workshop is to identify major difficulties in age determination and Standardize anchovy otolith ageing criteria for the Bay of Biscay and for division IXa. For the former case AZTI's methodology for age determination was to be presented and discussed by the Workshop in order to decide whether to adopt it as a standard procedure of reference or not.

For the Bay of Biscay two exchanges of otoliths took place some years ago, of which results were available at the meeting.

More recently an exchange of otoliths of the anchovy in IXa (Cadiz) have taken place in 1998.

For the purposes of this meeting an exchange of otoliths took place during Summer and Autumn 2001 based on which precision of current ageing procedures was assessed and served as starting point for analysis and discussions of the workshop. The sets of otoliths examined in the exercise were otoliths arising from the most recent monitoring of the fishery landings and from recent surveys mostly during 2000 and 2001, within the life period of PELASSES. Otoliths older than 3 years did not appear for subarea VIII and ages older than 2 seemed not to appear for subdivision IXa. For the Bay of Biscay the average percentage of agreement across ages and readers (83 %) and the average Coefficient of Variation (CV=30%) were rather low for a three-year living fish. The major disagreements arise from the ageing of the oldest age groups (2 and 3). Ages 0 and 1 seem to be much better determined. For the Atlantic coasts and Bay of Cadiz anchovy otoliths a rather similar low precision arisen: The Average percentage of agreement across ages and readers was 84 % and the average CV was 40.8%. A discussion on these results served to introduce the problems on age determination for the different areas during the workshop.

Otoliths in division IXa are known to be rather difficult for age determination. Age reading determination is less established in IXa than for the Bay of Biscay area and therefore standardization of age readings was only tentatively devised and its feasibility was to be discussed during the workshop.

Vasilyev, D. A.

Description of the ISVPA .

Document available from: Dimitri Vasilyev, Federal Research Institute of Fisheries and Oceanography (VNIRO), 17 Verhne Krasnoselskaya, 107140, Moscow, Russia.

Email: dvasilyev@vniro.ru

Description and Manual for ISVPA.

Vendrell, C., Farinha, A. and Cunha, M. E.

Horse mackerel egg staging for Daily Egg Production Method.

Document available from: Catarina Vendrell, Instituto de Investigação das Pescas e do Mar (IPIMAR), Av. Brasília, 1400 Lisboa, Portugal.

Email: cvendrel@ipimar.pt

Daily Egg Production Method (DEPM) to estimate the biomass of the spawning stock of fish with pelagic eggs requires, among others parameters, the estimation of daily egg production (DEP). DEP is estimated as the intercept of the egg mortality model determined on basis of the eggs sampled at sea. The model considers the number of eggs at different ages (hours) present instantaneously in the area of spawning of the species in study and assumes that mortality is constant between ages. Shorter time intervals will increase precision but accuracy will be worsened.

Ageing the eggs is a procedure that relates the stage of the egg, the time at which it was sampled, the mean water column temperature and the spawning time. The staging of the eggs is extremely important because each stage reflect, for the local water temperature, a possible age range for the egg. This age range is in turn related to the duration of the daily spawning. If spawning is confined to a certain period of day and the duration of the stages are short enough (shorter than a day) it is possible to identify cohorts of eggs that were spawned in the previous days. Based on the time of spawning and the hour of the plankton haul it is then possible to attribute an accurate age, in hours, to the egg.

Horse mackerel eggs (*Trachurus trachurus*) are normally classified in five development stages (IA, IB, II, III e IV) following Simpson's (1959) classification of plaice eggs which was based on Buchanan-Wollaston's (1923) grouping of Apstein's (1909) stages. Using these egg stages Pipe and Walker (1987) described their rates of development with temperature (Table I).

This staging do not allow the procedure described above because the first egg stage (IA and IB) last for more 24 hours for temperatures less then 17º C which does not permit to determine if it is an egg that was spawned on that day or the day before. If the subdivision of stage I is taking into consideration there will be confusion between the ages of stage IB and II since both are members of the set: day two.

To be able to discriminate between daily egg cohorts we subdivided the embryonic development of horse mackerel in 10 stages that were considered "easily" identifiable. The refinement of the description of the eggs stages and their duration was clarified afterwards using artificially fertilised eggs that were incubated at no controlled temperature.

Zabavnikov, V., Shamray, E., Iversen, S. and Tenningen, E.

Short review of joint Russian-Norwegian airborne investigations on mackerel in July 2002

Document available from: Evgeny Shamray, Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, 183763, Murmansk, Russia.

Email: inter@pinro.murmansk.ru

The new ICES Planning Group on Aerial and Acoustic Surveys for Mackerel (PGAAM) was established and first time met in A Coruña (Spain) from 18–20 February 2002. During PGAAM meeting was solved that two aircraft (Russian and Norwegian) will be work in the Norwegian Sea in July 2002. Number of commercial and research vessels will join to this work from both countries. According to above mentioned the Russian research aircraft, AN-26 "Arktika", carried out annual complex air research in Norwegian Sea during 19 July - 17 August in the International waters and inside different national EEZ while the Norwegian flights were mainly in the Norwegian economical zone during 15-25 July. The main goal of these investigations was studies of mackerel distribution and migration during summer seasons in the feeding migration in the Norwegian Sea.

ICES CM 2003/ACFM:7 (annex)

Annex 1 to the Report of the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy (WGMHSA), Copenhagen, Sept. 2002

Report of the

ad hoc Study Group on Data Revision and Archaeology for the North-East Atlantic Mackerel Assessment (SG DRAMA)

Dublin, Ireland
13-20 April 2002

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1 PURPOSE OF THE *AD HOC* STUDY GROUP

The purpose of this ad hoc study group was threefold: (i) to provide validated input data for the assessment of the North-East Atlantic (NEA) mackerel stock to the WG MHSA; (ii) to document clearly problems identified in the historical dataset; and (iii) to provide a record of the decisions made during the preparation of the updated, combined dataset for 1972–2000 (catch data 1963–2000). The aim was to avoid having to calculate a separate assessment for the Western stock component at future WG MHSA meetings.

2 INTRODUCTION AND PARTICIPANTS

The first analytical assessments on mackerel were conducted in 1976 (ICES CM 1976/H:3), separately for the Western and the North Sea stocks (now called stock components of the NEA mackerel). At that time, assessment input data was available for 1972–1975 for the western and for 1969–1975 for the North Sea stock (Table 1.1). The WG followed this approach until 1986 (ICES CM 1986/Assess:12), when a combined assessment for North Sea and Western mackerel was presented, using data for 1972–1985. However, ACFM did not accept the combined assessment and decided to use a separate assessment for the Western mackerel as basis for its advice. No separate assessment was done for the North Sea stock after this time, thus only one assessment (for Western mackerel) was produced at each consecutive WG meeting. From 1989 onwards the catches attributable to the North Sea mackerel were so low that they were included in the Western mackerel catch (ICES CM 1989/Assess:11, catch data 1988).

In 1995 (ICES CM 1996/Assess:7) the catch data for Southern mackerel for 1984–1994 were made available to the Mackerel, Horse Mackerel, Sardine and Anchovy Assessment Working Group (WG MHSA). An assessment for the combined North-East Atlantic Mackerel (NEAM) stock, consisting of all 3 different stock components, was carried out, for the period 1984–1994. At the 1995 and 1996 WGs an additional assessment was conducted solely for the Western mackerel component to obtain a more extended time series for recruitment, (for the period 1975–1995 in 1995 and 1975–1996 in 1996. The Western mackerel assessment was extended for the period 1972–1997 at the 1997 WG (ICES CM 1998/Assess:6), and since then 1972 has been the initial year of the assessment period. The results for this western component for the period 1972–2000 were then scaled to the whole NEA mackerel stock using information from both assessments for the period 1984–2000.

At the meeting of the WG MHSA in 2000, Uriarte *et al*. (WD 2000) provided an extended and revised data set for the catch of Southern mackerel for 1973–1988. This should have enabled the WG to run a combined assessment for the period 1973–2000 and to do without a separate run for Western mackerel for the estimation of geometric mean recruitment. However, during the process of merging the data, it became obvious that there were a number of inconsistencies in the catch tables and the assessment input data sets at various levels, which resulted in (for example) unacceptable sums-of-products (SOP's). As these problems could not be resolved during the WG meeting in 2000, the WG recommended setting up an *ad hoc* Study Group dealing with the historical data inter-sessionally in 2001 (ICES CM 2002/ACFM:06).

The Study Group met during 13–15 April 2002 at the Marine Institute, and part-time during 16–20 April 2002 at Dublin Castle, Dublin, Ireland, with the following participants:

Guus Eltink	The Netherlands	*(WG member since 1981, WG Chair 1990–94)*
Svein Iversen	Norway	*(WG member since 1981, WG Chair 1987–89)*
Ciarán Kelly	Ireland	*(NEA mackerel species coordinator 1999->)*
John Molloy	Ireland	*(WG member since 1977, mackerel species coordinator 1987–1998)*
Dave Reid	UK/Scotland	
Christopher Zimmermann (Chair)	Germany	

A. Uriarte and B. Villamor, Spain, provided data for catches of Southern mackerel in advance. Representatives of the government fisheries institutes of UK/England and Denmark had been invited.

3 OFFICIAL LANDINGS AND WORKING GROUP CATCH 1963–2000

The Study Group examined the catch and landings data by area from all Mackerel working group reports published to date (Mackerel Working Group meetings 1974–1991, WG on the Assessment of Pelagic Stocks in Division VIIIc and IXa and Horse Mackerel meetings 1985–1989, WG on the Assessment of the Stocks of Sardine, Horse Mackerel and Anchovy meetings 1990 and 1991, WG on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy meetings 1992–2001; Table 3.1), containing data for 1963 onwards. Additionally, information was used from the official landings database held at ICES (1972 onwards) and the FAO Bulletin Statistique (for 1963–1972; Table 3.2), from the personal notes of the former species co-ordinator John Molloy, Ireland, and from recent work conducted by Carryn Cunningham, UK/England. Summarised data were compared to those held in the CATON files used for the assessments of the different stocks in the past. Mis-matches between the sources utilised were identified, and possible reasons for these differences were investigated. Finally, a figure was agreed for further calculations. In general, if the reason for the appearance of conflicting information could not be found, it was assumed that the catch tables (national landings reported by WG members) of the most recent available year hold the most accurate information. There is evidence that these tables have been checked during WG meetings and updated in later years, while this has not been always the case for tables holding area-wise catch information.

For the earlier years (1963–1988) catch was taken from the official ICES database, or the *Bulletin Statistique* if the data were not available digitally (prior to 1972). Data were cross-checked for the period 1963–1973 with the 1974 WG report, which appeared to take unaltered data from the *Bulletin Statistique* for the western and North Sea areas. Catches were then reallocated to different components according to the following scheme:

1) catches reported from areas II, V, VI, VII, VIIIa,b,d,e were assumed to be taken in the western area (although catches in IIa were in earlier years assumed to belong to the North Sea stock)
2) catches reported from areas III and IV were assumed to be taken in the North Sea area
3) catches reported from areas X, XII and XIV and unallocated catches were assumed to be taken in area VII
4) catches reported from areas IX and VIIIc were assumed to be taken in the southern area
5) catches taken in VIII (unassigned)were split into the western and southern area as described in Section 3.2

3.1 Western and North Sea mackerel

No systematic corrections had to be applied to the dataset for North Sea and Western mackerel (except the minor amount of Spanish catches in VIII, see Section 3.2). However, SG DRAMA spent a significant amount of time identifying inconsistencies in single years as listed below.

3.1.1 Specific notes

North Sea area

- 1969: IIIa and IV 7 t of landings subtracted. Source of error: 1977 WG reports that 7 t were reported from IIa - this was incorrectly added to the North Sea in Table 2.2.2.1.
- 1976: IIIa and IV 1,867 t of landings added. Source of error: update in the 1981 WG report not made to Table 2.2.2.1.
- 1977: IIIa and IV 1,400 t of landings added. Source of error: the 1981 WG updated landings for the North Sea and transferred 1,400 t into IIa, this figure was mistakenly subtracted again from the corrected value in Table 2.2.2.1.
- 1980: IIIa and IV 540 t of landings added. Source of error: classic dispraxia where 87,931t from the 1982 WG report was written as 87,391 t.
- 1983–1988: Caton file for NEA mackerel was missing the North Sea component catches.
- 1984: Sub areas IIIa and IV 4,322 t of landings added. Source of error: the original data as reported in the 1985 WG were not updated for a change in the catch tables made by the 1986 WG.
- Subsequent to the corrections above it emerged that exactly 4,322 t were added to III and IV and IIa and Vb. Given that these catches were Russian in the period after the establishment of the national EEZ, it was believed that the catches correctly belonged to IIa and Vb and were incorrectly added to III and IV as well. Therefore, subsequent to the corrections above 4,322 t were removed from III and IV.
- 1994: IIIa and IV 3,583 t of landings subtracted. Source of error: value in Table 2.2.2.1 not changed for Faroese landings reported in the 2001 WG.
- 1995: IIIa and IV 1,196 t of landings subtracted. Source of error: typographical mistake (dispraxia) 322,204 incorrectly typed as 323,400.
- 1997: IIIa and IV 1,921 t of landings added. Source of error: the original data as reported in the 1998 WG was not updated for a change in the catch tables made by the 2001 WG where Faroese catches were adjusted from 1,367 t to 3,288 t.
- 1998: IIIa and IV the sum of the landings and discards rounded to 269,700 t. The figures in the table add to 269,682 t.

3.1.2 Western Area

- 1961: IIa and Vb the original record from the WG reported no catch, this was changed to 7 t from the official *Bulletin Statistique* figures.
- 1976: VII and VIIIabde landings which were originally altered for the component of Spanish VIII catches taken in VIIIc –16,188 t (based on Uriarte *et al.* WD 2000) were readjusted for total Spanish catches in VIIIc given in the 1986 WG report: –2,292 t.
- 1978: VI sum of catch changed from 166,900 t to 166,800 t. Source of error: incorrect summation of landing and discard figures.
- 1983: VI 20,000 t of discards removed. Source of error: typo in 1985 WG report
- 1983: VI 5,400 t of landings added and VII and VIIIabde 10,400 t subtracted. Source of error: an increase in the Faroese catch in VI from 9,500 t to 14,900 t reported by the 1986 WG. A decrease in the Netherlands catch from 83,100 t to 73,600 t plus another decrease in 900 t of unknown origin gives a decrease of 10,400 t in VII and VIIIa,b,d,e.
- 1984: VII and VIIIa,b,d,e 14,700 t landings removed. Source of error: the original data as reported in the 1985 WG was not updated for a change in the catch tables made by the 1987 WG.
- 1984: IIa and Vb 4,322 t of landings added. Source of error: The landings in this area reported as of 93,900 Table 2.2.2.1 (rounded from 93,935 t) were changed to 98,222 t by the 1987 WG, because of a change in the Russian catch from 5 t to 4,292 t.
- 1988: IIa and Vb 4,204 t of landings added. Source of error: the value reported in Table 2.2.2.1 must be a typographical error as the figure has always been 120,404 t in the WG report.
- 1989: IIa andVb 3,588 t of landings added. Source of error: original figure from the 1990 WG was not updated for changes made in the 1991 WG. The change was due to the revision of Danish and Faroese catches. In addition, the 1990 WG initially reported the Catch as 87,358 t, which was a mistake as the sum of the Catch by country adds to 86,368 t and this was incorrectly rounded to 86,900 by the WG in Table 2.2.2.1.
- 1990: IIa and Vb 1,900 t of landings added. Source of error: typo in Table 2.2.2.1.
- 1994: IIa and Vb 2,409 t of landings added. Source of error: the original data as reported in the 1995 WG was not updated for a change in the catch tables made by the 1996 WG (71,903 t) and further changed by the 1999 WG to 72,309 t.
- 1995: IIa and Vb 1,396 t of landings added. Source of error; the value reported in Table 2.2.2.1 must be a typographical error as the figure has always been 135,496 t in the WG report.
- 1997: IIa and Vb 1,851 t of landings removed. Source of error: the original data as reported in the 1998 WG was not updated for a change in the catch tables made by the 2001 WG where Faroese catches were adjusted from 7,628 to 5,777 t.
- 1997: VII and VIIIa,b,d,e the catch from Table 2.2.2.1 is more accurate than that given in the area sub-divided table which appears in the 1998 WG report (this is due to rounding in the latter table).

3.2 Southern mackerel

The Southern mackerel component is caught in Sub-Divisions VIIIc and XIa. However, the three nations catching mackerel in VIII did not report these catches separately by Sub-Division in earlier years. France started to report catches from VIIIc separately in 1976, Portugal in 1987 and Spain in 1989. A working document was presented to the WG MHSA in 2000 (Uriarte *et al.* WD 2000) suggesting a possible split of Spanish catches in VIII for the period 1973–1988 on the basis of the catch distribution 1988–1999.

Catches in VIIIc were dealt with by the Southern Pelagic WG until 1988. In 1989, Southern mackerel was transferred back into the Mackerel WG. A table appears in that report (ICES CM 1989/Assess:11) listing mackerel catches in VIIIc and IXa from 1977 onwards. To extend the data back to 1963 and check the validity of data up to 1999, SG DRAMA extracted catch information from the *Bulletin Statistique* and the official ICES database and re-allocated the catches in the following scheme:

1. catches reported from IX were assumed to be made in the southern area
2. catches reported from VIII (unassigned):

    a. all Spanish catch 1963–1988 were split on the basis of the catch distribution described by Uriarte *et al.* 2000 – 87.6% were assumed to be caught in VIIIc (southern area), the remaining 12.4% in VIIIa,b,d,e (western area)

b. all Portuguese catches 1963–1999 were assumed to be caught in VIIIc
c. catches of all other nations (including France) 1963–1991 were assumed to be caught in VIIIa,b,d,e

These figures were then cross-checked with various WG reports for the period 1976–1992 and altered if a specific catch distribution was given there (see Table 3.4 for detailed information). Practically, Spanish catches assumed to be made in VIIIc in the period 1963–1976 were subtracted from the western area, while in later years (1977–1987) there was evidence that the reported Spanish catch in VIIIc included the catch actually made in VIIIa,b,d,e. This amount was therefore subtracted from the southern area. However, it was not transferred back to the western area, as the WG 1986 report clearly states for the western area that “sub-area VIII does not include Div. VIIIc. Spanish catches have been adjusted accordingly”. For 1988 onwards, the differences between the catch listed in the WG report 1992 (Spanish catch in VIIIa,b) and the figures derived from the WD Uriarte *et al.* 2000 were found to be due to rounding and thus not altered (see Table 3.4).

Catches made in the period 1963–1984 may include an unknown amount of Spanish mackerel, *Scomber japonicus*.

Specific notes

- The original data for 1977 to 1984 in Table 2.2.2.1 had not been altered since its 1st appearance in the 1989 WG report. From 1985 onwards, some revisions have been made to the catches.
- 1976–1983: the official statistics (from *Bulletin Statistique*) adjusted for Spanish catches in VIIIa,b were used. Spanish catches in VIIIa,b for this period were given in the 1986 WG report
- 1984: VIIIc and IXa 100 t of landings added. Source of error: 100 t adjustment to landings made by 1992 WG not updated to Table 2.2.2.1.
- 1984–2001: Working group estimates are used. Note 1985–1987 catches are 0.

3.3 North-East Atlantic mackerel combined

The combined estimated total catch for North-East Atlantic mackerel by area 1963–2000 is given in Table 3.6. This table replaces the Table 2.2.2.1 displayed in recent WG MHSA reports for 1972–2000. To illustrate the magnitude of changes made to this dataset, differences are listed in Table 3.5. In total, more than 1.09 million t of catches have been shifted or corrected. Figure 3.1 illustrates the differences between the previously used and the validated dataset.

Specific notes

- 1963–1983: all areas. All the data in Table 2.2.2.1 from 1963 to 1983 are rounded to the nearest 100 t. These figures were not altered where the only difference with the corroborated figure was due to rounding. Except for changes due to the division of Spanish catches (between VIIc and IXa and VIIIa,b,d,e) the only change was for area VI in 1972 where the landings appeared to have been incorrectly rounded to the nearest 10,000 t and should be 13,000 t.

4 CATCH IN NUMBERS AT AGE AND MEAN WEIGHT AT AGE IN THE CATCH

4.1 Period 1972–1983

The evaluation of the mean weights at age in the catch used in previous mackerel assessments (for Western and North Sea mackerel) displayed the following problems:

a) **North Sea mackerel:** The original catch in tonnes (CATON) file for North Sea mackerel appeared to contain approximate values estimated by the SOP calculation and not the actual catches reported to the working group. Therefore, the SOP check did not indicate serious differences. However, if the actual catches are stored in the CATON file then the differences to the SOP range from 129% to 236% (See Table 4.1 in which the North Sea, Western and Southern mackerel area catches are set to be equal to those in the CATON catches as agreed by the study group, given in Table 3.7). Mean weights at age in the catch currently filed in the ICES database have been set to constant for the period 1969–1983 (Figure 4.1). The basis for this is given in the 1979 WG report (ICES CM 1979/H:5). There is some doubt about the high mean weights of 1-group fish in the period 1969–1983. However, as few 1-group mackerel were reported from this specific period, the influence of any possible error on the combined mean weight at age for NEA mackerel is believed to be minor. Therefore, it was decided not to alter the mean weights at age for the period 1972–1983.

b) **Western mackerel:** The catch in tonnes (CATON) file for the Western mackerel contained catches as estimated by the WG. This information differs significantly from the SOP's for the period 1972–1983: SOP's listed in the WG reports range from 56%–94%. Mean weights at age in the catch have been set to constant for 1972–1979 (on an unknown basis) and changed to different (mostly higher) constant values for 1980–1982 (Figure 4.2). This change was based on the examination of the catch data during the 1978 WG (ICES CM 1978/H:4). The differences to the weights used so far were tabulated in 1979 (ICES CM 1979/H:3) and came into effect in 1980 (ICES CM 1980/H:3) for catch data from 1979 onwards. There is some evidence that mean weights prior to 1979 might have been underestimated: it is believed that the fishery and migration patterns were rather constant until the early 1980's, when the fishing pattern began to shift to later quarters and an increasing part of the catch was taken from Norwegian vessels targeting large mackerel in the northern part of the distribution area. However, correcting the mean weights for the early period (except for the plus-group as there are no data available to correct this group) by setting them to the weights used for 1979–1982 did not change the SOP's for these years significantly. Therefore, the group has not altered the mean weights at age for the combination of Western and North Sea mackerel.

c) **Southern mackerel:** Figure 4.3 shows the constant mean weights at age in the catch for southern mackerel as obtained from Uriarte *et al.* (WD 2000), which were not changed by this study group.

The catch in numbers at age of North Sea mackerel and Western mackerel were combined and a weighted mean weight at age in the catch was calculated for the combined stocks of North Sea and Western mackerel (Table 4.1 and 4.5). SOP's of the combined stocks ranged from 73%–104% and appeared to be much closer to 100% than the SOP's for the Western and North Sea mackerel separately. This indicates that, historically, the split between stocks of both the catches and the numbers at age was not carried out in a consistent and correct way. Furthermore, it corroborates the study group's decision not to revise the mean catch weights at age to match the SOP's for the western and North Sea components before both components were merged. The major difference between SOP and catch (73%) occurred in 1975 for the combined North Sea and Western mackerel catch in number data. The study group could not find an obvious explanation for this. It was therefore decided to correct the catch in number data, because the catch weights at age in 1995 were similar to the other years and because the catch in number data of all age groups appeared to be relatively high in comparison to the catch in tonnes.

It was concluded that for all years the catch in numbers of the combined North Sea mackerel and Western mackerel were to be raised by a certain factor to match an SOP of 100% (Table 4.2), to clearly document the artificial character of the final values. To be consistent, this was also done for the catch in numbers of the southern component (Table 4.3). Then the catch in numbers at age of the combined North Sea/Western and Southern mackerel were combined in order to arrive at the catch in numbers of the NEA mackerel for the period 1972–1983, with an SOP of 100% for all years (Table 4.4). At the same time a weighted mean weight at age in the catch was calculated for the NEA mackerel (Tables 4.5 and 4.6). Figure 4.4 shows the new mean weights at age in the catch of NEA mackerel. The mean weights at age in the combined catch are not constant in the early period, although the mean weights by component have been constant. This is caused by the weighting of the mean weight at age in the catch by the catch in numbers at age.

4.2 Period 1984–1988

At the assessment WG meetings the mean weights at age in the catch of North Sea mackerel were updated annually for 1984–1990 to provide data for the ICES Multispecies WG on the basis of survey and catch data (Figure 4.1). The evaluation of the mean weights at age in the catch displayed the following problem: the estimated mean weights at age in the catch for 1989 and 1990 were considerably lower than estimated in earlier years. This was due to the inclusion of North Sea mackerel data (catches, catch in numbers at age and mean weight at age in the catch) in the Western mackerel data from 1989 onwards since it was not possible to separate these from the Western mackerel after this time. From 1991 onwards, data for the North Sea component was no longer collected separately. The group had no additional information on the quality of mean weights at age available and thus agreed not to revise the mean weights at age in the catch of the combined North Sea /Western mackerel from 1984 onwards (Table 4.7).

In 1995 an assessment for NEA mackerel was carried out for the first time (ICES CM 1996/Assess:7). At that meeting, the data of Western and Southern mackerel were combined (the catch in numbers at age, the mean weights at age in the catch and the catch in tonnes). As mentioned above, western data included the North Sea data at that time.

Differences between SOP and actual catch in tonnes were so large that these could not sensibly corrected by changing the mean weights at age in the catch. It was therefore decided to change only catch in number data. As NEA mackerel catch in numbers at age data for the period 1984–1988 could still be missing fish from the North Sea mackerel component, the catch in numbers at age data were converted to reflect a 100% SOP to the CATON-file of the NEA mackerel. Furthermore the CATON file was revised for 1984 according to the CATON file agreed by the study group (Table 3.7).

4.3 Period 1989–2000

For the period 1989–2000 no changes were made to the catch in numbers at age and the mean stock weights at age of the existing NEA mackerel data set.

5 MEAN WEIGHTS AT AGE IN THE STOCK AND PROPORTIONS MATURE AT AGE (REFER TO SECTION 7)

The mean weights at age in stock and the proportions mature for the NEA mackerel for the period 1972–1983 were calculated according to the method described in ICES 1998/Assess:6. This implied that the stock mean weights and the proportions mature should have been combined by weighting them according to the relative egg production spawning stock biomass estimates of the three mackerel components. However, for the period 1972–1983 this information was lacking for both the Southern and North Sea mackerel components and for the period 1972–1976 it was not available for the western component either. Therefore it was assumed that during the whole period of 1972–1983, 15% of the total SSB was present in the Southern mackerel component, a share which was also used for 1984 (ICES, 1998/Assess:6). This implied that the Western and North Sea mackerel comprised 85% of the SSB during this period. ICES (CM 1998/Assess:6) stated that in 1984 3% of the SSB was assumed to be present in the North Sea compared to 97% in the western area. For 1983 it was therefore assumed that 2.6%, 82.4% and 15.0% were located in the North Sea, the western and the southern areas, respectively. For 1972 is was assumed that 25%, 60% and 15% were distributed in the North Sea, western and southern areas, respectively, based on 1972 SSB estimates from assessments of the western stock in 1999 (3.085 million tonnes, ICES CM 2000/ACFM:5) and the North Sea stock in 1981 (1.249 million tonnes ICES CM 1981/H:7). For the intermediate period 1973–1982 a linear gradual change in SSB was assumed, with a reduction for the North Sea and an increase for the western component. Tables 5.1 and 5.2 show the weighting factors for the three components for the period 1972–1983, which were used to calculate the weighted mean stock weights at age as well as the proportions mature at age in the NEA mackerel stock (the tables show the original data by component and the combined data).

No changes were applied to the mean weights at age in the stock and to the proportions mature at age in the NEA mackerel stock for the period 1984–2000.

Figures 5.1, 5.2 and 5.3 show the mean weights at age in the stock for the North Sea, western and southern components of mackerel, respectively. Figure 5.4 shows the mean weights at age in the stock for the NEA mackerel stock. Data for the period 1972–1983 was created new, while those for the period 1984–2000 were unchanged. The mean weights at age in the stock were not constant in the early period, although the mean weights have been constant by component. This is because of the weighting of the mean stock weights at age by biomass per component.

6 EVALUATION

To explore the influence the numerous changes in the input data would have on the perception of the NEA mackerel stock, an assessment was carried out with the new, extended fisheries assessment data set, now covering the period 1972–2000 (Table 6.1). The results were compared to the assessment carried out at the last WG MHSA meeting in 2001 (ICES CM 2002/ACFM:06). To ease a comparison between assessments the input parameters were not altered. As expected, there were no changes detectable in SSB, fishing mortality and recruitment over the period 1989–2000 (Figures 6.1–6.3), because the input data were not altered for this period. Only minor changes appeared for the period 1984–1988, because of small SOP corrections applied to the catch in numbers at age data set for 1984–1988 and a slight change of the catch in tonnes for 1984 (see Section 4.2).

One of the main aims of this study group was to provide a validated and extended dataset for the combined NEA mackerel stock to be used for the calculation of geometric mean recruitment. Figure 6.3 shows the new NEA mackerel recruitment over the period 1972–2000 obtained using the new data in comparison to the recruitment calculated by raising the western recruitment with a raising factor. The latter was obtained from a comparison between the western recruitment and NEA recruitment over the period 1984–1997 (ICES CM 2002/ACFM:06). It is obvious that both sets of recruitments are almost similar. The calculated geometric mean recruitment of this new NEA mackerel assessment is only 3.2% lower than that of the raised western recruitment as estimated at last year's WG. Therefore, the SG recommends to use the new dataset as presented here also for the estimation of long-term geometric mean recruitment and to skip the laborious separate assessment for the Western mackerel component at future WG MHSA meetings.

7 POSTSCRIPT: UPDATE FOR MEAN WEIGHTS AT AGE IN THE STOCK (WEST) AND PROPORTION MATURE AT AGE (MATPROP)

For the 2002 Mackerel Assessment WG, a working document by Eltink *et al* (WD 2002) presented a revision of mean weights at age in the stock and proportion mature at age for the Southern mackerel. This required a further recalculation of the combined WEST and MATPROP data for the NEA mackerel. Thus, the relative share of spawning stock biomass between North Sea and Western mackerel in the period 1972–1983, which has been used for weighting the combined NEA mackerel values, was revisited. While previous calculations were based on a linear gradual change in the SG DRAMA work for the period 1972–1983, they are now based on actual assessment estimates for both components for the period 1972–1983, and three different values based on egg surveys for all three mackerel components (1984–1997, 1998–2000 and 2001). Both procedures give very similar results.

A detailed description of how the authors arrived at the updated values for WEST and MATPROP for the period 1972–2001 can be found in the working document (Eltink *et al* WD 2002), which is attached to this report. For convenience, the two tables are also reproduced in this report (Tables 7.1 and 7.2).

Epilogue

(taken from "*Ode to the Mackerel Working Group*" by W.A. Dawson, ICES CM 1989/Assess:11)

"It really is amazing
How we managed to get done
So many things to discuss
And lots of problems to overcome

Cries Paulino "in the area VIIIc
The catches aren't quite precise"
"Never mind" replies Pope John,
"We'll just have to count them twice".

8 REFERENCES

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Tables and Figures

Table 2.1: Input data (catch, mean weights and numbers at age) used for the assessment of the different North-East Atlantic Mackerel stock (components). *North Sea catch data included in Western Mackerel for 1988-. WG 2002 is a projection and reflects the Study Group's expectations.

WG	1976	1986		1987	1989	1995		1997		2002
North Sea	1969->	1972->		n.d	*					
Western	1972->		1972->	1972->	1972->	1984->	1975->	1984->	1972->	1972->
Southern	n.d.	n.d.		n.d.						

Table 3.1: Source of information for the data revision for different mackerel stocks/components by ICES assessment working groups. Southern mackerel (S) was dealt with in the Mackerel WG until 1984 and in the Southern Pelagic (later Sardine) WG until 1991, when both groups were joined to form the Mackerel, Horse Mackerel, Sardine and Anchovy WG. NS: North Sea mackerel, W: Western mackerel.

Year	Stock	**Chair**	Stock	Chair
	Mackerel WG			
1974	NS W	Hamre (NOR)		
1975	NS W	Hamre (NOR)		
1976	NS W	Bakken (NOR)		
1977	NS W	Bakken (NOR)		
1978	NS W	Bakken (NOR)		
1979	NS W	Bakken (NOR)		
1980	NS W	Guéguen (FRA)		
1981	**NS W S**	Guéguen (FRA)		
1982	**NS W S**	Guéguen (FRA)		
1983	**NS W S**	Guéguen (FRA)		
1984	**NS W S**	Anderson (USA)	Southern Pelagic WG	
1985	NS W	Anderson (USA)	S	Pestana (PT)
1986	NS W	Lockwood (UK/ENG)	**S**	Pestana (PT)
1987	NS W	Iversen (NOR)	**S**	Pestana (PT)
1988	NS W	Iversen (NOR)	**S**	MacCall (USA)
1989	NS W	Iversen (NOR)	**S**	Astudillo (ESP)
			Sardine WG	
1990	NS W	Kirkegaard (DEN)	S	Eltink (NED)
1991	NS W	Kirkegaard (DEN)	**S**	Eltink (NED)
	Mackerel, Horse Mackerel, Sardine and Anchovy WG			
1992	**NS W S**	Eltink (NED)		
1993	**NS W S**	Eltink (NED)		
1994	**NS W S**	Eltink (NED)		
1995	**NS W S**	Porteiro (ESP)		
1996	**NS W S**	Porteiro (ESP)		
1997	**NS W S**	Porteiro (ESP)		
1998	**NS W S**	Patterson (UK/SCO)		
1999	**NS W S**	Patterson (UK/SCO)		
2000	**NS W S**	Skagen (NOR)		
2001	**NS W S**	Skagen (NOR)		

Table 3.2a: Official national catch of Mackerel by area as stored in the official database of the International Council for the Exploration Sea, 1972-1999. These figures can differ from the ones used by the Mackerel WGs due to misreporting and unallocated catc

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	107	25857	6913	35290	11607	1757	4235	7078	8895	23256	34466	49594	93696	85509	100997	88615
	188599	326519	296137	263062	307246	259026	152967	155284	87931	66125	35034	38842	37602	51479	81266	123737
bde	148888	219211	263054	473552	491100	316552	493070	535508	509262	487792	489462	435998	467818	381404	331846	381828
	29262	25967	30630	25457	21014	24233	23730	20286	13967	15317	17985	12569	16762	16559	22447	21431
	366856	**597554**	**596734**	**797361**	**830968**	**601569**	**674001**	**718156**	**620055**	**592490**	**576947**	**537003**	**615877**	**534951**	**536556**	**615611**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	0		0												
									801	2389	10427	10356	7729	1653	3133
	6	4	1	5	2	2	1	1	3258				0		1
ales															
				105	363		9	394		237	300		1377	191	725
	3		7	12	9	8	2		6	34	3	2	14	17	38
		11	1		1				51		5			16	241
		0	0	0	0	53	174	2	0					99	
			11	8									341		
	25701	6893	34662	10516	1347	4171	6887	6706	12941	29934	38589	77087	64328	85078	68934
	90			32						231					
	47	5	4	8	6	0	0	342	2517					2130	297
			603												
	9			921	29		5	1450	3682	1641	270	6251	11720	11813	15246
ted	**25857**	**6913**	**35290**	**11607**	**1757**	**4235**	**7078**	**8895**	**23256**	**34466**	**49594**	**93696**	**85509**	**100997**	**88615**

Table 3.2a Continued

III and IV	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Belgium	78	145	134	292	49	10	10	5	57	102	93	68	44	49	13
Denmark	7459	3890	9836	27988	21833	18068	19833	13234	9982	2034	11285	9982	12387	23368	28217
England	31	61	33	89	106	142	100	76	3521	16	15	2	146	31	95
England & Wales															
Faroes	11202	18625	23424	63476	42836	34194	27272	14770	4950	720	243				281
France	636		2749	2607	2529	3452	3901	2238	3755	3041			1356	1752	2146
GDR	214	234	141	259	41	233	17								
Germany															
W Germany	563	270	276	284	577	284	209	56	59	29	10	112	219	1853	474
Iceland	3079	4689	198	302											
Ireland								738	733						
Netherlands	2339	3259	2390	2163	2373	1065	1010	853	1706	390	866		726	1949	2761
N Ireland															
Norway	277304	248314	206871	197351	180033	86826	92866	44781	28341	27966	24424	25848	25615	50423	66314
Poland	561	4520	2313	2020	298										
Russia															
Scotland	2943	390	578	1199	1574	3704	5272	9514	10575	44	1	13	10116	541	20273
Sweden	2960	3579	4789	7985	4012	4501	4665	1666	2446	692	1905	1576	870	1300	3162
USSR	17150	8161	9330	1231	2765	488	129								
Sum Allocated	**326519**	**296137**	**263062**	**307246**	**259026**	**152967**	**155284**	**87931**	**66125**	**35034**	**38842**	**37602**	**51479**	**81266**	**123737**

VI, VII, VIIIabde	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Belgium	3	7	17	10	2	1	4	0	10	4	9			3	2
CHG			11	6	1		3	1		1	2	4	5	7	6
CHI															
CHJ												2	2	2	2
Denmark				3	698	8677	9066	16482	14007	20468	14101	186			140
England	13082	21132	31535	57305	132320	213347	243974	151673	102568	81247	60417	30393	10379	10181	24526
Estonia															
England & Wales															
Faroes	635	8659	1760	5539	3978	12135	11244	14123	4570	11074	14906	15530	7400	1322	7085
France	41664		25818	33522	35703	37799	33624	26393	17572	12293	11617	12532	16145	11243	10922
GDR	1733	2885	9693	4509	431										
Germany															
W Germany	559	993	1941	391	4740	28873	17472	21089	27883	11572	22911	10918	11589	7711	15076
Iceland	52		21	10											
Isle of Man							36	0	0	1	1	2	0	2	5
Ireland	8314	8526	11567	14395	23022	33165	25120	52233	93821	119802	90375	88407	91251	74511	90058
Latvia															
Netherlands	7785	7315	13263	15007	35766	50556	62378	91081	88258	67196	73575	98952	37656	58854	31723
N Ireland	93	75	30	95	97	46	25	59	55	9	819	1124	23	1725	4244
Norway	34600	32597	1907	4252	362	1900	25744	25433	20817	16170	16958	39603	25416	21249	21926
Poland	10536	22405	21573	21375	2240		92		1						
Portugal			2	1	2	0			1						
Russia															
Scotland	5170	8466	16174	28399	52662	103671	103159	108966	116396	147442	127963	167202	180129	142443	174670
Spain	3184	3742	2903	2292	4463	2898	3567	1728	1698	1990	1343	1924	1372	1504	1433
Sweden				188											
USSR	87460	132693	312341	262384	20067				134	193	1000	1039	36	1089	10
Sum Allocated	**214870**	**249496**	**450556**	**449683**	**316552**	**493070**	**535508**	**509262**	**487792**	**489462**	**435998**	**467818**	**381404**	**331846**	**381828**
Bulgaria	4341	13558	20830	28195											
Romania			2166	13222											
Total	**219211**	**263054**	**473552**	**491100**	**316552**	**493070**	**535508**	**509262**	**487792**	**489462**	**435998**	**467818**	**381404**	**331846**	**381828**

Table 3.2a Continued

IXa, VIIIc	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
France	2		1	34		2	0	0							
Poland					8										
Portugal	1138	931	1562	1806	1021	1081	743	1335	1963	1864	1242	1429	3998	5581	5527
Russia															
Spain	24827	29699	23850	18708	20325	22465	19431	12632	13354	16121	11326	15333	12561	16866	15904
USSR			44	466	2879	182	111				1				
Sum Allocated	**25967**	**30630**	**25457**	**21014**	**24233**	**23730**	**20286**	**13967**	**15317**	**17985**	**12569**	**16762**	**16559**	**22447**	**21431**

Table 3.2a Continued

Official national catch of Mackerel by area as stored in the official database of the International Council for the Exploration of the Sea, 1972-1999. These figures can differ from the ones used by the Mackerel WGs due to misreporting and unallocated catch.

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
120472	87007	121091	103358	157553	171705	187308	158396	103933	109418	134398	110588
90317	159329	140609	197956	213428	221993	218771	196944	143339	149727	165285	170961
385546	319011	306303	295269	349140	376857	372825	353980	237487	235686	295637	179026
25241	10154	11601	11957	8685	12397	13554	13655	16755	22316	28296	2035
621576	**575501**	**579604**	**608540**	**728805**	**782951**	**792457**	**722975**	**501515**	**517146**	**623616**	**462610**

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1596	6433	6838	5711	4906	4900	5686	4746	3226	2165	2090	1183
			254	616	1100	3302	1925	3741	6324	7356	3595
	1	2		1		20				0	
639	1247	3113	2300	3347	4100	6258	11548	4997	7628	2716	
38				6609	6	5	2	2	1	7	
666	2409										
			252	196	0			1			
370	16										
						0	0	92	927	357	144
			988	311	2577	1508	413	233			
36								56			180
86053	64589	80636	79771	94464	112097	141114	93319	47997	41206	54472	53821
									22		
				45928	46692	27510	46249	43046	50207	67201	51003
1538	177	713	514	1174	233	1904	194	542	938	199	662
29536	12135	29789	13568								
120472	**87007**	**121091**	**103358**	**157553**	**171705**	**187308**	**158396**	**103933**	**109418**	**134398**	**110588**

Table 3.2a Continued

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
22	38	37	122	102	191	351	107	64	106	125	178
24416	18906	22611	26757	32329	35633	39051	30668	22431	21886	25325	28521
288											
	3507	2093	2789	2307	2309	2273	1637	1041	305	1530	830
	2685	5886	5338	1123	6980	10223	17884	1679	1367	4832	
2306	3625	4387	3486	955	1485	1633	3350	1243	1398	1907	
		25									
			4066	4618	4943	1485	715	542	214	493	475
224	6312	3377									
	2482		11650	13136	13185	9008	5607	5190	281	396	
2560	7346	1281	4581	6548	4046	3637	1274	821	952	1373	2052
100											
58676	75170	69211	99652	112492	111169	116456	108890	88702	96009	103783	106995
				1132		1999			3525	636	345
614	33348	28134	34014	33660	38442	25139	20537	16242	19294	19746	31565
1110	5910	3567	4281	5025	3610	7515	6275	5385	4391	5139	
			1220								
90317	**159329**	**140609**	**197956**	**213428**	**221993**	**218771**	**196944**	**143339**	**149727**	**165285**	**170961**

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0	3	2	2	3	1	0				
	10	10		3			2				3
						1		9			
3	2	3	2	1	1		1		9	23	16
	30		396	194	1522	2099	1343	581			
26348											
							361				
	19030	21837	26482	31972	40926	47735	52791	37407	43840	33200	25100
3000	1138	1040	4095	10428	2898	4285	5492	14002	2518	3681	
8689	15221	17559	17631	10127	10084	11745	19427	11893	12968	16850	
			16927	21687	23791	25006	23701	15685	15651	20998	19819
18491	16200	18226									
0	1	0	0	1	0	1	1	0	0	0	4
88583	68548	74629	64699	76484	81794	77266	72927	44776	52813	66914	
				328	847		121				
31753	24002	30628	29156	32366	38486	40698	34513	23370	22750	28790	25583
2811											
17410	3552		11	7	606	2552					
					2						
186574	170685	142251	135729	165470	175826	161386	143259	89733	85068	125037	108503
1883	176	118	139	71	71	49	41	31	69	144	
	416										
385546	**319011**	**306303**	**295269**	**349140**	**376857**	**372825**	**353980**	**237487**	**235686**	**295637**	**179026**
385546	**319011**	**306303**	**295269**	**349140**	**376857**	**372825**	**353980**	**237487**	**235686**	**295637**	**179026**

Table 3.2a Continued

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
10			12	3		2	28	29	1		
4330	3110	3819	2632	3576	2015	2149	3073	3009	2083	2899	2035
				31							
20901	7044	7621	9313	5075	10382	11403	10554	13717	20231	25397	
		161									
25241	**10154**	**11601**	**11957**	**8685**	**12397**	**13554**	**13655**	**16755**	**22316**	**28296**	**2035**

Table 3.2b: Commercial catch of NEA mackerel as extracted from the official ICES database: Sums by area. Figures may differ from those used by the WG due to misreporting And unallocated catches. Catch reported from area VIII (unassigned) and Spanish catch in VIII (unassigned) are listed separately.

Area	Baltic	IIIb-d	I	II	V	III	IV	VI	VII	VIII	X	XII	XIV	na	IX	VIIIc	VIIIxxx	VIIIxxspain	Baltic	NS & W	S
1973		32		21575	4282	8220	318299	52166	133239		22258				3474		29700	25677	32	560039	3474
1974		31	1	6829	84	6218	289919	63192	151599		29258				4195		31882	30177	31	547100	4195
1975		107	0	35273	16	10994	252068	62550	368109		2677				4952		37725	23408	107	731689	4952
1976		8	1	10527	1081	8880	296829	66788	352340	2490	1			1537	4792	34	44252	18480	8	738937	4826
1977		5		1349	46	7018	252008	74828	232233	3052	2			363	6843		23828	19852	5	570535	6843
1978		11	8	4056	179	9623	143344	152398	335174	2939	0		0		7484	2	18802	18543	11	647721	7486
1979		4	1	7066	12	8835	146449	189738	337880	4611	1162				7134	0	15268	15013	4	695755	7134
1980		20	0	8636	259	8578	79353	221871	281156	3911	267				4054	0	11970	11316	20	604031	4054
1981		55		21665	1591	9895	56230	304457	173938		71	64		3200	4074		17305	12834	55	567911	4074
1982		45		32901	1565	7732	27302	319384	148699		188	5		16253	4301		18617	15621	45	537776	4301
1983	2	39		47463	2131	6349	32493	290693	139550	3490	976				3467		10390	10390	42	523146	3467
1984	1	21		91067	2629	4831	32771	319243	139172	3963	802	61			3753		17585	14850	22	594539	3753
1985		25		76501	9008	4530	46949	339315	33918	6086	25	651			7089		10879	10810	25	516983	7089
1986	1	11		94604	6393	6147	75119	263209	62372	3595	689	1			11821		12606	12130	12	512129	11821
1987	6	12		80505	8110	11718	112018	330700	46257	3356	10				11246	61	11629	11557	18	592675	11307
1988	6	11		116005	4467	1812	88504	322441	59331	1891					11746	194	15184	15184	17	594452	11940
1989	12	12		78512	8495	4860	154469	238807	54254	346	246	0	1	25337	3727	6428	19		24	539991	10154
1990	1	6		113067	8024	2304	138305	251053	55132	118					4434	7167			8	568003	11601
1991	1	35		93238	10120	2791	195165	236582	58553	133					3543	8414	0		35	596583	11957
1992	2	1		141775	15777	4181	209246	279413	67161	2237	326	2	0		4512	4173			3	720120	8685
1993	2	1	0	148693	23012	2832	219161	281684	92022	2302	847	2			5171	7193	33		3	770555	12364
1994	2	805		169284	18023	9896	208875	262907	107883	2035					5362	7882	310		807	778903	13244
1995	1	12		137799	20597	5998	190946	248931	100977	3951	121				4810	8845			13	709320	13655
1996	2	2		92688	11245	6153	137186	169620	62091	5660			116		5426	11329			4	484760	16755
1997	3	0		98146	11272	5188	144538	136408	94241	5037					5295	17018	2		4	494831	22313
1998	1	22		127807	6591	5112	160173	206242	83079	6315					6067	22229			23	595320	28296
1999	1	1	0	108828	1760	3658	167303	128933	46792	2967				334	1624	383	29		2	460241	2006

Table 3.3 Total landings (catch in later years) of mackerel by component or area as listed by the ICES working groups (sum of landings by country) ("The WG cohort tables"). Changes to the previous year are marked yellow.

a. North Sea (IV and III) and IIa (incl. V in later years)

Year	From74W(	From75W(	From76W(	From77W(	From78W(	From79W(	From80W(	From81W(	From82W(	From83W(	From84W(	From85W(	From86W(	From87W(
1963	73068	73068						IIa now listed separately						
1964	114997	114997						NS catch now reported as one unit						
1965	208466	208466	208466											
1966	529728	529728	529728	531768										
1967	929948	929948	929948	932026	932026									
1968	821567	821567	821567	821926	821916	821916								
1969	738783	738783	738783	739182	739182	739182	739182							
1970	322400	322400	322400	322451	322451	322451	322451	322614						
1971	243400	243400	243394	243673	243673	243673	243673	244031						
1972	188190	188190	188190	188599	188599	188599	188599	188687	188687					
1973	393848	379255	379255	350092	348092	348092	348092	348089	348089	348089				
1974		326131	305013	305209	305209	305209	305209	305220	305220	305220	305220			
1975			314236	317800	297724	297724	297724	297731	297731	297731	297731			
1976				297150	314358	316225	316225	316235	316235	316235	316235	316235	316235	
1977					269336	260931	260931	260931	260931	260931	260931	260931	260931	260931
1978						154223	152967	153023	153023	153023	153023	153023	153023	153023
1979							158480	159902	159912	159895	159895	159895	159895	159895
1980								96017	96271	96271	96271	96271	96271	96271
1981									76551	86050	86050	86050	86050	86050
1982										71208	72733	72733	73091	73091
1983											84474	89165	90835	89935
1984												133196	133334	137798
1985													126938	128220
1986														191581

	From88W(	From89W(	From90W(	From91W(	From92W(	From93W(	From94W(	From95W(	From96W(	From97W(	From98W(	From99W(	From00W(	From01W(
1983	89935	89935	89935	89935	89935	89935	89935	89935	89935	89935	89935	89935	89935	89935
1984	137798	137798	137798	137798	137798	137798	137798	137798	137798	137798	137798	137798	137798	137798
1985	128220	128220	128542	128542	128542	128542	128542	128542	128542	128542	128542	128542	128542	128542
1986	189421	189421	189421	189421	189421	344812	344812	344812	344812	344812	344812	344812	344812	344812
1987	221015	221015	221492	222856	222856	348804	348804	348804	348804	348804	348804	348804	348804	348804
1988		248954	248954	248954	248954	458720	458720	458720	458720	458720	458720	458720	458720	458720
1989			270399	276214	276214	372088	372088	372088	372088	372088	372088	372088	372088	372088
1990				301200	301200	423800	423800	423800	423800	423800	423800	423800	423800	423800
1991					463703	463694	463694	463694	463694	463694	463694	463694	463694	463694
1992						506226	506226	506226	506226	506226	506226	506226	506226	506226
1993							556531	556531	556531	556531	556531	556531	556531	556531
1994								545880	545880	545880	545880	544706	544706	544706
1995									457595	457595	457595	457700	457700	457700
1996										316215	316215	316215	316215	316215
1997											333015	333015	333015	333085
1998												403919	403919	403919
1999													372647	372647
2000														364717

Table 3.3 Total landings (catch in later years) of mackerel by component or area as listed by the ICES working groups (sum of landings by country) ("The WG cohort tables"). Changes to the previous year are marked yellow.

b. Western area (VI, VII, VIIIab(de in later years))

Year	From74WG	From75W(	From76W(	From77W(	From78W(	From79W(	From80W(	From81W(	From82W(	From83W(	From84W(	From85W(	From86W(	From87W(
1963	27048	27048									Incl discards from 79			
1964	27188	27188												
1965	22270	22270	22270											
1966	45608	45608	45608	71738										
1967	38901	38901	38901	73818	73552									
1968	39918	39918	39918	65917	65911	65911								
1969	45454	45454	45454	71360	71100	71100	71100							
1970	65390	65390	65386	103321	104194	104194	104194	104194						
1971	86572	86572	86572	132862	132774	132774	132774	132774						
1972	133692	133692	133602	170794	170775	170775	170775	170775	170775					
1973	145010	170220	170220	223725	219445	219445	219445	219445	219445	219445				
1974		169699	248912	298138	298054	298054	298054	298054	298054	298054	298054			
1975			295380	492373	491380	491380	491380	491380	491380	491380	491380	491380		
1976				465364	507178	507178	507178	507178	507178	507178	507178	507178	488691	
1977					315155	325974	325974	325974	325974	325974	325974	325974	306122	306122
1978						507214	503913	503913	503913	503913	554613	554613	536070	536070
1979							605744	601303	601303	601303	661903	661903	646890	646890
1980								604761	604761	604761	626361	626361	615048	615048
1981									616032	609402	651702	651702	641598	641598
1982										595900	622700	622700	607700	607700
1983											587900	572100	567100	567100
1984												494300	479300	479600
1985													467700	467700
1986														378000

	From88WG	From89W(	From90W(	From91W(	From92W(	From93W(	From94W(	From95W(	From96W(	From97W(	From98W(	From99W(	From00W(	From01W(
1983	567100	567100	567100	567100	567100	567100	567100	567100	567100	567100	567100	567100	567100	567100
1984	479600	479600	479600	479600	479600	479600	479600	479600	479600	479600	479600	479600	479600	479600
1985	467700	467700	467700	467700	467700	467700	467700	467700	467700	467700	467700	467700	467700	467700
1986	380500	380500	380500	380500	380500	232599	232599	232599	232599	232599	232599	232599	232599	232599
1987	406900	401700	401700	401700	401700	284000	284000	284000	284000	284000	284000	284000	284000	284000
1988		377000	377000	377000	377000	377000	377000	377000	377000	197000	197000	197000	197000	197000
1989			293200	288900	288900	288900	288900	288900	288900	199100	199100	199100	199100	199100
1990				302900	302900	302900	302900	302900	302900	182400	182400	182400	182400	182400
1991					183509	183509	183509	183509	183509	183509	183509	183509	183509	183509
1992						236079	236079	236079	236079	236079	236079	236079	236079	236079
1993							248785	248785	248785	248785	248785	248785	248785	248785
1994								251646	251646	251646	251646	251646	251646	251646
1995									270476	270476	270476	270476	270476	270476
1996										213272	213272	213272	213272	213272
1997											195820	195820	195820	196110
1998												218599	218599	218599
1999													192486	192486
2000														266367

Table 3.4: Comparison of southern mackerel catch (Divisions VIIIc and IXa) from different sources. For the final estimate file, information for 1963-1976 was taken from the official ICES database and processed as described in Section 3.2; for later years, the latest WG estimates were used but altered if specific information on Western catch reported to the south was available (1977-1987)

	Data used in previous WG reports					Spanish catch in VIII to western area			SOUTHERN	OFFICIAL CATCH FROM ICES DATABASE										
Year	from WG 1989			from WG 0(	Diff.	from WG 1986 rep	from WG 1992 rep	WD Uriarte et al 00	NEW	as reported to ICES			whereof	after splitting:		whereof	after splitting:		official	official
	VIIIc	IX	total S			Spain VIIIab	Spain VIIIab	Spain VIIIb	FINAL	IX	VIIIc	VIIIx	Spain VIIIx	Spain VIIIc	Spain VIIIabde	Others VIIIx	Others VIIIc	Others VIIIabde	old S	south corr
1972										1742		35151	31416	27520	3896	3735		3735	1742	29262
1973										3474		29700	25677	22493	3184	4023		4023	3474	25967
1974										4195		31882	30177	26435	3742	1705		1705	4195	30630
1975										4952		37725	23408	20505	2903	14317		14317	4952	25457
1976						0				4792	34	44252	18480	16188	2292	25772		25772	4826	21014
1977	19852	7565	27417	27417	0	2001			25416	6843		23828	19852	17390	2462	3976		3976	6843	24233
1978	18543	7965	26508	26508	0	599			25909	7484	2	18802	18543	16244	2299	259		259	7486	23730
1979	15013	7462	22475	22475	0	543			21932	7134	0	15268	15013	13151	1862	255		255	7134	20286
1980	11316	4648	15964	15964	0	3684			12280	4054	0	11970	11316	9913	1403	654		654	4054	13967
1981	12834	5219	18053	18053	0	1365			16688	4074		17305	12834	11243	1591	4471		4471	4074	15317
1982	15621	5455	21076	21076	0	0	0		21076	4301		18617	15621	13684	1937	2996		2996	4301	17985
1983	10390	4463	14853	14853	0	0	0		14853	3467		10390	10390	9102	1288	0		0	3467	12569
1984	13852	6456	20308	20308	0	0	100		20208	3753		17585	14850	13009	1841	2735		2735	3753	16762
1985	11810	6178	17988	18111	-123	0	0		18111	7089		10879	10810	9470	1340	69		69	7089	16559
1986	16533	7402	23935	24789	-854		0		24789	11821		12606	12130	10626	1504	476		476	11821	22447
1987	15982	6016	21998	22187	-189		0		22187	11246	61	11629	11557	10124	1433	72		72	11307	21431
1988	16844	7422	24266	24772	-506		1500	1481	24772	11746	194	15184	15184	13301	1883	0		0	11940	25241
1989				18321			1400	1409	18321	3727	6428	19		0	0	19		19	10154	10154
1990				21311			400	432	21311	4434	7167					0		0	11601	11601
1991				20683			4020	3981	20683	3543	8414	0				0	0		11957	11957
1992				18046				2751	18046	4512	4173					0	0		8685	8685
1993				19720				2989	19720	5171	7193	33				33	33		12364	12397
1994				25043				4121	25043	5362	7882	310				310	310		13244	13554
1995				27600				4347	27600	4810	8845					0	0		13655	13655
1996				34123				2268	34123	5426	11329					0	0		16755	16755
1997				40708				7844	40708	5295	17018	2				2	2		22313	22316
1998				44164				3336	44164	6067	22229					0	0		28296	28296
1999				43796				4120	43796	1624	383	29				29	29		2006	2035

1986 report: "Sub-Area VIII does not include Div VIIIc. Spanish catches have been adjusted accordingly since 1976" (Tab 6.1)

Others VIIIx: attributed to the Western Stock (mainly Russian and French catches); from 1992 on only Portuguese catches, attributed to the Southern area.

Table 3.5: Total catch of NEA mackerel by area: changes applied to the summary table 2.2.2.1 taken from WG 2001 report (ICES CM2002/ACFM:6) Detailled information on the basis for these changes can be found in Sec. 3.

Area	*VI*			*VII & VIIIabde*			*IV & IIIa*			*IIa & Vb*	*VIIIc & IXa*	*Total*			absolute
Year	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Landings	Landings	Discards	Catch	change
1969	0	0	0	-18,896	0	-18,896	-7	0	-7	7	42,526	23,630	0	23,630	127599
1970	0	0	0	-27,478	0	-27,478	0	0	0	0	70,172	42,694	0	42,694	210516
1971	0	0	0	-32,855	0	-32,855	0	0	0	0	32,942	87	0	87	98826
1972	3,000	0	3,000	-27,520	0	-27,520	0	0	0	0	29,262	4,742	0	4,742	99786
1973	0	0	0	-22,493	0	-22,493	0	0	0	0	25,967	3,474	0	3,474	77901
1974	0	0	0	-26,435	0	-26,435	0	0	0	0	30,630	4,195	0	4,195	91890
1975	0	0	0	-20,505	0	-20,505	0	0	0	0	25,457	4,952	0	4,952	76371
1976	0	0	0	-18,480	0	-18,480	1,867	0	1,867	0	23,306	6,693	0	6,693	77386
1977	0	0	0	0	0	0	1,400	0	1,400	0	-2,001	-601	0	-601	6003
1978	0	0	-100	0	0	0	0	0	0	0	-599	-599	-100	-699	2097
1979	0	0	0	0	0	0	0	0	0	0	-543	-543	0	-543	1629
1980	0	0	0	0	0	0	540	0	540	0	-3,684	-3,144	0	-3,144	11052
1981	0	0	0	0	0	0	0	0	0	0	-1,365	-1,365	0	-1,365	4095
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	5,400	-20,000	-14,600	-10,400	0	-10,400	0	0	0	0	0	-5,000	-20,000	-25,000	110800
1984	0	0	0	-14,700	0	-14,700	0	0	0	4,322	-100	-6,156	0	-6,156	46134
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	4,204	0	4,204	0	4,204	12612
1989	0	0	0	0	0	0	0	0	0	3,588	0	3,588	0	3,588	10764
1990	0	0	0	0	0	0	0	0	0	1,900	0	1,900	0	1,900	5700
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	-3,583	0	-3,583	2,409	0	-1,173	0	-1,173	11921
1995	0	0	0	0	0	0	-1,196	0	-1,196	1,396	0	200	0	200	4188
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	1,921	0	1,921	-1,851	0	70	0	70	5833
1998	0	0	0	0	0	0	0	0	-18	0	0	0	-18	-18	54
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3.6: Total catch of NEA mackerel by area (resembles Table 2.2.2.1 in previous WG MHSA reports). Detailled information on the basis for the highlighted changes applied can be found in Sec. 3. Last column gives unresolved differences between this table and Table 3.7, assumed to be due to rounding. Year 2001 catch information was added during WGMHSA 2002.

Area	*VI*			*VII & VIIIabde*			*IV & IIIa*			*IIa & Vb*	*VIIIc & IXa*	*Total*			Diff. to
Year	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Landings	Landings	Discards	Catch	Tab 3.7
1963	2,488		2,488	42,381		42,381	73,548		73,548	889	19,342	138,648	0	138,648	0
1964	4,410		4,410	32,840		32,840	115,433		115,433	861	23,030	176,574	0	176,574	0
1965	5,703		5,703	26,695		26,695	208,944		208,944	712	49,301	291,355	0	291,355	0
1966	4,403		4,403	47,987		47,987	529,728		529,728	950	37,343	620,411	0	620,411	0
1967	5,383		5,383	43,730		43,730	931,129		931,129	897	46,627	1,027,766	0	1,027,766	0
1968	5,064		5,064	42,667		42,667	821,874		821,874	42	35,540	905,187	0	905,187	0
1969	4,800		4,800	47,404		47,404	739,175		739,175	7	42,526	833,912	0	833,912	0
1970	3,900		3,900	72,822		72,822	322,451		322,451	163	70,172	469,508	0	469,508	6
1971	10,200		10,200	89,745		89,745	243,673		243,673	358	32,942	376,918	0	376,918	26
1972	13,000		13,000	130,280		130,280	188,599		188,599	88	29,262	361,229	0	361,229	25
1973	52,200		52,200	144,807		144,807	326,519		326,519	21,600	25,967	571,093	0	571,093	82
1974	64,100		64,100	207,665		207,665	298,391		298,391	6,800	30,630	607,586	0	607,586	-46
1975	64,800		64,800	395,995		395,995	263,062		263,062	34,700	25,457	784,014	0	784,014	-56
1976	67,800		67,800	420,920		420,920	305,709		305,709	10,500	23,306	828,235	0	828,235	-4
1977	74,800		74,800	259,100		259,100	259,531		259,531	1,400	25,416	620,247	0	620,247	-29
1978	151,700	15,100	166,800	355,500	35,500	391,000	148,817		148,817	4,200	25,909	686,126	50,600	736,726	-106
1979	203,300	20,300	223,600	398,000	39,800	437,800	152,323	500	152,823	7,000	21,932	782,555	60,600	843,155	-72
1980	218,700	6,000	224,700	386,100	15,600	401,700	87,931		87,931	8,300	12,280	713,311	21,600	734,911	-40
1981	335,100	2,500	337,600	274,300	39,800	314,100	64,172	3,216	67,388	18,700	16,688	708,960	45,516	754,476	38
1982	340,400	4,100	344,500	257,800	20,800	278,600	35,033	450	35,483	37,600	21,076	691,909	25,350	717,259	-8
1983	320,500	2,300	322,800	235,000	9,000	244,000	40,889	96	40,985	49,000	14,853	660,242	11,396	671,638	50
1984	306,100	1,600	307,700	161,400	10,500	171,900	43,696	202	43,898	98,222	20,208	629,626	12,302	641,928	0
1985	388,140	2,735	390,875	75,043	1,800	76,843	46,790	3,656	50,446	78,000	18,111	606,084	8,191	614,275	-96
1986	104,100		104,100	128,499		128,499	236,309	7,431	243,740	101,000	24,789	594,697	7,431	602,128	-72
1987	183,700		183,700	100,300		100,300	290,829	10,789	301,618	47,000	22,187	644,016	10,789	654,805	-186
1988	115,600	3,100	118,700	75,600	2,700	78,300	308,550	29,766	338,316	120,404	24,772	644,926	35,566	680,492	0
1989	121,300	2,600	123,900	72,900	2,300	75,200	279,410	2,190	281,600	90,488	18,321	582,419	7,090	589,509	0
1990	114,800	5,800	120,600	56,300	5,500	61,800	300,800	4,300	305,100	118,700	21,311	611,911	15,600	627,511	0
1991	109,500	10,700	120,200	50,500	12,800	63,300	358,700	7,200	365,900	97,800	20,683	637,183	30,700	667,883	-3
1992	141,906	9,620	151,526	72,153	12,400	84,553	364,184	2,980	367,164	139,062	18,046	735,351	25,000	760,351	0
1993	133,497	2,670	136,167	99,828	12,790	112,618	387,838	2,720	390,558	165,973	19,720	806,856	18,180	825,036	0
1994	134,338	1,390	135,728	113,088	2,830	115,918	471,247	1,150	472,397	72,309	25,043	816,025	5,370	821,395	0
1995	145,626	74	145,700	117,883	6,917	124,800	321,474	730	322,204	135,496	27,600	748,079	7,721	755,800	24
1996	129,895	255	130,150	73,351	9,773	83,124	211,451	1,387	212,838	103,376	34,123	552,196	11,415	563,611	-1
1997	65,044	2,240	67,284	114,719	13,817	128,536	226,680	2,807	229,487	103,598	40,708	550,749	18,864	569,613	0
1998	110141	71	110,212	105,181	3,206	108,387	264,947	4,735	269,682	134,219	44,164	658,652	8,012	666,664	0
1999	98,666		98,666	93,821		93,821	299,798		299,798	72,848	43,796	608,929	0	608,929	-1
2000	150,927	1	150,928	113,520	1,918	115,438	271,997	165	272,162	92,557	36,074	665,075	2,084	667,159	0
2001	113,234	83	113,317	141,012	1,081	142,093	311,979	24	312,003	67,097	43,198	676,520	1,188	677,708	

NB: Data for 2000 and 2001 is preliminary. II and V include Sub-Area I and Div. Vb in 2000. For 1999, discards were reported as part of unallocated catch.

Table 3.7: Final catch in tonnes figures for NE-Atlantic Mackerel as agreed by SG DRAMA in 2002. Last column gives differences to the CATON file used in the latest assessment.

	NORTH SEA & WESTERN AREA						SOUTHERN	NEAM total		
Area/Div	Western Area			North Sea		total			WG 2000	
Year	VI	VII & VIIIabde	***Western all***	IV & III	IIa &Vb (incl. I)		VIIIc & IXa	all	CATON file	*Diff.*
1963	2488	42381	**44869**	73548	889	**119306**	19342	**138648**		
1964	4410	32840	**37250**	115433	861	**153544**	23030	**176574**		
1965	5703	26695	**32398**	208944	712	**242054**	49301	**291355**		
1966	4403	47987	**52390**	529728	950	**583068**	37343	**620411**		
1967	5383	43730	**49113**	931129	897	**981139**	46627	**1027766**		
1968	5064	42667	**47731**	821874	42	**869647**	35540	**905187**		
1969	4760	47444	**52204**	739175	7	**791386**	42526	**833912**		
1970	3854	72862	**76716**	322451	163	**399330**	70172	**469502**		
1971	10213	89706	**99919**	243673	358	**343950**	32942	**376892**		
1972	13013	130242	**143255**	188599	88	**331942**	29262	**361204**	328274	*32930*
1973	52166	144786	**196952**	326519	21573	**545044**	25967	**571011**	472757	*98254*
1974	64136	207646	**271782**	298391	6829	**577002**	30630	**607632**	520560	*87072*
1975	64849	396033	**460882**	263062	34669	**758613**	25457	**784070**	655012	*129058*
1976	67765	420933	**488698**	305709	10526	**804933**	23306	**828239**	693253	*134986*
1977	74829	259100	**333929**	259531	1400	**594860**	25416	**620276**	538504	*81772*
1978	166900	391000	**557900**	148817	4206	**710923**	25909	**736832**	633232	*103600*
1979	223600	437800	**661400**	152823	7072	**821295**	21932	**843227**	694108	*149119*
1980	224700	401700	**626400**	87931	8340	**722671**	12280	**734951**	681725	*53226*
1981	337600	314100	**651700**	67388	18662	**737750**	16688	**754438**	739815	*14623*
1982	344500	278600	**623100**	35483	37608	**696191**	21076	**717267**	684895	*32372*
1983	322800	244000	**566800**	40985	48950	**656735**	14853	**671588**	672140	*-552*
1984	307700	171900	**479600**	43898	98222	**621720**	20208	**641928**	648084	*-6156*
1985	390875	76843	**467718**	50446	78096	**596260**	18111	**614371**	614275	*96*
1986	104100	128499	**232599**	243700	101112	**577411**	24789	**602200**	602128	*72*
1987	183700	100300	**284000**	301618	47186	**632804**	22187	**654991**	654805	*186*
1988	118700	78300	**197000**	338316	120404	**655720**	24772	**680492**	676288	*4204*
1989	123900	75200	**199100**	281600	90488	**571188**	18321	**589509**	585921	*3588*
1990	120600	61800	**182400**	305100	118700	**606200**	21311	**627511**	625611	*1900*
1991	120200	63300	**183509**	365875	97819	**647203**	20683	**667886**	667883	*3*
1992	151526	84553	**236079**	367164	139062	**742305**	18046	**760351**	760351	*0*
1993	136167	112618	**248785**	390558	165973	**805316**	19720	**825036**	825036	*0*
1994	135728	115918	**251646**	472397	72309	**796352**	25043	**821395**	823477	*-2082*
1995	145700	124800	**270476**	322204	135496	**728176**	27600	**755776**	756291	*-515*
1996	130150	83124	**213274**	212839	103376	**529489**	34123	**563612**	563585	*27*
1997	67284	128536	**195820**	229487	103598	**528905**	40708	**569613**	569543	*70*
1998	110212	108387	**218599**	269682	134219	**622500**	44164	**666664**	667218	*-554*
1999	98666	93821	**192487**	299799	72848	**565134**	43796	**608930**	608928	*2*
2000*	150928	115438	**266366**	272162	92557	**631085**	36074	**667159**		

*Preliminary.

Table 4.1 Catch in numbers at age (CANUM) of the North Sea mackerel (from ICES data base) and the western mackerel (ICES CM 2002/ACFM:06) components for the period 1972-1983 and the North Sea/western combined mackerel together with the calculated SOP's. The catch in tonnes (CATON) files are obtained from the revised CATON files as agreed by SG DRAMA.

Unit: thousands

NORTH SEA MACKEREL (ICES fisheries assessment data base)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0	0	0	0	0	0	0	0	0	0	0	0
1	2600	4500	2900	11900	2700	1100	0	2300	2700	3900	3000	100
2	35600	12100	18700	10100	73600	19300	8200	500	5600	6000	14300	17300
3	162600	37600	23600	16200	69700	58900	34700	11300	2400	11500	15500	29300
4	102400	280200	39900	42400	13900	54300	40800	21200	14300	1100	9700	16900
5		169300	240800	27800	33800	9800	27900	33300	23500	12500	2000	6900
6			97900	193200	19500	26600	6000	14300	25900	17400	7700	1000
7				89700	118600	31600	14200	4200	15300	17800	7600	5600
8					56300	125900	16100	9200	12300	10500	8300	6600
9						56200	45700	2000	14000	5400	5300	5100
10							32300	27000	3500	7500	3000	4400
11								12700	19300	2200	3600	1800
12+									8900	26200	13800	14300
Total N	*303200*	*503700*	*423800*	*391300*	*388100*	*383700*	*225900*	*138000*	*147700*	*122000*	*93800*	*109300*
SOP (%)	160%	165%	161%	164%	181%	138%	139%	236%	129%	137%	164%	181%
Catch (t) by area	**188687**	**348092**	**305220**	**297731**	**316235**	**260931**	**153023**	**159895**	**96271**	**86050**	**73091**	**89935**

The catch by area is taken from the CATON-file (Table 3.7), which has been agreed at the SGDRAMA meeting.

WESTERN MACKEREL (Data from ICES CM 2002/ACFM:06)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	1600	0	1300	1000	34200	2000	10300	79500	19500	38300	2000	0
1	12400	33800	87000	52500	279400	153500	31300	351100	484500	266100	203000	43600
2	12100	49400	24300	104000	184900	289500	563800	61600	468700	506400	435900	712700
3	29400	64000	123500	94500	322300	154000	425000	602500	75200	225100	483600	444600
4	507700	115500	108500	306300	170600	166000	243700	365500	381300	31700	184100	391600
5		582300	191800	192200	288800	51000	258300	217200	282000	174800	24700	130400
6			567000	143800	118600	140000	71900	233100	145200	158500	136600	20200
7				1246200	279700	64400	151900	86800	158400	99500	108600	91300
8					438800	89400	56700	154200	52400	116600	84500	70900
9						158500	83200	70500	139600	35300	87000	47100
10							210800	74600	43600	138700	24400	48900
11								189100	47900	29400	90300	19100
12+									115400	176100	147600	126200
Total N	*563200*	*845000*	*1103400*	*2140500*	*2117300*	*1268300*	*2106900*	*2485700*	*2413700*	*1996500*	*2012300*	*2146600*
SOP (%)	65%	62%	66%	53%	72%	88%	89%	86%	78%	93%	89%	84%
Catch (t) by area	**143255**	**196952**	**271782**	**460882**	**488698**	**333929**	**557900**	**661400**	**626400**	**651700**	**623100**	**566800**

The catch by area is taken from the CATON-file (Table 3.7), which has been agreed at the SGDRAMA meeting.

NS&Western MACKEREL

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	1600	0	1300	1000	34200	2000	10300	79500	19500	38300	2000	0
1	15000	38300	89900	64400	282100	154600	31300	353400	487200	270000	206000	43700
2	47700	61500	43000	114100	258500	308800	572000	62100	474300	512400	450200	730000
3	192000	101600	147100	110700	392000	212900	459700	613800	77600	236600	499100	473900
4	610100	395700	148400	348700	184500	220300	284500	386700	395600	32800	193800	408500
5		751600	432600	220000	322600	60800	286200	250500	305500	187300	26700	137300
6			664900	337000	138100	166600	77900	247400	171100	175900	144300	21200
7				1335900	398300	96000	166100	91000	173700	117300	116200	96900
8					495100	215300	72800	163400	64700	127100	92800	77500
9						214700	128900	72500	153600	40700	92300	52200
10							243100	101600	47100	146200	27400	53300
11								201800	67200	31600	93900	20900
12+									124300	202300	161400	140500
Total	*866400*	*1348700*	*1527200*	*2531800*	*2505400*	*1652000*	*2332800*	*2623700*	*2561400*	*2118500*	*2106100*	*2255900*
SOP (%)	98%	103%	96%	73%	94%	104%	96%	98%	82%	97%	93%	90%
CATON (tonnes)	**331942**	**545044**	**577002**	**758613**	**804933**	**594860**	**710923**	**821295**	**722671**	**737750**	**696191**	**656735**

The catch by area is taken from the CATON-file (Table 3.7), which has been agreed at the SGDRAMA meeting.

SOP (%) = CATON / SUMPRODUCTS

Table 4.2 Catch in numbers at age (CANUM) of the North Sea / western mackerel combined for the period 1972-1983 and the correction to correspond to SOP's of 100%.

NS&Western

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	1600	0	1300	1000	34200	2000	10300	79500	19500	38300	2000	0
1	15000	38300	89900	64400	282100	154600	31300	353400	487200	270000	206000	43700
2	47700	61500	43000	114100	258500	308800	572000	62100	474300	512400	450200	730000
3	192000	101600	147100	110700	392000	212900	459700	613800	77600	236600	499100	473900
4	610100	395700	148400	348700	184500	220300	284500	386700	395600	32800	193800	408500
5		751600	432600	220000	322600	60800	286200	250500	305500	187300	26700	137300
6			664900	337000	138100	166600	77900	247400	171100	175900	144300	21200
7				1335900	398300	96000	166100	91000	173700	117300	116200	96900
8					495100	215300	72800	163400	64700	127100	92800	77500
9						214700	128900	72500	153600	40700	92300	52200
10							243100	101600	47100	146200	27400	53300
11								201800	67200	31600	93900	20900
12+									124300	202300	161400	140500
Total	*866400*	*1348700*	*1527200*	*2531800*	*2505400*	*1652000*	*2332800*	*2623700*	*2561400*	*2118500*	*2106100*	*2255900*
SOP (%)	98%	103%	96%	73%	94%	104%	96%	98%	82%	97%	93%	90%
CATON (tonnes)	**331942**	**545044**	**577002**	**758613**	**804933**	**594860**	**710923**	**821295**	**722671**	**737750**	**696191**	**656735**
Correction factor:	0.98	1.03	0.96	0.73	0.94	1.04	0.96	0.98	0.82	0.97	0.93	0.90

NS&Western Mackerel **CANUM CONVERTED DATA to achieve an SOP of 100%**

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	1561	0	1249	727	32131	2085	9916	78216	16048	37057	1870	0
1	14633	39436	86397	46803	265032	161184	30132	347692	400948	261238	192565	39456
2	46531	63324	41325	82923	242860	321951	550661	61097	390332	495772	420839	659099
3	187296	104613	141368	80452	368283	221967	442551	603886	63862	228922	466550	427873
4	595153	407434	142618	253421	173337	229682	273887	380454	325565	31736	181161	368825
5		773888	415744	159887	303082	63389	275523	246454	251416	181222	24959	123965
6			638993	244918	129745	173695	74994	243404	140809	170192	134889	19141
7				970879	374202	100088	159904	89530	142949	113494	108622	87489
8					465145	224469	70084	160761	53246	122976	86748	69973
9						223843	124091	71329	126407	39379	86280	47130
10							234031	99959	38762	141456	25613	48123
11								198541	55303	30575	87776	18870
12+									102294	195735	150874	126854
Total	*845175*	*1388695*	*1467694*	*1840012*	*2353818*	*1722353*	*2245774*	*2581323*	*2107941*	*2049754*	*1968747*	*2036797*
SOP (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CATON (tonnes)	**331942**	**545044**	**577002**	**758613**	**804933**	**594860**	**710923**	**821295**	**722671**	**737750**	**696191**	**656735**

SOP (%) = CATON / SUMPRODUCTS

Table 4.3 Catch in numbers at age (CANUM) of the southern mackerel for the period 1972-1983 as taken from Uriarte *et al* . (WD 2000) and then raised to correspond to SOP's of 100%.

SOUTHERN MACKEREL (Data from Uriarte&Villamor&Martins, WD2000)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	10190	17767	29381	34747	26945	3851	24620	36280	21868	20484	9399	7111
1	22668	7141	22727	15788	15775	13542	4365	12994	13309	15647	21576	8202
2	5705	11728	6380	9276	5706	6542	10041	1810	3454	6881	12143	9513
3	7983	4602	14699	3976	5288	4432	6763	5631	881	3018	5964	5693
4	62197	7924	6211	11478	3065	6208	5330	5119	3386	1125	3453	4303
5		42468	9139	4692	9915	4216	6611	4297	3535	3804	1601	2491
6			35983	6374	3617	12470	3869	4691	2781	3295	4119	1003
7				20345	4956	4743	12265	3122	3124	2958	3891	2582
8					12222	5146	3835	8836	1965	2685	2953	1996
9						12662	3870	2569	5595	1886	2469	1491
10							9269	2402	1486	4937	1958	1094
11								5745	1162	1111	4005	849
12+									3376	4050	5297	5029
Total	*108743*	*91629*	*124520*	*106675*	*87488*	*73812*	*90840*	*93495*	*65923*	*71882*	*78828*	*51358*
SOP (%)	90%	96%	95%	102%	113%	104%	100%	100%	78%	96%	99%	103%
CATON (t) revised	**29262**	**25967**	**30630**	**25457**	**23306**	**25416**	**25909**	**21932**	**12280**	**16688**	**21076**	**14853**

The catch by area is taken from the CATON-file (Table 3.7), which has been agreed at the SGDRAMA meeting.

Correction factor:	0.90	0.96	0.95	1.02	1.13	1.04	1.00	1.00	0.78	0.96	0.99	1.03

SOUTHERN MACKEREL **CANUM CONVERTED DATA to achieve SOP's of 100%**

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	9146	16997	28027	35444	30380	3992	24708	36314	17053	19625	9310	7333
1	20346	6832	21680	16104	17785	14036	4381	13006	10379	14990	21371	8458
2	5121	11220	6086	9462	6433	6781	10077	1812	2693	6593	12027	9810
3	7165	4402	14021	4056	5962	4593	6787	5636	687	2891	5907	5871
4	55826	7581	5925	11708	3456	6435	5349	5123	2641	1078	3420	4438
5		40630	8718	4786	11179	4369	6635	4301	2756	3645	1586	2568
6			34324	6502	4078	12924	3883	4695	2169	3157	4080	1034
7				20753	5588	4916	12309	3125	2436	2834	3855	2663
8					13780	5334	3849	8844	1532	2572	2925	2059
9						13123	3884	2571	4363	1807	2446	1538
10							9302	2404	1159	4730	1939	1128
11								5750	906	1064	3967	875
12+									2632	3880	5247	5185
Total	*97605*	*87662*	*118781*	*108815*	*98641*	*76503*	*91163*	*93581*	*51407*	*68866*	*78080*	*52959*
SOP (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CATON (tonnes)	**29262**	**25967**	**30630**	**25457**	**23306**	**25416**	**25909**	**21932**	**12280**	**16688**	**21076**	**14853**

The catch by area is taken from the CATON-file (Table 3.7), which has been agreed at the SGDRAMA meeting.

SOP (%) = CATON / SUMPRODUCTS

Table 4.4 Catch in numbers at age (CANUM) of the NEA mackerel for the period 1972-1983 obtained by combining the SOP corrected North Sea/western and the southern component catch in numbers at age.

NEA MACKEREL - CANUM

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	10707	16997	29277	36171	62510	6077	34623	114529	33101	56682	11180	7333
1	34979	46267	108077	62908	282818	175220	34513	360698	411327	276229	213936	47914
2	51652	74544	47410	92385	249293	328732	560738	62909	393025	502365	432867	668909
3	194461	109015	155390	84509	374245	226560	449338	609522	64549	231814	472457	433744
4	650980	415015	148543	265129	176793	236116	279236	385578	328206	32814	184581	373262
5		814518	424462	164673	314261	67758	282158	250755	254172	184867	26544	126533
6			673317	251420	133822	186619	78877	248099	142978	173349	138970	20175
7				991632	379790	105004	172213	92655	145385	116328	112476	90151
8					478925	229803	73933	169605	54778	125548	89672	72031
9						236966	127975	73900	130771	41186	88726	48668
10							243333	102363	39920	146186	27552	49252
11								204291	56210	31639	91743	19745
12+									104927	199615	156121	132040
Total	*942779*	*1476358*	*1586476*	*1948828*	*2452459*	*1798856*	*2336937*	*2674903*	*2159348*	*2118620*	*2046827*	*2089756*
SOP (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CATON (tonnes)	361204	571011	607632	784070	828239	620276	736832	843227	734951	754438	717267	671588

The catch by area is taken from the CATON-file (Table 3.7), which has been agreed at the SGDRAMA meeting.

Table 4.5 Mean catch weights at age (WECA) of the North Sea mackerel and the western mackerel components for the period 1972-1983 as obtained from the original ICES files and mean catch weights at age the North Sea/western combined mackerel (weighted by the catch in number data).

Unit: kg

NORTH SEA MACKEREL (ICES fisheries assessment data base)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0 #	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
1	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245
2	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329
3	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363
4	0.458	0.392	0.392	0.392	0.392	0.392	0.392	0.392	0.392	0.392	0.392	0.392
5		0.485	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438
6			0.536	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455
7				0.588	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520
8					0.596	0.580	0.580	0.580	0.580	0.580	0.580	0.580
9						0.608	0.585	0.585	0.585	0.585	0.585	0.585
10							0.636	0.610	0.610	0.610	0.610	0.610
11								0.656	0.635	0.635	0.635	0.635
12+									0.668	0.660	0.670	0.671

 # A constant weigth at age of 0.080kg has been assumed for 0-group

WESTERN MACKEREL (Original data 1999WG)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.066	0.066	0.066	0.066	0.066	0.066	0.000	0.000	0.066	0.066	0.066	0.066
1	0.137	0.137	0.137	0.137	0.137	0.137	0.137	0.137	0.131	0.131	0.131	0.178
2	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.248	0.248	0.248	0.216
3	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.283	0.283	0.283	0.270
4	0.416	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.343	0.343	0.343	0.306
5		0.437	0.334	0.334	0.334	0.334	0.334	0.334	0.373	0.373	0.373	0.383
6			0.472	0.398	0.398	0.398	0.398	0.398	0.455	0.455	0.455	0.425
7				0.480	0.410	0.410	0.410	0.410	0.497	0.497	0.497	0.430
8					0.508	0.503	0.503	0.503	0.508	0.508	0.508	0.491
9						0.511	0.511	0.511	0.539	0.539	0.539	0.542
10							0.511	0.511	0.573	0.573	0.573	0.608
11								0.511	0.573	0.573	0.573	0.608
12+									0.573	0.573	0.573	0.608

NS&Western MACKEREL Weighted mean (from CANUM and WECA)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.066	0.066	0.066	0.066	0.066	0.066	0.000	0.000	0.066	0.066	0.066	0.066
1	0.156	0.150	0.140	0.157	0.138	0.138	0.137	0.138	0.132	0.133	0.133	0.178
2	0.286	0.192	0.232	0.173	0.207	0.169	0.160	0.159	0.249	0.249	0.251	0.219
3	0.344	0.286	0.261	0.259	0.263	0.275	0.250	0.243	0.285	0.287	0.285	0.276
4	0.423	0.369	0.335	0.323	0.320	0.333	0.325	0.318	0.345	0.345	0.345	0.310
5		0.448	0.392	0.347	0.345	0.351	0.344	0.348	0.378	0.377	0.378	0.386
6			0.481	0.431	0.406	0.407	0.402	0.401	0.455	0.455	0.455	0.426
7				0.487	0.443	0.446	0.419	0.415	0.499	0.500	0.499	0.435
8					0.518	0.548	0.520	0.507	0.522	0.514	0.514	0.499
9						0.536	0.537	0.513	0.543	0.545	0.542	0.546
10							0.528	0.537	0.576	0.575	0.577	0.608
11								0.520	0.591	0.577	0.575	0.610
12+									0.580	0.584	0.581	0.614

Table 4.6 Mean catch weights at age (WECA) of the North Sea and western combined mackerel components and the southern mackerel component (Uriarte *et al*., WD 2000) for the period 1972-1983. The mean catch weights at age of the NEA mackerel is calculated by weighting by the catch in number data.

Unit: kg

NS&Western MACKEREL Weighted mean (from CANUM and WECA)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.066	0.066	0.066	0.066	0.066	0.066	0.000	0.000	0.066	0.066	0.066	0.066
1	0.156	0.150	0.140	0.157	0.138	0.138	0.137	0.138	0.132	0.133	0.133	0.178
2	0.286	0.192	0.232	0.173	0.207	0.169	0.160	0.159	0.249	0.249	0.251	0.219
3	0.344	0.286	0.261	0.259	0.263	0.275	0.250	0.243	0.285	0.287	0.285	0.276
4	0.423	0.369	0.335	0.323	0.320	0.333	0.325	0.318	0.345	0.345	0.345	0.310
5		0.448	0.392	0.347	0.345	0.351	0.344	0.348	0.378	0.377	0.378	0.386
6			0.481	0.431	0.406	0.407	0.402	0.401	0.455	0.455	0.455	0.426
7				0.487	0.443	0.446	0.419	0.415	0.499	0.500	0.499	0.435
8					0.518	0.548	0.520	0.507	0.522	0.514	0.514	0.499
9						0.536	0.537	0.513	0.543	0.545	0.542	0.546
10							0.528	0.537	0.576	0.575	0.577	0.608
11								0.520	0.591	0.577	0.575	0.610
12+									0.580	0.584	0.581	0.614

SOUTHERN MACKEREL (Data from Uriarte *et al*., WD2000)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
1	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121
2	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207
3	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264
4	0.419	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
5		0.452	0.374	0.374	0.374	0.374	0.374	0.374	0.374	0.374	0.374	0.374
6			0.480	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407
7				0.506	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440
8					0.531	0.479	0.479	0.479	0.479	0.479	0.479	0.479
9						0.550	0.504	0.504	0.504	0.504	0.504	0.504
10							0.566	0.530	0.530	0.530	0.530	0.530
11								0.579	0.545	0.545	0.545	0.545
12+									0.591	0.591	0.591	0.591

NEA MACKEREL - WECA

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.052	0.050	0.051	0.050	0.059	0.056	0.036	0.016	0.057	0.060	0.053	0.050
1	0.135	0.145	0.136	0.148	0.137	0.136	0.135	0.137	0.131	0.132	0.131	0.168
2	0.277	0.194	0.229	0.177	0.207	0.169	0.161	0.161	0.249	0.248	0.249	0.219
3	0.341	0.285	0.261	0.259	0.263	0.275	0.250	0.243	0.285	0.287	0.285	0.276
4	0.423	0.368	0.334	0.323	0.320	0.333	0.325	0.318	0.345	0.344	0.345	0.310
5		0.448	0.392	0.348	0.346	0.352	0.345	0.348	0.378	0.377	0.378	0.386
6			0.481	0.430	0.406	0.407	0.403	0.401	0.454	0.454	0.454	0.425
7				0.488	0.443	0.446	0.421	0.416	0.498	0.499	0.496	0.435
8					0.518	0.546	0.518	0.506	0.520	0.513	0.513	0.498
9						0.537	0.536	0.513	0.542	0.543	0.541	0.545
10							0.529	0.537	0.574	0.573	0.574	0.606
11								0.522	0.590	0.576	0.574	0.608
12+									0.580	0.584	0.582	0.614

Table 4.7 The catch in numbers at age (CANUM) and the mean catch weights at age (WECA) of the NEA mackerel for the period 1984-1988 (ICES CM 2002/ACFM:06). The catch in numbers at age were corrected to achieve 100% SOP's and the CATON file of the WG was replaced by the CATON file as agreed by this study group. No changes were made to the mean weights at age in the catches.

NEA MACKEREL - CANUM from ICES 2002/ACFM:06

Age	1984	1985	1986	1987	1988
0	288397	81220	48519	7417	55119
1	32024	267056	56423	40203	145969
2	86397	20745	412124	156970	131606
3	685128	57933	37262	664649	182062
4	389079	442205	74302	56789	514809
5	252475	250432	353451	89173	69720
6	98442	164050	201927	245038	83498
7	22171	61922	122477	150876	192215
8	62052	19424	41322	86027	117130
9	48110	47223	13137	34862	53464
10	37627	37341	31825	19696	19803
11	30221	26774	22298	25796	12601
12+	69450	96961	78775	63267	54975
Total	*2101573*	*1573286*	*1493842*	*1640763*	*1632971*
SOP (%)	100%	101%	103%	100%	105%
CATON (t) 2001WG	**641928**	**614371**	**602200**	**654991**	**680492**
Correction factor:	1.00	1.01	1.03	1.00	1.05

NEA MACKEREL - WECA data from ICES 2002/ACFM:06

Age	1984	1985	1986	1987	1988
0	0.031	0.055	0.039	0.076	0.055
1	0.102	0.144	0.146	0.179	0.133
2	0.184	0.262	0.245	0.223	0.259
3	0.295	0.357	0.335	0.318	0.323
4	0.326	0.418	0.423	0.399	0.388
5	0.344	0.417	0.471	0.474	0.456
6	0.431	0.436	0.444	0.512	0.524
7	0.542	0.521	0.457	0.493	0.555
8	0.48	0.555	0.543	0.498	0.555
9	0.569	0.564	0.591	0.58	0.562
10	0.628	0.629	0.552	0.634	0.613
11	0.636	0.679	0.694	0.635	0.624
12+	0.663	0.710	0.688	0.718	0.697

Revised CANUM - NEA MACKEREL

Age	1984	1985	1986	1987	1988
0	287287	81799	49983	7403	57644
1	31901	268960	58126	40126	152656
2	86064	20893	424563	156670	137635
3	682491	58346	38387	663378	190403
4	387582	445357	76545	56680	538394
5	251503	252217	364119	89003	72914
6	98063	165219	208021	244570	87323
7	22086	62363	126174	150588	201021
8	61813	19562	42569	85863	122496
9	47925	47560	13533	34795	55913
10	37482	37607	32786	19658	20710
11	30105	26965	22971	25747	13178
12+	69183	97652	81153	63146	57494
Total	*2093485*	*1584500*	*1538929*	*1637626*	*1707784*
SOP (%)	99.3%	100%	100%	100%	100%
CATON (tonnes)	**637606**	**614371**	**602200**	**654991**	**680492**
	Revised CATON - NEA MACKEREL (from Table 3.7)				

NOT revised WECA - NEA MACKEREL

Age	1984	1985	1986	1987	1988
0	0.031	0.055	0.039	0.076	0.055
1	0.102	0.144	0.146	0.179	0.133
2	0.184	0.262	0.245	0.223	0.259
3	0.295	0.357	0.335	0.318	0.323
4	0.326	0.418	0.423	0.399	0.388
5	0.344	0.417	0.471	0.474	0.456
6	0.431	0.436	0.444	0.512	0.524
7	0.542	0.521	0.457	0.493	0.555
8	0.480	0.555	0.543	0.498	0.555
9	0.569	0.564	0.591	0.580	0.562
10	0.628	0.629	0.552	0.634	0.613
11	0.636	0.679	0.694	0.635	0.624
12+	0.663	0.710	0.688	0.718	0.697

Table 5.1 Mean weight at age in the stock (WEST) of the North Sea (from ICES data base), western (ICES CM 2002/ ACFM:06) and southern (Uriarte *et al*., WD 2000) mackerel components for the period 1972-1983. The mean weight at age in the stock of the NEA mackerel is calculated by weighting according biomass by component (upper table).

North Sea Mack. biomass in 1972 (1981WG): 1249400 t 25%

Decrease North Sea fraction: **0.020**

Western Mackerel biomass in 1972 (1999WG): 3085197 t 60%

85%

WEIGHTING FACTORS

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
North Sea	0.250	0.230	0.209	0.189	0.168	0.148	0.128	0.107	0.087	0.066	0.046	0.026
Western	0.600	0.620	0.641	0.661	0.682	0.702	0.722	0.743	0.763	0.784	0.804	0.824
Southern	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150

Fraction North Sea compared to NS+western --> 3.0%

According combining data (1998WG)

Unit: kg

NORTH SEA MACKEREL (ICES fisheries assessment data base)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180
2	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275
3	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330
4	0.477	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415
5		0.497	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
6			0.543	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.495
7				0.572	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525
8					0.570	0.550	0.550	0.550	0.550	0.550	0.550	0.550
9						0.587	0.565	0.565	0.565	0.565	0.565	0.565
10							0.615	0.590	0.590	0.590	0.590	0.590
11								0.634	0.610	0.610	0.610	0.610
12+									0.647	0.636	0.646	0.648

WESTERN MACKEREL (Data from ICES 2000, ACFM:5)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.113	0.113	0.113	0.113	0.113	0.113	0.095	0.095	0.095	0.070	0.070	0.070
2	0.131	0.131	0.131	0.131	0.131	0.131	0.150	0.150	0.150	0.172	0.108	0.156
3	0.201	0.201	0.201	0.201	0.201	0.201	0.215	0.215	0.215	0.241	0.202	0.220
4	0.380	0.251	0.251	0.251	0.251	0.251	0.275	0.275	0.275	0.300	0.260	0.261
5		0.410	0.264	0.264	0.264	0.264	0.320	0.320	0.320	0.300	0.379	0.322
6			0.440	0.316	0.316	0.316	0.355	0.355	0.355	0.359	0.329	0.360
7				0.470	0.380	0.380	0.380	0.380	0.380	0.401	0.388	0.384
8					0.490	0.412	0.400	0.400	0.400	0.412	0.417	0.420
9						0.511	0.420	0.420	0.420	0.427	0.425	0.497
10							0.485	0.485	0.485	0.413	0.460	0.453
11								0.485	0.485	0.509	0.513	0.550
12+									0.485	0.509	0.513	0.550

Table 5.1 Continued

SOUTHERN MACKEREL (Data from Uriarte&Villamor&Martins, WD2000)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
1	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128
2	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213
3	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271
4	0.426	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
5		0.459	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376
6			0.489	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416
7				0.515	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
8					0.536	0.490	0.490	0.490	0.490	0.490	0.490	0.490
9						0.552	0.505	0.505	0.505	0.505	0.505	0.505
10							0.570	0.530	0.530	0.530	0.530	0.530
11								0.584	0.553	0.553	0.553	0.553
12+									0.594	0.594	0.594	0.594

NEA MACKEREL

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
1	0.132	0.131	0.129	0.128	0.127	0.125	0.111	0.109	0.107	0.086	0.084	0.082
2	0.179	0.176	0.173	0.170	0.168	0.165	0.175	0.173	0.170	0.185	0.131	0.168
3	0.244	0.241	0.238	0.236	0.233	0.231	0.238	0.236	0.233	0.251	0.218	0.230
4	0.411	0.299	0.296	0.293	0.289	0.286	0.300	0.297	0.294	0.311	0.276	0.274
5		0.437	0.322	0.318	0.314	0.310	0.346	0.343	0.341	0.322	0.382	0.334
6			0.469	0.365	0.361	0.357	0.382	0.379	0.376	0.377	0.350	0.372
7				0.496	0.416	0.413	0.411	0.408	0.405	0.418	0.405	0.399
8					0.510	0.444	0.433	0.430	0.427	0.433	0.434	0.434
9						0.528	0.451	0.448	0.445	0.448	0.443	0.500
10							0.514	0.503	0.501	0.442	0.476	0.468
11								0.516	0.506	0.522	0.523	0.552
12+									0.515	0.530	0.531	0.559

Table 5.2 Proportion mature (MATPROP) of the North Sea (from ICES data base), western (ICES CM 2002/ACFM:06) and southern (Uriarte *et al*., WD 2000) mackerel components for the period 1972-1983. The proportion mature in the stock of the NEA mackerel is calculated by weighting according biomass by component (upper table).

North Sea Mack. biomass in 1972 (1981WG): 1249400 t — 25%
Western Mackerel biomass in 1972 (1999WG): 3085197 t — 60%
85%

Decrease North Sea fraction: 0.020

WEIGHTING FACTORS

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
North Sea	0.250	0.230	0.209	0.189	0.168	0.148	0.128	0.107	0.087	0.066	0.046	0.026
Western	0.600	0.620	0.641	0.661	0.682	0.702	0.722	0.743	0.763	0.784	0.804	0.824
Southern	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150

Fraction North Sea compared to NS+western --> 3.0%
According combining data (1998WG)

Unit:

NORTH SEA MACKEREL (ICES fisheries assessment data base)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

WESTERN MACKEREL (Data from ICES 2000, ACFM:5, but corrected for SOP errors)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
3	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
4	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
5	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 5.2 Continued

SOUTHERN MACKEREL (Data from ICES 1995/Assess:2)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
2	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
3	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NEA MACKEREL

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13
2	0.59	0.59	0.60	0.60	0.60	0.61	0.61	0.62	0.62	0.63	0.63	0.64
3	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91
4	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
5	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 6.1 The new fisheries assessment data set for NEA mackerel 1972-2000 as agreed by SG DRAMA in 2002

CATON 1972-2000

year	tonnes
1972	361204
1973	571011
1974	607632
1975	784070
1976	828239
1977	620276
1978	736832
1979	843227
1980	734951
1981	754438
1982	717267
1983	671588
1984	641928
1985	614371
1986	602200
1987	654991
1988	680492
1989	589509
1990	627511
1991	667886
1992	760351
1993	825036
1994	821395
1995	755776
1996	563612
1997	569613
1998	666664
1999	608930
2000	667159

Table 6.1 Continued

CANUM 1972-2000

year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1972	10707	34979	51652	194461	650980	0	0	0	0	0	0	0	0
1973	16997	46267	74544	109015	415015	814518	0	0	0	0	0	0	0
1974	29277	108077	47410	155390	148543	424462	673317	0	0	0	0	0	0
1975	36171	62908	92385	84509	265129	164673	251420	991632	0	0	0	0	0
1976	62510	282818	249293	374245	176793	314261	133822	379790	478925	0	0	0	0
1977	6077	175220	328732	226560	236116	67758	186619	105004	229803	236966	0	0	0
1978	34623	34513	560738	449338	279236	282158	78877	172213	73933	127975	243333	0	0
1979	114529	360698	62909	609522	385578	250755	248099	92655	169605	73900	102363	204291	0
1980	33101	411327	393025	64549	328206	254172	142978	145385	54778	130771	39920	56210	104927
1981	56682	276229	502365	231814	32814	184867	173349	116328	125548	41186	146186	31639	199615
1982	11180	213936	432867	472457	184581	26544	138970	112476	89672	88726	27552	91743	156121
1983	7333	47914	668909	433744	373262	126533	20175	90151	72031	48668	49252	19745	132040
1984	287287	31901	86064	682491	387582	251503	98063	22086	61813	47925	37482	30105	69183
1985	81799	268960	20893	58346	445357	252217	165219	62363	19562	47560	37607	26965	97652
1986	49983	58126	424563	38387	76545	364119	208021	126174	42569	13533	32786	22971	81153
1987	7403	40126	156670	663378	56680	89003	244570	150588	85863	34795	19658	25747	63146
1988	57644	152656	137635	190403	538394	72914	87323	201021	122496	55913	20710	13178	57494
1989	65400	64263	312739	207689	167588	362469	48696	58116	111251	68240	32228	13904	35814
1990	24246	140534	209848	410751	208146	156742	254015	42549	49698	85447	33041	16587	27905
1991	10007	58459	212521	206421	375451	188623	129145	197888	51077	43415	70839	29743	52986
1992	43447	83583	156292	356209	266591	306143	156070	113899	138458	51208	36612	40956	68205
1993	19354	128144	210319	266677	398240	244285	255472	149932	97746	121400	38794	29067	68217
1994	25368	147315	221489	306979	267420	301346	184925	189847	106108	80054	57622	20407	57551
1995	14759	81529	340898	340215	275031	186855	197856	142342	113413	69191	42441	37960	39753
1996	37956	119852	168882	333365	279182	177667	96303	119831	55812	59801	25803	18353	30648
1997	36012	144390	186481	238426	378881	246781	135059	84378	66504	39450	26735	13950	24974
1998	61127	99352	229767	264566	323186	361945	207619	118388	72745	47353	24386	16551	22932
1999	67003	73520	131319	212652	249964	267014	228683	149107	81454	47004	28505	15787	30586
2000	36345	102153	133588	254133	345211	262174	215419	156339	95286	46546	27787	16747	30093

WECA 1972-2000

year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1972	0.052	0.135	0.277	0.341	0.423	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.050	0.145	0.194	0.285	0.368	0.448	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.051	0.136	0.229	0.261	0.334	0.392	0.481	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.050	0.148	0.177	0.259	0.323	0.348	0.430	0.488	0.000	0.000	0.000	0.000	0.000
1976	0.059	0.137	0.207	0.263	0.320	0.346	0.406	0.443	0.518	0.000	0.000	0.000	0.000
1977	0.056	0.136	0.169	0.275	0.333	0.352	0.407	0.446	0.546	0.537	0.000	0.000	0.000
1978	0.036	0.135	0.161	0.250	0.325	0.345	0.403	0.421	0.518	0.536	0.529	0.000	0.000
1979	0.016	0.137	0.161	0.243	0.318	0.348	0.401	0.416	0.506	0.513	0.537	0.522	0.000
1980	0.057	0.131	0.249	0.285	0.345	0.378	0.454	0.498	0.520	0.542	0.574	0.590	0.580
1981	0.060	0.132	0.248	0.287	0.344	0.377	0.454	0.499	0.513	0.543	0.573	0.576	0.584
1982	0.053	0.131	0.249	0.285	0.345	0.378	0.454	0.496	0.513	0.541	0.574	0.574	0.582
1983	0.050	0.168	0.219	0.276	0.310	0.386	0.425	0.435	0.498	0.545	0.606	0.608	0.614
1984	0.031	0.102	0.184	0.295	0.326	0.344	0.431	0.542	0.480	0.569	0.628	0.636	0.663
1985	0.055	0.144	0.262	0.357	0.418	0.417	0.436	0.521	0.555	0.564	0.629	0.679	0.710
1986	0.039	0.146	0.245	0.335	0.423	0.471	0.444	0.457	0.543	0.591	0.552	0.694	0.688
1987	0.076	0.179	0.223	0.318	0.399	0.474	0.512	0.493	0.498	0.580	0.634	0.635	0.718
1988	0.055	0.133	0.259	0.323	0.388	0.456	0.524	0.555	0.555	0.562	0.613	0.624	0.697
1989	0.049	0.136	0.237	0.320	0.377	0.433	0.456	0.543	0.592	0.578	0.581	0.648	0.739
1990	0.085	0.156	0.233	0.336	0.379	0.423	0.467	0.528	0.552	0.606	0.606	0.591	0.713
1991	0.068	0.156	0.253	0.327	0.394	0.423	0.469	0.506	0.554	0.609	0.630	0.649	0.708
1992	0.051	0.167	0.239	0.333	0.397	0.460	0.495	0.532	0.555	0.597	0.651	0.663	0.669
1993	0.061	0.134	0.240	0.317	0.376	0.436	0.483	0.527	0.548	0.583	0.595	0.647	0.679
1994	0.046	0.136	0.255	0.339	0.390	0.448	0.512	0.543	0.590	0.583	0.627	0.678	0.713
1995	0.072	0.143	0.234	0.333	0.390	0.452	0.501	0.539	0.577	0.594	0.606	0.631	0.672
1996	0.058	0.143	0.226	0.313	0.377	0.425	0.484	0.518	0.551	0.576	0.596	0.603	0.670
1997	0.076	0.143	0.230	0.295	0.359	0.415	0.453	0.481	0.524	0.553	0.577	0.591	0.636
1998	0.065	0.157	0.227	0.310	0.354	0.408	0.452	0.462	0.518	0.550	0.573	0.591	0.631
1999	0.062	0.176	0.236	0.307	0.361	0.406	0.454	0.501	0.537	0.569	0.587	0.609	0.688
2000	0.063	0.135	0.229	0.308	0.367	0.429	0.467	0.504	0.537	0.570	0.588	0.597	0.649

Table 6.1 Continued

WEST 1972-2000

Postscript: note updated Table 7.1!

year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1972	0.009	0.132	0.179	0.244	0.411	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.009	0.131	0.176	0.241	0.299	0.437	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.009	0.129	0.173	0.238	0.296	0.322	0.469	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.009	0.128	0.170	0.236	0.293	0.318	0.365	0.496	0.000	0.000	0.000	0.000	0.000
1976	0.009	0.127	0.168	0.233	0.289	0.314	0.361	0.416	0.510	0.000	0.000	0.000	0.000
1977	0.009	0.125	0.165	0.231	0.286	0.310	0.357	0.413	0.444	0.528	0.000	0.000	0.000
1978	0.009	0.111	0.175	0.238	0.300	0.346	0.382	0.411	0.433	0.451	0.514	0.000	0.000
1979	0.009	0.109	0.173	0.236	0.297	0.343	0.379	0.408	0.430	0.448	0.503	0.516	0.000
1980	0.009	0.107	0.170	0.233	0.294	0.341	0.376	0.405	0.427	0.445	0.501	0.506	0.515
1981	0.009	0.086	0.185	0.251	0.311	0.322	0.377	0.418	0.433	0.448	0.442	0.522	0.530
1982	0.009	0.084	0.131	0.218	0.276	0.382	0.350	0.405	0.434	0.443	0.476	0.523	0.531
1983	0.009	0.082	0.168	0.230	0.274	0.334	0.372	0.399	0.434	0.500	0.468	0.552	0.559
1984	0.000	0.087	0.198	0.257	0.297	0.321	0.389	0.435	0.435	0.474	0.521	0.508	0.573
1985	0.000	0.087	0.168	0.295	0.311	0.340	0.378	0.429	0.451	0.460	0.554	0.575	0.611
1986	0.000	0.087	0.180	0.270	0.302	0.353	0.354	0.407	0.473	0.455	0.469	0.488	0.586
1987	0.000	0.086	0.158	0.246	0.284	0.368	0.382	0.404	0.419	0.470	0.495	0.462	0.569
1988	0.000	0.084	0.161	0.244	0.310	0.336	0.433	0.455	0.445	0.468	0.531	0.597	0.647
1989	0.000	0.084	0.187	0.248	0.307	0.348	0.373	0.424	0.472	0.452	0.465	0.504	0.597
1990	0.000	0.084	0.146	0.227	0.291	0.339	0.374	0.412	0.408	0.434	0.519	0.519	0.537
1991	0.000	0.084	0.164	0.239	0.314	0.360	0.411	0.435	0.504	0.542	0.570	0.570	0.586
1992	0.000	0.084	0.221	0.264	0.316	0.363	0.404	0.429	0.468	0.492	0.526	0.555	0.592
1993	0.000	0.084	0.201	0.270	0.318	0.361	0.418	0.458	0.468	0.485	0.517	0.590	0.574
1994	0.000	0.084	0.186	0.241	0.299	0.358	0.410	0.466	0.468	0.478	0.549	0.602	0.579
1995	0.000	0.084	0.166	0.266	0.322	0.391	0.442	0.487	0.504	0.541	0.508	0.615	0.635
1996	0.000	0.084	0.141	0.253	0.320	0.360	0.440	0.463	0.503	0.566	0.575	0.613	0.638
1997	0.000	0.084	0.197	0.232	0.301	0.363	0.404	0.447	0.482	0.519	0.540	0.533	0.601
1998	0.000	0.094	0.168	0.241	0.298	0.353	0.413	0.439	0.478	0.514	0.561	0.539	0.624
1999	0.000	0.094	0.209	0.256	0.315	0.361	0.409	0.437	0.459	0.497	0.514	0.478	0.601
2000	0.000	0.094	0.203	0.255	0.301	0.360	0.397	0.434	0.460	0.499	0.504	0.542	0.572

Table 6.1 Continued

MATPROP 1972-2000

Postscript: note updated Table 7.2!

year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1972	0.000	0.116	0.586	0.933	0.982	0.982	0.994	1.000	1.000	1.000	1.000	1.000	1.000
1973	0.000	0.117	0.591	0.930	0.981	0.981	0.994	1.000	1.000	1.000	1.000	1.000	1.000
1974	0.000	0.119	0.595	0.928	0.981	0.981	0.994	1.000	1.000	1.000	1.000	1.000	1.000
1975	0.000	0.120	0.600	0.926	0.980	0.980	0.993	1.000	1.000	1.000	1.000	1.000	1.000
1976	0.000	0.122	0.605	0.924	0.980	0.980	0.993	1.000	1.000	1.000	1.000	1.000	1.000
1977	0.000	0.124	0.609	0.922	0.979	0.979	0.993	1.000	1.000	1.000	1.000	1.000	1.000
1978	0.000	0.125	0.614	0.920	0.978	0.978	0.993	1.000	1.000	1.000	1.000	1.000	1.000
1979	0.000	0.127	0.619	0.918	0.978	0.978	0.993	1.000	1.000	1.000	1.000	1.000	1.000
1980	0.000	0.129	0.624	0.916	0.977	0.977	0.992	1.000	1.000	1.000	1.000	1.000	1.000
1981	0.000	0.130	0.628	0.914	0.976	0.976	0.992	1.000	1.000	1.000	1.000	1.000	1.000
1982	0.000	0.132	0.633	0.912	0.976	0.976	0.992	1.000	1.000	1.000	1.000	1.000	1.000
1983	0.000	0.133	0.638	0.910	0.975	0.975	0.992	1.000	1.000	1.000	1.000	1.000	1.000
1984	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1985	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1986	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1987	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1988	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1989	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1990	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1991	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1992	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1993	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1994	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1995	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1996	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1997	0.000	0.140	0.650	0.910	0.970	0.970	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1998	0.000	0.060	0.580	0.850	0.980	0.980	0.990	1.000	1.000	1.000	1.000	1.000	1.000
1999	0.000	0.060	0.580	0.850	0.980	0.980	0.990	1.000	1.000	1.000	1.000	1.000	1.000
2000	0.000	0.060	0.580	0.850	0.980	0.980	0.990	1.000	1.000	1.000	1.000	1.000	1.000

Table 7.1 Mean weights at age in the stock (WEST) of NEA mackerel based on weighting by SSBs from egg surveys (1984-recent).

For 1972-1983 calculation is based on weighting by SSBs obtained from VPA .

Revision needed because from 1984-1994 ratio western/southern 85:15 was used and did not include North Sea SSB (WG1995)

WEIGHTING FACTORS

For 1984 up to 1997 the same SSB ratios are used as estimated from the 1995 Egg surveys

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
North Sea	0.2541	0.2487	0.2211	0.2047	0.2010	0.1774	0.1361	0.1251	0.1164	0.0860	0.0799	0.0743	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0178	0.0178	0.0178	0.0275
Western	0.6181	0.6235	0.6511	0.6675	0.6712	0.6948	0.7361	0.7471	0.7558	0.7862	0.7923	0.7979	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.7727	0.7727	0.7727	0.8481
Southern	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.2095	0.2095	0.2095	0.1244

The ratios between North Sea and western from 1972-1983 reflect the SSBs from VPA

(western SSB from ICES CM 2002/ACFM:06 and North Sea SSB from ICES CM 1984/Assess:8)

Ratios from 1995 onwards see Overview egg survey SSBs Table 6 (WD2002)

Unit: kg

NORTH SEA MACKEREL (ICES fisheries assessment data base 1972-1983)

From 1984 onwards a constant data set has been used

Data for 2001 from 2002 egg survey (Iversen & Eltink WD2002)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.120
2	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.209
3	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.295
4	0.477	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.342
5		0.497	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.364
6			0.543	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.437
7				0.572	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.444
8					0.570	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.429
9						0.587	0.565	0.565	0.565	0.565	0.565	0.565	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.509
10							0.615	0.590	0.590	0.590	0.590	0.590	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.606
11								0.634	0.610	0.610	0.610	0.610	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.643
12+									0.647	0.636	0.646	0.648	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.550

From 1988-2000 the stock weight of the 15+ group weight estimated from average over 12-15+group

WESTERN MACKEREL Data are taken from WEST file (2001WG)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.113	0.113	0.113	0.113	0.113	0.113	0.095	0.095	0.095	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
2	0.131	0.131	0.131	0.131	0.131	0.131	0.150	0.150	0.150	0.172	0.108	0.156	0.187	0.150	0.164	0.139	0.146	0.176	0.128	0.149	0.216	0.193	0.175	0.151	0.122	0.187	0.139	0.195	0.187	0.158
3	0.201	0.201	0.201	0.201	0.201	0.201	0.215	0.215	0.215	0.241	0.202	0.220	0.246	0.292	0.261	0.233	0.233	0.238	0.213	0.227	0.257	0.264	0.230	0.259	0.244	0.216	0.217	0.237	0.236	0.237
4	0.380	0.251	0.251	0.251	0.251	0.251	0.275	0.275	0.275	0.300	0.260	0.261	0.283	0.300	0.290	0.268	0.302	0.299	0.280	0.307	0.309	0.311	0.289	0.316	0.314	0.290	0.277	0.301	0.282	0.345
5		0.410	0.264	0.264	0.264	0.264	0.320	0.320	0.320	0.300	0.379	0.322	0.305	0.328	0.345	0.363	0.327	0.342	0.331	0.356	0.359	0.357	0.353	0.392	0.356	0.357	0.339	0.350	0.350	0.392
6			0.440	0.316	0.316	0.316	0.355	0.355	0.355	0.359	0.329	0.360	0.379	0.366	0.337	0.371	0.434	0.363	0.365	0.408	0.400	0.416	0.407	0.445	0.443	0.398	0.407	0.401	0.385	0.452
7				0.470	0.380	0.380	0.380	0.380	0.380	0.401	0.388	0.384	0.429	0.421	0.395	0.392	0.455	0.419	0.405	0.431	0.424	0.458	0.468	0.493	0.464	0.446	0.434	0.432	0.427	0.461
8					0.490	0.412	0.400	0.400	0.400	0.412	0.417	0.420	0.421	0.440	0.467	0.402	0.436	0.468	0.393	0.506	0.464	0.464	0.464	0.506	0.505	0.480	0.473	0.446	0.448	0.506
9						0.511	0.420	0.420	0.420	0.427	0.425	0.497	0.465	0.448	0.441	0.459	0.460	0.441	0.420	0.547	0.489	0.480	0.472	0.546	0.576	0.520	0.515	0.491	0.494	0.535
10							0.485	0.485	0.485	0.413	0.460	0.453	0.515	0.554	0.451	0.483	0.528	0.451	0.514	0.574	0.523	0.512	0.550	0.502	0.580	0.539	0.567	0.503	0.489	0.586
11								0.485	0.485	0.509	0.513	0.550	0.497	0.579	0.472	0.442	0.606	0.496	0.514	0.574	0.556	0.597	0.612	0.627	0.624	0.530	0.535	0.452	0.539	0.610
12+									0.485	0.509	0.513	0.550	0.549	0.599	0.568	0.547	0.645	0.585	0.514	0.574	0.582	0.561	0.568	0.633	0.638	0.579	0.588	0.574	0.543	0.589

Table 7.1 Continued

SOUTHERN MACKEREL				(1972-1983 Data from Uriarte&Villamor&Martins, WD2000)									Revised set 1984-2001 according WD 2002																	
Age	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
0	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.137	0.164	0.107	0.116	0.069	0.098	0.081	0.093	0.116	0.111	0.122	0.134	0.095	0.100	0.099	0.118	0.085	0.127
2	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.230	0.241	0.260	0.183	0.204	0.168	0.178	0.174	0.183	0.211	0.179	0.229	0.173	0.165	0.178	0.185	0.172	0.196
3	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.281	0.296	0.294	0.268	0.237	0.264	0.253	0.226	0.253	0.277	0.257	0.309	0.278	0.281	0.235	0.255	0.227	0.259
4	0.426	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.356	0.332	0.378	0.386	0.277	0.340	0.310	0.295	0.303	0.326	0.360	0.381	0.325	0.319	0.310	0.294	0.307	0.320
5		0.459	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.415	0.401	0.404	0.425	0.314	0.390	0.365	0.340	0.360	0.361	0.388	0.422	0.410	0.363	0.344	0.357	0.344	0.382
6			0.489	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.465	0.476	0.410	0.459	0.337	0.468	0.401	0.403	0.395	0.403	0.433	0.460	0.447	0.413	0.367	0.370	0.401	0.404
7				0.515	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.491	0.492	0.554	0.534	0.387	0.497	0.475	0.439	0.424	0.441	0.468	0.496	0.463	0.447	0.398	0.391	0.421	0.445
8					0.536	0.490	0.490	0.490	0.490	0.490	0.490	0.490	0.567	0.578	0.510	0.594	0.392	0.510	0.494	0.484	0.448	0.466	0.511	0.529	0.483	0.469	0.439	0.415	0.439	0.470
9						0.552	0.505	0.505	0.505	0.505	0.505	0.505	0.559	0.581	0.429	0.621	0.403	0.542	0.525	0.505	0.465	0.495	0.541	0.554	0.502	0.506	0.450	0.459	0.450	0.491
10							0.570	0.530	0.530	0.530	0.530	0.530	0.546	0.595	0.554	0.592	0.476	0.542	0.507	0.521	0.508	0.492	0.551	0.582	0.536	0.525	0.481	0.478	0.498	0.502
11								0.584	0.553	0.553	0.553	0.553	0.582	0.590	0.649	0.629	0.490	0.591	0.574	0.517	0.524	0.514	0.600	0.588	0.541	0.541	0.480	0.504	0.505	0.545
12+									0.594	0.594	0.594	0.594	0.520	0.643	0.591	0.529	0.536	0.643	0.584	0.700	0.562	0.656	0.664	0.674	0.584	0.597	0.545	0.523	0.538	0.570

NEA MACKEREL																														
Age	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
0	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.132	0.132	0.130	0.129	0.128	0.127	0.111	0.110	0.109	0.087	0.086	0.086	0.081	0.085	0.077	0.078	0.072	0.076	0.074	0.075	0.078	0.078	0.079	0.081	0.076	0.076	0.077	0.081	0.074	0.078
2	0.178	0.177	0.173	0.171	0.170	0.167	0.175	0.174	0.173	0.186	0.135	0.172	0.194	0.165	0.179	0.148	0.156	0.177	0.138	0.155	0.212	0.197	0.178	0.164	0.133	0.186	0.149	0.194	0.185	0.164
3	0.243	0.242	0.238	0.236	0.236	0.233	0.238	0.237	0.236	0.252	0.221	0.235	0.253	0.293	0.267	0.240	0.237	0.244	0.222	0.230	0.259	0.268	0.237	0.267	0.251	0.228	0.223	0.242	0.235	0.241
4	0.411	0.301	0.296	0.294	0.293	0.289	0.300	0.299	0.297	0.313	0.280	0.280	0.295	0.306	0.304	0.286	0.301	0.306	0.287	0.307	0.310	0.315	0.301	0.326	0.317	0.296	0.285	0.301	0.289	0.342
5	0.000	0.438	0.322	0.318	0.318	0.313	0.346	0.345	0.343	0.323	0.385	0.339	0.324	0.341	0.356	0.374	0.329	0.352	0.339	0.357	0.362	0.360	0.361	0.398	0.366	0.361	0.342	0.353	0.350	0.390
6	0.000	0.000	0.469	0.365	0.365	0.361	0.382	0.380	0.379	0.378	0.353	0.377	0.393	0.384	0.351	0.386	0.423	0.380	0.373	0.409	0.402	0.416	0.413	0.448	0.444	0.402	0.400	0.396	0.390	0.446
7	0.000	0.000	0.000	0.497	0.419	0.416	0.410	0.408	0.407	0.419	0.408	0.404	0.436	0.430	0.416	0.411	0.445	0.429	0.414	0.432	0.424	0.454	0.466	0.491	0.462	0.445	0.426	0.423	0.426	0.459
8	0.000	0.000	0.000	0.000	0.512	0.446	0.432	0.430	0.429	0.434	0.437	0.439	0.441	0.459	0.473	0.429	0.432	0.474	0.409	0.502	0.462	0.465	0.470	0.508	0.501	0.478	0.466	0.440	0.447	0.499
9	0.000	0.000	0.000	0.000	0.000	0.530	0.451	0.449	0.448	0.449	0.446	0.503	0.479	0.468	0.443	0.482	0.455	0.457	0.437	0.541	0.487	0.484	0.483	0.546	0.565	0.519	0.502	0.485	0.485	0.529
10	0.000	0.000	0.000	0.000	0.000	0.000	0.514	0.504	0.503	0.443	0.479	0.473	0.520	0.559	0.468	0.499	0.522	0.466	0.514	0.566	0.522	0.511	0.550	0.514	0.573	0.537	0.549	0.498	0.492	0.576
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.516	0.508	0.523	0.526	0.555	0.510	0.579	0.497	0.470	0.589	0.510	0.523	0.566	0.552	0.585	0.608	0.619	0.611	0.532	0.524	0.465	0.532	0.603
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.518	0.531	0.534	0.563	0.550	0.607	0.575	0.549	0.632	0.595	0.529	0.594	0.583	0.577	0.584	0.639	0.632	0.585	0.580	0.565	0.544	0.586

Table 7.1 Continued

NEA MACKEREL according SG DRAMA

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
1	0.132	0.131	0.129	0.128	0.127	0.125	0.111	0.109	0.107	0.086	0.084	0.082	0.087	0.087	0.087	0.086	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.094	0.094	0.094	
2	0.179	0.176	0.173	0.170	0.168	0.165	0.175	0.173	0.170	0.185	0.131	0.168	0.198	0.168	0.180	0.158	0.161	0.187	0.146	0.164	0.221	0.201	0.186	0.166	0.141	0.197	0.168	0.209	0.203	
3	0.244	0.241	0.238	0.236	0.233	0.231	0.238	0.236	0.233	0.251	0.218	0.230	0.257	0.295	0.270	0.246	0.244	0.248	0.227	0.239	0.264	0.270	0.241	0.266	0.253	0.232	0.241	0.256	0.255	
4	0.411	0.299	0.296	0.293	0.289	0.286	0.300	0.297	0.294	0.311	0.276	0.274	0.297	0.311	0.302	0.284	0.310	0.307	0.291	0.314	0.316	0.318	0.299	0.322	0.320	0.301	0.298	0.315	0.301	
5	0.000	0.437	0.322	0.318	0.314	0.310	0.346	0.343	0.341	0.322	0.382	0.334	0.321	0.340	0.353	0.368	0.336	0.348	0.339	0.360	0.363	0.361	0.358	0.391	0.360	0.363	0.353	0.361	0.360	
6	0.000	0.000	0.469	0.365	0.361	0.357	0.382	0.379	0.376	0.377	0.350	0.372	0.389	0.378	0.354	0.382	0.433	0.373	0.374	0.411	0.404	0.418	0.410	0.442	0.440	0.404	0.413	0.409	0.397	
7	0.000	0.000	0.000	0.496	0.416	0.413	0.411	0.408	0.405	0.418	0.405	0.399	0.435	0.429	0.407	0.404	0.455	0.424	0.412	0.435	0.429	0.458	0.466	0.487	0.463	0.447	0.439	0.437	0.434	
8	0.000	0.000	0.000	0.000	0.510	0.444	0.433	0.430	0.427	0.433	0.434	0.434	0.435	0.451	0.473	0.419	0.445	0.472	0.408	0.504	0.468	0.468	0.468	0.504	0.503	0.482	0.478	0.459	0.460	
9	0.000	0.000	0.000	0.000	0.000	0.528	0.451	0.448	0.445	0.448	0.443	0.500	0.474	0.460	0.455	0.470	0.468	0.452	0.434	0.542	0.492	0.485	0.478	0.541	0.566	0.519	0.514	0.497	0.499	
10	0.000	0.000	0.000	0.000	0.000	0.000	0.514	0.503	0.501	0.442	0.476	0.468	0.521	0.554	0.469	0.495	0.531	0.465	0.519	0.570	0.526	0.517	0.549	0.508	0.575	0.540	0.561	0.514	0.504	
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.516	0.506	0.522	0.523	0.552	0.508	0.575	0.488	0.462	0.597	0.504	0.519	0.570	0.555	0.590	0.602	0.615	0.613	0.533	0.539	0.478	0.542	
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.530	0.531	0.559	0.573	0.611	0.586	0.569	0.647	0.597	0.537	0.586	0.592	0.574	0.579	0.635	0.638	0.601	0.624	0.601	0.572	

NEA MACKEREL difference new and SG DRAMA data set

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.001	0.000	0.001	0.002	0.002	0.000	0.001	0.002	0.001	0.002	0.004	-0.006	-0.002	-0.010	-0.008	-0.012	-0.008	-0.010	-0.009	-0.006	-0.006	-0.005	-0.003	-0.008	-0.008	-0.017	-0.013	-0.020	0.078
2	-0.001	0.001	0.000	0.000	0.003	0.002	0.000	0.001	0.002	0.001	0.003	0.005	-0.004	-0.003	-0.001	-0.010	-0.005	-0.010	-0.008	-0.009	-0.009	-0.004	-0.008	-0.002	-0.008	-0.011	-0.019	-0.015	-0.018	0.164
3	-0.001	0.001	0.000	0.000	0.003	0.002	0.000	0.001	0.002	0.001	0.003	0.004	-0.004	-0.002	-0.003	-0.006	-0.007	-0.004	-0.005	-0.009	-0.005	-0.002	-0.004	0.001	-0.002	-0.004	-0.018	-0.014	-0.020	0.241
4	-0.001	0.002	0.000	0.001	0.004	0.003	0.000	0.001	0.003	0.002	0.004	0.006	-0.002	-0.005	0.002	0.002	-0.009	-0.001	-0.004	-0.007	-0.006	-0.003	0.002	0.004	-0.003	-0.005	-0.013	-0.014	-0.012	0.342
5	0.000	0.001	0.000	0.001	0.004	0.003	0.000	0.001	0.003	0.001	0.003	0.006	0.003	0.001	0.003	0.006	-0.007	0.004	0.000	-0.003	-0.001	-0.001	0.003	0.007	0.006	-0.002	-0.011	-0.008	-0.010	0.390
6	0.000	0.000	0.000	0.001	0.004	0.003	0.000	0.001	0.003	0.001	0.004	0.005	0.004	0.006	-0.003	0.004	-0.010	0.007	-0.001	-0.002	-0.002	-0.002	0.003	0.006	0.004	-0.002	-0.013	-0.013	-0.007	0.446
7	0.000	0.000	0.000	0.001	0.003	0.002	-0.001	0.001	0.003	0.001	0.003	0.005	0.001	0.001	0.009	0.007	-0.010	0.005	0.002	-0.003	-0.005	-0.004	0.000	0.004	-0.001	-0.002	-0.013	-0.014	-0.008	0.459
8	0.000	0.000	0.000	0.000	0.002	0.002	-0.001	0.001	0.002	0.001	0.003	0.005	0.006	0.008	0.000	0.010	-0.013	0.002	0.001	-0.002	-0.006	-0.003	0.002	0.004	-0.002	-0.004	-0.012	-0.019	-0.013	0.499
9	0.000	0.000	0.000	0.000	0.000	0.001	-0.001	0.001	0.002	0.001	0.003	0.003	0.005	0.008	-0.012	0.012	-0.013	0.005	0.003	-0.001	-0.005	-0.001	0.005	0.005	-0.001	0.000	-0.012	-0.012	-0.014	0.529
10	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.001	0.002	0.001	0.003	0.005	-0.001	0.005	-0.001	0.004	-0.009	0.001	-0.005	-0.004	-0.004	-0.006	0.001	0.006	-0.002	-0.003	-0.012	-0.016	-0.012	0.576
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.002	0.003	0.002	0.004	0.009	0.008	-0.008	0.006	0.004	-0.004	-0.003	-0.005	0.006	0.004	-0.002	-0.001	-0.015	-0.013	-0.010	0.603
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.003	0.004	-0.023	-0.004	-0.011	-0.020	-0.015	-0.002	-0.008	0.008	-0.009	0.003	0.005	0.004	-0.006	-0.016	-0.044	-0.036	-0.028	0.586
	-0.004	0.004	-0.001	0.003	0.022	0.021	-0.005	0.008	0.028	0.012	0.034	0.053	-0.018	0.017	-0.019	0.010	-0.118	0.006	-0.030	-0.044	-0.061	-0.036	0.008	0.039	-0.026	-0.058	-0.200	-0.188	-0.173	4.913

Table 7.2 Proportions mature at age in the stock (MATPROP) of the NEA mackerel based on weighting by SSBs from egg surveys (1984-recent).

For 1972-1983 calculation is based on weighting by SSBs obtained from VPA .

WEIGHTING FACTORS

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
North Sea	0.2541	0.2487	0.2211	0.2047	0.2010	0.1774	0.1361	0.1251	0.1164	0.0860	0.0799	0.0743	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0178	0.0178	0.0178	0.0275
Western	0.6181	0.6235	0.6511	0.6675	0.6712	0.6948	0.7361	0.7471	0.7558	0.7862	0.7923	0.7979	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.7727	0.7727	0.7727	0.8481
Southern	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.2095	0.2095	0.2095	0.1244

NORTH SEA MACKEREL (ICES fisheries assessment data base kept constant 1972-recent)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

WESTERN MACKEREL (Data from ICES 2001 WG)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
3	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
4	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
5	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 7.2 Continued

SOUTHERN MACKEREL Data set 1972-1997 revised to be the same as 1998-2001, because these were based on histology Revised from 1998 onwards (WG1999 section 2.4.4)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
2	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
3	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NEA MACKEREL

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
2	0.53	0.54	0.54	0.55	0.55	0.55	0.56	0.56	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59
3	0.90	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.88
4	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.97
5	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.97
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 7.2 Continued

NEA MACKEREL according SG DRAMA

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.06	0.06	0.06	0.06
2	0.59	0.59	0.60	0.60	0.60	0.61	0.61	0.62	0.62	0.63	0.63	0.64	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.58	0.58	0.58	0.58
3	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.85	0.85	0.85	0.85
4	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.98
5	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.98
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NEA MACKEREL difference new and SG DRAMA data set

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	-0.063	-0.065	-0.064	-0.064	-0.066	-0.066	-0.064	-0.065	-0.066	-0.065	-0.066	-0.067	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	0.006	0.006	0.006	0.010
2	-0.052	-0.056	-0.054	-0.055	-0.059	-0.058	-0.053	-0.055	-0.058	-0.056	-0.059	-0.062	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	0.003	0.003	0.003	0.006
3	-0.033	-0.031	-0.032	-0.031	-0.030	-0.030	-0.032	-0.031	-0.030	-0.031	-0.030	-0.028	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	0.010	0.010	0.010	0.028
4	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	-0.003	-0.003	-0.003	-0.005
5	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	-0.003	-0.003	-0.003	-0.005
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	-0.150	-0.152	-0.151	-0.151	-0.154	-0.153	-0.150	-0.151	-0.153	-0.152	-0.154	-0.156	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	0.015	0.015	0.015	0.035

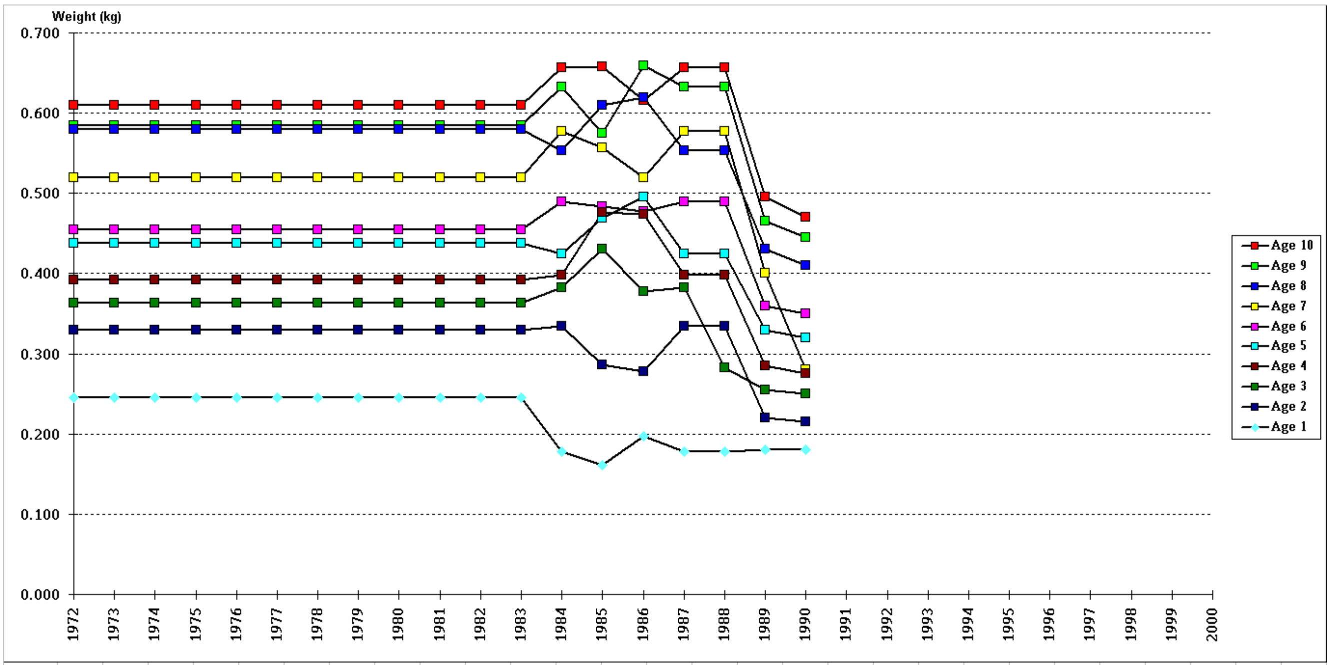

Figure 4.1 Mean weights at age in the catch of North Sea mackerel during the period 1972-1990 (from ICES data base).

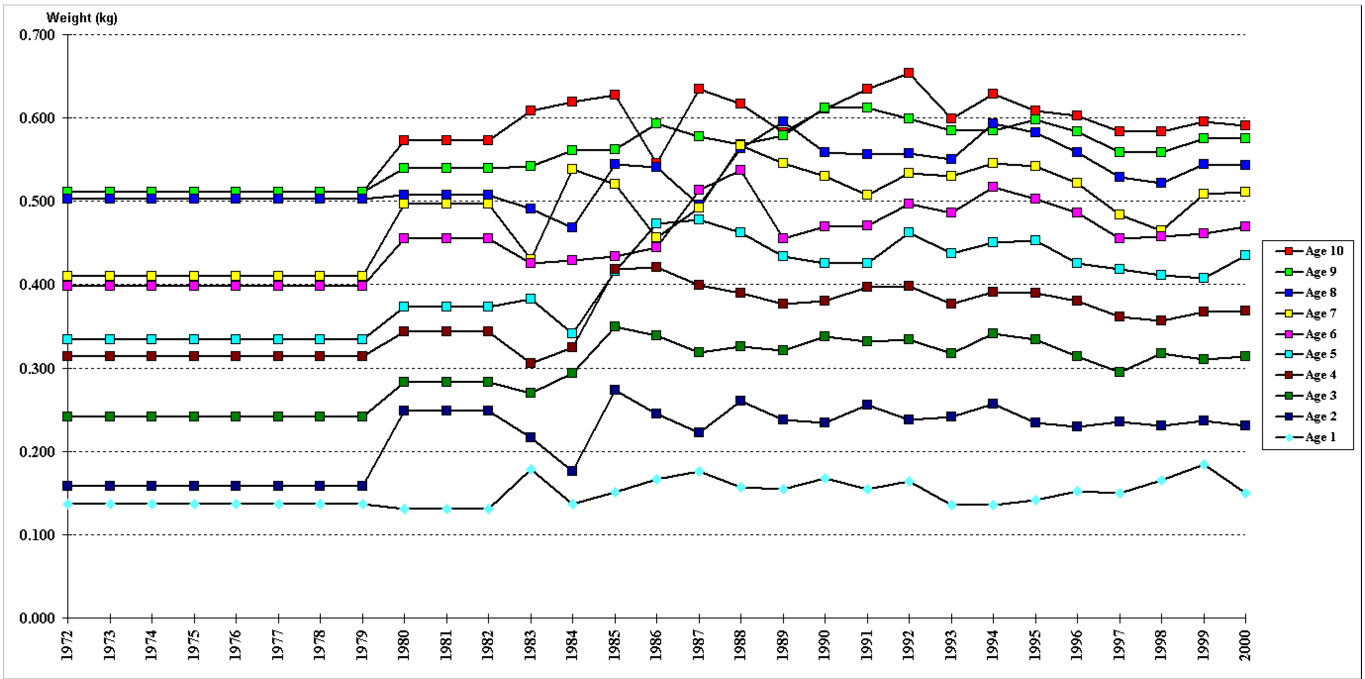

Figure 4.2 Mean weights at age in the catch of western mackerel during the period 1972-2000 (ICES CM 2002/ACFM:06).

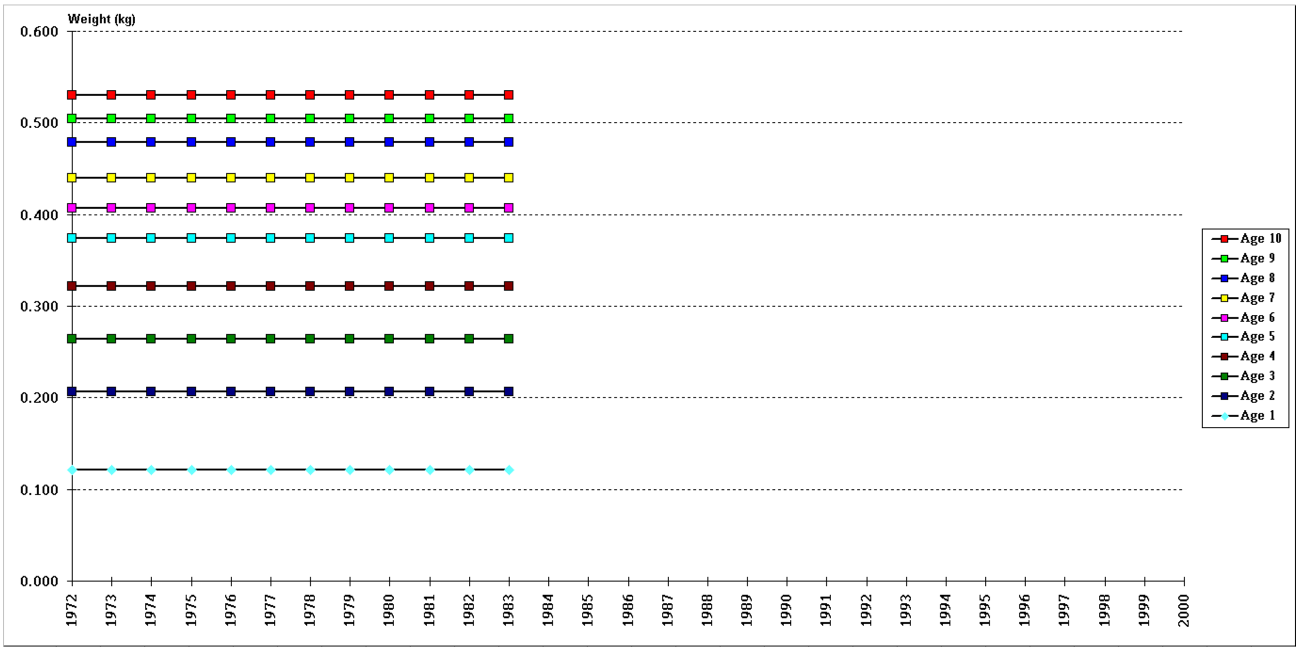

Figure 4.3 Mean weights at age in the <u>catch</u> of southern mackerel during the period 1972-1983 (from Uriarte *et al*., WD 2002)

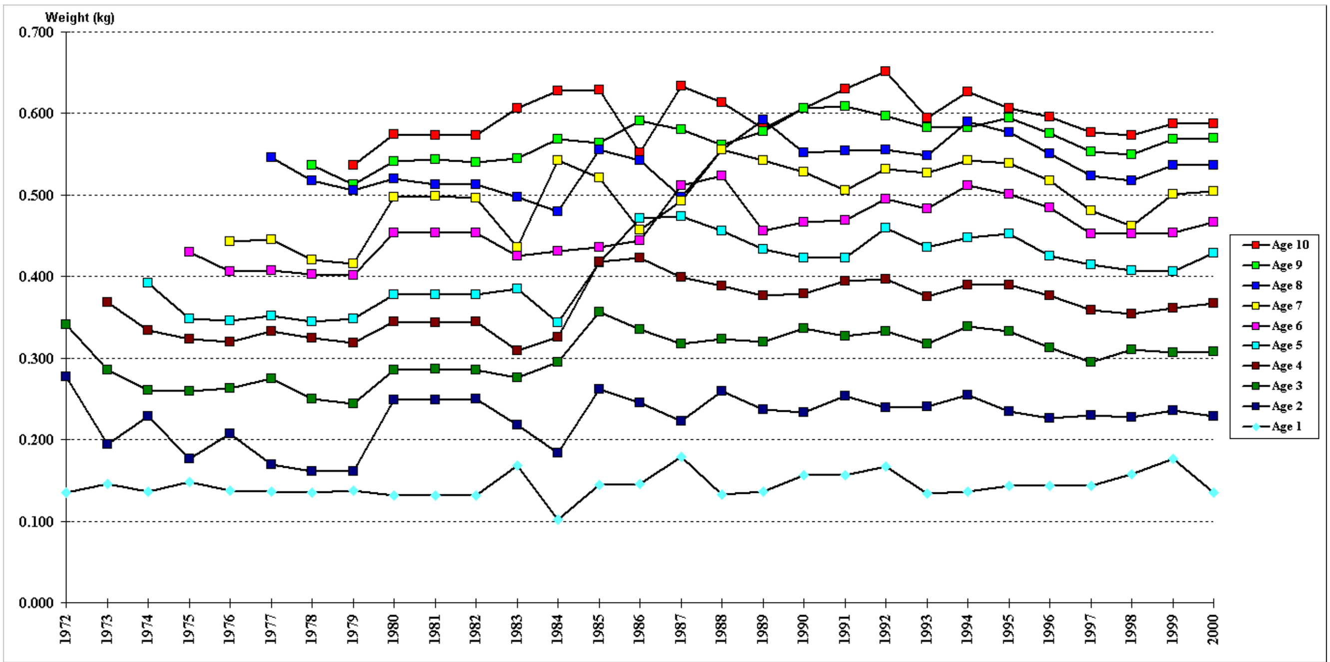

Figure 4.4 Mean weights at age in the <u>catch</u> of NEA mackerel during the period 1972-2000. For the period 1972-1983 this set is new, but for the period 1984-2000 the data set is unchanged.

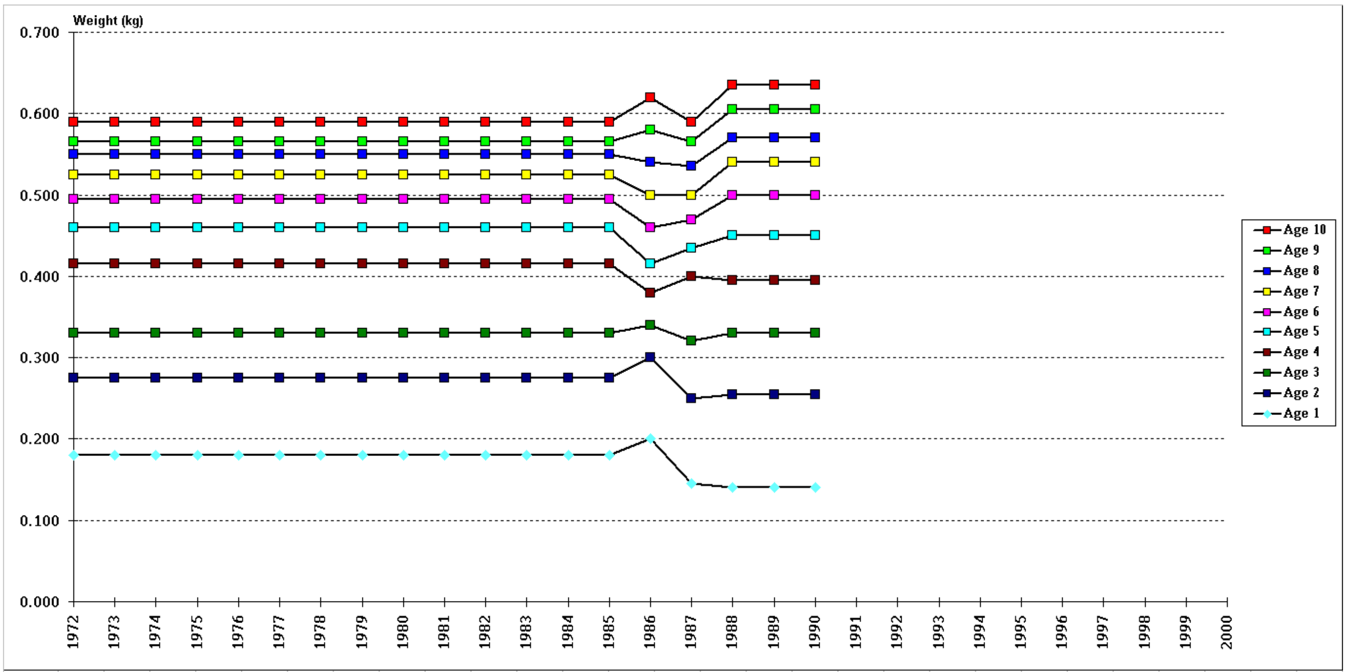

Figure 5.1	Mean weights at age in the stock of North Sea mackerel during the period 1972-1990 (from ICES data base).

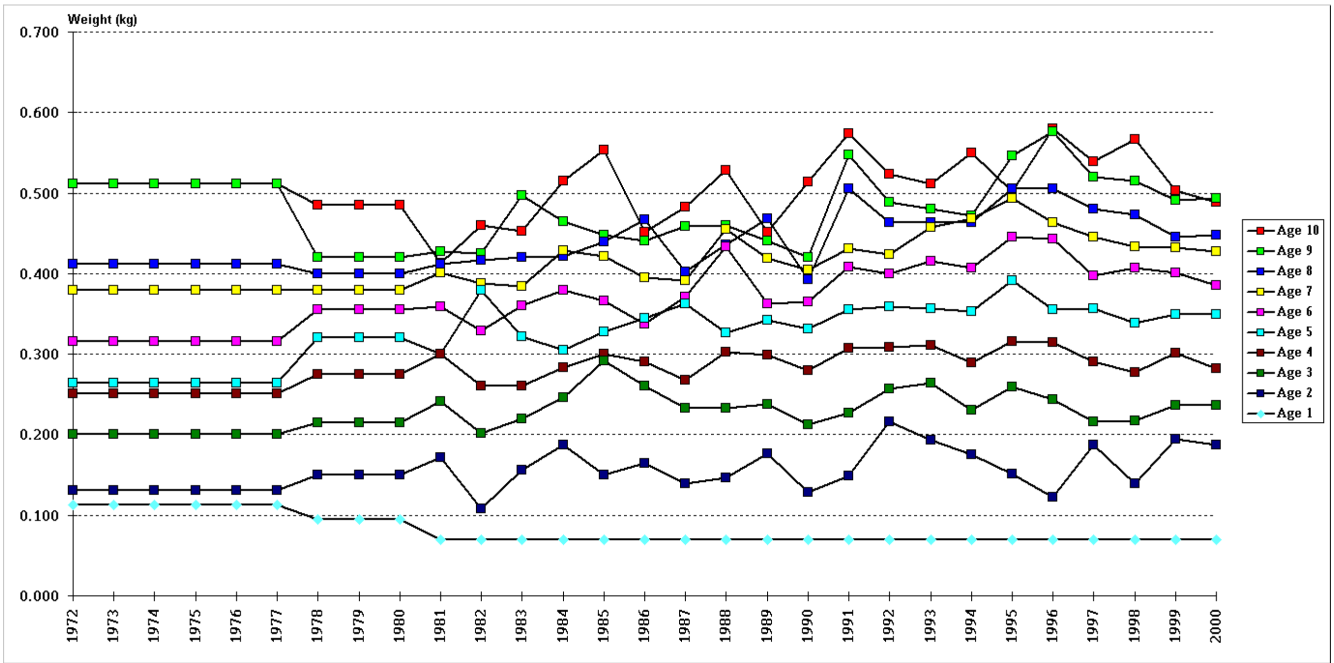

Figure 5.2	Mean weights at age in the stock of western mackerel during the period 1972-2000 (ICES CM 2002/ACFM:06).

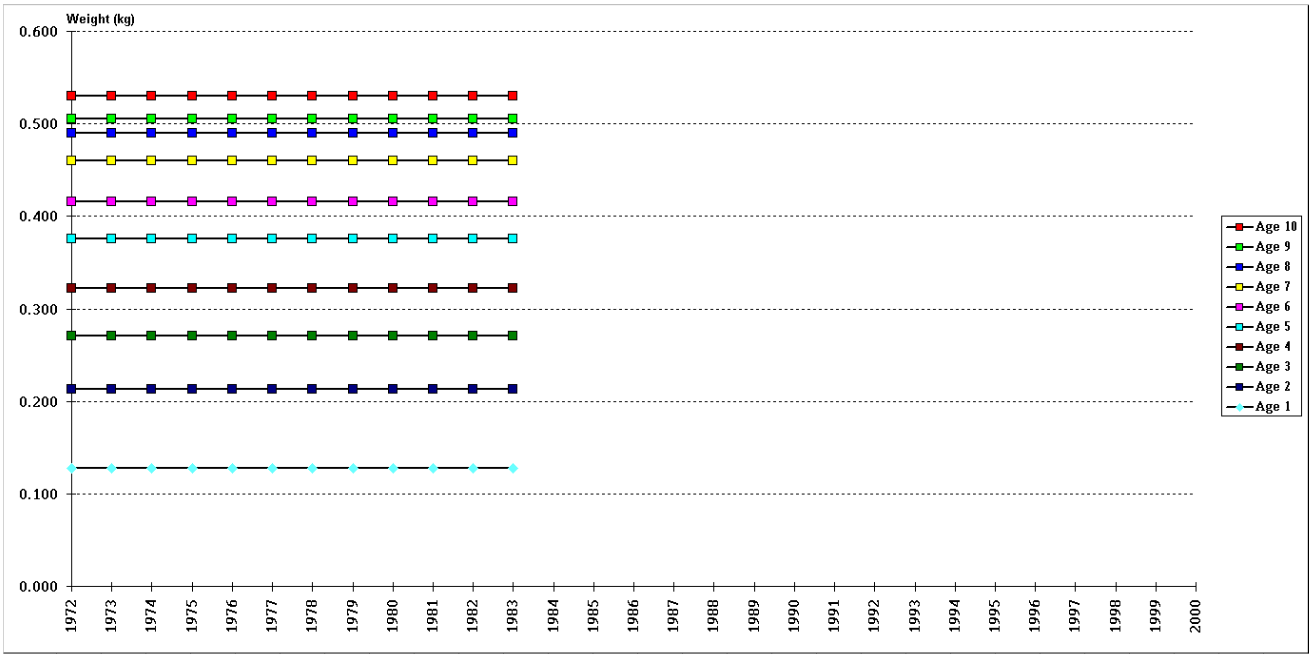

Figure 5.3 Mean weights at age in the <u>stock</u> of southern mackerel during the period 1972-1983 (from Uriarte *et al*., WD 2000)

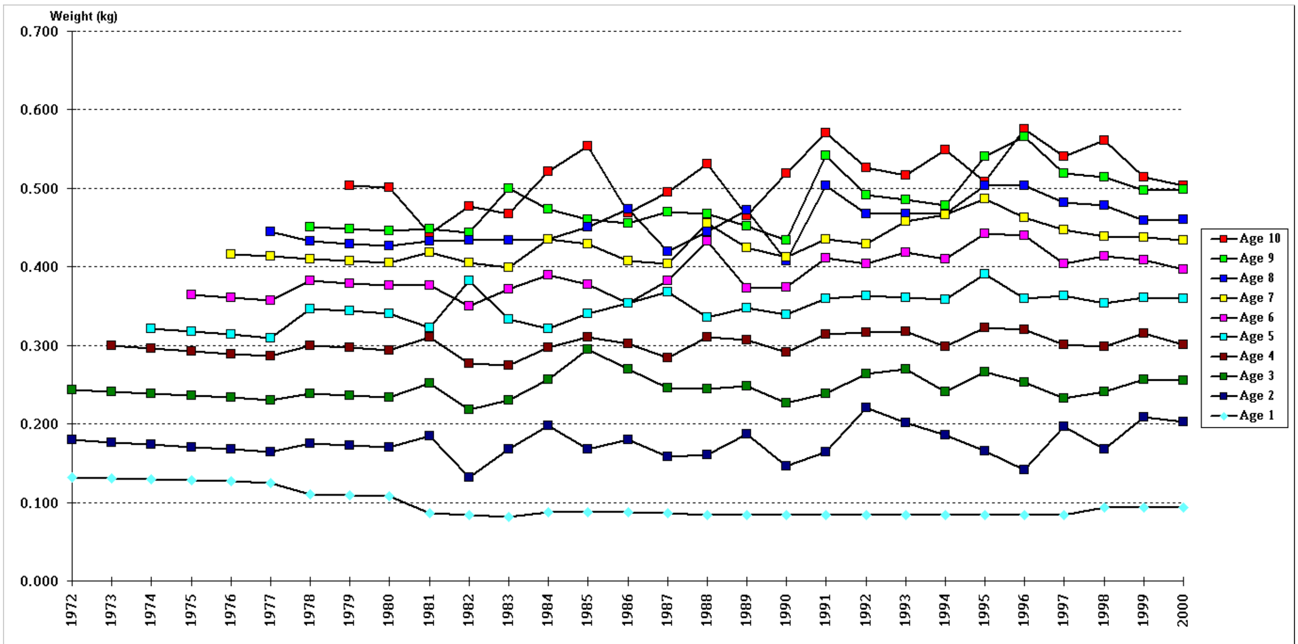

Figure 5.4 Mean weights at age in the <u>stock</u> of NEA mackerel during the period 1972-2000. For the period 1972-1983 this set is new, but for the period 1984-2000 the data set is unchanged.

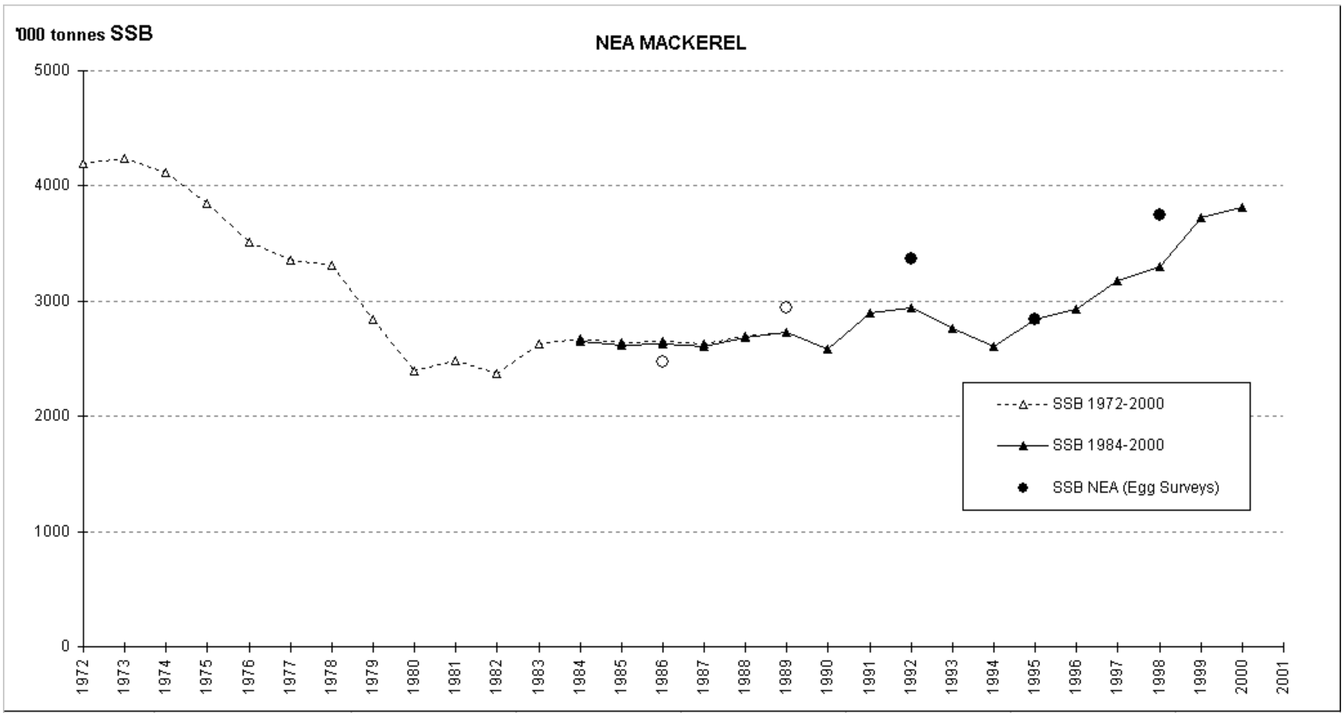

Figure 6.1 SSB's from egg surveys (1992-1998) compared to SSB's over two assessment periods:1972-2000 and 1984-2000. The open circles represent the SSB estimates from the 1986 and 1989 egg surveys, which were not used for tuning the assessment.

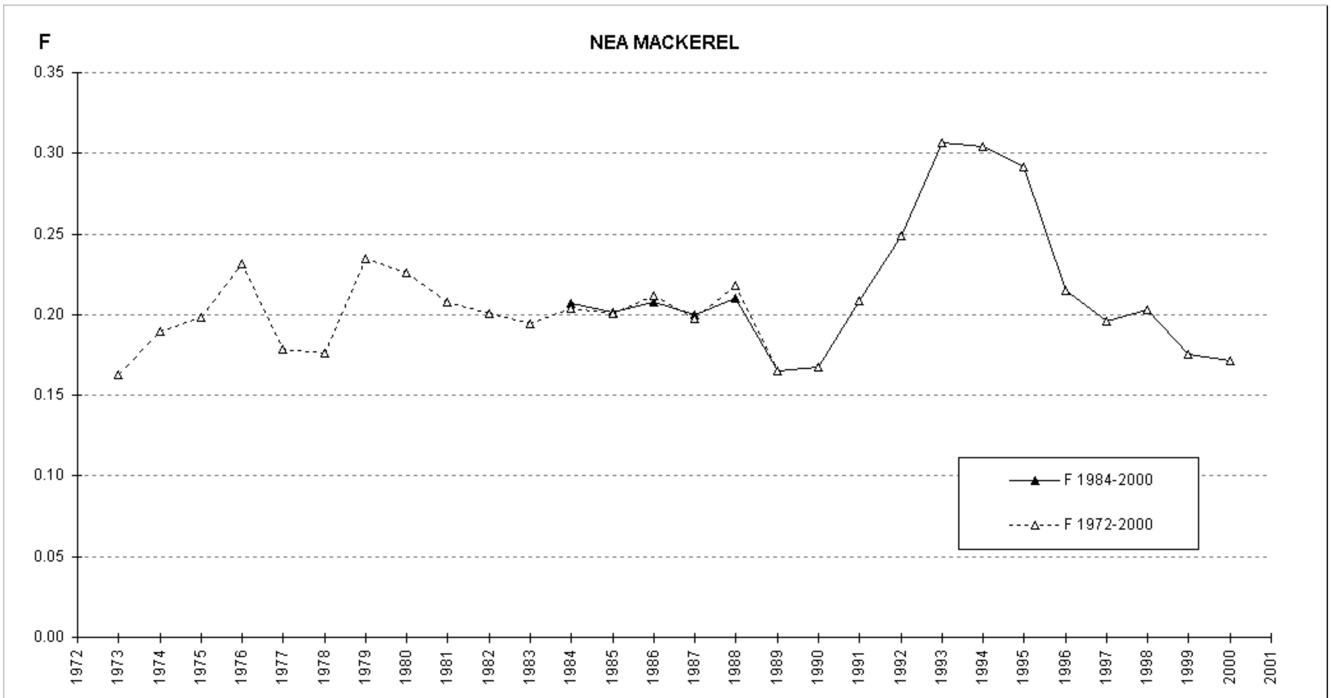

Figure 6.2 F's from the two assessment periods: 1972-2000 and 1984-2000.

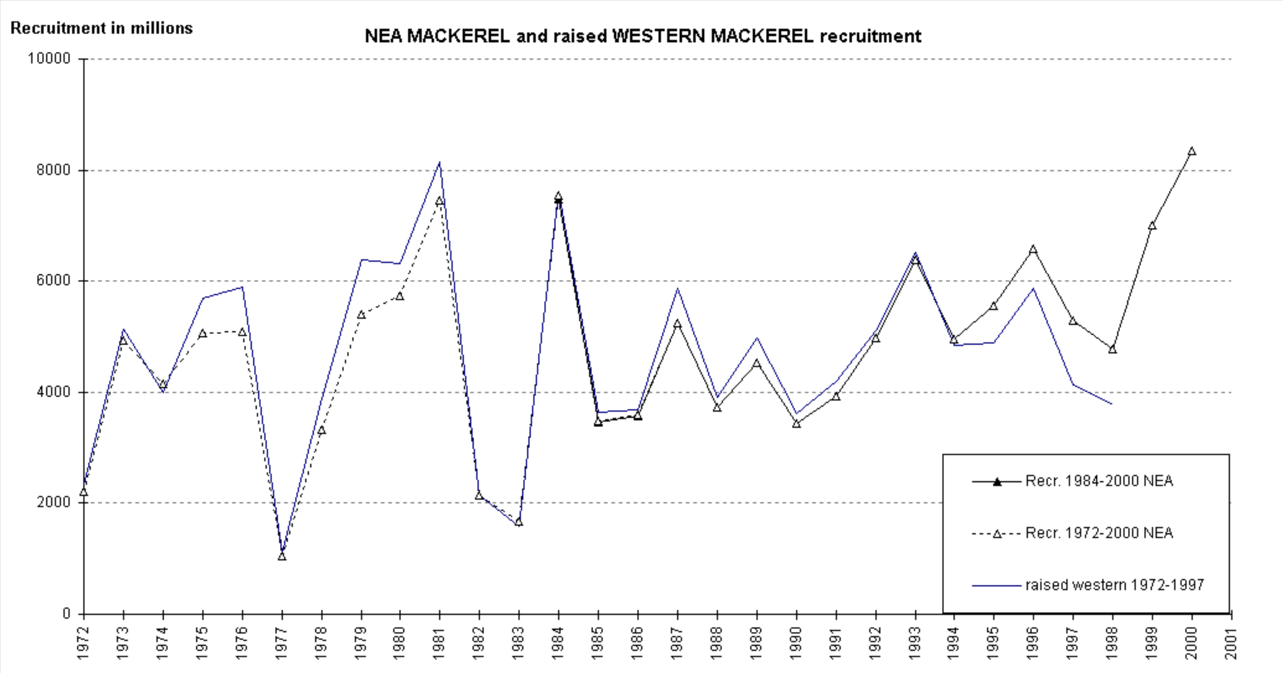

Figure 6.3 Recruitments of **NEA** mackerel over the two assessment periods 1972-2000 and 1984-2000 compared to the raised recruitment of the western component over the period 1972-2000.

Annex 2

Working Document to the ICES Working Group on the assessment of mackerel, horse mackerel, sardine and anchovy, held in Copenhagen from 14–23 September 2000

Estimates of Catches at age of mackerel for the southern fleets between 1972 and 1983 and comparison of alternative procedures

A. Uriarte (AZTI), B. Villamor (IEO) and M. Martins (IPIMAR)

1 INTRODUCTION

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 WG.

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.

2 MATERIAL AND METHODS

Catches in tonnes.

Catches in tonnes of Spain and Portugal as reported to ICES WG by the members of Spain and Portugal are included in Table 1. The shadowed period 1972–76 is the result of the recovery of catches in tonnes made for this paper. Portuguese catches are official figures, whereas Spanish catches are not official figures since 1980. Since 1988 Spanish catches made in Division VIIIb are reported splited from the catches in Division VIIIC whereas this was not the case before. Despite the WG reports the Spanish catches prior to 1988 as pertaining to VIIIC (as they mostly are) part of them originated in Division VIIIb. Because of this, these Spanish catches prior to 1988 are reported in column VIIIbc reflecting the true mixing of their origins. This means that for the period prior to 1988, we have to speak about catches made by the southern fleets, rather than in the southern area or sensu components.

Catches in tonnes for the period 1972–1980 for Spain have been obtained from official statistical data “Anuario Pesca Maritima”, for the years 1977–1980 are as reported to NEAFC (Anon, 1988). For the years 1981–1999 data of catches were obtained from fishing vessel owners’ associations and fisherman association through the existing information network of the IEO and AZTI (Advisory Organisations to Fisheries and Oceanography Administration) in all ports of the Cantabrian and Galician and these catches are as reported in Cort (1982), Cort *et al.* (1986), Villamor *et al* (1997) and the Assessment Working Group (ICES 2000).

Catches in tonnes for the period 1972- 76 for Portugal are reported in ICES (1982) and for the years 1977–83 are as reported to NEAFC (Anon, 1988).

Catches at age.

Tables 2, 3, 4 and 5 present respectively the basic catches at age corresponding to Divisions VIIIb, VIIIc and IXa by Countries (Spain and Portugal respectively) as reported to the ICES WG in previous years. Table 6 and 7 presents the Total catches at age obtained by Spain and Portugal together in Divisions VIIIbc and IXa. The catches in Divisions VIIIb,c are produced only by Spain, whereas those of Division IXa are produced by Portugal and Spain.

Catches at age in Division IXa produced by Portugal are known since 1981(table 5). While using the estimation procedure described below, they are kept unchanged and estimations for the Division IXa in the years 1981–83 only refer to the Catches in tonnes of Spain. These estimates added with the known Portuguese catches make the total IXa catch of the 1981–1983 years.

In order to infer the catches at age that should best correspond with the catches in tonnes recovered for the period 1972–1983 for the southern fleets, we have applied a separable model by Divisions that leads to the estimates through the following iterative procedure:

a) Guess an initial estimate of the compositions by age of the remote unknown catches of the southern fleets (for instance a fixed percentage at age composition for these catches).

b) Add the (new) estimates of catches at age of the southern fleet to the Western catches back to 1972. Thus new NEAM catches at age (1972–1983) are obtained.

c) Assess the NEAM from 1972 to 1998, as would be discussed latterly.

d) fitting a separable model of fishing mortality by Divisions VIIIb,c and IXa for the well known recent period of these fisheries, against the Population at age estimates obtained for the complete NEAM assessment.

e) Getting new estimates of catches at age for the southern fleets: the fishing pattern adjusted by Divisions are applied to the population at age estimates for the NEAM in the period 1972–1983, so as to deduce new catches at age estimates for these southern fleets. This is made by searching the fishing mortalities 1972–1983 by Divisions that multiplied by the respective fishing pattern produce the catches in tonnes recovered by Divisions for this paper. Subsequently the addition of these estimates of catches at age in Divisions VIIIb,c and IXa produce a new estimate for all the southern fleets in that remote period.

f) Evaluate convergence of new and prior estimates of the catches at age for the southern fleets in the period 1972–1983. If convergence is met then finish, otherwise repeat steps ***b*** to ***f***.

In this way the estimates of catches at age for the remote period of catches of the southern fleet are best consistent with the fishing pattern in this areas in the recent years and with the age structure of the NEAM population in the remote period as inferred from the assessment. (mainly guide by the catches of mackerel in the western area, the fitted remote fishing pattern and the Triannual egg survey biomass indexes).

The reason for using two fishing patterns for the southern fleets instead of a single one is due to the marked differences in the age composition of the catches at age between the IXa and VIIIb,c Divisions (compare Tables 6 and 7). The former is heavily dependent on young fishes, whereas the latter concentrates more on adults.

The separable model by Divisions can be fitted for the years 1986 and 1988–98. The Spanish catches of the years 1984, 85 & 87 cannot be splitted in by Divisions IXa and VIIIb,c. For this reason these years are eliminated from the separable fitting. We have checked the sensitivity of the fitting results to the period of fitting the separable fishing patterns by Divisions, including or excluding the 1986 data (i.e., fitting on the years 1986 and 1988–98, or simply 1988–98).

For tuning the separable models of the southern fleets, the weighting factor by age used by divisions were the following:

Ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Weighting factors VIIIb,c	0.01	1	1	1	1	1	1	1	1	1	1	1
Weighting factors IXa	1	1	1	1	0,5	0,1	0,1	0,1	0,1	0,1	0,1	0,1

They reflect approximately the relevance of the different ages in each catch.

Once fitted by the first time the separable models for the southern fleets in the recent period they have to remain almost invariant during the iterative procedure, since the new catches estimates affect in principle solely the remote period of the fishery. Therefore step ***d*** might in certain cases be omitted. However, this depends upon the actual procedure and objective function of the NEAM assessment. Step ***d*** must be retained, as much as the recent Population estimate of the NEAM can be affected by the remote estimates of the catches at age of the fishery.

With the Assessment of the Population of the NEAM and the fitted fishing pattern by Divisions the new catches at age for the southern fleets by areas are found by searching the separable fishing mortality by Division ($F_{Div,Y}$) that satisfies:

$$Catch_{Div,Y} = F_{Div,Y} \cdot \sum_{a=0}^{a=12+} Nneam_{a,Y} \cdot W_{Div,a} \cdot S_{Div.a}(1 - e^{-Zneam_{a,Y}}) / Zneam_{a,Y} \qquad \text{eq.1}$$

Where $F_{Div,Y}$ is the only unknown since all other parameters arise from the Assessment of the NEAM or the fitting of the separable fishing pattern by Divisions.

Hence catches at age for the Division each year are simply obtained by the usual catch equation:

$$Cage_{Div.a.Y} = F_{Div,Y} \cdot S_{Div.a} \cdot Nneam_{a,Y} \cdot (1 - e^{-Zneam_{a,Y}}) / Zneam_{a,Y} \qquad \text{eq.2}$$

Notice that we apply a separable Fishing mortality for the southern area without changing the total mortality in the context of the NEAM, hence the iterative approach to the final best estimate of the whole procedure.

As mentioned above for Divisions IXa in the period 1981–1984 only the Spanish catches at age are obtained in this way, because the Portuguese catches are already known.

The age structure of the western mackerel catches and its assessment has the peculiarity of starting in year 1972 with a plus group at the age of 4 which becomes 5+ in 1973 and so on until the age of 12+ reached by the first time in year 1980. This means that the population at age estimates provided by the assessment follow a similar pattern. Hence the age structure of the southern caches has to follow a parallel aging trend for the starting age of the plus groups between 1972 to 1980. The fitted fishing pattern for the southern fleets cover the whole range of ages from 0 to 11, the selectivity for these different age plus group were obtained by a weighted average of the selectivities at age in the plus group, with weighting factors proportional to the average numbers at age in the population for the next 10 subsequent cohorts present in the population as estimated by the assessment.

The assessment of NEAM.

Te assessment of the NEAM in the period 1984–98 was made in the last year WG (ICES CM 2000) by the Integrated Catch at Age analysis (ICA, Patterson and Melvin 1996), adjusting a separable model over the period 1992–98 to the catches at age and to the three estimates of the index of biomass of the Triennial Egg Surveys over the complete NEAM population. The period 1991–1984 was assessed though a VPA provided as well by ICA. The basis for such a VPA tuning of the early period of the fishery, apart from the starting populations of the separable period, are not fully described in the report (op.cit) and were not easily simulated by the authors in this paper.

With the recovery of the 1972–1983 period 12 years of additional NEAM catches arise and the assessment of the complete set may require a slightly different procedure. In ICES CM 2000 several possibilities for the assessment of NEAM were considered and the one here selected follows one of the consideration made then. In the current paper we have used a parallel assessment to the one adopted for the Western mackerel in ICES CM 2000, in the sense that we make as much use as possible of the separable fishing mortality models and of the Triennial egg surveys performed since 1977. We fit two separable models, one for the period 1989 to 1998 and the other for the period 1984–1988. The Triennial egg surveys are used in two different vectors of information as relative indexes of biomass: The first period covers the three most recent estimates of biomass made since 1992, which correspond with a surveying of the whole NEAM spawning area. The second period uses the surveys made between 1977 and 1989 that covered only the western spawning grounds. Two different catchabilities coefficients are estimated for these two sets of relative indexes of abundances and different weighting factors were applied: A factor of 5 for the most recent estimates of biomass index from the triennial egg surveys and a factor of 1 for the earlier period, which reflect the different confidence on the survey themselves and their relevance in the final output of the assessment.

The Sums of Squares defined by the objective function that was minimized for the assessment was therefore (***equation 3***):

$$\sum_{a=0}^{11}\sum_{y=1984}^{1988}\lambda_a\cdot\left(Ln(C_{a.y})-\ln(F_y\cdot S1_a\cdot\overline{N}_{a.y})\right)^2+\sum_{a=0}^{11}\sum_{y=1989}^{1998}\lambda_a\cdot\left(Ln(C_{a.y})-\ln(F_y\cdot S2_a\cdot\overline{N}_{a.y})\right)^2$$

$$\lambda_{EPB1}\cdot\sum_{y=1984}^{1988}\left[Ln(EPB_y)-\ln\left(Q1\cdot\sum_a(N_{a.y}\cdot O_{a.y}\cdot W_{a.y}\cdot\exp(-PF\cdot F_{a.y}-PM\cdot M))\right)\right]^2+$$

$$\lambda_{EPB2}\cdot\sum_{y=1998}^{1989}\left[Ln(EPB_y)-\ln\left(Q2\cdot\sum_a(N_{a.y}\cdot O_{a.y}\cdot W_{a.y}\cdot\exp(-PF\cdot F_{a.y}-PM\cdot M))\right)\right]^2$$

where ***a*** and ***y*** are age and year subscripts

C catch in numbers at age

N population abundance a t first of January

O percentage of maturity.

PF and ***PM*** percentages of F and M occurring till mid spawning within the year (=0.4 in both cases)

M natural mortality

F fishing mortality; F_y is separable fishing mortality and F_{ay} is fishing mortality in year y and at age a that may be or separable or VPA estimate depending on the year.

S1 and ***S2*** refer to the two fishing patterns fitted for the two periods considered, which are fitted subject to the constraint that $S1_5=S2_5=1$ and $S11_{11}$ and $S2_{11}=1.2$.

λ_a is the weighting factors at age set equal to 1 for all ages except for age 0 that has 0.01.

λ_{EPB} is the weighting factors for the two EPB set of estimates. Equal to 5 for the three most recent surveys and to 1 for the other earlier estimates.

EPB is Egg production estimates of mackerel spawning Biomass obtained by the Triennial Egg Surveys.

Q is the ratio of the egg survey estimates to the assessment model estimate of spawning biomass.

W is mean weight at age in the stock (at spawning time)

The assessment of the years prior to 1984 is made by a VPA which in fact is fitted to the 3 Index of Spawning Biomasses obtained for 1977, 80 and 83 by the triennial egg surveys.

All this assessment is made on an Excel workbook and is minimised with the solver Excel function. In order to check that workbook the assessment of the western mackerel and NEAM performed in last year was simulated with the workbook and the results turned out to be the same (with negligible differences). Finally the assessment undertaken here, after convergence of the southern catches at age was repeated with the ICA programme and turned out to be concordant. In annex 1 we give a summary of the results of that assessment.

Other simpler catches at age estimates.

The major drawback arising from the above procedure comes from the fact that those estimates may change slightly from year to year as the assessment of NEAM changes. Therefore other more simple estimation procedures may be preferable to avoid recalculating every year those catch estimates. Among them, in hierarchical order we considered:

a) Fix percentages of the catches at age in southern catches every year (a.1) or by Divisions (a.2).

b) Constant ratios by age of the percentages at age in the southern and western catches scaled to the total catch in tonnes from the southern fleets in all areas (b.1) or by Divisions (b.2).

This second type of estimates (b) is done as follows for every area:

The average ratio of percentages for a certain age for the southern and western fleets was calculated as:

$$R_a = \sum_{y=1986}^{1998} \frac{S\%Cage_a / W\%Cage_a}{12}$$

And hence for that age and a given year, the expected relative Catch at age in the southern area is calculated as: $S\%Cage_{a.Y} = W\%Cage_{a.Y} \cdot R_a$. This estimate is not exactly a percentage and does not sum to 1 over ages, but for the purposes of our estimates it is not important.

And the scaling process to get the catch at age composition that equals the actual catches in tonnes for the area being considered is made as (this is common to ***a*** and ***b*** procedures):

$$C_{a.Y} = S\%Cage_{a.Y} \cdot \frac{Catch(t)}{\sum_a S\%cage_{a.Y} \cdot W_a}$$

Where W_a is the mean weight at age for the southern division considered.

The years to estimate the parameters involved in procedures a, and b are the same as those selected for the fishing pattern procedure. As mentioned for the latter procedure, we have checked the sensitivity of the fitting results to the period for estimating the parameters involved (in this case the percentages at age or the constant ratio at age of the catches). The two checking periods were the years 1986 and 1988–98, or simply 1988–98.

The relative performance of all these alternative catch at age estimates were measured as usual for the models, i.e., by the log standard error of the log normal deviates between the actual and estimated catches at age for the well known recent period of the fishery, where the fitting takes place. That standard error of the fitting in log scale can be ascribed to CV of the error of the estimates at non log scale. We have also used the coefficient of determination of the catches at age.

Mean weight at age and maturity at age.

In the analysis of the catches at age for the southern fleets we have used the mean weight at age from 1986 to 1999 (without 1987) by Divisions (IXa and VIIIb,c) or for the total southern fleet catches (as appropriate). Those values are presented at the bottom of tables **Tables 6, 7 and 8**. For checking the performance of the different procedures over the recent total southern fleet catches (1984–98) the mean values changed according for the period of checking the data. On the other hand, for obtaining the remote 1972–83 catches at age only the mean weight at age by Divisions are used, because the final estimates are the addition of those two estimates by Divisions.

For the assessment of NEAM the mean weights at age in the catch and the stock are those used in the previous WG for NEAM. For the years prior to 1984, we used the same principles and procedures adopted in 1996 when the NEAM was by the first time dealt as a single assessment unit (ICES 1997/Assess:7). The mean weights at age in the catch are those Western mean weights at age reported for the years 1972–1983, averaged with the mean weights in the new southern catches derived for Divisions VIIIb,c + IXa, which were weighted by their relative numbers in the total new NEAM catches. **Table 9** summarize the mean weights at age in the catches so far described in this paper.

For the mean weights at age in the NEAM stock before 1984 we have used a weighted average of the weights in the stock reported for the western mackerel and the mean weight the southern catches weighted respectively by 0.85 and 0.15 (as relative average abundance in the Spawning Biomass of NEAM). We are therefore assuming that the mean weights at age in the spawning mackerel for the southern area is the same of the catches. We also adopt the same decision (for consistency purposes) undertaken in 1996 of conferring to the southern spawners about 15 % of the total NEAM spawning biomass, which is of course a rough guess nowadays put in doubt. If the preferred figures would be 20%/80% or 25%/80% then probably the mean weights of the whole series would have to be changed accordingly and that has to be considered by the WG. In **Table 9** we also present the mean weights at age for the stock in the earlier years deduced in this weighted procedure.

Before averaging western and southern mean weights at age, a mean weights in the plus groups of ages in the period 1972 to 1980 for the southern catches was calculated as follows:

$$Wcatch_{a+} = \frac{\sum_{a}^{12} \overline{N}_a \cdot Wsouthcatch_a}{\sum_{a}^{12} \overline{N}_a}$$ and, similarly for the southern weights for the stock.

where Na is the mean population at age a for the next ten cohorts as calculated in the assessment, This estimation is a rough estimate that implies equal selectivity values in the fishery for all the plus group.

A constant maturity at age for NEAM has been used for the last years and the same criteria and values are applied in this paper (see Table 2.9.2.5 of ICES CM 2000).

3 RESULTS

Actual fitting of the different procedures to the known catches at age of the southern fleets.

2 tables and 1 figure

In **Table 10** we present the squared residuals between the estimates of catch at age made by the different procedures for the recent (known) period of the fishery and the actual catches at age reported to ICES for these southern fleets. Those estimates were obtained from a fitting procedure based on the 1986 and 1988–98 reported catches. The table reports the fitting by Divisions or for both Divisions together (as appropriate) and for the fitting period or for the whole known southern fleet catches period (1984–1998).

The USSQ (un-weighted squared residuals) indicate that the simplest procedures, those based in single step estimates for the whole VIIIb,c–IXa catches together (a.1 and b.1) get worse fittings than those based on two step procedures (first by Divisions and finally added, a.2, b.2 or the separable fitting model).

From the three procedures considered (a, b and the separable), procedure b performs worse than the two other methods, which at the contrary show rather similar behaviour. The estimate of the catches at age by the average ratio between the percentages at age for the southern and western catches (procedure b) is not adequate especially for the fitting of the IXa catches at age. This is certainly due to the opposite age composition of both areas. The three procedures have rather similar fitting in Division VIIIb,c, but for the whole southern fleet catches (Divisions IXa and VIIIb,c together) the constant catch %age and the separable estimate behave better than the constant catch ratio S/W (b).

When the checking period of comparison between the estimates and the actual known catches expands back to 1984, then the overall fitting decrease for all procedures.

Table 11 shows parallel results to Table 10 but for a fitting period starting in 1988 (excluding therefore 1986). In this way the residual for the fitting period of catches at age diminishes in comparison when the 1986 year was considered. Clearly the earlier the period of the fishery the worse the fitting of any procedure to the catches reported to ICES. This is shown as well comparing the amount of residuals obtained for the period 1988- 98 compared to those for the whole period 1984.1998. We believe that the fishing pattern is best shown in the recent years of the fishery when sampling and ageing procedures have been enhanced in comparison with the previous periods. **Because of this we adopt the fitting procedures based on the period 1988–98 as the ones of reference.**

Table 12 shows the estimates of the catches at age for the constant percentage by age in the catch procedure (fitted to the 1988–98 data) and the individual log residuals for the period 1984–1998. **Table 13** shows the estimates of the catches at age for the separable model (fitted to the 1988–98 data) and the individual log residuals for the period 1984–1998.

Figure 1 shows the general fitting levels of the separable fishing pattern procedure according to the period of fitting and the period of checking that fitting.

3.1 The separable model by Divisions

Tables 14 shows the fitted separable models and the estimates of the catches at age for Divisions IXa and VIIIb,c respectively (fitted to the 1988–98 data) for the age of reference at age 5. Figure 2 plots those selectivities.

The estimates of the catches at age for the southern fleets from 1972 to 1983.

Table 15 y 16 show the constant percentage at age and the separable catch estimates for the period 1972–83 corresponding to the catch in tonnes of the southern fleets in IXa and VIIIb,c.

4 DISCUSSION AND CONCLUSIONS.

4.1 General

By the separable procedure adopted here, we separate the search for best estimates of catches at age for the southern fleets in the remote period from the Assessment itself of NEAM. It could have been considered to merge all this procedure into a single Assessment, by which the objective function of minimization would include, for instance, one or two terms for the southern fleet separable model(s). However this would have complicated the objective function and in addition the fitting of such southern separable model would have influenced largely the result of the whole NEAM assessment, which is undesired (given the small portion of the International catches of NEAM that the southern catches suppose).

Fitting results.

The fact that the fisheries in IXa and VIIIb,c are made by different fleets in different periods and have different fishing patterns explains the better performance of the estimates based on the addition of Divisions estimates than those made all at once from the pooled catch of both divisions.

The residuals from the known catches at age and the different estimates are high and therefore the fitting to the actual catches must be considered in any case poor. The level of residuals (defined by the standard deviation) from the final estimate obtained by the separable fishing pattern model (1988–98) and the total southern fleet catches is four times higher than the NEAM separable model fitted for the period 1992–98 (ICES CM 2000). The fitting worsens when checked against the complete 1984–1998 series of southern fleet catches at age. We consider that this is due more to a decreased level of quality of the estimates of the catches at age in the period 1984–1987 compared to more recent years, rather than thinking on a changed fishing pattern for those years in the southern area.

A reason for the poor general level of fitting may came from the fact that we are fitting separable models to small fleets. The more restricted is an analysis to a particular segments of a fleet, the more suffer the individual annual changes from year to year in the catchability of that fleet and the individual ageing or sampling errors that may occur. When adding the catches of several fleets those white errors respect a general fishing pattern tend to cancel and the fitting of fishing patterns are probably better achieved.

The fact that the procedure ***a*** (constant percentages at age in the catch for the southern fleets) performs as similar as the separable fishing pattern procedure is not so surprising as can be thought. Both procedures rely of estimates of average retrieving by age, the first one regardless the strength of the different age classes at sea and the second one depending upon the estimate of the population at age made by the assessment. In case of small fluctuations of recruitment this two estimates would tend to be close one to the other. For the recent period of the year the fluctuations of recruitment tend to be smaller than in the previous period of the fishery. The fishing pattern method is expected therefore to perform better under changing recruitment. When adding to the checking period of the fitting the four first years (1984–1987) of the southern fleet catches the separable model behave slightly better than the constant percentages at age in the catch.

Another reason for the rather similar performance of these two methods is that the catches at age 0, 1 and 2 (mainly caught in the Division IXa) seem not to follow a clear fishing pattern behaviour, and catches tend to fluctuate as much according to the fluctuation in recruitment as to other not understood causes. Is therefore specially in Division IXa where the two methods perform most similarly. In Division VIIIc the performance of the separable fishing pattern seem perform better (specially for ages 2 to 9) (Significant at *** level? For the period of fitting 1988–98).

The b procedure of getting southern fleet catches at age is rather parallel to the fitting fishing pattern procedure adopted here, but instead of using the population at age estimates provided by the assessment of the NEAM, the catches at age in the western area are used to obtain the catches at age of the southern fleets. In this way. For this reason it performs badly with Division IXa and as good as the other with Divisions VIIIb,c. The inconvenience of this method to make inference for the past is that it should be expected that the (lognormal assumed) errors of the catches at age are portaged from the western area to the southern fleet catches every year of estimates. Instead the separable fishing pattern procedure will avoid partly the year-to-year errors in the catches at age of the western fleet in the past.

4.2 The estimates for the period 1972–1983

The separable fitting procedure of the mackerel catches at age of the southern fleets can be adopted as the best ad hoc estimates of those catches, which are consistent with the fishing pattern in the southern fleets in the recent years and with the age structure of the NEAM population in the remote period as inferred from the assessment (mainly guide by the catches of mackerel in the western area and the triennial egg surveys). If the period covered for the fitting procedure of the fishing pattern can be considered sufficient, the current exercise would not have to be repeated every year, as far as the procedure of the assessment remain unchanged.

The problem of producing or not in future new estimates of the remote southern fleet catches at age is shared by all the procedure considered here and depend mainly upon the reliability of the fitting period for obtaining the estimates. In principle, the estimation of the past history (earlier to 1984) of the population will remain rather unchanged from year to year and therefore unnecessary the production of new estimates.

In any case, if the assessment of the complete period of the NEAM is preferred to be done via VPA for the period prior to 1992, then the current exercise of catch at age estimates could be repeated changing accordingly the procedure of the assessment (sensu VPA for the earlier period in the assessment).

Some comments on the assessment of the NEAM.

Apart form the lack of the southern catches for the first period of the assessment of the NEAM there is another major problem with the complete period assessment that refers to the use of the Triannual egg surveys estimates of Biomass, because the coverage of the southern spawning grounds has only recently started (in 1992, Anon. 1993). In this paper we have considered that the indexes of biomass derived from the previous surveys, when only the western spawning grounds were being covered, are sufficiently representative of major trends in the total NEAM population as to be included as relative indexes of abundance. Some overlapping of both indexes may be desirable in order to properly scale the catchability coefficients of both series (Q), although we have not applied that option. The doubts about the inter-annual variability in the percentage of biomass in the uncovered southern area in relation to the western area should not preclude the use of that index in this longer period of the assessment. The current figures for the percentage of Biomass in the southern area are in the range of 15 to 25% of the western area, which suppose about 10–20 % in relative trends between years, something expectable for this kind of indexes. Fitting fishing patterns for the mid halve of the historical catches at age and using the EPB index of biomass for the whole series may help to stabilize the assessment.

Fitting the fishing patterns to the two periods of the fishery reveal that the eighties show much poorer fitting to a separable model than the nineties. This may be due to a changing fishing pattern along the eighties or to some ageing errors in the matrix of catches at age. Depending upon what of these explanations are judged to be more realistic the assessment of the eighties should rely more on VPA or in Separable models. In this paper we have assumed that the sampling and ageing errors could be more relevant than the changing fishing pattern in the eighties and therefore we applied a separable fishing model for that period what is consistent with the approach adopted in last year with the western mackerel. It seems in any case that the approach adopted for the NEAM should be parallel to that adopted for the western mackerel.

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Footnote:

The assessment in the Excel Workbook can be shifted into a VPA type assessment for the period prior to 1992, as it was chosen in ICES CM 2000:

For that cases the VPA in the period 1991 to 1984 starts with the separable population at age estimates at the start of year 1992 and survivors at the end of age 11 produced by the previously described complete separable assessment (the one adopted here).

For the period prior to 1984 the criteria of covergence for the VPA is that the fishing mortality at age 11 should be as close as possible to:

$$F_{11.Y} = S1_{11} \cdot (1/5) \cdot \sum_{a=4}^{8} F\_vpa_{a.Y} / S1_{a}$$

Where S1a refers to the fishing pattern fitted for the period 1984–1988 in the assessment adopted and described in the main body of the paper.

Four guesses of such fishing mortality are implied in this procedure, those of the year 1979–83.

Tables and Figures

Tables 2, 3, 4 and 5 present respectively the basic catches at age corresponding to Divisions VIIIb, VIIIc and IXa by Countries (Spain and Portugal respectively) as reported to the ICES WG in previous years. Table 6 and 7 presents the Total catches at age obtained by Spain and Portugal together in Divisions VIIIb,c and IXa. The catches in Divisions VIIIb,c are produced only by Spain, whereas those of Division IXa are produced by Portugal and Spain.

Table 1:

Catches in tonnes of Mackerel (1972-1999) obtained by the Southern fleets operating in Division VIIIb, VIIIc and Ixa by country and total.

	SPAIN					PORTUGAL	TOTAL SPAIN + PORTUGAL		
	VIIIc	VIIIb	VIIIbc	IXa	TOTAL	IXa	VIIIbc	IXa	TOTAL
1972			26,827	4,589	**31,417**	1082	26,827	5,671	32,499
1973			21,656	4,021	**25,677**	1635	21,656	5,656	27,312
1974			21,243	8,934	**30,177**	2329	21,243	11,263	32,506
1975			15,555	7,853	**23,408**	2224	15,555	10,077	25,632
1976			13,707	4,773	**18,480**	2595	13,707	7,368	21,075
1977			19,852	2,935	**22,787**	1,743	19,852	4,678	24,530
1978			18,543	6,221	**24,764**	1,555	18,543	7,776	26,319
1979			15,013	6,280	**21,293**	1,071	15,013	7,351	22,364
1980			11,316	2,719	**14,035**	1,929	11,316	4,648	15,964
1981			12,834	2,111	**14,945**	3,108	12,834	5,219	18,053
1982			15,621	2,437	**18,058**	3,018	15,621	5,455	21,076
1983			10,390	2,224	**12,614**	2,239	10,390	4,463	14,853
1984			13,852	4,206	**18,058**	2,250	13,852	6,456	20,308
1985			11,810	2,123	**13,933**	4,178	11,810	6,301	18,111
1986			16,533	1,837	**18,370**	6,419	16,533	8,256	24,789
1987			15,982	491	**16,473**	5,714	15,982	6,205	22,187
1988	16,844	1,481		3,540	**21,865**	4,388	18,325	7,928	26,253
1989	13,446	1,409		1,763	**16,618**	3,112	14,855	4,875	19,730
1990	16,086	432		1,406	**17,924**	3,819	16,518	5,225	21,743
1991	16,940	3,981		1,051	**21,972**	2,789	20,921	3,840	24,761
1992	12,043	2,751		2,427	**17,221**	3,576	14,794	6,003	20,797
1993	16,675	2,989		1,027	**20,691**	2,015	19,664	3,042	22,706
1994	21,146	4,121		1,741	**27,008**	2,158	25,267	3,899	29,166
1995	23,631	4,347		1,025	**29,003**	2,893	27,978	3,918	31,896
1996	28,386	2,268		2,714	**33,368**	3,023	30,654	5,737	36,391
1997	35,015	7,844		3,613	**46,472**	2,080	42,859	5,693	48,552
1998	36,174	3,336		5,093	**44,603**	2,897	39,510	7,990	47,500
1999	37,631	4,120		4,164	**45,915**	2,002	41,751	6,166	47,917

Table 2. Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIb (Spain) during 1981-1999

Before 1989 VIIIb catches were pooled with VIIIc catches (and often with the Ixa catches as well).

CAGES	**SPAIN VIIIb**																**Total catch**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**in weight (t)**
1981																	0	unknown
1982																	0	unknown
1983																	0	unknown
1984																	0	unknown
1985																	0	unknown
1986																	0	unknown
1987																	0	unknown
1988																	0	
1989	0	65	1235	1175	866	803	218	292	175	110	36	9	12	2	3	3	5004	1,409
1990	0	7	16	224	358	190	212	75	79	127	18	24	7	0	0	0	1337	432
1991	0	180	692	1906	4132	1312	902	1296	220	425	899	142	154	3	2	35	12300	3,981
1992	0	67	256	1614	1380	2349	531	747	421	135	164	99	113	32	23	14	7944	2,751
1993	0	33	216	191	1684	1303	2159	591	423	786	313	135	13	1	1	18	7868	2,989
1994	0	6	505	988	1182	2135	1791	1472	686	644	275	236	138	54	51	16	10179	4,121
1995	0	50	143	1947	952	885	1280	1332	1330	836	527	370	214	126	117	90	10199	4,347
1996	5	158	77	342	791	539	535	782	572	575	353	199	98	29	30	11	5096	2,268
1997	1	335	567	2722	7981	3880	1694	1463	1244	892	374	292	208	96	15	26	21792	7,844
1998	2	485	970	1966	642	1847	1276	595	411	370	210	350	216	136	79	24	9576	3,336
1999	10	204	886	1455	1971	2041	2182	1215	539	412	199	232	78	62	22	0	11507	4,120

Mean Weight	**SPAIN VIIIb**																**Mean**	**SOPs**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**Weight**	**in weight (t)**
1981																		
1982																		
1983																		
1984																		
1985																		
1986																		
1987																		
1988																		
1989	0.000	0.072	0.159	0.247	0.296	0.342	0.363	0.418	0.464	0.494	0.552	0.563	0.592	0.714	0.675	0.675	0.279	1395
1990	0.000	0.055	0.188	0.240	0.261	0.313	0.378	0.394	0.421	0.406	0.393	0.432	0.528	0.000	0.000	0.000	0.319	426
1991	0.000	0.091	0.180	0.230	0.288	0.353	0.380	0.396	0.443	0.511	0.506	0.448	0.435	0.728	0.695	0.684	0.327	4016
1992	0.000	0.143	0.220	0.261	0.295	0.354	0.364	0.432	0.472	0.502	0.584	0.465	0.477	0.590	0.713	0.771	0.346	2749
1993	0.000	0.130	0.186	0.259	0.312	0.346	0.388	0.447	0.500	0.425	0.538	0.576	0.717	0.765	0.765	0.748	0.380	2989
1994	0.064	0.070	0.200	0.265	0.343	0.373	0.420	0.450	0.492	0.511	0.528	0.575	0.612	0.650	0.624	0.727	0.402	4089
1995	0.000	0.106	0.192	0.277	0.347	0.385	0.433	0.460	0.492	0.510	0.517	0.561	0.591	0.627	0.532	0.662	0.421	4297
1996	0.110	0.161	0.189	0.319	0.355	0.425	0.459	0.486	0.496	0.509	0.541	0.568	0.591	0.642	0.664	0.647	0.445	2269
1997	0.000	0.077	0.194	0.287	0.319	0.358	0.421	0.454	0.485	0.517	0.521	0.525	0.561	0.582	0.660	0.683	0.360	7841
1998	0.123	0.170	0.207	0.234	0.328	0.364	0.390	0.450	0.469	0.498	0.518	0.561	0.551	0.570	0.650	0.595	0.348	3334
1999	0.116	0.179	0.207	0.265	0.308	0.387	0.403	0.422	0.453	0.490	0.485	0.512	0.534	0.552	0.595	0.609	0.360	4143

Table 3. Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIc during 1981-1999

CAGES	**SPAIN VIIIC**																**Total catch**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**in weight (t)**
1981																	0	12,834
1982																	0	15,621
1983																	0	10,390
1984*	271337	13928	2149	7669	4500	6425	1630	926	1575	1532	601	732	348	500	360	4	314218	18,058
1985*	61231	4643	383	1508	10319	3284	2012	720	522	1022	931	775	528	364	313	558	89112	13,933
1986 (***)	12202	5907	4134	1564	4021	12454	3452	244	1501	623	487	196	3171	1697	0	3219	54872	16,533
1987*	2449	4149	3509	8495	4162	8769	6973	1652	1776	1079	1584	917	483	461	115	241	46813	16,473
1988 (**)	19	6391	1908	4648	9002	2924	5434	12784	5507	1785	530	283	752	712	124	932	53735	16,844
1989	6649	3094	2451	2780	3274	5764	2704	4053	5451	1553	804	329	288	289	84	343	39912	13,446
1990	7438	17050	2224	1785	2453	4510	6506	1883	4679	5427	1522	692	594	58	134	145	57100	16,087
1991	1472	6564	5007	8393	11764	6257	3862	5437	1287	1337	2861	518	56	107	78	359	55359	16,941
1992	567	4275	2832	6686	4397	7129	3112	1986	2736	834	926	1169	424	192	13	67	37345	12,043
1993	138	6612	5411	1411	9420	4114	8004	4221	2043	2220	1394	907	532	633	277	1172	48509	16,677
1994	331	669	5380	6747	7246	12350	8819	6227	2728	2587	1277	899	564	259	312	140	56533	21,146
1995	8126	851	2753	7569	5985	4603	6831	6601	6738	3644	2517	2171	1208	631	631	614	61473	23,631
1996	690	23902	7616	7636	13620	5840	4650	9100	5671	5741	2600	2089	885	190	245	286	90762	28,385
1997	7545	10750	18044	6747	25329	16351	5876	6536	5704	4765	2669	1577	1274	342	182	248	113938	35,015
1998	11204	17614	15882	18803	9941	18971	14959	6323	4201	4058	2632	1900	1875	555	409	657	129985	36,174
1999	7331	4862	4909	11293	21185	17200	21711	11354	4653	2871	2321	1786	986	585	203	172	113422	37,631

Mean Weight	**SPAIN VIIIC**																**Mean**	**SOPs**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**Weight**	**in weight (t)**
1981																		0
1982																		0
1983																		0
1984*	0.029	0.046	0.198	0.239	0.298	0.343	0.377	0.391	0.457	0.450	0.438	0.465	0.345	0.406	0.504	0.708	0.057	17795
1985*	0.055	0.092	0.189	0.299	0.339	0.408	0.484	0.502	0.593	0.596	0.609	0.607	0.646	0.636	0.679	0.667	0.153	13591
1986 (***)	0.051	0.144	0.256	0.295	0.369	0.398	0.397	0.554	0.510	0.416	0.554	0.649	0.528	0.526		0.679	0.312	17113
1987*	0.061	0.127	0.167	0.270	0.395	0.437	0.473	0.557	0.603	0.637	0.626	0.652	0.449	0.519	0.663	0.769	0.370	17312
1988 (**)	0.066	0.073	0.184	0.234	0.277	0.313	0.337	0.387	0.392	0.403	0.476	0.490	0.490	0.543	0.548	0.566	0.311	16705
1989	0.072	0.094	0.168	0.263	0.339	0.388	0.467	0.497	0.510	0.542	0.541	0.591	0.565	0.626	0.579	0.736	0.337	13431
1990	0.070	0.089	0.169	0.250	0.308	0.365	0.401	0.475	0.494	0.525	0.507	0.566	0.540	0.729	0.553	0.724	0.274	15629
1991	0.093	0.144	0.192	0.231	0.292	0.330	0.397	0.438	0.484	0.505	0.521	0.517	0.746	0.673	0.667	0.720	0.305	16872
1992	0.092	0.128	0.189	0.249	0.302	0.362	0.399	0.433	0.459	0.478	0.527	0.544	0.595	0.524	0.716	0.708	0.321	12001
1993	0.110	0.123	0.174	0.268	0.322	0.357	0.401	0.442	0.468	0.498	0.489	0.518	0.596	0.590	0.578	0.745	0.343	16662
1994	0.098	0.129	0.182	0.250	0.349	0.377	0.422	0.455	0.495	0.522	0.532	0.577	0.623	0.628	0.622	0.721	0.376	21236
1995	0.060	0.139	0.223	0.295	0.367	0.407	0.442	0.477	0.506	0.529	0.554	0.559	0.619	0.656	0.615	0.674	0.384	23601
1996	0.065	0.111	0.161	0.269	0.326	0.411	0.450	0.466	0.487	0.507	0.542	0.543	0.557	0.652	0.623	0.662	0.312	28326
1997	0.075	0.144	0.167	0.270	0.319	0.366	0.415	0.449	0.472	0.509	0.528	0.544	0.582	0.596	0.644	0.664	0.307	35000
1998	0.077	0.116	0.185	0.236	0.314	0.350	0.374	0.406	0.449	0.460	0.493	0.492	0.513	0.566	0.617	0.643	0.278	36160
1999	0.086	0.137	0.201	0.263	0.304	0.371	0.385	0.407	0.433	0.481	0.503	0.531	0.528	0.548	0.572	0.594	0.332	37627

* Division VIIIbc + IXa for Spanish data.
(**) In 1988 only part of the VIIIb catch (that from purse seiners) is included in the catch at age of the VIIIC.
The remainder VIIIb catch (corresponding to Trawlers 1480 t) was not included in the VIIIc reporting and its age composition is unknown.
(***) in 1986 Division VIIIbc

Table 4. Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division IXa (Spain) during 1981-1999

CAGES	SPAIN IXa																Total catch
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	TOTAL	in weight (t)
1981																	0	2,111
1982																	0	2,437
1983																	0	2,224
1984*																	0	
1985*																	0	
1986	15208	9244	124	30	84	262	60	2	15	12	4	2	53	17	0	18	25134	1,837
1987*																	0	
1988	38906	30807	841	359	93	36	51	183	77	31	10	8	12	4	1	8	71427	3,540
1989	27369	8682	668	93	35	52	29	47	66	21	10	5	3	3	1	3	37087	1,763
1990	5980	5452	1134	347	176	83	79	16	34	38	9	5	2	0	1	0	13356	1,406
1991	3062	1223	1354	925	412	265	107	79	20	17	27	5	0	1	1	2	7500	1,052
1992	40514	670	244	301	173	242	91	39	55	15	12	17	4	3	1	1	42382	2,427
1993	5457	2015	626	71	321	105	129	43	22	22	12	10	10	10	2	11	8866	1,027
1994	24340	38	71	120	120	214	228	195	114	131	66	53	46	16	25	8	25785	1,741
1995	301	2533	616	414	186	131	186	150	132	73	45	37	20	10	9	7	4849	1,025
1996	29047	2490	990	1141	761	71	27	37	17	17	11	8	3	1	1	1	34623	2,714
1997	19687	15352	897	302	796	361	122	139	106	80	44	29	18	5	3	3	37942	3,613
1998	38567	8093	3936	1979	432	449	244	82	38	35	24	16	18	6	4	14	53935	5,093
1999	53968	3096	1954	1011	665	93	69	21	8	2	2	1	1	0	0	0	60892	4,164

Mean Weight	SPAIN IXa																Mean	SOPs
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Weight	in weight (t)
1981																		
1982																		
1983																		
1984*																		
1985*																		
1986	0.063	0.067	0.175	0.268	0.378	0.405	0.398	0.554	0.510	0.364	0.554	0.649	0.479	0.525		0.666	0.073	1840
1987*																		
1988	0.041	0.059	0.163	0.192	0.292	0.337	0.436	0.514	0.523	0.536	0.564	0.607	0.632	0.566	0.701	0.668	0.054	3871
1989	0.032	0.078	0.150	0.225	0.318	0.385	0.506	0.533	0.543	0.567	0.566	0.629	0.606	0.628	0.621	0.713	0.049	1818
1990	0.086	0.092	0.157	0.208	0.239	0.319	0.367	0.463	0.462	0.494	0.478	0.491	0.499		0.553		0.106	1413
1991	0.047	0.142	0.175	0.206	0.278	0.311	0.370	0.425	0.440	0.458	0.489	0.495		0.699	0.703	0.703	0.140	1051
1992	0.048	0.161	0.218	0.246	0.289	0.348	0.382	0.436	0.454	0.470	0.508	0.544	0.586	0.495	0.755	0.744	0.057	2420
1993	0.076	0.119	0.169	0.266	0.310	0.328	0.366	0.424	0.456	0.501	0.514	0.520	0.611	0.596	0.566	0.625	0.116	1030
1994	0.045	0.122	0.196	0.253	0.358	0.402	0.470	0.500	0.545	0.565	0.580	0.606	0.666	0.651	0.657	0.734	0.067	1740
1995	0.099	0.120	0.189	0.278	0.365	0.409	0.439	0.483	0.509	0.536	0.566	0.561	0.627	0.675	0.617	0.645	0.211	1024
1996	0.058	0.123	0.158	0.240	0.280	0.338	0.387	0.426	0.452	0.485	0.560	0.576	0.578	0.655	0.621	0.655	0.078	2712
1997	0.076	0.083	0.165	0.248	0.298	0.352	0.407	0.436	0.454	0.494	0.516	0.522	0.585	0.595	0.628	0.614	0.095	3605
1998	0.058	0.157	0.175	0.217	0.273	0.315	0.342	0.364	0.428	0.434	0.463	0.477	0.503	0.568	0.589	0.662	0.094	5087
1999	0.055	0.128	0.178	0.225	0.250	0.326	0.366	0.417	0.398	0.470	0.470	0.490	0.493	0.494	0.490		0.068	4157

* Division VIIIbc + IXa for Spanish data.

Table 5. Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division IXa (Portugal during 1981-1999

CAGES	**PORTUGAL IXa**																**Total catch**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**in weight (t)**
1981	8833	8201	2853	986	178	74	58	28	16	11	63						21302	3,108
1982	5297	8759	6307	1010	238	57	37	55	33	19	80						21892	3,018
1983	3861	4747	2796	1264	186	56	16	18	13	12	23						12992	2,239
1984	16550	1356	1638	930	179	50	13	5	8	8	6	0	0	0	0	0	20744	2,250
1985	19990	26213	2663	426	187	49	38	2	2	2	10						49582	4,178
1986	3009	12171	9065	3267	1298	536	215	131	7	3	34						29738	6,419
1987	2477	12635	4531	2085	498	695	46	55	42	3	3	0	0	0	39	0	23108	5,714
1988	15904	9762	1598	1645	624	260	103	8	26	8	3						29943	4,388
1989	6943	9657	2761	1487	850	194	34	6	15	7	5						21957	3,112
1990	5478	9433	4160	530	247	90	30	30	5	3	1	0	0	0	2	0	20009	3,819
1991	584	3552	3481	2234	495	291	167	93	30	51	11	0	0	3	0	0	10992	2,789
1992	647	3689	2296	1902	912	442	227	35	117	19	115	0	0	0	0	0	10401	3,576
1993	639	4857	1512	995	1069	216	109	88	41	18	18	0	0	0	0	0	9562	2,015
1994	228	2169	2199	1082	554	563	378	186	57	17	50	6	13	0	0	0	7502	2,158
1995	2600	4052	2501	1265	586	336	239	156	74	41	50	18	15	2	2	3	11939	2,893
1996	1121	2635	1945	1299	926	389	364	515	499	415	200	81	51	17	5	8	10468	3,023
1997	1037	1495	4008	905	282	423	302	132	109	46	67	4	22	0	0	0	8831	2,080
1998	3353	5687	3008	684	250	276	247	179	59	42	46	73	35	16	7	4	13966	2,897
1999	5674	5150	1770	524	182	95	69	32	6	8	7	1	4	1	0	0	13523	2,002

Mean Weight	**PORTUGAL IXa**																**Mean**	**SOPs**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**Weight**	**in weight (t)**
1981	0.070	0.159	0.238	0.311	0.379	0.450	0.479	0.548	0.596	0.628	0.698						0.146	3108
1982	0.080	0.093	0.182	0.337	0.489	0.534	0.597	0.611	0.646	0.653	0.680						0.138	3018
1983	0.126	0.153	0.207	0.229	0.416	0.496	0.581	0.621	0.633	0.650	0.663						0.172	2239
1984	0.068	0.192	0.267	0.320	0.442	0.496	0.530	0.584	0.584	0.633	0.663						0.108	2250
1985 *	0.086	0.149	0.224	0.299	0.431	0.494	0.547	0.591	0.615	0.641	0.676						0.131	6492
1986	0.108	0.153	0.246	0.286	0.453	0.477	0.521	0.592	0.863	0.967	0.751						0.216	6419
1987	0.117	0.201	0.315	0.374	0.424	0.504	0.575	0.648	0.571	0.847	0.847				0.549		0.247	5714
1988	0.088	0.158	0.288	0.314	0.416	0.475	0.540	0.697	0.561	0.702	0.747						0.147	4388
1989	0.053	0.122	0.234	0.277	0.427	0.497	0.776	0.909	0.744	0.940	0.988						0.142	3112
1990	0.129	0.189	0.242	0.309	0.375	0.418	0.441	0.466	0.568	0.604	0.660				0.570		0.191	3819
1991	0.173	0.196	0.243	0.297	0.372	0.417	0.495	0.512	0.554	0.605	0.580			0.724			0.255	2801
1992	0.205	0.268	0.363	0.389	0.444	0.443	0.488	0.550	0.570	0.566	0.621						0.343	3573
1993	0.081	0.105	0.306	0.365	0.366	0.422	0.471	0.503	0.564	0.617	0.617						0.210	2012
1994	0.107	0.180	0.262	0.338	0.380	0.418	0.413	0.486	0.553	0.591	0.585	0.638	0.592				0.284	2131
1995	0.103	0.189	0.286	0.354	0.401	0.437	0.457	0.510	0.564	0.615	0.652	0.624	0.609	0.825	0.929	0.814	0.242	2893
1996	0.075	0.160	0.241	0.317	0.365	0.406	0.459	0.470	0.566	0.554	0.585	0.623	0.624	0.698	0.741	0.714	0.289	3023
1997	0.076	0.166	0.219	0.313	0.351	0.399	0.446	0.446	0.481	0.510	0.569	0.714	0.660			1.142	0.236	2080
1998	0.10	0.18	0.25	0.32	0.37	0.41	0.44	0.46	0.47	0.52	0.53	0.52	0.55	0.55	0.63	0.61	0.207	2894
1999	0.10	0.14	0.23	0.29	0.33	0.38	0.41	0.42	0.46	0.52	0.50	0.60	0.58	0.72	0.00	0.00	0.148	2001

* Average of the previous four years

Table 6. Catch number at age ('000) and mean weight (kg) at age for Mackerel in Divisions VIIIb & c (Spain) during 1981-1999

CAGES	**SPAIN VIIIbc**																	**Total catch**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**in weight (t)**
1981																		
1982																		
1983																		
1984*																		13,852
1985*																		11,810
1986	12202	5907	4134	1564	4021	12454	3452	244	1501	623	487	196	3171	1697	0	3219	54872	16,533
1987*																		15,982
1988 (**)	19	6391	1908	4648	9002	2924	5434	12784	5507	1785	530	283	752	712	124	932	53735	16,844
1989	6649	3159	3686	3955	4140	6568	2922	4346	5626	1663	841	338	301	290	87	346	44916	14,855
1990	7438	17057	2240	2009	2811	4700	6718	1958	4758	5554	1540	716	601	58	134	145	58437	16,519
1991	1472	6744	5699	10299	15896	7569	4764	6733	1507	1762	3760	660	210	110	80	394	67659	20,922
1992	567	4342	3088	8300	5777	9478	3643	2733	3157	969	1090	1268	537	224	36	81	45289	14,794
1993	138	6645	5627	1602	11104	5417	10163	4812	2466	3006	1707	1042	545	634	278	1190	56377	19,666
1994	331	675	5885	7735	8427	14485	10610	7699	3414	3232	1552	1135	702	313	363	156	66712	25,267
1995	8126	901	2896	9516	6937	5488	8110	7933	8068	4480	3044	2541	1421	758	748	704	71672	27,977
1996	694	24060	7693	7979	14411	6378	5186	9882	6243	6316	2953	2289	983	219	275	297	95858	30,652
1997	7547	11085	18612	9469	33310	20231	7571	7999	6948	5656	3043	1868	1483	438	197	275	135730	42,859
1998	11206	18099	16852	20770	10583	20818	16235	6917	4612	4427	2841	2250	2091	691	488	681	139560	39,510
1999	7341	5066	5795	12748	23155	19240	23893	12569	5192	3283	2520	2018	1065	647	225	172	124929	41,751

Mean Weight	**SPAIN VIIIb**																**Mean**	**SOPs**
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**Weight**	**in weight (t)**
1981																		
1982																		
1983																		
1984																		
1985																		
1986	0.051	0.144	0.256	0.295	0.369	0.398	0.397	0.554	0.510	0.416	0.554	0.649	0.528	0.526		0.679	0.312	17113
1987																		
1988	0.066	0.073	0.184	0.234	0.277	0.313	0.337	0.387	0.392	0.403	0.476	0.490	0.490	0.543	0.548	0.566	0.311	16705
1989	0.072	0.094	0.165	0.258	0.330	0.382	0.460	0.492	0.509	0.539	0.542	0.590	0.566	0.626	0.582	0.735	0.330	14826
1990	0.070	0.089	0.169	0.249	0.302	0.363	0.401	0.472	0.493	0.522	0.506	0.561	0.540	0.729	0.553	0.724	0.275	16055
1991	0.093	0.143	0.191	0.231	0.291	0.334	0.394	0.430	0.478	0.507	0.517	0.502	0.518	0.674	0.667	0.717	0.309	20888
1992	0.092	0.128	0.192	0.251	0.300	0.360	0.394	0.433	0.461	0.482	0.536	0.538	0.570	0.533	0.714	0.719	0.326	14750
1993	0.110	0.124	0.175	0.267	0.320	0.355	0.398	0.442	0.473	0.479	0.498	0.525	0.599	0.590	0.578	0.745	0.349	19651
1994	0.098	0.128	0.184	0.252	0.349	0.377	0.421	0.454	0.494	0.520	0.531	0.577	0.621	0.632	0.622	0.722	0.380	25326
1995	0.060	0.137	0.221	0.291	0.364	0.404	0.441	0.474	0.503	0.525	0.548	0.559	0.615	0.651	0.602	0.673	0.389	27899
1996	0.066	0.112	0.161	0.272	0.327	0.412	0.451	0.468	0.488	0.507	0.542	0.545	0.561	0.651	0.628	0.661	0.319	30595
1997	0.075	0.142	0.168	0.275	0.319	0.364	0.416	0.450	0.474	0.510	0.527	0.541	0.579	0.593	0.645	0.666	0.316	42841
1998	0.077	0.118	0.186	0.236	0.314	0.351	0.376	0.410	0.451	0.464	0.495	0.502	0.517	0.567	0.622	0.641	0.283	39495
1999	0.086	0.138	0.202	0.263	0.304	0.373	0.387	0.409	0.435	0.482	0.501	0.529	0.528	0.549	0.574	0.594	0.334	41770
Average 86-98	0.070	0.116	0.184	0.256	0.316	0.369	0.400	0.436	0.473	0.499	0.521	0.540	0.551	0.576	0.607	0.676	0.323	

* Division VIIIbc + IXa for Spanish data.
(**) Catches of the trawler in VIIIb are lacking. Only purse seine and handlines catches at age in VIIIb were available and are included.

Table 7. Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division IXa during 1981-1999

CAGES	DIVISION IXa																Total catch
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	TOTAL	in weight (t)
1981																	0	
1982																	0	
1983																	0	
1984*																	0	6,456
1985*																	0	6,301
1986	18217	21416	9189	3298	1382	798	275	133	22	15	38	2	53	17	0	18	54873	8,256
1987*																	0	6,205
1988	54810	40569	2439	2004	717	296	154	191	103	39	13	8	12	4	1	8	101370	7,928
1989	34312	18339	3429	1580	885	246	63	53	81	28	15	5	3	3	1	3	59044	4,875
1990	11458	14885	5294	877	423	173	109	46	39	41	10	5	2	0	3	0	33365	5,225
1991	3646	4775	4835	3159	907	556	274	172	50	68	38	5	0	4	1	2	18492	3,840
1992	41161	4359	2540	2203	1085	684	318	74	172	34	127	17	4	3	1	1	52783	6,003
1993	6096	6872	2138	1066	1390	321	238	131	63	40	30	10	10	10	2	11	18428	3,042
1994	24568	2207	2270	1202	675	776	607	381	171	147	116	59	60	16	25	8	33286	3,899
1995	2901	6585	3117	1679	772	466	425	306	206	115	94	55	35	12	11	9	16787	3,918
1996	30168	5124	2935	2441	1687	460	391	552	516	431	211	89	54	17	6	9	45091	5,737
1997	20724	16847	4905	1207	1078	784	424	271	215	126	112	32	40	5	3	3	46773	5,693
1998	41920	13780	6944	2663	682	725	491	261	97	77	70	89	53	22	11	18	67901	7,990
1999	59641	8247	3725	1535	846	188	138	53	15	11	9	2	4	1	0	0	74415	6,165

Mean Weight	SPAIN IXa																Mean	SOPs
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Weight	in weight (t)
1981																		0
1982																		0
1983																		0
1984*																		0
1985*																		0
1986	0.07	0.12	0.25	0.29	0.45	0.45	0.49	0.59	0.63	0.48	0.73	0.65	0.48	0.52	0.00	0.67	0.151	8259
1987*																		
1988	0.05	0.08	0.24	0.29	0.40	0.46	0.51	0.52	0.53	0.57	0.61	0.61	0.63	0.57	0.70	0.67	0.081	8259
1989	0.04	0.10	0.22	0.27	0.42	0.47	0.65	0.58	0.58	0.66	0.70	0.63	0.61	0.63	0.62	0.71	0.084	4931
1990	0.11	0.15	0.22	0.27	0.32	0.37	0.39	0.47	0.48	0.50	0.50	0.49	0.50	0.00	0.56	0.00	0.157	5232
1991	0.07	0.18	0.22	0.27	0.33	0.37	0.45	0.47	0.51	0.57	0.52	0.49	0.00	0.72	0.70	0.70	0.208	3852
1992	0.05	0.25	0.35	0.37	0.42	0.41	0.46	0.49	0.53	0.52	0.61	0.54	0.59	0.50	0.75	0.74	0.114	5992
1993	0.08	0.11	0.27	0.36	0.35	0.39	0.41	0.48	0.53	0.55	0.58	0.52	0.61	0.60	0.57	0.62	0.165	3042
1994	0.05	0.18	0.26	0.33	0.38	0.41	0.43	0.49	0.55	0.57	0.58	0.61	0.65	0.65	0.66	0.73	0.116	3871
1995	0.10	0.16	0.27	0.34	0.39	0.43	0.45	0.50	0.53	0.56	0.61	0.58	0.62	0.70	0.67	0.69	0.233	3917
1996	0.06	0.14	0.21	0.28	0.33	0.40	0.45	0.47	0.56	0.55	0.58	0.62	0.62	0.70	0.72	0.71	0.127	5735
1997	0.08	0.09	0.21	0.30	0.31	0.38	0.43	0.44	0.47	0.50	0.55	0.54	0.63	0.60	0.63	0.61	0.122	5685
1998	0.06	0.17	0.21	0.24	0.31	0.35	0.39	0.43	0.45	0.48	0.51	0.51	0.54	0.55	0.61	0.65	0.118	7981
1999	0.06	0.14	0.20	0.25	0.27	0.35	0.39	0.42	0.42	0.51	0.50	0.55	0.56	0.67	0.49	0.00	0.083	6158
Average 86-98	0.058	0.121	0.234	0.292	0.362	0.403	0.442	0.481	0.530	0.545	0.584	0.571	0.588	0.613	0.651	0.673	0.117	

* Division VIIIc + IXa for Spanish data.

Table 8. Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc and IXa during 1984-1999

CAGES	DIVISION VIIIc and IXa																Total catch
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**in weight (t)**
1981																		
1982																		
1983																		
1984	287887	15285	3788	8599	4679	6475	1643	931	1583	1540	608	732	348	500	360	4	334,962	20,308
1985	81221	30856	3046	1934	10506	3333	2050	722	524	1024	941	775	528	364	313	558	138,694	18,111
1986	30419	27323	13324	4862	5403	13252	3727	377	1523	637	526	198	3224	1714	0	3237	109,744	24,789
1987	4926	16783	8040	10580	4660	9464	7019	1707	1818	1082	1588	917	483	461	154	241	69,921	22,187
1988 (*)	54829	46960	4347	6652	9719	3220	5588	12975	5610	1824	543	291	764	716	125	940	155,105	24,773
1989	40961	21499	7115	5535	5025	6813	2984	4399	5707	1691	856	343	304	293	88	349	103,960	19,730
1990	18896	31942	7534	2886	3234	4873	6827	2004	4797	5595	1550	721	603	58	137	145	91,802	21,744
1991	5118	11519	10534	13458	16803	8125	5038	6905	1557	1830	3798	665	210	114	81	396	86,151	24,762
1992	41728	8701	5628	10503	6862	10162	3961	2807	3329	1004	1216	1285	541	227	37	82	98,072	20,797
1993	6234	13517	7765	2668	12494	5738	10401	4943	2529	3046	1737	1052	555	644	280	1201	74,805	22,708
1994	24899	2882	8155	8937	9102	15261	11216	8080	3585	3379	1667	1194	761	329	388	164	99,998	29,166
1995	11027	7486	6013	11195	7709	5954	8535	8239	8274	4595	3138	2596	1456	770	759	714	88,459	31,895
1996	30863	29185	10628	10419	16098	6838	5577	10434	6758	6747	3164	2378	1037	236	280	306	140,949	36,389
1997	28270	27931	23516	10676	34388	21015	7995	8269	7162	5782	3154	1901	1522	443	199	277	182,503	48,552
1998	53125	31879	23796	23432	11266	21543	16726	7178	4709	4504	2911	2339	2144	713	499	698	207,462	47,499
1999	66982	13312	9520	14283	24002	19428	24031	12621	5206	3294	2529	2020	1069	648	225	172	199,343	47,916

Mean Weight	DIVISION VIIIc and IXa																Mean	SOPs
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**Weight**	**in weight (t)**
1981																		
1982																		
1983																		
1984	0.031	0.059	0.228	0.248	0.303	0.344	0.378	0.392	0.457	0.451	0.441	0.465	0.345	0.406	0.504	0.708	0.060	20045
1985	0.062	0.141	0.219	0.299	0.341	0.409	0.485	0.502	0.593	0.596	0.609	0.607	0.646	0.636	0.679	0.667	0.153	20083
1986	0.063	0.122	0.249	0.289	0.390	0.401	0.404	0.567	0.512	0.418	0.567	0.649	0.528	0.526	0.614	0.679	0.286	25372
1987	0.089	0.183	0.251	0.291	0.398	0.442	0.474	0.560	0.602	0.638	0.626	0.652	0.449	0.519	0.634	0.769	0.329	23026
1988	0.055	0.082	0.218	0.252	0.286	0.326	0.342	0.389	0.394	0.406	0.479	0.494	0.492	0.543	0.549	0.567	0.161	24964
1989	0.042	0.100	0.190	0.263	0.346	0.386	0.464	0.493	0.510	0.541	0.545	0.591	0.567	0.626	0.583	0.735	0.186	19757
1990	0.092	0.119	0.207	0.255	0.304	0.363	0.400	0.472	0.493	0.522	0.506	0.561	0.540	0.729	0.553	0.724	0.231	21286
1991	0.075	0.159	0.206	0.240	0.293	0.336	0.397	0.431	0.479	0.509	0.517	0.502	0.518	0.676	0.668	0.717	0.281	24740
1992	0.051	0.190	0.263	0.276	0.319	0.364	0.399	0.435	0.464	0.483	0.544	0.538	0.570	0.533	0.715	0.719	0.200	20743
1993	0.077	0.116	0.200	0.303	0.324	0.357	0.399	0.443	0.474	0.480	0.499	0.525	0.600	0.590	0.578	0.744	0.294	22693
1994	0.046	0.167	0.205	0.262	0.351	0.378	0.422	0.456	0.497	0.522	0.535	0.578	0.623	0.633	0.625	0.722	0.280	29196
1995	0.071	0.160	0.245	0.298	0.367	0.406	0.441	0.475	0.504	0.526	0.549	0.560	0.615	0.652	0.603	0.673	0.352	31816
1996	0.059	0.117	0.175	0.274	0.327	0.411	0.451	0.468	0.493	0.510	0.544	0.548	0.564	0.654	0.630	0.663	0.251	36330
1997	0.076	0.111	0.176	0.278	0.319	0.365	0.417	0.450	0.474	0.510	0.528	0.541	0.580	0.593	0.645	0.666	0.253	48526
1998	0.065	0.139	0.192	0.237	0.314	0.351	0.376	0.411	0.451	0.464	0.496	0.503	0.517	0.566	0.622	0.642	0.223	47476
1999	0.062	0.138	0.203	0.261	0.303	0.373	0.387	0.409	0.435	0.482	0.501	0.529	0.528	0.549	0.574	0.594	0.233	47928
Aver. 86,88-97	0.060	0.119	0.203	0.263	0.320	0.371	0.401	0.438	0.475	0.500	0.523	0.540	0.552	0.577	0.607	0.676	0.242	
Average 84-98	0.050	0.121	0.207	0.264	0.322	0.374	0.407	0.440	0.479	0.504	0.530	0.545	0.548	0.566	0.605	0.678	0.211	
Average 84-99	0.050	0.121	0.207	0.264	0.322	0.374	0.407	0.440	0.479	0.504	0.530	0.545	0.548	0.566	0.605	0.678	0.211	

(*) In 1988 only part of the VIIIb catch (that from purse seiners) is included in the catch at age of the VIIIC.

The remainder VIIIb catch (corresponding to Trawlers 1480 t) was not included in the VIIIc reporting and its age composition is unknown.

Table 9. Mean weights at age (kg) used in the different analysis of this paper for the different periods, divisions and frames.

MEAN WEIGHTS IN THE CATCHES AT AGE

Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12+
Mean Weight 1986-99 in VIIIbc	0.070	0.116	0.184	0.256	0.316	0.369	0.400	0.436	0.473	0.499	0.521	0.540	0.591
For checking fitting 86-98			plus group		0.413	0.447	0.475	0.502	0.526	0.546	0.563	0.578	0.591
and for stimating the catches at age in Div VIIIbc 1972-1984													
Mean weight in IXa 86-99	0.058	0.121	0.234	0.292	0.362	0.403	0.442	0.481	0.530	0.545	0.584	0.571	0.611
For checking fitting 86-98			plus group		0.455	0.487	0.518	0.545	0.569	0.583	0.596	0.601	0.611
and for stimating the catches at age in Div IXa 1972-1984													
Mean WeightsVIIIbc-IXa 84-99	0.050	0.121	0.207	0.264	0.322	0.374	0.407	0.440	0.479	0.504	0.530	0.545	0.591
For checking fitting 86-98 & 84-99			plus group		0.419	0.452	0.480	0.506	0.531	0.550	0.566	0.579	0.591
and to produce a weighted average (with western weights at age) for the NEAM weights in the 1972-83 catches													
Mean Weight in NEAM 1984-98	0.059	0.145	0.236	0.323	0.383	0.432	0.475	0.516	0.546	0.580	0.607	0.637	0.687
Not used at all	and for the plus group				0.488	0.524	0.557	0.586	0.612	0.636	0.657	0.674	0.687
In the assessment the individual annual values are used for SOPs estimates													

Western Weights at age in the Catch 1972-1983 to produce a weighted average for the new NEAM weights in the 1972-83 catches

Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12+
1972	0.066	0.137	0.158	0.241	0.416	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.066	0.137	0.158	0.241	0.314	0.437	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.066	0.137	0.158	0.241	0.314	0.334	0.472	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.066	0.137	0.158	0.241	0.314	0.334	0.398	0.480	0.000	0.000	0.000	0.000	0.000
1976	0.066	0.137	0.158	0.241	0.314	0.334	0.398	0.410	0.508	0.000	0.000	0.000	0.000
1977	0.066	0.137	0.158	0.241	0.314	0.334	0.398	0.410	0.503	0.511	0.511	0.000	0.000
1978	0.000	0.137	0.158	0.241	0.314	0.334	0.398	0.410	0.503	0.511	0.511	0.000	0.000
1979	0.000	0.137	0.158	0.241	0.314	0.334	0.398	0.410	0.503	0.511	0.511	0.511	0.000
1980	0.066	0.131	0.248	0.283	0.343	0.373	0.455	0.497	0.508	0.539	0.573	0.573	0.573
1981	0.066	0.131	0.248	0.283	0.343	0.373	0.455	0.497	0.508	0.539	0.573	0.573	0.573
1982	0.066	0.131	0.248	0.283	0.343	0.373	0.455	0.497	0.508	0.539	0.573	0.573	0.573
1983	0.066	0.178	0.216	0.270	0.306	0.383	0.425	0.430	0.491	0.542	0.608	0.608	0.608

NEAM Weights at age in the Catch 1972-1983 New estimates (Weighted average)

Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12+
1972	0.064	0.131	0.191	0.259	0.418								
1973	0.066	0.124	0.197	0.263	0.322	0.451							
1974	0.065	0.125	0.197	0.262	0.322	0.373	0.479						
1975	0.066	0.125	0.203	0.263	0.322	0.374	0.406	0.506					
1976	0.057	0.122	0.205	0.264	0.322	0.373	0.406	0.440	0.530				
1977	0.061	0.123	0.206	0.264	0.322	0.371	0.406	0.438	0.480	0.547			
1978	0.015	0.123	0.206	0.264	0.322	0.373	0.406	0.438	0.480	0.504	0.564		
1979	0.034	0.122	0.205	0.264	0.322	0.374	0.406	0.439	0.480	0.504	0.529	0.577	
1980	0.058	0.122	0.207	0.265	0.323	0.374	0.407	0.441	0.480	0.505	0.531	0.546	0.590
1981	0.056	0.122	0.207	0.265	0.323	0.374	0.408	0.442	0.479	0.505	0.531	0.546	0.590
1982	0.063	0.122	0.208	0.265	0.323	0.374	0.408	0.442	0.480	0.505	0.533	0.547	0.590
1983	0.066	0.130	0.207	0.265	0.322	0.375	0.407	0.440	0.479	0.505	0.531	0.548	0.591

Table 9 Continued.

MEAN WEIGHTS AT AGE IN THE STOCK

Western Mackerel values

Average 84-98	0.050	0.121	0.207	0.264	0.322	0.374	0.407	0.440	0.479	0.504	0.530	0.545	0.591
Not used at all			plus group		0.477	0.482	0.502	0.519	0.535	0.548	0.556	0.581	0.591

Southern weights at age in the Stock 1972-1983

Mean VIIIc.IXa 84-99	0.063	0.128	0.213	0.271	0.332	0.376	0.416	0.460	0.490	0.505	0.530	0.553	0.594
Unweighted mean in the catch			plus group		0.426	0.459	0.489	0.515	0.536	0.552	0.570	0.584	0.594

used to produce a weighted average (with western weights at age) for the NEAM weights in the stock in 1972-83 period.

Mean weight NEAM 1984-98

	0.000	0.085	0.176	0.253	0.306	0.354	0.402	0.439	0.465	0.490	0.527	0.551	0.597
			plus group		0.408	0.444	0.476	0.503	0.526	0.548	0.570	0.585	0.597

Western weights at age in the Stock 1972-1983 to produce a weighted average for the new NEAM weights

Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**
1972	0.000	0.113	0.131	0.201	0.380	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.000	0.113	0.131	0.201	0.251	0.410	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.000	0.113	0.131	0.201	0.251	0.264	0.440	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.000	0.113	0.131	0.201	0.251	0.264	0.316	0.470	0.000	0.000	0.000	0.000	0.000
1976	0.000	0.113	0.131	0.201	0.251	0.264	0.316	0.380	0.490	0.000	0.000	0.000	0.000
1977	0.000	0.113	0.131	0.201	0.251	0.264	0.316	0.380	0.412	0.511	0.000	0.000	0.000
1978	0.000	0.095	0.150	0.215	0.275	0.320	0.355	0.380	0.400	0.420	0.485	0.000	0.000
1979	0.000	0.095	0.150	0.215	0.275	0.320	0.355	0.380	0.400	0.420	0.485	0.485	0.000
1980	0.000	0.095	0.150	0.215	0.275	0.320	0.355	0.380	0.400	0.420	0.485	0.485	0.485
1981	0.000	0.070	0.172	0.241	0.300	0.300	0.359	0.401	0.412	0.427	0.413	0.509	0.509
1982	0.000	0.070	0.108	0.202	0.260	0.379	0.329	0.388	0.417	0.425	0.460	0.513	0.513
1983	0.000	0.070	0.156	0.220	0.261	0.322	0.360	0.384	0.420	0.497	0.453	0.550	0.550

NEAM weights at age in the Stock 1972-1983 New estimates (Weighted average)

Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**
1972	0.000	0.115	0.143	0.212	0.387								
1973	0.000	0.115	0.143	0.212	0.263	0.417							
1974	0.000	0.115	0.143	0.212	0.263	0.281	0.447						
1975	0.000	0.115	0.143	0.212	0.263	0.281	0.331	0.477					
1976	0.000	0.115	0.143	0.212	0.263	0.281	0.331	0.392	0.497				
1977	0.000	0.115	0.143	0.212	0.263	0.281	0.331	0.392	0.424	0.517			
1978	0.000	0.100	0.159	0.223	0.284	0.328	0.364	0.392	0.413	0.433	0.498		
1979	0.000	0.100	0.159	0.223	0.284	0.328	0.364	0.392	0.413	0.433	0.492	0.500	
1980	0.000	0.100	0.159	0.223	0.284	0.328	0.364	0.392	0.413	0.433	0.492	0.495	0.501
1981	0.000	0.079	0.178	0.246	0.305	0.311	0.368	0.410	0.424	0.439	0.431	0.516	0.522
1982	0.000	0.079	0.124	0.212	0.271	0.379	0.342	0.399	0.428	0.437	0.471	0.519	0.525
1983	0.000	0.079	0.165	0.228	0.272	0.330	0.368	0.395	0.430	0.498	0.465	0.551	0.557

TABLE 10: Evaluation of the different procedures estimates fitted to the recent catches of the southern fisheries 1986, 1988-1998

Total Unweighted Squared (log) Residuals by ages and overall for the different models used for the estimation of the Catches of the souhtern fleets.

For each age the summation across years of the log squared residuals is presented

Simple Global methods		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
a.1 Contant % at age	All South	1986-98	7.51	7.42	1.45	2.84	2.94	2.68	2.13	9.37	2.96	4.30	3.73	6.28	4.75	58.37	156	12	144	0.4053	0.637
b.1 Constant Ratio S/W	All South	1986-98	41.10	13.86	2.76	7.31	3.87	1.29	2.57	7.97	2.99	2.36	2.65	4.48	6.06	99.26	156	12	144	0.6893	0.830
a.1 Contant % at age	All South	1984-98	22.83	8.35	2.21	4.30	3.65	3.08	4.10	14.52	6.05	5.16	4.29	6.23	4.88	89.64	195	12	183	0.4898	0.700
b.1 Constant Ratio S/W	All South	1984-98	138.72	17.68	7.57	9.69	6.26	2.92	4.78	10.88	4.92	3.69	3.91	4.98	7.98	223.99	195	12	183	1.2240	1.106

Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
a.2 Contant % at age	Ixa	1986-98	8.67	5.63	1.88	1.74	2.85	3.32	6.23	8.09	10.45	12.80	13.41	24.87	15.40	115.34	156	12	144	0.8010	0.895
a.2 Contant % at age	VIIIbc	1986-98	56.61	14.30	2.50	5.05	3.00	2.85	1.92	10.62	3.12	3.47	2.87	5.03	5.35	116.70	156	12	144	0.8104	0.900
a.2 Contant % at age	Ixa+VIIIbc	1986-98	4.70	5.67	1.65	2.85	2.65	2.68	1.83	8.58	3.06	3.58	2.93	5.23	5.22	50.62	156	24	132	0.3835	0.619
a.2 Contant % at age	Ixa+VIIIbc	1984-98	13.75	6.02	3.13	4.30	3.44	2.99	3.62	13.88	5.74	4.34	3.40	5.28	5.42	75.30	195	24	171	0.4403	0.664

Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
b.2 Constant Ratio S/W	Ixa	1986-98	27.21	18.33	7.13	13.44	14.59	4.72	7.81	9.60	10.00	10.84	13.03	21.08	21.34	179.12	156	12	144	1.2439	1.115
b.2 Constant Ratio S/W	VIIIbc	1986-98	26.64	16.51	3.97	5.81	1.96	1.10	2.26	10.57	1.81	1.14	2.00	4.10	4.95	82.83	156	12	144	0.5752	0.758
b.2 Constant Ratio S/W	Ixa+VIIIbc	1986-98	20.14	12.66	2.55	6.74	2.45	0.98	2.03	8.13	1.78	1.20	1.97	4.25	4.94	69.82	156	24	132	0.5290	0.727
b.2 Constant Ratio S/W	Ixa+VIIIbc	1984-98	110.37	15.81	5.59	8.50	4.44	3.19	3.30	10.72	2.29	1.29	2.81	4.31	5.75	178.37	195	24	171	1.0431	1.021

Scaled Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
Separable Models	Ixa	1986-98	7.34	5.65	1.36	3.52	4.42	5.58	7.71	8.43	10.97	13.57	17.91	36.00	32.63	155.09	156	12	144	1.0770	1.038
Separable Models	VIIIbc	1986-98	48.38	15.71	2.55	3.51	1.26	1.20	1.92	9.18	1.80	1.20	4.29	4.71	3.86	99.58	156	12	144	0.6915	0.832
Addition of Separ.Models	Ixa+VIIIbc	1986-98	4.39	6.16	1.57	2.90	1.37	1.11	1.83	7.29	1.76	1.28	4.37	5.09	3.89	43.01	156	24	132	0.3259	0.571
Addition of Separ.Models	Ixa+VIIIbc	1984-98	13.15	7.12	1.63	3.27	1.98	2.37	2.82	9.40	2.86	1.78	6.39	5.15	6.38	64.30	195	24	171	0.3760	0.613

In de frame of a separable model of NEAM

UnScaled Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
Separable Models	Ixa	1986-98	6.59	5.25	1.43	2.60	3.40	7.02	6.72	7.70	10.49	13.51	16.98	32.75	23.69	138.14	156	12	144	0.9593	0.979
Separable Models	VIIIbc	1986-98	50.24	13.98	1.58	3.92	1.56	1.56	1.72	6.84	2.11	1.59	3.03	3.83	5.69	97.66	156	12	144	0.6782	0.824
Addition of Separ.Models	Ixa+VIIIbc	1986-98	4.59	5.87	1.03	3.24	1.45	1.41	1.62	5.57	1.99	1.63	3.19	4.23	5.35	41.18	156	24	132	0.3119	0.559

TABLE 11: Evaluation of the different procedures estimates fitted to the recent catches of the southern fisheries 1988-1998

Total Unweighted Squared (log) Residuals by ages and overall for the different models used for the estimation of the Catches of the souhtern fleets.

For each age the summation across years of the log squared residuals is presented

Simple Global methods		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
a.1 Contant % at age	All South	1988-98	7.39	7.06	1.19	2.67	2.65	2.38	1.84	2.24	2.13	2.22	2.45	3.66	2.00	39.88	143	12	131	0.3045	0.552
b.1 Constant Ratio S/W	All South	1988-98	39.12	10.43	2.55	3.85	2.45	0.88	2.20	2.41	2.83	2.00	2.10	2.76	4.29	77.87	143	12	131	0.5944	0.771
a.1 Contant % at age	All South	1984-98	18.90	8.28	2.22	4.35	4.00	3.02	4.78	16.86	6.80	5.88	4.67	6.66	4.78	91.21	195	12	183	0.4984	0.706
b.1 Constant Ratio S/W	All South	1984-98	136.67	19.12	5.81	9.15	6.04	3.30	4.29	11.09	3.51	2.44	3.53	4.78	7.13	216.86	195	12	183	1.1850	1.089

Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
a.2 Contant % at age	Ixa	1988-98	8.57	5.48	1.64	1.71	2.85	3.32	6.04	7.58	5.85	8.29	12.85	15.47	14.97	94.62	143	12	131	0.7223	0.850
a.2 Contant % at age	VIIIbc	1988-98	50.72	14.27	2.50	3.77	2.69	2.33	1.77	2.34	2.63	1.93	1.92	3.03	2.01	91.94	143	12	131	0.7018	0.838
a.2 Contant % at age	Ixa+VIIIbc	1988-98	4.67	5.61	1.51	2.67	2.46	2.22	1.68	2.30	2.49	1.96	1.99	3.13	1.98	34.66	143	24	119	0.2913	0.540
a.2 Contant % at age	Ixa+VIIIbc	1984-98	13.76	5.99	2.93	4.37	3.55	2.89	3.77	14.58	5.91	4.57	3.53	5.51	5.60	76.95	195	24	171	0.4500	0.671

Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
b.2 Constant Ratio S/W	Ixa	1988-98	24.27	14.39	6.08	6.63	10.74	3.62	7.25	9.31	9.58	10.78	13.02	16.63	21.47	153.78	143	12	131	1.1739	1.083
b.2 Constant Ratio S/W	VIIIbc	1988-98	26.67	14.67	3.43	5.03	1.26	1.06	1.61	1.18	1.77	1.06	1.08	1.81	3.44	64.06	143	12	131	0.4890	0.699
b.2 Constant Ratio S/W	Ixa+VIIIbc	1988-98	17.99	9.51	2.44	3.67	1.39	0.90	1.44	1.10	1.75	1.14	1.15	1.94	3.46	47.86	143	24	119	0.4022	0.634
b.2 Constant Ratio S/W	Ixa+VIIIbc	1984-98	104.89	17.22	4.96	8.43	4.70	3.20	3.72	11.34	2.37	1.32	2.92	4.56	5.34	174.98	195	24	171	1.0233	1.012

Scaled Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
Separable Models	Ixa	1988-98	7.29	5.35	1.33	2.43	4.17	4.63	6.84	7.52	7.84	12.25	16.93	23.38	38.18	138.14	143	12	131	1.0545	1.027
Separable Models	VIIIbc	1988-98	40.62	15.19	2.35	3.53	1.16	1.24	1.47	1.14	1.68	1.08	3.13	2.51	3.68	78.80	143	12	131	0.6015	0.776
Addition of Separ.Models	Ixa+VIIIbc	1988-98	4.31	5.85	1.44	2.64	1.24	1.17	1.34	1.07	1.60	1.16	3.21	2.66	3.96	31.65	143	24	119	0.2659	0.516
Addition of Separ.Models	Ixa+VIIIbc	1984-98	13.14	7.28	1.61	3.15	1.92	2.43	2.68	10.47	2.56	1.54	6.28	4.99	8.65	66.69	195	24	171	0.3900	0.625

In de frame of a separable model of NEAM

UnScaled Estimates by Divisions		Checking	**Ages**													**USSQ**					
Estimation Procedure	Area/fleet	Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**	**Total**	**Obs**	**Params**	**D.f**	**Variance**	**S.d.**
Separable Models	Ixa	1988-98	6.55	5.06	1.37	1.74	3.25	5.53	5.64	6.60	6.95	11.77	15.80	20.05	24.66	114.96	143	12	131	0.8776	0.937
Separable Models	VIIIbc	1988-98	38.70	12.54	1.55	3.65	1.00	1.26	1.70	1.53	2.03	1.49	2.78	2.98	3.34	74.56	143	12	131	0.5691	0.754
Addition of Separ.Models	Ixa+VIIIbc	1988-98	4.47	5.63	1.02	2.66	1.04	1.20	1.56	1.45	1.96	1.58	2.88	3.12	3.39	31.96	143	24	119	0.2686	0.518

TABLE 12: Evaluation of the constant percentage at age estimation procedure (fitted for 1988-98 data) concerning the southern catches 1984-1998

MODEL: CONSTANT % OF CATCHES AT AGE FOR ALL YEARS

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc and IXa during 1984-1999 as summ of Division espected cages

CAGES	DIVISION VIIIc and IXa																	SOPs		Variation		
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	TOTAL	in weight (t)	gp 12+	%	W.factor1	W.factor2
1984	35186	18786	7979	6547	7575	6043	5038	4085	2727	1987	1214	767	503	236	141	246	99,058	19,999	1,126	-2%	0	1
1985	34059	17763	7348	5846	6595	5222	4340	3514	2346	1709	1045	658	432	202	121	211	91,410	17,779	966	-2%	0	1
1986	44801	23628	9900	7997	9136	7260	6044	4897	3269	2382	1456	918	602	283	169	294	123,036	24,373	1,348	-2%	0	1
1987	34259	18948	8353	7140	8527	6864	5743	4666	3113	2271	1384	877	575	270	162	282	103,433	21,938	1,289	-1%	0	1
1988	43182	23014	9755	7987	9225	7355	6130	4971	3318	2418	1477	933	611	287	172	299	121,134	24,391	1,369	-2%	1	1
1989	27294	15654	7152	6340	7773	6302	5288	4303	2870	2095	1275	810	530	250	149	261	88,346	19,575	1,191	-1%	1	1
1990	29355	16979	7819	6985	8609	6990	5869	4777	3186	2326	1415	900	589	278	166	291	96,533	21,588	1,323	-1%	1	1
1991	23028	15416	8000	7924	10428	8611	7279	5944	3961	2896	1756	1124	734	348	207	365	98,021	24,803	1,654	0%	1	1
1992	33033	18107	7910	6695	7937	6376	5331	4329	2888	2107	1284	814	533	251	150	262	98,006	20,544	1,195	-1%	1	1
1993	18751	13245	7131	7259	9705	8045	6810	5566	3709	2713	1643	1053	687	326	194	342	87,180	22,796	1,550	0%	1	1
1994	24044	16997	9155	9324	12468	10335	8750	7150	4765	3485	2111	1353	883	419	250	440	111,927	29,279	1,992	0%	1	1
1995	24590	17945	9864	10191	13737	11409	9666	7902	5265	3852	2333	1495	976	463	276	487	120,450	32,055	2,202	1%	1	1
1996	34299	22827	11797	11645	15297	12626	10671	8713	5807	4246	2574	1647	1076	510	304	535	144,573	36,440	2,424	0%	1	1
1997	36093	26812	14899	15509	20990	17451	14790	12094	8057	5895	3569	2289	1494	709	423	745	181,820	48,824	3,371	1%	1	1
1998	47242	30727	15613	15208	19820	16326	13787	11253	7501	5483	3326	2126	1389	658	392	690	191,543	47,514	3,129	0%	1	1
1999	38317	27477	14938	15314	20554	17053	14442	11805	7865	5754	3485	2233	1458	692	412	727	182,527	48,127	3,289	0%	0	0

Log Residuals

CAGES	DIVISION VIIIc and IXa																		Weighted			
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	gp 12+	Total SSQ	SSQ	Cuantos	Parametros1	g.l. (d.f.)
1984	2.10	-0.21	-0.75	0.27	-0.48	0.07	-1.12	-1.48	-0.54	-0.25	-0.69	-0.05	-0.37	0.75	0.94	-4.12	0.07	9.62	9.62	13	24	119
1985	0.87	0.55	-0.88	-1.11	0.47	-0.45	-0.75	-1.58	-1.50	-0.51	-0.10	0.16	0.20	0.59	0.95	0.98	0.60	9.45	9.45	13		
1986	-0.39	0.15	0.30	-0.50	-0.53	0.60	-0.48	-2.57	-0.76	-1.32	-1.02	-1.53	1.68	1.80	0.00	2.40	1.80	16.92	16.92	13		
1987	-1.94	-0.12	-0.04	0.39	-0.60	0.32	0.20	-1.01	-0.54	-0.74	0.14	0.04	-0.17	0.53	-0.05	-0.16	0.04	6.31	6.31	13	Parametros2	g.l. (d.f.)
1988	0.24	0.71	-0.81	-0.18	0.05	-0.83	-0.09	0.96	0.53	-0.28	-1.00	-1.16	0.22	0.91	-0.32	1.14	0.62	5.96	5.96	13	24	171
1989	0.41	0.32	-0.01	-0.14	-0.44	0.08	-0.57	0.02	0.69	-0.21	-0.40	-0.86	-0.56	0.16	-0.53	0.29	-0.14	2.25	2.25	13		
1990	-0.44	0.63	-0.04	-0.88	-0.98	-0.36	0.15	-0.87	0.41	0.88	0.09	-0.22	0.02	-1.57	-0.19	-0.70	-0.34	4.35	4.35	13	Case 1 = checking 1988-98	
1991	-1.50	-0.29	0.28	0.53	0.48	-0.06	-0.37	0.15	-0.93	-0.46	0.77	-0.52	-1.25	-1.12	-0.94	0.08	-0.73	5.57	5.57	13	Case 1 = checking 1984-98	
1992	0.23	-0.73	-0.34	0.45	-0.15	0.47	-0.30	-0.43	0.14	-0.74	-0.05	0.46	0.02	-0.10	-1.40	-1.16	-0.30	2.30	2.30	13		
1993	-1.10	0.02	0.09	-1.00	0.25	-0.34	0.42	-0.12	-0.38	0.12	0.06	0.00	-0.21	0.68	0.36	1.26	0.55	3.06	3.06	13	Coeff R2-1	Coeff R2-2
1994	0.03	-1.77	-0.12	-0.04	-0.31	0.39	0.25	0.12	-0.28	-0.03	-0.24	-0.12	-0.15	-0.24	0.44	-0.99	-0.19	3.68	3.68	13	0.754	0.333
1995	-0.80	-0.87	-0.50	0.09	-0.58	-0.65	-0.12	0.04	0.45	0.18	0.30	0.55	0.40	0.51	1.01	0.38	0.52	3.33	3.33	13		
1996	-0.11	0.25	-0.10	-0.11	0.05	-0.61	-0.65	0.18	0.15	0.46	0.21	0.37	-0.04	-0.77	-0.08	-0.56	-0.27	1.41	1.41	13		
1997	-0.24	0.04	0.46	-0.37	0.49	0.19	-0.62	-0.38	-0.12	-0.02	-0.12	-0.19	0.02	-0.47	-0.75	-0.99	-0.32	1.38	1.38	13	W.Variance1	W.Variance2
1998	0.12	0.04	0.42	0.43	-0.56	0.28	0.19	-0.45	-0.47	-0.20	-0.13	0.10	0.43	0.08	0.24	0.01	0.26	1.36	1.36	13	0.236	0.338
1999	0.56	-0.72	-0.45	-0.07	0.16	0.13	0.51	0.07	-0.41	-0.56	-0.32	-0.10	-0.31	-0.07	-0.61	-1.44	-0.44	2.14	0.00	0		
Total Marginal 84-98	-2.52	-1.30	-2.04	-2.16	-2.84	-0.91	-3.86	-7.41	-3.16	-3.14	-2.20	-2.98	0.24	1.75	-0.32	-2.12	2.18		GT		RMS	U.Variance
Total SSQ 88-98	4.67	5.61	1.51	2.67	2.46	2.22	1.68	2.30	2.49	1.96	1.99	3.13	2.34	6.17	5.24	7.21	1.98	34.65	34.65	143	0.242	0.291
Totals SSQ 84-98	13.76	5.99	2.93	4.37	3.55	2.89	3.77	14.58	5.91	4.57	3.53	5.51	5.37	10.61	7.02	30.90	5.60	76.95	76.95	195	0.395	0.450

TABLE 13: Evaluation of the separable modelling estimation procedure (fitted for 1988-98 data) concerning the southern catches 1984-1998

MODEL: Separable models of fishing mortality at age for the southern fleets in Divisions Ixa and Divisions VIIIbc (two fishing patterns fitted).

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc and IXa during 1986-1999 as summ of Division espected cages

CAGES	DIVISION VIIIc and IXa																SOPs		Variation		
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	TOTAL	in weight (t)	gp 12+	%	W.factor1	W.factor2
1984	42912	5460	3922	10263	7651	5960	2764	1297	2662	2003	1390	844	6142	0	0	0	93,269	19,818	6,142	-2%	0	1
1985	18837	26393	2549	2835	9232	6524	4073	1996	794	1589	1119	663	4061	0	0	0	80,663	17,899	4,061	-1%	0	1
1986	25278	16565	18074	2782	4005	12835	7427	4908	2047	794	1490	895	4595	0	0	0	101,698	24,385	4,595	-2%	0	1
1987	28156	12311	6615	12344	2627	3853	10022	6201	3487	1427	515	822	3682	0	0	0	92,061	21,901	3,682	-1%	0	1
1988	25614	24155	7956	6668	15405	3043	3467	9632	5024	2763	1049	324	3463	0	0	0	108,562	25,941	3,463	5%	1	1
1989	20496	11095	8438	4707	5307	12153	1915	2307	5414	2727	1423	458	2016	0	0	0	78,454	19,570	2,016	-1%	1	1
1990	15239	15969	6660	8219	5859	6247	11219	1906	1900	4294	2007	914	1937	0	0	0	82,371	21,653	1,937	0%	1	1
1991	13837	9505	8404	6276	10635	7408	6151	11996	1685	1622	3389	1378	2387	0	0	0	84,674	24,800	2,387	0%	1	1
1992	25484	13946	6130	7410	5947	8455	4436	3951	6300	846	756	1392	1894	0	0	0	86,947	20,535	1,894	-1%	1	1
1993	16258	11176	5782	5015	9061	7543	8544	4837	3562	5456	679	528	2791	0	0	0	81,231	22,781	2,791	0%	1	1
1994	14290	19421	9506	7839	8048	12579	7604	9396	4296	3034	4238	465	2794	0	0	0	103,512	29,369	2,794	1%	1	1
1995	17864	14146	13882	11042	10888	9701	10977	7264	7259	3191	2052	2525	2387	0	0	0	113,178	32,153	2,387	1%	1	1
1996	30836	21062	10805	16186	14790	12415	7972	9910	5314	5126	2049	1160	3413	0	0	0	141,036	36,483	3,413	0%	1	1
1997	23116	30771	15843	13746	25514	20722	12693	8979	9116	4739	4172	1457	3990	0	0	0	174,858	49,002	3,990	1%	1	1
1998	26800	26839	21516	16154	15711	24671	14502	9750	5627	5524	2630	2028	3252	0	0	0	175,003	47,696	3,252	0%	1	1
1999	22853	45675	12846	18827	18036	15029	18736	12182	6630	3677	3468	1402	3448	0	0	0	182,808	48,398	3,448	1%	0	0

Log Residuals

CAGES	DIVISION VIIIc and IXa																	Weighted			
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12+	13	14	15+	gp 12+	Total SSQ	SSQ	Cuantos	Parametros1	g.l. (d.f.)
1984	1.90	1.03	-0.03	-0.18	-0.49	0.08	-0.52	-0.33	-0.52	-0.26	-0.83	-0.14	-1.62				-1.62	9.02	9.02	13	24	119
1985	1.46	0.16	0.18	-0.38	0.13	-0.67	-0.69	-1.02	-0.42	-0.44	-0.17	0.16	-0.83				-0.83	5.43	5.43	13		
1986	0.19	0.50	-0.30	0.56	0.30	0.03	-0.69	-2.57	-0.30	-0.22	-1.04	-1.51	0.58				0.58	11.67	11.67	13		
1987	-1.74	0.31	0.20	-0.15	0.57	0.90	-0.36	-1.29	-0.65	-0.28	1.13	0.11	-1.01				-1.01	8.93	8.93	13	Parametros2	g.l. (d.f.)
1988	0.76	0.66	-0.60	0.00	-0.46	0.06	0.48	0.30	0.11	-0.42	-0.66	-0.11	-0.31				-0.31	2.64	2.64	13	24	171
1989	0.69	0.66	-0.17	0.16	-0.05	-0.58	0.44	0.65	0.05	-0.48	-0.51	-0.29	-0.67				-0.67	2.94	2.94	13		
1990	0.22	0.69	0.12	-1.05	-0.59	-0.25	-0.50	0.05	0.93	0.26	-0.26	-0.24	-0.72				-0.72	3.87	3.87	13	Case 1 = checking 1988-98	
1991	-0.99	0.19	0.23	0.76	0.46	0.09	-0.20	-0.55	-0.08	0.12	0.11	-0.73	-1.09				-1.09	3.98	3.98	13	Case 1 = checking 1984-98	
1992	0.49	-0.47	-0.09	0.35	0.14	0.18	-0.11	-0.34	-0.64	0.17	0.48	-0.08	-0.76				-0.76	2.02	2.02	13		
1993	-0.96	0.19	0.29	-0.63	0.32	-0.27	0.20	0.02	-0.34	-0.58	0.94	0.69	-0.04				-0.04	3.48	3.48	13	**Coeff R2-1**	**Coeff R2-2**
1994	0.56	-1.91	-0.15	0.13	0.12	0.19	0.39	-0.15	-0.18	0.11	-0.93	0.94	-0.53				-0.53	6.30	6.30	13	**0.614**	**0.430**
1995	-0.48	-0.64	-0.84	0.01	-0.35	-0.49	-0.25	0.13	0.13	0.36	0.42	0.03	0.44				0.44	2.30	2.30	13		
1996	0.00	0.33	-0.02	-0.44	0.08	-0.60	-0.36	0.05	0.24	0.27	0.43	0.72	-0.61				-0.61	2.00	2.00	13		
1997	0.20	-0.10	0.39	-0.25	0.30	0.01	-0.46	-0.08	-0.24	0.20	-0.28	0.27	-0.49				-0.49	1.07	1.07	13	**W.Variance1**	**W.Variance2**
1998	0.68	0.17	0.10	0.37	-0.33	-0.14	0.14	-0.31	-0.18	-0.20	0.10	0.14	0.22				0.22	1.04	1.04	13	**0.197**	**0.263**
1999	1.08	-1.23	-0.30	-0.28	0.29	0.26	0.25	0.04	-0.24	-0.11	-0.32	0.37	-0.49				-0.49	3.60	0.00	0		
Total Marginal 84-98	2.97	1.78	-0.69	-0.74	0.15	-1.44	-2.48	-5.45	-2.08	-1.38	-1.06	-0.04	-7.45	0.00	0.00	0.00	-7.45		**GT**		**RMS**	**U.Variance**
Total SSQ 88-98	4.31	5.85	1.44	2.64	1.24	1.17	1.34	1.07	1.60	1.16	3.21	2.66	3.96	0.00	0.00	0.00	3.96	31.65	**31.65**	143	**0.221**	**0.266**
Totals SSQ 84-98	13.14	7.28	1.61	3.15	1.92	2.43	2.68	10.47	2.56	1.54	6.28	4.99	8.65	0.00	0.00	0.00	8.65	66.69	**66.69**	195	**0.342**	**0.390**

TABLE 14: Selectivities at age fitted for the southern fishing fleets in Divisions VIIIbc and Ixa (unscaled to the catch in weight)

	0	1	2	3	4	5	6	7	8	9	10	11	12
NEAM 1989(92)-1999	0.0271	0.1283	0.3390	0.6119	0.8673	1.0000	1.0005	1.1641	1.2100	1.3676	1.2263	1.2	1.2
NEAM 1984(86)-1988	0.0707	0.1455	0.2982	0.5458	0.7808	1.0000	1.1555	1.1545	1.1745	1.1363	1.2634	1.2	1.2
Southern fleet VIIIbc	0.0281	0.1704	0.1966	0.3298	0.6240	1.0000	1.1256	1.4309	1.5032	1.5617	1.4755	1.2	1.2
Southern fleet IXa	12.0112	7.8301	3.8825	2.6155	1.7817	1.0000	1.3298	1.2022	1.2198	0.9932	1.2158	1.2	1.2

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division IXa during 1988-1999

CAGES	DIVISION IXa														SOPs		Variation	Raising
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**TOTAL**	**in weight (t)**	**gp 12+**	**%**	**Factor**
1986																		0.0000
1988	20798	16124	4200	2275	2565	204	270	549	277	121	59	22	135	47,600	6,510	135	-18%	1.4748
1989	20119	8525	4901	1669	873	782	144	126	286	114	76	29	76	37,722	4,886	76	0%	0.9068
1990	9414	7679	2409	1804	593	247	518	64	62	110	66	36	40	23,042	3,305	40	-37%	0.9720
1991	10926	5147	3102	1264	912	238	232	326	44	34	90	44	69	22,431	3,181	69	-17%	0.7144
1992	18401	8254	2861	2227	869	496	303	197	305	33	37	82	103	34,169	4,423	103	-26%	1.1167
1993	14208	5954	1949	863	635	194	259	105	75	90	14	14	47	24,408	2,848	47	-6%	0.5659
1994	11466	9255	2825	1174	487	279	199	176	78	43	78	10	50	26,120	3,387	50	-13%	0.7253
1995	12105	5305	3129	1218	478	155	206	98	94	33	27	40	32	22,921	2,919	32	-25%	0.7289
1996	27285	11241	3628	2759	1024	316	238	213	110	84	43	29	54	47,024	5,463	54	-5%	1.0672
1997	20597	14711	4485	1883	1380	407	294	149	146	60	68	29	48	44,256	5,612	48	-1%	1.0590
1998	56301	12610	6668	2649	1074	627	433	209	117	90	55	52	47	80,933	8,223	47	3%	1.4863
1999	34882	36393	5984	4205	1582	478	701	326	172	75	91	45	62	84,996	10,519	62	71%	1.1469

Log Residuals

CAGES	DIVISION IXa															Weighted			
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**gp 12+**	**Total SSQ**	**SSQ**	**Cuantos**		**Coeff R2**
1986														0.00	0.00	0.00	0		67.3%
																0.00	0		
1988	0.97	0.92	-0.54	-0.13	-1.27	0.37	-0.56	-1.06	-0.99	-1.13	-1.50	-1.00	-1.69	-1.69	13.63	13.63	13		
1989	0.53	0.77	-0.36	-0.05	0.01	-1.16	-0.83	-0.86	-1.27	-1.41	-1.64	-1.77	-2.03	-2.03	17.34	17.34	13		
1990	0.20	0.66	0.79	-0.72	-0.34	-0.36	-1.56	-0.33	-0.46	-0.99	-1.89	-1.98	-2.08	-2.08	17.37	17.37	13		
1991	-1.10	-0.08	0.44	0.92	-0.01	0.85	0.16	-0.64	0.12	0.71	-0.86	-2.18	-2.30	-2.30	14.72	14.72	13		
1992	0.81	-0.64	-0.12	-0.01	0.22	0.32	0.05	-0.98	-0.57	0.06	1.23	-1.57	-2.44	-2.44	12.45	12.45	13		
1993	-0.85	0.14	0.09	0.21	0.78	0.50	-0.08	0.22	-0.17	-0.82	0.73	-0.31	-0.36	-0.36	3.16	3.16	13		
1994	0.76	-1.43	-0.22	0.02	0.33	1.02	1.12	0.77	0.78	1.23	0.39	1.74	0.78	0.78	11.59	11.59	13		
1995	-1.43	0.22	0.00	0.32	0.48	1.10	0.72	1.14	0.78	1.26	1.25	0.31	0.75	0.75	9.86	9.86	13	**RMS**	**Variance**
1996	0.10	-0.79	-0.21	-0.12	0.50	0.38	0.49	0.95	1.54	1.64	1.59	1.11	0.46	0.46	11.25	11.25	13	**0.804**	**0.878**
1997	0.01	0.14	0.09	-0.44	-0.25	0.66	0.37	0.60	0.39	0.75	0.50	0.12	0.04	0.04	2.18	2.18	13		
1998	-0.29	0.09	0.04	0.01	-0.45	0.14	0.13	0.22	-0.19	-0.16	0.23	0.55	0.78	0.78	1.41	1.41	13		
1999	0.54	-1.48	-0.47	-1.01	-0.63	-0.93	-1.62	-1.82	-2.47	-1.95	-2.30	-3.04	-2.47	-2.47	41.48	0.00	0	Parametros	g.l. (d.f.)
Marginal SSQ 88-98	-0.29	0.00	0.00	-0.01	0.00	3.83	0.00	0.03	-0.03	1.13	0.03	-4.98	-8.09			**GT**			
Totals USSQ	6.55	5.06	1.37	1.74	3.25	5.53	5.64	6.60	6.95	11.77	15.80	20.05	24.66	24.66	114.96	**114.96**	143	12	131

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc during 1988-1999

CAGES	DIVISION VIIIc and IXa														SOPs		Variation
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**TOTAL**	**in weight (t)**	**gp 12+**	**%**
1986																	
1988	652	4700	2848	3843	12031	2731	3066	8756	4578	2555	955	291	1814	48,820	17,073	1,814	1%
1989	682	2688	3596	3050	4429	11333	1765	2173	5109	2603	1342	427	1105	40,302	14,274	1,105	-4%
1990	521	3957	2888	5387	4920	5848	10386	1802	1799	4112	1900	856	943	45,319	15,926	943	-4%
1991	833	3651	5118	5196	10411	7770	6407	12660	1780	1725	3579	1446	2238	62,815	22,597	2,238	8%
1992	763	3186	2569	4981	5397	8801	4552	4166	6657	906	798	1449	1833	46,058	16,585	1,833	12%
1993	1335	5204	3963	4368	8930	7810	8803	5030	3707	5706	706	546	1906	58,016	20,297	1,906	3%
1994	964	7236	5139	5320	6134	10040	6041	7530	3446	2444	3397	371	1786	59,847	20,358	1,786	-19%
1995	1270	5179	7107	6892	7501	6948	7831	5220	5220	2303	1475	1808	1427	60,183	20,236	1,427	-28%
1996	2685	10293	7727	14637	15086	13285	8490	10649	5716	5538	2203	1241	2291	99,842	32,786	2,291	7%
1997	2307	15333	10876	11374	23153	19494	11898	8473	8608	4490	3939	1371	2296	123,613	40,111	2,296	-6%
1998	5283	11010	13545	13403	15095	25158	14700	9995	5774	5701	2698	2068	1898	126,327	40,921	1,898	4%
1999	3502	33999	13006	22760	23785	20501	25473	16666	9075	5050	4746	1912	2649	183,125	56,611	2,649	36%

Log Residuals

CAGES	DIVISION VIIIbc														SOPs		Variation		
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**gp 12+**	**Total SSQ**	**SSQ**	**Cuantos**		**Coeff R2**
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0		56.7%
																0.00	0		
1988	-3.53	0.31	-0.40	0.19	-0.29	0.07	0.57	0.38	0.18	-0.36	-0.59	-0.03	0.33	0.33	13.96	13.96	13		
1989	2.28	0.16	0.02	0.26	-0.07	-0.55	0.50	0.69	0.10	-0.45	-0.47	-0.23	-0.08	-0.08	6.81	6.81	13		
1990	2.66	1.46	-0.25	-0.99	-0.56	-0.22	-0.44	0.08	0.97	0.30	-0.21	-0.18	-0.01	-0.01	11.91	11.91	13		
1991	0.57	0.61	0.11	0.68	0.42	-0.03	-0.30	-0.63	-0.17	0.02	0.05	-0.78	-1.04	-1.04	3.57	3.57	13		
1992	-0.30	0.31	0.18	0.51	0.07	0.07	-0.22	-0.42	-0.75	0.07	0.31	-0.13	-0.74	-0.74	1.93	1.93	13		
1993	-2.27	0.24	0.35	-1.00	0.22	-0.37	0.14	-0.04	-0.41	-0.64	0.88	0.65	0.33	0.33	8.42	8.42	13		
1994	-1.07	-2.37	0.14	0.37	0.32	0.37	0.56	0.02	-0.01	0.28	-0.78	1.12	-0.15	-0.15	9.44	9.44	13		
1995	1.86	-1.75	-0.90	0.32	-0.08	-0.24	0.04	0.42	0.44	0.67	0.72	0.34	0.93	0.93	9.80	9.80	13	**RMS**	**Variance**
1996	-1.35	0.85	0.00	-0.61	-0.05	-0.73	-0.49	-0.07	0.09	0.13	0.29	0.61	-0.26	-0.26	4.26	4.26	13	**0.521**	**0.569**
1997	1.19	-0.32	0.54	-0.18	0.36	0.04	-0.45	-0.06	-0.21	0.23	-0.26	0.31	0.04	0.04	2.44	2.44	13		
1998	0.75	0.50	0.22	0.44	-0.36	-0.19	0.10	-0.37	-0.22	-0.25	0.05	0.08	0.73	0.73	2.02	2.02	13		
1999	0.74	-1.90	-0.81	-0.58	-0.03	-0.06	-0.06	-0.28	-0.56	-0.43	-0.63	0.05	-0.23	-0.23	6.20	0.00	0	Parametros	g.l. (d.f.)
Marginal SSQ 88-98	0.77	0.00	0.00	0.00	-0.01	-1.77	0.02	0.00	0.01	-0.01	0.01	1.75	0.10			**GT**			
Totals USSQ	38.70	12.54	1.55	3.65	1.00	1.26	1.70	1.53	2.03	1.49	2.78	2.98	3.34	3.34	74.56	**74.56**	143	12	131

TABLE 15: Constant percentage at age procedure (fitted for 1988-98 data) estimates of catches for the southern fleets in 1972-84.

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc and IXa during 1972-83

CAGES	as addition of the partial estimates by Divisions																	Catch
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**gp 12+**	**in weight (t)**
1972	33659	21546	10816	10432	56332												132,785	2,128	32,499
1973	32725	19783	9478	8783	11096	34839											116,704	1,726	27,312
1974	61550	32076	13258	10536	11875	9399	26234										164,928	1,738	32,506
1975	54499	27544	10976	8330	9012	7044	5822	13693									136,920	1,287	25,632
1976	40232	20920	8624	6832	7680	6074	5045	4084	7815								107,306	1,122	21,075
1977	27388	17011	8337	7881	10084	8268	6969	5683	3789	7100							102,509	1,578	24,530
1978	43135	23442	10148	8506	10009	8023	6702	5440	3630	2647	4138						125,820	1,501	26,319
1979	40361	21319	8948	7242	8287	6589	5486	4445	2967	2162	1321	2057					111,184	1,224	22,364
1980	25822	14090	6125	5158	6091	4888	4084	3316	2213	1614	984	623	408	192	115	200	75,923	915	15,964
1981	21833	17174	7610	5774	6539	5338	4512	3667	2441	1784	1138	688	449	213	127	224	79,510	1,013	18,053
1982	20438	19387	12005	6793	7957	6452	5451	4479	2981	2175	1386	837	546	259	155	272	91,572	1,232	21,076
1983	17039	13152	7004	5313	5425	4364	3651	2983	1990	1456	900	560	366	173	103	182	64,662	824	14,853

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc during 1972-83

CAGES																			Catch	Sops
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**gp 12+**	**in weight (t)**	
1972	4436	8973	6886	8526	12531	10615	9061	7435	4950	3627	2188	1412	920	439	261	463	82,722	2,083	26,827	26,824
1973	3581	7243	5558	6882	10115	8568	7314	6002	3996	2928	1767	1140	743	354	211	373	66,776	1,681	21,656	21,653
1974	3513	7105	5452	6751	9922	8405	7175	5887	3920	2872	1733	1118	729	347	207	366	65,502	1,649	21,243	21,240
1975	2572	5203	3992	4943	7266	6155	5254	4311	2870	2103	1269	819	534	254	151	268	47,964	1,208	15,555	15,553
1976	2267	4585	3518	4356	6403	5423	4630	3799	2529	1853	1118	722	470	224	133	236	42,266	1,064	13,707	13,706
1977	3283	6640	5095	6309	9273	7855	6705	5502	3663	2684	1619	1045	681	325	193	342	61,214	1,541	19,852	19,850
1978	3066	6202	4759	5893	8661	7337	6263	5139	3421	2507	1513	976	636	303	181	320	57,178	1,440	18,543	18,541
1979	2482	5021	3853	4771	7012	5940	5071	4161	2770	2030	1225	790	515	245	146	259	46,293	1,166	15,013	15,011
1980	1871	3785	2904	3596	5286	4477	3822	3136	2088	1530	923	596	388	185	110	195	34,893	879	11,316	11,315
1981	2122	4292	3294	4079	5995	5078	4335	3557	2368	1735	1047	676	440	210	125	221	39,574	996	12,834	12,833
1982	2583	5225	4009	4964	7296	6181	5276	4329	2882	2112	1274	822	536	255	152	269	48,168	1,213	15,621	15,619
1983	1718	3475	2667	3302	4853	4111	3509	2880	1917	1405	848	547	356	170	101	179	32,038	807	10,390	10,389

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc during 1972-83

CAGES																			Catch	Sops
Year\ ages	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**TOTAL**	**gp 12+**	**in weight (t)**	
1972	29223	12574	3930	1906	983	500	320	220	152	102	74	33	24	9	6	6	50,063	45	5,671	5,735
1973	29145	12540	3920	1901	980	499	319	219	152	102	74	33	24	9	6	6	49,928	45	5,656	5,720
1974	58038	24971	7805	3785	1952	994	636	436	302	203	148	66	48	17	11	13	99,426	89	11,263	11,390
1975	51926	22342	6983	3387	1747	889	569	390	271	181	132	59	43	15	10	11	88,956	80	10,077	10,191
1976	37966	16335	5106	2476	1277	650	416	285	198	133	97	43	32	11	7	8	65,040	58	7,368	7,451
1977	24105	10371	3242	1572	811	413	264	181	126	84	61	27	20	7	5	5	41,295	37	4,678	4,731
1978	40069	17240	5389	2613	1348	686	439	301	209	140	102	46	33	12	8	9	68,643	62	7,776	7,864
1979	37879	16298	5094	2471	1274	649	415	285	197	132	96	43	32	11	7	8	64,891	58	7,351	7,434
1980	23951	10305	3221	1562	806	410	262	180	125	84	61	27	20	7	5	5	41,030	37	4,648	4,700
1981	10878	4680	1463	709	366	186	119	82	57	38	28	12	9	3	2	2	18,635	17	2,111	2,135
1982	12558	5403	1689	819	422	215	138	94	65	44	32	14	10	4	2	3	21,513	19	2,437	2,464
1983	11460	4931	1541	747	385	196	126	86	60	40	29	13	10	3	2	2	19,632	18	2,224	2,249

Reported Portuguese Catches at age from 1981 to 1983

Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	TOTAL	gp 12+	Catch
1981	8833	8201	2853	986	178	74	58	28	16	11	63						21302	0	3,108
1982	5297	8759	6307	1010	238	57	37	55	33	19	80						21892	0	3,018
1983	3861	4747	2796	1264	186	56	16	18	13	12	23						12992	0	2,239

TABLE 16: Separable model (fitted for 1988-98 data) estimates of catches for the southern fleets in 1972-84

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc and IXa during 1972-83

CAGES	as addition of the partial estimates by Divisions													Catch
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12+	TOTAL	in weight (t)
1972	10190	22668	5705	7983	62197									108,743	32,499
1973	17767	7141	11728	4602	7924	42468								91,629	27,312
1974	29381	22727	6380	14699	6211	9139	35983							124,520	32,506
1975	34747	15788	9276	3976	11478	4692	6374	20345						106,675	25,632
1976	26945	15775	5706	5288	3065	9915	3617	4956	12222					87,488	21,075
1977	3851	13542	6542	4432	6208	4216	12470	4743	5146	12662				73,812	24,530
1978	24620	4365	10041	6763	5330	6611	3869	12265	3835	3870	9269			90,840	26,319
1979	36280	12994	1810	5631	5119	4297	4691	3122	8836	2569	2402	5745		93,495	22,364
1980	21868	13309	3454	881	3386	3535	2781	3124	1965	5595	1486	1162	3376	65,923	15,964
1981	20484	15647	6881	3018	1125	3804	3295	2958	2685	1886	4937	1111	4050	71,882	18,053
1982	9399	21576	12143	5964	3453	1601	4119	3891	2953	2469	1958	4005	5297	78,828	21,076
1983	7111	8202	9513	5693	4303	2491	1003	2582	1996	1491	1094	849	5029	51,358	14,853

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc during 1972-83

CAGES															Catch	Sops
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	in weight (t)	
1972	422	6500	2757	5585	58343	0	0	0	0	0	0	0		73,606	26,827	26,827
1973	541	1615	4748	2894	6535	39707	0	0	0	0	0	0		56,040	21,656	21,656
1974	404	2608	1478	6305	4199	7826	31185	0	0	0	0	0		54,005	21,243	21,243
1975	407	1570	1895	1551	7344	3919	5170	17456	0	0	0	0		39,312	15,555	15,555
1976	388	1889	1371	2330	2104	8547	3042	4369	10775	0	0	0		34,816	13,707	13,707
1977	112	2958	2577	2740	5079	3911	11419	4452	4840	11875	0	0		49,963	19,852	19,852
1978	364	535	2463	3026	3689	5720	3268	10846	3405	3521	8078	0		44,914	18,543	18,543
1979	522	1555	435	2481	3513	3704	3945	2751	7820	2332	2122	4952		36,130	15,013	15,013
1980	442	2143	1066	464	2558	3175	2453	2852	1799	5219	1359	1044	3032	27,607	11,316	11,316
1981	745	2893	2403	1598	863	3606	3111	2848	2597	1835	4741	1074	3916	32,230	12,834	12,834
1982	284	5247	3602	3967	2950	1497	3936	3738	2847	2402	1830	3883	5136	41,321	15,621	15,621
1983	141	1028	3333	3147	3590	2315	930	2458	1904	1433	1027	807	4783	26,897	10,390	10,390

Expected Catch number at age ('000) and mean weight (kg) at age for Mackerel in Division VIIIbc during 1972-83

CAGES															Catch	Sops
Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	in weight (t)	
1972	9768	16169	2948	2398	3855	0	0	0	0	0	0	0		35,137	5,671	5,671
1973	17225	5525	6980	1708	1389	2761	0	0	0	0	0	0		35,589	5,656	5,656
1974	28977	20119	4901	8394	2012	1314	4797	0	0	0	0	0		70,515	11,263	11,263
1975	34340	14218	7381	2425	4134	773	1204	2889	0	0	0	0		67,363	10,077	10,077
1976	26557	13886	4334	2957	961	1368	575	587	1447	0	0	0		52,673	7,368	7,368
1977	3739	10585	3965	1692	1129	305	1051	291	306	787	0	0		23,849	4,678	4,678
1978	24256	3830	7578	3737	1641	891	601	1420	430	349	1191	0		45,925	7,776	7,776
1979	35758	11439	1375	3150	1606	593	746	370	1016	237	280	793		57,365	7,351	7,351
1980	21426	11166	2387	417	828	360	329	272	166	376	127	118	344	38,316	4,648	4,648
1981	10906	4552	1625	434	84	123	126	82	72	40	134	37	134	18,350	2,111	2,111
1982	3817	7569	2234	988	264	47	146	99	73	48	47	122	161	15,615	2,437	2,437
1983	3108	2428	3384	1283	527	119	56	106	79	47	44	41	246	11,469	2,224	2,224

Reported Portuguese Catches at age from 1981 to 1983

Year\ ages	0	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Catch
1981	8833	8201	2853	986	178	74	58	28	16	11	63			21302	3,108
1982	5297	8759	6307	1010	238	57	37	55	33	19	80			21892	3,018
1983	3861	4747	2796	1264	186	56	16	18	13	12	23			12992	2,239

Figure 1: Unweighted log squared residuals for the fitting models of southern fleet catches

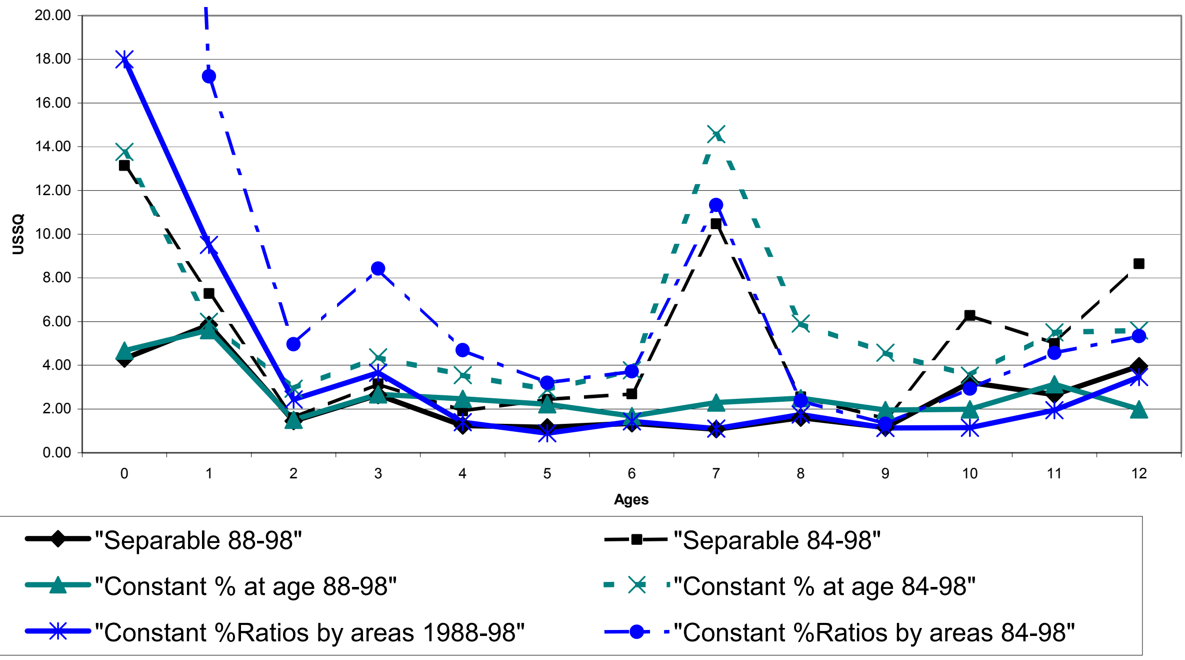
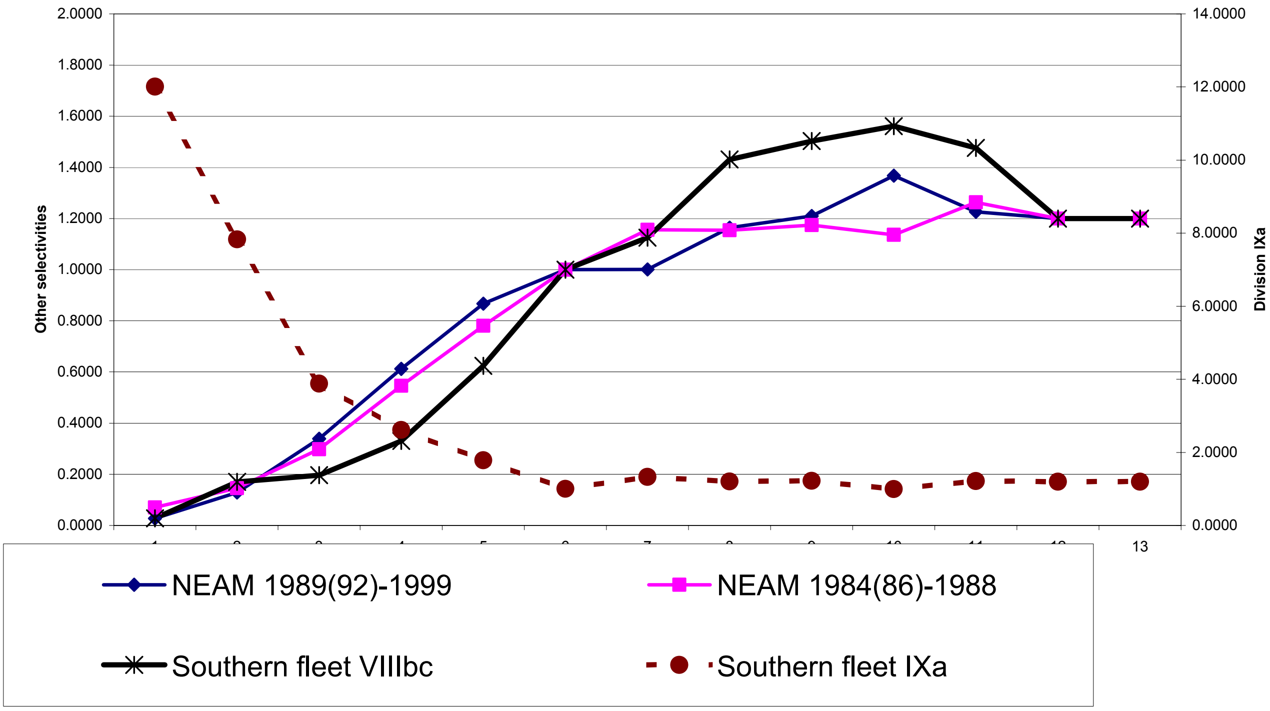


Figure 2: Selectivities at age fitted for the the southern fleets and NEAM



Annex 3

Working Document for the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, 10–19 September 2002

Revision of the mean weights at age in the stock (WEST) and the proportion mature at age (MATPROP) of NEA Mackerel over the period 1972–2001

by

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ABSTRACT

The mean weights at age in the stock and the proportions mature at age are calculated for the NEA mackerel by weighting this information by mackerel component according to the spawning stock biomass estimates from the southern, western and North Sea mackerel components. If possible these biomass estimates should be obtained from egg surveys. SG DRAMA (2002 WD) provided a complete data set for mean weights at age in the stock and for the proportions mature at age for the NEA mackerel over the whole time series 1972–2000. However, it is already necessary to revise this data set, because the data set on the mean weights at age in the stock for the southern mackerel component is revised for the period 1984-recent. The areas and periods of sampling for the collection of these mean weights at age in the stock have been evaluated. Furthermore, this additional revision is necessary because the weighting factors for calculation of the mean weights at age in the stock and the proportion mature at age for NEA mackerel were not correct for the period 1984–2000. It was necessary to create a database from which it is evident how the mean weights at age in the stock and the proportions mature are achieved for the NEA mackerel based on the information by mackerel component.

The total SSBs for NEA mackerel were not correct in the SSB assessment file for NEA mackerel, because the SSBs of the North Sea component were not included. Therefore a table was prepared that shows clearly the SSB estimates from the egg surveys by mackerel component; how the total SSBs for NEA mackerel are achieved and how the weighting factors are achieved for the calculation of mean weights at age in stock and the proportions mature of the NEA mackerel from these data by the mackerel component. The inclusion of the SSBs from the North Sea egg surveys is becoming more important now, because the SSB of the North Sea mackerel component has increased in 2002.

INTRODUCTION

At the 1995 meeting of the MHSA WG (ICES CM 1996/Assess:7) the assessment data of the North Sea, western and southern mackerel components were combined to enable an assessment for the NEA mackerel from 1984 onwards. The mean weights at age in the stock (WEST) and the proportions mature at age (MATPROP) were weighted at that time according SSBs from the egg surveys. The western and North Sea were combined assuming 97% western compared to 3% North Sea mackerel SSB and after that Western/North Sea was combined with the southern component assuming 15% southern compared to 85% Western/North Sea. This implied that relative weighting factors of 0.85*0.97= 82.45% for western mackerel, 0.85*0.03= 2.55% for North Sea mackerel and 15% for southern mackerel were applied.

The Study Group DRAMA prepared a WD for 2002 WG meeting and provided WEST and MATPROP data for the period 1972–1983, which for the southern component were estimated by Uriarte *et al*. (WD 2000). For the period 1984–2000 no revisions were made to the WEST and MATPROP data.

However, in addition to the results of SG DRAMA an extra revision of the WEST and MATPROP data for the whole time series has to be carried out because:

1) A new revised WEST data set for the southern mackerel component for the period 1984-recent should be combined with existing WEST data sets of North Sea and western mackerel by using the SSBs of the components for weighting;
2) The new MATPROP data for southern mackerel had only been used to update MATPROP from 1998 - recent, but these should have been used for the period 1972-recent, because these were based on histological research on the ovaries;
3) The total SSBs for NEA mackerel were not correct in the SSB assessment file, because they did not include the SSBs from the North Sea component. Therefore a new table had to be prepared with the SSBs from the egg surveys by mackerel component from which the relative weighting factors by component can be calculated in order to enable the estimation of WEST and MATPROP for the NEA mackerel. The inclusion of the SSB from the North Sea egg survey is becoming important because of the increase in SSB in 2002.

MATERIAL and METHODS

Mean weights at age in the stock (WEST) for the southern mackerel component during 1984–2001

In the southern area the mean of the weights at age in the catch based on Spanish sampling (IEO and AZTI sampling) during the first half of the year in Division VIIIc (Sub-division VIIIc West+ Sub-division VIIIc East) for the years 1984–2001 is taken as the mean weights at age in the stock. This method is evaluated in this Working Document.

SSBs from egg surveys by mackerel component and for NEA mackerel

From 1995 onwards two years are combined to calculate the total spawning stock biomass for the NEA mackerel from the egg surveys in the southern, western and North Sea area, because the North Sea mackerel egg survey is carried out one year later than the southern and western egg survey. In this way spawning stock biomass estimates for the NEA mackerel become available for 1995, 1998 and 2001. The percentage distributions of the SSBs over the three mackerel components can be used as weighting factors to estimate WEST and MATPROP for the NEA mackerel.

WEST and MATPROP by mackerel component and for NEA mackerel

All historic information on WEST and MATPROP by mackerel component was collected for the period 1972–2001. This information was put together with the available information on the percentage SSB distribution by mackerel component in a spreadsheet for the calculation of WEST and MATPROP for the NEA mackerel.

RESULTS

Mean weights at age in the stock (WEST) for the southern mackerel component during 1984–2001

Table 1 shows the monthly catches of the first half of the year for 1992 to 2001 in Division VIIIc. March to May make up over 95% of the catch of the first half of the year for 7 years out of 10. In 2001 the catch between March and May represents 90% of the six monthly catch, and is one of the lowest percentages in these three months.

Table 2 shows the monthly catches at age for 2001. A gradual change in the age composition over time can be observed.

Table 3 shows the mean weights estimated for different periods of months and the first half of 2001 and their error and percentage with respect to the six monthly estimates are presented in Table 4.

Table 5 shows the mean of the weights at age in the catch based on Spanish sampling (IEO and AZTI sampling) during the first half of the year in Division VIIIc for the years 1984–2001 is taken as the mean weights at age in the southern mackerel component.

SSBs from egg surveys by mackerel component and for NEA mackerel

Table 6 was prepared to show by year the spawning stock biomass estimates of the three mackerel components over the period 1977–2002. These egg survey SSB estimates are required for the SSB tuning in ICA. The percentage distributions of egg survey SSBs over the three mackerel components is calculated for three survey years 1995, 1998 and 2001, because these are required for the calculation of the WEST and MATPROP for the NEA mackerel.

WEST and MATPROP by mackerel component and for NEA mackerel

Tables 7 and 8 show all available information by mackerel component on respectively WEST and MATPROP for the period 1972–2001 together with the available information on the percentage SSB distribution by mackerel component. From this the WEST and MATPROP are calculated for the NEA mackerel.

DISCUSSION

Mean weights at age in the stock (WEST) for the southern mackerel component during 1984–2001

The best area to obtain mean weights at age for the southern component of the mackerel stock is the Cantabrian Sea (Division VIIIc), since it covers the largest spawning of the southern mackerel component (ICES, 2002a). Mackerel spawning in this area takes place in spring, from February to June, reaching a peak in April (Solá *et al*., 1990 and 1994) over the continental shelf and off it, with a great abundance of eggs to the south of 44º 30′ N in the central and western area of Division VIIIc (Lago de Lanzós *et al.,* 1993; Solá *et al*., 1994).

The most representative months to obtain mean weights in the stock in this area are March to May, since these are the months of greatest abundance of active spawners (Villamor *et al.,* 1997). May is the month of highest abundance of young spawners, which are recruiting to spawning. As the monthly length distributions for many years could not be obtained due to the use of quarterly data in databases, mean weights were obtained from length distributions of the first part of the year for 1984 to 2001. Given that the catches in the first half approximately correspond to those of March to May (90–95%), the approximation made by basing mean weights in the stock on mean weights in catches through the first half of the year instead of only from March to May must be sufficiently exact and valid. To find the error made in doing so, a test was performed for 2001 comparing the results of mean weights obtained from samples from March to May with those obtained from samples from the first half of the year. We see that the maximum error in 2001 (with only 90% of the catches between March and May) is 3.3% (discarding that of age 1 as only 8% are mature). The error for 7 out of 9 of the remaining years would have been less than half (a maximum of 1.6%) for ages 2–4 and much lower for the others. This level of error can be considered acceptable. More so if we take into account that these mean weights correspond to the mean weight in the southern component of the mackerel stock and represents approximately only 15% of Northeast Atlantic mackerel (relative size of this component with respect to the total NEA mackerel).Therefore the mean weights at age in stock for the southern mackerel component have been calculated from samples from Division VIIIc from the first half of the year for the period 1984 to 2001 (Table 5).

SSBs from egg surveys by mackerel component and for NEA mackerel

For the tuning of ICA in the assessment of NEA mackerel an SSB file is used. For 1995 and 1998 the SSB values, which have been used up to now are respectively 2840 kt and 3750 kt. However, these values did not include the SSB estimates from the North Sea mackerel egg surveys and only represented the total SSBs from the western and southern mackerel component. The reason for not including the North Sea mackerel SSB must have been, that the North Sea mackerel egg surveys were not carried out in the same year. From 1995 onwards the North Sea mackerel egg surveys are carried out one year later than the southern and western egg survey (Table 6). With an increasing SSB of the North Sea mackerel it is more appropriate that it is included in the SSB file for tuning the NEA mackerel assessment. This might be done by combining two years to calculate the total spawning stock biomass for the NEA mackerel (combining 1995 and 1996; combining 1998 and 1999; combining 2001 and 2002). This implies that the SSB estimate of the North Sea egg survey is moved to one year earlier. This is correct as long as the number of first time spawners is relatively low. However, the North Sea SSB will be an overestimate, if the number of first time spawners is relatively high. However, no corrections have been applied for the strong 1999 year class, which contributed to approximately 50% of the population in numbers (Iversen and Eltink, 2002 WD).

An explanation will be given on the weighting factors used over the period 1972–2001 as shown in Table 7 and 8:

2001	In Table 6 the SSB for 2002 includes a very large proportion of first time spawners, which were not spawning in 2001 (Iversen and Eltink, WD 2002). Therefore the percentage contribution was set as the mean of 1996 and 1999. The percentage contribution of the western and southern component reflect the SSBs from the egg surveys in 2001.
1998–2000	based on 1998 western and southern egg survey SSBs combined with the 1999 North Sea egg survey SSB (Table 6)
1995–1997	based on 1995 western and southern egg survey SSBs combined with the 1996 North Sea egg survey SSB (Table 6)
1984–1994	The same SSB ratio's are used as during 1995–1997 (based on 1995 western and southern egg survey SSBs combined with the 1996 North Sea egg survey SSB). This is consistent in the way it was done before.
1972-1983	The ratio's between western and North Sea reflect the SSBs from VPA (from ICES (2002b) for the western mackerel component and from ICES (1984) for the North Sea component). The fraction for southern mackerel remains the same for the period 1972–1997.

<u>WEST and MATPROP by mackerel component and for NEA mackerel</u>

SG DRAMA (2002 WD) completed the data set for WEST and MATPROP for the period 1972–1983 (2002 WD), which data were directly taken from Uriarte *et al*. (2000 WD). SG DRAMA did not revise WEST and MATPROP for the period 1984–2000.

The new MATPROP data for southern mackerel component has only been used to update MATPROP from 1998 - recent (ICES, 2000), but these should have been used for the entire period 1972-recent, because these have been based on histologic research on the ovaries and it is regarded to be better than old MATPROP data, which were obtained by visual inspection of the ovaries.

The information on SSB by mackerel component is used for weighting the WEST and MATPROP data by mackerel component in order to calculate these data for the NEA mackerel.

Table 7 and 8 provide a easy data base of all the historic information on WEST and MATPROP. Revisions to WEST and MATPROP can easily be made, if the weighting factors or data on WEST and MATPROP might change in future.

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Table 1: Mackerel catches (tonnes) by month in Division VIIIc during 1992–2001.

Catches (t)

	Division VIIIc						Total
	January	**February**	**March**	**April**	**May**	**June**	**1 half year**
1992	107	305	4292	5801	1189	52	11745
1993	44	85	4656	5902	2934	472	14094
1994	72	254	7366	9178	2982	350	20202
1995	185	268	5887	12275	3489	188	22293
1996	107	418	6512	14781	3234	699	25751
1997	298	394	12262	15842	2052	207	31056
1998	683	1727	12988	11282	4275	808	31763
1999	490	982	15782	15431	2535	146	35366
2000	1464	2837	18269	5320	516	187	28593
2001	670	2619	16736	15174	531	253	35982

Catches (%)

	Division VIIIc						Total
	January	**February**	**March**	**April**	**May**	**June**	**1 half year**
1992	0.9	2.6	36.5	49.4	10.1	0.4	100
1993	0.3	0.6	33.0	41.9	20.8	3.4	100
1994	0.4	1.3	36.5	45.4	14.8	1.7	100
1995	0.8	1.2	26.4	55.1	15.6	0.8	100
1996	0.4	1.6	25.3	57.4	12.6	2.7	100
1997	1.0	1.3	39.5	51.0	6.6	0.7	100
1998	2.1	5.4	40.9	35.5	13.5	2.5	100
1999	1.4	2.8	44.6	43.6	7.2	0.4	100
2000	5.1	9.9	63.9	18.6	1.8	0.7	100
2001	1.9	7.3	46.5	42.2	1.5	0.7	100

	% March-April-May	**% March-April**	**% February to May**
1992	96.1	85.9	98.6
1993	95.7	74.9	96.3
1994	96.7	81.9	97.9
1995	97.1	81.5	98.3
1996	95.2	82.7	96.9
1997	97.1	90.5	98.4
1998	89.9	76.4	95.3
1999	95.4	88.3	98.2
2000	84.3	82.5	94.2
2001	90.2	88.7	97.4

Table 2: Mackerel catch at age (%) in 2001 by months in Division VIIIc.

AGE	January (%)	Febr. (%)	March (%)	April (%)	May (%)	June (%)	1 half of year (%)
0	0	0	0	0	0	0	0
1	6	1	0	1	31	14	2
2	29	12	3	2	29	41	5
3	30	29	12	6	18	21	12
4	23	31	21	17	10	15	20
5	6	11	18	19	4	5	17
6	4	10	19	20	4	3	17
7	1	4	10	12	2	1	9
8	1	2	9	11	1	1	8
9	0	1	4	6	1	0	4
10	0	0	1	1	0	0	1
11	0	0	1	2	0	0	1
12	0	0	1	1	0	0	1
13	0	0	0	1	0	0	0
14	0	0	0	1	0	0	0
15+	0	0	0	1	0	0	0
TOTAL	100	100	100	100	100	100	100
CATCH (t)	670	2619	16736	15174	531	253	35982
SOP	672	2627	16725	15154	536	253	35968
SOP %	100	100	100	100	101	100	100
% Catch	1.9	7.3	46.5	42.2	1.5	0.7	

Table 3: Mean weight at age in the stock in 2001 estimated from different months in Division VIIIc.

	March-april	March-april-may	February to May	1 Half year
	W	W	W	W
EDAD	(g)	(g)	(g)	(g)
0	0.0	0.0	0.0	0.0
1	129.8	122.0	122.5	126.8
2	207.3	199.4	201.9	196.1
3	270.5	267.1	261.7	258.7
4	331.1	330.1	322.7	320.1
5	386.3	386.0	382.8	381.8
6	407.7	407.4	404.8	404.0
7	448.0	447.9	446.0	445.4
8	471.4	471.3	470.6	470.4
9	491.8	491.8	491.4	491.4
10	502.8	502.7	502.3	502.3
11	544.9	544.9	544.7	544.7
12	555.1	555.0	554.5	554.5
13	560.9	560.8	560.5	560.5
14	591.0	590.9	590.7	590.7
15+	592.2	592.1	591.9	592.0
TOTAL	392.0	385.9	376.1	369.7

Table 4: Differences in mean weights in the stock estimated from different periods of months with respect to the six monthly estimates.

	Differences					
AGE	1 half year - (March-april)	1 half year - (March-april-may)	1 half year - (February to-may)	Difs %	Difs %	Difs %
0	0.0	0.0	0.0			
1	-3.0	4.8	4.3	-2.4%	3.8%	3.4%
2	-11.2	-3.4	-5.8	-5.7%	-1.7%	-3.0%
3	-11.8	-8.4	-3.0	-4.6%	-3.3%	-1.2%
4	-10.9	-10.0	-2.5	-3.4%	-3.1%	-0.8%
5	-4.5	-4.3	-1.0	-1.2%	-1.1%	-0.3%
6	-3.7	-3.5	-0.8	-0.9%	-0.9%	-0.2%
7	-2.6	-2.5	-0.5	-0.6%	-0.6%	-0.1%
8	-1.0	-1.0	-0.2	-0.2%	-0.2%	0.0%
9	-0.5	-0.4	-0.1	-0.1%	-0.1%	0.0%
10	-0.5	-0.4	0.0	-0.1%	-0.1%	0.0%
11	-0.2	-0.2	0.0	0.0%	0.0%	0.0%
12	-0.6	-0.5	0.0	-0.1%	-0.1%	0.0%
13	-0.4	-0.4	0.0	-0.1%	-0.1%	0.0%
14	-0.3	-0.2	0.0	-0.1%	0.0%	0.0%
15+	-0.1	-0.1	0.2	0.0%	0.0%	0.0%
TOTAL	-22.3	-16.3	-6.4	-6.0%	-4.4%	-1.7%

Table 5: Mean weight at age in the stock of the southern mackerel from 1984 to 2001.

AGE	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.137	0.164	0.107	0.116	0.069	0.098	0.081	0.093	0.116
2	0.230	0.241	0.261	0.183	0.204	0.168	0.178	0.174	0.183
3	0.281	0.296	0.295	0.268	0.237	0.264	0.253	0.226	0.253
4	0.356	0.332	0.376	0.386	0.277	0.340	0.310	0.295	0.303
5	0.415	0.401	0.403	0.425	0.314	0.390	0.365	0.340	0.360
6	0.465	0.476	0.406	0.459	0.337	0.468	0.401	0.403	0.395
7	0.491	0.492	0.554	0.534	0.387	0.497	0.475	0.439	0.424
8	0.567	0.578	0.510	0.594	0.392	0.510	0.494	0.484	0.448
9	0.559	0.581	0.518	0.621	0.403	0.542	0.525	0.505	0.465
10	0.546	0.595	0.554	0.592	0.476	0.542	0.507	0.521	0.508
11	0.582	0.590	0.595	0.629	0.490	0.591	0.574	0.517	0.524
12	0.417	0.631	0.528	0.435	0.490	0.566	0.540	0.682	0.569
13	0.500	0.622	0.529	0.469	0.543	0.626	0.729	0.673	0.505
14	0.638	0.665	0.649	0.649	0.548	0.579	0.553	0.667	0.678
15+	0.938	0.655	0.681	0.792	0.567	0.736	0.739	0.719	0.659
TOTAL	0.396	0.418	0.443	0.416	0.320	0.413	0.314	0.324	0.329
12+	0.520	0.643	0.597	0.529	0.536	0.643	0.584	0.700	0.562

AGE	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.111	0.122	0.134	0.095	0.100	0.099	0.118	0.085	0.127
2	0.211	0.179	0.229	0.173	0.165	0.178	0.185	0.172	0.196
3	0.277	0.257	0.309	0.278	0.281	0.235	0.255	0.227	0.259
4	0.326	0.360	0.381	0.325	0.319	0.310	0.294	0.307	0.320
5	0.361	0.388	0.422	0.410	0.363	0.344	0.357	0.344	0.382
6	0.403	0.433	0.460	0.447	0.413	0.367	0.370	0.401	0.404
7	0.441	0.468	0.496	0.463	0.447	0.398	0.391	0.421	0.445
8	0.466	0.511	0.529	0.483	0.469	0.439	0.415	0.439	0.470
9	0.495	0.541	0.554	0.502	0.506	0.450	0.459	0.450	0.491
10	0.492	0.551	0.582	0.536	0.525	0.481	0.478	0.498	0.502
11	0.514	0.600	0.588	0.541	0.541	0.480	0.504	0.505	0.545
12	0.590	0.651	0.656	0.548	0.578	0.500	0.502	0.523	0.554
13	0.584	0.656	0.697	0.616	0.593	0.553	0.523	0.532	0.560
14	0.572	0.649	0.649	0.593	0.641	0.580	0.526	0.559	0.591
15+	0.743	0.760	0.714	0.663	0.669	0.638	0.604	0.602	0.592
TOTAL	0.404	0.396	0.461	0.339	0.354	0.307	0.348	0.294	0.370
12+	0.656	0.664	0.674	0.584	0.597	0.545	0.523	0.538	0.570

Table 6 Overview of the spawning stock biomass estimates from egg surveys in the southern, western and North Sea areas both in thousands of tonnes as in percentage.
The percentage distribution of SSB by mackerel component is used as weighting factors for the calculation of the mean stock weights and the proportions mature at age for the entire NEA mackerel.

	SSB from egg surveys (kt)			
	Western	Southern	North Sea	**NEA**
1977	3250	-	-	**-**
1978	-	-	-	**-**
1979	-	-	-	**-**
1980	2430	-	86	**-**
1981	-	-	57	**-**
1982	-	-	180	**-**
1983	2510	-	228	**-**
1984	-	-	111	**-**
1985	-	-	-	**-**
1986	2150	-	43	**-**
1987	-	-	-	**-**
1988	-	-	36	**-**
1989	2560	-	-	**-**
1990	-	-	76	**-**
1991	-	-	-	**-**
1992	2930	-	-	**-**
1993	-	-	-	**-**
1994	-	-	-	**-**
1995	2470	378	-	**2958**
1996	-	-	110	
1997	-	-	-	**-**
1998	2950	800	-	**3818**
1999	-	-	68	
2000	-	-	-	**-**
2001	2530	371	-	**3111**
2002	-	-	*210*	

	SSB from egg surveys (%)			
	Western	Southern	North Sea	**NEA**
1977	-	-	-	**-**
1978	-	-	-	**-**
1979	-	-	-	**-**
1980	-	-	-	**-**
1981	-	-	-	**-**
1982	-	-	-	**-**
1983	-	-	-	**-**
1984	-	-	-	**-**
1985	-	-	-	**-**
1986	-	-	-	**-**
1987	-	-	-	**-**
1988	-	-	-	**-**
1989	-	-	-	**-**
1990	-	-	-	**-**
1991	-	-	-	**-**
1992	-	-	-	**-**
1993	-	-	-	**-**
1994	-	-	-	**-**
1995	83.502%	12.779%	-	**100%**
1996	-	-	3.719%	
1997	-	-	-	
1998	77.266%	20.953%	-	**100%**
1999	-	-	1.781%	
2000	-	-	-	
2001	84.813%	12.437%	-	**100%**
2002	-	-	2.750% #	

Western component
1972-2001 SSB's from WGMEGS 2002 Table 5.5.1

Southern component
1995-2001 SSB's from WGMEGS 2002 text table section 5.5.2

North Sea component
1980-2002 preliminary SSB from Iversen & Eltink WD 2002.
All SSB estimates are based on fecundity of 1401 eggs/g female.
The percentage contribution of North Sea mackerel SSB in 2002 was set as the mean of 1996 and 1999, because SSB in 2002 contained high proportion of first time spawners.

Table 7 The calculation of the mean weights at age in the stock (WEST) of the NEA mackerel based on weighting by SSB's from egg surveys (1984-recent).
For 1972-1983 it is based on weighting by SSB,s from VPA (gradual change from 1972-1983).

Revision because from 1984-1994 ratio western/southern 85:15 was used and did not include North Sea SSB (WG1995)

WEIGHTING FACTORS

For 1984 up to 1997 the same SSB ratio's are used as estimated from the 1995 Egg surveys

Ratio's from 1995 onwards see Overview egg survey SSB's Table 6 (WD2002)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
North Sea	**0.2541**	**0.2487**	**0.2211**	**0.2047**	**0.2010**	**0.1774**	**0.1361**	**0.1251**	**0.1164**	**0.0860**	**0.0799**	**0.0743**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0372**	**0.0178**	**0.0178**	**0.0178**	**0.0275**		
Western	**0.6181**	**0.6235**	**0.6511**	**0.6675**	**0.6712**	**0.6948**	**0.7361**	**0.7471**	**0.7558**	**0.7862**	**0.7923**	**0.7979**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.8350**	**0.7727**	**0.7727**	**0.7727**	**0.8481**		
Southern	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.1278**	**0.2095**	**0.2095**	**0.2095**	**0.1244**		

The ratio's between North Sea and western from 1972-1983 reflect the SSB's from VPA
(western SSB from ICES CM 2002/ACFM:06 and North Sea SSB from ICES CM 1984/Assess:8)

Unit: kg

NORTH SEA MACKEREL (ICES fisheries assessment data base 1972-1983)

From 1984 onwards a constant data set has been used

Data for 2001 from 2002 egg survey (Iversen & Eltink WD2002)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.120		
2	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.209		
3	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.295		
4	0.477	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.357	0.342		
5		0.497	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.438	0.364		
6			0.543	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.495	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.437		
7				0.572	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.444		
8					0.570	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.429		
9						0.587	0.565	0.565	0.565	0.565	0.565	0.565	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.509		
10							0.615	0.590	0.590	0.590	0.590	0.590	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.606		
11								0.634	0.610	0.610	0.610	0.610	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.643		
12+									0.647	0.636	0.646	0.648	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.550		

From 1988-2000 the stock weight of the 15+ group weight estimated from average over 12-15+group

WESTERN MACKEREL Data are taken from WEST file (2001WG)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1	0.113	0.113	0.113	0.113	0.113	0.113	0.095	0.095	0.095	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070		
2	0.131	0.131	0.131	0.131	0.131	0.131	0.150	0.150	0.150	0.172	0.108	0.156	0.187	0.150	0.164	0.139	0.146	0.176	0.128	0.149	0.216	0.193	0.175	0.151	0.122	0.187	0.139	0.195	0.187	0.158		
3	0.201	0.201	0.201	0.201	0.201	0.201	0.215	0.215	0.215	0.241	0.202	0.220	0.246	0.292	0.261	0.233	0.233	0.238	0.213	0.227	0.257	0.264	0.230	0.259	0.244	0.216	0.217	0.237	0.236	0.237		
4	0.380	0.251	0.251	0.251	0.251	0.251	0.275	0.275	0.275	0.300	0.260	0.261	0.283	0.300	0.290	0.268	0.302	0.299	0.280	0.307	0.309	0.311	0.289	0.316	0.314	0.290	0.277	0.301	0.282	0.345		
5		0.410	0.264	0.264	0.264	0.264	0.320	0.320	0.320	0.300	0.379	0.322	0.305	0.328	0.345	0.363	0.327	0.342	0.331	0.356	0.359	0.357	0.353	0.392	0.356	0.357	0.339	0.350	0.350	0.392		
6			0.440	0.316	0.316	0.316	0.355	0.355	0.355	0.359	0.329	0.360	0.379	0.366	0.337	0.371	0.434	0.363	0.365	0.408	0.400	0.416	0.407	0.445	0.443	0.398	0.407	0.401	0.385	0.452		
7				0.470	0.380	0.380	0.380	0.380	0.380	0.401	0.388	0.384	0.429	0.421	0.395	0.392	0.455	0.419	0.405	0.431	0.424	0.458	0.468	0.493	0.464	0.446	0.434	0.432	0.427	0.461		
8					0.490	0.412	0.400	0.400	0.400	0.412	0.417	0.420	0.421	0.440	0.467	0.402	0.436	0.468	0.393	0.506	0.464	0.464	0.464	0.506	0.505	0.480	0.473	0.446	0.448	0.506		
9						0.511	0.420	0.420	0.420	0.427	0.425	0.497	0.465	0.448	0.441	0.459	0.460	0.441	0.420	0.547	0.489	0.480	0.472	0.546	0.576	0.520	0.515	0.491	0.494	0.535		
10							0.485	0.485	0.485	0.413	0.460	0.453	0.515	0.554	0.451	0.483	0.528	0.451	0.514	0.574	0.523	0.512	0.550	0.502	0.580	0.539	0.567	0.503	0.489	0.586		
11								0.485	0.485	0.509	0.513	0.550	0.497	0.579	0.472	0.442	0.606	0.496	0.514	0.574	0.556	0.597	0.612	0.627	0.624	0.530	0.535	0.452	0.539	0.610		
12+									0.485	0.509	0.513	0.550	0.549	0.599	0.568	0.547	0.645	0.585	0.514	0.574	0.582	0.561	0.568	0.633	0.638	0.579	0.588	0.574	0.543	0.589		

SOUTHERN MACKEREL (1972-1983 Data from Uriarte&Villamor&Martins, WD2000)

Revised set 1984-2001 according WD 2002

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.137	0.164	0.107	0.116	0.069	0.098	0.081	0.093	0.116	0.111	0.122	0.134	0.095	0.100	0.099	0.118	0.085	0.127		
2	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.230	0.241	0.260	0.183	0.204	0.168	0.178	0.174	0.183	0.211	0.179	0.229	0.173	0.165	0.178	0.185	0.172	0.196		
3	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.281	0.296	0.294	0.268	0.237	0.264	0.253	0.226	0.253	0.277	0.257	0.309	0.278	0.281	0.235	0.255	0.227	0.259		
4	0.426	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.356	0.332	0.378	0.386	0.277	0.340	0.310	0.295	0.303	0.326	0.360	0.381	0.325	0.319	0.310	0.294	0.307	0.320		
5		0.459	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.415	0.401	0.404	0.425	0.314	0.390	0.365	0.340	0.360	0.361	0.388	0.422	0.410	0.363	0.344	0.357	0.344	0.382		
6			0.489	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.465	0.476	0.410	0.459	0.337	0.468	0.401	0.403	0.395	0.403	0.433	0.460	0.447	0.413	0.367	0.370	0.401	0.404		
7				0.515	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.491	0.492	0.554	0.534	0.387	0.497	0.475	0.439	0.424	0.441	0.468	0.496	0.463	0.447	0.398	0.391	0.421	0.445		
8					0.536	0.490	0.490	0.490	0.490	0.490	0.490	0.490	0.567	0.578	0.510	0.594	0.392	0.510	0.494	0.484	0.448	0.466	0.511	0.529	0.483	0.469	0.439	0.415	0.439	0.470		
9						0.552	0.505	0.505	0.505	0.505	0.505	0.505	0.559	0.581	0.429	0.621	0.403	0.542	0.525	0.505	0.465	0.495	0.541	0.554	0.502	0.506	0.450	0.459	0.450	0.491		
10							0.570	0.530	0.530	0.530	0.530	0.530	0.546	0.595	0.554	0.592	0.476	0.542	0.507	0.521	0.508	0.492	0.551	0.582	0.536	0.525	0.481	0.478	0.498	0.502		
11								0.584	0.553	0.553	0.553	0.553	0.582	0.590	0.649	0.629	0.490	0.591	0.574	0.517	0.524	0.514	0.600	0.588	0.541	0.541	0.480	0.504	0.505	0.545		
12+									0.594	0.594	0.594	0.594	0.520	0.643	0.591	0.529	0.536	0.643	0.584	0.700	0.562	0.656	0.664	0.674	0.584	0.597	0.545	0.523	0.538	0.570		

NEA MACKEREL

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1	0.132	0.132	0.130	0.129	0.128	0.127	0.111	0.110	0.109	0.087	0.086	0.086	0.081	0.085	0.077	0.078	0.072	0.076	0.074	0.075	0.078	0.078	0.079	0.081	0.076	0.076	0.077	0.081	0.074	0.078		
2	0.178	0.177	0.173	0.171	0.170	0.167	0.175	0.174	0.173	0.186	0.135	0.172	0.194	0.165	0.179	0.148	0.156	0.177	0.138	0.155	0.212	0.197	0.178	0.164	0.133	0.186	0.149	0.194	0.185	0.164		
3	0.243	0.242	0.238	0.236	0.236	0.233	0.238	0.237	0.236	0.252	0.221	0.235	0.253	0.293	0.267	0.240	0.237	0.244	0.222	0.230	0.259	0.268	0.237	0.267	0.251	0.228	0.223	0.242	0.235	0.241		
4	0.411	0.301	0.296	0.294	0.293	0.289	0.300	0.299	0.297	0.313	0.280	0.280	0.295	0.306	0.304	0.286	0.301	0.306	0.287	0.307	0.310	0.315	0.301	0.326	0.317	0.296	0.285	0.301	0.289	0.342		
5	0.000	0.438	0.322	0.318	0.318	0.313	0.346	0.345	0.343	0.323	0.385	0.339	0.324	0.341	0.356	0.374	0.329	0.352	0.339	0.357	0.362	0.360	0.361	0.398	0.366	0.361	0.342	0.353	0.350	0.390		
6	0.000	0.000	0.469	0.365	0.365	0.361	0.382	0.380	0.379	0.378	0.353	0.377	0.393	0.384	0.351	0.386	0.423	0.380	0.373	0.409	0.402	0.416	0.413	0.448	0.444	0.402	0.400	0.396	0.390	0.446		
7	0.000	0.000	0.000	0.497	0.419	0.416	0.410	0.408	0.407	0.419	0.408	0.404	0.436	0.430	0.416	0.411	0.445	0.429	0.414	0.432	0.424	0.454	0.466	0.491	0.462	0.445	0.426	0.423	0.426	0.459		
8	0.000	0.000	0.000	0.000	0.512	0.446	0.432	0.430	0.429	0.434	0.437	0.439	0.441	0.459	0.473	0.429	0.432	0.474	0.409	0.502	0.462	0.465	0.470	0.508	0.501	0.478	0.466	0.440	0.447	0.499		
9	0.000	0.000	0.000	0.000	0.000	0.530	0.451	0.449	0.448	0.449	0.446	0.503	0.479	0.468	0.443	0.482	0.455	0.457	0.437	0.541	0.487	0.484	0.483	0.546	0.565	0.519	0.502	0.485	0.485	0.529		
10	0.000	0.000	0.000	0.000	0.000	0.000	0.514	0.504	0.503	0.443	0.479	0.473	0.520	0.559	0.468	0.499	0.522	0.466	0.514	0.566	0.522	0.511	0.550	0.514	0.573	0.537	0.549	0.498	0.492	0.576		
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.516	0.508	0.523	0.526	0.555	0.510	0.579	0.497	0.470	0.589	0.510	0.523	0.566	0.552	0.585	0.608	0.619	0.611	0.532	0.524	0.465	0.532	0.603		
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.518	0.531	0.534	0.563	0.550	0.607	0.575	0.549	0.632	0.595	0.529	0.594	0.583	0.577	0.584	0.639	0.632	0.585	0.580	0.565	0.544	0.586		

Table 7 Continued.

NEA MACKEREL according SG DRAMA

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.000	0.000	0.000	0.000
1	0.132	0.131	0.129	0.128	0.127	0.125	0.111	0.109	0.107	0.086	0.084	0.082	0.087	0.087	0.087	0.086
2	0.179	0.176	0.173	0.170	0.168	0.165	0.175	0.173	0.170	0.185	0.131	0.168	0.198	0.168	0.180	0.158
3	0.244	0.241	0.238	0.236	0.233	0.231	0.238	0.236	0.233	0.251	0.218	0.230	0.257	0.295	0.270	0.246
4	0.411	0.299	0.296	0.293	0.289	0.286	0.300	0.297	0.294	0.311	0.276	0.274	0.297	0.311	0.302	0.284
5	0.000	0.437	0.322	0.318	0.314	0.310	0.346	0.343	0.341	0.322	0.382	0.334	0.321	0.340	0.353	0.368
6	0.000	0.000	0.469	0.365	0.361	0.357	0.382	0.379	0.376	0.377	0.350	0.372	0.389	0.378	0.354	0.382
7	0.000	0.000	0.000	0.496	0.416	0.413	0.411	0.408	0.405	0.418	0.405	0.399	0.435	0.429	0.407	0.404
8	0.000	0.000	0.000	0.000	0.510	0.444	0.433	0.430	0.427	0.433	0.434	0.434	0.435	0.451	0.473	0.419
9	0.000	0.000	0.000	0.000	0.000	0.528	0.451	0.448	0.445	0.448	0.443	0.500	0.474	0.460	0.455	0.470
10	0.000	0.000	0.000	0.000	0.000	0.000	0.514	0.503	0.501	0.442	0.476	0.468	0.521	0.554	0.469	0.495
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.516	0.506	0.522	0.523	0.552	0.508	0.575	0.488	0.462
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.530	0.531	0.559	0.573	0.611	0.586	0.569

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
1	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.094	0.094	0.094			
2	0.161	0.187	0.146	0.164	0.221	0.201	0.186	0.166	0.141	0.197	0.168	0.209	0.203			
3	0.244	0.248	0.227	0.239	0.264	0.270	0.241	0.266	0.253	0.232	0.241	0.256	0.255			
4	0.310	0.307	0.291	0.314	0.316	0.318	0.299	0.322	0.320	0.301	0.298	0.315	0.301			
5	0.336	0.348	0.339	0.360	0.363	0.361	0.358	0.391	0.360	0.363	0.353	0.361	0.360			
6	0.433	0.373	0.374	0.411	0.404	0.418	0.410	0.442	0.440	0.404	0.413	0.409	0.397			
7	0.455	0.424	0.412	0.435	0.429	0.458	0.466	0.487	0.463	0.447	0.439	0.437	0.434			
8	0.445	0.472	0.408	0.504	0.468	0.468	0.468	0.504	0.503	0.482	0.478	0.459	0.460			
9	0.468	0.452	0.434	0.542	0.492	0.485	0.478	0.541	0.566	0.519	0.514	0.497	0.499			
10	0.531	0.465	0.519	0.570	0.526	0.517	0.549	0.508	0.575	0.540	0.561	0.514	0.504			
11	0.597	0.504	0.519	0.570	0.555	0.590	0.602	0.615	0.613	0.533	0.539	0.478	0.542			
12+	0.647	0.597	0.537	0.586	0.592	0.574	0.579	0.635	0.638	0.601	0.624	0.601	0.572			

NEA MACKEREL difference new and SG DRAMA data set

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000
1	0.000	0.001	0.000	0.001	0.002	0.002	0.000	0.001	0.002	0.001	0.002	0.004	-0.006	-0.002	-0.010	-0.008
2	-0.001	0.001	0.000	0.000	0.003	0.002	0.000	0.001	0.002	0.001	0.003	0.005	-0.004	-0.003	-0.001	-0.010
3	-0.001	0.001	0.000	0.000	0.003	0.002	0.000	0.001	0.002	0.001	0.003	0.004	-0.004	-0.002	-0.003	-0.006
4	-0.001	0.002	0.000	0.001	0.004	0.003	0.000	0.001	0.003	0.002	0.004	0.006	-0.002	-0.005	0.002	0.002
5	0.000	0.001	0.000	0.001	0.004	0.003	0.000	0.001	0.003	0.001	0.003	0.006	0.003	0.001	0.003	0.006
6	0.000	0.000	0.000	0.001	0.004	0.003	0.000	0.001	0.003	0.001	0.004	0.005	0.004	0.006	-0.003	0.004
7	0.000	0.000	0.000	0.001	0.003	0.002	-0.001	0.001	0.003	0.001	0.003	0.005	0.001	0.001	0.009	0.007
8	0.000	0.000	0.000	0.000	0.002	0.002	-0.001	0.001	0.002	0.001	0.003	0.005	0.006	0.008	0.000	0.010
9	0.000	0.000	0.000	0.000	0.000	0.001	-0.001	0.001	0.002	0.001	0.003	0.003	0.005	0.008	-0.012	0.012
10	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.001	0.002	0.001	0.003	0.005	-0.001	0.005	-0.001	0.004
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.002	0.003	0.002	0.004	0.009	0.008
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.003	0.004	-0.023	-0.004	-0.011	-0.020
	-0.004	0.004	-0.001	0.003	0.022	0.021	-0.005	0.008	0.028	0.012	0.034	0.053	-0.018	0.017	-0.019	0.010

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1	-0.012	-0.008	-0.010	-0.009	-0.006	-0.006	-0.005	-0.003	-0.008	-0.008	-0.017	-0.013	-0.020	0.078		
2	-0.005	-0.010	-0.008	-0.009	-0.009	-0.004	-0.008	-0.002	-0.008	-0.011	-0.019	-0.015	-0.018	0.164		
3	-0.007	-0.004	-0.005	-0.009	-0.005	-0.002	-0.004	0.001	-0.002	-0.004	-0.018	-0.014	-0.020	0.241		
4	-0.009	-0.001	-0.004	-0.007	-0.006	-0.003	0.002	0.004	-0.003	-0.005	-0.013	-0.014	-0.012	0.342		
5	-0.007	0.004	0.000	-0.003	-0.001	-0.001	0.003	0.007	0.006	-0.002	-0.011	-0.008	-0.010	0.390		
6	-0.010	0.007	-0.001	-0.002	-0.002	-0.002	0.003	0.006	0.004	-0.002	-0.013	-0.013	-0.007	0.446		
7	-0.010	0.005	0.002	-0.003	-0.005	-0.004	0.000	0.004	-0.001	-0.002	-0.013	-0.014	-0.008	0.459		
8	-0.013	0.002	0.001	-0.002	-0.006	-0.003	0.002	0.004	-0.002	-0.004	-0.012	-0.019	-0.013	0.499		
9	-0.013	0.005	0.003	-0.001	-0.005	-0.001	0.005	0.005	-0.001	0.000	-0.012	-0.012	-0.014	0.529		
10	-0.009	0.001	-0.005	-0.004	-0.004	-0.006	0.001	0.006	-0.002	-0.003	-0.012	-0.016	-0.012	0.576		
11	-0.008	0.006	0.004	-0.004	-0.003	-0.005	0.006	0.004	-0.002	-0.001	-0.015	-0.013	-0.010	0.603		
12+	-0.015	-0.002	-0.008	0.008	-0.009	0.003	0.005	0.004	-0.006	-0.016	-0.044	-0.036	-0.028	0.586		
	-0.118	0.006	-0.030	-0.044	-0.061	-0.036	0.008	0.039	-0.026	-0.058	-0.200	-0.188	-0.173	4.913		

Table 8 **The calculation of the proportions mature at age in the stock (MATPROP) of the NEA mackerel based on weighting by SSB's from egg surveys (1984-recent).**
For 1972-1983 it is based on weighting by SSB,s from VPA (gradual change from 1972-1983).

WEIGHTING FACTORS

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
North Sea	0.2541	0.2487	0.2211	0.2047	0.2010	0.1774	0.1361	0.1251	0.1164	0.0860	0.0799	0.0743	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0372	0.0178	0.0178	0.0178	0.0275		
Western	0.6181	0.6235	0.6511	0.6675	0.6712	0.6948	0.7361	0.7471	0.7558	0.7862	0.7923	0.7979	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.8350	0.7727	0.7727	0.7727	0.8481		
Southern	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.1278	0.2095	0.2095	0.2095	0.1244		

NORTH SEA MACKEREL (ICES fisheries assessment data base kept constant 1972-recent)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
2	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37		
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		

WESTERN MACK (Data from ICES 2001 WG)

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08		
2	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60		
3	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90		
4	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97		
5	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97		
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99		
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		

SOUTHERN MACKEREL Data set 1972-1997 revised to be the same as 1998-2001, because these were based on histology — Revised from 1998 onwards (WG1999 section 2.4.4)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		
2	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54		
3	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70		
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		

NEA MACKEREL

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
1	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		
2	0.53	0.54	0.54	0.55	0.55	0.55	0.56	0.56	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59		
3	0.90	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.88		
4	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.97		
5	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.97		
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99		
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		

Table 8 Continued.

NEA MACKEREL according SG DRAMA

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
1	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.06	0.06	0.06	0.06		
2	0.59	0.59	0.60	0.60	0.60	0.61	0.61	0.62	0.62	0.63	0.63	0.64	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.58	0.58	0.58	0.58		
3	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.85	0.85	0.85	0.85		
4	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.98		
5	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.98		
6	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99		
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
12+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		

NEA MACKEREL difference new and SG DRAMA data set

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1	-0.063	-0.065	-0.064	-0.064	-0.066	-0.066	-0.064	-0.065	-0.066	-0.065	-0.066	-0.067	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	-0.071	0.006	0.006	0.006	0.010		
2	-0.052	-0.056	-0.054	-0.055	-0.059	-0.058	-0.053	-0.055	-0.058	-0.056	-0.059	-0.062	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	0.003	0.003	0.003	0.006		
3	-0.033	-0.031	-0.032	-0.031	-0.030	-0.030	-0.032	-0.031	-0.030	-0.031	-0.030	-0.028	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	0.010	0.010	0.010	0.028		
4	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	-0.003	-0.003	-0.003	-0.005		
5	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	-0.003	-0.003	-0.003	-0.005		
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002		
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
	-0.150	-0.152	-0.151	-0.151	-0.154	-0.153	-0.150	-0.151	-0.153	-0.152	-0.154	-0.156	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	0.015	0.015	0.015	0.035		