Advisory Committee on Fisheries Management **ICES CM 2000/ACFM:7**

REPORT OF THE

WORKING GROUP ON THE ASSESSMENT OF DEMERSAL STOCKS IN THE NORTH SEA AND SKAGERRAK

ICES Headquarters
11–20 October 1999

PARTS 1, 2 and 3

International Council for the Exploration of the Sea

Conseil International pour l’Exploration de la Mer

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1 GENERAL

1.1 Participants

The Working Group met in Copenhagen from 11–20 October 1999 with the following participants:

Frans van Beek (Chair)	Netherlands
Ewen Bell	England
John Casey	England
Uli Damm	Germany
Tore Johannessen	Norway
Phil Kunzlik	Scotland
Peter Lewy	Denmark
Paul Marchal	Denmark
Capucine Mellon	France
Richard Millner	England
J. Rasmus Nielsen	Denmark
Martin Pastoors	Netherlands
Hans-Joachim Rätz	Germany
Stuart Reeves	Scotland
Anna Rindorf	Denmark
Odd M. Smedstad	Norway
Per Sparre	Denmark
Alain Tétard	France
Willy Vanhee	Belgium
Sieto Verver	Netherlands

1.2 Terms of Reference

The Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak [WGNSSK] (Chair: Mr F. van Beek, Netherlands) will meet at ICES Headquarters from 11–20 October 1999 to:

a) assess the status of and provide catch options for 2000 for the stocks of cod, haddock, whiting, saithe, sole, and plaice in Sub-area IV, Division IIIa (excluding sole in Division IIIa and cod in the Kattegat), and Division VIId (excluding haddock and saithe), taking into account the technical interactions among the stocks due to the mixed-species fisheries and new management measures coming into force in 2000;

b) assess the status of and provide catch forecasts for 2000 for Norway pout and sandeel stocks in Sub-area IV and Divisions IIIa and VIa, and identify any needs for management measures (including precautionary TACs) required to safeguard the stocks;

c) review progress in determining precautionary reference points;

d) quantify the species and size composition of by-catches taken in the fisheries for Norway pout and sandeel in the North Sea and adjacent waters and make this information available to WGECO;

e) provide the data required to carry out multispecies assessments (quarterly catches and mean weights at age in the catch and stock for 1998 for all species in the multispecies model that are assessed by this Working Group);

f) assess the status of saithe stocks in Sub-area IV and Divisions IIIa and VIa and provide catch options for each management area. The assessment should be based on the combined areas and be compared with assessments done on the individual units;

g) evaluate the potential impact on the stocks and the fisheries of the change in technical measures to be implemented by EC in year 2000.

The above Terms of Reference are set up to provide ACFM with the information required to respond to requests for advice/information from NEAFC and EC DGXIV.

In addition to the above Terms of Reference the Working Group considered a request to ICES by the European Community and Norway to provide

a) medium term analysis for Plaice in Sub-area IV; Cod in Sub-area IV and Divisions IIIa and VIId; Haddock in Sub-area IV and Division IIIa; Whiting in Sub-area IV and Division VIId and Saithe in Sub-area IV and Divisions IIIa and VIa in a format given in section 3.8[1]

b) a review of the reference points for whiting[2]

c) a proposal for reference points for saithe in the light of the new combined assessment unit[3]

Under the current EU legislation, the mesh size for targeting sole in NEAFC Regions 1 and 2 with static gears (mainly gill nets and trammel nets) should be 100 mm. However, a derogation from this basic condition is currently in place whereby sole may be targeted in ICES Divisions VIId and IVc with static gears of a mesh size of 90 mm.

d) What will be the short-term losses and long-term gains to the IVc and VIId sole stock, to the overall fishery and to each relevant sector of the fishery if the current derogation is annulled. If possible, losses and gains to the fishery should be expressed both in terms of yield and revenue[4]

1.3 Data

1.3.1 Data sources roundfish and flatfish

The data used in the assessment for roundfish and flatfish stocks are based on:

- total landings by market size categories
- sampling market size categories for weight, length, age and sometimes maturity
- discard data: available only for whiting and haddock in Division IV
- fleet data: effort data from logbooks and CPUE data from associated fleet landings
- survey data: catch per unit effort by age
- data on natural mortality from the MSVPA

1.3.1.1 Data on landings, age compositions, weight at age, maturity ogive

The Working Group estimates of total landings do for most stocks deviate from official figures. The discrepancies are shown in the landings Tables under the heading “unallocated landings”. These unallocated landings will in most cases include discrepancies which are due to differences in the calculation procedures, for instance that official landings use nominal box weights whereas the Working Group estimates are based on box weights are as measured during market samplings. Also in some cases national gutted-fresh conversion factors have been changed in the official statistics but not in the Working Group database. The SOP and differences introduced by conversion factors are in most cases minor. For all stocks except cod, haddock, saithe and whiting, SOP uncorrected estimates have been used in the assessments. The reason the SOP corrected data have been used for roundfish stocks is that some data in the historical time series have been corrected and that it has proven difficult to rectify this in a consistent manner. However, these corrections are relatively small.

Uncertainties on the data on landings have seriously affected the quality of some of the assessments and catch forecasts. The Working Group estimates of the landings do in some cases also include corrections for mis- or unreported landings. Such corrections may be based on direct information such as estimation from alternative sources or softer information. However, there are also situations that signals of mis- or unreported landings exist but could not be verified or quantified. Estimates of unreported landings for cod in area IV were estimated by the Working Group for part of the fleets. They have been included in the assessment for the year 1998 but not for other years. Estimates for other fleets were not available, although it is known that there is underreporting as well. A Historical time series of age compositions, weight and length at age by fleet for most of the stocks, considered by the Working Group, are kept and

[1] Item h) is dealt with in section 1.4. and the relevant sub-sections of the stocks concerned
[2] Item i) is dealt with in section 5.1.9
[3] Item j) is dealt with in section 6.3.10
[4] Item k) is dealt with in section 1.7

maintained in databases at some national institutes. The roundfish data (cod, haddock, whiting and saithe) are kept in Aberdeen. North Sea plaice and sole are kept in IJmuiden, VIId sole in Lowestoft, VIId plaice in Port-en-Bessin and IIIa plaice, sandeel and Norway pout in Denmark. No major revisions have been made in the catch, and weight at age data in the roundfish and flatfish stocks for years before 1998. The revisions made, are indicated in the relevant stock sections.

The mean weights at age used for stock biomass are in most cases derived from catch at age weights. Such weights may not represent the stock at young age groups due to selectivity. The biomasses for these stocks can therefore be used to investigate trends but the variability in relation of partly versus fully recruited age classes may generate bias.

Maturity ogives are generally based on historical biological information and kept constant over the whole time period of the assessment. For a number of stocks a knife-edge maturity has been assumed. Maturity at age data for some stocks from the samples of the landings in some fleets indicates that changes in age of first maturation occur. However, unbiased estimates for the stock are not available. The assumption of constant maturity-ogives may introduce bias in the trends in SSB developments, especially when exceptional large or small year classes enter the spawning stock.

1.3.1.2 Discard data used in the assessment

Estimates of discards are used in the assessment for North Sea haddock and North Sea whiting only.

Total annual international discard estimates by age group were derived by extrapolation from Scottish data. The inclusion of discard catches is considered to reduce bias and to give more realistic values of fishing mortality and biomass for these stocks but also contributes to the noise in the data. For the other stocks no discards estimates are available presently. Discard sampling schemes are implemented in a number of countries recently and discard data may become available within a few years.

1.3.1.3 Natural mortality

Natural mortality for plaice and sole in all areas has been taken as 0.1. For roundfish, values of M are based on predation mortality estimated from MSVPA. They were first adopted by the Roundfish Working Group for the assessment of North Sea Cod, Haddock and Whiting in 1986 (ICES 1986b). The values adopted were means at age over 1980–1982 as given by the MSWG (Section 3.1.1, ICES 1986a).

Subsequently, the Roundfish Working Group reviewed the values in use at its 1987 meeting (ICES 1987b), based on the results of a key run in the 1986 MSWG (Table 2.8.2, ICES 1987a). These used mean total Ms over the years 1978–1982. This review resulted in slight changes to the values used for Haddock and Whiting, but the values used for Cod were unchanged.

There was a further review by the Roundfish Working Group at its 1989 meeting (ICES 1990) which considered the values given by the 1989 MSWG (Table 2.8.2, ICES 1989). This used means over 1981–1986. As these values did not differ greatly from the values already in use by the Roundfish WG, the values were not changed.

The values of M in use for the assessment of North Sea cod, haddock and whiting have not subsequently been reviewed. However, the 1997 MSWG (ICES 1997a) performed an extensively revised MSVPA key run which may necessitate further review of the natural mortalities in use for these stocks. The values they give in Table 3.1.2.3 of the Report are means over the period 1974–1994. They compare with existing values for these stocks as follows:

	COD		HADDOCK		WHITING	
Age	Old	MWG97	Old	MWG97	Old	MWG97
0	[2.70]	2.21	2.05	2.19	2.55	2.08
1	0.80	0.91	1.65	1.57	0.95	1.21
2	0.35	0.40	0.40	0.34	0.45	0.46
3	0.25	0.29	0.25	0.27	0.35	0.34
4	0.20	0.19	0.25	0.27	0.30	0.38
5	0.20	0.18	0.20	0.28	0.25	0.41

As the MSWG note, “the values of total natural mortality from the keyrun are surprisingly close to those used by the single species assessment Working Groups.”

1.3.1.4 Fleet and research vessel data

Time series of CPUE and effort data from commercial fleets and research vessels have been used to 'tune' the assessments. The validity of many of these time series as indicators of stock size and fishing mortality in recent years has become more uncertain since enforcement of quota and technical measures are known to have led to changes in directivity of some fleets to other species. In general, there is still a lack of representative effort and CPUE series for most stocks. French commercial tuning data series for flatfish in Division VIId could not be continued and were replaced with new series.

In one research vessel survey series, the Scottish groundfish survey, there was a change in survey practice in 1998 due to the replacement of the previous research vessel, and also a changeover to a GOV Trawl and to a tow duration of 30 minutes. This means that indices from the 1998 and 1999 surveys are unlikely to be comparable with previous indices. Limited comparative fishing trials were performed to compare the performance of the old and new vessel/gear/haul length combinations. However, only haddock, whiting and herring were caught in sufficient numbers to enable a comparison to be made, and in the case of haddock and whiting, the data analysis indicated that the conversion factor for catch rates for the new vessel/gear did not differ significantly from one. Hence no correction has been made. Nonetheless, there is still reason to anticipate a change in catchability due to this change in practice, hence in cases where the tuning diagnostics indicated such a problem, these indice have not been used.

The whole time series of indices for North Sea plaice and sole of the Beam Trawl Survey have been revised. Previously ALK's, used in deriving the indices, included commercial samples and are excluded now. Consequently the age range of the survey has been reduced. Also the area, over which the indices were calculated was revised and a GLM model estimated missing values in rectangles (Figure 1.3.1).

During the meeting, results of the IBTS 3rd quarter survey data became available to the Working Group. These data have not been used in the assessments but gave in some occasions additional support to conclusions of the Working Group and are presented in the report when considered relevant.

1.3.2 Data sources Norway pout and sandeel

The data sources for Norway pout and sandeel were described in detail in the 1995 report of the Working Group (ICES 1996). The sampling system has not changed since then.

1.3.3 Sampling levels and sampling procedures

The methods of data collection and processing vary between countries and stocks. Sampling procedures applied in the various countries to the various stocks have been described in detail in last year report (ICES 1999a) and have not been changed since than. Table 1.3.3.1 gives an overview of the sampling levels in 1998 for each stock.

1.4 Methods and software

1.4.1 XSA

Extended survivors analysis (XSA) has been used as the main tool for catch-at-age analysis for all stocks. Three implementations were used: version 3.1 of the Lowestoft VPA package was used for roundfish and flatfish stocks; the Seasonal XSA (Skagen 1993, 1994) was used for Norway pout (quarterly) and sandeel (by half year) to allow for seasonal data.

The implementation of the various analysis tools is chosen on basis of explorations. The decision on such choices as ages for which catchabilities are assumed dependent on stock size, time taper and fleets to be included in the tuning is based on inspection of diagnostic output including residuals plots and retrospective analysis for a range of options. Such analysis has been done for all stocks included in the present report, but is not necessarily repeated every year for each stock since the outcome is normally not expected to change over a few years. Details of such analysis are included for those stocks for which the settings were changed or will be found in earlier reports of this working group otherwise.

Recruitment estimates have in several cases been made with RCT3. This is the case when recruitment indices from 1999 surveys are available and especially when indices are available from later than the first quarter. The present implementation of XSA cannot accommodate survey data in the year following the last catch data year and RCT3 is therefore implemented to utilise this information. This does in itself create some inconsistencies in the approaches used. The survey indices may end up being used twice for recruitment estimation - once in the survivors analysis (and thus in the VPA recruitment) and again with the same survey indices in RCT3. Another problem is the use of F-shrinkage for recruiting year classes in the present implementation of the XSA. This can not be turned off and has in some cases been seen to have strong influence on the recruitment estimates originating from XSA. The result of this feature is that the present implementation of XSA does not reproduce RCT3 values for recruiting year classes.

1.4.2 Forecasts, sensitivity analysis and medium-term projections, roundfish and flatfish

Short-term forecasts were made for each stock subject to a full analytical assessment. They are based on initial stock sizes as estimated by XSA (in a number of cases supplemented with separate recruitment estimates as described above), natural mortalities and maturity ogives as used in the XSA, mean weights at age averaged over recent years (normally 3) and fishing mortalities at age as a mean F-pattern over the last 3 years. The estimate of *status quo* F used by default in short-term predictions was the unscaled mean F at age for the last three years as recommended by ACFM. This was only scaled to the mean F in the terminal year if there was clear evidence of a recent trend in F. This procedure was applied for the first time last year and stemmed from the consideration that while the point estimate of terminal F represents the best available estimate of F in 1998, it does not necessarily follow that it will also be appropriate as an estimate of F in subsequent years.

Sensitivity analysis, and medium term projections made at the current Working Group meeting used the same software as at previous Working Group meetings. Details of the sensitivity analysis are given in Cook (1993), with an overview of the programs in ICES 1995 and more detailed documentation in Reeves and Cook (1994).

The program 'INSENS' has again been used for manipulation of catch data for stocks where discard/industrial bycatch data are used in the assessment. The program has also been used for most stocks to calculate coefficients of variation (CVs) of the input parameters for sensitivity analysis of the short-term catch predictions.

Short-term catch prediction with sensitivity analysis was based on the program WGFRAN4. In some cases the final prediction was run on IFAP and this output is presented in the Report in addition to the sensitivity analyses from WGFRAN4.

Key to parameters used in short-term prediction with sensitivity analysis
(HC = Human consumption, Disc = discards, Ind BC = industrial bycatch)

N0	Numbers at age 0 in 1999	sH0	Selectivity, HC, age 0
M0	Natural mortality, age 0	WH0	Weight in HC catch, age 0
N1	Numbers at age 1 in 1999	sH1	Selectivity, HC, age 1
M1	Natural mortality, age 1	WH1	Weight in HC catch, age 1
WS0	Weight in stock at age 0	sD0	Selectivity, Disc, age 0
MT0	Proportion mature, age 0	WD0	Weight in Discards, age 0
WS1	Weight in stock at age 1	sD1	Selectivity, Disc, age 1
MT1	Proportion mature, age 1	WD1	Weight in Discards, age 1
sI0	Selectivity, Ind BC, age 0	K99	Year effect on natural mortality, 1999
WI0	Weight in Ind Bycatch, age 0	K00	Year effect on natural mortality, 2000
sI1	Selectivity, Ind BC, age 1	K01	Year effect on natural mortality, 2001
WI1	Weight in Ind Bycatch, age 1		
HF99	Year effect on HC/discard F 1999	IF99	Year effect on Ind. bycatch F 1999
HF00	Year effect on HC/discard F 2000	IF00	Year effect on Ind. bycatch F 2000
HF01	Year effect on HC/discard F 2001	IF01	Year effect on Ind. bycatch F 2001
R99	Recruitment in 1999	R00	Recruitment in 2000

Short-term forecasts have been given on a stock basis, which in some cases includes more than one management areas. For management purposes it is suggested that the catch forecast could be split on Sub-areas and Divisions on basis of the distribution of recent landings. A recent average split of landings on the Sub-areas has been provided for these stocks.

1.4.3 Medium term projections

For standard medium term projections, stock-recruitment models were fitted using the program RECRUIT, which generates input data for the medium-term projection program WGMTERMA. Both of these programs are basically the same as used at the previous Working Group meetings. The stock-recruitment models selected for each stock were the same as those used for the derivation of precautionary reference points by the 1998 WG (ICES 1999a). Caution should be used in the interpretation of the medium-term projections. The estimated probabilities are contingent upon the model and the assumptions used in this program, and should not be interpreted too literally.

Responding to a request by the EU and Norway, additional to the terms of reference of this Working Group, medium term projections have been carried out showing for a period of 5 year:

- the probability that catches will exceed the catch in the first year
- the probability that SSB will exceed the SSB in the first year
- and the probabilities that SSB fall below $\mathbf{B}_{pa}$ and $\mathbf{B}_{lim}$.

This was requested for the following stocks: Plaice in Sub-area IV; Cod in Sub-area IV and Divisions IIIa and VIId; Haddock in Sub-area IV and Division IIIa; Whiting in Sub-area IV and Division VIId and Saithe in Sub-area IV and Divisions IIIa and VIa.

The projections are presented for two levels of fishing mortality: Fsq and $\mathbf{F}_{pa}$ and have been derived using output from the medium-term projection program WGMTERMA. As well as the summary output which is shown in the standard medium-term projections, each run of the program also produces an output file containing the results of each individual simulation run. By using these results directly it is possible to determine in how many simulations e.g., SSB falls below a given value in each year. The proportion of simulations in which this occurs is then used as an estimate of the probability of that event occurring. It should be noted that the medium-term projections are run applying the same F-factor throughout, whereas short-term forecasts are usually run assuming *status quo* F for the first year, and then applying an F-factor for subsequent years. This difference in practice means that for F values other than status quo, the estimates of the probabilities summarised here are biased. In particular, if $\mathbf{F}_{pa}$ is less than F-*status quo*, then the estimates of the probability of SSB being above the initial SSB will be over-estimated as they assume a lower F in the starting year than is assumed for the short-term forecast.

F	Year				
	1999	2000	2001	2002	2003
$\mathbf{F}_{pa}$	Yield 1	Prob(Yield2> Yield1)	Prob(Yield3> Yield1)	Prob(Yield4> Yield1)	Prob(Yield5> Yield1)
	SSB1	SSB2	Prob(SSB3> SSB1)	Prob(SSB4> SSB1)	Prob(SSB5> SSB1)
		Prob(SSB2< $\mathbf{B}_{pa}$)	Prob(SSB3< $\mathbf{B}_{pa}$)	Prob(SSB4< $\mathbf{B}_{pa}$)	Prob(SSB5< $\mathbf{B}_{pa}$)
		Prob(SSB2< $\mathbf{B}_{lim}$)	Prob(SSB3< $\mathbf{B}_{lim}$)	Prob(SSB4< $\mathbf{B}_{lim}$)	Prob(SSB5< $\mathbf{B}_{lim}$)
Fsq	Yield 1	Prob(Yield2> Yield1)	Prob(Yield3> Yield1)	Prob(Yield4> Yield1)	Prob(Yield5> Yield1)
	SSB1	SSB2	Prob(SSB3> SSB1)	Prob(SSB4> SSB1)	Prob(SSB5> SSB1)
		Prob(SSB2< $\mathbf{B}_{pa}$)	Prob(SSB3< $\mathbf{B}_{pa}$)	Prob(SSB4< $\mathbf{B}_{pa}$)	Prob(SSB5< $\mathbf{B}_{pa}$)
		Prob(SSB2< $\mathbf{B}_{lim}$)	Prob(SSB3< $\mathbf{B}_{lim}$)	Prob(SSB4< $\mathbf{B}_{lim}$)	Prob(SSB5< $\mathbf{B}_{lim}$)

Some strong reservations were expressed by Working Group members on the interpretation of results from this exercise. As with the short term catch forecasts, the outcome of these predictions over a short time period are heavily influenced by the assumed starting populations. In particular, the forecasts of yield and spawning stock biomass can be greatly influenced by the estimated abundance of a few or even a single year class in the stock because:

- the accuracy and/or precision with which these starting population estimates can be made, especially for recruiting year classes, means that population estimates of the same year class may differ from one assessment to the next.
- abundance of the recruiting year class may vary dramatically between years.

Consequently, the probabilities expressed over such a short time span as tabulated above, may change greatly from one assessment to the next depending on the starting conditions whereas the results over a longer time horizon are likely to be more stable. If managers are to be presented with this type of short term information, they need to be fully aware of its basis and interpretation, particularly if such information is requested from successive stock assessments.

1.5 Biological Reference points

Established biological reference points (**F**$_{med}$, F_{high}, $F_{0.1}$, F_{max} etc) have been estimated according to standard procedures and given for each stock where possible.

Last year, the Working Group proposed limit- and precautionary reference points for fishing mortality and SSB (**F**$_{lim}$, **F**$_{pa}$, **B**$_{lim}$ and **B**$_{pa}$) for all stocks based on guidelines by the ICES Study Group of the Precautionary approach to Fisheries Management (ICES 1998). These proposals were reviewed by ACFM and in most cases taken over or modified to ICES proposals of precautionary reference points to managers.

ACFM states that future management advice by ICES will be constrained by **F**$_{pa}$ and **B**$_{pa}$, the precautionary thresholds which imply a reasonably high probability of remaining below a limit fishing mortality and above a limit spawning stock biomass. **F**$_{pa}$ and **B**$_{pa}$ are thus the main devices to be used by ICES in providing Management Advice.

Following a request by Norway and the EU, new reference points are required for saithe in Sub-area IV, Division IIIA and Division VIA combined since the stock has been assessed in these areas combined for the first time. Also, given the uncertainties in last years assessment, the EU and Norway requested to review the precautionary reference points for whiting. The Working Group has dealt with these requests in the relevant subsections of the report.

The procedures in deriving the precautionary reference points for these stocks are same as applied by the Working Group last year following the guidelines given by SGPAFM.

For calculating the reference points the PA software, developed in Lowestoft and the "Aberdeen" programmes: INSENS, WGMTERMA, RECRUIT and REFPOINT were used. Last year a new version of WGMTERMA was compiled which included the Butterworth and Bergh stock recruit relationship, which was used for a number of flatfish stocks. This version was not available to the Working Group this year. For those stocks, which used this model last year, a Shepherd curve was used instead for stock recruitment, setting the model parameters such, that it produced a curve as close as possible to the results of the model used last year. The residuals were recalculated and manually corrected in the input file to WGMTERMA. The Working Group recognised that this process is error prone, however, giving the circumstances, it had no other choice.

1.5.1 Summary of PA reference points

In 1998 the Working Group calculated biological reference points for all stocks based on the precautionary approach criteria. These were reviewed by ACFM in November 1998. The reference points finally adopted by ACFM and proposed to the managers are given in the text table below. Revised proposals for biological reference points for whiting and for saithe in the new assessment area requested by the EU and Norway are provided by the Working Group and given in *italics* in the table. Their derivation and the basis for the Working Group choice is discussed in the relevant stock section of this report.

Biomass in '000 tonnes

Stock	**B**$_{lim}$	**B**$_{pa}$	**F**$_{lim}$	**F**$_{pa}$
Cod in IIIa (Skagerrak), IV and VIId	70	150	0.86	0.65
Haddock in IIIa and IV	100	140	1.00	0.70
Whiting in IV and VIId	225	315	0.90	0.65
	200	***280***	-	-
Saithe in IV and IIIa	82	150	0.60	0.40
Saithe in VI	11	35	0.51	0.25
Saithe in IV, VI and IIIa	***106***	***200***	***0.60***	***0.40***
Sole in IV	25	35	0.55	0.40
Sole in VIId	-	8	0.55	0.40
Plaice in IV	210	300	0.60	0.30
Plaice in VIId	5.6	8	0.54	0.45
Plaice in IIIa	-	24	-	-
	-	***24***	-	-
Norway pout in IV and IIIa	90	150	-	-
Sandeel IV	430	600	-	-

italics: WGNSSK-1999 proposal

1.6 Evaluation of the potential impact of the change in technical measures in the North Sea to be implemented by the EU in 2000

The Council Regulation No 850/98 of March 1998 (*Conservation of Fishery Resources through Technical Measures for the Protection of Juveniles of Marine Organisms, + Amendments*) coming into force with the start of 2000, modifies the technical conservation measures for fishery resources in the EU waters.

1.6.1 Summary

The Working Group understands that the aim of the revised Council Regulation 850/98 of March 1998, is to harmonise the existing Council Regulation (EC) No. 894/97 (the consolidated version of (EEC) No. 3094/86 and its amendments) to minimise the catch of juvenile fish and reduce discarding. The new regulation aims to do so by improving the selection and/or separating characteristics of gears, by prohibiting adverse manipulations or other forms of cheating, or by prohibiting the trade of undersized fish. A summary of the relevant aspects of this new regulation is given in Section 1.6.2.

The Working Group has identified three areas where the changes to the technical Conservation regulation may affect stocks and fisheries in Sub-area IV, Divisions IIIa and VIId. These are summarised below and a fuller discussion with supporting data on each of the points are given in Sections 1.6.3 –1.6.5

- **Revisions to technical measures relevant to roundfish**

The Working Group considers that the new regulation will have little impact on the roundfish fisheries, since some measures only reflect current practice at least in the UK fisheries, which are the major roundfish fisheries in the North Sea, while other measures will have to prove their effectiveness in practice. This point is discussed further in Section 1.6.3.

- **Revision of mesh size regulation**

The new regulation extends the area in Sub-area IV where the use of 80 mm codend meshes is permitted in towed gears. The WG recognises that the apparent relaxation of the current regulation may result in a re-direction of fishing effort into the area where 80 mm mesh towed gears are currently prohibited. In addition, the extension of the area where 80 mm meshes may be used, may result in changes in exploitation pattern on several species including plaice and sole. This will particularly be the case if vessels currently exploiting this area switch to using gears with smaller (80 mm) codend meshes. However, since it is not possible to make reliable predictions of the redistribution of fishing effort or the numbers of vessels reducing their mesh sizes, the WG is unable at present to adequately quantify the potential impact on stocks or fisheries. This point is discussed further in Section 1.6.4.

- **Reduction of minimum landing size (MLS) for plaice from 27 cm to 22 cm**

Provided that there is no change to the current fishing practice, the reduction in MLS from 27 cm to 22 cm will, by itself, have no impact on the fishing mortality rates of plaice. It is possible that the new landing size regulation may create an additional market for small plaice, which on one hand may result in reduced discarding of small fish. On the other hand however, this measure may result in increased targeting of small plaice, which would be undesirable from a stock conservation standpoint.

If fish, that are currently discarded, are landed in the future this would change the perceived exploitation pattern by raising fishing mortality rates on age groups that were previously discarded. The WG notes that in order to reconcile such a change of catch data, time series of discard estimates would have to be estimated for a number of years prior to 2000. In addition, biological reference points would require re-evaluation.

The WG notes that a possible increase in TAC to account for landings of 22–26 cm plaice could be utilised to land higher valued (larger) size groups. This would create an unintended increase of fishing mortality on a stock, which is currently outside safe biological limits.

1.6.2 Changes of technical measures relevant to the WGNSSK

Changes which concern the fisheries this Working Group is dealing with, include:

1. a revision of the minimum percentages target species for different gear types and mesh sizes that may be kept on board at any given time,
2. a prohibition to carry more than two net types on board which must consist of only one of a number of specified combinations of mesh size with corresponding target species definitions,
3. a limit to a codend circumference of 100 meshes in towed nets except beam trawls,
4. a limit to 8 mm (single) or 12 mm (double) twine thickness in bottom trawl codends,
5. a prohibition to use devices which obstruct the selectivity of meshes,
6. a prohibition to use other mesh types than diamond or square,
7. the option to use > = 80 mm square mesh windows in bottom trawl and seine nets with > = 100 mm diamond mesh codends,
8. a prohibition to sell or transport undersized fish,
9. the mandatory use of separating devices in shrimp fisheries,
10. the mandatory use of square mesh (> = 80 mm) windows in the fisheries directed to Nephrops using 70 mm mesh codends,
11. an extension to the area where the use of the 80 mm mesh is currently permitted for bottom trawling in the North Sea (see Figure 1.6.2.1)
12. a reduction of the minimum landing size for plaice from 27 to 22 cm in the North Sea and a reduction in the minimum landing size for some other flatfish species.

1.6.3 Revisions to technical measures relevant to roundfish

The large majority of catches of roundfish from the North Sea is taken using towed gears, e.g., trawls and seines. For vessels targeting cod, haddock and saithe, existing legislation dictates a minimum mesh size of 100 mm. As factors such as increasing the meshes round the codend and constructing the codend from thicker twine can be used to restrict the opening of codend meshes and thus the selectivity of the gear, the council regulation will add restrictions on the permissible number of meshes around the codend and on the twine thickness within the codend. These imply no more than 100 meshes around the codend which can be constructed from twine no more than 8 mm (for single twine) or 6 mm (for double twine) thick. However, as codends currently in use typically fall within this specification, these restrictions are unlikely to have any practical effect on the selectivity of the gears in use. The Regulation also allows for the incorporation of a square mesh panel or a “Baltic Panel” into a codend or extension. These measures could improve the selectivity of the gear in use, but their incorporation is not mandatory.

Vessels fishing for *Nephrops norvegicus* in the North Sea are permitted to use codends with a minimum mesh size of 70 mm. These vessels also catch some roundfish although the amount they can land is limited by bycatch regulations associated with the use of the smaller mesh size. In addition to these bycatch limits, the regulation will make it mandatory for vessels fishing with 70–79 mm mesh to fit an 80 mm square mesh panel in the top part of the codend or extension. However, this measure is already in place for UK-registered vessels through a unilateral UK regulation. UK vessels constitute the large majority of the vessels fishing for *Nephrops* in the North Sea, and many of these are now using 100 mm mesh to avoid bycatch restrictions. Hence the practical effect of this aspect of the Technical Regulation is likely to be small. The technical measure will also introduce measures to improve the selectivity of vessels fishing for the prawn *Pandalus borealis.* No information was available to the WG on the bycatch of roundfish species in this fishery, although this is thought to be small. Thus it is also unlikely to have any detectable effect on the overall exploitation pattern on the roundfish species.

Thus to consider the possible effects of the technical measures given in Council Regulation 850/98, we need consider only the possible effects of the voluntary use of square mesh panels in roundfish nets. Only haddock and whiting are considered here, as the potential changes in selectivity are too small to influence the selectivity of gears for the two larger species. In recent selectivity experiments (FRS Marine Lab Aberdeen, unpublished data), the use of 80 mm square mesh panels in 100 mm codends increased the L50 of the codend by 2.8 cm for haddock and 1.1 cm for whiting. However, these results are sensitive to the positioning of the square mesh panel; a panel in the wrong position will have no affect on the selectivity. Moreover, as the introduction of this measure is only optional, it seems likely that this regulation will have a negligible effect on the exploitation pattern of the fleet.

In conclusion, it appears unlikely that the new technical measures will have any practical effect on the gear selectivity of vessels fishing for roundfish.

1.6.4 Revision of mesh size regulation

In order to evaluate the likely consequences of extending the derogation to fish with 80 meshed beam trawls in the areas between 55º and 56º N and east of 5º, the WG explored the current distribution of effort and landings for the relevant areas. Furthermore, the WG made an inventory of the type of processes that could occur when this new regulation will come into action.

Effort (days at sea) of the Dutch, UK and German beam trawl fleets distributed over the three areas relevant to the beam trawl mesh size are shown in Figures 1.6.4.1.a and b. Beam trawl effort is predominantly distributed south of 55º N, and only a small fraction the effort is exerted in the new 80 mm area. For the years 1990–1999 on average 2% of the small (< = 300 HP) and 6% of the large (> 300 HP) international beam trawl effort is exerted in the new 80 mm area. Effort of Danish fleets distributed over areas is shown in Figure 1.6.4.2.

Figures 1.6.4.3.a and b show the landings of sole and plaice by Netherlands, England, Germany and Denmark by the 3 areas and by year. Table 1.6.4.1 shows that the area south of 55º N, where the present derogation applies, is the main area for the sole fishery with 24% sole and 76% plaice in the combined landings weight of the two species (average 1990–1997), whereas the new 80 mm area gives 5% sole and 95% plaice. The remaining part of the area north of 55% gives only 2% sole and 98% plaice; however, the differential catch rates are of course affected by the actual mesh size regulations.

Presently the new 80 mm area is primarily fished by Danish vessels. Figure 1.6.4.4.a and b. shows the landings of plaice by the Danish HC (Human Consumption) fishery. The major part of the Danish landings of flatfish is plaice caught north of 55º. The new 80 mm area is relatively more important for the Danish fishery, compared to the importance for the southern beam trawl fishery. Figure 1.6.4.5 show that gill net, Danish seine and otter board trawl are the important gears in this fishery.

Although the current fishing effort and landings in the new 80 mm area contributes only to a small degree to both the total international effort and international landings of plaice and sole, the expected consequences of the opening of the new area cannot be easily inferred from that information. It is likely that beam trawlers fishing in the new area will use the smaller mesh in the future. Also additional effort may be directed into that area. This could result in higher number of plaice and sole being caught in that area. It is unclear whether this would have any effects on these stocks.

1.6.5 Reduction of minimum landing size for plaice from 27 cm to 22 cm

The main questions to address in this context are:

- Does the reduction in minimum landing size lead to a reduction in discarding?
- How will the reduction of minimum landing size affect the plaice assessment?

There are several reasons why fish may be discarded (e.g., under the minimum legal size, low economic value, quota exhausted, etc.). The behaviour of fishermen and processors in respect to the acceptance of small-sized plaice is mainly based on economical and technical consideration, and is outside the scope of an ICES assessment working group. Anecdotal information suggests that the processing industry is at present opposing the reduction in minimum landing size because the filleteers do not want to cut fillets from these small plaice.

In case that effort will be directed towards juvenile plaice as a target, the biological exploitation would change in a way, which is adverse to the need to build up the spawning stock. If additional landings would only be generated out of the pool of current discards the biological exploitation would remain the same even though the stock would perhaps be economically better exploited.

Current assessments of plaice and sole do not include discards information because annual series of discard estimates covering the international fishery are not available. Inclusion of an additional catch in the landings, which was previously discarded, could change the perceived exploitation and raise average F. Also spawning stock and recruitment estimates for the recent years would change, leading to a discontinuity in the time series. Biological reference points would have to be recalculated.

The resulting dilemma for the WG is that either a discontinuous time series would have to be accepted or that a series of annual discard estimates should be generated (in the absence of real discard data).

Given the uncertainty in the estimation of the likely consequences of the new technical measures, the WG finds itself unable to quantify those effects. Therefore, there is at present no basis to revise the way advice on fishing mortality or harvest levels is supplied by ACFM. More importantly, the WG considers that there is no immediate reason to augment the TAC for North Sea plaice in order to cope with the situation of an increase in legally exploitable biomass. One of the unintended consequences of a measure like that could be an increase in high-grading of small-sized fish in order to be able to land more higher valued larger fish. This would entail an increase in fishing mortality, which is highly undesirable in the present stock situation.

1.7 Evaluation of the potential impact of the change in mesh size to 100 mm for fixed net for sole in VIId

Introduction

Under current EU legislation, for fisheries targeting sole in NEAFC Regions 1 and 2 with static gears, the mesh size should be 100 mm. A derogation for fisheries targeting sole in ICES Divisions Vid and IVc using static gear with a mesh size of 90 mm is in place. The EC has requested ICES for advice: *What will be the short-term losses and long-term gains to the stock, to the overall fishery and to each relevant sector of the fishery if the current derogation is annulled. If possible, losses and gains to the fishery should be expressed both in terms of yield and of revenue.* Previous to the regulation, there were no restrictions on the mesh size used by fixed net fishermen in EU waters.The main fishery which will be impacted by this legislation is the trammel net fishery for sole along the French coast of VIId although there are other areas where fixed nets with mesh sizes below 100 mm are also in use.

A detailed evaluation of the potential impact has been carried out (Tetard and Le Pape, 1997 – Working Doc XX). The conclusions of the report were:

- The trammel net fleet using < 100 mm mesh takes around 25% of total sole landings in VIId
- Increase in mesh size of trammel nets from 84 mm to 100 mm will result in losses of up to 40% for the trammel net fleet
- Long-term gains to the stock will be small (around 12%) assuming an increase from 84 mm to 100 mm
- present mesh size in use by the trammel fleet is uncertain

Background

The fixed net fishery for sole is carried out by vessels fishing in coastal waters along the coasts of England and France. Sole is the most important species to these metiers making up a significant part of their total income. The predominant mesh size used for sole on the English coast is 100 mm but at easterly ports in England, successful fisheries have recently developed using 84 mm mesh nets. On the French coast, fishermen in the Baie de Seine mainly use 100 mm mesh whereas in the east of the area VII, the mesh size is thought to vary between 84 mm and 90 mm. Trammel fleets fishing in VIId with mesh less than 100 mm are estimated to take around 25% of the total international landings of sole (Tetard & Le Pape, 1997). A further 19% is taken by fixed net fleets using 100 mm mesh or larger (see section 8.1).

A number of working documents and publications have been prepared on this topic and a list of references are given below.

The WG repeated the simulations originally reported by Tetard and Le Pape by assessing the impact on spawning stock biomass and yield over the medium term (10 years). Input data were the catch, stock weights and exploitation pattern from the North Sea and Skagerrak Working Group Report (ICES, 1996) and selection parameters were those given in Tetard and Le Pape. Simulations were made on the assumption that the mesh size in use was 84 mm and increases to 90 and 100 mm were investigated.

The results are presented in Figure1.7.1. Increase in mesh size from 84 mm to 90 or 100 mm resulted in increases in SSB of 4% and 13% respectively. Total landings were estimated to increase by 2% for a change from 84 mm nets and 1% from 90 mm nets. The expected loss to the trammel net fleets were 12% to 39%.

Conclusions

The WG confirmed the results of previous analyses on the potential impact of a mesh increase on trammel net fisheries. Small increases in stock biomass and landings would be expected compared with the potential losses to the trammel fishery. However, these results are dependant on the assumptions that the mesh size in use by the fleet is 84 mm. It is also sensitive to the split between trammel landings and landing by other gears which is not well recorded.

The WG also noted that the social and economic consequences should be thoroughly investigated with an updated fleet information on the currently used mesh size.

1.8 Presentation of reports, papers and working documents

A number of working papers was presented to the Working Group. These are listed in section 15. This section gives a short summary of the contents of the presentations.

A paper dealing with an evaluation of the accuracy ICES catch forecasts (van Beek and Pastoors, 1999) was presented to the Working Group. The evaluation indicates that a for the investigated roundfish and flatfish stocks in the North Sea there is no relationship between the realised fishing mortality and the fishing mortality predicted in the catch forecast used in the ICES advice. In the more detailed investigated years, the main cause of the discrepancy seems to be the error in the estimation of input stock size and fishing mortality and in some cases the estimation of recruitment. It was concluded that TACs, based on ICES forecasts, do not control the fishing mortality in the way they pretend to do.

A common assumption underlying fish stock assessment procedures is that fishing power is constant over time. This assumption raises two significant corollaries. First, it allows CPUE to be a good indicator of stock abundance. Second, it implies that fishing effort may be a good indicator of fishing mortality. However, evidence is accumulating that the fishing power of commercial fleets has changed over the past decades. The purpose of this exercise (Marchal et al. 1999) is to identify temporal dynamics in fishing power, by deriving three convergent indicators based on three independent methods. The first method estimates a single-species indicator of variations in catchability (IVC), derived from the relationship between fishing mortality and fishing effort. Fishing mortality estimates are provided by examining the convergent part of the retrospective analysis performed by XSA. The second method derives a single-species indicator of variations in fishing power (IVFP), based on the relationship between the CPUE of a fleet and the CPUE of a reference subfleet defined by objective criteria. The third method derives a combined-species indicator of variations in technical efficiency (IVTE) derived from a stochastic production frontier function of specific socio-economics related to the fishing activity. The three methods are applied to the Dutch flatfish fisheries operating in the North Sea. IVC and IVFP, individually calculated for sole and plaice, are closely related by a linear equation over period 1995–1997. Both IVC and IVFP are generally decreasing since 1990. IVTE, derived from total landing value, generally increases since 1990. The inconsistencies between IVTE and IVFP (or IVC) might result from different models (single- and combined-species) being used, and different inputs (e.g., prices and independent stock estimates for IVTE) being required. It is suggested to calculate IVFP for other by-catch species of beam-trawlers, and also to raise IVFP to total landing values, in order to make IVFP and IVTE more comparable.

A part of the report of the ICES Comprehensive Fishery Evaluation Working Group, which met from 14–21 January 1999 in Key Largo, Florida, was presented to the Working Group (ICES 1999). The chapter that was presented dealt with the comprehensive evaluation of the North Sea flatfish fisheries. Several elements of this comprehensive evaluation were addressed, with special attention on the fisheries aspects like effort allocation, fleet dynamics and economical relationships. There was no clear conclusion from the discussions on how comprehensive fishery evaluations like this could relate to the work of the WG.

The report of the study group on Market Sampling Methodology which met from 28–29 April 1999 in IJmuiden, The Netherlands, was presented to the Working Group (ICES 1999). The report contains an outline of the type of work that is intended concerning the evaluation of the international market sampling programs for North Sea cod, herring and plaice. The ICES studygroup coincides with an EU funded research project on the same issue which is to be finished by April 2001. The inventory of market sampling methods is currently being finished and the market sampling data are in the process of being collated. It is expected that at the workshop which will be organized in Aberdeen, 24–26 January 2000, results from the analysis at the national sampling level will be available and presented.

A suggestion for a methodology to assess the effect of the technical management measures for the flatfish of year 2000 was presented to the working group (Sparre, 1999). The paper was prepared in response to item g) of the TOR. The method is based on the traditional forecast model of ICES combined with traditional gear selection models. The only new element in the method is that it accounts for the effect of changes in the minimum legal landing size. The effect of the technical management measures is expressed in terms of changes in numbers discarded by age group, by fleet and by area. As no time series of discard data on flatfish are available to the WG (see Section 9.2), this method is to a large degree based on generated or “guessed” input parameters and data. Furthermore, assessment of the technical management measures of year 2000 also requires input data on the spatial distribution of resources and fishing effort, as well as knowledge on the migration of resources and fishing fleets. The working group has not previously applied this type of data. The application of the suggested methodology to address item g) of the TOR was therefore considered to involve too many assumptions and speculations, which could not be verified with the data in hand. The WG concluded that data was not available to warrant any quantitative prediction of the effect of the technical measures.

A new stochastic assessment model applied to North Sea sandeel (Lewy and Nielsen, 1999) was presented to the Working Group. The model applies a Bayesian approach and estimates stock size and fishing mortality and the associated uncertainties using Markov Chain Monte Carlo and graphical models. An autoregressive recruitment model assuming that recruitment has been fluctuating with a pattern of alternating strong and weak year classes has been used. Using these recruitment model stochastic *status quo* predictions of future recruitment, biomass and catches have been carried out assuming constant fishing mortality estimated as an average of the last 10 years. The advantage of the model is that all parameters are estimated simultaneously ensuring that correlations between them are included. For the first year of prediction predicted spawning stock biomass is very uncertain, CV equals to 25%. For the following years the uncertainties are even wider due to recruitment uncertainty, CV equal to 38%.

A working document was presented showing preliminary result of *ad hoc* multi species VPA tuning applied for the North Sea stocks. Multi species tuning is as a successive exchange of natural mortalities and terminal fishing mortalities between MSVPA and tuning modules for individual species, until equilibrium is obtained. The tuning modules are not integrated in the MSVPA program, but tuning is made through calls to separate external tuning modules (XSA, SXSA and ICA) normally used by the working groups.

Ad hoc multi species tuning is implemented in the 4M package (Vinther et al.,1998). The setup of MSVPA was identical to the key-run made at the last Multispecies Assessment Working Group meeting (ICES 1997/Assess:16). Single species data and tuning options were as similar to those used at the last single species WG. (ICES, 1999a) adjusted to 1995 as the last year.

Stable terminal fishing mortalities were obtained after 3–5 MSVPA/tuning iterations. The statistical output from the tuning modules was used to compare the performance of single species and multi species tuning. For XSA and SXSA tuning, the R-square values from log(stock number) ~ log (CPUE) regressions were used. With respect to in the tuning statistics, there were no significant differences between single and multi species tuning. This is however not to say, that single and multi species assessment gives the same result.

A document was presented (Brander and O'Brien 1999) indicating that trends in weight at ages 1–4 for North Sea cod correlate positively with changes in bottom water temperature. The paper indicates that information on water temperature to predict changes in weight in future years and can be potentially used by Working Groups in catch forecasts.

A working document was presented dealing with growth, sexual maturation, reproductive investment and the use of market sampling and survey data to derive maturity-ogives for North Sea plaice (Bromley 1999). Various factors are shown to influence sexual maturity. Including these variables in a GLM model accounted for up to 53 of the variance in the maturity. Problems with using market-sampling data to construct maturity ogives were discussed.

The Report of the Workshop on Otolith Ageing of North Sea whiting was available to the Working Group, but was not presented and discussed.

1.8.1 Plaice box

The report of the ICES Workshop on the Evaluation of the Plaice Box was presented to the Working Group (ICES 1999). The workshop was held in IJmuiden, The Netherlands from 22–25 June 1999 and well attended by participants from England, Belgium, Germany, Denmark and the Netherlands.

To reduce the discarding of plaice in the nursery grounds along the continental coast of the North Sea, an area between 53ºN and 57ºN ("Plaice Box") was closed to fishing for trawlers with engine power of more than 300 hp in the second and third quarter since 1989, and for the whole year since 1995. Contrary to expectations, the yield and spawning stock biomass of plaice decreased since then. The workshop considered the reasons for this decline and whether in the light of this decline something could be concluded on the effectiveness of the box in protecting juvenile plaice.

The effectiveness of the box cannot be estimated directly. The approach adopted, therefore, was to analyse the various factors that may contribute to the mortality of the discard size-class (fishing effort, growth, fish distribution, environmental conditions) and apply a modeling approach to study the combined effect of various factors.

Total fishing effort in the plaice box has decreased substantially since its establishment despite an increase in fishing effort by the exemption fleet (< 221 kW) between 1989 and 1994. Since 1995, the effort of the exemption fleet has decreased. This decrease was most pronounced in the German Bight area of the box and may have been a response to reduced availability of marketable sized sole and plaice in the more easterly, shallower part of the area. It may also have been in response to more effective enforcement of the plaice box regulations. Concentration of fishing effort of the large beam trawlers currently occurs along its borders and in the southern North Sea.

The growth rate of plaice showed a temporary decrease in the late 1980s, which was may be related to the high population abundance of undersized plaice of the strong 1981 and 1985 year classes. Growth rate in the mid-1990s is as high as in the late 1970s and early 1980s.

Plaice smaller than the legal minimum landing size (27 cm) are mainly distributed within the Plaice Box, although a substantial part of undersized plaice also occurred just outside the box in recent years. The largest concentrations of undersized plaice typically occur in the German part of the box. Survey data indicate that since 1995, the distribution pattern has changed. The relative abundance of all age groups of plaice in the shallower waters of the German part of the box has declined. In the summers of 1995–1998, the largest concentrations of 2 and 3 year old plaice were observed towards the western limit of the box.

The observed discard rate of plaice in the beam trawl fishery using 80 mm nets varies from 78% to 85% by number for Dutch and German observations respectively. Discard rates in the other parts of the North Sea were substantially lower (31%). High discard rates were observed along the borders of the Plaice Box.

Sea surface temperatures in the Plaice Box area have been generally high since 1990. Exceptionally high water temperatures, with summer temperatures reaching values above 20ºC, have been observed in the German part of the Plaice Box since 1995.

Benthos studies, conducted since the establishment of the Plaice Box, showed that benthic biomass in the inner areas of the German Bight have remained high and suggested that changes in the epi-benthos composition occurred, coinciding with the shifts in the management regime of the Plaice Box.

Simulations, using a spatially explicit model, are consistent with the results of previous ICES Working Groups (1987, 1994), but indicate that up to 1994 the combined effect of increased effort from the exemption fleets and reduced growth rate may have substantially reduced any gains from the closure. Discard estimation using a selectivity model suggests that discard rates of plaice, have declined since 1989, coincident with the introduction of the plaice box. The reduction is particularly evident for 3- and 4-year-old fish. However, a further reduction in the proportion of the catch discarded since the imposition of the year-round closure of the plaice box in 1995 was not evident from the model results.

The problems encountered in the scientific evaluation of the Plaice Box show that its effects are complicated to assess. The processes involved, such as the influence of eutrophication and other natural variations in the biotic and abiotic environment and the response of plaice to the reduction in beam trawl disturbance of the sea bed in the closed area, remain unclear. Therefore, the effectiveness of the plaice box at present cannot be demonstrated. In order to disentangle fisheries induced changes from changes induced by natural causes, an experimental approach to closed areas is required in conjunction with a research programme. The workshop has not specified the details of this experimental approach. In the light of the above findings the WG concluded that there is at present no reason to revisit the biological reference points estimated for North Sea plaice.

Table 1.3.3.1: Biological sampling level by stock and country: Official landings (t) and number of fish measured and aged to analyse commercial landings in 1998

	Cod in IV, IIIa, VIId			Haddock in IV, IIIa		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	6038	4093	723	724	4327	712
Denmark	39549	6324	6244	5776	5187	5059
England	18363	106756	9082	3280	47634	4667
Faroes	0	0	0	0	0	0
France*	10722	305	317	427	719	311
Germany*	8104	-	1348	1325	0	0
Netherlands	14695	6547	2095	275	0	0
Norway*	7028	3060	695	3198	13094	584
Scotland	35634	66982	11690	60324	132228	10488
Sweden*	4637	0	0	1002	0	0
others	25	0	0	7	0	0
Total	144795	194067	32194	76338	203189	21821

*Preliminary landings

	Whiting in IV, VIId			Saithe in IV, IIIa		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	321	4416	711	249	0	0
Denmark	46	277	242	3967	1834	1812
England	3094	28062	1676	2293	2133	0
Faroes	0	0	0	0	0	0
France*	6403	8896	2280	11786	0	0
Germany*	103	0	0	10117	-	1794
Netherlands	1973	8256	1200	7	0	0
Norway*	64	7243	248	49540	12832	2176
Scotland	16696	71541	5690	5353	14621	6235
Sweden*	0	0	0	1841	0	0
others	1	0	0	813	0	0
Total	28701	128691	12047	85966	31420	12017

*Preliminary landings

	Sole in IV			Sole in VIId		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	1844	4757	843	541	3931	944
Denmark	520	619	0	0	0	0
England	549	11983	1586	803	15415	2608
Faroes	0	0	0	0	0	0
France*	510	2697	1042	1703	4899	1042
Germany*	780	0	0	0	0	0
Netherlands	15198	3948	3948	0	0	0
Norway	0	0	0	0	0	0
Scotland	338	0	0	0	0	0
Sweden*	0	0	0	0	0	0
Total	19739	24004	7419	3047	24245	4594

*Preliminary landings

Table 1.3.3.1 cont.: Biological sampling level by stock and country: Official landings (t) and number of fish measured and aged to analyse commercial landings in 1998

	Plaice in IV			Plaice in VIId		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	5592	3891	557	854	3107	437
Denmark	10087	3173	3023	0	0	0
England	11473	32324	2907	700	11443	1687
Faroes	0	0	0	0	0	0
France*	489	3780	1186	3276	6482	1186
Germany*	2773	0	0	0	0	0
Netherlands	30541	4975	4975	0	0	0
Norway*	1004	0	0	0	0	0
Scotland	8442	0	0	0	0	0
Sweden*	2	0	0	0	0	0
others	0	0	0	0	0	0
Total	70403	48143	12648	4830	21032	3310

*Preliminary landings

	Plaice in IIIa		
	Landings (t)	Lengths (No)	Ages (No)
Belgium	0	0	0
Denmark	7918	4531	4135
England	0	0	0
Faroes	0	0	0
France	0	0	0
Germany*	22	0	0
Netherlands	0	0	0
Norway*	59	0	0
Scotland	0	0	0
Sweden*	409	0	0
others	0	0	0
Total	8408	4531	4135

*Preliminary landings

	N.Pout in IV, IIIa			Sandeel in IV		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	0	0	0	0	0	0
Denmark	53234	4005	2112	626629	12158	3996
England	0	0	0	0	0	0
Faroes	0	0	0	0	0	0
France	0	0	0	0	0	0
Germany*	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0
Norway*	22213	1729	455	343373	7502	1563
Scotland	0	0	0	23750	37468	702
Sweden*	0	0	0	8520	0	0
Total	75447	5734	2567	1002272	57128	6261

*Preliminary landings

Table 1.6.4.1. Landings of sole and plaice by area and year by Netherlands, England, Germany and Denmark.

		1990	1991	1992	1993	1994	1995	1996	1997	Mean
South 55	Plaice	64721	65989	62373	58065	54339	50322	49457	45393	**56332**
	Sole	16032	17656	17341	20517	23296	22356	15737	11132	**18009**
	Total	**80754**	**83645**	**79714**	**78582**	**77635**	**72677**	**65194**	**56525**	**74341**
New 80mm	Plaice	12451	13634	12710	12660	12536	8031	11308	8039	**11421**
	Sole	423	973	892	859	767	862	313	96	**648**
	Total	**12874**	**14607**	**13601**	**13519**	**13303**	**8893**	**11621**	**8135**	**12069**
North 55	Plaice	35532	29752	30022	29481	30517	28990	15796	20640	**27591**
	Sole	222	521	482	467	529	680	218	229	**419**
	Total	**35754**	**30273**	**30504**	**29949**	**31046**	**29670**	**16014**	**20870**	**28010**

Proportions (%)		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**Mean**
South 55	Plaice	80.1	78.9	78.2	73.9	70.0	69.2	75.9	80.3	**75.8**
	Sole	19.9	21.1	21.8	26.1	30.0	30.8	24.1	19.7	**24.2**
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	**100.0**
New 80mm	Plaice	96.7	93.3	93.4	93.6	94.2	90.3	97.3	98.8	**94.7**
	Sole	3.3	6.7	6.6	6.4	5.8	9.7	2.7	1.2	**5.3**
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	**100.0**
North 55	Plaice	99.4	98.3	98.4	98.4	98.3	97.7	98.6	98.9	**98.5**
	Sole	0.6	1.7	1.6	1.6	1.7	2.3	1.4	1.1	**1.5**
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	**100.0**

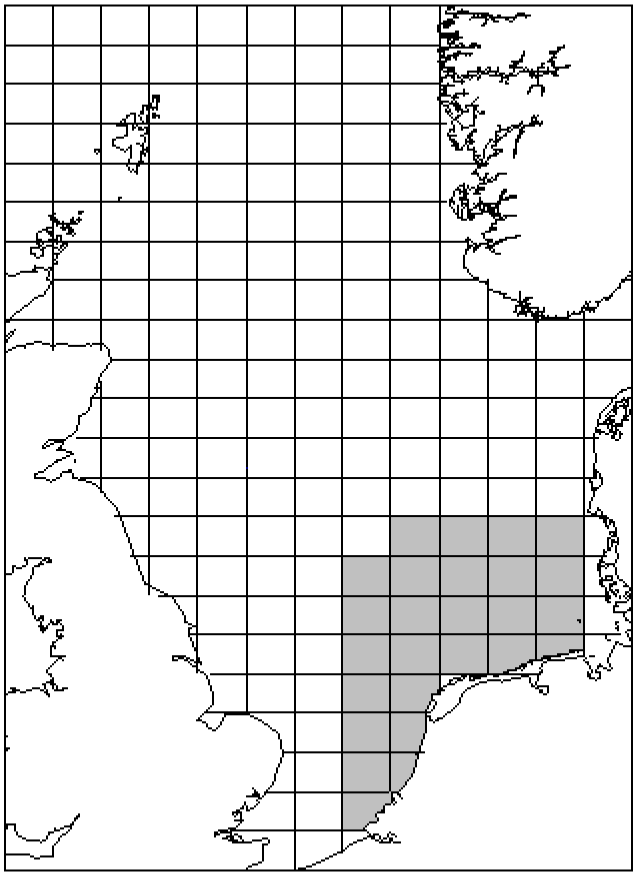


Figure 1.3.1 Beam Trawl Survey. Area over which the new indices were calculated.

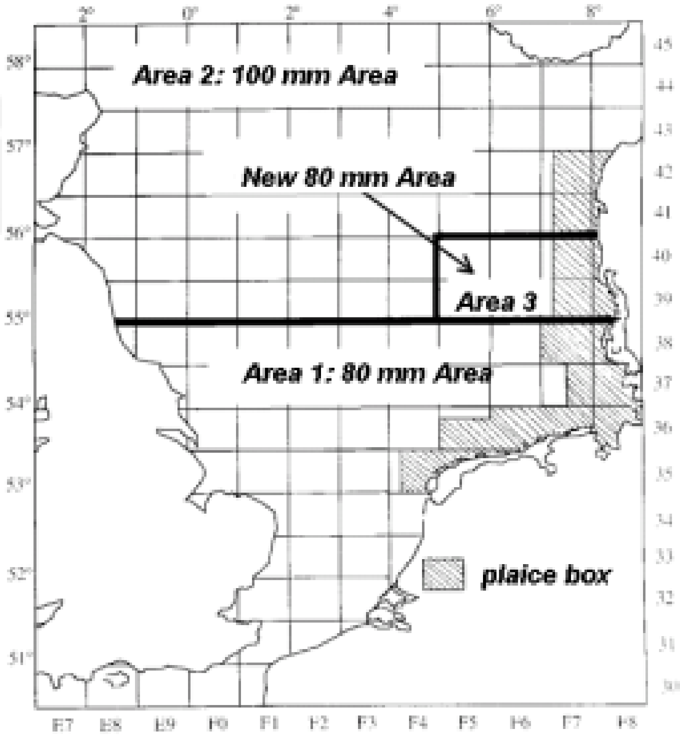


Figure 1.6.2.1. Minimum mesh size for beam trawlers. The minimum mesh size will be 80 mm areas 1 and 3, and 100 mm in area 2 from 1 January 2000.

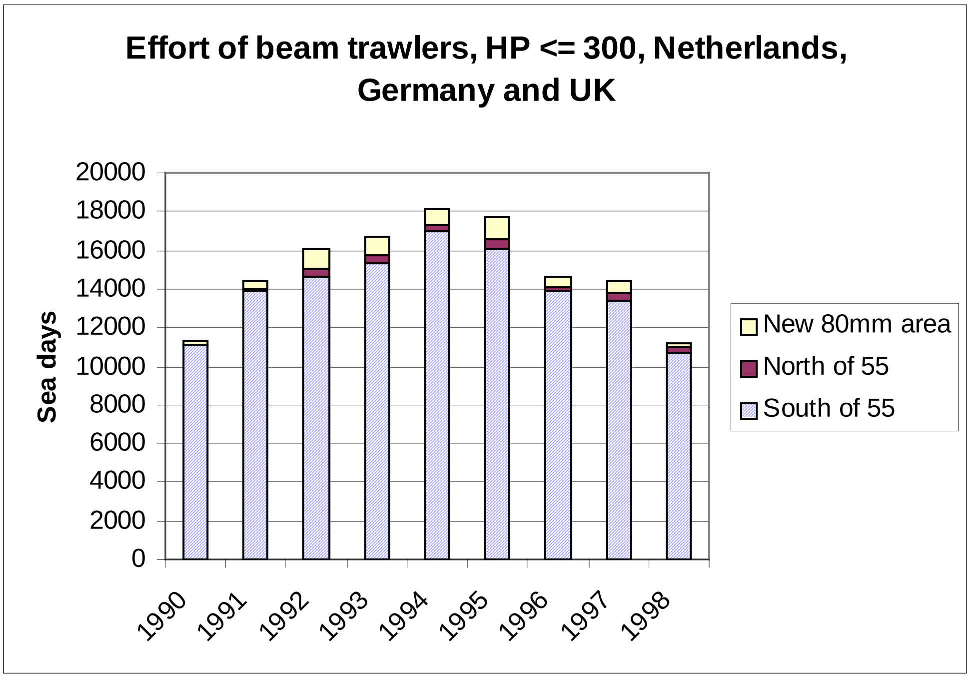


Figure 1.6.4.1.a. Beam trawl effort for vessel with engine power <= 300 HP from Netherlands, UK and Germany. (Derived from Table 2.5 of the Report of the workshop on the evaluation of the plaice box, 1999)

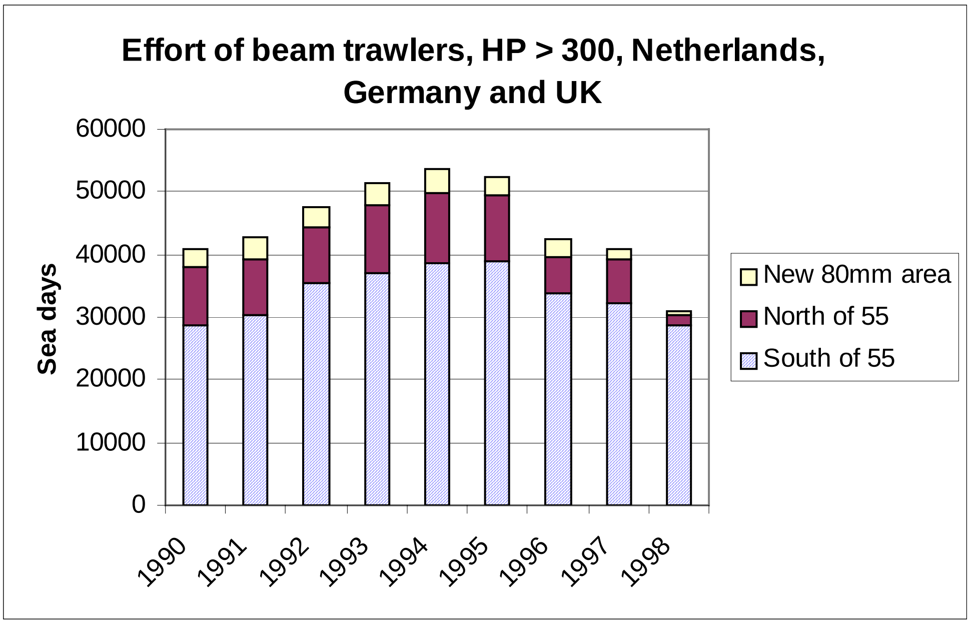


Figure 1.6.4.1.b. Beam trawl effort for vessel with engine power > 300 HP from Netherlands, UK and Germany (derived from Table 2.5 of the Report of the workshop on the evaluation of the plaice box, 1999)

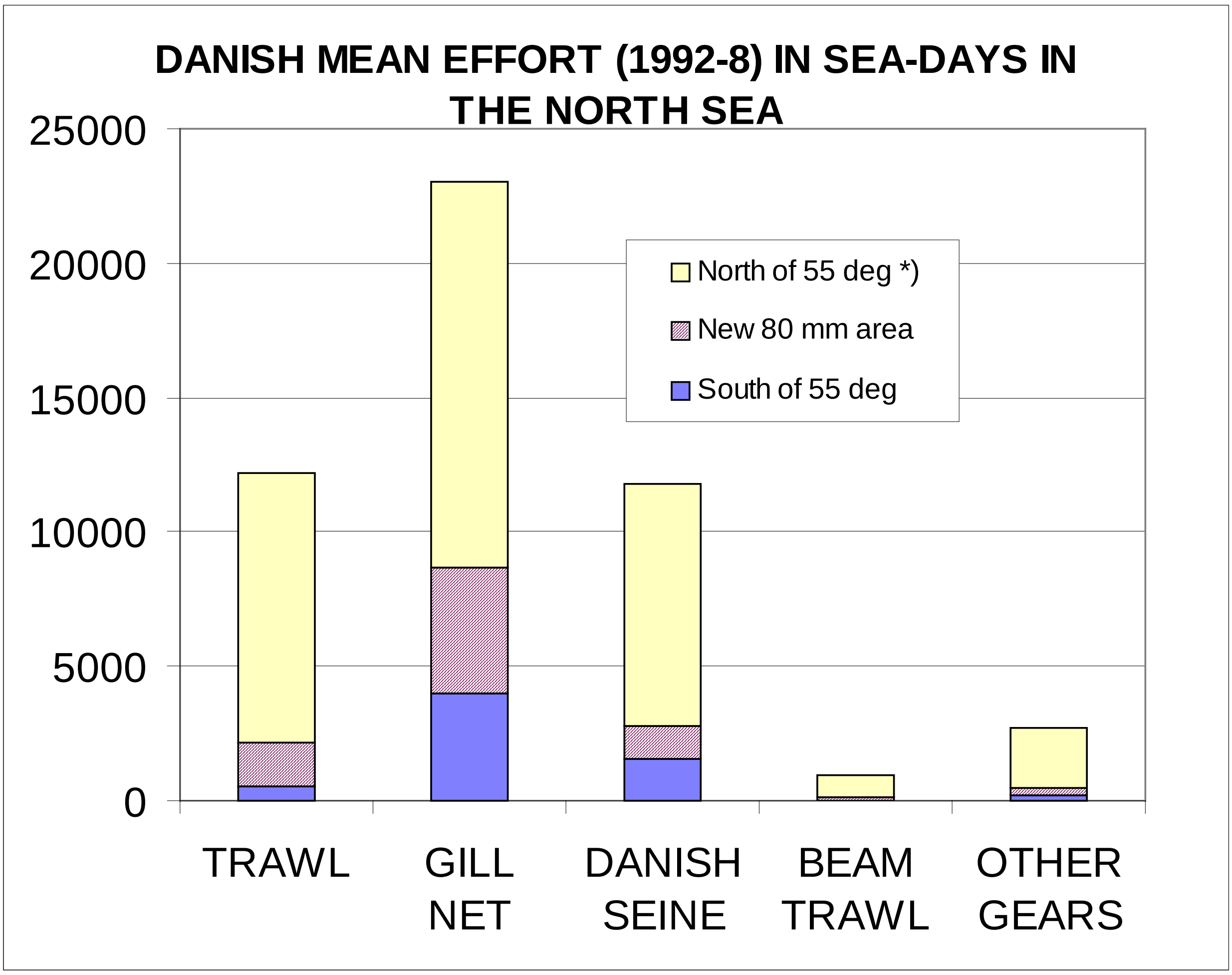


Figure 1.6.4.2 Average Danish HC effort by gear

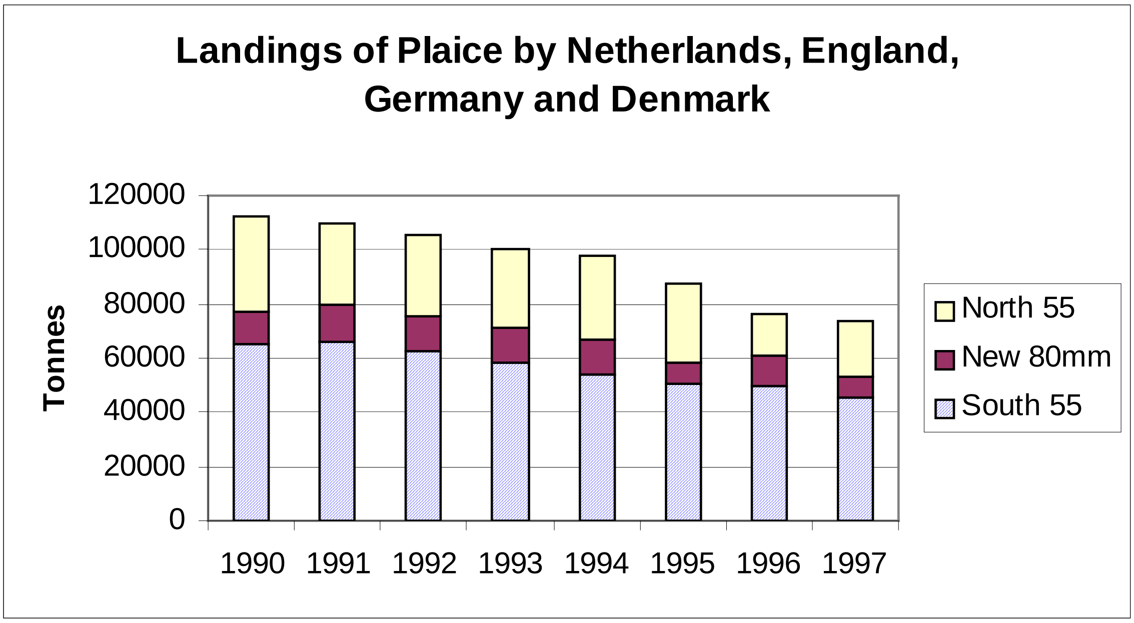


Figure 1.6.4.3a. North Sea landing of plaice by Netherlands, England, Germany and Denmark by area and year.

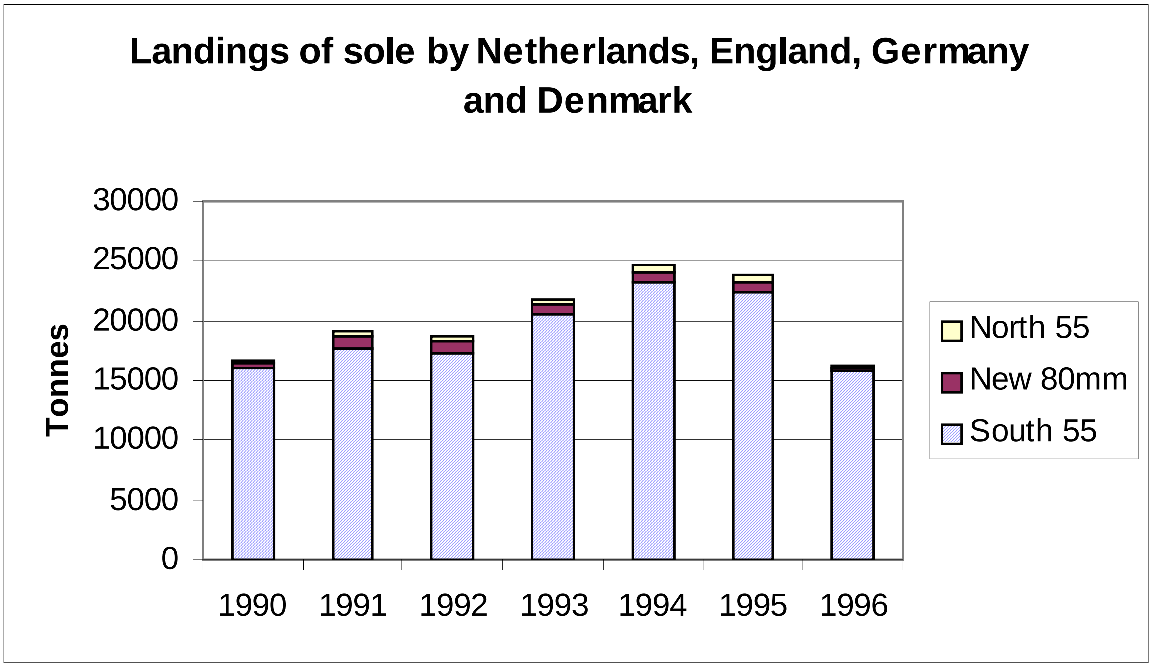


Figure1.6.4.3.b. North Sole landing of plaice by Netherlands, England, Germany and Denmark by area and year.

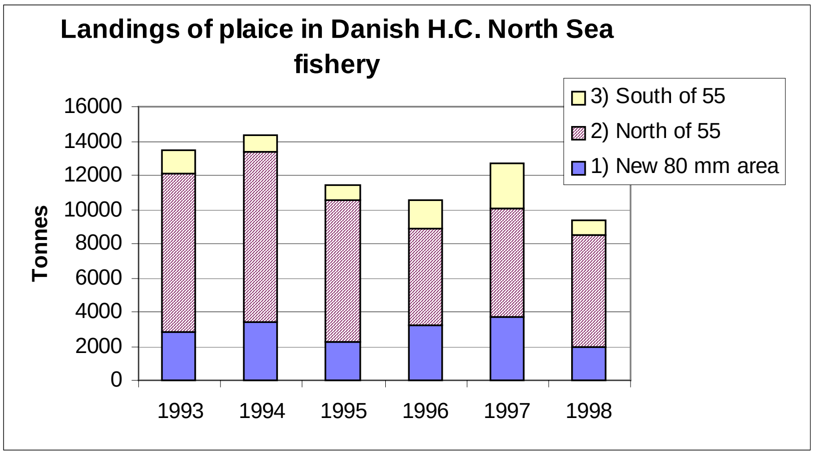


Figure 1.6.4.4.a. Danish H.C. landings of plaice and sole, by area and year from area IV.

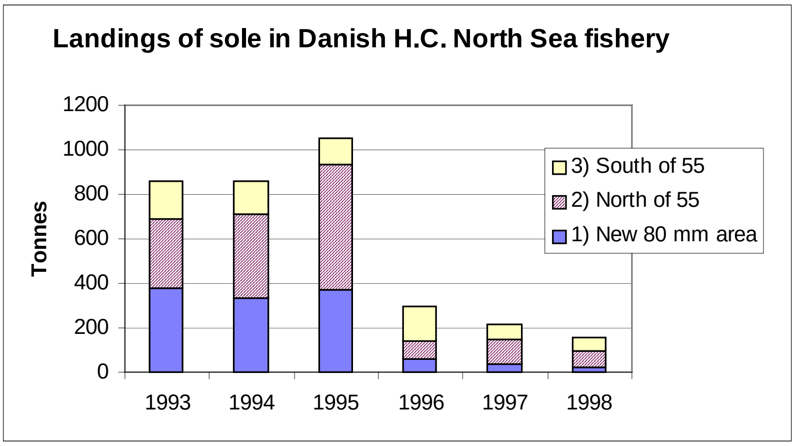


Figure 1.6.4.4.b. Danish H.C. landings of sole, by area and year from area IV.

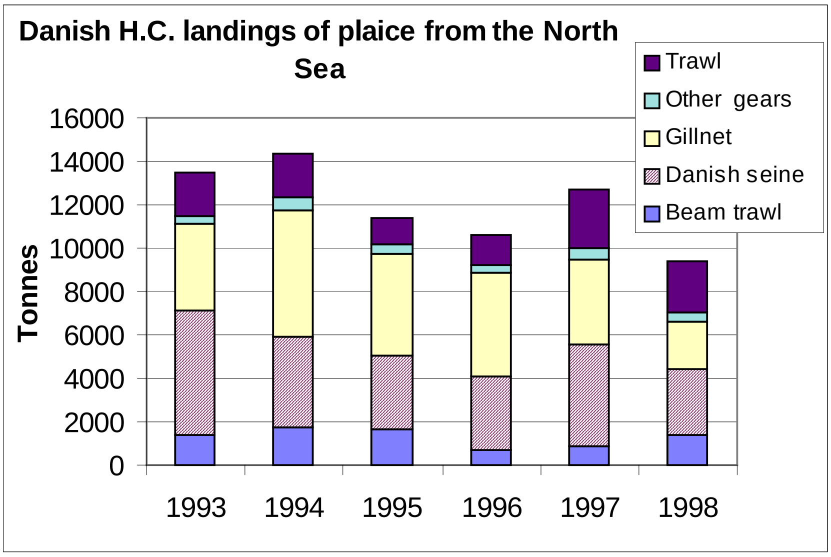
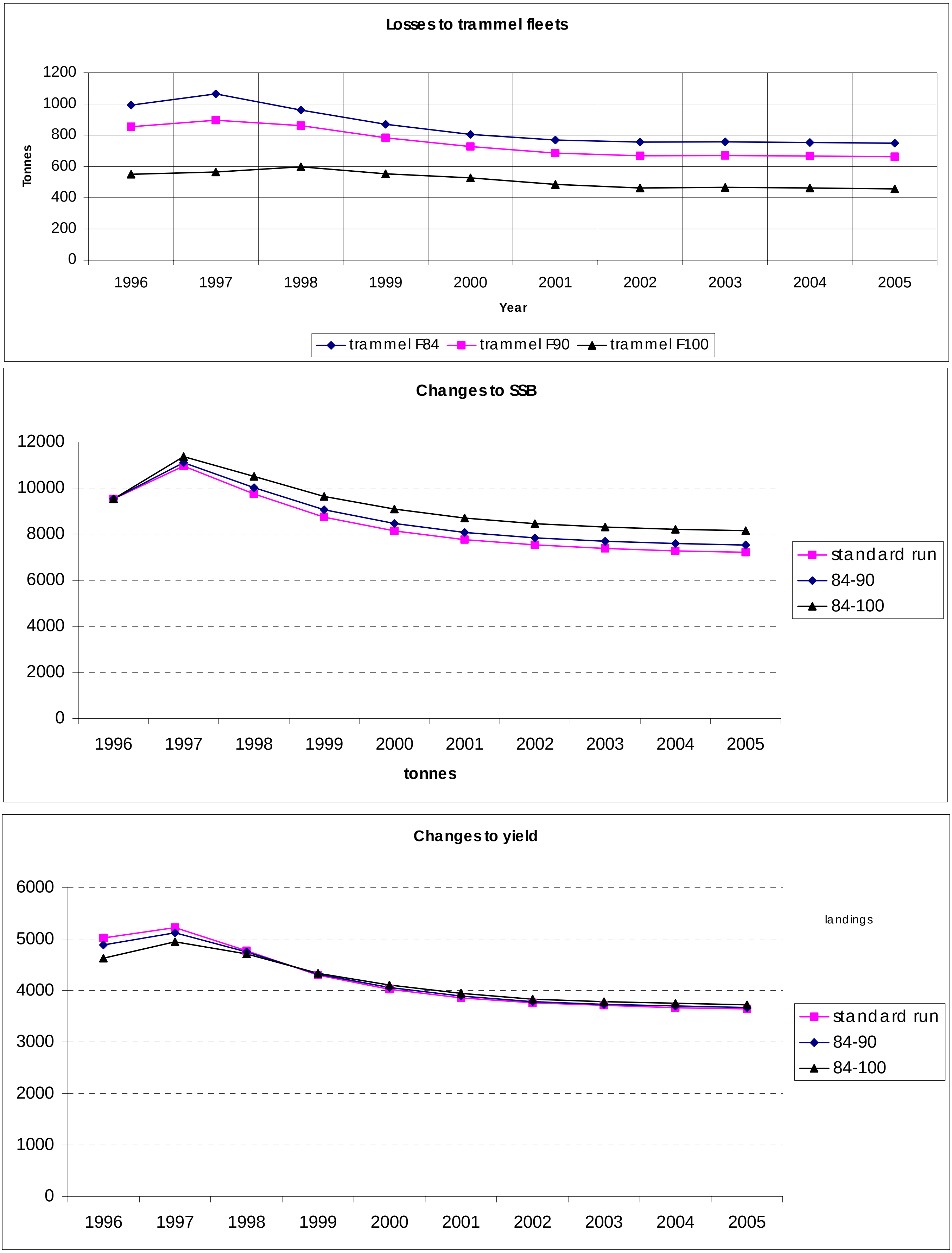


Figure 1.6.4.5 Danish H.C. landings of plaice by gear and year.

Figure 1.7.1 Potential impact of mesh increases from either 84mm or 90mm to 100mm



2 OVERVIEW

2.1 Stocks in the North Sea (Sub-area IV)

Description of the fisheries

The demersal fisheries in the North Sea can be grouped in human consumption fisheries and industrial fisheries which land their catch for reduction purposes. Demersal human consumption fisheries usually either target a mixture of roundfish species (cod, haddock, whiting), or a mixture of flatfish species (plaice and sole) with a by-catch of roundfish. A fishery directed at saithe exists along the shelf edge. The catch of the industrial fisheries mainly consists of sandeel, Norway pout and sprat. The industrial catches also contain by-catches of other species including herring, haddock and whiting (Table 2.1.2).

Each fishery uses a variety of gears. Human consumption fisheries: otter trawls, pair trawls, seines, gill nets, beam trawls. Industrial fisheries: small meshed otter trawls. Some major technological developments changed the fisheries in the North Sea in the 1960s such as the development of the beam trawl fishery for flatfish.

Trends in effort of the major fleets are shown in Figure 2.1.1. The trends in landings of the most important species landed by these fleets during the last 25 years, together with the total international landings, are shown in Table 2.1.1 and in the Figure 2.1.2. The human consumption landings have steadily declined over the last 25 years. The landings of the industrial fisheries are fluctuating around 1 million t over the years. These landings show the largest annual variations, probably due to the short life span of the species. The total demersal landings from the North Sea reached over 2 million t in 1974, and have been around 1.5 million t in the 1990s.

Most demersal effort series are stable or show a downward trend in the recent past. To what extent this is caused by poor economic results or effort reduction programmes is not clear. Effort in some fleets may vary between years because they visit other areas as well. The effort in the Danish and Norwegian fishery for Norway pout and sandeel has been gradually decreasing since 1989

For most stocks, the North Sea management area also comprises adjacent areas in addition to Division IV: Combined assessments were made for cod including IIIa Skagerrak and VIId, for haddock including IIIa, for whiting including VIId, for saithe including IIIa and newly VI, and for Norway pout including IIIa.

The national management measures with regard to the implementation of the quota in the fisheries differ between species and countries. The industrial fisheries are subject to regulations for the by-catches of protected species. TACs for these fisheries have only very recently been introduced.

Multispecies considerations are not incorporated in the assessments or the forecasts for the North Sea stocks. However, natural mortalities estimated by multispecies assessments for cod, haddock, whiting and sandeel are incorporated in the assessments of these species.

2.1.1 Human consumption fisheries

Data

The data available from scientific sources for the assessment of roundfish and flatfish stocks are relatively good. The level of biological sampling of most of the commercial landings is fairly high, but mostly the sample sizes in 1998 are lower than the year before (Table 1.3.3.1). Discard data as a series are only available for haddock and whiting from one country. Regular discard sampling programmes are ongoing in four countries in recent years.

In past years there was misreporting of roundfish and flatfish landings associated to restrictive TACs. While this had diminished in the most recent time, a substantial underreporting for cod landings occurred in 1998.

Several series of research vessel survey indices are available for most species and were used in the final VPA runs in some stocks.

Only whiting used to be subject to a significant by-catch in the industrial fisheries and this appears to be much reduced in recent years.

Stock impressions

In the North Sea all stocks of roundfish and flatfish species have been exposed to high levels of fishing mortality for a long period. For most of these stocks their lowest observed spawning stock size has been seen in recent years. This may be an indication of an excessive effort. In general, the roundfish stocks show a trend of declining fishing mortality, only in saithe the estimated fishing mortality in 1998 is higher than in the previous year. Fishing mortality on sole and plaice has been varying at a high level over a long period with no trend.

Information from several recruit surveys, and the catch-at-age analyses, indicate that a number of stocks in the North Sea have simultaneously produced a strong year class 1996, including cod, sole and plaice. The short-term forecasts show that this year class will contribute substantially to the spawning stock of each of these species.

For a number of years, ACFM has recommended significant and sustained reductions in fishing mortality on some of these stocks. In order to achieve this, significant reductions in fishing effort are required.

Landings of cod in 1998 were 146,000 t. Recruitment has been well below average in most years since 1985. While the 1996 year class seems to be well abundant and above the arithmetic mean, discard investgations showed heavy discarding on recruits. The two subsequent year classes appear to be poor. The cod spawning stock has been stable in recent years but on a very low level. It has increased recently to about 100,000 t since 1996 due to the contribution of an average 1993 year class.

Human consumption landings of haddock in 1998 were 77,000 t. The present spawning stock size is below, but close to the long term average. Historically the stock size has shown large variation due to the occasional occurrence of a very strong year class. It is by no means sure that the present stock size will be maintained in the medium term. The 1999 year class is estimated to be very good.

The assessment of whiting has always been of lower precision than the assessment for other stocks. Total landings and spawning stock biomass are gradually decreasing since 1976, and are on a record low level, 24,000 t in 1998. Fishing mortalities have been highly variable with no clear trend in the past, but with a downward shift in the most recent two assessment years. Different surveys give different signals about year class strength, and do not always correlate with XSA estimates. In recent years recruitment has been stable, but at a level well below the long term geometric mean, and the 1996 year class is indicated to be the weakest on record.

The spawning stock of saithe is at a low level compared to the seventies when it was lightly exploited and recruitment was higher. Landings in 1998 were 100,000 t for the former management area and 108,000 including the newly added stock from Division VI. Fishing mortality has declined considerably since 1986.

The spawning stock of plaice has been decreasing steadily and the stock and was at its lowest observed level in 1996. Landings have fallen since 1990 to 83,000 t in 1997. There are no trends in fishing mortality and it varies on a historically high level. Recent good recruitment from the 1996 year class is expected to increase the stock in the short term, but at its present level of exploitation there is a high probability that is will remain below the levels observed in the 1970s and 1980s in the medium term.

Landings of sole were at a high levels in the early 90's but decreased to a historic low of 15,000 t in 1997. From this, landings recovered to 21,000 t in 1998. There are no trends in fishing mortality, which varies on a historically high level. The spawning stock size of 25,000 t in 1998 is at the lowest observed level, but is predicted to recover in 1999 because of an strong 1996 year class. However, at the present fishing mortality there is a high probability that it will decline below the $\mathbf{B}_{pa}$ of 35,000 t in the medium term.

2.1.2 Industrial fisheries

2.1.2.1 Description of fisheries

The industrial fisheries dealt with in this report are the small meshed trawl fisheries targeted at Norway pout and sandeel.

Data available

Data on landings, fishing effort and species composition are available from all industrial fisheries.

Trends in landings and efforts

The sandeel landings in 1976-1986 of around 600,000 t have increased to about 800,000 t in 1987-1996. In 1997 the combined Danish and Norwegian landings were the highest on record since 1970, while the landings in 1998 were about 1 million t. The Norway pout catches showed a decreasing trend in the period 1974 - 1988. Thereafter the catches fluctuated around a level of 200,000 t. In 1998 catches decreased sharply to 75,000 t. The decrease can be explained by an exceptional poor 1997 year class and by a switch to the sandeel fishery, see Sections and 12.3 and 12.11.

Trends in effort of the Norwegian and Danish fleets fishing for Norway pout and sandeel are shown in Figure 2.1.1. The effort of the Danish fleet is gradually decreasing from 1989 to 1994 and then remaining at the same level while there has been no trend in effort of the Norwegian fleet.

2.1.2.2 Stock impressions

The SSB of Norway pout, which include both the North Sea and the Skagerrak, was increasing in the period 1974-1984. The next two years SSB dropped to a low level and has since been increasing and reached high levels in 1996 and 1997 due to the big 1994 and 1996 year classes. SSB decreased in 1999 relative to 1998. Fishing mortality has generally been decreasing in 1974 - 1987. In 1995-1997 the fishing mortality fell to about 0.4 compared to the stable level of about 0.6 in 1988-1994.

Over the years, SSB of sandeel has been fluctuating around 1 million t without a trend. There is a general pattern of large SSB being followed by a low SSB. This is caused by similar fluctuation in recruiting year classes. The 1996 year class and the spawning stock biomass at the start of 1998 is the highest since 1976. Spawning stock biomass at the start at 1999 is also relatively high due to the big 1996 year class as to year old.

2.1.3 By-catches of protected species

By-catches of the protected species, haddock, whiting and saithe in the industrial fisheries are presented in Table 2.1.2 for the years 1974-1996. For the last four years quarterly data are presented. In 1996 the combined by-catch of haddock, whiting and saithe was about 8,000 t, which is well below the average of 75,000 t in the period 1974 - 1995. Detailed catches of “other” species mentioned in Table 2.1.2 are given in Table 2.1.3.

Table 2.1.4 has not been updated this year.

2.2 Overview of the stocks in the Skagerrak and Kattegat (Division IIIa)

The fleets operating in the Skagerrak and Kattegat (Division IIIa) include vessels targeting species for both human consumption and reduction purposes. The human consumption fleets include gill-netters and Danish seiners exploiting flatfish and cod and demersal trawlers involved in various human consumption fisheries (roundfish, flatfish, *Pandalus* and *Nephrops*). Demersal trawling is also used in the fisheries for Norway pout and sandeel which are landed for reduction purposes.

The roundfish, flatfish and *Nephrops* stocks are mainly exploited by Danish and Swedish fleets consisting of bottom trawlers (*Nephrops* trawls with >70 mm mesh size and bottom trawls with >100 mm mesh size), gill-netters and Danish seiners. The number of vessels operating in IIIa has decreased in recent years. This is partly an effect of the EU withdrawal programme, which until now has affected the Danish fleets only, but these fleets still dominate the fishery in IIIa.

The industrial fishery is a small-mesh trawl fishery mainly carried out by vessels of a size above 20 m. This fleet component has also decreased over the past decade. The most important fisheries are those targeting sandeel and Norway pout. There is also a trawl fishery landing a mixture of species for reduction purposes. A description of the industrial fishery is given in Table 2.1.2.

There are important technical interactions between the fleets. Most of the human consumption demersal fleets are involved in mixed fisheries and the Norway pout and the mixed clupeoid fishery have by-catches of protected species.

Misreporting and non-reporting of catches have occurred in recent years, particularly for cod, but the amounts vary between years. There are no discards available for assessments. The time series of age samples from landings for industrial purposes is short and there are gaps in this series.

The Skagerrak-Kattegat area is to a large extent a transition area between the North Sea and the Baltic, with regards to the hydrology, the biology and the identity of stocks in the area. The exchange of water between the North Sea and the Baltic is the main hydrographic feature of the area.

Several of the stocks in the Skagerrak show close affinities to the North Sea stocks: cod, haddock, whiting, plaice and Norway pout.

The landings of cod in the Division IIIa were of 21,997 tonnes in the human consumption fishery. Landings have been stable since 1991. The majority of catches were taken by Denmark and Sweden. Cod in Skagerrak is assessed alongside with the North Sea (Division IV) and Eastern Channel (Division VIId) stock. Cod in Kattegat is assessed as a separate stock by the Baltic Sea Working Group.

Landings of haddock in Division IIIa, in the human consumption fishery, amounted to 3,897 tonnes in 1998, compared to 3,528 tonnes taken in 1997. Landings have consistently increased since 1994. Most of the catches are taken in Skagerrak. Haddock in IIIa is assessed alongside with the North Sea (Division IV) stock.

Landings of whiting for human consumption were about 150 tonnes in 1998, the same low level as reported in 1997. Official landings have steadily decreased since 1992. Most of the landings are taken in the Skagerrak. No analytical assessment of whiting in IIIa was possible.

Landings of saithe, included Divisions IV and IIIa, amounted 85,966 t in 1988 and have remained stable since 1989. The saithe assessment comprises Divisions IV and IIIa.

The plaice landings in division IIIa amounted to 8,408 tonnes in 1998, at about the same level as in 1997. Landings have steadily decreased since 1992. About 75% of the landings were taken in Skagerrak. Plaice in IIIa is assessed as a separate stock.

The sole landings in division IIIa are mostly taken in Kattegat and this stock is assessed by the Baltic Sea Working Group. Landings data are available in the report of this Working Group.

The Norway lobster stock in division IIIa is assessed by the *Nephrops* Working Group. Landings data may be found in the report of this Working Group.

Most of the landings from the industrial fisheries in IIIa consisted of sandeel, Norway pout, herring and sprat. In 1998, landings of sandeel and Norway pout in division IIIa have decreased to 11,500 and 11,100 t respectively. The Norway pout assessment comprises Divisions IIIa and IV. It was not possible to assess sandeel in Division IIIa.

2.3 Stocks in the eastern Channel (Sub-area VIId)

2.3.1 Description of the fisheries

Flatfish: The main feature of the flatfish fisheries in VIId are their importance to small (<10m) vessel fleets. Approximately 500 vessels fish for sole and plaice at some time during the year in the eastern Channel and are heavily dependent on sole. This fishery is unique in the ICES divisions IV and VII because more than 50% of the reported landings come from these small vessels. The gears used are mainly fixed nets but there is also considerable effort on trawling and potting. The other main commercial fleets fishing for flatfish in Division VIId include, Belgian and English offshore beam trawlers (>300HP) which fish mainly for sole and also take plaice. These vessels switch effort to other areas and and onto scallops leading to periodic large changes in effort in VIId. The minimum mesh size for trawls was increased from 75mm to 80mm in 1989. A mesh size of 100mm will be required from 1999. The mesh size for fixed nets was increased to 100mm from 1999 but there was a derogation to continue with 90mm mesh in VIId until January 2000.

Roundfish: The offshore French trawlers are the main fleet fishing for cod and whiting using high headline trawls.

Effort

Effort by English and Belgian beam trawlers and large French otter trawlers has increased by a factor of 7 between 1980s and 1990’s (Figure 2.3.1). The English beamers and French otter trawl fleets have remained at a high level whereas the Belgian beam trawl fleet shows a decline since 1988. The English fixed net fleet effort has been relatively stable since 1992. There is no information on the French inshore fixed net fleet which is one of the main fleets fishing on sole.

2.3.2 Data

a) Landings and discards: There is no data routinely collected for the level of discarding on any of the main species. The large 1996 year class of cod has been widely discarded as a result of quota controls in some countries. There is also thought to be wide scale discarding of juvenile plaice. No information is available for sole but discard levels are expected to be low.

b) Catch at age: French fleets are responsible for the major landings of cod, whiting, sole and plaice, taking around 80-95% of the roundfish species and between 45 and 60% of the flatfish. The level of sampling for age for cod is poor but has improved since 1994.

Sampling for flatfish species was poor before 1986 but has improved since then. Quarterly sampling for age is taken, covering more than 95% of the landings.

c) Surveys: There is a 1st quarter research vessel survey for roundfish in VIId which is used as part of the IBTS-Q1 survey used in tuning for cod and whiting. A research vessel survey using beam trawl which covers most of VIId in August (EBTS) is used in tuning sole and plaice. There are two inshore surveys for 0- and 1-gp sole and plaice along the English coast and in the Baie de Somme on the French coast.

2.3.3 State of the stocks

General: Cod and whiting have been assessed with the North Sea stocks for the first time last year and are included in the overview for the North Sea.

Sole: The spawning stock of sole has been declining from a high level in 1994 following a number of years of above average recruitment. The stock is above $\mathbf{B}_{pa}$ and is expected to increase slightly following good recruitment in 1996 and 1998. Fishing mortality in 1998 remains at historically high levels and is above $\mathbf{F}_{pa}$.

Plaice: Fishing mortality is variable and remains close to historically high levels at 0.59 in 1997. The spawning stock has declined since its peak in 1987-90 and follows a similar trend to plaice in the North Sea. In recent years the spawning stock has been relatively stable around the level of the $\mathbf{B}_{pa}$ (8,000 t). Recruitment since 1985 has fluctuated around the average level except for the strong 1996 year class. The precise level of fishing mortality in recent years has fluctuated widely and its estimate is regarded as uncertain.

Table 2.1.1 Landings of human consumption and industrial species from the North Sea management are. ('000 t) (Data compiled by WG members)

	cod	had hc	had ib	whit hc	whit ib	saithe hc	saithe ib	sole	plaice	N pout	sandeel	h cons total	industrial total	total
1970	226	525	180	83	115	163	59	20	130	238	191	1147	783	1930
1971	328	235	32	61	72	218	35	24	114	305	382	980	826	1806
1972	354	193	30	64	61	218	28	21	123	445	359	973	923	1896
1973	239	179	11	71	90	195	31	19	130	346	297	833	775	1608
1974	214	150	48	81	130	231	42	18	113	736	524	807	1480	2287
1975	205	147	41	84	86	240	38	21	108	560	428	805	1153	1958
1976	234	166	48	83	150	253	67	17	114	435	488	867	1188	2055
1977	209	137	35	78	106	190	6	18	119	390	786	751	1323	2074
1978	297	86	11	97	55	132	3	20	114	270	787	746	1126	1872
1979	270	83	16	107	59	113	2	23	145	329	578	741	984	1725
1980	294	99	22	101	46	120	0	16	140	483	729	770	1280	2050
1981	335	130	17	90	67	121	1	15	140	239	569	831	893	1724
1982	303	166	19	81	33	161	5	22	155	395	612	888	1064	1952
1983	259	159	13	88	24	167	1	25	144	451	537	842	1026	1868
1984	228	128	10	86	19	192	6	27	156	393	669	817	1097	1914
1985	213	159	6	62	15	192	8	24	160	205	623	810	857	1667
1986	196	166	3	64	18	163	1	18	165	178	848	772	1048	1820
1987	210	108	4	68	16	145	4	17	154	149	825	702	998	1700
1988	176	105	4	56	49	104	1	22	154	109	893	617	1056	1673
1989	140	76	2	45	43	90	2	22	170	173	1039	543	1259	1802
1990	125	51	3	47	51	86	2	35	156	152	591	500	799	1299
1991	102	45	5	53	38	98	1	34	148	193	843	480	1080	1560
1992	114	70	11	52	27	92	0	29	125	300	855	482	1193	1675
1993	122	80	11	48	20	104	0	31	117	184	579	502	794	1296
1994	111	80	4	43	10	97	0	33	110	182	766	474	962	1436
1995	139	75	8	41	27	114	0	30	98	241	918	497	1194	1691
1996	126	76	5	36	5	110	0	23	82	166	835	453	1011	1464
1997	124	79	7	31	6	103	0	15	83	201	1140	435	1354	1789
1998	146	77	5	24	3	108	0	21	71	75	993	447	1068	1515

Table 2.1.2 Species composition in the Danish and Norwegian small meshed fisheries in the North Sea ('000 t). (Data provided by WG members).

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1974	525	314	-	736	62	48	130	42		1857
1975	428	641	-	560	42	41	86	38		1836
1976	488	622	12	435	36	48	150	67		1858
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1674
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1039	63	146	162	28	2	36	1	59	1536
1990	591	71	115	140	22	3	50	8	40	1040
1991	843	110	131	155	28	5	38	1	38	1349
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1994	769	281	40	172	11	5	10	-	19	1307
1995	911	278	66	181	64	8	27	1	15	1551
1996	761	81	39	122	93	5	5	0	13	1119
1997	1091	99	15	126	46	7	7	3	21	1416
1998	956	131	16	72	72	5	3	3	24	1283
Mean 1974-1998	732	206	70	269	56	14	44	9	36	1418
1994 q1	2	19	2	34	3	1	2	-	3	66
1994 q2	643	11	3	15	4	2	1	-	4	683
1994 q3	124	175	22	51	4	1	4	-	7	388
1994 q4	+	76	13	72	+	1	3	-	5	170
1995 q1	18	20	1	36	-	2	2	-	2	81
1995 q2	752	6	1	17	4	1	3	-	2	786
1995 q3	132	157	49	48	48	2	16	1	7	460
1995 q4	8	96	15	79	11	3	6	1	4	223
1996 q1	3	34	5	21	4	0	1	0	0	68
1996 q2	479	3	1	7	28	1	1	0	1	521
1996 q3	256	7	11	54	30	2	1	0	1	362
1996 q4	22	37	22	41	31	1	1	0	1	156
1997 q1	37	7	1	11	4	0	1	0	2	65
1997 q2	802	1	2	7	11	3	2	0	4	833
1997 q3	238	28	5	59	16	3	2	2	11	363
1997 q4	13	63	7	49	14	1	1	0	5	155
1998 q1	37	7	7	13	11	1	0	0	5	80
1998 q2	754	1	2	8	12	2	1	0	4	784
1998 q3	153	60	4	29	38	2	1	2	9	298
1998 q4	12	63	4	23	12	0	0	0	6	121

Table 2.1.3 Sum of Danish and Norwegian North Sea by-catch by species (excluding those species accounted for in Table 2.1.2) and year in tonnes.

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gadus morhua	4175	544	710	1092	1404	2988	2948	570	1044	1052	876	955	366	1688	1281
Scomber scombrus	1278	4	534	2663	6414	8013	5212	7466	4631	4386	3576	2331	2019	3153	1934
Trachurus trachurus	133[3]	22789	16658	7391	18104	22723	14918	5704	6651	6169	4886	2746	2369	3332	2576
Trigla sp.	2168	0	888[2]	45342[2]	5394[2]	9391[2]	2598[2]	5622[2]	4209	1593	1139	2091	897	2618	1015
Limanda limanda	149[3]	187	3209	4632	3781	7743	4706	5578	3986	4871	528	1028	1065	2662	6620
Argentina spp.	6977[3]	8714	5210	3033	1918	778	2801	3434	2024	2874	2209	292	3101	2604	5205
Hippoglossoides platessoides	170[3]	59	718	1173	946	2160	1673	1024	1694	1428	529	617	339	1411	2229
Pleuronectes platessa	0	34	119	109	372	582	566	1305	218	128	143	33	90	73	91
Merluccius merluccius[4]	546	349	165	261	242	290	429	28	359	109	10	-	3625	2364	33
Trisopterus minutus	0	0	68[3]	0	5[2]	48[2]	121[2]	79[2]	111	36	0	9	30	181	261
Molva molva[3]	528	51	1	40	39	37	13	65	10	28	0	-	0	31	31
Glyptocephalus cynoglossus	241[3]	236[3]	132	341	44	255[3]	251[3]	1439[3]	195[3]	246	40	-	97	394	860
Gadiculus argenteus[3]	2690	1210	729	3043	2494	741	476	801	0	0	0	-	7	248	248
Others	29261	31715[1]	3853	3604	3670	3528	3154	4444	4553	4106	5141	5158	50	749	5405
Total	48316	65892	32994	72724	44827	59277	39866	37559	29685	27026	19077	15260	14055	21508	27787

[1]Danish cod and mackerel included.
[2]Only Danish catches.
[3]Norwegian catches. Danish catches included in "Others".
[4]Until 1995 Norwegian catches only with Danish catches included in "Others".

Table 2.1.4 Distribution of landings and associated by-catches of selected species ('000 t) from industrial fisheries by Norway north and south of 57° N

Area north	Fishery (target species)	Species composition									Total
		Norway pout	Sandeel	Sprat	Herring	Haddock	Whiting	Saithe	Blue whiting	Others	
	Nor.pout	119	1	+	2	4	3	3	31	3	166
	Sandeel	1	478	+	1	3	+		+	6	489
	Sprat	+		+	+		+			+	+
	Other	7	+	+	1	+	+	+	14	3	25
	Sum	127	479	+	4	6	3	3	45	12	
Area south	**Fishery (target species)**										
	Sandeel	+	608	6	3	+	2		+	4	623
	Sprat	+	4	92	7	+	+	+		1	104
	Other		+	1	+					+	1
	Sum	+	612	99	10	+	2	+	+	5	

Table 2.2.1 Catches of the most important species in the industrial fisheries in Division IIIa ('000 t), 1974–1998.

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Total
1974	8	71	76	13	-	168
1975	17	101	57	19	-	194
1976	22	59	38	42	-	161
1977	7	67	32	21	-	127
1978	23	78	16	25	-	142
1979	34	96	13	25	6	174
1980	39	84	25	26	14	188
1981	59	76	63	30	+	228
1982	25	40	54	44	5	168
1983	29	26	89	30	16	190
1984	26	36	112	46	15	235
1985	6	20	116	9	19	170
1986	73	11	65	6	9	164
1987	5	14	72	3	25	119
1988	23	9	97	8	15	152
1989	18	10	52	6	9	95
1990	16	10	51	27	10	114
1991	23	14	22	32	11	102
1992	39	2	47	42	18	148
1993	45	2	71	8	32	158
1994	55	58	30	7	12	162
1995	12	41	21	50	10	134
1996	54	10	26	36	15	141
1997	81	12	6	32	4	141
1998	11	11	5	15	7	49
Mean1974–1998	30	38	50	24	13	153

Notes:
Sprat figures are total landings from all fisheries.
Data from 1974–1984 from Anon. (1986), 1985–1993 provided by Working Group members.
For years 1974–1985, human consumption landings used for reduction are included in these data.
Blue whiting mean for 1979–1995.

Figure 2.1.1 Fishing effort of demersal fleets in the North Sea

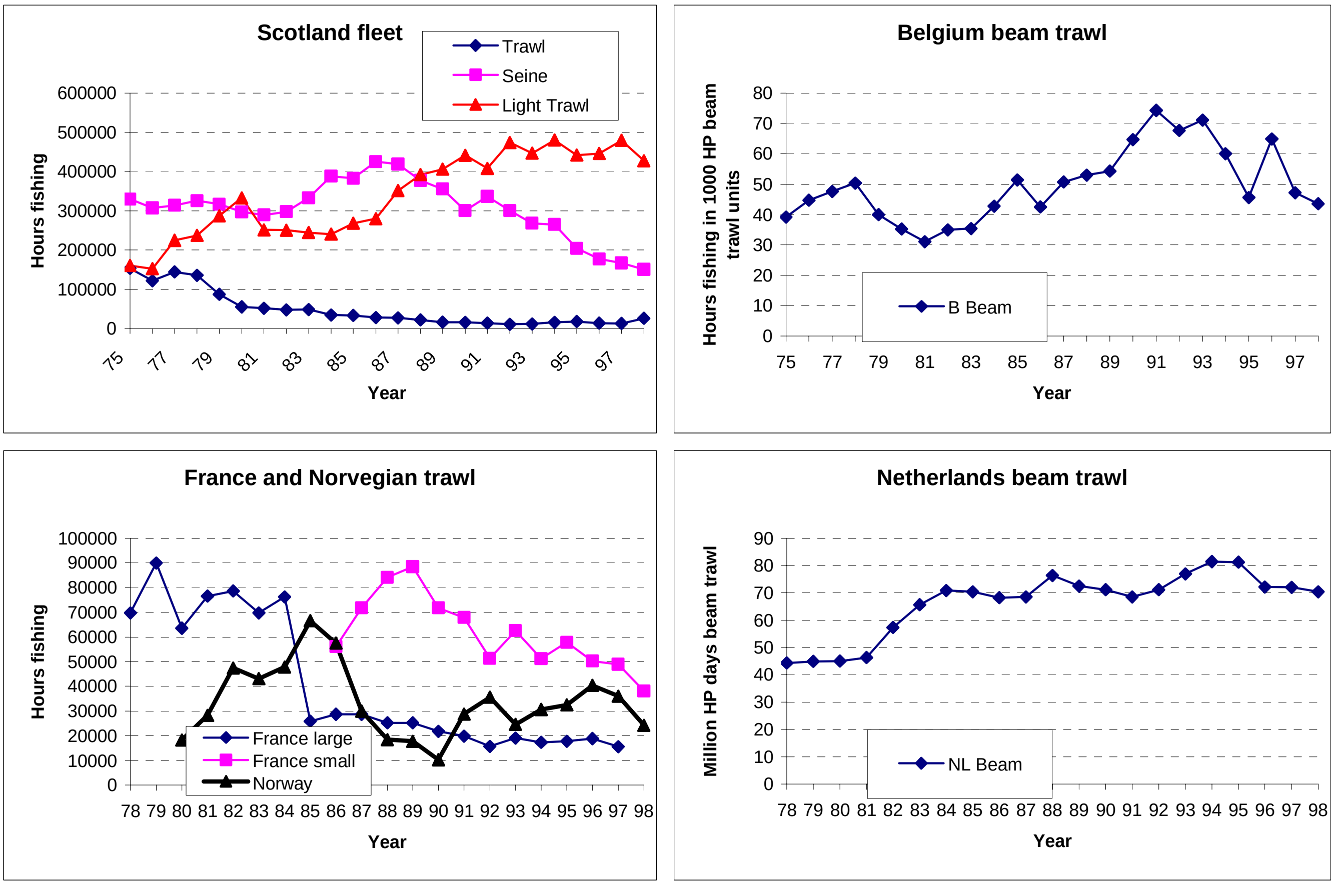
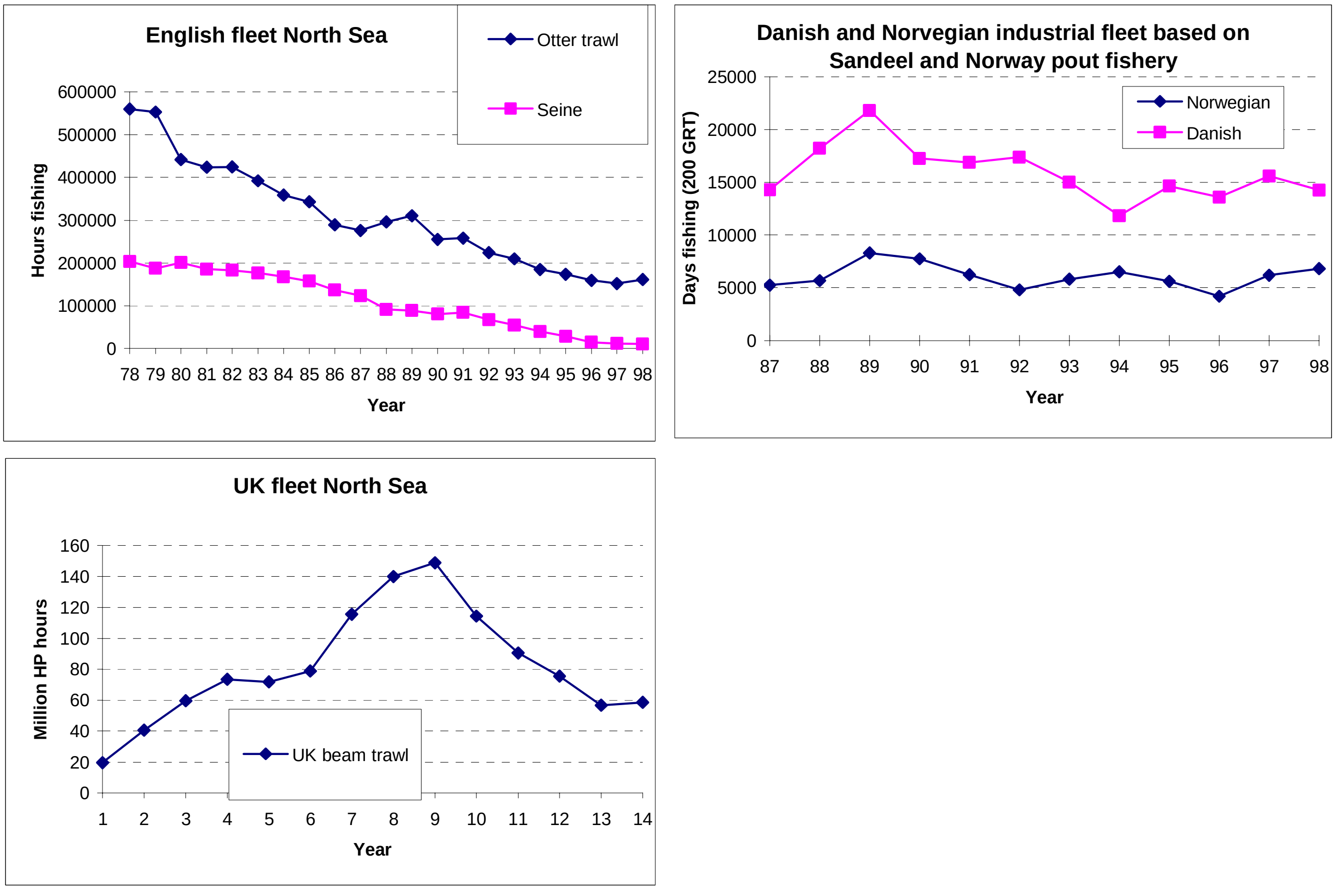


Figure 2.1.1 continued



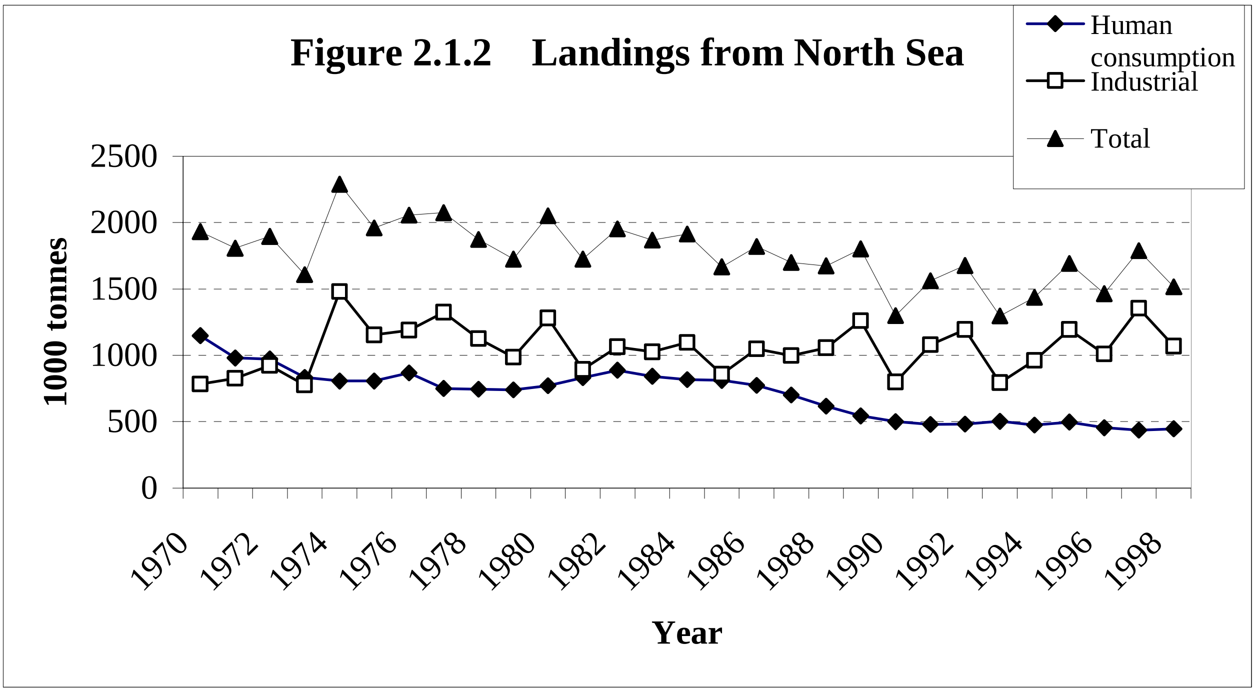
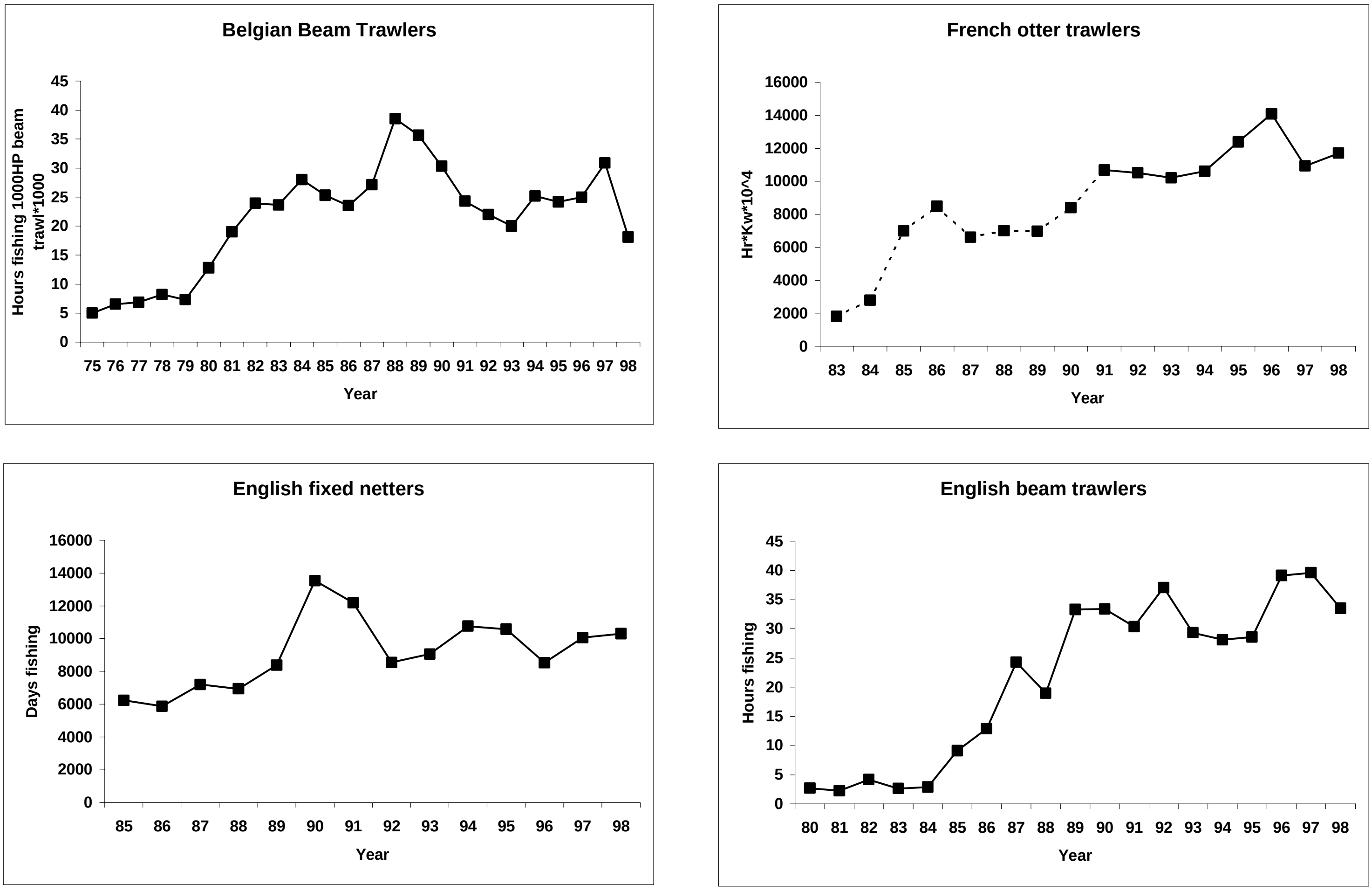


Figure 2.1.2 Landings from North Sea
Human consumption
Industrial
Total
1000 tonnes
2500
2000
1500
1000
500
0
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
Year

Figure 2.3.1. Fishing effort of demersal fleets in section VIId
(revised indices for French otter trawlers from 1991)



3 COD IN AREAS IIIA (SKAGERRAK), IV AND VIID

For the fourth year in succession, this assessment relates to the cod stock in the Skagerrak (Division IIIa), the North Sea (Sub-area IV), and the Eastern Channel (Division VIId). Prior to 1996 cod in these areas were assessed as separate stocks. A discussion of the implications of a combined assessment was presented in Section 1.3.3.4 of the 1996 report of this working group.

3.1 The Fishery

3.1.1 ACFM advice applicable to 1998 and 1999

The advice for 1998 was that fishing mortality should not exceed the 1996 value (F=0.64), which implied landings for Sub-area IV, Divisions IIIa and VIId combined of 180000 t.

The advice for 1999 was that fishing mortality should be reduced to F = 0.6 (below the proposed $\mathbf{F}_{pa}$ =0.65), corresponding to expected landings of 147,000 t in 1999 in order to bring Spawning Stock Biomass above the proposed $\mathbf{B}_{pa}$ (150,000t) in the short-term.

The precautionary fishing mortality and biomass reference points proposed by ACFM in 1998 are as follows:

$\mathbf{B}_{lim}$ = 70,000 t; $\mathbf{B}_{pa}$ = 150,000t; $\mathbf{F}_{lim}$ = 0.86; $\mathbf{F}_{pa}$ = 0.65.

3.1.2 Management applicable in 1998 and 1999

Management of cod is by TAC and technical measures. The agreed TACs for Cod in Division IIIa (Skagerrak) and Sub-area IV were as follows:

	1998 Agreed TAC (000 mt)	1999 Agreed TAC (000 mt)
IIIa(Skagerrak)	20	19
IIa + IV	140	132.4

There is no TAC for Cod set specifically for Division VIId. The overall TAC for 1998 for Division IIIa and Sub-area IV was lower than the catch corresponding to ACFM advice. The predicted landings for 1999 that corresponded to ICES advice for Divisions IIIa, VIId and Sub area IV combined are 147,000 t, whereas the TAC for Division IIIa and Sub-area IV for 1999 was set at 151,400 t.

The EU minimum mesh size for towed gears, in Sub-area IV and Division IIIa is 100 mm, and 80 mm in Division VIId. Trawlers directed to *Nephrops*, are permitted to use a 70 mm codend mesh but have to use a 80 mm square mesh panel, and are also subject to whitefish by-catch limits. Trawlers fishing in Division IVc are permitted to use a 90 mm codend mesh in fisheries directed to whiting. The minimum mesh size for towed gears in Norwegian waters is 100 mm. Minimum landing size for cod in all areas is 35 cm for EU member States, although the minimum landing size in Norway is 40 cm.

New technical conservation regulations for EU waters will come into force on 1 January 2000 (see Section 1.6).

3.1.3 The fishery in 1998

Landings data from human consumption fisheries for recent years as officially reported as well as those estimated by the Working Group are given for each area separately and combined in Table 3.1.1 and the data are plotted in Figure 3.1.1. The Working Group estimate for combined landings in 1998 is 146,000 t, split as follows for the separate areas.

	1998 Landings 000 t)
IIIa(Skagerrak)	15.3
IV	122.1
VIId	8.6
Total	146

In 1998, the landings were dominated by the abundant 1996 year class as 2-year olds, and accounted for 93% of the total numbers landed from VIId, 77% from Sub-area IV and 40% from Division IIIa Skagerrak.

The TAC in Sub-area IV and Division IIIa was not taken in 1998. The reasons for the shortfall in these areas are not clear, especially since the 1996 year class was relatively strong. The WG suspects that under-reporting of landings by some countries may have been significantly greater in 1998 than in other years.

Estimates of total international discards are not available. However, discard sampling carried out for some fleets indicate that in 1997 and 1998, the proportion in number of 2 year old cod discarded, increased from about 20% to 30%. This observation is consistent with the slower growth of the 1996 year class. The sampling programmes indicate that the proportion of 1-year old cod discarded in 1997 and 1998 remained about the same with 85% of the catch in numbers discarded. The industrial by-catch of cod, other than that sorted for human consumption, is small.

Cod are caught by virtually all the demersal gears in these areas, including trawls, seines, gill nets and lines. Most of these gears take a mixture of species, but some of the fixed gear fisheries are directed mainly towards cod.

3.2 Natural Mortality, Maturity, Age Compositions, and Mean Weight at Age

Values for natural mortality and maturity are given in Table 3.2.1, and they are unchanged from those used in last year's assessment and are applied to all years. The sources of these data are multi-species VPA as performed by the Multi-species Working Group in 1986 (natural mortality, see Section 13.1.3), and the International Young Fish Survey (maturity). These values were derived for the North Sea and are equally applied to the three stock components. Age compositions were provided by Belgium, Denmark, England, France, Germany the Netherlands and Scotland, based on a total of more than 28 thousand age readings (Table. 1.3.3.1). Mean weight at age data for landings are given in Table 3.2.3. These values were also used as stock mean weights.

Long-term trends in mean weight at age for age groups 1-6 are plotted in Figure 3.2.1 relative to the mean weight for each age group in 1963. Figure 3.2.1 indicates that there have been short-term trends in mean weight about a long term mean and that for the past few years, mean weight has been declining on all ages.

Landings in numbers at age for 1963-1998 are given in Table 3.2.2. SOP corrections have been applied. These catches do not include industrial fishery by-catches landed for reduction purposes, or discards. By-catch estimates are available for the total Danish and Norwegian small-meshed fishery in Sub-area IV (Table 2.1.3) and separately for the Skagerrak (Table 3.1.1.), but as in previous years, these data were not included in the assessment. Minor revisions to the 1997 landings data were provided by UK (E+W) for Sub-area IV and Division VIId.

The low proportion of the 1996 year-class as 2 year-olds in the landings from the Skagerrak, is surprising. In addition, the catch at age data indicate that there may be an age reading bias, since the mean weights at age from landings from IIIa in 1998, are lower on all ages greater than age 2 compared to recent years. However, this is also a feature from landings from Sub-area IV. The contribution of the 1995 year class as 3-year olds, to the landings from Division IIIa Skagerrak in 1998 was also 40%, compared to only 13% for Sub-area IV.

In 1997, the 1996 year class as 1-year olds, accounted for 86% of the numbers landed from VIId, but did not feature so strongly in Sub-area IV or Division IIIa Skagerrak. In these 2 areas, the 1996 year class accounted for 2% and 25 % of the total numbers landed respectively. As mentioned in last year's report of this Working Group, there is likely to have been significant discarding of 1-year old cod in 1997.

3.3 Catch, Effort, and Research Vessel Data

Trends in fishing effort for some fleets are shown in Figure 2.1.1.

Catch and effort data by age group for a total of 18 fleets were available, including 12 commercial and 6 survey fleets (Table 3.3.1).

3.4 Catch at Age Analysis

Single fleet diagnostics from XSA tuning runs carried out over 20 years with no taper were examined for trends in catchability and fit to the catch data. Eight of the 9 fleets chosen to tune the 1998 assessment were included in this year's XSA. A significant trend in the log catchability residuals for the French trawl fleet in VIId was identified and this fleet was excluded. The fleet data used for tuning the assessment are listed in Table 3.4.1.

The single fleet tuning diagnostics indicated that there was no *a priori* reason only to use a 10-year tuning window and that a 16-year tuning range (1983-1998) was appropriate for all fleets. Trial runs were therefore carried out using the 16 year data range with the same configuration of other parameters as last year's assessment i.e. F-shrinkage of 0.5, stock size catchability on age 1 only and age-dependent catchability on ages younger than 6. The diagnostics from this indicated that it may be appropriate to include age 2 as recruits because of the significant slope and high R^2 on this age group given by the EGFS. However, the WG agreed that since only a single fleet gave a significant slope, it would be more appropriate to treat only age 1 as recruits in the XSA tuning.

The Group also examined the effect of reduced shrinkage on the tuned assessment and F-shrinkage was relaxed to 1.5. The results of the comparison between the heavy and light shrinkage on the results of the assessment were negligible, so it was decided to retain the catchability and shrinkage configuration used for the previous 2 assessments.

Hence, for the final run, tuning was performed over the period 1983-1997 with no time taper, and a shrinkage factor of 0.5 was applied to the terminal population estimate. The recruiting age was set at age 1, and catchability was fixed for ages 6 and above. The age range used for VPA was 1 to 11 (the plus group). The differences in configuration for the 2 years are detailed below:

			1998 XSA	1999 XSA
Fleets	SCOTRL_IV		2-6	**1-7**
	SCOSEI_IV		1-10	**1-10**
	SCOLTR_IV		1-8	**1-9**
	ENGTRL_IV		2-8	**1-9**
	ENGSEI_IV		1-10	**1-10**
	SCOGFS_IV		1-6	**1-6**
	ENGGFS_IV		1-5	**1-5**
	IBTS+Q1_IV		1-6	**1-6**
	FRATR_VID		1-1	-
Taper			no	no
Tuning range			10yr	**16 yr**
q independent catchability			2+	2+
age independent q			6	6
F shrinkage			0.5	0.5
P shrinkage se			0.3	0.3

- = not used

The diagnostics from the final XSA run are given in Table 3.4.2. and plots of the log catchability residuals for each fleet from this run are given in Figure 3.4.1. This figure indicates that all fleets give relatively good fits to the catch data with no apparent trends but that for some fleets and age groups, the signal is relatively noisy. The relative importance for the result in terms of regression weights by type of fleet or shrinkage, respectively, are shown in Figure 3.4.2. Commercial fleets receive the highest relative weighting for all age groups and the influence of surveys is least on age groups 8-10.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and XSA are given in Tables 3.4.3 and 3.4.4 and are summarized in Table 3.4.5. The estimate of mean F for 1997 on 2-8 year olds has been revised from 0.63 in the 1998 assessment, to 0.69 in the current assessment. SSB for 1998 has been revised downwards from 148,000 t estimated in the 1998 assessment to 131,000 t in the current assessment.

The results from a retrospective analysis using XSA with the options specified above are shown in Figure 3.4.3. The retrospective plots indicate that there appears to be a retrospective bias, with reference F consistently underestimated and spawning stock biomass consistently overestimated. The effects of this bias are discussed in section 3.11 (Comments on the assessment). Table 3.4.4 also documents two levels of reference F; the standard age range of 2-8, and a shortened age range of 2-4. It is important to note that while F2-8 apparently declined in 1998, F2-4 increased, perhaps reflecting increased targeting of the abundant 1996 year class.

3.5 Recruitment Estimates

Average recruitment in the period 1963-1996 was 391 million (arithmetic mean) or 335 million (geometric mean) 1-year old fish. These estimates are only slightly lower than the values estimated last year. The GM recruitment in the recent period (1987-1996) is 230 million 1- year old fish.

Using RCT3, research vessel survey data for 1- and 2-year old fish (Table 3.5.1) were regressed against VPA population numbers for year classes back to and including 1995 to estimate recruitment at age 1. The indices for the English groundfish surveys after 1991 have been adjusted to take account of the change of gear to the GOV trawl in 1992. Estimates from the Scottish GFS in 1998 and 1999 were not included since the survey in 1998 and 1999 was carried out using a new vessel and different gear and calibration factors for cod are not available. The results of survey indices regressed against XSA recruitment at age 1 are presented in Table 3.5.2.

Year class 1997: RCT3 predicts the 1997 year class at age 1 as 65 million, compared to the XSA estimate of 67 million. This year class is still estimated to be the lowest on record. The XSA estimate was accepted by the WG.

Year class 1998: The weighted mean of this year class estimated by RCT3 was 118 million 1-year olds. Only 11% of the weighting used for this estimate derives from population shrinkage, and over 50% is derived from the English Groundfish survey 1-group estimate. The RCT3 estimate of the 1998 year class was therefore used for input to catch predictions.

Year class 1999: The only recruitment estimate available for the 1999 year class is derived from the EGFSQ4 research vessel survey 0-group index . The RCT 3 output (Table 3.5.2) indicates that the survey estimate of 241 million is less than the long-term GM from XSA. 60% of the RTC3 estimate is derived from the long-term mean. Since recruitment has been lower in the recent time period than in the earlier period, the WG decided to use the short-term GM estimate of 230 million from XSA (1987-1996) for the 1999 and subsequent year classes.

Working group estimates of year-class strength used for the prediction can be summarised as follows:

Year class	Millions age1	Basis
1997	67	XSA
1998	118	RCT3
1999	230	Short-term GM

3.6 Historical Stock Trends

Historical trends in mean fishing mortality, landings, spawning stock biomass, and recruitment are shown in Table 3.4.5 and Figure 3.1.1. Mean fishing mortality (F2-8) has shown a more or less continuous increase over the whole period up to the early 90’s and an overall decline since 1993. Spawning biomass decreased from a peak of 277,000 t in 1971 to a historical low of 63,000 t in 1993 and 1994. Recruitment has fluctuated considerably over the period but the frequency of good year classes has become reduced in recent years. However, the 1996 year class is still estimated the largest since 1985. Historically, landings increased in the 1960s and early 1970s to reach a peak of 350,000 t in 1972. After a further peak of about 335,000 t in 1981, landings have declined to levels similar to those observed in the early 1960s.

3.7 Short Term Forecast

The input data for the catch prediction are given in Table 3.7.1, and the parameter label values for the sensitivity plots are shown in Table 3.7.2. Mean weight at age is the average for the period 1996-98. Fishing mortality is the unscaled mean for the same period. Population numbers in 1999 are XSA survivor estimates, except for age 1, which was derived using RCT3.

The results of a *status quo* landings prediction for 1999 and 2000 are given in Tables 3.7.3 and 3.7.4 and shown in Figure 3.7.1D. The predicted *status quo* landings are 150,000 t for 1999, and 109,000 t for 2000. Spawning biomass is estimated to be 128,000 t at the start of 1999, and 131,000 t in 2000. Continued fishing at *status quo* in 2000, gives an estimate of SSB in 2001 of 116,000 t. The detailed output tables (Table 3.7.4 and Figure 3.7.2) confirm the importance of the estimate of the strength of the 1996 yearclass to predicted landings in 1999. About 67% of the predicted landings in 1999 are are expected to comprise this year-class, which is also predicted to contribute 50% to the spawning stock biomass in 2000 and 2001.

The results of sensitivity analyses of the *status quo* catch prediction are shown in Figures 3.7.3 and 3.7.4, with the input parameters given in Table 3.7.2. The CV used for the 1998 year class estimate is derived from RCT3. The CV on the short-term GM recruit estimate at age 1 is also derived from the RCT3 estimate of the 1999 year class. For all other parameters, the values estimated by XSA were used. Predicted yield in 2000 is sensitive to the estimates of overall fishing mortality (HF) in 1999 and 2000. 30% of the variance in the estimate of yield in 2000 is attributed to the assumption of F in that year, with a further 22% of the variance accounted for by the estimate of F in 1999.

The results also indicate that the estimate of SSB in 2000 is sensitive to the assumptions about fishing mortality in 1999 and 2000 with 24% of the variance of the estimate of SSB in 2001 dependent on 1996 year class estimate, 21% on the 1999 year class estimate and a further 34 % dependent on the estimated F in 1999 and 2000.

Figure 3.7.4 shows probability profiles for yield in 2000 and spawning biomass in 2001

3.8 Medium term projections

Projections were run for *status quo* F for a 10 year period to estimate probabilities of predicted yields. The input values are given in Table 3.7.2. and are the same as for the short-term forecast, except that mean weight at age is estimated from the long-term series from 1963 – 1998. The projections were carried forward for 10 years using the software WGMTERMA and assuming a Shepherd stock-recruit model. This was the model accepted last year and the one used to calculate precautionary reference points for cod. The results of medium term projections are given in Figure 3.8.1 and the probability profiles of SSB in 2008 for different fishing mortality rates in relation to the proposed $\mathbf{B}_{pa}$ are given in Figure 3.8.2. The trajectories indicate that there is a high probability of SSB being above $\mathbf{B}_{pa}$ by 2008 at *status quo* F.

The response to the EU/Norway special request on medium term probabilities are given in Table 3.8.1. The results indicate that fishing at F SQ or $\mathbf{F}_{pa}$ gives a high probability SSB remaining below $\mathbf{B}_{pa}$ at least until 2003.

3.9 Biological reference points

Inputs for long-term equilibrium yield and SSB-per-recruit analyses are given in Table 3.9.1 and results are presented in Table 3.9.2 and Figure 3.7.1C. The stock recruit relationship showing F_{high}, $\mathbf{F}_{med}$ and F_{98} is given in Figure 3.9.1.

Biological reference points proposed by ACFM were as follows:

$\boldsymbol{B}_{lim}$ = 70,000 t; $\boldsymbol{B}_{pa}$ = 150,000 t; $\boldsymbol{F}_{lim}$ = 0.86; $\boldsymbol{F}_{pa}$ = 0.65.

The historical performance of F and SSB in relation to the above precautionary reference points, are given in Figure 3.9.2.

3.10 Comments on the Assessment

The overall patterns of F, recruitment and SSB are consistent with previous assessments. However, the retrospective pattern of underestimating F and over-estimating SSB is worrying. SSB for 1998 may also be an over-estimate. This implies that the exploitation rate and state of the stock may be worse than we perceive, even though both F and SSB are currently outside their proposed precautionary reference points. In particular the over-estimation of stock size may lead to over-optimistic catch forecasts. The EU uptake figures for 1999, indicate that less than 40% of the 1999 TAC had been taken by the end of July. In addition, reports from the fishing industries from several countries suggest that cod is difficult to find this year.

The WG examined the XSA estimates of year class strength at age 1 regressed against RCT3 estimates of the same year classes. It was apparent that there seemed to be a consistent over-estimation of 1-year old cod by RCT3 by an average of 17%. This tendency to over-estimate recruitment of North Sea plaice and haddock by RCT3 relative to the converged XSA values, was also noted by the WG.

The WG presented mean F over ages 2-8 and 2-4 (Table 3.4.6). F2-8 in 1998 has declined compared to 1997, consistent with the declining trend observed over the past few years. F2-4 however has increased relative to 1997, perhaps reflecting increased targeting of the strong 1996 year class. The WG considers that since only a small proportion of the annual catch in numbers consists of ages 5 and older, F2-4 is a more appropriate age range for mean F for this stock. The WG also notes that if the mean F age range is re-defined, $\mathbf{F}_{pa}$ and $\mathbf{F}_{lim}$ will also have to be re-defined.

The WG considers that the medium-term catch forecasts carried out may be overly optimistic, since they are based on a stock/recruit relationship fitted to the whole time series of stock and recruit data. Apart from the 1996 year class, recruitment at age 1 since 1985 has been at or below average, and spawning stock biomass over the same period declined to an historic low in 1993, and has remained below the proposed $\mathbf{B}_{pa}$.

Table 3.1.1. Nominal catch (in tonnes) of COD in IIIa (Skagerrak), IV and VIId, 1984–1997 as officially reported to ICES and as used by the Working Group.

Sub-area IV

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	5,804	4,815	6,604	6,693	5,508	3,398	2,934	2,331	3,356	3,374	2,648	4,827	3,458	4,642	5799
Denmark	46,751	42,547	32,892	36,948	34,905	25,782	21,601	18,998	18,479	19,547	19,234	24,067	23,573	21,870	23002
Faroe Islands	-	71	45	57	46	35	96	23	109	46	80	219	44	40	
France	8,129	4,834	8,402	8,199	8,323	2,578	1,641	975	2,146	1,868	1,868	3,040	1,920	3,779	2934
Germany	13,453	7,675	7,667	8,230	7,707	11,430	11,725	7,278	8,446	6,800	5,974	9,457	8,344	5,179	8050
Netherlands	25,460	30,844	25,082	21,347	16,968	12,028	8,445	6,831	11,133	10,220	6,512	11,199	9,271	11,807	14676
Norway	7,005	5,766	4,864	5,000	3,585	4,813	5,168	6,022	10,476	8,742	7,707	7,358	5,884	5,829	5749
Poland	7		10	13	19	24	53	15					18	31	25
Sweden	575	748	839	688	367	501	620	784	823	646	630	709	617	774	520
UK (E/W/NI)	35,605	29,692	25,361	29,960	23,496	18,375	15,622	14,249	14,462	14,940	13,941	14,991	15,930	13,413	17745
UK (Scotland)	54,359	60,931	45,748	49,671	41,382	31,480	31,120	29,060	28,677	28,197	28,854	35,848	35,349	32,344	35633
Total Nominal Catch	197,148	187,923	157,514	166,806	142,306	110,444	99,025	86,566	98,107	94,380	87,448	111,715	104,408	99,708	114133
Unallocated landings	7,723	6,772	11,292	15,287	14,252	5,256	5,726	1,967	-758	10,200	7,075	8,308	2,129	2,454	7970
WG estimate of tota	204,871	194,695	168,806	182,093	156,558	115,700	104,751	88,533	97,349	104,580	94,523	120,023	106,537	102,162	122103
Agreed TAC	215,000	250,000	170,000	175,000	160,000	124,000	105,000	100,000	100,000	101,000	102,000	120,000	130,000	115,000	140000

Division VIId

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	331	501	650	815	486	173	237	182	187	157	228	377	321	310	239
Denmark	-	-	4	-	+	+	-	-	1	1	9	-	-	-	-
France	2,492	2,589	9,938	7,541	8,795	n/a	n/a	n/a	2,079	1,771	2,338	3,261	2,788	6387	7788
Netherlands	-	-	-	-	1	1	-	-	2	-	-	-	+	-	19
UK (E+W)	282	326	830	1,044	867	562	420	341	443	530	312	336	414	478	618
UK (Scotland)	-	-	-	-	-	-	7	2	22	2	+	+	4	3	1
Total Nominal Catch	3,105	3,416	11,422	9,400	10,149	n/a	n/a	n/a	2,734	2,461	2,887	3,974	3,527	7178	8665
Unallocated landings	419	-111	3,722	4,819	580	-	-	-	-65	-29	-37	-10	-24	-	-85
WG estimate of tota	3,524	3,305	15,144	14,219	10,729	5,538	2,763	1,886	2,669	2,432	2,850	3,964	3,503	7,043	8580

Division IIIa (Skagerrak)

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	17,443	14,521	18,424	17,824	14,806	16,634	15,788	10,396	11,194	11,997	11,953	8,948	13,573	12,164	12340
Sweden	1,981	1,914	1,505	1,924	1,648	1,902	1,694	1,579	2,436	2,574	1,821	2,658	2,208	2,303	1608
Norway	311	193	174	152	392	256	143	72	270	75	60	169	265	348	1279
Germany	-	-	-	-	-	12	110	12	-	-	301	200	203	81	16
Others	156	-	-	-	106	34	65	12	102	91	25	134	-	-	-
Norwegian coast *	1,187	990	917	838	769	888	846	854	923	909	760	846	748	911	976
Danish industrial by-	1,084	1,751	997	491	1,103	428	687	953	1,360	511	666	749	676	205	0
Total Nominal Catch	19,891	16,628	20,103	19,900	16,952	18,838	17,800	12,071	14,002	14,737	14,160	12,109	16,249	14,896	15243
Unallocated landings	235	983	1,039	955	-7	810	789	370	792	587	-250	0	134	50	88
WG estimate of tota	20,126	17,611	21,142	20,855	16,945	19,648	18,589	12,441	14,794	15,324	13,910	12,109	16,383	14,946	15331
Agreed TAC	28,000	29,000	29,000	22,500	21,500	20,500	21,000	15,000	15,000	15,000	15,500	20,000	23,000	16,100	20,000

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total Nominal Catch	220,144	207,967	189,039	196,106	169,407	n/a	n/a	n/a	114,843	111,578	104,495	127,798	124,184	121,782	138,041
Unallocated landings	8,377	7,644	16,053	21,061	14,825	-	-	-	-31	10,758	6,788	8,298	2,239	2,504	7,973
WG estimate of tota	228,521	215,611	205,092	217,167	184,232	140,886	126,103	102,860	114,812	122,336	111,283	136,096	126,423	124,151	146,014

* The Danish industrial by-catch and the Norwegian coast catches are not included in the (WG estimate of) total landings of Division IIIa (Skagerrak)

Table 3.2.1 Natural mortality and proportion mature in COD in IIIa (Skagerrak), IV and VIId

Age	Natural Mortality	Proportion Mature
1	0.80	0.01
2	0.35	0.05
3	0.25	0.23
4	0.20	0.62
5	0.20	0.86
6	0.20	1.00
7	0.20	1.00
8	0.20	1.00
9	0.20	1.00
10	0.20	1.00
11+	0.20	1.00

Table 3.2.2

Run title : Cod in IIIa,IV,VIId (run: XSAJC107/X07)
At 19/10/1999 7:39

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1963,	1964,	1965,	1966,	1967,	1968,
AGE						
1,	3214,	5030,	15813,	18224,	10803,	5829,
2,	42591,	22493,	51888,	62516,	70895,	83836,
3,	7030,	20113,	17645,	29845,	32693,	42586,
4,	3536,	4308,	9182,	6184,	11261,	12392,
5,	2788,	1918,	2387,	3379,	3271,	6076,
6,	1213,	1818,	950,	1278,	1974,	1414,
7,	81,	599,	658,	477,	888,	870,
8,	492,	118,	298,	370,	355,	309,
9,	14,	94,	51,	126,	138,	151,
10,	6,	12,	75,	56,	40,	111,
+gp,	0,	4,	8,	83,	17,	24,
TOTALNUM,	60965,	56507,	98955,	122538,	132335,	153598,
TONSLAND,	116457,	126041,	181036,	221336,	252977,	288368,
SOPCOF %,	100,	100,	100,	100,	100,	100,

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	2947,	54493,	44824,	3832,	25966,	15562,	33378,	5724,	75413,	29731,
2,	22674,	33917,	155345,	187686,	31755,	58920,	47143,	100283,	51118,	175727,
3,	31578,	18488,	17219,	48126,	54931,	11404,	18944,	18574,	25621,	17258,
4,	13710,	13339,	6754,	5682,	14072,	15824,	4663,	6741,	4615,	9440,
5,	4565,	6297,	7101,	2726,	2206,	4624,	7563,	1741,	2294,	3003,
6,	2895,	1763,	2700,	3201,	1109,	961,	2067,	3071,	836,	1108,
7,	588,	961,	893,	1680,	1060,	438,	449,	924,	1144,	410,
8,	422,	209,	458,	612,	489,	395,	196,	131,	371,	405,
9,	147,	186,	228,	390,	80,	332,	229,	67,	263,	153,
10,	46,	98,	77,	113,	58,	81,	95,	63,	26,	36,
+gp,	78,	40,	94,	18,	162,	189,	63,	43,	96,	44,
TOTALNUM,	79650,	129791,	235693,	254066,	131888,	108730,	114790,	137362,	161797,	237315,
TONSLAND,	200760,	226124,	328098,	353976,	239051,	214279,	205245,	234169,	209154,	297022,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	34837,	62605,	20279,	66777,	25733,	64751,	8845,	100239,	24915,	21480,
2,	91697,	104708,	189007,	65299,	129632,	66428,	118047,	32437,	128282,	55330,
3,	44653,	35056,	34821,	60411,	21662,	31276,	18995,	34109,	9800,	43955,
4,	4035,	12316,	9019,	9567,	11900,	4264,	7823,	5814,	8723,	3134,
5,	3395,	1965,	4118,	3476,	2830,	3436,	1377,	2993,	1534,	2557,
6,	712,	1273,	785,	2065,	1258,	1019,	1265,	604,	1075,	655,
7,	398,	495,	604,	428,	595,	437,	373,	556,	235,	295,
8,	140,	197,	134,	236,	181,	244,	173,	171,	215,	66,
9,	158,	74,	65,	78,	90,	60,	79,	69,	55,	63,
10,	42,	55,	37,	27,	28,	45,	16,	44,	48,	23,
+gp,	17,	25,	21,	16,	23,	20,	31,	23,	12,	18,
TOTALNUM,	180084,	218769,	258890,	208380,	193932,	171980,	157024,	177059,	174894,	127576,
TONSLAND,	269973,	293644,	335497,	303251,	259287,	228286,	214629,	204053,	216212,	184240,
SOPCOF %,	101,	100,	100,	99,	100,	100,	100,	101,	100,	100,

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	22239,	11738,	13466,	27668,	4783,	15557,	15717,	4938,	23769,	1202,
2,	36358,	54290,	23456,	32059,	55272,	25279,	63586,	36805,	29194,	77635,
3,	18193,	11906,	16776,	8682,	11360,	21144,	12943,	23364,	18646,	16325,
4,	9866,	4339,	3310,	5007,	3190,	3083,	5301,	3169,	6499,	5842,
5,	1002,	2468,	1390,	1060,	1577,	870,	802,	1860,	1238,	2361,
6,	1036,	310,	1053,	491,	435,	519,	286,	399,	700,	500,
7,	251,	310,	225,	329,	204,	142,	151,	162,	153,	228,
8,	140,	54,	139,	52,	108,	58,	42,	88,	47,	40,
9,	27,	60,	28,	40,	18,	32,	15,	43,	14,	16,
10,	31,	12,	4,	17,	10,	7,	13,	4,	15,	4,
+gp,	10,	9,	10,	9,	13,	16,	5,	8,	10,	12,
TOTALNUM,	89153,	85496,	59857,	75414,	76970,	66707,	98861,	70840,	80285,	104165,
TONSLAND,	139936,	125314,	102478,	114020,	121749,	110634,	136096,	126320,	124158,	146015,
SOPCOF %,	100,	99,	100,	99,	99,	99,	98,	100,	100,	104,

Table 3.2.3

Run title : Cod in IIIa,IV,VIId (run: XSAJC107/X07)
At 19/10/1999 7:39

Table 2 Catch weights at age (kg)

YEAR, AGE	1963,	1964,	1965,	1966,	1967,	1968,
1,	.5380,	.4960,	.5810,	.5790,	.5900,	.6400,
2,	1.0040,	.8630,	.9650,	.9940,	1.0350,	.9730,
3,	2.6570,	2.3770,	2.3040,	2.4420,	2.4040,	2.2230,
4,	4.4910,	4.5280,	4.5120,	4.1690,	3.1530,	4.0940,
5,	6.7940,	6.4470,	7.2740,	7.0270,	6.8030,	5.3410,
6,	9.4090,	8.5200,	9.4980,	9.5990,	9.6100,	8.0200,
7,	11.5620,	10.6060,	11.8980,	11.7660,	12.0330,	8.5810,
8,	11.9420,	10.7580,	12.0410,	11.9680,	12.4810,	10.1620,
9,	13.3830,	12.3400,	13.0530,	14.0590,	13.5890,	10.7200,
10,	13.7560,	12.5400,	14.4410,	14.7460,	14.2710,	12.4970,
+gp,	.0000,	14.9980,	15.6670,	15.6720,	19.0160,	11.5950,
SOPCOFAC,	.9998,	.9998,	1.0001,	1.0001,	1.0001,	.9999,

YEAR, AGE	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
1,	.5440,	.6260,	.5790,	.6160,	.5590,	.5940,	.6190,	.5680,	.5420,	.5720,
2,	.9210,	.9610,	.9410,	.8360,	.8690,	1.0390,	.8990,	1.0290,	.9480,	.9370,
3,	2.1330,	2.0410,	2.1930,	2.0860,	1.9190,	2.2170,	2.3480,	2.4700,	2.1600,	2.0010,
4,	3.8520,	4.0010,	4.2580,	3.9680,	3.7760,	4.1560,	4.2260,	4.5770,	4.6070,	4.1460,
5,	5.7150,	6.1310,	6.5280,	6.0110,	5.4880,	6.1740,	6.4040,	6.4940,	6.7130,	6.5310,
6,	6.7220,	7.9450,	8.6460,	8.2460,	7.4530,	8.3330,	8.6910,	8.6200,	8.8280,	8.6670,
7,	9.2620,	9.9530,	10.3560,	9.7660,	9.0190,	9.8890,	10.1070,	10.1320,	10.0710,	9.6860,
8,	9.7490,	10.1310,	11.2190,	10.2280,	9.8100,	10.7900,	10.9100,	11.3410,	11.0520,	11.0990,
9,	10.3840,	11.9190,	12.8810,	11.8750,	11.0770,	12.1750,	12.3390,	12.8880,	11.8240,	12.4270,
10,	12.7430,	12.5540,	13.1470,	12.5300,	12.3590,	12.4250,	12.9760,	14.1400,	13.1340,	12.7780,
+gp,	11.5670,	14.3670,	15.5440,	14.3500,	12.8860,	13.7310,	14.4310,	14.5570,	14.3620,	13.9810,
SOPCOFAC,	.9999,	1.0000,	.9998,	1.0001,	.9999,	.9999,	.9999,	1.0000,	.9999,	1.0035,

YEAR, AGE	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
1,	.5500,	.5500,	.7230,	.5890,	.6320,	.5940,	.5900,	.5830,	.6350,	.5860,
2,	.9360,	1.0030,	.8370,	.9620,	.9190,	1.0070,	.9330,	.8560,	.9760,	.8810,
3,	2.4110,	1.9480,	2.1890,	1.8580,	1.8350,	2.1560,	2.1400,	1.8340,	1.9550,	1.9820,
4,	4.4230,	4.4010,	4.6150,	4.1300,	3.8800,	3.9720,	4.1640,	3.5040,	3.6500,	3.1870,
5,	6.5800,	6.1090,	7.0450,	6.7840,	6.4910,	6.1900,	6.3240,	6.2300,	6.0520,	5.9920,
6,	8.4750,	9.1200,	8.8840,	8.9030,	8.4230,	8.3620,	8.4300,	8.1400,	8.3070,	7.9140,
7,	10.6370,	9.5500,	9.9340,	10.3990,	9.8480,	10.3170,	10.3620,	9.8960,	10.2420,	9.7640,
8,	11.5500,	11.8670,	11.5190,	12.5000,	11.8370,	11.3520,	12.0730,	11.9390,	11.4610,	12.1270,
9,	13.0570,	12.7820,	13.3380,	13.4690,	12.7970,	13.5050,	13.0720,	12.9510,	12.4470,	14.2420,
10,	14.1480,	14.0810,	14.8970,	12.8900,	12.5620,	13.4080,	14.4430,	13.8590,	18.6910,	17.7870,
+gp,	15.4780,	15.3920,	16.6290,	14.6080,	14.4260,	13.4720,	16.5880,	14.7070,	16.6040,	16.4770,
SOPCOFAC,	1.0087,	.9963,	.9985,	.9946,	.9968,	.9992,	.9951,	1.0098,	.9969,	1.0001,

YEAR, AGE	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
1,	.6730,	.7370,	.6700,	.6990,	.6990,	.6780,	.7210,	.6990,	.6560,	.5410,
2,	1.0520,	.9760,	1.0780,	1.1460,	1.0650,	1.0750,	1.0200,	1.1170,	.9600,	.9270,
3,	1.8460,	2.1760,	2.0370,	2.5460,	2.4790,	2.2010,	2.2100,	2.1470,	2.1200,	1.7290,
4,	3.5850,	3.7910,	3.9710,	4.2230,	4.5500,	4.4710,	4.2920,	4.0340,	3.8210,	3.4860,
5,	5.2730,	5.9320,	6.0830,	6.2480,	6.5400,	7.1670,	7.2200,	6.6370,	6.2280,	5.4070,
6,	7.9210,	7.8890,	8.0340,	8.4830,	8.0940,	8.4360,	8.9800,	8.4940,	8.3940,	7.5990,
7,	9.7250,	10.2350,	9.5450,	10.1020,	9.6410,	9.5360,	10.2830,	9.7290,	9.9790,	9.6070,
8,	11.2110,	10.9240,	10.9490,	10.4810,	10.7350,	10.3230,	11.7430,	11.0800,	11.4240,	10.6350,
9,	12.5860,	12.8020,	13.4810,	11.8500,	12.3290,	12.2240,	13.1070,	12.2640,	12.3000,	11.5080,
10,	15.5570,	15.5250,	13.1700,	13.9050,	13.4430,	14.2470,	12.0520,	12.7560,	12.7610,	13.1180,
+gp,	14.6940,	23.2330,	14.9890,	15.7940,	13.9610,	12.5230,	13.9540,	11.3040,	13.4160,	14.9270,
SOPCOFAC,	.9950,	.9945,	.9970,	.9929,	.9948,	.9940,	.9835,	.9989,	1.0002,	1.0370,

Table 3.3.1 Tuning fleets available for COD in IIIa (Skagerrak), IV and VIId

Fleet code	Fleet	First Year	Last Year	First Age	Last Age
SCOTRL_IV	Scottish trawl (IV)	1978	1998	1	10
SCOSEI_IV	Scottish seine (IV)	1978	1998	1	12
SCOLTR_IV	Scottish light trawl (IV)	1978	1998	1	11
ENGTRL_IV	English trawl (IV)	1978	1998	1	12
ENGSEI_IV	English seine (IV)	1978	1998	1	12
FRATRB_IV	French trawl (IV)	1978	1998	1	11
FRATRO_IV	French trawl offshore (IV)	1986	1998	1	7
SCOGFS_IV	Scottish groundfish survey (IV)	1982	1998	1	6
ENGGFS_IV	English groundfish survey (IV)	1977	1998	1	5
IBTS_Q1_IV	Int. bottom trawl survey Q1 (IV)	1976	1998	1	6
IBTS_Q2_IV	Int. bottom trawl survey Q2 (IV)	1991	1998	1	6
IBTS_Q4_IV	Int. bottom trawl survey Q4 (IV)	1991	1996	1	6
FRATRO_7d	French trawl offshore (VIId)	1986	1998	1	9
Den_Gill_Skag	Danish gill net (IIIa)	1987	1995	1	7
Den_Neph_Skag	Danish nephrops trawl	1987	1995	1	7
Den_Trawl_Skag	Danish trawl (IIIa)	1987	1995	1	7
Den_Sei_Skag	Danish seine (IIIa)	1987	1995	1	7
IBTS_Skag	Int. bottom trawl survey (IIIa)	1983	1995	1	6

Table 3.4.1 Tuning fleets used for COD in IIIa (Skagerrak), IV and VIID

Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak) (run name: XSAJC107)
108
FLT01: SCOTRL_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.00 1.00
1 7

48339	178.337	1427.663	208.383	112.430	23.261	9.692	1.938
34574	316.043	772.341	345.964	32.726	16.831	7.480	0.935
33103	82.048	781.283	196.005	79.313	9.116	4.558	2.735
27839	251.300	190.609	256.042	19.914	10.431	0.948	0.948
27208	272.057	606.030	38.463	39.401	8.443	1.876	0.000
21559	27.259	346.285	159.513	8.077	8.077	4.038	1.010
16657	58.153	29.428	134.388	40.929	2.974	2.233	1.194
14325	15.482	327.585	18.792	22.486	5.118	1.215	1.004
13495	45.113	94.909	103.953	7.731	6.998	1.718	0.483
10887	52.261	99.870	30.235	33.291	1.153	1.211	0.120
11657	4.716	124.610	31.231	4.273	6.325	0.634	0.055
15671	54.896	40.799	124.960	9.461	1.713	1.656	0.520
17728	29.099	254.011	93.718	49.032	1.501	0.465	0.538
13471	6.349	139.583	108.299	23.909	15.045	1.580	0.200
12651	40.656	81.864	91.362	26.785	4.988	2.978	0.731
25744	44.921	983.976	153.094	91.326	20.549	6.612	3.318

FLT02: SCOSEI_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.00 1.00
1 10

333168	1342.728	13320.380	1813.966	1289.703	227.494	98.353	39.341	18.815	15.394	2.566
388085	4839.125	9954.796	3783.950	453.752	381.259	108.292	46.539	25.954	6.265	7.160
382910	543.929	18367.311	2498.646	835.287	127.187	107.343	26.159	24.355	9.922	3.608
425017	5425.851	2656.135	6865.172	824.863	285.816	42.826	38.171	13.965	7.448	2.793
418536	1361.396	13452.120	680.241	1423.568	283.434	186.518	24.686	35.658	15.543	4.572
377132	842.968	7091.734	4631.826	201.992	471.982	131.995	55.998	15.999	10.000	3.000
355735	1684.028	3495.714	3173.118	1092.297	91.156	185.066	44.650	18.698	2.391	7.744
270869	379.134	12625.370	1096.540	671.531	291.604	38.807	50.407	11.534	3.699	1.793
336675	1708.483	4746.648	2986.177	241.370	173.924	113.164	32.981	25.229	7.592	0.570
300217	1056.525	4120.136	942.427	618.214	97.903	59.252	31.805	8.852	8.416	3.235
268413	259.816	5561.367	776.714	208.932	142.388	26.401	19.572	9.165	2.347	0.806
264738	1172.846	3129.865	2378.035	301.222	60.540	37.716	13.282	5.077	2.267	0.873
204545	743.283	8029.209	912.815	496.574	84.516	21.557	16.616	0.914	0.967	0.903
177092	303.656	3696.333	2598.453	239.201	165.108	19.699	8.662	5.688	1.849	1.188
166817	740.271	2267.133	1581.460	687.769	118.726	71.214	17.325	6.006	2.108	0.850
150361	71.553	5692.333	1088.959	423.297	287.297	46.103	29.685	4.187	0.993	0.803

Table 3.4.1 (continued) Tuning fleets used for COD in IIIa (Skagerrak), IV and VIID

FLT03: SCOLTR_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.00 1.00
1 9

244349	1321.201	6293.185	1020.032	459.821	111.146	31.372	14.341	5.378	2.689
240725	2723.570	3022.983	1543.958	180.369	85.675	36.074	9.920	7.215	2.706
268136	430.874	5959.050	865.407	293.653	39.337	21.041	3.659	2.744	0.915
279767	4140.451	1166.751	1847.672	250.965	95.651	12.311	8.523	4.735	1.894
351131	2045.224	5662.771	530.278	468.273	45.347	31.465	10.180	5.553	0.925
391988	403.133	3300.276	1912.375	133.375	148.417	33.093	14.039	2.006	1.003
405883	1574.048	1205.534	1594.526	565.712	48.605	45.236	13.343	3.382	0.894
398153	327.094	5739.588	523.696	456.829	179.523	25.746	11.324	3.712	0.999
408056	1821.110	1904.532	2125.128	138.039	94.188	48.099	8.199	8.482	1.206
473955	1401.577	2749.504	747.952	646.729	44.077	36.368	11.912	2.053	2.020
447064	250.643	4891.675	1262.363	163.983	80.122	9.885	5.161	3.794	0.416
480400	722.752	1924.201	2364.757	370.592	47.312	42.371	5.792	2.346	0.300
442010	879.046	5807.931	1579.502	797.169	73.989	8.577	6.861	0.637	0.882
445995	448.536	4060.709	3048.116	424.148	296.499	31.730	9.559	5.477	1.111
479449	1477.022	2931.063	2805.271	808.326	112.982	114.511	10.293	0.947	1.937
427868	249.668	8389.377	1575.674	675.569	193.144	36.465	31.481	2.838	0.227

FLT04: ENGTRL_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.00 1.00
1 9

392364	711.0000	14220.0000	1185.0000	907.0000	127.0000	87.0000	49.0000	16.0000	4.0000
358387	3469.0000	3459.0000	2656.0000	267.0000	217.0000	42.0000	32.0000	16.0000	3.0000
342844	675.0000	8212.0000	1047.0000	533.0000	72.0000	54.0000	16.0000	10.0000	4.0000
288867	9097.0000	2107.0000	2388.0000	209.0000	161.0000	15.0000	12.0000	4.0000	2.0000
275899	447.0000	10435.0000	682.0000	596.0000	36.0000	26.0000	3.0000	4.0000	2.0000
296092	1173.0000	2102.0000	2428.0000	90.0000	126.0000	17.0000	10.0000	0.0000	2.0000
310444	985.0000	1958.0000	718.0000	501.0000	25.0000	34.0000	5.0000	4.0000	0.0000
255314	573.0000	3101.0000	513.0000	134.0000	101.0000	11.0000	13.0000	4.0000	1.0000
258037	880.0000	1559.0000	1092.0000	88.0000	25.0000	17.0000	2.0000	2.0000	0.0000
223702	1463.0000	2171.0000	481.0000	234.0000	19.0000	5.0000	5.0000	0.0000	0.0000
209869	580.0000	4054.0000	442.0000	96.0000	55.0000	5.0000	3.0000	2.0000	0.0000
184764	1264.8020	2454.2870	1146.3820	78.1900	14.2840	7.0360	1.7620	0.6730	0.8470
173463	821.3920	3799.5720	871.8820	158.0300	11.0280	2.9920	1.8960	0.6620	0.1320
159155	659.7580	3179.3450	1646.8460	189.2380	43.9700	6.8120	1.6490	1.4640	0.5520
152030	828.4140	2752.8110	890.2500	334.5630	41.1200	14.8360	2.0630	0.7810	0.2860
161478	142.6695	10451.3850	1412.0550	199.2375	63.4575	10.1415	3.3060	0.6615	0.2670

Table 3.4.1 (continued) Tuning fleets used for COD in IIIa (Skagerrak), IV and VIID

FLT05: ENGSEI_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.00 1.00
1 10

177004	566.000	4741.000	573.000	557.000	207.000	150.000	104.000	18.000	17.000	8.000
167699	1232.000	1513.000	1215.000	147.000	290.000	72.000	50.000	32.000	6.000	5.000
157815	125.000	3242.000	326.000	241.000	72.000	117.000	40.000	27.000	13.000	4.000
136358	890.000	312.000	572.000	65.000	139.000	34.000	52.000	13.000	7.000	7.000
123281	262.000	2395.000	82.000	184.000	44.000	77.000	10.000	22.000	8.000	2.000
91178	297.000	879.000	594.000	19.000	80.000	19.000	12.000	3.000	3.000	1.000
88782	343.000	748.000	216.000	138.000	9.000	46.000	7.000	8.000	1.000	2.000
80537	176.000	1009.000	116.000	45.000	58.000	4.000	15.000	3.000	1.000	1.000
84346	129.000	262.000	207.000	33.000	26.000	38.000	6.000	16.000	1.000	1.000
67810	408.000	463.000	57.000	42.000	10.000	8.000	8.000	2.000	3.000	0.000
54574	44.000	497.000	41.000	19.000	22.000	4.000	3.000	2.000	0.000	1.000
39667	163.456	265.085	138.494	11.373	17.040	14.114	3.077	0.889	0.519	0.070
28406	91.043	444.628	83.186	21.000	5.216	3.742	5.623	3.043	0.608	0.162
14991	18.371	196.618	166.980	19.592	16.881	4.434	1.542	1.136	0.148	0.240
11823	23.430	76.342	35.304	27.906	6.115	5.284	1.700	0.333	0.357	0.260
10664	0.873	283.247	34.087	9.666	11.580	3.732	2.002	0.382	0.126	0.105

FLT06: SCOGFS_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.50 0.75
1 6

100	0.325	0.781	0.181	0.197	0.075	0.023
100	0.820	0.390	0.254	0.050	0.057	0.016
100	0.066	1.142	0.196	0.112	0.030	0.024
100	0.801	0.105	0.396	0.058	0.040	0.019
100	0.219	0.749	0.034	0.092	0.029	0.007
100	0.163	0.288	0.165	0.026	0.033	0.012
100	0.562	0.135	0.169	0.094	0.020	0.008
100	0.114	0.491	0.059	0.074	0.026	0.009
100	0.303	0.154	0.133	0.013	0.006	0.004
100	0.643	0.193	0.072	0.067	0.029	0.018
100	0.347	0.749	0.101	0.025	0.011	0.003
100	1.158	0.334	0.288	0.031	0.012	0.007
100	0.475	1.443	0.130	0.085	0.011	0.007
100	0.318	0.356	0.542	0.074	0.034	0.004
100	0.999	0.278	0.224	0.102	0.022	0.010
100	0.104	2.134	0.116	0.057	0.037	0.008

Table 3.4.1 (continued)   Tuning fleets used for COD in IIIa (Skagerrak), IV and VIID

```
FLT07: ENGGFS_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.50 0.75
1 5
   100   1.539   1.096   0.120   0.111   0.028
   100   6.122   0.474   0.178   0.040   0.021
   100   0.430   1.189   0.107   0.056   0.021
   100   3.438   0.115   0.202   0.029   0.011
   100   1.422   1.065   0.027   0.061   0.014
   100   0.836   0.407   0.199   0.001   0.043
   100   2.285   0.248   0.119   0.061   0.006
   100   0.608   0.503   0.060   0.014   0.012
   100   0.752   0.155   0.072   0.013   0.003
   100   2.441   0.158   0.046   0.035   0.008
   100   0.742   0.651   0.082   0.015   0.017
   100   2.637   0.295   0.154   0.019   0.005
   100   1.028   1.277   0.119   0.056   0.002
   100   0.619   0.668   0.162   0.019   0.020
   100   4.044   0.284   0.054   0.025   0.001
   100   0.118   1.396   0.082   0.008   0.007

FLT08: IBTS_Q1_IV (Catch: Unknown) (Effort: Unknown)
1983 1998
1 1 0.00 0.25
1 6
   1    3.9   16.6    2.7    1.8    0.8    1.5
   1   15.2    8.0    3.9    0.9    1.0    0.9
   1    0.9   17.6    3.5    1.7    0.5    1.0
   1   17.0    3.6    6.8    2.3    1.3    1.1
   1    8.8   28.8    1.4    1.7    0.6    0.9
   1    3.6    6.1    5.8    0.6    0.9    1.1
   1   13.1    6.3    5.0    2.3    0.4    1.0
   1    3.4   15.2    2.0    1.0    1.0    0.8
   1    2.4    4.1    3.4    0.8    0.4    0.8
   1   13.0    4.5    1.2    1.0    0.3    0.5
   1   12.7   19.9    2.0    0.7    0.6    0.4
   1   14.8    4.4    3.0    0.8    0.5    0.5
   1    9.7   22.1    2.8    1.1    0.3    0.3
   1    3.5    8.0    6.0    0.7    0.6    0.4
   1   40.0    6.9    2.3    1.1    0.4    0.4
   1    2.7   26.4    2.0    0.9    0.5    0.4
```

Table 3.4.2 Tuning output for run: XSAJC107/X07. Cod in IIIa (Skagerrak), IV and VIId.

```
Lowestoft VPA Version 3.1

  19/10/1999   7:35
Extended Survivors Analysis
Cod in IIIa,IV,VIId (run: XSAJC107/X07)
CPUE data from file fleet
Catch data for  36 years. 1963 to 1998. Ages  1 to  11.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,    year, year,  age ,  age
FLT01: SCOTRL_IV ,   1983, 1998,   1,     7,   .000,  1.000
FLT02: SCOSEI_IV ,   1983, 1998,   1,    10,   .000,  1.000
FLT03: SCOLTR_IV ,   1983, 1998,   1,     9,   .000,  1.000
FLT04: ENGTRL_IV ,   1983, 1998,   1,     9,   .000,  1.000
FLT05: ENGSEI_IV ,   1983, 1998,   1,    10,   .000,  1.000
FLT06: SCOGFS_IV ,   1983, 1998,   1,     6,   .500,   .750
FLT07: ENGGFS_IV ,   1983, 1998,   1,     5,   .500,   .750
FLT08: IBTS_Q1_IV,   1983, 1998,   1,     6,   .000,   .250

Time series weights :

     Tapered time weighting not applied


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 >=    6


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 =    .500

     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 =     .00011

Final year F values
```

Age	1,	2,	3,	4,	5,	6,	7,	8,	9,	10
Iteration 29,	.0273,	.5622,	.9570,	.7586,	.5044,	.4887,	.3509,	.4915,	.6896,	.2065
Iteration 30,	.0273,	.5622,	.9570,	.7586,	.5044,	.4886,	.3509,	.4915,	.6896,	.2065

```
Regression weights
      , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
```

Table 3.4.2 (continued)

Fishing mortalities

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.129	.140	.127	.144	.049	.071	.104	.042	.071	.027
2	.877	.909	.764	.847	.795	.633	.770	.611	.597	.562
3	1.091	.970	.962	.851	1.014	.988	.941	.856	.857	.957
4	1.016	.893	.844	.927	.961	.908	.753	.653	.638	.759
5	.756	.773	.831	.730	.885	.771	.635	.656	.579	.504
6	.901	.557	.936	.819	.775	.848	.629	.775	.556	.489
7	.872	.764	1.083	.895	1.031	.629	.643	.931	.796	.351
8	.967	.455	.989	.801	.869	.985	.380	1.027	.788	.491
9	.698	1.918	.454	.901	.732	.695	.755	.863	.428	.690
10	.722	.794	.640	.556	.592	.719	.689	.457	.877	.206

XSA population numbers (Thousands)

	AGE					
YEAR	1	2	3	4	5	6
1989	2.74E+05	7.42E+04	3.10E+04	1.71E+04	2.09E+03	1.93E+03
1990	1.34E+05	1.08E+05	2.17E+04	8.12E+03	5.07E+03	8.02E+02
1991	1.69E+05	5.23E+04	3.08E+04	6.42E+03	2.72E+03	1.91E+03
1992	3.08E+05	6.69E+04	1.72E+04	9.16E+03	2.26E+03	9.71E+02
1993	1.50E+05	1.20E+05	2.02E+04	5.71E+03	2.97E+03	8.91E+02
1994	3.37E+05	6.42E+04	3.82E+04	5.71E+03	1.79E+03	1.00E+03
1995	2.37E+05	1.41E+05	2.40E+04	1.11E+04	1.88E+03	6.77E+02
1996	1.80E+05	9.60E+04	4.60E+04	7.31E+03	4.27E+03	8.17E+02
1997	5.14E+05	7.74E+04	3.67E+04	1.52E+04	3.11E+03	1.81E+03
1998	6.66E+04	2.15E+05	3.00E+04	1.21E+04	6.59E+03	1.43E+03

7	8	9	10
4.77E+02	2.50E+02	5.94E+01	6.66E+01
6.41E+02	1.63E+02	7.77E+01	2.42E+01
3.76E+02	2.45E+02	8.48E+01	9.35E+00
6.15E+02	1.04E+02	7.44E+01	4.41E+01
3.50E+02	2.06E+02	3.83E+01	2.47E+01
3.36E+02	1.02E+02	7.06E+01	1.51E+01
3.52E+02	1.47E+02	3.13E+01	2.88E+01
2.95E+02	1.52E+02	8.22E+01	1.20E+01
3.08E+02	9.53E+01	4.44E+01	2.84E+01
8.51E+02	1.14E+02	3.55E+01	2.37E+01

Estimated population abundance at 1st Jan 1999

0.00E+00, 2.91E+04, 8.64E+04, 8.98E+03, 4.66E+03, 3.26E+03,
7.18E+02, 4.91E+02, 5.70E+01, 1.46E+01,

Taper weighted geometric mean of the VPA populations:

3.24E+05, 1.38E+05, 4.37E+04, 1.43E+04, 5.66E+03, 2.36E+03,
9.71E+02, 4.07E+02, 1.68E+02, 6.75E+01,

Standard error of the weighted Log(VPA populations) :

.6144, .5383, .5020, .5258, .5990, .6452,
.6915, .7959, .8692, .9131,

Table 3.4.2 (continued)

Log catchability residuals.

Fleet : FLT01: SCOTRL_IV (Ca

Age	1983	1984	1985	1986	1987	1988
1	.06	.33	.39	.16	1.15	-.42
2	.31	.57	.08	.04	-.13	.39
3	-.16	.16	.07	.03	-.77	-.33
4	-.20	-.17	.12	-.62	-.35	-.76
5	-.07	-.30	-.01	-.28	.02	-.22
6	-.02	.24	-.50	-1.01	-.74	.61
7	-.94	-1.10	.19	-.96	99.99	-.08
8	No data for this fleet at this age					
9	No data for this fleet at this age					
10	No data for this fleet at this age					

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.18	-.20	.63	.37	-1.27	-.04	-.39	-1.31	-.55	.91
2	-1.44	.75	.24	.30	-.16	-1.01	-.04	-.04	-.30	.44
3	.55	-.95	.47	-.02	-.15	.30	.33	.06	.18	.23
4	.14	.39	-.40	.95	-.69	-.21	.59	.52	-.05	.75
5	-.06	-.25	.77	-.67	.75	-.39	-.76	1.01	.25	.18
6	-.07	.20	-.10	.39	-.26	.32	-.77	.60	.41	.70
7	.69	.32	.31	-1.43	-1.66	.16	.03	-.38	.88	.47
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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
Mean Log q	-15.5578	-15.1209	-15.3509	-15.7730	-15.9083	-15.9083
S.E(Log q)	.5612	.4081	.5224	.4997	.5311	.8320

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.94	.201	17.62	.44	16	.71	-17.95

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	.74	1.287	14.53	.63	16	.41	-15.56
3	.81	.960	14.20	.63	16	.33	-15.12
4	.79	.829	14.08	.53	16	.42	-15.35
5	.87	.510	14.80	.53	16	.45	-15.77
6	1.13	-.353	16.99	.36	16	.62	-15.91
7	1.96	-1.169	25.60	.10	15	1.54	-16.14

Table 3.4.2 (continued)

Fleet : FLT02: SCOSEI_IV (Ca

Age	1983	1984	1985	1986	1987	1988
1	-.06	.21	-.14	.06	-.07	.02
2	.00	.10	.18	-.65	-.37	-.06
3	-.19	-.12	-.09	.34	-.88	-.08
4	.01	-.26	-.27	.08	.20	-.70
5	-.34	-.22	-.44	-.32	.18	.37
6	-.34	-.22	-.49	-.63	.42	.53
7	-.57	-.32	-.71	-.70	-.12	.36
8	.01	-.20	-.10	-.50	.25	.57
9	.16	-.25	-.25	-.60	.56	.02
10	-.22	.05	.02	-.73	-.14	-.13

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.24	.04	.77	-.10	-.39	-.04	.17	-.14	-.46	-.12
2	-.33	.86	.33	.09	-.10	-.11	.36	.05	-.17	-.18
3	.40	-.08	.35	-.15	-.33	.16	-.10	.41	.20	.17
4	.07	.55	-.48	.26	-.23	.13	.16	-.05	.32	.22
5	-.32	.23	.14	-.17	.11	-.28	.20	.21	.22	.43
6	.57	.02	.16	.26	-.37	-.09	-.09	-.16	.29	.17
7	.54	.59	.61	.12	.37	-.13	.31	.10	.75	.18
8	.35	.35	.74	.58	.08	.24	-1.83	.38	.86	.30
9	-.38	.52	.37	.91	.34	-.31	-.07	-.20	.42	.11
10	.69	.54	.06	.33	-.36	.29	-.08	1.11	.16	.09

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
Mean Log q	-14.9499	-14.8645	-15.0532	-15.1493	-15.1986	-15.1986	-15.1986	-15.1986	-15.1986
S.E(Log q)	.3455	.3311	.3183	.2878	.3632	.4788	.6439	.4193	.4462

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.76	1.993	16.48	.83	16	.29	-17.80

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	.98	.116	14.88	.70	16	.35	-14.95
3	.73	2.011	13.65	.80	16	.22	-14.86
4	.79	1.492	13.80	.78	16	.24	-15.05
5	.90	.654	14.47	.76	16	.26	-15.15
6	.96	.179	14.90	.62	16	.36	-15.20
7	2.70	-3.220	30.04	.20	16	.99	-15.11
8	1.37	-.926	18.68	.31	16	.87	-15.07
9	1.18	-.890	17.03	.64	16	.49	-15.11
10	1.35	-1.806	19.12	.66	16	.54	-15.09

Table 3.4.2 (continued)

Fleet : FLT03: SCOLTR_IV (Ca

Age	1983	1984	1985	1986	1987	1988
1	.32	.27	.14	.30	.52	-.38
2	.39	.22	.24	-.23	-.23	-.04
3	.13	.04	-.21	.02	-.38	-.43
4	-.09	-.08	-.33	-.07	-.11	-.53
5	.20	-.29	-.31	-.04	-.53	.12
6	-.12	.21	-.71	-.41	-.13	.16
7	-.21	-.33	-1.26	-.72	.22	.00
8	.13	.06	-.87	-.11	-.38	-.49
9	-.22	.45	-1.22	-.49	-1.03	-1.26
10	No data for this fleet at this age					

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.25	-.17	.84	-.06	-.59	-.67	-.10	-.34	-.57	.24
2	-.70	.51	.05	.06	.09	-.36	.10	.05	-.14	-.01
3	.15	-.63	.39	-.26	.22	.13	.26	.22	.29	.07
4	-.10	.40	-.60	.47	-.36	.36	.49	.22	.05	.26
5	-.14	.31	.29	-.48	-.03	-.17	.25	.82	.07	-.07
6	.09	.28	.17	.37	-.81	.49	-.73	.45	.77	-.06
7	.25	-.23	.08	-.26	-.42	-.50	-.29	.33	.23	.25
8	-.43	-.11	.51	-.28	-.26	-.07	-1.91	.48	-.98	-.08
9	-.44	-.12	-.61	.08	-.85	-1.88	.13	-.57	.34	-1.35
10	No data for this fleet at this age									

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
Mean Log q	-15.7787	-15.4404	-15.6783	-16.0978	-16.2538	-16.2538	-16.2538	-16.2538
S.E(Log q)	.2942	.2955	.3458	.3380	.4641	.4657	.6653	.8852

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.73	1.410	16.52	.66	16	.45	-18.03

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	.82	1.602	15.02	.84	16	.23	-15.78
3	.92	.462	15.04	.71	16	.28	-15.44
4	.95	.253	15.35	.64	16	.34	-15.68
5	.89	.655	15.20	.71	16	.31	-16.10
6	.99	.019	16.21	.49	16	.48	-16.25
7	1.54	-1.630	21.88	.40	16	.62	-16.43
8	.84	.666	14.81	.57	16	.51	-16.56
9	1.12	-.372	18.28	.42	16	.77	-16.82

Table 3.4.2 (continued)

Fleet : FLT04: ENGTRL_IV (Ca

Age	1983	1984	1985	1986	1987	1988
1	-.95	-.02	-.17	.88	-.90	.28
2	.23	-.55	-.19	-.18	.12	-.72
3	-.36	.02	-.43	.08	-.05	-.07
4	.18	-.02	.08	-.22	.44	-.58
5	-.01	.37	.17	.57	-.39	.36
6	.67	.22	.23	.01	.17	.03
7	.79	.69	.22	-.16	-.51	.19
8	.99	.70	.43	-.06	-.21	99.99
9	-.05	.40	.25	-.22	.23	-.04
10	No data for this fleet at this age					

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.27	.14	.28	.27	.18	.19	.23	.36	-.43	-.05
2	-.46	-.17	-.20	.07	.15	.33	.10	.33	.44	.68
3	-.54	-.37	.03	-.11	-.23	.20	.44	.48	.13	.77
4	.11	-.32	-.53	.27	-.07	-.17	-.13	.51	.38	.08
5	-.41	.31	-.45	-.44	.48	-.29	-.59	.07	.33	-.08
6	.32	.12	-.17	-.62	-.49	-.10	-.60	.19	.12	-.11
7	-.21	.60	-.62	-.13	.04	-.49	-.39	-.15	.02	-.78
8	.25	.65	-.23	99.99	.10	-.11	-.69	.44	.22	-.31
9	99.99	.58	99.99	99.99	99.99	.37	-.59	.01	-.18	.03
10	No data for this fleet at this age									

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
Mean Log q	-15.2729	-15.2805	-15.7413	-16.2247	-16.5040	-16.5040	-16.5040	-16.5040
S.E(Log q)	.3772	.3549	.3204	.3847	.3439	.4687	.4875	.3273

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.90	.464	17.07	.63	16	.48	-17.56

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	.88	.722	14.83	.71	16	.34	-15.27
3	.89	.580	14.72	.65	16	.32	-15.28
4	.71	2.484	13.85	.84	16	.20	-15.74
5	.65	3.188	13.39	.85	16	.20	-16.22
6	.66	3.369	13.36	.88	16	.17	-16.50
7	.68	2.103	13.29	.76	16	.29	-16.56
8	.77	1.341	13.84	.74	14	.34	-16.35
9	.88	.992	14.95	.86	12	.28	-16.44

Table 3.4.2 (continued)

Fleet : FLT05: ENGSEI_IV (Ca

Age	1983	1984	1985	1986	1987	1988
1	.00	-.04	-.22	-.28	-.12	.53
2	.36	-.19	.09	-.91	-.12	.02
3	.22	.50	-.31	-.09	-.86	.20
4	.62	.27	.19	-.51	.20	-.82
5	.38	.53	.06	.28	-.28	.20
6	.47	-.03	.23	.03	.51	-.23
7	.79	.35	.36	.51	-.05	.00
8	.36	.61	.65	.32	.75	.07
9	.65	.30	.66	.24	.87	.00
10	1.30	.29	.77	1.08	.01	-.06

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.30	.64	.17	.48	-.16	.12	.31	-.07	-.79	-.87
2	.26	.29	-.43	.14	-.17	.07	.20	.34	-.16	.22
3	.02	-.20	-.01	-.55	-.76	.13	.40	1.05	-.04	.27
4	.21	-.12	-.26	-.13	-.22	-.43	-.21	.73	.58	-.10
5	-1.07	.01	-.19	-.78	.02	.54	-.42	.58	.09	.05
6	.33	-1.29	.21	-.50	-.91	.58	-.11	.57	.09	.06
7	-.17	.35	.05	-.01	-.16	.06	.96	.60	.83	-.11
8	.65	-.03	1.42	.34	-.10	.16	1.10	1.00	.37	.31
9	-.11	.18	-.52	1.12	99.99	-.13	1.20	-.49	1.05	.45
10	.48	.93	1.77	99.99	1.21	-.58	-.07	1.74	1.38	.46

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
Mean Log q	-15.7014	-15.7858	-15.8718	-15.3336	-14.9550	-14.9550	-14.9550	-14.9550	-14.9550
S.E(Log q)	.3298	.4799	.4301	.4638	.5269	.4688	.6640	.6730	1.0237

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.66	1.796	16.22	.67	16	.44	-18.16

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	.81	1.527	14.91	.81	16	.25	-15.70
3	.59	2.938	13.56	.78	16	.23	-15.79
4	.64	2.653	13.44	.79	16	.23	-15.87
5	.64	2.501	12.76	.78	16	.26	-15.33
6	.64	2.053	12.16	.70	16	.31	-14.95
7	.96	.205	14.34	.65	16	.37	-14.68
8	.84	.955	13.02	.73	16	.36	-14.46
9	1.17	-.584	16.32	.47	15	.67	-14.59
10	1.45	-1.244	19.01	.37	15	1.01	-14.24

Table 3.4.2 (continued)

```
Fleet : FLT06: SCOGFS_IV (Ca

 Age  ,  1983,  1984,  1985,  1986,  1987,  1988
    1 ,  -.33,  -.10, -1.02,  -.27,  -.52,  -.40
    2 ,   .04,  -.15,   .39,  -.82,  -.20,  -.32
    3 ,   .21,  -.01,   .16,   .40, -1.01,  -.59
    4 ,   .46,  -.01,   .16,   .00,   .02,  -.31
    5 ,   .67,   .15,   .36,   .10,   .24,  -.05
    6 ,   .28,   .09,   .21,   .88,  -.53,   .34
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age


 Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    1 ,   .32,  -.35,   .27,   .33,   .46,   .72,   .31,   .20,   .17,   .21
    2 ,  -.70,   .23,  -.29,  -.26,   .48,   .20,   .96,  -.16,  -.20,   .80
    3 ,   .21,  -.56,  -.10,  -.20,   .08,   .48,   .11,   .84,   .18,  -.21
    4 ,   .03,   .46, -1.08,   .26,  -.24,  -.05,   .20,   .41,  -.01,  -.29
    5 ,   .34,  -.27, -1.08,   .62,  -.53,   .00,  -.23,   .10,  -.07,  -.35
    6 ,  -.40,   .38, -1.06,  1.05,  -.69,   .09,   .35,  -.31,  -.33,  -.36
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age


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
Mean Log q,  -16.3558,  -16.1055,  -15.9867,  -15.9081,  -15.9143,
S.E(Log q),     .4874,     .4503,     .3760,     .4381,     .5637,


Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 1,     .87,     .636,     16.87,     .65,     16,     .46,  -17.51,

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,    2.286,     14.79,     .77,     16,     .29,  -16.36,
 3,     .72,    1.464,     14.50,     .66,     16,     .31,  -16.11,
 4,     .74,    1.607,     14.26,     .74,     16,     .27,  -15.99,
 5,     .95,     .201,     15.53,     .55,     16,     .43,  -15.91,
 6,    1.45,    -.952,     19.82,     .24,     16,     .82,  -15.91,
```

Table 3.4.2 (continued)

Fleet : FLT07: ENGGFS_IV (Ca

Age	1983	1984	1985	1986	1987	1988
1	-.13	.15	-.23	-.38	-.03	.00
2	.27	-.05	.33	-.83	.05	-.07
3	.26	.10	.02	.19	-.78	.06
4	.80	.69	.39	.23	.53	-2.65
5	.65	.12	.97	-.22	.48	1.19
6	No data for this fleet at this age					
7	No data for this fleet at this age					
8	No data for this fleet at this age					
9	No data for this fleet at this age					
10	No data for this fleet at this age					

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.29	.18	.07	.22	.15	.15	-.08	-.14	-.01	-.20
2	-.20	.15	-.39	-.56	.24	-.03	.73	.37	-.28	.27
3	.32	-.08	-.25	-.18	.33	.31	.49	.09	-.78	-.10
4	.52	-.29	-.16	.53	.18	.38	.70	-.03	-.49	-1.33
5	.11	-.08	-.81	.30	.88	.09	-.97	.53	-2.20	-1.05
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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
Mean Log q	-16.2532	-16.5670	-16.9084	-16.8759
S.E(Log q)	.3907	.3660	.8930	.8843

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.63	4.596	14.81	.92	16	.19	-16.24

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	3.305	14.71	.87	16	.20	-16.25
3	.84	.834	15.58	.66	16	.31	-16.57
4	.59	1.333	13.76	.43	16	.51	-16.91
5	.83	.413	15.36	.29	16	.75	-16.88

Table 3.4.2 (continued)

```
Fleet : FLT08: IBTS_Q1_IV (C
 Age  ,  1983,  1984,  1985,  1986,  1987,  1988
    1 ,  -.78,  -.19, -1.35,  -.27,   .07,  -.35
    2 ,  -.18,  -.33,  -.09,  -.46,   .27,  -.45
    3 ,  -.15,  -.25,   .10,   .25,  -.21,  -.09
    4 ,  -.28,  -.02,  -.01,   .71,  -.02,  -.09
    5 ,  -.14,  -.15,   .03,   .36,   .12,   .08
    6 ,   .17,  -.15,  -.31,   .64,  -.04,   .55
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age


 Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    1 ,   .45,  -.01,  -.55,   .33,  1.02,   .34,   .33,  -.29,   .79,   .47
    2 ,  -.02,   .48,  -.12,  -.26,   .63,  -.27,   .57,  -.08,  -.01,   .31
    3 ,   .59,   .01,   .19,  -.28,   .09,  -.14,   .24,   .35,  -.39,  -.31
    4 ,   .22,   .12,   .13,   .00,   .12,   .25,  -.11,  -.16,  -.44,  -.40
    5 ,   .17,   .21,  -.08,  -.20,   .24,   .55,  -.03,  -.15,  -.25,  -.78
    6 ,   .08,   .69,  -.13,   .06,  -.08,   .03,  -.11,   .01,  -.82,  -.59
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age


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
Mean Log q,   -9.1990,   -9.1573,   -8.9885,   -8.6169,   -7.5086,
S.E(Log q),     .3506,     .2733,     .2768,     .3026,     .4000,


Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 1,     .88,     .465,     10.62,     .50,     16,     .63,  -10.36,

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,     .80,    1.475,      9.68,     .80,     16,     .27,   -9.20,
 3,     .95,     .310,      9.22,     .72,     16,     .27,   -9.16,
 4,    1.24,   -1.211,      8.93,     .64,     16,     .34,   -8.99,
 5,    1.33,   -1.512,      8.76,     .60,     16,     .39,   -8.62,
 6,    1.40,   -1.270,      7.62,     .42,     16,     .55,   -7.51,
```

Table 3.4.2 (continued)

```
Terminal year survivor and F summaries :

Age  1   Catchability dependent on age and year class strength

Year class = 1997

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SCOTRL_IV (Ca,     72060.,   .733,       .000,    .00,   1,  .040,     .011
FLT02: SCOSEI_IV (Ca,     25903.,   .337,       .000,    .00,   1,  .191,     .031
FLT03: SCOLTR_IV (Ca,     37217.,   .489,       .000,    .00,   1,  .090,     .021
FLT04: ENGTRL_IV (Ca,     27643.,   .546,       .000,    .00,   1,  .072,     .029
FLT05: ENGSEI_IV (Ca,     12156.,   .563,       .000,    .00,   1,  .068,     .064
FLT06: SCOGFS_IV (Ca,     35875.,   .509,       .000,    .00,   1,  .083,     .022
FLT07: ENGGFS_IV (Ca,     23931.,   .300,       .000,    .00,   1,  .240,     .033
FLT08: IBTS_Q1_IV (C,     46613.,   .664,       .000,    .00,   1,  .049,     .017
  P shrinkage mean  ,    137937.,    .54,,,,                        .077,     .006
  F shrinkage mean  ,     11185.,    .50,,,,                        .089,     .070

Weighted prediction :
Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    29135.,       .15,      .21,   10,   1.404,   .027


Age  2   Catchability constant w.r.t. time and dependent on age
Year class = 1996
Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SCOTRL_IV (Ca,     92987.,   .454,       .474,   1.05,   2,  .046,     .531
FLT02: SCOSEI_IV (Ca,     61551.,   .230,       .138,    .60,   2,  .178,     .722
FLT03: SCOLTR_IV (Ca,     72894.,   .254,       .252,    .99,   2,  .149,     .639
FLT04: ENGTRL_IV (Ca,    114268.,   .308,       .533,   1.73,   2,  .101,     .451
FLT05: ENGSEI_IV (Ca,     75925.,   .272,       .477,   1.75,   2,  .129,     .620
FLT06: SCOGFS_IV (Ca,    141279.,   .354,       .315,    .89,   2,  .075,     .379
FLT07: ENGGFS_IV (Ca,     95154.,   .241,       .134,    .56,   2,  .161,     .522
FLT08: IBTS_Q1_IV (C,    128974.,   .322,       .193,    .60,   2,  .093,     .409
  F shrinkage mean  ,     65156.,    .50,,,,                        .069,     .693

Weighted prediction :
Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    86370.,       .10,      .10,   17,   1.032,   .562


Age  3   Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SCOTRL_IV (Ca,      8668.,   .325,       .339,   1.04,   3,  .066,     .979
FLT02: SCOSEI_IV (Ca,      8953.,   .200,       .113,    .57,   3,  .152,     .959
FLT03: SCOLTR_IV (Ca,      8572.,   .205,       .103,    .50,   3,  .156,     .986
FLT04: ENGTRL_IV (Ca,     16638.,   .246,       .129,    .52,   3,  .108,     .624
FLT05: ENGSEI_IV (Ca,      9129.,   .249,       .139,    .56,   3,  .092,     .947
FLT06: SCOGFS_IV (Ca,      8091.,   .291,       .126,    .43,   3,  .074,    1.023
FLT07: ENGGFS_IV (Ca,      7714.,   .213,       .048,    .22,   3,  .132,    1.053
FLT08: IBTS_Q1_IV (C,      7108.,   .227,       .093,    .41,   3,  .135,    1.107
  F shrinkage mean  ,      9172.,    .50,,,,                        .085,     .944
Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     8983.,       .09,      .06,   25,    .691,   .957
```

Table 3.4.2 (continued)

Age 4 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
FLT01: SCOTRL_IV (Ca,	7008.,	.313,	.208,	.67,	4,	.063,	.562
FLT02: SCOSEI_IV (Ca,	5628.,	.201,	.029,	.14,	4,	.156,	.662
FLT03: SCOLTR_IV (Ca,	5777.,	.204,	.067,	.33,	4,	.146,	.650
FLT04: ENGTRL_IV (Ca,	5280.,	.226,	.045,	.20,	4,	.134,	.694
FLT05: ENGSEI_IV (Ca,	4864.,	.260,	.110,	.42,	4,	.090,	.736
FLT06: SCOGFS_IV (Ca,	4055.,	.269,	.131,	.49,	4,	.095,	.834
FLT07: ENGGFS_IV (Ca,	2969.,	.229,	.326,	1.43,	4,	.072,	1.023
FLT08: IBTS_Q1_IV (C,	3291.,	.204,	.086,	.42,	4,	.165,	.958
F shrinkage mean ,	4389.,	.50,,,,				.078,	.790

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4656.,	.09,	.06,	33,	.680,	.759

Age 5 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
FLT01: SCOTRL_IV (Ca,	3556.,	.306,	.050,	.16,	5,	.068,	.470
FLT02: SCOSEI_IV (Ca,	4722.,	.191,	.054,	.28,	5,	.183,	.373
FLT03: SCOLTR_IV (Ca,	3259.,	.204,	.076,	.37,	5,	.151,	.504
FLT04: ENGTRL_IV (Ca,	3838.,	.220,	.117,	.53,	5,	.129,	.443
FLT05: ENGSEI_IV (Ca,	4474.,	.265,	.167,	.63,	5,	.086,	.390
FLT06: SCOGFS_IV (Ca,	3193.,	.259,	.215,	.83,	5,	.094,	.512
FLT07: ENGGFS_IV (Ca,	2790.,	.280,	.290,	1.04,	5,	.047,	.569
FLT08: IBTS_Q1_IV (C,	2035.,	.191,	.217,	1.14,	5,	.181,	.718
F shrinkage mean ,	2058.,	.50,,,,				.061,	.712

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3257.,	.08,	.07,	41,	.820,	.504

Age 6 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
FLT01: SCOTRL_IV (Ca,	1126.,	.301,	.161,	.53,	6,	.075,	.338
FLT02: SCOSEI_IV (Ca,	805.,	.188,	.065,	.35,	6,	.185,	.446
FLT03: SCOLTR_IV (Ca,	745.,	.209,	.075,	.36,	6,	.137,	.475
FLT04: ENGTRL_IV (Ca,	825.,	.210,	.118,	.56,	6,	.160,	.437
FLT05: ENGSEI_IV (Ca,	873.,	.268,	.116,	.43,	6,	.088,	.418
FLT06: SCOGFS_IV (Ca,	699.,	.262,	.134,	.51,	6,	.089,	.499
FLT07: ENGGFS_IV (Ca,	502.,	.280,	.523,	1.87,	5,	.029,	.643
FLT08: IBTS_Q1_IV (C,	530.,	.191,	.119,	.62,	6,	.171,	.617
F shrinkage mean ,	426.,	.50,,,,				.067,	.724

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
718.,	.08,	.06,	48,	.674,	.489

Table 3.4.2 (continued)

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6
Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOTRL_IV (Ca,	854.,	.321,	.105,	.33,	7,	.073,	.216
FLT02: SCOSEI_IV (Ca,	606.,	.202,	.030,	.15,	7,	.190,	.293
FLT03: SCOLTR_IV (Ca,	809.,	.229,	.111,	.49,	7,	.157,	.227
FLT04: ENGTRL_IV (Ca,	397.,	.219,	.168,	.77,	7,	.176,	.419
FLT05: ENGSEI_IV (Ca,	511.,	.278,	.103,	.37,	7,	.122,	.339
FLT06: SCOGFS_IV (Ca,	486.,	.276,	.119,	.43,	6,	.063,	.354
FLT07: ENGGFS_IV (Ca,	732.,	.314,	.084,	.27,	5,	.018,	.248
FLT08: IBTS_Q1_IV (C,	336.,	.200,	.163,	.81,	6,	.122,	.479
F shrinkage mean ,	164.,	.50,,,,				.079,	.814

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
491.,	.09,	.07,	53,	.796,	.351

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOTRL_IV (Ca,	77.,	.345,	.256,	.74,	7,	.047,	.384
FLT02: SCOSEI_IV (Ca,	76.,	.252,	.123,	.49,	8,	.178,	.390
FLT03: SCOLTR_IV (Ca,	68.,	.279,	.073,	.26,	8,	.155,	.429
FLT04: ENGTRL_IV (Ca,	49.,	.260,	.089,	.34,	8,	.209,	.555
FLT05: ENGSEI_IV (Ca,	86.,	.318,	.157,	.49,	8,	.134,	.350
FLT06: SCOGFS_IV (Ca,	46.,	.285,	.058,	.20,	6,	.038,	.576
FLT07: ENGGFS_IV (Ca,	46.,	.342,	.290,	.85,	5,	.010,	.582
FLT08: IBTS_Q1_IV (C,	59.,	.205,	.050,	.24,	6,	.073,	.480
F shrinkage mean ,	29.,	.50,,,,				.155,	.818

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
57.,	.12,	.06,	57,	.514,	.491

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOTRL_IV (Ca,	9.,	.341,	.095,	.28,	7,	.021,	.986
FLT02: SCOSEI_IV (Ca,	17.,	.287,	.100,	.35,	9,	.212,	.615
FLT03: SCOLTR_IV (Ca,	7.,	.340,	.222,	.65,	9,	.099,	1.093
FLT04: ENGTRL_IV (Ca,	15.,	.249,	.064,	.26,	9,	.308,	.689
FLT05: ENGSEI_IV (Ca,	22.,	.366,	.075,	.21,	9,	.111,	.511
FLT06: SCOGFS_IV (Ca,	16.,	.294,	.108,	.37,	6,	.017,	.649
FLT07: ENGGFS_IV (Ca,	14.,	.320,	.098,	.31,	5,	.004,	.699
FLT08: IBTS_Q1_IV (C,	17.,	.212,	.140,	.66,	6,	.033,	.621
F shrinkage mean ,	14.,	.50,,,,				.197,	.701

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
15.,	.15,	.05,	61,	.339,	.690

Table 3.4.2 (continued)

```
Age 10   Catchability constant w.r.t. time and age (fixed at the value for age)  6

Year class = 1988

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SCOTRL_IV (Ca,        22.,   .373,       .120,    .32,   7,  .016,     .151
FLT02: SCOSEI_IV (Ca,        20.,   .269,       .056,    .21,  10,  .331,     .167
FLT03: SCOLTR_IV (Ca,        20.,   .359,       .108,    .30,   9,  .078,     .169
FLT04: ENGTRL_IV (Ca,        14.,   .258,       .080,    .31,   9,  .256,     .225
FLT05: ENGSEI_IV (Ca,        36.,   .388,       .102,    .26,  10,  .120,     .097
FLT06: SCOGFS_IV (Ca,        15.,   .305,       .140,    .46,   6,  .011,     .221
FLT07: ENGGFS_IV (Ca,        22.,   .342,       .224,    .66,   5,  .003,     .151
FLT08: IBTS_Q1_IV (C,        18.,   .219,       .051,    .23,   6,  .022,     .186
  F shrinkage mean  ,         5.,    .50,,,,                        .163,     .509

Weighted prediction :
Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       16.,       .15,      .08,   63,    .526,   .206
```

Table 3.4.3

Run title : Cod in IIIa,IV,VIId (run: XSAJC107/X07)

At 19/10/1999 7:39

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1963,	1964,	1965,	1966,	1967,	1968,
AGE						
1,	.0249,	.0203,	.0585,	.0551,	.0335,	.0457,
2,	.5316,	.3759,	.4704,	.5499,	.4973,	.6353,
3,	.3677,	.5929,	.6601,	.6280,	.7287,	.7390,
4,	.4525,	.4171,	.6211,	.5283,	.5326,	.7113,
5,	.4543,	.4767,	.4312,	.4894,	.5972,	.6228,
6,	.5625,	.6126,	.4612,	.4346,	.5988,	.5646,
7,	.1602,	.6078,	.4678,	.4452,	.6200,	.5823,
8,	.7852,	.3700,	.7098,	.5271,	.7130,	.4542,
9,	.3115,	.3262,	.2696,	.7630,	.3800,	.7773,
10,	.4581,	.4823,	.4714,	.5362,	.5868,	.6055,
+gp,	.4581,	.4823,	.4714,	.5362,	.5868,	.6055,
0 FBAR 2- 8,	.4734,	.4933,	.5459,	.5147,	.6125,	.6156,
FBAR 2- 4,	.4506,	.4620,	.5839,	.5687,	.5862,	.6952,

Table 8 Fishing mortality (F) at age

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.0213,	.1098,	.0763,	.0335,	.1292,	.0922,	.1080,	.0352,	.1439,	.0953,
2,	.3906,	.5787,	.8862,	.8906,	.6965,	.8120,	.7335,	.9384,	.8422,	1.0248,
3,	.6001,	.7465,	.7701,	.9069,	.8384,	.6696,	.7844,	.8571,	.7692,	.9219,
4,	.5817,	.5710,	.7086,	.6527,	.7782,	.6415,	.6698,	.7566,	.5482,	.7642,
5,	.6282,	.5845,	.6945,	.7100,	.5738,	.6397,	.7445,	.5709,	.6351,	.8683,
6,	.6990,	.5316,	.5377,	.8030,	.7210,	.5317,	.6718,	.7947,	.6006,	.7410,
7,	.4867,	.5279,	.5693,	.7790,	.6900,	.7127,	.5117,	.7400,	.8034,	.6795,
8,	.6313,	.3177,	.5188,	1.0275,	.5434,	.6020,	.8396,	.2719,	.7711,	.7619,
9,	.4065,	.6420,	.6898,	1.2287,	.3375,	.9127,	.8787,	.7969,	1.4535,	.8803,
10,	.5752,	.5249,	.6073,	.9196,	.5780,	.6861,	.7364,	.6406,	.8617,	.7942,
+gp,	.5752,	.5249,	.6073,	.9196,	.5780,	.6861,	.7364,	.6406,	.8617,	.7942,
0 FBAR 2- 8,	.5739,	.5511,	.6693,	.8243,	.6916,	.6585,	.7079,	.7042,	.7100,	.8231,
FBAR 2- 4,	.5241,	.6321,	.7883,	.8168,	.7710,	.7077,	.7292,	.8507,	.7199,	.9037,

Table 3.4.3 (continued)

Run title : Cod in IIIa,IV,VIId (run: XSAJC107/X07)
At 19/10/1999 7:39

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.1041,	.1096,	.1010,	.1756,	.1258,	.1767,	.0868,	.2342,	.1414,	.1775,
2,	.7939,	.8824,	.9716,	.9375,	1.0857,	.9540,	.9840,	.8946,	.9166,	.9148,
3,	.9488,	.9819,	1.0106,	1.2327,	1.1895,	1.0183,	.9574,	1.0595,	.8914,	1.1847,
4,	.5858,	.7911,	.7721,	.9192,	.9153,	.8288,	.8073,	.9550,	.9256,	.8582,
5,	.7011,	.6419,	.6782,	.7942,	.7865,	.7510,	.7114,	.8682,	.7240,	.7884,
6,	.5116,	.6261,	.5784,	.9022,	.7679,	.7462,	.6996,	.8107,	.9328,	.8079,
7,	.6574,	.8374,	.7019,	.7373,	.7248,	.6737,	.6848,	.7848,	.9008,	.7271,
8,	.5205,	.8257,	.5679,	.6648,	.8281,	.7617,	.6252,	.7999,	.8278,	.6959,
9,	.7861,	.5814,	.7282,	.7842,	.5793,	.7379,	.6007,	.5502,	.6565,	.6182,
10,	.6411,	.7092,	.6569,	.7843,	.7383,	.6526,	.4393,	.8214,	.9765,	.6425,
+gp,	.6411,	.7092,	.6569,	.7843,	.7383,	.6526,	.4393,	.8214,	.9765,	.6425,
0 FBAR 2- 8,	.6742,	.7981,	.7544,	.8840,	.8997,	.8191,	.7814,	.8818,	.8741,	.8539,
FBAR 2- 4,	.7762,	.8852,	.9181,	1.0298,	1.0635,	.9337,	.9162,	.9697,	.9112,	.9859,

Table 8 Fishing mortality (F) at age

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
1,	.1289,	.1401,	.1266,	.1437,	.0487,	.0713,	.1042,	.0419,	.0715,	.0273,	.0469,
2,	.8773,	.9087,	.7640,	.8468,	.7954,	.6326,	.7700,	.6105,	.5966,	.5622,	.5898,
3,	1.0910,	.9696,	.9618,	.8510,	1.0138,	.9876,	.9413,	.8561,	.8566,	.9570,	.8899,
4,	1.0160,	.8930,	.8437,	.9267,	.9609,	.9083,	.7529,	.6527,	.6380,	.7586,	.6831,
5,	.7564,	.7731,	.8311,	.7304,	.8846,	.7715,	.6354,	.6565,	.5786,	.5044,	.5798,
6,	.9009,	.5573,	.9361,	.8188,	.7750,	.8478,	.6291,	.7755,	.5561,	.4886,	.6067,
7,	.8720,	.7641,	1.0826,	.8953,	1.0311,	.6287,	.6428,	.9315,	.7957,	.3509,	.6927,
8,	.9669,	.4552,	.9894,	.8009,	.8688,	.9849,	.3801,	1.0270,	.7877,	.4915,	.7687,
9,	.6979,	1.9177,	.4543,	.9012,	.7320,	.6950,	.7548,	.8632,	.4283,	.6896,	.6604,
10,	.7220,	.7942,	.6400,	.5559,	.5917,	.7187,	.6892,	.4575,	.8772,	.2065,	.5137,
+gp,	.7220,	.7942,	.6400,	.5559,	.5917,	.7187,	.6892,	.4575,	.8772,	.2065,	
0 FBAR 2- 8,	.9258,	.7601,	.9155,	.8386,	.9042,	.8231,	.6788,	.7871,	.6870,	.5876,	
FBAR 2- 4,	.9948,	.9238,	.8565,	.8748,	.9234,	.8428,	.8214,	.7064,	.6971,	.7593,	

Table 3.4.4

Run title : Cod in IIIa,IV,VIId (run: XSAJC107/X07)
At 19/10/1999 7:39

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1963,	1964,	1965,	1966,	1967,	1968,
AGE						
1,	195108,	374091,	415441,	506863,	488808,	194595,
2,	123043,	85513,	164718,	176070,	215532,	212394,
3,	25892,	50953,	41378,	72517,	71595,	92370,
4,	10736,	13961,	21933,	16654,	30138,	26907,
5,	8439,	5591,	7532,	9649,	8039,	14486,
6,	3116,	4386,	2842,	4007,	4842,	3622,
7,	605,	1453,	1946,	1467,	2124,	2178,
8,	1000,	422,	648,	998,	770,	936,
9,	58,	373,	238,	261,	482,	309,
10,	18,	35,	221,	149,	100,	270,
+gp,	0,	11,	23,	219,	42,	58,
0 TOTAL,	368013,	536789,	656920,	788853,	822473,	548125,

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

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	209058,	781996,	910806,	173523,	319661,	263679,	486533,	246612,	839153,	488052,
2,	83530,	91960,	314846,	379205,	75400,	126227,	108047,	196239,	106973,	326505,
3,	79295,	39829,	36332,	91463,	109667,	26477,	39490,	36565,	54104,	32471,
4,	34356,	33888,	14703,	13099,	28760,	36932,	10556,	14037,	12085,	19526,
5,	10817,	15723,	15675,	5927,	5584,	10814,	15919,	4423,	5393,	5719,
6,	6362,	4725,	7175,	6408,	2386,	2575,	4670,	6190,	2046,	2340,
7,	1686,	2589,	2273,	3431,	2350,	950,	1239,	1953,	2290,	919,
8,	996,	849,	1250,	1053,	1289,	965,	381,	608,	763,	839,
9,	486,	434,	506,	609,	309,	613,	433,	135,	379,	289,
10,	116,	265,	187,	208,	146,	180,	201,	147,	50,	73,
+gp,	195,	107,	226,	33,	403,	415,	132,	99,	181,	87,
0 TOTAL,	426897,	972365,	1303978,	674959,	545955,	469828,	667602,	507010,	1023417,	876819,

1

Table 3.4.4 (continued)

Run title : Cod in IIIa,IV,VIId (run: XSAJC107/X07)
At 19/10/1999 7:39

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	525507	899625	314811	618517	324834	596381	158644	716246	281892	197073
2	199366	212774	362262	127860	233155	128708	224567	65354	254638	109961
3	82569	63515	62041	96619	35286	55481	34935	59155	18825	71753
4	10059	24898	18529	17588	21934	8364	15608	10445	15969	6012
5	7445	4584	9241	7010	5744	7191	2990	5700	3291	5181
6	1965	3023	1975	3840	2594	2142	2778	1202	1959	1306
7	913	965	1324	907	1275	985	831	1130	437	631
8	381	387	342	537	355	506	411	343	422	145
9	321	186	139	159	226	127	193	180	126	151
10	98	120	85	55	59	104	50	87	85	54
+gp	39	54	48	32	48	46	96	45	21	41
0 TOTAL	828663	1210131	770797	873123	625511	800034	441104	859887	577665	392310

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

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 63-96	AMST 63-96
AGE													
1	274287	133921	168889	308390	150101	337151	236995	179613	514055	66635	(0)*	335212	391672
2	74152	108338	52306	66860	120022	64239	141064	95953	77395	215047	29135	138480	159641
3	31041	21733	30770	17169	20203	38180	24047	46028	36721	30033	86370	44440	50287
4	17091	8120	6419	9159	5710	5709	11075	7306	15228	12143	8983	14290	16420
5	2087	5066	2722	2260	2968	1788	1885	4271	3114	6587	4656	5733	6799
6	1928	802	1915	971	891	1003	677	817	1814	1430	3257	2410	2926
7	477	641	376	615	350	336	352	295	308	851	718	1009	1244
8	250	163	245	104	206	102	147	152	95	114	491	441	558
9	59	78	85	74	38	71	31	82	44	35	57	183	242
10	67	24	9	44	25	15	29	12	28	24	15	71	100
+gp	21	18	23	23	32	34	11	24	19	71	63		
TOTAL	401461	278904	263758	405670	300547	448629	416313	334554	648822	332970	133744		

* replaced by RCT3 estimate

Table 3.4.5

Run title : Cod in IIIa,IV,VIId (run: XSAJC107/X07)
At 19/10/1999 7:39

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

YEAR,	RECRUITS(age 1),	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 8,	FBAR 2- 4,
1963,	195108,	452114,	151517,	116457,	.7686,	.4734,	.4506,
1964,	374091,	542257,	166128,	126041,	.7587,	.4933,	.4620,
1965,	415441,	714022,	205376,	181036,	.8815,	.5459,	.5839,
1966,	506863,	859769,	230735,	221336,	.9593,	.5147,	.5687,
1967,	488808,	923777,	250047,	252977,	1.0117,	.6125,	.5862,
1968,	194595,	788670,	258247,	288368,	1.1166,	.6156,	.6952,
1969,	209058,	630834,	255981,	200760,	.7843,	.5739,	.5241,
1970,	781996,	973125,	276925,	226124,	.8166,	.5511,	.6321,
1971,	910806,	1180319,	277314,	328098,	1.1831,	.6693,	.7883,
1972,	173523,	809732,	231098,	353976,	1.5317,	.8243,	.8168,
1973,	319661,	655950,	209196,	239051,	1.1427,	.6916,	.7710,
1974,	263679,	623403,	230880,	214279,	.9281,	.6585,	.7077,
1975,	486533,	704702,	211651,	205245,	.9697,	.7079,	.7292,
1976,	246612,	610602,	182115,	234169,	1.2858,	.7042,	.8507,
1977,	839153,	822265,	159440,	209154,	1.3118,	.7100,	.7199,
1978,	488052,	812614,	159580,	297022,	1.8613,	.8231,	.9037,
1979,	525507,	805137,	164671,	269973,	1.6395,	.6742,	.7762,
1980,	899625,	1015782,	182363,	293644,	1.6102,	.7981,	.8852,
1981,	314811,	855788,	196222,	335497,	1.7098,	.7544,	.9181,
1982,	618517,	840662,	190658,	303251,	1.5906,	.8840,	1.0298,
1983,	324834,	649644,	155430,	259287,	1.6682,	.8997,	1.0635,
1984,	596381,	718746,	133948,	228286,	1.7043,	.8191,	.9337,
1985,	158644,	503612,	126993,	214629,	1.6901,	.7814,	.9162,
1986,	716246,	683371,	114413,	204053,	1.7835,	.8818,	.9697,
1987,	281892,	571629,	105043,	216212,	2.0583,	.8741,	.9112,
1988,	197073,	426831,	99336,	184240,	1.8547,	.8539,	.9859,
1989,	274287,	416986,	91182,	139936,	1.5347,	.9258,	.9948,
1990,	133921,	329021,	78539,	125314,	1.5956,	.7601,	.9238,
1991,	168889,	297526,	71669,	102478,	1.4299,	.9155,	.8565,
1992,	308390,	406097,	69563,	114020,	1.6391,	.8386,	.8748,
1993,	150101,	342271,	65812,	121749,	1.8499,	.9042,	.9234,
1994,	337151,	434252,	66146,	110634,	1.6726,	.8231,	.8428,
1995,	236995,	441376,	74631,	136096,	1.8236,	.6788,	.8214,
1996,	179613,	402296,	84920,	126320,	1.4875,	.7871,	.7064,
1997,	514055,	587496,	98293,	124158,	1.2631,	.6870,	.6971,
1998,	66635,	387302,	101176,	146015,	1.4432,	.5876,	.7593,
1999,	(118000)*,		128082,				
Mean ,	386043,	644999,	159090,	206941,	1.3989,	.7305,	.7939,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

* RCT3 estimate

Cod in IIIa (Skagerrak), IV and VIId

Table 3.5.1 RCT3 Input values

COD (IIIa, IV, VIId) RCT3 INPUT VALUES: AGE 1*100; 08-Oct-98

20 30 2

'YEARCL	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS1'	'SGFS2'	'DGFS0'	'DGFS1'	'DGFS2'	'FRGSF'	'GGFS1'	'GGFS2'	'IBQ21'	'SCQ21'	'SCQ22'	'IBQ40'	'IBQ41'	'GQ40'	'GQ11'
1970	911	9830	3450	-1	-1	-1	-1	-1	-1	-1	-1	9040	-1	-1	-1	-1	-1	-1	-1	-1	-1
1971	173	410	1060	-1	-1	-1	-1	-1	-1	-1	-1	130	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	320	3800	950	-1	-1	-1	-1	-1	-1	-1	-1	160	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	264	1470	620	-1	-1	-1	-1	-1	-1	-1	-1	360	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	486	4030	1990	-1	-1	-1	-1	-1	-1	-1	-1	800	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	246	790	320	-1	-1	447	-1	-1	-1	-1	-1	780	-1	-1	-1	-1	-1	-1	-1	-1	-1
1976	839	3670	2930	-1	6270	1250	-1	-1	-1	-1	-1	2820	-1	-1	-1	-1	-1	-1	-1	-1	-1
1977	488	1290	930	1389	2284	580	-1	-1	-1	-1	-1	2720	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	525	990	1480	1256	2423	670	-1	-1	-1	-1	450	3110	-1	-1	-1	-1	-1	-1	-1	-1	-1
1979	900	1690	2550	1855	5084	1386	-1	-1	-1	16380	1120	3550	-1	-1	-1	-1	-1	-1	-1	-1	-1
1980	315	290	670	1023	1136	290	-1	351	4320	4690	160	1410	-1	-1	-1	-1	-1	-1	-1	-1	-1
1981	619	920	1660	7424	3237	1096	614	78	17680	8300	230	2320	-1	350	-1	-1	-1	-1	-1	-1	678.3
1982	325	390	800	255	1540	475	325	391	2690	2180	160	900	590	240	-1	-1	-1	-1	-1	303	66.2
1983	596	1520	1760	9510	6122	1189	819	1143	12150	12130	310	4300	260	2240	-1	-1	-1	-1	-1	566	406
1984	159	90	360	38	430	115	66	104	130	360	20	90	230	260	-1	-1	-1	-1	-1	2	9.6
1985	716	1700	2880	828	3438	1065	801	695	14360	11120	800	950	1540	1140	-1	-1	-1	-1	-1	724.6	197
1986	282	880	610	121	1422	407	219	288	3700	4150	170	230	700	950	-1	-1	-1	-1	-1	242.3	20.8
1987	197	360	630	38	836	248	162	135	3620	1780	220	210	200	720	-1	-1	-1	-1	-1	20	2.6
1988	274	1310	1520	1678	2285	504	561	49	1660	1660	190	420	9020	1470	-1	-1	-1	-1	-1	148.2	2.2
1989	134	340	410	598	608	155	114	154	1370	920	70	60	1190	620	-1	-1	3140	-1	-1	31	1
1990	169	240	450	383	752	159	303	193	2350	720	110	-1	1550	360	850	1490	5330	-1	567	33.8	34.6
1991	308	1300	1990	4840	2440	650	642	749	3980	4540	70	-1	1340	-1	3630	19080	14460	-1	2671	-1	-1
1992	150	1270	440	1684	742	295	347	334	1160	170	90	-1	-1	450	1100	4820	3410	-1	586	-1	1.2
1993	337	1480	2210	377	2637	1277	1158	1443	2410	4690	-1	-1	3080	1430	3200	2030	20470	-1	2552	8.4	-1
1994	237	970	800	2134	1028	668	475	356	6350	-1	-1	-1	430	-1	1960	4270	5660	-1	1489	133.4	32
1995	180	350	690	26	619	284	318	278	-1	-1	-1	-1	-1	-1	370	770	1920	-1	791	41	25.4
1996	-1	4000	2640	4122	4044	1396	999	-1	-1	-1	-1	-1	-1	-1	7580	2830	-1	-1	-1	109.2	9.4
1997	-1	270	160	4.9	118	55	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5.5	0.5
1998	-1	210	-1	389	367	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	4.1	1.3
1999	-1	-1	-1	95	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 3.5.2 RCT3 output for COD in IIIa, IV and VIId.

RCT3 output
COD in IIIa, IV and VIId

AGE 1*100
Data for 20 surveys over 30 years : 1970 - 1999

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
IYFS1	.81	.22	.61	.492	26	8.29	6.96	.665	.045
IYFS2	.97	-.97	.38	.708	26	7.88	6.71	.419	.115
EGFS0	.61	1.79	.90	.300	19	8.32	6.84	.999	.020
EGFS1	.79	-.11	.24	.869	20	8.31	6.49	.264	.288
EGFS2	.90	.21	.34	.759	21	7.24	6.71	.380	.139
SGFS1	.94	.07	.53	.519	15	6.91	6.56	.621	.052
IBQ21	.47	2.01	.26	.672	6	8.93	6.18	.440	.104
SCQ21	.73	-.49	.84	.165	6	7.95	5.33	1.106	.016
GQ40	.42	3.77	.52	.516	12	4.70	5.76	.596	.057
GQ11	.35	4.46	.39	.703	13	2.34	5.28	.439	.105
					VPA Mean =		5.80	.583	.059

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
IYFS1	.81	.22	.61	.492	26	5.60	4.77	.661	.070
IYFS2	.97	-.97	.38	.708	26	5.08	3.99	.456	.146
EGFS0	.61	1.79	.90	.300	19	1.77	2.86	1.151	.023
EGFS1	.79	-.11	.24	.869	20	4.78	3.69	.319	.298
EGFS2	.90	.21	.34	.759	21	4.03	3.82	.431	.163
GQ40	.42	3.77	.52	.516	12	1.87	4.56	.643	.073
GQ11	.35	4.46	.39	.703	13	.41	4.60	.469	.138
					VPA Mean =		5.80	.583	.089

Table 3.5.2 (Cont'd)

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
IYFS1	.81	.22	.61	.492	26	5.35	4.57	.669	.086
IYFS2									
EGFS0	.61	1.79	.90	.300	19	5.97	5.41	.974	.040
EGFS1	.79	-.11	.24	.869	20	5.91	4.58	.279	.491
GQ40	.42	3.77	.52	.516	12	1.63	4.46	.653	.090
GQ11	.35	4.46	.39	.703	13	.83	4.75	.460	.181
					VPA Mean =		5.80	.583	.112

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
EGFS0	.61	1.79	.90	.300	19	4.56	4.56	1.004	.252

VPA Mean = 5.80 .583 .748

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	553	6.32	.14	.15	1.19		
1997	65	4.19	.17	.25	2.04		
1998	**118**	**4.77**	**.20**	**.18**	**.87**	**** used for recruits in 1999**	
1999	241	5.49	.50	.54	1.15		

Table 3.7.1 Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak)

Single option prediction: Input data

Year: 1999

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	118000	0.8	0.01	0	0	0.632	0.047	0.632
2	29135	0.35	0.05	0	0	1.001	0.59	1.001
3	86370	0.25	0.23	0	0	1.999	0.89	1.999
4	8983	0.2	0.62	0	0	3.78	0.683	3.78
5	4656	0.2	0.86	0	0	6.091	0.58	6.091
6	3257	0.2	1	0	0	8.162	0.607	8.162
7	718	0.2	1	0	0	9.772	0.694	9.772
8	491	0.2	1	0	0	11.046	0.771	11.046
9	57	0.2	1	0	0	12.024	0.659	12.024
10	15	0.2	1	0	0	12.878	0.517	12.878
11+	63	0.2	1	0	0	13.077	0.517	13.077
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	230000	0.8	0.01	0	0	0.632	0.047	0.632
2	.	0.35	0.05	0	0	1.001	0.59	1.001
3	.	0.25	0.23	0	0	1.999	0.89	1.999
4	.	0.2	0.62	0	0	3.78	0.683	3.78
5	.	0.2	0.86	0	0	6.091	0.58	6.091
6	.	0.2	1	0	0	8.162	0.607	8.162
7	.	0.2	1	0	0	9.772	0.694	9.772
8	.	0.2	1	0	0	11.046	0.771	11.046
9	.	0.2	1	0	0	12.024	0.659	12.024
10	.	0.2	1	0	0	12.878	0.517	12.878
11+	.	0.2	1	0	0	13.077	0.517	13.077
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	230000	0.8	0.01	0	0	0.632	0.047	0.632
2	.	0.35	0.05	0	0	1.001	0.59	1.001
3	.	0.25	0.23	0	0	1.999	0.89	1.999
4	.	0.2	0.62	0	0	3.78	0.683	3.78
5	.	0.2	0.86	0	0	6.091	0.58	6.091
6	.	0.2	1	0	0	8.162	0.607	8.162
7	.	0.2	1	0	0	9.772	0.694	9.772
8	.	0.2	1	0	0	11.046	0.771	11.046
9	.	0.2	1	0	0	12.024	0.659	12.024
10	.	0.2	1	0	0	12.878	0.517	12.878
11+	.	0.2	1	0	0	13.077	0.517	13.077
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name :SpREDB06
Date and time : 20OCT99:11:12

Table 3.7.2.

Cod in IIIa (Skagerrak), IV and VIId.
Input data for catch forecast and linear sensitivity analysis.

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	118000	.20	WS1	.61	.10	M1	.80	.10	MT1	.01	.10
N2	29132	.21	WS2	.97	.08	M2	.35	.10	MT2	.05	.10
N3	86367	.10	WS3	2.16	.10	M3	.25	.10	MT3	.23	.10
N4	8980	.09	WS4	4.07	.10	M4	.20	.10	MT4	.62	.10
N5	4654	.09	WS5	6.34	.08	M5	.20	.10	MT5	.86	.10
N6	3254	.08	WS6	8.45	.07	M6	.20	.10	MT6	1.00	.10
N7	716	.08	WS7	10.11	.07	M7	.20	.10	MT7	1.00	.00
N8	489	.09	WS8	11.21	.06	M8	.20	.10	MT8	1.00	.00
N9	57	.12	WS9	12.58	.07	M9	.20	.10	MT9	1.00	.00
N10	14	.15	WS10	13.73	.10	M10	.20	.10	MT10	1.00	.00
N11	61	.15	WS11	14.44	.23	M11	.20	.10	MT11	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.05	.46	WH1	.61	.10
sH2	.59	.10	WH2	.97	.08
sH3	.89	.21	WH3	2.16	.10
sH4	.68	.24	WH4	4.07	.10
sH5	.58	.01	WH5	6.34	.08
sH6	.61	.11	WH6	8.45	.07
sH7	.69	.34	WH7	10.11	.07
sH8	.77	.22	WH8	11.21	.06
sH9	.66	.30	WH9	12.58	.07
sH10	.52	.63	WH10	13.73	.10
sH11	.52	.63	WH11	14.44	.23

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.14
K00	1.00	.10	HF00	1.00	.14
K01	1.00	.10	HF01	1.00	.14

Recruitment		
Labl	Value	CV
R00	229999	.54
R01	229999	.54

Proportion F before spawning= .00
Proportion M before spawning= .00

Stock numbers in 1999 are VPA survivors.
These are overwritten at Age 1

Table 3.7.3 Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak)

Predictionwith management option table

Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1	0.6879	379435	128082	149672	0	0	383699	131324	0	551885	222816
.	.	.	.	.	0.1	0.0688	.	131324	14230	531711	208604
.	.	.	.	.	0.2	0.1376	.	131324	27589	512840	195335
.	.	.	.	.	0.3	0.2064	.	131324	40134	495183	182946
.	.	.	.	.	0.4	0.2751	.	131324	51917	478659	171379
.	.	.	.	.	0.5	0.3439	.	131324	62990	463194	160576
.	.	.	.	.	0.6	0.4127	.	131324	73397	448715	150487
.	.	.	.	.	0.7	0.4815	.	131324	83182	435157	141065
.	.	.	.	.	0.8	0.5503	.	131324	92385	422459	132264
.	.	.	.	.	0.9	0.6191	.	131324	101044	410564	124042
.	.	.	.	.	1	0.6879	.	131324	109193	399417	116361
.	.	.	.	.	1.1	0.7566	.	131324	116866	388971	109185
.	.	.	.	.	1.2	0.8254	.	131324	124094	379178	102481
.	.	.	.	.	1.3	0.8942	.	131324	130904	369994	96215
.	.	.	.	.	1.4	0.963	.	131324	137323	361381	90360
.	.	.	.	.	1.5	1.0318	.	131324	143376	353300	84888
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANEDB09
Date and time : 20OCT99:10:43

Table 3.7.4 Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak)

Single option prediction: Detailed tables

Year: 1999 F-factor: 1.0000 Reference F: 0.6879 1-Jan Spawning time

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.047	3741	2364	118000	74576	1180	746	1180	746
2	0.59	11144	11155	29135	29164	1457	1458	1457	1458
3	0.89	45864	91682	86370	172654	19865	39710	19865	39710
4	0.683	4075	15403	8983	33956	5569	21053	5569	21053
5	0.58	1875	11421	4656	28360	4004	24389	4004	24389
6	0.607	1357	11074	3257	26584	3257	26584	3257	26584
7	0.694	329	3219	718	7016	718	7016	718	7016
8	0.771	242	2676	491	5424	491	5424	491	5424
9	0.659	25	303	57	685	57	685	57	685
10	0.517	6	71	15	193	15	193	15	193
11+	0.517	23	304	63	824	63	824	63	824
Total		68681	149672	251745	379435	36676	128082	36676	128082
Unit -		Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000 F-factor: 1.0000 Reference F: 0.6879 1-Jan Spawning time

Age	Absolute F	catch in numbers	catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.047	7291	4608	230000	145360	2300	1454	2300	1454
2	0.59	19348	19368	50586	50637	2529	2532	2529	2532
3	0.89	6043	12081	11381	22751	2618	5233	2618	5233
4	0.683	12530	47365	27623	104414	17126	64737	17126	64737
5	0.58	1496	9112	3715	22627	3195	19459	3195	19459
6	0.607	889	7257	2134	17420	2134	17420	2134	17420
7	0.694	667	6515	1453	14201	1453	14201	1453	14201
8	0.771	145	1600	294	3244	294	3244	294	3244
9	0.659	82	989	186	2236	186	2236	186	2236
10	0.517	9	115	24	311	24	311	24	311
11+	0.517	14	184	38	498	38	498	38	498
Total		48515	109193	327434	383699	31897	131324	31897	131324
Unit -		Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.6879 1-Jan Spawning time

Age	Absolute F	catch in numbers	catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.047	7291	4608	230000	145360	2300	1454	2300	1454
2	0.59	37713	37750	98601	98699	4930	4935	4930	4935
3	0.89	10493	20976	19760	39501	4545	9085	4545	9085
4	0.683	1651	6241	3640	13759	2257	8530	2257	8530
5	0.58	4600	28021	11423	69578	9824	59837	9824	59837
6	0.607	709	5790	1703	13899	1703	13899	1703	13899
7	0.694	437	4269	952	9306	952	9306	952	9306
8	0.771	293	3239	594	6566	594	6566	594	6566
9	0.659	49	591	111	1337	111	1337	111	1337
10	0.517	29	374	79	1014	79	1014	79	1014
11+	0.517	11	147	30	397	30	397	30	397
Total		63278	112007	366894	399417	27326	116361	27326	116361
Unit -		Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name :SpREDB06
Date and time : 20OCT99:11:12

Table 3.8.1
Medium Term Summary
Cod in the North Sea, Skagerrak and Eastern Channel

Bpa	150	thousand tonnes
Blim	70	thousand tonnes

F1	0.65	Basis :	Fpa	F multiplier	0.94
F2	0.69	Basis :	SQ	F multiplier	1

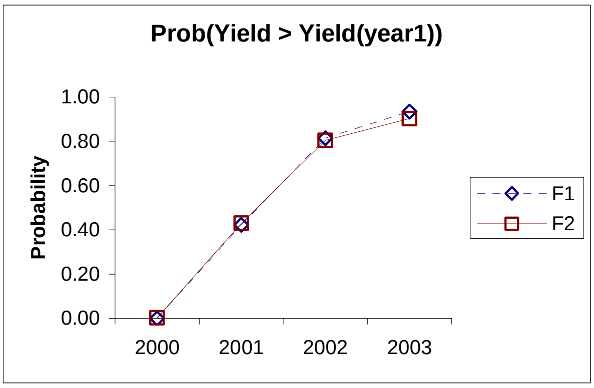
Year 1 1999

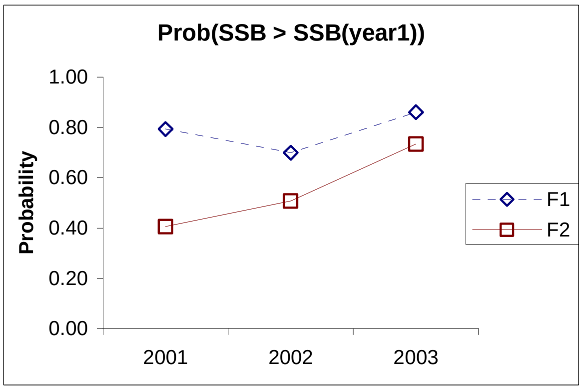
Format of tables:

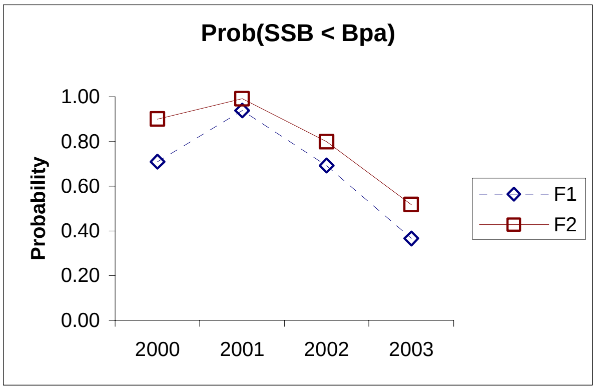
	1999	2000	2001	2002	2003
F1	Yield1999	Prob(Yield2000>Yield1999)	Prob(Yield2001>Yield1999)	Prob(Yield2002>Yield1999)	Prob(Yield2003>Yield1999)
	SSB1999	SSB2000	Prob(SSB2001>SSB1999)	Prob(SSB2002>SSB1999)	Prob(SSB2003>SSB1999)
		Prob(SSB2000< Bpa)	Prob(SSB2001< Bpa)	Prob(SSB2002< Bpa)	Prob(SSB2003< Bpa)
		Prob(SSB2000< Blim)	Prob(SSB2001< Blim)	Prob(SSB2002< Blim)	Prob(SSB2003< Blim)
F2	Yield1999	Prob(Yield2000>Yield1999)	Prob(Yield2001>Yield1999)	Prob(Yield2002>Yield1999)	Prob(Yield2003>Yield1999)
	SSB1999	SSB2000	Prob(SSB2001>SSB1999)	Prob(SSB2002>SSB1999)	Prob(SSB2003>SSB1999)
		Prob(SSB2000< Bpa)	Prob(SSB2001< Bpa)	Prob(SSB2002< Bpa)	Prob(SSB2003< Bpa)
		Prob(SSB2000< Blim)	Prob(SSB2001< Blim)	Prob(SSB2002< Blim)	Prob(SSB2003< Blim)

Medium Term Summary
Cod in the North Sea, Skagerrak and Eastern Channel

F	1999	2000	2001	2002	2003
0.65	150	0.00	0.42	0.81	0.93
	128	131	0.79	0.70	0.86
		0.71	0.94	0.69	0.37
		0.00	0.00	0.00	0.00
0.69	150	0.00	0.43	0.80	0.90
	128	131	0.41	0.51	0.73
		0.90	0.99	0.80	0.52
		0.00	0.00	0.00	0.00







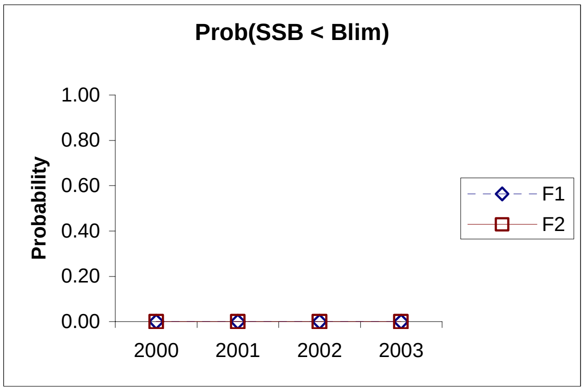


Table 3.9.1 Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak)

Yield per recruit input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1	0.8	0.01	0	0	612	0.047	0.612
2	.	0.35	0.05	0	0	971	0.59	0.971
3	.	0.25	0.23	0	0	2160	0.89	2.16
4	.	0.2	0.62	0	0	4074	0.683	4.074
5	.	0.2	0.86	0	0	6345	0.58	6.345
6	.	0.2	1	0	0	8447	0.607	8.447
7	.	0.2	1	0	0	10112	0.694	10.112
8	.	0.2	1	0	0	11206	0.771	11.206
9	.	0.2	1	0	0	12585	0.659	12.585
10	.	0.2	1	0	0	13732	0.517	13.732
11+	.	0.2	1	0	0	14442	0.517	14.442
Unit	Numbers	-	-	-	-	Grams	-	Kilograms

Notes: Run name : YLDJC104
Date and time: 20OCT99:12:14

Table 3.9.2 Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak)

Yield per recruit summary table

						1-Jan		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0	0	0	3.126	15030.8	1.344	12922.7	1.344	12922.7
0.1	0.0688	0.098	512.959	2.661	9879.9	0.914	7895.867	0.914	7895.867
0.2	0.1376	0.159	703.446	2.376	7023.664	0.661	5146.977	0.661	5146.977
0.3	0.2064	0.201	761.483	2.186	5305.458	0.5	3521.999	0.5	3521.999
0.4	0.2751	0.232	763.428	2.052	4205.852	0.391	2503.675	0.391	2503.675
0.5	0.3439	0.256	742.25	1.952	3466.607	0.314	1835.57	0.314	1835.57
0.6	0.4127	0.275	712.746	1.875	2949.215	0.259	1380.685	0.259	1380.685
0.7	0.4815	0.291	681.622	1.814	2574.776	0.217	1061.382	0.217	1061.382
0.8	0.5503	0.304	651.835	1.765	2296.045	0.185	831.474	0.185	831.474
0.9	0.6191	0.316	624.571	1.724	2083.51	0.16	662.34	0.16	662.34
1	0.6879	0.326	600.172	1.69	1918.049	0.14	535.605	0.14	535.605
1.1	0.7566	0.334	578.592	1.66	1786.875	0.124	439.117	0.124	439.117
1.2	0.8254	0.342	559.618	1.635	1681.199	0.111	364.62	0.111	364.62
1.3	0.8942	0.35	542.974	1.613	1594.83	0.101	306.38	0.101	306.38
1.4	0.963	0.356	528.379	1.594	1523.318	0.092	260.332	0.092	260.332
1.5	1.0318	0.362	515.571	1.576	1463.404	0.084	223.546	0.084	223.546
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDJC104
Date and time : 20OCT99:12:14
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.2228
F-max factor : 0.3520
F-0.1 reference F : 0.1532
F-max reference F : 0.2421
Recruitment : Single recruit

Figure 3.1.1 Cod in Sub-area IV, Division VIId and Division IIIa (Skagerrak)

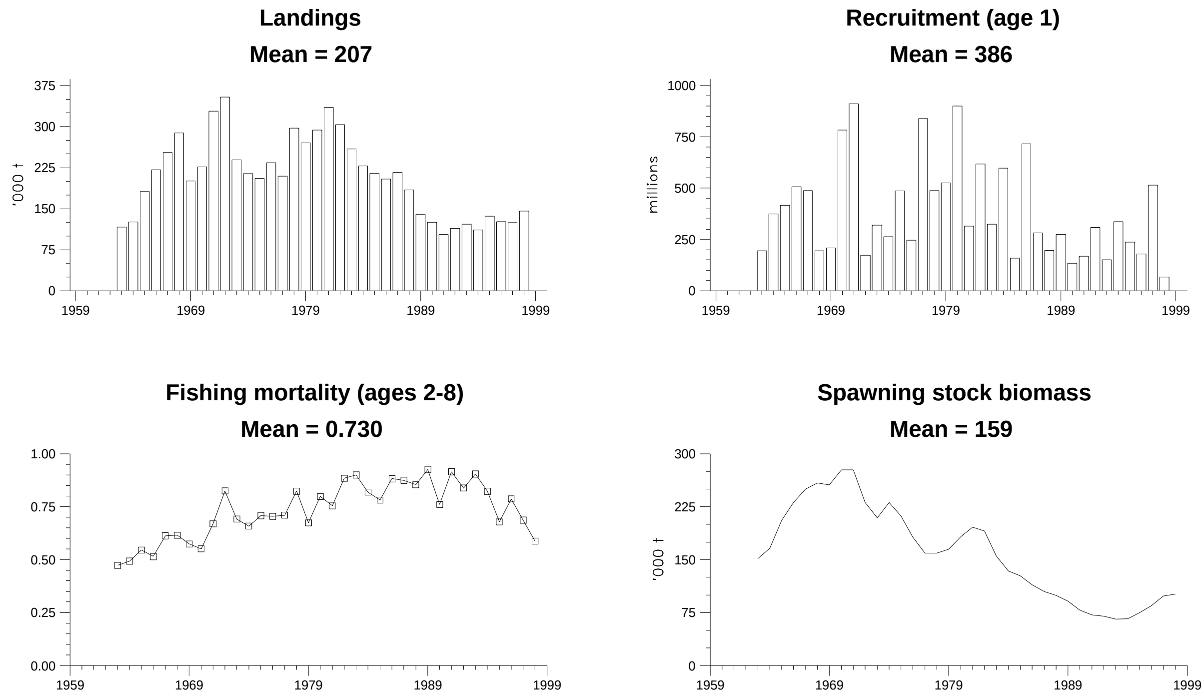
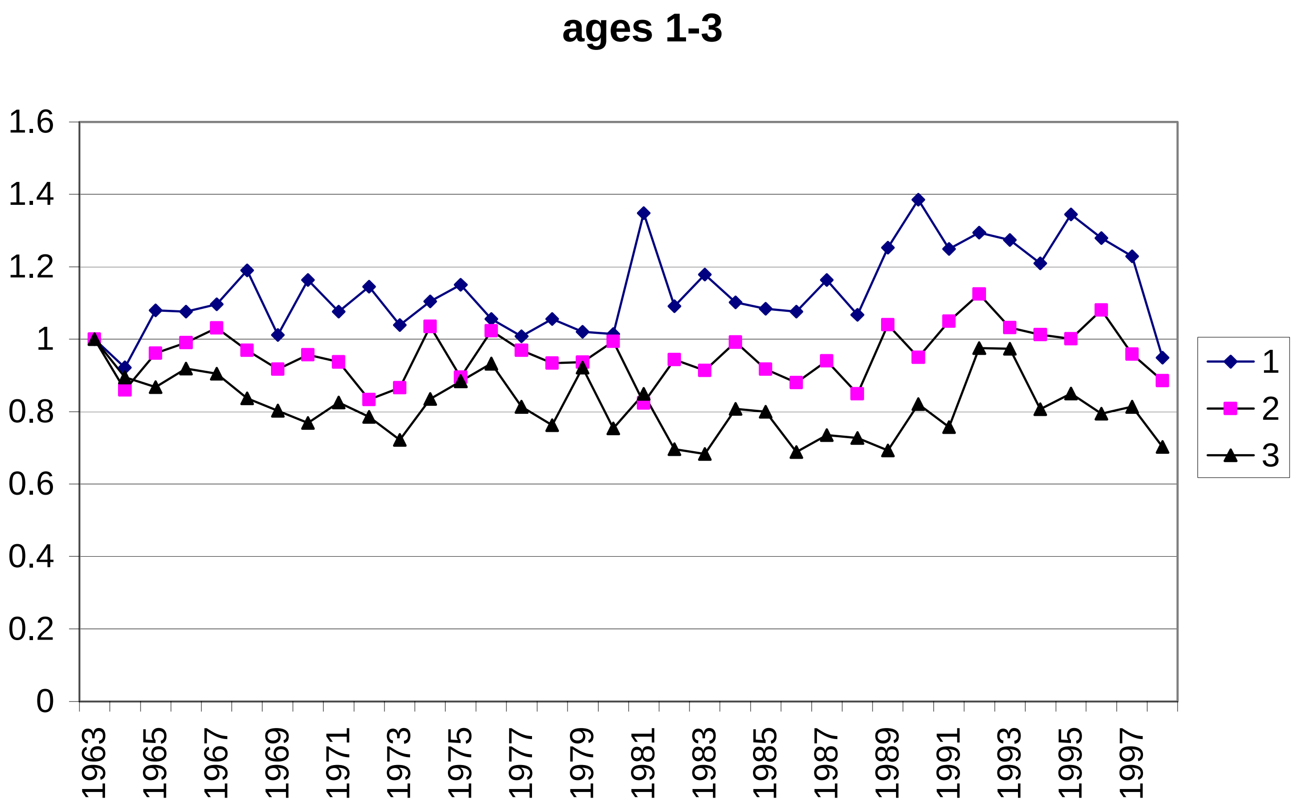
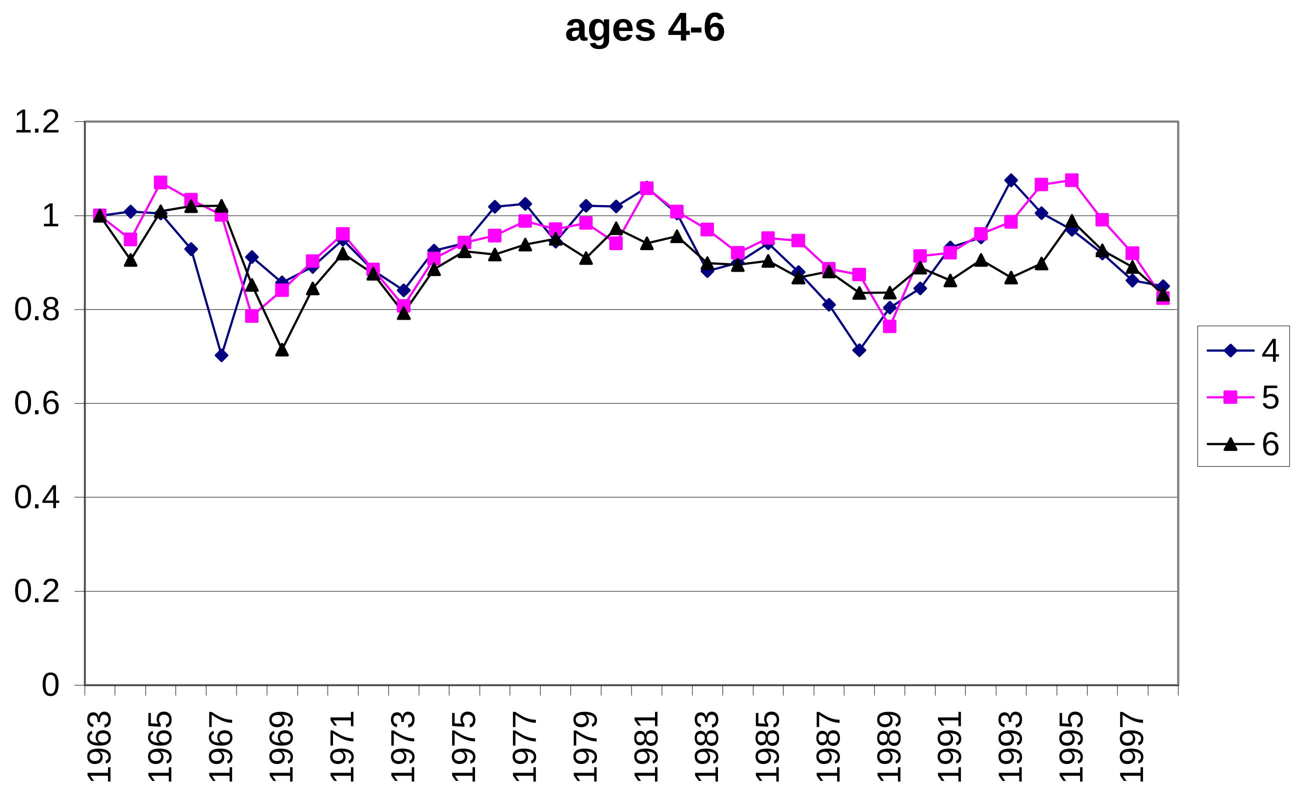


Figure 3.2.1

Cod IIIa, IV, VIId:trends in mean weight at age in the catch relative to mean weight in 1963





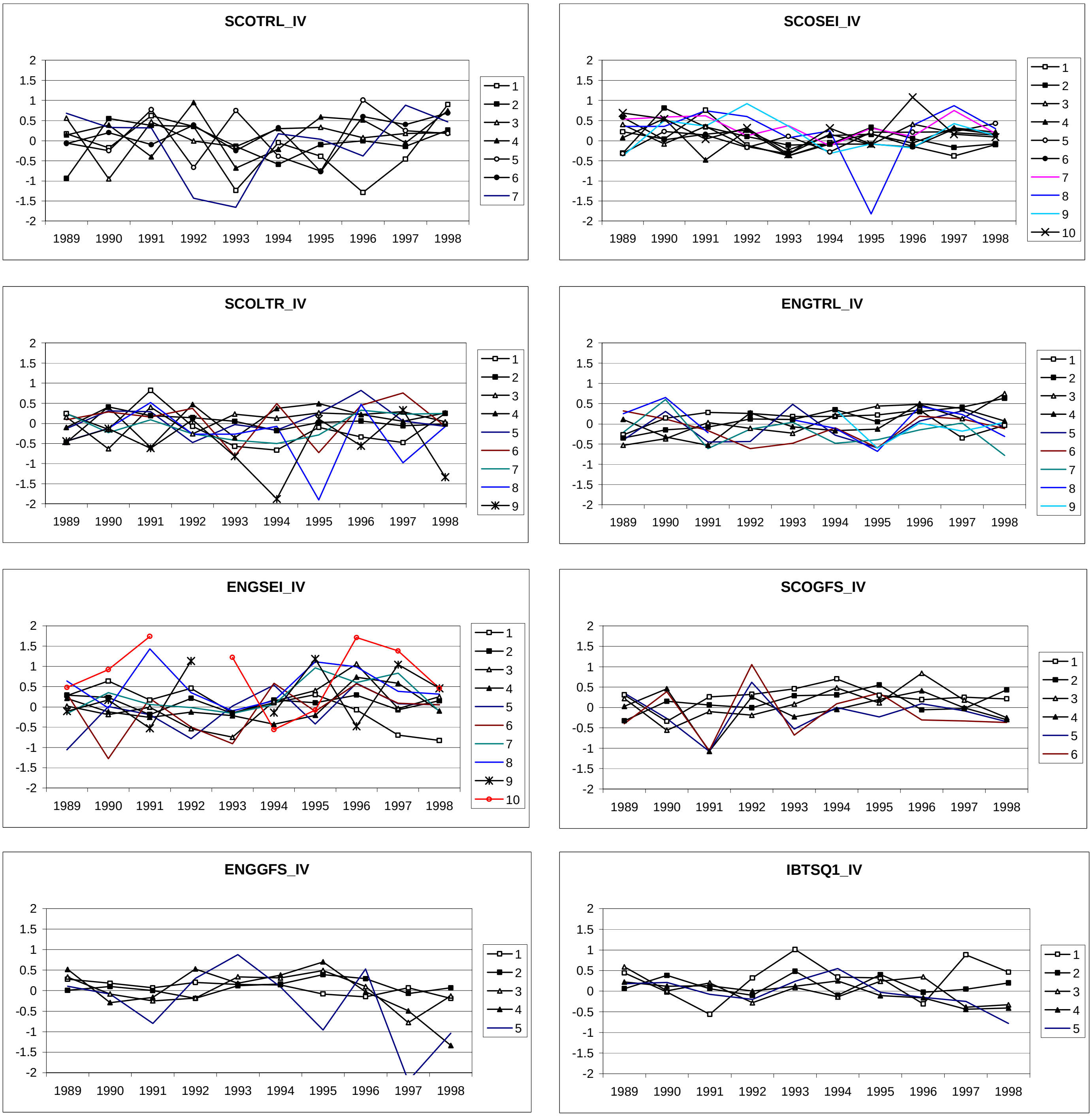


Figure 3.4.1
F shrinkage = 0.5, P-se = 0.3, q independent of age for ages 3+
Cod in IIIa (Skagerrak), IV and VIId - Log catchability residual plots - XSA All fleets

Figure 3.4.2. **Cod in IIIa (Skagerrak), IV and VIId.**
Relative contribution of surveys, commercial fleets and shrinkage to tuning

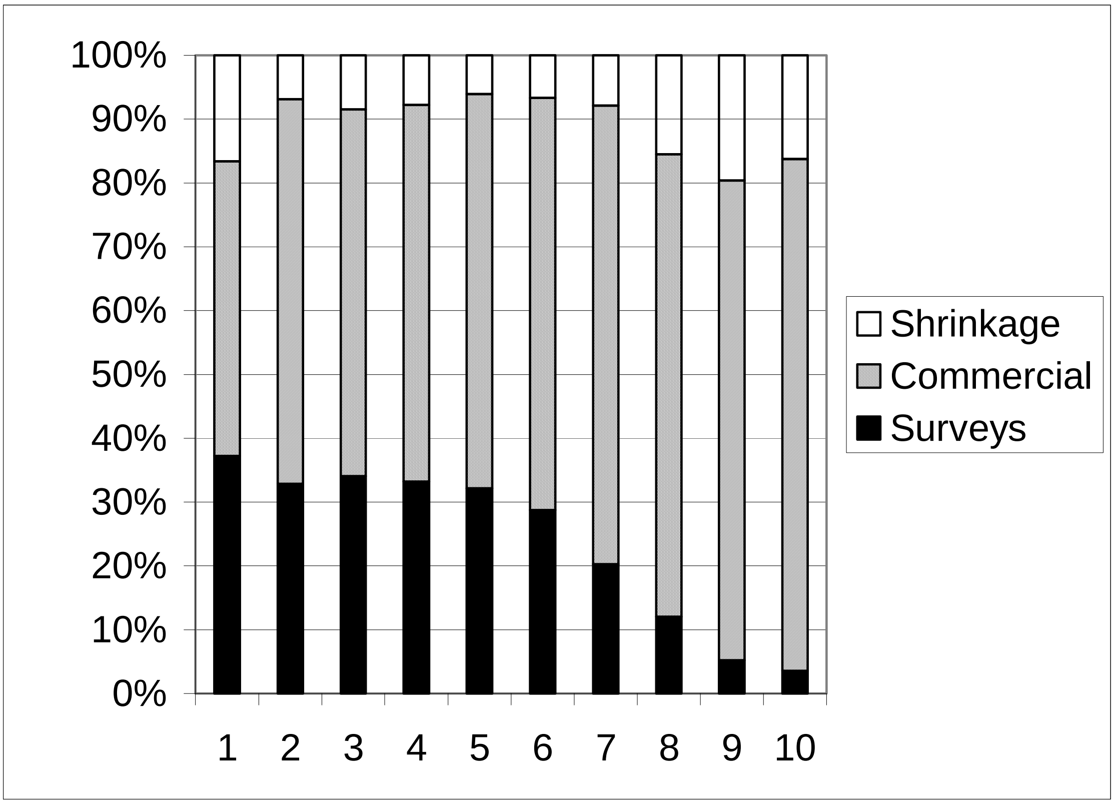


Figure 3.4.3 Cod IIIa, IV, VIId. Retrospective pattern in recruitment, F and SSB

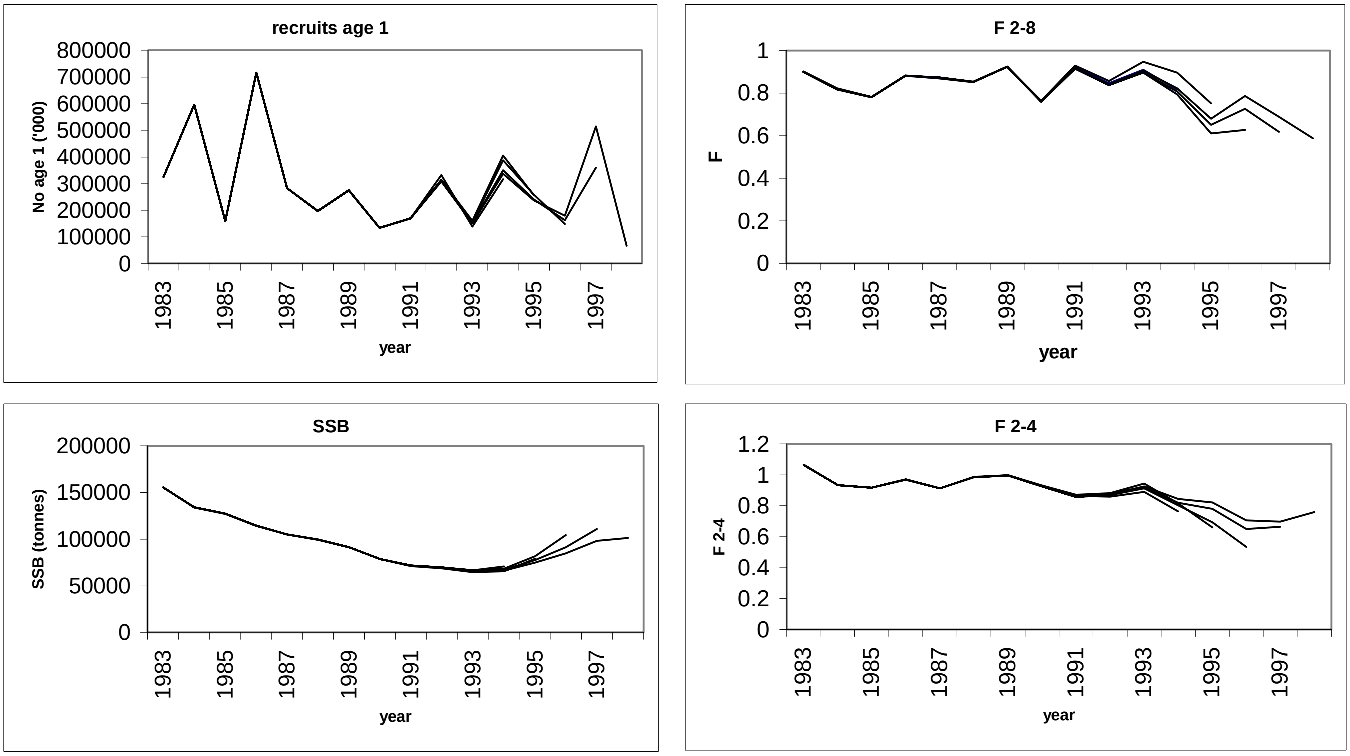


Figure 3.7.1 Fish Stock Summary. Cod in Sub-area IV, Division VIId and Division IIIa (Skagerrak)

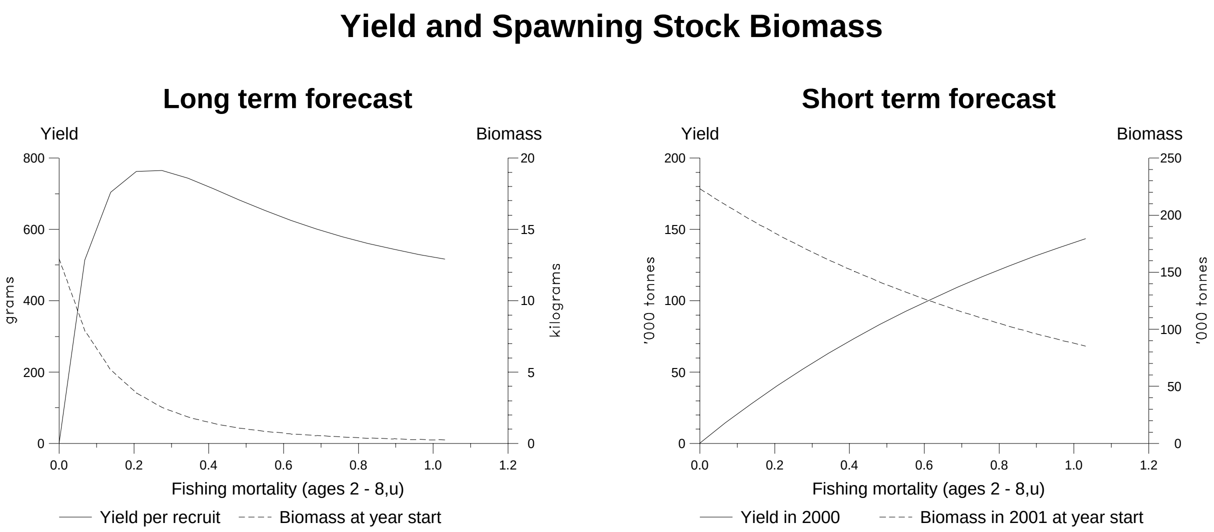


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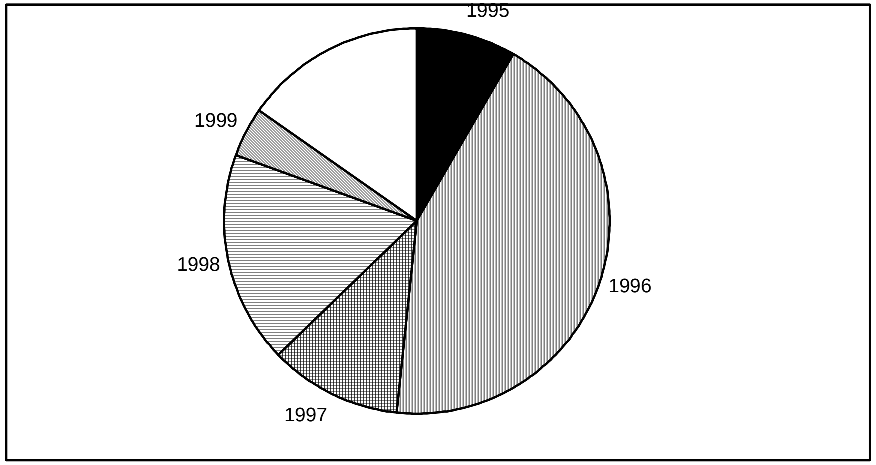
Figure 3.7.2 **Cod in IIIa (Skagerrak), IV and VIId**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	1995	1996	1997	1998	1999
Stock No. (thousands) of 1 year-olds	179613	514055	66635	118000	230000
Source	VPA	VPA	VPA	RCT3	st-GM
Status Quo F:					
% in 1999 landings	10.3	61.3	7.5	1.6	-
% in 2000	8.3	43.4	11.1	17.7	4.2
% in 1999 SSB	16.4	31.0	1.1	0.6	-
% in 2000 SSB	14.8	49.3	4.0	1.9	1.1
% in 2001 SSB	11.9	51.4	7.3	7.8	4.2

st-GM : short term geometric mean recruitment

Cod in IIIa (Skagerrak), IV and VIId : Year-class % contribution to

a) 2000 landings



b) 2001 SSB

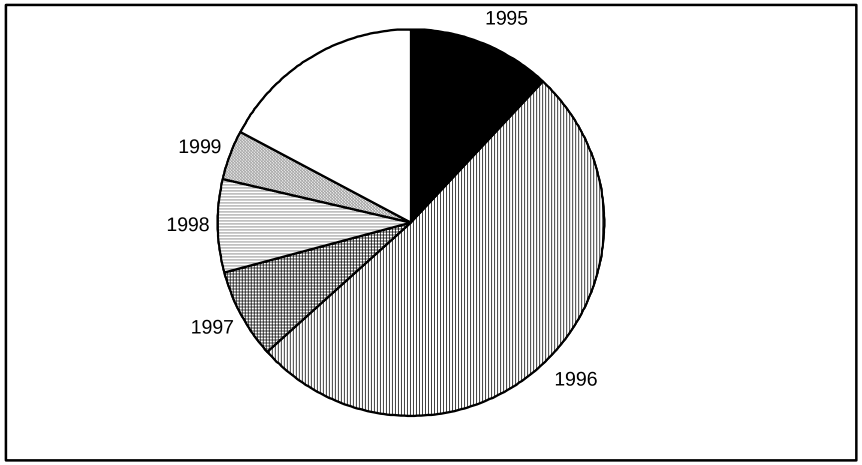


Figure 3.7.3 Cod in IIIa (Skagerrak), IV and VIId. Sensitivity analysis of short term forecast.

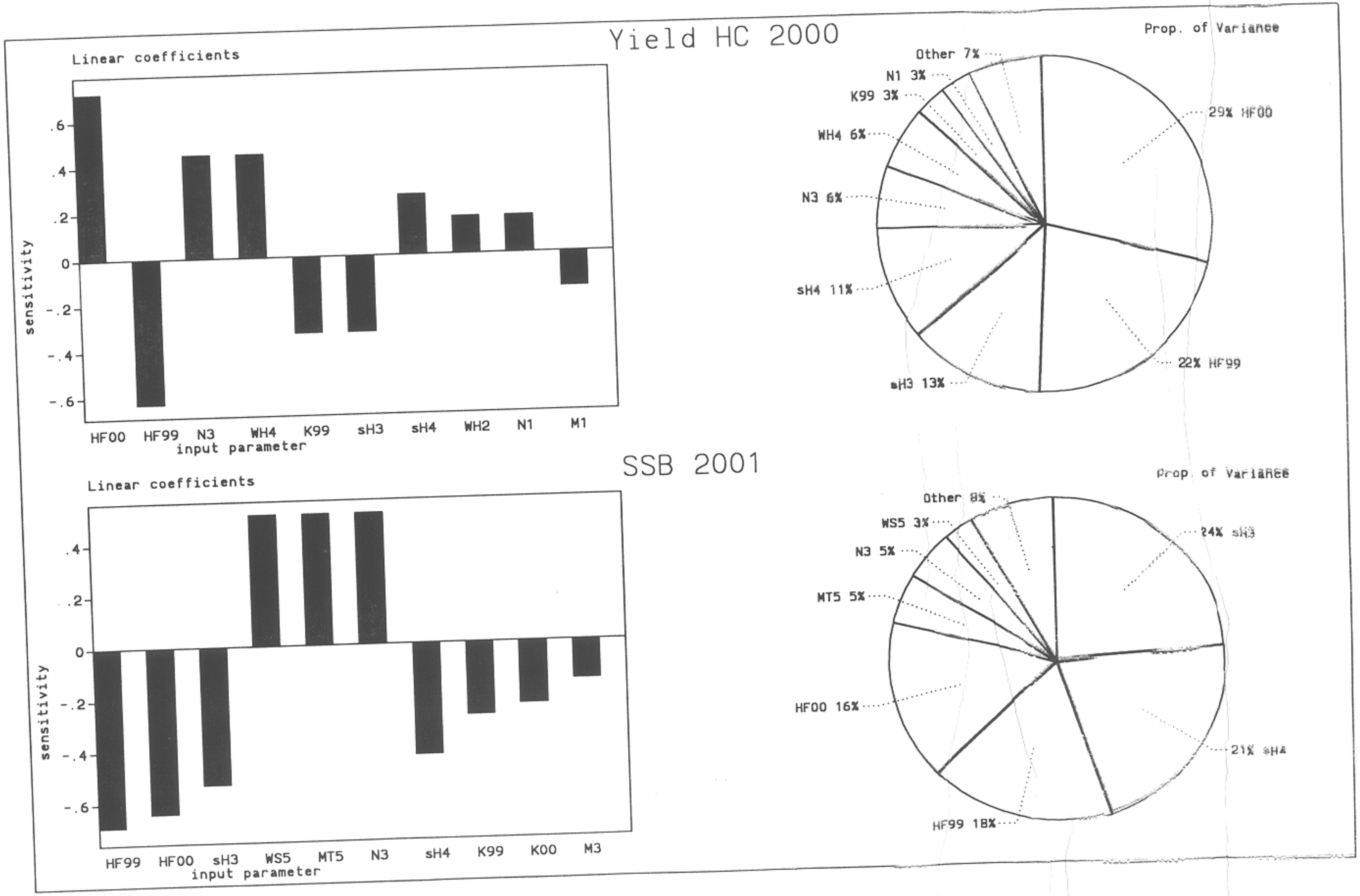
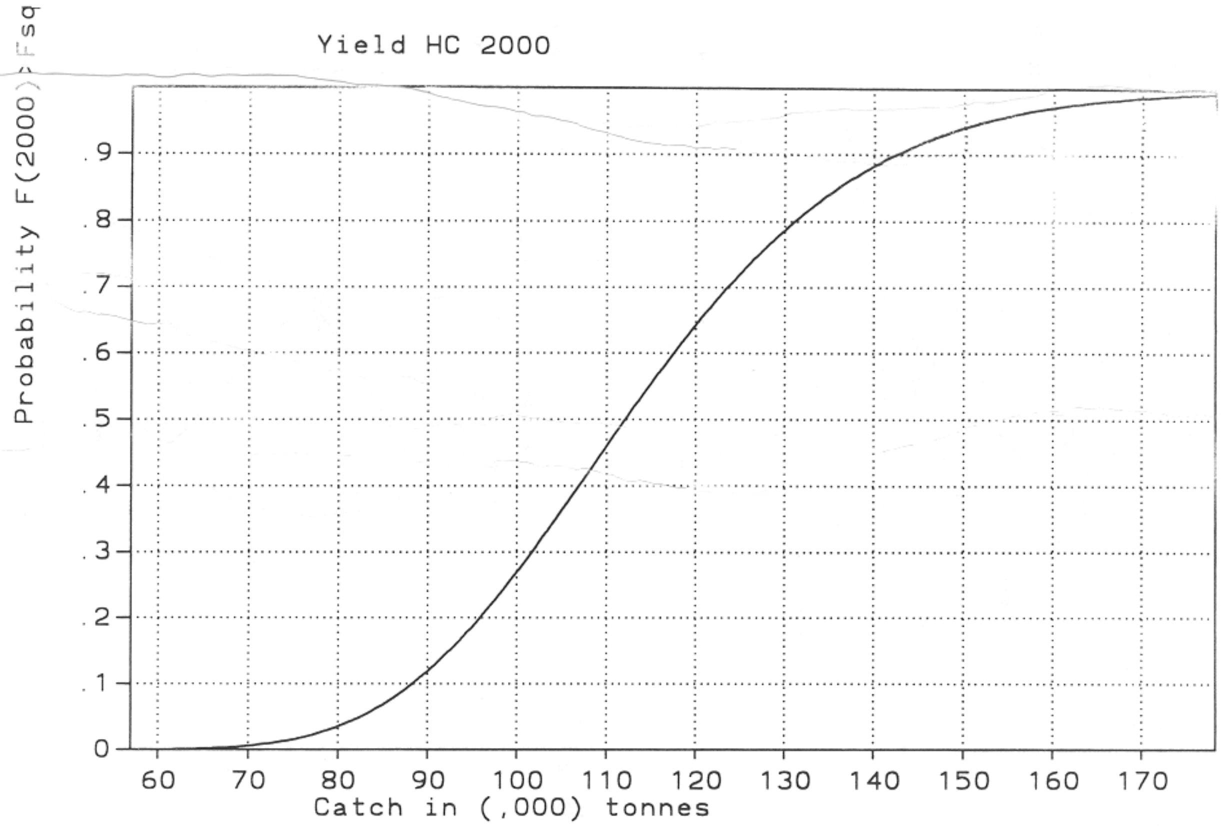


Figure 3.7.4 Cod in IIIa (Skagerrak), IV and VIId. Probability profiles for short term forecast.



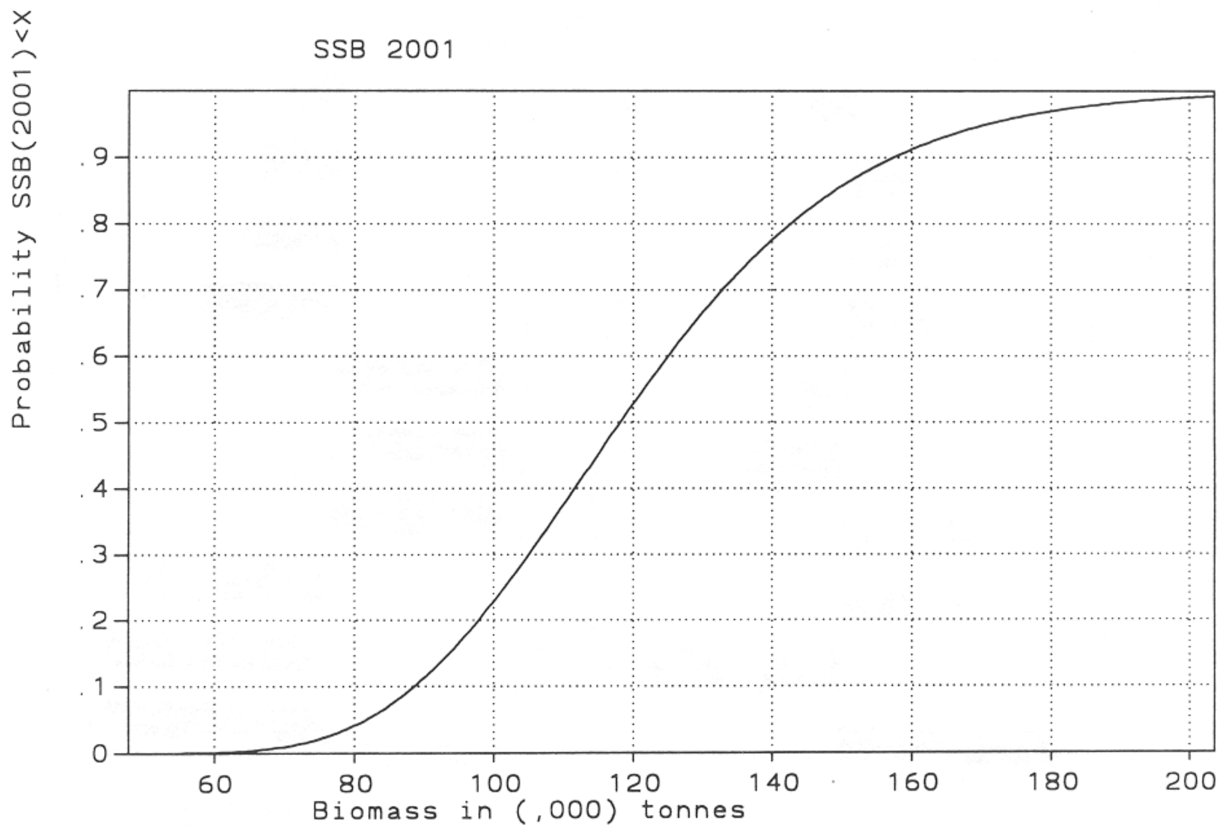


Figure 3.8.1 Cod in IIIa (Skagerrak), IV and VIId. Medium term projections. Solid lines show 5, 10, 20,50, and 95 percentiles
Shepherd stock-recruitment relationship
number of simulations 500

Relative Cons. effort = 1.00

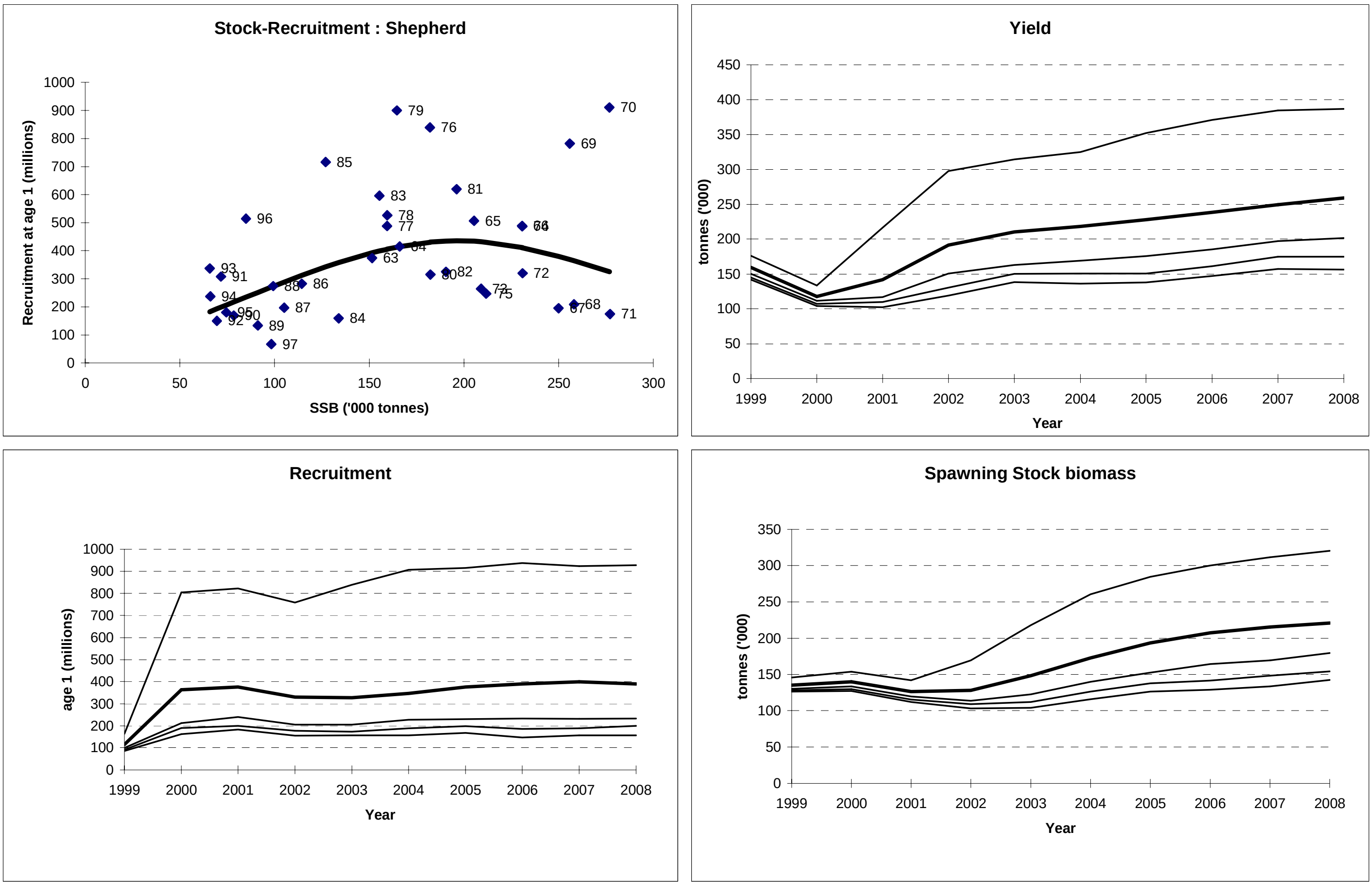


Figure 3.8.2 Cod. Medium term projections of SSB in 2008 at different levels of F

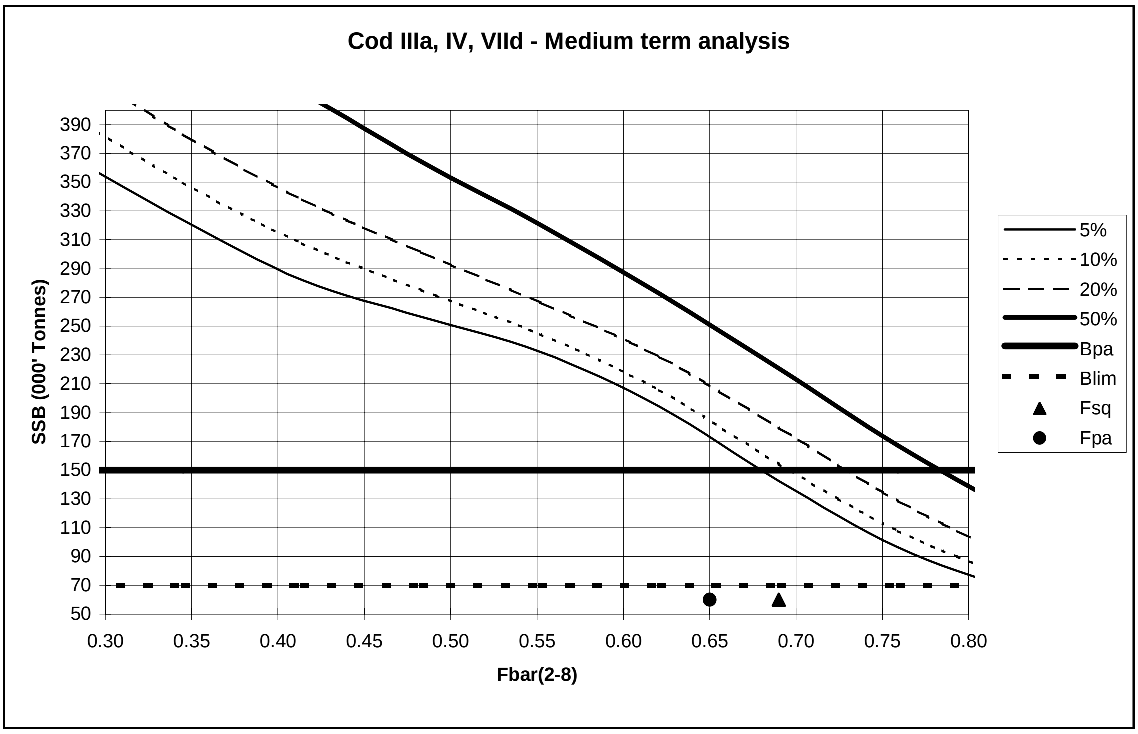


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Figure 3.9.1 Cod in IIIa (Skagerrak), IV and VIId. Stock and Recruitment

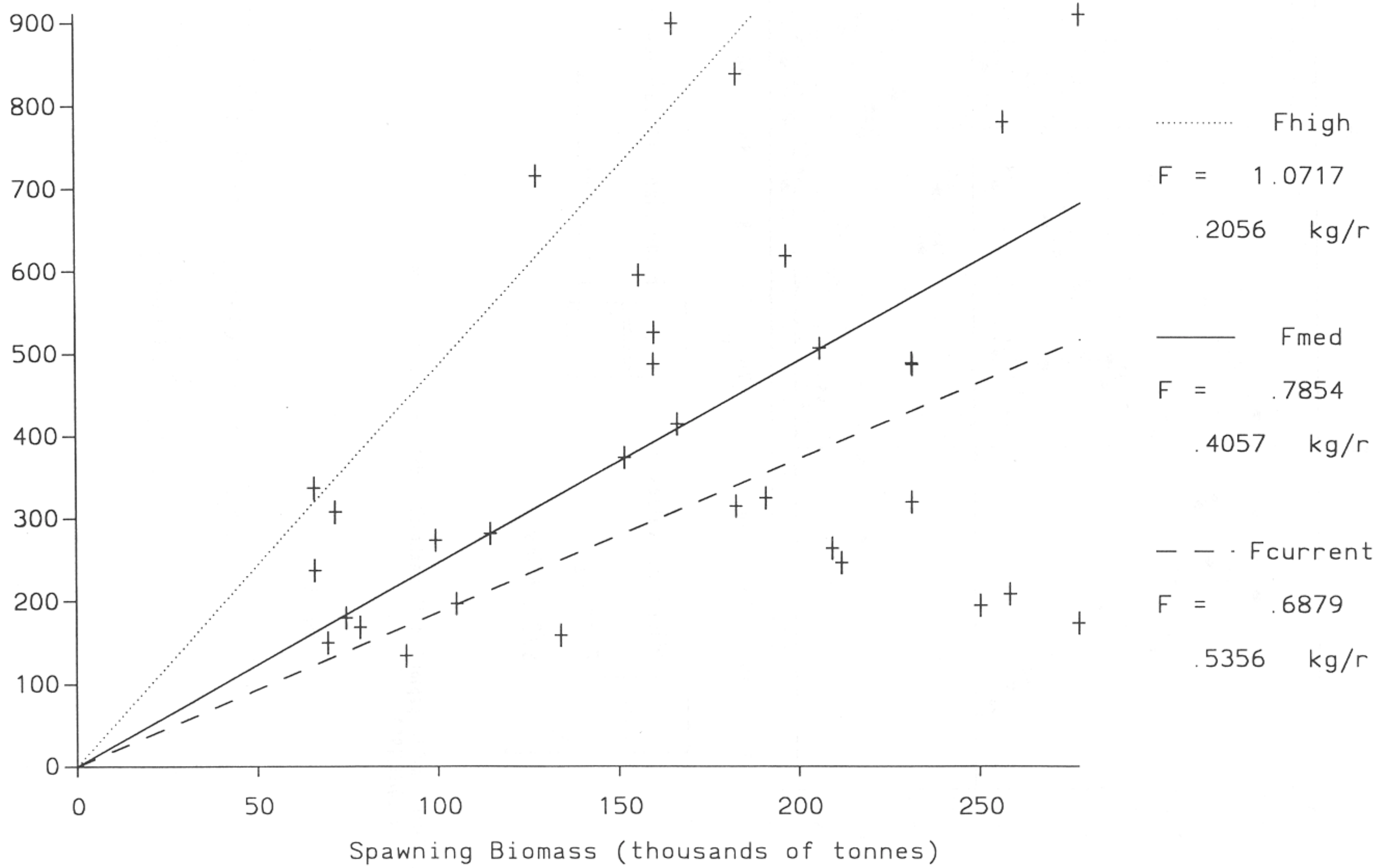
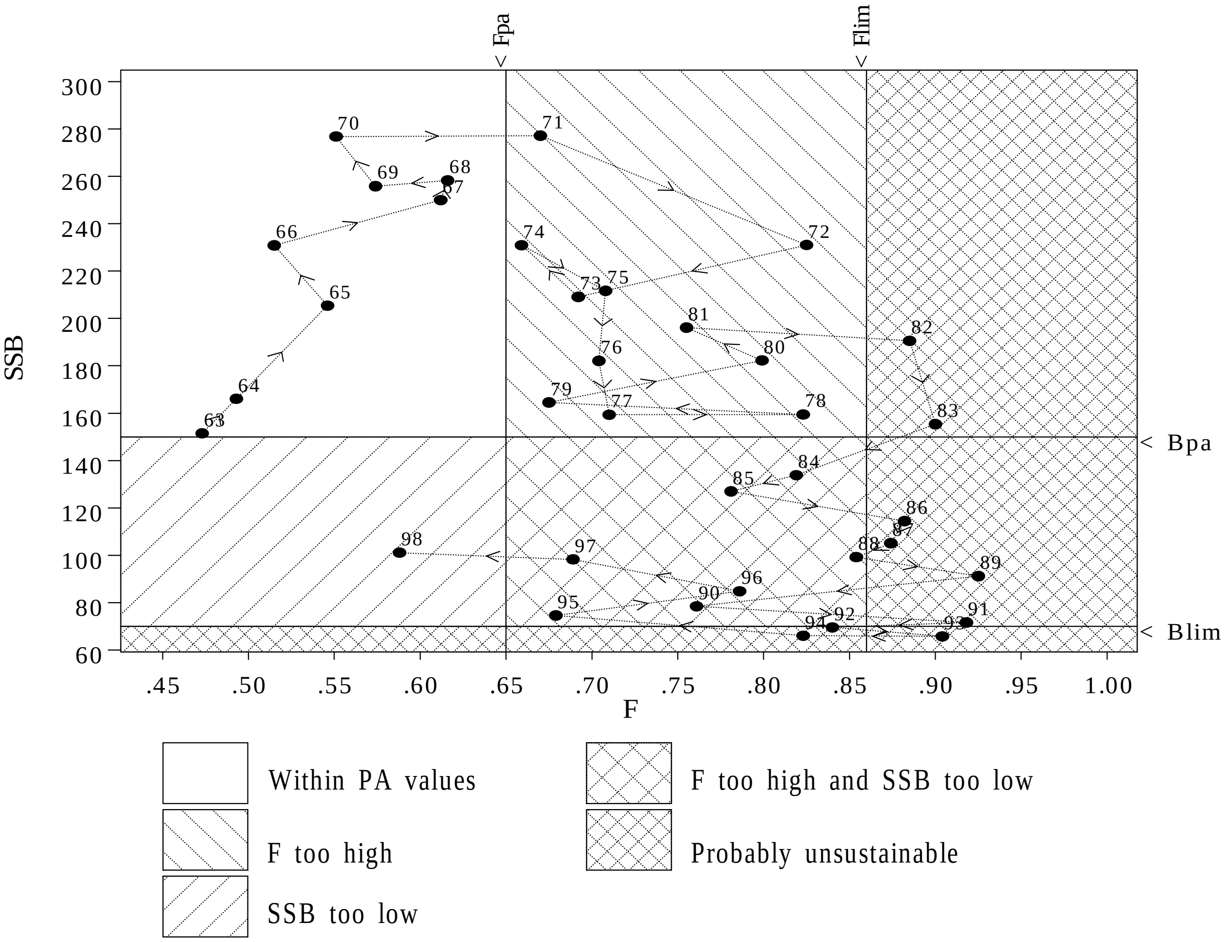


Figure 3.9.2 - Cod in subarea IV,VIId and IIIa



Data file(s):D:\ns99\Wpaplot\Cod347_final.pa;D:\ns99\Wpaplot\Cod347d.sum
Plotted on 20/10/1999 at 15:59:45

4 HADDOCK IN SUB-AREA IV AND DIVISION IIIA

4.1 The fishery

In the North Sea, haddock is taken as part of a mixed demersal fishery, with the large majority of the catch being taken by Scottish light trawlers, seiners and pair trawlers. These gears have a minimum legal mesh size of 100 mm. Smaller quantities are taken by other Scottish vessels, including *Nephrops* trawlers which use mesh sizes between 70 and 100mm mesh and thus discard higher quantities. Vessels from other countries including England, Denmark and Norway also participate in the fishery, and haddock are also taken as a by-catch by Danish and Norwegian vessels fishing for industrial species. In Division IIIa, haddock are taken as a bycatch in a mixed demersal fishery, and in the industrial fishery. Landings from Division IIIa are small compared to the North Sea, amounting to between 0.1 and 6.9% of the total catch over 1963–1998.

4.1.1 ACFM advice applicable to 1998 and 1999

On the basis of the 1998 assessment of this stock, ACFM concluded that the stock in 1998 was considered to be close to safe biological limits, with SSB above $\mathbf{B}_{pa}$ and F close to $\mathbf{F}_{pa}$. As a result, ACFM recommended that fishing mortality in 1999 should be reduced to F = 0.63, below the proposed $\mathbf{F}_{pa}$ (0.7) in order to maintain SSB above the proposed $\mathbf{B}_{pa}$ in the short term.

4.1.2 Management applicable to 1999

In the main North Sea fishery the minimum legal mesh size is 100 mm, although vessels using smaller mesh sizes to fish for *Nephrops* or industrial species can land some haddock, but are subject to bycatch limits. The closure of the Norway Pout box to industrial fishing is another measure by which by-catches of haddock are limited. The minimum landing size for haddock is 30 cm. On an annual basis, management of the fishery is through TACs.

In Division IIIa the 1999 TAC is 5,400 t and in the North Sea the 1999 TAC is 88,550t.

4.1.3 Catches in 1998

Nominal landings of haddock from Division IIIa for recent years are given in Table 4.1.1, along with Working Group estimates of landings and industrial bycatch. Table 4.1.2 gives the corresponding figures for haddock in the North Sea, and Table 4.1.3 gives the full time series of Working Group estimates for both areas.

In Division IIIa total landings during 1998 amounted to about 4 thousand tonnes, with industrial bycatch accounting for only 275 t of this total. This total is below the series average but higher than in the preceding five years. The level of industrial bycatch was very low in 1998.

In the North Sea, human consumption landings in 1998 were around 77,000 t, which is comparable to landings in the six preceding years during which landings have varied between 70 and 81 kt. The 1998 landing represents a considerable undershoot of the TAC of 115 kt. The level of discarding in 1998 was lower than in recent years, but the level of industrial bycatch is comparable to that of recent years. The Working Group estimate of the 1998 catch includes a small correction for suspected under-reporting by one nation.

4.2 Natural mortality, maturity, age composition, mean weight at age

Natural mortality estimates are given in Table 4.2.1 along with the maturity ogive. The estimates of natural mortality originate from MSVPA - see Section 1.3.1.3. The maturities are based on IBTS data. Both natural mortality and maturity are assumed constant with time. Biomass totals are calculated as at the beginning of the year.

For Division IIIa in 1998, age composition data for the human consumption catches were supplied by Denmark, who accounted for around 80% of the human consumption landings and all of the industrial bycatch in this area in 1998. No age composition data were available for the industrial by-catches in Division IIIa, so these were estimated using data form the Norwegian by-catches in the North Sea. For the North Sea catches, age composition data for the human consumption landings were supplied by Denmark, England, France, Scotland and Belgium. These nations accounted for over 90% of the total landings. Industrial bycatch age compositions for the North Sea were supplied by Norway. Discard totals and age compositions for the North Sea were estimated from Scottish data. No estimates of discards are available for Division IIIa. Catch-at-age data are given in Table 4.2.2. The catch-at-age data for the North Sea are SOP corrected; there are slight SOP discrepancies in the combined data arising from minor discrepancies in the Division IIIa data. As in 1996 and 1997, fish from the 1996 and 1994 year classes were most abundant in the total catches in 1998.

The mean weight at age data for the Division IIIa catches do not cover all years and for earlier years are not split by catch category, so only North Sea values have been used. Weight at age data from the total catch (i.e., Human consumption, discards and industrial bycatch) in the North Sea, which are also used as stock weights at age, are given in Table 4.2.3.

4.3 Catch, Effort and Research Vessel data

The fleets used in tuning are listed in Table 4.3.1 along with the age and year ranges used in the tuning file. The fleets consist of two Scottish commercial fleets and two research vessel surveys. Definitions of the commercial fleets are the same as those given for the equivalent vessels working in Division VIa which are given in the Report of the 1998 Working Group on the Assessment of Northern Shelf Demersal Stocks (ICES 1999, Appendix 2). In order to include the most recent information from the IBTS quarter 1 survey, this survey is treated as if it takes place at the end of the preceding year, by appropriate adjustments of the age and year ranges, and of the alpha and beta parameters. The IBTS quarter two survey, which was used in tuning the 1997 and 1998 assessments, was terminated in 1997, so was not included in the tuning data for this assessment. The tuning file is given in Table 4.3.2.

4.4 Catch-at-age analysis

As a baseline, the first XSA run made used the same settings as used in the final XSA run in the 1998 Working Group assessment of this stock. The fleets used were also the same, apart from the omission of the IBTS quarter two series.. The diagnostics from the baseline run showed indications of year effect for recent years in the Scottish groundfish survey data, with a pronounced year effect in the 1998 data where all residuals were large and positive. As the 1998 Scottish survey was the first to use a new vessel and gear combination, there was *a priori* reason to anticipate a change in catchability for this survey. As a consequence, this survey series was excluded from subsequent analyses.

To investigate the effects of varying the level of shrinkage, retrospective XSA runs were made using shrinkage SEs of 0.2, 0.5 (the default, as used in recent assessments) and 0.9. The resultant plots were uninformative; there was no difference in the extent of retrospective noise with the three levels of shrinkage. The only way in which the plots differed was in the extent to which F was indicated to have declined in recent years. To investigate this further, effort and CPUE data from the main fleets exploiting this stock were used. The fleets were Scottish Seiners, pair trawlers and light trawlers, which together have accounted for between 70 and 85% of the reported North Sea Haddock landings over the last ten years. CPUE trends in these fleets (Figure 4.4.1a) are similar, with pair trawl and seine CPUE very similar, and light trawl showing a similar trend but with lower catch rates. CPUE in light trawlers is well correlated with seine CPUE (Figure 4.4.1c). An overall effort index was constructed by assuming equivalence in pair trawl and seine effort then adjusting light trawl effort for the lower fishing power of this fleet using the relationship between light trawl and seine CPUE. Effort by both seiners and pair trawlers show declining trends (Figure 4.4.1b), but while effort by light trawlers has increased over the same period, the combined index shows a decrease since 1987. While it is necessary to be cautious in interpreting the link between F and fishing effort, there nonetheless appears to be some grounds to indicate that fishing mortality is likely to have decreased in recent years. Trends in mean F indicated by XSA using varying degrees of shrinkage are given alongside the effort index in Figure 4.4.1d. Apart from the spike in fishing mortality indicated in 1996, either of the runs using weaker shrinkage (0.5 or 0.9) appear broadly consistent with the trend in the effort index. There is no clear basis for choosing between these two values, and the choice makes relatively little difference to the estimate of terminal F so a value of 0.5 has been used for consistency with previous assessments.

The only differences in the configuration of this and the previous assessment of this stock are the omission of the Scottish groundfish survey and of the terminated IBTS Q2 series. The age ranges in all fleets are as used in the 1998 assessment. The XSA settings are given in the text table below:

	1998 assessment	1999 assessment
Catch at age method	XSA	XSA
Fleets	2 commercial, 4 surveys	2 commercial, 2 surveys.
Taper	Uniform over 10 years	uniform over 10 years
First age for constant q	0	0
q-plateau age	7	7
Shrinkage SE	0.5	0.5

Diagnostics from the final XSA run are given in Table 4.4.1 with log-catchability residuals in Figure 4.4.2. These show occasional large residuals, particularly in the younger (partially discarded) ages in the commercial fleets, but there are no clear indications of any problems in the CPUE data. The contribution of the survey and commercial tuning fleets and shrinkage to the survivor estimates at age is given in Figure 4.4.3. These show a smooth transition from estimates at younger ages based largely on survey data, to estimates at older ages where commercial data receive most of the weight. In addition, the survivor estimates form each fleet are rather homogeneous at most ages, and the shrinkage contributes relatively little to the estimates. Retrospective trends in mean F, recruitment and SSB are given in Figure 4.4.4. The retrospectives for mean F show quite a high degree of variation, but there is no obvious tendency to over or under-estimate F in the terminal year.

Estimates of fishing mortalities at age from the final XSA run are given in Table 4.4.2, and stock numbers at age are given in Table 4.4.3. The present assessment indicates a mean total F in 1998 of 0.67. The current XSA run has revised the estimate of F in 1997 from 0.63 to 0.76.

4.5 Recruitment Estimation

Indices from some 1999 surveys are available for this stock, making it appropriate to use RCT3 to provide estimates of recruiting year classes. However, due to the change in vessel and gear for the Scottish Groundfish survey in 1998 (see Section 1.3.1.4) the most recent indices from this survey were not used in RCT3, although they are shown in the RCT3 input file (Table 4.5.1) for comparison. As a result. indices from the 1999 English GFS were the only indices used in the RCT3 which were not already included in the XSA tuning. Output from the RCT3 runs at ages 0–2 are given in Tables 4.5.2a-c.

The only available index of the 1999 year class comes from the English GFS in August. The index is the highest in the series, indicating that the 1999 year class is strong. Although the indices from the 1999 Scottish August GFS have not been used because of the change in vessel and gear, catch rates of 0-group haddock during that survey were also very high, and the apparent strength of this year class is also supported by reports from the industry and from fishery observers of large catches of 0-group haddock. Hence all indications are that the 1999 year class is strong. The RCT3 estimate of this year class is 81.3 billion. The estimate results largely from the English GFS index, with the VPA mean receiving only 28% of the weight. However, as the 1999 English 0-gp index is largest in the series, the value is based on extrapolation beyond the range of values which feature in the regression. This will result in a more uncertain estimate, and given the potential importance of this year class and the apparent tendency for RCT3 to over-estimate year class strength (Section XXX [commenting on RCT3 problems somewhere ?]) it was considered appropriate to use a more conservative estimate for this year class. The approach used was to constrain the estimate to the range of values within the regression by replacing the 1999 index value with the previous highest in the series. This was the index for the 1981 year class which is 27% lower than the index for the 1999 year class. By substituting this value, the RCT3 estimates a value of 67.8 billion, i.e. 17% lower than the raw RCT3 estimate. This constrained value has been used as the estimate of the strength of the 1999 year class in the prediction.

The available indices for the 1998 year class indicate that it is well below average strength and thus unlikely to have much influence on the prediction. The RCT3 estimate at age 1 (1063 million) is higher than the XSA estimate (601 million) but the former receives much of its weight from an index which is not included in the XSA, so has been used here.

At age 2 in 1999, the RCT3 and XSA estimates of the 1997 year class are similar so the XSA estimate has been adopted for prediction purposes. XSA estimates of survivors in 1999 have also been used for all older ages.

There is no evidence of time trends in recruitment in this stock so the long-term geometric mean recruitment value of 26.3 billion has been used as the estimate of recruitment at age 0 in 2000 and 2001.

4.6 Historical stock trends

Trends in spawning stock biomass, recruitment and mean F since 1963 are given in Table 4.6.1 and Figure 4.6.1. Total F has fluctuated around a mean level of 0.92, although the present assessment indicates that total F in 1998 (0.67) is close to the lowest observed (0.63 in 1968). Recruitment shows considerable variation, with the current estimate of the 1994 year class indicating that it is one of the strongest since 1974, but the four subsequent year classes are all of below average strength. Spawning biomass has fluctuated, with occasional slight peaks corresponding to the maturation of strong year classes. SSB declined from 1985 to a series low of 63,300 t in 1991, since when an increase is indicated.

4.7 Short-term forecast

The short-term catch prediction for this stock considers three catch categories; human consumption landings, discards and industrial by-catch. The predicted HC landings and industrial by-catch each include a proportion which should be allocated to Division IIIa. The average proportion taken in IIIa is summarised in the following text table. These figures are based on Working Group estimates of catch. Information on the split of IIIa landings into industrial and human consumption components is only available for 1983 onwards.

		Percentage taken in Division IIIa	
Catch category	Year range	Mean	Range
Human consumption landings	Full, 1963–1998	3.33%	0.1% - 8.4%
Human consumption landings	Recent, 1996–1998	4.24%	-
Industrial by-catch	Full, 1983–1998	25.47%	5.1% - 43.2%
Industrial by-catch	Recent, 1996–1998	16.72%	-

As noted in Section 4.4, there are some indications of a recent decreasing trend in fishing effort in this stock. Under these circumstances it may be appropriate to estimate $F_{\text{-status quo}}$ by scaling the recent average exploitation pattern to the point estimate of current F, rather than using unscaled F which would normally be the practice. However the assessment indicates marked annual variation and retrospective noise in mean F, so it was considered more appropriate not to scale to current F. Thus for prediction purposes unscaled mean Fs over 1996–1998 were used. The mean HC F(2–6) over this period is 0.64, which compares with a point estimate for 1998 of 0.52. For the industrial by-catch, the mean F(0–3) over 1995–1998 of 0.0231 compares with a 1998 value of 0.030. The Fs at age for the human consumption/discard fleet were calculated by first obtaining partial Fs for this fleet over 1996–1998. The mean exploitation pattern over this period was then partitioned between the human consumption and discard components according to the mean proportion at each age over 1996–1998. This period was chosen after examination of the data showed no obvious recent trends in discard rate. Prediction Fs-at-age for the industrial by-catch were obtained using a similar procedure with the partial Fs for this fleet. It should be noted that the human consumption and by-catch reference Fs are calculated over different age ranges, reflecting their different exploitation patterns. This means that the mean F obtained from combining the partial Fs across these two fleets may not correspond to the mean total F. Mean weights at age were calculated over 1996–1998, again following examination of the data to check for the presence of trends. The mean Fs-at-age and weights-at-age are calculated automatically by the program 'Insens' and reflect recent practice for catch predictions for the North Sea stock.

The inputs to the prediction are given in Table 4.7.1. The results of this prediction are given in Table 4.7.2, with more detailed output assuming *status quo* F in 1999 summarised in Table 4.7.3. The assumption of *status quo* F in 1999 and 2000 leads to predicted human consumption landings for the North Sea and IIIa of 76,200 t in 1999 falling to 57,500 t in 2000. SSB is predicted to decrease from 150,000 t in 1999 to 121,000 t at the start of 2000, and then increase to 193,000 t at the start of 2001. For comparison, the total TAC for 1999 is 93,950 t (88,550 in the North Sea and 5,400 t in IIIa).

The predicted decrease in human consumption landings over 1999 and 2000 reflects the fact that all year classes which have recruited to the fishery since the 1994 year class have been of below average strength. This is apparent in the sensitivity analysis of the short-term forecast (Figure 4.7.1) which indicates that the estimate of the 2000 HC catch is sensitive primarily to the overall level of fishing and natural mortality in 1999 and 2000, with the estimates of year class strength being rather less important. This situation changes considerably for the predicted 2001 SSB which will be highly dependent on the strong 1999 year class, and hence the prediction is sensitive to the estimate of this year class and factors affecting its survival and contribution to the spawning stock.. The importance of the 1999 year class to the SSB in 2001 is also apparent in Table 4.7.4.

The cumulative probability distributions from the sensitivity analysis (Figure 4.7.2) indicate that the probability of the SSB falling below the $\mathbf{B}_{\text{lim}}$ of 100,000 t by 2001 is low. The input values to the catch prediction with sensitivity analysis are given in Table 4.7.5.

4.8 Medium-term projections

The input values for the medium-term projections were the same as those used for the short-term prediction (Table 4.7.1).

The stock and recruitment data for this stock do not show any evidence of a stock-recruitment relationship, and in particular they do not show any evidence of a decline in recruitment at low stock sizes. As the basis for the medium-term projections, a Beverton-Holt SRR curve was fitted to the data, although for the above reasons the model fit was not significant. Given the large variation in recruitment and the wide range of SSB values in the data, the results of the projections are likely to be rather insensitive to the SRR model chosen. The fitted Beverton-Holt curve is shown in Figure 4.8.1, along with the results of a medium-term projection assuming *status quo* fishing mortality in 1999 and subsequent years. The median line from this projection indicates an increase in landings and SSB after about 2000, reflecting the recruitment of the strong 1999 year class, after which both are indicated to remain stable. The recruitment of this year class is also apparent in the medium-term summaries in Table 4.7.1, where the probability of SSB falling below $\mathbf{B}_{lim}$ over the next four years is negligible, and the probability of SSB falling below $\mathbf{B}_{pa}$ over the same period drops sharply once this year class recruits to the spawning stock. These results are relatively insensitive to whether F is set at $F_{status\ quo}$ (0.79) or $\mathbf{F}_{pa}$ (0.7).

4.9 Biological Reference Points

A yield-per-recruit curve based on the inputs to the short-term forecast (Table 4.7.1) is given in Figure 4.9.1, and the stock-recruitment plot is given in Figure 4.9.2. The reference points given on Figure 4..9.1 are based on the total yield-per-recruit curve. The summary of medium-term projections at different levels of fishing mortality given in Figure 4.9.3 indicates that the probability of SSB falling below $\mathbf{B}_{pa}$ if F is maintained at F_{SQ} is approximately 20%. Reducing F to $\mathbf{F}_{pa}$ reduces this probability to about 10%. The time series of Mean F and SSB estimates is given relative to the precautionary reference points in Figure 4.9.4. In the majority of years, F has been above $\mathbf{F}_{pa}$ but SSB above $\mathbf{B}_{pa}$.

4.10 Comments on the Assessment

Recent assessments for this stock have tended to result in over-optimistic catch forecasts, with recent North Sea TACs being around the 120 kt mark but landings being closer to 80kt. This may be associated with a tendency to over-estimate strong year classes. There are in effect no strong year classes in the stock at present and the current forecast is indicating lower landings which are in line with or below the recent figures. Predictions for the spawning stock in 2001 and beyond are heavily dependent upon the estimate of the 1999 year class which is based on only a single recruitment index.

Table 4.1.1 **Nominal catch (t) of HADDOCK in Division IIIa as officially reported to ICES.**

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	19	5	13	4	14	9	4	18	-	-	-
Denmark	2558	3895	3885	2339	3812	1600	1458	1576	2523	2501	3168
Germany	-	-	3	-	-	+	1	1	5	5	11
Netherlands	8	-	-	-	-	-	-	-	-	-	-
Norway	245	84	100	110	184	153	142	134	114	187	188
Sweden	64	66	84	69	744	436	408	498	536	807	530
UK (Engl. & Wales)	-	-	-	-	-	+	-	-	-	-	-
Total	2894	4050	4085	2522	4754	2198	2013	2227	3178	3500	3897
WG estimate of H.cons. landings	2852	4098	4100	4086	4396	1959	1833	2191	3142	3401	3759
WG estimate of industrial bycatch	1480	360	1968	2593	4604	2415	2180	2162	2925	610	275
WG estimate of total catch	4332	4458	6068	6679	9000	4374	4013	4353	6067	4011	4034
Unallocated landings	-42	48	15	1564	-358	-239	-168	-36	-36	-99	-138

Table 4.1.2 **Nominal catch (t) of HADDOCK in Sub-Area IV as officially reported to ICES.**

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	220	145	192	168	415	292	306	407	215	436	724
Denmark	9174	2789	1993	1330	1476	3582	3208	2902	2520	2722	2608
Faroe Islands	35	16	6	15	13	25	43	49	13	9	
France	2193	1702	1115	631	508	960	678	441	368	804	427
Germany	802	447	749	535	764	348	1829	1284	1769	1462	1314
Netherlands	894	328	102	100	148	192	96	147	110	480	275
Norway	1590	1697	1572	2069	3273	2655	2355	2461	2297	2353	3010
Poland	-	-	-	-	-	-	-	-	18	8	7
Sweden	614	1051	900	957	1289	908	551	722	689	654	472
UK (Engl. & Wales)	5537	2507	2019	2173	2926	4259	4043	3616	3379	3330	3280
UK (Isle of Man)	-	-	-	-	11	-	-	-	-	-	-
UK (N. Ireland)	-	137	11	48	73	18	9	-	-	-	-
UK (Scotland)	84104	53587	34567	36474	39896	66799	73793	63411	63542	61098	60234
Total	105163	64406	43226	44500	50792	80038	86911	75440	74920	73356	72351
WG estimate of H.cons. landings	105126	76190	51458	44645	70218	79580	80897	75313	76034	79094	77311
WG estimate of discards	62062	25713	32603	40276	47967	79601	65392	57360	72522	52105	45175
WG estimate of industrial bycatch	3995	2410	2591	5421	10816	10741	3561	7747	5048	6689	5101
WG estimate of total catch	171183	104313	86652	90342	129001	169922	149850	140420	153604	137888	127587
Unallocated landings	-37	11784	8232	145	19426	-458	-6014	-127	1114	5738	4960

North Sea + Division IIIa

WG estimate of Total Catch	175515	108771	92720	97021	138001	174296	153863	144773	159671	141899	131621

Table 4.1.3; Catches ('000t) of Haddock from the North Sea and Division IIIa. Figures are Working Group estimates.

	North Sea				Division IIIa			Total
Year	H.cons	Disc	Ind. BC	Total	H. cons.	Ind. BC	Total	
1963	68.4	189.0	13.7	271.0	0.4	0.1	0.5	271.5
1964	130.5	160.3	88.6	379.4	0.4	0.3	0.7	380.2
1965	161.6	62.2	74.6	298.4	0.7	0.3	1.0	299.5
1966	225.8	73.6	46.7	346.0	0.6	0.1	0.7	346.7
1967	147.4	78.1	20.7	246.1	0.4	0.1	0.4	246.6
1968	105.4	161.9	34.2	301.5	0.4	0.1	0.5	302.0
1969	330.9	260.2	338.4	929.5	0.5	0.5	1.1	930.5
1970	524.6	101.4	179.7	805.7	0.7	0.2	0.9	806.7
1971	235.4	177.5	31.5	444.4	2.0	0.3	2.2	446.6
1972	192.9	128.1	29.6	350.6	2.6	0.4	3.0	353.6
1973	178.6	114.7	11.3	304.6	2.9	0.2	3.1	307.7
1974	149.6	166.8	47.8	364.2	3.5	1.1	4.6	368.8
1975	146.6	260.4	41.4	448.4	4.8	1.3	6.1	454.5
1976	165.6	154.3	48.2	368.1	7.0	2.0	9.1	377.1
1977	137.3	44.3	35.0	216.6	7.8	2.0	9.8	226.4
1978	85.8	76.9	10.8	173.5	5.9	0.7	6.6	180.1
1979	83.1	41.7	16.4	141.2	4.0	0.8	4.8	146.0
1980	98.6	94.7	22.3	215.7	6.4	1.5	7.9	223.6
1981	129.6	60.1	17.1	206.8	9.1	1.2	10.4	217.2
1982	165.8	40.5	19.4	225.8	10.8	1.3	12.1	237.8
1983	159.3	65.9	13.1	238.4	8.0	7.2	15.2	253.6
1984	128.1	75.3	10.1	213.5	6.4	2.7	9.1	222.6
1985	158.5	85.4	6.0	250.0	7.2	1.0	8.1	258.1
1986	165.5	52.2	2.6	220.4	3.6	1.7	5.3	225.7
1987	108.0	59.2	4.4	171.6	3.8	1.4	5.3	176.9
1988	105.1	62.1	4.0	171.2	2.9	1.5	4.3	175.5
1989	76.2	25.7	2.4	104.3	4.1	0.4	4.5	108.8
1990	51.5	32.6	2.6	86.7	4.1	2.0	6.1	92.7
1991	44.6	40.3	5.4	90.3	4.1	2.6	6.7	97.0
1992	70.2	48.0	10.8	129.0	4.4	4.6	9.0	138.0
1993	79.6	79.6	10.7	169.9	2.0	2.4	4.4	174.3
1994	80.9	65.4	3.6	149.9	1.8	2.2	4.0	153.9
1995	75.3	57.4	7.7	140.4	2.2	2.2	4.4	144.8
1996	76.0	72.5	5.0	153.6	3.1	2.9	6.1	159.7
1997	79.1	52.1	6.7	137.9	3.4	0.6	4.0	141.9
1998	77.3	45.2	5.1	127.6	3.8	0.3	4.0	131.6
Min	44.6	25.7	2.4	86.7	0.4	0.1	0.4	92.7
Mean	138.9	93.5	34.1	266.5	3.8	1.4	5.2	271.6
Max	524.6	260.4	338.4	929.5	10.8	7.2	15.2	930.5

Table 4.2.1 Haddock, North Sea + Skagerrak
Natural Mortality and proportion mature

Age	Natural Mortality	Mature
0	2.050	.000
1	1.650	.010
2	.400	.320
3	.250	.710
4	.250	.870
5	.200	.950
6	.200	1.000
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

Table 4.2.2; Haddock in the North Sea and Skagerrak

Catch numbers at age

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1963	1964	1965	1966	1967	1968
AGE						
0	1367	140235	652537	1671205	306037	11146
1	1307178	7436	368593	1007322	838189	1098748
2	335092	1296771	15184	25674	89083	439511
3	20963	135227	649840	6425	4863	19600
4	13026	9069	29496	412551	3585	1947
5	5781	5350	4662	9980	177857	2529
6	502	2405	1972	1045	2443	45973
7	653	287	452	601	215	325
8	566	236	107	165	216	40
9	59	231	90	90	57	13
+gp	18	25	41	25	34	5
0 TOTAI	1685205	1597272	1722974	3135083	1422579	1619837
TONSL	271531	380158	299464	346726	246589	302043
SOPCO	100	100	100	100	100	100

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
0	72670	925768	333396	244075	60545	614903	46388	174161	120798	305115
1	20493	266379	1815054	679205	366830	1220855	2116937	170529	258923	463554
2	3578611	218480	71035	587590	570630	176342	641755	1062943	107675	146957
3	303489	1908736	47546	40604	240604	332967	58991	211544	394175	30377
4	7596	57435	400469	21213	6192	54314	109062	9952	40185	113703
5	2411	1178	10374	158000	4470	1875	15813	31311	4318	8708
6	2515	1197	462	3563	39459	1351	983	4996	6275	1264
7	19129	256	195	190	1257	10922	620	206	1300	2076
8	200	5954	147	34	108	242	2714	76	135	402
9	24	67	1592	27	29	23	266	759	29	116
+gp	7	30	168	419	163	41	82	63	204	94
0 TOTAI	4007145	3385480	2680438	1734920	1290287	2413835	2993611	1666540	934017	1072366
TONSL	930538	806674	446634	353606	307688	368797	454536	377118	226411	180144
SOPCO	100	100	100	100	100	100	100	100	100	100

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
0	881823	399372	646419	278705	639814	95502	139579	56503	13384	16535
1	351451	678499	134470	275686	157259	432193	178878	160398	314017	30044
2	204046	333261	423059	86126	252258	168273	534269	178824	250496	490706
3	41297	73043	143151	299895	73920	122984	78726	323650	47432	89940
4	7406	10476	15228	41435	127250	22079	37445	27685	67864	13431
5	28024	1901	2034	3407	16480	32658	5306	9691	4761	18579
6	2237	8067	458	713	1708	3789	7355	1237	2877	1602
7	262	598	2498	279	297	596	965	1810	545	639
8	483	121	124	786	60	81	209	246	780	163
9	152	162	64	29	193	39	53	106	135	145
+gp	78	119	61	26	67	139	114	137	152	104
0 TOTAI	1517259	1505619	1367566	987087	1269306	878333	982899	760287	702443	661888
TONSL	146001	223610	217151	237842	253594	222563	258117	225697	176880	175516
SOPCO	100	100	102	102	104	102	101	101	99	100

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
0	12042	57702	123910	270758	141209	85966	273689	347568	40082	23902
1	47648	86819	228553	209879	359995	99260	301733	53415	134642	83557
2	35358	103021	78258	253286	262765	296776	85925	357942	86231	167359
3	182748	18947	23197	32494	108421	100476	167801	56894	213293	49648
4	18106	57830	3888	6552	7107	29609	25875	55147	15272	108066
5	2636	3905	12526	1250	1698	1920	7645	7503	15406	5743
6	4058	896	976	4861	450	573	511	3052	1892	3562
7	510	1380	401	454	1138	191	127	756	679	472
8	201	206	620	299	145	509	45	52	62	140
9	83	80	144	294	103	115	62	31	15	14
+gp	54	70	65	154	210	89	36	42	26	17
0 TOTAI	303444	330856	472538	780281	883241	615484	863449	882402	507600	442480
TONSL	108772	92720	97021	138001	174296	153864	144773	159671	141900	131621
SOPCO	102	102	104	104	100	102	101	100	101	101

Table 4.2.3 **Haddock in the North Sea and Skagerrak**
Stock weights at age

Table 3 Stock weights at age (kg)

YEAR	1963	1964	1965	1966	1967	1968
AGE						
0	0.012	0.011	0.01	0.01	0.011	0.01
1	0.123	0.118	0.069	0.088	0.115	0.126
2	0.253	0.239	0.225	0.247	0.281	0.253
3	0.473	0.403	0.366	0.367	0.461	0.509
4	0.695	0.664	0.648	0.533	0.594	0.731
5	0.807	0.814	0.844	0.949	0.639	0.857
6	1.004	0.908	1.193	1.266	1.057	0.837
7	1.131	1.382	1.173	1.525	1.501	1.606
8	1.173	1.148	1.482	1.938	1.922	2.26
9	1.576	1.47	1.707	1.727	2.069	2.702
+gp	1.825	1.781	2.239	2.889	2.348	2.073

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
0	0.011	0.013	0.011	0.024	0.044	0.024	0.02	0.013	0.019	0.011
1	0.063	0.073	0.107	0.116	0.112	0.128	0.101	0.125	0.108	0.144
2	0.216	0.222	0.247	0.242	0.24	0.226	0.241	0.224	0.241	0.253
3	0.406	0.352	0.362	0.388	0.372	0.343	0.356	0.401	0.345	0.418
4	0.799	0.735	0.506	0.506	0.586	0.548	0.449	0.512	0.601	0.441
5	0.891	0.873	0.887	0.606	0.649	0.891	0.68	0.588	0.613	0.719
6	1.031	1.191	1.267	1	0.725	0.895	1.245	0.922	0.802	0.742
7	1.094	1.362	1.534	1.366	1.044	0.952	1.124	1.933	1.181	0.955
8	2.04	1.437	1.337	2.241	1.302	1.513	1.093	1.784	1.943	1.398
9	3.034	2.571	1.275	2.006	2.796	2.315	1.72	1.306	2.322	2.124
+gp	3.264	3.899	2.058	1.684	1.828	2.639	2.42	2.43	1.812	2.158

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
0	0.009	0.012	0.009	0.011	0.022	0.01	0.013	0.025	0.008	0.024
1	0.095	0.104	0.074	0.1	0.135	0.141	0.149	0.124	0.126	0.165
2	0.29	0.283	0.262	0.292	0.297	0.3	0.279	0.242	0.265	0.217
3	0.443	0.486	0.476	0.46	0.448	0.489	0.48	0.397	0.406	0.417
4	0.637	0.732	0.745	0.784	0.651	0.67	0.668	0.613	0.615	0.589
5	0.664	1.046	1.147	1.166	0.915	0.805	0.857	0.863	1.029	0.748
6	0.933	0.936	1.479	1.441	1.214	1.097	1.049	1.257	1.276	1.284
7	1.187	1.394	1.18	1.672	1.162	1.1	1.459	1.195	1.433	1.424
8	1.187	1.599	1.634	1.456	1.92	1.868	1.833	1.715	1.529	1.551
9	1.468	1.593	1.764	2.634	1.376	2.425	2.124	1.525	1.877	1.627
+gp	2.374	2.143	1.709	2.156	1.725	2.046	2.043	2.612	2.22	2.346

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
0	0.027	0.044	0.029	0.018	0.01	0.017	0.013	0.019	0.021	0.023
1	0.197	0.194	0.177	0.107	0.115	0.116	0.102	0.127	0.133	0.153
2	0.3	0.292	0.32	0.306	0.28	0.25	0.297	0.246	0.277	0.252
3	0.372	0.43	0.472	0.486	0.447	0.419	0.363	0.388	0.359	0.392
4	0.605	0.473	0.639	0.748	0.68	0.597	0.592	0.483	0.579	0.44
5	0.811	0.771	0.65	1.016	0.894	0.943	0.763	0.78	0.615	0.651
6	0.982	0.967	1.042	0.896	1.173	1.208	1.099	0.87	0.909	0.76
7	1.364	1.167	1.232	1.395	1.102	1.57	1.423	0.846	0.966	1.103
8	1.655	1.529	1.481	1.537	1.592	1.469	1.685	1.833	1.647	1.153
9	1.684	2.037	1.776	1.912	1.737	1.62	1.873	2.025	2.247	1.825
+gp	2.229	2.606	2.064	2.021	1.873	2.444	1.986	1.97	2.388	2.352

Table 4.3.1; Haddock in the North Sea and Division IIIa
Summary of fleets used in catch-at-age analysis

Fleet	Abbreviation	Year range		Age range	
		First	Last	Youngest	Oldest
Scottish Seiners	SCOSEI	1978	1997	0	10
Scottish Light Trawlers	SCOLTR	1978	1997	0	10
Scottish Groundfish Survey (August)	SCOGFS	1982	1997	0	6
English Groundfish Survey (August)	ENGGFS	1978	1997	0	7
International Bottom Trawl Survey, Quarter 1	IBTSQ1	1978	1997	0	5 *1*

- Data used as if survey takes place at end of previous year; ages 2-5 from 1981 onwards.

Table 4.3.2; Haddock in the North Sea and Skagerrak
Tuning input file.

Haddock in Sub-area IV (North Sea) and Division IIIa (run name: XSASAR004)

104											
FLT01:	SCOSEI	(Catch:	Unknown)	(Effort:	Unknown)						
1989	1998										
1	1	0	1								
0	10										
355735	122.757	19003.76	19274.379	91069.77	8388.754	1091.295	1611.435	223.083	88.504	39.511	13.37
300076	712.19	35843.58	46489.32	9055.27	26705.22	1434.486	302.388	407.55	67.207	28.721	5.366
336675	2225.837	66143.56	30754.68	9530.928	1484.518	5028.135	307.511	122.391	183.01	42.406	10.676
300217	1231.55	30384.28	64732.898	8588.196	1511.942	290.016	1179.738	79.037	56.679	53.277	17.957
268413	2912.944	74523.46	88375.047	34996.9	2349.233	445.716	100.011	314.41	28.586	14.71	14.29
264738	3230.533	26626.01	125357.34	34126.9	10522.03	415.035	138.226	41.743	94.732	9.389	6.69
204545	236.434	67772.08	32300.982	70290.07	8734.379	2180.77	116.89	39.103	13.449	9.427	3.759
177092	1333.347	9191.87	123828.51	18532.25	17077.14	2161.283	707.006	83.724	11.556	8.436	11.111
166817	3108.574	30046.25	19165.139	59308.57	3917.753	4082.625	495.431	194.737	9.571	6.679	1.772
150361	38.313	12692.39	36812.77	12002.68	26564.22	1658.977	855.953	68.527	22.136	4.219	1.612
FLT02:	SCOLTR	(Catch:	Unknown)	(Effort:	Unknown)						
1989	1998										
1	1	0	1								
0	10										
405883	1076.998	10415.02	2919.387	24894.51	2753.952	541.324	626.922	108.898	30.131	21.314	6.988
441084	201.38	11886.35	19204.623	2664.623	10237.39	669.34	168.189	264.216	44.836	13.601	5.347
408056	1040.658	44141.13	12393.733	3355.596	564.193	2213.164	226.034	79.589	145.803	38.047	15.861
473955	1838.052	20443.35	31073.281	3889.02	756.982	144.252	765.573	97.505	52.225	57.939	17.465
447064	231.101	39863.39	39175.809	20213.47	1526.971	362.312	83.586	273.529	29.288	26.74	25.521
480400	1482.199	8266.777	49046.742	23557.34	6304.283	474.42	128.143	42.488	63.75	12.916	6.819
442010	143.844	22873.54	13761.645	32063.37	5821.263	1658.212	96.772	14.662	12.648	16.895	2.898
445995	352.525	14280.55	72692.008	9859.966	13958.75	2041.165	955.313	303.994	9.761	13.794	7.004
479449	459.847	15907.05	13450.542	49548.47	3536.682	4510.573	553.205	162.645	12.541	2.17	1.726
427868	156.69	27497.9	33166.45	9596.803	29613.58	1666.356	1228.13	173.209	46.331	4.427	0.827
FLT03:	ENGGFS	(Catch:	Unknown)	(Effort:	Unknown)						
1989	1998										
1	1	0.5	0.75								
0	5										
100	9.43	8.17	1.45	3.97	0.25	0.03					
100	28.19	6.65	1.98	0.29	0.88	0.05					
100	26.33	11.5	0.96	0.23	0.05	0.22					
100	82.77	19.69	9.77	0.58	0.05	0.01					
100	13.58	24.61	5.86	1.66	0.06	0.02					
100	94.3	8.07	9.02	0.84	0.28	0.02					
100	17.99	38.31	4.45	3.4	0.28	0.09					
100	19.92	8.31	14.57	1.22	0.83	0.07					
100	13.032	14.863	4.334	6.607	0.227	0.216					
100	5.302	8.891	5.681	1.347	1.418	0.083					
FLT04:	IBTS_Q1	(Catch:	Unknown)	(Effort:	Unknown)						
1989	1998										
1	1	0.99	1								
0	5										
1	0.22	0.11	0.031	0.051	0.003	0.002					
1	0.679	0.131	0.024	0.004	0.009	0.002					
1	1.115	0.371	0.019	0.003	0.001	0.002					
1	1.242	0.543	0.155	0.009	0.001	0.001					
1	0.229	0.504	0.098	0.023	0.002	0.001					
1	1.375	0.205	0.181	0.025	0.005	0.001					
1	0.267	0.813	0.066	0.047	0.0077	0.0031					
1	0.86	0.366	0.471	0.025	0.0151	0.0034					
1	0.374	0.423	0.106	0.114	0.0087	0.0054					
1	0.212	0.233	0.13	0.048	0.0366	0.0043					

TABLE 4.4.1 Haddock in the North Sea & Skagerrak
Diagnostics from the Final XSA run.

Lowestoft VPA Version 3.1
13/10/1999 9:45

Extended Survivors Analysis

Haddock in IV IIIa (run: XSASAR04/X04)

CPUE data from file fleet

Catch data for 36 years. 1963 to 1998. Ages 0 to 10.

Fleet	Firs year	Last year	First age	Last age	Alpha	Beta
FLT01: SCOSEI (Ca	1989	1998	0	9	0	1
FLT02: SCOLTR (C	1989	1998	0	9	0	1
FLT03: ENGGFS (C	1989	1998	0	5	0.5	0.75
FLT04: IBTS_Q1 (C	1989	1998	0	5	0.99	1

Time series weights :

Tapered time weighting applied
Power = 0 over 10 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

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 = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 24 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.004	0.006	0.013	0.019	0.031	0.004	0.062	0.043	0.008	0.014
1	0.106	0.195	0.156	0.148	0.173	0.152	0.104	0.083	0.116	0.117
2	0.655	1.121	0.781	0.739	0.812	0.569	0.503	0.45	0.495	0.553
3	0.987	1.16	1.033	1.138	1.046	1.089	0.915	0.915	0.632	0.713
4	1.185	1.152	0.86	1.068	0.906	1.042	1.054	0.997	0.726	0.851
5	0.701	0.95	0.884	0.796	0.968	0.69	0.899	1.136	0.913	0.698
6	0.781	0.547	0.661	1.118	0.765	1.116	0.39	1.24	1.055	0.547
7	0.607	0.676	0.507	0.76	0.889	0.906	0.812	1.983	1.1	0.844
8	0.795	0.532	0.756	0.922	0.587	1.527	0.552	0.984	0.987	0.703
9	0.746	0.893	0.914	1.062	1.012	1.484	0.769	0.967	0.892	0.623

Table 4.4.1 contd.

1

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6	7	8	9
1989	8.71E+06	1.08E+06	8.98E+04	3.30E+05	2.96E+04	5.78E+03	8.27E+03	1.24E+03	4.05E+02	1.75E+02
1990	2.82E+07	1.12E+06	1.87E+05	3.13E+04	9.58E+04	7.04E+03	2.35E+03	3.10E+03	5.52E+02	1.50E+02
1991	2.74E+07	3.60E+06	1.76E+05	4.08E+04	7.64E+03	2.36E+04	2.23E+03	1.11E+03	1.29E+03	2.66E+02
1992	4.09E+07	3.48E+06	5.92E+05	5.42E+04	1.13E+04	2.52E+03	7.98E+03	9.43E+02	5.49E+02	4.97E+02
1993	1.29E+07	5.17E+06	5.77E+05	1.89E+05	1.35E+04	3.03E+03	9.30E+02	2.14E+03	3.61E+02	1.79E+02
1994	5.44E+07	1.61E+06	8.36E+05	1.72E+05	5.18E+04	4.26E+03	9.42E+02	3.54E+02	7.19E+02	1.64E+02
1995	1.26E+07	6.97E+06	2.65E+05	3.17E+05	4.50E+04	1.42E+04	1.75E+03	2.52E+02	1.17E+02	1.28E+02
1996	2.28E+07	1.53E+06	1.21E+06	1.08E+05	9.90E+04	1.22E+04	4.75E+03	9.69E+02	9.18E+01	5.53E+01
1997	1.35E+07	2.81E+06	2.70E+05	5.16E+05	3.35E+04	2.84E+04	3.21E+03	1.12E+03	1.09E+02	2.81E+01
1998	4.74E+06	1.73E+06	4.81E+05	1.10E+05	2.14E+05	1.26E+04	9.34E+03	9.15E+02	3.06E+02	3.34E+01

Estimated population abundance at 1st Jan 1999

0.00E+00	6.01E+05	2.95E+05	1.85E+05	4.21E+04	7.11E+04	5.14E+03	4.43E+03	3.22E+02	1.24E+02

Taper weighted geometric mean of the VPA populations:

1.80E+07	2.41E+06	3.59E+05	1.31E+05	3.75E+04	8.49E+03	3.07E+03	9.74E+02	3.29E+02	1.21E+02

Standard error of the weighted Log(VPA populations) :

0.7423	0.6455	0.8006	0.9419	1.0577	0.8343	0.8589	0.7383	0.8805	0.9097

1

Log catchability residuals.

Fleet : FLT01: SCOSEI (Catch

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	-1.51	-0.76	0.29	-0.58	1.55	0.22	-0.66	0.62	2.03	-1.21
1	-0.06	0.74	0.06	-0.58	0.05	0.19	-0.1	-0.44	0.2	-0.07
2	0.1	0.6	0	-0.37	0.11	0	0.02	-0.03	-0.32	-0.11
3	0.02	0.3	-0.08	-0.31	-0.08	0.02	0.32	0.21	-0.25	-0.17
4	0.15	0.29	-0.3	-0.48	-0.17	0.06	0.27	0.28	-0.16	0.05
5	-0.24	0.11	0.01	-0.52	-0.1	-0.61	0.19	0.57	0.33	0.26
6	0.03	-0.32	-0.32	0.06	-0.29	0.17	-0.66	0.64	0.66	0.03
7	-0.1	-0.22	-0.59	-0.63	0.09	-0.11	0.38	0.38	0.82	-0.02
8	0.17	-0.36	-0.23	-0.36	-0.65	0.24	-0.03	0.39	0.09	-0.12
9	0.18	0.25	-0.04	-0.26	-0.44	-0.61	-0.38	0.58	1.05	0.41

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4	5	6	7	8	9
Mean Log q	-21.58	-16.0108	-13.9385	-13.5306	-13.5603	-13.7923	-13.9926	-14.0145	-14.0145	-14.0145
S.E(Log q)	1.1623	0.3626	0.2658	0.2208	0.2664	0.3747	0.4225	0.4459	0.3336	0.5242

Regression statistics :

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
0	0.76	0.572	20.43	0.42	10	0.92	-21.58
1	1.19	-0.851	16.26	0.71	10	0.44	-16.01
2	1.13	-1.014	14.08	0.89	10	0.3	-13.94
3	1.02	-0.228	13.56	0.95	10	0.24	-13.53
4	0.84	3.236	13.08	0.98	10	0.16	-13.56
5	0.75	3.009	12.62	0.95	10	0.21	-13.79
6	0.86	1.038	13.13	0.87	10	0.36	-13.99
7	1.13	-0.542	14.93	0.69	10	0.52	-14.01
8	1.18	-1.323	15.62	0.87	10	0.37	-14.1
9	1.74	-3.195	20.74	0.7	10	0.64	-13.94

Table 4.4.1 contd.

Fleet : FLT02: SCOLTR (Catch

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	1.64	-1.29	0.46	0.48	-0.38	-0.04	-0.81	-0.52	0.18	0.27
1	0.3	0.34	0.55	-0.34	0	-0.49	-0.87	0.16	-0.4	0.75
2	-0.51	0.74	0.3	-0.15	0.19	-0.13	-0.19	-0.08	-0.32	0.14
3	-0.1	0.01	0	-0.24	0.18	0.37	0.08	-0.02	-0.17	-0.12
4	0.04	0.08	-0.33	-0.49	0.03	0.08	0.23	0.29	-0.19	0.25
5	-0.14	-0.1	-0.06	-0.74	0.12	-0.14	0.08	0.53	0.31	0.15
6	-0.25	-0.49	-0.01	-0.03	-0.18	0.3	-0.82	0.82	0.52	0.15
7	-0.3	-0.39	-0.56	-0.23	0.1	-0.04	-0.72	1.4	0.23	0.51
8	-0.39	-0.5	0	-0.25	-0.49	-0.1	-0.21	-0.05	-0.04	0.23
9	0.08	-0.23	0.31	0.01	0.3	-0.23	0.09	0.8	-0.48	0.06

Mean log catchability and standard error of ages with catchability

independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4	5	6	7	8	9
Mean Log q	-22.6962	-17.0985	-15.3464	-14.8469	-14.6946	-14.7274	-14.7936	-14.6649	-14.6649	-14.6649
S.E(Log q)	0.8149	0.5117	0.3569	0.1792	0.2577	0.3371	0.4782	0.6148	0.3003	0.3615

Regression statistics :

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
0	1.38	-0.727	24.95	0.32	10	1.15	-22.7
1	1.68	-1.679	18.73	0.43	10	0.78	-17.1
2	1	0.018	15.34	0.83	10	0.38	-15.35
3	0.98	0.26	14.79	0.97	10	0.19	-14.85
4	0.84	3.73	14.02	0.99	10	0.14	-14.69
5	0.8	2.183	13.6	0.94	10	0.23	-14.73
6	0.9	0.563	14.13	0.8	10	0.45	-14.79
7	0.91	0.336	13.97	0.64	10	0.59	-14.66
8	1.04	-0.418	15.21	0.93	10	0.25	-14.84
9	0.96	0.283	14.23	0.88	10	0.36	-14.59
1							

Fleet : FLT03: ENGGFS (Catch

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	-0.09	-0.17	-0.21	0.54	-0.11	0.38	0.22	-0.29	-0.21	-0.06
1	0.35	0.16	-0.48	0.08	-0.07	-0.03	0.03	0	0	-0.03
2	0.28	0.15	-0.73	0.36	-0.08	-0.17	0.23	-0.13	0.18	-0.09
3	0.26	0.11	-0.47	0.24	-0.02	-0.58	0.1	0.16	0.1	0.1
4	0.39	0.46	-0.06	-0.33	-0.42	-0.14	0.01	0.27	-0.11	-0.06
5	-0.27	0.2	0.43	-0.48	0.14	-0.38	0.05	0.1	0.24	-0.04
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4	5
Mean Log q	-16.9738	-15.6561	-15.2671	-15.4242	-15.788	-15.9437
S.E(Log q)	0.2788	0.21	0.3172	0.2876	0.291	0.2903

Table 4.4.1 contd.

Regression statistics :
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
0	0.86	1.319	16.94	0.92	10	0.23	-16.97
1	1.18	-1.514	15.83	0.9	10	0.23	-15.66
2	1.05	-0.363	15.4	0.85	10	0.35	-15.27
3	0.95	0.522	15.23	0.93	10	0.28	-15.42
4	0.88	1.643	15.15	0.96	10	0.23	-15.79
5	0.8	2.847	14.58	0.96	10	0.17	-15.94

Fleet : FLT04: IBTS_Q1 (Catc

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	-0.13	-0.18	0.35	0.07	-0.46	-0.13	-0.25	0.31	-0.04	0.45
1	-0.27	-0.04	-0.21	0.2	-0.25	0	-0.14	0.56	0.13	0.02
2	0.38	-0.14	-0.66	0.19	-0.17	-0.17	-0.1	0.3	0.35	0.03
3	-0.04	-0.05	-0.73	0.19	-0.22	0.01	-0.15	0.3	-0.03	0.73
4	-0.08	-0.19	-0.14	-0.33	0.02	-0.27	0.32	0.14	0.41	0.12
5	0.16	0.21	-1.07	0.39	0.38	-0.24	-0.11	0.37	-0.23	0.14
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4	5
Mean Log q	-15.3193	-14.0819	-14.2093	-14.4164	-14.5997	-14.1384
S.E(Log q)	0.2917	0.2521	0.3192	0.375	0.2456	0.445

Regression statistics :

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
0	1.04	-0.293	15.26	0.86	10	0.32	-15.32
1	1.1	-0.68	14.02	0.85	10	0.29	-14.08
2	0.97	0.254	14.16	0.87	10	0.33	-14.21
3	0.96	0.262	14.32	0.87	10	0.38	-14.42
4	0.93	0.903	14.33	0.96	10	0.23	-14.6
5	1.48	-2.166	16.58	0.72	10	0.55	-14.14
1							

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

Year class = 1998

Fleet	I S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: SCOSEI (Ca	180112	1.219	0	0	1	0.024	0
FLT02: SCOLTR (C	790356	0.855	0	0	1	0.049	0
FLT03: ENGGFS (C	568959	0.3	0	0	1	0.398	0
FLT04: IBTS_Q1 (C	943946	0.306	0	0	1	0.383	0
F shrinkage mean	237527	0.5				0.145	0.035

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
601278	0.19	0.26	5	1.366	0.014

Table 4.4.1 contd.

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1997

Fleet	l	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	332215	0.363	0.596	1.64	2	0.125	0.105
FLT02: SCOLTR (C	532397	0.455	0.253	0.56	2	0.08	0.067
FLT03: ENGGFS (C	262018	0.212	0.09	0.42	2	0.364	0.131
FLT04: IBTS_Q1 (C	293079	0.214	0.029	0.13	2	0.357	0.118
F shrinkage mean	241071	0.5				0.074	0.141

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
295384	0.13	0.11	9	0.826	0.117

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet	l	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	189067	0.232	0.131	0.56	3	0.193	0.545
FLT02: SCOLTR (C	172621	0.29	0.199	0.69	3	0.123	0.584
FLT03: ENGGFS (C	163509	0.179	0.084	0.47	3	0.307	0.609
FLT04: IBTS_Q1 (C	216974	0.181	0.079	0.44	3	0.302	0.49
F shrinkage mean	175620	0.5				0.075	0.577

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
185363	0.1	0.06	13	0.542	0.553

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet	l	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	32211	0.19	0.068	0.36	4	0.219	0.859
FLT02: SCOLTR (C	35753	0.215	0.108	0.5	4	0.18	0.8
FLT03: ENGGFS (C	47505	0.16	0.043	0.27	4	0.284	0.654
FLT04: IBTS_Q1 (C	60714	0.17	0.213	1.25	4	0.236	0.543
F shrinkage mean	28453	0.5				0.081	0.932

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
42132	0.09	0.08	17	0.909	0.713
1					

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet	l	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	67669	0.174	0.064	0.37	5	0.222	0.879
FLT02: SCOLTR (C	73432	0.188	0.141	0.75	5	0.201	0.832
FLT03: ENGGFS (C	73687	0.156	0.075	0.48	5	0.254	0.83
FLT04: IBTS_Q1 (C	74618	0.165	0.07	0.43	5	0.233	0.823
F shrinkage mean	59322	0.5				0.09	0.958

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
71065	0.09	0.04	21	0.467	0.851

Table 4.4.1 contd.

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	5655	0.194	0.094	0.48	6	0.209	0.652
FLT02: SCOLTR (C	5077	0.198	0.077	0.39	6	0.22	0.705
FLT03: ENGGFS (C	5017	0.175	0.042	0.24	6	0.278	0.711
FLT04: IBTS_Q1 (C	6171	0.193	0.108	0.56	6	0.188	0.611
F shrinkage mean	3379	0.5				0.105	0.931

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
5145	0.1	0.05	25	0.493	0.698
1					

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	5195	0.24	0.059	0.25	7	0.267	0.483
FLT02: SCOLTR (C	5479	0.239	0.042	0.17	7	0.249	0.463
FLT03: ENGGFS (C	5506	0.19	0.057	0.3	6	0.189	0.461
FLT04: IBTS_Q1 (C	4111	0.213	0.078	0.37	6	0.121	0.579
F shrinkage mean	2124	0.5				0.174	0.923

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
4427	0.13	0.08	27	0.6	0.547

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	396	0.297	0.116	0.39	8	0.304	0.731
FLT02: SCOLTR (C	522	0.325	0.036	0.11	8	0.209	0.597
FLT03: ENGGFS (C	327	0.203	0.081	0.4	6	0.076	0.835
FLT04: IBTS_Q1 (C	432	0.232	0.062	0.27	6	0.047	0.687
F shrinkage mean	197	0.5				0.365	1.152

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
322	0.22	0.1	29	0.453	0.844
1					

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1990

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	S	s.e	s.e	Ratio		Weights	F
FLT01: SCOSEI (Ca	132	0.277	0.123	0.45	9	0.337	0.673
FLT02: SCOLTR (C	158	0.273	0.04	0.15	9	0.373	0.589
FLT03: ENGGFS (C	123	0.2	0.06	0.3	6	0.022	0.709
FLT04: IBTS_Q1 (C	105	0.227	0.048	0.21	6	0.014	0.792
F shrinkage mean	82	0.5				0.255	0.938

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
124	0.19	0.07	31	0.357	0.703

Table 4.4.1 contd.

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1989

Fleet	l S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: SCOSEI (Ca	18	0.302	0.081	0.27	10	0.267	0.529
FLT02: SCOLTR (C	15	0.258	0.06	0.23	10	0.428	0.611
FLT03: ENGGFS (C	11	0.197	0.092	0.47	6	0.012	0.787
FLT04: IBTS_Q1 (C	13	0.223	0.083	0.37	6	0.008	0.677
F shrinkage mean	12	0.5				0.285	0.736

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
15	0.2	0.05	33	0.233	0.623

Table 4.4.2; Haddock, North Sea & Skagerrak
Fishing mortality at age

Haddock in Sub-area IV (North Sea) and Division IIIa (run name: XSASAR004)

Table 8 Fishing mortality (F) at age

YEAR	1963	1964	1965	1966	1967	1968
AGE						
0	0.0016	0.0435	0.0716	0.0699	0.0022	0.0018
1	0.1241	0.0581	1.3627	1.3029	0.2626	0.0516
2	0.8053	0.4545	0.4164	0.8308	1.0805	0.5778
3	0.6704	1.1746	0.5093	0.3602	0.4148	0.8979
4	0.7614	0.756	0.9848	0.7794	0.372	0.3069
5	0.8802	0.8843	1.2993	1.2403	1.0137	0.5076
6	0.5085	1.2628	1.0212	1.3097	1.326	0.8082
7	0.8268	0.6215	0.8722	1.0825	1.1388	0.5968
8	0.7773	0.8385	0.4982	0.9695	1.9446	0.6586
9	0.7582	0.8819	0.9455	1.089	1.1731	0.5805
+gp	0.7582	0.8819	0.9455	1.089	1.1731	0.5805
0 FBAR 2- 6	0.7251	0.9064	0.8462	0.9041	0.8414	0.6197

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
0	0.0167	0.0298	0.0119	0.0321	0.0023	0.0129	0.0113	0.0299	0.0132	0.0217
1	0.0215	0.5004	0.4743	0.1692	0.3736	0.3532	0.3351	0.3077	0.3381	0.3905
2	0.6553	1.0385	0.659	0.7932	0.5649	0.9334	0.9691	0.8145	1.0051	1.0116
3	1.3759	1.1499	0.7977	1.3394	1.1582	0.9499	1.2536	1.371	1.0375	1.1281
4	1.2867	1.2693	0.8706	1.2012	0.8019	1.0028	1.0991	0.7813	1.2621	1.1235
5	0.8141	0.7114	0.8645	1.1583	0.95	0.628	0.9922	1.2713	1.0313	1.1628
6	1.6261	1.4369	0.6864	0.8587	1.0978	0.8804	0.8201	1.0639	0.9889	1.0363
7	1	0.7088	1.0169	0.6843	0.8819	1.1249	1.5674	0.3934	0.9242	1.1463
8	0.9509	1.0592	1.2854	0.4712	1.1459	0.4048	0.9978	0.8395	0.4875	0.8534
9	1.1493	1.0491	0.9552	0.8841	0.9865	0.8165	1.1083	0.8792	0.9492	1.0769
+gp	1.1493	1.0491	0.9552	0.8841	0.9865	0.8165	1.1083	0.8792	0.9492	1.0769
0 FBAR 2- 6	1.1516	1.1212	0.7756	1.0701	0.9146	0.8789	1.0268	1.0604	1.065	1.0925

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
0	0.0347	0.0738	0.0571	0.0384	0.027	0.0155	0.0163	0.0032	0.0089	0.0055
1	0.1755	0.1894	0.179	0.1735	0.1514	0.125	0.2064	0.128	0.1187	0.1368
2	0.8822	0.7074	0.4501	0.4307	0.6602	0.6687	0.614	1.018	0.9027	0.7962
3	1.1414	1.2096	0.9456	0.8157	1.0204	0.9969	0.9576	1.2404	1.0468	1.3044
4	1.0619	1.1849	0.9933	0.8798	1.1614	1.1409	1.1042	1.2907	1.0834	1.1149
5	1.0234	0.9369	0.803	0.6469	1.2124	1.2218	1.0243	1.0603	0.8382	1.1091
6	1.1708	0.9855	0.6102	0.7499	0.8141	1.0881	1.074	0.7099	1.153	0.7751
7	0.6171	1.296	1.0081	0.9823	0.8398	0.7675	0.9478	0.8657	0.8126	0.8869
8	0.9416	0.6568	1.1158	1.1054	0.5777	0.5768	0.682	0.6772	1.2893	0.6125
9	0.9737	1.0236	0.9159	0.8822	0.9312	0.9698	0.9773	0.9308	1.0473	0.9094
+gp	0.9737	1.0236	0.9159	0.8822	0.9312	0.9698	0.9773	0.9308	1.0473	0.9094
0 FBAR 2- 6	1.056	1.0049	0.7604	0.7046	0.9737	1.0233	0.9548	1.0639	1.0048	1.0199

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98
AGE											
0	0.0039	0.0057	0.0127	0.0186	0.031	0.0044	0.0623	0.0434	0.0083	0.0142	0.0219
1	0.106	0.1953	0.1563	0.1479	0.1729	0.1518	0.1039	0.0832	0.1157	0.1169	0.1052
2	0.6552	1.1207	0.7805	0.7394	0.8125	0.5686	0.5034	0.4497	0.4945	0.5534	0.4992
3	0.987	1.1597	1.0332	1.1382	1.0458	1.0887	0.9146	0.9154	0.6317	0.7129	0.7533
4	1.1847	1.1516	0.8599	1.0683	0.9055	1.0417	1.0543	0.9974	0.7261	0.851	0.8582
5	0.7005	0.9495	0.8839	0.7957	0.9676	0.69	0.8991	1.1365	0.913	0.6982	0.9159
6	0.7809	0.547	0.6611	1.1184	0.7651	1.1164	0.3901	1.24	1.0545	0.547	0.9471
7	0.6074	0.6764	0.5075	0.7599	0.8891	0.9058	0.8119	1.9825	1.1003	0.8439	1.3089
8	0.795	0.5315	0.7561	0.9215	0.5869	1.5272	0.5518	0.9841	0.9866	0.7031	0.8913
9	0.7455	0.8926	0.9136	1.0625	1.0124	1.4845	0.7686	0.9667	0.8922	0.6235	0.8274
+gp	0.7455	0.8926	0.9136	1.0625	1.0124	1.4845	0.7686	0.9667	0.8922	0.6235	
0 FBAR 2- 6	0.8617	0.9857	0.8437	0.972	0.8993	0.9011	0.7523	0.9478	0.764	0.6725	

Table 4.4.3; Haddock, North Sea & Skagerrak
Stock numbers at age

Haddock in Sub-area IV (North Sea) and Division IIIa (run name: XSASAR004)

Table 10 Stock number at age (start of year) Numbers*10**-5

YEAR	1963	1964	1965	1966	1967	1968
AGE						
0	23383	91721	263363	689923	3881120	171025
1	255640	3005	11304	31563	82821	498538
2	7401	43367	545	556	1647	12233
3	486	2217	18453	241	162	375
4	277	194	534	8636	131	83
5	109	101	71	155	3085	70
6	14	37	34	16	37	917
7	13	7	9	10	3	8
8	12	5	3	3	3	1
9	1	4	2	1	1	0
+gp	0	0	1	0	1	0
TOTAL	287335	140658	294317	731104	3969011	683249

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
0	121955	877639	782848	215392	728983	1334930	115423	164835	257514	395488
1	21977	15439	109661	99584	26853	93628	169646	14693	20595	32718
2	90929	4131	1798	13106	16149	3549	12631	23303	2074	2821
3	4601	31652	980	623	3975	6153	936	3213	6918	509
4	119	905	7806	344	127	972	1853	208	635	1909
5	48	26	198	2545	81	44	278	481	74	140
6	35	17	10	68	654	26	19	84	110	22
7	334	6	3	4	24	179	9	7	24	34
8	4	101	2	1	2	8	48	1	4	8
9	0	1	29	1	1	0	4	14	1	2
+gp	0	1	3	8	3	1	1	1	4	2
TOTAL	240002	929917	903339	331677	776850	1439491	300848	206840	287953	433650

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
0	721525	156543	324770	206131	669739	172689	240468	498850	42039	84426
1	49818	89722	18720	39490	25536	83923	21888	30456	64017	5364
2	4252	8027	14258	3006	6376	4215	14223	3420	5146	10918
3	688	1180	2652	6093	1310	2209	1448	5160	828	1399
4	128	171	274	802	2099	368	635	433	1162	226
5	483	35	41	79	259	512	91	164	93	306
6	36	142	11	15	34	63	123	27	46	33
7	6	9	43	5	6	12	17	35	11	12
8	9	3	2	13	2	2	5	6	12	4
9	3	3	1	1	4	1	1	2	2	3
+gp	1	2	1	0	1	2	2	2	3	2
TOTAL	776949	255836	360773	255636	705365	263996	278902	538554	113359	102693

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 63-9	AMST 63-96
AGE													
0	87078	281550	274033	409413	128854	544125	126286	228081	135403	47373	0	262674	450357
1	10809	11167	36038	34833	51734	16081	69739	15275	28115	17287	6013	35208	63596
2	898	1867	1764	5920	5770	8358	2653	12071	2700	4809	2954	5326	10276
3	3301	313	408	542	1894	1716	3173	1075	5161	1104	1854	1579	3438
4	296	958	76	113	135	518	450	990	335	2137	421	443	1017
5	58	70	236	25	30	43	142	122	284	126	711	124	303
6	83	24	22	80	9	9	17	47	32	93	51	38	86
7	12	31	11	9	21	4	3	10	11	9	44	12	27
8	4	6	13	5	4	7	1	1	1	3	3	4	9
9	2	1	3	5	2	2	1	1	0	0	1	2	3
+gp	1	1	1	3	4	1	1	1	0	0	0		
TOTAL	102543	295988	312606	450948	188457	570865	202467	257674	172043	72943	12053		

Table 4.5.2a, Haddock in the North Sea and Skagerrak
RCT3 output, Age 0.

Analysis by RCT3 ver3.1 of data from file :

hadiv0.rct

HADDOCK IN IV, RCT3 INPUT VALUES Age 0 14-Oct-99

Data for 18 surveys over 29 years : 1971 - 1999

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
IYFS1	1.21	5.07	.49	.743	26	5.36	11.55	.527	.200
IYFS2									
EGFS0	.85	7.57	.43	.761	20	3.99	10.94	.491	.230
EGFS1	1.02	7.11	.30	.860	21	4.04	11.25	.337	.487
EGFS2									
SGFS0									
SGFS1									
SGFS2									
					VPA Mean =		12.47	.812	.084

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
IYFS1									
IYFS2									
EGFS0	.85	7.57	.43	.761	20	7.65	14.05	.504	.722
EGFS1									
EGFS2									
SGFS0									
SGFS1									
SGFS2									
					VPA Mean =		12.47	.812	.278

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	236968	12.38	.13	.12	.75	228082	12.34
1997	137107	11.83	.17	.10	.33		
1998	84339	11.34	.24	.23	.94		
1999	812719	13.61	.43	.71	2.71		

Table 4.5.2b, Haddock in the North Sea and Skagerrak
RCT3 output, Age 1.

Analysis by RCT3 ver3.1 of data from file :

hadivl.rct

HADDOCK IN IV, RCT3 INPUT VALUES Age 1 14-Oct-99

Data for 18 surveys over 29 years : 1971 - 1999

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
IYFS1	1.21	2.99	.49	.745	26	5.36	9.47	.525	.211
IYFS2									
EGFS0	.85	5.45	.44	.746	20	3.99	8.86	.511	.223
EGFS1	1.03	5.01	.31	.852	21	4.04	9.17	.348	.479
EGFS2									
SGFS0									
SGFS1									
SGFS2									
VPA Mean =	10.40	.815	.087						

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
IYFS1									
IYFS2									
EGFS0	.85	5.45	.44	.746	20	7.65	11.99	.524	.708
EGFS1									
EGFS2									
SGFS0									
SGFS1									
SGFS2									
					VPA Mean =		10.40	.815	.292

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	30083	10.31	.14	.12	.74	28115	10.24
1997	17292	9.76	.18	.10	.33		
1998	10634	9.27	.24	.23	.94		
1999	100987	11.52	.44	.72	2.69		

Table 4.5.2c, Haddock in the North Sea and Skagerrak
RCT3 output, Age 2.

Analysis by RCT3 ver3.1 of data from file :

hadiv2.rct

HADDOCK IN IV, RCT3 INPUT VALUES Age 2 14-Oct-99

Data for 18 surveys over 29 years : 1971 - 1999

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1997

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.16	1.47	.42	.796	26	5.93	8.32	.442	.145
IYFS2	1.25	1.37	.43	.782	26	5.45	8.19	.461	.133
EGFS0	.87	3.54	.48	.715	20	4.88	7.79	.526	.103
EGFS1	1.03	3.20	.29	.866	21	4.50	7.82	.322	.274
EGFS2	.88	4.74	.32	.846	22	3.38	7.72	.349	.232
SGFS0	.89	3.91	.57	.665	15	4.59	7.98	.639	.069
SGFS1									
SGFS2									
						VPA Mean =	8.55	.805	.044

Yearclass = 1998

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.16	1.47	.42	.796	26	5.36	7.67	.450	.262
IYFS2									
EGFS0	.87	3.54	.48	.715	20	3.99	7.02	.553	.174
EGFS1	1.03	3.20	.29	.866	21	4.04	7.35	.332	.482
EGFS2									
SGFS0									
SGFS1									
SGFS2									
						VPA Mean =	8.55	.805	.332

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	5101	8.54	.13	.12	.81	4810	8.48
1997	2864	7.96	.17	.10	.37		
1998	1766	7.48	.23	.22	.93		
1999	15706	9.66	.46	.78	2.84		

Table 4.5.3; Haddock, North Sea & Skagerrak
RCT3 output for run for age 0 using constrained 1999 index.

Input values as in Table 4.5.1, except English GFS index at age 0 in 1999 (2110) replaced by corresponding index for 1981 year class (1537.5)

```
Analysis by RCT3 ver3.1 of data from file :

hadtry0.rct

HADDOCK IN IV,RCT3 INPUT VALUES, Age 0,14-Oct-99, EGFS0_99 replaced by 81 index

Data for   18 surveys over   29 years :  1971 - 1999

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as    .20
Minimum of   5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass =   1999
```

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
IYFS1									
IYFS2									
EGFS0	.85	7.57	.43	.761	20	7.34	13.78	.492	.732
EGFS1									
EGFS2									
SGFS0									
SGFS1									
SGFS2									
					VPA Mean =		12.47	.812	.268

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1999	678459	13.43	.42	.58	1.89		

TABLE 4.6.1; Haddock, North Sea + Skagerrak
Mean fishing mortality, biomass and recruitment, 1963 - 1998.

Year	Mean F: H.cons Ages 2 to 6	Mean F: Disc Ages 2 to 6	Mean F: Ind BC Ages 0 to 3	Stock Biomass ('000 tonnes): Total	Stock Biomass ('000 tonnes): Spawning	Recruits Age 0: Yclass	Recruits Age 0: Million	
1963	.579	.125	.026	3387	137	1963	2338	
1964	.699	.073	.131	1188	420	1964	9172	
1965	.647	.067	.343	812	526	1965	26336	
1966	.715	.104	.263	780	432	1966	68992	
1967	.678	.142	.052	1216	229	1967	388112	
1968	.485	.089	.056	6700	265	1968	17103	
1969	.843	.093	.198	2344	816	1969	12196	
1970	.804	.123	.266	1405	900	1970	87764	
1971	.629	.108	.078	1672	418	1971	78285	
1972	.900	.145	.051	1677	301	1972	21539	
1973	.777	.126	.034	900	294	1973	72898	
1974	.639	.140	.101	1568	258	1974	133493	
1975	.763	.203	.086	2163	238	1975	11542	
1976	.812	.153	.125	885	308	1976	16484	
1977	.807	.127	.173	567	239	1977	25751	
1978	.879	.185	.062	665	132	1978	39549	
1979	.939	.085	.056	673	109	1979	72153	
1980	.847	.080	.088	1250	153	1980	15654	
1981	.654	.086	.064	671	240	1981	32477	
1982	.588	.067	.066	840	300	1982	20613	
1983	.802	.145	.049	759	253	1983	66974	
1984	.907	.091	.032	1493	199	1984	17269	
1985	.856	.078	.018	860	241	1985	24047	
1986	.882	.178	.012	715	222	1986	49885	
1987	.858	.142	.019	1068	157	1987	4204	
1988	.844	.148	.026	427	159	1988	8443	
1989	.706	.132	.016	396	129	1989	8708	
1990	.702	.233	.026	343	81	1990	28155	
1991	.763	.065	.023	740	63	1991	27403	
1992	.861	.100	.033	602	101	1992	40941	
1993	.739	.143	.040	858	133	1993	12885	
1994	.711	.182	.015	506	154	1994	54413	
1995	.602	.146	.029	946	150	1995	12629	
1996	.783	.152	.033	595	183	1996	22808	
1997	.625	.121	.031	675	197	1997	13540	
1998	.522	.127	.030	540	170	1998	8433	*
1999					150		67846	*
Min.	.485	.065	.012	343	63	Min.	2338	
Mean	.746	.125	.076	1191	259	Gmean	26267	
Max.	.939	.233	.343	6700	900	Max.	388112	

Min, max and geo. mean recruitment calculated over years 1963 to 1996
(Arithmetic mean recruitment 1963 - 1996 = 45036)
Biomass totals calculated at start of year.

* RCT3 estimate

Table 4.7.1 Haddock in Sub-area IV (North Sea) and Division IIIa.

1999	H cons		Disc		Ind BC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.000	0.0010	0.050	0.0210	0.015	67845900	2.0500	0.0000	0.0000	0.0000	0.021
1	0.0010	0.313	0.0770	0.154	0.0270	0.076	1063400.0	1.6500	0.0100	0.0000	0.0000	0.138
2	0.1200	0.372	0.3360	0.235	0.0430	0.150	295400.00	0.4000	0.3200	0.0000	0.0000	0.258
3	0.4920	0.434	0.2250	0.286	0.0350	0.254	185400.00	0.2500	0.7100	0.0000	0.0000	0.380
4	0.7530	0.525	0.0970	0.311	0.0080	0.345	42100.000	0.2500	0.8700	0.0000	0.0000	0.501
5	0.9050	0.685	0.0070	0.378	0.0030	0.351	71100.000	0.2000	0.9500	0.0000	0.0000	0.682
6	0.9460	0.847	0.0020	0.143	0.0000	0.000	5100.000	0.2000	1.0000	0.0000	0.0000	0.846
7	1.3090	0.972	0.0000	0.000	0.0000	0.000	4400.000	0.2000	1.0000	0.0000	0.0000	0.972
8	0.8910	1.544	0.0000	0.000	0.0000	0.000	300.000	0.2000	1.0000	0.0000	0.0000	1.544
9	0.8270	2.032	0.0000	0.000	0.0000	0.000	100.000	0.2000	1.0000	0.0000	0.0000	2.032
10+	0.8270	2.237	0.0000	0.000	0.0000	0.000	0.000	0.2000	1.0000	0.0000	0.0000	2.237
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

2000	H cons		Disc		Ind BC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.000	0.0010	0.050	0.0210	0.015	26267500	2.0500	0.0000	0.0000	0.0000	0.021
1	0.0010	0.313	0.0770	0.154	0.0270	0.076	.	1.6500	0.0100	0.0000	0.0000	0.138
2	0.1200	0.372	0.3360	0.235	0.0430	0.150	.	0.4000	0.3200	0.0000	0.0000	0.258
3	0.4920	0.434	0.2250	0.286	0.0350	0.254	.	0.2500	0.7100	0.0000	0.0000	0.380
4	0.7530	0.525	0.0970	0.311	0.0080	0.345	.	0.2500	0.8700	0.0000	0.0000	0.501
5	0.9050	0.685	0.0070	0.378	0.0030	0.351	.	0.2000	0.9500	0.0000	0.0000	0.682
6	0.9460	0.847	0.0020	0.143	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.846
7	1.3090	0.972	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.972
8	0.8910	1.544	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	1.544
9	0.8270	2.032	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.032
10+	0.8270	2.237	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.237
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

(cont.)

Table 4.7.1 contd.

(cont.)

2001	H cons		Disc		Ind BC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.000	0.0010	0.050	0.0210	0.015	26267500	2.0500	0.0000	0.0000	0.0000	0.021
1	0.0010	0.313	0.0770	0.154	0.0270	0.076	.	1.6500	0.0100	0.0000	0.0000	0.138
2	0.1200	0.372	0.3360	0.235	0.0430	0.150	.	0.4000	0.3200	0.0000	0.0000	0.258
3	0.4920	0.434	0.2250	0.286	0.0350	0.254	.	0.2500	0.7100	0.0000	0.0000	0.380
4	0.7530	0.525	0.0970	0.311	0.0080	0.345	.	0.2500	0.8700	0.0000	0.0000	0.501
5	0.9050	0.685	0.0070	0.378	0.0030	0.351	.	0.2000	0.9500	0.0000	0.0000	0.682
6	0.9460	0.847	0.0020	0.143	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.846
7	1.3090	0.972	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.972
8	0.8910	1.544	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	1.544
9	0.8270	2.032	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.032
10+	0.8270	2.237	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.237
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

Notes: Run name : MANSAR02
Date and time: 17OCT99:19:36

Table 4.7.2 Haddock in Sub-area IV (North Sea) and Division IIIa.

Year: 1999											
H cons			Disc			Ind BC			Total		
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.6432	76164	1.0000	0.1334	31177	1.0000	0.0315	12457	119798	1797018	149550
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes

Year: 2000												Year: 2001	
H cons			Disc			Ind BC			Total				
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	Stock biomass	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0315	14059	14059	1890491	121167	1578739	273834
0.1000	0.0643	7892	0.1000	0.0133	6930	1.0000	0.0315	13976	28799	.	121167	1564511	262962
0.2000	0.1286	15201	0.2000	0.0267	13729	1.0000	0.0315	13896	42826	.	121167	1551121	252846
0.3000	0.1930	21972	0.3000	0.0400	20401	1.0000	0.0315	13819	56191	.	121167	1538506	243425
0.4000	0.2573	28248	0.4000	0.0534	26953	1.0000	0.0315	13743	68944	.	121167	1526607	234645
0.5000	0.3216	34068	0.5000	0.0667	33391	1.0000	0.0315	13670	81129	.	121167	1515369	226456
0.6000	0.3859	39468	0.6000	0.0800	39719	1.0000	0.0315	13599	92786	.	121167	1504745	218813
0.7000	0.4502	44480	0.7000	0.0934	45943	1.0000	0.0315	13530	103953	.	121167	1494688	211672
0.8000	0.5146	49136	0.8000	0.1067	52067	1.0000	0.0315	13462	114665	.	121167	1485156	204996
0.9000	0.5789	53462	0.9000	0.1201	58096	1.0000	0.0315	13397	124954	.	121167	1476112	198749
1.0000	0.6432	57484	1.0000	0.1334	64032	1.0000	0.0315	13333	134849	.	121167	1467520	192897
1.1000	0.7075	61226	1.1000	0.1467	69881	1.0000	0.0315	13271	144378	.	121167	1459346	187412
1.2000	0.7718	64709	1.2000	0.1601	75646	1.0000	0.0315	13210	153565	.	121167	1451562	182265
1.3000	0.8362	67953	1.3000	0.1734	81330	1.0000	0.0315	13151	162434	.	121167	1444139	177430
1.4000	0.9005	70976	1.4000	0.1868	86936	1.0000	0.0315	13093	171006	.	121167	1437052	172885
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSAR02
Date and time : 17OCT99:19:36
Computation of ref. F: H cons: Simple mean, age 2 - 6
Disc: Simple mean, age 2 - 6
Ind BC: Simple mean, age 0 - 3
Basis for 1999 : F factors

Table 4.7.3 Haddock in Sub-area IV (North Sea) and Division IIIa.

Year 1999. H cons	F-factor 1.0000 and reference F 0.6432
Disc	F-factor 1.0000 and reference F 0.1334
Ind BC	F-factor 1.0000 and reference F 0.0315

	H cons			Disc			Ind BC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0000	0	0	0.0010	28621	1431	0.0210	601032	9015	629653	10447	67845900	1424764	0	0	0	0
1	0.0010	501	157	0.0770	38589	5943	0.0270	13531	1028	52621	7128	1063400	146749	10634	1467	10634	1467
2	0.1200	23383	8699	0.3360	65473	15386	0.0430	8379	1257	97235	25342	295400	76213	94528	24388	94528	24388
3	0.4920	57612	25004	0.2250	26347	7535	0.0350	4098	1041	88057	33580	185400	70452	131634	50021	131634	50021
4	0.7530	19163	10061	0.0970	2469	768	0.0080	204	70	21835	10899	42100	21092	36627	18350	36627	18350
5	0.9050	38785	26568	0.0070	300	113	0.0030	129	45	39214	26726	71100	48490	67545	46066	67545	46066
6	0.9460	2869	2430	0.0020	6	1	0.0000	0	0	2875	2431	5100	4315	5100	4315	5100	4315
7	1.3090	2973	2890	0.0000	0	0	0.0000	0	0	2973	2890	4400	4277	4400	4277	4400	4277
8	0.8910	163	251	0.0000	0	0	0.0000	0	0	163	251	300	463	300	463	300	463
9	0.8270	52	105	0.0000	0	0	0.0000	0	0	52	105	100	203	100	203	100	203
10+	0.8270	0	0	0.0000	0	0	0.0000	0	0	0	0	0	0	0	0	0	0
Total		145501	76164		161804	31177		627373	12457	934678	119798	69513200	1797018	350868	149550	350868	149550
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.7.3 contd.

Multi fleet prediction: Detailed tables

(cont.)

Year 2000. H cons	F-factor 1.0000 and reference F	0.6432
Disc	F-factor 1.0000 and reference F	0.1334
Ind BC	F-factor 1.0000 and reference F	0.0315

	H cons			Disc			Ind BC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0000	0	0	0.0010	11081	554	0.0210	232698	3490	243779	4045	26267500	551618	0	0	0	0
1	0.0010	4027	1260	0.0770	310051	47748	0.0270	108719	8263	422797	57271	8544083	1179083	85441	11791	85441	11791
2	0.1200	14555	5414	0.3360	40753	9577	0.0430	5215	782	60523	15774	183870	47438	58838	15180	58838	15180
3	0.4920	37358	16213	0.2250	17084	4886	0.0350	2658	675	57100	21774	120221	45684	85357	32436	85357	32436
4	0.7530	30984	16267	0.0970	3991	1241	0.0080	329	114	35304	17621	68069	34102	59220	29669	59220	29669
5	0.9050	7584	5195	0.0070	59	22	0.0030	25	9	7668	5226	13902	9481	13207	9007	13207	9007
6	0.9460	13117	11110	0.0020	28	4	0.0000	0	0	13145	11114	23315	19724	23315	19724	23315	19724
7	1.3090	1093	1063	0.0000	0	0	0.0000	0	0	1093	1063	1618	1573	1618	1573	1618	1573
8	0.8910	528	815	0.0000	0	0	0.0000	0	0	528	815	973	1502	973	1502	973	1502
9	0.8270	52	106	0.0000	0	0	0.0000	0	0	52	106	101	205	101	205	101	205
10+	0.8270	19	41	0.0000	0	0	0.0000	0	0	19	41	36	80	36	80	36	80
Total		109315	57484		383047	64032		349645	13333	842007	134849	35223686	1890491	328105	121167	328105	121167
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.7.3 contd.

Multi fleet prediction: Detailed tables

(cont.)

Year 2001. H cons	F-factor 1.0000	and reference F	0.6432
Disc	F-factor 1.0000	and reference F	0.1334
Ind BC	F-factor 1.0000	and reference F	0.0315

	H cons			Disc			Ind BC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0000	0	0	0.0010	11081	554	0.0210	232698	3490	243779	4045	26267500	551618	0	0	0	0
1	0.0010	1559	488	0.0770	120041	18486	0.0270	42092	3199	163692	22173	3307962	456499	33080	4565	33080	4565
2	0.1200	116942	43503	0.3360	327439	76948	0.0430	41904	6286	486286	126736	1477334	381152	472747	121969	472747	121969
3	0.4920	23253	10092	0.2250	10634	3041	0.0350	1654	420	35541	13553	74831	28436	53130	20189	53130	20189
4	0.7530	20091	10548	0.0970	2588	805	0.0080	213	74	22893	11426	44138	22113	38400	19239	38400	19239
5	0.9050	12262	8399	0.0070	95	36	0.0030	41	14	12397	8449	22478	15330	21354	14563	21354	14563
6	0.9460	2565	2172	0.0020	5	1	0.0000	0	0	2570	2173	4559	3857	4559	3857	4559	3857
7	1.3090	4998	4858	0.0000	0	0	0.0000	0	0	4998	4858	7397	7190	7397	7190	7397	7190
8	0.8910	194	300	0.0000	0	0	0.0000	0	0	194	300	358	552	358	552	358	552
9	0.8270	169	343	0.0000	0	0	0.0000	0	0	169	343	327	664	327	664	327	664
10+	0.8270	25	57	0.0000	0	0	0.0000	0	0	25	57	49	109	49	109	49	109
Total		182058	80759		471883	99871		318603	13483	972544	194114	31206932	1467520	631400	192897	631400	192897
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSAR02
Date and time : 17OCT99:19:32
Computation of ref. F: H cons: Simple mean, age 2 - 6
Disc: Simple mean, age 2 - 6
Ind BC: Simple mean, age 0 - 3
Prediction basis : F factors

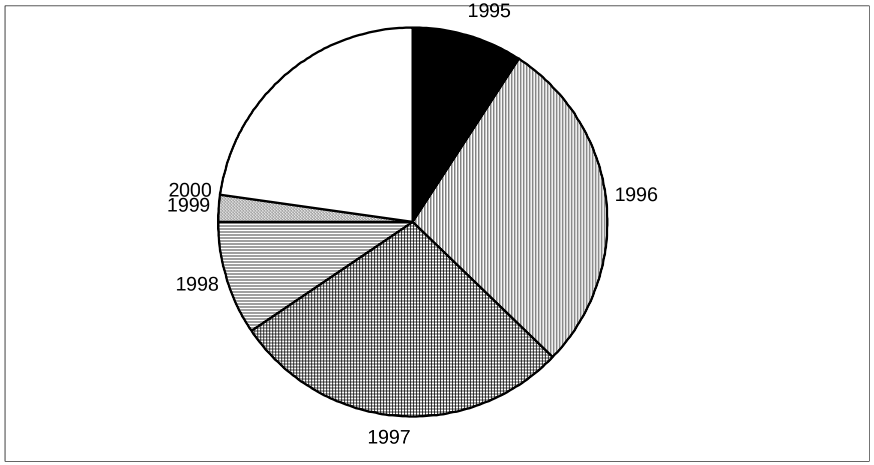
Table 4.7.4 **Haddock in IV/ IIIa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to HC landings and SSB (by weight) of these year classes

Year-class	1995	1996	1997	1998	1999	2000
Stock No. (thousands) of 0 year-olds	12628600	22808100	13540300	8433900	67845900	26267400
Source	VPA	VPA	VPA	RCT3	RCT3	GM
Status Quo F:						
% in 1999 landings	13.2	32.8	11.4	0.2	0.0	-
% in 2000	9.0	28.3	28.2	9.4	2.2	0.0
% in 1999 SSB	12.3	33.4	16.3	1.0	0.0	-
% in 2000 SSB	4.0	18.0	26.0	17.9	26.0	0.0
% in 2001 SSB	2.0	7.5	10.0	10.5	63.2	2.4

GM : geometric mean recruitment

Haddock in IV/ IIIa : Year-class % contribution to

a) 2000 HC landings



b) 2001 SSB

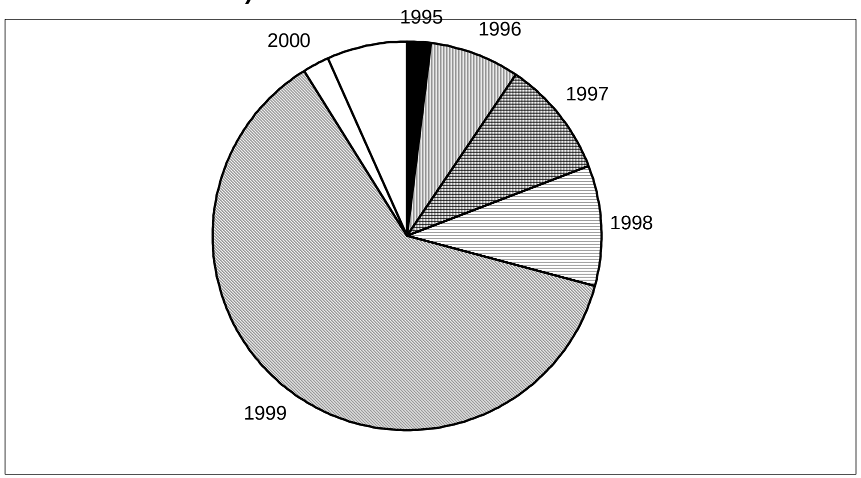


Table 4.7.5; Haddock in the North sea & Skagerrak
Input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock			Natural mortality		
N0	67845900	0.58	WS0	0.02	0.1	M0	2.05	0.03
N1	1063400	0.24	WS1	0.14	0.1	M1	1.65	0.05
N2	295398	0.13	WS2	0.26	0.06	M2	0.4	0.07
N3	185399	0.1	WS3	0.38	0.05	M3	0.25	0.19
N4	42100	0.09	WS4	0.5	0.14	M4	0.25	0.12
N5	71099	0.09	WS5	0.68	0.13	M5	0.2	0.17
N6	5098	0.1	WS6	0.85	0.09	M6	0.2	0.1
N7	4400	0.13	WS7	0.97	0.13	M7	0.2	0.1
N8	299	0.22	WS8	1.54	0.23	M8	0.2	0.1
N9	100	0.19	WS9	2.03	0.1	M9	0.2	0.1
N10	0	0.2	WS10	2.24	0.1	M10	0.2	0.1
H.cons selectivity			Weight in the HC catch			Proportion mature		
sH0	0	0	WH0	0	0	MT0	0	0.1
sH1	0	0.18	WH1	0.31	0.14	MT1	0.01	0.1
sH2	0.12	0.32	WH2	0.37	0.06	MT2	0.32	0.1
sH3	0.49	0.25	WH3	0.43	0.06	MT3	0.71	0.1
sH4	0.75	0.13	WH4	0.52	0.14	MT4	0.87	0.1
sH5	0.9	0.08	WH5	0.68	0.12	MT5	0.95	0.1
sH6	0.95	0.26	WH6	0.85	0.09	MT6	1	0.1
sH7	1.31	0.27	WH7	0.97	0.13	MT7	1	0
sH8	0.89	0.13	WH8	1.54	0.23	MT8	1	0
sH9	0.83	0.11	WH9	2.03	0.1	MT9	1	0
sH10	0.83	0.11	WH10	2.24	0.1	MT10	1	0
Discard selectivity			Weight in the discards			Relative effort		
sD0	0	0.66	WD0	0.05	0.23	in HC fishery		
sD1	0.08	0.47	WD1	0.15	0.09	HF99	1	0.19
sD2	0.34	0.25	WD2	0.24	0.08	HF00	1	0.19
sD3	0.23	0.2	WD3	0.29	0.02	HF01	1	0.19
sD4	0.1	0.42	WD4	0.31	0.04			
sD5	0.01	0.84	WD5	0.38	0.05	Relative effort in industrial fishery		
sD6	0	1.73	WD6	0.14	1.73	IF99	1	0.04
sD7	0	0	WD7	0	0	IF00	1	0.04
sD8	0	0	WD8	0	0	IF01	1	0.04
sD9	0	0	WD9	0	0			
sD10	0	0	WD10	0	0	Recruitment in 2000 and 2001		
						R00	26267500	1.01
Industrial s selectivity			Weight in the ind bycatch			R01	26267500	1.01
sI0	0.02	0.9	WI0	0.01	0.47			
sI1	0.03	0.5	WI1	0.08	0.01	Year effect for natural mortality		
sI2	0.04	0.7	WI2	0.15	0.1			
sI3	0.04	0.56	WI3	0.25	0.32	K99	1	0.21
sI4	0.01	0.71	WI4	0.35	0.23	K00	1	0.21
sI5	0	1.45	WI5	0.35	0.89	K01	1	0.21
sI6	0	0	WI6	0	0			
sI7	0	0	WI7	0	0			
sI8	0	0	WI8	0	0			
sI9	0	0	WI9	0	0			
sI10	0	0	WI10	0	0			

Proportion of F before spawning =	0
Proportion of M before spawning =	0

Table 4.8.1
Medium Term Summary
Haddock in the North Sea and Skaggerak

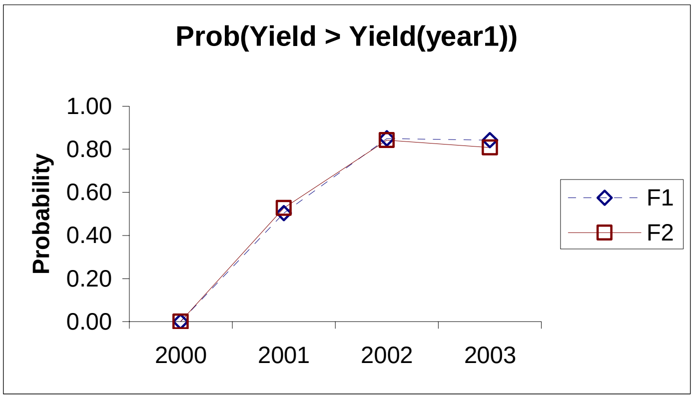
Bpa	140	thousand tonnes			
Blim	100	thousand tonnes			
F1	0.7	Basis :	Fpa	F multiplier	0.88
F2	0.79	Basis :	SQ	F multiplier	1
Year 1	1999				

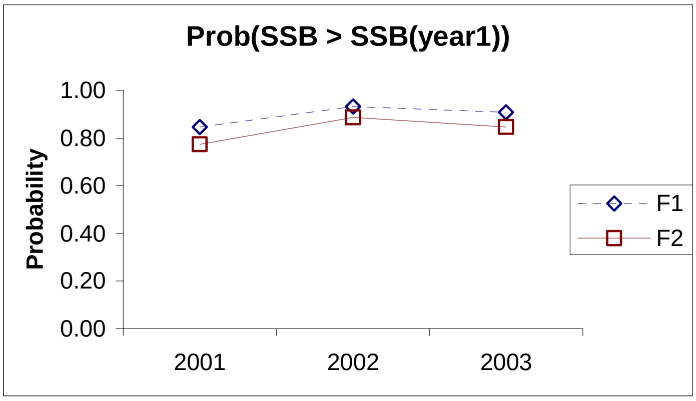
Format of tables:

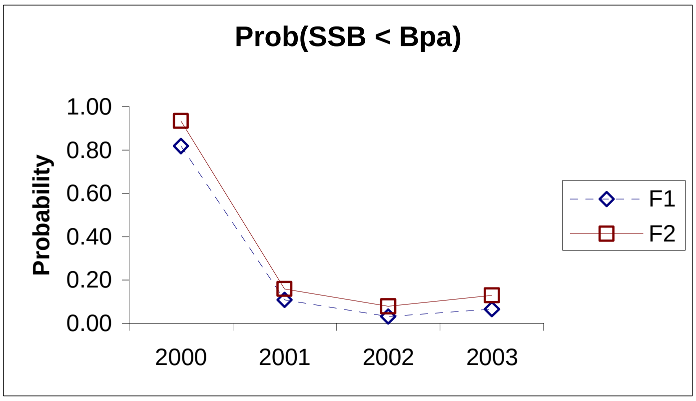
	1999	2000	2001	2002	2003
F1	Yield1999	Prob(Yield2000>Yield1999)	Prob(Yield2001>Yield1999)	Prob(Yield2002>Yield1999)	Prob(Yield2003>Yield1999)
	SSB1999	SSB2000	Prob(SSB2001>SSB1999)	Prob(SSB2002>SSB1999)	Prob(SSB2003>SSB1999)
		Prob(SSB2000< Bpa)	Prob(SSB2001< Bpa)	Prob(SSB2002< Bpa)	Prob(SSB2003< Bpa)
		Prob(SSB2000< Blim)	Prob(SSB2001< Blim)	Prob(SSB2002< Blim)	Prob(SSB2003< Blim)
F2	Yield1999	Prob(Yield2000>Yield1999)	Prob(Yield2001>Yield1999)	Prob(Yield2002>Yield1999)	Prob(Yield2003>Yield1999)
	SSB1999	SSB2000	Prob(SSB2001>SSB1999)	Prob(SSB2002>SSB1999)	Prob(SSB2003>SSB1999)
		Prob(SSB2000< Bpa)	Prob(SSB2001< Bpa)	Prob(SSB2002< Bpa)	Prob(SSB2003< Bpa)
		Prob(SSB2000< Blim)	Prob(SSB2001< Blim)	Prob(SSB2002< Blim)	Prob(SSB2003< Blim)

Medium Term Summary
Haddock in the North Sea and Skaggerak

F	1999	2000	2001	2002	2003
0.7	76.2	0.00	0.50	0.85	0.84
	150	121	0.85	0.93	0.91
		0.82	0.11	0.03	0.07
		0.00	0.00	0.01	0.02
0.79	76.2	0.00	0.53	0.84	0.81
	150	121	0.77	0.89	0.85
		0.93	0.16	0.08	0.13
		0.00	0.01	0.01	0.02







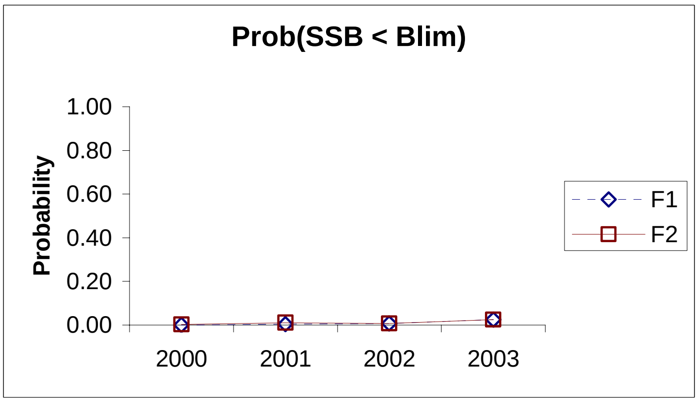
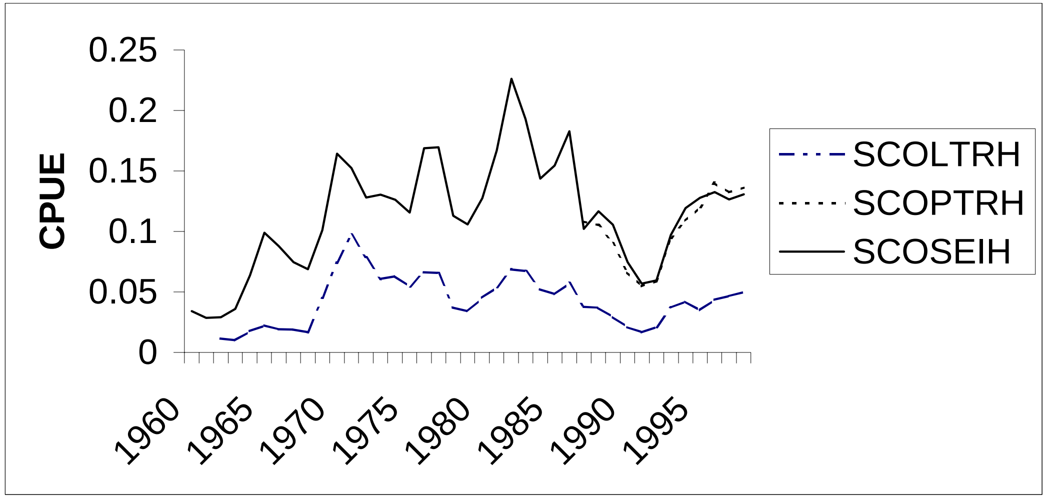
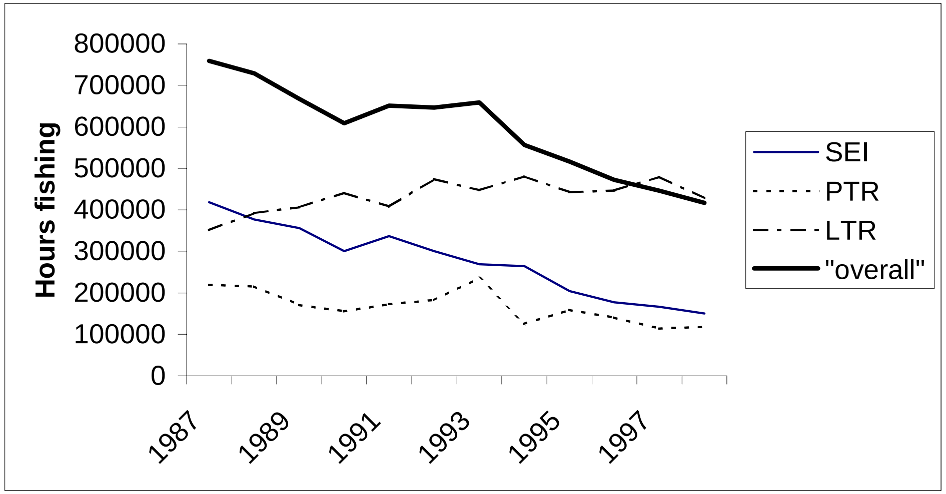


Figure 4.4.1; F, effort and CPUE in the major North Sea Haddock fleets

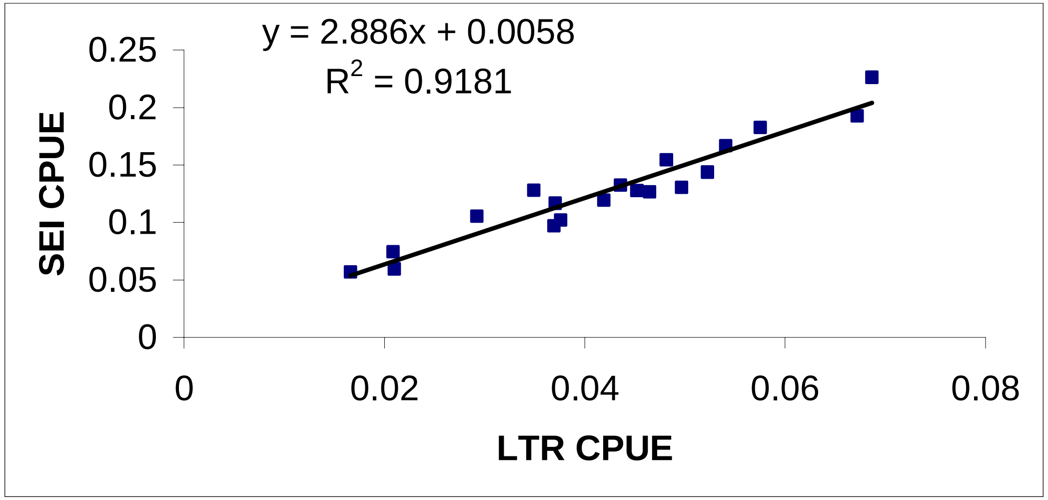
A, North Sea Haddock, CPUE trends in major fleets



B, North Sea Haddock, effort trends in major fleets



C, North Sea Haddock, relationship between Seine and Light Trawl CPUE, 1980-1998



D, North sea Haddock, trends in F and Effort

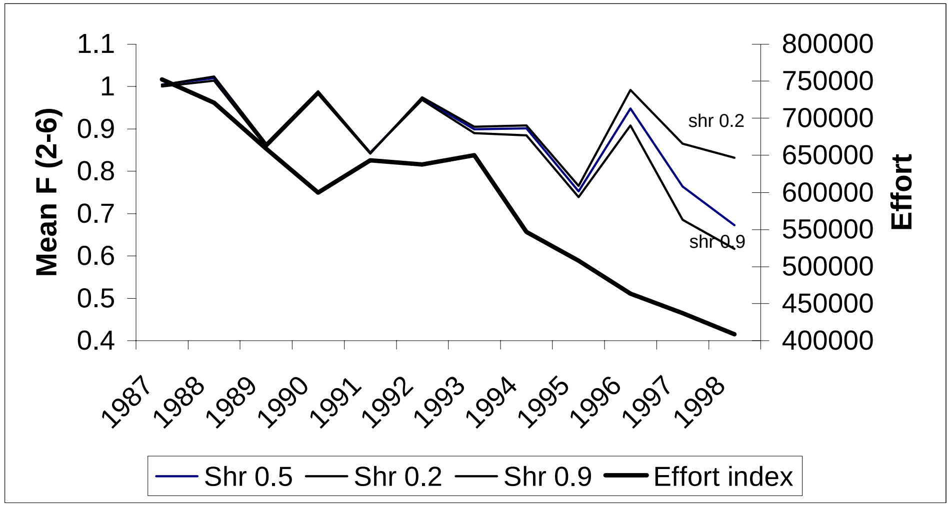


Figure 4.4.2 Haddock in the North Sea and Skagerrak, catchability residuals.

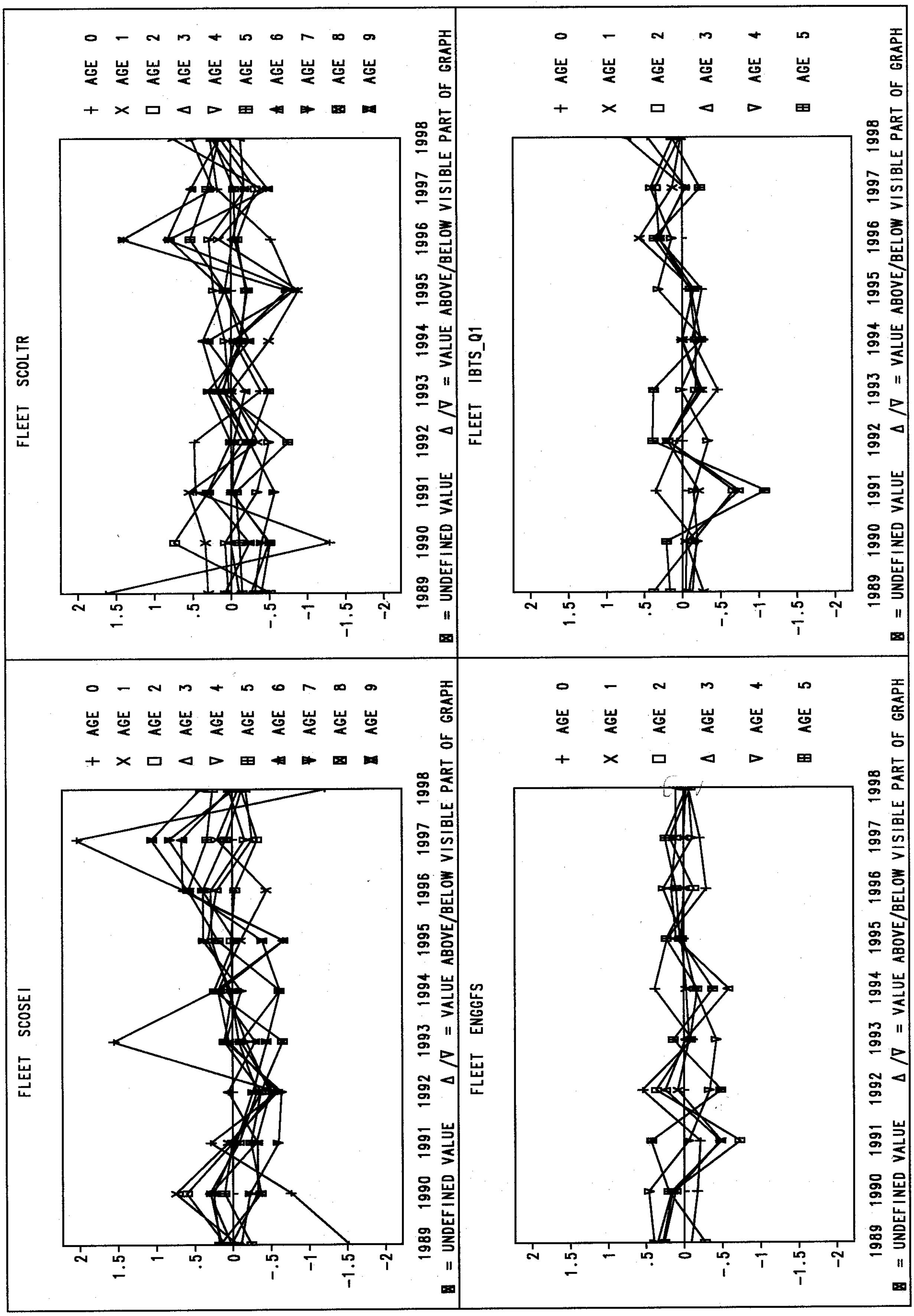


Figure 4.4.3 **Haddock, North Sea & Skagerrak**
Relative contribution of survey fleets, commercial fleets and F-shrinkage to estimates of survivors at age

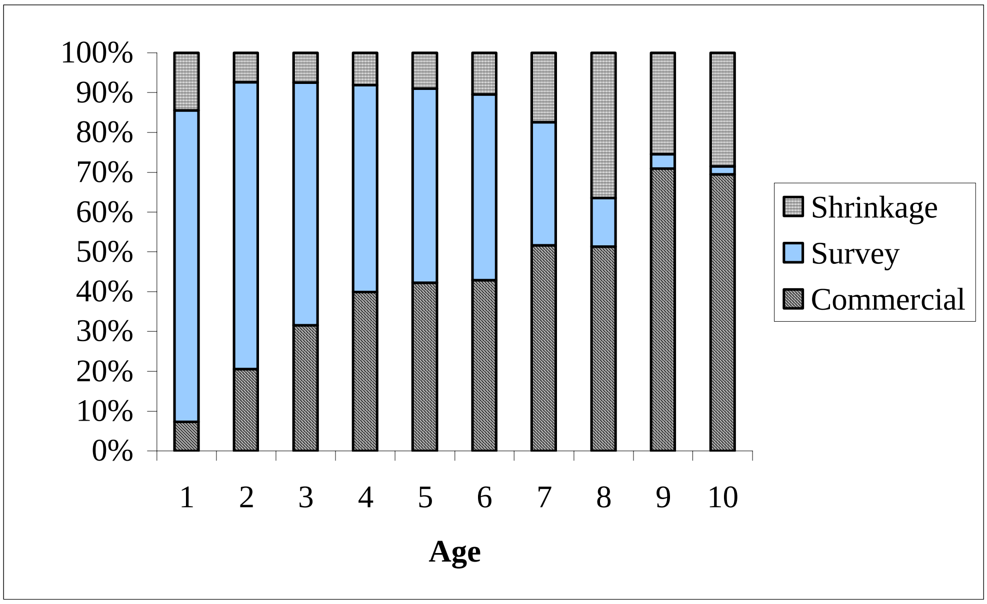
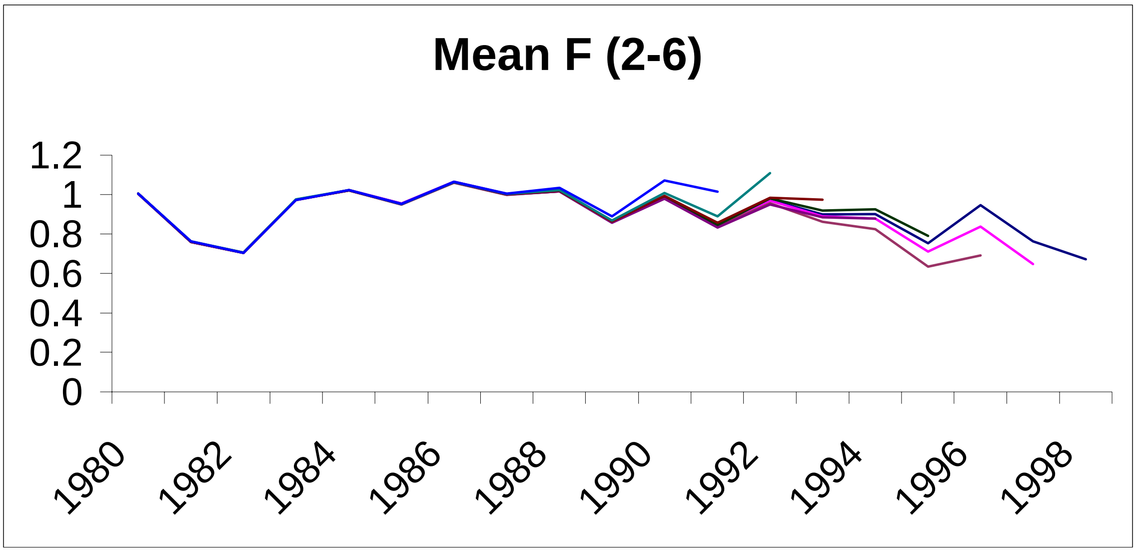
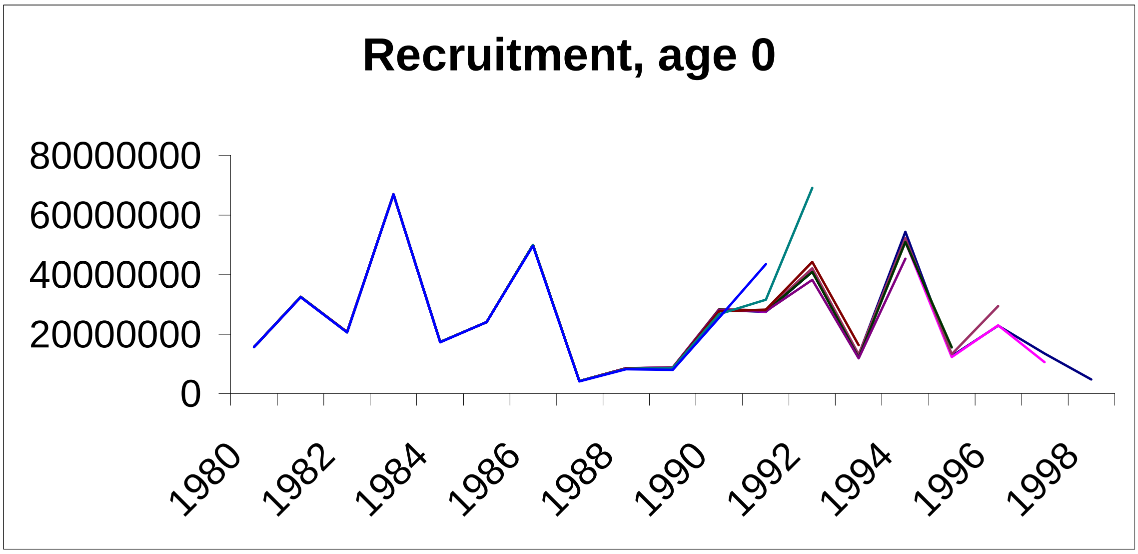


Figure 4.4.4 Haddock in the North Sea and Skagerrak
Retrospective performance of final XSA configuration





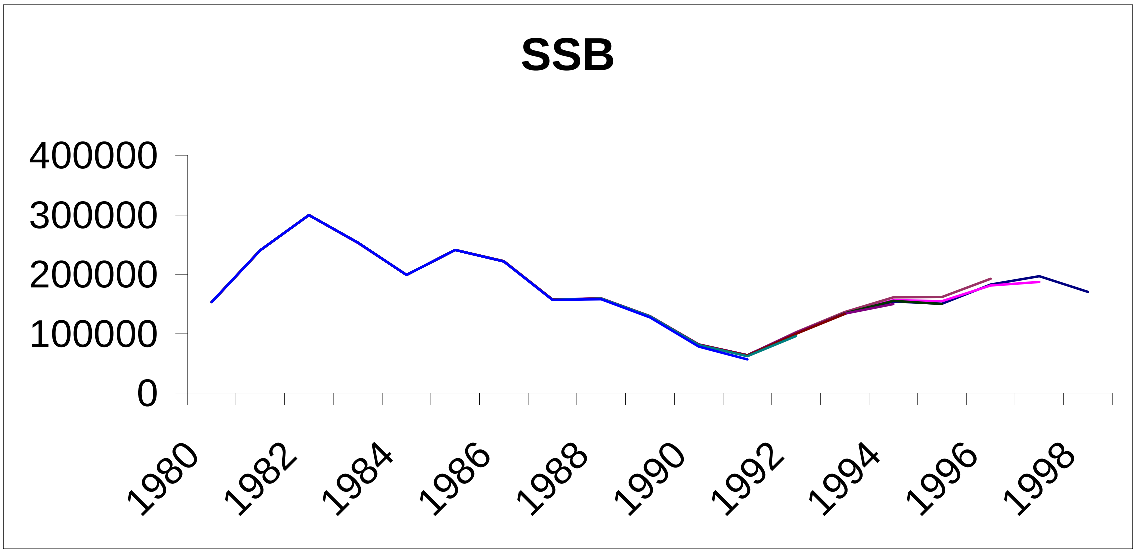


Figure 4.6.1 Stock summary, haddock, North Sea+Skagerrak

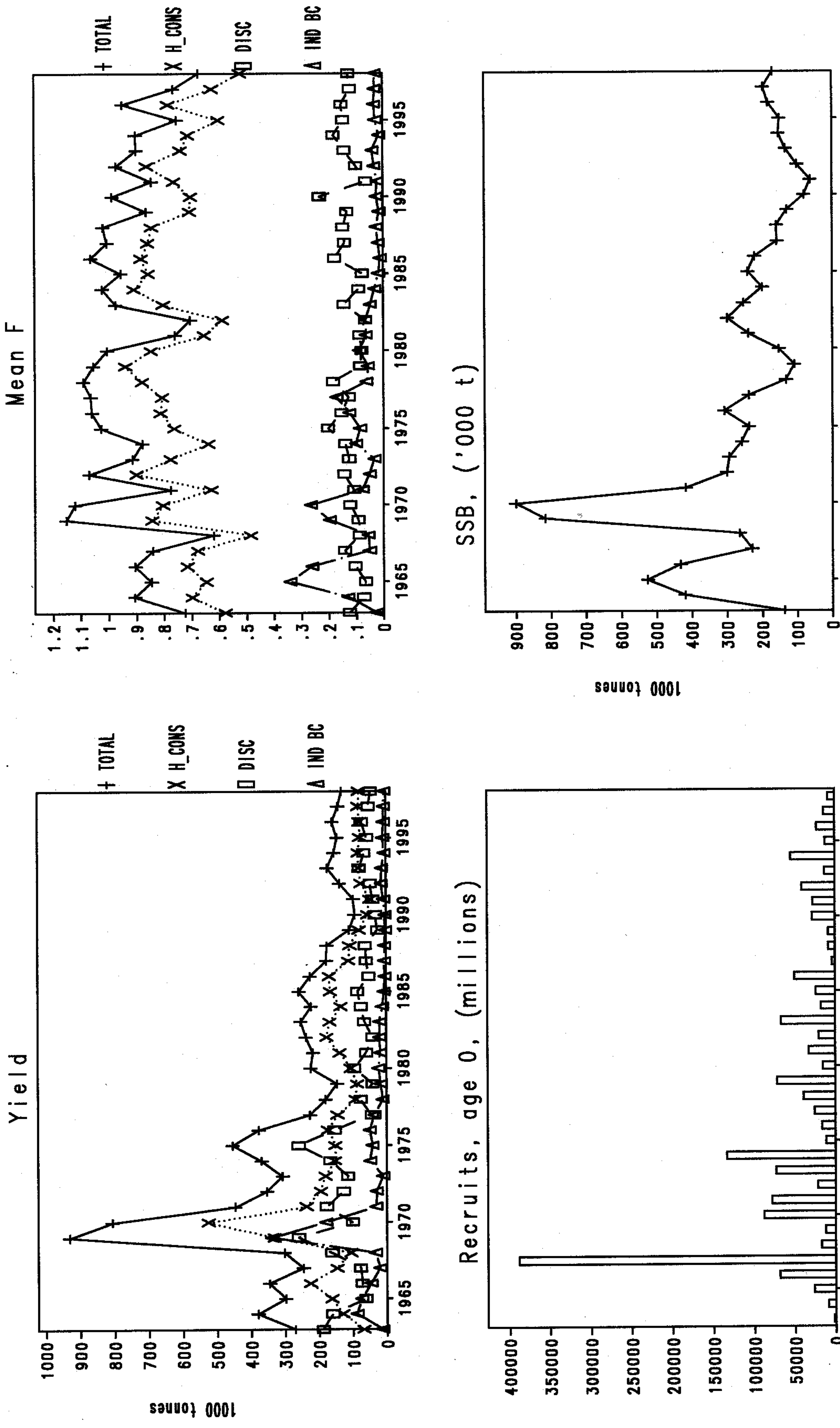
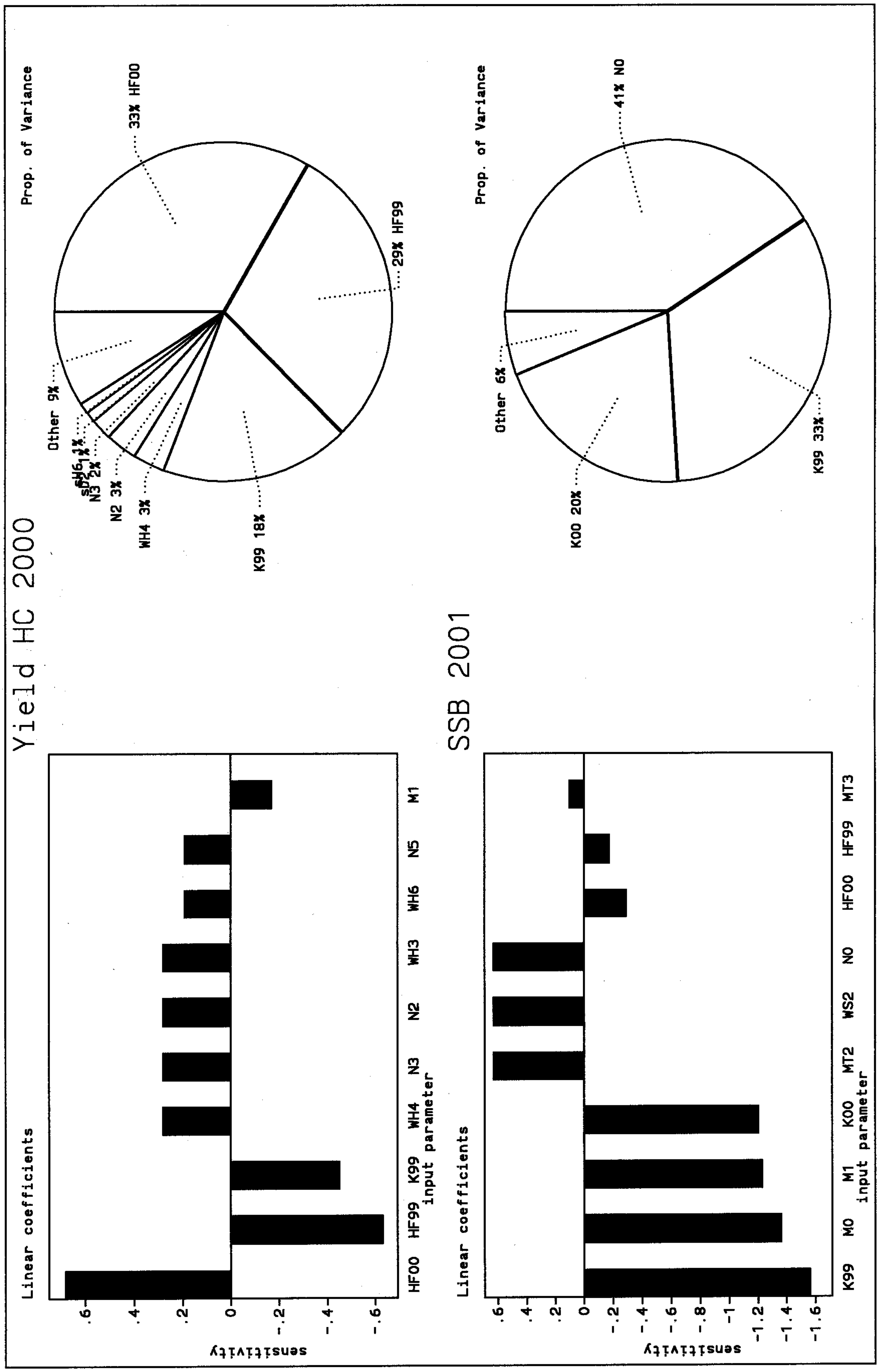
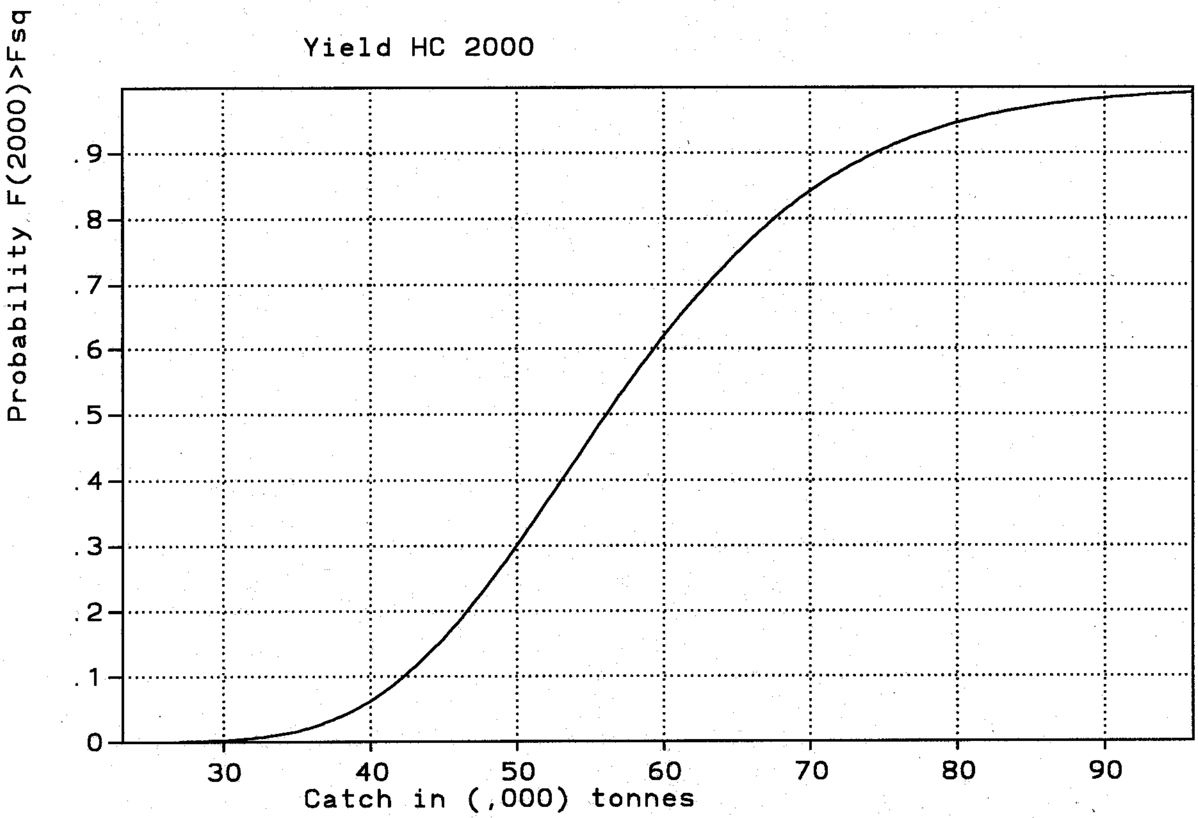


Figure 4.7.1 Haddock, North Sea + Skagerrak. Sensitivity analysis of short-term forecast.





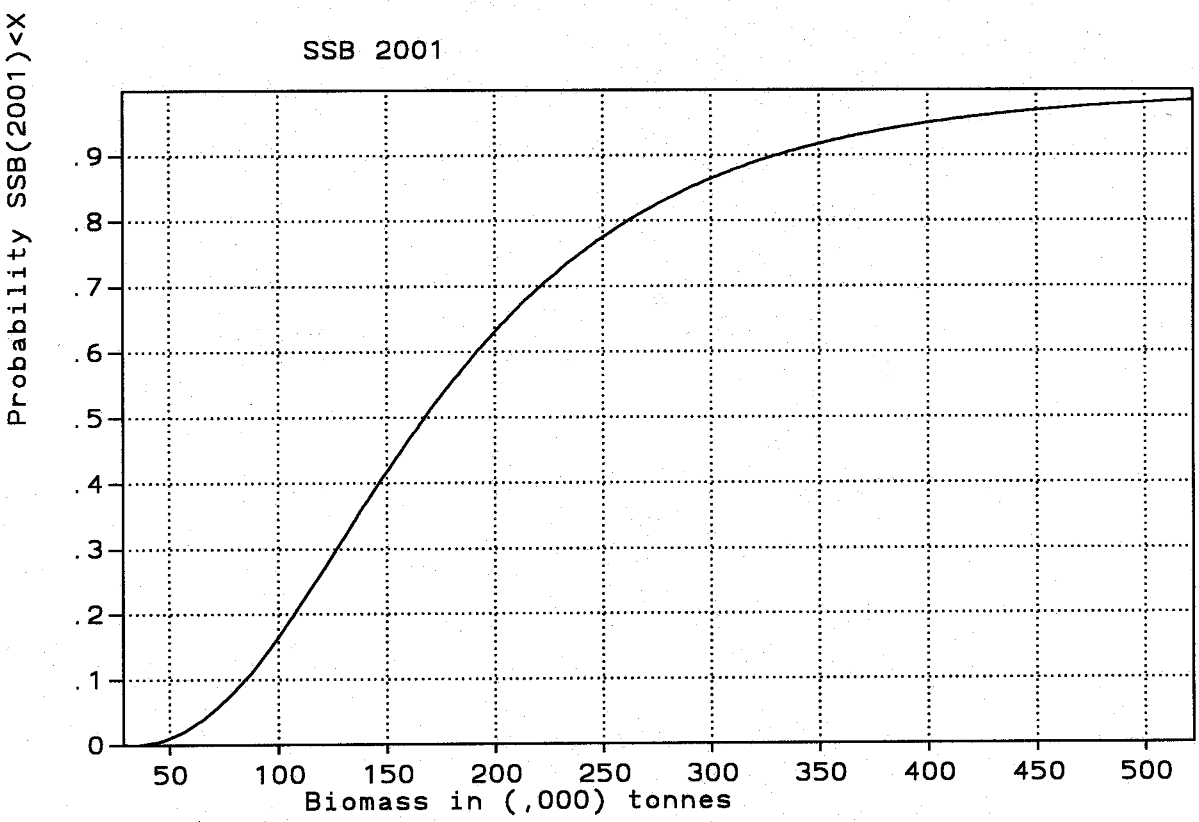


Figure 4.7.2 Haddock, North Sea + Skagerrak. Probability profiles for short-term forecast.

Figure 4.8.1; Haddock in the North Sea and Skagerrak, Medium term projection.
Assumes F multiplier of 1.0, i.e. H.cons + discard mean F99 = 0.78
Beverton-Holt SSR model used, lines show 5, 10, 20, 50 and 95 percentiles

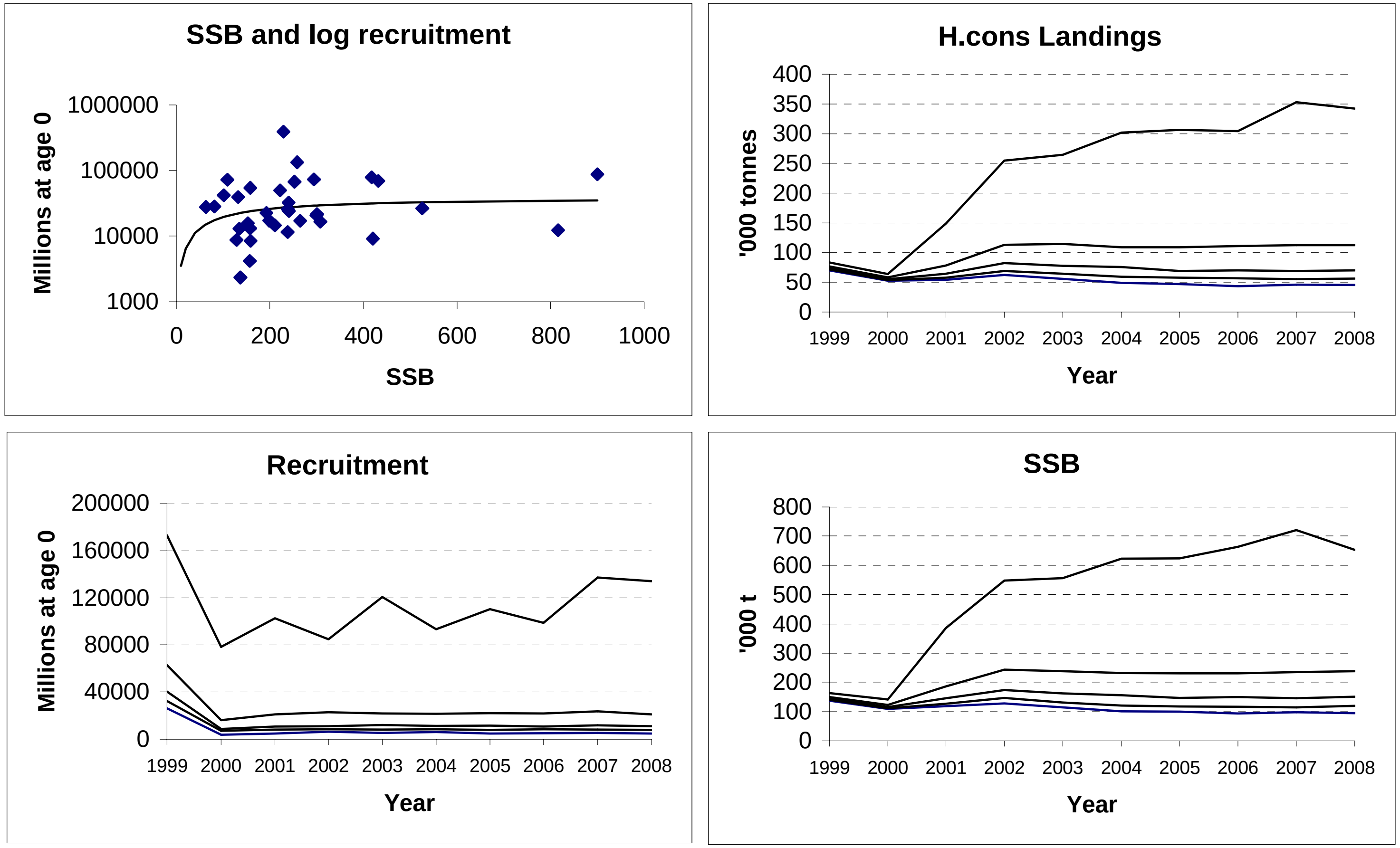


Figure 4.9.1 North Sea + Skagerrak, haddock: yield per recruit.

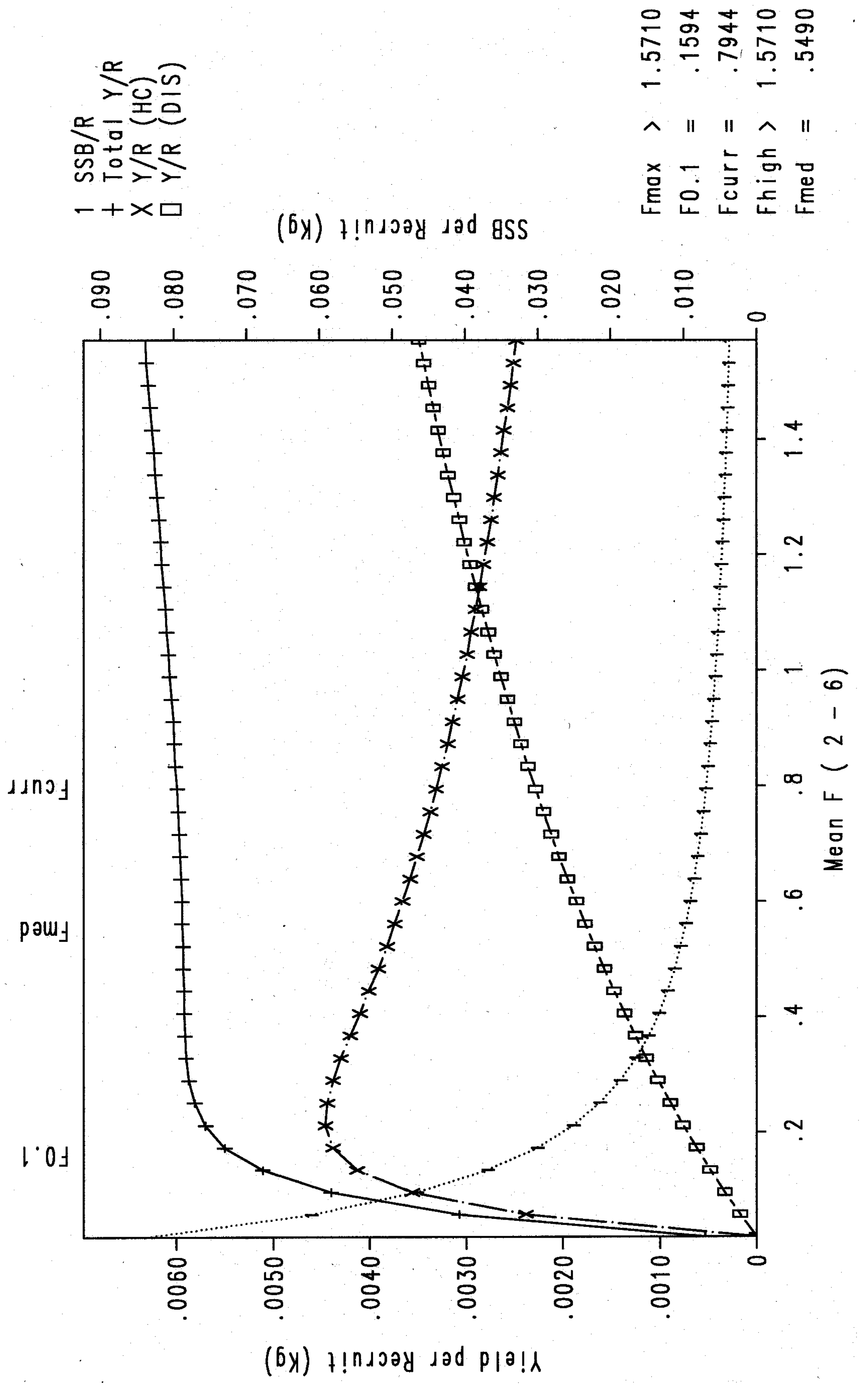


Figure 4.9.2 North Sea + Skagerrak, haddock: Stock and recruitment.

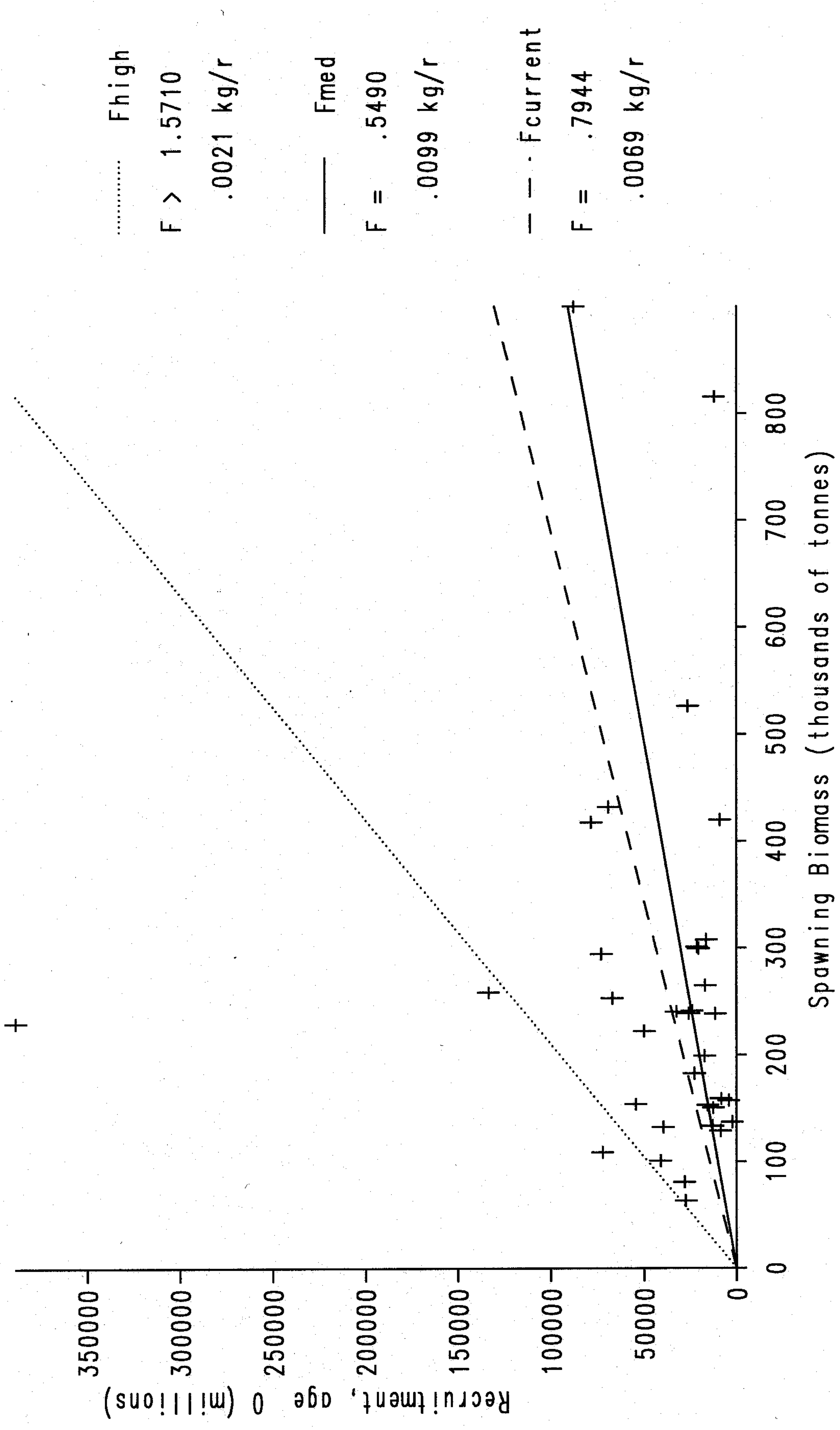


Figure 4.9.3 , Haddock in the North Sea and Skagerrak
Medium-term projections of SSB in 2008 at different F Levels

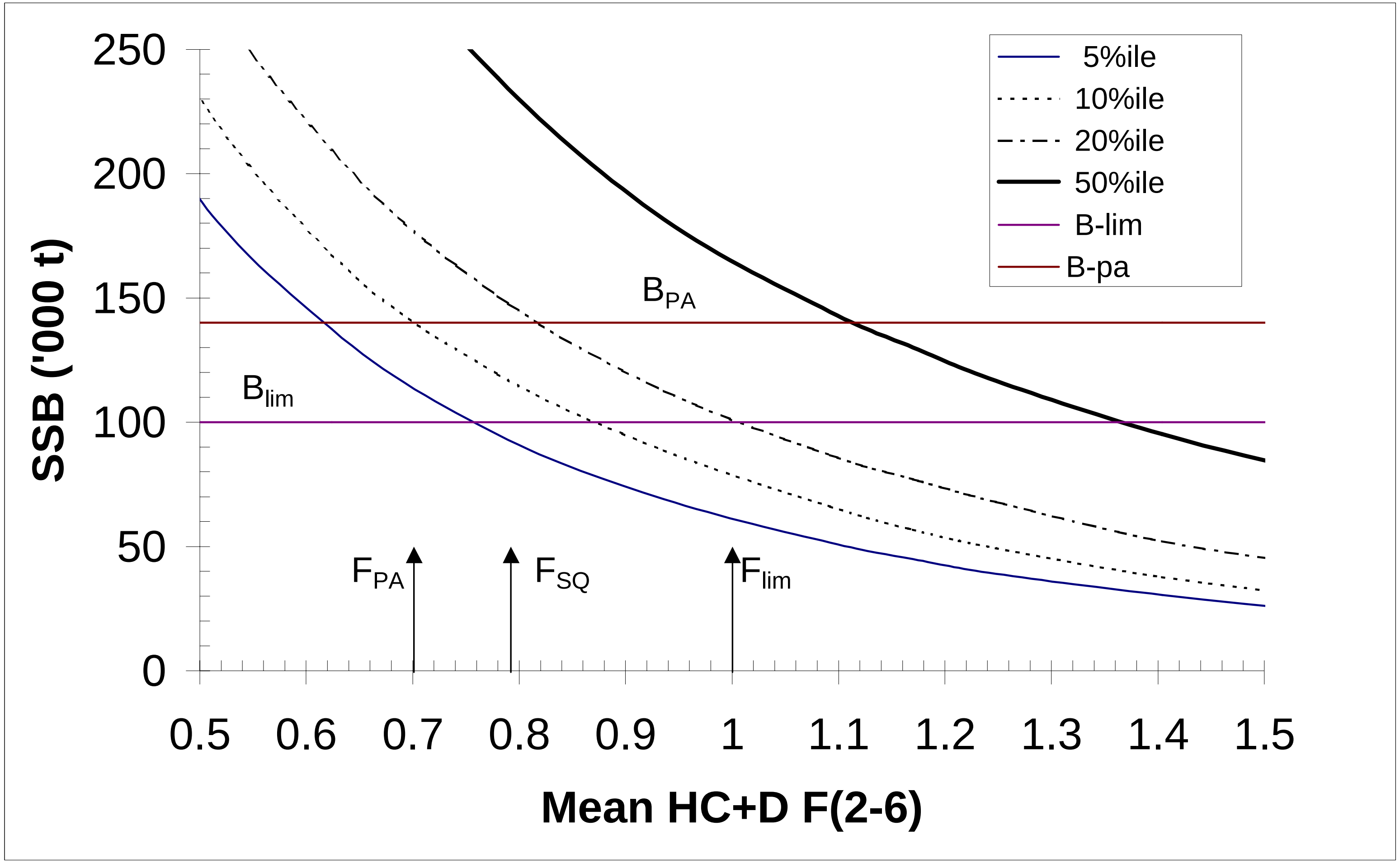


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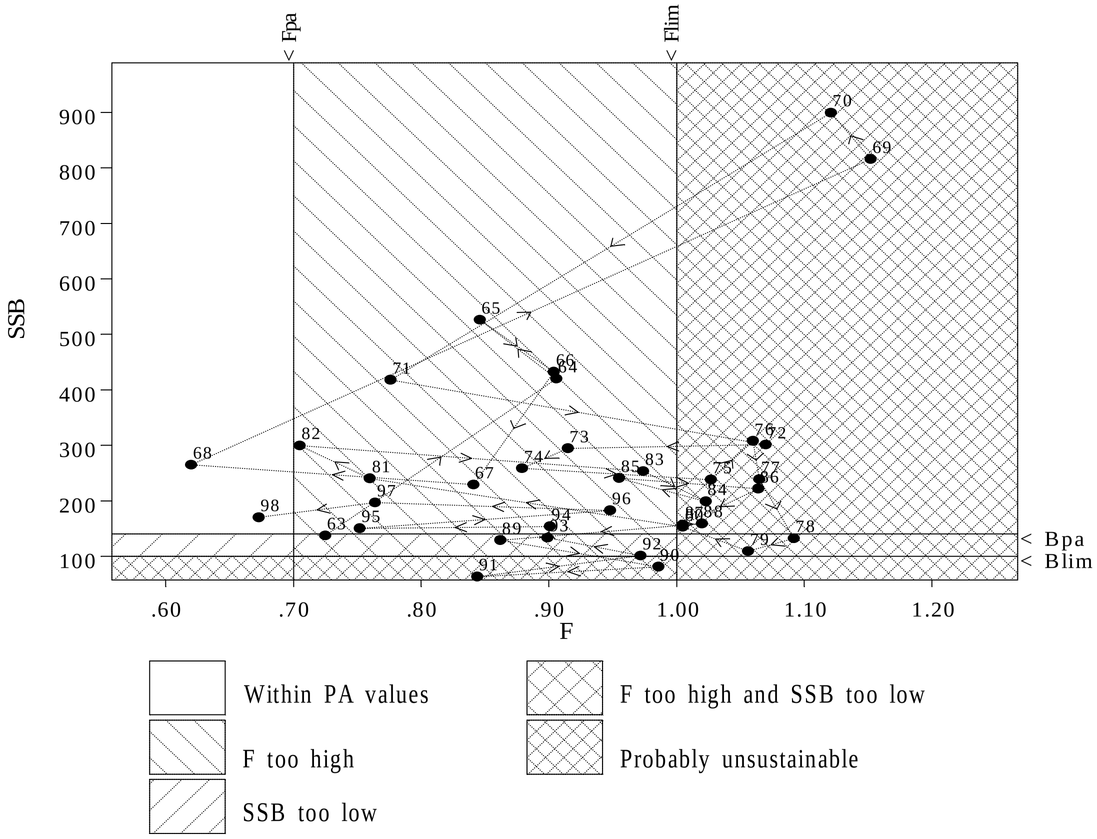
Figure 4.9.4; Haddock in the North Sea & Skagerrak



Data file(s):W:\acfm\wgnssk\1999\Report\had_IV\hadiv.pa;W:\acfm\wgnssk\1999\Report\had_IV\Hadiv.sum
Plotted on 19/10/1999 at 21:15:40

5 WHITING

5.1 Whiting in Sub-area IV and Division VIId

5.1.1 The fishery

Total nominal landings are given in Tables 5.1.1.1 and 5.1.1.2 for the North Sea and eastern Channel respectively. Total international catches as estimated by the Working Group for the combined North Sea and eastern Channel are shown in Table 5.1.1.3. Eastern Channel catches as used by the Working Group are also shown separately in Table 5.1.1.4.

In the North Sea, whiting are caught for human consumption in the mixed demersal fisheries for Scotland (seine and light trawl), England (seine and trawl) and France (inshore and offshore trawlers). They are also caught in the Dutch beam trawl and German trawl fisheries. French trawlers targeting saithe also take a by-catch of whiting. Whiting comprise a by-catch in the industrial fisheries for Norway pout and sprat.

In the eastern Channel, whiting are caught both by inshore and offshore trawlers in a mixed demersal fishery, with vessels from this area sometimes moving into the North Sea.

5.1.1.1 ACFM advice applicable to 1999

Last year's perception of the stock was that it was considered to be outside safe biological limits. Advice was that fishing mortality should be reduced to bring SSB above the proposed $\mathbf{B}_{pa}$ (315,000 t) in the medium term, recommending as a first step that fishing mortality should be reduced by at least 20 %. This corresponded to human consumption landings in 1999 of no more than 33,800 t and an industrial by-catch of 10,500 t. ACFM’s other proposed PA reference points were: $\mathbf{B}_{lim}$ = 225,000 t, $\mathbf{F}_{pa}$ = 0.65 and $\mathbf{F}_{lim}$ = 0.9.

The forecast catch levels provided by ACFM were divided between the North Sea (Sub-area IV) and Eastern Channel (Division VIId) on the basis of 11.5% of human consumption landings coming from the latter area.

5.1.1.2 Management applicable to 1999

The 1998 and 1999 TACs for area IIa (EC zone), IV are 60,000 t and 44,000 t respectively. The minimum mesh size for vessels fishing in the mixed demersal fishery in this area is 100 mm. For vessels fishing under the whiting derogation, the minimum mesh size is 90 mm. Industrial fishing with small-meshed gear is permitted subject to by-catch limits of protected species such as whiting. The minimum landing size of whiting from this area is 23 cm, although the UK has adopted a minimum landing size of 27 cm. Regulations applying to the Norway pout box prevent industrial fishing with small meshes in an area where the by-catch limits are likely to be exceeded.

There is no separate TAC for Division VIId, landings from this Division are counted against the TAC for Divisions VIIb-k combined. (27,000 t in 1998 and 25,000 t 1999). Minimum mesh size for whiting in Division VIId is 80 mm with a 23 cm minimum landing size.

5.1.1.3 Landings in 1998

For the North Sea, the total international catches were 40,000 t in 1998, of which 24,000 t were human consumption landings, 13,000 t discards and 3,000 t industrial by-catch. This represents a continued decrease in total catches since 1990 (149,000 t), and is 14,000 t less than the 1997 value (54,000 t). The 1998 human consumption landings were the lowest in the time series and 77% of the 1997 value. Both discards (76% of the 1997 value) and industrial by-catch (50% of the 1997 value) were also the lowest on record.

For the eastern Channel, the total catch in 1998 (4,600t) was the same as in 1997.

The total North Sea and eastern Channel landings of 44,600 t in 1998 were 65% of last year's *status quo* forecast (as revised by ACFM to remove an anomolously high *status quo* F on the 0-group industrial by-catch). The difference comprised 6,000 t industrial by-catch and 15,000 t human consumption landings. The forecast assumed short-term GM recruitment for the 1997 year-class at age 1 to reflect recent low recruitment. However, it is likely that even this resulted in a considerable overestimate of its abundance, leading to overestimates of the forecast catch for both 1998 and 1999 (see Section 5.1.7).

Misreporting is not considered to be a serious problem for either the North Sea or the eastern Channel components of the stock.

5.1.2 Natural mortality, Maturity, Age compositions, Mean weight at age

The natural mortality and maturity at age values as used are shown in Table 5.1.2.1. These are unchanged from last year. The natural mortality values are rounded averages of the estimates produced by an earlier key run of the North Sea MSVPA. Information from the key run made in 1997 is not included.

The maturity ogive is based on North Sea IBTS quarter 1 data, averaged over the period 1981–1985.

For Sub-area IV catches, human consumption landings data and age compositions were provided by Scotland, the Netherlands, England, France and Belgium. Discard data were provided by Scotland and used to estimate total international discards. Since 1991 the age composition of the Danish industrial by-catch has been directly sampled, whereas it was calculated from research vessel survey data during the period 1985–1990. Norway provided age composition data for its industrial by-catch.

Mean weights at age were available separately for the human consumption, discard and industrial by-catch components of the catch.

For Division VIId catches, age composition data were supplied by England and France. No estimates of discards are available for whiting in the eastern Channel, although given the size of the Channel catch compared to that in the North Sea, this is not considered to be a major omission. There is no industrial fishery in this area.

Total international catch at age and mean weight at age in the catch (North Sea and eastern Channel combined) are presented in Tables 5.1.2.2 and 5.1.2.3. The catch mean weight at age was also used as the stock mean weight at age.

5.1.3 Catch, Effort and Research Vessel Data

Catch and effort data from five commercial and six survey vessels series were available to calibrate the catch-at-age analysis. The fleets available for XSA tuning and the ages and number of years available for each fleet are listed in Table 5.1.3.1; values for the fleets used in the final run and their year and age ranges are presented in Table 5.1.3.2.

Fleet acronyms are:

ScoSei	Scottish seiners	ScoLtr	Scottish light trawlers
FraTrb	French trawlers (large)	FraTro_IV	French trawlers (small) (IV)
FraTro7d	French trawlers (small) (VIId)		
ScoGfs	Scottish QIII survey	EngGfs	English QIII survey
IBTS QI	International QI survey	IBTS QII	International QII survey
IBTS QIV	International QIV survey	FraGfs7d	French VIId survey

In common with earlier assessments of this stock, the indices for the second quarter IBTS comprise age-based indices from the Scottish component of the survey, while the fourth quarter values comprise age-based indices from the English component of the survey. These surveys are now discontinued, but as they still provide information on the abundance of cohorts present in the stock, they have been used in this assessment. IBTS data from the first quarter (formerly IYFS) have been treated as if the survey took place at the very end of the previous year, by adjusting the parameter values of alpha and beta in the tuning file and offsetting the index age by one year. This allows some survey data, collected after the most recent commercial catch at age data, to be used in tuning.

5.1.4 Catch-at-age analysis

For the previous assessment of this stock, a large number of exploratory analyses were made to determine the XSA configuration to be used. For this assessment, no further changes were made unless the tuning diagnostics clearly implied a need for change.

(i) Exploratory Analysis

A separable VPA was run on the basic catch-at-age data using default options, and unit selection and fully-exploited mortality values taken from previous assessments. This was undertaken to examine the consistency of the catch-at-age data. From Figure 5.1.4.1, it can be seen that the largest residuals are on the age 0:1 log catch ratios. These comprise partially recruited age groups subject to discarding in the human consumption fishery and taken as by-catch in the industrial fisheries. The residuals of the age 1:2 log catch ratios show better balance, suggesting that it is the 0-gp data that show inconsistencies rather than the 1-gp data. Last year the assessment continued with the inclusion of 0-gp catch-at-age data, although the Working Group questioned whether this should continue in future, particularly as F at age 0 is usually estimated to be very low with respect to natural mortality. This means that estimates of 0-group abundance are essentially 1-group abundance estimates corrected for natural mortality at age 0, and are not informative in the assessment. For these reasons, the age range in the assessment was modified this year to exclude age 0.

A tuning run based on last year's final XSA configuration (but excluding 0-group) produced diagnostics very similar to those of last year with two exceptions. The inclusion of 1998 data for the FraTRB fleet resulted in a very strong year effect in its log catchability residuals for 1998. This fleet does not target whiting and reported extremely low landings of whiting in 1998 despite relatively consistent fishing effort. Due to the strong year effect in the log catchabilities, 1998 data were excluded for this fleet. This made very little difference to the outcome of the assessment as this fleet receives low weighting in the XSA. 1998 data from the Scottish groundfish survey (ScoGFS) were also excluded from the XSA due to the use of a new vessel and gear.

(ii) Final Run

The log-catchability residual plots from the final run are shown in Figure 5.1.4.2 and full XSA diagnostics and the basic parameter selections and tuning options of the final run are shown in Table 5.1.4.1. Some noise is still apparent in the residual plots, and the ScoGfs and EngGFS surveys show a trend in log catchabilities. This was also apparent in last year's final XSA. However, in both cases, single-fleet calibration XSAs produced last year did not indicate a trend in log catchabilities, suggesting the trends to be imposed by the incorporation of the other tuning fleets in the XSA. The effect of removing the ScoGFS fleet from XSA is marginal, as its estimates of raised F are not heavily weighted (Figure 5.1.4.3, Table 5.1.4.1) and its estimate of terminal exploitation pattern is consistent with some others (Figure 5.1.4.4). The EngGFS estimate of survivors from age 1 is important to the raised value, but is consistent with the estimates from other North Sea tuning indices at that age. At older ages, the contribution of this fleet to the survivors estimate is less important.

Retrospective XSAs undertaken last year using both a "moving window" and "diminishing series" approach demonstrated a tendency to overestimate SSB in the most recent year and to underestimate mean F. This is again apparent from the "diminishing series" retrospective run presented this year (Figure 5.1.4.5). Previous retrospective runs have shown recruits to be poorly estimated in the terminal year, although this is not so apparent for the results shown in Figure 5.1.4.5.

The relative weighting of the different tuning fleets to the survivors estimates are indicated in Figure 5.1.4.3, where the scaled weights are shown plotted by fleet and age. In general, it can be seen that the weighting of survivors estimates from the commercial fleets from the North Sea increases with the age of fish. The exception to this is the FraTro fleet that is most heavily weighted at age 2 and whose influence then declines with age. The weighting of survivors from the North Sea surveys either decline with age, or they are least important at the extremes of the age range. The weighting of the F shrinkage mean is highest at the youngest and oldest ages (17% and 14% respectively).

The individual fleet estimates of survivors given in Table 5.1.4.1 are diverse at most ages, although the terminal exploitation patterns estimated for each fleet (Figure 5.1.4.4) do show some consistencies.

The fishing mortalities at age and stock numbers estimated from the final tuning run are presented in Tables 5.1.4.2 and 5.1.4.3.

This year's final configuration is given with last year's configuration, below:

	1998 Assessment	1999 Assessment
Calibration period	10 years	10 years
Age Range	0–8+	0–8+
Catchability model	Constant (all ages)	Constant (all ages)
Catchability plateau	age 6	age 6
F Shrinkage:		
SE	0.5	0.5
year range	5	5
age range	3	3
Fleets(ages):		
ScoSei	(1–7)	(2–7)
ScoLtr	(1–7)	(1–7)
FraTrb	(1–7)	(2–7)
FraTro_IV	(0–7)	(2–5)
ScoGfs	(1–6);	(1–6)
EngGfs	(1–5)	(1–5)
IBTS QI	(0–4, age-shifted)	(1–4, age-shifted)
IBTS QII	(1–6)	(1–6)
IBTS QIV	(0–5)	(1–4)
FraGfs(VIId)	(0–3)	(1–2)

5.1.5 Recruitment estimates

There has previously been an inconsistency between survey-based estimates of year class strength used in predictions and tuned values for the same year classes estimated by the Working Group at its subsequent meeting. The tuned values have consistently been lower than RCT3 estimates suggesting that, according to the tuned results, the previous year's predictions will have been based on overestimates of year class strength. These inconsistencies were further indicated by the plots of survey indices and XSA estimates of recruitment presented in ICES 1996/Assess:6, ICES 1998/D:4 and ICES 1999/ACFM:8. Consequently, assessments of this stock in the last few years have not used RCT3 estimates of abundance.

As in the previous assessment of this stock, all the XSA estimates of survivors except age 1 have been used as inputs to catch prediction, and no attempt has been made to use 1999 survey data in RCT3 estimates. The 1998 year class has been estimated for prediction using geometric mean recruitment over the period 1990–1997 (1,507 million). This period was selected as it reflects the currently low recruitment regime experienced by this stock. It is consistent with the period chosen last year, where GM 0-group recruitment was used, and has also been used for subsequent year class estimates in prediction.

5.1.6 Historical stock trends

Long term trends in fishing mortality, recruitment and spawning biomass are given in Table 5.1.6.1 and plotted in Figure 5.1.6.1.

Fishing mortalities have been highly variable with no clear trend. Mean F of all catch categories combined is indicated to have been reasonably stable over the period 1991–1996, with a fall in 1997 and 1998. The fall in 1998 is consistent with the XSA tendency to underestimate terminal fishing mortality. The human consumption landings component of F appears to have been stable or rising marginally since 1989, with a decline in 1997and 1998. Earlier explorations of an apparent decline in mean F in the most recent data years of the assessment suggested that the evidence from fleet effort and CPUE data supported the view of a decline, but was equivocal. Clear indications of the most recent values of fishing mortality are obscured by the retrospective pattern inherent in the XSA for this stock.

The current assessment indicates a decline in SSB since 1990 and that SSB since 1993 has been close to or below the historical low. The retrospective analysis for this assessment is to overestimate SSB. If the current SSB is similarly overestimated, the stock is likely to be in an even poorer state than indicated here. SSB is estimated to be at an historical low of 134,000 t at the start of 1998.

Estimates of all year classes between 1989 and 1997 lie below the long term geometric mean. This is consistent with previous estimates for this stock.

5.1.7 Short term forecast

A short term catch prediction was made on the basis of the area combined stocks. The catch category predictions therefore comprised: human consumption landings for IV and VIId combined; human consumption discards for IV only; and industrial by-catch for IV only.

Input data for combined area short term catch predictions are given in Table 5.1.7.1, and assume a short-term (1990–1997) GM recruitment at age 1 for the 1998 and subsequent year classes (1,507 million).

Calculation of the partial Fs at age and mean weights at age in the various catch categories used in prediction were averaged over a 3 year period, and mean F was unscaled

Results of a *status quo* catch forecast are given in Tables 5.1.7.2 (catch options) and 5.1.7.3 (detailed). The proportionate contribution of different year classes to the forecast human consumption landings in 2000 and SSB in 2001 is given in Table 5.1.7.4. It is noted that the year classes for which geometric mean recruitment is assumed, contribute to 24% to the human consumption landings in 2000 and to the to 74% of the forecast SSB in 2001.

At *status quo*, the area-combined human consumption landings are predicted to be 32,000 t in 2000. This is expected to result in a spawning biomass in 2000 of 168,000 t and 2001 of 188,000 t.

The intermediate year forecast (ie., for 1999) predicts catches of 32,000 t (human consumption), 17,000 t (discards) and 5,000 t (industrial by-catch). These values are 80%, 62% and 45% of the previous *status quo* forecast for 1999. Some of this discrepancy is due to the absence of 0-gp from the current assessment, particularly for the discard and industrial by-catch categories. However, the assumption of short-term GM recruitment for the 1997 year class at age 1 in last year's forecast (1,841 millions) was approximately double the current perception of that year-class' abundance from the current XSA (951 millions). (The corresponding estimate from last year's XSA was 93 millions)

Although no area split prediction is given here, ACFM has previously divided the catch into Sub-area IV and Division VIId on the basis of a 88.5% to 11.5% split, based on proportionate catches in weight over the period 1992–1996.

Inputs to a sensitivity analysis of the *status quo* combined area forecast are given in Table 5.1.7.5 and results presented in Figures 5.1.7.1 and 5.1.7.2.

The estimates of human consumption landings in 2000 are most sensitive to the overall level of fishing mortality in 2000 and the overall level of natural mortality in 1999. The estimate of spawning biomass at the start of 2001 is sensitive to the overall magnitude of natural mortality in 2000 as well as to the age-specific value of M at age 1 and the biological characteristics of the 1999 year class. The variance in the prediction of human consumption landings in 2000 is dominated by the level of, and uncertainty in, the overall level of fishing mortality in 2000. For SSB in 2001, the assumption of GM recruitment, and its uncertainty, contributes 34% of its variance with a further 23% of its variance due to magnitude and uncertainty of natural mortality in 2000.

Probability profiles for the human consumption landings in 2000 and the spawning biomass in 2001 are shown in Figure 5.1.7.2. They indicate approximately a 20% probability, at *status quo* human consumption F, that the spawning biomass at the start of 2001 will fall below its lowest recorded value of 134,000 t (1998) in the short term.

5.1.8 Medium term predictions

Because the Working Group has been asked to "review the assessment and reference points for whiting", it has looked again at the basis of its medium term forecasts, ie., the choice of time-series for the stock and recruit data and the most appropriate stock-recruitment function to use.

For a number of years, average year-class abundance has been below that indicated from historical values. Indeed, estimates of the most recent year classes are at very low values. The general reduction in recruitment levels may be due to a temporal shift in the recruitment regime. Alternatively, it may be due to the extrapolation of discard rates to earlier years from those in which observation have been made (mid-1970s onwards). In either case, it is not obvious that a stock and recruit relationship fitted to the entire time series is appropriate for input to medium term forecasts. This point has been made in earlier reports of this Working Group and, as last year, it was decide to truncate the time series at 1977 for stock and recruitment model fitting.

To comply with ACFM's recommendation that a stock and recruitment relationship should be used to generate diminishing recruitment at low stock sizes in medium term forecasts, several stock and recruitment models were again fitted to the data. Satisfactory sum-of-squares minima were not found for the Shepherd and Beverton-Holt model fits. The Ricker model did provide a satisfactory minimum, although its parameter estimates were highly correlated, as with the other models. Nevertheless, the Ricker curve was chosen for use in medium term forecasting as in previous assessments. The fitted curve is shown in Figure 5.1.8.1.

The inputs to medium term projection are similar to those for the sensitivity analysis except that long-term mean weights at age were used rather than a 3 year average, to avoid transitory changes in mean weights at age affecting the outcome.

The results of medium term projections corresponding to *status quo* human consumption F are presented in Figure 5.1.8.1. At the end of the 10 year projection, spawning biomass would, on average, be expected to increase marginally, as would the human consumption landings, although in both cases the 5% - 95% inter-percentile range is broad. Several other projections were made for various multipliers of human consumption F. The outcome of these is summarised for the end of the 10 year projection period in Figure 5.1.8.2. This shows that for the stock and recruitment model used, mean fishing would have to be reduced to 0.35 - 0.4 to give a 5%-10% probability of falling below the currently lowest observed SSB (134,000 t) in the medium term. This is consistent with the previous assessment of this stock, but it should be noted that the previous lowest observed SSB has been superseded by the 1998 value estimated this year.

The tabulated output following the EU/Norway request for medium term forecasts is shown in Table 5.1.8.1.

5.1.9 Biological reference points

Stock and recruitment reference points are shown in Figure 5.1.9.1 for the truncated recruitment time series. The plot for the full time series is in the stock file.

Inputs to yield per recruit are shown in Table 5.1.9.1. Yield per recruit results are presented in Table 5.1.9.2 and Figure 5.1.9.2 contingent on variation in the human consumption component of the total international reference F. F_{max} and $F_{0.1}$ calculations were carried out on the total yield curve. F_{max} is not defined within the range of multipliers used here, $F_{0.1}$ is estimated to be 0.32 and $\mathbf{F}_{med}$ is estimated as 0.66 (both values are fishing mortality in the human consumption fishery, ie., human consumption landings plus discards).

The Working Group has been asked to "review the assessment and reference points for whiting" In its previous evaluation of PA reference points for this stock, the Working Group made the following proposals:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$ = 200,000 t (1998 WG estimate of SSB in 1997).

$\mathbf{B}_{pa} = 1.4\mathbf{B}_{lim}$ = 280,000 t

$\mathbf{F}_{pa}$ = not defined

ACFM subsequently proposed the following values:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$ = 225,000 t

$\mathbf{B}_{pa} = 1.4\mathbf{B}_{lim}$ = 315,000 t

$\mathbf{F}_{lim} = \mathbf{F}_{loss}$ =0.9

$\mathbf{F}_{pa} = 0.7\mathbf{F}_{loss}$ = 0.65

The reason why ACFM differed in its choice of $\mathbf{B}_{loss}$ (and hence $\mathbf{B}_{lim}$ and $\mathbf{B}_{pa}$) compared with the Working Group is not clear, although the difference is relatively small.

SSB in 1998 is estimated to be at a new lowest observed value, below the value of $\mathbf{B}_{loss}$ used by either the previous Working Group or by ACFM in their proposals for $\mathbf{B}_{lim}$. However, the Working Group does not intend to substitute this lower value for $\mathbf{B}_{loss}$ in its review of $\mathbf{B}_{lim,}$. This is because SSB is currently following a downwards trajectory, with successive year's estimates observed as the lowest on record.

Inspection of the stock and recruitment plot for the truncated stock and recruitment series (Figure 5.1.9.1), gives an indication of reduced recruitment at a SSB of around 275,000 t – 280,000 t. Consequently, a SSB in the region of 275,000 t – 280,000 t is one candidate for $\mathbf{B}_{pa}$, irrespective of whether $\mathbf{B}_{lim}$ is defined. For the stock and recruitment data prior to the truncated time-series, recruitment appears inversely proportional to SSB, with the lowest SSB in that period of 238,000 t. Consequently, a $\mathbf{B}_{pa}$ = 275,000 t – 280,000 t based on this reasoning, is consistent with the full stock and recruit time-series as well as the truncated series. This value is similar to last year's Working Group proposal, although based on a different argument, and is lower than ACFM's proposed value of 315,000 t. Based on its reasoning of last year, and the above discussion, the Working Group would again propose $\mathbf{B}_{pa}$ = 280,000 t for this stock and $\mathbf{B}_{lim}$ = 200,000 t (= $\mathbf{B}_{loss}$ as estimated last year by the Working Group).

The Working Group was unable to propose a $\mathbf{F}_{pa}$ last year. Its medium term forecasts indicated that any reference F it could propose would be low compared with historical F even though this stock has a long history of withstanding high fishing mortality rates. The historical fishing mortality rates would be considered unsustainable under present medium term projections. This prognosis remains the case and implies that our analysis of the historical performance of the stock to withstand high fishing mortality is not appropriate to the immediate and medium term problems faced by this stock. Consequently, the ACFM proposal for $\mathbf{F}_{pa}$ = 0.65 leads to a very low probability of SSB greater than $\mathbf{B}_{pa}$ (Figure 5.1.8.2). This outcome is consistent with a number of medium term forecasts carried out inter-sessionally by the CEFAS (Lowestoft) and MLA (Aberdeen) laboratories. The work reported there sought to examine the robustness of the proposed ACFM reference points to a number of assumptions about fishing mortality and stock and recruitment. The outcome of these simulations indicated that F = 0.65 should be viewed as an upper limit to the choice of $\mathbf{F}_{pa}$ for this stock, recognising that whiting is caught in a multispecies fishery with cod and haddock, as well as in a directed derogation fishery. Nevertheless, given the current series of low recruitment, fishing at this value is unlikely to lead stock recovery in the medium term.

Precautionary reference points are superimposed on the stock trajectory of SSB and fishing mortality in Figure 5.1.9.3.

5.1.10 Comments on the assessment

(i) The historical pattern of stock size, fishing mortality and recruitment resulting from this assessment is consistent with the pattern observed from last year's assessment. The, perception of the recent trajectory of SSB is also similar, although the current assessment implies lower SSBs in recent years, consistent with the retrospective tendency to overestimate SSB.

(ii) The number of 1-group in 1999 is unknown. For the catch prediction made at this meeting, year classes with assumed short-term GM recruitment will account for 11% of the 1999 human consumption landings, 34% of the 2000 human consumption landings and 74% of the SSB in 2001 (Table 5.1.7.4). The current XSA implies the assumption of short-term GM recruitment made last year for the 1997 year class overestimated it by a factor of 2, despite being chosen to reflect the recent low recruitment to the stock.

(iii) Previous meetings have concluded that the survey data and commercial catch data contain varying signals concerning the stock, and that there remain inconsistencies in the annual international catch-at-age distributions.

(iv) An appropriate time-series of discard data suitable for use in catch-at-age analysis is available only for Scottish catches. For assessment purpose, discards for other human consumption fleets are estimated by extrapolation from Scottish data, which account for nearly 70% of human consumption landings.

5.2 Whiting in Division IIIa

Since 1981, landings have been reported separately for human consumption and reduction purposes. The Danish landings have been taken in a mixed clupeoid fishery and in industrial fisheries targeting Norway pout and sandeel.

Total landings are shown in Table 5.2.1.1

No analytical assessment of this stock was possible.

Table 5.1.1.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1984-1998, as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	2,798	2,177	2,275	1,404	1,984	1,271	1,040	913	1,030	944	1,042	880	843	391	268
Denmark	19,771	16,152	9,076	2,047	12,112	803	1,207	1,529	1,377	1,418	549	368	189	103	46
Faroe Islands	-	6	-	12	222	1	26	-	16	7	2	21	-	6	-
France[2]	19,209	10,853	8,250	10,493	10,569	5,277	4,951	5,188	5,071	5,502	4,735	5,963	4,704[1]	3,526	1,908[1]
Germany, Fed.Rep.	286	226	313	274	454	415	692	865	511	441	239	124	187	196	103[1]
Netherlands	8,767	6,973	13,741	8,542	5,087	3,860	3,272	4,028	5,390	4,799	3,864	3,640	3,388	2,539	1,941
Norway	88	103	103	74	52	32	55	103	232	130	79	115	65[1]	75[1]	64[1]
Poland	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Sweden	53	22	33	17	5	17	16	48	22	18	10	1	1	1	-[1]
UK (Engl.& Wales)[3]	5,017	5,024	3,805	4,485	4,008	2,178	2,338	2,676	2,528	2,774	2,722	2477	2,329	2,638	2,909
UK (Scotland)	42,967	30,398	29,113	37,630	31,804	26,271	27,486	31,257	30,821	31,268	28,974	27,811	23,409	22,098	16,696
Total	98,958	71,934	66,709	64,978	66,294	40,125	41,084	46,607	46,998	47,301	42,216	41,399	35,115	31,621	23,936
Total h.c. catch used by Working Group	79,000	55,000	59,000	64,000	52,000	41,000	43,000	47,000	46,000	48,000	43,000	41,000	36,000	31,000	24,000
Total discards	41,000	29,000	80,000	54,000	28,000	36,000	56,000	34,000	31,000	43,000	33,000	30,000	28,000	17,000	13,000
Total Ind. By-catch	19,000	15,000	18,000	16,000	49,000	43,000	51,000	38,000	27,000	20,000	10,000	27,000	5,000	6,000	3,000

[1]Preliminary.
[2]Includes Division IIa (EC).
n/a = Not available.
[3]1989-1994 revised. N. Ireland included with England and Wales.

Table 5.1.1.2 WHITING in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1982 to 1998.

Year	Belgium	France	Netherlands	UK (E+W)	UK (S)	Total	Unreported landings	Total as used by Working Group
1982	93	7,012	2	170	-	7,277	633	7,911
1983	84	5,057	1	198	-	5,340	1,600	6,936
1984	79	6,914	-	88	-	7,081	289	7,373
1985	82	7,563	-	186	-	7,831	491	7,390
1986	65	4,551	-	180	-	4,796	704	5,498
1987	136	6,730	-	287	-	7,153	2,463	4,671
1988	69	7,501	-	251	-	7,821	3,391	4,428
1989	38	n/a	-	231	-	n/a	-	4,156
1990	83	n/a	-	237	1	n/a	-	3,483
1991	83	n/a	-	292	1	n/a	-	5,718
1992	66	5,414	-	419	24	5,923	-	5,745
1993	74	5,032	-	321	2	5,429	-	5,215
1994	61	6,734	-	293	-	7,088	-	6,625
1995	68	5,202	-	280	1	5,551	-	5,390
1996	84	4,771	1	199	1	5,056	-	4,952
1997	98	4,532	1	147	1	4,779	-	4,623
1998[1]	53	4,495	32	185	-	4,765		4,598

[1]Preliminary

Table 5.1.1.3 Whiting in IV and VIId

Annual weight and numbers caught, 1960 to 1998.

Year	Wt.('000t)				Nos.(millions)			
	Total	H cons	Disc	IBC	Total	H cons	Disc	IBC
1960	182	49	122	11	1009	198	720	92
1961	326	69	241	16	1958	296	1581	81
1962	222	58	157	8	1438	229	1169	40
1963	261	61	154	45	1454	226	820	408
1964	150	63	59	28	709	233	326	150
1965	187	88	77	22	906	319	465	122
1966	242	108	84	51	1258	374	489	395
1967	237	72	143	23	1414	258	1065	91
1968	265	93	115	58	1556	314	739	503
1969	328	61	115	152	1610	216	589	804
1970	272	83	74	115	1331	284	349	698
1971	195	61	63	72	894	193	446	255
1972	191	64	67	61	1384	188	379	817
1973	271	71	110	90	2003	247	646	1111
1974	296	81	85	130	2023	270	456	1297
1975	305	84	135	86	1742	264	668	810
1976	368	83	136	150	1886	275	609	1003
1977	347	78	163	106	1824	280	519	1025
1978	188	97	35	55	1082	363	213	506
1979	244	107	78	59	1437	382	641	414
1980	224	101	77	46	1124	340	468	315
1981	192	90	36	67	922	296	213	413
1982	140	81	27	33	677	271	155	251
1983	161	88	50	24	689	290	299	100
1984	146	86	41	19	751	285	310	155
1985	106	62	29	15	501	176	223	102
1986	162	64	80	18	981	225	575	181
1987	139	68	54	16	861	245	406	210
1988	133	56	28	49	978	211	210	556
1989	124	45	36	43	796	172	273	350
1990	153	47	56	51	1009	177	394	438
1991	125	53	34	38	576	199	235	142
1992	110	52	31	27	610	182	209	219
1993	116	53	43	20	608	173	295	140
1994	93	49	33	10	485	162	227	96
1995	103	46	30	27	449	147	181	121
1996	74	41	28	5	355	142	175	38
1997	59	36	17	6	276	130	91	55
1998	44	28	13	3	221	108	80	33
Min.	44	28	13	3	221	108	80	33
Mean	192	69	76	48	1071	240	459	373
Max.	368	108	241	152	2023	382	1581	1297

Table 5.1.1.4 Whiting in VIId. Annual weight and numbers caught (1960-1998)

Year	Weight (tonnes)	Nos (millions)
1960	1900	8
1961	1382	6
1962	1590	6
1963	3066	11
1964	3309	12
1965	1568	6
1966	2474	9
1967	3475	13
1968	4593	16
1969	3539	13
1970	3534	12
1971	3103	10
1972	3689	11
1973	4311	15
1974	6592	22
1975	5212	16
1976	7715	27
1977	4954	21
1978	9113	38
1979	8910	36
1980	9167	36
1981	8932	34
1982	7911	33
1983	6936	29
1984	7373	33
1985	7390	20
1986	5498	21
1987	4671	18
1988	4428	18
1989	4156	17
1990	3483	14
1991	5718	18
1992	5745	19
1993	5215	18
1994	6625	24
1995	5390	18
1996	4952	22
1997	4623	23
1998	4598	23

Table 5.1.2.1 Whiting in IV and VIId

Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.950	.110
2	.450	.920
3	.350	1.000
4	.300	1.000
5	.250	1.000
6	.250	1.000
7	.200	1.000
8+	.200	1.000

Table 5.1.2.2. Whiting in IV and VIId

Run title : Whiting IV,VIId (run: XSAPAK04/X04)

At 14/10/1999 15:38

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE									
1,	482896,	1079197,	1022790,	549436,	137590,	342622,	517081,	973202,	830541,
2,	259440,	619965,	220148,	751817,	369668,	148166,	343402,	216064,	523774,
3,	215393,	219882,	156642,	96115,	164882,	330156,	93851,	122955,	111755,
4,	21460,	32745,	31722,	45332,	22843,	72200,	255875,	23958,	49514,
5,	23279,	1355,	5998,	9334,	10908,	8002,	37708,	69082,	7494,
6,	3634,	4099,	276,	1739,	2770,	3555,	8535,	7886,	31183,
7,	892,	385,	407,	9,	435,	765,	1520,	849,	1940,
+gp,	2380,	370,	125,	141,	56,	135,	470,	164,	127,
0 TOTALNUM,	1009374,	1957998,	1438108,	1453923,	709152,	905601,	1258442,	1414160,	1556328,
TONSLAND,	182361,	326093,	222431,	260771,	149956,	186760,	242233,	236994,	265266,
SOPCOF %,	102,	103,	102,	102,	107,	102,	103,	105,	102,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	374343,	606831,	621941,	939141,	1155304,	756260,	955910,	479610,	1006082,	418910,
2,	1025996,	83064,	107933,	319094,	666563,	986441,	407207,	1129375,	480939,	313391,
3,	158808,	571696,	18786,	46392,	135507,	234063,	303537,	169611,	279226,	242370,
4,	28972,	52108,	128541,	7833,	19028,	33307,	56549,	88015,	30130,	90047,
5,	13240,	11463,	13640,	59313,	5739,	4977,	9273,	15988,	21334,	7563,
6,	1734,	3723,	2306,	8392,	18186,	1243,	8014,	3163,	5561,	7565,
7,	5989,	1211,	730,	3486,	2504,	5856,	116,	495,	532,	1851,
+gp,	697,	1514,	628,	1009,	545,	427,	1526,	674,	418,	277,
0 TOTALNUM,	1609779,	1331610,	894505,	1384660,	2003376,	2022574,	1742132,	1886931,	1824222,	1081974,
TONSLAND,	327617,	271648,	195357,	191320,	270533,	296197,	305010,	368240,	347056,	188186,
SOPCOF %,	119,	109,	130,	107,	102,	105,	103,	102,	104,	104,

1

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	615524,	265359,	162899,	192640,	205646,	323408,	203321,	576731,	267051,	430344,
2,	467537,	416008,	346343,	114444,	184746,	175965,	141716,	167077,	368229,	307429,
3,	218283,	286077,	266517,	245247,	118412,	124886,	82037,	169577,	122748,	179502,
4,	100976,	90718,	102295,	88137,	131508,	49505,	37847,	46517,	85240,	39635,
5,	29267,	52969,	27776,	26796,	37231,	59817,	14420,	13367,	11392,	17901,
6,	3111,	10751,	12297,	6909,	8688,	13860,	17445,	3487,	4556,	2175,
7,	1657,	1152,	3540,	2082,	1780,	2964,	3328,	3975,	928,	544,
+gp,	304,	767,	327,	484,	930,	613,	904,	569,	1034,	168,
0 TOTALNUM,	1436659,	1123801,	921994,	676739,	688941,	751018,	501018,	981300,	861178,	977698,
TONSLAND,	243846,	223517,	192049,	140195,	161212,	145741,	106363,	161744,	138775,	133470,
SOPCOF %,	102,	102,	103,	102,	106,	102,	109,	102,	101,	105,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	331672,	253745,	128507,	239792,	217539,	163609,	137481,	72645,	53408,	71430,
2,	173676,	505010,	191193,	165354,	167577,	147177,	139010,	113956,	74200,	44697,
3,	191942,	129126,	187195,	89563,	124287,	90611,	111489,	98476,	82944,	42771,
4,	78464,	86324,	36830,	93636,	46543,	47533,	35728,	48575,	42154,	36459,
5,	14367,	32270,	26209,	11967,	46136,	17384,	15161,	14235,	18492,	17756,
6,	5050,	2003,	5519,	6878,	3946,	17264,	5159,	4695,	3358,	6392,
7,	516,	735,	543,	2609,	1519,	998,	4515,	1294,	1020,	1426,
+gp,	334,	112,	273,	118,	772,	460,	473,	1113,	461,	406,
0 TOTALNUM,	796021,	1009325,	576269,	609917,	608319,	485036,	449016,	354989,	276037,	221337,
TONSLAND,	123753,	153453,	124975,	109704,	116165,	92606,	103268,	73957,	59102,	44312,
SOPCOF %,	102,	103,	117,	103,	107,	103,	117,	103,	101,	102,

Table 5.1.2.3. Whiting in IV and VIId

Run title : Whiting IV,VIId (run: XSAPAK04/X04)

At 14/10/1999 15:37

Table 2 Catch weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE									
1,	.1170,	.1190,	.1190,	.1120,	.1240,	.1240,	.1090,	.1180,	.1120,
2,	.1900,	.1930,	.1870,	.1950,	.1740,	.2090,	.1870,	.1990,	.1880,
3,	.2560,	.2590,	.2670,	.2720,	.2680,	.2420,	.2490,	.2690,	.2950,
4,	.3140,	.3030,	.3330,	.3530,	.3550,	.3320,	.2880,	.3320,	.3590,
5,	.3440,	.4120,	.4000,	.4120,	.4440,	.4210,	.3680,	.3400,	.4840,
6,	.3840,	.4200,	.5200,	.4720,	.4890,	.4990,	.4340,	.4250,	.4470,
7,	.5010,	.4930,	.5190,	.8200,	.5350,	.5420,	.4730,	.4950,	.6200,
+gp,	.4494,	.4415,	.5438,	.6133,	.7411,	.6428,	.6969,	.6224,	.7437,
0 SOPCOFAC,	1.0211,	1.0268,	1.0199,	1.0224,	1.0699,	1.0207,	1.0253,	1.0476,	1.0160,

Table 2 Catch weights at age (kg)

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.0970,	.1100,	.1160,	.0710,	.0840,	.0710,	.1000,	.1070,	.1170,	.0740,
2,	.1730,	.2040,	.2190,	.2010,	.1660,	.1500,	.2150,	.1940,	.2100,	.1820,
3,	.2620,	.2410,	.2860,	.2840,	.2780,	.2590,	.2780,	.2940,	.3190,	.2340,
4,	.3630,	.3490,	.3190,	.3890,	.3720,	.3830,	.3760,	.3480,	.3990,	.3220,
5,	.4150,	.4550,	.4330,	.4190,	.4390,	.4710,	.4700,	.4390,	.4440,	.4270,
6,	.4190,	.4520,	.5310,	.5210,	.4630,	.5210,	.3560,	.5010,	.4620,	.4280,
7,	.5350,	.5120,	.6370,	.5750,	.5520,	.5440,	.8170,	.5140,	.5470,	.4660,
+gp,	.6769,	.6442,	.6823,	.8016,	.7765,	.8261,	.6065,	.7021,	.4750,	.6481,
0 SOPCOFAC,	1.1877,	1.0947,	1.3008,	1.0684,	1.0202,	1.0519,	1.0269,	1.0222,	1.0443,	1.0382,

1

Table 2 Catch weights at age (kg)

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.0980,	.0750,	.0830,	.0610,	.1070,	.0890,	.0940,	.1050,	.0770,	.0540,
2,	.1660,	.1760,	.1680,	.1840,	.1910,	.1880,	.1920,	.1830,	.1480,	.1460,
3,	.2590,	.2520,	.2420,	.2530,	.2730,	.2710,	.2840,	.2550,	.2470,	.2230,
4,	.3010,	.3280,	.3210,	.3140,	.3250,	.3370,	.3320,	.3180,	.2970,	.3010,
5,	.4110,	.3370,	.3790,	.3760,	.3840,	.3820,	.4020,	.3780,	.3750,	.3460,
6,	.4550,	.4580,	.4110,	.4780,	.4260,	.3910,	.4350,	.4750,	.3790,	.4230,
7,	.4920,	.4580,	.4440,	.5040,	.4520,	.4630,	.4940,	.4680,	.5420,	.5060,
+gp,	.5822,	.5721,	.7203,	.7353,	.5369,	.5670,	.4388,	.6256,	.5839,	.6933,
0 SOPCOFAC,	1.0190,	1.0220,	1.0301,	1.0210,	1.0630,	1.0236,	1.0897,	1.0231,	1.0071,	1.0461,

Table 2 Catch weights at age (kg)

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.0700,	.0830,	.1030,	.0820,	.0730,	.0800,	.0870,	.0930,	.0910,	.0910,
2,	.1570,	.1370,	.1690,	.1850,	.1750,	.1700,	.1810,	.1670,	.1780,	.1800,
3,	.2250,	.2090,	.2180,	.2570,	.2520,	.2540,	.2580,	.2360,	.2430,	.2360,
4,	.2670,	.2500,	.2900,	.2770,	.3190,	.3230,	.3410,	.3020,	.2950,	.2810,
5,	.3180,	.2790,	.3070,	.3320,	.3290,	.3710,	.3850,	.3870,	.3330,	.3140,
6,	.3910,	.4080,	.3380,	.3460,	.3490,	.3670,	.4300,	.4060,	.3810,	.3390,
7,	.4310,	.4900,	.3650,	.3140,	.4030,	.4140,	.4340,	.4280,	.3810,	.3300,
+gp,	.3944,	.5990,	.3999,	.5071,	.3806,	.4160,	.4202,	.4302,	.4178,	.3665,
0 SOPCOFAC,	1.0184,	1.0294,	1.1652,	1.0307,	1.0673,	1.0305,	1.1697,	1.0251,	1.0072,	1.0246,

Table 5.1.3.1 North Sea and eastern Channel whiting. Fleets available for VPA tuning.

Country	Fleet	Code	Initial Year	Age Range
Scotland	Groundfish survey	SCOGFS	1982	0-6
	Seiners	SCOSEI	1976	0-10
	Light trawlers	SCOLTR	1976	0-10
England	Groundfish survey	ENGGFS	1977	0-6
France	Trawlers	FRATRB	1985	0-11
		FRATRO_IV	1986	0-10
		FRATRO-7d	1986	1-7
		FRAGFS-7d	1988	0-3
International	Groundfish survey	IBTS-QI[3]	1973	0-5
	Q II survey[1]	IBTS_Q2_SCO	1991	1-6
	Q IV survey[2]	IBTS_Q4-ENG	1991	0-7

[1] Scottish sub-set of data – discontinued in 1997
[2]English sub-set of data – discontinued in 1996
[3]Formerly IYFS

Table 5.1.3.2. Whiting in IV and VIId

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Whiting in Sub-area IV and Division VIId (run name: XSAPAK04)
110
FLT11: SCOSEI_IV (Catch: Unknown) (Effort: Unknown)
1978 1998
1 1 0.00 1.00
2 7
    325246    29307.939    43710.809    15390.197     1057.941     1408.921      200.989
    316419    41091.742    28124.234    14745.013     6083.678      676.915      155.750
    297227    73704.438    37657.648    11914.984     9367.982     2556.000      260.000
    289672    22243.637    25047.811    10551.986     2401.997     2084.002      374.000
    297730     7032.000    26194.137    13117.107     2713.028      539.005      277.003
    333168    14957.378    21690.016    34199.105     9830.623     2154.563      406.795
    388035    24015.609    20669.760    14985.589    21269.320     4715.242      959.961
    381647    20263.316    19695.992     8956.377     4795.861     8013.077     1362.788
    425017    48705.180    34509.258    11340.962     2624.396     1097.504     1771.080
    418536    52715.141    38938.770    18440.258     3637.712     1096.908      297.738
    377132    28446.105    44869.258    12631.404     4071.612      678.724       63.973
    355735    15704.127    41407.430    23710.402     4769.041     1323.229      112.076
    252732   124635.820    27694.109    29920.980    14767.797      720.818      206.524
    336675    44964.258    63414.281    10436.101     8730.116     1742.927      195.190
    300217    19452.012    21217.148    27961.869     2804.536     1958.074      564.870
    268413    31623.355    26012.820    12457.879    14446.113      899.254      332.177
    264738    21451.654    22570.719    11778.492     5530.941     5611.981      203.907
    204545    22152.725    30006.961     9018.667     3874.625     1373.442     1270.024
    177092    26020.510    21430.220    10505.520     3483.373     1031.267      295.708
    166817     8974.445    16231.230     9922.011     4445.229      575.334      109.846
    150361     4694.825     6806.230     6840.320     3669.545     1417.125      243.736
FLT12: SCOLTR_IV (Catch: Unknown) (Effort: Unknown)
1978 1998
1 1 0.00 1.00
1 7
    236944     8785.464    19909.945    30722.309    14472.604      956.038     1612.065      635.026
    287494   171147.281    42910.398    23154.594    17995.664     4057.925      376.993      285.995
    333197    20805.963    58381.992    38436.160     9525.058     9430.050     1864.014      144.001
    251504     6576.457    19069.211    21549.754     9706.151     1777.022     1455.034      310.008
    250870     5214.103     8196.975    26680.535    12944.739     3333.924      646.980      338.988
    244349    37495.680    17925.867    12535.311    19234.307     6123.520     1216.612      182.797
    240775    38266.770    16048.092    10784.184     6306.822     9018.982     2371.186      478.594
    267393    28760.939     9368.367     7616.928     3085.792     1333.193     2901.185      443.130
    279727     8138.433     8571.900     9577.941     4108.819      767.442      425.282      608.602
    351131    18761.178    25933.338    16160.769     5954.478     1182.953      388.455      116.035
    391988     2397.963    15778.771    22525.543     5127.725     1640.626      207.218       31.033
    405883    20318.748    10051.615    21389.719    10836.808     2394.091      448.224       33.084
    371493     3676.882    35321.988     7664.570     8960.094     3423.009      159.541       39.935
    408056     8726.876    11908.029    22145.619     3192.247     2906.398      628.632       49.904
    473955    17580.582    14551.322    11822.715    15417.656     1500.403     1160.443      304.395
    447064    16438.910    20513.145    14385.548     6590.755    10105.473      574.199      203.582
    480400     4132.650    15771.000    13004.648     6453.762     2710.229     2997.307      171.833
    442010     9248.035    15886.830    19322.299     6261.604     2982.508     1092.214     1131.707
    445995     6661.924    12461.079    13523.105     9223.331     3012.112      860.730      281.907
    479449     2557.224     6767.919    15603.226     9463.723     4535.190      628.015      181.348
    427868     5096.422     5350.240     8058.403     9506.502     4311.783     1728.787      275.714
FLT13: FRATRB_IV (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
2 7
    69739   10312.000   14789.000    8544.000     807.000    1091.000     227.000
    89974   12272.000   14379.000   10884.000    3789.000     394.000     315.000
    63577    5388.000   11298.000    4605.000    4051.000    1004.000      78.000
    76517    6591.000   13139.000    8196.000    2090.000    1644.000     314.000
    78523    1643.000   16561.000   11241.000    3948.000    1035.000     539.000
    69720    4407.000    8188.000   16698.000    5541.000    1061.000     228.000
    76149    4281.000    7465.000    4576.000    5999.000    1596.000     308.000
    25915    3653.116    2942.089    1225.275     565.549     598.645     117.274
    28611    3830.333    3990.706    1202.062     368.637      93.789     160.456
    28692    4822.766    3667.480    2151.592     496.974     166.107      47.911
    25208    2717.686    4815.076    1124.874     529.693     100.132      31.077
    25184    2064.112    4351.490    1877.197     313.541     106.156       9.858
    21758    3793.839    2123.863    2009.647     619.549      55.057      13.446
    19840    2224.031    3828.925     818.810     657.218     137.586      15.328
    15656    1597.814    1685.797    2204.145     248.315     195.024      43.875
    19076    1224.587    2633.017    1141.302    1233.358      96.747      37.162
    17315    1805.605    1720.519    1466.297     412.543     429.990      29.428
    17794    1022.589    3304.452    1536.770    1162.942     240.081     211.604
    18883     655.484    1594.391    1438.238     482.197     199.090      37.912
    15574     356.961    1406.893    1138.705     606.014      85.942      15.858
FLT14: FRATRO_IV (Catch: Unknown) (Effort: Unknown)
1986 1998
1 1 0.00 1.00
2 5
    56099   1891.942   7145.979   3782.820    599.905
    71765   4984.961   1271.294   5713.138    412.560
    84052   8981.893   3222.825    704.344   1320.586
    88397   3739.547   5628.945   1654.265    208.584
    71750   6169.851   3780.845   2456.120    365.136
    67836   6083.866   2864.373   1412.447    776.926
    51340   6498.040   1939.687    635.383    358.076
    62553   4586.363   4306.749    877.038    289.873
```

Table 5.1.3.2 cont.

```
    51241   3298.430   1190.634    612.132    108.275
    57823   6125.084   2673.850    543.820     98.577
    50163   4742.850   3214.224    890.192    155.826
    48904   4676.603   3929.122   1020.106    220.783
    38103   1959.246    532.612    161.275     67.997
FLT15: SCOGFS_IV (Catch: Unknown) (Effort: Unknown)
1982 1997
1 1 0.50 0.75
1 6
   100    6.53    9.71    9.72    2.24    0.60    0.16
   100    5.63    5.78    4.07    5.11    1.16    0.17
   100   10.48    3.71    1.70    0.77    0.92    0.18
   100   15.77    9.73    2.47    0.63    0.36    0.18
   100   11.11    4.52    2.24    0.27    0.05    0.05
   100   14.05   11.50    2.08    0.77    0.16    0.03
   100    9.67   16.06    4.52    0.70    0.19    0.02
   100   40.43    7.41    7.33    1.57    0.13    0.06
   100   22.39   20.53    2.48    2.55    0.47    0.05
   100   17.69    9.50    7.59    0.51    0.40    0.09
   100   29.25   12.67    5.53    5.85    0.47    0.26
   100   31.69   11.68    4.23    1.56    1.82    0.06
   100   26.35    9.50    2.54    0.57    0.34    0.23
   100   41.76   20.10    9.03    1.96    0.58    0.22
   100   28.88   30.47   12.15    4.60    0.43    0.15
   100   18.24   14.34   11.91    3.19    1.22    0.17
FLT16: ENGGFS_IV (Catch: Unknown) (Effort: Unknown)
1977 1998
1 1 0.50 0.75
1 5
   100   21.953270000    7.441280000    1.109180000    0.216170000    0.090840000
   100   24.713640000    5.150570000    1.055150000    0.344730000    0.050650000
   100   20.063520000    7.116930000    1.898510000    0.842590000    0.057200000
   100   35.327200000   12.507960000    4.810440000    1.204540000    0.313630000
   100   18.314130000   28.803940000   16.051910000    0.617610000    0.616300000
   100   27.722170000    7.933870000    8.590360000    2.220090000    0.340390000
   100   11.853340000   10.802950000    1.906070000    1.696360000    0.242070000
   100   50.613450000   10.818120000    3.012090000    0.888830000    0.768760000
   100   15.878250000   17.042570000    1.672650000    0.981000000    0.181710000
   100   15.161830000    6.591950000    3.846880000    0.406000000    0.103730000
   100   22.762680000   13.036490000    2.687100000    2.008570000    0.351570000
   100   18.805800000   13.159620000    4.545580000    0.644980000    0.173710000
   100   29.474340000   11.759970000    7.693690000    1.674090000    0.344800000
   100   19.008500000   12.836000000    3.854400000    2.318200000    0.325400000
   100   33.303820000    7.665340000    3.817680000    1.085500000    0.370950000
   100   26.554592810   13.069844980    3.045499649    2.610061360    0.493258563
   100   25.103782760    9.629142430    3.750443641    1.161424116    0.741674633
   100   30.545999580   10.594363420    2.436781483    1.123923562    0.333277847
   100   35.506049220   23.737964310    7.360657157    1.870253285    0.250782553
   100   12.378695280   10.440137390    7.385773788    3.225023437    0.594152580
   100   20.292584610    9.719072673    6.987330313    5.406716063    1.675503986
   100   16.477275600   17.886561970    4.011279619    2.556504484    1.280933417
FLT17: IBTS_Q1_IV (Catch: Unknown) (Effort: Unknown)
1973 1998
1 1 0.99 1.00
1 4
   1   0.496  -1.000  -1.000  -1.000
   1   0.153  -1.000  -1.000  -1.000
   1   0.535  -1.000  -1.000  -1.000
   1   0.219  -1.000  -1.000  -1.000
   1   0.293  -1.000  -1.000  -1.000
   1   0.183  -1.000  -1.000  -1.000
   1   0.391  -1.000  -1.000  -1.000
   1   0.485  -1.000  -1.000  -1.000
   1   0.232  -1.000  -1.000  -1.000
   1   0.126   0.113   0.079   0.033
   1   0.179   0.091   0.031   0.026
   1   0.359   0.066   0.019   0.007
   1   0.261   0.198   0.033   0.007
   1   0.544   0.090   0.046   0.005
   1   0.862   0.315   0.034   0.012
   1   0.542   0.421   0.112   0.012
   1   0.887   0.202   0.093   0.017
   1   0.675   0.482   0.071   0.038
   1   0.748   0.261   0.169   0.016
   1   0.524   0.245   0.066   0.059
   1   0.637   0.180   0.067   0.012
   1   0.457   0.245   0.059   0.012
   1   0.486   0.245   0.070   0.023
   1   0.342   0.163   0.060   0.018
   1   0.162   0.125   0.054   0.016
   1   0.305   0.095   0.058   0.026
FLT18: IBTS_Q2_SCO_IV Survey discontinued (Catch: Unknown) (Effort: Unknown)
1991 1997
1 1 0.25 0.50
1 6
   100    94.90    38.56    22.86     3.74     1.23     0.51
   100   129.76    47.50    11.42     4.28     1.14     0.45
   100   104.67    41.49    20.86     5.17     4.85     0.36
   100    65.40    35.71     8.55     2.38     0.90     0.75
   100   191.61    77.30    26.19     4.42     2.21     0.41
```

Table 5.1.3.2 cont.

```
   100    44.02    49.62    22.30     8.33     1.25     0.59
   100    14.07    22.60    18.02     6.43     1.40     0.13
FLT19: FRAGFS_7d (Catch: Unknown) (Effort: Unknown)
1988 1998
1 1 0.75 1.00
1 2
    27      -1      -1
    27      -1      -1
    27      -1      -1
    27    1350     162
    27    1674     378
    27     675     216
    27    6993     837
    27    1836     216
    27    1107     297
    27     756     351
    27     621     351
FLT20: IBTS_Q4_ENG_IV Survey discontinued (Catch: Unknown) (Effort: Unknown)
1991 1996
1 1 0.75 1.00
1 4
   100    55.27577    19.64171    15.09189     3.25460
   100    45.08990    26.46158     5.37850     5.02968
   100    54.20958    19.47387     7.16071     2.33451
   100    61.33462    26.41324     4.14012     0.84180
   100   107.99600    41.71500    11.18600     2.56000
   100    36.55600    30.33000     8.65300     4.81500
```

Table 5.1.4.1 Whiting in IV and VIId.

Lowestoft VPA Version 3.1

14/10/1999 15:36

Extended Survivors Analysis

Whiting IV,VIId (run: XSAPAK04/X04)

CPUE data from file fleet

Catch data for 39 years. 1960 to 1998. Ages 1 to 8.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT11: SCOSEI_IV (Ca,	1989,	1998,	2,	7,	.000,	1.000
FLT12: SCOLTR_IV (Ca,	1989,	1998,	1,	7,	.000,	1.000
FLT13: FRATRB_IV (Ca,	1989,	1998,	2,	7,	.000,	1.000
FLT14: FRATRO_IV (Ca,	1989,	1998,	2,	5,	.000,	1.000
FLT15: SCOGFS_IV (Ca,	1989,	1998,	1,	6,	.500,	.750
FLT16: ENGGFS_IV (Ca,	1989,	1998,	1,	5,	.500,	.750
FLT17: IBTS_Q1_IV (C,	1989,	1998,	1,	4,	.990,	1.000
FLT18: IBTS_Q2_SCO_I,	1991,	1998,	1,	6,	.250,	.500
FLT19: FRAGFS_7d (Ca,	1989,	1998,	1,	2,	.750,	1.000
FLT20: IBTS_Q4_ENG_I,	1991,	1998,	1,	4,	.750,	1.000

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 6

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 30 iterations

1

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities

Age,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1,	.129,	.226,	.117,	.240,	.192,	.158,	.148,	.131,	.128,	.129
2,	.432,	.547,	.487,	.389,	.482,	.340,	.348,	.311,	.340,	.261
3,	.698,	.914,	.515,	.577,	.760,	.693,	.612,	.579,	.504,	.428
4,	.844,	.991,	.891,	.628,	.824,	.923,	.788,	.711,	.624,	.508
5,	1.551,	1.264,	1.130,	.955,	.838,	.991,	1.013,	.991,	.733,	.655
6,	1.635,	1.094,	.815,	1.226,	1.128,	.994,	1.037,	1.197,	.720,	.654
7,	1.644,	1.399,	1.121,	1.371,	1.096,	1.085,	.814,	.848,	.990,	.823

1

Table 5.1.4.1, cont.

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7
1989	4.41E+06	6.20E+05	4.55E+05	1.60E+05	2.07E+04	7.11E+03	7.07E+02
1990	2.01E+06	1.50E+06	2.57E+05	1.60E+05	5.10E+04	3.41E+03	1.08E+03
1991	1.87E+06	6.21E+05	5.54E+05	7.26E+04	4.39E+04	1.12E+04	8.90E+02
1992	1.80E+06	6.43E+05	2.43E+05	2.33E+05	2.20E+04	1.10E+04	3.86E+03
1993	2.00E+06	5.49E+05	2.78E+05	9.64E+04	9.22E+04	6.61E+03	2.52E+03
1994	1.80E+06	6.39E+05	2.16E+05	9.16E+04	3.13E+04	3.11E+04	1.67E+03
1995	1.60E+06	5.93E+05	2.90E+05	7.61E+04	2.70E+04	9.06E+03	8.96E+03
1996	9.50E+05	5.34E+05	2.67E+05	1.11E+05	2.57E+04	7.62E+03	2.50E+03
1997	7.16E+05	3.22E+05	2.50E+05	1.05E+05	4.03E+04	7.41E+03	1.79E+03
1998	9.51E+05	2.44E+05	1.46E+05	1.06E+05	4.19E+04	1.51E+04	2.81E+03

Estimated population abundance at 1st Jan 1999

, 0.00E+00, 3.23E+05, 1.20E+05, 6.71E+04, 4.74E+04, 1.69E+04, 6.11E+03,

Taper weighted geometric mean of the VPA populations:

, 2.80E+06, 8.50E+05, 3.28E+05, 1.03E+05, 3.07E+04, 8.58E+03, 1.91E+03,

Standard error of the weighted Log(VPA populations) :

, .6241, .6314, .5837, .6522, .7882, .8937, 1.2032,

1

Log catchability residuals.

Fleet : FLT11: SCOSEI_IV (Ca

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	-.82	.76	.31	-.49	.30	-.29	.08	.48	-.01	-.31
3	-.32	.28	-.12	-.25	.01	.11	.32	.20	.02	-.25
4	-.15	.49	-.10	-.28	-.01	.04	.16	.05	.06	-.26
5	.19	.66	-.06	-.46	-.19	.01	.07	.15	-.11	-.26
6	.07	.34	-.37	.04	-.15	.10	.20	.29	-.40	-.13
7	-.10	.34	.08	-.11	-.21	-.28	.02	.00	-.54	-.16

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
Mean Log q	-15.2263	-14.3770	-14.0261	-13.6719	-13.7369	-13.7369
S.E(Log q)	.4817	.2289	.2239	.3028	.2551	.2556

Regression statistics :

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	.71	1.236	14.65	.70	10	.33	-15.23
3	1.08	-.346	14.53	.69	10	.26	-14.38
4	1.09	-.379	14.24	.69	10	.26	-14.03
5	.98	.084	13.61	.70	10	.31	-13.67
6	1.11	-.627	14.22	.82	10	.29	-13.74
7	1.04	-.342	14.08	.91	10	.26	-13.83

1

Fleet : FLT12: SCOLTR_IV (Ca

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.03	-.76	.04	.67	.54	-.82	.18	.36	-.39	.13
2	-.27	.24	-.08	-.11	.50	-.05	.12	-.05	-.21	-.09
3	.04	-.24	-.20	-.13	.07	.12	.27	-.03	.08	.03
4	.07	.03	-.35	-.20	-.03	-.03	.15	.12	.09	.15

Table 5.1.4.1, cont.

```
    5 ,   .50,  -.07,  -.23,  -.42,   .07,  -.18,   .16,   .20,  -.02,  -.03
    6 ,   .00,  -.41,  -.44,   .21,   .03,   .01,   .34,   .33,  -.23,   .16
    7 ,  -.31,  -.55,  -.33,  -.05,  -.07,   .10,   .27,   .17,   .04,   .06
 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


   Age ,         1,         2,         3,         4,         5,         6,         7
 Mean Log q,  -17.8375,  -16.3617,  -15.5334,  -15.1549,  -14.7960,  -14.8769,  -14.8769,
 S.E(Log q),     .5088,     .2272,     .1545,     .1634,     .2538,     .2796,     .2661,


 Regression statistics :


 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

  1,     .99,     .032,     17.80,     .51,     10,     .53,  -17.84,
  2,     .84,    1.181,     15.88,     .88,     10,     .19,  -16.36,
  3,    1.12,    -.739,     15.89,     .83,     10,     .18,  -15.53,
  4,    1.02,    -.134,     15.23,     .83,     10,     .18,  -15.15,
  5,    1.10,    -.468,     15.23,     .73,     10,     .29,  -14.80,
  6,     .88,     .870,     14.17,     .86,     10,     .25,  -14.88,
  7,     .79,    3.516,     13.41,     .97,     10,     .13,  -14.95,
1


 Fleet : FLT13: FRATRB_IV (Ca

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    1 , No data for this fleet at this age
    2 ,   .14,   .06,   .48,   .31,   .04,   .31,  -.20,  -.62,  -.52, 99.99
    3 ,  -.07,   .02,  -.23,   .03,   .22,   .12,   .42,  -.30,  -.20, 99.99
    4 ,  -.35,  -.08,  -.13,  -.18,  -.07,   .36,   .52,  -.02,  -.05, 99.99
    5 ,  -.15,  -.33,  -.08,  -.20,  -.27,  -.13,  1.04,   .14,   .00, 99.99
    6 ,  -.18,  -.16,  -.45,   .31,  -.11,  -.12,   .52,   .50,  -.31, 99.99
    7 ,  -.26,  -.32,  -.01,  -.09,  -.14,   .14,   .29,  -.20,  -.49, 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
 Mean Log q,  -15.5726,  -14.2348,  -13.7094,  -13.4009,  -13.3580,  -13.3580,
 S.E(Log q),     .3772,     .2318,     .2708,     .4135,     .3542,     .2691,


 Regression statistics :


 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,     .71,    1.253,     14.92,     .73,      9,     .26,  -15.57,
  3,    1.30,    -.864,     14.72,     .54,      9,     .31,  -14.23,
  4,    1.69,   -1.893,     15.13,     .52,      9,     .40,  -13.71,
  5,    1.42,    -.953,     14.62,     .43,      9,     .59,  -13.40,
  6,     .99,     .034,     13.32,     .74,      9,     .38,  -13.36,
  7,     .86,    1.650,     12.67,     .95,      9,     .19,  -13.48,
1


 Fleet : FLT14: FRATRO_IV (Ca

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    1 , No data for this fleet at this age
    2 ,  -.70,  -.83,   .07,   .34,  -.01,  -.35,   .22,   .20,   .73,   .35
    3 ,  -.10,   .37,  -.79,  -.05,   .50,  -.37,  -.01,   .39,   .65,  -.60
    4 ,  -.06,   .61,   .86,  -.94,   .15,   .08,  -.02,   .20,   .38, -1.27
```

Table 5.1.4.1, cont.

```
     5 ,   .32,   .08,   .99,  1.12,  -.77,  -.42,  -.47,   .17,  -.01, -1.01
     6 , No data for this fleet at this age
     7 , No data for this fleet at this age



 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
 Mean Log q,  -15.3874,  -15.2025,  -15.3874,  -15.5395,
 S.E(Log q),     .4908,     .4800,     .6525,     .6981,



 Regression statistics :


 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,    4.42,   -3.201,     22.73,     .10,     10,    1.52,  -15.39,
  3,    1.22,    -.400,     15.80,     .29,     10,     .62,  -15.20,
  4,    3.50,   -1.230,     24.75,     .03,     10,    2.22,  -15.39,
  5,    3.07,   -1.376,     26.01,     .05,     10,    2.05,  -15.54,
1



 Fleet : FLT15: SCOGFS_IV (Ca

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
     1 ,  -.59,  -.33,  -.56,   .05,   .00,  -.10,   .47,   .62,   .44, 99.99
     2 ,  -.61,  -.40,  -.33,  -.13,   .00,  -.45,   .38,   .88,   .65, 99.99
     3 ,  -.20,  -.58,  -.48,   .07,  -.22,  -.52,   .40,   .76,   .76, 99.99
     4 ,  -.49,   .09,  -.80,   .31,  -.01,  -.90,   .44,   .87,   .50, 99.99
     5 ,  -.52,  -.31,  -.41,   .33,   .18,  -.32,   .38,   .12,   .55, 99.99
     6 ,  -.15,   .07,  -.71,   .62,  -.39,  -.68,   .54,   .42,   .28, 99.99
     7 , No data for this fleet at this age



 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


    Age ,         1,         2,         3,         4,         5,         6
 Mean Log q,  -14.9486,  -14.7835,  -14.7876,  -14.9321,  -14.9455,  -14.9666,
 S.E(Log q),     .4432,     .5243,     .5309,     .6105,     .3930,     .5097,



 Regression statistics :


 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

  1,    3.25,   -3.464,     16.31,     .25,      9,     .93,  -14.95,
  2,    4.13,   -1.843,     19.31,     .05,      9,    1.90,  -14.78,
  3,    1.84,    -.736,     16.62,     .10,      9,    1.01,  -14.79,
  4,     .75,     .581,     14.10,     .43,      9,     .48,  -14.93,
  5,     .96,     .117,     14.79,     .61,      9,     .40,  -14.95,
  6,    1.48,   -1.067,     17.78,     .42,      9,     .75,  -14.97,
1



 Fleet : FLT16: ENGGFS_IV (Ca

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
     1 ,  -.81,  -.41,   .16,   .05,  -.15,   .14,   .40,  -.14,   .63,   .14
     2 ,  -.10,  -.82,  -.49,  -.06,  -.14,  -.29,   .60,  -.14,   .31,  1.15
```

Table 5.1.4.1, cont.

```
     3 ,   .05,   .06,  -.96,  -.33,  -.14,  -.36,   .40,   .47,   .43,   .37
     4 ,  -.49,  -.07,  -.10,  -.56,  -.36,  -.28,   .33,   .45,   .96,   .13
     5 ,   .46,  -.68,  -.48,   .38,  -.71,  -.34,  -.46,   .44,   .87,   .51
     6 , No data for this fleet at this age
     7 , No data for this fleet at this age



 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


    Age ,         1,         2,         3,         4,         5
 Mean Log q,  -15.0366,  -14.8303,  -14.9904,  -14.8700,  -14.9480,
 S.E(Log q),     .4073,     .5608,     .4579,     .4750,     .5854,



 Regression statistics :


 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

  1,    2.46,   -3.197,     16.13,     .37,     10,     .70,  -15.04,
  2,   65.16,   -4.281,    116.70,     .00,     10,   21.36,  -14.83,
  3,    2.80,   -1.721,     19.42,     .10,     10,    1.16,  -14.99,
  4,    2.19,   -1.294,     18.70,     .13,     10,    1.00,  -14.87,
  5,    3.04,   -1.716,     24.03,     .08,     10,    1.61,  -14.95,
1


 Fleet : FLT17: IBTS_Q1_IV (C

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
     1 ,  -.42,   .19,   .26,   .06,   .11,  -.15,   .02,   .17,  -.30,   .05
     2 ,  -.07,   .03,   .24,   .04,  -.01,   .00,   .08,  -.26,   .01,  -.06
     3 ,  -.17,   .34,   .05,  -.01,   .05,   .11,  -.09,  -.20,  -.31,   .22
     4 ,  -.47,   .48,   .30,   .18,  -.33,  -.19,   .52,  -.18,  -.34,   .03
     5 , No data for this fleet at this age
     6 , No data for this fleet at this age
     7 , No data for this fleet at this age



 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


    Age ,         1,         2,         3,         4
 Mean Log q,  -13.9315,  -13.9885,  -14.1881,  -14.4464,
 S.E(Log q),     .2204,     .1254,     .1995,     .3557,



 Regression statistics :


 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

  1,    1.09,    -.561,     13.90,     .83,     10,     .25,  -13.93,
  2,     .95,     .614,     13.95,     .94,     10,     .12,  -13.99,
  3,    1.21,    -.957,     14.53,     .72,     10,     .24,  -14.19,
  4,    1.08,    -.219,     14.67,     .47,     10,     .41,  -14.45,
1


 Fleet : FLT18: IBTS_Q2_SCO_I

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
```

Table 5.1.4.1, cont.

1	99.99	99.99	.00	.40	.06	-.31	.87	-.08	-.94	99.99
2	99.99	99.99	-.18	-.04	.01	-.34	.51	.16	-.11	99.99
3	99.99	99.99	-.42	-.27	.26	-.40	.39	.30	.13	99.99
4	99.99	99.99	.19	-.94	.20	-.48	.27	.50	.26	99.99
5	99.99	99.99	-.38	.17	.14	-.40	.65	.12	-.31	99.99
6	99.99	99.99	.07	.11	.36	-.50	.14	.74	-.92	99.99
7	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	1,	2,	3,	4,	5,	6
Mean Log q,	-14.1006,	-13.7620,	-13.9545,	-14.2249,	-14.1972,	-14.2738,
S.E(Log q),	.5648,	.2733,	.3534,	.5141,	.3856,	.5499,

Regression statistics :

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
1,	.53,	1.736,	14.14,	.74,	7,	.26,	-14.10,
2,	.96,	.078,	13.74,	.46,	7,	.29,	-13.76,
3,	1.41,	-.583,	14.52,	.29,	7,	.53,	-13.95,
4,	12.12,	-2.150,	43.94,	.01,	7,	4.92,	-14.22,
5,	1.20,	-.475,	14.94,	.53,	7,	.50,	-14.20,
6,	1.64,	-.890,	17.47,	.28,	7,	.92,	-14.27,

1

Fleet : FLT19: FRAGFS_7d (Ca

Age ,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1 ,	99.99,	99.99,	-.33,	.03,	-1.03,	1.39,	.16,	.16,	.06,	-.42
2 ,	99.99,	99.99,	-.78,	-.05,	-.37,	.70,	-.57,	-.18,	.52,	.73
3 ,	No data for this fleet at this age									
4 ,	No data for this fleet at this age									
5 ,	No data for this fleet at this age									
6 ,	No data for this fleet at this age									
7 ,	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	1,	2
Mean Log q,	-9.2660,	-9.9488,
S.E(Log q),	.6897,	.5865,

Regression statistics :

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
1,	1.03,	-.035,	9.14,	.24,	8,	.76,	-9.27,
2,	67.60,	-1.881,	******,	.00,	8,	33.96,	-9.95,

1

Table 5.1.4.1, cont.

Fleet : FLT20: IBTS_Q4_ENG_I

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	99.99	99.99	-.20	-.26	-.23	-.02	.65	.07	99.99	99.99
2	99.99	99.99	-.26	-.08	-.14	-.12	.42	.18	99.99	99.99
3	99.99	99.99	-.08	-.23	.08	-.27	.35	.15	99.99	99.99
4	99.99	99.99	.63	-.33	-.05	-.93	.25	.44	99.99	99.99
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4
Mean Log q	-13.8995	-13.8929	-14.2834	-14.2053
S.E(Log q)	.3429	.2513	.2410	.5706

Regression statistics :

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
1	1.70	-.696	13.62	.20	6	.62	-13.90
2	-10.59	-.734	6.98	.00	6	2.79	-13.89
3	.91	.285	14.13	.70	6	.24	-14.28
4	1.88	-.745	16.54	.15	6	1.12	-14.21

1

Terminal year survivor and F summaries :

Age 1 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
FLT11: SCOSEI_IV (Ca	1.	.000	.000	.00	0	.000	.000
FLT12: SCOLTR_IV (Ca	369476.	.534	.000	.00	1	.132	.114
FLT13: FRATRB_IV (Ca	1.	.000	.000	.00	0	.000	.000
FLT14: FRATRO_IV (Ca	1.	.000	.000	.00	0	.000	.000
FLT15: SCOGFS_IV (Ca	1.	.000	.000	.00	0	.000	.000
FLT16: ENGGFS_IV (Ca	371718.	.427	.000	.00	1	.207	.113
FLT17: IBTS_Q1_IV (C	340665.	.300	.000	.00	1	.419	.123
FLT18: IBTS_Q2_SCO_I	1.	.000	.000	.00	0	.000	.000
FLT19: FRAGFS_7d (Ca	211845.	.732	.000	.00	1	.070	.190
FLT20: IBTS_Q4_ENG_I	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	258474.	.50				.172	.159

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
323386.	.20	.09	5	.447	.129

1

Age 2 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
FLT11: SCOSEI_IV (Ca	87847.	.505	.000	.00	1	.059	.341
FLT12: SCOLTR_IV (Ca	102636.	.262	.123	.47	2	.214	.298

Table 5.1.4.1, cont.

FLT13: FRATRB_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT14: FRATRO_IV (Ca,	169959.,	.515,	.000,	.00,	1,	.057,	.191
FLT15: SCOGFS_IV (Ca,	185170.,	.467,	.000,	.00,	1,	.061,	.176
FLT16: ENGGFS_IV (Ca,	273119.,	.346,	.251,	.72,	2,	.116,	.123
FLT17: IBTS_Q1_IV (C,	100774.,	.213,	.118,	.55,	2,	.315,	.303
FLT18: IBTS_Q2_SCO_I,	46724.,	.604,	.000,	.00,	1,	.036,	.568
FLT19: FRAGFS_7d (Ca,	191282.,	.475,	.329,	.69,	2,	.064,	.171
FLT20: IBTS_Q4_ENG_I,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	79478.,	.50,,,,				.078,	.371

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
119769.,	.12,	.13,	13,	1.064,	.261

Age 3 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
FLT11: SCOSEI_IV (Ca,	54991.,	.260,	.095,	.36,	2,	.126,	.503
FLT12: SCOLTR_IV (Ca,	65485.,	.201,	.123,	.61,	3,	.192,	.437
FLT13: FRATRB_IV (Ca,	40028.,	.398,	.000,	.00,	1,	.041,	.640
FLT14: FRATRO_IV (Ca,	63175.,	.365,	.649,	1.78,	2,	.060,	.450
FLT15: SCOGFS_IV (Ca,	126160.,	.358,	.018,	.05,	2,	.047,	.250
FLT16: ENGGFS_IV (Ca,	80072.,	.287,	.166,	.58,	3,	.089,	.370
FLT17: IBTS_Q1_IV (C,	77561.,	.177,	.064,	.36,	3,	.235,	.380
FLT18: IBTS_Q2_SCO_I,	60259.,	.269,	.012,	.05,	2,	.087,	.467
FLT19: FRAGFS_7d (Ca,	98154.,	.475,	.177,	.37,	2,	.027,	.312
FLT20: IBTS_Q4_ENG_I,	72132.,	.370,	.000,	.00,	1,	.041,	.404
F shrinkage mean ,	40020.,	.50,,,,				.056,	.640

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
67116.,	.09,	.07,	22,	.801,	.428

1

Age 4 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
FLT11: SCOSEI_IV (Ca,	42838.,	.204,	.156,	.77,	3,	.158,	.550
FLT12: SCOLTR_IV (Ca,	51914.,	.175,	.045,	.26,	4,	.194,	.473
FLT13: FRATRB_IV (Ca,	34259.,	.242,	.191,	.79,	2,	.077,	.650
FLT14: FRATRO_IV (Ca,	41339.,	.336,	.598,	1.78,	3,	.050,	.565
FLT15: SCOGFS_IV (Ca,	95128.,	.307,	.119,	.39,	3,	.041,	.285
FLT16: ENGGFS_IV (Ca,	59701.,	.264,	.113,	.43,	4,	.081,	.422
FLT17: IBTS_Q1_IV (C,	41453.,	.168,	.090,	.54,	4,	.186,	.564
FLT18: IBTS_Q2_SCO_I,	59003.,	.222,	.156,	.70,	3,	.082,	.426
FLT19: FRAGFS_7d (Ca,	45091.,	.475,	.163,	.34,	2,	.015,	.528
FLT20: IBTS_Q4_ENG_I,	66953.,	.234,	.227,	.97,	2,	.062,	.384
F shrinkage mean ,	26251.,	.50,,,,				.054,	.786

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
47377.,	.08,	.07,	31,	.886,	.508

Age 5 Catchability constant w.r.t. time and dependent on age

Table 5.1.4.1, cont.

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT11: SCOSEI_IV (Ca,	15710.,	.189,	.111,	.59,	4,	.192,	.692
FLT12: SCOLTR_IV (Ca,	16877.,	.171,	.074,	.43,	5,	.224,	.657
FLT13: FRATRB_IV (Ca,	14627.,	.199,	.083,	.42,	3,	.102,	.728
FLT14: FRATRO_IV (Ca,	14379.,	.347,	.380,	1.09,	4,	.048,	.737
FLT15: SCOGFS_IV (Ca,	25599.,	.299,	.174,	.58,	4,	.036,	.478
FLT16: ENGGFS_IV (Ca,	30524.,	.275,	.132,	.48,	5,	.074,	.414
FLT17: IBTS_Q1_IV (C,	14182.,	.172,	.086,	.50,	4,	.111,	.744
FLT18: IBTS_Q2_SCO_I,	23299.,	.219,	.120,	.55,	4,	.064,	.514
FLT19: FRAGFS_7d (Ca,	20251.,	.475,	.950,	2.00,	2,	.008,	.573
FLT20: IBTS_Q4_ENG_I,	20887.,	.188,	.116,	.62,	3,	.067,	.560
F shrinkage mean ,	10278.,	.50,,,,				.074,	.926

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
16940.,	.08,	.06,	39,	.741,	.655

1

Age 6 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
FLT11: SCOSEI_IV (Ca,	5678.,	.186,	.063,	.34,	5,	.248,	.690
FLT12: SCOLTR_IV (Ca,	6851.,	.175,	.046,	.26,	6,	.267,	.601
FLT13: FRATRB_IV (Ca,	6761.,	.201,	.103,	.51,	4,	.088,	.607
FLT14: FRATRO_IV (Ca,	6011.,	.357,	.097,	.27,	4,	.028,	.662
FLT15: SCOGFS_IV (Ca,	9722.,	.285,	.157,	.55,	5,	.054,	.458
FLT16: ENGGFS_IV (Ca,	9755.,	.284,	.192,	.68,	5,	.042,	.456
FLT17: IBTS_Q1_IV (C,	5693.,	.173,	.059,	.34,	4,	.061,	.689
FLT18: IBTS_Q2_SCO_I,	5631.,	.232,	.173,	.75,	5,	.070,	.694
FLT19: FRAGFS_7d (Ca,	6461.,	.476,	.839,	1.76,	2,	.005,	.628
FLT20: IBTS_Q4_ENG_I,	7080.,	.189,	.155,	.82,	4,	.044,	.586
F shrinkage mean ,	3132.,	.50,,,,				.094,	1.030

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6106.,	.09,	.05,	45,	.574,	.654

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT11: SCOSEI_IV (Ca,	849.,	.190,	.079,	.42,	6,	.298,	.924
FLT12: SCOLTR_IV (Ca,	1021.,	.186,	.066,	.35,	7,	.305,	.817
FLT13: FRATRB_IV (Ca,	944.,	.235,	.154,	.66,	5,	.090,	.862
FLT14: FRATRO_IV (Ca,	1001.,	.377,	.117,	.31,	4,	.012,	.828
FLT15: SCOGFS_IV (Ca,	1224.,	.314,	.080,	.25,	6,	.049,	.720
FLT16: ENGGFS_IV (Ca,	1252.,	.302,	.146,	.48,	5,	.018,	.708
FLT17: IBTS_Q1_IV (C,	1280.,	.181,	.129,	.71,	4,	.023,	.697
FLT18: IBTS_Q2_SCO_I,	712.,	.285,	.228,	.80,	6,	.051,	1.034
FLT19: FRAGFS_7d (Ca,	804.,	.477,	.192,	.40,	2,	.002,	.957
FLT20: IBTS_Q4_ENG_I,	881.,	.196,	.114,	.58,	4,	.017,	.902
F shrinkage mean ,	1532.,	.50,,,,				.137,	.611

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1011.,	.11,	.04,	50,	.395,	.823

1
1

Table 5.1.4.2. Whiting in IV and VIId

Run title : Whiting IV,VIId (run: XSAPAK04/X04)

At 14/10/1999 15:39

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE									
1,	.2153,	.7628,	.3319,	.1458,	.1680,	.2216,	.4089,	.4106,	.1582,
2,	.4675,	.9702,	.6350,	.8740,	.2391,	.5053,	.6945,	.5534,	.7992,
3,	1.4903,	1.4009,	.9613,	.8620,	.6104,	.4462,	.9711,	.7669,	.8448,
4,	2.3428,	1.2854,	.9435,	1.0411,	.5977,	.7130,	.9243,	.8670,	1.0291,
5,	1.5743,	1.5244,	.9967,	.9359,	.8686,	.4736,	1.2559,	.7773,	.8397,
6,	1.9538,	2.0047,	2.8062,	1.0115,	.8927,	.8651,	1.7693,	1.1218,	1.1436,
7,	1.9846,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,	.9321,	1.0156,
+gp,	1.9846,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,	.9321,	1.0156,
0 FBAR 2- 6,	1.5657,	1.4371,	1.2685,	.9449,	.6417,	.6006,	1.1230,	.8173,	.9313,

Table 8 Fishing mortality (F) at age

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.8141,	.7672,	.3989,	.3263,	.2881,	.4009,	.2261,	.1740,	.4265,	.1565,
2,	.5557,	.8249,	.5332,	.7060,	.8016,	.8535,	.7652,	.9250,	.4841,	.4059,
3,	.8065,	.9616,	.5664,	.6008,	1.0497,	1.0324,	.9642,	1.2525,	.8240,	.6314,
4,	.6468,	.8281,	.6989,	.5793,	.6302,	.9988,	.9276,	1.0533,	.9530,	.8465,
5,	1.0029,	.6420,	.5874,	.9531,	1.4145,	.3600,	.9906,	.8414,	.9059,	.7477,
6,	.4957,	.9761,	.2647,	.9982,	.9874,	2.0110,	2.2622,	1.3526,	.8900,	1.1122,
7,	.7220,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,	.9263,	.9120,
+gp,	.7220,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,	.9263,	.9120,
0 FBAR 2- 6,	.7015,	.8465,	.5301,	.7675,	.9767,	1.0511,	1.1819,	1.0850,	.8114,	.7487,

1

Table 8 Fishing mortality (F) at age

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.2327,	.1016,	.1653,	.1735,	.2106,	.2235,	.1903,	.2709,	.1408,	.3587,
2,	.4792,	.4408,	.3299,	.2935,	.4556,	.5172,	.2497,	.4261,	.5110,	.4315,
3,	.7344,	.8236,	.7540,	.5325,	.7477,	.8722,	.6370,	.7061,	.8728,	.6637,
4,	.7083,	.9772,	1.0018,	.7238,	.7380,	1.0313,	.8768,	1.2007,	1.2512,	.9750,
5,	.8434,	1.2439,	1.1024,	.9020,	.8935,	1.0605,	1.1781,	1.0568,	1.3816,	1.1702,
6,	.8853,	.9799,	1.3317,	1.0283,	.9408,	1.1713,	1.2273,	1.1974,	1.7236,	1.3126,
7,	.8207,	1.0795,	1.1591,	.8942,	.8665,	1.1006,	1.1070,	1.1656,	1.4713,	1.1665,
+gp,	.8207,	1.0795,	1.1591,	.8942,	.8665,	1.1006,	1.1070,	1.1656,	1.4713,	1.1665,
0 FBAR 2- 6,	.7301,	.8931,	.9040,	.6960,	.7551,	.9305,	.8338,	.9174,	1.1481,	.9106,

Table 8 Fishing mortality (F) at age

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
1,	.1287,	.2264,	.1171,	.2405,	.1919,	.1584,	.1484,	.1312,	.1277,	.1287,	.1292,
2,	.4318,	.5470,	.4868,	.3885,	.4822,	.3401,	.3476,	.3108,	.3402,	.2608,	.3039,
3,	.6982,	.9139,	.5151,	.5767,	.7602,	.6927,	.6120,	.5786,	.5038,	.4285,	.5036,
4,	.8437,	.9910,	.8911,	.6283,	.8236,	.9231,	.7879,	.7114,	.6241,	.5082,	.6146,
5,	1.5507,	1.2638,	1.1304,	.9546,	.8376,	.9910,	1.0134,	.9912,	.7333,	.6549,	.7931,
6,	1.6355,	1.0937,	.8154,	1.2261,	1.1283,	.9937,	1.0370,	1.1968,	.7200,	.6543,	.8570,
7,	1.6442,	1.3988,	1.1209,	1.3706,	1.0964,	1.0850,	.8145,	.8485,	.9897,	.8226,	.8870,
+gp,	1.6442,	1.3988,	1.1209,	1.3706,	1.0964,	1.0850,	.8145,	.8485,	.9897,	.8226,	
0 FBAR 2- 6,	1.0320,	.9619,	.7678,	.7548,	.8064,	.7881,	.7596,	.7578,	.5843,	.5013,	

1

Table 5.1.4.3. Whiting in IV and VIId

Run title : Whiting IV,VIId (run: XSAPAK04/X04)

At 14/10/1999 15:39

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968
AGE									
1	400923	325199	582247	651154	143068	277199	247767	464680	912864
2	87000	125023	58654	161573	217660	46774	85897	63665	119189
3	33121	34757	30213	19820	42990	109267	17993	27349	23342
4	2758	5259	6035	8141	5899	16453	49284	4801	8951
5	3327	196	1077	1740	2129	2404	5975	14487	1495
6	480	537	33	310	532	696	1166	1325	5186
7	114	53	56	2	88	170	228	155	336
+gp	295	50	17	24	11	30	69	29	22
0 TOTAL	528019	491073	678332	842765	412376	452992	408378	576492	1071384

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
1	108078	182153	304049	542473	742193	368189	759725	482959	465965	465039
2	301392	18518	32708	78911	151393	215190	95363	234370	156954	117641
3	34174	110249	5175	12237	24835	43306	58442	28290	59259	61675
4	7067	10751	29699	2070	4729	6126	10869	15703	5698	18319
5	2369	2742	3479	10938	859	1866	1671	3185	4057	1628
6	503	677	1124	1506	3284	163	1014	483	1069	1277
7	1287	238	199	672	432	953	17	82	97	342
+gp	148	294	169	191	92	68	218	110	75	50
0 TOTAL	455018	325622	376602	648998	927818	635860	927319	765182	693174	665970

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	476834	441762	171892	194467	174170	259649	188642	390742	327002	229567
2	153798	146133	154345	56347	63228	54570	80305	60312	115250	109857
3	49986	60732	59959	70759	26790	25564	20744	39888	25115	44083
4	23115	16901	18782	19880	29275	8938	7531	7731	13873	7394
5	5821	8433	4712	5110	7141	10369	2361	2322	1724	2941
6	600	1950	1893	1219	1615	2276	2796	566	628	337
7	327	193	570	389	339	491	549	638	133	87
+gp	59	126	52	89	175	100	146	90	145	26
0 TOTAL	710541	676230	412206	348260	302734	361956	303075	502289	483870	394294

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 60-96	AMST 60-96
AGE													
1	441488	201432	186977	180407	200295	179603	160255	94993	71631	95105	0	299450	349354
2	62021	150115	62122	64320	54858	63934	59285	53427	32220	24381	32339	90269	106273
3	45499	25678	55392	24344	27808	21598	29014	26702	24967	14619	11977	33724	39355
4	15996	15950	7255	23320	9636	9163	7613	11087	10550	10631	6712	10261	12758
5	2066	5097	4386	2205	9216	3133	2697	2565	4032	4187	4738	3018	3998
6	711	341	1122	1103	661	3106	906	762	741	1508	1694	849	1188
7	71	108	89	386	252	167	896	250	179	281	611	189	310
+gp	45	16	44	17	126	75	92	212	80	79	129		
0 TOTAL	567897	398738	317387	296102	302853	280779	260758	189998	144400	150792	58199		

Table 5.1.6.1 Whiting in IV and VIId

Mean fishing mortality, biomass and recruitment, 1960 - 1998.

	Mean F			Stock Biomass ('000 tonnes)		Recruits Age 1	
	H cons Ages	Disc Ages	IBC Ages				
Year	2 to 6	2 to 6	1 to 4	Total	Spawning	Yclass	Million
1960	1.106	.443	.018	743	312	1959	4009
1961	1.044	.386	.019	738	374	1960	3252
1962	.979	.267	.015	908	283	1961	5822
1963	.616	.290	.066	1136	462	1962	6512
1964	.489	.125	.044	705	517	1963	1431
1965	.429	.140	.040	775	461	1964	2772
1966	.848	.168	.160	646	393	1965	2478
1967	.600	.192	.039	820	322	1966	4647
1968	.664	.212	.083	1380	452	1967	9129
1969	.377	.180	.311	761	626	1968	1081
1970	.537	.217	.277	560	379	1969	1822
1971	.382	.127	.063	557	238	1970	3040
1972	.559	.134	.137	646	290	1971	5425
1973	.680	.161	.191	983	409	1972	7422
1974	.615	.130	.351	735	477	1973	3682
1975	.854	.207	.167	1181	488	1974	7597
1976	.674	.159	.320	1127	631	1975	4830
1977	.525	.108	.247	1110	599	1976	4660
1978	.595	.071	.111	776	452	1977	4650
1979	.569	.066	.116	950	514	1978	4768
1980	.624	.200	.097	836	520	1979	4418
1981	.674	.079	.186	636	488	1980	1719
1982	.488	.097	.114	491	378	1981	1945
1983	.563	.138	.067	512	337	1982	1742
1984	.746	.124	.077	484	271	1983	2596
1985	.699	.078	.063	440	270	1984	1886
1986	.719	.142	.061	662	288	1985	3907
1987	.940	.152	.083	536	298	1986	3270
1988	.707	.104	.190	417	294	1987	2296
1989	.617	.186	.167	561	278	1988	4415
1990	.485	.276	.217	483	317	1989	2014
1991	.524	.122	.104	457	277	1990	1870
1992	.546	.124	.109	407	265	1991	1804
1993	.511	.219	.080	377	239	1992	2003
1994	.559	.198	.047	361	224	1993	1796
1995	.585	.149	.053	366	233	1994	1603
1996	.571	.177	.024	289	203	1995	950
1997	.427	.127	.052	232	169	1996	716
1998	.362	.126	.026	214	134	1997	951
1999				269	141	1998	1507
Min.	.362	.066	.015	214	134	Min.	950
Mean	.628	.169	.118	667	363	Gmean	2994
Max.	1.106	.443	.351	1380	631	Max.	9129

Min, max and geo. mean recruitment calculated over years 1960 to 1996
(Arithmetic mean recruitment 1960 - 1996 = 3494)
Biomass totals calculated at start of year.

Recruitment in 1999 is Geometric Mean (1990-1997)

Table 5.1.7.1 Whiting in IV and VIId

The SAS System

Whiting in Sub-area IV and Division VIId

Multi fleet prediction: Input data

1999	H cons		Dis		IBC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
1	0.0230	0.168	0.0520	0.102	0.0540	0.051	1507.370	0.9500	0.1100	0.0000	0.0000	0.092
2	0.1030	0.213	0.1520	0.168	0.0500	0.131	323.390	0.4500	0.9200	0.0000	0.0000	0.175
3	0.2770	0.265	0.2080	0.205	0.0180	0.228	119.770	0.3500	1.0000	0.0000	0.0000	0.238
4	0.4470	0.315	0.1540	0.226	0.0140	0.286	67.120	0.3000	1.0000	0.0000	0.0000	0.293
5	0.6690	0.362	0.1190	0.249	0.0050	0.327	47.380	0.2500	1.0000	0.0000	0.0000	0.345
6	0.7660	0.390	0.0900	0.248	0.0010	0.279	16.940	0.2500	1.0000	0.0000	0.0000	0.375
7	0.8010	0.391	0.0860	0.389	0.0000	0.000	6.110	0.2000	1.0000	0.0000	0.0000	0.380
8+	0.7990	0.425	0.0880	0.186	0.0000	0.000	1.290	0.2000	1.0000	0.0000	0.0000	0.405
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

2000	H cons		Dis		IBC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
1	0.0230	0.168	0.0520	0.102	0.0540	0.051	1507.370	0.9500	0.1100	0.0000	0.0000	0.092
2	0.1030	0.213	0.1520	0.168	0.0500	0.131	.	0.4500	0.9200	0.0000	0.0000	0.175
3	0.2770	0.265	0.2080	0.205	0.0180	0.228	.	0.3500	1.0000	0.0000	0.0000	0.238
4	0.4470	0.315	0.1540	0.226	0.0140	0.286	.	0.3000	1.0000	0.0000	0.0000	0.293
5	0.6690	0.362	0.1190	0.249	0.0050	0.327	.	0.2500	1.0000	0.0000	0.0000	0.345
6	0.7660	0.390	0.0900	0.248	0.0010	0.279	.	0.2500	1.0000	0.0000	0.0000	0.375
7	0.8010	0.391	0.0860	0.389	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.380
8+	0.7990	0.425	0.0880	0.186	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.405
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

(cont.)

Table 5.1.7.1 (continued)

The SAS System

Whiting in Sub-area IV and Division VIId

Multi fleet prediction: Input data

(cont.)

2001	H cons		Dis		IBC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
1	0.0230	0.168	0.0520	0.102	0.0540	0.051	1507.370	0.9500	0.1100	0.0000	0.0000	0.092
2	0.1030	0.213	0.1520	0.168	0.0500	0.131	.	0.4500	0.9200	0.0000	0.0000	0.175
3	0.2770	0.265	0.2080	0.205	0.0180	0.228	.	0.3500	1.0000	0.0000	0.0000	0.238
4	0.4470	0.315	0.1540	0.226	0.0140	0.286	.	0.3000	1.0000	0.0000	0.0000	0.293
5	0.6690	0.362	0.1190	0.249	0.0050	0.327	.	0.2500	1.0000	0.0000	0.0000	0.345
6	0.7660	0.390	0.0900	0.248	0.0010	0.279	.	0.2500	1.0000	0.0000	0.0000	0.375
7	0.8010	0.391	0.0860	0.389	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.380
8+	0.7990	0.425	0.0880	0.186	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.405
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

Notes: Run name : SPRPAK01
Date and time: 15OCT99:09:55

Table 5.1.7.2 Whiting in Sub-area IV and Division VIId

Multi fleet prediction with mangement option table

Year: 1999											
H cons			Dis			IBC			Total		
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4524	32269	1.0000	0.1446	16892	1.0000	0.0340	4584	53745	268986	141035
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes

Year: 2000												Year: 2001	
H cons			Dis			IBC			Total				
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	Stock biomass	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0340	6001	6001	298153	167556	368421	237265
0.1000	0.0452	3956	0.1000	0.0145	2318	1.0000	0.0340	5944	12218	.	167556	362402	231304
0.2000	0.0905	7724	0.2000	0.0289	4569	1.0000	0.0340	5888	18181	.	167556	356646	225605
0.3000	0.1357	11314	0.3000	0.0434	6755	1.0000	0.0340	5834	23903	.	167556	351137	220153
0.4000	0.1810	14739	0.4000	0.0578	8879	1.0000	0.0340	5780	29399	.	167556	345862	214935
0.5000	0.2262	18008	0.5000	0.0723	10944	1.0000	0.0340	5727	34680	.	167556	340809	209937
0.6000	0.2714	21130	0.6000	0.0868	12952	1.0000	0.0340	5676	39758	.	167556	335964	205148
0.7000	0.3167	24114	0.7000	0.1012	14906	1.0000	0.0340	5625	44644	.	167556	331316	200556
0.8000	0.3619	26967	0.8000	0.1157	16807	1.0000	0.0340	5576	49349	.	167556	326855	196150
0.9000	0.4072	29698	0.9000	0.1301	18657	1.0000	0.0340	5527	53882	.	167556	322571	191920
1.0000	0.4524	32314	1.0000	0.1446	20459	1.0000	0.0340	5479	58252	.	167556	318454	187857
1.1000	0.4976	34820	1.1000	0.1591	22215	1.0000	0.0340	5432	62467	.	167556	314496	183953
1.2000	0.5429	37224	1.2000	0.1735	23926	1.0000	0.0340	5386	66536	.	167556	310689	180198
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPAK02
Date and time : 15OCT99:10:27
Computation of ref. F: H cons: Simple mean, age 2 - 6
Dis: Simple mean, age 2 - 6
IBC: Simple mean, age 1 - 4
Basis for 1999 : F factors

Table 5.1.7.3 Whiting in Sub-area IV and Division VIId

Multi fleet prediction: Detailed tables

```
Year 1999. H cons          F-factor  1.0000 and reference F  0.4524
           Dis             F-factor  1.0000 and reference F  0.1446
           IBC             F-factor  1.0000 and reference F  0.0340
```

	H cons			Dis			IBC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0230	21209	3563	0.0520	47950	4891	0.0540	49794	2540	118953	10993	1507370	138678	165811	15255	165811	15255
2	0.1030	23382	4980	0.1520	34506	5797	0.0500	11351	1487	69238	12264	323390	56593	297519	52066	297519	52066
3	0.2770	22320	5915	0.2080	16760	3436	0.0180	1450	331	40530	9681	119770	28505	119770	28505	119770	28505
4	0.4470	19657	6192	0.1540	6772	1531	0.0140	616	176	27045	7899	67120	19666	67120	19666	67120	19666
5	0.6690	19681	7125	0.1190	3501	872	0.0050	147	48	23329	8044	47380	16346	47380	16346	47380	16346
6	0.7660	7847	3060	0.0900	922	229	0.0010	10	3	8779	3292	16940	6353	16940	6353	16940	6353
7	0.8010	2984	1167	0.0860	320	125	0.0000	0	0	3304	1291	6110	2322	6110	2322	6110	2322
8+	0.7990	628	267	0.0880	69	13	0.0000	0	0	698	280	1290	522	1290	522	1290	522
Total		117708	32269		110800	16892		63368	4584	291876	53745	2089370	268986	721940	141035	721940	141035
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

```
Year 2000. H cons          F-factor  1.0000 and reference F  0.4524
           Dis             F-factor  1.0000 and reference F  0.1446
           IBC             F-factor  1.0000 and reference F  0.0340
```

	H cons			Dis			IBC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0230	21209	3563	0.0520	47950	4891	0.0540	49794	2540	118953	10993	1507370	138678	165811	15255	165811	15255
2	0.1030	37049	7891	0.1520	54674	9185	0.0500	17985	2356	109707	19433	512408	89671	471416	82498	471416	82498
3	0.2770	28325	7506	0.2080	21270	4360	0.0180	1841	420	51436	12286	151997	36175	151997	36175	151997	36175
4	0.4470	14947	4708	0.1540	5150	1164	0.0140	468	134	20565	6006	51038	14954	51038	14954	51038	14954
5	0.6690	11167	4042	0.1190	1986	495	0.0050	83	27	13236	4564	26883	9275	26883	9275	26883	9275
6	0.7660	7734	3016	0.0900	909	225	0.0010	10	3	8653	3245	16697	6261	16697	6261	16697	6261
7	0.8010	2735	1069	0.0860	294	114	0.0000	0	0	3028	1184	5600	2128	5600	2128	5600	2128
8+	0.7990	1216	517	0.0880	134	25	0.0000	0	0	1350	542	2495	1011	2495	1011	2495	1011
Total		124381	32314		132366	20459		70181	5479	326928	58252	2274487	298153	891935	167556	891935	167556
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 5.1.7.3 (Continued)

Multi fleet prediction: Detailed tables

(cont.)

```
Year 2001. H cons        F-factor  1.0000 and reference F  0.4524
           Dis           F-factor  1.0000 and reference F  0.1446
           IBC           F-factor  1.0000 and reference F  0.0340
```

	H cons			Dis			IBC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0230	21209	3563	0.0520	47950	4891	0.0540	49794	2540	118953	10993	1507370	138678	165811	15255	165811	15255
2	0.1030	37049	7891	0.1520	54674	9185	0.0500	17985	2356	109707	19433	512408	89671	471416	82498	471416	82498
3	0.2770	44881	11894	0.2080	33701	6909	0.0180	2916	665	81499	19467	240837	57319	240837	57319	240837	57319
4	0.4470	18969	5975	0.1540	6535	1477	0.0140	594	170	26098	7622	64771	18978	64771	18978	64771	18978
5	0.6690	8491	3074	0.1190	1510	376	0.0050	63	21	10065	3471	20442	7052	20442	7052	20442	7052
6	0.7660	4388	1711	0.0900	516	128	0.0010	6	2	4910	1841	9473	3553	9473	3553	9473	3553
7	0.8010	2695	1054	0.0860	289	113	0.0000	0	0	2985	1166	5519	2097	5519	2097	5519	2097
8+	0.7990	1330	565	0.0880	146	27	0.0000	0	0	1476	592	2730	1106	2730	1106	2730	1106
Total		139012	35728		145322	23106		71359	5753	355694	64586	2363550	318454	980999	187857	980999	187857
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

```
Notes: Run name            : SPRPAK01
       Date and time       : 15OCT99:09:55
       Computation of ref. F: H cons: Simple mean, age 2 - 6
                             Dis:    Simple mean, age 2 - 6
                             IBC:    Simple mean, age 1 - 4
       Prediction basis    : F factors
```

Table 5.1.7.4 Whiting in IV and VIId. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to HUMAN CONSUMPTION landings and SSB (by weight) of these year classes

Year-class	1995	1996	1997	1998	1999
Stock No. (millions) of one-year-olds	950	716	951	1507	1507
Source	XSA	XSA	XSA	GM	GM
Status Quo F:					
% in 1999 HC landings	19.2	18.3	15.4	11.0	-
% in 2000 HC landings	12.5	14.6	23.2	24.4	11.0
% in 1999 SSB	13.9	20.2	36.9	10.8	-
% in 2000 SSB	5.5	8.9	21.6	49.2	9.1
% in 2001 SSB	1.9	3.8	10.1	30.5	43.9

GM= geometric mean recruitment

IV and VIId Whiting : Year-class % contribution to a) 2000 Human Consumption landings and b) 2001 SSB

Table 5.1.7.5 Whiting in the North Sea and VIId

Input data for catch forecast and linear sensitivity analysis.

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	1507370	.39	WS1	.09	.01	M1	.95	.11	MT1	.11	.10
N2	323389	.20	WS2	.18	.04	M2	.45	.26	MT2	.92	.10
N3	119768	.13	WS3	.24	.02	M3	.35	.14	MT3	1.00	.10
N4	67118	.09	WS4	.29	.04	M4	.30	.14	MT4	1.00	.00
N5	47379	.08	WS5	.35	.11	M5	.25	.14	MT5	1.00	.00
N6	16940	.08	WS6	.38	.09	M6	.25	.14	MT6	1.00	.00
N7	6109	.09	WS7	.38	.13	M7	.20	.14	MT7	1.00	.00
N8	1288	.11	WS8	.41	.08	M8	.20	.14	MT8	1.00	.00

HC selectivity			HC.catch wt			Dis selectivity			Discrd catch wt		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
sH1	.02	.48	WH1	.17	.02	sD1	.05	.21	WD1	.10	.20
sH2	.10	.41	WH2	.21	.04	sD2	.15	.16	WD2	.17	.09
sH3	.28	.18	WH3	.27	.03	sD3	.21	.07	WD3	.20	.04
sH4	.45	.11	WH4	.31	.04	sD4	.15	.18	WD4	.23	.01
sH5	.67	.01	WH5	.36	.11	sD5	.12	.13	WD5	.25	.11
sH6	.77	.17	WH6	.39	.07	sD6	.09	.40	WD6	.25	.09
sH7	.80	.29	WH7	.39	.13	sD7	.09	.91	WD7	.39	.51
sH8	.80	.23	WH8	.43	.01	sD8	.09	1.41	WD8	.19	.95

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI1	.05	.27	WI1	.05	.15
sI2	.05	.53	WI2	.13	.17
sI3	.02	.14	WI3	.23	.11
sI4	.01	.32	WI4	.29	.16
sI5	.00	.67	WI5	.33	.11
sI6	.00	.72	WI6	.28	1.06
sI7	.00	.00	WI7	.00	.00
sI8	.00	.00	WI8	.00	.00

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K99	1.00	.23	HF99	1.00	.23	IF99	1.00	.45
K00	1.00	.23	HF00	1.00	.23	IF00	1.00	.45
K01	1.00	.23	HF01	1.00	.23	IF01	1.00	.45

Recruitment		
Labl	Value	CV
R00	1507370	.39
R01	1507370	.39

Proportion F before spawning= .00
Proportion M before spawning= .00

Stock numbers in 1999 are VPA survivors.
These are overwritten at Age 1

Human consumption + discard Fs are obtained from mean exploitation pattern over 1996 to 1998.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1998, i.e. .489
Fs are distributed between consumption and discards by mean proportion retained over 1996 to 1998.
N.B. Above value for H cons+Disc ref F is value for both catch categories combined.
Bycatch Fs are obtained from mean exploitation pattern over 1996 to 1998.
THIS IS SCALED TO GIVE A VALUE FOR MEAN F (AGES 1 TO 4) EQUAL TO THAT IN 1998, I.E. .026

Table 5.1.8.1
Medium Term Summary
Whiting in the North Sea and Eastern Channel

Bpa	280	thousand tonnes
Blim	200	thousand tonnes

F1	0.65	Basis :	Fpa	F multiplier	1.1
F2	0.6	Basis :	SQ	F multiplier	1

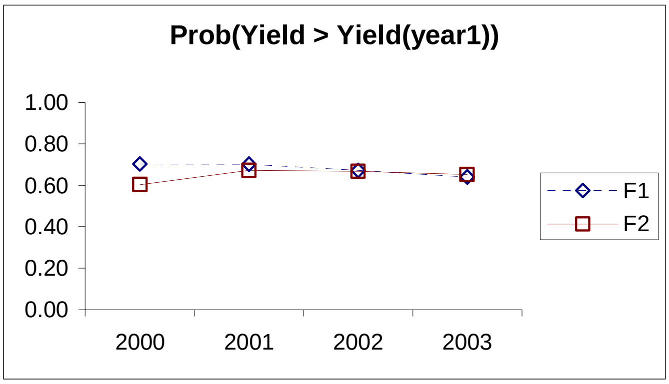
Year 1 1999

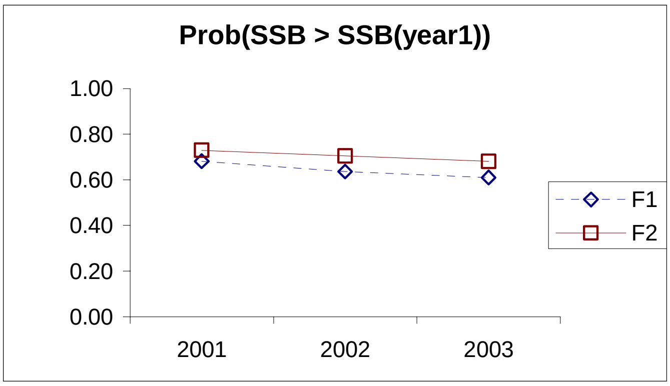
Format of tables:

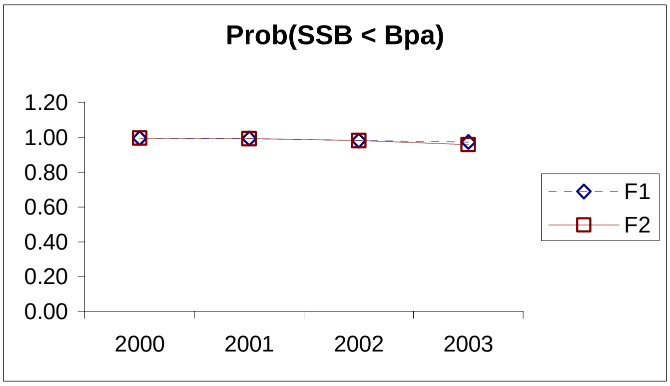
	1999	2000	2001	2002	2003
F1	Yield1999	Prob(Yield2000>Yield1999)	Prob(Yield2001>Yield1999)	Prob(Yield2002>Yield1999)	Prob(Yield2003>Yield1999)
	SSB1999	SSB2000	Prob(SSB2001>SSB1999)	Prob(SSB2002>SSB1999)	Prob(SSB2003>SSB1999)
		Prob(SSB2000< Bpa)	Prob(SSB2001< Bpa)	Prob(SSB2002< Bpa)	Prob(SSB2003< Bpa)
		Prob(SSB2000< Blim)	Prob(SSB2001< Blim)	Prob(SSB2002< Blim)	Prob(SSB2003< Blim)
F2	Yield1999	Prob(Yield2000>Yield1999)	Prob(Yield2001>Yield1999)	Prob(Yield2002>Yield1999)	Prob(Yield2003>Yield1999)
	SSB1999	SSB2000	Prob(SSB2001>SSB1999)	Prob(SSB2002>SSB1999)	Prob(SSB2003>SSB1999)
		Prob(SSB2000< Bpa)	Prob(SSB2001< Bpa)	Prob(SSB2002< Bpa)	Prob(SSB2003< Bpa)
		Prob(SSB2000< Blim)	Prob(SSB2001< Blim)	Prob(SSB2002< Blim)	Prob(SSB2003< Blim)

Medium Term Summary
Whiting in the North Sea and Eastern Channel

F	1999	2000	2001	2002	2003
0.65	32.3	0.70	0.70	0.67	0.64
	141	168	0.68	0.64	0.61
		1.00	0.99	0.98	0.97
		0.86	0.84	0.78	0.74
0.6	32.3	0.60	0.67	0.67	0.65
	141	168	0.73	0.70	0.68
		1.00	0.99	0.98	0.96
		0.85	0.82	0.78	0.74







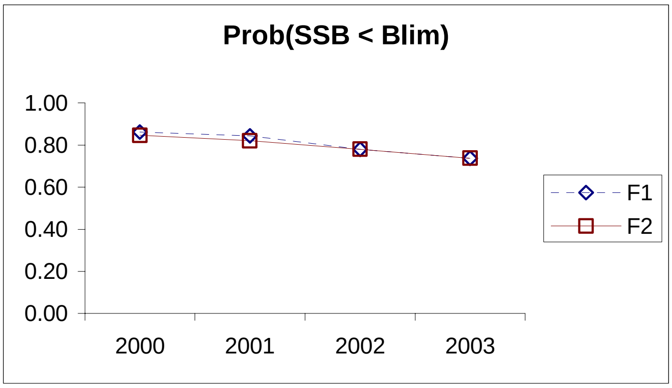


Table 5.1.9.1 Whiting in Sub-area IV and Division VIId

Whiting in Sub-area IV and Division VIId

The SAS System

Multi fleet yield per recruit: Input data

	H cons		Dis		IBC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
1	0.0230	0.183	0.0520	0.094	0.0540	0.060	100000	0.9500	0.1100	0.0000	0.0000	0.085
2	0.1030	0.234	0.1520	0.160	0.0500	0.138	.	0.4500	0.9200	0.0000	0.0000	0.170
3	0.2770	0.273	0.2080	0.199	0.0180	0.234	.	0.3500	1.0000	0.0000	0.0000	0.239
4	0.4470	0.320	0.1540	0.221	0.0140	0.286	.	0.3000	1.0000	0.0000	0.0000	0.294
5	0.6690	0.358	0.1190	0.237	0.0050	0.354	.	0.2500	1.0000	0.0000	0.0000	0.336
6	0.7660	0.390	0.0900	0.246	0.0010	0.296	.	0.2500	1.0000	0.0000	0.0000	0.376
7	0.8010	0.418	0.0860	0.319	0.0000	0.214	.	0.2000	1.0000	0.0000	0.0000	0.399
8+	0.7990	0.440	0.0880	0.225	0.0000	0.170	.	0.2000	1.0000	0.0000	0.0000	0.433
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Numbers	-	-	-	-	Kilograms

Notes: Run name : YLDPAK01
Date and time: 17OCT99:14:03

Table 5.1.9.2 Whiting in Sub-area IV and Division VIId

Multi fleet yield per recruit: Summary table

H cons			Dis			IBC			Total			1 January		Spawning time	
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0340	1	1	232	48	140	40	140	40
0.1000	0.0452	1	0.1000	0.0145	0	1.0000	0.0340	1	2	209	38	117	30	117	30
0.2000	0.0905	2	0.2000	0.0289	1	1.0000	0.0340	1	3	196	33	104	25	104	25
0.3000	0.1357	2	0.3000	0.0434	1	1.0000	0.0340	1	4	187	30	95	22	95	22
0.4000	0.1810	3	0.4000	0.0578	1	1.0000	0.0340	0	4	181	28	89	20	89	20
0.5000	0.2262	3	0.5000	0.0723	1	1.0000	0.0340	0	4	176	26	84	18	84	18
0.6000	0.2714	3	0.6000	0.0868	1	1.0000	0.0340	0	4	172	25	80	17	80	17
0.7000	0.3167	3	0.7000	0.1012	1	1.0000	0.0340	0	5	169	24	77	16	77	16
0.8000	0.3619	3	0.8000	0.1157	1	1.0000	0.0340	0	5	166	23	74	15	74	15
0.9000	0.4072	3	0.9000	0.1301	1	1.0000	0.0340	0	5	163	22	71	14	71	14
1.0000	0.4524	3	1.0000	0.1446	2	1.0000	0.0340	0	5	161	22	69	14	69	14
1.1000	0.4976	3	1.1000	0.1591	2	1.0000	0.0340	0	5	159	21	67	13	67	13
1.2000	0.5429	3	1.2000	0.1735	2	1.0000	0.0340	0	5	157	20	65	12	65	12
1.3000	0.5881	3	1.3000	0.1880	2	1.0000	0.0340	0	5	155	20	64	12	64	12
1.4000	0.6334	3	1.4000	0.2024	2	1.0000	0.0340	0	5	154	20	62	12	62	12
1.5000	0.6786	3	1.5000	0.2169	2	1.0000	0.0340	0	5	153	19	61	11	61	11
1.6000	0.7238	3	1.6000	0.2314	2	1.0000	0.0340	0	5	151	19	60	11	60	11
1.7000	0.7691	3	1.7000	0.2458	2	1.0000	0.0340	0	5	150	19	58	11	58	11
1.8000	0.8143	3	1.8000	0.2603	2	1.0000	0.0340	0	5	149	18	57	10	57	10
1.9000	0.8596	3	1.9000	0.2747	2	1.0000	0.0340	0	6	148	18	56	10	56	10
2.0000	0.9048	3	2.0000	0.2892	2	1.0000	0.0340	0	6	147	18	55	10	55	10
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

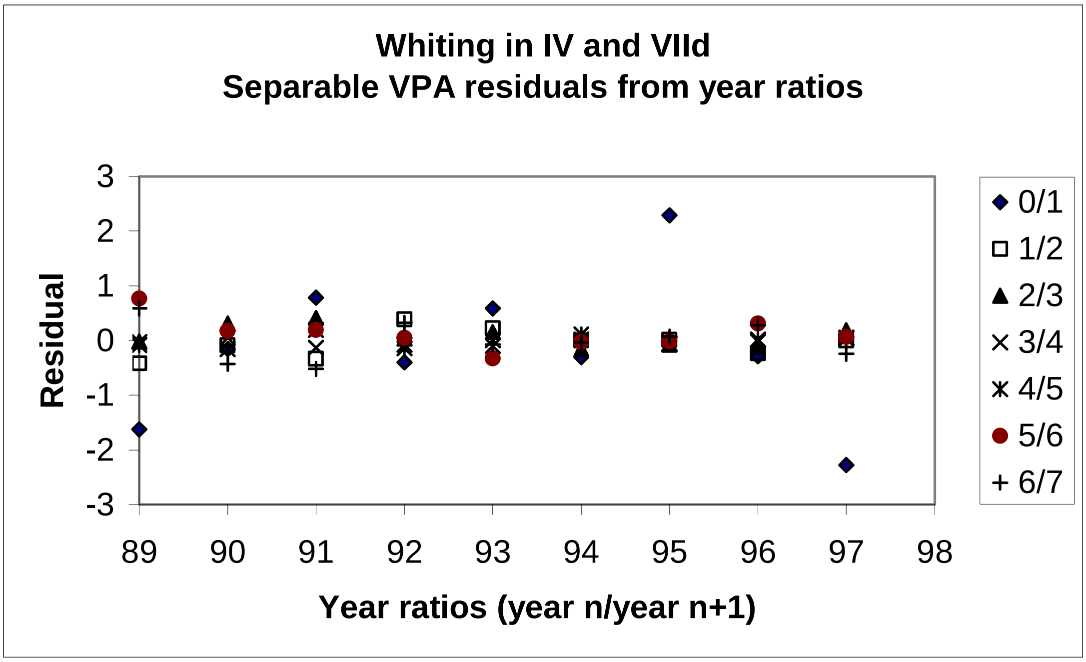
Notes: Run name : YLDPAK01
Date and time : 17OCT99:14:03
Computation of ref. F: H cons: Simple mean, age 2 - 6
Dis: Simple mean, age 2 - 6
IBC: Simple mean, age 1 - 4
Recruitment : 100000 (Number)

Table 5.2.1.1 Nominal landings (in tonnes) of WHITING from Division IIIa as supplied by the Study Group on Division IIIa Demersal Stocks (Anon., 1992b) and updated by the Working Group.

Year	Denmark			Norway	Sweden	Others	Total
1975		19,018		57	611	4	19,690
1976		17,870		48	1,002	48	18,968
1977		18,116		46	975	41	19,178
1978		48,102		58	899	32	49,091
1979		16,971		63	1,033	16	18,083
1980		21,070		65	1,516	3	22,654
	Total consumption	Total industrial	Total				
1981	1,027	23,915	24,942	70	1,054	7	26,073
1982	1,183	39,758	40,941	40	670	13	41,664
1983	1,311	23,505	24,816	48	1,061	8	25,933
1984	1,036	12,102	13,138	51	1,168	60	14,417
1985	557	11,967	12,524	45	654	2	13,225
1986	484	11,979	12,463	64	477	1	13,005
1987	443	15,880	16,323	29	262	43	16,657
1988	391	10,872	11,263	42	435	24	11,764
1989	917	11,662	12,579	29	675	-	13,283
1990	1,016	17,829	18,845	49	456	73	19,423
1991	871	12,463	13,344	56	527	97	14,041
1992	555	10,675	11,230	66	959	1	12,256
1993	261	3,581	3,842	42	756	1	4,654
1994	174	5,391	5,565	21	440	1	6,027
1995	85	9,029	9,114	24	431	1	9,570
1996	55	2,668	2,723	21	182	-	2,926
1997	38	568	606	18	94	-	718
1998	35	844		16	99	-	

[1]Preliminary.

Figure 5.1.4.1 Whiting in IV and VIId. Separable VPA



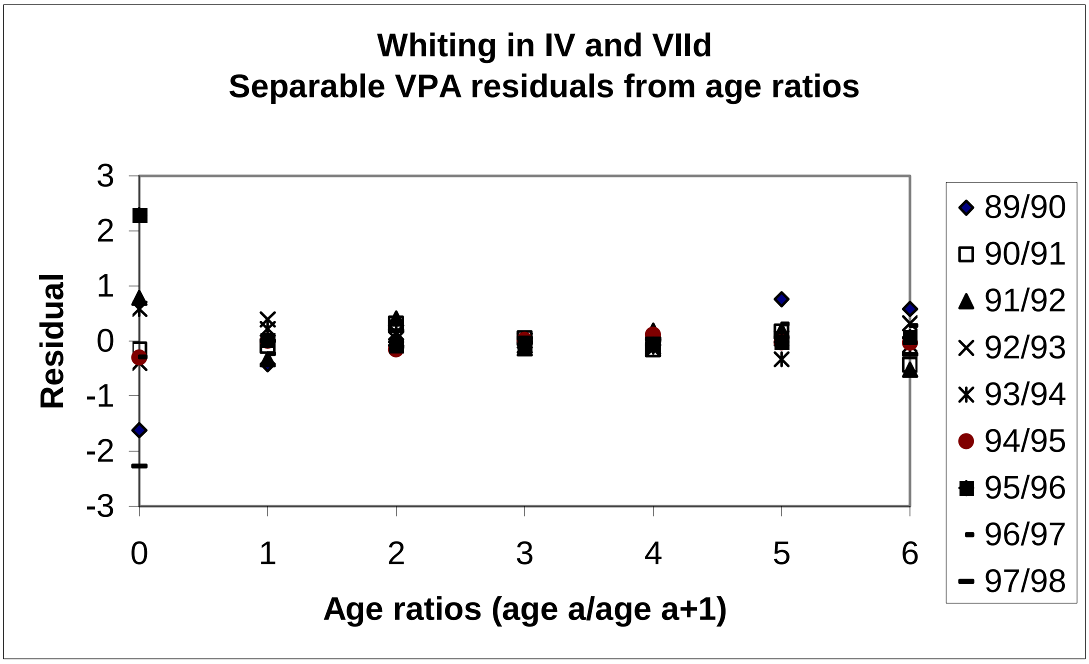


Figure 5.1.4.2aWhiting in IV and VIId. Log catchability residuals.

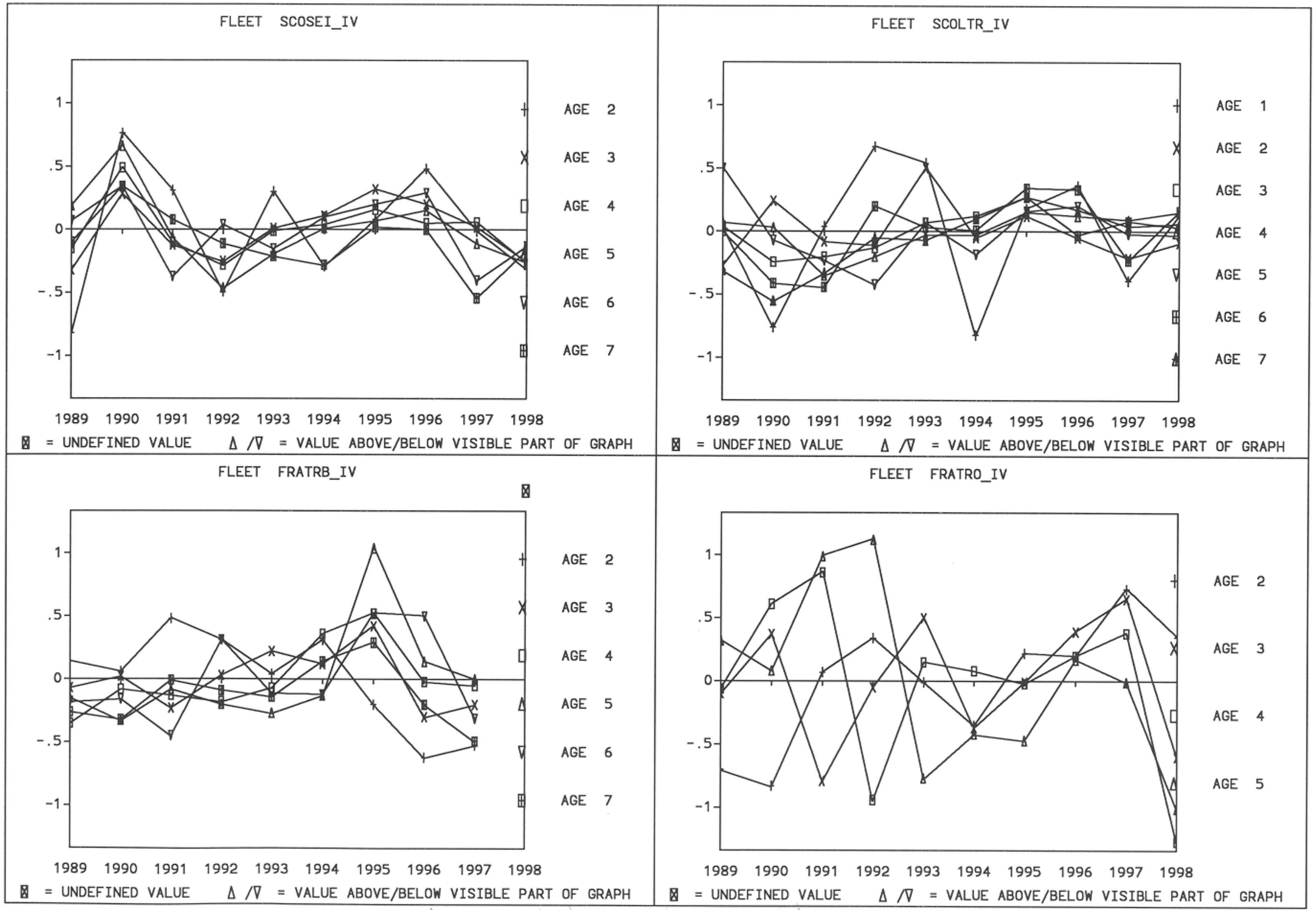


Figure 5.1.4.2 continued

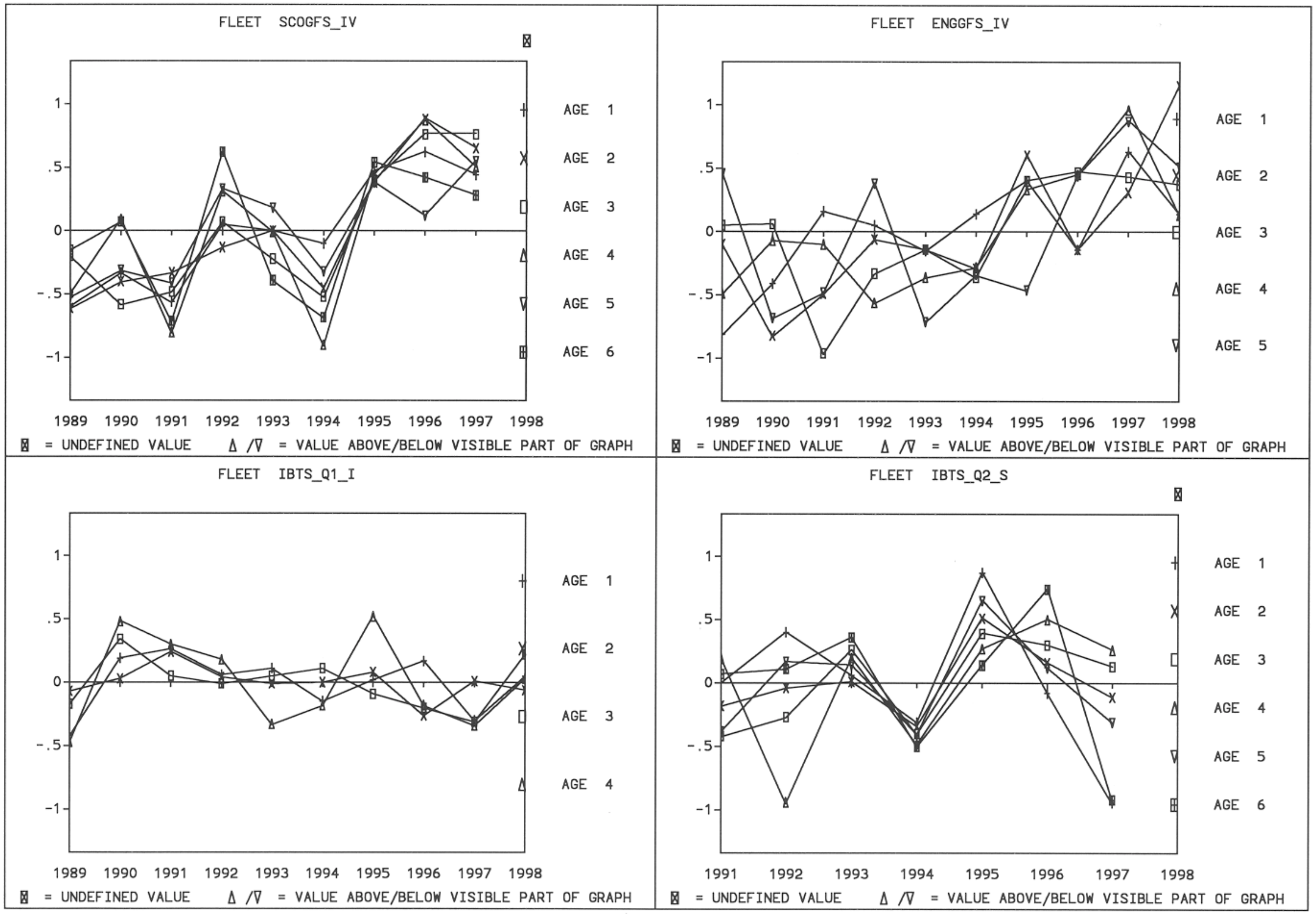


Figure 5.1.4.2 continued

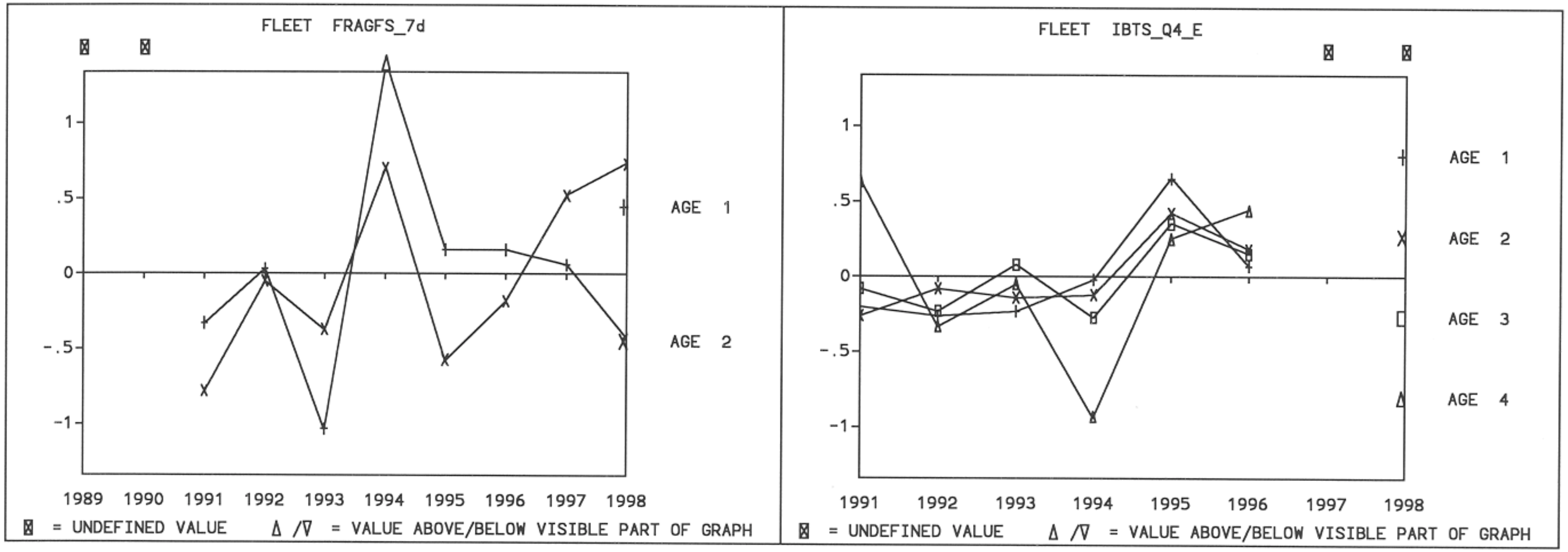


Figure 5.1.4.3 Whiting IV and VIId. Tuning fleets scaled weights at age

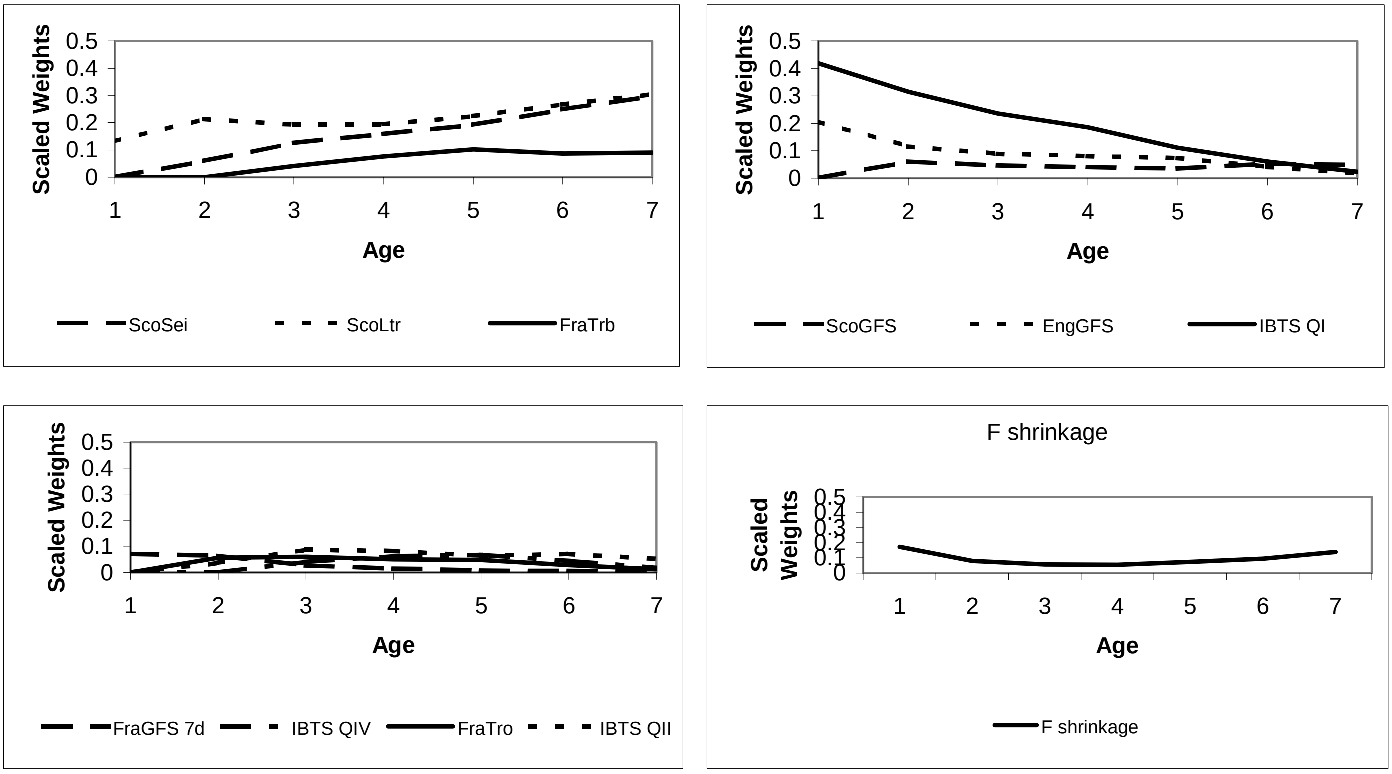


Figure 5.1.4.4 Whiting IV and VIId. Terminal exploitation pattern by fleet

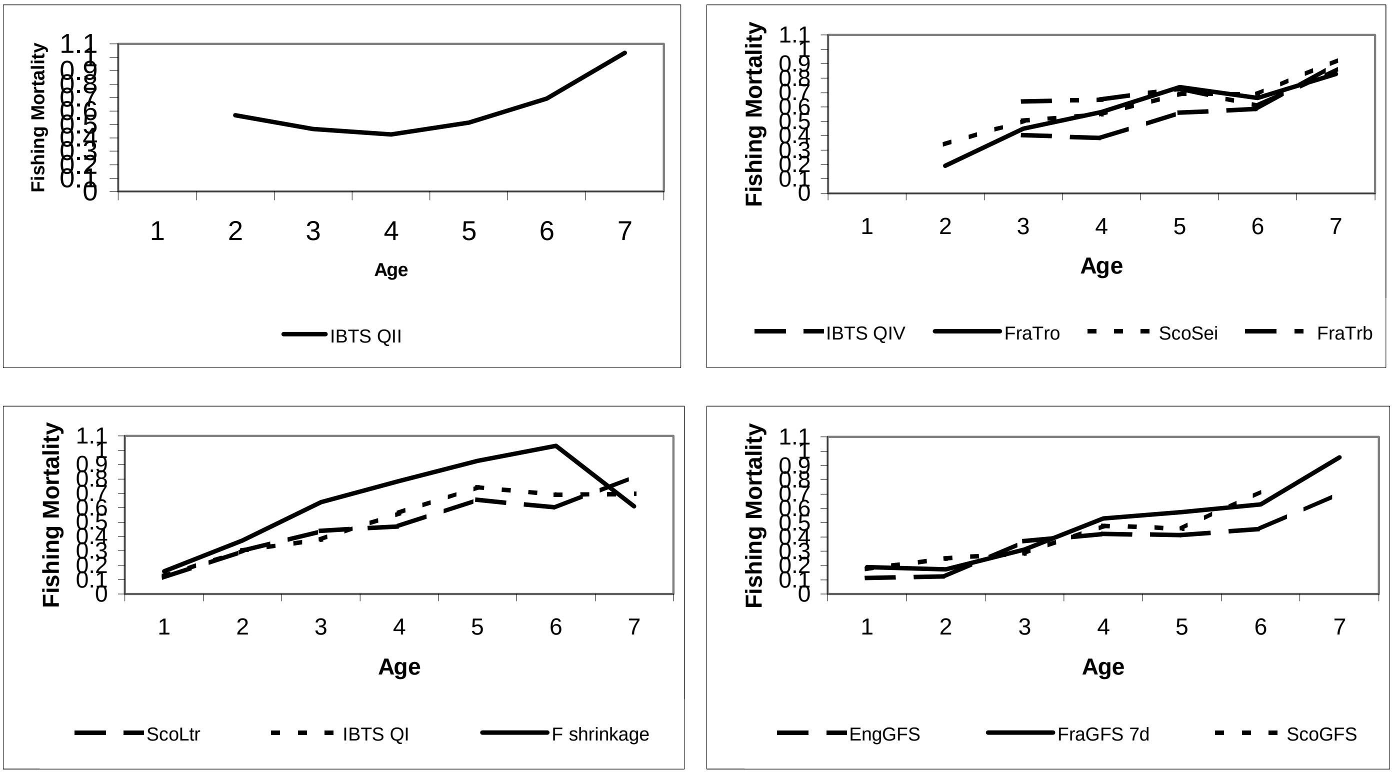


Figure 5.1.4.5   Whiting in IV and VIId, retrospective XSA (diminishing series)

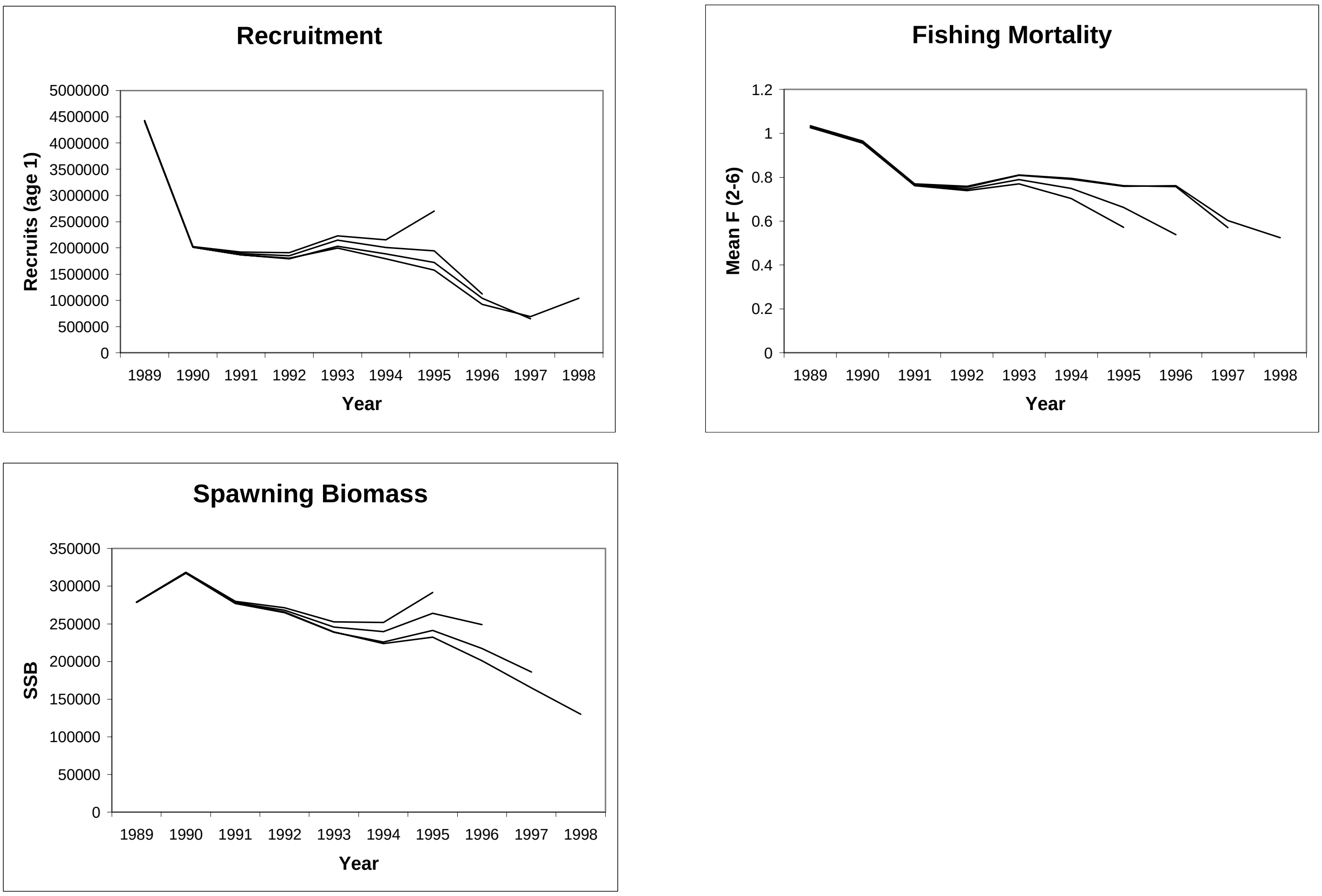


Figure 5.1.6.1 Stock summary, Whiting, North Sea and V.

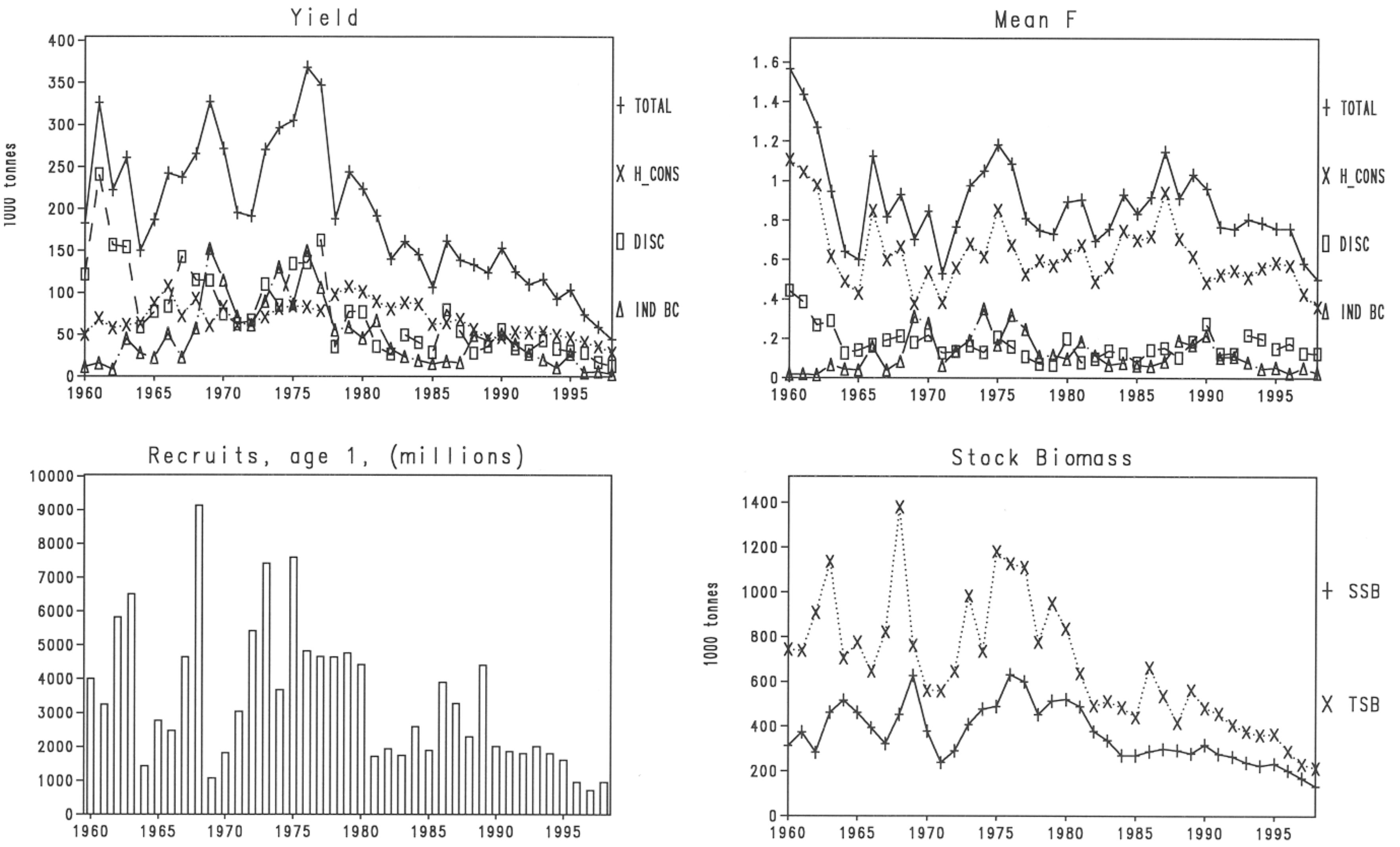


Figure 5.1.7.1 Whiting , North Sea and VIId. Sensitivity analysis of short term forecast.

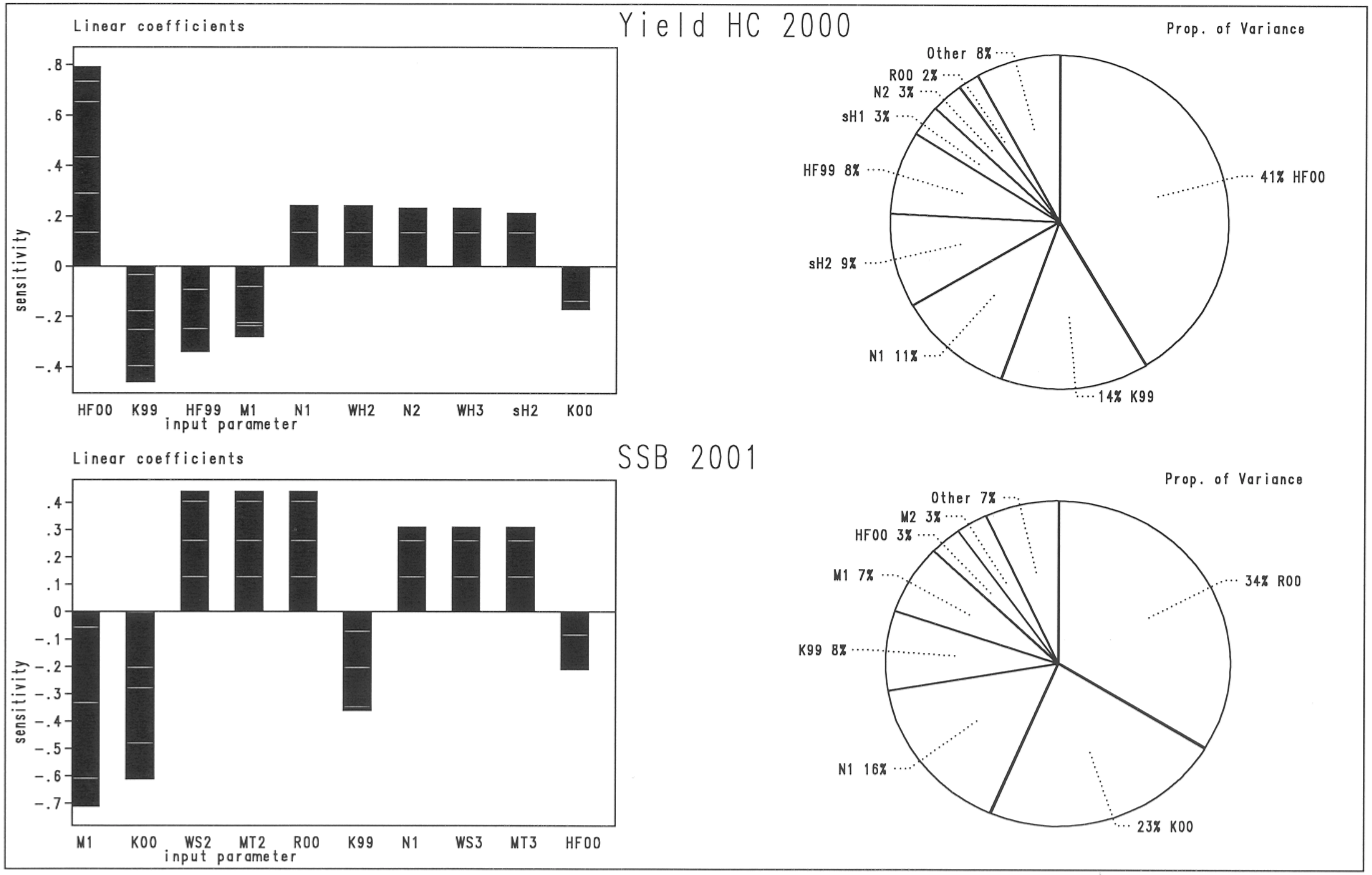
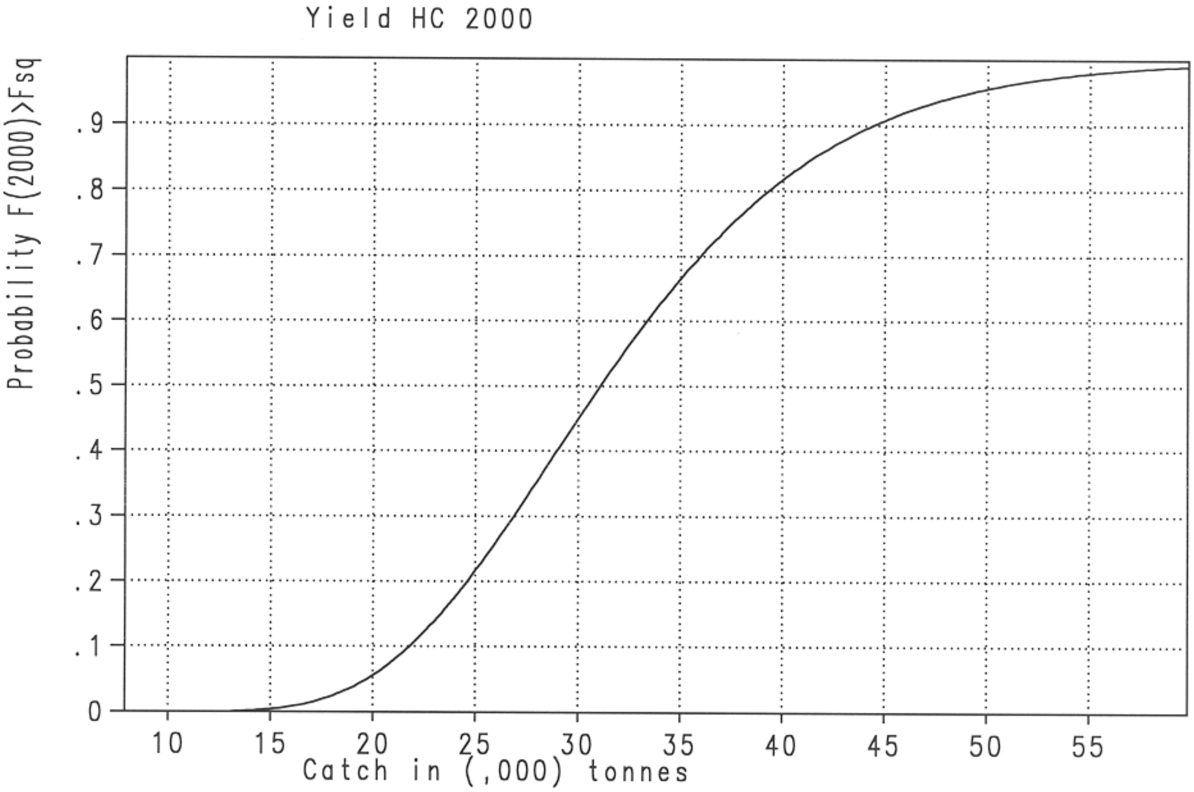


Figure 5.1.7.2 Whiting, North Sea and VIId. Probability profiles for short term forecast.



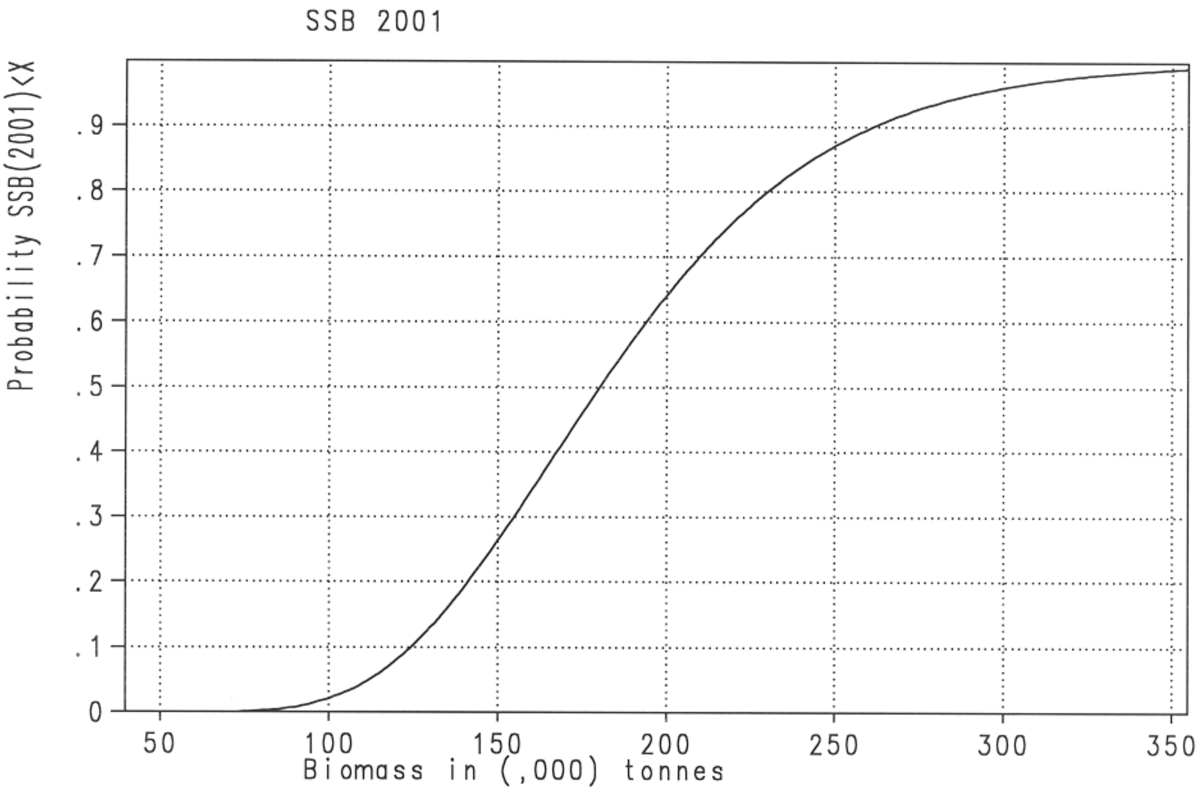


Figure 5.1.8.1 **Whiting in IV and VIId. Medium term stock projection at Status Quo F, showing 5, 50 and 95 percentiles (truncated stock and recruit series)**

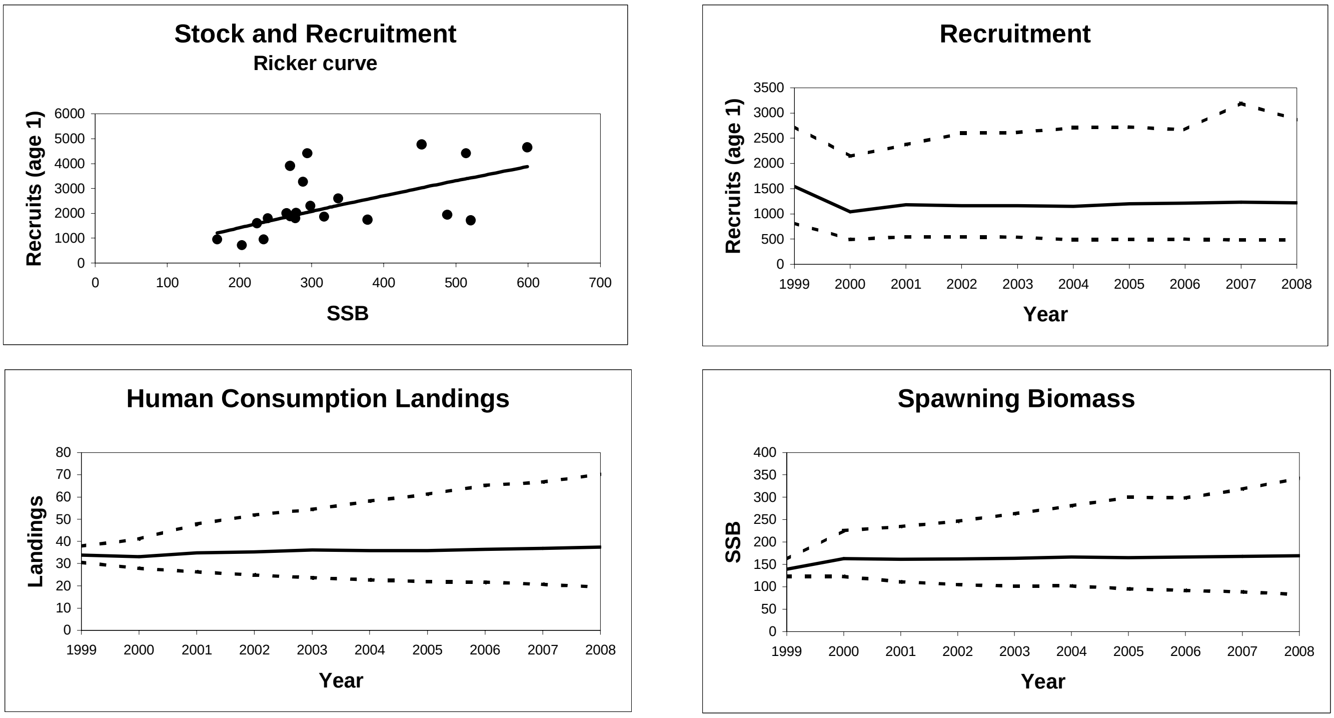


Figure 5.1.8.2 **Whiting in IV and VIId**
Probability of SSB 2008 < Bpa

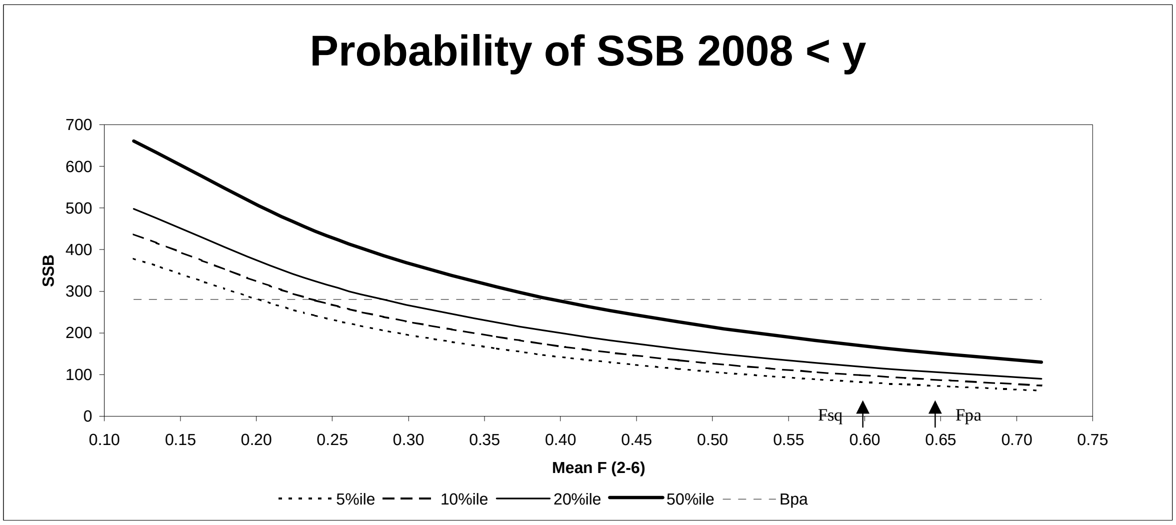


Figure 5.1.9.1 North Sea and VIId Whiting: Stock and Recruitment

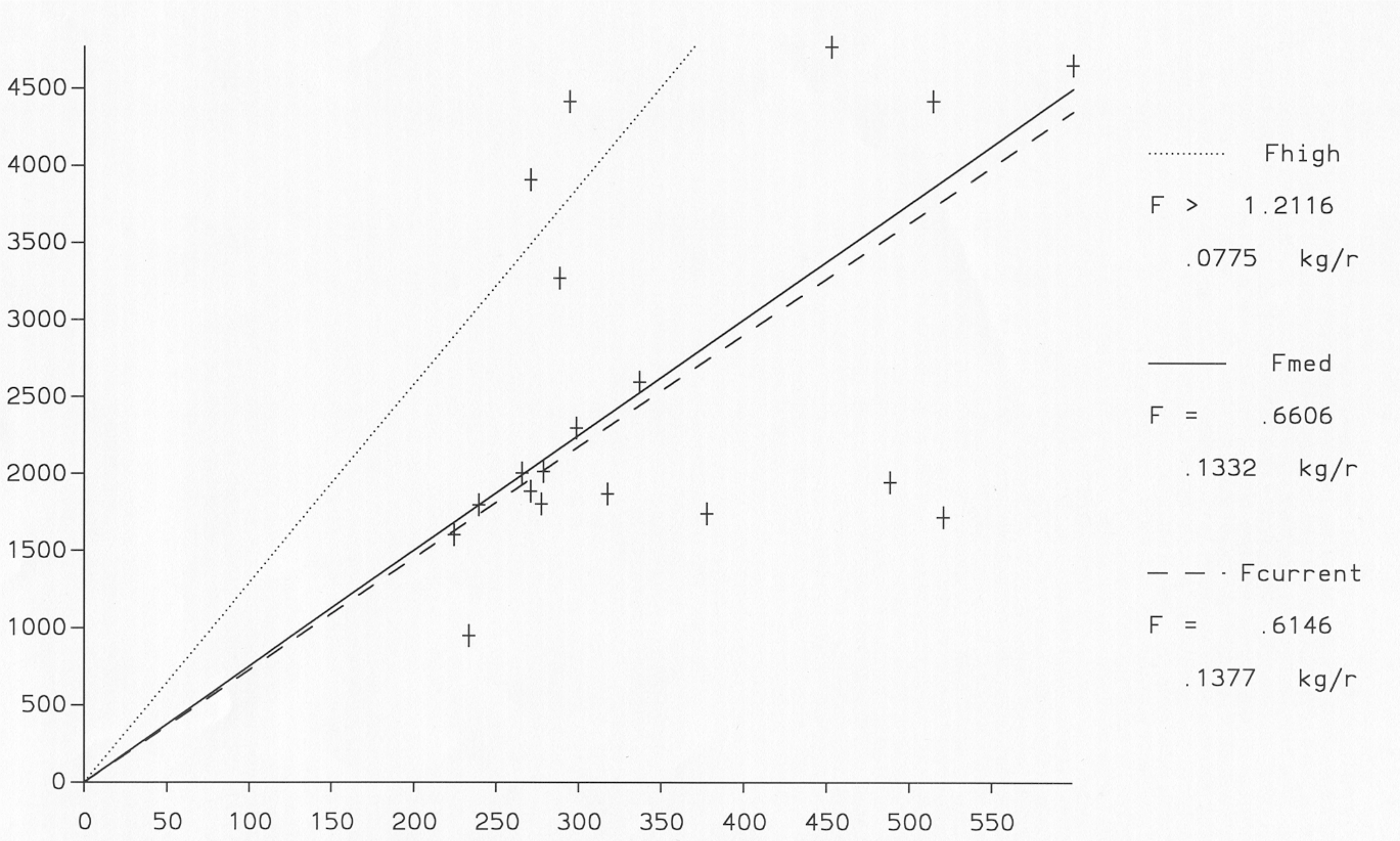


Figure 5.1.9.2 North Sea and VIId Whiting: Stock and Recruitment.

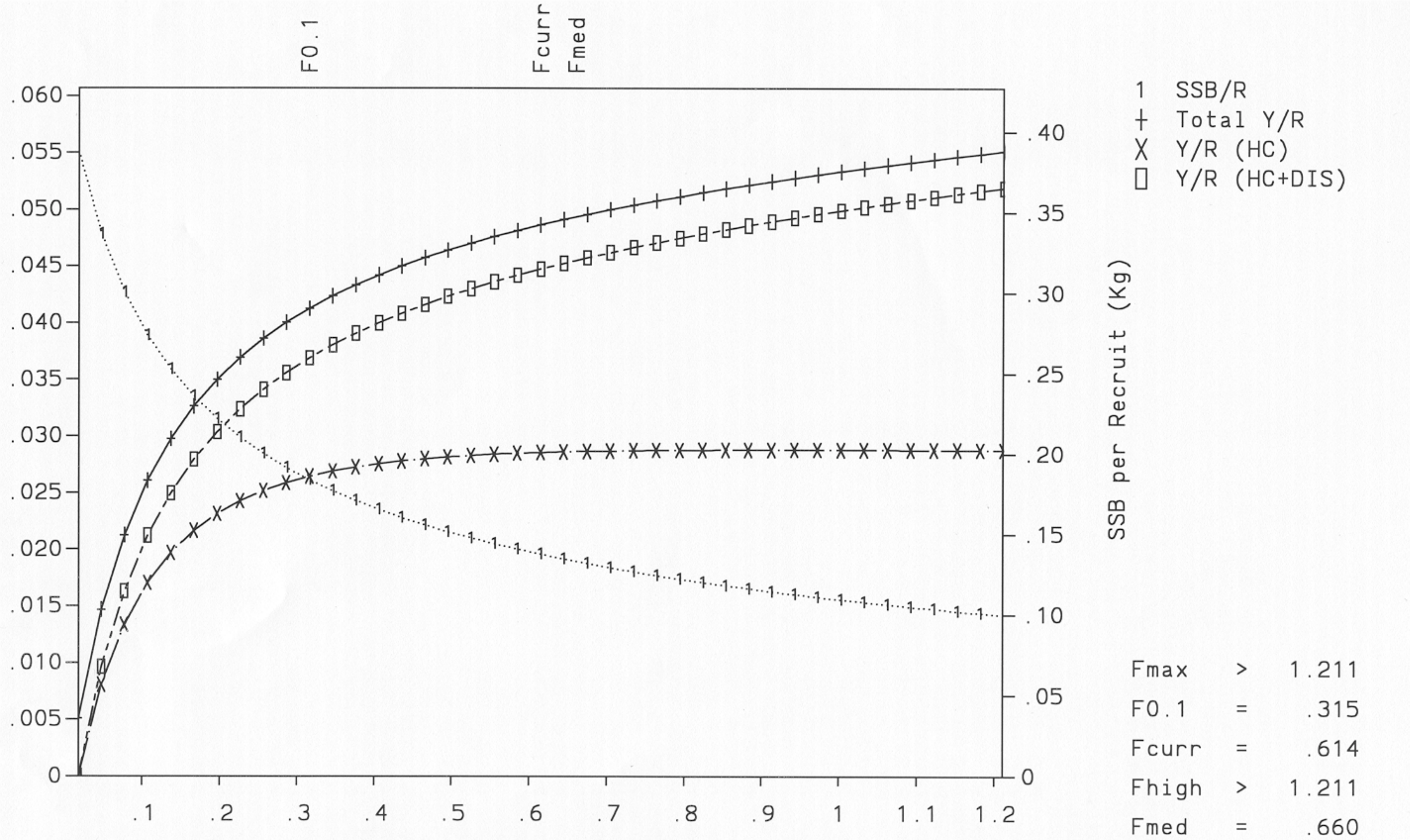
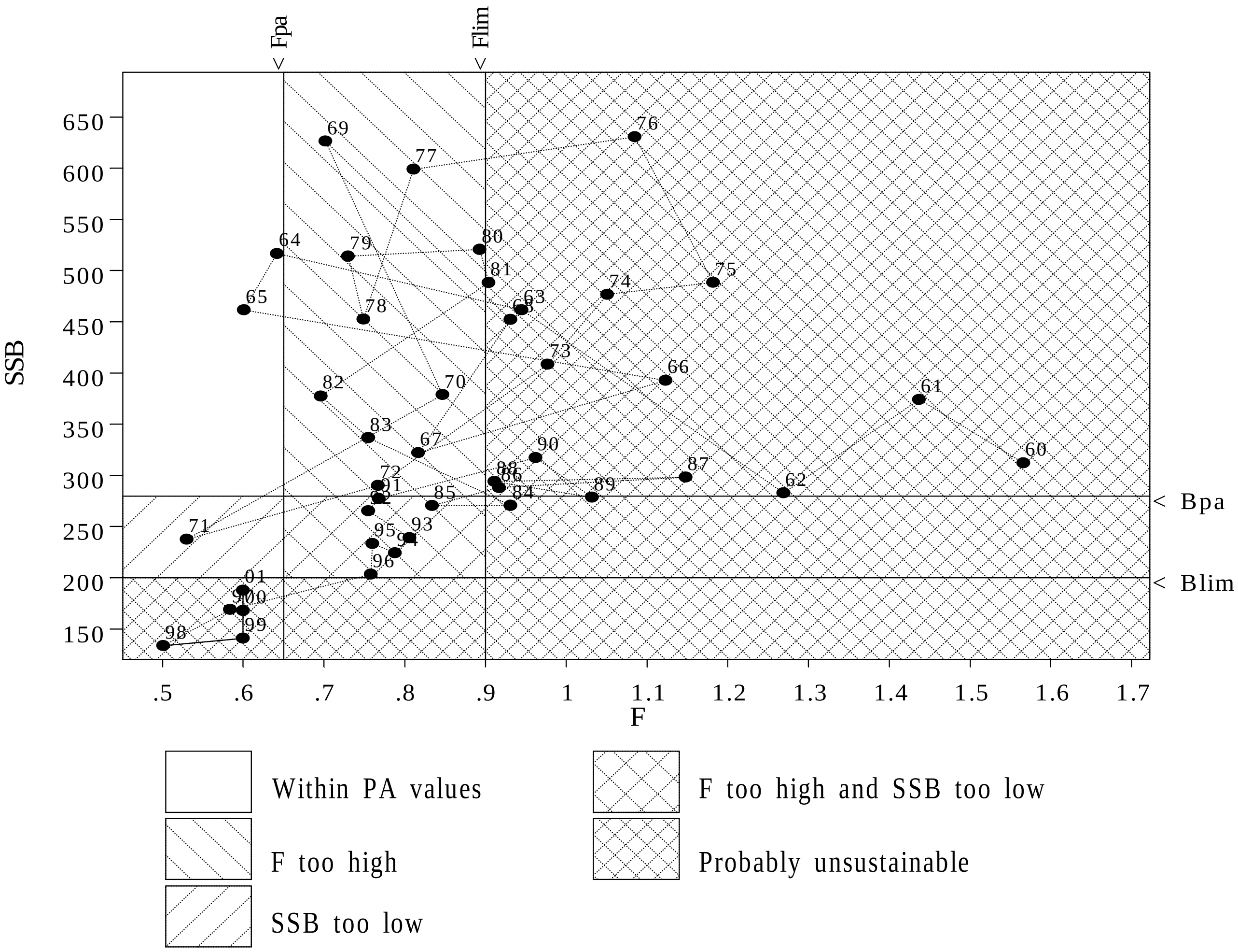


Figure 5.1.9.3 Whiting in IV and VIId



Data file(s):W:\acfm\wgnssk\1999\Personal\PK\whiiv.pa;W:\acfm\wgnssk\1999\Personal\PK\Whiiv.sum
Plotted on 19/10/1999 at 18:18:52

6 SAITHE

6.1 Saithe in Sub-area IV and Division IIIa

6.1.1 The fishery

6.1.1.1 ACFM advice applicable to 1999

ACFM proposed that B_{pa} be set at 150,000 t. This affords a high probability of maintaining SSB above B_{lim} (82,000 t), taking into account the uncertainty of the assessments. Below this value the probability of below average recruitment increases. They also proposed that F_{pa} be set at 0.40. This F is considered to provide approximately 95% probability of avoiding F_{lim} (0.60), taking into account the uncertainty of the assessment.

The stock was considered to be outside safe biological limits. ACFM therefore recommended that the fishing mortality in 1999 should be reduced to the proposed F_{pa} in order to rebuild the SSB above the proposed B_{pa} in the short term. The landings in 1999 corresponding to this reduction were predicted to be 104,000 t.

6.1.1.2 Management applicable to 1998

Management of saithe is by TAC and technical measures. The agreed TAC for saithe in IV and IIIa for 1999 is 110,000 t. The minimum mesh size is 100 mm in IV an 90 mm in Skagerrak.

Minimum landing size is 35 cm in EU waters. In Norwegian waters the minimum landing size is 32 cm in IV, and 30 cm in Skagerrak.

6.1.1.3 The fishery in 1998

Recent nominal landings are given in table 6.1.1.1. Working group estimates are in Table 6.1.1.2 and are plotted in Figure 6.1.1.1. In 1998 the landings are estimated to be 100,000 t. The agreed TAC in 1998 was 97,000 t. Small amounts of saithe are taken as industrial by-catch, but most of the saithe is sorted out and delivered for human consumption. In 1998 a by-catch of about 1000 t was reported.

Saithe is mainly taken in a directed trawl fishery which started in the beginning of the 1970s. The French, German and Norwegian catches made up about 83% of the reported total international catch in 1998.

6.1.2 Natural mortality, maturity, age compositions, mean weight at age

Conventional values of natural mortality rate, and maturity at age based on biological sampling are given in Table 6.1.2.1. They have been assumed to be the same all years. Total international age compositions are given in Table 6.1.2.2. Age compositions and weight at age for 1997 were updated with minor changes. Data for 1998 were supplied by Denmark, Germany, France, Norway, UK (England) and UK (Scotland) amounting to about 97% of the reported landings. Estimates of discards are available only from the Scottish fleet, and they are not representative for the total international catch, and not included in the assessment.

The mean weights at age in the landings are given in Table 6.1.2.3. These are also used as stock mean weights. SOP corrections have been applied. The mean weights for the 5 year olds and older have decreased during the last 20 years.

6.1.3 Catch, effort and research vessel data

The fleets used for tuning the VPA are given in Table 6.1.3.1. The data from the French trawlers starts in 1990 and contains the age groups 2 - 10. The data from the Norwegian trawlers starts in 1980 and contains the age groups 3 - 10.

There have been minor revisions to the data series for the fleets FRATRB and FRATRF, and for the FRATRF the years 1990 and 1991 have been added. This year we also had the data from Scottish light trawl, SCOLTR.

After the drop in effort in the period 1985 to 1990, the effort in recent years seems to have stabilised on half the level of 1985. The Scottish light trawl data start in 1989 and contains ages 2 – 10, the Scottish research vessel indices start in 1982 and contains age 2 and 3, and the English indices start in 1977 containing ages 2 - 8.

6.1.4 Catch-at-age analysis

The method used to tune the VPA was XSA. Preliminary runs were done with all fleets included. Diagnostics and plots of the residuals were inspected. Age 9 in FRATRB, ages 8 and 9 in FRATRF, ages 8 and 9 in NORTRL, ages 2, 3 and 4 in SCOLTR, age 2 in ENGGFS and age 2 in SCOGFS showed very low r^2 and most of them had also high residuals, and they were therefore excluded. Following data were used for the final run:

FRATRB	1990-1998	age 2-8
FRATRF	1990-1998	age 2-7
NORTRL	1989-1998	age 3-7
SCOLTR	1989-1998	age 5-9
ENGGFS	1989-1998	age 3-8
SCOGFS	1989-1998	age 3

Plots of the residuals are shown in Figure 6.1.4.1. The tuning configuration was the same as last year except that for this year it was decided to run the tuning with catchability independent for all ages since there is little information on the ages 1 and 2 and tuning diagnostics indicate no reason for using a power model. Last year catchability was dependent of stock size for age 1 and 2. Catchability was fixed for ages 7 and above as last year. The tuning were run with no taper over ten years. The age range used for VPA was 1 to 10 (the plus group), and F for the oldest ages was shrunk to the mean of the 3 younger ages. The tuning results are given in Table 6.1.4.1, Table 6.1.4.2 gives the values of fishing mortality rates, and Table 6.1.4.3 gives the stock numbers estimated by tuning. This years assessment estimated F in 1997 to be 0.36 compared to last years assessment of 0.51. For age 2 the shrinker and the commersial fleets share the weights, while on the older ages the commersial fleets got most of the weights. (Figure 6.1.4.2).

The results of the retrospective analysis are plotted in Figure 6.1.4.3. The figure shows that we have a tendency to overestimate $F_{3\text{-}6}$, but that the assessment of the spawning stock seems to be in reasonable agreement between the runs.

6.1.5 Recruitment Estimates

No survey data were available. The Group therefore decided to use a geometric mean to estimate recruitment. The XSA estimates the 1996 year class as very poor, but since the only data for this year class come from the French fleets, which don't fish in the shallow area, the Group decided to use a geometric mean for this year class also. All points in the left corner of the stock-recruitment plot are derived from the last decade. The geometric mean at age over the last ten years was therefore used in 1999 for ages 1 (161 million), 2 (140 million) and 3 (105 million). For the year classes 1999 and 2000 the short term GM of 161 millions was used.

6.1.6 Historical stock trends

Table 6.1.6.1 gives a summary of the trends in landings, fishing mortality, biomass and recruitment as estimated by VPA. These data are also plotted in Figure 6.1.1.1.

Mean fishing mortality increased substantially from 1981 to 1986. Since then, it has decreased to a level of about 0.45. Total biomass and spawning biomass show a continuous downwards trend until 1990 when they were on historically low levels. The present assessment shows a slight improvement of the stock up to 1995 and a decrease since then.

6.1.7 Short term forecast

Input data for prediction are given in Table 6.1.7.1. Ages 1, 2 and 3 are GM estimates. The period for calculations of mean exploitation pattern and mean weights is 1996 to 1998, and the fishing pattern were not scaled to F98. Geometric mean are used for the 1999 and the 2000 year classes. Results of the prediction are given in Tables 6.1.7.2.and 6.1.7.3.

Maintenance of the *status quo* of fishing mortality in 1999 is expected to lead to landings of 106,000 t in 1999 and 100,000 t in 2000. Spawning stock size is predicted to decrease from 177,000 t in 1999 to 152,000 t in 2001.

Table 6.1.7.4 shows the contribution of the different year classes in the catch in 2000 and the spawning stock in 2001. 45% of the expected landings in 2000, and 37% of the predicted SSB in 2001 is made up of year classes for which GM recruitment is assumed.

Table 6.1.1.1 Nominal catch (in tonnes) of Saithe in Sub-area IV and Division IIIa, 1987-1998, as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997[1]	1998
Belgium	4	60	13	23	29	70	113	130	228	157	254	249
Denmark	7,928	6,868	6,550	5,800	6,314	4,669	4,232	4,305[1]	4,388	4,705	4,513	3,967
Faroe Islands	691	276	739	1,650	671	2,480	2,875	1,780[1]	3,808	617	158	
France	38,356	28,913	30,761[1,2]	29,892[1,2]	14,795[1,2]	9,061[1]	15,258[1]	18,220[1,2]	11,224[1]	12,336	10,937	11,786
Germany	22,400	18,528	14,339	15,006	19,574	13,177	14,814	10,013	12,093	11,567	12,581	10,117
Netherlands	334	345	257	206	199	180	79	18	9	17	40	7
Norway	66,400	40,021	24,737	19,122	36,240	48,205	47,669	47,042	53,793	55,382	46,484[1]	49,540
Poland	832	1,016	809	1,244	1,336	1,238	937[1]	151	592	365	822	813
Sweden	1,732	2,064	797	838	1,514	3,302	4,955	5,366	1,891	1,771	1,592	1,841
UK (Engl.& Wales)	3,233	3,790	4,012	3,397	4,070	2,893	2,429	2,354	2,522	2,864	2,556	2,293
UK (Scotland)	11,911	10,850	9,190	7,703	8,602	6,881	5,929	5,566	6,341	5,848	6,329	5,353
USSR	-	-	-	-	116[3]	-	-	-	-	-	-	-
Total reported to ICES	153,821	112,731	92,204	84,881	93,460	92,156	99,290	90,337	96,889	95,629	86,316	85,966
Unreported landings	-4,414	-6,132	-172	3,199	5,093	343	5,316	12,256	16,525	14,607	17,006	14,120
Landings as used by WG	149,407	106,599	92,032	88,080	98,553	92,499	104,606	102,593	113,414	110,236	103,322	100,086
TAC	173,000	165,000	170,000	120,000	125,000	110,000	93,000	97,000	107,000	111,000	115,000	97,000

[1]Preliminary.
[2]Includes IIa(EC), IIIa-d(EC).
[3]Includes Estonia.

TABLE 6.1.1.2; Saithe in IV and IIIa
Annual weight and numbers caught, 1967 to 1998.

Year	Wt.('000 t)	Nos.(millions)
1967	78	54
1968	104	62
1969	115	66
1970	222	142
1971	253	176
1972	246	176
1973	226	169
1974	273	165
1975	278	189
1976	320	310
1977	196	121
1978	135	97
1979	114	68
1980	120	72
1981	123	70
1982	166	115
1983	169	112
1984	198	167
1985	200	208
1986	163	157
1987	149	166
1988	107	93
1989	92	75
1990	88	73
1991	99	93
1992	92	71
1993	105	79
1994	102	80
1995	113	75
1996	110	78
1997	103	79
1998	100	76

TABLE 6.1.2.1; Saithe in IV and IIIa
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.200	.000
2	.200	.000
3	.200	.000
4	.200	.150
5	.200	.700
6	.200	.900
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

Table 6.1.2.2 Saithe in IV and IIIA. Catch numbers at age Numbers*10**-3

(run: XSAODD04/X04)

	YEAR	1967	1968
	AGE		
	1	0	172
	2	8494	3783
	3	15277	20788
	4	13335	18944
	5	13597	11987
	6	2035	5402
	7	1141	281
	8	200	116
	9	154	94
	+gp	108	87
0	TOTALI	54342	61654
	TONSL/	78480	104002
	SOPCO	100	100

	YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
	AGE										
	1	36	234	594	379	4416	3947	312	235	2015	1215
	2	1764	2228	10773	20189	31275	16150	71766	31335	12891	16503
	3	28252	34392	68424	40162	47388	61201	50672	199669	22890	30972
	4	13063	74326	53348	62290	32955	31387	23406	50339	52270	24935
	5	9559	13194	30846	23108	24967	12123	9005	9902	13082	16771
	6	7103	11529	3650	20779	15228	20080	6706	5137	4753	2616
	7	5170	3654	3783	3363	7998	13734	12650	3317	3218	849
	8	685	1596	2481	2790	1689	4308	8650	4845	3062	790
	9	547	278	1574	1550	1165	988	3304	3003	3522	607
	+gp	79	144	536	1445	1927	1094	2347	2128	3780	2165
0	TOTALI	66257	141576	176011	176056	169008	165011	188819	309910	121484	97421
	TONSL/	114758	222100	252618	245879	225770	273466	278126	319933	196185	134829
	SOPCO	100	100	100	100	100	100	100	100	100	100

	YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	AGE										
	1	907	1276	5309	1932	270	59	226	89	786	10
	2	16787	23095	18195	28263	32798	34455	7191	6477	29143	5158
	3	14504	14159	22267	27405	23363	75449	129042	48517	28906	26865
	4	13022	11399	6362	38946	17980	29769	52613	82843	90314	22887
	5	10031	8338	6151	7934	25161	12081	11827	11422	12037	32693
	6	7991	6086	3265	5410	4903	12330	3543	3986	1789	2777
	7	2437	5189	2994	1761	4380	1357	2397	1549	1031	1016
	8	577	956	3173	1210	1333	1113	496	987	786	406
	9	349	418	504	846	929	279	295	260	649	446
	+gp	1333	1486	1863	794	819	487	519	555	483	351
0	TOTALI	67938	72402	70083	114502	111936	167379	208147	156685	165925	92608
	TONSL/	114363	120293	122518	165977	168884	198001	199534	162873	149407	106599
	SOPCO	100	100	100	100	100	100	100	100	100	100

	YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	AGE										
	1	3642	296	337	291	145	104	101	332	25	53
	2	9125	4270	11833	5815	7612	6782	2947	7735	11906	2526
	3	14870	35191	42515	16625	35157	16491	25258	9816	13297	9246
	4	25063	15840	26920	30518	18001	38154	24832	37724	17877	29336
	5	10934	10124	6289	11784	10660	12102	13857	11154	28563	15619
	6	9552	3925	2975	2838	2855	3904	3303	7313	3352	15293
	7	1182	2250	1292	1417	1456	831	3272	3011	2510	2091
	8	481	500	717	635	1455	279	585	742	958	1122
	9	262	148	271	464	771	382	488	176	270	535
	+gp	305	205	234	329	943	694	649	375	263	251
0	TOTALI	75415	72747	93385	70715	79054	79722	75292	78377	79022	76070
	TONSL/	92032	88080	98582	92343	105130	102435	113414	110236	103322	100086
	SOPCO	100	100	100	100	100	100	100	100	100	100

Table 6.1.2.3 Saithe in IV and IIIA. Catch weights at age (kg)

(run: XSAODD04/X04)

YEAR	1967	1968
AGE		
1	0	0.501
2	0.679	0.772
3	0.892	1.291
4	1.307	1.652
5	2.077	1.972
6	3.13	3.017
7	3.718	4.069
8	5.288	4.459
9	5.835	6.426
+gp	7.944	7.497
0 SOPCOF/	0.9998	1.0001

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
1	0.451	0.434	0.495	0.304	0.154	0.268	0.198	0.461	0.429	0.353
2	0.578	0.697	0.609	0.51	0.392	0.494	0.494	0.501	0.416	0.52
3	0.962	0.931	0.838	0.743	0.78	0.849	0.887	0.69	0.753	0.781
4	1.608	1.442	1.357	1.158	1.407	1.556	1.497	1.302	1.251	1.294
5	2.263	2.073	2.203	1.897	1.575	2.489	2.478	2.175	1.9	2.12
6	2.699	2.708	3.007	2.364	2.543	2.729	3.275	3.036	3.097	3.21
7	3.569	3.598	3.804	3.869	3.339	3.353	3.684	4.007	4.146	4.466
8	4.335	4.42	4.635	4.184	4.657	4.386	4.19	4.325	4.551	4.784
9	5.157	5.615	5.168	4.543	4.502	5.538	5.481	4.981	4.779	5.309
+gp	6.131	6.659	5.691	6.12	6.046	7.525	7.419	6.768	6.257	6.748
0 SOPCOF/	1.0001	0.9998	1.0001	0.9999	0.9999	1	0.9999	1.0002	1	1.0001

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	0.434	0.253	0.274	0.249	0.418	0.181	0.143	0.518	0.371	0.429
2	0.389	0.411	0.585	0.498	0.455	0.482	0.508	0.525	0.406	0.612
3	1.08	0.905	0.937	1.087	0.982	0.772	0.648	0.669	0.651	0.731
4	1.59	1.812	1.859	1.566	1.701	1.6	1.242	1.005	0.852	0.931
5	2.219	2.37	2.694	2.497	2.118	2.27	1.869	1.67	1.788	1.362
6	3.071	2.975	3.529	3.144	3.058	2.645	2.611	2.269	2.942	2.632
7	3.966	4.047	4.47	3.958	3.533	3.715	3.176	3.543	3.82	3.669
8	5.128	5.044	5.424	4.908	4.432	4.524	4.555	4.24	4.868	4.627
9	5.947	5.812	6.907	5.606	5.336	5.897	5.331	5.754	5.484	5.654
+gp	7.17	7.322	8.349	7.748	6.948	7.72	7.89	7.986	7.038	7.201
0 SOPCOF/	1.0001	1.0001	1	1.0001	1	0.9999	1	0.9999	1.0001	1

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	0.426	0.216	0.441	0.628	0.332	0.28	0.512	0.253	0.422	0.558
2	0.727	0.695	0.524	0.606	0.708	0.683	0.759	0.466	0.421	0.638
3	0.9	0.842	0.776	0.947	0.884	0.898	0.995	0.931	0.864	0.859
4	1.022	1.2	1.149	1.174	1.233	1.106	1.263	1.174	1.12	0.947
5	1.401	1.561	1.742	1.571	1.73	1.572	1.778	1.77	1.439	1.375
6	1.933	2.196	2.361	2.182	2.612	2.38	2.525	2.34	2.555	1.73
7	3.831	3.16	3.129	3.63	3.131	3.537	3.525	2.887	3.525	2.908
8	4.822	4.583	4.076	4.261	3.943	4.649	4.629	4.638	4.492	3.838
9	6.311	6.041	5.887	5.285	5.008	6.566	5.071	5.893	6.124	4.944
+gp	8.454	8.366	7.665	6.282	6.745	8.219	7.579	8.198	8.84	7.054
0 SOPCOF/	0.9999	0.9998	0.9997	0.9999	1	1	1.0002	1.0002	0.9998	0.9999

Table 6.1.3.1 Saithe in IV and IIIA - Tuning data (run: XSAODD04/X04)

106							
FRATRB_IV							
1990	1998						
1	1	0	1				
2	8						
21758	489.433	3379.574	2471.553	1405.54	304.063	290.298	32.728
15248	292.123	1381.383	2538.766	731.379	372.239	130.79	67.67
7902	351.996	717.161	1480.817	498.716	73.572	24.402	7.133
13527	1025.751	3917.8	2253.44	1162.23	103.625	8.299	8.648
14417	434.898	1770.754	3652.84	1381.104	434.086	38.895	5.317
14632	192.925	3151.807	1682.869	921.653	225.695	70.393	24.088
16241	195.815	895.031	4286.247	1053.226	535.95	107.63	24.634
12903	148.823	1087.28	1914.745	3175.192	190.091	83.908	16.535
12864	143.953	802.104	2501.398	1889.642	1512.791	53.6	23.458
FRATRF_IV							
1990	1998						
1	1	0	1				
2	7						
19797	502.155	3675.6	2595.437	1376.791	261.592	250.532	
18369	195.501	1132.7	2486.636	686.242	325.004	104.516	
1868	94.574	187.863	374.475	109.585	15.935	5.412	
8059	470.914	1920.268	1142.401	413.298	23.373	1.717	
8650	209.568	862.832	1664.065	559.652	165.489	14.853	
8844	67.656	1304.89	788.32	493.633	128.358	43.283	
7824	125.861	379.124	1790.438	344.79	128.358	36.854	
6767	112.318	635.062	1147.502	1643.947	128.358	28.562	
10031	125.282	626.69	2113.432	1361.636	128.358	34.816	
NORTRL_IV							
1980	1998						
1	1	0	1				
3	7						
18317	186	1290	658	980	797		
28229	88	844	1345	492	670		
47412	6624	12016	2737	2112	341		
43099	4401	4963	8176	1950	2367		
47803	20576	7328	2207	3358	433		
66607	27088	21401	5307	1569	637		
57468	5297	29612	3589	818	393		
30008	2645	18454	2217	290	235		
18402	3132	2042	2214	141	157		
17781	649	2126	835	694	309		
10249	804	781	924	519	203		
28768	14348	4968	1194	518	203		
35621	3447	9532	4031	1087	465		
24572	7635	4028	2878	1018	526		
30628	3939	16098	4276	926	251		
32489	4347	9366	5412	833	1644		
40400	3790	14429	4414	2765	1144		
36026	2894	5266	9837	1419	892		
24233	1342	8081	5329	5554	963		
SCOLTR_IV							
1989	1998						
1	1	0	1				
5	10						
405883	151.6	274.873	44.551	13.903	1.713	16.228	
387048	275.094	71.48	79.769	17.066	8.506	2.807	
408056	157.26	94.099	49.043	51.421	20.614	7.25	
473955	190.54	35.72	17.135	9.213	14.378	4.074	
447064	228.873	101.915	19.281	18.202	14.669	10.306	
480400	126.529	111.194	41.171	10.664	5.769	6.917	
442010	232.233	91.569	41.332	16.88	4.242	3.169	
445995	108.485	102.956	45.383	22.959	14.433	7.346	
479449	699.584	76.003	56.139	19.752	15.269	7.779	
427868	264.632	340.082	40.548	27.187	8.791	3.494	

Table 6.1.3.1 continued

ENGGFS_IV						
1977	1998					
1	1	0.5	0.75			
3	8					
1	484.91	867.58	52.62	21.41	17.21	13.43
1	57.36	34.98	93.01	6.2	1.45	1.45
1	104.99	160.31	116.69	69.46	84.15	4.79
1	179.6	164.15	91.24	17.96	41.47	13.39
1	119.76	113.16	248.67	0	68.66	73.61
1	2121.1	1921.41	105.19	28.92	5.5	9.1
1	547.22	257.72	312.34	41.38	23.94	24.16
1	4643.56	1284.03	364.63	503.53	39.46	37.64
1	2710.97	758.8	121.19	59.99	68.99	10.92
1	1708.74	695.4	133.5	50.66	17.07	31.3
1	255.12	1710.99	225.02	52.48	19.92	1.63
1	786.6	238.83	251.98	22.67	11.1	4.59
1	178.41	161.07	45.11	52.4	8	3.87
1	872.71	83.54	49.49	21.06	30.29	12.38
1	426.47	97.19	22.13	19.68	4.52	10.19
1	94.23	230.70	42.72	15.92	4.66	10.87
1	1091.48	413.09	83.55	33.27	1.62	9.76
1	123.26	75.18	55.16	49.26	9.43	4.72
1	1366.47	262.19	98.05	33.37	20.76	6.37
1	296.65	691.87	72.65	43.62	17.70	3.11
1	450.00	287.58	452.02	24.02	22.20	8.59
1	53.79	353.76	126.58	123.31	9.31	9.31
SCOGFS_IV						
1982	1997					
1	1	0.5	0.75			
3	3					
1	1370					
1	370					
1	26470					
1	40140					
1	43180					
1	1700					
1	1430					
1	1320					
1	4010					
1	3180					
1	1840					
1	7890					
1	1390					
1	13920					
1	4050					
1	3670					
1	1860					

Table 6.1.4.1 Saithe in IV and IIIA : 1967 - 1998

CPUE data from file saiivef3.dat (Run: XSAODD04/X04)

Catch data for 32 years. 1967 to 1998. Ages 1 to 10.

Fleet	Firs year	Last year	First age	Last age	Alpha	Beta
FRATRB_I	1990	1998	2	8	0	1
FRATRF_I	1990	1998	2	7	0	1
NORTRL_I	1989	1998	3	7	0	1
SCOLTR_I	1989	1998	5	9	0	1
ENGGFS_	1989	1998	3	8	0.5	0.75
SCOGFS_	1989	1998	3	3	0.5	0.75

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 46 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Estimated population abundance at 1st Jan 1999

0.00E+00	3.86E+04	4.01E+04	3.56E+04	3.54E+04	1.80E+04	2.32E+04	2.08E+03	1.72E+03

Taper weighted geometric mean of the VPA populations:

1.99E+05	1.68E+05	1.27E+05	7.52E+04	3.41E+04	1.49E+04	6.76E+03	3.24E+03	1.57E+03

Standard error of the weighted Log(VPA populations) :

0.59	0.5327	0.5181	0.4903	0.5247	0.6825	0.7201	0.7603	0.7971

Log catchability residuals.

Fleet : FRATRB_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	-0.23	-0.01	0.34	1.34	-0.42	-0.45	-0.69	-0.11	0.22
3	99.99	0.39	-0.31	0.01	0.67	0.26	-0.08	-0.65	-0.35	0.06
4	99.99	0.22	0.22	0.16	0.14	0.19	-0.2	-0.47	-0.26	-0.01
5	99.99	0	0.03	0.13	0.09	0.19	-0.52	-0.04	-0.1	0.23
6	99.99	-0.16	0.37	-0.26	-0.42	0.33	-0.33	0.22	-0.14	0.39
7	99.99	0.71	0.76	-0.39	-1.45	-0.07	0.02	0.26	0.1	0.06
8	99.99	-0.45	0.14	-0.92	-1.19	-1.27	0.03	-0.26	-0.56	-0.47
9	No data for this fleet at this age									

Table 6.1.4.1. Continued

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
Mean Log	-15.4439	-13.5331	-12.5105	-12.3597	-12.9289	-13.6335	-13.6335
S.E(Log q)	0.6003	0.4086	0.2527	0.2233	0.3223	0.6555	0.768

Regression statistics :

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	1.44	-0.651	17.08	0.24	9	0.9	-15.44
3	0.94	0.157	13.42	0.49	9	0.41	-13.53
4	1.75	-2.267	13.56	0.56	9	0.36	-12.51
5	1.13	-0.68	12.63	0.8	9	0.26	-12.36
6	0.74	2.164	11.99	0.91	9	0.2	-12.93
7	0.46	1.799	10.88	0.61	9	0.27	-13.63
8	0.62	1.097	11.77	0.55	9	0.31	-14.18

Fleet : FRATRF_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	-0.04	-0.53	0.54	1.15	-0.57	-0.92	-0.34	0.32	0.4
3	99.99	0.67	-0.6	0.22	0.57	0.16	-0.36	-0.68	-0.15	0.17
4	99.99	0.43	0.09	0.3	0.05	-0.02	-0.39	-0.54	-0.06	0.14
5	99.99	0.27	-0.02	0.25	-0.23	-0.01	-0.45	-0.23	0.08	0.35
6	99.99	0.11	0.36	-0.03	-1.07	0.2	-0.07	0.18	-0.2	0.53
7	99.99	0.99	0.68	-0.13	-2.18	-0.19	0.37	0.25	0	0.21
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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
Mean Log	-15.5107	-13.6336	-12.579	-12.5549	-13.2464	-13.9641
S.E(Log q)	0.6565	0.4818	0.3073	0.2668	0.4586	0.9005

Regression statistics :
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	1.76	-0.858	18.38	0.15	9	1.17	-15.51
3	1.33	-0.523	14.31	0.27	9	0.67	-13.63
4	2.23	-2.495	14.38	0.37	9	0.53	-12.58
5	0.98	0.098	12.51	0.78	9	0.28	-12.55
6	0.67	2.086	11.96	0.85	9	0.26	-13.25
7	0.35	2.211	10.44	0.62	9	0.26	-13.96

Fleet : NORTRL_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	No data for this fleet at this age									
3	-0.61	-0.34	1.34	0.02	0.69	0.26	-0.61	-0.18	-0.46	-0.11
4	-0.36	-0.41	0.03	0.28	-0.11	0.69	0.48	-0.4	-0.51	0.3
5	-0.68	0.02	-0.42	0.41	0.09	0.26	0.14	0.17	-0.31	0.32
6	-0.44	0.43	-0.64	0.23	0.57	-0.36	-0.52	0.24	0.14	0.35
7	-0.04	-0.41	-0.95	-0.47	0.58	-0.47	0.85	0.19	-0.08	0.8
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Table 6.1.4.1 continued

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7
Mean Log	-13.4792	-12.2774	-12.0503	-12.2278	-12.1151
S.E(Log q)	0.6178	0.4219	0.3537	0.4441	0.602

Regression statistics :

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
3	0.78	0.532	13.04	0.41	10	0.5	-13.48
4	0.9	0.272	12.16	0.48	10	0.4	-12.28
5	1	-0.007	12.05	0.63	10	0.38	-12.05
6	1.02	-0.063	12.28	0.6	10	0.48	-12.23
7	0.84	0.263	11.55	0.26	10	0.54	-12.12

Fleet : SCOLTR_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	-0.04	0.65	0.36	0.23	0.12	-0.55	-0.15	-0.47	-0.07	-0.08
6	0.68	0	0.18	-0.6	0.55	-0.06	-0.16	-0.27	-0.19	-0.13
7	0.27	0.39	0.34	-0.99	-0.26	0.33	-0.07	-0.07	-0.06	0.12
8	0.25	-0.13	0.43	-0.91	-0.09	-0.23	0.12	0.21	-0.15	0.02
9	-0.8	0.38	0.44	-0.57	0.39	-0.39	-0.31	0.5	0.31	-0.08

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	5	6	7	8	9
Mean Log	-17.5178	-17.4073	-17.4826	-17.4826	-17.4826
S.E(Log q)	0.3618	0.3815	0.4125	0.3715	0.4785

Regression statistics :

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
5	1.33	-0.941	19.88	0.51	10	0.48	-17.52
6	0.97	0.126	17.17	0.69	10	0.39	-17.41
7	1.06	-0.111	18	0.32	10	0.46	-17.48
8	0.91	0.263	16.65	0.51	10	0.35	-17.53
9	0.89	0.303	16.38	0.5	10	0.45	-17.5
1							

Table 6.1.4.1 continued

Fleet : ENGGFS_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	No data for this fleet at this age									
3	-0.03	1.08	0.19	-1.03	0.93	-0.81	0.67	-0.07	0.23	-1.17
4	-0.03	-0.3	-0.51	0.16	0.8	-1.24	0.41	0.22	0.13	0.36
5	-0.26	-0.12	-0.62	-0.06	0.19	-0.22	0.05	0.22	0.61	0.21
6	0.12	-0.22	-0.35	-0.2	0.58	0.32	-0.07	0.04	-0.14	-0.06
7	-0.13	0.71	-0.7	-0.81	-1.25	0.35	0.74	0.47	0.53	0.08
8	0.32	0.81	0.12	0.73	0.8	0.43	0.57	-0.35	0.54	0.34
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8
Mean Log	-5.4849	-5.2519	-5.4581	-5.4228	-5.813	-5.813
S.E(Log q)	0.792	0.5683	0.3351	0.2782	0.7011	0.5752

Regression statistics :

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
3	0.41	2.829	9.01	0.74	10	0.25	-5.48
4	1.04	-0.074	5	0.28	10	0.63	-5.25
5	0.62	4.25	7.26	0.94	10	0.12	-5.46
6	1.02	-0.126	5.33	0.79	10	0.3	-5.42
7	0.4	2.329	7.43	0.65	10	0.23	-5.81
8	1.02	-0.057	5.33	0.47	10	0.38	-5.38

Fleet : SCOGFS_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	No data for this fleet at this age									
3	-0.38	0.25	-0.15	-0.4	0.56	-0.74	0.65	0.2	-0.02	0.03
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3
Mean Log	-3.1365
S.E(Log q)	0.4357

Regression statistics :

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
3	0.59	2.288	6.56	0.8	10	0.21	-3.14

Table 6.1.4.1 continued

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age
Year class = 1997

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_I	1	0	0	0	0	0	0
FRATRF_I	1	0	0	0	0	0	0
NORTRL_I	1	0	0	0	0	0	0
SCOLTR_I	1	0	0	0	0	0	0
ENGGFS_	1	0	0	0	0	0	0
SCOGFS_	1	0	0	0	0	0	0
F shrinka	38592	0.5				1	0.001

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
38592	0.5	0	1	0	0.001

Age 2 Catchability constant w.r.t. time and dependent on age
Year class = 1996

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_I	50049	0.633	0	0	1	0.283	0.045
FRATRF_I	59722	0.692	0	0	1	0.237	0.038
NORTRL_I	1	0	0	0	0	0	0
SCOLTR_I	1	0	0	0	0	0	0
ENGGFS_	1	0	0	0	0	0	0
SCOGFS_	1	0	0	0	0	0	0
F shrinka	28952	0.5				0.48	0.076

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
40137	0.34	0.31	3	0.91	0.055

Age 3 Catchability constant w.r.t. time and dependent on age
Year class = 1995

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_I	36226	0.357	0.077	0.22	2	0.28	0.208
FRATRF_I	44192	0.411	0.072	0.18	2	0.211	0.173
NORTRL_I	31989	0.648	0	0	1	0.089	0.232
SCOLTR_I	1	0	0	0	0	0	0
ENGGFS_	11110	0.831	0	0	1	0.054	0.561
SCOGFS_	36689	0.457	0	0	1	0.18	0.205
F shrinka	39140	0.5				0.185	0.194

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
35620	0.2	0.11	8	0.579	0.211

Table 6.1.4.1 continued

Age 4 Catchability constant w.r.t. time and dependent on age
Year class = 1994

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_I	29751	0.23	0.168	0.73	3	0.325	0.638
FRATRF_I	36188	0.255	0.124	0.49	3	0.266	0.55
NORTRL_I	38519	0.366	0.342	0.93	2	0.131	0.524
SCOLTR_I	1	0	0	0	0	0	0
ENGGFS_	48749	0.485	0.06	0.12	2	0.074	0.435
SCOGFS_	34710	0.457	0	0	1	0.076	0.568
F shrinka	40918	0.5				0.128	0.5

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
35443	0.14	0.08	12	0.551	0.559

Age 5 Catchability constant w.r.t. time and dependent on age
Year class = 1993

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_I	16282	0.186	0.191	1.03	4	0.278	0.625
FRATRF_I	18514	0.198	0.234	1.18	4	0.251	0.567
NORTRL_I	18358	0.265	0.265	1	3	0.144	0.571
SCOLTR_I	16556	0.379	0	0	1	0.081	0.617
ENGGFS_	21344	0.289	0.054	0.19	3	0.128	0.508
SCOGFS_	21952	0.457	0	0	1	0.035	0.497
F shrinka	17092	0.5				0.083	0.603

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
17995	0.1	0.08	17	0.764	0.58

Age 6 Catchability constant w.r.t. time and dependent on age
Year class = 1992

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_I	22814	0.171	0.167	0.98	5	0.261	0.474
FRATRF_I	22431	0.189	0.203	1.07	5	0.197	0.481
NORTRL_I	20838	0.24	0.207	0.86	4	0.137	0.509
SCOLTR_I	20774	0.282	0.029	0.1	2	0.117	0.51
ENGGFS_	27455	0.215	0.179	0.83	4	0.198	0.408
SCOGFS_	44178	0.457	0	0	1	0.021	0.272
F shrinka	20243	0.5				0.07	0.521

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
23167	0.09	0.07	22	0.802	0.468

Table 6.1.4.1 continued

Age 7 Catchability constant w.r.t. time and dependent on age
Year class = 1991

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	!	s.e	s.e	Ratio		Weights	F
FRATRB_I	1998	0.193	0.104	0.54	6	0.215	0.666
FRATRF_I	1809	0.217	0.123	0.57	6	0.148	0.716
NORTRL_I	3030	0.261	0.143	0.55	5	0.138	0.485
SCOLTR_I	1896	0.256	0.161	0.63	3	0.18	0.692
ENGGFS_	2038	0.223	0.099	0.44	5	0.188	0.657
SCOGFS_	995	0.457	0	0	1	0.009	1.065
F shrinkage mean							
	2178	0.5				0.122	0.625

Weighted prediction :

Survivors at end of y	Int	Ext	N	Var	F
2081	s.e	s.e		Ratio	
	0.11	0.06	27	0.515	0.647

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7
Year class = 1990

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
FRATRB_I	!	s.e	s.e	Ratio		Weights	F
FRATRF_I	1613	0.214	0.149	0.7	7	0.186	0.488
NORTRL_I	1582	0.217	0.141	0.65	6	0.108	0.496
SCOLTR_I	2040	0.265	0.117	0.44	5	0.101	0.404
ENGGFS_	1620	0.237	0.059	0.25	4	0.273	0.487
SCOGFS_	2032	0.242	0.137	0.57	6	0.19	0.405
	3010	0.457	0	0	1	0.006	0.291
F shrinkage mean							
	1534	0.5				0.135	0.508

Weighted prediction :

Survivors at end of y	Int	Ext	N	Var	F
1719	s.e	s.e		Ratio	
	0.12	0.05	30	0.439	0.464

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7
Year class = 1989

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
FRATRB_I	!	s.e	s.e	Ratio		Weights	F
FRATRF_I	503	0.203	0.123	0.61	7	0.152	0.674
NORTRL_I	567	0.205	0.061	0.3	6	0.089	0.617
SCOLTR_I	526	0.248	0.167	0.67	5	0.079	0.652
ENGGFS_	488	0.233	0.056	0.24	5	0.315	0.689
SCOGFS_	658	0.236	0.16	0.68	6	0.152	0.551
	375	0.457	0	0	1	0.007	0.829
F shrinkage mean							
	691	0.5				0.206	0.531

Weighted prediction :

Survivors at end of y	Int	Ext	N	Var	F
561	s.e	s.e		Ratio	
	0.14	0.05	31	0.358	0.622

Table 6.1.4.2 Saithe in IV and IIIA. Fishing mortality (F) at age

(run XSAODD04/X04)

YEAR	1967	1968
AGE		
1	0	0.0005
2	0.0793	0.012
3	0.1619	0.2834
4	0.2433	0.3096
5	0.3822	0.3602
6	0.5186	0.2561
7	0.3789	0.1216
8	0.2123	0.0589
9	0.3724	0.1461
+gp	0.3724	0.1461
FBAR 3- 6	0.3265	0.3023

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
1	0.0001	0.0011	0.0029	0.0017	0.0182	0.0068	0.0017	0.0019	0.0176	0.0129
2	0.006	0.0065	0.0645	0.1282	0.1935	0.0856	0.1638	0.241	0.1326	0.1953
3	0.1162	0.1538	0.2804	0.3614	0.498	0.7142	0.4192	0.9286	0.2786	0.5378
4	0.2897	0.5043	0.3783	0.4461	0.5732	0.7384	0.6674	0.9993	0.6724	0.5577
5	0.2531	0.5353	0.4041	0.2788	0.3219	0.4273	0.4826	0.6742	0.787	0.4713
6	0.3766	0.5522	0.2735	0.5271	0.2995	0.4669	0.4466	0.566	0.8308	0.3457
7	0.4172	0.3387	0.3502	0.4369	0.3949	0.4855	0.6122	0.4157	0.8734	0.3319
8	0.4872	0.2172	0.407	0.4744	0.4094	0.3835	0.6554	0.5026	0.8698	0.5417
9	0.43	0.3718	0.3457	0.4831	0.3703	0.4486	0.5762	0.4986	0.8671	0.4092
+gp	0.43	0.3718	0.3457	0.4831	0.3703	0.4486	0.5762	0.4986	0.8671	0.4092
FBAR 3- 6	0.2589	0.4364	0.3341	0.4033	0.4231	0.5867	0.5039	0.792	0.6422	0.4781

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	0.0037	0.0087	0.031	0.0067	0.0006	0.0002	0.0016	0.0005	0.0088	0.0001
2	0.2472	0.1239	0.1646	0.2295	0.1501	0.1023	0.0243	0.0577	0.2397	0.0735
3	0.2634	0.3409	0.1688	0.3992	0.3017	0.6072	0.6786	0.2262	0.3915	0.3638
4	0.4553	0.3414	0.2522	0.4991	0.4996	0.794	1.2428	1.4335	0.8603	0.6226
5	0.4571	0.5996	0.3122	0.5744	0.7149	0.7589	0.8873	1.0605	0.8363	0.924
6	0.4314	0.5611	0.499	0.5004	0.8813	0.9806	0.5224	0.8867	0.448	0.4596
7	0.6348	0.5583	0.6018	0.5554	1.0276	0.6501	0.5034	0.4564	0.5993	0.4978
8	0.3959	0.5527	0.8171	0.5234	1.1608	0.8136	0.525	0.3992	0.4438	0.5018
9	0.4911	0.562	0.6451	0.5307	1.035	0.8231	0.521	0.5857	0.5009	0.4902
+gp	0.4911	0.562	0.6451	0.5307	1.035	0.8231	0.521	0.5857	0.5009	0.4902
FBAR 3- 6	0.4018	0.4607	0.3081	0.4933	0.5994	0.7852	0.8328	0.9017	0.634	0.5925

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98
AGE											
1	0.0203	0.0023	0.0017	0.0023	0.0005	0.0008	0.0007	0.0038	0.0004	0.0012	0.0018
2	0.0741	0.0298	0.1202	0.0361	0.0756	0.029	0.0281	0.0633	0.1828	0.0554	0.1005
3	0.3127	0.4498	0.4586	0.2475	0.3166	0.233	0.1439	0.1233	0.1475	0.211	0.1606
4	0.6931	0.6494	0.7566	0.7136	0.4643	0.6805	0.6589	0.3317	0.3452	0.559	0.412
5	0.7011	0.6799	0.586	0.9283	0.5875	0.6639	0.5665	0.7168	0.4522	0.5796	0.5829
6	0.7812	0.5896	0.4301	0.5782	0.6029	0.4426	0.3772	0.6758	0.4855	0.4683	0.5432
7	0.3614	0.4165	0.3902	0.3748	0.6745	0.3485	0.844	0.7134	0.5189	0.6466	0.6263
8	0.467	0.2548	0.2246	0.3374	0.8446	0.2552	0.4441	0.4573	0.5186	0.464	0.48
9	0.721	0.2534	0.213	0.2219	0.905	0.5545	0.9707	0.2294	0.2985	0.6221	0.3833
+gp	0.721	0.2534	0.213	0.2219	0.905	0.5545	0.9707	0.2294	0.2985	0.6221	
FBAR 3- 6	0.622	0.5922	0.5578	0.6169	0.4928	0.505	0.4366	0.4619	0.3576	0.4545	

Table 6.1.4.3 Saithe in IV and IIIA. Stock number at age (start of year) Numbers*10**-3

(run XSAODD04/X04)

YEAR	1967	1968
AGE		
1	429606	400315
2	123084	351731
3	112928	93087
4	68239	78634
5	47304	43803
6	5558	26427
7	3997	2709
8	1158	2241
9	548	767
+gp	381	705
TOTAL	792803	1000418

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
1	464409	233135	227095	240332	270657	645459	197848	140425	127784	104816
2	327595	380193	190663	185392	196424	217600	524886	161702	114757	102797
3	284550	266616	309260	146353	133518	132520	163543	364804	104038	82291
4	57403	207406	187167	191288	83484	66437	53121	88047	118008	64467
5	47239	35178	102557	104968	100251	38532	25994	22313	26538	49321
6	25016	30027	16862	56056	65031	59487	20578	13135	9309	9891
7	16748	14055	14152	10503	27093	39464	30535	10780	6106	3320
8	1964	9035	8201	8164	5555	14945	19884	13553	5824	2087
9	1729	988	5953	4470	4159	3020	8338	8453	6713	1998
+gp	248	510	2011	4127	6827	3315	5857	5930	7091	7063
TOTAL	1226902	1177142	1063922	951653	893000	1220780	1050584	829141	526168	428051

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	268478	163235	191939	319729	478632	404976	156098	184675	99129	172487
2	84717	218991	132491	152342	260024	391627	331513	127598	151119	80448
3	69231	54171	158397	92011	99154	183212	289460	264913	98608	97356
4	39350	43558	31540	109537	50535	60040	81732	120228	172993	54578
5	30219	20434	25348	20066	54441	25106	22221	19311	23475	59915
6	25205	15664	9185	15187	9250	21806	9623	7492	5475	8328
7	5731	13406	7318	4566	7539	3137	6697	4673	2527	2864
8	1951	2487	6280	3282	2145	2209	1341	3314	2424	1136
9	994	1075	1172	2271	1592	550	802	649	1820	1273
+gp	3758	3778	4279	2110	1379	945	1397	1367	1340	991
TOTAL	529633	536798	567948	721102	964691	1093608	900884	734220	558910	479376

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 67-96	GMST 87-96
AGE													
1	200350	141308	221825	141409	320035	143608	170430	96584	63314	47193	**0***	216390	**160703**
2	141211	160737	115426	181310	115513	261891	117482	139445	78776	51814	**38592***	178866	**139851**
3	61199	107358	127737	83795	143182	87686	208282	93519	107169	53724	**40137***	131956	**105142**
4	55400	36650	56055	66113	53563	85417	56869	147673	67685	75711	35620	75495	69761
5	23976	22680	15674	21536	26515	27566	35410	24092	86770	39240	35443	32881	26344
6	19472	9737	9408	7142	6969	12063	11619	16453	9632	45197	17995	14538	9931
7	4306	7299	4421	5010	3280	3122	6344	6524	6853	4853	23167	6834	4295
8	1425	2456	3940	2450	2820	1368	1804	2233	2617	3340	2081	3263	2070
9	563	732	1559	2577	1432	992	868	947	1158	1276	1719	1599	1162
+gp	647	1006	1340	1816	1721	1783	1134	2010	1121	591	821		
TOTAL	508549	489963	557385	513159	675029	625496	610243	529481	425096	322939	195574		

Table 6.1.6.1 Saithe in IV and IIIA. Summary (without SOP correction)

(run: XSAODD04/X04)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1967	429606	416347	125016	78480	0.6278	0.3265
1968	400315	919504	182930	104002	0.5685	0.3023
1969	464409	1017987	228171	114758	0.5029	0.2589
1970	233135	1167156	268536	222100	0.8271	0.4364
1971	227095	1152369	375945	252618	0.672	0.3341
1972	240332	949860	412235	245879	0.5965	0.4033
1973	270657	839890	453318	225770	0.498	0.4231
1974	645459	994156	468293	273466	0.584	0.5867
1975	197848	939815	402628	278126	0.6908	0.5039
1976	140425	784560	271108	319933	1.1801	0.792
1977	127784	536046	211653	196185	0.9269	0.6422
1978	104816	457535	197361	134829	0.6832	0.4781
1979	268478	496860	191578	114363	0.597	0.4018
1980	163235	454992	188388	120293	0.6385	0.4607
1981	191939	548445	196364	122518	0.6239	0.3081
1982	319729	588145	167039	165977	0.9936	0.4933
1983	478632	699516	173282	168884	0.9746	0.5994
1984	404976	646422	138397	198001	1.4307	0.7852
1985	156098	589141	109583	199534	1.8208	0.8328
1986	184675	555220	101264	162873	1.6084	0.9017
1987	99129	408664	106856	149407	1.3982	0.634
1988	172487	378834	114572	106599	0.9304	0.5925
1989	200350	403333	98277	92032	0.9365	0.622
1990	141308	380553	97781	88080	0.9008	0.5922
1991	221825	420697	98106	98582	1.0049	0.5578
1992	141409	458724	103009	92343	0.8965	0.6169
1993	320035	484892	98566	105130	1.0666	0.4928
1994	143608	502908	108913	102435	0.9405	0.505
1995	170430	591505	124961	113414	0.9076	0.4366
1996	96584	482246	141757	110236	0.7776	0.4619
1997	160703*	430670	173837	103322	0.5944	0.3576
1998	160703*	346790	156301	100086	0.6403	0.4545
1999	160703*	460000	177000			
Arith. Mean	233354	626368	196438	155008	0.8762	0.5186
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

* Replaced by geometric mean (1987-1996) at age 1, 2 and 3 in 1999

Table_6.1.7.1.Saithe in IV and IIIA (run: MANODD03)
Input data for catch forecast and linear sensitivity analysis.
Age 1, 2 and 3 GM(87-96), F unscaled (96-98), weights (96-98)

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	160701	.36	WS1	.41	.37	M1	.20	.10	MT1	.00	.00
N2	139850	.32	WS2	.51	.23	M2	.20	.10	MT2	.00	.00
N3	105141	.33	WS3	.88	.05	M3	.20	.10	MT3	.00	.10
N4	35620	.20	WS4	1.08	.11	M4	.20	.10	MT4	.15	.10
N5	35442	.14	WS5	1.53	.14	M5	.20	.10	MT5	.70	.10
N6	17993	.10	WS6	2.21	.19	M6	.20	.10	MT6	.90	.10
N7	23166	.09	WS7	3.11	.12	M7	.20	.10	MT7	1.00	.10
N8	2080	.11	WS8	4.32	.10	M8	.20	.10	MT8	1.00	.00
N9	1719	.12	WS9	5.65	.11	M9	.20	.10	MT9	1.00	.00
N10	821	.14	WS10	8.03	.11	M10	.20	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.94	WH1	.41	.37
sH2	.10	.86	WH2	.51	.23
sH3	.16	.27	WH3	.88	.05
sH4	.41	.26	WH4	1.08	.11
sH5	.58	.12	WH5	1.53	.14
sH6	.54	.18	WH6	2.21	.19
sH7	.63	.04	WH7	3.11	.12
sH8	.48	.22	WH8	4.32	.10
sH9	.38	.49	WH9	5.65	.11
sH10	.38	.49	WH10	8.03	.11

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.14
K00	1.00	.10	HF00	1.00	.14
K01	1.00	.10	HF01	1.00	.14

Recruitment		
Labl	Value	CV
R00	160701	.36
R01	160701	.36

Proportion F before spawning= .00
Proportion M before spawning= .00

Stock numbers in 1999 are VPA survivors.
These are overwritten at Age 2 Age 3

Table_<u>6.1.7.2</u>.Saithe in IV and IIIA (run: MANODD03)
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 1999	2000						
Mean F Ages								
H.cons 3 to 6	.42	.00	.08	.17	.25	.34	.42	.51
Effort relative to 1998								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Biomass at start of year								
Total	460	457	457	457	457	457	457	457
Spawning	177	153	153	153	153	153	153	153
Catch weight (,000t)								
H.cons	106	0	23	45	65	83	100	115
Biomass at start of 2001								
Total		581	552	525	500	478	457	438
Spawning		244	222	202	183	167	152	139

	Year 1999	2000						
Effort relative to 1998								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.12	.14	.14	.14	.14	.14	.14	.14
Spawning	.10	.12	.12	.12	.12	.12	.12	.12
Catch weight								
H.cons	.16	.00	.69	.35	.25	.20	.18	.17
Biomass at start of 2001								
Total		.13	.14	.14	.15	.15	.15	.16
Spawning		.14	.15	.16	.16	.16	.17	.17

Table 6.1.7.3.Saithe in IV and IIIA (run: MANODD03)
Detailed forecast tables.

Forecast for year 1999
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	160702	291	291
2	139851	12082	12082
3	105142	14209	14209
4	35620	10976	10976
5	35442	14328	14328
6	17994	6895	6895
7	23167	9871	9871
8	2080	724	724
9	1719	499	499
10	821	238	238
Wt	460	106	106

Forecast for year 2000
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	160702	291	291
2	131309	11344	11344
3	103604	14001	14001
4	73282	22582	22582
5	19315	7809	7809
6	16198	6207	6207
7	8559	3647	3647
8	10142	3532	3532
9	1054	306	306
10	1418	412	412
Wt	457	100	100

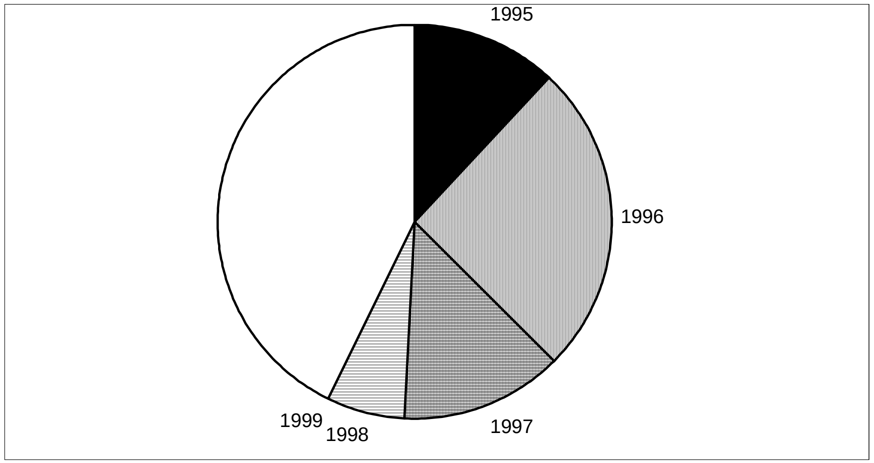
Table 6.1.7.4 **Saithe in IV and IIIa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	1995	1996	1997	1998	1999
Stock No. (thousands) of 1 year-olds	96584	160703	160703	160703	160703
Source	VPA	GM age 3	GM age 2	GM age 1	GM age 1
Status Quo F:					
% in 1999 landings	11.4	13.3	6.5	0.1	-
% in 2000	12.0	25.5	13.5	6.2	0.1
% in 1999 SSB	3.3	0.0	0.0	0.0	-
% in 2000 SSB	13.6	7.8	0.0	0.0	0.0
% in 2001 SSB	12.1	29.2	8.0	0.0	0.0

GM : geometric mean recruitment (1987 -1996)

Saithe in IV and IIIa : Year-class % contribution to

a) 2000 landings



b) 2001 SSB

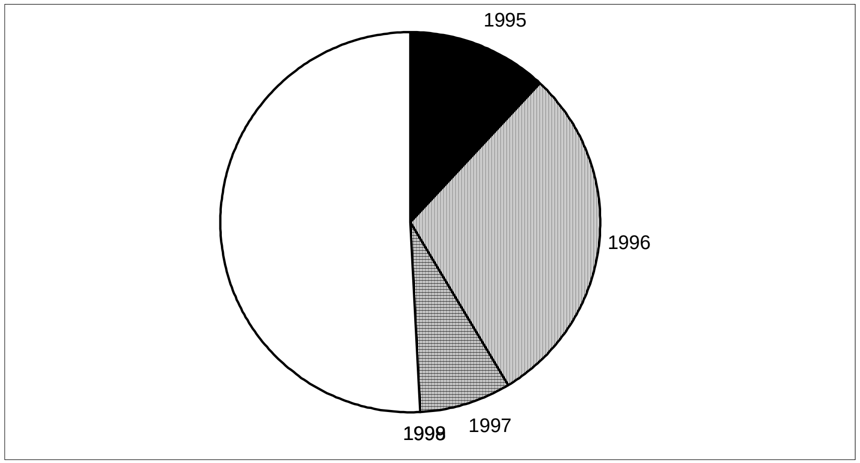


Figure 6.1.1.1 Saithe in IV and IIIA

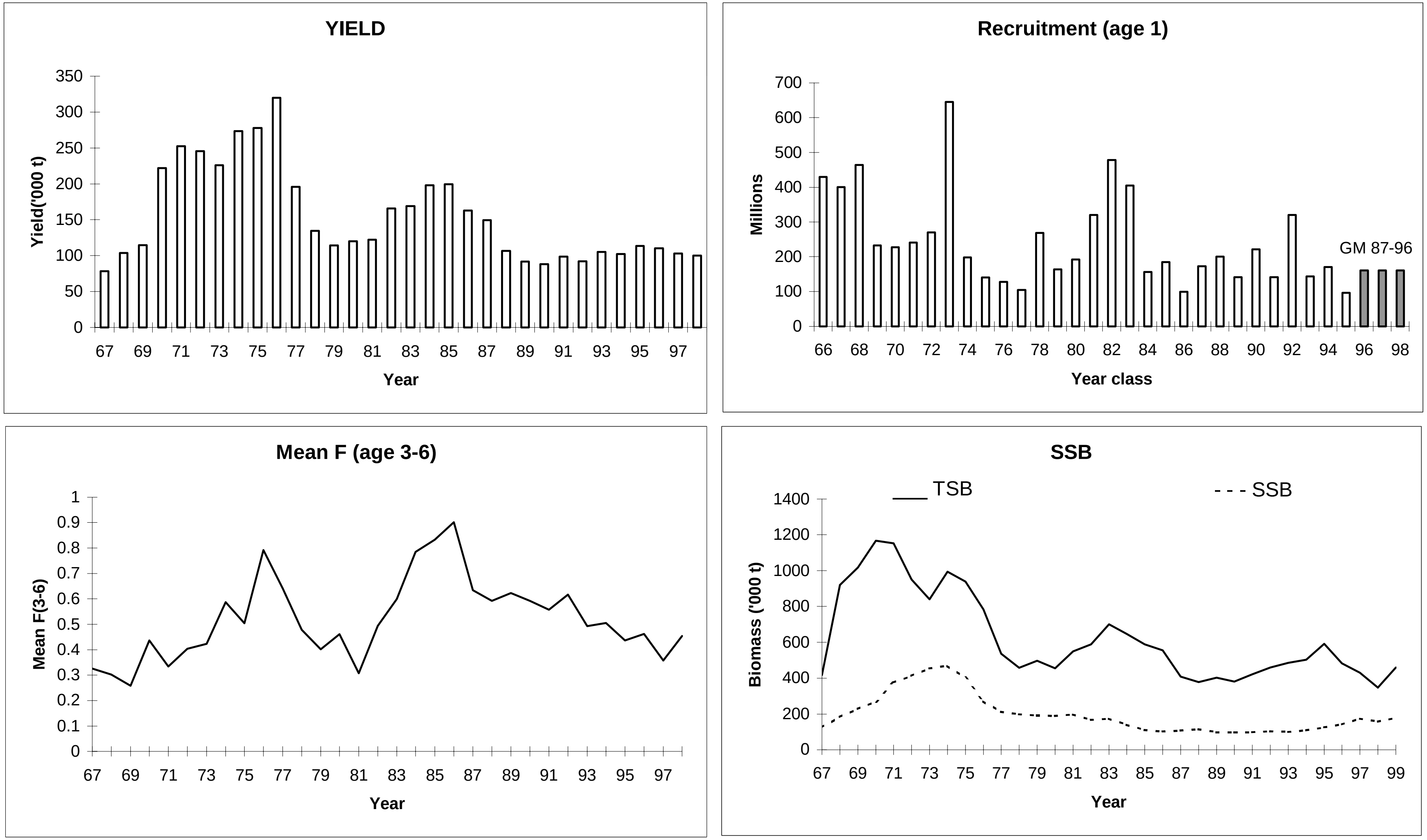


Figure 6.1.4.1 Saithe in IV and IIIA. Q residuals by fleet.

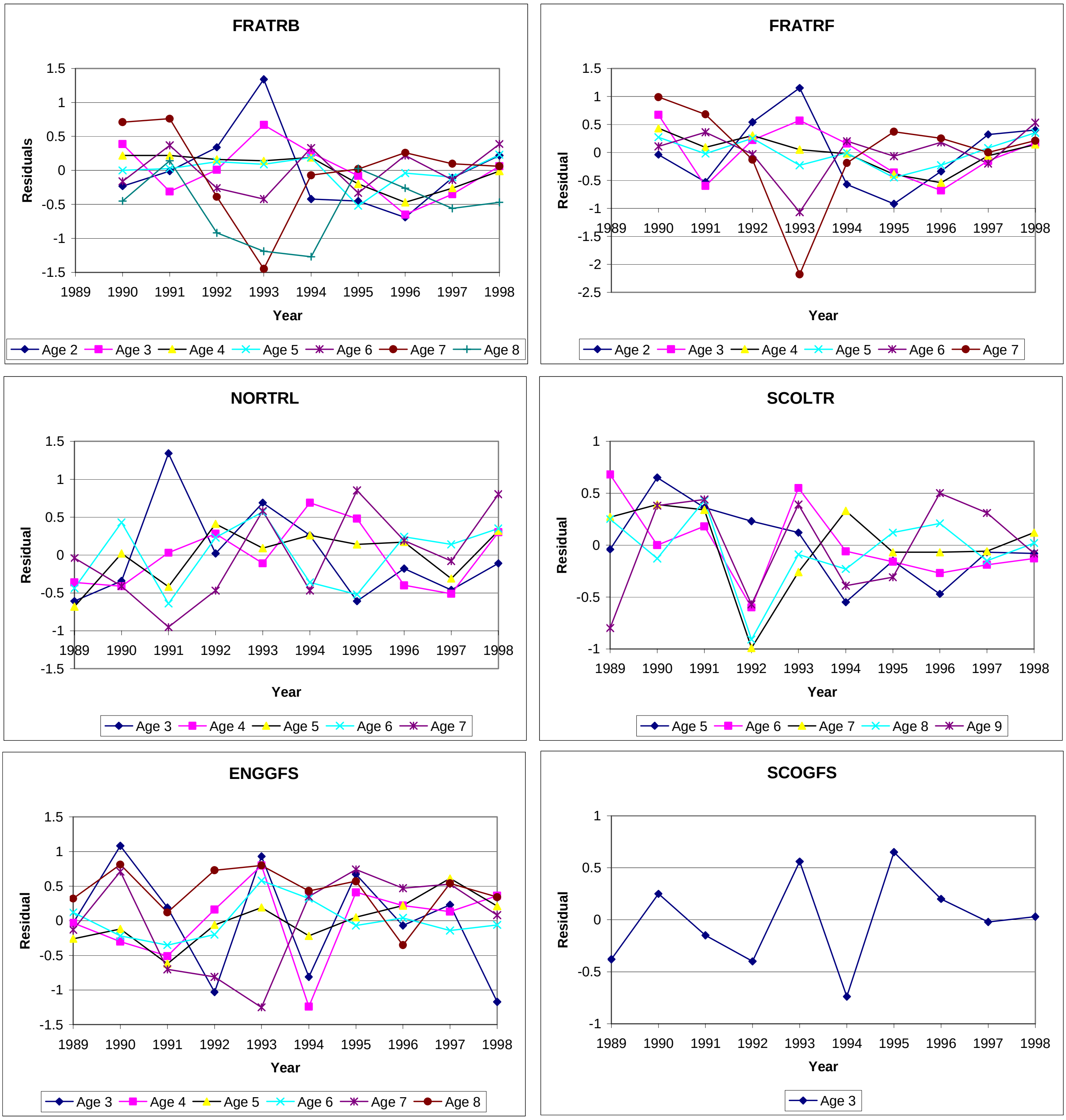


Figure 6.1.4.2. Saithe in IV and IIIA - Contribution of Commercial fleets, survey indices and shrinkage to tuned XSA

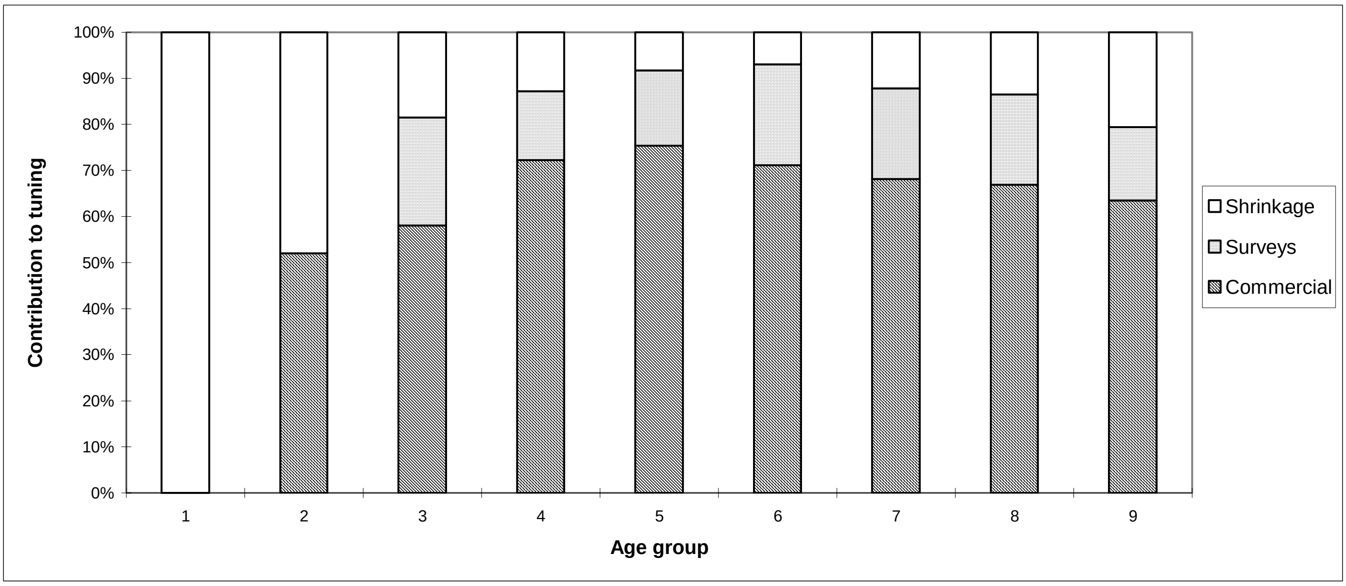
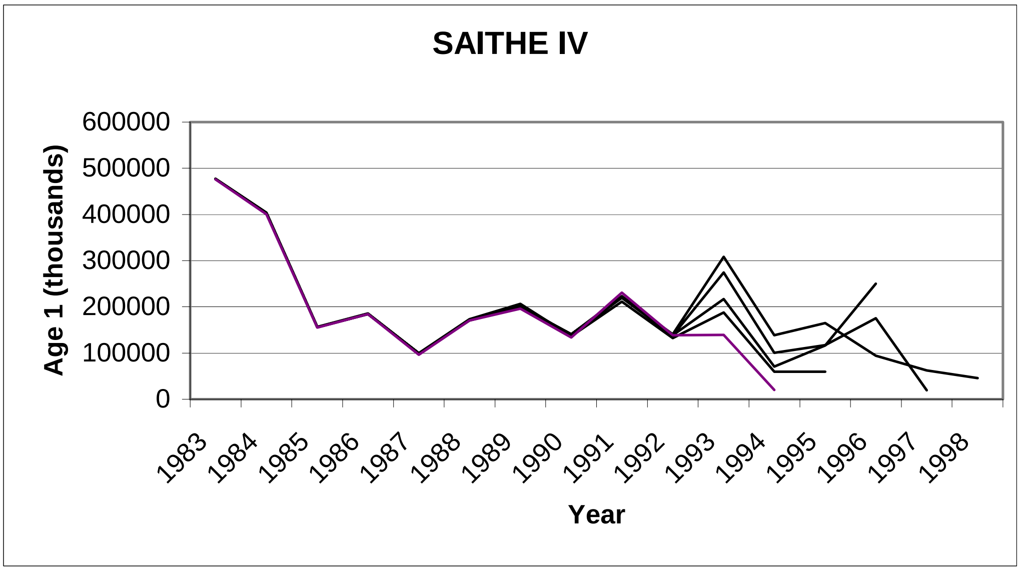
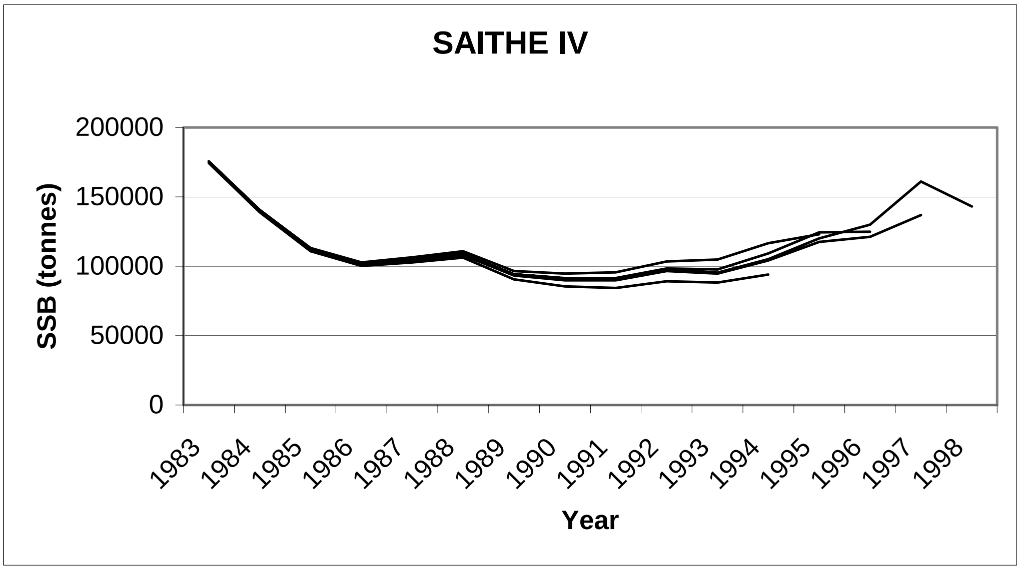
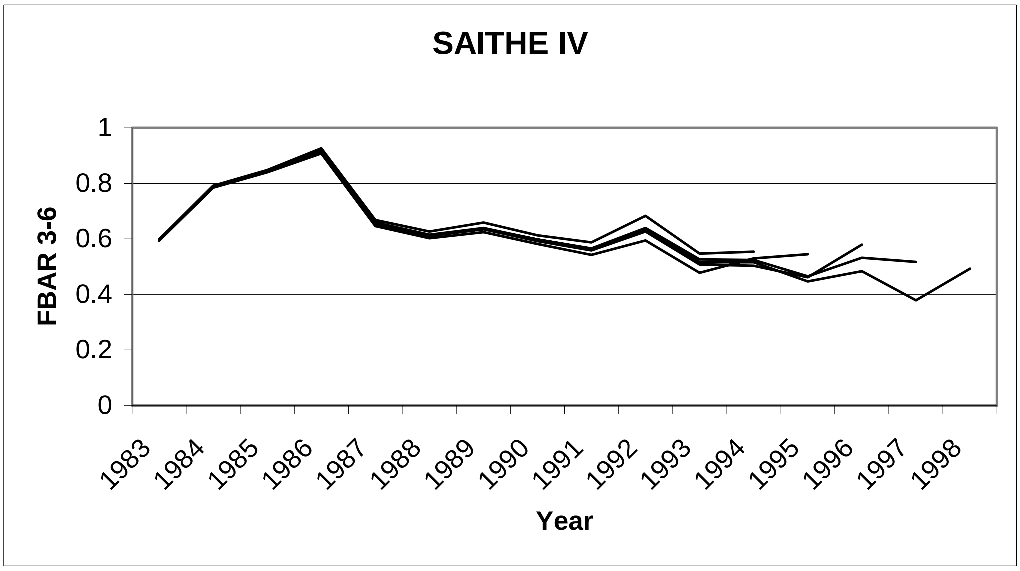


Figure 6.1.4.3 Saithe in IV and IIIA. Retrospective analysis with final run.
F shrinkage: 0.5







6.2 SAITHE IN SUB-AREA VI (West of Scotland and Rockall)

6.2.1 The fishery

6.2.1.1 ACFM advice applicable to 1999

The stock was considered to be outside safe biological limits. The fishing mortality in 1997 was about twice the proposed Fpa (0.25). ACFM therefore, recommended that the fishing mortality should be reduced by 60% compared to F1995-1997 ($F_{95\text{-}97}$= 0.48) in order to have a high probability to rebuilt the spawning stock biomass above the proposed Bpa (35,000 t) in the medium term. The landings in 1999 corresponding to this advice were 4,800 t.

B_{lim} = 11,000 t F_{lim} = 0.51

6.2.1.2 Management applicable to 1998 and 1999

Management of saithe is by TAC and technical measures. The agreed TAC for saithe in Division Vb, VI, XII and XIV was 10,900 t in 1998 and 7,500 t in 1999.

6.2.1.3 The fishery in 1998

Recent nominal landings data from human consumption fisheries as officially reported as well as those estimated by the Working Group are given in table 6.2.1.1 and table 6.2.1.2.The data are plotted in Figure 6.2.6.1. The Working Group estimate for landings in 1998 is 7,589 t below the TAC in Division Vb, VI, XII, XIV. The last year's *statu quo* prediction of 10,300 t for the year 1998 is 26% above the landings estimate by the Working Group. Landings have fluctuated over the period 1972-1986, reached two peaks over 40,000 t in 1976 and 1986 but from the date, have constantly decreased. The 1998 landings are the lowest in the series.

Scottish and French landings accounted for 92% of the officially reported landings in 1998. French catches of saithe are mainly taken in a directed trawl fishery. UK landings form part of a mixed demersal fishery with haddock, cod, monk and megrim.

6.2.2 Age composition, weight at age, maturity and natural mortality

Conventional values for natural mortality and maturity at age are given in Table 6.2.2.1. The same maturity at age is used in Area IV and VI. They have been assumed to be the same all years.

Age composition data were supplied by France and UK (Scotland) in 1998. Total international age compositions are given in Table 6.2.2.2. In contrast to the series, the landings of 1-year-olds have been particularly high in 1998.

The mean weights at age in the landings are provided in Table 6.2.2.3. These are also used as stock mean weights. SOP corrections have been applied.

6.2.3 Catch, effort and research vessel data

A constant decrease in effort is observed in the period 1988 to 1997. In 1998, a small increase appears nevertheless this value is one third the level of 1988. In the last year Working Group three fleets were available for the tuning, two inshore and offshore Scottish fleets and one French fleet. After having screened the tuning data by carrying out an XSA on each tuning fleet individually it was decided to exclude the inshore Scottish fleet. In the current Working Group only two fleets have been provided, the offshore Scottish and the offshore French fleets. Catch at age data and associated effort from the French trawlers are available from 1977 and contain the age groups 3 to 10. The data from the Scottish trawlers start in 1989 and contain the age groups 2 to 10.

No research vessel indices of abundance for saithe and no discards were available to the Working Group.

6.2.4 Catch-at-age analysis

6.2.4.1 Data exploration

Investigations have been carried out on the catch-at-age data in the Working Group last year. Although catch at age data is available from 1963 onwards it has been decided to use only the data set from 1972 onwards because the age compositions available for years prior to 1972 only exists for one fleet which was not considered to be representative of the total international catch. For this reason the data prior to 1972 has been excluded in this current assessment as well.

The first run was carried out using the same configuration as last year for the West Scotland stock with the two fleets and all ages included. Diagnostics and plots of the residuals were inspected. Large catchability residuals and/or negative slope for age 10 in the French fleet and for ages 2, 4 to 10 in the Scottish fleet were observed and for this reason these ages were excluded. The fleets used for tuning the VPA are given in Table 6.2.4.1.

Then exploration of different options has been considered particularly relevant in regard to the combined assessment which has to be done this year between the North Sea stock and the West Scotland stock. The options tested on the Western stock are those used in the North Sea stock. The main differences between the two areas are (1) the age from which catchability can be considered dependent on stock size, (2) the number of ages for shrinking, (3) the level of the Log(S.E.) for the mean to which the estimates are shrunk :

	1998 North Sea stock	1998 West Scotland stock	1999 West Scotland stock
(1) catchability independent of stock size	for ages ≥ 3	for all age	for all age
(2) survivor estimates - nb of ages for shringing	3	5	3
(3) minimum Log (S.E.) of the Fmean to which the estimates are shrunk	0.5	1.0	0.5

In the sense that no information is available to determine if catchability is dependant on stock size the Group has decided to keep catchability independent of stock size for all ages. As last year, catchability was fixed for age 6 and above, the tuning was run with no taper. The age range used for VPA was 1 to 10 (the plus group), and F for the oldest ages was shrunk to the mean of the 3 younger ages. Shrinkage SE has been set at 0.5 instead of 1.0 in the last year assessment.

6.2.4.2 Assessment

The method used to tune the VPA was XSA. A final XSA was run over the period 1988-1998 using the selected options as mentioned above and recapitulated under. The tuning results are given in Table 6.2.4.2. The fishing mortality rates are provided in Table 6.2.4.3 and Table 6.2.4.4 gives the stock numbers estimated from the tuning.

	1998 assessment	1999 assessment (Final : RUN09)
Age range	1 – 10+	1 – 10+
Catchability model	Constant (all ages)	Constant (all ages)
Catchability plateau	Age 6	Age 6
F shrinkage		
SE	1.0	0.5
Year range	5	5
Age range	5	3
Fleets (years) :		
SCOLTR_VI	1988 - 1997	1989 - 1998
FRASAI_VI	1988 - 1997	1988 - 1998
Fleets (ages) :		
SCOLTR_VI	2 - 6	3 - 4
FRASAI_VI	3 - 9	3 - 9

The log-catchability residual plots from the final VPA (RUN09) are shown in Figure 6.2.4.1. No trends from log catchabilities appear in the two fleets. The relative weighting of the fleets and F shrinkage mean to the survivors estimates are indicated in Figure 6.2.4.2.The F shrinkage mean gives overall weight for age 1 and 2 because there is no data from any fleet for these ages. For the ages 3 and older the commercial fleets get most of the weight.

A retrospective analysis using the same options and time series as the XSA was carried out and the plots are shown in Figure 6.2.4.3. There is a small tendency to overestimate SSB in the most recent year and underestimate mean F.

6.2.5 Recruitment

No survey data were available. The Group therefore decided to use a short term geometric mean calculated over the ten last years to estimate recruitment at age 1 in 1997, 1998, 1999 (15 million) because there is a tendency to decrease (Fig. 6.2.6.1) from the last decade. The geometric mean over the last ten years was used for ages 2 (14 million) and 3 (10.5 million) in 1999 (year classes 1997 and 1996) as well.

6.2.6 Historical stock trends

Long term trends in fishing mortality, recruitment and spawning biomass are given in Table 6.2.6.1.. These data are also plotted in Figure 6.2.6.1.

Mean fishing mortality increased substantially from 1984 (0.24) to 1989 (0.82). Since then, it has decreased to a level of about 0.5. Total biomass and spawning biomass show a continuous downwards trend all over the series.

6.2.7 Short term forecast

Input data for prediction are given in Table 6.2.7.1. Ages 1, 2 and 3 are GM estimates over ten years. The period for calculations of mean exploitation pattern and mean weights is 1996 to 1998, and the fishing pattern were not scaled to F98. Geometric mean recruitment over ten years are also used for the 1999 and 2000 year classes. Results of the prediction are given in Table 6.2.7.2. and in Table 6.2.7.3.

In the last year Working Group, under *status quo* fishing mortality in 1998, the spawning stock size was predicted to increase to 11,600 t in 1999. The predicted SSB value at *status quo* in this current assessment for the year 1999 is very similar since it is predicted to be 10,700 t.

Table 6.2.7.4 shows the contribution of the different year classes in the landings in 2000 and the spawning stock in 2001. Three quarter of the expected landings in 2000 and of the expected SSB in 2001 are made up of the year classes for which GM recruitment is assumed.

Table 6.2.1.1 Nominal catch (tonnes) of SAITHE in Sub-area VI, 1985–1998, as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]
Belgium	2	-	12	14	15	-	6	2	2	+	-	-[4]	-	-
Denmark	-	-	7	+	2	-	+	1	2	+	+	1	-	-
Faroe Islands	-	-	-	8	-	-	24	1	-	-	-	3	n/a	-
France	19,120	26,521	24,581	24,656	17,106[2]	12,961[2]	12,423[2]	6,534	10,216	8,423	6,145	4,781	4,662	3,635
Germany, Fed.Rep.	838	2,345	1,486	1,584	1,116	275	590	685	222	524	321	1,012	492	506
Ireland	670	660	704	544	593	520	260	278	317	438	530	419	411	-
Norway	51	72	38	50	72	64	31	67	59	74[1]	35	34[1]	26[1]	41
Spain	624	824	533	857	65	70	49	-	-	n/a	n/a	n/a	n/a	-
Portugal	-	-	-	-	-	-		-	-	-	-	-	1	+
UK (Engl.& Wales)[3]	1,349	1,259	1,708	1,193	462	855	593	540	799	744	317	...	...	n/a
UK (N. Ireland)	15	21	26	13								708	294	n/a
UK (Scotland)	3,118	3,697	3,442	3,925	2,971	3,258	3,885	2,708	2,903	2,828	3,279	2,435	2,659	n/a
UK (total)												3,143	2,961	2,907
Total	25,787	35,399	32,537	32,844	22,402	18,003	17,861	10,816	14,520	13,035	10,627	9,393	8,545	7,089
Unallocated	808	4,487	-1,168	1,334	3,175	1,862	-866	988	-577	-214	1143	40	873	500
Total figures used by WG	26,595	39,886	31,369	34,178	25,577	19,865	16,995	11,804	13,943	12,821	11,770	9,433	9,418	7,589

[1]Preliminary.
[2]Includes Division Vb (EC).
[3]1989–1995 N. Ireland included with England and Wales.
[4]Final Statlant 27a data.
n/a = not available.

TABLE 6.2.1.2; Saithe, Western Scotland (VI)
Annual weight and numbers caught, 1972 to 1998.

Year	Wt.('000t)	Nos.(millions)
1972	29	19
1973	34	23
1974	36	18
1975	31	16
1976	42	20
1977	27	13
1978	31	15
1979	22	7
1980	22	8
1981	24	11
1982	24	11
1983	29	14
1984	22	13
1985	27	14
1986	40	23
1987	31	16
1988	34	19
1989	26	18
1990	20	14
1991	17	11
1992	12	7
1993	14	10
1994	13	8
1995	12	6
1996	9	5
1997	9	6
1998	8	6
Min.	8	5
Mean	24	13
Max.	42	23

TABLE 6.2.2.1; Saithe, Western Scotland (VI)
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.200	.000
2	.200	.000
3	.200	.000
4	.200	.150
5	.200	.700
6	.200	.900
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

Table 6.2.2.2 : Saithe in Western Scotland (VI) - Catch numbers at age

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1972	1973	1974	1975	1976	1977	1978
AGE							
1	51	292	806	23	35	157	38
2	3644	6557	3056	2465	2776	1234	4048
3	7913	6944	5737	6315	8154	4571	4087
4	3805	4743	2353	2458	2721	2697	2334
5	2209	1882	2000	1314	1794	1673	1291
6	428	833	608	860	1116	737	696
7	309	430	932	1007	659	559	289
8	154	311	891	707	517	385	243
9	91	192	489	197	583	290	161
+gp	162	454	861	340	1362	921	1319
TOTALNUM	18766	22638	17733	15686	19717	13224	14506
TONSLAND	29219	33832	35973	30800	41747	27210	31370
SOPCOF %	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	9	45	148	38	42	147	5	233	1	22
2	969	1005	2449	1307	4026	2932	2224	750	1874	3604
3	1828	3335	3911	4490	4879	5484	4982	6918	2314	5713
4	1194	942	1977	1641	2624	2403	2992	8380	7156	3521
5	1151	677	588	1240	852	876	1454	3764	1953	2630
6	708	632	410	568	775	681	1222	1395	1369	1051
7	368	469	341	384	513	300	608	1054	780	892
8	156	194	223	244	161	139	186	469	454	698
9	191	91	153	136	107	56	104	185	261	330
+gp	756	816	673	460	508	159	223	345	217	329
TOTALNUM	7330	8206	10873	10508	14487	13177	14000	23493	16379	18790
TONSLAND	21604	22102	23574	23884	28890	21641	26595	39886	31369	34178
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	22	59	155	28	15	2	56	22	2	167
2	746	1494	1258	864	2506	1251	1391	1228	490	994
3	7258	5617	3602	1779	2666	3467	1406	1250	1739	1292
4	5689	3743	2951	3096	2827	2040	1202	1137	1422	1847
5	2253	1198	1178	969	1185	932	940	632	1614	529
6	1399	789	608	355	270	393	471	418	324	607
7	375	526	424	107	112	116	222	152	130	84
8	258	245	236	61	56	67	89	66	54	49
9	157	133	96	54	43	45	64	34	21	20
+gp	183	159	224	93	83	100	151	116	25	23
TOTALNUM	18340	13963	10732	7406	9763	8413	5992	5055	5821	5612
TONSLAND	25577	19865	16995	11804	13943	12821	11770	9433	9418	7589
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 6.2.2.3. : Saithe in Western Scotland (VI) - Catch weights at age

Table 2 Catch weights at age (kg)

YEAR	1972	1973	1974	1975	1976	1977	1978
AGE							
1	0.507	0.311	0.309	0.46	0.444	0.383	0.412
2	0.764	0.621	0.59	0.737	0.681	0.577	0.502
3	1.139	1.102	0.987	0.939	1.005	0.794	1.128
4	1.815	1.4	1.622	1.504	1.442	1.353	1.676
5	2.631	2.516	1.743	2.575	2.732	2.207	2.603
6	2.598	3.08	3.534	3.497	3.23	3.199	3.829
7	2.979	3.694	4.542	4.779	4.174	4.253	4.687
8	5.018	4.833	5.038	5.589	4.93	5.03	5.279
9	6.118	6.705	6.066	6.522	5.785	5.829	5.979
+gp	8.166	8.138	8.279	8.549	7.739	7.711	8.47
SOPCOFAC	0.9998	1.0001	0.9997	1	1.0001	1.0001	1.0001

Table 2 Catch weights at age (kg)

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	0.513	0.417	0.4	0.432	0.378	0.472	0.405	0.672	0.453	0.557
2	0.7	0.65	0.676	0.717	0.665	0.723	0.707	0.746	0.607	0.675
3	1.323	1.165	1.096	1.078	1.246	1.109	1.056	0.872	0.96	1.003
4	1.98	1.932	1.699	1.779	1.833	1.786	1.677	1.335	1.183	1.306
5	2.405	2.651	2.963	2.736	3.074	2.663	2.613	2.172	2.043	1.683
6	3.366	3.56	4.047	3.946	3.642	3.503	3.237	2.896	3.248	3.21
7	4.609	4.56	5.115	5.348	5.036	4.714	4.316	3.614	4.725	4.428
8	5.815	5.531	6.24	6.202	6.285	5.791	6.002	4.145	6.13	5.619
9	6.967	6.524	7.222	7.765	6.975	7.609	7.377	5.505	7.731	7.226
+gp	9.339	9.651	9.761	10.68	10.88	10.781	11.097	8.592	12.082	10.193
SOPCOFAC	0.9997	1	1.0001	1	0.9999	1	1.0002	1	1	0.9998

Table 2 Catch weights at age (kg)

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	0.5	0.551	0.563	0.524	0.614	0.632	0.485	0.682	0.564	0.619
2	0.718	0.724	0.868	0.791	0.852	0.776	0.76	0.789	0.794	0.744
3	0.886	0.857	0.972	1.124	1.102	1.162	1.131	1.248	1.216	1.09
4	1.099	1.178	1.239	1.34	1.434	1.359	1.929	1.63	1.456	1.213
5	1.51	1.767	1.807	2.04	1.974	1.977	2.374	2.457	1.686	1.833
6	2.445	2.502	2.382	2.719	2.893	2.967	2.821	2.855	2.915	1.991
7	4.175	3.592	3.276	4.167	3.888	4.194	3.996	4.235	4.146	3.962
8	5.382	5.42	4.666	5.044	4.937	5.361	5.675	5.461	5.112	5.04
9	6.628	6.62	6.571	6.508	6.375	6.394	6.764	7.122	6.589	6.574
+gp	8.392	8.481	8.741	9.745	8.548	9.066	9.229	8.976	9.144	9.019
SOPCOFAC	0.9998	0.9995	1.0001	1.0004	0.9994	0.9999	0.9998	1.0002	0.9994	1.0001

Table 6.2.4.1 : Saithe in West of Scotland (VI) 1972 - 1998 - Tuning data.

102
SCOLTR_VI
1989 1998
1 1 0 1
3 4

217443	648.848	165.336
198342	651.006	356.142
209901	357.835	235.374
189288	231.694	169.544
189925	260.937	75.114
174879	320.779	127.537
175631	391.613	69.993
214159	109.639	127.813
179605	358.712	124.024
142457	220.38	249.597

FRASAI_VI
1977 1998
1 1 0 1
3 9

62969	1031	1435	1156	531	440	308	219
68760	1989	1771	972	548	163	151	99
65281	1428	1101	808	444	303	133	198
53693	2626	698	538	492	409	194	69
50917	1562	1111	387	283	233	141	102
48428	2214	917	829	347	253	153	93
42497	2823	1762	647	605	434	129	82
42608	2273	1830	613	461	204	93	37
73608	3412	2358	1230	992	478	144	79
74959	4910	7188	3119	1016	678	228	109
75003	1492	5836	1651	1157	660	389	218
94109	4011	2534	2004	786	676	472	228
72656	4443	3975	1589	893	199	142	71
59465	2975	2028	684	477	330	161	85
51011	1792	1697	619	287	184	111	43
44974	637	1528	528	192	50	32	26
56762	1474	1921	855	196	70	33	22
41971	1810	1288	600	245	77	49	32
42174	206	657	516	257	118	48	33
33655	596	484	298	202	50	13	6
24262	519	579	640	120	47	18	4
33360	650	1051	359	401	40	24	10

Table 6.2.4.2. Saithe in Western Scotland (VI) : 1972 - 1998 (IFAP : RUN09)

Lowestoft VPA Version 3.1

14/10/1999 9:25

Extended Survivors Analysis

Saithe in VI: 1972 - 1998

CPUE data from file SAIVIEF2.DAT

Catch data for 27 years. 1972 to 1998. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SCOLTR_VI	1989	1998	3	4	0	1
FRASAI_VI	1988	1998	3	9	0	1

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 6

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 16 iterations

Regression weights

	1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.001	0.004	0.012	0.002	0.001	0	0.004	0.002	0	0.002
2	0.05	0.109	0.119	0.086	0.26	0.127	0.209	0.116	0.07	0.157
3	0.66	0.644	0.412	0.247	0.411	0.697	0.205	0.295	0.238	0.268
4	1.076	0.889	0.868	0.768	0.787	0.645	0.557	0.255	0.646	0.429
5	0.784	0.687	0.801	0.808	0.777	0.658	0.713	0.651	0.7	0.532
6	0.774	0.712	0.948	0.601	0.55	0.646	0.855	0.833	0.855	0.626
7	0.546	0.768	1.143	0.415	0.382	0.486	0.983	0.761	0.681	0.56
8	0.655	0.866	1.004	0.471	0.399	0.416	0.884	0.935	0.683	0.592
9	0.926	0.874	1.077	0.661	0.729	0.655	0.92	1.087	0.919	0.582

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9
1989	1.96E+04	1.68E+04	1.66E+04	9.54E+03	4.58E+03	2.87E+03	9.85E+02	5.93E+02	2.87E+02
1990	1.51E+04	1.60E+04	1.31E+04	7.02E+03	2.66E+03	1.71E+03	1.08E+03	4.67E+02	2.52E+02
1991	1.44E+04	1.23E+04	1.18E+04	5.62E+03	2.36E+03	1.10E+03	6.88E+02	4.12E+02	1.61E+02
1992	1.48E+04	1.16E+04	8.97E+03	6.38E+03	1.93E+03	8.68E+02	3.48E+02	1.80E+02	1.23E+02
1993	1.42E+04	1.21E+04	8.74E+03	5.73E+03	2.42E+03	7.05E+02	3.90E+02	1.88E+02	9.18E+01
1994	9.96E+03	1.16E+04	7.63E+03	4.74E+03	2.14E+03	9.13E+02	3.33E+02	2.18E+02	1.03E+02
1995	1.52E+04	8.15E+03	8.38E+03	3.11E+03	2.04E+03	9.06E+02	3.92E+02	1.68E+02	1.18E+02
1996	9.76E+03	1.24E+04	5.41E+03	5.59E+03	1.46E+03	8.17E+02	3.15E+02	1.20E+02	5.67E+01
1997	9.24E+03	7.97E+03	9.07E+03	3.30E+03	3.54E+03	6.23E+02	2.91E+02	1.21E+02	3.86E+01
1998	1.12E+05	7.56E+03	6.09E+03	5.85E+03	1.42E+03	1.44E+03	2.17E+02	1.20E+02	4.98E+01

Table 6.2.4.2. Saithe in Western Scotland (VI) : 1972 - 1998 (continued)

Estimated population abundance at 1st Jan 1999

0.00E+00	9.19E+04	5.29E+03	3.81E+03	3.12E+03	6.81E+02	6.31E+02	1.01E+02	5.45E+01

Taper weighted geometric mean of the VPA populations:

2.28E+04	1.78E+04	1.35E+04	7.77E+03	3.98E+03	2.11E+03	1.11E+03	6.14E+02	3.32E+02

Standard error of the weighted Log(VPA populations) :

0.5416	0.446	0.4411	0.4359	0.5439	0.6581	0.8678	0.9711	1.0747

Log catchability residuals.

Fleet : SCOLTR_VI

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
3	0.08	0.41	-0.24	-0.38	-0.16	0.39	0.27	-0.72	0.1	0.25
4	-0.46	0.63	0.37	-0.02	-0.72	0.02	-0.2	-0.52	0.33	0.59
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4
Mean Log q	-15.2145	-15.3121
S.E(Log q)	0.3685	0.4758

Regression statistics :

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
3	0.76	0.867	13.74	0.62	10	0.28	-15.21
4	1.18	-0.301	16.51	0.26	10	0.59	-15.31

Fleet : FRASAI_VI

	1988
Age	-0.08
3	-0.63
4	-0.57
5	-0.49
6	-0.24
7	-0.06
8	-0.17
9	

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Age	0.46	0.49	0.14	-0.58	0.13	0.9	-1.59	0.17	-0.18	0.14
3	0.31	0.06	0.25	0.1	0.22	0.25	-0.05	-0.85	0.36	-0.03
4	-0.13	-0.27	-0.05	0.12	0.13	0.15	0.07	0.05	0.28	0.23
5	-0.26	-0.19	-0.01	-0.19	-0.22	0.09	0.23	0.31	0.39	0.35
6	-0.79	-0.08	0.09	-0.71	-0.73	-0.13	0.34	-0.17	0.14	-0.09
7	-0.57	0.08	0.05	-0.47	-0.75	-0.19	0.25	-0.48	0.07	0
8	-0.43	0.06	0.07	-0.22	-0.29	0.23	0.24	-0.44	-0.2	0
9										

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

	3	4	5	6	7	8	9
Age	-12.5682	-11.8034	-11.6691	-11.6555	-11.6555	-11.6555	-11.6555
Mean Log q	0.6513	0.3904	0.247	0.2933	0.438	0.38	0.2641
S.E(Log q)							

Table 6.2.4.2. Saithe in Western Scotland (VI) : 1972 - 1998 (continued)

Regression statistics :

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
	0.85	0.314	12.06	0.32	11	0.58	-12.57
3	1.36	-0.744	12.93	0.33	11	0.54	-11.8
4	1.56	-2.714	13.82	0.72	11	0.3	-11.67
5	1.52	-2.136	14.04	0.65	11	0.38	-11.66
6	1.1	-0.494	12.45	0.72	11	0.43	-11.87
7	0.98	0.147	11.71	0.85	11	0.34	-11.84
8	0.99	0.075	11.71	0.92	11	0.25	-11.76
9							

Terminal year survivor and F summaries :

Age 1 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
	1	0	0	0	0	0	0
SCOLTR_VI	1	0	0	0	0	0	0
FRASAI_VI							
	91912	0.5				1	0.002
F shrinkage mean							

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
	0.5	0	1	0	0.002
91912					

Age 2 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
	1	0	0	0	0	0	0
SCOLTR_VI	1	0	0	0	0	0	0
FRASAI_VI							
	5293	0.5				1	0.157
F shrinkage mean							

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
	0.5	0	1	0	0.157
5293					

Age 3 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
	4916	0.387	0	0	1	0.475	0.213
SCOLTR_VI	4390	0.68	0	0	1	0.153	0.236
FRASAI_VI							
	2597	0.5				0.371	0.372
F shrinkage mean							

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
	0.28	0.26	3	0.94	0.268
3813					

Table 6.2.4.2. Saithe in Western Scotland (VI) : 1972 - 1998 (continued)

Age 4 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
	4251	0.308	0.244	0.79	2	0.401	0.332
SCOLTR_V	2928	0.351	0.061	0.17	2	0.333	0.451
FRASAI_VI							
	2111	0.5				0.265	0.583
F shrinkage mean							

Weighted prediction :

Survivors	Int s.e	Ext s.e	N	Var Ratio	F
at end of yea	0.22	0.18	5	0.82	0.429
3118					

Age 5 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
	528	0.309	0.521	1.69	2	0.177	0.645
SCOLTR_V	875	0.24	0.04	0.17	3	0.567	0.436
FRASAI_VI							
	466	0.5				0.256	0.707
F shrinkage mean							

Weighted prediction :

Survivors	Int s.e	Ext s.e	N	Var Ratio	F
at end of yea	0.19	0.17	6	0.893	0.532
681					

Age 6 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
	591	0.307	0.392	1.27	2	0.12	0.657
SCOLTR_V	707	0.199	0.29	1.46	4	0.633	0.575
FRASAI_VI							
	487	0.5				0.247	0.755
F shrinkage mean							

Weighted prediction :

Survivors	Int s.e	Ext s.e	N	Var Ratio	F
at end of yea	0.18	0.19	7	1.04	0.626
631					

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
	108	0.324	0.295	0.91	2	0.045	0.532
SCOLTR_V	115	0.214	0.115	0.54	5	0.615	0.509
FRASAI_VI							
	81	0.5				0.34	0.665
F shrinkage mean							

Weighted prediction :

Survivors	Int s.e	Ext s.e	N	Var Ratio	F
at end of yea	0.22	0.11	8	0.49	0.56
101					

Table 6.2.4.2. Saithe in Western Scotland (VI) : 1972 - 1998 (continued)

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class =	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Fleet	51	0.312	0.089	0.29	2	0.023	0.627
	60	0.226	0.053	0.24	6	0.623	0.55
SCOLTR_VI							
FRASAI_VI	46	0.5				0.354	0.669

F shrinkage mean

Weighted pre	Int s.e	Ext s.e	N	Var Ratio	F
Survivors	0.23	0.06	9	0.283	0.592
at end of year					
55					

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class =	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Fleet	13	0.308	0.172	0.56	2	0.009	0.85
	23	0.21	0.035	0.17	7	0.701	0.573
SCOLTR_VI							
FRASAI_VI	22	0.5				0.291	0.598

F shrinkage mean

Weighted pre	Int s.e	Ext s.e	N	Var Ratio	F
Survivors	0.21	0.03	10	0.151	0.582
at end of year					
23					

Table 6.2.4.3. : Saithe in Western Scotland (VI) - Fishing mortality (F) at age (IFAP : RUN09)

Table 8 Fishing mortality (F) at age

YEAR	1972	1973	1974	1975	1976	1977	1978
AGE							
1	0.002	0.010	0.027	0.001	0.002	0.010	0.002
2	0.155	0.310	0.142	0.109	0.165	0.102	0.360
3	0.430	0.493	0.491	0.486	0.625	0.448	0.570
4	0.374	0.500	0.306	0.403	0.400	0.432	0.434
5	0.258	0.320	0.406	0.280	0.584	0.460	0.380
6	0.130	0.145	0.161	0.306	0.408	0.508	0.352
7	0.109	0.187	0.241	0.437	0.407	0.369	0.381
8	0.094	0.153	0.734	0.291	0.421	0.444	0.270
9	0.111	0.162	0.381	0.346	0.415	0.443	0.336
+gp	0.111	0.162	0.381	0.346	0.415	0.443	0.336
FBAR 3- 6	0.298	0.365	0.341	0.369	0.504	0.462	0.434

Table 8 Fishing mortality (F) at age

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	0.000	0.002	0.006	0.001	0.001	0.004	0.000	0.009	0.000	0.001
2	0.065	0.061	0.115	0.061	0.148	0.103	0.072	0.047	0.090	0.179
3	0.273	0.334	0.353	0.317	0.338	0.308	0.256	0.335	0.199	0.433
4	0.321	0.220	0.339	0.244	0.310	0.277	0.275	0.917	0.698	0.528
5	0.396	0.304	0.208	0.370	0.193	0.160	0.269	0.666	0.558	0.604
6	0.371	0.395	0.304	0.318	0.418	0.233	0.351	0.448	0.545	0.676
7	0.318	0.451	0.384	0.522	0.533	0.282	0.336	0.585	0.488	0.859
8	0.365	0.276	0.402	0.527	0.433	0.265	0.283	0.473	0.541	1.162
9	0.353	0.376	0.366	0.459	0.465	0.261	0.325	0.506	0.529	1.015
+gp	0.353	0.376	0.366	0.459	0.465	0.261	0.325	0.506	0.529	1.015
FBAR 3- 6	0.340	0.313	0.301	0.312	0.315	0.244	0.288	0.591	0.500	0.560

Table 8 Fishing mortality (F) at age

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98
AGE											
1	0.001	0.004	0.012	0.002	0.001	0.000	0.004	0.003	0.000	0.002	0.002
2	0.050	0.109	0.120	0.086	0.260	0.127	0.209	0.116	0.070	0.157	0.114
3	0.660	0.644	0.413	0.248	0.411	0.697	0.205	0.295	0.238	0.268	0.267
4	1.076	0.889	0.868	0.768	0.787	0.645	0.557	0.255	0.646	0.429	0.443
5	0.784	0.687	0.801	0.808	0.777	0.658	0.713	0.651	0.700	0.532	0.628
6	0.774	0.712	0.948	0.601	0.550	0.646	0.855	0.833	0.855	0.626	0.772
7	0.546	0.768	1.143	0.415	0.382	0.486	0.983	0.761	0.681	0.560	0.667
8	0.655	0.866	1.004	0.471	0.399	0.416	0.884	0.935	0.683	0.592	0.737
9	0.926	0.874	1.077	0.661	0.730	0.655	0.920	1.087	0.919	0.582	0.863
+gp	0.926	0.874	1.077	0.661	0.730	0.655	0.920	1.087	0.919	0.582	
	0.824	0.733	0.757	0.606	0.631	0.662	0.583	0.509	0.610	0.464	

Table 6.2.4.4. : Saithe in Western Scotland (VI) - Stock number at age (IFAP : RUN09)

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

YEAR		1972	1973	1974	1975	1976	1977	1978
AGE								
	1	33290	31499	33138	24659	17208	18257	20693
	2	28117	27209	25525	26401	20169	14057	14805
	3	25022	19723	16344	18133	19385	14001	10392
	4	13480	13326	9865	8190	9132	8493	7327
	5	10749	7594	6619	5948	4482	5014	4513
	6	3877	6802	4514	3610	3680	2046	2592
	7	3305	2787	4815	3146	2177	2004	1008
	8	1900	2426	1893	3099	1664	1186	1135
	9	954	1416	1705	744	1898	895	623
+gp		1693	3333	2978	1274	4395	2817	5066
TOTAL		122387	116116	107395	95203	84190	68770	68154

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

YEAR		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE											
	1	23072	30604	29992	39593	40325	43252	22119	29592	29627	20535
	2	16908	18882	25016	24421	32381	32978	35278	18105	24017	24256
	3	8459	12966	14550	18265	18812	22869	24347	26871	14144	17968
	4	4811	5272	7598	8373	10892	10987	13761	15426	15741	9487
	5	3887	2858	3464	4432	5371	6543	6821	8559	5047	6412
	6	2527	2141	1727	2304	2507	3626	4564	4269	3602	2365
	7	1492	1428	1181	1043	1372	1351	2353	2631	2233	1710
	8	564	889	745	658	507	659	835	1376	1201	1122
	9	709	321	552	408	318	269	414	515	702	572
+gp		2785	2852	2409	1368	1497	760	881	951	578	560
TOTAL		65214	78213	87234	100866	113981	123294	111374	108295	96892	84987

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

YEAR		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 87-96
AGE													
	1	19611	15143	14374	14798	14200	9956	15245	9764	*9241	*112446	*0	15516
	2	16792	16036	12345	11628	12090	11613	8150	12431	7974	7564	*91912	14143
	3	16598	13073	11778	8969	8739	7631	8376	5414	9066	6085	*5293	10582
	4	9541	7022	5621	6383	5733	4742	3111	5585	3301	5849	3813	6652
	5	4581	2664	2362	1932	2425	2136	2037	1459	3544	1416	3118	2782
	6	2870	1712	1097	868	705	913	906	817	623	1441	681	1342
	7	985	1084	688	348	390	333	392	315	291	217	631	660
	8	593	467	412	180	188	218	168	120	121	120	101	343
	9	287	252	161	123	92	103	118	57	39	50	55	180
+gp		329	297	368	210	175	227	273	190	45	57	49	
TOTAL		72189	57752	49206	45440	44737	37873	38773	36151	34244	135246	105652	

*** GM 1987-1996**

Table 6.2.6.1. : Saithe in Western Scotland (VI)

Table 16 Summary (without SOP correction)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1972	33290	168717	71569	29219	0.4083	0.2979
1973	31499	165783	93670	33832	0.3612	0.3645
1974	33138	151325	91237	35973	0.3943	0.3411
1975	24659	136179	72024	30800	0.4276	0.3686
1976	17208	140442	83530	41747	0.4998	0.5042
1977	18257	96745	56783	27210	0.4792	0.4619
1978	20693	118976	76340	31370	0.4109	0.4341
1979	23072	103350	56736	21604	0.3808	0.3401
1980	30604	106572	54739	22102	0.4038	0.3132
1981	29992	113210	53606	23574	0.4398	0.3009
1982	39593	117861	46348	23884	0.5153	0.3123
1983	40325	134417	51365	28890	0.5624	0.3145
1984	43252	139796	47000	21641	0.4604	0.2443
1985	22119	143286	57235	26595	0.4647	0.2877
1986	29592	134591	53449	39886	0.7462	0.5914
1987	29627	112531	50862	31369	0.6167	0.5001
1988	20535	100329	39969	34178	0.8551	0.5601
1989	19611	72964	24706	25577	1.0352	0.8235
1990	15143	59035	19005	19865	1.0453	0.7331
1991	14374	52553	14836	16995	1.1455	0.7573
1992	14798	47094	11372	11804	1.038	0.6062
1993	14200	48221	10943	13943	1.2742	0.6314
1994	9956	42831	11644	12821	1.101	0.6616
1995	15245	42282	12415	11770	0.948	0.5827
1996	9764	42343	10073	9433	0.9365	0.5085
1997	*****15516	37655	9027	9418	1.0432	0.6099
1998	*****15516	96735	7774	7589	0.9762	0.4638
1999	*****15516	50500	10700			

*** GMST 87-96**

Arith. Mean	24423	99467	43802	23818	0.7053	0.4782
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 6.2.7.1. Saithe,Western Scotland (VI)
Input data for catch forecast and linear sensitivity analysis.
GM for ages 1, 2, 3, over 10 years (1987-1996), F unscalled,
3 years for the mean.

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	15515	.33	WS1	.62	.09	M1	.20	.10	MT1	.00	.00
N2	14143	.34	WS2	.78	.04	M2	.20	.10	MT2	.00	.00
N3	10582	.38	WS3	1.19	.07	M3	.20	.10	MT3	.00	.10
N4	3813	.28	WS4	1.43	.15	M4	.20	.10	MT4	.15	.10
N5	3116	.22	WS5	1.99	.21	M5	.20	.10	MT5	.70	.10
N6	681	.19	WS6	2.59	.20	M6	.20	.10	MT6	.90	.10
N7	631	.19	WS7	4.11	.03	M7	.20	.10	MT7	1.00	.10
N8	100	.22	WS8	5.20	.04	M8	.20	.10	MT8	1.00	.00
N9	54	.23	WS9	6.76	.05	M9	.20	.10	MT9	1.00	.00
N10	49	.21	WS10	9.05	.01	M10	.20	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.81	WH1	.62	.09
sH2	.11	.49	WH2	.78	.04
sH3	.27	.21	WH3	1.19	.07
sH4	.44	.35	WH4	1.43	.15
sH5	.63	.06	WH5	1.99	.21
sH6	.77	.10	WH6	2.59	.20
sH7	.67	.16	WH7	4.11	.03
sH8	.74	.27	WH8	5.20	.04
sH9	.86	.28	WH9	6.76	.05
sH10	.86	.28	WH10	9.05	.01

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.14
K00	1.00	.10	HF00	1.00	.14
K01	1.00	.10	HF01	1.00	.14

Recruitment		
Labl	Value	CV
R00	15515	.33
R01	15515	.33

Proportion F before spawning= .00
Proportion M before spawning= .00

Stock numbers in 1999 are VPA survivors.
These are overwritten at Age 2 Age 3

Table 6.2.7.2. Saithe,Western Scotland (VI)
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 1999	2000						
Mean F Ages H.cons 3 to 6	.53	.00	.11	.21	.32	.42	.53	.63
Effort relative to 1998 H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Biomass at start of year								
Total	50.5	51.8	51.8	51.8	51.8	51.8	51.8	51.8
Spawning	10.7	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Catch weight (,000t) H.cons	10.9	.0	2.8	5.3	7.6	9.7	11.6	13.3
Biomass at start of 2001								
Total		66.7	63.3	60.2	57.4	54.9	52.6	50.5
Spawning		20.9	18.7	16.6	14.9	13.3	11.9	10.7

	Year 1999	2000						
Effort relative to 1998 H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.15	.15	.15	.15	.15	.15	.15	.15
Spawning	.15	.18	.18	.18	.18	.18	.18	.18
Catch weight H.cons	.20	.00	.69	.36	.27	.23	.21	.20
Biomass at start of 2001								
Total		.14	.15	.15	.15	.15	.15	.16
Spawning		.20	.22	.23	.23	.24	.25	.26

Table 6.2.7.3. Saithe,Western Scotland (VI)
Detailed forecast tables.

Forecast for year 1999
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Total
1	15516	14	14
2	14143	1384	1384
3	10582	2257	2257
4	3813	1246	1246
5	3117	1331	1331
6	681	336	336
7	631	281	281
8	100	48	48
9	55	29	29
10	49	26	26
Wt	51	11	11

Forecast for year 2000
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Total
1	15516	14	14
2	12691	1242	1242
3	10332	2204	2204
4	6634	2168	2168
5	2005	856	856
6	1362	672	672
7	258	115	115
8	265	127	127
9	39	21	21
10	36	19	19
Wt	52	12	12

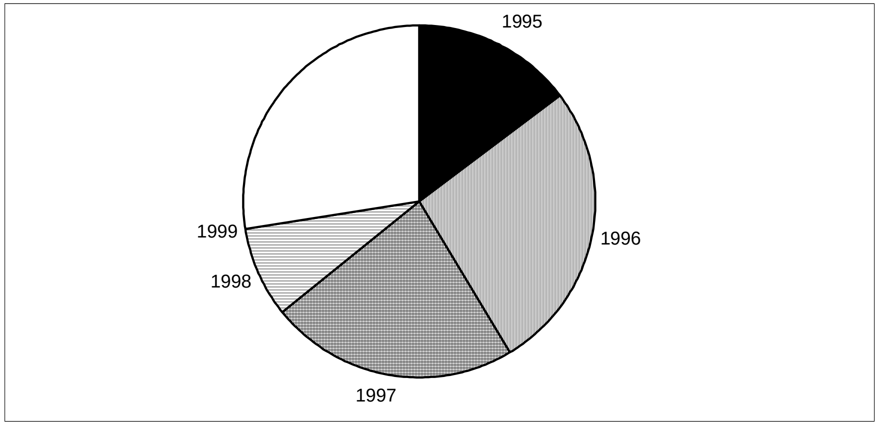
Table 6.2.7.4 Saithe in Western Scotland (VI)
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1995	1996	1997	1998	1999
Stock No. (thousands)			9.764	15.516	15.516	15.516	15.516
of	1 year-olds						
Source			VPA	GM	GM	GM	GM
Status Quo F:							
% in	1999	landings	16.3	24.6	9.9	0.1	-
% in	2000		14.7	26.7	22.6	8.4	0.1
% in	1999	SSB	7.7	0.0	0.0	0.0	-
% in	2000	SSB	26.8	13.7	0.0	0.0	0.0
% in	2001	SSB	27.5	28.0	17.1	0.0	0.0

GM : short term geometric mean recruitment (1987-1996)

Saithe in Western Scotland (VI) : Year-class % contribution to

a) 2000 landings



b) 2001 SSB

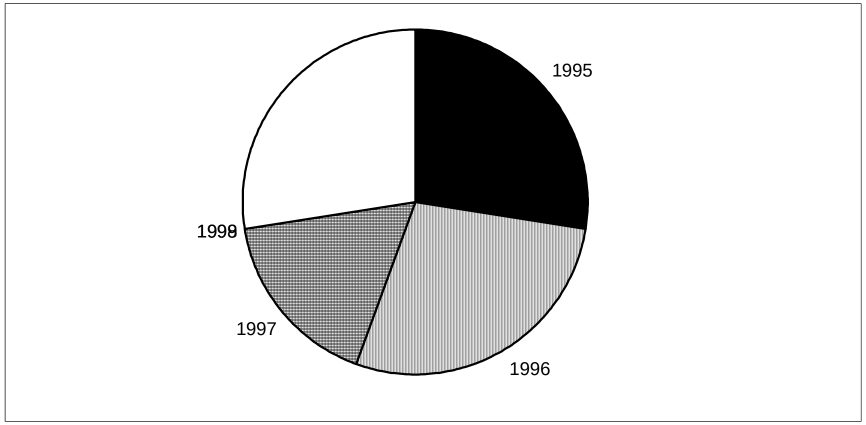
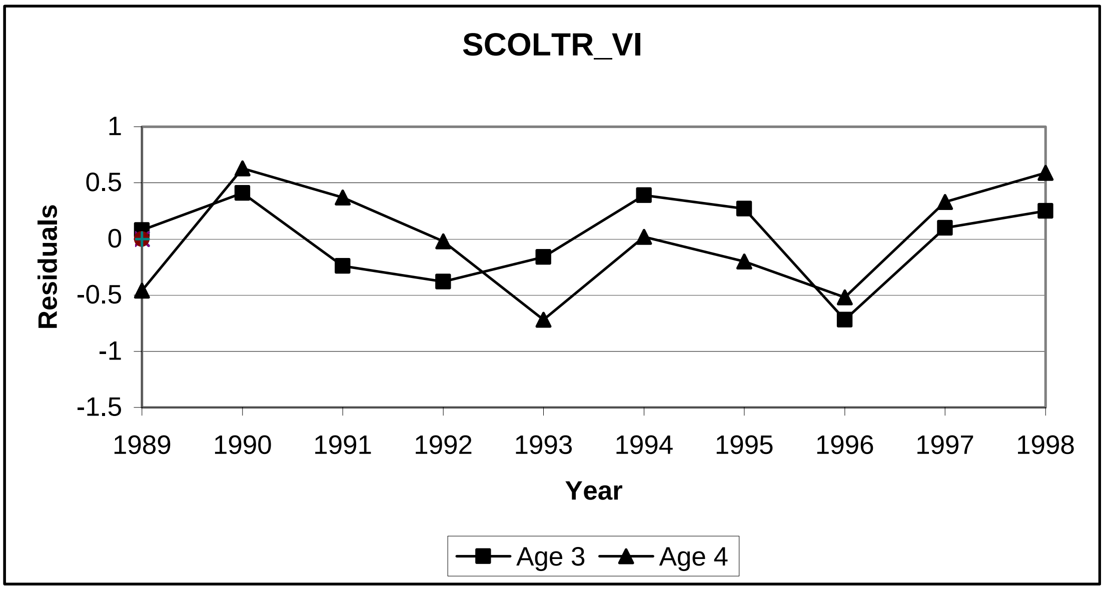


Figure 6.2.4.1. : Log catchability residual plots (XSA) for Saithe in Western Scotland (VI)



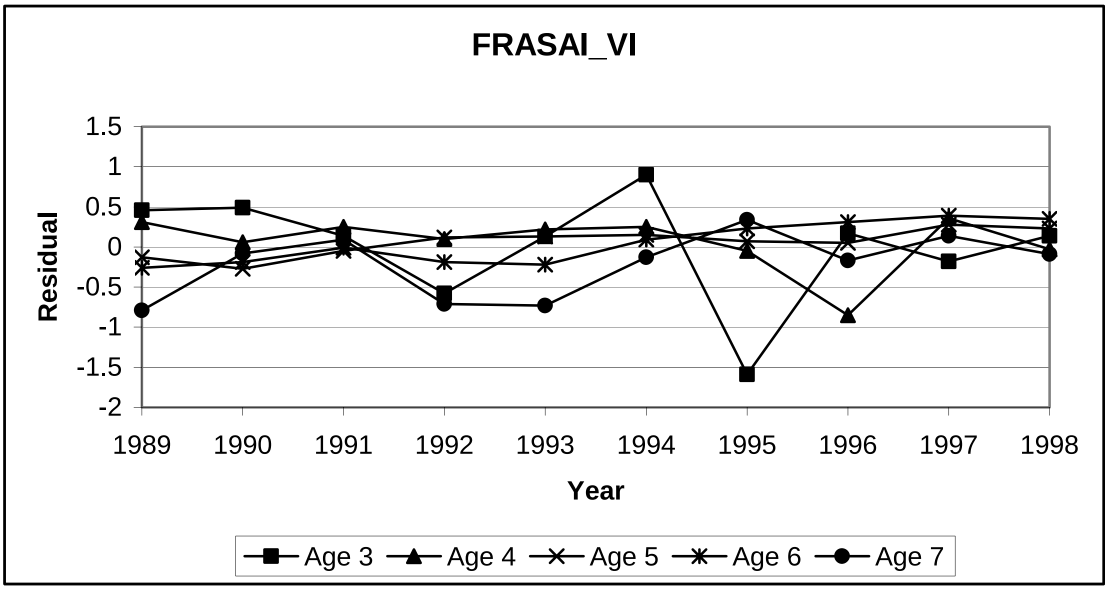


Figure 6.2.4.2. Saithe VI - Contribution of Commercial fleets, survey indices and shrinkage to tuned XSA

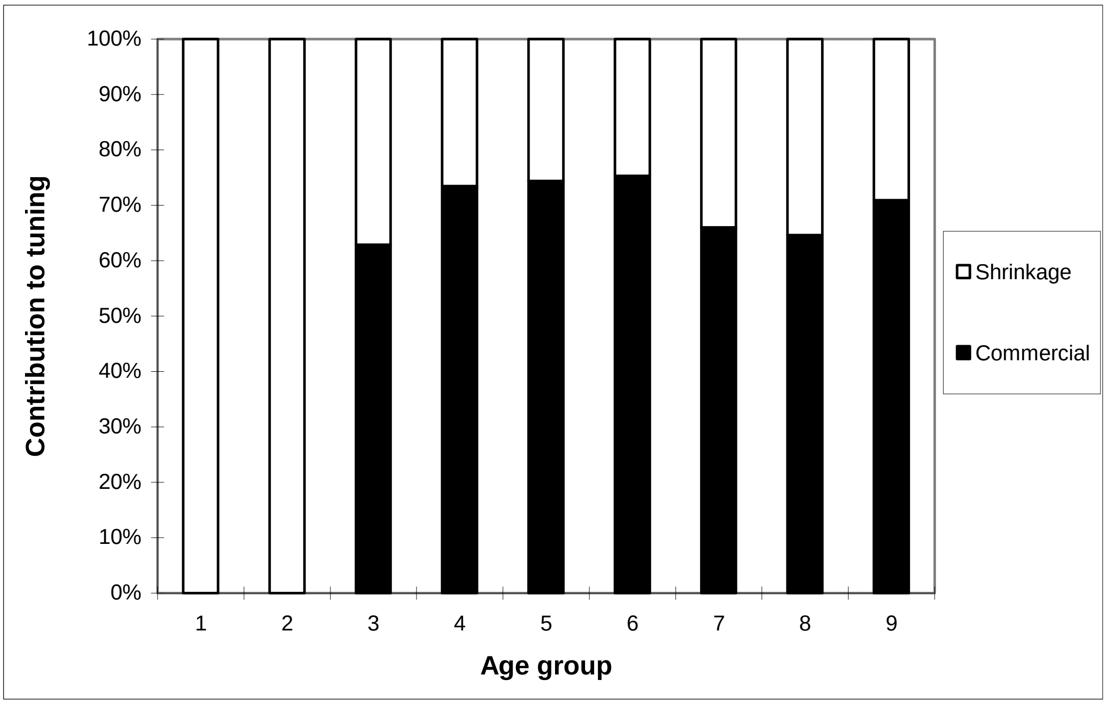
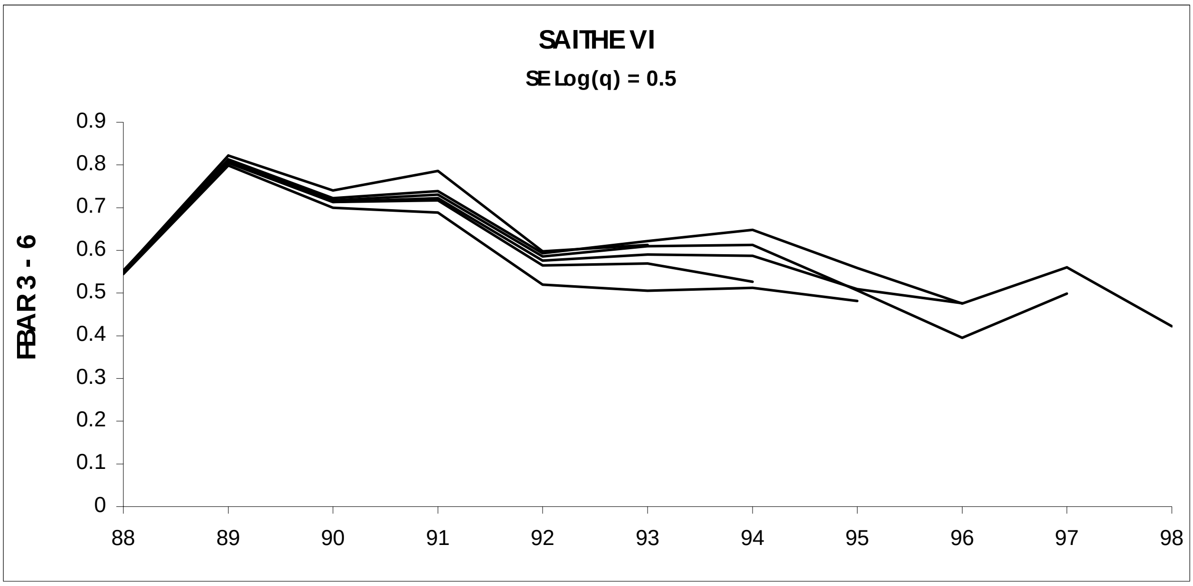
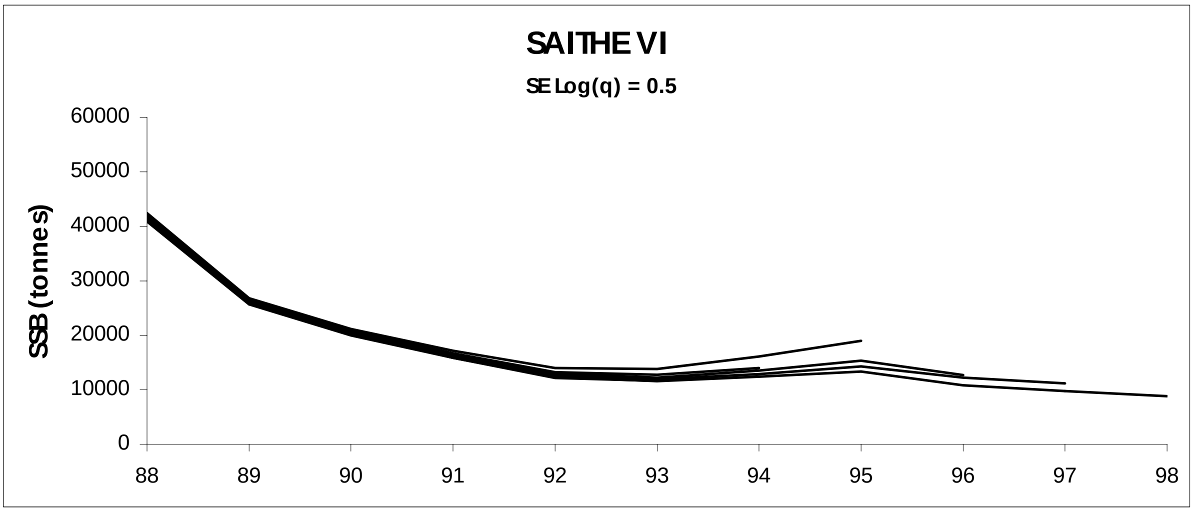


Figure 6.2.4.3.- Saithe in Division VI. Retrospective analysis.





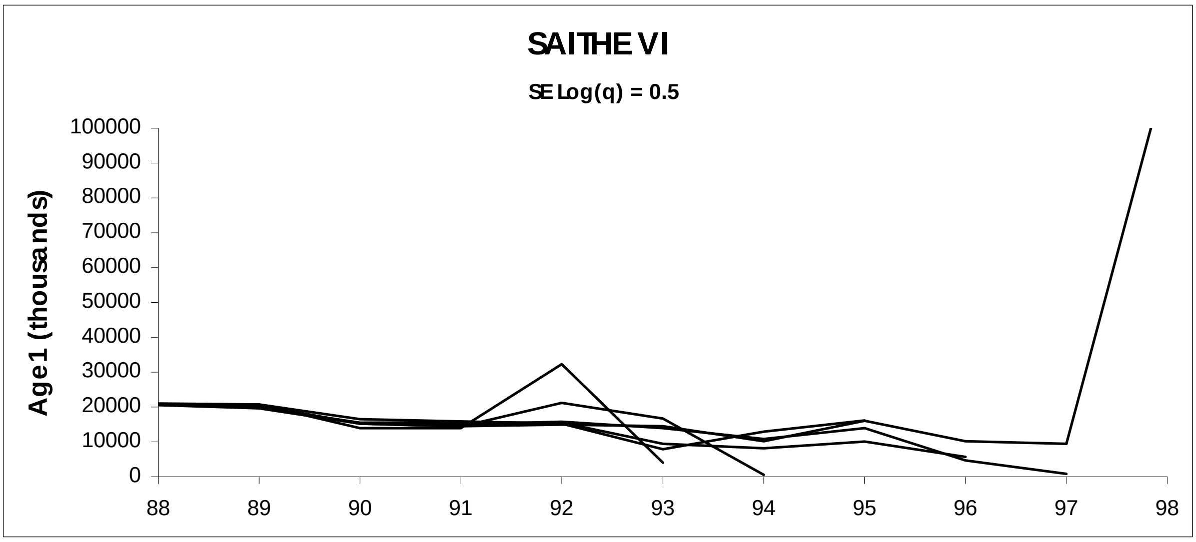
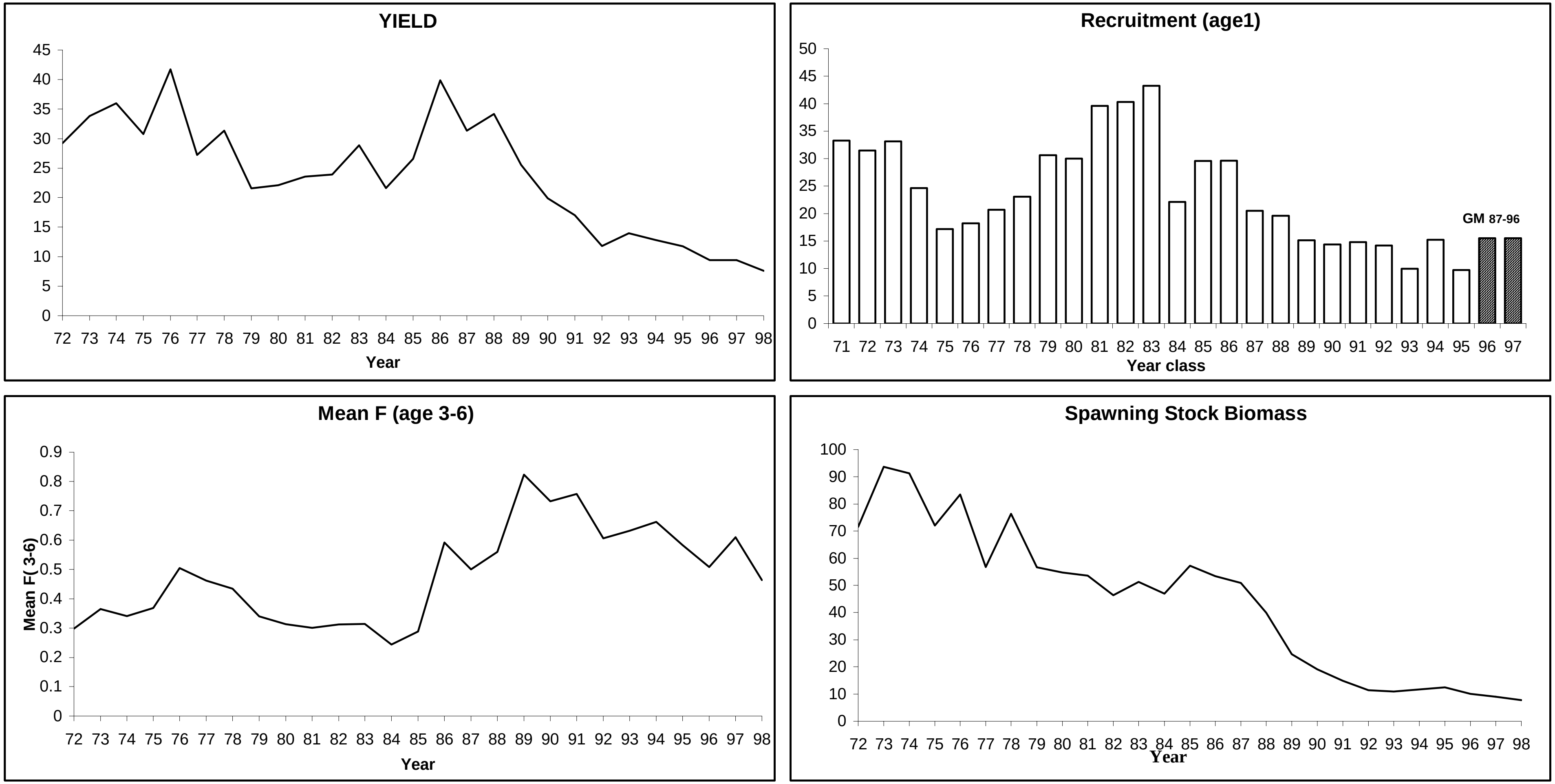


Figure 6.2.6.1 : Saithe in Western Scotland (VI).



6.3 Saithe in Sub-area IV, VI and Division IIIa

6.3.1 The fishery

6.3.1.1 ACFM advice applicable to 1999

As this combined assessment for areas IV, VI and division IIIa has been conducted for the first time, there is no explicit ACFM advice applicable to 1999 and no reference points exist. However, the separate assessments indicated both stock components in Sub-area IV, Division IIIa and Subarea VI to be outside safe biological limits.

6.3.1.2 Management applicable to 1999

Management of saithe is by TAC and technical measures in both areas. The agreed TAC for saithe in IV and IIIa for 1999 is 110,000 t and in Division Vb, VI, XII and XIV in 1999 is 7,500 t.

The minimum mesh size is 100 mm in IV and 90 mm in Skagerrak. Minimum landing size is 35 cm in EU waters. In Norwegian waters the minimum landing size is 32 cm in IV, and 30 cm in Skagerrak.

6.3.1.3 Trend in the landings and the fishery in 1998

Fleet descriptions, historical and recent development and in the saithe landings in areas IV, IIIa and VI are given in sections 6.1.1.3.and 6.2.1.3. For 1998, the WG estimates of the landings are 108,000 t from all areas, which corresponds to the sum of TACs. The landings peaked during the mid 1970s, dropped rapidly to 140,000 t in 1980, increased again and exceeded 220,000 t in 1985. During the last 10 years, the landings remained at a lower level with small variation between 104,000 and 125,000 t (Table 6.3.1.1, Fig. 6.3.1.1).

6.3.2 Natural mortality, maturity, age compositions, mean weight at age

Conventional values of natural mortality rate, and maturity at age based on biological sampling are given in Table 6.3.2.1. They have been assumed to be the same all years.

Total international age compositions are given in Table 6.3.2.2 and represent a simple sum of the catch in numbers of the 2 separate saithe assessments. Data for 1997 were updated with minor changes. Data for 1998 were supplied by Denmark, Germany, France, Norway, UK (England) and UK (Scotland) amounting to about 97 % of the reported landings.

The mean weights at age in the landings are given in Table 6.2.2.3. These are also used as stock mean weights. They are weighted means (according to catch in numbers) and SOP corrections have been applied. The mean weights for the 4 year olds and older have decreased during the last 20 years.

6.3.3 Catch, effort and research vessel data

The effort trends and age composition of the fleets and surveys are listed in Table 6.3.3.1. There were age disaggregated data available from five commercial fleets and 2 surveys starting in 1989 or 1990. They are also used in the separate assessments where minor changes in updating those series are described. Effort by large French trawlers (FRATRB_IV) and Norwegian trawlers (NORTRL_IV) in the North Sea has displayed a recent decrease. Effort by French Freezer trawlers (FRATRF_IV) increased from 1997 to 1998 while Effort by Scottish light trawlers in the North Sea and West of Scotland (SCOLTR_IV+VI) has been fairly stable since 1989. Effort by French trawlers targetting saithe west of Scotland (FRASAI_VI) has varied over a wide range but has reduced since 1996. The surveys data only cover area IV.

6.3.4 Catch-at-age analysis

The method used to tune the VPA was XSA. The age disaggregated data series are listed in Table 6.3.4.1 together with the periods and age ranges used in the final run. The only change compared to previous separate assessments of saithe in area IV and IIIa regards the catchability of all ages as independent of stock size (only F shrinkage), while it was previously considered dependent of stock size for ages 1 and 2. The presented tuning of the combined saithe assessment disregards ages with low r^2 or negative slopes between log-transformed indices and VPA estimates of the various series. The tuning converged after 46 iterations. Tuning diagnostics are given in Table 6.3.4.1. For age 2 the shrinker and the commercial fleets share the weights, while the estimation of survivors of the older ages are dominated by the commercial fleets (Figure 6.3.4.1).

The results of the retrospective analysis are plotted in Figure 6.3.4.2. The retrospective analysis reveals a tendency to overestimate F_{3-6}. However, the estimation of spawning stock biomass seems quite consistent with the year 1995 as the only exception. The retrospective estimation of the recruits at age 1 is scattered and needs almost 10 years to converge.

6.3.5 Recruitment Estimates

No survey or other independent recruitment indices were available to the working group. The group therefore decided to use geometric means 1987-96 to estimate recruitment at ages 1-3 in 1999 for the short-term prediction. This short-term GM was used as there is evidence of reduced recruitment in recent years (Figure 6.3.1.1). The XSA estimate of the 1996 year class was considered very poor since the only data for this year class were derived from French fleets which don't fish in the inshore areas where young saithe are found. Survivors at ages 1, 2 and 3 in 1999, were estimated using the short-term GM values of 175, 154 and 116 million respectively.

6.3.6 Historical trends

Tables 6.3.4.2 and 6.3.4.3 list the fishing mortality and stock number by year and age, respectively. The VPA results are summarized in Table 6.3.4.4 and illustrated in Figure 6.3.1.1. The mean F(3-6) decreased continuously from 0.8 in 1986 to 0.5 in 1998. Recently, the SSB was estimated to have increased by 30 % to 152,000 tons in 1998 from the lowest observed 106,000 tons in the early 1990s. However, the recent SSB represents only 30 % of the SSB estimated in the early 1970s. The overall trends are similar to those in the North Sea assessment. (Figure 6.1.1.1)

6.3.7 Short term forecast

Input data for the 1999-2001 prediction are given in Table 6.3.7.1. In 1999, numbers of ages 1, 2 and 3 are 1987-96-GM estimates. The year classes 1999 and 2000 at age 1 were estimated by the short-term GM value of 175 millions as input for 2000 and 2001, respectively. The exploitation pattern, mean weights in the stock and the catch is based on 1996-98 arithmetic means. The fishing pattern was not scaled to F1998. Results of the prediction are given in the management Tables 6.3.7.2.

The assumption of *status quo* fishing mortality in 1999 is expected to lead to landings of 113,000 t in 1999 and 109,000 t in 2000. Spawning stock size is predicted to decrease from 169,000 t in 1999 to 145,000 and 146,000 t in 2000 and 2001, respectively.

Table 6.3.7.3 lists the contribution of the different recruiting year classes in the catch in 2000 and the spawning stock in 2001. 46 % of the expected landings in 2000, and 42 % of the predicted SSB in 2001 is made up of year classes for which GM1987-96 recruitment is assumed.

The sensitivity analysis of the parameters of the short term predictions is illustrated in Figure 6.3.7.1. The yield in 2000 is indicated to be most dependent on the variation of the fishing mortality levels in 2000 and 1999. The prediction of the SSB in 2001 is identified to be most dependent on the fishing mortality. The stock numbers at age 3 contributes most to the variance in the prediction of SSB.

Given a *status quo* fishing mortality the probability plots shown in Figure 6.3.7.2 indicate that there is about a 98 % probability that the SSB will remain below 200,000 t in 2001. The predicted catch in 2000 of about 110,000 t implies a 55 % probability that the fishing mortality in 2000 exceeds the present fishing mortality.

Table 6.3.7.4 lists the proportion of landings by areas IV and VI and years 1972-1998. The percentage landings over various periods might be used as a basis of area-splitting the TAC.

6.3.8 Medium term projections

The input for medium term projections is given in Tables 6.3.7.1 and 6.3.8.1 applying a Ricker model as decided by the WG in 1998 for the assessment of saithe in IV and IIIa. It was also decided to use an average over 10 years for the calculations of stock and catch weights. The results indicate that under the *status quo* fishing scenario the median landings will stabilise at 120,000 t until 2008 (Figure 6.3.8.1). The median SSB is projected to remain at around 150,000 t during the same period.

The tabulated output following the EU/Norway request for medium term forecasts is shown in Table 6.3.8.2.

6.3.9 Long term considerations

Figure 6.3.9.1 shows the stock-recruitment plot. The *status quo* F (0.45) is slightly below Fmed (0.47). F high is estimated to be 0.67. The input parameters for the yield and biomass per recruit are listed in Table 6.3.9.1 and the results are shown in Table 6.3.9.2 and Figure 6.3.9.2. The mean weights in the stock and in the catch are identical and represent long term means (1972-1999). The exploitation pattern is calculated as the 1996-98 mean and the oldest age group defined as a plus group. The resulting F0.1 (0.12) and Fmax (0.22) rescaled to the reference F are very low.

6.3.10 Biological reference points

The SGPAFM used the MBAL concept to define the Bpa of the saithe in the North Sea and Skagerrak. Following this rationality an appropriate Bpa for the combined stock in the North Sea, Skagerrak and West of Scotland might be set close to 200,000 t. There are indications of increased probability of impaired recruitment for SSB values below 200,000 t from the SSB-recruitment plot (Figure 6.3.9.1). Bloss amounts to 106,000 t and is the candidate for Blim.

F reference points were estimated using the PA software. Input settings are given in Table 6.3.10.1 and results are illustrated in Figures 6.3.10.1 and 6.3.10.2. The Flim might be set at Floss which amounts to 0.6 in accordance with the defined values for the saithe in the North Sea and Skagerrak. The 5^{th} % of Floss amounts to 0.45. However, a fishing mortality of 0.45 implies an equilibrium SSB which is below the proposed Bpa (Fig. 6.3.10.2). However an F of 0.4 implies an equilibrium SSB of around 200,000t, so this is proposed as the candidate value for Fpa on the grounds of consistency with Bpa.

Figure 6.3.10.4 shows the history of $F_{3\text{-}6}$ versus SSB. In the last 15 years the SSB was below 200,000 t (candidate for Bpa). The fishing mortality has almost always exceeded 0.4, even though F has shown a recent declining trend. .

The stock of saithe in Sub-areas IV, VI and Division IIIa is considered to be outside safe biological limits.

6.3.11 Comments on the assessment

Saithe assessments across the North Atlantic are believed to be heavily affected by the unpredictable migrations between the various management units. The calibration of the terminal fishing mortality computation is dominated by commercial fleet data while independent stock indicators like scientific surveys represent a low weight. The present stock and catch prediction for 1999-2001 suffers from the lack of a representative data series for recruitment at ages 1-3.

Table 6.3.1.1 Saithe, IV, VI and IIIa
Annual weight and numbers caught, 1972 to 1998.

Year	Wt.('000t)	Nos.(millions)
1972	275	195
1973	260	192
1974	309	183
1975	309	205
1976	362	330
1977	223	135
1978	166	112
1979	136	75
1980	142	81
1981	146	81
1982	190	125
1983	198	126
1984	220	181
1985	226	222
1986	203	180
1987	181	182
1988	141	111
1989	118	94
1990	108	87
1991	116	104
1992	104	78
1993	119	89
1994	115	88
1995	125	81
1996	120	83
1997	113	85
1998	108	82
Min.	104	75
Mean	179	133
Max.	362	330

1

TABLE 6.3.2.1 Saithe, IV, VI and IIIa
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.200	.000
2	.200	.000
3	.200	.000
4	.200	.150
5	.200	.700
6	.200	.900
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

Table 6.3.2.2 Saithe in IIIa, IV and VI. Catch numbers at age Numbers*10**-3

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE							
1,	430,	4708,	4753,	335,	270,	2172,	1253,
2,	23833,	37832,	19206,	74231,	34111,	14125,	20551,
3,	48075,	54332,	66938,	56987,	207823,	27461,	35059,
4,	66095,	37698,	33740,	25864,	53060,	54967,	27269,
5,	25317,	26849,	14123,	10319,	11696,	14755,	18062,
6,	21207,	16061,	20688,	7566,	6253,	5490,	3312,
7,	3672,	8428,	14666,	13657,	3976,	3777,	1138,
8,	2944,	2000,	5199,	9357,	5362,	3447,	1033,
9,	1641,	1357,	1477,	3501,	3586,	3812,	768,
+gp,	1607,	2381,	1955,	2687,	3490,	4701,	3484,
0 TOTALNUM,	194821,	191646,	182745,	204504,	329627,	134707,	111929,
TONSLAND,	275098,	259602,	309439,	308926,	361680,	223395,	166199,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	916,	1321,	5457,	1970,	312,	206,	231,	322,	787,	32,
2,	17756,	24100,	20644,	29570,	36824,	37387,	9415,	7227,	31017,	8762,
3,	16332,	17494,	26178,	31895,	28242,	80933,	134024,	55435,	31220,	32578,
4,	14216,	12341,	8339,	40587,	20604,	32172,	55605,	91223,	97470,	26408,
5,	11182,	9015,	6739,	9174,	26013,	12957,	13281,	15186,	13990,	35323,
6,	8699,	6718,	3675,	5978,	5678,	13011,	4765,	5381,	3158,	3828,
7,	2805,	5658,	3335,	2145,	4893,	1657,	3005,	2603,	1811,	1908,
8,	733,	1150,	3396,	1454,	1494,	1252,	682,	1456,	1240,	1104,
9,	540,	509,	657,	982,	1036,	335,	399,	445,	910,	776,
+gp,	2089,	2302,	2536,	1254,	1327,	646,	742,	900,	700,	680,
0 TOTALNUM,	75268,	80608,	80956,	125009,	126423,	180556,	222149,	180178,	182303,	111399,
TONSLAND,	135967,	142395,	146092,	189861,	197774,	219642,	226129,	202759,	180776,	140778,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	3664,	355,	492,	319,	160,	106,	157,	354,	27,	220,
2,	9871,	5764,	13091,	6679,	10118,	8033,	4338,	8963,	12396,	3520,
3,	22128,	40808,	46117,	18404,	37823,	19958,	26664,	11066,	15036,	10538,
4,	30752,	19583,	29871,	33614,	20828,	40194,	26034,	38861,	19299,	31182,
5,	13187,	11322,	7467,	12753,	11845,	13034,	14797,	11786,	30177,	16148,
6,	10951,	4714,	3583,	3193,	3125,	4297,	3774,	7731,	3676,	15900,
7,	1557,	2776,	1716,	1524,	1568,	947,	3494,	3163,	2640,	2175,
8,	739,	745,	953,	696,	1511,	346,	674,	808,	1012,	1171,
9,	419,	281,	367,	518,	814,	427,	552,	210,	291,	555,
+gp,	488,	364,	458,	422,	1026,	794,	800,	491,	288,	274,
0 TOTALNUM,	93756,	86712,	104115,	78122,	88818,	88136,	81284,	83433,	84842,	81683,
TONSLAND,	117609,	107945,	115576,	104147,	119073,	115256,	125183,	119669,	112740,	107675,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

1

Table 6.3.2.3 Saithe in IIIa, IV and VI. Catch weights at age (kg)

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE							
1,	.3280,	.1640,	.2750,	.2160,	.4590,	.4260,	.3550,
2,	.5490,	.4320,	.5090,	.5020,	.5160,	.4300,	.5160,
3,	.8080,	.8210,	.8610,	.8930,	.7020,	.7600,	.8210,
4,	1.1960,	1.4060,	1.5610,	1.4980,	1.3090,	1.2560,	1.3270,
5,	1.9610,	1.6410,	2.3830,	2.4900,	2.2600,	1.9350,	2.1550,
6,	2.3690,	2.5710,	2.7530,	3.3000,	3.0710,	3.1110,	3.3400,
7,	3.7940,	3.3570,	3.4290,	3.7650,	4.0350,	4.1620,	4.5220,
8,	4.2280,	4.6840,	4.4980,	4.2960,	4.3830,	4.6050,	4.9000,
9,	4.6300,	4.8140,	5.7130,	5.5400,	5.1120,	4.8590,	5.4490,
+gp,	6.3260,	6.4450,	7.8570,	7.5620,	7.1470,	6.5420,	7.4000,
0 SOPCOFAC,	.9998,	.9999,	.9999,	.9999,	1.0004,	.9999,	1.0001,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.4350,	.2590,	.2770,	.2530,	.4130,	.3890,	.1490,	.6290,	.3710,	.5170,
2,	.4060,	.4210,	.5960,	.5080,	.4780,	.5010,	.5550,	.5480,	.4180,	.6380,
3,	1.1070,	.9550,	.9610,	1.0860,	1.0280,	.7950,	.6630,	.6940,	.6740,	.7790,
4,	1.6230,	1.8210,	1.8210,	1.5750,	1.7180,	1.6140,	1.2650,	1.0350,	.8760,	.9810,
5,	2.2380,	2.3910,	2.7170,	2.5290,	2.1490,	2.2970,	1.9500,	1.7940,	1.8240,	1.3860,
6,	3.0950,	3.0300,	3.5870,	3.2200,	3.1380,	2.6900,	2.7720,	2.4320,	3.0750,	2.7910,
7,	4.0500,	4.0900,	4.5360,	4.2070,	3.6910,	3.8960,	3.4070,	3.5720,	4.2100,	4.0240,
8,	5.2740,	5.1260,	5.4780,	5.1250,	4.6320,	4.6650,	4.9500,	4.2090,	5.3300,	5.2540,
9,	6.3080,	5.9390,	6.9800,	5.9050,	5.5050,	6.1830,	5.8650,	5.6510,	6.1280,	6.3220,
+gp,	7.9550,	8.1480,	8.7240,	8.8230,	8.4530,	8.4740,	8.8540,	8.2180,	8.6030,	8.6490,
0 SOPCOFAC,	1.0001,	1.0000,	1.0000,	.9999,	1.0000,	.9998,	1.0002,	1.0002,	1.0002,	.9999,
1										

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.4260,	.2720,	.4790,	.6190,	.3580,	.2870,	.5020,	.2800,	.4320,	.6040,
2,	.7260,	.7030,	.5570,	.6300,	.7440,	.6970,	.7590,	.5100,	.4360,	.6680,
3,	.8950,	.8440,	.7910,	.9640,	.8990,	.9440,	1.0020,	.9670,	.9050,	.8870,
4,	1.0360,	1.1960,	1.1580,	1.1890,	1.2600,	1.1190,	1.2940,	1.1870,	1.1450,	.9630,
5,	1.4200,	1.5830,	1.7520,	1.6070,	1.7540,	1.6010,	1.8160,	1.8070,	1.4520,	1.3900,
6,	1.9980,	2.2470,	2.3650,	2.2420,	2.6360,	2.4340,	2.5620,	2.3680,	2.5870,	1.7400,
7,	3.9140,	3.2420,	3.1650,	3.6680,	3.1850,	3.6170,	3.5550,	2.9520,	3.5560,	2.9490,
8,	5.0170,	4.8580,	4.2220,	4.3300,	3.9800,	4.7870,	4.7670,	4.7050,	4.5250,	3.8880,
9,	6.4300,	6.3150,	6.0660,	5.4120,	5.0800,	6.5480,	5.2670,	6.0920,	6.1580,	5.0030,
+gp,	8.4310,	8.4160,	8.1910,	7.0450,	6.8910,	8.3260,	7.8910,	8.3820,	8.8660,	7.2200,
0 SOPCOFAC,	1.0000,	.9996,	.9999,	1.0000,	1.0001,	.9999,	1.0001,	1.0003,	.9998,	.9998,
1										

Table 6.3.3.1 Saithe in IIIa, IV and VI

```
Saithe in IV, VI and IIIa - Combined tuning data
107
FRATRB_IV
1990 1998
1 1 0 1
2 7
21758  489.433 3379.574  2471.553 1405.540  304.063 290.298
15248  292.123 1381.383  2538.766  731.379  372.239 130.790
 7902  351.996  717.161  1480.817  498.716   73.572  24.402
13527 1025.751 3917.800  2253.440 1162.230  103.625   8.299
14417  434.898 1770.754  3652.840 1381.104  434.086  38.895
14632  192.925 3151.807  1682.869  921.653  225.695  70.393
16241  195.815  895.031  4286.247 1053.226  535.950 107.630
12903  148.823 1087.280  1914.745 3175.192  190.091  83.908
12864  143.953  802.104  2501.398 1889.642 1512.791  53.600
FRATRF_IV
1990 1998
1 1 0 1
2 7
19797 502.155 3675.600 2595.437 1376.791 261.592 250.532
18369 195.501 1132.700 2486.636  686.242 325.004 104.516
 1868  94.574  187.863  374.475  109.585  15.935   5.412
 8059 470.914 1920.268 1142.401  413.298  23.373   1.717
 8650 209.568  862.832 1664.065  559.652 165.489  14.853
 8844  67.656 1304.890  788.320  493.633 128.358  43.283
 7824 125.861  379.124 1790.438  344.790 181.635  36.854
 6767 112.318  635.062 1147.502 1643.947  68.276  28.562
10031 125.282  626.690 2113.432 1361.636 988.368  34.816
NORTRL_IV
1989 1998
1 1 0 1
3 9
17781   649  2126  835  694  309  154   65
10249   804   781  924  519  203   63   12
28768 14348  4968 1194  518  203   51   56
35621  3447  9532 4031 1087  465  165  109
24572  7635  4028 2878 1018  526  365  252
30628  3939 16098 4276  926  251   72  203
32489  4347  9366 5412  833 1644  273  203
40400  3790 14429 4414 2765 1144  189   16
36026  2894  5266 9837 1419  892  299   72
24233  1342  8081 5329 5554  963  480  240
ENGGFS_IV
1989 1998
1 1 0.5 0.75
3 8
1  178.408  161.070  45.107  52.403  7.995  3.872
1  872.711   83.540  49.492  21.056 30.292 12.380
1  426.470   97.186  22.129  19.685  4.524 10.191
1   94.232  230.703  42.716  15.925  4.665 10.867
1 1091.483  413.094  83.553  33.268  1.623  9.756
1  123.263   75.181  55.155  49.261  9.432  4.716
1 1366.470  262.193  98.051  33.370 20.760  6.372
1  296.650  691.866  72.652  43.622 17.702  3.110
1  450.000  287.584 452.022  24.024 22.195  8.595
1   53.790  353.759 126.577 123.314  9.312  9.312
FRASAI_VI
1990 1998
1 1 0 1
5 7
59465 684  477 330
51011 619  287 184
44974 528  192  50
56762 855  196  70
41971 600  245  77
42174 516  257 118
33655 298  202  50
24262 640  120  47
33360 359  401  40
```

Table 6.3.3.1 continued

```
SCOLTR_IV+VI
1989 1998
1 1 0 1
5 7
623326 191.218 311.675  54.991
585390 332.604  94.125 105.046
617957 262.891 123.379  66.874
663243 223.674  49.397  24.078
636989 245.524 121.282  33.495
655279 184.194 149.575  51.725
617641 283.081 115.441  56.061
660154 161.609 129.105  69.136
659054 875.805 131.943  75.736
570325 307.944 394.840  56.611
SCOGFS_IV
1989 1998
1 1 0.5 0.75
2 3
1   290  1320
1  3130  4010
1   700  3180
1   310  1840
1  2010  7890
1   810  1390
1   270 13920
1  1630  4050
1   200  3670
1   140  1860
```

Table 6.3.4.1 Saithe in IIIa, IV and VI (run: XSAHJR/X01)

Lowestoft VPA Version 3.1

13/10/1999 19:36

Extended Survivors Analysis

Saithe in IV, VI and IIIa : 1972 - 1998

CPUE data from file c:\eigene Dateien\ices\ns1999\stocks\saiall\SAIALLT2.DAT

Catch data for 27 years. 1972 to 1998. Ages 1 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FRATRB_IV ,	1990,	1998,	2,	7,	.000,	1.000
FRATRF_IV ,	1990,	1998,	2,	7,	.000,	1.000
NORTRL_IV ,	1989,	1998,	3,	9,	.000,	1.000
ENGGFS_IV ,	1989,	1998,	3,	8,	.500,	.750
FRASAI_VI ,	1990,	1998,	5,	7,	.000,	1.000
SCOLTR_IV+VI ,	1989,	1998,	5,	7,	.000,	1.000
SCOGFS_IV ,	1989,	1998,	2,	3,	.500,	.750

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 46 iterations

1

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities

Age,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1,	.019,	.003,	.002,	.002,	.001,	.001,	.001,	.004,	.000,	.001
2,	.072,	.037,	.120,	.039,	.092,	.034,	.040,	.068,	.180,	.071
3,	.377,	.476,	.459,	.247,	.324,	.264,	.153,	.136,	.155,	.229
4,	.739,	.684,	.789,	.732,	.491,	.688,	.657,	.349,	.373,	.553
5,	.700,	.676,	.610,	.983,	.625,	.663,	.588,	.721,	.504,	.620
6,	.862,	.585,	.468,	.578,	.694,	.486,	.404,	.716,	.516,	.547
7,	.478,	.551,	.436,	.371,	.635,	.464,	.970,	.714,	.573,	.668
8,	.653,	.444,	.368,	.315,	.786,	.273,	.719,	.621,	.522,	.543
9,	.666,	.558,	.409,	.350,	.754,	.531,	.945,	.512,	.476,	.615

1
XSA population numbers (Thousands)

Table 6.3.4.1 continued

AGE

YEAR	1	2	3	4	5	6	7	8	9
1989	2.18E+05	1.56E+05	7.78E+04	6.51E+04	2.89E+04	2.10E+04	4.53E+03	1.70E+03	9.52E+02
1990	1.56E+05	1.75E+05	1.19E+05	4.37E+04	2.55E+04	1.18E+04	7.25E+03	2.30E+03	7.26E+02
1991	2.35E+05	1.28E+05	1.38E+05	6.05E+04	1.81E+04	1.06E+04	5.37E+03	3.42E+03	1.21E+03
1992	1.56E+05	1.92E+05	9.28E+04	7.16E+04	2.25E+04	8.03E+03	5.43E+03	2.84E+03	1.94E+03
1993	3.21E+05	1.27E+05	1.51E+05	5.93E+04	2.82E+04	6.90E+03	3.69E+03	3.07E+03	1.70E+03
1994	1.49E+05	2.63E+05	9.50E+04	8.93E+04	2.97E+04	1.23E+04	2.82E+03	1.60E+03	1.15E+03
1995	1.85E+05	1.22E+05	2.08E+05	5.97E+04	3.68E+04	1.25E+04	6.22E+03	1.45E+03	9.98E+02
1996	1.02E+05	1.51E+05	9.59E+04	1.46E+05	2.53E+04	1.67E+04	6.85E+03	1.93E+03	5.79E+02
1997	6.96E+04	8.33E+04	1.16E+05	6.85E+04	8.43E+04	1.01E+04	6.69E+03	2.75E+03	8.49E+02
1998	1.86E+05	5.70E+04	5.70E+04	8.11E+04	3.86E+04	4.17E+04	4.93E+03	3.09E+03	1.33E+03

Estimated population abundance at 1st Jan 1999

, 0.00E+00, 1.52E+05, 4.35E+04, 3.71E+04, 3.82E+04, 1.70E+04, 1.98E+04, 2.07E+03, 1.47E+03,

Taper weighted geometric mean of the VPA populations:

, 2.10E+05, 1.73E+05, 1.32E+05, 7.90E+04, 3.58E+04, 1.67E+04, 7.74E+03, 3.84E+03, 1.92E+03,

Standard error of the weighted Log(VPA populations) :

, .4947, .4957, .4602, .4266, .4777, .6375, .6767, .7340, .7974,

1

Log catchability residuals.

Fleet : FRATRB_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	-.24	-.05	.35	1.32	-.36	-.41	-.70	-.10	.20
3	99.99	.36	-.34	-.03	.68	.26	-.02	-.61	-.37	.07
4	99.99	.12	.22	.15	.11	.21	-.19	-.39	-.20	-.02
5	99.99	-.08	-.06	.15	.09	.16	-.51	-.05	-.01	.30
6	99.99	-.31	.30	-.34	-.33	.37	-.35	.25	-.13	.54
7	99.99	.79	.60	-.46	-1.58	.10	.10	.22	.16	.06
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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
Mean Log q	-15.5087	-13.5911	-12.5692	-12.4023	-12.9674	-13.6454
S.E(Log q)	.5880	.4014	.2152	.2281	.3608	.6875

Regression statistics :

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	1.34	-.523	16.76	.26	9	.82	-15.51
3	.88	.321	13.36	.52	9	.38	-13.59
4	1.51	-1.651	13.28	.60	9	.29	-12.57
5	1.02	-.122	12.45	.78	9	.25	-12.40
6	.67	2.635	11.81	.90	9	.18	-12.97
7	.48	1.530	10.98	.55	9	.30	-13.65

1

Table 6.3.4.1 continued

Fleet : FRATRF_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	-.06	-.57	.55	1.12	-.51	-.89	-.35	.33	.37
3	99.99	.64	-.62	.17	.58	.15	-.29	-.64	-.16	.18
4	99.99	.33	.08	.28	.02	.00	-.38	-.47	.00	.13
5	99.99	.19	-.11	.27	-.23	-.04	-.43	-.24	.17	.42
6	99.99	-.05	.30	-.11	-.98	.23	-.10	.22	-.19	.68
7	99.99	1.07	.52	-.20	-2.30	-.02	.45	.21	.06	.21
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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
Mean Log q	-15.5755	-13.6916	-12.6377	-12.5975	-13.2849	-13.9761
S.E(Log q)	.6436	.4668	.2678	.2812	.4582	.9387

Regression statistics :

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	1.62	-.741	17.93	.17	9	1.08	-15.58
3	1.20	-.354	14.11	.30	9	.60	-13.69
4	1.88	-1.933	13.92	.41	9	.43	-12.64
5	.89	.539	12.34	.77	9	.26	-12.60
6	.59	3.414	11.70	.91	9	.18	-13.28
7	.37	1.784	10.58	.54	9	.31	-13.98

1

Fleet : NORTRL_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	No data for this fleet at this age									
3	-.75	-.36	1.33	-.01	.71	.26	-.53	-.12	-.45	-.08
4	-.43	-.51	.03	.28	-.13	.71	.50	-.31	-.44	.30
5	-.81	-.04	-.50	.44	.10	.24	.17	.18	-.20	.41
6	-.44	.28	-.70	.15	.66	-.33	-.55	.28	.15	.51
7	-.02	-.33	-1.12	-.54	.46	-.31	.94	.15	-.02	.80
8	.33	-.40	-2.08	-.96	.34	-1.08	.49	-.42	-.25	.52
9	.06	-.86	-.92	-.97	.55	.41	.66	-1.74	-.51	.69

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-13.5526	-12.3444	-12.1075	-12.2665	-12.1257	-12.1257	-12.1257
S.E(Log q)	.6273	.4313	.3995	.4700	.6229	.9141	.8941

Regression statistics :

Table 6.3.4.1 continued

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
3,	.73,	.612,	13.03,	.40,	10,	.48,	-13.55,
4,	.82,	.483,	12.13,	.46,	10,	.37,	-12.34,
5,	.97,	.101,	12.05,	.54,	10,	.41,	-12.11,
6,	.97,	.097,	12.18,	.56,	10,	.48,	-12.27,
7,	.97,	.046,	12.01,	.20,	10,	.64,	-12.13,
8,	4.08,	-.826,	27.02,	.01,	10,	3.47,	-12.48,
9,	.50,	1.352,	9.70,	.48,	10,	.41,	-12.39,

1

Fleet : ENGGFS_IV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	No data for this fleet at this age									
3	-.16,	1.06,	.18,	-1.06,	.95,	-.80,	.75,	-.01,	.23,	-1.14
4	-.10,	-.39,	-.50,	.16,	.78,	-1.21,	.42,	.31,	.20,	.35
5	-.39,	-.19,	-.69,	-.02,	.20,	-.24,	.07,	.23,	.72,	.30
6	.12,	-.38,	-.42,	-.29,	.68,	.36,	-.10,	.07,	-.14,	.10
7	-.10,	.80,	-.87,	-.89,	-1.40,	.53,	.84,	.42,	.59,	.08
8	.26,	.99,	.35,	.57,	.68,	.28,	.96,	-.11,	.50,	.47
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8
Mean Log q	-5.5554,	-5.3151,	-5.5108,	-5.4536,	-5.8132,	-5.8132,
S.E(Log q)	.8014,	.5729,	.3991,	.3411,	.7933,	.6166,

Regression statistics :

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
3,	.37,	3.450,	9.36,	.79,	10,	.20,	-5.56,
4,	.95,	.087,	5.62,	.26,	10,	.58,	-5.32,
5,	.57,	3.670,	7.59,	.90,	10,	.15,	-5.51,
6,	.98,	.075,	5.52,	.70,	10,	.36,	-5.45,
7,	.51,	1.117,	7.17,	.39,	10,	.40,	-5.81,
8,	.95,	.139,	5.44,	.50,	10,	.33,	-5.32,

1

Fleet : FRASAI_VI

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	99.99,	.08,	.44,	.35,	.22,	.13,	-.27,	-.16,	-.37,	-.43
6	99.99,	.38,	.08,	.13,	.12,	-.02,	-.03,	-.20,	.03,	-.49
7	99.99,	.69,	.50,	-.71,	-.11,	.49,	.33,	-.50,	-.28,	-.41
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Table 6.3.4.1 continued

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	5,	6,	7
Mean Log q,	-14.2803,	-14.2168,	-14.4173,
S.E(Log q),	.3180,	.2431,	.5111,

Regression statistics :

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
5,	2.25,	-3.207,	19.19,	.49,	9,	.49,	-14.28,
6,	1.62,	-3.748,	17.17,	.84,	9,	.24,	-14.22,
7,	1.29,	-.368,	16.12,	.19,	9,	.70,	-14.42,

1

Fleet : SCOLTR_IV+VI

Age ,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
2 ,	No data for this fleet at this age									
3 ,	No data for this fleet at this age									
4 ,	No data for this fleet at this age									
5 ,	-.26,	.47,	.50,	.20,	-.04,	-.39,	-.15,	-.35,	.05,	-.02
6 ,	.48,	-.20,	.07,	-.59,	.55,	.06,	-.19,	-.30,	.14,	-.02
7 ,	.09,	.36,	.11,	-1.03,	-.15,	.45,	.01,	-.05,	.01,	.21
8 ,	No data for this fleet at this age									
9 ,	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	5,	6,	7
Mean Log q,	-17.6825,	-17.5424,	-17.5247,
S.E(Log q),	.3127,	.3454,	.4047,

Regression statistics :

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
5,	1.24,	-.743,	19.41,	.56,	10,	.40,	-17.68,
6,	.99,	.061,	17.43,	.70,	10,	.36,	-17.54,
7,	1.28,	-.464,	20.05,	.25,	10,	.54,	-17.52,

1

Fleet : SCOGFS_IV

Age ,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
2 ,	-.84,	1.41,	.28,	-.99,	1.32,	-.35,	-.68,	.92,	-.51,	-.56
3 ,	-.51,	.24,	-.16,	-.43,	.58,	-.73,	.72,	.25,	-.02,	.05
4 ,	No data for this fleet at this age									
5 ,	No data for this fleet at this age									

Table 6.3.4.1 continued

```
     6 , No data for this fleet at this age
     7 , No data for this fleet at this age
     8 , No data for this fleet at this age
     9 , No data for this fleet at this age



 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


    Age ,         2,         3
 Mean Log q,   -5.2843,   -3.2069,
 S.E(Log q),     .9117,     .4704,




 Regression statistics :


 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,     .78,     .380,      6.72,     .27,     10,     .75,   -5.28,
  3,     .56,    2.095,      6.86,     .74,     10,     .23,   -3.21,
1


 Terminal year survivor and F summaries :

 Age  1   Catchability constant w.r.t. time and dependent on age

 Year class = 1997

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FRATRB_IV          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FRATRF_IV          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 NORTRL_IV          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 ENGGFS_IV          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FRASAI_VI          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 SCOLTR_IV+VI       ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 SCOGFS_IV          ,         1.,   .000,       .000,    .00,   0,  .000,     .000

   F shrinkage mean  ,    151713.,    .50,,,,                       1.000,     .001

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    151713.,       .50,      .00,    1,    .000,   .001



1
 Age  2   Catchability constant w.r.t. time and dependent on age

 Year class = 1996

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FRATRB_IV          ,     52975.,   .620,       .000,    .00,   1,  .256,     .058
 FRATRF_IV          ,     63213.,   .678,       .000,    .00,   1,  .214,     .049
 NORTRL_IV          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 ENGGFS_IV          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FRASAI_VI          ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 SCOLTR_IV+VI       ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 SCOGFS_IV          ,     24940.,   .956,       .000,    .00,   1,  .108,     .120

   F shrinkage mean  ,     36778.,    .50,,,,                        .422,     .083
```

Table 6.3.4.1 continued

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
43483.,	.32,	.18,	4,	.573,	.071

Age 3 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
FRATRB_IV	,	38015.,	.351,	.078,	.22,	2,	.282,	.224
FRATRF_IV	,	46357.,	.400,	.072,	.18,	2,	.216,	.187
NORTRL_IV	,	34097.,	.658,	.000,	.00,	1,	.084,	.247
ENGGFS_IV	,	11839.,	.841,	.000,	.00,	1,	.052,	.591
FRASAI_VI	,	1.,	.000,	.000,	.00,	0,	.000,	.000
SCOLTR_IV+VI	,	1.,	.000,	.000,	.00,	0,	.000,	.000
SCOGFS_IV	,	35295.,	.440,	.217,	.49,	2,	.183,	.239
F shrinkage mean	,	41335.,	.50,,,,				.183,	.208

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
37093.,	.19,	.11,	9,	.561,	.229

1

Age 4 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
FRATRB_IV	,	31526.,	.229,	.169,	.74,	3,	.318,	.639
FRATRF_IV	,	38807.,	.240,	.122,	.51,	3,	.290,	.546
NORTRL_IV	,	41333.,	.374,	.340,	.91,	2,	.121,	.520
ENGGFS_IV	,	52183.,	.490,	.056,	.11,	2,	.070,	.432
FRASAI_VI	,	1.,	.000,	.000,	.00,	0,	.000,	.000
SCOLTR_IV+VI	,	1.,	.000,	.000,	.00,	0,	.000,	.000
SCOGFS_IV	,	45063.,	.439,	.377,	.86,	2,	.078,	.486
F shrinkage mean	,	41823.,	.50,,,,				.123,	.516

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
38164.,	.14,	.08,	13,	.584,	.553

Age 5 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
FRATRB_IV	,	16422.,	.186,	.200,	1.08,	4,	.252,	.636
FRATRF_IV	,	18572.,	.192,	.238,	1.24,	4,	.240,	.580
NORTRL_IV	,	18198.,	.285,	.277,	.97,	3,	.111,	.589
ENGGFS_IV	,	21764.,	.324,	.068,	.21,	3,	.090,	.514
FRASAI_VI	,	11055.,	.335,	.000,	.00,	1,	.095,	.842
SCOLTR_IV+VI	,	16657.,	.328,	.000,	.00,	1,	.099,	.630
SCOGFS_IV	,	18112.,	.439,	.375,	.85,	2,	.033,	.592
F shrinkage mean	,	16801.,	.50,,,,				.079,	.626

Weighted prediction :

Table 6.3.4.1 continued

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17012.,	.10,	.08,	19,	.814,	.620

1

Age 6 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
FRATRB_IV	,	21137.,	.176,	.180,	1.02,	5,	.210,	.519
FRATRF_IV	,	20917.,	.186,	.220,	1.18,	5,	.178,	.523
NORTRL_IV	,	20301.,	.259,	.227,	.88,	4,	.103,	.536
ENGGFS_IV	,	26870.,	.251,	.164,	.65,	4,	.128,	.429
FRASAI_VI	,	12587.,	.230,	.059,	.26,	2,	.163,	.762
SCOLTR_IV+VI	,	19927.,	.251,	.034,	.14,	2,	.131,	.543
SCOGFS_IV	,	32734.,	.438,	.434,	.99,	2,	.019,	.364
F shrinkage mean	,	18820.,	.50,,,,				.068,	.568

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
19764.,	.09,	.08,	25,	.870,	.547

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet, ,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRB_IV	,	2005.,	.201,	.105,	.52,	6,	.168,	.684
FRATRF_IV	,	1785.,	.213,	.120,	.57,	6,	.130,	.743
NORTRL_IV	,	3085.,	.282,	.144,	.51,	5,	.105,	.493
ENGGFS_IV	,	2042.,	.262,	.105,	.40,	5,	.118,	.675
FRASAI_VI	,	1815.,	.226,	.131,	.58,	3,	.179,	.734
SCOLTR_IV+VI	,	2214.,	.235,	.153,	.65,	3,	.181,	.636
SCOGFS_IV	,	1490.,	.439,	.812,	1.85,	2,	.008,	.842
F shrinkage mean	,	2033.,	.50,,,,				.110,	.677

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2069.,	.10,	.05,	31,	.502,	.668

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1990

Fleet, ,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRB_IV	,	1530.,	.203,	.161,	.79,	6,	.142,	.526
FRATRF_IV	,	1397.,	.214,	.143,	.67,	6,	.110,	.565
NORTRL_IV	,	1941.,	.309,	.107,	.35,	6,	.116,	.436
ENGGFS_IV	,	1893.,	.291,	.156,	.54,	6,	.154,	.445
FRASAI_VI	,	1160.,	.230,	.026,	.11,	3,	.151,	.649
SCOLTR_IV+VI	,	1300.,	.241,	.094,	.39,	3,	.157,	.596
SCOGFS_IV	,	1910.,	.439,	.635,	1.45,	2,	.007,	.441
F shrinkage mean	,	1320.,	.50,,,,				.163,	.589

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1471.,	.12,	.05,	33,	.459,	.543

Table 6.3.4.1 continued

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRB_IV ,	574.,	.189,	.106,	.56,	6,	.129,	.629
FRATRF_IV ,	578.,	.200,	.060,	.30,	6,	.102,	.625
NORTRL_IV ,	648.,	.330,	.182,	.55,	7,	.135,	.574
ENGGFS_IV ,	691.,	.277,	.162,	.59,	6,	.133,	.546
FRASAI_VI ,	527.,	.221,	.165,	.75,	3,	.129,	.669
SCOLTR_IV+VI ,	492.,	.229,	.093,	.41,	3,	.128,	.703
SCOGFS_IV ,	438.,	.439,	.280,	.64,	2,	.008,	.764
F shrinkage mean ,	623.,	.50,,,,				.236,	.591

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
591.,	.14,	.05,	34,	.338,	.615

Table 6.3.4.2 Saithe in IIIa, IV and VI. Fishing mortality (run: XSAHJR/X01)

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE							
1,	.0017,	.0174,	.0078,	.0017,	.0019,	.0166,	.0111,
2,	.1320,	.2071,	.0916,	.1612,	.2323,	.1295,	.2147,
3,	.3711,	.4990,	.6879,	.4269,	.9112,	.2973,	.5431,
4,	.4397,	.5628,	.6748,	.6292,	.9305,	.6548,	.5445,
5,	.2767,	.3202,	.4242,	.4462,	.6615,	.7373,	.4639,
6,	.4925,	.2838,	.4388,	.4243,	.5383,	.7713,	.3552,
7,	.3537,	.3695,	.4556,	.5872,	.4143,	.7468,	.3486,
8,	.4052,	.3317,	.4106,	.5974,	.4831,	.7843,	.4634,
9,	.4201,	.3303,	.4382,	.5407,	.4822,	.7752,	.3917,
+gp,	.4201,	.3303,	.4382,	.5407,	.4822,	.7752,	.3917,
0 FBAR 3- 6,	.3950,	.4164,	.5564,	.4817,	.7604,	.6152,	.4767,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.0035,	.0076,	.0275,	.0061,	.0007,	.0005,	.0014,	.0017,	.0068,	.0002,
2,	.2145,	.1188,	.1569,	.2039,	.1505,	.1029,	.0290,	.0561,	.2175,	.0970,
3,	.2645,	.3395,	.1832,	.3864,	.3063,	.5724,	.6436,	.2380,	.3630,	.3736,
4,	.4421,	.3278,	.2684,	.4791,	.4654,	.6904,	1.0450,	1.3899,	.8606,	.6018,
5,	.4502,	.5631,	.2993,	.5339,	.6562,	.6074,	.6961,	.9542,	.8316,	.9264,
6,	.4265,	.5400,	.4724,	.4749,	.7622,	.8360,	.4705,	.6888,	.5201,	.5682,
7,	.5818,	.5491,	.5694,	.5630,	.9359,	.5232,	.4600,	.5123,	.5234,	.6999,
8,	.3978,	.5029,	.7687,	.5252,	1.0302,	.6621,	.4240,	.4241,	.4932,	.7175,
9,	.4722,	.5350,	.6088,	.5252,	.9193,	.6800,	.4548,	.5462,	.5163,	.6680,
+gp,	.4722,	.5350,	.6088,	.5252,	.9193,	.6800,	.4548,	.5462,	.5163,	.6680,
0 FBAR 3- 6,	.3958,	.4426,	.3058,	.4686,	.5475,	.6765,	.7138,	.8177,	.6438,	.6175,

1

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
1,	.0187,	.0025,	.0023,	.0023,	.0006,	.0008,	.0009,	.0038,	.0004,	.0013,	.0019,
2,	.0724,	.0370,	.1201,	.0393,	.0920,	.0344,	.0401,	.0678,	.1798,	.0707,	.1061,
3,	.3771,	.4763,	.4594,	.2474,	.3243,	.2642,	.1530,	.1364,	.1551,	.2288,	.1734,
4,	.7387,	.6835,	.7885,	.7323,	.4911,	.6876,	.6572,	.3486,	.3730,	.5535,	.4250,
5,	.7000,	.6765,	.6103,	.9831,	.6250,	.6629,	.5883,	.7214,	.5036,	.6200,	.6150,
6,	.8619,	.5845,	.4680,	.5785,	.6944,	.4857,	.4043,	.7155,	.5155,	.5469,	.5927,
7,	.4781,	.5507,	.4355,	.3711,	.6346,	.4637,	.9701,	.7136,	.5726,	.6684,	.6515,
8,	.6530,	.4436,	.3681,	.3152,	.7857,	.2729,	.7192,	.6212,	.5224,	.5426,	.5621,
9,	.6664,	.5584,	.4094,	.3502,	.7537,	.5312,	.9453,	.5119,	.4762,	.6154,	.5345,
+gp,	.6664,	.5584,	.4094,	.3502,	.7537,	.5312,	.9453,	.5119,	.4762,	.6154,	
0 FBAR 3- 6,	.6694,	.6052,	.5816,	.6353,	.5337,	.5251,	.4507,	.4805,	.3868,	.4873,	

1

Table 6.3.4.3 Saithe in IIIa, IV and VI. Stock number at age (start of year) Numbers *103 (run: XSAHJR/X01)**

	YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
	AGE							
	1,	273435,	301509,	678482,	222475,	157292,	145996,	125535,
	2,	213035,	223481,	242594,	551193,	181844,	128535,	117566,
	3,	171369,	152853,	148739,	181241,	384112,	118017,	92455,
	4,	205320,	96805,	75984,	61209,	96824,	126438,	71776,
	5,	115735,	108296,	45147,	31681,	26711,	31262,	53783,
	6,	60266,	71848,	64371,	24184,	16601,	11286,	12244,
	7,	13622,	30153,	44292,	33984,	12954,	7934,	4273,
	8,	9765,	7830,	17061,	22993,	15466,	7008,	3078,
	9,	5287,	5331,	4601,	9264,	10358,	7811,	2619,
	+gp,	5133,	9288,	6036,	7035,	9984,	9495,	11784,
0	TOTAL,	1072968,	1007394,	1327307,	1145260,	912146,	593781,	495113,

	YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
	AGE										
	1,	291409,	193414,	222435,	358042,	516422,	444448,	179092,	214510,	128820,	190914,
	2,	101646,	237757,	157158,	177177,	291357,	422528,	363697,	146419,	175335,	104756,
	3,	77659,	67154,	172852,	109991,	118304,	205223,	312108,	289251,	113339,	115487,
	4,	43973,	48804,	39152,	117833,	61193,	71305,	94791,	134262,	186659,	64545,
	5,	34091,	23139,	28791,	24509,	59749,	31458,	29269,	27295,	27383,	64629,
	6,	27690,	17794,	10787,	17474,	11766,	25380,	14031,	11946,	8607,	9760,
	7,	7028,	14800,	8490,	5507,	8898,	4495,	9007,	7176,	4912,	4189,
	8,	2468,	3216,	6997,	3933,	2568,	2857,	2181,	4655,	3520,	2383,
	9,	1586,	1358,	1592,	2656,	1904,	750,	1207,	1169,	2494,	1760,
	+gp,	6076,	6076,	6075,	3357,	2399,	1428,	2223,	2338,	1899,	1523,
0	TOTAL,	593627,	613511,	654330,	820479,	1074560,	1209874,	1007607,	839023,	652966,	559946,
1											

	YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	GMST 72-96	GMST 87-96
	AGE													
	1,	218244,	156497,	234699,	155746,	320846,	149042,	184789,	102086,	69650,	185542,	**(0)**[1],	220693,	**175487**,
	2,	156278,	175367,	127808,	191710,	127226,	262542,	121929,	151151,	83261,	57000,	**(151713)**[1],	186515,	**154184**,
	3,	77839,	119018,	138363,	92795,	150916,	95008,	207682,	95902,	115642,	56952,	**(43483)**[1],	137484,	**116091**,
	4,	65075,	43707,	60519,	71554,	59321,	89336,	59727,	145909,	68505,	81074,	37093,	79329,	76487,
	5,	28950,	25453,	18065,	22520,	28168,	29722,	36773,	25344,	84298,	38625,	38164,	34498,	28953,
	6,	20952,	11770,	10595,	8034,	6899,	12344,	12541,	16718,	10086,	41712,	17012,	16375,	11215,
	7,	4527,	7245,	5371,	5432,	3688,	2821,	6219,	6853,	6692,	4931,	19764,	7924,	4944,
	8,	1703,	2298,	3420,	2845,	3068,	1601,	1452,	1930,	2749,	3090,	2069,	3928,	2314,
	9,	952,	726,	1207,	1938,	1699,	1145,	998,	579,	849,	1335,	1471,	2008,	1231,
	+gp,	1095,	930,	1494,	1567,	2112,	2107,	1421,	1341,	832,	651,	879,		
0	TOTAL,	575614,	543011,	601541,	554141,	703944,	645668,	633532,	547813,	442562,	470912,	311647,		
1														

[1]**) Overwritten in the prediction with the GM 87-96**

Table 6.3.4.4 Saithe in IIIa, IV and VI. Summary table. Note 1999 values from prediction. (run: XSAHJR/X01)

Run title : Saithe in IV, VI and IIIa : 1972 - 1998 ,

At 13/10/1999 19:39

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 6,
1972,	273435,	1110323,	474122,	275098,	.5802,	.3950,
1973,	301509,	993453,	534492,	259602,	.4857,	.4164,
1974,	678482,	1143865,	554922,	309439,	.5576,	.5564,
1975,	222475,	1068236,	472050,	308926,	.6544,	.4817,
1976,	157292,	918133,	351519,	361680,	1.0289,	.7604,
1977,	145996,	626928,	263127,	223395,	.8490,	.6152,
1978,	125535,	569056,	268102,	166199,	.6199,	.4767,
1979,	291409,	587185,	241063,	135967,	.5640,	.3958,
1980,	193414,	547024,	235171,	142395,	.6055,	.4426,
1981,	222435,	650560,	241229,	146092,	.6056,	.3058,
1982,	358042,	692505,	210494,	189861,	.9020,	.4686,
1983,	516422,	820115,	214375,	197774,	.9226,	.5475,
1984,	444448,	850934,	176877,	219642,	1.2418,	.6765,
1985,	179092,	719590,	161189,	226129,	1.4029,	.7138,
1986,	214510,	703935,	152317,	202759,	1.3312,	.8177,
1987,	128820,	508457,	154368,	180776,	1.1711,	.6438,
1988,	190914,	489310,	150392,	140778,	.9361,	.6175,
1989,	218244,	468100,	118181,	117609,	.9952,	.6694,
1990,	156497,	432377,	106910,	107945,	1.0097,	.6052,
1991,	234699,	470842,	106217,	115576,	1.0881,	.5816,
1992,	155746,	499687,	108075,	104147,	.9637,	.6353,
1993,	320846,	534676,	109311,	119073,	1.0893,	.5337,
1994,	149042,	535960,	118254,	115256,	.9746,	.5251,
1995,	184789,	615105,	132758,	125183,	.9429,	.4507,
1996,	102086,	501064,	137742,	119669,	.8688,	.4805,
1997,	175487[1],	446817,	169769,	112740,	.6641,	.3868,
1998,	175487[1],	442938,	152550,	107675,	.7058,	.4873,
1999,	175487[1],	492000,	169000,			
Arith. Mean ,	237829,	664710,	226503,	178940,	.8800,	.5440,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

[1]) GM(87-96)

Table 6.3.7.1. Saithe,IV, VI and IIIa (run:MANHJR02)
Input data for catch forecast.

Saithe combined (Sub-areas IIIa, IV and VI)

The SAS System

Prediction with management option table: Input data

Year: 1999								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	175487.00	0.2000	0.0000	0.0000	0.0000	0.439	0.0000	0.439
2	154184.00	0.2000	0.0000	0.0000	0.0000	0.538	0.1100	0.538
3	116089.00	0.2000	0.0000	0.0000	0.0000	0.920	0.1700	0.920
4	37092.000	0.2000	0.1500	0.0000	0.0000	1.098	0.4300	1.098
5	38163.000	0.2000	0.7000	0.0000	0.0000	1.550	0.6100	1.550
6	17012.000	0.2000	0.9000	0.0000	0.0000	2.232	0.5900	2.232
7	19763.000	0.2000	1.0000	0.0000	0.0000	3.152	0.6500	3.152
8	2067.000	0.2000	1.0000	0.0000	0.0000	4.373	0.5600	4.373
9	1470.000	0.2000	1.0000	0.0000	0.0000	5.751	0.5400	5.751
10+	879.000	0.2000	1.0000	0.0000	0.0000	8.156	0.5400	8.156
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	175487.00	0.2000	0.0000	0.0000	0.0000	0.439	0.0000	0.439
2	.	0.2000	0.0000	0.0000	0.0000	0.538	0.1100	0.538
3	.	0.2000	0.0000	0.0000	0.0000	0.920	0.1700	0.920
4	.	0.2000	0.1500	0.0000	0.0000	1.098	0.4300	1.098
5	.	0.2000	0.7000	0.0000	0.0000	1.550	0.6100	1.550
6	.	0.2000	0.9000	0.0000	0.0000	2.232	0.5900	2.232
7	.	0.2000	1.0000	0.0000	0.0000	3.152	0.6500	3.152
8	.	0.2000	1.0000	0.0000	0.0000	4.373	0.5600	4.373
9	.	0.2000	1.0000	0.0000	0.0000	5.751	0.5400	5.751
10+	.	0.2000	1.0000	0.0000	0.0000	8.156	0.5400	8.156
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	175487.00	0.2000	0.0000	0.0000	0.0000	0.439	0.0000	0.439
2	.	0.2000	0.0000	0.0000	0.0000	0.538	0.1100	0.538
3	.	0.2000	0.0000	0.0000	0.0000	0.920	0.1700	0.920
4	.	0.2000	0.1500	0.0000	0.0000	1.098	0.4300	1.098
5	.	0.2000	0.7000	0.0000	0.0000	1.550	0.6100	1.550
6	.	0.2000	0.9000	0.0000	0.0000	2.232	0.5900	2.232
7	.	0.2000	1.0000	0.0000	0.0000	3.152	0.6500	3.152
8	.	0.2000	1.0000	0.0000	0.0000	4.373	0.5600	4.373
9	.	0.2000	1.0000	0.0000	0.0000	5.751	0.5400	5.751
10+	.	0.2000	1.0000	0.0000	0.0000	8.156	0.5400	8.156
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANHJR02
Date and time: 18OCT99:12:40

Table 6.3.7.2. Saithe,IV, VI and IIIa (run:MANHJR02)
Catch forecast output.

Saithe combined (Sub-areas IIIa, IV and VI) The SAS System 21:07 Monday, ...

(cont.) Prediction with management option table

Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4500	491500	168638	113008	0.0000	0.0000	490827	144713	0	627153	244124
.	.	.	.	.	0.1000	0.0450	.	144713	13247	610689	231799
.	.	.	.	.	0.2000	0.0900	.	144713	25903	594983	220127
.	.	.	.	.	0.3000	0.1350	.	144713	37999	579996	209074
.	.	.	.	.	0.4000	0.1800	.	144713	49564	565691	198605
.	.	.	.	.	0.5000	0.2250	.	144713	60623	552032	188690
.	.	.	.	.	0.6000	0.2700	.	144713	71204	538987	179297
.	.	.	.	.	0.7000	0.3150	.	144713	81328	526524	170398
.	.	.	.	.	0.8000	0.3600	.	144713	91021	514614	161967
.	.	.	.	.	0.9000	0.4050	.	144713	100302	503227	153977
.	.	.	.	.	1.0000	0.4500	.	144713	109192	492339	146407
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANHJR02
Date and time : 18OCT99:12:40
Computation of ref. F: Simple mean, age 3 - 6
Basis for 1999 : F factors

Table 6.3.7.3

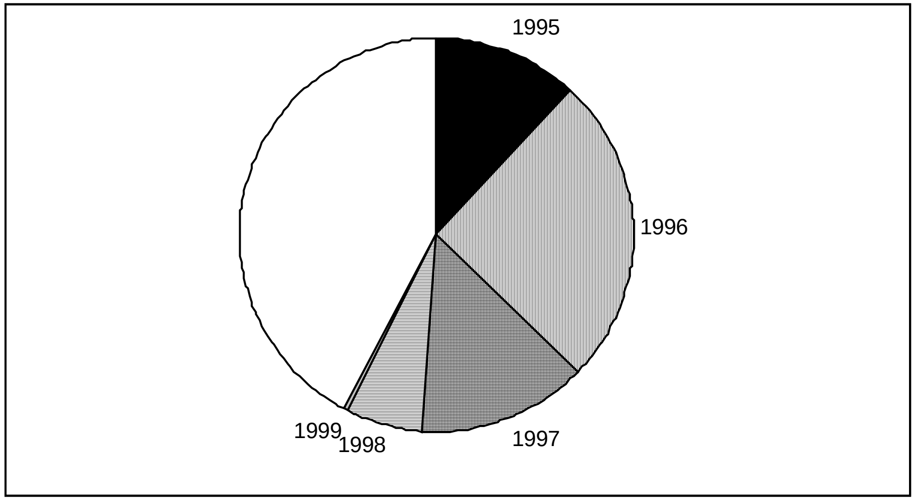
Saithe in IV, VI and IIIa
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1995	1996	1997	1998		1999
Stock No. (thousands)			102086	175487	175487	175487		175487
age			1	1	1	1		1
Source			VPA	GM	GM	GM		GM
Status Quo F:								
% in	1999	landings	11.4	13.6	6.7	0.1	-	
% in	2000		11.9	25.5	13.8	6.5		0.1
% in	1999	SSB	3.7	0.0	0.0	0.0	-	
% in	2000	SSB	14.9	9.1	0.0	0.0		0.0
% in	2001	SSB	12.4	32.7	9.1	0.0		0.0

GM : geometric mean recruitment 1987-96

Saithe in IV, VI and IIIa : Year-class % contribution to

a) 2000 landings



b) 2001 SSB

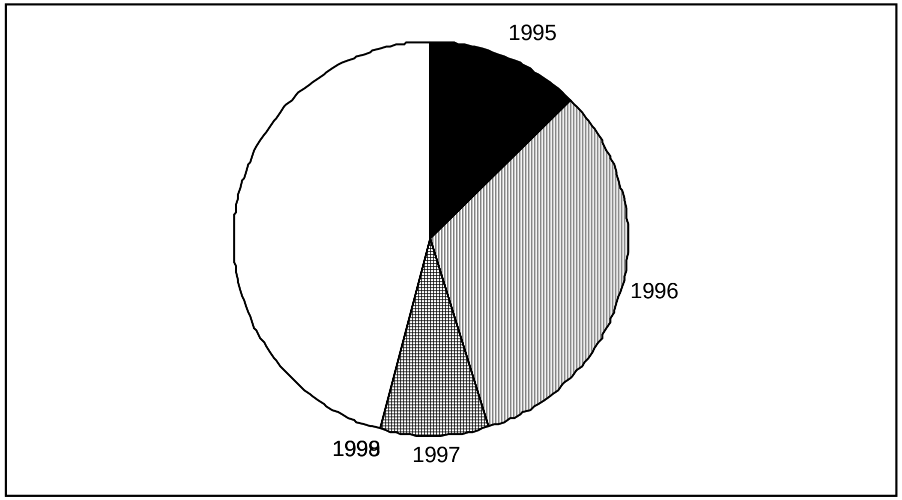


Table 6.3.7.4 Saithe, IV, VI and IIIa. Distribution of catches by area and periods.

% landings by area and year

	Area IV	Area VI
1972	89	11
1973	87	13
1974	88	12
1975	90	10
1976	88	12
1977	88	12
1978	81	19
1979	84	16
1980	84	16
1981	84	16
1982	87	13
1983	85	15
1984	90	10
1985	88	12
1986	80	20
1987	83	17
1988	76	24
1989	78	22
1990	82	18
1991	85	15
1992	89	11
1993	88	12
1994	89	11
1995	91	9
1996	92	8
1997	92	8
1998	93	7

% landings by area over different periods

Period	Area IV	Area VI
1972-1998	86	14
1973-1998	86	14
1974-1998	86	14
1975-1998	86	14
1976-1998	86	14
1977-1998	86	14
1978-1998	86	14
1979-1998	86	14
1980-1998	86	14
1981-1998	86	14
1982-1998	86	14
1983-1998	86	14
1984-1998	86	14
1985-1998	86	14
1986-1998	86	14
1987-1998	86	14
1988-1998	87	13
1989-1998	88	12
1990-1998	89	11
1991-1998	90	10
1992-1998	90	10
1993-1998	91	9
1994-1998	91	9
1995-1998	92	8
1996-1998	92	8
1997-1998	92	8
1998	93	7

Table 6.3.8.1 Saithe, IV, VI and IIIa. Model parameters for stock recruitment

```
Data read from file saiall.rec

 Ricker curve
 Moving average term NOT fitted

 IFAIL on exit from E04FDF =,   5

 Residual sum of squares=,    4.6698

 Number of observations=,  26

 Number of parameters  =,   2

 Residual mean square  =,     .1946

 Coefficient of determination =,     .0857

 Adj. coeff. of determination =,     .0476

 IFAIL from E04YCF=,  0

 Parameter  Correlation matrix

 ,  1.0000,
 ,   .8635,  1.0000,


  Parameter,s.d.

    1.9497,     .3344,
     .0026,     .0006,
```

Table 6.3.8.2
Medium Term Summary
Saithe in the North Sea, Skagerrak and West of Scotland

Bpa	200	thousand tonnes
Blim	106	thousand tonnes

F1	0.4	Basis :	Fpa	F multiplier	0.9
F2	0.45	Basis :	SQ	F multiplier	1

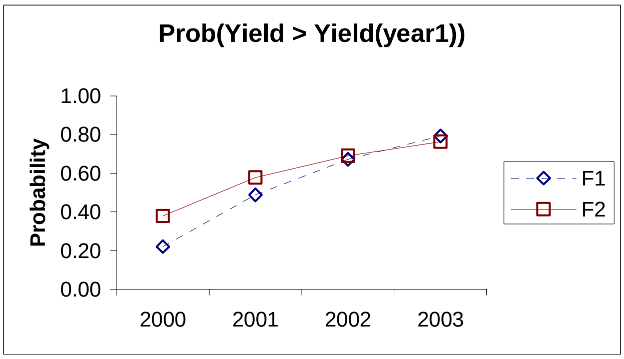
Year 1 1999

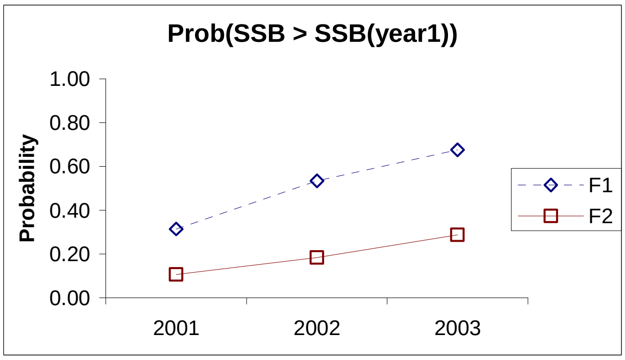
Format of tables:

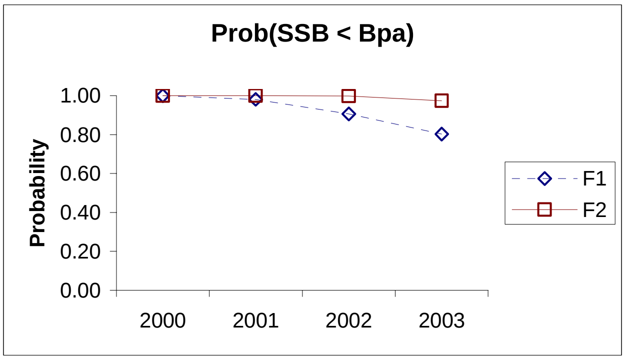
	1999	2000	2001	2002	2003
F1	Yield1999 SSB1999	Prob(Yield2000>Yield1999) SSB2000 Prob(SSB2000< Bpa) Prob(SSB2000< Blim)	Prob(Yield2001>Yield1999) Prob(SSB2001>SSB1999) Prob(SSB2001< Bpa) Prob(SSB2001< Blim)	Prob(Yield2002>Yield1999) Prob(SSB2002>SSB1999) Prob(SSB2002< Bpa) Prob(SSB2002< Blim)	Prob(Yield2003>Yield1999) Prob(SSB2003>SSB1999) Prob(SSB2003< Bpa) Prob(SSB2003< Blim)
F2	Yield1999 SSB1999	Prob(Yield2000>Yield1999) SSB2000 Prob(SSB2000< Bpa) Prob(SSB2000< Blim)	Prob(Yield2001>Yield1999) Prob(SSB2001>SSB1999) Prob(SSB2001< Bpa) Prob(SSB2001< Blim)	Prob(Yield2002>Yield1999) Prob(SSB2002>SSB1999) Prob(SSB2002< Bpa) Prob(SSB2002< Blim)	Prob(Yield2003>Yield1999) Prob(SSB2003>SSB1999) Prob(SSB2003< Bpa) Prob(SSB2003< Blim)

Medium Term Summary
Saithe in the North Sea, Skagerrak and West of Scotland

F	1999	2000	2001	2002	2003
0.4	113 169	0.22 145 1.00 0.00	0.49 0.31 0.98 0.00	0.67 0.53 0.91 0.00	0.79 0.68 0.80 0.00
0.45	113 169	0.38 145 1.00 0.00	0.58 0.11 1.00 0.00	0.69 0.18 1.00 0.00	0.76 0.29 0.97 0.00







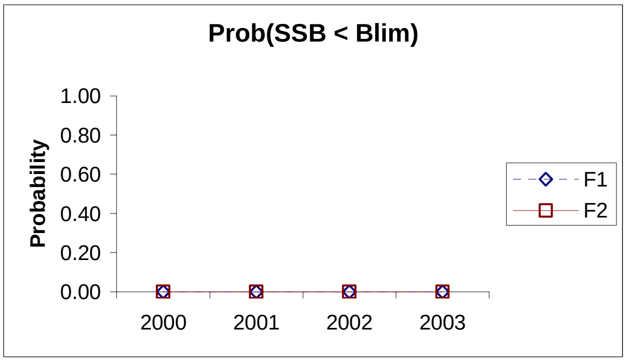


Table 6.3.9.1

The SAS System

Saithe combined (Sub-areas IIIa, IV and VI)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.2000	0.0000	0.0000	0.0000	0.377	0.0000	0.377
2	.	0.2000	0.0000	0.0000	0.0000	0.554	0.1100	0.554
3	.	0.2000	0.0000	0.0000	0.0000	0.871	0.1700	0.871
4	.	0.2000	0.1500	0.0000	0.0000	1.312	0.4300	1.312
5	.	0.2000	0.7000	0.0000	0.0000	1.936	0.6100	1.936
6	.	0.2000	0.9000	0.0000	0.0000	2.723	0.5900	2.723
7	.	0.2000	1.0000	0.0000	0.0000	3.724	0.6500	3.724
8	.	0.2000	1.0000	0.0000	0.0000	4.693	0.5600	4.693
9	.	0.2000	1.0000	0.0000	0.0000	5.751	0.5400	5.751
10+	.	0.2000	1.0000	0.0000	0.0000	7.920	0.5400	7.920
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDHJR04
Date and time: 17OCT99:15:49

Table 6.3.9.2

The SAS System 15:48 Sunday, October 17, 1999

Saithe combined (Sub-areas IIIa, IV and VI)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	14668.072	2.390	12280.937	2.390	12280.937
0.1000	0.0450	0.133	459.918	4.855	10516.083	1.762	8182.512	1.762	8182.512
0.2000	0.0900	0.219	663.788	4.427	8062.712	1.366	5779.410	1.366	5779.410
0.3000	0.1350	0.279	752.571	4.128	6496.776	1.098	4260.735	1.098	4260.735
0.4000	0.1800	0.324	786.459	3.905	5439.591	0.905	3248.062	0.905	3248.062
0.5000	0.2250	0.359	793.493	3.733	4693.905	0.761	2544.369	0.761	2544.369
0.6000	0.2700	0.387	787.459	3.595	4148.689	0.650	2038.836	0.650	2038.836
0.7000	0.3150	0.410	775.356	3.482	3737.712	0.562	1665.419	0.562	1665.419
0.8000	0.3600	0.430	760.791	3.387	3419.631	0.492	1382.943	0.492	1382.943
0.9000	0.4050	0.446	745.618	3.305	3167.668	0.434	1164.782	0.434	1164.782
1.0000	0.4500	0.461	730.764	3.234	2963.934	0.386	993.185	0.386	993.185
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDHJR04
Date and time : 17OCT99:15:49
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.2772
F-max factor : 0.4917
F-0.1 reference F : 0.1248
F-max reference F : 0.2213
Recruitment : Single recruit

Table6.3.10.1 Saithe, IV, VI and IIIa. Introduction to PA Add-in outputs

Four sheets of results are included in this workbook:

RefPts - provides stochastic output in the form of a table of reference points and a chart summarising the distributions of some reference points.

Plots - provides 4 plots:
A stock recruitment plot with a LOWESS smoother as a possible stock recruitment relationship. Some reference points are also indicated.
A plot of YPR and SPR curves with some reference points indicated.
A plot of historical SSB against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship.
A plot of historical yield against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship.

PD - gives the value of the reference points during each iteration of the simulation and the percentiles plotted on the chart on RefPts.

SV - contains the steady state vectors and stock recruitment series used. These can be used as the basis for further runs.

For estimation of Gloss and Floss:
A LOWESS smoother with a span of 0.5 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
For estimation of the stock recruitment relationship used in equilibrium calculations:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

IV, VI and IIIa Saithe

Steady state selection provided as input
FBar averaged from age 3 to 6

Number of iterations = 1000
Random number seed = -99
Stock recruitment data Monte Carloed using residuals from the equilibrium LOWESS fit

Data source:
C:\Saiall\SAIALL.SEN
C:\Saiall\Saiall.sum

FishLab DLL used
FLVB32.DLL built on Jun 14 1999 at 11:53:37
PASoft 4 October 1999

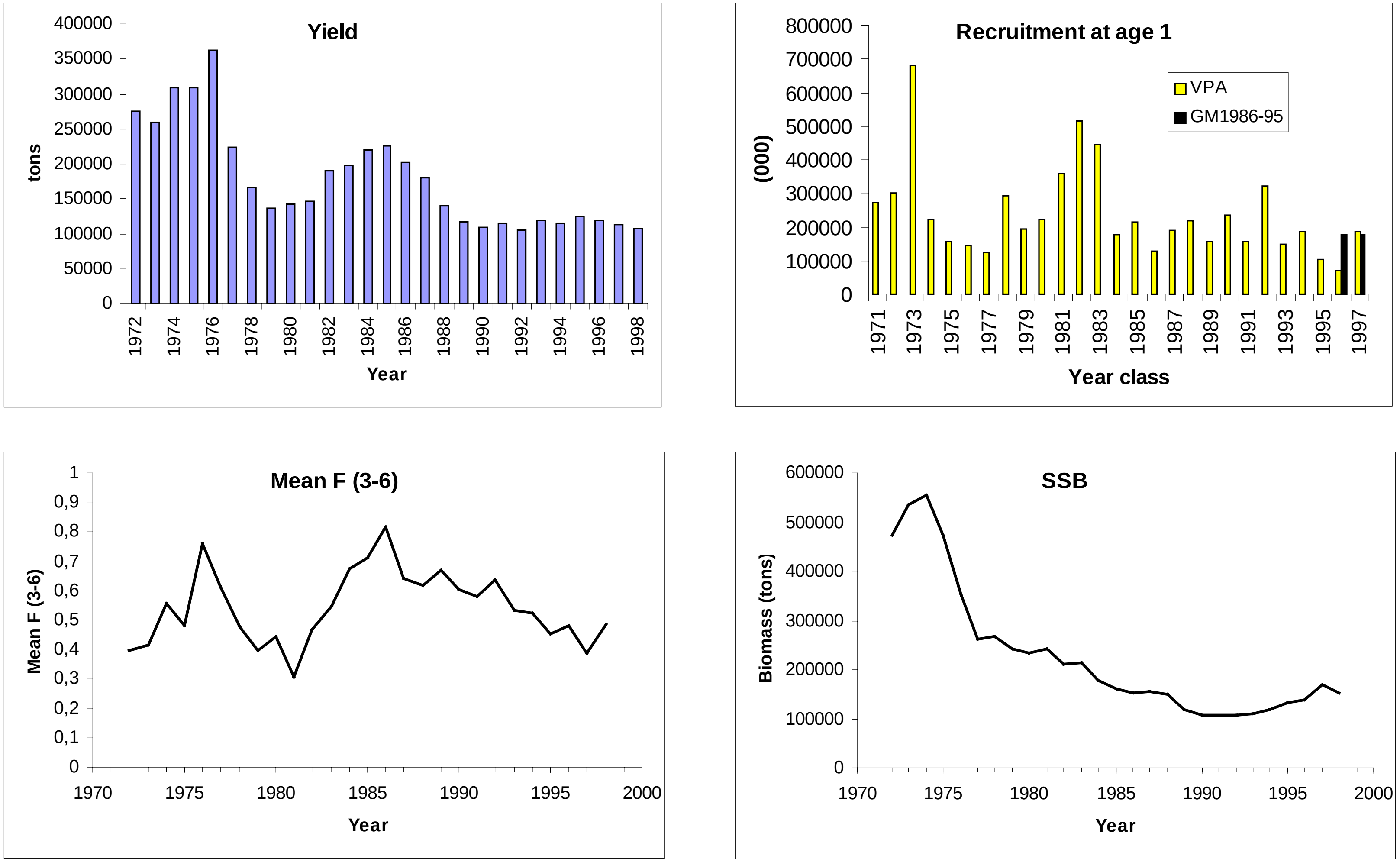


Figure 6.3.1.1. Saithe, IV, VI and IIIa.

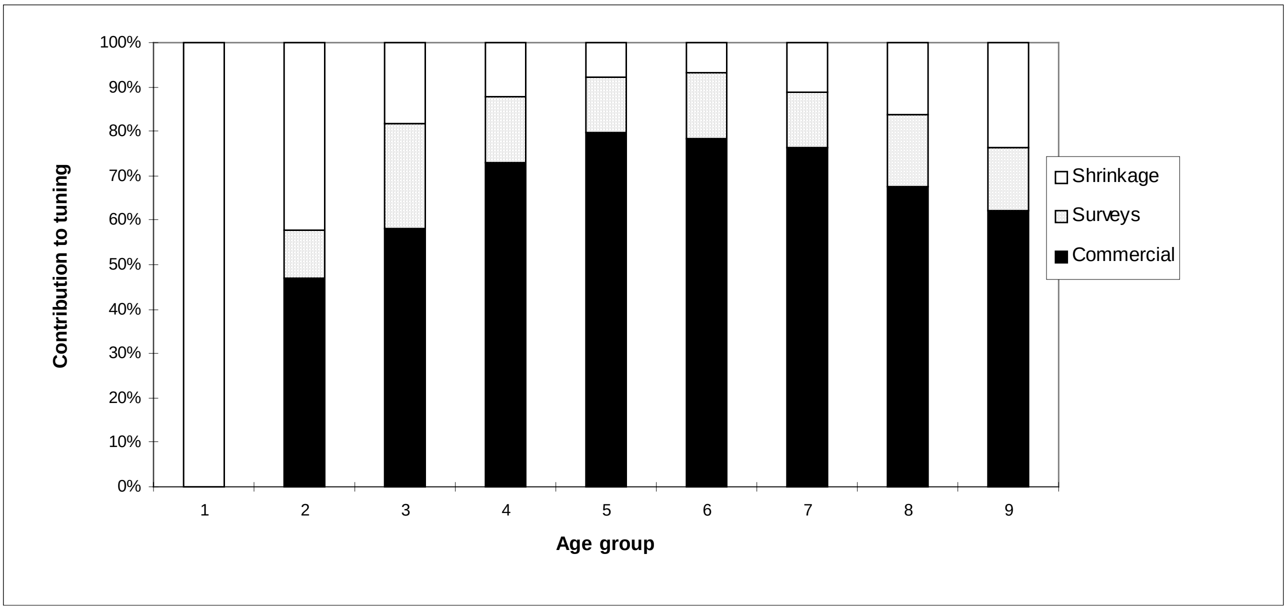


Figure 6.3.4.1. Saithe, IV, VI and IIIa. Contribution of commercial fleets, survey indices and shrinkage to tuned XSA.

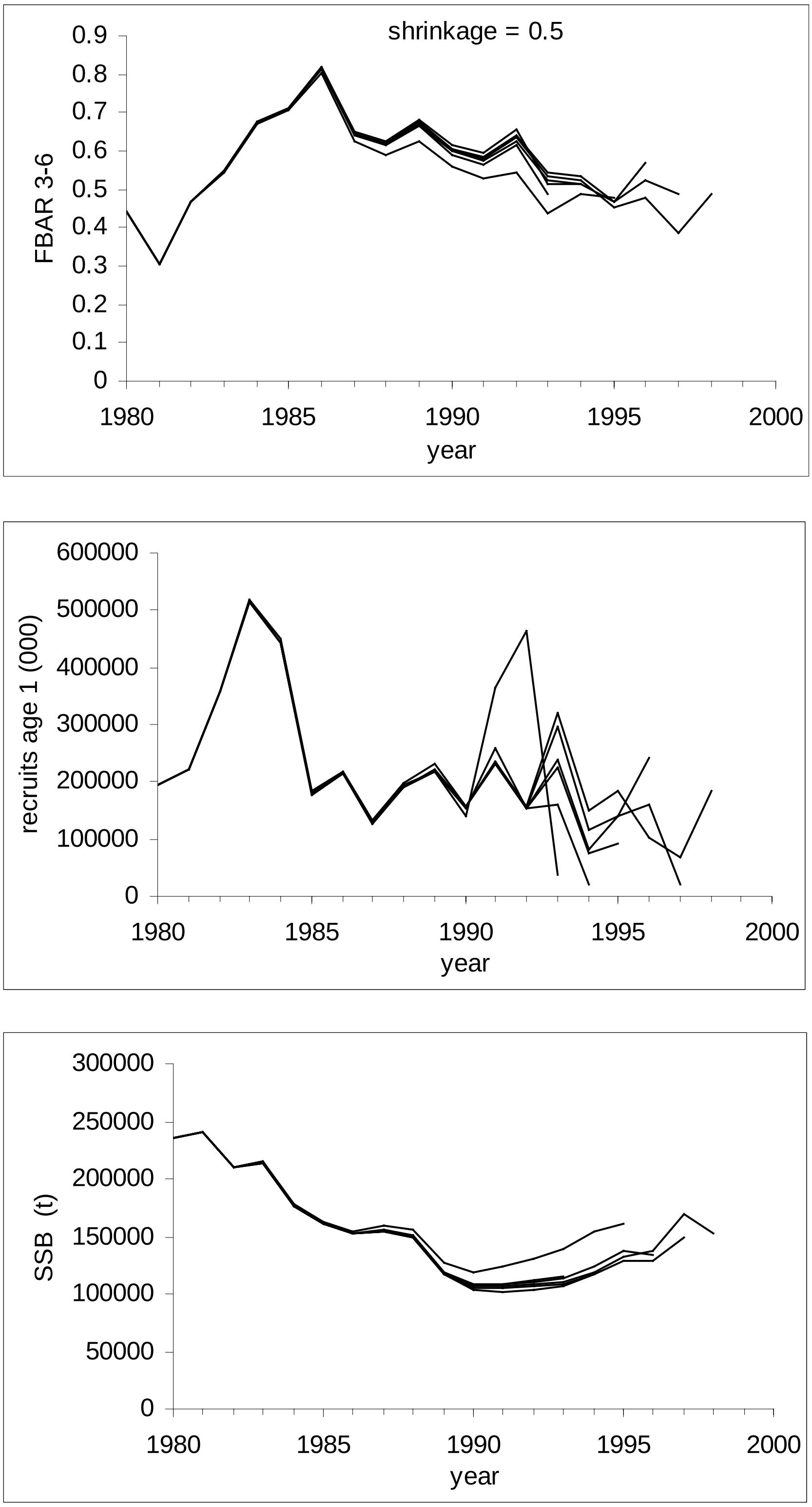


Figure 6.3.4.2. Saithe, IV, VI and IIIa. Rectrospective analysis with final run (shrinkage 0.5).

Figure 6.3.7.1. Saithe in IV, VI and IIIa. Sensitivity analysis of short term forecast.

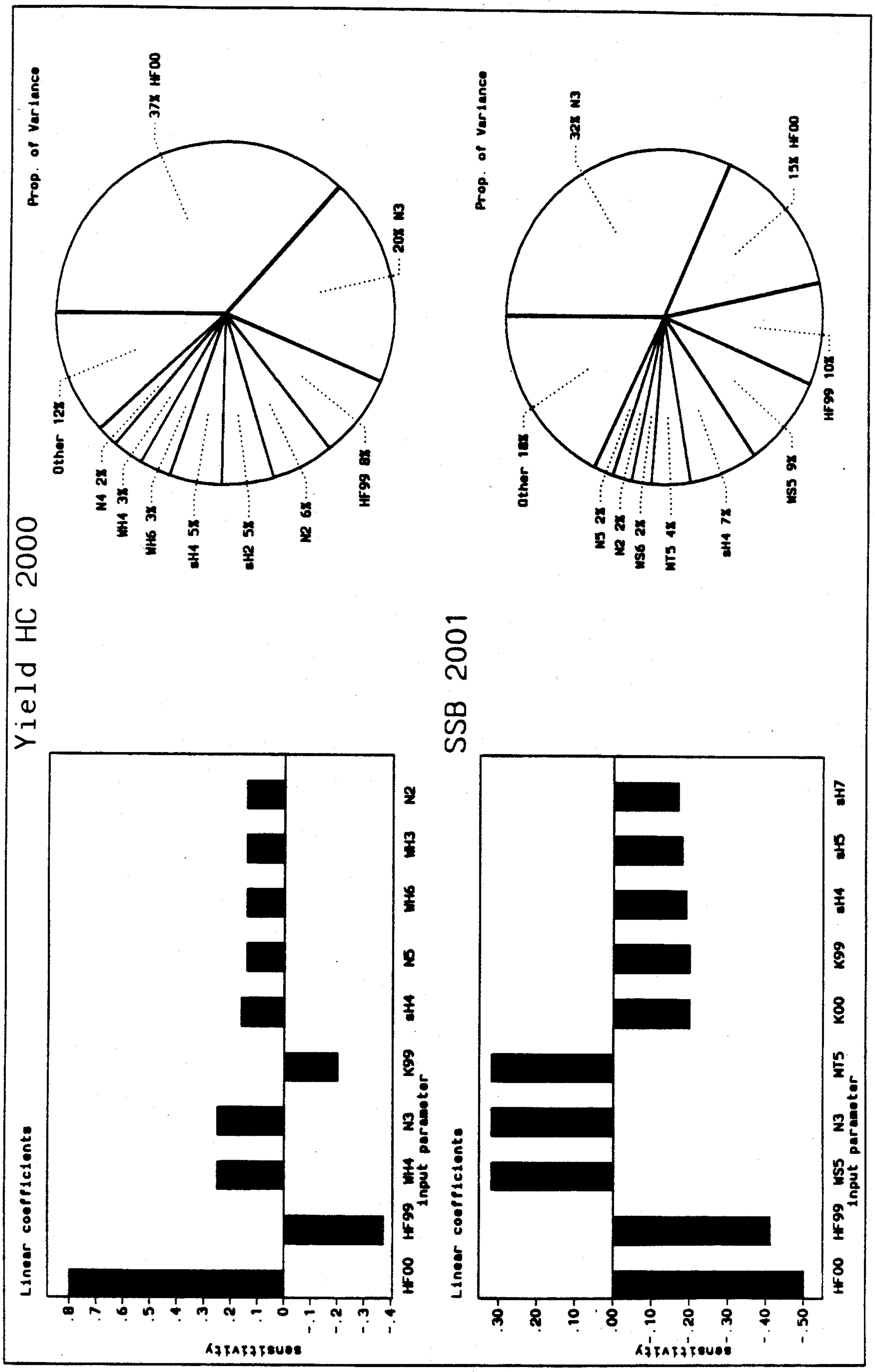


Figure 6.3.7.1. Saithe in IV, VI and IIIa. Sensitivity analysis of short term forecast.

Figure 6.3.7.2. Saithe in IV, VI and IIIa. Probability profiles for short term forecast.

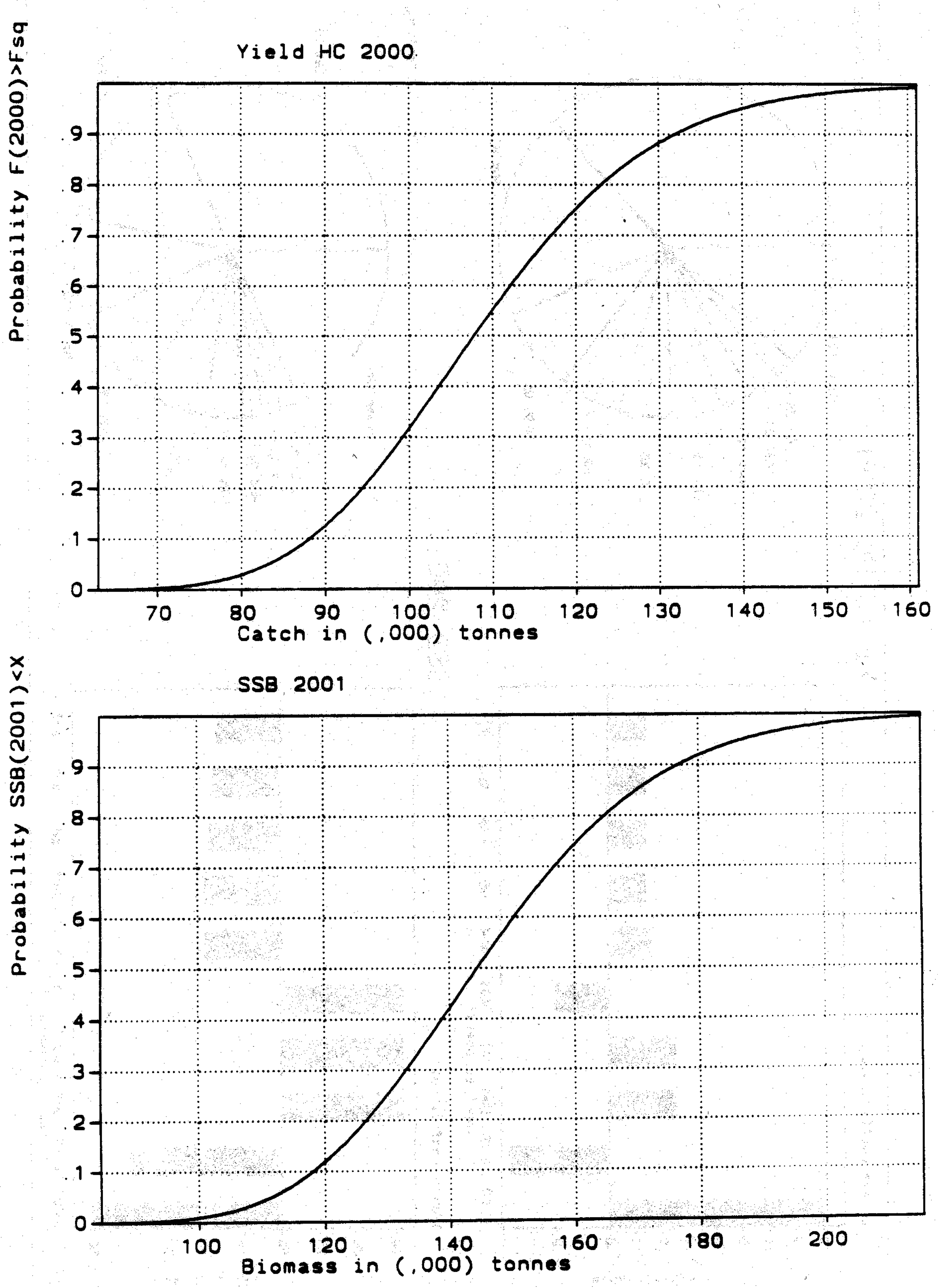


Figure 6.3.8.1 Saithe, IV, VI and IIIa. Status qou fishing mortality. Solid lines show 5,25,50,75,95 %. Number of simulations: 500 Model used: Ricker

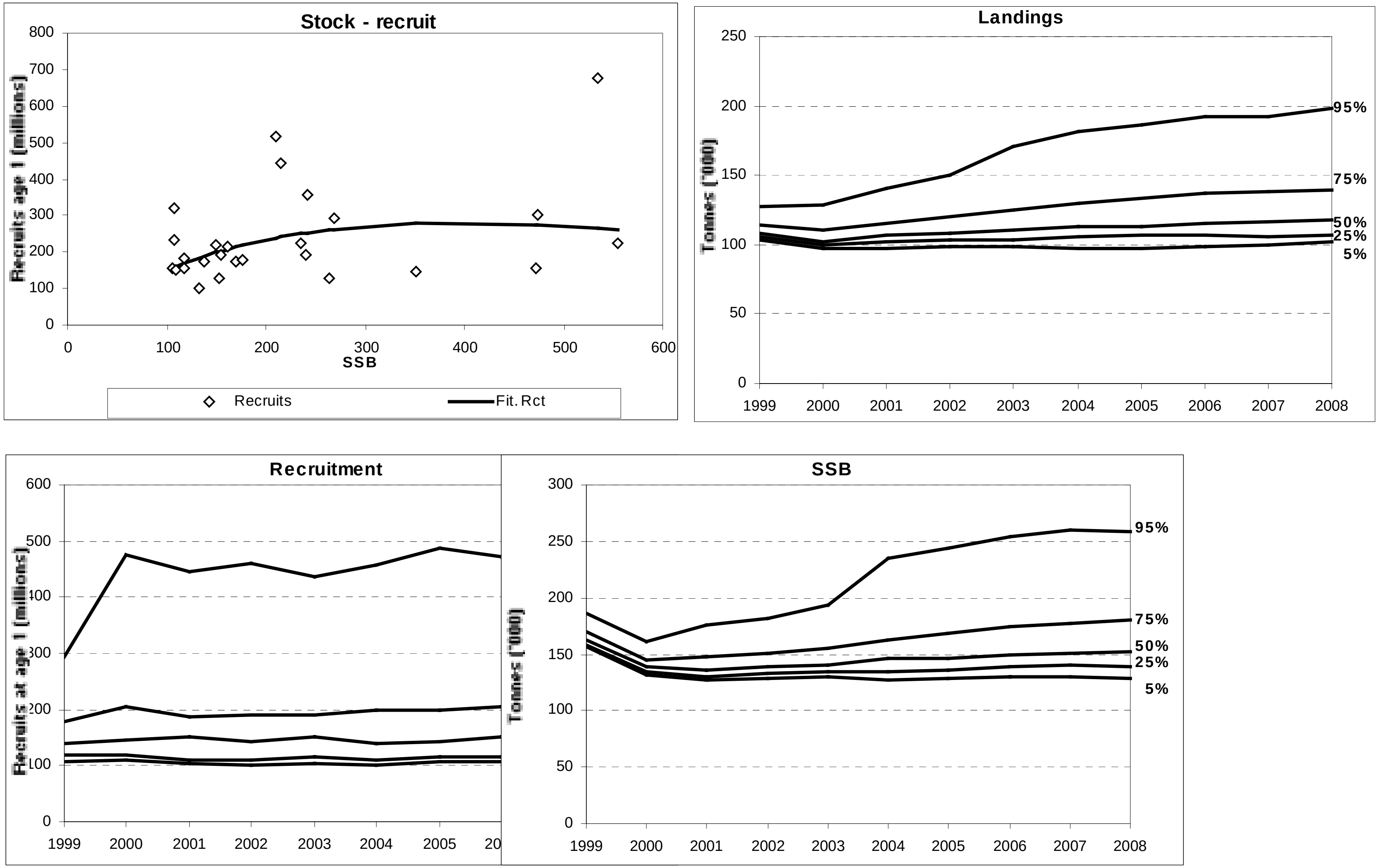


Figure 6.3.9.1. Saithe in IV, VI and IIIa: Stock and Recruitment.

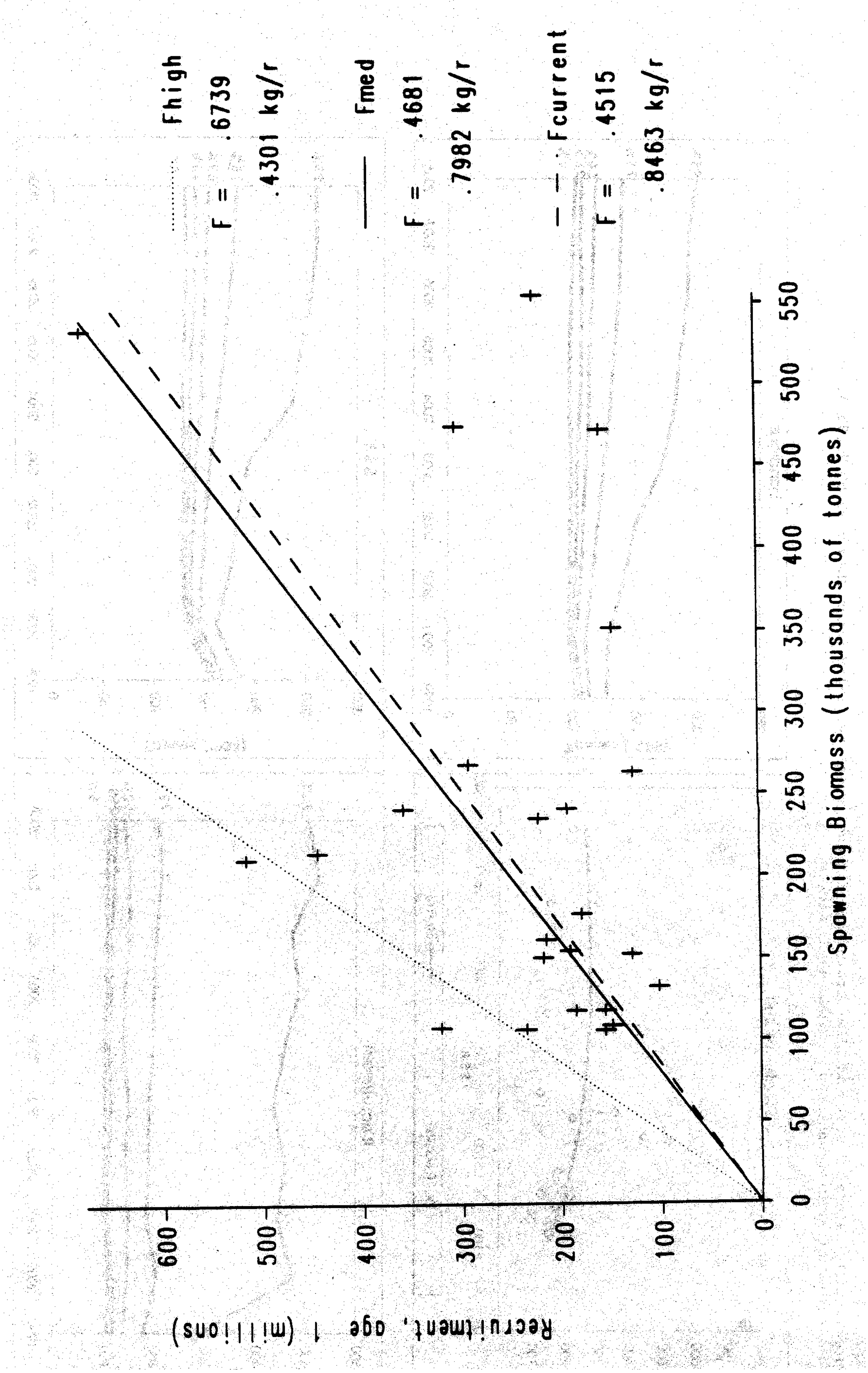
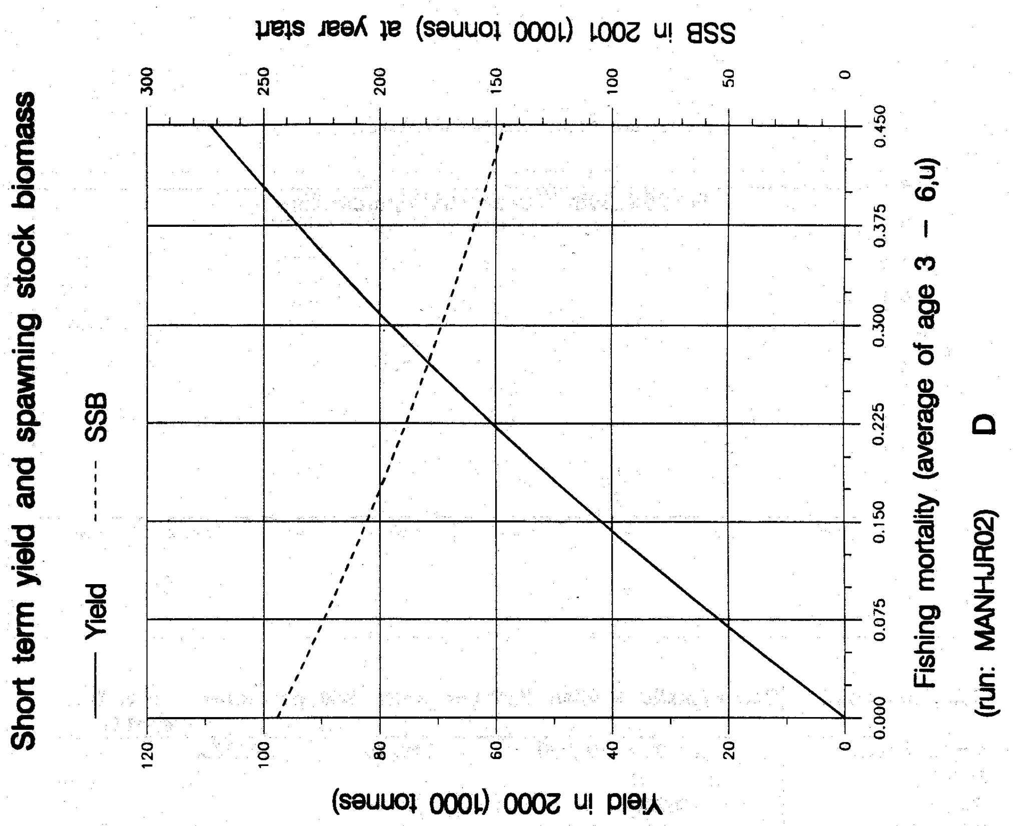


Figure 6.3.9.2. Saithe in IV, VI and IIIa. Long and short term yield and spawning stock biomass.



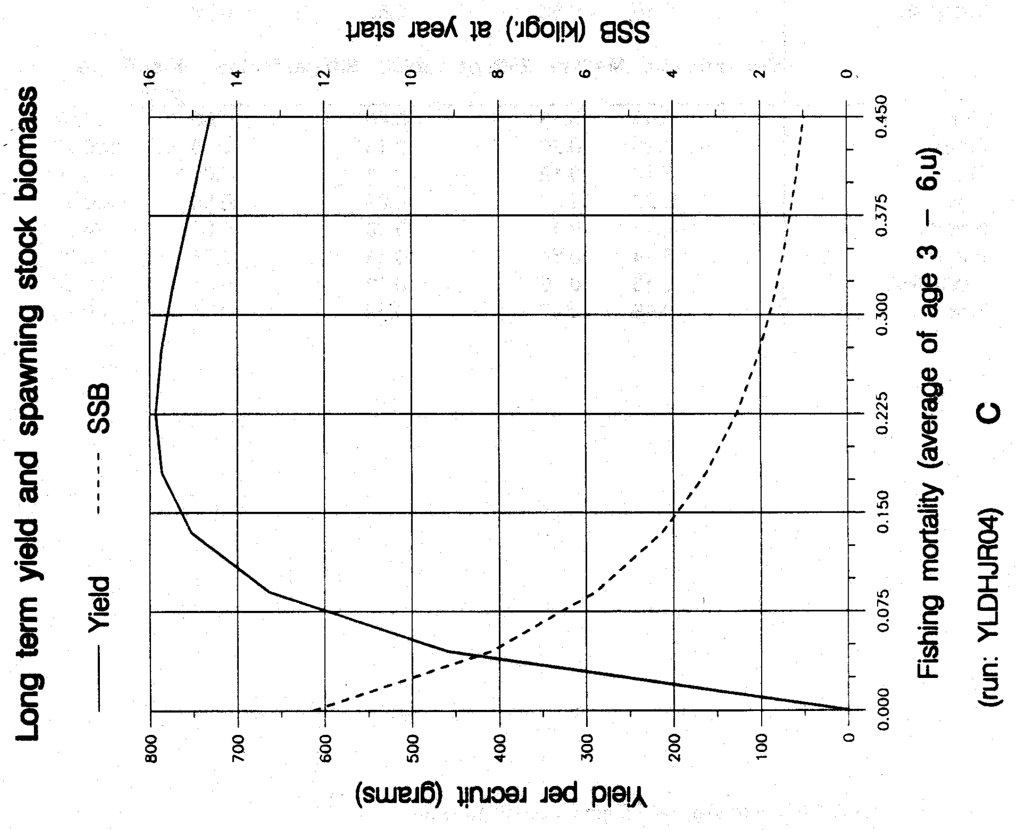
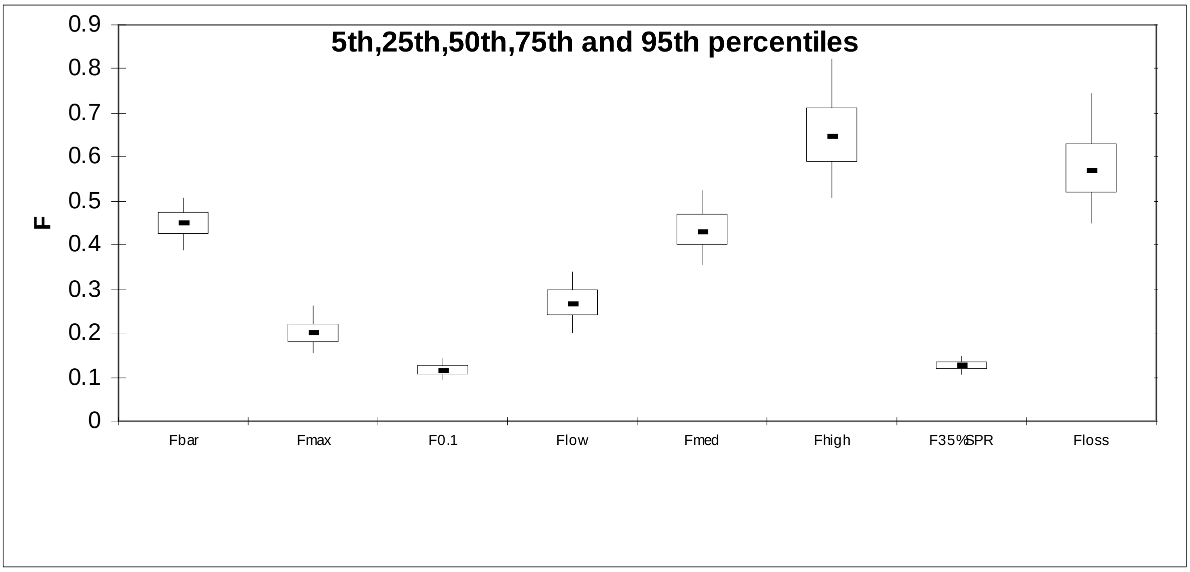


Figure 6.3.10.1. Saithe, IV, VI and IIIa. Reference points.



Reference point	Deterministic	Median	75th percentile	95th percentile	Hist SSB < ref pt %
MedianRecruits	193000	193000	218000	222000	
MBAL	0				0.00
Bloss	106200				
SSB90%R90%Surv	188024	183394	204774	235638	55.56
SPR%ofVirgin	7.09	7.04	8.08	9.47	
VirginSPR	11.94	12.18	14.33	18.03	
SPRloss	0.56	0.58	0.65	0.78	

	Deterministic	Median	25th percentile	5th percentile	Hist F > ref pt %
FBar	0.45	0.45	0.43	0.39	74.07
Fmax	0.20	0.20	0.18	0.16	100.00
F0.1	0.12	0.12	0.11	0.09	100.00
Flow	0.23	0.27	0.24	0.20	100.00
Fmed	0.47	0.43	0.40	0.35	74.07
Fhigh	0.64	0.65	0.59	0.51	22.22
F35%SPR	0.13	0.13	0.12	0.11	100.00
Floss	0.58	0.57	0.52	0.45	40.74

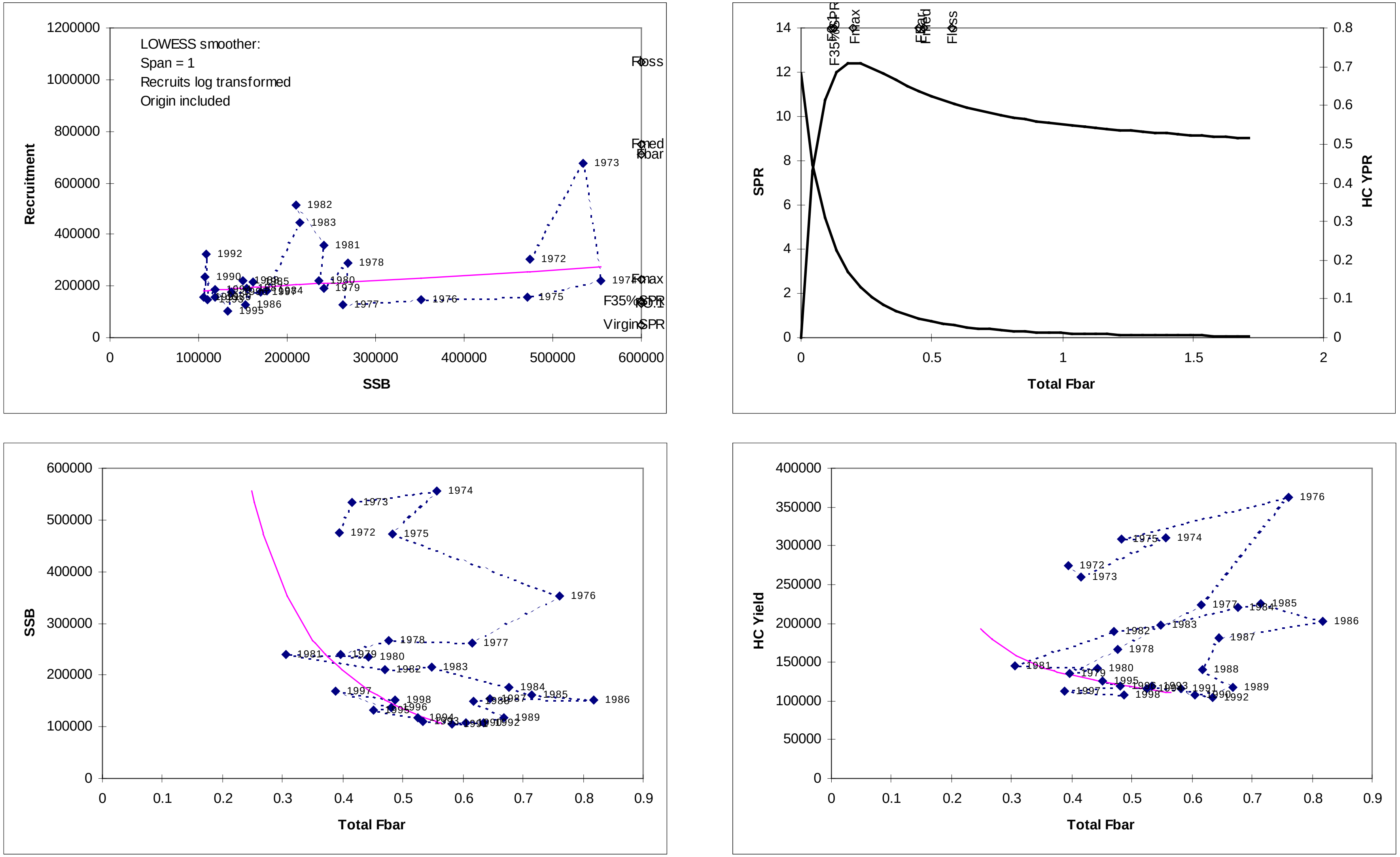


Figure 6.3.10.2. Saithe, IV, VI and IIIa. Output from PA software.

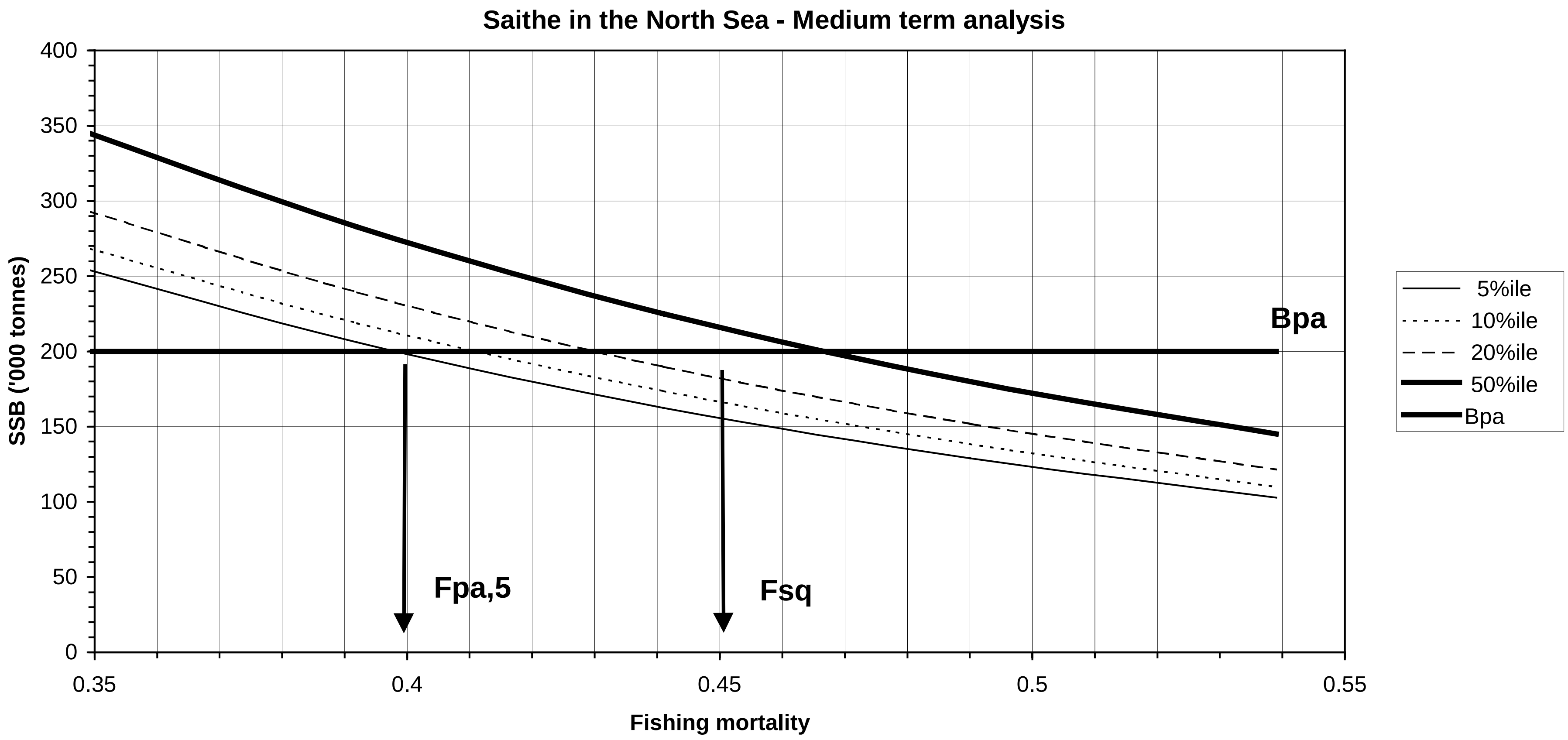


Figure 6.3.10.3. Saithe, IV, VI and IIIa. Medium term projections of SSB in 2008 at different F levles.

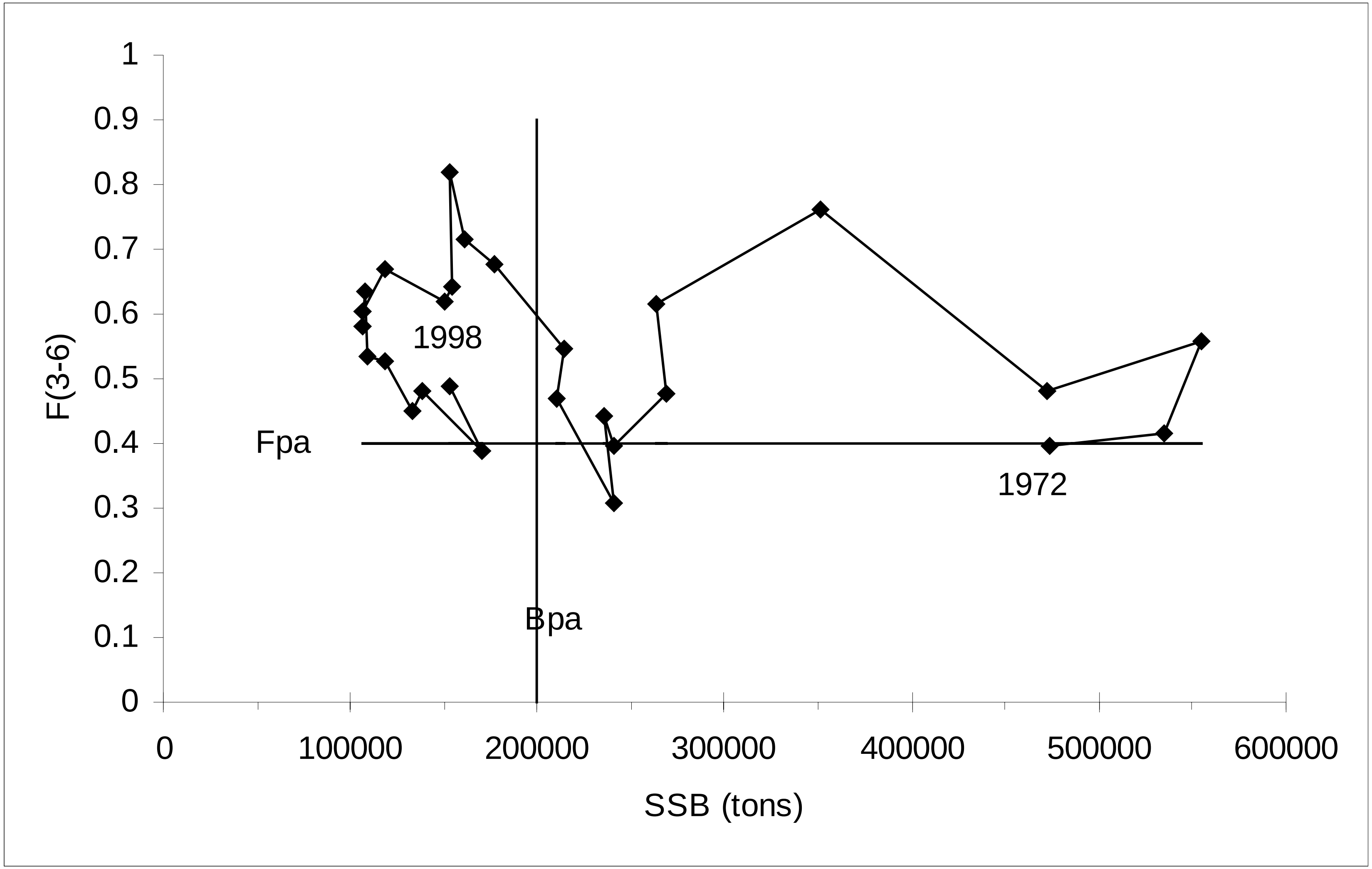


Figure 6.3.10.4. Saithe, IV, VI and IIIa. Medium term projections of SSB in 2008 at different F levles.

6.4 Comparison of the assessment of saithe in Sub-area IV, Division IIIA and Division VIA with the separate areas

The tuning configurations for the different assessments are given below

		Division VI	Area IV	All areas
Period for tuning		88-98	89-98	89-98
Taper		No	No	No
q independent of stock size		All ages	All ages	All ages
q independent of age		6	7	7
F shrinkage:	year range	5	5	5
	age range	3	3	3
	SE	0.5	0.5	0.5
Minimum Log(S.E.)		0.3	0.3	0.3
FRATRB_IV	ages	-	2-8	2-7
FRATRF_IV	ages	-	2-7	2-7
NORTRL_IV	ages	-	3-7	3-9
ENGGFS_IV	ages	-	3-8	3-8
FRASAI_VI	ages	3-9	-	5-7
SCOLTR_IV	ages	-	5-9	-
SCOLTR_VI	ages	3-4	-	-
SCOLTR_IV+VI	ages	-	-	5-7
SCOGFS_IV	ages	-	3	2-3

Tuning configurations for the different assessments are the same except for the age ranges of some fleets, and that the Area VI assessment use age 6 for the catchability plateau and 11 years for tuning.

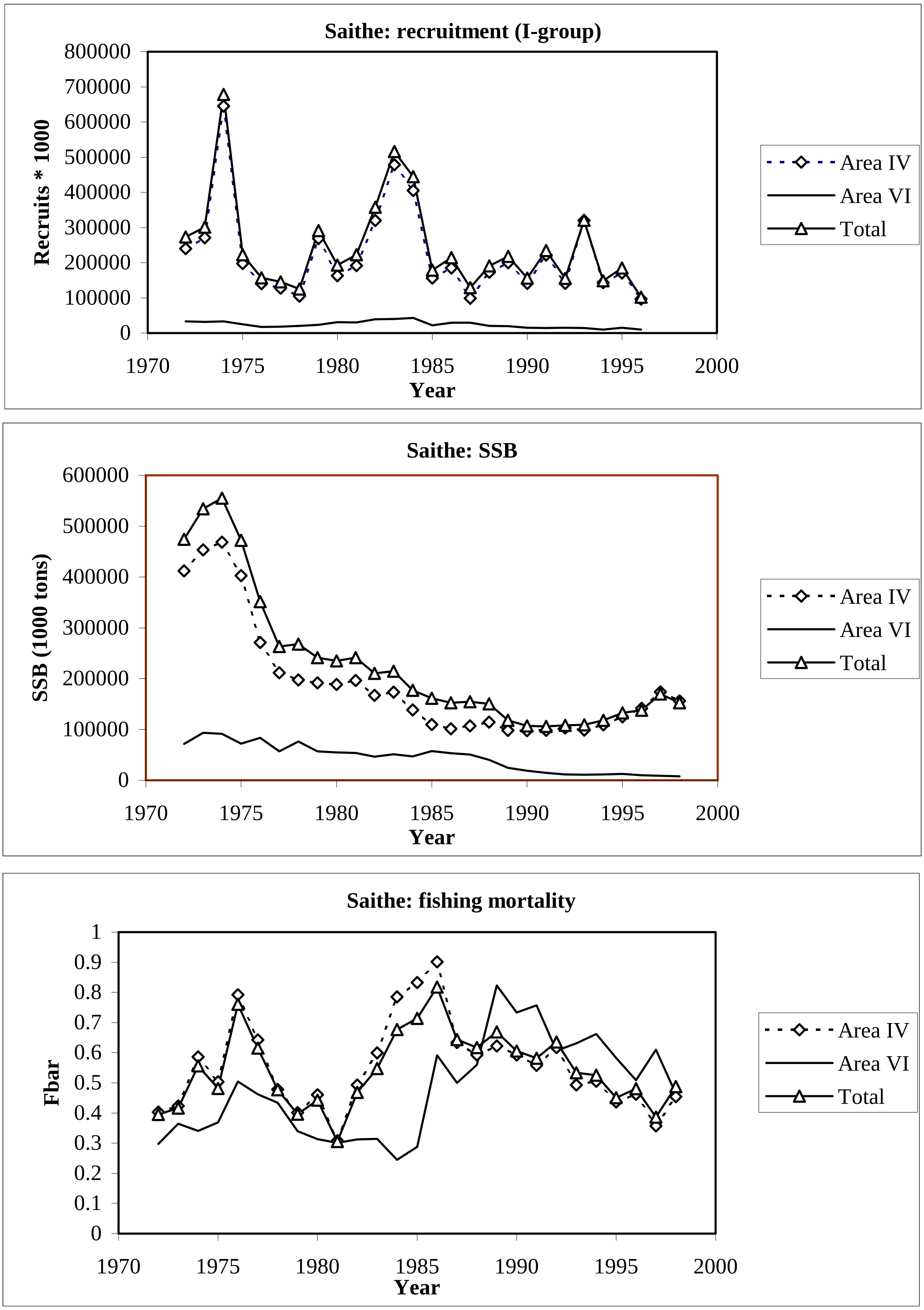
Figure 6.4.1 shows a comparison between the results from the different assessments. The combined assessment is almost identical with the North Sea assessment. The F_{3-6} in Division VI shows similar trend as in Area IV in the last 10 years, and show similar peaks.

Standard errors of the weighted Log(VPA populations) are as follows:

	Division VI	Area IV	All areas
Age 1(no data)	0.5416	0.59	0.4947
Age 2	0.446	0.5326	0.4957
Age 3	0.4411	0.5181	0.4602
Age 4	0.4359	0.4903	0.4266
Age 5	0.5439	0.5247	0.4777
Age 6	0.6581	0.6825	0.6375
Age 7	0.8678	0.7201	0.6767
Age 8	0.9711	0.7603	0.7340
Age 9	1.0747	0.7971	0.7974

The combined assessment has lower standard errors than the area IV assessment for all ages except age 9. Thus, making a combined assessment seems to improve the assessment for the North Sea rather than to deteriorate it.

Figure 6.4.1 Saithe. Comparison of the combined assessment with the assessment from Sub-Areas IV and VI.



7 SOLE IN SUB-AREA IV

7.1 The fishery

7.1.1 ACFM advice applicable to 1999

For 1999 ACFM advised that fishing mortality on North Sea sole should be reduced to below the proposed Fpa of 0.4, corresponding to catches less than 20,300 t. The reduction in fishing mortality of 20% from the 1997 value (0.51) would insure a high probability that SSB will remain above the proposed Bpa (35,000 t) in the medium term.

It was also emphasised that the large 1996 year class will temporally increase SSB above the proposed Bpa in the next few years, but the stock has high probability of decreasing below Bpa under current rate of exploitation in the medium term .

The advice of a reduction of F by 20% is consistent with the advice for plaice, which is taken in a mixed fishery with sole.

The advice in recent years has been based on the objective to maintain the SSB above a Bpa of 35,000 t for this stock and below a F_{pa} of 0.4. B_{lim} and F_{lim} were proposed to be 25,000 t and 0.55 respectively

7.1.2 Management applicable to 1999

The TAC's for 1999 was 22,000 t which is about 8% above the value recommended by ACFM.

Technical measures applicable to the sole fishery are an exemption to use 80 mm mesh codend when fishing south of 55° North. (Fishing for sole is defined as retaining at least 5% sole in weight on board). Additional protection is given to sole from the closure of the plaice box along the Dutch and Danish coast. In the years 1989 to 1993 the box was closed in the second and third quarter quarters to all vessels using towed gears and with engine power larger than 300 HP. Since the second quarter of 1994 the box was closed for all quarters.

Additional national management measures are in operation and will be discussed in section 7.1.3.

New technical measures, which will be in operation from the year 2000, include a shift of 80 mm mesh exemption from 55° North to 56° North, East of 5° E latitude.

Fishing with this mesh size is permitted within that area providing that the landings comprise at least 70% of a mix of species which are defined in the new technical measures of the EU.

7.1.3 The fishery in 1998

Sole is mainly taken by beam trawlers in a mixed fishery with plaice in the southern part of the North Sea. There is also a directed gill-net fishery in Danish coastal areas predominantly in the 2nd quarter of the year. Since 1989 the distribution pattern of beam trawl fleets > 300 HP has changed as a result of the Plaice Box.

The landings in 1998 (20,867 t) were 9% higher than the agreed TAC. This was mostly due to the strong 1996 year class. Unallocated landings have decreased considerably since 1993. For recent years, the officially reported landing by various countries as well as Working Group estimates of the total landings are given in Table 7.1. A longer time series of landings is given in Table 7.13 and plotted in Figure 7.4.

7.2 Age composition, weight at age, maturity and natural mortality

Age compositions, mean weight at age in the catch and mean length at age in the catch were available on a quarterly or annual basis from Belgium, France, the Netherlands and UK (England and Wales). These comprise 91% of the total landings in 1998. The age compositions were combined and raised to the international total on an annual basis.

Minor revisions have been made to the 1997 data. The age compositions are given in Table 7.2. No estimates of discards are available to the Working Group.

Weights at age in the catch are measured weights from the various national market sampling programmes of the landings. Weights at age in the stock are those of the 2nd quarter in the landings. Weights at age in the catch and stock are given in Tables 7.3 and 7.4.

As in all previous assessments, a knife-edged maturity-ogive was used in all years, assuming full maturation at age 3. The maturity-ogive is based on market samples of females from observations in the sixties and seventies. Maturity at age may have changed over time, but available data have not been analysed yet.

Natural mortality in the period 1957-1998 has been assumed constant over all ages at 0.1, except for 1963 where a value of 0.9 was used to take account the effect of a severe winter (ICES CM 1979/G:10). In 1996 additional natural mortality was observed in the cold winter of 1995/1996 (ICES 1997e/Assess:6). The actual value of M in 1996 could not be quantified.

7.3 Catch, effort and research vessel data

Catch and effort data, used for tuning the assessment are given in Table 7.5. Effort in the “Netherlands commercial beam trawl” has increased considerably over time but has been on the same level in the last three years. The effort in the “UK commercial beam trawl” fleet has decreased since 1993.

The other 2 tuning fleets are Dutch research vessel surveys. The SNS (Sole Net Survey) is a coastal survey with a 6- m beam trawl carried out in October. The BTS (Beam Trawl Survey) is carried out in the southern and south-eastern North Sea in August and September using an 8-m beam trawl.

The BTS survey indices have been revised this year by excluding rectangles above 55° 30’, which have not been sampled in the last few years (Figure 1.3.1). Also market ALK’s previously used in estimating the survey age distribution of older fish have been excluded. As a consequence, the tuning file has therefore been restricted to ages 1 to 4 instead of 1 to 7 as in last years assessment.

The Demersal Fish Survey (DFS) is an international survey by Belgium, Germany, the Netherlands and UK in their national nursery areas using a shrimp beam trawl and provides a combined international index.

Available trends in effort and cpue are listed in Table 7.6 and graphed in Figure 7.1. In Belgium, vessel landings are restricted to a maximum amount by trip. In the Netherlands vessel, ITQs may have restricted landings of sole and plaice. Changes in directivity between these species and towards other species may have occurred. Therefore cpue in these fleets are considered to be biased in recent years due to quota restrictions. The Dutch beam trawl cpue show a continuous decline since 1990 reaching a minimum in 1997. This low value could be related to the ITQ restrictions but also reflects the poor availability of sole in 1997. The good 1996 year class has reversed the downward trend in 1998. The UK beamtrawl CPUE series has been revised in line with HP corrected effort. This series also show a historical low value for 1997 and 1998. The Belgian beamtrawl fleet showed no clear trend in CPUE in recent years.

7.4 Catch at age analysis

General approaches and methods are described in section 1.4. As in previous assessments, the age range for the analyses was 1-15+.

7.4.1 Data exploration

The results of exploratory VPA runs, which are not included in this report, are available in ICES files.

A preliminary inspection of the quality of international catch-at-age data was carried out using separable VPA , with a reference age of 4, terminal F = 0.5 and terminal S = 0.8. Except for ages 1/ 2, log-catch ratios did not show any large residuals or trends (Table 7.7).

Repeating last years final assessment, with the corrected database, gave almost identical results compared to that of last years Working Group.

The tuning data were examined for trends in catchability by carrying out Laurec-Shepherd (without shrinkage) and XSA (settings as last year’s final run with a weak shrinkage of 1.5) tuning runs using data for each of the three fleets individually. Although catchability was variable in the less well-sampled ages, examination of the residuals and regression slopes revealed no apparent trends, except in the UK beam trawl fleet, which showed a negative trend from 1990 to 1993 and a positive trend from 1993 to 1995 for the younger ages. Runs, which included the UK fleet, revealed a more stable catchability residual pattern and showed little changes in the estimated survivors. The revised BTS survey gave a better residual pattern apart from the low value for age 4 in 1994. The residual patterns of catchability for the run including all the fleets are graphed in Figure 7.2.

Retrospective analyses with shrinkage SE of 0.5, with the power model as used last year, were carried out to investigate the consistency in estimating F(2-8), SSB and recruitment at age 1 (Figure 7.3). Since the XSA run uses a 10-year tuning range and the UK beamtrawl has only 13 years of data, retrospective runs with a 9-year window were investigated. Different F-shrinkages were also investigated and gave almost identical results.

7.4.2 Assessment

The configuration of the final XSA run is the same as last year: catchability independent on stock size for ages less than 3, q plateau at age 7, fleet SE threshold of 0.3, a shrinkage of 0.5 over 5 years and 5 ages, and 10 year no taper tuning window.

The only difference was the revision of the Netherlands BTS survey.

Full tuning diagnostics are given in Table 7.8.

For age 1, the two surveys, SNS and BTS are given most of the weight to the final survivors estimates with 42% and 37% respectively (F-shrinkage and P-shinkage taking only 15% and 5%). For age 2, the surveys also contribute 71 % to the weight, 17% coming from shrinkages and the remaining 12% from the two commercial fleets. From age group 3 onwards the commercial fleets start to contribute more with the most weight given to the Netherlands commercial fleet. Although estimates of survivors from most of the tuning fleets appear to be quite consistent for all ages, the UK beam trawl fleet tends to give slightly different estimates for all ages.

The fishing mortality stock numbers estimated by the final XSA are given in Tables 7.9 and 7.10.

7.5 Recruitment

Average recruitment in the period 1957-1996 was 133 million (arithmetic mean) or 97 million (geometric mean) 1-year-old-fish.

Recruitment indices were available from pre-recruit surveys carried out in 1999 and previous years. The surveys and indices are listed in Table 7.11. The Sole Net Survey (SNS) and Beam Trawl Survey (BTS) are Dutch beam trawl surveys directed to flatfish juveniles in their coastal nurseries.

Indices of the DFS for 1998 and 1999 were not available because the surveys had not finished due to technical problems with the vessels or bad weather.

The options used in RCT3 are the same as those used in previous years and are listed in Tables 7.12a and b. The results of the survey indices regressed against XSA recruitment at age 1 are presented in Table 7.12a and those against age 2 are given in Table 7.12b.

The 1996 year class was estimated to be poor by the DFS 0-group index. However, as 1- and 2-group it appears to be very abundant particularly along the continental coast where all surveys estimate it a strong year class. The weighted estimate from RCT3 is about 3.0 times higher than the GM recruitment and is almost the same estimate as XSA. Therefore the XSA estimate of 225 million at age 3 in 1999 has been used in the forecast.

The 1997 year class was estimated to be about average by XSA and RCT3. The XSA estimate is mainly influenced by the two surveys, which receive 79% of the weight. Both surveys giving similar estimates for this year class, well above the low estimate of the F-shrinkage. The RCT3 estimates were based on seven survey indices, which receive 93% of the weight. The Working Group therefore decided to retain the RCT3 value of 109 million at age 2 in 1999 for prediction

The 1998 year class was estimated just below average by the SNS 1-group index. Although this year class is chiefly determined by one survey, this survey has a high correlation with the VPA recruitment. The RCT3 estimates of 85 million at age 1 in 1999 were therefore used in the forecast

The long-term GM recruitment was assumed for 1999 and subsequent year classes.

Year class strength used for predictions are underlined and can be summarised as follows:

Year class	XSA age 1 Thousands	RCT3 age 1 Thousands	GM (57-96) Thousands
1996	342381	296529	
1997	94278	<u>121818</u>	
1998	----	<u>84152</u>	
1999			<u>96798</u>
2000			<u>96798</u>

7.6 Historical stock trends

Historical trends in landings, recruitment, fishing mortality and SSB are given in Table 7.13. and plotted in Figures 7.4.a-d.

Fishing Mortality F(2-8) has increased from 0.14 to 0.55 in the period 1957-1984, mainly because of a developing beam trawl fishery. Since then it has varied mainly between 0.40 and 0.55.

Recruitment shows considerable variation from year to year and is characterised by the occasional occurrence of exceptional large year classes. Most large year classes were born after cold winters. In the recent decade three outstanding year classes, spawned in 1987, 1991 and 1996, have dominated the landings. Most other year classes recruited in recent years seem to be poor or near GM average.

The major fluctuations in SSB are associated with the effect of strong year classes superimposed on a declining stock trend, caused by the increase in fishing mortality. A drastic decline in SSB in 1964 was caused by a high natural mortality in the strong winter of 1963-1964 when water temperatures were very low. After a 20 year period where SSB has varied between 25,000t and 50,000t, it increased sharply in 1990 and remained at a high level until 1994. Since 1994 it has declined from 76 000t to a historically low level of 25, 000 t in 1998 because of below average recruitment, high fishing mortality and also an extra natural mortality in the 1995/1996 winter.

7.7 Short term forecast

For the current prediction, population survivors at the start of 1999 for ages 1 and 2 were estimated by RCT3. Ages 3 and older were taken from the XSA output. Fishing mortality at age were set to the unscaled mean for the years 1996-1998. Weight at age in the catch and in the stock are averages for the years 1996-1998. Maturity-ogive and natural mortality was the same as in the XSA and the long-term GM recruitment (97 million) was assumed for age 1 in 2000 and 2001 All the input data are shown in Table 7.14.

The management options table is given in Tables 7.15 and the detailed predictions for F_{sq} are presented in Table 7.16 . The options are also graphed in Figure 7.5.

Assuming a status quo F results in an expected catch in 1999 of 29,000 t and a catch of 26,000 t in 2000. The assumed SSB of 55,000 t in 1999 is expected to decrease to 48,000 t in 2000 and 37,000 t in the year 2001.

The proportional contributions of recent year classes to catch in 2000 and SSB in 2001 are given in Table 7.17. It should be noted that the strong 1996 year class is expected account for 52% of the landings in 2000.

A sensitivity analysis (method in section 1.4.2) was carried out to examine the contribution of different sources of uncertainty to the partial variance of predicted SSB and yield. The input values are presented in Table 7.18. Figure 7.6 shows the sensitivity of the forecast of the predicted yields in 2000 and the predicted biomass in 2001 to the input parameters. The estimated Yield in 2000 is mostly sensitive to the fishing mortality in that year together with the weight in the catch and the estimate of the size of the 1996 year class. The estimated SSB is apart from the fishing mortality in 2000 mostly affected by the estimates of the 1996 year class, its stock weight and its maturity. The variance of the yield estimates is mostly determined by the 1996 year class whereas the SSB estimates is mostly determined by the 1998 year class.

Probability profiles of expected yield and SSB are given in Figure 7.7. Assuming *status quo* fishing mortality, there is a 40 % probability that SSB in 2001 will fall below the Bpa of 35,000t.

7.8 Medium term forecast

Medium term predictions were made for a period of 10 years, to estimate percentiles of the distribution of the predicted yields, SSB and recruitment at a *status quo* level of fishing mortality.

As the mean weight in the catches has changed considerably over time, an average of the last 15 year for stock weights as well as catch weights was used in the medium term predictions. The input values for the medium term predictions are presented in Table 7.19.

Although none of the stock and recruitment models tested appeared to give a good fit to the historical time series a Ricker curve was used for medium term projections as in last years assessment.

WGMTERM was run for a range of F multipliers. Figure 7.8 shows the trajectory of yields and SBB with associated 5, 10, 20 50 and 95 percentiles for the *status quo* projection. Assuming *status quo* fishing mortality, yield, SSB and their associated probabilities reach converged values within a rather short time period and may therefore also be indicative for the long term.

Figure 7.9 shows the percentile distributions of SSB in 2008 for a range of fishing mortalities, indicating that fishing at Fsq (0.57) there is a 50% probability of SSB falling below Bpa in 2008. Fishing at Fpa (0.40) will give a 5% probability of SSB falling below Bpa in ten years time.

7.9 Biological reference points

As in the medium term predictions the average of the last 15 year for stock weights as well as catch weights were used to calculate the yield (Table 7.19.).Yield-per-recruit analysis, long-term yield and SSB, conditional on the present exploitation pattern and assuming *status quo* F in 1999, are given in Table 7.20 and Figure 7.5. The stock and recruitment plot is given in Figure 7.10, and includes values of Fhigh, Fmed and Flow (1.07, 0.34 and 0.09 respectively) which are very similar to last year's values. Fsq (0.57) is estimated to be 68% above Fmed and 47% below Fhigh.

The Biological reference points proposed by the Working Group were adopted by ACFM and are as follows:

B_{lim} = 25000 t	F_{lim}= 0.55
B_{pa} = 35000 t.	F_{pa} = 0.40.

The Working Group decided that there were no reasons to change the proposed reference points. Figure 7.11 shows the relationship between historical SSBs on F values, plotted into zones according to the proposed precautionary reference points.

7.10 Comments on assessment

In the history of the assessment, recruitment of 1 year olds have been estimated well for poor and average year classes but has been initially underestimated for strong year classes. The estimate of the 1996 year class by XSA is about 3 times average recruitment and was estimated about the same size by RCT3 in last year’s assessment. Prognoses of landings in 2001 and the recovery of the stock from its low level are mainly depended on the estimate of the 1996 year class.

There is a lack of representative data on effort and cpue of fisheries that exploit sole. The available tuning fleets are likely to be biased because of quota restrictions. The two commercial fleets, for which measured data have been used, are mixed fisheries for sole and plaice. The variable catch opportunities of the two species between years and the improved enforcement of management measures in recent years, affect the CPUE’s in this fishery and may bias the assessment.

Table 7.1. Nominal catch (tonnes) of SOLE in Sub-area IV and landings as estimated by the Working Group, 1982-1998

Year	Belgium	Denmark	France	Germany Fed. Rep.	Netherlands	UK (Engl. Wales)	Other countries	Total reported	Unallocated landings	WG Total	TAC
1982	1,927	522	686	290	17,749	403		21,577	2	21,579	20,000
1983	1,740	730	332	619	16,101	435		19,957	4,970	24,927	20,000
1984	1,771	818	400	1,034	14,330	586	1	18,940	7,899	26,839	20,000
1985	2,390	692	875	303	14,897	774	3	19,934	4,313	24,247	22,000
1986	1,833	443	296	155	9,558	647	2	12,934	5,267	18,201	20,000
1987	1,644	342	318	210	10,635	676	4	13,829	3,539	17,368	14,000
1988	1,199	616	487	452	9,841	740	28	13,363	8,227	21,590	14,000
1989	1,596	1,020	312	864	9,620	1,033	50	14,495	7,311	21,806	14,000
1990	2,389	1,428	352	2,296	18,202	1,614	263	26,544	8,576	35,120	25,000
1991	2,977	1,307	465	2,107	18,758	1,723	271	27,608	5,905	33,513	27,000
1992	2,058	1,359	548	1,880	18,601	1,281	277	26,004	3,337	29,341	25,000
1993	2,783	1,661	490	1,379	22,015	1,149	298	29,775	1,716	31,491	32,000
1994	2,935	1,804	499	1,744	22,874	1,137	298	31,291	1,711	33,002	32,000
1995	2,624	1,673	640	1,564	20,927	1,040	312	28,780	1,687	30,467	28,000
1996	2,555	1,018	535	670	15,344	848	229	20,351	2,300	22,651	23,000
1997	1,519	689	99	510	10,241	479	204	13,741	1,239	14,980	18,000
1998	1,844	520	510	780	15,198	549	338	19,739	1,128	20,867	19,100

all landings reported to ICES
unreported landings estimated by the Working Group
1997 data are provisional
French data are provisional
No data on discards available
N-Ireland included with England & Wales

Table 7.2

Run title : Sole in IV (run: XSAWVN03/X03)

Table 1 Catch numbers at age Numbers*10**-3

YEAR, AGE	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
1,	0,	0,	0,	0,	0,	55,	0,	0,	0,	1037,
2,	3659,	12042,	959,	1594,	676,	155,	47100,	12278,	3686,	17148,
3,	12025,	14133,	49786,	6210,	8339,	2113,	1089,	133617,	25683,	13896,
4,	10401,	16798,	19140,	59191,	8555,	5712,	1599,	990,	85127,	24973,
5,	8975,	9308,	12404,	15346,	46201,	3809,	5002,	1181,	1954,	48571,
6,	5768,	8367,	4695,	10541,	8490,	17337,	2482,	3689,	536,	462,
7,	1206,	4846,	3944,	4826,	6658,	3126,	12500,	744,	1919,	245,
8,	2025,	1593,	4279,	4112,	2423,	1810,	1557,	6324,	760,	1644,
9,	2574,	1056,	836,	2087,	3393,	818,	1525,	702,	5047,	324,
10,	1366,	2800,	990,	900,	1566,	872,	389,	767,	538,	4407,
11,	736,	992,	1711,	1539,	1002,	495,	627,	287,	610,	254,
12,	2875,	515,	1154,	977,	764,	217,	475,	473,	455,	820,
13,	101,	3135,	444,	1161,	1778,	474,	322,	120,	348,	82,
14,	128,	133,	2539,	389,	413,	336,	200,	87,	277,	396,
+gp,	409,	326,	416,	2528,	2861,	621,	1195,	716,	685,	564,
0 TOTALNUM,	52248,	76044,	103297,	111401,	93119,	37950,	76062,	161975,	127625,	114823,
TONSLAND,	13832,	18620,	23566,	26877,	26164,	11342,	17043,	33340,	33439,	33179,
SOPCOF %,	101,	99,	101,	99,	99,	97,	96,	99,	102,	100,

Table 1 Catch numbers at age Numbers*10**-3

YEAR, AGE	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
1,	396,	1299,	420,	358,	703,	101,	264,	1041,	1747,	27,
2,	23922,	6140,	33369,	7594,	12228,	15380,	22954,	3542,	22328,	25031,
3,	21451,	25993,	14425,	36759,	12783,	21540,	28535,	27966,	12073,	29292,
4,	5326,	8235,	12757,	7075,	16187,	5487,	11717,	14013,	15306,	6129,
5,	12388,	1784,	4485,	4965,	4025,	7061,	2088,	4819,	7440,	6639,
6,	25139,	3231,	1442,	1565,	2324,	1922,	3830,	966,	1779,	4250,
7,	331,	11960,	2327,	523,	994,	1585,	790,	1909,	319,	1738,
8,	244,	246,	7214,	1232,	765,	658,	907,	550,	1112,	611,
9,	1190,	140,	192,	4706,	1218,	401,	508,	425,	256,	646,
10,	289,	686,	232,	120,	3337,	609,	234,	204,	211,	191,
11,	2961,	169,	826,	100,	221,	2363,	252,	195,	93,	235,
12,	291,	2416,	291,	492,	297,	104,	1905,	132,	122,	123,
13,	538,	238,	1413,	119,	499,	32,	25,	1320,	108,	106,
14,	151,	582,	466,	922,	110,	305,	84,	39,	852,	68,
+gp,	1042,	1143,	1366,	1048,	1326,	1401,	945,	773,	729,	879,
0 TOTALNUM,	95659,	64262,	81225,	67578,	57017,	58949,	75038,	57894,	64475,	75965,
TONSLAND,	27559,	19685,	23652,	21086,	19309,	17989,	20773,	17326,	18003,	20280,
SOPCOF %,	102,	100,	101,	99,	102,	99,	101,	102,	102,	100,

Table 1 Catch numbers at age Numbers*10**-3

YEAR, AGE	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
1,	9,	637,	423,	2660,	389,	191,	165,	373,	94,	10,
2,	8179,	1209,	29217,	26435,	34408,	30734,	16618,	9351,	29018,	13187,
3,	41170,	12511,	3259,	45746,	41386,	43931,	43213,	18494,	22052,	47140,
4,	16060,	17781,	6866,	1843,	21189,	22554,	20286,	17703,	8913,	15248,
5,	2996,	7297,	8223,	3535,	624,	8791,	9403,	7745,	6515,	4400,
6,	3222,	1450,	3661,	4789,	1378,	741,	3556,	5522,	3121,	3890,
7,	1747,	2197,	948,	1678,	1950,	854,	209,	2272,	1570,	1554,
8,	816,	1409,	886,	615,	978,	1043,	379,	110,	906,	898,
9,	241,	367,	766,	605,	386,	524,	637,	282,	81,	526,
10,	393,	54,	197,	527,	301,	242,	200,	620,	103,	38,
11,	154,	415,	107,	149,	423,	209,	192,	355,	166,	34,
12,	117,	52,	160,	74,	31,	146,	189,	173,	145,	86,
13,	103,	52,	92,	201,	14,	30,	94,	126,	63,	42,
14,	73,	32,	21,	12,	177,	24,	33,	105,	56,	10,
+gp,	687,	598,	331,	315,	230,	243,	267,	305,	165,	111,
0 TOTALNUM,	75967,	46061,	55157,	89184,	103864,	110257,	95441,	63536,	72968,	87174,
TONSLAND,	22598,	15807,	15403,	21579,	24927,	26839,	24248,	18200,	17368,	21590,
SOPCOF %,	101,	102,	103,	101,	100,	100,	99,	99,	99,	100,

Table 1 Catch numbers at age Numbers*10**-3

YEAR, AGE	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
1,	115,	837,	117,	968,	53,	637,	4723,	171,	1584,	244,
2,	46108,	12019,	13208,	6864,	49906,	7663,	12752,	18632,	6048,	56375,
3,	18198,	103860,	25452,	44201,	16871,	87050,	16957,	16101,	23640,	15173,
4,	22567,	9775,	77484,	16198,	31403,	13776,	68166,	16930,	7365,	14882,
5,	4697,	9357,	6661,	37983,	13883,	18787,	6584,	27213,	5148,	3528,
6,	1694,	3509,	3839,	2471,	23969,	5723,	7941,	3941,	12802,	1993,
7,	1454,	1164,	1828,	3083,	1494,	11263,	2043,	4812,	1260,	4767,
8,	654,	1273,	760,	788,	1217,	465,	5982,	981,	2343,	856,
9,	466,	604,	742,	430,	490,	925,	294,	3321,	351,	1049,
10,	240,	268,	325,	481,	194,	281,	345,	239,	1444,	245,
11,	45,	324,	329,	177,	306,	86,	65,	298,	33,	414,
12,	36,	59,	386,	235,	109,	215,	75,	155,	118,	44,
13,	49,	28,	18,	134,	85,	84,	49,	55,	22,	61,
14,	27,	63,	16,	7,	116,	45,	20,	105,	26,	13,
+gp,	95,	215,	168,	255,	109,	248,	149,	173,	70,	89,
0 TOTALNUM,	96445,	143355,	131333,	114275,	140205,	147248,	126145,	93127,	62254,	99733,
TONSLAND,	21806,	35120,	33513,	29341,	31491,	33002,	30467,	22651,	14980,	20867,
SOPCOF %,	99,	99,	98,	98,	99,	99,	99,	99,	99,	99,

Table 7.3

Run title : Sole in IV (run: XSAWVN03/X03)
At 14/10/1999 15:58

Table 2 Catch weights at age (kg)

YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.1530,	.0000,	.0000,	.0000,	.1570,
2,	.1620,	.1530,	.1460,	.1550,	.1630,	.1750,	.1690,	.1770,	.1920,	.1890,
3,	.1880,	.1850,	.1740,	.1650,	.1710,	.2130,	.2090,	.1900,	.2010,	.2070,
4,	.2280,	.2350,	.2110,	.2080,	.2190,	.2520,	.2460,	.1800,	.2520,	.2670,
5,	.2610,	.2540,	.2550,	.2410,	.2580,	.2740,	.2860,	.3010,	.2770,	.3270,
6,	.3010,	.2770,	.2880,	.2950,	.3090,	.3090,	.2820,	.3320,	.3890,	.3420,
7,	.3280,	.3010,	.3190,	.3200,	.3230,	.3270,	.3450,	.4290,	.4190,	.3540,
8,	.3210,	.3090,	.3040,	.3210,	.3870,	.3460,	.3780,	.3990,	.3390,	.4550,
9,	.3730,	.3810,	.3460,	.3340,	.3760,	.3880,	.4040,	.4490,	.4240,	.4650,
10,	.3910,	.3630,	.3720,	.3490,	.4400,	.4440,	.4250,	.4720,	.4980,	.4750,
11,	.4380,	.4360,	.3690,	.3470,	.3970,	.4390,	.4590,	.5410,	.4560,	.6740,
12,	.4170,	.4280,	.3970,	.3940,	.4330,	.4750,	.4800,	.5260,	.3890,	.5240,
13,	.4370,	.4420,	.4780,	.4350,	.4440,	.4030,	.4580,	.5210,	.5190,	.6560,
14,	.4120,	.4270,	.4500,	.3730,	.4900,	.4470,	.3970,	.4910,	.4420,	.4950,
+gp,	.5890,	.5780,	.5510,	.4760,	.5780,	.6440,	.5280,	.4990,	.5910,	.6500,
0 SOPCOFAC,	1.0095,	.9936,	1.0137,	.9940,	.9918,	.9661,	.9592,	.9892,	1.0225,	.9968,

Table 2 Catch weights at age (kg)

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.1520,	.1540,	.1450,	.1690,	.1460,	.1640,	.1290,	.1430,	.1470,	.1520,
2,	.1910,	.2120,	.1930,	.2040,	.2080,	.1920,	.1820,	.1900,	.1880,	.1960,
3,	.1960,	.2180,	.2370,	.2520,	.2380,	.2330,	.2250,	.2220,	.2360,	.2310,
4,	.2550,	.2850,	.3220,	.3340,	.3460,	.3380,	.3200,	.3060,	.3070,	.3140,
5,	.3110,	.3500,	.3580,	.4340,	.4040,	.4180,	.4060,	.3890,	.3690,	.3700,
6,	.3730,	.4040,	.4250,	.4250,	.4480,	.4480,	.4560,	.4410,	.4240,	.4260,
7,	.5530,	.4410,	.4200,	.5320,	.5520,	.5200,	.5290,	.5120,	.4300,	.4660,
8,	.3980,	.4630,	.4900,	.4850,	.5670,	.5590,	.5950,	.5620,	.5200,	.4170,
9,	.4680,	.4430,	.5340,	.5580,	.5090,	.6090,	.6290,	.6670,	.5620,	.5720,
10,	.4990,	.5110,	.4250,	.4810,	.5690,	.6020,	.5600,	.6580,	.6220,	.4710,
11,	.4960,	.5120,	.4890,	.4720,	.6440,	.6610,	.6480,	.5380,	.7310,	.6040,
12,	.5380,	.5410,	.4660,	.5770,	.3990,	.6780,	.6830,	.7360,	.6070,	.7110,
13,	.4740,	.4560,	.5780,	.5970,	.5470,	.5320,	.6200,	.6680,	.6050,	.5880,
14,	.6130,	.5420,	.5630,	.6770,	.6420,	.5820,	.6450,	.5980,	.6430,	.8300,
+gp,	.6130,	.5420,	.5830,	.6470,	.6700,	.6790,	.6780,	.6840,	.5810,	.7160,
0 SOPCOFAC,	1.0202,	1.0001,	1.0119,	.9890,	1.0189,	.9864,	1.0104,	1.0216,	1.0188,	.9956,

Table 2 Catch weights at age (kg)

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.1370,	.1410,	.1430,	.1410,	.1340,	.1530,	.1220,	.1350,	.1390,	.1270,
2,	.2080,	.1990,	.1870,	.1880,	.1820,	.1710,	.1870,	.1790,	.1850,	.1750,
3,	.2460,	.2440,	.2260,	.2160,	.2170,	.2210,	.2160,	.2130,	.2050,	.2170,
4,	.3230,	.3310,	.3240,	.3070,	.3010,	.2860,	.2880,	.2990,	.2760,	.2700,
5,	.3910,	.3710,	.3780,	.3710,	.3890,	.3610,	.3570,	.3570,	.3560,	.3530,
6,	.4480,	.4180,	.4240,	.4090,	.4160,	.3860,	.4270,	.4070,	.3780,	.4280,
7,	.5340,	.4990,	.4420,	.4370,	.4670,	.4650,	.4470,	.4850,	.4280,	.4830,
8,	.5440,	.5500,	.5160,	.4910,	.4890,	.5550,	.5440,	.5430,	.4810,	.5190,
9,	.6090,	.5980,	.5420,	.5800,	.5050,	.5750,	.6120,	.5680,	.3940,	.5580,
10,	.6570,	.5440,	.5530,	.5560,	.6090,	.5120,	.6340,	.5360,	.6080,	.5940,
11,	.7280,	.6580,	.4030,	.6280,	.6220,	.6550,	.5090,	.5750,	.6440,	.8070,
12,	.7740,	.6840,	.6650,	.5910,	.6000,	.6310,	.6560,	.6330,	.6140,	.7140,
13,	.8060,	.6740,	.5650,	.7710,	.3340,	.7220,	.7670,	.6310,	.6950,	.7540,
14,	.8390,	.6610,	.7210,	.8980,	.6310,	.8450,	.8010,	.7880,	.7270,	.7710,
+gp,	.8150,	.7170,	.7450,	.7680,	.7560,	.7070,	.6800,	.7150,	.6960,	.6940,
0 SOPCOFAC,	1.0124,	1.0201,	1.0262,	1.0138,	1.0040,	1.0034,	.9898,	.9936,	.9948,	.9990,

Table 2 Catch weights at age (kg)

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.1180,	.1240,	.1270,	.1460,	.0970,	.1420,	.1510,	.1620,	.1510,	.1280,
2,	.1730,	.1820,	.1850,	.1770,	.1670,	.1810,	.1850,	.1770,	.1800,	.1820,
3,	.2160,	.2260,	.2090,	.2130,	.1950,	.2020,	.1960,	.2020,	.2060,	.1890,
4,	.2880,	.2900,	.2630,	.2580,	.2390,	.2280,	.2470,	.2330,	.2360,	.2520,
5,	.3350,	.3680,	.3140,	.2990,	.2640,	.2570,	.2640,	.2740,	.2670,	.2620,
6,	.3740,	.4030,	.4280,	.3790,	.3010,	.3000,	.3190,	.2850,	.2960,	.2880,
7,	.4560,	.4010,	.4340,	.4100,	.3380,	.3170,	.3420,	.3190,	.3250,	.3360,
8,	.4900,	.4970,	.4550,	.4590,	.4420,	.4320,	.3560,	.3690,	.3070,	.2920,
9,	.4720,	.4570,	.5050,	.4840,	.4930,	.4110,	.4450,	.3900,	.3870,	.3350,
10,	.5090,	.5640,	.5480,	.5270,	.6220,	.4130,	.5050,	.5160,	.4070,	.3980,
11,	.6810,	.6220,	.5130,	.5900,	.5630,	.5160,	.7500,	.5400,	.5750,	.5020,
12,	.6300,	.5170,	.5080,	.4720,	.5870,	.4810,	.5450,	.5450,	.6030,	.4340,
13,	.7090,	.5710,	.8190,	.6180,	.6390,	.6690,	.7580,	.5900,	.6530,	.6480,
14,	.6350,	.4610,	.7420,	.7760,	.6080,	.6060,	.9310,	.6910,	.4620,	.5360,
+gp,	.7270,	.6300,	.5520,	.6350,	.6400,	.5590,	.6020,	.7470,	.7480,	.7240,
0 SOPCOFAC,	.9855,	.9922,	.9837,	.9847,	.9887,	.9885,	.9869,	.9892,	.9907,	.9915,

Table 7.4

Run title : Sole in IV (run: XSAWVN03/X03)

At 14/10/1999 15:58

Table 3 Stock weights at age (kg)

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
1,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,
2,	.0700,	.0700,	.0700,	.0700,	.0700,	.0700,	.1400,	.0700,	.1770,	.1220,
3,	.1590,	.1630,	.1480,	.1480,	.1480,	.1590,	.1980,	.1600,	.1640,	.1710,
4,	.1980,	.2070,	.2060,	.1920,	.1930,	.2140,	.2230,	.1490,	.2350,	.2480,
5,	.2390,	.2340,	.2350,	.2400,	.2430,	.2400,	.2510,	.3890,	.2420,	.3120,
6,	.2710,	.2400,	.2320,	.3010,	.2750,	.2910,	.2970,	.3100,	.3990,	.2800,
7,	.2920,	.2680,	.2590,	.2930,	.3110,	.3050,	.3370,	.4060,	.3620,	.6290,
8,	.2760,	.2420,	.2740,	.2820,	.3630,	.3060,	.3580,	.3770,	.2830,	.4160,
9,	.3030,	.3600,	.2810,	.2730,	.3290,	.3650,	.5260,	.3850,	.3810,	.4100,
10,	.4100,	.3570,	.3020,	.4100,	.4330,	.4430,	.4240,	.4270,	.4640,	.4500,
11,	.4080,	.5080,	.3790,	.3580,	.3650,	.3960,	.4640,	.5980,	.3780,	.7530,
12,	.4060,	.3900,	.3350,	.3150,	.3520,	.4580,	.4560,	.5550,	.3720,	.4450,
13,	.4130,	.4640,	.4820,	.4630,	.4910,	.4700,	.4180,	.4680,	.5440,	.6600,
14,	.5980,	.4660,	.4330,	.4620,	.4140,	.3940,	.3390,	.3800,	.4500,	.4560,
+gp,	.5990,	.5730,	.5480,	.5390,	.5400,	.6310,	.5040,	.5380,	.5460,	.6980,

Table 3 Stock weights at age (kg)

AGE	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1,	.0250,	.0250,	.0340,	.0380,	.0390,	.0350,	.0350,	.0350,	.0350,	.0350,
2,	.1370,	.1370,	.1480,	.1550,	.1490,	.1460,	.1480,	.1420,	.1470,	.1390,
3,	.1740,	.2010,	.2130,	.2180,	.2260,	.2180,	.2060,	.2010,	.2020,	.2110,
4,	.2520,	.2750,	.3130,	.3130,	.3220,	.3290,	.3110,	.3010,	.2910,	.2900,
5,	.3240,	.3410,	.3610,	.4190,	.3710,	.4080,	.4030,	.3790,	.3650,	.3650,
6,	.3640,	.3670,	.4100,	.4430,	.4330,	.4290,	.4460,	.4580,	.4090,	.4290,
7,	.5790,	.4230,	.4320,	.4430,	.4520,	.4990,	.5080,	.5080,	.4780,	.4270,
8,	.4150,	.4580,	.4740,	.4430,	.4720,	.5650,	.5820,	.5170,	.4870,	.3850,
9,	.4690,	.3900,	.4830,	.5080,	.4460,	.5420,	.5800,	.6440,	.5310,	.5420,
10,	.5240,	.4860,	.4510,	.4400,	.4890,	.5940,	.6170,	.6970,	.6170,	.4280,
11,	.5040,	.4900,	.4810,	.4710,	.6210,	.6320,	.6150,	.6140,	.6610,	.5700,
12,	.5640,	.5350,	.4250,	.5030,	.4660,	.5940,	.6470,	.7860,	.6560,	.6750,
13,	.5340,	.6220,	.5740,	.6310,	.5480,	.6500,	.6500,	.6480,	.6280,	.5890,
14,	.5150,	.5740,	.5020,	.6210,	.6240,	.5400,	.7050,	.6280,	.6320,	.8600,
+gp,	.5510,	.6220,	.5680,	.6590,	.6420,	.6230,	.6690,	.6790,	.6650,	.6970,

Table 3 Stock weights at age (kg)

AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1,	.0450,	.0390,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,
2,	.1480,	.1570,	.1370,	.1300,	.1400,	.1330,	.1270,	.1330,	.1540,	.1330,
3,	.2110,	.2000,	.2000,	.1930,	.2000,	.2030,	.1850,	.1910,	.1910,	.1930,
4,	.3000,	.3040,	.3050,	.2700,	.2850,	.2680,	.2670,	.2790,	.2620,	.2600,
5,	.3520,	.3450,	.3640,	.3590,	.3290,	.3480,	.3240,	.3460,	.3570,	.3350,
6,	.4290,	.3940,	.4020,	.4110,	.4350,	.3860,	.3810,	.4250,	.3810,	.4080,
7,	.5210,	.4890,	.4540,	.4290,	.4640,	.4880,	.3800,	.4980,	.4060,	.4170,
8,	.5620,	.5370,	.5220,	.4760,	.4830,	.5910,	.6260,	.4920,	.4540,	.4720,
9,	.5670,	.5790,	.5610,	.5830,	.5100,	.5670,	.5540,	.5900,	.3330,	.4850,
10,	.6560,	.5490,	.5200,	.5930,	.5830,	.5590,	.5890,	.5610,	.5120,	.4550,
11,	.7120,	.6640,	.4090,	.5700,	.6010,	.6320,	.5170,	.6810,	.6380,	.8290,
12,	.7160,	.6760,	.7130,	.5310,	.7210,	.7310,	.7340,	.6470,	.5810,	.6550,
13,	.7870,	.6380,	.5330,	.7910,	.7410,	.8730,	.7400,	.7390,	.6330,	.5350,
14,	.8150,	.6570,	.8220,	.6110,	.6800,	.9520,	.6420,	.9430,	.6910,	.8470,
+gp,	.7910,	.6380,	.7200,	.6910,	.7190,	.7000,	.6730,	.8890,	.6710,	.6870,

Table 3 Stock weights at age (kg)

AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,
2,	.1330,	.1480,	.1380,	.1560,	.1280,	.1430,	.1510,	.1470,	.1500,	.1400,
3,	.1950,	.2030,	.1830,	.1940,	.1830,	.1740,	.1780,	.1770,	.1900,	.1730,
4,	.2900,	.2920,	.2530,	.2560,	.2280,	.2090,	.2400,	.2080,	.2250,	.2340,
5,	.3480,	.3560,	.3000,	.3070,	.2640,	.2570,	.2510,	.2740,	.2520,	.2670,
6,	.3390,	.4380,	.4060,	.3970,	.2930,	.3260,	.3200,	.2670,	.3030,	.2810,
7,	.4100,	.3910,	.4370,	.4050,	.3440,	.3490,	.3630,	.3200,	.3180,	.3270,
8,	.4750,	.4860,	.4990,	.4680,	.4790,	.4020,	.3570,	.3720,	.3240,	.2710,
9,	.4180,	.4710,	.5450,	.4940,	.4330,	.4930,	.5440,	.4020,	.3580,	.3350,
10,	.4620,	.4960,	.5370,	.5440,	.5730,	.3410,	.4580,	.4020,	.3850,	.3320,
11,	.7040,	.6820,	.5010,	.4880,	.5630,	.4330,	.3950,	.4680,	.5780,	.4870,
12,	.7870,	.5500,	.5510,	.4430,	.5070,	.5190,	.7010,	.5370,	.6340,	.3050,
13,	.7160,	.7890,	.4300,	.5950,	.6760,	.4800,	.6920,	.6140,	.7100,	.5480,
14,	.6160,	.4580,	1.1090,	.6720,	.5800,	.6890,	.5840,	.6380,	.7050,	.4800,
+gp,	.7300,	.7490,	.6400,	.6070,	.6620,	.5050,	.6600,	.8000,	.6530,	.6380,

Table 7.5 North Sea Sole tuning fleets

Netherlands commercial beam trawl

1979	1998													
1	1	0	1											
2	15													
44.9	721.2	35400.6	12904.4	2096.5	2657.4	1490	641.6	177.2	323.3	104.9	85.5	77	53.7	476.1
45	938.3	11061	14294.5	4914.8	938.1	1731.7	1133.1	214.3	17	347.8	16.5	32.5	23.7	432.2
46.3	26036	2756	5720.5	6094.5	2265.5	586.6	531.3	439.4	98.9	15.3	102.4	56.9	4.4	173.2
57.3	24290.1	38683	1085.1	2638.3	3214.2	961.1	234.8	352.9	287.6	80.2	41.7	157.3	7.9	141.1
65.6	31274.7	36706.2	16386.3	375.1	768.9	1117.8	531.2	237.5	168.1	338.6	15	2	157.6	143.2
70.8	26976.3	37398.3	18212.1	6529	301.2	492	633.5	321.8	123.7	130.9	90.3	6.4	14.5	155.4
70.3	12923.7	34685.4	16979.4	7239.6	2536.8	146.5	285.1	426.8	84.9	68.7	113.3	61.9	9.1	134.5
68.2	8027	13755	13809.8	6353.7	4342.4	1712.2	71.8	223.4	405.6	211.1	124.6	73.4	88.5	247.6
68.5	23736.2	18618.8	6796	5209.3	2597.3	1136.9	580.1	44.4	67.4	70.1	83.3	29.7	31.2	122.1
76.3	12191.9	40595.2	12448.9	2982.9	2955.6	1274.8	652.4	384.5	30.4	25.4	42.7	26.1	3.2	60.9
61.6	40284.3	13165.6	17489.4	2688.9	1099.4	1134.4	409.4	333.9	161.6	8.9	22.7	16.2	10	40
71.4	9071.1	84629.7	7242	6586.7	1669.1	634.6	819.2	375.9	137.6	134.1	42.5	10.1	12.6	138.2
68.5	7336.6	17182.4	59754	4638.3	2137.6	682.7	312.1	392.3	156.6	98.4	180.5	6.3	6	48.1
71.1	5046.7	33880.5	11131	29835.9	1457.9	2081.2	446.1	218.6	274.8	75.7	164.1	66.4	3.9	109
76.9	39284.5	10948	24132	9625.4	18624	887.1	811.5	236.1	66.4	186.3	50.2	41.6	59.1	21.8
81.4	5389.9	69878.8	7411.7	13010.4	3104.8	8932.9	190	524.2	175.9	25.9	158.5	25.2	20.1	149.5
81.2	9778	11329.4	53488.8	2839.2	5128.8	896.5	4682.4	147.4	204.8	24.4	22.4	34.7	6.4	108.6
72.1	15843.4	9093.9	11170.8	21211.9	1570	3173.4	471.9	2773.8	160	190.5	85.7	23.3	62.4	99.5
72	4505.9	18426.8	4503.6	3329	9771.1	497.2	1800.4	94.6	1155.3	5.7	76.9	11.1	14.3	43.5
70.3	50570.7	9023.1	11123.1	1826.2	1145.6	3395	210.7	337	21.4	286.6	5.2	37.2	4.9	42.9

UK beamtrawl CPUE

1986	1998													
1	1	0	1											
2	15													
40.6	42.5	227.706	295.649	121.659	146.526	69.134	4.424	2.977	17.081	9.873	7.804	7.182	4.622	12.331
59.5	3.51	66.381	101.888	89.855	42.238	27.368	26.072	1.887	2.105	6.052	3.826	5.557	3.143	6.677
73.5	23.964	382.062	249.79	156.619	135.664	42.363	55.556	30.189	2.016	2.535	10.203	6.3	3.227	28.756
71.8	565.792	318.821	450.727	230.563	114.999	73.252	32.567	35.448	29.147	1.395	2.992	11.392	7.506	30.397
78.8	156.433	2511.246	302.16	427.945	241.296	164.299	114.464	63.3	55.541	35.517	2.404	3.588	22.576	23.777
115.6	123.4	513.669	2403.099	179.689	289.221	129.815	45.631	38.352	21.245	27.522	30.691	0.814	1.254	27.962
139.9	57.372	654.488	461.707	716.511	72.524	202.261	100.74	81.124	66.47	29.543	31.245	43.002	0.296	59.731
148.9	181.428	243.064	468.473	265.165	451.183	43.599	90.5	63.831	49.228	33.798	18.272	20.419	20.531	33.868
114.3	185.964	1036.164	505.135	465.135	142.426	186.756	13.034	40.721	32.599	25.364	13.245	14.576	8.37	16.848
90.5	86.311	303.447	783.082	456.297	226.653	110.484	106.186	9.779	31.89	20.171	19.567	6.574	1.69	17.641
75.5	92.399	136.566	221.037	464.569	201.271	166.369	80.273	99.947	7.5	23.4	13.836	11.684	12.093	24.623
56.7	24.685	124.198	111.961	111.309	113.751	120.337	47.796	32.019	20.383	3.745	8.16	4.303	5.196	11.673
58.6	456	284.2	168.5	105.9	108.8	83.5	119.5	52.2	17.3	14.5	3.2	4.4	2.4	10.7

BTS-ISIS Neth (survey)

1985	1998			
1	1	0.67	0.75	
1	4			
1	2.64	6.68	3.49	1.92
1	9.4	4.32	1.21	0.65
1	7.28	11.76	1.76	0.53
1	79.75	12.03	2.72	1
1	8.72	67.91	4.23	4.04
1	22.4	19.61	18.54	0.47
1	2.96	22.16	5.54	5.46
1	72.71	22.66	9.61	2.26
1	4.63	26.61	1.58	5.23
1	5.94	4.95	15.46	0.13
1	26.31	8.68	8.27	6.47
1	4.05	6.26	1.48	1.46
1	174.09	5.29	3.13	0.75
1	15.54	27.73	1.02	1.12

SNS-Tridens Neth (survey)

1970	1998			
1	1	0.67	0.75	
1	4			
1	4938	745	204	31
1	613	1961	99	7
1	1410	341	161	0.1
1	4686	905	73	35
1	1924	397	69	0.1
1	597	887	174	44
1	1413	79	187	70
1	3724	762	77	85
1	1552	1379	267	27
1	104	388	325	60
1	4483	80	99	45
1	3739	1411	51	13
1	5098	1124	231	7
1	2640	1137	107	43
1	2359	1081	307	102
1	2151	709	159	59
1	3791	465	67	30
1	1890	955	59	15
1	11227	594	284	81
1	3052	5369	248	50
1	2900	1078	907	100
1	1265	2515	527	607
1	11081	114	319	194
1	1351	3489	46	166
1	559	475	943	10
1	1501	234	126	365
1	691	473	27	48
1	10132	143	231	51
1	2876	1993	131	52

Table 7.6. North Sea sole Indices of effort and CPUE

	Effort			CPUE		
	1 Belgium	2 UK-bt	3 Netherlands	4 Belgium	5 UK-bt*	6 Netherlands
1971						
1972	29.8			33.5		
1973	29.4			33.1		
1974	32.2			23.7		
1975	39.2			26.2		
1976	44.7			24.5		
1977	47.6			27.2		
1978	50.3		44.3	25.9		375.8
1979	40.0		44.9	38.7		423.2
1980	35.2		45.0	30.9		282.1
1981	31.1		46.3	35.2		267.8
1982	34.9		57.3	44.7		309.8
1983	35.4		65.6	42.8		319.9
1984	42.8		70.8	35.2		307.3
1985	51.4	19.6	70.3	40.8	41.7	276.3
1986	42.5	40.6	68.2	38.8	16.0	213.4
1987	50.7	59.5	68.5	28.9	11.4	204.5
1988	53.0	73.5	76.3	19.2	10.1	235.9
1989	54.3	71.8	61.6	22.7	14.0	272.7
1990	64.7	78.8	71.4	24.8	22.5	378.1
1991	74.3	115.6	68.5	33.5	14.3	350.9
1992	67.7	139.9	71.1	22.5	8.9	307.1
1993	71.1	148.9	76.9	27.2	7.6	306.4
1994	60.0	114.3	81.4	32.5	9.6	295.6
1995	46.5	90.5	81.2	34.9	10.8	275.1
1996	64.9	75.5	72.1	29.0	10.5	227.1
1997	47.2	56.7	72.0	24.2	4.1	151.7
1998	43.6	58.6	70.3	25.0	5.6	230.7

CPUE in these fleets in recent years are biased because of quota restrictions

1 fishing hours in 1000 HP beam trawl units * 10E3
2 mllion HP hours (revised series)
3 million HP days beam trawl
4 Kg/FH 1000 HP beam trawl
5 kg/1000 HP hours
6 kg/1000 HP day

***** Revised in line with HP corrected effort

Table 7.7

Title : Sole in IV (run: SEPWVN01/S01)

At 14/10/1999 15:08

Separable analysis
from 1989 to 1998 on ages 1 to 14
with Terminal F of .500 on age 4 and Terminal S of .800

Initial sum of squared residuals was 203.103 and
final sum of squared residuals is 23.828 after 56 iterations

Matrix of Residuals

Years,	1989/90,	1990/91,	1991/92,	1992/93,	1993/94,	1994/95,	1995/96,	1996/97,	1997/98,	TOT,	WTS,
1/ 2,	-1.064,	.623,	-.704,	-.507,	-1.539,	.211,	2.211,	-.579,	-.302,	.000,	.165,
2/ 3,	.067,	-.093,	-.568,	-.204,	.118,	-.337,	.577,	-.001,	-.356,	.000,	.542,
3/ 4,	.675,	.094,	.231,	.167,	-.014,	-.195,	-.083,	.109,	.183,	.000,	.736,
4/ 5,	.490,	-.279,	.026,	-.487,	-.179,	-.190,	.363,	.012,	-.006,	.000,	.592,
5/ 6,	-.077,	.253,	.329,	-.156,	.220,	-.040,	-.015,	-.396,	.231,	.000,	.764,
6/ 7,	-.089,	-.079,	-.536,	-.203,	.003,	.039,	-.109,	-.103,	.171,	.000,	.928,
7/ 8,	-.195,	-.160,	.233,	.372,	.569,	-.200,	.278,	-.360,	-.287,	.000,	.539,
8/ 9,	-.156,	.049,	.057,	.013,	-.227,	-.276,	.227,	.050,	.225,	.000,	1.000,
9/10,	.365,	.174,	-.035,	.376,	.094,	.294,	-.117,	-.101,	-.171,	.000,	.844,
10/11,	-1.030,	-1.195,	-.405,	-.504,	-.178,	.226,	-.693,	.485,	.163,	.000,	.315,
11/12,	.045,	-.099,	.392,	.590,	.423,	-.012,	-.666,	.551,	-.297,	.000,	.428,
12/13,	-.271,	.401,	.248,	.259,	-.539,	.438,	-.344,	.659,	-.216,	.000,	.433,
13/14,	-.381,	.179,	.542,	-.207,	.247,	.816,	-1.012,	-.109,	.058,	.000,	.339,
TOT ,	.002,	.001,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	-2.429,	
WTS ,	.001,	.001,	.001,	.001,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
F-values,	.4464,	.5614,	.5772,	.5863,	.6415,	.7070,	.6144,	.7942,	.5487,	.5000,

Selection-at-age (S)

,	1,	2,	3,	4,
S-values,	.0076,	.2597,	.7041,	1.0000,

,	5,	6,	7,	8,	9,	10,	11,	12,	13,	14,
S-values,	.9717,	.9549,	.8209,	.7735,	.7944,	.8779,	.5261,	.9109,	.7103,	.8000,

Table 7.8

Lowestoft VPA Version 3.1

14/10/1999 15:57

Extended Survivors Analysis

Sole in IV (run: XSAWVN03/X03)

CPUE data from file fleet

Catch data for 42 years. 1957 to 1998. Ages 1 to 15.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT01: NL beamtrawl ,	1989,	1998,	2,	14,	.000,	1.000
FLT02: UK beamtrawl ,	1989,	1998,	2,	14,	.000,	1.000
FLT03: BTS-ISIS Neth,	1989,	1998,	1,	4,	.670,	.750
FLT04: SNS-Tridens N,	1989,	1998,	1,	4,	.670,	.750

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 3

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 3

Catchability independent of age for ages >= 7

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 = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 25 iterations

1

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities

Age,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1,	.001,	.005,	.002,	.003,	.001,	.012,	.049,	.003,	.005,	.003
2,	.127,	.137,	.089,	.117,	.178,	.133,	.297,	.247,	.143,	.213
3,	.522,	.413,	.419,	.423,	.412,	.471,	.428,	.657,	.498,	.557
4,	.654,	.522,	.548,	.456,	.534,	.617,	.736,	.892,	.635,	.596
5,	.423,	.551,	.726,	.503,	.792,	.628,	.599,	.653,	.662,	.633
6,	.384,	.570,	.405,	.575,	.608,	.800,	.525,	.783,	.652,	.513
7,	.295,	.439,	.584,	.586,	.733,	.571,	.660,	.621,	.544,	.475
8,	.326,	.404,	.506,	.475,	.427,	.465,	.601,	.686,	.622,	.782
9,	.305,	.500,	.386,	.531,	.542,	.592,	.534,	.705,	.493,	.557
10,	.158,	.257,	.488,	.412,	.430,	.608,	.405,	1.007,	.677,	.677
11,	.343,	.294,	.508,	.476,	.444,	.306,	.241,	.647,	.308,	.366
12,	.398,	.901,	.598,	.738,	.535,	.570,	.423,	1.262,	.508,	.758
13,	.311,	.545,	.679,	.377,	.574,	.924,	.215,	.556,	.506,	.476
14,	.393,	.730,	.611,	.541,	.576,	.604,	.511,	.841,	.492,	.562

Table 7.8 (Cont'd)

1

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9	10
1989	1.10E+05	4.05E+05	4.71E+04	4.94E+04	1.43E+04	5.59E+03	5.98E+03	2.47E+03	1.86E+03	1.73E+03
1990	1.81E+05	9.90E+04	3.23E+05	2.53E+04	2.32E+04	8.49E+03	3.45E+03	4.03E+03	1.61E+03	1.24E+03
1991	7.22E+04	1.63E+05	7.82E+04	1.93E+05	1.36E+04	1.21E+04	4.34E+03	2.01E+03	2.43E+03	8.85E+02
1992	3.57E+05	6.52E+04	1.35E+05	4.65E+04	1.01E+05	5.94E+03	7.31E+03	2.19E+03	1.10E+03	1.50E+03
1993	7.14E+04	3.22E+05	5.25E+04	7.98E+04	2.67E+04	5.53E+04	3.02E+03	3.68E+03	1.23E+03	5.83E+02
1994	5.84E+04	6.46E+04	2.44E+05	3.15E+04	4.23E+04	1.09E+04	2.72E+04	1.31E+03	2.18E+03	6.49E+02
1995	1.04E+05	5.22E+04	5.12E+04	1.38E+05	1.54E+04	2.04E+04	4.44E+03	1.39E+04	7.47E+02	1.09E+03
1996	5.29E+04	8.96E+04	3.51E+04	3.02E+04	5.97E+04	7.63E+03	1.09E+04	2.08E+03	6.90E+03	3.96E+02
1997	3.42E+05	4.77E+04	6.34E+04	1.65E+04	1.12E+04	2.81E+04	3.16E+03	5.32E+03	9.47E+02	3.09E+03
1998	9.43E+04	3.08E+05	3.74E+04	3.49E+04	7.90E+03	5.22E+03	1.33E+04	1.66E+03	2.58E+03	5.23E+02

Estimated population abundance at 1st Jan 1999

	0.00E+00	8.51E+04	2.25E+05	1.94E+04	1.74E+04	3.80E+03	2.83E+03	7.46E+03	6.86E+02	1.34E+03

Taper weighted geometric mean of the VPA populations:

	9.97E+04	8.79E+04	6.46E+04	3.70E+04	1.98E+04	1.14E+04	7.05E+03	4.39E+03	2.88E+03	1.99E+03

Standard error of the weighted Log(VPA populations) :

	.8018	.8458	.8592	.9027	.9528	.9494	1.0122	1.0555	1.1212	1.2900

YEAR	AGE 11	12	13	14
1989	1.63E+02	1.15E+02	1.93E+02	8.74E+01
1990	1.34E+03	1.04E+02	7.01E+01	1.28E+02
1991	8.69E+02	9.01E+02	3.84E+01	3.68E+01
1992	4.92E+02	4.73E+02	4.49E+02	1.76E+01
1993	8.96E+02	2.76E+02	2.05E+02	2.78E+02
1994	3.43E+02	5.20E+02	1.46E+02	1.04E+02
1995	3.20E+02	2.29E+02	2.66E+02	5.26E+01
1996	6.57E+02	2.27E+02	1.36E+02	1.94E+02
1997	1.31E+02	3.11E+02	5.83E+01	7.03E+01
1998	1.42E+03	8.70E+01	1.69E+02	3.18E+01

Estimated population abundance at 1st Jan 1999

	2.41E+02	8.91E+02	3.69E+01	9.52E+01

Taper weighted geometric mean of the VPA populations:

	1.35E+03	8.82E+02	5.55E+02	3.59E+02

Standard error of the weighted Log(VPA populations) :

	1.3554	1.4415	1.5478	1.6631

1

Log catchability residuals.

Fleet : FLT01: NL beamtrawl

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	.01	-.12	-.80	-.26	.03	-.31	.54	.54	-.05	.41
3	.29	.03	-.10	.00	-.27	.01	-.26	.12	.16	.03
4	.33	-.09	.04	-.29	-.10	-.37	.18	.32	-.09	.07
5	-.31	.01	.31	.03	.28	-.01	-.53	.27	.10	-.15
6	-.13	-.19	-.33	.04	.29	.15	-.09	-.06	.41	-.09
7	-.13	-.24	-.29	.26	.28	.26	-.18	.28	-.36	.12
8	-.25	-.16	-.34	-.12	-.14	-.60	.30	.07	.44	-.45
9	-.18	.02	-.36	-.12	-.23	-.04	-.26	.65	-.84	-.52
10	-.90	-.83	-.22	-.25	-.80	.09	-.37	.78	.56	-1.63
11	-1.35	-.92	-.66	-.40	-.19	-1.33	-1.34	.29	-1.75	-.17
12	-.05	.75	-.05	.53	-.29	.19	-1.01	.81	.07	-1.21
13	-.94	-.44	-.21	-.48	-.16	-.23	-.82	-.27	-.19	-.03
14	-.59	-.74	-.24	-.01	-.11	-.25	-.75	.48	-.13	-.35

Table 7.8 (Cont'd)

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9	10	11	12
Mean Log q	-5.3907	-5.1362	-5.2282	-5.3894	-5.4604	-5.4604	-5.4604	-5.4604	-5.4604	-5.4604
S.E(Log q)	.1765	.2363	.2702	.2252	.2659	.3488	.4328	.8151	1.0568	.6763

Age	13	14
Mean Log q	-5.4604	-5.4604
S.E(Log q)	.4957	.4679

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	.94	.318	6.71	.79	10	.44	-6.40

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
3	1.00	-.040	5.37	.95	10	.19	-5.39
4	.94	.637	5.49	.93	10	.23	-5.14
5	.90	.946	5.69	.92	10	.25	-5.23
6	.85	2.181	5.99	.96	10	.16	-5.39
7	.82	2.138	6.06	.95	10	.18	-5.46
8	.73	3.719	6.24	.96	10	.15	-5.59
9	.72	2.369	6.16	.90	10	.23	-5.65
10	.88	.330	5.94	.50	10	.67	-5.82
11	.63	3.031	6.24	.89	10	.30	-6.24
12	.83	.682	5.49	.66	10	.58	-5.48
13	1.19	-1.208	6.01	.84	10	.34	-5.84
14	.93	.461	5.64	.86	10	.36	-5.73

1

Fleet : FLT02: UK beamtrawl

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	.54	.48	-.70	-.79	-1.20	.69	.42	.12	-.40	.84
3	.53	.53	-.02	-.51	-.63	-.42	.13	-.01	-.48	.87
4	.33	.45	.11	-.34	-.90	.41	-.34	.16	.26	-.13
5	.39	.49	-.14	-1.06	-.66	-.36	.85	-.28	.25	.51
6	.48	.79	.16	-.62	-1.07	-.26	-.30	.86	-.79	.75
7	-.29	1.04	.25	-.01	-.66	-1.21	.35	.02	1.19	-.67
8	-.21	.51	-.06	.45	-.27	-.89	-.86	.98	-.22	1.90
9	.15	.87	-.48	.95	.53	-.20	-.35	.01	1.05	.53
10	-.04	.89	-.01	.38	.97	.80	.40	.40	-.50	1.08
11	-.63	.39	.28	.71	.17	1.04	1.09	.88	.80	-.24
12	.51	.51	.39	.92	.77	.10	1.48	1.67	.80	1.22
13	1.29	1.16	-.05	1.14	1.20	1.61	.14	1.73	1.84	.74
14	1.70	2.48	.40	-.53	.90	1.26	.54	1.53	1.83	1.85

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9	10	11	12
Mean Log q	-9.5082	-8.9437	-8.5456	-8.4056	-8.1919	-8.1919	-8.1919	-8.1919	-8.1919	-8.1919
S.E(Log q)	.5160	.4264	.5987	.7078	.7552	.8642	.6438	.6869	.7386	1.0132

Age	13	14
Mean Log q	-8.1919	-8.1919
S.E(Log q)	1.3025	1.5370

Table 7.8 (Cont'd)

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Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 2,    1.07,    -.210,     11.13,     .56,     10,     .76,  -11.16,

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

 3,    1.13,    -.484,      9.29,     .65,     10,     .61,   -9.51,
 4,    1.36,   -1.526,      8.29,     .70,     10,     .54,   -8.94,
 5,    2.33,   -3.388,      6.55,     .45,     10,     .95,   -8.55,
 6,    3.07,   -3.116,      6.42,     .22,     10,    1.55,   -8.41,
 7,    3.78,   -2.779,      6.62,     .11,     10,    2.16,   -8.19,
 8,    2.03,   -1.270,      8.12,     .16,     10,    1.67,   -8.06,
 9,    1.39,    -.957,      8.05,     .43,     10,     .78,   -7.89,
10,    2.32,   -2.777,      8.91,     .36,     10,     .90,   -7.76,
11,    1.13,    -.470,      7.93,     .63,     10,     .67,   -7.74,
12,    1.26,    -.943,      7.83,     .62,     10,     .63,   -7.35,
13,     .95,     .170,      7.01,     .60,     10,     .64,   -7.11,
14,     .66,    1.659,      6.07,     .74,     10,     .53,   -7.00,

Fleet : FLT03: BTS-ISIS Neth

 Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    1 ,  -.23,  -.20,  -.42,  -.23,  -.16,   .18,   .45,   .07,   .30,   .24
    2 ,   .46,   .45,   .05,  1.02,  -.35,  -.70,   .28,  -.67,  -.32,  -.23
    3 ,   .46,  -.06,   .15,   .16,  -.71,   .08,   .98,  -.20,  -.15,  -.71
    4 ,   .91,  -.66,  -.23,   .25,   .61, -2.10,   .42,   .56,   .31,  -.06
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age
   11 , No data for this fleet at this age
   12 , No data for this fleet at this age
   13 , No data for this fleet at this age
   14 , No data for this fleet at this age


Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time


   Age ,         3,         4
Mean Log q,   -9.3372,   -9.7880,
S.E(Log q),     .5059,     .8656,

Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 1,     .56,    2.960,     10.12,     .85,     10,     .31,   -8.92,
 2,    1.15,    -.605,      8.35,     .68,     10,     .59,   -8.78,

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

 3,     .93,     .348,      9.48,     .74,     10,     .49,   -9.34,
 4,     .82,     .572,      9.97,     .55,     10,     .74,   -9.79,

Fleet : FLT04: SNS-Tridens N

 Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    1 ,   .27,  -.27,   .05,   .01,   .11,  -.31,  -.16,  -.07,  -.01,   .38
    2 ,   .00,   .38,   .40,  -.65,  -.03,   .28,   .11,   .00,  -.18,  -.33
    3 ,   .70,   .00,   .88,  -.17, -1.17,   .36,  -.12, -1.13,   .32,   .32
    4 ,  -.61,   .66,   .44,   .66,   .02, -1.80,   .41,   .01,   .49,  -.27
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age
   11 , No data for this fleet at this age
   12 , No data for this fleet at this age
   13 , No data for this fleet at this age
   14 , No data for this fleet at this age
```

Table 7.8 (Cont'd)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	3,	4
Mean Log q,	-5.5086,	-5.7457,
S.E(Log q),	.6890,	.7567,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	.72,	2.510,	6.07,	.91,	10,	.23,	-3.87,
2,	.64,	2.510,	7.31,	.86,	10,	.35,	-4.84,

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
3,	.83,	.647,	6.46,	.66,	10,	.59,	-5.51,
4,	.85,	.501,	6.48,	.60,	10,	.67,	-5.75,

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT02: UK beamtrawl ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: BTS-ISIS Neth,	108154.,	.321,	.000,	.00,	1,	.370,	.002
FLT04: SNS-Tridens N,	123956.,	.300,	.000,	.00,	1,	.423,	.002
P shrinkage mean ,	87909.,	.85,,,,				.053,	.003
F shrinkage mean ,	16573.,	.50,,,,				.153,	.014

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
85075.,	.20,	.44,	4,	2.268,	.003

Age 2 Catchability dependent on age and year class strength

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	340079.,	.515,	.000,	.00,	1,	.095,	.146
FLT02: UK beamtrawl ,	522047.,	.900,	.000,	.00,	1,	.031,	.098
FLT03: BTS-ISIS Neth,	266025.,	.322,	.233,	.72,	2,	.244,	.184
FLT04: SNS-Tridens N,	196990.,	.234,	.155,	.66,	2,	.462,	.241
P shrinkage mean ,	64627.,	.86,,,,				.042,	.604
F shrinkage mean ,	242355.,	.50,,,,				.125,	.200

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
225329.,	.16,	.15,	8,	.895,	.213

Age 3 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
FLT01: NL beamtrawl ,	19532.,	.257,	.034,	.13,	2,	.259,	.553
FLT02: UK beamtrawl ,	33301.,	.458,	.556,	1.21,	2,	.081,	.360
FLT03: BTS-ISIS Neth,	15894.,	.261,	.236,	.91,	3,	.233,	.646
FLT04: SNS-Tridens N,	18249.,	.226,	.102,	.45,	3,	.303,	.583
F shrinkage mean ,	22528.,	.50,,,,				.123,	.495

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
19381.,	.13,	.10,	11,	.727,	.557

Table 7.8 (Cont'd)

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: NL beamtrawl ,	20244.,	.201,	.102,	.50,	3,	.363,	.530
FLT02: UK beamtrawl ,	14236.,	.329,	.130,	.39,	3,	.142,	.690
FLT03: BTS-ISIS Neth,	18985.,	.254,	.230,	.90,	4,	.160,	.557
FLT04: SNS-Tridens N,	16099.,	.221,	.094,	.43,	4,	.205,	.631
F shrinkage mean ,	14372.,	.50,,,,				.131,	.686

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
17389.,	.12,	.07,	15,	.548,	.596

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: NL beamtrawl ,	3568.,	.186,	.091,	.49,	4,	.476,	.663
FLT02: UK beamtrawl ,	5255.,	.321,	.103,	.32,	4,	.146,	.494
FLT03: BTS-ISIS Neth,	4298.,	.260,	.110,	.42,	4,	.091,	.577
FLT04: SNS-Tridens N,	3292.,	.229,	.258,	1.13,	4,	.115,	.703
F shrinkage mean ,	3519.,	.50,,,,				.171,	.670

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3796.,	.14,	.06,	17,	.466,	.633

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: NL beamtrawl ,	2797.,	.181,	.079,	.44,	5,	.563,	.517
FLT02: UK beamtrawl ,	4332.,	.346,	.137,	.40,	5,	.128,	.363
FLT03: BTS-ISIS Neth,	3196.,	.254,	.329,	1.30,	4,	.056,	.466
FLT04: SNS-Tridens N,	3225.,	.216,	.071,	.33,	4,	.075,	.462
F shrinkage mean ,	1961.,	.50,,,,				.177,	.676

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2829.,	.14,	.07,	19,	.514,	.513

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: NL beamtrawl ,	9226.,	.173,	.058,	.33,	6,	.626,	.400
FLT02: UK beamtrawl ,	4171.,	.363,	.097,	.27,	6,	.118,	.736
FLT03: BTS-ISIS Neth,	6857.,	.258,	.140,	.54,	4,	.033,	.508
FLT04: SNS-Tridens N,	8145.,	.222,	.095,	.43,	4,	.044,	.443
F shrinkage mean ,	5185.,	.50,,,,				.179,	.628

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
7462.,	.15,	.08,	21,	.521,	.475

Table 7.8 (Cont'd)

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	479.,	.174,	.055,	.32,	7,	.587,	.993
FLT02: UK beamtrawl ,	2150.,	.388,	.285,	.74,	7,	.106,	.321
FLT03: BTS-ISIS Neth,	428.,	.255,	.472,	1.85,	4,	.023,	1.066
FLT04: SNS-Tridens N,	421.,	.222,	.369,	1.66,	4,	.030,	1.076
F shrinkage mean ,	1079.,	.50,,,,				.255,	.562

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
686.,	.17,	.13,	23,	.791,	.782

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	1323.,	.180,	.147,	.82,	8,	.562,	.562
FLT02: UK beamtrawl ,	1511.,	.389,	.175,	.45,	8,	.149,	.507
FLT03: BTS-ISIS Neth,	1342.,	.246,	.152,	.62,	4,	.020,	.556
FLT04: SNS-Tridens N,	1317.,	.218,	.171,	.78,	4,	.026,	.564
F shrinkage mean ,	1283.,	.50,,,,				.243,	.575

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1339.,	.17,	.07,	25,	.426,	.557

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	150.,	.206,	.212,	1.03,	9,	.441,	.939
FLT02: UK beamtrawl ,	588.,	.400,	.147,	.37,	9,	.189,	.334
FLT03: BTS-ISIS Neth,	242.,	.246,	.152,	.62,	4,	.010,	.675
FLT04: SNS-Tridens N,	361.,	.216,	.112,	.52,	4,	.012,	.498
F shrinkage mean ,	267.,	.50,,,,				.348,	.628

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
241.,	.21,	.13,	27,	.626,	.677

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	1211.,	.230,	.090,	.39,	10,	.370,	.282
FLT02: UK beamtrawl ,	630.,	.408,	.105,	.26,	10,	.244,	.486
FLT03: BTS-ISIS Neth,	915.,	.391,	.183,	.47,	3,	.005,	.358
FLT04: SNS-Tridens N,	990.,	.327,	.135,	.41,	3,	.006,	.335
F shrinkage mean ,	824.,	.50,,,,				.375,	.390

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
891.,	.23,	.07,	27,	.297,	.366

Table 7.8 (Cont'd)

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	19.,	.299,	.246,	.82,	10,	.319,	1.153
FLT02: UK beamtrawl ,	67.,	.428,	.200,	.47,	10,	.189,	.485
FLT03: BTS-ISIS Neth,	39.,	.473,	.541,	1.15,	2,	.001,	.732
FLT04: SNS-Tridens N,	72.,	.552,	.024,	.04,	2,	.001,	.456
F shrinkage mean ,	45.,	.50,,,,				.489,	.663

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
37.,	.27,	.14,	25,	.522,	.758

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	94.,	.284,	.048,	.17,	10,	.458,	.482
FLT02: UK beamtrawl ,	166.,	.421,	.125,	.30,	10,	.153,	.300
FLT03: BTS-ISIS Neth,	237.,	.908,	.000,	.00,	1,	.001,	.219
FLT04: SNS-Tridens N,	52.,	.794,	.000,	.00,	1,	.001,	.754
F shrinkage mean ,	78.,	.50,,,,				.387,	.557

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
95.,	.24,	.07,	23,	.294,	.476

1

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: NL beamtrawl ,	13.,	.309,	.092,	.30,	10,	.476,	.675
FLT02: UK beamtrawl ,	68.,	.576,	.172,	.30,	10,	.087,	.166
FLT03: BTS-ISIS Neth,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: SNS-Tridens N,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	16.,	.50,,,,				.437,	.569

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
16.,	.27,	.12,	21,	.431,	.562

1

Table 7.9

Run title : Sole in IV (run: XSAWVN03/X03)

At 14/10/1999 15:59

Table 8 Fishing mortality (F) at age

YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0001,	.0000,	.0000,	.0000,	.0110,
2,	.0298,	.0253,	.0168,	.0161,	.0422,	.0176,	.1039,	.1249,	.1098,	.3072,
3,	.0993,	.1381,	.1248,	.1293,	.1511,	.2513,	.1481,	.4207,	.3675,	.6608,
4,	.2212,	.1757,	.2505,	.1919,	.3761,	.2036,	.2730,	.1748,	.4593,	.6488,
5,	.1578,	.2809,	.1705,	.2907,	.3177,	.4083,	.2467,	.2961,	.5390,	.4583,
6,	.1764,	.1937,	.1994,	.1919,	.3678,	.2632,	.4512,	.2588,	.1897,	.2066,
7,	.0951,	.1974,	.1181,	.2886,	.2489,	.3146,	.2743,	.2094,	.1861,	.1115,
8,	.1472,	.1574,	.2395,	.1559,	.3243,	.1354,	.2275,	.1942,	.3051,	.2152,
9,	.1380,	.0958,	.1041,	.1577,	.2608,	.2398,	.1451,	.1362,	.2095,	.1840,
10,	.1678,	.1958,	.1100,	.1399,	.2373,	.1350,	.1536,	.0908,	.1319,	.2548,
11,	.1701,	.1586,	.1579,	.2230,	.3224,	.1503,	.1220,	.1455,	.0872,	.0764,
12,	.1109,	.1548,	.2496,	.1142,	.2287,	.1460,	.1888,	.1145,	.3207,	.1455,
13,	.0923,	.1524,	.1738,	.3787,	.4511,	.3049,	.2981,	.0598,	.1038,	.0783,
14,	.1360,	.1517,	.1594,	.2031,	.3148,	.1956,	.1818,	.1095,	.1709,	.1480,
+gp,	.1360,	.1517,	.1594,	.2031,	.3148,	.1956,	.1818,	.1095,	.1709,	.1480,
0 FBAR 2- 8,	.1324,	.1669,	.1599,	.1806,	.2612,	.2277,	.2464,	.2398,	.3081,	.3726,
FBAR 3-10,	.1503,	.1794,	.1646,	.1932,	.2855,	.2439,	.2399,	.2226,	.2985,	.3425,

Table 8 Fishing mortality (F) at age

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.0083,	.0097,	.0106,	.0049,	.0070,	.0010,	.0066,	.0096,	.0131,	.0006,
2,	.3295,	.1534,	.3239,	.2391,	.2052,	.1852,	.2756,	.1041,	.2605,	.2351,
3,	.6874,	.6323,	.5628,	.6268,	.6980,	.5860,	.5400,	.5573,	.5329,	.5648,
4,	.5052,	.5436,	.6509,	.5268,	.5519,	.6519,	.6519,	.4920,	.6001,	.5023,
5,	.6945,	.2789,	.5705,	.5017,	.5728,	.4387,	.4887,	.5410,	.4667,	.5011,
6,	.4043,	.3411,	.3387,	.3518,	.4111,	.5244,	.4006,	.3890,	.3465,	.4707,
7,	.2005,	.3038,	.3909,	.1762,	.3510,	.4833,	.3756,	.3167,	.1906,	.5926,
8,	.1391,	.2014,	.2700,	.3283,	.3733,	.3676,	.4992,	.4320,	.2742,	.5878,
9,	.2133,	.0994,	.2137,	.2529,	.5528,	.3040,	.4764,	.4083,	.3257,	.2264,
10,	.2221,	.1643,	.2125,	.1798,	.2555,	.5240,	.2602,	.3159,	.3239,	.3819,
11,	.2427,	.1752,	.2713,	.1197,	.5124,	.2586,	.3783,	.3199,	.2072,	.6365,
12,	.1060,	.2846,	.4531,	.2296,	.5402,	.4278,	.3050,	.3095,	.3019,	.4104,
13,	.1206,	.1065,	.2392,	.2999,	.3415,	.0892,	.1530,	.3190,	.3975,	.4132,
14,	.1812,	.1663,	.2786,	.2168,	.4419,	.3216,	.3154,	.3354,	.3121,	.4150,
+gp,	.1812,	.1663,	.2786,	.2168,	.4419,	.3216,	.3154,	.3354,	.3121,	.4150,
0 FBAR 2- 8,	.4229,	.3506,	.4439,	.3930,	.4519,	.4624,	.4617,	.4046,	.3816,	.4935,
FBAR 3-10,	.3833,	.3206,	.4012,	.3681,	.4708,	.4850,	.4616,	.4315,	.3826,	.4784,

Table 8 Fishing mortality (F) at age

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.0008,	.0043,	.0030,	.0184,	.0028,	.0028,	.0021,	.0024,	.0014,	.0000,
2,	.2256,	.1264,	.2482,	.2304,	.3083,	.2846,	.3131,	.1418,	.2351,	.2363,
3,	.6574,	.5583,	.5131,	.6683,	.5949,	.7124,	.7165,	.6019,	.5059,	.6459,
4,	.6161,	.5867,	.6043,	.5430,	.6670,	.6725,	.7555,	.6428,	.5793,	.6996,
5,	.4347,	.5581,	.5240,	.6391,	.3145,	.5706,	.5832,	.6467,	.4570,	.5590,
6,	.4291,	.3442,	.5351,	.5858,	.4869,	.6638,	.4215,	.7213,	.5190,	.4817,
7,	.3189,	.5173,	.3523,	.4439,	.4437,	.5614,	.3477,	.4624,	.4037,	.4690,
8,	.5440,	.4077,	.3595,	.3606,	.4461,	.4007,	.4611,	.2768,	.2999,	.3775,
9,	.4289,	.4452,	.3601,	.3952,	.3584,	.4048,	.4045,	.6572,	.3005,	.2541,
10,	.1873,	.1423,	.4046,	.3999,	.3099,	.3547,	.2364,	.7685,	.4703,	.2006,
11,	.5351,	.2749,	.4077,	.5392,	.5729,	.3269,	.4674,	.7403,	.4188,	.2473,
12,	.6727,	.3066,	.1448,	.4856,	.1795,	.3496,	.4884,	.8998,	.6832,	.3536,
13,	.6340,	.6373,	1.2095,	.2438,	.1401,	.2361,	.3535,	.6236,	.8849,	.3766,
14,	.4933,	.3623,	.5072,	.4141,	.3130,	.3353,	.3912,	.7413,	.5537,	.2871,
+gp,	.4933,	.3623,	.5072,	.4141,	.3130,	.3353,	.3912,	.7413,	.5537,	.2871,
0 FBAR 2- 8,	.4608,	.4427,	.4481,	.4959,	.4659,	.5523,	.5141,	.4991,	.4286,	.4956,
FBAR 3-10,	.4521,	.4450,	.4566,	.5045,	.4527,	.5426,	.4908,	.5972,	.4420,	.4609,

Table 8 Fishing mortality (F) at age

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
1,	.0011,	.0049,	.0017,	.0029,	.0008,	.0115,	.0489,	.0034,	.0049,	.0027,	.0037,
2,	.1275,	.1365,	.0892,	.1172,	.1780,	.1332,	.2966,	.2466,	.1432,	.2135,	.2011,
3,	.5218,	.4132,	.4191,	.4232,	.4123,	.4711,	.4284,	.6572,	.4978,	.5566,	.5705,
4,	.6545,	.5220,	.5479,	.4559,	.5339,	.6170,	.7355,	.8920,	.6346,	.5956,	.7074,
5,	.4229,	.5507,	.7261,	.5029,	.7923,	.6284,	.5992,	.6528,	.6615,	.6334,	.6492,
6,	.3836,	.5703,	.4050,	.5753,	.6084,	.7997,	.5252,	.7827,	.6515,	.5129,	.6490,
7,	.2952,	.4387,	.5845,	.5856,	.7331,	.5708,	.6601,	.6210,	.5440,	.4748,	.5466,
8,	.3262,	.4038,	.5064,	.4753,	.4266,	.4653,	.6011,	.6856,	.6221,	.7824,	.6967,
9,	.3052,	.5003,	.3864,	.5315,	.5415,	.5922,	.5344,	.7046,	.4934,	.5567,	.5849,
10,	.1577,	.2573,	.4879,	.4124,	.4304,	.6078,	.4050,	1.0069,	.6765,	.6775,	.7870,
11,	.3435,	.2941,	.5076,	.4757,	.4445,	.3059,	.2406,	.6475,	.3080,	.3659,	.4405,
12,	.3979,	.9012,	.5981,	.7382,	.5354,	.5702,	.4229,	1.2615,	.5084,	.7583,	.8427,
13,	.3108,	.5448,	.6795,	.3770,	.5738,	.9241,	.2152,	.5563,	.5058,	.4758,	.5126,
14,	.3928,	.7296,	.6113,	.5415,	.5764,	.6040,	.5106,	.8407,	.4923,	.5620,	.6317,
+gp,	.3928,	.7296,	.6113,	.5415,	.5764,	.6040,	.5106,	.8407,	.4923,	.5620,	
0 FBAR 2- 8,	.3902,	.4336,	.4683,	.4479,	.5264,	.5265,	.5494,	.6483,	.5364,	.5385,	
FBAR 3-10,	.3834,	.4570,	.5079,	.4953,	.5598,	.5940,	.5611,	.7504,	.5977,	.5987,	

Table 7.10

Run title : Sole in IV (run: XSAWVN03/X03)

At 14/10/1999 15:59

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

YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	559007,	66859,	115734,	28345,	23008,	554353,	121486,	41181,	75332,	100099,
2,	131159,	505810,	60496,	104721,	25648,	9354,	501547,	109925,	37262,	68163,
3,	133739,	115197,	446221,	53827,	93239,	9997,	8317,	409015,	87785,	30210,
4,	55095,	109573,	90791,	356400,	42798,	32591,	7035,	6489,	242992,	55001,
5,	64634,	39958,	83167,	63944,	266180,	11945,	24056,	4845,	4930,	138893,
6,	37494,	49946,	27302,	63454,	43261,	78761,	7185,	17009,	3260,	2602,
7,	13976,	28439,	37234,	20238,	47389,	12175,	54775,	4141,	11881,	2440,
8,	15555,	11499,	21123,	29939,	13721,	15021,	8043,	37672,	3039,	8925,
9,	20999,	12148,	8889,	15043,	23178,	4034,	11870,	5797,	28071,	2027,
10,	9296,	16552,	9988,	7248,	11626,	7260,	2872,	9290,	4577,	20599,
11,	4946,	7112,	12314,	8096,	5702,	3728,	5740,	2228,	7676,	3630,
12,	28797,	3775,	5492,	9514,	5861,	1680,	2903,	4597,	1743,	6366,
13,	1204,	23322,	2926,	3871,	7680,	1896,	1313,	2175,	3710,	1145,
14,	1058,	993,	18120,	2225,	2399,	1989,	1265,	882,	1853,	3026,
+gp,	3376,	2431,	2964,	14430,	15701,	3668,	7541,	7249,	4575,	4302,
0 TOTAL,	1080334,	993614,	942760,	781294,	627390,	748452,	765947,	662494,	518688,	447427,

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

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	50588,	141489,	41935,	76956,	106424,	110821,	41920,	114195,	140634,	47079,
2,	89587,	45397,	126789,	37545,	69292,	95627,	100179,	37680,	102337,	125589,
3,	45365,	58307,	35237,	82982,	26748,	51066,	71897,	68811,	30725,	71360,
4,	14117,	20643,	28033,	18162,	40119,	12043,	25717,	37912,	35661,	16317,
5,	26012,	7707,	10845,	13230,	9704,	20903,	5678,	12124,	20975,	17707,
6,	79473,	11752,	5277,	5547,	7248,	4952,	12197,	3151,	6387,	11901,
7,	1915,	47998,	7561,	3403,	3530,	4348,	2652,	7394,	1933,	4087,
8,	1975,	1418,	32053,	4628,	2581,	2249,	2426,	1648,	4874,	1445,
9,	6512,	1555,	1049,	22141,	3015,	1608,	1409,	1333,	968,	3352,
10,	1526,	4760,	1274,	767,	15557,	1570,	1074,	792,	802,	633,
11,	14447,	1106,	3655,	932,	579,	10903,	841,	749,	522,	525,
12,	3043,	10256,	840,	2521,	748,	314,	7617,	521,	492,	384,
13,	4980,	2477,	6981,	483,	1813,	394,	185,	5080,	346,	329,
14,	958,	3994,	2014,	4973,	324,	1166,	326,	144,	3341,	210,
+gp,	6596,	7830,	5889,	5640,	3887,	5340,	3661,	2843,	2850,	2710,
0 TOTAL,	347093,	366688,	309431,	279908,	291570,	323304,	277781,	294376,	352847,	303629,

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

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	11840,	155129,	149676,	153476,	144582,	72019,	82351,	161313,	72895,	447611,
2,	42573,	10705,	139760,	135030,	136340,	130453,	64983,	74357,	145607,	65869,
3,	89828,	30742,	8536,	98668,	97034,	90636,	88804,	42992,	58386,	104148,
4,	36705,	42117,	15915,	4624,	45764,	48433,	40222,	39247,	21309,	31854,
5,	8934,	17936,	21195,	7870,	2431,	21253,	22370,	17098,	18673,	10803,
6,	9707,	5234,	9288,	11356,	3758,	1606,	10868,	11296,	8104,	10699,
7,	6726,	5719,	3357,	4921,	5720,	2090,	748,	6452,	4969,	4364,
8,	2044,	4424,	3085,	2135,	2857,	3321,	1079,	478,	3676,	3002,
9,	726,	1074,	2663,	1948,	1347,	1655,	2013,	615,	328,	2465,
10,	2419,	428,	622,	1681,	1187,	852,	999,	1215,	289,	220,
11,	391,	1815,	336,	376,	1020,	788,	541,	714,	510,	163,
12,	251,	207,	1247,	202,	198,	520,	514,	307,	308,	304,
13,	231,	116,	138,	977,	113,	150,	332,	285,	113,	141,
14,	197,	111,	55,	37,	692,	89,	107,	211,	138,	42,
+gp,	1846,	2061,	871,	973,	897,	894,	864,	609,	406,	466,
0 TOTAL,	214420,	277817,	356745,	424274,	443941,	374757,	316794,	357189,	335710,	682149,

Table 7.10 Continued

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

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	GMST 57-96	AMST 57-96
AGE													
1,	109543,	180698,	72219,	356532,	71440,	58403,	104026,	52850,	342381,	94278,	0,*	96798,	133113,
2,	405006,	99009,	162706,	65235,	321683,	64591,	52239,	89634,	47658,	308292,	85075,**	86508,	120456,
3,	47057,	322605,	78155,	134659,	52498,	243599,	51155,	35138,	63381,	37370,	225329,	65550,	94513,
4,	49396,	25268,	193111,	46506,	79799,	31454,	137613,	30157,	16478,	34862,	19381,	37825,	58086,
5,	14318,	23229,	13565,	101029,	26673,	42333,	15357,	59676,	11183,	7904,	17389,	20568,	34217,
6,	5589,	8487,	12118,	5938,	55284,	10929,	20434,	7632,	28111,	5222,	3796,	11383,	18279,
7,	5980,	3446,	4342,	7313,	3023,	27223,	4445,	10936,	3157,	13258,	2829,	7083,	12182,
8,	2470,	4028,	2011,	2190,	3684,	1314,	13919,	2078,	5318,	1658,	7462,	4481,	8032,
9,	1863,	1613,	2434,	1096,	1232,	2176,	747,	6904,	947,	2583,	686,	2970,	5699,
10,	1730,	1242,	885,	1496,	583,	649,	1089,	396,	3088,	523,	1339,	2031,	4979,
11,	163,	1337,	869,	492,	896,	343,	320,	657,	131,	1420,	241,	1426,	3656,
12,	115,	104,	901,	473,	276,	520,	229,	227,	311,	87,	891,	960,	2691,
13,	193,	70,	38,	449,	205,	146,	266,	136,	58,	169,	37,	605,	1953,
14,	87,	128,	37,	18,	278,	104,	53,	194,	70,	32,	95,	397,	1371,
+gp,	306,	434,	384,	638,	260,	572,	390,	318,	188,	217,	128,		
0 TOTAL,	643816,	671699,	543774,	724064,	617815,	484356,	402280,	296933,	522461,	507877,	364678,		

* Replaced by RCT3 estimates (84152)
** Replaced by RCT3 estimates (109210)

Table 7.11. NORTH SEA SOLE (IV) Indices of recruitment (input data for RCT3)

Year class	DFS INT-0	SNS Tridens 1	DFS INT-1	SNS Tridens 2	SNS Tridens 3	Ger Solea 3	BTS Neth-1	BTS Neth-2
1968	-11	-11	-11	745	99	-11	-11	-11
1969	-11	4938	-11	1961	161	-11	-11	-11
1970	-11	613	-11	341	73	-11	-11	-11
1971	-11	1410	-11	905	69	-11	-11	-11
1972	-11	4686	-11	397	174	-11	-11	-11
1973	-11	1924	-11	887	187	31.5	-11	-11
1974	-11	597	2.83	79	77	16.3	-11	-11
1975	160.94	1413	6.95	762	267	34.4	-11	-11
1976	80.99	3724	9.63	1379	325	-11	-11	-11
1977	27.95	1552	2.1	388	99	41.5	-11	-11
1978	89.98	104	2.27	80	51	1.9	-11	-11
1979	392.06	4483	-11	1411	231	76.1	-11	-11
1980	403.86	3739	14.59	1124	107	77.1	-11	-11
1981	295.15	5098	15.08	1137	307	147.1	-11	-11
1982	340.01	2640	-11	1081	159	77.8	-11	-11
1983	108.73	2359	12.31	709	67	10.8	-11	6.68
1984	195.01	2151	3.97	465	59	29.8	2.64	4.32
1985	300.66	3791	13.55	955	284	24.6	9.4	11.76
1986	72.06	1890	6.18	594	248	20.3	7.28	12.03
1987	532.11	11227	38.04	5369	907	66.9	79.75	67.91
1988	61.15	3052	9.25	1078	527	86.4	8.72	19.61
1989	83.38	2900	13.26	2515	319	54.1	22.4	22.16
1990	62.16	1265	12.26	114	46	11.3	2.96	22.66
1991	368.7	11081	18.44	3489	943	180.7	72.71	26.61
1992	32.65	1351	11.84	475	126	-11	4.63	4.95
1993	29.18	559	5.88	234	27	-11	5.94	8.68
1994	76.17	1501	7.16	473	231	-11	26.31	6.26
1995	18.13	691	3.25	143	131	-11	4.05	5.29
1996	61.03	10132	24.88	1993	381	-11	174.09	27.73
1997	55.86	2875	-11	919	-11	-11	15.54	-11
1998	-11	1649	-11	-11	-11	-11	-11	-11

DFS International Demersal Fish Survey
BTS International Beam Trawl Survey
SNS Sole Net Survey
GER German Solea survey

Table 7.12a

NORTH SEA SOLE (IV) - VPA (**1 year olds**)

Data for 8 surveys over 32 years : 1968 - 1999

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
DFS-0,	1.17	5.96	.92	.419	21	4.13	10.80	.996	.034
SNS-1,	.77	5.63	.28	.873	27	9.22	12.72	.307	.353
DFS-1,	1.42	8.28	.51	.718	20	3.25	12.90	.583	.098
SNS-2,	.79	6.33	.42	.746	28	7.60	12.33	.456	.160
SNS-3,	1.07	6.04	.60	.590	28	5.95	12.41	.649	.079
BTS-1,	.72	9.85	.35	.808	12	5.17	13.58	.500	.133
BTS-2,	1.14	8.67	.56	.615	13	3.36	12.49	.655	.078
					VPA Mean =		11.45	.710	.066

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
DFS-0,	1.17	5.96	.92	.419	21	4.04	10.69	.999	.039
SNS-1,	.77	5.63	.28	.873	27	7.96	11.75	.294	.452
SNS-2,	.79	6.33	.42	.746	28	6.82	11.72	.447	.195
BTS-1,	.72	9.85	.35	.808	12	2.81	11.88	.406	.237
					VPA Mean =		11.45	.710	.077

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
SNS-1,	.77	5.63	.28	.873	27	7.41	11.32	.293	.854
					VPA Mean =		11.45	.710	.146

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	296529	12.60	.18	.22	1.52		
1997	121818	11.71	.20	.11	.34		
1998	**84152**	11.34	.27	.05	.03		
1999	No valid surveys						

Table 7.12b

NORTH SEA SOLE (IV) - VPA (**2 year olds**)

Data for 8 surveys over 32 years : 1968 - 1999

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1996

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
DFS-0,	1.17	5.87	.91	.421	21	4.13	10.69	.992	.034
SNS-1,	.77	5.53	.27	.875	27	9.22	12.61	.304	.358
DFS-1,	1.42	8.18	.51	.720	20	3.25	12.79	.579	.099
SNS-2,	.79	6.24	.42	.747	28	7.60	12.23	.454	.161
SNS-3,	1.07	5.93	.60	.589	28	5.95	12.31	.650	.079
BTS-1,	.73	9.73	.37	.797	12	5.17	13.49	.518	.124
BTS-2,	1.13	8.58	.55	.621	13	3.36	12.38	.648	.079
					VPA Mean =		11.35	.710	.066

Yearclass = 1997

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
DFS-0,	1.17	5.87	.91	.421	21	4.04	10.59	.994	.040
SNS-1,	.77	5.53	.27	.875	27	7.96	11.64	.291	.463
SNS-2,	.79	6.24	.42	.747	28	6.82	11.62	.446	.198
BTS-1,	.73	9.73	.37	.797	12	2.81	11.77	.421	.222
					VPA Mean =		11.35	.710	.078

Yearclass = 1998

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-1,	.77	5.53	.27	.875	27	7.41	11.21	.291	.856
					VPA Mean =		11.35	.710	.144

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	264258	12.48	.18	.22	1.50		
1997	**109210**	11.60	.20	.12	.34		
1998	75643	11.23	.27	.05	.03		
1999	No valid surveys						

Table 7.13

Run title : Sole in IV (run: XSAWVN03/X03)

At 14/10/1999 15:59

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 8,	FBAR 3-10,
1957,	165503,	88541,	78903,	12067,	.1529,	.1369,	.1428,
1958,	144953,	99676,	85570,	14287,	.1670,	.1599,	.1806,
1959,	559007,	116348,	93191,	13832,	.1484,	.1324,	.1503,
1960,	66859,	138323,	101245,	18620,	.1839,	.1669,	.1794,
1961,	115734,	156083,	148954,	23566,	.1582,	.1599,	.1646,
1962,	28345,	156825,	148786,	26877,	.1806,	.1806,	.1932,
1963,	23008,	150773,	148403,	26164,	.1763,	.2612,	.2855,
1964,	554353,	68097,	53583,	11342,	.2117,	.2277,	.2439,
1965,	121486,	122207,	48953,	17043,	.3482,	.2464,	.2399,
1966,	41181,	113510,	104785,	33340,	.3182,	.2398,	.2226,
1967,	75332,	109353,	100874,	33439,	.3315,	.3081,	.2985,
1968,	100099,	99740,	88922,	33179,	.3731,	.3726,	.3425,
1969,	50588,	83911,	70373,	27559,	.3916,	.4229,	.3833,
1970,	141489,	72698,	62942,	19685,	.3127,	.3506,	.3206,
1971,	41935,	72568,	52377,	23652,	.4516,	.4439,	.4012,
1972,	76956,	64478,	55734,	21086,	.3783,	.3930,	.3681,
1973,	106424,	56343,	41868,	19309,	.4612,	.4519,	.4708,
1974,	110821,	60122,	42281,	17989,	.4255,	.4624,	.4850,
1975,	41920,	59316,	43022,	20773,	.4828,	.4617,	.4616,
1976,	114195,	52829,	43481,	17326,	.3985,	.4046,	.4315,
1977,	140634,	56016,	36050,	18003,	.4994,	.3816,	.3826,
1978,	47079,	57674,	38569,	20280,	.5258,	.4935,	.4784,
1979,	11840,	53021,	46187,	22598,	.4893,	.4608,	.4521,
1980,	155129,	43768,	36038,	15807,	.4386,	.4427,	.4450,
1981,	149676,	51366,	24735,	15403,	.6227,	.4481,	.4566,
1982,	153476,	60061,	34834,	21579,	.6195,	.4959,	.5045,
1983,	144582,	68569,	42252,	24927,	.5900,	.4659,	.4527,
1984,	72019,	66462,	45511,	26839,	.5897,	.5523,	.5426,
1985,	82351,	55143,	42772,	24248,	.5669,	.5141,	.4908,
1986,	161313,	53962,	36006,	18200,	.5055,	.4991,	.5972,
1987,	72895,	57444,	31375,	17368,	.5536,	.4286,	.4420,
1988,	447611,	72805,	41664,	21590,	.5182,	.4956,	.4609,
1989,	109543,	95545,	36202,	21806,	.6023,	.3902,	.3834,
1990,	180698,	114631,	90943,	35120,	.3862,	.4336,	.4570,
1991,	72219,	104151,	78086,	33513,	.4292,	.4683,	.5079,
1992,	356532,	105864,	77861,	29341,	.3768,	.4479,	.4953,
1993,	71440,	100578,	55830,	31491,	.5641,	.5264,	.5598,
1994,	58403,	87732,	75575,	33002,	.4367,	.5265,	.5940,
1995,	104026,	73862,	60772,	30467,	.5013,	.5494,	.5611,
1996,	52850,	54798,	38979,	22651,	.5811,	.6483,	.7504,
1997,	342381,	56095,	31828,	14980,	.4707,	.5364,	.5977,
1998,	121818, *	72864,	24989,	20867,	.8350,	.5385,	.5987,
1999,	84152, *		55326,				
Arith. Mean ,	137170,	83432,	62888,	22648,	.4227,	.3983,	.4090,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			
1							

* RCT3 estimates

Table 7.14 North Sea Sole

Prediction with management option table: Input data

Year: 1999								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	84152.000	0.1000	0.0000	0.0000	0.0000	0.050	0.0037	0.147
2	109210.00	0.1000	0.0000	0.0000	0.0000	0.146	0.2011	0.180
3	225329.00	0.1000	1.0000	0.0000	0.0000	0.180	0.5705	0.199
4	19381.000	0.1000	1.0000	0.0000	0.0000	0.222	0.7074	0.240
5	17389.000	0.1000	1.0000	0.0000	0.0000	0.264	0.6492	0.268
6	3796.000	0.1000	1.0000	0.0000	0.0000	0.284	0.6490	0.290
7	2829.000	0.1000	1.0000	0.0000	0.0000	0.322	0.5466	0.327
8	7462.000	0.1000	1.0000	0.0000	0.0000	0.322	0.6967	0.323
9	686.000	0.1000	1.0000	0.0000	0.0000	0.365	0.5849	0.371
10	1339.000	0.1000	1.0000	0.0000	0.0000	0.373	0.7870	0.440
11	241.000	0.1000	1.0000	0.0000	0.0000	0.511	0.4405	0.539
12	891.000	0.1000	1.0000	0.0000	0.0000	0.492	0.8427	0.527
13	37.000	0.1000	1.0000	0.0000	0.0000	0.624	0.5126	0.630
14	95.000	0.1000	1.0000	0.0000	0.0000	0.608	0.6317	0.563
15+	128.000	0.1000	1.0000	0.0000	0.0000	0.697	0.6317	0.740
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	96798.000	0.1000	0.0000	0.0000	0.0000	0.050	0.0037	0.147
2	.	0.1000	0.0000	0.0000	0.0000	0.146	0.2011	0.180
3	.	0.1000	1.0000	0.0000	0.0000	0.180	0.5705	0.199
4	.	0.1000	1.0000	0.0000	0.0000	0.222	0.7074	0.240
5	.	0.1000	1.0000	0.0000	0.0000	0.264	0.6492	0.268
6	.	0.1000	1.0000	0.0000	0.0000	0.284	0.6490	0.290
7	.	0.1000	1.0000	0.0000	0.0000	0.322	0.5466	0.327
8	.	0.1000	1.0000	0.0000	0.0000	0.322	0.6967	0.323
9	.	0.1000	1.0000	0.0000	0.0000	0.365	0.5849	0.371
10	.	0.1000	1.0000	0.0000	0.0000	0.373	0.7870	0.440
11	.	0.1000	1.0000	0.0000	0.0000	0.511	0.4405	0.539
12	.	0.1000	1.0000	0.0000	0.0000	0.492	0.8427	0.527
13	.	0.1000	1.0000	0.0000	0.0000	0.624	0.5126	0.630
14	.	0.1000	1.0000	0.0000	0.0000	0.608	0.6317	0.563
15+	.	0.1000	1.0000	0.0000	0.0000	0.697	0.6317	0.740
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	96798.000	0.1000	0.0000	0.0000	0.0000	0.050	0.0037	0.147
2	.	0.1000	0.0000	0.0000	0.0000	0.146	0.2011	0.180
3	.	0.1000	1.0000	0.0000	0.0000	0.180	0.5705	0.199
4	.	0.1000	1.0000	0.0000	0.0000	0.222	0.7074	0.240
5	.	0.1000	1.0000	0.0000	0.0000	0.264	0.6492	0.268
6	.	0.1000	1.0000	0.0000	0.0000	0.284	0.6490	0.290
7	.	0.1000	1.0000	0.0000	0.0000	0.322	0.5466	0.327
8	.	0.1000	1.0000	0.0000	0.0000	0.322	0.6967	0.323
9	.	0.1000	1.0000	0.0000	0.0000	0.365	0.5849	0.371
10	.	0.1000	1.0000	0.0000	0.0000	0.373	0.7870	0.440
11	.	0.1000	1.0000	0.0000	0.0000	0.511	0.4405	0.539
12	.	0.1000	1.0000	0.0000	0.0000	0.492	0.8427	0.527
13	.	0.1000	1.0000	0.0000	0.0000	0.624	0.5126	0.630
14	.	0.1000	1.0000	0.0000	0.0000	0.608	0.6317	0.563
15+	.	0.1000	1.0000	0.0000	0.0000	0.697	0.6317	0.740
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANWVN01
Date and time: 15OCT99:14:07

Table 7.15 North Sea Sole

Prediction with management option table

Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.5744	75478	55326	29307	0.0000	0.0000	63730	47814	0	81267	63639
.	.	.	.	.	0.1000	0.0574	.	47814	3365	77777	60154
.	.	.	.	.	0.2000	0.1149	.	47814	6531	74498	56880
.	.	.	.	.	0.3000	0.1723	.	47814	9510	71418	53804
.	.	.	.	.	0.4000	0.2297	.	47814	12313	68523	50914
.	.	.	.	.	0.5000	0.2872	.	47814	14952	65802	48198
.	.	.	.	.	0.6000	0.3446	.	47814	17437	63244	45645
.	.	.	.	.	0.7000	0.4021	.	47814	19777	60838	43244
.	.	.	.	.	0.8000	0.4595	.	47814	21982	58576	40986
.	.	.	.	.	0.9000	0.5169	.	47814	24060	56447	38862
.	.	.	.	.	1.0000	0.5744	.	47814	26019	54445	36864
.	.	.	.	.	1.1000	0.6318	.	47814	27865	52560	34984
.	.	.	.	.	1.2000	0.6892	.	47814	29607	50785	33214
.	.	.	.	.	1.3000	0.7467	.	47814	31250	49114	31548
.	.	.	.	.	1.4000	0.8041	.	47814	32800	47540	29979
.	.	.	.	.	1.5000	0.8615	.	47814	34264	46057	28501
.	.	.	.	.	1.6000	0.9190	.	47814	35646	44660	27108
.	.	.	.	.	1.7000	0.9764	.	47814	36952	43343	25795
.	.	.	.	.	1.8000	1.0338	.	47814	38186	42100	24558
.	.	.	.	.	1.9000	1.0913	.	47814	39352	40929	23391
.	.	.	.	.	2.0000	1.1487	.	47814	40455	39823	22290
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANWVN01
Date and time : 15OCT99:14:14
Computation of ref. F: Simple mean, age 2 - 8
Basis for 1999 : F factors

Table 7.16 **North Sea Sole: single option short term prediction at *status quo* fishing mortality (detailed table).**

Year: 1999	F-factor: 1.0000		Reference F: 0.5744			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0037	296	43	84152	4208	0	0	0	0
2	0.2011	18964	3414	109210	15945	0	0	0	0
3	0.5705	93666	18639	225329	40559	225329	40559	225329	40559
4	0.7074	9407	2258	19381	4303	19381	4303	19381	4303
5	0.6492	7945	2129	17389	4591	17389	4591	17389	4591
6	0.6490	1734	503	3796	1078	3796	1078	3796	1078
7	0.5466	1139	372	2829	911	2829	911	2829	911
8	0.6967	3584	1158	7462	2403	7462	2403	7462	2403
9	0.5849	290	108	686	250	686	250	686	250
10	0.7870	699	307	1339	499	1339	499	1339	499
11	0.4405	82	44	241	123	241	123	241	123
12	0.8427	486	256	891	438	891	438	891	438
13	0.5126	14	9	37	23	37	23	37	23
14	0.6317	43	24	95	58	95	58	95	58
15+	0.6317	57	42	128	89	128	89	128	89
Total		138405	29307	472965	75478	279603	55326	279603	55326
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000	F-factor: 1.0000		Reference F: 0.5744			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0037	340	50	96798	4840	0	0	0	0
2	0.2011	13173	2371	75863	11076	0	0	0	0
3	0.5705	33594	6685	80816	14547	80816	14547	80816	14547
4	0.7074	55937	13425	115245	25584	115245	25584	115245	25584
5	0.6492	3949	1058	8644	2282	8644	2282	8644	2282
6	0.6490	3755	1089	8221	2335	8221	2335	8221	2335
7	0.5466	723	236	1795	578	1795	578	1795	578
8	0.6967	712	230	1482	477	1482	477	1482	477
9	0.5849	1425	528	3364	1228	3364	1228	3364	1228
10	0.7870	180	79	346	129	346	129	346	129
11	0.4405	188	101	552	282	552	282	552	282
12	0.8427	77	40	140	69	140	69	140	69
13	0.5126	133	84	347	217	347	217	347	217
14	0.6317	9	5	20	12	20	12	20	12
15+	0.6317	48	36	107	75	107	75	107	75
Total		114242	26019	393739	63730	221079	47814	221079	47814
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 7.16 (Cont'd)

Year: 2001	F-factor: 1.0000	Reference F: 0.5744				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0037	340	50	96798	4840	0	0	0	0
2	0.2011	15153	2728	87263	12740	0	0	0	0
3	0.5705	23336	4644	56139	10105	56139	10105	56139	10105
4	0.7074	20062	4815	41333	9176	41333	9176	41333	9176
5	0.6492	23484	6294	51401	13570	51401	13570	51401	13570
6	0.6490	1867	541	4087	1161	4087	1161	4087	1161
7	0.5466	1565	512	3887	1252	3887	1252	3887	1252
8	0.6967	452	146	940	303	940	303	940	303
9	0.5849	283	105	668	244	668	244	668	244
10	0.7870	885	389	1696	633	1696	633	1696	633
11	0.4405	48	26	142	73	142	73	142	73
12	0.8427	175	92	321	158	321	158	321	158
13	0.5126	21	13	55	34	55	34	55	34
14	0.6317	84	47	188	114	188	114	188	114
15+	0.6317	27	20	61	43	61	43	61	43
Total		87782	20423	344980	54445	160919	36864	160919	36864
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRWVN01
Date and time : 15OCT99:14:19
Computation of ref. F: Simple mean, age 2 - 8
Prediction basis : F factors

Table 7.17 North Sea sole (IV)
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1995	1996	1997	1998	1999
Stock No. (thousands)			52850	342381	121818	84152	96798
of	1 year-olds						
Source			VPA	VPA	RCT3	RCT3	GM
Status Quo F:							
% in	1999	landings	7.7	63.6	11.6	0.1	-
% in	2000	landings	4.1	51.6	25.7	9.1	0.2
% in	1999	SSB	7.8	73.3	0.0	0.0	-
% in	2000	SSB	4.8	53.5	30.4	0.0	0.0
% in	2001	SSB	3.1	36.8	24.9	27.4	0.0

GM : geometric mean recruitment

North Sea sole (IV) : Year-class % contribution to

a) 2000 landings **b) 2001 SSB**

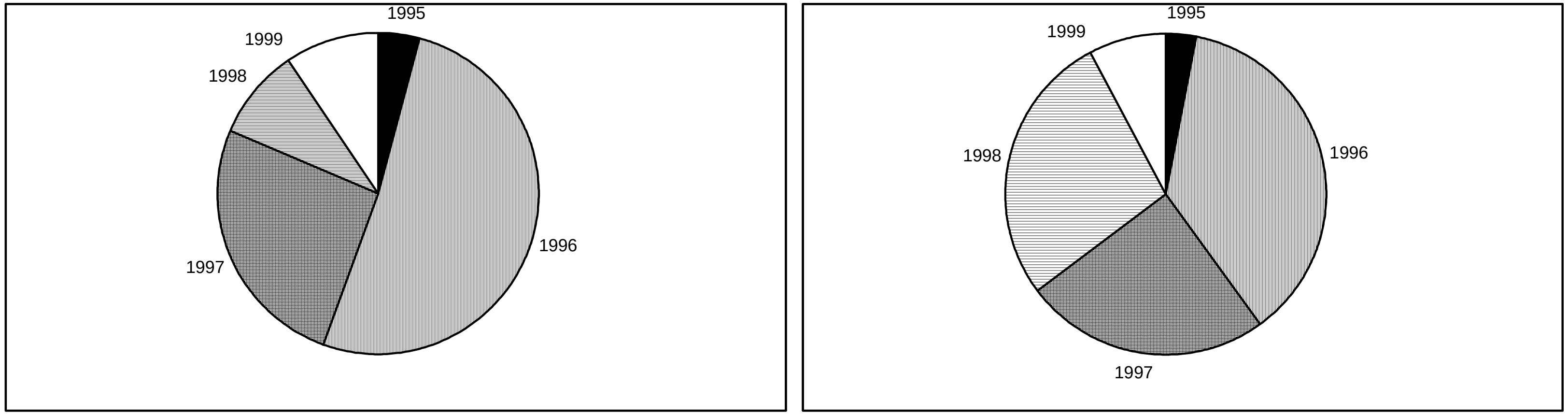


Table 7.18. North Sea Sole (IV) Input data for linear sensitivity analysis

Name	Value	ncertainty (CV)	Name	Value	ncertainty (CV)	Name	Value	ncertainty (CV)
Population at age in 1999			Fishing mortality pattern			Weight in the catch at age		
N1	84152	0.27	sH1	0.004	0.36	WH1	0.147	0.12
N2	109210	0.20	sH2	0.201	0.20	WH2	0.180	0.01
N3	225329	0.16	sH3	0.571	0.06	WH3	0.199	0.04
N4	19381	0.13	sH4	0.707	0.11	WH4	0.240	0.04
N5	17389	0.12	sH5	0.649	0.10	WH5	0.268	0.02
N6	3796	0.14	sH6	0.649	0.13	WH6	0.290	0.02
N7	2829	0.14	sH7	0.547	0.07	WH7	0.327	0.03
N8	7462	0.15	sH8	0.697	0.17	WH8	0.323	0.13
N9	686	0.17	sH9	0.585	0.08	WH9	0.371	0.08
N10	1339	0.17	sH10	0.787	0.12	WH10	0.440	0.15
N11	241	0.21	sH11	0.441	0.29	WH11	0.539	0.07
N12	891	0.23	sH12	0.847	0.35	WH12	0.527	0.16
N13	37	0.28	sH13	0.511	0.05	WH13	0.630	0.06
N14	95	0.24	sH14	0.634	0.17	WH14	0.563	0.21
N15	128	0.27	sH15	0.634	0.17	WH15	0.740	0.02

Name	Value	ncertainty (CV)	Name	Value	ncertainty (CV)	Name	Value	ncertainty (CV)
Natural mortality pattern			Maturity ogive pattern			Effort multiplier in year		
M1	0.1	0.1	MT1	0	0.0	HF99	1	0.11
M2	0.1	0.1	MT2	0	0.1	HF00	1	0.11
M3	0.1	0.1	MT3	1	0.1	HF01	1	0.11
M4	0.1	0.1	MT4	1	0.0			
M5	0.1	0.1	MT5	1	0.0	Recruitment in year		
M6	0.1	0.1	MT6	1	0.0			
M7	0.1	0.1	MT7	1	0.0	R00'	96798	0.8
M8	0.1	0.1	MT8	1	0.0	R01	96798	0.8
M9	0.1	0.1	MT9	1	0.0			
M10	0.1	0.1	MT10	1	0.0			
M11	0.1	0.1	MT11	1	0.0			
M12	0.1	0.1	MT12	1	0.0			
M13	0.1	0.1	MT13	1	0.0			
M14	0.1	0.1	MT14	1	0.0			
M15	0.1	0.1	MT15	1	0.0			

Table 7.19. North Sea Sole (IV) Input data for medium term analysis

Name	Value	ıcertainty (CV)
Population at age in 1999		
N1	84152	0.27
N2	109210	0.20
N3	225329	0.16
N4	19381	0.13
N5	17389	0.12
N6	3796	0.14
N7	2829	0.14
N8	7462	0.15
N9	686	0.17
N10	1339	0.17
N11	241	0.21
N12	891	0.23
N13	37	0.28
N14	95	0.24
N15	128	0.27

Name	Value	ıcertainty (CV)
Fishing mortality pattern		
sH1	0.004	0.36
sH2	0.201	0.20
sH3	0.571	0.06
sH4	0.707	0.11
sH5	0.649	0.10
sH6	0.649	0.13
sH7	0.547	0.07
sH8	0.697	0.17
sH9	0.585	0.08
sH10	0.787	0.12
sH11	0.441	0.29
sH12	0.847	0.35
sH13	0.511	0.05
sH14	0.634	0.17
sH15	0.634	0.17

Name	Value	ıcertainty (CV)
Weight in the catch at age		
WH1	0.135	0.12
WH2	0.179	0.03
WH3	0.209	0.05
WH4	0.266	0.09
WH5	0.317	0.15
WH6	0.363	0.15
WH7	0.403	0.16
WH8	0.452	0.18
WH9	0.474	0.17
WH10	0.531	0.14
WH11	0.604	0.15
WH12	0.573	0.13
WH13	0.661	0.17
WH14	0.688	0.20
WH15	0.676	0.10

Name	Value	ıcertainty (CV)
Natural mortality pattern		
M1	0.1	0.1
M2	0.1	0.1
M3	0.1	0.1
M4	0.1	0.1
M5	0.1	0.1
M6	0.1	0.1
M7	0.1	0.1
M8	0.1	0.1
M9	0.1	0.1
M10	0.1	0.1
M11	0.1	0.1
M12	0.1	0.1
M13	0.1	0.1
M14	0.1	0.1
M15	0.1	0.1

Name	Value	ıcertainty (CV)
Maturity ogive pattern		
MT1	0	0.0
MT2	0	0.1
MT3	1	0.1
MT4	1	0.0
MT5	1	0.0
MT6	1	0.0
MT7	1	0.0
MT8	1	0.0
MT9	1	0.0
MT10	1	0.0
MT11	1	0.0
MT12	1	0.0
MT13	1	0.0
MT14	1	0.0
MT15	1	0.0

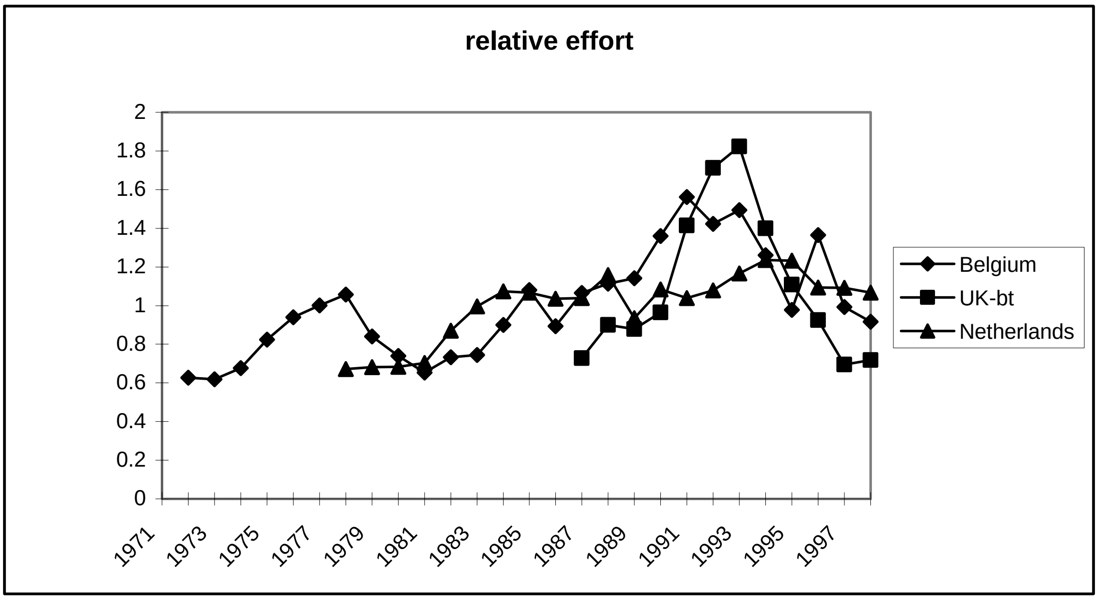
Name	Value	ıcertainty (CV)
Effort multiplier in year		
HF99	1	0.11
HF00	1	0.11
HF01	1	0.11
Recruitment in year		
R00'	96798	0.8
R01	96798	0.8

Table 7.20 North Sea Sole. Yield and Biomass per Recruit.

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	4375.311	8.603	4197.729	8.603	4197.729
0.1000	0.0574	0.329	134.942	7.225	2392.800	5.321	2215.265	5.321	2215.265
0.2000	0.1149	0.474	172.170	5.778	1602.369	3.874	1424.881	3.874	1424.881
0.3000	0.1723	0.556	183.546	4.965	1198.859	3.061	1021.418	3.061	1021.418
0.4000	0.2297	0.608	186.356	4.443	962.044	2.540	784.650	2.540	784.650
0.5000	0.2872	0.645	186.048	4.080	809.564	2.177	632.217	2.177	632.217
0.6000	0.3446	0.672	184.598	3.812	704.594	1.910	527.295	1.910	527.295
0.7000	0.4021	0.693	182.780	3.607	628.582	1.704	451.330	1.704	451.330
0.8000	0.4595	0.710	180.911	3.444	571.320	1.542	394.115	1.542	394.115
0.9000	0.5169	0.723	179.121	3.311	526.800	1.410	349.643	1.410	349.643
1.0000	0.5744	0.735	177.457	3.201	491.283	1.300	314.172	1.300	314.172
1.1000	0.6318	0.744	175.932	3.108	462.335	1.207	285.271	1.207	285.271
1.2000	0.6892	0.752	174.544	3.028	438.310	1.128	261.293	1.128	261.293
1.3000	0.7467	0.760	173.284	2.959	418.062	1.059	241.092	1.059	241.092
1.4000	0.8041	0.766	172.140	2.898	400.765	0.998	223.842	0.998	223.842
1.5000	0.8615	0.772	171.101	2.844	385.817	0.945	208.941	0.945	208.941
1.6000	0.9190	0.777	170.156	2.796	372.765	0.897	195.936	0.897	195.936
1.7000	0.9764	0.781	169.295	2.753	361.262	0.854	184.480	0.854	184.480
1.8000	1.0338	0.786	168.510	2.714	351.043	0.815	174.308	0.815	174.308
1.9000	1.0913	0.789	167.791	2.678	341.898	0.779	165.209	0.779	165.209
2.0000	1.1487	0.793	167.133	2.645	333.658	0.747	157.017	0.747	157.017
2.1000	1.2062	0.796	166.529	2.615	326.191	0.717	149.596	0.717	149.596
2.2000	1.2636	0.799	165.973	2.587	319.386	0.689	142.839	0.689	142.839
2.3000	1.3210	0.802	165.461	2.561	313.156	0.664	136.655	0.664	136.655
2.4000	1.3785	0.805	164.987	2.537	307.424	0.640	130.970	0.640	130.970
2.5000	1.4359	0.807	164.550	2.514	302.131	0.617	125.723	0.617	125.723
2.6000	1.4933	0.809	164.144	2.493	297.223	0.596	120.862	0.596	120.862
2.7000	1.5508	0.811	163.768	2.473	292.657	0.577	116.343	0.577	116.343
2.8000	1.6082	0.814	163.418	2.454	288.395	0.558	112.128	0.558	112.128
2.9000	1.6656	0.815	163.092	2.436	284.406	0.541	108.185	0.541	108.185
3.0000	1.7231	0.817	162.787	2.419	280.661	0.524	104.487	0.524	104.487
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDWVN05
Date and time : 17OCT99:14:21
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.1762
F-max factor : 0.4303
F-0.1 reference F : 0.1012
F-max reference F : 0.2471
Recruitment : Single recruit

Figure 7.1. North Sea Sole, trends in effort and cpue in commercial fleets. Cpue in these fleets in recent year may be biased because of quota restrictions.



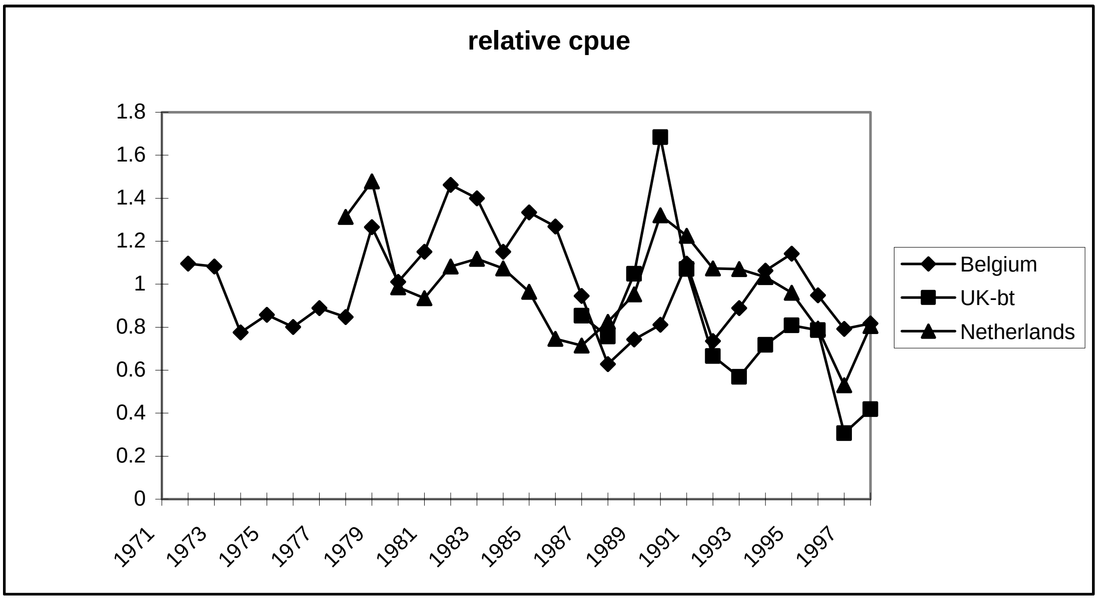
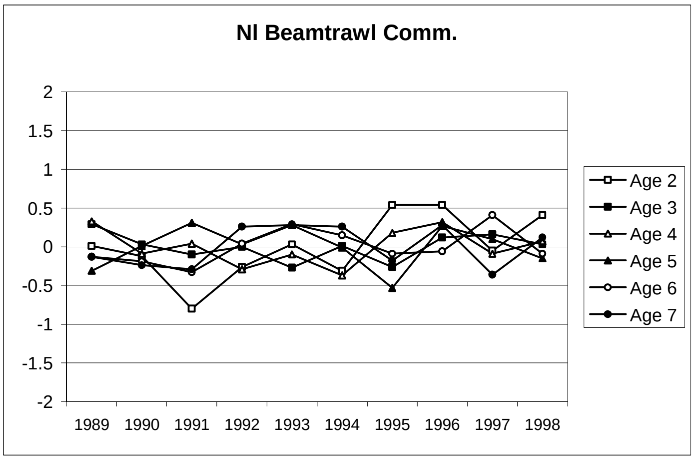
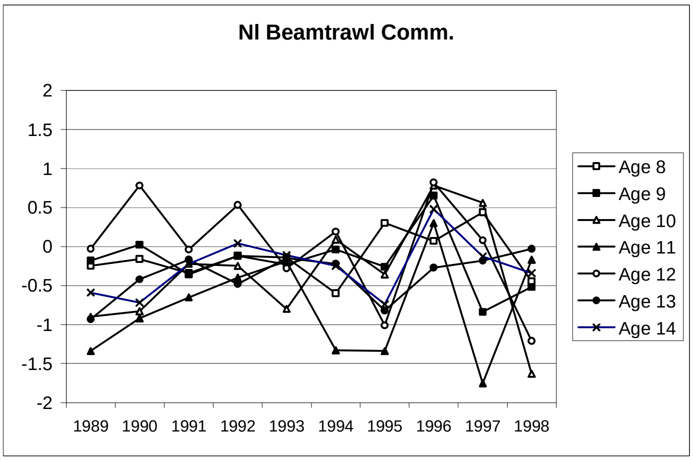
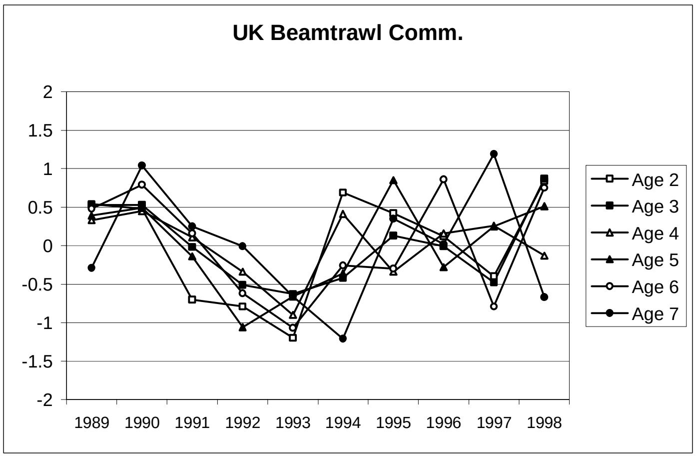


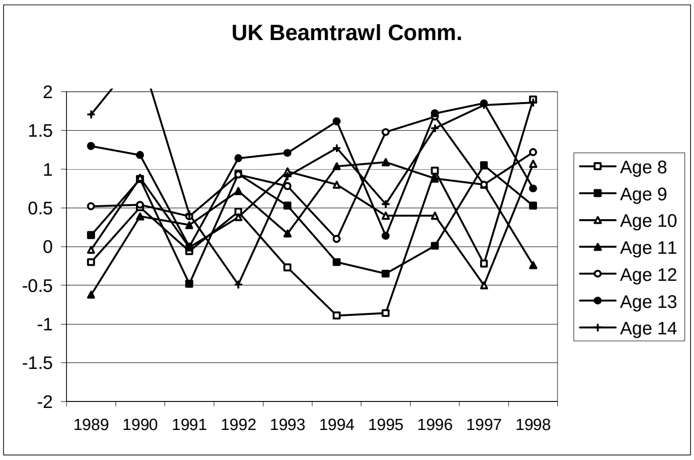
Figure 7.2.

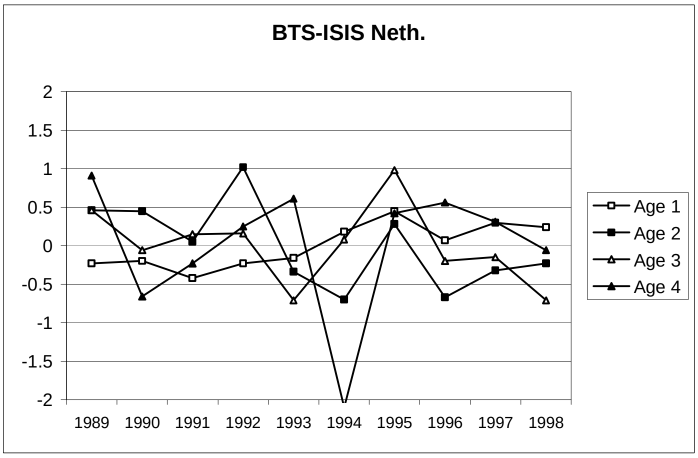
North Sea sole - Log catchability residual plots - XSA All fleets











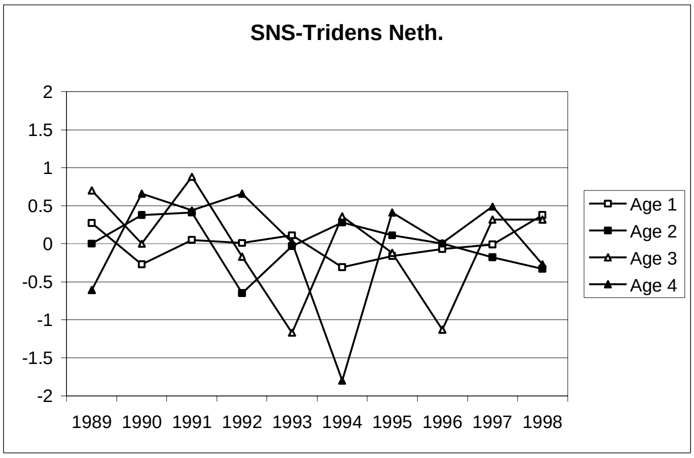
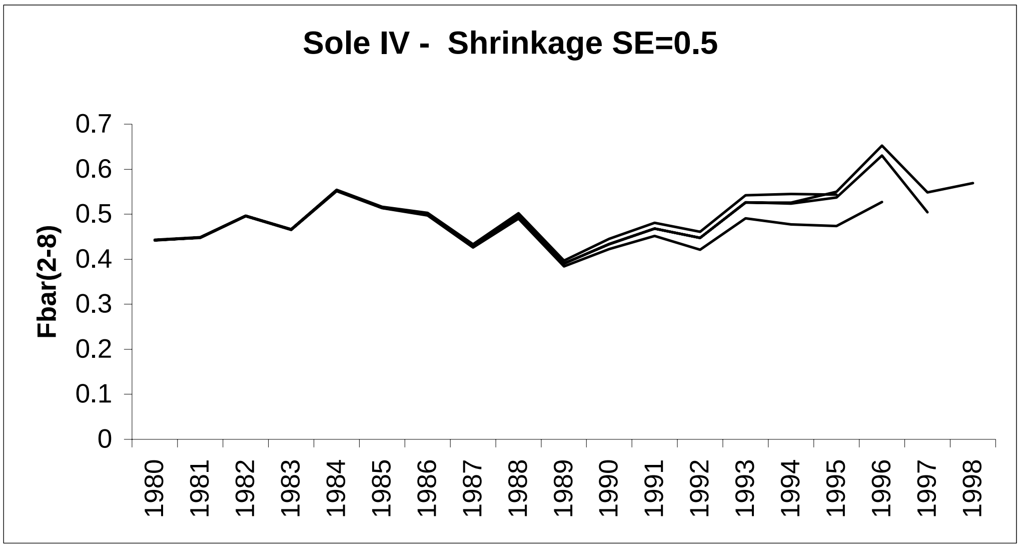
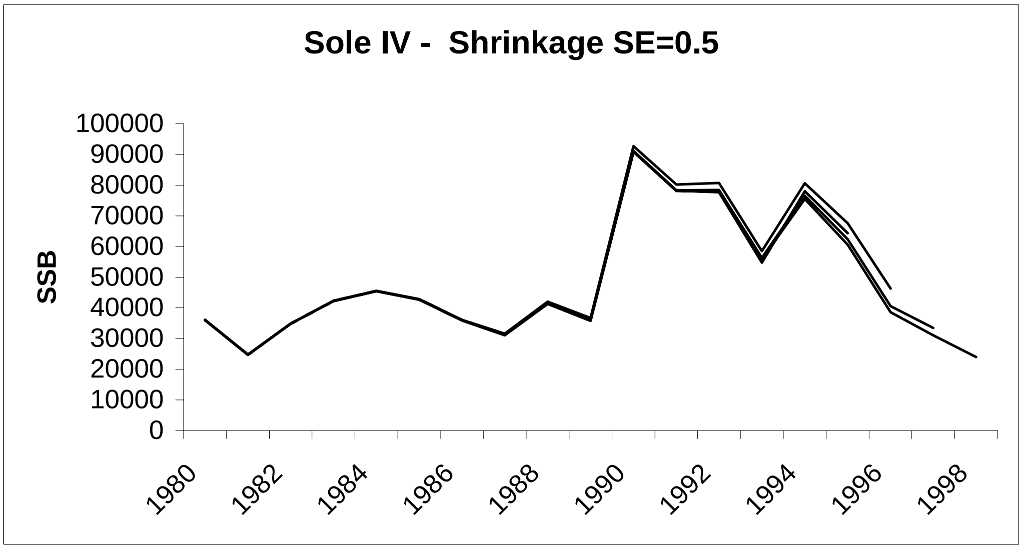


Figure 7.3 - North Sea sole (IV)
Retrospective analysis





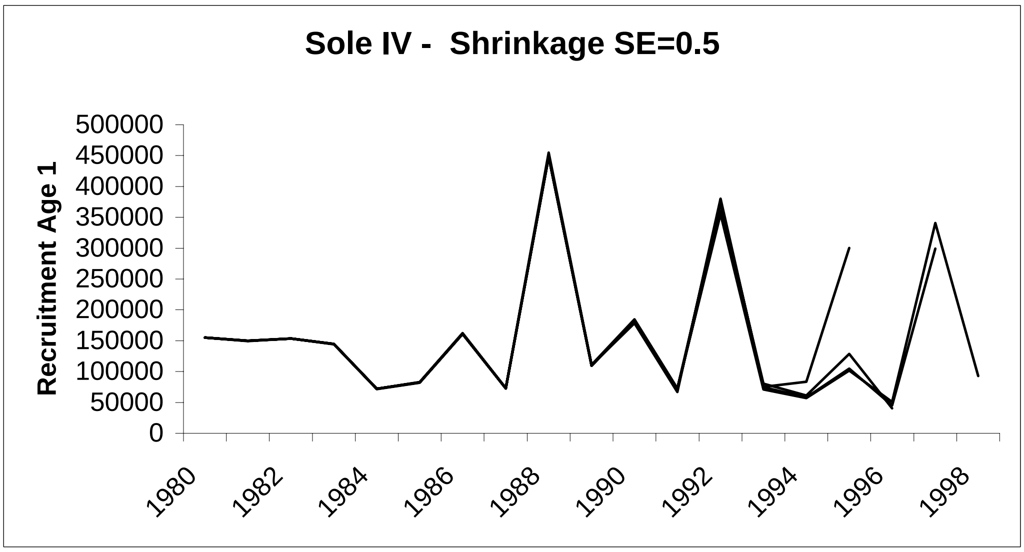


Figure 7.4 North Sea Sole

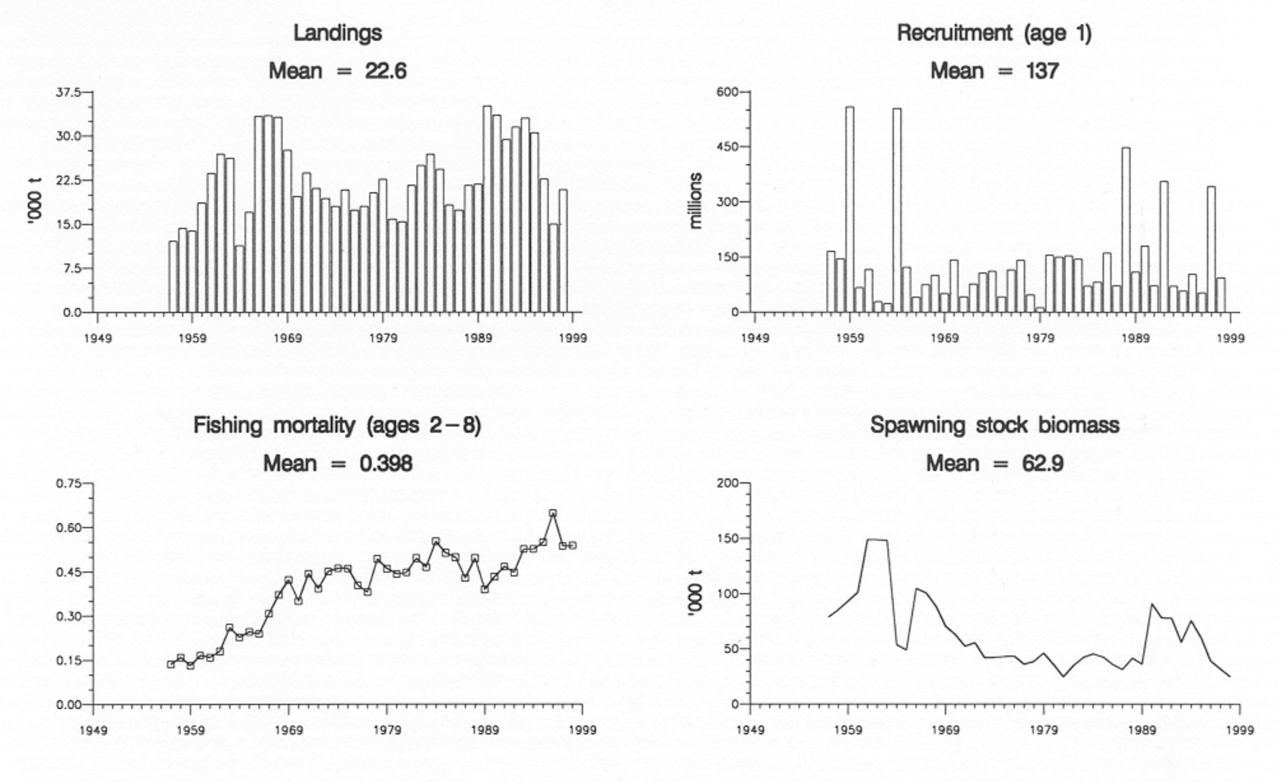
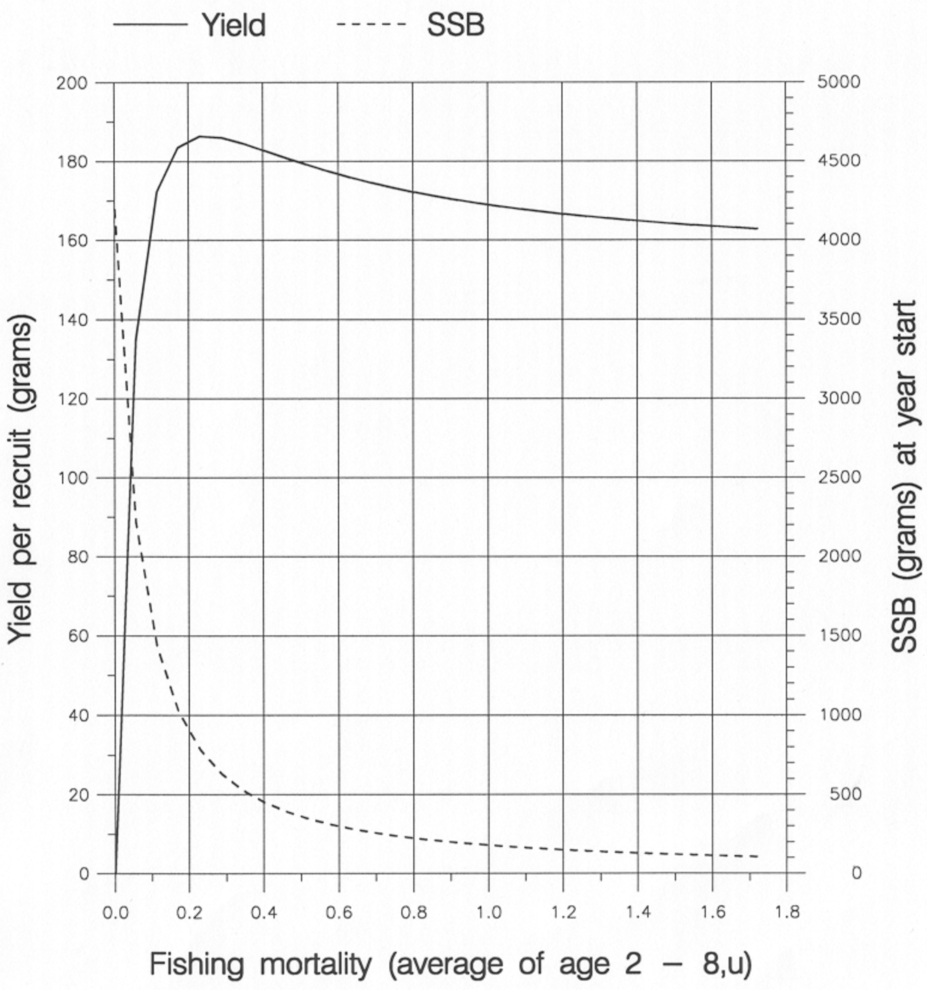
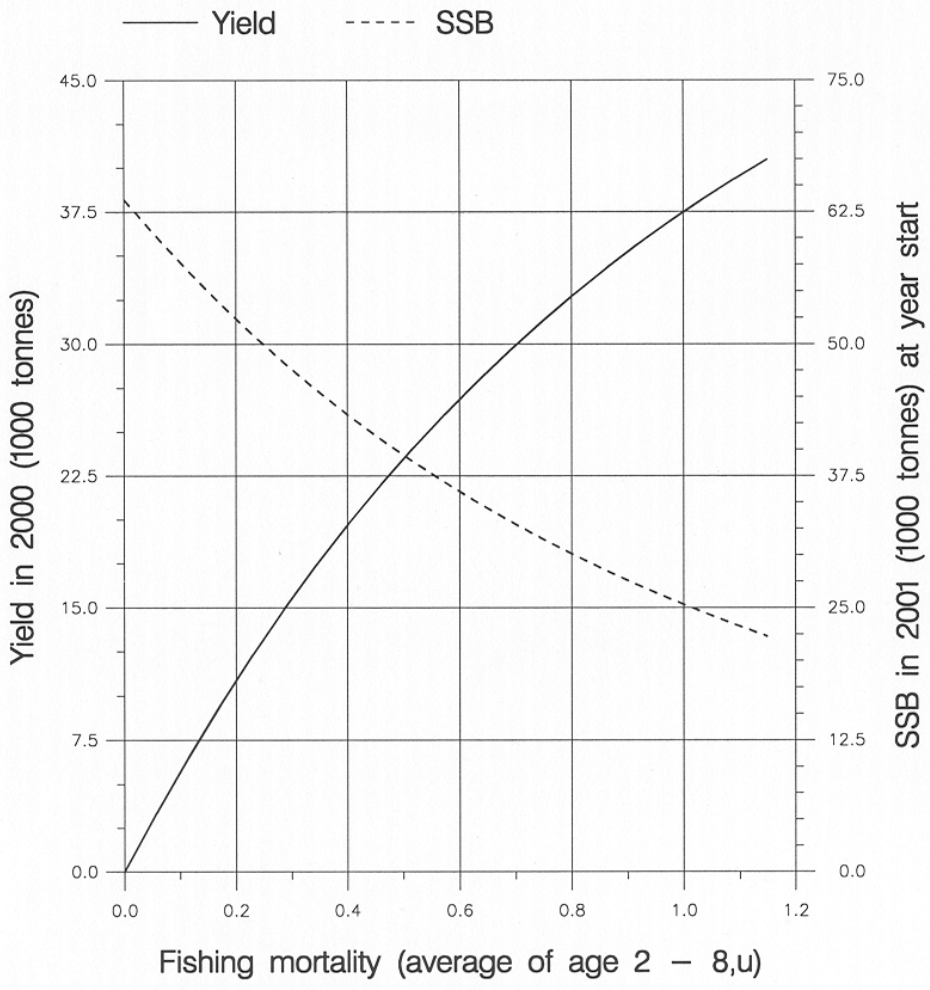


Figure 7.5 Fish Stock Summary. North Sea Sole.



(run: YLDWVN05) C



(run: MANWVN01) D

Figure 7.6 **Sole, North Sea. Sensitivity analysis of short term forecast.**

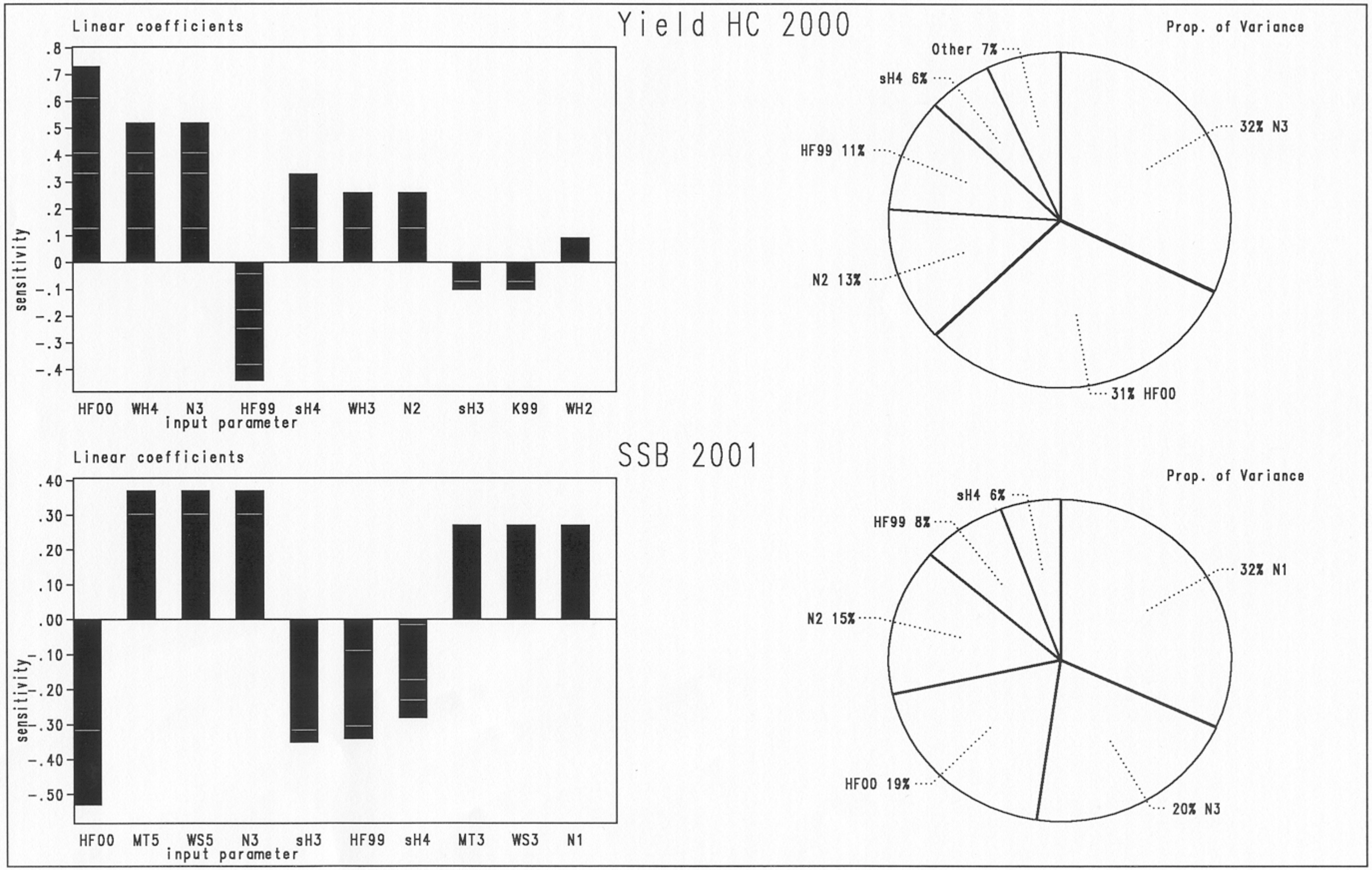


Figure 7.7 **Sole, North Sea. Probability profiles for short term forecast.**

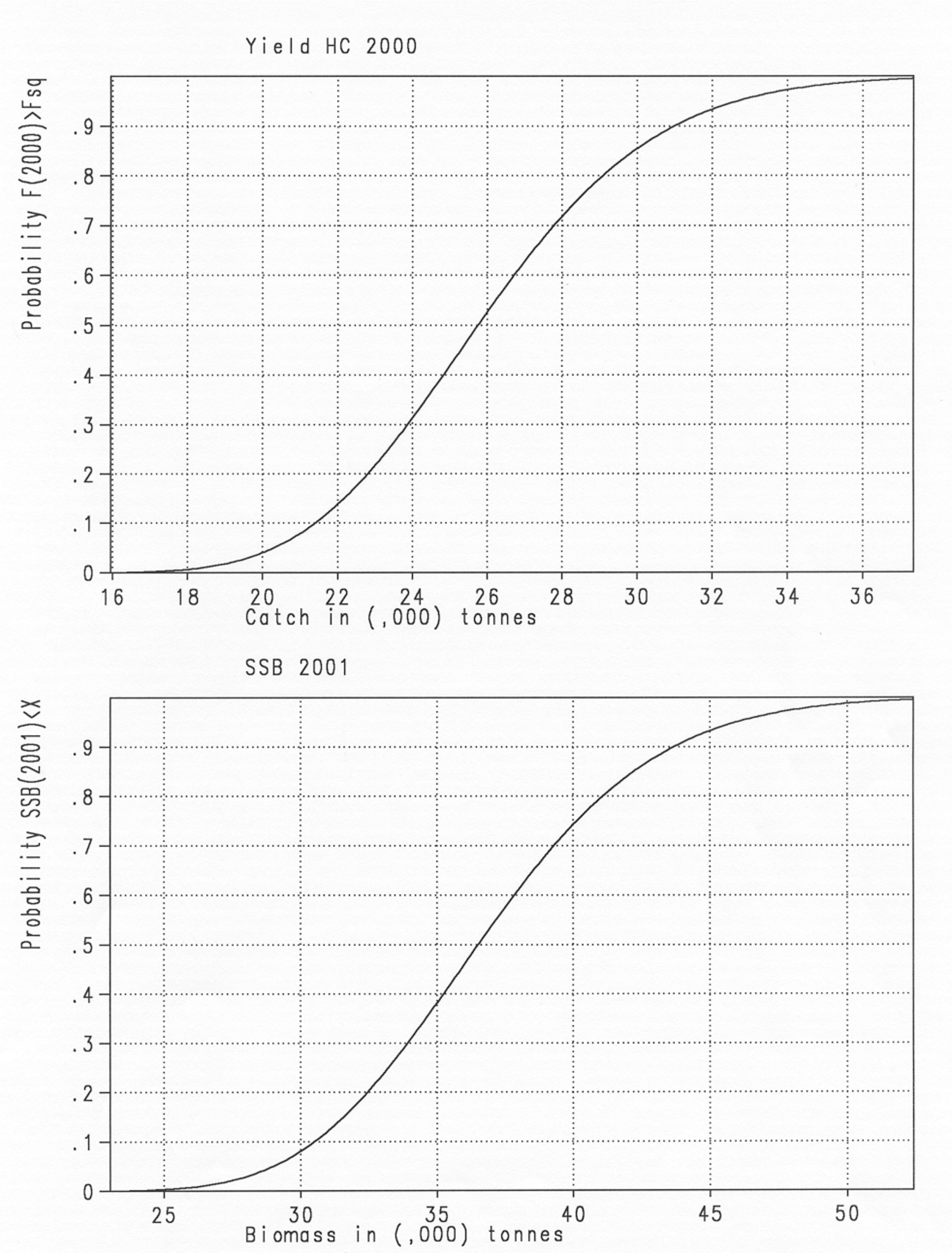


Figure 7.8 **North Sea Sole. Medium term projections. Solid lines show 5, 10, 20,50, and 95 percentiles**
Ricker stock-recruitment relationship
number of simulations 500 Relative Cons. effort = 1.00 Natural Mortality = 0.1

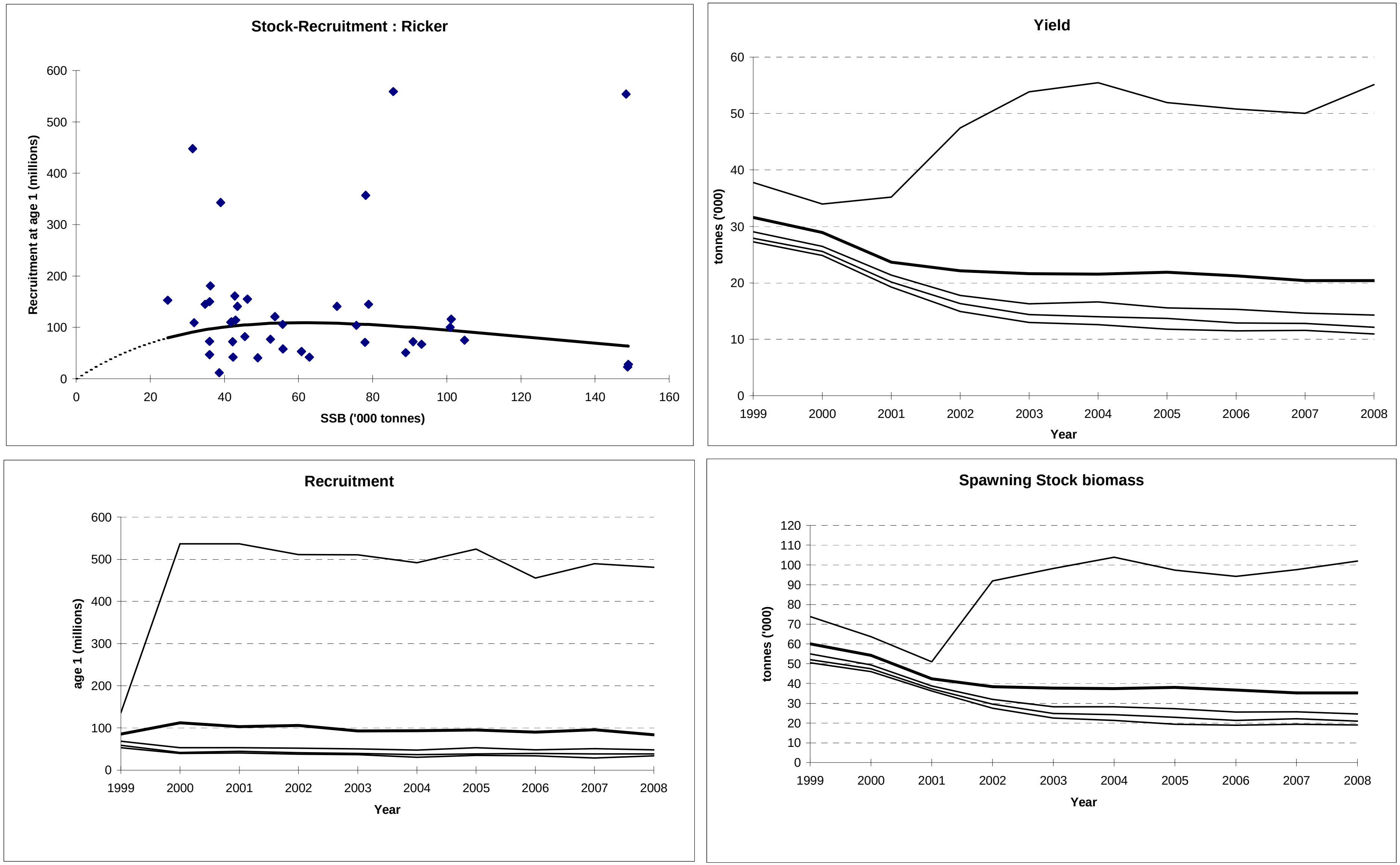


Figure 7.9 Sole IV - Medium term predictions showing 5th,10th,20th,50th percentiles of SSB in tenth year (2008) for different Fishing mortalities
Ricker stock-recruitment relationship
500 simulations

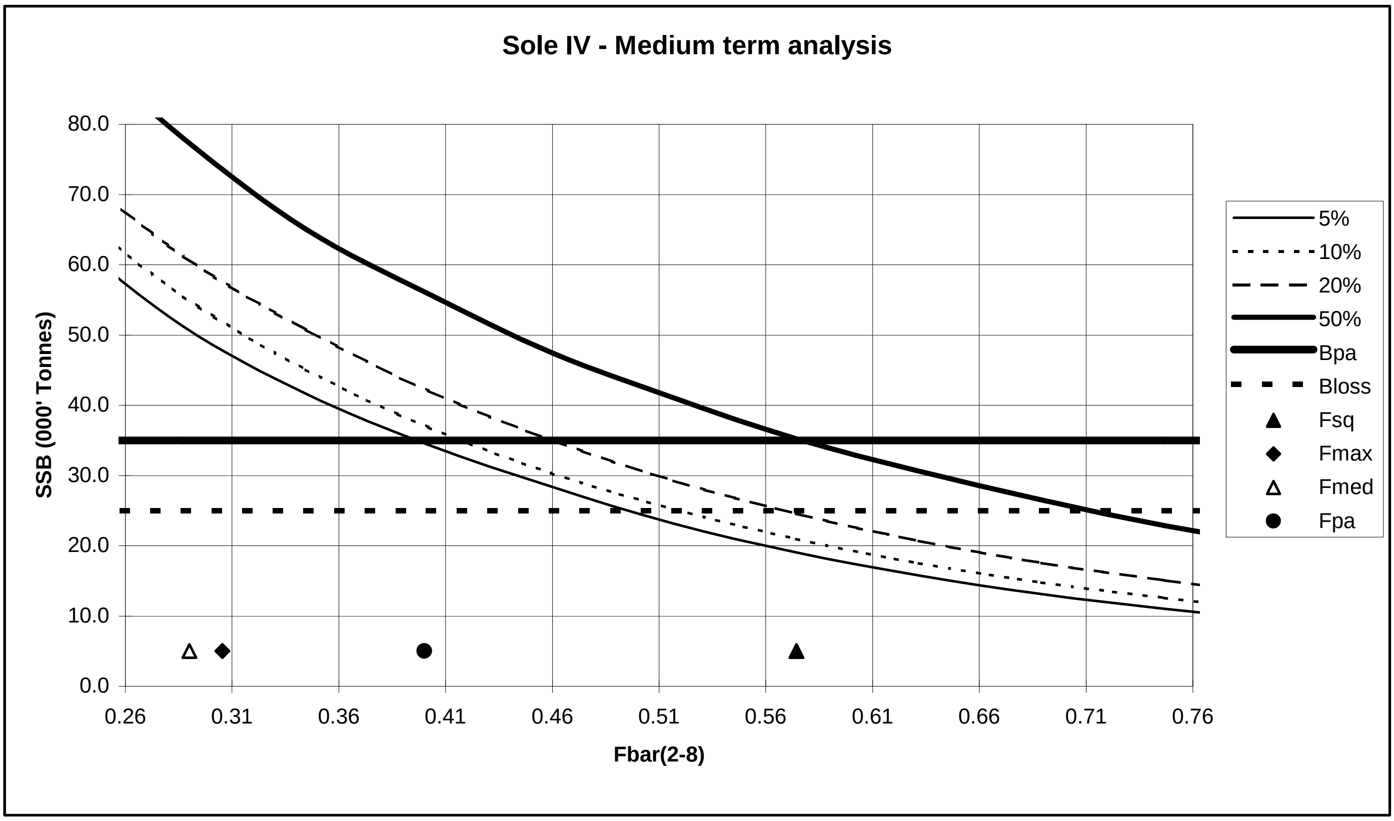


Figure 7.10 North Sea Sole.

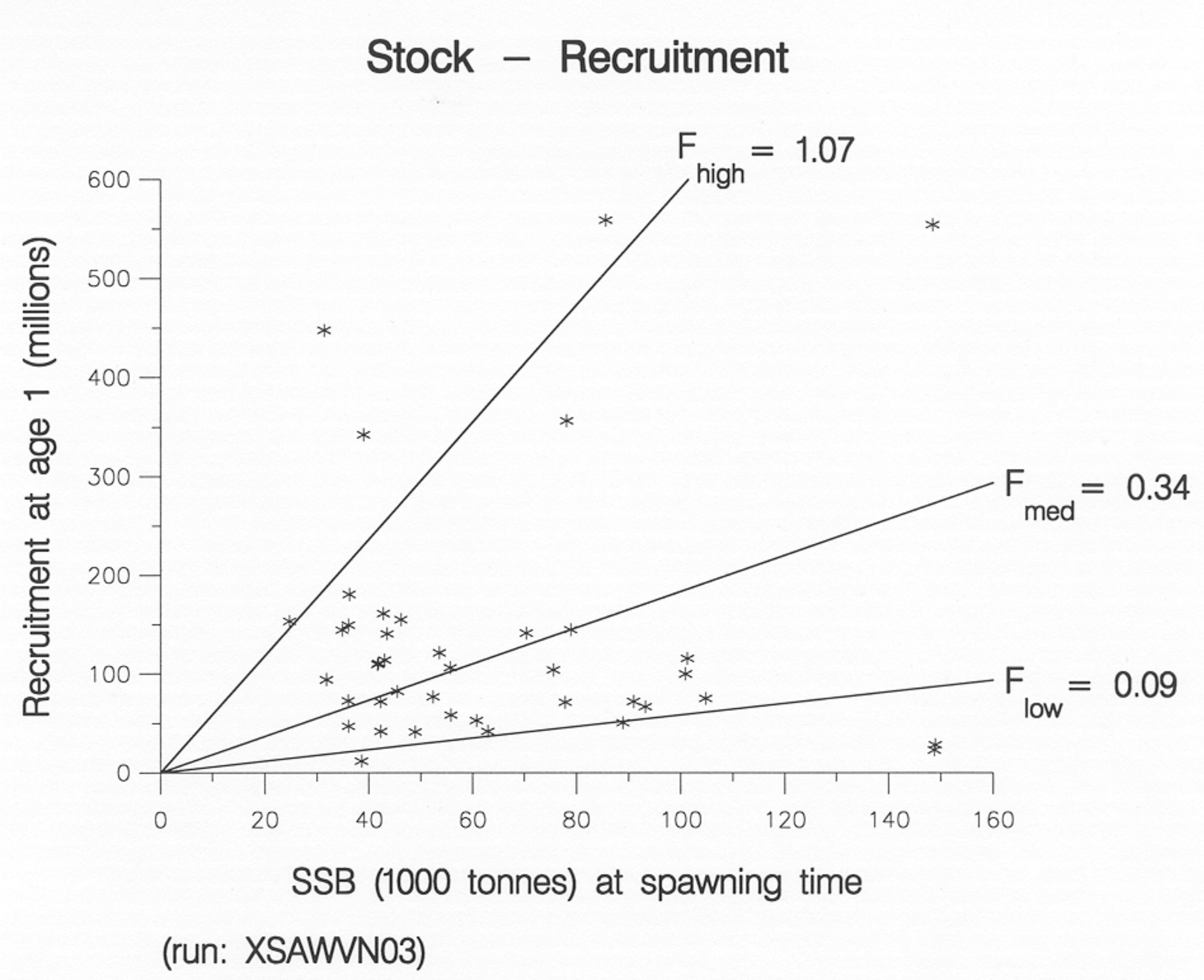
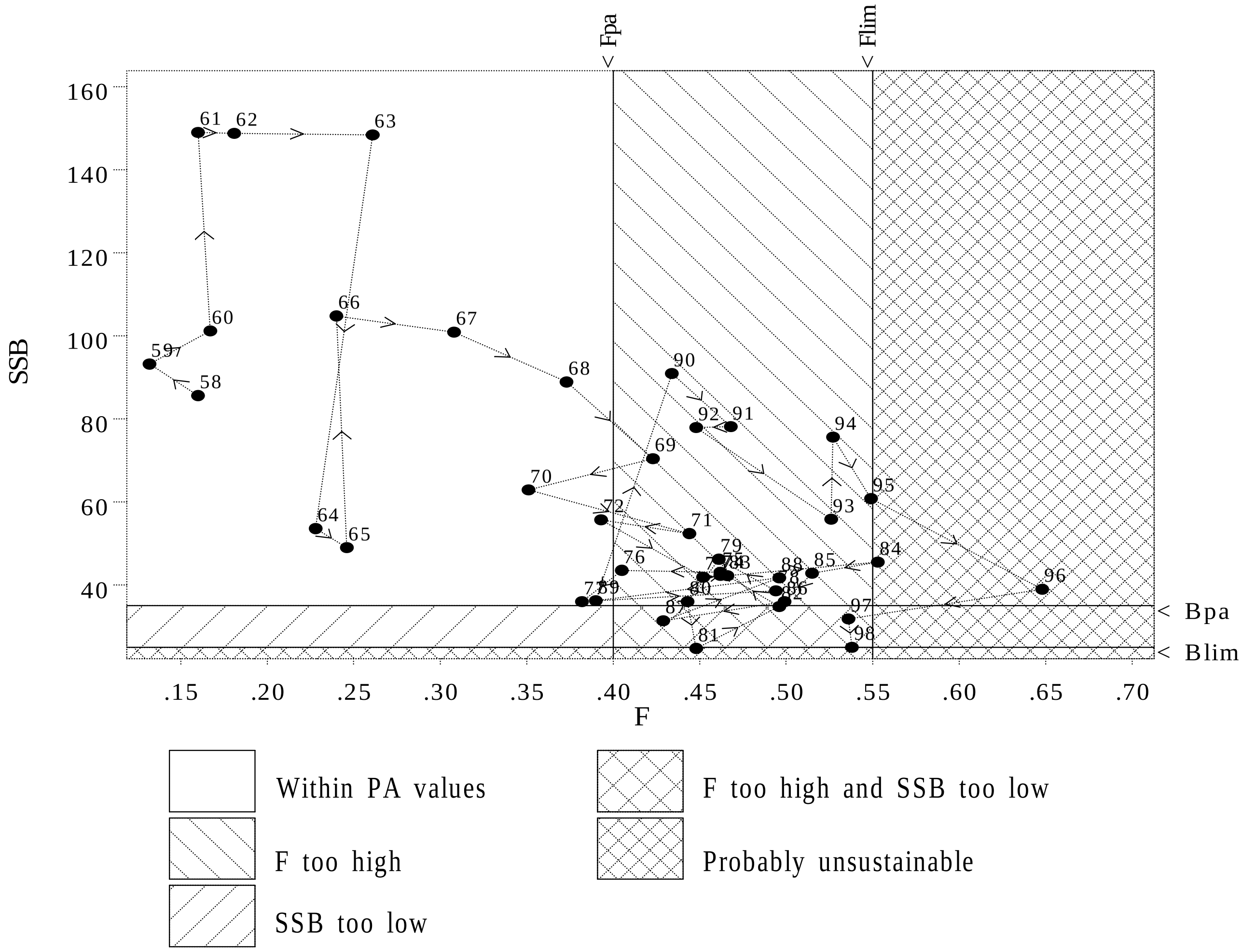


Figure 7.11 - North Sea sole (IV)



Data file(s):D:\ns99\Wpaplot\SolIV_final.pa;D:\ns99\Wpaplot\Soliv.sum
Plotted on 20/10/1999 at 12:11:52

8 SOLE IN DIVISION VIID

8.1 The fishery

There is a directed fishery for sole by small inshore vessels using trammel nets and trawls who fish mainly along the English and French coasts and possibly exploit different coastal populations. These vessels take about 58 % of the total recorded landings (Table 8.1.1a) and the fishery is of primary importance to these vessels. There is also a directed fishery by English and Belgian beam trawlers who are able to direct effort to different ICES divisions and report 31 % of the landings from VIId. These vessels are able to fish for sole in the winter before the fish move inshore and become accessible to the local fleets. In cold winters, sole are particularly vulnerable to the offshore beamers when they aggregate in localised areas of deeper water. Effort from the beam trawl metier can change considerably depending on whether the fleet moves to other areas or directs effort at other species such as scallops and cuttlefish. A third metier is made up of French offshore trawlers fishing for mixed demersal species and taking sole as a by-catch. This fleet takes about 2 % of the landings.

8.1.1 ACFM advice applicable to 1999

ACFM considered potential reference points and proposed that B_{pa} should be set at 8,000 t, F_{lim} at 0.55 and F_{pa} at 0.40. The stock was considered to be outside safe biological limits. Although the SSB in 1998 was estimated to be above the proposed B_{pa}, the current level of F was probably higher than F_{pa} of 0.4. ACFM recommended that F be reduced by 10 % to the proposed F_{pa}, corresponding to landings in 1999 of 3800 t.

8.1.2 Management applicable to 1999

The TACs for 1999 were set at 4700 t which is based on the average of recent landings but was equivalent to an increase in the estimated *status quo* fishing mortality of around 12 %.

Mesh size for trawling is 80 mm. There are no effort restrictions on fixed nets but there is a derogation from the minimum mesh size of 100 mm for fixed nets until 2000.

Minimum landing size for sole is 24 cm.

8.1.3 Landings in 1999

Landings data reported to ICES are shown in Table 8.1.1b together with the total landings estimated by the Working group. The high level of unallocated landings are mainly due to the late reporting of data by some countries. There is thought to be a considerable under-reporting by small vessels which take up to 60 % of the landings in the eastern Channel as well as some misreporting into VIId by beam trawlers. However, it has not been possible to quantify the level of these for inclusion in the assessment. The landings used by the Working Group in 1998 were 3694 t which is 30 % below the agreed TAC of 5230 t and also 12 % below the catch predicted at *status quo* fishing mortality in 1998 (4200).

Year	TAC	Predicted at SQ F	WG Landings
1997	5230	4800	4983
1998	5230	4570	3694
1999	4700	4200	not known

8.2 Natural mortality. maturity, age compositions and weight at age

As in previous assessments natural mortality was assumed constant over ages and years at 0.1 and the maturity ogive used was knife-edged with sole regarded as fully mature at age 3 and older (Table 8.2.1). Age sampling for the period before 1980 was poor, but between 1981 and 1984 quarterly samples were provided by both Belgium and England. Since 1985, quarterly catch and weight at age compositions were available from Belgium, France and England. Stock weights were calculated from a smoothed curve of the of the catch weights interpolated to 1st January.

The age composition data and the mean weight at age in the catch and stock are shown in Table 8.2.2–8.2.4.

No discard data are available for this stock.

8.3 Catch, effort and research vessel data

Catch per unit effort and effort data is shown for 4 main commercial fleets in Table 8.3.1. and Figure 8.3.1. The French otter trawl effort has been completely revised from 1991 and includes both inshore and offshore metiers together in a single fleet.

CPUE from the English beam trawl survey is shown in Table 8.3.2 and indicates a stable cpue for the 3+ fish over the last three years and a large increase in 1999 as the strong 1996 year class recruits to the SSB.

Effort increased from 1975 to reach a peak during 1989–90, followed by a decline in the early 1990's. There appears to have been a marked reduction in effort in the English and Belgian beam trawl fleets in 1998 (15 % and 40 % respectively). Effort in the revised French trawl fleet and in the English fixed net fleet are similar to the 1997 values and in both cases remain close to the average for the previous 5 years.

In last years WG, the effort data for the terminal year from one of the main fleets was not accepted and the analysis was run on a reduced year range for that fleet. ACFM commented that this may have compromised the quality of the assessment. This data problem has been resolved and a new effort and catch-at-age series provided.

8.4 Catch at age analysis

8.4.1 Data screening

a) Year range and age range: A separable analysis was run to examine the consistency of the age composition. The results are shown in Table 8.4.1a. The residuals on ages 1/2 were high as expected from the low catch and poor sampling of these ages. There were also increased anomalies at ages older than 11 and these ages were subsequently combined into an 11+ group. In the years 1982–1986 there were some high anomalies at ages 5/6 and 8/9 and these combined with some trends in fleet catchability (see below) in the early period provided support for a reduced year range in the final analysis.

8.4.2 Exploratory XSA runs

a) fleets: see section 8.3

b) Trends in catchability. Each fleet was initially run separately with similar parameters for XSA to those used last year except over the full year range from 1982 and no time taper was used. The log catchability residuals were plotted to examine trends across years. As last year, trends in residuals were evident in the Belgian and UK beam trawl fleets. Removing the years before 1986 reduced the trends. The revised French otter trawl fleet also showed a strong trend in residuals prior to 1991 when the revised data set was introduced. The fleet year range was reduced in the tuning file to include only the revised data from 1991. A final tuning run was done over the period 1986–98 for all fleets except French OT which was set to 1991–98 in the data file and the residuals plotted in Figure 8.4.1.

c) Time taper. As last year no time taper was applied since the fleets had already been truncated to remove trends in catchability.

d) Variability at age. Last year, high variability was seen in the log q residuals at age 2 in the Belgian beam trawl, and the two year olds were excluded from the Belgian data set. Following revisions to the tuning fleet, these trends were removed and age 2 was retained. In the French OT fleet, there was a steep trend in residuals at age two with a sharp increase in 1997 and 1998. This was thought to be due to poor sampling of this age group at one of the key markets and as a result age 2 was omitted from the final run.

e) Estimation of q in terminal year: As last year, catchability at all ages estimated from mean q.

f) Estimation of q on older ages: As last year catchability was considered constant on ages > 7.

g) Shrinkage: Retrospective runs showed that there was a tendency to overestimate F in 1996 and 1997 (Figure 8.4.2) and this was similar to the pattern found in last year's assessment. However the 1998 trend in F is strongly influenced by the high F in 1997 and this causes the retrospective pattern to diverge from the previous two years. Strong shrinkage emphasises this divergence and so a moderate shrinkage as used last year was adopted.

8.4.3 Final XSA run

The input parameters for the final runs compared with those from last year are shown below:

	Fleets	Age range	Age as recruits	q-plateau	Year range for tuning	Year taper	F shrinkage
1997 WG	As 1996 but excl Fr Tr	1–11+	< 3	> 7	1982–96	Tricubic over 10	0.5
1998 WG	As 1996 but new Fr Tr	1–11+	none	> 7	1986–97 except Fr Tr 1986–96	No taper	0.5
1999 WG	rev Bel BT rev Fr Tr rev FYFS	1–11+	none	> 7	1986–98 except Fr Tr 1991–98	No taper	0.5

The input fleets used in the final XSA run are given in Table 8.4.1b and tuning results using the selected parameters, in Table 8.4.1 c. The tables of fishing mortality and stock number at age in Table 8.4.2 and 8.4.3.

8.5 Recruitment estimates

Recruit indices were available for 1 and 2-gp sole from the English 4 m beam trawl survey which covers most of VIId in August and for 0 and 1-gp from English and French coastal young fish surveys (Tables 8.3.2 and 8.5.1a). The relationship between these series and the VPA is shown in Figure 8.5.1. The input file to RCT3 is given in Table 8.5.1b and the output in Table 8.5.2.

The geometric mean recruitment for the year classes 1981–95 at age 1 was 22.4 million and the arithmetic mean was 23.7 million.

1996 year class at age 3 in 1999: This was estimated at 21.6 million in XSA based on survey and commercial fleet estimates receiving 66 % of the weight. This value was therefore accepted. This year class was estimated by RCT3 at 24 million at two year old in last year’s assessment compared with 26 million at age two this year.

1997 year class at age 2 in 1999: This was estimated at 11.1 million by XSA and 19.0 million by RCT3. The survey estimates in XSA ranges between 11 and 29 million but the mean value was reduced by the F shrinkage which had 40 % of the weight and estimated a very low recruitment of only 4.3 million. All the survey estimates in RCT3 indicate a recruitment above 9 million and received 60 % weighting. The RCT3 value of 18.9 million was therefore accepted.

1998 year class at age 1 in 1999: Four survey estimates were available including the English beam trawl survey covering the whole of VIId. Three of the four surveys indicate an extremely strong year class and this has been confirmed by fishermen who have commented on the abundance of small sole corresponding to the 1998 year class. The survey estimates receiving most weight vary between 34 and 94 million but all surveys between them only account for 50 % of the weight on the final estimate. Nevertheless, it was decided to use the RCT3 estimate rather than GM (22.4 million) because of the signal in all the surveys of an above average year class.

Year class	At age in 1999	Estimate (‘000s)	Method
1996	3	21646	XSA
1997	2	18990	RCT3
1998	1	36943	RCT3
1999 2000	recruits	22400	GM 1982–96

8.6 Historical Stock trends

Trends in yield fishing mortality, SSB and recruitment are shown in Table 8.6.1 and Figure 8.6.1. Fishing mortality has been variable over the period and has increased since 1993 to a peak in 1997. The fishing mortality appears to have decreased in 1998 in line with a decrease in effort in some fleets. Following a relatively strong recruitment in 1996, there appears to be another very good year class in 1998 which will recruit to the spawning stock in 2001.

8.7 Short term forecast

The input data for the catch forecasts are given in Table 8.7.1. Stock numbers in 1999 were taken from the XSA output for age 3 and older, and from RCT3 for age 2 and age 1. The GM recruitment of 22.4 million was used for age 1 in 2000 and 2001. In order not to give undue weight to the peak F in 1997, it was decided to use the mean unscaled exploitation pattern for the period 1994–98 (F_{3-8} = .43. Catch and stock weights at age were the mean for the period 1996–98 and the proportions of M and F before spawning were set to zero.

The result of the *status quo* catch prediction are given in table 8.7.2 and a detailed output by age in Table 8.7.3. The predicted *status quo* landings in 1999 are estimated to be 4087 t compared with a TAC of 4,700 t. based on average landings. The predicted *status quo* landings in 2000 are estimated to be 4,140 t. Spawning stock biomass is forecast to increase from 9300 t in 2000 to 10800 t in 2001 as the strong 1998 year class recruits to the mature stock.

Table 8.7.3a shows the contribution of different year classes to the landings in 2000 and SSB in 2001 under *status quo* assumptions. The two year classes estimated from RCT3 (1996 and 1997) together contribute about 50 % of the landings in 2001. The 1998 year class is expected to contribute about 43 % of the SSB in 2001.

Sensitivity Analysis

Input data for the sensitivity analysis of the catch predictions using the programme INSENS are given in Table 8.7.4 and the results shown in Figures 8.7.1 and 8.7.2. For yield, the prediction in 1999 is most sensitive to the variability in the estimate of F in 2000 which also contributes 48 % of the variance. The SSB in 2000 is affected about equally by variability in the estimates of natural mortality on age 3, the stock weights at age 3 and numbers of the 1999 year class.

Probability profiles of expected yield and SSB are given in Figure 8.7.2. There is a relatively low probability (10 %) of the SSB falling below Bpa 2001.

The input data and plot of short term yield and SSB are shown in Table 8.7.1 and Figure 8.7.3.

8.8 Medium Term Projections

The Butterworth and Bergh model used last year was not available and an alternative which was a Shepherd curve constrained to go through both the GM recruitment and GM SSB was therefore selected as it gave a similar fit to the data. The outputs from WGMTERMA are shown in Figure 8.8.1. and indicate that SSB is expected to decline from 2001 with a 50 % probability of remaining above B_{pa} by 2008.

Figure 8.8.2 gives the medium term projections of SSB in 2008 under different levels of fishing mortality. The estimated likelihood of SSB falling below B_{pa} are shown. In order to reduce the probability to around 5 % that SSB will fall below B_{pa}, fishing mortality would need to be reduced to about 0.35 a reduction of about 20 % from the F in 1998. The 10 % probablity level is approximately consistent with F_{pa}.

8.9 Long Term Considerations

The input data for the yield per recruit analysis is given in Table 8.9.1. Mean weights were the long term average from the tuned period (1986–98). Last year the mean weights were the taken as the recent three year average. The effect of this has been to alter the Fmed value from 0.38 last year to 0.41. The results are shown in Table 8.9.2. Figure 8.9.1 shows the relationship between stock and recruitment and gives the calculated reference points. The current level of F_{3-8} (0.43) is close to Fmed (0.41) and well above Fmax (0.26).

8.10 Biological Reference Points

The precautionary reference points were not reviewed again in this assessment. The biological reference points agreed by ACFM are shown below together with a range of points calculated from the recent assessment:

F98	Fpa	Flim	Fmed	F0.1	Fmax	Bpa
0.43	0.4	0.55	0.41	0.11	0.26	8,000 t

8.11 Comments on the Assessment

Last year the main problem with the assessment of VIId sole was due to uncertainties in the catch-at age data in 1992/93 and the inability to use the 1997 cpue for the French trawl tuning fleet. The earlier data problems have been investigated but could not be resolved. However they now have less influence on the estimation of F in the terminal year. The tuning fleet problems have been improved by revising the French trawl fleet and deleting the earlier years where data is not consistent with the new series.

There is still an apparent lack of consistency between cpue indices, which show a fairly flat trend in abundance since 1993 compared with the marked increase in abundance of SSB over the same period. Part of this inconsistency may be due to under-reporting by important segments of the inshore fleet. In contrast to many other stocks, the inshore fleet in VIId takes a major part of the landings of sole.

Table 8.1.1a. VIId Sole Percentage of the landings by metier

	Landings %
Offshore Beam trawl	30.7
Offshore otter trawl	2.0
Inshore netters	43.6
Inshore trawl	15.1
Scallopers	8.4
Other	0.2
Total	100.0

Table 8.1.1b Sole in VIId. Nominal landings (tonnes)
as officially reported to ICES and used by the WG.

Year	Belgium	France	UK (E&W)	others	Total reported	Unallocated [1]	Total used by WG	TAC
1974	159	469	309	3	940	-56	884	
1975	132	464	244	1	841	41	882	
1976	203	599	404	.	1206	99	1305	
1977	225	737	315	.	1277	58	1335	
1978	241	782	366	.	1389	200	1589	
1979	311	1129	402	.	1842	373	2215	
1980	302	1075	159	.	1536	387	1923	
1981	464	1513	160	.	2137	340	2477	
1982	525	1828	317	4	2674	516	3190	
1983	502	1120	419	.	2041	1417	3458	
1984	592	1309	505	.	2406	1169	3575	
1985	568	2545	520	.	3633	204	3837	
1986	858	1528	551	.	2937	1087	4024	
1987	1100	2086	655	.	3841	1133	4974	3.85
1988	667	2057	578	.	3302	680	3982	3.85
1989	646	1610	689	.	2945	1242	4187	3.85
1990	996	1255	742	.	2993	1067	4060	3.85
1991	904	2054	825	.	3783	599	4382	3.85
1992	891	2187	706	10	3794	348	4142	3.50
1993	917	1907	610	13	3447	1064	4511	3.20
1994	940	2001	701	15	3657	984	4641	3.80
1995	817	2248	669	9	3743	759	4502	3.80
1996	899	2335	877		4111	914	5025	3.50
1997	1306	1609	933		3848	1135	4983	5.23
1998	541	1703	803	0	3047	647	3694	5.23

[1] Main unallocated due to late reporting by some countries;
also includes minor unreported landings estimated by the WG

Table 8.2.1 Sole in VIId Natural Mortality and proportion mature

age	M	Maturity ogive
1	0.1	0
2	0.1	0
3	0.1	1
4	0.1	1
5	0.1	1
6	0.1	1
7	0.1	1
8	0.1	1
9	0.1	1
10	0.1	1
11	0.1	1

Table 8.2.2 VIId SOLE Catch numbers at age

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1982	1983	1984	1985	1986	1987	1988
AGE							
1	155	0	24	49	49	9	95
2	2625	852	1977	3693	1264	3284	2227
3	5256	3452	3157	5211	5377	3827	7393
4	1727	3930	2610	1646	3273	3417	1648
5	570	897	1900	1027	925	2166	1219
6	653	735	742	1860	790	1064	910
7	549	627	457	144	1087	1110	400
8	240	333	317	158	156	828	268
9	122	108	136	156	192	114	280
10	83	89	99	69	216	163	84
+gp	202	193	238	128	381	469	284
TOTALNUM	12182	11216	11657	14141	13710	16451	14808
TONSLAND	3190	3458	3575	3837	4024	4974	3982
SOPCOF %	97	99	99	100	100	100	100

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	163	1271	383	106	85	34	683	11	30	41
2	3704	3092	7381	4082	5225	783	2974	2055	1740	1814
3	3424	6326	3796	8967	6716	6660	4558	7934	6444	5929
4	4842	1257	4316	1886	5735	6152	5003	3081	5228	2890
5	1530	1654	585	2065	1057	3514	3090	3381	2157	1760
6	943	329	1003	295	645	613	2052	1896	1840	651
7	651	432	256	382	171	613	394	1332	992	654
8	218	293	257	140	206	112	310	288	841	494
9	181	138	272	184	123	154	95	351	255	394
10	270	139	95	98	67	94	111	112	199	251
+gp	329	556	395	237	145	278	247	375	298	354
OTALNUM	16255	15487	18739	18442	20175	19007	19517	20816	20024	15232
TONSLAND	4187	4060	4382	4142	4511	4643	4583	5025	4983	3694
SOPCOF %	100	99	100	100	100	100	100	100	98	100

Table 8.2.3 VIId SOLE Catch weights at age (kg)

Table 2 Catch weights at age (kg)

YEAR	1982	1983	1984	1985	1986	1987	1988
AGE							
1	.1020	.0000	.1000	.0900	.1350	.0950	.1020
2	.1710	.1730	.1780	.1820	.1790	.1760	.1520
3	.2250	.2300	.2340	.2300	.2120	.2360	.2260
4	.3120	.3020	.3140	.2810	.3060	.2950	.2780
5	.3860	.4040	.3800	.3680	.3620	.3530	.3580
6	.4280	.4360	.4360	.3940	.3850	.4070	.4070
7	.4390	.4350	.4170	.5160	.4350	.4120	.4580
8	.5090	.5240	.5380	.5430	.5190	.4790	.5090
9	.5020	.5370	.5290	.5940	.5010	.4630	.5510
10	.4630	.5830	.5650	.5950	.5240	.5380	.5590
+gp	.6729	.6283	.7135	.8005	.6029	.6192	.6662
SOPCOFAC	.9713	.9910	.9884	.9980	1.0044	1.0003	.9970

Table 2 Catch weights at age (kg)

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.1060	.1210	.1140	.1030	.0850	.0990	.1270	.1420	.1390	.1330
2	.1560	.1800	.1610	.1530	.1480	.1510	.1740	.1670	.1550	.1600
3	.1930	.2400	.2110	.2020	.1970	.1880	.1800	.1790	.1890	.1740
4	.2740	.2910	.2670	.2670	.2450	.2360	.2330	.2300	.2330	.2360
5	.2950	.3510	.3490	.2910	.3310	.2900	.2570	.2720	.2910	.2850
6	.3570	.3430	.3900	.3990	.3740	.3540	.3320	.3230	.3410	.3410
7	.3910	.4690	.4150	.3860	.5280	.3800	.3560	.3600	.3850	.3790
8	.4690	.4630	.4260	.4550	.5400	.5050	.3800	.4030	.4010	.4120
9	.5160	.4890	.4330	.4450	.5050	.4920	.4800	.4360	.4950	.4800
10	.5380	.5190	.4770	.4610	.7420	.4960	.4900	.4610	.4690	.4320
+gp	.7047	.5667	.5590	.5576	.6467	.6155	.6419	.5852	.6428	.6043
SOPCOFAC	.9974	.9949	1.0004	1.0006	1.0009	.9997	1.0001	.9999	.9780	.9995

Table 8.2.4 VIId SOLE Stock weights at age (kg)

Table 3 Stock weights at age (kg)

YEAR	1982	1983	1984	1985	1986	1987	1988
AGE							
1	.0590	.0700	.0670	.0650	.0700	.0720	.0730
2	.1140	.1350	.1310	.1290	.1360	.1390	.1410
3	.1670	.1970	.1920	.1920	.1980	.2030	.2060
4	.2170	.2550	.2490	.2540	.2560	.2620	.2670
5	.2630	.3090	.3040	.3150	.3090	.3180	.3240
6	.3060	.3590	.3550	.3760	.3580	.3700	.3770
7	.3470	.4060	.4030	.4360	.4030	.4170	.4260
8	.3840	.4480	.4480	.4950	.4430	.4610	.4710
9	.4180	.4870	.4900	.5540	.4800	.5000	.5120
10	.4500	.5220	.5290	.6110	.5120	.5360	.5490
+gp	.5300	.6008	.6265	.7798	.5761	.6156	.6297

Table 3 Stock weights at age (kg)

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.0600	.0700	.0610	.0840	.0670	.0680	.0970	.1030	.0600	.1210
2	.1190	.1350	.1190	.1320	.0870	.1180	.1340	.1390	.1060	.1490
3	.1750	.1960	.1750	.1780	.1610	.1650	.1720	.1750	.1540	.1790
4	.2300	.2530	.2280	.2230	.2300	.2110	.2100	.2120	.2030	.2110
5	.2830	.3050	.2780	.2670	.2930	.2540	.2480	.2480	.2530	.2460
6	.3350	.3530	.3260	.3090	.3520	.2960	.2870	.2840	.3050	.2820
7	.3850	.3960	.3710	.3490	.4050	.3350	.3260	.3200	.3580	.3210
8	.4330	.4350	.4130	.3880	.4540	.3720	.3660	.3570	.4130	.3620
9	.4790	.4700	.4530	.4250	.4970	.4070	.4060	.3930	.4690	.4050
10	.5230	.5000	.4900	.4610	.5350	.4400	.4460	.4290	.5260	.4500
+gp	.6750	.5501	.5759	.5459	.6102	.5320	.5750	.5337	.6985	.5846

Table 8.3.1 Sole in VIId

Catch per unit effort

Year	Belgium Beam trawl (kg/10hr) HP corr	UK Trammel (kg/day)	UK Beam trawl (kg/hr) GRT corr	France* Trawl (kg/h*kw*10-4)
1972			15.2	
1973			12.1	
1974			11.6	
1975	24.1		11.5	
1976	27.3		10.5	
1977	30.0		11.0	
1978	26.3		9.1	
1979	37.4		8.3	
1980	23.3		15.2	
1981	24.5		13.7	
1982	23.6		11.2	
1983	22.4		21.4	
1984	21.6		13.3	
1985	22.9	33.8	12.8	
1986	33.5	38.9	10.9	
1987	36.6	31.6	11.0	
1988	15.9	33.8	11.3	
1989	16.8	28.2	10.6	
1990	25.9	20.2	11.9	
1991	22.6	31.8	8.1	18.5
1992	29.1	30.1	8.0	18.1
1993	34.8	18.7	8.4	21.6
1994	27.9	21.1	9.2	17.8
1995	24.7	21.8	9.0	18.5
1996	29.8	31.2	10.3	19.8
1997	32.6	32.8	9.9	14.4
1998	23.5	21.0	11.1	17.3

Effort

Year	Belgium Beam trawl ('000 hr) HP corr	UK Trammel (days at sea)	UK Beam trawl ('000 hr)	France* Trawl (h*kw*10-4)
1975	5.0			
1976	6.6			
1977	6.9			
1978	8.2			
1979	7.3			
1980	12.8		2.7	
1981	19.0		2.3	
1982	23.9		4.2	
1983	23.6		2.7	
1984	28.0		2.9	
1985	25.3	6243	9.1	
1986	23.5	5863	12.9	
1987	27.1	7192	24.3	
1988	38.5	6943	19.0	
1989	35.7	8380	33.3	
1990	30.3	13541	33.4	
1991	24.3	12188	30.4	10689
1992	22.0	8547	37.1	10519
1993	20.0	9062	29.3	10217
1994	25.2	10756	28.1	10609
1995	24.2	10571	28.6	12384
1996	25.0	8531	39.1	14088
1997	30.9	10066	39.6	10921
1998	18.1	10304	33.5	11707

* Revised series

Table 8.3.2 Sole in division VIId. English beam trawl survey numbers per hr raised to 8m beam trawl equivalent

(mean no/rectangle, averaged across rectangles).

Age	1	2	3	4	5	6	7	8	9	10+	1+	3+
1988	8.2	14.2	9.9	0.8	1.3	0.6	0.1	0.1	0.2			
1989	2.6	15.4	3.4	1.7	0.6	0.2	0.2	0.0	0.0	0.6	25.6	8.2
1990	12.1	3.7	3.4	0.7	0.8	0.2	0.1	0.2	0.0	0.2	25.2	6.4
1991	8.9	22.8	2.2	2.3	0.3	0.5	0.1	0.2	0.1	0.4	40.3	6.3
1992	1.4	12.0	10.0	0.7	1.1	0.3	0.5	0.1	0.2	0.8	28.9	14.2
1993	0.5	17.5	8.4	7.0	0.8	1.0	0.3	0.2	0.0	0.3	36.0	18.1
1994	4.8	3.2	8.3	3.3	3.3	0.2	0.6	0.1	0.3	0.3	24.2	16.3
1995	3.5	10.6	1.5	2.3	1.2	1.5	0.2	0.3	0.2	0.2	20.5	7.2
1996	3.5	7.3	3.8	0.7	1.3	0.9	1.1	0.1	0.5	0.4	19.5	8.8
1997	19.0	7.3	3.2	1.3	0.2	0.5	0.4	0.9	0.0	0.6	33.5	7.0
1998	2.0	21.2	2.5	1.0	0.9	0.1	0.3	0.0	0.1	0.3	28.4	5.2
1999	25.5	9.0	12.4	2.6	1.5	0.7	0.2	0.9	0.8	0.4	54.0	19.4
mean	7.6	11.8	5.4	2.2	1.1	0.6	0.4	0.3	0.2	0.4	30.6	10.7

Table 8.4.1a Sole in VIId Separable Analysis

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Title : 107D SOLE  WGNSSK98 1-15+ 80-98 SEXES COMB

Separable analysis
from 1982 to 1998 on ages  1 to 14
with Terminal F of  .500 on age  3 and Terminal S of  .500

Initial sum of squared residuals was   435.555 and
  final sum of squared residuals is     85.172 after  95 iterations
```

Matrix of Residuals

Years / Ages	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88
1/ 2	1.590	-4.483	-2.050	.408	-.564	-2.494
2/ 3	.722	-.166	-.266	.970	.137	-.162
3/ 4	-.169	-.031	-.122	.384	.207	-.080
4/ 5	-.012	.213	-.055	.296	-.031	-.109
5/ 6	-1.001	-.398	-1.048	-.095	-.632	-.322
6/ 7	-.559	.037	.720	.320	-.661	-.021
7/ 8	-.099	.248	.143	-.298	-.027	.449
8/ 9	.469	.731	.064	-.148	.290	.402
9/10	.025	-.039	.073	-.241	.177	-.337
10/11	-.037	.199	.552	-.671	.641	.342
11/12	.439	.169	.192	-.270	.587	-.177
12/13	.942	.145	.395	.535	-.729	-.549
13/14	-.683	-1.176	-.540	-1.287	-.586	1.012
TOT	-.005	-.005	-.005	-.004	-.004	-.004
WTS	.001	.001	.001	.001	.001	.001

Years	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	TOT	WTS
1/ 2	-.239	.323	1.496	.717	-.826	1.232	-1.113	2.446	-1.656	-.910	-.008	.109
2/ 3	.624	.357	.687	.566	.297	.930	-.694	.238	-.096	-.383	-.003	.390
3/ 4	-.025	.363	-.249	-.049	-.216	-.161	-.087	.159	-.034	.125	.001	1.000
4/ 5	-.578	.226	-.076	-.225	-.297	.036	.109	-.042	-.299	.201	.004	.839
5/ 6	-.450	.637	-.395	-.345	.203	.004	-.124	-.016	-.105	.251	.006	.442
6/ 7	-.202	.060	-.469	.101	-.271	-.355	-.078	.077	.102	.260	.005	.546
7/ 8	.089	.100	-.181	-.250	-.202	.010	.158	-.037	-.070	-.060	.001	.990
8/ 9	.152	.042	-.344	-.240	-.419	.142	-.092	-.205	-.131	.282	-.003	.610
9/10	-.166	-.112	-.007	.486	.501	.158	.110	-.208	.353	-.422	-.007	.710
10/11	.455	-.387	-.060	-.631	.127	-.089	.336	-.105	-.002	-.150	-.009	.501
11/12	.443	-.978	.227	.622	1.029	.184	-.049	-.336	.228	-.038	-.009	.416
12/13	.235	-.852	1.448	.705	.270	-.581	-.281	-.068	.750	.171	-.006	.300
13/14	.189	-.867	.751	-.277	.079	-.906	.892	.006	.270	-.261	-.002	.271
TOT	-.004	-.004	-.005	-.005	-.004	-.003	-.002	-.002	-.001	.000	-4.505	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Table 8.4.1b Sole in VIId. Tuning fleets for final XSA

107D SOLE,TUNI FILE,UK,B [REV:29/9/99 RM
106
BELGIAN BT (HP CORRECTED EFFORT & ALL GEARSAGE COMP)

1980	1998												
1	1	0	1										
3	15												
12.8	46.1	298.7	189.6	57.4	24.7	10.3	5.1	8.6	3.1	5.5	2.4	2.6	37.9
19	161.4	82.1	312.8	229.6	44.7	32.9	33.1	6.9	9	18.4	9.3	0.8	51.9
23.9	980.9	128	93.4	155.9	112.6	38.8	60.1	15.2	14	7.4	12.5	5.9	54.3
23.6	373	818.9	65.5	54	81.7	73.2	23.5	20.2	27	5	1	7.1	33
28	347.2	311.2	436	53.7	38.5	104.9	59.9	25.4	23.2	25.3	9	8.2	42.4
25.3	612.1	213	209.1	260.2	58.2	34.1	48	31	16.9	19.6	9.2	7.7	21.3
23.4	1522.3	675	233.7	170.6	194	30.1	53.1	64.2	32.6	12.7	2.6	43	29.3
27.1	451	739.3	724.4	344.5	232.4	152.7	25.3	86.5	56	56.1	54.5	9.3	109
38.5	990.4	243.3	362.9	216.7	111.8	41.8	73.8	47	9.8	22.3	35.8	8.6	25.3
35.7	512.6	543.6	748	276.6	225	53.1	36.4	12.7	4.7	0	0	4.7	27
30.3	1375.2	218.1	366.2	85.3	198.2	65.5	39	22.4	22.2	25.4	2.8	24	18.2
24.3	1358.6	710.1	125.6	283.9	60.6	56.2	21	19.8	22.2	18	5.6	0.3	21.4
22	1613.7	523.3	477.7	36.9	67.9	28.2	31.7	11.2	11.4	6	5.7	3.2	16.7
20	1520.4	889.5	215.5	78.5	38.9	40.8	37.8	11.3	8.7	13.3	1.5	3	22.4
22.2	1183.2	1598.5	912.9	201	160	39.5	33.8	46.2	16	10.2	14.9	8.8	18.6
24.2	542.7	671.3	590.9	409.4	100.6	40.3	25.4	14.2	9.3	5	11.9	3.4	8
25	975.5	628.7	560.1	354.3	316.8	68.3	77.6	34.2	26.2	15.8	10.8	1.1	4.2
30.9	1282.3	966.1	500.2	422.3	301.1	144.7	56.6	29.3	25.8	12.1	12.6	3.4	1.4
18.1	450.3	375.4	175.1	54.8	116.1	95.9	59.1	12.4	16	7.7	2.9	4.4	19.2

UK >40 BT BT EFFORT & ALL TRAWLS AGE COMP DE-RAISED

1981	1998													
1	1	0	1											
2	15													
2.27	41.5	31.2	6.7	25.7	8.5	1.9	2.3	1.6	0.3	0.4	0.8	0.1	0	2.8
4.17	17.2	137.2	10.1	3.3	14.1	1.8	1.8	1.9	4.5	1.1	0	0.1	0.1	2.3
2.66	18.5	38.4	118.6	2	2.8	6.9	4.4	0.3	0	0	0	0	1.7	1.3
2.88	42.6	34.8	26.1	30.1	2.6	1.1	0.7	0.6	0.4	0.1	0.1	0.1	0.3	1.5
9.11	12.8	295	43.8	21.9	79.8	0.3	0.1	4.9	0	0.1	0.5	1.8	0.5	0.5
12.92	38.4	185.4	128.7	35.9	36.9	50.5	1.5	3.1	6.7	3.3	3.6	2	2.2	6.8
24.27	362	152.3	206.4	142.6	26.8	21	54.1	2.1	0.6	4.8	1.5	2.2	4.7	3.5
18.98	145.2	402.6	81.8	94.4	61.4	13.4	17.6	25.6	2.6	0.4	6.7	7.1	0	0.3
33.29	310	186.9	369.7	44	81.7	60.5	12.7	10.8	42.6	2.5	1.1	5	6.8	34.5
33.39	199.8	662.3	97.2	146.7	29.1	34.2	34.7	8.7	15	48.6	4.1	1.1	6.8	17.7
30.38	488.9	200.3	287.8	12.3	45.9	7.5	11	16.3	4.1	2.7	12.7	0.4	0	7.4
37.1	332.3	684.6	105.6	215.2	15	26.1	8.2	19	6.6	3	1.9	4.2	0.1	3.3
29.32	272.1	358.5	357.3	56.9	86.8	8.6	17.7	7.4	5	5.5	1.9	2.1	3.5	4.6
28.13	49.6	394	217.4	170	41.6	68.3	6.7	15.8	4.9	5.9	5.5	3.6	2.4	13.9
28.6	229.9	136.3	291.6	140.5	124.3	24.4	51.3	7.2	13.1	2.6	5.9	6.1	1.2	10.8
39.1	446	376	118.1	251.3	127.7	101.8	26.3	50.5	6.3	13.5	6.3	8	5.4	18.2
39.6	427.3	504.4	239.9	64.2	180.2	75.3	71	16.6	33.1	4	10.4	1.7	5.4	12.1
33.5	527.5	337.9	185.8	125.1	41.7	94.1	54.3	43	10.8	22.9	4	10.2	2.8	17.5

FR OT New New Series 1991-98; Effort Hr*KW*10-4; 1985-92 Deraised; 1993-98 True Age Comp

1985	1998													
1	1	0	1											
2	15													
6997	419.1	406.3	150.4	87.7	146.3	10.6	15.5	9.8	4.8	1	1.2	0.1	0.8	1.7
8480	121.7	402.1	237.7	62.1	51.6	74.3	15.5	16.2	14.5	10.4	1.9	0.7	1	7.5
6609	239.2	446	294.9	129.7	93.5	120.6	68.3	11.7	11.4	4.4	3.6	4.9	1.4	5.2
7006	303	907.2	201.5	87.8	68.7	39.1	26.5	10.6	5.4	6.2	3.9	3.4	1.3	6.2
6983	534	424.2	545.8	113.3	73.3	41.3	21.8	18.9	21.7	4.6	5.2	5.6	3.6	8.8
8395	221.2	389.2	102	115.1	22.7	19	17.5	10.5	10.8	11.3	6.7	6.4	4	6.4
10689	554.1	121.1	138.9	26.8	32.3	9.8	7.9	9.2	3.4	3.8	3.5	0.5	0.9	4.1
10519	301.7	528.1	57.4	43	10.5	13.5	5.3	4.5	3.2	3.9	1.7	1.3	0.5	2.1
10217	400.4	397.8	243.6	36.8	12	5.4	4.8	3.3	1.7	0.6	0.3	0.2	0	0.2
10609	35.8	328	288	142.7	22.4	14.9	4.5	5	2.5	1.6	0.9	0.8	1.2	3.2
12384	163.1	292	223.2	138	87.6	18.1	6.4	3.6	3.9	3.2	3.2	0.8	0.4	6.6
14088	61.2	558.6	189.7	141.3	108.8	62.5	16.4	8.7	7.8	4	5.6	3.1	2.9	8.2
10921	21.3	164.6	164.1	79.6	42.6	30.8	31.5	12.6	2.9	4.3	2.7	0.7	1.4	3.2
11707	3.1	497.5	136.2	81.3	41.5	21.3	21.6	20.7	16.8	3.7	3.5	0.7	1.1	2.3

Table 8.4.1b (continued) Sole in VIId. Tuning fleets for final XSA

ENGLISH BTS Beam Trawl Survey (Age 6 not plus gp)

1988	1998					
1	1	0.5	0.75			
1	6					
1	8.2	14.2	9.9	0.8	1.3	0.6
1	2.6	15.4	3.4	1.7	0.6	0.2
1	12.1	3.7	3.4	0.7	0.8	0.2
1	8.9	22.8	2.2	2.3	0.3	0.5
1	1.4	12	10	0.7	1.1	0.3
1	0.5	17.5	8.4	7	0.8	1
1	4.7	3.2	8.3	3.3	3.3	0.2
1	3.5	10.6	1.5	2.3	1.2	1.1
1	3.5	7.4	3.8	0.7	1.3	0.9
1	19	7.3	3.2	1.3	0.25	0.5
1	1.95	21.23	2.45	0.99	0.91	0.12

ENGLISH YFS

1985	1998		
1	1	0.5	0.75
1	1		
1	1.84		
1	1.67		
1	1.72		
1	2.66		
1	0.98		
1	3.37		
1	6.8		
1	2.22		
1	1.73		
1	3.94		
1	4.27		
1	1.58		
1	2.2		
1	3.33		

FRENCH YFS

1987	1998		
1	1	0.5	0.75
1	1		
1	0.07		
1	0.17		
1	0.14		
1	0.54		
1	0.38		
1	0.22		
1	0.03		
1	0.7		
1	0.28		
1	0.15		
1	0.03		
1	0.11		

Table 8.4.1c Sole in VIId Tuning output from final XSA

Lowestoft VPA Version 3.1 (run: XSARIC07/X07)

15/10/1999 12:46

Extended Survivors Analysis

107D SOL WGNSSK98

CPUE data from file s7deff3.vpa

Catch data for 17 years. 1982 to 1998. Ages 1 to 11.

Fleet	Firs	Last year	First year	Last age	Alpha age	Beta
BELGIAN BT	1986	1998	2	10	0	1
UK >40 BT	1986	1998	2	10	0	1
FR OT New	1991	1998	3	10	0	1
ENGLISH BTS	1988	1998	1	6	0.5	0.75
ENGLISH YFS	1986	1998	1	1	0.5	0.75
FRENCH YFS	1987	1998	1	1	0.5	0.75

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 4 years or the 4 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 48 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Table 8.4.1c (cont)

Fishing mortalities

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.01	0.029	0.011	0.003	0.005	0.001	0.033	0.001	0.001	0.003
2	0.174	0.233	0.208	0.14	0.192	0.054	0.13	0.118	0.101	0.077
3	0.667	0.444	0.441	0.373	0.318	0.354	0.444	0.529	0.569	0.51
4	0.693	0.485	0.547	0.363	0.385	0.476	0.434	0.541	0.708	0.477
5	0.703	0.474	0.387	0.486	0.316	0.382	0.413	0.521	0.81	0.484
6	0.48	0.277	0.522	0.306	0.244	0.272	0.358	0.426	0.53	0.538
7	0.431	0.373	0.322	0.34	0.261	0.342	0.252	0.369	0.367	0.321
8	0.38	0.312	0.353	0.26	0.276	0.243	0.259	0.263	0.373	0.28
9	0.355	0.391	0.47	0.408	0.341	0.305	0.298	0.461	0.349	0.266
10	0.413	0.449	0.452	0.273	0.227	0.42	0.334	0.602	0.457	0.604

Standard error of the weighted Log(VPA populations) :

0.4055	0.3786	0.3759	0.4619	0.4784	0.5096	0.5097	0.4865	0.4492	0.3908

Log catchability residuals.

Fleet : BEI BT (HP CORRE

Age	1986	1987	1988
1	No data for this fleet at this age		
2	0.3	0.84	-0.48
3	0.66	-0.29	-0.51
4	0.13	0.31	-0.79
5	-0.22	0.42	-0.36
6	-0.15	0.84	-0.31
7	-0.19	0.47	-0.14
8	-0.19	-0.04	-0.95
9	0.34	-0.03	-0.62
10	0.21	1.31	0.82

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	-2.3	1.4	-0.51	0.22	1.58	-0.01	-0.51	0.05	-0.53	-0.05
3	-0.09	0.04	0.76	0	0.17	-0.07	-0.33	-0.16	0.18	-0.36
4	-0.44	-0.19	0.1	0.31	-0.12	0.5	-0.33	0.27	0.23	0.02
5	0.85	-0.17	-0.18	0.22	-0.24	0.09	-0.23	-0.17	0.39	-0.43
6	0.24	-0.26	0.67	-0.57	-0.73	0.26	-0.05	0.03	0.24	-0.21
7	0.17	0.47	-0.12	-0.25	-0.17	0.13	-0.28	0	0.02	-0.11
8	-0.31	-0.43	-0.1	-0.39	-0.25	0.09	-0.93	-0.34	-0.53	-0.16
9	-0.57	0.03	-0.86	-0.1	0.4	-0.15	-0.07	0.15	-0.34	-0.47
10	-1.87	-0.39	0.09	-0.91	-0.61	0.97	-0.69	0.73	-0.48	-0.76

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
Mean Log	-7.3835	-5.7974	-5.6984	-5.5031	-5.7824	-5.6521	-5.6521	-5.6521	-5.6521
S.E(Log q)	0.9845	0.3748	0.3616	0.374	0.4529	0.248	0.4774	0.4196	0.9147

Table 8.4.1c (cont)

Regression statistics :

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	1.07	-0.091	7.2	0.13	13	1.1	-7.38
3	1.07	-0.225	5.53	0.5	13	0.42	-5.8
4	0.84	0.865	6.25	0.72	13	0.31	-5.7
5	1.06	-0.255	5.31	0.6	13	0.41	-5.5
6	0.85	0.673	6.1	0.65	13	0.4	-5.78
7	0.94	0.463	5.77	0.83	13	0.24	-5.65
8	1.13	-0.674	5.87	0.71	13	0.36	-6
9	1.69	-1.968	5.36	0.42	13	0.57	-5.83
10	-2.44	-2.914	6.58	0.06	13	1.74	-5.77
1							

Fleet : UK >40 BT BT EFFO

Age	1986	1987	1988
1	No data for this fleet at this age		
2	-0.46	0.47	0.7
3	0.39	-0.02	0.54
4	0.35	0.43	0.12
5	0.11	0.51	0.6
6	0.19	-0.32	0.42
7	0.59	-0.29	-0.02
8	-1.06	0.57	0.43
9	-0.37	-0.87	0.56
10	0.08	-2.02	0.16

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	0.01	0.05	0.05	-0.34	-0.24	-1.26	-0.2	0.42	0.37	0.44
3	0.22	0.46	-0.14	-0.14	-0.42	-0.17	-0.64	-0.32	0.24	-0.01
4	0.53	0.19	0.25	-0.53	-0.13	-0.44	-0.05	-0.57	-0.13	-0.02
5	-0.31	0.42	-1.12	0.5	-0.35	-0.23	-0.23	0.18	-0.31	0.22
6	0.37	-0.16	-0.09	-0.72	0.26	-0.27	-0.13	-0.16	0.42	0.18
7	0.46	0.15	-0.89	-0.19	-0.53	0.58	-0.33	-0.05	-0.08	0.6
8	-0.13	0.38	-0.42	-0.61	0.07	-0.38	0.68	-0.21	0.05	0.19
9	-0.18	-0.03	0.2	0.4	-0.08	0.38	0.04	0.8	-0.28	0.14
10	0.95	0.65	-0.17	-0.43	-0.27	0.02	0.6	0.13	0.93	0.02

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
Mean Log	-7.7507	-7.0406	-6.9821	-7.1041	-7.062	-7.1871	-7.1871	-7.1871	-7.1871
S.E(Log q)	0.5186	0.354	0.358	0.485	0.3398	0.4655	0.5035	0.4423	0.76

Table 8.4.1c (cont)

Regression statistics :

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	1.01	-0.033	7.72	0.37	13	0.55	-7.75
3	1.19	-0.594	6.55	0.48	13	0.43	-7.04
4	1.13	-0.525	6.69	0.58	13	0.42	-6.98
5	0.73	1.34	7.49	0.69	13	0.34	-7.1
6	0.81	1.263	7.23	0.8	13	0.27	-7.06
7	0.67	2.212	7.31	0.8	13	0.27	-7.19
8	0.62	2.912	7.14	0.84	13	0.24	-7.22
9	0.68	1.996	6.93	0.78	13	0.27	-7.13
10	0.63	1.149	6.72	0.47	13	0.47	-7.14
1							

Fleet : FR OT New New Serie

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	99.99	99.99	-0.41	0.05	-0.08	-0.19	0.14	0.28	-0.4	0.61
4	99.99	99.99	-0.06	-0.5	-0.08	0.19	-0.11	0.31	0.16	0.1
5	99.99	99.99	0.08	-0.46	-0.35	-0.04	-0.03	0.01	0.58	0.22
6	99.99	99.99	0.26	-0.16	-1.01	-0.26	0.01	0.36	-0.08	0.88
7	99.99	99.99	0.16	0.15	-0.2	-0.23	-0.05	0.22	0.06	-0.1
8	99.99	99.99	0.03	-0.05	-0.45	-0.07	-0.83	0.08	0.26	0.06
9	99.99	99.99	0.41	-0.04	-0.1	-0.05	-0.08	-0.2	0.47	0.19
10	99.99	99.99	0.43	-0.15	-0.56	0.07	-0.04	1.1	-0.48	1.25

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9	10
Mean Log	-13.1318	-13.2659	-13.3932	-13.6237	-13.8334	-13.8334	-13.8334	-13.8334
S.E(Log q)	0.3479	0.25	0.3229	0.5447	0.1704	0.3716	0.2632	0.7111

Regression statistics :

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
3	0.89	0.308	12.76	0.56	8	0.33	-13.13
4	0.89	0.472	12.84	0.76	8	0.24	-13.27
5	1.11	-0.451	13.92	0.73	8	0.38	-13.39
6	1.09	-0.238	14.15	0.52	8	0.64	-13.62
7	0.93	0.679	13.39	0.94	8	0.16	-13.83
8	0.89	0.526	13.17	0.78	8	0.33	-13.95
9	0.83	1.109	12.5	0.87	8	0.2	-13.76
10	1.4	-0.33	16.72	0.1	8	1.02	-13.63

Table 8.4.1c (cont)

Fleet : ENGLISH BTS Beam Tr

Age	1986	1987	1988
1	99.99	99.99	0.65
2	99.99	99.99	1.12
3	99.99	99.99	0.77
4	99.99	99.99	-0.11
5	99.99	99.99	0.53
6	99.99	99.99	0.29
7	No data for this fleet at this age		
8	No data for this fleet at this age		
9	No data for this fleet at this age		
10	No data for this fleet at this age		

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-0.05	0.51	0.43	-1.37	-1.7	0.05	0.02	0.05	1.43	0
2	0.31	-0.63	0.2	-0.26	0.2	-0.88	-0.13	-0.23	-0.23	0.52
3	0.74	-0.32	-0.25	0.22	0.17	0.28	-0.81	-0.25	-0.13	-0.43
4	0.16	0.23	0.32	-0.48	0.77	0.17	-0.08	-0.55	-0.16	-0.27
5	0.23	0.01	-0.15	0.13	0.03	0.44	-0.36	-0.12	-0.83	0.1
6	-0.55	-0.08	0.39	0.54	0.72	-0.72	0.06	0.12	-0.2	-0.57
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6
Mean Log	-8.6871	-7.5114	-7.9459	-8.3656	-8.307	-8.5574
S.E(Log q)	0.8774	0.5544	0.4889	0.3811	0.3749	0.4759

Regression statistics :

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
1	0.62	0.834	9.23	0.35	11	0.55	-8.69
2	1.04	-0.078	7.42	0.32	11	0.61	-7.51
3	0.97	0.065	7.99	0.41	11	0.5	-7.95
4	0.77	1.331	8.54	0.79	11	0.28	-8.37
5	0.94	0.289	8.32	0.69	11	0.37	-8.31
6	0.97	0.094	8.54	0.6	11	0.49	-8.56
1							

Fleet : ENGLISH YFS

Age	1986	1987	1988
1	-0.53	0.34	-0.06
2	No data for this fleet at this age		
3	No data for this fleet at this age		
4	No data for this fleet at this age		
5	No data for this fleet at this age		
6	No data for this fleet at this age		
7	No data for this fleet at this age		
8	No data for this fleet at this age		
9	No data for this fleet at this age		
10	No data for this fleet at this age		

Table 8.4.1c (cont)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-0.62	-0.36	0.57	-0.5	-0.05	0.28	0.63	-0.34	-0.31	0.95
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1
Mean Log	-9.0989
S.E(Log q)	0.506

Regression statistics :

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
1	1.83	-1.328	8.29	0.19	13	0.9	-9.1
1							

Fleet : FRENCH YFS

Age	1986	1987	1988
1	99.99	-0.11	-0.07
2	No data for this fleet at this age		
3	No data for this fleet at this age		
4	No data for this fleet at this age		
5	No data for this fleet at this age		
6	No data for this fleet at this age		
7	No data for this fleet at this age		
8	No data for this fleet at this age		
9	No data for this fleet at this age		
10	No data for this fleet at this age		

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.18	0.55	0.43	-0.06	-1.35	1.3	0.65	0.05	-1.86	0.28
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1
Mean Log	-11.8456
S.E(Log q)	0.8547

Regression statistics :

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
1	0.76	0.502	11.42	0.31	12	0.67	-11.85

Table 8.4.1c (cont)

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1997

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	1	0	0	0	0	0	0
UK >40 BT	1	0	0	0	0	0	0
FR OT New	1	0	0	0	0	0	0
ENGLISH BTS	11116	0.916	0	0	1	0.118	0.004
ENGLISH YFS	28654	0.525	0	0	1	0.359	0.001
FRENCH YFS	14757	0.89	0	0	1	0.125	0.003

F shrinka	4334	0.5	0.398	0.009

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
11129	0.31	0.6	4	1.898	0.003

1

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	20654	1.022	0	0	1	0.054	0.08
UK >40 BT	33444	0.538	0	0	1	0.194	0.05
FR OT New	1	0	0	0	0	0	0
ENGLISH BTS	47182	0.49	0.414	0.85	2	0.235	0.036
ENGLISH YFS	15879	0.525	0	0	1	0.204	0.103
FRENCH YFS	3376	0.89	0	0	1	0.071	0.413

F shrinka	16244	0.5	0.243	0.101

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
21646	0.24	0.29	7	1.221	0.077

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	5833	0.364	0.055	0.15	2	0.17	0.676
UK >40 BT	9378	0.304	0.176	0.58	2	0.239	0.471
FR OT New	15572	0.369	0	0	1	0.167	0.309
ENGLISH BTS	6322	0.354	0.117	0.33	3	0.173	0.638
ENGLISH YFS	6053	0.525	0	0	1	0.074	0.658
FRENCH YFS	8959	0.89	0	0	1	0.026	0.488

F shrinka	9265	0.5	0.151	0.475

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
8487	0.16	0.11	11	0.717	0.51

Table 8.4.1c (cont)

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	4836	0.272	0.054	0.2	3	0.191	0.45
UK >40 BT	5083	0.246	0.116	0.47	3	0.223	0.432
FR OT New	4327	0.24	0.224	0.93	2	0.258	0.492
ENGLISH BTS	3604	0.277	0.046	0.17	4	0.179	0.567
ENGLISH YFS	8408	0.525	0	0	1	0.03	0.283
FRENCH YFS	8596	0.89	0	0	1	0.01	0.277

F shrinka	3822	0.5	0.109	0.542

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
4494	0.12	0.06	15	0.502	0.477

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	2197	0.244	0.166	0.68	4	0.21	0.566
UK >40 BT	2577	0.243	0.123	0.51	4	0.18	0.501
FR OT New	3308	0.213	0.03	0.14	3	0.276	0.41
ENGLISH BTS	2639	0.249	0.067	0.27	5	0.202	0.491
ENGLISH YFS	3572	0.525	0	0	1	0.016	0.384
FRENCH YFS	9894	0.89	0	0	1	0.005	0.156

F shrinka	2374	0.5	0.111	0.534

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
2692	0.12	0.06	19	0.506	0.484

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	896	0.242	0.146	0.61	5	0.202	0.525
UK >40 BT	769	0.23	0.201	0.87	5	0.257	0.591
FR OT New	1491	0.218	0.146	0.67	4	0.208	0.347
ENGLISH BTS	434	0.247	0.086	0.35	6	0.188	0.886
ENGLISH YFS	829	0.525	0	0	1	0.011	0.558
FRENCH YFS	224	0.89	0	0	1	0.004	1.325

F shrinka	1267	0.5	0.131	0.398

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
869	0.12	0.11	23	0.911	0.538

Table 8.4.1c (cont)

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	1525	0.198	0.089	0.45	6	0.288	0.342
UK >40 BT	2269	0.209	0.124	0.59	6	0.209	0.242
FR OT New	1507	0.191	0.023	0.12	5	0.298	0.346
ENGLISH BTS	1466	0.226	0.105	0.46	6	0.111	0.354
ENGLISH YFS	998	0.525	0	0	1	0.007	0.485
FRENCH YFS	1541	0.89	0	0	1	0.003	0.339
F shrinka	1573	0.5				0.084	0.333

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
1643	0.1	0.05	26	0.483	0.321

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1990

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	1454	0.185	0.073	0.39	7	0.278	0.28
UK >40 BT	1307	0.201	0.086	0.43	7	0.218	0.307
FR OT New	1566	0.175	0.042	0.24	6	0.323	0.262
ENGLISH BTS	1404	0.222	0.112	0.5	6	0.091	0.289
ENGLISH YFS	2576	0.525	0	0	1	0.006	0.168
FRENCH YFS	2244	0.89	0	0	1	0.002	0.19
F shrinka	1425	0.5				0.081	0.285

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
1455	0.1	0.03	29	0.351	0.28

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1989

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	982	0.18	0.092	0.51	8	0.262	0.323
UK >40 BT	1217	0.197	0.046	0.23	8	0.216	0.268
FR OT New	1445	0.161	0.043	0.27	7	0.376	0.231
ENGLISH BTS	1772	0.22	0.116	0.53	6	0.065	0.192
ENGLISH YFS	855	0.525	0	0	1	0.004	0.364
FRENCH YFS	2136	0.89	0	0	1	0.002	0.162
F shrinka	882	0.5				0.075	0.354

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
1227	0.1	0.05	32	0.489	0.266

Table 8.4.1c (cont)

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1988

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BELGIAN BT	238	0.17	0.121	0.71	9	0.249	0.696
UK >40 BT	223	0.184	0.049	0.26	9	0.217	0.727
FR OT New	337	0.151	0.172	1.14	8	0.349	0.535
ENGLISH BTS	201	0.219	0.139	0.64	6	0.069	0.784
ENGLISH YFS	155	0.525	0	0	1	0.004	0.932
FRENCH YFS	345	0.89	0	0	1	0.002	0.526
F shrinka	565	0.5				0.11	0.352

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
288	0.1	0.08	35	0.814	0.604

Table 8.4.2

Run title : 107D SOLE (run: XSARIC07/ X07)

WGNSSK98 1-15+ 80-98 SEXES COMB

At 15/10/1999 12:47

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988
AGE							
1	.0126	.0000	.0011	.0038	.0019	.0008	.0037
2	.1826	.0798	.1094	.2143	.1154	.1521	.2518
3	.3134	.3440	.4160	.4105	.4854	.5264	.5252
4	.4704	.3627	.4202	.3528	.4343	.5776	.4001
5	.2114	.4228	.2660	.2577	.3048	.5072	.3685
6	.2404	.4087	.6560	.4000	.2875	.6034	.3664
7	.4575	.3403	.4260	.2217	.3823	.7282	.4219
8	.4115	.4924	.2568	.2268	.3526	.4976	.3367
9	.3335	.2919	.3385	.1734	.4184	.4178	.2757
10	.3618	.3845	.4207	.2561	.3422	.6684	.5487
+gp	.3618	.3845	.4207	.2561	.3422	.6684	.5487
FBAR 3- 8	.3508	.3951	.4068	.3116	.3745	.5734	.4031

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98	FBAR 94-98
AGE												
1	.0099	.0289	.0110	.0032	.0052	.0013	.0329	.0005	.0011	.0035	.0017	.0079
2	.1739	.2334	.2085	.1395	.1919	.0542	.1304	.1179	.1008	.0767	.0985	.0960
3	.6666	.4439	.4412	.3729	.3179	.3537	.4442	.5288	.5686	.5095	.5356	.4810
4	.6932	.4853	.5471	.3632	.3848	.4761	.4343	.5408	.7084	.4773	.5755	.5274
5	.7028	.4741	.3875	.4862	.3164	.3825	.4133	.5213	.8099	.4836	.6049	.5221
6	.4796	.2774	.5218	.3062	.2435	.2725	.3576	.4262	.5302	.5381	.4982	.4249
7	.4306	.3733	.3215	.3402	.2607	.3420	.2517	.3688	.3672	.3211	.3524	.3301
8	.3799	.3115	.3532	.2603	.2764	.2429	.2586	.2629	.3728	.2799	.3052	.2834
9	.3550	.3906	.4700	.4082	.3407	.3052	.2980	.4609	.3485	.2665	.3586	.3358
10	.4129	.4489	.4519	.2730	.2268	.4198	.3345	.6021	.4570	.6043	.5545	.4836
+gp	.4129	.4489	.4519	.2730	.2268	.4198	.3345	.6021	.4570	.6043		
FBAR 3- 8	.5588	.3943	.4287	.3548	.3000	.3449	.3599	.4415	.5595	.4349		

Table 8.4.3

Run title : 107D SOLE (run: XSARIC07/ X07)

WGNSSK98 1-15+ 80-98 SEXES COMB

At 15/10/1999 12:47

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1982	1983	1984	1985	1986	1987	1988
AGE							
1	13063	22171	22271	13526	27101	11633	27062
2	16538	11673	20061	20129	12192	24475	10517
3	20537	12467	9752	16272	14701	9830	19022
4	4838	13583	7997	5821	9766	8187	5254
5	3145	2735	8552	4753	3701	5724	4157
6	3212	2303	1621	5931	3324	2469	3119
7	1572	2285	1385	761	3597	2256	1222
8	748	900	1472	819	552	2221	986
9	452	448	498	1030	590	351	1222
10	287	293	303	321	784	352	209
+gp	697	633	726	594	1378	1005	704
TOTAL	65090	69492	74637	69956	77685	68502	73473

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 82-96	AMST 82-96
AGE													
1	17426	46904	36814	34886	17318	28295	22186	21103	28577	12342*	0**	22399	24117
2	24396	15613	41231	32947	31465	15589	25570	19425	19084	25829	11129***	19919	21455
3	7398	18551	11186	30287	25929	23501	13361	20308	15622	15613	21646	15688	16873
4	10180	3437	10768	6511	18875	17073	14929	7754	10828	8005	8487	8670	9665
5	3186	4605	1914	5638	4097	11623	9596	8750	4085	4825	4494	4853	5478
6	2602	1428	2594	1176	3137	2702	7175	5744	4701	1645	2692	2865	3236
7	1956	1458	979	1393	783	2225	1862	4540	3393	2503	869	1668	1885
8	725	1151	908	642	897	546	1430	1310	2841	2127	1643	946	1020
9	637	449	763	577	448	616	388	999	911	1771	1455	589	631
10	839	404	275	431	347	288	410	260	570	582	1227	358	387
+gp	1019	1610	1137	1040	750	849	910	867	850	816	691		
TOTAL	70365	95609	108570	115527	104046	103307	97817	91059	91463	76058	54333		

- replaced by 22660 calculated from RCT3 estimate of 2 yr olds in 1999

** replaced by RCT3 estimate 36943

*** replaced by RCT3 estimate 18990

Table 8.5.1a Sole in VIId. Survey indices of recruitment

	English YFS		French YFS	
Year class	0 gp	1 gp	0 gp	1 gp
1980		8.31	2.34	1.33
1981	5.66	1.28	3.33	0.07
1982	5.32	2.16	1.04	0.02
1983	26.18	4.49	0.79	-
1984	3.35	1.84	-	-
1985	8.54	1.67	-	-
1986	7.49	1.72	-	0.07
1987	15.14	2.66	0.75	0.17
1988	5.67	0.98	0.04	0.14
1989	8.04	3.37	17.43	0.54
1990	9.47	6.80	0.57	0.38
1991	3.40	2.22	1.04	0.22
1992	4.00	1.73	0.48	0.03
1993	17.02	3.94	0.27	0.70
1994	12.06	4.20	4.04	0.28
1995	10.77	1.60	3.50	0.15
1996	4.08	2.20	0.28	0.03
1997	7.27	3.33	0.07	0.11
1998	13.93		10.52**	0.38*
MEAN	9.03	3.01	2.40	0.28

* preliminary estimate
** estimation for unsampled strata

Table 8.5.1b **Sole in VIId.** **Input data for RCT3**

7d Sole (1 year olds)

6	18	2					
1981	13063	5.66	1.28	3.33	0.07	-11	-11
1982	22171	5.32	2.16	1.04	0.02	-11	-11
1983	22271	26.18	4.49	0.79	-11	-11	-11
1984	13526	3.35	1.84	-11	-11	-11	-11
1985	27101	8.54	1.67	-11	-11	-11	-11
1986	11633	7.49	1.72	-11	0.07	-11	14.2
1987	27062	15.14	2.66	0.75	0.17	8.2	15.4
1988	17426	5.67	0.98	0.04	0.14	2.6	3.7
1989	46904	8.04	3.37	17.43	0.54	12.1	22.8
1990	36814	9.47	0.68	0.57	0.38	8.9	12
1991	34886	3.4	2.22	1.04	0.22	1.4	17.5
1992	17318	4	1.73	0.48	0.03	0.5	3.2
1993	28295	17.02	3.94	0.27	0.7	4.8	10.6
1994	22186	12.06	4.2	4.04	0.28	3.5	7.3
1995	21103	10.77	1.6	3.5	0.15	3.5	7.3
1996	-11	4.08	2.2	0.28	0.03	19	21.2
1997	-11	7.27	3.33	0.07	0.38	2	9
1998	-11	13.93	-11	10.52	-11	25.52	-11

7d Sole (2 year olds)

6	18	2					
1981	11673	5.66	1.28	3.33	0.07	-11	-11
1982	20061	5.32	2.16	1.04	0.02	-11	-11
1983	20129	26.18	4.49	0.79	-11	-11	-11
1984	12192	3.35	1.84	-11	-11	-11	-11
1985	24475	8.54	1.67	-11	-11	-11	-11
1986	10517	7.49	1.72	-11	0.07	-11	14.2
1987	24396	15.14	2.66	0.75	0.17	8.2	15.4
1988	15613	5.67	0.98	0.04	0.14	2.6	3.7
1989	41231	8.04	3.37	17.43	0.54	12.1	22.8
1990	32947	9.47	0.68	0.57	0.38	8.9	12
1991	31465	3.4	2.22	1.04	0.22	1.4	17.5
1992	15589	4	1.73	0.48	0.03	0.5	3.2
1993	25570	17.02	3.94	0.27	0.7	4.8	10.6
1994	19425	12.06	4.2	4.04	0.28	3.5	7.3
1995	19084	10.77	1.6	3.5	0.15	3.5	7.3
1996	-11	4.08	2.2	0.28	0.03	19	21.2
1997	-11	7.27	3.33	0.07	0.11	2	9
1998	-11	13.93	-11	10.52	0.38	25.52	-11

enyfs0
enyfs1
fyfs0
fyfs1
ebts1
ebts2

Table 8.5.2a Sole in VIId RCT3 estimate at age 1

```
Analysis by RCT3 ver3.1 of data from file :

s7drec1.csv

7d Sole (1 year olds)

Data for    6 surveys over   18 years :  1981 - 1998

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

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

Forecast/Hindcast variance correction used.


Yearclass =   1998

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error           Pts  Value   Value    Error   Weights

enyfs0    3.92   1.35   2.10   .038     15   2.70   11.95    2.563     .012
enyfs1
fyfs0,     .97   9.25    .84   .163     12   2.44   11.63    1.174     .056
fyfs1,    3.46   9.33    .44   .482     12    .32   10.44     .539     .265
ebts1      .74   9.02    .42   .441      9   3.28   11.45     .681     .166
ebts2,

                                       VPA Mean =   10.09     .391     .502


Year     Weighted      Log     Int     Ext     Var     VPA      Log
Class     Average      WAP     Std     Std    Ratio             VPA
         Prediction           Error   Error

1998      36943     10.52     .28     .29     1.07
```

Table 8.5.2b Sole in VIId RCT3 estimate at age 2

```
Analysis by RCT3 ver3.1 of data from file :

s7drec2.csv

7d Sole (2 year olds)

Data for    6 surveys over   18 years :  1981 - 1998

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

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

Forecast/Hindcast variance correction used.



Yearclass =   1997
```

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
enyfs0	3.62	1.91	1.93	.044	15	2.11	9.56	2.238	.010
enyfs1	1.68	7.82	.57	.344	15	1.47	10.29	.665	.114
frbds0	1.04	9.07	.89	.145	12	.07	9.14	1.119	.041
frbds1	3.48	9.22	.44	.485	12	.10	9.59	.533	.178
enbts1	.74	8.90	.42	.433	9	1.10	9.72	.526	.183
enbts2	1.06	7.50	.50	.422	10	2.30	9.95	.597	.142
					VPA Mean =		9.97	.391	.331

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1997	18990	9.85	.23	.10	.21		

Table 8.6.1 Sole in VIId VPA Summary

Run title : 107D SOLE (run: XSARIC07/ X07)

WGNSSK98 1-15+ 80-98 SEXES COMB

At 15/10/1999 12:47

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 8
1982	13063	10466	7810	3190	.4084	.3508
1983	22171	12803	9675	3458	.3574	.3951
1984	22271	13235	9115	3575	.3922	.4068
1985	13526	13773	10297	3837	.3726	.3116
1986	27101	14472	10917	4024	.3686	.3745
1987	11633	14061	9821	4974	.5065	.5734
1988	27062	13471	10012	3982	.3977	.4031
1989	17426	11857	7908	4187	.5295	.5588
1990	46904	14181	8790	4060	.4619	.3943
1991	36814	14816	7664	4382	.5718	.4287
1992	34886	17738	10459	4142	.3960	.3548
1993	17318	16308	12411	4511	.3635	.3000
1994	28295	16773	13010	4643	.3569	.3449
1995	22186	17445	11866	4583	.3862	.3599
1996	21103	16760	11886	5025	.4228	.4415
1997	28577	14518	10781	4983	.4622	.5595
1998	(12342)[1]	14506	9164	3694	.4031	.4349
1999	(36943)[2]	15485[3]	9854[3]			
Arith. Mean	23687	14540	10093	4191	.4210	.4113
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

1. Replaced by 22660 calculated from RCT3 estimate of age 2 in 1999
2. RCT3 estimate
3. Short Term Prediction

Table 8.7.1 Sole in Division VIId (Eastern English Channel)

Prediction with management option table: Input data

Year: 1999								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	36943.000	0.1000	0.0000	0.0000	0.0000	0.095	0.0079	0.138
2	18990.000	0.1000	0.0000	0.0000	0.0000	0.131	0.0960	0.161
3	21646.000	0.1000	1.0000	0.0000	0.0000	0.169	0.4810	0.181
4	8487.000	0.1000	1.0000	0.0000	0.0000	0.209	0.5274	0.233
5	4494.000	0.1000	1.0000	0.0000	0.0000	0.249	0.5221	0.283
6	2692.000	0.1000	1.0000	0.0000	0.0000	0.290	0.4249	0.335
7	869.000	0.1000	1.0000	0.0000	0.0000	0.333	0.3301	0.375
8	1643.000	0.1000	1.0000	0.0000	0.0000	0.377	0.2834	0.405
9	1455.000	0.1000	1.0000	0.0000	0.0000	0.422	0.3358	0.470
10	1227.000	0.1000	1.0000	0.0000	0.0000	0.468	0.4836	0.454
11+	691.000	0.1000	1.0000	0.0000	0.0000	0.606	0.4836	0.611
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	22400.000	0.1000	0.0000	0.0000	0.0000	0.095	0.0079	0.138
2	.	0.1000	0.0000	0.0000	0.0000	0.131	0.0960	0.161
3	.	0.1000	1.0000	0.0000	0.0000	0.169	0.4810	0.181
4	.	0.1000	1.0000	0.0000	0.0000	0.209	0.5274	0.233
5	.	0.1000	1.0000	0.0000	0.0000	0.249	0.5221	0.283
6	.	0.1000	1.0000	0.0000	0.0000	0.290	0.4249	0.335
7	.	0.1000	1.0000	0.0000	0.0000	0.333	0.3301	0.375
8	.	0.1000	1.0000	0.0000	0.0000	0.377	0.2834	0.405
9	.	0.1000	1.0000	0.0000	0.0000	0.422	0.3358	0.470
10	.	0.1000	1.0000	0.0000	0.0000	0.468	0.4836	0.454
11+	.	0.1000	1.0000	0.0000	0.0000	0.606	0.4836	0.611
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	.	0.1000	0.0000	0.0000	0.0000	0.095	0.0079	0.138
2	.	0.1000	0.0000	0.0000	0.0000	0.131	0.0960	0.161
3	.	0.1000	1.0000	0.0000	0.0000	0.169	0.4810	0.181
4	.	0.1000	1.0000	0.0000	0.0000	0.209	0.5274	0.233
5	.	0.1000	1.0000	0.0000	0.0000	0.249	0.5221	0.283
6	.	0.1000	1.0000	0.0000	0.0000	0.290	0.4249	0.335
7	.	0.1000	1.0000	0.0000	0.0000	0.333	0.3301	0.375
8	.	0.1000	1.0000	0.0000	0.0000	0.377	0.2834	0.405
9	.	0.1000	1.0000	0.0000	0.0000	0.422	0.3358	0.470
10	.	0.1000	1.0000	0.0000	0.0000	0.468	0.4836	0.454
11+	.	0.1000	1.0000	0.0000	0.0000	0.606	0.4836	0.611
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANRIC01
Date and time: 17OCT99:10:16

Table 8.7.2 Sole in Division VIId (Eastern English Channel)

Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4282	15845	9854	4087	0.0000	0.0000	15780	9304	0	17672	15010
.	.	.	.	.	0.0500	0.0214	.	9304	252	17414	14753
.	.	.	.	.	0.1000	0.0428	.	9304	499	17161	14501
.	.	.	.	.	0.1500	0.0642	.	9304	740	16913	14255
.	.	.	.	.	0.2000	0.0856	.	9304	976	16672	14014
.	.	.	.	.	0.2500	0.1070	.	9304	1207	16435	13778
.	.	.	.	.	0.3000	0.1284	.	9304	1433	16204	13548
.	.	.	.	.	0.3500	0.1499	.	9304	1654	15977	13323
.	.	.	.	.	0.4000	0.1713	.	9304	1871	15756	13102
.	.	.	.	.	0.4500	0.1927	.	9304	2083	15539	12887
.	.	.	.	.	0.5000	0.2141	.	9304	2290	15327	12676
.	.	.	.	.	0.5500	0.2355	.	9304	2493	15120	12469
.	.	.	.	.	0.6000	0.2569	.	9304	2692	14917	12268
.	.	.	.	.	0.6500	0.2783	.	9304	2887	14718	12070
.	.	.	.	.	0.7000	0.2997	.	9304	3077	14524	11877
.	.	.	.	.	0.7500	0.3211	.	9304	3264	14334	11688
.	.	.	.	.	0.8000	0.3425	.	9304	3447	14148	11503
.	.	.	.	.	0.8500	0.3639	.	9304	3625	13966	11322
.	.	.	.	.	0.9000	0.3853	.	9304	3801	13788	11145
.	.	.	.	.	0.9500	0.4067	.	9304	3972	13613	10971
.	.	.	.	.	1.0000	0.4282	.	9304	4140	13443	10802
.	.	.	.	.	1.0500	0.4496	.	9304	4305	13276	10636
.	.	.	.	.	1.1000	0.4710	.	9304	4466	13112	10473
.	.	.	.	.	1.1500	0.4924	.	9304	4624	12952	10314
.	.	.	.	.	1.2000	0.5138	.	9304	4778	12795	10158
.	.	.	.	.	1.2500	0.5352	.	9304	4930	12642	10006
.	.	.	.	.	1.3000	0.5566	.	9304	5078	12491	9857
.	.	.	.	.	1.3500	0.5780	.	9304	5223	12344	9711
.	.	.	.	.	1.4000	0.5994	.	9304	5366	12200	9567
.	.	.	.	.	1.4500	0.6208	.	9304	5505	12059	9427
.	.	.	.	.	1.5000	0.6422	.	9304	5642	11921	9290
.	.	.	.	.	1.5500	0.6636	.	9304	5776	11785	9156
.	.	.	.	.	1.6000	0.6850	.	9304	5908	11653	9024
.	.	.	.	.	1.6500	0.7064	.	9304	6036	11523	8896
.	.	.	.	.	1.7000	0.7279	.	9304	6163	11396	8769
.	.	.	.	.	1.7500	0.7493	.	9304	6286	11271	8646
.	.	.	.	.	1.8000	0.7707	.	9304	6408	11149	8525
.	.	.	.	.	1.8500	0.7921	.	9304	6526	11029	8406
.	.	.	.	.	1.9000	0.8135	.	9304	6643	10912	8290
.	.	.	.	.	1.9500	0.8349	.	9304	6757	10797	8176
.	.	.	.	.	2.0000	0.8563	.	9304	6869	10685	8065
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANRIC01
Date and time : 17OCT99:10:16
Computation of ref. F: Simple mean, age 3 - 8
Basis for 1999 : F factors

Table 8.7.3 Sole in Division VIId (Eastern English Channel)

Year: 1999	F-factor: 1.0000		Reference F: 0.4282			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0079	277	38	36943	3497	0	0	0	0
2	0.0960	1656	266	18990	2494	0	0	0	0
3	0.4810	7897	1427	21646	3665	21646	3665	21646	3665
4	0.5274	3325	775	8487	1771	8487	1771	8487	1771
5	0.5221	1747	494	4494	1119	4494	1119	4494	1119
6	0.4249	890	298	2692	782	2692	782	2692	782
7	0.3301	233	87	869	289	869	289	869	289
8	0.2834	387	157	1643	620	1643	620	1643	620
9	0.3358	396	186	1455	614	1455	614	1455	614
10	0.4836	450	204	1227	575	1227	575	1227	575
11+	0.4836	253	155	691	418	691	418	691	418
Total		17509	4087	99137	15845	43204	9854	43204	9854
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000	F-factor: 1.0000		Reference F: 0.4282			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0079	168	23	22400	2121	0	0	0	0
2	0.0960	2891	465	33164	4356	0	0	0	0
3	0.4810	5695	1029	15610	2643	15610	2643	15610	2643
4	0.5274	4743	1105	12107	2526	12107	2526	12107	2526
5	0.5221	1762	498	4532	1128	4532	1128	4532	1128
6	0.4249	798	267	2412	700	2412	700	2412	700
7	0.3301	427	160	1593	530	1593	530	1593	530
8	0.2834	133	54	565	213	565	213	565	213
9	0.3358	305	143	1120	473	1120	473	1120	473
10	0.4836	345	157	941	441	941	441	941	441
11+	0.4836	392	239	1070	648	1070	648	1070	648
Total		17658	4140	95515	15780	39950	9304	39950	9304
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001	F-factor: 1.0000		Reference F: 0.4282			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0079	168	23	22400	2121	0	0	0	0
2	0.0960	1753	282	20109	2641	0	0	0	0
3	0.4810	9945	1797	27262	4616	27262	4616	27262	4616
4	0.5274	3420	797	8731	1822	8731	1822	8731	1822
5	0.5221	2513	710	6465	1610	6465	1610	6465	1610
6	0.4249	804	269	2433	706	2433	706	2433	706
7	0.3301	383	143	1427	475	1427	475	1427	475
8	0.2834	244	99	1036	391	1036	391	1036	391
9	0.3358	105	49	385	163	385	163	385	163
10	0.4836	265	120	724	339	724	339	724	339
11+	0.4836	411	251	1122	679	1122	679	1122	679
Total		20012	4541	92094	15563	49585	10802	49585	10802
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRRIC01
Date and time : 17OCT99:10:14
Computation of ref. F: Simple mean, age 3 - 8
Prediction basis : F factors

Table 8.7.3 Continued

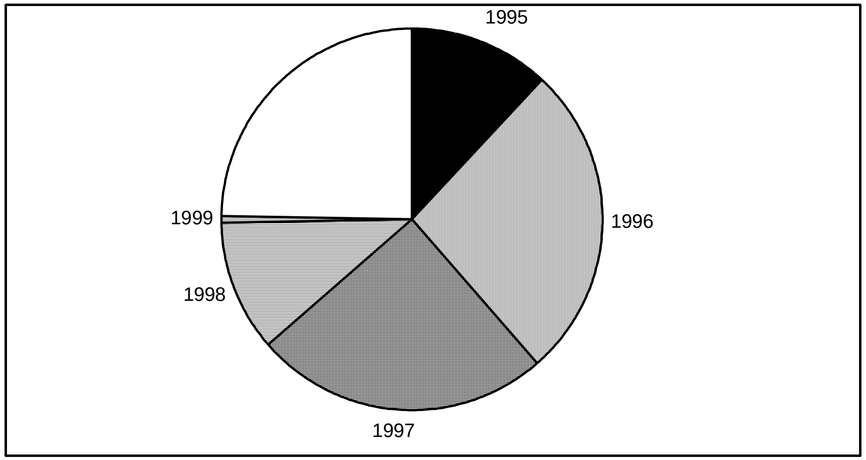
Table 8.7.3 **Sole in VIId**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	1995	1996	1997	1998	1999
Stock No. (thousands) of 1 year-olds	21103	28577	22660	36943	22400
Source	XSA	XSA	RCT3	RCT3	GM
Status Quo F:					
% in 1999 landings	19.0	34.9	6.5	0.9	-
% in 2000	12.0	26.7	24.9	11.2	0.6
% in 1999 SSB	18.0	37.2	0.0	0.0	-
% in 2000 SSB	12.1	27.2	28.4	0.0	0.0
% in 2001 SSB	6.5	14.9	16.9	42.7	0.0

GM : geometric mean recruitment

Sole in VIId : Year-class % contribution to

a) 2000 landings



b) 2001 SSB

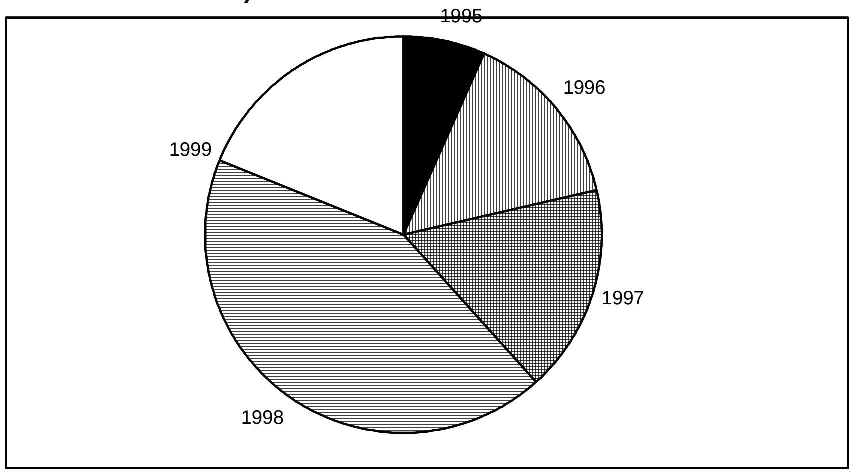


Table 8.7.4 Sole in VIId

Input data for catch forecast and linear sensitivity analysis.

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	36943	.40	WS1	.09	.33	M1	.10	.10	MT1	.00	.00
N2	18990	.60	WS2	.13	.17	M2	.10	.10	MT2	.00	.10
N3	21646	.29	WS3	.17	.08	M3	.10	.10	MT3	1.00	.10
N4	8486	.16	WS4	.21	.02	M4	.10	.10	MT4	1.00	.00
N5	4493	.12	WS5	.25	.01	M5	.10	.10	MT5	1.00	.00
N6	2691	.12	WS6	.29	.04	M6	.10	.10	MT6	1.00	.00
N7	867	.12	WS7	.33	.07	M7	.10	.10	MT7	1.00	.00
N8	1642	.10	WS8	.38	.08	M8	.10	.10	MT8	1.00	.00
N9	1454	.10	WS9	.42	.10	M9	.10	.10	MT9	1.00	.00
N10	1226	.10	WS10	.47	.11	M10	.10	.10	MT10	1.00	.00
N11	691	.10	WS11	.61	.14	M11	.10	.10	MT11	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.01	1.85	WH1	.14	.03
sH2	.10	.38	WH2	.16	.04
sH3	.48	.09	WH3	.18	.04
sH4	.53	.08	WH4	.23	.01
sH5	.52	.12	WH5	.28	.03
sH6	.43	.16	WH6	.34	.03
sH7	.33	.17	WH7	.38	.03
sH8	.28	.07	WH8	.41	.01
sH9	.34	.23	WH9	.47	.07
sH10	.48	.23	WH10	.45	.04
sH11	.48	.23	WH11	.61	.05

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.20
K00	1.00	.10	HF00	1.00	.20
K01	1.00	.10	HF01	1.00	.20

Recruitment		
Labl	Value	CV
R00	22399	.40
R01	22399	.40

Proportion F before spawning= .00
Proportion M before spawning= .00

Stock numbers in 1999 are VPA survivors.
These are overwritten at Age 1 Age 2

Table 8.9.1 Sole in Division VIId (Eastern English Channel)

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.1000	0.0000	0.0000	0.0000	0.077	0.0079	0.115
2	.	0.1000	0.0000	0.0000	0.0000	0.127	0.0960	0.162
3	.	0.1000	1.0000	0.0000	0.0000	0.180	0.4810	0.202
4	.	0.1000	1.0000	0.0000	0.0000	0.230	0.5274	0.261
5	.	0.1000	1.0000	0.0000	0.0000	0.279	0.5221	0.314
6	.	0.1000	1.0000	0.0000	0.0000	0.326	0.4249	0.366
7	.	0.1000	1.0000	0.0000	0.0000	0.370	0.3301	0.412
8	.	0.1000	1.0000	0.0000	0.0000	0.413	0.2834	0.459
9	.	0.1000	1.0000	0.0000	0.0000	0.454	0.3358	0.484
10	.	0.1000	1.0000	0.0000	0.0000	0.492	0.4836	0.516
11+	.	0.1000	1.0000	0.0000	0.0000	0.592	0.4836	0.616
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

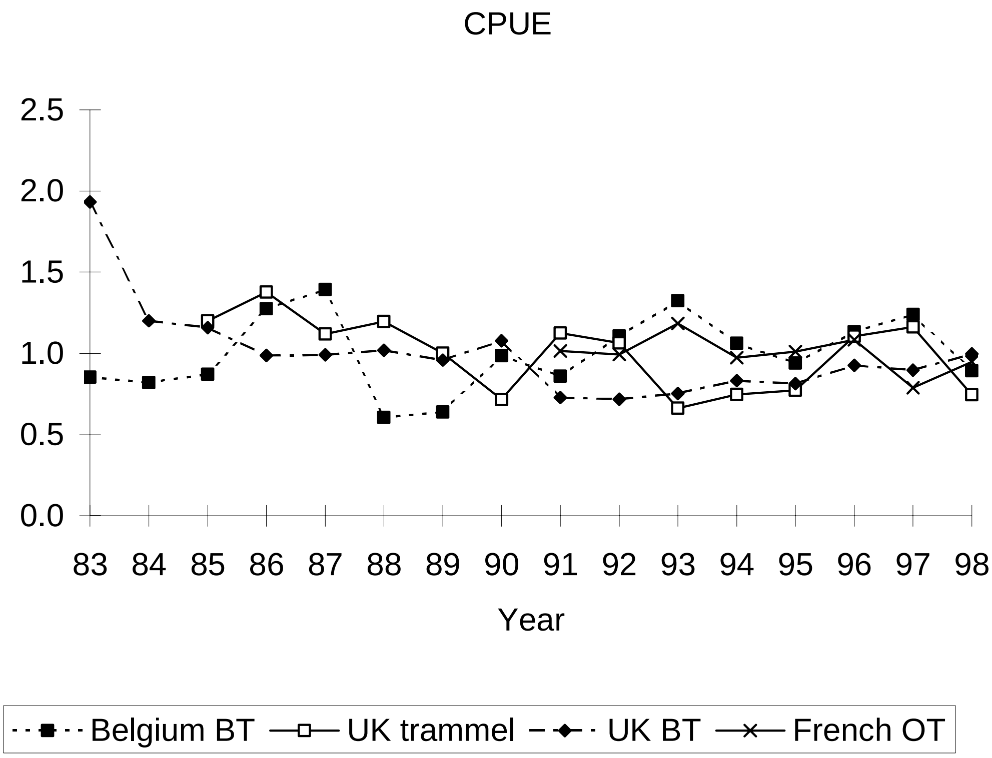
Notes: Run name : YLDRIC04
Date and time: 17OCT99:13:59

Table 8.9.2 Sole in Division VIId (Eastern English Channel)

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	3997.390	8.603	3804.882	8.603	3804.882
0.0500	0.0214	0.155	68.135	8.956	3146.642	7.051	2954.180	7.051	2954.180
0.1000	0.0428	0.262	109.026	7.892	2579.884	5.988	2387.467	5.988	2387.467
0.1500	0.0642	0.340	134.833	7.115	2177.381	5.211	1985.009	5.211	1985.009
0.2000	0.0856	0.399	151.632	6.520	1878.277	4.617	1685.951	4.617	1685.951
0.2500	0.1070	0.447	162.760	6.050	1648.371	4.147	1456.090	4.147	1456.090
0.3000	0.1284	0.485	170.181	5.668	1466.966	3.765	1274.731	3.765	1274.731
0.3500	0.1499	0.517	175.109	5.351	1320.810	3.449	1128.620	3.449	1128.620
0.4000	0.1713	0.544	178.324	5.085	1201.026	3.183	1008.882	3.183	1008.882
0.4500	0.1927	0.567	180.345	4.857	1101.448	2.955	909.349	2.955	909.349
0.5000	0.2141	0.586	181.524	4.660	1017.661	2.759	825.607	2.759	825.607
0.5500	0.2355	0.604	182.104	4.489	946.425	2.588	754.416	2.588	754.416
0.6000	0.2569	0.619	182.257	4.338	885.307	2.437	693.343	2.437	693.343
0.6500	0.2783	0.632	182.106	4.205	832.449	2.304	640.531	2.304	640.531
0.7000	0.2997	0.644	181.739	4.086	786.408	2.186	594.535	2.186	594.535
0.7500	0.3211	0.655	181.221	3.979	746.046	2.080	554.218	2.080	554.218
0.8000	0.3425	0.665	180.597	3.883	710.456	1.984	518.674	1.984	518.674
0.8500	0.3639	0.674	179.904	3.796	678.908	1.897	487.170	1.897	487.170
0.9000	0.3853	0.682	179.165	3.717	650.804	1.819	459.112	1.819	459.112
0.9500	0.4067	0.689	178.400	3.645	625.655	1.747	434.008	1.747	434.008
1.0000	0.4282	0.696	177.624	3.579	603.056	1.681	411.454	1.681	411.454
1.0500	0.4496	0.702	176.845	3.518	582.668	1.621	391.111	1.621	391.111
1.1000	0.4710	0.708	176.072	3.463	564.207	1.566	372.695	1.566	372.695
1.1500	0.4924	0.713	175.309	3.411	547.432	1.514	355.966	1.514	355.966
1.2000	0.5138	0.718	174.561	3.363	532.140	1.467	340.718	1.467	340.718
1.2500	0.5352	0.723	173.831	3.319	518.155	1.423	326.779	1.423	326.779
1.3000	0.5566	0.727	173.120	3.277	505.328	1.382	313.997	1.382	313.997
1.3500	0.5780	0.731	172.428	3.238	493.531	1.343	302.244	1.343	302.244
1.4000	0.5994	0.735	171.758	3.202	482.650	1.307	291.409	1.307	291.409
1.4500	0.6208	0.738	171.109	3.168	472.590	1.274	281.394	1.274	281.394
1.5000	0.6422	0.742	170.481	3.136	463.265	1.242	272.114	1.242	272.114
1.5500	0.6636	0.745	169.873	3.106	454.602	1.212	263.495	1.212	263.495
1.6000	0.6850	0.748	169.286	3.078	446.535	1.184	255.473	1.184	255.473
1.6500	0.7064	0.751	168.719	3.051	439.007	1.158	247.990	1.158	247.990
1.7000	0.7279	0.753	168.172	3.026	431.967	1.133	240.995	1.133	240.995
1.7500	0.7493	0.756	167.643	3.002	425.371	1.109	234.444	1.109	234.444
1.8000	0.7707	0.758	167.132	2.979	419.179	1.087	228.297	1.087	228.297
1.8500	0.7921	0.760	166.639	2.957	413.355	1.066	222.518	1.066	222.518
1.9000	0.8135	0.763	166.163	2.937	407.868	1.045	217.076	1.045	217.076
1.9500	0.8349	0.765	165.702	2.917	402.690	1.026	211.942	1.026	211.942
2.0000	0.8563	0.767	165.258	2.898	397.795	1.007	207.092	1.007	207.092
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDRIC04
Date and time : 17OCT99:13:59
Computation of ref. F: Simple mean, age 3 - 8
F-0.1 factor : 0.2520
F-max factor : 0.5974
F-0.1 reference F : 0.1079
F-max reference F : 0.2558
Recruitment : Single recruit

Figure 8.3.1 Sole in VIId. Trends in cpue and effort for the main commercial fleets



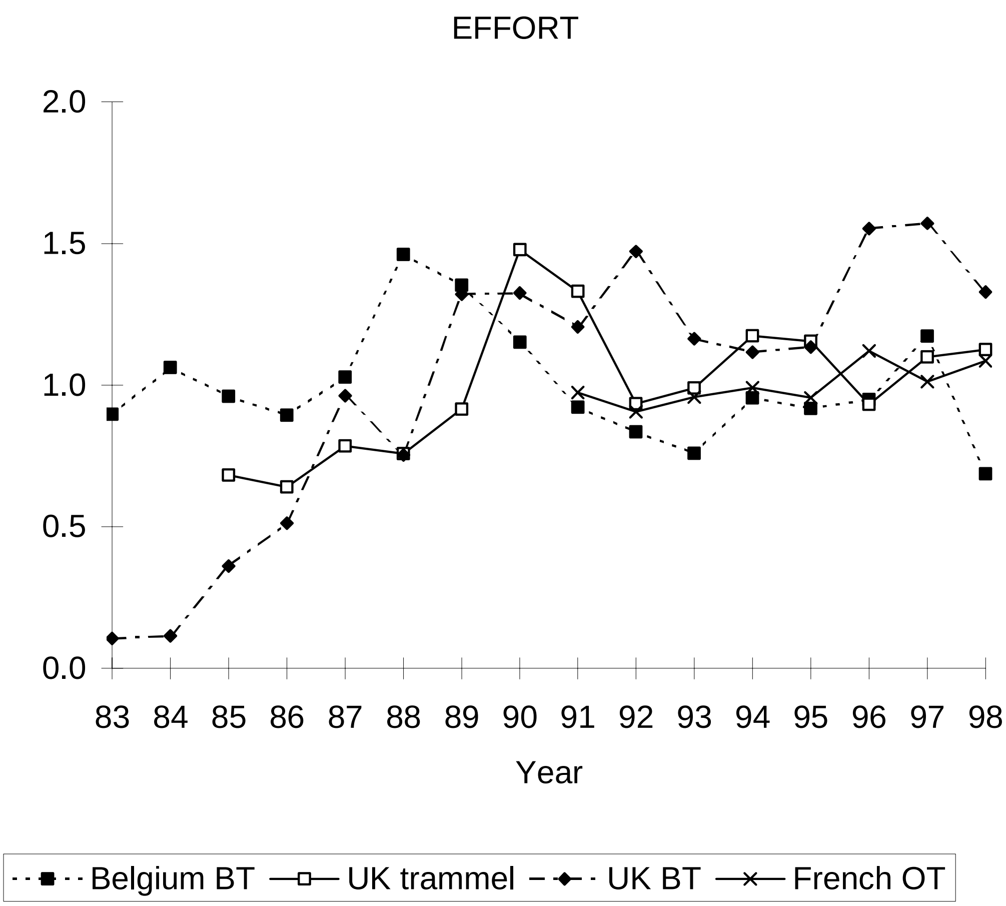


Figure 8.4.1 Sole in VIId Trends in log catchability residuals final XSA (combined fleets)

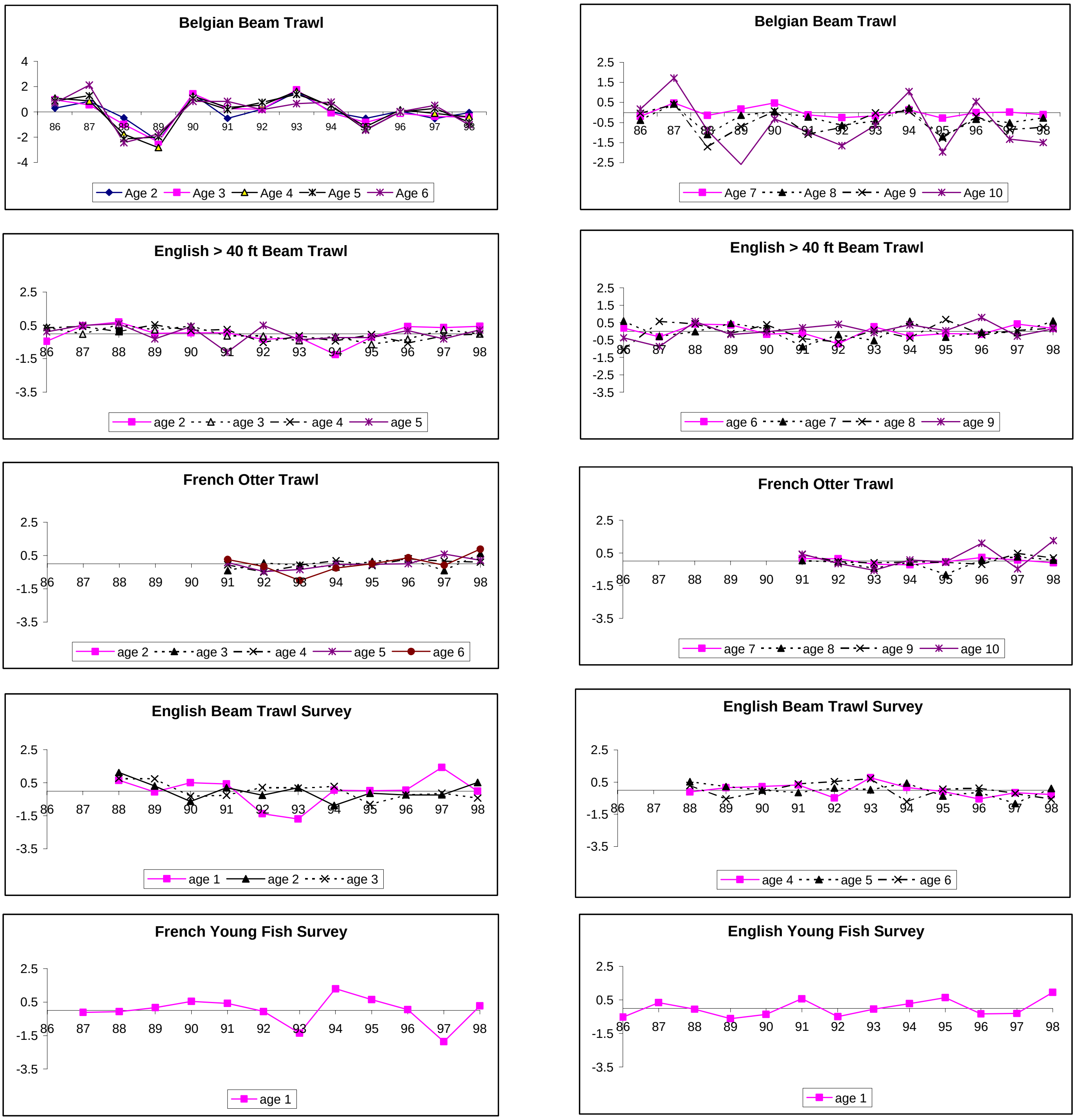
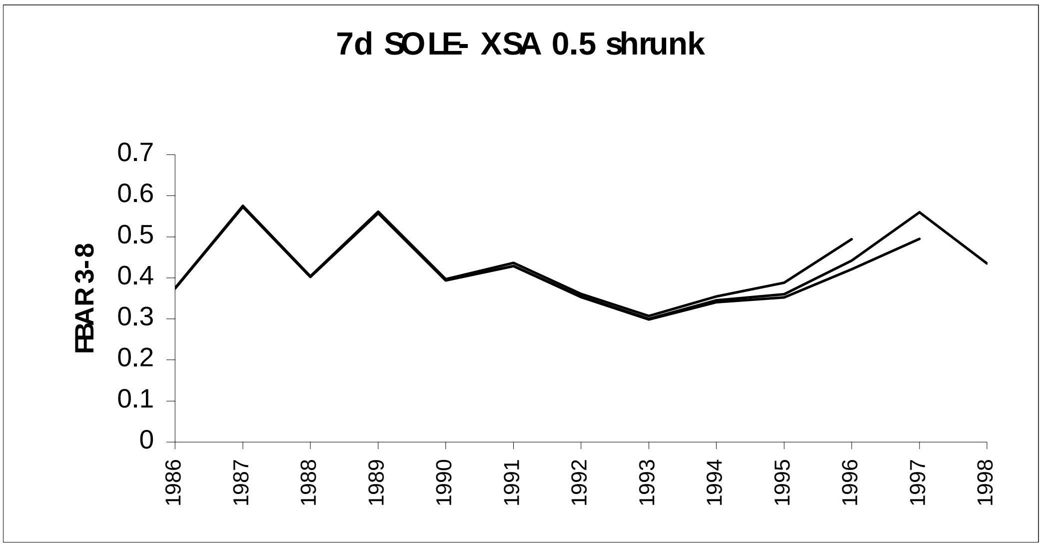
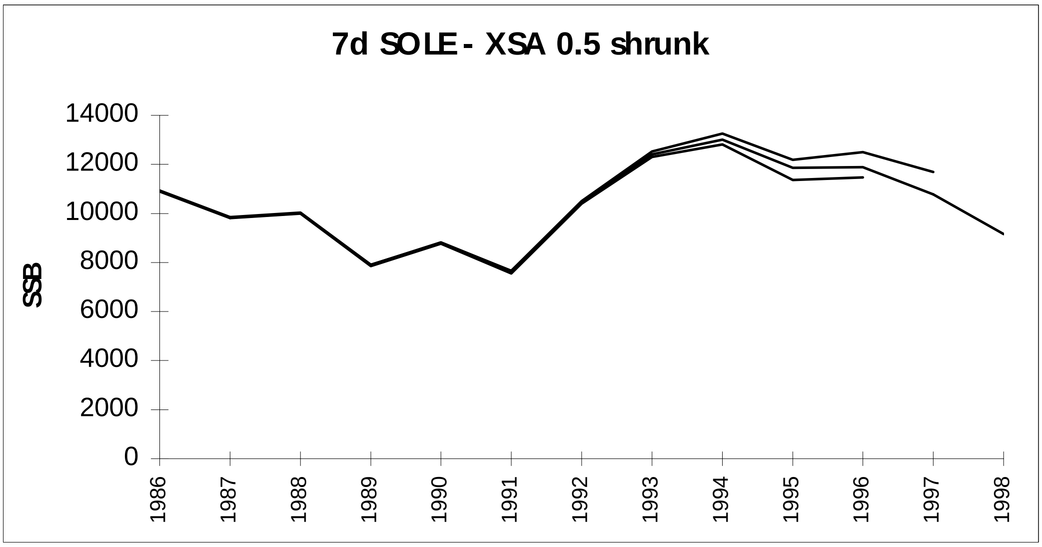


Figure 8.4.2 Sole in VIId. Retrospective analysis using shrinkage of 0.5





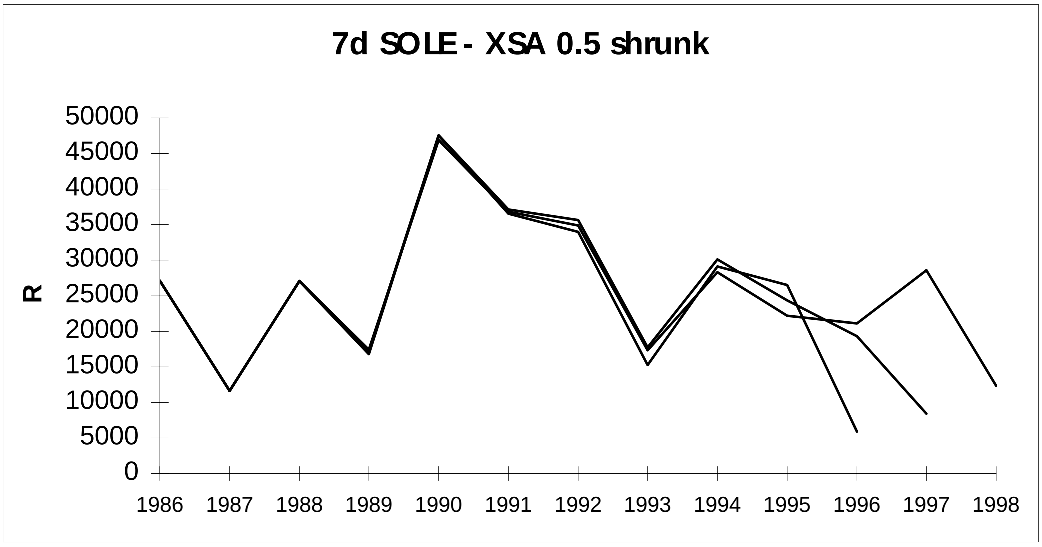


Figure 8.5.1
Sole in VIId. Relationship between survey indices and VPA 1 yr olds.

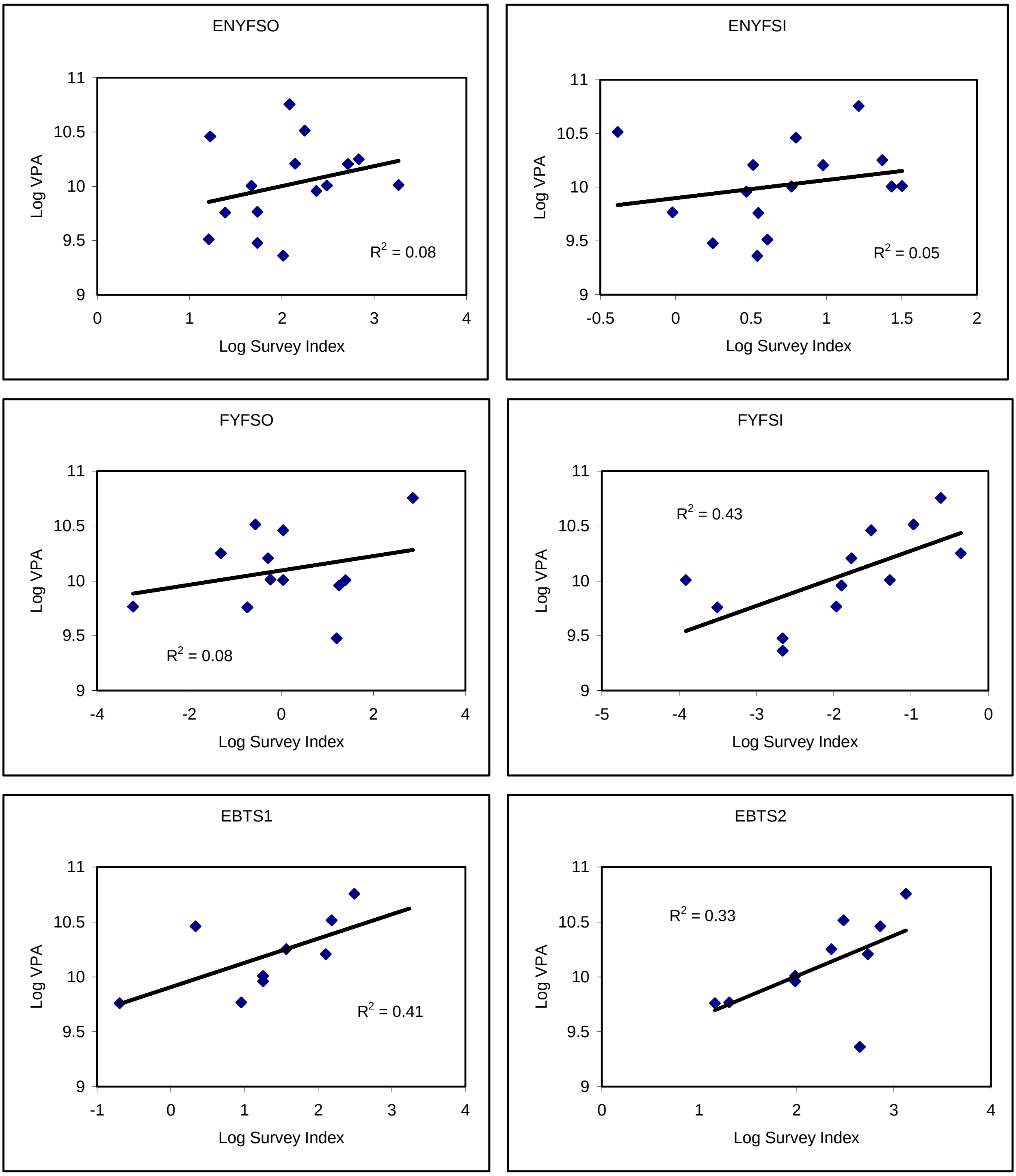


Figure 8.6.1 **Sole in Division VIId (Eastern English Channel)**

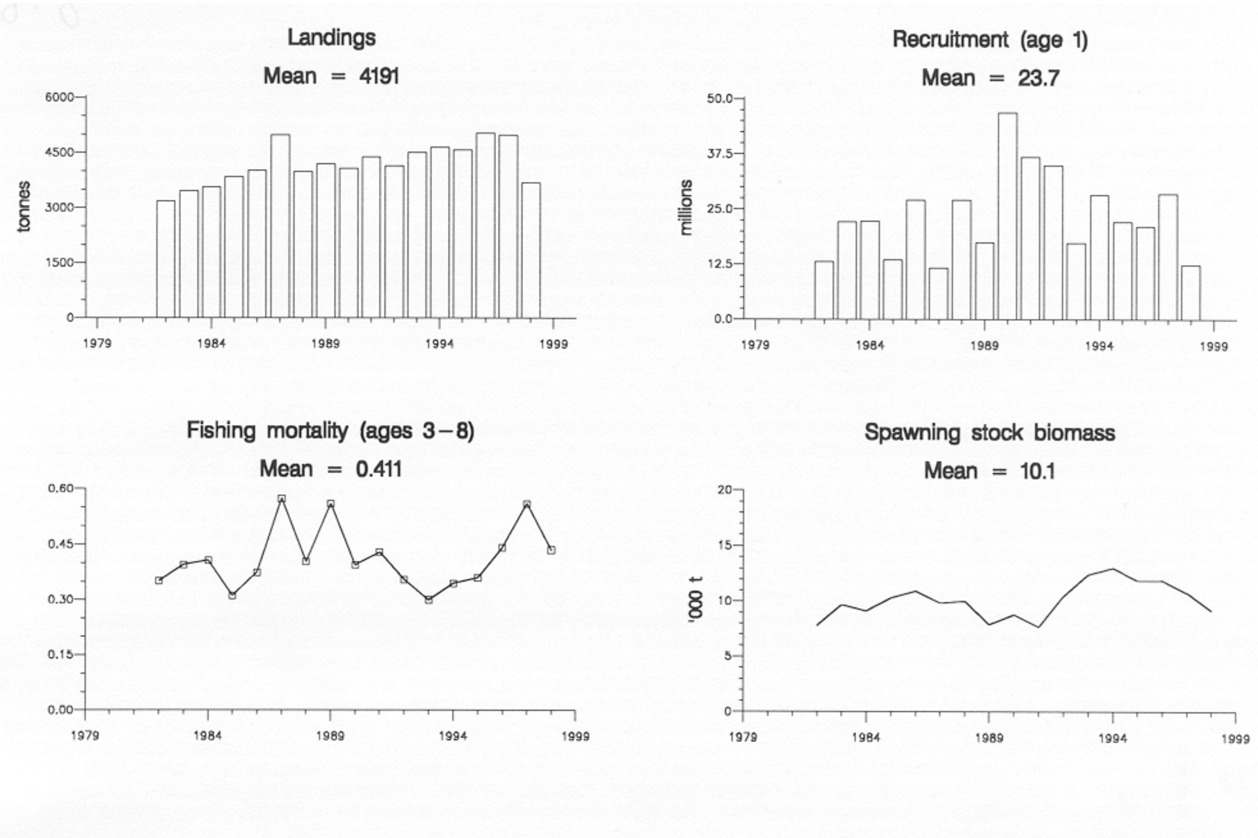


Figure 8.7.1 Sole, Eastern Channel. Sensitivity analysis of short term forecast.

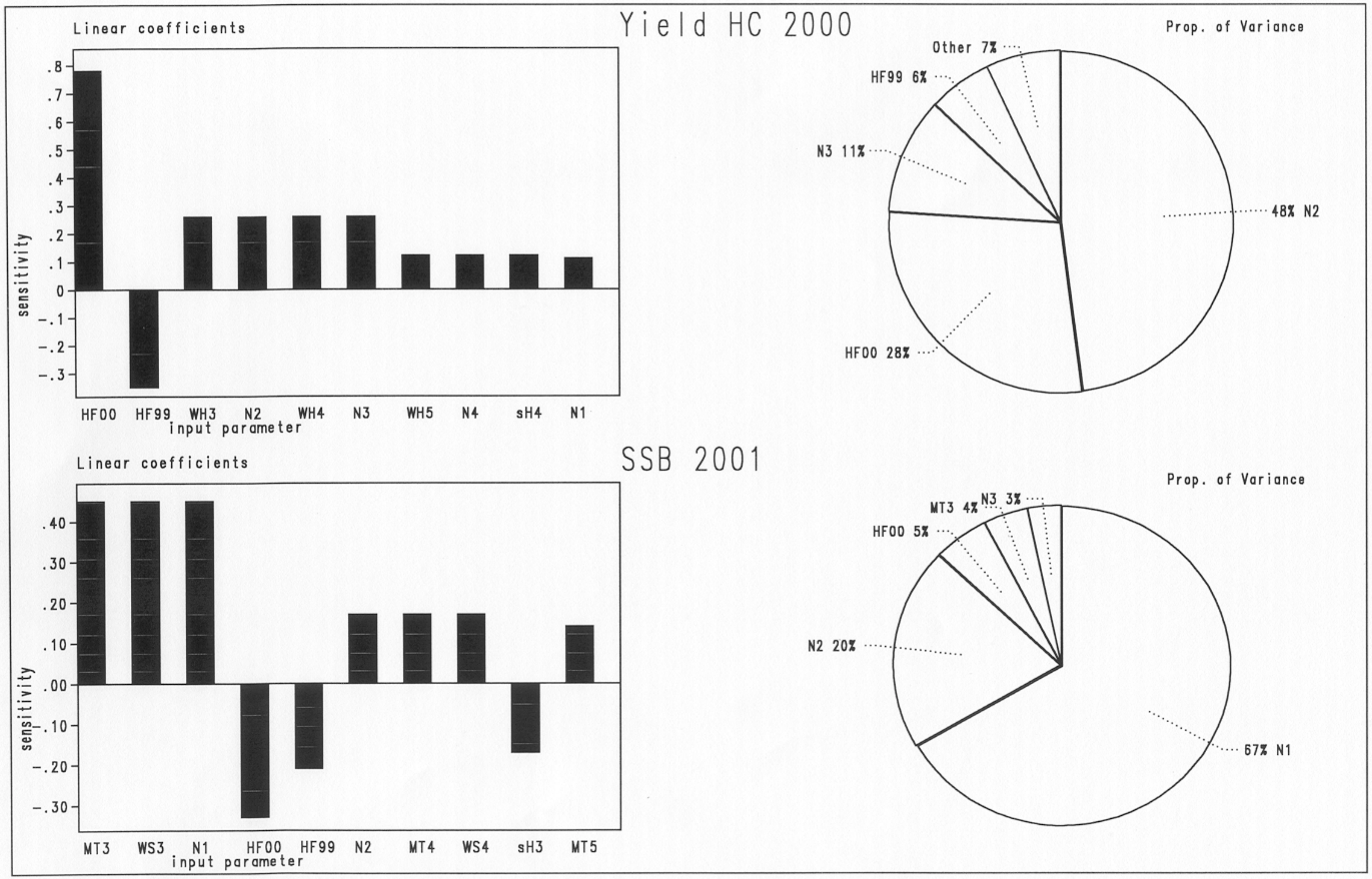
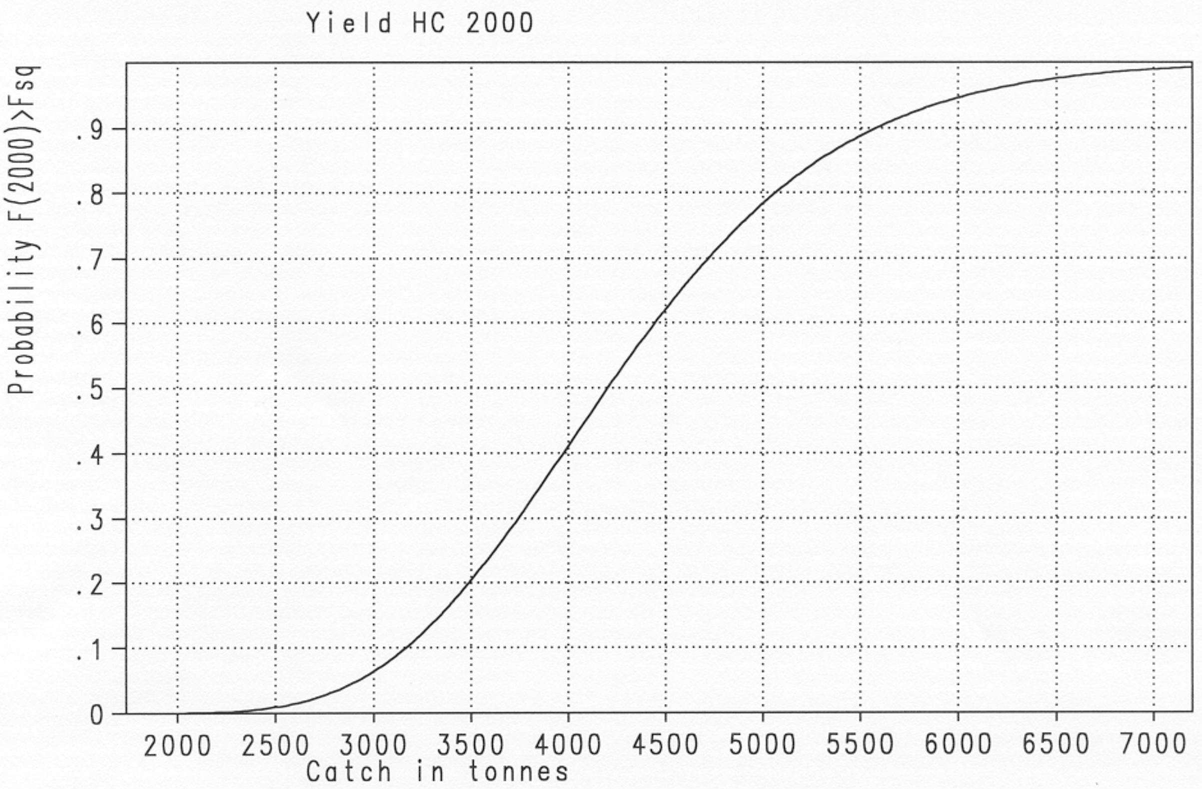


Figure 8.7.2 Sole, Eastern Channel. Probability profiles for short term forecast.



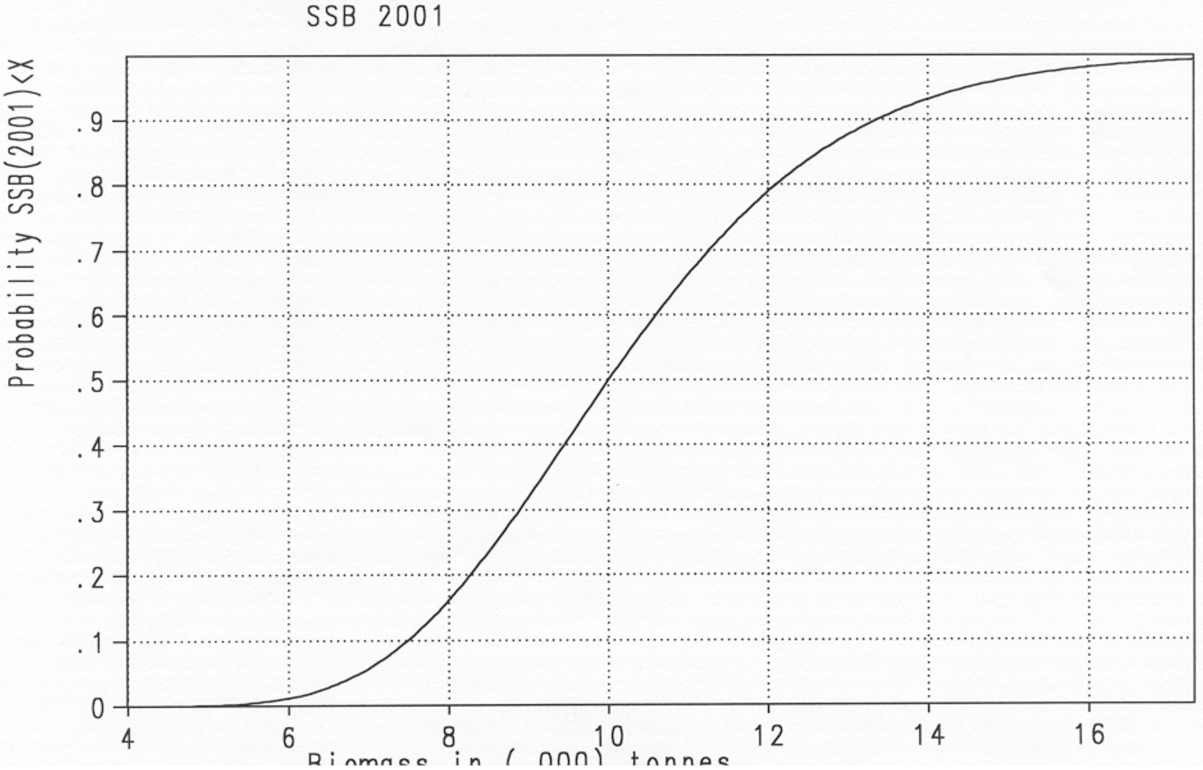


Figure 8.7.3 Fish Stock Summary. Sole in Division VIId (Eastern English Channel)

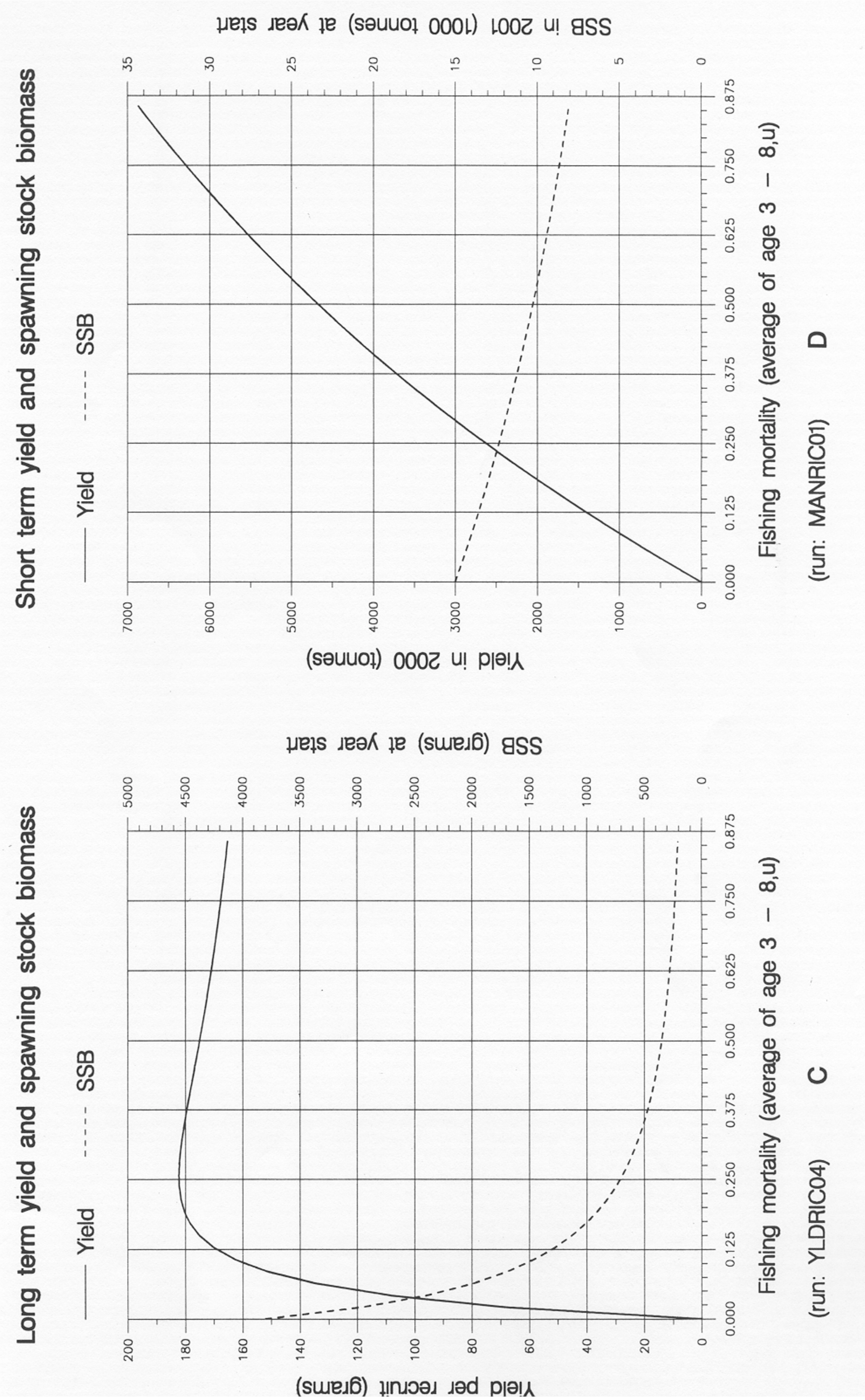


Figure 8.8.1 Sole in V11d. Medium term projections, showing 50 percentile (black line) and 5,10,20,95 percentiles from Shepherd stock recruit model constrained to go through GM recruit & SSB at SQ F

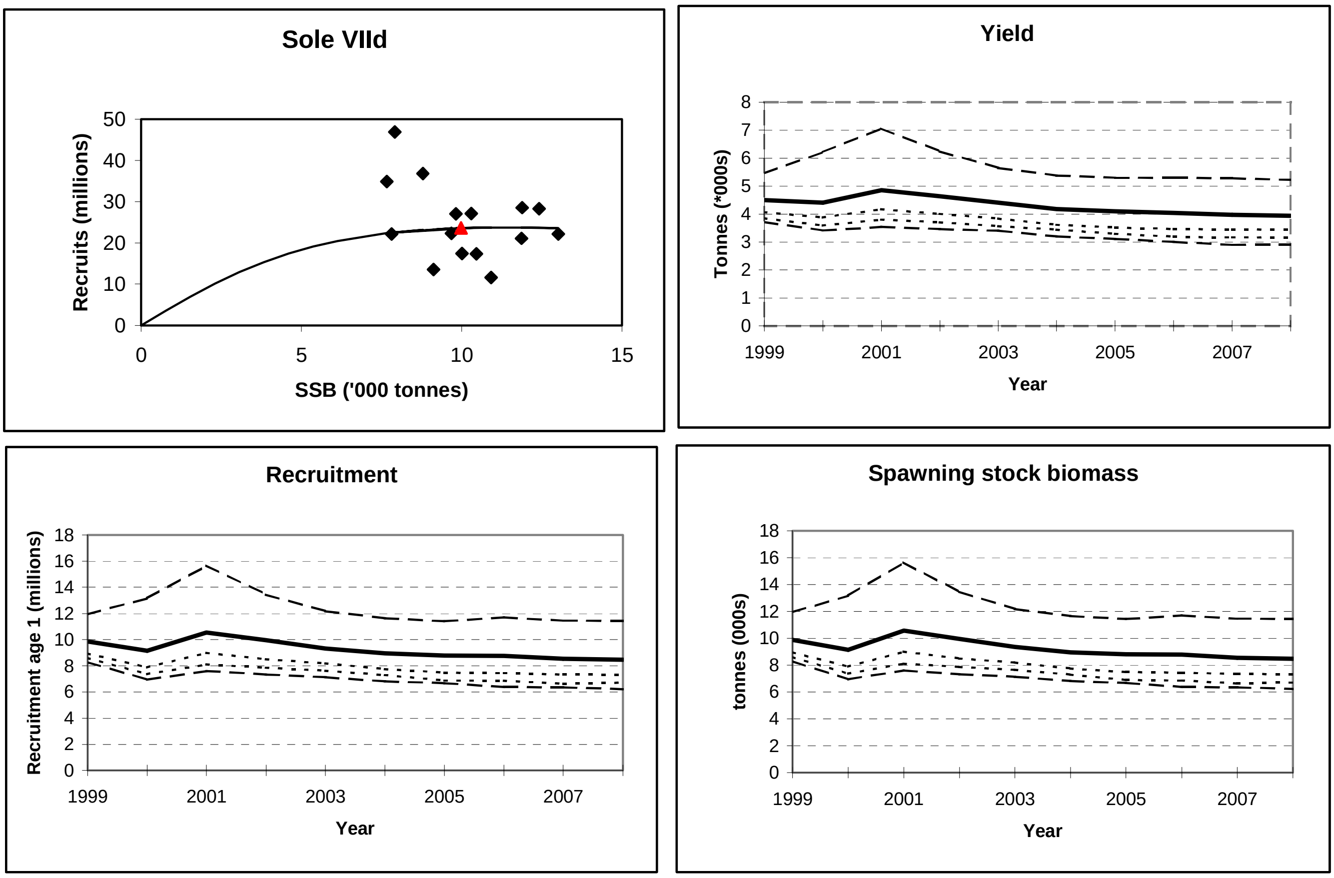


Figure 8.8.2 Medium term proj ections of SSB in 2008 at different F levels

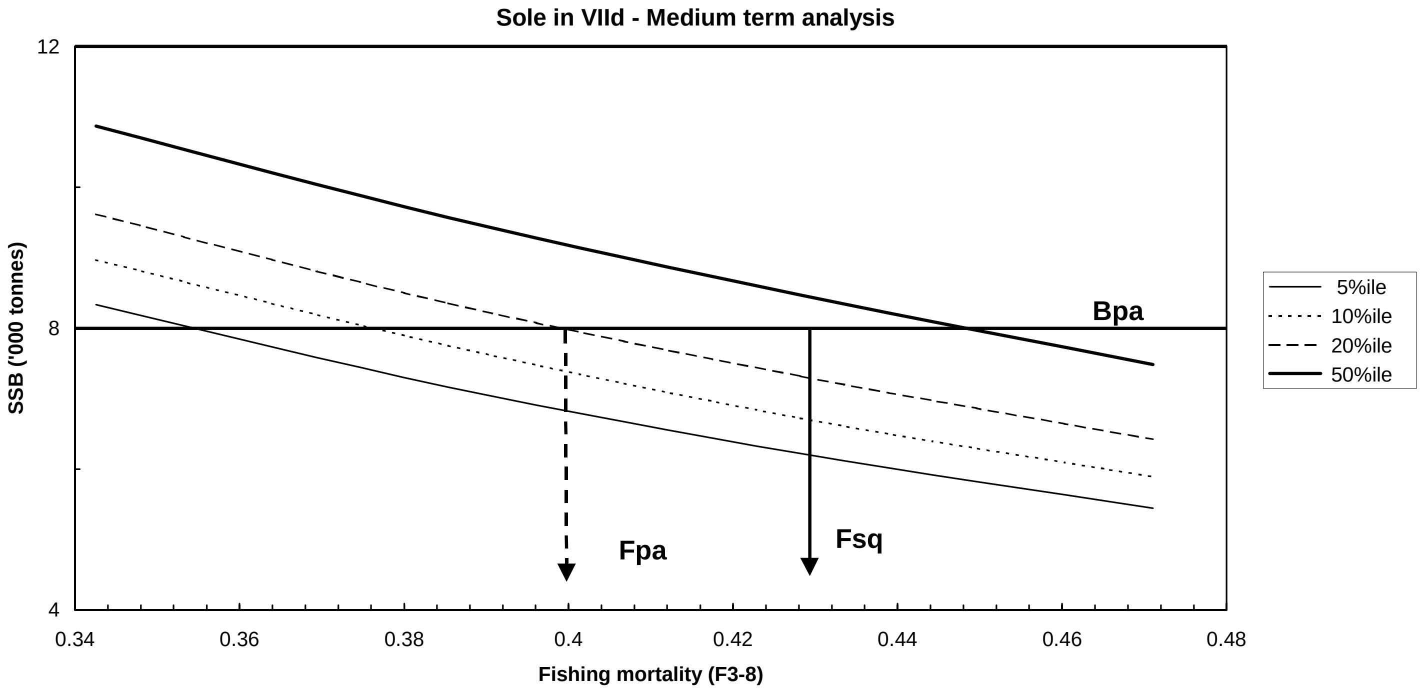
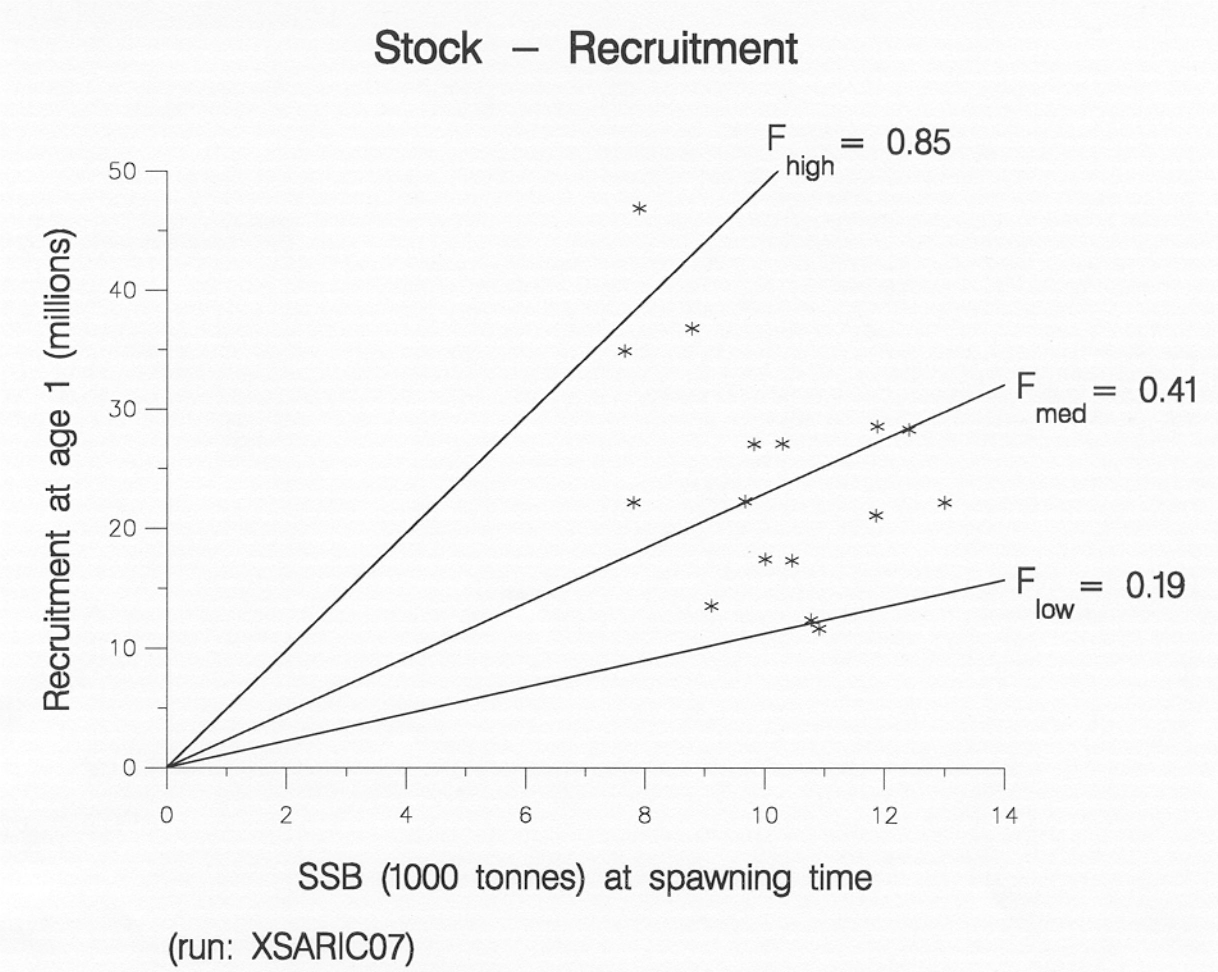


Figure 8.9.1 Sole in division VIId (Eastern English Channel)



9 NORTH SEA PLAICE

9.1 The fishery

9.1.1 ACFM advice applicable to 1998 and 1999

In October 1997 ACFM considered that the North Sea plaice stock was outside safe biological limits. SSB was well below the MBAL of 300,000 t. ACFM recommended that there was no biological requirement to modify the EC/Norway agreement to fish at F=0.3 in 1998. This corresponded to landings of **82,000 t** in 1998.

In October 1998 ACFM again considered the North Sea plaice stock to be outside safe biological limits (although the definition of SBL had changed compared to 1997). SSB was below the proposed B_{pa} and fishing mortality was above the proposed F_{pa}. The advice provided by ACFM was based on the Agreed Record of the 1997 EC/Norway consultation

ACFM considered that the agreed fishing mortality of F = 0.30 is consistent with the precautionary approach and advised that fishing mortality in 1999 should be reduced to F = 0.3 corresponding to landings of **106 000 t** in 1999. However, due to the uncertainty about the recruitment of the 1996 yearclass, ACFM warned that: *"the advantages of the stronger year class are potentially negated by poor growth rate and there is a danger of over-fishing the stock even if management follows advice corresponding to landings of 106 kt in 1999".*

9.1.2 Management applicable to 1998 and 1999

The North Sea plaice TAC for 1998 was agreed at 87,000 tonnes, 5,000 tonnes more than advised by ACFM. The 1999 TAC was agreed at 102,000 tonnes, 4,000 tonnes lower than advised by ACFM.

In 1995 the EU and Norway agreed to develop multi-annual management strategies for North Sea plaice, which was reiterated in 1997 and formulated as:

"In light of the current serious stock situation for plaice, the Parties agreed to continue to apply a multi-annual management strategy to achieve the objective of reaching a level of spawning stock biomass defined by ICES as the minimum biologically acceptable level (MBAL). For 1999, the Parties agreed to adopt a TAC consistent with a fishing mortality rate of 0.3 unless future scientific advice requires modification of this agreement, and to request ICES for appropriate advice on this matter. The Parties agreed that, to provide increased security and greater potential yield, the stock needs to be rebuilt to progressively higher levels." (Agreed Record of Conclusions of Fisheries Consultations between the European Community and Norway, Brussels, 2 December 1997)

Technical measures applicable to the plaice fishery in the North Sea include mesh size regulations, minimum landing size and a closed area (the plaice box). Mesh size regulations for towed gears require that vessels fishing North of 55° N should have a minimum mesh of 100 mm. Below 55° N vessels are allowed to fish for sole with 80 mm.

A closed area has been in operation since 1989: the plaice box. The box was closed to all vessels using towed gears and with an engine power larger than 300 HP. In the years 1989 to 1993 the box was closed in the second and third quarter. Since the second quarter of 1994 the box is closed for all quarters. An exemption fleet of vessels smaller than 300 HP has been allowed to fish inside the plaice box. An evaluation of the plaice box is presented in **section 1.8.1**.

New technical measures have been agreed which will be in operation from the year 2000 onward. Important elements in these new regulations that are relevant to the evaluation of this stock are:

- reduction of the minimum landing size from 27 cm to 22 cm
- shift of 80 mm mesh size border from 55° N to 56° N, east of 5° E.

An evaluation of the likely impact of the agreed changes in technical measures is presented **section 1.6.** Multi-annual guidance programs are generic policy instruments developed by the EC. The current MAGP-IV program has defined national targets for fleet reductions in either fleet capacity and/or days at sea.

9.1.3 Fleet developments

Fleets exploiting North Sea plaice have generally decreased in numbers in the last 10 years, partly due to the MAGP policies. However, in some instances these reductions have been compensated by reflagging vessels to other countries. The Dutch beam trawl fleet, one of the major operators in the mixed flatfish fishery in the North Sea, has seen a reduction in the number of vessels but also a shift towards two categories of vessels (2000 HP and 300 HP). The overall effort level (expressed as HP days) has remained relatively constant.

9.1.4 Landings in 1998

Total landings of North Sea plaice in 1998 (**table 9.1**) were estimated by the WG to be just over 71 thousand tonnes which is much lower than in recent years and around the same level as in 1957.

Year	Total WG landings	TAC
1995	98,356	115,000
1996	81,673	81,000
1997	83,048[1)]	91,000
1998	71,534	87,000
1999		102,000

1) Slight revisions were made in the estimated landings of 1997 (Northern Ireland and Norway) and the catch in number table was changed accordingly.

The TAC in 1998 was not taken (82%). The 1999 landings reported to the EU (up to July 1999) was 39 thousand tonnes, which is around 40% of the TAC set for this year.

9.2 Age composition, natural mortality, maturity, weight at age

Natural mortality and maturity at age were the conventional numbers used in previous assessments (**Table 9.2**). Maturation is taken as a step function representing the difference in maturation of males and females and is assumed constant over time. Estimation of maturation was originally based on biological sampling of maturity and sex ratio.

The age composition of the landings is presented in **table 9.3.** The catch at age table has been revised slightly for 1997. SOP corrections were used in the calculations of the English and Belgian age compositions. No SOP corrections were used in the Danish, French and Dutch age compositions. The SOP-discrepancy was small (2%) but may be underestimated due to the reasons given above.

Age distributions were available from samples which are thought to be representative of 81% of the official total landings. However, because the fishery for plaice is increasingly international, a major part of the landings may in practice be undersampled.

No time series of discards estimates are available to incorporate in the assessment. There are indications that the discard pattern may vary due to changes in growth, market conditions and quota regulations. An exploration of the likely consequences of discarding is presented in ICES 1999 (**see section 1.8.1**).

Mean weights at age in the catch were estimated from the market samples taken throughout the year **(Table 9.4)**. Weights-at-age in the stock were first quarter weights **(Table 9.5)**. Weight at age has varied considerably over time. Weight at age increased during the 1960s and 1970s, whereas cohorts born in the second half of the 1980s showed a reduced weight at age. In the recent years, stock weight at age of the main age groups in the catch (age 4-8) appears to increase again whereas for the ages 2 and 3 there seems to be a slightly lower weight **(Figure 9.1)**

9.3 Catch, effort and research vessel data

The following tuning data were available for North Sea plaice:

- NL commercial beam trawl CPUE
- UK commercial beam trawl CPUE
- Beam Trawl Survey (BTS)
- Sole Net Survey (SNS)
- Demersal Young Fish Survey (DFS)

The Dutch commercial beam trawl CPUE consist of the total catch at age by the Dutch (beam trawl) fleet and the effort in horsepower days (days absent from port times the horsepower of the vessel). The effort series are estimated by the Agricultural Economics Institute (LEI-DLO). The series are available for 1980 onwards and for the age 2 to 14. Only the years 1989 onwards have been used in the recent assessments because of strong patterns in log catchability residuals in the earlier years.

The English commercial beam trawl CPUE is derived from the catch at age of all beam trawlers registered in England and Wales but excluding Scottish registered vessels. The fleets landings and effort include landings into England and Wales as well as landings abroad. Effort was calculated on a trip basis as hours fishing times the horsepower (HP) of the vessel.

The Beam Trawl Survey (BTS) was initiated in 1985 and aims at obtaining pre-recruit indices for 1- and 2-group plaice and sole. However, due to its spatial distribution the BTS survey also catches considerable numbers of older plaice and sole. The survey is carried out in international cooperation and covers both inshore and offshore areas throughout the North Sea, Channel and western waters of the UK. The Dutch survey is carried out using the RV ISIS. The fishing gear used is a pair of 8-m beam trawls with 40 mm stretched mesh cod-ends. The Dutch participation in the survey is used as a tuning series for the plaice assessment and consists of average catches in numbers per haul. A number of changes have been introduced in the calculation of the BTS indices, which are listed below:

- age samples from market sampling have no longer been used to age the older individuals.
- a 5+ group has been used instead of a 10+ group
- previously, all fish smaller than 10 cm were allocated to age 0 by default. In the new algorithm all ageings have been used, also for individuals smaller than 10 cm if otoliths were available. For lengths below 10 cm for which no otoliths were available, the default age 0 was still used.
- the index area has been slightly altered. The rectangles north of the Horn Rif were excluded from the index calculation due to bad coverage over the years (see **figure 1.3.1**).

The Sole Net Survey (SNS) was carried out with RV Tridens until 1995. Since 1996 the RV ISIS is used for this survey. The gear used is a pair of 6 m beam trawls with 40 mm stretched mesh cod-ends. The stations fished are in lines perpendicular to the coast. The index has a year range of 1977 to 1999 and an age range of 0 to 3. Only the ages 1 to 3 are used for tuning North Sea plaice assessment, the 0-group index is used in the RCT3.

The Demersal Young Fish Survey (DFS) is an international survey carried out by The Netherlands, England, Belgium and Germany. Two types of gear are used. In the Wadden Sea and Scheldt Estuaries a single light 3 meter beam trawl is used with a 20 mm cod-end and one light tickler chain from the shoes. The coastal area are fished with a pair of 6 m beam trawls rigged with a similar net as the 3 meter beam trawl. The combined index is calculated as a mean of the international indices with a fixed weighting by country, which refers to the area, covered. In 1998 and 1999 no estimate of the DFS will be available due to bad weather conditions during the period of the survey and technical problems with one of the Dutch research vessels. The DFS survey is only used for the RCT3 analysis and not for tuning the VPA.

The tuning fleets used for the XSA analysis are presented in **table 9.6**. **Table 9.7** and **figure 9.2** summarize the trends in CPUE for the indices relevant to the estimation of the adult population.

9.4 Assessment

9.4.1 Data exploration

A number of exploratory assessment runs were performed to explore the catch data and the tuning indices. A separable VPA was run using a reference F at age 4 of 0.6 and selection at the final age of 0.6. Log catch ratio residuals are shown in **figure 9.3**. No strong trends appear from this analysis which means that the catch data are consistent within themselves.

Next two Laurec-Shepherd tuned VPA’s were run for both commercial fleets separately, without shrinkage. Results are not presented in this report but can be summarized as follows: for the Dutch beam trawl fleet the 1988 yearclass showed consistent negative log catchability residuals and positive log catchability residuals for the recent years and youngest ages (from yc 1992 onwards). The UK beam trawl fleet showed consistent positive log catchability residuals for the years 1996 and 1997. In general however, the residuals were relatively small.

A number of different XSA runs were explored to determine the optimal settings for XSA. It was discovered that no matter what settings one would use, there remained a discrepancy between the catch at age data and CPUE data on the one hand, and the survey data on the other hand. It was hypothesized that this discrepancy was caused by the 1996 yearclass which was detected by the research vessel surveys as relatively strong but which did not recruit to the fishery until July 1999 (i.e. one year later than normal) as observed from the Dutch commercial market category data which is available up to autumn 1999. The discrepancy between survey and commercial catch data (including CPUE) resulted in a number of trends, which could not be remedied in the current assessment model:

- a positive trend in the log catchability residuals for the UK beam trawl fleet and the survey fleets
- a negative trend in the log catchability residuals for the NL beam trawl fleet
- a high weight given to population shrinkage for the youngest ages (if population shrinkage was used)
- or alternatively if no population shrinkage was used: high weights given to the commercial tuning data rather than the survey data.
- Negative slopes for the BTS age 1 index.

Inspection of the regression diagnostics from XSA indicated that catchability should be considered independent of stock size for all ages. Further, it was reasoned, a priori, that for a fishery that generates high levels of discards which are not included in the assessment, it may not be appropriate to include the power model into the XSA even though it is used in the RCT3 estimation procedure.

9.4.2 final assessment

The settings of the final XSA assessment are given in **table 9.8**. It was decided – based on the reasoning above – to drop the power model for the recruiting ages. As last year, a 10 year tuning window was used. Due to a problem in the age reading of the 1996 yearclass in the 1997 survey (which was already noted in last years report) and the accumulating evidence that it is indeed the 1996 yearclass which is the strong yearclass (see below), it was decided to exclude the 1997 survey data for 1 and 2 groups for SNS and BTS. This procedure was also used for the RCT3 analysis.

Diagnostics of the final run are presented in **table 9.9**. **Figure 9.4** shows the log catchability residuals for the tuning fleets. Fishing mortality and stock numbers are shown in **tables 9.10** and **9.11.** A summary of the assessment is presented in **table 9.12** and **figure 9.8**.

Weighting of the different data sources in the assessment is shown in **figure 9.5**, where it is compared with the weighting from last year. It is clear that the surveys have lost considerable weight in this assessment as compared to last year. Therefore, the commercial fleets are the most dominant source for tuning in this assessment. Furthermore, it is noted that the F-shrinkage has a high weight in the estimation of the younger ages, and that the survivor estimates generated by the F-shrinkage for these ages are fully out of range with any other values. However, in the present implementation of XSA, F-shrinkage can not be turned off for younger ages only.

A retrospective analysis using a 8 year tuning window shifted backward in three years is shown in **figure 9.6**. The analysis shows a retrospective patterns in both fishing mortality and recruitment.

9.5 Recruitment

Survey data on recruitment are presented in **figure 9.7** for the three surveys (BTS, SNS and DFS) The 1996 yearclass, which gave reason for suspicion due to aging problems in the 1997 survey, shows up very clearly in the 1999 survey as three year olds. Information from the fishery further confirms that this yearclass has started to recruit to the fishery in the summer of 1999, i.e. one year later than normal. The recruitment was estimated using the RCT3 program. Runs were performed for ages 1, 2 and 3. Inputs for these runs are presented in **tables 9.13-9.15** and results are in **tables 9.16-9.18**. In general the surveys received a relatively high weighting compared to the VPA mean recruitment. As the XSA did not provide reliable estimates of yearclasses 1996 to 1998, it was decided to replace the survivors for these yearclasses by RCT3 estimates.

However, on comparing the VPA and RCT3 estimates of recruitment (**figure 9.8**) it appeared that RCT3 tends to overestimate recruitment on average by 20%. There was no time available to look more closely into the reasons for this discrepancy, so the WG decided, as an intermediate solution to the problem, to correct the recruitment estimates by reducing the RCT3 estimates by 20%. It was stresses that this problem be addressed in more detail before the next meeting of this working group.

The following two text tables summarize the recruitment estimates. The estimates of yearclass strength are presented in the first text table below. Estimates selected for further use in the analysis are denoted in bold and underlined print.. All estimates are expressed as yearclass strength at age 1. RCT-1 modified refers to the RCT estimate at age but modified by –20% to take account of the bias in the RCT recruitment estimation.

yearclass	xsa-1	rct-1	rct-1 modified	GM 57-95
1995	**<u>368</u>**	509	407	
1996	336	969	**<u>775</u>**	
1997	124	458	**<u>366</u>**	
1998	---	556	**<u>445</u>**	
1999		590	472	**<u>415</u>**

The second text table shows the actual values that were input to the short term and medium term forecasts, as estimated survivors in 1999 and recruiting yearclasses in 2000 and 2001.

yearclass	age in 1999	basis	xsa-1
1995	4	xsa-1	**<u>181</u>**
1996	3	rct-1 modified	**<u>579</u>**
1997	2	rct-2 modified	**<u>330</u>**
1998	1	rct-3 modified	**<u>445</u>**
1999	0	GM	**<u>415</u>**
2000	---	GM	**<u>415</u>**

9.6 Historic stock trends

Figure 9.9 shows the trends in yield, mean F (2-10), SSB and recruitment since 1957. Yield has gradually increased up to the late 1980s and rapidly declined since then and is currently at the same level as in 1957 when beam trawling started.

Fishing mortality increased until the early 1980s, and leveled off in the 1980s after which there have been slight fluctuations in fishing mortality. Current fishing mortality seems to be slightly lower than in earlier years but it may be rather imprecise.

The SSB increased to a peak in 1967 when the strong 1963 year class became mature. Since then, SSB declined to a level of 300 kt in the early 1980s. Due to the recruitment of the strong yearclasses 1981 and 1985, SSB again increased to a peak in 1989 and rapidly declined since then. The 1998 SSB is estimated to have been below B_{lim} (210,000 tonnes).

Except for the occurrence of exceptionally strong year classes (1963, 1981 and 1985), which coincided with cold winters, inter-annual variability in recruitment is rather small. VPA estimates of recruitment show a periodic change with relative poor recruitment in the 1960s and relatively strong recruitment in the 1980s. The recruitment level in the early 1990s appears to be somewhat lower than in the 1980s. The 1996 yearclass appears to be rather strong and is currently estimated at 775 million (4th in the time series 1957-1998).

9.7 Short term forecast

The input data to the short term forecast are given in **table 9.19a** and for the medium term forecasts in **table 9.19b** (the change being only the year range over which weight in the stock and catch were calculated). Weight at age in the stock and in the catch were taken as a mean over the last three years. The exploitation pattern was taken as the mean value of the last three years and not scaled to the average F for 1998. Population numbers were taken from the final VPA. The number of 1,2 and 3 year olds were taken from the text table presented in section 9.5. All other ages were taken from the XSA survivors in 1999.

In **table 9.20** the results of a detailed *status-quo* prediction are shown. The strong 1996 yearclass is now expected to recruit into the fishery in 1999, rather than in 1998. The yearclass is expected to contribute around 45% to the total landings (in weight) in 2000. In 2001, the 1996 yearclass is expected to contribute 28% to the total SSB **(Table 9.21)**.

A management option table for *status quo* fishing mortality in 1999 is presented in **table 9.22**. At *status quo* fishing mortality in 1999 and 2000 the SSB is expected to increase to 258 kt in 2000 and to 268 kt. in 2001. The yield at *status quo* F is expected to be around 127 kt in 1999 (TAC 102 kt) and 132 kt in 2000.

The sensitivity of the short-term predictions to the uncertainties in the input parameters was explored using the programs WGFRAN4 and SENPLOT. **Figure 9.10** (right hand side) indicates that the yield in 2000 is most sensitive to the exploitation level in 2000 and the yearclass 1996 at age 3 at the start of 1999. The SSB in 2001 is mostly affected by the uncertainties in the recruitment in 2000, the exploitation level in 2000 and the 1996 yearclass.

Cumulative probability profiles for the landings in 2000 and for the SSB in 2001 are shown in **Figure 9.11**. The probability that the SSB in 2001 will be above B_{pa} at the *status quo* fishing mortality (0.45) is around 15%.

9.8 Medium term forecast

Last year the Butterworth-Bergh model was used to describe the relationship between SSB and recruitment. However, since the medium term program used last year was no longer available, it was decided this year to use a constrained Shepherd curve, so as to obtain qualitatively the same model. This was done by fixing the shape parameter C to 1.8, to set the B parameter to the geometric mean SSB and to constrain the model to go through the geometric mean recruitment at geometric mean SSB. This leaves only the A parameter to be estimated. The fitting routine is shown in **table 9.23**. The estimated parameters and the residuals from the fit were exported to the input file for the WGMTERM program.

A 15 year long term average was used for the catch weight and stock weight at age. The exploitation pattern was averaged over three years (96-98).

Results of a single medium term forecast, using 500 iterations at *status quo* fishing mortality are presented in **figure 9.12.** This shows that at current fishing levels both the spawning stock and yield are expected to decrease once the 1996 yearclass has been fished out.

Using a range of F-multipliers in medium term forecasts, a probability plot was generated for the SSB in 2008 (**figure 9.13**). It shows that fishing at F_{pa}, the probability of being below B_{pa} in 2008 is approximately 5%.

9.9 Long term considerations

A yield per recruit analysis was performed. Input data for this analysis are given in **table 9.24**. Results are presented in **table 9.25**.

9.10 Biological reference points

Biological reference points were not revisited for this stock. The possible reason for revisiting biological reference points would have been the outcome of the plaice box evaluation. Since the results of this evaluation were that an effect of the plaice box on recruitment of plaice could not be demonstrated, there is currently no basis to change the proposed precautionary reference points.

9.11 Additional requests

The European Commission requested a new form of advice, which is based on the medium term forecasts but applied to the first few years of that forecast, in order to arrive at probability estimates of SSB and yield levels at two different levels of fishing mortality: F_{sq} (0.45) and F_{pa} (0.30). Results of this analysis are presented in **table 9.26a.**

The sensitivity of the proposed method to the starting conditions of the medium term simulations was explored using a different starting population in 1999. For this run the original RCT3 estimates for the survivors in 1999 were used rather than the modified values that were used by default in all other projections. Results of this alternative run are presented in table **9.26b.** It can be concluded that the proposed new format of advice is sensitive to the input stock used for the medium term forecasts.

9.12 Comments on the assessment

The fundamental problem in the assessment that is presented here concerns the discrepancy between the survey data and the (commercial) catch data on the 1996 yearclass. This yearclass was originally measured as very strong in the 0-group surveys (e.g. **figure 9.7**), but was afterwards difficult to pick up in the surveys because of aging problems, where it was found very difficult to distinguish the 1995 and 1996 yearclasses. The 1999 surveys suggest very clearly that it is the 1996 yearclass which is strong rather than 1995 yearclass. Since this yearclass was not observed in the catch in 1998, this means that the yearclass has grown slower than usual which caused it to recruit to the fishery one year later than expected. This is also demonstrated in **table 9.27** which shows the catch at age data and the survey indices for the BTS and SNS survey. If compared to the mean catches of 2-groups, the 1996 yc catch in 1998 was at around 25% lower than the average value, whereas the survey indices were around 2.5 times higher than the average 2-group level, and as 3-groups (in 1999) even as 5 to 8 times average.

The historical performance of the assessments of this stock are shown in **figure 9.14**. It appears that there has been a slight trend to overestimate SSB (and corresponding underestimate fishing mortality),

The problem with the bias in the RCT3 estimation of recruitment has not been resolved within the time-span of the working group. However, the WG recognizes the need to address this problem, also since the same phenomenon has been observed for other stocks (e.g. cod, haddock).

The discrepancy between the short term catch prediction from last year and the realization in 1998 can be explained as by the much lower catch and stock numbers in the 1998 data (**figure 9.15**).

The issue of reflagging may have consequences for the North Sea plaice assessments. Landing data are currently presented by country and no separate estimates are available of the landings taken by flag-vessels. Information from the EU logbook databases suggests that currently around 22% of the total international landings is landed in the Netherlands, predominantly by flag-vessels. These landings are not routinely sampled in market sampling programs and currently national age-length keys are raised to the total landings by country, rather than by fleet segment. The WG recognized the need to revisit both the catch at age data and the commercial tuning fleet data and recommends that this be done in intersessional work.

Table 9.1 North Sea plaice. Nominal landings (tonnes) in Sub-Area IV as officially reported to ICES, 1987-1998

	1993	1994	1995	1996	1997	1998
Belgium	10,814	7,951	7,093	5,765	5,223	5,592
Denmark	16,452	17,056	13,358	11,776	13,940	*10,087*
France	603	407	442	379	254	489
Germany	6,895	5,697	6,329	4,780	4,159	*2,773*
Netherlands	48,552	50,289	44,263	35,419	34,143	*30,541*
Norway	827	524	527	1,242	1,775	*1,004*
Sweden	7	6	3	5	4	*2*
UK (E/W/NI)	20,586	17,806	15,801	13,541	13,789	*11,473*
UK (Scotland)	10,542	9,943	8,594	7,451	8,345	*8,442*
Others						
total	115,278	109,679	96,410	80,358	81,632	70,403
Unallocated	1,835	713	1,946	1,315	1,416	1,131
WG estimate	**117,113**	**110,392**	**98,356**	**81,673**	**83,048**	***71,534***
TAC	*175,000*	*165,000*	*115,000*	*81,000*	*91,000*	*87,000*

Table 9.2 North Sea plaice: natural mortality and maturity at age

	M	maturity
1	0.1	0
2	0.1	0.5
3	0.1	0.5
4	0.1	1
5	0.1	1
6	0.1	1
7	0.1	1
8	0.1	1
9	0.1	1
10	0.1	1
11	0.1	1
12	0.1	1
13	0.1	1
14	0.1	1
15+	0.1	1

Table 9.3 North Sea plaice, catch numbers at age (thousands).

Run title : Plaice in IV (run: XSAMAP09/X09)

At: 14/10/1999 17:02

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	16556,	5959,	2264,	2147,	4340,	14708,	9858,	4144,	5982,	9474,
3,	30427,	61876,	33392,	35876,	21471,	40486,	42202,	65009,	30304,	40698,
4,	25489,	51022,	67906,	66779,	76926,	64735,	53188,	51488,	112917,	38140,
5,	41099,	21321,	32699,	50060,	54364,	57408,	43674,	36667,	41383,	123619,
6,	22936,	27329,	12759,	20628,	31799,	37091,	30151,	27370,	22053,	17139,
7,	13873,	14186,	14680,	9060,	12848,	15819,	18361,	16500,	16175,	10341,
8,	6408,	9013,	9748,	9035,	6833,	6595,	8554,	10784,	8004,	10102,
9,	6596,	5087,	5996,	5257,	7047,	3980,	4213,	6467,	6728,	3925,
10,	5360,	4711,	3446,	3428,	3863,	3804,	4015,	3336,	3045,	4891,
11,	3386,	3418,	3621,	2659,	3591,	3066,	2807,	1843,	2033,	2273,
12,	3564,	2391,	2887,	2266,	2117,	1905,	2221,	2552,	968,	1556,
13,	1507,	1966,	1743,	2001,	2089,	1518,	1745,	1624,	1303,	607,
14,	869,	1014,	1345,	1061,	1536,	1300,	1338,	1032,	783,	1007,
+gp,	1494,	1653,	1618,	1386,	3396,	5293,	5461,	4541,	3043,	3031,
0 TOTALNUM,	179564,	210946,	194104,	211643,	232220,	257708,	227788,	233357,	254721,	266803,
TONSLAND,	79300,	87541,	85984,	87472,	107118,	110540,	97143,	101834,	108819,	111534,
SOPCOF %,	102,	101,	102,	97,	102,	101,	101,	102,	102,	103,

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	3,	76,	19,	2233,	1268,	2223,	981,	2820,	3220,	1143,
2,	15017,	17294,	29591,	36528,	31733,	23120,	28124,	33643,	56969,	60578,
3,	45187,	51174,	48282,	62199,	59099,	55548,	61623,	77649,	43289,	62343,
4,	36084,	56153,	33475,	52906,	73065,	42125,	31262,	96398,	66013,	54341,
5,	35585,	40686,	26059,	23043,	42255,	41075,	25419,	13779,	83705,	50102,
6,	102014,	35074,	22903,	16998,	13817,	19666,	21188,	9904,	9142,	35510,
7,	10410,	78886,	16913,	14380,	8885,	8005,	11873,	9120,	5912,	5940,
8,	6086,	6311,	29730,	10903,	9848,	6321,	5923,	6391,	5022,	3352,
9,	8192,	4185,	6414,	18585,	6084,	5568,	4106,	2947,	4061,	2419,
10,	3739,	4778,	4602,	3467,	13829,	3931,	3337,	2020,	1927,	2176,
11,	4760,	2202,	3377,	2841,	1680,	10118,	1741,	2111,	1301,	1145,
12,	1796,	2871,	2213,	2538,	1995,	1634,	7935,	911,	1357,	603,
13,	1223,	1150,	1910,	1553,	1516,	1686,	1080,	4478,	489,	689,
14,	703,	939,	929,	1591,	1355,	1242,	1424,	388,	2290,	330,
+gp,	3871,	2900,	3879,	3661,	3603,	3369,	4178,	2644,	1827,	2525,
0 TOTALNUM,	274670,	304679,	230296,	253426,	270032,	225631,	210194,	265203,	286524,	283196,
TONSLAND,	121651,	130342,	113944,	122843,	130429,	112540,	108536,	113670,	119188,	113984,
SOPCOF %,	106,	97,	103,	103,	105,	104,	106,	103,	100,	96,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	1318,	979,	253,	3334,	1214,	108,	121,	1674,	0,	0,
2,	58031,	64904,	100927,	47776,	119695,	63252,	73552,	67125,	85123,	15146,
3,	118863,	133741,	122296,	209007,	115034,	274209,	144316,	163717,	115951,	250675,
4,	48962,	77523,	57604,	69544,	99076,	53549,	185203,	93801,	111239,	74335,
5,	47886,	24974,	35745,	28655,	29359,	37468,	32520,	84479,	64758,	47380,
6,	39932,	17982,	12414,	16726,	12906,	13661,	15544,	24049,	34728,	25091,
7,	24228,	13761,	9564,	7589,	8216,	6465,	6871,	9299,	11452,	16774,
8,	4161,	8458,	8092,	5470,	4193,	5544,	3650,	4490,	4341,	5381,
9,	2807,	1864,	4874,	4482,	3013,	2720,	2698,	2733,	2154,	3162,
10,	2333,	1326,	1406,	3706,	2947,	2088,	1543,	2026,	1743,	1671,
11,	1849,	952,	1097,	1134,	2144,	1307,	1030,	1178,	1033,	932,
12,	1113,	1173,	830,	712,	1219,	1143,	1070,	1084,	663,	932,
13,	707,	433,	796,	575,	581,	455,	727,	806,	529,	505,
14,	707,	284,	468,	519,	344,	310,	371,	628,	296,	516,
+gp,	2579,	1209,	1306,	2007,	1052,	1262,	1057,	1228,	1214,	1677,
0 TOTALNUM,	355476,	349563,	357672,	401236,	400993,	463541,	470273,	458317,	435224,	444177,
TONSLAND,	145347,	139951,	139747,	154547,	144038,	156147,	159838,	165347,	153670,	154475,
SOPCOF %,	100,	101,	102,	101,	99,	98,	98,	99,	99,	98,

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	1261,	1512,	1416,	3196,	3170,	1288,	6981,	963,	616,	176,
2,	46757,	31766,	42027,	41447,	49674,	41773,	33499,	37503,	34132,	27796,
3,	105929,	96067,	81484,	81827,	93111,	95773,	76526,	57925,	80307,	64146,
4,	231414,	109559,	113986,	70534,	70839,	77935,	76168,	43759,	46941,	53948,
5,	52909,	160287,	72475,	71836,	51090,	39615,	35882,	32512,	22337,	16693,
6,	19247,	26895,	78494,	33685,	29811,	21353,	18947,	15054,	15667,	6908,
7,	10567,	8431,	15113,	30684,	13805,	15850,	10669,	11579,	8220,	5567,
8,	7561,	4410,	5509,	7253,	12710,	6690,	5054,	5427,	6420,	2886,
9,	2120,	3717,	3267,	3450,	4128,	6155,	2688,	3324,	2991,	2329,
10,	1692,	1176,	2565,	2497,	2235,	2745,	2174,	1999,	1395,	1391,
11,	927,	767,	1039,	1786,	1588,	1134,	1321,	1735,	783,	689,
12,	630,	487,	670,	1006,	1173,	820,	631,	867,	1126,	555,
13,	446,	325,	396,	624,	861,	768,	370,	512,	575,	777,
14,	328,	235,	332,	629,	310,	459,	396,	427,	302,	305,
+gp,	1557,	1222,	1296,	1648,	1321,	1022,	937,	1537,	1033,	1353,
0 TOTALNUM,	483345,	446856,	420069,	352102,	335826,	313380,	272243,	215123,	222845,	185519,
TONSLAND,	169818,	156240,	148004,	125190,	117113,	110392,	98356,	81673,	83048,	71534,
SOPCOF %,	99,	98,	96,	98,	98,	99,	100,	99,	99,	99,

Table 9.4 North Sea plaice, catch weights at age (kg)

Run title : Plaice in IV (run: XSAMAP09/X09)

At: 14/10/1999 17:02

Table 2 Catch weights at age (kg)

YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.2180,	.2000,	.1910,	.2110,	.2530,	.2500,	.2420,	.2320,	.2320,	.2670,
3,	.2460,	.2360,	.2330,	.2480,	.2860,	.2730,	.2820,	.2700,	.2790,	.2980,
4,	.2930,	.2890,	.3020,	.3000,	.3190,	.3120,	.3210,	.3480,	.3220,	.3310,
5,	.3620,	.3860,	.4120,	.4000,	.3990,	.3880,	.3850,	.4360,	.4250,	.3660,
6,	.4730,	.4850,	.5090,	.5410,	.5330,	.4870,	.4710,	.4840,	.5470,	.5170,
7,	.5920,	.6010,	.6040,	.5700,	.6240,	.6280,	.5390,	.5590,	.5970,	.5900,
8,	.6230,	.6830,	.6710,	.6920,	.6670,	.7000,	.6630,	.6240,	.6620,	.5960,
9,	.7500,	.7240,	.8120,	.7770,	.7150,	.7370,	.7260,	.6900,	.7380,	.6860,
10,	.7910,	.8740,	.8700,	.9590,	.8600,	.8410,	.6150,	.8130,	.8370,	.7500,
11,	.9180,	.9590,	.9420,	.9950,	.9200,	.8900,	.7920,	.8580,	.8700,	.8170,
12,	1.0090,	1.1620,	1.0330,	1.1000,	1.0330,	.9540,	.8570,	.8430,	.9020,	.9390,
13,	1.1900,	1.2320,	1.2240,	1.1870,	1.0040,	.9380,	.9740,	.9430,	.9500,	.9360,
14,	1.2670,	1.3600,	1.2390,	1.4100,	1.1820,	1.0980,	.8780,	1.0180,	1.0320,	.9730,
+gp,	1.5630,	1.5720,	1.5530,	1.5400,	1.2760,	1.2040,	1.1210,	1.0800,	1.2140,	1.2010,
0 SOPCOFAC,	1.0217,	1.0067,	1.0156,	.9665,	1.0193,	1.0075,	1.0057,	1.0182,	1.0198,	1.0291,

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.2170,	.3150,	.2560,	.2460,	.2720,	.2850,	.2490,	.2650,	.2540,	.2440,
2,	.2940,	.2860,	.3180,	.2960,	.3160,	.3110,	.3000,	.2950,	.3230,	.3150,
3,	.3100,	.3180,	.3560,	.3520,	.3440,	.3540,	.3300,	.3380,	.3530,	.3690,
4,	.3330,	.3560,	.4030,	.4280,	.4050,	.4050,	.4200,	.3750,	.3800,	.3970,
5,	.3590,	.4190,	.4480,	.4930,	.4860,	.4760,	.4950,	.5130,	.4180,	.4380,
6,	.4120,	.4430,	.5140,	.5410,	.5390,	.5540,	.5870,	.5940,	.5560,	.4910,
7,	.5730,	.4990,	.5420,	.6080,	.6050,	.6090,	.6360,	.6410,	.6470,	.6090,
8,	.6550,	.6720,	.6070,	.6460,	.6270,	.6930,	.7030,	.7050,	.7210,	.6870,
9,	.6580,	.7440,	.6990,	.6740,	.6770,	.7070,	.7830,	.7410,	.7150,	.7760,
10,	.6940,	.7620,	.7240,	.7850,	.7290,	.7790,	.8530,	.8130,	.7910,	.7810,
11,	.8100,	.7800,	.8180,	.8410,	.9780,	.8490,	.8540,	.8510,	.8980,	.8860,
12,	.8380,	.8920,	.8480,	.9010,	.9070,	.9710,	.9830,	.9280,	.9700,	.9830,
13,	1.0220,	.9410,	.9220,	.9000,	.9420,	1.0020,	.9530,	1.0190,	.8550,	1.0390,
14,	.8630,	1.0210,	1.0040,	.9640,	.9830,	1.0400,	1.1380,	1.0090,	1.0630,	.9330,
+gp,	1.1790,	1.1280,	1.1330,	1.1920,	1.0790,	1.2240,	1.2640,	1.1590,	1.1650,	1.0940,
0 SOPCOFAC,	1.0582,	.9744,	1.0331,	1.0283,	1.0508,	1.0369,	1.0624,	1.0254,	1.0016,	.9643,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.2350,	.2380,	.2370,	.2790,	.2000,	.2330,	.2470,	.2210,	.2210,	.2210,
2,	.3110,	.2860,	.2740,	.2620,	.2500,	.2630,	.2640,	.2690,	.2490,	.2540,
3,	.3490,	.3440,	.3290,	.3110,	.3000,	.2830,	.2900,	.3040,	.3000,	.2780,
4,	.3880,	.4010,	.4160,	.4240,	.3830,	.3750,	.3370,	.3470,	.3510,	.3520,
5,	.4290,	.4730,	.5050,	.5140,	.5150,	.4910,	.4620,	.4250,	.4020,	.4530,
6,	.4740,	.5450,	.5580,	.6080,	.6040,	.6130,	.5770,	.4880,	.5040,	.5120,
7,	.5500,	.5880,	.6040,	.6640,	.6770,	.6840,	.6780,	.6750,	.5830,	.6080,
8,	.6750,	.6620,	.6420,	.7120,	.7710,	.7250,	.7290,	.7510,	.7280,	.6990,
9,	.7960,	.7720,	.7250,	.7380,	.8150,	.8370,	.8040,	.8530,	.8290,	.8130,
10,	.8710,	.9310,	.8690,	.8400,	.8930,	.9160,	.9000,	.9210,	.8260,	.9360,
11,	.8180,	.9430,	.9500,	.9830,	.9130,	.9810,	1.0010,	.9480,	.9960,	.9640,
12,	.8940,	.8480,	.9310,	1.0450,	.9840,	1.0260,	.9500,	1.0630,	1.0150,	1.0410,
13,	1.0830,	1.0150,	.9330,	1.1740,	1.2400,	1.1120,	1.0710,	1.0780,	1.0450,	1.1370,
14,	1.0440,	1.3080,	1.1790,	.9700,	1.2090,	1.2500,	1.1390,	1.0740,	1.1270,	1.1150,
+gp,	1.1150,	1.2480,	1.2360,	1.1770,	1.1670,	1.2140,	1.2150,	1.1100,	1.1500,	1.0380,
0 SOPCOFAC,	.9983,	1.0136,	1.0175,	1.0062,	.9938,	.9844,	.9799,	.9877,	.9875,	.9848,

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.2360,	.2710,	.2270,	.2510,	.2490,	.2330,	.2720,	.2400,	.2080,	.1520,
2,	.2800,	.2850,	.2860,	.2630,	.2730,	.2630,	.2770,	.2800,	.2710,	.2600,
3,	.3090,	.2980,	.2950,	.2910,	.2900,	.2870,	.3020,	.3100,	.3140,	.3120,
4,	.3320,	.3180,	.3070,	.3200,	.3270,	.3390,	.3410,	.3610,	.3660,	.3980,
5,	.3920,	.3680,	.3670,	.3440,	.3580,	.3920,	.4030,	.4280,	.4470,	.5010,
6,	.5330,	.4480,	.4560,	.4270,	.4240,	.4400,	.4500,	.4910,	.5110,	.6020,
7,	.6030,	.5960,	.5280,	.5310,	.5190,	.4960,	.5170,	.5030,	.5570,	.6260,
8,	.6700,	.6870,	.6640,	.6030,	.6180,	.5910,	.5880,	.5720,	.5310,	.6770,
9,	.7920,	.7520,	.7380,	.7040,	.6930,	.6960,	.7030,	.6910,	.6350,	.6740,
10,	.8190,	.8170,	.8220,	.7370,	.7550,	.7320,	.8190,	.8080,	.7540,	.7190,
11,	.9230,	1.0250,	.9020,	.8090,	.7710,	.8560,	.7750,	.8400,	.8550,	.8880,
12,	.9520,	1.0770,	.9170,	.9240,	.8730,	.8700,	.8220,	.8490,	.8770,	.9810,
13,	1.1570,	1.0960,	.9790,	.9690,	.8250,	.9210,	.8670,	.8160,	.8380,	.8210,
14,	1.0840,	.9680,	.9440,	.8790,	.8700,	.7870,	.8720,	.7840,	.9920,	.8750,
+gp,	.9940,	1.0750,	1.0040,	1.0590,	1.0360,	.9790,	1.0360,	.8510,	1.0330,	.9110,
0 SOPCOFAC,	.9854,	.9827,	.9644,	.9827,	.9791,	.9858,	.9977,	.9854,	.9862,	.9858,

Table 9.5 North Sea plaice, stock weights at age (kg) derived from 1st quarter catch weights

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Run title : Plaice in IV (run: XSAMAP09/X09)

      At: 14/10/1999  17:02

      Table  3    Stock weights at age (kg)
```

YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,
2,	.1460,	.1900,	.1260,	.1870,	.2000,	.2000,	.2000,	.2000,	.2030,	.2000,
3,	.1940,	.2080,	.2020,	.2580,	.2320,	.2280,	.2460,	.2430,	.2460,	.2650,
4,	.2400,	.2400,	.2540,	.3060,	.2900,	.2760,	.2740,	.3010,	.2810,	.3010,
5,	.3290,	.3640,	.3370,	.4240,	.3780,	.3730,	.3330,	.4030,	.4420,	.3440,
6,	.4700,	.4690,	.4830,	.5730,	.5400,	.4770,	.4300,	.4550,	.5280,	.5320,
7,	.6500,	.6330,	.5790,	.6840,	.6630,	.6450,	.5160,	.5030,	.5850,	.5920,
8,	.6860,	.7260,	.6910,	.8060,	.7880,	.6730,	.6010,	.5650,	.6500,	.3620,
9,	.9080,	.8450,	.7790,	.8730,	.8820,	.8450,	.7220,	.5810,	.7030,	.6670,
10,	.8970,	.9180,	.9110,	1.3350,	.9610,	.9730,	.5780,	.8480,	.8330,	.7460,
11,	.9010,	.9750,	.9470,	1.0740,	1.0970,	.9990,	.7900,	.9490,	.9070,	.7910,
12,	1.1380,	1.1260,	1.0790,	1.2400,	1.2610,	1.2550,	.8430,	.7040,	1.0070,	.9190,
13,	1.4100,	1.1480,	1.1840,	1.1410,	1.2460,	1.2010,	1.0720,	1.0520,	.8980,	.8100,
14,	.9450,	1.3730,	1.1860,	1.8000,	1.4030,	1.6200,	.7210,	1.0560,	.9760,	.9380,
+gp,	1.3400,	1.5220,	1.4240,	1.6190,	1.6780,	1.4600,	1.2340,	1.2160,	1.2210,	1.1700,

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.1750,	.1750,	.1750,	.1750,	.1750,	.1700,	.1700,	.1700,	.1600,	.1500,
2,	.2030,	.2500,	.2480,	.2740,	.2640,	.2340,	.2750,	.2170,	.2500,	.2420,
3,	.2580,	.2610,	.3050,	.3210,	.3220,	.3040,	.2940,	.2810,	.3090,	.3360,
4,	.2970,	.3110,	.3630,	.4010,	.3800,	.3750,	.4170,	.3320,	.3640,	.3670,
5,	.3440,	.3690,	.4130,	.4730,	.4680,	.4370,	.4830,	.4840,	.4050,	.4110,
6,	.3900,	.4100,	.4890,	.5340,	.5210,	.5240,	.5440,	.5500,	.5510,	.4670,
7,	.5650,	.4680,	.5120,	.5790,	.5660,	.5700,	.6100,	.5930,	.6270,	.5470,
8,	.6210,	.6360,	.5830,	.6060,	.5830,	.6290,	.6680,	.6580,	.6900,	.6300,
9,	.6790,	.7320,	.6960,	.6550,	.6170,	.6520,	.7040,	.6940,	.6670,	.7040,
10,	.6350,	.7470,	.7070,	.7590,	.6900,	.6900,	.7620,	.7430,	.7590,	.7730,
11,	.7720,	.7710,	.8170,	.8150,	.9260,	.7740,	.8300,	.7840,	.8180,	.8480,
12,	.7410,	.8980,	.8470,	.8690,	.8990,	.9320,	.8860,	.8750,	.9090,	.9390,
13,	.9950,	.8390,	.9410,	.8490,	.9610,	1.0170,	.8740,	.9720,	.8380,	.9590,
14,	.9070,	1.1550,	.9360,	.9710,	.9770,	.9620,	1.0700,	1.1580,	1.0550,	1.0240,
+gp,	1.1790,	1.1750,	1.1020,	1.2370,	.9980,	1.1130,	1.2170,	1.1070,	1.1160,	1.1190,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,
2,	.2430,	.2290,	.2500,	.2420,	.2110,	.2030,	.2080,	.1950,	.1940,	.2120,
3,	.3030,	.3070,	.2820,	.2650,	.2480,	.2420,	.2430,	.2530,	.2650,	.2380,
4,	.3630,	.3720,	.3780,	.3810,	.3290,	.3380,	.3100,	.3360,	.3300,	.3150,
5,	.4140,	.4440,	.4730,	.4900,	.4940,	.4640,	.4520,	.4400,	.4010,	.4260,
6,	.4590,	.5240,	.5360,	.5890,	.5590,	.5710,	.5360,	.5330,	.5030,	.4670,
7,	.5430,	.5820,	.5700,	.6310,	.6240,	.6490,	.6350,	.6920,	.5730,	.5470,
8,	.6670,	.6510,	.6240,	.6790,	.7120,	.6920,	.6560,	.7790,	.7110,	.6440,
9,	.7640,	.7780,	.7070,	.7260,	.7540,	.7870,	.7640,	.8880,	.7470,	.7060,
10,	.8260,	1.0250,	.8490,	.8280,	.7910,	.8980,	.8690,	.9710,	.8170,	.8970,
11,	.8940,	.9470,	.9100,	.9810,	.8240,	.9320,	.9550,	.9530,	1.0090,	.9370,
12,	.8800,	.8380,	.8660,	1.0660,	1.0110,	1.0420,	.9060,	1.1070,	1.0180,	1.0090,
13,	1.1270,	1.2090,	1.1140,	1.1820,	1.1300,	1.2350,	1.0680,	1.1530,	1.0190,	1.0650,
14,	1.0410,	1.1940,	1.2180,	.8970,	1.2570,	1.1270,	1.1080,	1.1260,	1.2140,	1.1350,
+gp,	1.2550,	1.3100,	1.3240,	1.1970,	1.1240,	1.2350,	1.3080,	1.3540,	1.1140,	.9720,

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.1500,	.1500,	.1310,	.1310,	.1310,	.1310,	.1240,	.1240,	.1240,	.1240,
2,	.2150,	.2450,	.2080,	.2620,	.2570,	.2220,	.2450,	.2450,	.2120,	.2050,
3,	.2480,	.2720,	.2630,	.2670,	.2640,	.2490,	.2650,	.2830,	.2530,	.2700,
4,	.2820,	.2820,	.2760,	.3010,	.3020,	.3010,	.3120,	.3300,	.3460,	.3650,
5,	.3620,	.3430,	.3420,	.3180,	.3300,	.3600,	.3990,	.3900,	.4390,	.4740,
6,	.4840,	.4220,	.4010,	.4030,	.3910,	.4040,	.4480,	.4620,	.4920,	.5770,
7,	.5530,	.5550,	.4630,	.5000,	.4900,	.4620,	.5090,	.4880,	.5210,	.5810,
8,	.6160,	.6470,	.6330,	.5730,	.5870,	.5330,	.5840,	.5540,	.5430,	.6480,
9,	.7590,	.7010,	.6520,	.6830,	.6330,	.6530,	.6780,	.6600,	.6270,	.6560,
10,	.8370,	.7600,	.7440,	.7300,	.7230,	.7020,	.7890,	.7910,	.7340,	.6420,
11,	.7910,	1.0170,	.8240,	.8030,	.7640,	.8640,	.6690,	.7950,	.8470,	.9240,
12,	.9680,	1.1440,	.9600,	.8520,	.9140,	.8790,	.8200,	.8450,	.8300,	1.0030,
13,	1.2150,	.9960,	.9510,	.9580,	.7980,	.9390,	.8520,	.7250,	.8240,	.7360,
14,	.8990,	1.0460,	.8250,	.7740,	.8220,	.7010,	.9000,	.7630,	1.1170,	1.1430,
+gp,	.8570,	1.0680,	.8910,	1.0160,	.9690,	.8880,	1.1100,	.8960,	1.0220,	.8050,

Table 9.6 North Sea plaice: tuning fleets

Plaice Sub-area IV (run name: XSAMAP09)
104
FLT01: NL Beam Trawl[1)] (Catch: Unknown) (Effort: Unknown)
1989 1998
1 1 0.00 1.00
2 9

72.5	40443	73696	131915	23064	9634	5240	2715	947
71.1	21956	60038	49862	76521	12187	3682	1790	1161
68.5	27501	42376	53152	30697	34092	6879	1954	1137
71.1	24271	44306	31854	27165	12219	9485	2464	993
76.9	27552	46536	31333	19705	10984	6040	3611	1025
81.4	30194	48106	35901	15371	7938	6174	2866	1929
81.2	22519	43505	33883	14453	6575	3418	1549	931
72.1	26600	27628	20922	13980	5313	3644	1366	944
72.0	23098	45655	18156	6884	4337	2016	975	460
70.3	15288	32486	26751	6389	2290	1359	669	314

FLT02: UK Beamtrawl[2)] (Catch: Unknown) (Effort: Unknown)
1988 1998
1 1 0.00 1.00
4 12

123.3	4756	4471	2719	2852	585	439	249	229	231
150.5	11964	4463	2897	1796	2311	448	506	330	262
151.0	3652	12539	2360	1497	954	1113	332	224	129
197.8	4101	5352	9984	2004	1266	647	923	343	277
248.9	5123	7829	4907	6470	1705	983	855	874	293
276.5	7576	6747	5579	2035	4136	1400	881	787	563
250.2	6973	6633	4068	2874	1362	1950	988	435	368
222.1	8808	4082	3635	2512	1529	818	931	707	353
188.2	3352	4790	2700	2535	1646	1177	628	833	495
173.0	3348	2256	2848	1601	1835	1349	564	396	611
164.2	3931	2161	1493	1447	840	1004	767	324	266

FLT03: BTS-ISIS new 1999[3)] (Catch: Unknown) (Effort: Unknown)
1985 1998
1 1 0.66 0.75
1 4

1	115.52	179.92	38.81	11.82
1	660.20	131.77	50.87	8.93
1	225.14	764.98	33.07	4.79
1	605.15	139.90	173.21	9.22
1	426.65	333.52	39.13	47.56
1	106.99	99.83	57.68	24.81
1	184.38	122.08	28.55	11.85
1	172.83	125.66	27.27	5.61
1	122.60	180.98	38.79	6.13
1	141.70	65.66	37.42	11.93
1	249.42	43.33	14.08	8.21
1	215.96	215.04	21.74	4.84
1	-11.00	-11.00	19.85	3.13
1	347.61	422.17	52.12	8.20

FLT04: SNS September survey[4)] (Catch: Unknown) (Effort: Unknown)
1982 1998
1 1 0.66 0.75
1 3

1	70108	8503	1146
1	34884	14708	308
1	44667	10413	2480
1	27832	13789	1584
1	93573	7558	1155
1	33426	33021	1232
1	36672	14430	13140
1	37238	14952	3709
1	24903	7287	3248
1	57349	11149	1507
1	48223	13742	2257
1	22184	9484	988
1	18225	4866	884
1	24900	2786	415
1	24663	10377	1189
1	-11	-11	1393
1	33391	29431	5739

[1)] Effort is specified in HP days (*100,000), catchnumbers in thousands. Source: RIVO-DLO.
[2)] Effort specified in HP fishing hours (millions), catchnumbers in thousands. Source: CEFAS.
[3)] Revised series. Source: RIVO-DLO.
[4)] Source: RIVO-DLO.

Table 9.7 North Sea plaice: effort and CPUE trends for the NL and UK commercial beamtrawl fleets

	Effort		CPUE	
Fleet	NL beam	UK beam	NL beam	UK beam
Unit	HP days * 100000	HP Fishing hours	tonnes / (100,000 HP days)	tonnes / HP fish hour
1979	44.3		1693	
1980	45.0		1729	
1981	46.3		1853	
1982	57.3		1707	
1983	65.6		1441	
1984	70.8		1439	
1985	70.3	23.7	1511	78
1986	68.2	49.7	1651	79
1987	68.4	93.5	1440	88
1988	76.2	123.3	1194	91
1989	72.5	150.5	1379	87
1990	71.1	151.0	1104	81
1991	68.5	197.8	1022	69
1992	71.1	248.9	745	67
1993	76.9	276.5	656	60
1994	81.4	250.2	626	64
1995	81.2	222.1	565	57
1996	72.1	188.2	510	61
1997	72.0	173.0	492	73
1998	70.3	164.2	451	63

Table 9.8. North Sea plaice: summary of XSA setttings

Assessment year	**1998**				**1999**			
		years	ages	alpha-beta		years	ages	alpha-beta
Tuning fleets	NL BT cpue	88-97	**2-9**	0-1	NL BT cpue	89-98	2-9	0-1
	UK BT cpue	88-97	**4-12**	0-1	UK BT cpue	89-98	4-12	0-1
	BTS-ISIS	88-97	**1-7**	0.66-0.75	BTS-ISIS*	89-98	1-7	0.66-0.75
	SNS	88-97	1-3	0.66-0.75	SNS*	89-98	1-3	0.66-0.75
First tuning year	1988				1989			
Last datayear	1997				1998			
Time series weights	none				none			
Catchability dependent on stock size for age <	4				1			
Catchability independent of age for ages >=	10				10			
Survivor estimates shrunk towards mean F	5 years / 5 ages				5 years / 5 ages			
s.e. of the means	0.5				0.5			
Minimum standard error for pop. estimates	0.3				0.3			
Prior weighting	none				none			

* 1997 values ages 1 and 2 not used.

Table 9.9. North Sea plaice: XSA diagnostics

```
Lowestoft VPA Version 3.1
   14/10/1999  17:02
 Extended Survivors Analysis
 Plaice in IV (run: XSAMAP09/X09)

 CPUE data from file fleet

 Catch data for  42 years. 1957 to 1998. Ages  1 to  15.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 FLT01: NL Beam Trawl,   1989, 1998,   2,     9,   .000,  1.000
 FLT02: UK Beamtrawl ,   1989, 1998,   4,    12,   .000,  1.000
 FLT03: BTS-ISIS new ,   1989, 1998,   1,     4,   .660,   .750
 FLT04: SNS September,   1989, 1998,   1,     3,   .660,   .750


 Time series weights :

      Tapered time weighting not applied


 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=   10


 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 =    .500

      Minimum standard error for population
      estimates derived from each fleet =    .300

      Prior weighting not applied


 Tuning converged after   56 iterations

1


 Regression weights
       , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
```

Table 9.9. (continued)

Fishing mortalities

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.003	.004	.004	.008	.012	.006	.021	.003	.002	.001
2	.101	.094	.130	.130	.157	.193	.175	.138	.114	.101
3	.298	.275	.326	.355	.423	.450	.564	.454	.430	.290
4	.493	.506	.536	.460	.523	.668	.693	.651	.724	.509
5	.515	.668	.658	.681	.631	.552	.660	.638	.729	.540
6	.484	.476	.722	.650	.593	.521	.494	.569	.645	.457
7	.429	.358	.476	.611	.536	.646	.474	.564	.620	.439
8	.384	.284	.373	.390	.488	.478	.385	.417	.625	.405
9	.263	.293	.313	.375	.357	.410	.318	.418	.378	.428
10	.354	.204	.301	.372	.394	.379	.221	.367	.276	.270
11	.266	.239	.249	.314	.380	.315	.281	.245	.213	.190
12	.238	.194	.303	.360	.312	.307	.259	.268	.223	.206
13	.292	.166	.214	.452	.528	.308	.197	.308	.256	.211
14	.283	.220	.228	.544	.377	.527	.230	.326	.268	.187

1

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9	10
1989	4.14E+05	5.14E+05	4.32E+05	6.25E+05	1.38E+05	5.28E+04	3.18E+04	2.50E+04	9.65E+03	5.97E+03
1990	4.02E+05	3.74E+05	4.20E+05	2.90E+05	3.46E+05	7.47E+04	2.94E+04	1.88E+04	1.54E+04	6.71E+03
1991	3.96E+05	3.63E+05	3.08E+05	2.89E+05	1.58E+05	1.60E+05	4.20E+04	1.86E+04	1.28E+04	1.04E+04
1992	4.00E+05	3.57E+05	2.88E+05	2.01E+05	1.53E+05	7.41E+04	7.05E+04	2.36E+04	1.16E+04	8.46E+03
1993	2.80E+05	3.59E+05	2.84E+05	1.83E+05	1.15E+05	7.00E+04	3.50E+04	3.46E+04	1.45E+04	7.22E+03
1994	2.44E+05	2.50E+05	2.78E+05	1.68E+05	9.81E+04	5.53E+04	3.50E+04	1.85E+04	1.92E+04	9.15E+03
1995	3.46E+05	2.20E+05	1.87E+05	1.60E+05	7.81E+04	5.11E+04	2.97E+04	1.66E+04	1.04E+04	1.15E+04
1996	3.68E+05	3.06E+05	1.67E+05	9.61E+04	7.25E+04	3.65E+04	2.82E+04	1.67E+04	1.02E+04	6.84E+03
1997	3.36E+05	3.32E+05	2.42E+05	9.58E+04	4.54E+04	3.47E+04	1.87E+04	1.45E+04	9.98E+03	6.09E+03
1998	1.24E+05	3.03E+05	2.68E+05	1.42E+05	4.20E+04	1.98E+04	1.65E+04	9.10E+03	7.03E+03	6.19E+03

Estimated population abundance at 1st Jan 1999

	0.00E+00	1.12E+05	2.48E+05	1.81E+05	7.73E+04	2.22E+04	1.13E+04	9.60E+03	5.49E+03	4.15E+03

Taper weighted geometric mean of the VPA populations:

	4.01E+05	3.66E+05	3.01E+05	1.97E+05	1.15E+05	6.54E+04	3.97E+04	2.52E+04	1.69E+04	1.17E+04

Standard error of the weighted Log(VPA populations) :

	.4206	.3944	.3964	.4252	.4771	.4859	.4700	.4893	.5197	.5542

YEAR	AGE 11	12	13	14
1989	4.18E+03	3.13E+03	1.85E+03	1.40E+03
1990	3.79E+03	2.90E+03	2.23E+03	1.25E+03
1991	4.96E+03	2.70E+03	2.16E+03	1.71E+03
1992	6.96E+03	3.50E+03	1.80E+03	1.58E+03
1993	5.28E+03	4.60E+03	2.21E+03	1.04E+03
1994	4.41E+03	3.26E+03	3.04E+03	1.18E+03
1995	5.67E+03	2.91E+03	2.17E+03	2.02E+03
1996	8.38E+03	3.87E+03	2.03E+03	1.61E+03
1997	4.28E+03	5.93E+03	2.68E+03	1.35E+03
1998	4.18E+03	3.13E+03	4.30E+03	1.88E+03

Estimated population abundance at 1st Jan 1999

	4.28E+03	3.13E+03	2.31E+03	3.15E+03

Taper weighted geometric mean of the VPA populations:

	8.13E+03	5.72E+03	3.94E+03	2.70E+03

Standard error of the weighted Log(VPA populations) :

	.5895	.5947	.6046	.6410

1

Table 9.9. (continued)

Log catchability residuals.

Fleet : FLT01: NL Beam Trawl

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	.03	-.25	.06	-.09	-.03	.38	.21	.15	-.08	-.39
3	.02	-.15	-.12	-.04	-.02	-.01	.34	.07	.19	-.29
4	.08	-.10	.02	-.20	-.17	.05	.06	.19	.08	.00
5	-.09	.28	.18	.07	-.07	-.25	-.03	.12	-.08	-.14
6	.17	.07	.48	.16	.00	-.17	-.29	-.02	-.13	-.27
7	.18	-.10	.26	.08	.22	.23	-.27	.01	-.15	-.47
8	.12	-.04	.13	.10	.07	.40	-.15	-.15	-.25	-.23
9	.22	-.01	.20	.16	-.12	.20	.04	.24	-.47	-.46
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									

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
Mean Log q	-6.7542	-5.8814	-5.6369	-5.6953	-5.8734	-6.0189	-6.3884	-6.6505
S.E(Log q)	.2228	.1773	.1225	.1610	.2345	.2441	.2019	.2710

Regression statistics :

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	1.66	-1.296	2.82	.32	10	.36	-6.75
3	1.45	-1.749	2.90	.66	10	.23	-5.88
4	1.05	-.678	5.29	.95	10	.13	-5.64
5	.86	2.359	6.52	.97	10	.11	-5.70
6	.75	3.742	7.13	.97	10	.11	-5.87
7	.71	2.558	7.27	.91	10	.14	-6.02
8	.76	1.892	7.22	.89	10	.14	-6.39
9	.70	1.444	7.47	.74	10	.18	-6.65

1

Fleet : FLT02: UK Beamtrawl

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	-.14	-.55	-.69	-.37	.04	.20	.62	.31	.43	.15
5	-.18	.00	-.34	-.15	-.14	.07	-.02	.37	.21	.21
6	.07	-.49	.03	-.17	-.12	-.13	-.06	.18	.40	.29
7	.00	-.14	-.42	.06	-.53	-.04	.04	.30	.36	.36
8	.33	-.32	-.25	-.42	.03	-.36	-.06	.18	.61	.25
9	-.40	.06	-.56	-.25	-.23	-.06	-.23	.36	.59	.72
10	.21	-.40	-.04	-.11	-.01	-.04	-.29	.08	.13	.47
11	.10	-.20	-.31	.09	.18	-.16	.18	.10	.09	-.04
12	.15	-.51	.11	-.30	-.05	-.03	.14	.36	.21	.06

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8	9	10	11	12
Mean Log q	-8.5508	-7.9732	-7.7072	-7.6357	-7.4942	-7.5108	-7.4768	-7.4768	-7.4768
S.E(Log q)	.4298	.2152	.2557	.3046	.3427	.4254	.2456	.1721	.2537

Regression statistics :

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
4	1.96	-2.346	5.10	.43	10	.69	-8.55
5	1.27	-2.226	7.02	.90	10	.23	-7.97
6	1.37	-2.051	6.54	.80	10	.30	-7.71
7	1.65	-1.725	5.88	.47	10	.45	-7.64
8	1.42	-.898	6.52	.37	10	.49	-7.49
9	3.32	-1.496	3.21	.05	10	1.32	-7.51
10	2.34	-1.857	5.51	.19	10	.51	-7.48
11	.78	1.309	7.71	.81	10	.13	-7.47
12	.77	.829	7.62	.63	10	.20	-7.46

1

Table 9.9. (continued)

Fleet : FLT03: BTS-ISIS new

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.48	-.87	-.31	-.38	-.37	-.09	.14	-.08	99.99	1.48
2	.38	-.51	-.25	-.21	.17	-.46	-.76	.49	99.99	1.15
3	-.28	.12	-.23	-.19	.22	.23	-.27	.20	-.28	.48
4	.37	.50	-.21	-.65	-.43	.43	.12	.07	-.31	.11
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4
Mean Log q	-7.2873	-7.5812	-8.7523	-9.4394
S.E(Log q)	.6718	.5993	.2807	.3875

Regression statistics :

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
1	-3.66	-2.941	32.30	.05	9	1.76	-7.29
2	.56	.902	9.83	.38	9	.34	-7.58
3	1.09	-.253	8.41	.49	10	.32	-8.75
4	.82	.917	9.92	.77	10	.32	-9.44

1

Fleet : FLT04: SNS September

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.08	-.45	.40	.22	-.20	-.26	-.29	-.37	99.99	1.02
2	-.02	-.43	.06	.28	-.08	-.36	-.80	.16	99.99	1.18
3	.31	.18	-.24	.25	-.51	-.58	-.86	.23	.00	1.21
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3
Mean Log q	-2.2593	-3.3755	-4.7820
S.E(Log q)	.4725	.5546	.5876

Regression statistics :

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
1	4.19	-2.157	-30.86	.06	9	1.64	-2.26
2	.64	.679	6.72	.34	9	.37	-3.38
3	.69	.666	7.18	.37	10	.42	-4.78

1

Table 9.9. (continued)

```
 Terminal year survivor and F summaries :

 Age  1   Catchability constant w.r.t. time and dependent on age

 Year class = 1997

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT02: UK Beamtrawl ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: BTS-ISIS new ,    493076.,   .708,       .000,    .00,   1,  .199,     .000
 FLT04: SNS September,    310334.,   .498,       .000,    .00,   1,  .402,     .001

   F shrinkage mean  ,     19073.,    .50,,,,                        .399,     .009

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    111691.,       .32,     1.32,    3,   4.180,   .001


1
 Age  2   Catchability constant w.r.t. time and dependent on age

 Year class = 1996

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,    168373.,   .300,       .000,    .00,   1,  .530,     .146
 FLT02: UK Beamtrawl ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: BTS-ISIS new ,    780171.,   .632,       .000,    .00,   1,  .119,     .033
 FLT04: SNS September,    810953.,   .585,       .000,    .00,   1,  .140,     .032

   F shrinkage mean  ,    156966.,    .50,,,,                        .211,     .156

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    248138.,       .22,      .40,    4,   1.833,   .101


 Age  3   Catchability constant w.r.t. time and dependent on age

 Year class = 1995

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,    149458.,   .212,       .105,    .49,   2,  .462,     .342
 FLT02: UK Beamtrawl ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: BTS-ISIS new ,    271889.,   .276,       .194,    .70,   2,  .283,     .202
 FLT04: SNS September,    244837.,   .388,       .783,   2.02,   2,  .137,     .223

   F shrinkage mean  ,    102823.,    .50,,,,                        .118,     .466

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    181290.,       .15,      .19,    7,   1.287,   .290


1
 Age  4   Catchability constant w.r.t. time and dependent on age

 Year class = 1994

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,     85069.,   .179,       .061,    .34,   3,  .427,     .472
 FLT02: UK Beamtrawl ,     89891.,   .451,       .000,    .00,   1,  .085,     .452
 FLT03: BTS-ISIS new ,     74761.,   .221,       .144,    .65,   4,  .274,     .523
 FLT04: SNS September,     72258.,   .324,       .133,    .41,   3,  .097,     .537

   F shrinkage mean  ,     55536.,    .50,,,,                        .115,     .654

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     77293.,       .12,      .06,   12,    .515,   .509
```

Table 9.9. (continued)

```
 Age  5   Catchability constant w.r.t. time and dependent on age

 Year class = 1993

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,     21924.,   .173,       .076,    .44,   4,  .428,     .545
 FLT02: UK Beamtrawl ,     28347.,   .259,       .084,    .32,   2,  .253,     .445
 FLT03: BTS-ISIS new ,     20016.,   .222,       .177,    .80,   4,  .141,     .584
 FLT04: SNS September,     17021.,   .324,       .281,    .87,   3,  .049,     .659

   F shrinkage mean  ,     17534.,    .50,,,,                        .129,     .645

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     22168.,       .12,      .07,   14,    .546,   .540


1
 Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 1992

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,     10418.,   .173,       .115,    .66,   5,  .434,     .489
 FLT02: UK Beamtrawl ,     14761.,   .211,       .028,    .13,   3,  .347,     .368
 FLT03: BTS-ISIS new ,      9762.,   .225,       .112,    .50,   4,  .071,     .515
 FLT04: SNS September,      7207.,   .324,       .201,    .62,   3,  .023,     .648

   F shrinkage mean  ,      8624.,    .50,,,,                        .124,     .566

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     11334.,       .12,      .07,   16,    .563,   .457


 Age  7   Catchability constant w.r.t. time and dependent on age

 Year class = 1991

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,      7561.,   .168,       .105,    .62,   6,  .451,     .531
 FLT02: UK Beamtrawl ,     14087.,   .192,       .028,    .15,   4,  .374,     .319
 FLT03: BTS-ISIS new ,     11026.,   .221,       .087,    .39,   4,  .042,     .392
 FLT04: SNS September,      8571.,   .324,       .236,    .73,   3,  .015,     .481

   F shrinkage mean  ,      6888.,    .50,,,,                        .120,     .570

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      9602.,       .12,      .09,   18,    .711,   .439


1
 Age  8   Catchability constant w.r.t. time and dependent on age

 Year class = 1990

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,      4737.,   .164,       .038,    .23,   7,  .480,     .457
 FLT02: UK Beamtrawl ,      7007.,   .186,       .054,    .29,   5,  .367,     .331
 FLT03: BTS-ISIS new ,      6864.,   .220,       .133,    .60,   4,  .025,     .336
 FLT04: SNS September,      6010.,   .324,       .281,    .87,   3,  .009,     .376

   F shrinkage mean  ,      4452.,    .50,,,,                        .119,     .480

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      5492.,       .12,      .05,   20,    .431,   .405
```

Table 9.9. (continued)

Age 9 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL Beam Trawl,	3077.,	.158,	.064,	.40,	8,	.521,	.542
FLT02: UK Beamtrawl ,	6479.,	.188,	.128,	.68,	6,	.323,	.294
FLT03: BTS-ISIS new ,	2972.,	.219,	.107,	.49,	4,	.022,	.557
FLT04: SNS September,	3793.,	.324,	.217,	.67,	3,	.008,	.460
F shrinkage mean ,	4832.,	.50,,,,				.126,	.377

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
4147.,	.12,	.09,	22,	.726,	.428

1

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL Beam Trawl,	3194.,	.148,	.057,	.38,	8,	.397,	.347
FLT02: UK Beamtrawl ,	5842.,	.168,	.102,	.60,	7,	.473,	.204
FLT03: BTS-ISIS new ,	3001.,	.218,	.177,	.81,	4,	.019,	.365
FLT04: SNS September,	3405.,	.323,	.102,	.32,	3,	.007,	.328
F shrinkage mean ,	3408.,	.50,,,,				.104,	.328

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
4276.,	.11,	.08,	23,	.684,	.270

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL Beam Trawl,	3425.,	.155,	.065,	.42,	8,	.290,	.175
FLT02: UK Beamtrawl ,	3239.,	.159,	.053,	.33,	8,	.595,	.184
FLT03: BTS-ISIS new ,	3207.,	.228,	.141,	.62,	3,	.010,	.186
FLT04: SNS September,	3395.,	.425,	.102,	.24,	2,	.002,	.177
F shrinkage mean ,	1965.,	.50,,,,				.102,	.288

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3128.,	.12,	.05,	22,	.412,	.190

1

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL Beam Trawl,	2746.,	.158,	.062,	.39,	7,	.218,	.176
FLT02: UK Beamtrawl ,	2283.,	.146,	.063,	.43,	9,	.674,	.208
FLT03: BTS-ISIS new ,	2432.,	.244,	.384,	1.57,	2,	.007,	.196
FLT04: SNS September,	3131.,	.616,	.000,	.00,	1,	.001,	.156
F shrinkage mean ,	1672.,	.50,,,,				.100,	.274

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2306.,	.12,	.05,	20,	.423,	.206

Table 9.9. (continued)

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL Beam Trawl,	3712.,	.165,	.049,	.30,	6,	.207,	.182
FLT02: UK Beamtrawl ,	3262.,	.146,	.065,	.44,	9,	.667,	.204
FLT03: BTS-ISIS new ,	4571.,	.406,	.000,	.00,	1,	.003,	.150
FLT04: SNS September,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	1959.,	.50,,,,				.123,	.320

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3149.,	.12,	.06,	17,	.524,	.211

1

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: NL Beam Trawl,	1445.,	.157,	.070,	.45,	5,	.201,	.183
FLT02: UK Beamtrawl ,	1538.,	.146,	.104,	.71,	8,	.638,	.173
FLT03: BTS-ISIS new ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: SNS September,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	970.,	.50,,,,				.162,	.262

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1410.,	.13,	.08,	14,	.635,	.187

Table 9.10. North Sea plaice: fishing mortality

Run title : Plaice in IV (run: XSAMAP09/X09)   At 14/10/1999 17:03

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
AGE										
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0458	.0161	.0065	.0070	.0159	.0557	.0113	.0157	.0230	.0405
3	.1458	.2150	.1059	.1215	.0804	.1811	.2006	.0862	.1366	.1925
4	.2472	.3439	.3437	.2837	.3654	.3270	.3401	.3560	.1898	.2276
5	.3336	.3001	.3435	.4067	.3497	.4522	.3403	.3691	.4778	.2914
6	.3146	.3439	.2633	.3365	.4344	.3794	.4033	.3295	.3520	.3290
7	.2857	.2913	.2793	.2697	.3221	.3554	.2909	.3573	.2943	.2467
8	.2001	.2710	.2968	.2474	.2984	.2428	.2944	.2474	.2617	.2694
9	.2273	.2161	.2599	.2306	.2770	.2534	.2157	.3369	.2151	.1769
10	.2391	.2250	.1992	.2077	.2365	.2112	.3880	.2365	.2337	.2142
11	.2482	.2112	.2412	.2082	.3110	.2666	.2130	.2750	.1981	.2449
12	.3095	.2482	.2478	.2091	.2277	.2406	.2805	.2724	.2030	.2050
13	.2444	.2499	.2575	.2426	.2704	.2265	.3221	.3034	.1944	.1696
14	.2543	.2306	.2416	.2201	.2651	.2402	.2845	.2855	.2093	.2025
+gp	.2543	.2306	.2416	.2201	.2651	.2402	.2845	.2855	.2093	.2025
0 FBAR 2-10	.2266	.2469	.2331	.2345	.2644	.2731	.2761	.2594	.2427	.2209
FBARC	.2434	.2815	.2822	.2839	.3224	.3037	.3025	.3091	.2927	.2341
FBARP	.1430	.1535	.1396	.1407	.1479	.1653	.1571	.1462	.1424	.1422

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE										
1	.0000	.0002	.0001	.0100	.0025	.0052	.0031	.0091	.0072	.0028
2	.0737	.0633	.0974	.1672	.1726	.0509	.0754	.1238	.2297	.1625
3	.2458	.3397	.2251	.2713	.3936	.4534	.1671	.2729	.2076	.3744
4	.2331	.4823	.3459	.3650	.5186	.4780	.4412	.3774	.3493	.3857
5	.3059	.3963	.3825	.3775	.4923	.5487	.5254	.3149	.5797	.4319
6	.3690	.4940	.3603	.4094	.3622	.3963	.5390	.3532	.3167	.4593
7	.3032	.4803	.4163	.3581	.3457	.3278	.3923	.4152	.3278	.3113
8	.2009	.2709	.2968	.4586	.3943	.3925	.3816	.3366	.3758	.2785
9	.3245	.1852	.4299	.2728	.4444	.3596	.4233	.2950	.3299	.2782
10	.2278	.2838	.2841	.3869	.2983	.5102	.3378	.3376	.2850	.2632
11	.2969	.1822	.2961	.2538	.2917	.3299	.3942	.3298	.3366	.2441
12	.2775	.2619	.2509	.3372	.2539	.4526	.4136	.3277	.3252	.2294
13	.2202	.2566	.2486	.2500	.3076	.3147	.5415	.3850	.2614	.2429
14	.2700	.2344	.3027	.3009	.3200	.3946	.4234	.3359	.3084	.2521
+gp	.2700	.2344	.3027	.3009	.3200	.3946	.4234	.3359	.3084	.2521
0 FBAR 2-10	.2538	.3329	.3154	.3407	.3802	.3908	.3648	.3141	.3335	.3272
FBARC	.2572	.3804	.2988	.3057	.3858	.4347	.3803	.2966	.3304	.3403
FBARP	.1604	.1984	.1796	.2024	.2291	.2152	.1885	.1911	.2094	.2125

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	.0031	.0016	.0006	.0034	.0021	.0002	.0002	.0014	.0000	.0000
2	.1700	.1860	.1953	.1394	.1452	.1318	.1496	.1565	.0814	.0328
3	.4825	.6386	.5547	.6804	.5074	.5036	.4390	.5060	.3906	.3230
4	.5011	.5923	.5542	.6273	.7145	.4156	.6706	.5041	.6824	.4134
5	.6132	.4568	.5307	.5228	.5227	.5727	.4244	.6571	.6934	.6174
6	.6458	.4327	.3829	.4496	.4183	.4356	.4376	.5657	.5485	.5594
7	.5791	.4241	.3831	.3786	.3684	.3390	.3616	.4510	.5113	.4943
8	.3324	.3605	.4205	.3496	.3300	.4037	.2900	.3777	.3481	.4256
9	.3527	.2172	.3235	.3857	.2941	.3288	.3113	.3264	.2788	.4083
10	.4183	.2495	.2259	.3871	.4185	.3036	.2799	.3611	.3175	.3225
11	.3324	.2669	.2998	.2560	.3599	.2940	.2149	.3181	.2811	.2495
12	.3523	.3235	.3492	.2887	.4257	.2946	.3700	.3270	.2652	.3910
13	.4067	.2004	.3376	.3856	.3594	.2470	.2756	.4664	.2339	.2953
14	.3736	.2520	.3080	.3416	.3726	.2944	.2910	.3608	.2760	.3342
+gp	.3736	.2520	.3080	.3416	.3726	.2944	.2910	.3608	.2760	.3342
0 FBAR 2-10	.4550	.3953	.3968	.4356	.4132	.3816	.3738	.4339	.4280	.3996
FBARC	.4525	.4970	.4558	.5439	.4904	.4240	.4431	.4613	.5056	.4268
FBARP	.2490	.2605	.2537	.2619	.2494	.2304	.2359	.2474	.2315	.2000

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98
AGE											
1	.0032	.0040	.0038	.0084	.0120	.0056	.0214	.0028	.0019	.0015	.0021
2	.1006	.0936	.1299	.1301	.1571	.1930	.1748	.1378	.1144	.1013	.1178
3	.2984	.2749	.3261	.3545	.4230	.4503	.5638	.4543	.4301	.2901	.3915
4	.4926	.5065	.5359	.4602	.5228	.6677	.6929	.6512	.7236	.5092	.6280
5	.5153	.6680	.6580	.6809	.6307	.5524	.6602	.6377	.7294	.5402	.6357
6	.4836	.4760	.7222	.6505	.5932	.5209	.4939	.5685	.6446	.4573	.5568
7	.4290	.3582	.4757	.6115	.5363	.6459	.4739	.5645	.6200	.4392	.5412
8	.3835	.2838	.3726	.3902	.4877	.4781	.3855	.4168	.6251	.4054	.4824
9	.2627	.2930	.3130	.3747	.3570	.4101	.3177	.4183	.3783	.4280	.4082
10	.3541	.2035	.3006	.3717	.3937	.3788	.2206	.3673	.2756	.2696	.3042
11	.2657	.2394	.2490	.3145	.3804	.3154	.2809	.2454	.2134	.1902	.2163
12	.2379	.1945	.3026	.3602	.3123	.3067	.2588	.2683	.2226	.2062	.2323
13	.2918	.1662	.2143	.4520	.5280	.3082	.1972	.3078	.2556	.2108	.2581
14	.2831	.2197	.2283	.5441	.3766	.5273	.2303	.3258	.2678	.1872	.2602
+gp	.2831	.2197	.2283	.5441	.3766	.5273	.2303	.3258	.2678	.1872	
0 FBAR 2-10	.3689	.3508	.4260	.4471	.4557	.4775	.4426	.4685	.5046	.3822	
FBARC	.3816	.4104	.4417	.4314	.4357	.4673	.5053	.4848	.5310	.3903	
FBARP	.2079	.2073	.2283	.2303	.2445	.2573	.2704	.2477	.2482	.2083	

Table 9.11. North Sea plaice: stock numbers at age.

Run title : Plaice in IV (run: XSAMAP09/X09)

At 14/10/1999 17:03

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	433454,	405342,	359402,	318833,	315198,	1022030,	309599,	305439,	277282,	245606,
2,	389072,	392206,	366769,	325201,	288492,	285203,	924771,	280137,	276373,	250895,
3,	235704,	336299,	349214,	329712,	292211,	256910,	244072,	827390,	249536,	244382,
4,	122339,	184330,	245437,	284218,	264210,	243980,	193950,	180701,	686815,	196964,
5,	152306,	86451,	118255,	157487,	193649,	165893,	159184,	124899,	114528,	514046,
6,	89337,	98718,	57943,	75898,	94881,	123508,	95498,	102492,	78135,	64265,
7,	58692,	59018,	63327,	40292,	49053,	55604,	76473,	57729,	66703,	49722,
8,	37146,	39910,	39907,	43337,	27840,	32164,	35265,	51730,	36540,	44970,
9,	34102,	27516,	27539,	26837,	30619,	18691,	22830,	23772,	36549,	25449,
10,	26496,	24582,	20058,	19214,	19283,	21002,	13126,	16649,	15358,	26671,
11,	16198,	18876,	17762,	14872,	14125,	13773,	15384,	8058,	11892,	11000,
12,	14076,	11435,	13828,	12627,	10927,	9365,	9546,	11250,	5538,	8826,
13,	7306,	9347,	8073,	9766,	9270,	7873,	6662,	6525,	7752,	4090,
14,	4069,	5177,	6587,	5646,	6933,	6401,	5680,	4368,	4359,	5775,
+gp,	6978,	8420,	7905,	7360,	15289,	25997,	23119,	19166,	16904,	17346,
0 TOTAL,	1627274,	1707625,	1702007,	1671300,	1631980,	2288393,	2135159,	2020307,	1884266,	1710007,

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	327610,	370560,	275671,	234889,	542512,	452440,	336652,	325489,	472523,	432479,
2,	222233,	296431,	335224,	249420,	210412,	489679,	407270,	303682,	291832,	424493,
3,	218007,	186800,	251771,	275175,	190938,	160203,	421088,	341760,	242781,	209870,
4,	182413,	154278,	120346,	181885,	189823,	116551,	92119,	322398,	235376,	178499,
5,	141940,	130730,	86182,	77051,	114251,	102258,	65389,	53616,	200021,	150183,
6,	347538,	94583,	79588,	53193,	47799,	63184,	53455,	34987,	35406,	101364,
7,	41846,	217427,	52219,	50228,	31962,	30108,	38464,	28213,	22237,	23341,
8,	35154,	27962,	121697,	31162,	31769,	20468,	19628,	23510,	16853,	14497,
9,	31081,	26019,	19298,	81836,	17825,	19378,	12508,	12126,	15193,	10472,
10,	19294,	20331,	19562,	11360,	56370,	10342,	12238,	7412,	8169,	9885,
11,	19481,	13901,	13851,	13323,	6981,	37851,	5618,	7899,	4785,	5558,
12,	7791,	13099,	10484,	9321,	9353,	4719,	24624,	3427,	5139,	3092,
13,	6506,	5342,	9122,	7381,	6019,	6565,	2715,	14733,	2235,	3359,
14,	3123,	4724,	3739,	6437,	5201,	4004,	4337,	1430,	9071,	1557,
+gp,	17153,	14554,	15568,	14768,	13788,	10822,	12673,	9710,	7216,	11882,
0 TOTAL,	1621172,	1576741,	1414322,	1297427,	1475004,	1528572,	1508778,	1490393,	1568837,	1580532,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	445613,	662031,	426956,	1032541,	596251,	614951,	538552,	1266840,	544843,	567573,
2,	390236,	401954,	598099,	386085,	931111,	538355,	556328,	487187,	1144692,	492994,
3,	326474,	297899,	301964,	445178,	303898,	728646,	426957,	433421,	376974,	954788,
4,	130596,	182340,	142332,	156897,	204000,	165555,	398471,	249049,	236443,	230804,
5,	109822,	71594,	91246,	73992,	75814,	90343,	98863,	184381,	136123,	108129,
6,	88233,	53821,	41025,	48561,	39694,	40672,	46105,	58521,	86476,	61569,
7,	57940,	41852,	31594,	25312,	28029,	23640,	23807,	26931,	30076,	45212,
8,	15469,	29380,	24779,	19490,	15684,	17547,	15240,	15005,	15523,	16320,
9,	9929,	10039,	18539,	14724,	12432,	10203,	10603,	10318,	9306,	9917,
10,	7175,	6314,	7311,	12138,	9059,	8383,	6645,	7028,	6737,	6372,
11,	6874,	4273,	4452,	5278,	7458,	5394,	5599,	4545,	4432,	4437,
12,	3940,	4461,	2961,	2985,	3697,	4709,	3637,	4086,	2992,	3028,
13,	2224,	2507,	2921,	1889,	2023,	2185,	3173,	2273,	2666,	2076,
14,	2384,	1340,	1856,	1886,	1163,	1278,	1545,	2180,	1290,	1909,
+gp,	8667,	5691,	5164,	7268,	3543,	5188,	4388,	4248,	5278,	6186,
0 TOTAL,	1605576,	1775493,	1701197,	2234223,	2233856,	2257048,	2139912,	2756013,	2603850,	2511313,

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	GMST 57-96
AGE												
1,	414231,	402400,	396240,	400278,	279880,	243993,	345891,	367748,	336018,	123622,	0 *	415075,
2,	513561,	373613,	362669,	357186,	359146,	250231,	219549,	306334,	331836,	303456,	111691 **	368811,
3,	431672,	420212,	307842,	288179,	283769,	277717,	186683,	166791,	241509,	267791,	248138 ***	304015,
4,	625479,	289830,	288842,	201037,	182919,	168195,	160187,	96124,	95819,	142136,	181290,	202516,
5,	138130,	345829,	158034,	152928,	114812,	98128,	78055,	72490,	45351,	42049,	77293,	120485,
6,	52770,	74657,	160449,	74054,	70043,	55288,	51107,	36495,	34665,	19788,	22168,	68427,
7,	31843,	29440,	41969,	70514,	34965,	35020,	29715,	28220,	18703,	16464,	11334,	41342,
8,	24954,	18761,	18618,	23599,	34617,	18506,	16611,	16738,	14520,	9104,	9602,	26206,
9,	9648,	15387,	12781,	11606,	14454,	19232,	10381,	10222,	9983,	7032,	5492,	17489,
10,	5965,	6714,	10387,	8457,	7220,	9152,	11547,	6836,	6088,	6188,	4147,	12132,
11,	4176,	3788,	4956,	6958,	5277,	4407,	5670,	8380,	4284,	4181,	4276,	8397,
12,	3129,	2897,	2698,	3496,	4597,	3264,	2909,	3874,	5933,	3132,	3128,	5804,
13,	1853,	2232,	2158,	1804,	2207,	3044,	2173,	2032,	2680,	4297,	2306,	3966,
14,	1398,	1252,	1710,	1576,	1039,	1178,	2024,	1615,	1351,	1878,	3149,	2770,
+gp,	6620,	6497,	6660,	4109,	4410,	2609,	4778,	5794,	4611,	8316,	7650,	
0 TOTAL,	2265429,	1993508,	1776012,	1605781,	1399354,	1189964,	1127278,	1129694,	1153352,	959433,	691665,	

* Replaced by modified RCT3 value at age 1 (yc 1998): 445,000.

** Replaced by the modified RCT3 value at age 2 (yc 1997): 330,000

*** Replaced by the modified RCT3 value at age 3 (yc 1996): 579,000

Table 9.12 North Sea plaice assessment summary

Run title : Plaice in IV (run: XSAMAP09/X09) ,

At 14/10/1999 17:03

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2-10,	FBARC,	FBARP,
1957,	296172,	457381,	354631,	70563,	.1990,	.1973,	.2317,	.1376,
1958,	429991,	443688,	340644,	73354,	.2153,	.2118,	.2500,	.1413,
1959,	433454,	457579,	345196,	79300,	.2297,	.2266,	.2434,	.1430,
1960,	405342,	497712,	368324,	87541,	.2377,	.2469,	.2815,	.1535,
1961,	359402,	461945,	352893,	85984,	.2437,	.2331,	.2822,	.1396,
1962,	318833,	564489,	446594,	87472,	.1959,	.2345,	.2839,	.1407,
1963,	315198,	547194,	440005,	107118,	.2434,	.2644,	.3224,	.1479,
1964,	1022030,	624884,	422970,	110540,	.2613,	.2731,	.3037,	.1653,
1965,	309599,	580555,	414404,	97143,	.2344,	.2761,	.3025,	.1571,
1966,	305439,	588055,	416446,	101834,	.2445,	.2594,	.3091,	.1462,
1967,	277282,	590937,	493095,	108819,	.2207,	.2427,	.2927,	.1424,
1968,	245606,	548301,	456200,	111534,	.2445,	.2209,	.2341,	.1422,
1969,	327610,	526407,	418395,	121651,	.2908,	.2538,	.2572,	.1604,
1970,	370560,	526001,	399722,	130342,	.3261,	.3329,	.3804,	.1984,
1971,	275671,	500748,	372542,	113944,	.3059,	.3154,	.2988,	.1796,
1972,	234889,	495497,	376055,	122843,	.3267,	.3407,	.3057,	.2024,
1973,	542512,	488481,	335026,	130429,	.3893,	.3802,	.3858,	.2291,
1974,	452440,	467778,	309220,	112540,	.3639,	.3908,	.4347,	.2152,
1975,	336652,	495728,	320598,	108536,	.3385,	.3648,	.3803,	.1885,
1976,	325489,	451535,	315235,	113670,	.3606,	.3141,	.2966,	.1911,
1977,	472523,	479762,	330170,	119188,	.3610,	.3335,	.3304,	.2094,
1978,	432479,	475330,	323836,	113984,	.3520,	.3272,	.3403,	.2125,
1979,	445613,	474732,	311016,	145347,	.4673,	.4550,	.4525,	.2490,
1980,	662031,	488263,	297207,	139951,	.4709,	.3953,	.4970,	.2605,
1981,	426956,	489423,	308040,	139747,	.4537,	.3968,	.4558,	.2537,
1982,	1032541,	561851,	301268,	154547,	.5130,	.4356,	.5439,	.2619,
1983,	596251,	550835,	325482,	144038,	.4425,	.4132,	.4904,	.2494,
1984,	614951,	562484,	327432,	156147,	.4769,	.3816,	.4240,	.2304,
1985,	538552,	551646,	361130,	159838,	.4426,	.3738,	.4431,	.2359,
1986,	1266840,	656677,	364322,	165347,	.4538,	.4339,	.4613,	.2474,
1987,	544843,	638210,	395499,	153670,	.3885,	.4280,	.5056,	.2315,
1988,	567573,	629970,	378957,	154475,	.4076,	.3996,	.4268,	.2000,
1989,	414231,	592344,	421474,	169818,	.4029,	.3689,	.3816,	.2079,
1990,	402400,	560053,	396777,	156240,	.3938,	.3508,	.4104,	.2073,
1991,	396240,	469762,	339655,	148004,	.4357,	.4260,	.4417,	.2283,
1992,	400278,	440518,	302819,	125190,	.4134,	.4471,	.4314,	.2303,
1993,	279880,	391340,	271067,	117113,	.4320,	.4557,	.4357,	.2445,
1994,	243993,	322659,	228344,	110392,	.4834,	.4775,	.4673,	.2573,
1995,	345891,	306298,	211778,	98356,	.4644,	.4426,	.5053,	.2704,
1996,	367748,	297738,	191010,	81673,	.4276,	.4685,	.4848,	.2477,
1997*	**775000 ***	288575,	181183,	83048,	.4584,	.5046,	.5310,	.2482,
1998*	**366000** **	276128,	193543,	71534,	.3696,	.3822,	.3903,	.2083,
1999*,	**445000** ***		**259000 ******					
Arith. Mean ,	440372,	495702,	344291,	118638,	.3567,	.3495,	.0000,	.2027,
	(Tonnes),	(Tonnes),	(Tonnes),					

* XSA recruitment estimate of yearclass 1996 (336,018) replaced by modified RCT3 value.

** XSA recruitment estimate of yearclass 1997 (123,622) replaced by modified RCT3 value.

*** Modified RCT3 values used for yearclass 1998.

**** SSB estimated using the average weight at age in the stock over the years 1996-1998.

Table 9.13 North Sea plaice: input to the RCT3 analysis – age 1

```
Plaice North Sea - 1-Y-Rcr.
9    33   2
'yc' 'VPA-1'   'SNS-0'   'SNS-1'   'SNS-2'   'SNS-3'   'BTS-1'   'BTS-2'   'BTS-3'   'com-0'   'com-1'
1967 246  -11  -11  -11  2813 -11  -11  -11  -11  -11
1968 328  -11  -11  9450 1008 -11  -11  -11  -11  -11
1969 371  -11  8032 238484484 -11  -11  -11  -11  -11
1970 276  3678 181019584 1631 -11  -11  -11  -11  -11
1971 235  6708 6437 4191 1261 -11  -11  -11  -11  -11
1972 543  9242 572381798510744-11  -11  -11  -11  -11
1973 452  5451 156489171 791  -11  -11  -11  -11  -11
1974 337  2193 9781 2274 1720 -11  -11  -11  112.684.8
1975 325  1151 9037 2900 435  -11  -11  -11  71.9 81.5
1976 473  115441911912714157 -11  -11  -11  243  159
1977 432  4378 139249540 456  -11  -11  -11  171.783.5
1978 446  3252 2168112084785  -11  -11  -11  223.9176.3
1979 662  2783558049161061146 -11  -11  -11  366.9252.1
1980 427  4039 196118503 308  -11  -11  -11  167.1154.3
1981 1033 3154270108147082480 -11  -11  -11  615.3285.3
1982 596  2398734884104131584 -11  -11  39.5 460.1160.8
1983 615  3672244667137881155 -11  185.950.4 475.4115.7
1984 539  7958 278327557 1232 115.5125.532.1 259  106
1985 1267 473859357333021131406660.2707.4208  719.1267.6
1986 545  8818 33426144293709 225.1151.156.1 357.7190.3
1987 568  2127036672149523248 605.2337.967.4 471.7105.5
1988 414  15598372387287 1507 426.7122.130.1 347  131.5
1989 402  2419824903111482257 107  125.520.6 462  126.6
1990 396  9559 5734913742988  184.4117.236.9 450.8153.9
1991 400  17120482239484 884  172.8164.132.2 496.5130.5
1992 280  5398 221844866 415  122.665.2 14.3 365.175.3
1993 244  9226 182252786 1189 141.748.2 23.9 267.930.1
1994 346  2790124900103771393 249.4193.121   461.334.8
1995 -11  1302924663-11  5739 216  -11  54   182.4117.7
1996 -11  91713-11  2943114347-11  421  183.2548.2158.4
1997 -11  15363333919235 -11  347.6137.3-11  182.2-11
1998 -11  2272035188-11  -11  311.9-11  -11  -11  -11
1999 -11  39201-11  -11  -11  -11  -11  -11  -11  -11
```

Table 9.14 North Sea plaice: input to the RCT3 analysis – age 2

```
Plaice North Sea - 2-Y-Rcr.
9    33   2
'yc' 'VPA-2'   'SNS-0'   'SNS-1’   'SNS-2'   'SNS-3'   'BTS-1'   'BTS-2'   'BTS-3'   'com-0'   'com-1'
1967 222  -11  -11  -11  2813 -11  -11  -11  -11  -11
1968 296  -11  -11  9450 1008 -11  -11  -11  -11  -11
1969 335  -11  8032 238484484 -11  -11  -11  -11  -11
1970 249  3678 181019584 1631 -11  -11  -11  -11  -11
1971 210  6708 6437 4191 1261 -11  -11  -11  -11  -11
1972 490  9242 572381798510744-11  -11  -11  -11  -11
1973 407  5451 156489171 791  -11  -11  -11  -11  -11
1974 304  2193 9781 2274 1720 -11  -11  -11  112.684.8
1975 292  1151 9037 2900 435  -11  -11  -11  71.9 81.5
1976 424  115441911912714157 -11  -11  -11  243  159
1977 390  4378 139249540 456  -11  -11  -11  171.783.5
1978 402  3252 2168112084785  -11  -11  -11  223.9176.3
1979 598  2783558049161061146 -11  -11  -11  366.9252.1
1980 386  4039 196118503 308  -11  -11  -11  167.1154.3
1981 931  3154270108147082480 -11  -11  -11  615.3285.3
1982 538  2398734884104131584 -11  -11  39.5 460.1160.8
1983 556  3672244667137881155 -11  185.950.4 475.4115.7
1984 487  7958 278327557 1232 115.5125.532.1 259  106
1985 1145 473859357333021131406660.2707.4208  719.1267.6
1986 493  8818 33426144293709 225.1151.156.1 357.7190.3
1987 514  2127036672149523248 605.2337.967.4 471.7105.5
1988 374  15598372387287 1507 426.7122.130.1 347  131.5
1989 363  2419824903111482257 107  125.520.6 462  126.6
1990 357  9559 5734913742988  184.4117.236.9 450.8153.9
1991 359  17120482239484 884  172.8164.132.2 496.5130.5
1992 250  5398 221844866 415  122.665.2 14.3 365.175.3
1993 220  9226 182252786 1189 141.748.2 23.9 267.930.1
1994 306  2790124900103771393 249.4193.121   461.334.8
1995 -11  1302924663363745739 216  -11  54   182.4117.7
1996 -11  917136452429431143347-11  421  183.2548.2158.4
1997 -11  15363333919235 -11  347.6137.3-11  182.2-11
1998 -11  2272035188-11  -11  311.9-11  -11  -11  -11
1999 -11  39201-11  -11  -11  -11  -11  -11  -11  -11
```

Table 9.15 North Sea plaice: input to the RCT3 analysis – age 3

```
Plaice North Sea - 3-Y-Rcr.
9    33   2
'yc' 'VPA-3'   'SNS-0'   'SNS-1'   'SNS-2'   'SNS-3'   'BTS-1'   'BTS-2'   'BTS-3'   'com-0'   'com-1'
1967 187  -11  -11  -11  2813 -11  -11  -11  -11  -11
1968 252  -11  -11  9450 1008 -11  -11  -11  -11  -11
1969 275  -11  8032 238484484 -11  -11  -11  -11  -11
1970 191  3678 181019584 1631 -11  -11  -11  -11  -11
1971 160  6708 6437 4191 1261 -11  -11  -11  -11  -11
1972 421  9242 572381798510744-11  -11  -11  -11  -11
1973 342  5451 156489171 791  -11  -11  -11  -11  -11
1974 243  2193 9781 2274 1720 -11  -11  -11  112.684.8
1975 210  1151 9037 2900 435  -11  -11  -11  71.9 81.5
1976 326  1154419119127141577 -11  -11  -11  243  159
1977 298  4378 139249540 456  -11  -11  -11  171.783.5
1978 302  3252 2168112084785  -11  -11  -11  223.9176.3
1979 445  2783558049161061146 -11  -11  -11  366.9252.1
1980 304  4039 196118503 308  -11  -11  -11  167.1154.3
1981 729  3154270108147082480 -11  -11  -11  615.3285.3
1982 427  2398734884104131584 -11  -11  39.5 460.1160.8
1983 433  3672244667137881155 -11  185.950.4 475.4115.7
1984 377  7958 278327557 1232 115.5125.532.1 259  106
1985 955  47385935733302113140660.2707.4208  719.1267.6
1986 432  8818 33426144293709 225.1151.156.1 357.7190.3
1987 420  2127036672149523248 605.2337.967.4 471.7105.5
1988 308  15598372387287 1507 426.7122.130.1 347  131.5
1989 288  2419824903111482257 107  125.520.6 462  126.6
1990 284  9559 5734913742988  184.4117.236.9 450.8153.9
1991 278  17120482239484 884  172.8164.132.2 496.5130.5
1992 187  5398 221844866 415  122.665.2 14.3 365.175.3
1993 167  9226 182252786 1189 141.748.2 23.9 267.930.1
1994 242  2790124900103771393 249.4193.121   461.334.8
1995 -11  1302924663363745739 216  -11  54   182.4117.7
1996 -11  91713645242943114347-11  421  183.2548.2158.4
1997 -11  15363333919235 -11  347.6137.3-11  182.2-11
1998 -11  2272035188-11  -11  311.9-11  -11  -11  -11
1999 -11  39201-11  -11  -11  -11  -11  -11  -11  -11
```

Table 9.16 North Sea plaice: diagnostics of RCT3 at age 1

Analysis by RCT3 ver3.1 of data from file :
rct99_1.csv
Plaice North Sea - 1-Y-Rcr.,,,,,,,,,,
Data for 9 surveys over 33 years : 1967 - 1999
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.68	-.19	.53	.371	25	9.48	6.30	.564	.063
SNS-1o	.76	-1.61	.36	.548	26	10.11	6.08	.385	.135
SNS-3o	1.04	-1.51	.84	.190	28	8.66	7.48	.921	.024
BTS-1	1.03	.51	.54	.424	11	5.38	6.07	.619	.052
BTS-3	.69	3.62	.20	.828	13	4.01	6.39	.225	.396
com-0	1.29	-1.28	.64	.283	21	5.21	5.45	.704	.041
com-1	.88	1.92	.33	.600	21	4.78	6.14	.353	.161
					VPA Mean =		6.07	.397	.127

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.68	-.19	.53	.371	25	11.43	7.63	.621	.051
SNS-2o	.89	-2.05	.41	.483	27	10.29	7.09	.459	.093
SNS-3o	1.04	-1.51	.84	.190	28	9.57	8.43	.984	.020
BTS-2	.69	2.64	.23	.791	12	6.05	6.83	.285	.242
BTS-3	.69	3.62	.20	.828	13	5.22	7.23	.267	.275
com-0	1.29	-1.28	.64	.283	21	6.31	6.87	.704	.040
com-1	.88	1.92	.33	.600	21	5.07	6.40	.355	.155
					VPA Mean =		6.07	.397	.124

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.68	-.19	.53	.371	25	9.64	6.41	.565	.077
SNS-1o	.76	-1.61	.36	.548	26	10.42	6.31	.386	.165
SNS-2o	.89	-2.05	.41	.483	27	9.13	6.06	.435	.131
BTS-1	1.03	.51	.54	.424	11	5.85	6.56	.632	.062
BTS-2	.69	2.64	.23	.791	12	4.93	6.05	.262	.359
com-0	1.29	-1.28	.64	.283	21	5.21	5.45	.704	.050
					VPA Mean =		6.07	.397	.156

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.68	-.19	.53	.371	25	10.03	6.68	.571	.165
SNS-1o	.76	-1.61	.36	.548	26	10.47	6.35	.387	.359
BTS-1	1.03	.51	.54	.424	11	5.75	6.45	.627	.137
					VPA Mean =		6.07	.397	.340

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.68	-.19	.53	.371	25	10.58	7.05	.586	.315
					VPA Mean =		6.07	.397	.685

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	509	6.23	.14	.11	.58		
1996	969	6.88	.14	.18	1.70		
1997	458	6.13	.16	.09	.33		
1998	**556**	6.32	.23	.12	.27	Modified value: **445**	
1999	590	6.38	.33	45	1.90		

Table 9.17 North Sea plaice: diagnostics of RCT3 at age 2

Analysis by RCT3 ver3.1 of data from file :
rct99_2.csv
Plaice North Sea - 2-Y-Rcr.,,,,,,,,,,
Data for 9 surveys over 33 years : 1967 - 1999
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.69	-.36	.54	.367	25	9.48	6.19	.572	.057
SNS-1o	.77	-1.77	.37	.547	26	10.11	5.97	.388	.123
SNS-2o	.89	-2.20	.41	.483	27	10.50	7.18	.472	.083
SNS-3o	1.04	-1.63	.84	.191	28	8.66	7.38	.922	.022
BTS-1	1.04	.35	.54	.422	11	5.38	5.96	.626	.047
BTS-3	.70	3.50	.20	.830	13	4.01	6.29	.225	.365
com-0	1.31	-1.47	.65	.279	21	5.21	5.34	.714	.036
com-1	.89	1.80	.33	.604	21	4.78	6.03	.352	.150
					VPA Mean =		5.97	.399	.116

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.69	-.36	.54	.367	25	11.43	7.54	.629	.045
SNS-1o	.77	-1.77	.37	.547	26	11.07	6.71	.401	.110
SNS-2o	.89	-2.20	.41	.483	27	10.29	6.99	.462	.083
SNS-3o	1.04	-1.63	.84	.191	28	9.57	8.33	.985	.018
BTS-2	.70	2.49	.24	.784	12	6.05	6.73	.293	.207
BTS-3	.70	3.50	.20	.830	13	5.22	7.13	.267	.249
com-0	1.31	-1.47	.65	.279	21	6.31	6.77	.714	.035
com-1	.89	1.80	.33	.604	21	5.07	6.29	.354	.142
					VPA Mean =		5.97	.399	.111

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.69	-.36	.54	.367	25	9.64	6.31	.573	.078
SNS-1o	.77	-1.77	.37	.547	26	10.42	6.20	.389	.168
SNS-2o	.89	-2.20	.41	.483	27	9.13	5.96	.437	.133
BTS-1	1.04	.35	.54	.422	11	5.85	6.46	.639	.062
BTS-2	.70	2.49	.24	.784	12	4.93	5.95	.270	.350
com-0	1.31	-1.47	.65	.279	21	5.21	5.34	.714	.050
					VPA Mean =		5.97	.399	.160

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.69	-.36	.54	.367	25	10.03	6.58	.579	.163
SNS-1o	.77	-1.77	.37	.547	26	10.47	6.24	.390	.359
BTS-1	1.04	.35	.54	.422	11	5.75	6.34	.634	.136
					VPA Mean =		5.97	.399	.342

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.69	-.36	.54	.367	25	10.58	6.95	.594	.311
					VPA Mean =		5.97	.399	.689

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	501	6.22	.14	.14	1.08		
1996	871	6.77	.13	.16	1.50		
1997	**413**	6.02	.16	.09	.33	modified value: **330**	
1998	501	6.22	.23	.12	.27		
1999	531	6.28	.33	.46	1.90		

Table 9.18 North Sea plaice: diagnostics of RCT3 at age 3

```
Analysis by RCT3 ver3.1 of data from file :
 rct99_3.csv
 Plaice North Sea - 3-Y-Rcr.,,,,,,,,,,
 Data for    9 surveys over   33 years :  1967 - 1999
 Regression type = C
 Tapered time weighting not applied
 Survey weighting not applied
 Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as    .20
 Minimum of   3 points used for regression
 Forecast/Hindcast variance correction used.

 Yearclass =   1995

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error  Weights
 SNS-0      .72   -.87    .56   .373     25   9.48    5.96     .593     .055
 SNS-1      .80  -2.38    .38   .547     26  10.11    5.73     .407     .116
 SNS-2      .90  -2.49    .40   .517     27  10.50    6.95     .459     .092
 SNS-3      .94  -1.16    .73   .247     28   8.66    7.02     .807     .030
 BTS-1     1.09   -.10    .55   .446     11   5.38    5.74     .638     .047
 BTS-3      .73   3.14    .20   .843     13   4.01    6.08     .228     .371
 com-0     1.31  -1.72    .64   .306     21   5.21    5.09     .701     .039
 com-1      .93   1.33    .35   .595     21   4.78    5.79     .375     .137
                                        VPA Mean =    5.74     .412     .114

 Yearclass =   1996

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error  Weights
 SNS-0      .72   -.87    .56   .373     25  11.43    7.37     .653     .044
 SNS-1      .80  -2.38    .38   .547     26  11.07    6.50     .421     .106
 SNS-2      .90  -2.49    .40   .517     27  10.29    6.76     .449     .093
 SNS-3      .94  -1.16    .73   .247     28   9.57    7.88     .862     .025
 BTS-2      .75   2.04    .25   .786     12   6.05    6.55     .310     .195
 BTS-3      .73   3.14    .20   .843     13   5.22    6.96     .270     .257
 com-0     1.31  -1.72    .64   .306     21   6.31    6.53     .701     .038
 com-1      .93   1.33    .35   .595     21   5.07    6.06     .377     .131
                                        VPA Mean =    5.74     .412     .110

 Yearclass =   1997

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error  Weights
 SNS-0      .72   -.87    .56   .373     25   9.64    6.08     .595     .077
 SNS-1      .80  -2.38    .38   .547     26  10.42    5.98     .408     .162
 SNS-2      .90  -2.49    .40   .517     27   9.13    5.72     .425     .150
 BTS-1     1.09   -.10    .55   .446     11   5.85    6.25     .652     .064
 BTS-2      .75   2.04    .25   .786     12   4.93    5.72     .285     .333
 com-0     1.31  -1.72    .64   .306     21   5.21    5.09     .701     .055
                                        VPA Mean =    5.74     .412     .159

 Yearclass =   1998

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error  Weights
 SNS-0      .72   -.87    .56   .373     25  10.03    6.36     .601     .163
 SNS-1      .80  -2.38    .38   .547     26  10.47    6.02     .409     .351
 BTS-1     1.09   -.10    .55   .446     11   5.75    6.13     .646     .141
                                        VPA Mean =    5.74     .412     .346

 Yearclass =   1999

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error  Weights
 SNS-0      .72   -.87    .56   .373     25  10.58    6.76     .616     .309
                                        VPA Mean =    5.74     .412     .691


 Year      Weighted       Log     Int     Ext      Var      VPA       Log
 Class      Average       WAP     Std     Std     Ratio               VPA
          Prediction             Error   Error

 1995         405        6.01     .14     .15     1.13
 1996         724        6.59     .14     .17     1.50     modified value: 579
 1997         327        5.79     .16     .10      .34
 1998         400        5.99     .24     .13      .27
 1999         425        6.05     .34     .47     1.89
```

Table 9.19a North Sea plaice: input to the short term projection

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	444799	.23	WS1	.12	.00	M1	.10	.10	MT1	.00	.10
N2	330399	.16	WS2	.22	.10	M2	.10	.10	MT2	.50	.10
N3	579200	.17	WS3	.27	.06	M3	.10	.10	MT3	.50	.10
N4	181288	.19	WS4	.35	.05	M4	.10	.10	MT4	1.00	.10
N5	77292	.12	WS5	.43	.10	M5	.10	.10	MT5	1.00	.00
N6	22168	.12	WS6	.51	.12	M6	.10	.10	MT6	1.00	.00
N7	11333	.12	WS7	.53	.09	M7	.10	.10	MT7	1.00	.00
N8	9601	.12	WS8	.58	.10	M8	.10	.10	MT8	1.00	.00
N9	5491	.12	WS9	.65	.03	M9	.10	.10	MT9	1.00	.00
N10	4147	.12	WS10	.72	.10	M10	.10	.10	MT10	1.00	.00
N11	4275	.11	WS11	.86	.08	M11	.10	.10	MT11	1.00	.00
N12	3128	.12	WS12	.89	.11	M12	.10	.10	MT12	1.00	.00
N13	2305	.12	WS13	.76	.07	M13	.10	.10	MT13	1.00	.00
N14	3148	.12	WS14	1.01	.21	M14	.10	.10	MT14	1.00	.00
N15	7650	.13	WS15	.91	.12	M15	.10	.10	MT15	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.27	WH1	.20	.22
sH2	.12	.13	WH2	.27	.04
sH3	.39	.12	WH3	.31	.01
sH4	.63	.04	WH4	.38	.05
sH5	.64	.03	WH5	.46	.08
sH6	.56	.03	WH6	.54	.11
sH7	.54	.03	WH7	.56	.11
sH8	.48	.16	WH8	.59	.13
sH9	.41	.20	WH9	.67	.04
sH10	.30	.18	WH10	.76	.06
sH11	.22	.11	WH11	.86	.03
sH12	.23	.13	WH12	.90	.08
sH13	.26	.14	WH13	.82	.01
sH14	.26	.19	WH14	.88	.12
sH15	.26	.19	WH15	.93	.10

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.14
K00	1.00	.10	HF00	1.00	.14
K01	1.00	.10	HF01	1.00	.14

Recruitment		
Labl	Value	CV
R00	414999	.40
R01	414999	.40

Proportion F before spawning= .00
Proportion M before spawning= .00
Stock numbers in 1999 are XSA survivors.
These are overwritten at Age 1 Age 2 Age 3

Table 9.19b North Sea plaice: input to the medium term projection and yield per recruit analysis

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	444799	.23	WS1	.14	.09	M1	.10	.10	MT1	.00	.10
N2	330399	.16	WS2	.22	.10	M2	.10	.10	MT2	.50	.10
N3	579200	.17	WS3	.26	.05	M3	.10	.10	MT3	.50	.10
N4	181288	.19	WS4	.31	.08	M4	.10	.10	MT4	1.00	.10
N5	77292	.12	WS5	.40	.13	M5	.10	.10	MT5	1.00	.00
N6	22168	.12	WS6	.47	.13	M6	.10	.10	MT6	1.00	.00
N7	11333	.12	WS7	.55	.13	M7	.10	.10	MT7	1.00	.00
N8	9601	.12	WS8	.63	.11	M8	.10	.10	MT8	1.00	.00
N9	5491	.12	WS9	.71	.10	M9	.10	.10	MT9	1.00	.00
N10	4147	.12	WS10	.79	.11	M10	.10	.10	MT10	1.00	.00
N11	4275	.11	WS11	.87	.11	M11	.10	.10	MT11	1.00	.00
N12	3128	.12	WS12	.95	.11	M12	.10	.10	MT12	1.00	.00
N13	2305	.12	WS13	.97	.17	M13	.10	.10	MT13	1.00	.00
N14	3148	.12	WS14	.98	.18	M14	.10	.10	MT14	1.00	.00
N15	7650	.13	WS15	1.03	.16	M15	.10	.10	MT15	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.27	WH1	.23	.12
sH2	.12	.13	WH2	.27	.04
sH3	.39	.12	WH3	.30	.04
sH4	.63	.04	WH4	.35	.07
sH5	.64	.03	WH5	.42	.12
sH6	.56	.03	WH6	.50	.12
sH7	.54	.03	WH7	.58	.11
sH8	.48	.16	WH8	.66	.10
sH9	.41	.20	WH9	.75	.09
sH10	.30	.18	WH10	.82	.09
sH11	.22	.11	WH11	.90	.09
sH12	.23	.13	WH12	.95	.09
sH13	.26	.14	WH13	.98	.13
sH14	.26	.19	WH14	.98	.14
sH15	.26	.19	WH15	1.05	.09

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.14
K00	1.00	.10	HF00	1.00	.14
K01	1.00	.10	HF01	1.00	.14

Recruitment		
Labl	Value	CV
R00	414999	.40
R01	414999	.40

Proportion F before spawning= .00
Proportion M before spawning= .00
Stock numbers in 1999 are XSA survivors.
These are overwritten at Age 1 Age 2 Age 3

Table 9.20 North Sea plaice: single option short term prediction at *status quo* fishing mortality

Single option prediction: Detailed tables

Year: 1999 F-factor: 1.0000 Reference F: 0.4518

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
1	0.0021	888	178	444800	55155	0	0	0	0
2	0.1178	34974	9443	330400	73018	165200	36509	165200	36509
3	0.3915	179141	55892	579200	155805	289600	77902	289600	77902
4	0.6280	80872	30327	181290	62908	181290	62908	181290	62908
5	0.6358	34789	15968	77293	33545	77293	33545	77293	33545
6	0.5568	9049	4841	22168	11306	22168	11306	22168	11306
7	0.5412	4528	2545	11334	6007	11334	6007	11334	6007
8	0.4824	3511	2082	9602	5588	9602	5588	9602	5588
9	0.4082	1758	1172	5492	3559	5492	3559	5492	3559
10	0.3042	1038	789	4147	2994	4147	2994	4147	2994
11	0.2163	793	683	4276	3656	4276	3656	4276	3656
12	0.2324	618	558	3128	2793	3128	2793	3128	2793
13	0.2581	500	413	2306	1757	2306	1757	2306	1757
14	0.2603	688	608	3149	3174	3149	3174	3149	3174
15+	0.2603	1672	1558	7650	6946	7650	6946	7650	6946
Total		354819	127056	1686235	428212	786635	258645	786635	258645
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000 F-factor: 1.0000 Reference F: 0.4518

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
1	0.0021	828	166	415000	51460	0	0	0	0
2	0.1178	42514	11479	401627	88760	200814	44380	200814	44380
3	0.3915	82190	25643	265736	71483	132868	35742	132868	35742
4	0.6280	158051	59269	354301	122943	354301	122943	354301	122943
5	0.6358	39401	18085	87540	37992	87540	37992	87540	37992
6	0.5568	15116	8087	37033	18887	37033	18887	37033	18887
7	0.5412	4592	2581	11494	6092	11494	6092	11494	6092
8	0.4824	2183	1294	5969	3474	5969	3474	5969	3474
9	0.4082	1716	1145	5363	3475	5363	3475	5363	3475
10	0.3042	827	628	3304	2385	3304	2385	3304	2385
11	0.2163	513	442	2768	2367	2768	2367	2768	2367
12	0.2324	616	556	3117	2783	3117	2783	3117	2783
13	0.2581	487	402	2243	1709	2243	1709	2243	1709
14	0.2603	352	311	1612	1625	1612	1625	1612	1625
15+	0.2603	1646	1534	7532	6839	7532	6839	7532	6839
Total		351033	131622	1604640	422274	855959	290693	855959	290693
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.4518

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
1	0.0021	828	166	415000	51460	0	0	0	0
2	0.1178	39666	10710	374720	82813	187360	41407	187360	41407
3	0.3915	99908	31171	323023	86893	161512	43447	161512	43447
4	0.6280	72514	27193	162553	56406	162553	56406	162553	56406
5	0.6358	77002	35344	171083	74250	171083	74250	171083	74250
6	0.5568	17120	9159	41942	21391	41942	21391	41942	21391
7	0.5412	7671	4311	19202	10177	19202	10177	19202	10177
8	0.4824	2213	1313	6054	3523	6054	3523	6054	3523
9	0.4082	1067	712	3334	2161	3334	2161	3334	2161
10	0.3042	807	614	3226	2329	3226	2329	3226	2329
11	0.2163	409	352	2205	1886	2205	1886	2205	1886
12	0.2324	399	360	2018	1802	2018	1802	2018	1802
13	0.2581	485	400	2235	1703	2235	1703	2235	1703
14	0.2603	343	303	1568	1581	1568	1581	1568	1581
15+	0.2603	1394	1299	6378	5791	6378	5791	6378	5791
Total		321827	123406	1534541	404165	770670	267852	770670	267852
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSWV03
Date and time : 17OCT99:19:24
Computation of ref. F: Simple mean, age 2 - 10
Prediction basis : F factors

Table 9.21 North Sea plaice: contribution of year classes to yield 2000 and SSB 2001 at status quo fishing mortality

Year-class			1995	1996	1997	1998	1999
Stock No. (thousands) of		1 year-olds	367748	775000	366000	445000	415000
Source			XSA	mod RCT3	mod RCT3	mod RCT3	GM
Status Quo F:							
% in	1999	landings	23.9	44.0	7.4	0.1	-
% in	2000		13.7	45.0	19.5	8.7	0.1
% in	1999	SSB	24.3	30.1	14.1	0.0	-
% in	2000	SSB	13.1	42.3	12.3	15.2	0.0
% in	2001	SSB	8.0	27.7	21.1	16.2	15.4

GM : geometric mean recruitment

North Sea plaice (IV) : Year-class % contribution to

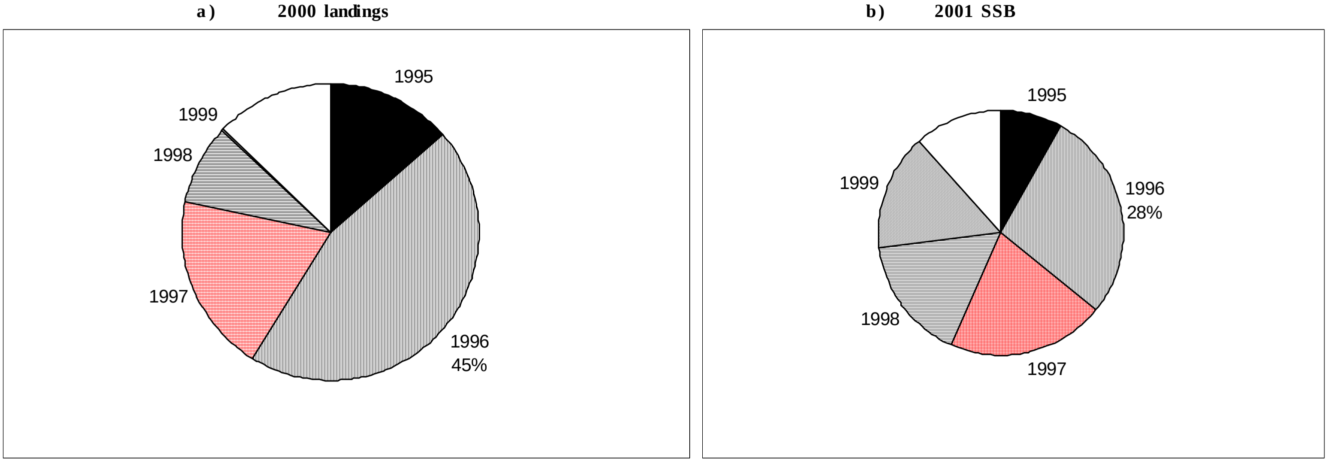


Table 9.22 North Sea plaice: short term prediction with management option table using F *status quo* for 1999.

Prediction with management option table

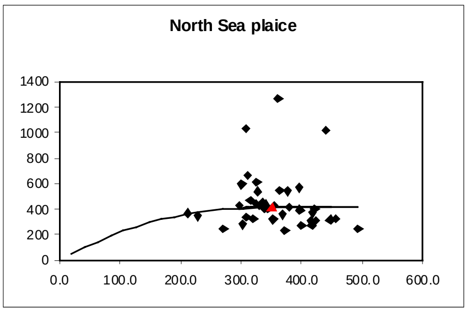
Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4518	428212	258645	127056	0.0000	0.0000	422274	290693	0	542487	400655
.	.	.	.	.	0.1000	0.0452	.	290693	16386	525159	383908
.	.	.	.	.	0.2000	0.0904	.	290693	31945	508729	368053
.	.	.	.	.	0.3000	0.1355	.	290693	46722	493148	353039
.	.	.	.	.	0.4000	0.1807	.	290693	60762	478367	338820
.	.	.	.	.	0.5000	0.2259	.	290693	74105	464342	325349
.	.	.	.	.	0.6000	0.2711	.	290693	86788	451030	312586
.	.	.	.	.	0.7000	0.3162	.	290693	98849	438393	300491
.	.	.	.	.	0.8000	0.3614	.	290693	110320	426393	289027
.	.	.	.	.	0.9000	0.4066	.	290693	121234	414995	278158
.	.	.	.	.	1.0000	0.4518	.	290693	131622	404165	267852
.	.	.	.	.	1.1000	0.4969	.	290693	141512	393872	258076
.	.	.	.	.	1.2000	0.5421	.	290693	150930	384087	248803
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

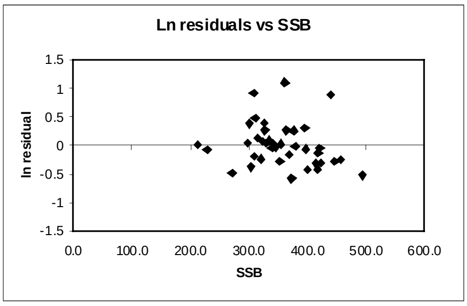
```
Notes: Run name            : MANSWV05
       Date and time       : 18OCT99:14:54
       Computation of ref. F: Simple mean, age 2 - 10
       Basis for 1999      : F factors
```

Table 9.23. North Sea plaice: estimation of constrained Shepherd stock recruitment model

Stock	North Sea plaice	Model	
Data	Final run (XSAMAP09)	Shepherd	
Modified	16-Oct-99 18:09	R = aS/(1+[S/b] ^ c)	
Remarks			
		Parameters	
		a	2.385156
		b	351.07
		c	1.8
		SSQ	5.626128
		N	39

	Input		Observed		Model		Residuals	
	SSB	R	log S	log R	Rhat	log Rhat	simple	squared
1957	354.6	430.0	5.871	6.064	419	6.038	0.026	0.00065959
1958	340.6	433.5	5.831	6.072	417	6.034	0.038	0.00144819
1959	345.2	405.3	5.844	6.005	418	6.035	-0.031	0.00093512
1960	368.3	359.4	5.909	5.884	420	6.041	-0.157	0.02450429
1961	352.9	318.8	5.866	5.765	419	6.038	-0.273	0.07450357
1962	446.6	315.2	6.102	5.753	419	6.038	-0.285	0.08105713
1963	440.0	1022.0	6.087	6.930	420	6.039	0.890	0.79273883
1964	423.0	309.6	6.047	5.735	421	6.042	-0.306	0.09392732
1965	414.4	305.4	6.027	5.722	421	6.043	-0.321	0.10294549
1966	416.4	277.3	6.032	5.625	421	6.042	-0.417	0.17421673
1967	493.1	245.6	6.201	5.504	414	6.025	-0.521	0.27178565
1968	456.2	327.6	6.123	5.792	418	6.036	-0.244	0.05951226
1969	418.4	370.6	6.036	5.915	421	6.042	-0.127	0.01618746
1970	399.7	275.7	5.991	5.619	421	6.043	-0.424	0.17984298
1971	372.5	234.9	5.920	5.459	421	6.042	-0.583	0.33931919
1972	376.1	542.5	5.930	6.296	421	6.042	0.254	0.064584
1973	335.0	452.4	5.814	6.115	416	6.032	0.083	0.00690653
1974	309.2	336.7	5.734	5.819	411	6.018	-0.199	0.03954464
1975	320.6	325.5	5.770	5.785	414	6.025	-0.239	0.05729764
1976	315.2	472.5	5.753	6.158	412	6.022	0.136	0.01861259
1977	330.2	432.5	5.800	6.070	415	6.029	0.040	0.00160668
1978	323.8	445.6	5.780	6.099	414	6.026	0.073	0.00533647
1979	311.0	662.0	5.740	6.495	411	6.019	0.476	0.22680992
1980	297.2	427.0	5.694	6.057	407	6.009	0.047	0.00224845
1981	308.0	1032.5	5.730	6.940	410	6.017	0.923	0.85128221
1982	301.3	596.3	5.708	6.391	408	6.012	0.378	0.14310864
1983	325.5	615.0	5.785	6.422	415	6.027	0.394	0.15548444
1984	327.4	538.6	5.791	6.289	415	6.028	0.261	0.06796868
1985	361.1	1266.8	5.889	7.144	420	6.040	1.105	1.22028443
1986	364.3	544.8	5.898	6.300	420	6.040	0.260	0.06772185
1987	395.5	567.6	5.980	6.341	421	6.043	0.298	0.08885055
1988	379.0	414.2	5.937	6.026	421	6.042	-0.016	0.00025504
1989	421.5	402.4	6.044	5.997	421	6.042	-0.044	0.00197824
1990	396.8	396.2	5.983	5.982	421	6.043	-0.061	0.00375517
1991	339.7	400.3	5.828	5.992	417	6.033	-0.041	0.00169795
1992	302.8	279.9	5.713	5.634	409	6.014	-0.379	0.1437465
1993	271.1	244.0	5.602	5.497	397	5.984	-0.487	0.23742506
1994	228.3	345.9	5.431	5.846	373	5.921	-0.075	0.00560135
1995	211.8	367.7	5.356	5.907	360	5.886	0.021	0.00043758
Reference	351	419	5.861	6.037	419	6.037		





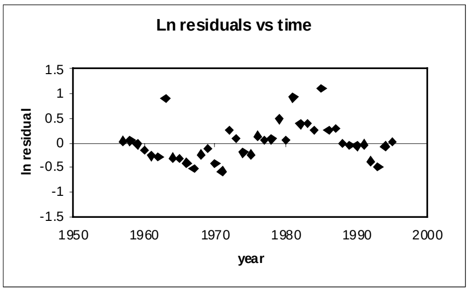


Table 9.24 North sea plaice: yield per recruit input data

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.1000	0.0000	0.0000	0.0000	0.138	0.0021	0.232
2	.	0.1000	0.5000	0.0000	0.0000	0.222	0.1178	0.269
3	.	0.1000	0.5000	0.0000	0.0000	0.258	0.3915	0.298
4	.	0.1000	1.0000	0.0000	0.0000	0.315	0.6280	0.345
5	.	0.1000	1.0000	0.0000	0.0000	0.396	0.6358	0.416
6	.	0.1000	1.0000	0.0000	0.0000	0.473	0.5568	0.498
7	.	0.1000	1.0000	0.0000	0.0000	0.548	0.5412	0.580
8	.	0.1000	1.0000	0.0000	0.0000	0.627	0.4824	0.656
9	.	0.1000	1.0000	0.0000	0.0000	0.706	0.4082	0.748
10	.	0.1000	1.0000	0.0000	0.0000	0.794	0.3042	0.819
11	.	0.1000	1.0000	0.0000	0.0000	0.872	0.2163	0.902
12	.	0.1000	1.0000	0.0000	0.0000	0.953	0.2324	0.949
13	.	0.1000	1.0000	0.0000	0.0000	0.969	0.2581	0.982
14	.	0.1000	1.0000	0.0000	0.0000	0.980	0.2603	0.984
15+	.	0.1000	1.0000	0.0000	0.0000	1.034	0.2603	1.047
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDSWV06
Date and time: 18OCT99:12:13

Table 9.25 North sea plaice: yield per recruit analysis

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	6464.333	8.647	6120.280	8.647	6120.280
0.1000	0.0452	0.250	142.412	8.012	4239.732	6.156	3896.959	6.156	3896.959
0.2000	0.0904	0.397	206.980	6.546	3004.531	4.695	2663.023	4.695	2663.023
0.3000	0.1355	0.490	236.813	5.617	2267.461	3.770	1927.203	3.770	1927.203
0.4000	0.1807	0.553	250.197	4.993	1803.013	3.150	1463.990	3.150	1463.990
0.5000	0.2259	0.597	255.548	4.553	1497.008	2.715	1159.206	2.715	1159.206
0.6000	0.2711	0.630	256.947	4.231	1287.476	2.398	950.880	2.398	950.880
0.7000	0.3162	0.655	256.441	3.987	1138.973	2.159	803.570	2.159	803.570
0.8000	0.3614	0.674	255.073	3.796	1030.369	1.973	696.145	1.973	696.145
0.9000	0.4066	0.689	253.377	3.644	948.626	1.825	615.566	1.825	615.566
1.0000	0.4518	0.702	251.622	3.519	885.454	1.704	553.545	1.704	553.545
1.1000	0.4969	0.713	249.941	3.415	835.448	1.604	504.677	1.604	504.677
1.2000	0.5421	0.722	248.390	3.326	794.994	1.520	465.347	1.520	465.347
1.3000	0.5873	0.730	246.988	3.249	761.622	1.448	433.087	1.448	433.087
1.4000	0.6325	0.737	245.736	3.183	733.613	1.385	406.175	1.385	406.175
1.5000	0.6777	0.743	244.624	3.124	709.739	1.331	383.387	1.331	383.387
1.6000	0.7228	0.749	243.640	3.071	689.114	1.282	363.834	1.282	363.834
1.7000	0.7680	0.754	242.769	3.023	671.082	1.239	346.862	1.239	346.862
1.8000	0.8132	0.758	241.999	2.981	655.152	1.200	331.980	1.200	331.980
1.9000	0.8584	0.762	241.316	2.941	640.948	1.165	318.812	1.165	318.812
2.0000	0.9035	0.766	240.710	2.905	628.182	1.133	307.068	1.133	307.068
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDSWV06
Date and time : 18OCT99:12:13
Computation of ref. F: Simple mean, age 2 - 10
F-0.1 factor : 0.2923
F-max factor : 0.6121
F-0.1 reference F : 0.1321
F-max reference F : 0.2765
Recruitment : Single recruit

Table 9.26a North Sea plaice: short term effects of medium term forecasts using the reduced RCT3 estimates of recruitment as discussed in the text.

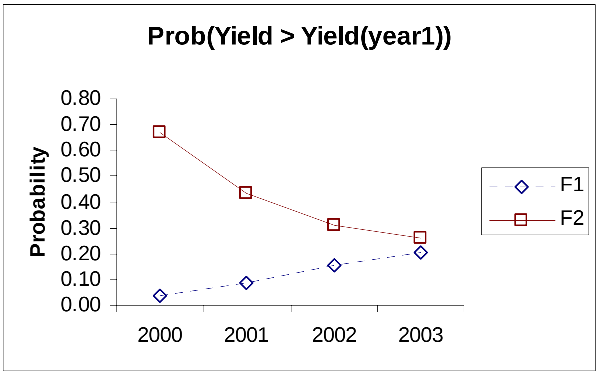
Bpa	300 thousand tonnes				
Blim	210 thousand tonnes				
F1	0.3	Basis :	Fpa	F multiplier	0.66
F2	0.45	Basis :	SQ	F multiplier	1
Year 1	1999				

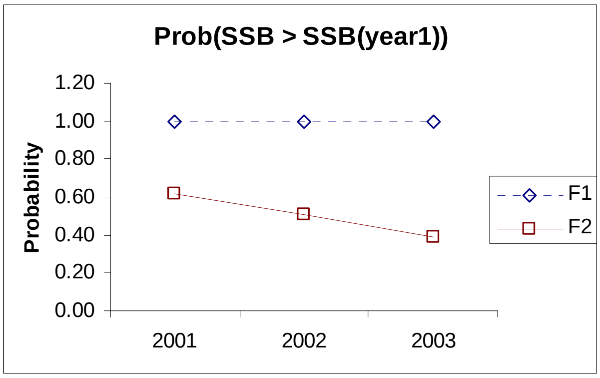
Format of tables:

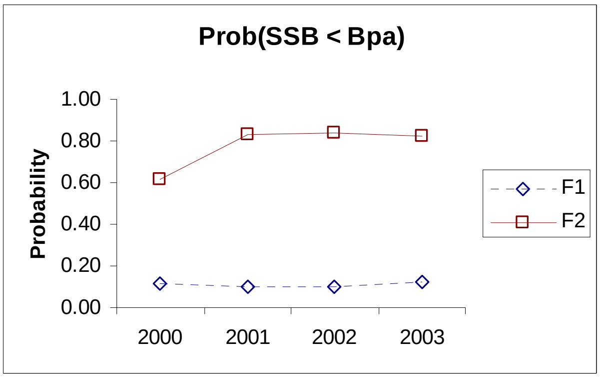
	1999	2000	2001	2002	2003
F1	Yield1999 SSB1999	Prob(Yield2000>Yield1999) SSB2000 Prob(SSB2000< Bpa) Prob(SSB2000< Blim)	Prob(Yield2001>Yield1999) Prob(SSB2001>SSB1999) Prob(SSB2001< Bpa) Prob(SSB2001< Blim)	Prob(Yield2002>Yield1999) Prob(SSB2002>SSB1999) Prob(SSB2002< Bpa) Prob(SSB2002< Blim)	Prob(Yield2003>Yield1999) Prob(SSB2003>SSB1999) Prob(SSB2003< Bpa) Prob(SSB2003< Blim)
F2	Yield1999 SSB1999	Prob(Yield2000>Yield1999) SSB2000 Prob(SSB2000< Bpa) Prob(SSB2000< Blim)	Prob(Yield2001>Yield1999) Prob(SSB2001>SSB1999) Prob(SSB2001< Bpa) Prob(SSB2001< Blim)	Prob(Yield2002>Yield1999) Prob(SSB2002>SSB1999) Prob(SSB2002< Bpa) Prob(SSB2002< Blim)	Prob(Yield2003>Yield1999) Prob(SSB2003>SSB1999) Prob(SSB2003< Bpa) Prob(SSB2003< Blim)

Medium Term Summary
North Sea Plaice

F	1999	2000	2001	2002	2003
0.3	127	0.04	0.09	0.16	0.21
	259	291	1.00	1.00	0.99
		0.12	0.10	0.10	0.13
		0.00	0.00	0.01	0.10
0.45	127	0.67	0.43	0.31	0.26
	259	291	0.62	0.51	0.39
		0.61	0.83	0.84	0.83
		0.00	0.00	0.01	0.10







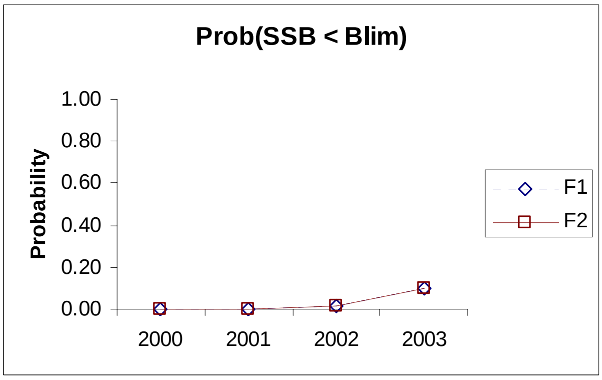


Table 9.26b North Sea plaice: short term effects of medium term forecasts using the RCT3 estimates of recruitment.

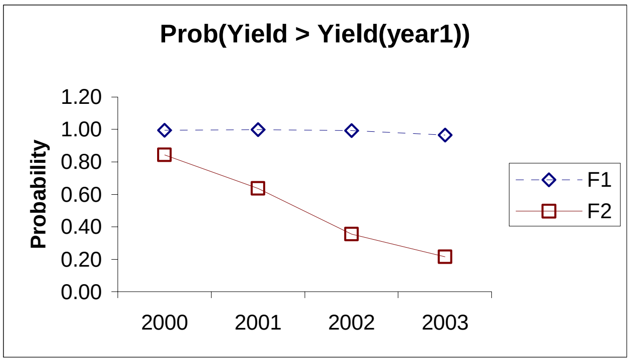
Bpa	300 thousand tonnes				
Blim	210 thousand tonnes				
F1	0.3	Basis :	Fpa	F multiplier	0.66
F2	0.45	Basis :	SQ	F multiplier	1
Year 1	1999				

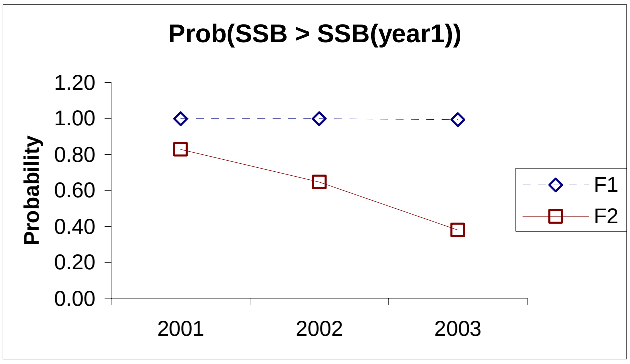
Format of tables:

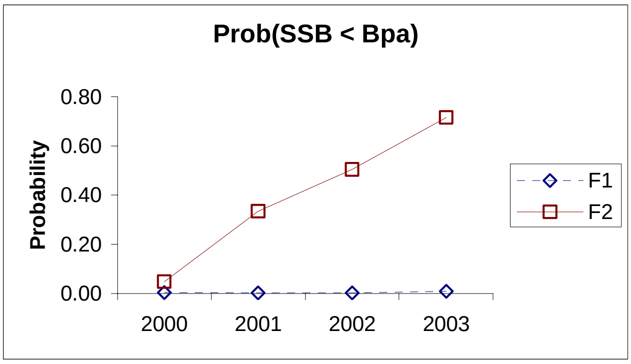
	1999	2000	2001	2002	2003
F1	Yield1999 SSB1999	Prob(Yield2000>Yield1999) SSB2000 Prob(SSB2000< Bpa) Prob(SSB2000< Blim)	Prob(Yield2001>Yield1999) Prob(SSB2001>SSB1999) Prob(SSB2001< Bpa) Prob(SSB2001< Blim)	Prob(Yield2002>Yield1999) Prob(SSB2002>SSB1999) Prob(SSB2002< Bpa) Prob(SSB2002< Blim)	Prob(Yield2003>Yield1999) Prob(SSB2003>SSB1999) Prob(SSB2003< Bpa) Prob(SSB2003< Blim)
F2	Yield1999 SSB1999	Prob(Yield2000>Yield1999) SSB2000 Prob(SSB2000< Bpa) Prob(SSB2000< Blim)	Prob(Yield2001>Yield1999) Prob(SSB2001>SSB1999) Prob(SSB2001< Bpa) Prob(SSB2001< Blim)	Prob(Yield2002>Yield1999) Prob(SSB2002>SSB1999) Prob(SSB2002< Bpa) Prob(SSB2002< Blim)	Prob(Yield2003>Yield1999) Prob(SSB2003>SSB1999) Prob(SSB2003< Bpa) Prob(SSB2003< Blim)

Medium Term Summary
North Sea Plaice

F	1999	2000	2001	2002	2003
0.3	102 287	1.00 383 0.00 0.00	1.00 1.00 0.00 0.00	0.99 1.00 0.00 0.00	0.97 0.99 0.01 0.01
0.45	143.4 287	0.84 341 0.05 0.00	0.64 0.83 0.33 0.00	0.36 0.65 0.50 0.00	0.22 0.38 0.72 0.01







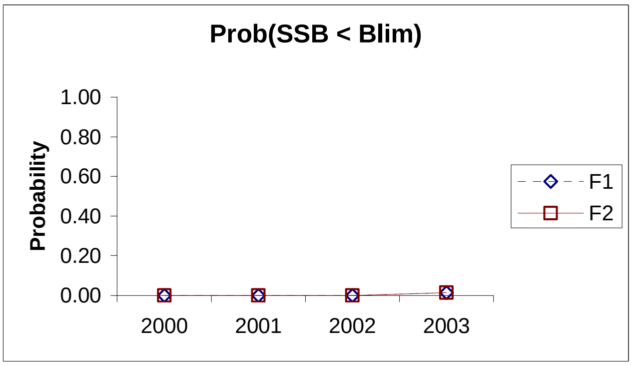


Table 9.27 North Sea Plaice. Comparison of catch data to survey data for the 1996 year class.

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1992	1993	1994	1995	1996	1997	1998	GM	1996/GM
1	3196	3170	1288	6981	963	616	176	*1380*	0.45
2	41447	49674	41773	33499	37503	34132	27796	*37408*	0.74
3	81827	93111	95773	76526	57925	80307	64146	*77414*	

BTS survey	1992	1993	1994	1995	1996	1997	1998	1999	GM	1996/GM
0	11.11	54.69	144.09	94.78	210.19	31.86	242.86	202.81	*85*	2.47
1	172.83	122.60	141.70	249.42	215.96	*440.04*	347.61	311.90	*230*	1.92
2	125.66	180.98	65.66	43.33	215.04	*742.59*	422.17	137.29	*167*	2.53
3	27.27	38.79	37.42	14.08	21.74	19.85	52.12	183.15	*35*	5.22

SNS survey	1992	1993	1994	1995	1996	1997	1998	1999	GM	1996/GM
0	5398	9226	27901	13029	91713	15363	22720	**45357**	*20066*	4.57
1	48223	22184	18225	24900	24663	*64523*	33391	**39603**	*31707*	2.03
2	13742	9484	4866	2786	10377	*36373*	29431	**9925**	*10869*	2.71
3	2257	988	884	415	1189	1393	5739	**15238**	*1816*	8.39

Figure 9.1 North Sea plaice: stock weights at age (kg)

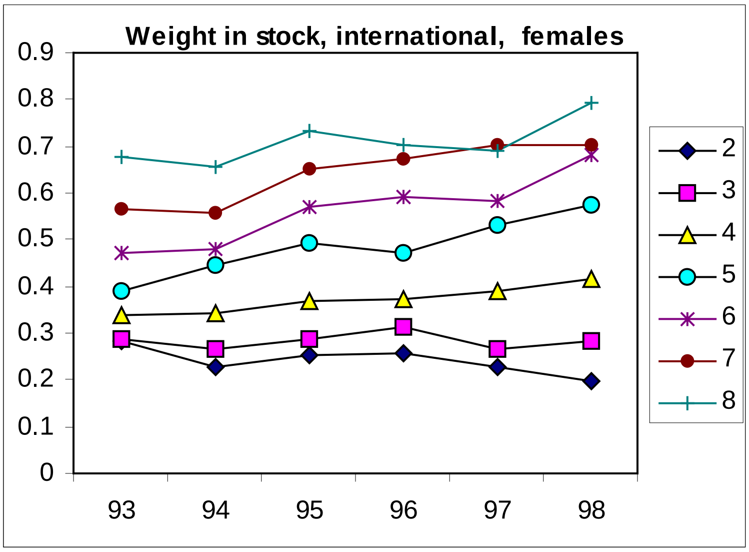


Figure 9.2 North Sea plaice: relative CPUE (scaled to the average CPUE for each fleet in the years 1990-1993)

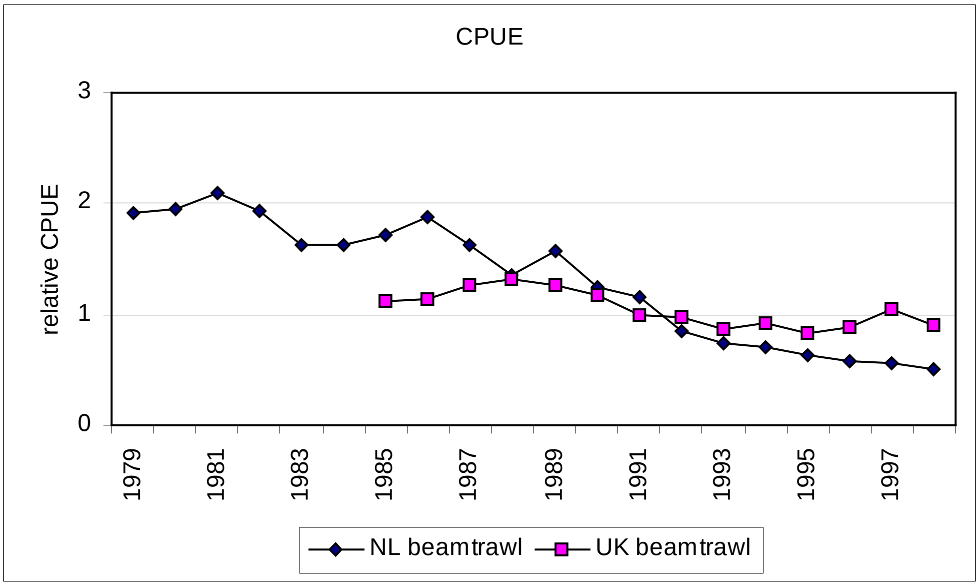


Figure 9.3 North Sea plaice: matrix of log catch-ratio residuals from a seperable analysis using F(4) = 0.6 and S(14) = 0.6. Positive residuals are indicated by dark circles, negative residuals by light circles.

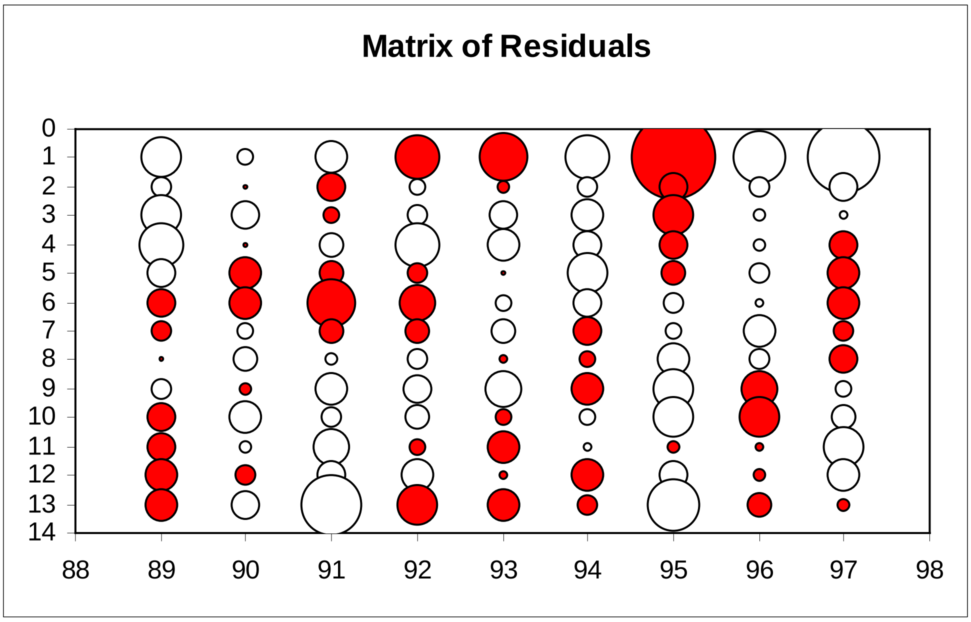


Figure 9.4 North Sea plaice: Log catchability residuals for the final XSA run; all fleets combined.

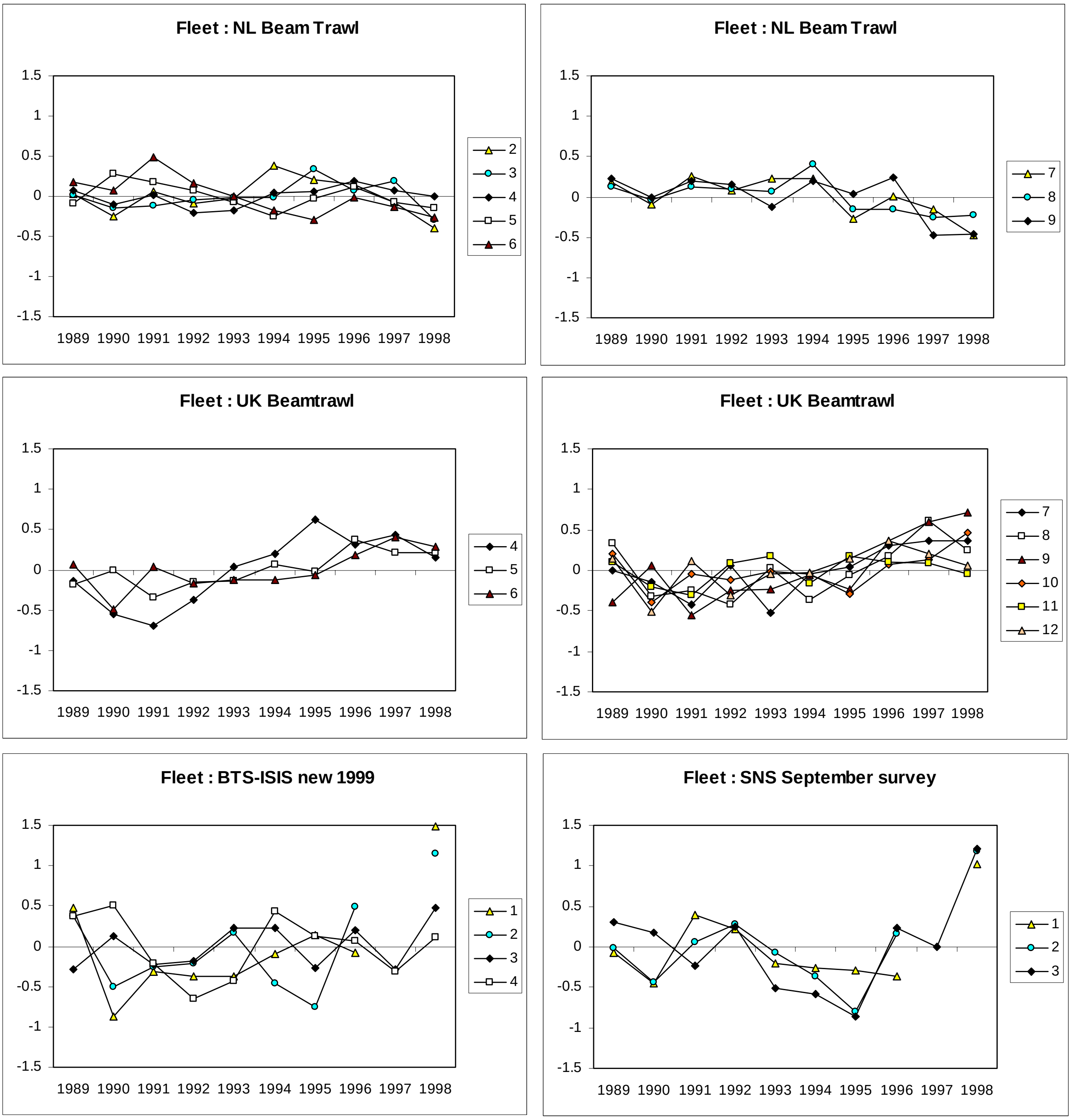


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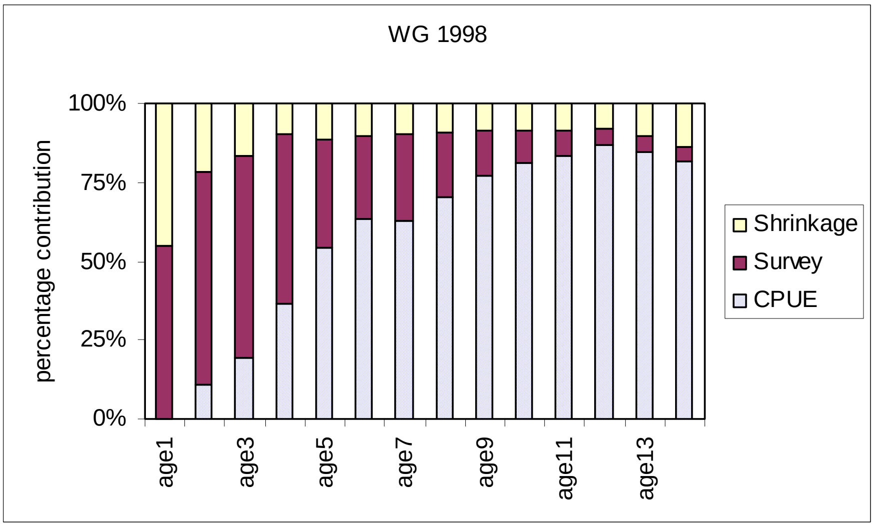
Figure 9.5 North Sea plaice: Weighting of tuning fleets in the 1998 WG (top) and current 1999 WG (bottom) XSA assessments.



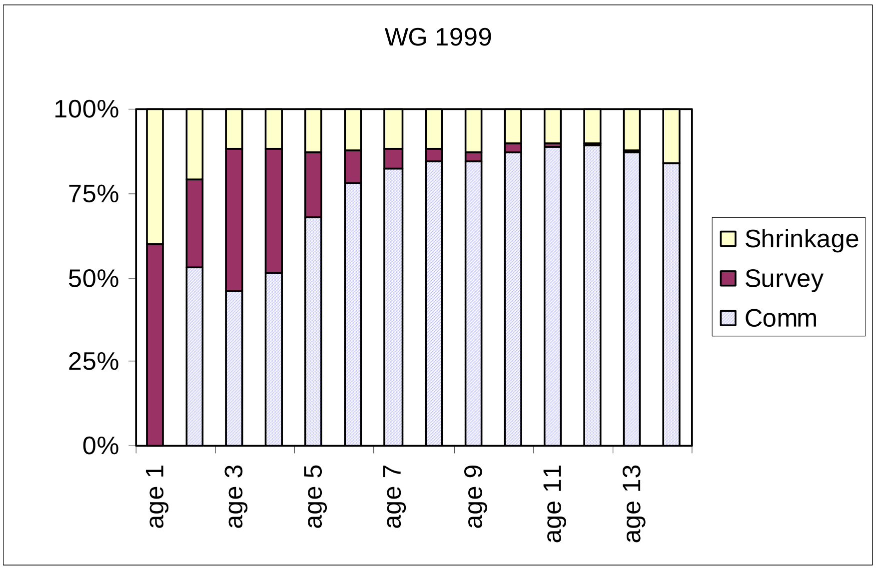


Figure 9.6 North Sea plaice: retrospective XSA using three consecutive 8 year tuning windows shifted back over time (shrinkage = 0.5)

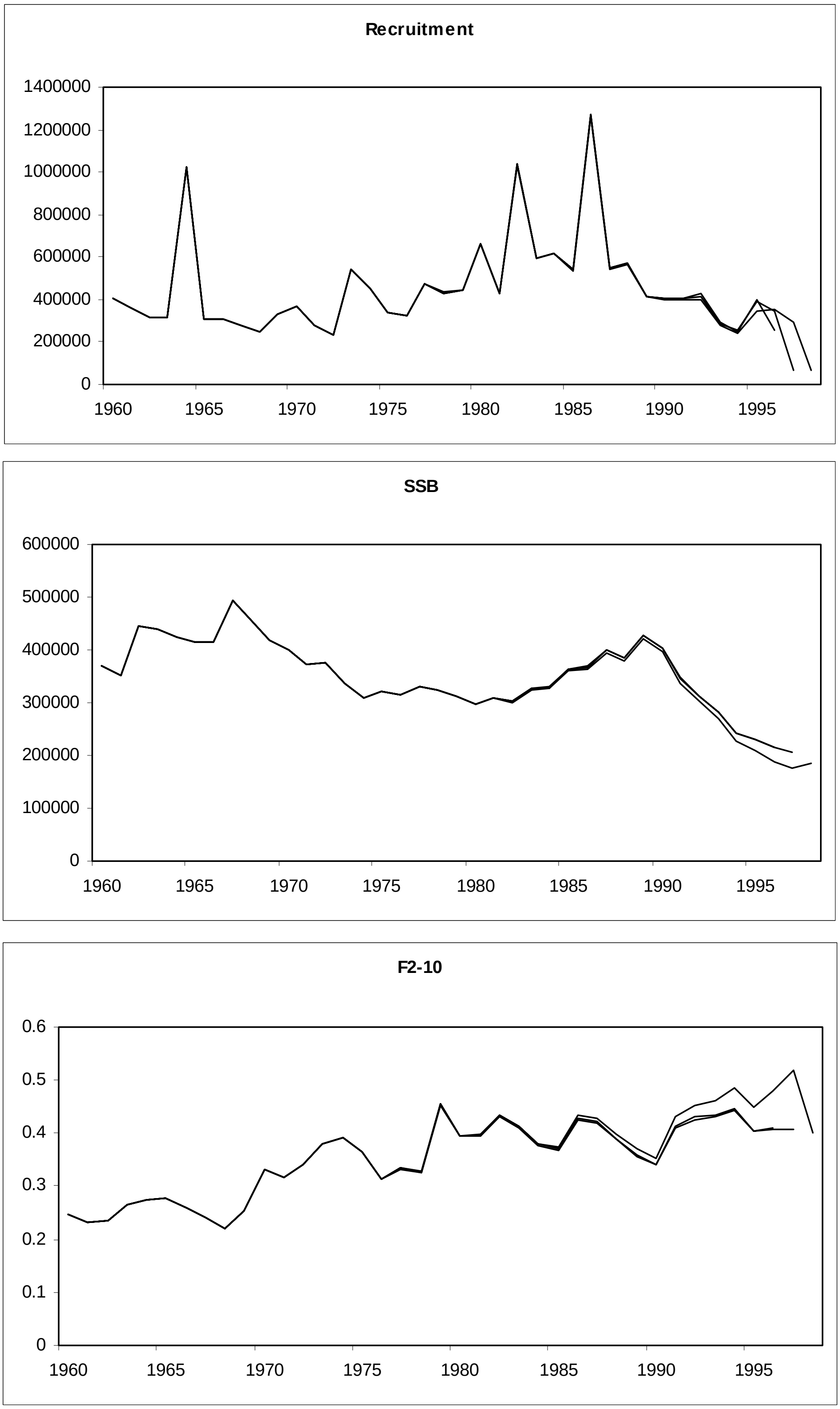


Figure 9.7 North Sea plaice: survey indices.

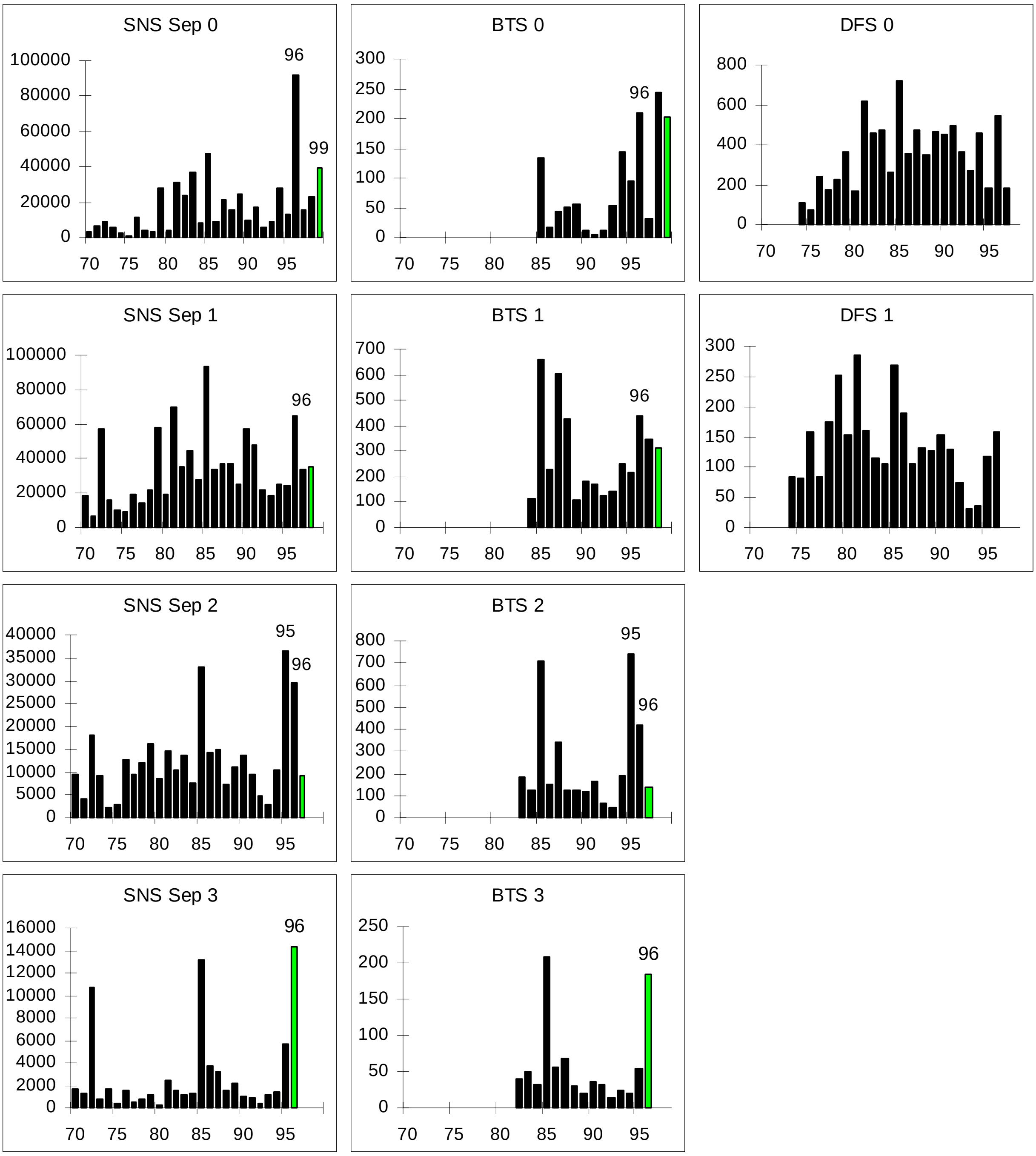


Figure 9.8 North Sea plaice: comparison of RCT3 estimates to the (converged) XSA estimates of recruitment at age 1.

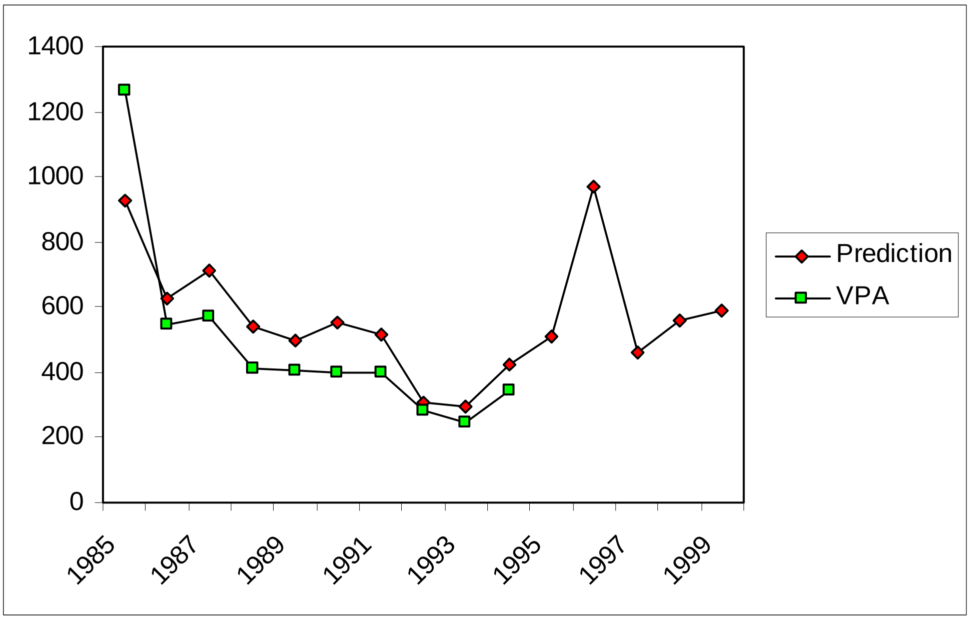


Figure 9.9 North Sea plaice: Stock summary

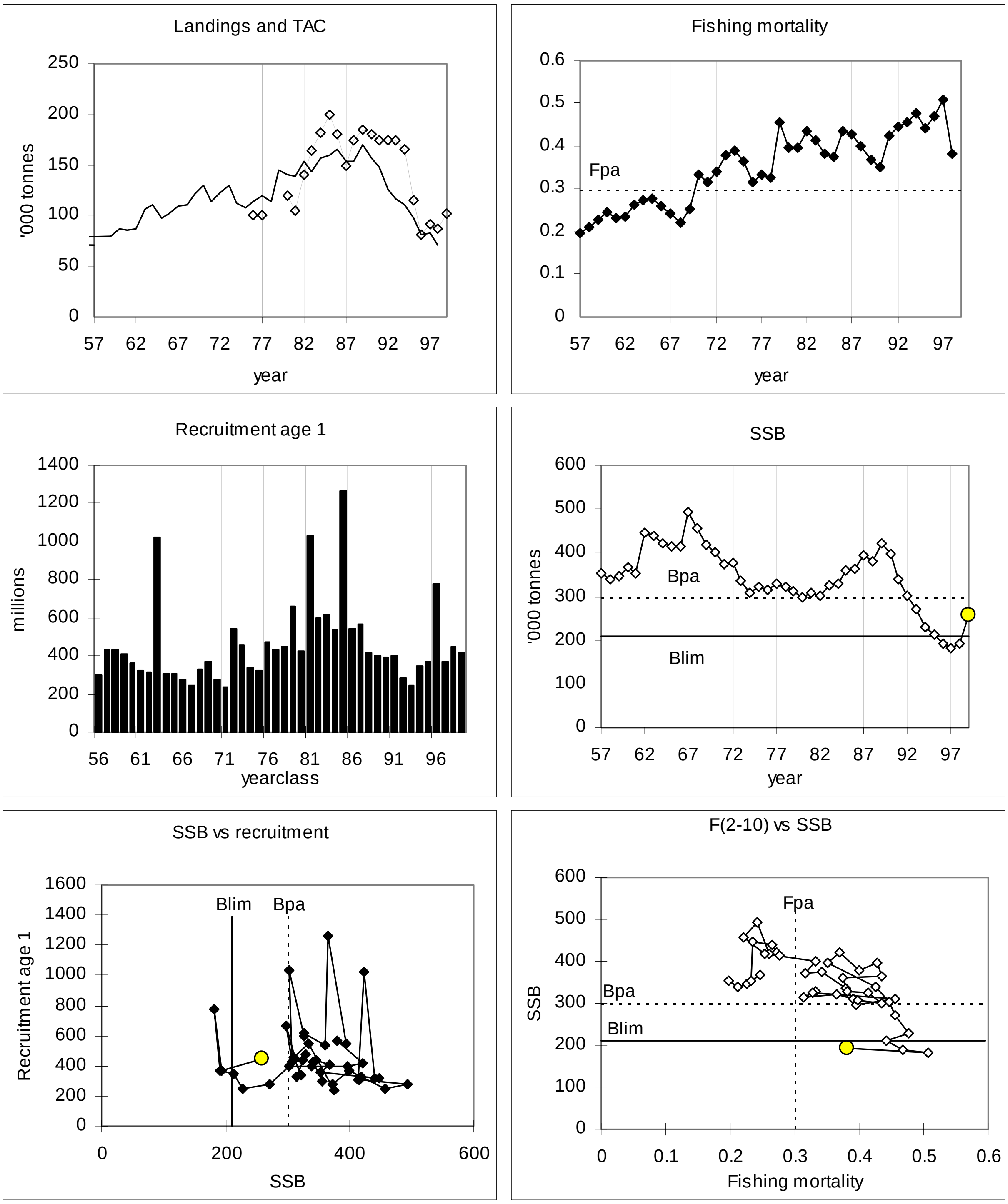


Figure 9.10 North Sea plaice: Sensitivity analysis SSB

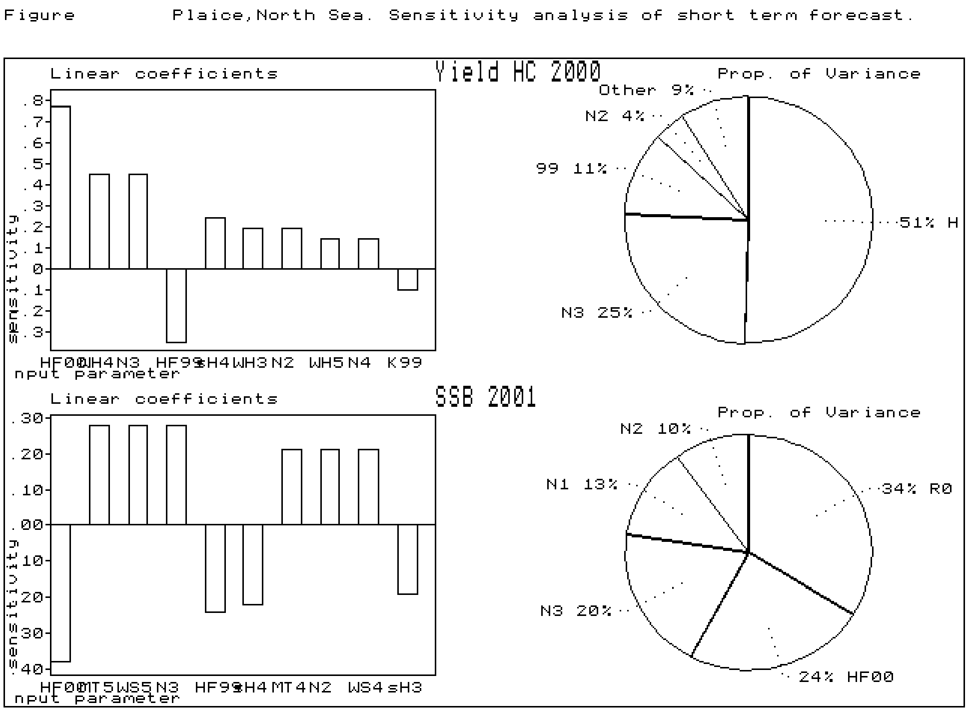


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Figure 9.11 North Sea plaice: Probability profile for short term forecast

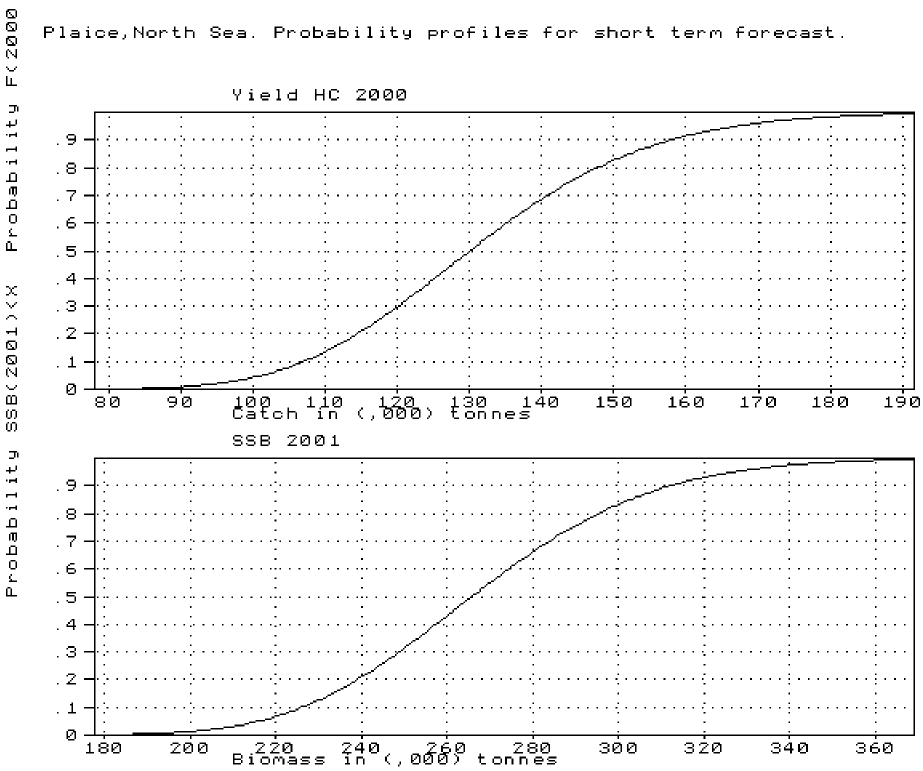

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Figure 9.12 North Sea plaice: medium term forecast at status quo fishing mortality (F2-10 = 0.45). 5, 50 and 95 percentiles are shown.

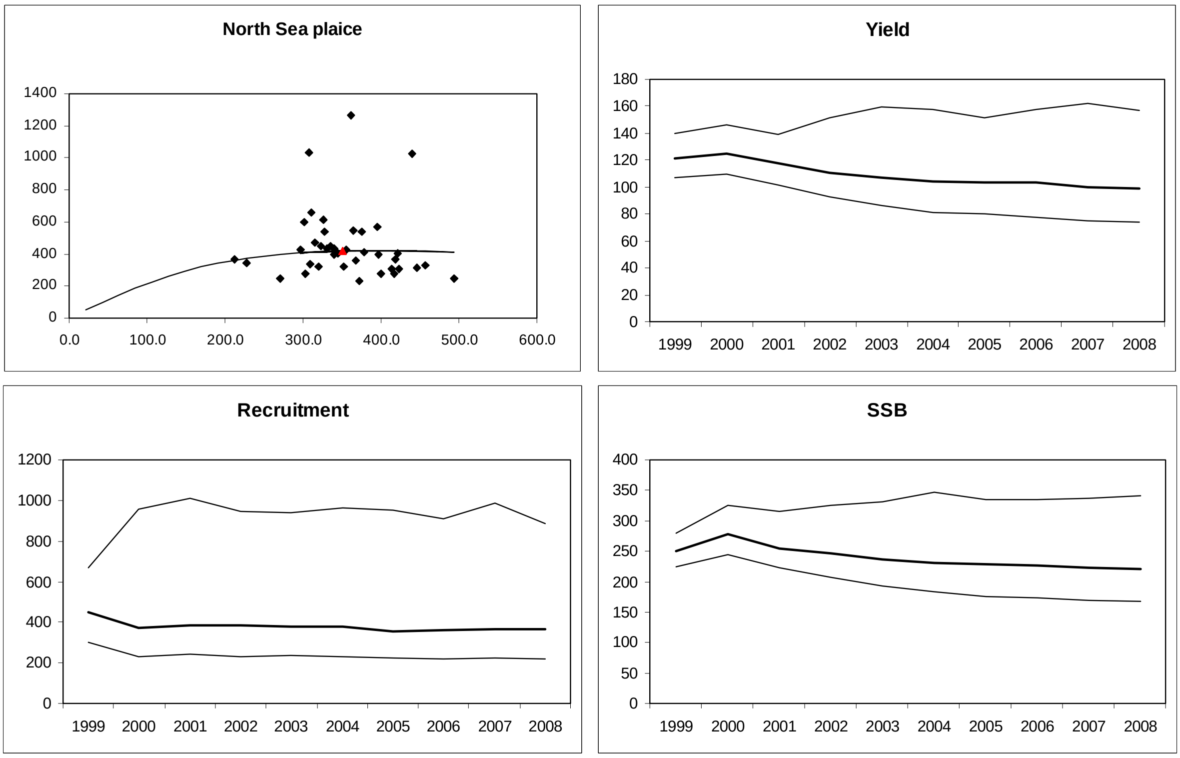


Figure 9.13 North Sea plaice: probability profile for SSB in 2008 using medium term simulations.

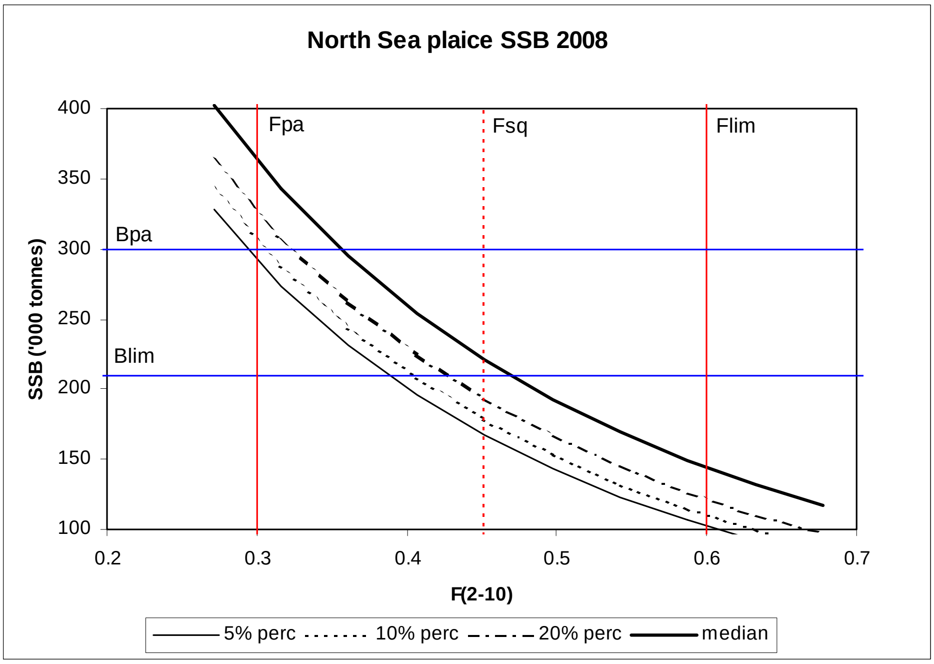
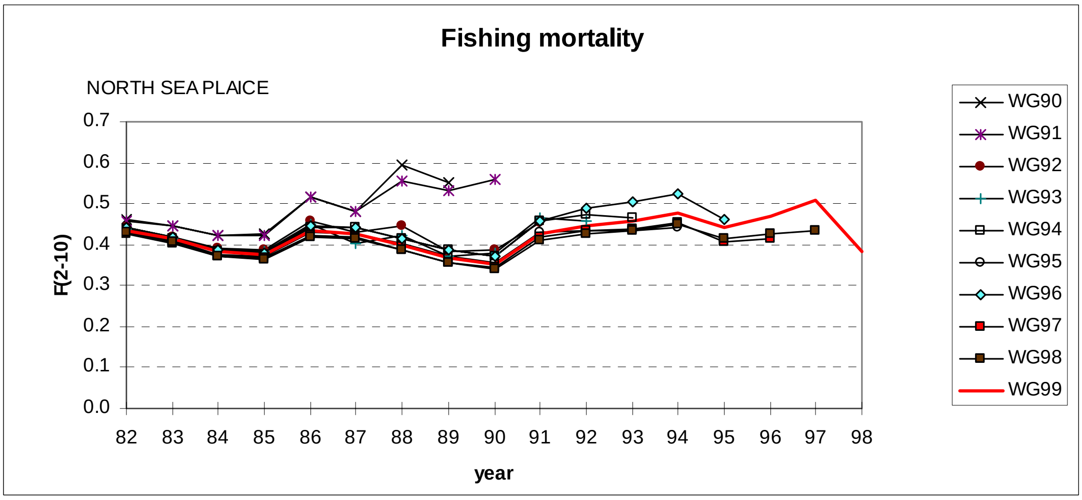
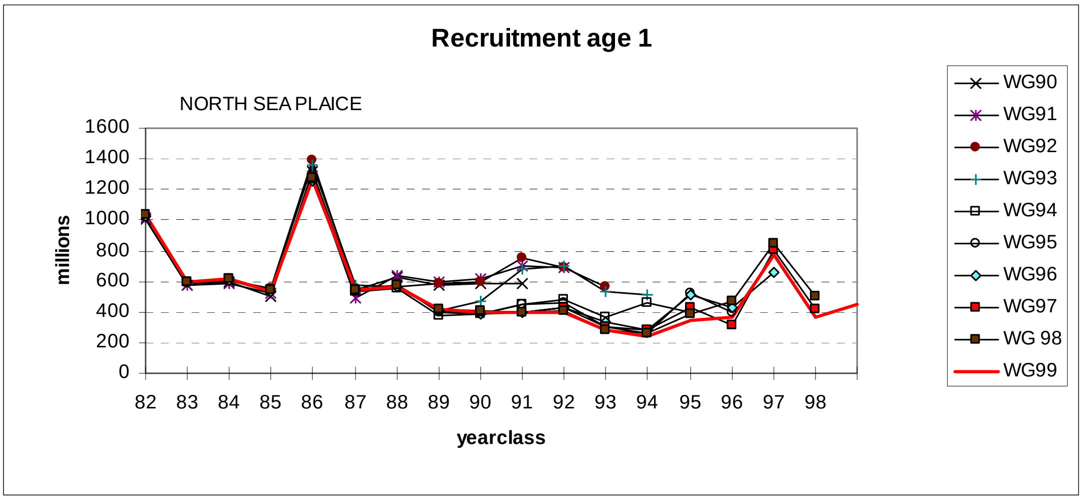


Figure 9.14 North Sea plaice: historic performance of past working group assessments.





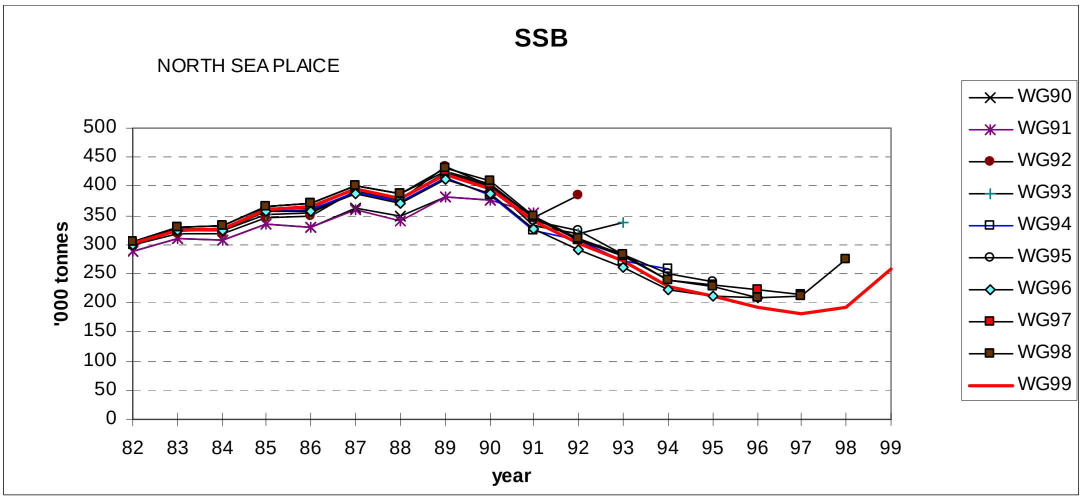
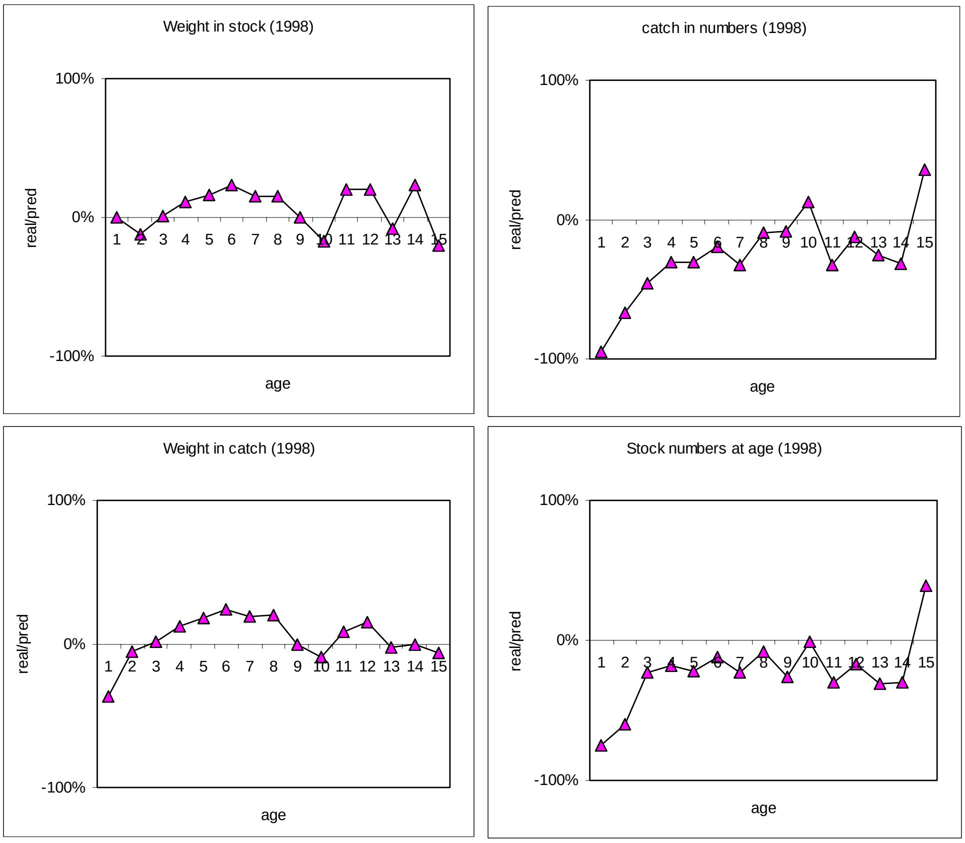


Figure 9.15 North Sea plaice: comparison of the 1998 values estimated in the 1998 WG with the realization of the current assessment (1999 WG). Values are expressed as relative to the 1998 WG values. Catch numbers for the younger ages in 1998 are much lower than expected last year.



10 PLAICE IN DIVISION IIIA

10.1 The fishery

10.1.1 ACFM advice applicable to 1999

ACFM recommended that fishing mortality should not be allowed to increase, corresponding to landings in 1999 of 11,000 t, and a high probability of keeping SSB above the proposed B_{pa} of 24,000 t in the short term. No other precautionary reference points were defined.

10.1.2 Management applicable to 1998 and 1999

The 1998 and 1999 TACs were 14,000 tonnes (11,200 t in Skagerrak and 2,800 t in Kattegat). The same TAC has been implemented since 1992.

10.1.3 Landings in 1998

A directed plaice fishery is carried out by otter-trawlers, Danish seiners and gill-netters. Most of the catches are taken in mixed human consumption fisheries. A considerable number of vessels have been taken out of the fisheries in recent years (ICES CM 1996/Assess:6). Plaice landings dropped to 8,741 tonnes in 1998, which is the second lowest record since 1972. The fishery is dominated by Denmark with Danish catches accounting for more than 90% of the total. The annual landings, available since 1972, are given by country for Kattegat and Skagerrak separately in Table 10.1.3. In the start of this period, catches were mostly provided by Kattegat but from the mid-1970s, Skagerrak has supplied the major proportion of the catch. In 1998, about 75% of the catches were taken in Skagerrak.

The landing data for 1983–1988 are considered uncertain and have been adjusted on the assumption that mis-reporting was a serious source of bias (ICES CM 1991/Assess: 9). In recent years no strong incentive has existed to omit the reporting of plaice catches and these are therefore considered reliable.

10.2 Natural mortality, Maturity, Age Compositions and Mean Weight at Age

As in previous years catch at age and mean weight at age information are provided by Denmark only. The total international catch was broken down by quarter and landing harbours for Kattegat and Skagerrak separately. The procedures being used to derive the distribution of fish length from market size categories and age from length are the same as in last year's assessment. In last year's assessment, catch numbers and mean weights at age had been reconstructed on the basis of a new perception of the sorting process in landings at the fish market and were only available over period 1987–1997. In this year's assessment, data are covering period 1978–1998. The catch numbers at age and the mean catch weight at age are presented in Figure 10.2.1 and in Tables 10.2.1 and 10.2.2.

In 1996 and 1998, the catch numbers at age were dominated by 4-year old fish, whereas the maximum catch numbers at age were generally recorded at age 5 since 1987 (Figure 10.2.1.). The mean catch weights at age calculated for the plaice in IIIa have been decreasing steadily since 1992 for fish older than 8, a feature which has not been observed for the other plaice stocks assessed in this working group (Figure 10.2.2). Time series of catch weights at age shown separately for Kattegat and Skagerrak in Figure 10.2.3. Time series related to all age groups have remained stable since 1987 in Kattegat. By contrast, decreasing trends are observed in the Skagerrak for age groups 8–11+, with a historical minimum reached in 1997. This trend may not be due to age reading problems. It is not excluded that decreasing weights-at-age observed since 1978 in the Skagerrak may be attributed to environmental changes. However, the low values perceived in year 1997 for plaice aged 8+ could be due to the low number of large fish being sampled in the most recent years. Weight at age in the stock was assumed equal to that of the catch.

A natural mortality of 0.1 per year was assumed for all years and ages. A knife-edge maturity distribution was employed: age group 2 was assumed to be immature whereas all age 3 and older plaice were assumed mature.

10.3 Catch, Effort and Research Vessel Data

Three Danish fleets, i.e., trawlers, gill-netters and Danish seiners, are available for tuning. The age dis-aggregated indices were derived by merging logbook statistics supplying catch weight per market category with the age distribution within these categories available from the market sampling.

The same criteria were used this year to configure the tuning fleets as in last year's assessment. Thus, all the fishing trips during which plaice was caught were included, while the effect of size determined differences in fishing power was reduced by standardising fishing effort in each vessel. The following multiplicative model was used:

$$E = E_0 \left(\frac{L}{15} \right)^{\alpha}$$

where E, E_0 and L respectively refer to as standardised fishing effort, number of days fishing and vessel length. The parameter α is estimated for all the commercial fleets as the slope of the regression between the log-CPUE (calculated as the ratio between landings and the number of days fishing) and the log-vessel length over 1987–1998. α has been updated to –1.59, -1.07, -0.71 for gill-netters, trawlers and seiners respectively. These negative values indicate that, within the present fleet configuration, the biggest fishing vessels are the less efficient, with regards to plaice landings. The tuning fleet data are provided in Table 10.3.1.

IBTS survey data for Kattegat and Skagerrak for the first quarter were provided by Sweden for the period 1992–1999, as numbers-per-age on a haul by haul basis. Stock abundance indices and their associated CVs are given in Table 10.3.2. An error was found in the calculation of the coefficient of variation of the 1998 abundance index in last year's assessment. CV was calculated to measure the relative variation in the observed abundance indices instead of measuring the relative variation in the indices estimations. The CV for 1998 have been substituted by the relevant values in this year's assessment. The highest precision of the estimates is found for the ages 3–6, which are estimated with a precision of approximately 20%.

10.4 Catch at Age Analysis

10.4.1 Data exploration

Tuning was carried out by using the CPUE information from the three commercial fleets and the survey indices. The survey indices were shifted from February to the preceding December to allow for a full use of the available data. The catch information in the age groups used in the VPA were restricted to ages 2–11+ as age 1 plaice rarely accounted for more than 1% of the total catch number. Very few plaices aged 7–9 were caught during the survey and these ages were removed from the IBTS tuning fleet.

Plots of the log catchability residuals, derived from a run with combined fleets, show little trend over time, except for the Argos survey and a year effect in 1997 for the oldest age groups caught by the Danish seine fleet (Figure 10.4.1).

Retrospective VPA runs are carried back to 1996 with a 10 years moving window of tuning (Figure 10.4.2). Only small differences are observed in the retrospective pattern of recruitment and SSB. The retrospective patterns of fishing mortality seem to indicate that F is neither over- nor underestimated consistently. However, there is a notable difference in the estimates of fishing mortality in 1997 between this year's assessement (F_{97} = 1.11) and last year's (F_{97} = 0.74). In the 1997 retrospecitve run, catches at ages 5–8 are high relative to 1996. The resulting estimated F in 1997 associated to these ages is high relative to F in 1996, but close to F averaged over 1978–1997, while SSB has remained stable. In the 1997 retrospecitve run the high value of F in 1997 relative to F in 1998 is associated to a sharp reduction in both catch at ages 5–8 and fishing effort between 1997 and 1998, while SSB has remained stable. Low levels of catch and fishing effort recorded in 1998 affect the calculation of F in 1998, but also in the most recent years including 1997. Thus, F(1997) is increased to better fit the model.

Despite the year effect in 1997, which is documented above, the overall assessment appears reasonable, for four reasons. First the residuals related to the regression of the Log-catchabilities have low variability. Second, the R-squares associated to the estimation of Log-catchabilities of the commercial fleets are all higher than 40% for the age range 4–10 for the commercial fleets, even if these R-squares are somewhat lower for the IBTS survey (Table 10.4.1.). Third, for all ages, the estimation of survivors differed only slightly between fleets, including the Argos survey. Fourth, Figure 10.4.2 shows that the uncertainty on fishing mortality in 1997 does not affect much the estimation of SSB. The WG accepted this assessment.

10.4.2 Final assessment

The tuning window used in last year's assessment was of 11 years (the whole range of data available). In this year's assessment, where a wider range of data is available, the tuning window has been reduced to 10 years. The other tuning settings used last year were maintained: catchability independent of stock size at age 3, catchability plateau at age 8, population shrinkage of 0.3, F shrinkage of 0.5, taper not applied.

The VPA results are given in Tables 10.4.1.-10.4.4. The fishing mortality (age 4–8) estimated for 1998 is 0.62, which is much below the value estimated for 1997 (1.11). The exploitation pattern increases up to age 7 from where on F remains at a constant level. Although total and spawning stock biomass in 1998 are estimated to be lower than in 1997, they remain in the range of historical values.

10.5 Recruitment estimates

The abundance indices from the IBTS surveys in Kattegat and Skagerrak are given in Table 10.3.2. The time series indicate that the 1997 and 1998 year-classes are well above average. The coefficients of variation calculated in 1999 for ages 4–7 are high compared to the previous years, making estimations uncertain. Despite the short time span available, RCT3 analysis was operated this year, based on the Argos survey indices. However, the contribution of the surveys to the predicted value of age 2 group was lower than 30% for year classes 1995–1998. The estimations of recruitment at age 2 (year class 1996) were consistent across the four tuning fleets, including the research survey (Table 10.4.1). As a result, the estimates of recruitment provided by the XSA were retained and not replaced by the outcomes of the RCT3 program. Recruitment in 1998 was estimated by the geometric mean of 47,462, calculated over period 1978–1996.

10.6 Historical trends

The historical trends in the fisheries are presented in Tables 10.1.3., 10.4.4. and in Figure 10.6.1.

In the 1970s, landings fluctuated between 14,000 and 27,000 tonnes. Since then the catches have declined to the present range of 8,000–12,000 tonnes. Landings in 1998 were the second lowest since 1972. The fishing mortality has consistently remained at a rather high level of 0.6–1.0 over the period of assessment, with extreme values observed in 1988 and 1997. SSB and recruitment have oscillated around a stable mean since 1980. SSB has varied in the range 25,000–45,000 tonnes, while recruitment has fluctuated between 30 and 90 million per year.

10.7 Short-term forecast

The inputs used for the predictions are given in Table 10.7.1. Stock sizes for age 3 and above are taken from the estimated number of survivors from the XSA. The age 2 recruitment in 1999, 2000 and 2001 is taken as the geometric average over the 1978–1996 period. The mean weight at age are taken as the average for the years 1996–1998. The exploitation pattern in the prognosis are based on the non-scaled average exploitation pattern over the period 1996–1998.

The status quo predictions result in catches of 12,600 and 12,200 tonnes in 1999 and 2000, respectively (Tables 10.7.2). The detailed predicted outputs are given in Table 10.7.3. The status quo estimate of SSB remains in the range 34,000–37,000 tonnes over the 1999–2001 period. The short-term yield and SSB are shown in Figure 10.9.1.

The inputs of the sensitivity analysis are given in Table 10.7.4. Figure 10.7.1. shows the sensitivity and the sources of variations connected to the various input parameters for the status quo catch predictions. Yield in year 2000 is found most sensitive to the fishing mortalities in 1999 and 2000, which contribute to 87% of the variance of the total variance. The variance of SSB at the start of 2001 is essentially shared between recruitment in 2000 (34%), the abundance in 1999 of age group 2 (24%) and fishing mortality in 2000 (29%).

The results of a detailed status quo short-term forecast are shown in Table 10.7.5. Year classes 1994 and 1995 are expected to provide the largest contribution to landings in years 1999 and 2000 (60%).

It is also anticipated that year classes 1997 and 1998 might contribute to 60% of the prediction of SSB at the beginning of year 2001.

Figure 10.7.2. shows the probability profiles for yield in year 2000 and the SSB in year 2001, under the status quo projection. The plots show that the probability to achieve a catch level just higher than that of 1998 with a fishing mortality above $F_{status\ quo}$ is lower than 30%. It may also be anticipated that it is unlikely (probability lower than 5%) that the SSB fall below the historical minimum SSB found at 23,000 tonnes.

10.8 Medium-term projections

In last year's assessment, where data were only covering period 1987–1997, stock-recruitment was modelled by a Butterworth and Bergh curve. In this year's assessment, data are available over period 1978–1998. As a result, several stock recruitment functions (autocorrelated recruitment, Beverton and Holt, Ricker and Shepherd) are fitted to the updated set of stock and recruitment data (Figure 10.8.1). The auto-correlation and the Beverton and Holt models do not fit the data (R-square lower than 12%). The Ricker and the Shepherd curves provide a more appropriate fit, and similar coefficients of determination (R-squares in the range 35–39%). The Ricker model was chosen for its better robustness, since it has only 2 parameters to be estimated against 3 for the Shepherd model.

A medium term projection, using status quo fishing mortality, has been run over the period 1999–2008, by using the program WGTERM. Weights-at-age have been averaged over 1978–1998, in order to account for their decreasing trend over time. The outcomes of the medium-term status quo projections have been reported in Figures 10.8.2. Results suggest that yield would slightly decrease from 12,200 to 11,100 t over 1999–2001 and remain constant afterwards. On the other hand, SSB and recruitment would overall be stable.

10.9 Long-term considerations

A yield per recruit analysis was performed. The input data are given in Table 10.9.1. They only differ from the inputs of the short-term forecasts by the weights-at-age, which have here been averaged over 1978–1998. The outputs are summarised in Table 10.9.2 and Figure 10.9.1. The stock and recruitment relationship is given in Figure 10.9.2.

10.10 Biological Reference Points

ACFM advised last year that B_{pa} should be set to 24,000 t, the lowest biomass at which there is no indication of impaired recruitment, and did not recommend any B_{lim}, F_{lim}, or F_{pa}. B_{pa} was calculated by rounding up B_{loss}, on the grounds of (i) the stock not being currently at a low level and, (ii) the moderate inter-annual variability in SSB.

Biological reference points have been computed again this year with the PA software, so as to take into consideration the whole range of data available this year (1978–1998) (Figure 10.10.1). Values of the SSB related reference points are consistent with those calculated last year. F_{max}, $F_{0.1}$ and $F_{35\%SPR}$ are also consistent with the figures estimated in last year's assessment. However, there are differences in the estimations of F_{low}, F_{med}, F_{high} and F_{loss} between this year's and last year's assessment.

In this year's assessment, the validity of last year's precautionary definitions is revisited. Figure 10.10.2 shows historical and projected trends in F and SSB, in relation to B_{pa}, using the same definitions as last year ($B_{pa} = B_{loss}$ = 24,000 t). It may be observed that the probability of historical SSB to fall below B_{pa}, is much lower than 5%. It is also shown that the probability of the projected SSB to fall below B_{pa} is lower than 5% for a wide range of F (0.0–1.6).

The WG suggests the same B_{pa} as last year: $B_{pa} = B_{loss}$ = 24,000 t.

10.11 Comments on the assessment

The span of the time series available in this year's assessment (1978–1998) is wider than in last year's (1987–1997). The results of the assessment are not notably affected by this update. The volume of data available this year provided better insights into the modelling of stock recruitment, but it did not contribute to affect the definition of B_{pa}.

In last year's assessment, the decreasing trends in stock and catch weights at age have not been specifically accounted for in the set up of the predictions. Projected weights at age were estimated by the average over the whole range of data available (1987–1997), for short- and medium-term projections. In this year's assessment, weights at age being used in the short- and the medium-term predictions are taken as the average over 1996–1998 and 1978–1998 respectively. This change may contribute to explain the differences between this year's and last year's short-term predictions in yield and SSB.

Like last year, the estimated fishing mortality of c.a. 0.77 calculated in IIIa is higher than the one estimated in division IV (c.a. 0.40). The difference may be caused by older, mature, plaice emigrating from the Skagerrak to the North Sea for spawning (Ulmestrand 1989; Stæhr and Støttrup 1991). When not specifically accounting for migrations (by adding the rate of migration to the natural mortality) the VPA calculation will overestimate the fishing mortality.

Table 10.1.3. Plaice landings from the Kattegat and Skagerrak (tonnes) 1972-1998.

Year	Denmark		Sweden		Germany		Belgium	Norway	Total		
	Kattegat	Skagerrak	Kattegat	Skagerrak	Kattegat	Skagerrak	Skagerrak	Skagerrak	Kattegat	Skagerrak	Div. IIIa
1972	15,504	5,095	348	70					15,852	5,165	21,017
1973	10,021	3,871	231	80					10,252	3,951	14,203
1974	11,401	3,429	255	70					11,656	3,499	15,155
1975	10,158	4,888	369	77					10,527	4,965	15,492
1976	9,487	9,251	271	81					9,758	9,332	19,090
1977	11,611	12,855	300	142					11,911	12,997	24,908
1978	12,685	13,383	368	94					13,053	13,477	26,530
1979	9,721	11,045	281	105					10,002	11,150	21,152
1980	5,582	9,514	289	92					5,871	9,606	15,477
1981	3,803	8,115	232	123					4,035	8,238	12,273
1982	2,717	7,789	201	140					2,918	7,929	10,847
1983	3,280	6,828	291	170			133	14	3,571	7,145	10,716
1984	3,252	7,560	323	356	32		27	22	3,607	7,965	11,572
1985	2,979	9,646	403	296	4		136	18	3,386	10,096	13,482
1986	2,468	10,653	170	215			505	24	2,638	11,397	14,035
1987	2,868	11,370	283	222	104		907	25	3,255	12,524	15,779
1988	1,818	9,781	210	281	3		716	41	2,031	10,819	12,850
1989	1,596	5,387	135	320	4	0	230	33	1,735	5,970	7,705
1990	1,831	8,726	201	777	2	1	471	69	2,034	10,044	12,078
1991	1,756	5,849	267	472	6	4	315	68	2,029	6,708	8,737
1992	2,071	8,522	208	381			537	107	2,279	9,547	11,826
1993	1,289	9,128	287	175			339	78	1,576	9,720	11,296
1994	1,553	8,790	315	227	4	33	325	65	1,872	9,440	11,312
1995	1,555	8,479	132	338	6	42	302	76	1,693	9,237	10,930
1996	2,336	7,256	195	198	11	19		105	2,542	7,578	10,120
1997	2,198	7,307	261	251	25	15		93	2,484	7,665	10,149
1998	1,849	6,383	201	227	11	11		59	2,061	6,680	8,741

Table 10.2.1. Plaice IIIa. Catch numbers at age ('000)

	2	3	4	5	6	7	8	9	10	11+
1978	489	15692	39531	24919	8011	620	63	63	48	60
1979	1105	9789	29655	20807	7646	2514	170	75	50	55
1980	362	4772	16353	12575	6033	2393	949	203	54	50
1981	190	4048	13098	10970	4306	1427	546	213	119	97
1982	526	2067	9204	10602	5554	1851	758	301	113	48
1983	1481	9715	8630	8026	2673	925	531	257	96	106
1984	2125	12577	11182	4489	2190	972	882	677	328	117
1985	1341	8466	21903	6307	1738	705	257	195	164	150
1986	375	4361	14731	19170	4472	632	274	154	140	98
1987	673	4405	12594	17644	10129	2076	376	247	130	200
1988	101	3058	12037	13775	6854	2743	946	322	136	157
1989	1009	3829	7067	6224	2695	1165	547	253	135	235
1990	3189	8772	8600	9675	3207	978	480	348	155	273
1991	2314	8640	9629	4688	2908	896	307	157	87	137
1992	887	3802	11652	17302	4269	1025	294	113	27	113
1993	1003	3465	10091	13252	6893	1650	374	103	46	66
1994	1382	6894	8019	9877	8013	2772	445	111	38	54
1995	454	2315	6708	11703	6721	5002	866	139	66	52
1996	4350	5139	7650	5069	4558	1739	1300	145	22	43
1997	501	4511	6281	9417	5085	3063	1365	847	113	35
1998	570	6937	8464	7154	3106	825	403	244	177	66

Table 10.2.2. Plaice IIIa. Mean weight in catch (kg)

	2	3	4	5	6	7	8	9	10	11+
1978	0.236	0.248	0.268	0.322	0.417	0.598	0.752	0.818	0.914	0.843
1979	0.222	0.255	0.267	0.297	0.378	0.451	0.655	0.922	1.02	1.044
1980	0.261	0.274	0.306	0.345	0.414	0.579	0.64	0.753	0.811	0.91
1981	0.23	0.263	0.296	0.357	0.432	0.537	0.671	0.813	0.912	0.999
1982	0.27	0.301	0.286	0.318	0.386	0.544	0.704	0.813	0.912	0.986
1983	0.285	0.274	0.293	0.356	0.423	0.483	0.531	0.647	0.986	1.184
1984	0.282	0.299	0.304	0.372	0.404	0.408	0.384	0.361	0.444	1.062
1985	0.277	0.283	0.308	0.354	0.437	0.544	0.683	0.743	0.76	0.917
1986	0.25	0.277	0.284	0.31	0.384	0.531	0.707	0.85	0.903	1.099
1987	0.322	0.281	0.282	0.293	0.363	0.528	0.709	0.904	1.03	1.084
1988	0.252	0.267	0.269	0.29	0.35	0.475	0.567	0.756	0.833	1.192
1989	0.274	0.263	0.282	0.32	0.376	0.466	0.635	0.741	0.825	1.003
1990	0.292	0.289	0.294	0.337	0.397	0.499	0.685	0.776	0.951	1.15
1991	0.263	0.27	0.259	0.274	0.365	0.492	0.584	0.67	0.882	1.08
1992	0.309	0.31	0.272	0.28	0.336	0.501	0.646	0.817	0.804	0.976
1993	0.267	0.271	0.271	0.294	0.338	0.441	0.567	0.711	0.801	1.167
1994	0.275	0.263	0.272	0.289	0.33	0.381	0.517	0.658	0.767	0.977
1995	0.263	0.301	0.303	0.289	0.328	0.368	0.499	0.737	0.752	1.022
1996	0.266	0.268	0.294	0.384	0.399	0.436	0.43	0.561	0.87	0.957
1997	0.3	0.294	0.282	0.299	0.341	0.41	0.465	0.445	0.53	0.752
1998	0.26	0.249	0.279	0.327	0.398	0.464	0.515	0.586	0.64	0.858

Table 10.3.1. Plaice IIIa. Tuning fleet information.

Plaice	in	the	Kattegat	and	Skagerrak	(Fishing	Area	IIIa)		
104										
ARGOS:	Argos,	1st	Q	(IBTS)						
1991	1998									
1	1	0.99	1							
1	6									
1	4.17	9.29	6.44	1.62	0.38	0.08				
1	6.5	6.02	5.78	5.11	2.03	0.22				
1	8.5	6.48	1.89	1.09	1.19	0.25				
1	4.48	10.4	4.2	1.13	0.85	0.4				
1	17.05	13.35	4.9	1.54	0.46	0.13				
1	6.86	12.9	3.26	1.14	0.12	0.04				
1	8.06	8	4.24	1.48	0.32	0.12				
1	17.31	9.14	2.59	2.32	0.13	0.07				
FLT07:	Danish	gill-netters								
1987	1998									
1	1	0	1							
2	11									
7915	20592.3	169059.2	650915.7	1071313	803164.5	286784.3	58777.3	33990.7	18818.4	24876.8
5819	27444.2	168503.6	529771.3	606818.1	410015.6	309311.4	133999.9	55392.7	19491.5	23976.7
5485	18881.5	63446.8	175205.5	186617.2	129660.6	111414.7	85514	44763.5	24563.5	43810.2
6349	64307.8	246879.5	272983.5	362431.8	157274.3	62093.7	42382.9	38229.8	20604.3	41000.9
4943	43033.5	181507.1	242270.8	148621.9	168825.7	68492	32399.3	14923.2	11663.1	17808.8
6519	67456.2	350854.7	854331.1	1065380	260668.7	108795.4	39020.5	18754.9	5675.4	21064
7407	4845.8	80410.5	339540	652443.1	591403.6	199281.6	42122.4	12860	3774.2	2596.8
16963	93331.6	788950.1	992743.9	1280086	1145581	443000.3	78442.7	26304.2	7858.6	14155.4
14521	93996.5	320239	744931.3	1661991	911911.5	979461.7	185417.9	30434.1	13975.7	10309.3
13733	431699.5	632570.9	858288.4	762350.3	711939.5	291166.6	215021.6	22193.1	3298.1	8388.2
10953	67268.4	468036.5	544401.2	912160.6	684170.5	509591	271093.8	101873.8	19323.2	7745.1
9796	52000	481000	803000	854000	380000	112000	63000	42000	31000	15000
FLT08:	Danish	trawlers								
1987	1998									
1	1	0	1							
2	11									
51121	255914.6	1177661	2468347	2379126	1046122	215077.7	50415	32514	24419.7	37437.7
39597	108177.7	839066.1	1906117	1819047	700988.1	226895.2	75480.6	23885.3	20953	22426.2
43521	430316	927354.5	1291748	1026225	456677.9	165557	71803	37576.1	18120.9	35818.8
49100	1181442	2311097	2020630	2065160	631904.4	200415.8	85590.4	45586.3	22634	42974.6
46207	660031.2	2459249	2424238	1085399	580774.1	151469.9	52785.8	31364.1	18474.6	27440.7
42859	324053.8	1244765	2463167	3594631	910595.2	232057.5	62318.1	14226.3	3014.4	12454
36773	172192	866648	2265364	2200206	1312213	455227.1	82231.2	15921.3	12070.9	15308.8
35892	506609	1815439	1886714	2177012	1785146	732728.8	113302.5	17908.9	12336.2	11983.1
32029	262364.1	791717.7	1217689	2119319	1052643	706431.7	144495.7	23084.1	11096.1	8823
34026	1044742	1432920	1503021	1053244	772862	329651.2	235696.1	24500.8	4352	9874.4
31494	166014.2	1234787	1637715	1843447	841072.5	352323.7	143468.1	96236.5	15808.9	6255.1
30369	210000	1613000	1953000	1285000	495000	120000	54000	36000	23000	9000
FLT12:	Danish	seiners								
1987	1998									
1	1	0	1							
2	11									
12964	97425.8	1157332	4050596	5227390	2536790	426009.3	72397.8	40924.6	20943.5	22943.2
9852	466749.6	1343996	3116463	3368983	1446989	521282.5	158464.1	47106.1	16430.8	19005.8
12373	334835.2	1483241	3030013	2733969	1193297	477611.7	171227.1	76748.9	33562.5	39868.4
11921	1116082	3542256	3431384	3748325	1097119	299715.7	116327.5	81119	32921.9	60674.3
10454	515011.9	2426848	3289407	1838074	1057052	265605.5	88516.4	42174.3	17972.1	28586.9
10143	106266.7	791895.1	4199036	6819566	1725235	324760.3	77399.8	27069.6	4686.3	17868.1
8472	139121	509252.6	1721085	2800822	1649545	413535.4	89600.8	21957.5	5718.1	3978.3
8124	336892.3	1620907	1883228	2514844	1977352	552285.4	69992.5	19936.8	4536.3	4288.3
7679	195908	569870.6	1348638	2282155	1664669	1118605	153080.6	23915.4	11390.9	8384.1
7048	949341.9	1363113	1878662	980781.5	913660.5	327088.5	230807	22761.6	3018.6	6501.7
6303	165538.1	1193786	1794123	2572264	1359436	909633.7	392850.4	278160.3	26735.9	5420.2
6046	144000	2251000	2489000	2044000	884000	231000	109000	61000	49000	14000

Table 10.3.2. Plaice IIIa. Mean nos. per haul and CVs for Argos IBTS survey in first quarter

Year	**#hauls**	**age 1**	**age 2**	**age 3**	**age 4**	**age 5**	**age 6**	**age 7**	**age 8**	**age 9**	**age 10+**	**Total**
1992	45	0.00	4.17	9.29	6.44	1.62	0.38	0.08	0.02	0.00	0.00	22.00
1993	45	0.35	6.50	6.02	5.78	5.11	2.03	0.22	0.04	0.00	0.05	26.10
1994	48	0.33	8.50	6.48	1.89	1.09	1.19	0.25	0.04	0.02	0.03	19.82
1995	48	0.29	4.48	10.40	4.20	1.13	0.85	0.40	0.00	0.00	0.00	21.75
1996	48	0.00	17.05	13.35	4.90	1.54	0.46	0.13	0.08	0.00	0.01	37.52
1997	46	0.13	6.86	12.90	3.26	1.14	0.12	0.04	0.10	0.02	0.08	24.65
1998	45	0.63	8.06	8.00	4.24	1.48	0.32	0.12	0.02	0.07	0.00	22.93
1999	46	1.59	17.31	9.14	2.59	2.32	0.13	0.07	0.04	0.00	0.00	33.20

Year	**#hauls**	**age 1**	**age 2**	**age 3**	**age 4**	**age 5**	**age 6**	**age 7**	**age 8**	**age 9**	**age 10+**	**Total**
1992	45		74	27	14	16	20	38	100			28
1993	45	49	33	14	14	17	40	346	1663		1439	12
1994	48	28	24	14	13	17	19	23	54	69	29	14
1995	48	56	40	24	20	17	20	21				21
1996	48		39	30	24	22	22	24	29		46	32
1997	46	86	25	34	23	22	33	65	26	35	45	27
1998	45	45	24	22	21	17	18	23	74	45		18
1999	46	37	22	17	37	65	45	73	69			21
Mean	45	50	35	23	21	24	27	77	288	50	390	22

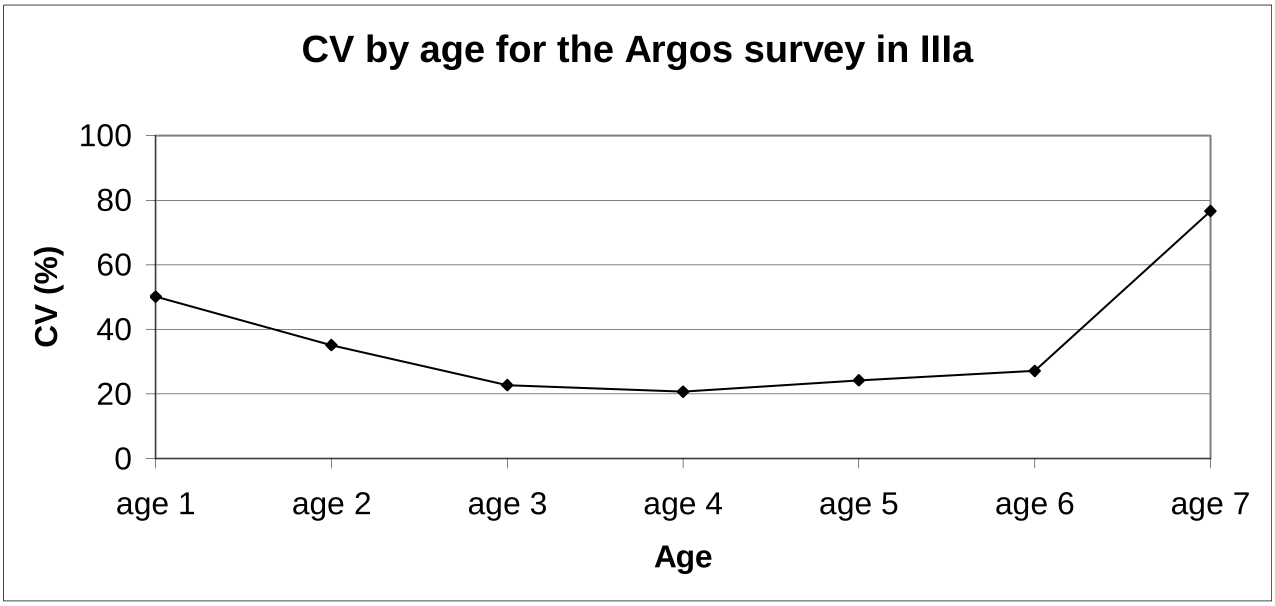


Table 10.4.1. Plaice in IIIa. Diagnostics from the XSA run: XSAPAM04

Lowestoft VPA Version 3.1

8/10/1999 10:15

Extended Survivors Analysis

Plaice IIIa VPA data 1999 WG ANON COMBSEX PLUSGROUP

CPUE data from file c:\paul\z\vpa\input\ple3afl2.dat

Catch data for 21 years. 1978 to 1998. Ages 2 to 11.

Fleet	Firs year	Last year	First age	Last age	Alpha	Beta
ARGOS: Argos Q1	1991	1998	1	6	0.99	1
FLT07: Danish gill-n	1989	1998	2	10	0	1
FLT08: Danish trawle	1989	1998	2	10	0	1
FLT12: Danish seiner	1989	1998	2	10	0	1

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 8

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 = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 21 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1

Table 10.4.1. (Cont'd)

Fishing mortalities

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.016	0.047	0.049	0.021	0.03	0.04	0.012	0.069	0.011	0.015
3	0.145	0.17	0.155	0.096	0.094	0.266	0.078	0.158	0.086	0.186
4	0.356	0.49	0.255	0.287	0.349	0.292	0.397	0.351	0.262	0.206
5	0.777	1.039	0.48	0.862	0.54	0.6	0.793	0.523	0.847	0.473
6	0.944	1.107	0.934	0.968	0.922	0.651	0.962	0.735	1.433	0.664
7	0.913	0.995	0.983	0.92	1.196	1.119	1.004	0.621	1.639	0.849
8	0.686	1.137	0.894	0.932	0.937	1.163	1.244	0.686	1.374	0.924
9	0.708	1.179	1.451	0.886	0.906	0.712	1.423	0.61	1.236	0.874
10	0.899	1.197	0.973	0.971	1.025	0.919	1.147	0.8	1.287	0.831

1

XSA population numbers (Thousands)

YEAR \ AGE	2	3	4	5	6	7	8	9	10
1989	6.61E+04	2.98E+04	2.48E+04	1.21E+04	4.64E+03	2.05E+03	1.16E+03	5.24E+02	2.39E+02
1990	7.34E+04	5.89E+04	2.33E+04	1.57E+04	5.04E+03	1.63E+03	7.43E+02	5.28E+02	2.33E+02
1991	5.09E+04	6.34E+04	4.49E+04	1.29E+04	5.04E+03	1.51E+03	5.46E+02	2.16E+02	1.47E+02
1992	4.56E+04	4.38E+04	4.91E+04	3.15E+04	7.24E+03	1.79E+03	5.10E+02	2.02E+02	4.57E+01
1993	3.53E+04	4.04E+04	3.60E+04	3.34E+04	1.20E+04	2.49E+03	6.46E+02	1.82E+02	7.54E+01
1994	3.74E+04	3.10E+04	3.33E+04	2.30E+04	1.76E+04	4.33E+03	6.81E+02	2.29E+02	6.65E+01
1995	4.14E+04	3.25E+04	2.15E+04	2.25E+04	1.14E+04	8.30E+03	1.28E+03	1.93E+02	1.02E+02
1996	6.81E+04	3.71E+04	2.72E+04	1.31E+04	9.21E+03	3.95E+03	2.75E+03	3.34E+02	4.20E+01
1997	4.80E+04	5.75E+04	2.86E+04	1.73E+04	7.02E+03	4.00E+03	1.92E+03	1.25E+03	1.64E+02
1998	3.92E+04	4.29E+04	4.77E+04	1.99E+04	6.73E+03	1.52E+03	7.02E+02	4.40E+02	3.30E+02

Estimated population abundance at 1st Jan 1999

0.00E+00	3.50E+04	3.22E+04	3.51E+04	1.12E+04	3.13E+03	5.87E+02	2.52E+02	1.66E+02

Taper weighted geometric mean of the VPA populations:

4.71E+04	4.33E+04	3.50E+04	2.02E+04	8.09E+03	2.74E+03	9.98E+02	4.05E+02	1.60E+02

Standard error of the weighted Log(VPA populations) :

0.3234	0.3438	0.3803	0.4103	0.4421	0.4882	0.5573	0.6137	0.7188

1

Log catchability residuals.

Fleet : ARGOS: "Argos 1st

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	99.99	-0.06	-0.76	-0.36	0.43	0.71	0.26	-0.33	0.11
3	99.99	99.99	0.91	0.86	-1.89	0.83	0.7	-0.26	-0.22	-0.92
4	99.99	99.99	-0.33	0.76	-0.42	-0.36	0.49	-0.09	0.03	-0.08
5	99.99	99.99	0.13	1.29	0.38	0.47	0.08	-0.99	0.03	-1.39
6	99.99	99.99	0.11	0.8	0.37	0.19	-0.19	-1.38	0.68	-0.58
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Table 10.4.1. (Cont'd)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6
Mean Log q	-9.5429	-9.9852	-10.1346
S.E(Log q)	0.4216	0.843	0.7138

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	1.74	-0.807	6.63	0.16	8	0.51	-8.37
3	2.53	-0.925	6.62	0.06	8	1.1	-9.06

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
4	1.13	-0.198	9.42	0.28	8	0.51	-9.54
5	0.42	1.756	9.95	0.6	8	0.31	-9.99
6	1.08	-0.102	10.22	0.21	8	0.83	-10.13
1							

Fleet : FLT07: Danish gill-n

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	-0.57	-0.17	0.13	0.31	-0.72	0.22	0.19	0.44	0.02	0.15
3	-0.86	-0.06	-0.21	0.58	-1.27	0.85	-0.2	0.6	0.03	0.55
4	-0.29	0.13	-0.5	0.41	-0.3	0	0.35	0.29	-0.03	-0.07
5	-0.24	0.13	-0.56	0.41	-0.4	-0.16	0.36	0.06	0.33	0.07
6	-0.11	-0.08	0.17	-0.02	0.15	-0.52	-0.03	-0.1	0.64	-0.11
7	0.16	-0.32	0.11	0.09	0.36	-0.26	-0.01	-0.58	0.6	-0.15
8	0.2	-0.01	0.18	0.17	-0.11	-0.28	0.14	-0.66	0.44	-0.08
9	0.36	0.24	0.56	0.35	-0.04	-0.47	0.29	-0.85	-0.16	-0.04
10	0.63	0.45	0.5	0.67	-0.34	-0.35	0.05	-0.6	0.23	-0.07

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8	9	10
Mean Log q	-6.1503	-5.2298	-4.6923	-4.3039	-4.1462	-4.1462	-4.1462
S.E(Log q)	0.3018	0.3318	0.2924	0.3429	0.3066	0.4318	0.4669

Table 10.4.1. (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
2	0.47	1.044	9.92	0.33	10	0.4	-8.92
3	1.21	-0.235	6.35	0.14	10	0.72	-7.08

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
4	1.33	-0.736	4.74	0.38	10	0.41	-6.15
5	0.82	0.698	6.06	0.65	10	0.28	-5.23
6	1.32	-1.11	3.31	0.59	10	0.38	-4.69
7	1.02	-0.08	4.24	0.73	10	0.37	-4.3
8	1.14	-0.653	3.77	0.73	10	0.36	-4.15
9	1.1	-0.386	3.95	0.64	10	0.5	-4.12
10	0.79	1.289	4.18	0.83	10	0.35	-4.03
1							

Fleet : FLT08: Danish trawle

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	-0.34	0.1	0.15	-0.13	-0.15	0.45	0.02	0.32	-0.39	-0.03
3	-0.48	0.09	0.2	-0.42	-0.67	0.91	-0.39	0.37	-0.23	0.61
4	-0.21	0.24	-0.28	-0.26	0.15	0.04	0.2	0.1	0.17	-0.16
5	-0.16	0.26	-0.36	0.18	-0.35	0.06	0.25	-0.08	0.41	-0.21
6	-0.18	0.01	-0.09	0.09	0.08	-0.08	0.07	-0.18	0.53	-0.23
7	-0.47	-0.14	-0.28	0.02	0.63	0.55	-0.07	-0.32	0.22	-0.16
8	-0.75	-0.06	-0.28	0.05	0.24	0.63	0.39	-0.18	0.04	-0.07
9	-0.6	-0.34	0.35	-0.52	-0.14	-0.31	0.51	-0.37	0.01	-0.03
10	-0.46	-0.21	0.02	-0.55	0.51	0.64	0.31	0.06	0.26	-0.21

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8	9	10
Mean Log q	-6.3033	-5.6697	-5.4323	-5.3566	-5.4362	-5.4362	-5.4362
S.E(Log q)	0.2038	0.2746	0.2201	0.3645	0.3788	0.3923	0.4005

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	0.6	1.116	9.36	0.49	10	0.29	-8.39
3	1.56	-0.827	4.88	0.22	10	0.55	-6.94

Ages with q independent of year class strength and constant w.r.t. time.

Table 10.4.1. (Cont'd)

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	1.87	-2.746	2.74	0.55	10	0.29	-6.3
5	0.92	0.31	5.99	0.67	10	0.27	-5.67
6	0.96	0.205	5.56	0.81	10	0.22	-5.43
7	0.85	0.841	5.75	0.79	10	0.31	-5.36
8	1.14	-0.512	5.25	0.64	10	0.45	-5.44
9	1.12	-0.537	5.55	0.71	10	0.42	-5.58
10	1.2	-0.876	5.53	0.72	10	0.48	-5.4
1							

Fleet : FLT12: Danish seiner

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	-0.42	0.12	0.16	-0.53	-0.04	0.38	0.02	0.39	-0.11	0.04
3	0.08	0.38	0.03	-0.79	-0.99	0.64	-0.55	0.38	-0.12	0.94
4	0.17	0.45	-0.22	-0.02	-0.4	-0.21	0	0.16	0.13	-0.04
5	0.2	0.4	-0.22	0.4	-0.51	-0.18	-0.11	-0.45	0.49	-0.01
6	0.08	0.02	0.04	0.21	-0.18	-0.45	0	-0.4	0.67	0.01
7	-0.03	-0.2	-0.11	-0.08	0.12	-0.13	-0.07	-0.63	0.9	0.23
8	-0.43	-0.14	-0.08	-0.1	-0.01	-0.17	0.07	-0.43	0.85	0.44
9	-0.43	-0.15	0.33	-0.24	-0.16	-0.53	0.17	-0.67	0.88	0.3
10	-0.39	-0.23	-0.33	-0.47	-0.57	-0.68	-0.04	-0.54	0.59	0.36

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8	9	10
Mean Log q	-4.565	-3.7988	-3.4777	-3.475	-3.6323	-3.6323	-3.6323
S.E(Log q)	0.242	0.3583	0.3144	0.3886	0.3886	0.4739	0.4823

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	0.51	1.21	8.96	0.44	10	0.32	-7.22
3	1.06	-0.079	5.16	0.16	10	0.66	-5.49

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
4	1.84	-1.977	-0.3	0.41	10	0.39	-4.57
5	1.09	-0.247	3.23	0.46	10	0.41	-3.8
6	1.64	-1.817	-0.02	0.5	10	0.46	-3.48
7	0.99	0.061	3.54	0.69	10	0.41	-3.48
8	0.95	0.204	3.78	0.7	10	0.39	-3.63
9	0.75	1.387	4.21	0.79	10	0.34	-3.68
10	0.74	2.218	4.1	0.9	10	0.26	-3.86
1							

Table 10.4.1. (Cont'd)

Terminal year survivor and F summaries :

Age 2 Catchability dependent on age and year class strength

Year class = 1996

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos 1st ,	39094.,	.545,	.000,	.00,	1,	.082,	.014
FLT07: Danish gill-n	40626	0.423	0	0	1	0.136	0.013
FLT08: Danish trawle	33923	0.306	0	0	1	0.26	0.016
FLT12: Danish seiner	36330	0.337	0	0	1	0.214	0.015
P shrinkage mean	43255	0.34				0.209	0.012
F shrinkage mean	16447	0.5				0.099	0.032

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
34960	0.16	0.12	6	0.769	0.015

Age 3 Catchability dependent on age and year class strength

Year class = 1995

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos 1st ,	20956.,	.504,	.223,	.44,	2,	.083,	.274
FLT07: Danish gill-n	37021	0.371	0.222	0.6	2	0.152	0.164
FLT08: Danish trawle	26936	0.282	0.411	1.46	2	0.264	0.219
FLT12: Danish seiner	34250	0.307	0.391	1.27	2	0.223	0.176
P shrinkage mean	35021	0.38				0.176	0.173
F shrinkage mean	45086	0.5				0.102	0.137

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
32247	0.15	0.12	10	0.822	0.186

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos 1st ,	35308.,	.344,	.118,	.34,	3,	.118,	.205
FLT07: Danish gill-n	37585	0.25	0.153	0.61	3	0.224	0.194
FLT08: Danish trawle	35125	0.211	0.168	0.8	3	0.31	0.206
FLT12: Danish seiner	38251	0.225	0.145	0.65	3	0.276	0.191
F shrinkage mean	20523	0.5				0.072	0.331

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
35144	0.12	0.08	13	0.634	0.206

Table 10.4.1. (Cont'd)

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet		I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos	1st ,	10620.,	.323,	.388,	1.20,	4,	.086,	.495
FLT07: Danish gill-n		12197	0.201	0.084	0.42	4	0.241	0.443
FLT08: Danish trawle		11199	0.169	0.108	0.64	4	0.334	0.475
FLT12: Danish seiner		12102	0.188	0.056	0.3	4	0.264	0.446
F shrinkage mean		7232	0.5				0.075	0.663

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11241	0.1	0.07	17	0.689	0.473

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet		I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos	1st ,	2763.,	.339,	.200,	.59,	5,	.067,	.727
FLT07: Danish gill-n		3327	0.192	0.101	0.52	5	0.262	0.636
FLT08: Danish trawle		3238	0.17	0.153	0.9	5	0.313	0.648
FLT12: Danish seiner		3623	0.19	0.111	0.58	5	0.253	0.596
F shrinkage mean		1876	0.5				0.106	0.946

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3133	0.1	0.07	21	0.682	0.664

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet		I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos	1st ,	743.,	.327,	.299,	.91,	5,	.028,	.721
FLT07: Danish gill-n		626	0.23	0.153	0.67	6	0.269	0.813
FLT08: Danish trawle		610	0.216	0.132	0.61	6	0.274	0.827
FLT12: Danish seiner		734	0.238	0.135	0.57	6	0.232	0.727
F shrinkage mean		379	0.5				0.197	1.122

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
587	0.14	0.08	24	0.57	0.849

Table 10.4.1. (Cont'd)

1

Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos 1st ,	115.,	.341,	.279,	.82,	5,	.011,	1.463
FLT07: Danish gill-n	255	0.244	0.096	0.39	7	0.307	0.917
FLT08: Danish trawle	244	0.262	0.057	0.22	7	0.233	0.944
FLT12: Danish seiner	356	0.282	0.156	0.55	7	0.211	0.731
F shrinkage mean	195	0.5				0.238	1.087

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
252	0.16	0.06	27	0.395	0.924

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1989

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos 1st ,	147.,	.318,	.169,	.53,	5,	.008,	.945
FLT07: Danish gill-n	170	0.251	0.115	0.46	8	0.259	0.862
FLT08: Danish trawle	161	0.26	0.041	0.16	8	0.267	0.894
FLT12: Danish seiner	214	0.286	0.163	0.57	8	0.204	0.735
F shrinkage mean	139	0.5				0.262	0.983

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
166	0.17	0.06	30	0.328	0.874

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1988

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
ARGOS: "Argos 1st ,	216.,	.366,	.157,	.43,	4,	.004,	.577
FLT07: Danish gill-n	106	0.273	0.085	0.31	9	0.239	0.95
FLT08: Danish trawle	111	0.267	0.034	0.13	9	0.28	0.922
FLT12: Danish seiner	170	0.305	0.145	0.48	9	0.205	0.688
F shrinkage mean	148	0.5				0.273	0.761

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
130	0.18	0.05	32	0.3	0.831

Table 10.4.2. Plaice in IIIa. Fishing mortalities from XSA run: XSAPAM04

Run title 1999 WG ANON COMBSEX PLUSGROUP

At 8/10/1999 10:18

Table 8 Fishing mortality (F) at age

YEAR	1978
AGE	
2	0.0084
3	0.2337
4	0.7575
5	1.0754
6	1.0201
7	0.5955
8	0.2825
9	0.4846
10	0.6947
+gp	0.6947
0 FBAR 4	0.7462

Table 8 Fishing mortality (F) at age

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
2	0.0257	0.0111	0.0078	0.0114	0.0167	0.0324	0.0291	0.0106	0.0207	0.0032
3	0.206	0.1326	0.1485	0.0985	0.2676	0.1716	0.1565	0.1123	0.1492	0.1108
4	0.7979	0.5486	0.5626	0.5147	0.6491	0.4948	0.4466	0.3941	0.4769	0.6656
5	1.0759	0.849	0.7806	1.1257	1.0462	0.7451	0.5092	0.7865	1.0199	1.3418
6	1.0638	0.9658	0.7053	1.084	0.8681	0.814	0.6416	0.7346	1.198	1.432
7	0.9547	1.0678	0.5539	0.6669	0.4465	0.811	0.5927	0.4487	0.8131	1.1791
8	0.2833	1.0985	0.6566	0.5699	0.3576	0.899	0.4546	0.4268	0.4657	0.9996
9	0.5613	0.5659	0.6852	0.8337	0.3394	0.9305	0.4402	0.4799	0.7558	0.824
10	0.7916	0.9141	0.6793	0.8603	0.6141	0.8441	0.5296	0.5776	0.8547	1.162
+gp	0.7916	0.9141	0.6793	0.8603	0.6141	0.8441	0.5296	0.5776	0.8547	1.162
0 FBAR 4	0.8351	0.9059	0.6518	0.7923	0.6735	0.7528	0.5289	0.5581	0.7947	1.1236
1										

Run title 1999 WG ANON COMBSEX PLUSGROUP

At 8/10/1999 10:18

Table 8 Fishing mortality (F) at age

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98
AGE											
2	0.0162	0.0467	0.049	0.0207	0.0303	0.0397	0.0116	0.0695	0.011	0.0154	0.032
3	0.1451	0.1704	0.1546	0.0956	0.0945	0.266	0.0778	0.1576	0.0861	0.1862	0.1433
4	0.3557	0.4904	0.2554	0.2867	0.3485	0.2922	0.3971	0.3505	0.262	0.2063	0.2729
5	0.7774	1.0392	0.4801	0.8621	0.5402	0.5998	0.7925	0.5228	0.8465	0.4733	0.6142
6	0.9443	1.1073	0.9336	0.9681	0.9223	0.6514	0.9624	0.7347	1.4328	0.6643	0.9439
7	0.913	0.9945	0.9826	0.9197	1.1958	1.1188	1.0036	0.6211	1.6387	0.8488	1.0362
8	0.6855	1.1373	0.894	0.9317	0.9373	1.1626	1.2436	0.6859	1.3737	0.9244	0.9946
9	0.7084	1.1791	1.4512	0.8861	0.9058	0.7122	1.4226	0.6101	1.2365	0.8741	0.9069
10	0.8986	1.1969	0.9731	0.9707	1.0254	0.9187	1.147	0.7999	1.2875	0.8309	0.9727
+gp	0.8986	1.1969	0.9731	0.9707	1.0254	0.9187	1.147	0.7999	1.2875	0.8309	
0 FBAR 4	0.7352	0.9537	0.7091	0.7937	0.7888	0.765	0.8798	0.583	1.1107	0.6234	

Table 10.4.3. Plaice in IIIa. Estimated population abundance from XSA run: XSAPAM04

	Table 10	Stock number at age (start of year) Numbers*10**-3
	YEAR	1978
	AGE	
	2	61615
	3	79172
	4	78240
	5	39762
	6	13171
	7	1452
	8	269
	9	172
	10	101
	+gp	125
0	TOTA	274080

	Table 10	Stock number at age (start of year)			Numbers*10**-3					
	YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	AGE										
	2	45794	34459	25808	48627	94248	70145	49112	37312	34579	33045
	3	55286	40385	30835	23172	43499	83871	61448	43163	33405	30648
	4	56711	40713	32002	24050	19000	30119	63926	47548	34907	26035
	5	33191	23106	21284	16498	13006	8983	16616	37008	29010	19605
	6	12275	10241	8945	8823	4843	4134	3858	9035	15251	9466
	7	4297	3833	3527	3998	2700	1839	1658	1838	3922	4164
	8	724	1497	1192	1834	1857	1564	740	829	1062	1574
	9	184	494	451	560	939	1175	576	425	490	603
	10	96	95	254	206	220	605	419	335	238	208
	+gp	105	87	206	87	242	214	382	234	363	238
0	TOTA	208663	154909	124505	127854	180555	202649	198734	177726	153226	125588
	1										

Run title 1999 WG ANON COMBSEX PLUSGROUP

At 8/10/1999 10:18

	Table 10	Stock number at age (start of year)			Numbers*10**-3								
	YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 78-96	AMST 78-96
	AGE													
	2	66115	73411	50879	45599	35345	37365	41435	68122	47974	39236	0*	47462	50159
	3	29804	58863	63392	43836	40416	31028	32495	37060	57501	42932	34960	42629	45357
	4	24823	23326	44918	49141	36048	33274	21517	27200	28645	47738	32247	34821	37553
	5	12108	15738	12926	31484	33381	23019	22480	13089	17335	19944	35144	20405	22226
	6	4636	5035	5037	7236	12030	17598	11433	9208	7021	6728	11241	8235	9066
	7	2046	1632	1506	1792	2487	4328	8301	3952	3996	1516	3133	2775	3120
	8	1159	743	546	510	646	681	1279	2753	1921	702	587	982	1129
	9	524	528	216	202	182	229	193	334	1255	440	252	380	446
	10	239	233	147	46	75	66	102	42	164	330	166	154	196
	+gp	413	407	230	190	107	94	79	82	50	122	178		
0	TOTA	141868	179918	179795	180035	160717	147681	139314	161841	165863	159688	117909		
	1													

* Replaced by GMST 78-96 (47462)

Table 10.4.4. Plaice in IIIa. Historical trends in SSB, recruitment and F-bar from XSA run: XSAPAM04

Table 16 Summary (without SOP correction)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 8
1978	61615	74849	60308	26530	0.4399	0.7462
1979	45794	56693	46527	21152	0.4546	0.8351
1980	34459	48434	39440	15477	0.3924	0.9059
1981	25808	38479	32543	12273	0.3771	0.6518
1982	48627	39829	26700	10847	0.4063	0.7923
1983	94248	54426	27565	10716	0.3888	0.6735
1984	70145	61297	41516	11572	0.2787	0.7528
1985	49112	60754	47150	13482	0.2859	0.5289
1986	37312	52212	42884	14035	0.3273	0.5581
1987	34579	48306	37171	15779	0.4245	0.7947
1988	33045	36296	27968	12850	0.4594	1.1236
1989	66115	41262	23146	7705	0.3329	0.7352
1990	73411	55032	33595	12078	0.3595	0.9537
1991	50879	49093	35711	8737	0.2447	0.7091
1992	45599	53907	39816	11826	0.297	0.7937
1993	35345	45817	36380	11296	0.3105	0.7888
1994	37365	42240	31965	11312	0.3539	0.765
1995	41435	41437	30540	10930	0.3579	0.8798
1996	68122	47958	29838	10121	0.3392	0.583
1997	47974	50168	35776	10149	0.2837	1.1107
1998	39236	45048	34847	8742	0.2509	0.6234
1999	47462*	49848**	36780**			
Arith.						
Mean (78-98)	49535	49692	36257	12743	0.3507	0.7765
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		
1						

* Geometric mean over 1978-1996

** Weights in stock at age in 1999 set to average over 1996-1998

Table 10.7.1 Plaice in Division IIIa. Input data to Catch Forecast.

Year: 1999

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47462.000	0.1000	0.0000	0.0000	0.0000	0.275	0.0320	0.275
3	34960.000	0.1000	1.0000	0.0000	0.0000	0.270	0.1433	0.270
4	32247.000	0.1000	1.0000	0.0000	0.0000	0.285	0.2729	0.285
5	35144.000	0.1000	1.0000	0.0000	0.0000	0.337	0.6142	0.337
6	11241.000	0.1000	1.0000	0.0000	0.0000	0.379	0.9439	0.379
7	3133.000	0.1000	1.0000	0.0000	0.0000	0.437	1.0362	0.437
8	587.000	0.1000	1.0000	0.0000	0.0000	0.470	0.9946	0.470
9	252.000	0.1000	1.0000	0.0000	0.0000	0.531	0.9069	0.531
10	166.000	0.1000	1.0000	0.0000	0.0000	0.680	0.9727	0.680
11+	178.000	0.1000	1.0000	0.0000	0.0000	0.856	0.9727	0.856
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47462.000	0.1000	0.0000	0.0000	0.0000	0.275	0.0320	0.275
3	.	0.1000	1.0000	0.0000	0.0000	0.270	0.1433	0.270
4	.	0.1000	1.0000	0.0000	0.0000	0.285	0.2729	0.285
5	.	0.1000	1.0000	0.0000	0.0000	0.337	0.6142	0.337
6	.	0.1000	1.0000	0.0000	0.0000	0.379	0.9439	0.379
7	.	0.1000	1.0000	0.0000	0.0000	0.437	1.0362	0.437
8	.	0.1000	1.0000	0.0000	0.0000	0.470	0.9946	0.470
9	.	0.1000	1.0000	0.0000	0.0000	0.531	0.9069	0.531
10	.	0.1000	1.0000	0.0000	0.0000	0.680	0.9727	0.680
11+	.	0.1000	1.0000	0.0000	0.0000	0.856	0.9727	0.856
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47462.000	0.1000	0.0000	0.0000	0.0000	0.275	0.0320	0.275
3	.	0.1000	1.0000	0.0000	0.0000	0.270	0.1433	0.270
4	.	0.1000	1.0000	0.0000	0.0000	0.285	0.2729	0.285
5	.	0.1000	1.0000	0.0000	0.0000	0.337	0.6142	0.337
6	.	0.1000	1.0000	0.0000	0.0000	0.379	0.9439	0.379
7	.	0.1000	1.0000	0.0000	0.0000	0.437	1.0362	0.437
8	.	0.1000	1.0000	0.0000	0.0000	0.470	0.9946	0.470
9	.	0.1000	1.0000	0.0000	0.0000	0.531	0.9069	0.531
10	.	0.1000	1.0000	0.0000	0.0000	0.680	0.9727	0.680
11+	.	0.1000	1.0000	0.0000	0.0000	0.856	0.9727	0.856
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANPAM04
Date and time: 16OCT99:17:08

Table 10.7.2 Plaice in Division IIIa. Prediction with management option table.

Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.7724	49848	36780	12628	0.0000	0.0000	48596	35528	0	60624	47556
.	.	.	.	.	0.1000	0.0772	.	35528	1604	58906	45838
.	.	.	.	.	0.2000	0.1545	.	35528	3104	57302	44234
.	.	.	.	.	0.3000	0.2317	.	35528	4509	55802	42734
.	.	.	.	.	0.4000	0.3089	.	35528	5825	54398	41330
.	.	.	.	.	0.5000	0.3862	.	35528	7060	53083	40015
.	.	.	.	.	0.6000	0.4634	.	35528	8221	51850	38782
.	.	.	.	.	0.7000	0.5407	.	35528	9312	50693	37625
.	.	.	.	.	0.8000	0.6179	.	35528	10339	49605	36537
.	.	.	.	.	0.9000	0.6951	.	35528	11307	48581	35513
.	.	.	.	.	1.0000	0.7724	.	35528	12220	47617	34549
.	.	.	.	.	1.1000	0.8496	.	35528	13083	46708	33641
.	.	.	.	.	1.2000	0.9268	.	35528	13899	45851	32783
.	.	.	.	.	1.3000	1.0041	.	35528	14671	45040	31972
.	.	.	.	.	1.4000	1.0813	.	35528	15402	44273	31205
.	.	.	.	.	1.5000	1.1585	.	35528	16097	43547	30479
.	.	.	.	.	1.6000	1.2358	.	35528	16756	42858	29790
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPAM04
Date and time : 16OCT99:17:08
Computation of ref. F: Simple mean, age 4 - 8
Basis for 1999 : F factors

Table 10.7.3 Plaice in division IIIa. Single option short term prediction at *status quo* fishing mortality (detailed table)

Year: 1999 F-factor: 1.0000 Reference F: 0.7724						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0320	1423	392	47462	13068	0	0	0	0
3	0.1433	4447	1202	34960	9451	34960	9451	34960	9451
4	0.2729	7346	2094	32247	9190	32247	9190	32247	9190
5	0.6142	15426	5194	35144	11832	35144	11832	35144	11832
6	0.9439	6586	2498	11241	4264	11241	4264	11241	4264
7	1.0362	1940	847	3133	1368	3133	1368	3133	1368
8	0.9946	355	167	587	276	587	276	587	276
9	0.9069	144	76	252	134	252	134	252	134
10	0.9727	99	67	166	113	166	113	166	113
11+	0.9727	106	91	178	152	178	152	178	152
Total		37872	12628	165370	49848	117908	36780	117908	36780
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000 F-factor: 1.0000 Reference F: 0.7724						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0320	1423	392	47462	13068	0	0	0	0
3	0.1433	5291	1430	41593	11244	41593	11244	41593	11244
4	0.2729	6244	1779	27410	7812	27410	7812	27410	7812
5	0.6142	9749	3282	22210	7477	22210	7477	22210	7477
6	0.9439	10080	3824	17206	6527	17206	6527	17206	6527
7	1.0362	2451	1070	3958	1728	3958	1728	3958	1728
8	0.9946	608	286	1006	473	1006	473	1006	473
9	0.9069	112	60	196	104	196	104	196	104
10	0.9727	55	37	92	63	92	63	92	63
11+	0.9727	70	60	118	101	118	101	118	101
Total		36082	12220	161250	48596	113788	35528	113788	35528
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.7724						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0320	1423	392	47462	13068	0	0	0	0
3	0.1433	5291	1430	41593	11244	41593	11244	41593	11244
4	0.2729	7428	2117	32610	9294	32610	9294	32610	9294
5	0.6142	8287	2790	18878	6356	18878	6356	18878	6356
6	0.9439	6370	2416	10873	4125	10873	4125	10873	4125
7	1.0362	3751	1638	6058	2645	6058	2645	6058	2645
8	0.9946	768	361	1271	597	1271	597	1271	597
9	0.9069	192	102	337	179	337	179	337	179
10	0.9727	43	29	72	49	72	49	72	49
11+	0.9727	43	37	72	61	72	61	72	61
Total		33596	11312	159225	47617	111763	34549	111763	34549
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRPAM01
Date and time : 19OCT99:09:32
Computation of ref. F: Simple mean, age 4 - 8
Prediction basis : F factors

Table 10.7.4. Plaice,IIIa
Input data for catch forecast and linear sensitivity analysis.

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N2	47461	.34	WS2	.28	.08	M2	.10	.10	MT2	.00	.10
N3	34960	.20	WS3	.27	.08	M3	.10	.10	MT3	1.00	.10
N4	32246	.20	WS4	.28	.03	M4	.10	.10	MT4	1.00	.00
N5	35142	.20	WS5	.34	.13	M5	.10	.10	MT5	1.00	.00
N6	11240	.20	WS6	.38	.09	M6	.10	.10	MT6	1.00	.00
N7	3131	.20	WS7	.44	.06	M7	.10	.10	MT7	1.00	.00
N8	585	.20	WS8	.47	.09	M8	.10	.10	MT8	1.00	.00
N9	250	.20	WS9	.53	.14	M9	.10	.10	MT9	1.00	.00
N10	166	.20	WS10	.68	.26	M10	.10	.10	MT10	1.00	.00
N11	177	.20	WS11	.86	.12	M11	.10	.10	MT11	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH2	.03	1.16	WH2	.28	.08
sH3	.14	.56	WH3	.27	.08
sH4	.27	.49	WH4	.28	.03
sH5	.61	.10	WH5	.34	.13
sH6	.94	.10	WH6	.38	.09
sH7	1.04	.16	WH7	.44	.06
sH8	.99	.12	WH8	.47	.09
sH9	.91	.16	WH9	.53	.14
sH10	.97	.09	WH10	.68	.26
sH11	.97	.09	WH11	.86	.12

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.38
K00	1.00	.10	HF00	1.00	.38
K01	1.00	.10	HF01	1.00	.38

Recruitment		
Labl	Value	CV
R00	47461	.34
R01	47461	.34

Table 10.7.5. Plaice (IIIa)
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1994	1995	1996	1997	1998
Stock No. (thousands) of	2 year-olds		68122	47974	39236	47462	47462
Source			VPA	VPA	VPA	GM	GM
Status Quo F:							
% in	1999	landings	41.2	16.6	9.5	3.1	-
% in	2000		31.3	26.9	14.6	11.7	3.2
% in	1999	SSB	32.2	25.0	25.7	0.0	-
% in	2000	SSB	18.4	21.1	22.0	31.6	0.0
% in	2001	SSB	7.7	11.9	18.4	26.9	32.5

GM : geometric mean recruitment

Plaice (IIIa) : Year-class % contribution to

a) 2000 landings **b) 2001 SSB**

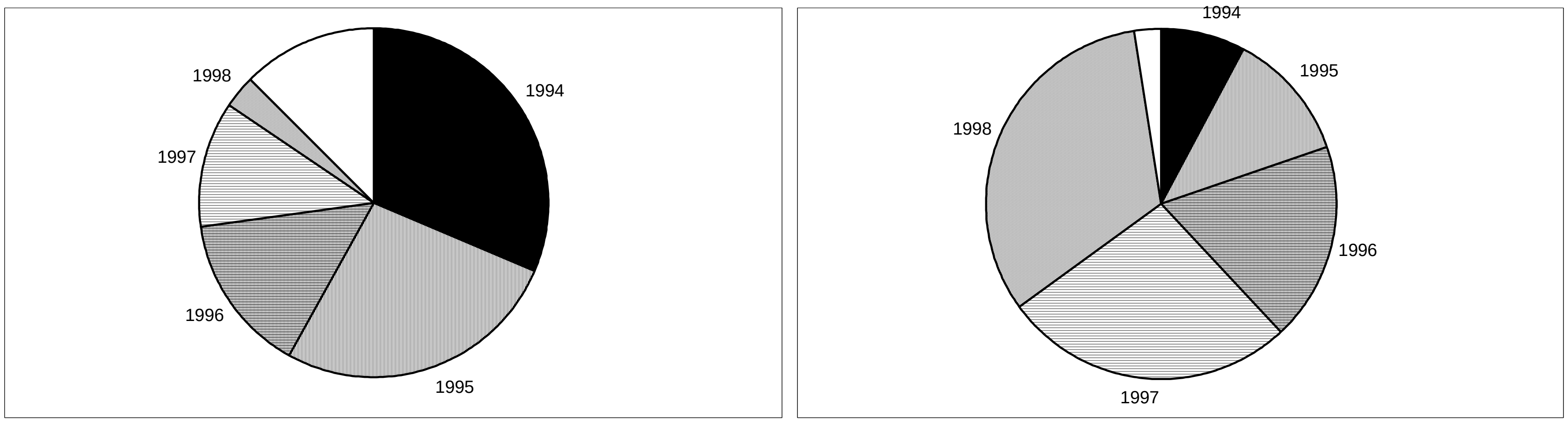


Table 10.9.1 Plaice in division IIIa.
Input data to Yield and Biomass per Recruit and Medium Term analyses

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47462.000	0.1000	0.0000	0.0000	0.0000	0.269	0.0320	0.269
3	.	0.1000	1.0000	0.0000	0.0000	0.276	0.1433	0.276
4	.	0.1000	1.0000	0.0000	0.0000	0.284	0.2729	0.284
5	.	0.1000	1.0000	0.0000	0.0000	0.319	0.6142	0.319
6	.	0.1000	1.0000	0.0000	0.0000	0.381	0.9439	0.381
7	.	0.1000	1.0000	0.0000	0.0000	0.483	1.0362	0.483
8	.	0.1000	1.0000	0.0000	0.0000	0.597	0.9946	0.597
9	.	0.1000	1.0000	0.0000	0.0000	0.718	0.9069	0.718
10	.	0.1000	1.0000	0.0000	0.0000	0.826	0.9727	0.826
11+	.	0.1000	1.0000	0.0000	0.0000	1.012	0.9727	1.012
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDPAM04
Date and time: 17OCT99:15:00

Table 10.9.2 Plaice in Division IIIa. Yield and Biomass per recruit.

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0	498746	328341	451284	315558	451284	315558
0.0500	0.0386	11722	8244	381670	216801	334208	204018	334208	204018
0.1000	0.0772	17718	11335	321846	162383	274384	149600	274384	149600
0.1500	0.1159	21382	12577	285326	130846	237864	118063	237864	118063
0.2000	0.1545	23869	13036	260580	110625	213118	97842	213118	97842
0.2500	0.1931	25677	13137	242613	96751	195151	83967	195151	83967
0.3000	0.2317	27058	13072	228907	86750	181445	73967	181445	73967
0.3500	0.2703	28154	12933	218056	79261	170594	66478	170594	66478
0.4000	0.3089	29048	12765	209213	73479	161751	60696	161751	60696
0.4500	0.3476	29795	12594	201836	68898	154374	56115	154374	56115
0.5000	0.3862	30431	12429	195565	65191	148103	52408	148103	52408
0.5500	0.4248	30981	12276	190146	62133	142684	49350	142684	49350
0.6000	0.4634	31463	12137	185402	59569	137940	46786	137940	46786
0.6500	0.5020	31891	12013	181199	57388	133737	44605	133737	44605
0.7000	0.5407	32274	11902	177439	55509	129977	42726	129977	42726
0.7500	0.5793	32621	11804	174046	53871	126584	41088	126584	41088
0.8000	0.6179	32936	11716	170960	52428	123498	39645	123498	39645
0.8500	0.6565	33225	11639	168134	51147	120672	38364	120672	38364
0.9000	0.6951	33491	11571	165532	49998	118070	37215	118070	37215
0.9500	0.7337	33737	11511	163123	48961	115661	36178	115661	36178
1.0000	0.7724	33967	11457	160882	48018	113420	35235	113420	35235
1.0500	0.8110	34181	11410	158789	47156	111327	34373	111327	34373
1.1000	0.8496	34383	11368	156826	46364	109364	33581	109364	33581
1.1500	0.8882	34572	11331	154978	45631	107516	32848	107516	32848
1.2000	0.9268	34751	11298	153234	44951	105772	32168	105772	32168
1.2500	0.9655	34921	11268	151583	44317	104121	31534	104121	31534
1.3000	1.0041	35082	11242	150016	43724	102554	30941	102554	30941
1.3500	1.0427	35235	11219	148525	43167	101063	30384	101063	30384
1.4000	1.0813	35381	11198	147104	42643	99642	29860	99642	29860
1.4500	1.1199	35520	11180	145746	42147	98284	29364	98284	29364
1.5000	1.1585	35654	11163	144446	41678	96984	28895	96984	28895
1.5500	1.1972	35782	11149	143200	41233	95738	28450	95738	28450
1.6000	1.2358	35905	11136	142004	40809	94542	28026	94542	28026
1.6500	1.2744	36023	11125	140853	40405	93391	27622	93391	27622
1.7000	1.3130	36137	11115	139745	40019	92283	27236	92283	27236
1.7500	1.3516	36247	11106	138677	39650	91215	26867	91215	26867
1.8000	1.3902	36353	11098	137646	39296	90184	26513	90184	26513
1.8500	1.4289	36456	11091	136650	38956	89188	26173	89188	26173
1.9000	1.4675	36555	11085	135686	38630	88224	25847	88224	25847
1.9500	1.5061	36651	11080	134752	38315	87290	25532	87290	25532
2.0000	1.5447	36744	11076	133848	38012	86386	25229	86386	25229
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDPAM04
Date and time : 17OCT99:15:00
Computation of ref. F: Simple mean, age 4 - 8
F-0.1 factor : 0.1184
F-max factor : 0.2490
F-0.1 reference F : 0.0914
F-max reference F : 0.1923
Recruitment : 47462 (Thousands)

Figure 10.2.1. Plaice IIIa. Distribution of catch in numbers (%) by age and by year

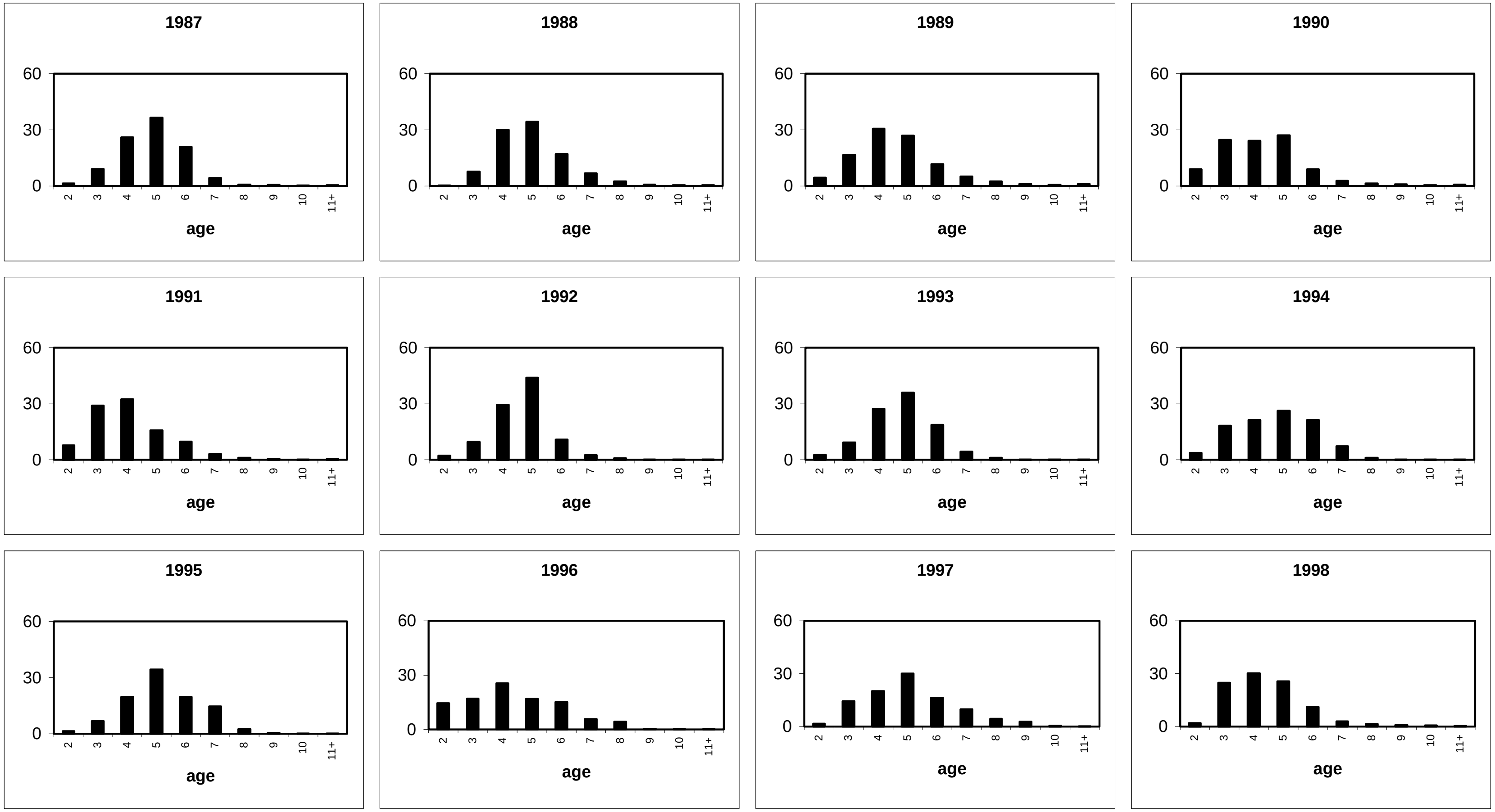


Figure 10.2.2. Time series of catch weight at age for the different plaice stocks assessed by the working group.

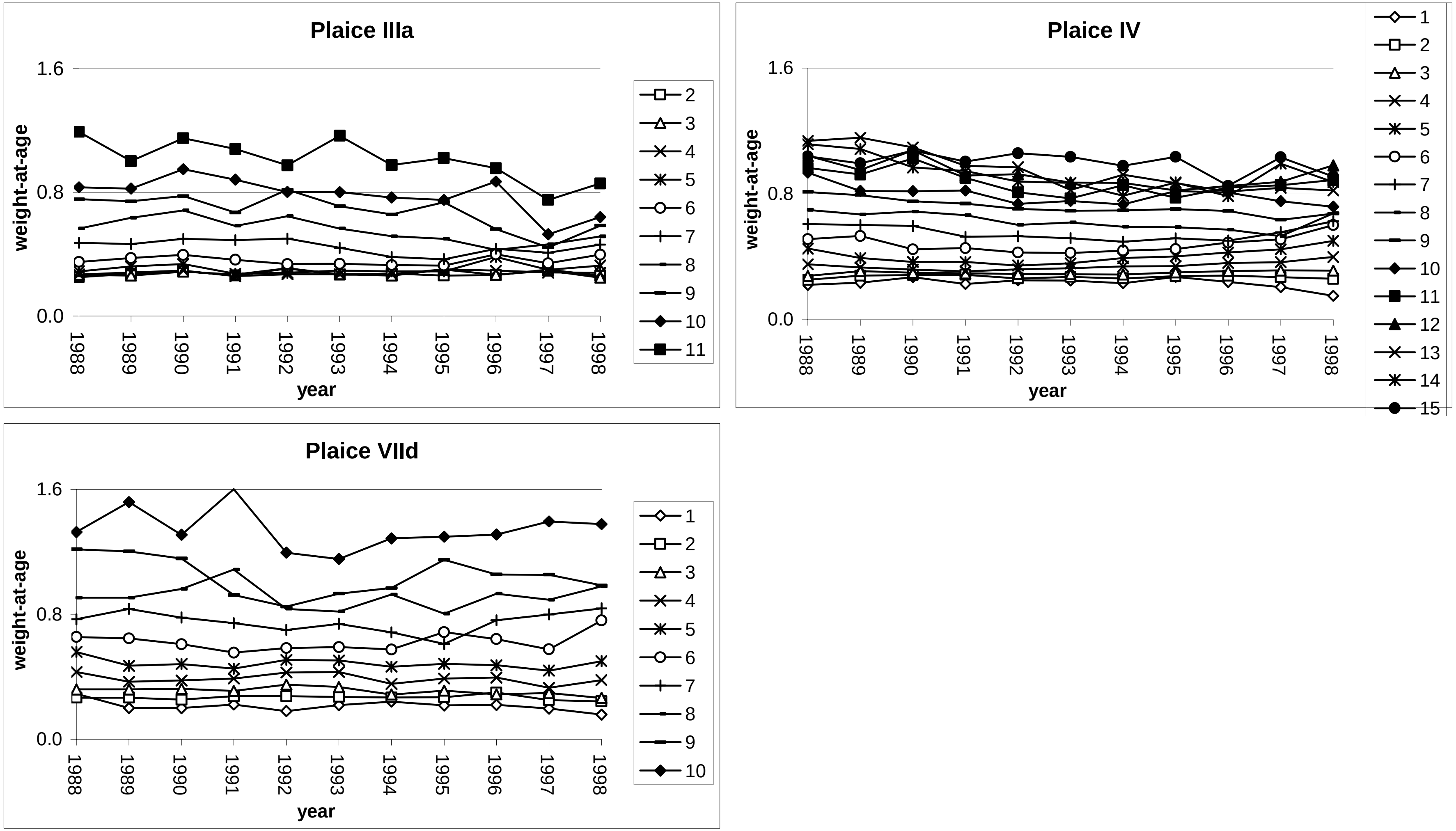


Figure 10.2.3. Time series of catch weight at age for plaice in Kattegat and Skagerrak.

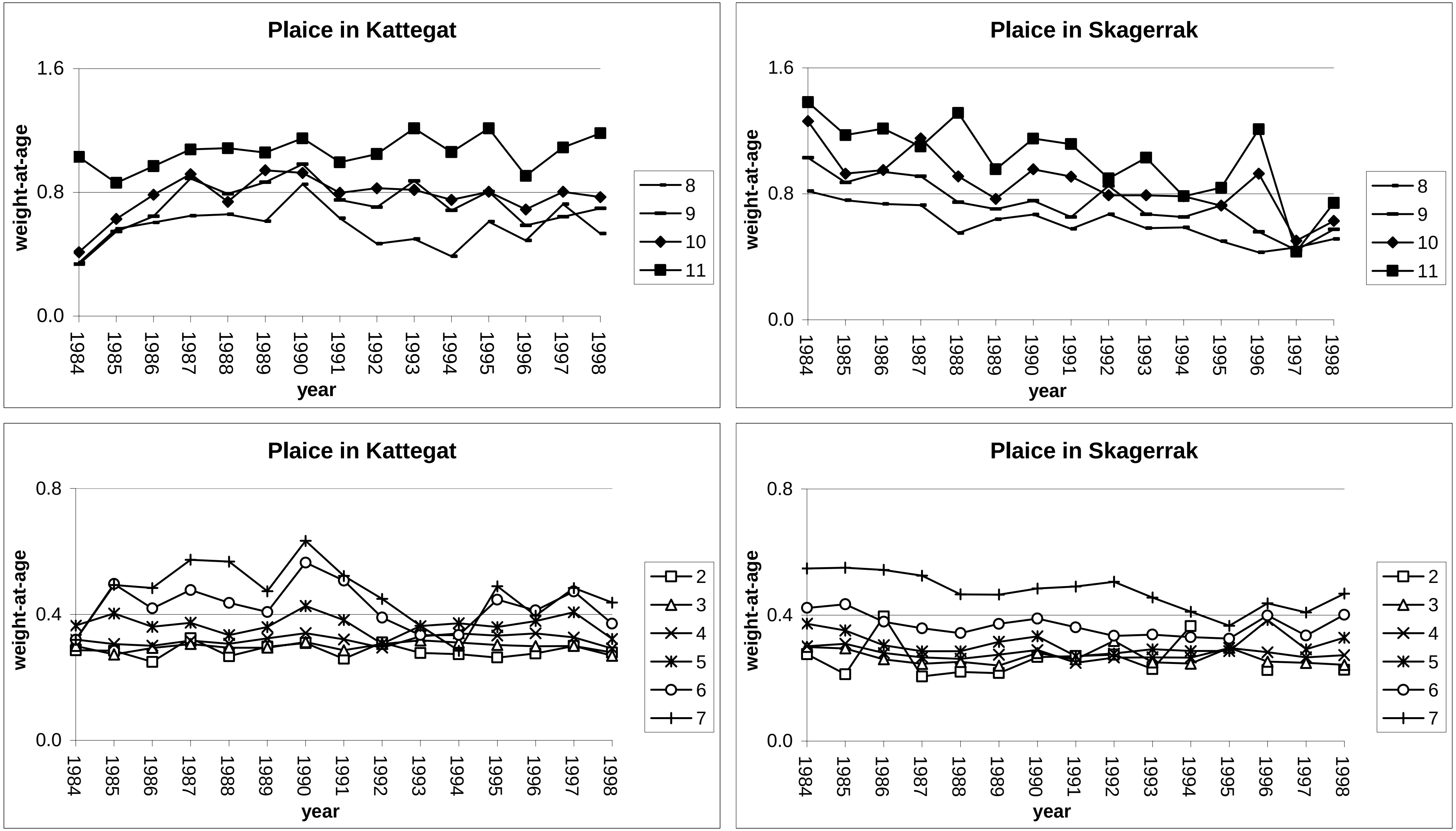


Figure 10.4.1. Plaice IIIa. XSA log residuals by fleet and age (combined fleet run: XSAPAM04)

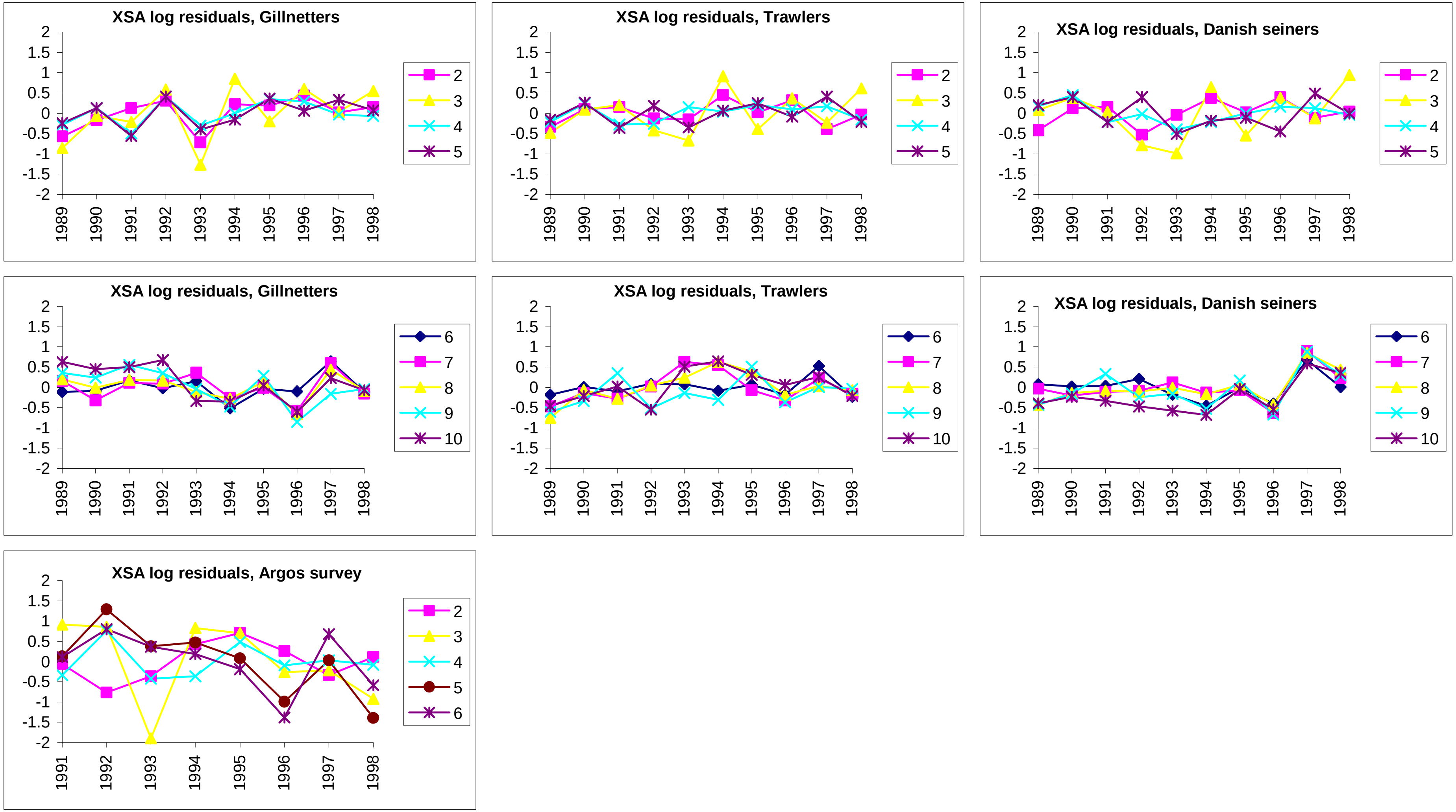


Figure 10.4.2. Plaice IIIa. Retrospective analysis with shrinker set to 0.5. Run: XSAPAM04

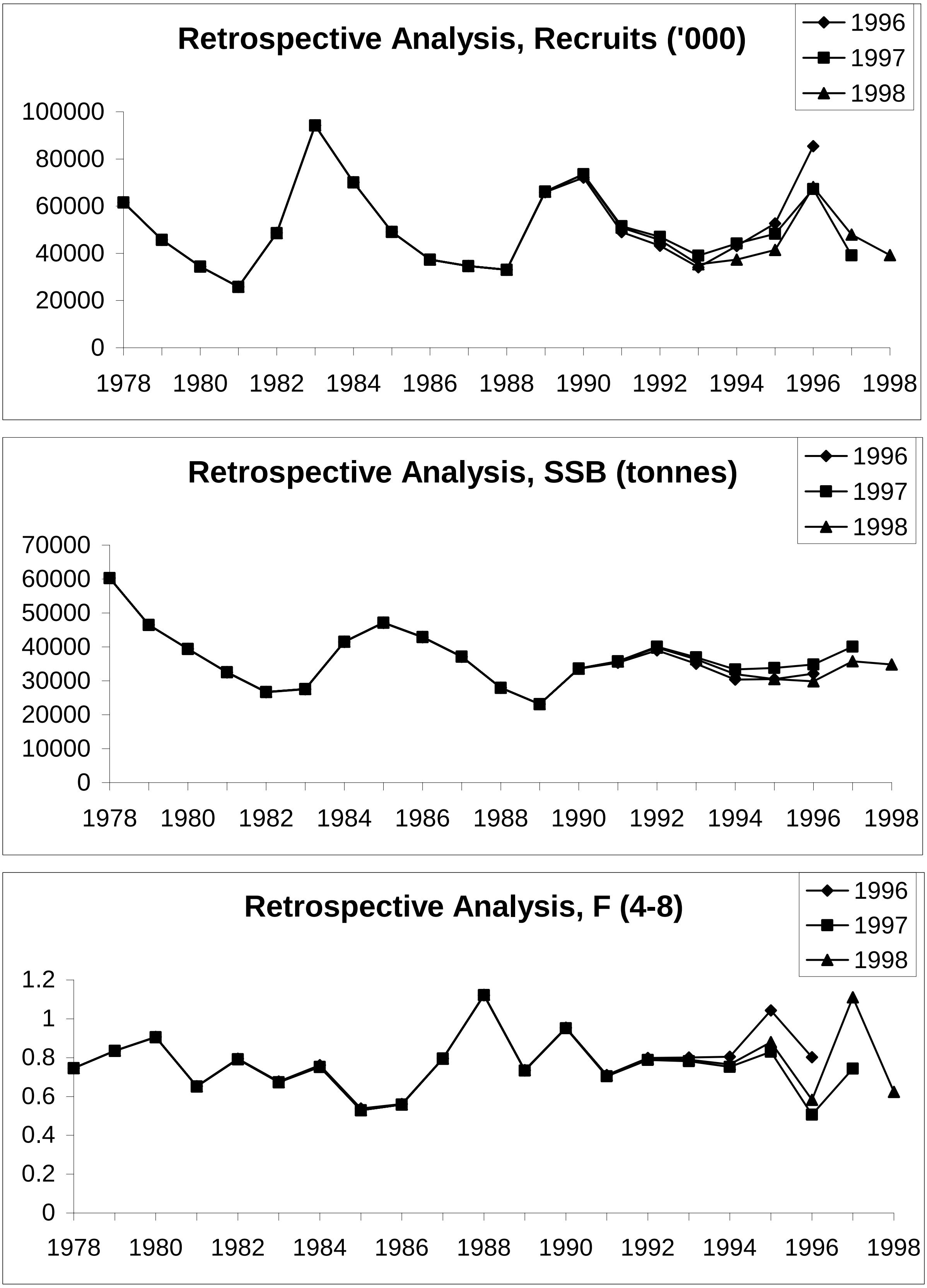


Figure 10.6.1 Fish Stock Summary. Plaice in Division IIIa.

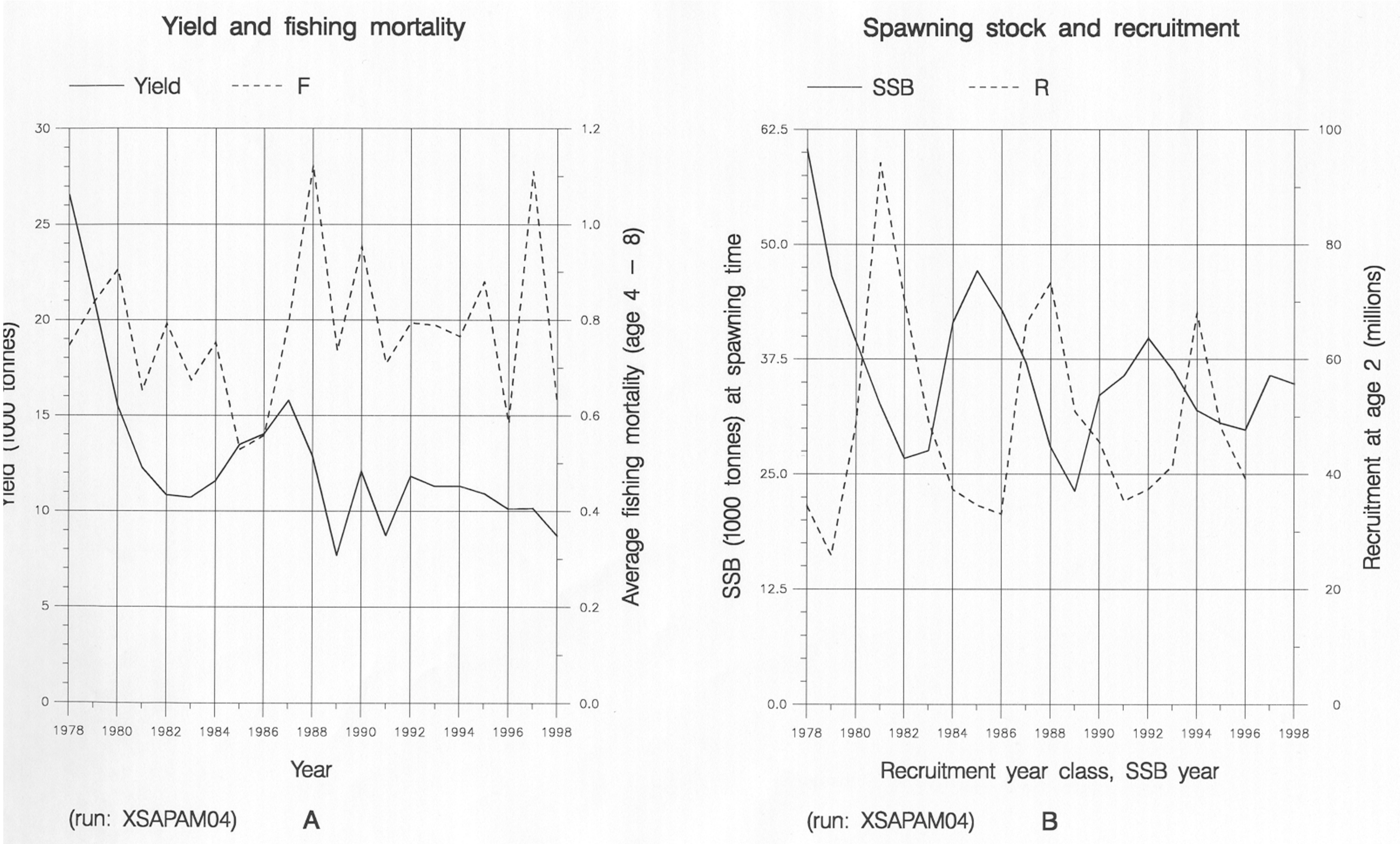


Figure 10.7.1 Plaice in Division IIIa. Sensitivity analysis of short term forecast.

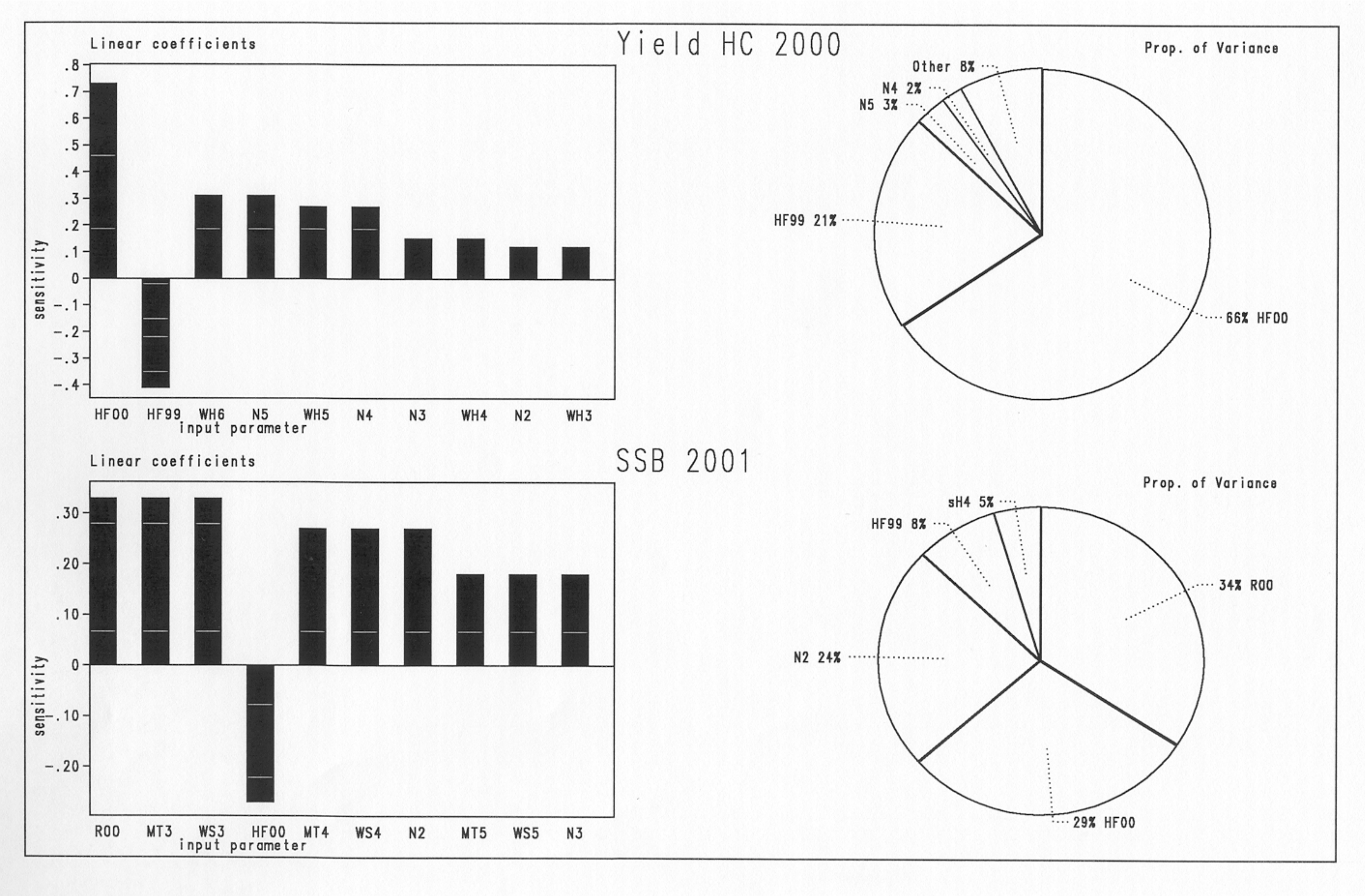


Figure 10.7.2 Plaice in Division IIIa. Probability profiles for short term forecast.

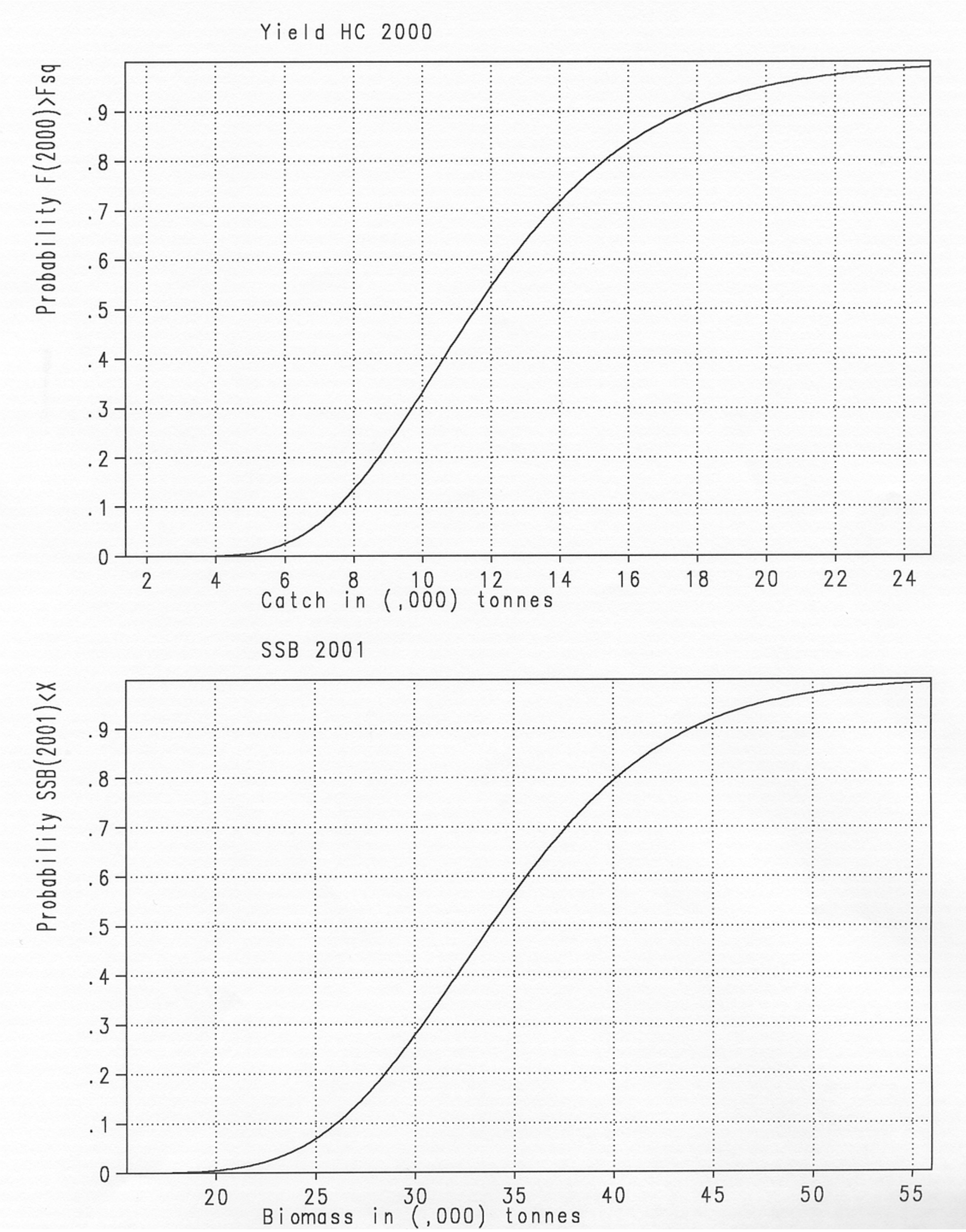


Figure 10.8.1. Plaice IIIa. Description of the stock and recruitment relationship with 4 traditional stock recruitment functions

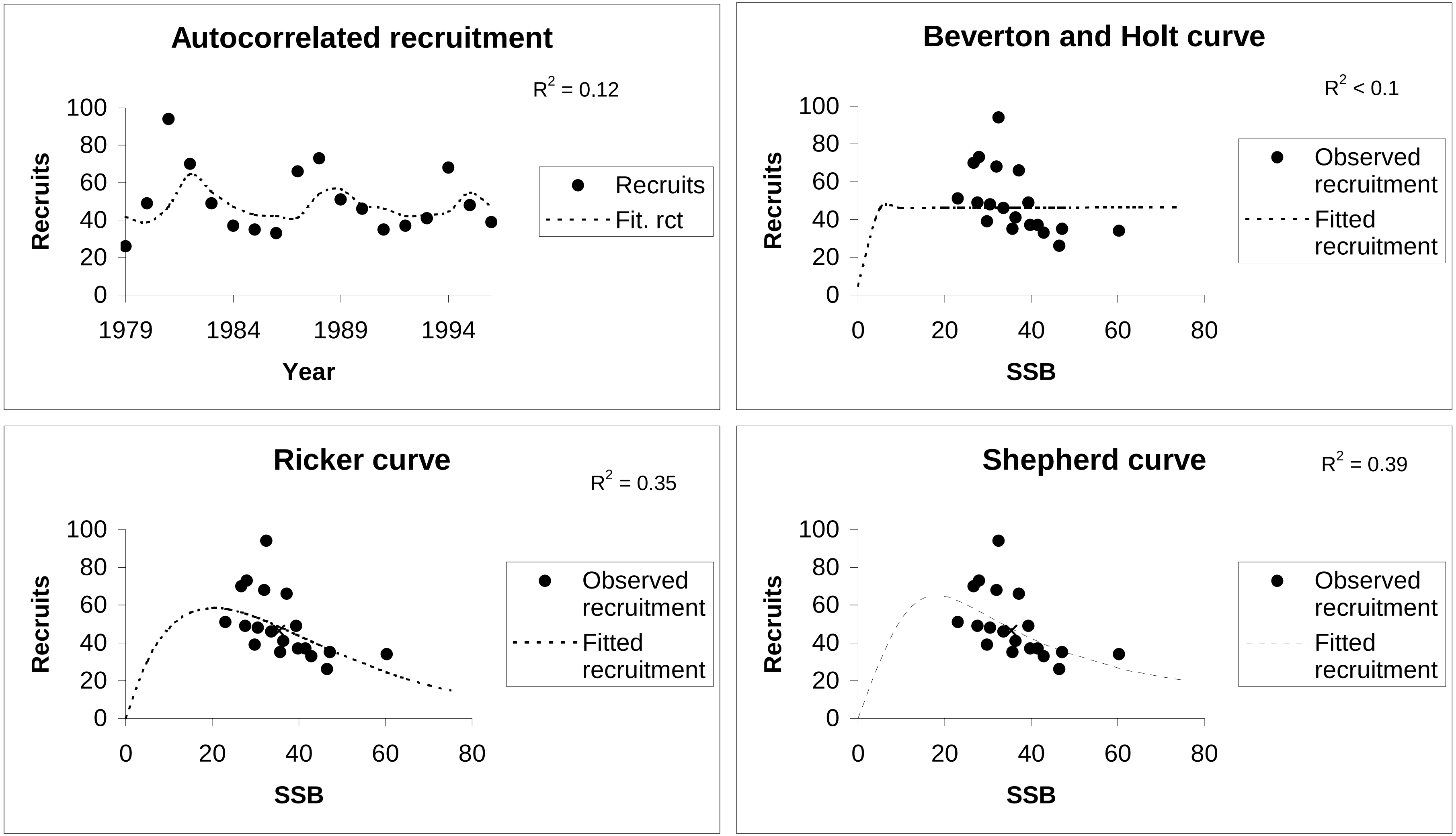


Figure 10.8.2. Plaice IIIa. Stock recruitment relationship and outcomes of the medium-term proj ections

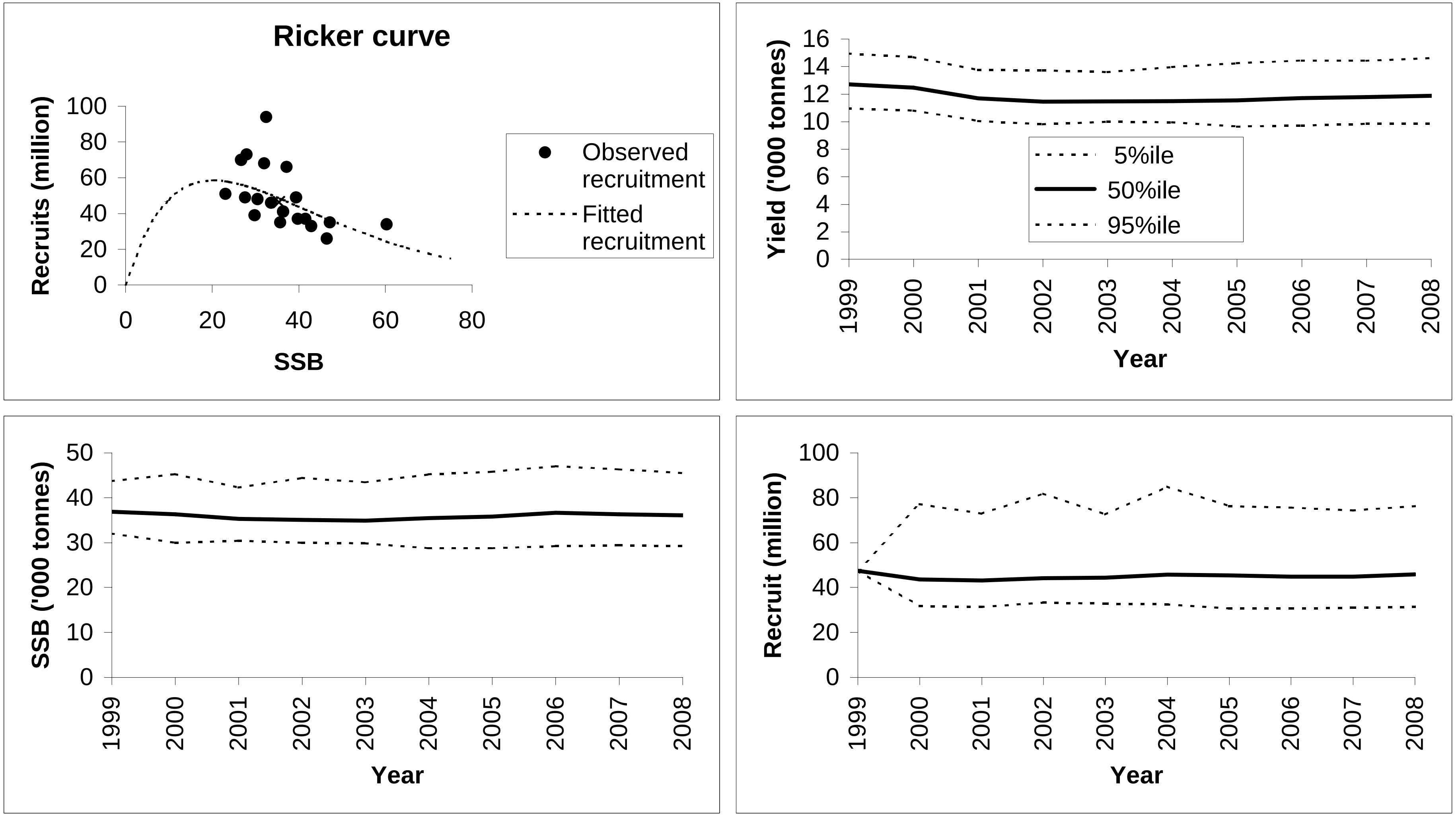


Figure 10.9.1 Fish Stock Summary. Plaice in Division IIIa.

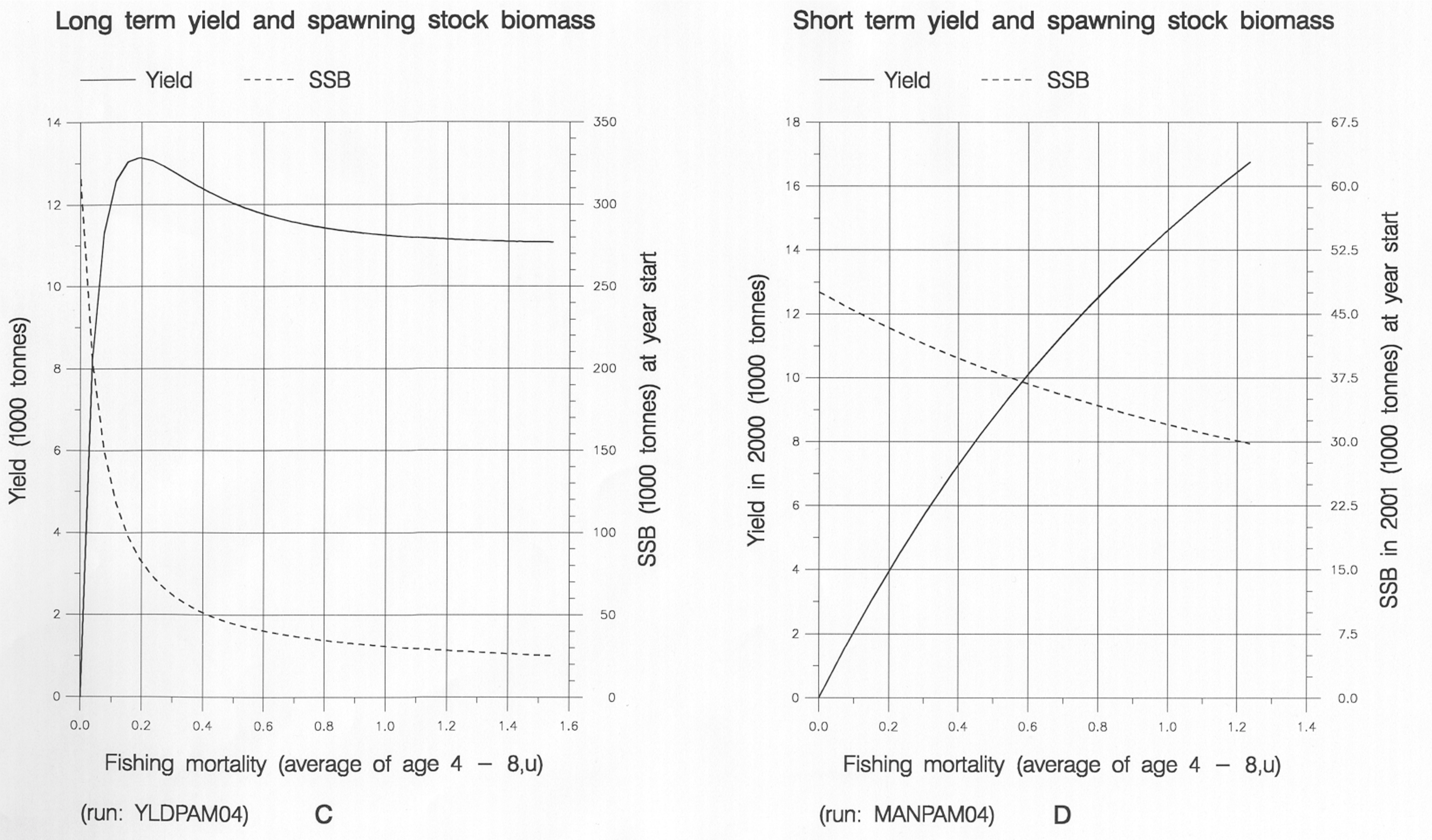


Figure 10.9.2 Plaice in Division IIIa.

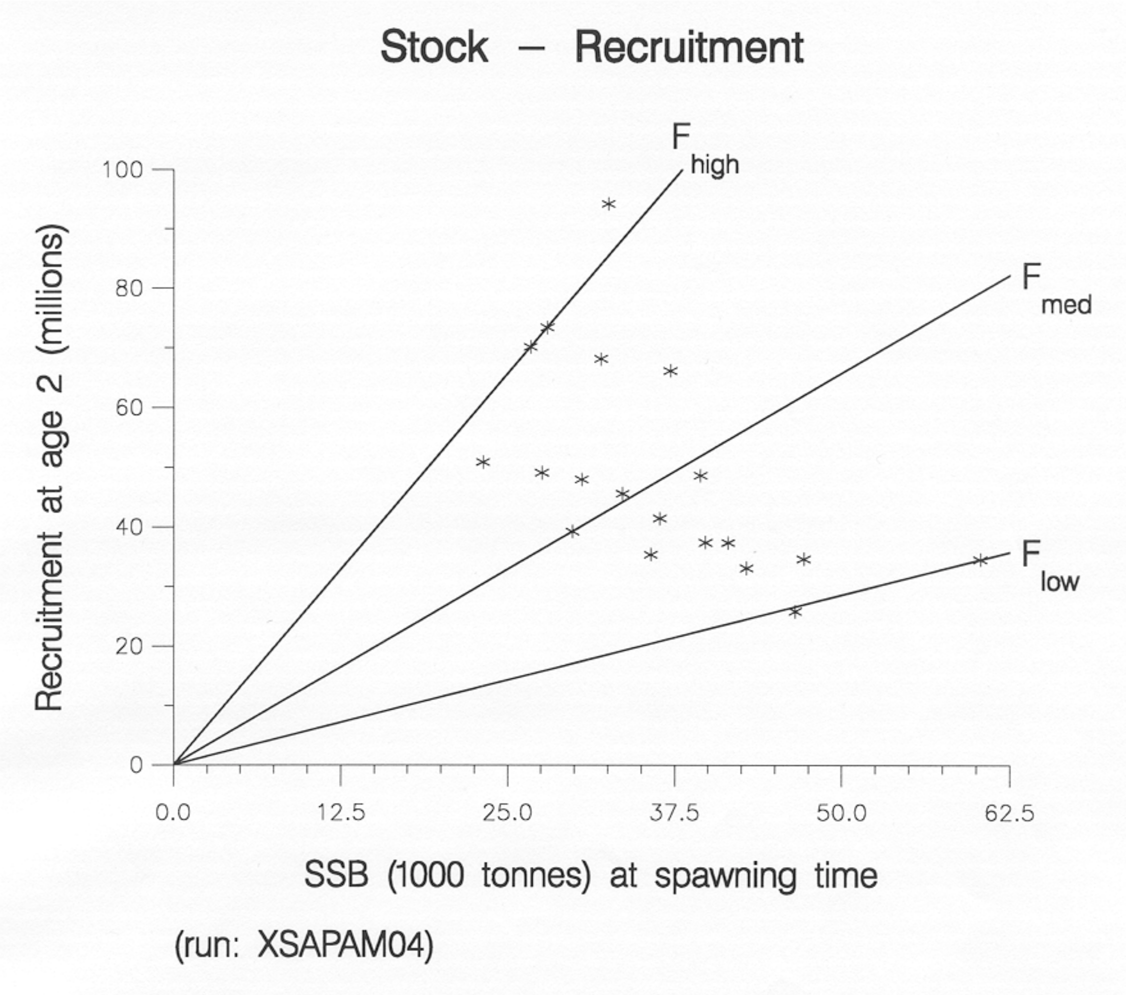
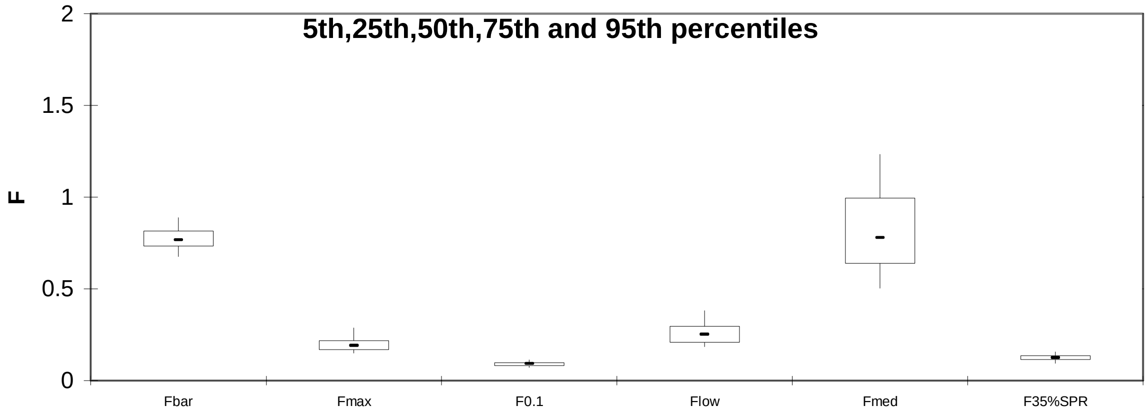


Figure 10.10.1. Plaice IIIa. Representation of the potential reference points and associated percentiles.



F_{high} and F_{loss} have not been represented

Reference point	Deterministic	Median	75th percentile	95th percentile	Hist SSB < ref pt %
MedianRecruits	46000	46000	49000	51000	
MBAL	0				0.00
Bloss	23100				
SSB90%R90%Surv	27049	30948	33044	36760	9.52
SPR%ofVirgin	11.17	10.81	11.92	13.92	
VirginSPR	6.65	6.87	7.60	9.83	
SPRloss	0.35	0.37	0.41	0.49	

	Deterministic	Median	25th percentile	5th percentile	Hist F > ref pt %
FBar	0.77	0.77	0.73	0.68	47.62
Fmax	0.19	0.19	0.17	0.15	100.00
F0.1	0.09	0.09	0.08	0.07	100.00
Flow	0.26	0.25	0.21	0.18	100.00
Fmed	0.73	0.78	0.64	0.50	66.67
Fhigh	3.01	2.71	2.00	1.42	0.00
F35%SPR	0.13	0.12	0.11	0.09	100.00
Floss	3.57	3.18	2.20	1.52	0.00

For estimation of Gloss and Floss:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
For estimation of the stock recruitment relationship used in equilibrium calculations:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

iiia plaice

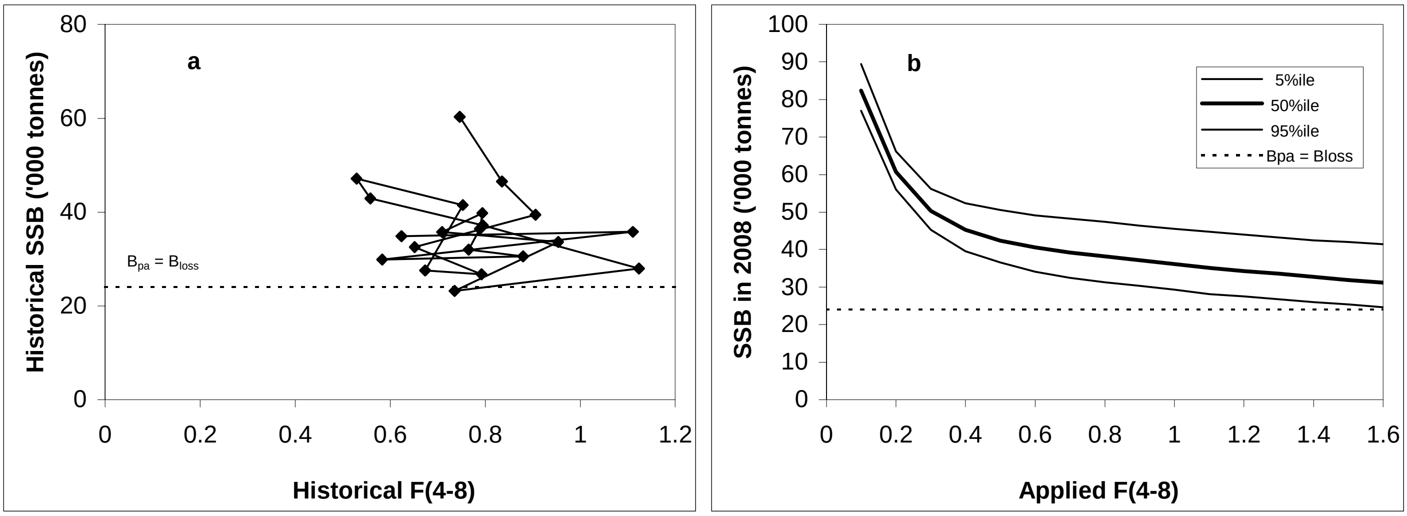
Steady state selection provided as input
FBar averaged from age 4 to 8

Number of iterations = 100
Random number seed = -99
Stock recruitment data Monte Carloed using residuals from the equilibrium LOWESS fit

Data source:
D:\ns99\Paul\Ple3a.sen
D:\ns99\Paul\Ple3a.sum

FishLab DLL used
FLVB32.DLL built on May 6 1999 at 12:54:28
PASoft 10 June 1999

Figure 10.10.2. Plaice IIIa. Historical F and SSB (a); proj ected SSB(2008) in relation to F levels



11 PLAICE IN DIVISION VIID

11.1 The fishery

Plaice is caught all year in a mixed fishery with sole by Belgian and UK offshore beam trawlers and French inshore trawlers. It's also a seasonal target in winter for some French offshore otter trawlers

11.1.1 ICES advice applicable to 1999

ACFM considered the state of the stock uncertain but probably close to safe biological limits. Fishing mortality is estimated to be slightly above $\mathbf{F}_{pa}$ ICES recommended that fishing mortality should not be allowed to increase and proposed following $\mathbf{F}_{pa}$. (0.45) and considers that $\mathbf{F}_{\mathbf{lim}}$ is 0.54 and $\mathbf{B}_{\mathbf{lim}}$ 5600 t. The expected landings in 1999 corresponding to F at $\mathbf{F}_{pa}$ were 6300 t.

11.1.2 Management applicable to 1999

There is no separate TAC for VIId plaice which at present is managed together with area VIIe. The TAC was set to 7400 t in both area in 1999 (TAC_{98} was 5700 t). Technical conservation measures including minimum mesh size of 80 mm and minimum landing size of 25 cm are in force.

11.1.3 Trends in landings

Landings data reported to ICES are shown in Table 11.1.1 together with the total landings estimated by the Working Group. The unallocated landings are mainly due to discrepancies between the officially reported figures and those available to WG members. No correction was made for SOP discrepancies which are very low since 1992. The trend in landings is shown in Figure 11.1.1. Landings peaked at 10400 t in 1988 and have declined by nearly half since then to 5762 t in 1998 which is less than the 6500 t predicted in last year's assessment. France contributes 67.8 % of the official landings in 1998 followed by Belgium (17.7 %) and UK (14.5 %).

11.2 Natural mortality, maturity, age compositions and mean weight at age

The natural mortality was assumed to be constant over ages and years at 0.10 as for the North Sea (table 11.2.1). The maturity ogive used is similar to that for VIIe plaice and is the same for all years, it is shown in Table 11.2.1. Age compositions for 1980-98 were available for the UK and for 1981-98 for Belgium. France provided age compositions since 1989. However, levels of sampling prior to 1985 were poor and those data are considered to be less reliable..

Quarterly catch weights were available from UK since 1980 and from Belgium since 1986. French catch weights have been collected since 1989.

The age-composition data and the mean weight at age in the catch are shown in Tables 11.2.2 and 11.2.3. In 1998 international landings covered by sampling schemes represented 97 % of the total landings. Stock weights at the 1st of January were calculated from a smoothed curve of catch weights (Table 11.2.4). Data before 1998 were not revised except minor changes in stock weights at age in 1997 which were recalculated. The data do not include discards that are not sampled for this stock although they are probably quite substantial.

11.3 Catch, effort and research vessel data

Commercial effort and CPUE data are available from four commercial fleets covering inshore and offshore trawlers. The two French fleets INSHORE TRAWL and OFFSHORE TRAWL used in previous assessments were grouped last year into FRENCH TRAWLERS because it was not possible to continue to distinguish them on the same basis due to a new statistical database. All fleets show a steep decline in CPUE from 1988/89 to 1996. Since then the CPUE seems stabilised but divergent signals are given by the French and the UK fleets. Effort has increased in all fleets since 1983 to 1989 and remained thereafter at a high level except in 1998 where some fleets switched to cod. Trends in effort and CPUE are shown in Table 11.3.2 and Figure 11.3.1 (see also overview section 2.3).

Effort and age compositions were available for three commercial fleets. FRENCH TRAWLERS fleet was recalculated this year using a more consistent serie of auction data and the age composition was improved since 1991 (before this date the age compositions were deraised from the total French age composition). Survey data were obtained since 1988 from two trawls surveys covering most of VIId. These were the English beam trawl survey in August (Table 11.3.3) and

French otter trawl ground fish survey in October. Recruit survey estimates for 0 and 1-gp fish were also available from coastal research surveys in VIId, the English and French YFS (Table 11.3.4). New indices, restricted to the most important area of the Baie of Somme flatfish nursery were recalculated this year for French YFS.

All these data (including age 1) were used to tune the VPA. The range of ages and years used in each fleet is shown in the input file for tuning (Table 11.3.1).

11.4 Catch at age analysis

As previously the analysis was carried out with XSA. A number of trial runs were made to select the most appropriate model for the data and a multi stage process was used to select the final tuning options:

1. Input data: a separable VPA was made to check the input data (Table 11.4.1). High residuals occur between age 1/2 and 2/3 in 1997 and 1998. To explain this anomaly, the tuning data were explored and a big decrease in the effort was noted in 1998 for UK INSHORE TRAWL. The data for this fleet excludes trips in which plaice was not the main landings and it confirm information that some fishermen in 1998 switched to fish cod instead of plaice. Residuals are lower since 1989 when France began to provide age compositions, the ages 10+ which show also high residuals were combined as a plus group

2. Trends in catchability were examined for residual trends by fleet. Trends were examined from exploratory runs using XSA with single fleet tuning runs. We noticed big residuals and a trend for age 1 in the UK INSHORE TRAWL. Age 1 in the FRENCH TRAWLERS and age 2 in BELGIAN BEAM TRAWL were also removed from the final analysis. Catchability residuals of the fleets from final XSA are presented in Figure 11.4.1.

3. Choice of age to be treated as recruits: an exploratory run was made with all ages below 8 (default) treated as recruits (all other options accepted also by defaults). Examination of the regression statistics showed slopes significantly different from 1.0 for age 1 and 6 in UK BTS and therefore age 1 was treated as recruit (as in 98WG) (Figure 11.4.3).

4. Time serie. As the data were relatively poor before 1989 (as shown in the separable VPA) this period was excluded from the tuning using a selection range since 1988 for the final run. This date correspond also to the beginning of the UK BTS which has an important weight in this assessment. A trial run was made with the tricubic taper over 15 years we used previously and the results were very similar.

5. Choice of age for which catchability can be assumed to be constant: from the previous trial run where catchability depends on year class strength for ages 1 and is not dependant of age until 8 (default), the patterns of q with age were examined for each fleet. In most fleets, q showed a slight decline with age from a peak at age 3 or 4 and catchability become constant at age 7. Age 7 was therefore taken as an acceptable value (as in 98WG).

6. Survival estimates were shrunk towards the mean F of the final 5 years or the 3 oldest ages in the final run (as in 98WG).

7. Retrospective analysis was carried out using final XSA options and various level of shrinkage were tested. A low shrinkage of 1.0 seems to improve the retrospective pattern between years but this gives considerable weight to a single survey fleet (UK BTS). Because this survey does not very well sample the older fish, a strong shrinkage of 0.5 was preferred , as in 98 WG.

An unrealistic high value for F in 97 was noted. The retrospective pattern showed no particular trend for the 3 years available with the short tuning range of 8 years used (Figure 11.4.2).

The following table summarise the changes from last year assessment, others parameters are the same:

	98WG	99WG
Tuning fleets	New fleet FRENCH TRAWL including inshore and offshore boats	This fleet was completely recalculated this year using a more consistent series of auction markets
Excluding ages/fleets	Age 1 in UK INSHORE TRAWL Age 1 in FRENCH GFS Ages 2 and 3 in BELGIAN BEAM TRAWL	Age 1 in UK INSHORE TRAWL Age 1 in FRENCH TRAWL Ages 2 in BELGIAN BEAM TRAWL

The list of tuning fleets, input parameters and output from the final run are shown in Tables 11.4.2. Fishing mortality and stock numbers are in Tables 11.4.3 and 11.4.4 respectively. The weights of tuning categories are presented in Figure 11.4.4. Surveys are dominant for younger ages and commercial fleet for older ones. The weight of F shrinkage is nearly the same for all ages.

11.5 Recruit estimates

Research vessel survey indices of 0, 1 and 2 year olds were available and are shown in Table 11.3.3 and Table 11.3.4. These survey data were already used in XSA together with those of the three commercial fleets but additional data was available for O groups and for 1999 surveys. Figure 11.5.1 presents the survey indices compared with the VPA numbers (year class 1981 to 1995).

RCT3 was used to predict recruitment at age 1 and age 2 in 1999, and the input file using 0 and 1 group indices is presented in Table 11.5.1. Results are shown in Table 11.5.2 and Table 11.5.3 and can be compared to those of XSA :

		RCT3		XSA
Year-Class	Age in 1999	Weighted average (age*10-3)	Var Ratio	(age*10-3)
1996	3			19902
1997	2	18015	1.00	17168
1998	1	23757	.34	-

For the 1996 year-class the XSA estimation was accepted. For the 1997 year class results show not big differences between XSA and RCT3 and the estimate from the surveys was preferred to XSA which is influenced by F shrinkage (weight of .15). For the 1998 year class the estimate of RCT3 was used and for 2000 and 2001 the $GM_{80\text{-}96}$ of 23.4 millions.

11.6 Historical Stock Trends

Trends in fishing mortality, SSB and recruitment are shown in Table 11.6.1 and Figure 11.1.1. Fishing mortality shows big variations in recent years, increasing steeply in 1991 and fluctuates thereafter. This recent trend in F can be explained by the evolution of the effort made by the various fleets. SSB increased rapidly in 1987 following recruitment of the strong 1985 year class. Since 1990 SSB has declined steeply until 1992 and now is at a plateau near 7000 t. Recruitment has been close to the GM level of 23.4 million of 1 yr olds since 1987.

11.7 Short term forecast

The input data for the catch forecasts are given in Table 11.7.1. Stock numbers in 1999 were taken from the VPA for age 3 and older, RCT3 at age 1 and 2 and the GM of 23.4 million was used for age 1 in 2000 and 2001. This year a mean F over 5 years was preferred instead of the default 3 years to downweight the unrealistically high F estimated for 1997 so the exploitation pattern was the unscaled mean of the period 1994-98. Catch and stock weights at age were the mean for the period 1996-98 and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Table 11.7.3 and Figure 11.7.1. The predicted catch in 1999 is estimated to be 6800 t with a SSB of 8400 t for the same year. This compares with a figure of 6500 t forecast for the catch and 10500 t for the SSB made last year. Continuing with the same level of F implies a decrease in catch with 6400 t in 2000 and a predicted SSB to 8100 t in 2000 and 7500 t in 2001. A detailed prediction output by age is shown in table 11.7.4.

Figure 11.7.2 shows the contribution of different year classes to landings in 2000 and SSB in 2001 under *status quo* assumptions.

The input data for sensitivity analysis are shown in table 11.7.2.and the results of the status quo catch prediction are shown in Figures 11.7.3 and 11.7.4.

Figure 11.7.3 shows that the yield in 2000 and the SSB in 2001 are very dependent of the fishing mortality in 2000 and 1999. In the same Figure is shown the proportion of total variance of the estimated yields and spawning biomass contributed by the input parameters. For yield in 2000 and SSB 2001, most of the variance is contributed by the fishing mortality rate in 1999 and 2000.

Figure 11.7.4 shows probability profiles for yields in 2000 and spawning biomass in 2001. For SSB there is a probability of 10 % that the SSB will fall below the lowest observed value by 2001.

11.8 Medium term predictions

Last year a medium term prediction was carried out assuming that recruitment is fitted with a Butterworth Bergh model. We use this year a Shepherd model constrained to go through GM recruit and SSB at SQ F. We use this model instead the Butterworth Berg which was not available this year to obtain qualitatively the same model, developments are given in the North Sea Plaice section.

One run over 10 years with 500 simulations was carried out for the status quo F. Results in Figure 11.8.1 show the 5, 10, 20, 50 and 95 percentiles for yield, recruitment and SSB. These figures indicate a slight decrease for the landings and the SSB.

The same model was used again to analysise the medium term projections of SSB in 2008 at different F levels. Figure 11.8.2 shows that at F_{pa} there is less than 5 % probability that SSB will fall below B_{pa}.

11.9 Long term considerations

A stock-recruitment scatter plot is shown in Figure 11.10.1. The current F (0.64) is well above the value of Fmed (0.55). The yield per recruit input values are given in Table 11.9.1 and the output summary in Table 11.9.2. The YPR and SSB/R curves are shown in Figure 11.7.1.

11.10 Biological reference points

There is no need for review the precautionary reference points in this assessment.

B_{lim}	B_{pa}	F_{pa}	F_{lim}	F_{med}	F_{SQ}
5 600 t	8 000 t	0.45	0.54	0.55	0.64

11.11 Comments on the assessment

If we compare with last year's assessment some important changes appear in the trend of this stock. The higher estimate of the F in 1997 give a more pessimistic view of the situation of this stock, the current F is now estimated to be above F_{pa}. and the SSB well under last year estimation will be expected to decrease on the short term until 7500 t in 2001. However, the view of this stock is not clear from one year to the next since the calculation of F is not very precise and the result of this assessment should be treated with caution.

The WG was asked to consider the possibility of carrying out a single combined assessment for the two stocks VIId and VIIe plaice. The management of plaice involves a combined TAC for VIId+e since these stocks are evaluated by two separate WGs (WGNSSK and WGSSDS). Existing knowledge about the biology of the plaice in the English Channel indicates that the two stocks are biologically separate. Information about adults migration coming from tagging experiments (Houghton and Harding, 1976 in Anon., 1993) indicates that, after spawning some plaice migrate rapidly to the North Sea and others remained in the western as in the eastern part of the Channel. Houghton (1976), cited in Anon., 1993, reviewed these previous data and concluded that the resident plaice appeared to be members of two groups which return to specific (east or west Channel) spawning areas each winter. Migratory North Sea plaice only entered the Channel in autumn, and left rapidly after spawning. The conclusions about the stock identity of the plaice in the Channel (Anon., 1993) is that it is possible that three stocks , which probably have sufficient integrity to be considered as largely self-perpetuating units, could be recognised in the Channel: the eastern Channel stock; the western Channel stock; and an eastern/southern North Sea stock. However, their distributions frequently overlap for considerable periods and thus it would be almost impossible to manage them independently.

Table 11.1.1.- Plaice in Division VIId. Nominal landings (tonnes) as officially reported to ICES, 1976–1998.

Year	Belgium	Denmark	France	UK (E+W)	Others	Total reported	Un-allocated	Total as used by WG
1976	147	1[1]	1,439	376	-	1,963	-	1,963
1977	149	81[2]	1,714	302	-	2,246	-	2,246
1978	161	156[2]	1,810	349	-	2,476	-	2,476
1979	217	28[2]	2,094	278	-	2,617	-	2,617
1980	435	112[2]	2,905	304	-	3,756	-1,106	2,650
1981	815	-	3,431	489	-	4,735	34	4,769
1982	738	-	3,504	541	22	4,805	60	4,865
1983	1,013	-	3,119	548	-	4,680	363	5,043
1984	947	-	2,844	640	-	4,431	730	5,161
1985	1,148	-	3,943	866	-	5,957	65	6,022
1986	1,158	-	3,288	828	488[2]	5,762	1,072	6,834
1987	1,807	-	4,768	1,292	-	7,867	499	8,366
1988	2,165	-	5,688[2]	1,250	-	9,103	1,317	10,420
1989	2,019	+	3,265[1]	1,383	-	6,667	2,091	8,758
1990	2,149	-	4,170[1]	1,479	-	7,798	1,249	9,047
1991	2,265	-	3,606[1]	1,566	-	7,437	376	7,813
1992	1,560	1	3,099	1,553	19	6,232	105	6,337
1993	0,877	+[2]	2,792	1,075	27	4,771	560	5,331
1994	1,418	+	3,199	993	23	5,633	488	6,121
1995	1,157	-	2,598	796	18	4,569	561	5,130
1996	1,112	-	2,630	856	+	4,598	795	5,393
1997	1,161	-	3,077	1,078	+	5,316	991	6,307
1998	854	-	3,276[3]	700	+	4,830	932	5,762

[1]Estimated by the Working Group from combined Division VIId+e.
[2]Includes Division VIIe.
[3]Provisional.

Table 11.2.1.- Plaice in Division VIId. Natural mortality and proportion mature.

Age	Nat Mor	Mat.
1	.100	.000
2	.100	.150
3	.100	.530
4	.100	.960
5	.100	1.000
6	.100	1.000
7	.100	1.000
8	.100	1.000
9	.100	1.000
10+	.100	1.000

Table 11.2.2.- Plaice in Division VIId. Catch numbers at age.

Table 1 Catch numbers at age Numbers*10**-3

	YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
	AGE									
	1,	53,	16,	265,	92,	350,	142,	679,	25,	16,
	2,	2644,	2446,	1393,	3030,	1871,	5714,	4884,	8499,	5011,
	3,	1451,	6795,	6909,	3199,	7310,	6195,	7034,	7508,	18813,
	4,	540,	2398,	3302,	5908,	2814,	4883,	3663,	3472,	4900,
	5,	490,	290,	762,	931,	1874,	413,	1458,	1257,	1118,
	6,	75,	159,	206,	226,	533,	612,	562,	430,	541,
	7,	45,	51,	96,	92,	236,	164,	254,	442,	439,
	8,	44,	42,	62,	122,	101,	99,	69,	154,	127,
	9,	4,	56,	21,	4,	34,	139,	19,	105,	105,
	+gp,	103,	200,	88,	101,	100,	50,	34,	77,	174,
0	TOTALNUM,	5449,	12453,	13104,	13705,	15223,	18411,	18656,	21969,	31244,
	TONSLAND,	2650,	4769,	4865,	5043,	5161,	6022,	6834,	8366,	10420,
	SOPCOF %,	100,	94,	92,	90,	86,	92,	100,	98,	92,

Table 1 Catch numbers at age Numbers*10**-3

	YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
	AGE										
	1,	826,	1632,	1542,	1665,	740,	1242,	2592,	1119,	550,	464,
	2,	3638,	2627,	5860,	6193,	7606,	3633,	4340,	4847,	4246,	4400,
	3,	7227,	8746,	5445,	4450,	3817,	6968,	2933,	3606,	7189,	8629,
	4,	9453,	5983,	4524,	1725,	1259,	3111,	2928,	1547,	3434,	3419,
	5,	2672,	3603,	2437,	1187,	542,	850,	922,	1436,	1080,	537,
	6,	588,	801,	1681,	1044,	468,	419,	228,	488,	752,	143,
	7,	288,	243,	286,	698,	334,	312,	277,	179,	464,	136,
	8,	179,	203,	120,	200,	287,	267,	225,	176,	199,	81,
	9,	81,	178,	113,	116,	102,	275,	122,	165,	114,	52,
	+gp,	197,	231,	125,	118,	152,	312,	258,	347,	306,	188,
0	TOTALNUM,	25149,	24247,	22133,	17396,	15307,	17389,	14825,	13910,	18334,	18049,
	TONSLAND,	8758,	9047,	7813,	6337,	5331,	6121,	5130,	5393,	6307,	5762,
	SOPCOF %,	93,	98,	96,	98,	99,	99,	98,	102,	97,	102,

Table 11.2.3.- Plaice in Division VIId. Catch weights at age.

Table 2 Catch weights at age (kg)

	YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
	AGE									
	1,	.3090,	.2390,	.2450,	.2660,	.2330,	.2540,	.2260,	.2510,	.2920,
	2,	.3120,	.2990,	.2710,	.2960,	.2950,	.2780,	.3060,	.2820,	.2680,
	3,	.4990,	.3730,	.3530,	.3490,	.3360,	.3010,	.3310,	.3600,	.3210,
	4,	.6270,	.4640,	.4310,	.4200,	.4020,	.4270,	.4060,	.4770,	.4320,
	5,	.7870,	.7120,	.6400,	.5420,	.5080,	.5020,	.5460,	.5770,	.5600,
	6,	1.1390,	.8700,	.7950,	.8220,	.6890,	.5700,	.4860,	.7830,	.6570,
	7,	1.1790,	.8630,	1.1530,	.9530,	.7030,	.5570,	.6290,	.7350,	.7700,
	8,	1.2930,	.8970,	1.0670,	1.1440,	.9450,	1.0810,	.8710,	1.1420,	.9080,
	9,	1.4750,	.9920,	1.5040,	.9430,	1.0280,	.8490,	1.4460,	1.2680,	1.2180,
	+gp,	1.5572,	1.1736,	1.3552,	1.5907,	1.4269,	1.4209,	1.5789,	1.5148,	1.3280,
0	SOPCOFAC,	.9995,	.9353,	.9208,	.9003,	.8632,	.9239,	1.0001,	.9757,	.9224,

Table 2 Catch weights at age (kg)

	YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
	AGE										
	1,	.2010,	.2010,	.2250,	.1820,	.2200,	.2430,	.2180,	.2210,	.1990,	.1590,
	2,	.2680,	.2560,	.2770,	.2770,	.2720,	.2700,	.2710,	.3000,	.2520,	.2440,
	3,	.3210,	.3260,	.3110,	.3520,	.3360,	.2880,	.3130,	.2900,	.2980,	.2670,
	4,	.3700,	.3780,	.3900,	.4290,	.4320,	.3560,	.3900,	.3960,	.3320,	.3810,
	5,	.4730,	.4830,	.4540,	.5090,	.5070,	.4660,	.4850,	.4750,	.4420,	.5020,
	6,	.6480,	.6100,	.5560,	.5850,	.5910,	.5760,	.6880,	.6430,	.5770,	.7620,
	7,	.8370,	.7810,	.7450,	.7010,	.7410,	.6860,	.6120,	.7640,	.8010,	.8390,
	8,	.9070,	.9630,	1.0870,	.8370,	.8200,	.9280,	.8060,	.9340,	.8940,	.9810,
	9,	1.2040,	1.1590,	.9240,	.8500,	.9340,	.9690,	1.1500,	1.0570,	1.0550,	.9860,
	+gp,	1.5195,	1.3099,	1.6015,	1.1947,	1.1555,	1.2866,	1.2977,	1.3124,	1.3948,	1.3792,
0	SOPCOFAC,	.9313,	.9795,	.9625,	.9846,	.9940,	.9930,	.9807,	1.0201,	.9748,	1.0222,

Table 11.2.4.- Plaice in Division VIId. Stock weights at age.

Table 3 Stock weights at age (kg)

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE									
1,	.1710,	.1100,	.1050,	.0970,	.0820,	.0840,	.1010,	.1220,	.0840,
2,	.3320,	.2160,	.2080,	.1920,	.1640,	.1710,	.2050,	.2420,	.1680,
3,	.4820,	.3170,	.3080,	.2860,	.2480,	.2590,	.3110,	.3610,	.2540,
4,	.6220,	.4140,	.4060,	.3790,	.3330,	.3480,	.4200,	.4790,	.3400,
5,	.7510,	.5060,	.5020,	.4700,	.4200,	.4400,	.5320,	.5960,	.4270,
6,	.8700,	.5940,	.5960,	.5600,	.5070,	.5330,	.6460,	.7120,	.5140,
7,	.9770,	.6770,	.6870,	.6480,	.5960,	.6280,	.7630,	.8260,	.6030,
8,	1.0740,	.7560,	.7760,	.7350,	.6860,	.7250,	.8820,	.9390,	.6920,
9,	1.1610,	.8300,	.8620,	.8210,	.7770,	.8240,	1.0040,	1.0510,	.7830,
+gp,	1.3392,	1.0419,	1.1184,	1.1688,	1.0858,	1.2060,	1.3126,	1.3055,	.9519,

Table 3 Stock weights at age (kg)

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.0790,	.0850,	.0650,	.0880,	.1080,	.1650,	.0580,	.1780,	.0590,	.0720,
2,	.1620,	.1720,	.1410,	.1770,	.2140,	.2150,	.1720,	.2380,	.1510,	.1630,
3,	.2500,	.2620,	.2270,	.2680,	.3150,	.2740,	.2840,	.3070,	.2460,	.2560,
4,	.3420,	.3550,	.3240,	.3610,	.4140,	.3440,	.3960,	.3850,	.3430,	.3520,
5,	.4390,	.4510,	.4320,	.4560,	.5090,	.4220,	.5060,	.4730,	.4430,	.4500,
6,	.5410,	.5490,	.5500,	.5520,	.6010,	.5110,	.6150,	.5690,	.5450,	.5500,
7,	.6480,	.6510,	.6790,	.6510,	.6900,	.6090,	.7230,	.6750,	.6490,	.6540,
8,	.7590,	.7550,	.8190,	.7510,	.7760,	.7160,	.8300,	.7900,	.7560,	.7590,
9,	.8740,	.8620,	.9690,	.8530,	.8580,	.8340,	.9350,	.9150,	.8650,	.8680,
+gp,	1.2112,	1.1247,	1.4036,	1.1158,	1.0384,	1.1472,	1.1891,	1.2233,	1.1466,	1.1988,

Table 11.3.1.- Plaice in VIId. Tuning input file. (Continued)

Plaice in Division VIId (Eastern English Channel) (run name: TUNATT01)
107
FLT01: UK INSHORE TRAWL METIER <40 trawl lands all trawl age comps fleet (Catch: Unknown) (Effort: Unknown)
1985 1998
1 1 0.00 1.00
2 10

2520	618.3	419.7	221.1	18.8	0.0	0.0	0.0	19.0	0.0
1804	237.9	300.2	132.9	51.6	6.5	4.7	2.9	0.0	0.0
2556	456.0	430.2	153.2	48.0	25.1	5.0	6.3	4.3	0.0
2500	382.4	856.1	141.7	57.8	30.1	14.1	2.8	4.0	5.2
2131	47.4	221.7	465.4	97.1	41.3	19.0	5.5	1.2	6.2
1094	34.3	92.1	52.6	56.9	18.0	7.5	5.5	3.6	3.1
2349	240.2	229.7	166.6	76.6	64.9	10.7	4.3	2.1	1.3
2527	298.0	225.5	140.4	77.8	55.3	44.2	14.6	2.9	2.4
2503	309.3	181.4	66.6	40.5	30.1	21.5	25.1	8.5	3.8
2635	176.0	240.2	99.7	37.8	21.0	17.0	8.9	17.9	3.5
1531	124.1	70.7	54.6	23.5	8.5	5.0	5.5	3.9	6.8
1659	274.4	63.8	16.9	19.1	10.0	2.5	3.1	2.5	2.5
2024	317.1	223.8	20.4	7.7	10.2	8.0	4.9	2.8	4.0
733	92.7	69.0	24.6	3.3	1.6	3.5	1.2	1.0	0.3

FLT02: BELGIAN BEAM TRAWL(HP corr) all gears age comp [rev: 29/7/99-WV] (Catch: Unknown) (Effort: Unknown)
1981 1998
1 1 0.00 1.00
3 10

24.4	1126.5	593.3	67.3	21.6	8.3	7.1	13.3	14.1
29.8	1065.4	688.2	187.2	55.1	21.1	6.5	4.6	4.0
26.4	654.3	1384.5	165.0	52.2	23.0	31.6	1.3	1.4
35.4	1570.4	712.1	467.5	134.3	61.0	28.2	5.4	6.8
33.4	1125.3	1115.1	93.9	197.2	52.9	31.9	5.3	6.1
30.8	1141.8	667.8	269.9	145.9	60.3	11.3	5.6	6.4
49.3	1639.7	889.0	343.1	92.7	154.5	41.1	28.0	14.1
48.9	4264.6	1301.8	237.1	109.9	113.2	35.8	25.4	24.0
43.8	1733.7	2950.5	973.4	212.8	113.1	61.1	21.7	0.1
38.5	2687.5	1942.8	1007.0	184.8	43.9	50.5	13.1	14.0
32.8	1689.2	1149.4	1089.5	698.4	86.9	36.0	58.9	1.7
30.9	1031.7	403.8	277.6	282.1	159.7	58.2	60.7	6.7
28.2	684.2	274.3	197.6	121.6	74.7	62.8	10.6	19.3
32.8	1259.2	1426.5	268.0	132.6	109.5	75.5	90.0	37.6
31.7	591.9	925.2	396.5	82.0	140.1	82.6	26.1	0.7
32.6	689.3	541.5	503.7	137.6	46.4	49.9	38.4	44.4
39.7	287.3	931.8	570.2	295.7	143.7	37.3	27.7	11.2
23.6	900.7	616.6	122.0	39.0	40.0	18.2	18.4	13.7

FLT03: FRENCH TRAWLERS (EFFORT H*KW*10-4) 1989-90 DERAISED 1991-98 TRUE (Catch: Unknown) (Effort: Unknown)
1989 1998
1 1 0.00 1.00
2 10

6983	1190.1	1635.9	1643.2	466.2	73.5	34.3	34.1	19.3	16.1
8395	698.2	1876.1	1289.5	728.3	153.7	42.6	33.1	46.5	14.4
10689	1938.7	1474.1	1430.0	399.5	255.2	41.0	17.6	11.9	9.9
10519	1802.9	1396.1	370.2	269.4	230.7	143.5	21.2	12.1	11.6
10217	2124.4	1118.2	268.4	56.0	73.4	48.7	32.3	14.3	4.6
10609	1034.2	2271.2	476.4	177.6	69.5	48.2	48.3	32.0	25.0
12384	1354.7	686.5	578.5	95.4	21.4	19.5	27.5	21.8	28.2
14476	1133.3	1283.9	352.7	317.5	98.8	43.6	33.3	34.6	36.9
10921	1396.2	3536.0	1155.4	139.0	170.7	88.3	50.8	22.4	28.2
11707	1446.0	3541.9	1534.4	205.4	29.8	20.2	17.8	6.9	8.2

FLT04: UK BEAM TRAWL SURVEY true age 6 [rev: 31/8/99-RM] (Catch: Unknown) (Effort: Unknown)
1988 1998
1 1 0.50 0.75
1 6

1	26.5	31.3	43.8	7.0	4.6	1.5
1	2.3	12.1	16.6	19.9	3.3	1.5
1	5.2	4.9	5.8	6.7	7.5	1.8
1	11.8	9.1	7.0	5.3	5.4	3.2
1	16.5	12.5	4.2	4.2	5.6	4.9
1	3.2	13.4	5.0	1.7	1.9	1.6
1	8.3	7.5	9.2	5.6	1.9	0.8
1	11.3	4.1	3.0	3.7	1.5	0.6
1	13.2	11.9	1.3	0.7	1.3	0.9
1	33.1	13.5	4.2	0.6	0.3	0.3
1	11.4	27.3	7.0	3.1	0.3	0.2

Table 11.3.1.continued- Plaice in VIId. Tuning input file.

```
FLT05: French GFS [option 2]  true age 5 [rev: 5/10/99-AT] (Catch: Unknown) (Effort: Unknown)
1988 1998
1 1 0.75 1.00
1 5
   1    8.0   17.6    9.9    1.7    0.6
   1    3.5    7.4    2.7    1.1    0.1
   1    3.3    0.9    2.3    1.4    1.3
   1    1.6    0.6    0.4    0.2    0.2
   1   37.7    3.2    0.5    0.2    0.1
   1   10.0    5.4    2.0    0.4    0.2
   1    6.3    2.4    0.9    0.3    0.2
   1    3.9    3.7    1.5    0.9    0.2
   1    5.7    3.3    0.4    0.2    0.2
   1   36.2    7.4    4.6    0.3    0.1
   1   10.6   12.9    2.9    0.5    0.0
FLT06: English YFS [new indices] [rev: 12/10/99-RM] (Catch: Unknown) (Effort: Unknown)
1981 1998
1 1 0.50 0.75
1 1
   1   0.4
   1   0.5
   1   1.1
   1   0.7
   1   1.7
   1   2.1
   1   2.4
   1   1.6
   1   1.5
   1   0.8
   1   0.6
   1   1.5
   1   0.9
   1   0.8
   1   3.3
   1   1.4
   1   0.4
   1   0.4
FLT07: French YFS [rev: 2/10/99-AT] (Catch: Unknown) (Effort: Unknown)
1987 1998
1 1 0.50 0.75
1 1
   1   1.7
   1   1.7
   1   0.5
   1   0.9
   1   0.8
   1   2.4
   1   1.0
   1   1.0
   1   1.0
   1   0.6
   1   1.3
   1   1.2
```

Table 11.3.2

Plaice in Division VIId. Catch per unit effort

Year	United Kingdom Beam trawl (kg/hr)	United Kingdom Inshore trawl (kg/day)	Belgium Beam trawl (kg/hr)	France Otter trawl (kg/(hr*kw*10-4))
1980			24.4	
1981			31.2	
1982			24.5	
1983	21.6		36.2	
1984	18.5		25.9	
1985	19.9	165.3	31.8	
1986	27.7	147.4	34.9	
1987	15.5	178.7	33.7	
1988	8.9	212.8	40.7	
1989	17.6	157.4	42.8	
1990	17.4	117.4	48.8	
1991	18.3	123.0	45.5	181.9
1992	14.2	129.7	34.9	155.6
1993	11.9	105.0	24.2	125.9
1994	11.1	98.2	32.4	136.5
1995	9.3	76.4	25.7	100.8
1996	10.0	86.8	26.2	97.2
1997	13.9	103.2	21.2	183.7
1998	6.1	85.0	25.9	181.9

Plaice in Division VIId. Effort data

Year	United Kingdom Beam trawl(1) ('000 hr)	United Kingdom Inshore trawl ('000 days)	Belgium Beam trawl(1) ('000 hr)	France Otter trawl(1) hr*kw*10-4
1980			29.8	
1981			24.4	
1982			29.8	
1983	2.9		26.4	
1984	2.3		35.4	
1985	7.9	2.520	33.4	
1986	7.3	1.804	30.8	
1987	24.3	2.556	49.3	
1988	19.7	2.500	48.9	
1989	24.6	2.131	43.8	
1990	32.8	1.094	38.5	
1991	29.5	2.349	32.8	10689
1992	35.0	2.527	30.9	10519
1993	29.2	2.503	28.2	10217
1994	26.8	2.635	32.8	10609
1995	28.1	1.531	31.7	12384
1996	37.1	1.659	32.6	14476
1997	36.0	2.024	39.7	10921
1998	34.1	0.733	23.6	11707

1. Corrected for HP

Table 11.3.3.- Plaice in Division VIId. English beam trawl survey numbers per hr raised to 8m beam trawl equivalent (mean no/rectangle, average across rectangles).

Age	1	2	3	4	5	6	7	8	9	10+	1+	3+
1988	26.5	31.3	43.8	7.0	4.6	1.5	0.8	0.7	0.6	1.2	117.9	60.1
1989	2.3	12.1	16.6	19.9	3.3	1.5	1.3	0.5	0.3	1.7	59.6	45.2
1990	5.2	4.9	5.8	6.7	7.5	1.8	0.7	1.0	0.8	0.4	34.5	24.5
1991	11.8	9.1	7.0	5.3	5.4	3.2	1.2	1.0	0.1	1.2	45.2	24.4
1992	16.5	12.5	4.2	4.2	5.6	4.9	3.4	0.7	0.5	0.7	53.2	24.1
1993	3.2	13.4	5.0	1.7	1.9	1.6	2.0	2.8	0.4	0.6	32.6	15.9
1994	8.3	7.5	9.2	5.6	1.9	0.8	0.9	1.8	1.2	0.8	38.0	22.2
1995	11.3	4.1	3.0	3.7	1.5	0.6	0.6	1.3	0.8	0.8	27.6	12.3
1996	13.2	11.9	1.3	0.7	1.3	0.9	0.4	0.3	0.4	2.8	33.3	8.1
1997	33.1	13.5	4.2	0.6	0.3	0.3	0.2	0.2	0.2	1.9	54.6	8.0
1998	11.4	27.3	7.0	3.1	0.3	0.2	0.2	0.1	1.0	1.0	51.6	11.9
1999	12.4	15.8	17.5	3.3	1.1	0.2	0.1	0.3	0.1	0.8	51.5	23.3

Table 11.3.4.- Plaice in division VIId. Survey indices of recruitment

	English YFS		English BTS			French YFS		French CGFS		
Year class	0 gp	1 gp	1 gp	2 gp	3 gp	0 gp	1 gp	0 gp	1 gp	2 gp
1978						-	0.50			
1979						8.40	0.77			
1980		0.36				2.53	0.09	-		
1981	3.37	0.45				11.97	0.54	-		
1982	2.45	1.14				3.37	0.07	-		
1983	14.47	0.73				5.47	-	-		
1984	6.29	1.71				-	-	-		
1985	10.90	2.08			43.75	-	-	-		
1986	20.14	2.38		31.33	16.63	-	1.75	-	-	26.46
1987	22.33	1.61	26.47	12.13	5.76	9.82	1.74	-	10.33	8.79
1988	12.98	1.47	2.31	4.86	6.98	2.50	0.49	0.19	4.08	1.27
1989	3.71	0.76	5.16	9.06	4.19	5.36	0.87	0.16	3.95	0.91
1990	6.45	0.64	11.75	12.54	4.96	2.34	0.77	0.16	1.95	6.05
1991	2.68	1.45	16.53	13.40	9.17	6.83	2.35	0.15	33.61	6.79
1992	4.27	0.85	3.22	7.46	3.00	4.95	1.00	0.98	11.68	3.45
1993	7.64	0.83	8.33	4.06	1.30	2.00	0.96	2.41	9.02	4.32
1994	17.23	3.27	11.32	11.90	4.20	5.47	1.03	7.39	5.07	4.59
1995	12.04	1.42	13.20	13.50	7.00	6.42	0.61	0.77	6.84	8.57
1996	2.38	0.42	33.10	27.30	17.50	6.40	1.28	21.13	37.56	13.61
1997	2.38	0.39	11.40	15.77		3.07	1.22	9.83	10.74	
1998	7.19		12.44			5.36	0.38	5.59		
1999						3.00				

Table 11.4.1.- Plaice in Division VIId. Separable VPA.

```
Title : 107D PLAICE 1999 WG,1-15+,80-98,SEXES COMB [rev: 2/10/99-AT] At  6/10/1999  14:41
Separable analysis from 1980 to 1998 on ages  1 to 14
with Terminal F of  .500 on age  3 and Terminal S of  .700
Initial sum of squared residuals was   532.250 and
final sum of squared residuals is    282.638 after  94 iterations


Matrix of Residuals
       Years,    1980/81,1981/82,1982/83,1983/84,1984/85,1985/86,1986/87,1987/88,
       Ages
       1/ 2,    -1.938, -2.993, -1.165, -1.179, -1.825, -2.422,  -.793, -3.779,
       2/ 3,     -.201,  -.760,  -.751,  -.276, -1.471,  -.257,   .139,  -.478,
       3/ 4,     -.284,   .429,  -.338,   .149,  -.500,  -.081,   .736,   .166,
       4/ 5,      .468,   .461,   .371,   .794,   .586,   .199,   .722,   .481,
       5/ 6,      .851,  -.443,   .215,   .126,  -.294, -1.438,   .759,   .097,
       6/ 7,      .460,   .098,   .191,  -.096,   .188,   .127,   .136,  -.385,
       7/ 8,      .170,  -.571,  -.825,  -.114,  -.086,   .142,   .424,   .914,
       8/ 9,     -.206,   .256,  2.093,  1.203, -1.333,   .860,  -.561,  -.010,
       9/10,    -2.342,   .678,   .271, -1.607,  -.151,  1.326,  -.544,  -.163,
      10/11,     1.296,   .514,  -.273,  -.539,  1.441,  4.425,  1.821,  -.422,
      11/12,    -1.563,  -.260,  -.113,  -.089,  4.111,  2.173, -5.733, -1.512,
      12/13,      .538,  1.720,   .351,   .527,  4.274,  -.612, -2.964,  3.056,
      13/14,     -.330,   .142,  -.467, -1.117,  -.890, -4.992, -3.263,   .186,
       TOT ,      .002,   .001,   .001,   .001,   .001,   .000,   .000,   .000,
       WTS ,      .001,   .001,   .001,   .001,   .001,   .001,   .001,   .001,

      Years,    1988/89,1989/90,1990/91,1991/92,1992/93,1993/94,1994/95,1995/96,1996/97,1997/98,        TOT,         WTS,
       1/ 2,    -3.845,   .342,  -.054,  -.172,  -.472,   .081,  -.070,   .811,   .439, -1.242,       -.002,        .181,
       2/ 3,     -.031,  -.680,  -.824,   .205,   .296,   .534,   .154,   .400,   .087, -1.172,       -.002,        .455,
       3/ 4,      .416,  -.269,  -.123,   .419,   .455,   .063,   .187,   .259,  -.103,  -.410,       -.002,        .735,
       4/ 5,     -.058,   .103,  -.313,   .185,  -.072,  -.133,   .120,  -.066,  -.175,   .248,       -.001,        .799,
       5/ 6,     -.092,   .303,  -.482,  -.357,  -.383,  -.349,   .141,  -.227,   .071,   .364,        .000,        .495,
       6/ 7,      .292,   .406,   .235,   .109,   .241,   .183,  -.348,  -.229,  -.121,   .514,        .001,       1.000,
       7/ 8,      .594,  -.088,  -.048,  -.373,   .025,   .034,  -.400,   .016,  -.239,   .591,        .001,        .596,
       8/ 9,      .093,  -.479,  -.214,  -.748,  -.249,  -.203,  -.001,  -.185,   .255,   .135,        .001,        .339,
       9/10,      .299,  -.301,   .650,   .371,   .158,  -.299,   .279,  -.541,   .485,   .078,        .001,        .305,
      10/11,      .904,  -.526,   .558,  -.099, -1.054,  -.600,   .631,  -.261,   .608,  -.386,       -.001,        .201,
      11/12,     -.517,  -.374,   .596,  -.329,  -.531,  -.023,   .185,  -.273,   .381,  -.267,       -.002,        .137,
      12/13,    -1.173,  1.022,   .340,   .035,  -.021,  -.337,  -.119,  1.053,   .042,  -.649,       -.002,        .164,
      13/14,    -1.163,   .618,  2.297,  -.176,  -.414,   .665,   .049,   .051,  -.549,  -.209,       -.002,        .166,
       TOT ,     -.001,  -.001,  -.001,  -.001,  -.001,  -.001,  -.001,  -.001,  -.001,   .000,     -18.460,
       WTS ,      .001,   .001,   .001,   .001,   .001,  1.000,  1.000,  1.000,  1.000,  1.000,

Fishing Mortalities (F)
,    1980,   1981,   1982,   1983,   1984,   1985,   1986,   1987,   1988,
F-values,   .2635,  .4271,  .4624,  .4039,  .6571,  .4312,  .3147,  .4367,  .5013,
,    1989,   1990,   1991,   1992,   1993,   1994,   1995,   1996,   1997,   1998,
F-values,   .6332,  .7665,  .6986,  .6182,  .4387,  .5997,  .4929,  .5245,  .8452,  .5000,
Selection-at-age (S)
,       1,      2,      3,      4,
S-values,   .1034,  .5303, 1.0000, 1.2490,
,       5,      6,      7,      8,      9,     10,     11,     12,     13,     14,
S-values,  1.0786,  .7565,  .7129,  .6811,  .5967,  .6829,  .5785,  .4706,  .4602,  .7000,
```

Table 11.4.2.- Plaice in Division VIId. Tuning diagnostics.

Lowestoft VPA Version 3.1

15/10/1999 19:28

Extended Survivors Analysis

Plaice in VIId (run: TUNATT01/T01)

CPUE data from file fleet

Catch data for 19 years. 1980 to 1998. Ages 1 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT01: UK INSHORE TR,	1988,	1998,	2,	9,	.000,	1.000
FLT02: BELGIAN BEAM ,	1988,	1998,	3,	9,	.000,	1.000
FLT03: FRENCH TRAWLE,	1989,	1998,	2,	9,	.000,	1.000
FLT04: UK BEAM TRAWL,	1988,	1998,	1,	6,	.500,	.750
FLT05: French GFS [o,	1988,	1998,	1,	5,	.750,	1.000
FLT06: English YFS [,	1988,	1998,	1,	1,	.500,	.750
FLT07: French YFS [r,	1988,	1998,	1,	1,	.500,	.750

Time series weights :

Tapered time weighting not applied

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 >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

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 = .00014

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 29,	.0254,	.1909,	.7401,	.7910,	.8506,	.5576,	.3884,	.3961,	.4102
Iteration 30,	.0254,	.1909,	.7401,	.7910,	.8506,	.5576,	.3884,	.3961,	.4101

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities

Age,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1,	.055,	.095,	.077,	.064,	.061,	.078,	.109,	.044,	.019,	.025
2,	.174,	.220,	.505,	.440,	.409,	.414,	.378,	.271,	.209,	.191
3,	.452,	.701,	.828,	.803,	.472,	.718,	.611,	.548,	.713,	.740
4,	.738,	.740,	.870,	.601,	.486,	.785,	.669,	.676,	1.462,	.791
5,	.838,	.616,	.680,	.515,	.337,	.629,	.495,	.726,	1.366,	.851
6,	.569,	.571,	.578,	.619,	.347,	.419,	.301,	.469,	.960,	.558
7,	.407,	.431,	.362,	.445,	.361,	.365,	.478,	.363,	.991,	.388
8,	.356,	.496,	.348,	.411,	.294,	.485,	.433,	.563,	.772,	.396
9,	.670,	.635,	.502,	.589,	.338,	.449,	.378,	.577,	.778,	.410

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9
1989	1.63E+04	2.40E+04	2.09E+04	1.90E+04	4.95E+03	1.42E+03	9.06E+02	6.28E+02	1.74E+02
1990	1.89E+04	1.40E+04	1.82E+04	1.20E+04	8.24E+03	1.94E+03	7.30E+02	5.46E+02	3.98E+02
1991	2.18E+04	1.55E+04	1.02E+04	8.18E+03	5.19E+03	4.03E+03	9.90E+02	4.29E+02	3.01E+02
1992	2.81E+04	1.83E+04	8.48E+03	4.02E+03	3.10E+03	2.38E+03	2.04E+03	6.24E+02	2.74E+02
1993	1.32E+04	2.38E+04	1.07E+04	3.44E+03	1.99E+03	1.68E+03	1.16E+03	1.19E+03	3.74E+02
1994	1.73E+04	1.13E+04	1.43E+04	6.02E+03	1.91E+03	1.29E+03	1.07E+03	7.31E+02	8.00E+02
1995	2.65E+04	1.45E+04	6.74E+03	6.31E+03	2.48E+03	9.23E+02	7.66E+02	6.74E+02	4.07E+02
1996	2.73E+04	2.15E+04	8.98E+03	3.31E+03	2.93E+03	1.37E+03	6.18E+02	4.30E+02	3.95E+02
1997	3.00E+04	2.36E+04	1.48E+04	4.70E+03	1.52E+03	1.28E+03	7.76E+02	3.89E+02	2.22E+02
1998	1.95E+04	2.66E+04	1.73E+04	6.58E+03	9.85E+02	3.52E+02	4.44E+02	2.60E+02	1.62E+02

Estimated population abundance at 1st Jan 1999

0.00E+00	1.72E+04	1.99E+04	7.49E+03	2.70E+03	3.81E+02	1.82E+02	2.73E+02	1.59E+02

Taper weighted geometric mean of the VPA populations:

2.35E+04	2.06E+04	1.36E+04	6.24E+03	2.48E+03	1.17E+03	6.41E+02	3.57E+02	1.63E+02

Standard error of the weighted Log(VPA populations) :

.3515	.3617	.4498	.5243	.5450	.6609	.6689	.7017	1.1573

Log catchability residuals.

Fleet : FLT01: UK INSHORE TR

Age	1988
1	No data for this fleet at this age
2	.11
3	.24
4	-.14
5	.25
6	.07
7	-.20
8	-.55
9	.01

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	-1.67	-.76	.45	.40	.17	.30	.23	.50	.32	-.03
3	-.37	-.34	.45	.53	-.05	-.01	.02	-.48	.15	-.16
4	.66	-.39	.44	.79	.16	.08	-.08	-.68	-.72	-.12
5	.46	-.01	.01	.40	.11	.17	-.09	-.44	-.63	-.23
6	.70	.23	.02	.33	-.04	-.15	-.24	-.47	-.37	-.09
7	.45	.42	-.33	.33	.15	-.06	-.35	-.96	.05	.53
8	-.45	.42	-.41	.39	.25	-.27	-.15	-.30	.15	.00
9	-.55	.38	-.70	-.32	.34	.32	-.02	-.42	.16	.29

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
Mean Log q	-12.0901	-11.5761	-11.6481	-11.6246	-11.5908	-11.7365	-11.7365	-11.7365
S.E(Log q)	.6514	.3283	.4964	.3353	.3336	.4470	.3567	.3934

Regression statistics :

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	1.43	-.422	13.04	.10	11	.97	-12.09
3	1.08	-.364	11.75	.67	11	.37	-11.58
4	.81	.811	11.10	.67	11	.41	-11.65
5	.82	1.318	10.95	.85	11	.26	-11.62
6	.87	.876	11.01	.83	11	.29	-11.59
7	.90	.284	11.26	.49	11	.42	-11.74
8	.81	.921	10.74	.72	11	.28	-11.82
9	.81	.868	10.61	.69	11	.32	-11.78

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Fleet : FLT02: BELGIAN BEAM

Age	1988
1	No data for this fleet at this age
2	No data for this fleet at this age
3	-.10
4	-.53
5	-.95
6	-.86
7	-.33
8	-.21
9	-.35

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-.32	.50	.83	.57	-.12	.15	.14	-.06	-1.56	-.04
4	-.15	.02	.10	-.29	-.48	.59	.09	.17	.49	-.01
5	.11	-.33	.40	-.47	-.36	-.03	.07	.22	1.06	.27
6	.06	-.26	.50	.20	-.33	-.09	-.26	-.09	.76	.37
7	-.03	-.62	-.11	-.13	-.27	.04	.71	-.26	.72	.26
8	-.30	-.16	-.16	.03	-.49	.11	.29	.27	-.03	.01
9	.09	-1.13	.76	.98	-1.10	.18	-.38	.10	.24	.50

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-5.6900	-5.1058	-5.0827	-5.4231	-5.5922	-5.5922	-5.5922
S.E(Log q)	.6213	.3531	.5277	.4485	.4184	.2447	.6807

Regression statistics :

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
3	1.44	-.777	3.99	.26	11	.91	-5.69
4	1.09	-.399	4.76	.67	11	.40	-5.11
5	1.32	-.864	4.17	.45	11	.71	-5.08
6	1.02	-.080	5.39	.64	11	.48	-5.42
7	1.38	-.817	5.13	.33	11	.59	-5.59
8	1.18	-.843	5.54	.71	11	.28	-5.65
9	1.87	-.970	5.48	.12	11	1.28	-5.60

Fleet : FLT03: FRENCH TRAWLE

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	-.04	-.19	.61	.36	.28	.27	.12	-.66	-.29	-.46
3	-.24	-.04	.12	.25	-.32	.17	-.48	-.32	.54	.33
4	.08	.11	.42	-.32	-.51	-.40	-.46	-.46	.97	.58
5	.62	.28	-.07	-.01	-1.19	.10	-1.00	-.01	.36	.91
6	.21	.46	-.01	.45	-.44	-.23	-1.28	-.23	.88	.18
7	.09	.35	-.26	.32	-.20	-.17	-.84	-.03	1.00	-.25
8	.43	.42	-.28	-.42	-.67	.27	-.39	.15	1.05	.16
9	1.28	1.14	-.25	-.08	-.31	-.25	-.15	.28	.79	-.31

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
Mean Log q	-11.6828	-10.8951	-10.9918	-11.4055	-11.7098	-11.9757	-11.9757	-11.9757
S.E(Log q)	.4001	.3335	.5200	.6530	.5973	.4892	.5203	.6659

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Regression statistics :

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,	2.89,	-1.524,	15.17,	.08,	10,	1.08,	-11.68,
3,	.75,	1.130,	10.53,	.72,	10,	.25,	-10.90,
4,	.78,	.894,	10.50,	.67,	10,	.41,	-10.99,
5,	1.02,	-.050,	11.47,	.48,	10,	.71,	-11.41,
6,	.87,	.449,	11.14,	.60,	10,	.55,	-11.71,
7,	.85,	.406,	11.22,	.49,	10,	.44,	-11.98,
8,	2.65,	-1.639,	21.14,	.11,	10,	1.25,	-11.90,
9,	1.68,	-.909,	15.86,	.18,	10,	1.06,	-11.76,

Fleet : FLT04: UK BEAM TRAWL

Age	1988
1	.15
2	.57
3	.84
4	.15
5	.75
6	.17
7	No data for this fleet at this age
8	No data for this fleet at this age
9	No data for this fleet at this age

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.27	-.10	.06	-.07	.07	.16	-.14	-.13	.12	.15
2	-.23	-.57	.12	.24	.03	.20	-.68	-.08	-.09	.49
3	.41	-.35	.50	.16	-.10	.37	-.07	-1.23	-.46	-.09
4	.66	.03	.27	.58	-.24	.58	.04	-.97	-.99	-.10
5	.01	.18	.35	.80	.05	.28	-.30	-.47	-.89	-.77
6	.34	.22	.07	1.05	.11	-.28	-.30	-.19	-.92	-.28
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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
Mean Log q,	-7.1897,	-7.2067,	-7.0038,	-6.7363,	-6.7840,
S.E(Log q),	.3913,	.5624,	.5660,	.5602,	.4932,

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.38,	3.386,	9.08,	.77,	11,	.16,	-7.59,

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,	.63,	1.532,	8.18,	.66,	11,	.23,	-7.19,
3,	.66,	1.567,	7.99,	.70,	11,	.35,	-7.21,
4,	.64,	1.919,	7.64,	.76,	11,	.32,	-7.00,
5,	.68,	1.783,	7.12,	.77,	11,	.34,	-6.74,
6,	.73,	1.548,	6.92,	.78,	11,	.34,	-6.78,

Fleet : FLT05: French GFS [o

Age	1988
1	-.17
2	1.03
3	.73
4	.69
5	1.02
6	No data for this fleet at this age
7	No data for this fleet at this age
8	No data for this fleet at this age
9	No data for this fleet at this age

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.29	-.46	-1.18	1.04	.74	.12	-.66	-.43	.91	.38
2	.30	-1.23	-1.49	-.04	.20	.14	.29	-.31	.35	.77
3	-.08	.11	-.94	-.56	.31	-.57	.60	-1.06	1.02	.43
4	-.26	.44	-1.01	-.53	.22	-.37	.58	-.27	.47	.06
5	-1.12	.75	-.61	-.93	.05	.35	-.03	.00	.52	99.99
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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
Mean Log q	-8.1442	-8.3916	-8.7638	-8.8749
S.E(Log q)	.7625	.6995	.5342	.7047

Regression statistics :
Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.79	.244	8.32	.13	11	.74	-7.86

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	.41	2.151	9.17	.59	11	.27	-8.14
3	.64	1.340	8.80	.61	11	.43	-8.39
4	.92	.263	8.77	.56	11	.52	-8.76
5	1.47	-.688	9.27	.21	10	1.07	-8.87

Fleet : FLT06: English YFS [

Age	1988
1	.79
2	No data for this fleet at this age
3	No data for this fleet at this age
4	No data for this fleet at this age
5	No data for this fleet at this age
6	No data for this fleet at this age
7	No data for this fleet at this age
8	No data for this fleet at this age
9	No data for this fleet at this age

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	1.20	-.29	-1.11	.68	.28	-.23	2.57	.52	-2.42	-1.98
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	2.24	-.693	9.78	.03	11	1.51	-9.89

Fleet : FLT07: French YFS [r

Age	1988
1	.49
2	No data for this fleet at this age
3	No data for this fleet at this age
4	No data for this fleet at this age
5	No data for this fleet at this age
6	No data for this fleet at this age
7	No data for this fleet at this age
8	No data for this fleet at this age
9	No data for this fleet at this age

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.80	-.03	-.37	1.01	.45	.20	-.20	-1.05	-.01	.30
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.49	-.662	9.79	.17	11	.62	-9.85

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1997

Fleet	Estimated Survivors	Int, s.e	Ext, s.e	Var, Ratio	N	Scaled, Weights	Estimated F
FLT01: UK INSHORE TR	1.	.000	.000	.00	0	.000	.000
FLT02: BELGIAN BEAM	1.	.000	.000	.00	0	.000	.000
FLT03: FRENCH TRAWLE	1.	.000	.000	.00	0	.000	.000
FLT04: UK BEAM TRAWL	19950.	.300	.000	.00	1	.406	.022
FLT05: French GFS [o	25101.	.780	.000	.00	1	.060	.017
FLT06: English YFS [	2377.	1.721	.000	.00	1	.012	.170
FLT07: French YFS [r	23280.	.655	.000	.00	1	.085	.019
P shrinkage mean	20583.	.36,,,,				.286	.021
F shrinkage mean	6868.	.50,,,,				.150	.062

Weighted prediction :

Survivors, at end of year	Int, s.e	Ext, s.e	N	Var, Ratio	F
17168.	.19	.22	6	1.121	.025

Age 2 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
FLT01: UK INSHORE TR	19406.	.680	.000	.00	1	.062	.195
FLT02: BELGIAN BEAM	1.	.000	.000	.00	0	.000	.000
FLT03: FRENCH TRAWLE	12612.	.420	.000	.00	1	.162	.287
FLT04: UK BEAM TRAWL	25531.	.242	.178	.73	2	.482	.152
FLT05: French GFS [o	45653.	.586	.070	.12	2	.082	.088
FLT06: English YFS [	1773.	1.722	.000	.00	1	.009	1.212
FLT07: French YFS [r	19617.	.659	.000	.00	1	.065	.193
F shrinkage mean	10437.	.50,,,,				.138	.337

Weighted prediction :

Survivors, at end of year	Int, s.e	Ext, s.e	N	Var, Ratio	F
19902.	.17	.18	9	1.055	.191

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Age 3 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
FLT01: UK INSHORE TR,	6938.,	.307,	.178,	.58,	2,	.182,	.781
FLT02: BELGIAN BEAM ,	7206.,	.649,	.000,	.00,	1,	.042,	.760
FLT03: FRENCH TRAWLE,	8314.,	.270,	.299,	1.11,	2,	.226,	.687
FLT04: UK BEAM TRAWL,	6722.,	.225,	.015,	.07,	3,	.290,	.798
FLT05: French GFS [o,	8746.,	.446,	.266,	.60,	3,	.078,	.662
FLT06: English YFS [,	12604.,	1.599,	.000,	.00,	1,	.005,	.502
FLT07: French YFS [r,	2622.,	.697,	.000,	.00,	1,	.028,	1.418
F shrinkage mean ,	9661.,	.50,,,,				.148,	.615

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7488.,	.14,	.08,	14,	.605,	.740

Age 4 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
FLT01: UK INSHORE TR,	2876.,	.283,	.134,	.47,	3,	.168,	.756
FLT02: BELGIAN BEAM ,	2163.,	.331,	.531,	1.61,	2,	.164,	.918
FLT03: FRENCH TRAWLE,	3595.,	.261,	.360,	1.38,	3,	.183,	.644
FLT04: UK BEAM TRAWL,	2300.,	.232,	.070,	.30,	4,	.197,	.881
FLT05: French GFS [o,	3015.,	.383,	.275,	.72,	4,	.101,	.732
FLT06: English YFS [,	35093.,	1.822,	.000,	.00,	1,	.002,	.089
FLT07: French YFS [r,	2215.,	.652,	.000,	.00,	1,	.015,	.903
F shrinkage mean ,	2562.,	.50,,,,				.170,	.819

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2698.,	.14,	.10,	19,	.716,	.791

Age 5 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
FLT01: UK INSHORE TR,	284.,	.282,	.095,	.34,	4,	.283,	1.029
FLT02: BELGIAN BEAM ,	525.,	.363,	.097,	.27,	3,	.145,	.680
FLT03: FRENCH TRAWLE,	647.,	.350,	.314,	.90,	4,	.124,	.582
FLT04: UK BEAM TRAWL,	197.,	.330,	.199,	.60,	5,	.150,	1.279
FLT05: French GFS [o,	425.,	.375,	.340,	.90,	4,	.035,	.790
FLT06: English YFS [,	302.,	1.587,	.000,	.00,	1,	.001,	.990
FLT07: French YFS [r,	465.,	.652,	.000,	.00,	1,	.005,	.742
F shrinkage mean ,	490.,	.50,,,,				.256,	.714

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
381.,	.17,	.11,	23,	.610,	.851

Age 6 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
FLT01: UK INSHORE TR,	149.,	.259,	.119,	.46,	5,	.315,	.649
FLT02: BELGIAN BEAM ,	279.,	.340,	.148,	.44,	4,	.179,	.397
FLT03: FRENCH TRAWLE,	193.,	.383,	.149,	.39,	5,	.120,	.533
FLT04: UK BEAM TRAWL,	130.,	.344,	.138,	.40,	6,	.160,	.718
FLT05: French GFS [o,	230.,	.374,	.198,	.53,	5,	.032,	.464
FLT06: English YFS [,	240.,	1.581,	.000,	.00,	1,	.000,	.449
FLT07: French YFS [r,	286.,	.652,	.000,	.00,	1,	.003,	.389
F shrinkage mean ,	209.,	.50,,,,				.191,	.501

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
182.,	.16,	.07,	28,	.445,	.558

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	289.,	.246,	.199,	.81,	6,	.295,	.370
FLT02: BELGIAN BEAM ,	384.,	.294,	.109,	.37,	5,	.246,	.290
FLT03: FRENCH TRAWLE,	267.,	.343,	.189,	.55,	6,	.177,	.395
FLT04: UK BEAM TRAWL,	161.,	.289,	.193,	.67,	6,	.085,	.591
FLT05: French GFS [o,	339.,	.384,	.203,	.53,	5,	.024,	.323
FLT06: English YFS [,	536.,	1.609,	.000,	.00,	1,	.000,	.216
FLT07: French YFS [r,	747.,	.757,	.000,	.00,	1,	.001,	.160
F shrinkage mean ,	193.,	.50,,,,				.173,	.514

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
273.,	.15,	.08,	31,	.552,	.388

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	147.,	.231,	.071,	.31,	7,	.295,	.420
FLT02: BELGIAN BEAM ,	177.,	.230,	.115,	.50,	6,	.354,	.361
FLT03: FRENCH TRAWLE,	197.,	.318,	.206,	.65,	7,	.149,	.330
FLT04: UK BEAM TRAWL,	148.,	.267,	.114,	.43,	6,	.047,	.420
FLT05: French GFS [o,	134.,	.381,	.162,	.43,	5,	.014,	.453
FLT06: English YFS [,	52.,	1.620,	.000,	.00,	1,	.000,	.906
FLT07: French YFS [r,	110.,	.661,	.000,	.00,	1,	.001,	.531
F shrinkage mean ,	116.,	.50,,,,				.139,	.511

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
159.,	.14,	.06,	34,	.415,	.396

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	103.,	.204,	.147,	.72,	8,	.356,	.393
FLT02: BELGIAN BEAM ,	96.,	.209,	.113,	.54,	7,	.272,	.414
FLT03: FRENCH TRAWLE,	101.,	.288,	.260,	.90,	8,	.158,	.399
FLT04: UK BEAM TRAWL,	87.,	.278,	.105,	.38,	6,	.048,	.449
FLT05: French GFS [o,	103.,	.375,	.238,	.63,	5,	.015,	.391
FLT06: English YFS [,	73.,	1.586,	.000,	.00,	1,	.000,	.519
FLT07: French YFS [r,	95.,	.654,	.000,	.00,	1,	.001,	.420
F shrinkage mean ,	87.,	.50,,,,				.150,	.449

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
98.,	.13,	.07,	37,	.520,	.410

Table 11.4.3.- Plaice in Division VIId. F at age.

Run title : Plaice in VIId (run: TUNATT01/T01)

At 15/10/1999 19:34

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE									
1	.0022	.0013	.0111	.0049	.0148	.0050	.0119	.0008	.0006
2	.1674	.1181	.1347	.1519	.1158	.3130	.2124	.1807	.2055
3	.2789	.7290	.4967	.4555	.5754	.5962	.6933	.5143	.6626
4	.3369	.8857	.8586	.9364	.8231	.8539	.7608	.7890	.6636
5	.6175	.2715	.6938	.5512	.7844	.2322	.5889	.5662	.5577
6	.4143	.3658	.2809	.3978	.6259	.5620	.4994	.3030	.4498
7	.3990	.4874	.3491	.1744	.8297	.3508	.4245	.8280	.5097
8	.2537	.7046	1.8575	.8838	.2630	.9145	.2174	.4375	.5263
9	.3567	.5212	.8332	.4871	.5751	.6116	.3816	.5248	.5337
+gp	.3567	.5212	.8332	.4871	.5751	.6116	.3816	.5248	.5337
FBAR 2- 6	.3630	.4740	.4929	.4986	.5849	.5115	.5510	.4706	.5078
FBAR 3- 6	.4119	.5630	.5825	.5852	.7022	.5611	.6356	.5431	.5834

Table 8 Fishing mortality (F) at age

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98
AGE											
1	.0546	.0953	.0771	.0644	.0606	.0784	.1087	.0441	.0195	.0254	.0296
2	.1737	.2199	.5053	.4399	.4094	.4138	.3781	.2708	.2093	.1909	.2237
3	.4521	.7014	.8285	.8026	.4723	.7179	.6112	.5481	.7129	.7401	.6670
4	.7379	.7403	.8703	.6007	.4861	.7846	.6688	.6758	1.4620	.7910	.9762
5	.8384	.6158	.6805	.5147	.3368	.6294	.4948	.7256	1.3663	.8506	.9808
6	.5691	.5708	.5779	.6190	.3472	.4188	.3009	.4691	.9595	.5576	.6621
7	.4067	.4310	.3620	.4447	.3610	.3651	.4780	.3632	.9915	.3884	.5810
8	.3561	.4958	.3483	.4111	.2936	.4847	.4326	.5627	.7724	.3961	.5771
9	.6699	.6351	.5023	.5889	.3377	.4485	.3782	.5774	.7783	.4101	.5886
+gp	.6699	.6351	.5023	.5889	.3377	.4485	.3782	.5774	.7783	.4101	
FBAR 2- 6	.5543	.5696	.6925	.5954	.4104	.5929	.4908	.5379	.9420	.6260	
FBAR 3- 6	.6494	.6571	.7393	.6343	.4106	.6377	.5189	.6046	1.1252	.7348	

Table 11.4.4.- Plaice in Division VIId. N at age.

Run title : Plaice in VIId (run: TUNATT01/T01)

At 15/10/1999 19:34

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE									
1	25559	12862	25252	19983	25067	29800	60448	31361	26520
2	18032	23076	11622	22597	17994	22349	26829	54050	28353
3	6267	13801	18554	9191	17564	14502	14787	19630	40822
4	1985	4290	6024	10216	5274	8939	7229	6689	10620
5	1118	1282	1601	2310	3624	2095	3444	3057	2750
6	232	546	884	724	1204	1497	1503	1729	1570
7	144	139	342	604	440	583	772	825	1156
8	206	87	77	219	459	174	371	457	326
9	14	145	39	11	82	319	63	270	267
+gp	360	515	162	274	239	114	112	197	440
TOTAL	53917	56744	64559	66129	71948	80372	115558	118266	112824

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

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	GMST 80-96	AMST 80-96
AGE													
1	16333	18879	21837	28054	13234	17321	26463	27298	29998	19461(*)	0(**)	23441	25075
2	23981	13993	15530	18292	23801	11271	14492	21480	23635	26620	17168(***)	20109	21632
3	20888	18239	10162	8478	10661	14301	6742	8984	14825	17347	19902	13344	14916
4	19042	12026	8184	4016	3438	6015	6312	3311	4699	6576	7488	6323	7271
5	4949	8238	5190	3101	1993	1913	2484	2926	1524	985	2698	2697	3063
6	1424	1936	4026	2378	1677	1287	923	1370	1281	352	381	1248	1465
7	906	730	990	2044	1159	1072	766	618	776	444	182	647	782
8	628	546	429	624	1186	731	674	430	389	260	273	362	448
9	174	398	301	274	374	800	407	395	222	162	159	160	255
+gp	422	514	331	277	556	904	858	827	591	585	449		
TOTAL	88747	75496	66980	67538	58077	55615	60120	67639	77940	72794	48699		

* replaced by RCT3 (21157)
** replaced by RCT3 (23757)
*** replaced by RCT3 (18015)

Table 11.5.1.- Plaice in Division VIId. RCT3 input files.

7D PLAICE - VPA AGE 1 / indices all * per 100

7	19	2						
'YEARCLASS'	'VPA'	'eyfs0'	'eyfs1'	'fyfs0'	'fyfs1'	'ebt1'	'fbt0'	'fbt1'
1981	25252	337	45	1197	54	-11	-11	-11
1982	19983	245	114	337	7	-11	-11	-11
1983	25067	1447	73	547	-11	-11	-11	-11
1984	29800	629	171	-11	-11	-11	-11	-11
1985	60448	1090	208	-11	-11	-11	-11	-11
1986	31361	2014	238	-11	175	-11	-11	-11
1987	26520	2233	161	982	174	2647	-11	1033
1988	16333	1298	147	250	49	231	19	408
1989	18879	371	76	536	87	516	16	395
1990	21837	645	64	234	77	1175	16	195
1991	28054	268	145	683	235	1653	15	3361
1992	13234	427	85	495	100	322	98	1168
1993	17321	764	83	200	96	833	241	902
1994	26463	1723	327	547	103	1132	739	507
1995	27298	1204	142	642	61	1320	77	684
1996	-11	238	42	640	128	3310	2113	3756
1997	-11	238	39	307	122	1140	983	1074
1998	-11	719	-11	536	38	1244	559	-11
1999	-11	-11	-11	300	-11	-11	-11	-11

7D PLAICE - VPA AGE 2 / indices all * per 100

7	19	2						
'YEARCLASS'	'VPA'	'eyfs0'	'eyfs1'	'fyfs0'	'fyfs1'	'ebt1'	'fbt0'	'fbt1'
1981	22597	337	45	1197	54	-11	-11	-11
1982	17994	245	114	337	7	-11	-11	-11
1983	22349	1447	73	547	-11	-11	-11	-11
1984	26829	629	171	-11	-11	-11	-11	-11
1985	54050	1090	208	-11	-11	-11	-11	-11
1986	28353	2014	238	-11	175	-11	-11	-11
1987	23981	2233	161	982	174	2647	-11	1033
1988	13993	1298	147	250	49	231	19	408
1989	15530	371	76	536	87	516	16	395
1990	18292	645	64	234	77	1175	16	195
1991	23801	268	145	683	235	1653	15	3361
1992	11271	427	85	495	100	322	98	1168
1993	14492	764	83	200	96	833	241	902
1994	21480	1723	327	547	103	1132	739	507
1995	23635	1204	142	642	61	1320	77	684
1996	-11	238	42	640	128	3310	2113	3756
1997	-11	238	39	307	122	1140	983	1074
1998	-11	719	-11	536	38	1244	559	-11
1999	-11	-11	-11	300	-11	-11	-11	-11

Table 11.5.2.- Plaice in Division VIId. RCT3 output.

Analysis by RCT3 ver3.1 of data from file : rct_1_01.csv
7D PLAICE - VPA AGE 1 / indices all * per 100,,,,,,,,
Data for 7 surveys over 19 years : 1981 - 1999
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1996

	Regression				Prediction				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
eyfs0	1.52	.01	1.11	.098	15	5.48	8.32	1.332	.016
eyfs1	1.35	3.60	.66	.233	15	3.76	8.69	.823	.041
fyfs0	.75	5.35	.36	.335	12	6.46	10.19	.412	.162
fyfs1	.93	5.92	.80	.105	12	4.86	10.44	.926	.032
ebt1	.40	7.28	.17	.751	9	8.11	10.49	.230	.522
fbt0	4.34	-7.68	6.78	.002	8	7.66	25.52	11.087	.000
fbt1	1.80	-1.84	1.54	.034	9	8.23	12.98	2.235	.006
					VPA Mean =		10.10	.353	.221

Yearclass = 1997

	Regression				Prediction				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
eyfs0	1.52	.01	1.11	.098	15	5.48	8.32	1.332	.013
eyfs1	1.35	3.60	.66	.233	15	3.69	8.59	.835	.034
fyfs0	.75	5.35	.36	.335	12	5.73	9.64	.419	.136
fyfs1	.93	5.92	.80	.105	12	4.81	10.40	.923	.028
ebt1	.40	7.28	.17	.751	9	7.04	10.07	.201	.591
fbt0	4.34	-7.68	6.78	.002	8	6.89	22.21	10.120	.000
fbt1	1.80	-1.84	1.54	.034	9	6.98	10.73	1.865	.007
					VPA Mean =		10.10	.353	.191

Yearclass = 1998

	Regression				Prediction				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
eyfs0	1.52	.01	1.11	.098	15	6.58	9.99	1.233	.016
eyfs1									
fyfs0	.75	5.35	.36	.335	12	6.29	10.06	.408	.149
fyfs1	.93	5.92	.80	.105	12	3.66	9.33	.940	.028
ebt1	.40	7.28	.17	.751	9	7.13	10.11	.202	.608
fbt0	4.34	-7.68	6.78	.002	8	6.33	19.76	9.510	.000
fbt1									
					VPA Mean =		10.10	.353	.199

Yearclass = 1999

	Regression				Prediction				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
eyfs0									
eyfs1									
fyfs0	.75	5.35	.36	.335	12	5.71	9.63	.420	.414
fyfs1									
ebt1									
fbt0									
fbt1									
					VPA Mean =		10.10	.353	.586

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	28685	10.26	.17	.20	1.50		
1997	21157	9.96	.15	.16	1.02		
1998	**23757**	10.08	.16	.09	.34		
1999	19961	9.90	.27	.23	.74		

Table 11.5.3.- Plaice in Division VIId. RCT3 output.

```
Analysis by RCT3 ver3.1 of data from file : rct_2_01.csv

7D PLAICE - VPA AGE 2 / indices all * per 100,,,,,,,,
Data for    7 surveys over   19 years :  1981 - 1999
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as    .20
Minimum of   5 points used for regression
Forecast/Hindcast variance correction used.
```

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
eyfs0	1.60	-.67	1.17	.097	15	5.48	8.08	1.403	.014
eyfs1	1.47	2.87	.73	.217	15	3.76	8.42	.907	.033
fyfs0	.74	5.25	.34	.375	12	6.46	10.04	.395	.173
fyfs1	1.15	4.79	1.01	.076	12	4.86	10.40	1.167	.020
ebt1	.40	7.10	.16	.777	9	8.11	10.33	.219	.559
fbt0	12.87	-42.51	20.15	.000	8	7.66	56.05	32.941	.000
fbt1	1.58	-.54	1.34	.047	9	8.23	12.44	1.944	.007
					VPA Mean =		9.95	.371	.196

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
eyfs0	1.60	-.67	1.17	.097	15	5.48	8.08	1.403	.012
eyfs1	1.47	2.87	.73	.217	15	3.69	8.31	.920	.029
fyfs0	.74	5.25	.34	.375	12	5.73	9.50	.401	.151
fyfs1	1.15	4.79	1.01	.076	12	4.81	10.35	1.164	.018
ebt1	.40	7.10	.16	.777	9	7.04	9.91	.192	.605
fbt0	12.87	-42.51	20.15	.000	8	6.89	46.20	30.069	.000
fbt1	1.58	-.54	1.34	.047	9	6.98	10.47	1.622	.009
					VPA Mean =		9.95	.371	.176

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
eyfs0	1.60	-.67	1.17	.097	15	6.58	9.84	1.299	.015
eyfs1									
fyfs0	.74	5.25	.34	.375	12	6.29	9.91	.391	.163
fyfs1	1.15	4.79	1.01	.076	12	3.66	9.02	1.185	.018
ebt1	.40	7.10	.16	.777	9	7.13	9.94	.193	.623
fbt0	12.87	-42.51	20.15	.000	8	6.33	38.95	28.254	.000
fbt1									
					VPA Mean =		9.95	.371	.181

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
eyfs0									
eyfs1									
fyfs0	.74	5.25	.34	.375	12	5.71	9.48	.402	.459
fyfs1									
ebt1									
fbt0									
fbt1									
					VPA Mean =		9.95	.371	.541

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	25122	10.13	.16	.20	1.46		
1997	**18015**	9.80	.16	.16	1.00		
1998	20359	9.92	.16	.09	.33		
1999	16913	9.74	.27	.24	.76		

Table 11.6.1.- Plaice in Division VIId. Historical stock data.

Run title : Plaice in VIId (run: TUNATT01/T01)
,

At 15/10/1999 19:34

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 6,	FBAR 3- 6,
1980,	25559,	16515,	5586,	2650,	.4744,	.3630,	.4119,
1981,	12862,	14341,	6562,	4769,	.7268,	.4740,	.5630,
1982,	25252,	15070,	7581,	4865,	.6418,	.4929,	.5825,
1983,	19983,	15150,	8134,	5043,	.6200,	.4986,	.5852,
1984,	25067,	14152,	7470,	5161,	.6909,	.5849,	.7022,
1985,	29800,	15804,	8163,	6022,	.7377,	.5115,	.5611,
1986,	60448,	23170,	10107,	6834,	.6762,	.5510,	.6356,
1987,	31361,	31902,	13499,	8366,	.6197,	.4706,	.5431,
1988,	26520,	24502,	13208,	10420,	.7889,	.5078,	.5834,
1989,	16333,	21580,	14272,	8758,	.6136,	.5543,	.6494,
1990,	18879,	19645,	13578,	9047,	.6663,	.5696,	.6571,
1991,	21837,	14804,	10333,	7813,	.7561,	.6925,	.7393,
1992,	28054,	14497,	8151,	6337,	.7775,	.5954,	.6343,
1993,	13234,	15944,	8550,	5331,	.6235,	.4104,	.4106,
1994,	17321,	15614,	8772,	6121,	.6978,	.5929,	.6377,
1995,	26463,	12780,	8126,	5130,	.6313,	.4908,	.5189,
1996,	27298,	18298,	7746,	5393,	.6962,	.5379,	.6046,
1997,	29998,	13638,	7056,	6307,	.8939,	.9420,	1.1252,
1998,	21157(*),	14464,	7194,	5762,	.8009,	.6260,	.7348,
1999,	23757(**)		8374(***)				
Arith. Mean ,	25038,	17467,	9163,	6323,	.6912,	.5508,	.6253,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

(*) rct3 estimate
(**) rct3 estimate
(***) short term prediction

Table 11.7.1 Plaice in Division VIId. Inputs for prediction.

Year: 1999

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	23757.000	0.1000	0.0000	0.0000	0.0000	0.103	0.0552	0.193
2	18015.000	0.1000	0.1500	0.0000	0.0000	0.184	0.2926	0.265
3	19902.000	0.1000	0.5300	0.0000	0.0000	0.270	0.6660	0.285
4	7488.000	0.1000	0.9600	0.0000	0.0000	0.360	0.8764	0.370
5	2698.000	0.1000	1.0000	0.0000	0.0000	0.455	0.8133	0.473
6	381.000	0.1000	1.0000	0.0000	0.0000	0.555	0.5412	0.661
7	182.000	0.1000	1.0000	0.0000	0.0000	0.659	0.5172	0.801
8	273.000	0.1000	1.0000	0.0000	0.0000	0.768	0.5297	0.936
9	159.000	0.1000	1.0000	0.0000	0.0000	0.883	0.5185	1.033
10+	449.000	0.1000	1.0000	0.0000	0.0000	1.190	0.5185	1.362
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	23441.000	0.1000	0.0000	0.0000	0.0000	0.103	0.0552	0.193
2	.	0.1000	0.1500	0.0000	0.0000	0.184	0.2926	0.265
3	.	0.1000	0.5300	0.0000	0.0000	0.270	0.6660	0.285
4	.	0.1000	0.9600	0.0000	0.0000	0.360	0.8764	0.370
5	.	0.1000	1.0000	0.0000	0.0000	0.455	0.8133	0.473
6	.	0.1000	1.0000	0.0000	0.0000	0.555	0.5412	0.661
7	.	0.1000	1.0000	0.0000	0.0000	0.659	0.5172	0.801
8	.	0.1000	1.0000	0.0000	0.0000	0.768	0.5297	0.936
9	.	0.1000	1.0000	0.0000	0.0000	0.883	0.5185	1.033
10+	.	0.1000	1.0000	0.0000	0.0000	1.190	0.5185	1.362
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	23441.000	0.1000	0.0000	0.0000	0.0000	0.103	0.0552	0.193
2	.	0.1000	0.1500	0.0000	0.0000	0.184	0.2926	0.265
3	.	0.1000	0.5300	0.0000	0.0000	0.270	0.6660	0.285
4	.	0.1000	0.9600	0.0000	0.0000	0.360	0.8764	0.370
5	.	0.1000	1.0000	0.0000	0.0000	0.455	0.8133	0.473
6	.	0.1000	1.0000	0.0000	0.0000	0.555	0.5412	0.661
7	.	0.1000	1.0000	0.0000	0.0000	0.659	0.5172	0.801
8	.	0.1000	1.0000	0.0000	0.0000	0.768	0.5297	0.936
9	.	0.1000	1.0000	0.0000	0.0000	0.883	0.5185	1.033
10+	.	0.1000	1.0000	0.0000	0.0000	1.190	0.5185	1.362
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANATT05
Date and time: 17OCT99:11:47

Table 11.7.2.- Plaice in Division VIId.
Input data for catch forecast and linear sensitivity analysis.

Populations in 1999			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	23757	.16	WS1	.10	.63	M1	.10	.10	MT1	.00	.10
N2	18015	.16	WS2	.18	.26	M2	.10	.10	MT2	.15	.10
N3	19901	.20	WS3	.27	.12	M3	.10	.10	MT3	.53	.10
N4	7487	.20	WS4	.36	.06	M4	.10	.10	MT4	.96	.10
N5	2697	.20	WS5	.46	.03	M5	.10	.10	MT5	1.00	.10
N6	379	.20	WS6	.55	.02	M6	.10	.10	MT6	1.00	.00
N7	181	.20	WS7	.66	.02	M7	.10	.10	MT7	1.00	.00
N8	271	.20	WS8	.77	.02	M8	.10	.10	MT8	1.00	.00
N9	158	.20	WS9	.88	.03	M9	.10	.10	MT9	1.00	.00
N10	449	.20	WS10	1.19	.03	M10	.10	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.06	.81	WH1	.19	.16
sH2	.29	.48	WH2	.27	.11
sH3	.67	.19	WH3	.28	.06
sH4	.88	.09	WH4	.37	.09
sH5	.81	.16	WH5	.47	.06
sH6	.54	.20	WH6	.66	.14
sH7	.52	.27	WH7	.80	.05
sH8	.53	.18	WH8	.94	.05
sH9	.52	.19	WH9	1.03	.04
sH10	.52	.19	WH10	1.36	.03

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K99	1.00	.10	HF99	1.00	.28
K2000	1.00	.10	HF2000	1.00	.28
K2001	1.00	.10	HF2001	1.00	.28

Recruitment		
Labl	Value	CV
R2000	23441	.36
R2001	23441	.36

Proportion F before spawning= .00
Proportion M before spawning= .00

Stock numbers in 1999 are VPA survivors.
These are overwritten at Age 1 Age 2

Table 11.7.3 Plaice in Division VIId. Prediction with management options table.

Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.6379	16268	8374	6817	0.0000	0.0000	15379	8108	0	21844	13620
.	.	.	.	.	0.1000	0.0638	.	8108	834	20922	12795
.	.	.	.	.	0.2000	0.1276	.	8108	1616	20061	12027
.	.	.	.	.	0.3000	0.1914	.	8108	2350	19255	11311
.	.	.	.	.	0.4000	0.2552	.	8108	3039	18501	10645
.	.	.	.	.	0.5000	0.3190	.	8108	3686	17795	10024
.	.	.	.	.	0.6000	0.3827	.	8108	4294	17133	9446
.	.	.	.	.	0.7000	0.4465	.	8108	4866	16512	8906
.	.	.	.	.	0.8000	0.5103	.	8108	5405	15930	8403
.	.	.	.	.	0.9000	0.5741	.	8108	5912	15384	7933
.	.	.	.	.	1.0000	0.6379	.	8108	6390	14871	7495
.	.	.	.	.	1.1000	0.7017	.	8108	6841	14388	7085
.	.	.	.	.	1.2000	0.7655	.	8108	7266	13935	6703
.	.	.	.	.	1.3000	0.8293	.	8108	7668	13508	6345
.	.	.	.	.	1.4000	0.8931	.	8108	8047	13107	6011
.	.	.	.	.	1.5000	0.9569	.	8108	8406	12728	5698
.	.	.	.	.	1.6000	1.0206	.	8108	8745	12372	5405
.	.	.	.	.	1.7000	1.0844	.	8108	9067	12035	5131
.	.	.	.	.	1.8000	1.1482	.	8108	9371	11718	4875
.	.	.	.	.	1.9000	1.2120	.	8108	9660	11418	4634
.	.	.	.	.	2.0000	1.2758	.	8108	9934	11135	4408
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANATT05
Date and time : 17OCT99:11:47
Computation of ref. F: Simple mean, age 2 - 6
Basis for 1999 : F factors

Table 11.7.4 Plaice in Division VIId. (Eastern English Channel)
Single option short term prediction at *status quo* fishing mortality (detailed table).

Year: 1999 F-factor: 1.0000 Reference F: 0.6379

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0552	1215	234	23757	2447	0	0	0	0
2	0.2926	4360	1157	18015	3315	2702	497	2702	497
3	0.6660	9260	2639	19902	5367	10548	2844	10548	2844
4	0.8764	4189	1549	7488	2696	7188	2588	7188	2588
5	0.8133	1439	680	2698	1228	2698	1228	2698	1228
6	0.5412	152	101	381	211	381	211	381	211
7	0.5172	70	56	182	120	182	120	182	120
8	0.5297	107	100	273	210	273	210	273	210
9	0.5185	61	63	159	140	159	140	159	140
10+	0.5185	174	236	449	534	449	534	449	534
Total		21027	6817	73304	16268	24581	8374	24581	8374
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000 F-factor: 1.0000 Reference F: 0.6379

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0552	1199	231	23441	2414	0	0	0	0
2	0.2926	4923	1306	20342	3743	3051	561	3051	561
3	0.6660	5660	1613	12166	3281	6448	1739	6448	1739
4	0.8764	5176	1914	9252	3331	8882	3197	8882	3197
5	0.8133	1504	711	2820	1284	2820	1284	2820	1284
6	0.5412	432	286	1082	600	1082	600	1082	600
7	0.5172	77	62	201	132	201	132	201	132
8	0.5297	39	36	98	75	98	75	98	75
9	0.5185	56	58	145	128	145	128	145	128
10+	0.5185	127	173	328	390	328	390	328	390
Total		19193	6390	69875	15379	23055	8108	23055	8108
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.6379

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0552	1199	231	23441	2414	0	0	0	0
2	0.2926	4857	1289	20071	3693	3011	554	3011	554
3	0.6660	6391	1822	13737	3704	7280	1963	7280	1963
4	0.8764	3164	1170	5655	2036	5429	1954	5429	1954
5	0.8133	1858	879	3485	1587	3485	1587	3485	1587
6	0.5412	452	299	1132	628	1132	628	1132	628
7	0.5172	220	176	570	376	570	376	570	376
8	0.5297	43	40	108	83	108	83	108	83
9	0.5185	20	21	52	46	52	46	52	46
10+	0.5185	99	134	255	303	255	303	255	303
Total		18303	6060	68506	14871	21322	7495	21322	7495
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRATT02
Date and time : 17OCT99:15:38
Computation of ref. F: Simple mean, age 2 - 6
Prediction basis : F factors

Table 11.9.1 Plaice in Division VIId (Eastern English Channel)
Input data to Yield and Biomass per Recruit and MediumTerm analyses.

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.1000	0.0000	0.0000	0.0000	0.095	0.0552	0.215
2	.	0.1000	0.1500	0.0000	0.0000	0.179	0.2926	0.269
3	.	0.1000	0.5300	0.0000	0.0000	0.268	0.6660	0.311
4	.	0.1000	0.9600	0.0000	0.0000	0.360	0.8764	0.390
5	.	0.1000	1.0000	0.0000	0.0000	0.455	0.8133	0.487
6	.	0.1000	1.0000	0.0000	0.0000	0.554	0.5412	0.627
7	.	0.1000	1.0000	0.0000	0.0000	0.657	0.5172	0.752
8	.	0.1000	1.0000	0.0000	0.0000	0.764	0.5297	0.915
9	.	0.1000	1.0000	0.0000	0.0000	0.874	0.5185	1.046
10+	.	0.1000	1.0000	0.0000	0.0000	1.159	0.5185	1.344
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDATT03
Date and time: 17OCT99:15:10

Table 11.9.2 Plaice in Division VIId (Eastern English Channel). Yield and Biomass per recruit.

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	7469.032	8.325	7122.835	8.325	7122.835
0.1000	0.0638	0.332	238.011	7.192	4062.315	5.029	3721.425	5.029	3721.425
0.2000	0.1276	0.489	298.877	5.630	2592.872	3.486	2257.064	3.486	2257.064
0.3000	0.1914	0.578	309.698	4.742	1831.726	2.617	1500.790	2.617	1500.790
0.4000	0.2552	0.635	305.106	4.177	1392.263	2.070	1066.003	2.070	1066.003
0.5000	0.3190	0.674	296.366	3.790	1118.646	1.701	796.876	1.701	796.876
0.6000	0.3827	0.703	287.334	3.510	938.134	1.438	620.679	1.438	620.679
0.7000	0.4465	0.724	279.250	3.299	813.276	1.243	499.971	1.243	499.971
0.8000	0.5103	0.741	272.391	3.134	723.368	1.093	414.057	1.093	414.057
0.9000	0.5741	0.755	266.693	3.001	656.325	0.976	350.862	0.976	350.862
1.0000	0.6379	0.766	261.989	2.891	604.773	0.881	303.019	0.881	303.019
1.1000	0.7017	0.775	258.100	2.799	564.046	0.803	265.868	0.803	265.868
1.2000	0.7655	0.784	254.867	2.720	531.093	0.738	236.367	0.738	236.367
1.3000	0.8293	0.791	252.158	2.652	503.865	0.683	212.473	0.683	212.473
1.4000	0.8931	0.797	249.868	2.592	480.951	0.636	192.780	0.636	192.780
1.5000	0.9569	0.803	247.914	2.538	461.355	0.595	176.297	0.595	176.297
1.6000	1.0206	0.808	246.231	2.490	444.359	0.559	162.314	0.559	162.314
1.7000	1.0844	0.812	244.767	2.446	429.439	0.527	150.309	0.527	150.309
1.8000	1.1482	0.817	243.484	2.406	416.201	0.499	139.894	0.499	139.894
1.9000	1.2120	0.820	242.350	2.369	404.345	0.474	130.773	0.474	130.773
2.0000	1.2758	0.824	241.340	2.335	393.641	0.451	122.720	0.451	122.720
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDATT05
Date and time : 18OCT99:12:09
Computation of ref. F: Simple mean, age 2 - 6
F-0.1 factor : 0.1672
F-max factor : 0.3012
F-0.1 reference F : 0.1066
F-max reference F : 0.1921
Recruitment : Single recruit

Figure 11.1.1 Stock Summary, Plaice in VIId, Eastern English Channel.

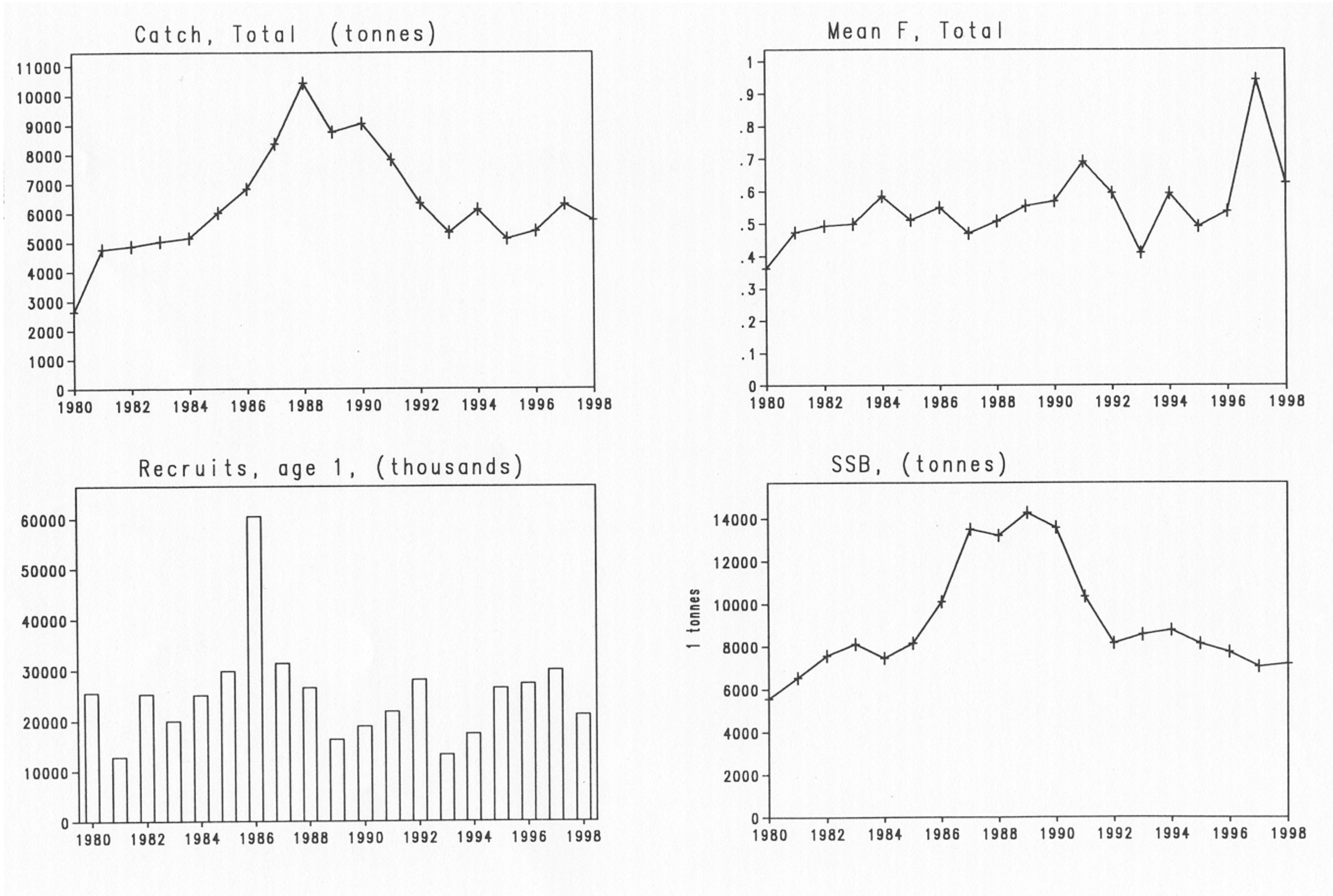
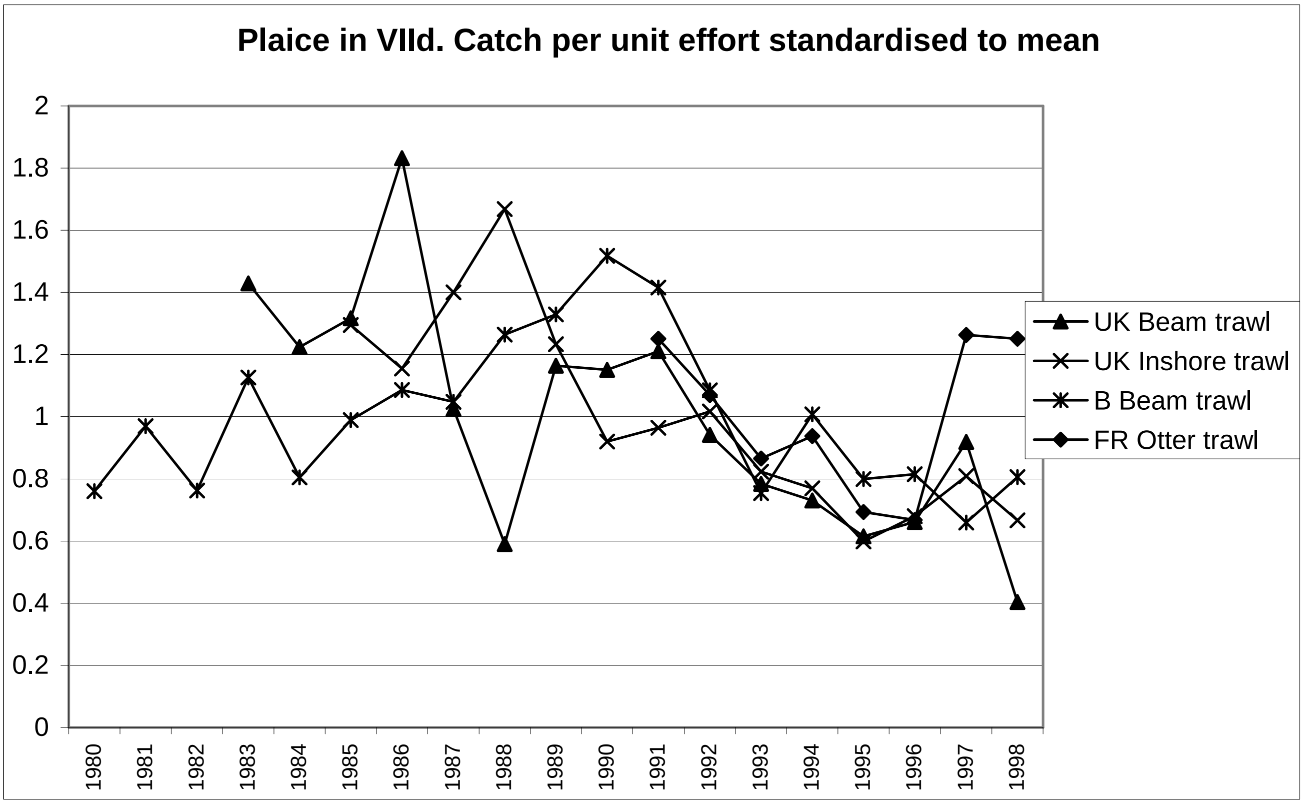
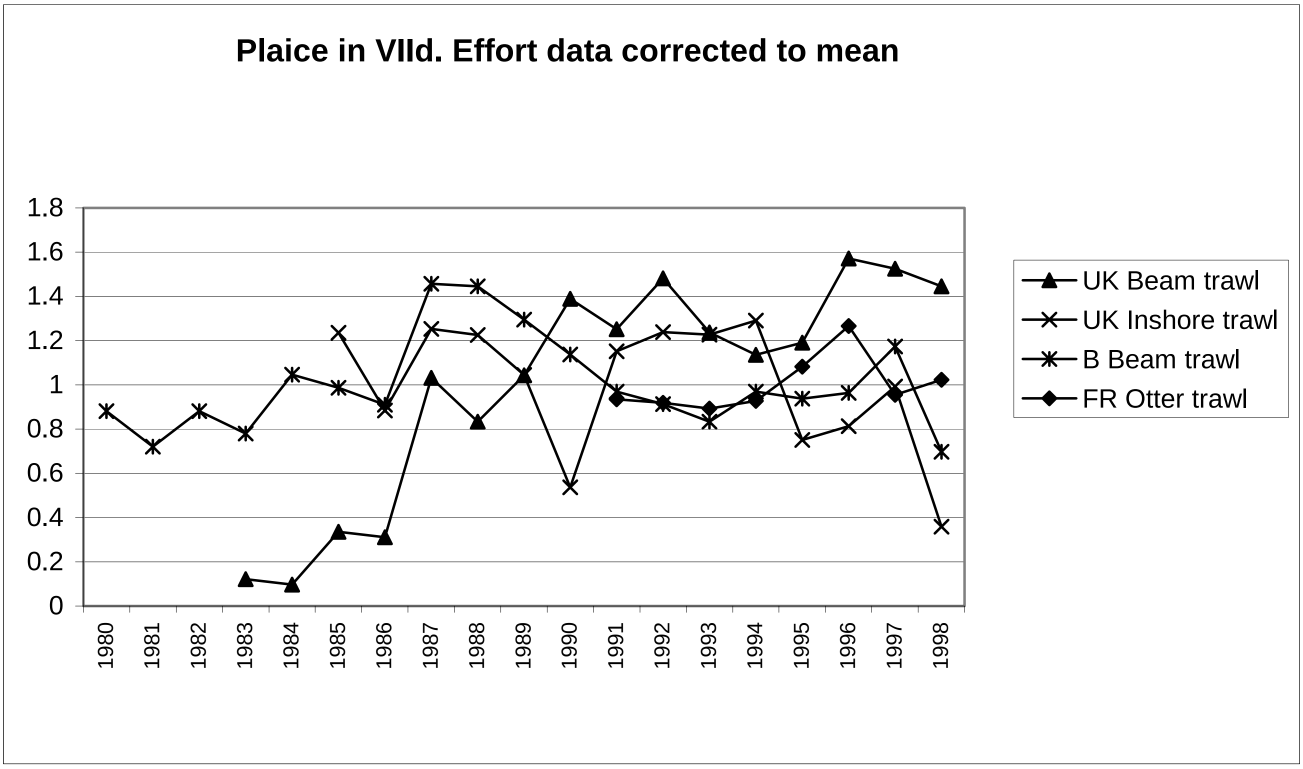


Figure 11.3.1



Plaice in VIId. Catch per unit effort standardised to mean
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
UK Beam trawl
UK Inshore trawl
B Beam trawl
FR Otter trawl



Plaice in VIId. Effort data corrected to mean
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
UK Beam trawl
UK Inshore trawl
B Beam trawl
FR Otter trawl

Figure 11.4.1 Plaice in Division VIId. Log q residual per fleet and age (XSA, final Run).

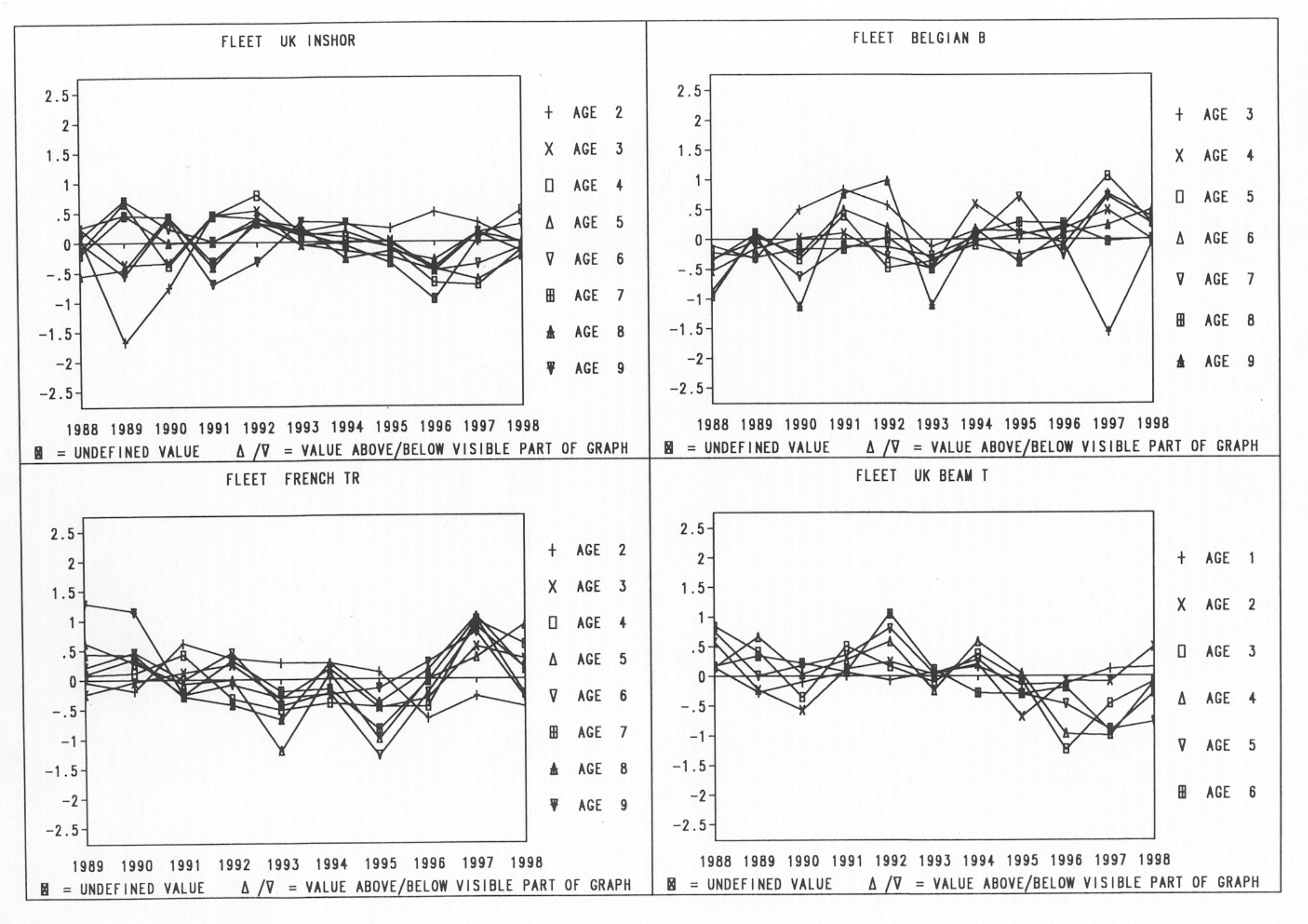


Figure 11.4.1 (Cont'd)

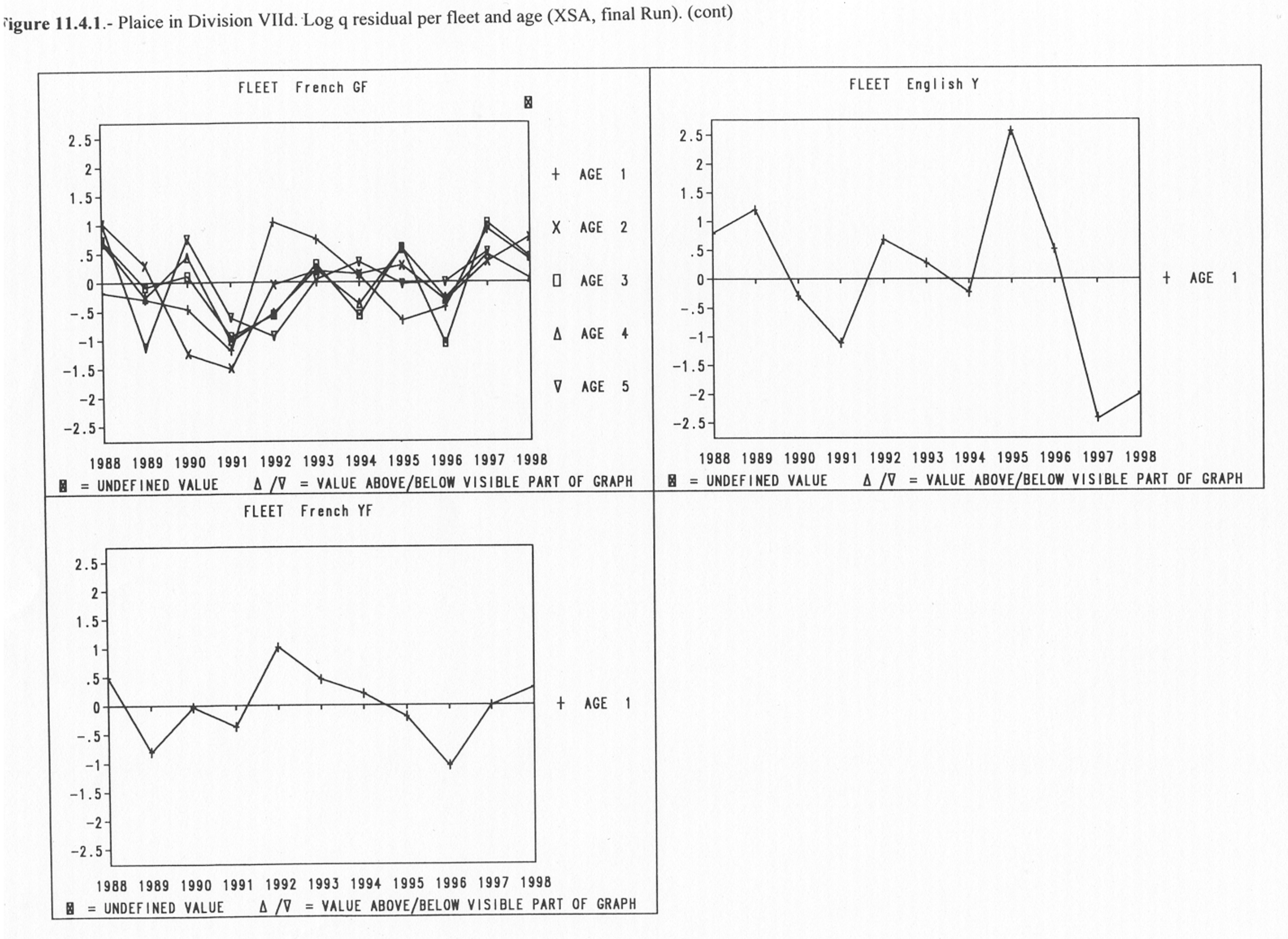


Figure 11.4.2 Plaice in Division VIId. Retrospective analysis with final run (windows 8 years)

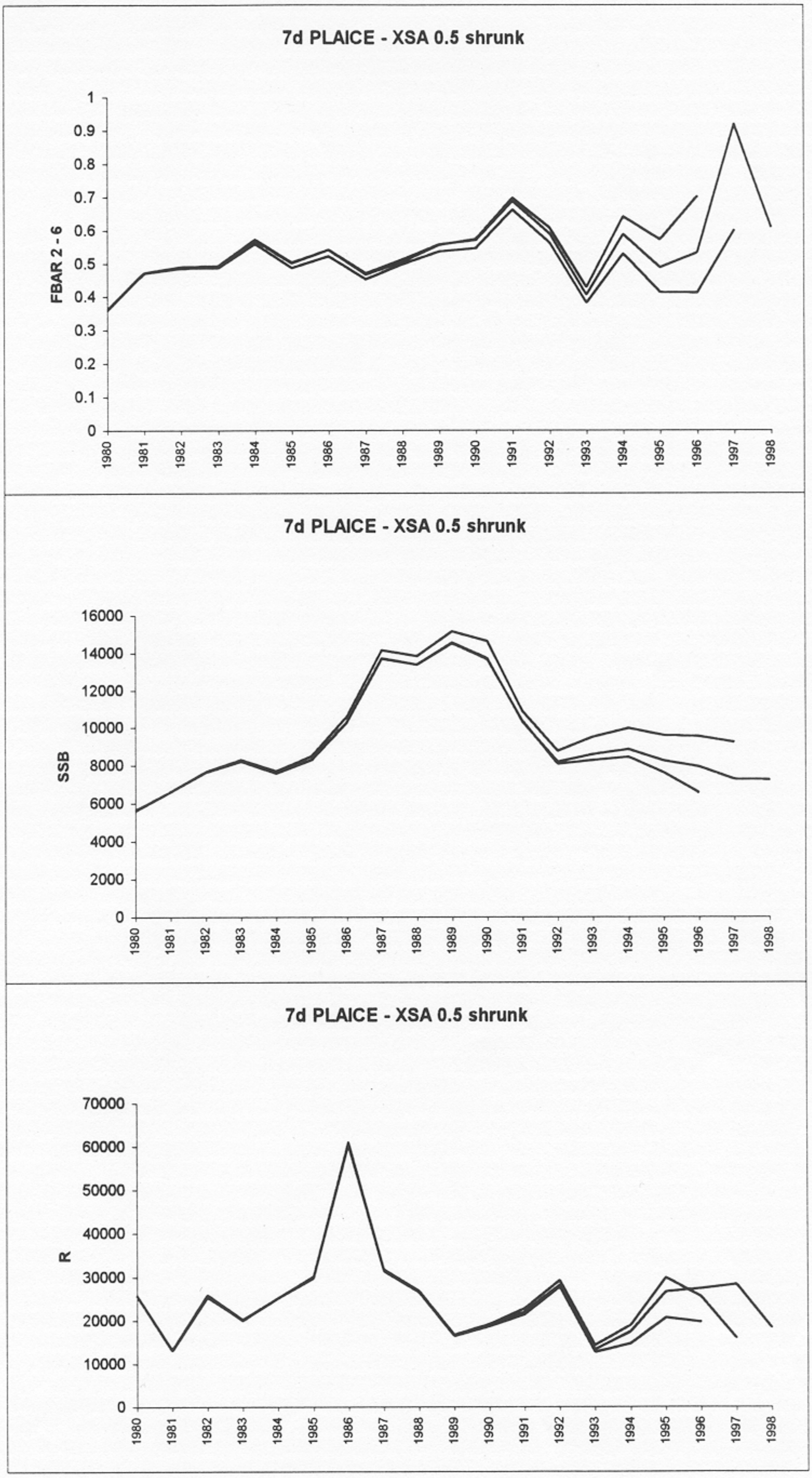


Figure 11.4.3.- Plaice in Division VIId. Log VPA vs. log Index (year range : 1989-1998)

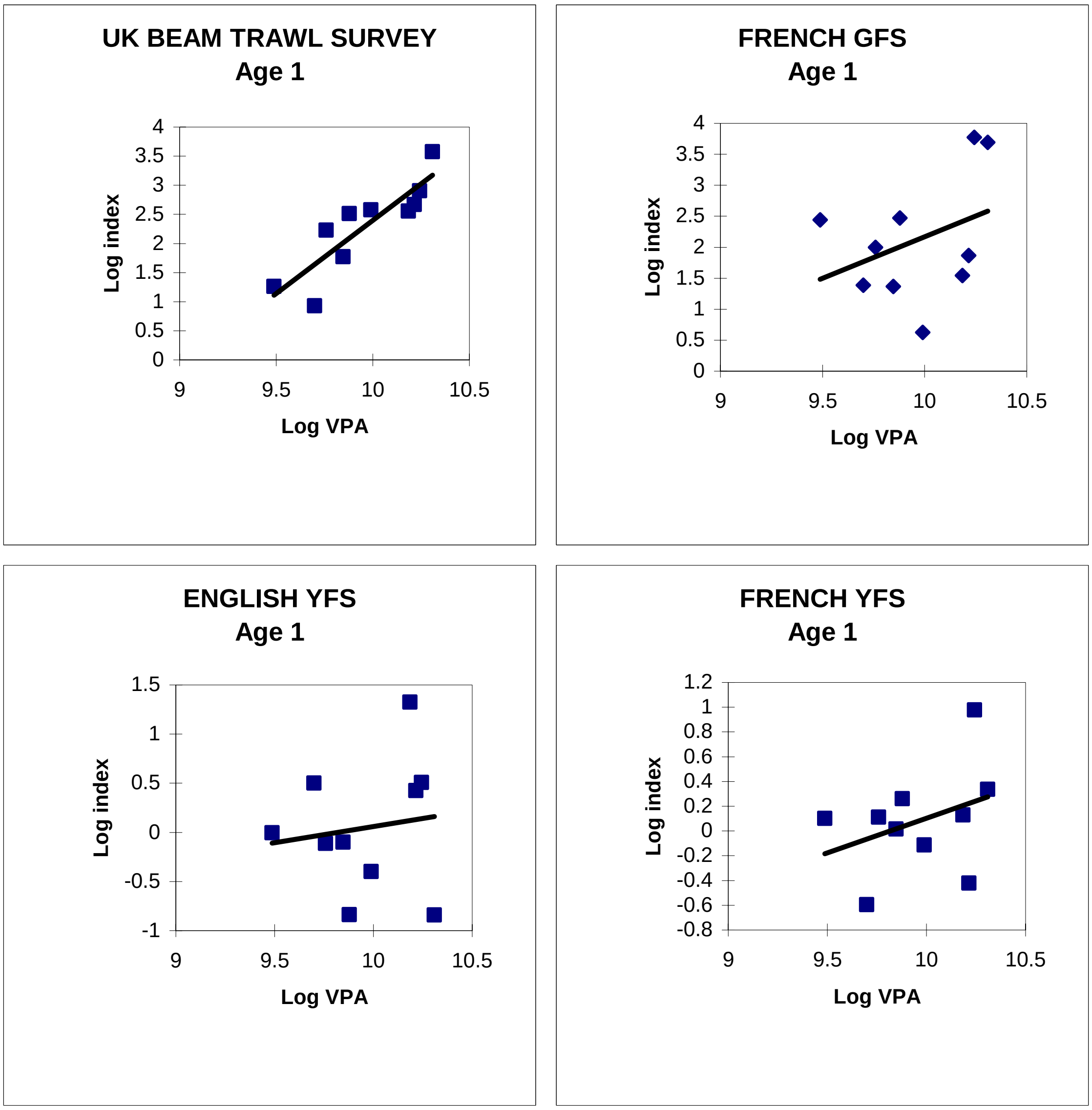


Figure 11.4.4.- Plaice in Division VIId. Weights of tuning categories in final assessment.

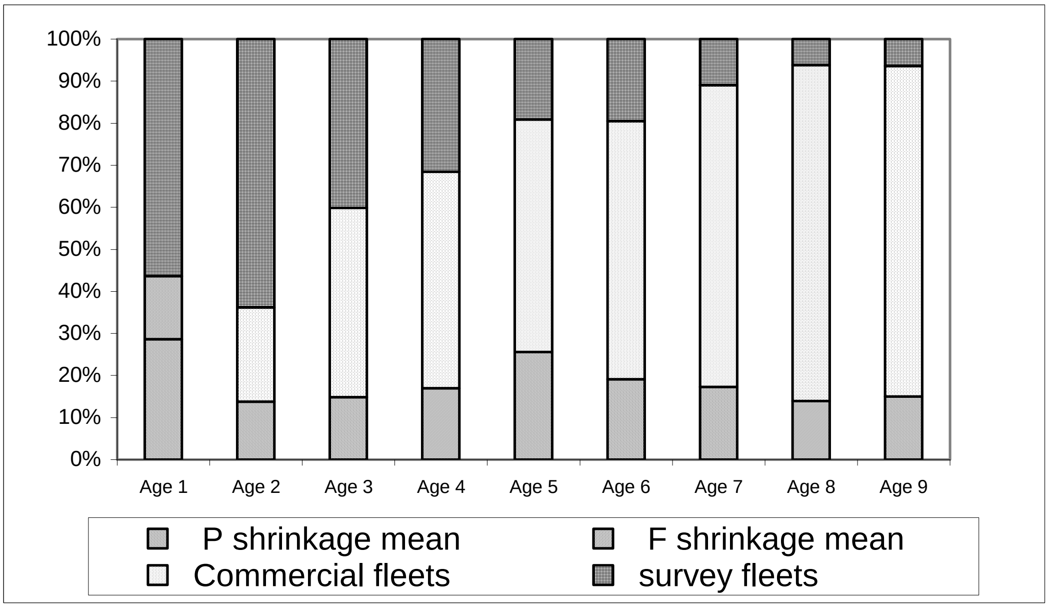


Figure 11.5.1.- Plaice in Division VIId. LN (Survey index) versus LN (VPA-N Age 1)

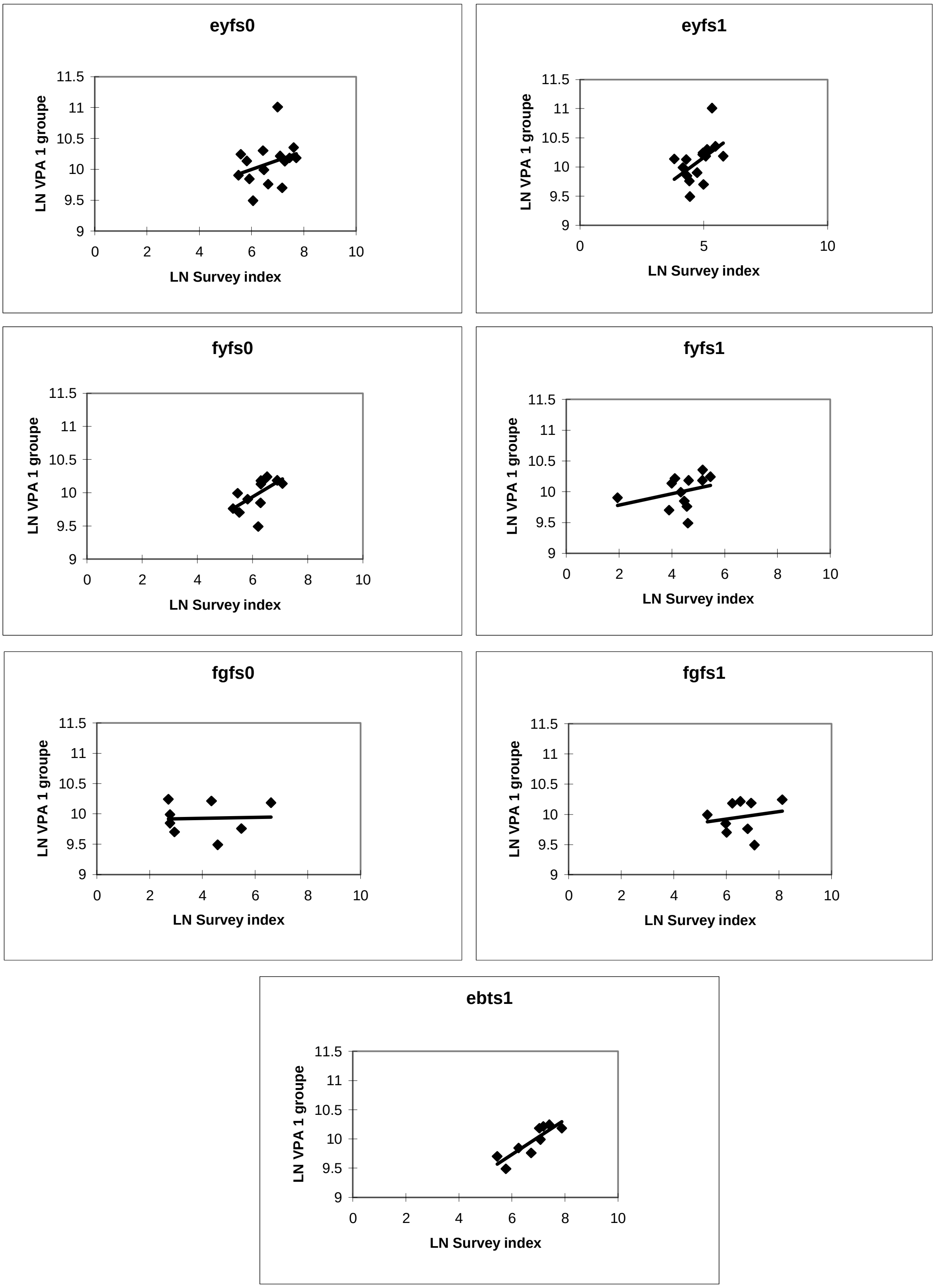
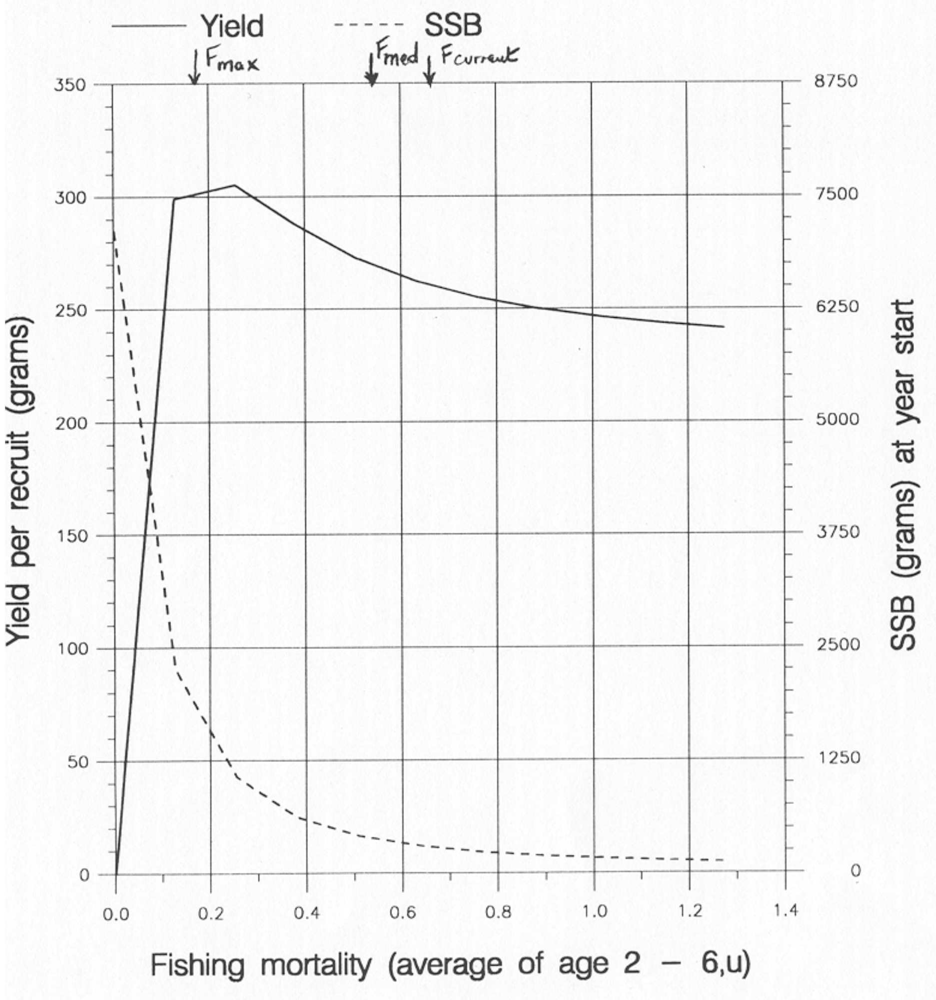
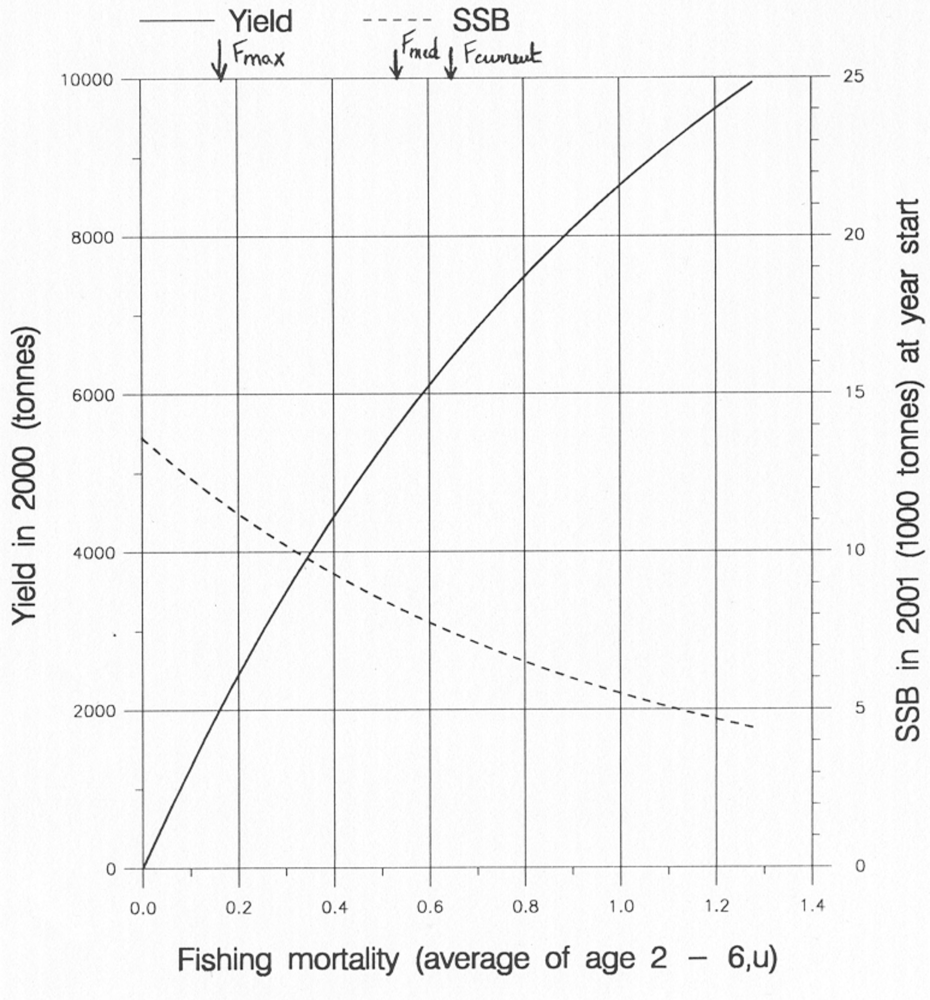


Figure 11.7.1 Fish Stock Summary. Plaice in Division VIId (Eastern English Channel)



(run: YLDATT03) C



(run: MANATT05) D

Figure 11.7.2 **Plaice in VIId**

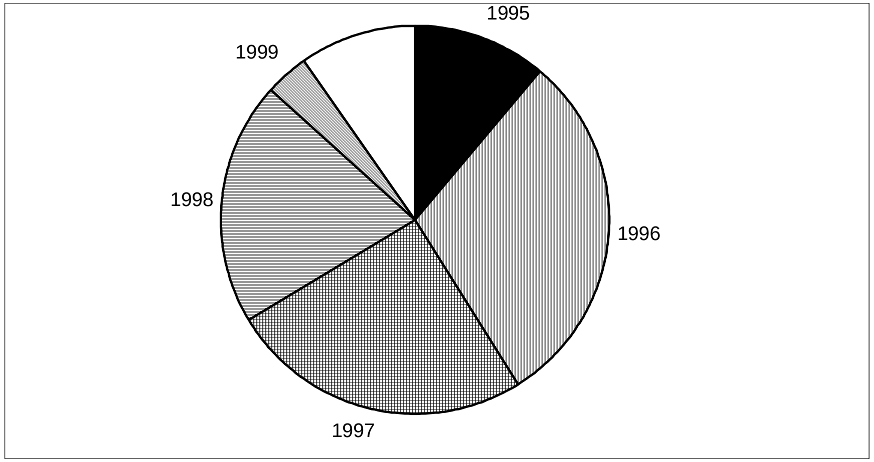
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1995	1996	1997	1998	1999
Stock No. (thousands) of 1 year-olds			27298	29998	21157	23757	23441
Source			VPA	VPA	RCT3	RCT3	GM
Status Quo F:							
% in	1999	landings	22.7	38.7	17.0	3.4	-
% in	2000		11.1	30.0	25.2	20.4	3.6
% in	1999	SSB	30.9	34.0	5.9	0.0	-
% in	2000	SSB	15.8	39.4	21.5	6.9	0.0
% in	2001	SSB	8.4	21.2	26.1	26.2	7.4

GM : geometric mean recruitment

Plaice in VIId : Year-class % contribution to

a) 2000 landings



b) 2001 SSB

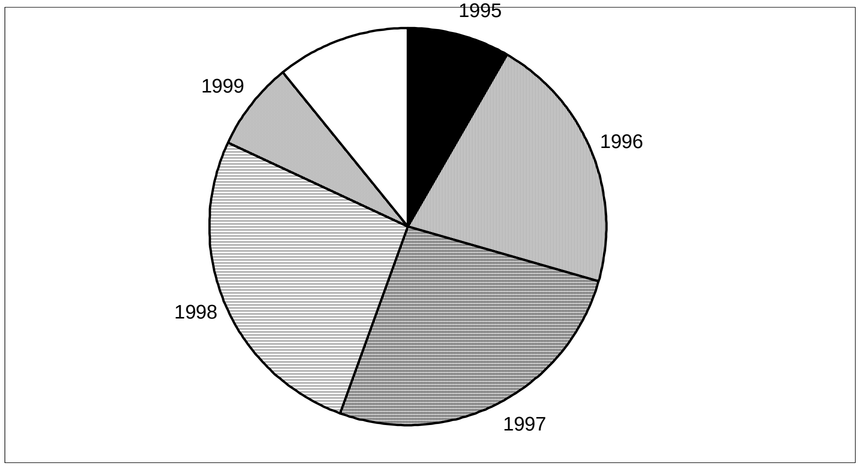


Figure 11.7.3 Plaice, East English Channel. Sensitivity analysis of short term forecast.

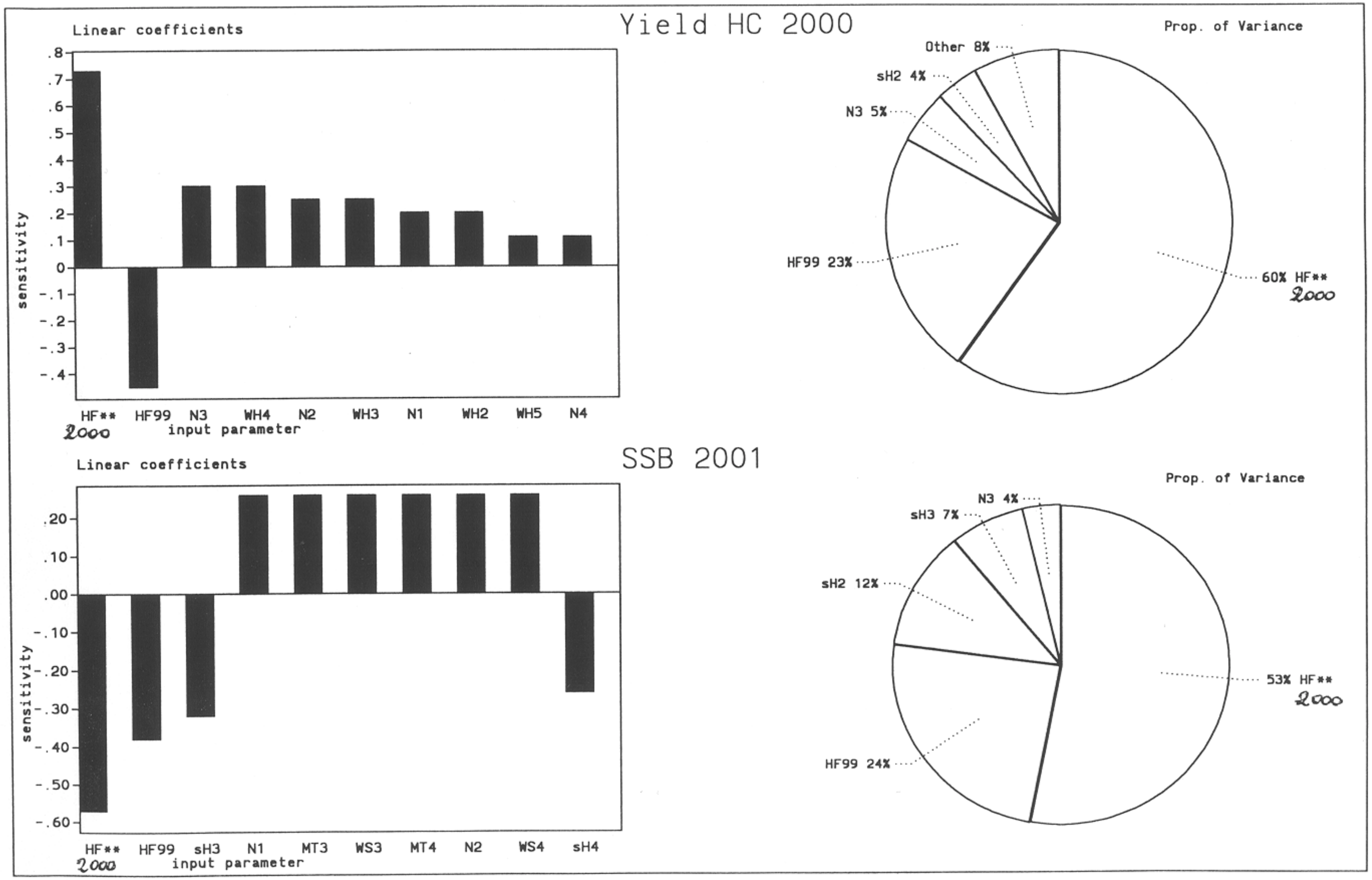
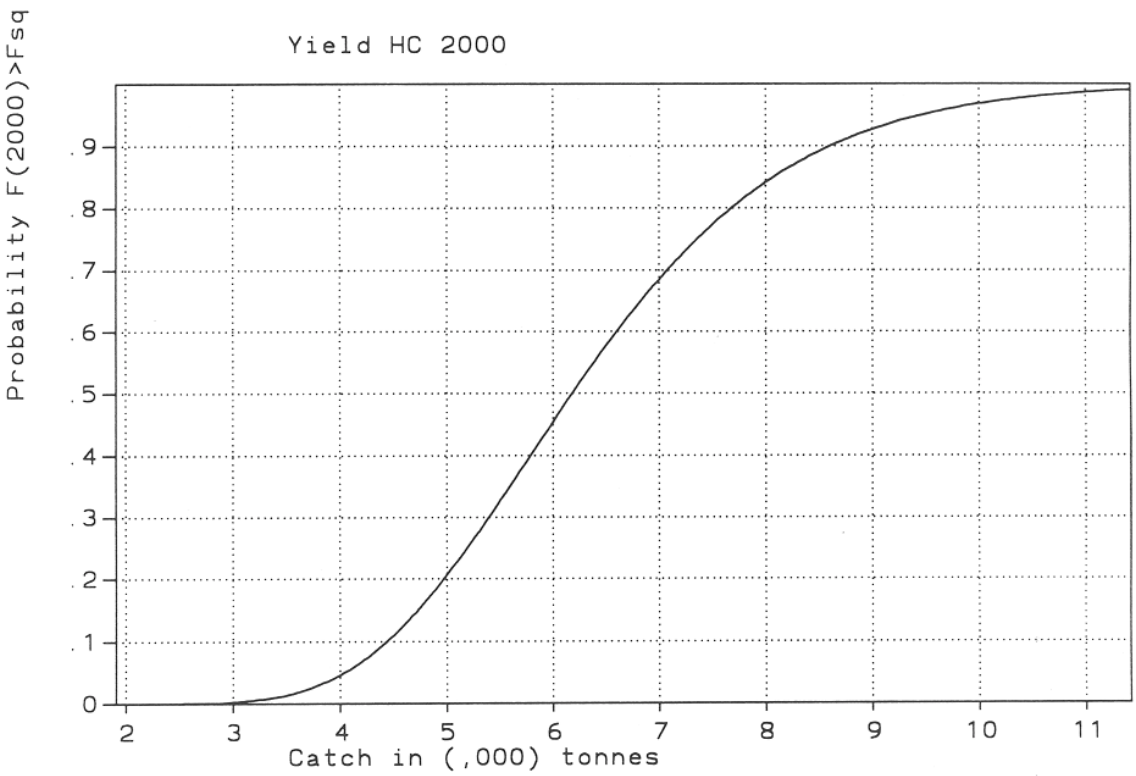


Figure 11.7.4 Plaice, English Channel East. Probability profiles for short term forecast.



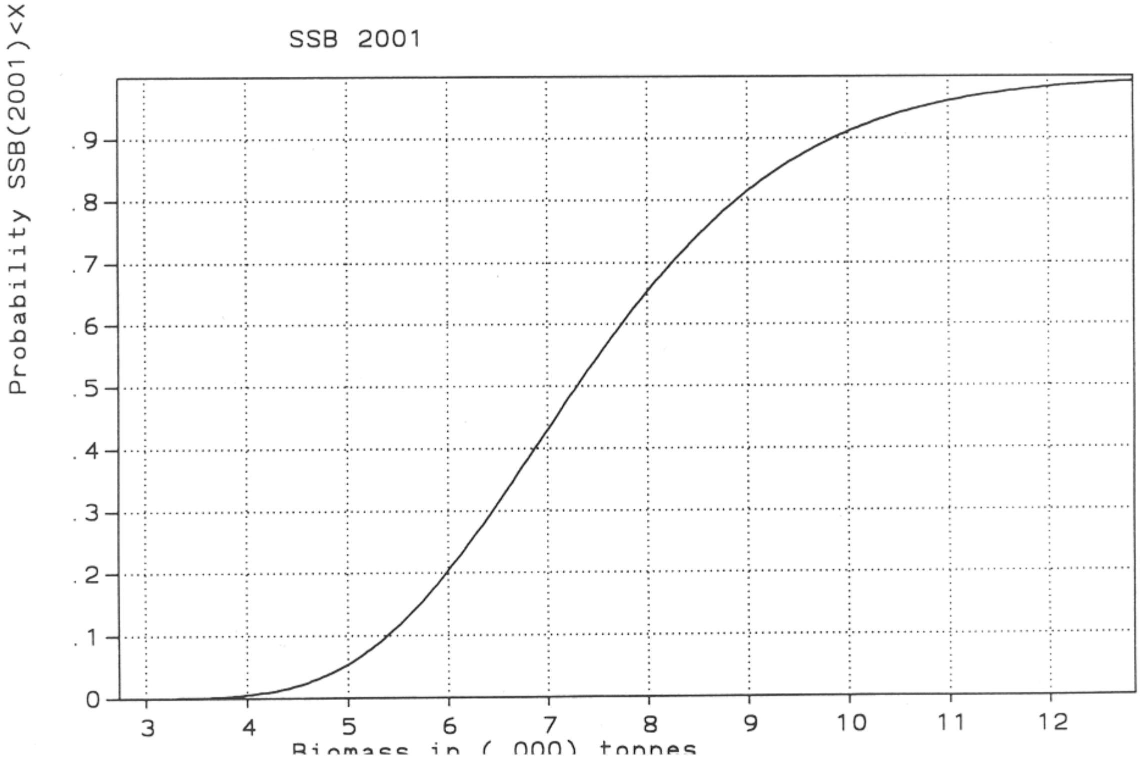


Figure 11.8.1.- Plaice in VIID. Medium term projections showing 5, 10, 20, 50 and 95 percentiles from a constraint Shepherd Stock recruitment model.

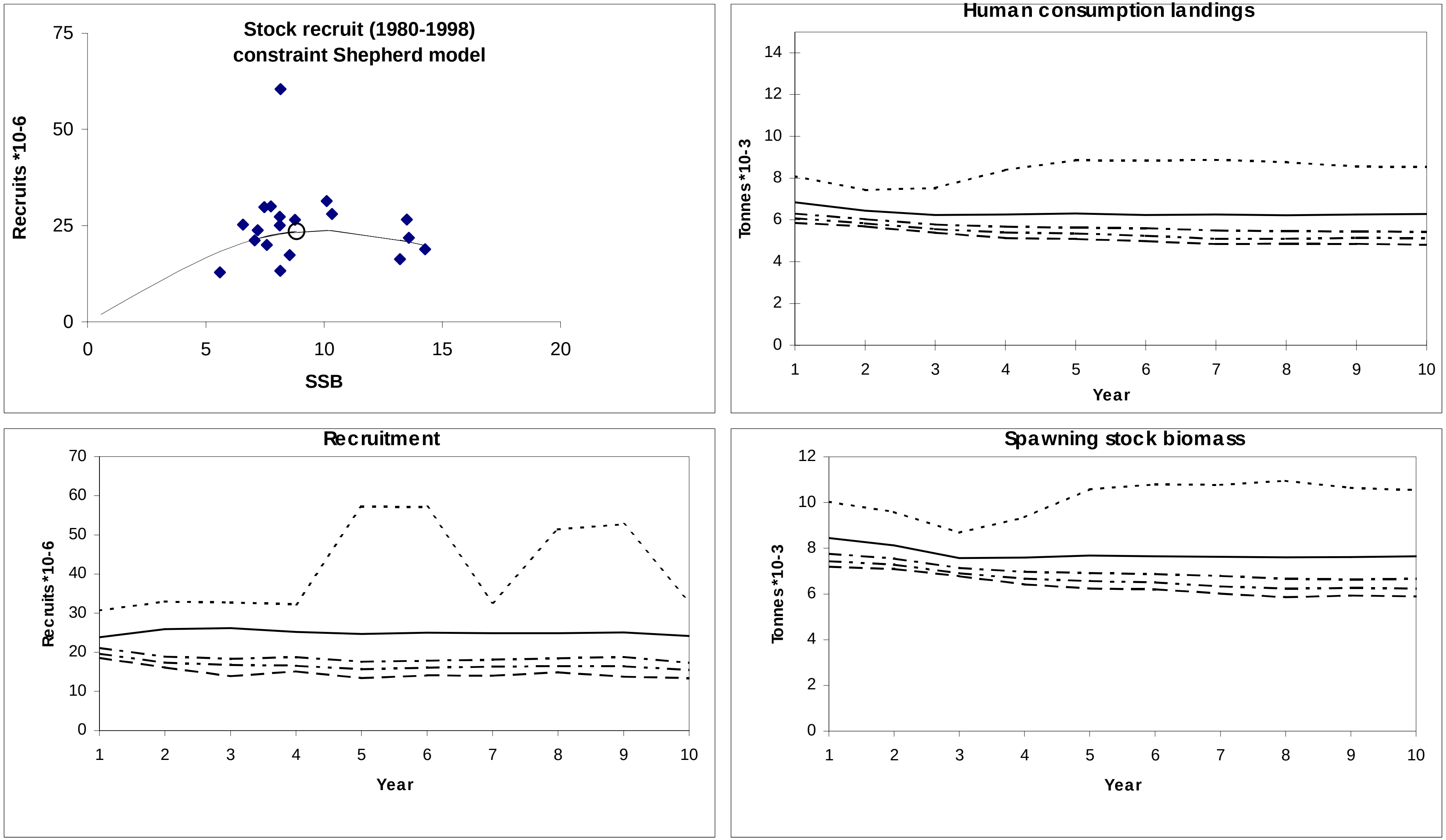


Figure 11.8.2.- Plaice in Division VIId. Medium term projections of SSB in 2008 at different F levels

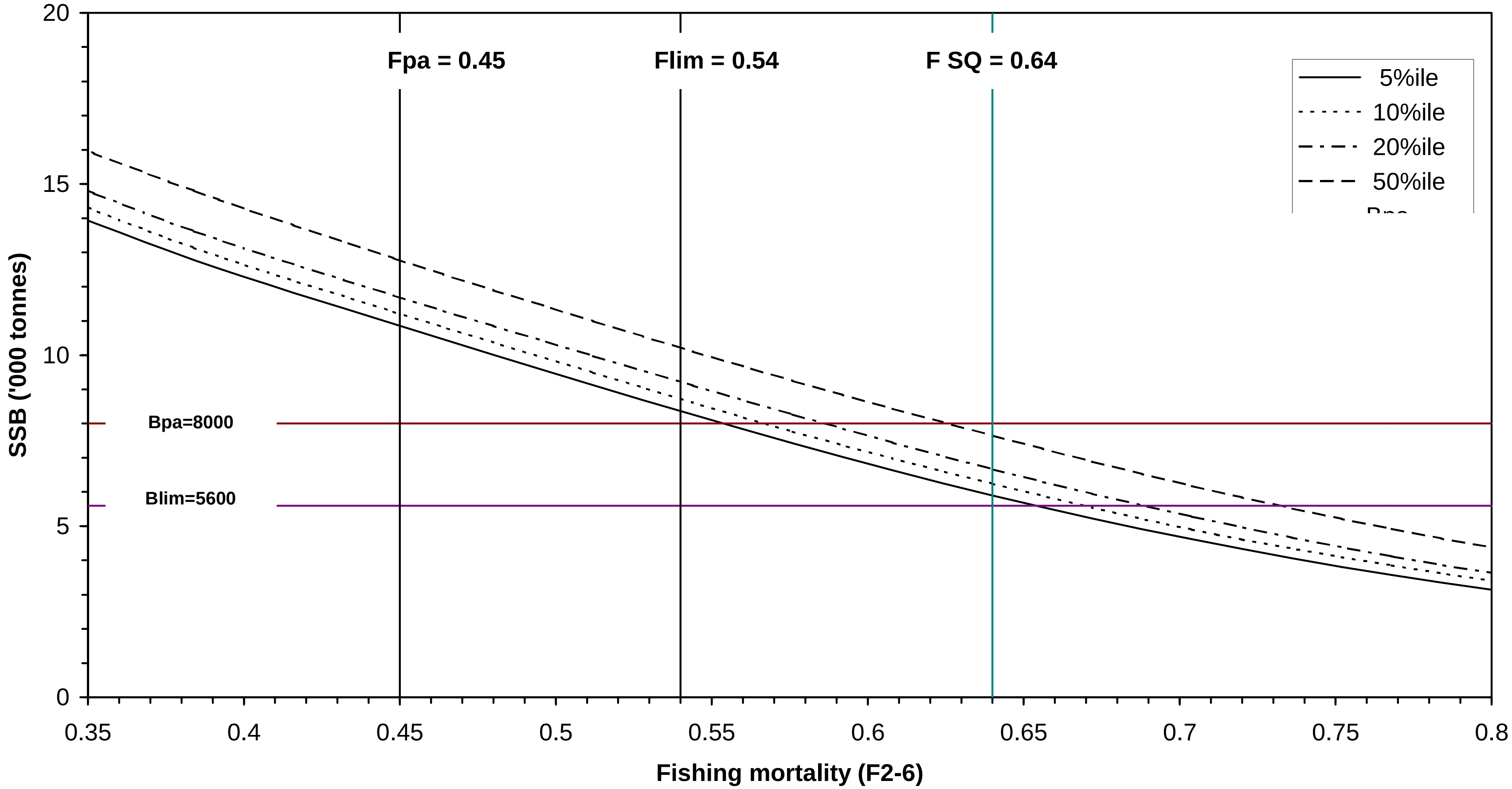
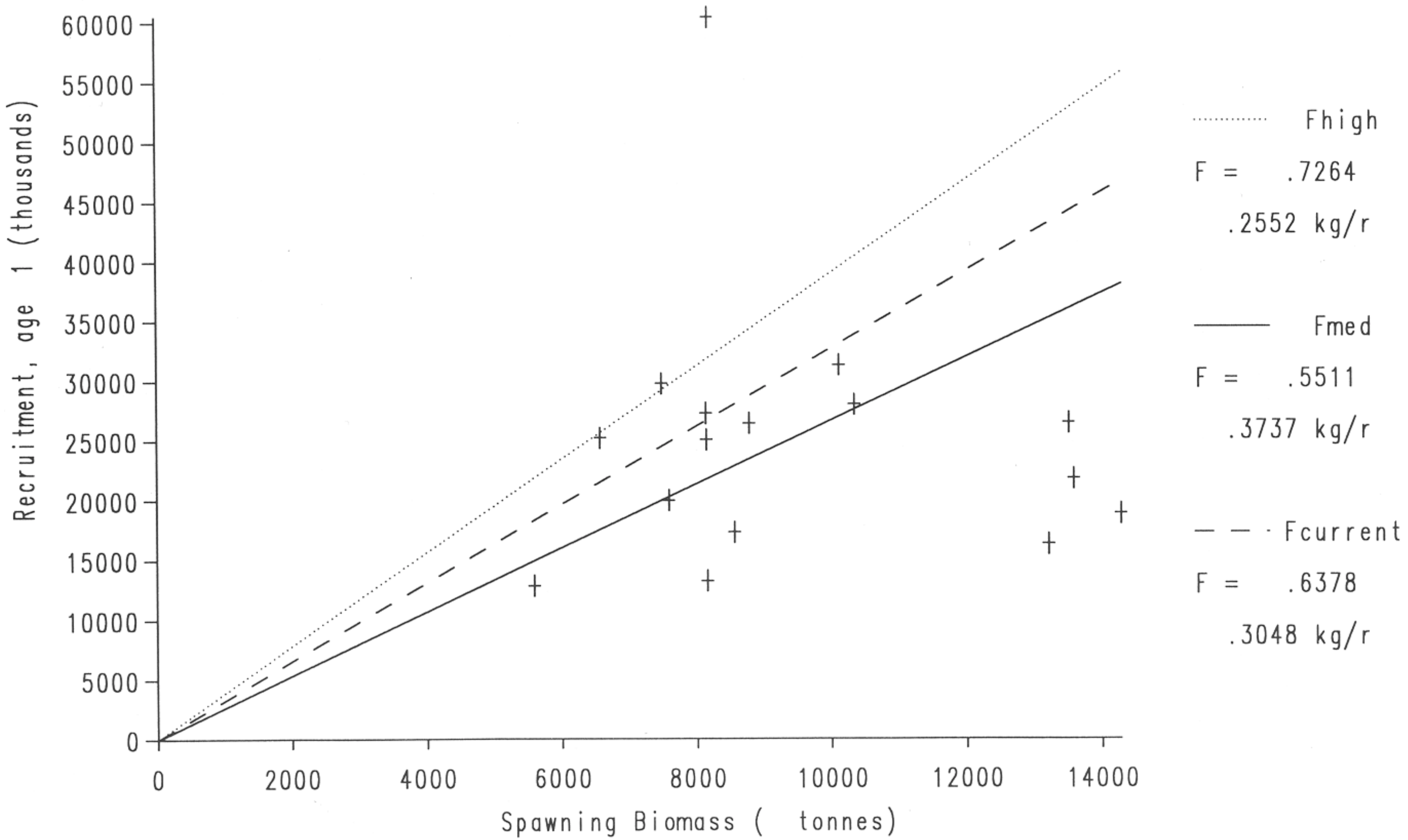


Figure 11.10.1 English Channel Plaice. Stock and Recruitment



12 NORWAY POUT IN ICES SUB-AREA IV AND DIVISION IIIA

12.1 The fishery

12.1.1 ICES advice applicable to 1999

There is no management objective set for this stock. With historical and present fishing mortality levels the status of the stock is mainly determined by natural processes and less by the fishery. The ACFM advice and assessment conclusion for 1997-98 was that the stock was considered to be within safe biological limits and the stock can on average sustain current fishing mortality. However, there is a need to ensure that the stock remains high enough to provide food for a variety of predator species. Recruitment is highly variable and influences SSB rapidly due to the short life span of the species. Fishing mortality has generally been lower than the natural mortality and has decreased in recent years. ICES proposes that a B_{lim} = 90,000 t as the lowest observed biomass and a B_{pa} = 150,000 t should be established.

12.1.2 Management applicable to 1998 and 1999

In 1997-99 the TAC for Norway pout was set to 220,000 t. In managing this fishery by-catches of other species should be taken into account. Existing technical measures such as the closed Norway pout box, minimum mesh size in the fishery, and by-catch regulations to protect other species have been maintained.

12.1.3 Trends in landings

Annual landings (1959-98) as provided by Working Group members are shown in Table 12.1.1. The total landings in 1998 were 75,000 t which is approximately a 60 % decrease from the 1997-level. Both the Danish and Norwegian catches have decreased from 1997 to 1998. The long term averages in landings were in the period 1959-66 below 100,000 t raising to a level around 375,000 t in the period 1967-84 and falling again to approximately 180,000 t in the period 1985-98. The decrease in landings in 1998 is probably caused by the historically weak 1997 year class and the relatively weak 1998 year class compared to the very strong 1996 year class. The fishery is mainly targeting 1-group Norway pout in the first, third and fourth quarter of the year rather than targeting the spawning stock consisting of the 2+-group. A plot with trends in yield is shown in Figure 12.6.1. The Danish CPUE has declined from 1997 to 1998 (Tab. 12.3.1). Directed effort for Norway pout only decreased slightly during this period (Tab. 12.3.3). The seasonal distribution of the landings by country are shown in Table 12.1.2. Usually catches are highest in Aug.-Nov. over the year. It seems that the Norway pout fishery in these months in 1998 has been very poor compared to the previous years resulting in the low total yearly catch in 1998.

12.2 Natural Mortality, Maturity, Age Composition and Mean Weight at Age

Age compositions were available from Norway and Denmark, Table 12.2.1. Mean weight at age in the catch was estimated as a weighted average of Danish and Norwegian data, Table 12.2.2. The mean weights at age in the catches are very variable between years and seasons, and also between countries, for the same age groups in the same year. The same mean weight at age in the stock, maturity ogive and natural mortality are used for all years, Table 12.2.3. The natural mortality is set to 0.4 for all age groups in all seasons which results in an annual natural mortality of 1.6 for all age groups (see background description for this in ICES CM 1987/Assess:17, p. 4-5).

The natural mortality estimates from the MSVPA have not been used in the present assessment because the MSVPA estimates of natural mortality of Norway pout are variable and rather uncertain. The MSVPA data are only available for age groups 0-3 and do not include all predators on Norway pout. As nearly no Norway pout above the age 4-5 years is observed in the stock the natural mortality for the older age groups (from 3- to 4-group) seems to be relatively high. Furthermore, the migration patterns of important predators (especially saithe) in the North Sea and in Skagerak, and the variation in overlap in distribution between Norway pout and saithe, are not well known.

12.3 Catch, Effort and Research Vessel Data

The assessment uses the combined catch and effort data from the commercial Danish and Norwegian small meshed trawler fleets fishing mainly in the northern North Sea. The fishery targets both Norway pout and blue whiting. Previous years reports (ICES CM 1997/Assess:16, ICES CM 1998/Assess:7) give background descriptions of the commercial fishery tuning series used. In 1997 Norwegian effort data were revised as described in sections 13.1.3.1 and 1.3.2 of the 1997 working group report (ICES CM 1998/Assess:7). Tables 12.3.1 and 12.3.2 give CPUE data by vessel category for the Danish and Norwegian commercial fleets in the period 1983-99.

The combined and standardised Danish and Norwegian fishing effort data for commercial vessels targeting Norway pout are given in Table 12.3.3. Research vessel data: Survey indices series of abundance of Norway pout were available from the IBTS and the EGFS and SGFS (English and Scottish Ground Fish Surveys), Table 12.3.4. Furthermore, research vessel indices from the 3rd quarter IBTS is given in Table 12.3.5 in order to follow the spawning stock indices, i.e. the 2+-group, in 1998-99.

12.4 Catch-at-Age Analysis

The SXSA (Seasonal Extended Survivors Analysis: Skagen (1993)) was used to estimate quarterly stock numbers and fishing mortalities for Norway pout in the North Sea and Skagerrak. The settings of the SXSA was the same this year as in the last year's assessment. In the SXSA the catchability was assumed to be constant within the period 1983-1999. Tuning was performed over the period 1983 to 1999 producing log residual stock numbers and survivor estimates, where the contributions from the various age groups to the survivor estimates were weighted in proportion to the inverse of their variance. The three surveys and the commercial fleet were all used in the tuning. Cosine time taper has not been used in this assessment to shrink the estimated values towards the mean. Table 12.4.1 contains the options used as well as the estimated stock numbers, fishing mortalities and additional output from the analysis. The log residual stock numbers are plotted in Figure 12.4.2. Weighting factors for computing survivors of the different tuning fleets as well as the SSQ Residuals are shown in Figure 12.4.3. A summary of the SXSA results are shown in Table 12.6.1 and in Figures 12.6.1-2.

The log residual stock numbers are least variable for 1- and 2-year-old fish as the precision in the estimated catch is higher for these age groups (Fig. 12.4.2). There is no apparent trend in the residuals with time. Figure 12.4.3 indicates large inter-annual variations with large sum of squared residuals for commercial fishery in 1992 (3rd quart.), 1993 (4th quart.), and 1996 (2nd and 4th quart.) and show only relatively smaller variations in SSQ of the surveys compared to the commercial fishery. However, the EGFS gives slightly higher residuals with peaks in 1987, '92, and '96.

The weights in the tuning process in the final run (constant catchability) were evenly distributed over the different CPUE series with a general tendency towards most weight given to the CPUE data from the commercial fishery, Figure 12.4.3. The commercial fishery was used in tuning in each quarter of the year while survey weighting was only used for the 1st and 3rd quarter of the year. For several age groups and seasons approximately the same weight were given to the IBTS and SGFS surveys as the weight given to the commercial fishery. Higher weight is given to SGFS age 3, season 3 compared with EGFS and the commercial fishery.

Retrospective analyses has been done for recruitment and SSB as in previous years (Figure 12.4.1). The retrospective analyses for recruitment, SSB and fishing mortality performed as in previous years revealed a general tendency to overestimate SSB and recruitment values and underestimate fishing mortality in the last year. In most cases the estimates converged rapidly, but the initial high estimates of SSB and recruitment for the large 1991 and 1994 year classes have in general been gradually revised downwards in the successive years. Basically the estimate of the strong 1996 year class is consistent in the successive years.

12.5 Recruitment Estimates

The long term geometric mean recruitment is 135 millions for the period 1974-1998 and 105 millions for 1983-1998. The recruitment in 1997 and 1998 is below these long term averages. Recruitment estimates are available from the English and Scottish groundfish surveys carried out in August (Tab. 12.3.4). As the current SXSA also includes catch at age data for the 1st and 2nd quarter of 1999 (Tab. 12.4.1), these surveys have been included in the VPA based on the assumption that the survey in August are representative for the stock situation on 1 July. The SGFS recruitment indices from 1998-99 should be used with caution as a new survey design (new vessel in 1998 and new gear and extended survey area in 1999) was introduced. The 0-group indices from this survey were not used. The same trends for the 1+-group is observed for the SGFS as for the EGFS for which reason the SGFS survey index for the age groups 1-3 was included in the SXSA. Historically, the EGFS estimates the strong year classes as 1-group better than as 0-group. Recruitment indices are now also available for the IBTS 3rd quarter survey for the period 1991-99 (Table 12.3.5). This new time series has been made available late in the WG-meeting and could not be used in the SXSA in 1999. This time series will be introduced in the assessment in year 2000 because it seems to estimate 0-group Norway pout better than the EGFS alone (Tabs. 12.3.4-5) and it gives a longer time series than the (new) SGFS alone.

12.6 Historical Stock Trends

The landings of Norway pout for the period 1974–97 are presented in Table 12.6.1. In addition, the estimated average fishing mortality for the 1- and 2-group, the trends in the SSB, and the recruitment trends for the period 1974–97 are shown in Table 12.6.1. These results are also presented in Figure 12.6.1. Historical trends in fishing mortality for 1- and 2-group are shown in Figure 12.6.2.

Average fishing mortality for ages 1–2 was at a level of around 1.0 in the early 1980's up to 1986 but then declined to the a level of approximately 0.7 until 1994 and then again to a level around 0.4 in 1995 to 1997 (Fig. 12.6.1). In 1998 the fishing mortality was historically low at approximately 0.25. Total effort was high in the period 1982-86.

Spawning stock biomass decreased in the mid 1980s after having reached peaks at above 300,000 t in 1983-84, but has since slowly increased again with a smaller drop in 1994 and 1995. The spawning stock biomass has in the period 1996-98 increased to 250,000-400,000 t. This is on the same level as in 1983-84 because of the strong 1991, 1994 and 1996 year classes and probably also because of the reduction in F. Survey indices of the 0-group suggest the 1999 year class to be very strong (on the 1991 year class level) which indicate that the high stock level will be maintained. (Fig. 12.6.1 & Tab. 12.6.1 & Tab. 12.3.4 & Tab. 12.3.5).

12.7 Short-Term Forecasts

No forecast is given for this stock. Deterministic catch forecasts as given for most other stocks are not possible to give due to the fact that only few year classes are contributing to the catch, the large dependence of the forecast on the size of year classes which are poorly known, and the uncertainty in the forecast arising from variations in natural mortality. The assessment indicates a strong 1996 year class, a very weak 1997 year class, a relatively weak 1998 year class and a very strong 1999 year class. The SSB in 1998 was very high. Consequently, the historically relatively high stock biomass level in recent years will be maintained although an intermediate biomass reduction in 1999 can be expected.

12.8 Medium-Term Predictions

No medium term predictions are given for this stock (see also under section 12.9 and 12.10).

12.9 Biological Reference Points

In the 1997 assessment for this stock (ICES CM 1998/Assess:7) SSB/R and Y/R -plots were generated for Norway pout in order to produce long term projections for the stock using a quarterly based model for the period 1974-1996. However, no F_{max} could be estimated based on the Y/R-plot (Fig. 12.8.3).

Fmed has been estimated based on a 50 %-quantile plot of SSB/R using mean weights and fishing mortalities from the period 1974-1998 (Fig. 12.8.1). This is well above the current F-level around 0.25-0.40.

In 1998 a precautionary limit reference point for SSB was proposed based on the lowest observed level of SSB where the stock has produced strong year classes, i.e. the level of below average recruitment. ACFM considered that B_{lim} = 90,000 t as the lowest observed biomass and proposed that a B_{pa} should be set at 150,000 t. This affords a high probability of maintaining the SSB above B_{lim}, taking into account the uncertainty of the assessment. Below this value the probability of below average recruitment increases.

The historical performance of F and SSB in relation to the above precautionary reference points, are given in Fig. 12.8.2.

A major concern is to ensure that the stock remains on a high enough level to satisfy both a number of fish predators and the fishery. The biomass necessary to support the different predator stocks (especially saithe in the North Sea and Skagerrak) at given levels is not known. It is therefore presently impossible to adjust reference points to take account of predator-prey effects. However, in general it is more appropriate to formulate reference points based on biomass or of total mortality rather than only on fishing mortality. This is based on the fact that the population dynamics for Norway pout in the North Sea and Skagerrak is mainly dependent on changes caused by recruitment variation and predation mortality and less by the fishery. The stock size and catch possibilities are largely dependent on the size of a few year classes. The size of the year classes cannot be predicted within the precision required for traditional catch prediction for traditional TAC based management. As the stock is driven by natural processes and less by fishery it is appropriate to formulate reference points based on total mortality for use within alternative management approaches and procedures using surveys and “real time” monitoring of the catches in the fishery. (Figs. 12.8.1-2).

12.10 Comments on the Assessment

The reasons for performing seasonal VPA are that there are seasonal differences in the fishery and in the fishing pattern (and most likely also in the natural mortality). If the ratio between F and M varies between seasons, then seasonal and annual VPAs will produce different results. Comparisons between annual and seasonal assessments were performed for Norway pout in 1997 (ICES CM 1998/Assess:7). Here it was shown that the annual VPA had a tendency to under-estimate the stock numbers. This indicates that the seasonal VPA is the most adequate for Norway pout.

The fishing mortalities and the catches vary considerably between years and seasons for both the important age groups (Table 12.4.1). Calculating an average fishing mortality for the 1- and 2-group therefore seems reasonable. Because of this variation a weighted average of the two Fs would give a more precise picture. This is, however, not possible within the used SXSA-program.

Variation in the exploitation pattern between age groups, years, and season can be a result of a) changes in distribution of fishing effort which could have lead to reduction in effort targeted at a certain age group; b) when the proportion of a certain age group is very low in the catches one year this proportion is estimated with a higher CV. The presently estimated high SSB of 330,000 t in 1998 might be in conflict with the yield of only 75,000 t in 1998 (this yield is mainly 1- and 2-group varying by quarter of year in the autumn 1998 and in the spring 1999) and that yield of the 2+-group is low except for the 1st quarter of the year in 1999. There might be a conflict in the above on basis of the expectation that the fishery would target the SSB (2+-group) more heavily when the SSB is at that high level. However, survey indices indicate that SSB is high as the strong 1996 year class can be found as strong 2- and 3-year classes in 1998 and 1999, respectively (Tab. 12.3.5). Plots of CPUE vs biomass by age (1-group and 2+-group) and quarter for the commercial fleet and the surveys, respectively, do all indicate good correlation and a relatively strong 2+-group in 1998 (Figs 12.3.1-2). A plot of quarterly yield by age vs. yearly SSB (Fig. 12.3.3) do not indicate an un-realistic relationship in 1998 compared to previous years. The low yield for Norway pout in 1998 may also be explained by a change in the directivity in the fishery towards sandeel (Aug.-Nov. 1998, especially), Fig. 12.3.4.

It should be noted that there seems to be two levels of the stock-recruitment-relationship for the stock (Fig. 12.8.1) with no periodical and historical trends to explain them. Evaluation of the stock-recruitment relationship for this stock and the factors and biological processes affecting it, as well as fisheries interactions should be performed in order to investigate the possibilities for producing a realistic stock-recruitment-model and realistic medium term predictions for this stock.

Table 12.1.1 Norway pout annual landings ('000 t) in the North Sea and Division IIIa, by country, for 1959–1998. (Data provided by Working Group members).

Year	Denmark		Faroes	Norway	Sweden	UK (Scotland)	Others	Total
	North Sea	Div. IIIa						
1959	61.5	-	-	7.8	-	-	-	69.3
1960	17.2	-	-	13.5	-	-	-	30.7
1961	20.5	-	-	8.1	-	-	-	28.6
1962	121.8	-	-	27.9	-	-	-	149.7
1963	67.4	-	-	70.4	-	-	-	137.8
1964	10.4	-	-	51.0	-	-	-	61.4
1965	8.2	-	-	35.0	-	-	-	43.2
1966	35.2	-	-	17.8	-	-	+	53.0
1967	169.6	-	-	12.9	-	-	+	182.6
1968	410.8	-	-	40.9	-	-	+	451.8
1969	52.5	-	19.6	41.4	-	-	+	113.5
1970	142.1	-	32.0	63.5	-	0.2	0.2	238.0
1971	178.5	-	47.2	79.3	-	0.1	0.2	305.3
1972	259.6	-	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	-	51.2	63.0	2.9	13.0	0.6	345.9
1974	464.5	-	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	-	63.6	218.9	2.3	22.7	1.0	559.7
1976	244.9	-	64.6	108.9	+	17.3	1.7	435.4
1977	232.2	-	50.9	98.3	2.9	4.6	1.0	389.9
1978	163.4	-	19.7	80.8	0.7	5.5	-	270.1
1979	219.9	9.0	21.9	75.4	-	3.0	-	329.2
1980	366.2	11.6	34.1	70.2	-	0.6	-	482.7
1981	167.5	2.8	16.6	51.6	-	+	-	238.5
1982	256.3	35.6	15.4	88.0	-	-	-	395.3
1983	301.1	28.5	24.5	97.3	-	+	-	451.4
1984	251.9	38.1	19.1[1]	83.8	-	0.1	-	393.0
1985	163.7	8.6	9.9	22.8	-	0.1	-	205.1
1986	146.3	4.0	6.6	21.5	-	-	-	178.4
1987	108.3	2.1	4.8	34.1	-	-	-	149.3
1988	79.0	7.9	1.5	21.1	-	-	-	109.5
1989	95.6	5.4	0.8	65.3	+	0.1	0.3	172.5
1990	61.5	12.1	0.9	77.1	+	-	-	151.6
1991	85.0	38.3	1.3	68.3	+	-	+	192.9
1992	146.9	44.7	2.6	105.5	+	-	0.1	299.8
1993	97.3	7.8	2.4	76.7	-	-	+	184.2
1994	97.9	6.6	3.6	74.2	-	-	+	182.3
1995	138.4	50.3	8.9	43.1	0.1	-	0.2	241.0
1996	74.3	36.2	7.6	47.8	0.2	0.1	+	166.2
1997	125.8	29.3	7.0	39.1	+	+	0.1	201.3
1998	39.8	13.2	-	22,1	-	-	+	75.1

Table 12.1.2 Norway pout, North Sea and Skagerrak. National landings (t) by month 1993-1999**.** (Data provided by Working Group members).

Month	Denmark	Norway	Total	Denmark	Norway	Total	Denmark	Norway	Total
		1993			**1994**			**1995**	
Jan	5,678	2,578	8,256	8,600	3,425	12,025	6,501	1,195	7,696
Feb	10,871	7,460	18,331	9,579	4,146	13,725	6,501	8,966	15,467
Mar	6,654	2,558	9,212	4,603	3,478	8,101	8,345	5,360	13,705
Apr	0	4,128	4,128	681	5,126	5,807	3,448	2,646	6,074
May	79	12,585	12,664	0	4,209	4,209	6,695	5,326	12,021
Jun	1,419	10,171	11,590	0	5,340	5,340	7,191	2,667	9,858
Jul	9,646	10,713	20,359	312	9,653	9,965	19,833	1,671	21,504
Aug	10,686	7,866	18,552	4,763	13,524	18,287	11,620	471	12,091
Sep	12,609	7,358	19,967	13,697	8,629	22,326	32,529	3,648	36,177
Oct	20,741	4,168	24,909	17,750	8,435	26,185	39,772	6,837	46,609
Nov	10,650	3,995	14,645	21,538	4,706	26,244	31,378	2,578	33,956
Dec	8,296	3,092	11,388	16,335	3,501	19,836	14,675	1,716	16,391
Total	97,329	76,672	174,001	97,858	74,192	172,050	188,488	43,117	231,605

Month	Denmark	Norway	Total	Denmark	Norway	Total	Denmark	Norway	Total
		1996			**1997**			**1998**	
Jan	3,246	458	3,704	6,490	1,151	7,641	4,702	1,040	5,742
Feb	3,307	3,304	6,611	3,344	1,513	4,857	2,696	3,470	6,166
Mar	3,390	6,842	10,232	1,303	1,519	2,822	3,121	4,403	7,524
Apr	1,675	1,802	3,477	6	2,137	2,143	2,894	2,086	4,980
May	1,118	1,351	2,469	3,319	3,391	6,710	322	2,985	3,307
Jun	153	1,128	1,281	2,516	2,938	5,454	924	2,814	3,738
Jul	1,134	6,739	7,873	11,425	10,351	21,776	3,804	2,143	5,947
Aug	7,192	9,053	16,245	19,890	8091	27,981	7,984	875	8,859
Sep	17,861	11,674	29,535	25,934	3,104	29,038	5,520	541	6,061
Oct	14,475	3,028	17,503	31,713	2,056	33,769	6,410	1,322	7,732
Nov	14,813	1,361	16,174	10,901	1,210	12,111	10,442	171	10,613
Dec	5,893	1,077	6,970	6,614	1,618	8,232	4,188	285	4,473
Total	74,257	47,817	122,074	123,455	39,079	162,534	53,007	22,135	75,142

Month	Denmark	Norway	Total
		1999	
Jan	566	307	873
Feb	1,124	1,089	2,213
Mar	2,330	1,625	3,955
Apr	1,615	2,639	4,254
May	678	1,674	2,352
Jun	1,007	5,826	6,833
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			
Total	7,320	13,160	20,480

Table 12.2.1 NORWAY POUT in the North Sea. Catch in numbers at age by quarter (millions). + represents less than half a million. Data for 1990 were estimated within the SXSA program used in the 1996 assessment.

Age	Year	1981				1982				1983			
0		0	0	78	36,926	0	0	156	1,090	0	0	446	2,671
1		2,245	1,083	1,329	1,048	5,425	3,349	6,773	3,108	4,207	1,826	5,825	4,296
2		1,705	627	953	304	427	283	444	47	1,297	1,234	1,574	379
3		77	78	17	3	222	24	64	0	15	10	17	7
4+		6	2	0	0	0	0	0	0	0	2	0	0
SOP										58587	69964	216106	131207
Age	Year	1984				1985				1986			
0		0	0	1	2,231	0	0	6	678	0	0	0	5,572
1		2,759	2,252	5,290	3,492	2,264	857	1,400	2,991	396	260	1,186	1,791
2		1,375	1,165	1,683	734	1,364	145	793	174	1,069	87	245	39
3		143	269	8	0	192	13	19	0	72	3	6	0
4+		0	0	0	0	1	0	0	0	3	0	0	0
SOP		56790	56532	152291	110942	57464	15509	62489	92017	37889	7657	45085	89993
Age	Year	1987				1988				1989			
0		0	0	8	227	0	0	741	3,146	0	0	151	4,854
1		2,687	1,075	1,627	2,151	249	95	183	632	1,736	678	1,672	1,741
2		401	60	171	233	700	73	250	405	48	133	266	93
3		12	0	0	5	20	0	0	0	6	6	5	13
4+		1	0	0	0	0	0	0	0	0	0	0	0
SOP		33894	15435	38729	60847	22181	3559	21793	61762	15379	13234	55066	82880
Age	Year	1990				1991				1992			
0		0	0	20	993	0	0	734	3,486	0	0	879	954
1		1,840	1,780	971	1,181	1,501	636	1,519	1,048	3,556	1,522	3,457	2,784
2		584	572	185	116	1,336	404	215	187	1,086	293	389	267
3		20	19	6	4	93	19	22	18	118	20	1	2
4+		10	0	0	0	6	0	0	0	3	0	0	0
SOP		28287	39713	26156	45242	42776	20786	62518	64380	62224	27973	114122	96177
Age	Year	1993				1994				1995			
0		0	0	96	1,175	0	0	647	4,238	0	0	700	1,692
1		1,942	813	1,147	1,050	1,975	372	1,029	1,148	3,992	1,905	2,545	3,348
2		699	473	912	445	591	285	421	134	240	256	47	59
3		15	58	19	2	56	29	71	0	6	32	3	3
4+		0	0	0	0	0	0	0	0	0	0	0	0
SOP		36206	29291	62290	53470	34575	15373	53799	79838	36942	28019	69763	97048
Age	Year	1996				1997				1998			
0		0	0	724	2,517	0	0	109	343	0	0	94	339
1		535	560	1,043	650	672	99	3,090	1,922	265	198	410	531
2		772	201	1,002	333	325	131	372	207	731	263	329	216
3		14	38	37	0	79	119	105	35	53	15	2	13
4+		0	0	0	0	0	0	0	0	40	19	0	0
SOP		21888	13366	74631	46194	15320	8708	78809	54100	20798	10396	20398	22720
Age	Year	1999											
0		0	302										
1		159	204										
2		84	106										
3		110	1										
4+		2	0										
SOP		7814	12499										
Age	Year												

Table 12.2.2 Norway pout in North Sea + Division IIIa. Mean weights (grams) at age, by quarter, 1983-1999, from Danish and Norwegian catches combined. Data for 1974 to 1982 are assumed to be the same as 1983.

		Age-Group							Age-Group				
Year	Qtr	0	1	2	3	4	Year	Qtr	0	1	2	3	4
1983	1	.00	7.00	22.00	40.00	56.00	1992	1	.00	8.78	25.73	41.80	43.90
1983	2	.00	15.00	34.00	50.00	56.00	1992	2	8.00	11.71	31.25	49.49	.00
1983	3	4.00	25.00	43.00	60.00	.00	1992	3	6.70	26.52	42.42	50.00	.00
1983	4	6.00	23.00	42.00	58.00	.00	1992	4	8.14	27.49	44.14	50.30	.00
1984	1	.00	6.55	24.04	39.54	.00	1993	1	.00	9.32	24.94	46.50	.00
1984	2	.00	8.97	22.66	37.00	.00	1993	2	.00	14.76	30.58	48.73	.00
1984	3	6.54	17.83	34.28	34.10	.00	1993	3	4.40	25.03	35.19	55.40	.00
1984	4	6.54	20.22	35.07	46.23	.00	1993	4	8.14	26.24	36.44	70.80	.00
1985	1	.00	7.86	22.70	45.26	41.80	1994	1	.00	8.56	25.91	42.09	.00
1985	2	.00	12.56	28.81	43.38	.00	1994	2	.00	15.22	29.27	46.88	.00
1985	3	8.37	23.10	36.52	58.99	.00	1994	3	5.40	29.26	38.91	53.95	.00
1985	4	6.23	26.97	40.90	.00	.00	1994	4	8.81	31.23	49.59	.00	.00
1986	1	.00	6.69	29.74	44.08	82.51	1995	1	.00	7.70	24.69	50.78	.00
1986	2	.00	14.49	42.92	55.39	.00	1995	2	.00	10.99	22.95	37.69	.00
1986	3	.00	28.81	43.39	47.60	.00	1995	3	5.01	25.37	33.40	45.56	.00
1986	4	7.20	26.90	44.00	.00	.00	1995	4	7.19	24.60	39.57	57.00	.00
1987	1	.00	8.13	28.26	52.93	63.09	1996	1	.00	8.95	21.47	37.58	.00
1987	2	.00	12.59	31.51	.00	.00	1996	2	.00	12.06	25.72	37.94	.00
1987	3	5.80	20.16	34.53	.00	.00	1996	3	3.88	27.81	40.90	50.44	.00
1987	4	7.40	23.36	37.32	46.60	.00	1996	4	5.95	28.09	38.81	56.00	.00
1988	1	.00	9.23	27.31	38.38	69.48	1997	1	.00	7.01	23.11	39.11	.00
1988	2	.00	11.61	33.26	.00	.00	1997	2	.00	11.69	26.40	34.47	.00
1988	3	9.42	26.54	39.82	.00	.00	1997	3	3.61	20.14	31.13	44.03	.00
1988	4	7.91	30.60	43.31	.00	.00	1997	4	10.18	22.11	32.69	38.62	.00
1989	1	.00	7.98	26.74	39.95	.00	1998	1	.00	8.76	22.21	34.65	.00
1989	2	.00	13.49	28.70	44.39	.00	1998	2	.00	12.38	25.50	32.41	.00
1989	3	7.48	26.58	35.44	.00	.00	1998	3	4.82	23.62	31.00	42.82	.00
1989	4	6.69	26.76	34.70	46.50	.00	1998	4	8.32	24.30	30.33	32.89	.00
1990	1	.00	6.51	25.47	37.72	68.00	1999	1	.00	9.50	25.25	37.17	46.00
1990	2	.00	13.75	25.30	40.35	0.00	1999	1	.00	12.67	23.94	35.58	46.00
1990	3	6.40	20.29	32.92	39.40	0.00							
1990	4	6.67	28.70	38.90	52.94	0.00							
1991	1	.00	7.85	20.54	35.43	44.30							
1991	2	.00	12.95	28.75	49.87	.00							
1991	3	6.06	30.95	44.28	67.25	.00							
1991	4	6.64	30.65	43.10	59.37	.00							

Table 12.2.3 Norway pout in the North Sea and Skagerrak. Mean weight at age in the stock, proportion mature and natural mortality.

Age	w(g)				Matprop	M (per quarter)
	Q1	Q2	Q3	Q4		
0	-	-	4.0	6.0	0.0	0.4
1	7.0	15.0	25.0	23.0	0.1	0.4
2	22.0	34.0	43.0	42.0	1.0	0.4
3	40.0	50.0	60.0	58.0	1.0	0.4
4	56.0	56.0	-	-	1.0	0.4

Table 12.3.1 Norway pout in the North Sea and Skagerrak. Danish CPUE data (tonnes/day fishing) by vessel category for 1985-98.

Vessel GRT	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
51-100	11.60	10.83	11.73	20.26	14.64	9.68	12.56	-	-	-	29.53	-	20.00	-
101-150	17.98	19.49	20.70	19.83	19.93	18.21	24.14	26.43	23.72	26.45	39.81	20.67	23.33	-
151-200	20.76	22.97	22.20	23.91	24.06	25.62	28.22	34.20	27.36	31.43	42.77	32.55	28.42	16.85
201-250	24.80	25.20	27.51	30.50	27.43	25.34	29.45	37.50	28.44	40.70	39.60	25.00	34.26	19.48
251-300	22.86	25.12	25.58	24.03	26.10	21.87	28.15	31.90	32.05	37.94	37.91	30.25	32.94	17.48
301-	26.86	26.63	31.10	40.09	28.92	25.91	36.73	41.84	35.10	46.09	59.11	85.38	42.97	32.46

Table 12.3.2 Days fishing and average GRT of Norwegian vessels fishing for Norway pout in the North Sea and Skagerrak by quarter, 1983-1999.

	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
Year	Effort	Aver. GRT	Effort	Aver. GRT	Effort	Aver. GRT	Effort	Aver. GRT
1983	293	167.6	1168	168.4	2039	159.9	552	171.7
1984	509	178.5	1442	141.6	1576	161.2	315	212.4
1985	363	166.9	417	169.1	230	202.8	250	221.4
1986	429	184.3	598	148.2	195	197.4	222	226.0
1987	412	199.3	555	170.5	208	158.4	334	196.3
1988	296	216.4	152	146.5	73	191.1	590	202.9
1989	132	228.5	586	113.7	1054	192.1	1687	178.7
1990	369	211	2022	171.7	1102	193.9	1143	187.6
1991	774	196.1	820	180.0	1013	179.4	836	187.7
1992	847	206.3	352	181.3	1030	202.2	1133	199.8
1993	475	227.5	1045	206.6	1129	217.8	501	219.8
1994	436	226.5	450	223.5	1302	212.0	686	211.4
1995	545	223.6	237	233.8	155	221.7	297	218.1
1996	456	213.6	136	219.9	547	208.3	132	207.2
1997	132	202.4	193	218.9	601	194.8	218	182.3
1998	497	192.6	272	213.6	263	176.8	203	193.8
1999	634	195.6	124	180.3				

Table 12.3.3 Combined Danish and Norwegian fishing effort (standardised) for Norway pout in the North Sea and Skagerrak. These effort numbers are to be used in the assessment.

Year	Quarter 1			Quarter 2			Quarter 3			Quarter 4			Year total		
	Norway	Denmark	Total	Norway	Denmark	Total	Norway	Denmark	Total	Norway	Denmark	Total	Norway	Denmark	Total
1987	441	1169	1610	547	7	554	197	1333	1530	355	1946	2301	1539	4455	5994
1988	316	910	1226	143	3	146	75	464	539	617	1957	2574	1151	3334	4485
1989	146	565	711	483	76	559	1093	1323	2416	1701	2009	3710	3423	3973	7396
1990	408	574	982	2001	616	2617	1165	446	1611	1188	1167	2355	4762	2803	7565
1991	824	979	1803	833	18	851	1027	517	1544	869	1524	2393	3553	3038	6591
1992	901	1682	2583	357	101	458	1087	1213	2300	1191	1264	2455	3536	4260	7796
1993	525	1210	1735	1115	35	1150	1229	1527	2756	547	1650	2197	3416	4422	7838
1994	502	1106	1608	514	27	541	1447	452	1899	761	1283	2044	3224	2868	6092
1995	581	685	1266	256	78	334	165	571	736	315	1561	1876	1317	2895	4212
1996	511	456	967	155	116	271	604	571	1175	145	905	1050	1415	2048	3463
1997	132	321	453	193	5	198	601	1444	2045	218	1413	1631	1144	3183	4327
1998	680	551	1231	516	16	532	272	528	800	283	962	1245	1751	2057	3808
1999	634	402	1036	124	131	255							758	533	1291

Table 12.3.4 Research vessel indices of abundance for Norway Pout in the North Sea and Skagerrak.

Year	IBTS/IYFS[1] February			EGFS[2,3] August				SGFS[4] August			
	1-group	2-group	3-group	0-group	1-group	2-group	3-group	0-group	1-group	2-group	3-group
1970	35	6	-	-	-	-	-	-	-		-
1971	1,556	22	-	-	-	-	-	-	-	-	-
1972	3,425	653	-	-	-	-	-	-	-	-	-
1973	4,207	438	-	-	-	-	-	-	-	-	-
1974	25,626	399	-	-	-	-	-	-	-	-	-
1975	4,242	2,412	-	-	-	-	-	-	-	-	-
1976	4,599	385	-	-	-	-	-	-	-	-	-
1977	4,813	334	-	-	-	-	-	-	-	-	-
1978	1,913	1,215	-	-	-	-	-	-	-	-	-
1979	2,690	240	-	-	-	-	-	-	-	-	-
1980	4,081	611	-	-	-	-	-	-	1,928	346	12
1981	1,375	557	-	-	-	-	-	-	185	127	9
1982	3,315	403	-	6,594	2,609	39	77	8	991	44	22
1983	2,331	663	9	6,067	1,558	114	0.4	13	490	91	1
1984	3,925	802	58	457	3,605	359	14	2	615	69	9
1985	2,109	1,423	71	362	1,201	307	0	5	636	173	5
1986	2,043	384	23	285	717	150	80	38	389	54	9
1987	3,023	469	65	8	552	122	0.9	7	338	23	1
1988	127	760	13	165	102	134	21	14	38	209	4
1989	2,079	260	178	1,530	1,274	621	20	2	382	21	14
1990	1,320	773	46	2,692	917	158	23	58	206	51	2
1991	2,497	677	129	1,509	683	399	6	10	732	42	6
1992	5,121	902	33	2,885	6,193	1,069	157	12	1,715	221	24
1993	2,681	2,644	259	5,699	3,278	1,715	0	2	580	329	20
1994	1,868	375	67	7,764	1,305	112	7	136	387	106	6
1995	5,941	785	77	7,546	6,174	387	14	37	2,438	234	21
1996	912	2,635	234	3,274	1,262	303	2	127	412	321	8
1997	9,752	1,474	670	1,103	5,579	364	32	1	2,154	130	32
1998	1,006	5,343	300	2,684	411	248	0	2,628	938	1,027	5
1999	3,527	597	667	6,358	1,930	88	26	3,603	1,784	180	37

[1]International Bottom Trawl Survey, arithmetic mean catch in no./h in standard area.
[2]English groundfish survey, arithmetic mean catch in no./h, 22 selected rectangles within Roundfish areas 1, 2, and 3.
[3]1982-91 EGFS numbers adjusted from Granton trawl to GOV trawl by multiplying by 3.5.
[4]Scottish groundfish surveys, arithmetic mean catch no./h. Survey design changed in 1998 and 1999. 0-group indices not used from this survey.

Table 12.3.5 Research vessel indices of abundance of Norway pout in the North Sea and Skagerrak. CPUE-data (kg/trawl hour). IBTS 3rd quarter of the year 1991-1999.

Year / Age	0	1	2	3	4	5	6+
1991	7382.9	1104.9	222.2	2.6	0	0	0
1992	2587.8	4365.8	640.2	48.2	2.8	0	0.1
1993	4103.9	1831.5	608.5	52.6	3.3	0	0
1994	3195.8	704.4	101.6	13.5	0.3	0	0
1995	2859.6	4440.2	597.4	68.6	1.7	0	0
1996	4542.6	745.6	388.2	14.7	0.8	0	0
1997	491.2	3398	235.1	46.4	1.6	0	0
1998	2931.4	800.9	747.5	12.1	3	0	0
1999	7832.2	2562.5	204.3	114.8	1.6	0	0.3

Table 12.4.1 Seasonal extended survivors analysis (SXSA) of Norway Pout in the North Sea and Skagerrak.

SURVIVORS ANALYSIS OF: Norway pout 1999

The following parameters were used:

```
Year range: 1983 - 1999
Seasons per year:    4
The last season in the last year is season : 2
Youngest age:  0; Oldest age:  3; (Plus age:  4)
Recruitment in season: 3
Spawning in season: 1
```

The following fleets were included:

```
Fleet  1:   commercial (1983-1999)
Fleet  2:   ibts       (1983-1999)
Fleet  3:   egfs       (1983-1998)
Fleet  4:   sgfs       (1983-1998)
```

The following options were used:

```
1: Inv. catchability:              2
  (1: Linear; 2: Log; 3: Cos. filter)
2: Indiv. shats:                   2
  (1: Direct; 2: Using z)
3: Comb. shats:                    2
  (1: Linear; 2: Log.)
4: Fit catches:                    0
  (0: No fit; 1: No SOP corr; 2: SOP corr.)
5: Est. unknown catches:           0
  (0: No; 1: No SOP corr; 2: SOP corr; 3: Sep. F)
6: Weighting of rhats:             0            (Weighting of rhats: Set to 1.00 for all fleets, years, and quarters of the year).
  (0: Manual)
7: Weighting of shats:             2
  (0: Manual; 1: Linear; 2: Log.)
8: Handling of the plus group:     1
  (1: Dynamic; 2: Extra age group)
```

Data were input from the following files:

```
Catch in numbers:       canum.qrt
Weight in catch:        weca.qrt
Weight in stock:        west.qrt
Natural mortalities:    natmor.qrt
Maturity ogive:         matprop.qrt
Tuning data (CPUE):     tuning.xsa
Weighting for rhats:    rweigh.xsa
```

Table 12.4.1 (Cont'd)

Stock numbers in millions (at start of season)

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	154312.	103073.	*	*	79376.	53207.	*	*	58070.	38921.
1	109341.	69849.	45326.	25614.	66905.	42589.	26704.	13569.	33839.	20829.	13261.	7742.
2	13725.	8138.	4444.	1690.	13652.	8026.	4426.	1589.	6237.	3064.	1935.	648.
3	117.	67.	37.	11.	822.	434.	71.	41.	464.	154.	93.	46.
4+	6.	3.	0.	0.	1.	1.	1.	0.	28.	18.	12.	8.
SSN	24783.				21166.				10113.			
SSB	383546.				380137.				181015.			
TSN	123189.	78056.	204119.	130388.	81381.	51049.	110578.	68406.	40567.	24065.	73371.	47365.
TSB	1072392.	1327890.	1943701.	1279175.	801639.	933442.	1179691.	700451.	394200.	425328.	652565.	441505.

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	114466.	76729.	*	*	33264.	22291.	*	*	90386.	59981.
1	25534.	16791.	11042.	6431.	46871.	29218.	18705.	11207.	14756.	9688.	6416.	4151.
2	2741.	962.	574.	184.	2845.	1578.	1009.	537.	5751.	3282.	2140.	1230.
3	292.	136.	89.	55.	91.	51.	34.	23.	169.	97.	65.	43.
4+	36.	22.	15.	10.	43.	28.	19.	13.	20.	13.	9.	6.
SSN	5623.				7667.				7415.			
SSB	91889.				101483.				144717.			
TSN	28603.	17912.	126186.	83408.	49851.	30876.	53031.	34070.	20696.	13080.	99016.	65411.
TSB	252753.	292627.	763943.	619192.	396771.	496093.	646131.	415360.	237682.	262491.	617847.	509525.

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	101469.	67887.	*	*	98192.	65803.	*	*	170263.	113530.
1	37631.	23803.	15400.	8955.	41532.	26333.	16194.	10060.	43296.	27793.	18110.	10896.
2	2265.	1479.	883.	373.	4577.	2590.	1268.	698.	5777.	2779.	1532.	851.
3	493.	325.	213.	139.	174.	100.	52.	30.	373.	174.	101.	49.
4+	33.	22.	15.	10.	89.	52.	35.	23.	32.	17.	11.	8.
SSN	6554.				8994.				10512.			
SSB	97734.				141741.				174130.			
TSN	40422.	25630.	117980.	77364.	46373.	29075.	115740.	76615.	49479.	30763.	190018.	125333.
TSB	334810.	424846.	841625.	637025.	403392.	490975.	855250.	657271.	446897.	521019.	1205755.	970374.

Table 12.4.1 (Cont'd)

Stock numbers in millions (at start of season)

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	80573.	53290.	*	*	64982.	43480.	*	*	252615.	168804.
1	73248.	46188.	29714.	17088.	34940.	21831.	13968.	8424.	28184.	17275.	11275.	6715.
2	6445.	3431.	2060.	1062.	9175.	5578.	3352.	1500.	4787.	2725.	1593.	723.
3	417.	183.	107.	71.	494.	319.	166.	96.	641.	384.	234.	99.
4+	24.	13.	9.	6.	50.	33.	22.	15.	73.	49.	33.	22.
SSN	14211.				13212.				8319.			
SSB	211082.				248833.				154761.			
TSN	80134.	49815.	112463.	71517.	44659.	27761.	82491.	53515.	33684.	20433.	265750.	176363.
TSB	672542.	819389.	1160121.	761471.	468957.	534925.	763239.	523190.	332318.	373703.	1374861.	1203376.

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	78742.	52209.	*	*	182122.	121487.	*	*	40889.	27320.
1	109682.	70254.	45533.	28438.	33611.	22093.	14350.	8765.	79374.	52656.	35215.	21076.
2	3562.	2191.	1259.	806.	16321.	10308.	6745.	3701.	5343.	3315.	2115.	1113.
3	375.	247.	140.	91.	492.	318.	182.	92.	2208.	1416.	852.	485.
4+	81.	54.	36.	24.	75.	50.	34.	23.	77.	51.	34.	23.
SSN	14986.				20249.				15565.			
SSB	174661.				406451.				265738.			
TSN	113700.	72746.	125709.	81568.	50499.	32769.	203434.	134068.	87002.	57438.	79105.	50017.
TSB	865660.	1143683.	1515789.	1006448.	618203.	700585.	1388225.	1091331.	765796.	976213.	1185979.	723553.

Year	1998				1999	
Season	1	2	3	4	1	2
AGE						
0	*	*	68782.	46029.	*	*
1	18032.	11871.	7795.	4889.	30577.	20366.
2	12554.	7816.	5024.	3099.	2843.	1837.
3	577.	343.	218.	145.	1900.	1184.
4+	312.	202.	119.	80.	140.	92.
SSN	15246.				7940.	
SSB	329355.				167775.	
TSN	31475.	20232.	81939.	54242.	35459.	23479.
TSB	442959.	472258.	699119.	527172.	360410.	432277.

Table 12.4.1 (Cont'd)

Partial fishing mortality for fleet: 1
Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.004	0.032	*	*	0.000	0.052	*	*	0.000	0.021
1	0.048	0.032	0.168	0.224	0.051	0.066	0.270	0.364	0.084	0.051	0.136	0.595
2	0.121	0.201	0.534	0.311	0.129	0.191	0.583	0.751	0.302	0.059	0.641	0.383
3	0.165	0.189	0.748	1.340	0.234	1.139	0.148	0.000	0.648	0.109	0.287	0.000
4+	0.000	1.807	*	*	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000
F (1- 2)	0.084	0.116	0.351	0.267	0.090	0.129	0.426	0.557	0.193	0.055	0.389	0.489

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.000	0.092	*	*	0.000	0.012	*	*	0.010	0.066
1	0.019	0.019	0.138	0.399	0.072	0.046	0.111	0.260	0.021	0.012	0.035	0.202
2	0.603	0.115	0.677	0.290	0.186	0.047	0.226	0.692	0.158	0.028	0.151	0.488
3	0.348	0.026	0.085	0.000	0.173	0.000	0.012	0.302	0.154	0.000	0.000	0.000
4+	0.105	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.311	0.067	0.408	0.345	0.129	0.046	0.168	0.476	0.089	0.020	0.093	0.345

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.002	0.090	*	*	0.000	0.018	*	*	0.005	0.038
1	0.057	0.035	0.140	0.264	0.055	0.085	0.075	0.152	0.043	0.028	0.107	0.123
2	0.026	0.115	0.439	0.350	0.166	0.305	0.192	0.222	0.321	0.192	0.185	0.303
3	0.015	0.023	0.027	0.120	0.149	0.256	0.150	0.176	0.350	0.141	0.306	0.549
4+	0.000	0.000	0.000	0.000	0.145	0.000	0.000	0.000	0.252	0.000	0.000	0.000
F (1- 2)	0.042	0.075	0.290	0.307	0.111	0.195	0.134	0.187	0.182	0.110	0.146	0.213

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.013	0.022	*	*	0.002	0.033	*	*	0.003	0.031
1	0.061	0.041	0.151	0.217	0.070	0.046	0.104	0.162	0.088	0.026	0.117	0.229
2	0.225	0.109	0.256	0.354	0.096	0.108	0.388	0.430	0.161	0.135	0.375	0.250
3	0.405	0.141	0.011	0.035	0.037	0.245	0.148	0.026	0.111	0.096	0.443	0.000
4+	0.167	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.143	0.075	0.203	0.285	0.083	0.077	0.246	0.296	0.125	0.081	0.246	0.240

Table 12.4.1 (Cont'd)

Partial fishing mortality for fleet: 1
Commercial fishery

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.011	0.040	*	*	0.005	0.025	*	*	0.003	0.015
1	0.045	0.033	0.070	0.153	0.019	0.031	0.092	0.094	0.010	0.002	0.112	0.116
2	0.085	0.152	0.046	0.093	0.059	0.024	0.196	0.115	0.076	0.049	0.236	0.252
3	0.018	0.168	0.026	0.041	0.035	0.155	0.273	0.004	0.044	0.107	0.160	0.090
4+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.065	0.093	0.058	0.123	0.039	0.028	0.144	0.104	0.043	0.026	0.174	0.184

Year	1998				1999	
Season	1	2	3	4	1	2
AGE						
0	*	*	0.002	0.009	*	*
1	0.018	0.020	0.066	0.140	0.006	0.018
2	0.073	0.042	0.082	0.088	0.036	0.143
3	0.118	0.053	0.009	0.118	0.072	0.114
4+	0.036	0.122	0.000	0.000	0.020	0.010
F (1- 2)	0.045	0.031	0.074	0.114	0.021	0.081

Log inverse catchabilities, fleet no: 1
Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	15.528	11.663	*	*	15.528	11.663	*	*	15.528	11.663
1	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436
2	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103
3	9.545	8.811	8.985	9.103	9.545	8.811	8.985	*	9.545	8.811	8.985	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	11.663	*	*	15.528	11.663	*	*	15.528	11.663
1	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436
2	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103
3	9.545	8.811	8.985	*	9.545	*	*	9.103	9.545	*	*	*

Table 12.4.1 (Cont'd)

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	15.528	11.663	*	*	15.528	11.663	*	*	15.528	11.663
1	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436
2	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103
3	9.545	8.811	*	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	15.528	11.663	*	*	15.528	11.663	*	*	15.528	11.663
1	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436
2	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103
3	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	*

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	15.528	11.663	*	*	15.528	11.663	*	*	15.528	11.663
1	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436	10.717	10.313	9.933	9.436
2	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103
3	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103	9.545	8.811	8.985	9.103

Log inverse catchabilities, fleet no: 1
Commercial fishery

	1998				1999	
Season	1	2	3	4	1	2
AGE						
0	*	*	15.528	11.663	*	*
1	10.717	10.313	9.933	9.436	10.717	10.313
2	9.545	8.811	8.985	9.103	9.545	8.811
3	9.545	8.811	8.985	9.103	9.545	8.811

Table 12.4.1 (Cont'd)

Log residual stocknr. (nhat/n), fleet no: 1
Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	1.177	-0.175	*	*	-4.134	0.225	*	*	-1.193	-0.398
1	-0.249	-0.589	-0.553	-0.452	-0.048	0.294	0.039	-0.058	0.388	0.855	0.181	0.702
2	-0.490	-0.260	-0.344	-0.458	-0.294	-0.145	-0.138	0.335	0.490	-0.504	0.784	-0.071
3	-0.182	-0.323	-0.006	1.003	0.299	1.639	-1.511	*	1.255	0.116	-0.019	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	0.536	*	*	0.056	-0.493	*	*	1.190	1.019
1	-1.449	-0.531	0.245	-0.257	0.692	0.905	0.374	0.343	-0.286	0.756	0.296	-0.019
2	0.836	-0.230	0.884	-0.925	0.468	-0.561	0.132	0.981	0.588	0.205	0.810	0.533
3	0.286	-1.717	-1.193	*	0.399	*	*	0.165	0.541	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	-1.679	1.012	*	*	-0.423	0.145	*	*	0.667	0.319
1	1.283	0.660	-0.244	-0.003	0.715	-0.005	-0.084	-0.264	0.060	-0.421	-0.055	-0.455
2	-0.670	0.414	0.075	-0.196	0.938	-0.305	0.059	-0.197	0.912	0.395	-1.220	0.122
3	-1.071	-1.220	*	-1.260	1.334	0.060	0.373	0.072	0.997	0.109	-2.272	0.678

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.207	-0.701	*	*	-0.913	0.331	*	*	0.960	0.452
1	-0.007	0.562	0.019	0.051	0.584	0.114	-0.347	-0.093	0.872	0.388	0.235	0.339
2	0.180	0.223	-0.165	0.208	-0.262	-0.465	0.091	0.559	0.331	0.512	0.410	0.095
3	0.781	0.714	-3.309	-1.883	-1.301	0.353	-0.859	-2.396	-0.028	0.166	0.615	*

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	2.635	-0.648	*	*	1.585	0.481	*	*	-1.276	-1.141
1	0.463	0.573	0.376	-0.069	-0.473	-1.467	-0.386	0.101	-0.236	-1.178	-0.175	-0.178
2	-0.076	1.114	-0.873	-0.809	-0.212	-0.994	0.190	-0.029	0.595	0.416	-0.355	0.311
3	-1.615	1.217	-1.251	-1.635	-0.737	1.279	0.574	-3.398	0.279	1.200	-0.482	-0.702

Table 12.4.1 (Cont'd)

Log residual stocknr. (nhat/n), fleet no: 1
Commercial fishery

Year	1998				1999	
Season	1	2	3	4	1	2
AGE						
0	*	*	1.141	-0.963	*	*
1	-1.013	-1.310	0.078	0.312	-1.293	0.394
2	-2.624	-0.949	-0.340	-0.459	-0.710	1.133
3	2.913	-0.448	-2.991	-0.158	-0.023	1.098

Log residual stocknr. (nhat/n), fleet no: 2
ibts

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	-0.889	*	*	*	0.125	*	*	*	0.200	*	*	*
2	-1.164	*	*	*	-0.965	*	*	*	0.463	*	*	*
3	-0.685	*	*	*	-0.739	*	*	*	0.192	*	*	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.421	*	*	*	0.229	*	*	*	-1.808	*	*	*
2	0.088	*	*	*	0.090	*	*	*	-0.142	*	*	*
3	-0.582	*	*	*	1.546	*	*	*	-0.684	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.068	*	*	*	-0.486	*	*	*	0.104	*	*	*
2	-0.341	*	*	*	0.106	*	*	*	-0.196	*	*	*
3	0.801	*	*	*	0.546	*	*	*	0.897	*	*	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.304	*	*	*	0.401	*	*	*	0.263	*	*	*
2	-0.057	*	*	*	0.611	*	*	*	-0.664	*	*	*
3	-0.556	*	*	*	1.184	*	*	*	-0.397	*	*	*

Table 12.4.1 (Cont'd)

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.042	*	*	*	-0.660	*	*	*	0.846	*	*	*
2	0.338	*	*	*	0.015	*	*	*	0.559	*	*	*
3	0.237	*	*	*	1.086	*	*	*	0.639	*	*	*

Log residual stocknr. (nhat/n), fleet no: 2
ibts

Year	1998				1999	
Season	1	2	3	4	1	2
AGE						
0	*	*	*	*	*	*
1	0.060	*	*	*	0.781	*
2	0.991	*	*	*	0.268	*
3	1.211	*	*	*	0.798	*

Log residual stocknr. (nhat/n), fleet no: 3
egfs

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.942	*	*	*	-0.981	*	*	*	-0.901	*
1	*	*	-0.774	*	*	*	0.636	*	*	*	0.181	*
2	*	*	-1.640	*	*	*	-0.471	*	*	*	0.220	*
3	*	*	*	*	*	*	0.250	*	*	*	*	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	-1.819	*	*	*	-1.918	*	*	*	-2.125	*
1	*	*	-0.150	*	*	*	-0.951	*	*	*	-1.603	*
2	*	*	0.733	*	*	*	-0.208	*	*	*	-0.898	*
3	*	*	1.736	*	*	*	-1.728	*	*	*	0.679	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	-0.017	*	*	*	0.580	*	*	*	-0.547	*
1	*	*	0.093	*	*	*	-0.315	*	*	*	-0.707	*
2	*	*	1.637	*	*	*	-0.192	*	*	*	0.542	*
3	*	*	-0.548	*	*	*	1.061	*	*	*	-0.888	*

Table 12.4.1 (Cont'd)

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.853	*	*	*	1.743	*	*	*	0.695	*
1	*	*	1.021	*	*	*	1.120	*	*	*	0.418	*
2	*	*	1.260	*	*	*	1.299	*	*	*	-0.700	*
3	*	*	2.200	*	*	*	*	*	*	*	-1.519	*

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	1.836	*	*	*	0.160	*	*	*	0.565	*
1	*	*	0.556	*	*	*	0.133	*	*	*	0.730	*
2	*	*	0.648	*	*	*	-1.211	*	*	*	0.149	*
3	*	*	-0.481	*	*	*	-2.588	*	*	*	-1.405	*

Log residual stocknr. (nhat/n), fleet no: 3
egfs

Year	1998				1999	
Season	1	2	3	4	1	2
AGE						
0	*	*	0.934	*	*	*
1	*	*	-0.390	*	*	*
2	*	*	-1.165	*	*	*
3	*	*	*	*	*	*

Log residual stocknr. (nhat/n), fleet no: 4
sgfs

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	-1.013	*	*	*	-0.215	*	*	*	0.464	*
2	*	*	-0.941	*	*	*	-1.196	*	*	*	0.571	*
3	*	*	-0.583	*	*	*	0.615	*	*	*	-0.065	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.156	*	*	*	-0.523	*	*	*	-1.672	*
2	*	*	0.635	*	*	*	-0.952	*	*	*	0.471	*
3	*	*	0.476	*	*	*	-0.804	*	*	*	-0.055	*

Table 12.4.1 (Cont'd)

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	-0.194	*	*	*	-0.890	*	*	*	0.280	*
2	*	*	-0.826	*	*	*	-0.399	*	*	*	-0.785	*
3	*	*	0.020	*	*	*	-0.456	*	*	*	0.037	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.655	*	*	*	0.306	*	*	*	0.121	*
2	*	*	0.608	*	*	*	0.572	*	*	*	0.178	*
3	*	*	1.246	*	*	*	0.678	*	*	*	-0.749	*

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.545	*	*	*	-0.069	*	*	*	0.696	*
2	*	*	1.069	*	*	*	-0.229	*	*	*	0.043	*
3	*	*	0.849	*	*	*	-0.278	*	*	*	-0.480	*

Log residual stocknr. (nhat/n), fleet no: 4
sgfs

Year	1998				1999	
Season	1	2	3	4	1	2
AGE						
0	*	*	*	*	*	*
1	*	*	1.353	*	*	*
2	*	*	1.180	*	*	*
3	*	*	-1.039	*	*	*

Table 12.6.1 Trends in Yield, Average fishing mortality for 1- and 2-group, SSB (beginning of year) and Recruitment (0-group beginning of Q3) for Norway Pout in the North Sea and Skagerrak[1]. 1974-1999.

Year	Yield ('000 tonnes)	$F_{av(1-2)}$	SSB ('000 tonnes)	Recruitment ('000 millions)
1974	735.8	1.84	171	176
1975	559.7	1.206	208	212
1976	435.4	1.204	200	198
1977	389.9	0.835	242	102
1978	270.1	0.907	241	201
1979	329.2	1.006	198	233
1980	482.7	1.233	332	61
1981	238.5	0.777	278	306
1982	395.3	1.016	174	238
1983	451.4	0.818	384	154
1984	393.0	1.202	380	79
1985	205.1	1.126	181	58
1986	178.4	1.131	92	114
1987	149.3	0.819	101	33
1988	109.5	0.547	144	90
1989	172.5	0.714	98	101
1990	151.6	0.627	142	98
1991	192.9	0.651	174	170
1992	299.8	0.706	211	81
1993	184.2	0.702	249	65
1994	182.3	0.692	155	253
1995	241.0	0.339	175	79
1996	166.2	0.315	406	182
1997	201.3	0.427	266	41
1998	75.1	0.264	329	69
1999			168	

[1] The estimates before 1983 are based on previous assessment runs which does not include data from Skagerrak

Figure 12.3.1 **CPUE (in number per unit of effort) vs VPA estimates of stock abundance by age and year for corresponding quarters of year. (SXSA VPA-model). Fleets: Combined Danish and Norwegian commercial fleet in North Area 2 (northern North Sea excl. the Norway pout box and exclusive Skagerrak) for all 4 quarters of the year, IBTS in the 1st quarter of the year, the English and Scottish Ground Fish Surveys (EGFS and SGFS) in the 3rd quarter of the year, and IBTS in 3rd quarter of the year. The plots cover the period from 1983 to 1999.**

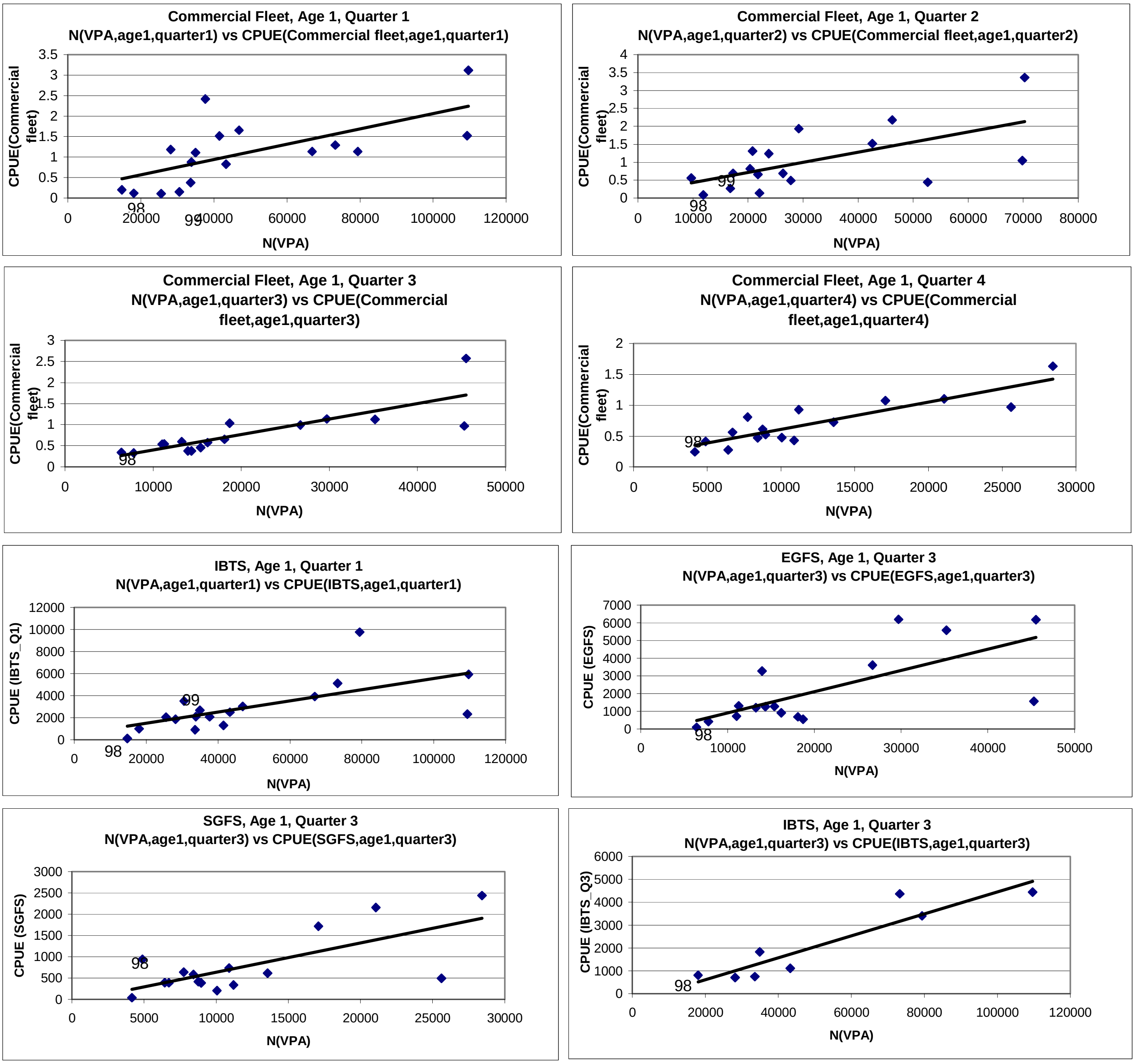


Figure 12.3.2 **CPUE (in number per unit of effort) vs VPA estimates of stock abundance by age and year for corresponding quarters of year. (SXSA VPA-model). Fleets: Combined Danish and Norwegian commercial fleet in North Area 2 (northern North Sea excl. the Norway pout box and exclusive Skagerrak) for all 4 quarters of the year, IBTS in the 1st quarter of the year, the English and Scottish Ground Fish Surveys (EGFS and SGFS) in the 3rd quarter of the year, and IBTS in 3rd quarter of the year. The plots cover the period from 1983 to 1999.**

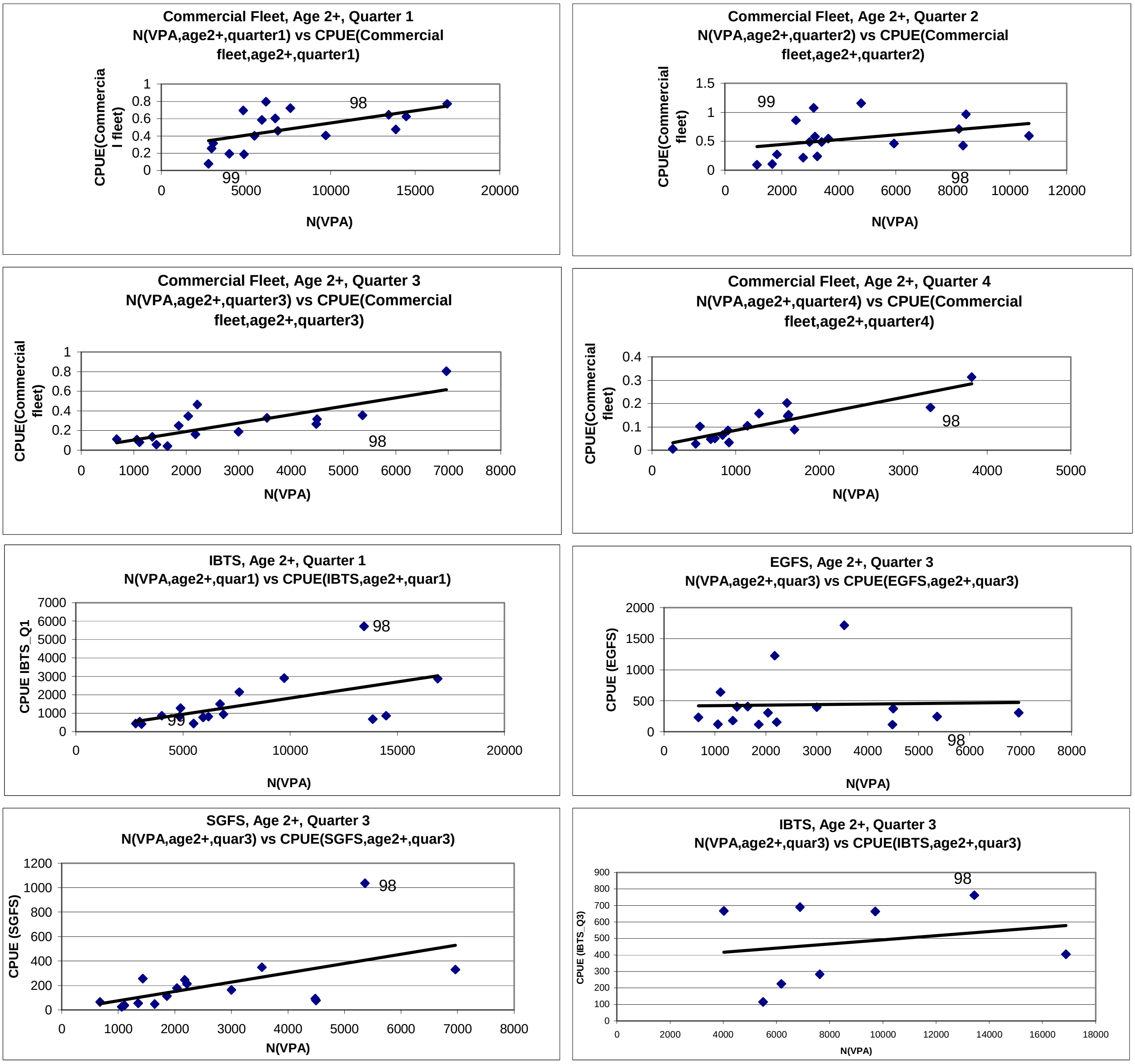


Figure 12.3.3 Plot of quarterly yield by age vs yearly spawning stock biomass (SSB consisting mainly of 2+-group) for Norway pout in the North Sea and Skagerrak for each quarter of the year in the period 1983-1999. For age group 1 yield is plotted vs SSB the following year.

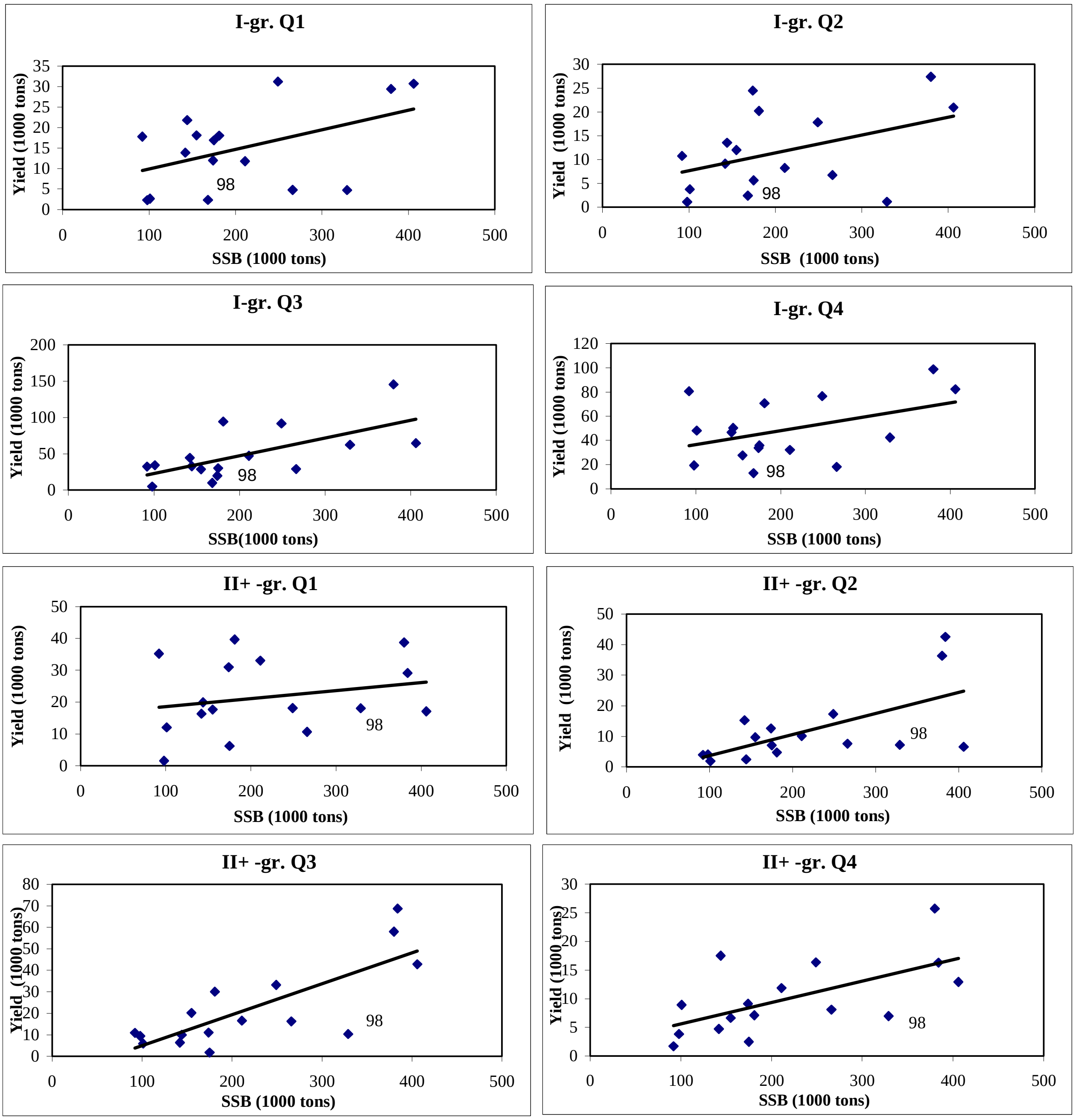
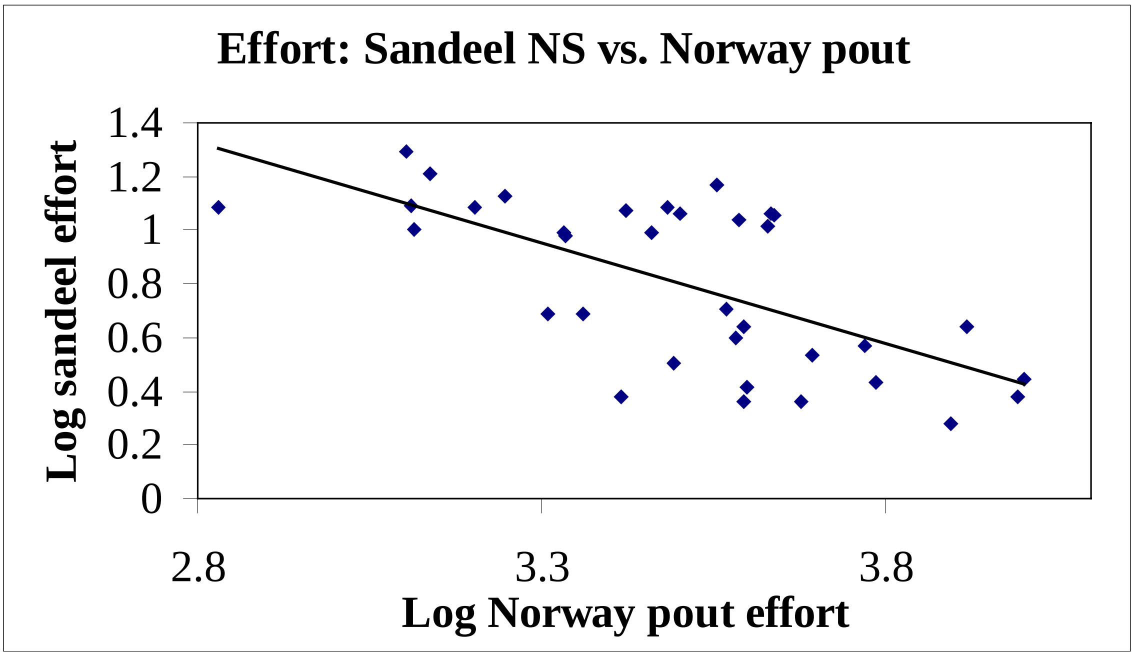


Figure 12.3.4 Correlation between effort for the fleet targeting Norway pout (standardised fishing days) and the fleet targeting sandeel (relative standardised effort). The two plots show the correlation for partly sandeel effort in the whole North Sea (NS, i.e. both the southern and northern area) and the sandeel effort in the northern North Sea alone (NNS). Period: 1982-1999 on half year basis.



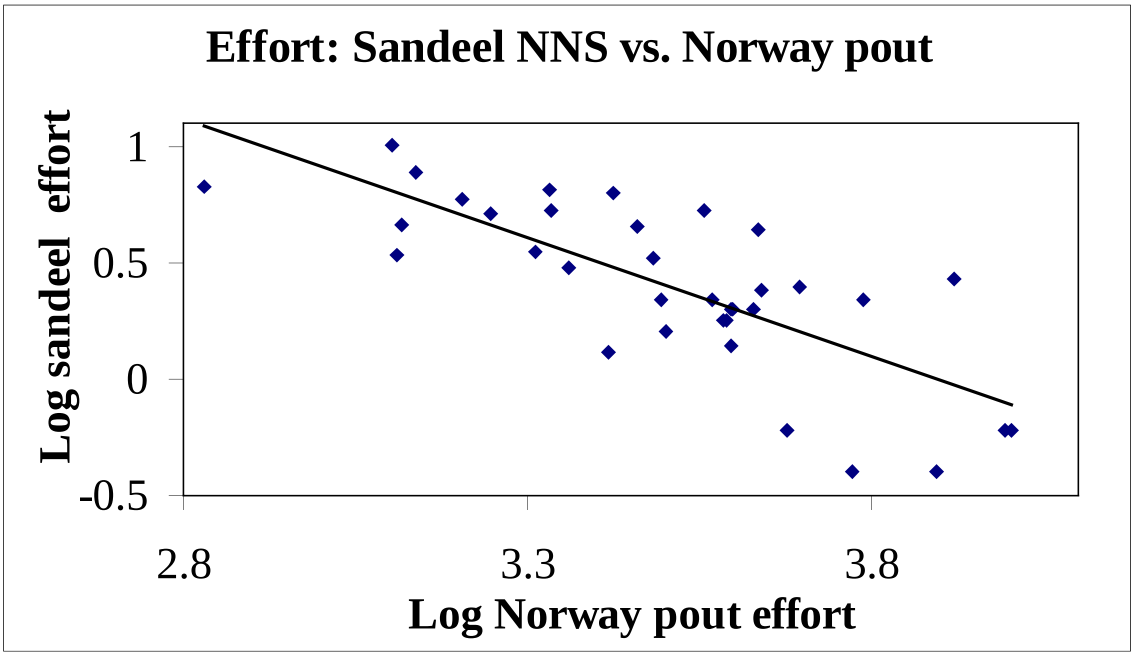
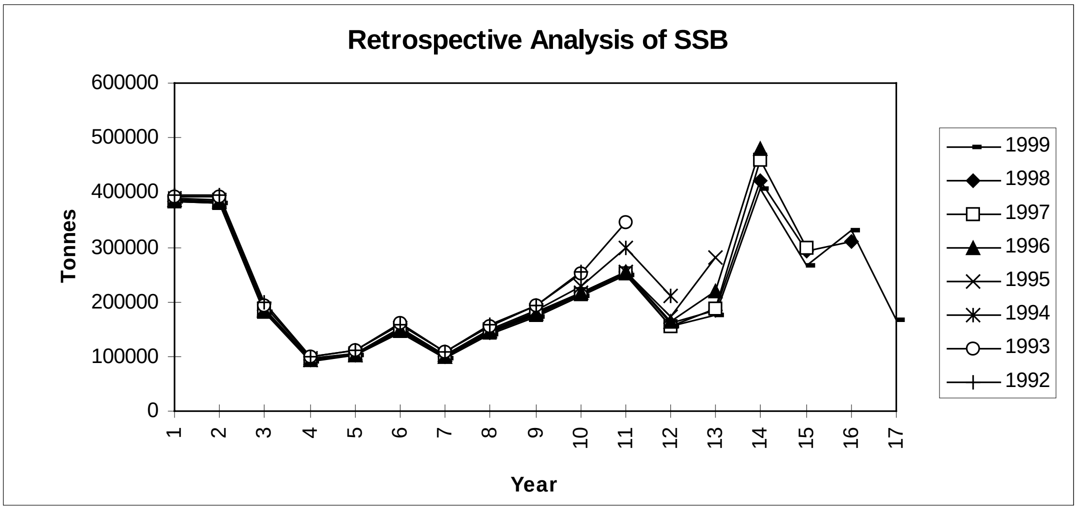
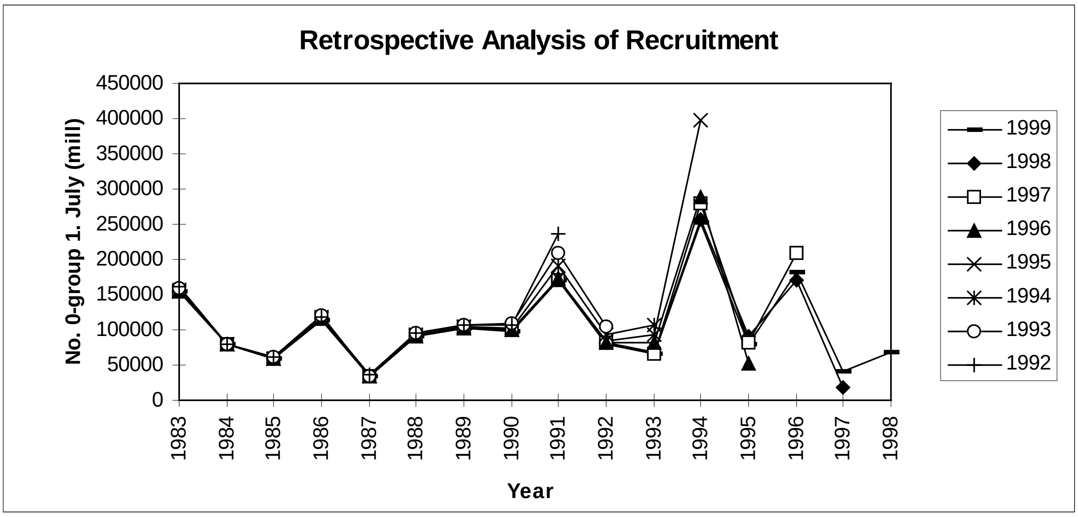


Figure 12.4.1 Norway Pout in the North Sea and Skagerrak. Retrospective analyses of SSB and Recruitment and average $F_{1\text{-}2,ann}$. No shrinkage used.





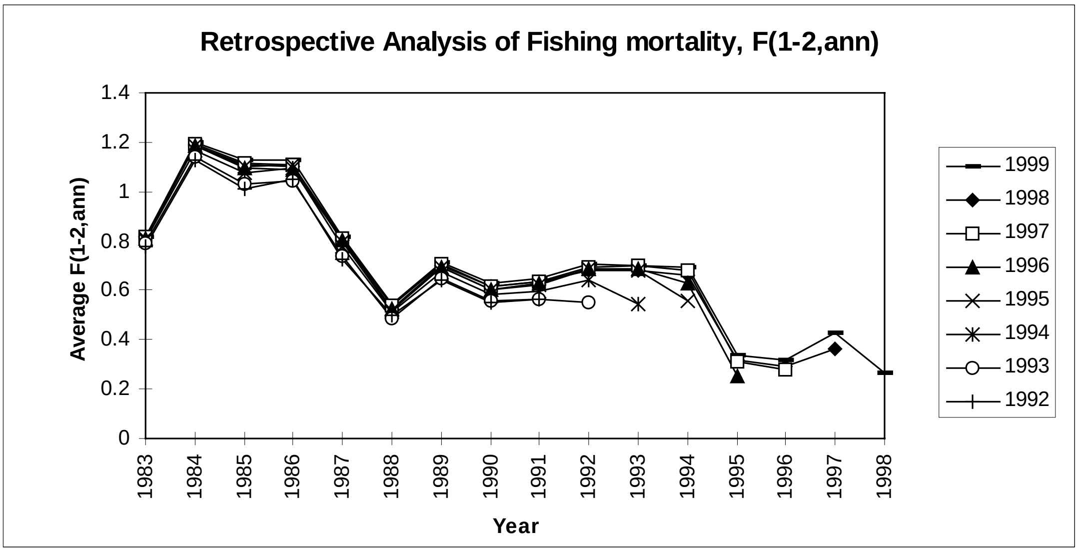


Figure 12.4.2 **Log residual stock numbers per age group divided by fleet and season.**
SXSA-Norway pout in the North Sea and Skagerak.

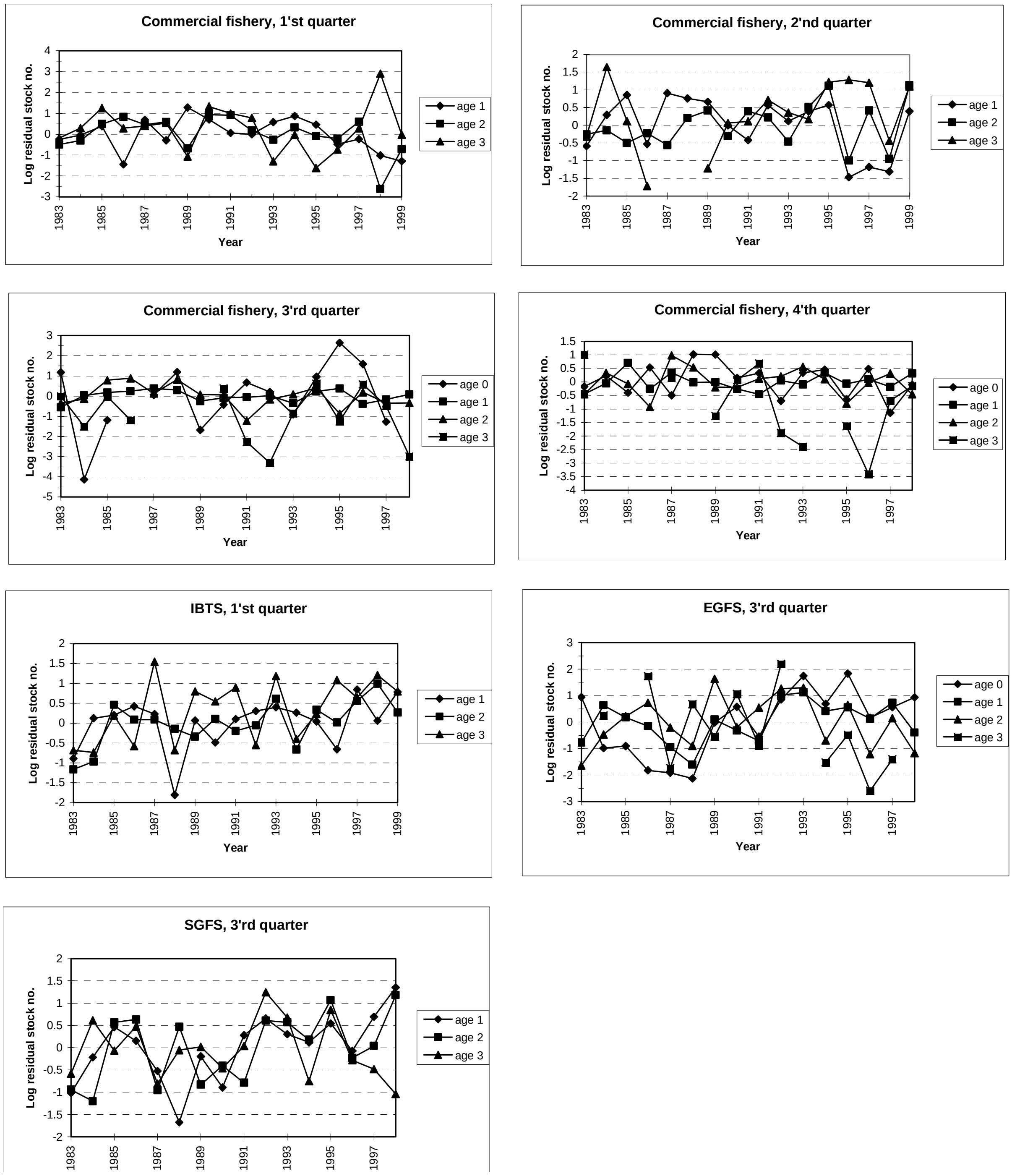
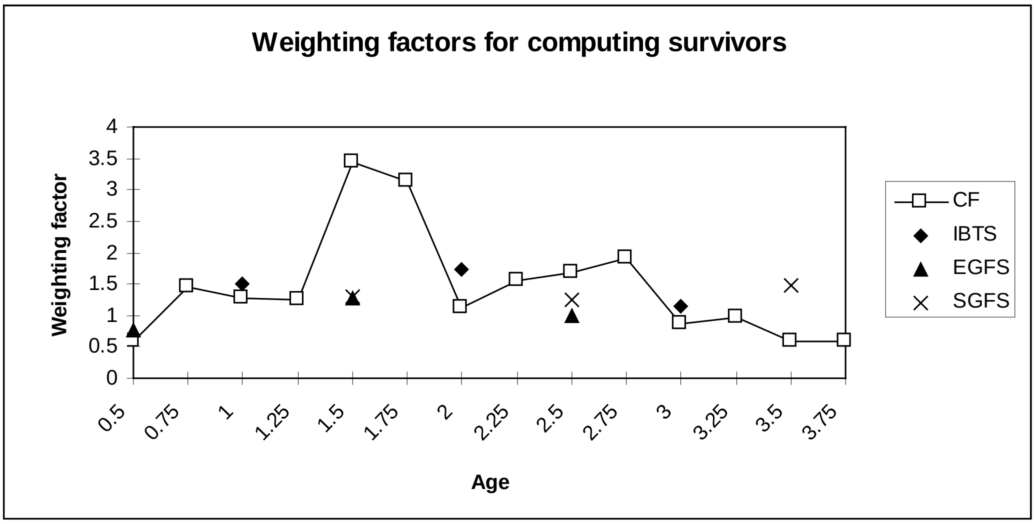
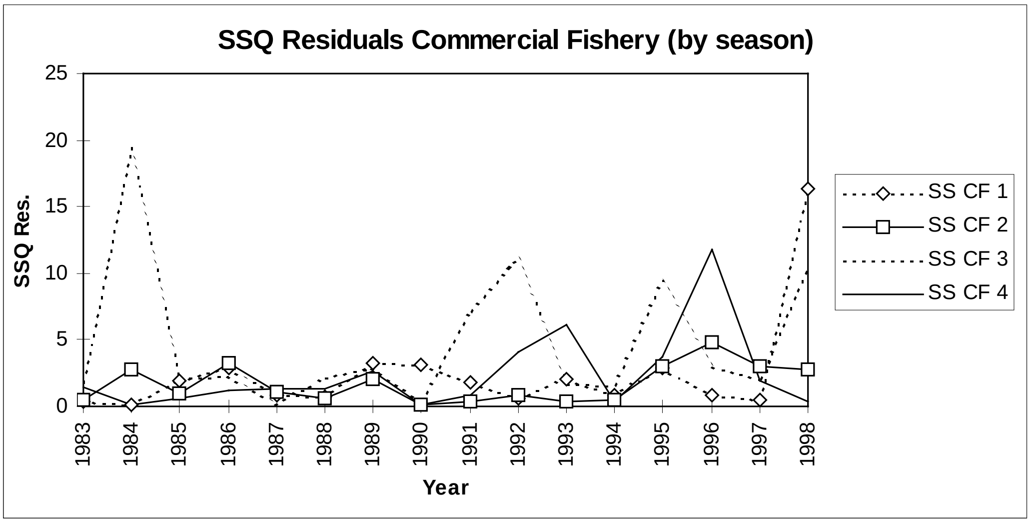


Figure 12.4.3 Norway Pout in the North Sea and Skagerrak. Weighting factors for computing survivors and summed of squared (SSQ) residual stock number for commercial fishery (by season) and for the survey series summed for all age groups. Output from seasonal extended survivors analysis (SXSA). Commercial fishery fleet (CF), IBTS, EGFS and SGFS.





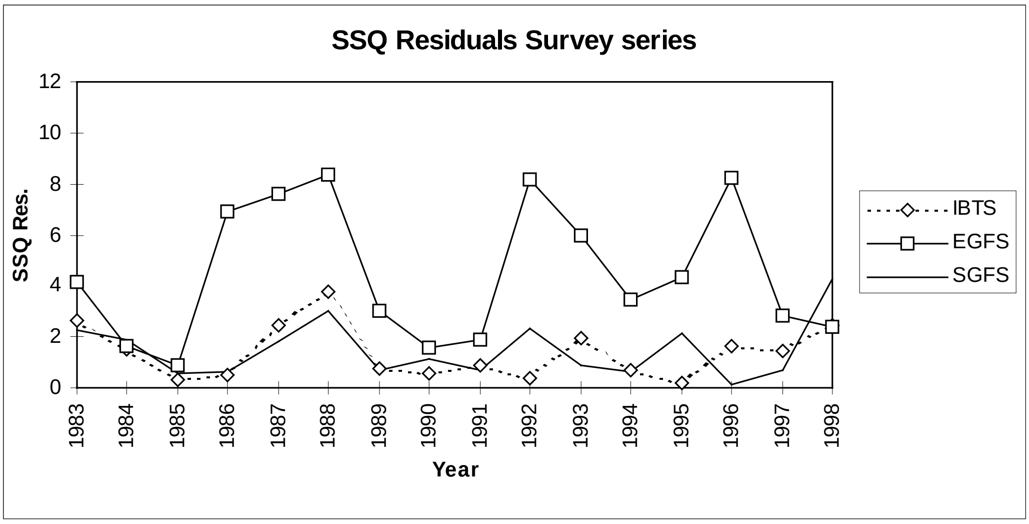


Figure 12.6.1 **Norway Pout in the North Sea and Skagerrak. Historical trends in landings (yield), recruitment at age 0 in 3rd quarter of the year, annual fishing mortality as average for age 1 and 2, and in spawning stock biomass .**

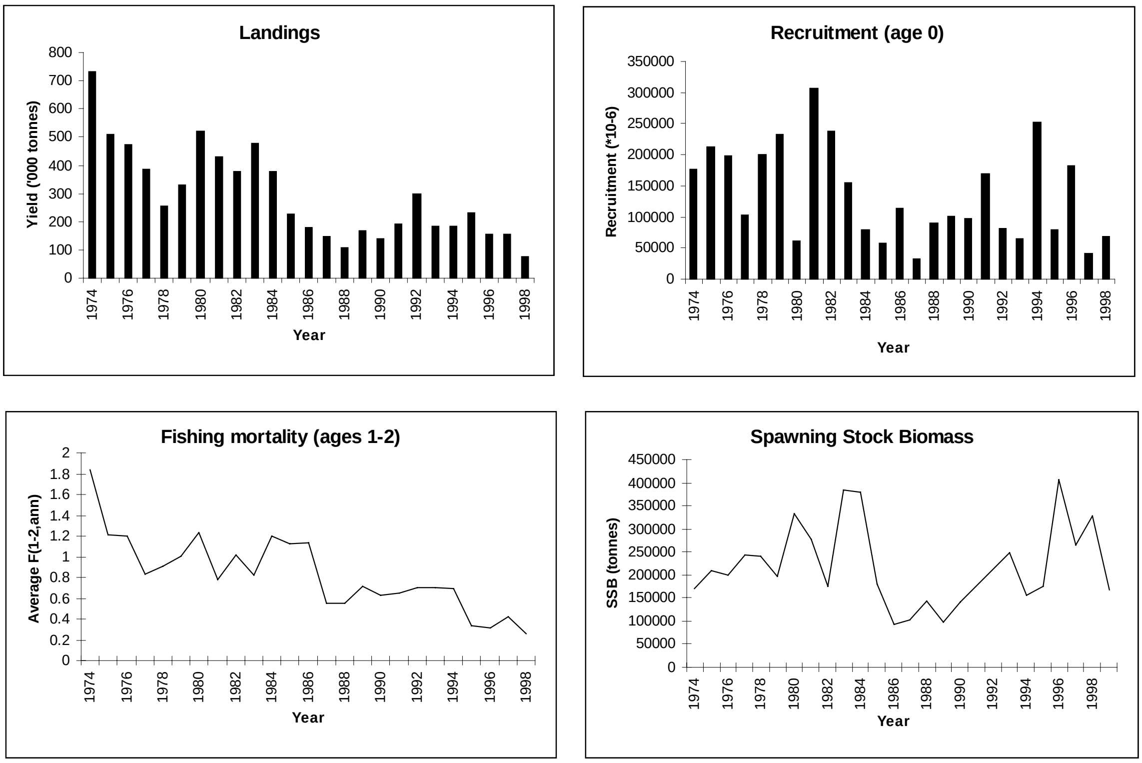


Figure 12.6.2 Norway Pout in the North Sea and Skagerrak. Historical trends in fishing mortality for 1- and 2-group.

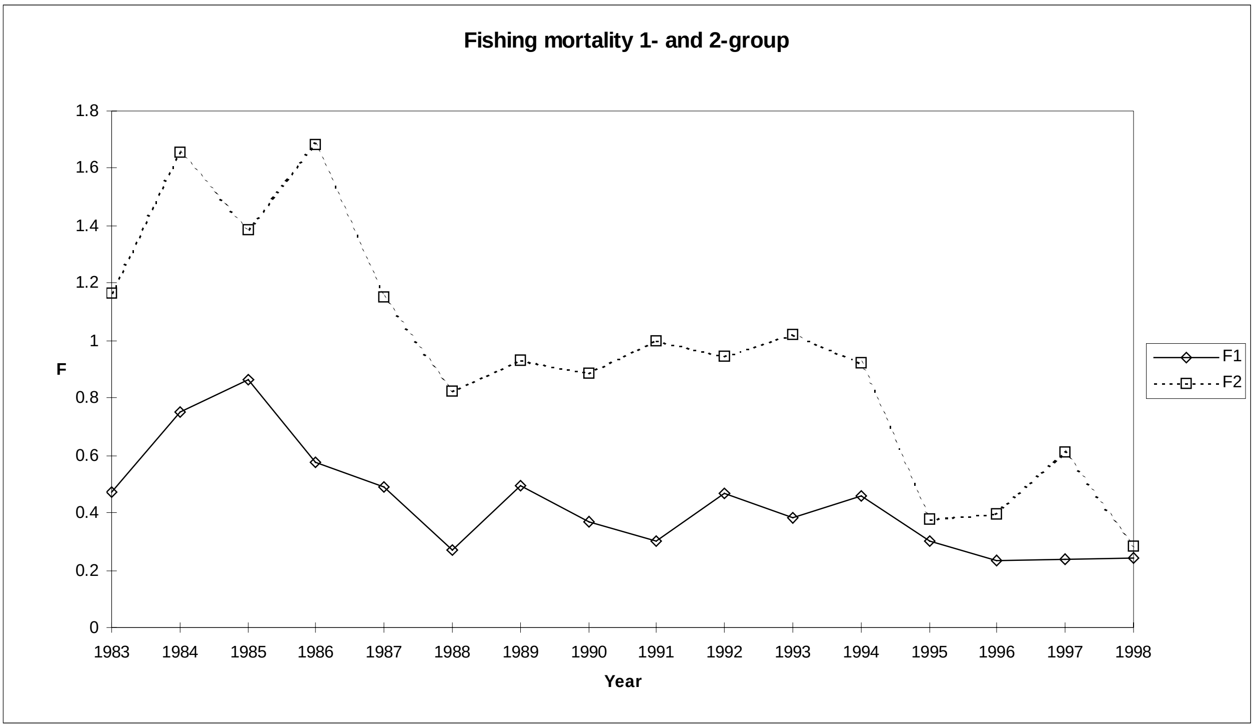


Figure 12.8.1 Recruitment / SSB plot used to calculate F(pa). SXSA - Norway pout in the North Sea and Skagerak. Period: 1974-1998.

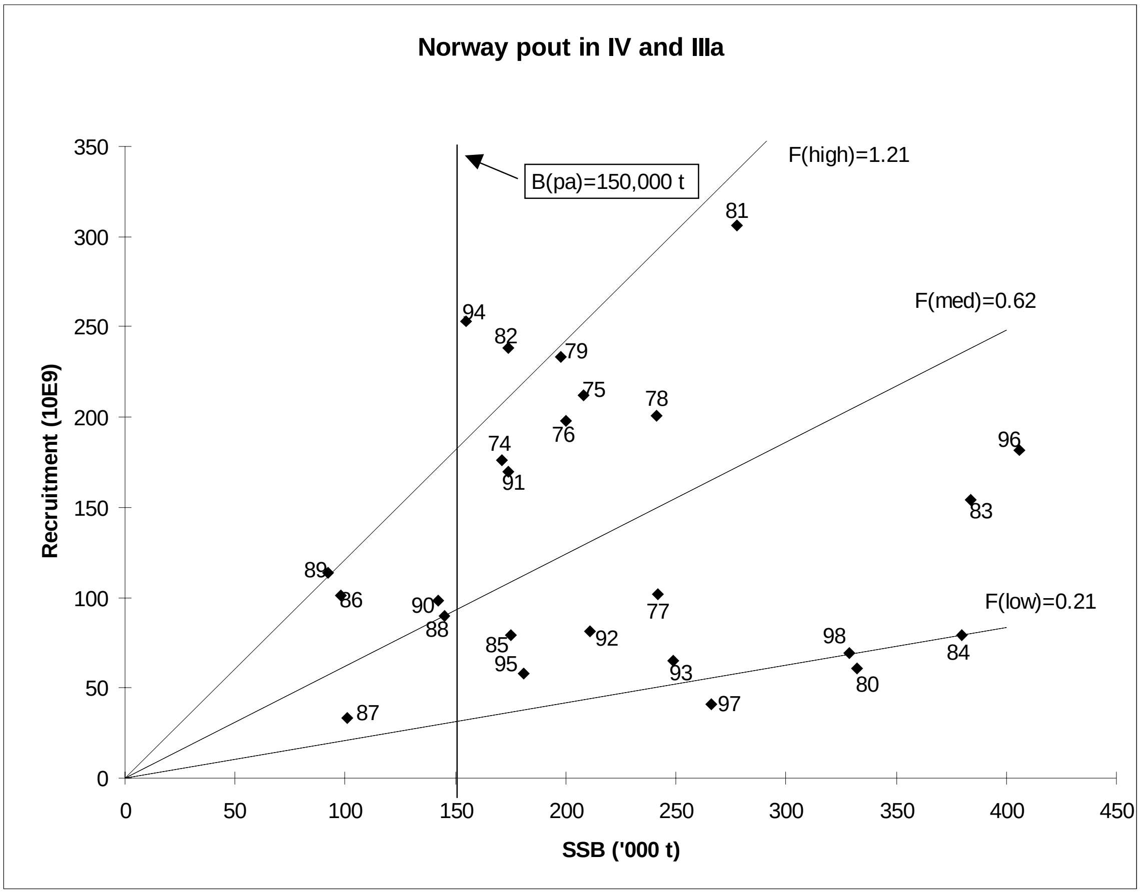
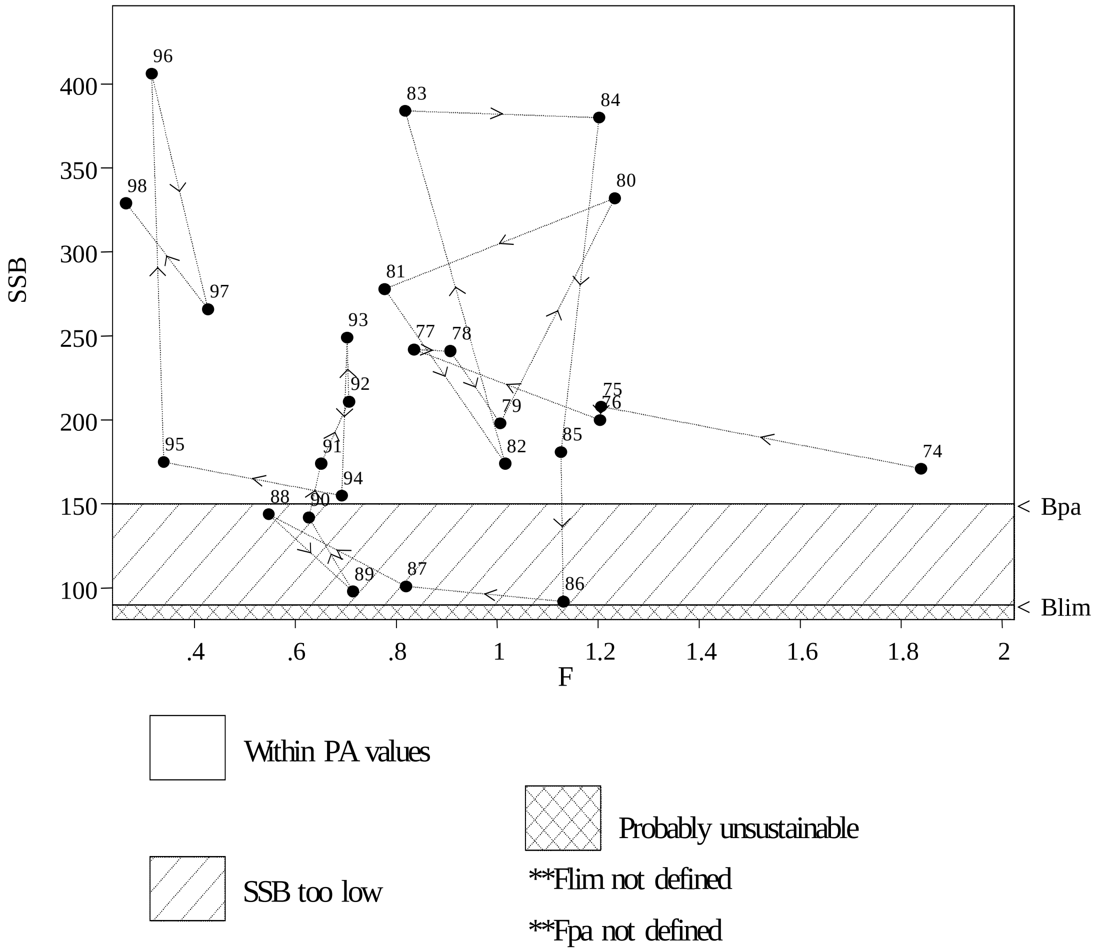
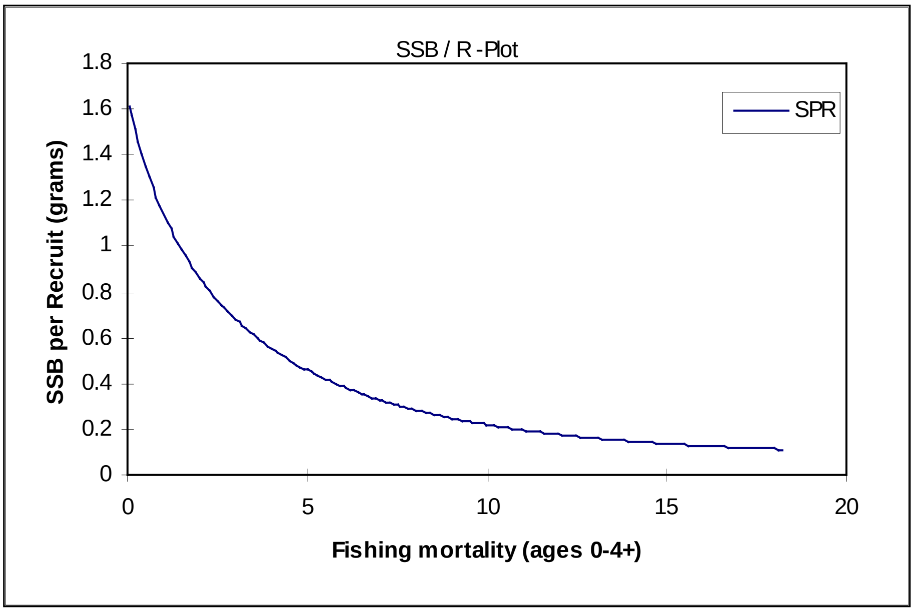


Figure 12.8.2 SSB vs. annual fishing mortality, $F_{ann, 1\text{-}2}$, for Norway pout in the North Sea and the Skagerrak[2].



[2] Results and data previous to 1983 do not include Skagerrak.

Figure 12.8.3 **SSB / R plot and Y / R plot for Norway pout**
in the North Sea and Skagerrak.



13 SANDEEL

13.1 Sandeel in Sub-area IV

13.1.1 The fishery

13.1.1.1 ACFM advice applicable to 1999

There is no management objective set for this stock. There is a need to ensure that the stock remains high enough to provide food for a variety of predator species. The ACFM advice for 1999 was that "the stock can sustain current fishing mortality". The fishing mortality should not to be allowed to increase because the consequences of removing a larger fraction of the food-biomass for other biota are unknown.

"Because of high natural mortality and a few year classes in the fishery, traditional deterministic catch forecasts are not considered appropriate."

In the light of studies linking low sandeel abundance with poor breeding success of some seabird species, ICES advises for 1999 that closure and re-opening sandeel fisheries in area 3 (Figure 13.1.1.1) should be linked to the breeding success of kittiwake. An area is proposed west of 1 ^{o}W (within sandeel area 3) which will exclude all commercial fishing except for a maximum of 10 boat days for stock monitoring. In order to avoid increased fishing pressure to the area immediately west of the closed zone, a TAC of approximately 30,000 for the region east of 1 ^{o}W (within sandeel area 3) region is recommended.

ICES also recommends that the fishery does not exceed historical effort in the remaining areas, particularly sandeel areas 1 and 2. ICES advises that any expansion of the fishery is accompanied by close monitoring of kittiwake productivity.

ACFM proposed 430,000 t as B_{lim} and 600,000 t as B_{pa}. For the first time a TAC was set for this stock in 1998.

13.1.1.2 Management applicable to 1998 and 1999

The TAC of 1 million tonnes was proposed.

13.1.1.3 Catch trends

The overall landings of sandeel in the North Sea decreased from 1,140,000 tonnes in 1997 (the highest on record) to 993,000 t in 1998, of which 62% was landed by the Danish fishery, Table 13.1.1.1. The catch in 1998 is a bit larger than the average of the last 5 years of 930,000 tonnes (Figure 13.1.6.1).

Figure 13.1.1.2 shows the areas for which catches are tabulated in Tables 13.1.1.3 and 13.1.1.4.

The distribution of the fishery by area did not change in 1998 relative to 1997. Figure 13.1.1.3, based on fishermen's logbooks, shows the distribution of catches by quarter and ICES statistical rectangle for 1998 and the first half of 1999.

From 1976 and onwards landings have fluctuated around a long term mean without any particular trend, Fig. 13.1.6.1.

13.1.2 Natural mortality, maturity, age composition, mean weight at age

Values of natural mortality and maturity at age assumed in the assessment were the same as used at previous meetings and are given together with weight at age in the stock in Table 13.1.2.1. Natural mortality is an average over years of multispecies M's. The mean weight at age in the stock by half-year was constructed as a weighted average of the mean weight at age in the catch in the northern and southern North Sea weighted by catch in numbers.

The catch and weight at age data for the southern and northern North Sea were worked up separately. The catch and weight at age data from the northern North Sea were constructed by combining Danish and Norwegian data. Before 1996 the Norwegian age composition data were based on Danish ALK's. For 1997 and onwards the Norwegian age compositions are based on samples from their own fishery. Weight at age are given in Tables 13.1.2.2 and 13.1.2.3.

Catch numbers and weight at age for the southern North Sea were based on Danish age composition data, Tables 13.1.2.4 and 13.1.2.5. Weights at age are average values prior to 1987 in the southern North Sea and 1989 for the northern North Sea.

Tables 13.1.2.3 and 13.1.2.5 shows that mean weight at age for the 1-group for both the northern and southern area year decreased from the first half to the second half of 1998. This has happened before e. g. 1995. One explanation may be that the fleet in the first and second half year is fishing on different parts of the stock due to the behaviour of the sandeel. Research on sandeel behaviour (Winslade, 1974) indicates that the smaller sandeel of a year class remain in the water column for a longer time than the larger sandeel which may imply that the fleet in the second half of the year fish on the smaller fish of the year class compared to the first half. This could lead to lower mean weights in the second half of the year.

13.1.3 Catch, effort and research vessel data

13.1.3.1 Calculation of the total international effort in the sandeel fishery

The data from the southern and northern North Sea were treated as two independent fleets. The fleet fishing in the southern North Sea consists only of Danish vessels except for 1999, which also includes small catches taken by Norwegian vessels. The fleet in the northern North Sea is a mixture of Danish and Norwegian vessels. Total international standardised effort was estimated as described in the WG report from 1996. Input data for these calculations are given in the Tables 13.1.3.1 - 13.1.3.6 and total international effort is given in Tables 13.1.3.4 and 13.1.3.6.

13.1.3.2 Research vessel data

There are no survey data available for this stock.

13.1.4 Catch-at-age analysis

13.1.4.1 Data exploration

The Seasonal XSA (SXSA) developed by Skagen (1993) was used to estimate fishing mortalities and stock numbers at age by half year. The first run assumed the same options as in last years report, Table 13.1.4.1. The resulting VPA stock estimates are given in Table 13.1.4.2. The residuals of log stock number are given in Figure 13.1.4.3.

Partial fishing mortality for the 1-group for the fleet fishing in the southern North Sea in the first half of the year is estimated to equal 0.40 (Table 13.1.4.2), which the highest on record and much higher than the previous years. One should bear in mind that the 1-group of sandeel constitutes the main part of the catches. This high value of terminal F of 0.4 can be explained by the following: Comparison of the CPUE's for the fleets fishing in the southern and northern areas for the 1-group for the first half of the year shows significant conflicting signals as CPUE for 1999 decreases for the northern area and increases for the southern area compared to 1998. This means that the stock numbers for this 1-group estimated by the northern and southern fleets is underestimated and overestimated respectively compared to the combined estimated VPA stock number. This situation is illustrated in Figure 13.1.4.2 showing large negative and positive residuals in first half of 1999 of N estimated by the northern and southern fleets respectively and the VPA N. For the southern area this implies that F will be overestimated while the northern will be underestimated.

Another problem may be that there seems to be a trend in the residuals for the fleet fishing in the northern area in the first half of year from 1993-1999, which is in contradiction with the assumption of constant catchability.

Because of the high F of 0.4 in 1999 for the 1-group in the first half year in the southern area and the trend in catchability another run with the SXSA was tried. For this run an option was applied for which the inverse catchability in the terminal year is computed as a weighted geometric mean over years, which allows for a gradual change of catchability over years. This resulted in a F of 0.29 which is more in line with the previous years. However, the new plot of residual of stock numbers shows that apart from this particular value the new run did not improve the model fit. On that background the WG did not want to change the existing model. The run presented in Table 13.1.4.1 with the standard options was therefore accepted as the final run.

13.1.4.2 Assessment

A plot of fishing mortality versus effort show a correlation (r^2 =0.50) between effort and average fishing mortality for ages 1 and 2, Figure 13.1.4.3.

The retrospective analysis, Figure 13.1.4.1, indicates that the SXSA estimates of sandeel SSB converge rapidly and show no sign of a consistent bias in the most recent estimates.

Recruitment in 1998 is estimated to be 372 billions, which is well below the average (1983-1998) of 623 billion. Because the weight at age of the 0-group in the stock has been set equal to the weight at age in the catch the estimate of total stock biomass in the second half of the year is likely to be an overestimate and should hence be treated with caution.

The stock-recruitment relationship is shown in Figure 13.1.4.5 indicating that there is no relationship between stock and recruitment. This can also be seen from Figure 13.1.6.1 which indicates that a high sandeel year-class is followed by a low year-class and reverse.

Figure 13.1.4.4 shows the relationship between log stock numbers and log CPUE by age of the tuning fleets.

13.1.5 Recruitment estimates

As no recruitment estimates from surveys are available, recruitment estimates are based exclusively on commercial catch-at-age data.

13.1.6 Historical stock trends

Average fishing mortality, recruitment at age 0 and SSB are shown in Table 13.1.6.1 and Figure 13.1.6.1 for the period 1976 to 1998.

Fishing mortality has been fluctuating around the long term average, but appears to have decreased since 1991 to a value below the long-term average of 0.59.

In most years recruitment has been fluctuating with a pattern of alternating strong and weak year classes. The 1996 year class is estimated to be the largest in the time series while the 1997 and 1998 year classes are low.

Spawning stock biomass has fluctuated around a level of 1 million t. Due to the exceptional large 1996 year class the 1998 estimate is the largest since 1976.

13.1.7 Stochastic assessments of historical and predicted stock trends

As stated by ACFM traditional deterministic forecasts are not appropriate because of high natural mortality and a few year classes in the fishery. Furthermore, as increasing focus has been put on the precautionary approach, probabilistic evaluation of undesirable events, e. g. that the spawning stock biomass is falling below a critical limit, has become increasingly important. On that background the need of stochastic assessment models evaluating uncertainties of stock estimates has accordingly been increasing.

A new stochastic Bayesian stock assessment model (Lewy and Nielsen, 1999) was presented. The model is also briefly described in the appendix. The model includes the same type of data as the standard VPA type of models e. g. catch-at-age and effort data for commercial and scientific fleets. All observations - except for the effort data – are assumed to be stochastic variables for which the mean value and the variance have to be estimated.

The model formulated above has been applied to North Sea sandeel for the period 1983-1998 using almost the same data as used by last years ICES Working Group (ICES, 1998). The model assumptions are the same as applied in the seasonal SXA used by the Working Group assuming that catchability by fleet and age is constant over years and that catchabilities for the two oldest true age groups are equal to each other. Data on natural mortality, mean weight at age and proportion mature are also the same as used by the Working Group.

Short and long term, status quo predictions have been carried out simultaneously with the historical analysis in one single run assuming that:

F-at-age by half year in predictions is set to the average of 1988-1998.

Recruitment for each prediction year has been simulated by drawing randomly from the autoregressive recruitment model applied.

Weight at age used in a prediction year is obtained by selecting the weight at age for all age groups from a randomly selected year.

13.1.7.1 Results and Conclusions

The probability distribution of the estimated recruitment and spawning stock biomass in the historical period as well as predictions 10 years ahead are given in Tables 13.1.7.1 and 13.1.7.2 and in Figures 13.1.7.1 and 13.1.7.2.

Comparisons with results of last year WG report are indicated in the two Figures 13.1.7.1 and 13.1.7.2. Recruitment estimates obtained by the two methods seem to be in good agreement as only one year out of 16, the big 1996 year class, lies outside the 95% confidence limits of the stochastic model. In general the SXSA results in a greater recruitment estimate value than the stochastic model. With respect to the spawning stock biomass the picture is different. Even though the trend seems to be similar for the two methods, several SXSA points lie outside the credibility limits. Although the deterministic tuned VPA not is expected to give the same results as a stochastic model the discrepancies can not be explained for the present.

In 1998, the first year of the prediction, recruitment is predicted to $9*10^{11}$ individuals on average with 95% credibility limits of $3*10^{11}$ and $15*10^{11}$ individuals. In the following years recruitment is predicted to $7*10^{11}$ on average individuals with 95% credibility limits of $1*10^{11}$ and $14*10^{11}$ individuals, Figure 13.1.7.1 and Table 13.1.7.1 With such wide credibility limits it is evident that predictions of future spawning stock biomass will be uncertain. In 1999, the first year of prediction for the spawning stock biomass, the 95% credibility limits are predicted to be $3*10^5$ and $9*10^5$ tons, Figure 13.1.7.2 and Table 13.1.7.2 Due to recruitment uncertainty the 95% credibility limits of the predicted spawning stock biomass are even wider in the following years. In the longer term the limits are predicted to be app. $3*10^5$ and $17*10^5$ tonnes. These results underline the large uncertainties inherent in the present sandeel assessment.

13.1.8 Biological reference points

Last year ACFM set B_{lim} to 430,000 t, the lowest observed biomass. The B_{pa} was estimated to 600,000 t, approximately B_{lim} * 1.4. This corresponds to that if SSB is estimated to be larger than B_{pa} then the probability that estimated SSB is less than B_{lim} will be less than 5% (assuming that estimated SSB is log normal distributed with a cv of 0.2).

Figure 13.1.8.1 shows the relationship between B_{pa} and the time series of spawning stock biomass 1983-1999.

Stock recruitment modelling showed no clear indications of a reduction in recruitment at the lower levels of SSB in the time series.

A definition of reference points based on the North Sea assessment assumes that the sandeel stock can be treated as a unit stock. However, it was suggested (Wright, 1998) that sandeel in the North sea may consist of several self-sustained sub-stocks. The use of a reference point for the entire North Sea may therefore be inappropriate and may be replaced by regional reference points.

13.1.9 Comments on the assessment

Comparison of the CPUE's for the fleets fishing in the southern and northern areas for the 1-group for the first half of the year shows significant conflicting signals as CPUE for 1999 decreases for the northern area and increases for the southern area compared to 1998.

As a consequence the present assessment shows large negative and positive residuals in the stock numbers in first half of 1999 estimated by the northern and southern fleets respectively and the VPA. This implies further that partial F for the southern area fleet is overestimated while the northern fleet F is underestimated compared to previous years.

The conflicting signals of the two fleets may be real as the catch weight in the first half of 1999 for the northern fleet decreased by 66% compared to 1998, while it was at the same level as in 1998 for the southern fleet. This corresponds to reports from the fishermen indicating difficulties in finding and catching the 1-group in the first half of 1999 for the northern fleet. Catchability for this period and fleet therefore may have decreased, which is in conflict with the assumption of constant catchability. The conclusion of these problems is that the estimated biomass in the first half of 1999 should be treated with caution.

Another problem with the assessment is that the dynamics of the sandeel stock is mainly driven by changes in natural mortality as this is about twice fishing mortality and is highly variable. Estimates of population size and reference points are very different if annual rather than average natural mortality from the Multi-Species WG group are used.

As mentioned in section 13.1.8 sandeel in the North Sea may consist of several sub-stocks. This implies that the assessment of the combined North Sea area, preferably should be replaced by regional assessments.

13.2 Sandeel at Shetland

13.2.1 Catch trends

The sandeel population adjacent to Shetland has been exploited since the early 1970s. The grounds fished are close inshore and the vessels involved are generally small and local. Seasonal closures were introduced in 1989 following a decline in SSB and recruitment and poor breeding success of sandeel-dependent seabird populations, and the fishery was closed completely from 1991–1994. A restricted fishery has operated since 1995. Landings in 1998 were 5,211 tonnes, which is the highest figure since the fishery was re-opened (Table 13.1.1.4) but still short of the 7,000t TAC.

13.2.2 Assessment

Management of the Shetland fishery is on a three year basis, with management measure being agreed in advance of the fishing season and then reviewed every three years. As a result of this ACFM have previously commented that the assessment of this stock need not be updated annually, but instead the assessments need only reflect the three-year management cycle. For this reason the assessment has not been updated this year.

13.2.3 Management in 1999

The fishery re-opened at the start of the 1998 season with a pre-emptive TAC of 7,000t, limited licensing and seasonal closures. The fishery is closed during the months of June and July to avoid any possibility of the fishery having any impact on the availability of 0-group sandeels to Shetlands seabird populations during their chick-rearing season. These measures remained in place for the 1999 season and will be reviewed in advance of the 2001 season.

13.3 Sandeel in Sub-area IIIa

The catches since 1974 are given in Table 2.2.1.The catches decreased from 81,000 tonnes in 1997 to 11,000 tonnes in 1998 well below the average of 30,000 tonnes.

Table 13.1.1.1. Landings ('000 t) of sandeel from the North Sea, 1952-1998.
(Data provided by Workinggroup members.)

Year	Denmark	Germany	Faroes	Netherlands	Norway	Sweden	UK	Total
1952	1.6	-	-	-	-	-	-	1.6
1953	4.5	+	-	-	-	-	-	4.5
1954	10.8	+	-	-	-	-	-	10.8
1955	37.6	+	-	-	-	-	-	37.6
1956	81.9	5.3	-	+	1.5	-	-	88.7
1957	73.3	25.5	-	3.7	3.2	-	-	105.7
1958	74.4	20.2	-	1.5	4.8	-	-	100.9
1959	77.1	17.4	-	5.1	8.0	-	-	107.6
1960	100.8	7.7	-	+	12.1	-	-	120.6
1961	73.6	4.5	-	+	5.1	-	-	83.2
1962	97.4	1.4	-	-	10.5	-	-	109.3
1963	134.4	16.4	-	-	11.5	-	-	162.3
1964	104.7	12.9	-	-	10.4	-	-	128.0
1965	123.6	2.1	-	-	4.9	-	-	130.6
1966	138.5	4.4	-	-	0.2	-	-	143.1
1967	187.4	0.3	-	-	1.0	-	-	188.7
1968	193.6	+	-	-	0.1	-	-	193.7
1969	112.8	+	-	-	-	-	0.5	113.3
1970	187.8	+	-	-	+	-	3.6	191.4
1971	371.6	0.1	-	-	2.1	-	8.3	382.1
1972	329.0	+	-	-	18.6	8.8	2.1	358.5
1973	273.0	-	1.4	-	17.2	1.1	4.2	296.9
1974	424.1	-	6.4	-	78.6	0.2	15.5	524.8
1975	355.6	-	4.9	-	54.0	0.1	13.6	428.2
1976	424.7	-	-	-	44.2	-	18.7	487.6
1977	664.3	-	11.4	-	78.7	5.7	25.5	785.6
1978	647.5	-	12.1	-	93.5	1.2	32.5	786.8
1979	449.8	-	13.2	-	101.4	-	13.4	577.8
1980	542.2	-	7.2	-	144.8	-	34.3	728.5
1981	464.4	-	4.9	-	52.6	-	46.7	568.6
1982	506.9	-	4.9	-	46.5	0.4	52.2	610.9
1983	485.1	-	2	-	12.2	0.2	37	536.5
1984	596.3	-	11.3	-	28.3	-	32.6	668.6
1985	587.6	-	3.9	-	13.1	-	17.2	621.8
1986	752.5	-	1.2	-	82.1	-	12	847.8
1987	605.4	-	18.6	-	193.4	-	7.2	824.6
1988	686.4	-	15.5	-	185.1	-	5.8	892.8
1989	824.4	-	16.6	-	186.8	-	11.5	1039.1
1990	496.0	-	2.2	0.3	88.9	-	3.9	591.3
1991	701.4	-	11.2	-	128.8	-	1.2	842.6
1992	751.1	-	9.1	-	89.3	0.5	4.9	855.0
1993	482.2	-	-	-	95.5	-	1.5	579.2
1994	603.5	-	10.3	-	165.8	-	5.9	765.5
1995	647.8	-	-	-	263.4	-	6.7	917.9
1996	669.1	-	5	-	160.7	-	9.7	834.8
1997	751.9	-	11.2	-	350.1	-	26.6	1139.8
1998	617.8	-	-	+	343.3	8.5	23.8	993.4

+ = less than half unit.

- = no information or no catch.

Table 13.1.1.2 Sandeel North Sea. Monthly landings (t) by country, 1996-1999. (Data provided by Working Group members).

Year	Month	Denmark	Faroes	Norway	Scotland	Total[1]
1996	Mar	1,202		829	-	2,031
	Apr	30,651		7,720	-	38,371
	May	137,629		45,637	2,742	186,008
	Jun	184,507		50,912	3,740	239,159
	Jul	131,018	n/a	17,610	68	148,696
	Aug	67,913		11,829	-	79,742
	Sep	34,257		11,955	-	46,212
	Oct	13,222		12,480	-	25,702
	Nov	-		927	-	927
	Total	600,399		159,899	6,550	766,848
1997	Mar	15,343		23,005		38,348
	Apr	88,690		52,642		141,332
	May	208,647	n/a	71,951	8029	288,627
	Jun	276,974		107,270	11581	395,825
	Jul	136,708		35,369	2396	174,473
	Aug	22,394		22,811		45,205
	Sept	2,490		24,448		26,938
	Oct	640		13,067		13,707
	Nov	0		-		0
	Total	751,886		350,563	22,007	1,124,456
1998	Mar	14,729		9,332	-	24,061
	Apr	130,629		60,852	2,359	193,840
	May	191,407	n/a	80,885	8,246	280,538
	Jun	204,102		77,929	7,933	289,964
	Jul	56,586		29,457	-	86,043
	Aug	17,894		43,084	-	60,978
	Sept	2,395		37,331	-	39,726
	Oct	17		4,503	-	4,520
	Nov	-		-	-	0
	Total	617,759	0	343,373	18,538	979,670
1999	Mar	6,851		8,496		15,347
	Apr	115,596		24,149		139,745
	May	202,813	n/a	56,961	n/a	259,774
	Jun	97,284		13,394		110,678
	Total	422,544	0	103,000		525,544

Table 13.1.1.3. Monthly landings of sandeels (t) by Denmark and Norway from each area in Figure 13.1, 1994-1998

	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland
1994											
Mar	79	0	21	168	1730	0	0	0	0	0	0
Apr	10512	41080	0	9700	33383	2249	17145	318	0	113	0
May	47346	36777	6	21386	78640	281	83588	1064	10	2314	0
Jun	85405	29250	0	23947	47986	38	41184	10087	2572	16450	0
Jul	13679	1483	0	4966	27474	0	27813	4521	267	23164	0
Aug	0	0	0	1	7794	128	174	0	0	5	0
Sep	0	0	0	1487	5845	0	5048	0	0	0	0
Oct	0	0	0	0	522	0	79	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0
Total	157,021	108,590	0,027	61,655	203,374	2,696	175,031	15,990	2,849	42,046	0
1995											
Mar	0	3,769	0	317	14,428	0	94	0	0	18	
Apr	64,640	29,155	17,990	10,529	26,818	248	123	751	0	171	
May	105,246	9,646	25,901	62,345	47,201	340	27,795	2,267	293	3,539	
Jun	139,864	1,308	68,056	3,874	58,920	369	16,343	12,261	4,424	18,676	
Jul	12,612	0	104	8,811	9,605	0	7,541	11,301	367	25,548	
Aug	0	0	34,151	867	3,242	0	6,507	0	193	7,801	
Sep	0	0	1,234	4	1,683	0	615	0	0	85	
Oct	0	0	0	0	7,555	0	410	0	0	4	
Total	322,361	43,878	147,436	86,747	169,452	957	59,428	26,580	5,277	55,842	1,160
1996											
Mar	0	28	10	0	2,379	0	0	0	0	0	
Apr	8,792	35	1,551	3,944	21,184	0	5,438	247	0	534	
May	78,847	13,217	4,595	13,739	54,993	611	18,817	2,509	455	3,064	
Jun	112,059	81	20,441	12,692	32,264	489	25,078	7,097	1,711	35,186	
Jul	108,624	1,976	59	1,282	9,565	1	22,477	2,885	802	6,034	
Aug	1,313	461	3,679	7,153	8,849	125	34,315	0	0	5,441	
Sep	875	43	767	1,256	12,586	3,307	19,781	0	0	2,262	
Oct	0	2,671	0	726	10,252	0	8,156	0	0	0	
Nov	0	48	0	0	879	0	0	0	0	0	
Total	310,510	18,560	31,102	40,792	152,951	4,533	134,062	12,738	2,968	52,521	1,000
1997											
Mar	17	7,562	2,326	1,402	25,821		1,220				
Apr	23,736	35,036	5,800	11,404	42,308	535	21,745	588		180	
Mai	117,700	6,326	584	24,309	76,216	487	36,499	3,074	1,768	13,636	
Jun	132,631	2,751		37,848	142,941		36,966	1,121	51	29,935	
Jul	58,429	1,235	197	14,212	42,478		11,632	11,057	1,278	31,738	
Aug	1,660	293		1,552	24,113	15	3,497	83	1,602	12,211	
Sep				1,024	23,859	156	1,230			666	
Okt		140		859	12,513		134			61	
Total	334,173	53,343	8,907	92,610	390,249	1,193	112,923	15,923	4,699	88,427	2,100
1998											
Mar	5,631	6,378	322	1,176	8,431	150	697	1,275	0	0	
Apr	55,616	12,943	589	34,884	73,929	351	11,619	482	225	843	
May	80,124	30,002	1,103	41,509	85,448	481	13,613	8,688	1,173	10,151	
Jun	129,065	6,115	0	7,693	86,544	0	9,248	14,485	1,488	27,392	
Jul	6,172	396	0	1,675	43,587	0	2,490	6,750	1,188	23,786	
Aug	149	1,477	0	964	55,421	0	1,852	642	0	473	
Sept	0	676	0	733	37,012	0	1,094	0	0	212	
Oct	0	26	4	0	4,472	0	0	0	0	16	
Total	276,757	58,013	2,018	88,635	394,844	981	40,613	32,322	4,074	62,873	961,129

Table 13.1.1.4 Annual landings ('000 t) of Sandeels by area of the North Sea (Denmark, Norway and UK (Scotland)). Data provided by Working Group members (Figure 13.1).

	Area										Assessment areas[1]		
Year	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland	Northern	Southern
1972	98.8	28.1	3.9	24.5	85.1	0.0	13.5	58.3	6.7	28.0	0.0	130.6	216.3
1973	59.3	37.1	1.2	16.4	60.6	0.0	8.7	37.4	9.6	59.7	0.0	107.6	182.4
1974	50.4	178.0	1.7	2.2	177.9	0.0	29.0	27.4	11.7	25.4	7.4	386.6	117.1
1975	70.0	38.2	17.8	12.2	154.7	4.8	38.2	42.8	12.3	19.2	12.9	253.7	156.5
1976	154.0	3.5	39.7	71.8	38.5	3.1	50.2	59.2	8.9	36.7	20.2	135.0	330.6
1977	171.9	34.0	62.0	154.1	179.7	1.3	71.4	28.0	13.0	25.3	21.5	348.4	392.3
1978[2]	159.7	50.2		346.5	70.3		42.5	37.4	6.4	27.2	28.1	163.0	577.2
1979	194.5	0.9	61.0	32.3	27.0	72.3	34.1	79.4	5.4	44.3	13.4	195.3	355.9
1980	215.1	3.3	119.3	89.5	52.4	27.0	90.0	30.8	8.7	57.1	25.4	292.0	401.2
1981	105.2	0.1	42.8	151.9	11.7	23.9	59.6	63.4	13.3	45.1	46.7	138.1	378.9
1982	189.8	5.4	4.4	132.1	24.9	2.3	37.4	75.7	6.9	74.7	52.0	74.4	479.2
1983	197.4	-	2.8	59.4	17.7	-	57.7	87.6	8.0	66.0	37.0	78.2	419.0
1984	337.8	4.1	5.9	74.9	30.4	0.1	51.3	56.0	3.9	60.2	32.6	91.8	532.8
1985	281.4	46.9	2.8	82.3	7.1	0.1	29.9	46.6	18.7	84.5	17.2	79.7	513.5
1986	295.2	35.7	8.5	55.3	244.1	2.0	84.8	22.5	4.0	80.3	14.0	375.1	457.4
1987	275.1	63.6	1.1	53.5	325.2	0.4	5.6	21.4	7.7	45.1	7.2	395.9	402.8
1988	291.1	58.4	2.0	47.0	256.5	0.3	37.6	35.3	12.0	102.2	4.7	384.8	487.6
1989	228.3	31.0	0.5	167.9	334.1	1.5	125.3	30.5	4.5	95.1	3.5	492.4	526.3
1990	141.4	1.4	0.1	80.4	156.4	0.6	61.0	45.5	13.8	85.5	2.3	219.5	366.7
1991	228.2	7.1	0.7	114.0	252.8	1.8	110.5	22.6	1.0	93.1	+	372.9	458.9
1992	422.4	3.9	4.2	168.9	67.1	0.3	101.2	20.1	2.8	54.4	0	176.7	668.6
1993	196.5	21.9	0.1	26.2	164.9	0.3	88.0	26.6	3.9	48.7	0	276.0	301.9
1994	157.0	108.6	-	61.7	203.4	2.7	175.0	16.0	2.8	42.0	0	489.7	279.5
1995	322.4	43.9	147.4	86.7	169.5	1.0	59.4	26.6	5.3	55.8	1.2	421.2	496.8
1996	310.5	18.6	31.2	40.8	153.0	4.5	134.1	12.7	3.0	52.5	1.0	341.2	419.5
1997	352.0	53.3	8.9	92.8	390.5	1.2	112.9	18.1	4.7	88.6	2.1	566.8	535.8
1998	282.2	58.3	2.0	90.3	395.3	1.0	40.6	34.5	4.2	63.4		497.2	480.7
1999[3]	254.1	50.4	0.1	211.7	86.0	-	19.1	16.1	1.8	22.1		155.6	505.7

[1]Assessment areas: Northern - Areas 1B, 1C, 2B, 2C, 3.
Southern - Areas 1A, 2A, 4, 5, 6.
[2]Catches in area 1B and 1C as well as 2B and 2C given together.
[3]Only January–June included.

Table 13.1.2.1 Sandeel in the North Sea. Natural mortality, maturity and stock weight at age.

Age	Weight at age in the stock			Maturity	Natural mortality	
	1998 Jan-Jun	1998 Jul-Dec	1999 Jan-Jun		Jan-Jun	Jul-Dec
0	1.6	2.5	2.5	0.0		0.8
1	5.0	3.8	5.5	0.0	1.0	0.2
2	8.5	12.1	8.9	1.0	0.4	0.2
3	12.0	13.5	13.4	1.0	0.4	0.2
4+	15.4	17.1	19.4	1.0	0.4	0.2

Table13.1.2.2 SANDEEL, North Sea. Northern area. Mean weight at age (g) in the catch for 1994-1998 and 1999, first half. Data from Denmark and Norway.

1994	Half-year	
Age	1	2
0	1.10	6.58
1	6.43	22.75
2	13.70	30.20
3	15.08	58.07
4	18.18	59.30
5+	21.47	85.00
1995	Half-year	
Age	1	2
0	-	5.08
1	6.95	13.46
2	19.75	14.20
3	24.90	21.00
4	23.01	19.00
5+	31.47	-
1996	Half-year	
Age	1	2
0	-	2.94
1	7.80	10.85
2	14.98	14.92
3	25.93	15.59
4	36.29	20.72
5+	42.04	25.81
1997	Half-year	
Age	1	2
0	2.2	2.1
1	4.6	8.0
2	7.7	10.6
3	13.0	10.7
4+	21.7	17.2
1998	Half-year	
Age	1	2
0	1.6	2.5
1	4.2	3.9
2	8.7	11.1
3	14.2	20.1
4+	28.6	13.4
1999	Half-year	
Age		
0	2.5	
1	5.7	
2	8.1	
3	13.0	
4+	20.6	

Table 13.1.2.3 SANDEEL, North Sea. Southern area. Mean weight at age (g) in the catch for 1992–1998 and 1999 first half.

1994	Half-year	
Age	1	2
0		
1	6.07	8.56
2	11.01	17.16
3	13.46	19.50
4	16.17	23.29
5	17.90	26.25
6	18.49	
7	19.15	
1995	**Half-year**	
Age	1	2
0	-	-
1	7.30	6.60
2	13.20	13.60
3	16.60	17.70
4	19.50	20.90
5	25.00	21.30
6	20.00	21.20
7+	-	30.00
1996	**Half-year**	
Age	1	2
0	-	2.3
1	5.6	9.9
2	8.3	16.7
3	13.2	21.8
4	15.9	31.5
5	17.9	33.3
6	18.0	36.8
7		43.8
1997	**Half-year**	
Age	1	2
0	-	4.7
1	6.5	8.0
2	10.9	13.5
3	11.8	14.7
4+	16.3	18.9
1998	**Half-year**	
Age	1	2
0	-	2.8
1	5.5	3.0
2	8.4	12.7
3	10.6	11.6
4+	13.2	17.1
1999	**Half-year**	
Age	1	
0	-	
1	5.5	
2	9.3	
3	13.6	
4+	18.4	

Table 13.1.3.1 Sandeel. Northern North Sea. Danish CPUE data (t/day) by half year

Year	Vessel size (GRT)						
	0-50	50-100	100-150	150-200	200-250	250-300	>300
First half year							
1982	11.2	17.2	31.8	26.7	47.6	40.8	25.8
1983	11.1	17.1	23.6	23.9	31.6	36.4	41.3
1984	14.6	24.8	33.4	32.1	44.4	55.5	19.7
1985	12.1	17.2	35.7	51.2	57.9	67.2	55.8
1986	21	32	45.5	50.2	63.9	57.4	71.8
1987	23.7	37.8	67	66.5	78.6	79.9	113
1988	19	25.6	34.4	42.5	48	47.8	75.3
1989	16.3	25.2	36.7	41	49.6	51.4	76.2
1990	14.5	21.6	27.3	27.8	29.5	27.4	39.7
1991	16.7	25.5	38.4	42.5	47.6	47.5	72.2
1992	16.6	24.6	36.3	34.7	60.6	46.9	76.9
1993	14.9	19.3	33.6	36.5	47.2	51.1	51.8
1994	26.9	32	53.9	61.8	75	87.9	102.5
1995	19.6	29.5	49.5	57.8	61	66.9	73.6
1996	16.5	21.1	35.9	39.1	36.7	40	56.2
1997	24.9	34.9	51.4	56.1	76.8	58.9	90.4
1998	16.9	24.4	28.7	44.6	52.8	54.3	64.8
1999	24.2	27.3	22.7	34.9	40.4	47.3	67.4

Year	Vessel size (GRT)						
	0-50	50-100	100-150	150-200	200-250	250-300	>300
Second half year							
1982	-	17.7	33.6	46.7	19.9	-	-
1983	17.9	25.7	31	32.9	44.5	34.3	57.1
1984	113.2	22	21.5	35.2	-	28.3	24
1985	21.6	23.5	25.8	39.6	60.7	33.3	-
1986	17.1	27.5	50.2	50	77.9	74	80.7
1987	21.3	31.8	23.9	24.3	42.6	25.4	46.3
1988	16.8	21.3	30	32.4	38	33.1	43.9
1989	16.6	22.3	23.6	27.3	28.3	35.6	25
1990	17.6	32.5	29.4	34.1	40.4	32.6	53.3
1991	15.1	26.3	40.8	44.8	54.4	51.3	72.5
1992	20.4	25.4	35.2	38.2	53.6	50.9	52.1
1993	18.5	21.4	26.5	27.5	38.8	47.9	59
1994	24.3	31.5	42.7	53.5	59.8	65.8	74.6
1995	21.9	34.6	46.1	53.8	58.6	62.7	68.6
1996	15.3	30.6	41.9	37.8	47.4	44.9	47.3
1997	14.1	26.2	32.5	34.1	40.2	33.6	43.3
1998	12.4	18.9	14.4	28	33.1	31.1	38.5

Table 13.1.3.2 Sandeel. Southern North Sea. Danish CPUE data (t/day) by half year

Year	Vessel size (GRT)						
	0-50	50-100	100-150	150-200	200-250	250-300	>300
First half year							
1982	16.1	26.9	43.1	47.2	59.2	53/2	59.6
1983	17	20.6	36.3	44.4	49.1	51.2	50.9
1984	19.9	26.3	42.6	50.4	60.9	56.4	60.1
1985	13.8	21.2	35.5	43.4	49.8	49.1	56.3
1986	23.2	31.4	41.1	49.8	58.9	58.4	69.4
1987	23.9	33.9	53.9	67.4	76.1	76.4	115.5
1988	19.2	26.8	42.9	52.3	60	56.6	82.8
1989	19.4	24.5	43.3	52.3	58.9	55.2	74.3
1990	20	20.8	30.4	33.7	39.8	35.7	49.1
1991	27	30	49.5	50.3	62.8	60.7	92.8
1992	18.4	23.4	53.1	63.2	83.8	82.4	115.9
1993	17.2	18.1	38.1	40.2	58.6	60.9	89.5
1994	24.6	29	59.1	59.5	75.2	78.9	96.6
1995	23.6	33.2	63.7	63.5	68	80	0.8
1996	23.4	25.3	40.9	48.4	58.8	56.4	84.1
1997	32.2	36.7	60.1	55.9	86.5	90.3	124.9
1998	20	27.1	40.7	44.7	58	60.9	87.7
1999	19.7	28.2	38.2	43.5	55	52.3	66

Year	Vessel size (GRT)						
	0-50	50-100	100-150	150-200	200-250	250-300	>300
Second half year							
1982	-	20.3	37.5	40.5	-	27.9	-
1983	15.1	21.3	25.1	32.4	45.4	34	34.7
1984	12.7	16.4	26.9	34.2	36.5	40.2	40.9
1985	13.2	19.5	26	35.8	36.2	38.2	39.4
1986	18.4	25.2	32.5	44.5	45.8	51.8	55.5
1987	16.2	22.6	41.4	45.8	49.3	45.6	75.4
1988	18.8	29.3	29.9	31.1	38.6	31.1	44
1989	26.7	26.2	27	38.3	38	29.3	40.4
1990	27.9	32.8	36.4	41.3	48.3	45.2	42.7
1991	21.4	26.8	41.8	49.4	65.1	53.7	98.3
1992	21.3	28.7	36.7	42.6	44.8	39.1	58.3
1993	20.2	22.7	30.8	35.6	45.3	39.3	51.8
1994	28.6	38.9	50.4	54.3	60.7	56.9	65.2
1995	28.6	42.2	50.2	53.3	72.4	60.8	73.9
1996	22.9	23.3	56.3	69.4	81	87.5	123.6
1997	22.9	25.9	35.5	41.7	54.8	51	74.9
1998	12.8	17.9	19.1	36.5	36.5	32.7	40

Table 13.1.3.3 Sandeels North Sea. Danish CPUE data. Parameter estimates from regressions of ln(CPUE) versus ln(Av. GRT) together with estimates of standardized CPUE (200 GRT)

$$CPUE = b \cdot GRT^{a}$$

Northern North Sea

	Jan-Jun				Jul-Dec			
Year	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**
1987	0.57	3.60	0.98	75.2	0.20	11.22	0.58	31.9
1988	0.48	3.58	0.95	46.4	0.36	5.06	0.96	33.9
1989	0.55	2.54	0.98	47.5	0.23	8.11	0.87	27.3
1990	0.33	5.13	0.95	29.4	0.33	6.37	0.89	37.3
1991	0.52	2.99	0.97	46.5	0.58	2.31	0.99	49.4
1992	0.55	2.55	0.94	47.0	0.41	5.05	0.96	43.7
1993	0.54	2.40	0.97	40.9	0.43	3.86	0.90	37.4
1994	0.54	4.02	0.96	70.3	0.45	5.20	0.98	56.1
1995	0.54	3.36	0.99	57.8	0.45	5.15	1.00	55.5
1996	0.44	3.74	0.95	38.9	0.43	4.3	0.96	42.3
1997	0.47	5.11	0.95	62.6	0.40	4.24	0.96	35.6
1998	0.54	2.66	0.97	45.9	0.44	2.73	0.89	27.7
1999	0.35	6.43	0.79	40.4				

Southern North Sea

	Jan -Jun				Jul-Dec			
Year	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**
1987	0.58	3.28	0.97	71.7	0.55	2.54	0.95	47.4
1988	0.55	3.00	0.97	54.7	0.27	8.17	0.91	34.4
1989	0.53	3.18	0.96	52.6	0.15	15.33	0.69	33.7
1990	0.34	5.93	0.92	35.8	0.20	14.18	0.94	41.8
1991	0.45	5.54	0.93	58.8	0.54	3.23	0.93	56.3
1992	0.74	1.41	0.96	70.6	0.34	6.85	0.95	42.5
1993	0.64	1.67	0.93	51.0	0.37	5.56	0.94	38.5
1994	0.55	3.60	0.96	67.8	0.32	10.23	0.99	55.6
1995	0.55	3.71	0.97	69.6	0.36	8.88	0.97	60.1
1996	0.48	4.14	0.93	53.3	0.68	1.97	0.93	73.8
1997	0.51	5.17	0.92	76.7	0.44	4.67	0.93	48.3
1998	0.54	3.06	0.96	54.1	0.47	2.61	0.93	31.0
1999	0.46	4.19	0.99	48.4				

Table 13.1.3.4 SANDEEL Southern North Sea. Standardized CPUE, based on Danish data.

Year	Half-year	CPUE (t/day)	Total Int'l Catch ('000 t)	Total Int'l fishing effort ('000 days)
1982	1	48.2	426.5	8.9
	2	35.7	52.6	1.5
1983	1	42.8	359.8	8.4
	2	33.9	59.3	1.8
1984	1	50.5	461.1	9.1
	2	32.9	71.1	2.2
1985	1	41.9	417.1	10.0
	2	33.6	110.6	3.3
1986	1	53.7	386.4	7.2
	2	44.1	75.5	1.7
1987	1	71.7	297.7	4.2
	2	47.4	105.1	2.2
1988	1	54.7	462.0	8.5
	2	34.4	33.4	1.0
1989	1	52.6	506.1	9.6
	2	33.7	18.5	0.5
1990	1	35.8	341.7	9.5
	2	41.8	24.0	0.6
1991	1	58.8	326.6	5.6
	2	56.3	132.3	2.4
1992	1	70.6	621.1	8.8
	2	42.5	73.0	1.7
1993	1	51.0	267.7	5.3
	2	38.5	34.2	0.9
1994	1	67.8	226.4	3.3
	2	55.6	47.6	0.9
1995	1	69.6	429.2	6.2
	2	60.1	67.6	1.1
1996	1	53.3	292.5	5.5
	2	73.8	138.7	1.9
1997	1	76.7	421	5.5
	2	48.3	139	2.9
1998	1	54.1	448	8.3
	2	31.0	43	1.4
1999	1	63.1[1]	429	6.8

[1]Weighted average of Danish and Norwegian CPUE

Table 13.1.3.5 Sandeel in the northern North Sea. Norwegian effort data.

Year	Fishing days		Mean gross register tonnage (GRT)[1]	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
1976	595		198.8	
1977	2212	457	172.3	184.9
1978	1747	806	203.4	203.7
1979	1407	1720	213.8	188.9
1980	2642	1099	215.5	210.3
1981	1740	404	216.6	190.9
1982	1206		209.1	
1983	304	66	254.6	191.1
1984	145		182.6	
1985	366		219.5	
1986	1562	567	201.1	187.4
1987	2123	1584	218.8	200.9
1988	3571	925	203.3	198.2
1989	4292	588	192.3	202.1
1990	2275	731	207.9	189.2
1991	1749	958	199.7	194.1
1992	1202	23	204.5	212.7
1993	1462	971	230.9	200.6
1994	2559	742	222.3	226.5
1995	3305	980	215.7	217.6
1996	1935	724	223.9	218.6
1997	3354	1484	217.9	221.2
1998	2567	2176	222.1	219.2
1999	2023		261.9	

[1]Av. GRT pr. trip

Table 13.1.3.6 Fishing effort indices for SANDEEL in the Northern North Sea (days fishing multiplied by scaling factors for each vessel category to represent days fishing for a vessel of 200 GRT).

Year	Norwegian			Danish		Mean CPUE (t/day)	Total Intnat. catch ('000 t)	Derived Intnat. effort ('000 days)
	Standardized fishing days	Catch sampled for fishing effort ('000 t)	CPUE (t/day)	Catch sampled for fishing effort ('000 t)	CPUE (t/day)			
				First half of year				
1976	593	11.1	18.7	-	-	18.7	110.3	5.9
1977	2,061	50.4	24.4	-	-	24.5	276.0	11.2
1978	1,761	44.9	25.5	-	-	25.5	109.7	4.3
1979	1,451	29.6	20.4	-	-	20.4	47.7	2.3
1980	2,733	112.8	41.3	-	-	41.3	220.9	5.4
1981	1,804	42.8	23.7	-	-	23.7	93.3	3.9
1982	1,231	26.9	21.9	13.5	34.9	26.2	62.3	2.4
1983	338	8.7	25.7	17.4	28.9	27.8	54.5	2.0
1984	139	3.5	25.2	54.1	41.2	40.2	74.1	1.8
1985	382	8.7	22.8	47.4	46.7	43.0	69.9	1.6
1986	1,565	60.4	38.6	154.1	54.7	50.2	221.3	4.4
1987	2,235	122.9	55.0	213.2	75.2	67.8	360.9	5.3
1988	3,599	143.8	40.0	158.1	46.4	43.3	332.0	7.7
1989	4,200	146.9	35.0	267.3	47.5	43.1	435.2	10.1
1990	2,304	58.6	25.4	94.9	29.4	27.9	148.7	5.3
1991	1,748	67.7	38.7	210.6	46.5	44.6	282.2	6.3
1992	1,217	53.7	44.1	124.0	47.0	46.1	151.2	3.3
1993	1,461	70.7	45.6	133.8	40.8	42.2	189.0	4.5
1994	2,559	130.1	54.0	299.6	70.3	63.6	413.4	6.5
1995	3,305	208.6	63.6	143.2	57.8	59.5	348.5	5.9
1996	1,935	100.9	54.3	107.1	38.9	44.1	202.8	4.6
1997	3,354	217.9	73.2	207.4	62.6	68.3	458.4	6.7
1998	2,479	220.9	84.2	144.2	45.9	69.1	353.8	5.1
1999	2,023	77.4	35.9	49.0	40.4	37.6	128.8	3.4
				Second half of year				
1976	108	2.0	18.5	-	-	18.5	44.9	2.4
1977	445	11.8	26.5	-	-	26.5	110.0	4.2
1978	811	22.5	27.6	-	-	27.8	53.3	1.9
1979	1,688	52.2	30.9	-	-	30.9	147.7	4.8
1980	1,117	33.1	29.6	-	-	29.5	71.1	2.4
1981	398	7.9	19.6	-	-	19.9	44.9	2.3
1982	-	-	-	1.8	32.3	33.0	12.0	0.4
1983	65	2.4	36.9	12.3	36.6	37.3	23.7	0.6
1984	-	-	-	10.7	29.6	30.2	17.7	0.6
1985	-	-	-	16.4	38.0	38.8	16.8	0.4
1986	555	21.8	39.3	96.1	60.2	57.4	153.8	2.7
1987	1,585	68.1	43.0	5.5	31.9	42.1	76.9	1.8
1988	922	26.9	29.2	41.5	33.9	32.0	71.4	2.2
1989	589	11.5	19.5	44.9	27.3	25.7	57.2	2.2
1990	718	22.8	31.8	65.8	37.3	35.9	70.8	2.0
1991	942	30.3	32.2	96.0	49.4	45.3	90.7	2.0
1992	24	1.5	63.6	48.0	43.7	44.3	25.5	0.6
1993	971	30.7	29.7	59.4	37.4	35.4	87.0	2.5
1994	742	35.7	48.1	90.8	56.1	53.1	76.4	1.4
1995	980	53.3	54.3	77.6	55.5	54.2	72.6	1.3
1996	724	42.9	75.7	93.3	42.3	47.0	140.7	3.0
1997	1,484	91.3	64.5	25.7	35.6	56.4	122.9	2.2
1998	2,176	114.4	46.7	34.6	27.7	42.3	148.5	3.5

Table 13.1.4.1 Input for the seasonal survivor analysis

```
SURVIVORS ANALYSIS OF:
Sandeel in the North Sea

The following parameters were used:

Year range: 1983 - 1999
Seasons per year:    2
The last season in the last year is season : 1
Youngest age:  0; Oldest age:  3; (Plus age:  4)
Recruitment in season: 2
Spawning in season: 1

The following fleets were included:
Fleet  1:  Fishery in the Northern North Sea
Fleet  2:  Fishery in the Southern North Sea

The following options were used:

1: Inv. catchability:              2
  (1: Linear; 2: Log; 3: Cos. filter)
2: Indiv. shats:                   2
  (1: Direct; 2: Using z)
3: Comb. shats:                    2
  (1: Linear; 2: Log.)
4: Fit catches:                    0
  (0: No fit; 1: No SOP corr; 2: SOP corr.)
5: Est. unknown catches:           2
  (0: No; 1: No SOP corr; 2: SOP corr; 3: Sep. F)
6: Weighting of rhats:             0
  (0: Manual)
7: Weighting of shats:             0
  (0: Manual; 1: Linear; 2: Log.)
8: Handling of the plus group:           1
  (1: Dynamic; 2: Extra age group)


Data were input from the following files:
Catch in numbers:       CANUM4.hyr
Weight in catch:        WECA4.hyr
Weight in stock:        WEST4.hyr
Natural mortalities:    natmor.hyr
Maturity ogive:         matprop.hyr
Tuning data (CPUE):     Tuning4.hyr
Weighting for rhats:    tweq.new
Weighting for shats:    twred.xsa
Unknown catches:        UC4.txt
```

Table 13.1.4.1 cont.

Catch in numbers for fleet: 1
Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	7911.	*	0.	*	349.	*	7105.	*	455.	*	13196.
1	5684.	303.	11692.	1207.	2688.	109.	23934.	7077.	26236.	5768.	9855.	1283.
2	1215.	316.	1647.	121.	3292.	239.	2600.	473.	10855.	198.	25922.	340.
3	89.	19.	153.	43.	1002.	89.	200.	0.	350.	0.	1319.	119.
4+	12.	0.	5.	0.	480.	11.	0.	0.	155.	0.	26.	17.
SOP	50871.	37464.	91792.	20871.	106279.	12946.	174378.	128325.	305979.	83202.	430970.	71479.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	3380.	*	12107.	*	13616.	*	6797.	*	26960.	*	457.
1	56661.	4038.	13101.	1670.	41855.	866.	9871.	48.	15768.	1004.	28490.	829.
2	2219.	274.	3907.	342.	2342.	28.	4056.	3.	2635.	112.	7225.	1211.
3	3385.	0.	578.	51.	908.	8.	486.	0.	1023.	34.	5954.	396.
4+	0.	0.	175.	15.	318.	3.	305.	0.	646.	22.	2155.	25.
SOP	437540.	57222.	148411.	70806.	374465.	55404.	115957.	38189.	188264.	86785.	413536.	83222.

Year	1995		1996		1997		1998		1999
Season	1	2	1	2	1	2	1	2	1
AGE									
0	*	4046.	*	31822.	*	2460.	*	35220.	*
1	36140.	3374.	11507.	1706.	70163.	11512.	6466.	10005.	1969.
2	3360.	338.	5377.	1772.	3600.	628.	32214.	1837.	3143.
3	1091.	26.	760.	136.	3065.	6.	1977.	79.	5115.
4+	145.	2.	300.	55.	1066.	2.	281.	1.	610.
SOP	348280.	71351.	201253.	141923.	413447.	104011.	343529.	149056.	115743.

Catch in numbers for fleet: 2
Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	9298.	*	0.	*	11940.	*	112.	*	298.	*	0.
1	2232.	240.	62517.	9423.	7790.	1896.	43629.	5350.	4351.	3095.	2349.	0.
2	35029.	2806.	2257.	92.	39301.	3229.	7333.	293.	22771.	6664.	10074.	234.
3	934.	513.	13272.	577.	2490.	2234.	1604.	241.	1158.	196.	17914.	2084.
4+	387.	2.	442.	44.	265.	298.	30.	18.	165.	51.	2769.	68.
SOP	380561.	61745.	556796.	80581.	472949.	114931.	335960.	47286.	296758.	105111.	464851.	40003.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	1.	*	597.	*	12115.	*	134.	*	838.	*	0.
1	44444.	1619.	20179.	1438.	20058.	11411.	60337.	3903.	3581.	1037.	24697.	4093.
2	4525.	165.	16670.	477.	9224.	344.	10021.	382.	14659.	953.	2594.	322.
3	957.	35.	2467.	71.	1320.	111.	1002.	157.	3707.	266.	2654.	198.
4+	3368.	123.	745.	21.	454.	0.	621.	34.	1012.	87.	715.	137.
SOP	309830.	22244.	341693.	24002.	345866.	123092.	618474.	47520.	267430.	34453.	226318.	47670.

Year	1995		1996		1997		1998		1999
Season	1	2	1	2	1	2	1	2	1
AGE									
0	*	0.	*	2089.	*	198.	*	1142.	*
1	39683.	3166.	10152.	2031.	52357.	15263.	9546.	738.	30888.
2	6607.	2789.	15949.	4082.	3648.	536.	39553.	2672.	6693.
3	1555.	307.	6377.	536.	2404.	407.	3188.	209.	13168.
4+	1226.	157.	1164.	1023.	683.	136.	1572.	63.	677.
SOP	427820.	67591.	293099.	138914.	419584.	138824.	439291.	42848.	423671.

Weighting factors for computing survivors:

Season	1	2
AGE		
0	*	0.020
1	1.000	0.100
2	1.000	0.100
3	1.000	0.100

Table 13.1.4.2 Output from SXSA of sandeel in the North Sea

Stock numbers (at start of season)
****

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	869469.	*	227834.	*	1206754.	*	630205.	*	200994.	*	724224.
1	98750.	31527.	379142.	94468.	102373.	31306.	533992.	155466.	278332.	83841.	89808.	25636.
2	88373.	29564.	25321.	13777.	67726.	10526.	23817.	7832.	116040.	50253.	60623.	11166.
3	3442.	1470.	21380.	3341.	11087.	4573.	5480.	2196.	5719.	2599.	34935.	7671.
4+	498.	6.	725.	120.	2233.	887.	2088.	1375.	2690.	1541.	3166.	0.
SSN	92314.		47426.		81046.		31385.		124449.		98724.	
SSB	1209705.		712975.		1123406.		459469.		1636251.		1512667.	
TSN	191064.	932036.	426568.	339540.	183419.	1254046.	565377.	797075.	402781.	339228.	188532.	768697.
TSB	1706418.	1801822.	2267458.	1566925.	1552347.	2049873.	2691556.	2934947.	2944409.	2019965.	1907821.	1653644.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	332678.	*	651809.	*	831148.	*	325604.	*	634305.	*	811902.
1	316569.	55136.	147215.	33972.	284361.	67058.	356211.	88459.	141657.	40377.	266378.	65735.
2	19828.	7770.	40023.	9981.	25002.	7290.	43794.	17831.	68849.	31992.	31211.	12882.
3	8623.	2225.	5964.	1505.	7431.	3157.	5632.	2557.	14250.	5680.	25229.	9864.
4+	4287.	116.	1790.	447.	1455.	343.	2755.	1089.	2812.	527.	4711.	808.
SSN	32738.		47777.		33887.		52181.		85911.		61152.	
SSB	514675.		672086.		486514.		727409.		1167806.		861425.	
TSN	349307.	397924.	194992.	697713.	318248.	908996.	408391.	435539.	227568.	712880.	327530.	901191.
TSB	1907579.	1182038.	1299224.	1443506.	1706422.	1806231.	2180749.	1771217.	1805263.	1920619.	2528951.	6887266.

Year	1995		1996		1997		1998		1999
Season	1	2	1	2	1	2	1	2	1
AGE									
0	*	356491.	*	2207671.	*	350570.	*	371743.	*
1	364505.	88105.	157470.	44793.	969239.	282251.	155740.	47582.	142661.
2	49366.	24931.	66216.	26926.	33292.	16382.	206861.	79905.	29236.
3	9159.	3973.	17582.	5942.	16748.	6749.	12359.	4056.	61341.
4+	8054.	4276.	6309.	3030.	5763.	2431.	7017.	3187.	5612.
SSN	66579.		90107.		55803.		226237.		96188.
SSB	1112667.		1050100.		631914.		2014695.		1191030.
TSN	431084.	477776.	247577.	2288363.	1025042.	658383.	381977.	506472.	238849.
TSB	3711585.	3206882.	2113020.	7520878.	5962731.	3406058.	2793393.	2186268.	1975664.

Partial fishing mortality for fleet: 1
Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.013	*	0.000	*	0.000	*	0.016	*	0.003	*	0.027
1	0.096	0.011	0.056	0.015	0.044	0.004	0.077	0.052	0.160	0.080	0.190	0.057
2	0.022	0.012	0.086	0.010	0.090	0.030	0.172	0.070	0.135	0.005	0.770	0.035
3	0.038	0.018	0.013	0.016	0.133	0.029	0.054	0.000	0.087	0.000	0.066	0.020
4+	0.051	0.000	0.011	0.000	0.319	0.017	0.000	0.000	0.075	0.000	0.028	*
F (1- 2)	0.059	0.012	0.071	0.012	0.067	0.017	0.124	0.061	0.148	0.043	0.480	0.046

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.015	*	0.027	*	0.024	*	0.031	*	0.063	*	0.001
1	0.353	0.085	0.164	0.057	0.269	0.016	0.050	0.001	0.192	0.028	0.193	0.014
2	0.167	0.040	0.165	0.040	0.152	0.004	0.136	0.000	0.054	0.004	0.340	0.111
3	0.659	0.000	0.163	0.039	0.178	0.003	0.123	0.000	0.107	0.007	0.352	0.046
4+	0.000	*	0.165	0.039	0.375	0.010	0.165	0.000	0.413	0.052	0.835	0.038
F (1- 2)	0.260	0.063	0.164	0.048	0.211	0.010	0.093	0.000	0.123	0.016	0.266	0.063

Year	1995		1996		1997		1998		1999
Season	1	2	1	2	1	2	1	2	1
AGE									
0	*	0.017	*	0.021	*	0.010	*	0.146	*
1	0.180	0.044	0.126	0.044	0.124	0.047	0.070	0.263	0.025
2	0.093	0.016	0.120	0.082	0.149	0.044	0.233	0.026	0.160
3	0.172	0.008	0.068	0.027	0.271	0.001	0.252	0.022	0.121
4+	0.024	0.001	0.066	0.025	0.269	0.001	0.057	0.000	0.151
F (1- 2)	0.137	0.030	0.123	0.063	0.137	0.046	0.152	0.145	0.093

Table 13.1.4.2 cont.

Partial fishing mortality for fleet: 2
Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.016	*	0.000	*	0.014	*	0.000	*	0.002	*	0.000
1	0.038	0.008	0.297	0.117	0.129	0.069	0.140	0.040	0.027	0.043	0.045	0.000
2	0.621	0.111	0.118	0.007	1.076	0.409	0.485	0.044	0.283	0.158	0.299	0.024
3	0.394	0.475	1.150	0.211	0.330	0.735	0.434	0.128	0.287	0.087	0.892	0.353
4+	1.655	0.485	1.120	0.498	0.176	0.454	0.018	0.015	0.080	0.037	2.984	*
F (1- 2)	0.329	0.060	0.208	0.062	0.602	0.239	0.313	0.042	0.155	0.100	0.172	0.012

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.000	*	0.001	*	0.022	*	0.001	*	0.002	*	0.000
1	0.277	0.034	0.252	0.049	0.129	0.208	0.305	0.050	0.044	0.029	0.167	0.072
2	0.341	0.024	0.705	0.055	0.600	0.054	0.337	0.024	0.300	0.033	0.122	0.029
3	0.186	0.018	0.698	0.054	0.258	0.040	0.253	0.070	0.386	0.053	0.157	0.023
4+	1.678	*	0.704	0.054	0.535	0.000	0.335	0.035	0.646	0.204	0.277	0.209
F (1- 2)	0.309	0.029	0.478	0.052	0.365	0.131	0.321	0.037	0.172	0.031	0.145	0.050

Year	1995		1996		1997		1998		1999
Season	1	2	1	2	1	2	1	2	1
AGE									
0	*	0.000	*	0.001	*	0.001	*	0.005	*
1	0.198	0.041	0.112	0.052	0.093	0.063	0.104	0.019	0.400
2	0.183	0.132	0.355	0.189	0.151	0.037	0.287	0.038	0.341
3	0.245	0.089	0.567	0.106	0.212	0.069	0.406	0.059	0.312
4+	0.204	0.041	0.257	0.458	0.173	0.064	0.318	0.022	0.167
F (1- 2)	0.190	0.087	0.233	0.121	0.122	0.050	0.195	0.029	0.370

Log inverse catchabilities, fleet no: 1
Fishery in the Northern North Sea

Season	1	2
AGE		
0	*	4.865
1	3.605	4.089
2	3.510	4.504
3	3.510	4.504

Log inverse catchabilities, fleet no: 2
Fishery in the Southern North Sea

Season	1	2
AGE		
0	*	7.011
1	4.075	3.436
2	3.048	3.315
3	3.048	3.315

Table 13.1.4.3. Residuals from SXSA of sandeel in the North Sea

Log residual stocknr. (nhat/n), fleet no: 1
Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	1.061	*	*	*	-1.988	*	-0.234	*	-1.438	*	0.455
1	0.567	0.062	0.127	0.399	0.019	-0.523	-0.441	0.147	0.105	0.980	-0.099	0.430
2	-1.021	0.631	0.471	0.383	0.634	1.923	0.267	0.855	-0.160	-1.448	1.208	0.349
3	-0.467	0.975	-1.403	0.853	1.020	1.889	-0.889	*	-0.601	*	-1.254	-0.189

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	-0.134	*	0.571	*	0.452	*	1.892	*	1.190	*	-2.581
1	0.252	0.840	0.128	0.530	0.452	-0.755	-0.586	-2.798	0.453	-0.397	0.089	-0.483
2	-0.592	0.499	0.041	0.579	-0.212	-1.626	0.325	-3.566	-0.915	-1.951	0.558	1.966
3	0.780	*	0.031	0.568	-0.059	-2.049	0.216	*	-0.233	-1.404	0.595	1.083

Year	1995		1996		1997		1998		1999
Season	1	2	1	2	1	2	1	2	1
AGE									
0	*	0.504	*	-0.091	*	-0.505	*	1.689	*
1	0.116	0.702	0.011	-0.135	-0.382	0.250	-0.681	1.501	-1.289
2	-0.641	0.107	-0.139	0.904	-0.296	0.590	0.426	-0.393	0.454
3	-0.026	-0.644	-0.711	-0.212	0.301	-3.234	0.502	-0.551	0.174

Log residual stocknr. (nhat/n), fleet no: 2
Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	2.271	*	*	*	1.581	*	-1.774	*	0.085	*	*
1	-1.333	-1.922	0.653	0.502	-0.278	-0.429	0.137	-0.323	-0.989	-0.496	-1.161	*
2	0.443	0.528	-1.296	-2.380	0.818	1.228	0.349	-0.350	0.351	0.679	-0.299	-0.424
3	-0.013	1.984	0.979	0.972	-0.365	1.814	0.238	0.733	0.365	0.081	0.793	2.274

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	-4.631	*	0.912	*	2.300	*	-0.928	*	0.888	*	*
1	0.531	0.755	0.447	0.932	0.305	0.989	0.715	-0.093	-0.723	0.005	1.095	0.903
2	-0.291	0.285	0.446	0.928	0.814	-0.488	-0.214	-0.949	0.175	0.023	-0.251	-0.104
3	-0.895	-0.037	0.436	0.914	-0.030	-0.790	-0.503	0.126	0.428	0.486	0.003	-0.359

Year	1995		1996		1997		1998		1999
Season	1	2	1	2	1	2	1	2	1
AGE									
0	*	*	*	-0.211	*	-1.154	*	1.323	*
1	0.615	0.153	0.177	-0.156	-0.007	-0.397	-0.308	-0.842	1.242
2	-0.493	1.196	0.308	1.007	-0.547	-1.033	-0.318	-0.291	0.054
3	-0.200	0.803	0.775	0.427	-0.207	-0.427	0.031	0.150	-0.036

Table 13.1.6.1 North Sea sandeel. Average fishing mortality, recruitment and SSB 1976-1999

Year	Mean F (age 1-2)	Recruits age 0 in year (billions)	SSB ('000 t)
1976	0.67	456	665
1977	0.74	629	387
1978	0.77	448	556
1979	0.75	605	751
1980	0.87	225	619
1981	0.54	976	692
1982	0.57	241	461
1983	0.46	870	1286
1984	0.35	229	756
1985	0.92	1211	1149
1986	0.53	631	481
1987	0.44	202	1654
1988	0.71	725	1525
1989	0.66	334	521
1990	0.74	655	672
1991	0.71	837	487
1992	0.45	328	727
1993	0.34	638	1168
1994	0.52	812	861
1995	0.44	356	1113
1996	0.53	2208	1050
1997	0.35	351	632
1998	0.51	372	2015
1999			1500
Average	0.59	623	879

Table 13.1.7.1. Mean and cv of recruitment in millions of sandeel in the North Sea estimated for 1976-1997 and predicted for 1998-2008. Predictions assume that $F_{predicted} = \overline{F}_{87-97}$ and that recruitment follows the autoregressive model defined

Year	mean	CV(%)
1983	877200	12
1984	219500	41
1985	969000	11
1986	633900	15
1987	206100	35
1988	827200	9
1989	342900	23
1990	773800	12
1991	730200	14
1992	421700	22
1993	704900	13
1994	822700	11
1995	263100	30
1996	1498000	8
1997	168000	52
Predictions		
1998	889700	35
1999	525400	57
2000	718200	45
2001	608500	52
2002	671200	48
2003	635300	50
2004	657700	48
2005	644100	50
2006	645300	50
2007	664600	51

Table 13.1.7.2 Probability distribution (mean, cv and percentiles) of spawning stock biomass in tonnes of sandeel in the North Sea estimated for 1976-1998 and predicted for 1999-2008. Predictions assume that $F_{predicted} = \overline{F}_{87-97}$ and that recruitment follows the autoregressive model defined

Year	mean	CV (%)	2.5%	5%	10%	median	90%	95%	97.5%
1983	1265000	17	839800	909600	987100	1262000	1545000	1624000	1693000
1984	580900	25	326800	357800	401300	569700	774400	841300	896900
1985	1153000	13	874800	915400	969100	1151000	1338000	1399000	1452000
1986	488400	24	272500	300000	338900	483300	643900	693500	736500
1987	1163000	13	884800	928000	977400	1159000	1355000	1415000	1466000
1988	1167000	13	880000	924500	970700	1163000	1366000	1427000	1480000
1989	473500	21	289900	316500	347400	469400	605700	653400	687400
1990	836800	12	644300	674900	709200	833200	969300	1007000	1046000
1991	560200	18	368100	396400	428400	557500	690300	735200	769700
1992	974900	14	726100	764400	809300	971700	1145000	1199000	1246000
1993	1037000	13	769500	812500	862400	1034000	1214000	1271000	1318000
1994	809700	17	550900	586800	633500	805100	993200	1050000	1102000
1995	1328000	13	996300	1047000	1106000	1320000	1562000	1633000	1692000
1996	993500	12	774900	806900	846600	990200	1145000	1190000	1235000
1997	497100	18	327900	353800	385100	493000	616700	651200	685500
1998	1076000	11	851900	885600	924700	1073000	1237000	1284000	1322000
Predictions									
1999	569000	25	316300	346700	390100	561900	757000	817800	877300
2000	1088000	34	421100	505800	625800	1075000	1571000	1711000	1848000
2001	826400	40	313700	365600	440900	788900	1261000	1418000	1560000
2002	981500	37	361100	430700	533400	951700	1461000	1610000	1743000
2003	892400	39	338500	401200	480000	858300	1354000	1524000	1669000
2004	941900	38	343600	411600	503100	916600	1401000	1553000	1705000
2005	913900	38	338000	396400	485500	882700	1376000	1529000	1691000
2006	930200	38	335100	404100	500100	903800	1386000	1539000	1679000
2007	920400	38	337500	404100	499700	887300	1385000	1553000	1706000
2008	919200	39	330300	395500	479600	885000	1391000	1547000	1685000

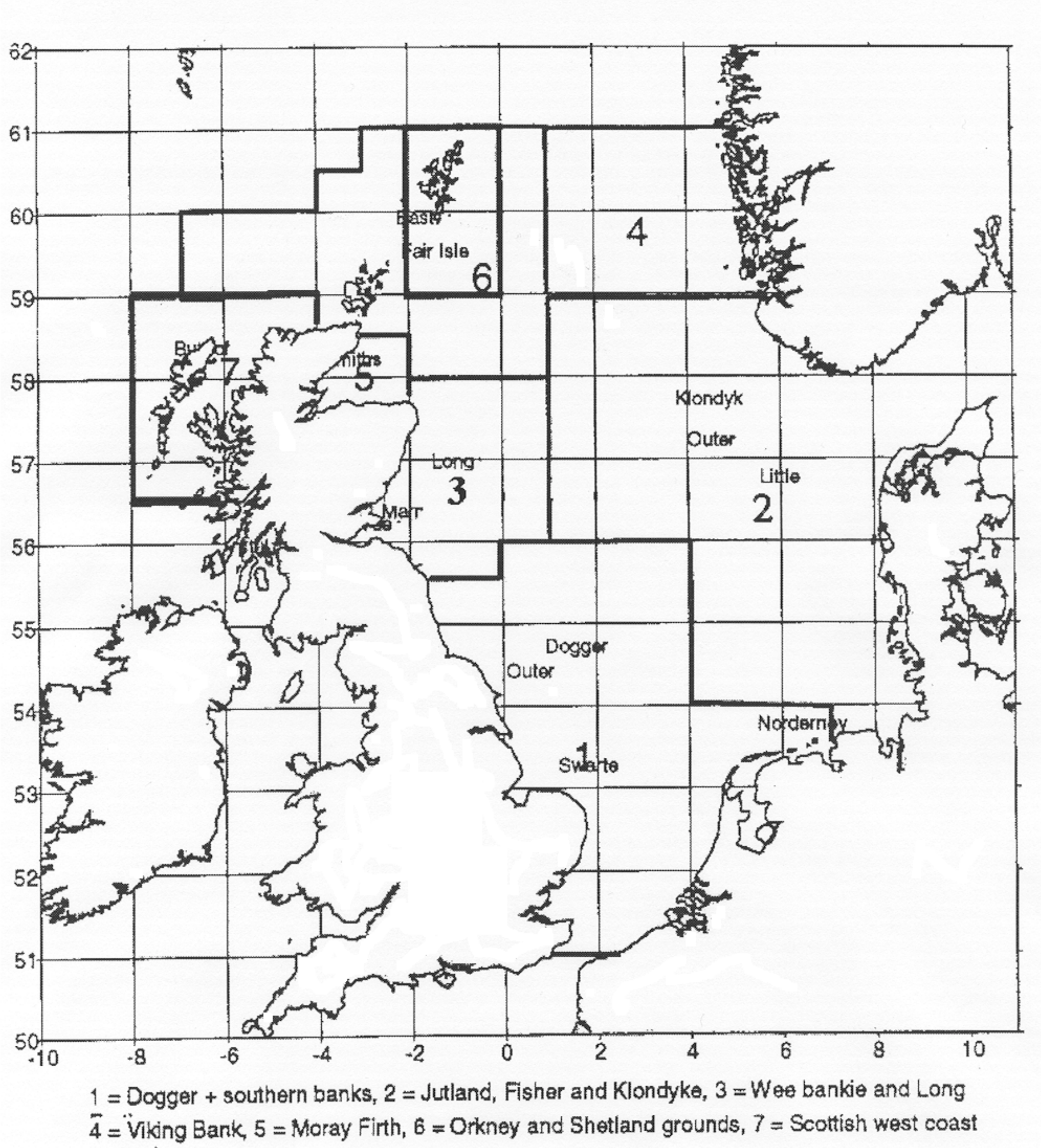


Figure 13.1.1.1 Proposed sandeel stock structure (Areas 1-7), based on particle drift analysis

Figure 13.1.1.2 The North Sea showing Danish Sandeel sampling and assessment areas used by the Working Group

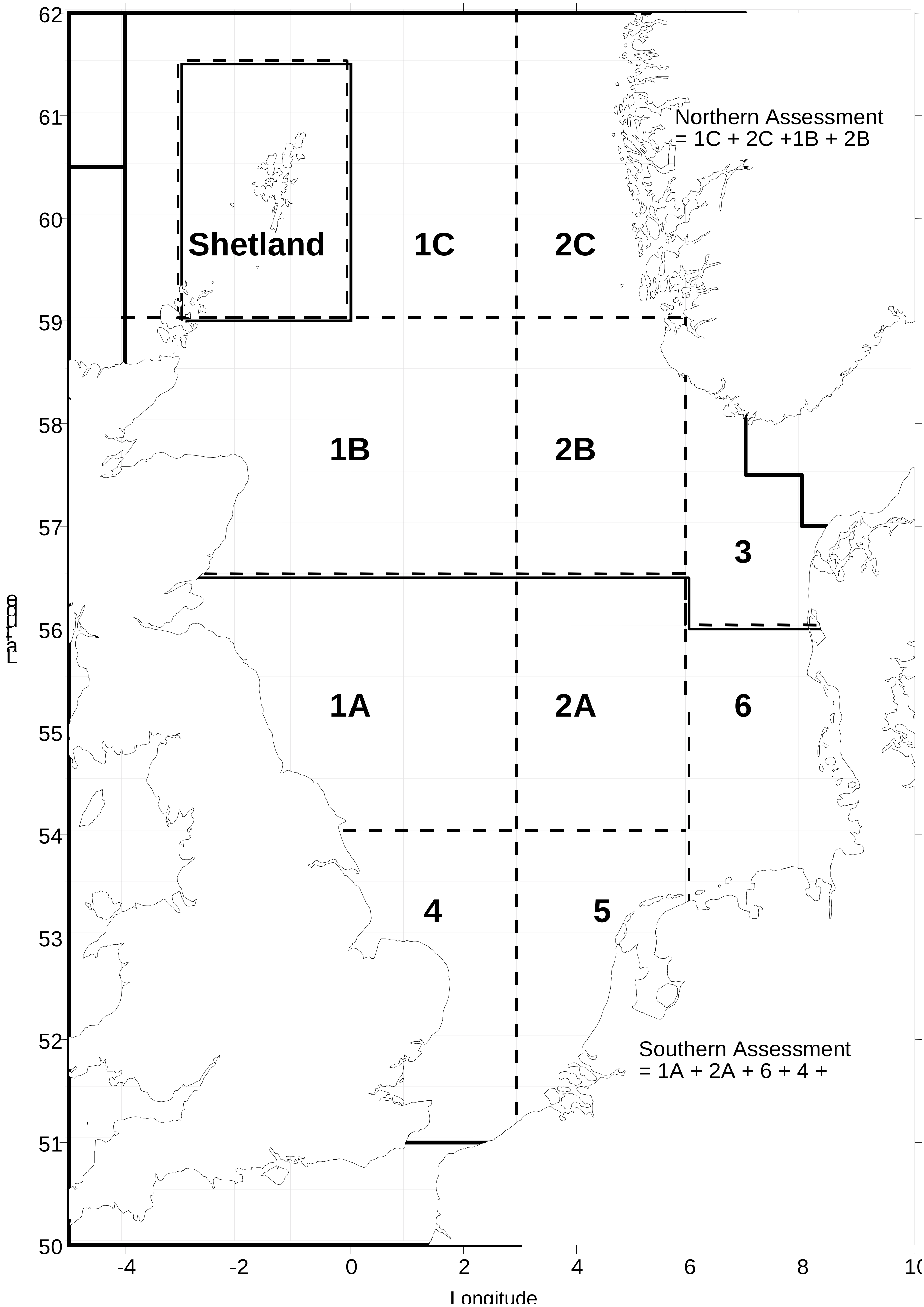


Figure 13.1.1.3

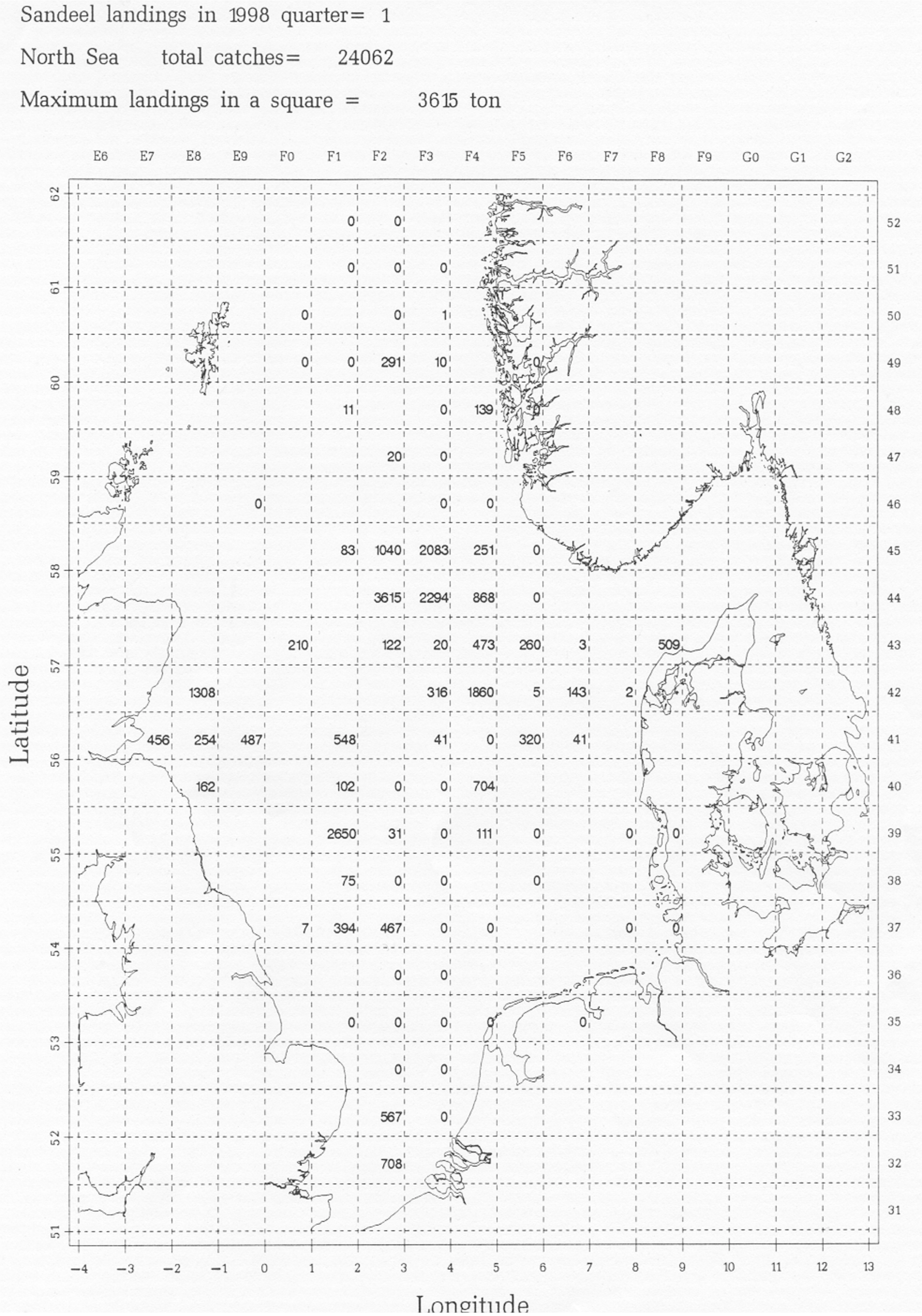


Figure 13.1.1.3 (Continued)

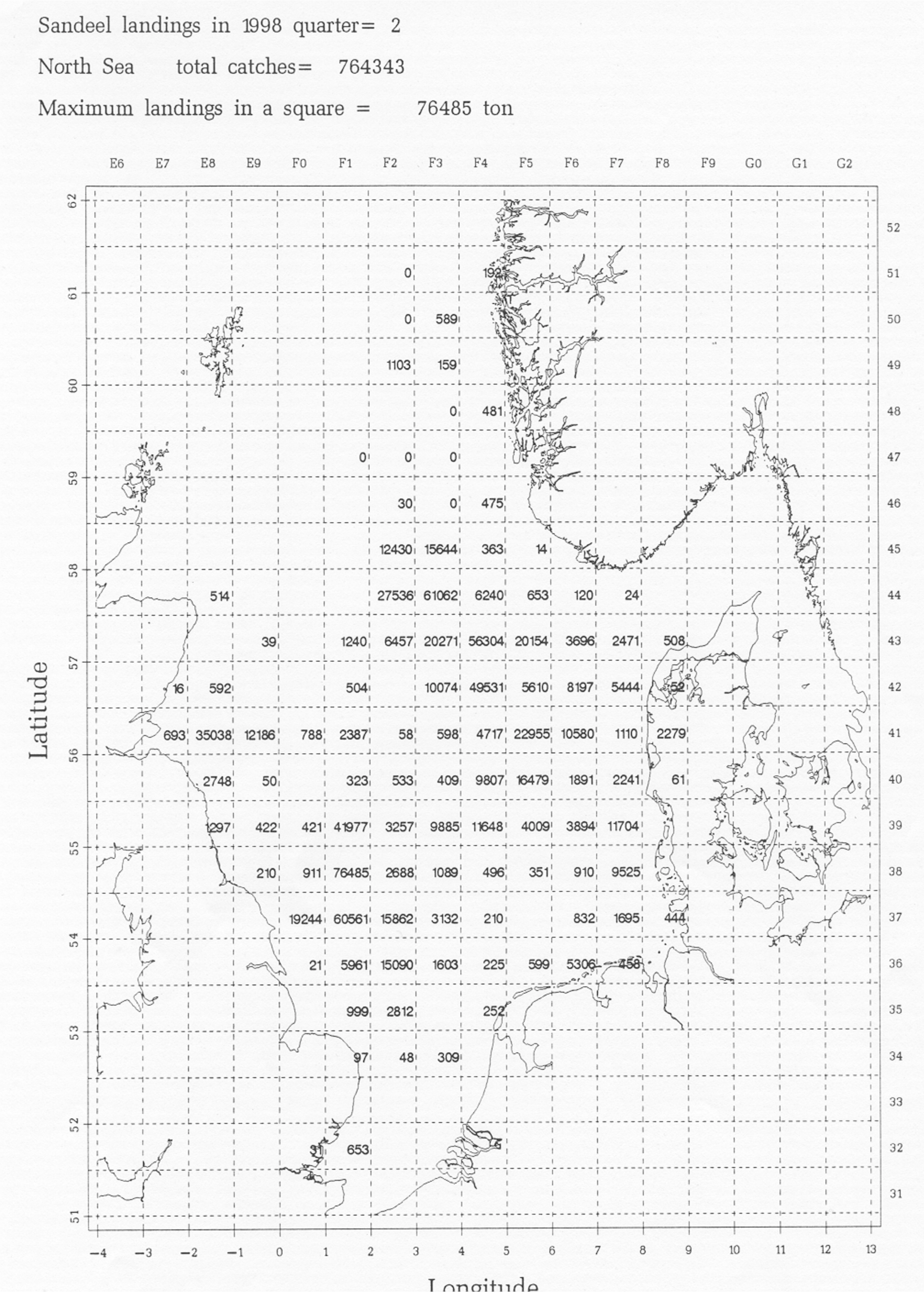


Figure 13.1.1.3 (Continued)

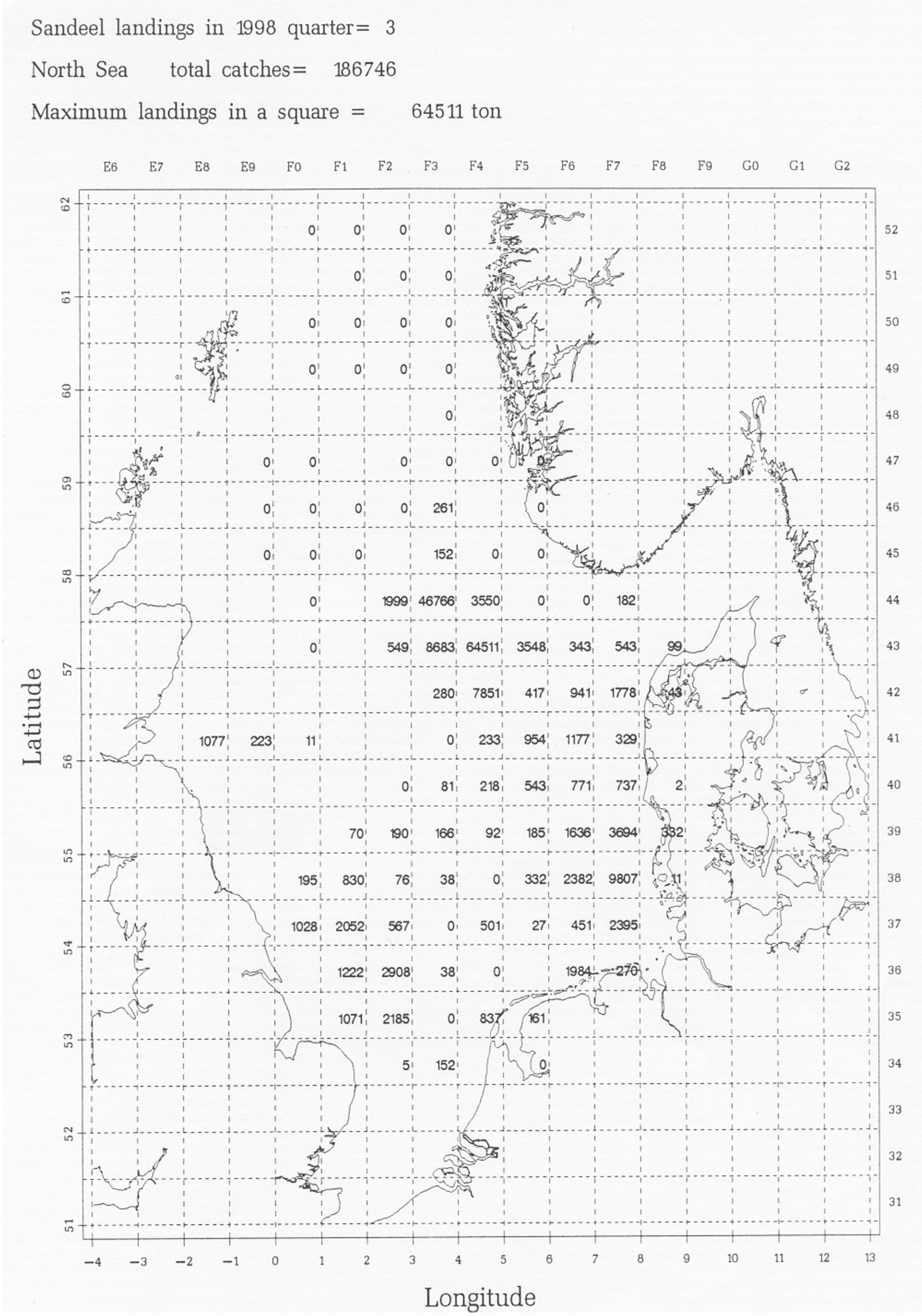


Figure 13.1.1.3 (Continued)

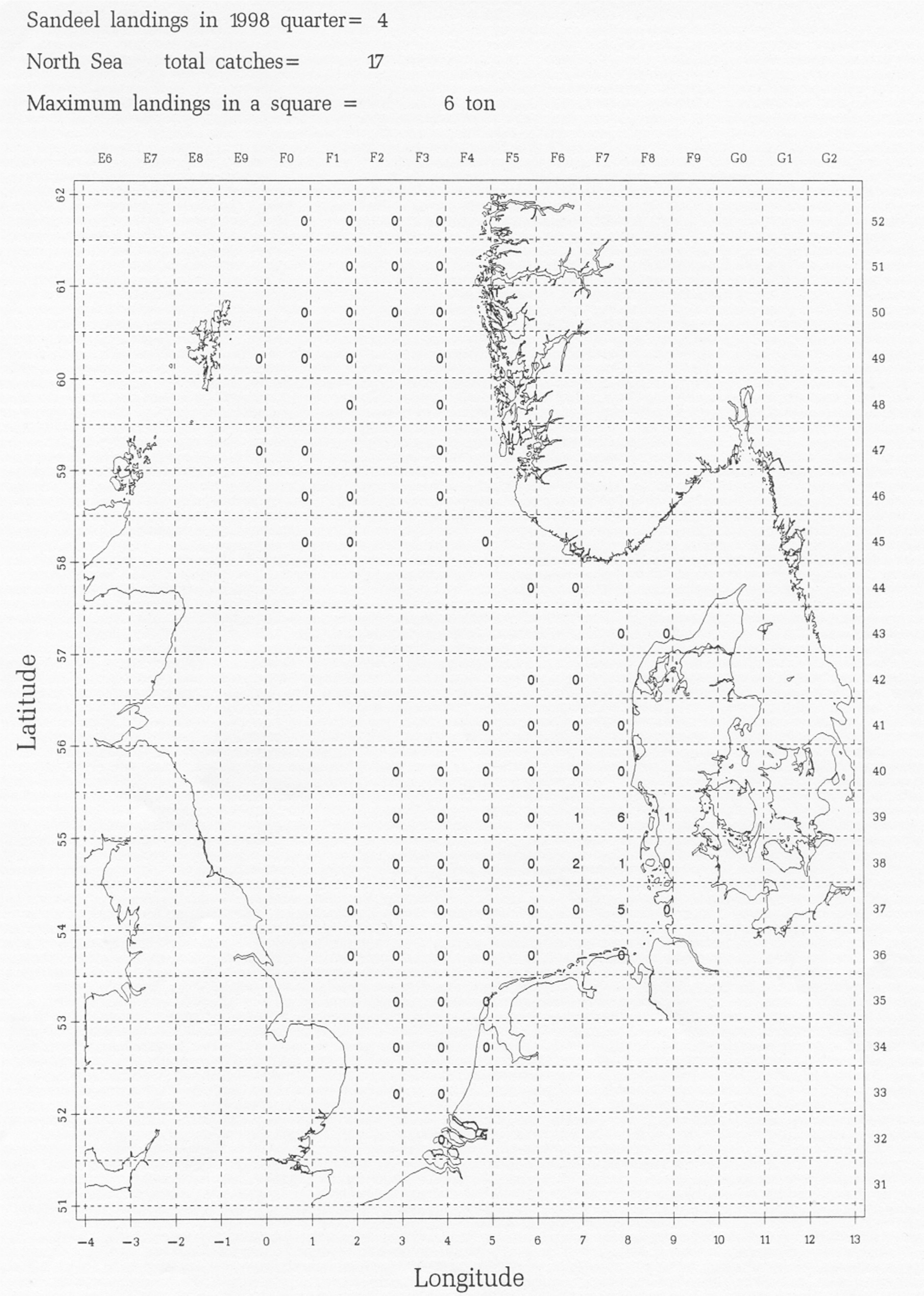


Figure 13.1.1.3 (Continued)

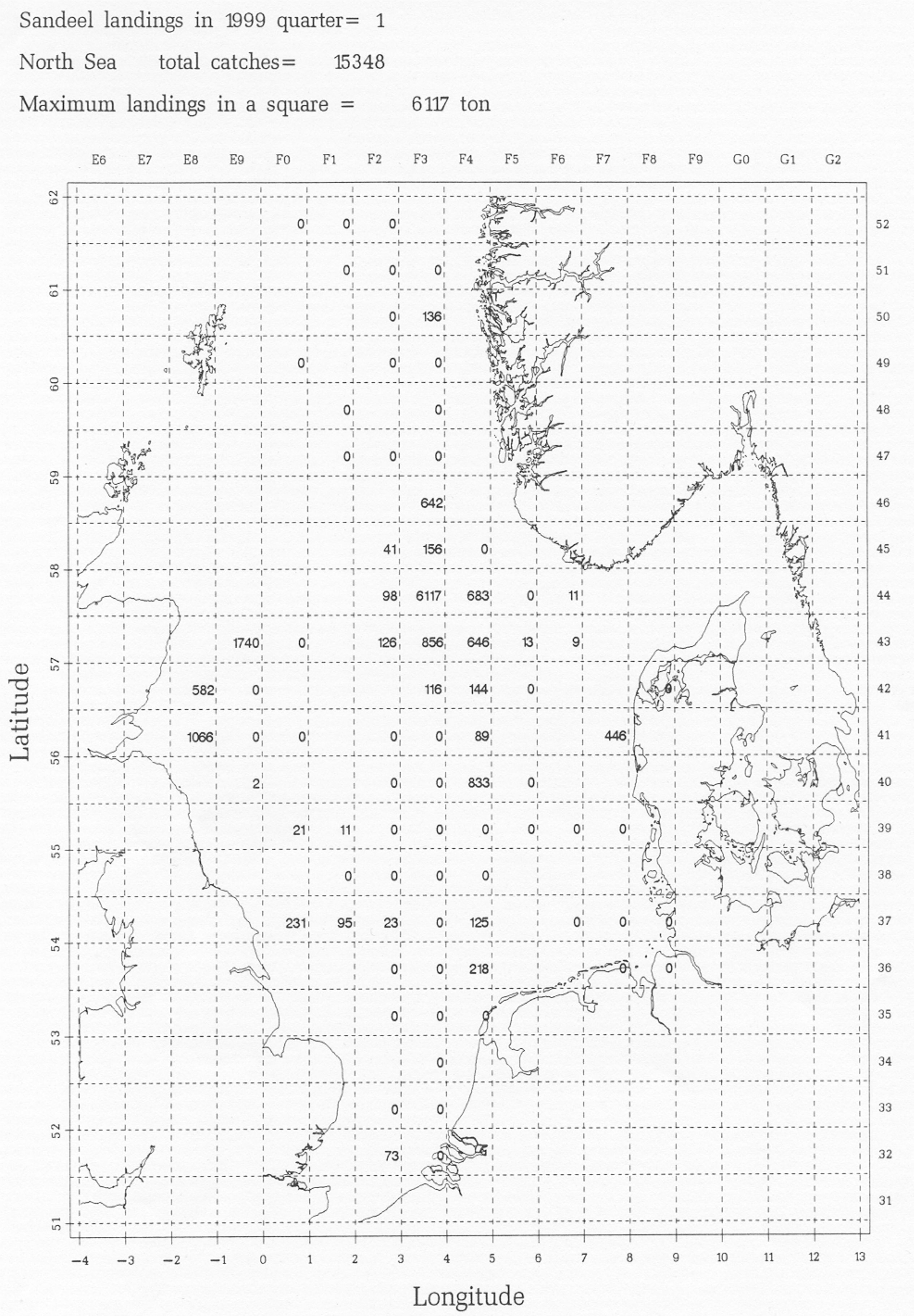


Figure 13.1.1.3 (Continued)

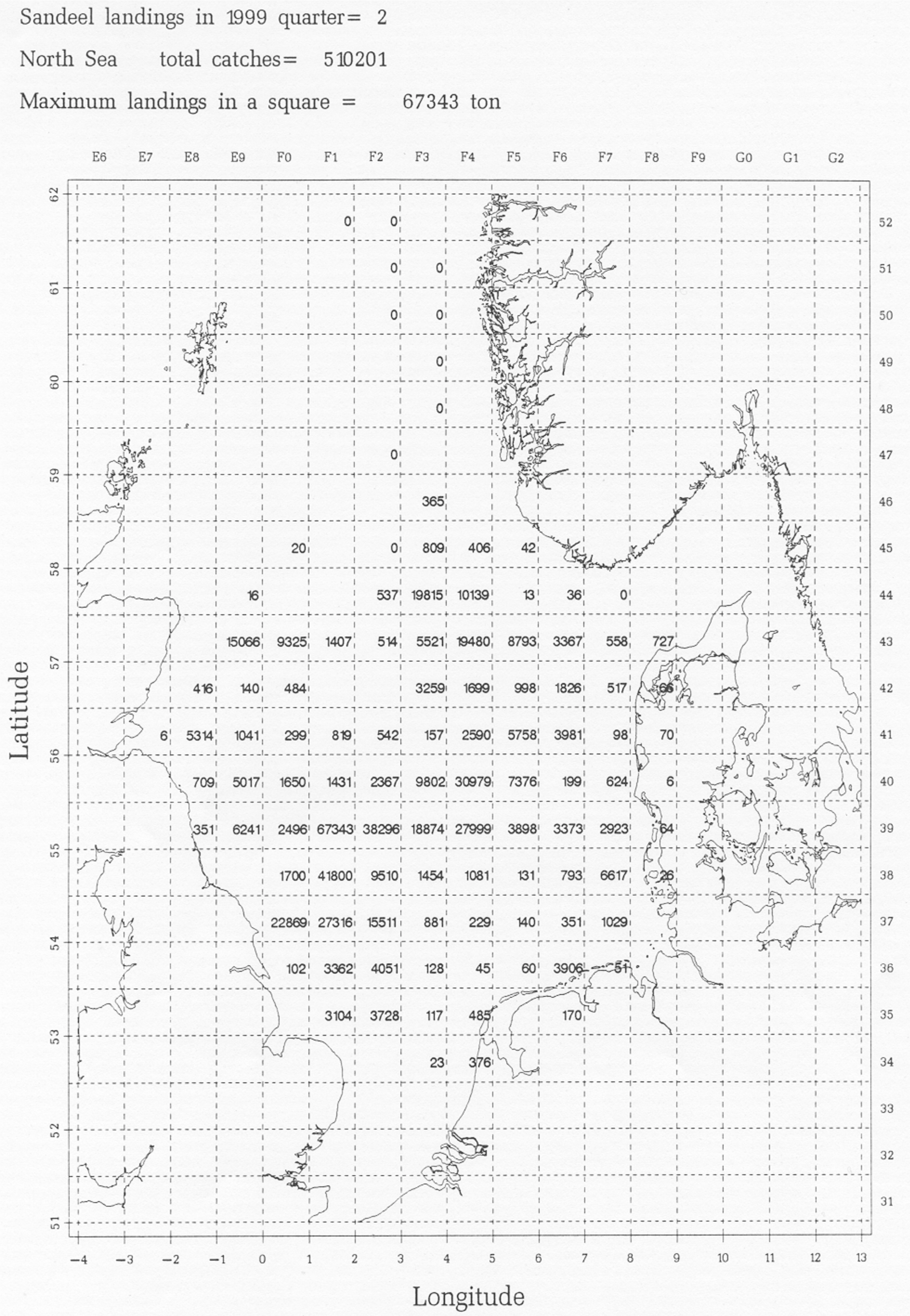
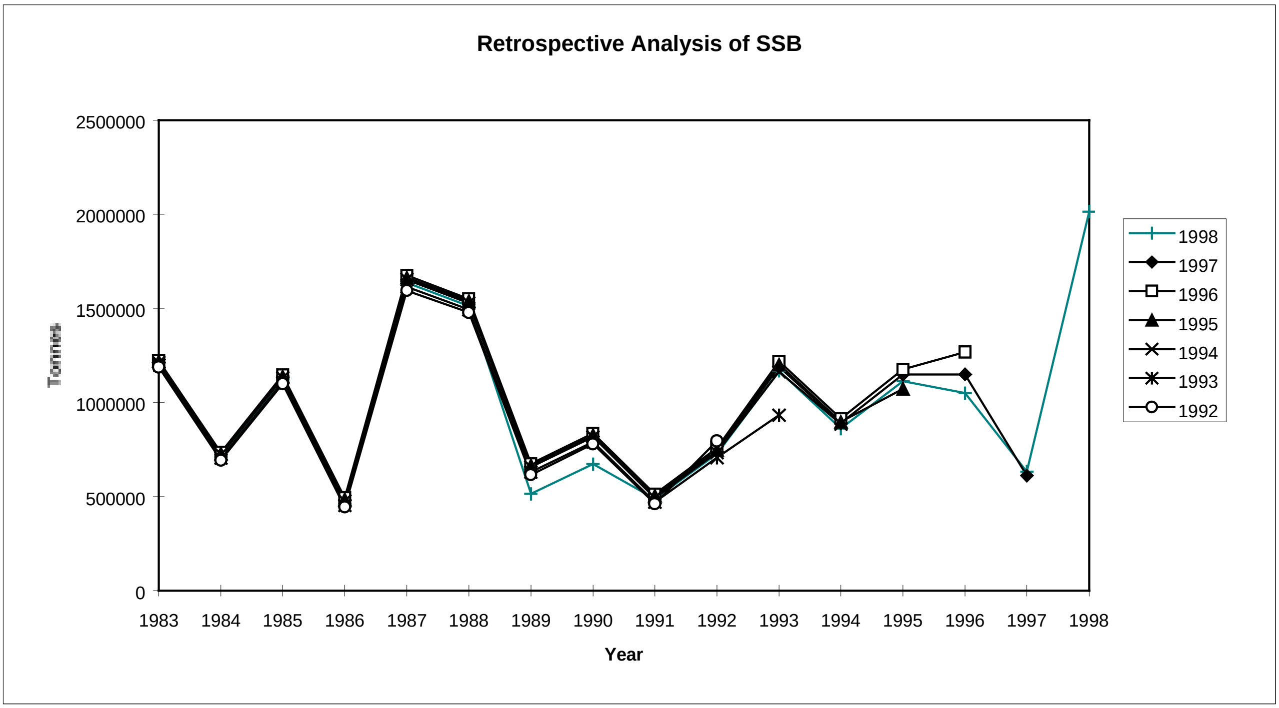


Figure 13.1.4.1 Retrospective analysis of SSB and Recruitment[1]

SXSA – Sandeel in the North Sea



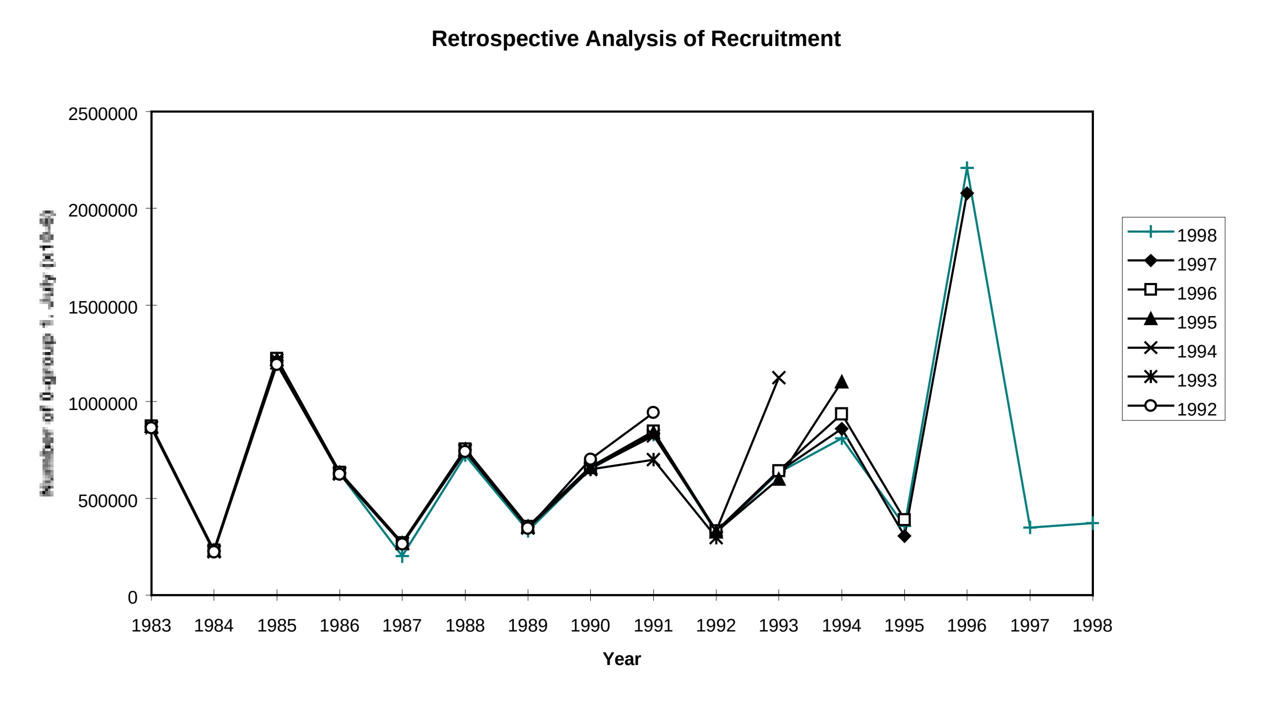
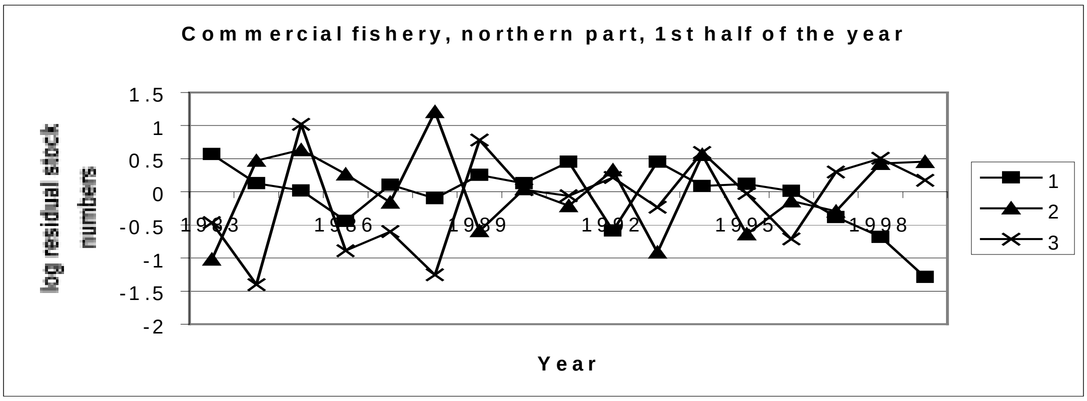
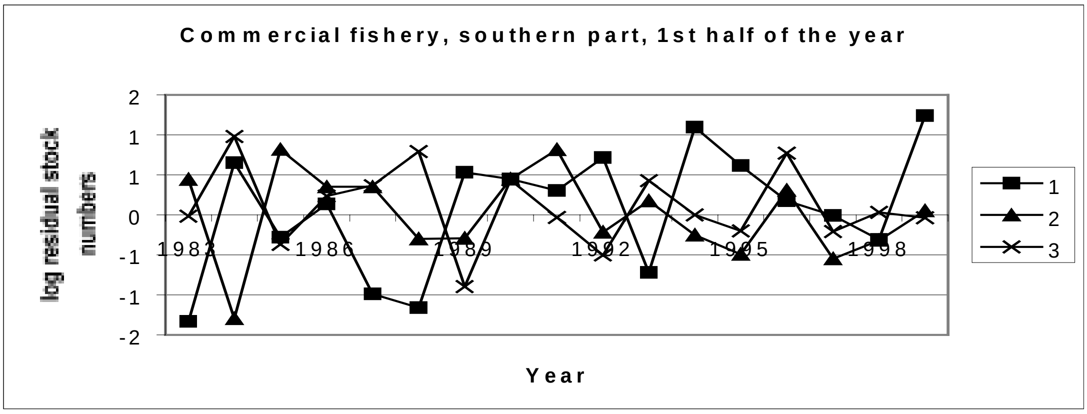
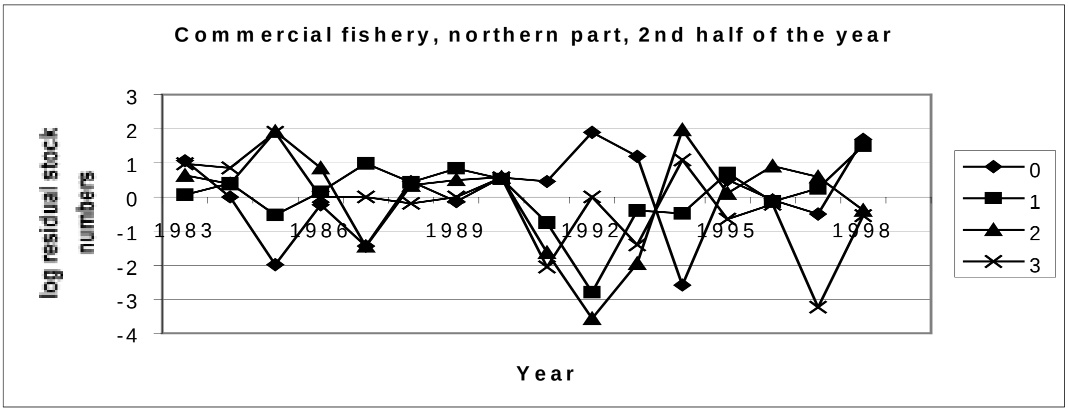


Figure 13.1.4.2 Log residual stock numbers by fleet and season.

SXSA – Sandeel in the North Sea







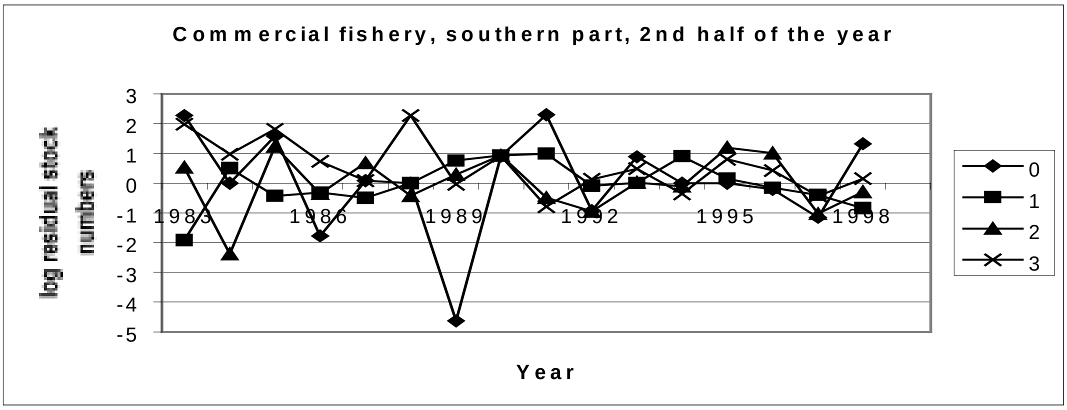


Figure 13.1.4.3 North Sea sandeel. Average fishing mortality for ages 1 and 2 versus fishing effort

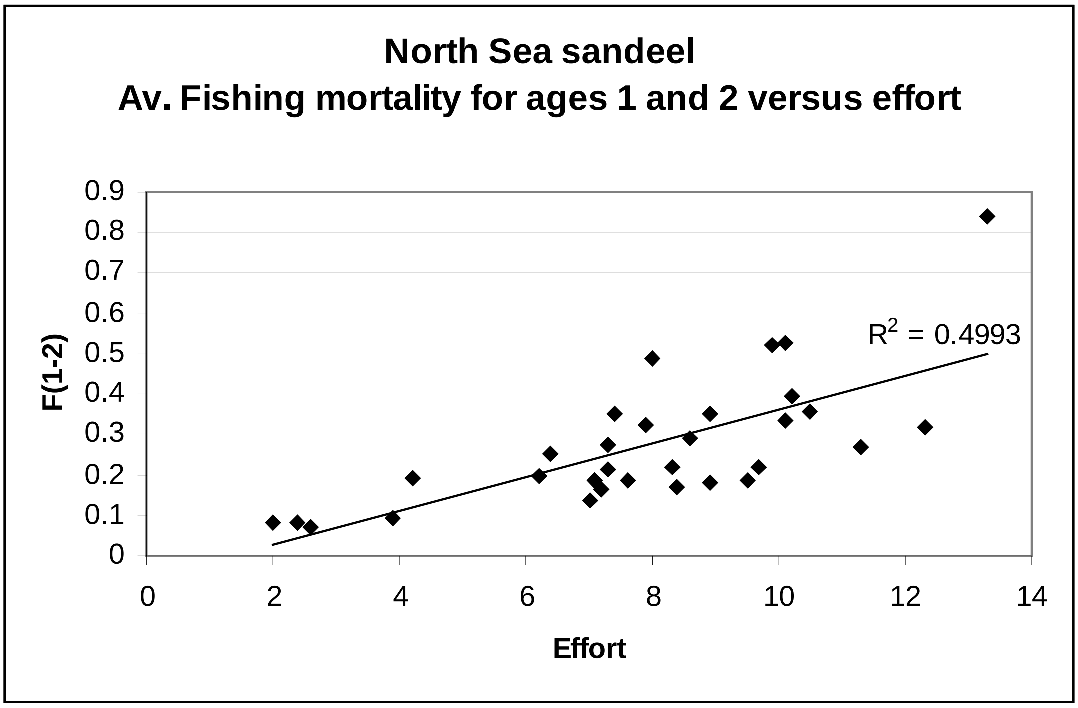


Figure 13.1.4.4 North Sea sandeel. Relationship between stocknumbers estimated by SXSA and CPUE of tuning fleet.

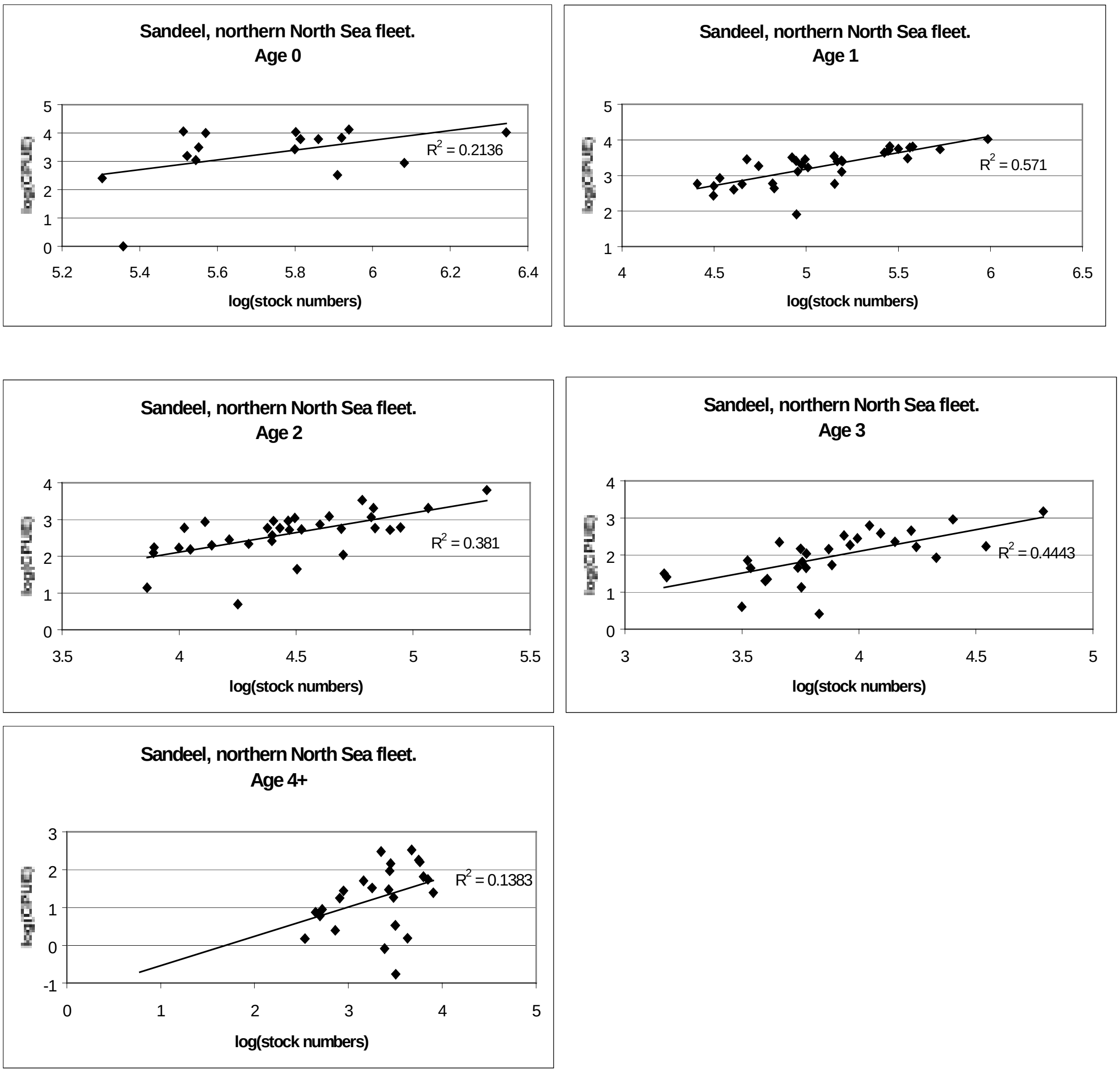


Figure 13.1.4.4 cont. North Sea sandeel. Relationship between stocknumbers estimated by SXSA and CPUE of tuning fleet.

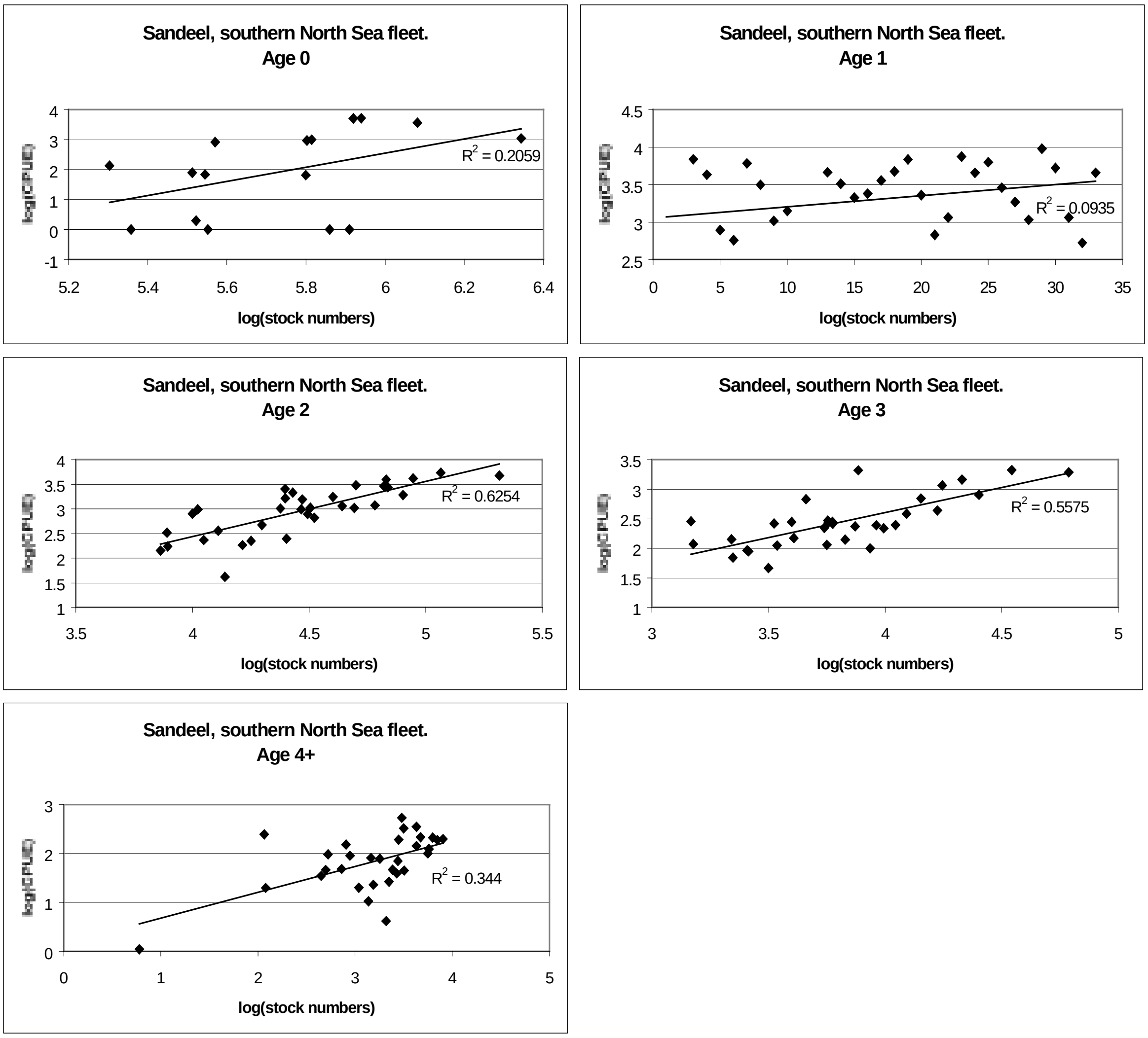


Figure 13.1.4.5 Stock recruitment relationship for sandeel in the North Sea.

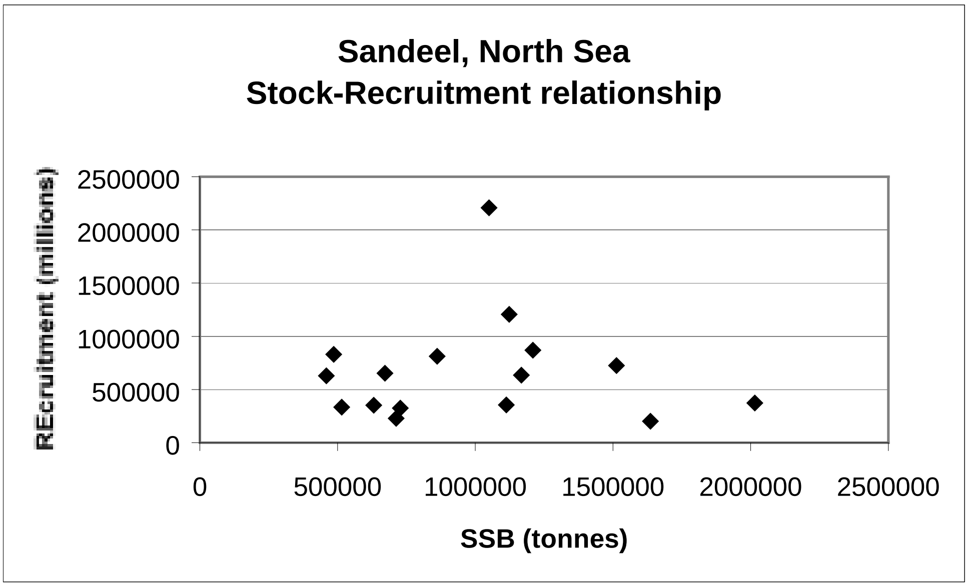
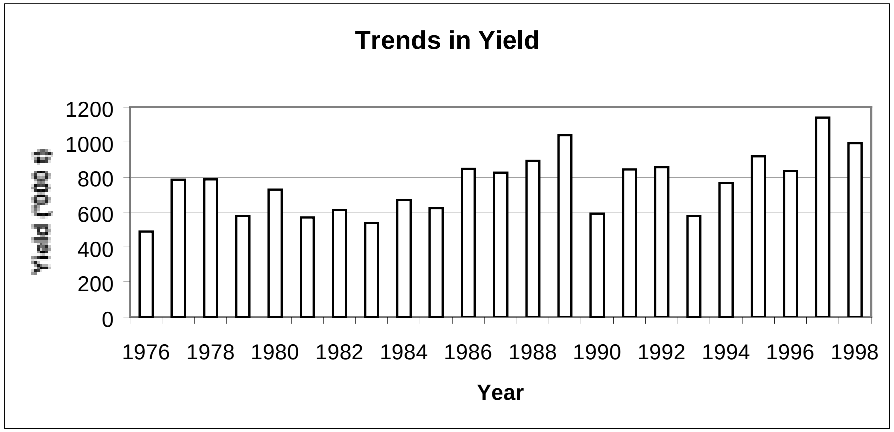
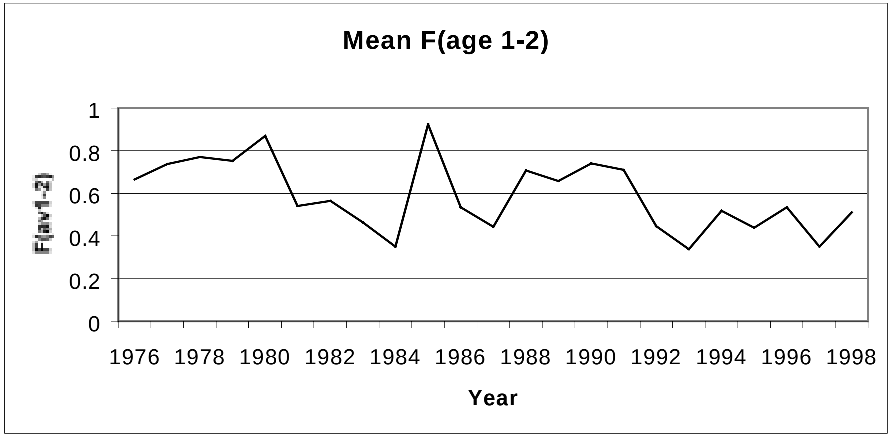
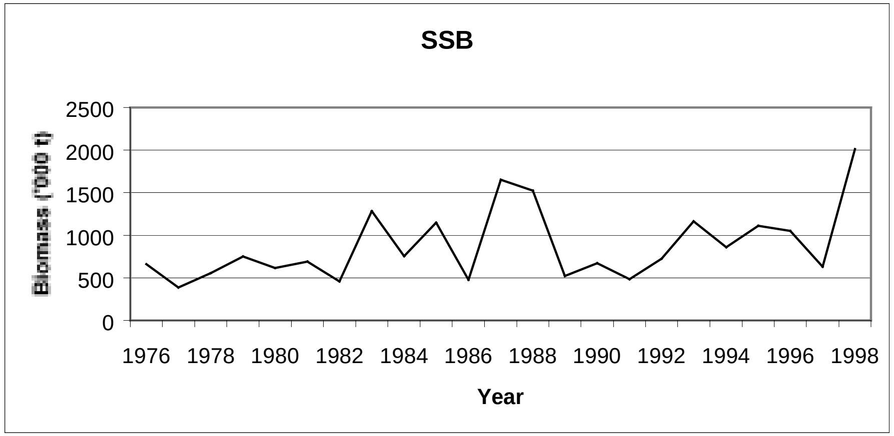


Figure 13.1.6.1 Sandeels North Sea. Trends in yield, fishing mortality (F(av1-2)), SSB and recruitment







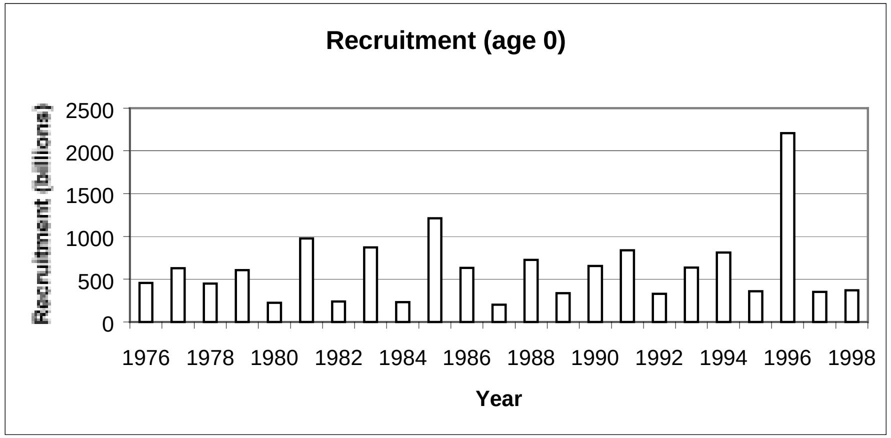
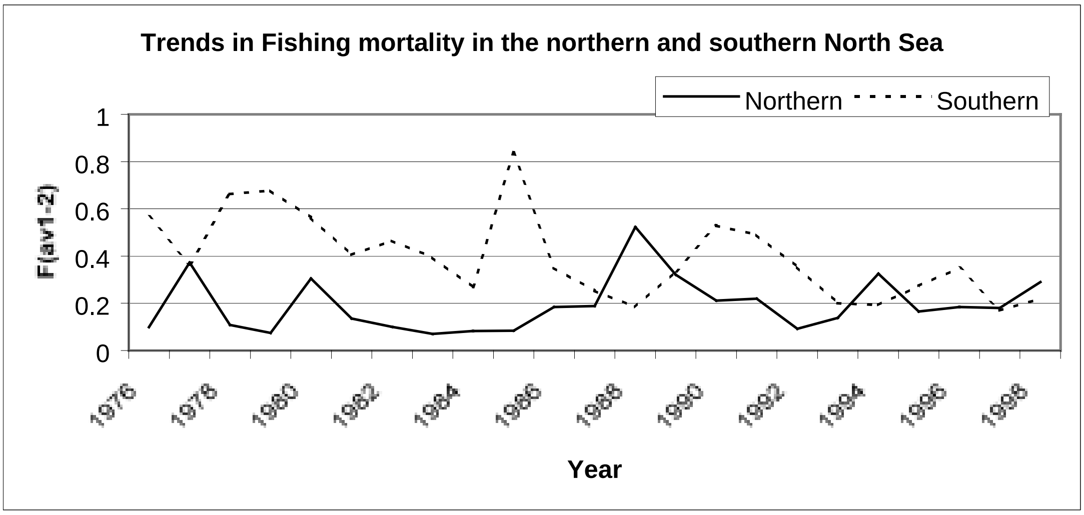


Figure 13.1.6.1 cont.



$F_{predictions}$ = average of 1987-1997

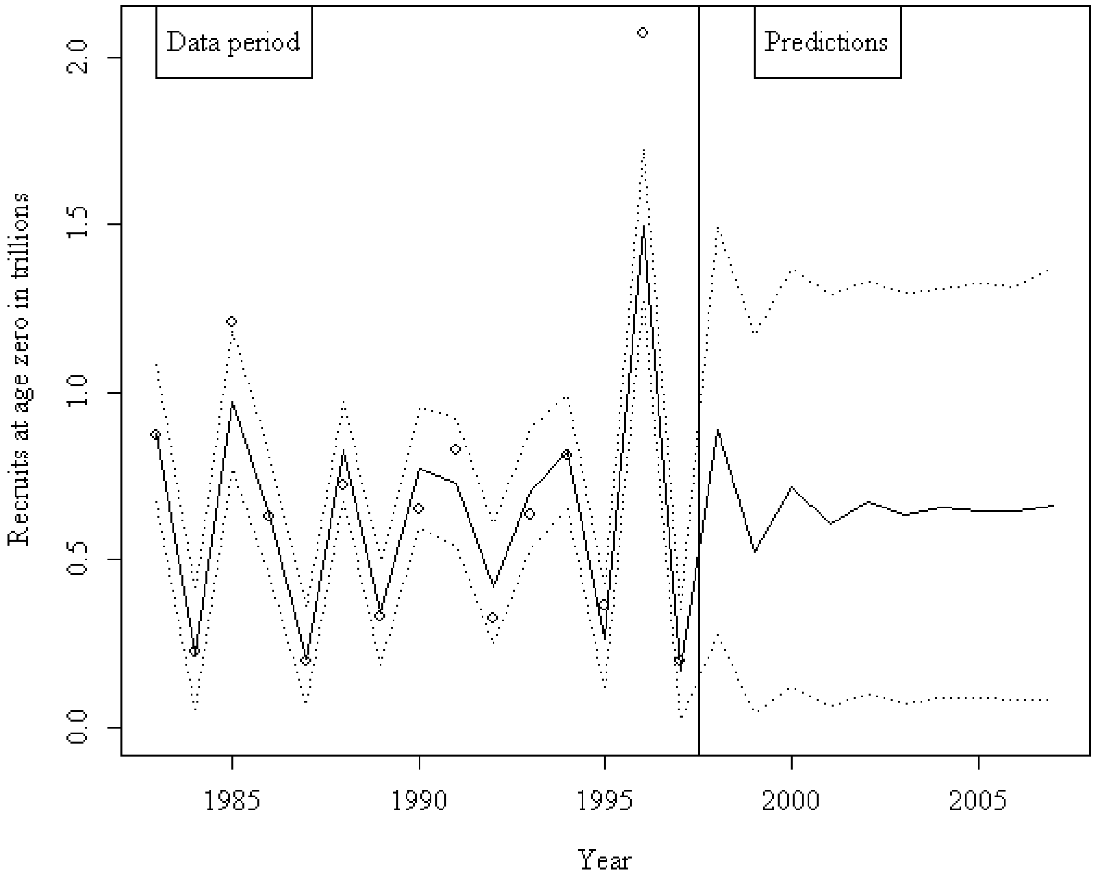


Figure 13.1.7.1. Mean value (solid line) and 95% credibility limits (dotted lines) of recruitment at age zero of North Sea sandeel 1983-2007. Circles indicate WG results.

$F_{predictions}$ = average of 1987-1997

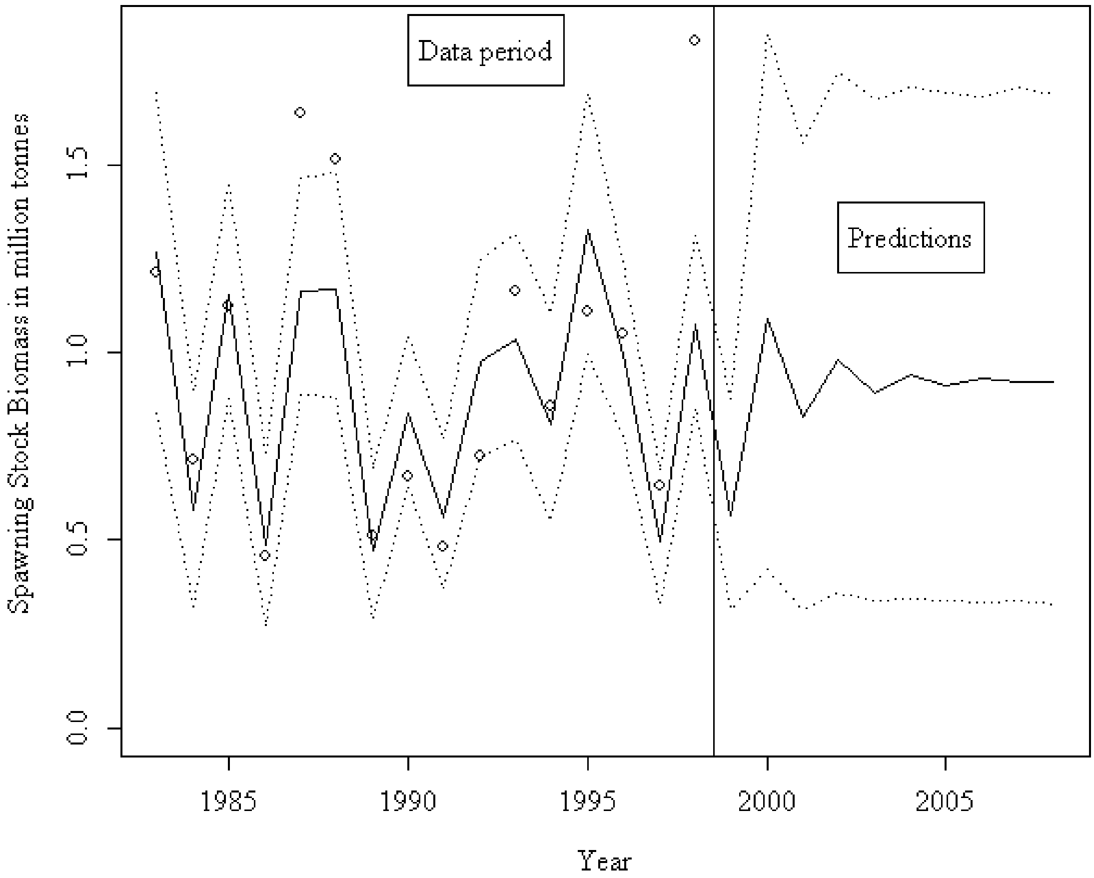
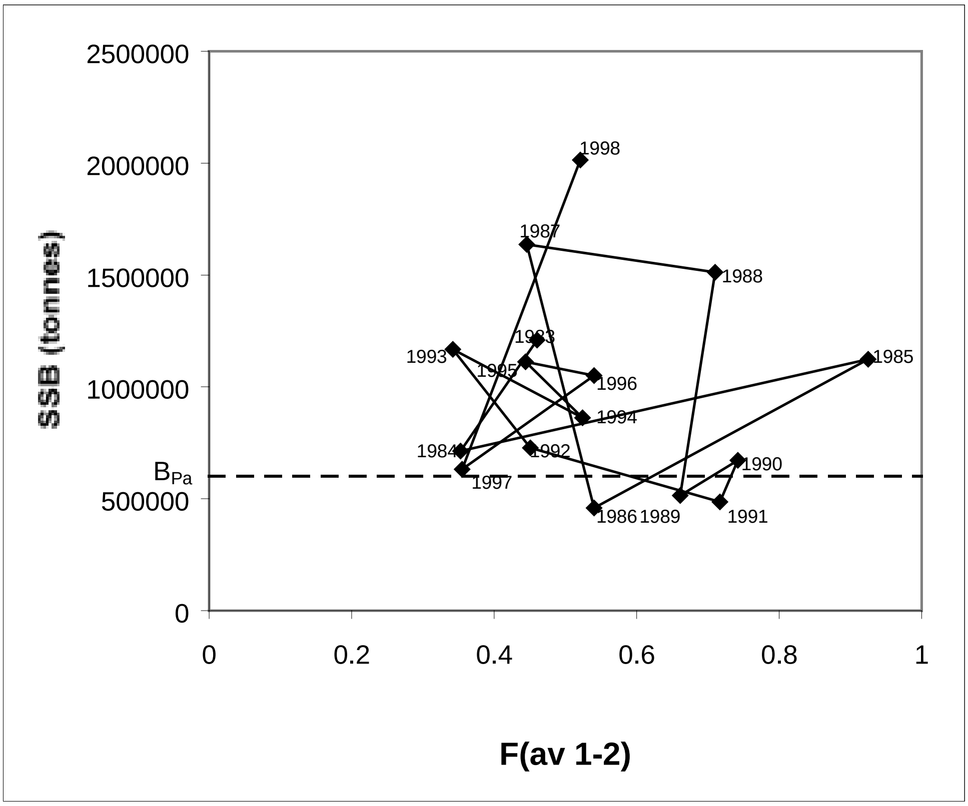


Figure 13.1.7.2 Mean value (solid line) and 95% credibility limits (dotted lines) of spawning stock biomass of North Sea sandeel 1983-2007. Circles indicate WG results.

Figure 13.1.8.1. Sandeels North Sea. Development in SSB and F(av 1-2) from 1983 to 1998.



14 NORWAY POUT AND SANDEEL IN DIVISION VIA

14.1 Overview of Industrial Fisheries in Division Via

There are two distinct industrial fisheries operating in Division VIa; a Norway Pout fishery and a sandeel fishery. The Norway Pout fishery is predominately Danish, whereas the sandeel fishery is almost exclusively Scottish and operates in more inshore areas. No information is available on by-catches in the Norway Pout fishery. The sandeel fishery has a small by-catch of other species; information from the 1995 and 1996 catches indicates that in excess of 97% of the catch consisted of *Ammodytes marinus*, with the by-catch consisting mostly of other species of sandeel. Landings from both fisheries are small compared to the fisheries in the North Sea.

14.2 Norway Pout in Division Via

Landings of Norway Pout from Division VIa as reported to ICES are given in Table 14.2.1 and Figure 14.2.1. Landings in 1998 were 7,186 t, which is below the series average of 12,055 t. No data are available on by-catches in this fishery. In addition, no age composition date are available so there are insufficient data available to assess this stock.

14.3 Sandeel in Division Via

14.3.1 Catch trends

Landings of sandeel in Division VIa as officially reported to ICES are given in Table 14.3.1.1, and trends in landings are given in Figure 14.3.1.1. In 1998 landings decreased relative to 1997 with only 5,320t being caught. This is close to the lowest recorded landing in the fishery.

14.3.2 Assessment

As with the fishery at Shetland, management of this fishery is on a three-yearly basis, with management measures effort being agreed and then kept in place for a three year period. As ACFM have noted that the assessment does not need to be updated annually, but only needs to reflect the three-year interval of the management regime, the assessment has not been updated this year.

Table 14.2.1 Norway Pout. Annual landings (t) in Division VIa (Data officially reported to ICES)

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	37714	5849	28180	3316	4348	5147	7338	14147	24431	6175	9549	7186
Faroes	-	376	11	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	-	1	-	-	-
Netherlands	-	-	-	-	-	10	-	-	7	7	-	-
Norway	-	-	-	-	-	-	-	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-	-	-	-	-
UK (E+W)	-	-	-	-	-	1	-	1	-	-	-	-
UK (Scotland)	553	517	5	-	-	-	-	+	-	140	13	-
Total	38267	6742	28196	3316	4348	5158	7338	14148	24439	6322	9562	7186

Figure 14.2.1; **Norway Pout in Division VIa**
Catch trends

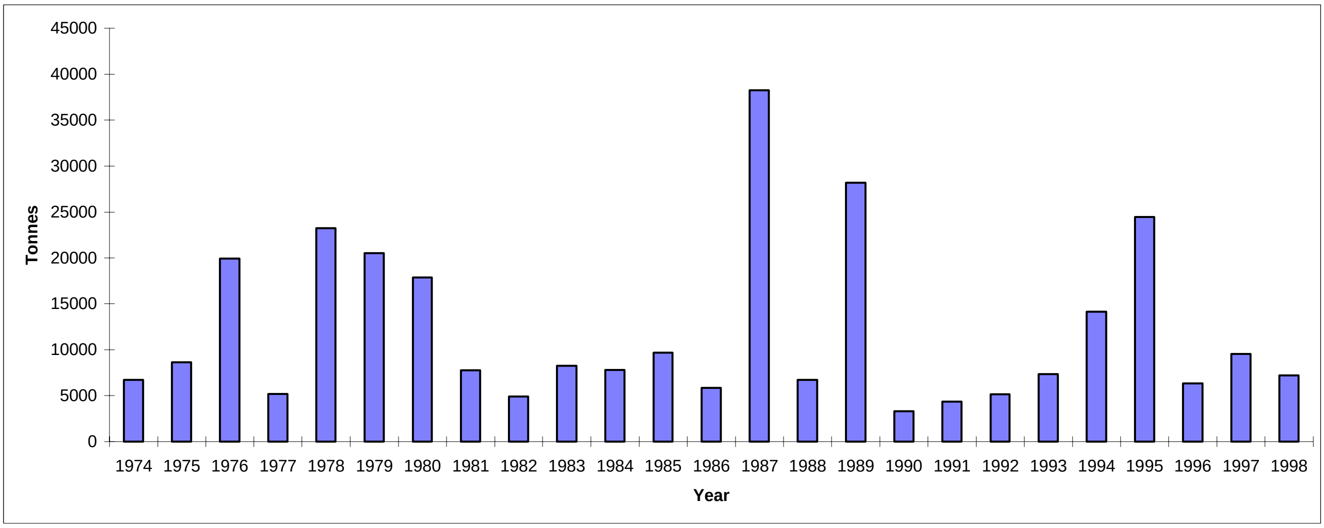
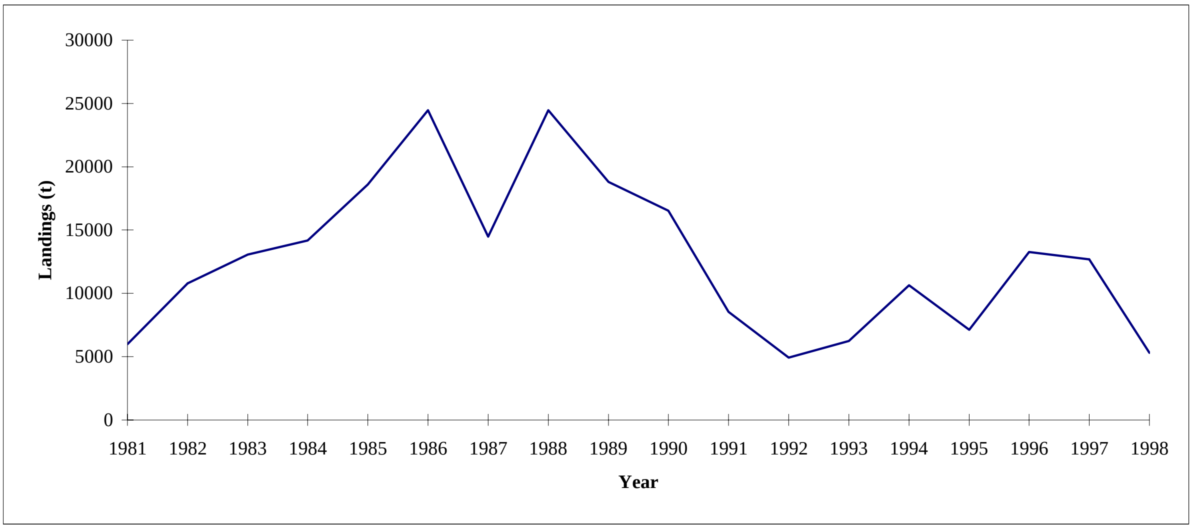


Table 14.3.1.1, Sandeel, Division VIa
Landings (tonnes), 1981-1998, as officially reported to ICES,

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Denmark	-	-	-	-	-	-	-	-	-	-
UK, Scotland	5972	10786	13051	14166	18586	24469	14479	24465	18785	16515
Total	5972	10786	13051	14166	18586	24469	14479	24465	18785	16515

Country	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	80	-	-	-	-	-
UK, Scotland	8532	4935	6156	10627	7111	13,257	12,679	5,320
Total	8532	4935	6236	10627	7111	13257	12679	5320

Figure 14.3.1.1, Sandeel in Division VIa.
Trends in landings



15 REFERENCES AND WORKING PAPERS

Anon. 1993. Biogeographical identification of English Channel fish and shellfish stocks. Report by Ifremer and MAFF DFR to EC Commission DG14, March 1993.

Anon, 1997a. Demande de modification du règlement 3071/95 du conseil du 22 décembre 1995 en faveur des flottilles des fileyeurs exerçant leur activité dans le détroit du Pas-de-calais. Document submitted to the Commission by French authorities, 22 pp.

Anon., 1998. Trémailleurs du Nord de la France. Maintien de la dérogation à 90 mm. Note du Ministère de l'Agriculture et de la pêche, Direction des Pêches Maritimes et des Cultures Marines. Document submitted to the Commission by French authorities, 4 pp. + tables.

Beek, F.A. and M.A. Pastoors. Evaluating ICES catch forecasts: the relationships between implied and realised fishing mortality. ICES CM 1999/R:04

Brabant J-C., 1997. Comparaison de la sélectivé entre trémails et chaluts à perche pour la sole. IFREMER Working paper, 17 pp.

Brander, K., and D. O'Brien. 1999. Temperature data may provide additional information for predicting recruitment of North Sea cod. Working paper to WGNSSK 1999.

Bromley, P.J. 1999. Growth sexual maturation, reproductive investment and the use of marker sampling and survey data to derive maturity ogives for North Sea plaice (*Pleuronectes platessa* L.). draft paper to the Flatfish Symposium 1999.

Cook R. M. 1993. The use of sensitivity analysis to quantify uncertainties in stock projections. ICES C. M. 1993/D:66.

EC, 1997a. Report of the meeting of a STECF sub-group on certain fisheries issues. SEC(97) 1938, Brussels 22-23 Sep. 1997.

EC, 1997b. 5th Report of the STECF. SEC(97) 2388, Brussels 10-13 Nov. 1997.

EC, 1998, 1999: Council Regulation No 850/98 of March 1998 (Conservation of Fishery Resources through Technical Measures for the Protection of Juveniles of Marine Organisms, + Amendments).

EC, 1999: “Preserving young fish to ensure tomorrow’s fisheries” (EC, 15 Sep 1999), Information note of the EC Commission on Council Regulation No. 850/98

Gilks, W.R., Richardson, S. and Spiegelhalter, D. J. 1996. Markov Chaine Monte Carlo in Practise. Chapman & Hall, London.

ICES 1986 a. Report of the Ad Hoc Multispecies Assessment Working Group. ICES CM 1986/Assess:9.

ICES 1986 b. Report of the North Sea Roundfish Working Group. ICES CM 1986/Assess:16.

ICES 1987. Industrial Fisheries Working Group Report 1986. ICES CM1987/Assess:17, p. 4-5.

ICES 1987 a. Report of the Ad Hoc Multispecies Assessment Working Group. ICES CM 1987/Assess:9.

ICES 1987 b. Report of the North Sea Roundfish Working Group. ICES CM 1987/Assess:15.

ICES 1989. Report of the Multispecies Assessment Working Group. ICES CM 1989/Assess:20.

ICES 1990. Report of the North Sea Roundfish Working Group. ICES CM 1990/Assess:7.

ICES 1991. Report of Division IIIa Demersal Stocks Working Group. ICES CM 1991 / Assess:9.

ICES 1996. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1996/ Assess:6.

ICES 1997 a. Report of the Multispecies Assessment Working Group. ICES CM 1997/Assess:16.

ICES 1997. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 1996. ICES CM 1997/Assess:16,

ICES 1998. Report of the Study Group of the Precautionary Approach to Fisheries Management ICES CM 1998/ACFM:10

ICES 1998. Report of the Study Group on the Evaluation of the Quarterly IBTS Surveys. ICES CM1998/D:4

ICES 1998. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 1997. ICES CM 1998/Assess:7

ICES 1999a. Report of the working group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1999/ACFM:8

ICES 1999b. Report of the Workshop on Otolith ageing of North Sea Whiting. ICES CM 1999/G:14

ICES 1999c. Report of the Workshop on Evaluation of the Plaice Box. ICES CM 1999/D:6

ICES (1999d) Report of Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1999/ACFM:1

ICES, 1999. Report of the Comprehensive Fishery Evaluation Working Group. Key Largo, Florida, 14-21 January 1999. ICES C.M. 1999/D:1 ref. ACFM.

ICES, 1999. Report of the study group on Market Sampling Methodology. IJmuiden, 28-29 April 1999. ICES C.M. 1999 / **???**

ICES 1999. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak ICES CM1999/ACFM:8.

Kell, L. T., Smith, M. T. and O'Brien, C. M. 1997. A bootstrapped seasonal survivors analysis for North Sea sandeel. Working Document no 1 (unpublished) to the ICES Working Group on the Assessment of Demersal Stocks in the North Sea and the Skagerrak, 1997.

Lewy, P. and A. Nielsen. 1999. A Bayesian approach to fish stock assessment of North Sea sandeel using Markov Chain Monte Calo and graphical models. Working paper to WGNSSK 1999.

Marchal, P., Andersen, J., de Wilde, J.-W., Hovgård, H., Pascoe, S. and Pastoors, M., 1999. A comparison of biological and economic indicators to estimate efficiency creeping in the Dutch flatfish fisheries in the North Sea. ICES CM 1999, R:11.

Minet J-P., 1997. Comparaison des captures de soles au filet trémail pour les maillages 84, 90 et 100 mm dans le détroit du Pas-de-Calais. IFREMER Working paper, 42 pp.

O'Brien, C. M., Kell, L. T. and Smith, M. T. 1997. Stock-recruitment modelling of North Sea sandeels and advice on the simulation of the distribution of G_{loss}. Unpublished.

Reeves, S. and R. Cook, 1994. Demersal assessment programs, September 1994. Working Document (unpublished) to the 1994 meeting of the North Sea Demersal Working Group.

Skagen, D. W. 1993. A seasonal extended survivors analysis (SXSA) with optional estimation of unknown catches at age. Report of the Working Group on the Assessment of Norway Pout and Sandeel. ICES CM 1994/Assess:7, Appendix I.

Skagen, D. 1994. Revision and extension of the Seasonal Extended Survivors Analysis (SXSA). Working Document (unpublished) to the 1994 meeting of the Report of the Working Group on the Assessment of Norway Pout and Sandeel.

Sparre, P. A suggestion for methodology to assess the effect of the new technical management measures of year 2000. Working paper to WGNSSK 1999.

Stæhr and Støttrup, 1991. Migration of plaice transplanted from the North Sea to the Kattegat. ICES CM 1991/G:39.

Tétard A et Le Pape O., 1997a. Simulations d'une augmentation du maillage des fileyeurs (passage du 84 au 100 mm) pour le stock de sole en Manche-Est. IFREMER Working document, 9 pp.

Tétard A and Le Pape O., 1997b. Simulations of mesh size changes (from 84 to 90 or 100 mm) of the French trammel net fleet for the eastern English Channel sole fishery. IFREMER Working document, 6 pp.

Tétard A and Le Pape O., 1998a. Minimum mesh size for French trammels nets for sole in Dover Straits (VIId/Ivc). Complementary information on methodology after observations made by STECF in 1997. IFREMER Working document, 3 pp.

Ulmestrand, 1989. Erfarenheter och preliminaere resultat fron et umplatnings med roedspaetter i 1987. 6 p. (in Swedish).

Vinther, M., Lewy, P., Thomsen, L. & U. Petersen. 1998. Specification and Documentation of the 4M Package containing Multi-species, Multi-Fleet and Multi-Area Models. Danish Institute for Fisheries Research, Charlottenlund, 70pp.

Vinther, M. 1999. *ad hoc* Multi Species VPA tuning applied for North Sea stocks. Working paper to WGNSSK 1999.

Winslade, P. 1974. Behavioural studies on the lesser sandeel *Ammodytes marinus* (Raitt) I. The effect of food availability on activity and the role of olfaction in food detection. J. Fish. Biol. 1974, 6, 565-576.

Wright , P. 1998. Population structure in the lesser sandeel (*Ammodytes marinus*) and its implications for fishery-predator interactions. EU study DG XIV, contract 94071.

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The model formulated above has been applied to sandeel in the North Sea for the period including1983 and the first half of1998 using almost the same data as used by last years ICES Working Group (ICES, 1998). A seasonal analysis by half year has been carried out in order to correspond to the seasonal tuning method, SXSA (Dankert, 1994), applied by he Working Group. Data on natural mortality, mean weight at age and proportion mature are also the same as used by the Working Group. Data for two commercial fleets both including catch and effort information have been included in the analysis. Catch data without effort information, which constituted less than 3% of total catches have been excluded from the analysis. No survey data were available.

Catchability for the two commercial fleets has been modelled in the same way as in the SXSA by assuming that catchability by fleet and age is constant over years and that catchabilities for the two oldest true age groups are equal to each other.

Recruitment has been modelled applying an autoregressive time series model assuming that recruitment has been fluctuating with a pattern of alternating strong and weak year classes has been used. The same type of model was assumed in the bootstrap SXSA applied by Kell et al. (1997) and O'Brien et al. (1997). The parameters in the autoregressive model have been estimated simultaneously with all other parameters considered. This is an important advantage compared to e. g. the XSA because all correlations between parameters (F, N and the recruitment parameters) are estimated and automatically are included in the forecasts. The same applies to the uncertainties of the parameters estimated.

For 1990 no age composition data are available. In the Bayesian approach used this problem is easily solved by simulating the missing data applying the model assumption that catchability by age and fleet remains constant over years.

Predictions

Short and long term, status quo predictions have been carried out simultaneously with the historical analysis in one single run assuming that:

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Recruitment for each prediction year has been simulated by drawing randomly from the autoregressive recruitment model applied.

Weight at age used in a prediction year is obtained by selecting the weight at age for all age groups from a randomly selected year.

The last choice is due to that the mean weight at age by year varies considerable in 1983-1998 without any particular trend. This variation apparently strongly affect predicted catch and biomass (Kell et al., 1996). Therefore it is important to include this variation in the predictions. As this variation for the present is not understood it is included in predictions as described.

A Bayesian stock assessment model for sandeel in the North Sea

A Bayesian approach was applied. Markov Chain Monte Carlo simulation, MCMC, was used to simulate the posterior distribution of the parameters. The parameter were simulated by stepwise simulation using graphical model. A detailed description of the model is given by Lewy and Nielsen (1999).

Catch at age by fleet was assumed to follow a normal distribution. The autoregressive recruitment model for the 0-group was

$$N_{0,y} \mid N_{0,y-1} = \mu + \rho(N_{0,y-1} - \mu) + \sigma_R \varepsilon_y$$

$N_{0,y}$ is the recruitment at age zero in year y, μ is the equilibrium of $N_{0,y}$, ρ expresses the strength of autocorrelation between recruitment, ε_y denotes a standardised normal distribution and σ_R denotes the standard deviation of the normal distribution. The absolute value of ρ is assumed to less than one in order to be stationary.

The prior distributions applied for the all parameters are given in the below text table:

Parameter	Prior distribution
q_{fa} (catchability)	U(0,2)
α_a (variance parameter)	U(0,10^{10})
β_2 (variance parameter)	U(0,100)
$N_{a1},\ a \geq 0$	U(0,10^8)
$N_{\min,y} \mid N_{\min,y-1} \quad y \geq 2$	$\mathrm{N_t}(\mu + \rho(N_{\min,y-1} - \mu),\ \sigma_R{}^2)$
μ	N(0,10^{20})
ρ	U(-1,1)
σ_R	U(0,10^6)

U(a,b) denotes the uniform distribution on the interval from a to b.
N($\mu, \sigma_R{}^2$) denotes the normal distribution with mean = μ and variance = $\sigma_R{}^2$
N_t($\mu, \sigma_R{}^2$) denotes the normal distribution truncated at zero

Application of the truncated normal distribution for the autoregressive recruitment model, (19), is especially important for the predicted recruitment, which of course needs to be positive.

All prior distributions except for the autoregressive recruitment model are intended to be non-informative.

Computational methods

The computations have been carried out using WinBUGS Version 1.2 (Gilks et al. 1996). WinBUGS is a program using MCMC for simulating full conditional parameter distributions using Gibbs sampling for specified graphical models and prior distributions. The advantage of WinBUGS is that it simple to program even complicated models and that the user only has to provide the relations between the parameters and their prior distributions. The program then uses efficient methods for simulation of the posterior distributions.