Advisory Committee on Fisheries Management **ICES CM 2001/ACFM:07**

REPORT OF THE

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

ICES Headquarters
3–12 October 2000

PART 1 OF 2

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

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1 GENERAL

1.1 Participants

The Working Group met in Copenhagen from 3–12 October 2000 with the following participants:

Frans van Beek (Chair)	Netherlands
Ewen Bell	England
John Casey	England
Wim Demaré	Belgium
Uli Damm	Germany
Maria Hansson	Sweden
Tore Johannessen	Norway
Knut Korsbrekke	Norway
Phil Kunzlik	Scotland
Paul Marchal	Denmark
Capucine Mellon	France
Richard Millner	England
Coby Needle	Scotland
J. Rasmus Nielsen	Denmark
Martin Pastoors	Netherlands
Hans-Joachim Rätz	Germany
Stuart Reeves	Scotland
Odd M. Smedstad	Norway
Alain Tétard	France
Sieto Verver	Netherlands
Morten Vinther	Denmark

1.2 Terms of Reference

The **Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak** [WGNSSK] (Chair: F. van Beek, Netherlands) will meet at ICES Headquarters from 3–12 October 2000 to:

a) assess the status of and provide catch options for 2001 for the following stocks:

   1) cod in Sub-area IV, Division IIIaN (Skagerrak), and Division VIId,

   2) haddock in Sub-area IV and Division IIIa,

   3) whiting and plaice in Sub-area IV, Division IIIa, and Division VIId,

   4) sole in Sub-area IV and Division VIId,

   5) saithe in Sub-area IV, Sub-area VIa and Division IIIa.

   The assessment should take into account the technical interactions among the stocks due to the mixed-species fisheries and the new management measures coming into force in 2000;

b) assess the status of and provide catch forecasts for 2001 for Norway pout and sandeel stocks in Sub-area IV and Divisions IIIa and VIa, and identify any needs for management measures (including TACs) required to safeguard the stocks;

c) 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;

d) 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);

e) identify major deficiencies in the assessments.

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 Fisheries.

WGNSSK will report to ACFM at its October/November 2000 meeting.

There were no additional requests. The WG noted that in addition to the-terms of reference medium predictions were required to allow ACFM to make statements on medium-term consequences associated with short-term management options presented by ICES. These have been carried out for a number of stocks. For other stocks, medium-term analyses carried out in previous years were still considered to be representative. It was also noted that-term of reference d) had been dealt with last year. It was assumed that the request applies to the 1999 data.

1.3 Data

1.3.1 Data sources for 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 as a time series
- 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

For most stocks, the Working Group estimates of total landings do 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 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.

In a number of occasions, management areas do not entirely correspond with areas for which the assessments are carried out. If the management areas are wider, landings cannot always be obtained for the assessment area separately. In these cases landings have to be estimated by the WG from external information.

Due to problems with the national French fishery statistics database in 1999, only official data by Sub-area were available to the Working Group and landings for ICES Divisions were estimated by the Working Group (see also fleet and research data).

Uncertainties in the data on landings have seriously affected the quality of some of the assessments and catch forecasts. In some cases, the Working Group estimates of the landings 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 indicating the existence of mis- or unreported landings that 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 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 to 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 exceptionally large or small year classes enter the spawning stock.

A number of working papers were presented to WGNSSK, presenting information on maturity for plaice, whiting and Norway pout in the North Sea. Also for other stocks maturity data are available. The WG discussed the possible use of these data in its assessments. There is general agreement that including maturity data would make the assessments more realistic and the biological information should be included in the assessment in the future. There are, however, several reasons for not including these data presently. The main effect of including measured maturity data would be on the historical time series of SSB and on the stock-recruitment plot. Presently by ICES proposed or by managers agreed precautionary reference points are conditional to the maturity data used in deriving these reference points and would have to be reconsidered when changing maturity in the assessment. WGNSSK proposes to implement the changes when it is requested to reconsider the PA reference points. General guidelines to assessment Working Groups, on how to implement such data would be welcomed.

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 discard estimates are available presently. Discard sampling schemes are implemented in a number of countries recently and a short time series, 1-3 years, is available for some countries and fleets.

1.3.1.3 Natural mortality

Natural mortality for plaice and sole in all areas has been taken as 0.1. Natural mortality for saithe has been taken as 0.2. The values of M in use for the assessment of North Sea cod, haddock and whiting have been reconsidered a few years ago in the light of new information but have not been changed. The existing values are as follows:

	COD	HADDOCK	WHITING
0	[2.70]	2.05	2.55
1	0.80	1.65	0.95
2	0.35	0.40	0.45
3	0.25	0.25	0.35
4	0.20	0.25	0.30
5	0.20	0.20	0.25

Unless specified otherwise, the same values have been used in all years of the assessment.

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 national quota, ITQ’s and technical measures are known to have led to changes in directivity of some fleets to other species and in some cases to underreporting and discarding for legal reasons.

A noticeable feature of the Scottish commercial effort data for 1999 is that it is substantially lower than the data for 1998. While some decline might be expected, the magnitude of the decline in one year is very much larger than expected. In the case of Scottish seine, for example, effort has more or less halved in 1999. Examination of the Official Scottish Executive database (FIN) from which the Scottish effort tuning series is constructed showed that unlike the years 1997 and 1998, 1999 contained a large number of landing records with no hours fished data. It is possible that up to 40% of the effort data are missing as a result, and it seems very likely that the effort data for 1999 are seriously under-estimated. This problem is being further investigated, and WGNSSK felt that for the present it was unwise to include these data in the XSA at this stage until the question has been adequately resolved.

French commercial tuning series in 1999 were discontinued because of problems with the national French fishery statistics database. These problems arose from a transfer to new software. This made it impossible to obtain catch data by (Sub)Division and size category and effort data by fleet. The problem is not restricted to the stocks considered by WGNSSK only, but also to stocks assessed by other Working Groups. The absence of up-to-date French information affects all assessments for stocks which are also exploited by French fleets. Particularly in the eastern Channel (Sub-Division VIId), a large part of the landings is taken by French fleets and the quality of the assessments in this area largely depend on the quality of French data and the availability of information of the French fleets operating in this area. The absence of French data has affected the quality of the assessments carried out for plaice and sole in this area.

In previous years WGNSSK noted that in general, there was still a lack of representative effort and CPUE series for most stocks. This situation has further deteriorated in 1999.

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, 1999 and 2000 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 indices have not been used.

The whole time series of indices for North Sea plaice and sole of the Beam Trawl Survey have been revised again in 2000. 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.

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

1.3.2 Data sources Norway pout and sandeel

The data used in assessment for Norway pout and sandeel stock are based on:

- total landings
- samples of landings for species composition, weight, length, age and sometimes maturity
- fleet data: effort data from logbooks and CPUE data from associated fleet landings
- survey data: catch per unit effort by age for Norway pout
- data on natural mortality from the MSVPA.

1.3.2.1 Data on landings, age composition, weight-at-age, maturity ogive

The sampling of Norway pout and sandeel landings were described in detail in the 1995 report of the Working Group (ICES CM 1996/Assess:6). The sampling system has generally not changed since then. The applied sampling systems vary between countries.

In Norway, the sampling system since 1993 is based on catch samples from three market categories: E02 (sandeel, if mainly sandeel), D13 (blue whiting, if not sandeel and catch taken west of 0^{o} E), D12 (Norway pout, if not sandeel and catch taken east of 0^{o} E). The samples are raised to total landings on basis of sales slip information on landed categories. Effort is estimated from total number of trips and an estimate of average days at sea per trip.

In Denmark, the catch estimates are based on sales slip information, logbook data, species composition from inspectors and biological data, including age-length keys from independent biological sampling. Total landings are estimated per statistical rectangle based on total catch estimates from sales slip and logbook data, together with data on species composition and biological data.

For Norway pout, the mean weights-at-age used for stock biomass is the same for all years. Samples from the landings suggest, however, high variability both between years and seasons. One problem using catch mean weights is that the 0-group is not fully recruited in the 3rd quarter, giving an overestimate of weight-at-age in the stock for this age-group. More knowledge is needed before variable weight-at-age in the catches can fully be taken into account in the assessment. For sandeel, weights-at-age in the catches are used as an estimator for weight-at-age in the stock.

The maturity ogives for Norway pout and sandeel are kept constant over the whole period of assessment. For both species knife-edge maturity are assumed. A paper (WD-7) presented at the meeting indicated that the age of 50% maturation of sandeel from the east central North was 3.2 years. The age estimate is one year higher than that found previously in the southern North Sea and adopted for the ICES-assessments of the North Sea spawning stock. Hence, the SSB may be significantly overestimated.

Another paper (WD-12) indicated high variability in maturity for the 1-group Norway pout.

1.3.2.2 Natural mortality

Natural mortality for Norway pout has been taken as 0.4 per quarter, corresponding to an annual figure of 1.6. A paper (WD-11) on Norway pout indicated a much higher natural mortality.

For sandeel, natural mortality has been derived from MSVPA results, and varies with age and season:

Age	M: Jan – Jun	M: Jul - Dec
0	-	0.8
1	1.0	0.2
2+	0.4	0.2

1.3.2.3 Fleet and research vessel data

For Norway pout, time series of CPUE and effort data from Danish and Norwegian commercial fleets and data from research vessels have been used to tune the assessment. The same survey tuning series was used as in previous years. The research vessel data include 1st quarter IBTS, 3rd quarter EGFS and 3rd quarter SGFS. This year, data from the 3. quarter IBTS was made available, but not used.

For sandeel, only data from the Danish and Norwegian commercial fleets are available.

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 the report of the WGNSSK meeting in 1998 (ICES 1999a) and have not been changed since then. Table 1.3.3.1 gives an overview of the sampling levels in 1999 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 and a beta-release of a new version (XXSA) was explored in some stocks. This new release allows for using research vessel data beyond the last year in the assessment.

The implementation of the various analysis tools is chosen on basis of explorations. The decision on choices, such as the 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 analyses have been done for all stocks included in the present report, but are not necessarily repeated every year for each stock since the outcome is not normally expected to change over a few years. Details of such analyses are included for those stocks for which the settings were changed. Those without any changes can be found in earlier reports of this Working Group.

As in previous years, in several cases recruitment estimates have 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. For plaice, haddock, whiting and cod, large discrepancies are observed in the recruitment predicted by RCT3 and the observed recruitment in XSA (Figure 1.6.1). In most cases RCT3 seems to overestimate recruitment and WGNSSK considers this may partly explain the overestimation of landings in the short-term forecasts for these species.

Another problem is that the use of the power model for recruiting age groups cannot be restricted to those tuning fleets, for which the use of this model is appropriate. In the present implementation of XSA the use of the power model may solve problems in some fleets while creating problems in other fleets. The fact that the F-shrinkage can not be turned off for recruiting age groups has in some cases been seen to have an undesirable strong influence on the recruitment estimates originating from XSA. The present implementation of the power model in XSA is not transparent.

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 most recent 3 years. The estimate of *status quo* F used by default in short-term predictions was the scaled mean F-at-age for the most recent three years.

Last year, the WG defined *status quo* F by default as the unscaled average of the most recent 3 years in the assessment as recommended by ACFM. This procedure was based on the consideration that while the point estimate of-terminal F represents the best available estimate of F in the last year, it does not necessarily follow that it will also be appropriate as an estimate of F in subsequent years. WGNSSK decided to abandon this procedure and return to its previous procedure, since it realised that it had not improved the prediction of the 1999 landings. In fact, last years prediction produced the poorest forecast with respect to expected landings in the mid-year since 1983.

Following comments in the technical minutes of the ACFM meeting of October in 1999, sensitivity analysis as presented in previous reports were no longer carried out. Medium-term projections made at the current Working Group meeting used the same software (WGTERM, RECRUIT) 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).

Short-term forecasts have been given on a stock basis, which in some cases includes more than one management area. For management purposes the catch forecast has been split by Sub-area and Division on the basis of the distribution of recent landings.

1.5 Biological Reference points

Established biological reference points ($\mathbf{F}_{med}$, $\mathbf{F}_{\mathbf{high}}$, $\mathbf{F}_{\mathbf{0}.1}$, $\mathbf{F}_{\mathbf{max}}$ etc.) have been estimated according to standard procedures and given for each stock where possible.

Two years ago, the Working Group proposed limit- and precautionary reference points for fishing mortality and SSB ($\mathbf{F}_{lim}$, $\mathbf{F}_{pa}$, $\mathbf{B}_{lim}$ and $\mathbf{B}_{pa}$) 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. Some of the reference points for North Sea stocks have been adopted by managers (Norway and EU), notably those for cod, haddock, (sole) and plaice.

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

1.5.1 Summary of PA reference points

In 1998 and 1999 the Working Group proposed and reviewed biological reference points for all stocks based on the precautionary approach criteria. These were reviewed by ACFM. The reference points finally adopted by ICES and proposed to the managers are given in the text table below.

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
Saithe in IV, VI and IIIa	106	200	0.60	0.40
Sole in IV	25	35	-	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	-	0.73
Norway pout in IV and IIIa	90	150	-	-
Sandeel IV	430	600	-	-

Biomass in '000 tonnes
– no estimate available

1.6 Presentation of reports, papers and working documents

A number of working papers were presented to the Working Group. These are listed in section 15. The present Section gives a short summary of the contents of the presentations.

Paper: North Sea Cod Meeting: Lowestoft 22–23 August 2000. (WD-1)

The paper is a report of a meeting, which discussed and evaluated a preliminary assessment of North Sea Cod prior to the meeting of WGNSSK in 2000. The preliminary assessment identified two main issues regarding the configuration of the assessment. These are related to the catchability model used for ages 1 to 3 in the XSA, and more significantly, whether or not Scottish commercial effort data should be used in the assessment. The two questions were investigated in some detail. In contrast to the WGNSSK assessment of 1999 the new assessment indicates no decline in fishing mortality in recent years and it estimates a spawning stock biomass of almost half the size estimated by WGNSSK. The paper was evaluated by WGNSSK and the presented assessment was a starting point for the assessment presented in this report.

Paper: A note on the Working Group performance of short-term predictions for North Sea cod, plaice and sole by: Frans van Beek, Netherlands Institute for Fisheries Research (WD-2)

ICES short-term predictions of landings of cod, plaice and sole in 1999 show large discrepancies compared to estimates of actual landings for that year. The advice based on these predictions undermines the credibility of ICES. The paper evaluates the historical performance of the WG in estimating the expected landings in the TAC year and the mid-year of the prediction since 1983. The assumption of status quo F in both years has been applied by the WG and in the ICES advice in all years. The predictions were compared with the actual landings.

For cod the expected landings are overestimated in most years. The average error in the prediction is +32% in the TAC year, ranging between –17% to +64% per year and 25% in the mid-year, ranging between –4 to +56 % . The prediction of the landings in the current year is only slightly better. There are no clear time trends in the residuals of predicted and actual landings although most of the lowest residuals are in the earlier years.

Also for plaice in most years the expected landings have been overestimated as well in the TAC year as in the mid-year. Over the whole period, the average error on the prediction of the landings is 19% in the TAC year ranging between -9% to +74% and 19% in the mid-year ranging between –13% to +61%. Predictions for the mid-year are not better than those made one year earlier for the TAC year. The quality of the plaice predictions have deteriorated considerable in recent years.

For sole, expected landings for the TAC year are underestimated in most years. The prediction error is smaller than for cod and plaice, 11% ranging between –-20% to +17% per year. There is no systematic over- or underestimation of predicted landings in the mid-year, the average prediction error is 9% ranging between –19% to +25% per year. There are no time trends in the accuracy of the prediction.

For all three stocks the poorest predictions originate from last year. In a discussion the WG noted that the exploitation of stocks considered was mostly on recruits and that it was likely that the estimation of year class strength would be a major cause of the discrepancy.

Paper: Highlights of the Report of the Study Group on Market Sampling Methodology by: Martin Pastoors, Netherlands Institute for Fisheries Research (WD-3)

Results were presented of the Study Group on Market Sampling Methodology which met in Aberdeen on 24-25 January 2000 with participants from England, Denmark, Norway, Scotland, The Netherlands, Belgium and Spain. The Study Group was convened in conjunction with a project meeting for the EMAS project (Evaluation of market sampling strategies for a number of commercially exploited stocks in the North Sea and development of procedures for consistent data storage and retrieval, CFP 98/075). Inventories were made of sampling and raising procedures for herring, cod and plaice in the North Sea by different countries. The uncertainty in the nationally raised age-composition was evaluated. Results will be taken forward to a workshop to be held in Lowestoft (28-30 November 2000).

Paper: Annual variation in the growth and maturity of North Sea plaice – implications for estimating spawning stock biomass by: P.J. Bromley, CEFAS UK (WD-4)

The estimation of spawning stock biomass in North Sea plaice is based on a single knife edged maturity ogive assuming full maturation-at-age three. Although growth of plaice has fluctuated widely over the past 30 years and this is likely to have affected the proportion of females maturing, this information has not been used in assessing stock biomass. An analysis of English market samples from 28,000 plaice sampled between 1983 and 1996 has been carried out. The results indicate that:

1. weight-at-age has varied significantly within year classes over the past two decades;
2. the proportion of plaice maturing has varied substantially between years, even with age groups and is strongly correlated (P=0.001) with body weight;
3. based on annually collected length and weight data, it would be possible to prepare annual maturity ogives for the full time series of data;
4. application of year specific maturity ogives indicates that SSB may be wrongly estimated in some years.

The WG concluded that this approach should be further evaluated and requested that English and Dutch data should be analysed together to assess the potential impact on SSB of using annual maturity keys.

Paper: Fifteen years of IBTS distribution maps of cod, whiting and haddock by: J. Casey, CEAFS UK. (WD-5)

The working document presented maps of the spatial distribution of cod, haddock and whiting as 1-, 2- and 3+ group from the IBTS 1st quarter survey for the years 1986-1990. These maps indicate changes in distribution between age groups, but also changes in distribution over time. The document was provided as back-ground information.

Paper: Evaluation of the effects of the Beam Trawl Survey (BTS) on the recruitment estimation for plaice and sole in the North Sea by: Martin Pastoors, Netherlands Institute for Fisheries Research (WD-6)

Stock assessment of commercially exploited flatfish species (plaice, sole) in the North Sea are carried out using Extended Survivors Analysis (XSA, Darby &Flatman 1994; Shepherd 1999a). Both information from the commercial fisheries (e.g. catch-at-age, CPUE-at-age) and from research surveys (e.g. BTS and SNS) are used (Van Beek 1997). In this contribution the effects of in- or excluding the Beam Trawl Survey (BTS) into the assessments and stock projections for plaice and sole is explored. It was found that excluding the BTS resulted in lower estimates of recruitment, especially in the RCT3 procedure. Statistical analysis aimed at improving the BTS indices are presented in WD 15, which was supplied to the WG as reference material only.

Paper: Spawning time, age and size at maturity, and fecundity of sandeel, *Ammodytes marinus*, in the North Sea and in unfished coastal waters off Norway by: O. A. Bergstad, Å. S. Høines and E. M. Krüger-Johnsen, Institute of Marine Research, Flødevigen Marine Research Station. (WD-7)

The reproductive biology of lesser sandeel was studied on the fishing grounds of the east central North Sea and on an unfished ground off the coast off the southwest Norway. The length and age at 50% maturity was 14 cm and 3.2 years in both study areas. The age estimate is one year higher than that found previously in the southern North Sea and adopted for the ICES-assessments of the North Sea spawning stock. In most years between 30 and 50% of the sandeel landings from the North Sea come from the east central North Sea and adjacent grounds. Catches from that area thus have significant impact on the results of the North Sea wide stock assessments. The proportion of adults in the catches on the main fishing banks was usually appreciable lower than on the coast where the age distributions were wider.

Paper: Annual trends in catchability and fish stock assessments by: Paul Marchal, Clara Ulrich, Knut Korsbrekke, Martin Pastoors, Brian Rackham and Holger Hovgård. Danish Institute for Fisheries Research, Denmark. (WD-8)

A key feature that undermines the assessment of fish stocks is the assumption of constant catchability. We assume here that trends in catchability occur through fishing power creeping. A range of catchability trends, including values derived from external data, are implemented to standardise the fishing effort of some tuning fleets used in the stock assessments performed by XSA (eXtended Survivors Analysis). Stocks being assessed are the North Sea cod, saithe, plaice and sole. The performance of the new assessments are compared with the traditional approach, by using criteria based on the precision of catchability estimates, stationarity of log-catchability residuals and retrospective patterns relative to fishing mortality, spawning stock biomass and recruitment estimates. The performances of the North Sea cod and sole assessments could be enhanced by accounting for an annual increase in catchability of about 6%, for the English otter-trawlers and the Dutch beam-trawlers. By contrast with the current assessment, the spawning biomass of cod is expected to have decreased between 1997 and 1998, while the fishing mortality of sole is expected to have increased over the same period. No firm conclusions could be drawn out from the North Sea saithe and plaice assessments.

Paper: withdrawn (WD-9)

Paper: Sexual maturation and spawning of North Sea whiting by: P.J. Bromley and J. Casey. (WD-10)

The paper examined maturity data collected during the quarterly International Bottom Trawl Surveys (IBTS) of the North Sea. Sexual maturation was investigated on an annual, seasonal, regional, age, and body size basis.

During the 1st and 2nd quarter, running females were distributed throughout the North Sea, except for the central region in the vicinity of the Dogger Bank. Moderate spawning activity took place during the 1st quarter and peaked in the 2nd quarter. The proportion of spent females peaked in the 3rd quarter. During the 3rd quarter running females were occasionally found in the western North Sea, south of 58°N. The results indicated that during the 2nd quarter of the year, only up to 30% of mature fish spawned. This observation was consistent with observations for the 3rd quarter.

The paper suggests that the maturity ogive currently used by the WG to estimate SSB may be in error since even for older ages >2 years, 100% maturity is assumed, whereas the IBTS observations revealed that the maximum proportion mature at any age in any quarter was 90%.

The Working Group considered that further work on this topic could prove useful in determining the inter-annual variability in whiting maturity-at-age. The results from such a study would provide useful input to a future comprehensive assessment of whiting. Furthermore, using annual estimates of maturity-at-age in the assessments would most likely change our perception of the historic stock trends and would also have an impact on estimated biological reference points.

Paper: Residual mortality of Norway Pout in the North Sea by: Henrik Sparholt, Lena Larsen and Rasmus Nielsen. (WD-11)

A WG Doc was presented on Residual natural mortality of Norway pout in the North Sea. Various authors have indicated that M increases with age. In the routine assessment this is not assumed. The WG Doc tried to resolve the discrepancy.

The paper attempts primarily to estimate residual natural mortality, M1, i.e. the part of the natural mortality that is not covered by the MSVPA estimate of predation mortality from the five MSVPA predators (cod, haddock, whiting, saithe, and mackerel).

Based on IBTS indices from 1st quarter survey 1974-1999 and 3rd quarter 1991-1999, the English Ground Fish Survey indices (EGFS, 3q 1982-1999), the Scottish Ground Fish Survey indices (SGFS, 3q 1980-1999), commercial catch-at-age data, and number of N. pout predated by the MSVPA predators, simple catch curve analysis showed that Z increases from age 1 and onwards:

Data source / Age	0	1	2	3	4
IBTS 1q		1.02	2.13	3.13	2.68
IBTS 3q	0.40	1.60	2.26	2.84	
EGFS 3q	0.31	1.78	2.68		
SGFS 3q	-1.49	1.51	2.73		
Commercial catch	-0.95	1.53	2.78	4.41	
Stomach data	1.35	2.45	3.45		

A simple steady state model with IBTS 1q data, commercial catch data, and numbers predated gave the following maximum likelihood estimates of F, M1, and M2.

Age	0	1	2	3	4
F	0.02	0.19	0.19	0.19	0.19
M1	0.21	0.11	1.85	3.23	8.06
M2	1.01	0.87	0.38	0.19	0.08
Z	1.25	1.17	2.42	3.61	8.33

It can still be postulated that old Norway pout might migrate out of the North Sea and Z therefore is over-estimated (is the North Sea only a juvenile area for N. pout?). The only possibility, which has not yet been tested, is that N. pout could migrate out to the north and Northwest. However, around the Faroe Islands very few N. pout of age 3 and older are found (Jakup Reinert, pers. comm.). Furthermore, it would be an unusual phenomenon if N. pout spawn in the North Sea as 2 groups and to some extent 3 groups, and then migrate out and spawn outside the North Sea as 3+ groups. At least homing can then not be a feature for N. pout. Norway pout has normally a depth range distribution limit of 250-300 m bottom depth. Extensive migration to the Skagerrak Trench or out of the North Sea area to the deeper northern and north-western areas is not likely.

The only realistic conclusion at the moment of the estimated increase in Z is that M1 (residual natural mortality) increase by age.

Consequences for the assessment (and for the MSVPA) of this is that SXSA (or XSA) has to be run with revised M values (MSVPA with revised M1 values) and it is a question whether SXSA will then be sufficiently converging to give reasonable results if the latter is the case. Alternative assessment methods would be preferable.

Paper: Spatial distribution and maturity of Norway Pout in the North Sea by: Lena Larsen, Hans Lassen, Rasmus Nielsen and Henrik Sparholt. (WD-12)

Norway pout's main distribution area is Roundfish area 1-3 for age group 1-5 in the first quarter of the year. However, in 1996 47 percent of 1-year-old was found in round fish area 8. The distribution of ages 4 and 5 are very variable over years. This is probably due to imprecise estimation based on limited data.

The main vertical distribution of Norway pout is from 100 to 200 m, with the highest catch rate at 150 m. There is almost no catch at depths above 50 m, but some fish are caught deeper than 200 m bottom depth. Depths over 200 m are not properly covered in the IBTS survey in the North Sea. However, alternative survey sources indicate low catch of Norway pout in deep areas below 200 m in e.g. the Skagerrak Trench.

Relative maturity by age, sex and quarter has been analysed. On average over the years 1981 – 1999, 20 percent of females-at-age one in the first quarter are mature compared to 40 percent of the males. The average of the two sexes is therefore about 30 percent. There is a large variation in percent mature when analysed per year. However, very often more than 10 % of the 1-group is mature, which is the proportion used in the SXSA assessment in the North Sea (and Skagerrak). Consequently, it should be considered to run the SXSA with revised proportion mature of at least the 1-group by age and quarter of the year. This would have significant implications for the assessment output as the 1-group generally is a significant part of the total Norway pout stock in the North Sea and Skagerrak. Furthermore, these results are contradictory to previous reports (Raitt, 1968) stating that only a very small proportion of the 1-group is mature. Surprisingly, maturity for age 2 and 3 decrease from first quarter to second, firth and fourth quarter. This can be explained by either a mortality of mature fish after spawning, which takes place in the time period between the first and second quarter of the year, or by fish expected to be mature in first quarter and take part in the coming spawning returns to an immature phase without having spawned. Uncertainties in maturity determination might also be a problem.

Paper: North Sea cod meets the Kalman Filter by: Rob Fryer, FRS Marine Laboratory, Aberdeen. (WD-13)

The Kalman filter approach to catch-at-age analysis (TSA, Gudmundsson, 1994) as implemented by the FRS Marine Laboratory, Aberdeen, has previously been used to assess the state of cod and whiting in Division VIa at meetings of the WGNSDS. The method and its application to those stocks is widely discussed in reports of the WGNSDS, see, for example, ICES CM 1999/ACFM:1. An extended version of the Aberdeen TSA program that can account for multiple tuning fleets was produced for exploratory analyses of the North Sea cod assessment prior to the current meeting of WGNSSK, and the results presented in a Working Paper (Fryer, 2000).

TSA was applied to the cod stock because two candidate XSA runs that were available to the Working Group presented different interpretations for the current state of the stock. Compared to the XSA configuration used during the 1999 WG, a new XSA that did not use Scottish commercial fleet tuning data, and which treated catchability on fish aged 1-3 as dependent on abundance, indicated that fishing mortality was higher than otherwise considered, and that SSB was lower. That XSA was presented to a meeting of the North Sea Commission earlier this year. The TSA was applied to see whether it supported either interpretation, or whether it indicated other differences.

In the time available before the Working Group meeting, it was not possible to fine-tune the TSA. Nevertheless, it was possible to develop a configuration that gave a reasonable fit of the model to the data. Assuming year-class strength to be distributed according to a Ricker stock and recruitment function, and using commercial catch-at-age data from 1963-1999 for ages 1-8+, the TSA was fitted using IBTS (Q1), EGFS (Q3), and SGFS (Q4) indices as auxiliary data. Full details of the model specification are given in the Working Document. A second Kalman filter run that did not use any auxiliary data was also produced. A comparison of the stock trends available from these runs, and the XSA analysis presented to the North Sea Commission is given in Figure 1.6.1. It can be seen that for recent years, the analyses are remarkably consistent. In particular, they do not imply a recent reduction in fishing mortality as indicated by the previous WGNSSK XSA configuration, and they indicate that SSB for North Sea cod is currently at its lowest observed level. This also contrasts with the WGNSSK XSA interpretation of recent SSB values.

Paper: German Otter Trawl Board Fleet as Tuning Series For the Assessment of Saithe in IV, VI and IIIa, 1995-1999 by: Hans-Joachim Rätz. Institute for Sea Fisheries, Germany. (WD-14)

The analysed commercial catch and effort data of saithe in Sub-areas IV and VI and Division IIIa are derived from the official German log book statistics which have been made available in a consistent data base for the period 1995-1999. Only otter trawl board catches were considered of 16 vessels continuously being engaged in the directed saithe fishery. During 1995-1999, this fleet consisting of 16 vessels accounted for 55 255 t or 93 % of the entire saithe catch officially reported. Both information on age group representation in the annual German catch and the effort was used to calculate abundance indices and catch curves for year classes 1988 to 1996. There was no general trend in the mean CPUE, and catch curves also revealed that the year classes 1992 to 1994 were subject to lower mortality rates-at-ages 4 to 7 than the previous year classes. This indicates a significant reduction in fishing mortality. The recruiting year classes 1995 and 1996 are indicated to be weak as 3 and 4-year-olds.

Paper: Evaluation of the incorporation of external information using GAM on the catch-at-age indices estimation for North Sea plaice and sole by: G.J. Piet, Netherlands Institute for Fisheries Research, Netherlands. ICES CM2000/K;27 (WD-15)

Paper: Preliminary Report on the Commercial Monitoring Fishery directed towards sandeel in the area around Wee Bankie by: Jørgen Dalskov and Palle Brogaard, Danish Institute for Fisheries Research, Denmark. (WD-16)

With reference to the advice from ICES, where it was recommended that during a period where sandeel fishery was closed in an area east of the Scottish East Coast a very limited commercial fishery should be conducted. The objective of this fishery was to maintain a time series of CPUE and biological sampling data on sandeels in this area. It was also recommended that the participating vessels should be representative of the fleet operating in that area in recent years. The paper presents catch rates and length distributions from 4 trips in May-June 2000. One trip only was conducted in the area in May. The catch rates were so low that it was not economically profitable to fish in the area, therefore the skipper decided to move to other fishing grounds. In June the catch rate was high and three trips totalling 10 days of fishing were conducted.

Table 1.3.3.1. Biological sampling level by stock and country: Official landings (t) and number of fish measured and aged to analyse comercial landings in 1999

	Cod in IV, IIIa, VIId			Haddock in IV, IIIa		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	4,054	4,981	1,010	462	4,975	1,116
Denmark	32,373	4,475	4,465	3,116	5,549	5,533
England	10,798	68,239	7,895	2,398	35,505	3,919
Faroes	0	0	0	0	0	0
France*	1,750	0	662	742	0	311
Germany	3,440	22,614	0	568	0	0
Netherlands	10,204	6,337	2,140	110	0	0
Norway*	7,770	3,337	640	4,014	22,877	946
Scotland	23,017	70,945	14,703	53,486	231,283	14,436
Sweden*	4,893	994	184	920	0	0
others	19	0	0	17	0	0
Total	98,318	181,922	31,699	65,833	300,189	26,261

* Preliminary landings

	Whiting in IV, VIId			Saithe in IV, IIIa		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	577	4,631	1,000	200	0	0
Denmark	58	1,252	978	4,494	1,204	1,204
England	2,403	17,063	3,043	2,874	2,269	0
Faroes	0	0	0	0	0	0
France*	4,292	2,930	3,582	24,305	0	0
Germany	176	0	0	10,481	24,793	2,067
Netherlands	1,801	9,324	1,200	7	0	0
Norway*	68	10,331	312	55,816	17,830	3,357
Scotland	17,206	127,719	8,723	5,420	19,031	6,939
Sweden*	13	0	0	1,869	0	0
others	0	0	0	862	0	0
Total	26,594	173,250	18,838	106,328	65,127	13,567

* Preliminary landings

	Sole in IV			Sole in VIId		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	1,919	6,025	1,050	880	4,189	1,187
Denmark	828	597	0	0	0	0
England	645	16,634	1,768	769	14,838	2,929
Faroes	0	0	0	0	0	0
France*	357	2127^	1060^	2,239	2127^	1060^
Germany	1,458	10,482	0	0	0	0
Netherlands	16,283	3,983	3,982	0	0	0
Norway*	0	0	0	0	0	0
Scotland	501	0	0	0	0	0
Sweden*	0	0	0	0	0	0
Total	21,991	37,721	6,800	3,888	19,027	4,116

* Preliminary landings

^ Data from area IV and VIId combined.

Table 1.3.3.1. (Cont`d)

	Plaice in IV			Plaice in VIId		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	6,160	3,528	840	1,306	3,083	761
Denmark	13,468	4,162	4,064	0	0	0
England	9,743	27,746	2,777	743	11,808	1,794
Faroes	0	0	0	0	0	0
France*	624	2391^	1557^	3,259	2391^	1557^
Germany	3,144	5,353	0	0	0	0
Netherlands	37,513	4,869	4,869	0	0	0
Norway*	913	0	0	0	0	0
Scotland	7,318	0	0	0	0	0
Sweden*	4	0	0	0	0	0
Total	78,887	45,658	12,550	5,308	14,891	2,555

* Preliminary landings

^ Data from area IV and VIId combined.

	Plaice in IIIa		
	Landings (t)	Lengths (No)	Ages (No)
Belgium	0	0	0
Denmark	7,983	1,959	1,948
England	0	0	0
Faroes	0	0	0
France*	0	0	0
Germany	27	1,097	0
Netherlands	0	0	0
Norway*	66	0	0
Scotland	0	0	0
Sweden*	393	0	0
Total	8,469	3,056	1,948

* Preliminary landings

	Norway 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	52,326	2,720	1,749	528,489	21,783	7,148
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*	44,784	1,728	210	187,589	2,236	633
Scotland	0	0	0	11,475	0	0
Sweden*	25	0	0	23,225	0	0
Total	97,135	4,448	1,959	750,778	24,019	7,781

* Preliminary landings

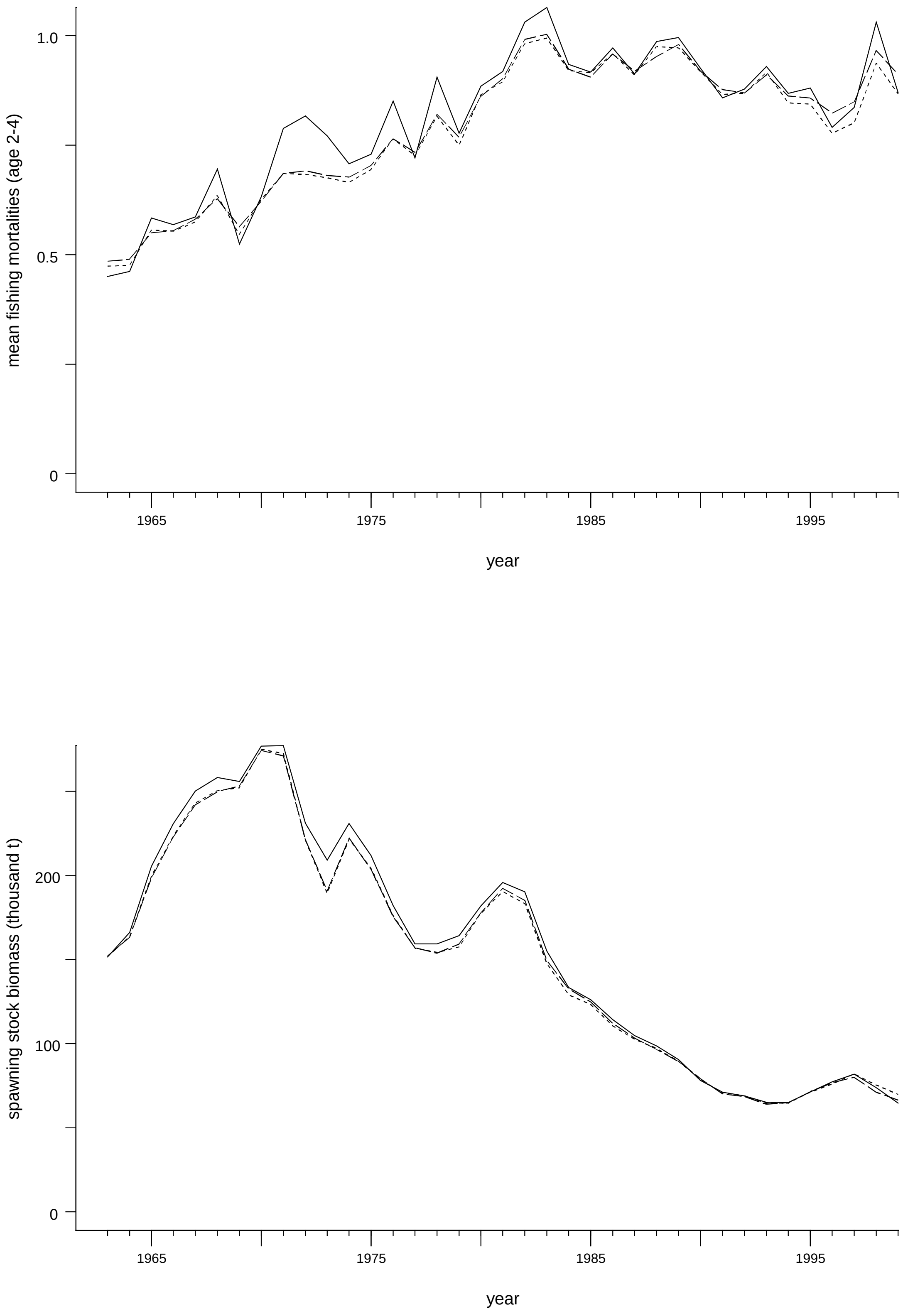


Figure 1.6.1 Comparison of stock trends: XSA as presented to the North Sea Commission (solid line), Kalman filter using only landings data (short dashed lines), Kalman filter with landings and survey data (long dashed lines).

2 OVERVIEW

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

2.1.1 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).

The fisheries for human consumption are using various types of gear such as otter trawls, pair trawls, seines, gill nets and beam trawls, while most Industrial fisheries use small meshed otter trawls. Although effort in a number of fleets has decreased, efficiency of the fleets have increased by improvement of the fishing gear, but also to sophisticated electronic equipment for navigation and finding fish.

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 show the largest annual variations, probably due to the short life span of the species, and are fluctuating around 1 million t per year. 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, where effort is measured as time fishing, show stable or downward trends in the recent past. To what extent this is caused by economic results or effort reduction programmes is not clear in every case. Effort in some fleets may vary between years because they visit other areas as well.

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 VI, and for Norway pout including IIIa. Sandeel stocks at Shetlands and in IIIa are separately dealt with.

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 other species. TACs for these fisheries have only recently been introduced.

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

2.1.2 Human consumption fisheries

2.1.2.1 Data

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, being approximately the same in 1999 as 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 several countries in recent years.

In a number of past years, substantial misreporting of roundfish and flatfish landings had occurred, associated to restrictive TACs. There are no indications that this had happened on a large scale in 1999.

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

Of the species considered in this report, only whiting used to be subject to a significant by-catch in the industrial fisheries. This bycatch appears to be much reduced in recent years.

2.1.2.2 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 and/or an effect of a climatic phase which is unfavourable to the recruitment of some species.

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

Information from several pre-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. Landings figures and forecasts show that this year class contributes substantially to the yield and spawning stock of each of these species.

In all species, fluctuations in the weights-at-age have been observed over time (Cod, Figure 3.2.1; haddock, Figure 4.7.3; whiting, Figure 5.1.2.1; saithe, Figure 6.2.1; sole, Figure 7.1a; plaice, Figure 9.2). All of these show declines in the weights of higher ages within the recent ten years. In addition it is known from survey information that the strong 1996 and 1999 year classes of plaice and haddock, respectively, are delayed in growth. While the phenomenon is far from being well understood and may have different causes for different species, there are some common implications for assessment and management. Lower size at younger ages widens the time span, thus the amount of discarding of a year class, and the recruitment to the landings occurs at a later age. Both effects will distort the correlation of estimated stock numbers with survey estimates. Cyclic variability in mean weight-at-age requires a careful choice of the input to the yield predictions.

Landings of cod in 1999 of 96,000 t were the lowest on record, indicating that most of the potential of the good 1996 yearclass was exhausted already by 1998. This is probably due in part to the heavy discarding on the recruits of this year class which was reported from discard investigations. With the mentioned exception, recruitment has been well below average in most years since 1985, with no signs of improvement in the most recent years. The cod spawning stock has been stable in recent years but on a very low level. Fishing mortality is fluctuating on a high level. The poor year classes in recent years do not promise a quick recovery of the stock.

Human consumption landings of haddock in 1999 were 64,000 t. Historically the stock size has shown large variation due to the occasional occurrence of a very strong year class. Spawning stock size is currently low at less than half the long-term average, but the 1999 year class is estimated to be exceptionally good by all sources and will soon build up the spawning stock. Fishing mortality is fluctuating on a high level, around a slowly decreasing trend over the last 20 years.

The human consumption yield of whiting in 1999 of 30,000 t remains remains close to the record-low level of the previous year, whereas the spawning stock biomass is expected to rise slightly from its low in1997 because of an estimated modest improvement in recruitment. Overall, landings and spawning stock biomass have been gradually decreasing since 1976. Fishing mortalities have been highly variable with no clear trend in the past, but are below long-term average in the recent years. In recent years recruitment have always been below the long-term geometric mean, with the 1996 year class as the weakest on record. The assessment has always been of lower precision than those for the other gadoid stocks.

The spawning stock of saithe is low compared to the seventies when it was lightly exploited and recruitment was higher. Landings in 1999 were 114,000 t, which is about average for the recent years. Fishing mortality has declined considerably since 1986, but appears now to be rising from a low in 1997.

The landings of sole in 1999 were 23,000 t. They were at high in the early nineties but decreased to a low of 15,000 t in 1997. Fishing mortality remains fluctuating near a historically high level. In 1998, the spawning stock was near a record low of 25,000 t but has increased thereafter. The recovery of both yield and stock is due to a strong 1996 year class.

The spawning stock of plaice has been decreasing steadily and the stock arrived at its lowest observed level in 1997. Landings have fallen since 1990 to 71,000 t in 1998, recovering to 81,000 t in 1999. There are no trends in fishing mortality and it fluctuates near a historically high level. Recent good recruitment from the 1996 year class is expected to increase the stock and yield, but the effect is dampened due to the retarded growth of that year class.

2.1.3 Industrial fisheries

2.1.3.1 Data available

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

2.1.3.2 Trends in landings and efforts

The sandeel landings in 1974-1985 of around 600,000 t have increased to about 800,000 t in 1986-1999. In 1997 the combined Danish and Norwegian landings were more than 1 million t and the highest ever recorded. Landings in 1999 were 675,000 t. The Norway pout catches showed a decreasing trend in the period 1974 - 1988. Thereafter the catches fluctuated around a level of 150,000 t. The landings in 1998 and 1999 are less than 100,000 t and the lowest recorded in the period since 1974. 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 1995 and then remaining at the same level while there has been no trend in effort of the Norwegian fleet.

2.1.3.3 Stock impressions

The SSB of Norway pout is fluctuating around 200,000 t in the period 1974-2000. Since 1996, SSB has shown a decreasing trend. However, high recruitment in 1999 contributed to a high Total Stock Biomass in 1999/2000. Fishing mortality has increased from 1998 to 1999.

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 are the highest recorded. Spawning stock biomass at the start at 2000 is estimated to 700,000 t and below the long-term average. Number of recruits for the 1999 year class are slightly higher than the overall average.

2.1.4 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 1974-1999. For the last five years quarterly data are presented. In 1999 the combined by-catch of haddock, whiting and saithe was about 11,000 t, which is well below the average of 75,000 t in the period 1974 - 1999. Detailed catches of “other” species mentioned in Table 2.1.2 are for the period 1984-1999 given in Table 2.1.3.

For four small meshed fisheries in 1999 the distribution of industrial landings and the associated by-catch of a number of species is shown in Table 2.1.4, for two areas in the North Sea, north and south of 57 degrees N. This table is based on Danish and Norwegian estimates. In the northern area, the Norwegian fishery for Norway pout is associated with by-catch of blue whiting. The Danish fishery for blue whiting is included in the “other” fishery. There is a by-catch of totally 8,000 t of haddock, whiting and saithe in the combined small meshed fisheries in the northern area. In the southern area the by-catch of these species is totally about 4,000 tons. The sprat fishery has had increasing landings since 1996 and has a by-catch of mainly herring, sandeel and whiting.

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.

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 2.2.1.

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 18,159 tonnes in the human consumption fishery. Landings have slightly decreased since 1992. 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. The spawning biomass of this stock is estimated to be at its lowest historical level, and does not show any sign of recovery. The cod stock in Kattegat, which is assessed as a separate stock by the Baltic Sea Working Group, is considered to be outside safe limits ($F > F_{pa}$).

Landings of haddock in Division IIIa, in the human consumption fishery, amounted to 1,400 tonnes in 1999, compared to 3,896 tonnes taken in 1998. Landings in 1999 is lowest on record since 1990. Most of the catches are taken in Skagerrak. Haddock in IIIa is assessed alongside with the North Sea (Division IV) stock. Both landings and SSB of this stock are expected to increase due to a strong 1999 year class.

Landings of whiting for human consumption were about 230 tonnes in 1999, which was100 tonnes more than was reported in 1998. Official landings have steadily decreased since 1992 except from the landings in 1999. 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 to 106,328 t in 1999 which is the highest record since 1989. The saithe assessment comprises Divisions IV and IIIa. This stock is estimated to be this year just outside safe limits.

The plaice landings in Division IIIa amounted to 8,470 tonnes in 1999, at about the same level as in 1998. Landings have steadily decreased since 1992. About 80% of the landings were taken in Skagerrak. Plaice in IIIa is assessed as a separate stock. The stock is estimated to be within safe limits.

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 stock is estimated to be within safe limits.

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. No analytical assessment of this assessment was possible.

Most of the landings from the industrial fisheries in IIIa consisted of sandeel, Norway pout, herring and sprat. In 1999, landings of Norway pout in division IIIa have decreased to 7,500 t respectively. By contrast, landings of industrial herring and sprat have increased to 9,000 t and 17,200 t respectively. Sandeel landings have stabilised at about 11,000 t. 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 unusual 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 fishing for flatfish was increased from 75mm to 80mm in 1989. From 2000, the EU Technical Regulation (850/98) sets out mesh sizes for defined groups of species. The minimum mesh size for fixed nets has been set at 100mm but there is currently an exemption in force for 90mm mesh.

Roundfish: The offshore French trawlers are the main fleet fishing for cod and whiting using high headline trawls, but cod is also very important for inshore fishers who target this species during the winter using trawls and fixed nets.

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). Effort has remained high until 1990 but shows some indication of a decrease in the last two years. There was no information on effort for the French fleets in 1999.

2.3.2 Data

Landings: French fleets take the major landings of cod, whiting, sole and plaice, accounting for around 80-95% of the roundfish species and between 45 and 60% of the flatfish. Landings of both plaice and sole are at the levels taken in the mid-1980s.

Discards: No information on French landings in VIId were available for 1999 and Working Group estimates had to be used for all demersal stocks. There is no data routinely collected for the level of discarding on any of the main species. 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.

Catch-at-age: 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 and sex is taken, and is thought to be representative of more than 80% of the landings of flatfish.

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 since 1998 and are included in the overview for the North Sea.

Sole: Fishing mortality) remains at historically high levels and is above F_{pa}. The SSB increased in the early 1980s following several above average recruitments but has declined slowly since then. The SSB in 2000 is estimated to be above B_{pa} and is expected to remain above following recruitment of the strong 1998 year class.

Plaice: Fishing mortality is variable and remains close to historically high levels in 1999. The spawning stock has declined from 1987 to a level close to Bpa in 1995. Since then it has remained relatively stable. Recruitment since 1985 has fluctuated around the average except for the strong 1996 year class.

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

Year	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	248	28	21	123	445	359	1003	923	1926
1973	239	179	11	71	90	229	31	19	130	346	297	867	775	1642
1974	214	150	48	81	130	267	42	18	113	736	524	843	1480	2323
1975	205	147	41	84	86	271	38	21	108	560	428	836	1153	1989
1976	234	166	48	83	150	295	67	17	114	435	488	909	1188	2097
1977	209	137	35	78	106	217	6	18	119	390	786	778	1323	2101
1978	297	86	11	97	55	163	3	20	114	270	787	777	1126	1903
1979	270	83	16	107	59	134	2	23	145	329	578	762	984	1746
1980	294	99	22	101	46	142	0	16	140	483	729	792	1280	2072
1981	335	130	17	90	67	145	1	15	140	239	569	855	893	1748
1982	303	166	19	81	33	185	5	22	155	395	612	912	1064	1976
1983	259	159	13	88	24	197	1	25	144	451	537	872	1026	1898
1984	228	128	10	86	19	214	6	27	156	393	669	839	1097	1936
1985	215	159	6	62	15	222	8	24	160	205	623	842	857	1699
1986	204	166	3	64	18	202	1	18	165	178	848	819	1048	1867
1987	216	108	4	68	16	177	4	17	154	149	825	740	998	1738
1988	184	105	4	56	49	140	1	22	154	109	893	661	1056	1717
1989	140	76	2	45	43	117	1	22	170	173	1039	570	1258	1828
1990	125	51	3	47	51	100	8	35	156	152	591	514	805	1319
1991	102	45	5	53	38	115	1	34	148	193	843	497	1080	1577
1992	114	70	11	52	27	104	0	29	125	300	855	494	1193	1687
1993	122	80	11	53	20	118	1	31	117	184	579	521	795	1316
1994	111	80	4	49	10	115	0	33	110	182	766	498	962	1460
1995	136	75	8	46	27	124	1	30	98	241	918	509	1195	1704
1996	126	76	5	41	5	120	0	23	82	166	777	468	953	1421
1997	124	79	7	36	6	110	3	15	83	170	1140	447	1326	1773
1998	146	77	5	28	3	106	3	21	71	80	1004	449	1095	1544
1999	96	66	4	30	5	111	3	23	81	93	721	407	826	1233

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
1999	678	166	23	97	89	4	5	2	40	1103
Mean 1974-1999	729	205	68	263	57	14	42	9	37	1406
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
1999 q1	14	14	4	8	23	1	1	1	8	74
1999 q2	507	2	4	22	30	1	2	1	8	577
1999 q3	139	129	10	41	18	1	2	0	7	347
1999 q4	17	21	6	25	17	1	1	0	18	106

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

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gadus morhua	4175	544	710	1092	1404	2988	2948	570	1044	1052	876	955	366	1688	1281	532
Scomber scombrus	1278	4	534	2663	6414	8013	5212	7466	4631	4386	3576	2331	2019	3153	1934	2728
Trachurus trachurus	133[3]	22789	16658	7391	18104	22723	14918	5704	6651	6169	4886	2746	2369	3332	2576	5116
Trigla sp.	2168	0	888[2]	45342[2]	5394[2]	9391[2]	2598[2]	5622[2]	4209	1593	1139	2091	897	2618	1015	2566
Limanda limanda	149[3]	187	3209	4632	3781	7743	4706	5578	3986	4871	528	1028	1065	2662	6620	4317
Argentina spp.	6977[3]	8714	5210	3033	1918	778	2801	3434	2024	2874	2209	292	3101	2604	5205	3580
Hippoglossoides platessoides	170[3]	59	718	1173	946	2160	1673	1024	1694	1428	529	617	339	1411	2229	1272
Pleuronectes platessa	0	34	119	109	372	582	566	1305	218	128	143	33	90	73	91	88
Merluccius merluccius[4]	546	349	165	261	242	290	429	28	359	109	10	-	3625	2364	33	211
Trisopterus minutus	0	0	68[3]	0	5[2]	48[2]	121[2]	79[2]	111	36	0	9	30	181	261	922
Molva molva[3]	528	51	1	40	39	37	13	65	10	28	0	-	0	31	31	125
Glyptocephalus cynoglossus	241[3]	236[3]	132	341	44	255[3]	251[3]	1439[3]	195[3]	246	40	-	97	394	860	437
Gadiculus argenteus[3]	2690	1210	729	3043	2494	741	476	801	0	0	0	-	7	248	248	387
Others	29261	31715[1]	3853	3604	3670	3528	3154	4444	4553	4106	5141	5158	50	749	5405	17931
Total	48316	65892	32994	72724	44827	59277	39866	37559	29685	27026	19077	15260	14055	21508	27787	40211

[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 the North Sea small meshed fisheries in 1999 By Denmark and 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	
	Norway pout	82	0	1	6	2	2	2	49	9	152
	Sandeel	2	183	+	3	1	+	+	1	6	196
	Sprat	0	1	1	+	+	+	0	+	+	2
	Other	11	2	+	3	+	+	+	39	6	62
	Sum	95	185	2	11	4	2	2	88	21	412
Area south	**Fishery (target species)**										
	Norway pout	0	0	0	0	0	0	0	0	0	0
	Sandeel	2	487	7	4	+	2	+	+	3	505
	Sprat	+	4	156	7	+	1	0	0	1	170
	Other	+	1	1	+	+	+	0	+	14	16
	Sum	2	492	164	11	1	3	+	+	19	692

Table 2.2.1 Catches of the most important species in the industrial fisheries in Division IIIa ('000 t), 1974–1999.

Year	Sandeel	Sprat2	Herring3	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	55
1999	12	17	9	7	4	55
Mean1974–1999	29	38	49	23	13	149

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

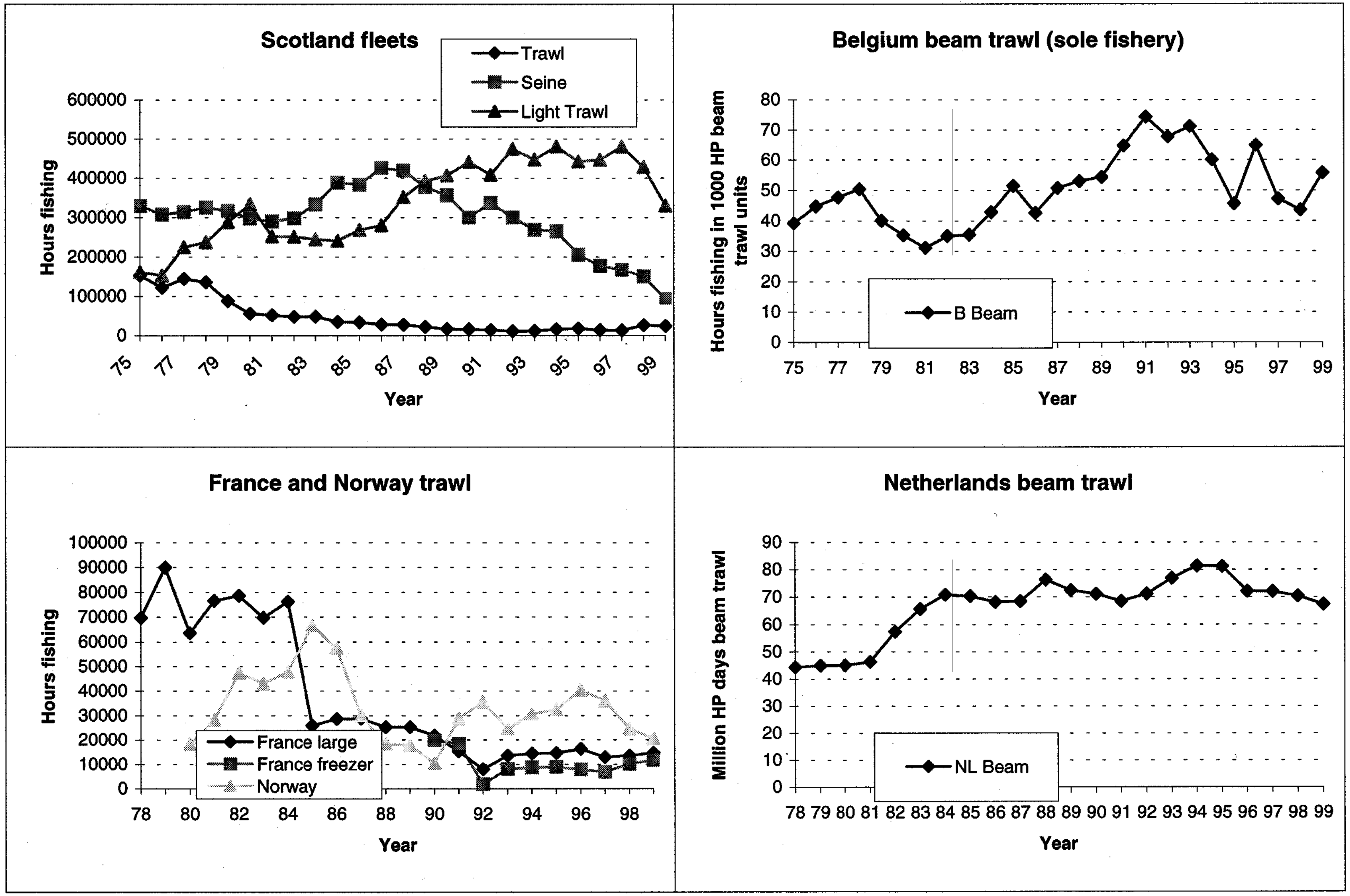
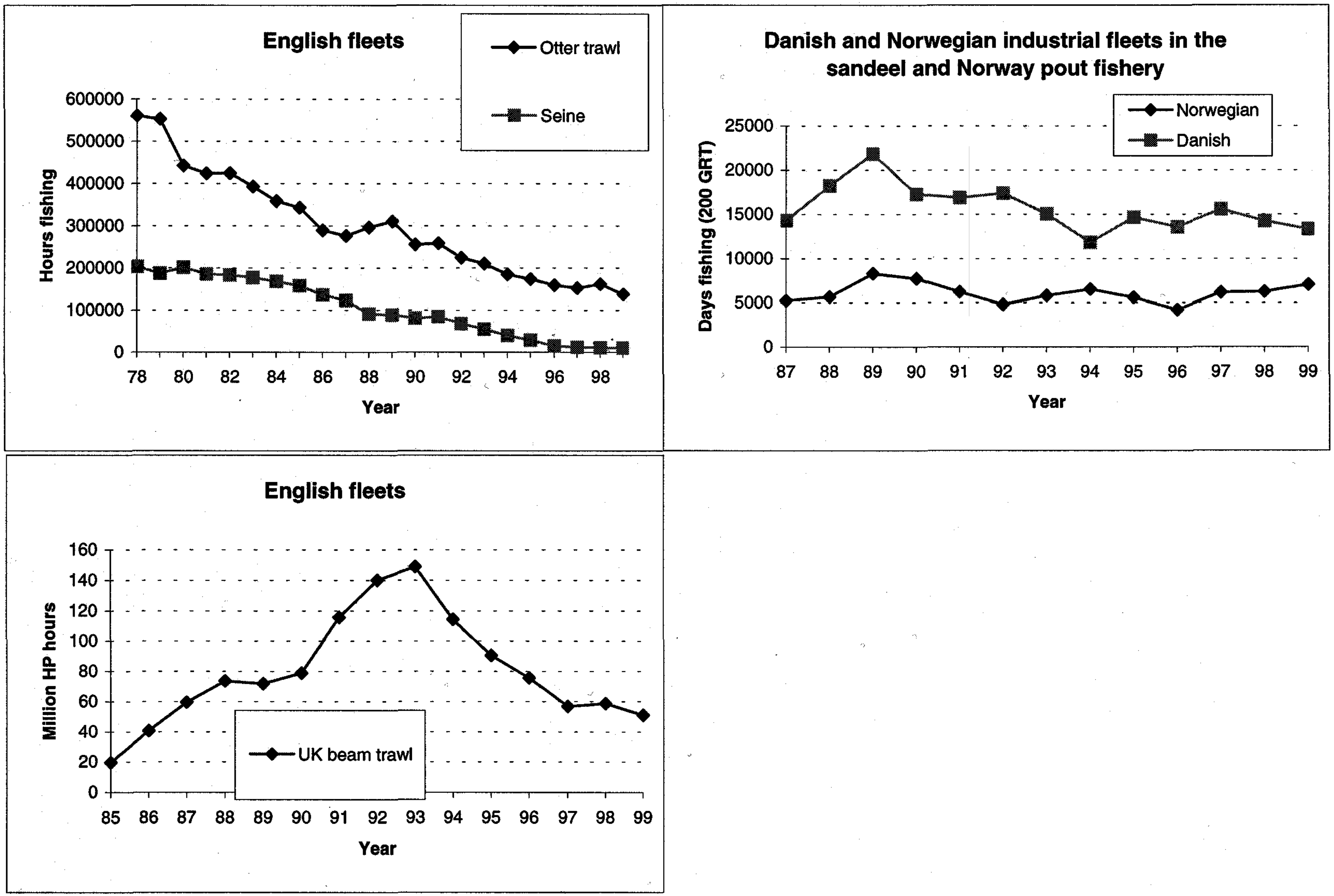


Figure 2.1.1 continued



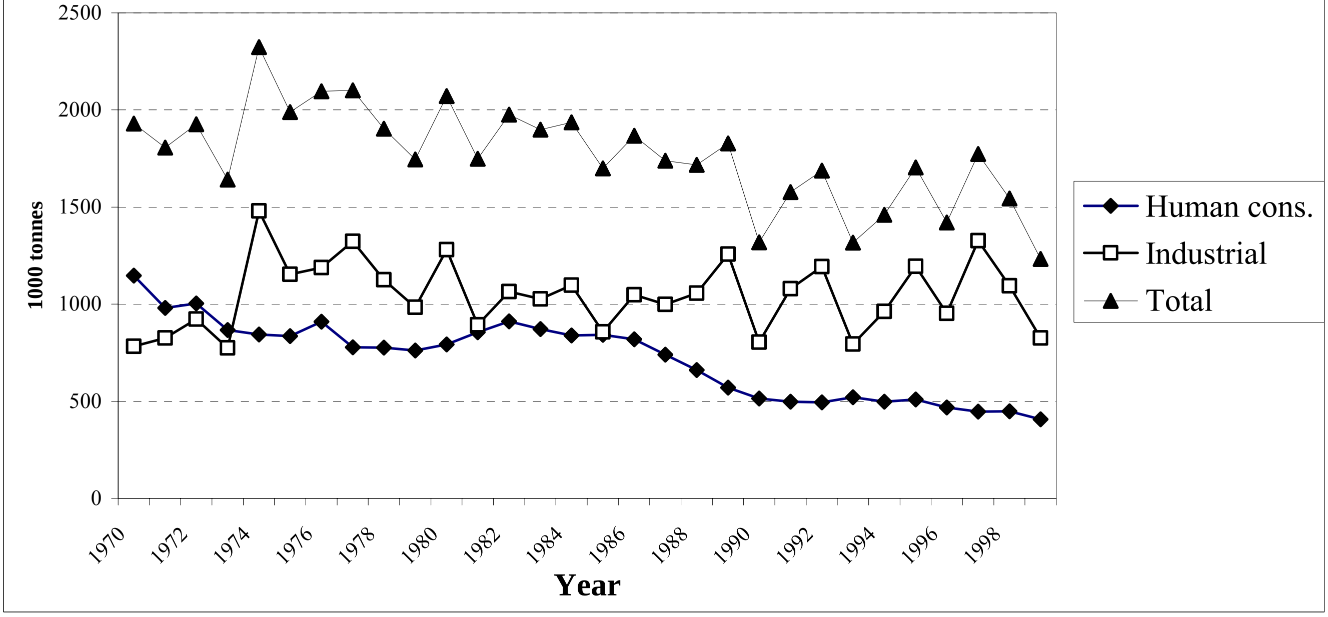
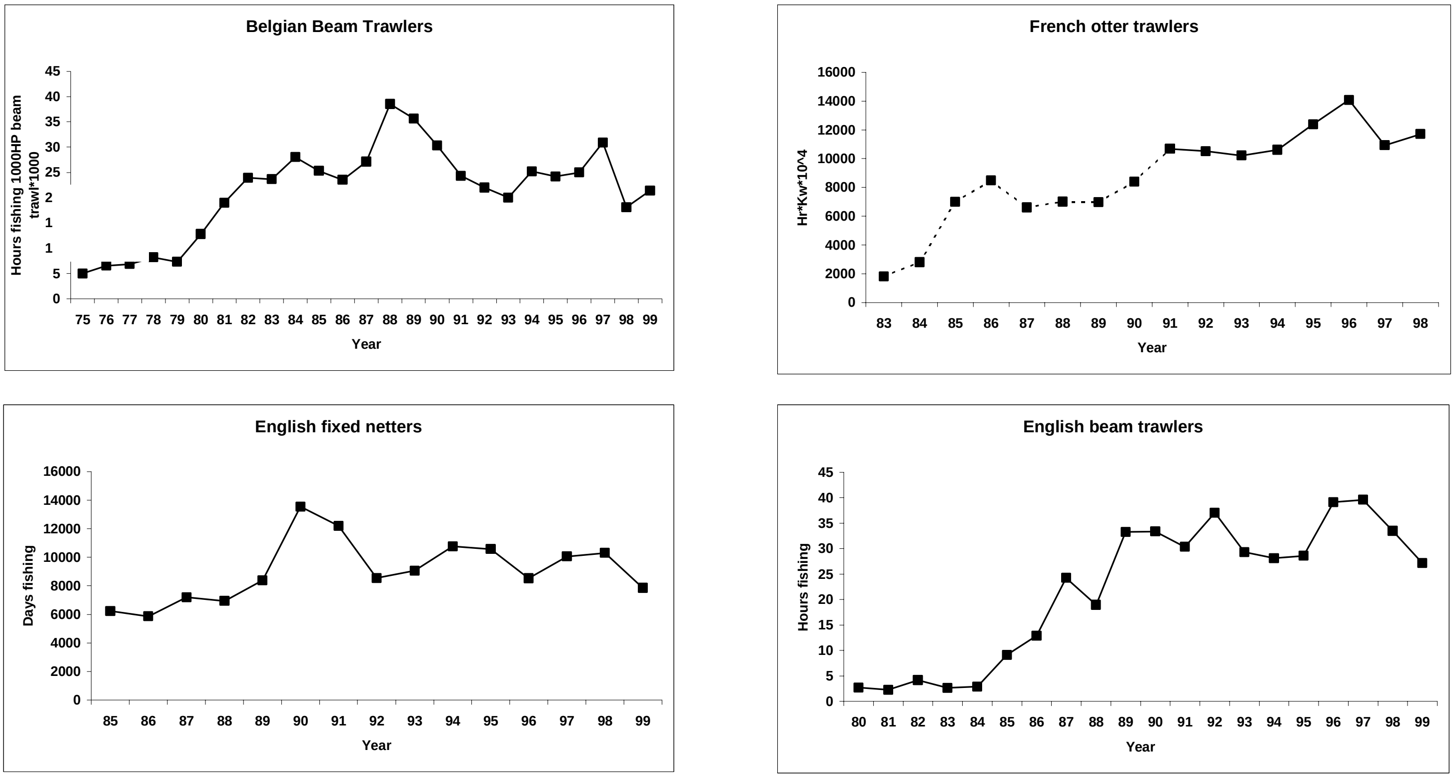


Figure 2.1.2 Demersal landings from North Sea

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

Since 1996, this assessment has related 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.

3.1 The Fishery

3.1.1 ACFM advice applicable to 1999 and 2000

The advice from ICES for 1999 was that in order to prevent further decline of SSB in the short-term, fishing mortality in 2000 should be less than 0.55, corresponding to landings in 1999 of less than 92,300 t. ICES also pointed out, that assessments in 1997 and 1998 were thought to have overestimated SSB and underestimated F. ICES further pointed out that the likelihood that F in 1998 was underestimated and SSB was overestimated in the 1999 assessment could not be evaluated at that time.

The precautionary fishing mortality and biomass reference points agreed by the EU and Norway are as follows:

Blim = 70,000 t; Bpa = 150,000t; Flim = 0.86; Fpa = 0.65.

3.1.2 Management applicable in 1999 and 2000

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:

	1999 TAC (000 t)	2000 TAC (000 t)
IIIa(Skagerrak)	19	11.6
IIa + IV	132.4	81

The 2000 TAC was set at a level roughly corresponding to the upper limit implied by the advice from ICES in 1999. There is no TAC for cod set for Division VIId alone. Landings from Division VIId count against the overall TAC agreed for ICES Divisions VII e-k.

In 1999, the EU minimum mesh size for towed gears in Sub-area IV and Division IIIa was 100mm, and 80 mm in Division VIId. Trawlers targeting *Nephrops*, were permitted to use a 70 mm codend mesh but had to incorporate an 80 mm square mesh panel in the trawl. Nephrops trawlers were also subject to whitefish by-catch limits. In sub-area IV, vessels targeting sole, which take a by-catch of cod were permitted to use a minimum codend mesh size of 80 mm, south of 55^{o} N. Trawlers fishing in Division IVc were 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. The minimum landing size for cod in all areas is 35 cm for EU Member States, although the minimum landing size in Norwegian waters is 40 cm. The minimum mesh size for fixed nets in 1999 was 120 mm.

New technical regulations for EU waters came into force on 1 January 2000. The regulation describes the minimum target species’ composition for different mesh size ranges. Cod in the whole of NEAFC region 2 can now only be targeted by towed gears with a minimum codend mesh size of 100 mm. Cod will continue to form a by-catch in the fisheries using 80mm codend meshes targeting sole, south of 56^{o} N, and in the fisheries targeting Nephrops. The minimum mesh size for fixed gears targeting cod remains unchanged at 120 mm.

3.1.3 The fishery in 1999

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 landings from the three areas combined in 1999 is 97,000 t, split as follows for the separate areas.

	1999 Landings 000 t
IIIa(Skagerrak)	11.0
IV	78.3
VIId	6.9
Total	96.2

In 1999, the landings were dominated by the abundant 1996 year class as 3-year olds, and accounted for 30% of the total numbers landed from VIId, 63% from Sub-area IV and 53% from Division IIIa Skagerrak. This year class also dominated the landings in 1998 with 93%, 77% and 40% of the 1998 catch in numbers being made up of this year class from Divisions VIId, IV and IIIa respectively.

For 1999, French landings from Sub-area VII were unavailable by Division, and the landings from Division VII d were estimated by the Working Group using the 1998 landings ratio: Landings from VIId (1999) = VIId landings (1998) / Total Sub-area VII landings (1998). In addition, for both Sub-area IV and Division VIId, 1999 landings by individual fleets were estimated in a similar manner e.g. Fleet landings (VIId, 1999) = Fleet landings (VIId, 1998) / Total landings (VIId, 1998).

The TACs for Sub-area IV and Division IIIa was not taken in 1999. This was also the case in 1998 and in fact has been a regular feature for a number of years. Although the WG is unable to fully explain why this occurs, a possible explanation is discussed in Section 1.6, WD 2 of this report. The WG suspects that under-reporting of landings by some countries may have been significantly greater in 1998 than in other years. However, for 1999, the WG has no evidence that there was significant under reporting of landings.

Estimates of total international discards are not available. However, discard sampling carried out for some of the main fleets indicate that in 1999, the proportion in number of cod discarded by age group over the year was as follows (approximate values only):

	Q1	**Q2**	**Q3**	**Q4**
Age 1	56-99%	66-100%	57-100%	57-79%
Age 2	11-46%	10-51%	9-67%	1-11%
Age 3	5-6%	7-37%	3-6%	1-6%
Age 4	0-6%	0%	0%	0%

The variations in the quarterly discard proportions are primarily due to the different discarding patterns for the different fleets. *Nephrops* trawlers for example generally discard higher proportions of cod than do otter trawlers targeting cod.

The industrial by-catch of cod by weight (532 t in 1999), other than that sorted for human consumption is small compared to the overall landings from this stock.

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 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, and the International Bottom Trawl 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, the Netherlands, Scotland and Sweden, based on a total of more than 31 thousand age-readings (Table 1.3.3.1). Age compositions were also provided by France based on the landings estimates discussed in section 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 1963-1999 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.

3.3 Catch, Effort, and Research Vessel Data

Trends in fishing effort for selected commercial fleets exploiting cod are shown in Figure 2.1.1.

Data from 3 surveys and 5 commercial fleets were available for tuning XSA: Scottish Heavy Trawl (SCOTRL), Scottish seine (SCOSEI), Scottish light trawl (SCOLTR), English Groundfish Survey (EGFS), Scottish Groundfish survey (SCOGFS), International quarter 1 Bottom trawl survey (IBTS Q1), English Trawl (ENGTRL) and English seine (EGNSEI). These fleets are those that have been used to tune the cod assessment for a number of years. The Scottish commercial fleets mainly fish in the Northern North Sea, while the English trawl fleet primarily exploits cod in the central and eastern North Sea, although some vessels venture into the Norwegian Zone. Both the IBTS Q1 and EGFS surveys cover the whole of the North Sea basin to depths down to 200 m. The SCOGFS survey covers the Northern North sea north of the Dogger Bank. None of the surveys covers the coastal areas at depths less than about 35 m.

3.4 Catch at Age Analysis

A preliminary assessment of North Sea cod was presented at a meeting of the North Sea Commission Fisheries Partnership, held in Peterhead, UK in July this year. That preliminary assessment identified a number of issues regarding the assessment that needed to be addressed. A subsequent meeting of UK scientists in Lowestoft, UK, explored the assessment further and provided the WG with a working paper highlighting its findings (Working Document WD-13, see section 6). The main issues arising from the Peterhead and Lowestoft meetings were concerned with the choice of catchability model for age groups 1-3 and which tuning fleets to include in the assessment. Other issues identified were the use of English commercial fleet catch and effort data in tuning, the choice of weighting for older data in the time series of catch and effort and the age range in the analysis

The WG reviewed the working document and used it as a basis for discussion on the issues identified.

3.4.1 Tuning fleets

It was noted that Scottish effort data for 1999 was substantially lower than in 1998 by 30-40 %. This discrepancy is apparently a result of a problem with the Scottish catch and effort database, and is currently being investigated. There is also some concern that effort data for years prior to 1999 for the same fleets may also be incorrectly stored in the database. Apart from the database problem, commercial catch and effort data are prone to biases if the distribution of the fleet effort changes in relation to the distribution of the stock. It appears also that there has been a major expansion of effort by the Scottish heavy otter trawl fleet over the past 10 years, and a shift in the distribution of the light trawl effort. As a result, the WG decided to omit the Scottish Commercial fleets from this year’s assessment.

The time series of catch and effort data for English seiners was also discussed. The WG considered that because of the significant changes in fleet composition; there were about 80 vessels in this fleet some 20 years ago, but only 5 in 1999, this fleet should also be excluded from the assessment. Apart from the fleet now being relatively small, the partial F over the converged part of the VPA is highly variable. The English seine fleet was therefore excluded. There was no *a priori* reason to exclude any of the survey series or the English trawl commercial catch and effort series.

The WG discussed whether the use of the Scottish groundfish survey data for the years 1998 and 1999 was appropriate. In 1998 and 1999, the survey was undertaken with a new vessel and gear and in the haddock and whiting assessments, these two years have been excluded from the series, primarily because the gear used is now the GOV trawl. The GOV has a high headline, whereas previously, the Aberdeen 48 foot trawl, which has a lower headline, was used. The group argued that headline height is unlikely to have a significant effect on the catch rate index for cod, and decided to include the time series of survey data including the 1998 and 1999 points.

The assessment was therefore carried out using 3 surveys and one commercial fleet, leaving only 4 time series of catch and effort data for tuning.

3.4.2 Year range for tuning

A separable VPA was run using a-terminal F of 1.0 and a-terminal S of 0.8 to examine the catch data for changes in selection over time. The results are given in Table 3.4.1 and the log catch ratio residuals are given in Figure 3.4.1. The results indicate that there was a shift in the selection pattern of age groups 1-2 and 2-3 about the beginning of the 1990s indicating that either a truncated time series should be used for tuning the VPA or that a tapered time weighting should be applied. Since this appears to be a shift in selection pattern rather than a gradual change, and taking into account the observations made with regard to changes in catchability in section 3.4.3, the Working Group chose to use a truncated time series (1990-1999) to tune the XSA.

3.4.3 Catchability model

The WG noted that the preliminary assessments carried out for the Peterhead and Lowestoft meetings had identified that the 1999 assessment WG configuration of XSA applied to catch-at-aged data up to and including 1999, resulted in an unusually low F on age 3 in 1999 (the large 1996 year class), but that treating age groups 1-3 as recruits, resulted in a F value in line with recent estimates for this age group. The evidence presented in support of this approach was relatively weak but plots of log population number plotted against log catchability residuals from XSA indicated a change in catchability from about the beginning of the 1990s. The Working Group explored this further by examining the results of Laurec Shepherd-tuned VPAs without shrinkage for each of the four tuning fleets separately. The log catchability residuals are plotted in Figures 3.4.2.a and b. The results indicate that there has been a change in catchability for the SCOGFS, ENGTRL and IBTS Q1 fleets for age groups 1 and 2, and for the EGFS-at-age 2. There is also appears to be an increase in catchability-at-age 3 for the EGFS and the SCOGFS fleets.

The results of a Kalman filter time series analysis by Fryer (WD-13, see section 1.6), indicated that for the North Sea cod there is evidence of an increasing trend in fishing mortality and a permanent change in exploitation pattern. The results also indicated that there is evidence for transitory changes in catchability. Taking into account the results from the Lowestoft meeting, of the single fleet Laurec Shepherd tuning runs and the results of the Kalman filter time series analysis, the WG considered that there was sufficient evidence that catchability on age groups 1-3 should be assumed to be dependent on year-class strength.

3.4.4 XSA tuning

XSA was carried out using a 10 year tuning range with no taper, and using 3 surveys and one commercial fleet series of catch and effort. The tuning fleet data are given in Table 3.4.2. Catchability was set dependent on year class strength (stock size) for age groups 1-3, and with age independent catchability on age groups older than 4. The Report of the preliminary assessment meeting held in Lowestoft suggested that using an age range in the assessment of 1-8+ may be more appropriate than the traditional age range of 1-11+. The effect of changing the age range on the assessment was tested and the differences were negligible. Since currently agreed precautionary reference points are based on an average F on age groups 2-8, and the fact that a change in the age range used would require revisiting the precautionary reference points, the WG decided to retain the age range 1-11+ in the analysis.

A comparison of the configuration used in the 1999 assessment with the current assessment is given below:

	1999 XSA	2000 XSA
SCOTRL_IV	1-7	Not used
SCOSEI_IV	1-10	Not used
SCOLTR_IV	1-9	Not used
ENGTRL_IV	1-9	1-10
ENGSEI_IV	1-10	Not used
SCOGFS_IV	1-6	1-5
ENGGFS_IV	1-5	1-5
IBTS+Q1_IV	1-6	1-6
Time-series Taper	No	No
Tuning range	16 yr	10 yr
q independent catchability	2+	4+
age independent q	>=6	>=5
F shrinkage	0.5	0.5
Min SE of fleet estimates of Population size	0.3	0.3

The initial run with the above configuration gave a negative slope on age 6 for the Scottish groundfish survey, so this age group was excluded from the final run.

The diagnostics from the final XSA run are given in Table 3.4.3. and plots of the log catchability residuals for each fleet from this run are given in Figure 3.4.3. Figure 3.4.3 indicates that the ENGTRL fleet residuals are noisy, particularly-at-age 6. This fleet also gives large negative residuals-at-ages 5-10 for the final year.

Plots of log VPA population numbers against log tuning index are given in Figure 3.4.4, which indicates relatively good fits to the catch data for the surveys at younger ages, but poorer fits for older ages. The-terminal exploitation patterns by fleet are shown in Figure 3.4.5 and the relative importance for the result in-terms of regression weights by type of fleet or shrinkage are shown in Fig. 3.4.6.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and XSA are given in Tables 3.4.4 and 3.4.5 and are summarized in Table 3.4.6. The effect on the assessment of excluding the Scottish commercial fleet tuning data and the revised XSA configuration has been to increase recent estimates of fishing mortality on all ages apart from age 2 compared to the 1999 assessment and to reduce the estimate of SSB for 1999 from 128,000 t to 67,000 t. The assessment also indicates that there has been no downward trend in mean F over the past few years.

The results from a retrospective XSA analysis using a 10-year moving window with the options specified above are shown in Figure 3.4.7, together with the retrospective plots generated by XSA in the 1999 assessment. The retrospective plots indicate that although there appears to be a retrospective bias, the new configuration seems to have reduced the bias compared to other recent assessments. The effects of this bias are discussed in section 3.11 (Comments on the assessment). Table 3.4.6 also documents two levels of reference F; the standard age range of 2-8, and a shortened age range of 2-4, the ages that are predominant in the catches.

3.5 Recruitment Estimates

Average recruitment in the period 1963-1997 was **383** million (arithmetic mean) or 336 million (geometric mean) 1--year-old fish. The GM recruitment in the recent period (1988-1997) is 202 million 1--year-old fish.

Using RCT3, research vessel survey data for 1-year old fish (Table 3.5.1) were regressed against VPA population numbers for year classes back to and including 1970 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. The results of survey indices regressed against XSA recruitment-at-age 1 are presented in Table 3.5.2.

Year class 1998: RCT3 predicts the 1998 yearclass-at-age 1 as 136 million, compared to the XSA estimate of 178 million. Since the XSA estimate of 178 million was derived using the year class dependent catchability (power) model, this value was accepted by the WG in preference to the RCT3 estimate.

Year class 1999: The weighted mean estimated by RCT3 using 1 group recruitment from XSA was 213 million 1-year olds in 2000. This is close to the short-term GM of 202 million. Less than 10% of the weighting used for this estimate is derived from population shrinkage, and about 50% is derived from the English Groundfish survey 1-group estimate. Since there was little to choose between the two estimates, the WG therefore decided to use the GM estimate of 202 million as input to the catch predictions.

Year class 2000. The only recruitment estimate available for the 2000 year class-at-age 1 in 2001, is derived from the EGFS Q3 research vessel survey 0-group index for 2000. The RCT 3 output (Table 3.5.2) indicates that the survey estimate (187 million) is less than the short-term GM from XSA. (202 million). 60% of the RTC3 estimate of the 1999 year class is derived from the long-term mean.

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

Year class	XSA Estimate (Millions age 1)	RCT3 estimate	Short-term GM
1998	**<u>178</u>**	136	202
1999	-	213	**<u>202</u>**
2000	-	187	**<u>202</u>**
2001	-	-	**<u>202</u>**

Values used for input to prediction are underlined in bold.

With the exception of the strong 1996 year-class, recruitment since the mid-1980s, has been at or below the long-term mean. The WG therefore decided to use the short-term GM estimate of 202 million from XSA (1987-1996) for the 1999 and subsequent year classes.

3.6 Historical Stock Trends

Historical trends in mean fishing mortality, landings, spawning stock biomass, and recruitment are shown in Table 3.4.6 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 80's and has remained at about that level since that time. Spawning biomass decreased from a peak of 277,000 t in 1971 to a historical low of about 65,000 t in 1993 and 1994. SSB increased slightly in 1997, but has since declined to about the historical low level. Recruitment has fluctuated considerably over the period but the frequency of good year classes has become reduced since 1985. The 1996 year class is still estimated as the largest since 1985, but the 1997 and subsequent year classes-at-age 1 have been poor and below the short-term GM. It seems that there has been a succession of 4 relatively poor year classes. 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 an historical low in 1999.

3.7 Short Term Forecast

The input data for the catch prediction are given in Table 3.7.1. Mean weight-at-age is the average for the period 1997-99. Fishing mortalites-at-age are the unscaled means for the same period, but are almost identical to the scaled values. Population numbers in 2000 are XSA survivor estimates, except for age 1, which was derived from the short-term GM estimate of 202 million from XSA (1989-1998).

The management option table is given in Table 3.7.2 and shown graphically in Figure 3.7.1D. The predicted *status quo* landings are 93,000 t for 2000, and 96,000 t for 2001. Under these conditions spawning biomass is estimated to be 67,000 t at the start of 2000, and 59,000 t in 2001. The detailed output tables (Table 3.7.3) and Figure 3.7.2 confirm that the landings in 2001 and SSB in 2002 will be dominated by the recruiting year classes 1998 and 1999 while the importance of the previously strong 1996 year class is predicted to decrease substantially. Only about 33% of the predicted landings in weight in 2000 are expected to comprise this year class, which is also predicted to contribute 49%, 38% and 20% to the spawning stock biomass in 2000, 2001 and 2002, respectively.

3.8 Medium-term projections

Since the present assessment gives a radically different perception of the stock compared to previous ICES assessments, the WG undertook medium-term projections of landings and SSB for a range of fishing mortalities over a 10 year period. The input values are given in Table 3.8.1. and are the same as for the short-term forecast, except that mean weight-at-age is the average over the period 1990-99. 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. A plot of the observed data and the fitted Shepherd Stock-recruit relationship model is given in Figure 3.8.3. The input data and parameter estimates from the model fit are given in Table 3.8.2.

The results of medium-term projections are given in Figure 3.8.1. and the SSB trajectories for different fishing mortality rates in relation to the agreed B_{pa} are shown. Figure 3.8.2 displays probability profiles of SSB expressed as percentiles in relation to B_{pa} after 10 years. The trajectories indicate that there is a high probability of SSB being recovered to 150,000 t (proposed B_{pa}), by 2009 at F_{pa} while *status quo* F implies no stock recovery potential at all. Short-term reductions in catches resulting from fishing at F_{pa} are indicated to be compensated after a 3 to 4 year period.

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}, F_{med} and F_{low} is given in Figure 3.9.1.

Biological reference points for cod are given in the text table below:

Reference Point	Estimate
Blim	70,000 t
Bpa	150,000 t
Flim	0.86
Fpa	0.65
Fmax	0.24
F0.1	0.14
Fmed	0.78
Flow	-
Fhigh	1.13

3.10 Comments on the Assessment

This assessment dramatically changes the perception of the current stock status. In recent assessments, it appeared that there had been a downward trend in mean fishing mortality over the recent period. The results from the current configuration indicate that this is not the case, with mean F remaining at the high level observed since the early-1980s. SSB is now estimated at about the historic low level at 67,000 t in 2000 and at status quo F is predicted to decline further to 59,000t. Both of these estimates are below the agreed B_{lim} (70,000 t). Furthermore, current F (0.9) is above the agreed F_{lim} (0.86). The results of this assessment are generally in agreement with the preliminary assessment presented at the meeting of the North Sea Fisheries Partnership in Peterhead in July this year.

The XSA configuration is significantly changed from previous assessments, notably the exclusion of Scottish commercial fleet data from the tuning, and also the exclusion of the English seine catch and effort series. Exploratory XSA runs including Scottish commercial data, indicated that the F on older ages estimated by these fleets would be lower than those estimated by this assessment, and that they would have some influence on the XSA results, reducing overall F by about 10 to 15%. This is to be expected if the effort in the Scottish fleet's catch and effort series is under-represented in the tuning series.

The results from XSA and the Kalman filter time series analysis are in close agreement with respect to trends in SSB, F and recruitment. Furthermore, Separable VPA and the time series analyses also indicate that there has been a change in exploitation pattern for North Sea cod.

There still appears to be a retrospective bias in that F is underestimated and SSB is overestimated. This may partly explain why catch forecasts have been over optimistic in the past, although mean weights and the method of calculating status quo F may also have had an influence.

The WG notes that although the medium-term projections were undertaken assuming a Shepherd stock recruit relationship using the whole time series of data from 1963 to 1998, the form of the stock recruit relationship has a large influence on the outcome of the projections. Furthermore, there is evidence that average recruitment of cod in the period since the mid-1980s has been lower than prior to the mid-1980s. If there has been a regimen shift in the recruitment of cod, then it would be more appropriate to use only the post mid-1980s stock and recruit data as input to medium-term projections. In addition, if this is the case, biological reference points would be radically different and would need to be re-estimated. The results of medium-term projections presented in this report would also be over-optimistic.

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	1999
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	5,799	3,882
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	23,002	19,697
Faroe Islands	-	71	45	57	46	35	96	23	109	46	80	219	44	40	102	
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	2,934	1,750
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	8,045	3,386
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	14,676	9,068
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	5,749	7,770
Poland	7	-	10	13	19	24	53	15	-	-	-	-	18	31	25	19
Sweden	575	748	839	688	367	501	620	784	823	646	630	709	617	832	540	597
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	17,745	10,344
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	35,633	23,017
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	99,766	114,250	79,530
Unallocated landings	7,723	6,773	11,292	15,288	14,253	5,256	5,726	1,967	-758	10,200	7,075	8,308	2,160	2,403	7,853	-1,138
WG estimate of total landings	**204,871**	**194,696**	**168,806**	**182,094**	**156,559**	**115,700**	**104,751**	**88,533**	**97,349**	**104,580**	**94,523**	**120,023**	**106,568**	**102,169**	**122,103**	**78,392**
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**	**140,000**	**132,400**

Division VIId																
Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	331	501	650	815	486	173	237	182	187	157	228	377	321	310	239	172
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	6,387	7,788	
Netherlands	-	-	-	-	1	1	-	-	2	-	-	-	+	-	19	3
UK (E/W/NI)	282	326	830	1,044	867	562	420	341	443	530	312	336	414	478	618	454
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	7,178	8,665	629
Unallocated landings	419	-111	3,722	4,819	580	-	-	-	-65	-29	-37	-10	-24	-135	-85	6,229
WG estimate of total landings	**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**	**8,580**	**6,858**

Division IIIa (Skagerrak)																
Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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	12,340	8,734
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	1,909
Norway	311	193	174	152	392	256	143	72	270	75	60	169	265	348	303	345
Germany	-	-	-	-	-	12	110	12	-	-	301	200	203	81	16	54
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	788
Danish industrial by-catch *	1,084	1,751	997	491	1,103	428	687	953	1,360	511	666	749	676	205	97	62
Total Nominal Catch	19,891	16,628	20,103	19,900	16,952	18,838	17,800	12,071	14,002	14,737	14160	12109	16249	14896	14267	11042
Unallocated landings	0	0	0	0	0	-141	0	-12	0	0	-899	0	0	50	1,064	-68
WG estimate of total landings	**19,891**	**16,628**	**20,103**	**19,900**	**16,952**	**18,697**	**17,800**	**12,059**	**14,002**	**14,737**	**13,261**	**12,109**	**16,249**	**14,946**	**15,331**	**10,974**
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**	**19,000**
	19891	16628	20103	19900	16952	18697	17800	12059	14002	14737	13261	12109	16249	14946	15330.9	10973.9

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined																
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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	121,840	137,182	91,201
Unallocated landings	8,142	6,662	15,014	20,106	14,833	-	-	-	-823	10,171	6,139	8,298	2,136	2,318	8,832	5,024
WG estimate of total landings	**228,286**	**214,629**	**204,053**	**216,212**	**184,240**	**139,936**	**125,314**	**102,478**	**114,020**	**121,749**	**110,634**	**136,096**	**126,320**	**124,158**	**146,014**	**96,225**

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

n/a not available

** provisional

Table 3.2.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Catch numbers-at-age.

Run title : Cod in IIIa,IV,VIId (run: XSAHJR03/X03)

At 11/10/2000 8:40

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

YEAR,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE							
1,	3214,	5030,	15813,	18224,	10803,	5829,	2947,
2,	42591,	22493,	51888,	62516,	70895,	83836,	22674,
3,	7030,	20113,	17645,	29845,	32693,	42586,	31578,
4,	3536,	4308,	9182,	6184,	11261,	12392,	13710,
5,	2788,	1918,	2387,	3379,	3271,	6076,	4565,
6,	1213,	1818,	950,	1278,	1974,	1414,	2895,
7,	81,	599,	658,	477,	888,	870,	588,
8,	492,	118,	298,	370,	355,	309,	422,
9,	14,	94,	51,	126,	138,	151,	147,
10,	6,	12,	75,	56,	40,	111,	46,
+gp,	0,	4,	8,	83,	17,	24,	78,
0 TOTALNUM,	60965,	56507,	98955,	122538,	132335,	153598,	79650,
TONSLAND,	116457,	126041,	181036,	221336,	252977,	288368,	200760,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	54493,	44824,	3832,	25966,	15562,	33378,	5724,	75413,	29731,	34837,
2,	33917,	155345,	187686,	31755,	58920,	47143,	100283,	51118,	175727,	91697,
3,	18488,	17219,	48126,	54931,	11404,	18944,	18574,	25621,	17258,	44653,
4,	13339,	6754,	5682,	14072,	15824,	4663,	6741,	4615,	9440,	4035,
5,	6297,	7101,	2726,	2206,	4624,	7563,	1741,	2294,	3003,	3395,
6,	1763,	2700,	3201,	1109,	961,	2067,	3071,	836,	1108,	712,
7,	961,	893,	1680,	1060,	438,	449,	924,	1144,	410,	398,
8,	209,	458,	612,	489,	395,	196,	131,	371,	405,	140,
9,	186,	228,	390,	80,	332,	229,	67,	263,	153,	158,
10,	98,	77,	113,	58,	81,	95,	63,	26,	36,	42,
+gp,	40,	94,	18,	162,	189,	63,	43,	96,	44,	17,
0 TOTALNUM,	129791,	235693,	254066,	131888,	108730,	114790,	137362,	161797,	237315,	180084,
TONSLAND,	226124,	328098,	353976,	239051,	214279,	205245,	234169,	209154,	297022,	269973,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	101,

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	62605,	20279,	66777,	25733,	64751,	8845,	100239,	24915,	21480,	22239,
2,	104708,	189007,	65299,	129632,	66428,	118047,	32437,	128282,	55330,	36358,
3,	35056,	34821,	60411,	21662,	31276,	18995,	34109,	9800,	43955,	18193,
4,	12316,	9019,	9567,	11900,	4264,	7823,	5814,	8723,	3134,	9866,
5,	1965,	4118,	3476,	2830,	3436,	1377,	2993,	1534,	2557,	1002,
6,	1273,	785,	2065,	1258,	1019,	1265,	604,	1075,	655,	1036,
7,	495,	604,	428,	595,	437,	373,	556,	235,	295,	251,
8,	197,	134,	236,	181,	244,	173,	171,	215,	66,	140,
9,	74,	65,	78,	90,	60,	79,	69,	55,	63,	27,
10,	55,	37,	27,	28,	45,	16,	44,	48,	23,	31,
+gp,	25,	21,	16,	23,	20,	31,	23,	12,	18,	10,
0 TOTALNUM,	218769,	258890,	208380,	193932,	171980,	157024,	177059,	174894,	127576,	89153,
TONSLAND,	293644,	335497,	303251,	259287,	228286,	214629,	204053,	216212,	184240,	139936,
SOPCOF %,	100,	100,	99,	100,	100,	100,	101,	100,	100,	100,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	11738,	13466,	27668,	4783,	15557,	15717,	4938,	23769,	1255,	5941,
2,	54290,	23456,	32059,	55272,	25279,	63586,	36805,	29194,	81737,	9731,
3,	11906,	16776,	8682,	11360,	21144,	12943,	23364,	18646,	16958,	32225,
4,	4339,	3310,	5007,	3190,	3083,	5301,	3169,	6499,	5967,	4034,
5,	2468,	1390,	1060,	1577,	870,	802,	1860,	1238,	2402,	1446,
6,	310,	1053,	491,	435,	519,	286,	399,	700,	509,	626,
7,	310,	225,	329,	204,	142,	151,	162,	153,	236,	223,
8,	54,	139,	52,	108,	58,	42,	88,	47,	41,	91,
9,	60,	28,	40,	18,	32,	15,	43,	14,	16,	14,
10,	12,	4,	17,	10,	7,	13,	4,	15,	4,	10,
+gp,	9,	10,	9,	13,	16,	5,	8,	10,	12,	2,
0 TOTALNUM,	85496,	59857,	75414,	76970,	66707,	98861,	70840,	80285,	109137,	54343,
TONSLAND,	125314,	102478,	114020,	121749,	110634,	136096,	126320,	124158,	146014,	96225,
SOPCOF %,	99,	100,	99,	99,	99,	98,	100,	100,	100,	100,

Table 3.2.3 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Catch weights-at-age.

Run title : Cod in IIIa,IV,VIId (run: XSAHJR03/X03)

At 11/10/2000 8:40

Table 2 Catch weights-at-age (kg)

YEAR,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE							
1,	.5380,	.4960,	.5810,	.5790,	.5900,	.6400,	.5440,
2,	1.0040,	.8630,	.9650,	.9940,	1.0350,	.9730,	.9210,
3,	2.6570,	2.3770,	2.3040,	2.4420,	2.4040,	2.2230,	2.1330,
4,	4.4910,	4.5280,	4.5120,	4.1690,	3.1530,	4.0940,	3.8520,
5,	6.7940,	6.4470,	7.2740,	7.0270,	6.8030,	5.3410,	5.7150,
6,	9.4090,	8.5200,	9.4980,	9.5990,	9.6100,	8.0200,	6.7220,
7,	11.5620,	10.6060,	11.8980,	11.7660,	12.0330,	8.5810,	9.2620,
8,	11.9420,	10.7580,	12.0410,	11.9680,	12.4810,	10.1620,	9.7490,
9,	13.3830,	12.3400,	13.0530,	14.0590,	13.5890,	10.7200,	10.3840,
10,	13.7560,	12.5400,	14.4410,	14.7460,	14.2710,	12.4970,	12.7430,
+gp,	.0000,	14.9980,	15.6670,	15.6720,	19.0160,	11.5950,	11.5670,
0 SOPCOFAC,	.9998,	.9998,	1.0001,	1.0001,	1.0001,	.9999,	.9999,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	.6260,	.5790,	.6160,	.5590,	.5940,	.6190,	.5680,	.5420,	.5720,	.5500,
2,	.9610,	.9410,	.8360,	.8690,	1.0390,	.8990,	1.0290,	.9480,	.9370,	.9360,
3,	2.0410,	2.1930,	2.0860,	1.9190,	2.2170,	2.3480,	2.4700,	2.1600,	2.0010,	2.4110,
4,	4.0010,	4.2580,	3.9680,	3.7760,	4.1560,	4.2260,	4.5770,	4.6070,	4.1460,	4.4230,
5,	6.1310,	6.5280,	6.0110,	5.4880,	6.1740,	6.4040,	6.4940,	6.7130,	6.5310,	6.5800,
6,	7.9450,	8.6460,	8.2460,	7.4530,	8.3330,	8.6910,	8.6200,	8.8280,	8.6670,	8.4750,
7,	9.9530,	10.3560,	9.7660,	9.0190,	9.8890,	10.1070,	10.1320,	10.0710,	9.6860,	10.6370,
8,	10.1310,	11.2190,	10.2280,	9.8100,	10.7900,	10.9100,	11.3410,	11.0520,	11.0990,	11.5500,
9,	11.9190,	12.8810,	11.8750,	11.0770,	12.1750,	12.3390,	12.8880,	11.8240,	12.4270,	13.0570,
10,	12.5540,	13.1470,	12.5300,	12.3590,	12.4250,	12.9760,	14.1400,	13.1340,	12.7780,	14.1480,
+gp,	14.3670,	15.5440,	14.3500,	12.8860,	13.7310,	14.4310,	14.5570,	14.3620,	13.9810,	15.4780,
0 SOPCOFAC,	1.0000,	.9998,	1.0001,	.9999,	.9999,	.9999,	1.0000,	.9999,	1.0035,	1.0087,

1

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.5500,	.7230,	.5890,	.6320,	.5940,	.5900,	.5830,	.6350,	.5860,	.6730,
2,	1.0030,	.8370,	.9620,	.9190,	1.0070,	.9330,	.8560,	.9760,	.8810,	1.0520,
3,	1.9480,	2.1890,	1.8580,	1.8350,	2.1560,	2.1400,	1.8340,	1.9550,	1.9820,	1.8460,
4,	4.4010,	4.6150,	4.1300,	3.8800,	3.9720,	4.1640,	3.5040,	3.6500,	3.1870,	3.5850,
5,	6.1090,	7.0450,	6.7840,	6.4910,	6.1900,	6.3240,	6.2300,	6.0520,	5.9920,	5.2730,
6,	9.1200,	8.8840,	8.9030,	8.4230,	8.3620,	8.4300,	8.1400,	8.3070,	7.9140,	7.9210,
7,	9.5500,	9.9340,	10.3990,	9.8480,	10.3170,	10.3620,	9.8960,	10.2420,	9.7640,	9.7250,
8,	11.8670,	11.5190,	12.5000,	11.8370,	11.3520,	12.0730,	11.9390,	11.4610,	12.1270,	11.2110,
9,	12.7820,	13.3380,	13.4690,	12.7970,	13.5050,	13.0720,	12.9510,	12.4470,	14.2420,	12.5860,
10,	14.0810,	14.8970,	12.8900,	12.5620,	13.4080,	14.4430,	13.8590,	18.6910,	17.7870,	15.5570,
+gp,	15.3920,	16.6290,	14.6080,	14.4260,	13.4720,	16.5880,	14.7070,	16.6040,	16.4770,	14.6940,
0 SOPCOFAC,	.9963,	.9985,	.9946,	.9968,	.9992,	.9951,	1.0098,	.9969,	1.0001,	.9950,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	.7370,	.6700,	.6990,	.6990,	.6780,	.7210,	.6990,	.6560,	.5420,	.6400,
2,	.9760,	1.0780,	1.1460,	1.0650,	1.0750,	1.0200,	1.1170,	.9600,	.9220,	.9350,
3,	2.1760,	2.0370,	2.5460,	2.4790,	2.2010,	2.2100,	2.1470,	2.1200,	1.7240,	1.6630,
4,	3.7910,	3.9710,	4.2230,	4.5500,	4.4710,	4.2920,	4.0340,	3.8210,	3.4950,	3.3050,
5,	5.9320,	6.0830,	6.2480,	6.5400,	7.1670,	7.2200,	6.6370,	6.2280,	5.3870,	5.7260,
6,	7.8890,	8.0340,	8.4830,	8.0940,	8.4360,	8.9800,	8.4940,	8.3940,	7.5630,	7.4030,
7,	10.2350,	9.5450,	10.1020,	9.6410,	9.5360,	10.2830,	9.7290,	9.9790,	9.6280,	8.5820,
8,	10.9240,	10.9490,	10.4810,	10.7350,	10.3230,	11.7430,	11.0800,	11.4240,	10.6430,	10.3650,
9,	12.8020,	13.4810,	11.8500,	12.3290,	12.2240,	13.1070,	12.2640,	12.3000,	11.4990,	11.6000,
10,	15.5250,	13.1700,	13.9050,	13.4430,	14.2470,	12.0520,	12.7560,	12.7610,	13.0850,	12.3300,
+gp,	23.2330,	14.9890,	15.7940,	13.9610,	12.5230,	13.9540,	11.3040,	13.4160,	14.9210,	11.9260,
0 SOPCOFAC,	.9945,	.9970,	.9929,	.9948,	.9940,	.9835,	.9989,	1.0002,	.9998,	1.0033,

Table 3.4.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Separable analysis

Title : Cod, North Sea/Skaggerak/Eastern Channel 15/8/2000

At 4/10/2000 14:39

Separable analysis
from 1980 to 1999 on ages 1 to 10
with Terminal F of 1.000 on age 3 and Terminal S of .800

Initial sum of squared residuals was 157.220 and
final sum of squared residuals is 19.445 after 79 iterations

Matrix of Residuals

Years, Ages	1980/81,	1981/82,	1982/83,	1983/84,	1984/85,	1985/86,	1986/87,	1987/88,	1988/89,
1/ 2,	.342,	.436,	.741,	.437,	.792,	.273,	1.160,	.635,	.959,
2/ 3,	.324,	.513,	.206,	.523,	.395,	.578,	.315,	.228,	.316,
3/ 4,	.017,	.115,	.139,	.141,	-.047,	-.034,	-.103,	-.282,	.123,
4/ 5,	-.066,	-.042,	-.070,	-.048,	-.117,	-.075,	.061,	-.003,	-.037,
5/ 6,	-.099,	-.162,	-.117,	-.117,	-.100,	-.067,	-.095,	-.229,	-.123,
6/ 7,	-.203,	-.182,	.178,	-.013,	-.025,	-.004,	-.106,	.283,	-.001,
7/ 8,	.241,	.038,	-.326,	-.300,	-.223,	-.159,	-.224,	.138,	-.336,
8/ 9,	.037,	-.362,	-.226,	-.088,	-.024,	-.029,	-.044,	.084,	-.183,
9/10,	-.286,	.065,	-.076,	-.409,	.260,	-.287,	-.727,	-.171,	-.282,
TOT ,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,
WTS ,	.001,	.001,	.001,	.001,	.001,	.001,	.001,	.001,	.001,

Years,	1989/90,	1990/91,	1991/92,	1992/93,	1993/94,	1994/95,	1995/96,	1996/97,	1997/98,	1998/99,	TOT,	WTS,
1/ 2,	.436,	.804,	.550,	.791,	-.267,	-.065,	.732,	-.299,	.281,	-.657,	.000,	.176,
2/ 3,	.149,	.421,	.144,	.261,	.088,	-.220,	.396,	-.069,	-.178,	.067,	.000,	.364,
3/ 4,	-.130,	-.039,	-.219,	-.344,	-.150,	-.081,	.260,	-.030,	-.143,	-.006,	.000,	.533,
4/ 5,	.019,	.005,	-.100,	-.003,	.036,	.062,	.070,	-.191,	-.104,	.163,	.000,	1.000,
5/ 6,	-.039,	-.135,	-.047,	-.118,	-.002,	-.025,	-.139,	-.009,	-.065,	.239,	.000,	.870,
6/ 7,	.065,	-.599,	.141,	-.064,	.075,	.172,	-.199,	.037,	.201,	-.211,	.000,	.407,
7/ 8,	.267,	-.238,	.329,	.052,	.097,	.037,	-.343,	.194,	.313,	-.201,	.000,	.343,
8/ 9,	-.433,	-.377,	.110,	.002,	.044,	.175,	-.912,	.773,	.080,	-.115,	.000,	.251,
9/10,	-.377,	1.712,	-.587,	.418,	-.093,	-.214,	.439,	.109,	.282,	-.615,	.000,	.151,
TOT ,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	6.410,	
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,	1989,
F-values,	1.0030,	.9708,	1.1619,	1.1360,	1.0692,	.9883,	1.1378,	1.1056,	1.0991,	1.1762,

,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
F-values,	1.0372,	1.0946,	1.0589,	1.1075,	1.0482,	.8969,	.9990,	1.0084,	1.0796,	1.0000,

Selection-at-age (S)

,	1,	2,	3,	4,	5,	6,	7,	8,	9,	10,
S-values,	.0621,	.6904,	1.0000,	.8693,	.7835,	.7727,	.8300,	.8177,	.7790,	.8000,

Table 3.4.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Tuning fleets.

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Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak) (run name: XSAHJR03)
104
FLT01: ENGTRL_IV (Catch: Unknown) (Effort: Unknown)
1990 1999
1 1 0.00 1.00
1 11
255314  573.000 3101.000  513.000  134.000  101.000   11.000   13.000  4.000  1.000  0.000  0.000
258037  880.000 1559.000 1092.000   88.000   25.000   17.000    2.000  2.000  0.000  0.000  0.000
223702 1463.000 2171.000  481.000  234.000   19.000    5.000    5.000  0.000  0.000  0.000  0.000
209869  580.000 4054.000  442.000   96.000   55.000    5.000    3.000  2.000  0.000  1.000  0.000
184764 1264.802 2454.287 1146.382   78.190   14.284    7.036    1.762  0.673  0.847  0.023  0.063
173463  821.392 3799.572  871.882  158.030   11.028    2.992    1.896  0.662  0.132  0.247  0.048
159155  659.758 3179.345 1646.846  189.238   43.970    6.812    1.649  1.464  0.552  0.155  0.003
152030  828.414 2752.811  890.250  334.563   41.120   14.836    2.063  0.781  0.286  0.084  0.173
161478  174.05712750.690 1722.707  243.070   77.418   12.373    4.033  0.807  0.326  0.086  0.000
137705  744.618  675.664 1951.444   97.058   11.516    3.962    0.446  0.319  0.043  0.015  0.000


FLT06: SCOGFS_IV (Catch: Unknown) (Effort: Unknown)
1990 1999
1 1 0.50 0.75
1 5
   100   0.114   0.491   0.059   0.074   0.026
   100   0.303   0.154   0.133   0.013   0.006
   100   0.643   0.193   0.072   0.067   0.029
   100   0.347   0.749   0.101   0.025   0.011
   100   1.158   0.334   0.288   0.031   0.012
   100   0.475   1.443   0.130   0.085   0.011
   100   0.318   0.356   0.542   0.074   0.034
   100   0.999   0.278   0.224   0.102   0.022
   100   0.104   2.134   0.116   0.057   0.037
   100   0.440   0.010   0.616   0.027   0.010


FLT07: ENGGFS_IV (Catch: Unknown) (Effort: Unknown)
1990 1999
1 1 0.50 0.75
1 5
   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
   100   0.367   0.055   0.236   0.013   0.006


FLT08: IBTS_Q1_IV (Catch: Unknown) (Effort: Unknown)
1990 1999
1 1 0.00 0.25
1 6
   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
   1    2.1    1.6    8.1    0.8    0.5    0.5
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Table 3.4.3 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Tuning output and diagnostics.

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Lowestoft VPA Version 3.1

   11/10/2000   8:38

 Extended Survivors Analysis

 Cod in IIIa,IV,VIId (run: XSAHJR03/X03)

 CPUE data from file fleet

 Catch data for  37 years. 1963 to 1999. Ages  1 to  11.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 FLT01: ENGTRL_IV (Ca,   1990, 1999,   1,    10,   .000,  1.000
 FLT06: SCOGFS_IV (Ca,   1990, 1999,   1,     5,   .500,   .750
 FLT07: ENGGFS_IV (Ca,   1990, 1999,   1,     5,   .500,   .750
 FLT08: IBTS_Q1_IV (C,   1990, 1999,   1,     6,   .000,   .250


 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 >=    5


 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   23 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,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999

      1,  .140,  .127,  .145,  .049,  .074,  .109,  .043,  .086,  .026,  .051
      2,  .910,  .764,  .850,  .809,  .647,  .818,  .652,  .623,  .803,  .454
      3,  .970,  .965,  .850, 1.024, 1.031,  .990,  .988,  .989, 1.133, 1.067
      4,  .896,  .845,  .936,  .959,  .931,  .836,  .730,  .885, 1.130,  .986
      5,  .773,  .838,  .733,  .906,  .767,  .671,  .821,  .720, 1.027,  .969
      6,  .561,  .937,  .834,  .780,  .897,  .622,  .869,  .879,  .755,  .846
      7,  .783, 1.101,  .898, 1.081,  .637,  .727,  .908, 1.045,  .868,  .925
      8,  .525, 1.052,  .836,  .875, 1.128,  .388, 1.428,  .743,  .925, 1.054
      9, 2.118,  .576, 1.063,  .805,  .706, 1.079,  .899,  .958,  .614, 1.008
     10,  .963,  .905,  .860,  .864,  .886,  .711, 1.001,  .970,  .822, 1.041
```

Table 3.4.3 (Cont'd)

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9	10
1990	1.34E+05	1.08E+05	2.17E+04	8.10E+03	5.06E+03	7.98E+02	6.31E+02	1.46E+02	7.54E+01	2.15E+01
1991	1.69E+05	5.23E+04	3.07E+04	6.41E+03	2.71E+03	1.91E+03	3.73E+02	2.36E+02	7.07E+01	7.42E+00
1992	3.05E+05	6.67E+04	1.72E+04	9.11E+03	2.26E+03	9.59E+02	6.14E+02	1.01E+02	6.75E+01	3.26E+01
1993	1.48E+05	1.19E+05	2.01E+04	5.72E+03	2.93E+03	8.88E+02	3.41E+02	2.05E+02	3.60E+01	1.91E+01
1994	3.25E+05	6.32E+04	3.72E+04	5.62E+03	1.80E+03	9.68E+02	3.33E+02	9.48E+01	6.98E+01	1.32E+01
1995	2.27E+05	1.36E+05	2.33E+04	1.03E+04	1.81E+03	6.82E+02	3.23E+02	1.44E+02	2.51E+01	2.82E+01
1996	1.74E+05	9.16E+04	4.22E+04	6.76E+03	3.67E+03	7.59E+02	3.00E+02	1.28E+02	8.01E+01	6.99E+00
1997	4.28E+05	7.50E+04	3.36E+04	1.22E+04	2.66E+03	1.32E+03	2.61E+02	9.90E+01	2.51E+01	2.67E+01
1998	7.26E+04	1.76E+05	2.83E+04	9.74E+03	4.13E+03	1.06E+03	4.49E+02	7.51E+01	3.85E+01	7.89E+00
1999	1.79E+05	3.18E+04	5.57E+04	7.11E+03	2.57E+03	1.21E+03	4.09E+02	1.54E+02	2.44E+01	1.71E+01

Estimated population abundance at 1st Jan 2000

	0.00E+00	7.64E+04	1.42E+04	1.49E+04	2.17E+03	8.00E+02	4.26E+02	1.33E+02	4.41E+01	7.28E+00

Taper weighted geometric mean of the VPA populations:

	3.17E+05	1.31E+05	4.37E+04	1.38E+04	5.41E+03	2.27E+03	9.22E+02	3.86E+02	1.53E+02	5.94E+01

Standard error of the weighted Log(VPA populations) :

	.6065	.5816	.5005	.5386	.6152	.6644	.7210	.8362	.9609	1.0441

1

Log catchability residuals.

Fleet : FLT01: ENGTRL_IV (Ca

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-.12	.06	.10	-.05	.06	.07	.18	-.44	-.27	.41
2	-.37	-.17	-.05	-.16	.16	-.21	.08	.20	.42	.10
3	-.24	-.16	.00	-.13	-.12	.22	.04	-.06	.49	-.04
4	-.44	-.66	.15	-.21	-.28	-.16	.49	.57	.52	.02
5	.28	-.47	-.46	.47	-.32	-.56	.27	.52	.78	-.51
6	-.18	-.47	-.90	-.78	-.35	-.91	.00	.27	.20	-.88
7	.32	-.91	-.43	-.21	-.78	-.57	-.48	-.01	-.02	-1.94
8	.49	-.47	99.99	-.19	-.28	-.97	.46	-.14	.19	-1.25
9	.37	99.99	99.99	99.99	.08	-.54	-.26	.32	-.19	-1.43
10	99.99	99.99	99.99	1.48	-1.78	-.18	.96	-.96	.16	-2.11

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	-15.6112	-16.2003	-16.2003	-16.2003	-16.2003	-16.2003	-16.2003
S.E(Log q)	.4268	.5140	.6246	.8227	.6471	.6679	1.3985

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	.97	.155	17.21	.82	10	.25	-17.34
2	.70	1.854	13.91	.82	10	.25	-15.03
3	.58	2.051	13.00	.75	10	.23	-15.01

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	.53	1.814	12.52	.65	10	.20	-15.61
5	.49	2.732	11.95	.78	10	.19	-16.20
6	.82	.426	14.82	.40	10	.39	-16.60
7	.74	.457	13.96	.29	10	.49	-16.70
8	1.99	-.857	27.89	.10	9	1.20	-16.44
9	.64	1.275	11.93	.72	7	.38	-16.43
10	2.80	-.609	41.42	.02	7	3.98	-16.55

1

Table 3.4.3 (Cont'd)

```
 Fleet : FLT06: SCOGFS_IV (Ca

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     1 ,  -.43,   .00,  -.07,   .19,   .23,   .00,  -.03,  -.14,   .08,   .16
     2 ,  -.08,   .21,   .07,  -.05,   .26,   .04,  -.08,   .03,  -.09,  -.30
     3 ,  -.21,  -.17,   .08,   .14,   .02,   .10,   .18,  -.01,  -.11,  -.01
     4 ,   .42, -1.12,   .23,  -.28,  -.06,   .28,   .50,   .32,   .12,  -.40
     5 ,  -.18,  -.98,   .71,  -.41,   .08,  -.08,   .44,   .26,   .53,  -.34
     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 ,         4,         5
 Mean Log q,  -15.9462,  -15.9946,
 S.E(Log q),     .4902,     .5101,


 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,     .68,    2.411,     15.58,     .88,     10,     .20,  -17.20,
  2,     .34,    5.799,     13.07,     .91,     10,     .17,  -16.39,
  3,     .47,    4.139,     12.93,     .89,     10,     .14,  -15.89,

 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,     .51,    1.670,     12.56,     .60,     10,     .23,  -15.95,
  5,     .92,     .172,     15.32,     .34,     10,     .49,  -15.99,
1

 Fleet : FLT07: ENGGFS_IV (Ca

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     1 ,   .20,   .08,   .09,   .18,   .04,  -.07,  -.08,  -.01,  -.05,  -.37
     2 ,  -.06,   .05,  -.16,  -.06,   .14,   .13,   .16,  -.06,  -.09,  -.05
     3 ,  -.09,  -.29,  -.15,   .28,   .19,   .42,   .09,  -.61,  -.01,   .17
     4 ,  -.33,  -.20,   .50,   .13,   .37,   .78,   .06,  -.17,  -.93,  -.21
     5 ,   .11,  -.61,   .49,  1.09,   .27,  -.72,   .97, -1.76,  -.07,   .22
     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 ,         4,         5
 Mean Log q,  -16.8654,  -17.0643,
 S.E(Log q),     .4811,     .8505,


 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,     .51,    4.336,     14.31,     .91,     10,     .17,  -16.37,
  2,     .48,    6.582,     13.71,     .95,     10,     .12,  -16.26,
  3,     .85,     .529,     15.52,     .59,     10,     .32,  -16.48,

 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,    1.20,    -.262,     18.46,     .17,     10,     .61,  -16.87,
  5,     .66,     .590,     13.96,     .27,     10,     .58,  -17.06,
1
```

Table 3.4.3 (Cont'd)

```
Fleet : FLT08: IBTS_Q1_IV (C

 Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
    1 ,  -.07,  -.54,   .01,   .71,   .03,   .10,  -.33,   .42,   .37,  -.70
    2 ,   .09,   .08,  -.11,   .14,  -.08,   .07,  -.12,   .00,  -.10,   .03
    3 ,   .05,   .08,  -.09,   .13,  -.19,   .22,   .17,  -.29,  -.20,   .12
    4 ,   .10,   .10,  -.01,   .10,   .24,  -.06,  -.10,  -.22,  -.16,   .02
    5 ,   .14,  -.14,  -.26,   .19,   .48,  -.05,  -.04,  -.14,  -.32,   .15
    6 ,  1.74,   .91,  1.12,   .97,  1.12,   .92,  1.13,   .58,   .78,   .89
    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 ,         4,         5,         6
 Mean Log q,   -8.9635,   -8.5500,   -8.5500,
 S.E(Log q),     .1405,     .2419,    1.1123,



 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,     .67,    1.077,     10.83,     .58,     10,     .46,  -10.18,
  2,     .56,    6.665,     10.08,     .97,     10,     .10,   -9.09,
  3,     .72,    1.625,      9.43,     .80,     10,     .19,   -9.10,

 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,    1.75,   -3.810,      8.96,     .77,     10,     .16,   -8.96,
  5,    1.22,    -.727,      8.68,     .58,     10,     .30,   -8.55,
  6,    1.89,   -1.499,      8.09,     .26,     10,     .54,   -7.54,


 Terminal year survivor and F summaries :

 Age  1   Catchability dependent on age and year class strength

 Year class = 1998

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: ENGTRL_IV (Ca,    115472.,   .300,       .000,    .00,   1,  .250,     .034
 FLT06: SCOGFS_IV (Ca,     90007.,   .300,       .000,    .00,   1,  .250,     .043
 FLT07: ENGGFS_IV (Ca,     52698.,   .300,       .000,    .00,   1,  .250,     .073
 FLT08: IBTS_Q1_IV (C,     38106.,   .517,       .000,    .00,   1,  .084,     .099

   P shrinkage mean  ,    131327.,    .58,,,,                        .070,     .030

   F shrinkage mean  ,     55070.,    .50,,,,                        .095,     .070

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     76385.,       .15,      .18,    6,   1.170,   .051


Age  2   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: ENGTRL_IV (Ca,     13259.,   .219,       .182,    .83,   2,  .223,     .480
 FLT06: SCOGFS_IV (Ca,     12708.,   .212,       .186,    .88,   2,  .239,     .496
 FLT07: ENGGFS_IV (Ca,     13520.,   .212,       .004,    .02,   2,  .239,     .473
 FLT08: IBTS_Q1_IV (C,     16022.,   .258,       .149,    .58,   2,  .162,     .412

   P shrinkage mean  ,     43656.,    .50,,,,                        .068,     .172

   F shrinkage mean  ,      7726.,    .50,,,,                        .069,     .721

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     14217.,       .11,      .12,   10,   1.154,   .454
```

Table 3.4.3 (Cont'd)

```
 Age  3   Catchability dependent on age and year class strength

 Year class = 1996

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: ENGTRL_IV (Ca,     14560.,   .192,       .204,   1.07,   3,  .210,    1.083
 FLT06: SCOGFS_IV (Ca,     14058.,   .189,       .037,    .19,   3,  .214,    1.106
 FLT07: ENGGFS_IV (Ca,     15541.,   .202,       .081,    .40,   3,  .170,    1.040
 FLT08: IBTS_Q1_IV (C,     16149.,   .214,       .097,    .45,   3,  .181,    1.016

   P shrinkage mean  ,     13751.,    .54,,,,                        .104,    1.121

   F shrinkage mean  ,     15515.,    .50,,,,                        .121,    1.041

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     14913.,       .11,      .05,   14,    .403,  1.067


1
 Age  4   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: ENGTRL_IV (Ca,      2671.,   .211,       .112,    .53,   4,  .199,     .862
 FLT06: SCOGFS_IV (Ca,      1826.,   .212,       .099,    .46,   4,  .179,    1.098
 FLT07: ENGGFS_IV (Ca,      1949.,   .222,       .049,    .22,   4,  .170,    1.055
 FLT08: IBTS_Q1_IV (C,      2076.,   .206,       .060,    .29,   4,  .279,    1.015

   F shrinkage mean  ,      2449.,    .50,,,,                        .173,     .912

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      2171.,       .12,      .05,   17,    .385,   .986


 Age  5   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: ENGTRL_IV (Ca,       710.,   .266,       .201,    .76,   5,  .163,    1.045
 FLT06: SCOGFS_IV (Ca,       687.,   .276,       .094,    .34,   5,  .155,    1.066
 FLT07: ENGGFS_IV (Ca,       595.,   .283,       .240,    .85,   5,  .102,    1.163
 FLT08: IBTS_Q1_IV (C,       828.,   .208,       .080,    .38,   5,  .358,     .948

   F shrinkage mean  ,      1049.,    .50,,,,                        .222,     .809

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       800.,       .15,      .07,   21,    .477,   .969


1
 Age  6   Catchability constant w.r.t. time and age (fixed at the value for age)  5

 Year class = 1993

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: ENGTRL_IV (Ca,       376.,   .315,       .317,   1.00,   6,  .201,     .919
 FLT06: SCOGFS_IV (Ca,       602.,   .258,       .086,    .33,   5,  .109,     .663
 FLT07: ENGGFS_IV (Ca,       417.,   .267,       .057,    .21,   5,  .074,     .857
 FLT08: IBTS_Q1_IV (C,       378.,   .213,       .164,    .77,   6,  .271,     .915

   F shrinkage mean  ,       452.,    .50,,,,                        .345,     .813

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       426.,       .20,      .09,   23,    .440,   .846
```

Table 3.4.3 (Cont'd)

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: ENGTRL_IV (Ca,	95.,	.311,	.419,	1.35,	7,	.201,	1.142
FLT06: SCOGFS_IV (Ca,	173.,	.237,	.066,	.28,	5,	.091,	.774
FLT07: ENGGFS_IV (Ca,	112.,	.241,	.388,	1.61,	5,	.066,	1.029
FLT08: IBTS_Q1_IV (C,	131.,	.195,	.118,	.60,	6,	.209,	.933
F shrinkage mean ,	152.,	.50,,,,				.432,	.846

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
133.,	.23,	.12,	24,	.510,	.925

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: ENGTRL_IV (Ca,	22.,	.416,	.252,	.61,	8,	.212,	1.543
FLT06: SCOGFS_IV (Ca,	56.,	.258,	.103,	.40,	5,	.035,	.909
FLT07: ENGGFS_IV (Ca,	72.,	.267,	.198,	.74,	5,	.024,	.760
FLT08: IBTS_Q1_IV (C,	44.,	.205,	.082,	.40,	6,	.087,	1.055
F shrinkage mean ,	53.,	.50,,,,				.641,	.933

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
44.,	.33,	.12,	25,	.362,	1.054

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: ENGTRL_IV (Ca,	3.,	.452,	.263,	.58,	9,	.221,	1.588
FLT06: SCOGFS_IV (Ca,	7.,	.267,	.044,	.16,	5,	.015,	1.017
FLT07: ENGGFS_IV (Ca,	7.,	.273,	.213,	.78,	5,	.010,	1.014
FLT08: IBTS_Q1_IV (C,	8.,	.206,	.143,	.69,	6,	.038,	.939
F shrinkage mean ,	9.,	.50,,,,				.716,	.860

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
7.,	.37,	.17,	26,	.447,	1.008

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: ENGTRL_IV (Ca,	3.,	.426,	.245,	.57,	10,	.173,	1.442
FLT06: SCOGFS_IV (Ca,	5.,	.253,	.097,	.38,	5,	.015,	1.051
FLT07: ENGGFS_IV (Ca,	5.,	.264,	.074,	.28,	5,	.010,	.979
FLT08: IBTS_Q1_IV (C,	7.,	.204,	.121,	.59,	6,	.035,	.825
F shrinkage mean ,	6.,	.50,,,,				.768,	.971

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
5.,	.39,	.11,	27,	.274,	1.041

Table 3.4.4 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Fishing mortality.

Run title : Cod in IIIa,IV,VIId (run: XSAHJR03/X03)

At 11/10/2000 8:41

Table 8 Fishing mortality (F)-at-age

YEAR,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE							
1,	.0249,	.0203,	.0585,	.0551,	.0335,	.0457,	.0213,
2,	.5316,	.3759,	.4704,	.5499,	.4973,	.6353,	.3906,
3,	.3677,	.5929,	.6601,	.6280,	.7287,	.7390,	.6001,
4,	.4525,	.4171,	.6211,	.5283,	.5326,	.7113,	.5817,
5,	.4543,	.4767,	.4312,	.4894,	.5972,	.6228,	.6282,
6,	.5625,	.6126,	.4612,	.4346,	.5988,	.5646,	.6990,
7,	.1602,	.6078,	.4678,	.4452,	.6200,	.5823,	.4867,
8,	.7852,	.3700,	.7098,	.5271,	.7130,	.4542,	.6313,
9,	.3115,	.3262,	.2696,	.7630,	.3800,	.7773,	.4065,
10,	.4581,	.4823,	.4714,	.5362,	.5868,	.6055,	.5752,
+gp,	.4581,	.4823,	.4714,	.5362,	.5868,	.6055,	.5752,
0 FBAR 2- 8,	.4734,	.4933,	.5459,	.5147,	.6125,	.6156,	.5739,
FBAR 2- 4,	.4506,	.4620,	.5839,	.5687,	.5862,	.6952,	.5241,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	.1098,	.0763,	.0335,	.1292,	.0922,	.1080,	.0353,	.1439,	.0953,	.1042,
2,	.5787,	.8862,	.8906,	.6966,	.8121,	.7336,	.9390,	.8432,	1.0247,	.7936,
3,	.7465,	.7701,	.9070,	.8384,	.6697,	.7844,	.8574,	.7702,	.9246,	.9485,
4,	.5710,	.7086,	.6528,	.7782,	.6416,	.6700,	.7568,	.5486,	.7665,	.5893,
5,	.5845,	.6945,	.7100,	.5739,	.6398,	.7446,	.5713,	.6354,	.8694,	.7054,
6,	.5316,	.5377,	.8030,	.7211,	.5318,	.6719,	.7949,	.6013,	.7417,	.5128,
7,	.5279,	.5693,	.7790,	.6900,	.7127,	.5118,	.7403,	.8040,	.6809,	.6586,
8,	.3177,	.5188,	1.0276,	.5434,	.6020,	.8397,	.2720,	.7716,	.7632,	.5224,
9,	.6420,	.6898,	1.2287,	.3375,	.9128,	.8788,	.7971,	1.4542,	.8818,	.7888,
10,	.5249,	.6073,	.9196,	.5780,	.6862,	.7365,	.6408,	.8623,	.7954,	.6434,
+gp,	.5249,	.6073,	.9196,	.5780,	.6862,	.7365,	.6408,	.8623,	.7954,	.6434,
0 FBAR 2- 8,	.5511,	.6693,	.8243,	.6916,	.6585,	.7080,	.7045,	.7106,	.8244,	.6758,
FBAR 2- 4,	.6321,	.7883,	.8168,	.7711,	.7078,	.7293,	.8510,	.7207,	.9053,	.7772,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.1096,	.1010,	.1756,	.1258,	.1767,	.0869,	.2342,	.1414,	.1775,	.1290,
2,	.8827,	.9718,	.9377,	1.0858,	.9549,	.9843,	.8949,	.9166,	.9152,	.8775,
3,	.9810,	1.0113,	1.2336,	1.1903,	1.0185,	.9597,	1.0603,	.8920,	1.1847,	1.0924,
4,	.7906,	.7704,	.9208,	.9171,	.8302,	.8078,	.9609,	.9274,	.8596,	1.0162,
5,	.6492,	.6772,	.7904,	.7898,	.7544,	.7140,	.8695,	.7342,	.7920,	.7593,
6,	.6335,	.5905,	.8993,	.7600,	.7530,	.7062,	.8171,	.9362,	.8330,	.9105,
7,	.8415,	.7183,	.7679,	.7197,	.6596,	.6977,	.8007,	.9178,	.7331,	.9381,
8,	.8289,	.5733,	.6963,	.9080,	.7504,	.6008,	.8325,	.8665,	.7254,	.9860,
9,	.5851,	.7344,	.7994,	.6325,	.9138,	.5835,	.5129,	.7141,	.6800,	.7602,
10,	.7144,	.6648,	.7987,	.7696,	.7739,	.6665,	.7742,	.8425,	.7602,	.8801,
+gp,	.7144,	.6648,	.7987,	.7696,	.7739,	.6665,	.7742,	.8425,	.7602,	.8801,
0 FBAR 2- 8,	.8010,	.7590,	.8923,	.9101,	.8173,	.7815,	.8908,	.8844,	.8633,	.9400,
FBAR 2- 4,	.8848,	.9178,	1.0307,	1.0644,	.9345,	.9172,	.9720,	.9120,	.9865,	.9954,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
1,	.1401,	.1269,	.1452,	.0495,	.0741,	.1089,	.0432,	.0865,	.0261,	.0508,	.0545,
2,	.9100,	.7637,	.8499,	.8091,	.6466,	.8178,	.6516,	.6230,	.8032,	.4540,	.6267,
3,	.9701,	.9653,	.8501,	1.0235,	1.0311,	.9897,	.9879,	.9894,	1.1329,	1.0671,	1.0631,
4,	.8960,	.8449,	.9356,	.9586,	.9313,	.8358,	.7305,	.8847,	1.1304,	.9862,	1.0004,
5,	.7735,	.8377,	.7326,	.9057,	.7671,	.6706,	.8209,	.7204,	1.0274,	.9693,	.9057,
6,	.5613,	.9372,	.8338,	.7800,	.8975,	.6220,	.8689,	.8794,	.7549,	.8463,	.8269,
7,	.7830,	1.1012,	.8980,	1.0810,	.6369,	.7266,	.9084,	1.0452,	.8684,	.9246,	.9461,
8,	.5253,	1.0516,	.8364,	.8752,	1.1281,	.3882,	1.4283,	.7435,	.9252,	1.0539,	.9075,
9,	2.1179,	.5755,	1.0629,	.8052,	.7060,	1.0791,	.8992,	.9579,	.6138,	1.0078,	.8598,
10,	.9628,	.9051,	.8604,	.8642,	.8859,	.7114,	1.0012,	.9704,	.8222,	1.0412,	.9446,
+gp,	.9628,	.9051,	.8604,	.8642,	.8859,	.7114,	1.0012,	.9704,	.8222,	1.0412,	
0 FBAR 2- 8,	.7742,	.9288,	.8480,	.9190,	.8626,	.7215,	.9138,	.8408,	.9489,	.9002,	
FBAR 2- 4,	.9254,	.8580,	.8785,	.9304,	.8697,	.8811,	.7900,	.8324,	1.0222,	.8358,	

Table 3.4.5 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Stock numbers-at-age

Run title : Cod in IIIa,IV,VIId (run: XSAHJR03/X03)

At 11/10/2000 8:41

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

YEAR	1963	1964	1965	1966	1967	1968	1969
AGE							
1	195108	374091	415441	506863	488808	194595	209057
2	123043	85513	164718	176070	215532	212394	83530
3	25892	50953	41378	72517	71595	92370	79295
4	10736	13961	21933	16654	30138	26907	34356
5	8439	5591	7532	9649	8039	14486	10817
6	3116	4386	2842	4007	4842	3622	6362
7	605	1453	1946	1467	2124	2178	1686
8	1000	422	648	998	770	936	996
9	58	373	238	261	482	309	486
10	18	35	221	149	100	270	116
+gp	0	11	23	219	42	58	195
0 TOTAL	368013	536789	656920	788853	822472	548124	426896

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	781993	910798	173513	319652	263657	486379	246432	839199	488160	525428
2	91960	314844	379201	75396	126223	108037	196170	106892	326525	199415
3	39829	36331	91462	109664	26474	39487	36558	54056	32414	82583
4	33887	14703	13099	28759	36930	10554	14035	12080	19488	10014
5	15723	15675	5926	5583	10813	15918	4421	5391	5714	7414
6	4725	7175	6408	2386	2575	4669	6189	2045	2338	1961
7	2589	2273	3431	2350	950	1239	1952	2288	918	912
8	849	1250	1053	1289	965	381	608	762	838	380
9	434	506	609	309	613	433	135	379	289	320
10	265	187	208	146	180	201	147	50	73	98
+gp	107	226	33	403	415	132	99	181	87	39
0 TOTAL	972361	1303968	674944	545938	469796	667430	506747	1023323	876845	828565

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	899516	314774	618491	324679	596305	158618	716238	281824	197050	274075
2	212738	362213	127844	233144	128638	224533	65343	254634	109931	74142
3	63550	62016	96584	35274	55473	34886	59131	18817	71750	31020
4	24910	18556	17569	21907	8355	15602	10407	15950	6006	17089
5	4548	9250	7032	5728	7169	2982	5695	3259	5166	2082
6	2998	1945	3848	2612	2129	2760	1196	1954	1281	1916
7	962	1303	882	1282	1000	821	1115	432	627	456
8	386	339	520	335	511	423	334	410	141	247
9	185	138	157	212	111	198	190	119	141	56
10	119	84	54	58	92	36	90	93	48	59
+gp	53	47	32	47	40	70	46	23	37	19
0 TOTAL	1209965	770667	873011	625277	799823	440929	859785	577516	392178	401158

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 63-97	AMST 63-97
AGE													
1	133955	168539	305419	147874	325003	227247	174286	427960	72570	178861	0	336225	391744
2	108242	52322	66703	118687	63238	135605	91573	75002	176362	31767	76385	135614	156857
3	21726	30703	17180	20092	37239	23342	42182	33634	28346	55665	14217	43892	49642
4	8103	6413	9107	5718	5623	10342	6757	12232	9739	7110	14913	14151	16254
5	5064	2708	2256	2925	1795	1814	3671	2665	4135	2575	2171	5570	6655
6	798	1913	959	888	968	682	759	1323	1061	1212	800	2356	2874
7	631	373	614	341	333	323	300	261	449	409	426	963	1212
8	146	236	101	205	95	144	128	99	75	154	133	416	541
9	75	71	68	36	70	25	80	25	39	24	44	168	234
10	21	7	33	19	13	28	7	27	8	17	7	65	96
+gp	16	18	17	24	30	11	14	17	23	3	6		
0 TOTAL	278778	263303	402456	296810	434407	399565	319757	553245	292808	277797	109102		

Table 3.4.6 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Summary table.

Run title : Cod in IIIa,IV,VIId (run: XSAHJR03/X03) ,

At 11/10/2000 8:41

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 8,	FBAR 2- 4,
1963,	195108,	452114,	151517,	116457,	.7686,	.4734,	.4506,
1964,	374091,	542256,	166128,	126041,	.7587,	.4933,	.4620,
1965,	415441,	714022,	205376,	181036,	.8815,	.5459,	.5839,
1966,	506863,	859768,	230735,	221336,	.9593,	.5147,	.5687,
1967,	488808,	923776,	250047,	252977,	1.0117,	.6125,	.5862,
1968,	194595,	788669,	258247,	288368,	1.1166,	.6156,	.6952,
1969,	209057,	630832,	255981,	200760,	.7843,	.5739,	.5241,
1970,	781993,	973121,	276923,	226124,	.8166,	.5511,	.6321,
1971,	910798,	1180310,	277312,	328098,	1.1831,	.6693,	.7883,
1972,	173513,	809718,	231095,	353976,	1.5317,	.8243,	.8168,
1973,	319652,	655931,	209190,	239051,	1.1427,	.6916,	.7711,
1974,	263657,	623364,	230866,	214279,	.9282,	.6585,	.7078,
1975,	486379,	704563,	211626,	205245,	.9698,	.7080,	.7293,
1976,	246432,	610370,	182071,	234169,	1.2861,	.7045,	.8510,
1977,	839199,	822039,	159355,	209154,	1.3125,	.7106,	.7207,
1978,	488160,	812354,	159391,	297022,	1.8635,	.8244,	.9053,
1979,	525428,	804702,	164313,	269973,	1.6430,	.6758,	.7772,
1980,	899516,	1015285,	181920,	293644,	1.6141,	.8010,	.8848,
1981,	314774,	855327,	195812,	335497,	1.7134,	.7590,	.9178,
1982,	618491,	840194,	190280,	303251,	1.5937,	.8923,	1.0307,
1983,	324679,	649064,	155027,	259287,	1.6725,	.9101,	1.0644,
1984,	596305,	718098,	133458,	228286,	1.7105,	.8173,	.9345,
1985,	158618,	502700,	126223,	214629,	1.7004,	.7815,	.9172,
1986,	716238,	683047,	114193,	204053,	1.7869,	.8908,	.9720,
1987,	281824,	571179,	104703,	216212,	2.0650,	.8844,	.9120,
1988,	197050,	426066,	98634,	184240,	1.8679,	.8633,	.9865,
1989,	274075,	416215,	90601,	139936,	1.5445,	.9400,	.9954,
1990,	133955,	328416,	78035,	125314,	1.6059,	.7742,	.9254,
1991,	168539,	296641,	71126,	102478,	1.4408,	.9288,	.8580,
1992,	305419,	403142,	68902,	114020,	1.6548,	.8480,	.8785,
1993,	147874,	338438,	65107,	121749,	1.8700,	.9190,	.9304,
1994,	325003,	422037,	64840,	110634,	1.7063,	.8626,	.8697,
1995,	227247,	423199,	71168,	136096,	1.9123,	.7215,	.8811,
1996,	174286,	378313,	77029,	126320,	1.6399,	.9138,	.7900,
1997,	427960,	503103,	81778,	124158,	1.5182,	.8408,	.8324,
1998,	72570,	321167,	74070,	146014,	1.9713,	.9489,	1.0222,
1999,	178861,	289596,	65779,	96225,	1.4628,	.9002,	.8358,
2000,	202000*		66711**				
Arith. Mean ,	377364,	629436,	154834,	203949,	1.4327,	.7580,	.8111,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

*) short-term GM year classes 1988-1997
**) based on Fsq and 1997-1999 arithmetic means of weight-at-age

Table 3.5.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). RCT3 Input.

COD IV RCT3 INPUT VALUES; AGE 1*100; 06. Okt 00

20 31 2

YEARCLASS	VPA	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS1	SGFS2	DGFS0	DGSF1	DGSF2	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	618	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	305	1300	1990	4840	2440	650	642	749	3980	4540	70	-1	1340	-1	3630	19080	14460	848	2671	-1	-1
1992	148	1270	440	1684	742	295	347	334	1160	170	90	-1	-1	450	1100	4820	3410	722	586	-1	1.2
1993	325	1480	2210	377	2637	1277	1158	1443	2410	4690	-1	-1	3080	1430	3200	2030	20470	358	2552	8.4	-1
1994	227	970	800	2134	1028	668	475	356	6350	-1	-1	-1	430	-1	1960	4270	5660	518	1489	133.4	32
1995	174	350	690	26	619	284	318	278	-1	-1	-1	-1	-1	-1	370	770	1920	1085	791	41	25.4
1996	428	4000	2640	4122	4044	1396	999	2134	-1	-1	-1	-1	-1	-1	7580	2830	-1	2206	-1	109.2	9.4
1997	73	270	160	4.9	118	55	104	103	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5.5	0.6
1998	-1	210	380	389	367	197	440	237	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	4.1	1.3
1999	-1	660	-1	95	953	-1	700	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	15	3
2000	-1	-1	-1	40	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 3.5.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). RCT3 results.

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

 rct3in2.csv

 COD IV,RCT3 INPUT VALUES; AGE 1*100; ,,,,,06-Oct-00,,,,,,,,,,,,,,

 Data for   20 surveys over   31 years :  1970 - 2000

 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

         I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 IYFS1      .85   -.09    .64   .503     28   5.35    4.46     .703     .048
 IYFS2      .93   -.64    .38   .746     28   5.94    4.86     .408     .144
 EGFS0      .47   2.66    .71   .455     21   5.97    5.49     .765     .041
 EGFS1      .72    .46    .25   .882     22   5.91    4.70     .277     .311
 EGFS2      .82    .64    .34   .789     23   5.29    5.00     .371     .174
 SGFS1      .94    .03    .52   .591     17   6.09    5.74     .569     .074
 SGFS2     1.20  -1.29   1.13   .224     18   5.47    5.27    1.233     .016
 GQ40       .47   3.57    .54   .579     14   1.63    4.34     .644     .058
 GQ11       .41   4.30    .49   .648     15    .83    4.64     .565     .075

                                        VPA Mean =    5.75     .634     .060


 Yearclass =   1999

         I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 IYFS1      .85   -.09    .64   .503     28   6.49    5.43     .679     .074
 IYFS2
 EGFS0      .47   2.66    .71   .455     21   4.56    4.82     .779     .056
 EGFS1      .72    .46    .25   .882     22   6.86    5.38     .266     .482
 SGFS1      .94    .03    .52   .591     17   6.55    6.18     .579     .102
 GQ40       .47   3.57    .54   .579     14   2.77    4.88     .612     .091
 GQ11       .41   4.30    .49   .648     15   1.39    4.87     .555     .111

                                        VPA Mean =    5.75     .634     .085


 Yearclass =   2000

         I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights


 EGFS0      .47   2.66    .71   .455     21   3.71    4.42     .797     .387


                                        VPA Mean =    5.75     .634     .613




 Year     Weighted      Log     Int     Ext      Var      VPA       Log
 Class     Average      WAP     Std     Std     Ratio               VPA
          Prediction           Error   Error

 1998        136       4.92     .15     .13       .74
 1999        213       5.36     .18     .16       .71
 2000        187       5.24     .50     .65      1.72
```

Table 3.7.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak).

The SAS System 14:49 Monday, October 9, 2000
Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak)

Single option prediction: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	202000.00	0.8000	0.0100	0.0000	0.0000	0.613	0.0545	0.613
2	76385.000	0.3500	0.0500	0.0000	0.0000	0.939	0.6267	0.939
3	14217.000	0.2500	0.2300	0.0000	0.0000	1.836	1.0631	1.836
4	14913.000	0.2000	0.6200	0.0000	0.0000	3.540	1.0004	3.540
5	2171.000	0.2000	0.8600	0.0000	0.0000	5.780	0.9057	5.780
6	800.000	0.2000	1.0000	0.0000	0.0000	7.787	0.8269	7.787
7	426.000	0.2000	1.0000	0.0000	0.0000	9.396	0.9461	9.396
8	133.000	0.2000	1.0000	0.0000	0.0000	10.811	0.9075	10.811
9	44.000	0.2000	1.0000	0.0000	0.0000	11.800	0.8598	11.800
10	7.000	0.2000	1.0000	0.0000	0.0000	12.725	0.9446	12.725
11+	6.000	0.2000	1.0000	0.0000	0.0000	13.421	0.9446	13.421
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	202000.00	0.8000	0.0100	0.0000	0.0000	0.613	0.0545	0.613
2	.	0.3500	0.0500	0.0000	0.0000	0.939	0.6267	0.939
3	.	0.2500	0.2300	0.0000	0.0000	1.836	1.0631	1.836
4	.	0.2000	0.6200	0.0000	0.0000	3.540	1.0004	3.540
5	.	0.2000	0.8600	0.0000	0.0000	5.780	0.9057	5.780
6	.	0.2000	1.0000	0.0000	0.0000	7.787	0.8269	7.787
7	.	0.2000	1.0000	0.0000	0.0000	9.396	0.9461	9.396
8	.	0.2000	1.0000	0.0000	0.0000	10.811	0.9075	10.811
9	.	0.2000	1.0000	0.0000	0.0000	11.800	0.8598	11.800
10	.	0.2000	1.0000	0.0000	0.0000	12.725	0.9446	12.725
11+	.	0.2000	1.0000	0.0000	0.0000	13.421	0.9446	13.421
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	202000.00	0.8000	0.0100	0.0000	0.0000	0.613	0.0545	0.613
2	.	0.3500	0.0500	0.0000	0.0000	0.939	0.6267	0.939
3	.	0.2500	0.2300	0.0000	0.0000	1.836	1.0631	1.836
4	.	0.2000	0.6200	0.0000	0.0000	3.540	1.0004	3.540
5	.	0.2000	0.8600	0.0000	0.0000	5.780	0.9057	5.780
6	.	0.2000	1.0000	0.0000	0.0000	7.787	0.8269	7.787
7	.	0.2000	1.0000	0.0000	0.0000	9.396	0.9461	9.396
8	.	0.2000	1.0000	0.0000	0.0000	10.811	0.9075	10.811
9	.	0.2000	1.0000	0.0000	0.0000	11.800	0.8598	11.800
10	.	0.2000	1.0000	0.0000	0.0000	12.725	0.9446	12.725
11+	.	0.2000	1.0000	0.0000	0.0000	13.421	0.9446	13.421
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SPRHJR01
Date and time: 09OCT00:15:37

Table 3.7.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak).

```
                                            The SAS System                          11:10 Tuesday, October 10, 2000
Cod in Sub-area IV, Divison VIId & Division IIIa (Skagerrak)

                              Prediction with management option table
```

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.8966	299287	66711	92936	0.0000	0.0000	307276	58650	0	456239	134471
.	.	.	.	.	0.1000	0.0897	.	58650	13337	435984	123138
.	.	.	.	.	0.2000	0.1793	.	58650	25636	417398	112824
.	.	.	.	.	0.3000	0.2690	.	58650	36985	400333	103437
.	.	.	.	.	0.4000	0.3587	.	58650	47465	384657	94891
.	.	.	.	.	0.5000	0.4483	.	58650	57149	370249	87109
.	.	.	.	.	0.6000	0.5380	.	58650	66106	356998	80021
.	.	.	.	.	0.7000	0.6276	.	58650	74397	344805	73563
.	.	.	.	.	0.8000	0.7173	.	58650	82077	333579	67678
.	.	.	.	.	0.9000	0.8070	.	58650	89197	323236	62313
.	.	.	.	.	1.0000	0.8966	.	58650	95804	313701	57422
.	.	.	.	.	1.1000	0.9863	.	58650	101940	304905	52960
.	.	.	.	.	1.2000	1.0760	.	58650	107644	296786	48890
.	.	.	.	.	1.3000	1.1656	.	58650	112951	289286	45175
.	.	.	.	.	1.4000	1.2553	.	58650	117894	282354	41784
.	.	.	.	.	1.5000	1.3449	.	58650	122502	275941	38687
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

```
Notes: Run name              : MANHJR03
       Date and time         : 10OCT00:11:12
       Computation of ref. F: Simple mean, age 2 - 8
       Basis for 2000        : F factors
```

Table 3.7.3 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak).

The SAS System 14:49 Monday, October 9, 2000

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

Single option prediction: Detailed tables

Year: 2000 F-factor: 1.0000 Reference F: 0.8966

				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	0.0545	7402	4535	202000	123759	2020	1238	2020	1238
2	0.6267	30557	28693	76385	71726	3819	3586	3819	3586
3	1.0631	8414	15446	14217	26098	3270	6002	3270	6002
4	1.0004	8686	30753	14913	52797	9246	32734	9246	32734
5	0.9057	1190	6877	2171	12549	1867	10792	1867	10792
6	0.8269	413	3220	800	6229	800	6229	800	6229
7	0.9461	240	2254	426	4003	426	4003	426	4003
8	0.9075	73	789	133	1438	133	1438	133	1438
9	0.8598	23	275	44	519	44	519	44	519
10	0.9446	4	50	7	89	7	89	7	89
11+	0.9446	3	45	6	81	6	81	6	81
Total		57006	92936	311102	299287	21638	66711	21638	66711
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.8966

				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	0.0545	7402	4535	202000	123759	2020	1238	2020	1238
2	0.6267	34383	32286	85950	80707	4298	4035	4298	4035
3	1.0631	17023	31248	28763	52799	6615	12144	6615	12144
4	1.0004	2227	7886	3824	13539	2371	8394	2371	8394
5	0.9057	2461	14223	4490	25953	3861	22320	3861	22320
6	0.8269	371	2892	719	5595	719	5595	719	5595
7	0.9461	161	1516	286	2692	286	2692	286	2692
8	0.9075	74	803	135	1464	135	1464	135	1464
9	0.8598	23	275	44	518	44	518	44	518
10	0.9446	9	109	15	194	15	194	15	194
11+	0.9446	2	31	4	56	4	56	4	56
Total		64137	95804	326231	307276	20369	58650	20369	58650
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 1.0000 Reference F: 0.8966

				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	0.0545	7402	4535	202000	123759	2020	1238	2020	1238
2	0.6267	34383	32286	85950	80707	4298	4035	4298	4035
3	1.0631	19155	35162	32365	59411	7444	13664	7444	13664
4	1.0004	4507	15955	7737	27391	4797	16982	4797	16982
5	0.9057	631	3647	1151	6655	990	5723	990	5723
6	0.8269	768	5981	1486	11572	1486	11572	1486	11572
7	0.9461	145	1362	257	2418	257	2418	257	2418
8	0.9075	50	540	91	985	91	985	91	985
9	0.8598	24	280	45	528	45	528	45	528
10	0.9446	9	109	15	194	15	194	15	194
11+	0.9446	3	47	6	83	6	83	6	83
Total		67076	99902	331104	313701	21449	57422	21449	57422
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Table 3.8.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Input for medium-term projection.

Input for Catch Prediction

Age	2000 Stock Numbers (10**-3)	F and mean Wt-at-age used in prediction: Scaled Mean F 1997 - 1999	Mean Wt.-at-age (kg) 1990 - 1999: Stock	Catch	M and maturity: M	P. mat
1	202000	.055	.674	.674	.800	.010
2	76385	.629	1.029	1.029	.350	.050
3	14217	1.068	2.130	2.130	.250	.230
4	14913	1.005	3.995	3.995	.200	.620
5	2172	.909	6.317	6.317	.200	.860
6	800	.830	8.177	8.177	.200	1.000
7	426	.945	9.726	9.726	.200	1.000
8	133	.903	10.867	10.867	.200	1.000
9	45	.845	12.346	12.346	.200	1.000
10	8	.943	13.327	13.327	.200	1.000
11	6	.943	14.602	14.602	.200	1.000

Mean F	(2 - 8)
Unscaled	.895
Scaled	.898

Recruits-at-age 1 in 2001 = 202000
Recruits-at-age 1 in 2002 = 202000

Stock numbers in 2000 are VPA survivors.
These are overwritten at Age 1

Table 3.8.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Parameters of the Shepherd stock-recruitment relationship used in the medium-term projections.

Data read from file codiv.rec

Shepherd curve
Moving average term NOT fitted

IFAIL on exit from E04FDF = 0

Residual sum of squares= 9.3608

Number of observations= 36

Number of parameters = 3

Residual mean square = 0.2837

Coefficient of determination = 0.2785

Adj. coeff. of determination = 0.2348

IFAIL from E04YCF= 0

Parameter Correlation matrix

1		
-0.5755	1	
-0.583	0.0787	1

Parameter	s.d.
2.7715	0.4003
259.6943	25.3046
5.0376	3.6236

Y/Class	SSB	Recruits	Fit. rct	residuals	residuals	wt
94	64.8	227	179.43	0.2352	0.2352	1
93	65.1	325	180.25	0.5895	0.5895	1
92	68.9	148	190.72	-0.2536	-0.2536	1
91	71.1	305	196.76	0.4383	0.4383	1
95	71.2	174	197.04	-0.1243	-0.1243	1
98	74.1	179	205	-0.1356	-0.1356	1
96	77	428	212.94	0.6981	0.6981	1
90	78	169	215.67	-0.2439	-0.2439	1
97	81.8	73	226.04	-1.1302	-1.1302	1
89	90.6	134	249.86	-0.623	-0.623	1
88	98.7	274	271.47	0.0093	0.0093	1
87	104.7	197	287.22	-0.377	-0.377	1
86	114.2	282	311.54	-0.0996	-0.0996	1
85	126.2	716	340.77	0.7425	0.7425	1
84	133.4	159	357.26	-0.8095	-0.8095	1
63	151.5	374	393.81	-0.0516	-0.0516	1
83	155	596	399.88	0.3991	0.3991	1
77	159.4	488	406.97	0.1816	0.1816	1
78	159.4	525	406.97	0.2547	0.2547	1
79	164.3	900	414.1	0.7763	0.7763	1
64	166.1	415	416.51	-0.0036	-0.0036	1
80	181.9	315	432.23	-0.3164	-0.3164	1
76	182.1	839	432.36	0.6629	0.6629	1
82	190.2	325	436.27	-0.2944	-0.2944	1
81	195.7	618	437.25	0.346	0.346	1
65	205.4	507	435.62	0.1517	0.1517	1
73	209.1	264	433.88	-0.4968	-0.4968	1
75	211.7	246	432.29	-0.5638	-0.5638	1
66	230.8	489	412.15	0.171	0.171	1
74	230.8	486	412.15	0.1648	0.1648	1
72	231	320	411.87	-0.2524	-0.2524	1
67	250	195	379.53	-0.6659	-0.6659	1
69	255.9	782	367.75	0.7544	0.7544	1
68	258.2	209	363	-0.5521	-0.5521	1
70	276.8	911	322.47	1.0385	1.0385	1
71	277.2	173	321.57	-0.6199	-0.6199	1

Table 3.9.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak).

19:38 Monday, October 9, 2000

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	1.000	0.8000	0.0100	0.0000	0.0000	0.613	0.0545	0.613
2	.	0.3500	0.0500	0.0000	0.0000	0.969	0.6267	0.969
3	.	0.2500	0.2300	0.0000	0.0000	2.147	1.0631	2.147
4	.	0.2000	0.6200	0.0000	0.0000	4.053	1.0004	4.053
5	.	0.2000	0.8600	0.0000	0.0000	6.327	0.9057	6.327
6	.	0.2000	1.0000	0.0000	0.0000	8.418	0.8269	8.418
7	.	0.2000	1.0000	0.0000	0.0000	10.071	0.9461	10.071
8	.	0.2000	1.0000	0.0000	0.0000	11.183	0.9075	11.183
9	.	0.2000	1.0000	0.0000	0.0000	12.558	0.8598	12.558
10	.	0.2000	1.0000	0.0000	0.0000	13.693	0.9446	13.693
11+	.	0.2000	1.0000	0.0000	0.0000	14.374	0.9446	14.374
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDHJR05
Date and time: 09OCT00:19:48

19:38 Monday, October 9, 2000

Table 3.9.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak).

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

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	3.126	14977.239	1.344	12874.231	1.344	12874.231
0.1000	0.0897	0.119	637.950	2.559	8668.631	0.816	6706.066	0.816	6706.066
0.2000	0.1793	0.183	786.621	2.264	5821.897	0.557	3977.458	0.557	3977.458
0.3000	0.2690	0.224	797.586	2.083	4300.372	0.407	2555.921	0.407	2555.921
0.4000	0.3587	0.252	767.343	1.961	3397.452	0.312	1738.180	0.312	1738.180
0.5000	0.4483	0.274	727.004	1.873	2820.817	0.248	1234.573	0.248	1234.573
0.6000	0.5380	0.291	687.149	1.807	2431.520	0.203	908.282	0.203	908.282
0.7000	0.6276	0.306	651.173	1.754	2156.829	0.170	688.291	0.170	688.291
0.8000	0.7173	0.318	619.832	1.712	1955.835	0.146	535.075	0.146	535.075
0.9000	0.8070	0.328	592.920	1.678	1804.196	0.127	425.413	0.127	425.413
1.0000	0.8966	0.337	569.926	1.648	1686.751	0.113	345.061	0.113	345.061
1.1000	0.9863	0.346	550.282	1.623	1593.695	0.101	284.961	0.101	284.961
1.2000	1.0760	0.353	533.460	1.602	1518.478	0.091	239.176	0.091	239.176
1.3000	1.1656	0.360	519.002	1.582	1456.601	0.084	203.715	0.084	203.715
1.4000	1.2553	0.366	506.522	1.565	1404.901	0.077	175.835	0.077	175.835
1.5000	1.3449	0.372	495.701	1.550	1361.102	0.072	153.610	0.072	153.610
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

```
Notes: Run name              : YLDHJR05
       Date and time         : 09OCT00:19:48
       Computation of ref. F: Simple mean, age 2 - 8
       F-0.1 factor          : 0.1583
       F-max factor          : 0.2620
       F-0.1 reference F     : 0.1419
       F-max reference F     : 0.2349
       Recruitment           : Single recruit
```

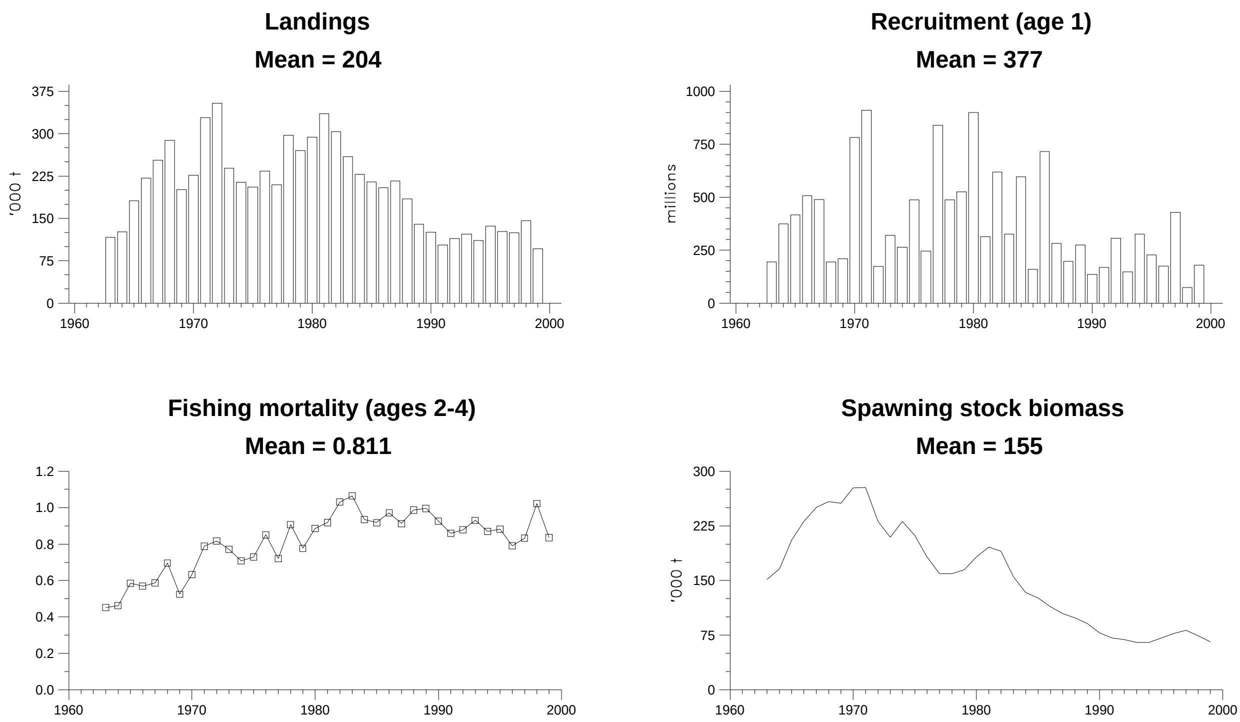


Figure 3.1.1 Cod in Sub-area IV, Division VIId and Division IIIa (Skagerrak)

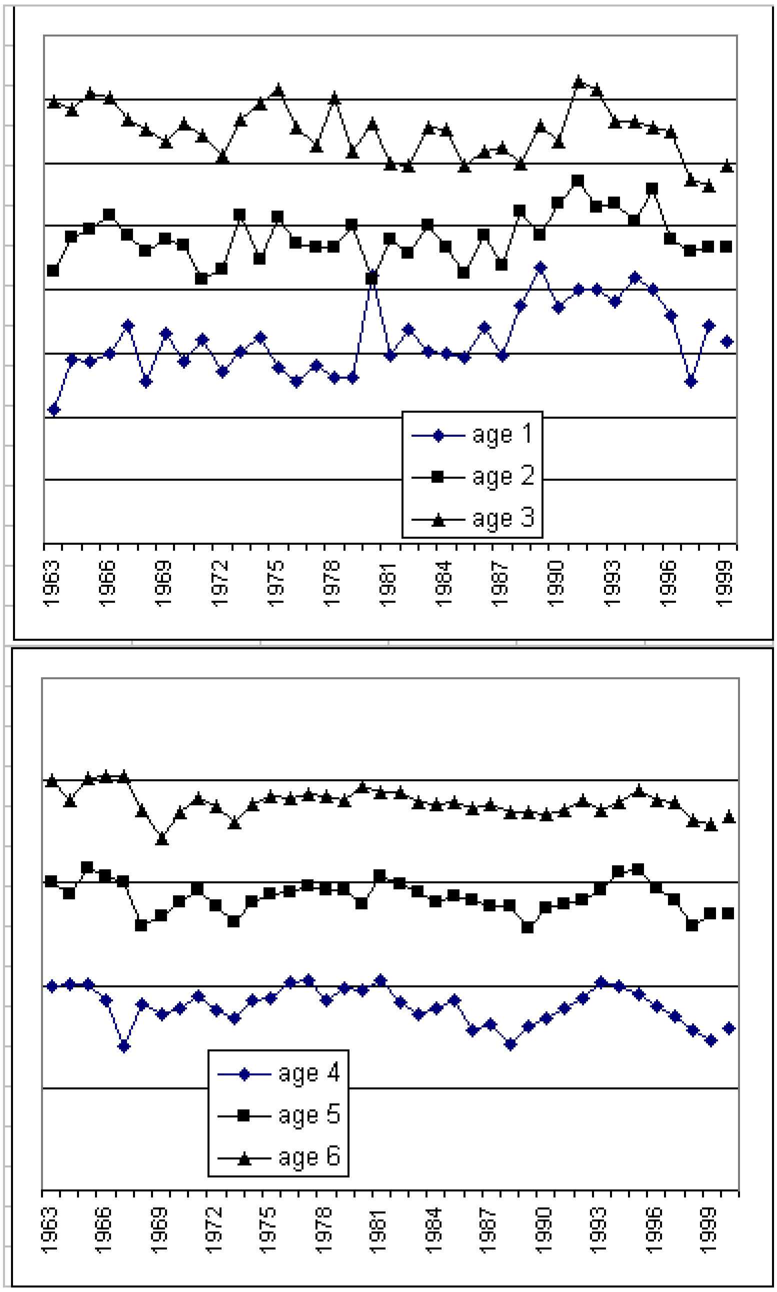


Figure 3.2.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Relative Trends in mean weight-at-age scaled to the mean weights in 1963. The 2000 data points are the means over 1997-99 used as input to the catch predictions.

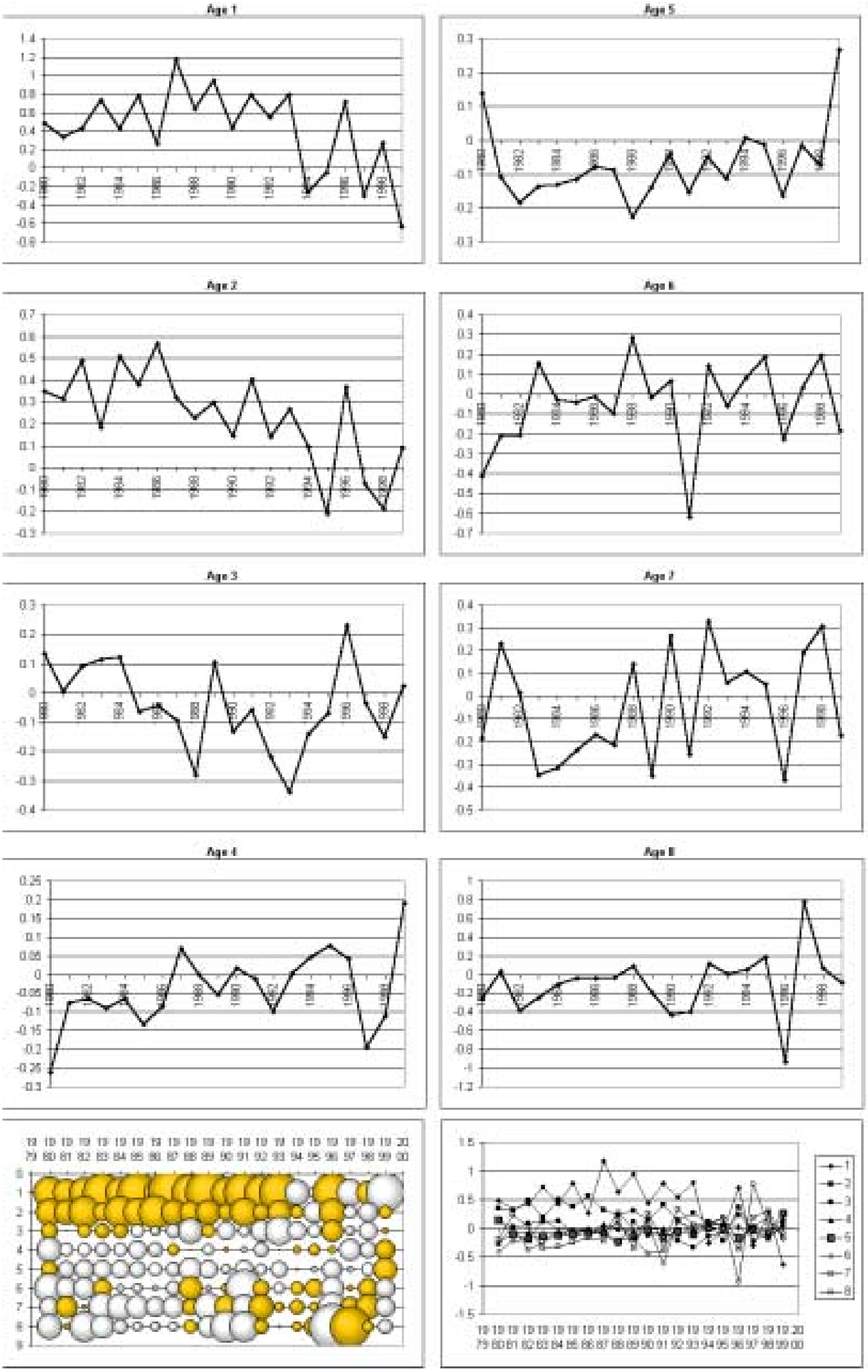


Figure 3.4.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Log catch ratio residuals from Separable VPA, 11+-gp, F=1, S=0.8.

English GFS IBTS Q1

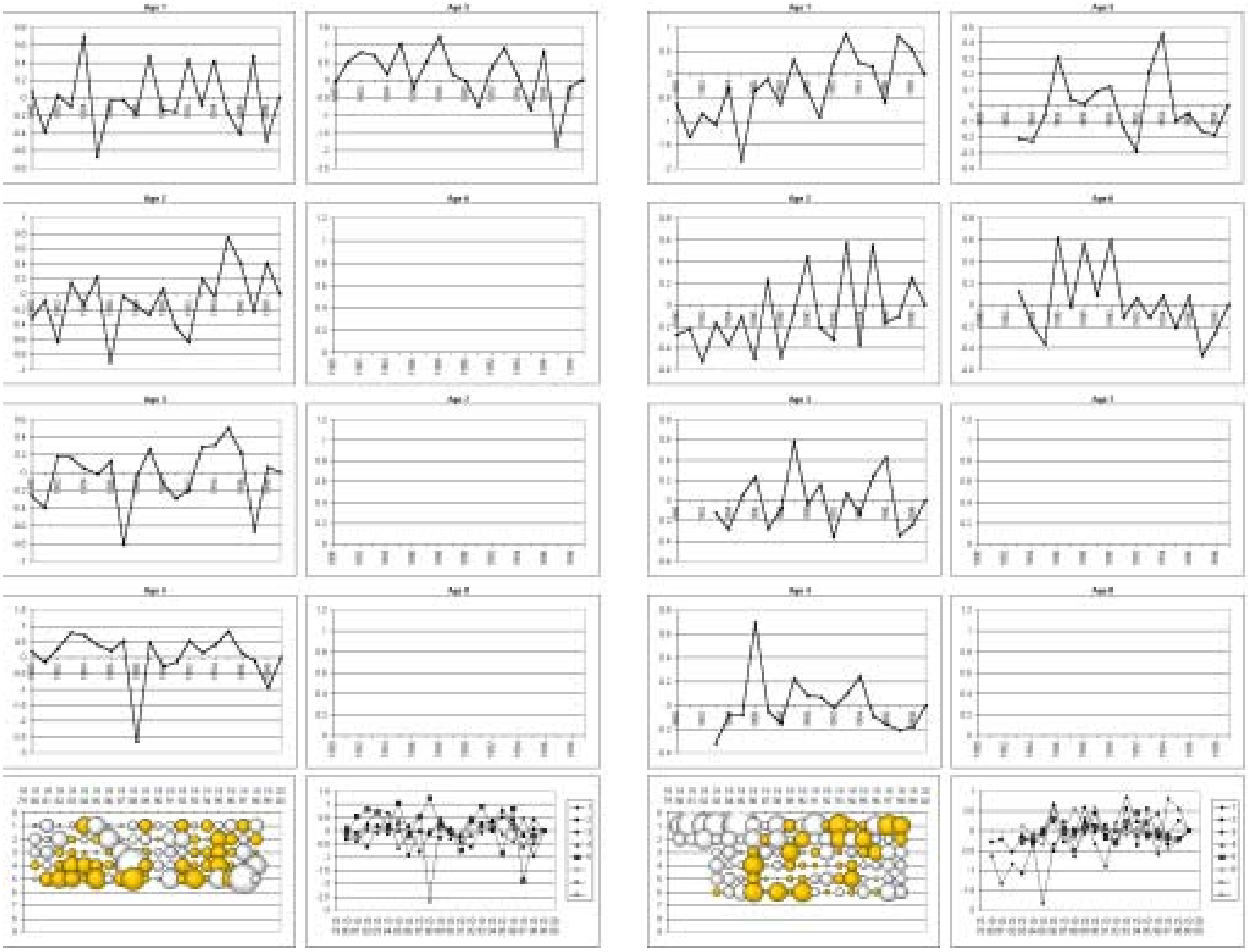


Figure 3.4.2a Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Laurec Shepherd log catchability residual plots for single fleet tuning English GFS and IBTS Q1.

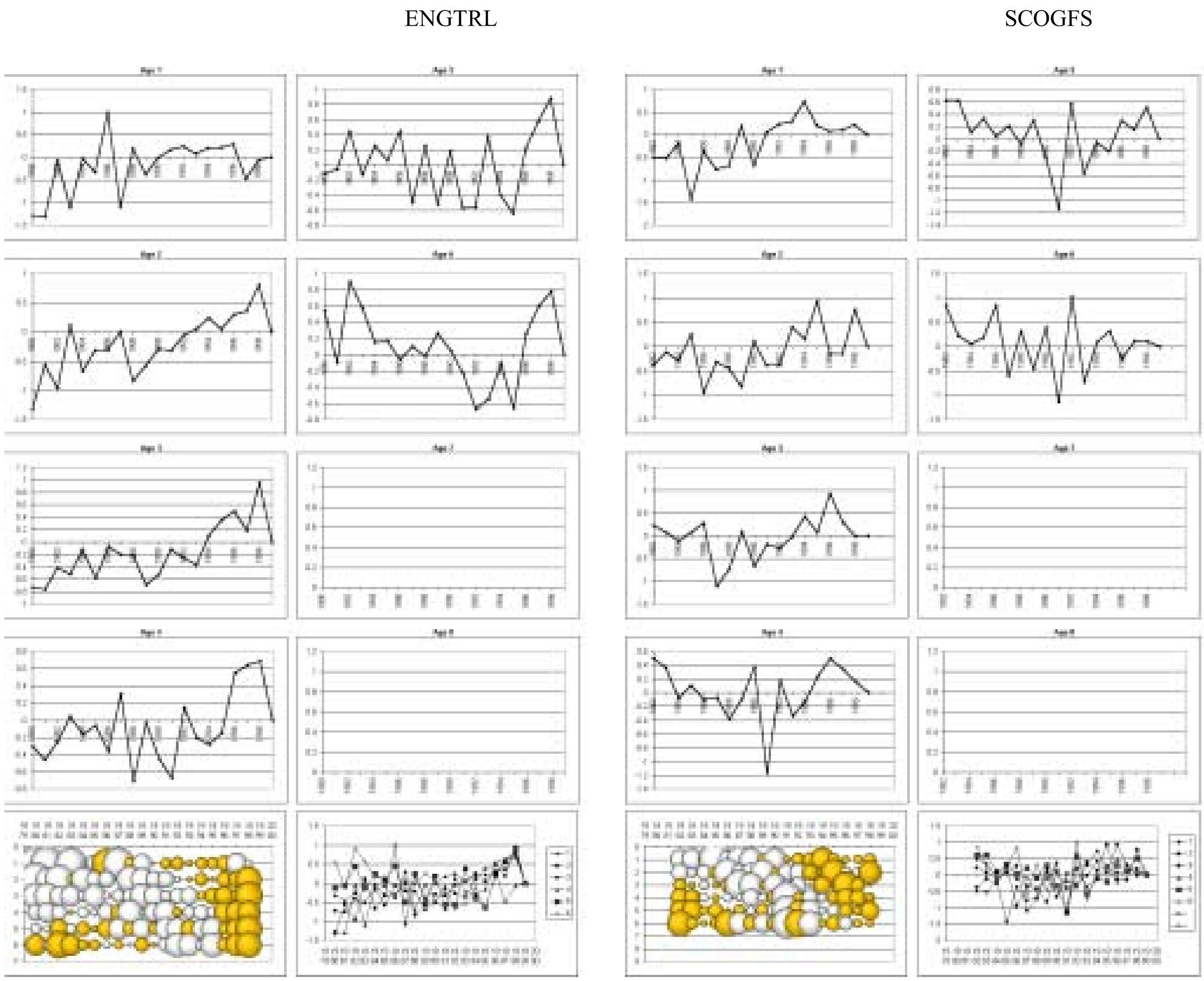


Figure 3.4.2b Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Laurec Shepherd log catchability residual plots for single fleet tuning ENGTRL and SCOGFS.

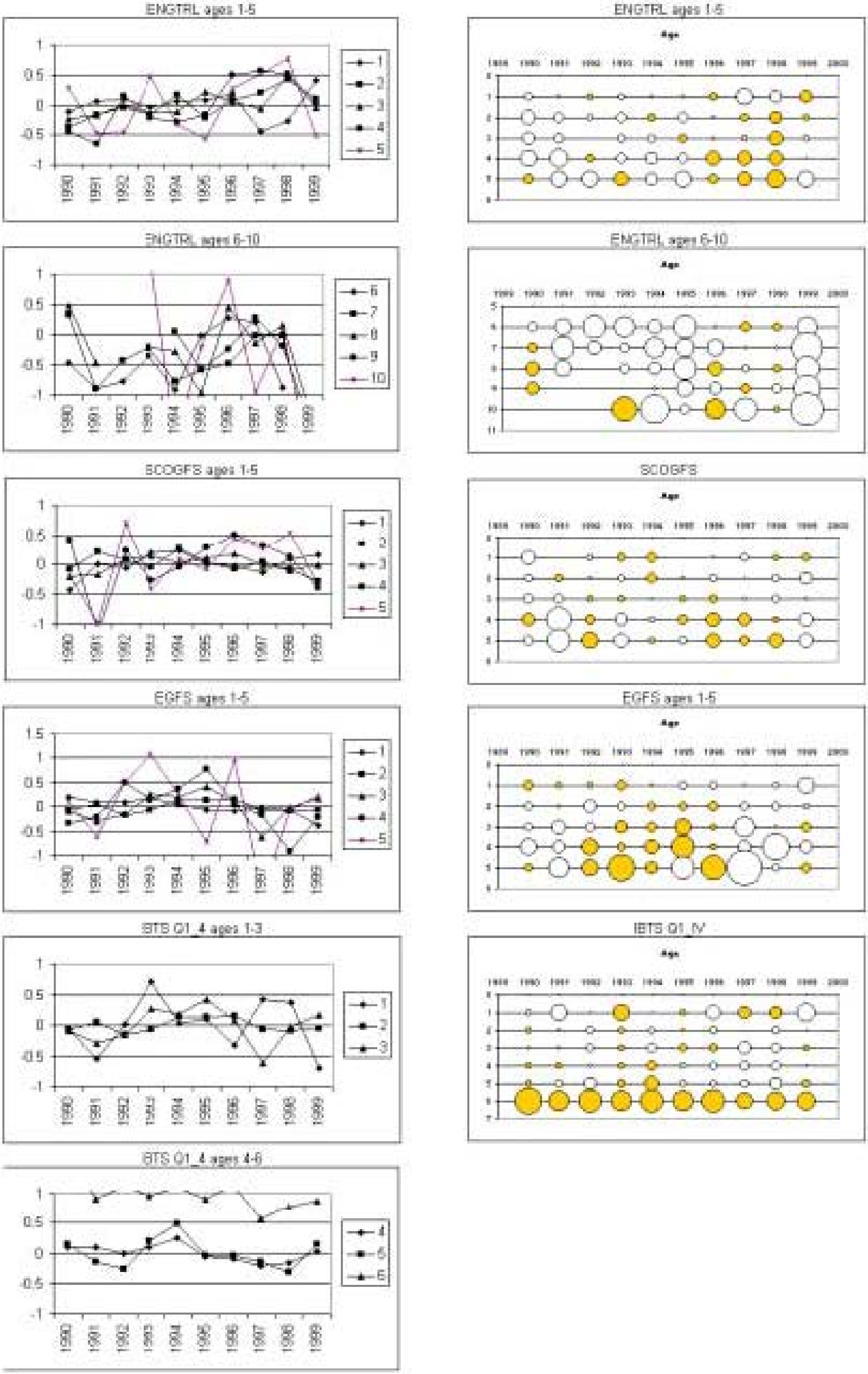


Figure 3.4.3 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Log catchability residuals - final XSA.

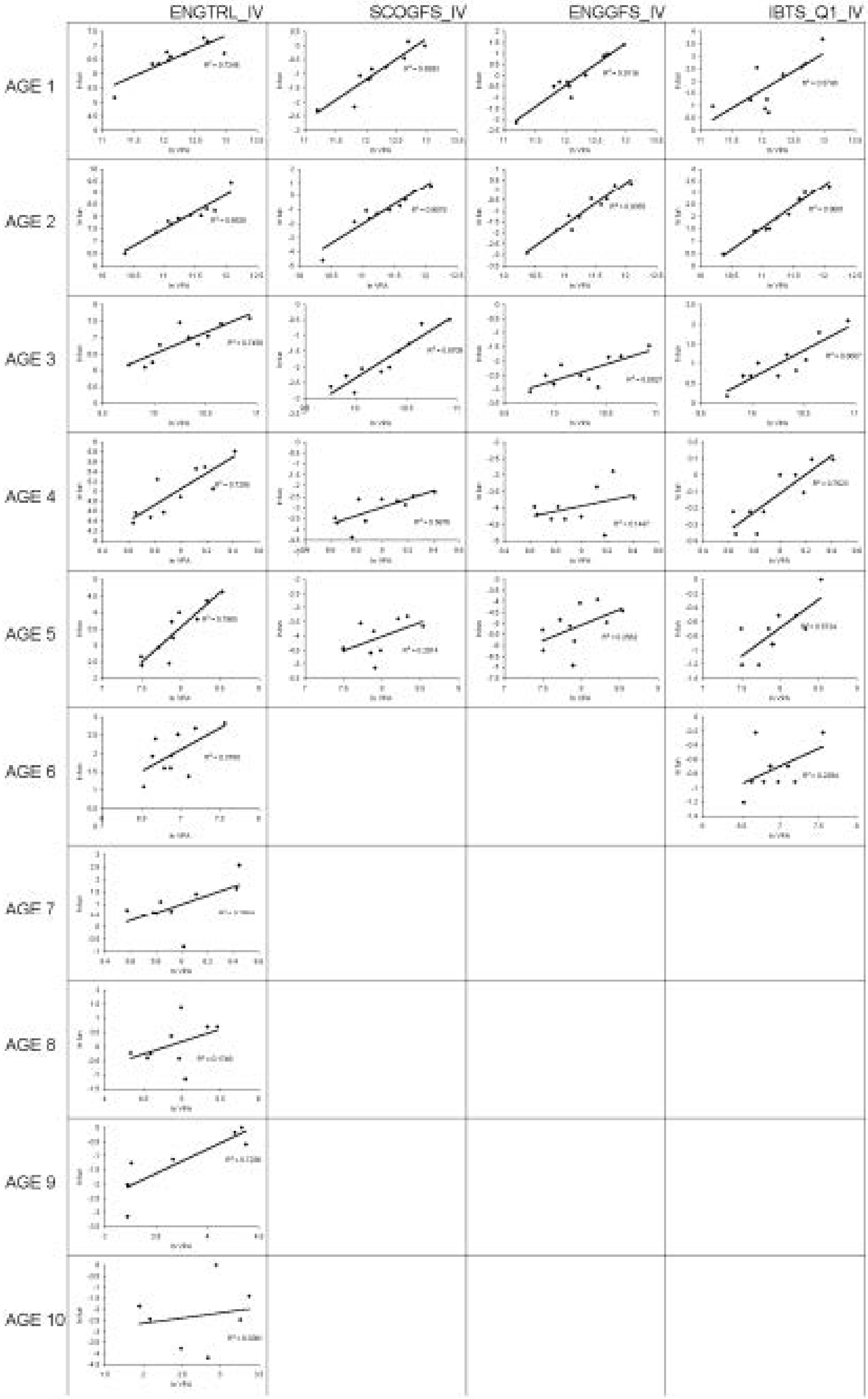


Figure 3.4.4 Cod in Sub-area IV, Division VIId & Division IIIa (Skagerrak). Linear regressions of ln transformed numbers-at-age from the 4 tuning series used vs. the final VPA stock numbers-at-age for age groups 1-10.

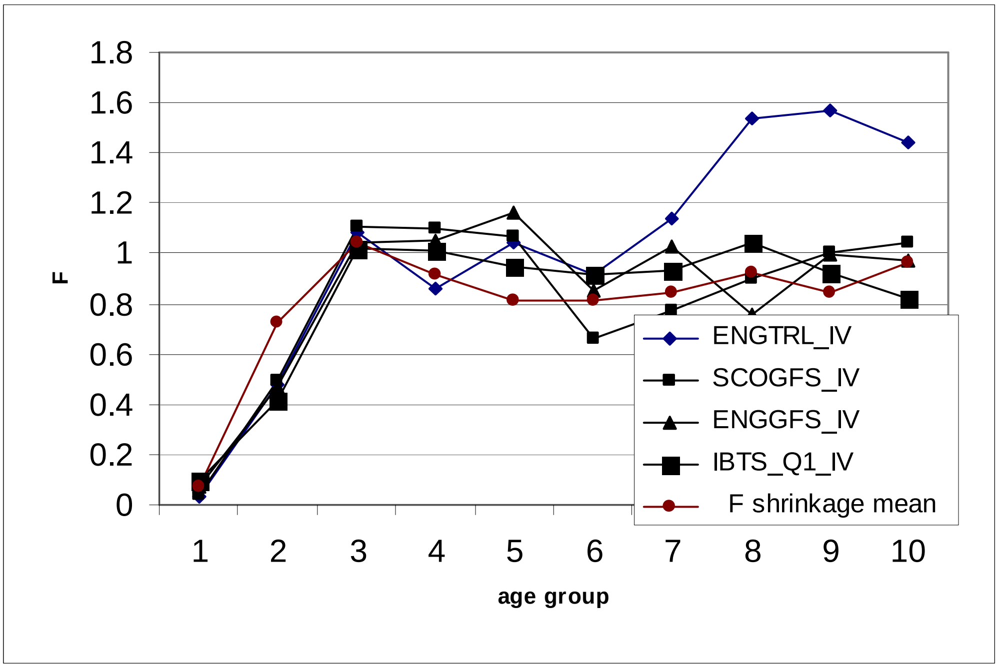


Figure 3.4.5 Cod in Sub-area IV, Division VIId & Division IIIa (Skagerrak). Exploitation patterns by fleet.

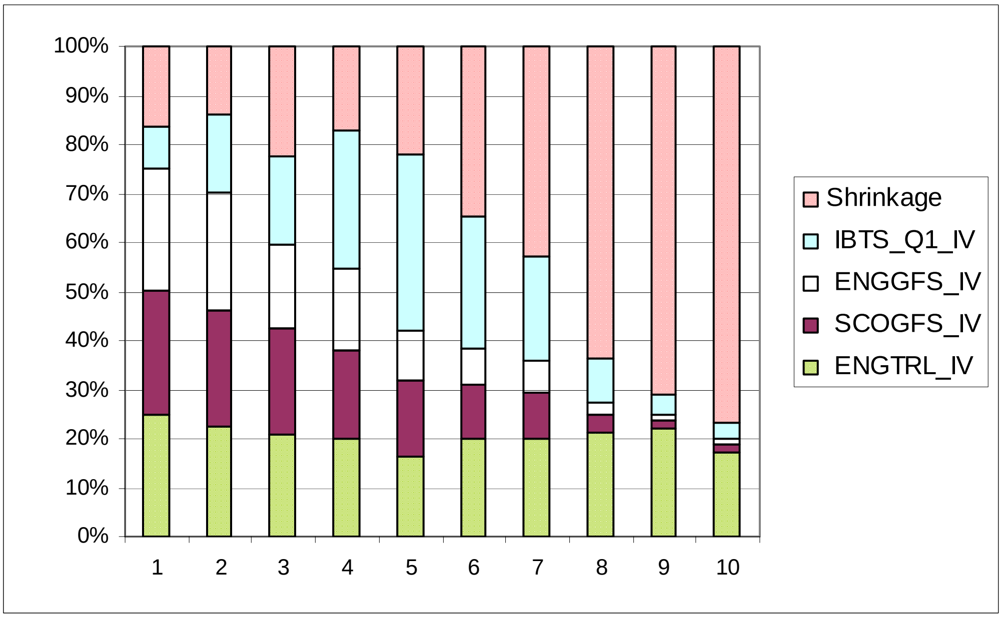


Figure 3.4.6 Cod in Sub-area IV, Division VIId & Division IIIa (Skagerrak). Contribution of tuning fleets and shrinkage to F and population estimates.

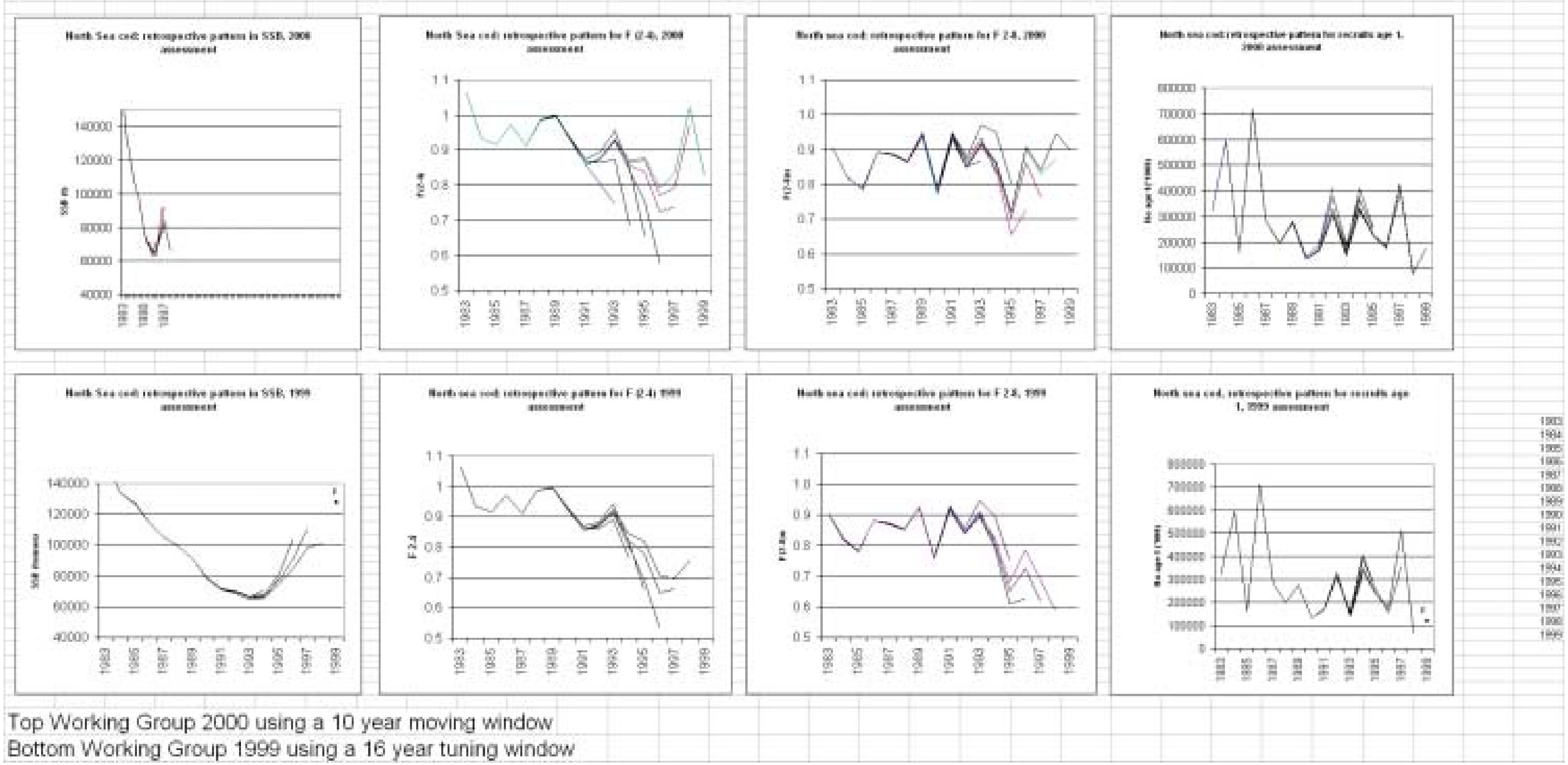
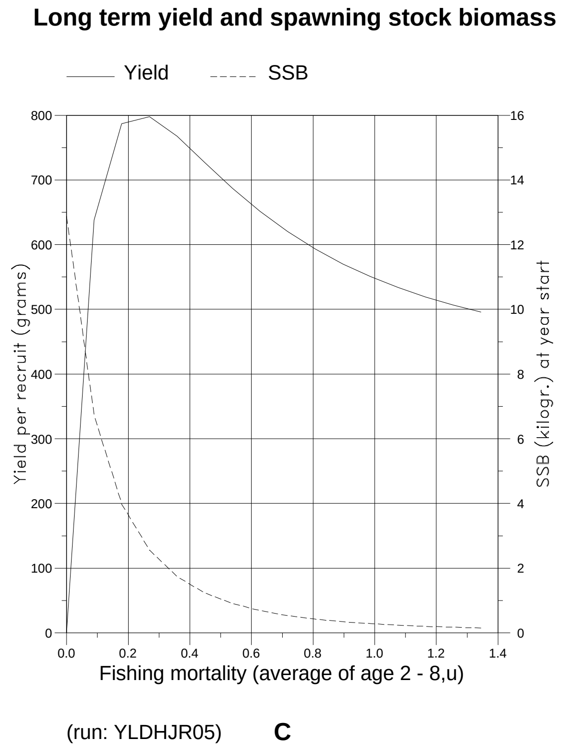


Figure 3.4.7 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Retrospective results of 1999 and 2000 assessments.



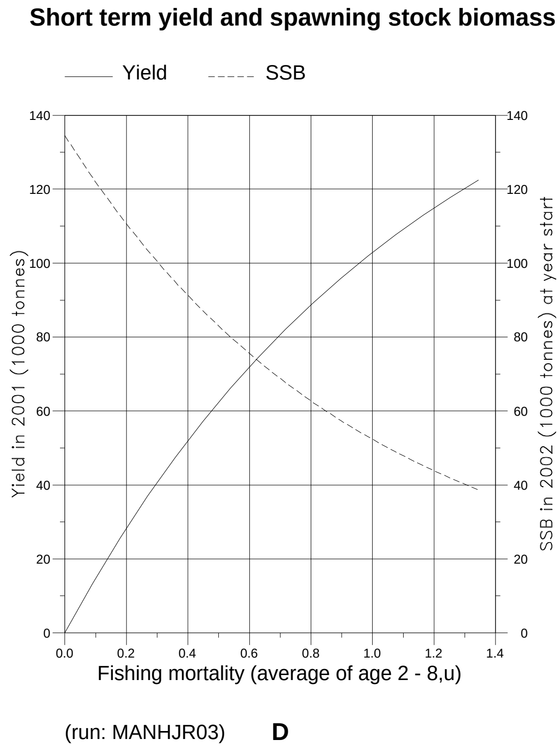


Figure 3.7.1 Fish Stock Summary, Cod in Sub-area IV, Division VIId and Division IIIa (Skagerrak)

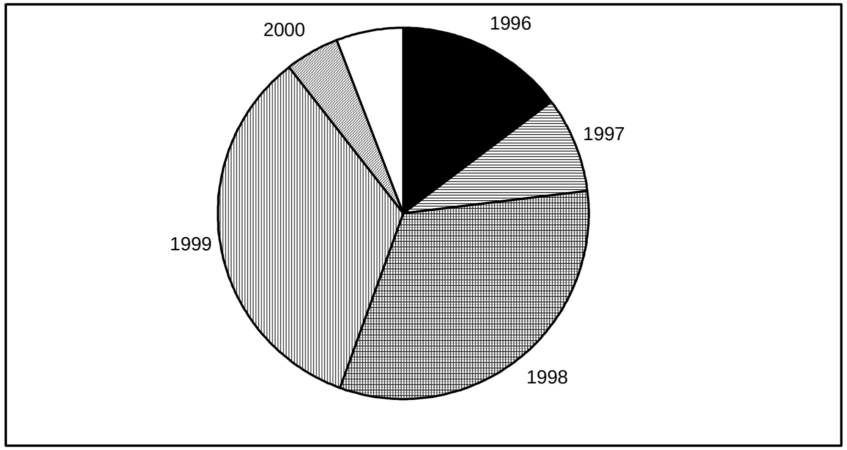
Figure 3.7.2 **Cod in IIIa (Skagerrak), IV and VIId**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	1996	1997	1998	1999	2000
Stock No. (thousands) of 1 year-olds	427960	72570	178861	202000	202000
Source	VPA	VPA	VPA	st-GM	st-GM
Status Quo F:					
% in 2000 landings	33.1	16.6	30.9	4.9	-
% in 2001	14.8	8.2	32.6	33.7	4.7
% in 2000 SSB	49.1	9.0	5.4	1.9	-
% in 2001 SSB	38.1	14.3	20.7	6.9	2.1
% in 2002 SSB	20.2	10.0	29.6	23.8	7.0

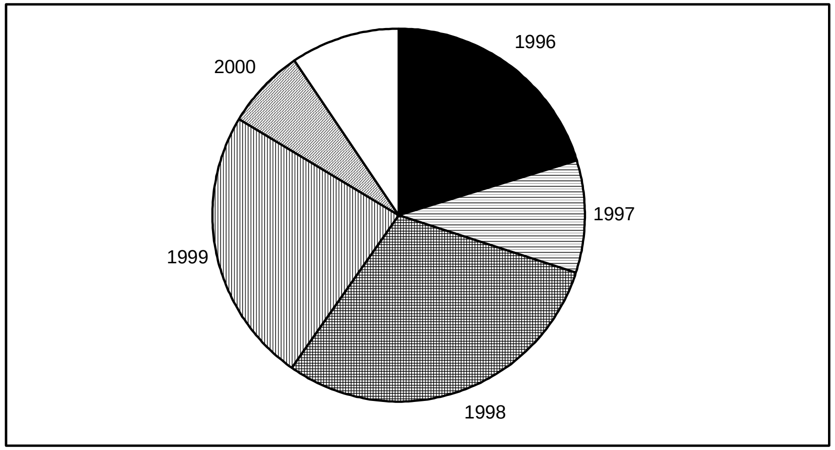
st-GM : short term geometric mean recruitment

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

a) 2001 landings



b) 2002 SSB



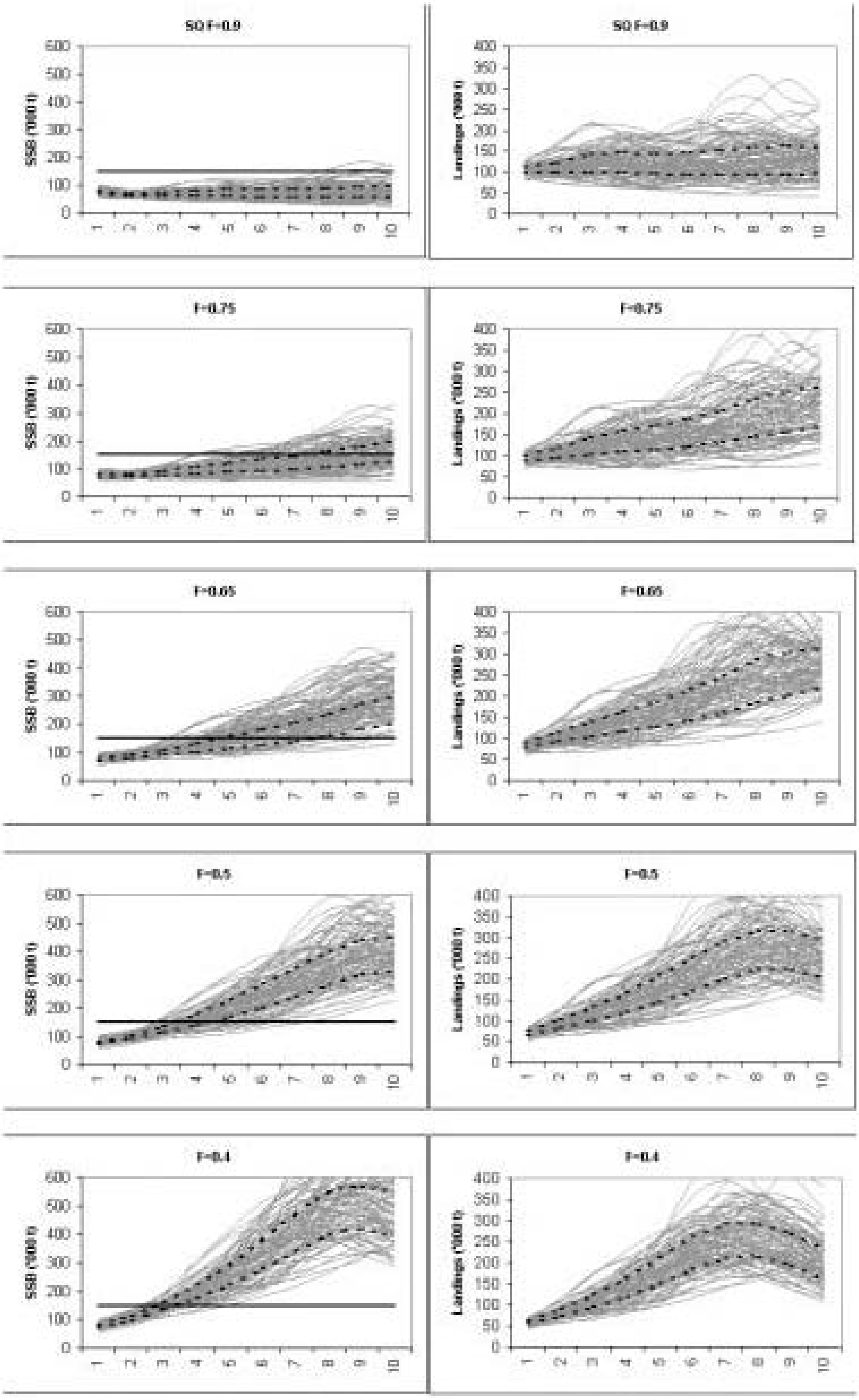


Figure 3.8.1 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). 10-year medium-term projections of SSB ('000 t) left panel, and landings ('000 t) right panel. The horizontal solid line in th SSB plots indicate Bpa. The grey lines each represent one of 100 separate simulations. Heavy dashed lines indicate the 25 and 75 percentiles from 500 simulations. Input parameters are given in Table 3.8.1 and 3.8.2.

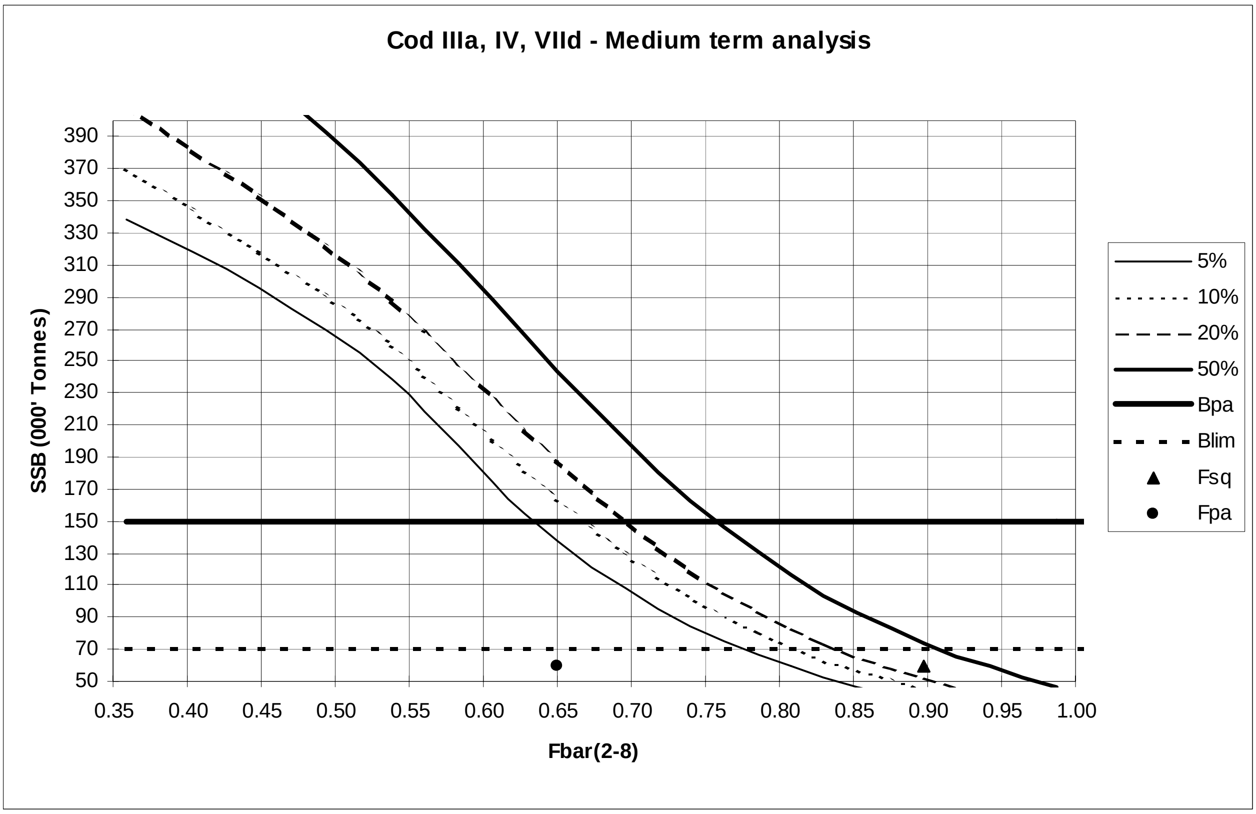


Figure 3.8.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). Medium-term projections of SSB in 2009 at different levels of F.

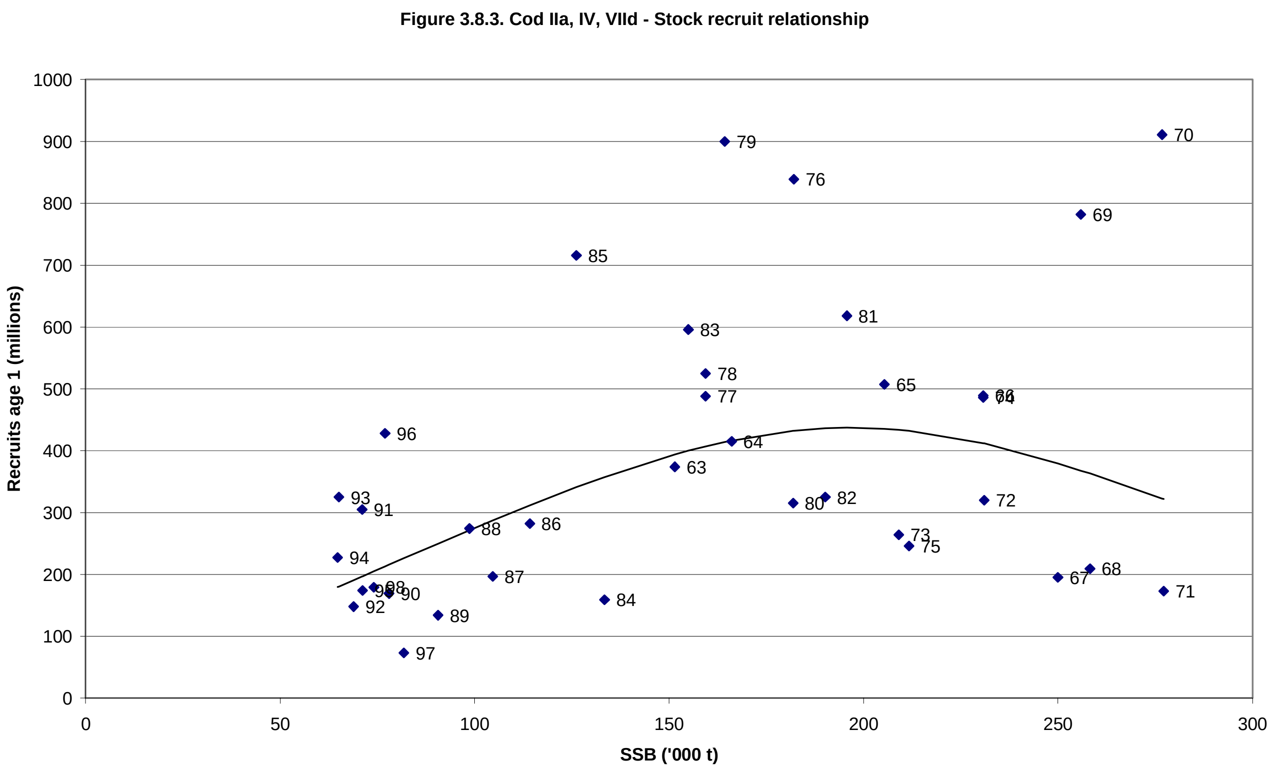


Figure 3.8.3 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak).

Figure 3.9.1 Cod in Sub-area IV, Division VIId and Division IIIa (Skagerrak)

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 1963–1999.

4.1.1 ACFM advice applicable to 1999 and 2000

On the basis of the 1999 assessment of this stock, ACFM concluded that the stock in 1999 was considered to be within safe biological limits, with SSB close to but above Bpa and F close to but below Fpa. As a result, ACFM recommended that fishing mortality in 2000 should be below the proposed Fpa (0.7) in order to increase or maintain SSB above the proposed Bpa. (140,000t)

4.1.2 Management applicable to 2000

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. Unilateral legislation making square mesh panels mandatory for UK vessels fishing for roundfish was introduced during summer 2000. The legislation also includes constraints on the positioning and construction of the panel, with the intention of making gears more selective for haddock and thus reducing discarding of the large 1999 year class. Ferro *et al* (2000) contains more details of this initiative. 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 in the North Sea and 27cm in Division IIIa. On an annual basis, management of the fishery is through TACs.

In Division IIIa the 2000 TAC is 4450 t and in the North Sea the 2000 TAC is 73,000t.

4.1.3 Catches in 1999

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 4.1.1 also gives the corresponding figures for haddock in the North Sea, and Table 4.1.2 gives the full time series of Working Group estimates for both areas.

In Division IIIa total landings during 1999 amounted to about 1.7 thousand tonnes, with industrial bycatch accounting for only 334 t of this total. This total is the lowest since 1970.

In the North Sea, human consumption landings in 1999 were around 64,000 t, which represents a drop in landings compared to the relatively stable landings of recent years (landings over 1992 to 1998 varied between 70 and 81 kt). The 1999 landing represents an undershoot of the TAC (88.5 kt), although the latter figure includes an allowance for industrial bycatch. The levels of discarding and industrial bycatch in 1999 were relatively low.

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 of 1999 WG report (ICES CM 2000/ACFM:7). 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 1999, age composition data for the human consumption and industrial catches were supplied by Denmark, who accounted for around 72% of the human consumption landings and all of the industrial bycatch in this area. Age composition data for the North Sea 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 Denmark and 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. No single year class dominated the catches in 1999, although the 1996 and 1994 year-classes were numerically the most abundant in the landings. The 1999 year class dominated the industrial bycatch, comprising 83% of the catch in numbers.

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 fleet data available for tuning are listed in Table 4.3.1 along with the age and year ranges for which data are available. The fleets consist of two Scottish commercial fleets and three 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 CM 1999/ACFM:1, 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 tuning file, which contains only the fleets used in the final tuning configuration, is given in Table 4.3.2.

4.4 Catch-at-age analysis

The five tuning fleets available for this stock include two Scottish commercial series, where the 1999 effort figures are known to be under-estimates (Section 1.3.1.4) leading to a likely bias in the 1999 CPUE figures. They also include data from the Scottish August groundfish survey, where the vessel and gear used were changed for the 1998 and subsequent surveys, leading to the possibility of catchability change in this series. These survey data were excluded from the 1999 assessment because of evidence of an increase in catchability. Hence there are *a priori* reasons to treat all three of the Scottish tuning series with caution for this stock. Initial exploratory XSA runs used all five of the available tuning series, in both single fleet and combined runs.

Log catchability residuals from the single fleet runs are given in Figure 4.4.1. Both Scottish commercial series show all positive residuals in 1999, and the Scottish groundfish survey shows all positive residuals in 1998 and mostly positive in 1999. The residuals for the remaining two survey fleets do not show any obvious problems for 1999, apart from a large positive residual-at-age 0. This is common to all fleets and is discussed below. Runs where the three Scottish series were included in the tuning resulted in lower mean F and higher SSB than otherwise (Figure 4.4.2) The year effects apparent in the residuals for the three Scottish fleets are consistent with the known problems in these data, and for this reason these series were excluded from subsequent analyses. A run was made including the Scottish survey data only up to 1997, but this had practically no effect on the XSA results, so for consistency and simplicity, these data were not included.

As noted above, the single fleet runs all showed a large positive residual-at-age 0 in 1999. This was associated with the large 1999 year class and highlighted the need to examine the catchability model used for this age. To investigate this, a run was made using all available data for the two survey series which have been retained in the tuning. The long time series were used to cover as wide a range of year-class strengths as possible. The run used the mean q model for all ages. The log catchability residuals by fleet and age were then plotted against population numbers to investigate the existence of any dependence of catchability on population size. These plots are given in Figure 4.4.3. It can be seen that the residuals-at-age 0 for the last ten years at least show an increasing trend with population number for both fleets. There is no such clear indication for the older ages, so a power-q model was used for age 0 only. Although it is clearly an appropriate choice for this assessment, the use of the power-q model-at-age 0 had little effect on the assessment results. Estimate of F and stock numbers in 1999 were very similar whether or not the power-q model was used, with the only real difference being in the estimate of the survivors of the 1999 year class-at-age 1, which was 63% higher if the mean-q model was used. The use of the power-q model did result in slightly lower standard errors on the survivor estimates.

The differences in configuration between this assessment and the previous assessment of this stock are in the choice of fleets used and in the choice of the catchability model at the youngest age. The XSA settings are summarised in the text table below.

	1999 Assessment	2000 Assessment
Catch-at-age method	XSA	XSA
Fleets :	Two commercial, two survey	Two surveys
Scottish Light Trawl	1989 – 1998, age 0 – 9	Excluded
Scottish Seiners	1989 – 1998, age 0 – 9	Excluded
English Groundfish Survey	1989 – 1998, age 0 - 5	1990 – 1999, age 0 - 5
IBTS Quarter 1	1989-1999, age 0 – 5	1990 – 1999, age 0 - 5
Taper	Uniform over 10 years	Uniform over 10 years
First age for constant q	0	1
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 4.4.4. These show indications of slight year effects in some years, e.g. in 1997 where the residuals for most ages in both fleets are positive, but there are no clear indications of any problems in the CPUE data. The contributions of the survey tuning fleets and shrinkage to the survivor estimates-at-age is given in Figure 4.4.5. The contribution of the shrinkage estimate increases above age 5, reflecting the absence of tuning data for the these ages. In addition, the survivor estimates from each fleet are rather homogeneous at most ages, and the shrinkage contributes relatively little to the estimates except-at-age 0. Retrospective trends in mean F, recruitment and SSB are given in Figure 4.4.6. These used a moving window so that all runs used the ten most recent years of data. 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. Little retrospective variation is apparent in the estimates of SSB.

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 1999 of 0.78. The current XSA run has revised the estimate of F in 1998 from 0.67 to 0.70.

4.5 Recruitment Estimation

4.5.1 The 1999 year class

The recruitment time series for haddock in the North Sea and Skagerrak. has tended to be characterised by occasional very strong year classes. However, over 1995 to 1998, the year classes which have recruited to the stock have all been of below average strength and although the 1994 year class was somewhat stronger, this has now been largely fished-out. Following this series of poor year classes, the 1999 cohort appears to be very strong and thus is likely to form a major part of the catch and the stock in the short to medium-term. For this reason, the estimation of the strength of this year class is likely to be very important for the short-term forecasts for this stock and hence it is considered in detail here.

Indices of the strength of the 1999 year class are available from the first quarter International Bottom Trawl Survey-at-age 1, and from the Scottish and English August groundfish surveys-at-ages 0 and 1. The full time series of these indices are given by year class in Table 4.5.1 and Figure 4.5.1 along with the XSA estimates-at-age 0 for the corresponding year classes. In all cases it can be seen that the indices for the 1999 year class are the highest in the series. The Scottish indices follow a change in the vessel and gear used for the survey, which may well have resulted in a change in the catchability of the survey, hence these indices are not considered any further here. For the IBTS indices there are indications of an increasing trend in the catchability of the survey, e.g. the IBTS index for the exceptional 1974 year class is smaller than those for more recent year classes of less pronounced strength such as the 1991 and the 1994, and see also Figure 4.5.2. Even taking this into account however, the index for the 1999 year class is still exceptionally large, being more than twice as high as the previous series maximum. The indices from the English groundfish survey are less extreme, with the index-at-age 1 implying that the year class may be roughly comparable in strength with the 1979 and 1983 year classes. Figure 4.5.2 does not give any indication of any catchability trends for this survey.

The XSA estimate for the 1999 year class uses the IBTS age 1 index and the English age 0 index, but not the English age 1 index. The overall XSA estimate of survivors is rather low due to the influence of F-shrinkage. The weighting the F-shrinkage mean receives in the estimate is relatively small, but because the associated survivors estimate is very much smaller than the fleet estimates, it results in a much lower overall estimate of survivors. The Fs-at-age 0 are not well defined as the catches at this age are mostly industrial bycatch with some discards. Furthermore, the XSA estimate indicates a year-class which is comparable in strength with the 1994 cohort, whereas the consistent reports of high catches and extensive discarding indicate that this year-class is likely to be considerably in excess of the 1994 year class in strength. Hence the XSA estimate is not considered to provide an adequate representation of the strength of the 1999 year class.

The estimate of the strength of this year-class using RCT3 is likely to be problematic due to the fact that all available indices are beyond the range of the RCT3 regressions. This is made worse by the tendency for RCT3 to over-estimate year-class strength (exploratory runs for haddock indicated an average of 20% over-estimation). To investigate this problem, a number of exploratory RCT3 runs were made. These were as follows :

- 'Raw' Rct3; using the 1999 indices without any adjustments.
- 'Reduced' RCT3; replacing the 1999 indices with the previous highest values in the relevant series.
- Untapered RCT3; using the 1999 indices, without any time tapering.
- English groundfish survey only, excluding the IBTS index.

The 'reduced' RCT3 run reflects the practice adopted for the prediction of this year class in the 1999 assessment, and is intended to constrain the estimate to within the range of the RCT3 regression. The untapered run was intended to allow information on as wide a range of year class strengths as possible to be included in the regression, and the run using only the English GFS indices was made to investigate the effect of excluding the IBTS index due to its possible catchability trend. The estimates for the 1999 year class from all of these runs are given in Table 4.5.2. The Raw RCT3 run gives an estimate-at-age 0 of around 113 billion, which is similar to the estimate from the Eng GFS run (107 billion). Running RCT3 without a taper leads to an estimate of 125 billion; the increase presumably resulting from the catchability trend in the IBTS series. The estimates from all of these approaches were broadly similar, and given the problems with using indices beyond the range of the regression and the estimation bias within RCT3, they are most likely to be over-estimates of the year class strength. The RCT3 run where the indices were replaced with the previous series maxima gave an estimate of 73 billion. This approach is inherently conservative and less subject to the problems outlined above. For this reason, this approach was adopted to estimate the strength of the 1999 year-class. The numbers of survivors-at-age 1 in 2000 was estimated by a RCT3 using this approach with the XSA estimates-at-age 1 as the input (Table 4.5.3). This run gave an estimate of 9.2 billion-at-age 1.

4.5.2 Other recent year classes.

A RCT3 run-at-age 0 (the 'raw' RCT3 run referred to above, Table 4.5.4) was also used to provide estimates of the 1998 and 2000 year classes-at-age 0. The RCT3 estimate of the 1998 year class (7.3 billion) is rather similar to the XSA estimate (8.7 billion) so the latter estimate was adopted. An index of the 2000 year class-at-age 0 is available from the English GFS. When used in RCT3, this resulted in an estimate of the year class of 25.3 billion. This is very similar to the long-term GM value of 25.8 billion, so the latter value was used as an estimate of the strength of this year class. Neither of these year classes is likely to have any significant influence on the short-term catch forecast.

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 1999 (0.78) is below this level. Recruitment shows considerable variation, with the current estimate of the 1999 year class indicating that it is the strongest since at least 1983, although the four preceding year classes were 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 63,500 t in 1991, since when an increase is indicated. A slight decrease since 1997 should be reversed by the maturation of the strong 1999 year class which will form a significant part of the spawning stock in 2001.

4.7 Short-term forecast

The recruitment of a very strong year class following a series of below-average cohorts means that the results of the short-term forecast are likely to be strongly dependent not only on the estimate of the strength of the year class but also on estimates of other factors influencing its survival and contribution to catches etc., e.g. fishing and natural mortality, weights-at-age etc. For the purposes of the current short-term forecast, 2001 is the most important year, hence most attention has been paid to the weights-at-age, proportion discarded etc. which will effect the 1999 year class-at-age 2.

4.7.1 Fishing mortality-at-age

Recent mean fishing mortality has fluctuated without trend, and there is relatively little difference between the point estimate of fishing mortality in 1999 (0.784) and the mean over 1997-1999 (0.745). Hence there are no clear grounds for choosing whether or not to scale the recent mean exploitation pattern to the 1999 mean F or not. Following the general practice for other stocks at this WG meeting, the scaled values were used.

4.7.2 Discarding

For partitioning the Fs of the human consumption fleet into landings and discards, recent practice has been to assume a three-year mean of proportion discarded-at-age. However, there are indications that large year classes of haddock within the North Sea are relatively slow growing, and mean length-at-age data from research vessel surveys support this observation for the 1999 year class. (Figure 4.7.1). One consequence of this is that they will take longer to reach the minimum landing size and hence a higher proportion of the catch is likely to be discarded. Figure 4.7.2 shows the relationship between mean length-at-age 1 as measured during the English GFS, and proportion discarded of the same cohort in the following year. Using this relationship implies that 82.5% of fish caught of the 1999 year class-at-age 2 will be discarded. This compares with the three year mean value of 73.5%.

4.7.3 Selectivity changes

As noted in Section 4.1.2, square mesh panels became mandatory for UK vessels in late summer of 2000. The available mesh selectivity data indicate that this technical measure could increase the L50 of current roundfish gears by around 2.8cm. Mesh assessment calculations by Reeves and Furness (in prep.) indicate that if implementation of this measure was completely effective, it could reduce F-at-age 2 by around 25%.

The mesh assessments of Reeves & Furness assumed a recent average age-length distribution for the population, whereas the actual length distribution of the 1999 year class is likely to be rather different to the average and it is not clear how sensitive the estimates would be to such effects. To investigate this, an adjustment was made to the length distribution-at-age 2 used in the mesh assessment model. The adjustment made was to shift the length distribution-at-age 2 downward by 2cm; this increment corresponding to the approximate difference between the length-at-age 1 of the 1999 year class in data from the English groundfish data, and the mean length-at-age 1 from those data. The resultant estimate implies that F-at-age 2 would be reduced by around 37%. These estimates assume full and effective implementation of the technical measure and as such represent an upper bound on the possible effect. In addition, the recent F-at-age 2 has been rather variable, varying from 0,41 in 1997 to 0.69 in 1999, with the scaled mean over 1997 to 1999 being 0.59, hence it can be seen that the inter-annual changes in F-at-age 2 are at least as great as the possible change due to the new technical measure.

4.7.4 Weights-at-age

There are indications of a recent downward trend in the stock weights-at-age for all ages from four upwards for this stock (Figure 4.7.3) and analysis of the last WG forecast for this stock indicated that taking a three year mean for weights-at-age had over-estimated the weight-at-age for all of these ages, hence for the current forecast, weights-at-age averaged over only the last two years were used.

As noted above, survey data indicate that fish of the 1999 year class are rather small for their age, and clearly this may also be reflected in the weight-at-age in the catch and stock. From past trends in the weights-at-age 2, there are indications that the stronger year classes may have smaller weights-at-age (Figure 4.7.4). To look at whether this should be taken into account in the forecast, the average weights-at-age 2 over the three most recent strong year classes (1983, 1986 and 1994), all of which had comparable survey lengths-at-age 1 to the 1999 year class, were compared with the recent mean (1998–1999) figures. The comparison indicated that the two-year means for each category were all relatively low-at-age 2 and the differences between these and the mean values across recent strong year classes were very similar. Only the weights in the discards really showed any difference, the strong year-class mean being 10% lower than the recent mean. As the differences are small, no corrections were applied to the weights-at-age 2.

4.7.5 Discussion

A sensitivity analysis for a catch forecast made assuming all defaults, i.e. no changes to discarding or selectivity-at-age 2 is given in Figure 4.7.5. From this it is clear that only factors affecting the survival and contribution of the 1999 year class will have any influence on the forecast catch in 2001. In particular the two most influential parameters refer to the natural mortality which will affect this year class during 2000. This sensitivity analysis takes no account of the additional uncertainty introduced by the possible effects of the change in technical measures introduced during 2000. Given this extreme sensitivity to assumptions made about this year class, any single catch forecast giving point estimates of short-term catch and SSB is likely to be subject to very high uncertainty. As this is the case, the approach used here has been to run parallel catch forecasts for a number of possible scenarios, and then to summarise the results. This permits the investigation of the implications of making various assumptions about what will happen in the stock and fishery during 2001. Three scenarios were run in this manner :

1. A run accepting all defaults, i.e. no accounting for selectivity or growth changes.
2. A run as 1, but assuming 82.5% discarding-at-age 2 in 2001 instead of the default of 73.5%.
3. A run as 1, but assuming that the new technical measures are completely and effectively implemented at the start of 2001.

No attempt was made to combine the changes in discarding and selectivity due to the problems in modelling the interaction between the two effects.

Of these scenarios, No. 1 is considered least plausible, but it provides a baseline by which the effects of the assumptions made in Nos. 2 and 3 can be judged. Scenario 2 is perhaps the most realistic of the three runs, as there are strong indications that due to the small size of fish of the 1999 year class the proportion discarded during 2001 will be higher than the recent average. Scenario 3 is more exploratory, given the uncertainty over the extent to which the technical measure will be effectively implemented, the precise effect that they might have on the catches, and whether any effect will actually be detectable given the high inter-annual variation in F-at-age 2. As management of the fishery during 2001 is likely to be primarily through an annual TAC, the results of these three parallel runs are expressed in-terms of specific choices of HC landings and the mean F, F multiplier, and SSB that this would imply in each scenario. These results are summarised in Table 4.7.1 and Figure 4.7.6.

It can be seen from Figure 4.7.6 that both scenario 2 and scenario 3 imply a similar F for a given HC. Under all scenarios, a high F-multiplier would be required to bring SSB in 2002 close to the proposed Bpa (140 kt*). All scenarios imply extremely high discards in 2001*, with the quantities being in excess of the forecast landings in all cases.

Given that the 1999 year class will result in a substantial increase in SSB in the short-term, there are no immediate concerns about this stock in relation to biomass reference points. With regard to fishing mortality, the F implied for a given level of landings is rather similar whether scenario 2 or scenario 3 is selected, although the forecast discards and SSB are rather different. Scenario 2 is considered to be the most likely representation of the operation of the fishery during 2001, and is presented as a conventional forecast in this report. However, there is similarity between scenarios 2 and 3, at least in-terms of the consequences for F of setting a given TAC.

4.7.6 Results

The inputs to a short-term catch forecast under scenario 2 are given in Table 4.7.2, with the management option table given in Table 4.7.3, and detailed output assuming Status quo F in 2000 and 2001 given in Table 4.7.4. The contributions of recent year classes to forecast landings and SSB are given in Table 4.7.5.

In all the outputs from the forecast, the importance of the 1999 year class is very clear. Table 4.7.5 shows that this year-class is forecast to contribute more than 50% of the HC landings during 2001, even though the forecast assumes that 82.5% of the catch in numbers of this year-class will be discarded. As a result of high discarding, the landings forecast for 2001 are not high; the *status* quo forecast indicates human consumption landings of around 65 kt, which is similar to the 1999 landing of 64.2 kt. The status quo forecast indicates an SSB of around 230 kt in 2002. This represents a substantial increase relative to the 2000 estimate of 111 kt.

4.7.7 Allocation to area

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.

Catch category	Year range	Percentage taken in Division IIIa Mean	Range
Human consumption landings	Full, 1963–1999	3.30%	0.1% - 8.4%
Human consumption landings	Recent, 1997–1999	3.61%	-
Industrial by-catch	Full, 1983–1999	24.45%	5.1% - 43.2%
Industrial by-catch	Recent, 1997–1999	7.16%	-

4.8 Medium-Term Projections

The current assessment has not resulted in any qualitative change in the perception of the state of this stock compared to the 1999 WG assessment; the strength of the 1999 year class was already apparent at that stage, and had a strong influence on short-and-medium-term projections. Because of this, and because existing medium-term forecast programs are unable to accommodate the complexities of changing exploitation pattern by year which assumptions made about discarding and/or selectivity changes require, no medium-term forecasts have been run for this stock during this assessment. It is likely that the medium-term probabilities of the stock falling below biomass reference points would be similar to those estimated during the previous WG assessment.

4.9 Biological Reference Points

A yield-per-recruit curve based on the inputs to the short-term forecast (Table 4.7.2) 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 time series of Mean F and SSB estimates is given relative to the precautionary reference points in Figure 4.9.3. In the majority of years, F has been above Fpa but SSB above Bpa. The text table below gives the values of various reference points for this stock.

F_{max}	$F_{0.1}$	F_{high}	F_{med}	F_{pa}	F_{lim}	B_{pa}	B_{lim}
1.55	0.15	1.55	0.48	0.7	1.0	140,000t	100,000t

4.10 Comments on the Assessment

Two commercial tuning fleets have been excluded from the current assessments, so the assessment is now tuned using only two survey fleets.

The current age structure of the haddock stock means that during 2001 the fishery will essentially be a classic recruitment fishery, entirely dependent upon the incoming year class. By nature this is an extremely difficult situation to forecast adequately. In the current situation variation in growth of this year class, and possibly also changes in gear selectivity add further complications. Previous assessments of this stock have tended to result in the over-estimation of strong year classes (see below), but the procedure used to estimate the strength of the 1999 year class has been deliberately conservative, with the intention of minimising the risk of over-estimation in this case.

As noted in last years WG Report, past assessments of this stock have tended to result in over-optimistic catch forecasts, possibly due to a tendency to over-estimate strong year classes. As there were in effect no strong year classes contributing to the forecast during last years assessment, the comment was made that that forecast might prove more realistic. Comparison between the catches in 1999 as *status quo* forecast during the 1999 assessment, and as currently estimated (Figure 4.10.1) indicate that this was indeed the case.

Table 4.1.1 Nominal catch (t) of HADDOCK from Division IIIa and the North Sea 1990–1999, as officially reported to ICES.

Division IIIa

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	13	4	14	9	4	18	-	-	-	-
Denmark	3885	2339	3812	1600	1458	1576	2523	2501	3168	1012
Germany	3	-	-	+	1	1	5	5	11	3
Netherlands	-	-	-	-	-	-	-	-	-	
Norway	100	110	184	153	142	135	115	187[1]	188[1]	168
Sweden	84	69	744	436	408	498	536	835	529	212
UK (Engl. & Wales)	-	-	-	+	-	-	-	-	-	
Total	4085	2522	4754	2198	2013	2228	3179	3528	3896	1395
WG estimate of H.cons. landings	4100	4086	4396	1959	1833	2191	3142	3401	3759	1360
WG estimate of industrial bycatch	1968	2593	4604	2415	2180	2162	2925	610	275	334
WG estimate of total catch	6068	6679	9000	4374	4013	4353	6067	4011	4034	1694
Unallocated landings	15	1564	-358	-239	-168	-37	-37	-127	-137	-35

Sub-area IV

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	192	168	415	292	306	407	215	436	724	462
Denmark	1993	1330	1476	3582	3208	2902	2520	2722	2608	2104
Faroe Islands	6	15	13	25	43	49	13	9	43	-
France	1115	631	508	960	587	441	369	548	427[1]	742[1]
Germany	749	535	764	348	1829	1284	1769	1462	1314	565
Netherlands	102	100	148	192	96	147	110	480	275	110
Norway	1572	2069	3273	2655	2355	2461	2295	2351	3010[1]	3846
Poland	-	-	-	-	-	-	18	8	7	17
Sweden	900	957	1289	908	551	722	689	655	472	708
UK (Engl. & Wales)	2019	2173	2926	4259	4043	3616	3379	3330	3280	2398
UK (Isle of Man)	-	-	11	-	-	-	-	-	-	-
UK (N. Ireland)	11	48	73	18	9	-	-	-	-	-
UK (Scotland)	34567	36474	39896	66799	73793	63411	63542	61098	60234	53486
Total	43226	44500	50792	80038	86820	75440	74919	73099	72394	-
WG estimate of H.cons. landings	51458	44645	70218	79580	80897	75313	76034	79095	77311	64209
WG estimate of discards	32603	40276	47967	79601	65392	57360	72522	52105	45175	42562
WG estimate of industrial bycatch	2591	5421	10816	10741	3561	7747	5048	6689	5101	3834
WG estimate of total catch	86652	90342	129001	169922	149850	140420	153604	137889	127587	110605
Unallocated landings	8232	145	19426	-458	-6014	-127	1114	5738	4960	-

Division IIIa and Sub-area IV

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WG estimate of Total Catch	92720	97021	138001	174296	153863	144773	159671	141900	131621	112299

Table 4.1.2 Catches ('000t) of HADDOCK from the North Sea and Division IIIa, 1963–1999. 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
1999	64.2	42.6	3.8	110.6	1.4	0.3	1.7	112.3
Min	44.6	25.7	2.4	86.7	0.4	0.1	0.4	92.7
Mean	136.9	92.1	33.3	262.3	3.7	1.4	5.1	267.3
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	1969
AGE							
0	1367	140235	652537	1671205	306037	11146	72670
1	1307178	7436	368393	1007322	838189	1098748	20493
2	335092	1296771	15184	25674	89083	439511	3578611
3	20963	135227	649840	6425	4863	19600	303489
4	13026	9069	29496	412551	3585	1947	7596
5	5781	5350	4662	9980	177857	2529	2411
6	302	2405	1972	1045	2443	45973	2515
7	653	287	452	601	215	325	19129
8	566	236	107	165	216	40	200
9	39	231	90	90	57	13	24
+gp	18	25	41	25	34	5	7
Total Num.	1685205	1597272	1722974	3135083	1422579	1619837	4007145
Tonnes	271531	380158	299464	346726	246589	302043	930538

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
0	925768	333396	244075	60545	614903	46388	174161	120798	305115	881823
1	266379	1813054	679205	366830	1220855	2116937	170529	258923	463554	351451
2	218480	71035	587590	570630	176342	641755	1062943	107675	146957	204046
3	1908736	47546	40604	240604	332967	58991	211544	394175	30377	41297
4	57435	400469	21213	6192	54314	109062	9952	40185	113703	7406
5	1178	10374	158000	4470	1875	15813	31311	4318	8708	28024
6	1197	462	3563	39459	1351	983	4996	6275	1264	2237
7	256	195	190	1257	10922	630	206	1300	2076	262
8	5954	147	34	108	242	2714	76	135	402	483
9	67	1592	27	29	23	266	759	29	116	152
+gp	30	168	419	163	41	82	63	204	94	78
Total Num.	3385480	2680408	1734920	1290287	2413835	2993611	1666540	934017	1072366	1517259
Tonnes	806674	446634	353606	307688	368797	454536	377118	226411	180144	148001

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
0	399372	646419	278705	639814	95502	139579	56503	13384	16335	12042
1	678499	134470	275686	157259	432193	178878	160398	314017	30044	47648
2	333261	423059	86126	252258	168273	534069	178824	250496	490706	35358
3	73043	143151	299895	73920	122984	78726	323650	47432	89940	182748
4	10476	15228	41435	127250	22079	37445	27685	67864	13431	18106
5	1901	2034	3407	16480	32658	5306	9691	4761	18579	2636
6	8067	458	713	1708	3789	7355	1237	2877	1602	4058
7	598	2498	279	297	596	965	1810	545	639	510
8	121	124	786	60	81	209	246	780	163	201
9	162	64	29	193	39	53	106	135	145	83
+gp	119	61	26	67	139	114	137	152	104	54
Total Num.	1505619	1367566	987087	1269306	878333	982899	760287	702443	661888	303444
Tonnes	223610	217151	237842	253594	222563	258117	225697	176880	175516	108772

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
0	57702	123910	270738	141209	85966	273689	347568	40082	23902	108254
1	86819	228553	209879	359995	99260	301733	53415	134642	83557	81423
2	103021	78258	253286	262765	296776	85925	357942	86231	167359	121249
3	18947	23197	32494	108421	100476	167801	56894	213293	49648	87242
4	57830	3888	6552	7107	29609	25875	55147	15272	108066	24739
5	3905	12526	1230	1698	1920	7645	7503	15406	5743	39860
6	896	976	4861	450	573	511	3052	1892	3562	2338
7	1380	401	454	1138	191	127	756	679	472	1595
8	206	620	299	145	509	45	52	62	140	342
9	80	144	294	103	115	62	31	15	14	41
+gp	70	65	154	210	89	36	42	26	17	10
Total Num.	330856	472538	780281	883241	615484	863449	882402	507600	442480	467093
Tonnes	92720	97021	138001	174296	153864	144773	159671	141900	131621	112299

Table 4.2.3; Haddock in the North Sea and Skagerrak

Catch weights at age

Table 2 Catch weights at age (kg)

	YEAR	1963	1964	1965	1966	1967	1968	1969			
	AGE										
0		0.012	0.011	0.01	0.01	0.011	0.01	0.011			
1		0.123	0.118	0.069	0.088	0.115	0.126	0.063			
2		0.253	0.239	0.225	0.247	0.281	0.253	0.216			
3		0.473	0.403	0.366	0.367	0.461	0.509	0.406			
4		0.695	0.664	0.648	0.533	0.594	0.731	0.799			
5		0.807	0.814	0.844	0.949	0.639	0.857	0.891			
6		1.004	0.908	1.193	1.266	1.057	0.837	1.031			
7		1.131	1.382	1.173	1.525	1.501	1.606	1.094			
8		1.173	1.148	1.482	1.938	1.922	2.26	2.04			
9		1.576	1.47	1.707	1.727	2.069	2.702	3.034			
	+gp	1.825	1.781	2.239	2.889	2.348	2.073	3.264			
0	SOPCOI	1.0011	0.9992	0.9997	1.0015	1.0011	0.9986	1			
	YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	AGE										
0		0.013	0.011	0.024	0.044	0.024	0.02	0.013	0.019	0.011	0.009
1		0.073	0.107	0.116	0.112	0.128	0.101	0.125	0.108	0.144	0.095
2		0.222	0.247	0.242	0.24	0.226	0.241	0.224	0.241	0.253	0.29
3		0.352	0.362	0.388	0.372	0.343	0.356	0.401	0.345	0.418	0.443
4		0.735	0.506	0.506	0.586	0.548	0.449	0.512	0.601	0.441	0.637
5		0.873	0.887	0.606	0.649	0.891	0.68	0.588	0.613	0.719	0.664
6		1.191	1.267	1	0.725	0.895	1.245	0.922	0.802	0.742	0.933
7		1.362	1.534	1.366	1.044	0.952	1.124	1.933	1.181	0.955	1.187
8		1.437	1.337	2.241	1.302	1.513	1.093	1.784	1.943	1.398	1.187
9		2.571	1.275	2.006	2.796	2.315	1.72	1.306	2.322	2.124	1.468
	+gp	3.899	2.058	1.684	1.828	2.639	2.42	2.43	1.812	2.158	2.374
0	SOPCOI	1.0012	0.9971	0.9996	1.0017	1.0004	0.9975	1.0022	1.0006	0.999	1.0035
	YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	AGE										
0		0.012	0.009	0.011	0.022	0.01	0.013	0.025	0.008	0.024	0.027
1		0.104	0.074	0.1	0.135	0.141	0.149	0.124	0.126	0.165	0.197
2		0.283	0.262	0.292	0.297	0.3	0.279	0.242	0.265	0.217	0.3
3		0.486	0.476	0.46	0.448	0.489	0.48	0.397	0.406	0.417	0.372
4		0.732	0.745	0.784	0.651	0.67	0.668	0.613	0.615	0.589	0.605
5		1.046	1.147	1.166	0.915	0.805	0.857	0.863	1.029	0.748	0.811
6		0.936	1.479	1.441	1.214	1.097	1.049	1.257	1.276	1.284	0.982
7		1.394	1.18	1.672	1.162	1.1	1.459	1.195	1.433	1.424	1.364
8		1.599	1.634	1.456	1.92	1.868	1.833	1.715	1.529	1.551	1.655
9		1.593	1.764	2.634	1.376	2.425	2.124	1.525	1.877	1.627	1.684
	+gp	2.143	1.709	2.156	1.725	2.046	2.043	2.612	2.22	2.346	2.229
0	SOPCOI	0.9986	1.022	1.0209	1.0386	1.0165	1.0133	1.0118	0.9927	1.0038	1.0197
	YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	AGE										
0		0.044	0.029	0.018	0.01	0.017	0.013	0.019	0.021	0.023	0.023
1		0.194	0.177	0.107	0.115	0.116	0.102	0.127	0.133	0.153	0.168
2		0.292	0.32	0.306	0.28	0.25	0.297	0.246	0.277	0.252	0.243
3		0.43	0.472	0.486	0.447	0.419	0.363	0.388	0.359	0.392	0.361
4		0.473	0.639	0.748	0.68	0.597	0.592	0.483	0.579	0.44	0.473
5		0.771	0.65	1.016	0.894	0.943	0.763	0.78	0.615	0.651	0.498
6		0.967	1.042	0.896	1.173	1.208	1.099	0.87	0.909	0.76	0.68
7		1.167	1.232	1.395	1.102	1.57	1.423	0.846	0.966	1.103	0.782
8		1.529	1.481	1.537	1.592	1.469	1.685	1.833	1.647	1.153	0.749
9		2.037	1.776	1.912	1.737	1.62	1.873	2.025	2.247	1.825	1.247
	+gp	2.606	2.064	2.021	1.873	2.444	1.986	1.97	2.388	2.352	1.78
0	SOPCOI	1.0176	1.0378	1.0367	1.0029	1.0196	1.0129	1.0008	1.0129	1.0147	1.0041

Table 4.3.1; Haddock in the North Sea and Skagerrak,
Summary of fleet data available for use in catch-at-age analysis.

Fleet	Abbreviation	Year Range		Age range	
Scottish Seiners	SCOSEI	1970	1999	0	10
Scottish Light Trawlers	SCOLTR	1970	1999	0	10
Scottish Groundfish survey (August)	SCOGFS	1982	1999	0	5
English Groundfish survey (August)	ENGGFS	1977	1999	0	5
International Bottom trawl Survey, Quarter 1	IBTSQ1	1973	1999	0	5[1]

[1] Data used as if survey takes place at end of previous year

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: XSASAR05)
102
FLT01: ENGGFS (Catch: Unknown) (Effort: Unknown)
1977 1999
1 1 0.50 0.75
0 5

100	53.480	6.680	3.210	6.160	0.920	0.070
100	35.830	13.690	2.620	0.240	2.220	0.210
100	87.550	29.550	5.460	0.870	0.110	0.440
100	37.400	62.330	16.730	2.570	0.270	0.040
100	153.750	17.320	43.910	7.560	0.740	0.060
100	28.130	31.550	7.980	11.800	1.030	0.240
100	83.190	21.820	10.950	2.140	2.170	0.270
100	22.850	59.930	6.160	3.080	0.420	0.480
100	24.590	18.660	23.820	2.110	0.700	0.200
100	26.600	14.970	4.470	3.380	0.280	0.180
100	2.240	28.190	4.310	0.530	0.690	0.050
100	6.070	2.860	18.350	1.550	0.160	0.280
100	9.430	8.170	1.450	3.970	0.250	0.030
100	28.190	6.650	1.980	0.290	0.880	0.050
100	26.330	11.500	0.960	0.230	0.050	0.220
100	82.770	19.690	9.770	0.580	0.050	0.010
100	13.580	24.610	5.860	1.660	0.060	0.020
100	94.300	8.070	9.020	0.840	0.280	0.020
100	17.990	38.310	4.450	3.400	0.280	0.090
100	19.920	8.310	14.570	1.220	0.830	0.070
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
100	210.984	5.572	2.830	1.233	0.423	0.405

FLT02: IBTS_Q1 (Catch: Unknown) (Effort: Unknown)
1973 1999
1 1 0.99 1.00
0 5

1	1.0920	0.1100	-1.0000	-1.0000	-1.0000	-1.0000
1	1.1680	0.3850	-1.0000	-1.0000	-1.0000	-1.0000
1	0.1770	0.6700	-1.0000	-1.0000	-1.0000	-1.0000
1	0.1620	0.0840	-1.0000	-1.0000	-1.0000	-1.0000
1	0.3850	0.1080	-1.0000	-1.0000	-1.0000	-1.0000
1	0.4800	0.2400	-1.0000	-1.0000	-1.0000	-1.0000
1	0.8960	0.4020	-1.0000	-1.0000	-1.0000	-1.0000
1	0.2680	0.6750	-1.0000	-1.0000	-1.0000	-1.0000
1	0.5260	0.2520	-1.0000	-1.0000	-1.0000	-1.0000
1	0.3070	0.4000	0.0890	0.1140	0.0130	0.0020
1	1.0570	0.2190	0.1340	0.0220	0.0220	0.0050
1	0.2290	0.8280	0.1050	0.0340	0.0040	0.0070
1	0.5790	0.2440	0.2940	0.0180	0.0060	0.0020
1	0.8850	0.3260	0.0480	0.0610	0.0050	0.0030
1	0.0920	0.6880	0.0980	0.0130	0.0140	0.0020
1	0.2100	0.0970	0.2810	0.0170	0.0020	0.0050
1	0.2200	0.1100	0.0310	0.0510	0.0030	0.0020
1	0.6790	0.1310	0.0240	0.0040	0.0090	0.0020
1	1.1150	0.3710	0.0190	0.0030	0.0010	0.0020
1	1.2420	0.5430	0.1550	0.0090	0.0010	0.0010
1	0.2290	0.5040	0.0980	0.0230	0.0020	0.0010
1	1.3750	0.2050	0.1810	0.0250	0.0050	0.0010
1	0.2670	0.8130	0.0660	0.0470	0.0077	0.0031
1	0.8600	0.3660	0.4710	0.0250	0.0151	0.0034
1	0.3740	0.4230	0.1060	0.1140	0.0087	0.0054
1	0.2120	0.2330	0.1300	0.0480	0.0366	0.0043
1	3.7020	0.1080	0.0500	0.0250	0.0156	0.0103

Table 4.4.1 Haddock in the North Sea and Skagerrak. Tuning Diagnostics

Lowestoft VPA Version 3.1

7/10/2000 14:36

Extended Survivors Analysis

Haddock in IV IIIa (run: XSASAR03/X05)

CPUE data from file fleet

Catch data for 37 years. 1963 to 1999. Ages 0 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT01: ENGGFS	1977	1999	0	5	0.5	0.75
FLT02: IBTS_Q1	1973	1999	0	5	0.99	1

Time series weights :

Tapered time weighting applied
Power = 0 over 10 years

Catchability analysis :

Catchability dependent on stock size for ages < 1

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 1

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 19 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.006	0.013	0.019	0.031	0.004	0.055	0.045	0.008	0.008	0.006
1	0.195	0.156	0.148	0.174	0.152	0.104	0.073	0.121	0.116	0.182
2	1.121	0.781	0.74	0.81	0.575	0.506	0.451	0.418	0.591	0.686
3	1.162	1.034	1.139	1.047	1.08	0.935	0.925	0.634	0.534	0.87
4	1.152	0.864	1.069	0.907	1.047	1.03	1.06	0.744	0.858	0.601
5	0.935	0.884	0.805	0.97	0.693	0.91	1.061	1.078	0.734	0.988
6	0.534	0.64	1.118	0.785	1.125	0.393	1.288	0.873	0.792	0.773
7	0.657	0.487	0.712	0.889	0.962	0.828	2.035	1.248	0.553	1.081
8	0.472	0.712	0.847	0.519	1.525	0.627	1.035	1.097	0.983	1.058
9	0.757	0.724	0.92	0.822	1.075	0.765	1.32	1.02	0.798	0.911

Table 4.4.1 (Cont'd)

XSA population numbers (Thousands)

	AGE									
YEAR	0	1	2	3	4	5	6	7	8	9
1990	2.81E+07	1.12E+06	1.87E+05	3.12E+04	9.58E+04	7.10E+03	2.39E+03	3.17E+03	6.05E+02	1.66E+02
1991	2.74E+07	3.60E+06	1.76E+05	4.08E+04	7.61E+03	2.36E+04	2.28E+03	1.15E+03	1.34E+03	3.09E+02
1992	4.07E+07	3.49E+06	5.92E+05	5.42E+04	1.13E+04	2.50E+03	7.98E+03	9.85E+02	5.78E+02	5.40E+02
1993	1.28E+07	5.14E+06	5.78E+05	1.89E+05	1.35E+04	3.02E+03	9.15E+02	2.14E+03	3.96E+02	2.03E+02
1994	5.43E+07	1.60E+06	8.29E+05	1.72E+05	5.17E+04	4.25E+03	9.38E+02	3.42E+02	7.19E+02	1.93E+02
1995	1.42E+07	6.96E+06	2.64E+05	3.13E+05	4.56E+04	1.41E+04	1.74E+03	2.49E+02	1.07E+02	1.28E+02
1996	2.19E+07	1.73E+06	1.20E+06	1.07E+05	9.56E+04	1.27E+04	4.66E+03	9.61E+02	8.91E+01	4.67E+01
1997	1.37E+07	2.69E+06	3.08E+05	5.15E+05	3.30E+04	2.58E+04	3.59E+03	1.05E+03	1.03E+02	2.59E+01
1998	8.74E+06	1.74E+06	4.58E+05	1.36E+05	2.13E+05	1.22E+04	7.20E+03	1.23E+03	2.47E+02	2.81E+01
1999	5.04E+07	1.12E+06	2.98E+05	1.70E+05	6.20E+04	7.02E+04	4.80E+03	2.67E+03	5.79E+02	7.58E+01

Estimated population abundance at 1st Jan 2000

	0.00E+00	6.45E+06	1.79E+05	1.01E+05	5.55E+04	2.65E+04	2.14E+04	1.81E+03	7.41E+02	1.64E+02

Taper weighted geometric mean of the VPA populations:

	2.30E+07	2.43E+06	4.07E+05	1.25E+05	4.02E+04	1.08E+04	2.87E+03	1.08E+03	3.37E+02	1.14E+02

Standard error of the weighted Log(VPA populations) :

	0.6267	0.6303	0.635	0.8896	1.0622	1.0434	0.77	0.8137	0.9449	1.0162

1

Log catchability residuals.

Fleet : FLT01: ENGGFS (Catch

Age	1973	1974	1975	1976	1977	1978	1979
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	-0.22	-0.24	0.06	0.13	-0.16	0.21	-0.17	0.04	-0.06	0.4
1	0.21	-0.44	0.13	-0.02	0.01	0.07	-0.08	0.09	0	0.02
2	0.21	-0.66	0.42	-0.02	-0.1	0.29	-0.07	0.06	0.04	-0.17
3	0.19	-0.38	0.32	0.07	-0.5	0.21	0.26	0.19	-0.13	-0.23
4	0.5	-0.01	-0.28	-0.37	-0.09	0.03	0.39	-0.04	0	-0.13
5	0.13	0.38	-0.51	0.09	-0.42	0.02	-0.03	0.39	-0.03	-0.03

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	-15.701	-15.3275	-15.51	-15.836	-15.8964
S.E(Log q)	0.174	0.298	0.2912	0.269	0.2923

Table 4.4.1 (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
0	0.6	3.383	16.92	0.9	10	0.22	-16.91

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	1.07	-0.644	15.77	0.92	10	0.19	-15.7
2	0.92	0.512	15.14	0.85	10	0.29	-15.33
3	0.99	0.121	15.46	0.91	10	0.3	-15.51
4	0.87	2.001	15.17	0.97	10	0.2	-15.84
5	0.86	1.922	15	0.96	10	0.22	-15.9
1							

Fleet : FLT02: IBTS_Q1 (Catc

Age	1973	1974	1975	1976	1977	1978	1979
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	-0.21	0.18	-0.13	-0.2	-0.35	-0.17	0.24	0.08	0.11	0.45
1	-0.03	-0.2	0.2	-0.24	0.01	-0.13	0.44	0.18	0.02	-0.24
2	-0.07	-0.58	0.27	-0.1	-0.08	-0.01	0.38	0.22	0.2	-0.23
3	0	-0.68	0.24	-0.17	0.04	-0.07	0.37	0.02	0.39	-0.13
4	-0.23	-0.18	-0.37	-0.02	-0.31	0.23	0.2	0.4	0.08	0.21
5	0.22	-1.03	0.46	0.41	-0.2	-0.06	0.29	0.06	0.24	-0.38

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	-14.0876	-14.2887	-14.4667	-14.5546	-14.1716
S.E(Log q)	0.2203	0.282	0.3104	0.2624	0.4497

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0	0.73	1.914	15.73	0.86	10	0.27	-15.28

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	1.07	-0.567	14.04	0.88	10	0.25	-14.09
2	0.78	2.231	13.99	0.93	10	0.18	-14.29
3	0.95	0.473	14.32	0.9	10	0.31	-14.47
4	0.92	1.043	14.24	0.96	10	0.24	-14.55
5	1.34	-2.053	15.83	0.82	10	0.52	-14.17

Table 4.4.1 (Cont'd)

Terminal year survivor and F summaries :

Age 0 Catchability dependent on age and year class strength

Year class = 1999

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	9665912	0.3	0	0	1	0.407	0
FLT02: IBTS_Q1	10069690	0.322	0	0	1	0.353	0
P shrinkage mea	2433710	0.63				0.093	0.016
F shrinkage mea	1334860	0.5				0.147	0.029

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
6447398	0.19	0.51	4	2.646	0.006

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

Year class = 1998

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	175699	0.212	0.041	0.2	2	0.451	0.185
FLT02: IBTS_Q1	167419	0.212	0.176	0.83	2	0.451	0.193
F shrinkage mea	262221	0.5				0.098	0.128

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
178780	0.14	0.09	5	0.63	0.182

1

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

Year class = 1997

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	96377	0.176	0.064	0.36	3	0.436	0.708
FLT02: IBTS_Q1	95490	0.173	0.097	0.56	3	0.449	0.713
F shrinkage mea	146470	0.5				0.116	0.517

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
100735	0.12	0.07	7	0.597	0.686

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

Year class = 1996

Fleet	I	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	50317	0.161	0.08	0.5	4	0.43	0.928
FLT02: IBTS_Q1	60038	0.161	0.1	0.62	4	0.418	0.825
F shrinkage mea	59239	0.5				0.152	0.833

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
55529	0.12	0.06	9	0.484	0.87

Table 4.4.1 (Cont'd)

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

Year class = 1995

Fleet	1	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	23073	0.15	0.06	0.4	5	0.447	0.626
FLT02: IBTS_Q1	33204	0.151	0.089	0.39	5	0.441	0.505
F shrinkage mea	13521	0.5				0.112	0.961

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
26478	0.11	0.1	11	0.922	0.601

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

Year class = 1994

Fleet	1	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	21308	0.168	0.037	0.22	6	0.454	0.991
FLT02: IBTS_Q1	19631	0.174	0.113	0.65	6	0.325	1.043
F shrinkage mea	24511	0.5				0.221	0.905

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
21400	0.15	0.05	13	0.353	0.988

1

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

Year class = 1993

Fleet	1	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	1859	0.175	0.049	0.28	6	0.392	0.76
FLT02: IBTS_Q1	2308	0.185	0.082	0.44	6	0.276	0.65
F shrinkage mea	1440	0.5				0.333	0.904

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
1813	0.19	0.07	13	0.381	0.773

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

Year class = 1992

Fleet	1	Int	Ext	Var	N	Scaled	Estimated
	:	s.e	s.e	Ratio		Weights	F
FLT01: ENGGFS	1029	0.193	0.063	0.33	6	0.17	0.877
FLT02: IBTS_Q1	781	0.209	0.057	0.27	6	0.112	1.046
F shrinkage mea	680	0.5				0.718	1.139

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
741	0.36	0.08	13	0.222	1.081

Table 4.4.1 (Cont'd

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7								
Year class = 1991								
Fleet	I	Int	Ext	Var	N	Scaled	Estimated	
	S	s.e	s.e	Ratio		Weights	F	
FLT01: ENGGFS	156	0.2	0.061	0.3	6	0.105	1.094	
FLT02: IBTS_Q1	204	0.22	0.047	0.21	6	0.067	0.922	
F shrinkage mea	163	0.5				0.828	1.065	
Weighted prediction :								
Survivors	Int	Ext	N	Var	F			
at end of year	s.e	s.e		Ratio				
164	0.41	0.03	13	0.066	1.058			
Age 9 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: ENGGFS	25	0.199	0.056	0.28	6	0.02	0.918	
FLT02: IBTS_Q1	21	0.218	0.067	0.31	6	0.013	1.004	
F shrinkage mea	25	0.5				0.967	0.91	
Weighted prediction :								
Survivors	Int	Ext	N	Var	F			
at end of year	s.e	s.e		Ratio				
25	0.48	0.02	13	0.043	0.911			

Table 4.4.2; Haddock in the North Sea and Skagerrak
Estimates of fishing mortality at age

Run title : IIIa (run: XSASAR05/X05)

At 7/10/2000 14:38

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1963	1964	1965	1966	1967	1968	1969
AGE							
0	0.0016	0.0435	0.0716	0.0699	0.0022	0.0018	0.0167
1	0.1241	0.0581	1.3627	1.3029	0.2626	0.0516	0.0215
2	0.8053	0.4545	0.4164	0.8308	1.0805	0.5778	0.6553
3	0.6704	1.1746	0.5093	0.3602	0.4148	0.8979	1.3759
4	0.7614	0.756	0.9848	0.7794	0.372	0.3069	1.2867
5	0.8802	0.8843	1.2993	1.2403	1.0137	0.5076	0.8141
6	0.5085	1.2628	1.0212	1.3097	1.326	0.8082	1.6261
7	0.8268	0.6215	0.8722	1.0825	1.1388	0.5968	1
8	0.7773	0.8385	0.4982	0.9695	1.9446	0.6586	0.9509
9	0.7582	0.8819	0.9455	1.089	1.1731	0.5805	1.1493
+gp	0.7582	0.8819	0.9455	1.089	1.1731	0.5805	1.1493
FBAR 2- 6	0.7251	0.9064	0.8462	0.9041	0.8414	0.6197	1.1516

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
0	0.0298	0.0119	0.0321	0.0023	0.0129	0.0113	0.0299	0.0132	0.0217	0.0347
1	0.5004	0.4743	0.1692	0.3736	0.3532	0.3351	0.3077	0.3381	0.3905	0.1755
2	1.0385	0.659	0.7932	0.5649	0.9534	0.9691	0.8145	1.0051	1.0116	0.8822
3	1.1499	0.7977	1.3394	1.1582	0.9499	1.2536	1.371	1.0375	1.1281	1.1414
4	1.2693	0.8706	1.2012	0.8019	1.0028	1.0991	0.7813	1.2621	1.1235	1.0619
5	0.7114	0.8645	1.1583	0.95	0.628	0.9922	1.2713	1.0313	1.1628	1.0234
6	1.4369	0.6864	0.8587	1.0978	0.8804	0.8201	1.0639	0.9839	1.0363	1.1708
7	0.7088	1.0169	0.6843	0.8819	1.1249	1.5674	0.3934	0.9242	1.1463	0.6171
8	1.0592	1.2854	0.4712	1.1459	0.4048	0.9978	0.8395	0.4875	0.8534	0.9416
9	1.0491	0.9552	0.8841	0.9865	0.8165	1.1083	0.8792	0.9492	1.0769	0.9737
+gp	1.0491	0.9552	0.8841	0.9865	0.8165	1.1083	0.8792	0.9492	1.0769	0.9737
FBAR 2- 6	1.1212	0.7756	1.0702	0.9146	0.8789	1.0268	1.0604	1.0630	1.0925	1.0559

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
0	0.0738	0.0571	0.0384	0.027	0.0155	0.0163	0.0032	0.0089	0.0055	0.0039
1	0.1894	0.179	0.1735	0.1514	0.125	0.2063	0.128	0.1187	0.1368	0.106
2	0.7074	0.4501	0.4308	0.66	0.6681	0.6138	1.0173	0.9023	0.7962	0.6557
3	1.2096	0.9456	0.8157	1.0208	0.9965	0.9558	1.2397	1.0448	1.3024	0.987
4	1.1849	0.9932	0.8798	1.1614	1.1422	1.1027	1.2832	1.0813	1.1087	1.1785
5	0.9369	0.803	0.6468	1.2123	1.2216	1.0276	1.056	0.8249	1.1027	0.6912
6	0.9855	0.6102	0.7499	0.814	1.0878	1.0735	0.7152	1.139	0.7481	0.7697
7	1.3946	1.0081	0.9823	0.9399	0.7673	0.9471	0.8646	0.9259	0.8592	0.567
8	0.6568	1.1157	1.1053	0.5778	0.5768	0.6815	0.6761	1.2846	0.633	0.7383
9	1.0236	0.9159	0.8822	0.9311	0.9699	0.9773	0.9291	1.043	0.8997	0.7969
+gp	1.0236	0.9159	0.8822	0.9311	0.9699	0.9773	0.9291	1.043	0.8997	0.7969
FBAR 2- 6	1.0049	0.7604	0.7046	0.9737	1.0232	0.9547	1.0623	0.9984	1.0116	0.8564

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99
AGE											
0	0.0057	0.0127	0.0187	0.0311	0.0044	0.0553	0.0453	0.0082	0.0077	0.006	0.0073
1	0.1953	0.1564	0.1476	0.1741	0.1524	0.1041	0.0732	0.1211	0.1158	0.182	0.1396
2	1.1208	0.7807	0.7399	0.81	0.5746	0.506	0.4507	0.4184	0.5907	0.6859	0.565
3	1.1619	1.0335	1.1389	1.0475	1.0799	0.9355	0.9252	0.6342	0.5343	0.8698	0.6794
4	1.1516	0.8643	1.0693	0.9072	1.0466	1.03	1.0596	0.7439	0.8581	0.6013	0.7344
5	0.9354	0.8838	0.803	0.9702	0.6927	0.9103	1.0613	1.0775	0.7338	0.9878	0.9331
6	0.5337	0.6399	1.1182	0.7849	1.125	0.3927	1.2876	0.8727	0.7921	0.7733	0.8127
7	0.6567	0.4869	0.7117	0.8887	0.9623	0.8282	2.0345	1.2484	0.5526	1.081	0.9607
8	0.4723	0.7123	0.8469	0.5187	1.5246	0.6265	1.035	1.0965	0.9828	1.0583	1.0459
9	0.7573	0.7243	0.9201	0.8223	1.0747	0.7648	1.3203	1.0203	0.7983	0.9115	0.91
+gp	0.7573	0.7243	0.9201	0.8223	1.0747	0.7648	1.3203	1.0203	0.7983	0.9115	
FBAR 2- 6	0.9807	0.8404	0.9743	0.9039	0.9038	0.7549	0.9569	0.7493	0.7018	0.7836	

Table 4.4.3; Haddock in the North Sea and Skagerrak

Estimates of stock numbers at age

Run title : IIIa (run: XSASAR05/X05)

At 7/10/2000 14:38

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1963	1964	1965	1966	1967	1968	1969
AGE							
0	23383	91721	263363	689923	3881120	171025	121955
1	255640	3005	11304	31563	82821	498538	21977
2	7401	43367	545	556	1647	12233	90929
3	486	2217	18453	241	162	375	4601
4	277	194	534	8636	131	83	119
5	109	101	71	155	3085	70	48
6	14	37	34	16	37	917	35
7	13	7	9	10	3	8	334
8	12	5	3	3	3	1	4
9	1	4	2	1	1	0	0
+gp	0	0	1	0	1	0	0
TOTAL	287335	140658	294317	731104	3969011	683249	240002

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
0	877639	782848	215392	728983	1334930	115423	164835	257514	395489	721529
1	15439	109661	99584	26853	93628	169646	14693	20595	32718	49818
2	4131	1798	13106	16149	3549	12631	23303	2074	2821	4252
3	31652	980	623	3975	6153	936	3213	6918	509	688
4	905	7806	344	127	972	1853	208	635	1909	128
5	26	198	2545	81	44	278	481	74	140	483
6	17	10	68	654	26	19	84	110	22	36
7	6	3	4	24	179	9	7	24	34	6
8	101	2	1	2	8	48	1	4	8	9
9	1	29	1	1	0	4	14	1	2	3
+gp	1	3	8	3	1	1	1	4	2	1
TOTAL	929917	903339	331677	776850	1439491	300848	206840	287953	433652	776954

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
0	156526	324807	206227	669835	172743	240531	498851	42020	84421	87067
1	89722	18717	39495	25549	83936	21895	30464	64017	5361	10809
2	8027	14258	3005	6377	4217	14226	3421	5148	10918	898
3	1180	2652	6093	1309	2209	1449	5162	829	1400	3301
4	171	274	802	2099	367	635	434	1164	227	296
5	35	41	79	259	512	91	164	94	307	58
6	142	11	15	34	63	123	27	47	34	84
7	9	43	5	6	12	17	35	11	12	13
8	3	2	13	2	2	5	6	12	4	4
9	3	1	1	4	1	1	2	2	3	2
+gp	2	1	0	1	2	2	2	3	2	1
TOTAL	255820	360808	255736	705474	264065	278977	538567	113345	102689	102533

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GM 63-97	AM 63-9
AGE													
0	281443	274498	406802	128432	543254	141704	218906	136611	87410	503842	0	258290	441479
1	11165	36025	34893	51398	16027	69627	17260	26934	17443	11167	64474	35053	62594
2	1867	1764	5917	5781	8293	2643	12050	3081	4583	2984	1788	5241	10068
3	312	408	542	1892	1724	3129	1068	5147	1359	1702	1007	1633	3485
4	958	76	113	135	517	456	956	330	2126	620	555	439	996
5	71	236	25	30	42	141	127	258	122	702	265	126	302
6	24	23	80	9	9	17	47	36	72	48	214	38	85
7	32	11	10	21	3	2	10	11	12	27	18	12	27
8	6	13	6	4	7	1	1	1	2	6	7	4	9
9	2	3	5	2	2	1	0	0	0	1	2	1	3
+gp	1	1	3	4	1	1	1	0	0	0	0		
TOTAL	295882	313059	448395	187710	569882	217724	250426	172409	113130	521098	68331		

Table 4.5.1; Haddock in the North Sea and Skagerrak; RCT3 input values, age 0

HADDOCK IN IV, RCT3 INPUT VALUES Age 0 06-Oct-00 XSASAR05

8 30 2

YEARCLASS' 'VPA' 'IYFS1' 'IYFS2' 'EGFS0' 'EGFS1' 'EGFS2' 'SGFS0' 'SGFS1' 'SGFS2'

1971	782848	740	971	-1	-1	-1	-1	-1	-1
1972	215392	187	110	-1	-1	-1	-1	-1	-1
1973	728983	1092	385	-1	-1	-1	-1	-1	-1
1974	1334930	1168	670	-1	-1	-1	-1	-1	-1
1975	115423	177	84	-1	-1	32.1	-1	-1	-1
1976	164835	162	108	-1	66.8	26.2	-1	-1	-1
1977	257514	385	240	534.8	136.9	54.6	-1	-1	-1
1978	395489	480	402	358.3	295.5	167.3	-1	-1	-1
1979	721529	896	675	875.5	623.3	439.1	-1	-1	-1
1980	156526	268	252	374	173.2	79.8	-1	-1	99.6
1981	324807	526	400	1537.5	315.5	109.5	-1	248.8	161.1
1982	206227	307	219	281.3	218.2	61.6	123.5	181.3	78.8
1983	669835	1057	828	831.9	599.3	238.2	220.3	436.7	298.1
1984	172743	229	244	228.5	186.6	44.7	87.3	197.6	57.4
1985	240531	579	326	245.9	149.7	43.1	81.8	232.9	70.4
1986	498851	885	688	266	281.9	183.5	174.7	239.3	198.2
1987	42020	92	97	22.4	28.6	14.5	27.7	46.7	21.4
1988	84421	210	114	60.7	81.7	19.8	40.6	88.6	24
1989	87067	219	131	94.3	66.4	9.6	43.2	100.2	17.8
1990	281443	679	371	281.9	115	97.7	316.3	170.5	96.3
1991	274498	1115	543	263.3	196.9	58.6	347.1	383.2	138
1992	406802	1242	504	827.7	246.1	90.2	827	583.6	208
1993	128432	229	205	135.8	80.7	44.5	85.9	126.5	73.4
1994	543254	1375	813.3	943	383.1	145.7	1376.2	815.3	470.5
1995	141704	267.4	366.4	180	83.1	43.3	156.6	223.1	84.9
1996	218906	860.2	423.3	199	149	56.8	198	277.9	-1
1997	136611	373.6	232.9	130	89	28.3	97.2	-1	-1
1998	-1	211.8	107.8	53	56	15.2	-1	-1	-1
1999	-1	3702.1	-1	2110	841	-1	-1	-1	-1
2000	-1	-1	-1	310	-1	-1	-1	-1	-1
Yclass	VPA	IBQ11	IBQ12	egfs0	egfs1	egfs2	sgfs0	sgfs1	sgfs2

index	Survey	Quarter	Age	
IBQ11	IBTS	1	1	
IBQ12	IBTS	1	2	
EGFS0	English GFS	3	0	
EGFS1	English GFS	3	1	
EGFS2	English GFS	3	2	
SGFS0	Scottish GFS	3	0	New gear & vessel in 98 & area 99 onwards
SGFS1	Scottish GFS	3	1	New gear & vessel in 98 & area 99 onwards
SGFS2	Scottish GFS	3	2	New gear & vessel in 98 & area 99 onwards

NB indices from Scottish 1998 and 1999 GFS (boxed) included here for comparison,
Note that indices from 1999 onwards as used here refer only to old sampling area

	sgfs0	sgfs1	sgfs2
			192.4
		634.9	114.1
1998	328	190.7	46
1999	6607	3061.1	
2000	1190		

Table 4.5.2 Haddock, North Sea and Skagerrak,
Summary of estimates of 1999 yearclass-at-age 0 from RCT3 runs.

Raw RCT3 – all 1999 indices included, tricubic time taper 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	.93	6.40	.29	.872	27	8.22	14.08	.418	.258
IYFS2									
EGFS0	.79	7.95	.27	.886	21	7.65	14.01	.387	.301
EGFS1	1.09	6.87	.24	.909	22	6.74	14.21	.357	.355
EGFS2									
					VPA Mean =		12.18	.720	.087

Reduced RCT3 (1999 indices replaced by previous series maxima)

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	.93	6.40	.29	.872	27	7.23	13.16	.359	.299
IYFS2									
EGFS0	.79	7.95	.27	.886	21	7.34	13.76	.370	.282
EGFS1	1.09	6.87	.24	.909	22	6.44	13.88	.335	.344
EGFS2									
					VPA Mean =		12.18	.720	.074

Untapered RCT3 (As raw RCT3 but without time taper)

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	1.22	4.96	.49	.733	27	8.22	15.02	.591	.167
IYFS2									
EGFS0	.83	7.65	.41	.771	21	7.65	14.03	.479	.255
EGFS1	1.01	7.17	.29	.861	22	6.74	14.00	.346	.487
EGFS2									
					VPA Mean =		12.45	.803	.091

Eng GFS Only (IBTS Index excluded)

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	.79	7.95	.27	.886	21	7.65	14.01	.387	.405
EGFS1	1.09	6.87	.24	.909	22	6.74	14.21	.357	.478
EGFS2									
					VPA Mean =		12.18	.720	.117

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1999	1131972	13.94	.21	.32	2.22	Raw RCT3	
1999	731763	13.50	.20	.28	2.01	Reduced RCT3	
1999	1248726	14.04	.24	.36	2.23	Untapered RCT3	
1999	1077601	13.89	.25	.44	3.25	Eng GFS only	

Table 4.5.3 Haddock in the North Sea and Skagerrak, RCT3 output, age 1.

Analysis by RCT3 ver3.1 of data from file :

rctred1.inp

HADDOCK IN IV, RCT3 INPUT VALUES Age 1, 09-Oct-00, XSASAR05; 99 indices replaced by previous series maxima

Data for 8 surveys over 30 years : 1971 - 2000

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 = 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	.94	4.32	.29	.872	27	7.23	11.09	.359	.304
IYFS2									
EGFS0	.80	5.86	.28	.881	21	7.34	11.70	.380	.271
EGFS1	1.09	4.79	.24	.909	22	6.44	11.82	.335	.349
EGFS2									
					VPA Mean =		10.12	.722	.075

Yearclass = 2000

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	.79	5.88	.26	.892	21	5.74	10.42	.311	.840
EGFS1									
EGFS2									
					VPA Mean =		10.11	.713	.160

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1999	92401	11.43	.20	.28	2.01		
2000	31893	10.37	.29	.11	.15		

TABLE 4.5.4; Haddock in the North Sea and Skagerrak, RCT3 output, age 0

Analysis by RCT3 ver3.1 of data from file hadrct0.inp

HADDOCK IN IV, RCT3 INPUT VALUES Age 0 06-Oct-00 XSASAR05

Data for 8 surveys over 30 years : 1971 - 2000
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

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.95	6.31	.30	.864	27	5.36	11.41	.359	.173
IYFS2	1.17	5.43	.26	.896	27	4.69	10.93	.328	.207
EGFS0	.80	7.92	.29	.874	21	3.99	11.10	.356	.175
EGFS1	1.08	6.88	.25	.903	22	4.04	11.26	.302	.244
EGFS2	.95	8.46	.30	.862	23	2.79	11.09	.375	.159
					VPA Mean =		12.19	.728	.042

Yearclass = 1999

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.93	6.40	.29	.872	27	8.22	14.08	.418	.258
IYFS2									
EGFS0	.79	7.95	.27	.886	21	7.65	14.01	.387	.301
EGFS1	1.09	6.87	.24	.909	22	6.74	14.21	.357	.355
EGFS2									
					VPA Mean =		12.18	.720	.087

Yearclass = 2000

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.79	7.97	.26	.896	21	5.74	12.49	.303	.846
EGFS1									
EGFS2									
					VPA Mean =		12.18	.711	.154

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1998	73381	11.20	.15	.12	.62		
1999	1131972	13.94	.21	.32	2.22		
2000	252748	12.44	.28	.11	.15		

TABLE 4.6.1; Haddock, North Sea & Skagerrak

Mean fishing mortality, biomass and recruitment, 1963 - 1999.

	Mean F			Stock Biomass ('000 tonnes)		Recruits Age 0	
Year	Hcons. Ages 2 to 6	Disc Ages 2 to 6	Ind BC Ages 0 to 3	Total	Spawning	Yclass	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	15653
1981	.654	.086	.064	671	240	1981	32481
1982	.588	.067	.066	840	300	1982	20623
1983	.802	.145	.049	759	253	1983	66984
1984	.907	.091	.032	1493	199	1984	17274
1985	.856	.078	.018	860	241	1985	24053
1986	.880	.178	.012	716	222	1986	49885
1987	.852	.142	.019	1068	158	1987	4202
1988	.836	.147	.026	428	159	1988	8442
1989	.701	.132	.016	397	129	1989	8707
1990	.698	.232	.026	343	81	1990	28144
1991	.760	.065	.023	740	63	1991	27450
1992	.863	.100	.033	603	101	1992	40680
1993	.743	.142	.040	854	133	1993	12843
1994	.713	.183	.015	503	153	1994	54325
1995	.603	.147	.028	943	149	1995	14170
1996	.789	.155	.033	618	181	1996	21891
1997	.620	.113	.029	668	198	1997	13661
1998	.554	.125	.027	544	173	1998	8741
1999	.578	.192	.021	392	133	1999	73176 *
2000					111		
Min.	.485	.065	.012	343	63	Min.	2338
Mean	.742	.127	.075	1170	255	Gmean	25829
Max.	.939	.232	.343	6700	900	Max.	388112

Min, max and geo. mean recruitment calculated over years 1963 to 1997
(Arithmetic mean recruitment 1963 - 1997 = 44148)
Biomass totals calculated at start of year.
* RCT3 estimate

Table 4.7.1; Haddock, North Sea and Skagerrak.
Summary of parallel short-term catch forecasts

		IFAP run
Scenario 1	Accepting all defaults	MANSAR01
Scenario 2	Assuming increased discarding at age 2	MANSAR03
Scenario 3	Assuming effective implementation of technical measure	MANSAR04

Scenario	001 HC landings (approx), '000t	2001 HC landings (actual), '000t	Implied discards 2001, '000t	Ind Bycatch 2001 '000t	F mult	F (HC+D) (2-6)	SSB 2001 '000t	SSB 2002 '000t
1	40	38.8	55.3	11.2	0.40	0.308	185.1	309.9
1	50	51.0	73.8	10.9	0.55	0.424	185.1	287.1
1	60	58.6	85.6	10.7	0.65	0.501	185.1	273.0
1	70	69.1	102.4	10.4	0.80	0.616	185.1	253.0
1	80	78.8	118.2	10.2	0.95	0.732	185.1	235.5
1	90	90.3	138.0	9.8	1.15	0.886	185.1	213.8
1	100	100.7	156.3	9.5	1.35	1.040	185.1	194.5
2	40	40.6	80.4	10.9	0.55	0.424	185.1	287.1
2	50	49.5	99.4	10.6	0.70	0.539	185.1	266.3
2	60	60.0	122.9	10.3	0.90	0.693	185.1	241.3
2	70	69.3	144.7	9.9	1.10	0.847	185.1	219.0
2	80	79.5	169.7	9.5	1.35	1.040	185.1	194.5
2	90	89.8	196.8	9.1	1.65	1.271	185.1	169.5
2	100	99.8	225.0	8.7	2.00	1.540	185.1	145.1
3	40	39.4	47.2	11.3	0.55	0.389	185.1	312.7
3	50	51.2	62.7	11.0	0.75	0.530	185.1	291.8
3	60	59.2	73.8	10.8	0.90	0.636	185.1	277.3
3	70	69.0	87.9	10.6	1.10	0.778	185.1	259.4
3	80	80.1	104.6	10.3	1.35	0.954	185.1	239.2
3	90	89.9	120.2	10.1	1.60	1.131	185.1	221.0
3	100	100.3	137.7	9.8	1.90	1.343	185.1	198.6

Exploitation patterns used	**Scenario 1**	**Scenario 2**	**Scenario 3**
	2001	**2001**	**2001**
age	**HC F**	**HC F**	**HC F**
0	0	0	0
1	0.002	0.002	0.001
2	0.145	0.096	0.090
3	0.463	0.463	0.410
4	0.704	0.704	0.685
5	0.957	0.957	0.950
6	0.836	0.836	0.833
7	1.016	1.016	1.016
8	1.106	1.106	1.106
9	0.963	0.963	0.963
age	**disc F**	**disc F**	**disc F**
0	0.001	0.001	0.001
1	0.117	0.117	0.610
2	0.403	0.452	0.254
3	0.230	0.230	0.204
4	0.062	0.062	0.060
5	0.025	0.025	0.025
6	0.024	0.024	0.024
7	0.000	0.000	0.000
8	0.000	0.000	0.000
9	0.000	0.000	0.000
10	0.000	0.000	0.000

Table 4.7.2

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

Multi fleet prediction with mangement option table: Input data

2000	H.cons		disc		Ind BC	
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch
0	0.0000	0.000	0.0010	0.045	0.0050	0.019
1	0.0020	0.275	0.1170	0.172	0.0220	0.069
2	0.1450	0.354	0.4030	0.224	0.0380	0.171
3	0.4630	0.423	0.2300	0.283	0.0200	0.298
4	0.7040	0.471	0.0620	0.311	0.0080	0.384
5	0.9570	0.584	0.0250	0.347	0.0040	0.381
6	0.8360	0.740	0.0240	0.339	0.0000	0.000
7	1.0160	0.942	0.0000	0.000	0.0000	0.000
8	1.1060	0.951	0.0000	0.000	0.0000	0.000
9	0.9630	1.536	0.0000	0.000	0.0000	0.000
10+	0.9630	2.066	0.0000	0.000	0.0000	0.000
Unit	-	Kilograms	-	Kilograms	-	Kilograms

2000						
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	25829039	2.0500	0.0000	0.0000	0.0000	0.023
1	9240100.0	1.6500	0.0100	0.0000	0.0000	0.161
2	178800.00	0.4000	0.3200	0.0000	0.0000	0.248
3	100700.00	0.2500	0.7100	0.0000	0.0000	0.377
4	55500.000	0.2500	0.8700	0.0000	0.0000	0.457
5	26500.000	0.2000	0.9500	0.0000	0.0000	0.575
6	21400.000	0.2000	1.0000	0.0000	0.0000	0.720
7	1800.000	0.2000	1.0000	0.0000	0.0000	0.943
8	700.000	0.2000	1.0000	0.0000	0.0000	0.951
9	200.000	0.2000	1.0000	0.0000	0.0000	1.536
10+	10.000	0.2000	1.0000	0.0000	0.0000	1.955
Unit	Thousands	-	-	-	-	Kilograms

(cont.)

Table 4.7.2 (Cont'd)

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

Multi fleet prediction with mangement option table: Input data (cont.)

2001	H.cons		disc		Ind BC	
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch
0	0.0000	0.000	0.0010	0.045	0.0050	0.019
1	0.0020	0.275	0.1170	0.172	0.0220	0.069
2	0.0960	0.354	0.4520	0.224	0.0380	0.171
3	0.4630	0.423	0.2300	0.283	0.0200	0.298
4	0.7040	0.471	0.0620	0.311	0.0080	0.384
5	0.9570	0.584	0.0250	0.347	0.0040	0.381
6	0.8360	0.740	0.0240	0.339	0.0000	0.000
7	1.0160	0.942	0.0000	0.000	0.0000	0.000
8	1.1060	0.951	0.0000	0.000	0.0000	0.000
9	0.9630	1.536	0.0000	0.000	0.0000	0.000
10+	0.9630	2.066	0.0000	0.000	0.0000	0.000
Unit	-	Kilograms	-	Kilograms	-	Kilograms

2001						
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	25829039	2.0500	0.0000	0.0000	0.0000	0.023
1	.	1.6500	0.0100	0.0000	0.0000	0.161
2	.	0.4000	0.3200	0.0000	0.0000	0.248
3	.	0.2500	0.7100	0.0000	0.0000	0.377
4	.	0.2500	0.8700	0.0000	0.0000	0.457
5	.	0.2000	0.9500	0.0000	0.0000	0.575
6	.	0.2000	1.0000	0.0000	0.0000	0.720
7	.	0.2000	1.0000	0.0000	0.0000	0.943
8	.	0.2000	1.0000	0.0000	0.0000	0.951
9	.	0.2000	1.0000	0.0000	0.0000	1.536
10+	.	0.2000	1.0000	0.0000	0.0000	1.955
Unit	Thousands	-	-	-	-	Kilograms

(cont.)

Table 4.7.2 (Cont'd)

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

Multi fleet prediction with mangement option table: Input data (cont.)

2002	H.cons		disc		Ind BC	
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch
0	0.0000	0.000	0.0010	0.045	0.0050	0.019
1	0.0020	0.275	0.1170	0.172	0.0220	0.069
2	0.1450	0.354	0.4030	0.224	0.0380	0.171
3	0.4630	0.423	0.2300	0.283	0.0200	0.298
4	0.7040	0.471	0.0620	0.311	0.0080	0.384
5	0.9570	0.584	0.0250	0.347	0.0040	0.381
6	0.8360	0.740	0.0240	0.339	0.0000	0.000
7	1.0160	0.942	0.0000	0.000	0.0000	0.000
8	1.1060	0.951	0.0000	0.000	0.0000	0.000
9	0.9630	1.536	0.0000	0.000	0.0000	0.000
10+	0.9630	2.066	0.0000	0.000	0.0000	0.000
Unit	-	Kilograms	-	Kilograms	-	Kilograms

2002						
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	25829039	2.0500	0.0000	0.0000	0.0000	0.023
1	.	1.6500	0.0100	0.0000	0.0000	0.161
2	.	0.4000	0.3200	0.0000	0.0000	0.248
3	.	0.2500	0.7100	0.0000	0.0000	0.377
4	.	0.2500	0.8700	0.0000	0.0000	0.457
5	.	0.2000	0.9500	0.0000	0.0000	0.575
6	.	0.2000	1.0000	0.0000	0.0000	0.720
7	.	0.2000	1.0000	0.0000	0.0000	0.943
8	.	0.2000	1.0000	0.0000	0.0000	0.951
9	.	0.2000	1.0000	0.0000	0.0000	1.536
10+	.	0.2000	1.0000	0.0000	0.0000	1.955
Unit	Thousands	-	-	-	-	Kilograms

Notes: Run name : MANSAR03
Date and time: 11OCT00:10:57

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

Multi fleet prediction with mangement option table

Year: 2000											
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	0.6210	50809	1.0000	0.1488	102382	1.0000	0.0213	8821	162011	2217927	110512
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes

Year: 2001												Year: 2002	
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	0.0213	12068	12068	1573855	185087	1718335	381587
0.1000	0.0611	8508	0.1000	0.0159	16038	1.0000	0.0213	11838	36384	.	185087	1691406	362003
0.2000	0.1222	16476	0.2000	0.0317	31409	1.0000	0.0213	11617	59502	.	185087	1665970	343571
0.3000	0.1834	23943	0.3000	0.0476	46147	1.0000	0.0213	11403	81492	.	185087	1641937	326217
0.4000	0.2445	30943	0.4000	0.0634	60283	1.0000	0.0213	11196	102421	.	185087	1619222	309875
0.5000	0.3056	37508	0.5000	0.0793	73848	1.0000	0.0213	10996	122351	.	185087	1597746	294481
0.6000	0.3667	43668	0.6000	0.0952	86869	1.0000	0.0213	10802	141340	.	185087	1577436	279976
0.7000	0.4278	49451	0.7000	0.1110	99375	1.0000	0.0213	10615	159442	.	185087	1558221	266306
0.8000	0.4890	54883	0.8000	0.1269	111391	1.0000	0.0213	10434	176708	.	185087	1540037	253419
0.9000	0.5501	59987	0.9000	0.1427	122940	1.0000	0.0213	10259	193187	.	185087	1522823	241268
1.0000	0.6112	64786	1.0000	0.1586	134047	1.0000	0.0213	10089	208922	.	185087	1506522	229806
1.1000	0.6723	69299	1.1000	0.1745	144732	1.0000	0.0213	9925	223957	.	185087	1491081	218993
1.2000	0.7334	73546	1.2000	0.1903	155017	1.0000	0.0213	9767	238329	.	185087	1476449	208789
1.3000	0.7946	77544	1.3000	0.2062	164920	1.0000	0.0213	9613	252077	.	185087	1462580	199158
1.4000	0.8557	81310	1.4000	0.2220	174462	1.0000	0.0213	9464	265235	.	185087	1449429	190064
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSAR03
Date and time : 11OCT00:11:00
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 2000 : F factors

Table 4.7.4

11:04 Monday, October 16, 2000
Haddock in Sub-area IV (North Sea) and Division IIIa

Multi fleet prediction: Detailed tables

Year 2000. H.cons	F-factor 1.0000 and reference F	0.6210
disc	F-factor 1.0000 and reference F	0.1488
Ind BC	F-factor 1.0000 and reference F	0.0213

	H.cons			disc			Ind BC		
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
0	0.0000	0	0	0.0010	10955	493	0.0050	54776	1041
1	0.0020	8597	2364	0.1170	502944	86506	0.0220	94571	6525
2	0.1450	16485	5836	0.4030	45816	10263	0.0380	4320	739
3	0.4630	29933	12662	0.2300	14870	4208	0.0200	1293	385
4	0.7040	24452	11517	0.0620	2153	670	0.0080	278	107
5	0.9570	14852	8674	0.0250	388	135	0.0040	62	24
6	0.8360	11030	8162	0.0240	317	107	0.0000	0	0
7	1.0160	1058	997	0.0000	0	0	0.0000	0	0
8	1.1060	432	411	0.0000	0	0	0.0000	0	0
9	0.9630	114	175	0.0000	0	0	0.0000	0	0
10+	0.9630	6	12	0.0000	0	0	0.0000	0	0
Total		106959	50809		577443	102382		155300	8821
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes

	Total				1 January		Spawning time	
Age	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	65731	1534	25829039	594068	0	0	0	0
1	606112	95396	9240100	1483036	92401	14830	92401	14830
2	66621	16837	178800	44253	57216	14161	57216	14161
3	46096	17255	100700	37914	71497	26919	71497	26919
4	26884	12293	55500	25336	48285	22042	48285	22042
5	15302	8832	26500	15224	25175	14463	25175	14463
6	11347	8270	21400	15408	21400	15408	21400	15408
7	1058	997	1800	1697	1800	1697	1800	1697
8	432	411	700	666	700	666	700	666
9	114	175	200	307	200	307	200	307
10+	6	12	10	20	10	20	10	20
Total	839702	162011	35454749	2217927	318684	110512	318684	110512
Unit	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.7.4 (Cont'd)

Monday, October 16, 2000
Haddock in Sub-area IV (North Sea) and Division IIIa

Multi fleet prediction: Detailed tables

(cont.)

Year 2001.	H.cons	F-factor 1.0000	and reference F	0.6112
	disc	F-factor 1.0000	and reference F	0.1586
	Ind BC	F-factor 1.0000	and reference F	0.0213

	H.cons			disc			Ind BC		
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
0	0.0000	0	0	0.0010	10955	493	0.0050	54776	1041
1	0.0020	3075	846	0.1170	179904	30944	0.0220	33828	2334
2	0.0960	94074	33302	0.4520	442934	99217	0.0380	37238	6368
3	0.4630	19828	8387	0.2300	9850	2787	0.0200	856	255
4	0.7040	16937	7977	0.0620	1492	464	0.0080	192	74
5	0.9570	11172	6524	0.0250	292	101	0.0040	47	18
6	0.8360	4172	3087	0.0240	120	41	0.0000	0	0
7	1.0160	4359	4106	0.0000	0	0	0.0000	0	0
8	1.1060	329	313	0.0000	0	0	0.0000	0	0
9	0.9630	108	166	0.0000	0	0	0.0000	0	0
10+	0.9630	37	77	0.0000	0	0	0.0000	0	0
Total		154091	64786		645546	134047		126937	10089
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes

	Total				1 January		Spawning time	
Age	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	65731	1534	25829039	594068	0	0	0	0
1	216808	34123	3305208	530486	33052	5305	33052	5305
2	574246	138887	1541187	381444	493180	122062	493180	122062
3	30534	11430	66704	25114	47360	17831	47360	17831
4	18621	8515	38442	17549	33444	15267	33444	15267
5	11510	6643	19933	11452	18936	10879	18936	10879
6	4292	3128	8094	5828	8094	5828	8094	5828
7	4359	4106	7414	6988	7414	6988	7414	6988
8	329	313	534	507	534	507	534	507
9	108	166	190	291	190	291	190	291
10+	37	77	66	128	66	128	66	128
Total	926575	208922	30816810	1573855	642270	185087	642270	185087
Unit	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.7.4 (Cont'd)

11:04 Monday, October 16, 2000
Haddock in Sub-area IV (North Sea) and Division IIIa

Multi fleet prediction: Detailed tables
(cont.)

Year 2002.		
H.cons	F-factor 1.0000 and reference F	0.6210
disc	F-factor 1.0000 and reference F	0.1488
Ind BC	F-factor 1.0000 and reference F	0.0213

	H.cons			disc			Ind BC		
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
0	0.0000	0	0	0.0010	10955	493	0.0050	54776	1041
1	0.0020	3075	846	0.1170	179904	30944	0.0220	33828	2334
2	0.1450	50827	17993	0.4030	141263	31643	0.0380	13320	2278
3	0.4630	170908	72294	0.2300	84900	24027	0.0200	7383	2200
4	0.7040	11219	5284	0.0620	988	307	0.0080	127	49
5	0.9570	7738	4519	0.0250	202	70	0.0040	32	12
6	0.8360	3138	2322	0.0240	90	31	0.0000	0	0
7	1.0160	1649	1553	0.0000	0	0	0.0000	0	0
8	1.1060	1357	1290	0.0000	0	0	0.0000	0	0
9	0.9630	82	126	0.0000	0	0	0.0000	0	0
10+	0.9630	45	94	0.0000	0	0	0.0000	0	0
Total		250038	106321		418303	87514		109467	7914
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes

	Total				1 January		Spawning time	
Age	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	65731	1534	25829039	594068	0	0	0	0
1	216808	34123	3305208	530486	33052	5305	33052	5305
2	205409	51913	551287	136443	176412	43662	176412	43662
3	263191	98521	574964	216474	408225	153697	408225	153697
4	12334	5640	25464	11624	22154	10113	22154	10113
5	7972	4601	13807	7932	13116	7535	13116	7535
6	3228	2353	6088	4384	6088	4384	6088	4384
7	1649	1553	2804	2643	2804	2643	2804	2643
8	1357	1290	2198	2090	2198	2090	2198	2090
9	82	126	145	222	145	222	145	222
10+	45	94	80	156	80	156	80	156
Total	777807	201749	30311083	1506522	664273	229806	664273	229806
Unit	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

```
Notes: Run name             : SPRSAR01
       Date and time        : 12OCT00:14:05
       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 4.7.5 HADDOCK in IV/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	1997	1998	1999	2000	2001
Stock No. (millions) of 0-group	13661	8741	73176	25829	25829
Source	XSA	XSA	RCT	LTGM	LTGM
Status Quo F:					
% in 2000 landings	24.9	11.5	4.7	0.0	-
% in 2001 landings	12.3	12.9	51.4	1.3	0.0
% in 2000 SSB	24.4	12.8	13.4	0.0	-
% in 2001 SSB	8.2	9.6	65.9	2.9	0.0
% in 2002 SSB	3.3	4.4	66.9	19.0	2.3

GM = geometric mean recruitment

HADDOCK in IV/IIIa : Year-class % contribution to a) 2001 landings and b) 2002 SSB

Figure 4.4.1; Haddock in the North sea and Skagerrak
Log catchability residuals from single fleet XSA runs

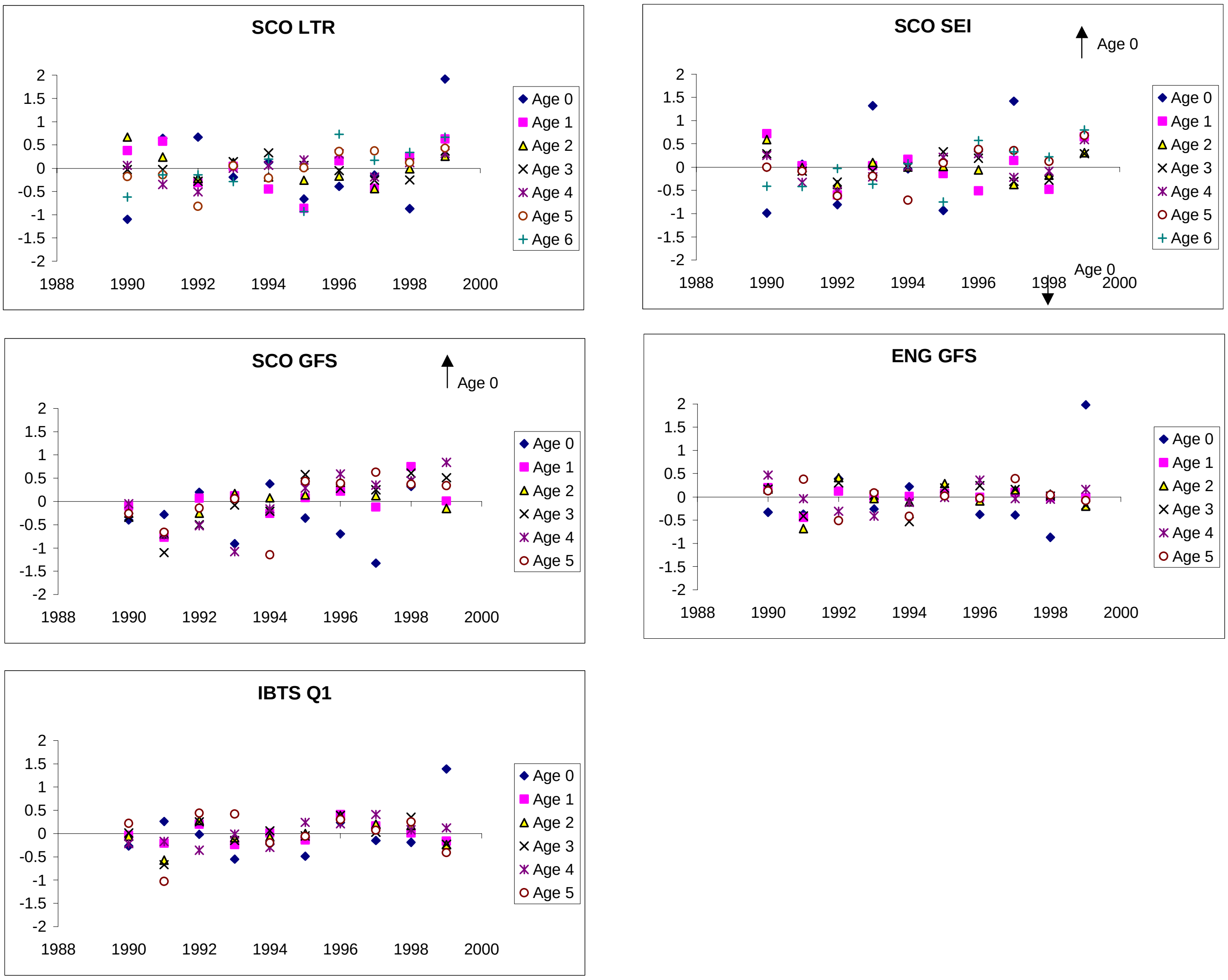
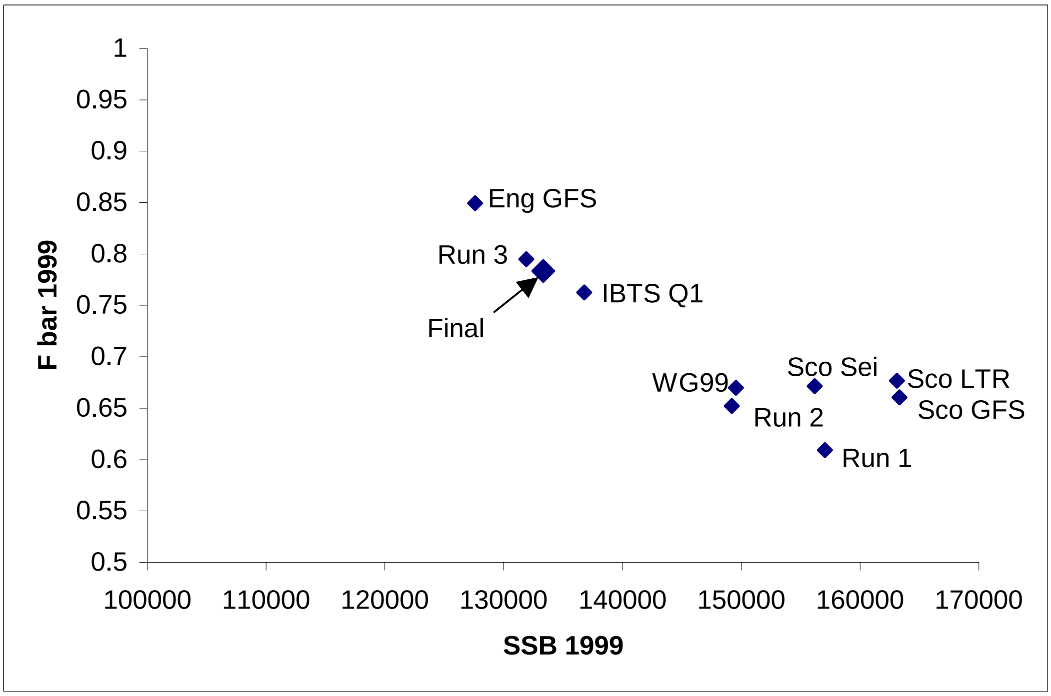


Figure 4.4.2; Haddock, North Sea and Skagerrak
Summary of results of exploratory XSA runs



Key :

WG 1999	SCOLTR+SCOSEI+ENGGFS+IBTSQ1(NO SCOGFS) - prediction
run 1	AS WG99 but with SCOGFS included
run 2	AS WG99
Run 3	ENGGFS+IBTSQ1 only
Final	as run3 except power model age 0

Single fleet runs :	Sco LTR	Sco SEI	Sco GFS
	Eng GFS	IBTS Q1	

dodgy XXSA all data + IBTS indices corrected for q trends (indefensible !)

Figure 4.4.3; Haddock in the North Sea and Skagerrak;
Plots of log catchability residuals vs. population size

Results from Run 5 **two fleets, long TS of data, 30 yr tricubic taper, constant q**
Ln q residuals vs. Abundance

All Years

Last ten years only

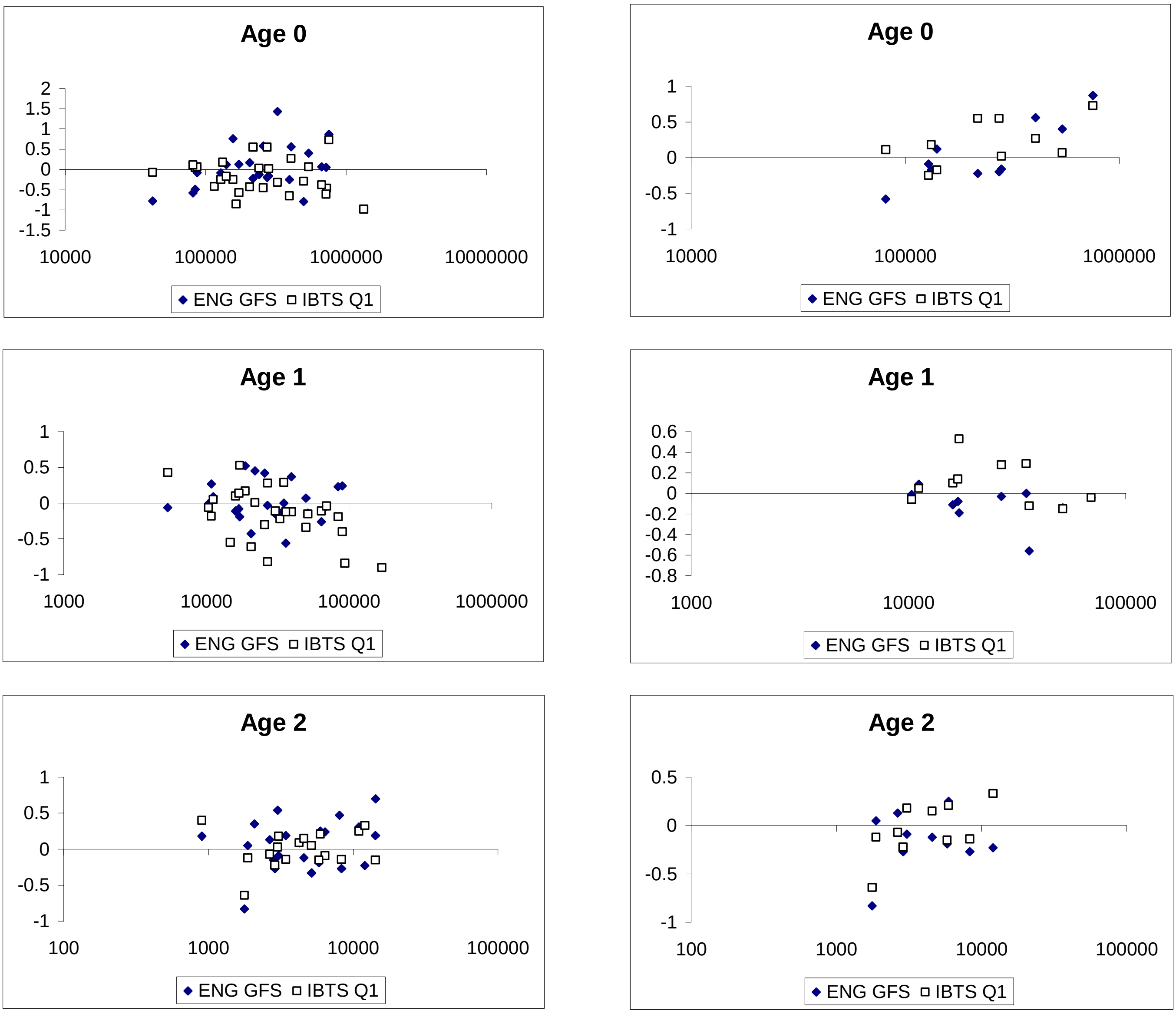
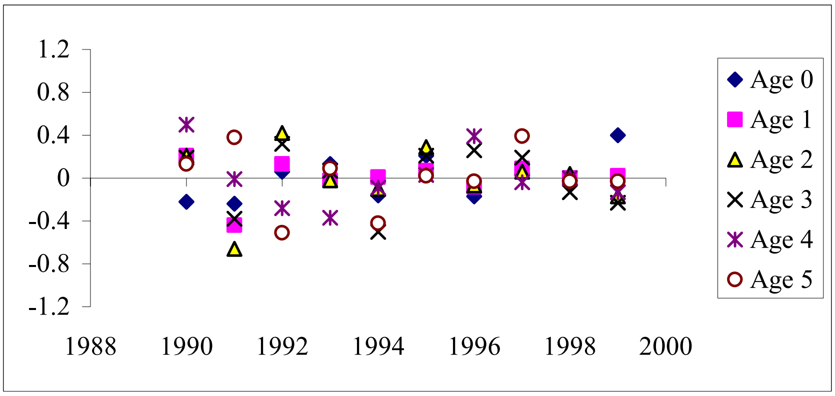


Figure 4.4.4; Haddock in the North Sea and Skagerrak
Log catchability residuals Final XSA run XSASAR05

ENG GFS



IBTS Q1

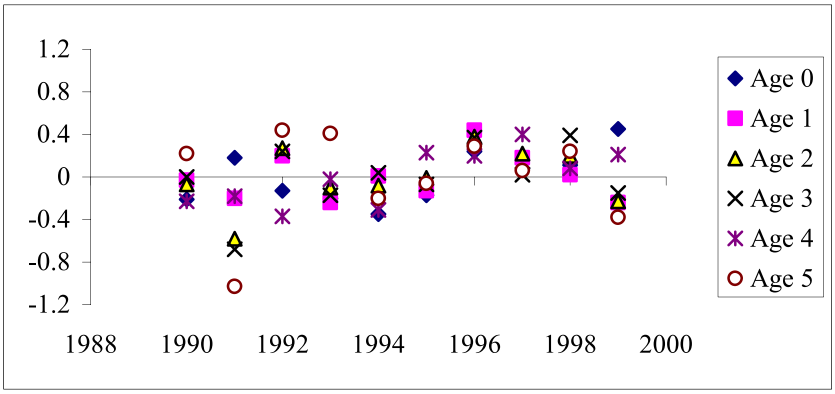


Figure 4.4.5; Haddock in the North Sea and Skagerrak
Contributions of tuning fleets and shrinkage to survivor estimates

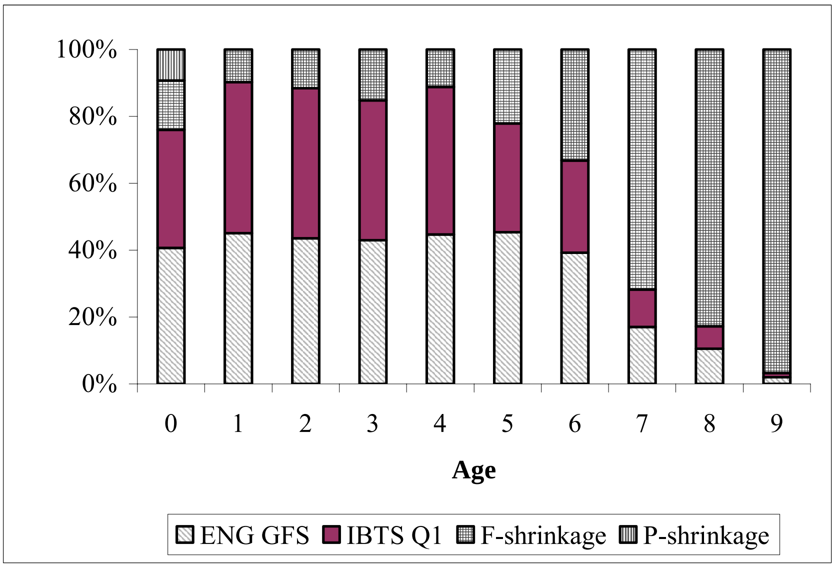
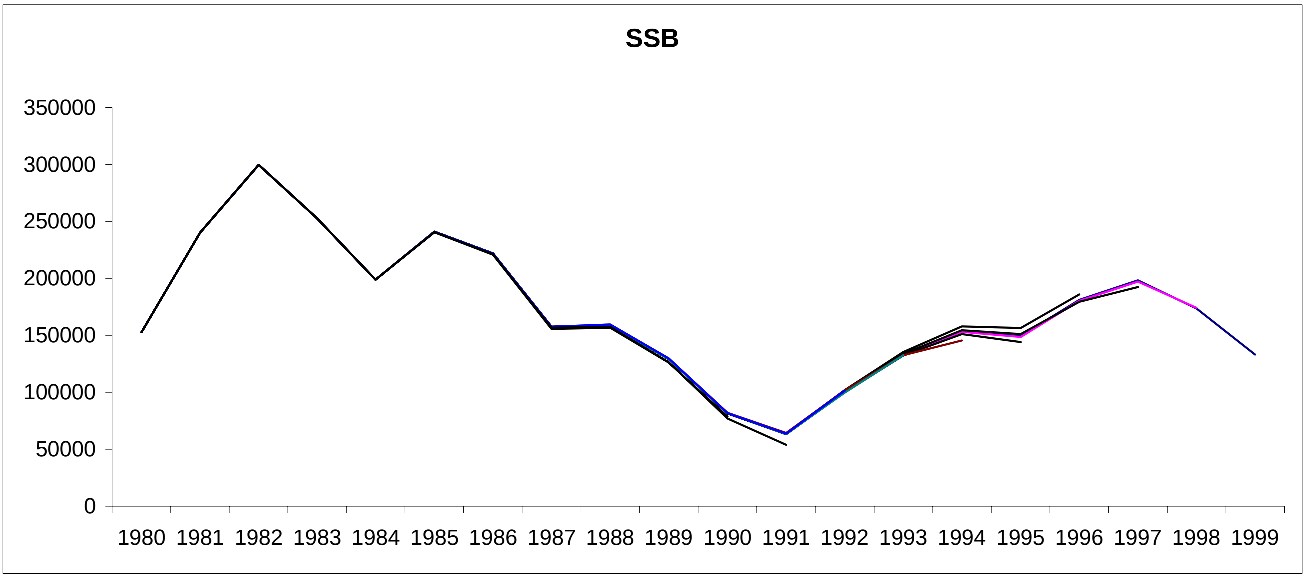


Figure 4.4.6
Haddock in the north Sea and Skagerrak
Retrospective trends in Mean F and SSB
XSASAR05



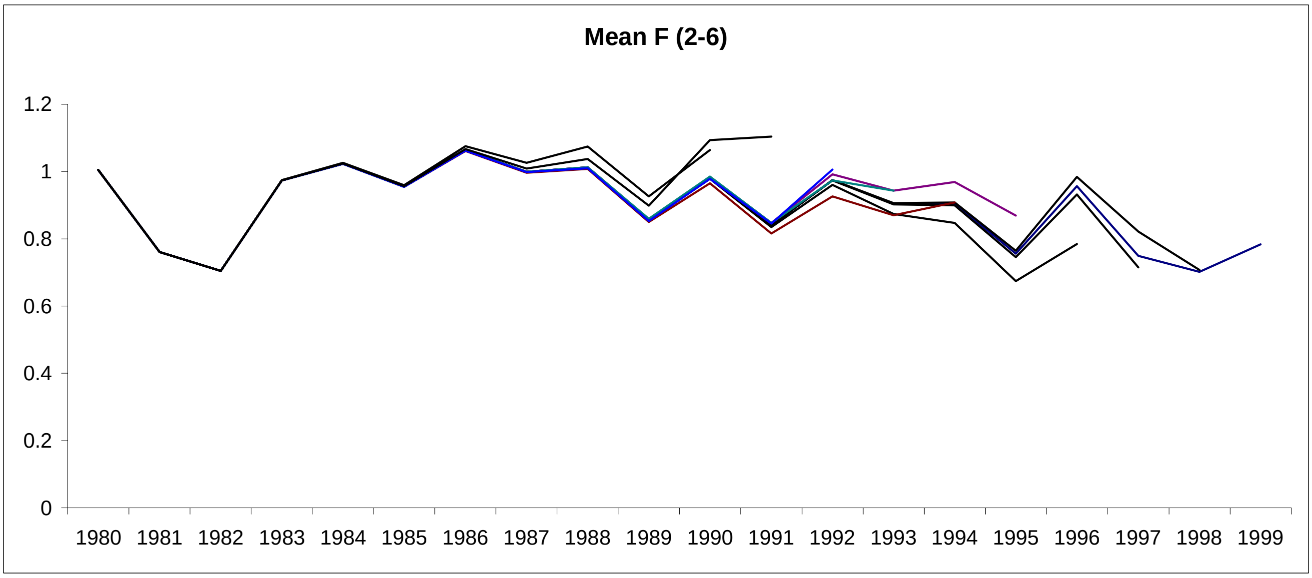
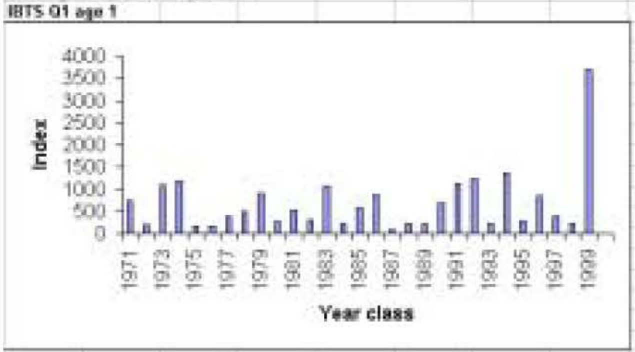
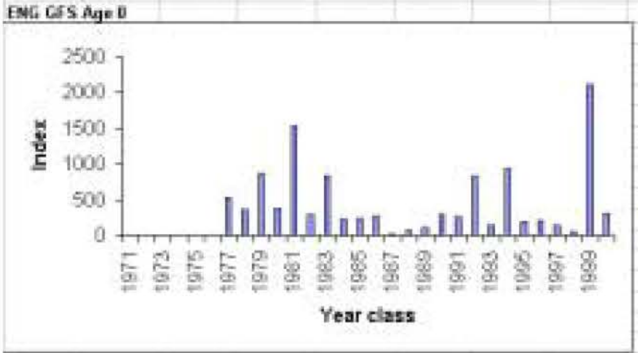


Figure 4.5.1
Survey indices for Haddock n the North Sea & skagerrak.
Showing indices for 1999 year class

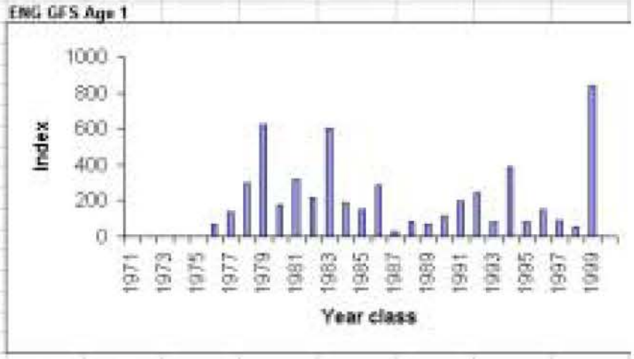
IBTS Q1 age 1



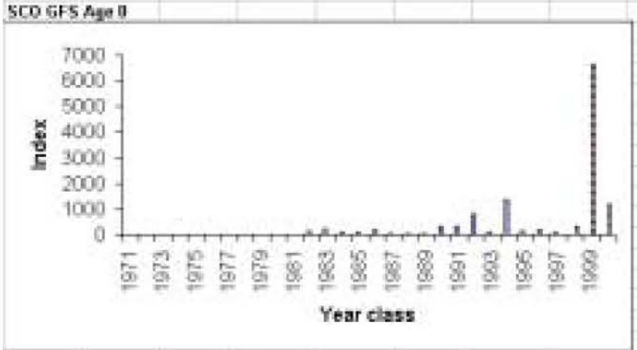
ENG GFS Age 0



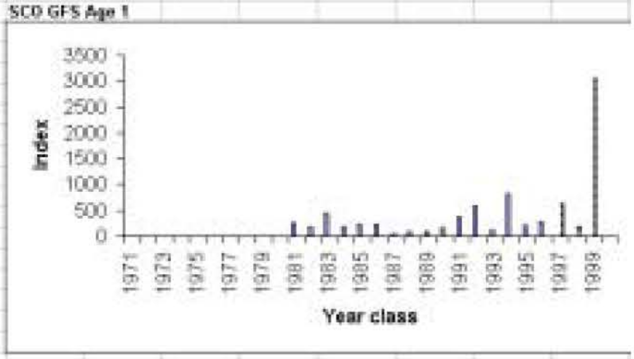
ENG GFS Age 1



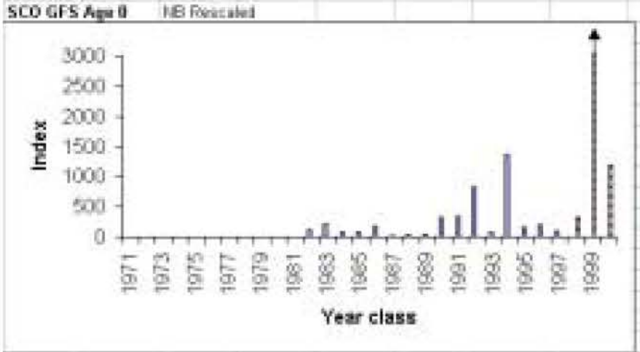
SCO GFS Age 0



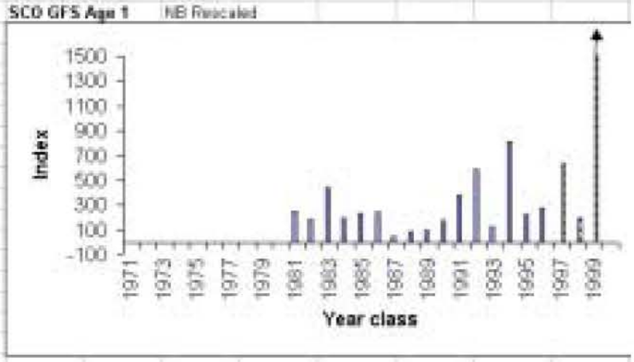
SCO GFS Age 1



SCO GFS Age 0 NB Rescaled



SCO GFS Age 1 NB Rescaled



XSA age 0, run 7

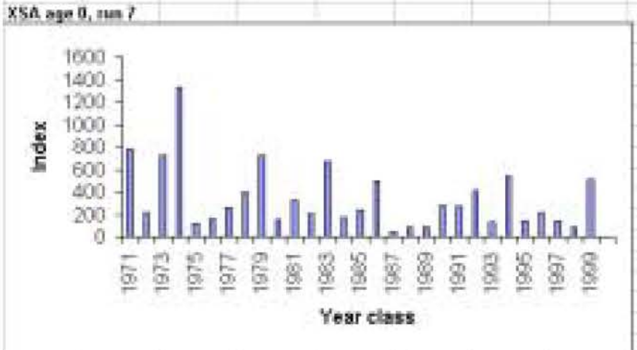


Figure 4.5.2; Haddock in the North Sea and Skagerrak
Catchabilities of survey series.

Plots show converged VPA estimate /index by year
i.e. approximate inverse catchability

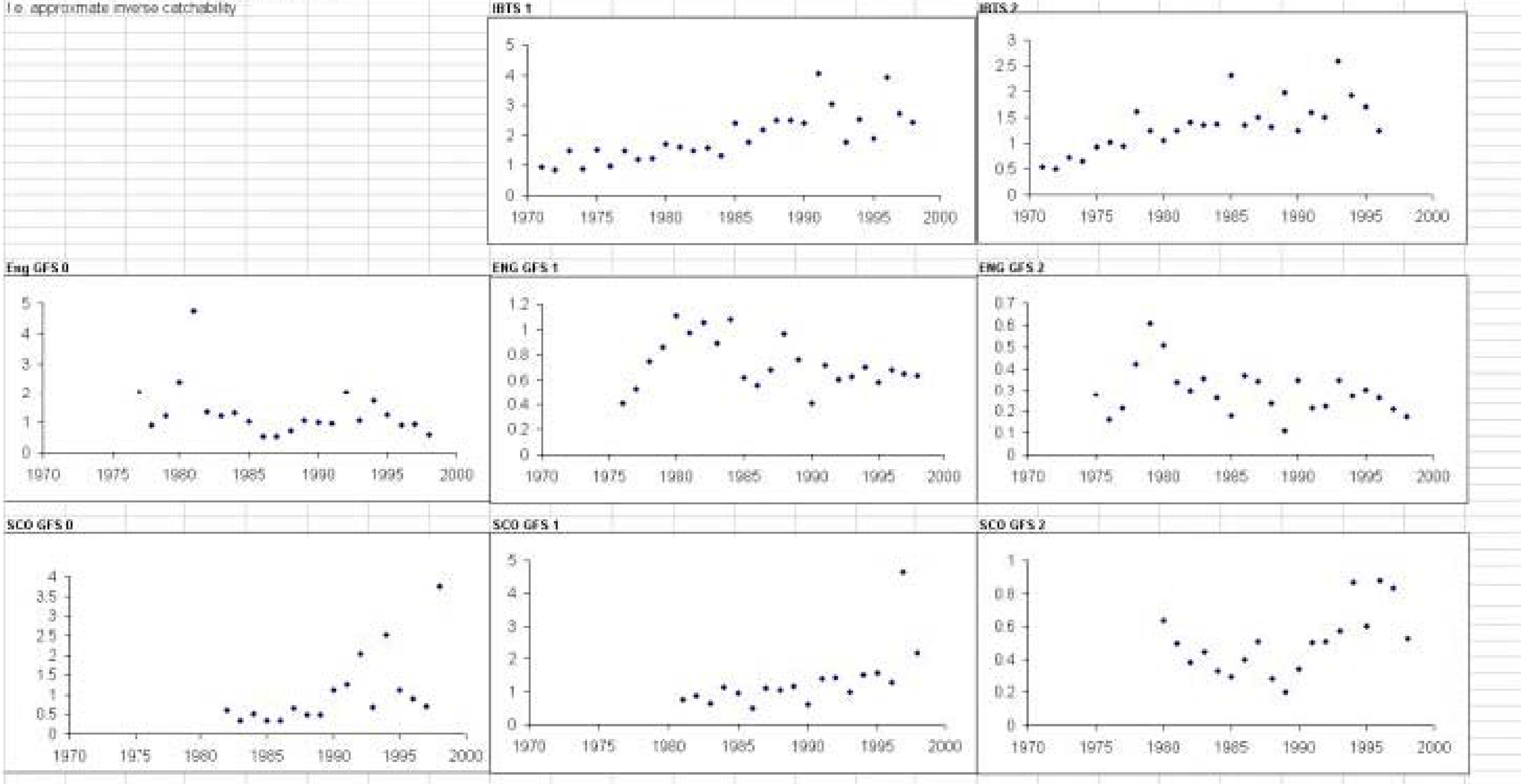
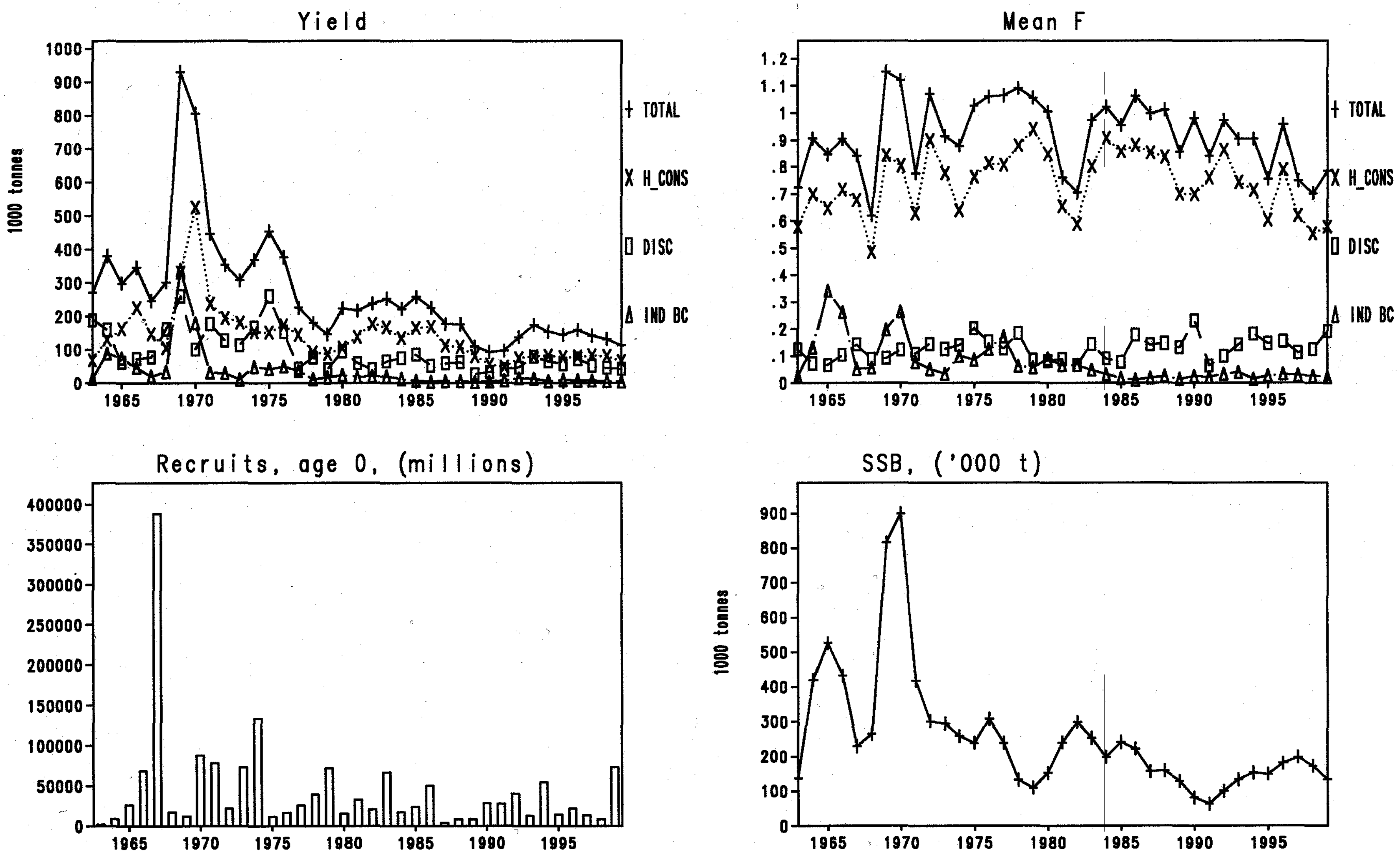


Figure 4.6.1 Haddock, North Sea & Skagerrak.



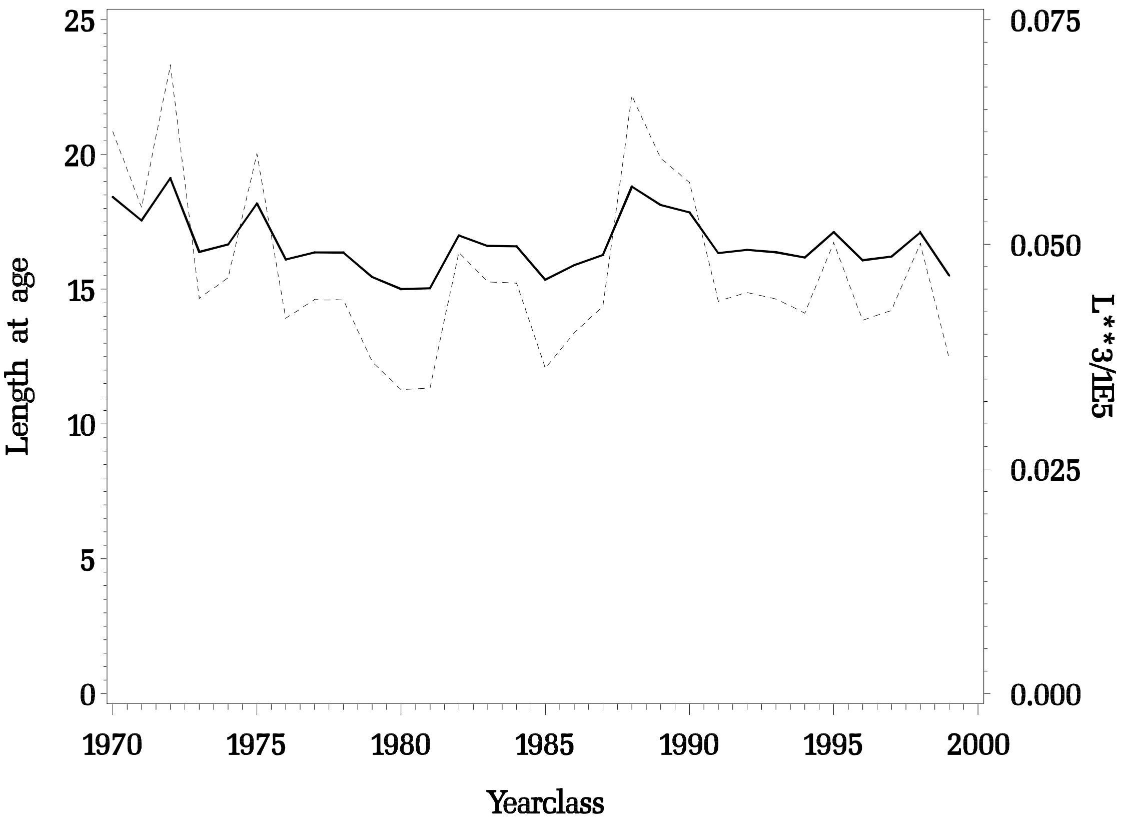


Figure 4.7.1. Haddock in the North sea and Skagerrak

Mean length-at-age 1 from IBTS first quarter survey data. Solid line shows Mean length, dashed line shows L^3 to give indication of weight**.**

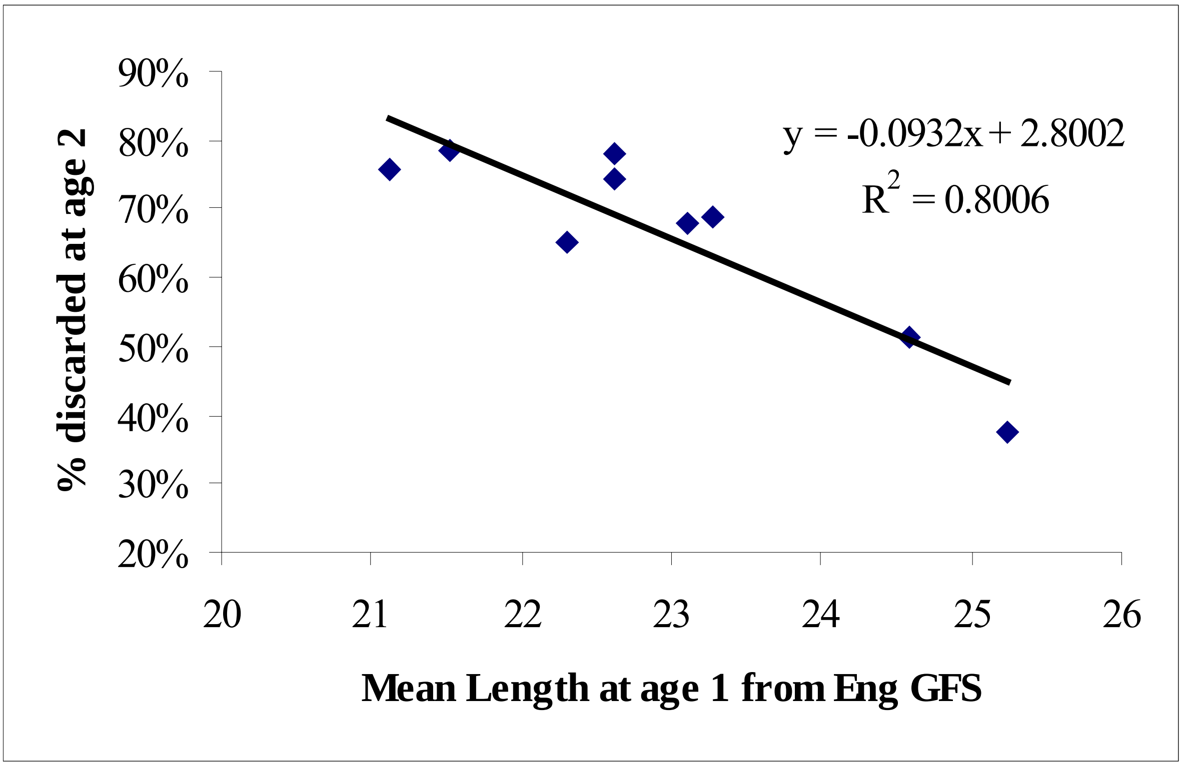


Figure 4.7.2. Haddock in the North Sea and Skagerrak.

Mean length-at-age 1 vs. proportion discarded-at-age 2 of the same cohort.

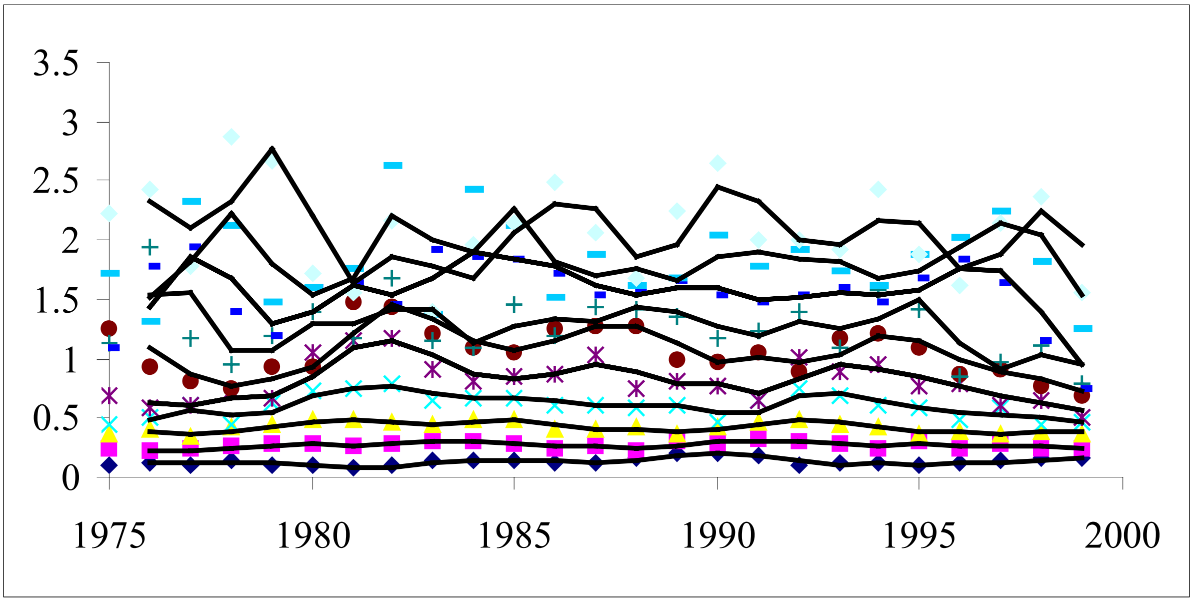


Figure 4.7.3. Haddock in the North Sea and Skagerrak. Stock weights-at-age (in kg.) with moving average trend lines.

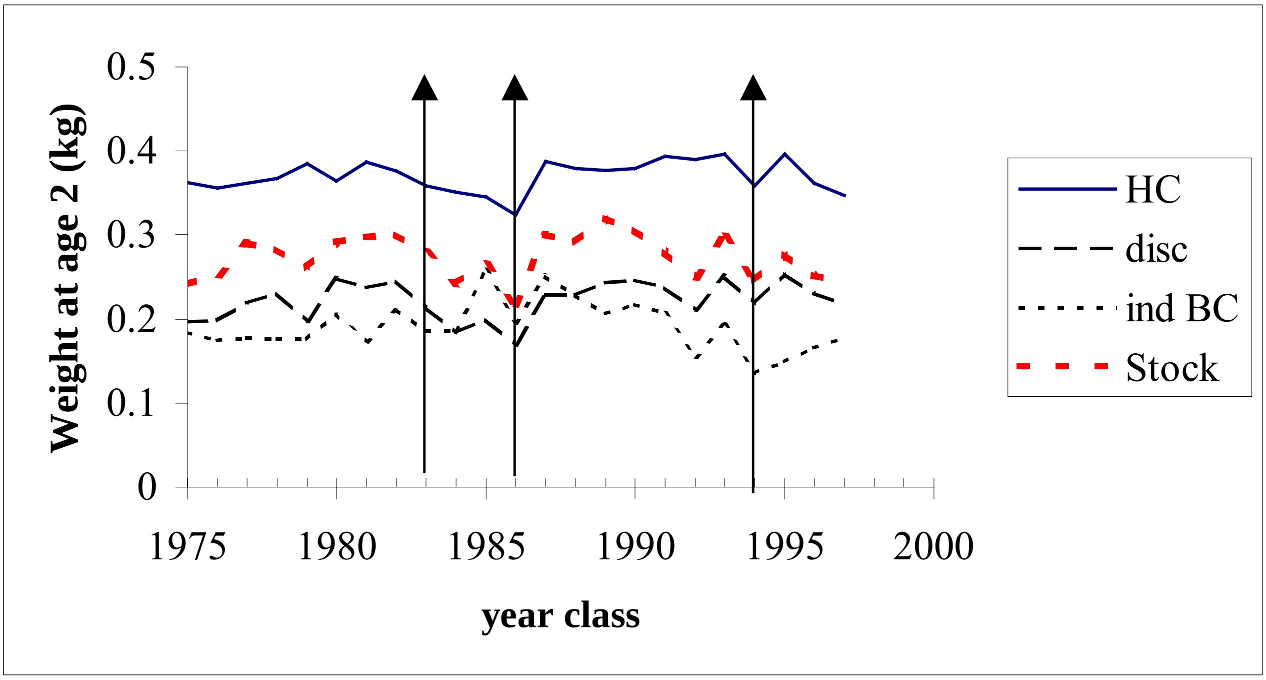


Figure 4.7.4; Haddock in the North Sea and Skagerrak

Weight-at-age 2 in the stock and catch categories showing recent strong year classes

Figure 4.7.5

Figure Haddock,North Sea & skagerra. Sensitivity analysis of short term forecast.

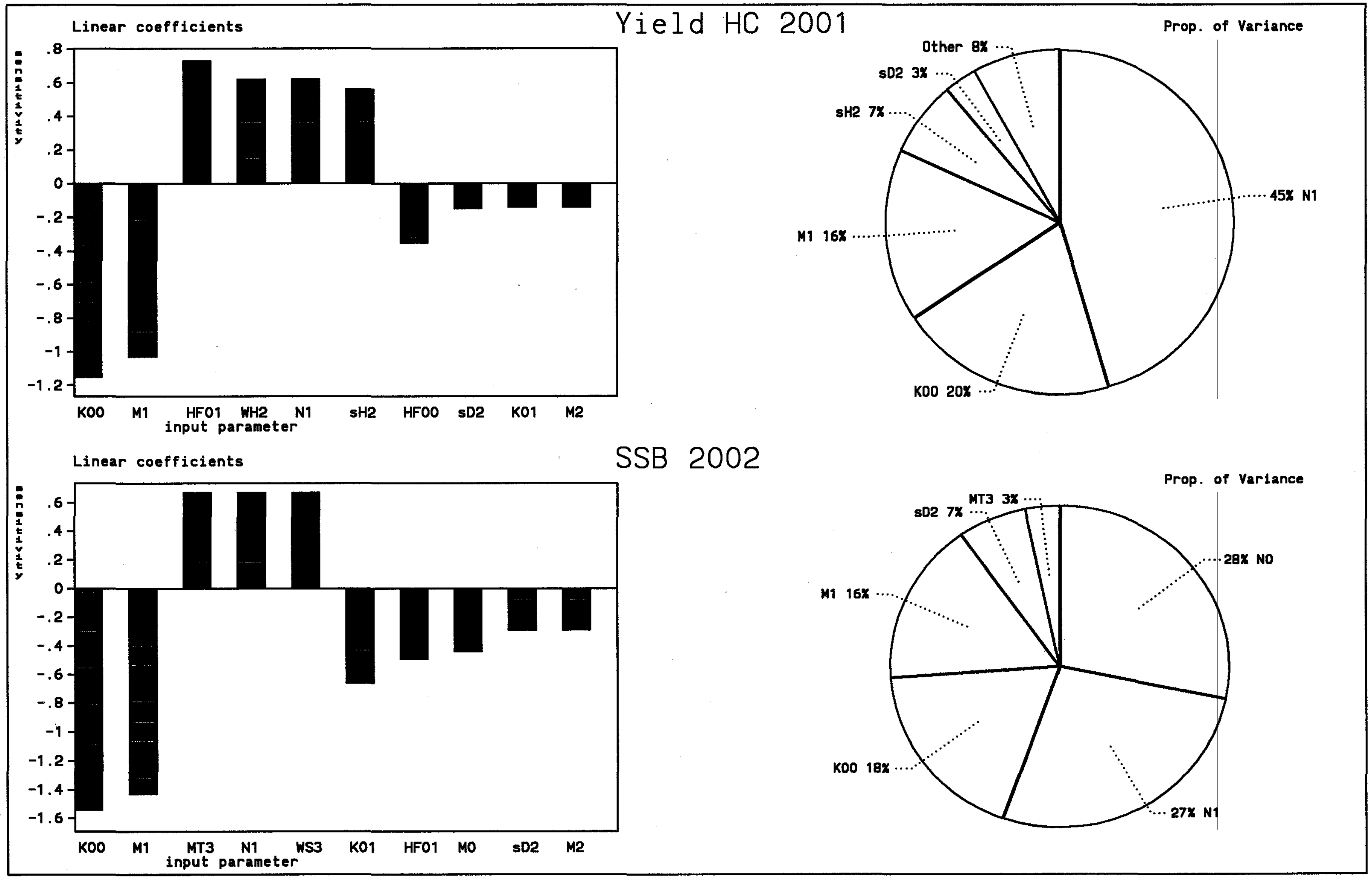
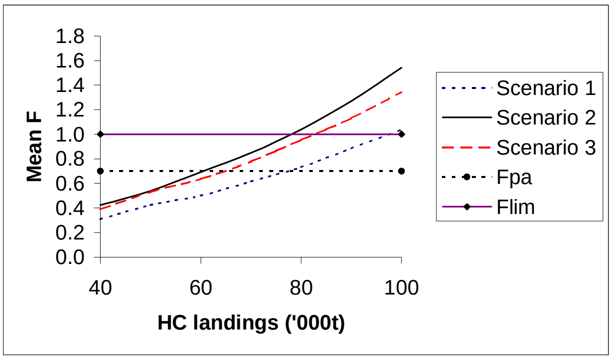


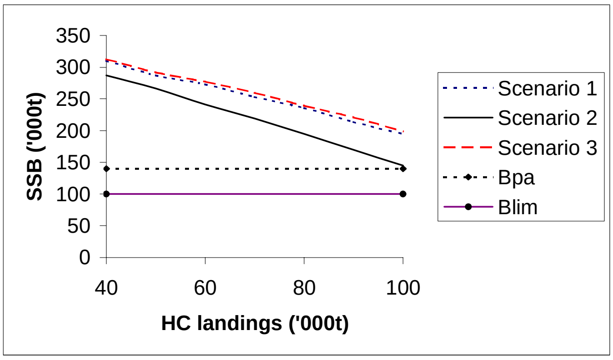
Figure 4.7.6
Haddock, North Sea and Skagerrak.
Summary of short-term catch forecasts
Results are expressed in terms of the implications of various levels of human consumption landings in 2001 on the quantity graphed e.g. Mean F in 2001

Scenario 1 Accepting all defaults
Scenario 2 Assuming increased discarding at age 2
Scenario 3 Assuming effective implementation of technical measure

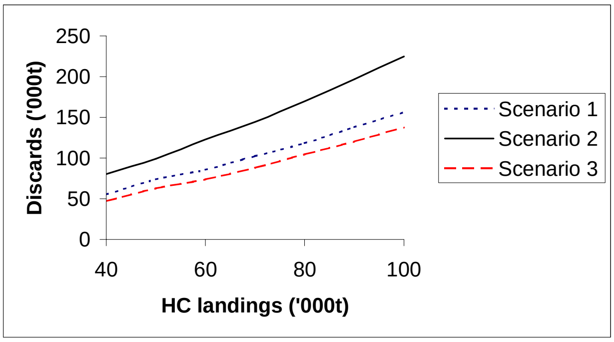
Mean F in 2001



SSB in 2002



Discards in 2001



Total discarded as percentage

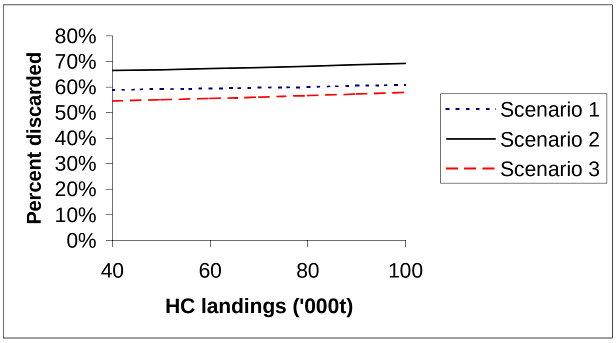


Figure 4.9.1

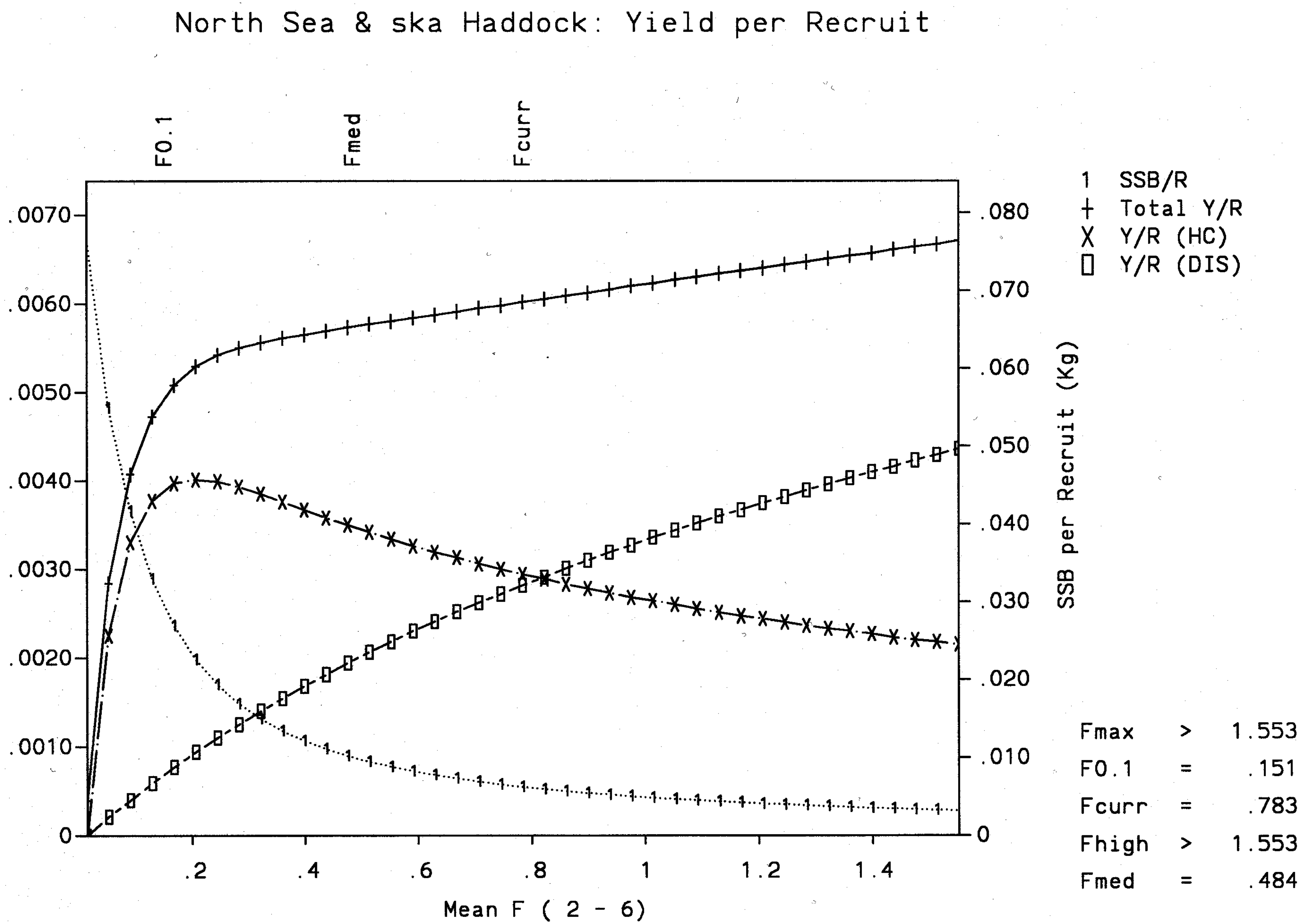

North Sea & ska Haddock: Yield per Recruit
F0.1
Fmed
Fcurr
1 SSB/R
+ Total Y/R
X Y/R (HC)
▯ Y/R (DIS)
.0070
.0060
.0050
.0040
.0030
.0020
.0010
0
.080
.070
.060
.050
.040
.030
.020
.010
0
SSB per Recruit (Kg)
.2
.4
.6
.8
1
1.2
1.4
Mean F (2 - 6)
Fmax > 1.553
F0.1 = .151
Fcurr = .783
Fhigh > 1.553
Fmed = .484

Figure 4.9.2

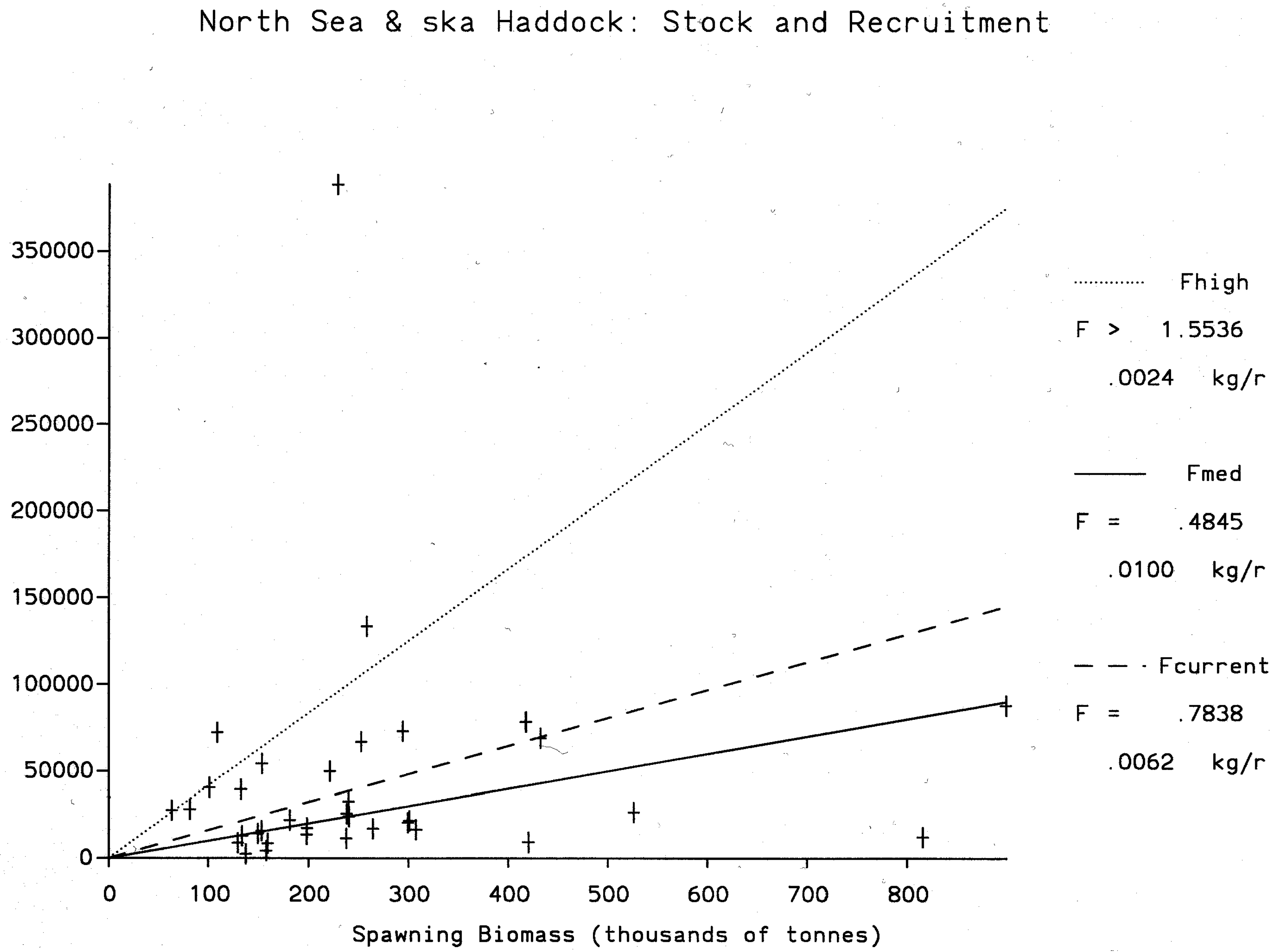
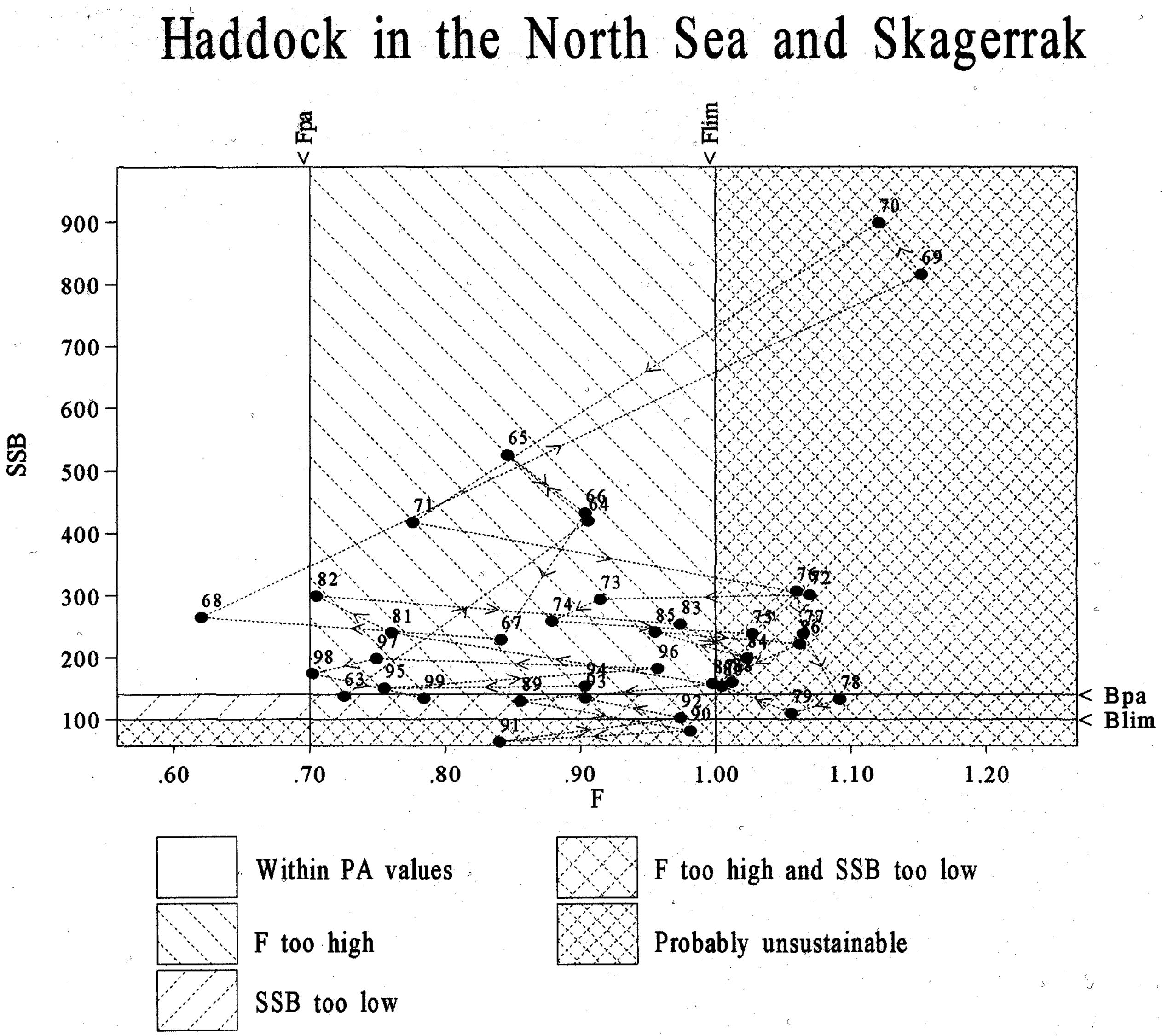
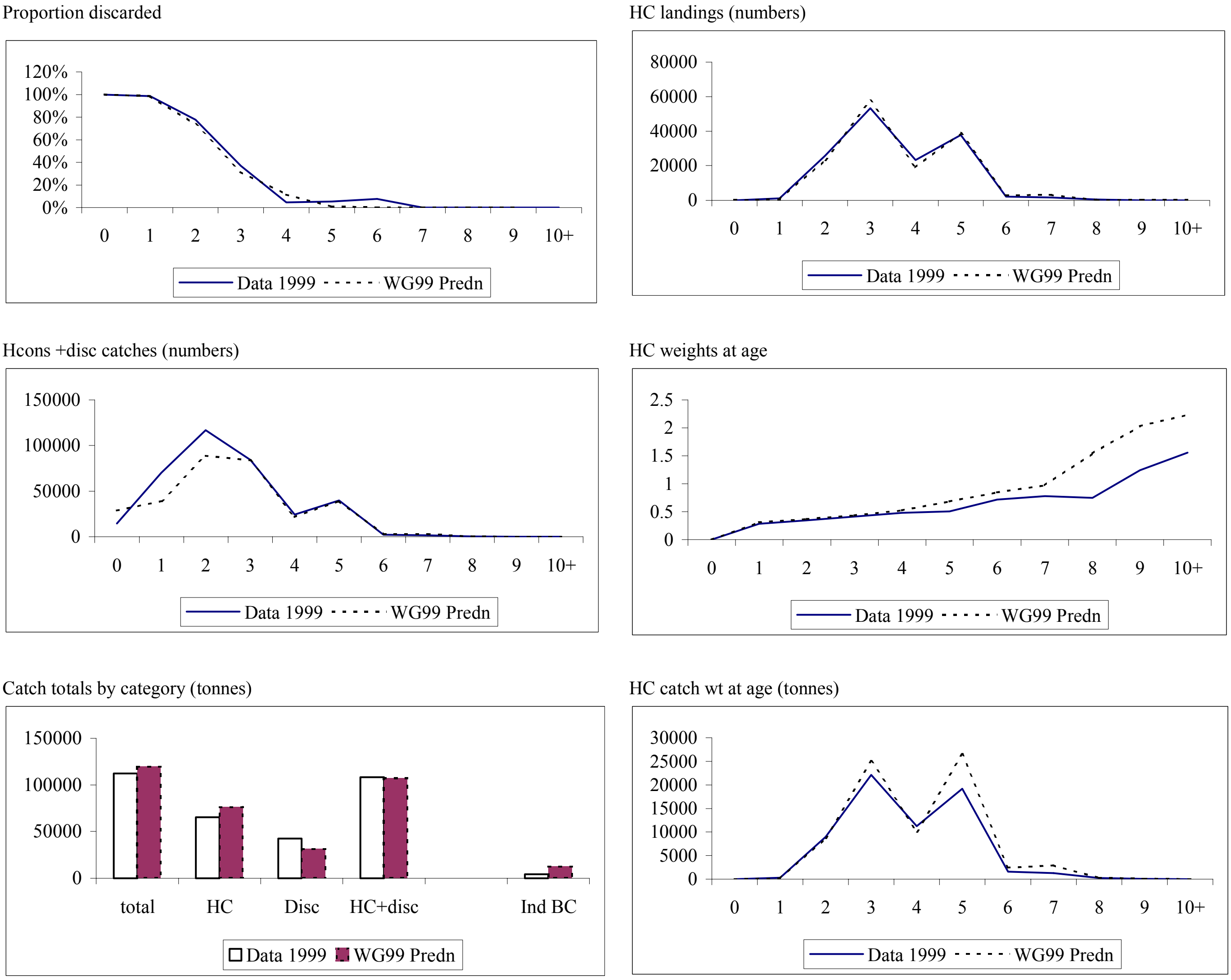

North Sea & ska Haddock: Stock and Recruitment
350000
300000
250000
200000
150000
100000
50000
0
0
100
200
300
400
500
600
700
800
Spawning Biomass (thousands of tonnes)
Fhigh
F > 1.5536
.0024 kg/r
Fmed
F = .4845
.0100 kg/r
Fcurrent
F = .7838
.0062 kg/r

Figure 4.9.3



Data file(s):C:\MyFiles\NS2000\Haddock\had34.pa;C:\MyFiles\NS2000\Haddock\Had34.sum
Plotted on 10/10/2000 at 17:54:19

Figure 4.10.1; Haddock in the North Sea and Skagerrak
Comparison of WG99 *status quo* prediction with resultant catches in '1999'



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, sandeel 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 ICES advice applicable to 1999 and 2000

ICES advice for the fishery in 1999 was to reduce fishing mortality to bring SSB above the proposed B_{pa} of 315,000 t. The stock was considered to be outside safe biological limits and ICES considered that, as a first step, fishing mortality should be reduced by 20%.

In its 1999 advice, the ICES perception of the stock was that it remained outside safe biological limits. Its advice was to recommend the lowest possible catches in 2000 and for the development of a recovery plan for whiting that takes account of its role in mixed demersal fisheries and as a by-catch in industrial fisheries. ICES proposed the following PA reference points: $\mathbf{B}_{pa}$ = 315,000 t, $\mathbf{B}_{lim}$ = 225,000 t, $\mathbf{F}_{pa}$ = 0.65 and $\mathbf{F}_{lim}$ = 0.9. These values were unchanged from the previous year.

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. This value represents an average split of the landings' distribution during the years immediately prior to the merger of VIId and IV whiting in assessments.

5.1.1.2 Management applicable to 1999 and 2000

The 1999 and 2000 TACs for Areas IIa (EC zone) and IV are 44,000 t and 30,000 t. 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 in 1999, the minimum mesh size was 90 mm. This derogation lapsed at the start of 2000 when EU technical conservation measures were harmonised. Whiting are a by-catch in some Nephrops fisheries that use a smaller mesh size, although landings are restricted through by-catch regulations. 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 in the human consumption fishery 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.

The UK has implemented a national regulation in late summer 2000, requiring the mandatory fitting of a square mesh panel in certain towed gears (Ferro and Graham, 2000). This measure was adopted with the support of the UK fishing industry and is specifically aimed at protecting the 1999 yearclass of haddock.

There is no separate TAC for Division VIId, landings from this Division are counted against the TAC for Divisions VIIb-k combined (25,000 t in 1999 and 22,500 t in 2000). Minimum mesh size for whiting in Division VIId is 80 mm with a 23 cm minimum landing size.

5.1.1.3 Fishery in 1999 and 2000

For the North Sea, the total international catches were 54,700 t in 1999, of which 26,000 t were human consumption landings, 23,600 t discards and 5,200 t industrial by-catch. This represents an increase in discards over the 1998 values (12,700 t), but human consumption landings and industrial by-catch remained close to their lowest recorded levels. The increase in discards and the marginal increases in human consumption landings and industrial by-catch from 1998 to 1999 arrests the decline in total catches seen since 1990 and restores them to their 1997 value. However, the total catch remains at a low value.

For the eastern Channel, the total catch in 1999 (4,400 t) was similar to the catches in both 1997 and 1998, at the lower end of the available data series.

The total North Sea and eastern Channel landings of 35,600 t in 1999 were 97% of the *status quo* forecast from the 1999 assessment. The difference comprised an underestimate by 1,800 t for the human consumption landings and an overestimate by 600 t of the industrial by-catch. Discards were underestimated by 40% (6,600 t). Although the overall differences in the forecast landings for 1999 are small, they hide the detail whereby catches of younger age groups in the human consumption landings were overestimated in the prediction, but balanced by underestimates of the landings of older fish.

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

The WG notes that several nations anticipate difficulties with quota management for whiting in 2000, as the uptake of some national quotas are running ahead of expectation. This is likely to be due to several factors:

- The setting of a restrictive TAC for 2000, with no corresponding reduction in fishing effort;
- The use of a short-term GM assumption for recruitment of the 1998 yearclass-at-age 1 in prediction. This may have significantly underestimated the strength of this yearclass;
- It is possible that changes in the distribution of whiting in recent years may have promoted its availability to those fleets currently showing high quota uptake rates.

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 estimates produced by an earlier key run of the North Sea MSVPA.

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. There were no revisions made to 1998 data.

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. There were no revisions made to 1998 data. No estimates of discards are available for whiting in the eastern Channel, although given the relatively low numbers in 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. Recent trends in mean weights-at-age are shown in Figure 5.1.2.1.

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. The catch and effort data used in the final XSA run 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.

All the available survey indices of recruitment are shown in Table 5.1.3.3.

5.1.4 Catch-at-age analysis

Concerns over the reliability of recent Scottish commercial fleet tuning data (see Section 1.3.1.4) meant that several exploratory runs were undertaken to evaluate the performance of the assessment in their absence. The aspects of the assessment that were changed in these runs were, firstly, the assumption of a constant catchability model on the younger ages, and secondly, the removal of particular ages or years of certain fleets as suggested by tuning diagnostics.

(i) Exploratory analysis

A separable VPA was run on the basic catch-at-age data using the default options, and unit selection and fully-exploited mortality values taken from previous assessments, in order to examine the consistency of the catch-at-age data. Figure 5.1.4.1 shows that the largest residuals detected in this model occur on the partially recruited youngest and relatively poorly-sampled oldest ages. The 0-group is not included in this analysis – it was removed from the age range in the 1999 assessment and has been removed again in the present assessment. The remaining ages do not show large residuals and are retained.

Single-fleet XSA runs were made using each of the available tuning series in turn and assuming light shrinkage. The time-series of log catchability residuals given in Figure 5.1.4.2 do not show discernible trends. In addition, there is no evidence of consistent trends or curvilinear relationships between log catchability residuals and log abundance across fleets for any of the younger ages. This suggests that a power catchability model on these ages would not be appropriate for whiting: in any case, exploratory XSA runs using such a catchability model did not converge and yielded extremely large log catchability residuals. A power model has not been used in recent assessments of this stock, so there is no change in this respect.

Consequently, a multi-fleet tuning run was made using the same XSA settings as last year, but excluding the Scottish commercial tuning fleets for reasons discussed elsewhere (Section 1.3.1.4). In addition, following changes in gear and vessel in the ScoGFS series, the 1998 and 1999 data were removed from this series. From the tuning diagnostics for this run, the FraTRB_IV showed a large negative year-effect in log catchability residuals for 1998, so that year was removed from that fleet in all subsequent analyses, as in the 1999 assessment: this had little effect as the fleet receives low weighting (Figure 5.1.4.6). The fitted log fleet CPUE to log XSA abundance regression lines had negative slopes for ages 2 and 3 in the EngGFS series (Figure 5.1.4.3), which was problematic because those ages received significant weighting for that fleet in the XSA tuning (23.1% and 13.6% respectively, Table 5.1.4.1). As a result, the EngGFS series was restricted to age 1 only. A negative slope was also evident for age 2 in the IBTS QIV series (Figure 5.1.4.3), but this is given no weighting in XSA tuning (Table 5.1.4.1): hence the full age range was retained for the IBTS QIV series.

(ii) Final run

The log-catchability residual plots from the final run are given in Figure 5.1.4.4, 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 survey shows a trend in log catchabilities. However, there is no corresponding trend in the plot of log catchability residuals for the single-fleet XSA run performed using this series (Figure 5.1.4.2), so it seems plausible that the trend observed in the multi-fleet run is a result of the influence of other tuning series rather than an inherent flaw in the ScoGFS survey. As for last year, the estimates of survivors for this survey are not heavily weighted (Figure 5.1.4.5 and Table 5.1.4.1) while its estimates of-terminal exploitation pattern and survivors are consistent with some others (Figures 5.1.4.6 and 5.1.4.7), and it was retained in the assessment.

The relative weightings of the different tuning fleets to the survivors' estimates are indicated in Figure 5.1.4.5, where the scaled weights are shown plotted by age and fleet. The most heavily weighted fleets on the younger ages are the IBTS Q1 and EngGFS surveys, while the oldest ages are heavily influenced by F shrinkage.

The-terminal exploitation patterns estimated for each fleet (Figure 5.1.4.6) show broad consistencies, although the discontinued IBTS QII survey is unusual in apportioning the highest-terminal F to age 3. It is also noticeable that exploitation on age 5 is less than that on ages 4 and 6 for five of the eight tuning fleets. The individual fleet estimates of log survivors given in Table 5.1.4.1 and plotted in Figure 5.1.4.7 show wider variation-at-age 3–5, while ages 1–2 are relatively consistent.

Retrospective analyses were undertaken this year using only the "diminishing series" approach, as the 10-year span to which tuning series were truncated did not permit retrospective runs using the "moving window" method. The tendency that has been observed in recent assessments for retrospective runs to show consistent underestimation in F and overestimation in SSB has been reduced this year (Figure 5.1.4.8): the estimates from runs using 1997–99 as final years do not show any such pattern. With the exception of the run using 1995 as the final-year, estimates of recruitment seem fairly consistent.

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.

Figure 5.1.4.9 gives a scatterplot of the estimates from the present assessment of spawning stock biomass and $\overline{F}_{2-6}$ in 1999 for the single-fleet and final multi-fleet tuning runs described above, and compares these with the predicted values from the 1999 assessment of this stock. The estimates of SSB from most of the single-fleet runs are comparable, with the exception of the third-quarter ScoGFS and EngGFS surveys which imply quite different final-year SSBs: in contrast, there is a wide range of estimates for final-year $\overline{F}_{2-6}$. The SSB and $\overline{F}_{2-6}$ predicted by the 1999 assessment is very close to that estimated by this year's assessment.

This year's final XSA configuration is given below, along with those from the 1999 assessment. Differences are highlighted in bold text, with the exception of the starting year for the tuning fleets:

	1999 assessment		**2000 assessment**	
Calibration period	10 years		10 years	
Age range	1–8+		1–8+	
Catchability model	Constant for all ages		Constant for all ages	
Catchability plateau	age 6		age 6	
F shrinkage:				
SE	0.5		0.5	
Year range	5		5	
Age range	3		3	
Fleets used:	**Ages**	**Years**	**Ages**	**Years**
ScoSei	2–7	1989–1998	**Not included**	**Not included**
ScoLtr	1–7	1989–1998	**Not included**	**Not included**
FraTrb	2–7	1989–1997	2–7	1990–1997
FraTro_IV	2–5	1989–1998	2–5	1990–1998
ScoGFS	1–6	1989–1997	1–6	1990–1997
EngGFS	1–5	1989–1998	**1**	1990–1999
IBTS QI	1–4, age-shifted	1989–1998	1–4, age-shifted	1990–1999
FraGFS VIId	1–2	1991–1998	1–2	1991–1999
IBTS QIV (Eng)	1–4	1991–1996	1–4	1991–1996
IBTS QII (Sco)	1–6	1991–1997	1–6	1991–1997

5.1.5 Recruitment estimates

Consistency of surveys

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.

The relationship between survey indices and XSA estimates of population size were examined once more during the present meeting. Two aspects were considered: the concordance between different surveys/estimates of abundance for one-year-old fish, and the consistency of successive age group indices within individual surveys. Pairwise scatterplots of 1-gp abundance from XSA, IBTS QI, ScoGFS and EngGFS are shown in Figure 5.1.5.1 (The Scottish survey series is truncated from 1997 and does not include subsequent indices due to the change of vessel and gear in 1998). Although most of the plots in Figure 5.1.5.1 indicate a positive relationship between indices, there is a high degree of scatter associated with them. A feature of the ScoGFS data is the apparent increase in catchability in the last four years of the series. No identifiable change occurred in the conduct of the survey over that period. This feature is clearly identifiable in the time series plots of Log(Index/XSA estimate - approximately equivalent to plots of Log catchability) shown in Figure 5.1.5.2. It is also a feature of all the surveys that catchability appears to fluctuate and increase with time. This implies that older survey data should be downweighted or excluded from analyses incorporating the survey series.

The consistency of successive age group indices within the survey series was examined through scatterplots of successive indices of the same yearclass (Figure 5.1.5.3). All the plots presented show positive associations between age groups within surveys, particularly those between 1-gp and 2-gp indices.

Estimation of recruitment

As in the previous assessment of this stock, all the XSA estimates of survivors in 2000 have been used as inputs to catch prediction. However, no estimate of survivors as 1gp fish is available from the XSA. In recent assessments for this stock, the short-term GM of 1 gp abundance has been used as an estimate of recruitment for input to prediction. This was done to reflect the recent apparent regimen of low recruitment for this stock. The experience of the last two assessments is that this procedure greatly over-estimated recruitment for 1998 in the forecast undertaken in that year, and greatly under-estimated recruitment for 1999 in the forecast undertaken last year. This caused the WG to look again at its procedure for estimating 1gp abundance in the intermediate forecast year, starting with the following summary:

- The available 1-gp indices are IBTS, EngGFS and ScoGFS.
- All have low r^2 and unbalanced residuals over their full time series when fitted against XSA abundance.
- ScoGFS has a new vessel and gear, beginning in 1998.
- There is an indication of successive “high” and “low” recruitment regimens: high, 1960-1979, low 1980 to date.
- All surveys indicate that the 1999 year class as 1-year-olds is stronger than the preceding 1998 yearclass.
- XSA estimates the 1998 year class abundance to be 230235 x 10^4, there is no strong indication of retrospective patterns in XSA recruitment estimates.

Because of the apparent trend in Log catchability (Figure 5.1.5.2), and due to the apparent lower overall recruitment to the stock from 1980 onwards, the XSA abundance estimates were plotted against the IBTS and EngGFS 1-gp indices over that period. The results are shown in Figure 5.1.5.4. The 2000 survey index is shown in the Figures, indicating a value within the range of the data for the IBTS, but outside the range of the EngGFS data. Simple predictive regressions were made on the basis of these plots, as well as RCT3 predictions combining both survey series. Because the truncated data series was used, the RCT3 regressions were not taper-weighted. Results are summarised below:

Numbers x 10^{-4}	**Truncated survey series (1980 on)**				**Geometric Mean**		
Source	IBTS	EGFS	RCT3	RCT3	(60-98)	(80-98)	(90-98) WG99
Regression	Predictive	Predictive	Calibration	Predictive			
Shrinkage	No	No	Yes	No			
1999 yc estimate (age 1)	217026	259970	242325	232705	282243	200338	147551

The regressions still demonstrate low values for r^2 in all cases. Nevertheless, they all indicate the abundance of the 1999 year class as 1-gp to be around 220000 x 10^4, above the GM from 1980-1998, but well below that of the full series and much higher than the severely truncated GM period used in the previous assessment of this stock. The RCT3 calibration estimate of 242325 x 10^4 was taken forward into prediction as 1-gp abundance in 2000. This is because the procedure uses information from both surveys and the XSA mean in its estimation. Although RCT3 has in the past tended to overestimate recruitment when contrasted with subsequent XSA estimates of yearclass strength, the prediction this year is consistent with the 1999 yearclass estimate being greater than the XSA estimate of the 1998 yearclass, and also consistent with all the survey indices indicating the 1999 yearclass to be stronger than its predecessor. The input to RCT3 is given in Table 5.1.5.1 and the results are shown in Table 5.1.5.2.

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 for all the catch categories combined is indicated to have been reasonably stable over the period 1991–1996, with a fall in 1997 and 1998 although rising again in the most recent year. The human consumption landings component of F appears to have been stable or rising marginally since 1989, with a similar decline and rise over the most recent years as exhibited by total F.

The current assessment indicates a decline in SSB since 1990 and that SSB since 1993 has been successively lower each year, falling to an historical low value in 1998 (140,000 t). It is estimated to have increased slightly by 1 January in 1999 (151,000 t).

Estimates of all year classes between 1989 and 1999 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, an RCT3 estimate (2423 million, Table 5.1.5.2) was used for the 1999 year class-at-age 1, and short-term (1980–1998) GM recruitment-at-age 1 for subsequent year classes (2,003 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 rescaled to mean F in 1999 (rescaled and unscaled values were similar).

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 the very uncertain RCT3 estimate or geometric mean recruitment is assumed, contribute to 36% to the human consumption landings in 2000 and to 73% of the forecast SSB in 2001.

At *status quo*, the area-combined human consumption landings are predicted to be 49,000 t in 2001. This is expected to result in a spawning biomass in 2001 of 271,000 t and 2002 of 274,000 t.

The intermediate year forecast (i.e. for 2000) predicts catches of 40,000 t (human consumption), 28,000 t (discards) and 9,000 t (industrial by-catch). These values are 23%, 40% and 64% above the previous *status quo* forecast for 2000. *Status quo* reference F at the previous meeting was estimated to be 0.45, 0.14 and 0.34 for human consumption landings, discards and industrial by-catch. The corresponding values used this year are: 0.47, 0.15 and 0.05. Although the forecast human consumption landings of 40,000 t are above the TAC for the North Sea (30,000 t), approximately 5,000 t of this is attributable to landings taken from Division VIId. Much of the remaining difference is probably due to the assumption of a very short-term GM recruitment value for the 1999 yearclass made last year (1,507 millions) compared to the RCT3 value predicted this year of 2,423 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.

UK Technical Conservation Measures

To help protect the 1999 haddock yearclass, the UK in cooperation with its fishing industry, has enacted a regulation requiring the use of a square mesh panel in certain towed demersal gears. This measure came into force in late summer 2000 and the varying selection characteristics of the gear should, properly, be accounted for in the short-term forecasts. Consequently, a forecast was made assuming an age-dependent multiplier on F attributable to UK fleets. This was assumed to act over 5/12 of 2000 and throughout 2001. The input data and results are available on the ICES stock file. A comparison of the forecasts is given in Figure 5.1.7.1. From this it is clear that a full and effective implementation of the square mesh panel in UK fleets would greatly reduce both landings and discards in 2001. It is not currently possible to comment on the effectiveness of the panel. Some UK industry sources consider it to be ineffective, whilst others are concerned at the loss of fish above the minimum landing size from their catches.

Sensitivity Analysis

Inputs to a sensitivity analysis of the *status quo* combined area forecast are given in Table 5.1.7.4 and results presented in Figures 5.1.7.2 and 5.1.7.3.

The estimates of human consumption landings in 2001 are most sensitive to the overall level of fishing mortality in 2001 and the overall level of natural mortality in 2000. The estimate of spawning biomass at the start of 2002 is sensitive to the overall magnitude of natural mortality in 2001 as well as to the age-specific value of M-at-age 1 and recruitment and the biological characteristics of the 2000 year class. The variance in the prediction of human consumption landings in 2001 is dominated by the level of, and uncertainty in, strength of the 1998 yearclass. For SSB in 2002, the RCT3 estimate of the 1999 year class and its uncertainty, contributes 35% of its variance with a further 29% of its variance due to the magnitude and uncertainty of the 1998 year class strength.

Probability profiles for the human consumption landings in 2001 and the spawning biomass in 2002 are shown in Figure 5.1.7.3. They indicate approximately a 5% probability, at *status quo* human consumption F, that the spawning biomass at the start of 2002 will be below its lowest recorded value of 140,000 t (1998) in the short-term, but a 70% probability that it will lie below B_{pa} (315,000 t).

5.1.8 Medium-term predictions

The estimates in the present assessment for the 1998 and 1999 year classes are large when compared to the short-term GM 1990–97 used to predict them in the 1999 assessment. Taken together with the corresponding increase in SSB, this means that perceptions of stock size in the 10-year medium-term are likely to differ from those arising from the 1999 assessment. For this reason the WG decided that it was necessary to produce a new medium-term forecast in this year's assessment.

As a precursor to this, the Working Group re-examined the choice of time-series for stock and recruitment data to be used in medium-term forecasts. In the 1999 assessment the time-series was truncated at 1977, partly to attempt to account for the extrapolation of discard rates to earlier years from those in which the observations have been made, and partly to acknowledge a possible temporal shift in recruitment regime. From the stock summary plots in Figure 5.1.6.1 it would appear that such a temporal shift was more likely to have occurred around 1980. Consequently the stock-recruitment time-series for medium-term forecasts was truncated to year-classes 1980–1996: this change still accounts for the extrapolation of discard rates as discussed in the 1999 assessment, although it leads to a slightly modified impression of SSB/R references points such as F_{med}. The 1997 and 1998 year-classes were also removed as they represent uncoverged VPA estimates.

Parameters for four stock-recruitment models were estimated from these data, the models being Ricker, Beverton-Holt, Shepherd and Ockham (geometric mean recruitment over observed SSB range, linear decline to origin). The model-fitting program used was RecAn, a Windows-based alternative to the usual RECRUIT program which uses a more robust fitting algorithm. All model fits with the exception of the Okham fit were very similar and would lead to similar conclusions from the forecasts. From model-fit diagnostics it was seen that the Ricker model had slightly lower log residual sums-of-squares, and it was chosen for use in medium-term forecasts for this reason. This choice also complies with ACFM's recommendation that a stock-recruitment relationship should be used to generate diminishing recruitment at low stock sizes, and is the same as used in the 1999 assessment. The results of these recruitment model analyses are in the stock file.

The inputs to medium-term projections are similar to those for the sensitivity analysis, except that 10-year mean weights-at-age were used rather than a 3-year average: this was to avoid transitory changes in mean weights-at-age affecting the outcome. Projections were performed using the WGMTERMA program.

The results of medium-term projections corresponding to *status quo* human consumption F are presented in Figure 5.1.8.1. It must be borne in mind that such forecasts are strongly contingent on the assessment model and assumptions used. Given this caveat, it can be seen that both SSB and landings would be expected to have increased (on average) by the end of the 10-year projection. Several other projections were made for various multipliers of human consumption F, and the outcome of these are summarised in Figures 5.1.8.2 and 5.1.8.3. From the former, it would appear that there is a less than 5% probability of SSB being less than B_{lim} in 2009 given a continuance of *status quo* F. This is a considerable departure from the conclusion reached in last year's forecast, but it should be noted that the improvement is dependent on:

- the current evaluation of the 1998 and 1999 year-classes which are now considered to be relatively strong, as compared to their evaluation in the 1999 assessment;
- The truncation of the stock-recruitment time-series used for model fitting at 1980 this year, compared to 1977 in the previous assessment.

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 (1980-1997).

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.

Fmax	F0.1	Fmed	Fpa	Flim	Bpa	Blim
>1.3	0.36	0.56	0.65	0.9	315,000 t	225,000 t

Values for F are fishing mortality in the human consumption fishery, ie., human consumption landings plus discards. 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 the 1999 assessment. The perception of the recent trajectory of SSB is also similar.

(ii) Catch forecasts for this stock are uncertain due to the difficulties of estimating recruiting yearclass abundance. For the catch prediction made at this meeting, yearclasses with an RCT3 estimate of recruitment or assumed GM recruitment will account for 12% of the 2000 human consumption landings, 37% of the 2001 human consumption landings and 73% of the SSB in 2002 (Table 5.1.7.4).

(iii) The forecast is more problematic this year due to the implementation of UK technical conservation measures. It is not possible to evaluate whether there will be a full and effective implementation of these measures in 2001.

(iv) Previous meetings of WGNSSK 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.

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

(vi) The medium-term forecast results appear to be very sensitive to the choice of input period for stock-recruitment estimation, and variation in the starting population size of recruits.

(vii) It has been mentioned in previous assessments of this stock that there may have been a regimen shift in overall recruitment levels since the late 1970s. If this is true, then it has implications for management of this stock. In particular, biological reference points dependent upon long-term historical data may be inappropriate for current management purposes.

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, 1985–1999, as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	2,177	2,275	1,404	1,984	1,271	1,040	913	1,030	944	1,042	880	843	391	268	529
Denmark	16,152	9,076	2,047	12,112	803	1,207	1,529	1,377	1,418	549	368	189	103	46	58
Faroe Islands	6	-	12	222	1	26	-	16	7	2	21	-	6	1	-
France[2]	10,853	8,250	10,493	10,569	5,277	4,951	5,188	5,071	5,502	4,735	5,963,	4,704	3,526	1,908[1]	4,292
Germany, Fed.Rep.	226	313	274	454	415	692	865	511	441	239	124	187	196	103	176
Netherlands	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	1,795
Norway	103	103	74	52	32	55	103	232	130	79	115	66	75[1]	64[1]	68
Poland	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Sweden	22	33	17	5	17	16	48	22	18	10	1	1	1	1	13
UK (Engl.& Wales)[3]	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	2,268
UK (Scotland)	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	17,206
Total	71,934	66,709	64,978	66,294	40,125	41,084	46,607	46,998	47,301	42,216	41,399	35,116	31,573	23,938	25,405
WG estimate of H.Cons. landings	54,737	58,616	63,629	51,675	41,033	43,413	47,307	46,444	47,981	42,617	41,052	36,122	31,297	23,866	25,981
WG estimate of discards	28,912	79,664	53,996	28,147	35,852	55,839	33,639	30,615	42,871	33,010	30,264	28,181	17,217	12,708	23,584
WG estimate of Ind. By-catch	15,325	17,966	16,479	49,219	42,711	50,718	38,311	26,901	20,099	10,354	26,561	4,702	5,965	3,141	5,183
WG estimate of total catch	98,973	156,245	134,103	129,042	119,597	149,970	119,258	103,960	110,951	85,981	97,877	69,005	54,479	39,715	54,748
Unallocated landings	-17,197	-8,093	-1,349	-14,619	908	2,329	700	-554	680	401	-347	1,006	-276	-72	576

[1]Preliminary.
[2]Includes Division IIa (EC).
[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 1999.

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	53	4,495	32	185	-	4,765	-	4,598
1999[1]	48		6	135	-		-	4,431

[1]Preliminary
n/a = Not available

Table 5.1.1.3. Whiting in IV and VIId.

Annual weight and numbers caught, 1960 to 1999.

Year	Wt.('000t)				Nos.(millions)			
	Total	H Cons	Dis	IBC	Total	H Cons	Dis	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
1999	59	30	24	5	378	117	164	97
Min.	44	28	13	3	221	108	80	33
Mean	189	68	74	46	1054	236	452	366
Max.	368	108	241	152	2023	382	1581	1297

Table 5.1.1.4 Whiting in VIId. Annual weight and numbers caught (1960-1999)

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
1999	4431	19

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: catch numbers-at-age.

Run title : Whiting IV, VIId (run: XSACLN06/X06)

At 10/10/2000 20:41

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
1,	482896,	1079197,	1022790,	549436,	137590,	342622,	517081,	973202,	830541,	374343,
2,	259440,	619965,	220148,	751817,	369668,	148166,	343402,	216064,	523774,	1025996,
3,	215393,	219882,	156642,	96115,	164882,	330156,	93851,	122955,	111755,	158808,
4,	21460,	32745,	31722,	45332,	22843,	72200,	255875,	23958,	49514,	28972,
5,	23279,	1355,	5998,	9334,	10908,	8002,	37708,	69082,	7494,	13240,
6,	3634,	4099,	276,	1739,	2770,	3555,	8535,	7886,	31183,	1734,
7,	892,	385,	407,	9,	435,	765,	1520,	849,	1940,	5989,
+gp,	2380,	369,	125,	142,	55,	134,	470,	164,	127,	697,
0 TOTALNUM,	1009372,	1957996,	1438108,	1453923,	709151,	905600,	1258443,	1414158,	1556327,	1609779,
TONSLAND,	182361,	326093,	222431,	260771,	149956,	186760,	242233,	236994,	265266,	327617,
SOPCOF %,	102,	103,	102,	102,	107,	102,	103,	105,	102,	119,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	606831,	621941,	939141,	1155304,	756260,	955910,	479610,	1006082,	418910,	615524,
2,	83064,	107933,	319094,	666563,	986441,	407207,	1129375,	480939,	313391,	467537,
3,	571696,	18786,	46392,	135507,	234063,	303537,	169611,	279226,	242370,	218283,
4,	52108,	128541,	7833,	19028,	33307,	56549,	88015,	30130,	90047,	100976,
5,	11463,	13640,	59313,	5739,	4977,	9273,	15988,	21334,	7563,	29267,
6,	3723,	2306,	8392,	18186,	1243,	8014,	3163,	5561,	7565,	3111,
7,	1211,	730,	3486,	2504,	5856,	116,	495,	532,	1851,	1657,
+gp,	1514,	628,	1009,	546,	427,	1525,	675,	419,	277,	304,
0 TOTALNUM,	1331608,	894505,	1384660,	2003376,	2022574,	1742131,	1886931,	1824223,	1081974,	1436658,
TONSLAND,	271648,	195357,	191320,	270533,	296197,	305010,	368240,	347056,	188186,	243846,
SOPCOF %,	109,	130,	107,	102,	105,	103,	102,	104,	104,	102,

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	265359,	162899,	192640,	205646,	323408,	203321,	576731,	267051,	430344,	331672,
2,	416008,	346343,	114444,	184746,	175965,	141716,	167077,	368229,	307429,	173676,
3,	286077,	266517,	245247,	118412,	124886,	82037,	169577,	122748,	179502,	191942,
4,	90718,	102295,	88137,	131508,	49505,	37847,	46517,	85240,	39635,	78464,
5,	52969,	27776,	26796,	37231,	59817,	14420,	13367,	11392,	17901,	14367,
6,	10751,	12297,	6909,	8688,	13860,	17445,	3487,	4556,	2175,	5050,
7,	1152,	3540,	2082,	1780,	2964,	3328,	3975,	928,	544,	516,
+gp,	767,	326,	484,	930,	613,	904,	569,	1035,	168,	334,
0 TOTALNUM,	1123802,	921993,	676738,	688941,	751017,	501017,	981301,	861178,	977697,	796021,
TONSLAND,	223518,	192049,	140195,	161212,	145741,	106363,	161744,	138775,	133470,	123753,
SOPCOF %,	102,	103,	102,	106,	102,	109,	102,	101,	105,	102,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	253745,	128507,	239791,	217539,	163609,	137481,	72645,	53408,	71430,	178079,
2,	505010,	191193,	165354,	167577,	147177,	139010,	113956,	74200,	44697,	91355,
3,	129126,	187195,	89563,	124287,	90611,	111489,	98476,	82944,	42771,	45627,
4,	86324,	36830,	93636,	46543,	47533,	35728,	48575,	42154,	36459,	34175,
5,	32270,	26209,	11967,	46136,	17384,	15161,	14235,	18492,	17756,	18528,
6,	2003,	5519,	6878,	3946,	17264,	5159,	4695,	3358,	6392,	7547,
7,	735,	543,	2609,	1519,	998,	4515,	1294,	1020,	1426,	2049,
+gp,	112,	273,	117,	771,	460,	474,	1113,	460,	407,	676,
0 TOTALNUM,	1009325,	576269,	609915,	608317,	485037,	449016,	354990,	276036,	221338,	378036,
TONSLAND,	153453,	124975,	109704,	116166,	92606,	103268,	73957,	59102,	44312,	59179,
SOPCOF %,	103,	117,	103,	107,	103,	117,	103,	101,	102,	103,

Table 5.1.2.3. Whiting in IV and VIId: catch weights-at-age

Run title : Whiting IV, VIId (run: XSACLN06/X06)

At 10/10/2000 20:41

Table 2 Catch weights-at-age (kg)

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	.1170	.1190	.1190	.1120	.1240	.1240	.1090	.1180	.1120	.0970
2	.1900	.1930	.1870	.1950	.1740	.2090	.1870	.1990	.1880	.1730
3	.2560	.2590	.2670	.2720	.2680	.2420	.2490	.2690	.2950	.2620
4	.3140	.3030	.3330	.3530	.3550	.3320	.2880	.3320	.3590	.3630
5	.3440	.4120	.4000	.4120	.4440	.4210	.3680	.3400	.4840	.4150
6	.3840	.4200	.5200	.4720	.4890	.4990	.4340	.4250	.4470	.4190
7	.5010	.4930	.5190	.8200	.5350	.5420	.4730	.4950	.6200	.5350
+gp	.4494	.4416	.5439	.6133	.7424	.6415	.6969	.6223	.7437	.6772
0 SOPCOFAC	1.0211	1.0268	1.0199	1.0224	1.0699	1.0208	1.0253	1.0476	1.0160	1.1877

Table 2 Catch weights-at-age (kg)

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	.1100	.1160	.0710	.0840	.0710	.1000	.1070	.1170	.0740	.0980
2	.2040	.2190	.2010	.1660	.1500	.2150	.1940	.2100	.1820	.1660
3	.2410	.2860	.2840	.2780	.2590	.2780	.2940	.3190	.2340	.2590
4	.3490	.3190	.3890	.3720	.3830	.3760	.3480	.3990	.3220	.3010
5	.4550	.4330	.4190	.4390	.4710	.4700	.4390	.4440	.4270	.4110
6	.4520	.5310	.5210	.4630	.5210	.3560	.5010	.4620	.4280	.4550
7	.5120	.6370	.5750	.5520	.5440	.8170	.5140	.5470	.4660	.4920
+gp	.6442	.6823	.8016	.7765	.8258	.6064	.7022	.4753	.6488	.5822
0 SOPCOFAC	1.0947	1.3008	1.0684	1.0201	1.0520	1.0269	1.0222	1.0443	1.0382	1.0190

Table 2 Catch weights-at-age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	.0750	.0830	.0610	.1070	.0890	.0940	.1050	.0770	.0540	.0700
2	.1760	.1680	.1840	.1910	.1880	.1920	.1830	.1480	.1460	.1570
3	.2520	.2420	.2530	.2730	.2710	.2840	.2550	.2470	.2230	.2250
4	.3280	.3210	.3140	.3250	.3370	.3320	.3180	.2970	.3010	.2670
5	.3370	.3790	.3760	.3840	.3820	.4020	.3780	.3750	.3460	.3180
6	.4580	.4110	.4780	.4260	.3910	.4350	.4750	.3790	.4230	.3910
7	.4580	.4440	.5040	.4520	.4630	.4940	.4680	.5420	.5060	.4310
+gp	.5720	.7201	.7351	.5369	.5672	.4384	.6253	.5840	.6939	.3940
0 SOPCOFAC	1.0220	1.0301	1.0210	1.0630	1.0236	1.0897	1.0231	1.0071	1.0461	1.0184

Table 2 Catch weights-at-age (kg)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	.0830	.1030	.0820	.0730	.0800	.0870	.0930	.0910	.0910	.0760
2	.1370	.1690	.1850	.1750	.1700	.1810	.1670	.1780	.1800	.1740
3	.2090	.2180	.2570	.2520	.2540	.2580	.2360	.2430	.2360	.2330
4	.2500	.2900	.2770	.3190	.3230	.3410	.3020	.2950	.2810	.2560
5	.2790	.3070	.3320	.3290	.3710	.3850	.3870	.3330	.3140	.2890
6	.4080	.3380	.3460	.3490	.3670	.4300	.4060	.3810	.3390	.3030
7	.4900	.3650	.3140	.4030	.4140	.4340	.4280	.3810	.3300	.3090
+gp	.5988	.4004	.5031	.3806	.4160	.4202	.4302	.4178	.3667	.2867
0 SOPCOFAC	1.0294	1.1652	1.0307	1.0674	1.0305	1.1697	1.0251	1.0072	1.0246	1.0332

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: tuning fleet data used in final assessment.

```
Whiting in the North Sea/Eastern Channel     Tuning data 26/09/2000
108
FRATRB_IV
1990 1997
1    1    0    1
2    7
21758    3793.839     2123.863     2009.647     619.549      55.057       13.446
19840    2224.031     3828.925     818.81       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      429.99       29.428
17794    1022.589     3304.452     1536.77      1162.942     240.081      211.604
18883    655.484      1594.391     1438.238     482.197      199.09       37.912
15574    356.961      1406.893     1138.705     606.014      85.942       15.858
FRATRO_IV
1990 1998
1    1    0    1
2    5
71750    6169.851     3780.845     2456.12      365.136
67836    6083.866     2864.373     1412.447     776.926
51340    6498.04      1939.687     635.383      358.076
62553    4586.363     4306.749     877.038      289.873
51241    3298.43      1190.634     612.132      108.275
57823    6125.084     2673.85      543.82       98.577
50163    4742.85      3214.224     890.192      155.826
48904    4676.603     3929.122     1020.106     220.783
38103    1959.246     532.612      161.275      67.997
SCOGFS_IV
1990 1997
1    1    0.5  0.75
1    6
100  22.39    20.53    2.48     2.55     0.47     0.05
100  17.69    9.5      7.59     0.51     0.4      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    9.5      2.54     0.57     0.34     0.23
100  41.76    20.1     9.03     1.96     0.58     0.22
100  28.88    30.47    12.15    4.6      0.43     0.15
100  18.24    14.34    11.91    3.19     1.22     0.17
ENGGFS_IV
1990 1999
1    1    0.5  0.75
1    1
100  19.0085
100  33.30382
100  26.55459281
100  25.10378276
100  30.54599958
100  35.50604922
100  12.37869528
100  20.29258461
100  16.4772756
100  47.88862257
IBTS_Q1_IV
1990 1999
1    1    0.99 1
1    4
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    0.18     0.067    0.012
1    0.457    0.245    0.059    0.012
1    0.486    0.245    0.07     0.023
1    0.342    0.163    0.06     0.018
1    0.162    0.125    0.054    0.016
1    0.305    0.095    0.058    0.026
1    0.537    0.182    0.053    0.02
```

Table 5.1.3.2. Whiting in IV and VIId: tuning fleet data used in final assessment (continued).

```
FRAGFS_7d
1991 1999
1    1    0.75 1
1    2
27   1350     162
27   1674     378
27   675      216
27   6993     837
27   1836     216
27   1107     297
27   756      351
27   621      351
27   2712     255
IBTS_Q4_ENG_IV    Survey discontinued
1991 1996
1    1    0.75 1
1    4
100  55.27577     19.64171     15.09189     3.2546
100  45.0899      26.46158     5.3785       5.02968
100  54.20958     19.47387     7.16071      2.33451
100  61.33462     26.41324     4.14012      0.8418
100  107.996      41.715       11.186       2.56
100  36.556       30.33        8.653        4.815
IBTS_Q2_SCO_IV    Survey discontinued
1991 1997
1    1    0.25 0.5
1    6
100  94.9     38.56    22.86    3.74     1.23     0.51
100  129.76   47.5     11.42    4.28     1.14     0.45
100  104.67   41.49    20.86    5.17     4.85     0.36
100  65.4     35.71    8.55     2.38     0.9      0.75
100  191.61   77.3     26.19    4.42     2.21     0.41
100  44.02    49.62    22.3     8.33     1.25     0.59
100  14.07    22.6     18.02    6.43     1.4      0.13
```

Table 5.1.3.3 Whiting in IV. Research vessel survey recruitment indices.

Survey	IBTS	IBTS	EGFS	EGFS	EGFS	SGFS	SGFS	SGFS	DGFS	DGFS	DGFS	GGFS	GGFS	IBTS Q2	SGFS Q2	SGFS Q2	IBTS Q4
Index age	1	2	0	1	2	0	1	2	0	1	2	1	2	1	1	2	0
Year																	
1972	332																
1973	1156	763															
1974	322	496															
1975	893	153															
1976	679	535															
1977	418	219	284	220	74												
1978	513	293	184	247	52												
1979	457	183	355	201	71												
1980	692	391	199	353	125				166	330	62						
1981	227	485	349	183	288				1393	205	131						
1982	161	232	69	277	79	102	65	97	166	640	105						
1983	128	126	717	119	109	210	56	58	2649	431	224	6.8	15.3				
1984	436	179	173	506	108	454	108	37	143	1330	141	5.7	12.9				
1985	341	359	200	159	170	169	158	97	859	783	893	9.6	22.8				
1986	456	261	163	152	66	406	111	45	1784	384	75	12.2	24.6				
1987	669	544	137	228	130	120	141	115	2883	2004	252	91	70.8				
1988	394	862	382	188	132	642	97	161	629	1441	612	15.1	79.8				
1989	1465	542	1170	295	118	427	404	74	1882	1049	803	603.1	392.3				
1990	509	887	882	194	129	1943	224	205	5543	963	196	280.2	248.5				
1991	1014	675	167	333	77	1379	177	95	806	1552	214	324.3	163.7	1298	9490	3856	761
1992	916	748	455	266	131	2417	293	127	453	272	310	120.7	73.3	816	12976	4750	1219
1993	1087	524	252	251	96	247	317	117	2655	340	61			710	10467	4149	1326
1994	721	637	211	305	106	648	2365	950	1795	660	353	181.8	79	806	6540	3571	1318
1995	679	457	363	355	237	1243	4176	2010				104.7	74.5	1592	19161	7730	2013
1996	502	486	103	124	104	440	2888	3047						627	4402	4962	
1997	288	342	599	203	97	317	1824	1434						254	1407	2260	
1998	556	162	2048	165	179	12302*	4141*	5426*									
1999	676	305	1325	479	218	15276*	5410*	2090*									
2000	757	537	962	703	280	17076*	6646*	3329*									

* new vessel and gear

Key

IBTS	International bottom trawl survey, quarter 1
EGFS	English groundfish survey
SGFS	Scottish groundfish survey
DGFS	Dutch groundfish survey
GGFS	German groundfish survey
IBTS Q2	International bottom trawl survey, quarter 2
SGFS Q2	International bottom trawl survey, quarter 2 (Scottish component)
IBTS Q4	International bottom trawl survey, quarter 4
EGFS Q4	International bottom trawl survey, quarter 4 (English component)

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics.

Lowestoft VPA Version 3.1

8/10/2000 16:52

Extended Survivors Analysis

North Sea/Eastern Channel Whiting 1960-1999 21/09/00

CPUE data from file WHIIVEF.TUN

Catch data for 40 years. 1960 to 1999. Ages 1 to 8.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FRATRB_IV	1990	1999	2	7	0	1
FRATRO_IV	1990	1999	2	5	0	1
SCOGFS_IV	1990	1999	1	6	0.5	0.75
ENGGFS_IV	1990	1999	1	1	0.5	0.75
IBTS_Q1_IV	1990	1999	1	4	0.99	1
FRAGFS_7d	1990	1999	1	2	0.75	1
IBTS_Q4_ENG_IV	1991	1999	1	4	0.75	1
IBTS_Q2_SCO_IV	1991	1999	1	6	0.25	0.5

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 37 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.227	0.117	0.24	0.194	0.161	0.154	0.123	0.113	0.109	0.133
2	0.549	0.488	0.388	0.482	0.346	0.356	0.325	0.312	0.226	0.353
3	0.912	0.518	0.579	0.757	0.692	0.629	0.601	0.541	0.379	0.488
4	0.987	0.887	0.635	0.829	0.915	0.786	0.75	0.67	0.574	0.712
5	1.238	1.117	0.943	0.858	1.007	0.99	0.985	0.821	0.754	0.73
6	1.053	0.771	1.18	1.09	1.057	1.084	1.117	0.709	0.833	0.952
7	1.242	1.002	1.165	0.978	0.982	0.954	0.954	0.818	0.797	0.738

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics continued.

XSA population numbers (Thousands)

YEAR	AGE 1.00E+00	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00
1990	2.01E+06	1.50E+06	2.57E+05	1.60E+05	5.15E+04	3.49E+03	1.14E+03
1991	1.87E+06	6.20E+05	5.51E+05	7.28E+04	4.41E+04	1.16E+04	9.47E+02
1992	1.80E+06	6.44E+05	2.43E+05	2.31E+05	2.22E+04	1.12E+04	4.19E+03
1993	1.98E+06	5.49E+05	2.79E+05	9.60E+04	9.08E+04	6.74E+03	2.69E+03
1994	1.77E+06	6.31E+05	2.16E+05	9.21E+04	3.10E+04	3.00E+04	1.76E+03
1995	1.55E+06	5.81E+05	2.85E+05	7.63E+04	2.73E+04	8.83E+03	8.12E+03
1996	1.01E+06	5.14E+05	2.60E+05	1.07E+05	2.57E+04	7.91E+03	2.33E+03
1997	8.01E+05	3.46E+05	2.37E+05	1.00E+05	3.74E+04	7.49E+03	2.02E+03
1998	1.11E+06	2.77E+05	1.62E+05	9.71E+04	3.80E+04	1.28E+04	2.87E+03
1999	2.30E+06	3.85E+05	1.41E+05	7.80E+04	4.05E+04	1.39E+04	4.34E+03

Estimated population abundance at 1st Jan 2000

0.00E+00	7.80E+05	1.72E+05	6.08E+04	2.84E+04	1.52E+04	4.19E+03

Taper weighted geometric mean of the VPA populations:

2.81E+06	8.36E+05	3.21E+05	1.02E+05	3.08E+04	8.68E+03	1.97E+03

Standard error of the weighted Log(VPA populations) :

0.6026	0.6282	0.5891	0.6449	0.7773	0.8809	1.1902

Log catchability residuals.

Fleet : FRATRB_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	0.08	0.5	0.32	0.06	0.35	-0.16	-0.56	-0.58	99.99	99.99
3	-0.01	-0.25	0.01	0.19	0.09	0.42	-0.29	-0.16	99.99	99.99
4	-0.14	-0.2	-0.23	-0.13	0.3	0.45	-0.02	-0.03	99.99	99.99
5	-0.38	-0.12	-0.24	-0.28	-0.14	0.99	0.1	0.08	99.99	99.99
6	-0.2	-0.51	0.27	-0.15	-0.07	0.56	0.43	-0.33	99.99	99.99
7	-0.44	-0.12	-0.26	-0.25	0.03	0.44	-0.09	-0.68	99.99	99.99

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

Age	2	3	4	5	6	7
Mean Log q	-15.5899	-14.2089	-13.6504	-13.3721	-13.353	-13.353
S.E(Log q)	0.4067	0.237	0.2457	0.4322	0.3788	0.3793

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	0.68	1.28	14.88	0.73	8	0.27	-15.59
3	1.32	-0.754	14.74	0.49	8	0.32	-14.21
4	1.47	-1.444	14.62	0.61	8	0.34	-13.65
5	1.67	-1.145	15.27	0.33	8	0.71	-13.37
6	0.97	0.114	13.23	0.73	8	0.4	-13.35
7	0.79	1.575	12.33	0.91	8	0.24	-13.52

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics continued.

Fleet : FRATRO_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	-0.89	0.01	0.27	-0.07	-0.4	0.18	0.18	0.58	0.15	99.99
3	0.35	-0.79	-0.06	0.48	-0.38	0.01	0.41	0.71	-0.73	99.99
4	0.57	0.82	-0.96	0.13	0.04	-0.06	0.22	0.42	-1.19	99.99
5	0.07	0.99	1.12	-0.74	-0.39	-0.48	0.18	0.11	-0.86	99.99
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	-15.3245	-15.1898	-15.3547	-15.5513
S.E(Log q)	0.4263	0.5403	0.6688	0.7025

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	3.67	-3.501	20.88	0.2	9	1.01	-15.32
3	1.33	-0.4	16.08	0.17	9	0.76	-15.19
4	3.23	-1.077	23.77	0.03	9	2.14	-15.35
5	2.61	-1.071	23.65	0.06	9	1.82	-15.55

Fleet : SCOGFS_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.39	-0.62	0	-0.05	-0.14	0.45	0.49	0.26	99.99	99.99
2	-0.47	-0.4	-0.21	-0.08	-0.51	0.33	0.85	0.48	99.99	99.99
3	-0.63	-0.51	0.03	-0.27	-0.56	0.39	0.76	0.8	99.99	99.99
4	0	-0.88	0.25	-0.08	-0.99	0.35	0.85	0.5	99.99	99.99
5	-0.42	-0.5	0.24	0.14	-0.38	0.28	0.03	0.6	99.99	99.99
6	0.02	-0.77	0.58	-0.43	-0.6	0.59	0.34	0.27	99.99	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	-14.8905	-14.7071	-14.7436	-14.8536	-14.8699	-14.9696
S.E(Log q)	0.39	0.5019	0.5872	0.6452	0.3922	0.5365

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	4.23	-2.212	16.99	0.07	8	1.32	-14.89
2	4.14	-1.927	19.02	0.06	8	1.76	-14.71
3	2.34	-0.722	17.71	0.05	8	1.43	-14.74
4	0.66	0.782	13.76	0.48	8	0.44	-14.85
5	1.21	-0.497	15.76	0.49	8	0.5	-14.87
6	1.44	-0.905	17.54	0.41	8	0.78	-14.97

Fleet : ENGGFS_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.49	0.07	-0.04	-0.22	0.07	0.35	-0.3	0.42	-0.11	0.24
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									

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics continued.

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 q	-14.9515
S.E(Log q)	0.2911

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	1.21	-0.589	15.1	0.51	10	0.36	-14.95

Fleet : IBTS_Q1_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.21	0.27	0.08	0.14	-0.12	0.07	0.11	-0.41	-0.11	-0.25
2	0.02	0.23	0.03	-0.03	0.01	0.1	-0.22	-0.1	-0.24	0.21
3	0.3	0.01	-0.05	0.01	0.07	-0.1	-0.19	-0.26	0.03	0.19
4	0.37	0.19	0.09	-0.43	-0.31	0.41	-0.21	-0.35	0.08	0.17
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	-13.9461	-13.9746	-14.1449	-14.3393
S.E(Log q)	0.2147	0.1564	0.1654	0.3024

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	0.79	1.39	14.01	0.84	10	0.16	-13.95
2	0.9	0.96	13.9	0.92	10	0.14	-13.97
3	1.11	-0.623	14.33	0.81	10	0.19	-14.14
4	0.95	0.172	14.2	0.61	10	0.3	-14.34

Fleet : FRAGFS_7d

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	99.99	-0.32	0.04	-1	1.42	0.21	0.1	-0.05	-0.58	0.18
2	99.99	-0.77	-0.04	-0.36	0.74	-0.53	-0.11	0.44	0.59	0.05
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	-9.28	-9.9623
S.E(Log q)	0.6668	0.5112

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	0.87	0.203	9.9	0.27	9	0.62	-9.28
2	7.34	-1.59	-9.88	0.01	9	3.44	-9.96

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics continued.

Fleet : IBTS_Q4_ENG Sur

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	99.99	-0.21	-0.26	-0.21	0	0.69	0	99.99	99.99	99.99
2	99.99	-0.27	-0.1	-0.16	-0.11	0.43	0.21	99.99	99.99	99.99
3	99.99	-0.08	-0.24	0.06	-0.29	0.37	0.18	99.99	99.99	99.99
4	99.99	0.61	-0.33	-0.05	-0.96	0.23	0.5	99.99	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	-13.8998	-13.8767	-14.269	-14.1936
S.E(Log q)	0.3546	0.2662	0.2563	0.5825

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	1.78	-0.638	13.59	0.14	6	0.67	-13.9
2	-2.69	-1.026	11.69	0.02	6	0.71	-13.88
3	0.92	0.212	14.14	0.66	6	0.26	-14.27
4	1.91	-0.732	16.6	0.14	6	1.17	-14.19

Fleet : IBTS_Q2_SCO Sur

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	99.99	0.02	0.41	0.09	-0.28	0.93	-0.13	-1.04	99.99	99.99
2	99.99	-0.18	-0.05	0.01	-0.33	0.53	0.2	-0.2	99.99	99.99
3	99.99	-0.44	-0.29	0.24	-0.42	0.4	0.32	0.18	99.99	99.99
4	99.99	0.17	-0.95	0.19	-0.51	0.25	0.53	0.31	99.99	99.99
5	99.99	-0.4	0.15	0.15	-0.4	0.62	0.1	-0.22	99.99	99.99
6	99.99	0.03	0.09	0.34	-0.43	0.2	0.69	-0.92	99.99	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	-14.1177	-13.762	-13.9354	-14.2079	-14.1838	-14.2883
S.E(Log q)	0.6077	0.2894	0.3666	0.5267	0.3665	0.5277

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	0.48	1.786	14.16	0.7	7	0.25	-14.12
2	0.89	0.197	13.7	0.41	7	0.28	-13.76
3	1.51	-0.667	14.64	0.26	7	0.58	-13.94
4	21.89	-2.167	69.92	0	7	9.07	-14.21
5	1.14	-0.356	14.7	0.57	7	0.45	-14.18
6	1.5	-0.752	16.79	0.31	7	0.82	-14.29

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics continued.

Terminal year survivor and F summaries :

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

Year class = 1998

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	1	0	0	0	0	0	0
FRATRO_IV	1	0	0	0	0	0	0
SCOGFS_IV	1	0	0	0	0	0	0
ENGGFS_IV	990644	0.305	0	0	1	0.377	0.106
IBTS_Q1_IV	608627	0.3	0	0	1	0.391	0.167
FRAGFS_7d	937748	0.703	0	0	1	0.071	0.112
IBTS_Q4_ENG_IV	1	0	0	0	0	0	0
IBTS_Q2_SCO_IV	1	0	0	0	0	0	0
F shrinkage mean	747648	0.5				0.161	0.138

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
779667	0.19	0.13	4	0.67	0.133

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

Year class = 1997

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	1	0	0	0	0	0	0
FRATRO_IV	1	0	0	0	0	0	0
SCOGFS_IV	1	0	0	0	0	0	0
ENGGFS_IV	154061	0.305	0	0	1	0.231	0.388
IBTS_Q1_IV	182995	0.212	0.158	0.74	2	0.506	0.335
FRAGFS_7d	145615	0.428	0.299	0.7	2	0.126	0.406
IBTS_Q4_ENG_IV	1	0	0	0	0	0	0
IBTS_Q2_SCO_IV	1	0	0	0	0	0	0
F shrinkage mean	194450	0.5				0.137	0.319

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
172285	0.16	0.08	6	0.535	0.353

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

Year class = 1996

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	1	0	0	0	0	0	0
FRATRO_IV	70354	0.449	0	0	1	0.07	0.435
SCOGFS_IV	78646	0.414	0	0	1	0.074	0.397
ENGGFS_IV	93000	0.305	0	0	1	0.136	0.345
IBTS_Q1_IV	54119	0.175	0.181	1.04	3	0.498	0.535
FRAGFS_7d	87762	0.428	0.305	0.71	2	0.075	0.362
IBTS_Q4_ENG_IV	1	0	0	0	0	0	0
IBTS_Q2_SCO_IV	21471	0.65	0	0	1	0.03	1.024
F shrinkage mean	48991	0.5				0.116	0.578

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
60825	0.13	0.12	10	0.935	0.488

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics continued.

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

Year class = 1995

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	15811	0.431	0	0	1	0.042	1.051
FRATRO_IV	27703	0.357	0.653	1.83	2	0.071	0.724
SCOGFS_IV	46127	0.327	0.002	0.01	2	0.068	0.493
ENGGFS_IV	21044	0.305	0	0	1	0.074	0.875
IBTS_Q1_IV	30344	0.16	0.058	0.36	4	0.435	0.678
FRAGFS_7d	39143	0.428	0.16	0.37	2	0.041	0.56
IBTS_Q4_ENG_IV	28387	0.383	0	0	1	0.047	0.711
IBTS_Q2_SCO_IV	23558	0.28	0.024	0.09	2	0.097	0.81
F shrinkage mean	26309	0.5				0.126	0.75

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
28354	0.11	0.07	16	0.675	0.712

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

Year class = 1994

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	11720	0.249	0.176	0.71	2	0.107	0.873
FRATRO_IV	13390	0.337	0.561	1.67	3	0.072	0.798
SCOGFS_IV	29706	0.295	0.131	0.44	3	0.062	0.439
ENGGFS_IV	21566	0.305	0	0	1	0.047	0.564
IBTS_Q1_IV	14223	0.165	0.091	0.55	4	0.307	0.765
FRAGFS_7d	15135	0.429	0.152	0.35	2	0.027	0.733
IBTS_Q4_ENG_IV	22122	0.237	0.226	0.95	2	0.087	0.553
IBTS_Q2_SCO_IV	19731	0.231	0.152	0.66	3	0.111	0.604
F shrinkage mean	10760	0.5				0.18	0.924

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
15203	0.12	0.09	21	0.761	0.73

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

Year class = 1993

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	3679	0.203	0.082	0.41	3	0.146	1.033
FRATRO_IV	3678	0.356	0.341	0.96	4	0.07	1.034
SCOGFS_IV	5893	0.296	0.19	0.64	4	0.052	0.756
ENGGFS_IV	4505	0.305	0	0	1	0.027	0.908
IBTS_Q1_IV	3457	0.168	0.093	0.55	4	0.182	1.074
FRAGFS_7d	4735	0.429	0.919	2.14	2	0.015	0.878
IBTS_Q4_ENG_IV	5302	0.19	0.111	0.58	3	0.095	0.814
IBTS_Q2_SCO_IV	5954	0.228	0.114	0.5	4	0.087	0.751
F shrinkage mean	4041	0.5				0.326	0.974

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4189	0.17	0.06	26	0.343	0.952

Table 5.1.4.1. Whiting in IV and VIId: tuning diagnostics continued.

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

Year class = 1992

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	1929	0.207	0.1	0.48	4	0.133	0.673
FRATRO_IV	1721	0.366	0.126	0.34	4	0.043	0.731
SCOGFS_IV	2723	0.289	0.173	0.6	5	0.086	0.519
ENGGFS_IV	1365	0.305	0	0	1	0.015	0.858
IBTS_Q1_IV	1544	0.169	0.072	0.42	4	0.107	0.789
FRAGFS_7d	2010	0.429	0.815	1.9	2	0.009	0.654
IBTS_Q4_ENG_IV	2015	0.191	0.162	0.85	4	0.067	0.652
IBTS_Q2_SCO_IV	1623	0.239	0.157	0.66	5	0.115	0.762
F shrinkage mean	1496	0.5				0.424	0.806

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1696	0.22	0.05	30	0.242	0.738

Table 5.1.4.2. Whiting in IV and VIId: XSA-estimated fishing mortality-at-age.

Run title : Whiting IV,VIId (run: XSACLN06/X06)

At 10/10/2000 20:41

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F)-at-age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
1,	.2153,	.7628,	.3319,	.1458,	.1680,	.2216,	.4089,	.4106,	.1582,	.8141,
2,	.4675,	.9702,	.6350,	.8740,	.2391,	.5053,	.6945,	.5534,	.7992,	.5557,
3,	1.4903,	1.4009,	.9613,	.8620,	.6104,	.4462,	.9711,	.7669,	.8448,	.8065,
4,	2.3428,	1.2854,	.9435,	1.0411,	.5977,	.7130,	.9243,	.8670,	1.0291,	.6468,
5,	1.5743,	1.5244,	.9967,	.9359,	.8686,	.4736,	1.2559,	.7773,	.8397,	1.0029,
6,	1.9538,	2.0047,	2.8062,	1.0115,	.8927,	.8651,	1.7693,	1.1218,	1.1436,	.4957,
7,	1.9846,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,	.9321,	1.0156,	.7220,
+gp,	1.9846,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,	.9321,	1.0156,	.7220,
0 FBAR 2- 6,	1.5657,	1.4371,	1.2685,	.9449,	.6417,	.6006,	1.1230,	.8173,	.9313,	.7015,

Table 8 Fishing mortality (F)-at-age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	.7672,	.3989,	.3263,	.2881,	.4009,	.2261,	.1740,	.4265,	.1565,	.2327,
2,	.8249,	.5332,	.7060,	.8016,	.8535,	.7652,	.9250,	.4841,	.4059,	.4792,
3,	.9616,	.5664,	.6008,	1.0497,	1.0324,	.9642,	1.2525,	.8240,	.6314,	.7344,
4,	.8281,	.6989,	.5793,	.6302,	.9988,	.9276,	1.0533,	.9530,	.8465,	.7083,
5,	.6420,	.5874,	.9531,	1.4145,	.3600,	.9906,	.8414,	.9059,	.7477,	.8434,
6,	.9761,	.2647,	.9982,	.9874,	2.0110,	2.2622,	1.3526,	.8900,	1.1122,	.8853,
7,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,	.9263,	.9120,	.8207,
+gp,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,	.9263,	.9120,	.8207,
0 FBAR 2- 6,	.8465,	.5301,	.7675,	.9767,	1.0511,	1.1819,	1.0850,	.8114,	.7487,	.7301,

Run title : Whiting IV,VIId (run: XSACLN06/X06)

At 10/10/2000 20:41

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,	1989,
AGE										
1,	.1016,	.1653,	.1735,	.2104,	.2234,	.1902,	.2706,	.1407,	.3585,	.1291,
2,	.4408,	.3299,	.2935,	.4555,	.5168,	.2496,	.4258,	.5101,	.4311,	.4314,
3,	.8235,	.7540,	.5325,	.7476,	.8720,	.6361,	.7056,	.8718,	.6615,	.6970,
4,	.9772,	1.0018,	.7238,	.7379,	1.0312,	.8764,	1.1963,	1.2487,	.9721,	.8378,
5,	1.2439,	1.1024,	.9019,	.8934,	1.0602,	1.1774,	1.0555,	1.3629,	1.1623,	1.5339,
6,	.9799,	1.3317,	1.0283,	.9407,	1.1711,	1.2264,	1.1952,	1.7139,	1.2476,	1.5894,
7,	1.0795,	1.1591,	.8942,	.8664,	1.1004,	1.1064,	1.1629,	1.4608,	1.1409,	1.3372,
+gp,	1.0795,	1.1591,	.8942,	.8664,	1.1004,	1.1064,	1.1629,	1.4608,	1.1409,	1.3372,
0 FBAR 2- 6,	.8931,	.9039,	.6960,	.7550,	.9303,	.8332,	.9157,	1.1415,	.8949,	1.0179,

Table 8 Fishing mortality (F)-at-age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
1,	.2266,	.1169,	.2403,	.1944,	.1613,	.1540,	.1226,	.1134,	.1093,	.1328,	.1185,
2,	.5490,	.4877,	.3877,	.4818,	.3457,	.3560,	.3255,	.3123,	.2261,	.3531,	.2972,
3,	.9121,	.5184,	.5785,	.7573,	.6918,	.6287,	.6012,	.5408,	.3787,	.4884,	.4693,
4,	.9870,	.8868,	.6354,	.8288,	.9149,	.7859,	.7503,	.6702,	.5735,	.7117,	.6518,
5,	1.2378,	1.1171,	.9431,	.8577,	1.0069,	.9901,	.9848,	.8214,	.7537,	.7301,	.7684,
6,	1.0525,	.7712,	1.1804,	1.0901,	1.0566,	1.0844,	1.1165,	.7093,	.8332,	.9515,	.8313,
7,	1.2413,	1.0027,	1.1654,	.9777,	.9818,	.9536,	.9543,	.8183,	.7966,	.7384,	.7844,
+gp,	1.2413,	1.0027,	1.1654,	.9777,	.9818,	.9536,	.9543,	.8183,	.7966,	.7384,	
0 FBAR 2- 6,	.9477,	.7562,	.7450,	.8031,	.8032,	.7690,	.7557,	.6108,	.5530,	.6470,	

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Table 5.1.4.3. Whiting in IV and VIId: XSA-estimated stock numbers-at-age.

Run title : Whiting IV,VIId (run: XSACLN06/X06)

At 10/10/2000 20:41

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number-at-age (start of year) Numbers*10**-4

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
1,	400923,	325199,	582247,	651154,	143068,	277199,	247767,	464680,	912864,	108078,
2,	87000,	125023,	58654,	161573,	217660,	46774,	85897,	63665,	119189,	301392,
3,	33121,	34757,	30213,	19820,	42990,	109267,	17993,	27349,	23342,	34174,
4,	2758,	5259,	6035,	8141,	5899,	16453,	49284,	4801,	8951,	7067,
5,	3327,	196,	1077,	1740,	2129,	2404,	5975,	14487,	1495,	2369,
6,	480,	537,	33,	310,	532,	696,	1166,	1325,	5186,	503,
7,	114,	53,	56,	2,	88,	170,	228,	155,	336,	1287,
+gp,	295,	50,	17,	24,	11,	30,	69,	29,	22,	148,
0 TOTAL,	528019,	491073,	678332,	842765,	412376,	452992,	408378,	576492,	1071384,	455018,

Table 10 Stock number-at-age (start of year) Numbers*10**-4

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	182153,	304049,	542473,	742193,	368189,	759725,	482959,	465965,	465039,	476836,
2,	18518,	32708,	78911,	151393,	215190,	95363,	234370,	156954,	117641,	153798,
3,	110249,	5175,	12237,	24835,	43306,	58442,	28290,	59259,	61675,	49986,
4,	10751,	29699,	2070,	4729,	6126,	10869,	15703,	5698,	18319,	23115,
5,	2742,	3479,	10938,	859,	1866,	1671,	3185,	4057,	1628,	5821,
6,	677,	1124,	1506,	3284,	163,	1014,	483,	1069,	1277,	600,
7,	238,	199,	672,	432,	953,	17,	82,	97,	342,	327,
+gp,	294,	169,	191,	92,	68,	218,	110,	75,	50,	59,
0 TOTAL,	325622,	376602,	648998,	927818,	635860,	927319,	765182,	693174,	665971,	710543,

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Run title : Whiting IV,VIId (run: XSACLN06/X06)

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Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number-at-age (start of year) Numbers*10**-4

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	441772,	171898,	194480,	174255,	259731,	188716,	391158,	327219,	229693,	440415,
2,	146134,	154349,	56349,	63233,	54603,	80336,	60340,	115411,	109942,	62069,
3,	60733,	59960,	70761,	26791,	25567,	20765,	39908,	25133,	44186,	45553,
4,	16901,	18783,	19880,	29277,	8939,	7533,	7746,	13888,	7407,	16069,
5,	8433,	4712,	5110,	7142,	10370,	2362,	2323,	1735,	2952,	2076,
6,	1950,	1893,	1219,	1615,	2276,	2797,	567,	630,	346,	719,
7,	193,	570,	389,	339,	491,	550,	639,	134,	88,	77,
+gp,	126,	52,	89,	175,	100,	146,	90,	145,	27,	49,
0 TOTAL,	676241,	412216,	348278,	302827,	362077,	303206,	502771,	484294,	394639,	567027,

Table 10 Stock number-at-age (start of year) Numbers*10**-4

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 60-97	AMST 60-97
AGE													
1,	201208,	187263,	180483,	198029,	176602,	154926,	101245,	80106,	110934,	230236,	0,	289266,	342157,
2,	149700,	62036,	64431,	54888,	63057,	58124,	51367,	34638,	27659,	38461,	77967,	87859,	104281,
3,	25709,	55127,	24289,	27879,	21617,	28455,	25962,	23653,	16161,	14067,	17229,	33372,	38909,
4,	15988,	7277,	23133,	9597,	9213,	7627,	10693,	10028,	9705,	7798,	6083,	10247,	12676,
5,	5150,	4414,	2221,	9078,	3104,	2734,	2575,	3741,	3801,	4052,	2835,	3037,	3991,
6,	349,	1163,	1125,	674,	2999,	883,	791,	749,	1281,	1393,	1520,	848,	1177,
7,	114,	95,	419,	269,	176,	812,	233,	202,	287,	434,	419,	191,	306,
+gp,	17,	47,	19,	134,	80,	84,	197,	90,	81,	141,	225,		
0 TOTAL,	398236,	317422,	296118,	300548,	276847,	253644,	193061,	153206,	169909,	296582,	106278,		

Table 5.1.5.1 Whiting in IV and VIId. Input file to RCT3-at-age 1

```
"WHITING in IV, RCT3 INPUT VALUES; WGNSSK 2000 (Age 1)
2   21  2
'YEARCLASS' 'XSA'   'IYFS1' 'EGFS1'
   1980   171898     227    183
   1981   194480     161    277
   1982   174255     128    119
   1983   259731     436    506
   1984   188716     341    159
   1985   391158     456    152
   1986   327219     669    228
   1987   229693     394    188
   1988   440415     1465   295
   1989   201208     509    194
   1990   187263     1014   333
   1991   180483     916    266
   1992   198029     1087   251
   1993   176602     721    305
   1994   154926     679    355
   1995   101245     502    124
   1996   80106      288    203
   1997   -1         556    165
   1998   -1         676    479
   1999   -1         757    703
   2000   -1         -1     -1
```

Table 5.1.5.2 Whiting in IV and VIId. Results from RCT3-at-age 1

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

whiiv.rct

"WHITING in IV, RCT3 INPUT VALUES; WGNSSK 2000 (Age 1)

Data for    2 surveys over   21 years :  1980 - 2000

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

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

IYFS1     1.92    .32   1.26   .107     17   6.52   12.83    1.385     .082
EGFS1     4.97 -14.76   1.93   .048     17   6.17   15.90    2.339     .029

                                       VPA Mean =   12.20     .421     .889


Yearclass =   1999

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

IYFS1     1.92    .32   1.26   .107     17   6.63   13.05    1.393     .082
EGFS1     4.97 -14.76   1.93   .048     17   6.56   17.80    2.597     .024

                                       VPA Mean =   12.20     .421     .895


Year     Weighted      Log     Int     Ext     Var     VPA      Log
Class     Average      WAP     Std     Std    Ratio             VPA
         Prediction           Error   Error

1998      232215     12.36     .40     .45     1.28
1999      242325     12.40     .40     .62     2.39
2000      No valid surveys
```

Table 5.1.6.1. Whiting in IV and VIId: stock summary.

Run title : Whiting IV,VIId (run: XSACLN06/X06) ,

At 10/10/2000 20:41

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,
1960,	4009230,	743018,	312313,	182361,	.5839,	1.5657,
1961,	3251988,	737778,	374056,	326093,	.8718,	1.4371,
1962,	5822470,	908187,	282755,	222431,	.7867,	1.2685,
1963,	6511545,	1135803,	461526,	260771,	.5650,	.9449,
1964,	1430682,	704891,	516702,	149956,	.2902,	.6417,
1965,	2771995,	775236,	461499,	186760,	.4047,	.6006,
1966,	2477665,	646040,	392831,	242233,	.6166,	1.1230,
1967,	4646796,	820362,	322220,	236994,	.7355,	.8173,
1968,	9128643,	1380136,	452267,	265266,	.5865,	.9313,
1969,	1080778,	761259,	626243,	327617,	.5231,	.7015,
1970,	1821534,	560012,	378662,	271648,	.7174,	.8465,
1971,	3040487,	557321,	237691,	195357,	.8219,	.5301,
1972,	5424730,	645644,	290167,	191320,	.6593,	.7675,
1973,	7421927,	983469,	408501,	270533,	.6623,	.9767,
1974,	3681893,	735205,	476723,	296197,	.6213,	1.0511,
1975,	7597246,	1181014,	488457,	305010,	.6244,	1.1819,
1976,	4829595,	1126859,	630562,	368240,	.5840,	1.0850,
1977,	4659648,	1110395,	598817,	347056,	.5796,	.8114,
1978,	4650393,	775877,	452473,	188186,	.4159,	.7487,
1979,	4768363,	950254,	513933,	243846,	.4745,	.7301,
1980,	4417716,	835961,	520503,	223518,	.4294,	.8931,
1981,	1718975,	635921,	488196,	192049,	.3934,	.9039,
1982,	1944802,	491421,	377543,	140195,	.3713,	.6960,
1983,	1742550,	512294,	336689,	161212,	.4788,	.7550,
1984,	2597306,	484577,	270632,	145741,	.5385,	.9303,
1985,	1887161,	440641,	270422,	106363,	.3933,	.8332,
1986,	3911582,	662563,	288192,	161744,	.5612,	.9157,
1987,	3272194,	536556,	298648,	138775,	.4647,	1.1415,
1988,	2296925,	417685,	294453,	133470,	.4533,	.8949,
1989,	4404151,	561075,	278900,	123753,	.4437,	1.0179,
1990,	2012084,	482248,	317208,	153453,	.4838,	.9477,
1991,	1872628,	457019,	276968,	124975,	.4512,	.7562,
1992,	1804826,	406369,	265117,	109704,	.4138,	.7450,
1993,	1980288,	375300,	238956,	116166,	.4861,	.8031,
1994,	1766016,	356725,	222409,	92606,	.4164,	.8032,
1995,	1549260,	357608,	229233,	103268,	.4505,	.7690,
1996,	1012448,	288519,	197856,	73957,	.3738,	.7557,
1997,	801056,	238065,	168255,	59102,	.3513,	.6108,
1998,	1109339,	233668,	139840,	44312,	.3169,	.5530,
1999,	2302363,	312316,	151230,	59179,	.3913,	.6470,
2000	2423250*		223822**			
Arith. Mean ,	3335781,	658132,	357741,	188535,	.5197,	.8783,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

*RCT3 calibration estimate.

** calculated using mean weights-at-age, 1997-1999.

Table 5.1.7.1

Whiting in Sub-area IV and Division VIId

Multi fleet prediction: Input data

2000	Hcons		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	0.0190	0.173	0.0530	0.104	0.0620	0.040	2423.250	0.9500	0.1100	0.0000	0.0000	0.086
2	0.1110	0.218	0.1440	0.173	0.0700	0.109	779.670	0.4500	0.9200	0.0000	0.0000	0.177
3	0.2870	0.263	0.1760	0.205	0.0390	0.199	172.290	0.3500	1.0000	0.0000	0.0000	0.237
4	0.4900	0.299	0.1790	0.218	0.0250	0.274	60.820	0.3000	1.0000	0.0000	0.0000	0.277
5	0.6730	0.327	0.1260	0.231	0.0180	0.307	28.350	0.2500	1.0000	0.0000	0.0000	0.312
6	0.7680	0.357	0.1110	0.237	0.0020	0.196	15.200	0.2500	1.0000	0.0000	0.0000	0.341
7	0.7670	0.347	0.0640	0.359	0.0000	0.000	4.190	0.2000	1.0000	0.0000	0.0000	0.340
8+	0.7140	0.380	0.1170	0.262	0.0000	0.000	2.250	0.2000	1.0000	0.0000	0.0000	0.357
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

2001	Hcons		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	0.0190	0.173	0.0530	0.104	0.0620	0.040	2003.880	0.9500	0.1100	0.0000	0.0000	0.086
2	0.1110	0.218	0.1440	0.173	0.0700	0.109	.	0.4500	0.9200	0.0000	0.0000	0.177
3	0.2870	0.263	0.1760	0.205	0.0390	0.199	.	0.3500	1.0000	0.0000	0.0000	0.237
4	0.4900	0.299	0.1790	0.218	0.0250	0.274	.	0.3000	1.0000	0.0000	0.0000	0.277
5	0.6730	0.327	0.1260	0.231	0.0180	0.307	.	0.2500	1.0000	0.0000	0.0000	0.312
6	0.7680	0.357	0.1110	0.237	0.0020	0.196	.	0.2500	1.0000	0.0000	0.0000	0.341
7	0.7670	0.347	0.0640	0.359	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.340
8+	0.7140	0.380	0.1170	0.262	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.357
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

(cont.)

Table 5.1.7.1 (Cont'd)

Whiting in Sub-area IV and Division VIId

Multi fleet prediction: Input data

(cont.)

2002	Hcons		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	0.0190	0.173	0.0530	0.104	0.0620	0.040	2003.880	0.9500	0.1100	0.0000	0.0000	0.086
2	0.1110	0.218	0.1440	0.173	0.0700	0.109	.	0.4500	0.9200	0.0000	0.0000	0.177
3	0.2870	0.263	0.1760	0.205	0.0390	0.199	.	0.3500	1.0000	0.0000	0.0000	0.237
4	0.4900	0.299	0.1790	0.218	0.0250	0.274	.	0.3000	1.0000	0.0000	0.0000	0.277
5	0.6730	0.327	0.1260	0.231	0.0180	0.307	.	0.2500	1.0000	0.0000	0.0000	0.312
6	0.7680	0.357	0.1110	0.237	0.0020	0.196	.	0.2500	1.0000	0.0000	0.0000	0.341
7	0.7670	0.347	0.0640	0.359	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.340
8+	0.7140	0.380	0.1170	0.262	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.357
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

Notes: Run name : SPRCLN02
Date and time: 09OCT00:17:16

Table 5.1.7.2

Whiting in Sub-area IV and Division VIId

Multi fleet prediction with mangement option table

Year: 2000											
Hcons			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	0.4658	39799	1.0000	0.1472	28208	1.0000	0.0490	9072	77079	420337	223822
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes

Year: 2001												Year: 2002	
Hcons			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	0.0490	10854	10854	435733	270750	511301	347610
0.1000	0.0466	5844	0.1000	0.0147	3647	1.0000	0.0490	10722	20213	.	270750	502510	338893
0.2000	0.0932	11440	0.2000	0.0294	7189	1.0000	0.0490	10592	29221	.	270750	494072	330529
0.3000	0.1397	16803	0.3000	0.0442	10628	1.0000	0.0490	10466	37897	.	270750	485970	322500
0.4000	0.1863	21944	0.4000	0.0589	13969	1.0000	0.0490	10343	46256	.	270750	478187	314789
0.5000	0.2329	26876	0.5000	0.0736	17215	1.0000	0.0490	10222	54313	.	270750	470706	307380
0.6000	0.2795	31608	0.6000	0.0883	20372	1.0000	0.0490	10104	62084	.	270750	463514	300259
0.7000	0.3261	36152	0.7000	0.1030	23442	1.0000	0.0490	9989	69583	.	270750	456595	293411
0.8000	0.3726	40516	0.8000	0.1178	26428	1.0000	0.0490	9877	76821	.	270750	449937	286823
0.9000	0.4192	44711	0.9000	0.1325	29334	1.0000	0.0490	9767	83812	.	270750	443527	280483
1.0000	0.4658	48744	1.0000	0.1472	32162	1.0000	0.0490	9660	90567	.	270750	437352	274378
1.1000	0.5124	52625	1.1000	0.1619	34917	1.0000	0.0490	9555	97096	.	270750	431403	268497
1.2000	0.5590	56359	1.2000	0.1766	37600	1.0000	0.0490	9452	103411	.	270750	425668	262831
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANCLN02
Date and time : 09OCT00:17:11
Computation of ref. F: Hcons: Simple mean, age 2 - 6
Dis: Simple mean, age 2 - 6
IBC: Simple mean, age 1 - 4
Basis for 2000 : F factors

Table 5.1.7.3

Whiting in Sub-area IV and Division VIId

Multi fleet prediction: Detailed tables

Year 2000. Hcons	F-factor	1.0000	and reference F	0.4658
Dis	F-factor	1.0000	and reference F	0.1472
IBC	F-factor	1.0000	and reference F	0.0490

	Hcons			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	0.0190	28108	4863	0.0530	78405	8154	0.0620	91719	3669	198232	16686	2423250	208400	266558	22924	266558	22924
2	0.1110	60223	13129	0.1440	78127	13516	0.0700	37978	4140	176327	30784	779670	138002	717296	126961	717296	126961
3	0.2870	33280	8753	0.1760	20409	4184	0.0390	4522	900	58212	13837	172290	40833	172290	40833	172290	40833
4	0.4900	18886	5647	0.1790	6899	1504	0.0250	964	264	26748	7415	60820	16847	60820	16847	60820	16847
5	0.6730	11730	3836	0.1260	2196	507	0.0180	314	96	14239	4439	28350	8845	28350	8845	28350	8845
6	0.7680	6991	2496	0.1110	1010	239	0.0020	18	4	8019	2739	15200	5183	15200	5183	15200	5183
7	0.7670	2005	696	0.0640	167	60	0.0000	0	0	2173	756	4190	1425	4190	1425	4190	1425
8+	0.7140	1002	381	0.1170	164	43	0.0000	0	0	1167	424	2250	803	2250	803	2250	803
Total		162224	39799		187378	28208		135516	9072	485118	77079	3486020	420337	1266954	223822	1266954	223822
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year 2001. Hcons	F-factor	1.0000	and reference F	0.4658
Dis	F-factor	1.0000	and reference F	0.1472
IBC	F-factor	1.0000	and reference F	0.0490

	Hcons			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	0.0190	23243	4021	0.0530	64836	6743	0.0620	75846	3034	163926	13798	2003880	172334	220427	18957	220427	18957
2	0.1110	63310	13802	0.1440	82132	14209	0.0700	39925	4352	185367	32362	819640	145076	754069	133470	754069	133470
3	0.2870	69384	18248	0.1760	42549	8723	0.0390	9429	1876	121362	28847	359197	85130	359197	85130	359197	85130
4	0.4900	22821	6823	0.1790	8337	1817	0.0250	1164	319	32321	8960	73492	20357	73492	20357	73492	20357
5	0.6730	9313	3045	0.1260	1744	403	0.0180	249	76	11306	3525	22509	7023	22509	7023	22509	7023
6	0.7680	4486	1601	0.1110	648	154	0.0020	12	2	5146	1757	9754	3326	9754	3326	9754	3326
7	0.7670	2348	815	0.0640	196	70	0.0000	0	0	2544	885	4905	1668	4905	1668	4905	1668
8+	0.7140	1023	389	0.1170	168	44	0.0000	0	0	1191	433	2297	820	2297	820	2297	820
Total		195928	48744		200610	32162		126625	9660	523163	90567	3295673	435733	1446649	270750	1446649	270750
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 5.1.7.3 (Cont'd)

Whiting in Sub-area IV and Division VIId

Multi fleet prediction: Detailed tables

(cont.)

Year 2002. Hcons	F-factor 1.0000 and reference F	0.4658
Dis	F-factor 1.0000 and reference F	0.1472
IBC	F-factor 1.0000 and reference F	0.0490

	Hcons			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	0.0190	23243	4021	0.0530	64836	6743	0.0620	75846	3034	163926	13798	2003880	172334	220427	18957	220427	18957
2	0.1110	52353	11413	0.1440	67918	11750	0.0700	33016	3599	153287	26762	677792	119969	623569	110372	623569	110372
3	0.2870	72941	19184	0.1760	44731	9170	0.0390	9912	1972	127584	30326	377611	89494	377611	89494	377611	89494
4	0.4900	47577	14226	0.1790	17380	3789	0.0250	2427	665	67385	18680	153219	42442	153219	42442	153219	42442
5	0.6730	11253	3680	0.1260	2107	487	0.0180	301	92	13661	4259	27199	8486	27199	8486	27199	8486
6	0.7680	3562	1271	0.1110	515	122	0.0020	9	2	4086	1395	7744	2641	7744	2641	7744	2641
7	0.7670	1506	523	0.0640	126	45	0.0000	0	0	1632	568	3148	1070	3148	1070	3148	1070
8+	0.7140	1144	435	0.1170	188	49	0.0000	0	0	1332	484	2569	917	2569	917	2569	917
Total		213581	54752		197800	32154		121512	9364	532893	96271	3253162	437352	1415485	274378	1415485	274378
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRCLN02
Date and time : 09OCT00:17:16
Computation of ref. F: Hcons: 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.

Input data for catch forecast and linear sensitivity analysis.

Populations in 2000			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	2423250	.62	WS1	.09	.10	M1	.95	.11	MT1	.11	.10
N2	779669	.19	WS2	.17	.08	M2	.45	.26	MT2	.92	.10
N3	172288	.16	WS3	.24	.07	M3	.35	.14	MT3	1.00	.10
N4	60819	.13	WS4	.29	.10	M4	.30	.14	MT4	1.00	.00
N5	28348	.11	WS5	.33	.11	M5	.25	.14	MT5	1.00	.00
N6	15199	.12	WS6	.37	.11	M6	.25	.14	MT6	1.00	.00
N7	4190	.17	WS7	.39	.15	M7	.20	.14	MT7	1.00	.00
N8	2249	.22	WS8	.42	.20	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	.01	.59	WH1	.18	.08	sD1	.06	.30	WD1	.10	.12
sH2	.08	.30	WH2	.24	.08	sD2	.17	.25	WD2	.16	.09
sH3	.28	.12	WH3	.28	.06	sD3	.20	.17	WD3	.20	.06
sH4	.50	.13	WH4	.32	.09	sD4	.16	.21	WD4	.22	.07
sH5	.68	.15	WH5	.35	.10	sD5	.14	.63	WD5	.24	.09
sH6	.77	.16	WH6	.38	.11	sD6	.08	.51	WD6	.24	.06
sH7	.75	.10	WH7	.41	.14	sD7	.10	1.19	WD7	.31	.39
sH8	.82	.16	WH8	.43	.18	sD8	.04	1.93	WD8	.23	1.61

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI1	.05	.41	WI1	.06	.36
sI2	.06	.31	WI2	.13	.19
sI3	.05	.45	WI3	.23	.20
sI4	.03	.46	WI4	.28	.23
sI5	.02	.83	WI5	.35	.27
sI6	.03	1.22	WI6	.25	.86
sI7	.02	1.64	WI7	.17	1.09
sI8	.01	1.93	WI8	.13	1.69

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K**	1.00	.23	HF**	1.00	.12	IF**	1.00	.76
K**	1.00	.23	HF**	1.00	.12	IF**	1.00	.76
K**	1.00	.23	HF**	1.00	.12	IF**	1.00	.76

Recruitment		
Labl	Value	CV
R**	2003879	.46
R**	2003879	.46

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

Stock numbers in 2000 are VPA survivors.
These are overwritten at Age 1

Human consumption + discard Fs are obtained from mean exploitation pattern over 1990 to 1999.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1999, i.e. .613
Fs are distributed between consumption and discards by mean proportion retained over 1990 to 1999.
N.B. Above value for H Cons+Dis ref F is value for both catch categories combined.
Bycatch Fs are obtained from mean exploitation pattern over 1990 to 1999.
This is scaled to give a value for mean F (ages 1 to 4) equal to that in 1999, i.e. .049.

Table 5.1.9.1

Whiting in Sub-area IV and Division VIId

Multi fleet yield per recruit: Input data

	Hcons		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	0.0190	0.173	0.0530	0.104	0.0620	0.040	100000.00	0.9500	0.1100	0.0000	0.0000	0.086
2	0.1110	0.218	0.1440	0.173	0.0700	0.109	.	0.4500	0.9200	0.0000	0.0000	0.177
3	0.2870	0.263	0.1760	0.205	0.0390	0.199	.	0.3500	1.0000	0.0000	0.0000	0.237
4	0.4900	0.299	0.1790	0.218	0.0250	0.274	.	0.3000	1.0000	0.0000	0.0000	0.277
5	0.6730	0.327	0.1260	0.231	0.0180	0.307	.	0.2500	1.0000	0.0000	0.0000	0.312
6	0.7680	0.357	0.1110	0.237	0.0020	0.196	.	0.2500	1.0000	0.0000	0.0000	0.341
7	0.7670	0.347	0.0640	0.359	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.340
8+	0.7140	0.380	0.1170	0.262	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.357
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

Notes: Run name : YLDCLN02
Date and time: 09OCT00:17:21

Table 5.1.9.2

Whiting in Sub-area IV and Division VIId

Multi fleet yield per recruit: Summary table

Hcons			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	0.0490	650947	650947	225989041	42557665	134081111	34388962	134081111	34388962
0.1000	0.0466	1138592	0.1000	0.0147	292323	1.0000	0.0490	620879	2051794	204786978	35327518	112899910	27162507	112899910	27162507
0.2000	0.0932	1717440	0.2000	0.0294	510543	1.0000	0.0490	593893	2821876	192589898	31280547	100723542	23119202	100723542	23119202
0.3000	0.1397	2055186	0.3000	0.0442	691089	1.0000	0.0490	569565	3315841	184444207	28653271	92598415	20495566	92598415	20495566
0.4000	0.1863	2269784	0.4000	0.0589	847929	1.0000	0.0490	547542	3665255	178485365	26784017	86659989	18629926	86659989	18629926
0.5000	0.2329	2414399	0.5000	0.0736	987805	1.0000	0.0490	527523	3929727	173852843	25368785	82047736	17218281	82047736	17218281
0.6000	0.2795	2516207	0.6000	0.0883	1114546	1.0000	0.0490	509254	4140007	170093213	24248313	78308231	16101371	78308231	16101371
0.7000	0.3261	2590369	0.7000	0.1030	1230603	1.0000	0.0490	492519	4313491	166943974	23331034	75178972	15187629	75178972	15187629
0.8000	0.3726	2645913	0.8000	0.1178	1337691	1.0000	0.0490	477132	4460735	164241999	22560489	72496833	14420594	72496833	14420594
0.9000	0.4192	2688489	0.9000	0.1325	1437088	1.0000	0.0490	462935	4588512	161880130	21899905	70154658	13763497	70154658	13763497
1.0000	0.4658	2721780	1.0000	0.1472	1529793	1.0000	0.0490	449794	4701366	159784753	21324251	68078835	13191303	68078835	13191303
1.1000	0.5124	2748266	1.1000	0.1619	1616610	1.0000	0.0490	437591	4802467	157903398	20815852	66216891	12686340	66216891	12686340
1.2000	0.5590	2769664	1.2000	0.1766	1698204	1.0000	0.0490	426224	4894092	156197485	20361839	64530252	12235739	64530252	12235739
1.3000	0.6055	2787193	1.3000	0.1914	1775130	1.0000	0.0490	415608	4977931	154637899	19952594	62989801	11829881	62989801	11829881
1.4000	0.6521	2801731	1.4000	0.2061	1847864	1.0000	0.0490	405665	5055261	153202160	19580766	61573060	11461416	61573060	11461416
1.5000	0.6987	2813929	1.5000	0.2208	1916812	1.0000	0.0490	396330	5127071	151872572	19240623	60262334	11124611	60262334	11124611
1.6000	0.7453	2824273	1.6000	0.2355	1982325	1.0000	0.0490	387543	5194140	150634967	18927619	59043455	10814921	59043455	10814921
1.7000	0.7919	2833130	1.7000	0.2502	2044709	1.0000	0.0490	379255	5257095	149477827	18638096	57904907	10528689	57904907	10528689
1.8000	0.8384	2840787	1.8000	0.2650	2104235	1.0000	0.0490	371420	5316442	148391667	18369068	56837205	10262929	56837205	10262929
1.9000	0.8850	2847463	1.9000	0.2797	2161138	1.0000	0.0490	363999	5372600	147368584	18118071	55832449	10015175	55832449	10015175
2.0000	0.9316	2853334	2.0000	0.2944	2215628	1.0000	0.0490	356956	5425918	146401924	17883046	54883983	9783371	54883983	9783371
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDCLN02
Date and time : 09OCT00:17:21
Computation of ref. F: Hcons: Simple mean, age 2 - 6
Dis: Simple mean, age 2 - 6
IBC: Simple mean, age 1 - 4
Recruitment : 100000 (Millions)

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	4,641
1994	174	5,391	5,391	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	847	882	16	99	-	997
1999	37	1199	1156	15	178	-	1349

Figure 5.1.2.1 Whiting in IV and VIId. Mean weights-at-age in the catch

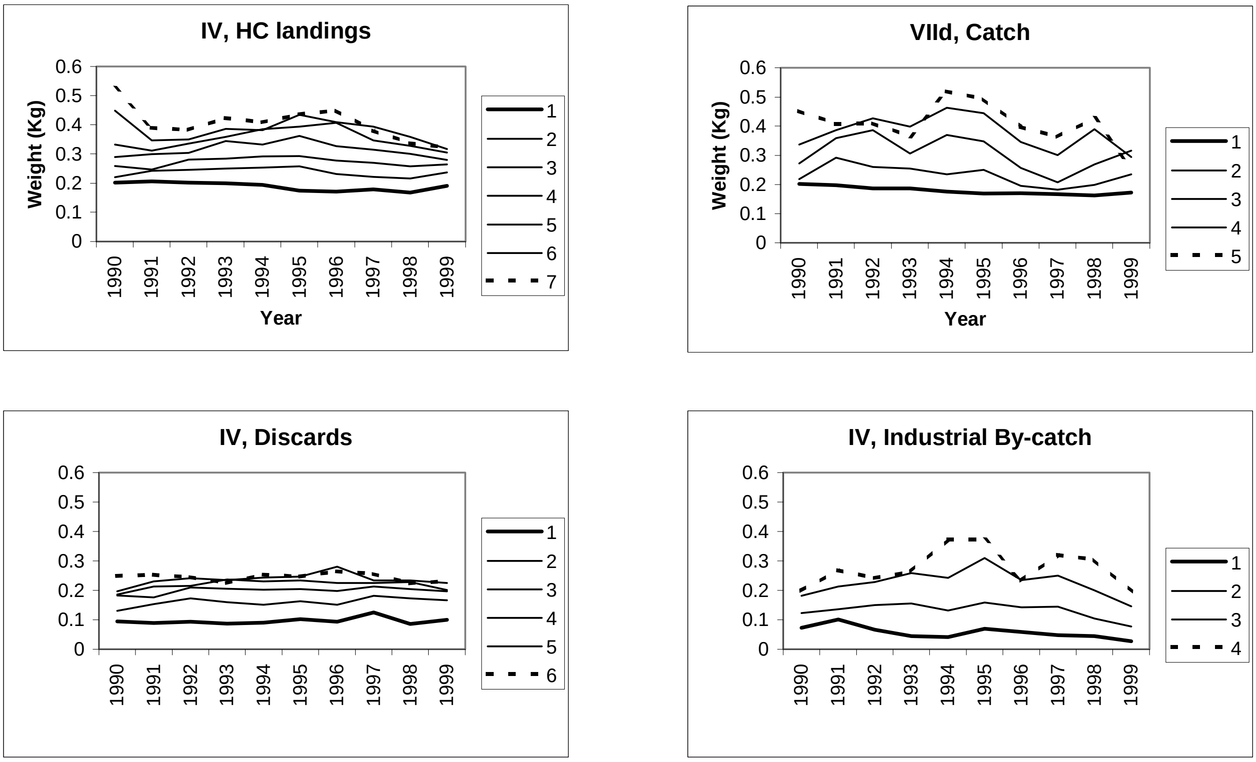
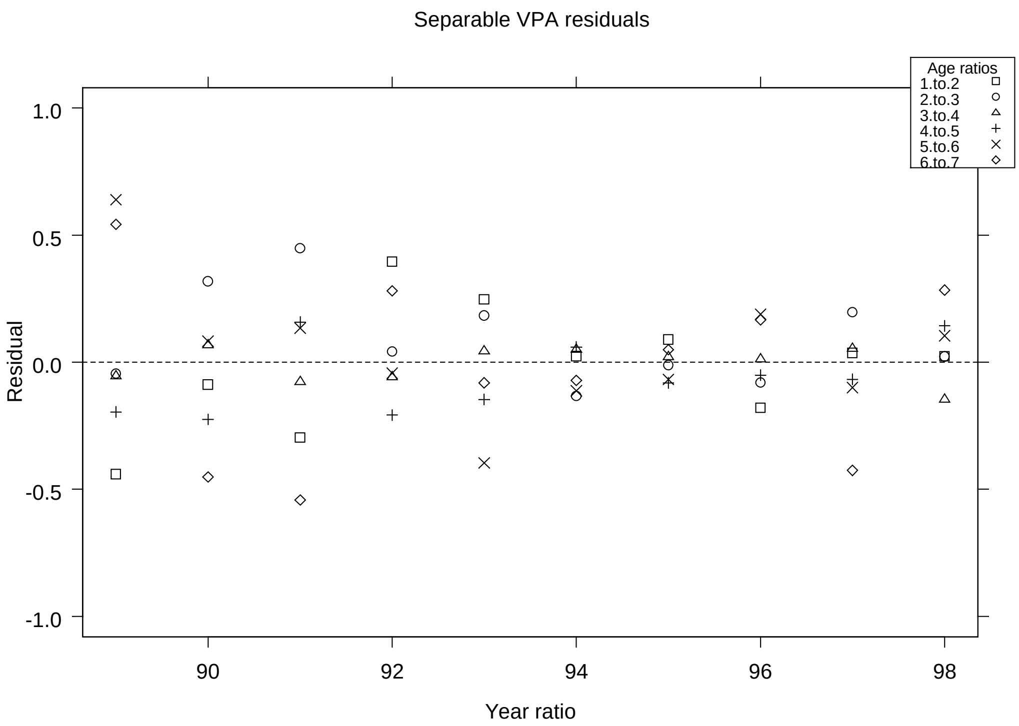


Figure 5.1.4.1. Whiting in IV and VIId: residuals from separable VPA run.



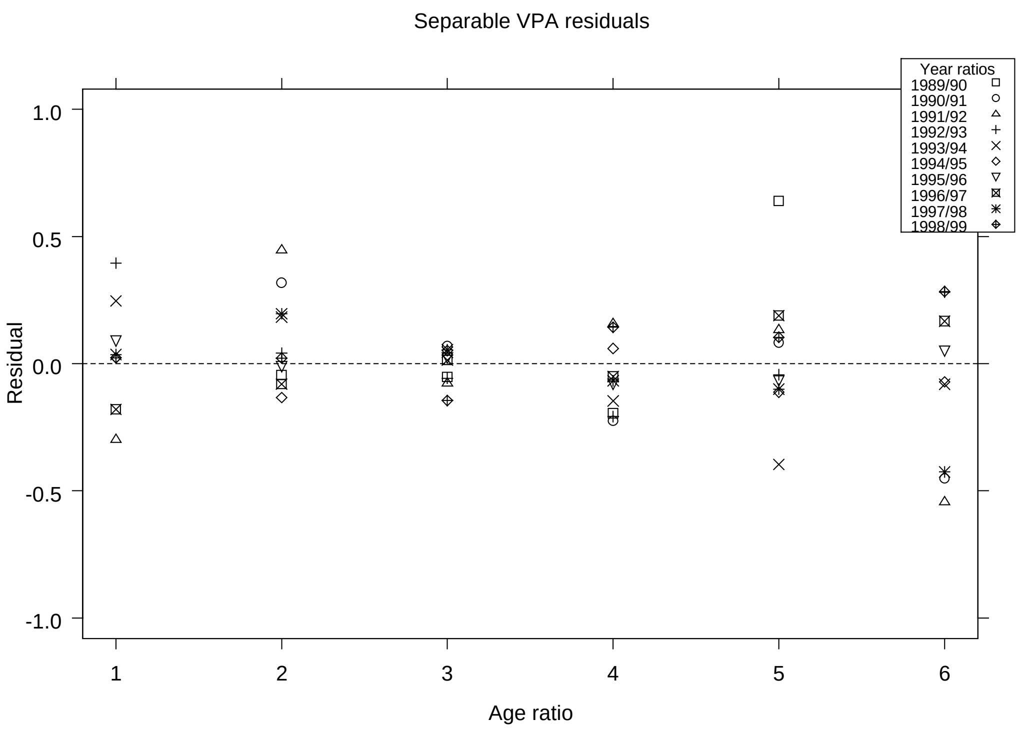
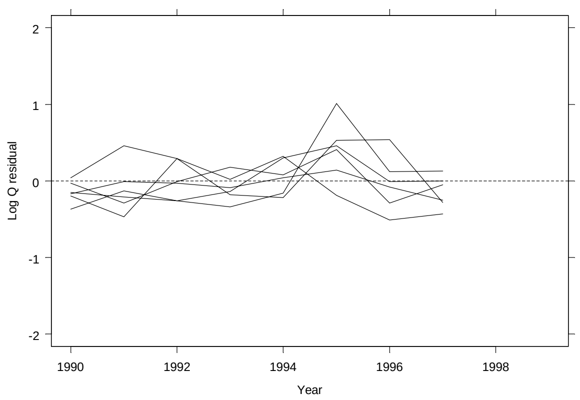
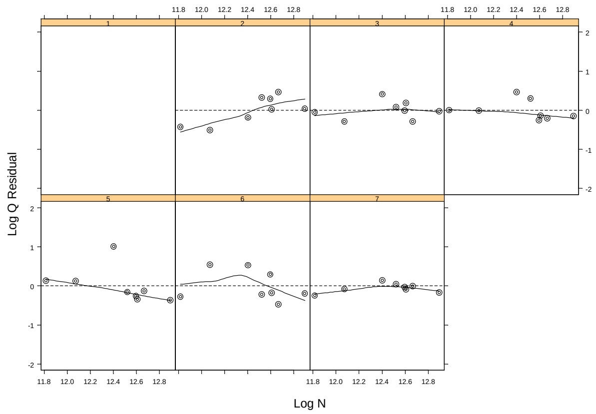


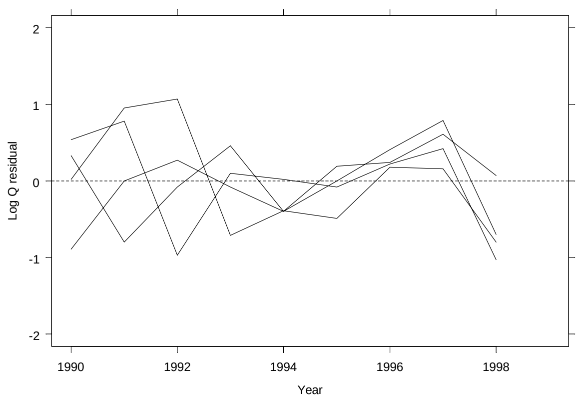
Figure 5.1.4.2. Whiting in IV and VIId: diagnostics from single-fleet XSA runs using light shrinkage (1.5). The upper plot for each fleet gives the time-series of log catchability residuals, with each line representing one age in the tuning fleet. The lower plot shows the log catchability residuals against log abundance by age: ages in panels are 1–4 across the top row, 5–7 across the bottom, and a lowess smoother of span 1.0 is fitted through each scatterplot to highlight any trends..

Fleet: FraTRB





Fleet: FraTRO



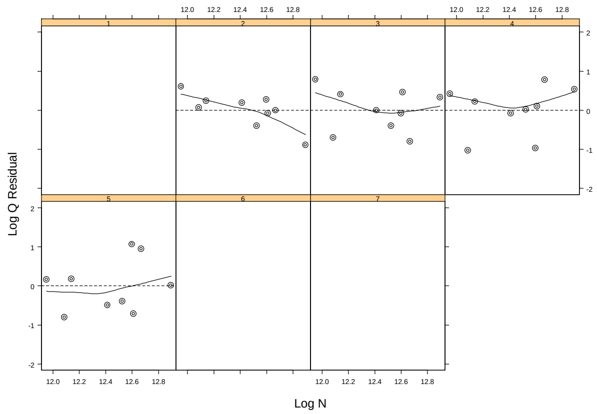
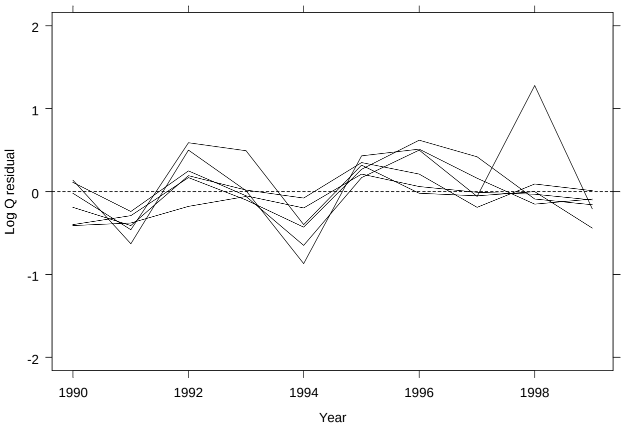
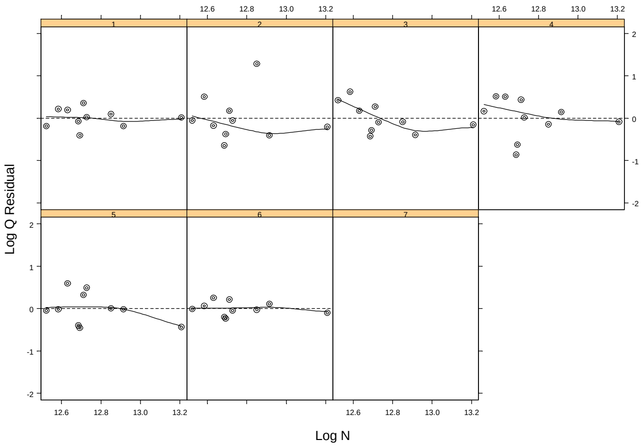


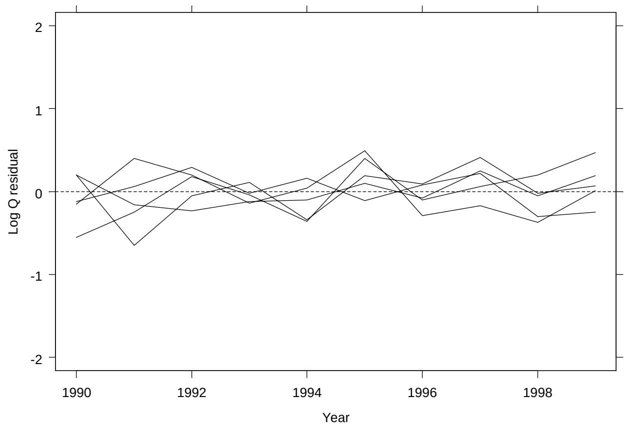
Figure 5.1.4.2. Whiting in IV and VIId: diagnostics from single-fleet XSA runs using light shrinkage (1.5) continued.

Fleet: ScoGFS





Fleet: EngGFS



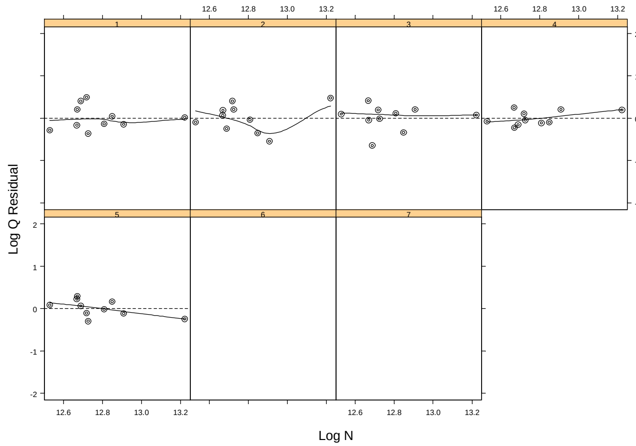


Figure 5.1.4.2. Whiting in IV and VIId: diagnostics from single-fleet XSA runs using light shrinkage (1.5) continued.

Fleet: IBTS Q1 Fleet: FraGFS 7d

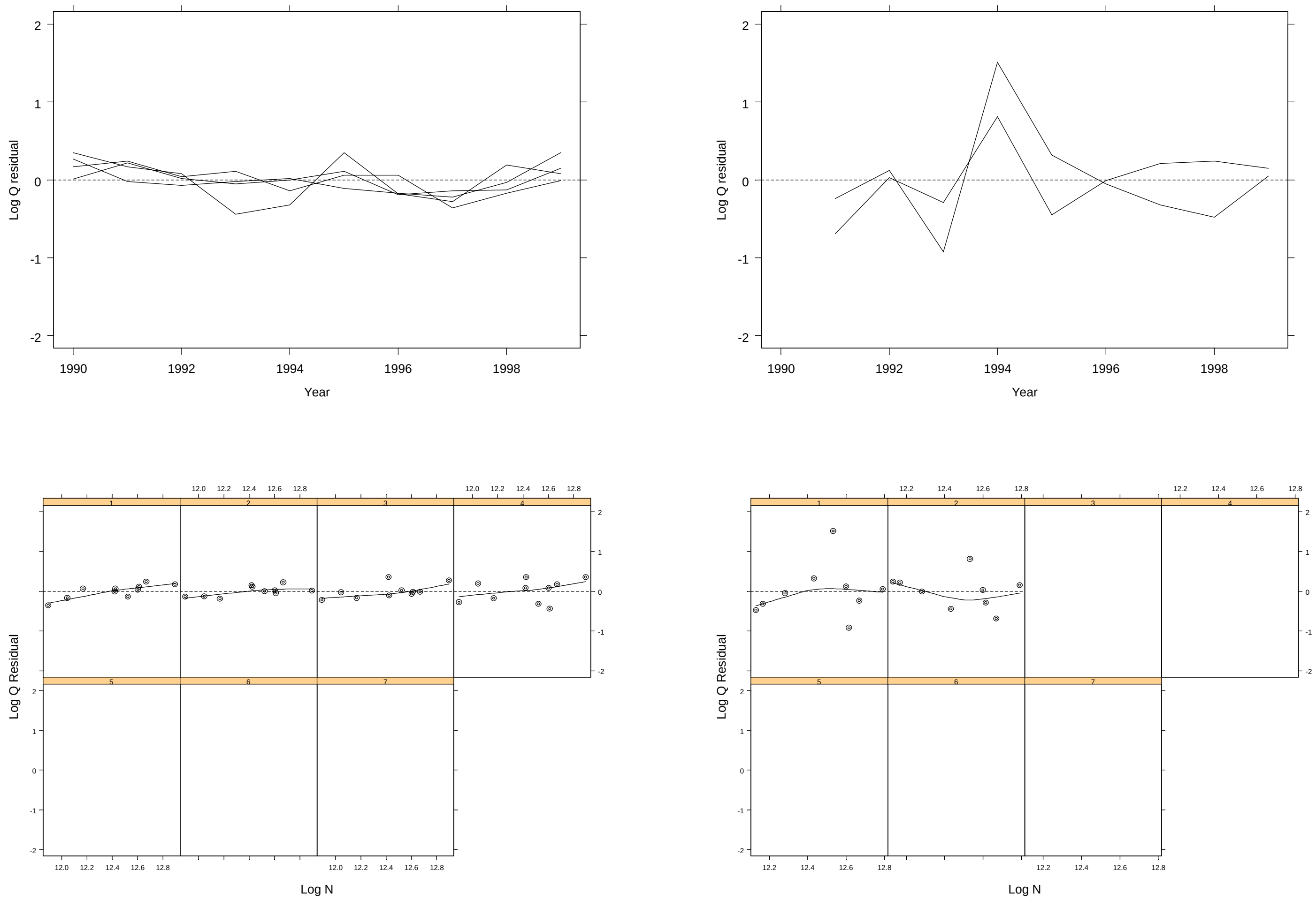
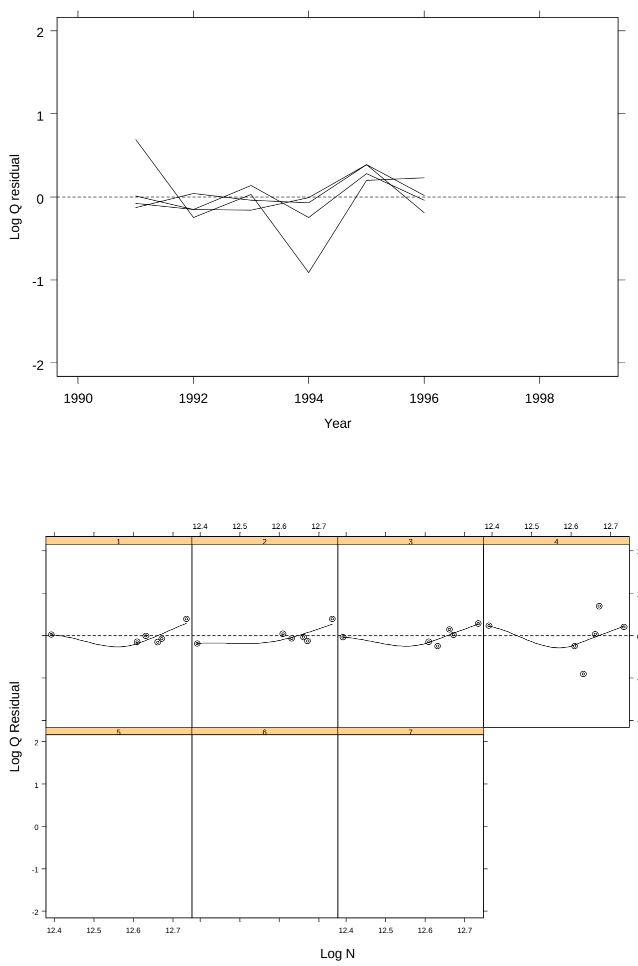


Figure 5.1.4.2. Whiting in IV and VIId: diagnostics from single-fleet XSA runs using light shrinkage (1.5) continued.

Fleet: IBTS Q4 Eng



Fleet: IBTS Q2 Sco

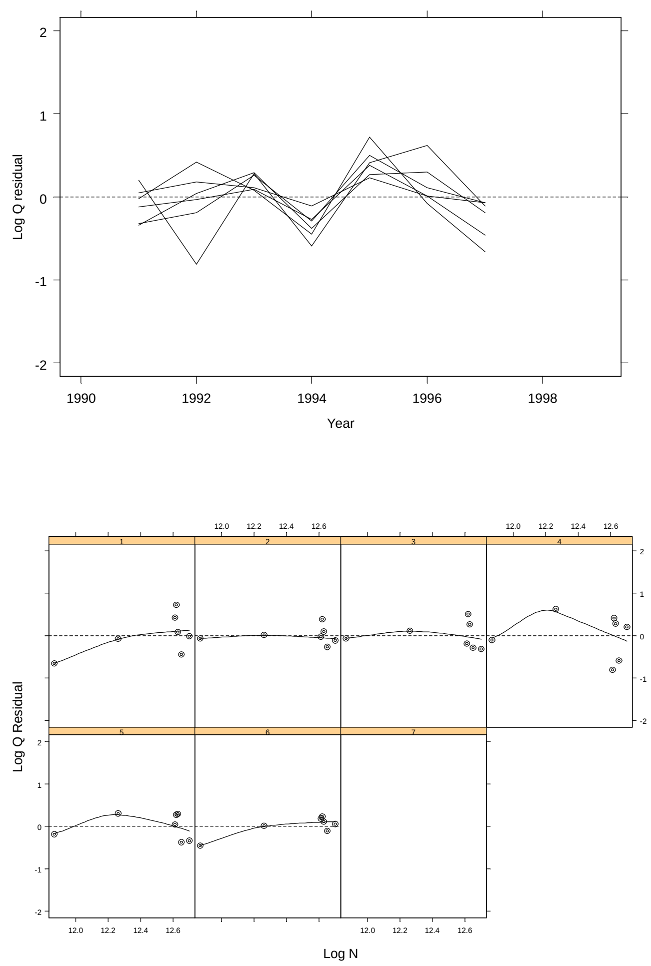
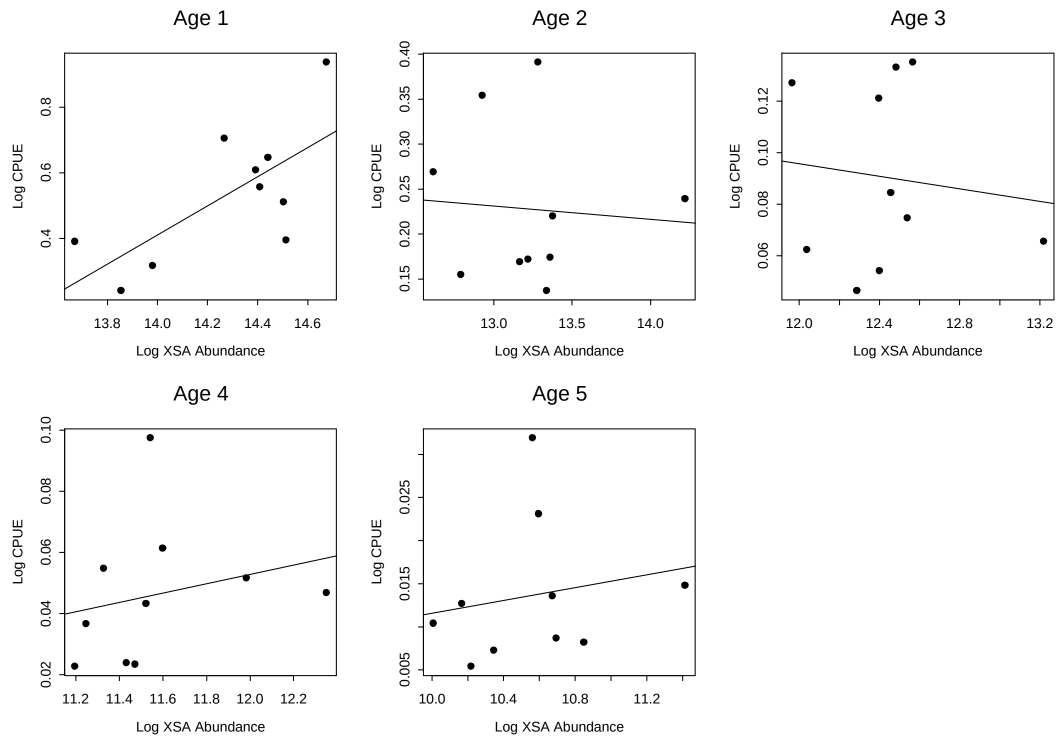


Figure 5.1.4.3. Whiting in IV and VIId: Log fleet CPUE against log XSA abundance, with least-squares regression fit.

(a) EngGFS series.



(b) IBTS Q4 Eng series.

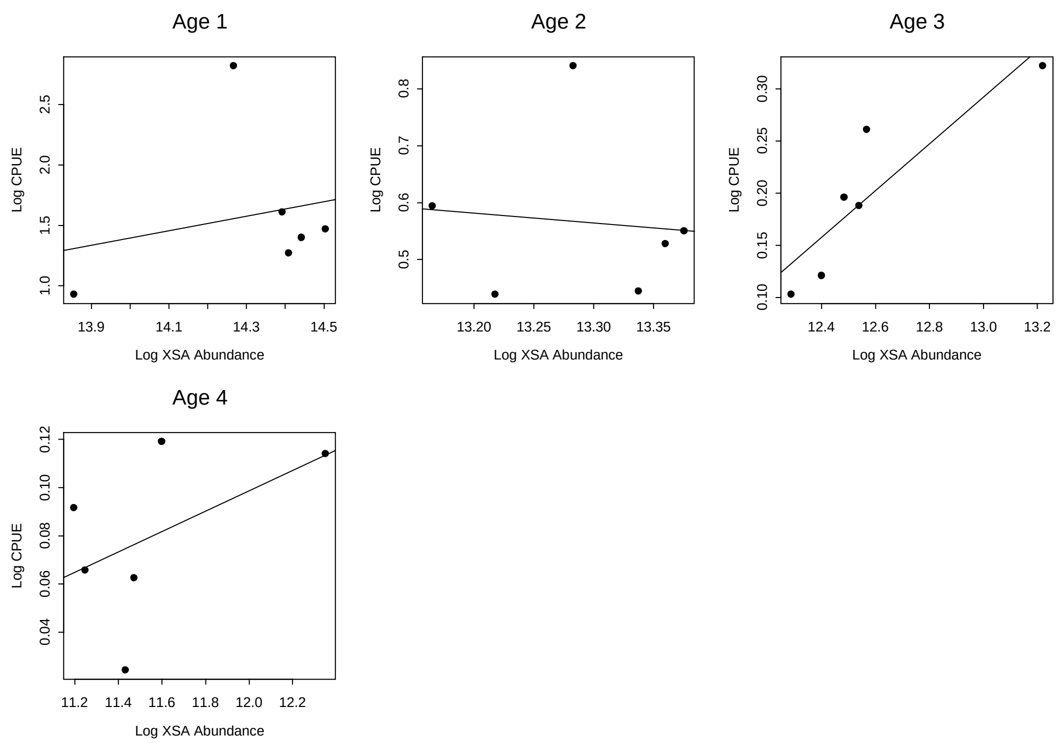


Figure 5.1.4.4. Whiting in IV and VIId: Fleet log catchability residuals by year and age for combined-fleet XSA run.

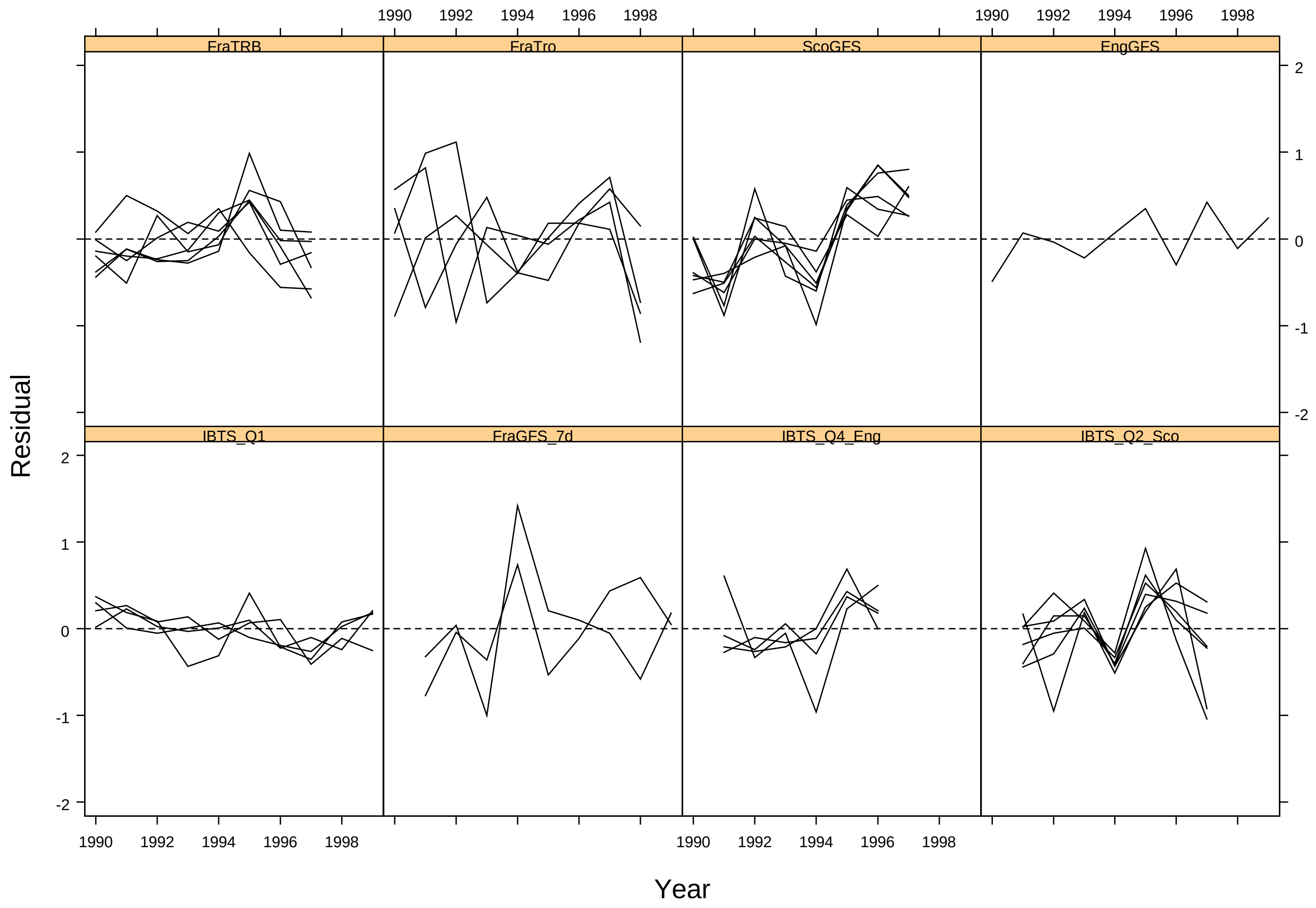


Figure 5.1.4.5. Whiting in IV and VIId: tuning fleets' scaled weightings in combined-fleet XSA runs..

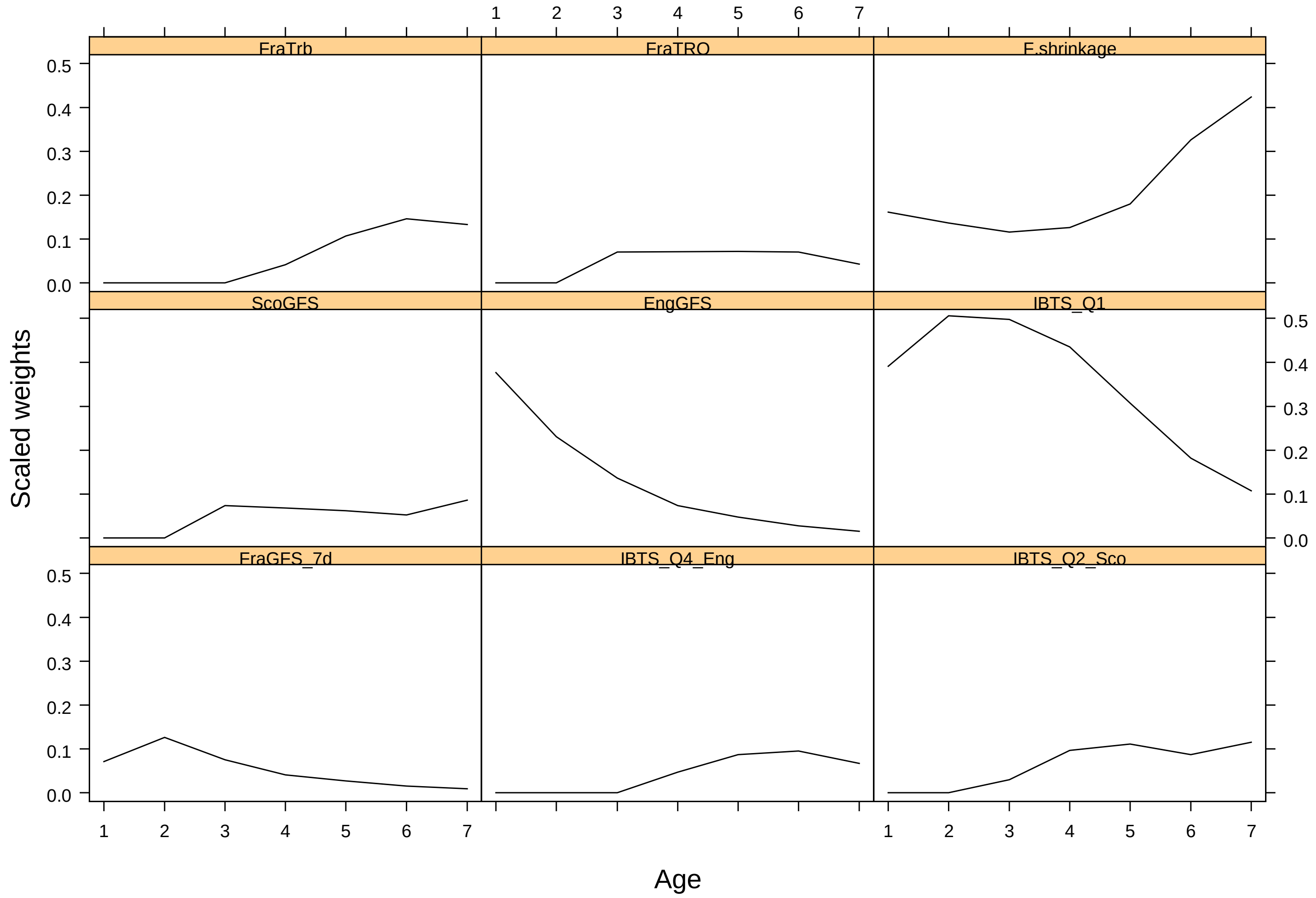


Figure 5.1.4.6. Whiting in IV and VIId: Tuning fleets'-terminal exploitation pattern in combined-fleet XSA run.

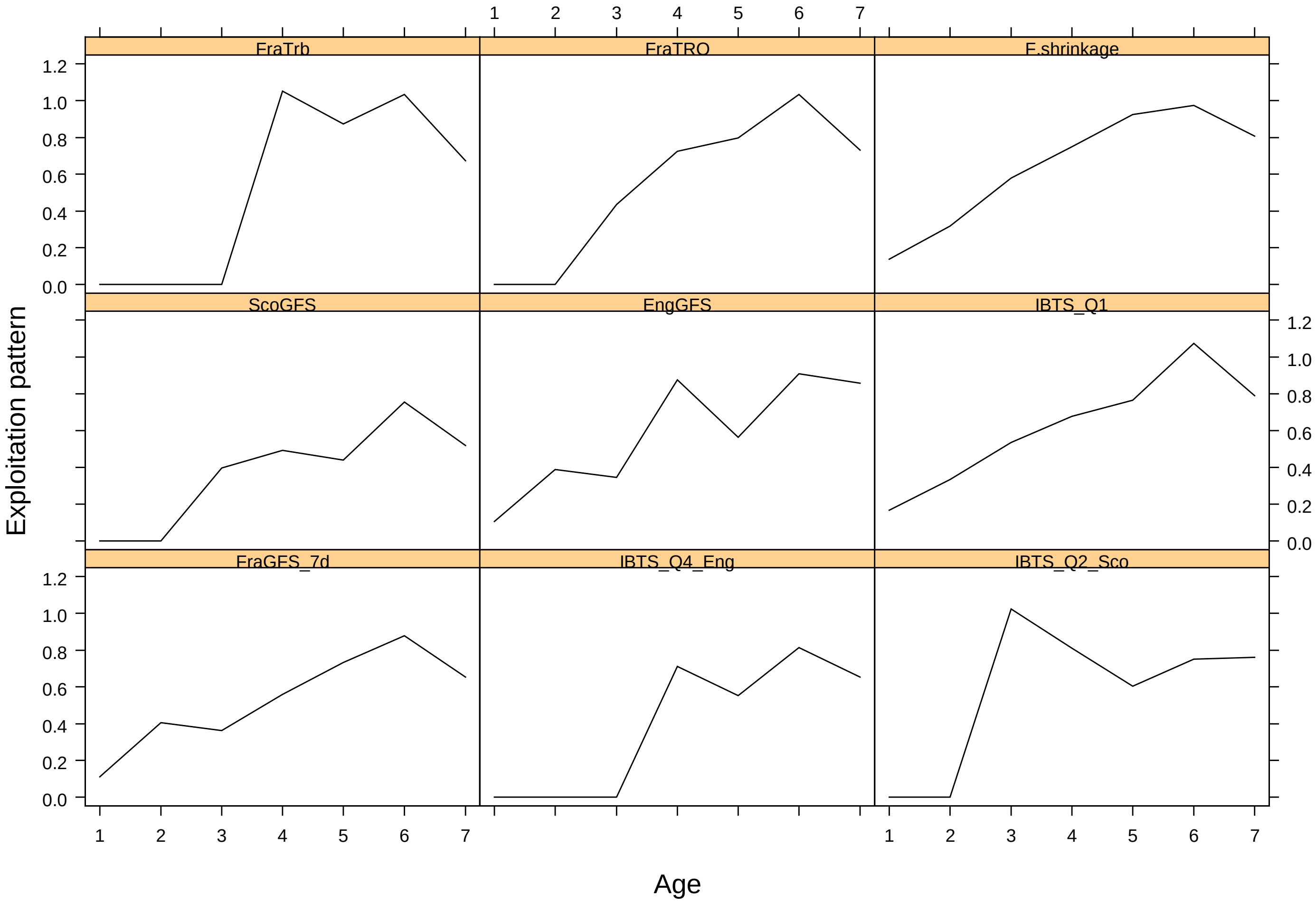


Figure 5.1.4.7. Whiting in IV and VIId: Tuning fleets' estimates of log survivors in combined-fleet XSA runs.

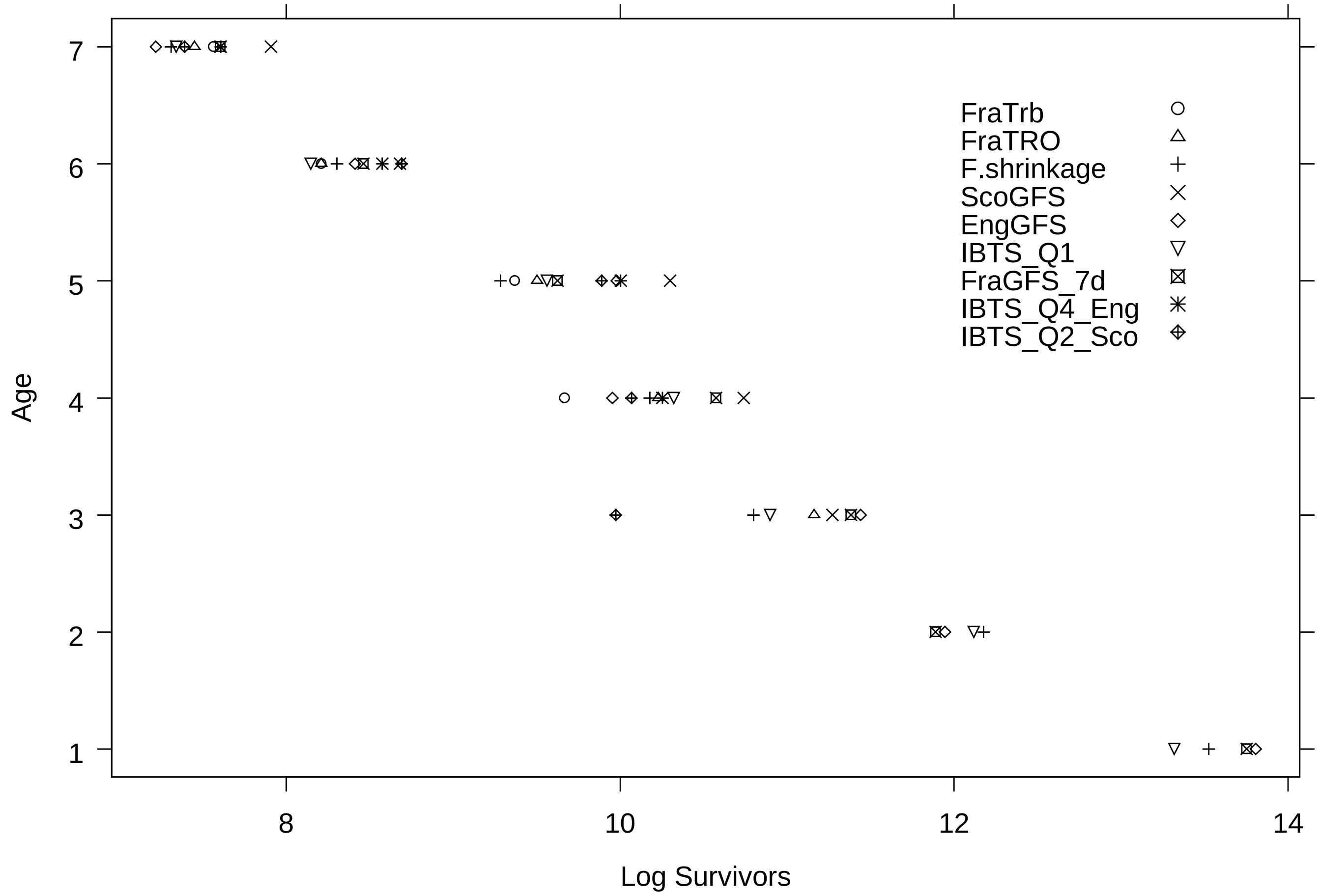


Figure 5.1.4.8. Whiting in IV and VIId: retrospective analysis using the "diminishing series" method. Years 1960-1989 have been omitted for emphasis.

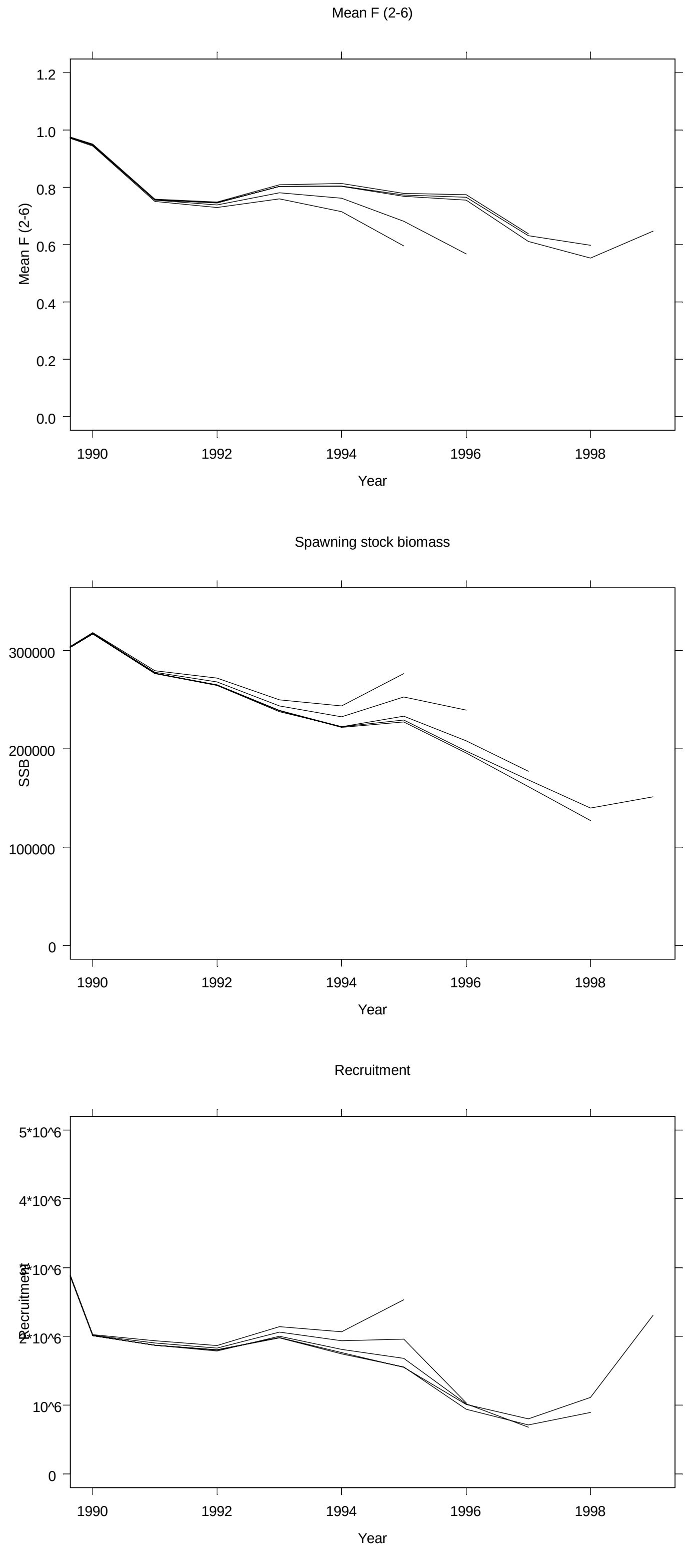


Figure 5.1.4.9. Final-year estimates for 1999 from single-fleet runs, final mutlifleet XSA run, and the prediction from the 1999 assessment.

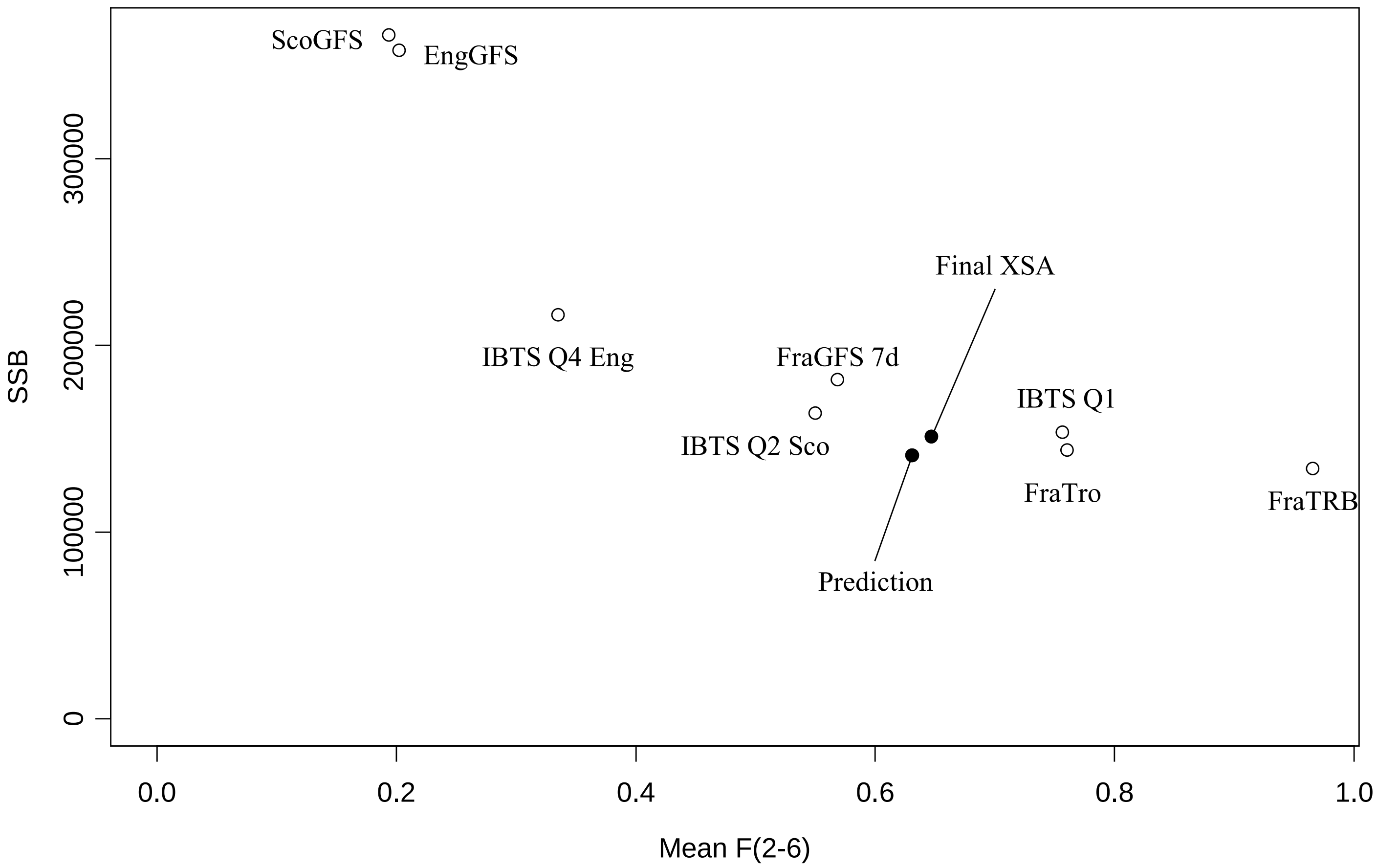


Figure 5.1.5.1 Whiting in IV. Pairwise scatterplots of 1-gp abundance from surveys and XSA

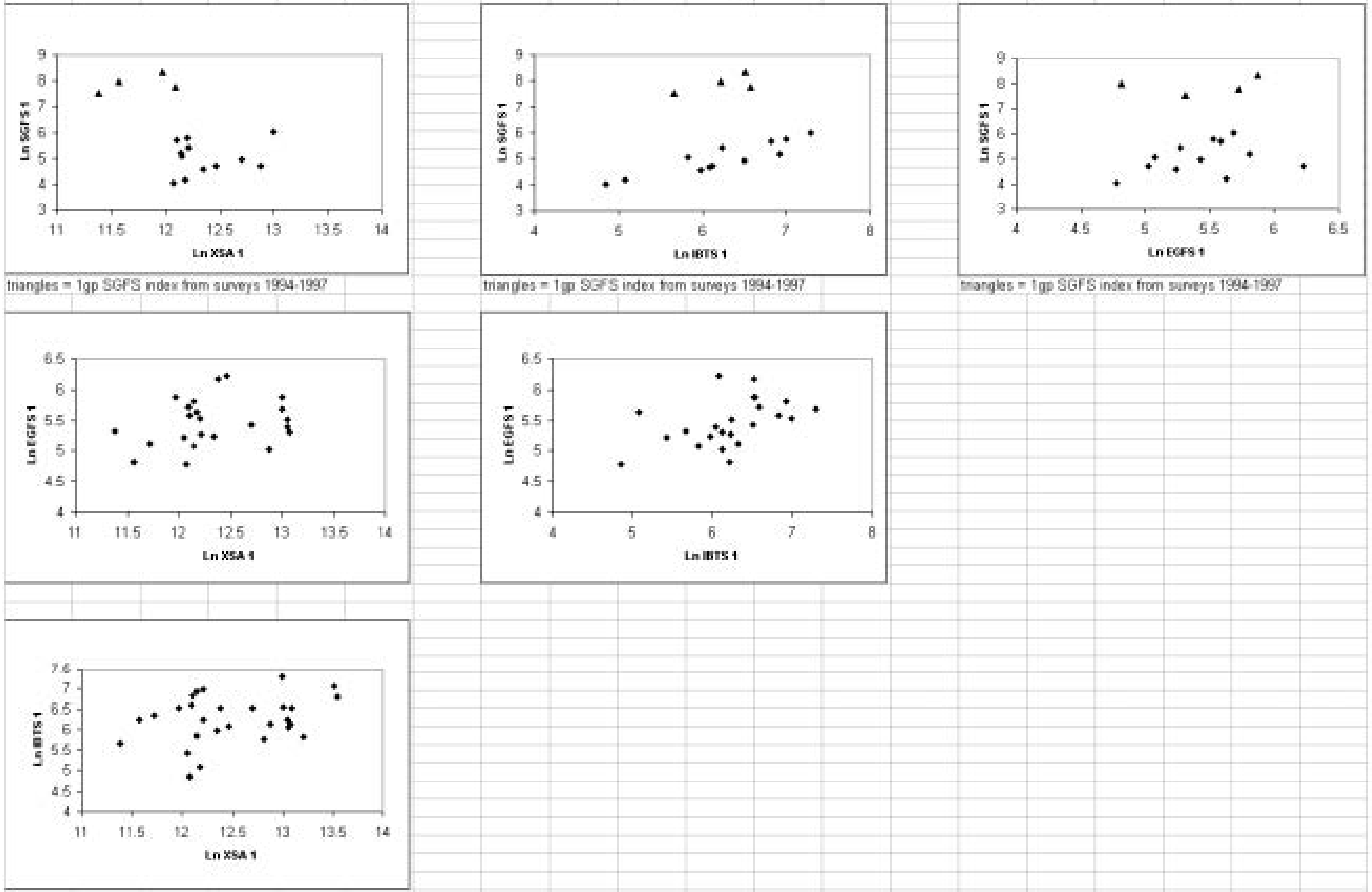
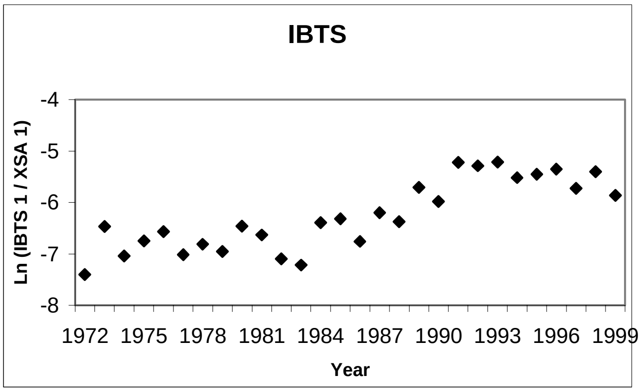
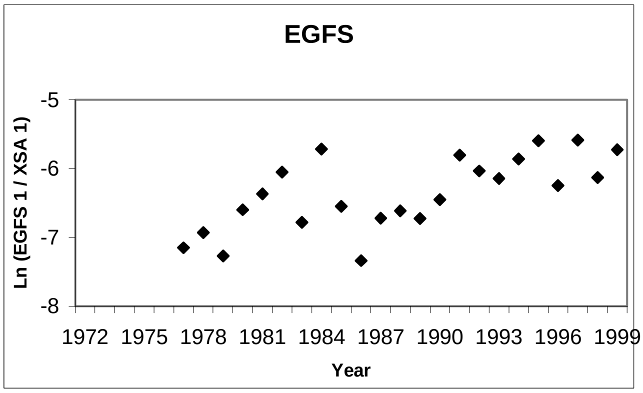


Figure 5.1.5.2 Whiting in IV. Log (Index/XSA) plots for North Sea surveys (XSA and survey abundance at age 1)





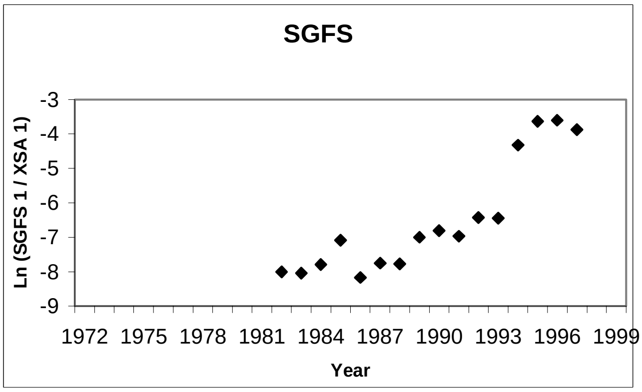


Figure 5.1.6.3 Whiting in IV. Pairwise scatterplots of survey abundance at successive ages

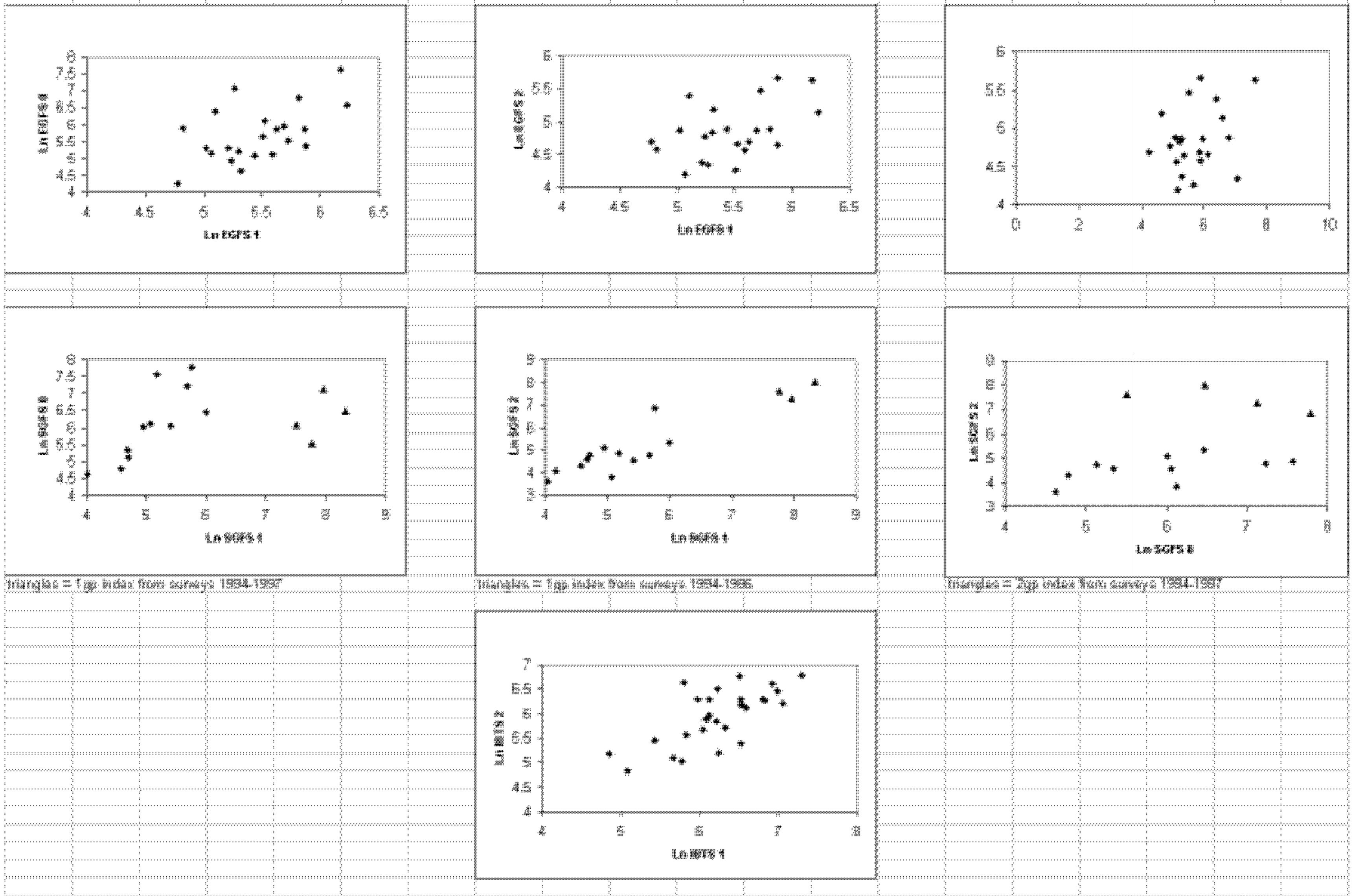
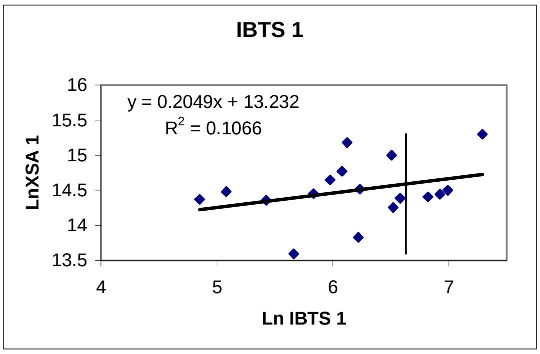
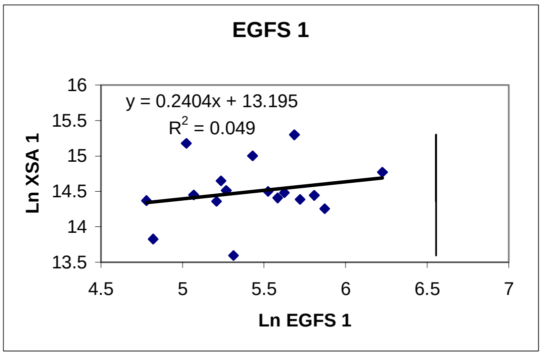


Figure 5.1.5.4 Whiting in IV. XSA abundance and survey indices truncated at 1980





vertival line is 2000 index value

Figure 5.1.6.1. Whiting in IV and VIId: stock summary.

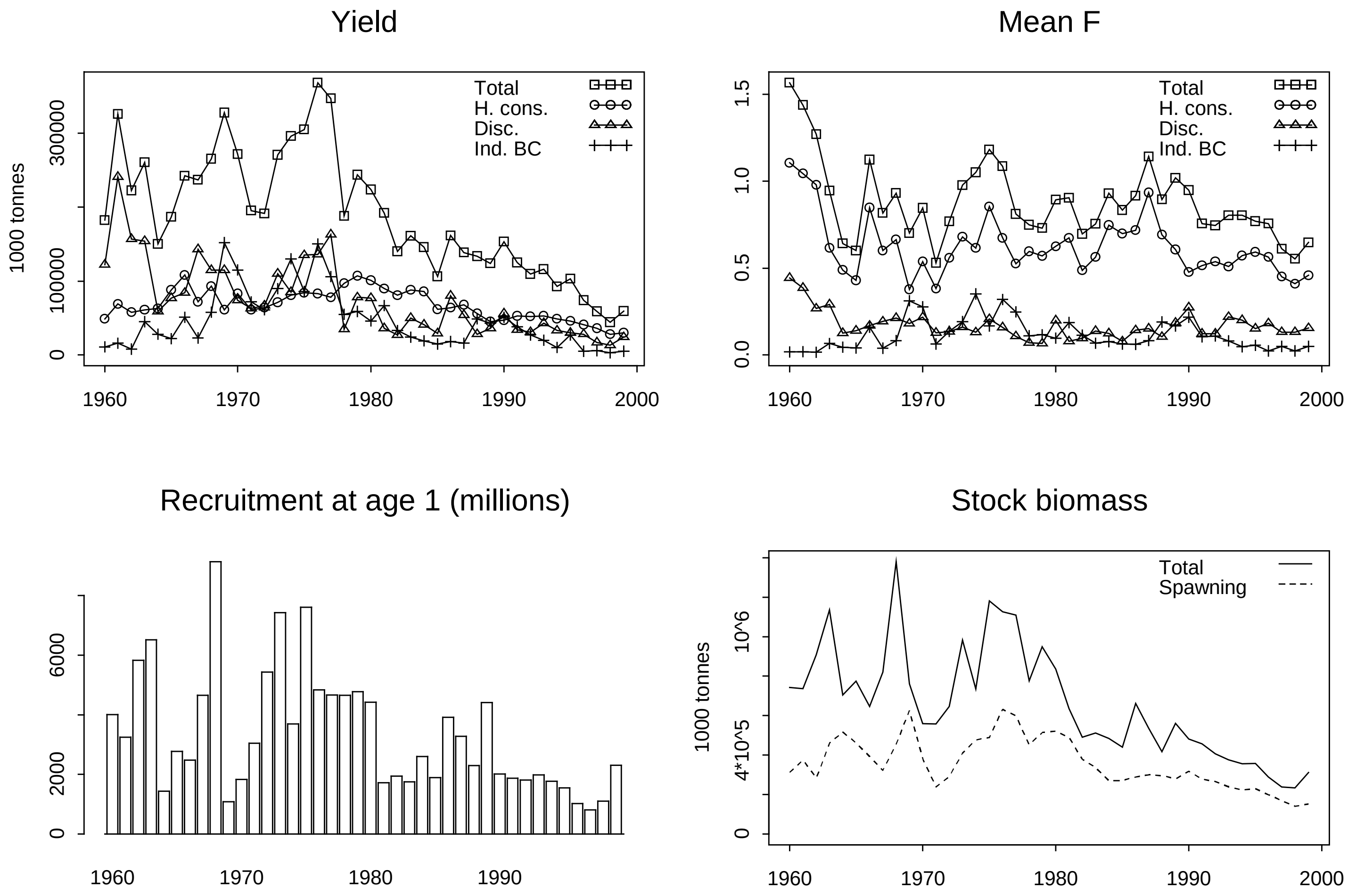
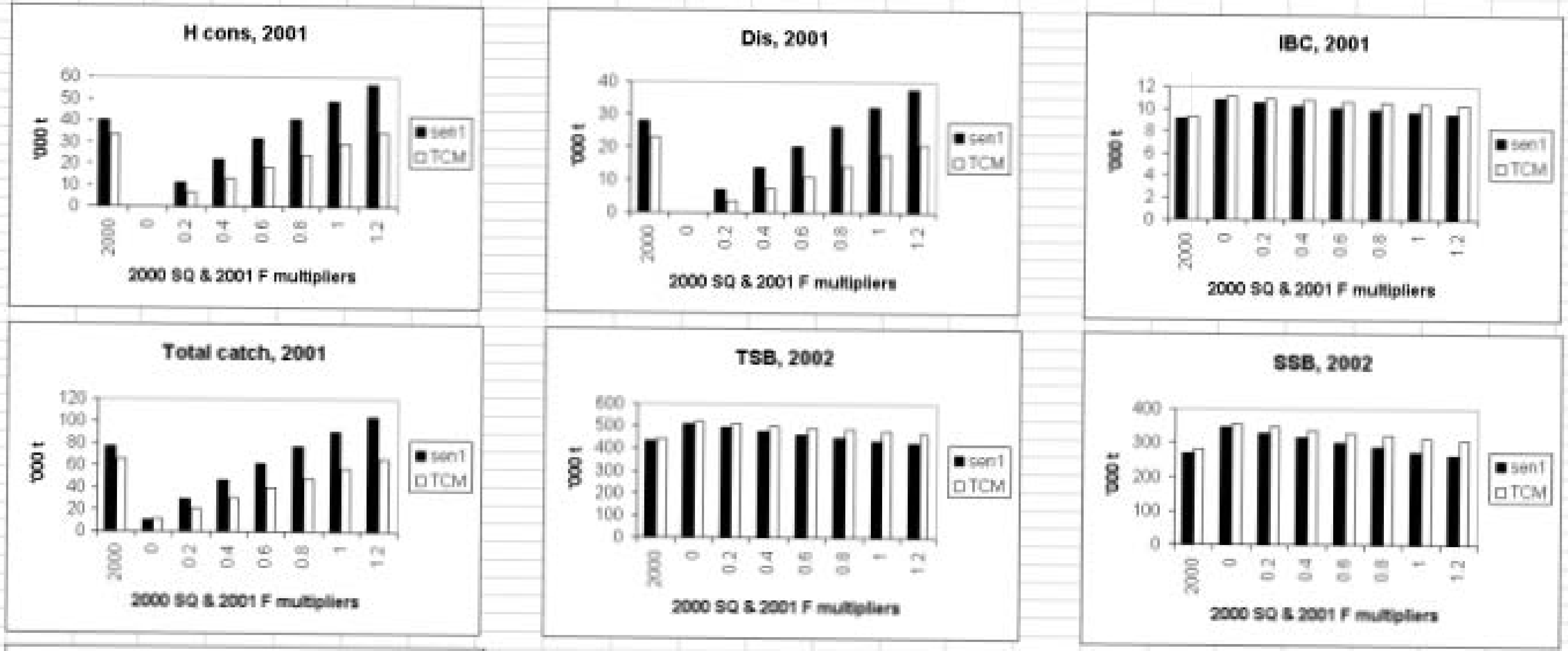
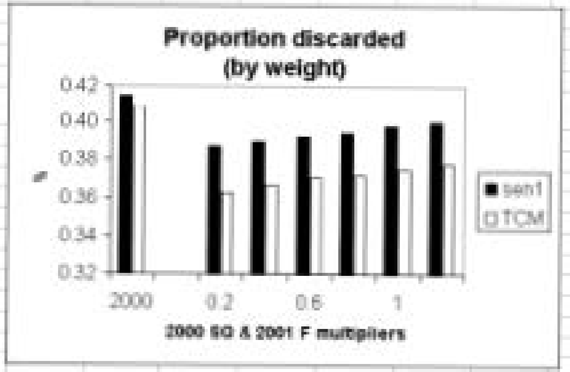


Figure 5.1.7.1 **Whiting in IV and VIId. Comparison of status quo catch forecast (sen1) and one assuming a full and effective implementation of recent UK technical conservation measures (TCM)**





Multipliers on fishing mortality at age attributable to UK technical conservation measures

Age	Multiplier on F H cons + Disc
1	0.57
2	0.45
3	0.48
4	0.58
5	0.68
6	0.74
7	0.71
8	0.78

TCM forecast assumes multipliers are applied to 5/12 of 2000 and fully throughout 2001

Figure 5.1.7.2 Whiting, 4 & 7d. Sensitivity analysis of short term forecast.

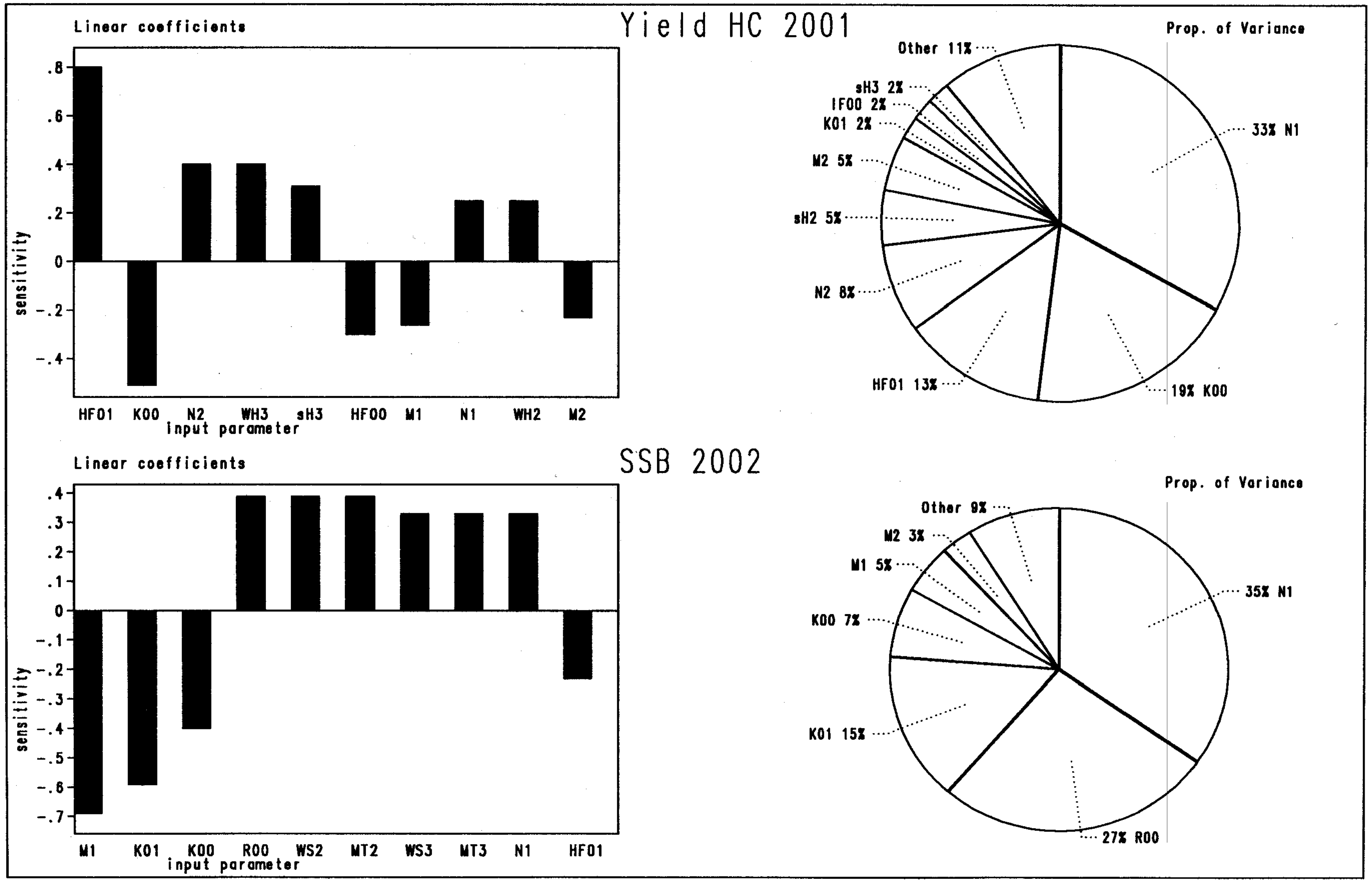
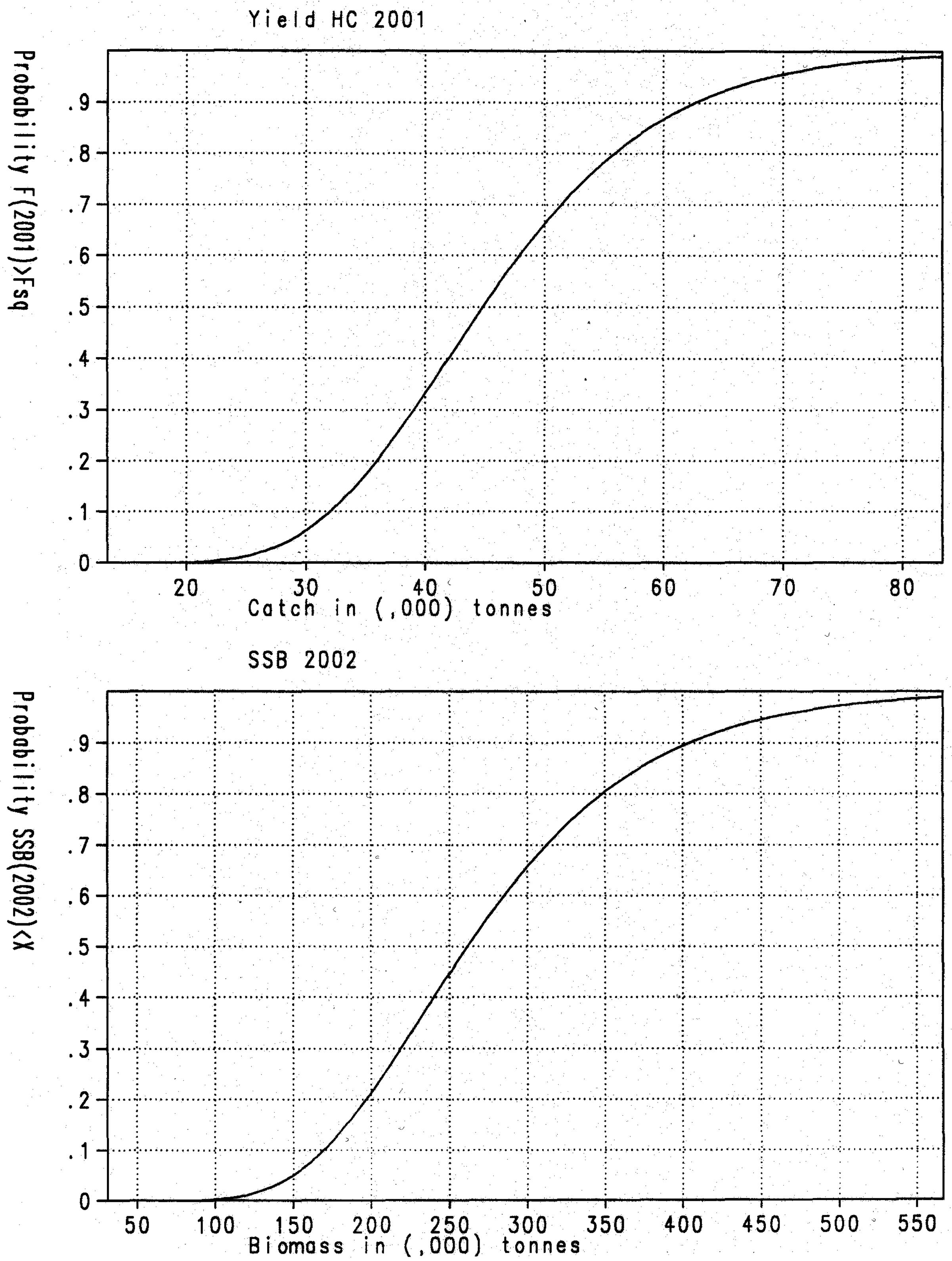


Figure 5.1.7.3

Figure Whiting,4 & 7d. Probability profiles for short term forecast.



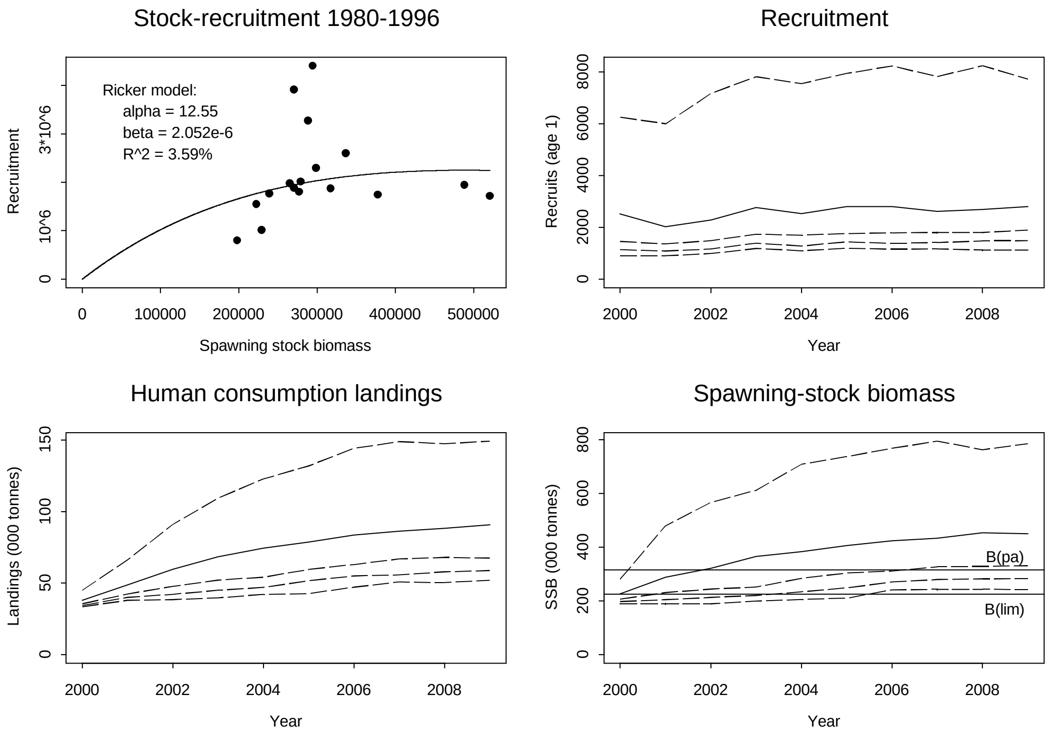


Figure 5.1.8.1. Whiting in IV and VIId: medium-term projection at status quo F, using a Ricker model fitted to stock-recruitment data for year-classes 1980–1996. Percentiles shown are 5%, 10%, 20%, 50% and 95%.

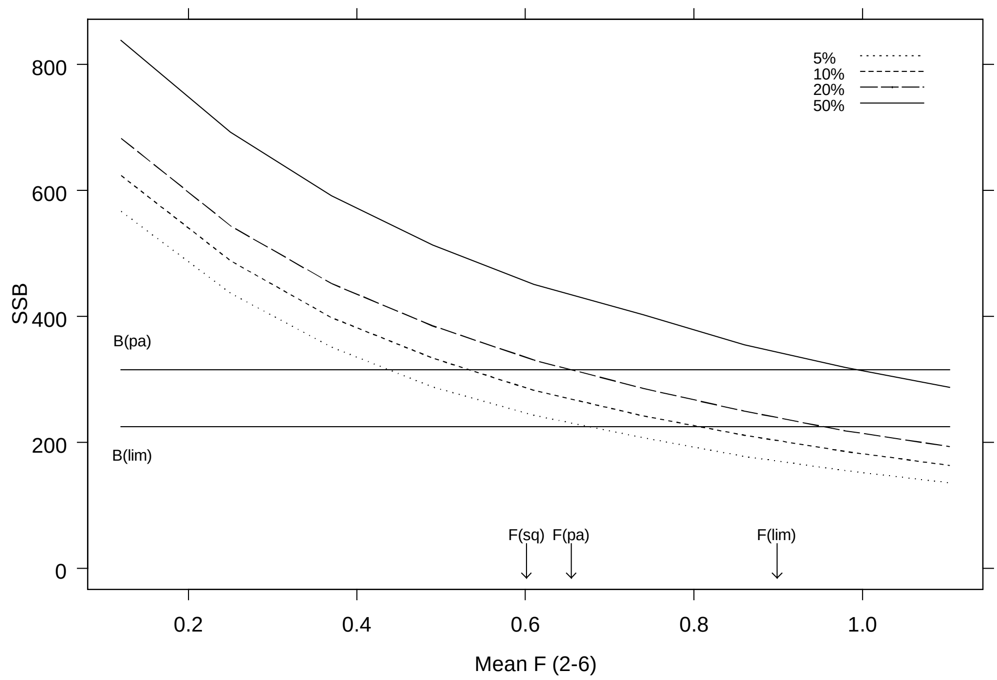


Figure 5.1.8.2. Whiting in IV and VIId: probability of SSB in 2009 < B_{pa}.

Figure 5.1.8.3. Whiting in IV and VIId: medium-term projection results for SSB and human consumption landings, for three different multipliers of F (details of the stock-recruitment model used are given in Figure 5.1.8.2). The thick lines in each plot give the 5th, 50th and 95th percentiles of 500 projection runs, while the first 100 projections are plotted using thinner lines: the thick horizontal line on the SSB plots givs the B_{pa} level. A cubic-spline smoother has been applied to each line.

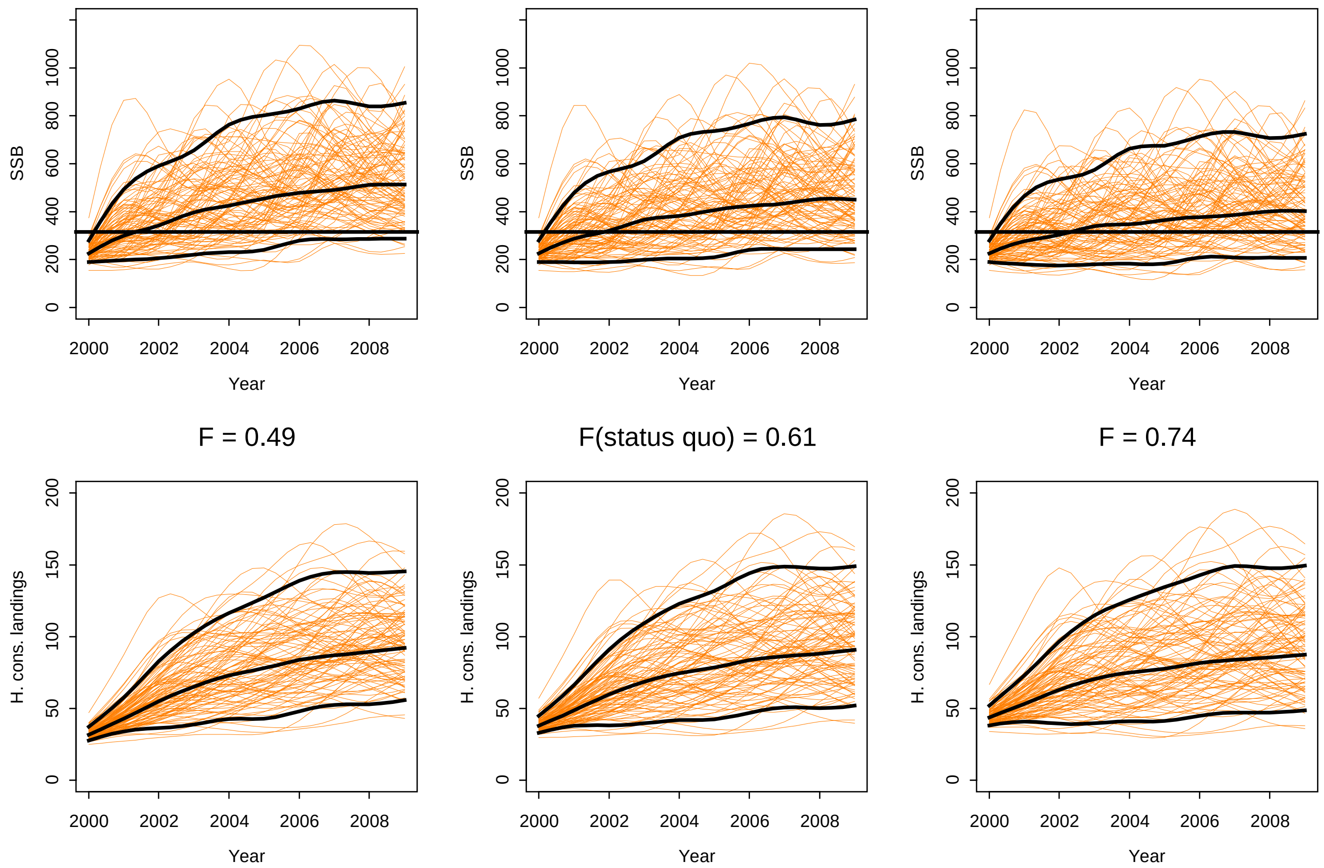
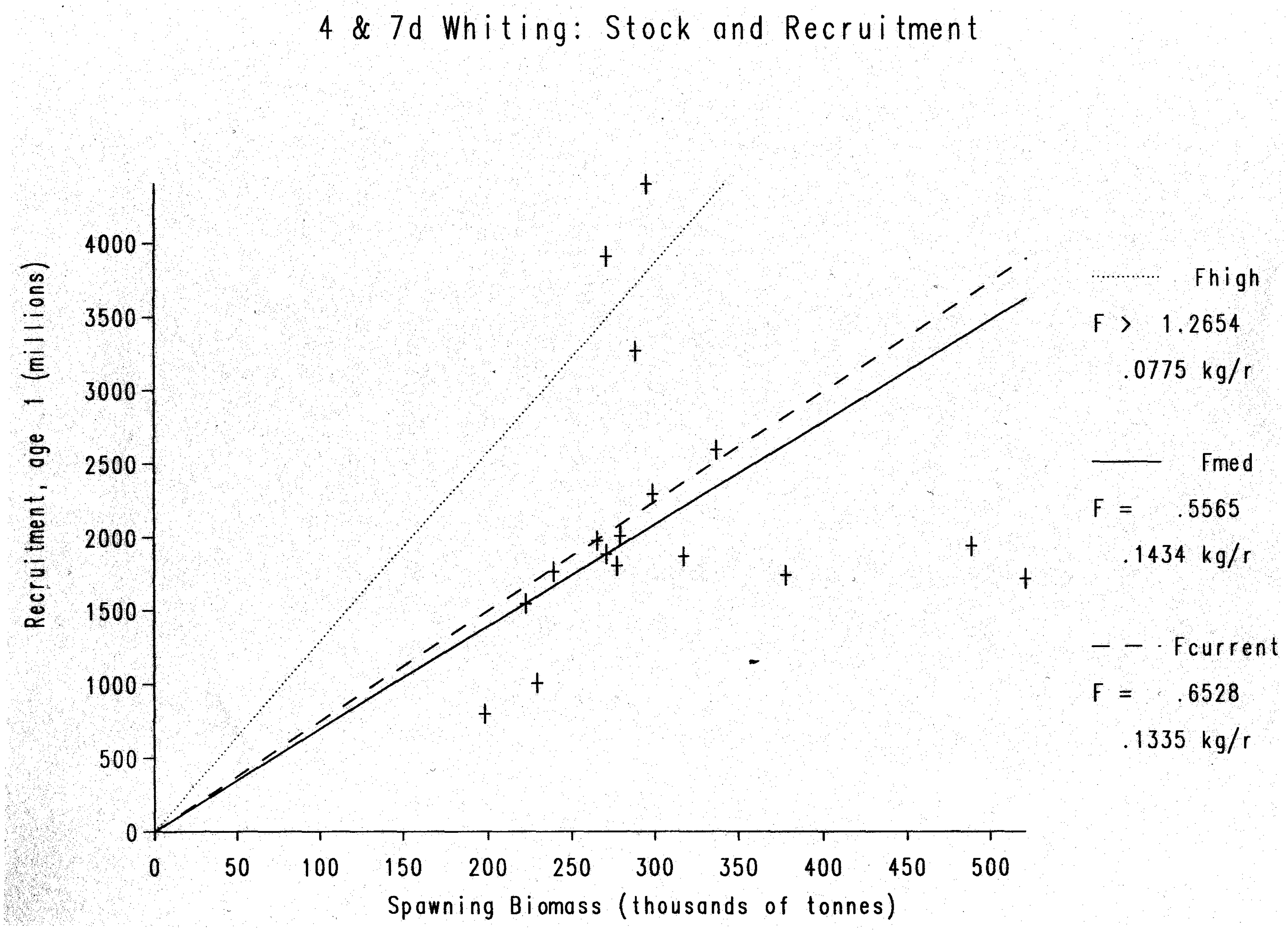
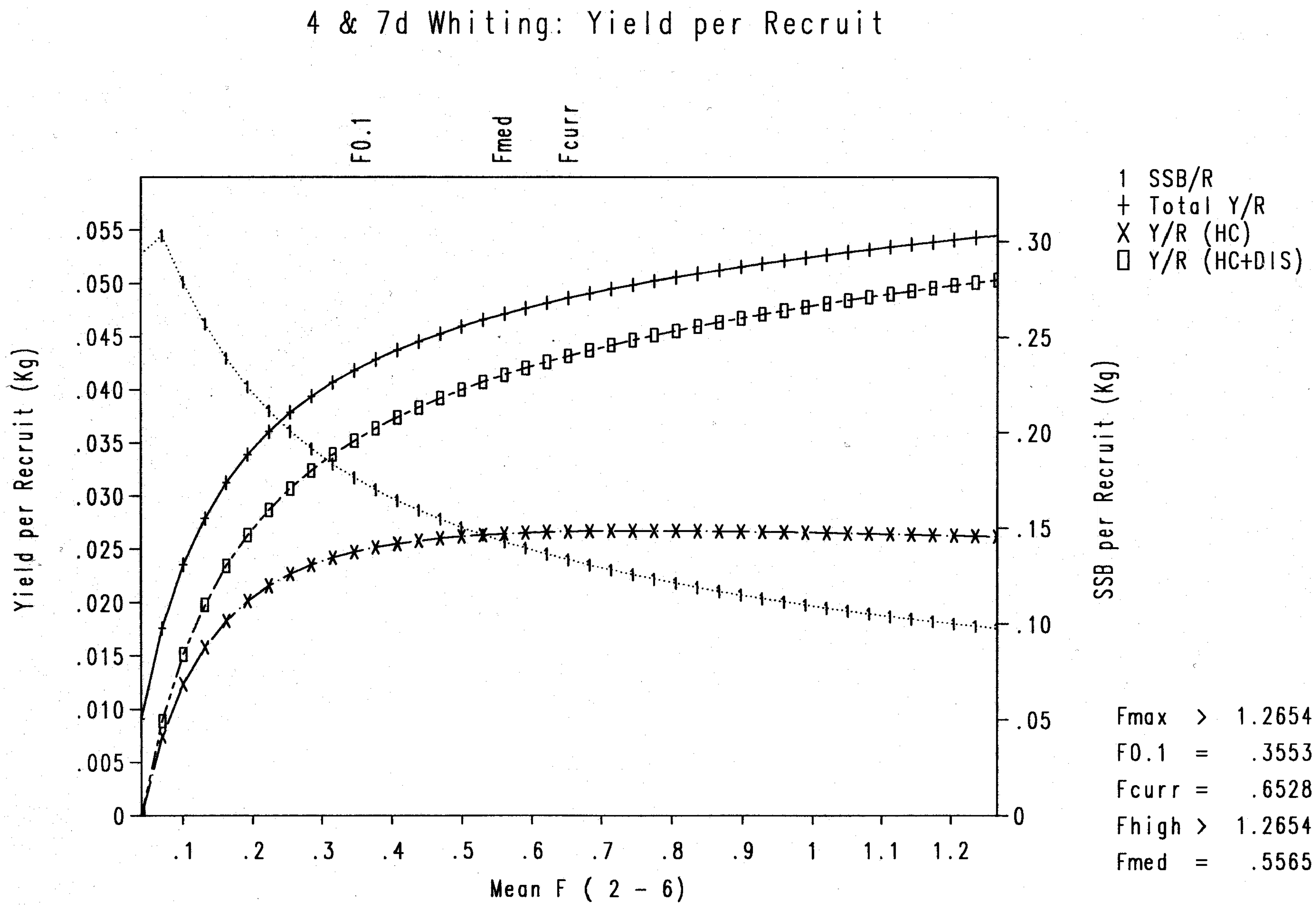


Figure 5.1.9.1



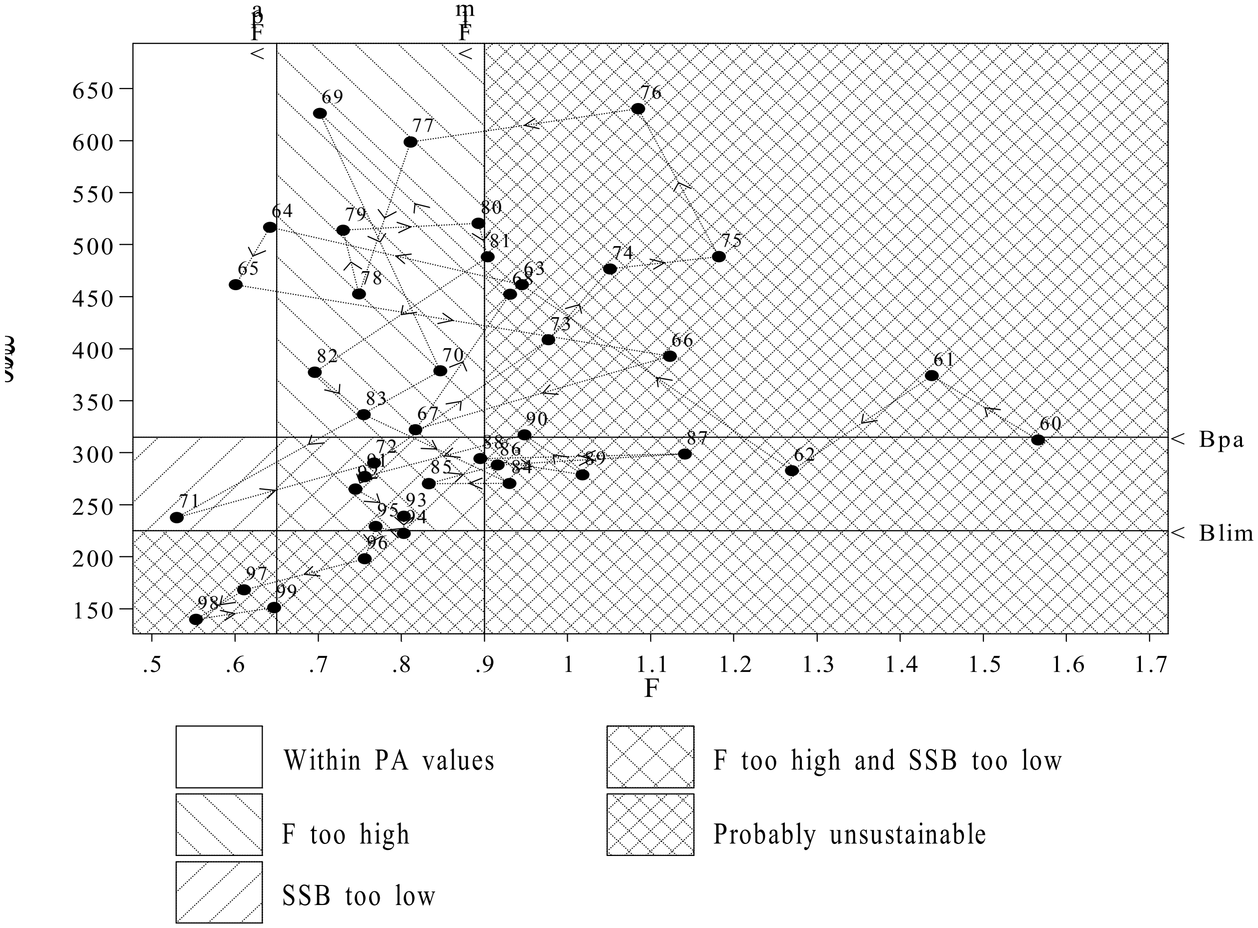
4 & 7d Whiting: Stock and Recruitment
Recruitment, age 1 (millions)
0
500
1000
1500
2000
2500
3000
3500
4000
0
50
100
150
200
250
300
350
400
450
500
Spawning Biomass (thousands of tonnes)
Fhigh
F > 1.2654
.0775 kg/r
Fmed
F = .5565
.1434 kg/r
Fcurrent
F = .6528
.1335 kg/r

Figure 5.1.9.2



4 & 7d Whiting: Yield per Recruit
F0.1
Fmed
Fcurr
1 SSB/R
+ Total Y/R
X Y/R (HC)
□ Y/R (HC+DIS)
Yield per Recruit (Kg)
SSB per Recruit (Kg)
Mean F (2 - 6)
Fmax > 1.2654
F0.1 = .3553
Fcurr = .6528
Fhigh > 1.2654
Fmed = .5565

Whiting, IV and VIId



Data file(s):C:\MyFiles\NS2000\Whiting\Run16\Medium_Terms\whiiv.pa;C:\MyFiles\NS2000\Whiting\Run16\Medium_Terms\whiiv.sum
Plotted on 10/10/2000 at 13:42:39

Figure 5.1.9.3

6 SAITHE IN SUB-AREA IV, VI AND DIVISION IIIA

6.1 The fishery

6.1.1 ACFM advice applicable to 1999 and 2000

ACFM proposed in 2000 that B_{pa} be set at 200,000 t. This affords a high probability of maintaining SSB above B_{lim} (106,000 t), taking into account the uncertainty of the assessment. Below B_{pa} 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.

Since this combined assessment for areas IV, VI and division IIIa has been conducted for the first time in 1999, there was no explicit ACFM advice for the combined area for 1999. In area IV and IIIa ACFM recommended that F should be reduced to $\mathbf{F_{pa}}$, corresponding to 104,000 t, while in area VI ACFM recommended a 60% reduction in F corresponding to 4.800 t.

For 2000 ACFM recommended that F on the combined stock should be reduced by 30%, corresponding to landings of 81,000 t in 2000 (75,000 t in IV+IIIa and 6,000 in VI).

6.1.2 Management applicable to 1999 and 2000

Saithe in the North Sea are mainly taken in a direct trawl fishery in deep water near the Northern Shelf edge and the Norwegian deeps. In the beginning of the year the fishery is directed towards mature fish, while immature fish dominate in the catches the rest of the year. The main fishery developed in the beginning of 1970s. The fishery in Area VI consists largely of a directed French, German and Norwegian deep water fishery operating on the shelf edge, and a Scottish fishery operating inshore.

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. For 2000 the TACs were 85,000 t and 7,000 t, respectively.

The minimum mesh size for towed gears is 100 mm in IV and VI 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.

6.1.3 The fishery in 1999

Recent nominal landings are given in Tables 6.1.1 and 6.1.2. The main part of the Working Group estimates are in Table 6.1.3 and are plotted in Figure 6.1.1. In 1999 the landings are estimated to be 107,313 t in Area IV and IIIa, and 6,946 t in Area VI, which are close to the TAC in both areas. Saithe are taken as by-catch in the industrial fishery, but most of it is sorted out and delivered for human consumption. In 1999 a by-catch of about 2,000 t was estimated to go to industrial reduction.

Discard data are not available. However, since the fish are distributed inshore until it is 3-4 years old, discard is assumed to be a small problem in this fishery. Problems with quotas may cause some discard.

6.2 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 6.2.1. They have been assumed to be the same all years.

Total international age compositions are given in Table 6.2.2. Catch-at-age data for 1998 were updated with minor changes. Catch-at-age and weight-at-age data for 1999 were supplied by Denmark, Germany, France, Norway, UK (England) and UK (Scotland) for Area IV amounting to about 97 % of the reported total landings, and France and UK(Scotland) for Area VI (see Section 1.3.1.4 for comments on the French data for 1999).

The mean weights-at-age in the landings are given in Table 6.2.3 and plotted in Figure 6.2.1 for the last ten years. 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 5-year-olds and older have decreased during the last 2 years.

6.3 Catch, effort and research vessel data

The available tuning fleets are listed in Table 6.3.1. There were data for 2 new tuning fleets: GER_OTB_IV and NORACU_IV. The fleet GER_OTB_IV is described in Working Paper 14 (see section 1.6). As a result of the discussions on the method used to standardise the data of this fleet, and because it contained only 5 years, it was decided not to use the series for the moment. NORACU contains acoustic measurements from the Norwegian IBTS in the third quarter. This fleet had also only 5 year data, and there seems to be a trend in the residuals for some of the ages. It was therefore decided to exclude this fleet as well. Further, the effort data from 1999 for FRASAI_VI were not available, and due to uncertainty about the Scottish effort in the commercial fleet data in recent years, these fleets were also excluded.

Effort by large French trawlers (FRATRB_IV) and Norwegian trawlers (NORTRL_IV) in the North Sea has displayed a recent decrease except for the last year by the French trawlers. Effort by French Freezer trawlers (FRATRF_IV) increased from 1997 to 1999. The surveys data only cover area IV.

6.4 Catch-at-age analysis

6.4.1 Exploration of data

Preliminary XSA runs were done with all single fleets and different combination of fleets. Some of the results are shown in Figure 6.4.1, and the residuals from single fleet runs are shown in Figure 6.4.2. As seen from Figure 6.4.1, the survey data in combination with commercial fleet have very little influence on the results ("All data" in the Figure compared with "All commercial"). The surveys in the North Sea are not directed at saithe. All trawl hauls are taken shallower than 200 m, and the saithe are distributed further down at the edge of the Northern Shelf and Norwegian Deeps. The indices are often dominated by a few big hauls caused by the schooling of the saithe, and age 1 and 2 are living inshore and are caught in few numbers in the surveys. It was therefore decided to run the tuning without the surveys. Further, ages with negative slopes or very low r^2 were excluded. The effort trends and age composition of the fleets used in the assessment are listed in Table 6.4.1. The settings of the final run are presented in the text table below:

		1999 XSA		2000 XSA	
Fleets	FRATRB_IV	1990-1998	2-7	1990-1999	2-7
	FRATRF_IV	1990-1998	2-7	1990-1999	3-7
	NORTRL_IV	1989-1998	3-9	1990-1999	3-9
	FRASAI_VI	1990-1998	5-9	Not used	
	SCOLTR_IV+VI	1989-1998	5-7	Not used	
	ENGGFS_IV	1989-1998	3-8	Not used	
	SCOGFS_IV	1989-1998	2-3	Not used	
Taper			no		no
Tuning rage			10 yr		10 yr
Power model			no		no
q plateau			7		7
F shrinkage			0.5		0.5
-year range			5		5
-age range			3		3

6.4.2 Final assessment

The method used to tune the VPA was XSA. The tuning converged after 32 iterations. Tuning diagnostics are given in Table 6.4.2, and plots of the log residuals are given in Fig. 6.4.3. For age 2 the shrinker have greatest weight, while the estimation of survivors of the older ages are dominated by the commercial fleets (Figure 6.4.4).

Tables 6.4.3 and 6.4.4 list the fishing mortality and stock number by year and age, respectively. The VPA results are summarized in Table 6.4.5 and illustrated in Figure 6.1.1.

The results of the retrospective analysis are plotted in Figure 6.4.5. The retrospective analysis reveals a tendency to overestimate F_{3-6} and underestimate SSB in recent years. The retrospective estimation of the recruits-at-age 1 is scattered and needs almost 10 years to converge.

6.5 Recruitment Estimates

Mean recruitment-at-age 1 over the period 1972–1997 was 245 million (AM) or 218 million (GM). The GM over a shorter period (1988-1997) where lower recruitment has been observed was 181 million 1-year-olds.

No survey data or other independent recruitment indices were available to the Working Group. The group therefore decided to use geometric means 1988-97 to estimate recruitment-at-ages 1-3 in 2000 for the short-term prediction because they have not been well estimated by catch data. This short-term GM was used as there is evidence of reduced recruitment in recent years (Figure 6.1.1). The XSA estimate of the 1996 year class was low. Data from the French commercial fleet (FRATRB) in second quarter 2000 give a rather high CPUE for age 4, and data from ENGFS also give a high index for this age 4 in 2000. However, the data for the same year class in 1999 give contradicting signals for all fleets. A run with age 3 and age 4 in ENGGFS and age 3 and 4 in FRATRB_IV for first and second quarter was done with RCT3 (Tables 6.5.1 and 6.5.2). However, because of contradicting signals between the 1999 data and the 2000 data in both the survey data and the CPUE data, it was decided to use the XSA value for the 4-year-olds in 2000. Year class strength used for predictions are printed bold and can be summarized as follows (numbers in thousands):

Year class	Age	XSA	RCT3	GM(88-97)
1996	4	**40,222**	65,000	72,142
1997	3	76,967		**123,636**
1998	2	39,048		**152,113**
1999	1			**180,623**
2000	1			**180,623**

6.6 Historical trends

For the combined area 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.

The mean $F_{3\text{-}6}$ decreased continuously from 0.82 in 1986 to 0.30 in 1997, but has increased again to 0.45. Recently, the SSB was estimated to have increased to 204,000 tons in 1997 from the lowest observed 102,000 tons in the early 1990s.

6.7 Short-term forecast

Input data for the 2000-2002 prediction are given in Table 6.7.1. In 2000, numbers of ages 1, 2 and 3 are GM(88-97) estimates. The year classes 2000 and 2001-at-age 1 were estimated by the short-term GM value of 180 millions. The exploitation pattern, mean weights in the stock and the catch are based on 1997–99 arithmetic means. The fishing pattern was scaled to $F_{3\text{-}6}$ in 1999. Results of the prediction are given in Table 6.7.2. The assumption of *status quo* fishing mortality in 2000 and 2001 is expected to lead to landings of 119,000 t in 2000 and 115,000 t in 2001. As a consequence, spawning stock size is predicted to decrease from 188,000 t in 2000 to 157,000 and 149,000 t in 2001 and 2002, respectively.

Table 6.7.3 lists the contribution of the different recruiting year classes in the catch in 2001 and the spawning stock in 2002. 48% of the expected landings in 2001, and 35% of the predicted SSB in 2002 are made up of year classes for which GM1988-97 recruitment is assumed. Detailed tables of the prediction are seen in Table 6.7.4.

6.8 Medium-term projections

The input for medium-term projections is given in Table 6.8.1. A Ricker model was applied with an alpha value of 1.7823 and a beta value of 0.3965. The results indicate that under the *status quo* fishing scenario the median landings will stabilize at 150,000 t after 10 years (Figure 6.8.1). The median SSB is projected to remain at around 180,000 t after the same period. This is about 30,000 t higher for both landings and SSB than the medium-term projection from last year estimated. This might be due to differences in the stock/recruitment scatterplot. The alpha and beta values were estimated to be 1.9497 and 0.3344 respectively in 1999.

6.9 Biological reference points

Figure 6.9.1 shows the stock-recruitment plot. The input parameters for the yield and biomass per recruit are listed in Table 6.9.1 and the results are shown in Table 6.9.2 and Figure 6.9.2. The mean weights in the stock and in the catch are assumed to be the same and represents the mean over the last 10 years. The exploitation pattern is calculated as the 1997–99 mean and scaled to $F_{3\text{-}6}$ in 1999. The oldest age group is defined as a plus group. The different reference points are listed in the text table below:

$\mathbf{F_{0.1}}$	0.12	$\mathbf{F_{lim}}$	0.60
$\mathbf{F_{max}}$	0.21	$\mathbf{F_{pa}}$	0.40
$\mathbf{F_{med}}$	0.46	$\mathbf{B_{lim}}$	106,000 t
$\mathbf{F_{high}}$	0.63	$\mathbf{B_{pa}}$	200,000 t

Figure 6.9.3 shows the history of $F_{3\text{-}6}$ versus SSB. In the period 1984 – 1996 the SSB was below B_{pa}, but the last three years SSB has stayed around B_{pa}. The fishing mortality has almost always exceeded 0.4. F has shown a recent declining trend, but in the last two years it has increased again.

6.10 Comment on the assessment

This year's estimation of fishing mortality in 1999 of 0.45 is equal to last year's prediction. However, this assessment gives a reduction in fishing mortalities for the other most recent years of about 25%, and an increase in the SSB for 1999 of about 20%.

Both the assessment and the present stock and catch prediction suffers from the lack of a representative data series for recruitment-at-ages 1–3. The fact that the forecast does not track recruitment fluctuations can lead to management problems. In addition CPUE data and survey data from 2000 give signals that the 1996 year class might be stronger than estimated by this assessment.

Table 6.1.1. 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	1998	1999
Belgium	4	60	13	23	29	70	113	130	228	157	254	249	200
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	4,494
Faroe Islands	691	276	739	1,650	671	2,480	2,875	1,780[1]	3,808	617	158	1,298	
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[1]	24,305[14]
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	10,481
Netherlands	334	345	257	206	199	180	79	18	9	17	40	7	7
Norway	66,400	40,021	24,737	19,122	36,240	48,205	47,669	47,042	53,293[1]	55,382	46,484[1]	49,540[1]	55,816[1]
Poland	832	1,016	809	1,244	1,336	1,238	937[1]	151	592	365	822	813	862
Sweden	1,732	2,064	797	838	1,514	3,302	4,955	5,366	1,891	1,771	1,592	1,841	1,869[1]
UK (E&W)	3,233	3,790	4,012	3,397	4,070	2,893	2,429	2,354	2,522	2,864	2,556	2,293	2,874
UK (Scot.)	11,911	10,850	9,190	7,703	8,602	6,881	5,929	5,566	6,341	5,848	6,329	5.353	5,420
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	106,328
Unreported landings	-4,414	-6,132	-172	3,199	5,093	343	5,316	12,256	16,525	14,607	17,006	14,120	985
Landings as used by WG	149,407	106,599	92,032	88,080	98,553	92,499	104,606	102,593	113,414	110,326	103,322	100,086	107,313
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	110,000

[1]Preliminary.
[2]Includes IIa(EC), IIIa-d(EC).
[3]Includes Estonia.
[4]Includes IIa(EC)

Table 6.1.2. Nominal catch (tonnes) of SAITHE in Sub-area VI, 1987–1999, as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]
Belgium	12	14	15	-	6	2	2	+	-	-[4]	-	-	
Denmark	7	+	2	-	+	1	2	+	+	1	-	-	
Faroe Islands	-	8	-	-	24	1	-	-	-	3	n/a	-	
France	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.	1,486	1,584	1,116	275	590	685	222	524	321	1,012	492	506	250
Ireland	704	544	593	520	260	278	317	438	530	419	411	-	
Norway	38	50	72	64	31	67	59	74[1]	35	34	26[1]	41	126[1]
Spain	533	857	65	70	49	-	-	n/a	n/a	n/a	n/a	-	
Portugal											1	+	
UK (Engl.& Wales)[3]	1,708	1,193	462	855	593	540	799	744	317	...	...	n/a	503
UK (N. Ireland)	26	13								708	294	n/a	
UK (Scotland)	3,442	3,925	2,971	3,258	3,885	2,708	2,903	2,828	3,279	2,435	2,659	n/a	2,084
UK (total)										3,143	2,961	3,170	
Total reported to ICES	32,537	32,844	22,402	18,003	17,861	10,816	14,520	13,035	10,627	9,393	8,545	7,089	2,963
Unallocated	-1,168	1,334	3,175	1,862	-866	988	-577	-214	1,143	40	873	500	3,983
Total figures used by WG	31,369	34,178	25,577	19,865	16,995	11,804	13,943	12,821	11,770	9,433	9,418	7,589	6,946

[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 6.1.3. Saithe in IV, VI and IIIa
Annual weight and numbers caught, 1972 to 1999.

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	109	82
1999	114	79
Min.	104	75
Mean	177	131
Max.	362	330

TABLE 6.2.1 Saithe in 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 6.2.2 Saithe in IV, VI and IIIa. Catch numbers at age Numbers*10**-3

YEAR		1972	1973	1974	1975	1976	1977	1978	1979		
AGE											
	1	430	4708	4753	335	270	2172	1253	916		
	2	23833	37832	19206	74231	34111	14125	20551	17756		
	3	48075	54332	66938	56987	207823	27461	35059	16332		
	4	66095	37698	33740	25864	53060	54967	27269	14216		
	5	25317	26849	14123	10319	11696	14755	18062	11182		
	6	21207	16061	20688	7566	6253	5490	3312	8699		
	7	3672	8428	14666	13657	3976	3777	1138	2805		
	8	2944	2000	5199	9357	5362	3447	1033	733		
	9	1641	1357	1477	3501	3586	3812	768	540		
+gp		1607	2381	1955	2687	3490	4701	3484	2089		
TOTALNUM		194822	191646	182744	204505	329627	134708	111927	75268		
TONSLAND		275098	259602	309439	308926	361680	223395	166199	135967		
SOPCOF %		100	100	100	100	100	100	100	100		

YEAR		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE											
	1	1321	5457	1970	312	206	231	322	787	32	3664
	2	24100	20644	29570	36824	37387	9415	7227	31017	8762	9871
	3	17494	26178	31895	28242	80933	134024	55435	31220	32578	22128
	4	12341	8339	40587	20604	32172	55605	91223	97470	26408	30752
	5	9015	6739	9174	26013	12957	13281	15186	13990	35323	13187
	6	6718	3675	5978	5678	13011	4765	5381	3158	3828	10951
	7	5658	3335	2145	4893	1657	3005	2603	1811	1908	1557
	8	1150	3396	1454	1494	1252	682	1456	1240	1104	739
	9	509	657	982	1036	335	399	445	910	776	419
+gp		2302	2536	1254	1327	646	742	900	700	680	488
TOTALNUM		80608	80956	125010	126423	180556	222147	180178	182304	111398	93755
TONSLAND		142395	146092	189861	197774	219642	226129	202758	180776	140778	117609
SOPCOF %		100	100	100	100	100	100	100	100	100	100

YEAR		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE											
	1	355	492	319	160	106	157	354	27	218	64
	2	5764	13091	6679	10118	8033	4338	8963	12396	3706	6575
	3	40808	46117	18404	37823	19958	26664	11066	15036	10363	9369
	4	19583	29871	33614	20828	40194	26034	38861	19299	31017	13834
	5	11322	7467	12753	11845	13034	14797	11786	30177	16367	26622
	6	4714	3583	3193	3125	4297	3774	7731	3676	16077	8369
	7	2776	1716	1524	1568	947	3494	3163	2640	2231	10052
	8	745	953	696	1511	346	674	808	1012	1206	2343
	9	281	367	518	814	427	552	210	291	567	889
+gp		364	458	422	1026	794	800	491	288	277	678
TOTALNUM		86710	104117	78121	88817	88135	81284	83432	84843	82028	78795
TONSLAND		107945	115576	104147	119073	115255	125183	119669	112740	108699	114259
SOPCOF %		100	100	100	100	100	100	100	100	100	100

Table 6.2.3 Saithe in IV, VI and IIIa. Catch weights at age and Stock weights at age (kg)

YEAR		1972	1973	1974	1975	1976	1977	1978	1979
AGE									
	1	0.3281	0.1637	0.275	0.216	0.4588	0.4257	0.3548	0.4348
	2	0.5488	0.4317	0.5093	0.5021	0.5156	0.4301	0.5165	0.406
	3	0.8082	0.8212	0.8608	0.8928	0.7024	0.7598	0.8215	1.1072
	4	1.1958	1.4061	1.5606	1.4977	1.3092	1.256	1.3267	1.6228
	5	1.961	1.641	2.3834	2.4904	2.2604	1.9348	2.1545	2.2381
	6	2.3687	2.5709	2.7527	3.3002	3.0706	3.1107	3.3401	3.095
	7	3.7941	3.3571	3.4286	3.7647	4.0347	4.1618	4.5221	4.0504
	8	4.2276	4.6844	4.4977	4.2957	4.3833	4.6045	4.9005	5.2742
	9	4.6304	4.8138	5.7128	5.5396	5.1117	4.8589	5.4494	6.3077
+gp		6.3263	6.4449	7.857	7.562	7.147	6.5419	7.4	7.9551
SOPCOFAC		0.9999	1	1	0.9999	1.0002	1	1.0001	1.0001

YEAR		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE											
	1	0.2586	0.2774	0.2525	0.4126	0.3886	0.1487	0.6295	0.3711	0.5165	0.4264
	2	0.421	0.5958	0.5077	0.478	0.5009	0.555	0.5479	0.4181	0.6379	0.7263
	3	0.9546	0.9608	1.0857	1.0276	0.7948	0.6632	0.6943	0.6739	0.7787	0.8954
	4	1.8212	1.8211	1.5746	1.7178	1.6139	1.2654	1.0353	0.8763	0.981	1.0362
	5	2.3911	2.7175	2.5293	2.1493	2.2966	1.9505	1.7944	1.8236	1.3859	1.4196
	6	3.03	3.5868	3.2202	3.1377	2.6899	2.7715	2.4316	3.0747	2.7907	1.9984
	7	4.0895	4.536	4.2069	3.6906	3.8959	3.4067	3.5717	4.2098	4.0238	3.9139
	8	5.1262	5.4776	5.1251	4.6317	4.6647	4.9499	4.2094	5.33	5.2544	5.0175
	9	5.9393	6.9804	5.9049	5.5053	6.183	5.8649	5.6506	6.1284	6.3221	6.4298
+gp		8.1476	8.7237	8.8232	8.4529	8.4735	8.8543	8.2184	8.6026	8.6489	8.4308
SOPCOFAC		1.0001	1	1.0001	1	1	1	0.9999	1.0001	1	0.9999

YEAR		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE											
	1	0.2717	0.4794	0.6189	0.3585	0.2866	0.5024	0.2797	0.4324	0.6027	0.5193
	2	0.7025	0.5571	0.6299	0.7437	0.6975	0.7593	0.5103	0.4357	0.6594	0.5867
	3	0.8441	0.7913	0.9641	0.8994	0.9439	1.0022	0.9668	0.9047	0.8917	0.8795
	4	1.1958	1.1579	1.1893	1.2603	1.1188	1.2937	1.1873	1.1448	0.966	1.0598
	5	1.5828	1.7523	1.6066	1.7544	1.601	1.8159	1.8068	1.4522	1.3925	1.2103
	6	2.2472	2.3646	2.2417	2.6363	2.4337	2.5619	2.3678	2.5867	1.744	1.7527
	7	3.2419	3.1653	3.6677	3.1851	3.6175	3.5549	2.9518	3.5556	2.9486	2.3367
	8	4.8583	4.2221	4.3296	3.9798	4.7869	4.767	4.7053	4.5251	3.8829	3.4914
	9	6.3149	6.0661	5.4125	5.0802	6.5479	5.2674	6.0922	6.1575	4.9955	4.8408
+gp		8.4162	8.1914	7.0455	6.8909	8.3256	7.8907	8.3821	8.8663	7.2273	6.7928
SOPCOFAC		0.9997	0.9998	1	0.9999	1	1.0001	1.0002	0.9998	1	1

Table 6.3.1 Saithe in IV, VI and IIIa. Tuning fleets available to the Working Group..

Fleet	Name	Area	Period	Ages	Used
French large trawlers	FRATRB_IV	IV	1978-1999	2-10	yes
French freezer trawlers	FRATRF_IV	IV	1990-1999	2-10	yes
French trawlers	FRASAI_VI	VI	1977-1998	3-10	no
Norwegian trawlers	NORTRL_IV	IV	1980-1999	3-10	yes
German trawlers*	GER_OTB_IV	IV	1995-1999	2-10	no
Scottish light trawlers	SCOLTR_IV+VI	IV+VI	1989-1999	2-3	no
English groundfish survey	ENGGFS_IV	IV	1977-2000	2-9	no
Scottish groundfish survey	SCOGFS_IV	IV	1982-1999	2-3	no
Norwegian acoustic survey*	NORACU_IV	IV	1995-1999	3-7	no

*New fleets

Table 6.4.1 Saithe in IV, VI and IIIa - Combined tuning data

103								
FRATRB_IV								
1978	1999							
1	1	0	1					
2	7							
69739	248	1853	3183	5447	762	190		
89974	230	4525	3618	4128	2809	329		
63577	528	3149	4450	2322	1412	746		
76517	4538	9067	2893	2423	939	456		
78523	1285	6001	10009	2630	1328	543		
69720	799	3487	5770	8617	1183	270		
76149	1311	5482	8632	5121	3837	232		
25915	836.335	5281.644	4310.798	1509.202	448.289	267.927		
28611	729.658	4055.637	7070.781	1775.235	588.972	158.056		
28692	935.823	1309.565	7304.318	2025.032	244.229	96.101		
25208	540.473	1839.994	1960.061	5873.634	481.893	84.136		
25184	802.91	2628.746	3697.394	1719.062	1877.664	100.777		
21758	489.433	3379.574	2471.553	1405.54	304.063	290.298		
15248	292.123	1381.383	2538.766	731.379	372.239	130.79		
7902	351.996	717.161	1480.817	498.716	73.572	24.402		
13527	1025.751	3917.8	2253.44	1162.23	103.625	8.299		
14417	434.898	1770.754	3652.84	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	535.95	107.63		
12903	148.823	1087.28	1914.745	3175.192	190.091	83.908		
13559	147.772	799.753	2538.413	1870.453	1480.902	52.256		
14588	187.322	852.467	1233.817	2666.699	620.174	399.661		
NORTRL_IV								
1980	1999							
1	1	0	1					
3	9							
18317	186	1290	658	980	797	261	60	82
28229	88	844	1345	492	670	699	119	64
47412	6624	12016	2737	2112	341	234	19	77
43099	4401	4963	8176	1950	2367	481	357	84
47803	20576	7328	2207	3358	433	444	106	51
66607	27088	21401	5307	1569	637	56	46	4
57468	5297	29612	3589	818	393	122	25	33
30008	2645	18454	2217	290	235	201	198	64
18402	3132	2042	2214	141	157	74	134	43
17781	649	2126	835	694	309	154	65	7
10249	804	781	924	519	203	63	12	3
28768	14348	4968	1194	518	203	51	56	1
35621	3447	9532	4031	1087	465	165	109	6
24572	7635	4028	2878	1018	526	365	252	252
30628	3939	16098	4276	926	251	72	203	21
32489	4347	9366	5412	833	1644	273	203	104
40400	3790	14429	4414	2765	1144	189	16	13
36026	2894	5266	9837	1419	892	299	72	28
24510	1376	8279	5454	5662	977	489	243	55
20570	783	2527	6741	2333	3573	1162	342	187
FRATRF_IV								
1990	1999							
1	1	0	1					
3	7							
19797	3676	2595	1377	262	251			
18369	1133	2487	686	325	105			
1868	188	374	110	16	5			
8059	1920	1142	413	23	2			
8650	863	1664	560	165	15			
8844	1305	788	494	128	43			
7824	379	1790	345	182	37			
6767	635	1148	1644	68	29			
10031	627	2113	1362	988	35			
11667	642	890	1783	375	229			

Table 6.4.2 Saithe in IV, VI and IIIa.

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Extended Survivors Analysis

SAITHE IN IV VI and IIIa : 1972 - 1999

CPUE data from file commers4.tun

Catch data for 28 years. 1972 to 1999. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FRATRB_IV	1990	1999	2	7	0	1
NORTRL_IV	1990	1999	3	9	0	1
FRATRF_IV	1990	1999	3	7	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 >= 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 32 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.002	0.002	0.002	0.001	0.001	0.001	0.004	0	0.002	0.001
2	0.037	0.118	0.038	0.086	0.032	0.035	0.052	0.172	0.055	0.074
3	0.478	0.457	0.242	0.316	0.242	0.141	0.118	0.117	0.213	0.191
4	0.679	0.795	0.726	0.476	0.659	0.574	0.313	0.31	0.373	0.489
5	0.655	0.603	1.003	0.614	0.626	0.543	0.56	0.429	0.473	0.643
6	0.575	0.443	0.567	0.726	0.471	0.368	0.617	0.337	0.429	0.474
7	0.623	0.424	0.341	0.611	0.503	0.91	0.608	0.44	0.352	0.526
8	0.511	0.45	0.303	0.679	0.257	0.84	0.543	0.396	0.368	0.778
9	0.642	0.512	0.474	0.704	0.408	0.848	0.693	0.382	0.404	0.513

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9
1990	1.59E+05	1.76E+05	1.19E+05	4.39E+04	2.60E+04	1.19E+04	6.62E+03	2.06E+03	6.56E+02
1991	2.40E+05	1.30E+05	1.39E+05	6.02E+04	1.82E+04	1.11E+04	5.49E+03	2.91E+03	1.01E+03
1992	1.67E+05	1.96E+05	9.46E+04	7.20E+04	2.23E+04	8.16E+03	5.82E+03	2.94E+03	1.52E+03
1993	3.46E+05	1.36E+05	1.54E+05	6.08E+04	2.85E+04	6.69E+03	3.79E+03	3.39E+03	1.78E+03
1994	1.70E+05	2.83E+05	1.03E+05	9.21E+04	3.09E+04	1.26E+04	2.65E+03	1.68E+03	1.41E+03
1995	2.38E+05	1.39E+05	2.24E+05	6.59E+04	3.90E+04	1.35E+04	6.47E+03	1.31E+03	1.07E+03
1996	1.06E+05	1.94E+05	1.10E+05	1.60E+05	3.04E+04	1.86E+04	7.67E+03	2.13E+03	4.64E+02
1997	9.38E+04	8.67E+04	1.51E+05	7.99E+04	9.56E+04	1.42E+04	8.20E+03	3.42E+03	1.01E+03
1998	1.24E+05	7.67E+04	5.97E+04	1.10E+05	4.80E+04	5.09E+04	8.31E+03	4.32E+03	1.88E+03
1999	4.78E+04	1.01E+05	5.95E+04	3.95E+04	6.20E+04	2.45E+04	2.72E+04	4.79E+03	2.45E+03

Estimated population abundance at 1st Jan 2000

0.00E+00	3.90E+04	7.70E+04	4.02E+04	1.99E+04	2.67E+04	1.25E+04	1.31E+04	1.80E+03

Table 6.4.2. Continued

Taper weighted geometric mean of the VPA populations:

2.03E+05	1.76E+05	1.32E+05	7.90E+04	3.73E+04	1.73E+04	8.30E+03	3.92E+03	1.93E+03

Standard error of the weighted Log(VPA populations) :

0.5478	0.4704	0.4716	0.445	0.4858	0.6341	0.7012	0.7243	0.7953

Log catchability residuals.

Fleet : FRATRB_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	-0.13	0.05	0.45	1.37	-0.31	-0.43	-0.84	-0.02	-0.01	-0.12
3	0.45	-0.26	0.03	0.73	0.25	-0.02	-0.68	-0.57	0.04	0.03
4	0.22	0.34	0.25	0.19	0.27	-0.22	-0.39	-0.27	-0.33	-0.05
5	-0.02	0.02	0.26	0.16	0.19	-0.5	-0.21	-0.08	0.05	0.15
6	-0.22	0.35	-0.25	-0.18	0.44	-0.34	0.21	-0.45	0.32	0.13
7	1.01	0.67	-0.45	-1.51	0.28	0.14	0.16	0	-0.58	0.28
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	-15.6285	-13.6723	-12.6782	-12.4894	-13.072	-13.7444
S.E(Log q)	0.586	0.4294	0.2831	0.2239	0.3243	0.7072

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	1.32	-0.475	16.82	0.22	10	0.81	-15.63
3	1.03	-0.068	13.72	0.47	10	0.47	-13.67
4	1.57	-1.774	13.52	0.55	10	0.4	-12.68
5	1.09	-0.527	12.67	0.81	10	0.25	-12.49
6	0.8	1.35	12.39	0.86	10	0.25	-13.07
7	0.8	0.602	12.78	0.54	10	0.59	-13.74

Fleet : NORTRL_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	No data for this fleet at this age									
3	-0.31	1.37	0.02	0.73	0.22	-0.57	-0.22	-0.69	-0.08	-0.47
4	-0.47	0.09	0.32	-0.11	0.72	0.41	-0.37	-0.58	-0.03	0.03
5	-0.1	-0.54	0.43	0.05	0.15	0.06	-0.1	-0.39	0.11	0.32
6	0.28	-0.73	0.15	0.73	-0.34	-0.62	0.16	-0.25	0.29	0.33
7	-0.15	-1.09	-0.57	0.48	-0.17	0.93	0.05	-0.23	0.2	0.56
8	-0.21	-1.82	-0.94	0.25	-1.08	0.7	-0.5	-0.46	0.17	1.28
9	-0.66	-0.64	-0.61	0.54	0.2	0.61	-1.38	-0.68	0.31	0.62

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	-13.599	-12.3905	-12.0775	-12.2906	-12.1813	-12.1813	-12.1813
S.E(Log q)	0.6365	0.4075	0.2968	0.4643	0.5826	0.9486	0.7284

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	0.87	0.287	13.34	0.36	10	0.58	-13.6
4	1.01	-0.032	12.4	0.5	10	0.44	-12.39
5	1	0.011	12.07	0.74	10	0.31	-12.08
6	0.95	0.182	12.16	0.63	10	0.47	-12.29
7	0.78	0.882	11.43	0.66	10	0.46	-12.18
8	0.68	0.613	11	0.32	10	0.64	-12.44
9	0.47	3.654	9.58	0.86	10	0.22	-12.35

Table 6.4.2 continued

Fleet : FRATRF_IV

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	No data for this fleet at this age									
3	0.72	-0.55	0.22	0.63	0.13	-0.31	-0.72	-0.37	0.19	0.06
4	0.43	0.2	0.38	0.1	0.07	-0.41	-0.46	-0.07	-0.15	-0.09
5	0.24	-0.05	0.37	-0.17	-0.02	-0.43	-0.41	0.09	0.22	0.15
6	0.03	0.34	-0.03	-0.86	0.29	-0.1	0.17	-0.53	0.52	0.16
7	1.27	0.58	-0.28	-2.11	0.15	0.46	0.13	-0.1	-0.36	0.26
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	5	6	7
Mean Log q	-13.7631	-12.7466	-12.6762	-13.3803	-14.0567
S.E(Log q)	0.4795	0.2979	0.2722	0.4153	0.8778

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	1.34	-0.638	14.49	0.31	10	0.66	-13.76
4	1.63	-1.806	13.72	0.51	10	0.43	-12.75
5	0.96	0.204	12.59	0.78	10	0.28	-12.68
6	0.69	2.255	12.2	0.87	10	0.24	-13.38
7	0.73	0.753	12.63	0.49	10	0.66	-14.06

Terminal year survivor and F summaries :

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

Year class = 1998

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	1	0	0	0	0	0	0
NORTRL_IV	1	0	0	0	0	0	0
FRATRF_IV	1	0	0	0	0	0	0
F shrinkage mean	39048	0.5				1	0.001

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
39048	0.5	0	1	0	0.001

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

Year class = 1997

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	68393	0.615	0	0	1	0.381	0.083
NORTRL_IV	1	0	0	0	0	0	0
FRATRF_IV	1	0	0	0	0	0	0
F shrinkage mean	82758	0.5				0.619	0.069

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
76967	0.39	0.15	2	0.387	0.074

Table 6.4.2 continued

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

Year class = 1996

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	40789	0.363	0.02	0.06	2	0.402	0.189
NORTRL_IV	25048	0.668	0	0	1	0.121	0.292
FRATRF_IV	42665	0.503	0	0	1	0.214	0.181
F shrinkage mean	46722	0.5				0.262	0.167

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
40222	0.24	0.1	5	0.403	0.191

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

Year class = 1995

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	19333	0.233	0.028	0.12	3	0.383	0.499
NORTRL_IV	19960	0.361	0.049	0.13	2	0.165	0.487
FRATRF_IV	19449	0.266	0.119	0.45	2	0.304	0.497
F shrinkage mean	22078	0.5				0.148	0.449

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
19856	0.15	0.03	8	0.216	0.489

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

Year class = 1994

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	22538	0.188	0.189	1.01	4	0.348	0.727
NORTRL_IV	30810	0.24	0.212	0.89	3	0.231	0.578
FRATRF_IV	26402	0.203	0.135	0.67	3	0.307	0.648
F shrinkage mean	34418	0.5				0.114	0.531

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
26685	0.12	0.1	11	0.801	0.643

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

Year class = 1993

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	11574	0.171	0.126	0.74	5	0.378	0.503
NORTRL_IV	12891	0.222	0.182	0.82	4	0.224	0.462
FRATRF_IV	13054	0.19	0.151	0.79	4	0.295	0.457
F shrinkage mean	13416	0.5				0.103	0.448

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
12473	0.11	0.07	14	0.658	0.474

Table 6.4.2 continued

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

Year class = 1992

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	13383	0.171	0.123	0.72	6	0.352	0.519
NORTRL_IV	12717	0.219	0.211	0.96	5	0.242	0.54
FRATRF_IV	13866	0.191	0.182	0.95	5	0.271	0.504
F shrinkage mean	11917	0.5				0.135	0.567

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
13139	0.12	0.08	17	0.703	0.526

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

Year class = 1991

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	1365	0.182	0.149	0.82	6	0.302	0.937
NORTRL_IV	2067	0.23	0.203	0.88	6	0.239	0.706
FRATRF_IV	1196	0.201	0.072	0.36	5	0.231	1.02
F shrinkage mean	3400	0.5				0.228	0.485

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1800	0.15	0.13	18	0.884	0.778

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

Year class = 1990

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB_IV	1230	0.191	0.158	0.83	6	0.243	0.503
NORTRL_IV	1514	0.272	0.131	0.48	7	0.284	0.426
FRATRF_IV	1112	0.211	0.151	0.72	5	0.185	0.544
F shrinkage mean	983	0.5				0.288	0.598

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1200	0.17	0.08	19	0.45	0.513

Table 6.4.3 Saithe in IV, VI and IIIa. Fishing mortality (F) at age

YEAR		1972	1973	1974	1975	1976	1977	1978	1979
AGE									
	1	0.0017	0.0174	0.0078	0.0017	0.0019	0.0166	0.0111	0.0035
	2	0.132	0.2071	0.0916	0.1612	0.2323	0.1295	0.2147	0.2146
	3	0.3711	0.499	0.6879	0.427	0.9112	0.2973	0.5432	0.2646
	4	0.4397	0.5628	0.6748	0.6292	0.9305	0.6548	0.5446	0.4421
	5	0.2767	0.3202	0.4242	0.4462	0.6615	0.7374	0.4639	0.4503
	6	0.4925	0.2838	0.4388	0.4243	0.5383	0.7713	0.3552	0.4265
	7	0.3538	0.3695	0.4556	0.5872	0.4143	0.7468	0.3485	0.582
	8	0.4054	0.3317	0.4106	0.5974	0.4831	0.7841	0.4633	0.3977
	9	0.4201	0.3303	0.4381	0.5407	0.4822	0.7751	0.3916	0.4723
+gp		0.4201	0.3303	0.4381	0.5407	0.4822	0.7751	0.3916	0.4723
FBAR 3- 6		0.395	0.4164	0.5564	0.4817	0.7604	0.6152	0.4767	0.3959

YEAR		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE											
	1	0.0076	0.0275	0.0061	0.0007	0.0005	0.0014	0.0016	0.0068	0.0002	0.0187
	2	0.1189	0.1571	0.2042	0.1506	0.1031	0.0292	0.056	0.2161	0.0967	0.0726
	3	0.3398	0.1833	0.3871	0.3068	0.5733	0.6454	0.2393	0.362	0.3702	0.3758
	4	0.3279	0.2686	0.4797	0.4667	0.6924	1.0487	1.402	0.8691	0.599	0.7269
	5	0.5633	0.2996	0.5345	0.6575	0.6103	0.7	0.9634	0.8529	0.9491	0.6938
	6	0.5402	0.4727	0.4755	0.764	0.8397	0.4743	0.6965	0.5303	0.5977	0.9153
	7	0.5492	0.5697	0.5633	0.9382	0.5255	0.4638	0.5193	0.5341	0.7263	0.5214
	8	0.5029	0.7688	0.5259	1.0318	0.6654	0.4266	0.4296	0.5044	0.7455	0.7031
	9	0.5351	0.609	0.5257	0.9213	0.6832	0.4583	0.553	0.5271	0.6963	0.7201
+gp		0.5351	0.609	0.5257	0.9213	0.6832	0.4583	0.553	0.5271	0.6963	0.7201
FBAR 3- 6		0.4428	0.306	0.4692	0.5487	0.6789	0.7171	0.8253	0.6536	0.629	0.6779

YEAR		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99
AGE												
	1	0.0025	0.0023	0.0021	0.0005	0.0007	0.0007	0.0037	0.0003	0.0019	0.0015	0.0012
	2	0.0369	0.118	0.0384	0.0855	0.0319	0.0351	0.0523	0.172	0.0548	0.0745	0.1004
	3	0.4783	0.4571	0.242	0.316	0.2422	0.1407	0.118	0.1166	0.2128	0.1913	0.1735
	4	0.6794	0.7948	0.7255	0.4756	0.6586	0.5739	0.3133	0.3103	0.3733	0.4888	0.3908
	5	0.655	0.6033	1.0025	0.6139	0.6264	0.5432	0.5597	0.4292	0.473	0.6433	0.5152
	6	0.5747	0.4426	0.5666	0.7263	0.4709	0.3682	0.6169	0.3365	0.429	0.4744	0.4133
	7	0.6228	0.4238	0.3413	0.611	0.5028	0.9096	0.6081	0.4399	0.3518	0.5261	0.4392
	8	0.5107	0.4503	0.3028	0.6786	0.2573	0.8399	0.5426	0.3963	0.3685	0.7784	0.5144
	9	0.6422	0.5118	0.474	0.7043	0.4084	0.8482	0.693	0.3818	0.4045	0.5131	0.4331
+gp		0.6422	0.5118	0.474	0.7043	0.4084	0.8482	0.693	0.3818	0.4045	0.5131	
FBAR 3- 6		0.5968	0.5745	0.6342	0.533	0.4995	0.4065	0.402	0.2982	0.372	0.4495	

Table 6.4.4 Saithe in IV, VI and IIIa. Stock number at age (start of year) Numbers*10-3**

YEAR		1972	1973	1974	1975	1976	1977	1978	1979
AGE									
	1	273436	301503	678475	222466	157282	145955	125483	291213
	2	213033	223481	242590	551188	181836	128527	117532	101603
	3	171372	152852	148740	181238	384107	118010	92448	77632
	4	205322	96808	75983	61209	96820	126435	71771	43967
	5	115736	108298	45149	31680	26711	31259	53779	34087
	6	60268	71848	64373	24186	16601	11286	12242	27688
	7	13622	30155	44292	33984	12955	7934	4273	7027
	8	9765	7829	17063	22993	15466	7009	3078	2469
	9	5286	5330	4601	9266	10359	7811	2620	1586
+gp		5132	9288	6037	7036	9984	9495	11784	6074
TOTAL		1072971	1007392	1327301	1145246	912122	593721	495009	593345

YEAR		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE											
	1	193172	222184	357696	515450	442364	179489	215814	129158	190345	219060
	2	237597	156960	176971	291074	421732	361991	146744	176402	105033	155812
	3	67119	172721	109829	118136	204992	311456	287853	113605	116360	78066
	4	48782	39123	117726	61060	71166	94601	133729	185515	64763	65790
	5	23134	28773	24486	59661	31349	29156	27140	26946	63692	29129
	6	17789	10784	17459	11747	25309	13942	11854	8479	9402	20185
	7	14798	8486	5503	8885	4480	8948	7103	4836	4085	4235
	8	3215	6996	3930	2565	2847	2169	4608	3460	2321	1618
	9	1358	1592	2655	1902	748	1198	1159	2455	1711	902
+gp		6075	6074	3356	2396	1424	2209	2316	1868	1478	1037
TOTAL		613039	653692	819611	1072876	1206411	1005159	838319	652723	559191	575833

YEAR		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 72-97	GMST 88-97
AGE														
	1	159214	239702	166980	345921	169892	237538	106257	93769	123937	47763	**0**	218577	180623
	2	176036	130032	195806	136423	283072	139000	194338	86676	76747	101274	**39048**	185084	152113
	3	118637	138911	94616	154269	102538	224491	109878	151000	59748	59482	**76967**	139756	123636
	4	43893	60207	72002	60813	92081	65892	159671	79947	110023	39541	40222	80102	72142
	5	26039	18217	22265	28536	30943	39021	30392	95565	47993	62015	19856	36255	33825
	6	11917	11074	8158	6689	12645	13541	18559	14218	50937	24484	26685	16372	11997
	7	6617	5492	5824	3790	2649	6465	7671	8199	8314	27157	12473	7931	5217
	8	2058	2906	2943	3389	1685	1312	2131	3419	4324	4789	13139	3876	2268
	9	656	1011	1517	1780	1408	1066	464	1014	1883	2449	1800	1916	1069
+gp		838	1250	1223	2213	2596	1522	1071	997	913	1847	2106		
TOTAL		545905	608803	571334	743823	699509	729849	630433	534805	484820	370799	232296		

Bold figures overwritten by GM (88-97) in the prediction

Table 6.4.5 Saithe in IV, VI and IIIa. Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1972	273436	1110283	474092	275098	0.5803	0.395
1973	301503	993330	534484	259602	0.4857	0.4164
1974	678475	1143829	554903	309439	0.5576	0.5564
1975	222466	1068221	472063	308926	0.6544	0.4817
1976	157282	918186	351527	361680	1.0289	0.7604
1977	145955	626824	263116	223395	0.849	0.6152
1978	125483	569024	268078	166199	0.62	0.4767
1979	291213	586951	241034	135967	0.5641	0.3959
1980	193172	546659	235118	142395	0.6056	0.4428
1981	222184	650120	241140	146092	0.6058	0.306
1982	357696	691524	210338	189861	0.9026	0.4692
1983	515450	818580	214065	197774	0.9239	0.5487
1984	442364	848418	176319	219642	1.2457	0.6789
1985	179489	717159	160345	226129	1.4103	0.7171
1986	215814	702449	151146	202758	1.3415	0.8253
1987	129158	505940	152158	180776	1.1881	0.6536
1988	190345	486206	147170	140778	0.9566	0.629
1989	219060	465580	114705	117609	1.0253	0.6779
1990	159214	430189	103474	107945	1.0432	0.5968
1991	239702	471126	102398	115576	1.1287	0.5745
1992	166980	508527	105277	104147	0.9893	0.6342
1993	345921	558399	112266	119073	1.0606	0.533
1994	169892	574727	126302	115255	0.9125	0.4995
1995	237538	687512	140470	125183	0.8912	0.4065
1996	106257	568029	150902	119669	0.793	0.402
1997	93769	541710	203680	112740	0.5535	0.2982
1998	**180623**	497841	199985	108699	0.5435	0.372
1999	**180623**	400992	202022	114259	0.5656	0.4495
2000	**180623**	527160	188377*			
Arith. Mean	233983	667441	228878	176667	0.8581	0.529
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Bold figures GM(88-97)

* SSB estimated using the average weight at age in the stock over the years 1997-1999.

Table 6.5.1 Saithe in IV, IIIa, Via. Input for RCT3 at age 4

North Sea Saithe: RCT3 input: Age 4, 04/10/00

6 12 2

YEARCLASS'	'VPA'	'TRBQ13'	'TRBQ14'	'TRBQ23'	'TRBQ24'	'EGFS3'	'EGFS4'
1986	43.9	-1	487	-1	957	-1	84
1987	60.2	102	910	763	582	873	97
1988	72	221	416	172	284	426	231
1989	60.8	108	393	98	447	94	413
1990	92.1	362	1052	316	1142	1091	75
1991	65.9	243	297	371	529	123	262
1992	159.7	192	550	600	1233	1366	692
1993	79.9	116	142	258	357	297	288
1994	110	89	168	293	499	450	354
1995	39.5	36	108	316	267	54	83
1996	-1	39	391	194	798	87	489
1997	-1	193	-1	275	-1	190	-1

Table 6.5.2. Saithe in IV, IIIa and Via. Diagnostics of RCT3-at-age 4

Analysis by RCT3 ver3.1 of data from file :
sairct4.txt
North Sea Saithe: RCT3 input: Age 4, 04/10/00
Data for 6 surveys over 12 years : 1986 - 1997
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 = 1995

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
TRBQ13	4.50	-18.43	2.41	.022	8	3.61	-2.18	4.270	.004
TRBQ14	-5.55	37.68	3.98	.010	9	4.69	11.66	5.686	.003
TRBQ23	1.47	-3.96	.97	.122	8	5.76	4.50	1.184	.058
TRBQ24	2.57	-12.09	1.35	.081	9	5.59	2.30	1.827	.025
EGFS3	.56	1.08	.46	.377	8	4.01	3.31	.704	.165
EGFS4	.83	-.08	.55	.348	9	4.43	3.57	.710	.163
					VPA Mean =		4.36	.375	.582

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
TRBQ13	1.11	-1.11	.69	.275	9	3.69	2.99	.958	.070
TRBQ14	2.62	-11.10	2.07	.043	10	5.97	4.54	2.426	.011
TRBQ23	2.50	-9.97	1.57	.067	9	5.27	3.24	1.936	.017
TRBQ24	1.66	-6.20	.86	.204	10	6.68	4.91	1.031	.060
EGFS3	.46	1.67	.37	.570	9	4.48	3.74	.472	.289
EGFS4	.79	.14	.49	.442	10	6.19	5.00	.611	.172
					VPA Mean =		4.30	.411	.381

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
TRBQ13	1.11	-1.11	.69	.275	9	5.27	4.74	.831	.114
TRBQ14									
TRBQ23	2.50	-9.97	1.57	.067	9	5.62	4.11	1.883	.022
TRBQ24									
EGFS3	.46	1.67	.37	.570	9	5.25	4.10	.445	.398
EGFS4									
					VPA Mean =		4.30	.411	.466

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	54	4.01	.29	.31	1.20	40	3.70
1996	65	4.19	.25	.23	.85		
1997	70	4.26	.28	.11	.16		

Table 6.7.1

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Saithe in Sub-area IV, Division IIIa and Sub-area VI

Single option prediction: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	180623	0.2000	0.0000	0.0000	0.0000	0.518	0.0010	0.518
2	152113	0.2000	0.0000	0.0000	0.0000	0.561	0.1210	0.561
3	123636	0.2000	0.0000	0.0000	0.0000	0.892	0.2090	0.892
4	40222	0.2000	0.1500	0.0000	0.0000	1.057	0.4710	1.057
5	19854	0.2000	0.7000	0.0000	0.0000	1.352	0.6200	1.352
6	26685	0.2000	0.9000	0.0000	0.0000	2.028	0.4980	2.028
7	12472	0.2000	1.0000	0.0000	0.0000	2.947	0.5290	2.947
8	13138	0.2000	1.0000	0.0000	0.0000	3.966	0.6190	3.966
9	1798	0.2000	1.0000	0.0000	0.0000	5.331	0.5220	5.331
10+	2105	0.2000	1.0000	0.0000	0.0000	7.629	0.5220	7.629
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	180623	0.2000	0.0000	0.0000	0.0000	0.518	0.0010	0.518
2	-	0.2000	0.0000	0.0000	0.0000	0.561	0.1210	0.561
3	-	0.2000	0.0000	0.0000	0.0000	0.892	0.2090	0.892
4	-	0.2000	0.1500	0.0000	0.0000	1.057	0.4710	1.057
5	-	0.2000	0.7000	0.0000	0.0000	1.352	0.6200	1.352
6	-	0.2000	0.9000	0.0000	0.0000	2.028	0.4980	2.028
7	-	0.2000	1.0000	0.0000	0.0000	2.947	0.5290	2.947
8	-	0.2000	1.0000	0.0000	0.0000	3.966	0.6190	3.966
9	-	0.2000	1.0000	0.0000	0.0000	5.331	0.5220	5.331
10+	-	0.2000	1.0000	0.0000	0.0000	7.629	0.5220	7.629
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	180623	0.2000	0.0000	0.0000	0.0000	0.518	0.0010	0.518
2	-	0.2000	0.0000	0.0000	0.0000	0.561	0.1210	0.561
3	-	0.2000	0.0000	0.0000	0.0000	0.892	0.2090	0.892
4	-	0.2000	0.1500	0.0000	0.0000	1.057	0.4710	1.057
5	-	0.2000	0.7000	0.0000	0.0000	1.352	0.6200	1.352
6	-	0.2000	0.9000	0.0000	0.0000	2.028	0.4980	2.028
7	-	0.2000	1.0000	0.0000	0.0000	2.947	0.5290	2.947
8	-	0.2000	1.0000	0.0000	0.0000	3.966	0.6190	3.966
9	-	0.2000	1.0000	0.0000	0.0000	5.331	0.5220	5.331
10+	-	0.2000	1.0000	0.0000	0.0000	7.629	0.5220	7.629
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SPRODD04
Date and time: 09OCT00:14:36

Table 6.7.2

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Saithe in Sub-area IV, Division IIIa and Sub-area VI

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4495	527160	188377	118536	0.0000	0.0000	515551	156775	0	549895	247184
.	.	.	.	.	0.1000	0.0450	.	156775	13899	533113	234847
.	.	.	.	.	0.2000	0.0899	.	156775	27195	517087	223146
.	.	.	.	.	0.3000	0.1349	.	156775	39918	501779	212046
.	.	.	.	.	0.4000	0.1798	.	156775	52095	487153	201517
.	.	.	.	.	0.5000	0.2248	.	156775	63753	473176	191527
.	.	.	.	.	0.6000	0.2697	.	156775	74917	459814	182050
.	.	.	.	.	0.7000	0.3147	.	156775	85611	447038	173057
.	.	.	.	.	0.8000	0.3596	.	156775	95857	434820	164525
.	.	.	.	.	0.9000	0.4046	.	156775	105677	423131	156428
.	.	.	.	.	1.0000	0.4495	.	156775	115090	411946	148745
.	.	.	.	.	1.1000	0.4945	.	156775	124117	401239	141453
.	.	.	.	.	1.2000	0.5394	.	156775	132776	390989	134532
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANODD04
Date and time : 08OCT00:15:17
Computation of ref. F: Simple mean, age 3 - 6
Basis for 2000 : F factors

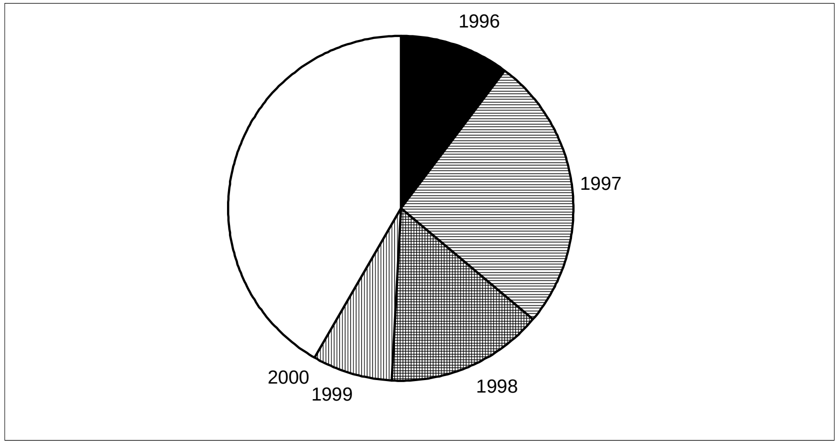
Table 6.7.3 **Saithe in VI, VI and IIIa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1996	1997	1998	1999	2000
Stock No. (thousands)			93769	180623	180623	180623	180623
age			1	1	1	1	1
Source			XSA	GM	GM	GM	GM
Status Quo F:							
% in	2000	landings	12.3	16.0	7.5	0.1	-
% in	2001		10.2	25.9	14.7	7.5	0.1
% in	2000	SSB	3.4	0.0	0.0	0.0	-
% in	2001	SSB	12.4	8.3	0.0	0.0	0.0
% in	2002	SSB	11.1	26.7	7.8	0.0	0.0

GM : geometric mean recruitment 1987-96

Saithe in VI, VI and IIIa : Year-class % contribution to

a) 2001 landings



b) 2002 SSB

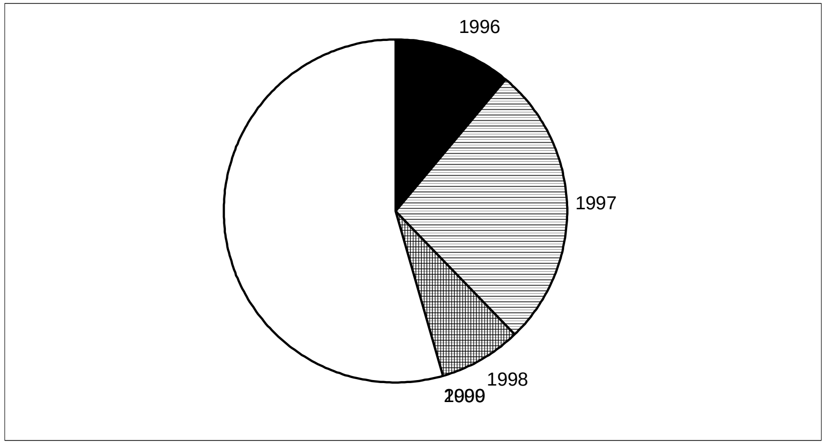


Table 6.7.4

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Saithe in Sub-area IV, Division IIIa and Sub-area VI

Single option prediction: Detailed tables

Year: 2000 F-factor: 1.0000 Reference F: 0.4495

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	0.0010	164	85	180623	93563	0	0	0	0
2	0.1210	15744	8832	152113	85335	0	0	0	0
3	0.2090	21208	18918	123636	110283	0	0	0	0
4	0.4710	13801	14587	40222	42515	6033	6377	6033	6377
5	0.6200	8400	11357	19854	26843	13898	18790	13898	18790
6	0.4980	9566	19399	26685	54117	24017	48705	24017	48705
7	0.5290	4685	13805	12472	36755	12472	36755	12472	36755
8	0.6190	5552	22019	13138	52105	13138	52105	13138	52105
9	0.5220	668	3564	1798	9585	1798	9585	1798	9585
10+	0.5220	783	5970	2105	16059	2105	16059	2105	16059
Total		80569	118536	572646	527160	73461	188377	73461	188377
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.4495

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	0.0010	164	85	180623	93563	0	0	0	0
2	0.1210	15291	8578	147734	82879	0	0	0	0
3	0.2090	18928	16884	110346	98429	0	0	0	0
4	0.4710	28181	29787	82133	86815	12320	13022	12320	13022
5	0.6200	8699	11761	20561	27799	14393	19459	14393	19459
6	0.4980	3134	6357	8744	17734	7870	15960	7870	15960
7	0.5290	4987	14697	13278	39130	13278	39130	13278	39130
8	0.6190	2542	10083	6016	23861	6016	23861	6016	23861
9	0.5220	2153	11480	5792	30878	5792	30878	5792	30878
10+	0.5220	705	5378	1896	14465	1896	14465	1896	14465
Total		84785	115090	577124	515551	61565	156775	61565	156775
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 1.0000 Reference F: 0.4495

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	0.0010	164	85	180623	93563	0	0	0	0
2	0.1210	15291	8578	147734	82879	0	0	0	0
3	0.2090	18383	16398	107170	95595	0	0	0	0
4	0.4710	25151	26585	73305	77483	10996	11622	10996	11622
5	0.6200	17764	24017	41986	56765	29390	39736	29390	39736
6	0.4980	3246	6583	9056	18365	8150	16529	8150	16529
7	0.5290	1634	4816	4351	12822	4351	12822	4351	12822
8	0.6190	2707	10735	6405	25403	6405	25403	6405	25403
9	0.5220	986	5257	2652	14140	2652	14140	2652	14140
10+	0.5220	1388	10593	3735	28492	3735	28492	3735	28492
Total		86715	113647	577016	505508	65680	148745	65680	148745
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRODD04
Date and time : 09OCT00:14:36
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors

11:04

Table 6.8.1 Saithe in IV, IIIa, and VIa. Input data for medium term analysis.

Name	Value	uncertainty (CV)
Population at age in 2000		
N1	180622	0.39
N2	152113	0.39
N3	123636	0.39
N4	40221	0.24
N5	19855	0.15
N6	26685	0.12
N7	12472	0.11
N8	13139	0.12
N9	1799	0.15
N10	2106	0.17

Name	Value	uncertainty (CV)
Fishing mortality pattern		
sH1	0.001	0.65
sH2	0.121	0.82
sH3	0.209	0.21
sH4	0.471	0.04
sH5	0.62	0.07
sH6	0.498	0.05
sH7	0.529	0.22
sH8	0.619	0.27
sH9	0.522	0.09
sH10	0.522	0.09

Name	Value	uncertainty (CV)
Weight in the catch at age and stoc		
WH1	0.441	0.27
WH2	0.637	0.16
WH3	0.897	0.08
WH4	1.133	0.09
WH5	1.565	0.12
WH6	2.31	0.15
WH7	3.347	0.14
WH8	4.485	0.12
WH9	5.794	0.11
WH10	7.926	0.09

Name	Value	uncertainty (CV)
Natural mortality pattern		
M1	0.2	0.1
M2	0.2	0.1
M3	0.2	0.1
M4	0.2	0.1
M5	0.2	0.1
M6	0.2	0.1
M7	0.2	0.1
M8	0.2	0.1
M9	0.2	0.1
M10	0.2	0.1

Name	Value	uncertainty (CV)
Maturity ogive pattern		
MT1	0	0
MT2	0	0
MT3	0	0.1
MT4	0.15	0.1
MT5	0.7	0.1
MT6	0.9	0.1
MT7	1	0.1
MT8	1	0
MT9	1	0
MT10	1	0

Name	Value	uncertainty (CV)
Effort multiplier by year		
HF01	1	0.2
HF02	1	0.2
HF03	1	0.2
Recruitment in year		
R01	180623	0.39
R02	180623	0.39

Table 6.9.1

Monday, October 16, 2000
Saithe in Sub-area IV, Division IIIa and Sub-area 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	0.441	0.0010	0.441
2	-	0.2000	0.0000	0.0000	0.0000	0.637	0.1210	0.637
3	-	0.2000	0.0000	0.0000	0.0000	0.897	0.2090	0.897
4	-	0.2000	0.1500	0.0000	0.0000	1.133	0.4710	1.133
5	-	0.2000	0.7000	0.0000	0.0000	1.565	0.6200	1.565
6	-	0.2000	0.9000	0.0000	0.0000	2.310	0.4980	2.310
7	-	0.2000	1.0000	0.0000	0.0000	3.347	0.5290	3.347
8	-	0.2000	1.0000	0.0000	0.0000	4.485	0.6190	4.485
9	-	0.2000	1.0000	0.0000	0.0000	5.794	0.5220	5.794
10+	-	0.2000	1.0000	0.0000	0.0000	7.926	0.5220	7.926
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDODD01
Date and time: 10OCT00:09:44
11:04

Table 6.9.2

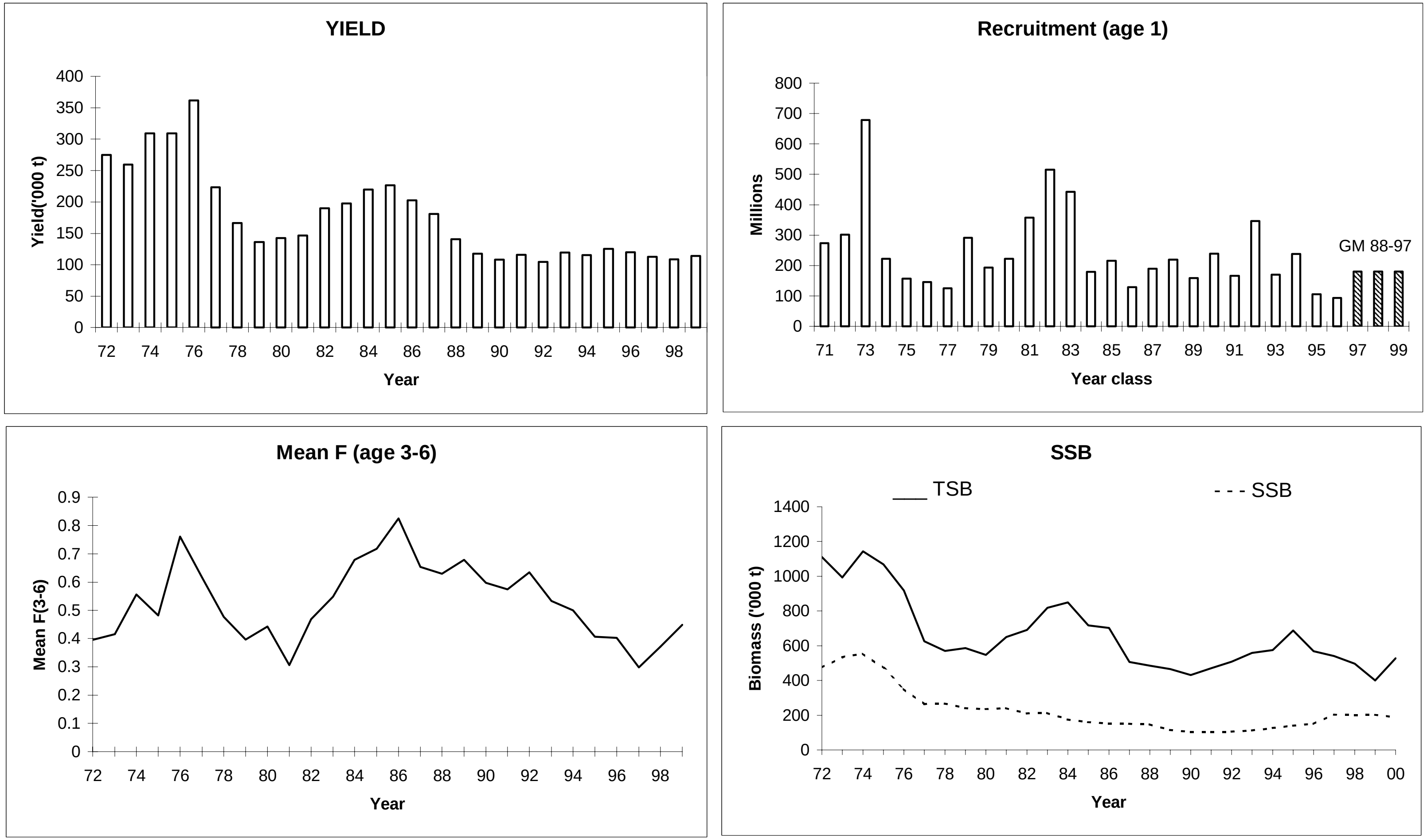
Monday, October 16, 2000
Saithe in Sub-area IV, Division IIIa and Sub-area VI

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	14250.182	2.390	11861.900	2.390	11861.900
0.1000	0.0450	0.133	424.980	4.854	10207.353	1.765	7871.145	1.765	7871.145
0.2000	0.0899	0.221	609.562	4.419	7802.173	1.367	5514.644	1.367	5514.644
0.3000	0.1349	0.283	686.251	4.111	6263.553	1.094	4021.622	1.094	4021.622
0.4000	0.1798	0.329	712.203	3.881	5225.655	0.896	3026.521	0.896	3026.521
0.5000	0.2248	0.366	714.087	3.701	4495.836	0.749	2336.946	0.749	2336.946
0.6000	0.2697	0.395	704.934	3.557	3964.828	0.635	1843.853	0.635	1843.853
0.7000	0.3147	0.419	691.249	3.439	3567.093	0.545	1481.902	0.545	1481.902
0.8000	0.3596	0.439	676.287	3.339	3261.558	0.472	1210.200	0.472	1210.200
0.9000	0.4046	0.457	661.632	3.254	3021.546	0.413	1002.228	0.413	1002.228
1.0000	0.4495	0.472	648.000	3.179	2829.205	0.364	840.279	0.364	840.279
1.1000	0.4945	0.485	635.662	3.114	2672.277	0.323	712.224	0.323	712.224
1.2000	0.5394	0.497	624.657	3.056	2542.155	0.288	609.572	0.288	609.572
1.3000	0.5844	0.508	614.917	3.004	2432.672	0.258	526.261	0.258	526.261
1.4000	0.6293	0.518	606.326	2.957	2339.329	0.232	457.888	0.232	457.888
1.5000	0.6743	0.527	598.753	2.915	2258.791	0.210	401.204	0.210	401.204
1.6000	0.7192	0.535	592.070	2.876	2188.547	0.191	353.774	0.191	353.774
1.7000	0.7642	0.542	586.159	2.839	2126.678	0.174	313.752	0.174	313.752
1.8000	0.8091	0.549	580.915	2.806	2071.703	0.159	279.720	0.159	279.720
1.9000	0.8541	0.556	576.244	2.775	2022.461	0.146	250.576	0.146	250.576
2.0000	0.8990	0.562	572.069	2.746	1978.032	0.134	225.455	0.134	225.455
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDODD01
Date and time : 10OCT00:09:44
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.2676
F-max factor : 0.4590
F-0.1 reference F : 0.1203
F-max reference F : 0.2063
Recruitment : Single recruit

Figure 6.1.1. Saithe in IV, VI and IIIA



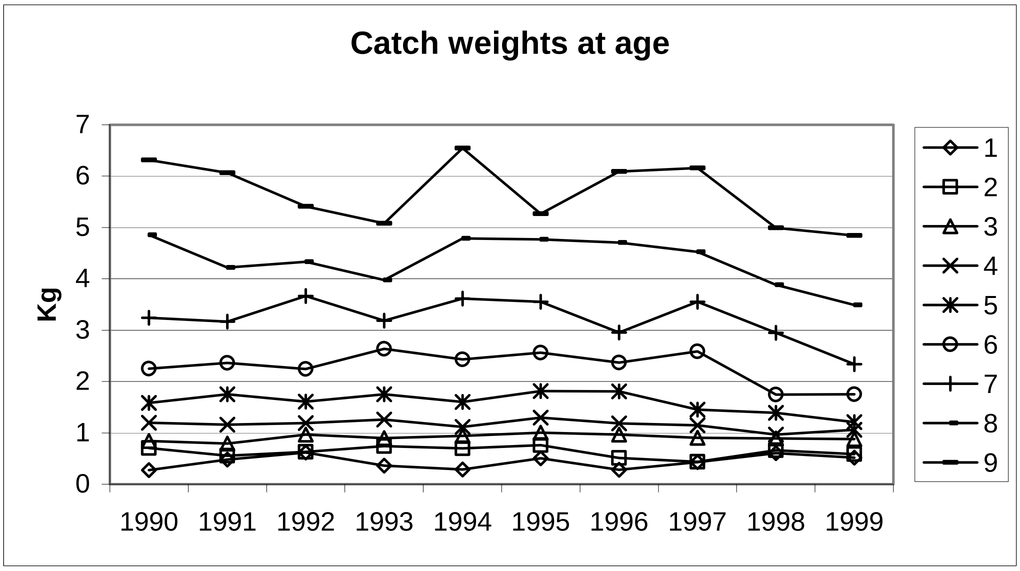
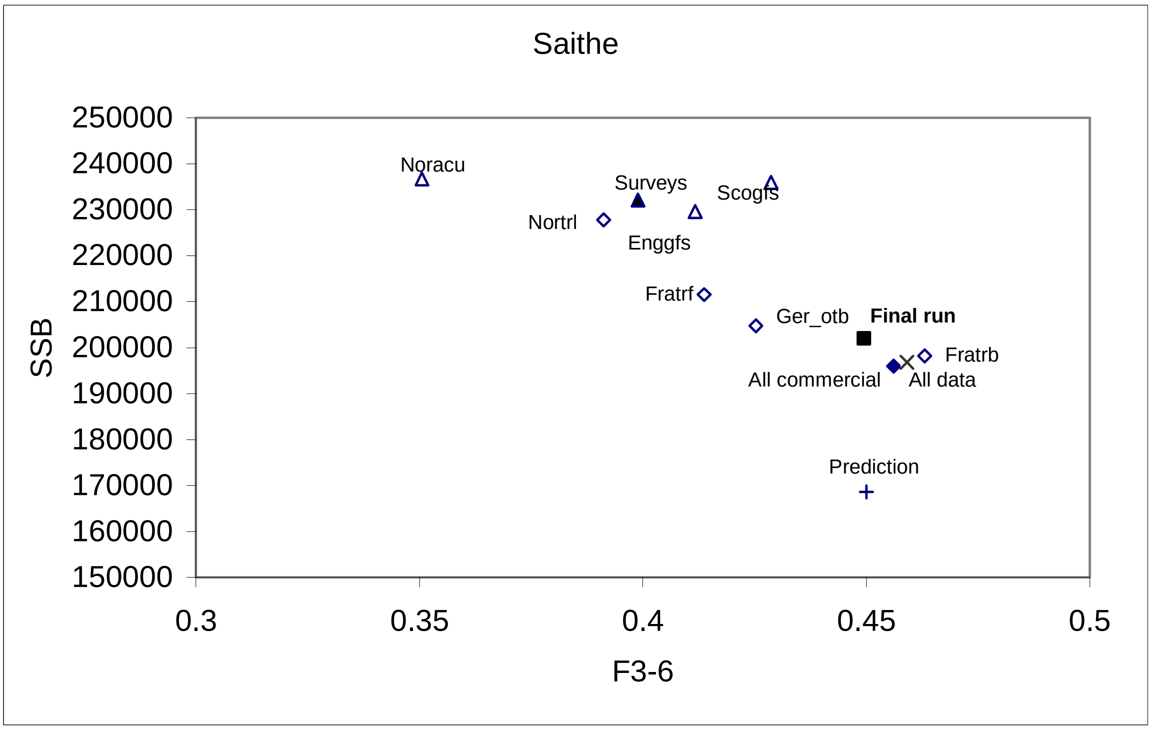


Figure 6.2.1 Saithe in IV, VI and IIIa. Mean weights at age.

Figure 6.4.1 Saithe in IV, VI and IIIa Results from single fleet tunings and combined fleet tunings



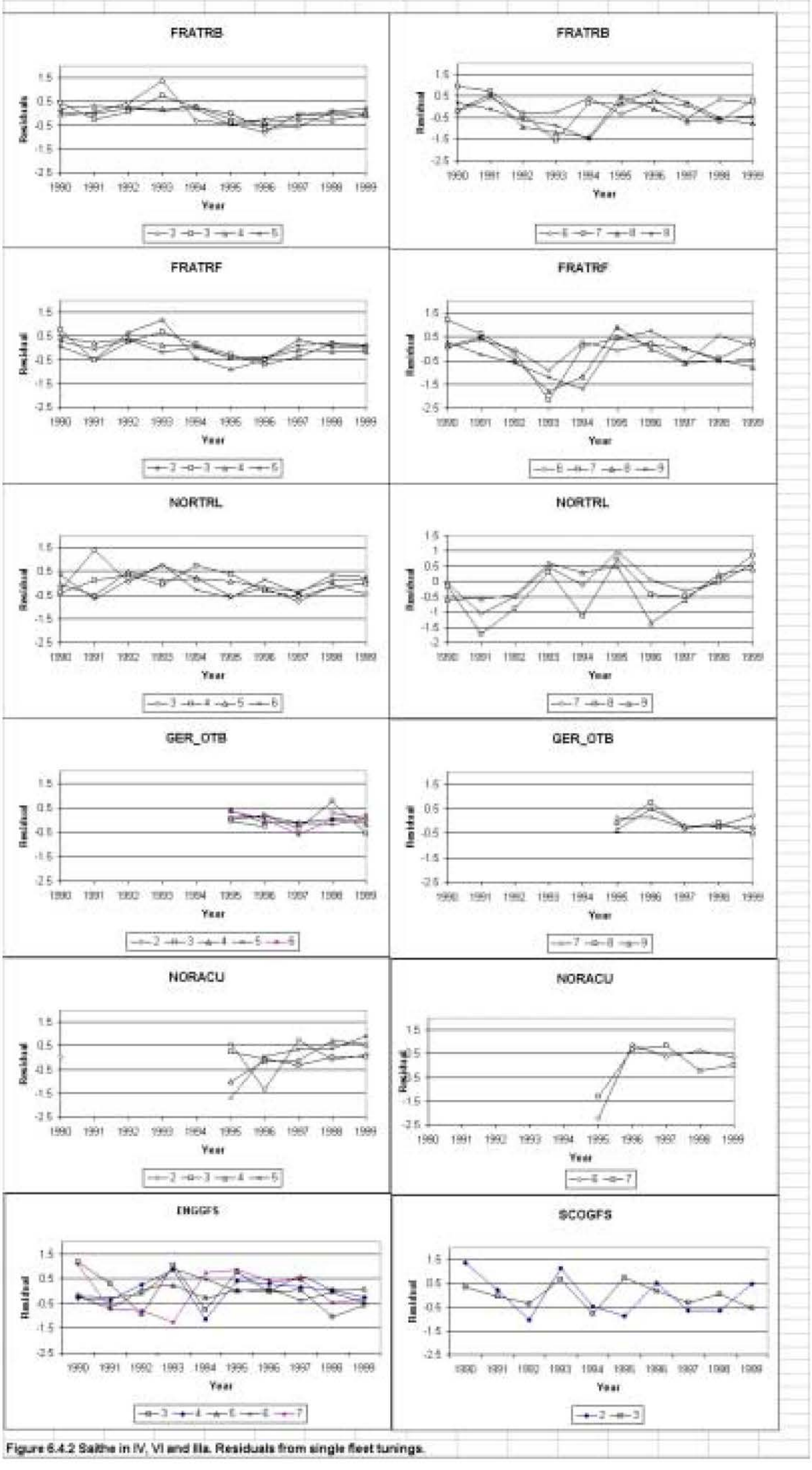


Figure 6.4.2 Saithe in IV, VI and IIIa. Residuals from single fleet tunings.

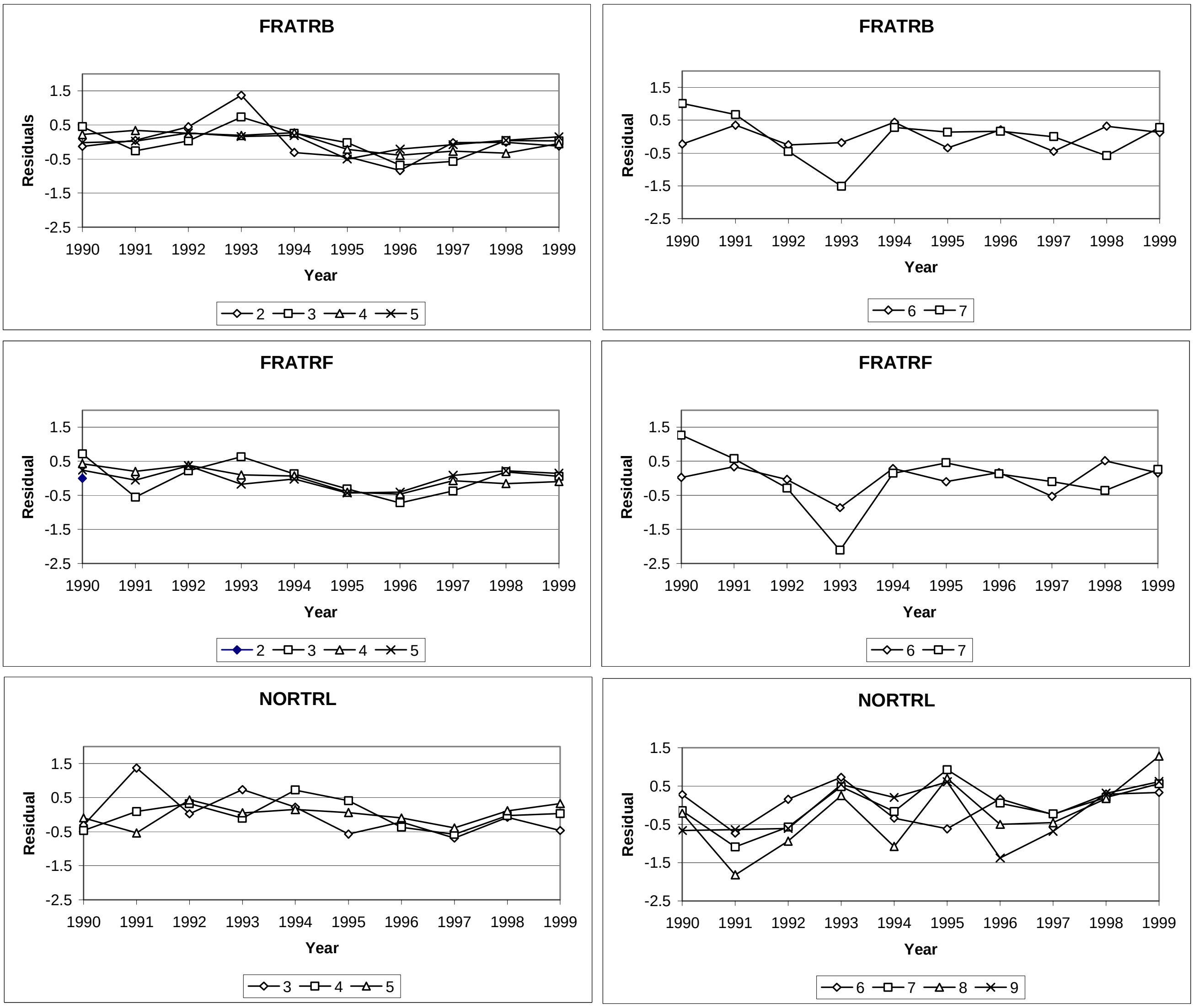


Figure 6.4.3. Saithe IV, VI and IIIa. Residuals from combined tuning

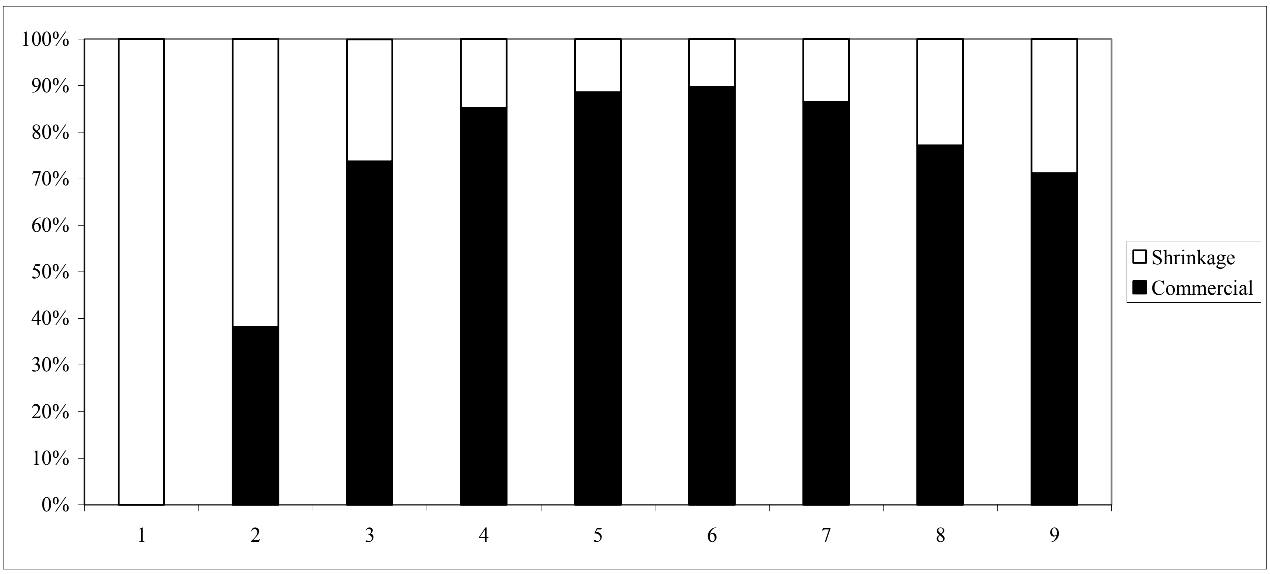


Figure 6.4.4. Saithe IV, VIa and IIIa - Contribution of Commercial fleets and shrinkage to tuned XSA

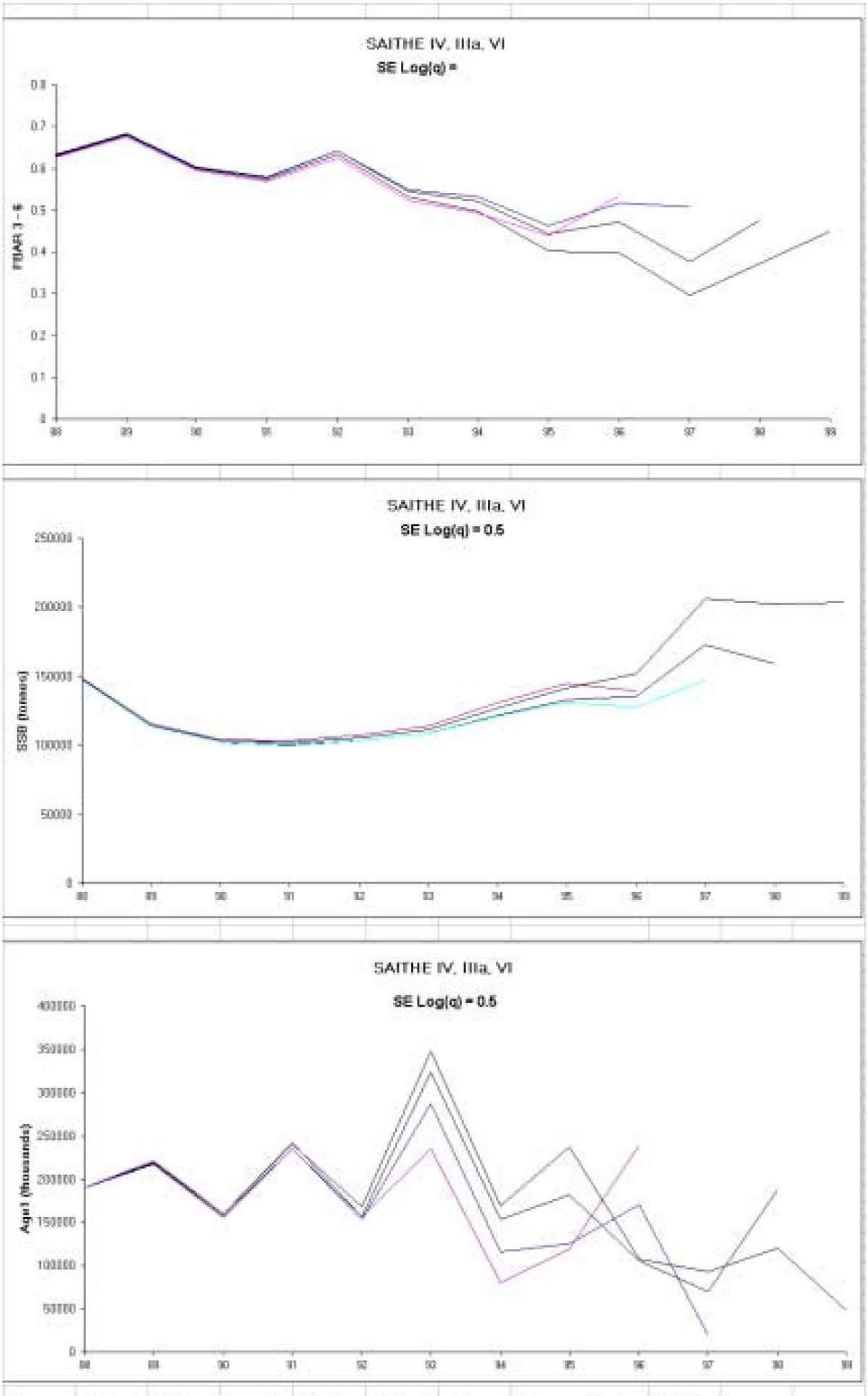


Figure 6.4.5.- Saithe in Division IV, VIa and IIIa. Retrospective analysis with final run.

Number of simulations: 500 Model used: Ricker

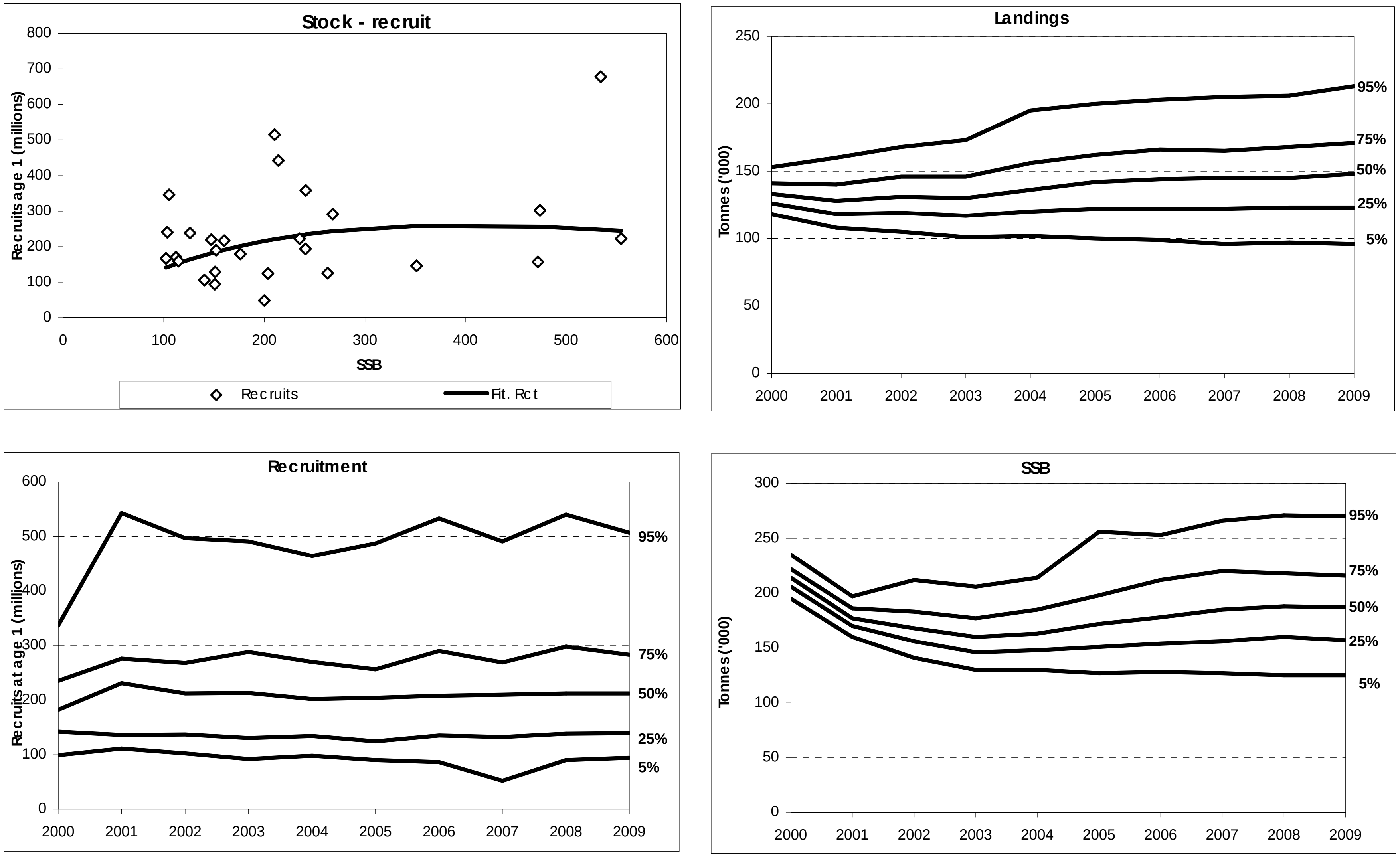
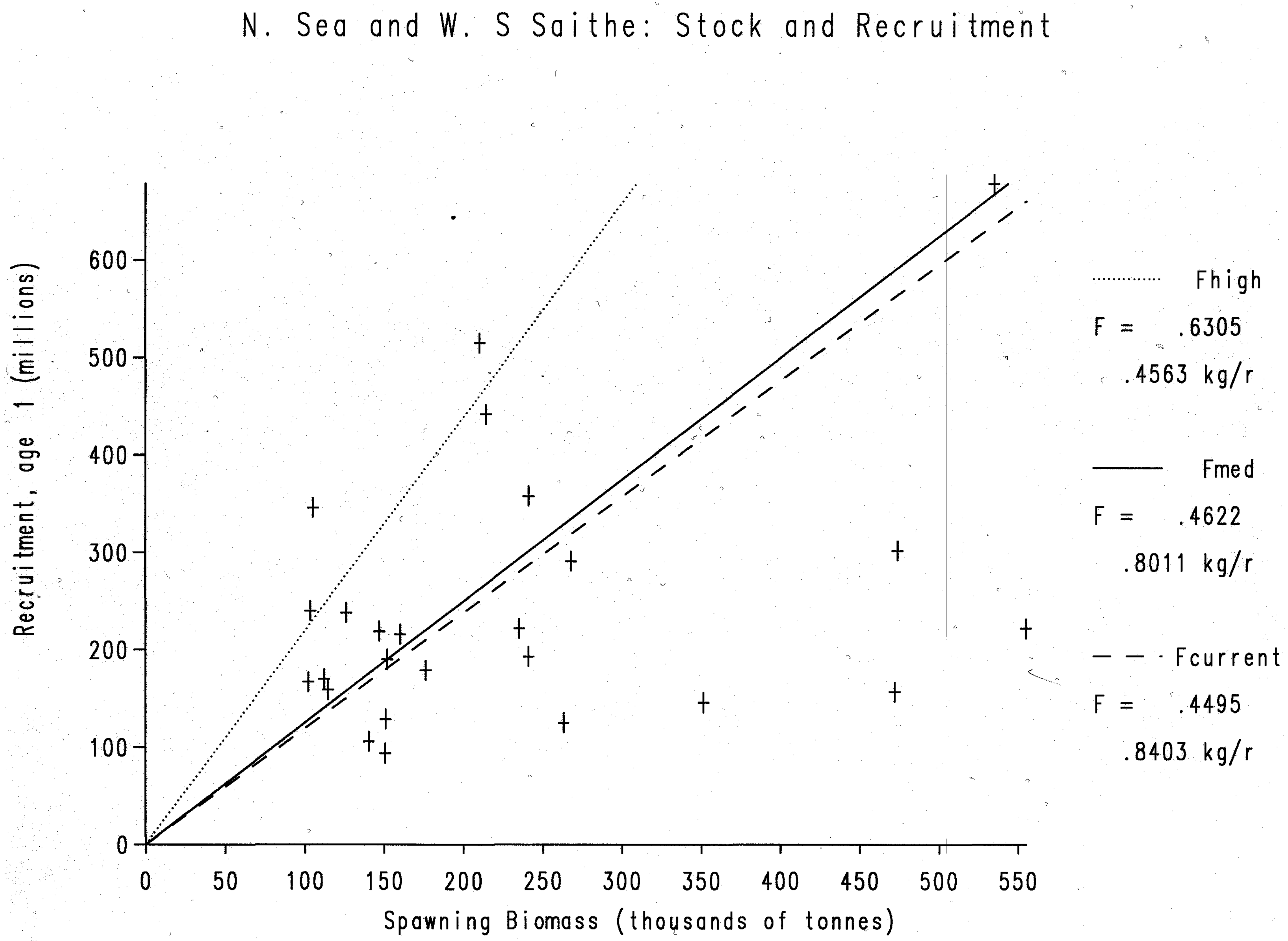


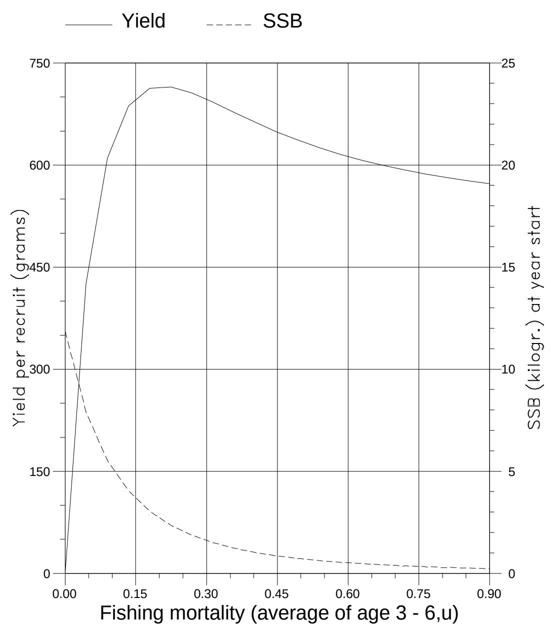
Figure 6.8.1. Saithe in North Sea, West Scotland, Skagerrak. Medium Term predictions. Status quo Fishing mortality. Solid lines show 5, 25, 50, 75, 95 %.



N. Sea and W. S Saithe: Stock and Recruitment
Recruitment, age 1 (millions)
0
100
200
300
400
500
600
0
50
100
150
200
250
300
350
400
450
500
550
Spawning Biomass (thousands of tonnes)
Fhigh
F = .6305
.4563 kg/r
Fmed
F = .4622
.8011 kg/r
Fcurrent
F = .4495
.8403 kg/r

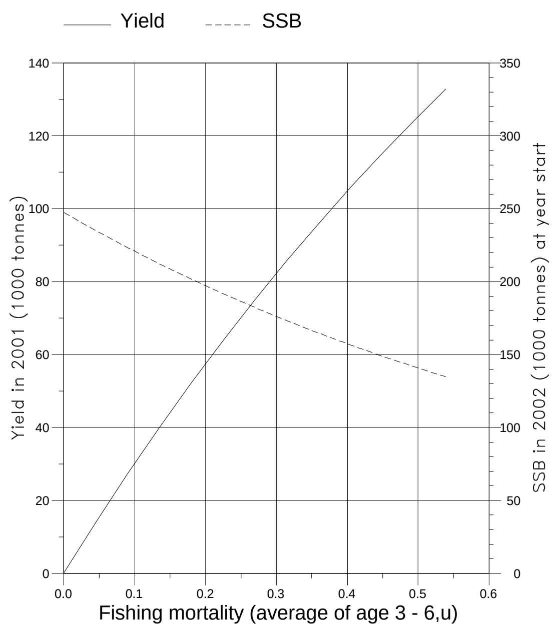
Figure 6.9.1

Long term yield and spawning stock biomass



(run: YLDODD01) **C**

Short term yield and spawning stock biomass



(run: MANODD04) **D**

Figure 6.9.2 Fish Stock Summary, Saithe in Sub-area IV, Division IIIa and Sub-area VI

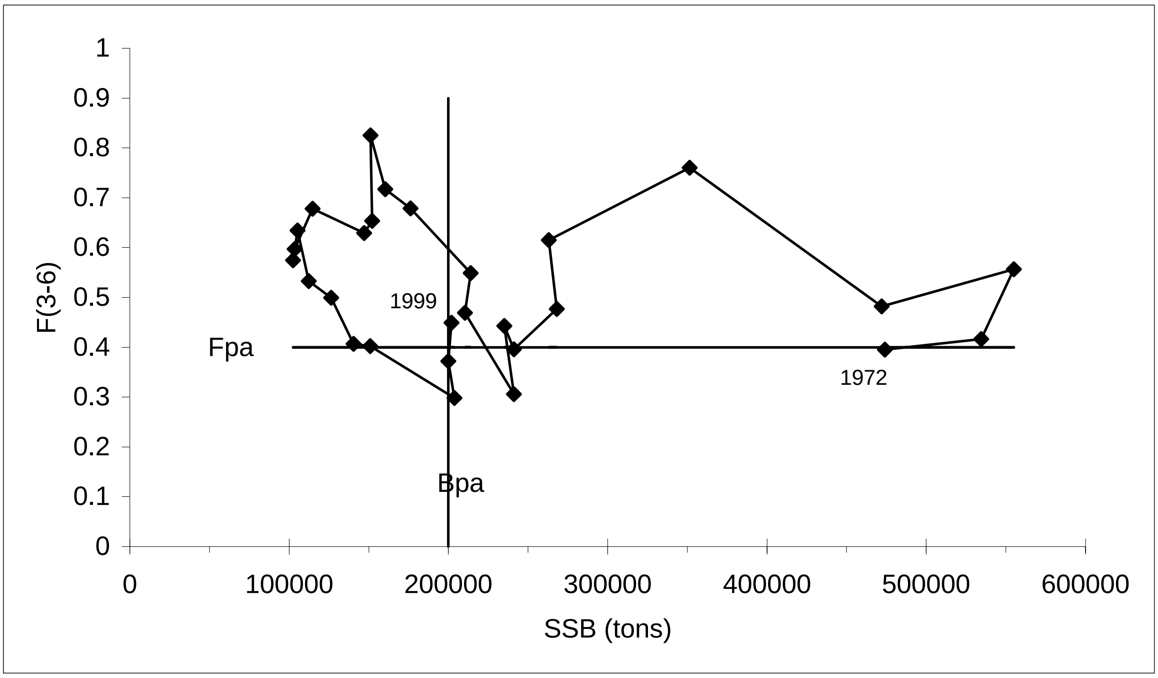


Figure 6.9.3. Saithe in IV, VIa and IIIa. $F_{3\text{-}6}$ versus SSB.

7 SOLE IN SUB-AREA IV

7.1 The fishery

7.1.1 ACFM advice applicable to 2000

For 1999 ACFM noted that North Sea sole was being harvested outside safe biological limits. 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 19,800 t. The reduction in fishing mortality of 30% from the 1998 value (0.57) would ensure a high probability that SSB will remain above the proposed Bpa (35,000 t) in the medium-term.

It was also emphasised that the catch forecast was sensitive to the estimate of the abundant 1996 year class. At status quo F, this year class was expected to contribute 52% to the expected landings in 2000, and 53% and 37% to the SSB in 2000 and 2001, respectively.

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 2000

The TACs for 2000 was 22,000 t, which is about 9% above the maximum 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. 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.

Some 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 quarters of the year 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.

7.1.3 The fishery in 1999

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 and re-flagging of Dutch vessels.

The Working Group estimate of landings in 1999 (23,431 t) were 6% higher than the agreed TAC. Unallocated landings have decreased considerably since 1993. No quantitative estimates of sole discards are available for 1999, but the amounts are expected to be relatively low. 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 7.15 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 and by sex separately from Belgium, France, the Netherlands, and UK (England and Wales). The samples are thought to be representative of 82% of the total landings in 1999. However, no samples are collected from national vessels which land abroad and this constitutes an increasing proportion of the total landings by some countries. The age compositions were combined and raised to the international total on an annual basis. Minor revisions have been made to the 1998 data. The age compositions are given in Table 7.2. 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 and the trend in catch weights-at-age shown in Figure 7.1a.

As in all previous assessments, a knife-edged maturity-ogive was used in all years, assuming full maturation-at-age 3 (Table 7.5). 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 1957-1999 has been assumed constant over all ages at 0.1 (Table 7.5), except for 1963 where a value of 0.9 was used to take into account the effect of the severe winter (ICES CM 1979/G:10). In 1996 additional natural mortality was observed in the cold winter of 1995/1996 (ICES 1997/Assess:6), but in the absence of a precise estimate, the standard value of 0.1 has been retained.

7.3 Catch, effort, and research vessel data

Catch and effort data, used for tuning the assessment are given in Table 7.6. Effort in the Netherlands commercial beam trawl is total HP effort days and this has nearly doubled between 1978 and 1994, but has declined slightly since then. The effort in the UK commercial beam trawl fleet is calculated from vessels fishing south of 56^0 North to avoid vessels targeting plaice and is measured as HP hours for trips where sole is caught. The effort of this fleet has decreased since 1993. Belgian effort data is from the beam trawl fleet and is in HP corrected hours.

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 was revised in 1998 by excluding rectangles above 55° 30’, which have not been sampled in the last few years. 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 as in last year’s assessment. In 2000, a number of further changes have been introduced in the calculation of the BTS indices, which are listed below and the index has been revised over the full year range:

- age samples from market sampling have no longer been used to age the older individuals.
- 5+ has been used instead of a 10+gp.
- previously, all fish smaller than 10cm were allocated to age 0 by default. In the new algorithm ALKs have been applied to all fish, including 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.

Available trends in effort and CPUE are listed in Table 7.7 and graphed in Figure 7.1.b. The Dutch beam trawl CPUE show a continuous decline since 1990, reaching a minimum in 1997. This low value could be related to the poor availability of sole in 1997. The good 1996 year class has reversed the downward trend in 1998 and in 1999. The UK beam trawl CPUE series has been revised in line with HP corrected effort. This series also show a historical low value for 1997 and 1998 but has increased as the 1996 year class has recruited to the UK fishery, one year later than for the Netherlands fleet. The Belgian beam trawl fleet also shows an increase in recent years.

7.4 Catch-at-age analysis

General approaches and methods are described in section 1.4.

7.4.1 Data exploration

Exploratory runs were carried out to look at fleet catchability trends, the influence of different fleets, ages and year ranges. The results of the exploratory runs are summarised in Table 7.8 and Figure 7.9. In general, the configuration used last year appeared to be an appropriate choice. Removal of ages with high log catch residuals or inclusion of extra ages with catchability dependent on stock size (power model), had little effect.

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 7.9). As in previous assessments, the age range for the analyses was kept as 1–15+.

Repeating last years final assessment, with the corrected database, gave almost identical results compared to that of last years Working Group.

Single fleet catchability: The fleet data were examined for trends in catchability by carrying out XSA for single fleets over the year range available for each fleet, (settings as last year's final run except for a weak shrinkage of 1.5). Strong trends in catchability were apparent in the Netherlands BT fleet before 1989, particularly-at-ages 2-7. Years before 1990 were therefore excluded from subsequent tuning runs. The UK beam trawl fleet showed a negative trend from 1990 to 1993 and a positive trend from 1993 to 1995 for the younger ages. The survey fleets showed no clear trends.

Combined fleet catchability: When combined with other fleets, the pattern of log catchability residuals for the Netherlands and surveys were not markedly different from single fleet runs (Figure 7.2). However, in the UK BT fleet log catchability residuals increased considerably, resulting in high SEs (>0.5)-at-ages above 5. The CPUE trend from this fleet matches the Netherlands BT series and it is likely that the poor performance reflects the fact that it is sampling a different area and age range compared with the Netherlands fleet. Despite the poor performance of the UK fleet, it was decided to retain it as it provides additional information on the stock, behaved reasonably as a single fleet, and maintains consistency with previous assessments. Retrospective analyses were run with a 10-year window, using the same configuration as in the final XSA to investigate the consistency in estimating F(2-8), SSB and recruitment-at-age 1. The results (Figure 7.3a) are similar to last year and suggest that F has been underestimated in previous years, although the effects on SSB and recruitment are small.

7.4.2 Assessment

The configuration of the final XSA run is the same as last year except for the year range:

	1999 XSA		**2000 XSA**	
Fleets	Years	Ages	Years	Ages
Neth Beam trawl - commercial	1989-98	2-14	1990-99	2-14
UK Beam trawl - commercial	1989-98	2-14	1990-99	2-14
BTS – survey	1989-98	1-4	1990-99	1-4
SNS – survey	1989-98	1-4	1990-99	1-4
Time Taper		No		No
First tuning year		1989		1990
last tuning year		1998		1999
Catchability dependent on stock size (power model)		ages 1,2		ages 1,2
catchability independent of age for ages ≥		7		7
Survivor estimates shrunk towards mean F		5 years/5 ages		5 years/5 ages
SE of the mean F to which estimates are shrunk		0.5		0.5
Minimum standard error for pop estimates		0.3		0.3
Prior weighting applied to fleets		no		no

Full tuning diagnostics are given in Table 7.10.

For age 1 (1998 yr class), the two surveys, BTS and SNS are given most of the weight to the final survivors estimates (Figure 7.3b) with 38% and 42%, respectively (F-shrinkage and P-shrinkage taking only 15% and 5%). For age 2, the surveys also contribute 72% to the weight, 11% 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 most ages.

The fishing mortality stock numbers estimated by the final XSA are given in Tables 7.11 and 7.12.

7.5 Recruitment

Average recruitment in the period 1957-1997 was 138 million (arithmetic mean) or 99 million (geometric mean) 1-year-old-fish.

Recruitment indices were available from pre-recruit surveys carried out in 2000 and previous years. The surveys and indices are listed in the RCT3 input (Table 7.13). The Sole Net Survey (SNS) and Beam Trawl Survey (BTS) are Dutch surveys directed to flatfish juveniles in their coastal nurseries. The BTS is a third quarter survey and covers both inshore and offshore areas of the North Sea using a pair of 8m beam trawls with 40mm stretched mesh cod-ends. The SNS is a 4th quarter survey using 6m beam trawls with 40mm stretched mesh cod-ends.

The DFS index is an area weighted survey index combining the inshore surveys of Netherlands, Belgian, Germany, and UK. The 0-group index for 1999 and 1-group for 1998 were not available because bad weather had prevented the completion of the survey in 1999. The 2000 survey index will become available after the Working Group meeting.

The Solea survey is a 7m beam trawl survey carried out in May during the sole spawning season in the inshore area of the German Bight. The survey uses 6m beam trawls with 80mm mesh cod-ends, and age-groups younger than 3 are not sampled effectively.

The options used in RCT3 are the same as those used in previous years and are shown in Tables 7.14a,b and c, together with the results of the survey indices regressed against XSA recruitment-at-age 1-3

The 1997 year class was estimated to be above average by all fleets and surveys in XSA, but below average by the population and F shrinkage. The XSA estimate is mainly influenced by the two surveys, which receive 73% of the weight. The RCT3 estimate also indicates an above average year class. The XSA value of 87549 was accepted.

The 1998 year class was estimated below average by both XSA and RCT3. Both estimates were similar, but since the RCT3 estimate uses additional survey data not available in XSA, the RCT3 value of 63463 was accepted.

The 1999 year class was estimated as 95 million by RCT3, based on two survey indices compared with 99 million from GM. The GM value was used in the prediction.

The long-term GM recruitment was assumed for year classes 2000 and 2001.

Year class strength used for predictions are in bold and underlined and can be summarised as follows:

Year class	Age in 2000	XSA Thousands	RCT3 Thousands	GM (57-97) Thousands
1997	3	**<u>87549</u>**	78759	65301
1998	2	68062	**<u>63463</u>**	84975
1999	1		95926	**<u>99452</u>**
2000	0			**<u>99452</u>**

7.6 Historical stock trends

Historical trends in landings, recruitment, fishing mortality and SSB are given in Table 7.15 and plotted in Figures 7.4.a-d.

Fishing mortality F(2-8) has more than trebled in the period 1957-1984, mainly because of a developing beam trawl fishery. It has exceeded the Fpa of 0.4 in most years since 1970.

Recruitment varies by a factor of 50 between the smallest and largest year classes although more generally, interannual variation is relatively low. Most of the strong year classes seem to have developed following cold winters (1958, 1963, 1991, and 1996), and year classes recruited in recent years seem to be poor or near GM average.

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 22,000t and 50,000t, it increased sharply in 1990 and remained at a high level until 1994. Since 1994 it has declined from 75,000t to a historically low level of 23,000 t in 1998 because of below average recruitment, high fishing mortality and also an extra natural mortality in the 1995/1996 winter. Following recruitment of the strong 1996 year class, the SSB has shown a temporary recovery.

7.7 Short-term forecast

For the current prediction, population survivors at the start of 2000 for age 1 were from GM recruitment (1957-97). Age 2 was estimated by RCT3. Ages 3 and older were taken from the XSA output. Fishing mortality-at-age was set to the mean for the years 1997-1999, scaled to the reference $F_{(2\text{-}8)}$ in 1999 of 0.47. Weight-at-age in the catch and in the stock are averages for the years 1997-1999. Maturity-ogive and natural mortality were the same as in the XSA and the long-term GM recruitment (99 million) was assumed for age 1 in 2001. The input data are shown in Table 7.16.

The management options table is given in Table 7.17 and the detailed predictions for F_{sq} are presented in Table 7.18. The options are also graphed in Figure 7.5.

Yield and SSB at *status quo* F: Assuming a *status quo* F results in an expected catch in 2000 of 23,500 t (compared with a TAC of 22,000 t). The yield in 2001 is expected to be 20,000 t at *status quo*. The assumed SSB of 53,000 t in 2000 is expected to decrease to 42,000 t in 2000 and 38,000 t in the year 2002.

Yield at Fpa: Fishing at Fpa in 2001 corresponds to an expected yield of 17,700 t.

The proportional contributions of recent year classes to catch in 2000 and SSB in 2001 are given in Table 7.19. The fishery remains highly dependent on the 1996 year class which is expected to contribute over half the landings in the current year and 38.4% of the landings in 2001. One third of the SSB in 2002 is dependent on the 1999 year class which has been based on GM only.

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.

The input values for the medium-term predictions are presented in Table 7.20. Catch and stock weights were the average for the past three years.

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.

WGMTERM1 was run using *status quo* F. Figure 7.6 shows the trajectory of yields and SBB with associated 5, 25, 50, 75 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. The plots indicate that the 50 percentile of yield remains close to 20,000t over the medium-term. SSB is expected to remain close to the Bpa of 35,000t.

Figure 7.7 shows the percentile distributions and range of simulated projections of yield and SSB up to 2009 for a range of fishing mortalities. This indicates that:

- SSB falls within a narrower range as F increases and has a high probability of declining below Fpa
- Yield has an increased stability at F below Fpa and both increasing variability and a high probability of declining at F above Fpa.

7.9 Biological reference points

Input data to the yield-per-recruit analysis are given in Table 7.21. Catch and stock weights were the averages for the last three years as in the short-term forecast. The yield-per-recruit analysis, long-term yield and SSB, conditional on the present exploitation pattern and assuming *status quo* F in 2000, are given in Table 7.22 and Figure 7.5. The stock and recruitment plot is given in Figure 7.8, and includes values of Fhigh, Fmed and Flow which are similar to last year's values. Fsq (0.47) is estimated to be 40% above Fmed and 64% below Fhigh.

The Biological reference points were not re-evaluated for this stock and are shown below:

F_{lim}	F_{pa}	F_{max}	$F_{0.1}$	F_{low}	F_{med}	F_{high}	F_{sq}	B_{lim}	B_{pa}
0.55	0.40	0.42	0.16	0.02	0.28	1.02	0.47	25,000t	35,000t

7.10 Comments on the assessment

The assessment of North Sea sole appears to be relatively stable from year to year and comparison of the historical trends in F and SSB between this year and last show a close similarity.

The present assessment implies that F has decreased from 0.60 in 1999 to 0.47 in 2000. This apparent decrease in F is not supported by the effort of the Dutch beam trawl fleet which shows a relatively small decline in effort.

The short-term prediction seems to be more in line with the perception of the catch possibilities of the stock. Last year, the yield in 1999 corresponding to the *status quo* fishing mortality (29,000 t) was higher than the agreed TAC for that year (22,000 t) and also higher than the reported landings (23,000 t). In this year's assessment, the yield in 2000 at *status quo* fishing mortality is predicted to be 24,000 t, which is closer to the agreed TAC of 22,000 t.

Recruitment of the strong 1996 year class appears to have been estimated at a similar level to last year, and the retrospective pattern of RCT3 estimates compared with XSA estimates shows no particular bias over the period 1980 to 1990. In recent years, RCT3 estimates appear to have overestimated recruitment by between 5- 25%.

There is a shortage of representative data on effort and CPUE of fisheries that exploit sole. 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, 1982-1999

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	4,314	24,248	22,000
1986	1,833	443	296	155	9,558	647	2	12,934	5,266	18,200	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	1,160	14,901	18,000
1998	1,844	520	510	782	15,198	549	338	19,739	1,129	20,868	19,100
1999	1,919	828	357	1,458	16,283	645	501	21,991	1,440	23,431	22,000

French data are provisional for 1999

Table 7.2 Catch number at age

Run title : Sole in IV (run: XSARIC07/X07)

Catch numbers at age Numbers*10**-3

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	0	0	0	0	55	0	0	0	1037	396
2	12042	959	1594	676	155	47100	12278	3686	17148	23922
3	14133	49786	6210	8339	2113	1089	133617	25683	13896	21451
4	16798	19140	59191	8555	5712	1599	990	85127	24973	5326
5	9308	12404	15346	46201	3809	5002	1181	1954	48571	12388
6	6367	4695	10541	8490	17337	2482	3889	536	462	25139
7	4846	3944	4826	6658	3126	12500	744	1919	245	331
8	1593	4279	4112	2423	1810	1557	6324	760	1644	244
9	1056	836	2087	3393	818	1525	702	5047	324	1190
10	2800	990	900	1566	872	389	767	538	4407	289
11	992	1711	1539	1002	495	627	287	610	254	2961
12	515	1154	977	764	217	476	473	456	820	291
13	3135	444	1161	1778	474	322	120	348	82	538
14	133	2539	389	413	336	200	87	277	396	151
+gp	326	416	2528	2861	621	1195	716	685	564	1042
TOTALNUM	76044	103297	111401	93119	37950	76062	161975	127625	114823	95659
TONSLAND	18620	23566	26877	26164	11342	17043	33340	33439	33179	27559
SOPCOF %	99	101	99	99	97	96	99	102	100	102
YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	1299	420	358	703	101	264	1041	1747	27	9
2	6140	33369	7594	12228	15380	22964	3542	22328	26031	8179
3	25993	14426	36769	12763	21540	28536	27966	12073	29292	41170
4	8235	12757	7075	16187	5487	11717	14013	15306	6129	16060
5	1784	4485	4965	4025	7061	2088	4819	7440	6639	2996
6	3231	1442	1565	2324	1922	3830	966	1779	4250	3222
7	11960	2327	523	994	1595	790	1909	319	1738	1747
8	246	7214	1232	765	658	907	950	1112	611	816
9	140	192	4706	1218	401	508	425	256	646	241
10	686	232	120	3337	609	234	204	211	191	393
11	169	826	100	221	2363	252	195	93	236	154
12	2416	291	492	297	104	1906	132	122	123	117
13	238	1413	119	499	32	25	1320	108	106	103
14	582	466	922	110	305	84	39	852	68	73
+gp	1143	1366	1048	1326	1401	945	773	729	879	687
TOTALNUM	64262	81225	67578	57017	58949	75038	57894	64475	75965	75967
TONSLAND	19685	23652	21086	19309	17989	20773	17326	18003	20280	22598
SOPCOF %	100	101	99	102	99	101	102	102	100	101
YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	637	423	2680	389	191	165	373	94	10	115
2	1209	29217	26435	34408	30734	16618	9351	29018	13187	46108
3	12511	3259	45746	41386	43931	43213	18494	22052	47140	18198
4	17781	6866	1843	21189	22554	20286	17703	8913	15248	22567
5	7297	8223	3535	624	8791	9403	7745	6515	4400	4697
6	1460	3661	4789	1378	741	3566	5622	3121	3890	1694
7	2197	948	1678	1950	854	209	2272	1570	1554	1454
8	1409	886	615	978	1043	379	110	906	898	654
9	367	766	605	386	524	637	282	81	526	466
10	54	197	527	301	242	200	620	103	38	240
11	415	107	149	423	209	192	355	166	34	45
12	52	160	74	31	146	189	173	146	86	36
13	62	92	201	14	30	94	126	63	42	49
14	32	21	12	177	24	33	105	56	10	27
+gp	598	331	315	230	243	267	305	165	111	95
TOTALNUM	46061	55157	89184	103864	110257	95441	63536	72968	87174	96445
TONSLAND	15807	15403	21579	24927	26839	24248	18200	17368	21590	21806
SOPCOF %	102	103	101	100	100	99	99	99	100	99
YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	837	117	968	53	637	4723	171	1575	244	283
2	12019	13208	6864	49906	7663	12752	18632	6016	56378	15657
3	103860	25452	44201	16871	87050	16967	16101	23615	15173	71994
4	9775	77484	16198	31403	13776	68166	16930	7326	14863	8246
5	9357	6861	37983	13883	18787	6584	27213	5121	3528	6094
6	3509	3839	2471	23969	5723	7941	3941	12735	1993	1246
7	1164	1828	3083	1494	11263	2043	4812	1254	4767	704
8	1273	760	788	1217	465	5982	981	2331	856	2008
9	604	742	430	490	925	294	3321	349	1049	373
10	268	325	481	194	281	345	239	1436	245	502
11	324	329	177	306	86	65	298	33	414	50
12	59	386	235	109	215	75	155	118	44	181
13	28	18	134	85	84	49	55	22	61	9
14	63	16	7	116	45	20	105	26	13	37
+gp	215	168	255	109	248	149	173	70	89	64
TOTALNUM	143356	131333	114275	140205	147248	126146	93127	61927	99737	107446
TONSLAND	35120	33513	29341	31491	33002	30467	22651	14901	20868	23431
SOPCOF %	99	98	98	99	99	99	99	99	99	99

Table 7.3 Catch weight at age

Run title : Sole in IV (run: XSARIC07/X07)

Catch weights at age (kg)

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	0.000	0.000	0.000	0.000	0.153	0.000	0.000	0.000	0.157	0.152
2	0.153	0.146	0.155	0.163	0.175	0.169	0.177	0.192	0.189	0.191
3	0.185	0.174	0.165	0.171	0.213	0.209	0.190	0.201	0.207	0.196
4	0.235	0.211	0.208	0.219	0.252	0.246	0.180	0.252	0.267	0.255
5	0.254	0.255	0.241	0.258	0.274	0.286	0.301	0.277	0.327	0.311
6	0.277	0.288	0.295	0.309	0.309	0.282	0.332	0.389	0.342	0.373
7	0.301	0.319	0.320	0.323	0.327	0.345	0.429	0.419	0.354	0.553
8	0.309	0.304	0.321	0.387	0.346	0.378	0.399	0.339	0.455	0.398
9	0.381	0.346	0.334	0.376	0.388	0.404	0.449	0.424	0.465	0.468
10	0.363	0.372	0.349	0.440	0.444	0.425	0.472	0.498	0.475	0.499
11	0.436	0.369	0.347	0.397	0.439	0.459	0.541	0.456	0.674	0.496
12	0.428	0.397	0.394	0.433	0.475	0.480	0.526	0.389	0.524	0.538
13	0.442	0.478	0.435	0.444	0.403	0.458	0.521	0.519	0.656	0.474
14	0.427	0.450	0.373	0.490	0.447	0.397	0.491	0.442	0.495	0.613
+gp	0.578	0.551	0.476	0.578	0.644	0.528	0.499	0.591	0.650	0.613
SOPCOFAC	0.994	1.014	0.994	0.992	0.966	0.959	0.989	1.023	0.997	1.020
1										

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	0.154	0.145	0.169	0.146	0.164	0.129	0.143	0.147	0.152	0.137
2	0.212	0.193	0.204	0.208	0.192	0.182	0.190	0.188	0.196	0.208
3	0.218	0.237	0.252	0.238	0.233	0.225	0.222	0.236	0.231	0.246
4	0.285	0.322	0.334	0.346	0.338	0.320	0.306	0.307	0.314	0.323
5	0.350	0.358	0.434	0.404	0.418	0.406	0.389	0.369	0.370	0.391
6	0.404	0.425	0.425	0.448	0.448	0.456	0.441	0.424	0.426	0.448
7	0.441	0.420	0.532	0.552	0.520	0.529	0.512	0.430	0.466	0.534
8	0.463	0.490	0.485	0.567	0.559	0.595	0.562	0.520	0.417	0.544
9	0.443	0.534	0.558	0.509	0.609	0.629	0.667	0.562	0.572	0.609
10	0.511	0.425	0.481	0.569	0.602	0.560	0.658	0.622	0.471	0.657
11	0.512	0.489	0.472	0.644	0.661	0.648	0.538	0.731	0.604	0.728
12	0.541	0.466	0.577	0.399	0.678	0.683	0.736	0.607	0.711	0.774
13	0.456	0.578	0.597	0.547	0.532	0.620	0.668	0.605	0.588	0.806
14	0.542	0.563	0.677	0.642	0.582	0.645	0.598	0.643	0.830	0.839
+gp	0.542	0.583	0.647	0.670	0.679	0.678	0.684	0.581	0.716	0.815
SOPCOFAC	1.000	1.012	0.989	1.019	0.986	1.010	1.022	1.019	0.996	1.012

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.141	0.143	0.141	0.134	0.153	0.122	0.135	0.139	0.127	0.118
2	0.199	0.187	0.188	0.182	0.171	0.187	0.179	0.185	0.175	0.173
3	0.244	0.226	0.216	0.217	0.221	0.216	0.213	0.205	0.217	0.216
4	0.331	0.324	0.307	0.301	0.286	0.288	0.299	0.276	0.270	0.288
5	0.371	0.378	0.371	0.389	0.361	0.357	0.357	0.356	0.353	0.335
6	0.418	0.424	0.409	0.416	0.386	0.427	0.407	0.378	0.428	0.374
7	0.499	0.442	0.437	0.467	0.465	0.447	0.485	0.428	0.483	0.456
8	0.550	0.516	0.491	0.489	0.555	0.544	0.543	0.481	0.519	0.490
9	0.598	0.542	0.580	0.505	0.575	0.612	0.568	0.394	0.558	0.472
10	0.544	0.553	0.556	0.609	0.512	0.634	0.536	0.608	0.594	0.509
11	0.658	0.403	0.628	0.622	0.655	0.509	0.575	0.644	0.807	0.681
12	0.684	0.665	0.591	0.600	0.631	0.656	0.633	0.614	0.714	0.630
13	0.674	0.565	0.771	0.334	0.722	0.767	0.631	0.695	0.754	0.709
14	0.661	0.721	0.898	0.631	0.845	0.801	0.788	0.727	0.771	0.635
+gp	0.717	0.745	0.768	0.756	0.707	0.680	0.715	0.696	0.694	0.727
SOPCOFAC	1.020	1.026	1.014	1.004	1.003	0.990	0.994	0.995	0.999	0.986

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.124	0.127	0.146	0.097	0.142	0.151	0.162	0.151	0.128	0.163
2	0.182	0.185	0.177	0.167	0.181	0.185	0.177	0.180	0.182	0.179
3	0.226	0.209	0.213	0.195	0.202	0.196	0.202	0.206	0.189	0.212
4	0.290	0.263	0.258	0.239	0.228	0.247	0.233	0.236	0.252	0.229
5	0.368	0.314	0.299	0.264	0.257	0.264	0.274	0.267	0.262	0.288
6	0.403	0.428	0.379	0.301	0.300	0.319	0.285	0.296	0.288	0.325
7	0.401	0.434	0.410	0.338	0.317	0.342	0.319	0.325	0.336	0.353
8	0.497	0.455	0.459	0.442	0.432	0.356	0.369	0.307	0.292	0.373
9	0.457	0.505	0.484	0.493	0.411	0.445	0.390	0.387	0.335	0.372
10	0.564	0.548	0.527	0.622	0.413	0.505	0.516	0.407	0.398	0.366
11	0.622	0.513	0.590	0.563	0.516	0.750	0.540	0.575	0.502	0.511
12	0.517	0.508	0.472	0.587	0.481	0.545	0.545	0.603	0.434	0.554
13	0.571	0.819	0.618	0.639	0.669	0.758	0.590	0.653	0.648	0.684
14	0.461	0.742	0.776	0.608	0.606	0.931	0.691	0.462	0.536	0.568
+gp	0.630	0.552	0.635	0.640	0.559	0.602	0.747	0.748	0.724	0.677
SOPCOFAC	0.992	0.984	0.985	0.989	0.989	0.987	0.989	0.991	0.992	0.990

Table 7.4 Stock weight at age derived from 2nd quarter weights

Run title : Sole in IV (run: XSARIC07/X07)

Stock weights at age (kg)

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
2	0.070	0.070	0.070	0.070	0.070	0.140	0.070	0.177	0.122	0.137
3	0.163	0.148	0.148	0.148	0.159	0.198	0.160	0.164	0.171	0.174
4	0.207	0.206	0.192	0.193	0.214	0.223	0.149	0.235	0.248	0.252
5	0.234	0.235	0.240	0.243	0.240	0.251	0.389	0.242	0.312	0.324
6	0.240	0.232	0.301	0.275	0.291	0.297	0.310	0.399	0.280	0.364
7	0.268	0.259	0.293	0.311	0.305	0.337	0.406	0.362	0.629	0.579
8	0.242	0.274	0.282	0.363	0.306	0.358	0.377	0.283	0.416	0.415
9	0.360	0.281	0.273	0.329	0.365	0.526	0.385	0.381	0.410	0.469
10	0.357	0.302	0.410	0.433	0.443	0.424	0.427	0.464	0.450	0.524
11	0.508	0.379	0.358	0.365	0.396	0.464	0.598	0.378	0.753	0.504
12	0.390	0.335	0.315	0.352	0.458	0.456	0.555	0.372	0.445	0.564
13	0.464	0.482	0.463	0.491	0.470	0.418	0.468	0.544	0.660	0.534
14	0.466	0.433	0.462	0.414	0.394	0.339	0.380	0.450	0.456	0.515
+gp	0.573	0.548	0.539	0.540	0.631	0.504	0.538	0.546	0.698	0.551

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	0.025	0.034	0.038	0.039	0.035	0.035	0.035	0.035	0.035	0.045
2	0.137	0.148	0.155	0.149	0.146	0.148	0.142	0.147	0.139	0.148
3	0.201	0.213	0.218	0.226	0.218	0.206	0.201	0.202	0.211	0.211
4	0.275	0.313	0.313	0.322	0.329	0.311	0.301	0.291	0.290	0.300
5	0.341	0.361	0.419	0.371	0.408	0.403	0.379	0.365	0.365	0.352
6	0.367	0.410	0.443	0.433	0.429	0.446	0.458	0.409	0.429	0.429
7	0.423	0.432	0.443	0.452	0.499	0.508	0.508	0.478	0.427	0.521
8	0.458	0.474	0.443	0.472	0.565	0.582	0.517	0.487	0.385	0.562
9	0.390	0.483	0.508	0.446	0.542	0.580	0.644	0.531	0.542	0.567
10	0.486	0.451	0.440	0.489	0.594	0.617	0.697	0.617	0.428	0.656
11	0.490	0.481	0.471	0.621	0.632	0.615	0.614	0.661	0.570	0.712
12	0.535	0.425	0.503	0.466	0.594	0.647	0.786	0.656	0.675	0.716
13	0.622	0.574	0.631	0.548	0.650	0.650	0.648	0.628	0.589	0.787
14	0.574	0.502	0.621	0.624	0.540	0.705	0.628	0.632	0.860	0.815
+gp	0.622	0.568	0.659	0.642	0.623	0.669	0.679	0.665	0.697	0.791

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.039	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
2	0.157	0.137	0.130	0.140	0.133	0.127	0.133	0.154	0.133	0.133
3	0.200	0.200	0.193	0.200	0.203	0.185	0.191	0.191	0.193	0.195
4	0.304	0.305	0.270	0.285	0.268	0.267	0.279	0.262	0.260	0.290
5	0.345	0.364	0.359	0.329	0.348	0.324	0.346	0.357	0.335	0.348
6	0.394	0.402	0.411	0.435	0.386	0.381	0.425	0.381	0.408	0.339
7	0.489	0.454	0.429	0.464	0.488	0.380	0.498	0.406	0.417	0.410
8	0.537	0.522	0.476	0.483	0.591	0.626	0.492	0.454	0.472	0.475
9	0.579	0.561	0.583	0.510	0.567	0.554	0.590	0.333	0.485	0.418
10	0.549	0.520	0.593	0.583	0.559	0.589	0.561	0.512	0.455	0.462
11	0.664	0.409	0.570	0.601	0.632	0.517	0.681	0.638	0.829	0.704
12	0.676	0.713	0.531	0.721	0.731	0.734	0.647	0.581	0.655	0.787
13	0.638	0.533	0.791	0.741	0.873	0.740	0.739	0.633	0.535	0.716
14	0.657	0.822	0.611	0.680	0.952	0.642	0.943	0.691	0.847	0.616
+gp	0.638	0.720	0.691	0.719	0.700	0.673	0.889	0.671	0.687	0.730

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
2	0.148	0.138	0.156	0.128	0.143	0.151	0.147	0.150	0.140	0.131
3	0.203	0.183	0.194	0.183	0.174	0.178	0.177	0.190	0.173	0.187
4	0.292	0.253	0.256	0.228	0.209	0.240	0.208	0.225	0.234	0.216
5	0.356	0.300	0.307	0.264	0.257	0.251	0.274	0.252	0.267	0.259
6	0.438	0.406	0.397	0.293	0.326	0.320	0.267	0.303	0.281	0.295
7	0.391	0.437	0.405	0.344	0.349	0.363	0.320	0.318	0.327	0.339
8	0.486	0.499	0.468	0.479	0.402	0.357	0.372	0.324	0.271	0.322
9	0.471	0.545	0.494	0.433	0.493	0.544	0.402	0.358	0.335	0.361
10	0.496	0.537	0.544	0.573	0.341	0.458	0.402	0.385	0.332	0.416
11	0.682	0.501	0.488	0.563	0.433	0.395	0.468	0.578	0.487	0.418
12	0.550	0.551	0.443	0.507	0.519	0.701	0.537	0.634	0.305	0.497
13	0.789	0.430	0.595	0.676	0.480	0.692	0.614	0.710	0.548	0.562
14	0.458	1.109	0.672	0.580	0.689	0.584	0.638	0.705	0.480	0.674
+gp	0.749	0.640	0.607	0.662	0.505	0.660	0.800	0.653	0.638	0.628

Table 7.5 North Sea Sole: maturity ogive an Natural mortality

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Nat Mortali	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

*Mortality on all ages in 1963=0.9

Table 7.6 North Sea Sole tuning fleets

NL commercial beam trawl														
1979	1999													
1	1	0	1											
2	15													
44.8	721.2	35400.6	12904.4	2098.5	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	18.5	32.5	23.7	432.2
46.3	26038	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	24280.1	38683	1085.1	2838.3	3214.2	981.1	234.8	262.9	287.6	80.2	41.7	157.3	7.9	141.1
65.6	31274.7	36708.2	16386.3	375.1	768.9	1117.8	531.2	237.5	169.1	338.6	15	2	157.6	143.2
70.8	28876.3	37398.3	16212.1	6529	301.2	492	633.5	321.8	123.7	130.9	98.3	6.4	14.5	155.4
70.3	12923.7	34685.4	16978.4	7239.6	2536.8	146.5	285.1	426.9	84.9	68.7	113.3	61.9	9.1	134.5
68.2	8027	13766	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	18818.8	6798	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	2866.6	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	2898.9	1089.4	1134.4	409.4	333.9	161.6	8.9	22.7	16.2	10	40
71.4	9071.1	84629.7	7242	6596.7	1669.1	634.6	819.2	375.9	137.6	134.1	42.6	10.1	12.6	138.2
68.5	7336.8	17182.4	59754	4838.3	2137.6	882.7	312.1	392.3	156.6	98.4	188.5	6.3	8	48.1
71.1	5046.7	330880.5	11131	29835.9	1457.9	2081.2	446.1	218.6	274.8	75.7	164.1	66.4	3.9	109
76.8	38284.5	10848	24132	9825.4	19824	987.1	811.5	236.1	68.4	186.3	59.2	41.6	58.1	21.8
81.4	5369.9	69879.8	7411.7	13010.4	3104.6	8932.9	180	524.2	175.9	25.9	158.5	25.2	20.1	149.5
81.2	9778	11329.4	53488.8	3839.2	5128.6	886.5	4682.4	147.4	204.8	24.4	23.4	34.7	6.4	108.6
72.1	15643.4	9093.9	11170.8	21211.9	1570	3173.4	471.9	2773.8	160	180.5	85.7	23.3	62.4	99.5
72	4505.9	18428.8	4503.6	3329	8771.1	457.2	1800.4	94.6	1165.3	5.7	78.9	11.1	14.3	43.5
70.2	50570.7	9023.1	11123.1	1828.2	1145.6	3395	210.7	337	21.4	286.6	5.2	37.2	4.9	42.9
67.3	11820.5	55177.2	4152.6	4459.8	730.2	335.7	1526.8	120.4	382.5	8	126.7	2	21.5	30.1
UK beamtrawl CPUE														
1986	1999													
1	1	0	1											
2	15													
40.6	42.5	227.706	295.649	121.659	146.526	89.134	4.424	2.977	17.081	8.873	7.804	7.182	4.622	12.331
59.5	3.51	66.381	101.898	89.855	42.238	27.368	26.072	1.887	2.105	6.052	3.826	5.557	3.143	6.677
73.5	23.984	382.062	249.79	158.619	135.884	42.383	55.556	30.189	2.016	2.535	10.203	6.3	3.227	28.756
71.8	585.792	318.821	450.727	230.563	114.999	73.252	32.567	35.449	28.147	1.395	2.892	11.382	7.506	30.387
78.8	156.433	2511.25	302.16	427.945	241.296	164.299	114.464	63.3	65.541	35.517	2.404	3.588	22.676	23.777
115.6	123.4	513.669	2403.1	179.669	289.221	128.815	45.631	38.352	21.245	27.522	30.691	0.814	1.254	27.962
139.9	57.373	654.408	461.707	716.511	72.524	303.261	100.74	81.134	66.47	29.543	31.245	43.002	8.298	59.731
148.9	181.428	243.064	468.473	285.166	451.183	43.599	90.5	63.831	49.228	33.798	18.272	20.418	20.531	33.868
114.3	185.984	1036.16	505.135	465.135	142.426	186.756	13.034	40.721	32.569	25.364	13.245	14.576	8.37	16.848
90.5	86.311	303.447	763.083	458.297	226.853	110.484	106.186	8.779	31.89	20.171	19.587	6.574	1.89	17.641
75.5	92.399	136.566	221.037	464.569	201.271	188.369	80.273	89.947	7.5	23.4	13.836	11.884	12.093	24.623
66.7	24.685	124.198	111.981	111.309	113.751	120.337	47.786	32.019	20.383	3.745	8.16	4.303	5.198	11.673
58.6	459	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
50.8	84	516.7	177.9	83.9	62.8	62.5	78.7	64.8	25.5	11.4	13.3	2.4	4	10.4
BTS* (survey)														
1985	1999													
1	1	0.67	0.75											
1	4													
1	2.64	7.28	3.75	1.87										
1	7.76	4.58	1.7	0.81										
1	6.98	12.5	1.85	0.55										
1	81.23	12.81	2.79	0.99										
1	8.67	67.76	4.19	4.09										
1	22.44	22.33	20.06	0.59										
1	3.43	23.2	5.84	6.01										
1	72.71	22.66	8.61	2.26										
1	4.63	26.61	1.59	5.23										
1	5.94	4.95	15.48	0.13										
1	26.31	8.68	8.27	6.47										
1	3.49	6.94	1.8	1.45										
1	173.51	5.36	3.23	0.8										
1	14.16	29.15	2	1.33										
1	11.2	19.51	16.82	0.63										
SNS (survey)														
1970	1999													
1	1	0.67	0.75											
1	4													
1	4939	745	204	31										
1	613	1061	99	7										
1	1410	341	161	0.1										
1	4699	605	73	35										
1	1924	397	69	0.1										
1	597	667	174	44										
1	1413	79	197	70										
1	3724	762	77	85										
1	1552	1379	287	27										
1	104	389	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	865	59	15										
1	11227	594	284	81										
1	3052	5369	348	50										
1	2900	1078	907	100										
1	1365	2515	527	607										
1	11081	114	319	194										
1	1351	3469	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										
1	1649	919	381	12.3										

*BTS series revised in 2000

Table 7.7 **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
1999	55.7	50.8	67.3	24.3	6.9	257.9

1 fishing hours in 1000 HP beam trawl units * 10E3
2 mllion HP hours
3 million HP days beam trawl
4 Kg/FH 1000 HP beam trawl
5 kg/1000 HP hours
6 kg/1000 HP day

Table 7.8 North Sea sole: Preliminary tuning trials

Run	Tuning fleets	Tuning ages	Tuning years	Plus group	mean q age	Fshk SE	Comments	Change in residual pattern
1	NLB	2-14	1978-1999	15	all	1.5		
2	UKB	2-14	1986-1999	15	all	1.5		
3	BTS	1-4	1985-1999	15	all	1.5		
4	SNS	1-4	1970-1999	15	all	1.5		
5								
6	NLB	2-14	1990-1999	15	3+	1.5		
7	UKB	2-14	1990-1999	15	3+	1.5		
8	BTS	1-4	1990-1999	15	3+	1.5		
9	SNS	1-4	1990-1999	15	3+	1.5		
10								
11	NLB,UKB,BTS,SNS	2-14,2-14,1-4,1-4	1990-1999	15	3+	0.5	Baseline- as last years	
12								
13	NLB,UKB,BTS,SNS	5-14,2-14,1-4,1-4	1990-1999	15	3+	0.5	Remove noisy ages from NLB	No benefit obvious
14	NLB,UKB,BTS,SNS	5-14,2-14,1-4,1-4	1990-1999	15	3+	1.5	Remove noisy ages from NLB - low F shrinkage	Slightly worse
15	NLB,UKB,BTS,SNS	5-14,2-14,1-4,1-4	1990-1999	15	2+	1.5	Remove noisy ages from NLB - power model on age 1 - low F shrinkage	Slightly worse
16	NLB,UKB,BTS,SNS	4-14,3-14,1-3,1-3	1990-1999	15	2+	1.5	Remove noisy ages from tuning - power model on age 1 - low F shrinkage	Commercial worse -no benefit obvious
17	NLB,UKB,BTS,SNS	4-14,3-14,1-3,1-3	1990-1999	15	2+	1.5	Remove noisy ages from tuning - power model on age 1 - low F shrinkage - q plateau on age 10	Slightly worse
18	NLB,UKB,BTS,SNS	5-14,3-14,1-4,1-4	1990-1999	15	2+	1.5	Remove noisy ages from NLB and UKB - power model on age 1 - low F shrinkage	Slightly worse
19								
20	NLB,UKB,BTS,SNS	4-14,3-14,1-3,1-3	1990-1999,1990-1999	15	3+	1	Remove noisy ages from tuning - extend survey tuning range - moderately low F shrinkage	Commercial worse -no benefit obvious
21			,1985-1999,1970-1999					
22	NLB,UKB,BTS,SNS	3-14,3-14,1-4,1-4	1990-1999	15	3+	1	Remove noisy age from NLB and UKB - moderately low F shrinkage	Commercial worse - perhaps slight benefit to SNS
23	NLB,BTS,SNS	3-14,1-4,1-4	1990-1999	15	3+	1	Remove noisy age from NLB -remove UKB completely - moderately low F shrinkage	Benefit to NLB and SNS
24								
25	NLB,UKB,BTS,SNS	2-10,2-10,1-4,1-4	1990-1999	11	3+	0.5	Plus group at age 11	Little change
26	NLB,UKB,BTS,SNS	4-10,3-10,1-3,1-3	1990-1999	11	3+	1.5	Remove noisy ages from tuning - plus group at age 11 - low F shrinkage	Little change but looks better
27	NLB,UKB,BTS,SNS	4-10,3-10,1-3,1-3	1990-1999	11	2+	1.5	Remove noisy ages from tuning - plus group at age 11 - power model on age 1 - low F shrinkage	Little change - BTS better SNS worse
28	NLB,UKB,BTS,SNS	4-10,3-10,1-3,1-3	1990-1999	11	2+	1	Remove noisy ages from tuning - plus group at age 11 - power model on age 1 - moderately low F shrinkage	Little change - BTS better SNS worse

Notes:

1. Survivor estimates shrunk towards mean of last 5 years and 5 ages
2. Minimum standard error for population shrinkage 0.3
3. Time series taper not applied
4. Catchability independent of age (q plateau) for ages >= 7 in all runs except 21 when age 10 used

Table 7.9 North Sea sole: Separable VPA output

Title : Sole in IV (run: SEPRIC02/S02)

At 6/10/2000 15:11

Separable analysis
from 1990 to 1999 on ages 1 to 14
with Terminal F of .500 on age 4 and Terminal S of .800

Initial sum of squared residuals was 196.196 and
final sum of squared residuals is 21.048 after 42 iterations

Matrix of Residuals

Years	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	TOT	WTS
1/ 2	0.785	-0.561	-0.348	-1.365	0.410	2.414	-0.344	-0.047	-0.936	0.009	0.113
2/ 3	-0.016	-0.509	-0.130	0.204	-0.233	0.667	0.110	-0.247	0.162	0.006	0.373
3/ 4	0.038	0.156	0.111	-0.059	-0.232	-0.141	0.040	0.102	-0.009	0.006	1.000
4/ 5	-0.171	0.114	-0.381	-0.062	-0.062	0.456	0.100	0.055	-0.045	0.005	0.552
5/ 6	0.214	0.270	-0.196	0.190	-0.063	-0.065	-0.466	0.146	-0.025	0.006	0.538
6/ 7	0.026	-0.450	-0.100	0.116	0.165	-0.016	-0.012	0.244	0.031	0.006	0.636
7/ 8	-0.191	0.181	0.337	0.543	-0.217	0.237	-0.410	-0.341	-0.133	0.006	0.380
8/ 9	0.045	0.032	0.005	-0.226	-0.263	0.215	0.034	0.202	-0.038	0.006	0.774
9/10	0.132	-0.097	0.332	0.060	0.269	-0.165	-0.160	-0.239	-0.126	0.006	0.614
10/11	-0.983	-0.213	-0.297	0.038	0.460	-0.491	0.693	0.370	0.429	0.006	0.233
11/12	-0.247	0.224	0.435	0.272	-0.154	-0.835	0.373	-0.460	0.399	0.006	0.282
12/13	0.265	0.091	0.120	-0.671	0.312	-0.489	0.484	-0.374	0.268	0.006	0.310
13/14	0.149	0.492	-0.238	0.229	0.809	-1.037	-0.144	0.025	-0.278	0.006	0.241
TOT	0.021	0.018	0.013	0.005	-0.002	-0.007	-0.006	-0.004	-0.001	0.078	
WTS	1	1	1	1	1	1	1	1	1		

Fishing Mortalities (F)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
F-values	0.5213	0.5407	0.5431	0.5968	0.6718	0.6136	0.8434	0.6396	0.6654	0.5

Selection-at-age (S)

	1	2	3	4
S-values	0.0067	0.2632	0.7625	1

	5	6	7	8	9	10	11	12	13	14
S-values	1.0527	0.9782	0.924	0.8513	0.8725	0.9159	0.6889	1.0834	0.7513	0.8

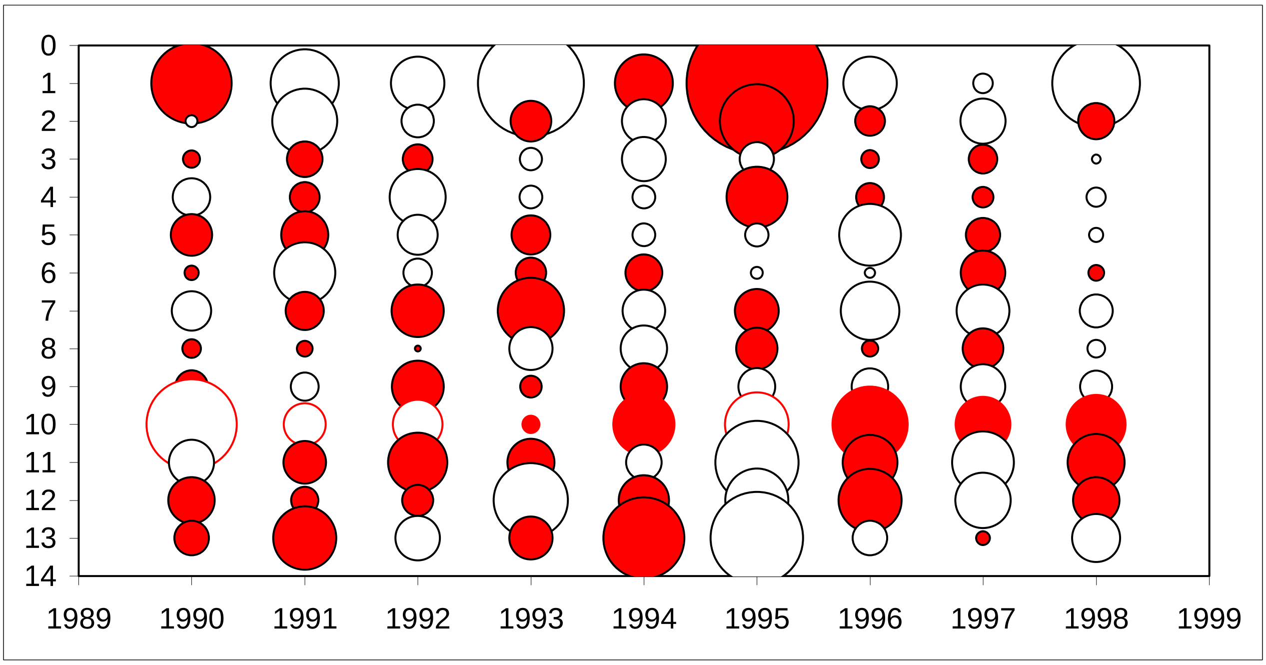


Table 7.10 North Sea sole: XSA tuning output

Lowestoft VPA Version 3.1
6/10/2000 9:13
Extended Survivors Analysis

Sole in IV (run: XSARIC07/X07)

CPUE data from file fleet
Catch data for 43 years. 1957 to 1999. Ages 1 to 15.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT01: NL beamtrawl	1990	1999	2	14	0	1
FLT02: UK beamtrawl	1990	1999	2	14	0	1
FLT03: BTS-ISIS Neth	1990	1999	1	4	0.67	0.75
FLT04: SNS-Tridens N	1990	1999	1	4	0.67	0.75

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 22 iterations

1
Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.005	0.002	0.003	0.001	0.012	0.051	0.004	0.005	0.002	0.004
2	0.137	0.09	0.117	0.18	0.137	0.304	0.257	0.148	0.218	0.157
3	0.415	0.42	0.425	0.411	0.478	0.443	0.685	0.525	0.591	0.422
4	0.523	0.552	0.458	0.538	0.614	0.755	0.956	0.683	0.66	0.661
5	0.551	0.729	0.509	0.8	0.637	0.593	0.687	0.767	0.736	0.551
6	0.571	0.405	0.58	0.622	0.816	0.539	0.767	0.716	0.685	0.552
7	0.441	0.586	0.586	0.745	0.595	0.689	0.65	0.52	0.567	0.484
8	0.406	0.511	0.478	0.427	0.479	0.648	0.748	0.673	0.722	0.439
9	0.503	0.389	0.54	0.547	0.594	0.562	0.82	0.575	0.65	0.714
10	0.259	0.492	0.417	0.442	0.618	0.407	1.13	0.933	0.925	0.662
11	0.298	0.512	0.482	0.453	0.318	0.247	0.652	0.385	0.676	0.42
12	0.905	0.61	0.751	0.548	0.588	0.448	1.338	0.515	1.18	0.63
13	0.565	0.686	0.389	0.593	0.973	0.225	0.611	0.581	0.486	0.712
14	0.698	0.653	0.551	0.608	0.642	0.567	0.911	0.581	0.723	0.543

table 7.10 Cont'd

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9	10
1990	1.80E+05	9.88E+04	3.21E+05	2.52E+04	2.32E+04	8.48E+03	3.43E+03	4.01E+03	1.61E+03	1.24E+03
1991	7.24E+04	1.62E+05	7.80E+04	1.92E+05	1.35E+04	1.21E+04	4.33E+03	2.00E+03	2.42E+03	8.79E+02
1992	3.53E+05	6.54E+04	1.34E+05	4.63E+04	1.00E+05	5.90E+03	7.31E+03	2.18E+03	1.08E+03	1.48E+03
1993	6.98E+04	3.19E+05	5.26E+04	7.93E+04	2.65E+04	5.44E+04	2.99E+03	3.68E+03	1.22E+03	5.71E+02
1994	5.72E+04	6.31E+04	2.41E+05	3.16E+04	4.19E+04	1.08E+04	2.64E+04	1.28E+03	2.17E+03	6.41E+02
1995	1.00E+05	5.11E+04	4.98E+04	1.35E+05	1.55E+04	2.00E+04	4.31E+03	1.32E+04	7.19E+02	1.09E+03
1996	5.09E+04	8.64E+04	3.41E+04	2.89E+04	5.75E+04	7.74E+03	1.06E+04	1.96E+03	6.24E+03	3.71E+02
1997	3.36E+05	4.59E+04	6.05E+04	1.56E+04	1.01E+04	2.62E+04	3.25E+03	5.00E+03	8.39E+02	2.49E+03
1998	1.25E+05	3.02E+05	3.58E+04	3.24E+04	7.12E+03	4.23E+03	1.16E+04	1.75E+03	2.31E+03	4.27E+02
1999	7.55E+04	1.13E+05	2.20E+05	1.79E+04	1.51E+04	3.08E+03	1.93E+03	5.94E+03	7.69E+02	1.09E+03

Estimated population abundance at 1st Jan 2000

0.00E+00	6.81E+04	8.75E+04	1.30E+05	8.38E+03	7.89E+03	1.61E+03	1.08E+03	3.47E+03	3.41E+02

Taper weighted geometric mean of the VPA populations:

9.94E+04	8.81E+04	6.62E+04	3.62E+04	1.96E+04	1.10E+04	6.81E+03	4.41E+03	2.77E+03	1.94E+03

Standard error of the weighted Log(VPA populations) :

0.7941	0.8366	0.8701	0.8993	0.9449	0.9611	1.0163	1.043	1.1288	1.2845

YEAR	AGE 11	12	13	14
1990	1.32E+03	1.04E+02	6.82E+01	1.32E+02
1991	8.63E+02	8.89E+02	3.81E+01	3.51E+01
1992	4.86E+02	4.68E+02	4.37E+02	1.74E+01
1993	8.84E+02	2.72E+02	2.00E+02	2.68E+02
1994	3.32E+02	5.08E+02	1.42E+02	9.99E+01
1995	3.13E+02	2.19E+02	2.56E+02	4.86E+01
1996	6.54E+02	2.21E+02	1.26E+02	1.85E+02
1997	1.08E+02	3.08E+02	5.25E+01	6.21E+01
1998	8.85E+02	6.68E+01	1.67E+02	2.66E+01
1999	1.53E+02	4.07E+02	1.86E+01	9.28E+01

Estimated population abundance at 1st Jan 2000

5.09E+02	9.10E+01	1.96E+02	8.24E+00

Taper weighted geometric mean of the VPA populations:

1.26E+03	8.61E+02	5.12E+02	3.46E+02

Standard error of the weighted Log(VPA populations) :

1.3896	1.4409	1.6183	1.6648

1

Log catchability residuals.

Fleet : FLT01: NL beamtrawl

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	-0.14	-0.82	-0.3	0.04	-0.32	0.54	0.57	-0.05	0.44	0.04
3	0.04	-0.1	0	-0.28	0.03	-0.22	0.16	0.22	0.09	0.05
4	-0.06	0.07	-0.27	-0.07	-0.36	0.23	0.41	0.01	0.19	-0.16
5	-0.07	0.24	-0.04	0.21	-0.08	-0.62	0.24	0.17	-0.07	0.02
6	-0.25	-0.39	-0.01	0.25	0.11	-0.13	-0.14	0.45	0.14	-0.01
7	-0.26	-0.31	0.24	0.28	0.28	-0.16	0.31	-0.42	0.28	-0.24
8	-0.17	-0.35	-0.14	-0.16	-0.59	0.36	0.13	0.5	-0.54	0.13
9	0.01	-0.37	-0.12	-0.24	-0.05	-0.23	0.78	-0.7	-0.38	-0.14
10	-0.85	-0.23	-0.26	-0.8	0.09	-0.38	0.87	0.87	-1.34	0.49
11	-0.93	-0.67	-0.41	-0.2	-1.31	-1.34	0.28	-1.55	0.42	-1.76
12	0.74	-0.05	0.52	-0.28	0.2	-0.97	0.85	0.07	-0.79	0.41
13	-0.42	-0.22	-0.47	-0.15	-0.2	-0.8	-0.19	-0.07	-0.03	-0.62
14	-0.8	-0.2	-0.01	-0.08	-0.22	-0.67	0.54	0.02	-0.12	0.07

table 7.10 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	-5.3931	-5.1578	-5.1478	-5.3274	-5.4398	-5.4398	-5.4398	-5.4398	-5.4398	-5.4398
S.E(Log q)	0.1578	0.2348	0.2551	0.2463	0.3	0.3751	0.4117	0.7576	1.0939	0.6149

Age	13	14
Mean Log q	-5.4398	-5.4398
S.E(Log q)	0.418	0.408

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	0.96	0.192	6.61	0.72	10	0.46	-6.39

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	0.99	0.223	5.48	0.97	10	0.16	-5.39
4	0.95	0.591	5.46	0.94	10	0.23	-5.16
5	0.97	0.313	5.31	0.92	10	0.26	-5.15
6	0.91	1.074	5.69	0.95	10	0.22	-5.33
7	0.79	2.663	6.1	0.95	10	0.18	-5.44
8	0.72	3.386	6.25	0.95	10	0.18	-5.52
9	0.72	2.539	6.07	0.91	10	0.22	-5.59
10	0.75	0.771	5.89	0.55	10	0.57	-5.59
11	0.6	2.95	6.17	0.87	10	0.33	-6.18
12	0.85	0.666	5.41	0.7	10	0.53	-5.37
13	1.01	-0.066	5.76	0.94	10	0.27	-5.76
14	0.95	0.351	5.52	0.86	10	0.38	-5.59

Fleet : FLT02: UK beamtrawl

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	0.6	-0.73	-1.05	-1.18	0.79	0.41	0.18	-0.6	1.31	0.24
3	0.59	0.04	-0.45	-0.57	-0.35	0.22	0.08	-0.37	0.98	-0.17
4	0.38	0.05	-0.41	-0.96	0.33	-0.39	0.16	0.26	-0.1	0.69
5	0.52	-0.11	-1.02	-0.62	-0.32	0.87	-0.2	0.43	0.68	-0.24
6	0.71	0.08	-0.7	-1.14	-0.32	-0.37	0.75	-0.78	0.96	0.81
7	0.88	0.09	-0.18	-0.82	-1.34	0.22	-0.1	0.98	-0.67	0.94
8	0.34	-0.22	0.28	-0.43	-1.03	-0.95	0.9	-0.3	1.65	0
9	0.71	-0.64	0.79	0.37	-0.37	-0.47	-0.01	1.04	0.51	2
10	0.73	-0.17	0.22	0.83	0.64	0.23	0.35	-0.35	1.21	0.7
11	0.23	0.12	0.56	0.02	0.91	0.94	0.72	0.85	0.2	1.75
12	0.35	0.24	0.77	0.63	-0.04	1.36	1.56	0.64	1.49	1.01
13	1.02	-0.21	1	1.06	1.5	0.01	1.65	1.8	0.6	2.43
14	2.26	0.29	-0.68	0.78	1.15	0.47	1.44	1.83	1.93	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	11	12
Mean Log q	-9.5624	-8.8713	-8.5735	-8.3198	-8.022	-8.022	-8.022	-8.022	-8.022	-8.022
S.E(Log q)	0.4929	0.4802	0.6071	0.7642	0.7907	0.8184	0.9049	0.6634	0.8455	1.0066

Age	13	14
Mean Log q	-8.022	-8.022
S.E(Log q)	1.4019	1.435

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	1.3	-0.698	11.06	0.4	10	0.89	-11.17

table 7.10 Cont'd

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.11	-0.463	9.37	0.7	10	0.57	-9.56
4	1.53	-2.152	7.92	0.67	10	0.62	-8.87
5	2.2	-3.083	6.83	0.45	10	0.96	-8.57
6	3.18	-3.51	6.24	0.24	10	1.62	-8.32
7	4.02	-3.208	6.2	0.12	10	2.23	-8.02
8	1.79	-1.162	7.94	0.21	10	1.44	-8
9	2.21	-1.453	7.98	0.15	10	1.68	-7.63
10	1.97	-2.183	8.37	0.39	10	0.79	-7.58
11	2.09	-4.019	8.75	0.63	10	0.67	-7.39
12	1.59	-1.711	8.17	0.51	10	0.79	-7.22
13	1.45	-1.125	7.97	0.44	10	1.16	-6.94
14	0.69	1.4	6.11	0.72	10	0.58	-6.95

Fleet : FLT03: BTS-ISIS Neth

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.23	-0.39	-0.23	-0.18	0.16	0.47	-0.03	0.32	-0.13	0.24
2	0.64	0.15	1.06	-0.26	-0.86	0.23	-0.83	-0.43	-0.05	0.35
3	-0.08	0.1	0.06	-0.82	-0.01	0.92	-0.06	-0.16	-0.07	0.11
4	-0.44	-0.13	0.25	0.61	-2.11	0.44	0.63	0.46	0.22	0.07
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	-9.2337	-9.7819
S.E(Log q)	0.4186	0.8138

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	0.57	2.996	10.05	0.86	10	0.3	-8.88
2	1.3	-0.942	7.9	0.56	10	0.65	-8.73

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	0.99	0.069	9.26	0.8	10	0.44	-9.23
4	0.89	0.348	9.87	0.57	10	0.77	-9.78
1							

Fleet : FLT04: SNS-Tridens N

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.24	0.07	0.05	0.15	-0.27	-0.11	-0.01	0.03	0.11	0.22
2	0.35	0.38	-0.69	-0.05	0.27	0.11	0.01	-0.17	-0.33	0.12
3	0.1	0.97	-0.07	-1.08	0.47	0.01	-0.98	0.48	0.48	-0.39
4	0.66	0.46	0.67	0.03	-1.8	0.44	0.1	0.58	-0.14	-1
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									

table 7.10 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	-5.6023	-5.7493
S.E(Log q)	0.6601	0.8095

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	0.72	3.418	6.08	0.95	10	0.17	-3.9
2	0.64	2.105	7.26	0.81	10	0.35	-4.87

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	0.86	0.567	6.39	0.69	10	0.59	-5.6
4	0.78	0.839	6.81	0.66	10	0.65	-5.75

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1998

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	1	0	0	0	0	0	0
FLT02: UK beamtrawl	1	0	0	0	0	0	0
FLT03: BTS-ISIS Neth	86822	0.315	0	0	1	0.379	0.003
FLT04: SNS-Tridens N	84823	0.3	0	0	1	0.417	0.003
P shrinkage mean	88106	0.84				0.054	0.003
F shrinkage mean	18298	0.5				0.151	0.015

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
68062	0.19	0.35	4	1.787	0.004

Age 2 Catchability dependent on age and year class strength

Year class = 1997

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	91175	0.484	0	0	1	0.101	0.151
FLT02: UK beamtrawl	111558	0.938	0	0	1	0.027	0.125
FLT03: BTS-ISIS Neth	83453	0.286	0.181	0.63	2	0.289	0.164
FLT04: SNS-Tridens N	98310	0.233	0.005	0.02	2	0.436	0.141
P shrinkage mean	66237	0.87				0.037	0.203
F shrinkage mean	62641	0.5				0.111	0.213

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
87549	0.16	0.07	8	0.461	0.157

table 7.10 Cont'd

Age 3 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
FLT01: NL beamtrawl	147590	0.265	0.151	0.57	2	0.257	0.381
FLT02: UK beamtrawl	136004	0.472	0.518	1.1	2	0.082	0.408
FLT03: BTS-ISIS Neth	158118	0.264	0.094	0.36	3	0.238	0.36
FLT04: SNS-Tridens N	113233	0.225	0.135	0.6	3	0.308	0.473
F shrinkage mean	94184	0.5				0.115	0.546

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
130449	0.13	0.09	11	0.648	0.422

Age 4 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
FLT01: NL beamtrawl	7835	0.205	0.08	0.39	3	0.356	0.694
FLT02: UK beamtrawl	16685	0.356	0.271	0.76	3	0.121	0.385
FLT03: BTS-ISIS Neth	7855	0.247	0.071	0.29	4	0.176	0.692
FLT04: SNS-Tridens N	7367	0.226	0.219	0.97	4	0.202	0.725
F shrinkage mean	7200	0.5				0.145	0.737

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
8380	0.13	0.09	15	0.726	0.661

Age 5 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
FLT01: NL beamtrawl	8970	0.184	0.076	0.41	4	0.476	0.499
FLT02: UK beamtrawl	6475	0.335	0.073	0.22	4	0.133	0.639
FLT03: BTS-ISIS Neth	8852	0.243	0.232	0.96	4	0.111	0.504
FLT04: SNS-Tridens N	7818	0.222	0.107	0.48	4	0.125	0.555
F shrinkage mean	5867	0.5				0.155	0.687

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7893	0.13	0.06	17	0.481	0.551

Age 6 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
FLT01: NL beamtrawl	1598	0.183	0.046	0.25	5	0.575	0.555
FLT02: UK beamtrawl	2823	0.366	0.133	0.36	5	0.117	0.35
FLT03: BTS-ISIS Neth	1863	0.249	0.101	0.4	4	0.056	0.492
FLT04: SNS-Tridens N	1428	0.23	0.249	1.08	4	0.061	0.604
F shrinkage mean	1151	0.5				0.192	0.708

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1607	0.15	0.07	19	0.48	0.552

table 7.10 Cont'd

Age 7 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
FLT01: NL beamtrawl	1023	0.184	0.096	0.52	6	0.625	0.504
FLT02: UK beamtrawl	2235	0.414	0.139	0.33	6	0.107	0.262
FLT03: BTS-ISIS Neth	1303	0.242	0.342	1.42	4	0.031	0.415
FLT04: SNS-Tridens N	1276	0.217	0.047	0.22	4	0.036	0.422
F shrinkage mean	803	0.5				0.201	0.607

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1075	0.16	0.08	21	0.513	0.484

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

Year class = 1991

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	4406	0.182	0.047	0.26	7	0.621	0.36
FLT02: UK beamtrawl	2472	0.417	0.133	0.32	7	0.117	0.572
FLT03: BTS-ISIS Neth	3226	0.246	0.131	0.53	4	0.023	0.465
FLT04: SNS-Tridens N	3887	0.225	0.11	0.49	4	0.026	0.4
F shrinkage mean	2056	0.5				0.213	0.657

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3466	0.16	0.08	23	0.508	0.439

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

Year class = 1990

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	247	0.194	0.069	0.35	8	0.548	0.891
FLT02: UK beamtrawl	1383	0.442	0.26	0.59	8	0.108	0.228
FLT03: BTS-ISIS Neth	191	0.241	0.448	1.86	4	0.017	1.048
FLT04: SNS-Tridens N	214	0.223	0.362	1.62	4	0.019	0.977
F shrinkage mean	393	0.5				0.307	0.643

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
341	0.19	0.13	25	0.648	0.714

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1989

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	552	0.207	0.134	0.65	9	0.439	0.623
FLT02: UK beamtrawl	747	0.438	0.166	0.38	9	0.169	0.494
FLT03: BTS-ISIS Neth	504	0.235	0.154	0.66	4	0.014	0.667
FLT04: SNS-Tridens N	503	0.22	0.155	0.71	4	0.016	0.668
F shrinkage mean	385	0.5				0.362	0.806

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
509	0.22	0.08	27	0.389	0.662

table 7.10 Cont'd

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1988

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	46	0.272	0.229	0.84	10	0.328	0.714
FLT02: UK beamtrawl	348	0.485	0.168	0.35	10	0.203	0.128
FLT03: BTS-ISIS Neth	116	0.348	0.146	0.42	3	0.003	0.343
FLT04: SNS-Tridens N	156	0.312	0.176	0.56	3	0.003	0.266
F shrinkage mean	82	0.5				0.463	0.457

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
91	0.27	0.17	27	0.634	0.42

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1987

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	307	0.37	0.063	0.17	10	0.314	0.445
FLT02: UK beamtrawl	275	0.516	0.215	0.42	10	0.156	0.486
FLT03: BTS-ISIS Neth	179	0.397	0.02	0.05	2	0.002	0.675
FLT04: SNS-Tridens N	259	0.548	0.179	0.33	2	0.001	0.51
F shrinkage mean	136	0.5				0.527	0.818

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
196	0.3	0.13	25	0.429	0.63

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	5	0.344	0.097	0.28	10	0.419	1.06
FLT02: UK beamtrawl	33	0.623	0.327	0.53	10	0.078	0.233
FLT03: BTS-ISIS Neth	5	0.854	0	0	1	0	0.96
FLT04: SNS-Tridens N	16	0.849	0	0	1	0	0.429
F shrinkage mean	11	0.5				0.503	0.577

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
8	0.29	0.16	23	0.528	0.712

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: NL beamtrawl	50	0.252	0.036	0.14	10	0.562	0.535
FLT02: UK beamtrawl	91	0.508	0.157	0.31	10	0.09	0.326
FLT03: BTS-ISIS Neth	1	0	0	0	0	0	0
FLT04: SNS-Tridens N	1	0	0	0	0	0	0
F shrinkage mean	40	0.5				0.348	0.63

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
49	0.23	0.07	21	0.288	0.543

Table 7.11 North Sea Sole: fishing mortality

Run title : Sole in IV (run: XSARC07/X07)

At 6/10/2000 14:19

Terminal Fs derived using XSA (With F shrinkage)

Fishing mortality (F) at age

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0110	0.0083
2	0.0253	0.0168	0.0161	0.0422	0.0176	0.1039	0.1249	0.1098	0.3072	0.3296
3	0.1381	0.1248	0.1293	0.1511	0.2513	0.1481	0.4207	0.3675	0.6608	0.6873
4	0.1757	0.2506	0.1919	0.3761	0.2036	0.2730	0.1748	0.4593	0.6488	0.5052
5	0.2809	0.1705	0.2907	0.3177	0.4083	0.2467	0.2961	0.5390	0.4583	0.6945
6	0.1937	0.1994	0.1919	0.3678	0.2632	0.4612	0.2588	0.1897	0.2066	0.4043
7	0.1974	0.1181	0.2886	0.2469	0.3146	0.2743	0.2094	0.1861	0.1115	0.2005
8	0.1574	0.2386	0.1559	0.3243	0.1354	0.2275	0.1942	0.3061	0.2162	0.1391
9	0.0958	0.1041	0.1576	0.2608	0.2398	0.1451	0.1362	0.2095	0.1840	0.2133
10	0.1958	0.1100	0.1399	0.2373	0.1350	0.1636	0.0908	0.1319	0.2548	0.2221
11	0.1586	0.1579	0.2230	0.3224	0.1503	0.1220	0.1455	0.0872	0.0764	0.2427
12	0.1648	0.2496	0.1142	0.2287	0.1460	0.1888	0.1145	0.3207	0.1455	0.1060
13	0.1524	0.1738	0.3767	0.4511	0.3049	0.2981	0.0598	0.1038	0.0783	0.1206
14	0.1517	0.1594	0.2031	0.3148	0.1956	0.1818	0.1095	0.1709	0.1480	0.1812
+gp	0.1517	0.1594	0.2031	0.3148	0.1956	0.1818	0.1095	0.1709	0.1480	0.1812
FBAR 2- 8	**0.1669**	**0.1599**	**0.1886**	**0.2612**	**0.2277**	**0.2464**	**0.2398**	**0.3081**	**0.3726**	**0.4229**
FBAR 3-10	**0.1794**	**0.1646**	**0.1932**	**0.2655**	**0.2439**	**0.2399**	**0.2226**	**0.2985**	**0.3425**	**0.3833**
1										

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	0.0097	0.0106	0.0049	0.0070	0.0010	0.0066	0.0096	0.0131	0.0006	0.0008
2	0.1534	0.3239	0.2390	0.2062	0.1862	0.2796	0.1040	0.2603	0.2361	0.2296
3	0.6323	0.5627	0.6267	0.6979	0.5859	0.5399	0.5572	0.5328	0.5641	0.6573
4	0.5436	0.6509	0.5268	0.5618	0.6618	0.6619	0.4918	0.5998	0.6021	0.6149
5	0.2788	0.5704	0.5017	0.5728	0.4385	0.4885	0.5409	0.4665	0.5008	0.4344
6	0.3411	0.3387	0.3518	0.4111	0.5243	0.4004	0.3887	0.3464	0.4704	0.4297
7	0.3037	0.3909	0.1762	0.3509	0.4832	0.3756	0.3164	0.1904	0.5922	0.3186
8	0.2014	0.2700	0.3283	0.3732	0.3675	0.4991	0.4319	0.2739	0.6970	0.5434
9	0.0994	0.2137	0.2529	0.5527	0.3039	0.4763	0.4083	0.3256	0.2360	0.4279
10	0.1643	0.2126	0.1798	0.2566	0.6239	0.2602	0.3158	0.3239	0.3818	0.1969
11	0.1752	0.2713	0.1197	0.5123	0.2585	0.3782	0.3197	0.2071	0.6363	0.5348
12	0.2846	0.4531	0.2296	0.5401	0.4278	0.3050	0.3094	0.3018	0.4101	0.6722
13	0.1065	0.2392	0.2998	0.3415	0.0891	0.1529	0.3189	0.3973	0.4129	0.6334
14	0.1663	0.2786	0.2168	0.4419	0.3215	0.3153	0.3353	0.3119	0.4147	0.4928
+gp	0.1663	0.2786	0.2168	0.4419	0.3215	0.3153	0.3353	0.3119	0.4147	0.4928
FBAR 2- 8	**0.3506**	**0.4439**	**0.3929**	**0.4618**	**0.4623**	**0.4616**	**0.4044**	**0.3814**	**0.4931**	**0.4604**
FBAR 3-10	**0.3206**	**0.4012**	**0.3680**	**0.4707**	**0.4649**	**0.4615**	**0.4314**	**0.3824**	**0.4701**	**0.4515**

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.0043	0.0030	0.0184	0.0028	0.0028	0.0021	0.0024	0.0014	0.0000	0.0011
2	0.1264	0.2482	0.2305	0.3083	0.2847	0.3133	0.1418	0.2361	0.2366	0.1279
3	0.5585	0.5131	0.6686	0.5950	0.7126	0.7169	0.6024	0.5061	0.6460	0.5225
4	0.5865	0.6045	0.5431	0.6676	0.6727	0.7558	0.6434	0.5802	0.7001	0.6546
5	0.5560	0.5237	0.6396	0.3146	0.5716	0.5836	0.6472	0.4577	0.5604	0.4234
6	0.3439	0.6316	0.5861	0.4875	0.6641	0.4227	0.7222	0.5198	0.4829	0.3952
7	0.5165	0.3518	0.4392	0.4430	0.5627	0.3479	0.4643	0.4046	0.4701	0.2963
8	0.4072	0.3686	0.3600	0.4388	0.3996	0.4628	0.2771	0.3017	0.3787	0.3273
9	0.4444	0.3594	0.3937	0.3575	0.3948	0.4029	0.6615	0.3009	0.2561	0.3066
10	0.1418	0.4034	0.3988	0.3083	0.3635	0.2284	0.7629	0.4757	0.2009	0.1592
11	0.2743	0.4060	0.5368	0.5704	0.3245	0.4650	0.6998	0.4134	0.2513	0.3443
12	0.3064	0.1444	0.4826	0.1784	0.3472	0.4830	0.8903	0.6115	0.3470	0.4069
13	0.6364	1.2071	0.2430	0.1389	0.2343	0.3500	0.6116	0.8625	0.3146	0.3027
14	0.3617	0.5069	0.4123	0.3116	0.3317	0.3870	0.7286	0.5348	0.2746	0.3047
+gp	0.3617	0.5059	0.4123	0.3115	0.3317	0.3870	0.7285	0.5348	0.2746	0.3047
FBAR 2- 8	**0.4421**	**0.4474**	**0.4952**	**0.4650**	**0.5526**	**0.5147**	**0.4998**	**0.4293**	**0.4964**	**0.3910**
FBAR 3-10	**0.4443**	**0.4558**	**0.5036**	**0.4515**	**0.5414**	**0.4901**	**0.5376**	**0.4433**	**0.4619**	**0.3844**

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99	**Fbar 97-99 scaled to F2-8 in 1999**
AGE												
1	0.0049	0.0017	0.0029	0.0008	0.0118	0.0507	0.0035	0.0049	0.0020	0.0039	0.0036	**0.0031**
2	0.1369	0.0896	0.1169	0.1798	0.1367	0.3041	0.2570	0.1484	0.2183	0.1571	0.1746	**0.1490**
3	0.4151	0.4204	0.4253	0.4109	0.4776	0.4434	0.6850	0.5254	0.5906	0.4220	0.5126	**0.4375**
4	0.5233	0.6520	0.4582	0.6382	0.6135	0.7546	0.9562	0.6826	0.6605	0.6606	0.6679	**0.5701**
5	0.5509	0.7293	0.5094	0.7997	0.6374	0.5931	0.6875	0.7686	0.7362	0.5507	0.6845	**0.5842**
6	0.6713	0.4063	0.5801	0.6223	0.8166	0.5386	0.7668	0.7161	0.6846	0.5622	0.6510	**0.5556**
7	0.4413	0.5864	0.5861	0.7453	0.5947	0.6694	0.6499	0.5199	0.5672	0.4841	0.5237	**0.4470**
8	0.4060	0.5114	0.4779	0.4272	0.4700	0.6400	0.7400	0.6705	0.7224	0.4350	0.6116	**0.5220**
9	0.5030	0.3895	0.5403	0.5466	0.5937	0.5616	0.8196	0.5754	0.6501	0.7137	0.6464	**0.5517**
10	0.2588	0.4922	0.4173	0.4421	0.6181	0.4067	1.1300	0.9333	0.9249	0.6622	0.8401	**0.7170**
11	0.2978	0.5122	0.4625	0.4527	0.3180	0.2467	0.6521	0.3853	0.6764	0.4203	0.4940	**0.4216**
12	0.9062	0.6101	0.7509	0.5482	0.5880	0.4475	1.3376	0.5149	1.1799	0.6295	0.7748	**0.6613**
13	0.5851	0.6861	0.3893	0.5930	0.9727	0.2251	0.6115	0.5812	0.4857	0.7125	0.5931	**0.5062**
14	0.6977	0.6534	0.5511	0.6077	0.6416	0.5671	0.9112	0.5807	0.7229	0.5433	0.6156	**0.5254**
+gp	0.6977	0.6534	0.5511	0.6077	0.6416	0.5671	0.9112	0.5807	0.7229	0.5433		
FBAR 2- 8	**0.4350**	**0.4706**	**0.4606**	**0.6319**	**0.6365**	**0.6673**	**0.6706**	**0.5761**	**0.6971**	**0.4605**		
FBAR 3-10	**0.4587**	**0.5108**	**0.4553**	**0.5665**	**0.6038**	**0.5794**	**0.6054**	**0.6741**	**0.6320**	**0.5006**		

Table 7.12 North Sea Sole: Stock numbers-at-age

Run title : Sole in IV (run: XSARIC07/X07)

At 6/10/2000 14:19

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	66859	115735	28346	23008	554357	121486	41181	75333	100100	50589
2	505813	60496	104722	25648	9354	501550	109925	37262	68164	89588
3	115197	446224	53827	93240	9997	8317	409019	87785	30210	45366
4	109575	90791	356402	42798	32591	7036	6489	242995	55001	14117
5	39958	83168	63945	266182	11945	24056	4845	4930	138896	26012
6	49946	27302	63455	43262	78762	7185	17009	3261	2602	79476
7	28439	37234	20238	47389	12176	54776	4141	11881	2440	1915
8	11499	21123	29939	13721	15022	8043	37673	3039	8925	1975
9	12149	8889	15043	23179	4034	11871	5797	28072	2027	6512
10	16552	9988	7248	11626	7260	2872	9290	4577	20600	1526
11	7112	12314	8096	5702	3728	5740	2228	7677	3630	14447
12	3775	5492	9514	5861	1680	2903	4597	1743	6366	3043
13	23322	2926	3871	7680	1896	1313	2175	3710	1145	4980
14	993	18120	2225	2399	1989	1265	882	1853	3026	958
+gp	2431	2964	14430	15701	3668	7542	7249	4575	4302	6596
TOTAL	993620	942767	781301	627396	748458	765954	662501	518694	447434	347099

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	141499	41938	76959	106433	110834	41926	114270	140649	47073	11840
2	45398	126798	37547	69295	95636	100191	37685	102406	125602	42568
3	58307	35237	82990	26751	51069	71905	68822	30730	71422	89840
4	20644	28033	18162	40126	12045	25720	37919	35671	16321	36762
5	7707	10846	13230	9704	20910	5680	12127	20981	17716	8938
6	11753	5277	5547	7249	4952	12204	3153	6389	11907	9715
7	48000	7561	3403	3531	4348	2652	7399	1934	4089	6731
8	1418	32055	4628	2582	2249	2427	1648	4879	1447	2046
9	1555	1049	22143	3015	1608	1409	1333	968	3357	728
10	4760	1274	767	15559	1570	1074	792	802	633	2423
11	1106	3655	932	580	10904	841	749	523	525	391
12	10256	840	2521	748	314	7619	521	492	384	251
13	2477	6982	483	1813	394	185	5082	346	329	231
14	3994	2015	4973	324	1166	327	144	3342	211	197
+gp	7830	5889	5640	3887	5340	3662	2843	2851	2712	1848
TOTAL	366704	309448	279927	291596	323341	277821	294488	352963	303728	214508

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	155090	149659	153461	144547	71988	82332	161304	72834	446136	109301
2	10704	139725	135015	136327	130421	64956	74340	145599	65814	403671
3	30737	8536	98636	97021	90624	88775	42967	58371	104141	47007
4	42128	15911	4623	45735	48420	40211	39221	21286	31839	49389
5	17987	21205	7866	2430	21227	22359	17088	18649	10782	14305
6	5238	9334	11365	3754	1605	10845	11287	8095	10677	5571
7	5726	3360	4963	5728	2086	748	6430	4960	4356	5961
8	4429	3091	2138	2895	3328	1075	478	3657	2994	2463
9	1075	2667	1954	1350	1689	2019	613	328	2447	1855
10	429	624	1685	1193	854	1030	1221	286	219	1714
11	1819	337	377	1023	793	543	741	515	161	162
12	207	1251	203	199	523	519	309	333	308	113
13	116	138	980	113	151	335	290	115	164	197
14	111	56	37	695	89	108	213	142	44	108
+gp	2064	872	976	901	902	871	616	417	485	379
0 TOTAL	277859	356766	424280	443911	374703	316725	357117	335587	680568	642198

Table 7.12 Continued

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

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 57-97	AMST 57-97
AGE													
1	180058	72391	353353	69757	57174	100497	50853	335686	125380	75517***	0*	99452	137715
2	98790	162127	65391	318806	63068	51127	86441	45851	302243	113216	68062**	84975	118374
3	321398	77956	134135	52639	240996	49777	34132	60492	35765	219853	87549	65301	93516
4	25223	192018	46327	79325	31581	135258	28910	15568	32367	17928	130449	36948	56920
5	23223	13525	100040	26510	41905	15472	57545	10055	7118	15130	8380	20182	33539
6	8476	12112	5901	54389	10782	20046	7737	26183	4227	3084	7893	11604	18438
7	3429	4331	7308	2989	26413	4312	10585	3252	11577	1929	1607	6931	11932
8	4011	1996	2180	3680	1284	13186	1958	5000	1749	5941	1075	4477	7937
9	1606	2418	1083	1223	2172	719	6241	839	2307	769	3466	2869	5563
10	1235	879	1482	571	641	1085	371	2488	427	1090	341	2036	4917
11	1323	863	486	884	332	313	654	108	885	153	509	1337	3569
12	104	889	468	272	508	219	221	308	67	407	91	933	2633
13	68	38	437	200	142	256	126	52	167	19	196	570	1907
14	132	35	17	268	100	49	185	62	27	93	8	380	1339
+gp	447	366	630	250	547	360	302	166	181	160	133		
TOTAL	669524	541944	719238	611763	477645	392675	286260	506110	524486	455288	309758		

* Replaced by GM (99452)
** Replaced by RCT3 (63463)
*** Replaced by RCT3 (71001)

Table 7.13 NORTH SEA SOLE (IV) Indices of recruitment (input data for RCT3)

Year class	VPA-1	VPA-2	VPA-3	DFS INT-0	SNS Tridens 1	DFS INT-1	SNS Tridens 2	SNS Tridens 3	Ger Solea 3	BTS Neth-1	BTS Neth-2
									-11		
1968	50589	45398	35237	-11	-11	-11	745	99	-11	-11	-11
1969	141499	126798	82990	-11	4938	-11	1961	161	-11	-11	-11
1970	41938	37547	26751	-11	613	-11	341	73	-11	-11	-11
1971	76959	69295	51069	-11	1410	-11	905	69	-11	-11	-11
1972	106433	95636	71905	-11	4686	-11	397	174	31.5	-11	-11
1973	110834	100191	68822	-11	1924	-11	887	187	16.3	-11	-11
1974	41926	37685	30730	-11	597	2.83	79	77	34.4	-11	-11
1975	114270	102406	71422	160.94	1413	6.95	762	267	-11	-11	-11
1976	140649	125602	89840	80.99	3724	9.63	1379	325	41.5	-11	-11
1977	47073	42568	30737	27.95	1552	2.1	388	99	1.9	-11	-11
1978	11840	10704	8536	89.98	104	2.27	80	51	76.1	-11	-11
1979	155090	139725	98636	392.06	4483	-11	1411	231	77.1	-11	-11
1980	149659	135015	97021	403.86	3739	14.59	1124	107	147.1	-11	-11
1981	153461	136327	90624	295.15	5098	15.08	1137	307	77.8	-11	-11
1982	144547	130421	88775	340.01	2640	-11	1081	159	10.8	-11	-11
1983	71988	64956	42967	108.73	2359	12.31	709	67	29.8	-11	7.28
1984	82332	74340	58371	195.01	2151	3.97	465	59	24.6	2.64	4.58
1985	161304	145599	104141	300.66	3791	13.55	955	284	20.3	7.76	12.5
1986	72834	65814	47007	72.06	1890	6.18	594	248	66.9	6.96	12.81
1987	446136	403671	321398	532.11	11227	38.04	5369	907	86.4	81.23	67.76
1988	109301	98790	77956	61.15	3052	9.25	1078	527	54.1	8.67	22.33
1989	180058	162127	134135	83.38	2900	13.26	2515	319	11.3	22.44	23.2
1990	72391	65391	52639	62.16	1265	12.26	114	46	180.7	3.43	22.66
1991	353353	318806	240996	368.7	11081	18.44	3489	943	-11	72.71	26.61
1992	69757	63068	49777	32.65	1351	11.84	475	126	-11	4.63	4.95
1993	57174	51127	34132	29.18	559	5.88	234	27	12.9	5.94	8.68
1994	100497	86441	60492	76.17	1501	7.16	473	231	0.9	26.31	5.94
1995	50853	45851	35765	18.13	691	3.25	143	131	45.7	3.48	5.36
1996	335686	302243	219853	61.03	10132	24.88	1993	381	13.6	173.51	29.15
1997	-11	-11	-11	55.86	2875	-11	919	187	-11	14.16	19.51
1998	-11	-11	-11	-11	1649	-11	150	-11	-11	11.2	6.1
1999	-11	-11	-11	-11	1735	-11	-11	-11	-11	13.6	-11

DFS International Demersal Fish Survey
BTS International Beam Trawl Survey
SNS Sole Net Survey
GER German Solea survey

Table 7.14a Recruitment estimates at age 1

Analysis by RCT3 ver3.1 of data from file :
rctdata1.csv

Sole North Sea - 1-Y-Rcr.

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
	|----------Regression---------|					|----------Prediction--------|			
DFS-0	1.16	5.99	0.9	0.428	21	4.13	10.8	0.981	0.033
SNS-1	0.77	5.63	0.27	0.877	27	9.22	12.71	0.302	0.344
DFS-1	1.42	8.28	0.51	0.719	20	3.25	12.9	0.581	0.093
SNS-2	0.79	6.34	0.42	0.76	28	7.6	12.33	0.451	0.154
SNS-3	1.07	6.02	0.61	0.589	28	5.95	12.41	0.652	0.074
Solea-	0.87	8.52	0.69	0.58	20	3.84	11.88	0.746	0.056
BTS-1	0.73	9.83	0.37	0.793	12	5.16	13.6	0.528	0.113
BTS-2	1.15	8.61	0.57	0.611	13	3.41	12.51	0.667	0.071

VPA Mean = 11.45 .711 .062

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	|----------Regression---------|					|----------Prediction--------|			
DFS-0	1.4	4.96	1.16	0.323	22	4.04	10.62	1.261	0.02
SNS-1	0.77	5.62	0.27	0.888	28	7.96	11.74	0.283	0.393
SNS-2	0.81	6.18	0.43	0.752	29	6.82	11.74	0.455	0.152
SNS-3	1.1	5.89	0.61	0.601	29	5.24	11.66	0.646	0.076
Solea-	0.94	8.32	0.75	0.553	21	2.68	10.85	0.814	0.048
BTS-1	0.64	10	0.38	0.807	13	2.72	11.75	0.423	0.176
BTS-2	1.18	8.52	0.56	0.638	14	3.02	12.1	0.636	0.078

VPA Mean = 11.49 .737 .058

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	|----------Regression---------|					|----------Prediction--------|			
SNS-1	0.77	5.62	0.27	0.888	28	7.41	11.32	0.283	0.466
SNS-2	0.81	6.18	0.43	0.752	29	5.02	10.27	0.47	0.169
BTS-1	0.64	10	0.38	0.807	13	2.5	11.61	0.424	0.208
BTS-2	1.18	8.52	0.56	0.638	14	1.96	10.84	0.65	0.088

VPA Mean = 11.49 .737 .069

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	|----------Regression---------|					|----------Prediction--------|			
SNS-1	0.77	5.62	0.27	0.888	28	7.46	11.36	0.283	0.627
BTS-1	0.64	10	0.38	0.807	13	2.68	11.72	0.423	0.28

VPA Mean = 11.49 .737 .092

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	280750	12.55	0.18	0.21	1.41	335686	12.72
1997	118931	11.69	0.18	0.1	0.33		
1998	71001	11.17	0.19	0.23	1.37		
1999	**95906**	11.47	0.22	0.11	0.26		

Table 7.14b Recruitment estimates at age 2

Analysis by RCT3 ver3.1 of data from file :
rctdata2.csv

Sole North Sea - 2-Y-Rcr.

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	1.16	5.9	0.9	0.43	21	4.13	10.69	0.976	0.033
SNS-1	0.77	6.53	0.27	0.879	27	9.22	12.6	0.3	0.349
DFS-1	1.42	8.18	0.51	0.721	30	3.25	12.79	0.578	0.094
SNS-2	0.79	6.24	0.42	0.751	28	7.6	12.22	0.45	0.155
SNS-3	1.08	5.91	0.61	0.588	28	5.95	12.3	0.652	0.074
Solea-	0.87	8.42	0.69	0.582	30	3.84	11.77	0.743	0.057
BTS-1	0.74	9.71	0.39	0.781	12	5.16	13.52	0.548	0.104
BTS-2	1.14	8.51	0.56	0.618	13	3.41	12.4	0.658	0.072

VPA Mean = 11.34 .711 .062

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	1.4	4.87	1.16	0.325	22	4.04	10.51	1.257	0.02
SNS-1	0.77	5.52	0.27	0.89	28	7.96	11.64	0.281	0.4
SNS-2	0.81	6.08	0.43	0.753	29	6.82	11.63	0.453	0.153
SNS-3	1.1	5.78	0.61	0.6	29	5.24	11.56	0.647	0.075
Solea-	0.94	8.22	0.75	0.554	21	2.68	10.75	0.811	0.048
BTS-1	0.65	9.88	0.39	0.798	13	2.72	11.64	0.436	0.166
BTS-2	1.18	8.42	0.56	0.644	14	3.02	11.99	0.629	0.08

VPA Mean = 11.39 .737 .058

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	0.77	6.52	0.27	0.89	28	7.41	11.21	0.281	0.474
SNS-2	0.81	6.08	0.43	0.753	29	5.02	10.16	0.469	0.17
BTS-1	0.65	9.88	0.39	0.798	13	2.5	11.5	0.437	0.196
BTS-2	1.18	8.42	0.56	0.644	14	1.96	10.74	0.643	0.09

VPA Mean = 11.39 .737 .069

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			
SNS-1	0.77	5.52	0.27	0.89	28	7.46	11.25	0.281	0.642
BTS-1	0.65	9.88	0.39	0.798	13	2.68	11.62	0.436	0.266

VPA Mean = 11.39 .737 .093

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	250434	12.43	0.18	0.21	1.4	302244	12.62
1997	106911	11.58	0.19	0.1	0.34		
1998	**63463**	11.06	0.19	0.23	1.36		
1999	85776	11.36	0.22	0.11	0.25		

Table 7.14c Recruitment estimates at age 3

Analysis by RCT3 ver3.1 of data from file :
rctdata3.csv

Sole North Sea - 3-Y-Rcr.

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
	|---------Regression---------|					|---------Prediction---------|			
DFS-0	1.19	5.46	0.94	0.409	21	4.13	10.37	1.018	0.033
SNS-1	0.77	5.2	0.29	0.869	27	9.22	12.3	0.324	0.328
DFS-1	1.42	7.88	0.51	0.714	20	3.25	12.49	0.586	0.1
SNS-2	0.79	6.9	0.44	0.727	28	7.6	11.92	0.474	0.153
SNS-3	1.05	5.75	0.58	0.608	28	5.95	11.97	0.62	0.09
Solea	0.88	8.1	0.71	0.561	20	3.84	11.48	0.767	0.058
BTS-1	0.78	9.33	0.44	0.744	12	5.16	13.35	0.625	0.088
BTS-2	1.17	8.15	0.56	0.635	13	3.41	12.14	0.658	0.079

VPA Mean = 11.03 .703 .070

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	|---------Regression---------|					|---------Prediction---------|			
DFS-0	1.43	4.4	1.2	0.309	22	4.04	10.18	1.303	0.021
SNS-1	0.77	5.2	0.29	0.872	28	7.98	11.33	0.303	0.382
SNS-2	0.82	5.74	0.45	0.731	29	6.82	11.33	0.476	0.156
SNS-3	1.08	5.61	0.58	0.618	29	5.24	11.25	0.616	0.092
Solea	0.95	7.9	0.77	0.535	21	2.68	10.44	0.834	0.06
BTS-1	0.68	9.53	0.44	0.759	13	2.72	11.36	0.497	0.142
BTS-2	1.2	8.09	0.55	0.662	14	3.02	11.71	0.621	0.091

VPA Mean = 11.08 .730 .066

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	|---------Regression---------|					|---------Prediction---------|			
SNS-1	0.77	5.2	0.29	0.872	28	7.41	10.9	0.303	0.465
SNS-2	0.82	5.74	0.45	0.731	29	5.02	9.85	0.492	0.176
BTS-1	0.68	9.53	0.44	0.759	13	2.5	11.22	0.497	0.173
BTS-2	1.2	8.09	0.55	0.662	14	1.96	10.44	0.635	0.106

VPA Mean = 11.08 .730 .080

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	|---------Regression---------|					|---------Prediction---------|			
SNS-1	0.77	5.2	0.29	0.872	28	7.46	10.94	0.303	0.648
BTS-1	0.68	9.53	0.44	0.759	13	2.68	11.34	0.497	0.241

VPA Mean = 11.08 .730 .112

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	181422	12.11	0.19	0.22	1.36	219864	12.3
1997	**78759**	11.27	0.19	0.11	0.33		
1998	45803	10.73	0.21	0.23	1.23		
1999	62945	11.05	0.24	0.12	0.24		

Table 7.15 North Sea Sole, Assessment Summary Table

Run title : Sole in IV (run: XSARIC07/X07)

At 6/10/2000 9:14

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2- 8	FBAR 3-10
1957	165505	88542	78903	12067	0.15	0.137	0.143
1958	144954	99677	85570	14287	0.17	0.160	0.181
1959	559010	116348	93192	13832	0.15	0.132	0.150
1960	66859	138324	101246	18620	0.18	0.167	0.179
1961	115735	156084	148956	23566	0.16	0.160	0.165
1962	28346	156826	148787	26877	0.18	0.181	0.193
1963	23008	150775	148404	26164	0.18	0.261	0.286
1964	554357	68098	53584	11342	0.21	0.228	0.244
1965	121486	122208	48954	17043	0.35	0.246	0.240
1966	41181	113511	104787	33340	0.32	0.240	0.223
1967	75333	109354	100876	33439	0.33	0.308	0.299
1968	100100	99742	88924	33179	0.37	0.373	0.343
1969	50589	83913	70375	27559	0.39	0.423	0.383
1970	141499	72701	62944	19685	0.31	0.351	0.321
1971	41938	72571	52379	23652	0.45	0.444	0.401
1972	76959	64483	55739	21086	0.38	0.393	0.368
1973	106433	56348	41873	19309	0.46	0.452	0.471
1974	110834	60130	42288	17989	0.43	0.462	0.485
1975	41926	59326	43030	20773	0.48	0.462	0.462
1976	114270	52843	43492	17326	0.40	0.404	0.431
1977	140649	56039	36062	18003	0.50	0.381	0.382
1978	47073	57701	38595	20280	0.53	0.493	0.478
1979	11840	53053	46220	22598	0.49	0.460	0.452
1980	155090	43800	36071	15807	0.44	0.442	0.444
1981	149659	51393	24768	15403	0.62	0.447	0.456
1982	153461	60086	34861	21579	0.62	0.495	0.504
1983	144547	68587	42274	24927	0.59	0.465	0.452
1984	71988	66478	45532	26839	0.59	0.553	0.541
1985	82332	55149	42783	24248	0.57	0.515	0.490
1986	161304	53962	36010	18200	0.51	0.500	0.598
1987	72834	57434	31370	17368	0.55	0.429	0.443
1988	446136	72715	41655	21590	0.52	0.496	0.462
1989	109301	95378	36225	21806	0.60	0.391	0.384
1990	180058	114280	90657	35120	0.39	0.435	0.459
1991	72391	103705	77711	33513	0.43	0.471	0.511
1992	353353	105225	77357	29341	0.38	0.451	0.499
1993	69757	99688	55393	31491	0.57	0.532	0.567
1994	57174	86540	74663	33002	0.44	0.537	0.604
1995	100497	72246	59501	30467	0.51	0.567	0.579
1996	50853	52772	37523	22651	0.60	0.679	0.805
1997	335686	53485	29823	14901	0.50	0.576	0.674
1998	125380	71278	22695	20868	0.92	0.597	0.692
1999	71001*	72158	53551	23431	0.44	0.467	0.561
2000	99452**		52509***				
Arith. Mean	135981	82906	62456	22664	0.43	0.404	0.419
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

1

* RCT3 estimate

** GM (1957-97)

*** SSB estimated using average weight at age in the stock (1997-1999)

Table 7.16

11:04 Monday, October 16, 2000
Sole in Sub-area IV (North Sea)
Single option prediction: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	99452	0.1000	0.0000	0.0000	0.0000	0.050	0.0031	0.147
2	63463	0.1000	0.0000	0.0000	0.0000	0.140	0.1490	0.180
3	87549	0.1000	1.0000	0.0000	0.0000	0.183	0.4375	0.202
4	130449	0.1000	1.0000	0.0000	0.0000	0.225	0.5701	0.239
5	8380	0.1000	1.0000	0.0000	0.0000	0.259	0.5842	0.272
6	7893	0.1000	1.0000	0.0000	0.0000	0.293	0.5556	0.303
7	1607	0.1000	1.0000	0.0000	0.0000	0.328	0.4470	0.338
8	1075	0.1000	1.0000	0.0000	0.0000	0.306	0.5220	0.324
9	3466	0.1000	1.0000	0.0000	0.0000	0.351	0.5517	0.365
10	341	0.1000	1.0000	0.0000	0.0000	0.378	0.7170	0.390
11	509	0.1000	1.0000	0.0000	0.0000	0.494	0.4216	0.529
12	91	0.1000	1.0000	0.0000	0.0000	0.479	0.6613	0.530
13	196	0.1000	1.0000	0.0000	0.0000	0.607	0.5062	0.662
14	8	0.1000	1.0000	0.0000	0.0000	0.620	0.5254	0.522
15+	133	0.1000	1.0000	0.0000	0.0000	0.640	-	0.716
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	99452	0.1000	0.0000	0.0000	0.0000	0.050	0.0031	0.147
2	-	0.1000	0.0000	0.0000	0.0000	0.140	0.1490	0.180
3	-	0.1000	1.0000	0.0000	0.0000	0.183	0.4375	0.202
4	-	0.1000	1.0000	0.0000	0.0000	0.225	0.5701	0.239
5	-	0.1000	1.0000	0.0000	0.0000	0.259	0.5842	0.272
6	-	0.1000	1.0000	0.0000	0.0000	0.293	0.5556	0.303
7	-	0.1000	1.0000	0.0000	0.0000	0.328	0.4470	0.338
8	-	0.1000	1.0000	0.0000	0.0000	0.306	0.5220	0.324
9	-	0.1000	1.0000	0.0000	0.0000	0.351	0.5517	0.365
10	-	0.1000	1.0000	0.0000	0.0000	0.378	0.7170	0.390
11	-	0.1000	1.0000	0.0000	0.0000	0.494	0.4216	0.529
12	-	0.1000	1.0000	0.0000	0.0000	0.479	0.6613	0.530
13	-	0.1000	1.0000	0.0000	0.0000	0.607	0.5062	0.662
14	-	0.1000	1.0000	0.0000	0.0000	0.620	0.5254	0.522
15+	-	0.1000	1.0000	0.0000	0.0000	0.640	-	0.716
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	99452	0.1000	0.0000	0.0000	0.0000	0.050	0.0031	0.147
2	-	0.1000	0.0000	0.0000	0.0000	0.140	0.1490	0.180
3	-	0.1000	1.0000	0.0000	0.0000	0.183	0.4375	0.202
4	-	0.1000	1.0000	0.0000	0.0000	0.225	0.5701	0.239
5	-	0.1000	1.0000	0.0000	0.0000	0.259	0.5842	0.272
6	-	0.1000	1.0000	0.0000	0.0000	0.293	0.5556	0.303
7	-	0.1000	1.0000	0.0000	0.0000	0.328	0.4470	0.338
8	-	0.1000	1.0000	0.0000	0.0000	0.306	0.5220	0.324
9	-	0.1000	1.0000	0.0000	0.0000	0.351	0.5517	0.365
10	-	0.1000	1.0000	0.0000	0.0000	0.378	0.7170	0.390
11	-	0.1000	1.0000	0.0000	0.0000	0.494	0.4216	0.529
12	-	0.1000	1.0000	0.0000	0.0000	0.479	0.6613	0.530
13	-	0.1000	1.0000	0.0000	0.0000	0.607	0.5062	0.662
14	-	0.1000	1.0000	0.0000	0.0000	0.620	0.5254	0.522
15+	-	0.1000	1.0000	0.0000	0.0000	0.640	-	0.716
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SPRRIC02
Date and time: 07OCT00:13:58

Table 7.17

11:04 Monday, October 16, 2000
Sole in Sub-area IV (North Sea)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4665	66472	52509	23503	0.0000	0.0000	59512	41951	0	76196	58595
.	.	.	.	.	0.1000	0.0466	.	41951	2479	73658	56061
.	.	.	.	.	0.2000	0.0933	.	41951	4837	71248	53655
.	.	.	.	.	0.3000	0.1399	.	41951	7079	68958	51369
.	.	.	.	.	0.4000	0.1866	.	41951	9211	66783	49197
.	.	.	.	.	0.5000	0.2332	.	41951	11241	64715	47134
.	.	.	.	.	0.6000	0.2799	.	41951	13172	62750	45173
.	.	.	.	.	0.7000	0.3265	.	41951	15010	60882	43309
.	.	.	.	.	0.8000	0.3732	.	41951	16760	59106	41536
.	.	.	.	.	0.9000	0.4198	.	41951	18426	57417	39851
.	.	.	.	.	1.0000	0.4665	.	41951	20013	55810	38248
.	.	.	.	.	1.1000	0.5131	.	41951	21526	54281	36724
.	.	.	.	.	1.2000	0.5598	.	41951	22967	52827	35273
.	.	.	.	.	1.3000	0.6064	.	41951	24340	51442	33892
.	.	.	.	.	1.4000	0.6531	.	41951	25650	50124	32577
.	.	.	.	.	1.5000	0.6997	.	41951	26899	48868	31326
.	.	.	.	.	1.6000	0.7464	.	41951	28090	47673	30134
.	.	.	.	.	1.7000	0.7930	.	41951	29227	46533	28999
.	.	.	.	.	1.8000	0.8397	.	41951	30312	45448	27917
.	.	.	.	.	1.9000	0.8863	.	41951	31348	44413	26886
.	.	.	.	.	2.0000	0.9330	.	41951	32337	43426	25903
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANRIC06
Date and time : 07OCT00:17:46
Computation of ref. F: Simple mean, age 2 - 8
Basis for 2000 : F factors

Table 7.18

11:04 Monday, October 16, 2000
Sole in Sub-area IV (North Sea)

Single option prediction: Detailed tables

Year: 2000 F-factor: 1.0000 Reference F: 0.4665

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	0.0031	293	43	99452	4973	0	0	0	0
2	0.1490	8371	1510	63463	8906	0	0	0	0
3	0.4375	29630	5995	87549	16051	87549	16051	87549	16051
4	0.5701	54197	12953	130449	29351	130449	29351	130449	29351
5	0.5842	3545	966	8380	2173	8380	2173	8380	2173
6	0.5556	3217	975	7893	2313	7893	2313	7893	2313
7	0.4470	553	187	1607	527	1607	527	1607	527
8	0.5220	418	135	1075	329	1075	329	1075	329
9	0.5517	1405	512	3466	1218	3466	1218	3466	1218
10	0.7170	167	65	341	129	341	129	341	129
11	0.4216	167	89	509	252	509	252	509	252
12	0.6613	42	22	91	44	91	44	91	44
13	0.5062	74	49	196	119	196	119	196	119
14	0.5254	3	2	8	5	8	5	8	5
15+	.	0	0	133	85	133	85	.	.
Total		102083	23503	404612	66472	241697	52594	241564	52509
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.4665

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	0.0031	293	43	99452	4973	0	0	0	0
2	0.1490	11832	2134	89709	12589	0	0	0	0
3	0.4375	16744	3388	49474	9070	49474	9070	49474	9070
4	0.5701	21250	5079	51147	11508	51147	11508	51147	11508
5	0.5842	28239	7690	66745	17309	66745	17309	66745	17309
6	0.5556	1723	522	4228	1239	4228	1239	4228	1239
7	0.4470	1411	477	4097	1344	4097	1344	4097	1344
8	0.5220	361	117	930	284	930	284	930	284
9	0.5517	234	85	577	203	577	203	577	203
10	0.7170	885	345	1806	682	1806	682	1806	682
11	0.4216	49	26	151	74	151	74	151	74
12	0.6613	140	74	302	145	302	145	302	145
13	0.5062	16	11	43	26	43	26	43	26
14	0.5254	42	22	107	66	107	66	107	66
15+	.	0	0	.	.	.	.	.	.
Total		83219	20013	368769	59512	179607	41951	179607	41951
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 7.18 (Cont'd)

11:04 Monday, October 16, 2000
Sole in Sub-area IV (North Sea)

Single option prediction: Detailed tables

(cont.)

Year: 2002   F-factor: 1.0000   Reference F: 0.4665

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	0.0031	293	43	99452	4973	0	0	0	0
2	0.1490	11832	2134	89709	12589	0	0	0	0
3	0.4375	23669	4789	69936	12822	69936	12822	69936	12822
4	0.5701	12008	2870	28903	6503	28903	6503	28903	6503
5	0.5842	11072	3015	26170	6787	26170	6787	26170	6787
6	0.5556	13722	4158	33673	9866	33673	9866	33673	9866
7	0.4470	756	255	2195	720	2195	720	2195	720
8	0.5220	922	299	2371	725	2371	725	2371	725
9	0.5517	202	74	499	175	499	175	499	175
10	0.7170	147	58	301	114	301	114	301	114
11	0.4216	262	139	798	394	798	394	798	394
12	0.6613	41	22	89	43	89	43	89	43
13	0.5062	54	35	141	86	141	86	141	86
14	0.5254	9	5	23	14	23	14	23	14
15+	.	0	0	.	.	.	.	.	.
Total		74990	17895	354260	55810	165099	38248	165099	38248
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRRIC02
Date and time : 07OCT00:13:58
Computation of ref. F: Simple mean, age 2 - 8
Prediction basis : F factors

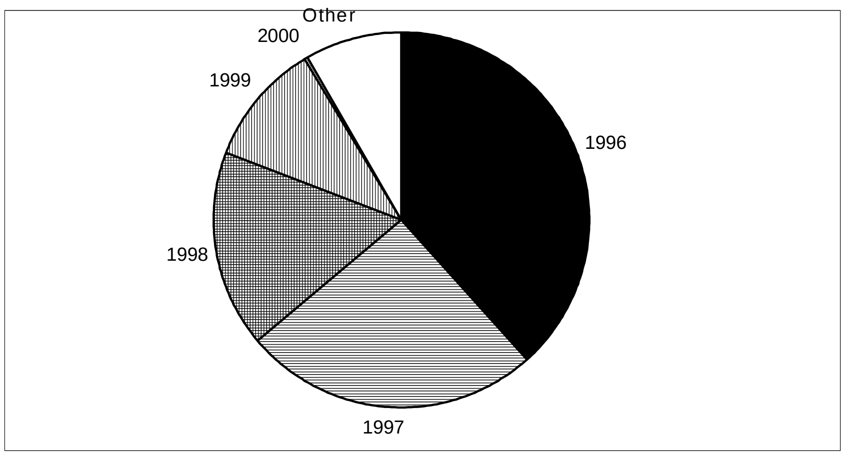
Table 7.19 Sole in North Sea
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1996	1997	1998	1999	2000
Stock No. (thousands) of 1 year-olds			335686	125380	71001	99452	99452
Source			VPA	VPA	RCT3	GM	GM
Status Quo F:							
% in	2000	landings	55.1	25.5	6.4	0.2	-
% in	2001		38.4	25.4	16.9	10.7	0.2
% in	2000	SSB	55.8	30.5	0.0	0.0	-
% in	2001	SSB	41.3	27.4	21.6	0.0	0.0
% in	2002	SSB	25.8	17.7	17.0	33.5	0.0

GM : geometric mean recruitment

Sole in North Sea : Year-class % contribution to

a) 2001 landings



b) 2002 SSB

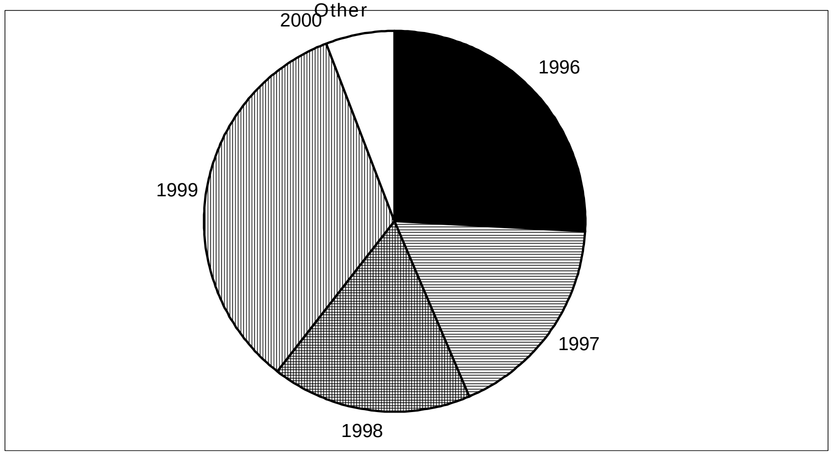


Table 7.20 North Sea Sole (IV) Input data for medium term analysis

Population at age in 2000	Value	uncertainty (CV)
N1	99451	0.81
N2	63463	0.35
N3	87548	0.16
N4	130448	0.13
N5	8379	0.13
N6	7893	0.13
N7	1607	0.15
N8	1074	0.16
N9	3465	0.16
N10	341	0.19
N11	508	0.22
N12	91	0.27
N13	196	0.3
N14	8	0.29
N15	132	0.23

Fishing mortality pattern	Value	uncertainty (CV)
sH1	0.004	0.44
sH2	0.175	0.17
sH3	0.513	0.05
sH4	0.668	0.13
sH5	0.684	0.06
sH6	0.651	0.04
sH7	0.524	0.07
sH8	0.612	0.13
sH9	0.646	0.24
sH10	0.84	0.07
sH11	0.494	0.26
sH12	0.775	0.39
sH13	0.593	0.33
sH14	0.616	0.09
sH15	0.616	0.09

Weight in the catch at age	Value	uncertainty (CV)
WH1	0.147	0.12
WH2	0.18	0.01
WH3	0.202	0.06
WH4	0.239	0.05
WH5	0.272	0.05
WH6	0.303	0.06
WH7	0.338	0.04
WH8	0.324	0.13
WH9	0.365	0.07
WH10	0.39	0.06
WH11	0.529	0.08
WH12	0.53	0.16
WH13	0.662	0.03
WH14	0.522	0.1
WH15	0.716	0.05

Natural mortality pattern	Value	uncertainty (CV)
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

Maturity ogive pattern	Value	uncertainty (CV)
MT1	0	0
MT2	0	0.1
MT3	1	0.1
MT4	1	0
MT5	1	0
MT6	1	0
MT7	1	0
MT8	1	0
MT9	1	0
MT10	1	0
MT11	1	0
MT12	1	0
MT13	1	0
MT14	1	0
MT15	1	0

Effort multiplier by year	Value	uncertainty (CV)
HF01	1	0.13
HF02	1	0.13
Recruitment in year		
R01	99452	0.81
R02	99452	0.81

Table 7.21

11:04 Monday, October 16, 2000
Sole in Sub-area IV (North Sea)

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	0.050	0.0031	0.147
2	-	0.1000	0.0000	0.0000	0.0000	0.140	0.1490	0.180
3	-	0.1000	1.0000	0.0000	0.0000	0.183	0.4375	0.202
4	-	0.1000	1.0000	0.0000	0.0000	0.225	0.5701	0.239
5	-	0.1000	1.0000	0.0000	0.0000	0.259	0.5842	0.272
6	-	0.1000	1.0000	0.0000	0.0000	0.293	0.5556	0.303
7	-	0.1000	1.0000	0.0000	0.0000	0.328	0.4470	0.338
8	-	0.1000	1.0000	0.0000	0.0000	0.306	0.5220	0.324
9	-	0.1000	1.0000	0.0000	0.0000	0.351	0.5517	0.365
10	-	0.1000	1.0000	0.0000	0.0000	0.378	0.7170	0.390
11	-	0.1000	1.0000	0.0000	0.0000	0.494	0.4216	0.529
12	-	0.1000	1.0000	0.0000	0.0000	0.479	0.6613	0.530
13	-	0.1000	1.0000	0.0000	0.0000	0.607	0.5062	0.662
14	-	0.1000	1.0000	0.0000	0.0000	0.620	0.5254	0.522
15+	-	0.1000	1.0000	0.0000	0.0000	0.640	-	0.716
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDRIC03
Date and time: 10OCT00:09:49

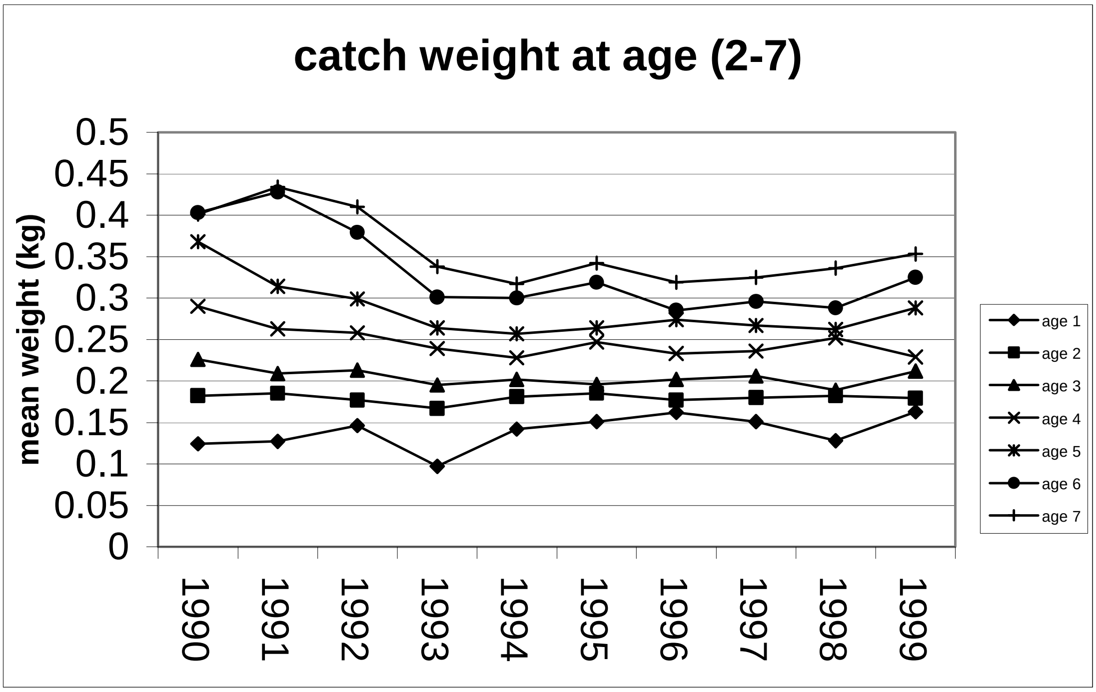
Table 7.22

Sole in Sub-area IV (North Sea) The SAS System 15:00 Satu

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	7.917	2181.318	6.012	2004.339	6.012	2004.339
0.1000	0.0466	0.249	80.256	6.686	1671.250	4.782	1494.311	4.782	1494.311
0.2000	0.0933	0.401	121.699	5.823	1330.262	3.918	1153.362	3.918	1153.362
0.3000	0.1399	0.497	143.080	5.199	1096.266	3.295	919.405	3.295	919.405
0.4000	0.1866	0.560	154.078	4.738	931.276	2.834	754.454	2.834	754.454
0.5000	0.2332	0.605	159.687	4.387	811.722	2.484	634.940	2.484	634.940
0.6000	0.2799	0.637	162.490	4.114	722.747	2.211	546.004	2.211	546.004
0.7000	0.3265	0.661	163.823	3.897	654.824	1.994	478.120	1.994	478.120
0.8000	0.3732	0.680	164.381	3.721	601.731	1.818	425.066	1.818	425.066
0.9000	0.4198	0.696	164.527	3.575	559.324	1.673	382.699	1.673	382.699
1.0000	0.4665	0.708	164.454	3.453	524.790	1.551	348.205	1.551	348.205
1.1000	0.5131	0.719	164.265	3.349	496.178	1.447	319.632	1.447	319.632
1.2000	0.5598	0.729	164.014	3.259	472.108	1.358	295.601	1.358	295.601
1.3000	0.6064	0.737	163.734	3.181	451.584	1.280	275.115	1.280	275.115
1.4000	0.6531	0.744	163.443	3.112	433.874	1.211	257.445	1.211	257.445
1.5000	0.6997	0.750	163.150	3.051	418.430	1.151	242.041	1.151	242.041
1.6000	0.7464	0.756	162.862	2.996	404.838	1.096	228.487	1.096	228.487
1.7000	0.7930	0.761	162.583	2.947	392.773	1.047	216.462	1.047	216.462
1.8000	0.8397	0.766	162.314	2.902	381.986	1.002	205.714	1.002	205.714
1.9000	0.8863	0.770	162.058	2.861	372.275	0.962	196.042	0.962	196.042
2.0000	0.9330	0.774	161.815	2.824	363.481	0.925	187.287	0.925	187.287
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDRIC03
Date and time : 07OCT00:18:52
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.3477
F-max factor : 0.9068
F-0.1 reference F : 0.1622
F-max reference F : 0.4230
Recruitment : Single recruit



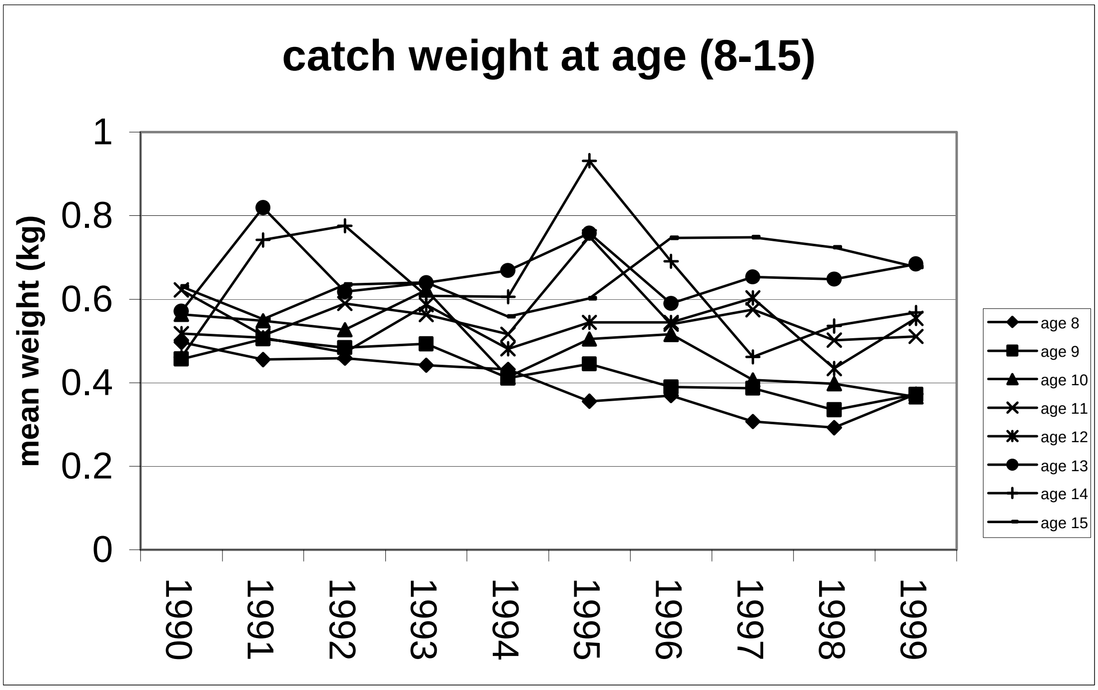
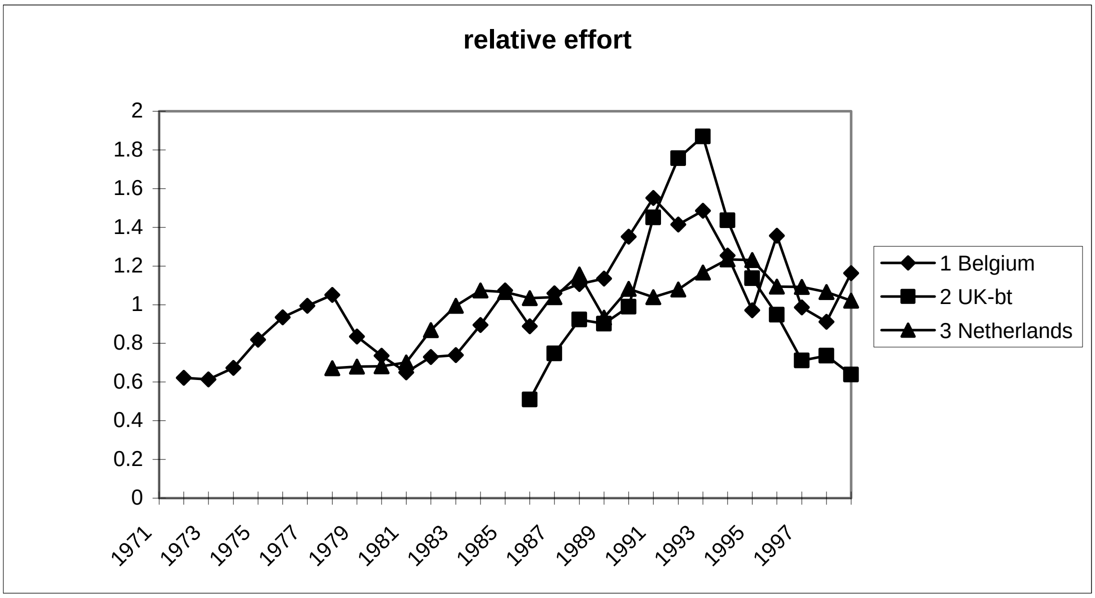


Figure 7.1.a North Sea Sole: Catch weights-at-age

Figure 7.1b North Sea Sole, trends in effort and cpue in commercial fleets.



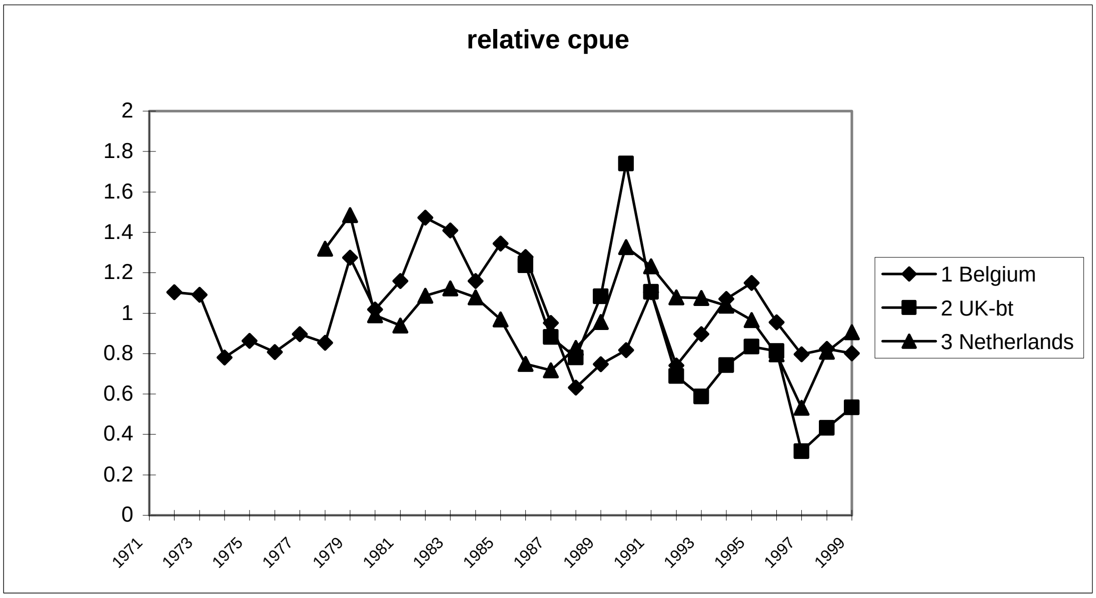


Figure 7.2a Comparison between single fleet XSA-runs and combined runs by fleet

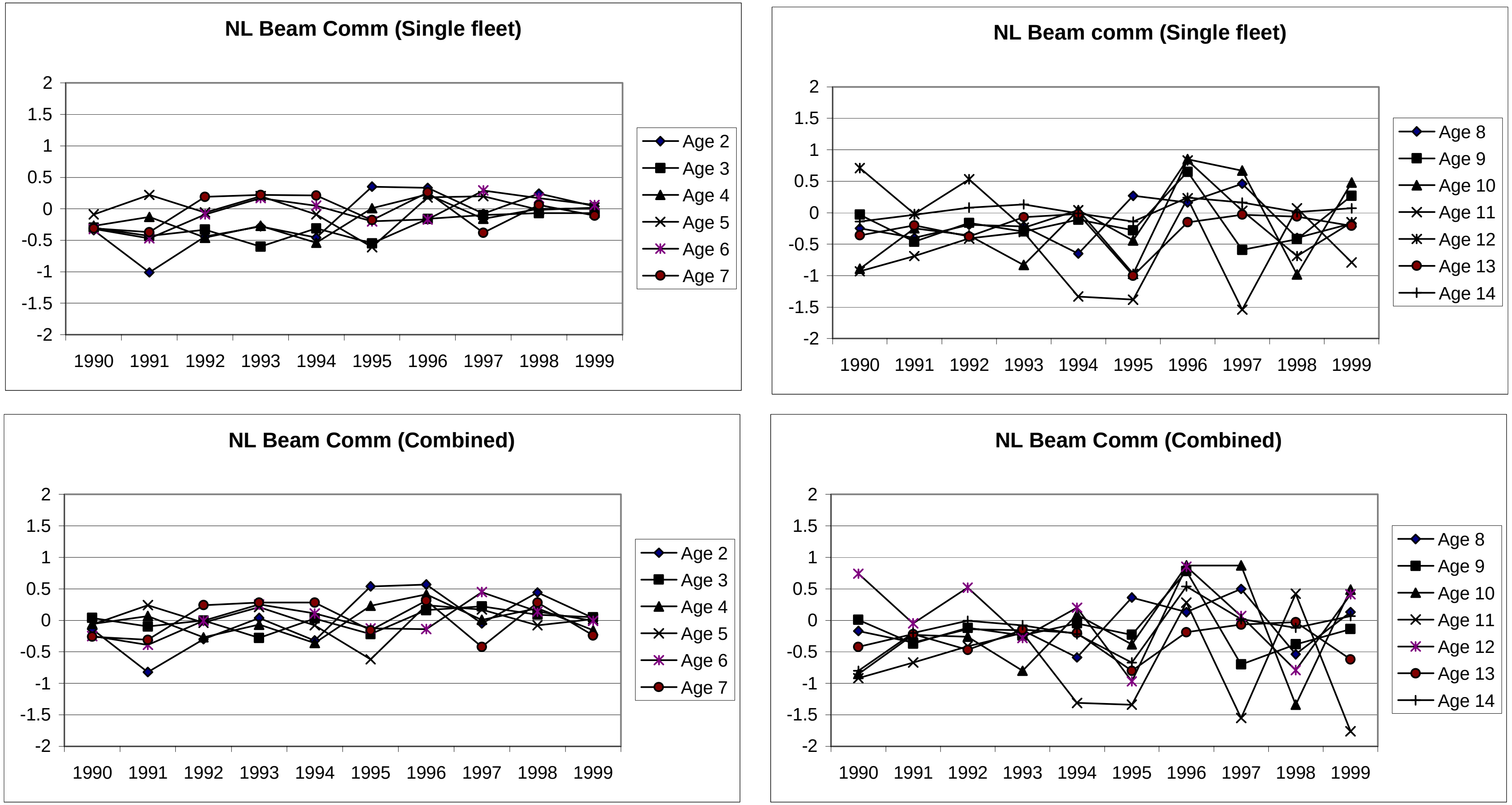


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Figure 7.2b Comparison between single fleet XSA-runs and combined runs by fleet

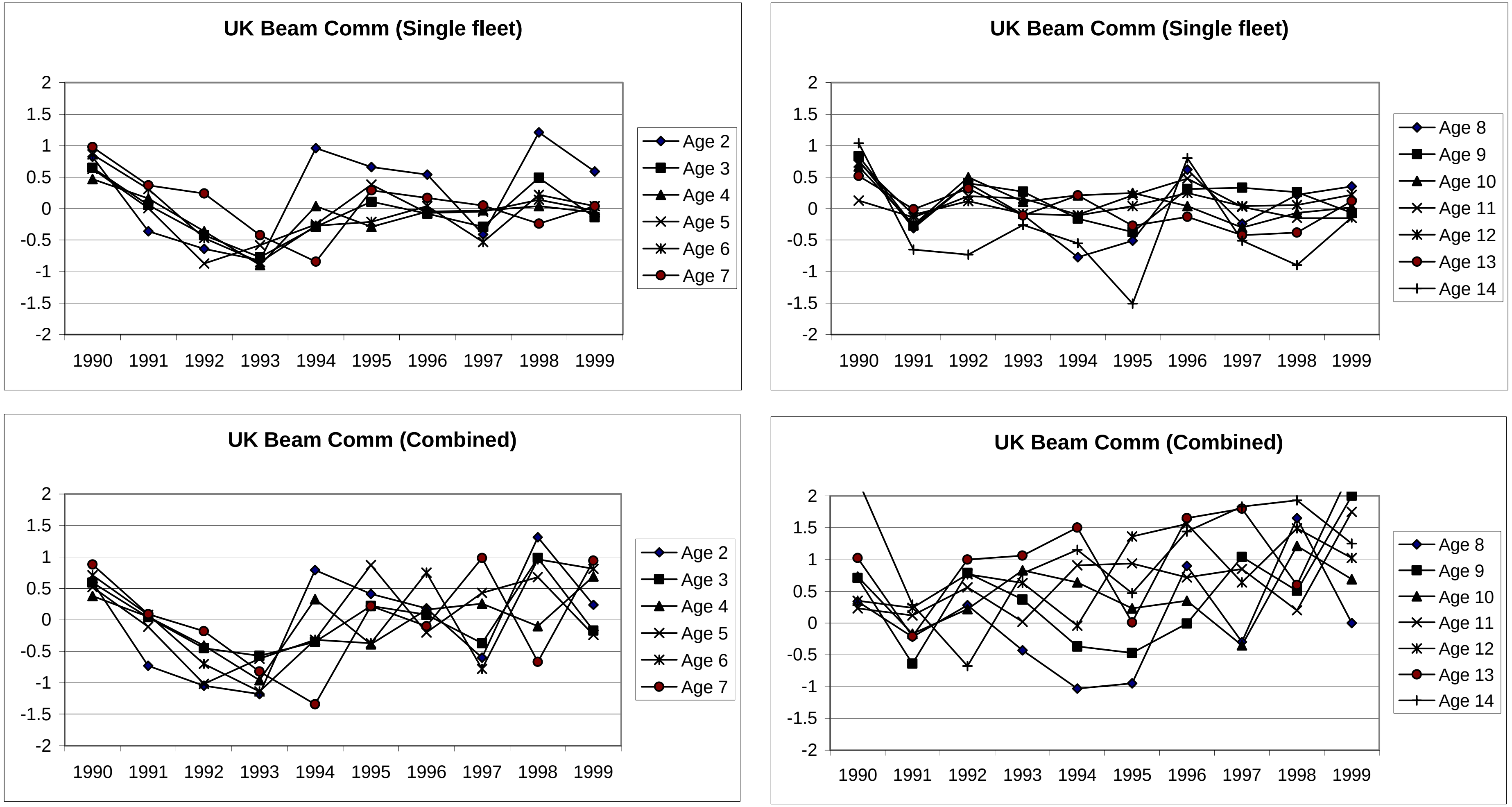


Figure 7.2c Comparison between single fleet XSA-runs and combined runs by fleet

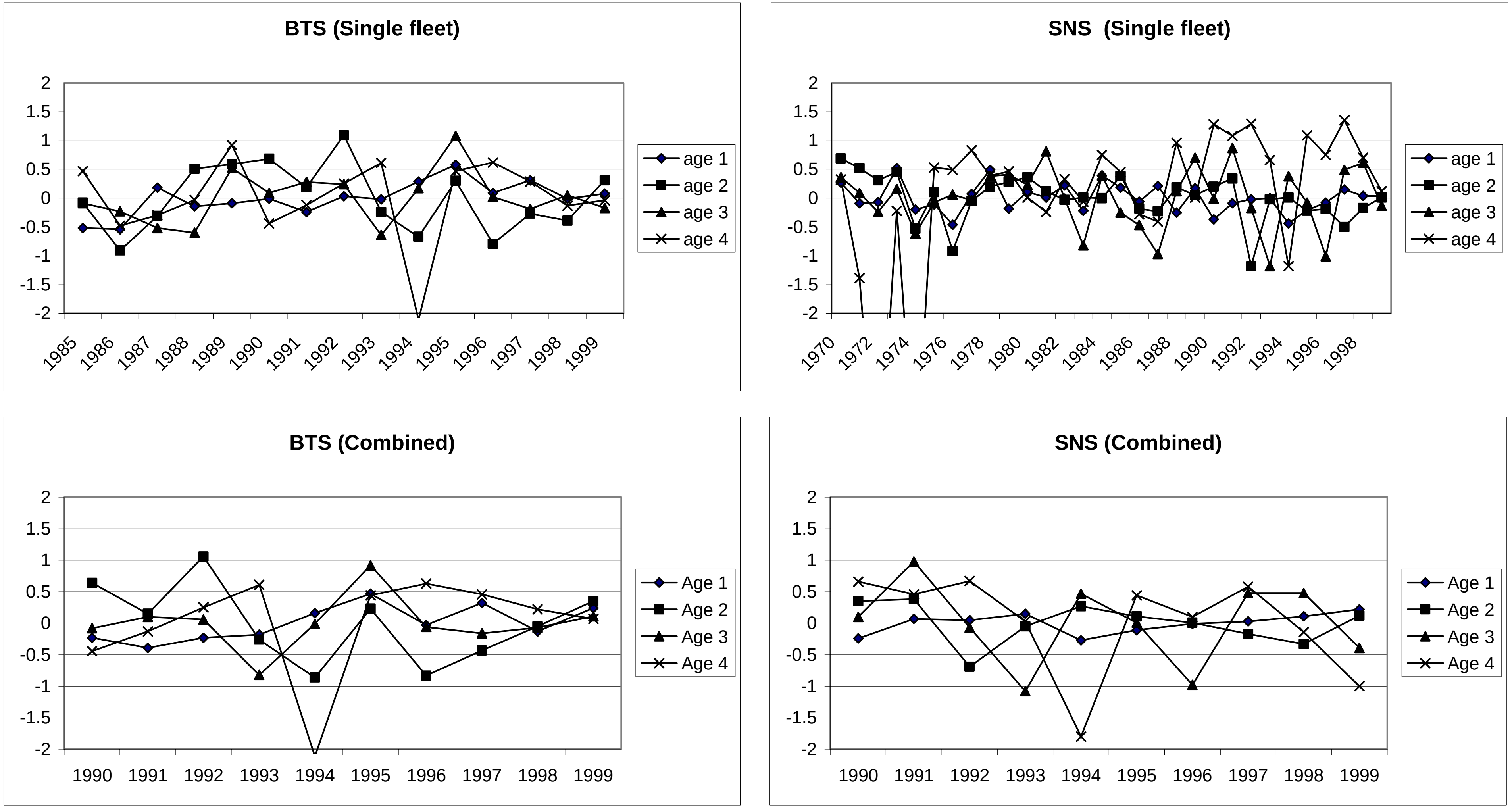
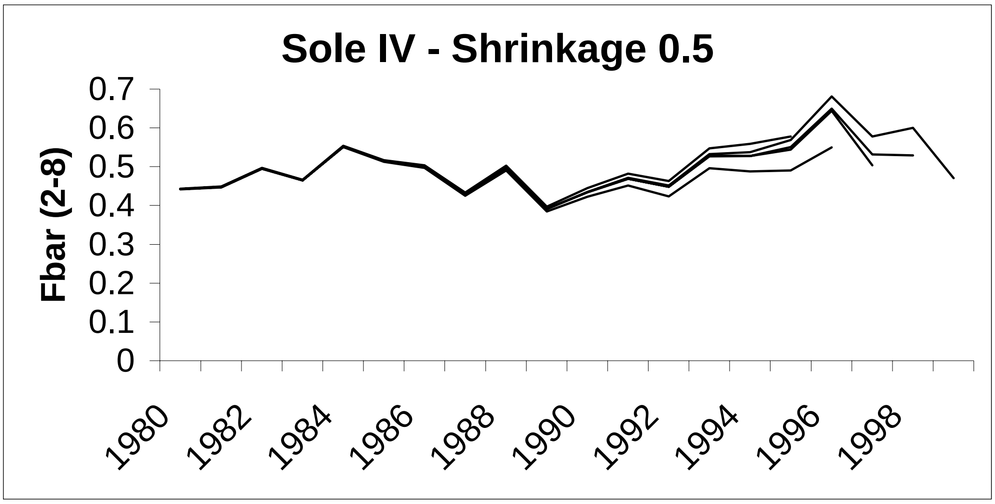
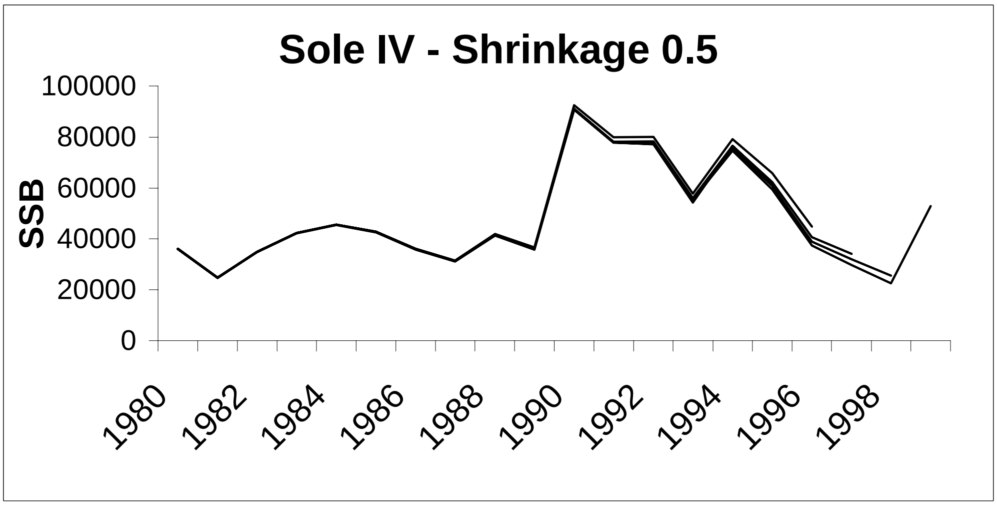


Figure 7.3a - North Sea sole
Retrospective Analysis





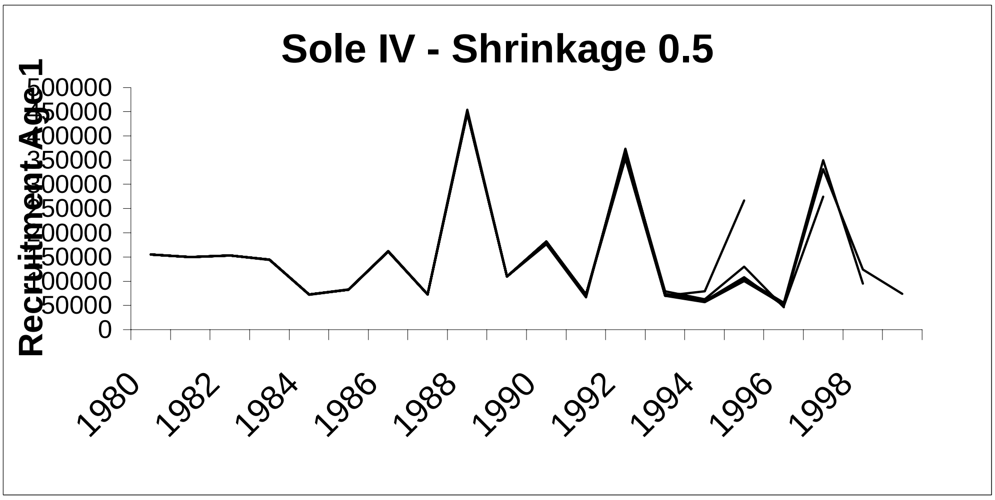
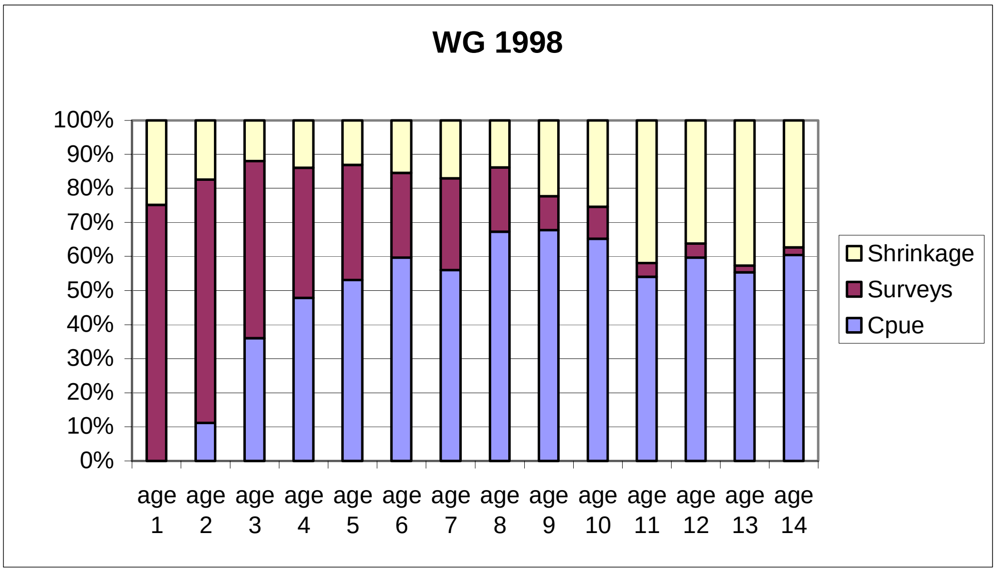
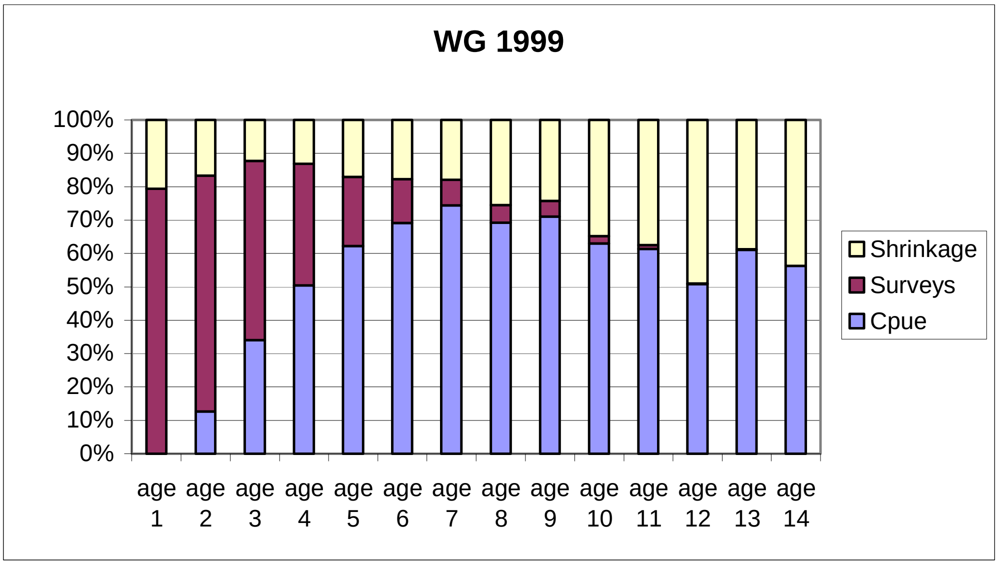
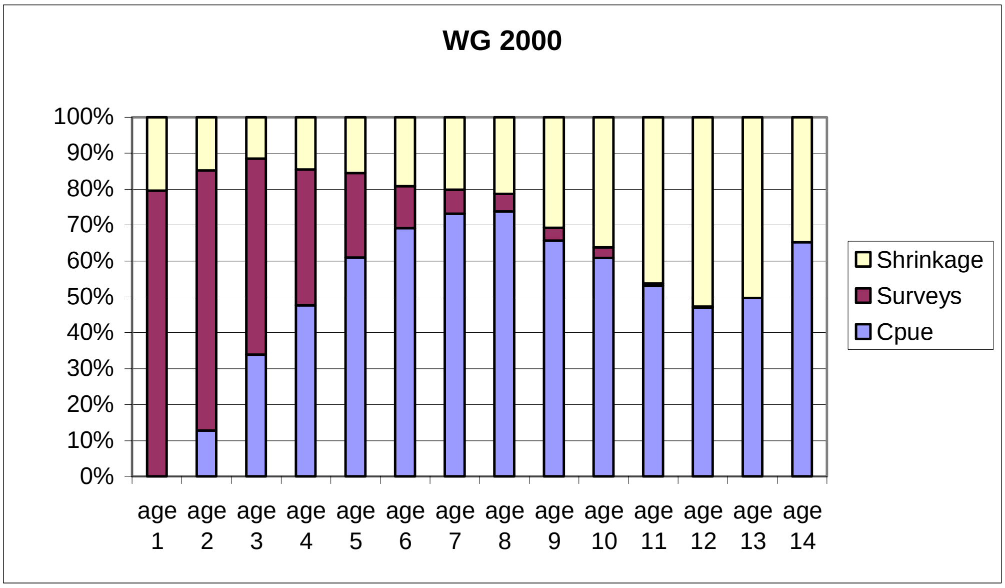


Figure 7.3b Weighting of tuning fleets in the 1998 (top), 1999 (middle) and 2000 Wg (bottom) assessments







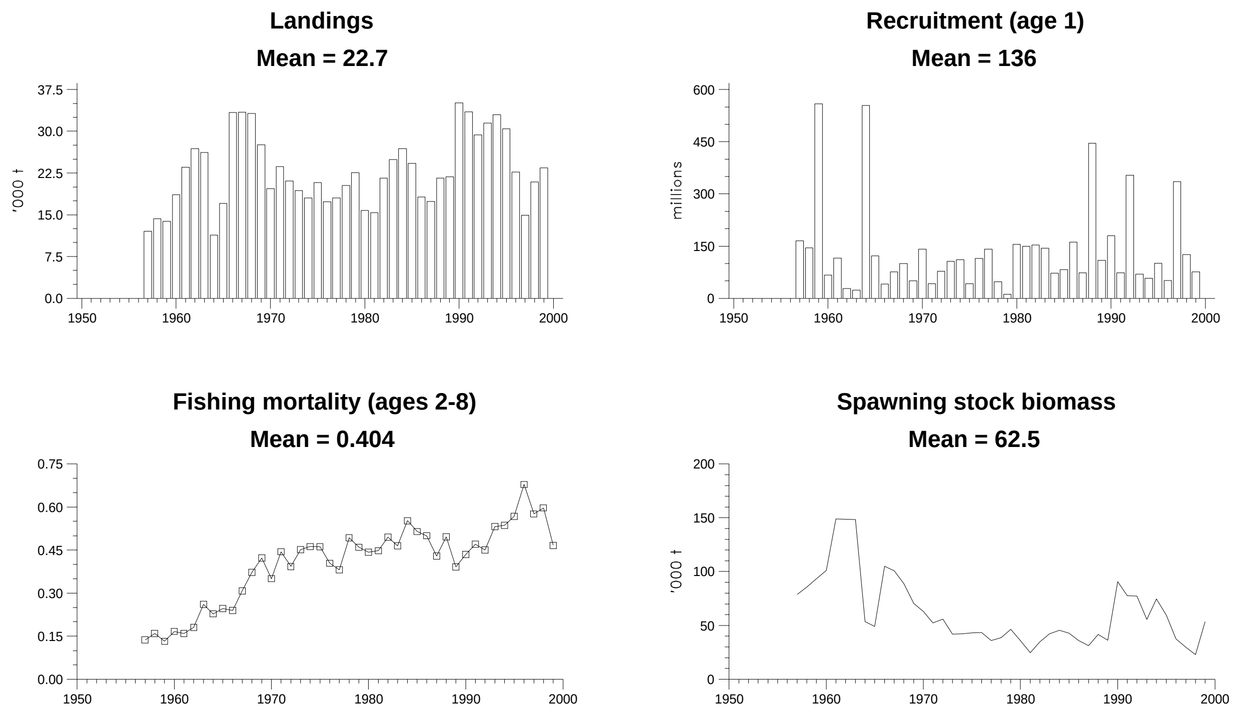
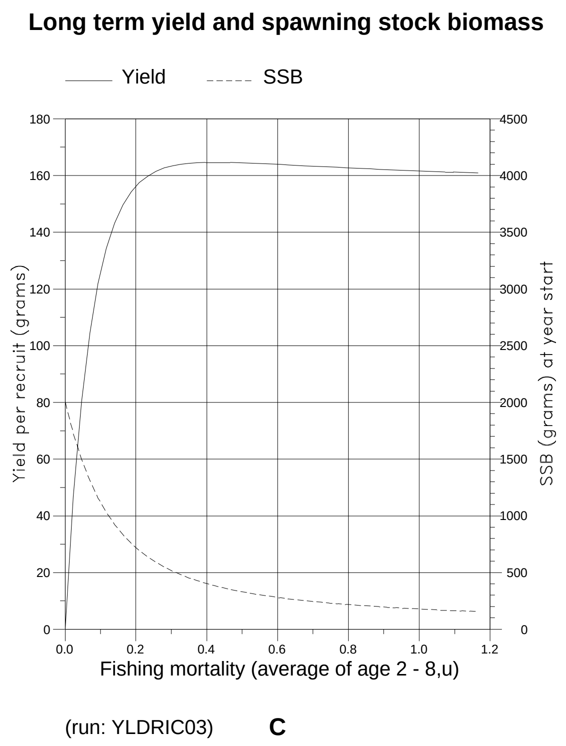


Figure 7.4 Sole in Sub-area IV (North Sea)



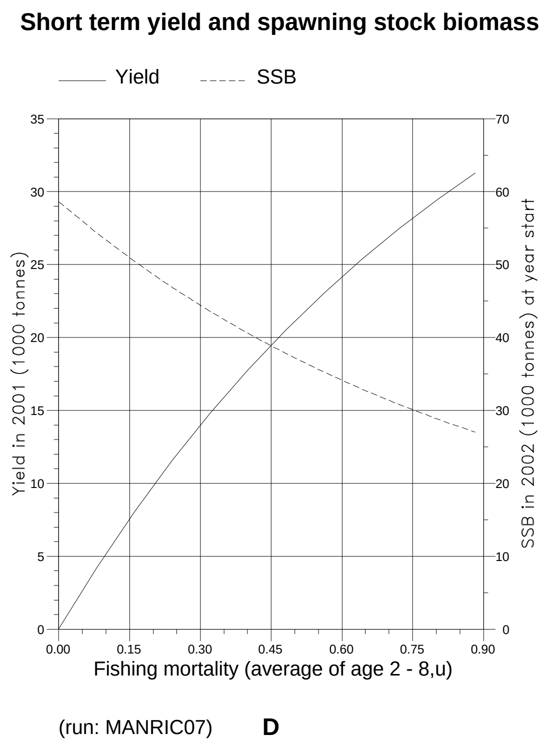


Figure 7.5 Fish Stock Summary, Sole in Sub-area IV (North Sea)

Figure 7.6 **North Sea Sole. Medium term projections. Solid lines show 5, 25, 50, 75 and 95 percentiles**

Ricker stock-recruitment relationship

number of simulations 500

Status quo (F2000=0.47) Natural Mortality = 0.1

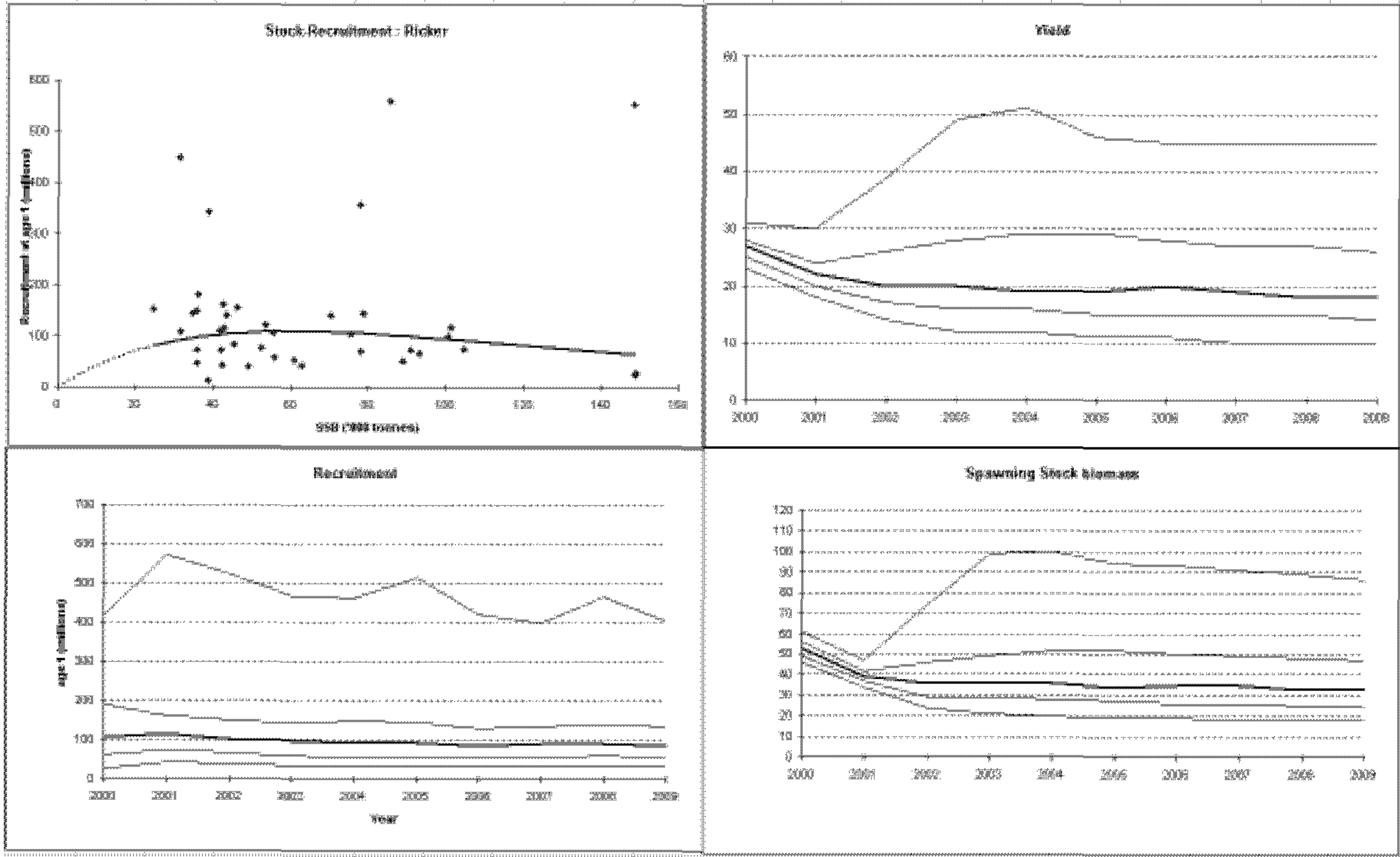
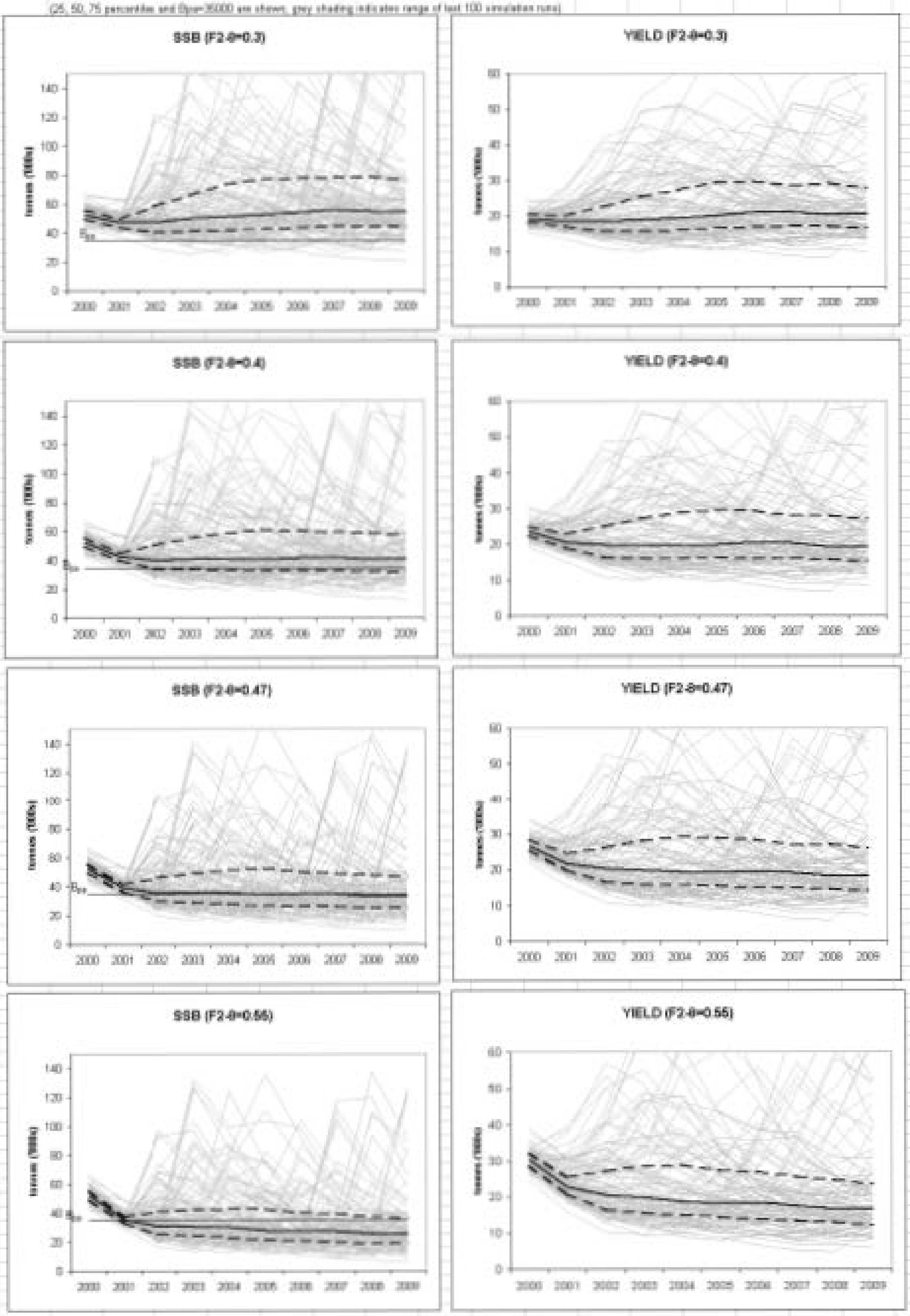


Figure 7.7 North Sea sole: Medium term predictions at different levels of F

(25, 50, 75 percentiles and Bpa=35000 are shown, grey shading indicates range of last 100 simulation runs)



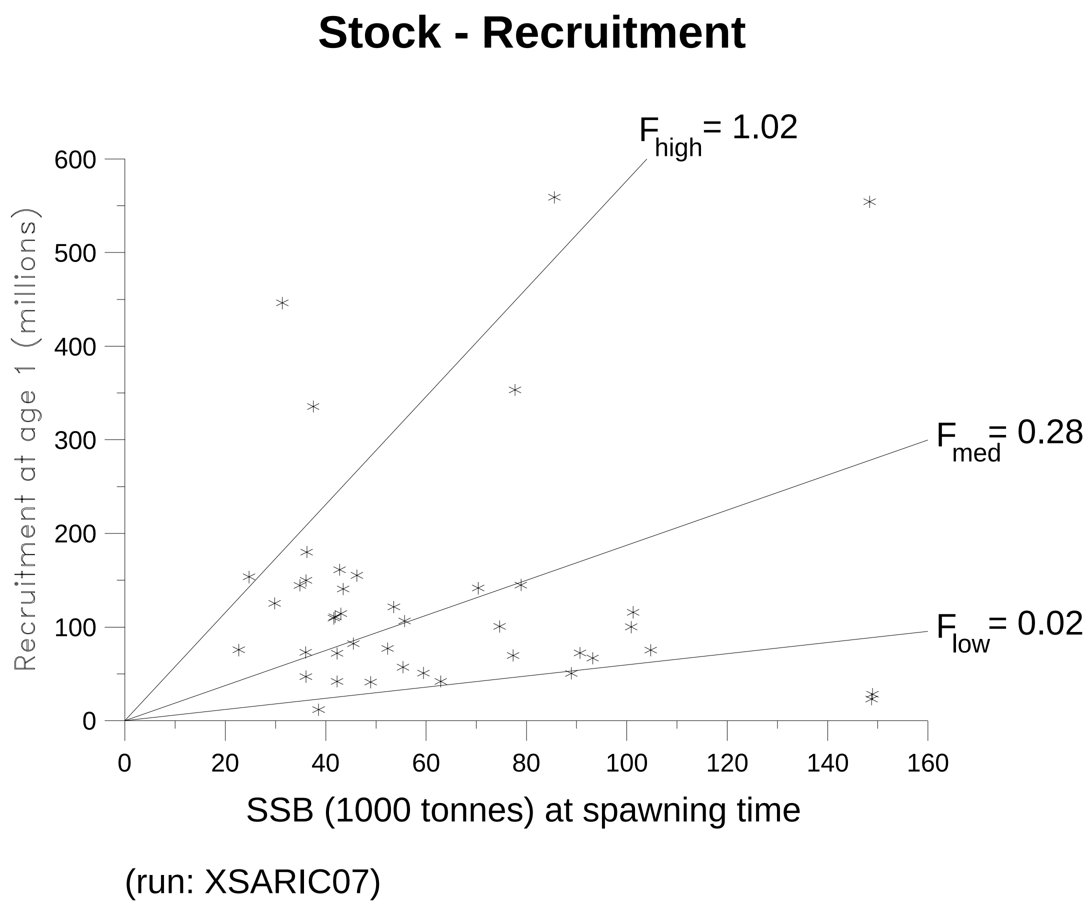


Figure 7.8 **Sole in Sub-area IV (North Sea)**

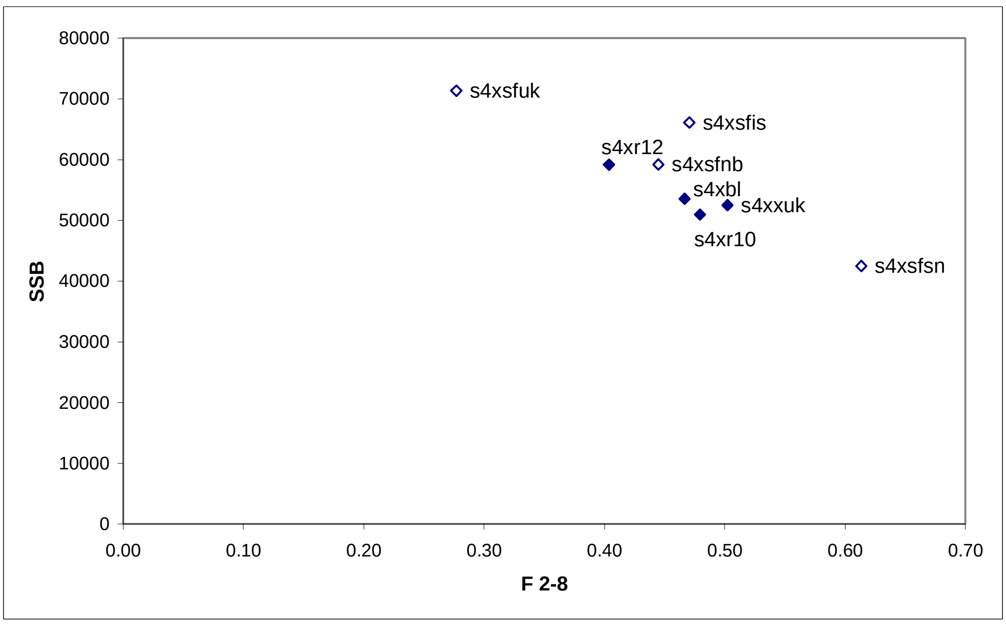


Figure 7.9 North Sea Sole
Summary of results of exploratory XSA runs

Advisory Committee on Fisheries Management **ICES CM 2001/ACFM:07**

REPORT OF THE

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

ICES Headquarters
3–12 October 2000

PART 2 OF 2

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

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PART 2

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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 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 and 2000

In 1999 ACFM considered the stock to be harvested outside safe biological limits. Although the SSB in 1999 was estimated to be above the proposed B_{pa}, the current level of fishing mortality in 1998 was probably higher than F_{pa} of 0.4. ACFM recommended that F be reduced to less than the proposed F_{pa} corresponding to landings in 2000 of 3900t.

8.1.2 Management applicable to 1999 and 2000

Minimum mesh size for trawling is 80 mm. Under the EU legislation, for fisheries targeting sole in NEACF Regions 1 and 2 with static gears, the minimum mesh size should be 100 mm. Derogation for fisheries targeting sole in ICES division VIId and IVc permit to use static gears with a minimum mesh size of 90 mm.

TAC's for 1999 and 2000 were 4700t and 4100t, respectively.

8.1.3 Landings in 1999

Landings data reported to ICES are shown in Table 8.1.1 together with the total landings estimated by the Working group. The unallocated landings are mainly due to the late reporting of data by some countries. Because of problems with the national database, the precise level of the 1999 French landings was uncertain. Therefore the Working Group used an estimate based on the 1998 ratio 'official reported landings/landings used by the Working Group'. 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 by beam trawlers fishing from adjacent areas. However, it has not been possible to quantify the level of these for inclusion in the assessment. The 1999 landings used by the Working Group were 4238t, which is 10% below the agreed TAC of 4700t and 3% above the catch predicted at *status quo* fishing mortality in 1999 (4100t).

Year	TAC	WG Landings
1998	5230	3694
1999	4700	4238
2000	4100	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. 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. In 1999 there was an age-reading problem in France. Therefore it was decided to use the English ALK to calculate French age compositions. Stock weights were calculated from a smoothed curve 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 8.2.1-8.2.3. Younger ages show an increase in mean weight, while older ages show a decrease.

No information on discarding is available, although this is thought to occur.

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. French 1999 data were not available (see section 1.3.1.4).

CPUE from the English beam trawl survey is shown in Table 8.3.2. In 1999 a large increase in CPUE for the 3+ fish was noticed as the strong 1996 year class recruited to the SSB. The CPUE for the 3+ fish decreases again in 2000 but remains above the CPUE of the previous years.

Effort increased from 1975 to reach a peak during 1988-90, followed by a decline in the early 1990's and a fluctuation around the same level until 1995. After an increase in 1996-97, the effort decreased again in 1998-1999.

8.4 Catch At Age Analysis

8.4.1 Data screening

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 same conclusions, based on similar results, can be drawn as last year. 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

Three commercial fleets, i.e. the Belgian Beam Trawl fleet (BELGIAN BT), the UK Beam Trawl fleet (UK BT), the French Otter Trawl fleet (FR OT) and three surveys, i.e. the UK Beam Trawl Survey (UK BTS), the UK Young Fish Survey (UK YFS), and the French Young Fish Survey (FR YFS), were available for the tuning.

Trends in catchability. Each fleet was initially run separately, with similar settings as the 1999 final XSA run, except over the full year range and no shrinkage was used. The log catchability residuals were plotted to examine trends across years (Figure 8.4.1.a). As last year, trends in residuals were evident in the Belgian and UK beam trawl fleets. Removing the years before 1986 reduced the trends. Trends in log catchability residuals for the final XSA are plotted in Figure 8.4.1b.

Time taper. No time taper was applied since the fleets had already been truncated to remove trends in catchability.

Variability at age. In an exploratory XSA run, using the same settings as in 1999, it was noticed that the estimate at age 10 for the Belgian Beam Trawl Fleet, had a negative slope and a low R^2. Therefore the age range for this fleet was set between 2 and 9.

No power model was used.

Estimation of q on older ages: As in the 1999 assessment, catchability was considered constant on ages >7.

8.4.3 Final XSA run

The input parameters for the final runs used in the 1999 and 2000 assessment are compared below:

	1999 assessment			2000 assessment		
Fleets	Years	Ages	α-β	Years	Ages	α-β
Belgian Beam Trawl (BELGIAN BT)	86-98	2-11+	0-1	86-99	2-9+	0-1
UK Beam Trawl (UK BT)	86-98	2-11+	0-1	86-99	2-11+	0-1
French Otter Trawl (FR OT)	91-98	3-11+	0-1	91-98	3-11+	0-1
UK Beam Trawl Survey (UK BTS)	86-98	1-6	0.5-0.75	86-99	1-6	0.5-0.75
UK Young Fish Survey (UK YFS)	86-98	1	0.5-0.75	86-99	1	0.5-0.75
French Young Fish Survey (FR YFS)	87-98	1	0.5-0.75	87-99	1	0.5-0.75
-First tuning year	1986			1986		
-Last data year	1998			1999		
Time series weights	None			None		
-Catchability dependent on stock size for age <	1			1		
-Catchability independent of age for ages >=	7			7		
-Survivors estimates shrunk towards mean F	4 years / 4 ages			4 years / 4 ages		
-s.e. of the means	0.5			0.5		
-Min s.e. for pop. estimates	0.3			0.3		
-Prior weighting	None			None		

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 8.4.1c. Fishing mortality and stock number at age are presented in Table 8.4.2 and 8.4.3. Fishing mortality at age predicted by the different fleets is shown in Figure 8.4.2. The FR YFS gives high fishing mortalities for age 3 and 7 compared with the other fleets, but low weights are given to the FR YFS estimates at these ages.

A retrospective analysis using F shrinkage (s.e. 0.5) was taken over the full year range. Results are shown in Figure 8.4.3. The retrospective pattern is similar to the pattern in 1999. There is no tendency to over- or underestimate SSB and fishing mortality.

We can conclude that the results of the final XSA are very similar to the 1999 final XSA.

8.5 Recruitment Estimates

Recruit indices were available for 1 and 2-gp sole from the English 4m 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 8.5.1). Since 2000, the area covered by English inshore survey index (EYFS) has changed to reflect the distribution of plaice and sole more effectively. As a result, the full time series of the index has been revised. The input file to RCT3 is given in Table 8.5.1 and the output in Tables 8.5.2a,b,c.

1997 year class at age 3 in 2000: This was estimated at 21.7 million in XSA (ranges between 11.2 and 26.9 million) based on survey and commercial fleet estimates receiving 74% of the weight. However, there are no indications that this year class is above average (GM 82-97 15.8 million). Therefore the RCT3 estimate of 15 million was chosen. In the 1999 assessment, the 1997 year class was estimated at 11.1 million by XSA and 18.9 million by RCT3.

1998 year class at age 2 in 2000: The 1998 year class was estimated at 26.3 million by XSA and 35.4 million by RCT3. The survey estimates in RCT3 received 60% weighting. Since no power model was used in XSA and there is variable information on catch at age 1 together with high F shrinkage and indications that the 1998 year class is above the mean (GM 82-97 20.1 million), the RCT3 value of 35.4 million was accepted.

1999 year class at age 1 in 2000: Three survey estimates were available, including the English beam trawl survey covering the whole of VIId. 37% and 58% of the weight on the final RCT3 estimate were given to the English beam trawl survey and the VPA mean, respectively. Given the weak regression values and no indications of an above mean year class, it was decided to use the GM 82-97 (23.4 million) as an estimate for this year class.

The table below gives an overview of the estimates for year classes 1997-1999 obtained by the different methods.

Year class	At age in 2000	XSA	GM 82-97	RCT3	Accepted Estimate
1997	3	21706	15817	15012	RCT3
1998	2	26326	20133	35360	RCT3
1999	1	-	23362	31962	GM 1982-97
2000 & 2001	recruits	-	-	-	GM 1982-97

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 followed by a slight increase in 1999 in line with 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 4 and older, from RCT3 for age 2 and age 3, and from the GM for age 1 and the recruits in 2000 and 2001. An exploitation pattern for the period 1997-99 scaled to Fbar (3-8) in 1999 was used ($F_{3\text{-}8} = 0.43$). The rescaled F values are presented in Table 8.4.2. Catch and stock weights at age were the mean for the period 1997-99, 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 2000 are estimated to be 4693 t compared with a TAC of 4100 t. The predicted *status quo* landings in 2001 are estimated to be 4994 t. Spawning stock biomass is forecast to increase slightly from 11283 t in 2000 to 11436 t in 2002.

Table 8.7.4 shows the contribution of different year classes to the landings in 2000 and SSB in 2001 under *status quo* assumptions. The 1998 year class contributes about 38% to the landings in 2001, and the 1996 and 1997 year classes about 15%. SSB in 2002 mainly consists of the 1998 and 1999 year classes, 30% and 26% respectively.

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

This year's assessment, as mentioned before, is very similar with the 1999 assessment. Therefore, no medium-term prediction has been carried out and the medium-term prediction for 1999 is still considered to be representative for 2000.

8.9 Biological Reference Points

The input data for the yield per recruit analysis are given in Table 8.9.1. Mean weights were the recent three year average (1997-1999). 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 $F_{3\text{-}8}$ (0.43) is close to Fmed (0.44) and well above Fmax (0.28).

The precautionary reference points were not reviewed again in this assessment. The biological reference points proposed by ACFM are shown below together with a range of points calculated from the recent assessment:

F99	Fpa	Flim	Fmed	F0.1	Fmax	Bpa
0.43	0.4	0.55	0.44	0.12	0.28	8,000 t

8.10 Comments on the Assessment

Quality of landing statistics and catch at age data has been further deteriorated and this will lead to uncertainty in estimates of fishing mortality, particularly in the final year.

The main uncertainty in the current assessment is the absence of French tuning data for 1999 and the use of an English ALK to calculate French length compositions. In addition the precise level of French landings is not certain because of problems with the national database.

Under-reporting by important segments of the inshore fleet remains a problem, since this fleet takes a major part of the landings of sole in VIId.

Poor quality of data at the youngest ages (because of a low sampling level) led to inconsistent results at these ages.

The 2000 assessment was consistent with the 1999 assessment.

Table 8.1.1 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 *	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	3850
1988	667	2057	578	.	3302	680	3982	3850
1989	646	1610	689	.	2945	1242	4187	3850
1990	996	1255	742	.	2993	1067	4060	3850
1991	904	2054	825	.	3783	599	4382	3850
1992	891	2187	706	10	3794	348	4142	3500
1993	917	1907	610	13	3447	1064	4511	3200
1994	940	2001	701	15	3657	984	4641	3800
1995	817	2248	669	9	3743	759	4502	3800
1996	899	2335	877	.	4111	914	5025	3500
1997	1306	1609	933	.	3848	1135	4983	5230
1998	541	1703	803	.	3047	647	3694	5230
1999	880	2261**	769	.	3910	328	4238	4700

* Unallocated mainly due to late reporting by some countries;
also includes minor unreported landings estimated by the WG

** Estimate by the working group

Table 8.2.1 Sole in VIId. Catch Numbers at age (Numbers*10-3)**

YEAR	1982	1983	1984	1985	1986	1987	1988	1989
AGE								
1	155	0	24	49	49	9	95	163
2	2625	852	1977	3693	1264	3284	2227	3704
3	5256	3452	3157	5211	5377	3827	7393	3424
4	1727	3930	2610	1646	3273	3417	1648	4842
5	570	897	1900	1027	925	2166	1219	1530
6	653	735	742	1860	790	1064	910	943
7	549	627	457	144	1087	1110	400	651
8	240	333	317	158	156	828	268	218
9	122	108	136	156	192	114	280	181
10	83	89	99	69	216	163	84	270
+gp	202	193	238	128	381	469	284	329
TOTALNUM	12182	11216	11657	14141	13710	16451	14808	16255
TONSLAND	3190	3458	3575	3837	4024	4974	3982	4187
SOPCOF %	97	99	99	100	100	100	100	100

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	1271	383	106	85	34	683	11	30	41	182
2	3092	7381	4082	5225	783	2974	2055	1740	1814	3512
3	6326	3796	8967	6716	6660	4558	7934	6444	5929	9126
4	1257	4316	1886	5735	6152	5003	3081	5228	2890	3543
5	1654	585	2065	1057	3514	3090	3381	2157	1760	1406
6	329	1003	295	645	613	2052	1896	1840	651	945
7	432	256	382	171	613	394	1332	992	654	379
8	293	257	140	206	112	310	288	841	494	731
9	138	272	184	123	154	95	351	255	394	379
10	139	95	98	67	94	111	112	199	251	209
+gp	556	395	237	145	278	247	375	298	354	389
TOTALNUM	15487	18739	18442	20175	19007	19517	20816	20024	15232	20801
TONSLAND	4060	4382	4142	4511	4643	4583	5025	4983	3694	4238
SOPCOF %	99	100	100	100	100	100	100	98	100	93

Table 8.2.2 Sole in VIId.   Catch Weights at age (kg)

YEAR	1982	1983	1984	1985	1986	1987	1988	1989
AGE								
1	0.102	0.000	0.100	0.090	0.135	0.095	0.102	0.106
2	0.171	0.173	0.178	0.182	0.179	0.176	0.152	0.156
3	0.225	0.230	0.234	0.230	0.212	0.236	0.226	0.193
4	0.312	0.302	0.314	0.281	0.306	0.295	0.278	0.274
5	0.386	0.404	0.380	0.368	0.362	0.353	0.358	0.295
6	0.428	0.436	0.436	0.394	0.385	0.407	0.407	0.357
7	0.439	0.435	0.417	0.516	0.435	0.412	0.458	0.391
8	0.509	0.524	0.538	0.543	0.519	0.479	0.509	0.469
9	0.502	0.537	0.529	0.594	0.501	0.463	0.551	0.516
10	0.463	0.583	0.565	0.595	0.524	0.538	0.559	0.538
+gp	0.673	0.628	0.714	0.801	0.603	0.619	0.666	0.705
SOPCOFAC	0.971	0.991	0.988	0.998	1.004	1.000	0.997	0.997

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.121	0.114	0.103	0.085	0.099	0.127	0.142	0.139	0.133	0.133
2	0.180	0.161	0.153	0.148	0.151	0.174	0.167	0.155	0.160	0.153
3	0.240	0.211	0.202	0.197	0.188	0.180	0.179	0.189	0.174	0.193
4	0.291	0.267	0.267	0.245	0.236	0.233	0.230	0.233	0.236	0.219
5	0.351	0.349	0.291	0.331	0.290	0.257	0.272	0.291	0.285	0.264
6	0.343	0.390	0.399	0.374	0.354	0.332	0.323	0.341	0.341	0.285
7	0.469	0.415	0.386	0.528	0.380	0.356	0.360	0.385	0.379	0.295
8	0.463	0.426	0.455	0.540	0.505	0.380	0.403	0.401	0.412	0.347
9	0.489	0.433	0.445	0.505	0.492	0.480	0.436	0.495	0.480	0.363
10	0.519	0.477	0.461	0.742	0.496	0.490	0.461	0.469	0.432	0.379
+gp	0.567	0.559	0.558	0.647	0.616	0.642	0.585	0.643	0.604	0.545
SOPCOFAC	0.995	1.000	1.001	1.001	1.000	1.000	1.000	0.978	1.000	0.935

Table 8.2.3 Sole in VIId. Stock Weights at Age (kg)

YEAR	1982	1983	1984	1985	1986	1987	1988	1989
AGE								
1	0.059	0.070	0.067	0.065	0.070	0.072	0.073	0.060
2	0.114	0.135	0.131	0.129	0.136	0.139	0.141	0.119
3	0.167	0.197	0.192	0.192	0.198	0.203	0.206	0.175
4	0.217	0.255	0.249	0.254	0.256	0.262	0.267	0.230
5	0.263	0.309	0.304	0.315	0.309	0.318	0.324	0.283
6	0.306	0.359	0.355	0.376	0.358	0.370	0.377	0.335
7	0.347	0.406	0.403	0.436	0.403	0.417	0.426	0.385
8	0.384	0.448	0.448	0.495	0.443	0.461	0.471	0.433
9	0.418	0.487	0.490	0.554	0.480	0.500	0.512	0.479
10	0.450	0.522	0.529	0.611	0.512	0.536	0.549	0.523
+gp	0.530	0.601	0.627	0.780	0.576	0.616	0.630	0.675

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.070	0.061	0.084	0.067	0.068	0.097	0.103	0.060	0.121	0.153
2	0.135	0.119	0.132	0.087	0.118	0.134	0.139	0.106	0.149	0.164
3	0.196	0.175	0.178	0.161	0.165	0.172	0.175	0.154	0.179	0.179
4	0.253	0.228	0.223	0.230	0.211	0.210	0.212	0.203	0.211	0.198
5	0.305	0.278	0.267	0.293	0.254	0.248	0.248	0.253	0.246	0.221
6	0.353	0.326	0.309	0.352	0.296	0.287	0.284	0.305	0.282	0.248
7	0.396	0.371	0.349	0.405	0.335	0.326	0.320	0.358	0.321	0.279
8	0.435	0.413	0.388	0.454	0.372	0.366	0.357	0.413	0.362	0.314
9	0.470	0.453	0.425	0.497	0.407	0.406	0.393	0.469	0.405	0.353
10	0.500	0.490	0.461	0.535	0.440	0.446	0.429	0.526	0.450	0.396
+gp	0.550	0.576	0.546	0.610	0.532	0.575	0.534	0.699	0.585	0.534

Table 8.3.1 Sole in VIId

	Catch per unit effort					Effort			
	Belgium	UK		France*		Belgium	UK		France*
Year	Beam trawl	Trammel	Beam trawl	Trawl	Year	Beam trawl	Trammel	Beam trawl	Trawl
	(kg/10hr)	(kg/day)	(kg/hr)	(kg/h*kw*10-4)		('000 hr)	(days at sea)	('000 hr)	(h*kw*10-4)
	HP corr		GRT corr			HP corr			
1972			15.2						
1973			12.1						
1974			11.6						
1975	24.1		11.5		1975	5.0			
1976	27.3		10.5		1976	6.6			
1977	30.0		11.0		1977	6.9			
1978	26.3		9.1		1978	8.2			
1979	37.4		8.3		1979	7.3			
1980	23.3		15.2		1980	12.8		2.7	
1981	24.5		13.7		1981	19.0		2.3	
1982	23.6		11.2		1982	23.9		4.2	
1983	22.4		21.4		1983	23.6		2.7	
1984	21.6		13.3		1984	28.0		2.9	
1985	22.9	33.8	12.8		1985	25.3	6243	9.1	
1986	33.5	38.9	10.9		1986	23.5	5863	12.9	
1987	36.6	31.6	11.0		1987	27.1	7192	24.3	
1988	15.9	33.8	11.3		1988	38.5	6943	19.0	
1989	16.8	28.2	10.6		1989	35.7	8380	33.3	
1990	25.9	20.2	11.9		1990	30.3	13541	33.4	
1991	22.6	31.8	8.1	18.5	1991	24.3	12188	30.4	10689
1992	29.1	30.1	8.0	18.1	1992	22.0	8547	37.1	10519
1993	34.8	18.7	8.4	21.6	1993	20.0	9062	29.3	10217
1994	27.9	21.1	9.2	17.8	1994	25.2	10756	28.1	10609
1995	24.7	21.8	9.0	18.5	1995	24.2	10571	28.6	12384
1996	29.8	31.2	10.3	19.8	1996	25.0	8531	39.1	14088
1997	32.6	32.8	9.9	14.4	1997	30.9	10066	39.6	10921
1998	23.5	21.1	11.1	17.3	1998	18.1	10307	33.5	11707
1999	26.4	26.4	12.0	-	1999	21.4	7862	27.2	-

*no data available for France in 1999

Table 8.3.2 Sole in 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	28.1	9.4	13.2	2.5	1.7	1.3	0.2	0.9	1.1	0.5	58.9	21.3
2000	10.5	22.0	4.1	4.2	1.0	0.6	0.3	0.0	0.2	1.2	44.3	11.8
mean	7.8	11.9	5.4	2.1	1.1	0.6	0.4	0.3	0.2	0.4	31.0	10.8

Table 8.4.1.a Sole in VIId. Separable Analysis

Title : Sole in VIId

Separable analysis
from 1982 to 1999 on ages 1 to 15
with Terminal F of .450 on age 3 and Terminal S of .500

Initial sum of squared residuals was 547.853 and
final sum of squared residuals is 93.586 after 150 iterations

Matrix of Residuals

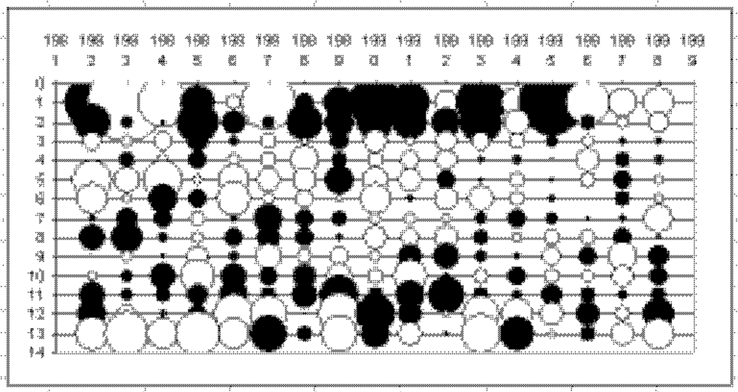
Years	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	TOT	WTS
Ages																			
1/ 2	2.106	-4.012	-1.574	0.916	-0.130	-2.043	0.288	0.768	1.916	1.190	-0.329	1.731	-0.647	2.956	-1.229	-0.474	-0.596	0.011	0.107
2/ 3	1.058	0.123	0.033	1.268	0.388	0.123	0.972	0.632	0.950	0.884	0.632	1.259	-0.336	0.577	0.173	-0.093	-0.259	0.011	0.350
3/ 4	-0.190	-0.107	-0.194	0.341	0.032	-0.159	-0.029	0.273	-0.341	-0.075	-0.232	-0.164	-0.143	0.160	-0.116	0.074	0.045	0.009	1.000
4/ 5	0.001	0.175	-0.088	0.288	-0.098	-0.135	-0.534	0.186	-0.123	-0.210	-0.279	0.043	0.085	-0.015	-0.340	0.192	0.083	0.006	0.860
5/ 6	-0.957	-0.403	-1.048	-0.072	-0.664	-0.309	-0.373	0.633	-0.412	-0.304	0.244	0.034	-0.124	0.037	-0.119	0.266	-0.058	0.008	0.434
6/ 7	-0.598	-0.048	0.638	0.265	-0.767	-0.092	-0.206	-0.025	-0.573	0.058	-0.320	-0.413	-0.165	0.045	0.002	0.181	-0.066	-0.006	0.538
7/ 8	0.068	0.368	0.271	-0.149	0.068	0.556	0.236	0.321	-0.082	-0.099	-0.047	0.155	0.275	0.132	0.030	0.060	-0.508	-0.009	0.758
8/ 9	0.536	0.752	0.090	-0.056	0.286	0.430	0.246	0.058	-0.351	-0.195	-0.367	0.188	-0.074	-0.137	-0.134	0.295	0.040	-0.008	0.601
9/10	0.014	-0.094	0.020	-0.364	0.101	-0.364	-0.146	-0.171	-0.039	0.453	0.474	0.126	0.049	-0.216	0.275	-0.466	0.371	-0.007	0.666
10/11	-0.073	0.120	0.475	-0.720	0.543	0.276	0.454	-0.466	-0.165	-0.689	0.073	-0.149	0.248	-0.138	-0.104	-0.238	0.232	-0.002	0.430
11/12	0.478	0.165	0.167	-0.243	0.574	-0.164	0.521	-0.976	0.202	0.639	1.045	0.195	-0.065	-0.294	0.306	-0.049	0.204	0.004	0.409
12/13	0.659	-0.176	0.069	0.241	-1.049	-0.841	0.006	-1.158	1.113	0.406	-0.038	-0.856	-0.620	-0.344	0.414	-0.152	0.712	0.008	0.281
13/14	-0.713	-1.244	-0.610	-1.330	-0.648	0.956	0.217	-0.918	0.675	-0.319	0.023	-0.873	0.806	-0.819	0.192	-0.927	-0.638	0.011	0.266
14/15	-0.507	0.322	0.249	-0.407	0.623	0.239	-0.925	0.276	0.592	-0.340	-0.408	-0.197	0.231	-0.693	0.519	-0.006	-0.041	0.011	0.400
TOT	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.002	0.001	0.476	
WTS	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1982	1983	1984	1985	1986	1987	1988	1989		
F-values	0.3955	0.4025	0.4666	0.3330	0.4877	0.5626	0.4828	0.5747		
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
F-values	0.5368	0.4808	0.3730	0.2938	0.3436	0.3632	0.4712	0.4958	0.4212	0.4606

Selection-at-age (S)

	1	2	3	4	5					
S-values	0.0038	0.1930	1.0000	0.9971	0.8090					
	6	7	8	9	10	11	12	13	14	15
S-values	0.5748	0.4010	0.3269	0.3100	0.2802	0.2106	0.2378	0.1518	0.1130	0.5000



8.4.1.b Sole in VIId. Tuning Fleets for Final XSA.

SOLE 7d,TUNING
106 1
BELGIAN BT
1980 1999
1 1 0 1
2 9

12.8	69.3	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
19.0	640.7	161.4	82.1	312.8	229.6	44.7	32.9	33.1	6.9	9.0	18.4	9.3	0.8	51.9
23.9	148.7	980.9	128.0	93.4	155.9	112.6	38.8	60.1	15.2	14.0	7.4	12.5	5.9	54.3
23.6	190.4	373.0	818.9	65.5	54.0	81.7	73.2	23.5	20.2	27.0	5.0	1.0	7.1	33.0
28.0	603.8	347.2	311.2	436.0	53.7	38.5	104.9	59.9	25.4	23.2	25.3	9.0	8.2	42.4
25.3	382.9	612.1	213.0	209.1	260.2	58.2	34.1	48.0	31.0	16.9	19.6	9.2	7.7	21.3
23.4	215.0	1522.3	675.0	233.7	170.6	194.0	30.1	53.1	64.2	32.6	12.7	2.6	43.0	29.3
27.1	843.6	451.0	739.3	724.4	344.5	232.4	152.7	25.3	86.5	56.0	56.1	54.5	9.3	109.0
38.5	131.6	990.4	243.3	362.9	216.7	111.8	41.8	73.8	47.0	9.8	22.3	35.8	8.6	25.3
35.7	47.5	512.6	543.6	748.0	276.6	225.0	53.1	36.4	12.7	4.7	0.0	0.0	4.7	27.0
30.3	1011.4	1375.2	218.1	366.2	85.3	198.2	65.5	39.0	22.4	22.2	25.4	2.8	24.0	18.2
24.3	320.2	1358.6	710.1	125.6	283.9	60.6	56.2	21.0	19.8	22.2	18.0	5.6	0.3	21.4
22.0	499.3	1613.7	523.3	477.7	36.9	67.9	28.2	31.7	11.2	11.4	6.0	5.7	3.2	16.7
20.0	1654.5	1520.4	889.5	215.5	78.5	38.9	40.8	37.8	11.3	8.7	13.3	1.5	3.0	22.4
22.2	196.9	1183.2	1598.5	912.9	201.0	160.0	39.5	33.8	46.2	16.0	10.2	14.9	8.8	18.6
24.2	206.2	542.7	671.3	590.9	409.4	100.6	40.3	25.4	14.2	9.3	5.0	11.9	3.4	8.0
25.0	284.1	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	196.0	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	254.1	450.3	375.4	175.1	54.8	116.1	95.9	59.1	12.4	16.0	7.7	2.9	4.4	19.2
21.4	367.7	1043.6	640.2	308.3	94.6	48.7	90.6	68.3	28.2	44.7	22.9	4.7	8.5	11.3

UK BT
1981 1999
1 1 0 1
2 15

2.3	41.5	31.2	6.7	25.7	8.5	1.9	2.3	1.6	0.3	0.4	0.8	0.1	0.0	2.8
4.2	17.2	137.2	10.1	3.3	14.1	1.8	1.8	1.9	4.5	1.1	0.0	0.1	0.1	2.3
2.7	18.5	38.4	118.6	2.0	2.8	6.9	4.4	0.3	0.0	0.0	0.0	0.0	1.7	1.3
2.9	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
9.1	12.8	295.0	43.8	21.9	79.8	0.3	0.1	4.9	0.0	0.1	0.5	1.8	0.5	0.5
12.9	38.4	185.4	128.7	35.9	36.9	50.5	1.5	3.1	6.7	3.3	3.6	2.0	2.2	6.8
24.3	362.0	152.3	206.4	142.6	26.8	21.0	54.1	2.1	0.6	4.8	1.5	2.2	4.7	3.5
19.0	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	0.3
33.3	310.0	186.9	369.7	44.0	81.7	60.5	12.7	10.8	42.6	2.5	1.1	5.0	6.8	34.5
33.4	199.8	662.3	97.2	146.7	29.1	34.2	34.7	8.7	15.0	48.6	4.1	1.1	6.8	17.7
30.4	488.9	200.3	287.8	12.3	45.9	7.5	11.0	16.3	4.1	2.7	12.7	0.4	0.0	7.4
37.1	332.3	684.6	105.6	215.2	15.0	26.1	8.2	19.0	6.6	3.0	1.9	4.2	0.1	3.3
29.3	272.1	358.5	357.3	56.9	86.8	8.6	17.7	7.4	5.0	5.5	1.9	2.1	3.5	4.6
28.1	49.6	394.0	217.4	170.0	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	446.0	376.0	118.1	251.3	127.7	101.8	26.3	50.5	6.3	13.5	6.3	8.0	5.4	18.2
39.6	427.3	504.4	239.9	64.2	180.2	75.3	71.0	16.6	33.1	4.0	10.4	1.7	5.4	12.1
33.5	527.5	337.9	185.8	125.1	41.7	94.1	54.3	43.0	10.8	22.9	4.0	10.2	2.8	17.5
27.2	350.3	613.7	214.2	87.8	64.8	25.3	54.0	26.7	14.8	7.1	7.7	1.4	5.1	8.5

FR OT*
1991 1998
1 1 0 1
3 15

10689	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	528.1	57.4	43.0	10.5	13.5	5.3	4.5	3.2	3.9	1.7	1.3	0.5	2.1

Table 8.4.1b (Continued)

UK BTS

1988	1999					
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	12.0	10.0	0.7	1.1	0.3
1	0.5	17.5	8.4	7.0	0.8	1.0
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	19.0	7.3	3.2	1.3	0.3	0.5
1	2.0	21.2	2.5	1.0	0.9	0.1
1	28.1	9.4	13.2	2.5	1.7	1.3

UK YFS**

1985	1999		
1	1	0.5	0.75
1	1		
1	1.7		
1	1.3		
1	1.4		
1	1.9		
1	0.5		
1	2.5		
1	4.9		
1	1.9		
1	1.8		
1	3.4		
1	3.7		
1	0.8		
1	1.3		
1	1.8		
1	1.3		

FR YFS

1987	1999		
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	0.70		
1	0.28		
1	0.15		
1	0.03		
1	0.10		
1	0.35		

* No data available for the French Otter Trawl Fleet in 1999

** Revised, some areas previously sampled are being omitted, therefore the index has been recalculated

Table 8.4.1c Sole in VIId. Tuning diagnostics.

Lowestoft VPA Version 3.1

7/10/2000 14:56

Extended Survivors Analysis

Sole in VIId (run: XSAWD105/X05)

CPUE data from file fleet

Catch data for 18 years. 1982 to 1999. Ages 1 to 11.

Fleet	Fi year	Last year	First age	Last age	Alpha	Beta
FLT07: BELGIAN BT (C	1986	1999	2	9	0	1
FLT12: FR YFS (Catch	1987	1999	1	1	0.5	0.75
FLT11: UK YFS (Catch	1986	1999	1	1	0.5	0.75
FLT10: UK BTS (Catch	1988	1999	1	6	0.5	0.75
FLT08: UK BT (Catch:	1986	1999	2	10	0	1
FLT09: FR OT (Catch:	1991	1999	3	10	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 >= 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 had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00206

Final year F values

Age	1	2	3	4	5	6	7	8	9	10
Iteration 29	0.0066	0.1432	0.4318	0.4499	0.3646	0.3866	0.4645	0.4667	0.3212	0.2171
Iteration 30	0.0066	0.1432	0.4317	0.4498	0.3644	0.3864	0.4641	0.4662	0.3208	0.2167

Regression weights

	1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.029	0.011	0.003	0.005	0.001	0.032	0	0.001	0.001	0.007
2	0.233	0.21	0.14	0.187	0.053	0.127	0.115	0.09	0.061	0.143
3	0.441	0.439	0.376	0.318	0.342	0.432	0.511	0.549	0.437	0.432
4	0.486	0.542	0.36	0.389	0.476	0.413	0.516	0.664	0.45	0.45
5	0.469	0.388	0.478	0.313	0.389	0.413	0.481	0.741	0.432	0.364
6	0.279	0.512	0.307	0.238	0.269	0.367	0.427	0.464	0.456	0.386
7	0.362	0.324	0.331	0.262	0.332	0.247	0.383	0.368	0.264	0.464
8	0.298	0.339	0.263	0.266	0.244	0.248	0.257	0.393	0.28	0.466
9	0.387	0.439	0.384	0.345	0.29	0.3	0.434	0.338	0.287	0.321
10	0.43	0.446	0.248	0.209	0.427	0.312	0.607	0.417	0.574	0.217

Table 8.4.1c Continued

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9	10
1990	4.67E+04	1.57E+04	1.86E+04	3.43E+03	4.65E+03	1.42E+03	1.49E+03	1.20E+03	4.52E+02	4.18E+02
1991	3.68E+04	4.10E+04	1.12E+04	1.08E+04	1.91E+03	2.63E+03	9.73E+02	9.41E+02	8.04E+02	2.78E+02
1992	3.57E+04	3.29E+04	3.01E+04	6.55E+03	5.71E+03	1.17E+03	1.43E+03	6.37E+02	6.07E+02	4.69E+02
1993	1.77E+04	3.22E+04	2.59E+04	1.87E+04	4.13E+03	3.20E+03	7.81E+02	9.27E+02	4.43E+02	3.74E+02
1994	2.90E+04	1.59E+04	2.42E+04	1.71E+04	1.15E+04	2.73E+03	2.28E+03	5.44E+02	6.43E+02	2.84E+02
1995	2.27E+04	2.62E+04	1.37E+04	1.56E+04	9.59E+03	7.03E+03	1.69E+03	1.48E+03	3.86E+02	4.36E+02
1996	2.35E+04	1.99E+04	2.09E+04	8.03E+03	9.32E+03	5.74E+03	4.41E+03	1.34E+03	1.06E+03	2.59E+02
1997	3.56E+04	2.13E+04	1.60E+04	1.13E+04	4.33E+03	5.21E+03	3.39E+03	2.72E+03	9.36E+02	6.14E+02
1998	3.06E+04	3.21E+04	1.76E+04	8.39E+03	5.28E+03	1.87E+03	2.97E+03	2.12E+03	1.66E+03	6.04E+02
1999	2.93E+04	2.77E+04	2.74E+04	1.03E+04	4.84E+03	3.10E+03	1.07E+03	2.06E+03	1.45E+03	1.13E+03

Estimated population abundance at 1st Jan 2000

0.00E+00	2.63E+04	2.17E+04	1.61E+04	5.94E+03	3.04E+03	1.91E+03	6.11E+02	1.17E+03	9.54E+02

Taper weighted geometric mean of the VPA populations:

2.40E+04	2.10E+04	1.64E+04	8.92E+03	4.87E+03	2.92E+03	1.76E+03	1.11E+03	6.81E+02	4.10E+02

Standard error of the weighted Log(VPA populations) :

0.3861	0.386	0.3895	0.4535	0.4705	0.4963	0.5218	0.5035	0.4859	0.4861

Log catchability residuals.

Fleet : FLT07: BELGIAN BT (C

Age	1986	1987	1988	1989
1	No data for this fleet at this age			
2	0.32	0.86	-0.45	-2.28
3	0.69	-0.24	-0.47	-0.05
4	0.13	0.31	-0.77	-0.43
5	-0.19	0.44	-0.34	0.89
6	-0.09	0.91	-0.27	0.29
7	-0.21	0.5	-0.1	0.18
8	-0.12	-0.1	-0.93	-0.27
9	0.45	0.05	-0.73	-0.56
10	No data for this fleet at this age			

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	1.42	-0.49	0.24	1.58	-0.01	-0.51	0.04	-0.62	-0.25	0.14
3	0.08	0.79	0.05	0.21	-0.07	-0.32	-0.15	0.19	-0.47	-0.24
4	-0.18	0.09	0.31	-0.1	0.51	-0.38	0.23	0.17	-0.03	0.13
5	-0.15	-0.15	0.24	-0.22	0.14	-0.19	-0.22	0.33	-0.51	-0.06
6	-0.19	0.72	-0.51	-0.69	0.32	0.04	0.1	0.17	-0.31	-0.47
7	0.49	-0.07	-0.23	-0.12	0.15	-0.26	0.08	0.07	-0.26	-0.19
8	-0.43	-0.1	-0.34	-0.25	0.14	-0.93	-0.32	-0.43	-0.11	-0.22
9	0.07	-0.88	-0.12	0.45	-0.16	-0.02	0.13	-0.33	-0.35	-0.22
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	-7.4066	-5.8384	-5.7073	-5.5329	-5.8474	-5.6955	-5.6955	-5.6955
S.E(Log q)	0.9521	0.381	0.3464	0.3685	0.4591	0.2557	0.4436	0.4262

Table 8.4.1c 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
2	1.12	-0.155	7.1	0.12	14	1.11	-7.41
3	1.17	-0.538	5.18	0.46	14	0.46	-5.84
4	0.84	0.914	6.27	0.72	14	0.29	-5.71
5	1.08	-0.342	5.28	0.58	14	0.41	-5.53
6	0.86	0.643	6.16	0.62	14	0.4	-5.85
7	0.94	0.44	5.8	0.83	14	0.25	-5.7
8	1.11	-0.652	5.89	0.74	14	0.34	-6.01
9	1.68	-2.129	5.36	0.45	14	0.59	-5.85

Fleet : FLT12: FR YFS (Catch

Age	1986	1987	1988	1989
1	99.99	-0.05	-0.01	0.24
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	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.62	0.5	-0.02	-1.31	1.34	0.69	0.01	-2.01	-0.66
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 q	-11.9109
S.E(Log q)	0.8942

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	0.82	0.302	11.6	0.21	13	0.77	-11.91

Table 8.4.1c Continued

Fleet : FLT11: UK YFS (Catch

Age	1986	1987	1988	1989
1	-0.32	0.6	0.06	-0.83
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	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.19	0.71	-0.21	0.44	0.58	0.92	-0.66	-0.59	-0.11	-0.39
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 q	-9.564
S.E(Log q)	0.5597

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	1.43	-0.691	9.3	0.17	14	0.82	-9.56

Fleet : FLT10: UK BTS (Catch

Age	1986	1987	1988	1989
1	99.99	99.99	0.61	-0.1
2	99.99	99.99	1.19	0.37
3	99.99	99.99	0.74	0.71
4	99.99	99.99	-0.12	0.14
5	99.99	99.99	0.49	0.21
6	99.99	99.99	0.21	-0.63
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	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.47	0.39	-1.44	-1.76	-0.02	-0.05	-0.1	1.18	-0.95	1.77
2	-0.57	0.27	-0.19	0.24	-0.84	-0.09	-0.19	-0.28	0.35	-0.26
3	-0.35	-0.28	0.21	0.14	0.22	-0.87	-0.31	-0.2	-0.63	0.61
4	0.22	0.3	-0.5	0.77	0.16	-0.15	-0.61	-0.24	-0.35	0.38
5	-0.03	-0.17	0.09	-0.01	0.43	-0.38	-0.23	-0.96	-0.05	0.62
6	-0.13	0.31	0.48	0.64	-0.79	0.03	0.07	-0.4	-0.81	1.03
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 Continued

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	-8.6477	-7.5756	-7.9187	-8.3543	-8.2819	-8.4997
S.E(Log q)	1.0148	0.528	0.5248	0.3994	0.4275	0.5803

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	0.46	1.152	9.51	0.31	12	0.46	-8.65
2	1.07	-0.144	7.41	0.32	12	0.59	-7.58
3	0.88	0.329	8.14	0.43	12	0.48	-7.92
4	0.78	1.187	8.53	0.74	12	0.31	-8.35
5	0.97	0.11	8.29	0.59	12	0.44	-8.28
6	0.98	0.07	8.49	0.47	12	0.59	-8.5

Fleet : FLT08: UK BT (Catch:

Age	1986	1987	1988	1989
1	No data for this fleet at this age			
2	-0.44	0.49	0.71	0.03
3	0.39	-0.01	0.54	0.22
4	0.35	0.44	0.13	0.54
5	0.13	0.52	0.61	-0.28
6	0.2	-0.3	0.41	0.37
7	0.52	-0.31	-0.03	0.43
8	-1.04	0.46	0.41	-0.14
9	-0.31	-0.84	0.41	-0.21
10	0.11	-1.9	0.22	0.74

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	0.06	0.08	-0.32	-0.24	-1.26	-0.21	0.41	0.27	0.23	0.21
3	0.46	-0.14	-0.12	-0.41	-0.19	-0.66	-0.34	0.22	-0.16	0.2
4	0.2	0.26	-0.53	-0.11	-0.43	-0.09	-0.6	-0.18	-0.06	0.08
5	0.43	-1.1	0.51	-0.34	-0.19	-0.2	0.12	-0.37	0.13	0.04
6	-0.13	-0.09	-0.7	0.26	-0.26	-0.08	-0.14	0.3	0.03	0.14
7	0.12	-0.89	-0.22	-0.53	0.55	-0.35	-0.02	-0.08	0.4	0.4
8	0.33	-0.47	-0.61	0.02	-0.38	0.64	-0.24	0.1	0.19	0.51
9	-0.04	0.13	0.34	-0.07	0.33	0.04	0.74	-0.31	0.21	0.09
10	0.6	-0.18	-0.52	-0.36	0.04	0.53	0.14	0.83	-0.03	-0.3

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	-7.7682	-7.0478	-6.9947	-7.1264	-7.0797	-7.1848	-7.1848	-7.1848	-7.1848
S.E(Log q)	0.4885	0.3521	0.3519	0.4606	0.3073	0.4328	0.4868	0.3882	0.685

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	0.98	0.07	7.82	0.41	14	0.5	-7.77
3	1.12	-0.437	6.72	0.52	14	0.41	-7.05
4	1.15	-0.587	6.68	0.57	14	0.41	-6.99
5	0.73	1.422	7.51	0.7	14	0.32	-7.13
6	0.79	1.67	7.27	0.84	14	0.23	-7.08
7	0.72	1.884	7.28	0.79	14	0.29	-7.18
8	0.61	3.642	7.14	0.88	14	0.21	-7.2
9	0.71	2.206	6.98	0.83	14	0.24	-7.15
10	0.77	0.801	6.94	0.5	14	0.54	-7.19

Table 8.4.1c Continued

Fleet : FLT09: FR OT (Catch:

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	99.99	-0.38	0.09	-0.04	-0.19	0.15	0.28	-0.4	0.49	99.99
4	99.99	-0.04	-0.48	-0.04	0.22	-0.13	0.29	0.12	0.07	99.99
5	99.99	0.12	-0.44	-0.32	0.01	0.01	-0.04	0.52	0.14	99.99
6	99.99	0.28	-0.12	-0.99	-0.23	0.08	0.4	-0.17	0.75	99.99
7	99.99	0.19	0.15	-0.17	-0.23	-0.04	0.28	0.09	-0.27	99.99
8	99.99	0.02	-0.01	-0.46	-0.04	-0.84	0.08	0.34	0.09	99.99
9	99.99	0.37	-0.07	-0.06	-0.08	-0.04	-0.23	0.47	0.3	99.99
10	99.99	0.44	-0.22	-0.61	0.11	-0.08	1.14	-0.54	1.23	99.99

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 q	-13.1671	-13.2941	-13.4294	-13.6646	-13.8618	-13.8618	-13.8618	-13.8618
S.E(Log q)	0.316	0.2396	0.2963	0.519	0.2077	0.3865	0.2703	0.7316

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	0.81	0.654	12.52	0.65	8	0.27	-13.17
4	0.86	0.683	12.73	0.79	8	0.21	-13.29
5	1.09	-0.386	13.84	0.77	8	0.34	-13.43
6	1.04	-0.107	13.88	0.56	8	0.58	-13.66
7	0.96	0.304	13.61	0.9	8	0.21	-13.86
8	0.88	0.498	13.16	0.75	8	0.35	-13.96
9	0.8	1.248	12.37	0.87	8	0.2	-13.78
10	1.93	-0.593	20.86	0.06	8	1.43	-13.68

Terminal year survivor and F summaries :

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

Year class = 1998

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	1	0	0	0	0	0	0
FLT12: FR YFS (Catch	50066	0.928	0	0	1	0.128	0.003
FLT11: UK YFS (Catch	17790	0.579	0	0	1	0.329	0.01
FLT10: UK BTS (Catch	153814	1.056	0	0	1	0.099	0.001
FLT08: UK BT (Catch:	1	0	0	0	0	0	0
FLT09: FR OT (Catch:	1	0	0	0	0	0	0
F shrinkage mean	19731	0.5				0.444	0.009

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
26326	0.33	0.41	4	1.229	0.007

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

Year class = 1997

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	24996	0.986	0	0	1	0.058	0.125
FLT12: FR YFS (Catch	11238	0.928	0	0	1	0.065	0.26
FLT11: UK YFS (Catch	19352	0.579	0	0	1	0.166	0.159
FLT10: UK BTS (Catch	14443	0.487	0.283	0.58	2	0.235	0.208
FLT08: UK BT (Catch:	26895	0.506	0	0	1	0.219	0.117
FLT09: FR OT (Catch:	1	0	0	0	0	0	0
F shrinkage mean	32302	0.5				0.258	0.098

Table 8.4.1c Continued

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
21706	0.24	0.16	7	0.676	0.143

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

Year class = 1996

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	12659	0.366	0.004	0.01	2	0.206	0.522
FLT12: FR YFS (Catch	2151	0.928	0	0	1	0.03	1.617
FLT11: UK YFS (Catch	3916	0.579	0	0	1	0.078	0.68
FLT10: UK BTS (Catch	23362	0.364	0.178	0.49	3	0.203	0.267
FLT08: UK BT (Catch:	13824	0.296	0.012	0.04	2	0.312	0.363
FLT09: FR OT (Catch:	1	0	0	0	0	0	0
F shrinkage mean	13953	0.5				0.171	0.484

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
16081	0.17	0.17	10	0.981	0.432

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

Year class = 1995

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	5348	0.262	0.212	0.81	3	0.241	0.489
FLT12: FR YFS (Catch	5997	0.928	0	0	1	0.013	0.446
FLT11: UK YFS (Catch	3060	0.579	0	0	1	0.034	0.743
FLT10: UK BTS (Catch	6054	0.282	0.241	0.86	4	0.2	0.443
FLT08: UK BT (Catch:	6130	0.236	0.107	0.45	3	0.282	0.438
FLT09: FR OT (Catch:	9684	0.335	0	0	1	0.11	0.299
F shrinkage mean	5033	0.5				0.12	0.513

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5935	0.13	0.09	14	0.707	0.45

Table 8.4.1c Continued

Age 5 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
FLT07: BELGIAN BT (C	3017	0.228	0.051	0.22	4	0.257	0.367
FLT12: FR YFS (Catch	6066	0.928	0	0	1	0.007	0.199
FLT11: UK YFS (Catch	7669	0.579	0	0	1	0.017	0.161
FLT10: UK BTS (Catch	3435	0.254	0.225	0.88	5	0.201	0.329
FLT08: UK BT (Catch:	3275	0.225	0.087	0.39	4	0.234	0.342
FLT09: FR OT (Catch:	2804	0.231	0.22	0.95	2	0.183	0.39
F shrinkage mean	1968	0.5				0.102	0.518

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3043	0.12	0.08	18	0.669	0.364

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

Year class = 1993

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	1375	0.225	0.135	0.6	5	0.222	0.503
FLT12: FR YFS (Catch	7304	0.928	0	0	1	0.004	0.116
FLT11: UK YFS (Catch	3394	0.579	0	0	1	0.009	0.235
FLT10: UK BTS (Catch	2336	0.257	0.24	0.93	6	0.16	0.326
FLT08: UK BT (Catch:	1978	0.207	0.086	0.42	5	0.299	0.375
FLT09: FR OT (Catch:	2228	0.201	0.038	0.19	3	0.206	0.339
F shrinkage mean	1675	0.5				0.101	0.43

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1907	0.11	0.08	22	0.678	0.386

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

Year class = 1992

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	540	0.204	0.093	0.46	6	0.34	0.511
FLT12: FR YFS (Catch	165	0.928	0	0	1	0.002	1.16
FLT11: UK YFS (Catch	945	0.579	0	0	1	0.006	0.323
FLT10: UK BTS (Catch	264	0.263	0.079	0.3	6	0.096	0.86
FLT08: UK BT (Catch:	601	0.205	0.183	0.9	6	0.284	0.47
FLT09: FR OT (Catch:	984	0.202	0.119	0.59	4	0.153	0.312
F shrinkage mean	970	0.5				0.118	0.316

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
611	0.12	0.09	25	0.818	0.464

Table 8.4.1c Continued

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

Year class = 1991

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	966	0.183	0.081	0.44	7	0.307	0.542
FLT12: FR YFS (Catch	1145	0.928	0	0	1	0.002	0.475
FLT11: UK YFS (Catch	946	0.579	0	0	1	0.005	0.551
FLT10: UK BTS (Catch	955	0.243	0.123	0.51	6	0.076	0.547
FLT08: UK BT (Catch:	1547	0.188	0.092	0.49	7	0.258	0.371
FLT09: FR OT (Catch:	967	0.179	0.044	0.25	5	0.254	0.542
F shrinkage mean	2024	0.5				0.098	0.295

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1172	0.1	0.06	28	0.628	0.466

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

Year class = 1990

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	925	0.178	0.072	0.4	8	0.306	0.329
FLT12: FR YFS (Catch	1570	0.928	0	0	1	0.002	0.207
FLT11: UK YFS (Catch	1937	0.579	0	0	1	0.004	0.171
FLT10: UK BTS (Catch	897	0.242	0.108	0.45	6	0.057	0.338
FLT08: UK BT (Catch:	920	0.185	0.07	0.38	8	0.289	0.331
FLT09: FR OT (Catch:	1057	0.171	0.044	0.26	6	0.255	0.293
F shrinkage mean	889	0.5				0.087	0.341

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
954	0.1	0.03	31	0.336	0.321

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1989

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT07: BELGIAN BT (C	711	0.179	0.085	0.48	8	0.244	0.247
FLT12: FR YFS (Catch	1534	0.928	0	0	1	0.001	0.122
FLT11: UK YFS (Catch	680	0.579	0	0	1	0.003	0.257
FLT10: UK BTS (Catch	1202	0.24	0.12	0.5	6	0.047	0.153
FLT08: UK BT (Catch:	825	0.187	0.061	0.33	9	0.269	0.216
FLT09: FR OT (Catch:	1044	0.16	0.049	0.31	7	0.348	0.174
F shrinkage mean	391	0.5				0.089	0.411

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
823	0.1	0.06	33	0.613	0.217

Table 8.4.2 Sole in VIId. Fishing mortality (F) at age

Run title : Sole in VIId (run: XSAWD105/X05)

At 7/10/2000 14:57

Terminal Fs derived using XSA (With F shrinkage)

YEAR	1982	1983	1984	1985	1986	1987	1988	1989
AGE								
1	0.0125	0.0000	0.0011	0.0038	0.0019	0.0008	0.0037	0.0099
2	0.1822	0.0798	0.1089	0.2136	0.1155	0.1517	0.2519	0.1731
3	0.3079	0.3431	0.4157	0.4081	0.4831	0.5270	0.5234	0.6670
4	0.4725	0.3538	0.4186	0.3524	0.4306	0.5730	0.4008	0.6888
5	0.2148	0.4258	0.2572	0.2562	0.3044	0.5002	0.3638	0.7049
6	0.2429	0.4178	0.6641	0.3818	0.2854	0.6020	0.3586	0.4703
7	0.4576	0.3450	0.4406	0.2259	0.3570	0.7192	0.4202	0.4170
8	0.4148	0.4927	0.2616	0.2377	0.3616	0.4482	0.3298	0.3777
9	0.3362	0.2953	0.3388	0.1775	0.4467	0.4335	0.2374	0.3448
10	0.3640	0.3889	0.4277	0.2563	0.3526	0.7517	0.5833	0.3363
+gp	0.3640	0.3889	0.4277	0.2563	0.3526	0.7517	0.5833	0.3363
FBAR 3- 8	0.3518	0.3963	0.4096	0.3103	0.3703	0.5616	0.3994	0.5543

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99	Frescaled
AGE												
1	0.0291	0.0110	0.0031	0.0051	0.0012	0.0321	0.0005	0.0009	0.0014	0.0066	0.0030	0.0029
2	0.2326	0.2097	0.1396	0.1868	0.0531	0.1272	0.1150	0.0899	0.0612	0.1432	0.0981	0.0936
3	0.4413	0.4390	0.3759	0.3179	0.3417	0.4318	0.5106	0.5486	0.4373	0.4317	0.4725	0.4507
4	0.4858	0.5418	0.3605	0.3894	0.4763	0.4127	0.5165	0.6640	0.4498	0.4498	0.5212	0.4972
5	0.4687	0.3881	0.4784	0.3131	0.3892	0.4135	0.4805	0.7406	0.4318	0.3644	0.5123	0.4887
6	0.2788	0.5121	0.3069	0.2380	0.2687	0.3668	0.4266	0.4637	0.4556	0.3864	0.4352	0.4152
7	0.3624	0.3236	0.3306	0.2615	0.3315	0.2472	0.3825	0.3676	0.2636	0.4641	0.3651	0.3483
8	0.2976	0.3385	0.2626	0.2659	0.2438	0.2481	0.2568	0.3933	0.2804	0.4662	0.3800	0.3625
9	0.3872	0.4394	0.3839	0.3447	0.2899	0.2995	0.4344	0.3376	0.2870	0.3208	0.3151	0.3006
10	0.4299	0.4459	0.2481	0.2086	0.4271	0.3118	0.6070	0.4168	0.5743	0.2167	0.4026	0.3841
+gp	0.4299	0.4459	0.2481	0.2086	0.4271	0.3118	0.6070	0.4168	0.5743	0.2167		
FBAR 3- 8	0.3891	0.4239	0.3525	0.2976	0.3419	0.3533	0.4289	0.5296	0.3864	0.4271		

factor 0.953951532

Table 8.4.3 Sole in VIId. Stock number at age (start of year) Numbers*10**-3

Run title : Sole in VIId (run: XSAWD105/X05)

At 7/10/2000 14:57

Terminal Fs derived using XSA (With F shrinkage)

YEAR	1982	1983	1984	1985	1986	1987	1988	1989
AGE								
1	13071	22264	22337	13516	27163	11629	27169	17481
2	16569	11679	20145	20189	12183	24531	10514	24493
3	20848	12495	9757	16347	14755	9822	19073	7395
4	4821	13865	8023	5826	9835	8236	5247	10226
5	3100	2720	8807	4776	3706	5786	4202	3180
6	3183	2263	1608	6162	3345	2473	3175	2642
7	1572	2259	1348	749	3806	2275	1226	2007
8	743	900	1448	785	540	2410	1003	729
9	449	444	498	1009	560	341	1393	652
10	286	290	299	321	764	324	200	994
+gp	694	627	716	594	1343	927	672	1207
TOTAL	65336	69807	74986	70273	78001	68754	73872	71006

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 82-97	AMST 82-97
AGE													
1	46659	36809	35731	17690	28968	22701	23526	35561	**30633** [5]	**29283** [4]	**0** [1]	23362	25142
2	15662	41010	32941	32230	15926	26179	19891	21277	32148	27679	**26326** [2]	20133	21589
3	18639	11231	30086	25924	24192	13665	20859	16043	17597	27364	**21706** [3]	15817	16946
4	3434	10847	6551	18693	17068	15555	8029	11327	8387	10282	16081	8880	9849
5	4647	1912	5710	4134	11459	9592	9316	4335	5276	4840	5935	4853	5461
6	1422	2631	1173	3202	2735	7026	5740	5213	1870	3100	3043	2986	3375
7	1494	973	1427	781	2284	1891	4405	3390	2967	1073	1907	1753	1993
8	1197	941	637	927	544	1483	1337	2719	2124	2062	611	1022	1146
9	452	804	607	443	643	386	1047	936	1660	1452	1172	614	666
10	418	278	469	374	284	436	259	614	604	1128	954	376	413
+gp	1666	1149	1131	808	837	966	862	916	847	2094	2348		
TOTAL	95689	108585	116463	105206	104942	99881	95271	102330	104113	110356	80083		

[1] Replaced by GM
[2] Replaced by 35360 calculated from RCT3 estimate of 2 yr olds in 2000
[3] Replaced by 15012 calculated from RCT3 estimate of 3 yr olds in 2000
[4] Replaced by RCT3 estimate (39570)
[5] Replaced by RCT3 estimate (21330)

Table 8.5.1 Sole in VIId. Input data for RCT3

Year class	VPA-1	VPA-2	VPA-3	enyfs0	enyfs1	fyfs0	fyfs1	ebts1	ebts2
1981	13071	11679	9757	-11	0.4	3.3	0.1	-11	-11
1982	22264	20145	16347	4.5	2.2	1.0	0.0	-11	-11
1983	22337	20189	14755	40.1	4.0	0.8	-11	-11	-11
1984	13516	12183	9822	3.5	1.7	-11	-11	-11	-11
1985	27163	24531	19073	8.9	1.3	-11	-11	-11	-11
1986	11629	10514	7395	6.9	1.4	-11	0.1	-11	14.2
1987	27169	24493	18639	15.5	1.9	0.8	0.2	8.2	15.4
1988	17481	15662	11231	2.6	0.5	0.0	0.1	2.6	3.7
1989	46659	41010	30086	6.1	2.5	17.4	0.5	12.1	22.8
1990	36809	32941	25924	9.6	4.9	0.6	0.4	8.9	12.0
1991	35731	32230	24192	2.8	1.9	1.0	0.2	1.4	17.5
1992	17690	15926	13665	3.5	1.8	0.5	0.0	0.5	3.2
1993	28968	26179	20859	19.6	3.4	0.3	0.7	4.7	10.6
1994	22701	19891	16043	13.8	3.7	4.0	0.3	3.5	7.4
1995	23526	21277	17597	9.5	0.8	3.5	0.2	3.5	7.3
1996	35561	32148	27364	3.1	1.3	0.3	0.0	19.0	21.2
1997	-11	-11	-11	5.4	1.8	0.1	0.1	2.0	9.4
1998	-11	-11	-11	13.2	1.3	10.5	0.4	28.1	22.0
1999	-11	-11	-11	5.0	-11	2.8	-11	10.5	-11

Table 8.5.2a Sole in VIId. RCT3 estimate at age 1

Data for 6 surveys over 19 years : 1981 - 1999

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.

Year class = 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			
enyfs0	7.60	-5.85	5.38	.006	15	1.86	8.26	6.193	.001
enyfs1	2.39	7.54	.94	.161	16	1.03	10.00	1.070	.049
fyfs0,	1.23	9.14	1.04	.103	13	.07	9.23	1.272	.035
fyfs1,	4.52	9.24	.68	.272	13	.10	9.67	.807	.087
ebts1,	.60	9.21	.38	.457	10	1.08	9.85	.464	.263
ebts2,	.99	7.77	.46	.444	11	2.35	10.08	.542	.192
					VPA Mean =		10.13	.390	.372

Year class = 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			
enyfs0	8.95	-8.62	6.31	.004	15	2.65	15.12	7.533	.001
enyfs1	2.43	7.50	.97	.150	16	.83	9.52	1.135	.048
fyfs0,	1.20	9.17	1.03	.103	13	2.44	12.11	1.424	.031
fyfs1,	4.55	9.23	.70	.254	13	.30	10.60	.836	.088
ebts1,	.59	9.22	.38	.459	10	3.37	11.21	.545	.208
ebts2,	.94	7.88	.43	.470	11	3.14	10.84	.549	.206
					VPA Mean =		10.15	.385	.418

Year class = 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			
enyfs0	11.54	-13.98	8.13	.002	15	1.79	6.69	9.638	.001
enyfs1									
fyfs0,	1.21	9.17	1.05	.098	13	1.35	10.80	1.285	.050
fyfs1,									
ebts1,	.58	9.23	.37	.461	10	2.44	10.65	.472	.370
ebts2,									
					VPA Mean =		10.16	.378	.579

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1997	21330	9.97	.24	.09	.14		
1998	39570	10.59	.25	.23	.87		
1999	31962	10.37	.29	.16	.31		

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 19 years : 1981 - 1999

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.

Year class = 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			
enyfs0	9.39	-9.65	6.62	.004	15	2.65	15.26	7.903	.001
enyfs1	2.48	7.34	.99	.143	16	.83	9.40	1.162	.046
fyfs0,	1.29	8.99	1.12	.088	13	2.44	12.14	1.543	.026
fyfs1,	4.60	9.11	.71	.246	13	.30	10.49	.850	.086
ebts1,	.59	9.11	.38	.456	10	3.37	11.10	.546	.207
ebts2,	.93	7.80	.43	.475	11	3.14	10.73	.540	.212
					VPA Mean =		10.04	.383	.422

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1998	35360	10.47	.25	.23	.87		

Table 8.5.2c Sole in VIId. RCT3 estimate at age 3

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

S7DREC3.CSV

7D Sole (3-year-olds),,,,,,,

Data for    6 surveys over   19 years :  1981 - 1999

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.

Year class =   1997

         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    9.85 -10.93   6.98   .003     15   1.86    7.36    8.036     .001
enyfs1    2.50   7.07    .99   .150     16   1.03    9.64    1.130     .048
fyfs0,    1.40   8.65   1.21   .074     13    .07    8.74    1.475     .028
fyfs1,    5.23   8.74    .82   .210     13    .10    9.24     .973     .065
ebts1,     .57   8.90    .36   .465     10   1.08    9.52     .443     .315
ebts2,    1.11   7.11    .55   .370     11   2.35    9.72     .650     .146

                                        VPA Mean =    9.78     .395     .396


Year     Weighted      Log      Int      Ext      Var      VPA       Log
Class     Average      WAP      Std      Std     Ratio               VPA
         Prediction             Error    Error

1997       15012       9.62      .25      .09       .14
```

Table 8.6.1 Sole in VIId. Stock summary

Run title : Sole in VIId (run: XSAWD105/X05)

At 7/10/2000 14:57

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	13071	10492	7832	3190	0.4073	0.3518
1983	22264	12850	9715	3458	0.3559	0.3963
1984	22337	13298	9162	3575	0.3902	0.4096
1985	13516	13856	10373	3837	0.3699	0.3103
1986	27163	14547	10989	4024	0.3662	0.3703
1987	11629	14128	9881	4974	0.5034	0.5616
1988	27169	13595	10129	3982	0.3931	0.3994
1989	17481	12130	8166	4187	0.5127	0.5543
1990	46659	14272	8891	4060	0.4566	0.3891
1991	36809	14865	7740	4382	0.5662	0.4239
1992	35731	17890	10540	4142	0.393	0.3525
1993	17690	16451	12462	4511	0.362	0.2976
1994	28968	16962	13113	4643	0.3541	0.3419
1995	22701	17788	12078	4583	0.3794	0.3533
1996	23526	17351	12163	5025	0.4132	0.4289
1997	35561	15583	11194	4983	0.4451	0.5296
1998	21330*	18403	9906	3694	0.3729	0.3864
1999	39570*	20816	11797	4238	0.3593	0.4271
2000	23362**		11283***			
Arith. Mean	25053	15293	10341	4194	0.4111	0.4047
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

* RCT3 estimate
** GM 82-97
*** SSB estimated using the average weight at age over the years 1997-99

Table 8.7.1

11:04 Monday, October 16, 2000
Sole in Division VIId (Eastern English Channel)

Prediction with management option table: Input data

Year: 2000								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	23362	0.1000	0.0000	0.0000	0.0000	0.111	0.0029	0.135
2	35360	0.1000	0.0000	0.0000	0.0000	0.140	0.0936	0.156
3	15012	0.1000	1.0000	0.0000	0.0000	0.171	0.4507	0.185
4	16081	0.1000	1.0000	0.0000	0.0000	0.204	0.4972	0.229
5	5935	0.1000	1.0000	0.0000	0.0000	0.240	0.4887	0.280
6	3043	0.1000	1.0000	0.0000	0.0000	0.278	0.4152	0.322
7	1907	0.1000	1.0000	0.0000	0.0000	0.319	0.3483	0.353
8	611	0.1000	1.0000	0.0000	0.0000	0.363	0.3625	0.387
9	1172	0.1000	1.0000	0.0000	0.0000	0.409	0.3006	0.446
10	954	0.1000	1.0000	0.0000	0.0000	0.457	0.3841	0.427
11+	2348	0.1000	1.0000	0.0000	0.0000	0.606	0.3841	0.597
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	23362	0.1000	0.0000	0.0000	0.0000	0.111	0.0029	0.135
2	-	0.1000	0.0000	0.0000	0.0000	0.140	0.0936	0.156
3	-	0.1000	1.0000	0.0000	0.0000	0.171	0.4507	0.185
4	-	0.1000	1.0000	0.0000	0.0000	0.204	0.4972	0.229
5	-	0.1000	1.0000	0.0000	0.0000	0.240	0.4887	0.280
6	-	0.1000	1.0000	0.0000	0.0000	0.278	0.4152	0.322
7	-	0.1000	1.0000	0.0000	0.0000	0.319	0.3483	0.353
8	-	0.1000	1.0000	0.0000	0.0000	0.363	0.3625	0.387
9	-	0.1000	1.0000	0.0000	0.0000	0.409	0.3006	0.446
10	-	0.1000	1.0000	0.0000	0.0000	0.457	0.3841	0.427
11+	-	0.1000	1.0000	0.0000	0.0000	0.606	0.3841	0.597
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	23362	0.1000	0.0000	0.0000	0.0000	0.111	0.0029	0.135
2	-	0.1000	0.0000	0.0000	0.0000	0.140	0.0936	0.156
3	-	0.1000	1.0000	0.0000	0.0000	0.171	0.4507	0.185
4	-	0.1000	1.0000	0.0000	0.0000	0.204	0.4972	0.229
5	-	0.1000	1.0000	0.0000	0.0000	0.240	0.4887	0.280
6	-	0.1000	1.0000	0.0000	0.0000	0.278	0.4152	0.322
7	-	0.1000	1.0000	0.0000	0.0000	0.319	0.3483	0.353
8	-	0.1000	1.0000	0.0000	0.0000	0.363	0.3625	0.387
9	-	0.1000	1.0000	0.0000	0.0000	0.409	0.3006	0.446
10	-	0.1000	1.0000	0.0000	0.0000	0.457	0.3841	0.427
11+	-	0.1000	1.0000	0.0000	0.0000	0.606	0.3841	0.597
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANWD104
Date and time: 09OCT00:14:09

Table 8.7.2

11:04 Monday, October 16, 2000
Sole in Division VIId (Eastern English Channel)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4271	18822	11283	4693	0.0000	0.0000	18096	12551	0	21999	16446
.	.	.	.	.	0.1000	0.0427	.	12551	599	21396	15843
.	.	.	.	.	0.2000	0.0854	.	12551	1174	20817	15266
.	.	.	.	.	0.3000	0.1281	.	12551	1724	20263	14712
.	.	.	.	.	0.4000	0.1708	.	12551	2252	19732	14182
.	.	.	.	.	0.5000	0.2136	.	12551	2758	19223	13674
.	.	.	.	.	0.6000	0.2563	.	12551	3243	18736	13188
.	.	.	.	.	0.7000	0.2990	.	12551	3709	18269	12721
.	.	.	.	.	0.8000	0.3417	.	12551	4155	17821	12275
.	.	.	.	.	0.9000	0.3844	.	12551	4583	17392	11846
.	.	.	.	.	1.0000	0.4271	.	12551	4994	16980	11436
.	.	.	.	.	1.1000	0.4698	.	12551	5388	16586	11042
.	.	.	.	.	1.2000	0.5125	.	12551	5767	16208	10665
.	.	.	.	.	1.3000	0.5552	.	12551	6130	15845	10303
.	.	.	.	.	1.4000	0.5979	.	12551	6478	15497	9956
.	.	.	.	.	1.5000	0.6407	.	12551	6812	15164	9623
.	.	.	.	.	1.6000	0.6834	.	12551	7133	14844	9304
.	.	.	.	.	1.7000	0.7261	.	12551	7441	14537	8998
.	.	.	.	.	1.8000	0.7688	.	12551	7737	14242	8704
.	.	.	.	.	1.9000	0.8115	.	12551	8022	13959	8422
.	.	.	.	.	2.0000	0.8542	.	12551	8295	13688	8152
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANWD104
Date and time : 09OCT00:14:09
Computation of ref. F: Simple mean, age 3 - 8
Basis for 2000 : F factors

Table 8.7.3

11:04 Monday, October 16, 2000
Sole in Division VIId (Eastern English Channel)
Single option prediction: Detailed tables

Year: 2000 F-factor: 1.0000 Reference F: 0.4271

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	0.0029	64	9	23362	2601	0	0	0	0
2	0.0936	3009	469	35360	4939	0	0	0	0
3	0.4507	5203	964	15012	2562	15012	2562	15012	2562
4	0.4972	6020	1381	16081	3281	16081	3281	16081	3281
5	0.4887	2192	614	5935	1424	5935	1424	5935	1424
6	0.4152	987	318	3043	847	3043	847	3043	847
7	0.3483	535	189	1907	609	1907	609	1907	609
8	0.3625	177	69	611	222	611	222	611	222
9	0.3006	290	129	1172	479	1172	479	1172	479
10	0.3841	290	124	954	436	954	436	954	436
11+	0.3841	715	427	2348	1422	2348	1422	2348	1422
Total		19484	4693	105785	18822	47063	11283	47063	11283
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.4271

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	0.0029	64	9	23362	2601	0	0	0	0
2	0.0936	1794	280	21078	2944	0	0	0	0
3	0.4507	10097	1871	29136	4973	29136	4973	29136	4973
4	0.4972	3240	743	8655	1766	8655	1766	8655	1766
5	0.4887	3269	915	8850	2124	8850	2124	8850	2124
6	0.4152	1069	345	3294	917	3294	917	3294	917
7	0.3483	510	180	1818	580	1818	580	1818	580
8	0.3625	354	137	1218	442	1218	442	1218	442
9	0.3006	95	43	385	157	385	157	385	157
10	0.3841	239	102	785	359	785	359	785	359
11+	0.3841	620	370	2035	1233	2035	1233	2035	1233
Total		21351	4994	100616	18096	56176	12551	56176	12551
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 1.0000 Reference F: 0.4271

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	0.0029	64	9	23362	2601	0	0	0	0
2	0.0936	1794	280	21078	2944	0	0	0	0
3	0.4507	6019	1116	17368	2964	17368	2964	17368	2964
4	0.4972	6289	1442	16798	3427	16798	3427	16798	3427
5	0.4887	1759	493	4763	1143	4763	1143	4763	1143
6	0.4152	1594	514	4912	1367	4912	1367	4912	1367
7	0.3483	552	195	1968	628	1968	628	1968	628
8	0.3625	337	130	1161	421	1161	421	1161	421
9	0.3006	190	85	767	314	767	314	767	314
10	0.3841	78	33	258	118	258	118	258	118
11+	0.3841	529	316	1738	1053	1738	1053	1738	1053
Total		19206	4612	94173	16980	49733	11436	49733	11436
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRWD104
Date and time : 09OCT00:13:42
Computation of ref. F: Simple mean, age 3 - 8
Prediction basis : F factors

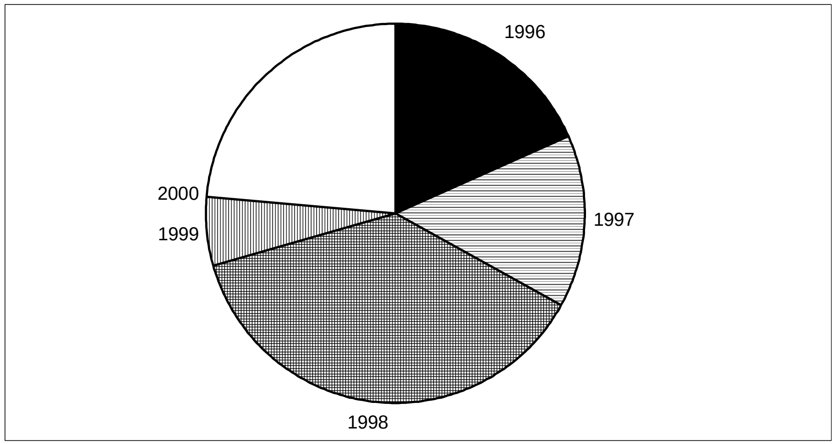
Table 8.7.4 **Sole in VIId**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	1996	1997	1998	1999	2000
Stock No. (thousands) of 1 year-olds	35561	21330	39570	23362	23362
Source	XSA	RCT	RCT	GM	GM
Status Quo F:					
% in 2000 landings	29.4	20.5	10.0	0.2	-
% in 2001	18.3	14.9	37.5	5.6	0.2
% in 2000 SSB	29.1	22.7	0.0	0.0	-
% in 2001 SSB	16.9	14.1	39.6	0.0	0.0
% in 2002 SSB	12.0	10.0	30.0	25.9	0.0

GM : geometric mean recruitment

Sole in VIId : Year-class % contribution to

a) 2001 landings



b) 2002 SSB

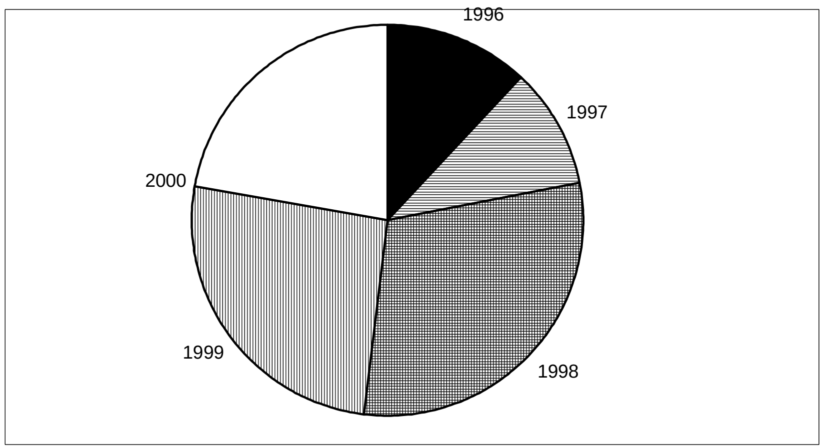


Table 8.9.1

11:04 Monday, October 16, 2000
Sole in Division VIId (Eastern English Channel)

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	0.111	0.0029	0.135
2	-	0.1000	0.0000	0.0000	0.0000	0.140	0.0936	0.156
3	-	0.1000	1.0000	0.0000	0.0000	0.171	0.4507	0.185
4	-	0.1000	1.0000	0.0000	0.0000	0.204	0.4972	0.229
5	-	0.1000	1.0000	0.0000	0.0000	0.240	0.4887	0.280
6	-	0.1000	1.0000	0.0000	0.0000	0.278	0.4152	0.322
7	-	0.1000	1.0000	0.0000	0.0000	0.319	0.3483	0.353
8	-	0.1000	1.0000	0.0000	0.0000	0.363	0.3625	0.387
9	-	0.1000	1.0000	0.0000	0.0000	0.409	0.3006	0.446
10	-	0.1000	1.0000	0.0000	0.0000	0.457	0.3841	0.427
11+	-	0.1000	1.0000	0.0000	0.0000	0.606	0.3841	0.597
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDWD107
Date and time: 11OCT00:22:57

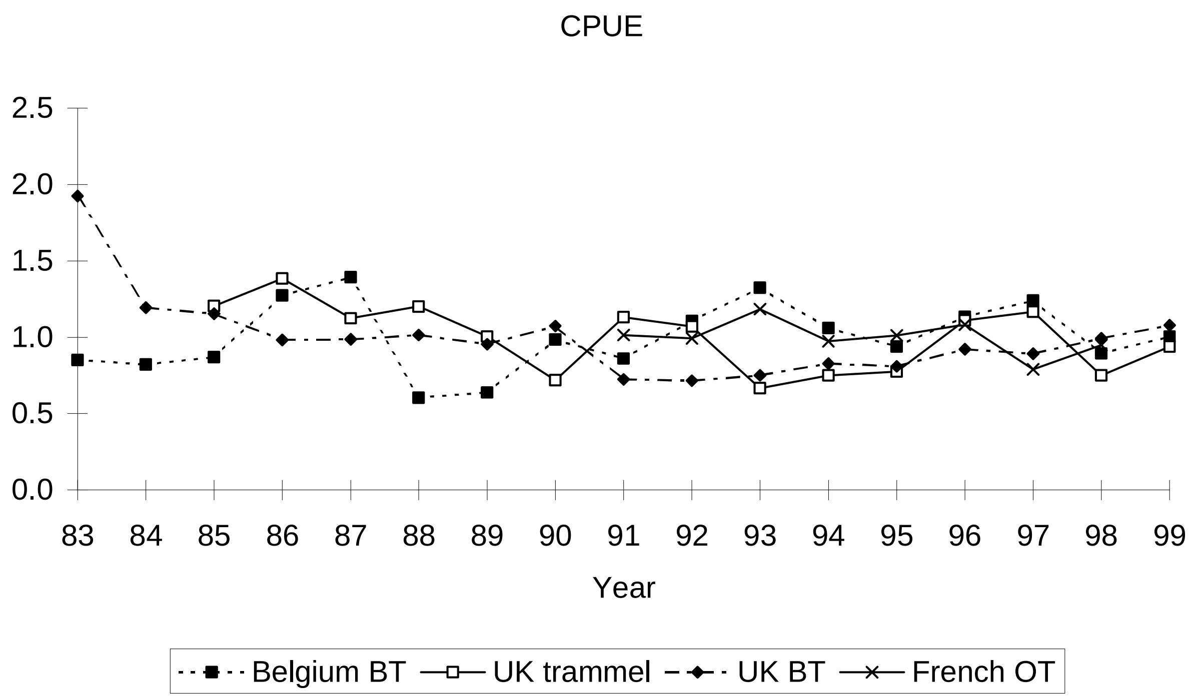
Table 8.9.2

11:04 Monday, October 16, 2000
Sole in Division VIId (Eastern English Channel)

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	3925.230	8.603	3687.521	8.603	3687.521
0.1000	0.0427	0.244	92.171	8.071	2609.588	6.167	2371.916	6.167	2371.916
0.2000	0.0854	0.382	131.639	6.699	1912.834	4.795	1675.198	4.795	1675.198
0.3000	0.1281	0.469	149.851	5.823	1495.272	3.919	1257.673	3.919	1257.673
0.4000	0.1708	0.530	158.339	5.217	1224.580	3.313	987.018	3.313	987.018
0.5000	0.2136	0.575	162.053	4.776	1039.110	2.872	801.585	2.872	801.585
0.6000	0.2563	0.609	163.331	4.441	906.599	2.538	669.109	2.538	669.109
0.7000	0.2990	0.635	163.349	4.179	808.717	2.276	571.264	2.276	571.264
0.8000	0.3417	0.656	162.723	3.969	734.398	2.067	496.982	2.067	496.982
0.9000	0.3844	0.674	161.784	3.798	676.637	1.896	439.258	1.896	439.258
1.0000	0.4271	0.688	160.710	3.656	630.827	1.753	393.484	1.753	393.484
1.1000	0.4698	0.700	159.601	3.536	593.842	1.634	356.536	1.634	356.536
1.2000	0.5125	0.711	158.510	3.433	563.506	1.531	326.236	1.531	326.236
1.3000	0.5552	0.720	157.462	3.345	538.268	1.443	301.034	1.443	301.034
1.4000	0.5979	0.728	156.472	3.267	517.000	1.366	279.803	1.366	279.803
1.5000	0.6407	0.735	155.544	3.200	498.870	1.299	261.710	1.299	261.710
1.6000	0.6834	0.741	154.678	3.139	483.252	1.239	246.128	1.239	246.128
1.7000	0.7261	0.747	153.872	3.086	469.668	1.185	232.581	1.185	232.581
1.8000	0.7688	0.752	153.124	3.037	457.750	1.137	220.699	1.137	220.699
1.9000	0.8115	0.757	152.429	2.994	447.211	1.094	210.197	1.094	210.197
2.0000	0.8542	0.761	151.783	2.954	437.823	1.055	200.845	1.055	200.845
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDWD107
Date and time : 11OCT00:22:57
Computation of ref. F: Simple mean, age 3 - 8
F-0.1 factor : 0.2799
F-max factor : 0.6493
F-0.1 reference F : 0.1196
F-max reference F : 0.2773
Recruitment : Single recruit



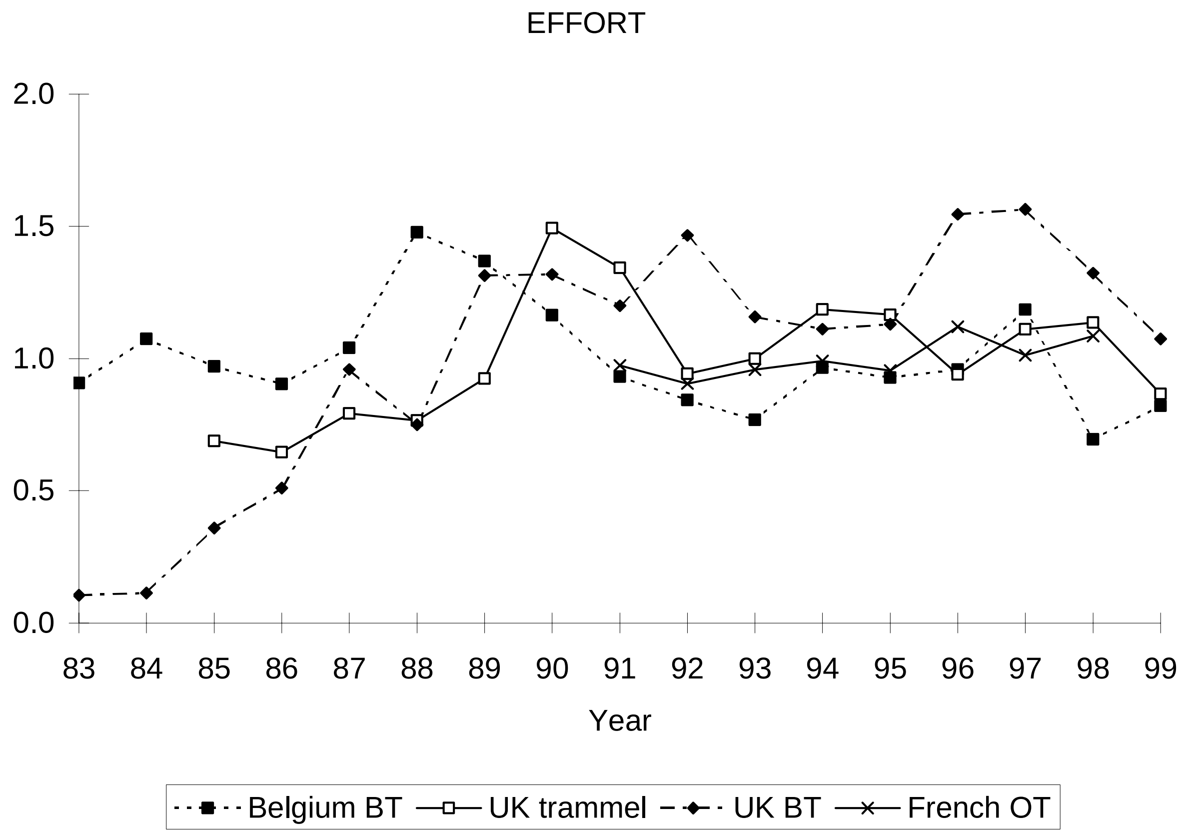


Figure 8.3.1 Sole in VIId. Trends in cpue and effort for the main commercial fleets

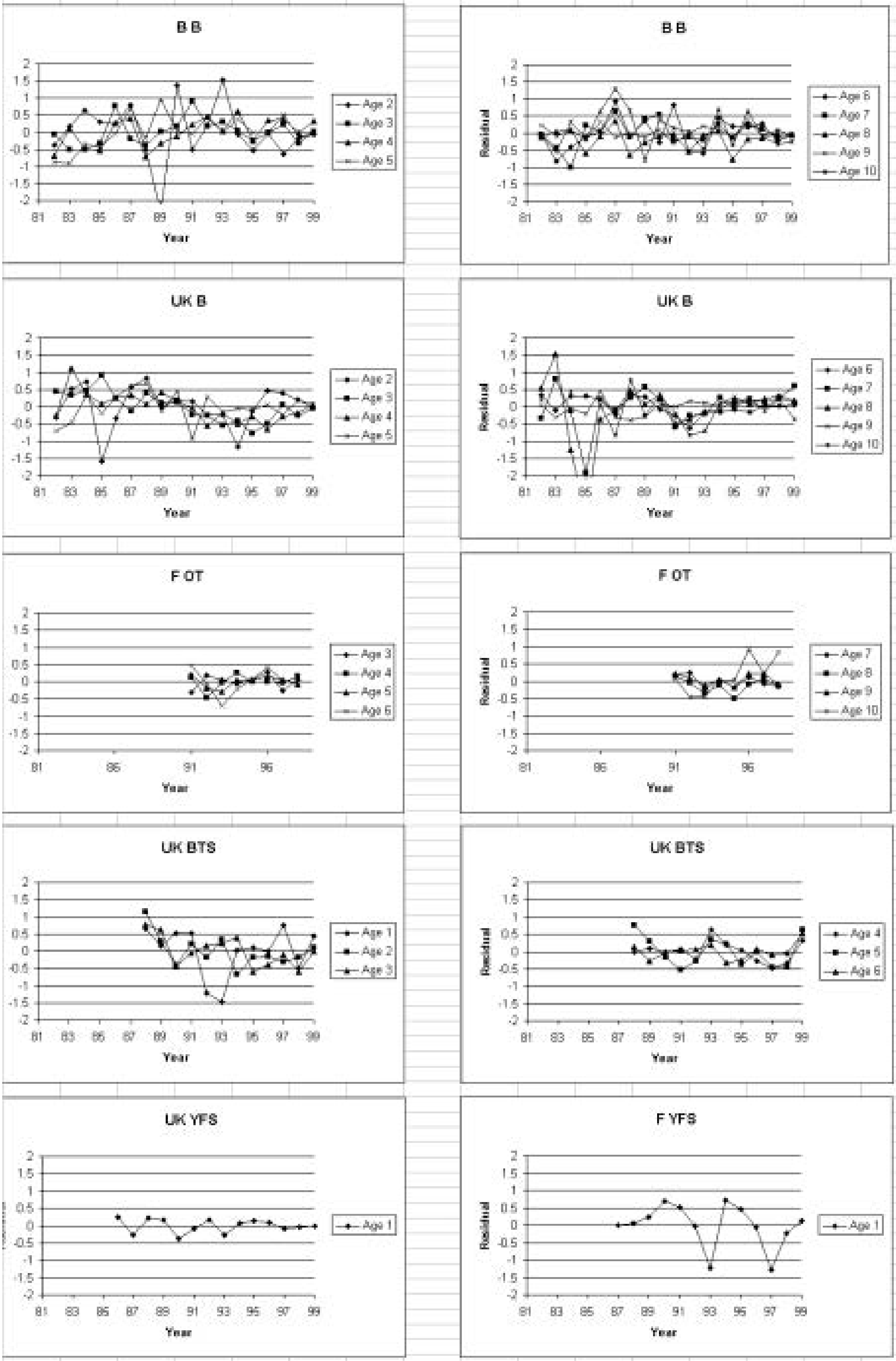


Figure 8.4.1a Sole in VIId. Trends in log catchability residuals (single fleets)

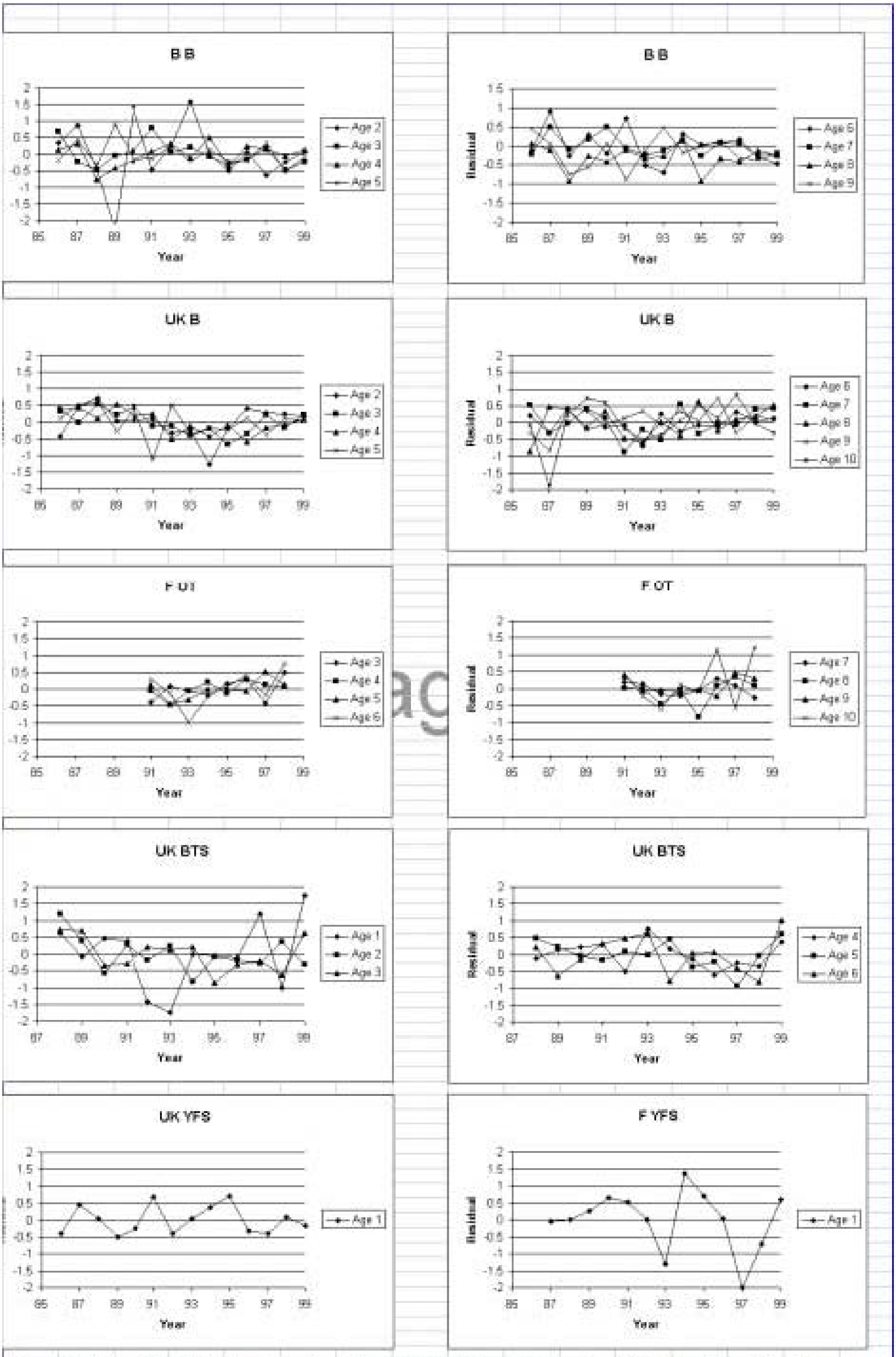


Figure 8.4.1b Sole in VIId. Trends in log catchability residuals final XSA (combined fleets)

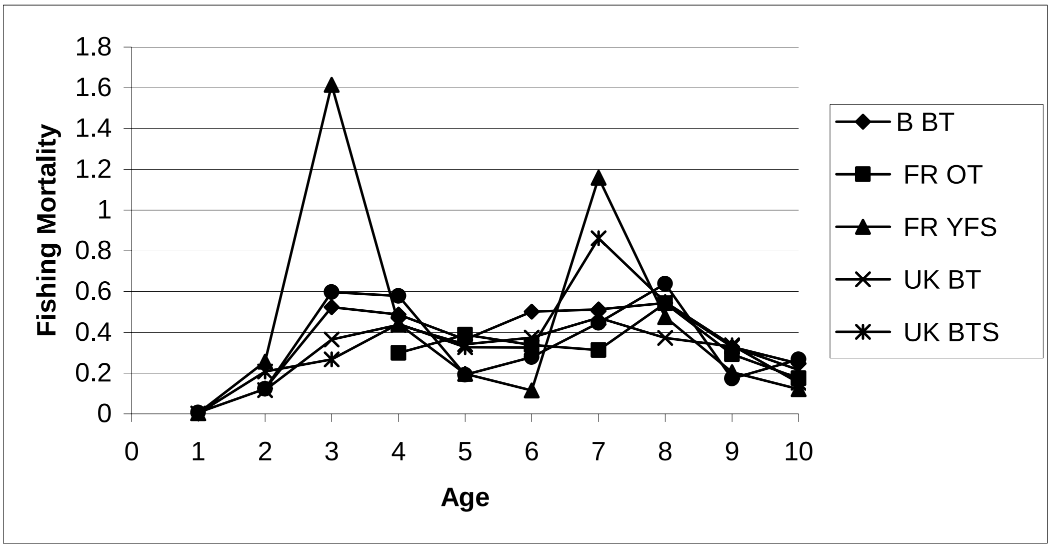


Figure 8.4.2 Sole in VIId. Fishing Mortality at Age (combined fleets)

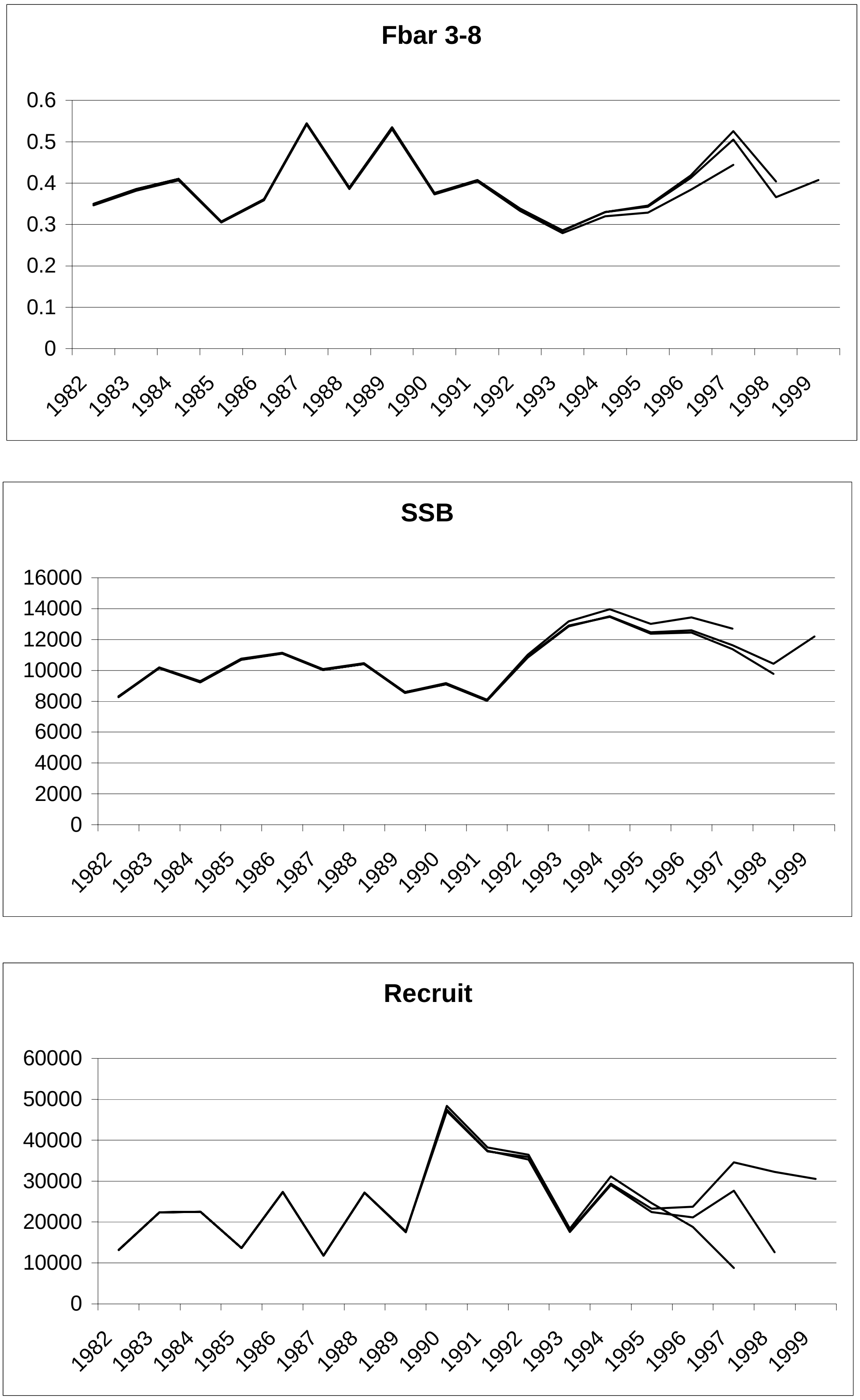


Figure 8.4.3 Sole in VIId. Retrospective analysis using shrinkage of 0.5

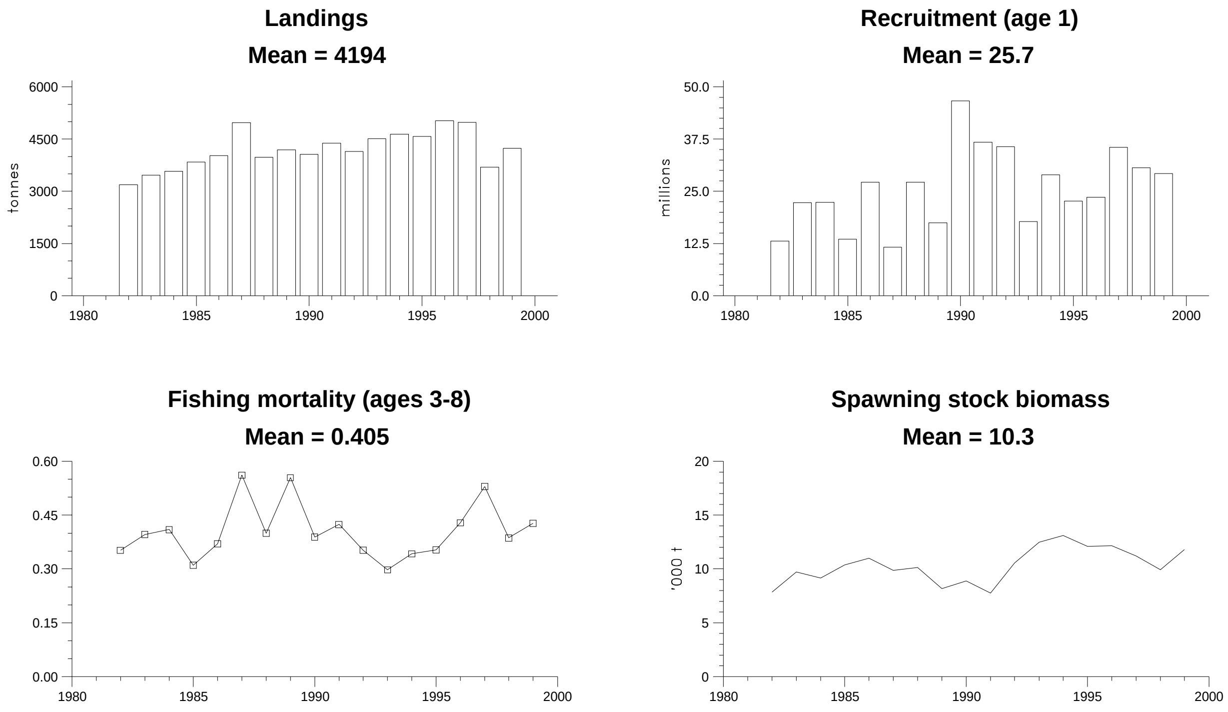


Figure 8.6.1 Sole in Division VIId (Eastern English Channel

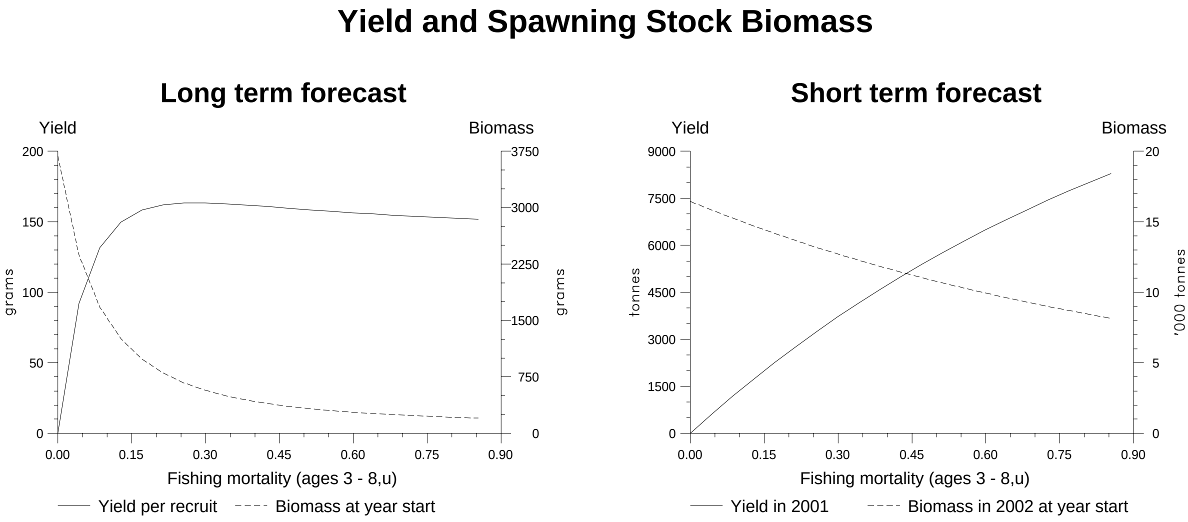


Figure 8.7.3 Fish Stock Summary. Sole in Division VIId, (Eastern English Channel)

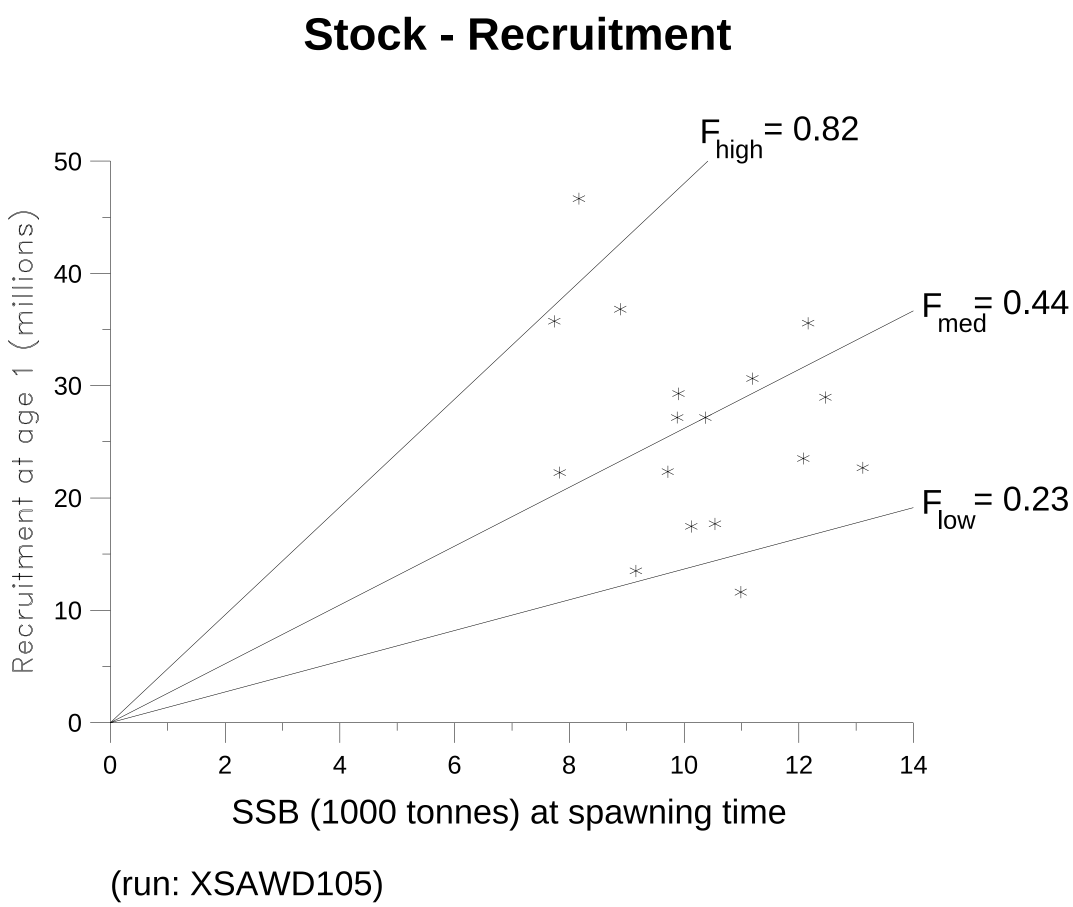


Figure 8.9.1 Sole in Division VIId (Eastern English Channel)

9 NORTH SEA PLAICE

9.1 The fishery

9.1.1 ACFM advice applicable to 1999 and 2000

In October 1998 ACFM considered that the North Sea plaice stock was outside safe biological limits. SSB is below the proposed B_{pa} (300,000 t.) and fishing mortality is above the proposed F_{pa} (0.3). ACFM recommended that there was no biological requirement to propose a modification of the EC/Norway agreement to fish at F = 0.3 in 1999. An F = 0.3 corresponded to landings of 106,000 t in 1999. However, due to the uncertainty about the recruitment of the 1996 year class, 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"*.

In October 1999 ACFM again considered the North Sea plaice stock to be outside safe biological limits. SSB was still 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 EC/Norway consultation. ACFM considered that the agreed fishing mortality of F = 0.30 was consistent with the precautionary approach and advised a reduction in fishing mortality in 2000 to F = 0.3 corresponding to landings of 95,000 t in 2000. ACFM noted that the observed reduced growth rate of the strong 1996 year class resulted in this year class becoming available to the fishery (in marketable size) one year later than normally expected. This could result in additional discard mortality. If this had been the case, the year class would contribute less to future yields and SSB than was forecast.

9.1.2 Management applicable to 1999 and 2000

The North Sea plaice TAC for 1999 was agreed at 102,000 tonnes, 4,000 tonnes below the maximum catch implied by the ACFM advice. The 2000 TAC was agreed at 97,000 tonnes.

The Agreed Record of Conclusions of Fisheries Consultations between the European Community and Norway (Brussels, 2 December 1999) agreed for North Sea plaice "*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*".

Technical measures applicable to the plaice fishery in the North Sea in 1999 included mesh size regulations, minimum landing size and a closed area (the plaice box). Mesh size regulations for towed gears required that vessels fishing North of 55° N should have a minimum mesh of 100 mm. Below 55° N vessels were allowed to fish for sole with 80 mm. A closed area has been in operation since 1989 (the plaice box). Since 1994 this area was closed for all quarters. The closed area is only applicable for towed gears, but vessels smaller than 300 HP using towed gears have been exempted from the regulation.

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.

However, the decision to reduce the minimum landing size was postponed.

The current Multi-Annual Guidance Program (MAGP-IV) has defined national targets for EU fleet reductions in fleet capacity and/or days at sea.

9.1.3 Fleet developments

North Sea plaice is taken mainly in a mixed flatfish fishery by beam trawlers in the southern and south-eastern North Sea. Directed fisheries are also carried out with seine and gill net, and by beam trawlers in the central North Sea. Due to the minimum mesh size (80 mm) in the mixed beam trawl fishery, large numbers of (undersized) plaice are discarded.

Fleets exploiting North Sea plaice have generally decreased in number of vessels in the last 10 years, partly due to the MAGP policy. 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 and also a shift towards only two categories of vessels: 2000 HP (the maximum engine power allowed) and 300 HP (the maximum engine power for vessels that are allowed to fish within the 12 mile coastal zone and the plaice box). The overall effort level (expressed as HP days) has remained relatively constant.

9.1.4 Landings in 1999

Total landings of North Sea plaice in 1999 (Table 9.1) were estimated by the WG to be just over 80 thousand tonnes which is at the same level as in the years 1996 and 1997. The text table below summarizes total landings (estimated by the WG) with the agreed TAC.

Year	Total WG landings	TAC
1996	81,673	81,000
1997	83,048	91,000
1988	71,534	87,000
1999	80,662	102,000
2000		97,000

The relative contribution of different countries to the total yield are summarized in Figure 9.1 and shows that the Netherlands and Denmark contribution has increased in 1999, whereas the contribution of UK fleets has decreased. This is possibly due to the recruitment of the strong 1996 year class which has become available in 1999, but predominantly in the southern and eastern parts of the North Sea which is outside the main fishing areas for the UK fleets.

The TAC in 1999 was not taken (79%). The national uptake rates reported by the WG members indicated that for 2000 it is again unlikely that the TAC will be fully taken, since on average only 46% of the national quota were fished by July 2000.

In 1999 the WG noted that the English beam trawl fleet can be divided into two components based on their fishing pattern and where they land their catch. One group lands predominantly in the UK and the second lands mainly in the Netherlands. In the most recent 5 years around 60% of the English landings are landed outside the UK (Table 9.2). The UK age length key information is derived from landings into the UK only and this fleet component tends to fish in more northerly areas and exploit a different part of the stock to the fleet component which lands predominantly into the Netherlands. The WG therefore explored the effects of treating the landings data from the two fleet components separately (see section 9.2).

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 9.3). 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. A working document (WD 4) was presented on maturity data in the English market sampling programme. A summary of the working document is presented in section 1.6.

The age composition of the landings is presented in Table 9.4. 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 is underestimated due to the reasons given above. Age compositions by sex and quarter were available from Belgium, England and the Netherlands. Combined age compositions by quarter were available from Denmark and France. All other landings were raised to the total international age composition (either by quarter or by year).

Age distributions were available from countries which take in 85% of the official total landings in 1999. However, for some countries a substantial proportion of the landings are landed in other countries (and are thus not sampled). The effective sampling may thus apply to a smaller proportion of the total landings..

To explore the possible bias in the catch at age data which is introduced by raising so-called ‘flag-vessel’ landings to the English age composition, a trial was set up to explore the effects of raising this fleet component to the total international age composition rather than to the English age composition. Results are shown in Table 9.5 and indicate this procedure would substantially raise the contribution of the younger age groups and decrease the number of older fish. It is recommended that work be done inter-sessionally to explore the effects of this procedure within the assessment.

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. Especially the slow growth observed from the strong 1996 year class may have induced higher discard rates.

Mean weights at age in the catch were estimated from the market samples taken throughout the year (Table 9.6). Weights-at-age in the stock were first quarter weights (Table 9.7). 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 9.2)

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
- Three Danish commercial CPUE series
- 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 ages 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.

Three new Danish commercial CPUE series were made available to the WG:

- Gill-net
- Trawlers
- Danish seiners

All Danish series consist of total effort, total yield and catch numbers at age. The age range is 1–14 and the year range 1987–1999. Effort was expressed as number of days fishing standardized by the vessel length. A directed plaice fishery is carried out by Danish seiners. Plaice is also an important by-catch to otter-trawlers (which target cod and nephrops, but also go for industrial fishing) and gill-netters (which target sole).

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. The whole series has been revised slightly before this WG, however without noticeable effects.

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. 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 estimates of the DFS were 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 results of the 2000 survey will be available shortly after the WG meeting.

The tuning fleets used for the final XSA analysis are presented in Table 9.8.

Table 9.9 and Figure 9.3 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 0.65 and selection at the final age of 0.45. Log catch ratio residuals are shown in Table 9.10. No strong trends appear from this analysis although there are strong negative residuals in the last years and on the youngest ages, which will probably be caused by the lower catchability of the 1996 year class.

Laurec-Shepherd tuned VPA’s were carried out for all available commercial fleets separately, without shrinkage. Results are presented in Figure 9.4 and are summarized below.

For the Dutch beam trawl CPUE, there appears to be a strong year class effect for the 1988 year class, which shows up consistently with negative residuals. Also residuals in the lower left and upper right corner are predominantly positive. The following ages had significant trends in catchability (according to the criterion that the slope exceeds twice their standard error): age 3, 7 and 8. No ages had standard errors of log catchability greater than 0.5 which indicates that the quality of the data is not problematic.

The UK beam trawl CPUE shows no consistent patterns in log catchability residuals, except for the predominant positive residuals in the last three years. The following ages had significant trends in catchability (according to the criterion that the slope exceeds twice their standard error): age 4 and 9. No ages had standard errors of log catchability greater than 0.5.

The Danish fleets all showed very high log catchability residuals. Also residuals are predominantly negative in the earlier years and positive in the last years. For the Gillnet fleet, all ages except ages 10–12 had significant trends in catchability. Standard errors of log catchability were almost consistently higher than 0.5.

The Danish trawler fleet had statistics which performed slightly better. The following ages had significant trends in catchability: age 3, 8 and 11–13. Standard errors of log catchability were below 0.5 for ages: 4–7 and 8–10. This indicates that the most usuable part of the tuning index would be ages 4–10.

For the Danish seiner fleet, the following ages had significant trends in catchability: age 2, 3 and 6–9. Standard errors of log catchability were below 0.5 for ages: 4–6 and 9–10.

The conclusion regarding the commercial tuning fleets is that the Dutch and English beam trawl fleets in combination with the Danish trawler fleet were selected for the final assessment of this stock.

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 the Dutch CPUE data on the one hand, and all the other tuning series on the other hand. The Dutch beam trawl fleet showed negative log catchability residuals in recent years whereas all other fleets showed positive residuals. Also the results of the assessment were found to be sensitive to the assumption about the recruiting ages.

From the diagnostics there were no clear indications that catchability could be considered dependent on year class strength for any of the youngest ages, as there were no consistent significant slopes over different fleets. Last year, it was a priori reasoned 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. However, in this year's assessment, it was found that leaving out the power model for the youngest ages (notably age 3) gave an unrealistic low estimate of fishing mortality on the 1996 year class (0.25 compared to the average of 0.47 in the preceding 5 years). The 1996 year class was estimated very abundant in the recruitment surveys, but has not shown up fully in the catch at age 3 because of reduced growth. It is hypothesized that this will have induced an increase in discard mortality for that cohort, so that the estimated survivors in 2000 with the low F on that age would be an substantial overestimate. Exploratory runs with the separable VPA and a Laurec-Shepherd tuned VPA also indicated that F on this age may be substantially higher than 0.25. Figure 9.5 shows the results of several exploratory runs with regards to the exploitation pattern in 1999, stock numbers at age in 2000 (survivors) and recruitment patterns over the years. Based on the arguments above, it was decided to incorporate the power model again for the ages 1–3, and thereby increase F and reduce survivors in 2000 for the 1996 year class.

9.4.2 Final assessment

The settings of the final XSA assessment are given in the text table below:

year of assessment	**1999**				**2000**			
		years	ages	alpha-beta		years	ages	alpha-beta
Fleets	NL beamtrawl	89-98	2-9	0-1	NL	90-99	2-9	0-1
	UK beamtrawl	89-98	4-12	0-1	UK	90-99	4-12	0-1
	DK trawl				**DK trawl**	**90-99**	**2-9**	**0-1**
	BTS	89-98	1-4	0.66-0.75	BTS	90-99	1-4	0.66-0.75
	SNS	89-98	1-3	0.66-0.75	SNS	90-99	1-3	0.66-0.75
First tuning year	1989				1990			
Last datayear	1998				1999			
Time series weights	none				none			
Catchability dependent on stock size for age <	1				**4**			
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			

As last year, the 1997 survey results for the year classes 1995 and 1996 in the BTS and SNS surveys were not used in the assessment or RCT3, due to age-reading problems in that year.

Diagnostics of the final run are presented in Table 9.11. Figure 9.6 shows the log catchability residuals for the tuning fleets in the final run. Fishing mortality and stock numbers are shown in Tables 9.12 and 9.13. Weighting of the different data sources in the assessment is shown in Figure 9.7, where it is compared with the weighting from last years. The surveys have regained most of the weight on ages 2 and 3 (at the expense of the commercial fleets). The commercial fleets are the dominant source for tuning from ages 4 and upwards. F-shrinkage has a weight between 9 and 17 percent on ages 1 and 3 and generates estimates of survivors which are clearly out of line with the other information. Although this is presumably unrealistic, in the present implementation of XSA, F-shrinkage can not be turned off for younger ages only.

A summary of the assessment is presented in Table 9.14 and Figure 9.8.

A retrospective analysis using a 8 year tuning window shifted backover three years is shown in Figure 9.9. The analysis shows retrospective patterns in both fishing mortality and recruitment with a marked difference between the assessments up to 1997 and 1998. It is unclear which process is responsible for this retrospective pattern.

9.5 Recruitment

Survey data on recruitment are presented in Figure 9.10 for the three available recruitment surveys (BTS, SNS and DFS). The 1996 year class, which gave reason for suspicion due to aging problems in the 1997 survey, showed up very clearly in the 1999 survey as three-year-olds. RCT3 runs were carried out for ages 1, 2 and 3. Inputs for these runs are presented in Table 9.15 and results are in Tables 9.16–9.18. In general the VPA mean received weights ranging from 71% (1999 yc) to 14% (1997 yc).

No additional work has been carried out to investigate the bias problem which was discovered at the 1999 WG. However, on comparing the VPA and RCT3 estimates of recruitment (Figure 9.11) it again appeared that RCT3 tends to overestimate recruitment on average by just over 20%. Therefore, the WG decided, as an intermediate solution to the problem, to correct the recruitment estimates by reducing the RCT3 estimates by 20%.

Even though the XSA estimates of recruitment were influenced by F shrinkage, it was decided to keep the XSA values for year classes 1996–1998 and to use the geometric mean recruitment for the year classes 1999 and 2000. The following text table summarizes the recruitment estimates. Estimates selected for further use in the analysis are denoted in bold and underlined print. All estimates are expressed as year class strength at the respective ages in 2000:

Year class	age in 2000	XSA	RCT3	RCT3 reduced	GM 57–97
1996	4	<u>**349**</u>	--		199
1997	3	<u>**236**</u>	309	247	303
1998	2	<u>**243**</u>	323	258	365
1999	1	--	502	402	<u>**417**</u>
2000	0		521[1)]	410	<u>**417**</u>

[1)] Expressed as abundance at age 1 in 2001.

9.6 Historical stock trends

Figure 9.8 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. In 1999, yield again increased because of the recruitment of the strong 1996 year class.

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 substantially lower than in previous years.

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 year classes 1981 and 1985, SSB again increased to a peak in 1989 and rapidly declined since then. The 1999 SSB is estimated to be just above $B_{\mathbf{lim}}$ (210,000 tonnes), but SSB in 2000 is thought to be around 270,000 tonnes. SSB is still below B_{pa} (300,000 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 relatively small. The ratio of the largest to the smallest year class size (in numbers) is 5. 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 year class appears to be rather strong and is currently estimated at 691 million (4 th in the time series 1957–1999).

9.7 Short-term forecast

The input data to the short-term forecast are given in Table 9.19. 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 scaled to the average F for 1999 (0.3193). Population numbers were taken from the final XSA. Recruitment of year classes 1999–2001 were taken as the long-term geometric mean (1957–1997).

In Table 9.20 the results of a detailed status-quo prediction are shown. The strong 1996 year class is expected to contribute 35% of the landings (in weight) in 2001 (Table 9.21). In 2002, the 1996 year class is expected to contribute 21% to the total SSB. Around 30% of the predicted SSB in 2000 comes from the assumed geometric averaged recruitment of the 2000 and 2001 year classes.

A management option table for status quo fishing mortality in 1999 is presented in Table 9.22. At status quo fishing mortality in 2000 and 2001 the SSB is expected to increase to 270,000 tonnes in 2002. The yield at status quo F is expected to be around 98 kt in 2000 (TAC 97 kt) and 94 kt in 2001. Fishing at F_{pa} in 2001 corresponded to an expected yield of 89 kt in 2001.

9.8 Medium-term forecast

Input to the medium-term forecast is presented in Table 9.23. A 3 year average was used for the catch weight and stock weight-at-age. The exploitation pattern was averaged over three years (1997–1999) and scaled to the average of 1999. A constrained Shepherd stock recruitment curve was used so as to obtain qualitatively the same model as the Butterworth-Berg model. This constrained Shepherd model was implemented 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 9.24. The estimated parameters and the residuals from the fit were exported to the input file for the WGMTERM program.

Results of medium-term forecasts at fishing mortality (F2–8) of 0.2, 0.3, 0.4 and 0.5 using 500 iterations are presented in Figure 9.12. Shown are the median, 25 th and 75 th percentiles of the 500 iterations. Furthermore, 100 realizations of the medium-term forecasts are shown as background to the percentiles. 5 th and 95 t h percentiles are no longer given because there are strong indications that these percentiles are heavily dependent on the method used (Gavaris et al. 2000, Patterson et al. 2000, Restrepo et al. 2000). Nevertheless, the results of the method that has been applied, suggests that fishing at F_{pa} should give a high probability of rebuilding the stock above B_{pa}.

9.9 Biological reference points

A yield-per-recruit analysis was performed, using 10 year average weights at age. Input data for this analysis are given in Table 9.25. Results are presented in Table 9.26. Biological reference points have been calculated and are shown in the text table below and also in Figures 9.13 and 9.14.

Reference point	value
Fmax	0.31
Fhigh	0.50
Fmed	0.29
F0.1	0.15
Fcurr	0.32
Fpa	0.3
Flim	0.6
Bpa	300,000 t.
Blim	210,000 t.

9.10 Comments on the assessment

Figure 9.15 shows the comparison of SSB, F(2–10) and recruitment as estimated in the most recent Working Groups. SSB in 1998 is now estimated slightly higher than in last year’s assessment and fishing mortality is lower. On the whole, the outlook from the current assessment is however reasonably consistent with previous assessments.

The 1996 year class for North Sea plaice (as for North Sea cod) is the main reason for worry. This is probably the strongest year class since the strong 1985 year class. However, because of the reduced growth of this cohort, recruitment to the fishery has been retarded by almost a year. This causes a discrepancy in the assessment because we have high recruitment estimates from the recruitment surveys and low catch numbers at age 3, which would suggest a low fishing mortality on that cohort and a high number of survivors in 2000. It is hypothesized that the reduced growth will have resulted in an increased discard mortality for that year class. Therefore, the survivors in 2000 should actually be lower than when estimated with the low F. In this assessment, this was accomplished by re-introducing the power-model for the recruiting ages (1–3). The separable model and the Laurec-Shepherd tuned VPA also suggested a higher F and lower survivors, and this information was used to determine the final configuration of the XSA assessment.

The assessment should still be considered suspicious, because the low mean F is not confirmed by external information. There is no information from the fishery that effort has substantially reduced. Therefore, the reduction in mean fishing mortality from 0.46 (1997) to 0.32 (1999) may be misleading.

The short-term prediction seems to be more in line with the perception of the catch possibilities for the stock. Last year, the yield in 1999 corresponding to the status quo fishing mortality (127 kt.) was far higher than the agreed TAC for that year (102 kt.) which was again based on an F = 0.3 in the 1998 forecast. In this year's WG, the yield in 2000 at status quo fishing mortality is predicted to be 98 kt. which is close to the agreed TAC (95 kt.), and can be explained by a slightly higher fishing mortality than used to set the TAC.

Table 9.1 North Sea plaice. Nominal landings in Sub-area IV as officially reported to ICES, 1993-1999.

	1993	1994	1995	1996	1997	1998	1999
Belgium	10,814	7,951	7,093	5,765	5,223	5,592	6,160
Denmark	16,452	17,056	13,358	11,776	13,940	*10,087*	*13,468*
France	603	407	442	379	254	489	624
Germany	6,895	5,697	6,329	4,780	4,159	*2,773*	*3,144*
Netherlands	48,552	50,289	44,263	35,419	34,143	*30,541*	*37,513*
Norway	827	524	527	917	1,775	*1,004*	*913*
Sweden	7	6	3	5	10	*2*	*4*
UK (E/W/NI)	20,586	17,806	15,801	13,541	13,789	*11,473*	*9,743*
UK (Scotland)	10,542	9,943	8,594	7,451	8,345	*8,442*	*7,318*
Others						*1*	
total	115,278	109,679	96,410	80,033	81,638	70,404	78,887
Unallocated	1,835	713	1,946	1,640	1,410	1,130	1,775
WG estimate	**117,113**	**110,392**	**98,356**	**81,673**	**83,048**	***71,534***	***80,662***
TAC	175,000	165,000	115,000	81,000	*91,000*	*87,000*	*102,000*

Table 9.2 Beam trawl (BT) effort and landings by UK vessels into England and Wales (columns A and B). Beam trawl effort and landings by England and Wales vessels outside the UK (columns C and D), the respective sums of both (E and F) and the proportion of beam trawl effort and landings outside the UK (C and D) to the total (E and F). Effort is expressed in million HP days; landings in tonnes.

Column	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
year	**UK BT landings into EN+WA**		**EN+WA BT landings outside UK**		**Sum**		**Proportion outside UK**	
	effort	**yield**	**effort**	**yield**	**effort**	**yield**	**effort**	***yield***
1990	102.3	8820	48.7	2836	151.0	11656	*32%*	*24%*
1991	123.6	8607	74.2	4415	197.8	13022	*38%*	*34%*
1992	151.5	8955	97.4	6813	248.9	15768	*39%*	*43%*
1993	146.6	7544	129.9	9088	276.5	16632	*47%*	*55%*
1994	131.4	6232	118.8	8071	250.2	14303	*47%*	*56%*
1995	105.0	5152	116.9	7540	221.9	12692	*53%*	*59%*
1996	82.9	3778	105.3	7686	188.2	11464	*56%*	*67%*
1997	76.3	4193	96.7	7015	173.0	11208	*56%*	*63%*
1998	68.8	3819	95.4	5431	164.2	9250	*58%*	*59%*
1999	68.6	3075	95.7	5147	164.3	8222	*58%*	*63%*

Table 9.3 North Sea plaice: natural mortality and maturity at age

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Natural mortality	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maturity	0	0.5	0.5	1	1	1	1	1	1	1	1	1	1	1	1

Table 9.4 North Sea plaice, catch numbers at age (thousands)

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	3,
2,	5959,	2264,	2147,	4340,	14708,	9858,	4144,	5982,	9474,	15017,
3,	61876,	33392,	35876,	21471,	40486,	42202,	65009,	30304,	40698,	45187,
4,	51022,	67906,	66779,	76926,	64735,	53188,	51488,	112917,	38140,	36084,
5,	21321,	32699,	50060,	54364,	57408,	43674,	36667,	41383,	123619,	35585,
6,	27329,	12759,	20628,	31799,	37091,	30151,	27370,	22053,	17139,	102014,
7,	14186,	14680,	9060,	12848,	15819,	18361,	16500,	16175,	10341,	10410,
8,	9013,	9748,	9035,	6833,	6595,	8554,	10784,	8004,	10102,	6086,
9,	5087,	5996,	5257,	7047,	3980,	4213,	6467,	6728,	3925,	8192,
10,	4711,	3446,	3428,	3863,	3804,	4015,	3336,	3045,	4891,	3739,
11,	3418,	3621,	2659,	3591,	3066,	2807,	1843,	2033,	2273,	4760,
12,	2391,	2887,	2266,	2117,	1905,	2221,	2552,	968,	1556,	1796,
13,	1966,	1743,	2001,	2089,	1518,	1745,	1624,	1303,	607,	1223,
14,	1014,	1345,	1061,	1536,	1300,	1338,	1032,	783,	1007,	703,
+gp,	1653,	1618,	1386,	3396,	5293,	5461,	4541,	3043,	3031,	3871,
0 TOTALNUM,	210946,	194104,	211643,	232220,	257708,	227788,	233357,	254721,	266803,	274670,
TONSLAND,	87541,	85984,	87472,	107118,	110540,	97143,	101834,	108819,	111534,	121651,
SOPCOF %,	101,	102,	97,	102,	101,	101,	102,	102,	103,	106,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	76,	19,	2233,	1268,	2223,	981,	2820,	3220,	1143,	1318,
2,	17294,	29591,	36528,	31733,	23120,	28124,	33643,	56969,	60578,	58031,
3,	51174,	48282,	62199,	59099,	55548,	61623,	77649,	43289,	62343,	118863,
4,	56153,	33475,	52906,	73065,	42125,	31262,	96398,	66013,	54341,	48962,
5,	40686,	26059,	23043,	42255,	41075,	25419,	13779,	83705,	50102,	47886,
6,	35074,	22903,	16998,	13817,	19666,	21188,	9904,	9142,	35510,	39932,
7,	78886,	16913,	14380,	8885,	8005,	11873,	9120,	5912,	5940,	24228,
8,	6311,	29730,	10903,	9848,	6321,	5923,	6391,	5022,	3352,	4161,
9,	4185,	6414,	18585,	6084,	5568,	4106,	2947,	4061,	2419,	2807,
10,	4778,	4602,	3467,	13829,	3931,	3337,	2020,	1927,	2176,	2333,
11,	2202,	3377,	2841,	1680,	10118,	1741,	2111,	1301,	1145,	1849,
12,	2871,	2213,	2538,	1995,	1634,	7935,	911,	1357,	603,	1113,
13,	1150,	1910,	1553,	1516,	1686,	1080,	4478,	489,	689,	707,
14,	939,	929,	1591,	1355,	1242,	1424,	388,	2290,	330,	707,
+gp,	2900,	3879,	3661,	3603,	3369,	4178,	2644,	1827,	2525,	2579,
0 TOTALNUM,	304679,	230296,	253426,	270032,	225631,	210194,	265203,	286524,	283196,	355476,
TONSLAND,	130342,	113944,	122843,	130429,	112540,	108536,	113670,	119188,	113984,	145347,
SOPCOF %,	97,	103,	103,	105,	104,	106,	103,	100,	96,	100,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	979,	253,	3334,	1214,	108,	121,	1674,	0,	0,	1261,
2,	64904,	100927,	47776,	119695,	63252,	73552,	67125,	85123,	15146,	46757,
3,	133741,	122296,	209007,	115034,	274209,	144316,	163717,	115951,	250675,	105929,
4,	77523,	57604,	69544,	99076,	53549,	185203,	93801,	111239,	74335,	231414,
5,	24974,	35745,	28655,	29359,	37468,	32520,	84479,	64758,	47380,	52909,
6,	17982,	12414,	16726,	12906,	13661,	15544,	24049,	34728,	25091,	19247,
7,	13761,	9564,	7589,	8216,	6465,	6871,	9299,	11452,	16774,	10567,
8,	8458,	8092,	5470,	4193,	5544,	3650,	4490,	4341,	5381,	7561,
9,	1864,	4874,	4482,	3013,	2720,	2698,	2733,	2154,	3162,	2120,
10,	1326,	1406,	3706,	2947,	2088,	1543,	2026,	1743,	1671,	1692,
11,	952,	1097,	1134,	2144,	1307,	1030,	1178,	1033,	932,	927,
12,	1173,	830,	712,	1219,	1143,	1070,	1084,	663,	932,	630,
13,	433,	796,	575,	581,	455,	727,	806,	529,	505,	446,
14,	284,	468,	519,	344,	310,	371,	628,	296,	516,	328,
+gp,	1209,	1306,	2007,	1052,	1262,	1057,	1228,	1214,	1677,	1557,
0 TOTALNUM,	349563,	357672,	401236,	400993,	463541,	470273,	458317,	435224,	444177,	483345,
TONSLAND,	139951,	139747,	154547,	144038,	156147,	159838,	165347,	153670,	154475,	169818,
SOPCOF %,	101,	102,	101,	99,	98,	98,	99,	99,	98,	99,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	1512,	1416,	3196,	3170,	1288,	6981,	963,	616,	176,	501,
2,	31766,	42027,	41447,	49674,	41773,	33499,	37503,	34132,	27796,	8152,
3,	96067,	81484,	81827,	93111,	95773,	76526,	57925,	80307,	64146,	146167,
4,	109559,	113986,	70534,	70839,	77935,	76168,	43759,	46941,	53948,	38798,
5,	160287,	72475,	71836,	51090,	39615,	35882,	32512,	22337,	16693,	24391,
6,	26895,	78494,	33685,	29811,	21353,	18947,	15054,	15667,	6908,	7238,
7,	8431,	15113,	30684,	13805,	15850,	10669,	11579,	8220,	5567,	3258,
8,	4410,	5509,	7253,	12710,	6690,	5054,	5427,	6420,	2886,	2840,
9,	3717,	3267,	3450,	4128,	6155,	2688,	3324,	2991,	2329,	1948,
10,	1176,	2565,	2497,	2235,	2745,	2174,	1999,	1395,	1391,	1558,
11,	767,	1039,	1786,	1588,	1134,	1321,	1735,	783,	689,	891,
12,	487,	670,	1006,	1173,	820,	631,	867,	1126,	555,	559,
13,	325,	396,	624,	861,	768,	370,	512,	575,	777,	364,
14,	235,	332,	629,	310,	459,	396,	427,	302,	305,	468,
+gp,	1222,	1296,	1648,	1321,	1022,	937,	1537,	1033,	1353,	1028,
0 TOTALNUM,	446856,	420069,	352102,	335826,	313380,	272243,	215123,	222845,	185519,	238161,
TONSLAND,	156240,	148004,	125190,	117113,	110392,	98356,	81673,	83048,	71534,	80662,
SOPCOF %,	98,	96,	98,	98,	99,	100,	99,	99,	99,	99,

Table 9.5 Comparison of 'normally' raised age composition in 1999 for North Sea plaice (2nd column) to the raised age composition where the English 'flag-vessels' were raised against the international age composition (3rd column). Last column has the relative difference between columns 3 and 2.

Age	Original age comp.	Flag vessels raised to Int. Age Comp.	Relative difference
1	501	544	8%
2	8152	8632	6%
3	146167	154913	6%
4	38798	39733	2%
5	24391	24126	-1%
6	7238	6869	-5%
7	3258	2828	-13%
8	2840	2309	-19%
9	1948	1570	-19%
10	1558	1226	-21%
11	891	556	-38%
12	559	400	-28%
13	364	245	-33%
14	468	289	-38%
15	1028	577	-44%

Table 9.6 North Sea plaice, catch weights at age (kg)

Table 2 Catch weights at age (kg)

YEAR, AGE	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.2170,
2,	.2000,	.1910,	.2110,	.2530,	.2500,	.2420,	.2320,	.2320,	.2670,	.2940,
3,	.2360,	.2330,	.2480,	.2860,	.2730,	.2820,	.2700,	.2790,	.2980,	.3100,
4,	.2890,	.3020,	.3000,	.3190,	.3120,	.3210,	.3480,	.3220,	.3310,	.3330,
5,	.3860,	.4120,	.4000,	.3990,	.3880,	.3850,	.4360,	.4250,	.3660,	.3590,
6,	.4850,	.5090,	.5410,	.5330,	.4870,	.4710,	.4840,	.5470,	.5170,	.4120,
7,	.6010,	.6040,	.5700,	.6240,	.6280,	.5390,	.5590,	.5970,	.5900,	.5730,
8,	.6830,	.6710,	.6920,	.6670,	.7000,	.6630,	.6240,	.6620,	.5960,	.6550,
9,	.7240,	.8120,	.7770,	.7150,	.7370,	.7260,	.6900,	.7380,	.6860,	.6580,
10,	.8740,	.8700,	.9590,	.8600,	.8410,	.6150,	.8130,	.8370,	.7500,	.6940,
11,	.9590,	.9420,	.9950,	.9200,	.8900,	.7920,	.8580,	.8700,	.8170,	.8100,
12,	1.1620,	1.0330,	1.1000,	1.0330,	.9540,	.8570,	.8430,	.9020,	.9390,	.8380,
13,	1.2320,	1.2240,	1.1870,	1.0040,	.9380,	.9740,	.9430,	.9500,	.9360,	1.0220,
14,	1.3600,	1.2390,	1.4100,	1.1820,	1.0980,	.8780,	1.0180,	1.0320,	.9730,	.8630,
+gp,	1.5720,	1.5530,	1.5400,	1.2760,	1.2040,	1.1210,	1.0800,	1.2140,	1.2010,	1.1790,
0 SOPCOFAC,	1.0067,	1.0156,	.9665,	1.0193,	1.0075,	1.0057,	1.0182,	1.0198,	1.0291,	1.0582,

YEAR, AGE	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
1,	.3150,	.2560,	.2460,	.2720,	.2850,	.2490,	.2650,	.2540,	.2440,	.2350,
2,	.2860,	.3180,	.2960,	.3160,	.3110,	.3000,	.2950,	.3230,	.3150,	.3110,
3,	.3180,	.3560,	.3520,	.3440,	.3540,	.3300,	.3380,	.3530,	.3690,	.3490,
4,	.3560,	.4030,	.4280,	.4050,	.4050,	.4200,	.3750,	.3800,	.3970,	.3880,
5,	.4190,	.4480,	.4930,	.4860,	.4760,	.4950,	.5130,	.4180,	.4380,	.4290,
6,	.4430,	.5140,	.5410,	.5390,	.5540,	.5870,	.5940,	.5560,	.4910,	.4740,
7,	.4990,	.5420,	.6080,	.6050,	.6090,	.6360,	.6410,	.6470,	.6090,	.5500,
8,	.6720,	.6070,	.6460,	.6270,	.6930,	.7030,	.7050,	.7210,	.6870,	.6750,
9,	.7440,	.6990,	.6740,	.6770,	.7070,	.7830,	.7410,	.7150,	.7760,	.7960,
10,	.7620,	.7240,	.7850,	.7290,	.7790,	.8530,	.8130,	.7910,	.7810,	.8710,
11,	.7800,	.8180,	.8410,	.9780,	.8490,	.8540,	.8510,	.8980,	.8860,	.8180,
12,	.8920,	.8480,	.9010,	.9070,	.9710,	.9830,	.9280,	.9700,	.9830,	.8940,
13,	.9410,	.9220,	.9000,	.9420,	1.0020,	.9530,	1.0190,	.8550,	1.0390,	1.0830,
14,	1.0210,	1.0040,	.9640,	.9830,	1.0400,	1.1380,	1.0090,	1.0630,	.9330,	1.0440,
+gp,	1.1280,	1.1330,	1.1920,	1.0790,	1.2240,	1.2640,	1.1590,	1.1650,	1.0940,	1.1150,
0 SOPCOFAC,	.9744,	1.0331,	1.0283,	1.0508,	1.0369,	1.0624,	1.0254,	1.0016,	.9643,	.9983,

YEAR, AGE	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
1,	.2380,	.2370,	.2790,	.2000,	.2330,	.2470,	.2210,	.2210,	.2210,	.2360,
2,	.2860,	.2740,	.2620,	.2500,	.2630,	.2640,	.2690,	.2490,	.2540,	.2800,
3,	.3440,	.3290,	.3110,	.3000,	.2830,	.2900,	.3040,	.3000,	.2780,	.3090,
4,	.4010,	.4160,	.4240,	.3830,	.3750,	.3370,	.3470,	.3510,	.3520,	.3320,
5,	.4730,	.5050,	.5140,	.5150,	.4910,	.4620,	.4250,	.4020,	.4530,	.3920,
6,	.5450,	.5580,	.6080,	.6040,	.6130,	.5770,	.4880,	.5040,	.5120,	.5330,
7,	.5880,	.6040,	.6640,	.6770,	.6840,	.6780,	.6750,	.5830,	.6080,	.6030,
8,	.6620,	.6420,	.7120,	.7710,	.7250,	.7290,	.7510,	.7280,	.6990,	.6700,
9,	.7720,	.7250,	.7380,	.8150,	.8370,	.8040,	.8530,	.8290,	.8130,	.7920,
10,	.9310,	.8690,	.8400,	.8930,	.9160,	.9000,	.9210,	.8260,	.9360,	.8190,
11,	.9430,	.9500,	.9830,	.9130,	.9810,	1.0010,	.9480,	.9960,	.9640,	.9230,
12,	.8480,	.9310,	1.0450,	.9840,	1.0260,	.9500,	1.0630,	1.0150,	1.0410,	.9520,
13,	1.0150,	.9330,	1.1740,	1.2400,	1.1120,	1.0710,	1.0780,	1.0450,	1.1370,	1.1570,
14,	1.3080,	1.1790,	.9700,	1.2090,	1.2500,	1.1390,	1.0740,	1.1270,	1.1150,	1.0840,
+gp,	1.2480,	1.2360,	1.1770,	1.1670,	1.2140,	1.2150,	1.1100,	1.1500,	1.0380,	.9940,
0 SOPCOFAC,	1.0136,	1.0175,	1.0062,	.9938,	.9844,	.9799,	.9877,	.9875,	.9848,	.9854,

YEAR, AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
1,	.2710,	.2270,	.2510,	.2490,	.2330,	.2720,	.2400,	.2080,	.1520,	.2450,
2,	.2850,	.2860,	.2630,	.2730,	.2630,	.2770,	.2800,	.2710,	.2600,	.2540,
3,	.2980,	.2950,	.2910,	.2900,	.2870,	.3020,	.3100,	.3140,	.3120,	.2820,
4,	.3180,	.3070,	.3200,	.3270,	.3390,	.3410,	.3610,	.3660,	.3980,	.3600,
5,	.3680,	.3670,	.3440,	.3580,	.3920,	.4030,	.4280,	.4470,	.5010,	.4600,
6,	.4480,	.4560,	.4270,	.4240,	.4400,	.4500,	.4910,	.5110,	.6020,	.5510,
7,	.5960,	.5280,	.5310,	.5190,	.4960,	.5170,	.5030,	.5570,	.6260,	.6250,
8,	.6870,	.6640,	.6030,	.6180,	.5910,	.5880,	.5720,	.5310,	.6770,	.6600,
9,	.7520,	.7380,	.7040,	.6930,	.6960,	.7030,	.6910,	.6350,	.6740,	.7090,
10,	.8170,	.8220,	.7370,	.7550,	.7320,	.8190,	.8080,	.7540,	.7190,	.6190,
11,	1.0250,	.9020,	.8090,	.7710,	.8560,	.7750,	.8400,	.8550,	.8880,	.6990,
12,	1.0770,	.9170,	.9240,	.8730,	.8700,	.8220,	.8490,	.8770,	.9810,	.8570,
13,	1.0960,	.9790,	.9690,	.8250,	.9210,	.8670,	.8160,	.8380,	.8210,	.9350,
14,	.9680,	.9440,	.8790,	.8700,	.7870,	.8720,	.7840,	.9920,	.8750,	.8960,
+gp,	1.0750,	1.0040,	1.0590,	1.0360,	.9790,	1.0360,	.8510,	1.0330,	.9110,	1.0370,
0 SOPCOFAC,	.9827,	.9644,	.9827,	.9791,	.9858,	.9977,	.9854,	.9862,	.9858,	.9864,

Table 9.7 North Sea plaice, stock weights at age (kg) derived from 1st quarter catch weights

Table 3 Stock weights at age (kg)

YEAR, AGE	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
1,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1410,	.1750,
2,	.1900,	.1260,	.1870,	.2000,	.2000,	.2000,	.2000,	.2030,	.2000,	.2030,
3,	.2080,	.2020,	.2580,	.2320,	.2280,	.2460,	.2430,	.2460,	.2650,	.2580,
4,	.2400,	.2540,	.3060,	.2900,	.2760,	.2740,	.3010,	.2810,	.3010,	.2970,
5,	.3640,	.3370,	.4240,	.3780,	.3730,	.3330,	.4030,	.4420,	.3440,	.3440,
6,	.4690,	.4830,	.5730,	.5400,	.4770,	.4300,	.4550,	.5280,	.5320,	.3900,
7,	.6330,	.5790,	.6840,	.6630,	.6450,	.5160,	.5030,	.5850,	.5920,	.5650,
8,	.7260,	.6910,	.8060,	.7880,	.6730,	.6010,	.5650,	.6500,	.3620,	.6210,
9,	.8450,	.7790,	.8730,	.8820,	.8450,	.7220,	.5810,	.7030,	.6670,	.6790,
10,	.9180,	.9110,	1.3350,	.9610,	.9730,	.5780,	.8480,	.8330,	.7460,	.6350,
11,	.9750,	.9470,	1.0740,	1.0970,	.9990,	.7900,	.9490,	.9070,	.7910,	.7720,
12,	1.1260,	1.0790,	1.2400,	1.2610,	1.2550,	.8430,	.7040,	1.0070,	.9190,	.7410,
13,	1.1480,	1.1840,	1.1410,	1.2460,	1.2010,	1.0720,	1.0520,	.8980,	.8100,	.9950,
14,	1.3730,	1.1860,	1.8000,	1.4030,	1.6200,	.7210,	1.0560,	.9760,	.9380,	.9070,
+gp,	1.5220,	1.4240,	1.6190,	1.6780,	1.4600,	1.2340,	1.2160,	1.2210,	1.1700,	1.1790,

YEAR, AGE	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
1,	.1750,	.1750,	.1750,	.1750,	.1700,	.1700,	.1700,	.1600,	.1500,	.1500,
2,	.2500,	.2480,	.2740,	.2640,	.2340,	.2750,	.2170,	.2500,	.2420,	.2430,
3,	.2610,	.3050,	.3210,	.3220,	.3040,	.2940,	.2810,	.3090,	.3360,	.3030,
4,	.3110,	.3630,	.4010,	.3800,	.3750,	.4170,	.3320,	.3640,	.3670,	.3630,
5,	.3690,	.4130,	.4730,	.4680,	.4370,	.4830,	.4840,	.4050,	.4110,	.4140,
6,	.4100,	.4890,	.5340,	.5210,	.5240,	.5440,	.5500,	.5510,	.4670,	.4590,
7,	.4680,	.5120,	.5790,	.5660,	.5700,	.6100,	.5930,	.6270,	.5470,	.5430,
8,	.6360,	.5830,	.6060,	.5830,	.6290,	.6680,	.6580,	.6900,	.6300,	.6670,
9,	.7320,	.6960,	.6550,	.6170,	.6520,	.7040,	.6940,	.6670,	.7040,	.7640,
10,	.7470,	.7070,	.7590,	.6900,	.6900,	.7620,	.7430,	.7590,	.7730,	.8260,
11,	.7710,	.8170,	.8150,	.9260,	.7740,	.8300,	.7840,	.8180,	.8480,	.8940,
12,	.8980,	.8470,	.8690,	.8990,	.9320,	.8860,	.8750,	.9090,	.9390,	.8800,
13,	.8390,	.9410,	.8490,	.9610,	1.0170,	.8740,	.9720,	.8380,	.9590,	1.1270,
14,	1.1550,	.9360,	.9710,	.9770,	.9620,	1.0700,	1.1580,	1.0550,	1.0240,	1.0410,
+gp,	1.1750,	1.1020,	1.2370,	.9980,	1.1130,	1.2170,	1.1070,	1.1160,	1.1190,	1.2550,

YEAR, AGE	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
1,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,
2,	.2290,	.2500,	.2420,	.2110,	.2030,	.2080,	.1950,	.1940,	.2120,	.2150,
3,	.3070,	.2820,	.2650,	.2480,	.2420,	.2430,	.2530,	.2650,	.2380,	.2480,
4,	.3720,	.3780,	.3810,	.3290,	.3380,	.3100,	.3360,	.3300,	.3150,	.2820,
5,	.4440,	.4730,	.4900,	.4940,	.4640,	.4520,	.4400,	.4010,	.4260,	.3620,
6,	.5240,	.5360,	.5890,	.5590,	.5710,	.5360,	.5330,	.5030,	.4670,	.4840,
7,	.5820,	.5700,	.6310,	.6240,	.6490,	.6350,	.6920,	.5730,	.5470,	.5530,
8,	.6510,	.6240,	.6790,	.7120,	.6920,	.6560,	.7790,	.7110,	.6440,	.6160,
9,	.7780,	.7070,	.7260,	.7540,	.7870,	.7640,	.8880,	.7470,	.7060,	.7590,
10,	1.0250,	.8490,	.8280,	.7910,	.8980,	.8690,	.9710,	.8170,	.8970,	.8370,
11,	.9470,	.9100,	.9810,	.8240,	.9320,	.9550,	.9530,	1.0090,	.9370,	.7910,
12,	.8380,	.8660,	1.0660,	1.0110,	1.0420,	.9060,	1.1070,	1.0180,	1.0090,	.9680,
13,	1.2090,	1.1140,	1.1820,	1.1300,	1.2350,	1.0680,	1.1530,	1.0190,	1.0650,	1.2150,
14,	1.1940,	1.2180,	.8970,	1.2570,	1.1270,	1.1080,	1.1260,	1.2140,	1.1350,	.8990,
+gp,	1.3100,	1.3240,	1.1970,	1.1240,	1.2350,	1.3080,	1.3540,	1.1140,	.9720,	.8570,

YEAR, AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
1,	.1500,	.1310,	.1310,	.1310,	.1310,	.1240,	.1240,	.1240,	.1240,	.1240,
2,	.2450,	.2080,	.2620,	.2570,	.2220,	.2450,	.2450,	.2120,	.2050,	.2110,
3,	.2720,	.2630,	.2670,	.2640,	.2490,	.2650,	.2830,	.2530,	.2700,	.2520,
4,	.2820,	.2760,	.3010,	.3020,	.3010,	.3120,	.3300,	.3460,	.3650,	.3490,
5,	.3430,	.3420,	.3180,	.3300,	.3600,	.3990,	.3900,	.4390,	.4740,	.4370,
6,	.4220,	.4010,	.4030,	.3910,	.4040,	.4480,	.4620,	.4920,	.5770,	.5240,
7,	.5550,	.4630,	.5000,	.4900,	.4620,	.5090,	.4880,	.5210,	.5810,	.5860,
8,	.6470,	.6330,	.5730,	.5870,	.5330,	.5840,	.5540,	.5430,	.6480,	.6440,
9,	.7010,	.6520,	.6830,	.6330,	.6530,	.6780,	.6600,	.6270,	.6560,	.6640,
10,	.7600,	.7440,	.7300,	.7230,	.7020,	.7890,	.7910,	.7340,	.6420,	.6200,
11,	1.0170,	.8240,	.8030,	.7640,	.8640,	.6690,	.7950,	.8470,	.9240,	.7150,
12,	1.1440,	.9600,	.8520,	.9140,	.8790,	.8200,	.8450,	.8300,	1.0030,	.8290,
13,	.9960,	.9510,	.9580,	.7980,	.9390,	.8520,	.7250,	.8240,	.7360,	1.0060,
14,	1.0460,	.8250,	.7740,	.8220,	.7010,	.9000,	.7630,	1.1170,	1.1430,	.8300,
+gp,	1.0680,	.8910,	1.0160,	.9690,	.8880,	1.1100,	.8960,	1.0220,	.8050,	1.0470,

Table 9.8 North Sea plaice: tuning fleets

```
Plaice in the North Sea (Area IV)
105
NL Beam Trawl (1)
   1989      1999
    1         1        0.0       1.0
    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        23098     45655     18156      6884      4337      2016       975       460
   70.3       15288     32486     26751      6389      2290      1359       669       314
   67.3        4341     76295     18251     11058      2999       998       833       506

UK Beamtrawl (2)
   1988      1999
    1         1         0         1
    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        3932      2161      1493      1447       840      1004       767       324       266
  164.6        2702      2794      1223       875       980       690       599       515       262

DK Trawlers (3)
   1987      1999
    1         1        0.0       1.0
    2         9
   9219      1208.4    4024.9    3341.8    2642.6    1710.2     496.8      79.2      30.3
   6553        72.6    5797.0    2212.0     888.7     484.3     201.3      57.0      17.6
   7886        50.2    1633.0   11842.7    3349.8     517.4     160.2      57.2      25.1
  10274       162.4    3294.2    9747.4   11811.5    1108.8     161.8      82.5      38.8
   9703       787.8    3054.1    6732.5    5043.1    3467.7     450.3     101.1      63.5
   6171       560.7    1469.2    1808.0    2531.3    1094.8     768.4     127.4      50.3
   5203       182.7    2308.4    1928.0    1679.2     793.4     215.1     151.2      57.5
   5537       427.2    3152.1    1936.8     931.8     457.3     244.9      78.3      57.2
   4579       207.9    1357.5    1615.0     775.3     302.1     114.5      32.5      12.0
   4543       671.8    1871.1     721.2     538.5     264.1     204.7      69.7      26.7
   4037      1319.5    3906.3    1918.4     582.0     394.6     203.6     191.7      28.8
   4572      1959.0    2851.0    1888.0     601.0     182.0     185.0      74.0      52.0
   6145       576.0   13197.0    1415.0    1036.0     249.0     109.0      52.0      33.0

BTS (4)
   1985      1999
    1         1        0.66      0.75
    1         4
    1      115.52    179.92    38.81     11.82
    1      660.2     131.77    50.87     8.93
    1      225.14    764.98    33.07     4.79
    1      605.15    139.9     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      122.6     180.98    38.79     6.13
    1      141.7     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       -11       19.85     3.13
    1      347.61    422.17    52.12     8.2
    1      311.9     137.29    183.15    4.01
```

Table 9.8 (Continued)

```
SNS (4)
   1982      1999
    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          35188      9235     14347
```

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) Effort specified in standardized effort series, catchnumbers in thousands. Source: DIFRES.
4) Source: RIVO-DLO.

Table 9.9 North Sea plaice: effort and CPUE trends for the NL, UK and DK commercial fleets

Effort	NL beam	UK beam	DK Danish seine	DK Gill-netters	DK Trawlers
Unit	HP days * 100000	HP days *million	Standardized effort	Standardized effort	Standardized effort
1979	44.3				
1980	45.0				
1981	46.3				
1982	57.3				
1983	65.6				
1984	70.8				
1985	70.3	23.7			
1986	68.2	49.7			
1987	68.4	93.5	13356	6424	9219
1988	76.2	123.3	14419	7132	6553
1989	72.5	150.5	15216	7021	7886
1990	71.1	151.0	12946	7429	10274
1991	68.5	197.8	14304	11375	9703
1992	71.1	248.9	12644	13158	6171
1993	76.9	276.5	11151	14190	5203
1994	81.4	250.2	8207	18486	5537
1995	81.2	222.1	7600	16395	4579
1996	72.1	188.2	6630	14399	4543
1997	72.0	173.0	4720	12447	4037
1998	70.3	164.2	4331	11457	4572
1999	67.3	164.6	5266	12764	6145

CPUE	NL beam	UK beam	DK Danish seine	DK Gill-netters	DK Trawlers
1979	1693				
1980	1729				
1981	1853				
1982	1707				
1983	1441				
1984	1439				
1985	1511	77.7			
1986	1651	78.6			
1987	1440	87.6	0.677	0.324	0.469
1988	1194	90.6	0.828	0.226	0.449
1989	1379	87.0	0.898	0.183	0.626
1990	1104	81.2	0.939	0.179	0.709
1991	1022	68.7	0.544	0.387	0.594
1992	745	66.9	0.601	0.408	0.449
1993	656	59.6	0.543	0.314	0.431
1994	626	63.9	0.527	0.341	0.400
1995	565	57.2	0.457	0.315	0.296
1996	510	60.8	0.515	0.349	0.339
1997	492	64.7	1.002	0.352	0.684
1998	451	56.4	0.741	0.205	0.533
1999	577	***50.0***	0.771	0.146	0.734

Table 9.10. North Sea plaice: separable VPA diagnostics

Title : Plaice in IV

At 25/09/2000 17:13

Separable analysis
from 1990 to 1999 on ages 1 to 14
with-terminal F of .650 on age 4 and-terminal S of .450

Initial sum of squared residuals was   183.969 and
final sum of squared residuals is   8.889 after 47 iterations

Matrix of Log catch ratio Residuals

Years,	1990/91,	1991/92,	1992/93,	1993/94,	1994/95,	1995/96,	1996/97,	1997/98,	1998/99,	TOT,	WTS,
1/ 2,	.136,	.049,	.583,	.690,	-.160,	1.651,	-.288,	-.726,	-.489,	-.010,	.147,
2/ 3,	.171,	.376,	.110,	.196,	.101,	.392,	.116,	.075,	-.691,	-.007,	.336,
3/ 4,	-.209,	-.006,	-.165,	-.216,	-.304,	.286,	-.142,	-.120,	.277,	-.003,	.499,
4/ 5,	-.038,	-.116,	-.431,	-.266,	-.215,	.140,	-.126,	.065,	.136,	-.002,	.554,
5/ 6,	.210,	.143,	.086,	-.013,	-.296,	.114,	-.110,	.159,	.132,	.000,	.661,
6/ 7,	.211,	.463,	.253,	-.095,	-.181,	-.110,	-.079,	.175,	.195,	.001,	.491,
7/ 8,	-.057,	.147,	.137,	-.106,	.158,	-.035,	-.201,	.074,	.005,	.001,	.849,
8/ 9,	-.044,	.032,	-.020,	.061,	.091,	-.136,	-.034,	.201,	-.123,	-.001,	1.000,
9/10,	.008,	-.179,	-.155,	-.259,	.214,	-.267,	.233,	-.057,	-.126,	-.004,	.574,
10/11,	-.188,	-.025,	-.069,	.083,	-.027,	-.274,	.369,	-.053,	-.023,	-.007,	.592,
11/12,	.025,	-.149,	.109,	.277,	.041,	.130,	.075,	-.202,	-.052,	-.008,	.725,
12/13,	.056,	-.153,	-.198,	-.003,	.207,	-.125,	.010,	-.218,	.118,	-.007,	.718,
13/14,	-.169,	-.682,	.350,	.207,	.079,	-.472,	.132,	.049,	.208,	-.005,	.310,
TOT ,	.002,	-.002,	-.006,	-.009,	-.009,	-.008,	-.006,	-.002,	-.001,	1.105,	
WTS ,	.001,	.001,	.001,	.001,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
F-values,	.4725,	.5743,	.6809,	.7354,	.7511,	.6399,	.6921,	.7122,	.5948,	.6500,

Selection-at-age (S)

,	1,	2,	3,	4,
S-values,	.0067,	.2056,	.7293,	1.0000,

,	5,	6,	7,	8,	9,	10,	11,	12,	13,	14,
S-values,	.9625,	.8448,	.8212,	.6796,	.6128,	.5198,	.4443,	.4577,	.4534,	.4500,

Log catch-ratio residuals by age and year. Bubbles are scaled to the maximum of 2.5. Note that age are reported as lower ages only, i.e. age 1 should be read as age 1/2. Similarly year 1990 should be read as year 1990-91.

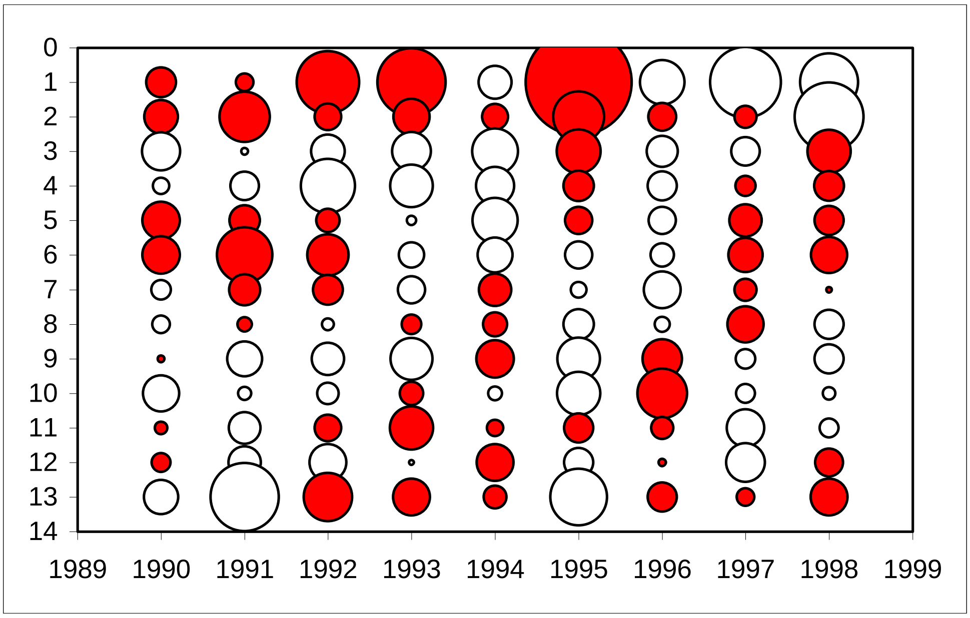


Table 9.11. North Sea plaice: XSA diagnostics

```
Lowestoft VPA Version 3.1
    9/10/2000  10:49
 Extended Survivors Analysis
 Plaice in IV (run: XSAULI05/X05)
 CPUE data from file fleet
 Catch data for  43 years. 1957 to 1999. Ages  1 to  15.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 FLT01: NL Beam Trawl,   1990, 1999,   2,     9,   .000,  1.000
 FLT02: UK Beam trawl,   1990, 1999,   4,    12,   .000,  1.000
 FLT03: DK Trawlers (,   1990, 1999,   2,     9,   .000,  1.000
 FLT04: BTS (Catch: U,   1990, 1999,   1,     4,   .660,   .750
 FLT05: SNS (Catch: U,   1990, 1999,   1,     3,   .660,   .750

 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 >=   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 had not converged after   30 iterations


 Total absolute residual between iterations
 29 and  30 =     .00896

 Final year F values
 Age         ,      1,      2,      3,      4,      5,      6,      7,      8,      9,     10
 Iteration 29,  .0020,  .0323,  .3355,  .4838,  .4523,  .4093,  .3416,  .2818,  .2888,  .2534
 Iteration 30,  .0020,  .0323,  .3355,  .4835,  .4519,  .4088,  .3409,  .2810,  .2877,  .2522


 Age         ,     11,     12,     13,     14
 Iteration 29,  .1756,  .1790,  .1746,  .1430
 Iteration 30,  .1748,  .1781,  .1736,  .1419


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

Table 9.11. (continued)

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.004	.004	.008	.012	.006	.022	.004	.001	.001	.002
2	.093	.127	.128	.155	.192	.174	.142	.162	.048	.032
3	.274	.322	.345	.414	.442	.561	.452	.449	.453	.335
4	.506	.533	.451	.502	.644	.670	.645	.717	.547	.484
5	.664	.657	.675	.610	.515	.615	.598	.715	.531	.452
6	.469	.714	.648	.583	.491	.441	.501	.572	.441	.409
7	.354	.464	.598	.533	.626	.431	.468	.499	.361	.341
8	.282	.367	.376	.470	.473	.366	.360	.456	.289	.281
9	.291	.310	.366	.338	.387	.313	.388	.307	.263	.288
10	.200	.299	.367	.380	.351	.204	.359	.248	.204	.252
11	.237	.244	.312	.373	.301	.253	.222	.207	.167	.175
12	.194	.299	.351	.308	.299	.243	.234	.197	.199	.178
13	.193	.213	.444	.506	.303	.191	.283	.215	.181	.174
14	.224	.274	.540	.367	.491	.225	.312	.240	.152	.142

1

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9	10
1990	4.10E+05	3.77E+05	4.21E+05	2.90E+05	3.47E+05	7.55E+04	2.97E+04	1.89E+04	1.55E+04	6.81E+03
1991	4.02E+05	3.70E+05	3.11E+05	2.90E+05	1.58E+05	1.62E+05	4.28E+04	1.89E+04	1.29E+04	1.04E+04
1992	4.05E+05	3.63E+05	2.95E+05	2.04E+05	1.54E+05	7.42E+04	7.17E+04	2.43E+04	1.18E+04	8.55E+03
1993	2.81E+05	3.64E+05	2.89E+05	1.89E+05	1.18E+05	7.09E+04	3.51E+04	3.57E+04	1.51E+04	7.42E+03
1994	2.45E+05	2.51E+05	2.82E+05	1.73E+05	1.03E+05	5.79E+04	3.58E+04	1.87E+04	2.02E+04	9.75E+03
1995	3.36E+05	2.20E+05	1.87E+05	1.64E+05	8.21E+04	5.59E+04	3.20E+04	1.73E+04	1.05E+04	1.24E+04
1996	2.67E+05	2.97E+05	1.67E+05	9.68E+04	7.60E+04	4.01E+04	3.25E+04	1.89E+04	1.09E+04	6.97E+03
1997	6.91E+05	2.40E+05	2.33E+05	9.64E+04	4.60E+04	3.78E+04	2.20E+04	1.84E+04	1.19E+04	6.67E+03
1998	2.98E+05	6.25E+05	1.85E+05	1.35E+05	4.26E+04	2.04E+04	1.93E+04	1.21E+04	1.06E+04	7.92E+03
1999	2.70E+05	2.70E+05	5.39E+05	1.06E+05	7.05E+04	2.27E+04	1.19E+04	1.22E+04	8.19E+03	7.35E+03

Estimated population abundance at 1st Jan 2000

0.00E+00	2.43E+05	2.36E+05	3.49E+05	5.94E+04	4.06E+04	1.37E+04	7.64E+03	8.35E+03	5.58E+03

Taper weighted geometric mean of the VPA populations:

4.10E+05	3.67E+05	3.03E+05	1.95E+05	1.14E+05	6.43E+04	3.91E+04	2.52E+04	1.69E+04	1.17E+04

Standard error of the weighted Log(VPA populations) :

.3944	.4054	.4087	.4310	.4743	.5000	.4868	.4769	.5082	.5440

YEAR	AGE 11	12	13	14
1990	3.82E+03	2.91E+03	1.95E+03	1.23E+03
1991	5.04E+03	2.73E+03	2.17E+03	1.46E+03
1992	7.01E+03	3.58E+03	1.83E+03	1.58E+03
1993	5.36E+03	4.65E+03	2.28E+03	1.06E+03
1994	4.59E+03	3.34E+03	3.09E+03	1.24E+03
1995	6.21E+03	3.08E+03	2.24E+03	2.07E+03
1996	9.15E+03	4.36E+03	2.18E+03	1.68E+03
1997	4.40E+03	6.63E+03	3.12E+03	1.49E+03
1998	4.71E+03	3.24E+03	4.93E+03	2.28E+03
1999	5.84E+03	3.60E+03	2.40E+03	3.72E+03

Estimated population abundance at 1st Jan 2000

5.19E+03	4.46E+03	2.74E+03	1.84E+03

Taper weighted geometric mean of the VPA populations:

8.12E+03	5.69E+03	3.91E+03	2.73E+03

Standard error of the weighted Log(VPA populations) :

.5810	.5909	.6024	.6331

Table 9.11. (continued)

Log catchability residuals.

Fleet : FLT01: NL Beam Trawl

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	1.66	6.99	3.93	5.09	6.46	.90	5.74	3.47	-5.92	-28.31
3	-.06	-.18	-.10	-.08	-.07	.27	-.18	.23	.00	.17
4	-.08	.04	-.20	-.19	.04	.05	.20	.09	.10	-.04
5	.31	.21	.09	-.07	-.29	-.07	.08	-.07	-.13	-.07
6	.13	.55	.23	.07	-.15	-.33	-.06	-.17	-.23	-.04
7	.03	.38	.20	.36	.35	-.22	-.04	-.22	-.52	-.31
8	.09	.26	.20	.17	.53	-.06	-.15	-.42	-.43	-.18
9	.12	.33	.26	-.04	.27	.16	.29	-.55	-.81	-.02
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	4	5	6	7	8	9
Mean Log q	-5.6591	-5.7261	-5.9516	-6.1614	-6.5277	-6.7814
S.E(Log q)	.1277	.1744	.2571	.3163	.3066	.3856

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	19.00	-1.466	-96.22	.00	10	11.28	-6.95
3	1.47	-2.989	2.71	.83	10	.18	-5.85

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	1.20	-1.786	4.39	.91	10	.14	-5.66
5	.84	2.675	6.65	.97	10	.11	-5.73
6	.76	3.103	7.11	.96	10	.14	-5.95
7	.68	2.979	7.50	.91	10	.16	-6.16
8	.66	1.682	7.64	.76	10	.19	-6.53
9	.70	.830	7.58	.49	10	.27	-6.78

Fleet : FLT02: UK Beam trawl

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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	-.56	-.71	-.40	-.01	.16	.57	.29	.41	.21	.04
5	.01	-.33	-.14	-.15	.02	-.07	.32	.21	.21	-.07
6	-.44	.08	-.11	-.07	-.13	-.11	.12	.35	.32	-.01
7	-.09	-.38	.11	-.47	.00	.00	.18	.21	.23	.20
8	-.20	-.15	-.33	.11	-.25	.01	.16	.42	.04	.18
9	.09	-.53	-.23	-.24	-.07	-.21	.33	.42	.27	.16
10	-.33	.04	-.04	.03	-.04	-.29	.13	.10	.27	.12
11	-.13	-.25	.16	.24	-.13	.15	.08	.15	-.09	.16
12	-.43	.18	-.24	.02	.02	.16	.31	.16	.10	-.03

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	-8.5403	-7.9938	-7.7713	-7.7006	-7.6175	-7.5522	-7.5573	-7.5573	-7.5573
S.E(Log q)	.4248	.1971	.2312	.2484	.2316	.3032	.1871	.1717	.2199

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	5.53	-3.626	-7.12	.07	10	1.53	-8.54
5	1.21	-1.826	7.27	.91	10	.21	-7.99
6	1.21	-1.467	7.12	.86	10	.26	-7.77
7	1.28	-1.312	6.98	.74	10	.30	-7.70
8	1.15	-.512	7.28	.58	10	.28	-7.62
9	1.58	-.902	6.47	.23	10	.48	-7.55
10	1.47	-1.080	6.86	.39	10	.27	-7.56
11	.77	1.483	7.78	.83	10	.12	-7.52
12	.79	.957	7.67	.72	10	.17	-7.53

Table 9.11. (continued)

Fleet : FLT03: DK Trawlers

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	-3.30	-.28	-.06	-1.76	.07	-.78	1.04	2.71	2.14	.21
3	-1.35	-1.04	-1.48	-.26	.24	-.45	.18	1.40	.84	1.92
4	.30	.00	-.55	-.21	-.12	-.04	-.33	.80	.26	-.12
5	.31	.30	.09	.09	-.47	-.19	-.47	.27	.18	-.11
6	-.26	.29	.34	.20	-.25	-.46	-.23	.38	.04	-.06
7	-.93	-.16	.37	-.05	.04	-.51	.08	.60	.45	.10
8	-.66	-.36	.07	.07	.00	-.66	.02	1.22	.49	-.17
9	-.79	-.05	.28	.32	-.01	-.77	.05	.11	.68	.19
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	4	5	6	7	8	9
Mean Log q	-12.6449	-12.5675	-12.9309	-13.3033	-13.8208	-14.2411
S.E(Log q)	.3778	.2981	.2946	.4555	.5548	.4604

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	1.81	-.401	16.89	.03	10	1.86	-15.00
3	1.82	-.753	13.34	.09	10	1.21	-12.97

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	1.19	-.485	12.77	.46	10	.47	-12.64
5	.90	.694	12.46	.85	10	.28	-12.57
6	.92	.531	12.76	.84	10	.28	-12.93
7	1.13	-.337	13.68	.47	10	.54	-13.30
8	1.06	-.088	14.05	.22	10	.62	-13.82
9	1.55	-.560	16.89	.11	10	.74	-14.24

Fleet : FLT04: BTS

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.85	-.16	-.05	.96	.83	-.58	-.05	99.99	-1.06	-.75
2	-.29	-.13	-.10	.13	-.09	-.21	.43	99.99	.05	.21
3	-.15	-.35	-.32	.00	.01	-.24	.13	-.27	.69	.49
4	.58	-.14	-.59	-.39	.46	.16	.14	-.24	.27	-.25
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	4
Mean Log q	-9.5203
S.E(Log q)	.3826

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	-1.90	-2.094	22.79	.07	9	.79	-7.34
2	.59	1.451	9.74	.65	9	.24	-7.70
3	.75	.757	9.58	.53	10	.37	-8.57

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	.88	.408	9.81	.60	10	.35	-9.52

Table 9.11. (continued)

```
 Fleet : FLT05: SNS (Catch: U

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     1 ,  -.42,   .32,   .17,  -.14,  -.17,  -.21,   .00, 99.99,   .15,   .30
     2 ,  -.25,   .01,   .15,  -.05,  -.03,  -.21,   .20, 99.99,  -.01,   .19
     3 ,  -.12,  -.32,   .02,  -.49,  -.53,  -.59,   .20,  -.03,  1.18,   .69
     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

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,     .86,     .287,      3.69,     .39,      9,     .27,   -2.28,
  2,     .55,    2.285,      7.67,     .78,      9,     .17,   -3.45,
  3,     .69,     .572,      7.07,     .30,     10,     .60,   -4.62,
1


-terminal year survivor and F summaries :

 Age  1   Catchability dependent on age and year class strength

 Year class = 1998

 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 Beam trawl,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: DK Trawlers (,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT04: BTS (Catch: U,    114445.,   .901,       .000,    .00,   1,  .055,     .004
 FLT05: SNS (Catch: U,    327848.,   .300,       .000,    .00,   1,  .495,     .001

   P shrinkage mean  ,    367323.,    .41,,,,                        .272,     .001
   F shrinkage mean  ,     71922.,    .50,,,,                        .179,     .007

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    243429.,       .21,      .38,    4,   1.780,   .002


 Age  2   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: NL Beam Trawl,         0., 15.532,       .000,    .00,   1,  .000,     .000
 FLT02: UK Beam trawl,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: DK Trawlers (,    292196.,  1.951,       .000,    .00,   1,  .006,     .026
 FLT04: BTS (Catch: U,    259285.,   .286,       .371,   1.30,   2,  .272,     .029
 FLT05: SNS (Catch: U,    280052.,   .212,       .020,    .09,   2,  .493,     .027

   P shrinkage mean  ,    303248.,    .41,,,,                        .137,     .025
   F shrinkage mean  ,     50112.,    .50,,,,                        .092,     .144

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    236225.,       .15,      .23,    8,   1.552,   .032

 Age  3   Catchability dependent on age and year class strength

 Year class = 1996

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,    411400.,   .300,       .149,    .50,   2,  .213,     .291
 FLT02: UK Beam trawl,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: DK Trawlers (,   2559451.,  1.262,       .103,    .08,   2,  .012,     .053
 FLT04: BTS (Catch: U,    415185.,   .255,       .203,    .79,   2,  .285,     .289
 FLT05: SNS (Catch: U,    380617.,   .279,       .246,    .88,   2,  .237,     .311

   P shrinkage mean  ,    194749.,    .43,,,,                        .145,     .539
   F shrinkage mean  ,    229876.,    .50,,,,                        .107,     .473
```

Table 9.11. (continued)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
348903.,	.14,	.15,	10,	1.014,	.335

1

Age 4 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 Beam Trawl,	58080.,	.217,	.038,	.17,	3,	.331,	.492
FLT02: UK Beam trawl,	61861.,	.445,	.000,	.00,	1,	.092,	.468
FLT03: DK Trawlers (,	58305.,	.376,	.300,	.80,	3,	.125,	.490
FLT04: BTS (Catch: U,	65866.,	.276,	.315,	1.14,	3,	.200,	.445
FLT05: SNS (Catch: U,	74383.,	.275,	.462,	1.68,	2,	.134,	.403
F shrinkage mean ,	40565.,	.50,,,,				.118,	.647

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
59388.,	.13,	.10,	13,	.772,	.484

Age 5 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: NL Beam Trawl,	42070.,	.187,	.076,	.41,	4,	.293,	.439
FLT02: UK Beam trawl,	39993.,	.255,	.116,	.46,	2,	.190,	.458
FLT03: DK Trawlers (,	41066.,	.249,	.142,	.57,	4,	.192,	.448
FLT04: BTS (Catch: U,	48015.,	.208,	.178,	.86,	4,	.133,	.394
FLT05: SNS (Catch: U,	40374.,	.201,	.135,	.67,	3,	.108,	.454
F shrinkage mean ,	28402.,	.50,,,,				.085,	.597

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
40644.,	.10,	.06,	18,	.537,	.452

1

Age 6 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: NL Beam Trawl,	12884.,	.176,	.039,	.22,	5,	.305,	.428
FLT02: UK Beam trawl,	15034.,	.205,	.095,	.46,	3,	.255,	.377
FLT03: DK Trawlers (,	15108.,	.207,	.130,	.63,	5,	.246,	.376
FLT04: BTS (Catch: U,	12390.,	.208,	.143,	.69,	4,	.064,	.442
FLT05: SNS (Catch: U,	11806.,	.205,	.090,	.44,	3,	.050,	.459
F shrinkage mean ,	10864.,	.50,,,,				.080,	.491

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
13653.,	.10,	.04,	21,	.445,	.409

Age 7 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: NL Beam Trawl,	6380.,	.172,	.079,	.46,	6,	.320,	.396
FLT02: UK Beam trawl,	9719.,	.182,	.030,	.17,	4,	.319,	.277
FLT03: DK Trawlers (,	8278.,	.204,	.065,	.32,	6,	.219,	.318
FLT04: BTS (Catch: U,	7724.,	.215,	.140,	.65,	4,	.036,	.337
FLT05: SNS (Catch: U,	6677.,	.203,	.115,	.57,	3,	.027,	.381
F shrinkage mean ,	5048.,	.50,,,,				.080,	.479

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7644.,	.10,	.05,	24,	.526,	.341

Table 9.11. (continued)

```
1
 Age  8   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,      6639.,   .164,       .080,    .49,   7,  .341,     .341
 FLT02: UK Beam trawl,     10618.,   .166,       .041,    .25,   5,  .360,     .227
 FLT03: DK Trawlers (,      9214.,   .206,       .148,    .72,   7,  .180,     .257
 FLT04: BTS (Catch: U,      9237.,   .206,       .038,    .19,   4,  .026,     .257
 FLT05: SNS (Catch: U,      8225.,   .205,       .150,    .73,   3,  .020,     .284

   F shrinkage mean  ,      5661.,    .50,,,,                        .073,     .390

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      8351.,       .10,      .06,   27,    .616,   .281


Age  9   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,      4595.,   .162,       .066,    .41,   8,  .323,     .339
 FLT02: UK Beam trawl,      6244.,   .156,       .035,    .23,   6,  .387,     .260
 FLT03: DK Trawlers (,      6490.,   .209,       .117,    .56,   8,  .184,     .251
 FLT04: BTS (Catch: U,      6269.,   .205,       .148,    .72,   4,  .019,     .259
 FLT05: SNS (Catch: U,      6399.,   .210,       .174,    .83,   3,  .014,     .254

   F shrinkage mean  ,      4697.,    .50,,,,                        .073,     .333

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      5581.,       .10,      .04,   30,    .459,   .288

1
 Age 10   Catchability constant w.r.t. time and dependent on age

 Year class = 1989

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,      3384.,   .160,       .104,    .65,   8,  .259,     .363
 FLT02: UK Beam trawl,      6272.,   .147,       .059,    .40,   7,  .477,     .212
 FLT03: DK Trawlers (,      6627.,   .209,       .236,   1.13,   8,  .149,     .202
 FLT04: BTS (Catch: U,      4119.,   .205,       .141,    .69,   4,  .020,     .307
 FLT05: SNS (Catch: U,      4326.,   .201,       .153,    .76,   3,  .017,     .295

   F shrinkage mean  ,      4703.,    .50,,,,                        .078,     .274

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      5194.,       .10,      .07,   31,    .775,   .252


 Age 11   Catchability constant w.r.t. time and age (fixed at the value for age) 10

 Year class = 1988

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: NL Beam Trawl,      3403.,   .158,       .065,    .41,   8,  .216,     .222
 FLT02: UK Beam trawl,      5361.,   .136,       .059,    .43,   8,  .564,     .147
 FLT03: DK Trawlers (,      3975.,   .207,       .101,    .49,   8,  .123,     .193
 FLT04: BTS (Catch: U,      2951.,   .209,       .096,    .46,   3,  .016,     .252
 FLT05: SNS (Catch: U,      3399.,   .271,       .028,    .10,   2,  .008,     .223

   F shrinkage mean  ,      3269.,    .50,,,,                        .073,     .231

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      4459.,       .10,      .05,   30,    .540,   .175

1
```

Table 9.11. (continued)

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1987

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: NL Beam Trawl,	3122.,	.171,	.069,	.40,	7,	.158,	.157
FLT02: UK Beam trawl,	2784.,	.133,	.047,	.36,	9,	.666,	.175
FLT03: DK Trawlers (,	2593.,	.226,	.121,	.54,	7,	.088,	.187
FLT04: BTS (Catch: U,	2359.,	.285,	.008,	.03,	2,	.005,	.203
FLT05: SNS (Catch: U,	2419.,	.639,	.000,	.00,	1,	.001,	.199
F shrinkage mean ,	2009.,	.50,,,,				.081,	.235

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2741.,	.10,	.04,	27,	.361,	.178

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1986

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: NL Beam Trawl,	2493.,	.176,	.076,	.43,	6,	.146,	.130
FLT02: UK Beam trawl,	1858.,	.136,	.065,	.48,	9,	.663,	.171
FLT03: DK Trawlers (,	1490.,	.230,	.208,	.91,	6,	.084,	.209
FLT04: BTS (Catch: U,	3265.,	.401,	.000,	.00,	1,	.003,	.101
FLT05: SNS (Catch: U,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	1306.,	.50,,,,				.105,	.235

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1838.,	.11,	.06,	23,	.541,	.174

1

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1985

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: NL Beam Trawl,	3764.,	.186,	.055,	.30,	5,	.141,	.112
FLT02: UK Beam trawl,	2978.,	.136,	.062,	.46,	8,	.661,	.139
FLT03: DK Trawlers (,	3353.,	.245,	.078,	.32,	5,	.080,	.125
FLT04: BTS (Catch: U,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: SNS (Catch: U,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	1869.,	.50,,,,				.118,	.214

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2941.,	.11,	.06,	19,	.513,	.142

Table 9.12. North Sea plaice: fishing mortality

Run title : Plaice in IV (run: XSAULI05/X05)
At 9/10/2000 10:52

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0161,	.0065,	.0070,	.0159,	.0557,	.0113,	.0157,	.0230,	.0405,	.0737,
3,	.2150,	.1059,	.1215,	.0804,	.1811,	.2006,	.0862,	.1366,	.1925,	.2458,
4,	.3439,	.3437,	.2837,	.3654,	.3270,	.3401,	.3560,	.1898,	.2276,	.2332,
5,	.3001,	.3435,	.4067,	.3497,	.4522,	.3403,	.3691,	.4778,	.2915,	.3059,
6,	.3440,	.2633,	.3365,	.4344,	.3794,	.4033,	.3295,	.3520,	.3290,	.3690,
7,	.2913,	.2793,	.2697,	.3221,	.3554,	.2909,	.3574,	.2943,	.2467,	.3032,
8,	.2710,	.2968,	.2474,	.2984,	.2428,	.2944,	.2474,	.2617,	.2694,	.2009,
9,	.2161,	.2599,	.2306,	.2770,	.2534,	.2157,	.3369,	.2151,	.1769,	.3245,
10,	.2250,	.1992,	.2077,	.2365,	.2112,	.3880,	.2365,	.2337,	.2142,	.2278,
11,	.2112,	.2412,	.2082,	.3110,	.2666,	.2130,	.2750,	.1981,	.2449,	.2969,
12,	.2482,	.2478,	.2091,	.2277,	.2406,	.2805,	.2724,	.2031,	.2050,	.2775,
13,	.2499,	.2575,	.2426,	.2704,	.2265,	.3221,	.3034,	.1944,	.1696,	.2202,
14,	.2306,	.2416,	.2201,	.2651,	.2402,	.2845,	.2855,	.2093,	.2025,	.2700,
+gp,	.2306,	.2416,	.2201,	.2651,	.2402,	.2845,	.2855,	.2093,	.2025,	.2700,
0 FBAR 2-10,	.2469,	.2331,	.2345,	.2644,	.2732,	.2761,	.2594,	.2427,	.2209,	.2538,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	.0002,	.0001,	.0100,	.0025,	.0052,	.0031,	.0092,	.0072,	.0028,	.0031,
2,	.0633,	.0974,	.1672,	.1727,	.0509,	.0754,	.1239,	.2298,	.1626,	.1704,
3,	.3397,	.2252,	.2713,	.3937,	.4535,	.1671,	.2730,	.2077,	.3745,	.4826,
4,	.4823,	.3459,	.3650,	.5186,	.4781,	.4414,	.3775,	.3494,	.3859,	.5014,
5,	.3963,	.3826,	.3775,	.4924,	.5488,	.5256,	.3151,	.5800,	.4321,	.6138,
6,	.4941,	.3603,	.4094,	.3623,	.3964,	.5392,	.3535,	.3170,	.4597,	.6464,
7,	.4804,	.4163,	.3581,	.3457,	.3280,	.3925,	.4154,	.3281,	.3117,	.5800,
8,	.2709,	.2969,	.4586,	.3944,	.3926,	.3818,	.3368,	.3761,	.2788,	.3329,
9,	.1853,	.4299,	.2728,	.4445,	.3597,	.4235,	.2953,	.3302,	.2784,	.3533,
10,	.2838,	.2841,	.3870,	.2983,	.5103,	.3380,	.3378,	.2853,	.2635,	.4189,
11,	.1822,	.2962,	.2539,	.2917,	.3300,	.3944,	.3300,	.3369,	.2444,	.3329,
12,	.2619,	.2509,	.3373,	.2540,	.4528,	.4138,	.3279,	.3254,	.2297,	.3530,
13,	.2566,	.2487,	.2500,	.3076,	.3148,	.5418,	.3852,	.2617,	.2431,	.4073,
14,	.2345,	.3027,	.3010,	.3201,	.3947,	.4236,	.3362,	.3087,	.2524,	.3742,
+gp,	.2345,	.3027,	.3010,	.3201,	.3947,	.4236,	.3362,	.3087,	.2524,	.3742,
0 FBAR 2-10,	.3329,	.3154,	.3408,	.3803,	.3909,	.3649,	.3142,	.3337,	.3275,	.4555,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.0016,	.0006,	.0034,	.0021,	.0002,	.0002,	.0014,	.0000,	.0000,	.0032,
2,	.1860,	.1953,	.1393,	.1452,	.1318,	.1495,	.1560,	.0813,	.0328,	.1003,
3,	.6409,	.5547,	.6802,	.5070,	.5034,	.4388,	.5054,	.3891,	.3223,	.2982,
4,	.5926,	.5578,	.6272,	.7142,	.4150,	.6704,	.5037,	.6808,	.4110,	.4910,
5,	.4573,	.5311,	.5286,	.5225,	.5722,	.4235,	.6566,	.6923,	.6147,	.5105,
6,	.4334,	.3835,	.4501,	.4258,	.4353,	.4370,	.5638,	.5477,	.5577,	.4800,
7,	.4248,	.3840,	.3795,	.3690,	.3480,	.3612,	.4500,	.5084,	.4932,	.4270,
8,	.3613,	.4215,	.3508,	.3311,	.4048,	.3007,	.3772,	.3470,	.4218,	.3821,
9,	.2176,	.3246,	.3870,	.2955,	.3304,	.3125,	.3428,	.2783,	.4064,	.2593,
10,	.2500,	.2265,	.3890,	.4207,	.3055,	.2817,	.3630,	.3400,	.3217,	.3517,
11,	.2674,	.3007,	.2569,	.3624,	.2962,	.2167,	.3209,	.2831,	.2735,	.2649,
12,	.3242,	.3501,	.2898,	.4277,	.2976,	.3738,	.3304,	.2683,	.3950,	.2679,
13,	.2009,	.3386,	.3871,	.3613,	.2487,	.2792,	.4737,	.2372,	.2999,	.2960,
14,	.2526,	.3089,	.3430,	.3747,	.2965,	.2936,	.3674,	.2823,	.3406,	.2890,
+gp,	.2526,	.3089,	.3430,	.3747,	.2965,	.2936,	.3674,	.2823,	.3406,	.2890,
0 FBAR 2-10,	.3960,	.3977,	.4369,	.4145,	.3829,	.3750,	.4354,	.4294,	.3979,	.3667,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	F 97-99
AGE											
1,	.0039,	.0037,	.0083,	.0119,	.0055,	.0221,	.0038,	.0009,	.0006,	.0020,	.0012,
2,	.0926,	.1272,	.1280,	.1549,	.1922,	.1742,	.1423,	.1617,	.0479,	.0323,	.0806,
3,	.2740,	.3218,	.3453,	.4141,	.4417,	.5606,	.4519,	.4494,	.4533,	.3355,	.4127,
4,	.5060,	.5333,	.4512,	.5018,	.6435,	.6697,	.6445,	.7168,	.5468,	.4835,	.5824,
5,	.6641,	.6568,	.6748,	.6097,	.5154,	.6154,	.5975,	.7146,	.5307,	.4519,	.5658,
6,	.4688,	.7139,	.6481,	.5834,	.4909,	.4407,	.5013,	.5717,	.4410,	.4088,	.4738,
7,	.3542,	.4643,	.5981,	.5327,	.6263,	.4307,	.4685,	.4989,	.3608,	.3409,	.4002,
8,	.2819,	.3666,	.3760,	.4696,	.4729,	.3664,	.3605,	.4560,	.2890,	.2810,	.3420,
9,	.2915,	.3101,	.3660,	.3385,	.3868,	.3127,	.3882,	.3070,	.2635,	.2877,	.2861,
10,	.2003,	.2985,	.3669,	.3805,	.3510,	.2038,	.3591,	.2484,	.2042,	.2522,	.2349,
11,	.2371,	.2440,	.3115,	.3733,	.3006,	.2531,	.2223,	.2071,	.1672,	.1748,	.1830,
12,	.1937,	.2989,	.3506,	.3083,	.2987,	.2429,	.2344,	.1967,	.1987,	.1781,	.1912,
13,	.1926,	.2132,	.4441,	.5062,	.3029,	.1907,	.2831,	.2152,	.1813,	.1736,	.1900,
14,	.2238,	.2741,	.5400,	.3666,	.4914,	.2251,	.3119,	.2399,	.1517,	.1419,	.1778,
+gp,	.2238,	.2741,	.5400,	.3666,	.4914,	.2251,	.3119,	.2399,	.1517,	.1419,	
0 FBAR 2-10,	.3482,	.4214,	.4394,	.4428,	.4579,	.4194,	.4349,	.4583,	.3486,	.3193,	

Table 9.13. North Sea plaice: stock numbers at age.

Run title : Plaice in IV (run: XSAULI05/X05)
At 9/10/2000 10:52

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
1,	405338,	359398,	318827,	315195,	1022003,	309593,	305427,	277272,	245588,	327587,
2,	392203,	366765,	325197,	288486,	285200,	924747,	280131,	276362,	250886,	222217,
3,	336297,	349211,	329709,	292208,	256905,	244069,	827368,	249531,	244372,	217999,
4,	184329,	245436,	284216,	264207,	243977,	193946,	180699,	686795,	196959,	182404,
5,	86450,	118254,	157486,	193647,	165890,	159182,	124895,	114526,	514028,	141936,
6,	98717,	57942,	75897,	94880,	123506,	95495,	102490,	78131,	64263,	347522,
7,	59017,	63327,	40292,	49052,	55603,	76471,	57727,	66701,	49719,	41844,
8,	39910,	39907,	43336,	27839,	32163,	35264,	51728,	36539,	44968,	35151,
9,	27515,	27538,	26837,	30618,	18690,	22829,	23772,	36548,	25448,	31079,
10,	24582,	20058,	19214,	19282,	21001,	13126,	16649,	15358,	26670,	19293,
11,	18876,	17761,	14871,	14125,	13773,	15384,	8057,	11891,	11000,	19479,
12,	11435,	13828,	12627,	10927,	9365,	9546,	11250,	5538,	8826,	7791,
13,	9347,	8073,	9766,	9270,	7873,	6662,	6524,	7752,	4090,	6506,
14,	5177,	6587,	5646,	6933,	6400,	5680,	4368,	4359,	5775,	3123,
+gp,	8420,	7905,	7359,	15289,	25997,	23119,	19165,	16903,	17345,	17152,
0 TOTAL,	1707613,	1701991,	1671280,	1631959,	2288347,	2135111,	2020252,	1884206,	1709936,	1621083,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
1,	370540,	275642,	234846,	542393,	452347,	336542,	325398,	472448,	431545,	445646,
2,	296410,	335206,	249393,	210374,	489571,	407186,	303583,	291750,	424425,	389391,
3,	186786,	251752,	275159,	190914,	160168,	420990,	341685,	242691,	209796,	326412,
4,	154271,	120333,	181867,	189809,	116529,	92088,	322309,	235307,	178418,	130528,
5,	130722,	86176,	77039,	114235,	102245,	65369,	53587,	199941,	150121,	109748,
6,	94580,	79580,	53187,	47789,	63170,	53443,	34969,	35380,	101291,	88177,
7,	217412,	52216,	50221,	31956,	30098,	38451,	28203,	22221,	23317,	57874,
8,	27960,	121684,	31159,	31763,	20464,	19619,	23498,	16843,	14482,	15448,
9,	26016,	19296,	81824,	17822,	19373,	12504,	12118,	15183,	10464,	9916,
10,	20329,	19560,	11359,	56359,	10339,	12233,	7408,	8162,	9875,	7167,
11,	13900,	13850,	13321,	6980,	37841,	5616,	7895,	4782,	5552,	6865,
12,	13098,	10483,	9319,	9351,	4718,	24615,	3425,	5135,	3089,	3934,
13,	5341,	9120,	7380,	6018,	6563,	2714,	14725,	2233,	3356,	2221,
14,	4723,	3739,	6436,	5200,	4003,	4335,	1429,	9064,	1555,	2381,
+gp,	14553,	15566,	14766,	13786,	10819,	12668,	9704,	7210,	11870,	8655,
0 TOTAL,	1576641,	1414202,	1297276,	1474748,	1528248,	1508374,	1489936,	1568349,	1579157,	1604365,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
1,	662116,	427196,	1032693,	596473,	615454,	540019,	1268929,	545161,	568996,	418485,
2,	401984,	598176,	386302,	931248,	538557,	556783,	488514,	1146582,	493282,	514849,
3,	297135,	301991,	445247,	304095,	728770,	427139,	433833,	378174,	956499,	431933,
4,	182284,	141640,	156921,	204063,	165733,	398583,	249214,	236816,	231890,	627027,
5,	71533,	91195,	73367,	75836,	90400,	99024,	184482,	136272,	108466,	139113,
6,	53754,	40970,	48515,	39128,	40692,	46156,	58666,	86568,	61704,	53075,
7,	41801,	31534,	25262,	27988,	23127,	23825,	26978,	30207,	45295,	31965,
8,	29320,	24733,	19435,	15639,	17509,	14777,	15022,	15565,	16439,	25029,
9,	10020,	18485,	14682,	12382,	10163,	10570,	9899,	9321,	9955,	9756,
10,	6302,	7293,	12089,	9022,	8338,	6608,	6997,	6357,	6385,	6000,
11,	4266,	4441,	5262,	7414,	5360,	5558,	4512,	4404,	4094,	4188,
12,	4453,	2954,	2975,	3682,	4669,	3607,	4050,	2962,	3003,	2818,
13,	2501,	2914,	1883,	2014,	2172,	3137,	2246,	2633,	2049,	1830,
14,	1337,	1851,	1879,	1157,	1270,	1533,	2147,	1265,	1879,	1374,
+gp,	5679,	5151,	7243,	3527,	5156,	4355,	4184,	5175,	6088,	6503,
0 TOTAL,	1774485,	1700524,	2233758,	2233668,	2257369,	2141673,	2759672,	2607463,	2516025,	2273944,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 57-97	
AGE													
1,	410276,	402248,	405485,	280831,	244833,	335787,	266634,	691486,	298132,	269515,	0,*	417402,	454787,
2,	377462,	369794,	362622,	363858,	251091,	220309,	297192,	240345,	625096,	269593,	243429,	365336,	399640,
3,	421378,	311325,	294627,	288688,	281981,	187461,	167478,	233236,	185006,	539170,	236225,	302647,	330738,
4,	290066,	289897,	204188,	188753,	172646,	164044,	96828,	96441,	134650,	106382,	348903,	199429,	220320,
5,	347229,	158247,	153882,	117663,	103407,	82082,	75980,	45988,	42611,	70520,	59388,	118226,	132546,
6,	75546,	161716,	74247,	70906,	57868,	55883,	40139,	37823,	20364,	22677,	40644,	67867,	76409,
7,	29716,	42774,	71661,	35140,	35801,	32049,	32542,	22000,	19321,	11855,	13653,	40978,	46153,
8,	18871,	18868,	24327,	35654,	18664,	17317,	18851,	18431,	12087,	12187,	7644,	26118,	29424,
9,	15455,	12880,	11832,	15113,	20171,	10524,	10862,	11894,	10570,	8192,	8351,	17388,	19974,
10,	6811,	10448,	8547,	7425,	9748,	12397,	6966,	6666,	7917,	7349,	5581,	11994,	14100,
11,	3819,	5044,	7014,	5358,	4592,	6209,	9149,	4401,	4705,	5841,	5194,	8295,	9929,
12,	2908,	2726,	3576,	4648,	3338,	3076,	4362,	6628,	3238,	3602,	4459,	5834,	6984,
13,	1950,	2168,	1829,	2279,	3090,	2240,	2183,	3122,	4926,	2402,	2741,	3938,	4747,
14,	1232,	1456,	1585,	1062,	1243,	2065,	1675,	1489,	2278,	3718,	1838,	2719,	3321,
+gp,	6391,	5667,	4132,	4509,	2755,	4875,	6012,	5079,	10089,	8155,	9343,		
0 TOTAL,	2009110,	1795259,	1629556,	1421886,	1211227,	1136320,	1036853,	1425030,	1380992,	1341159,	987393,		

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* Replaced by GM value 417,000.

Table 9.14 North Sea plaice assessment summary

Run title : Plaice in IV (run: XSAULI05/X05) ,

At 9/10/2000 10:52

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2-10,
1957,	296170,	457379,	354629,	70563,	.1990,	.1973,
1958,	429990,	443686,	340642,	73354,	.2153,	.2118,
1959,	433451,	457576,	345194,	79300,	.2297,	.2266,
1960,	405338,	497708,	368321,	87541,	.2377,	.2469,
1961,	359398,	461941,	352889,	85984,	.2437,	.2331,
1962,	318827,	564483,	446590,	87472,	.1959,	.2345,
1963,	315195,	547186,	439999,	107118,	.2435,	.2644,
1964,	1022003,	624872,	422963,	110540,	.2613,	.2732,
1965,	309593,	580542,	414394,	97143,	.2344,	.2761,
1966,	305427,	588038,	416435,	101834,	.2445,	.2594,
1967,	277272,	590917,	493079,	108819,	.2207,	.2427,
1968,	245588,	548278,	456182,	111534,	.2445,	.2209,
1969,	327587,	526378,	418374,	121651,	.2908,	.2538,
1970,	370540,	525966,	399695,	130342,	.3261,	.3329,
1971,	275642,	500704,	372508,	113944,	.3059,	.3154,
1972,	234846,	495439,	376011,	122843,	.3267,	.3408,
1973,	542393,	488400,	334975,	130429,	.3894,	.3803,
1974,	452347,	467676,	309152,	112540,	.3640,	.3909,
1975,	336542,	495590,	320504,	108536,	.3386,	.3649,
1976,	325398,	451381,	315118,	113670,	.3607,	.3142,
1977,	472448,	479578,	330022,	119188,	.3612,	.3337,
1978,	431545,	474996,	323663,	113984,	.3522,	.3275,
1979,	445646,	474332,	310723,	145347,	.4678,	.4555,
1980,	662116,	487833,	296878,	139951,	.4714,	.3960,
1981,	427196,	489009,	307576,	139747,	.4543,	.3977,
1982,	1032693,	561414,	300772,	154547,	.5138,	.4369,
1983,	596473,	550451,	325025,	144038,	.4432,	.4145,
1984,	615454,	562159,	326997,	156147,	.4775,	.3829,
1985,	540019,	551629,	360823,	159838,	.4430,	.3750,
1986,	1268929,	656946,	364096,	165347,	.4541,	.4354,
1987,	545161,	638740,	395639,	153670,	.3884,	.4294,
1988,	568996,	630858,	379397,	154475,	.4072,	.3979,
1989,	418485,	594047,	422368,	169818,	.4021,	.3667,
1990,	410276,	563393,	398305,	156240,	.3923,	.3482,
1991,	402248,	473476,	341383,	148004,	.4335,	.4214,
1992,	405485,	447055,	307101,	125190,	.4077,	.4394,
1993,	280831,	398554,	276903,	117113,	.4229,	.4428,
1994,	244833,	330224,	235173,	110392,	.4694,	.4579,
1995,	335787,	313457,	219993,	98356,	.4471,	.4194,
1996,	266634,	291610,	198444,	81673,	.4116,	.4349,
1997,	691486,	320349,	179624,	83048,	.4623,	.4583,
1998,	298132,	349181,	223165,	71534,	.3205,	.3486,
1999,	269515,	351996,	222199,	80662,	.3630,	.3193,
2000,	**417000,***		**270517, ****			
Arith. Mean ,	446836,	495475,	342882,	117755,	.3544,	.3446,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

* GM (1957-1997)

** SSB estimated using the average weight-at-age in the stock over the years 1997-1999

Table 9.15 North Sea plaice: input to the RCT3 analysis – ages 1-3

'yc'	'VPA-1'	VPA-2'	VPA-3'	'SNS-0'	'SNS-1'	'SNS-2'	'SNS-3'	'BTS-1'	'BTS-2'	'BTS-3'	'com-0'	'com-1'
1967	246	222	187	-11	-11	-11	2813	-11	-11	-11	-11	-11
1968	328	296	252	-11	-11	9450	1008	-11	-11	-11	-11	-11
1969	371	335	275	-11	8032	23848	4484	-11	-11	-11	-11	-11
1970	276	249	191	3678	18101	9584	1631	-11	-11	-11	-11	-11
1971	235	210	160	6708	6437	4191	1261	-11	-11	-11	-11	-11
1972	542	490	421	9242	57238	17985	10744	-11	-11	-11	-11	-11
1973	452	407	342	5451	15648	9171	791	-11	-11	-11	-11	-11
1974	337	304	243	2193	9781	2274	1720	-11	-11	-11	112.6	84.8
1975	325	292	210	1151	9037	2900	435	-11	-11	-11	71.9	81.5
1976	472	424	326	11544	19119	12714	1577	-11	-11	-11	243	159
1977	432	389	297	4378	13924	9540	456	-11	-11	-11	171.7	83.5
1978	446	402	302	3252	21681	12084	785	-11	-11	-11	223.9	176.3
1979	662	598	445	27835	58049	16106	1146	-11	-11	-11	366.9	252.1
1980	427	386	304	4039	19611	8503	308	-11	-11	-11	167.1	154.3
1981	1033	931	729	31542	70108	14708	2480	-11	-11	-11	615.3	285.3
1982	596	539	427	23987	34884	10413	1584	-11	-11	38.8	460.1	160.8
1983	615	557	434	36722	44667	13788	1155	-11	180	50.9	475.4	115.7
1984	540	489	378	7958	27832	7557	1232	130	131.8	33.1	259	106
1985	1269	1147	956	47385	93573	33021	13140	660.2	765	173.2	719.1	267.6
1986	545	493	432	8818	33426	14429	3709	225.1	139.9	38.6	357.7	190.3
1987	569	515	421	21270	36672	14952	3248	605.1	332.6	57.7	471.7	105.5
1988	418	377	311	15598	37238	7287	1507	426.6	99.8	28.5	347	131.5
1989	410	370	295	24198	24903	11148	2257	107	122.1	27.3	462	126.6
1990	402	363	289	9559	57349	13742	988	184.4	125.7	38.8	450.8	153.9
1991	405	364	282	17120	48223	9484	884	172.8	181	37.4	496.5	130.5
1992	281	251	187	5398	22184	4866	415	122.6	65.7	14.2	365.1	75.3
1993	245	220	167	9226	18225	2786	1189	141.7	43.6	22.8	267.9	30.1
1994	336	297	233	27901	24900	10377	1393	249.4	206.8	19.9	461.3	34.8
1995	267	240	185	13029	24663	-11	5739	215.8	-11	47.3	182.4	117.7
1996	-11	-11	-11	91713	-11	29431	14347	-11	433.1	181.8	548.2	158.4
1997	-11	-11	-11	15363	33391	9235	905	337	133.1	32	182.2	-11
1998	-11	-11	-11	22720	35188	2489	-11	298.9	73	-11	-11	-11
1999	-11	-11	-11	39201	23028	-11	-11	276	-11	-11	-11	-11
2000	-11	-11	-11	24185	-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 :
rct00_1b.csv
Plaice North Sea - 1-Y-Rcr.,,,,,,,,,,,
Data for 9 surveys over 34 years : 1967 - 2000
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.

Year class = 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
SNS-0	.75	-.82	.59	.329	26	11.43	7.75	.686	.056
SNS-2	.89	-2.06	.41	.482	27	10.29	7.09	.460	.126
SNS-3	1.30	-3.47	1.11	.118	29	9.57	8.94	1.292	.016
BTS-2	.67	2.74	.26	.751	12	6.07	6.84	.318	.263
BTS-3	.91	2.79	.31	.666	14	5.21	7.54	.436	.140
com-0	1.26	-1.08	.61	.314	22	6.31	6.86	.665	.060
com-1	.96	1.53	.36	.560	22	5.07	6.39	.392	.173
					VPA Mean =		6.06	.401	.166

Year class = 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
SNS-0	.75	-.82	.59	.329	26	9.64	6.41	.626	.057
SNS-1	.80	-2.08	.39	.523	27	10.42	6.30	.411	.132
SNS-2	.89	-2.06	.41	.482	27	9.13	6.06	.435	.117
SNS-3	1.30	-3.47	1.11	.118	29	6.81	5.36	1.181	.016
BTS-1	1.15	-.17	.57	.399	12	5.82	6.53	.660	.051
BTS-2	.67	2.74	.26	.751	12	4.90	6.04	.294	.258
BTS-3	.91	2.79	.31	.666	14	3.50	5.98	.352	.180
com-0	1.26	-1.08	.61	.314	22	5.21	5.47	.663	.051
com-1									
					VPA Mean =		6.06	.401	.139

Year class = 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-0	.75	-.82	.59	.329	26	10.03	6.70	.632	.078
SNS-1	.80	-2.08	.39	.523	27	10.47	6.34	.411	.184
SNS-2	.89	-2.06	.41	.482	27	7.82	4.89	.471	.140
BTS-1	1.15	-.17	.57	.399	12	5.70	6.39	.654	.073
BTS-2	.67	2.74	.26	.751	12	4.30	5.64	.305	.333
					VPA Mean =		6.06	.401	.193

Year class = 1999

	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-0	.75	-.82	.59	.329	26	10.58	7.11	.648	.141
SNS-1	.80	-2.08	.39	.523	27	10.04	6.00	.410	.352
BTS-1	1.15	-.17	.57	.399	12	5.62	6.30	.651	.139
					VPA Mean =		6.06	.401	.368

Year class = 2000

	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-0	.75	-.82	.59	.329	26	10.09	6.75	.633	.286
					VPA Mean =		6.06	.401	.714

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	942	6.85	.16	.22	1.77		
1997	435	6.08	.15	.08	.29		
1998	359	5.88	.18	.23	1.75		
1999	**502**	6.22	.24	.22	.79	RCT3 corrected: **402**; GM: **417**	
2000	521	6.26	.34	.31	.85		

Table 9.17 North Sea plaice: diagnostics of RCT3 at age 2

Analysis by RCT3 ver3.1 of data from file :
rct00_2b.csv
Plaice North Sea - 2-Y-Rcr.,,,,,,,,,,
Data for 9 surveys over 34 years : 1967 - 2000
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.

Year class = 1996

Survey/ Series	Slope (Regression)	Inter- cept	Std Error	Rsquare	No. Pts	Index Value (Prediction)	Predicted Value	Std Error	WAP Weights
SNS-0	.76	-1.01	.60	.326	26	11.43	7.67	.697	.056
SNS-2	.90	-2.22	.41	.482	27	10.29	6.99	.463	.127
SNS-3	1.30	-3.59	1.12	.119	29	9.57	8.84	1.294	.016
BTS-2	.69	2.58	.27	.743	12	6.07	6.74	.328	.253
BTS-3	.92	2.66	.32	.668	14	5.21	7.45	.437	.142
com-0	1.27	-1.27	.62	.311	22	6.31	6.76	.675	.060
com-1	.96	1.42	.36	.565	22	5.07	6.29	.391	.178
					VPA Mean =		5.95	.403	.168

Year class = 1997

Survey/ Series	Slope (Regression)	Inter- cept	Std Error	Rsquare	No. Pts	Index Value (Prediction)	Predicted Value	Std Error	WAP Weights
SNS-0	.76	-1.01	.60	.326	26	9.64	6.31	.635	.057
SNS-1	.81	-2.24	.39	.522	27	10.42	6.20	.414	.133
SNS-2	.90	-2.22	.41	.482	27	9.13	5.96	.438	.119
SNS-3	1.30	-3.59	1.12	.119	29	6.81	5.25	1.183	.016
BTS-1	1.16	-.34	.58	.396	12	5.82	6.43	.669	.051
BTS-2	.69	2.58	.27	.743	12	4.90	5.94	.303	.249
BTS-3	.92	2.66	.32	.668	14	3.50	5.87	.353	.183
com-0	1.27	-1.27	.62	.311	22	5.21	5.36	.673	.050
					VPA Mean =		5.95	.403	.141

Year class = 1998

Survey/ Series	Slope (Regression)	Inter- cept	Std Error	Rsquare	No. Pts	Index Value (Prediction)	Predicted Value	Std Error	WAP Weights
SNS-0	.76	-1.01	.60	.326	26	10.03	6.61	.641	.078
SNS-1	.81	-2.24	.39	.522	27	10.47	6.24	.415	.186
SNS-2	.90	-2.22	.41	.482	27	7.82	4.78	.474	.143
BTS-1	1.16	-.34	.58	.396	12	5.70	6.29	.663	.073
BTS-2	.69	2.58	.27	.743	12	4.30	5.53	.315	.323
					VPA Mean =		5.95	.403	.197

Year class = 1999

Survey/ Series	Slope (Regression)	Inter- cept	Std Error	Rsquare	No. Pts	Index Value (Prediction)	Predicted Value	Std Error	WAP Weights
SNS-0	.76	-1.01	.60	.326	26	10.58	7.02	.657	.139
SNS-1	.81	-2.24	.39	.522	27	10.04	5.90	.413	.352
BTS-1	1.16	-.34	.58	.396	12	5.62	6.20	.660	.138
					VPA Mean =		5.95	.403	.371

Year class = 2000

Survey/ Series	Slope (Regression)	Inter- cept	Std Error	Rsquare	No. Pts	Index Value (Prediction)	Predicted Value	Std Error	WAP Weights
SNS-0	.76	-1.01	.60	.326	26	10.09	6.65	.643	.282
					VPA Mean =		5.95	.403	.718

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	853	6.75	.16	.22	1.78		
1997	391	5.97	.15	.08	.29		
1998	**323**	5.78	.18	.24	1.74	RCT corrected: **258**; GM: **365**	
1999	452	6.12	.25	.22	.78		
2000	469	6.15	.34	.31	.85		

Table 9.18 North Sea plaice: diagnostics of RCT3 at age 3

Analysis by RCT3 ver3.1 of data from file :
rct00_3b.csv
Plaice North Sea - 3-Y-Rcr.,,,,,,,,,,
Data for 9 surveys over 34 years : 1967 - 2000
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.

Year class = 1996

Survey/ Series	I-----------Regression----------I Slope	Inter-cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.79	-1.54	.62	.331	26	11.43	7.50	.723	.056
SNS-2	.90	-2.51	.40	.517	27	10.29	6.77	.451	.145
SNS-3	1.16	-2.80	.97	.160	29	9.57	8.30	1.128	.023
BTS-2	.73	2.11	.29	.735	12	6.07	6.57	.356	.232
BTS-3	.98	2.22	.34	.666	14	5.21	7.31	.467	.135
com-0	1.28	-1.56	.61	.335	22	6.31	6.52	.667	.066
com-1	1.01	.94	.38	.561	22	5.07	6.06	.412	.173
					VPA Mean =		5.72	.416	.170

Year class = 1997

Survey/ Series	I-----------Regression----------I Slope	Inter-cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.79	-1.54	.62	.331	26	9.64	6.08	.659	.057
SNS-1	.85	-2.88	.41	.522	27	10.42	5.97	.435	.131
SNS-2	.90	-2.51	.40	.517	27	9.13	5.72	.426	.136
SNS-3	1.16	-2.80	.97	.160	29	6.81	5.10	1.031	.023
BTS-1	1.21	-.85	.59	.416	12	5.82	6.22	.688	.052
BTS-2	.73	2.11	.29	.735	12	4.90	5.70	.329	.228
BTS-3	.98	2.22	.34	.666	14	3.50	5.64	.377	.174
com-0	1.28	-1.56	.61	.335	22	5.21	5.11	.665	.056
					VPA Mean =		5.72	.416	.143

Year class = 1998

Survey/ Series	I-----------Regression----------I Slope	Inter-cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.79	-1.54	.62	.331	26	10.03	6.39	.666	.079
SNS-1	.85	-2.88	.41	.522	27	10.47	6.02	.435	.184
SNS-2	.90	-2.51	.40	.517	27	7.82	4.54	.461	.164
BTS-1	1.21	-.85	.59	.416	12	5.70	6.07	.682	.075
BTS-2	.73	2.11	.29	.735	12	4.30	5.27	.342	.297
					VPA Mean =		5.72	.416	.201

Year class = 1999

Survey/ Series	I-----------Regression----------I Slope	Inter-cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.79	-1.54	.62	.331	26	10.58	6.82	.682	.139
SNS-1	.85	-2.88	.41	.522	27	10.04	5.66	.434	.345
BTS-1	1.21	-.85	.59	.416	12	5.62	5.98	.679	.141
					VPA Mean =		5.72	.416	.374

Year class = 2000

Survey/ Series	I-----------Regression----------I Slope	Inter-cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
SNS-0	.79	-1.54	.62	.331	26	10.09	6.44	.667	.280
					VPA Mean =		5.72	.416	.720

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	702	6.55	.17	.23	1.77		
1997	**309**	5.73	.16	.09	.30	RCT3 corrected: **247**; GM: **303**	
1998	251	5.53	.19	.25	1.79		
1999	360	5.89	.25	.23	.78		
2000	373	5.92	.35	.32	.84		

Table 9.19 North Sea plaice: input to the short-term projection

11:04 Monday, October 16, 2000
Plaice Sub-area IV
Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	417000	0.1000	0.0000	0.0000	0.0000	0.124	0.0010	0.202
2	243429	0.1000	0.5000	0.0000	0.0000	0.209	0.0686	0.262
3	236225	0.1000	0.5000	0.0000	0.0000	0.258	0.3510	0.303
4	348903	0.1000	1.0000	0.0000	0.0000	0.353	0.4954	0.375
5	59388	0.1000	1.0000	0.0000	0.0000	0.450	0.4813	0.469
6	40644	0.1000	1.0000	0.0000	0.0000	0.531	0.4030	0.555
7	13653	0.1000	1.0000	0.0000	0.0000	0.563	0.3404	0.603
8	7644	0.1000	1.0000	0.0000	0.0000	0.612	0.2909	0.623
9	8351	0.1000	1.0000	0.0000	0.0000	0.649	0.2434	0.673
10	5581	0.1000	1.0000	0.0000	0.0000	0.665	0.1998	0.697
11	5194	0.1000	1.0000	0.0000	0.0000	0.829	0.1557	0.814
12	4459	0.1000	1.0000	0.0000	0.0000	0.887	0.1626	0.905
13	2741	0.1000	1.0000	0.0000	0.0000	0.855	0.1616	0.865
14	1838	0.1000	1.0000	0.0000	0.0000	1.030	0.1512	0.921
15+	9343	0.1000	1.0000	0.0000	0.0000	0.958	0.1512	0.994
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	417000	0.1000	0.0000	0.0000	0.0000	0.124	0.0010	0.202
2	-	0.1000	0.5000	0.0000	0.0000	0.209	0.0686	0.262
3	-	0.1000	0.5000	0.0000	0.0000	0.258	0.3510	0.303
4	-	0.1000	1.0000	0.0000	0.0000	0.353	0.4954	0.375
5	-	0.1000	1.0000	0.0000	0.0000	0.450	0.4813	0.469
6	-	0.1000	1.0000	0.0000	0.0000	0.531	0.4030	0.555
7	-	0.1000	1.0000	0.0000	0.0000	0.563	0.3404	0.603
8	-	0.1000	1.0000	0.0000	0.0000	0.612	0.2909	0.623
9	-	0.1000	1.0000	0.0000	0.0000	0.649	0.2434	0.673
10	-	0.1000	1.0000	0.0000	0.0000	0.665	0.1998	0.697
11	-	0.1000	1.0000	0.0000	0.0000	0.829	0.1557	0.814
12	-	0.1000	1.0000	0.0000	0.0000	0.887	0.1626	0.905
13	-	0.1000	1.0000	0.0000	0.0000	0.855	0.1616	0.865
14	-	0.1000	1.0000	0.0000	0.0000	1.030	0.1512	0.921
15+	-	0.1000	1.0000	0.0000	0.0000	0.958	0.1512	0.994
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	417000	0.1000	0.0000	0.0000	0.0000	0.124	0.0010	0.202
2	-	0.1000	0.5000	0.0000	0.0000	0.209	0.0686	0.262
3	-	0.1000	0.5000	0.0000	0.0000	0.258	0.3510	0.303
4	-	0.1000	1.0000	0.0000	0.0000	0.353	0.4954	0.375
5	-	0.1000	1.0000	0.0000	0.0000	0.450	0.4813	0.469
6	-	0.1000	1.0000	0.0000	0.0000	0.531	0.4030	0.555
7	-	0.1000	1.0000	0.0000	0.0000	0.563	0.3404	0.603
8	-	0.1000	1.0000	0.0000	0.0000	0.612	0.2909	0.623
9	-	0.1000	1.0000	0.0000	0.0000	0.649	0.2434	0.673
10	-	0.1000	1.0000	0.0000	0.0000	0.665	0.1998	0.697
11	-	0.1000	1.0000	0.0000	0.0000	0.829	0.1557	0.814
12	-	0.1000	1.0000	0.0000	0.0000	0.887	0.1626	0.905
13	-	0.1000	1.0000	0.0000	0.0000	0.855	0.1616	0.865
14	-	0.1000	1.0000	0.0000	0.0000	1.030	0.1512	0.921
15+	-	0.1000	1.0000	0.0000	0.0000	0.958	0.1512	0.994
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANULI04
Date and time: 10OCT00:09:52

Table 9.20 North Sea plaice: single option short-term prediction at *status quo* fishing mortality

11:04 Monday, October 16, 2000
Plaice Sub-area IV

Single option prediction: Detailed tables

Year: 2000 F-factor: 1.0000 Reference F: 0.3193

						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	0.0010	397	80	417000	51708	0	0	0	0
2	0.0686	15367	4021	243429	50958	121715	25479	121715	25479
3	0.3510	66738	20199	236225	61025	118113	30512	118113	30512
4	0.4954	130247	48799	348903	123279	348903	123279	348903	123279
5	0.4813	21676	10173	59388	26725	59388	26725	59388	26725
6	0.4030	12872	7140	40644	21582	40644	21582	40644	21582
7	0.3404	3759	2266	13653	7682	13653	7682	13653	7682
8	0.2909	1841	1146	7644	4676	7644	4676	7644	4676
9	0.2434	1720	1157	8351	5420	8351	5420	8351	5420
10	0.1998	963	672	5581	3713	5581	3713	5581	3713
11	0.1557	714	581	5194	4304	5194	4304	5194	4304
12	0.1626	638	577	4459	3957	4459	3957	4459	3957
13	0.1616	390	337	2741	2344	2741	2344	2741	2344
14	0.1512	246	226	1838	1893	1838	1893	1838	1893
15+	0.1512	1249	1241	9343	8951	9343	8951	9343	8951
Total		258817	98616	1404393	378216	747566	270517	747566	270517
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.3193

						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	0.0010	397	80	417000	51708	0	0	0	0
2	0.0686	23796	6227	376940	78906	188470	39453	188470	39453
3	0.3510	58103	17586	205660	53129	102830	26564	102830	26564
4	0.4954	56172	21046	150473	53167	150473	53167	150473	53167
5	0.4813	70212	32953	192365	86564	192365	86564	192365	86564
6	0.4030	10517	5833	33208	17633	33208	17633	33208	17633
7	0.3404	6767	4078	24578	13829	24578	13829	24578	13829
8	0.2909	2116	1318	8790	5376	8790	5376	8790	5376
9	0.2434	1065	717	5171	3356	5171	3356	5171	3356
10	0.1998	1023	713	5924	3941	5924	3941	5924	3941
11	0.1557	568	462	4135	3427	4135	3427	4135	3427
12	0.1626	575	521	4022	3569	4022	3569	4022	3569
13	0.1616	488	422	3429	2933	3429	2933	3429	2933
14	0.1512	282	260	2110	2173	2110	2173	2110	2173
15+	0.1512	1163	1156	8697	8332	8697	8332	8697	8332
Total		233244	93370	1442502	388045	734202	270319	734202	270319
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Table 9.20 (Cont'd)

11:04 Monday, October 16, 2000
Plaice Sub-area IV

Single option prediction: Detailed tables

Year: 2002 F-factor: 1.0000 Reference F: 0.3193						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	0.0010	397	80	417000	51708	0	0	0	0
2	0.0686	23796	6227	376940	78906	188470	39453	188470	39453
3	0.3510	89970	27231	318457	82268	159228	41134	159228	41134
4	0.4954	48904	18323	131004	46288	131004	46288	131004	46288
5	0.4813	30281	14212	82962	37333	82962	37333	82962	37333
6	0.4030	34066	18895	107565	57117	107565	57117	107565	57117
7	0.3404	5529	3332	20081	11299	20081	11299	20081	11299
8	0.2909	3810	2372	15823	9678	15823	9678	15823	9678
9	0.2434	1225	824	5946	3859	5946	3859	5946	3859
10	0.1998	633	442	3668	2440	3668	2440	3668	2440
11	0.1557	603	491	4389	3637	4389	3637	4389	3637
12	0.1626	458	414	3202	2842	3202	2842	3202	2842
13	0.1616	440	380	3093	2646	3093	2646	3093	2646
14	0.1512	353	325	2640	2719	2640	2719	2640	2719
15+	0.1512	1124	1117	8407	8054	8407	8054	8407	8054
Total		241588	94665	1501176	400794	736478	268499	736478	268499
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRULI04
Date and time : 09OCT00:17:40
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 2001 and SSB 2002 at status quo fishing mortality

Year-class			1996	1997	1998	1999	2000
Stock No. (thousands) of		1 year-olds	691486	298132	269515	417000	417000
Source			XSA	XSA	XSA	GM	GM
Status Quo F:							
% in	2000	landings	49.5	20.5	4.1	0.1	-
% in	2001		35.3	22.6	18.8	6.7	0.1
% in	2000	SSB	45.6	11.3	9.4	0.0	-
% in	2001	SSB	32.0	19.7	9.8	14.6	0.0
% in	2002	SSB	21.3	13.9	17.2	15.3	14.7

GM : geometric mean recruitment

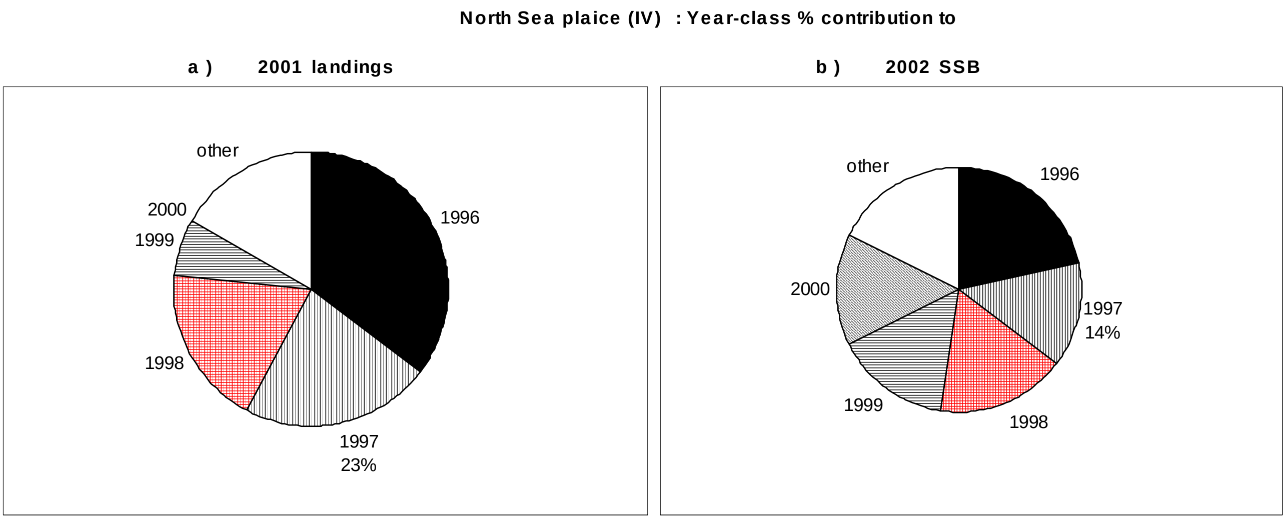


Table 9.22 North Sea plaice: short-term prediction with management option table using F *status quo* for 2000.

11:04 Monday, October 16, 2000
Plaice Sub-area IV

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.3193	378216	270517	98616	0.0000	0.0000	388045	270319	0	500472	365217
.	.	.	.	.	0.1000	0.0319	.	270319	11099	488562	353612
.	.	.	.	.	0.2000	0.0639	.	270319	21761	477136	342489
.	.	.	.	.	0.3000	0.0958	.	270319	32002	466173	331826
.	.	.	.	.	0.4000	0.1277	.	270319	41843	455651	321604
.	.	.	.	.	0.5000	0.1597	.	270319	51299	445553	311803
.	.	.	.	.	0.6000	0.1916	.	270319	60388	435859	302404
.	.	.	.	.	0.7000	0.2235	.	270319	69125	426553	293391
.	.	.	.	.	0.8000	0.2554	.	270319	77525	417617	284746
.	.	.	.	.	0.9000	0.2874	.	270319	85602	409036	276454
.	.	.	.	.	1.0000	0.3193	.	270319	93370	400794	268499
.	.	.	.	.	1.1000	0.3512	.	270319	100843	392876	260866
.	.	.	.	.	1.2000	0.3832	.	270319	108032	385269	253542
.	.	.	.	.	1.3000	0.4151	.	270319	114950	377959	246514
.	.	.	.	.	1.4000	0.4470	.	270319	121608	370934	239768
.	.	.	.	.	1.5000	0.4790	.	270319	128018	364181	233292
.	.	.	.	.	1.6000	0.5109	.	270319	134189	357689	227076
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANULI06
Date and time : 10OCT00:11:49
Computation of ref. F: Simple mean, age 2 - 10
Basis for 2000 : F factors

Table 9.23 North Sea plaice: input to the medium-term projections

Populations in 2000			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	417000	.24	WS1	.12	.00	M1	.10	.10	MT1	.00	.10
N2	243428	.24	WS2	.21	.02	M2	.10	.10	MT2	.50	.10
N3	236224	.16	WS3	.26	.04	M3	.10	.10	MT3	.50	.10
N4	348903	.14	WS4	.35	.03	M4	.10	.10	MT4	1.00	.10
N5	59387	.13	WS5	.45	.05	M5	.10	.10	MT5	1.00	.00
N6	40644	.10	WS6	.53	.08	M6	.10	.10	MT6	1.00	.00
N7	13652	.10	WS7	.56	.06	M7	.10	.10	MT7	1.00	.00
N8	7644	.10	WS8	.61	.10	M8	.10	.10	MT8	1.00	.00
N9	8351	.10	WS9	.65	.03	M9	.10	.10	MT9	1.00	.00
N10	5581	.10	WS10	.66	.09	M10	.10	.10	MT10	1.00	.00
N11	5193	.10	WS11	.83	.13	M11	.10	.10	MT11	1.00	.00
N12	4459	.10	WS12	.89	.11	M12	.10	.10	MT12	1.00	.00
N13	2740	.10	WS13	.86	.16	M13	.10	.10	MT13	1.00	.00
N14	1838	.11	WS14	1.03	.17	M14	.10	.10	MT14	1.00	.00
N15	9343	.11	WS15	.96	.14	M15	.10	.10	MT15	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.74	WH1	.20	.23
sH2	.07	.69	WH2	.26	.03
sH3	.35	.15	WH3	.30	.06
sH4	.49	.02	WH4	.38	.05
sH5	.48	.05	WH5	.47	.06
sH6	.40	.01	WH6	.55	.08
sH7	.34	.03	WH7	.60	.07
sH8	.29	.09	WH8	.62	.13
sH9	.24	.15	WH9	.67	.06
sH10	.20	.21	WH10	.70	.10
sH11	.16	.10	WH11	.81	.12
sH12	.16	.15	WH12	.90	.07
sH13	.16	.07	WH13	.87	.07
sH14	.15	.10	WH14	.92	.07
sH15	.15	.10	WH15	.99	.07

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K00	1.00	.10	HF00	1.00	.20
K01	1.00	.10	HF01	1.00	.20
K02	1.00	.10	HF02	1.00	.20

Recruitment		
Labl	Value	CV
R01	416999	.41
R02	416999	.41

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

Stock numbers in 2000 are VPA survivors.
These are overwritten at Age 1

Table 9.24. North Sea plaice: estimation of constrained Shepherd stock recruitment model

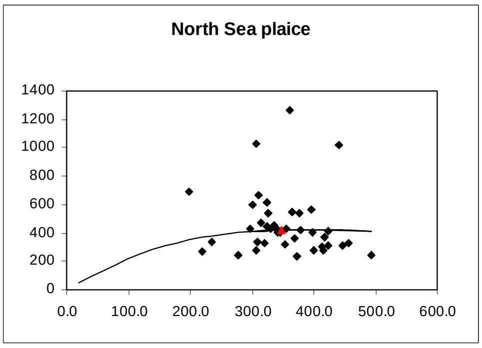
Stock	North Sea plaice			Model
Data	Final run (XSAULI05)			Shepherd
Modified	10-Oct-00	08:54 MP		R = aS/(1+[S/b]^c)
Remarks				

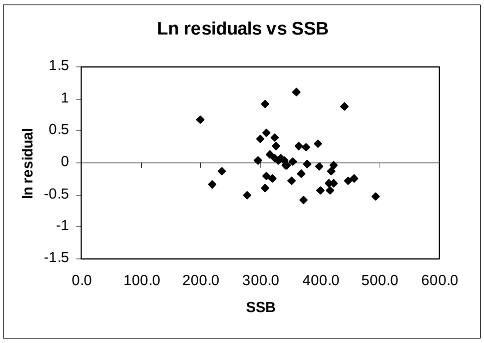
Parameters

a	2.426507
b	347.00
c	1.8

SSQ 6.192654 N 40

	Input		Observed		Model		Residuals	
	SSB	R	log S	log R	Rhat	log Rhat	simple	squared
1957	354.6	430.0	5.871	6.064	422	6.045	0.019	0.00036676
1958	340.6	433.5	5.831	6.072	420	6.041	0.031	0.00096962
1959	345.2	405.3	5.844	6.005	421	6.042	-0.037	0.00139679
1960	368.3	359.4	5.909	5.884	423	6.047	-0.163	0.02647809
1961	352.9	318.8	5.866	5.765	422	6.044	-0.280	0.0781467
1962	446.6	315.2	6.102	5.753	421	6.042	-0.289	0.08358013
1963	440.0	1022.0	6.087	6.930	421	6.044	0.886	0.78466006
1964	423.0	309.6	6.047	5.735	423	6.047	-0.311	0.09695558
1965	414.4	305.4	6.027	5.722	423	6.048	-0.326	0.10625046
1966	416.4	277.3	6.032	5.625	423	6.047	-0.422	0.17846739
1967	493.1	245.6	6.201	5.504	415	6.029	-0.525	0.27554451
1968	456.2	327.6	6.123	5.792	420	6.040	-0.248	0.06161409
1969	418.4	370.5	6.036	5.915	423	6.047	-0.132	0.01749465
1970	399.7	275.6	5.991	5.619	424	6.049	-0.430	0.1845468
1971	372.5	234.8	5.920	5.459	423	6.048	-0.589	0.34663201
1972	376.0	542.4	5.930	6.296	423	6.048	0.248	0.06147555
1973	335.0	452.3	5.814	6.114	419	6.039	0.076	0.00575357
1974	309.2	336.5	5.734	5.819	414	6.026	-0.207	0.04283393
1975	320.5	325.4	5.770	5.785	417	6.032	-0.247	0.06104996
1976	315.1	472.4	5.753	6.158	415	6.029	0.129	0.01656231
1977	330.0	431.5	5.799	6.067	418	6.037	0.031	0.00094736
1978	323.7	445.6	5.780	6.100	417	6.034	0.066	0.0043324
1979	310.7	662.1	5.739	6.495	414	6.027	0.469	0.21975953
1980	296.9	427.2	5.693	6.057	410	6.017	0.040	0.00160316
1981	307.6	1032.7	5.729	6.940	414	6.025	0.915	0.83765805
1982	300.8	596.5	5.706	6.391	412	6.020	0.371	0.13761056
1983	325.0	615.5	5.784	6.422	418	6.034	0.388	0.15054941
1984	327.0	540.0	5.790	6.292	418	6.035	0.256	0.06571061
1985	360.8	1268.9	5.888	7.146	422	6.046	1.100	1.21002724
1986	364.1	545.2	5.897	6.301	423	6.047	0.255	0.06481129
1987	395.6	569.0	5.981	6.344	424	6.049	0.295	0.08707283
1988	379.4	418.5	5.939	6.037	423	6.048	-0.012	0.00013664
1989	422.4	410.3	6.046	6.017	423	6.047	-0.030	0.00089324
1990	398.3	402.2	5.987	5.997	424	6.049	-0.052	0.00266946
1991	341.4	405.5	5.833	6.005	420	6.041	-0.036	0.00128194
1992	307.1	280.8	5.727	5.638	413	6.024	-0.387	0.1494825
1993	276.9	244.8	5.624	5.501	403	6.000	-0.499	0.24900429
1994	235.2	335.8	5.460	5.816	381	5.944	-0.127	0.01617417
1995	220.0	266.6	5.394	5.586	371	5.915	-0.329	0.10845337
1996	198.4	691.5	5.291	6.539	353	5.865	0.674	0.45369715





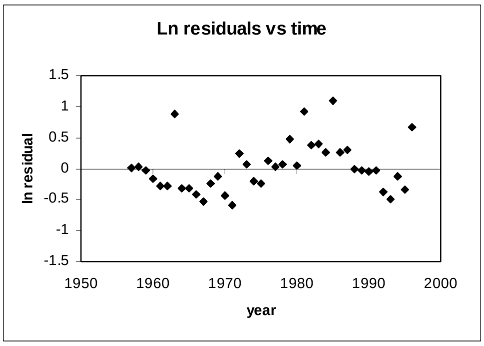


Table 9.25 North sea plaice: yield per recruit input data

11:04 Monday, October 16, 2000
Plaice Sub-area IV

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	0.129	0.0010	0.235
2	-	0.1000	0.5000	0.0000	0.0000	0.231	0.0686	0.271
3	-	0.1000	0.5000	0.0000	0.0000	0.264	0.3510	0.298
4	-	0.1000	1.0000	0.0000	0.0000	0.316	0.4954	0.344
5	-	0.1000	1.0000	0.0000	0.0000	0.383	0.4813	0.407
6	-	0.1000	1.0000	0.0000	0.0000	0.452	0.4030	0.480
7	-	0.1000	1.0000	0.0000	0.0000	0.516	0.3404	0.550
8	-	0.1000	1.0000	0.0000	0.0000	0.595	0.2909	0.619
9	-	0.1000	1.0000	0.0000	0.0000	0.661	0.2434	0.700
10	-	0.1000	1.0000	0.0000	0.0000	0.724	0.1998	0.758
11	-	0.1000	1.0000	0.0000	0.0000	0.822	0.1557	0.842
12	-	0.1000	1.0000	0.0000	0.0000	0.908	0.1626	0.905
13	-	0.1000	1.0000	0.0000	0.0000	0.879	0.1616	0.907
14	-	0.1000	1.0000	0.0000	0.0000	0.892	0.1512	0.887
15+	-	0.1000	1.0000	0.0000	0.0000	0.971	0.1512	1.002
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDULI04
Date and time: 10OCT00:11:50

11:04

Table 9.26 North sea plaice: yield per recruit analysis

Monday, October 16, 2000
Plaice Sub-area IV

Yield per recruit: Summary table

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	6118.444	8.647	5776.454	8.647	5776.454
0.1000	0.0319	0.189	101.529	8.623	4550.621	6.764	4209.391	6.764	4209.391
0.2000	0.0639	0.319	161.736	7.319	3504.794	5.463	3164.318	5.463	3164.318
0.3000	0.0958	0.413	197.925	6.389	2785.596	4.536	2445.869	4.536	2445.869
0.4000	0.1277	0.481	219.771	5.706	2278.260	3.855	1939.277	3.855	1939.277
0.5000	0.1597	0.533	232.884	5.192	1912.374	3.345	1574.130	3.345	1574.130
0.6000	0.1916	0.573	240.611	4.798	1643.223	2.953	1305.713	2.953	1305.713
0.7000	0.2235	0.604	244.992	4.489	1441.605	2.647	1104.824	2.647	1104.824
0.8000	0.2554	0.629	247.290	4.243	1287.995	2.404	951.938	2.404	951.938
0.9000	0.2874	0.649	248.296	4.044	1169.073	2.208	833.735	2.208	833.735
1.0000	0.3193	0.665	248.511	3.881	1075.593	2.047	740.968	2.047	740.968
1.1000	0.3512	0.679	248.251	3.745	1001.033	1.914	667.117	1.914	667.117
1.2000	0.3832	0.691	247.719	3.630	940.729	1.801	607.518	1.801	607.518
1.3000	0.4151	0.701	247.042	3.531	891.303	1.706	558.791	1.706	558.791
1.4000	0.4470	0.710	246.302	3.447	850.276	1.624	518.458	1.624	518.458
1.5000	0.4790	0.717	245.547	3.373	815.809	1.552	484.681	1.552	484.681
1.6000	0.5109	0.724	244.809	3.308	786.524	1.490	456.081	1.490	456.081
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDULI04
Date and time : 10OCT00:11:50
Computation of ref. F: Simple mean, age 2 - 10
F-0.1 factor : 0.4480
F-max factor : 0.9866
F-0.1 reference F : 0.1430
F-max reference F : 0.3150
Recruitment : Single recruit

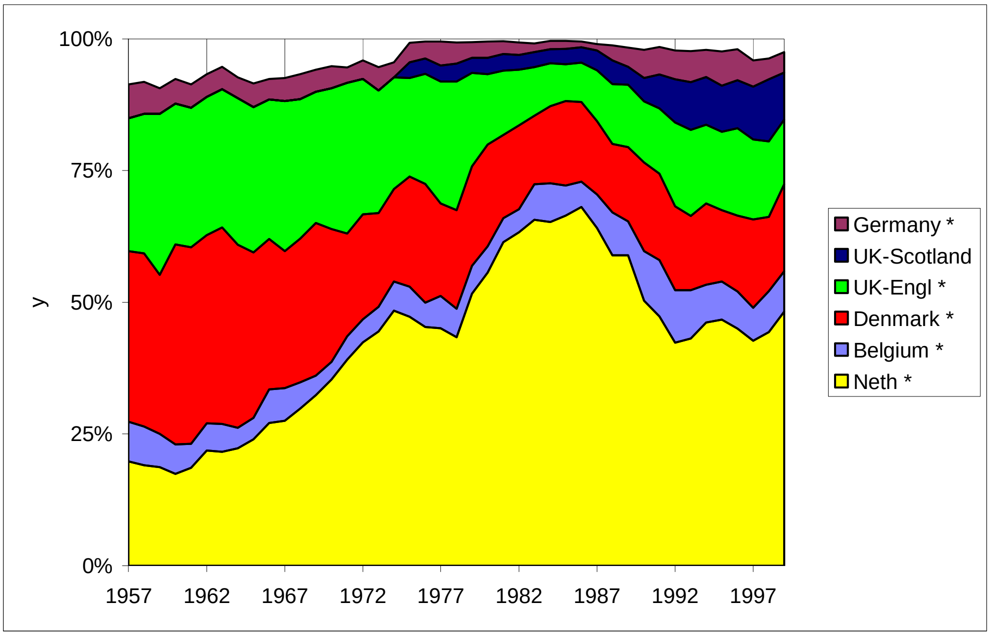


Figure 9.1 North Sea plaice: proportion of total landings by major fleets

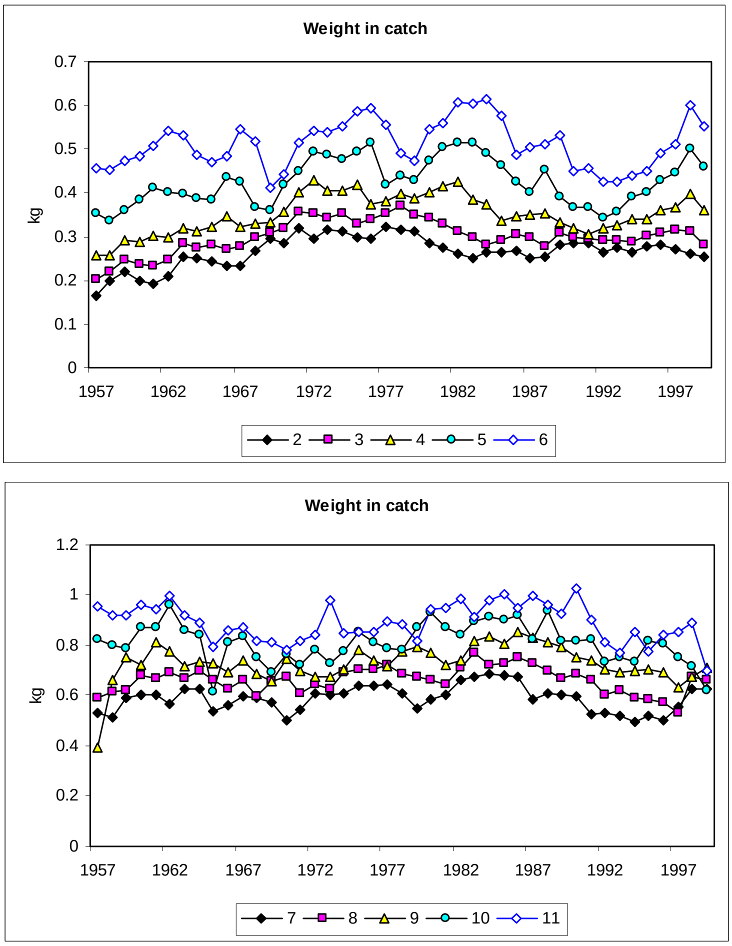
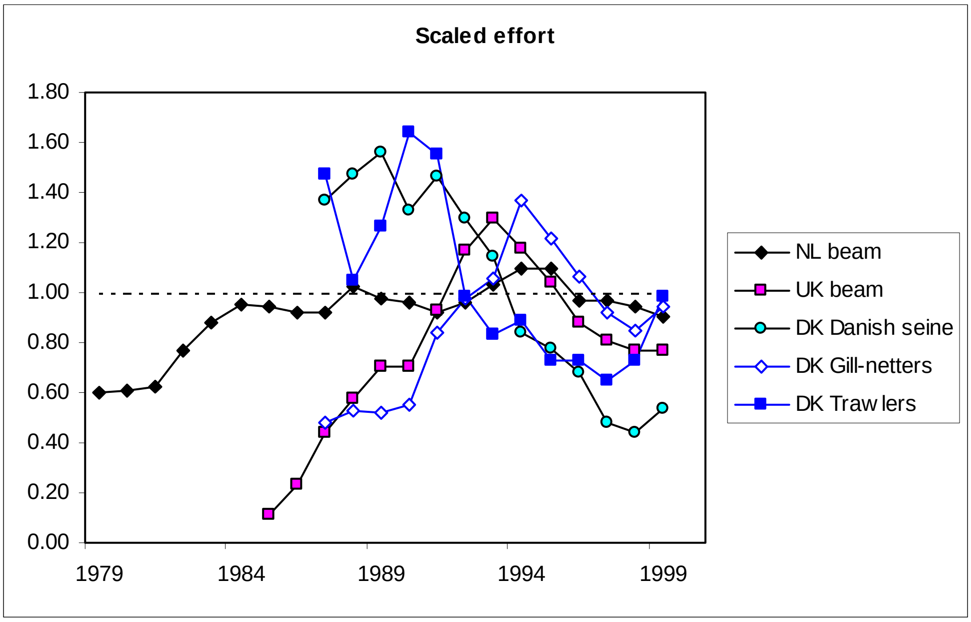


Figure 9.2 North Sea plaice: catch weights at age (kg)



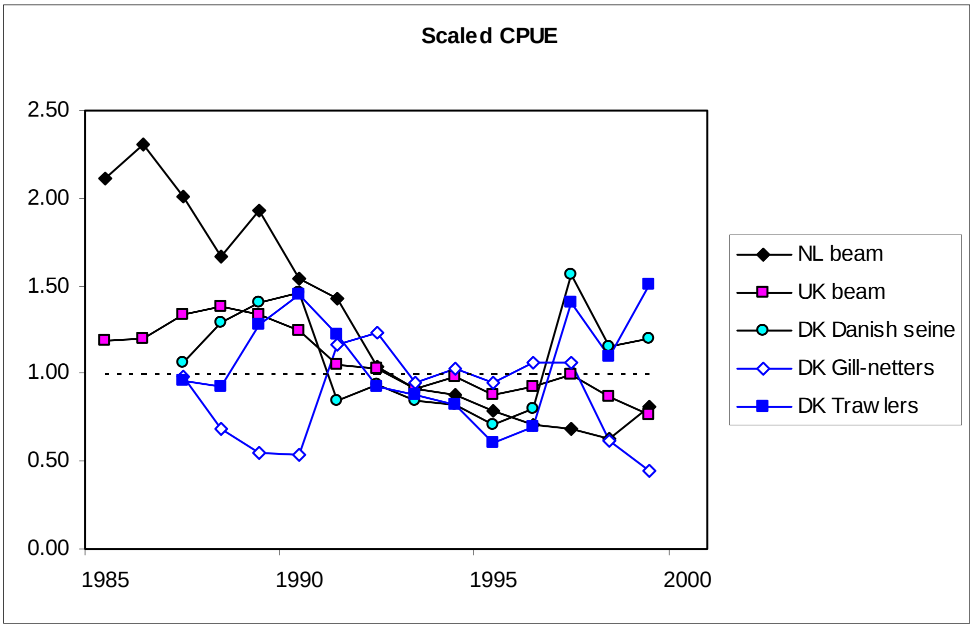


Figure 9.3 North Sea plaice: relative effort and CPUE (scaled to the average for each fleet in the years 1990-1997).

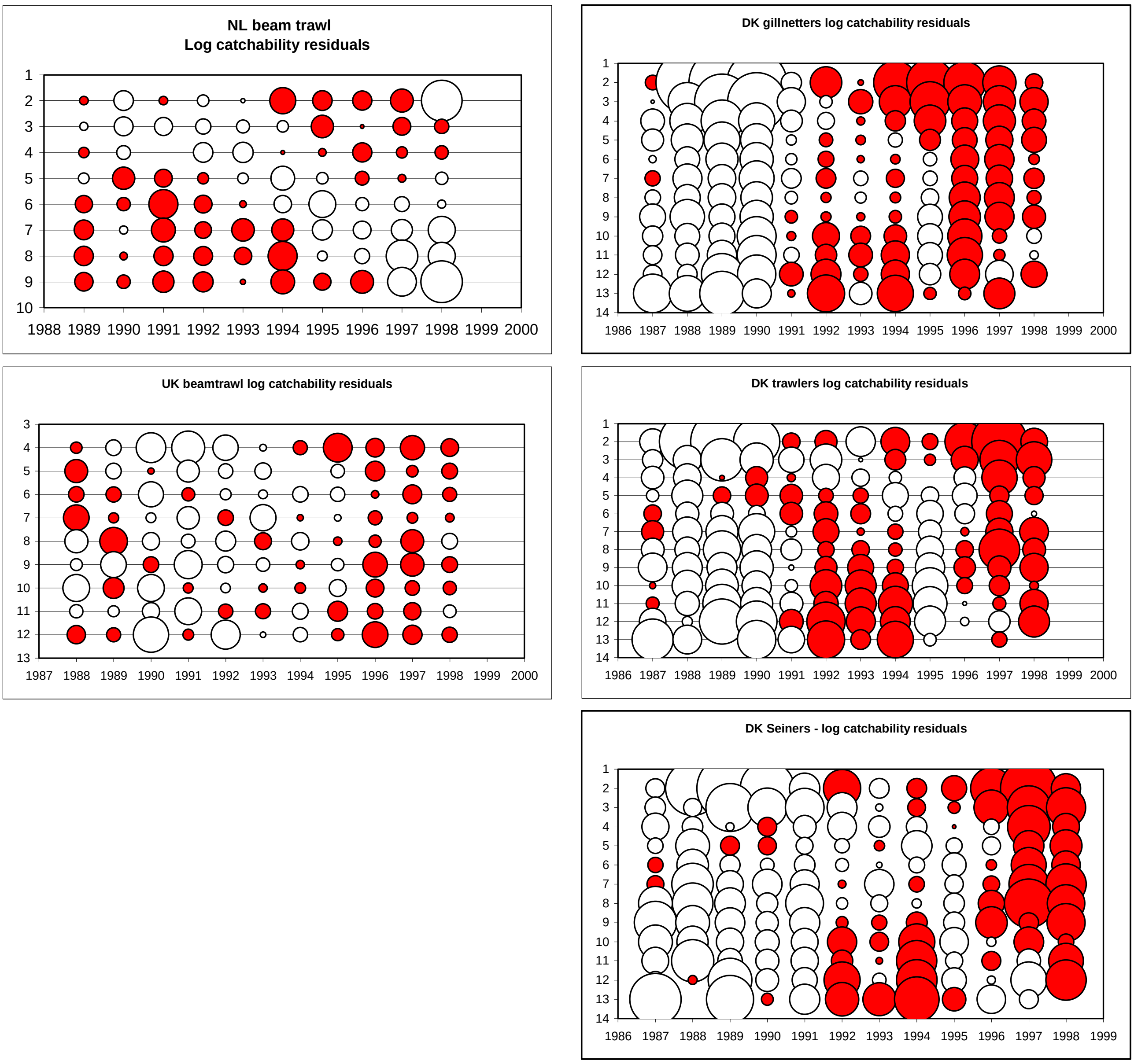


Figure 9.4 Log catchability residuals of single fleet Laurec-Shepherd tuned VPA's without shrinkage. Positive residuals are indicated by dark circles, negative residuals by light circles. Bubbles are scaled to the maximum of 2.5. Fleets: NL beam trawl (left-top), UK beam trawl (left-bottom), DK gillnet (right-top), DK trawlers (right-middle), DK seiners (right-bottom).

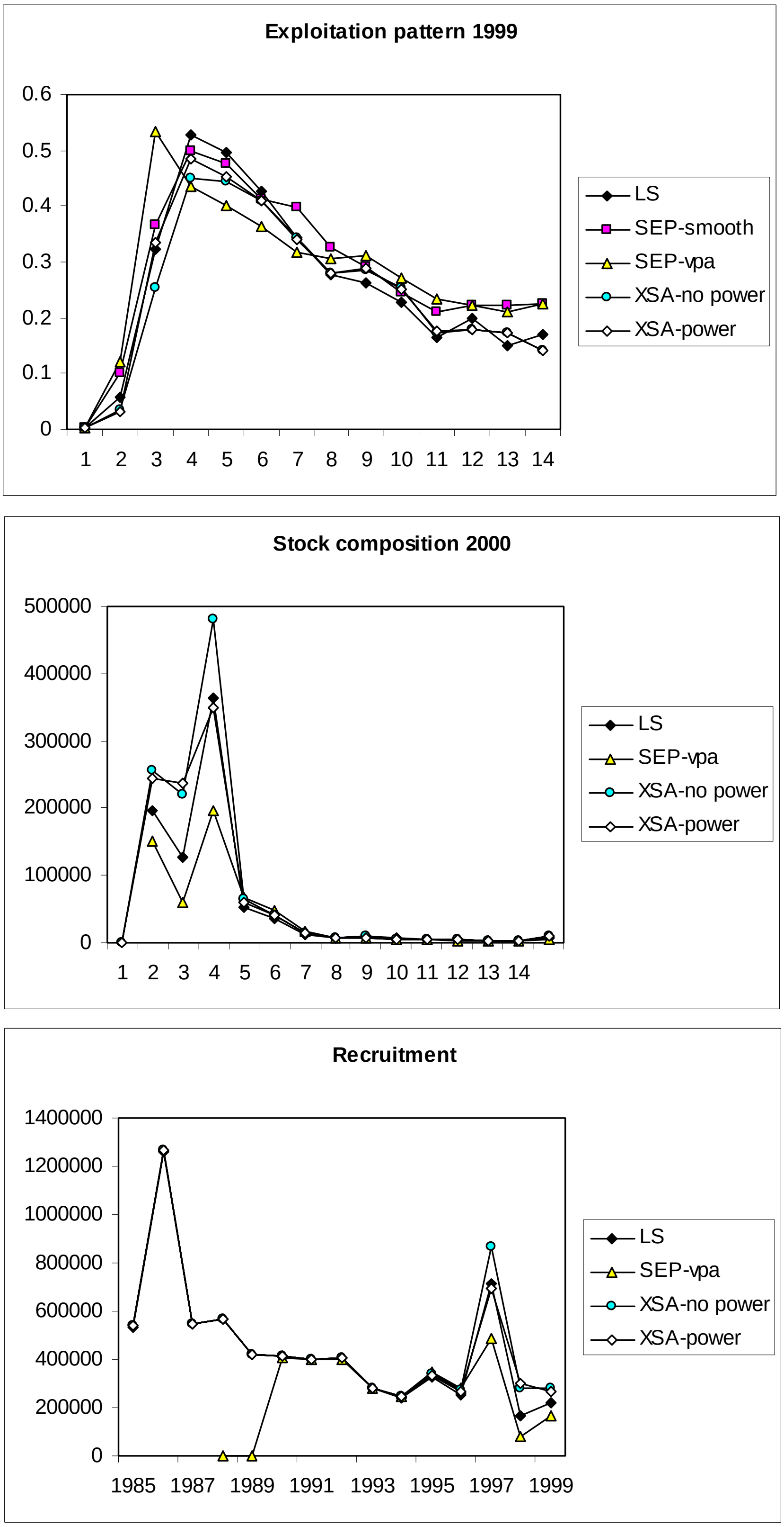


Figure 9.5 Comparison of exploitation patterns in 1999, stock composition in 2000 (survivors) and recruitment at age 1 from 5 different assessment methods: Laurec Shepherd (LS), Separable model smoothed (SEP-smooth), Separable VPA (SEP-vpa), XSA without power model (XSA-no power) and XSA with power model for ages 1-3 (XSA-power).

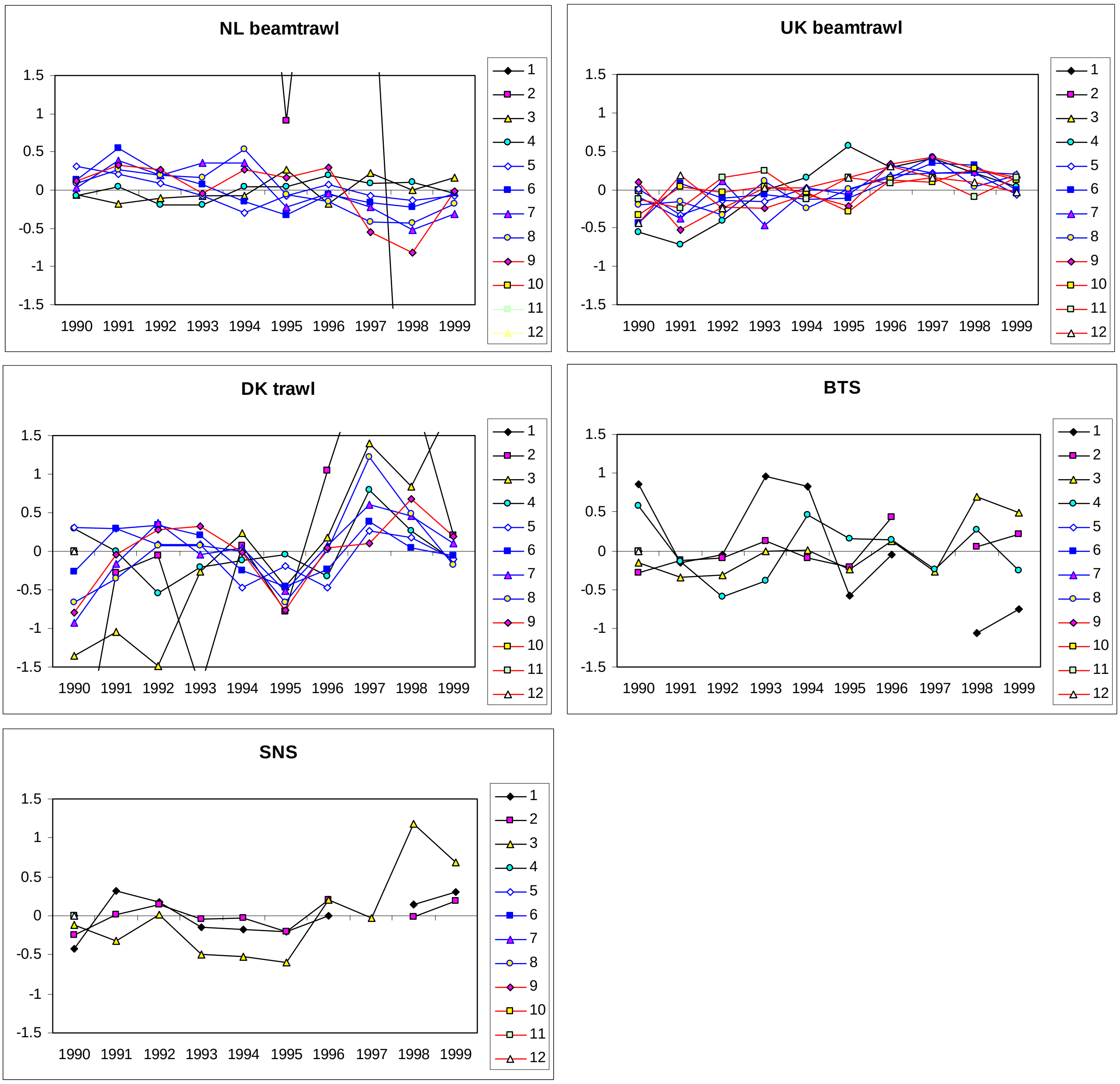


Figure 9.6 North Sea plaice: Log catchability residuals for the final XSA run; all fleets combined.

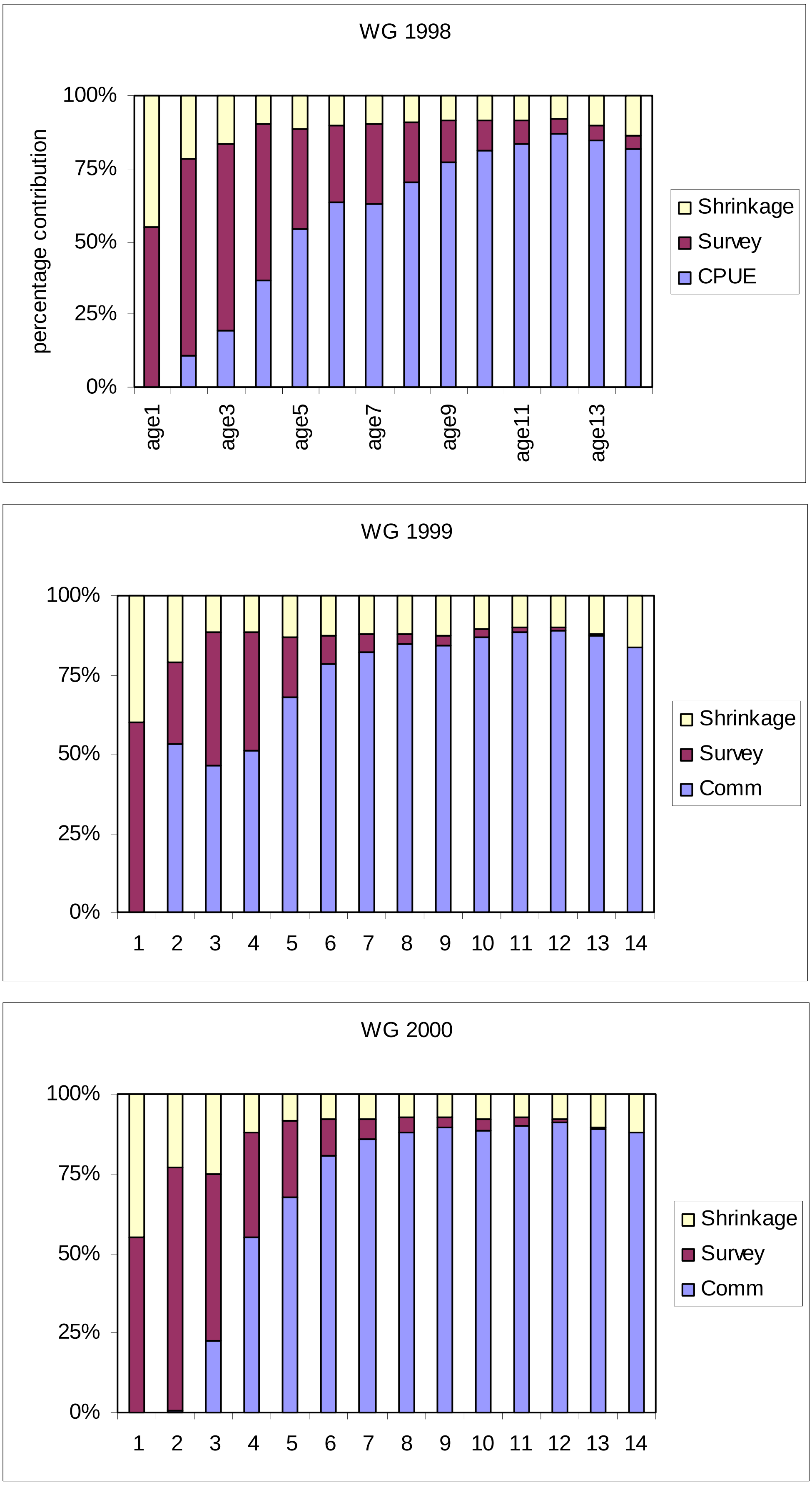


Figure 9.7 North Sea plaice: Weighting of tuning fleets in the 1998 (top), 1999 (middle) and 2000 WG (bottom) XSA assessments.

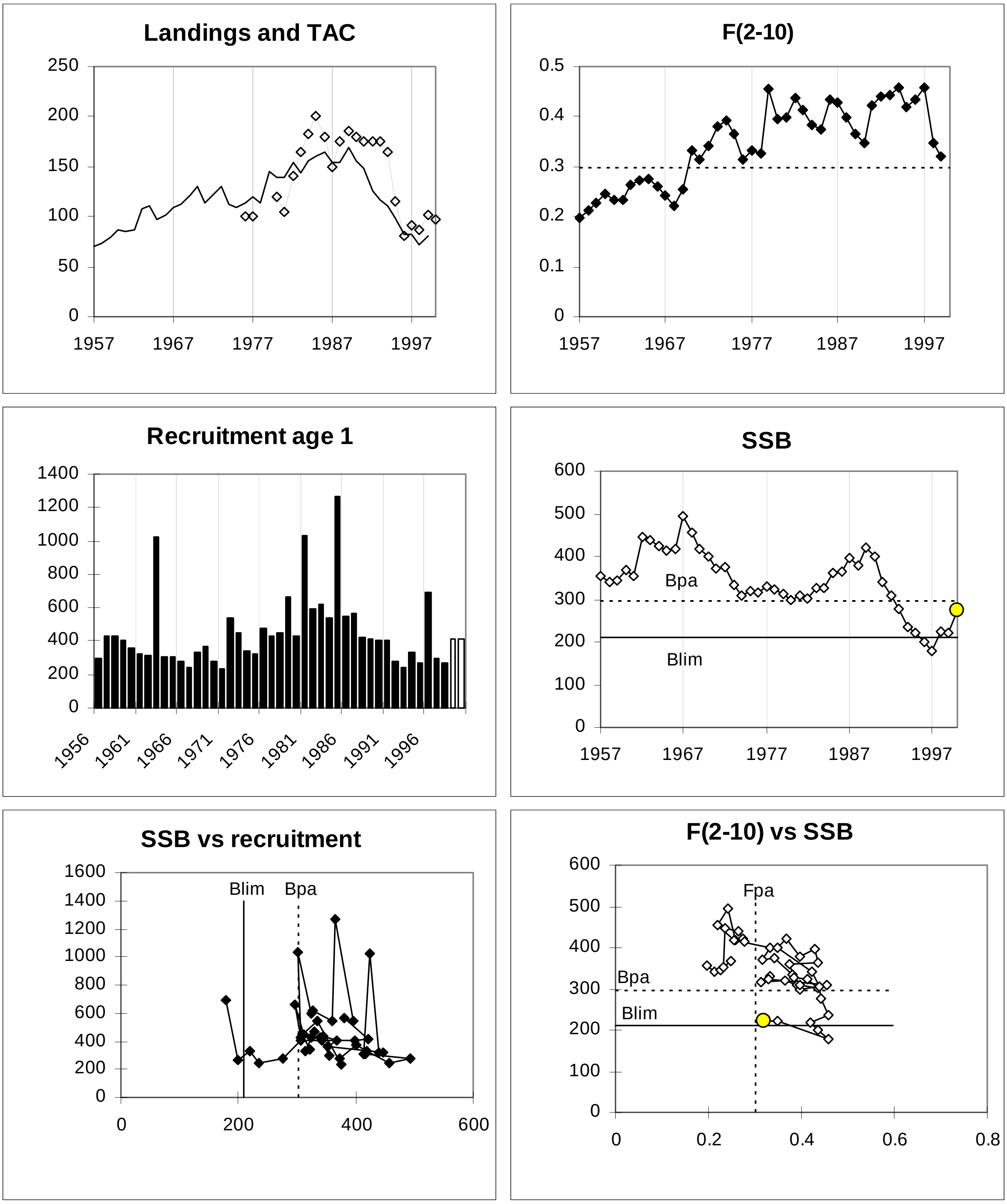


Figure 9.8 North Sea plaice: Stock summary. In the SSB graph the SSB in 2000 (prediction) is indicated by a circle. In the F vs. SSB plot, the 1999 value is indicated by a circle.

Figure 9.9 North Sea plaice: retrospective XSA using four consecutive 8 year tuning windows shifted back over time (shrinkage = 0.5)

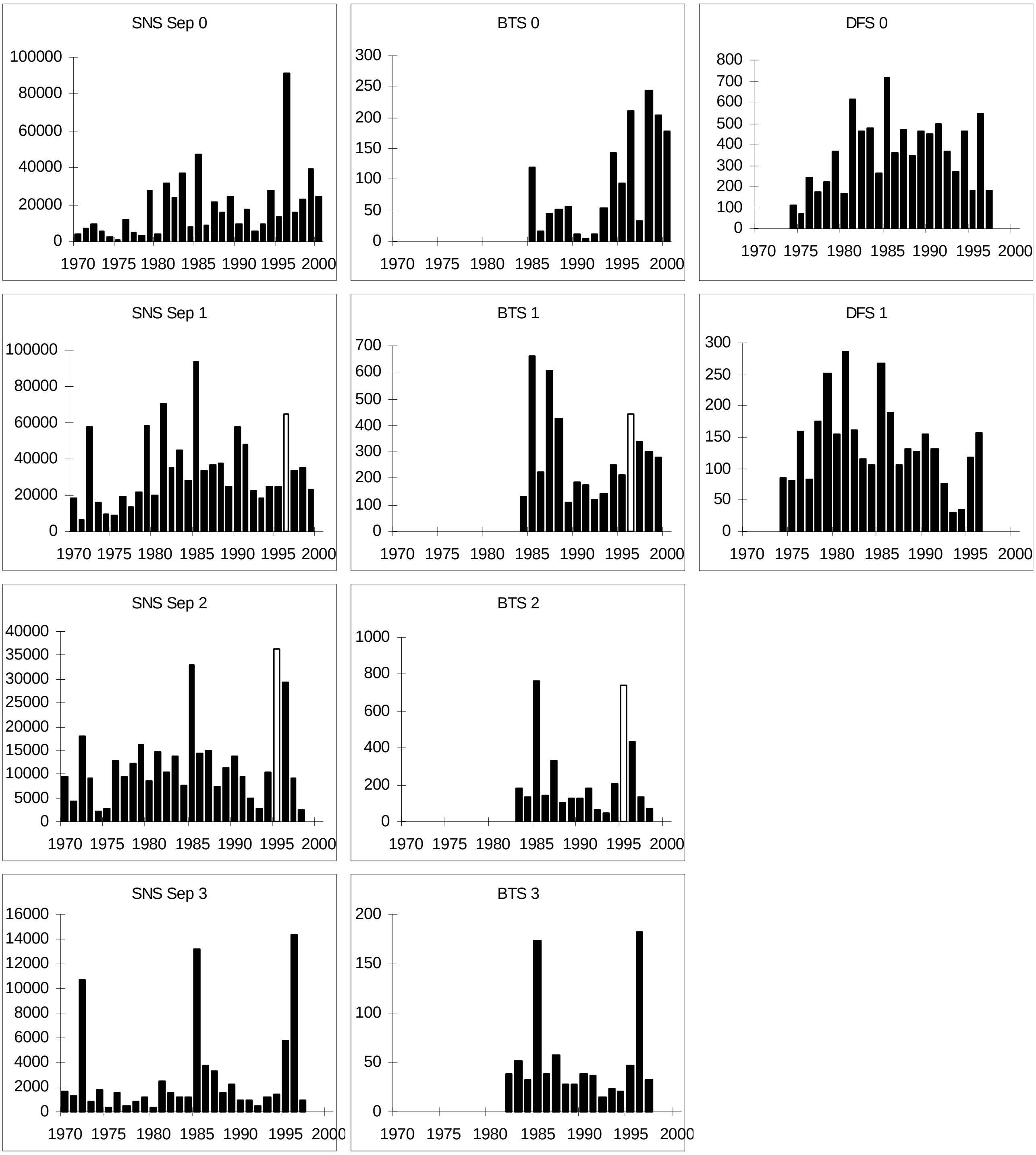


Figure 9.10 North Sea plaice: survey indices (white columns are removed from tuning and RCT3)

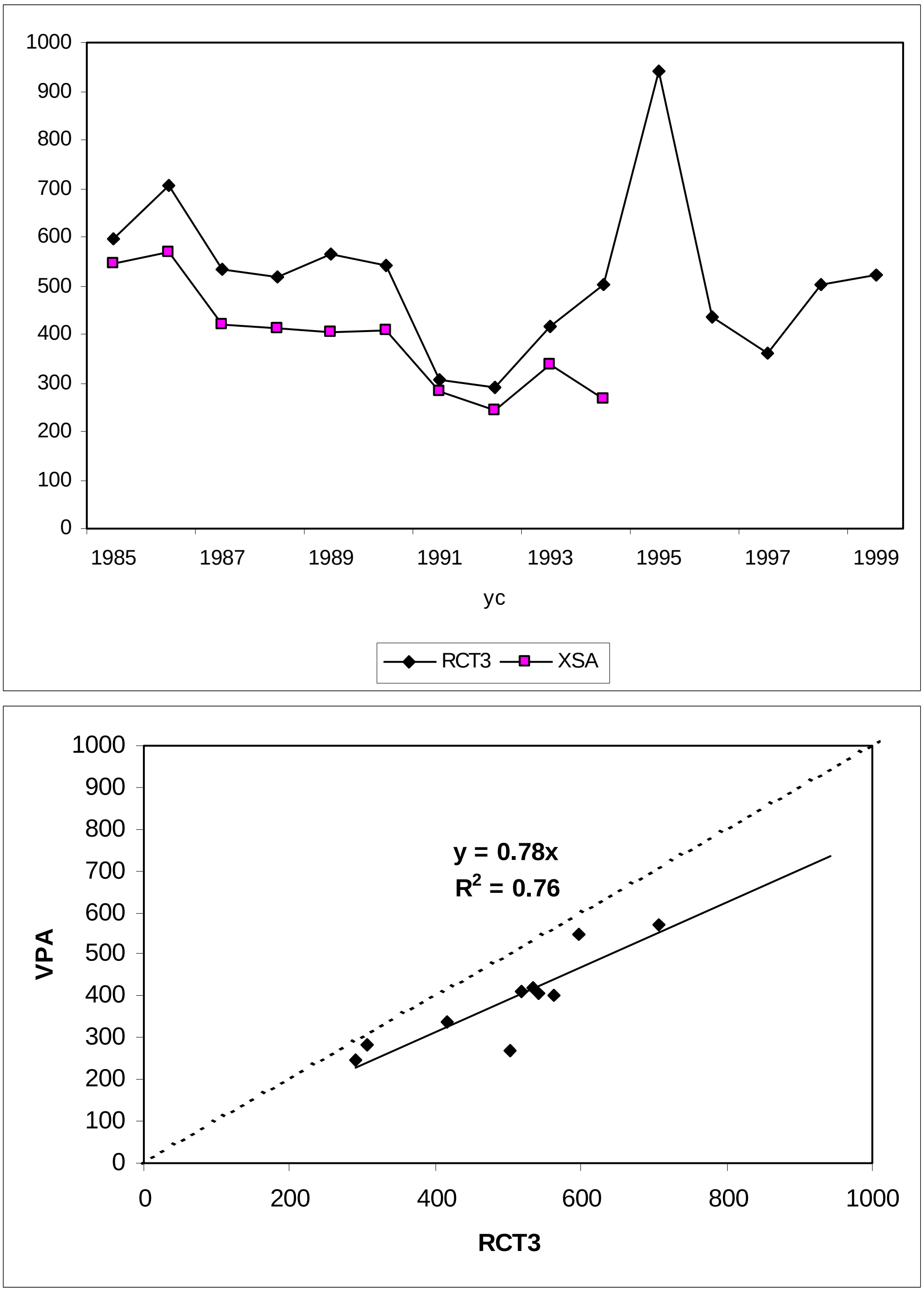


Figure 9.11 North Sea plaice: comparison of RCT3 estimates to the (converged) XSA estimates of recruitment at age 1.

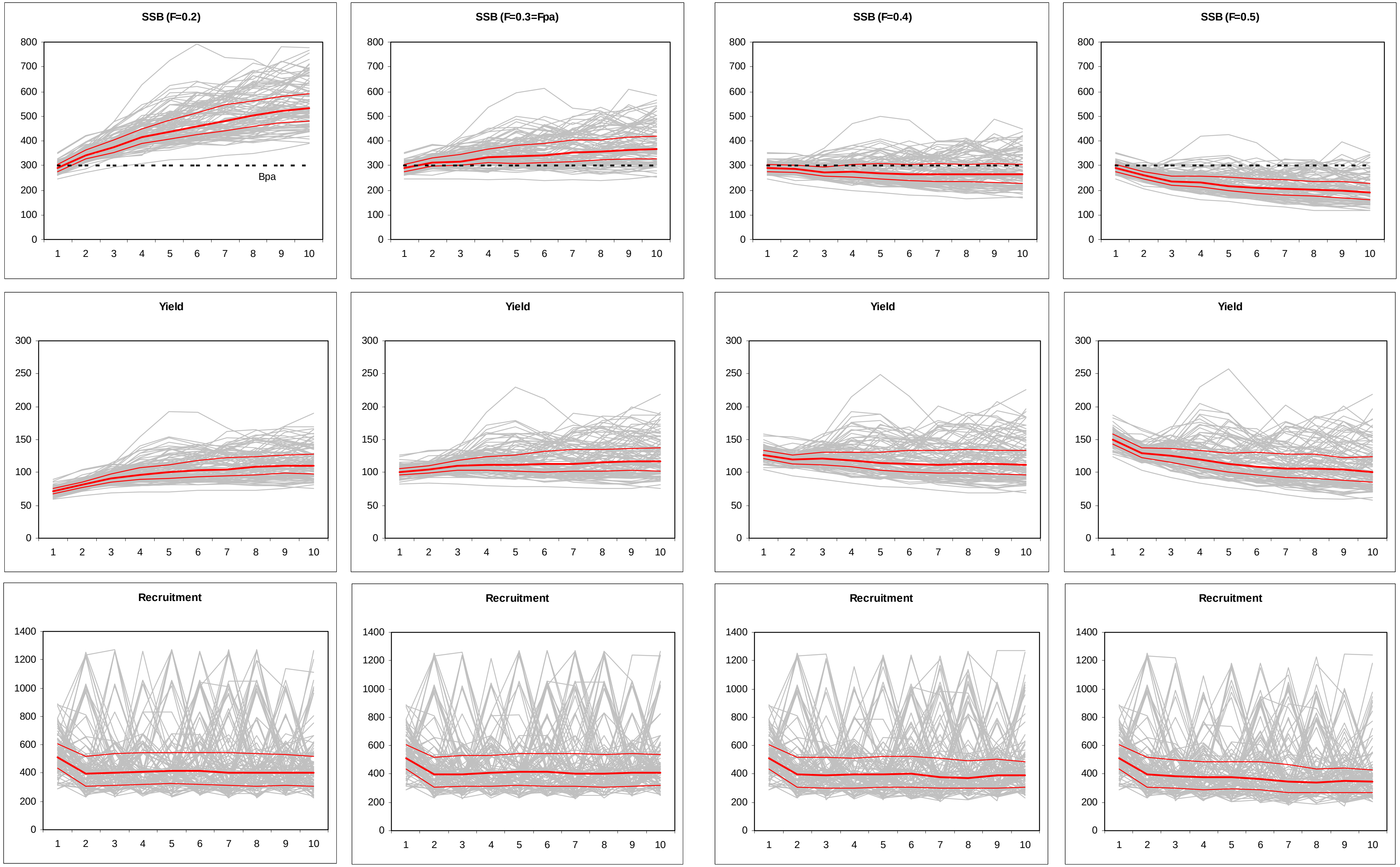


Figure 9.12 North Sea plaice: medium-term forecasts at different levels of fishing mortality (dark lines are 25th, median and 75th percentiles)

Figure 9.13 North Sea plaice: Stock and recruitment.

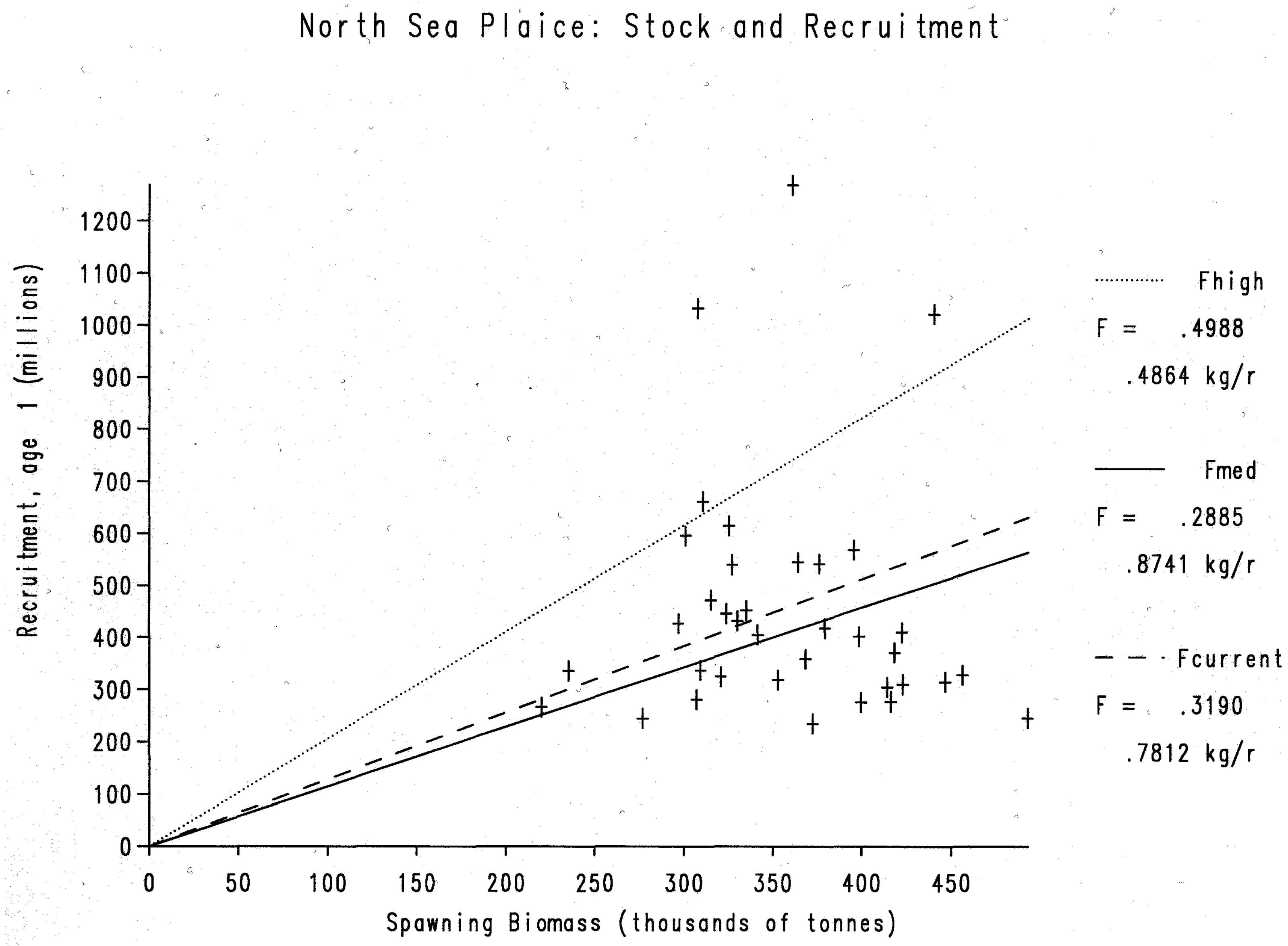
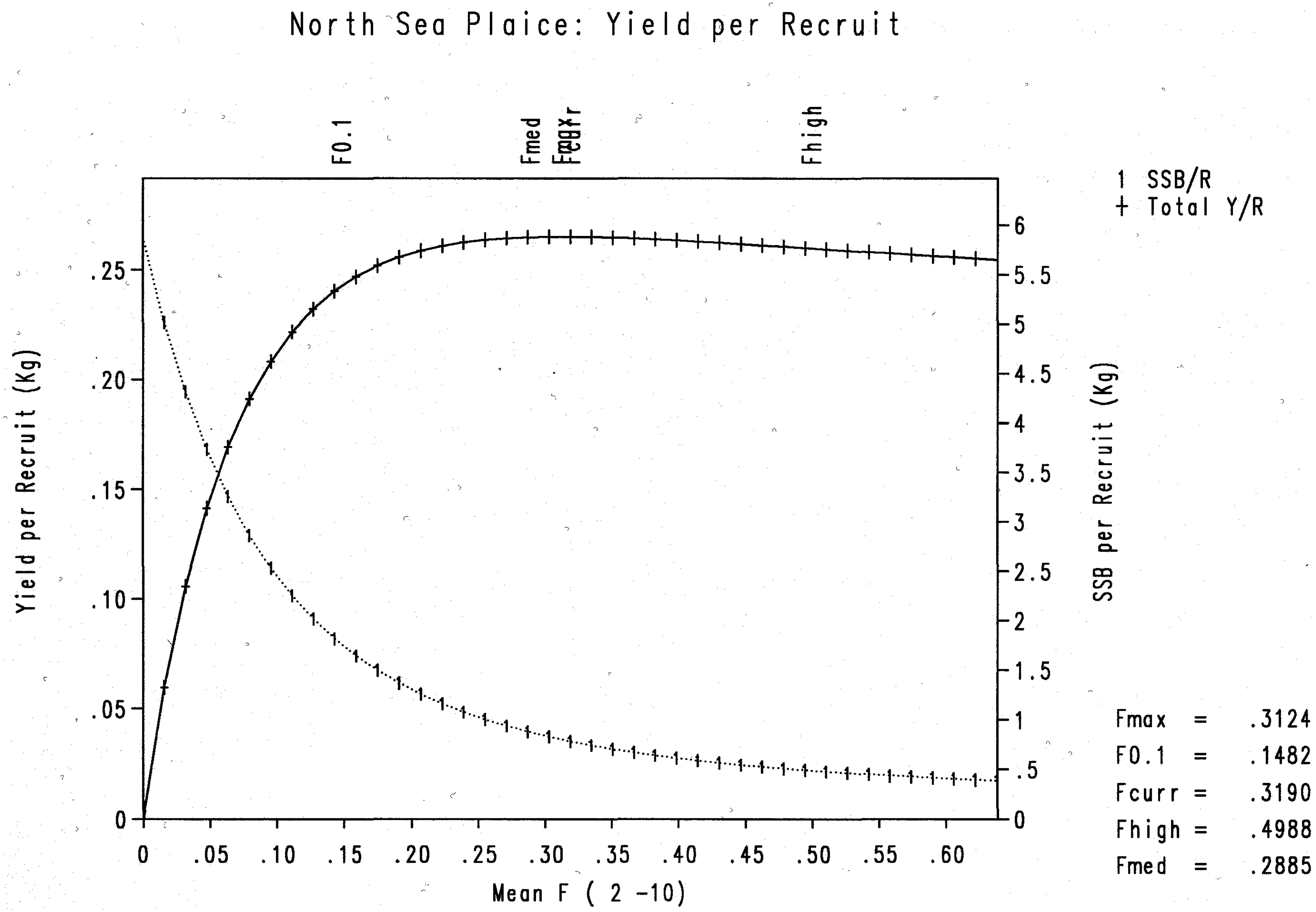


Figure 9.14 North Sea plaice: Yield per recruit



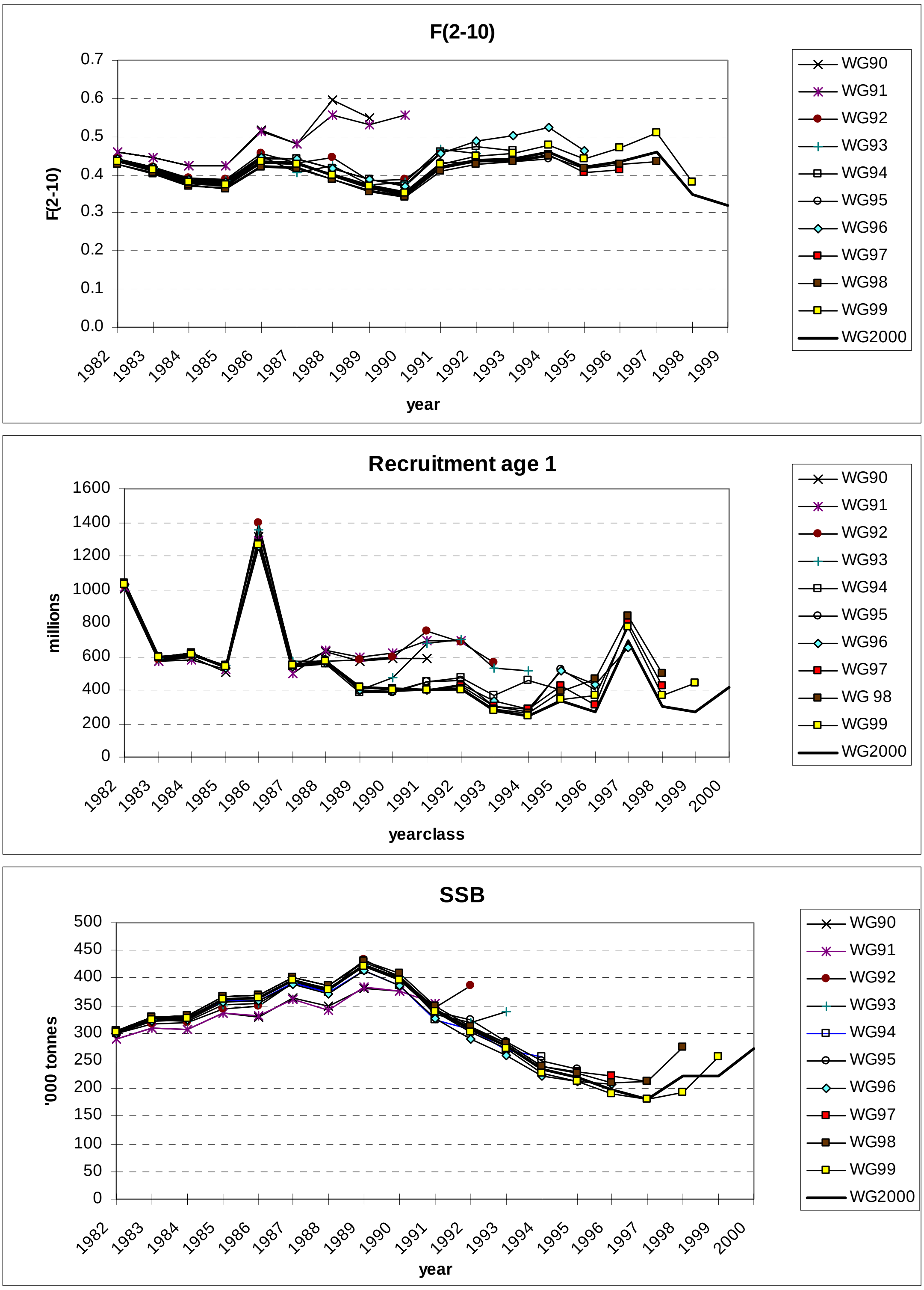


Figure 9.15 North Sea plaice: historic performance of past Working Group assessments.

10 PLAICE IN DIVISION IIIA

10.1 The Fishery

10.1.1 ACFM advice applicable to 1999 and 2000

ACFM recommended for 1999 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.

ACFM recommended for 2000 to reduce or maintain fishing mortality below the proposed F_{pa} ($F_{pa} = 0.73$), corresponding to landings in 2000 of 11,800 t, and also to increase or maintain spawning stock biomass above B_{pa} (B_{pa} = 24,000 t). F_{pa} was set to the value of F_{med} in 1998. Neither F_{lim} nor B_{lim} were defined.

10.1.2 Management applicable to 1999 and 2000

The 1999 and 2000 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 1999

A directed plaice fishery is carried out by Danish seiners. Plaice is also an important by-catch to otter-trawlers and gill-netters. A considerable number of vessels have been taken out of the fisheries in recent years. The official landings have been updated this year according to ICES official tables (Belgian, Norwegian and German landings) and national statistics (Danish and Swedish landings). The Netherlands reported a substantial amount of landings to ICES over period 1983–1988. However, these landings have not been accounted for in the assessment of this stock since 1991 (ICES CM 1991/Assess: 9), on the grounds of mis-reporting suspicions. In the absence of any information on mis-reporting, the Working Group decided to use total landings reported from Denmark, Sweden, Germany, Norway and Belgium to carry out this assessment (Table 10.1.3).

Plaice landings in 1999 stabilised around the same low level as in 1998 (8,500 t). 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 1999, more than 80% of the catches were taken in Skagerrak.

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 were provided by Denmark only and are available over the period 1978–1999. 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. 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 1998 and 1999, the fishery has mainly exploited the three same year classes: 1993–1995 (Figure 10.2.1.). Mean catch weights-at-age of Kattegat plaice have remained stable over years for all age groups (Figure 10.2.2). By contrast, decreasing trends in weights at age are observed in the Skagerrak for age groups 8–11+, with a historical minimum reached in 1997. 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. Discards time series were not available to this assessment.

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 disaggregated 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.

Compared to last year, the fishing effort definition of the tuning fleets has been altered in two ways. First, the number of days fishing have been made available and used as fishing effort unit in replacement to the number of days at sea. This procedure is expected to refine the definition of fishing effort by removing steaming time, which is not directly allocated to the fishery. Second, the number of days fishing has been standardised by vessel length. The vessel length effect was identified by modelling Log-CPUE using a GLM approach, with (Log-) vessel length (continuous variable), year (discrete variable), and quarter (discrete variable) taken as external factors. A 15 m vessel was used as the reference fishing unit. This procedure explicitly splits some important sources of variability that underlie CPUE dynamics, and was therefore preferred to last year's, where the vessel length effect was identified by operating a simple linear regression of Log-CPUE versus Log-Length. The coefficients associated to the vessel length effect relative to trawlers and gill-netters are negative but closer to zero than last year's (-0.89 versus –1.07 and -0.73 versus –1.59, respectively). These negative values may indicate that plaice is essentially a by-catch to both trawlers and gill-netters. The coefficient associated to the vessel length effect relative to Danish seiners is 0.19 (-0.71 last year). This positive value suggests that plaice is a target species to this fleet. Overall, these results suggest that the present effort configuration better reflects the expected fishing pattern of the tuning fleets under examination than last year's.

The trends in fishing effort and CPUE of the tuning fleets are presented in Figure 10.2.3. The fishing effort of towed-geared fleets has overall decreased since 1990. The fishing effort of gill-netters has steeply increased over 1990–1994, and steadily decreased since then. The CPUE time series do not reveal consistent trends for any fleet. The Danish seiners have been the most effective in relation to plaice fishing. 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 1992–2000, as numbers-per-age and hour on a haul by haul basis. This survey is hereby referred to as "Argos". Stock abundance indices and their associated CVs are given in Table 10.3.2. One haul was excluded from the survey conducted in 2000 due to very high catches of age-groups 1–6. This was not thought to be representative for the area. CV was calculated to measure the relative variation in the observed abundance indices instead of measuring the relative variation in the indices estimations. 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

International catches-at-age were preliminarily examined using separable VPA, with a reference age of 6,-terminal F = 0.9, and-terminal selectivity set to unity (Table 10.4.1). Large residuals in Log-catch ratios were detected for ages 2/3 and 3/4 in some years (94/95 to 97/98), but no consistent trends could be detected for these ages. The other residuals showed little variability and trends. As in previous years, the age range for the analyses was set to 2–11+.

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 plaice aged 7–9 were caught during the survey and these ages were removed from the IBTS tuning fleet.

Five assessment runs have been carried out. Run 1 uses exactly the same configuration as last year. Run 2 used the same settings as run 1, but using standardised days fishing instead of standardised days at sea. There were almost no differences in the assessment outputs derived from runs 1 and 2, suggesting that refining effort definition did not alter assessment performance. A single-fleet Laurec-Shepherd run was carried out for each of the tuning fleets (run 3). The Log-catchability residuals derived from run 3 were generally high for gill-netters harvesting plaice aged 2–3 (Figure 10.4.1). These ages were removed in subsequent runs. The Laurec-Shepherd single-fleet analysis did not converge, when applied to the Argos survey. Run 4 used the same configuration as run 2, but age range for gill-netters was restricted to 4–11. The slope of the regression between corrected (Log-) CPUE and (Log-) stock abundance, as derived from run 4, was negative for the Argos survey over age range 2–3. These ages were removed in run 5 (final run), which is presented below.

Plots of the log catchability residuals, derived from a run with combined fleets, show little trend over time, despite a year effect in 1997 for the oldest age groups caught by the Danish seine fleet (Figure 10.4.2). Figure 10.4.3 shows the weighting in tuning fleets and shrinkage, as derived from this year and last year's final assessments. There were only little changes in the weighting of the tuning fleets, with the exception of ages 2–3, which were not tuned by the survey this year. Overall, the weight of shrinkage was lower than 40% in this year's assessment. Retrospective VPA runs are carried back to 1995, by chopping off one year for each retrospective run (Figure 10.4.4). 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. The F trajectories derived from the 1999 and the 1998 runs are almost identical.

The overall assessment appears reasonable, for five 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 5–10 for the commercial fleets, even if these R-squares are somewhat lower for the Argos survey (Table 10.4.2). Third, the estimation of survivors differed only slightly between the fleets except for age 4, where the estimation of survivors from Argos survey for age 4 was about 50% higher than average from the other fleets. The apparent discrepancy between the estimates from the commercial fleets and from the survey results from hauls of high abundance operated by Argos in the Kattegat, an area which contributed to only 20% of commercial catches in 1999. Fourth, shrinkage is never dominant. Five, the retrospective patterns are reasonably consistent.

10.4.2 Final assessment

The configuration of the final assessment is the same as last year, except for the choice of fishing effort unit and of the age range relative to the Argos survey and the gill-netters.

	XSA (1999)	XSA (2000)
Argos survey (1991–1999) DK gill-netters (1987–1999) DK trawlers (1987–1999) DK seiners (1987–1999)	4–6 4–11+ 2–11+ 2–11+	1–6 2–11+ 2–11+ 2–11+
Fishing effort	Standardised days at sea	Standardised days fishing
Taper	No	No
Tuning window	10 years	10 years
q dependent on N	Ages < 4	Ages < 4
q plateau	Ages > = 8	Ages > = 8
Shrinkage	F(0.5); P(0.3)	F(0.5); P(0.3)

The VPA results are given in Tables 10.4.2.-10.4.5. The fishing mortality (age 4–8) estimated for 1999 is 0.70, which is about the same as F_{1998} and F_{pa}. The exploitation pattern increases up to age 6 from which point F approximately remains at a constant level. Total and spawning stock biomass in 1999 are estimated to be at about the same level as in 1998 (36,000 t).

10.5 Recruitment estimates

The abundance indices from the Argos surveys in Kattegat and Skagerrak are given in Table 10.3.2. The time series indicate that the 2000 indices corresponding to the 1996, 1997, 1998, and 1999 year-classes are the highest in the time series. The coefficients of variation calculated in 2000 are within the historical range for the ages included in the assessment (ages 4–6). 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 5% for year classes 1996–1999. The estimations of recruitment at age 2 were consistent across the commercial tuning fleets (Table 10.4.2). As a result, the estimates of recruitment provided by the XSA were retained. Recruitment in 2000 was estimated by the geometric mean of 47.2 million, calculated over period 1978–1997. Year class strength used for predictions are underlined in the following summary table:

Year class	Age	RCT3 (Thousand)	XSA (Thousand)	GM (78–97) (Thousand)
1997	3	N/A	<u>32,336</u>	42,852
1998	2	N/A	N/A	<u>47,241</u>

10.6 Historical trends

The historical trends in the fisheries are presented in Tables 10.1.3, 10.4.5 and in Figure 10.6.1.

Since 1978, landings have declined from 25,000 to 9,000 tonnes. Landings in 1999 were the third 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 older are taken from the estimated number of survivors from the XSA. The age 2 recruitment in 2000, 2001, and 2002 is taken as the geometric average over the 1978–1997 period. The mean weights-at-age are taken as the average for the years 1997–1999. The exploitation pattern is calculated as the average F over 1997–1999, and then rescaled to the 1999 value of F(4–8) = 0.70.

The *status quo* predictions result in catches of 9,300 and 9,100 tonnes in 2000 and 2001, respectively (Tables 10.7.2). These values are substantially lower than those derived last year (about 12,000 t), as a result of lower F and weights-at-age used in the predictions. The landings predicted this year are more consistent with recent trends. The detailed predicted outputs are given in Table 10.7.3. Estimate of SSB over 2000–2002, at *status quo* F, remains in the range 31,000–34,000 tonnes. The short-term yield and SSB are shown in Figure 10.8.1.

The results of a detailed *status quo* short-term forecast are shown in Table 10.7.4. Year classes 1995 and 1996 are expected to provide the largest contribution to landings predicted in year 2001 (50%). Recruitments in 2000 and 2001, which have been set to the geometric mean calculated over 1978–1997, contribute to more than 60% of SSB predicted in 2002.

10.8 Biological reference points

A yield per recruit analysis was performed. The input data are given in Table 10.8.1. 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 10.8.2 and Figure 10.8.1. The stock and recruitment relationship is given in Figure 10.8.2. The values of the biological and precautionary reference points are presented in the following table:

$F_{0.1}$	0.09	F_{lim}	N/A
F_{max}	0.19	F_{pa}	0.73
F_{med}	0.72	B_{lim}	N/A
F_{high}	> 1.5	B_{pa}	24,000 t

F_{max}, $F_{0.1}$ and F_{med} remain at the same level as last year. Figure 10.8.3 shows historical and projected trends in F and SSB, in relation to F_{pa} and B_{pa}. It may be observed that the current F is at about F_{pa}, while SSB is above B_{pa}.

10.9 Comments on the assessment

The plaice stock in Kattegat and Skagerrak is apparently subjected to three major trends. First is the decreasing landings in Kattegat, in comparison to Skagerrak, since 1978. This could result from either reduced recruitments in Kattegat due to oxygen limitations (Anon. 1991/Assess: 9), or shifts in fishing strategies. Second is the decreasing weights-at-age observed in Skagerrak since 1984. This trend has also been observed for other stocks in the area, including cod. Third is the high estimated fishing mortality of ca. 0.7 calculated in IIIa, relative to plaice assessed in Division IV (ca. 0.40). The difference may be caused by older, mature plaice emigrating from the Skagerrak to the North Sea for spawning.

The effort definition (number of days fishing standardised by vessel length) used in the tuning fleet configuration differs from last year's, without notably affecting the results of this assessment. It is however suggested that the same definition should be used in further assessments of this stock, since it is estimated to better reflect the fishing pattern of the tuning fleets under examination.

In last year's assessment, the exploitation pattern used in the short-term predictions was not re-scaled to last year's value. In this year's assessment, exploitation pattern was scaled to the 1999 value, resulting in an overall decrease in exploitation rate. Changes in exploitation pattern definition and also lower catch weights-at-age used in the predictions explain the differences between this year's and last year's short-term predictions in yield. The short-term predictions, and in particular those dealing with SSB, should be interpreted cautiously, as a result of the high contribution of recruitments in 2000 and 2001, which have been extrapolated using the geometric mean average (Table 10.7.4). The Working Group notes that the assessment of plaice in Kattegat and Skagerrak has become more consistent over the years.

Table 10.1.3. Plaice landings (tonnes) used by the Working Group, Division IIIa, Kattegat and Skagerrak, 1972-1999.

Year	Denmark		Sweden		Germany		Belgium	Norway	Netherlands	Correction	Total WG		
	Kattegat	Skagerrak	Kattegat	Skagerrak	Kattegat	Skagerrak	Skagerrak	Skagerrak	Skagerrak	Skagerrak	Kattegat	Skagerrak	Div. IIIa
1972	15,504	5,095	348	70	77			3			15,929	5,168	21,097
1973	10,021	3,871	231	80	48			6			10,300	3,957	14,257
1974	11,401	3,429	255	70	52			5			11,708	3,504	15,212
1975	10,158	4,888	296	77	39			6			10,493	4,971	15,464
1976	9,487	9,251	177	51	32		717	6			9,696	10,025	19,721
1977	11,611	12,855	300	142	32		846	6			11,943	13,849	25,792
1978	12,685	13,383	312	94	100		371	9			13,097	13,857	26,953
1979	9,721	11,045	333	67	38		763	9			10,092	11,884	21,976
1980	5,582	9,514	313	71	40		914	11			5,935	10,510	16,445
1981	3,803	8,115	256	110	42		263	13			4,101	8,501	12,602
1982	2,717	7,789	238	146	19		127	11			2,974	8,073	11,047
1983	3,280	6,828	334	155	36		133	14	594	-594	3,650	7,130	10,780
1984	3,252	7,560	388	311	31		27	22	1,580	-1,580	3,671	7,920	11,591
1985	2,979	9,646	403	296	4		136	18	2,225	-2,225	3,386	10,096	13,482
1986	2,470	10,645	202	202	2		505	26	4,024	-4,024	2,674	11,378	14,052
1987	2,846	11,327	307	241	3		907	27	2,209	-2,209	3,156	12,502	15,658
1988	1,820	9,782	210	281	0		716	41	2,087	-2,087	2,030	10,820	12,850
1989	1,609	5,414	135	320	0		230	33			1,744	5,997	7,741
1990	1,830	8,729	202	779	2		471	69			2,034	10,048	12,082
1991	1,737	5,809	265	472	19	34	315	68			2,021	6,698	8,719
1992	2,068	8,514	208	381	101	117	537	106			2,377	9,655	12,032
1993	1,294	9,125	175	287	0	37	326	79			1,469	9,854	11,323
1994	1,547	8,783	227	315	0	37	325	91			1,774	9,551	11,325
1995	1,254	8,468	133	337	0	48	302	224			1,387	9,379	10,766
1996	2,337	7,304	205	260	0	11		428			2,542	8,003	10,545
1997	2,198	7,306	255	244	25	14		93			2,478	7,657	10,135
1998	1,786	6,132	185	208	10	11		59			1,981	6,410	8,391
1999	1510	6473	161	233	20	7		66			1,691	6,779	8,470

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	2140	12664	11259	4520	2205	979	888	682	330	118
1985	1352	8538	22090	6361	1753	711	259	197	166	151
1986	375	4370	14762	19211	4481	633	274	154	141	98
1987	669	4381	12526	17549	10075	2065	374	245	129	199
1988	101	3060	12045	13784	6859	2745	946	322	137	157
1989	1008	3827	7063	6221	2693	1164	546	253	135	235
1990	3189	8774	8601	9677	3208	979	480	348	155	273
1991	2324	8680	9674	4710	2922	901	309	158	88	138
1992	904	3871	11864	17617	4346	1044	299	116	27	116
1993	1006	3473	10116	13285	6910	1654	375	104	46	67
1994	1384	6907	8035	9896	8028	2777	446	111	38	54
1995	447	2280	6607	11527	6620	4927	853	137	65	51
1996	4511	5330	7934	5257	4728	1803	1348	150	23	45
1997	501	4505	6273	9405	5078	3059	1364	846	113	35
1998	547	6658	8125	6867	2982	792	387	234	170	64
1999	578	2460	8075	8352	7390	1291	377	76	105	41

Table 10.2.2 Plaice IIIa. Mean weight in catch and in stock (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	1.020	1.044
1980	0.261	0.274	0.306	0.345	0.414	0.579	0.640	0.753	0.811	0.910
1981	0.230	0.263	0.296	0.357	0.432	0.537	0.671	0.813	0.912	0.999
1982	0.270	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	0.760	0.917
1986	0.250	0.277	0.284	0.310	0.384	0.531	0.707	0.850	0.903	1.099
1987	0.322	0.281	0.282	0.293	0.363	0.528	0.709	0.904	1.030	1.084
1988	0.252	0.267	0.269	0.290	0.350	0.475	0.567	0.756	0.833	1.192
1989	0.274	0.263	0.282	0.320	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	1.150
1991	0.263	0.270	0.259	0.274	0.365	0.492	0.584	0.670	0.882	1.080
1992	0.309	0.310	0.272	0.280	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	0.330	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	0.430	0.561	0.870	0.957
1997	0.300	0.294	0.282	0.299	0.341	0.410	0.465	0.445	0.530	0.752
1998	0.260	0.249	0.279	0.327	0.398	0.464	0.515	0.586	0.640	0.858
1999	0.271	0.272	0.290	0.290	0.294	0.335	0.368	0.657	0.563	0.818

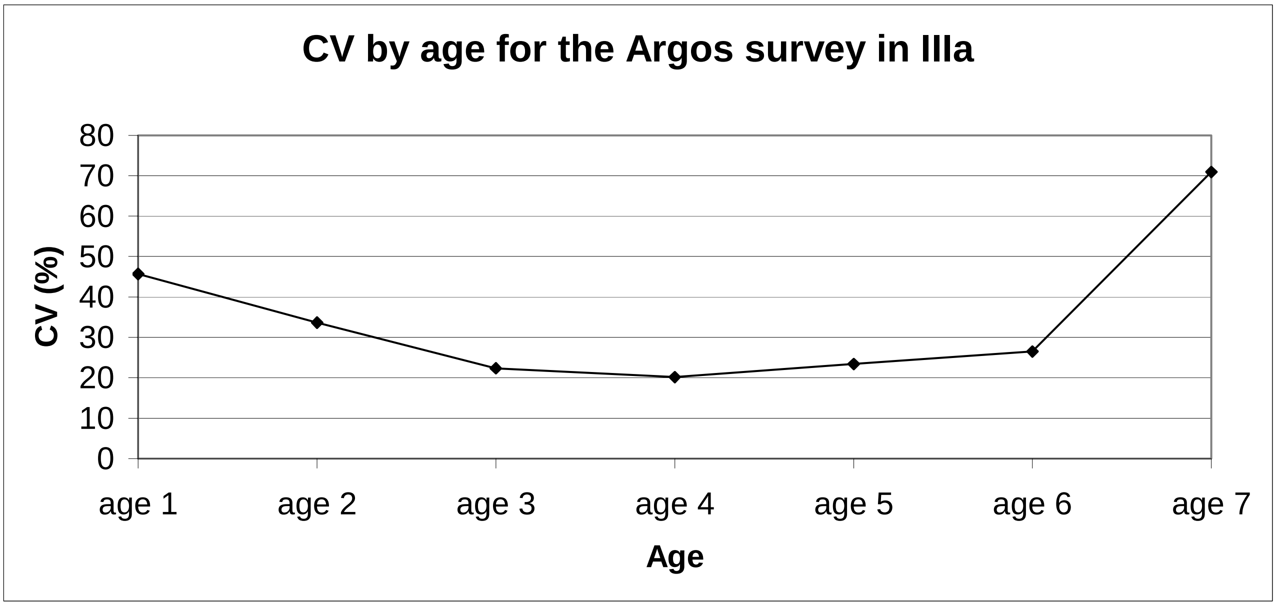
Table 10.3.1 Plaice in IIIa. Tuning fleet information

Plaice	in	Division	IIIa	(run	name:	XSAPAM06)					
104											
FLT01:	ARGOS:	Argos	1st	Q	(IBTS)						
1991	1999										
1	1	0.99	1								
4	6										
	1	1.62	0.38	0.08							
	1	5.11	2.03	0.22							
	1	1.09	1.19	0.25							
	1	1.13	0.85	0.4							
	1	1.54	0.46	0.13							
	1	1.14	0.12	0.04							
	1	1.48	0.32	0.12							
	1	2.32	0.13	0.07							
	1	3.08	1.71	0.17							
FLT04:	Danish	seiners									
1987	1999										
1	1	0	1								
2	11										
	7922	97425.8	1157332	4050596	5227390	2536790	426009.3	72397.8	40924.6	20943.5	22943.2
	6984	466749.6	1343996	3116463	3368983	1446989	521282.5	158464.1	47106.1	16430.8	19005.8
	9653	334835.2	1483241	3030013	2733969	1193297	477611.7	171227.1	76748.9	33562.5	39868.4
	9449	1116082	3542256	3431384	3748325	1097119	299715.7	116327.5	81119	32921.9	60674.3
	8991	515011.9	2426848	3289407	1838074	1057052	265605.5	88516.4	42174.3	17972.1	28586.9
	8850	106266.7	791895.1	4199036	6819566	1725235	324760.3	77399.8	27069.6	4686.3	17868.1
	7415	139121	509252.6	1721085	2800822	1649545	413535.4	89600.8	21957.5	5718.1	3978.3
	7279	336892.3	1620907	1883228	2514844	1977352	552285.4	69992.5	19936.8	4536.3	4288.3
	6827	195908	569870.6	1348638	2282155	1664669	1118605	153080.6	23915.4	11390.9	8384.1
	6420	949341.9	1363113	1878662	980781.5	913660.5	327088.5	230807	22761.6	3018.6	6501.7
	5794	165538.1	1193786	1794123	2572264	1359436	909633.7	392850.4	278160.3	26735.9	5420.2
	5537	144000	2251000	2489000	2044000	884000	231000	109000	61000	49000	14000
	6068	173000	721000	2487000	2755000	2425000	367000	103000	16000	36000	9000
FLT03:	Danish	trawlers									
1987	1999										
1	1	0	1								
2	11										
	33363	255914.6	1177661	2468347	2379126	1046122	215077.7	50415	32514	24419.7	37437.7
	30571	108177.7	839066.1	1906117	1819047	700988.1	226895.2	75480.6	23885.3	20953	22426.2
	33894	430316	927354.5	1291748	1026225	456677.9	165557	71803	37576.1	18120.9	35818.8
	38689	1181442	2311097	2020630	2065160	631904.4	200415.8	85590.4	45586.3	22634	42974.6
	37711	660031.2	2459249	2424238	1085399	580774.1	151469.9	52785.8	31364.1	18474.6	27440.7
	34936	324053.8	1244765	2463167	3594631	910595.2	232057.5	62318.1	14226.3	3014.4	12454
	29896	172192	866648	2265364	2200206	1312213	455227.1	82231.2	15921.3	12070.9	15308.8
	29373	506609	1815439	1886714	2177012	1785146	732728.8	113302.5	17908.9	12336.2	11983.1
	26085	262364.1	791717.7	1217689	2119319	1052643	706431.7	144495.7	23084.1	11096.1	8823
	28057	1044742	1432920	1503021	1053244	772862	329651.2	235696.1	24500.8	4352	9874.4
	26008	166014.2	1234787	1637715	1843447	841072.5	352323.7	143468.1	96236.5	15808.9	6255.1
	25203	210000	1613000	1953000	1285000	495000	120000	54000	36000	23000	9000
	26703	223000	761000	1739000	1403000	1024000	212000	58000	10000	11000	8000
FLT02:	Danish	gill-netters									
1987	1999										
1	1	0	1								
4	11										
	4258	650915.7	1071313	803164.5	286784.3	58777.3	33990.7	18818.4	24876.8		
	4060	529771.3	606818.1	410015.6	309311.4	133999.9	55392.7	19491.5	23976.7		
	3845	175205.5	186617.2	129660.6	111414.7	85514	44763.5	24563.5	43810.2		
	4237	272983.5	362431.8	157274.3	62093.7	42382.9	38229.8	20604.3	41000.9		
	3856	242270.8	148621.9	168825.7	68492	32399.3	14923.2	11663.1	17808.8		
	4955	854331.1	1065380	260668.7	108795.4	39020.5	18754.9	5675.4	21064		
	5751	339540	652443.1	591403.6	199281.6	42122.4	12860	3774.2	2596.8		
	12089	992743.9	1280086	1145581	443000.3	78442.7	26304.2	7858.6	14155.4		
	10411	744931.3	1661991	911911.5	979461.7	185417.9	30434.1	13975.7	10309.3		
	10123	858288.4	762350.3	711939.5	291166.6	215021.6	22193.1	3298.1	8388.2		
	8399	544401.2	912160.6	684170.5	509591	271093.8	101873.8	19323.2	7745.1		
	7440	803000	854000	380000	112000	63000	42000	31000	15000		
	7311	698000	841000	1001000	206000	70000	21000	13000	9000		

Table 10.3.2. Plaice IIIa. Mean nos. per hour 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
2000	43*	3.12	57.85	30.98	10.31	3.08	1.71	0.17	0.13	0.00	0.14	107.50

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
2000	43*	19	22	19	16	17	21	26	42		70	43
Mean	46	46	34	22	20	23	26	71	257		326	24



* =One haul excluded due to very high catches. The haul was not representative for the area.

Table 10.4.1. Plaice in IIIa. Separable VPA output.

Title : Plaice IIIa VPA data 2000 WG ANON COMBSEX PLUSGROUP

At 11/10/2000 17:54

Separable analysis
from 1990 to 1999 on ages 2 to 10
with Terminal F of .940 on age 6 and Terminal S of 1.000

Initial sum of squared residuals was 102.279 and
final sum of squared residuals is 17.401 after 30 iterations

Matrix of Residuals

Years	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	TOT	WTS
2/ 3	0.179	0.892	0.066	-0.533	1.058	-1.335	1.882	-1.562	-0.008	0.035	0.158
3/ 4	0.09	0.114	-0.524	-0.419	0.617	-1.078	0.719	-0.564	0.324	0.016	0.292
4/ 5	0.433	-0.506	-0.008	0.113	-0.135	0.069	0.343	-0.432	0.154	-0.001	0.554
5/ 6	0.437	-0.371	0.498	0.053	0.073	0.178	-0.015	0.193	-0.437	-0.007	0.555
6/ 7	-0.026	0.09	0.042	-0.024	-0.328	0.08	-0.09	0.339	-0.009	-0.008	1
7/ 8	-0.282	0.042	-0.022	0.254	0.24	-0.052	-0.369	0.398	-0.225	-0.008	0.67
8/ 9	-0.581	-0.325	-0.233	-0.084	0.008	0.13	-0.392	-0.174	0.423	-0.007	0.587
9/10	0.062	0.806	-0.021	0.048	-0.299	0.539	-0.253	0.069	-0.065	-0.008	0.492
TOT	0.011	0.011	0.009	0.006	0.003	-0.002	-0.004	-0.006	-0.006	0.273	
WTS	0.001	0.001	0.001	0.001	1	1	1	1	1		

Fishing Mortalities (F)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
F-values	1.1266	0.8977	0.8887	0.8884	0.8706	1.0162	0.7706	1.2653	0.8624	0.94

Selection-at-age (S)

	2	3	4	5	6	7	8	9	10
S-values	0.0333	0.165	0.3538	0.6784	1	1.112	1.1965	0.9721	1

Table 10.4.2 Plaice in IIIa. Diagnostics from the XSA run: XSAPAM06.

Lowestoft VPA Version 3.1

Extended Survivors Analysis

Plaice in IIIa (run: XSAPAM06/X06)

CPUE data from file fleet

Catch data for 22 years. 1978 to 1999. Ages 2 to 11.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT01: ARGOS: Argos	1991	1999	4	6	0.99	1
FLT04: Danish seiner	1990	1999	2	10	0	1
FLT03: Danish trawler	1990	1999	2	10	0	1
FLT02: Danish gill-n	1990	1999	4	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 22 iterations

Regression weights

	1	1	1	1	1	1	1	1	1	1

Table 10.4.2. (Con't)

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.047	0.049	0.021	0.03	0.041	0.011	0.091	0.01	0.017	0.017
3	0.169	0.155	0.097	0.095	0.265	0.079	0.155	0.111	0.165	0.089
4	0.487	0.254	0.291	0.35	0.295	0.387	0.383	0.247	0.265	0.275
5	1.035	0.478	0.872	0.543	0.602	0.784	0.538	0.944	0.414	0.423
6	1.104	0.931	0.979	0.926	0.656	0.943	0.776	1.427	0.799	0.941
7	0.993	0.982	0.934	1.2	1.129	0.992	0.639	1.827	0.789	0.88
8	1.136	0.899	0.949	0.95	1.176	1.238	0.72	1.375	1.305	1
9	1.171	1.465	0.928	0.937	0.731	1.43	0.646	1.313	0.822	0.876
10	1.119	0.972	0.99	1.108	0.987	1.193	0.891	1.411	0.924	0.999

XSA population numbers (Thousands)

AGE YEAR	2	3	4	5	6	7	8	9	10
1990	73700	59300	23500	15800	5050	1630	743	530	242
1991	51000	63600	45300	13000	5070	1510	548	216	149
1992	45400	43900	49300	31800	7320	1810	513	202	45
1993	35500	40200	36100	33300	12000	2490	643	180	72
1994	36100	31200	33100	23000	17500	4320	678	225	64
1995	43500	31400	21600	22300	11400	8230	1260	189	98
1996	54700	38900	26200	13300	9210	4020	2760	331	41
1997	51400	45200	30100	16200	7020	3830	1920	1220	157
1998	34200	46000	36700	21300	5700	1530	558	439	296
1999	36300	30400	35300	25400	12700	2320	627	137	175

Estimated population abundance at 1st Jan 2000

0	32300	25200	24300	15100	4500	871	209	52

Taper weighted geometric mean of the VPA populations:

46000	42300	34700	20500	8210	2730	968	385	160

Standard error of the weighted Log(VPA populations) :

0.3176	0.3388	0.3645	0.4029	0.4447	0.4739	0.5623	0.6444	0.7109

Log catchability residuals.

Fleet : FLT01: ARGOS: Argos

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	99.99	-0.44	0.66	-0.51	-0.45	0.38	-0.12	-0.13	0.14	0.47
5	99.99	0.01	1.19	0.28	0.37	-0.03	-1.1	0.09	-1.61	0.79
6	99.99	0.07	0.77	0.34	0.17	-0.24	-1.37	0.65	-0.31	-0.08
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 10.4.2. (Con't)

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	-9.4451	-9.8815	-10.105
S.E(Log q)	0.4348	0.8722	0.6317

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	0.99	0.01	9.45	0.26	9	0.46	-9.45
5	0.43	1.639	9.92	0.54	9	0.34	-9.88
6	1.1	-0.159	10.21	0.26	9	0.74	-10.11
1							

Fleet : FLT04: Danish seiner

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.05	0.07	-0.56	-0.1	0.31	-0.11	0.46	-0.28	0.09	0.07
3	0.23	-0.09	-0.55	-0.66	0.52	-0.28	0.23	0.04	0.54	0.02
4	0.52	-0.24	-0.04	-0.42	-0.25	-0.05	0.15	0	0.19	0.14
5	0.53	-0.18	0.43	-0.47	-0.17	-0.09	-0.46	0.58	-0.11	-0.07
6	0.07	0.01	0.17	-0.22	-0.51	-0.07	-0.46	0.57	0.14	0.31
7	-0.12	-0.12	-0.1	0.11	-0.17	-0.1	-0.7	0.94	0.14	0.13
8	-0.17	-0.18	-0.21	-0.11	-0.3	-0.06	-0.58	0.69	0.66	0.27
9	-0.17	0.23	-0.34	-0.25	-0.64	0.06	-0.81	0.77	0.12	-0.12
10	-0.31	-0.44	-0.57	-0.61	-0.75	-0.12	-0.63	0.51	0.34	0.5

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	-4.4114	-3.7025	-3.2998	-3.3226	-3.3801	-3.3801	-3.3801
S.E(Log q)	0.2678	0.3844	0.3343	0.4075	0.4117	0.4661	0.5377

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	1.27	8.95	0.42	10	0.3	-7.01
3	0.74	0.464	6.74	0.28	10	0.43	-5.37

Table 10.4.2. (Con't)

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	-1.442	-0.6	0.27	10	0.47	-4.41
5	1.09	-0.208	3.13	0.39	10	0.44	-3.7
6	1.58	-1.512	-0.04	0.46	10	0.49	-3.3
7	1.02	-0.091	3.21	0.65	10	0.44	-3.32
8	1.07	-0.256	3.15	0.64	10	0.46	-3.38
9	0.74	1.669	4.06	0.84	10	0.3	-3.5
10	0.66	2.874	3.96	0.9	10	0.24	-3.59

Fleet : FLT03: Danish trawler

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.03	0.08	-0.18	-0.21	0.41	-0.09	0.46	-0.52	0.04	-0.02
3	0.04	0.07	-0.37	-0.55	0.78	-0.26	0.25	-0.03	0.38	-0.3
4	0.23	-0.33	-0.31	0.11	0	0.15	0.09	0.05	0.07	-0.06
5	0.32	-0.34	0.21	-0.32	0.09	0.29	-0.07	0.54	-0.29	-0.44
6	0.01	-0.13	0.05	0.05	-0.11	0.03	-0.21	0.49	-0.06	-0.13
7	-0.15	-0.33	-0.03	0.59	0.51	-0.11	-0.38	0.28	-0.25	-0.12
8	-0.15	-0.4	-0.07	0.13	0.51	0.27	-0.3	-0.09	0.17	-0.06
9	-0.43	0.23	-0.63	-0.24	-0.42	0.41	-0.48	-0.06	-0.19	-0.34
10	-0.37	-0.12	-0.66	0.47	0.58	0.25	-0.01	0.22	-0.21	-0.44

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	-6.0543	-5.4969	-5.1987	-5.1072	-5.1086	-5.1086	-5.1086
S.E(Log q)	0.1854	0.3389	0.1928	0.3416	0.2745	0.3975	0.4056

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	0.58	1.014	9.22	0.42	10	0.31	-8.13
3	1.29	-0.527	5.59	0.29	10	0.42	-6.72

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	2.48	-4.738	-0.37	0.56	10	0.25	-6.05
5	1.18	-0.441	4.68	0.42	10	0.42	-5.5
6	1.09	-0.539	4.84	0.81	10	0.22	-5.2
7	0.86	0.758	5.49	0.8	10	0.3	-5.11
8	1.11	-0.598	4.93	0.79	10	0.32	-5.11
9	1.01	-0.042	5.32	0.8	10	0.35	-5.32
10	1.16	-0.7	5.21	0.7	10	0.48	-5.14

Table 10.4.2. (Con't)

Fleet : FLT02: Danish gill-n

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	0.17	-0.63	0.32	-0.41	-0.02	0.31	0.28	-0.19	0.13	0.05
5	0.23	-0.62	0.38	-0.45	-0.12	0.4	0.06	0.4	-0.05	-0.22
6	-0.04	0.05	-0.12	0.03	-0.54	-0.07	-0.14	0.54	0.03	0.27
7	-0.21	0.06	0.07	0.32	-0.21	0.03	-0.58	0.68	-0.2	0.05
8	0.05	0.09	0.11	-0.19	-0.27	0.14	-0.68	0.37	0.24	0.13
9	0.3	0.47	0.3	-0.1	-0.44	0.31	-0.86	-0.18	-0.12	0.39
10	0.45	0.4	0.63	-0.35	-0.28	0.09	-0.57	0.25	0.01	-0.28

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	-5.7836	-4.9285	-4.3259	-4.0085	-3.8081	-3.8081	-3.8081
S.E(Log q)	0.3199	0.3608	0.2782	0.3391	0.3024	0.4275	0.3993

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	2.02	-1.314	1.08	0.17	10	0.62	-5.78
5	0.98	0.05	5.02	0.47	10	0.38	-4.93
6	1.32	-1.128	2.83	0.61	10	0.36	-4.33
7	0.98	0.114	4.1	0.74	10	0.35	-4.01
8	1.23	-1.083	3.14	0.74	10	0.37	-3.81
9	1.24	-0.874	3.36	0.63	10	0.54	-3.8
10	0.85	0.892	3.91	0.82	10	0.34	-3.77

Table 10.4.2. (Con't)
Terminal year survivor and F summaries :

Age 2 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: ARGOS: Argos	1	0	0	0	0	0	0
FLT04: Danish seiner	34703	0.321	0	0	1	0.303	0.016
FLT03: Danish trawler	31713	0.326	0	0	1	0.293	0.017
FLT02: Danish gill-n	1	0	0	0	0	0	0
P shrinkage mean	42328	0.34				0.277	0.013
F shrinkage mean	15903	0.5				0.127	0.034

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
32336	0.18	0.17	4	0.957	0.017

Age 3 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: ARGOS: Argos	1	0	0	0	0	0	0
FLT04: Danish seiner	26894	0.265	0.032	0.12	2	0.35	0.083
FLT03: Danish trawler	23507	0.27	0.159	0.59	2	0.337	0.095
FLT02: Danish gill-n	1	0	0	0	0	0	0
P shrinkage mean	34688	0.36				0.204	0.065
F shrinkage mean	13919	0.5				0.108	0.155

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
25203	0.16	0.12	6	0.749	0.089
1					

Age 4 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: ARGOS: Argos	38878	0.458	0	0	1	0.074	0.18
FLT04: Danish seiner	25544	0.201	0.199	0.99	3	0.355	0.263
FLT03: Danish trawler	21181	0.203	0.222	1.09	3	0.35	0.309
FLT02: Danish gill-n	25567	0.335	0	0	1	0.139	0.263
F shrinkage mean	20651	0.5				0.082	0.316

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
24256	0.12	0.11	9	0.858	0.275

Table 10.4.2. (Con't)

Age 5 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: ARGOS: Argos	20363	0.413	0.281	0.68	2	0.067	0.329
FLT04: Danish seiner	17537	0.187	0.109	0.58	4	0.315	0.374
FLT03: Danish trawler	14604	0.181	0.184	1.02	4	0.342	0.434
FLT02: Danish gill-n	14399	0.253	0.176	0.7	2	0.191	0.439
F shrinkage mean	8514	0.5				0.085	0.659

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
15071	0.11	0.09	13	0.834	0.423

1

Age 6 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: ARGOS: Argos	3259	0.366	0.372	1.02	3	0.062	1.15
FLT04: Danish seiner	4917	0.168	0.091	0.55	5	0.273	0.888
FLT03: Danish trawler	4118	0.158	0.073	0.46	5	0.321	0.996
FLT02: Danish gill-n	4937	0.2	0.14	0.7	3	0.229	0.885
F shrinkage mean	4618	0.5				0.115	0.925

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4500	0.1	0.06	17	0.571	0.941

Age 7 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: ARGOS: Argos	712	0.418	0.096	0.23	3	0.032	1.003
FLT04: Danish seiner	1033	0.212	0.069	0.33	6	0.23	0.784
FLT03: Danish trawler	868	0.191	0.094	0.49	6	0.3	0.881
FLT02: Danish gill-n	949	0.213	0.065	0.3	4	0.268	0.83
F shrinkage mean	630	0.5				0.17	1.081

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
871	0.13	0.05	20	0.42	0.88

Table 10.4.2. (Con't)

1

Age 8 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: ARGOS: Argos	280	0.382	0.411	1.08	3	0.01	0.825
FLT04: Danish seiner	258	0.256	0.081	0.32	7	0.185	0.871
FLT03: Danish trawler	199	0.208	0.078	0.37	7	0.318	1.03
FLT02: Danish gill-n	228	0.22	0.096	0.44	5	0.287	0.946
F shrinkage mean	161	0.5				0.2	1.17

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
209	0.14	0.05	23	0.37	1

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: ARGOS: Argos	22	0.396	0.374	0.95	3	0.003	1.467
FLT04: Danish seiner	56	0.343	0.145	0.42	8	0.184	0.828
FLT03: Danish trawler	44	0.268	0.095	0.35	8	0.282	0.966
FLT02: Danish gill-n	72	0.286	0.058	0.2	6	0.247	0.693
F shrinkage mean	43	0.5				0.284	0.994

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
52	0.19	0.06	26	0.346	0.876

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1989

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: ARGOS: Argos	45	0.384	0.2	0.52	3	0.003	1.173
FLT04: Danish seiner	78	0.316	0.118	0.37	9	0.17	0.822
FLT03: Danish trawler	43	0.253	0.056	0.22	9	0.275	1.207
FLT02: Danish gill-n	49	0.264	0.09	0.34	7	0.263	1.117
F shrinkage mean	77	0.5				0.29	0.828

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
58	0.18	0.07	29	0.368	0.999

Table 10.4.3. Plaice in IIIa. Fishing mortalities from XSA run: XSAPAM06

Terminal Fs derived using XSA (With F shrinkage)

YEAR	1978	1979
AGE		
2	0.0084	0.0257
3	0.2336	0.2059
4	0.7574	0.7975
5	1.0753	1.0756
6	1.02	1.0636
7	0.5954	0.9545
8	0.2825	0.2831
9	0.4845	0.5611
10	0.6946	0.7914
+gp	0.6946	0.7914
0 FBAR 4- 8	0.7461	0.8349

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	0.0111	0.0077	0.0114	0.0166	0.0326	0.0294	0.0106	0.0205	0.0032	0.016
3	0.1326	0.1483	0.0981	0.2664	0.1722	0.1579	0.1127	0.1484	0.1107	0.1443
4	0.5483	0.5623	0.5139	0.645	0.4959	0.4498	0.3958	0.4746	0.6656	0.3548
5	0.8481	0.7797	1.1243	1.0425	0.7433	0.5122	0.7896	1.0162	1.3422	0.776
6	0.9649	0.7038	1.0808	0.8653	0.8154	0.64	0.7357	1.1938	1.4327	0.9428
7	1.0674	0.5529	0.6641	0.4438	0.8138	0.5961	0.4428	0.8065	1.1789	0.9121
8	1.0979	0.6559	0.5681	0.3551	0.898	0.4579	0.4263	0.4522	0.9884	0.6828
9	0.5654	0.6843	0.8319	0.3377	0.9292	0.4411	0.4806	0.7452	0.7853	0.6904
10	0.9135	0.6783	0.8581	0.6114	0.8441	0.5314	0.5773	0.8469	1.1521	0.8047
+gp	0.9135	0.6783	0.8581	0.6114	0.8441	0.5314	0.5773	0.8469	1.1521	0.8047
0 FBAR 4- 8	0.9053	0.6509	0.7902	0.6703	0.7533	0.5312	0.558	0.7886	1.1216	0.7337

Terminal Fs derived using XSA (With F shrinkage)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99
AGE											
2	0.0466	0.0491	0.0212	0.0302	0.0411	0.0109	0.0906	0.0103	0.0169	0.0169	0.0147
3	0.169	0.1548	0.0972	0.0952	0.2652	0.0794	0.1555	0.1106	0.165	0.0888	0.1215
4	0.487	0.254	0.2915	0.3495	0.2948	0.3872	0.3827	0.247	0.2653	0.2751	0.2625
5	1.0352	0.4776	0.8724	0.5427	0.6021	0.7844	0.5376	0.9439	0.4139	0.4234	0.5937
6	1.1037	0.9311	0.9789	0.9255	0.6563	0.9431	0.7763	1.4269	0.7988	0.9409	1.0555
7	0.9933	0.9824	0.9339	1.2	1.1287	0.9921	0.6385	1.8267	0.789	0.8797	1.1652
8	1.1358	0.899	0.9488	0.9496	1.1758	1.2381	0.7197	1.375	1.3054	0.9996	1.2267
9	1.171	1.4648	0.9276	0.9373	0.7307	1.4298	0.6462	1.3126	0.8217	0.8763	1.0035
10	1.1188	0.9724	0.9897	1.1083	0.9866	1.1929	0.8908	1.4111	0.9241	0.9995	1.1115
+gp	1.1188	0.9724	0.9897	1.1083	0.9866	1.1929	0.8908	1.4111	0.9241	0.9995	
0 FBAR 4- 8	0.951	0.7088	0.8051	0.7935	0.7715	0.869	0.611	1.1639	0.7145	0.7037	

Table 10.4.4. Plaice in IIIa. Estimated population abundance from XSA run ('000 numbers): XSAPAM06

Terminal Fs derived using XSA (With F shrinkage)

YEAR	1978	1979
AGE		
2	61636	45808
3	79190	55305
4	78247	56727
5	39763	33198
6	13171	12276
7	1453	4297
8	269	725
9	172	184
10	101	96
+gp	125	105
0 TOTAL	274128	208721

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	34494	25912	48817	94568	70157	49061	37306	34624	33199	66626
3	40398	30867	23266	43671	84160	61445	43106	33399	30692	29943
4	40731	32014	24079	19086	30274	64105	47476	34847	26053	24861
5	23120	21299	16509	13032	9060	16683	36992	28916	19616	12116
6	10246	8958	8837	4853	4158	3899	9045	15198	9471	4638
7	3834	3532	4010	2713	1848	1665	1860	3921	4168	2045
8	1497	1193	1839	1868	1575	741	830	1081	1584	1160
9	494	452	560	943	1185	581	424	490	622	533
10	95	254	206	221	609	423	338	237	211	257
+gp	87	206	87	242	216	383	234	364	239	444
0 TOTAL	154997	124689	128210	181197	203242	198985	177610	153077	125855	142624
1										

Run title : Plaice in IIIa (run: XSAPAM06/X06)

Terminal Fs derived using XSA (With F shrinkage)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 78-97	AMST 78-97
AGE													
2	73686	50977	45394	35505	36139	43470	54745	51373	34217	36345	0*	47241	49675
3	59327	63640	43915	40214	31170	31383	38909	45244	46008	30440	32336	42852	45462
4	23453	45335	49328	36054	33084	21633	26228	30136	36653	35296	25203	34563	37188
5	15777	13040	31819	33348	23000	22292	13290	16185	21301	25437	24256	20211	21953
6	5046	5070	7319	12033	17537	11398	9206	7025	5698	12742	15071	8183	8969
7	1635	1514	1808	2488	4315	8232	4016	3833	1526	2320	4500	2828	3159
8	743	548	513	643	678	1263	2762	1919	558	627	871	1017	1172
9	530	216	202	180	225	189	331	1217	439	137	209	403	487
10	242	149	45	72	64	98	41	157	296	175	52	154	196
+gp	422	231	192	104	90	76	80	48	111	68	81		
0 TOTAL	180861	180721	180535	160642	146302	140036	149608	157136	146807	143586	102579		

*Replaced by GMST 78-97 (47241)

Table 10.4.5. Plaice in IIIa. Historical trends in SSB, recruitment and F-bar from XSA run: XSAPAM06.

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 8
1978	61636	74861	60315	26953	0.4469	0.7461
1979	45808	56708	46539	21976	0.4722	0.8349
1980	34494	48460	39458	16445	0.4168	0.9053
1981	25912	38530	32570	12602	0.3869	0.6509
1982	48817	39936	26756	11047	0.4129	0.7902
1983	94568	54619	27667	10780	0.3896	0.6703
1984	70157	61488	41704	11591	0.2779	0.7533
1985	49061	60849	47259	13482	0.2853	0.5312
1986	37306	52188	42861	14052	0.3278	0.558
1987	34624	48269	37120	15658	0.4218	0.7886
1988	33199	36381	28015	12850	0.4587	1.1216
1989	66626	41504	23249	7741	0.333	0.7337
1990	73686	55329	33813	12082	0.3573	0.951
1991	50977	49346	35939	8719	0.2426	0.7088
1992	45394	54052	40025	12032	0.3006	0.8051
1993	35505	45789	36309	11323	0.3118	0.7935
1994	36139	41848	31910	11325	0.3549	0.7715
1995	43470	41566	30133	10766	0.3573	0.869
1996	54745	44714	30152	10545	0.3497	0.611
1997	51373	47571	32159	10135	0.3151	1.1639
1998	34217	41349	32453	8391	0.2586	0.7145
1999	36345	40739	30890	8470	0.2742	0.7037
2000	47241*	41955**	31892**			
Arith. Mean	48366	48914	35786	12680	0.3524	0.7807
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

*Geometric mean over 1978-1997

**Weights at age in stock in 1999 set to average over 1997-1999.

Table 10.7.1

11:04 Monday, October 16, 2000
Plaice in Division IIIa

Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47241	0.1000	0.0000	0.0000	0.0000	0.277	0.0120	0.277
3	32336	0.1000	1.0000	0.0000	0.0000	0.272	0.0990	0.272
4	25203	0.1000	1.0000	0.0000	0.0000	0.284	0.2150	0.284
5	24256	0.1000	1.0000	0.0000	0.0000	0.305	0.4850	0.305
6	15071	0.1000	1.0000	0.0000	0.0000	0.344	0.8630	0.344
7	4500	0.1000	1.0000	0.0000	0.0000	0.403	0.9530	0.403
8	871	0.1000	1.0000	0.0000	0.0000	0.449	1.0030	0.449
9	209	0.1000	1.0000	0.0000	0.0000	0.563	0.8200	0.563
10	52	0.1000	1.0000	0.0000	0.0000	0.578	0.9090	0.578
11+	81	0.1000	1.0000	0.0000	0.0000	0.809	0.9090	0.809
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	47241	0.1000	0.0000	0.0000	0.0000	0.277	0.0120	0.277
3	-	0.1000	1.0000	0.0000	0.0000	0.272	0.0990	0.272
4	-	0.1000	1.0000	0.0000	0.0000	0.284	0.2150	0.284
5	-	0.1000	1.0000	0.0000	0.0000	0.305	0.4850	0.305
6	-	0.1000	1.0000	0.0000	0.0000	0.344	0.8630	0.344
7	-	0.1000	1.0000	0.0000	0.0000	0.403	0.9530	0.403
8	-	0.1000	1.0000	0.0000	0.0000	0.449	1.0030	0.449
9	-	0.1000	1.0000	0.0000	0.0000	0.563	0.8200	0.563
10	-	0.1000	1.0000	0.0000	0.0000	0.578	0.9090	0.578
11+	-	0.1000	1.0000	0.0000	0.0000	0.809	0.9090	0.809
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47241	0.1000	0.0000	0.0000	0.0000	0.277	0.0120	0.277
3	-	0.1000	1.0000	0.0000	0.0000	0.272	0.0990	0.272
4	-	0.1000	1.0000	0.0000	0.0000	0.284	0.2150	0.284
5	-	0.1000	1.0000	0.0000	0.0000	0.305	0.4850	0.305
6	-	0.1000	1.0000	0.0000	0.0000	0.344	0.8630	0.344
7	-	0.1000	1.0000	0.0000	0.0000	0.403	0.9530	0.403
8	-	0.1000	1.0000	0.0000	0.0000	0.449	1.0030	0.449
9	-	0.1000	1.0000	0.0000	0.0000	0.563	0.8200	0.563
10	-	0.1000	1.0000	0.0000	0.0000	0.578	0.9090	0.578
11+	-	0.1000	1.0000	0.0000	0.0000	0.809	0.9090	0.809
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANPAM05
Date and time: 09OCT00:14:28

Table 10.7.2

11:04 Monday, October 16, 2000
Plaice in Division IIIa

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.7038	44039	30953	9271	0.0000	0.0000	45632	32546	0	56917	43831
.	.	.	.	.	0.1000	0.0704	.	32546	1178	55653	42567
.	.	.	.	.	0.2000	0.1408	.	32546	2285	54468	41382
.	.	.	.	.	0.3000	0.2111	.	32546	3326	53357	40271
.	.	.	.	.	0.4000	0.2815	.	32546	4306	52312	39227
.	.	.	.	.	0.5000	0.3519	.	32546	5229	51331	38245
.	.	.	.	.	0.6000	0.4223	.	32546	6100	50407	37321
.	.	.	.	.	0.7000	0.4927	.	32546	6923	49536	36450
.	.	.	.	.	0.8000	0.5630	.	32546	7701	48715	35629
.	.	.	.	.	0.9000	0.6334	.	32546	8437	47940	34854
.	.	.	.	.	1.0000	0.7038	.	32546	9135	47207	34121
.	.	.	.	.	1.1000	0.7742	.	32546	9797	46513	33428
.	.	.	.	.	1.2000	0.8446	.	32546	10425	45857	32771
.	.	.	.	.	1.3000	0.9149	.	32546	11023	45234	32148
.	.	.	.	.	1.4000	0.9853	.	32546	11591	44643	31557
.	.	.	.	.	1.5000	1.0557	.	32546	12132	44081	30995
.	.	.	.	.	1.6000	1.1261	.	32546	12649	43546	30460
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

```
Notes: Run name            : MANPAM05
       Date and time       : 09OCT00:14:28
       Computation of ref. F: Simple mean, age 4 - 8
       Basis for 2000      : F factors
```

Table 10.7.3

11:04 Monday, October 16, 2000
Plaice in Division IIIa
Single option prediction: Detailed tables

Year: 2000 F-factor: 1.0000 Reference F: 0.7038

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
2	0.0120	536	149	47241	13086	0	0	0	0
3	0.0990	2903	790	32336	8795	32336	8795	32336	8795
4	0.2150	4648	1320	25203	7158	25203	7158	25203	7158
5	0.4850	8906	2716	24256	7398	24256	7398	24256	7398
6	0.8630	8350	2872	15071	5184	15071	5184	15071	5184
7	0.9530	2652	1069	4500	1814	4500	1814	4500	1814
8	1.0030	529	238	871	391	871	391	871	391
9	0.8200	112	63	209	118	209	118	209	118
10	0.9090	30	17	52	30	52	30	52	30
11+	0.9090	46	38	81	66	81	66	81	66
Total		28713	9271	149820	44039	102579	30953	102579	30953
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.7038

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
2	0.0120	536	149	47241	13086	0	0	0	0
3	0.0990	3792	1031	42236	11488	42236	11488	42236	11488
4	0.2150	4888	1388	26501	7526	26501	7526	26501	7526
5	0.4850	6754	2060	18393	5610	18393	5610	18393	5610
6	0.8630	7487	2576	13513	4649	13513	4649	13513	4649
7	0.9530	3390	1366	5753	2319	5753	2319	5753	2319
8	1.0030	954	428	1570	705	1570	705	1570	705
9	0.8200	155	87	289	163	289	163	289	163
10	0.9090	48	28	83	48	83	48	83	48
11+	0.9090	28	22	48	39	48	39	48	39
Total		28031	9135	155628	45632	108387	32546	108387	32546
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 1.0000 Reference F: 0.7038

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
2	0.0120	536	149	47241	13086	0	0	0	0
3	0.0990	3792	1031	42236	11488	42236	11488	42236	11488
4	0.2150	6384	1813	34614	9830	34614	9830	34614	9830
5	0.4850	7101	2166	19340	5899	19340	5899	19340	5899
6	0.8630	5677	1953	10247	3525	10247	3525	10247	3525
7	0.9530	3040	1225	5159	2079	5159	2079	5159	2079
8	1.0030	1220	548	2007	901	2007	901	2007	901
9	0.8200	279	157	521	293	521	293	521	293
10	0.9090	66	38	115	67	115	67	115	67
11+	0.9090	28	22	48	39	48	39	48	39
Total		28123	9102	161528	47207	114287	34121	114287	34121
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRPAM02
Date and time : 09OCT00:14:32
Computation of ref. F: Simple mean, age 4 - 8
Prediction basis : F factors

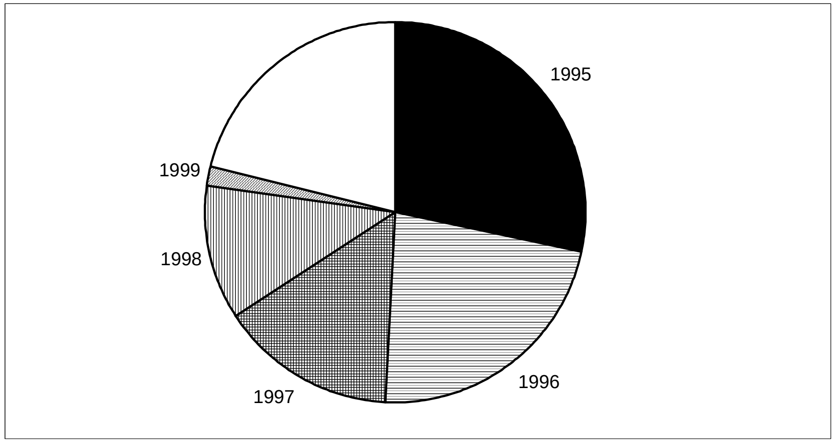
Table 10.7.4. **Plaice (IIIa)**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1995	1996	1997	1998	1999
Stock No. (thousands) of 2 year-olds			51373	34217	36345	47241	47241
Source			VPA	VPA	VPA	GM	GM
Status Quo F:							
% in	2000	landings	29.3	14.2	8.5	1.6	-
% in	2001		28.2	22.6	15.2	11.3	1.6
% in	2000	SSB	23.9	23.1	28.4	0.0	-
% in	2001	SSB	14.3	17.2	23.1	35.3	0.0
% in	2002	SSB	6.1	10.3	17.3	28.8	33.7

GM : geometric mean recruitment

Plaice (IIIa) : Year-class % contribution to

a) 2001 landings



b) 2002 SSB

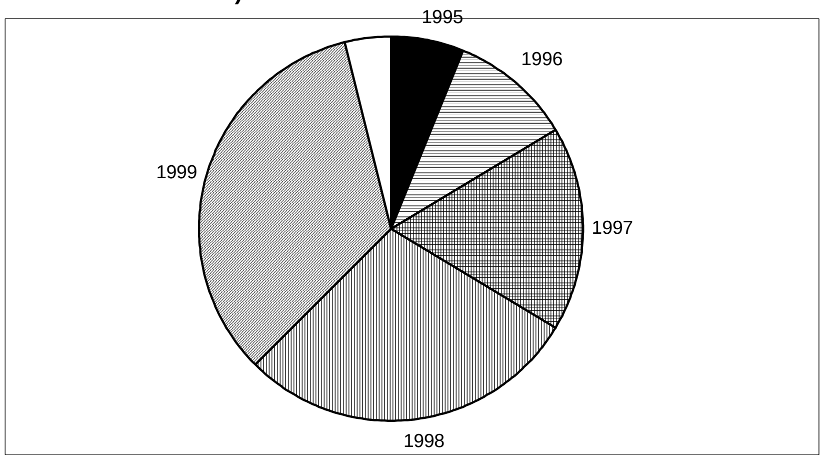


Table 10.8.1

11:04 Monday, October 16, 2000
Plaice in Division IIIa

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
2	47241	0.1000	0.0000	0.0000	0.0000	0.269	0.0120	0.269
3	-	0.1000	1.0000	0.0000	0.0000	0.276	0.0990	0.276
4	-	0.1000	1.0000	0.0000	0.0000	0.284	0.2150	0.284
5	-	0.1000	1.0000	0.0000	0.0000	0.318	0.4850	0.318
6	-	0.1000	1.0000	0.0000	0.0000	0.377	0.8630	0.377
7	-	0.1000	1.0000	0.0000	0.0000	0.476	0.9530	0.476
8	-	0.1000	1.0000	0.0000	0.0000	0.587	1.0030	0.587
9	-	0.1000	1.0000	0.0000	0.0000	0.715	0.8200	0.715
10	-	0.1000	1.0000	0.0000	0.0000	0.814	0.9090	0.814
11+	-	0.1000	1.0000	0.0000	0.0000	1.004	0.9090	1.004
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDPAM05
Date and time: 09OCT00:14:46

Table 10.8.2

11:04 Monday, October 16, 2000
Plaice in Division IIIa

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0	496424	324105	449183	311397	449183	311397
0.1000	0.0704	16665	10923	330024	168043	282783	155335	282783	155335
0.2000	0.1408	22680	12857	270103	116653	222862	103945	222862	103945
0.3000	0.2111	25833	13050	238787	92324	191546	79616	191546	79616
0.4000	0.2815	27804	12823	219266	78593	172025	65885	172025	65885
0.5000	0.3519	29173	12519	205751	69944	158510	57236	158510	57236
0.6000	0.4223	30192	12235	195714	64054	148473	51346	148473	51346
0.7000	0.4927	30991	11993	187876	59798	140635	47090	140635	47090
0.8000	0.5630	31639	11795	181520	56574	134279	43867	134279	43867
0.9000	0.6334	32182	11634	176215	54038	128974	41331	128974	41331
1.0000	0.7038	32646	11504	171684	51981	124443	39273	124443	39273
1.1000	0.7742	33050	11398	167742	50268	120501	37560	120501	37560
1.2000	0.8446	33407	11312	164261	48812	117020	36104	117020	36104
1.3000	0.9149	33727	11241	161150	47552	113909	34844	113909	34844
1.4000	0.9853	34016	11183	158339	46445	111098	33737	111098	33737
1.5000	1.0557	34280	11135	155779	45462	108538	32754	108538	32754
1.6000	1.1261	34521	11095	153429	44579	106188	31871	106188	31871
1.7000	1.1965	34745	11061	151259	43778	104018	31070	104018	31070
1.8000	1.2668	34952	11034	149243	43047	102002	30339	102002	30339
1.9000	1.3372	35146	11010	147363	42375	100122	29667	100122	29667
2.0000	1.4076	35328	10991	145601	41753	98360	29045	98360	29045
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDPAM05
Date and time : 09OCT00:14:46
Computation of ref. F: Simple mean, age 4 - 8
F-0.1 factor : 0.1288
F-max factor : 0.2742
F-0.1 reference F : 0.0907
F-max reference F : 0.1930
Recruitment : 47241 (Thousands)

Figure 10.2.1. Plaice IIIa. Distribution of catch in numbers (%) by age and by year.

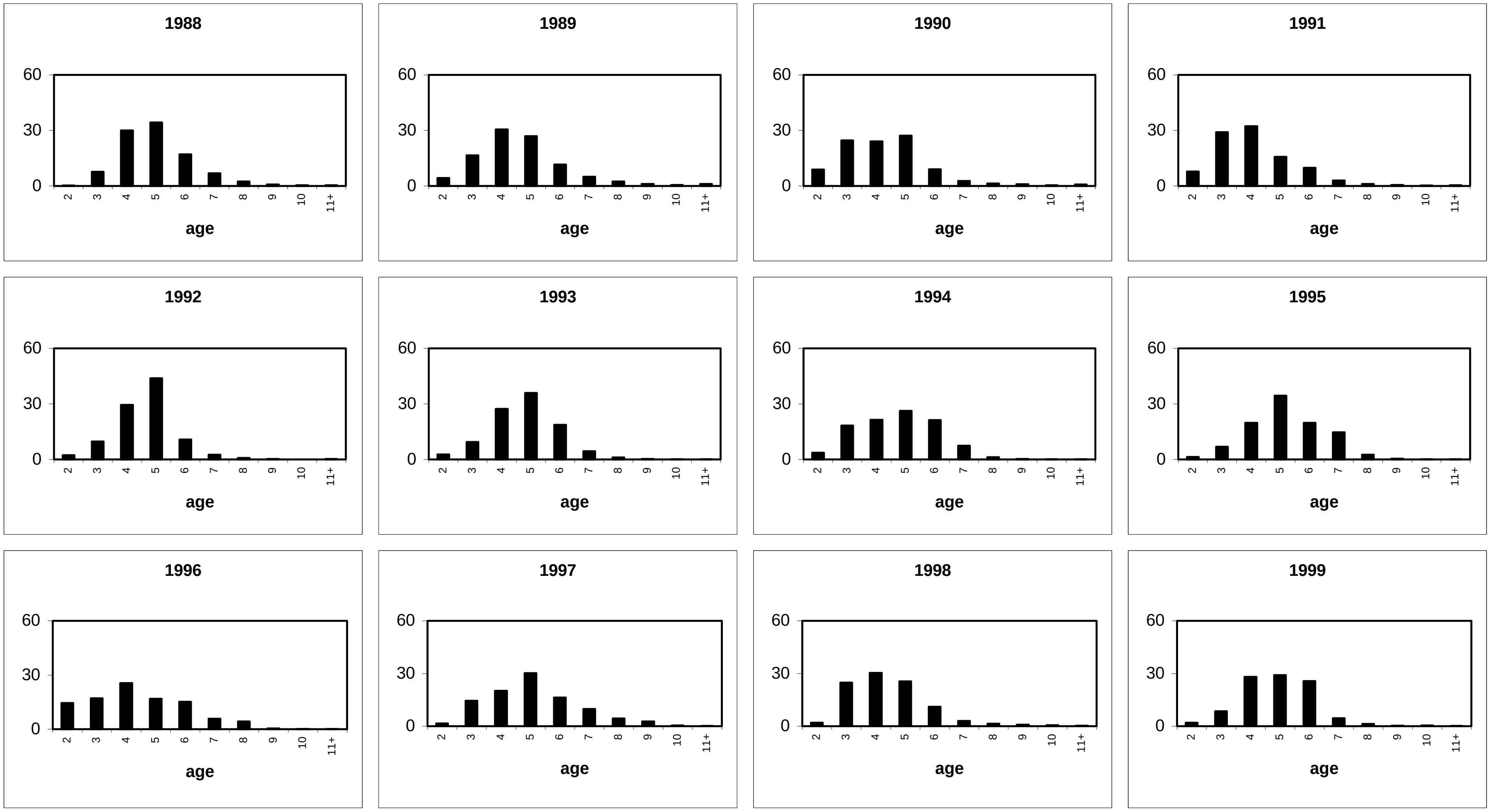


Figure 10.2.2. Time series of catch weight at age for plaice in Kattegat and Skagerrak.

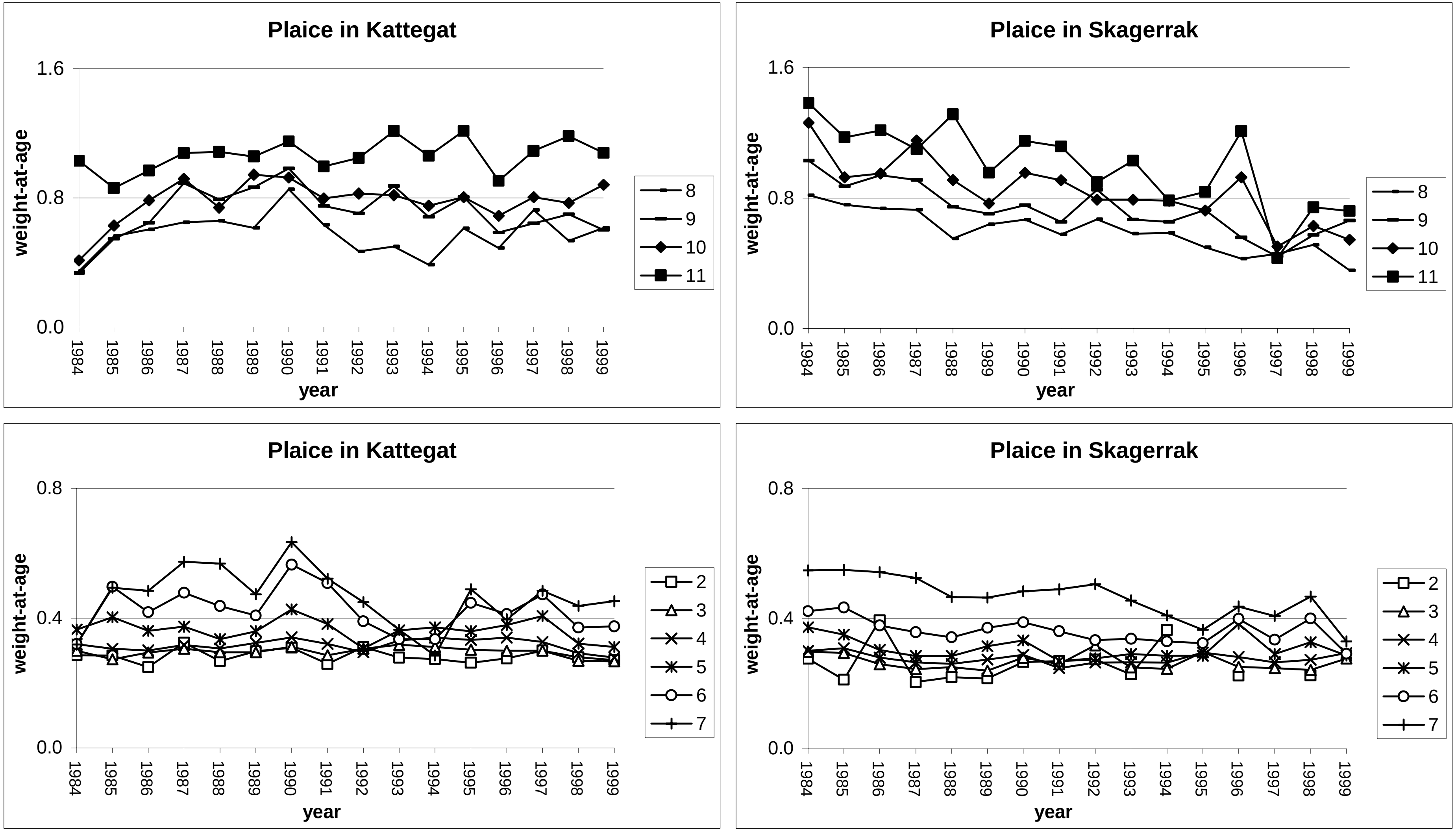


Figure 10.2.3. Time series of fishing effort (days fishing standardised by vessel length) and CPUE. Plaice in IIIa.

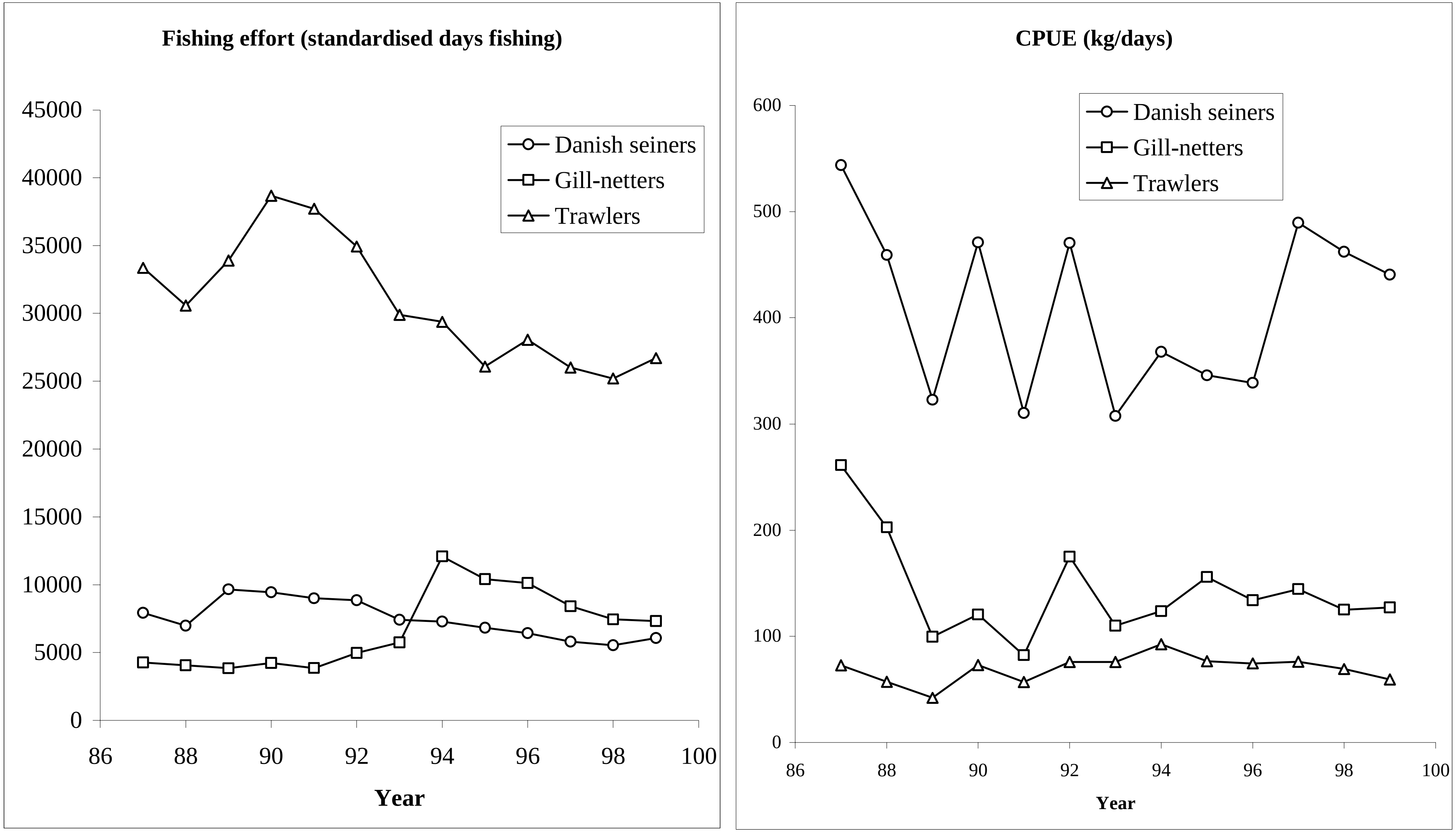
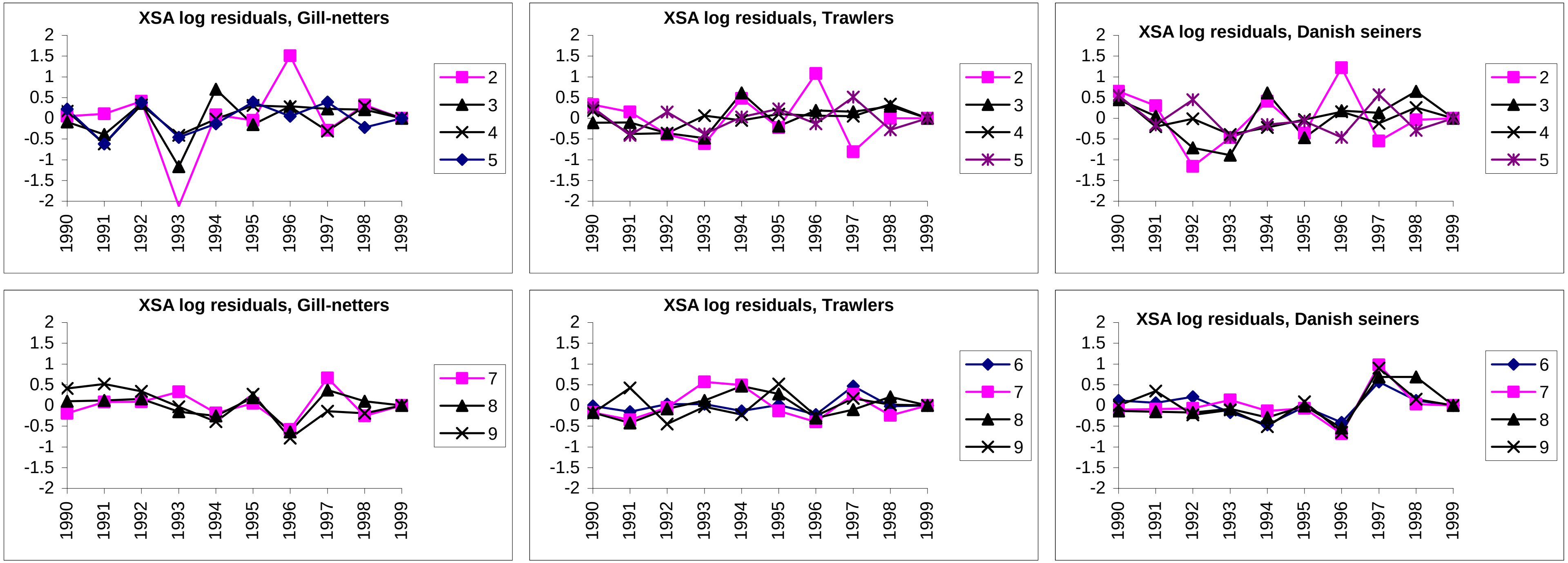


Figure 10.4.1. Plaice IIIa. XSA log residuals by fleet and age (single fleet Laurec/Shepherd run)



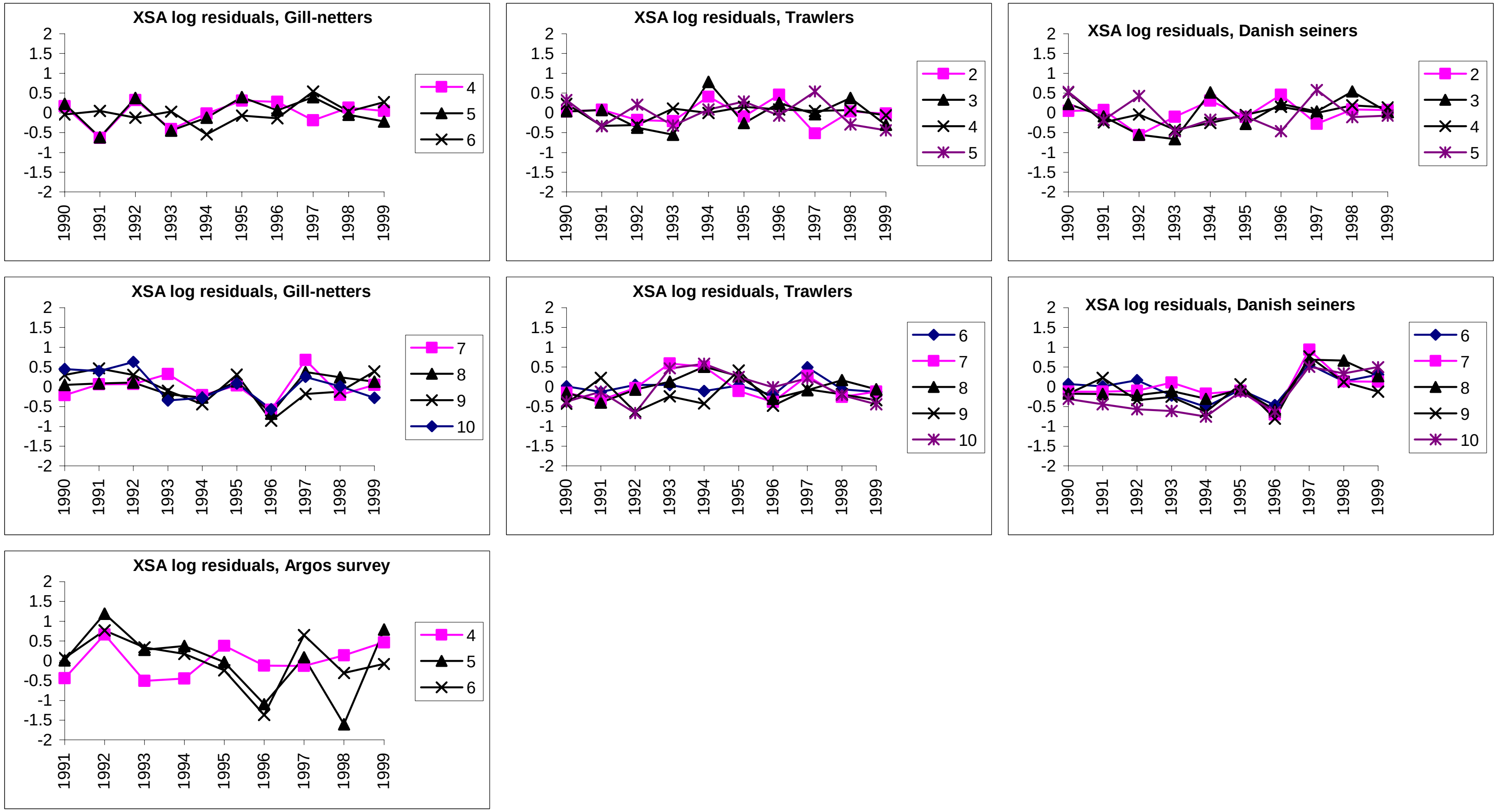
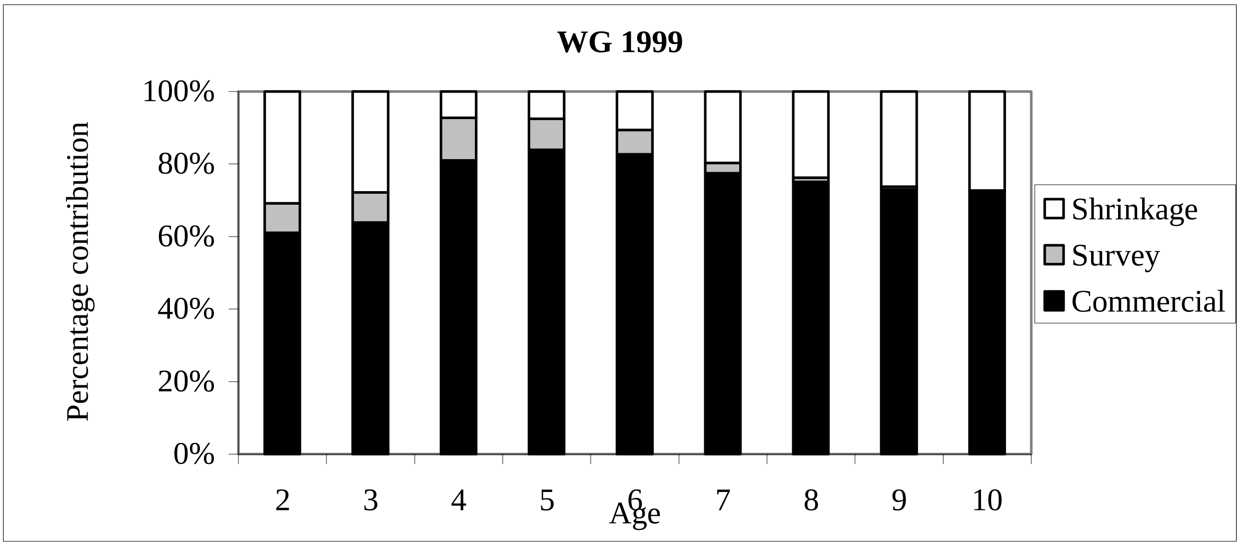


Figure 10.4.2. Plaice IIIa. XSA log residuals by fleet and age (combined fleet run: XSAPAM06)



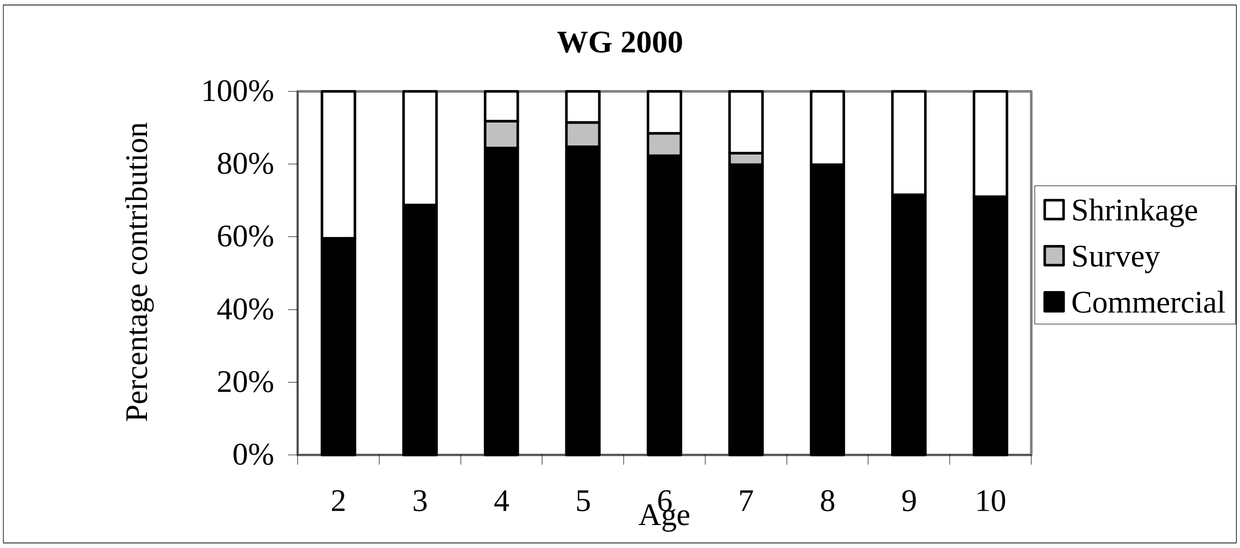


Figure 10.4.3. Plaice in IIIa. Weighting in tuning fleets in 1999 and 2000 XSA assessments.

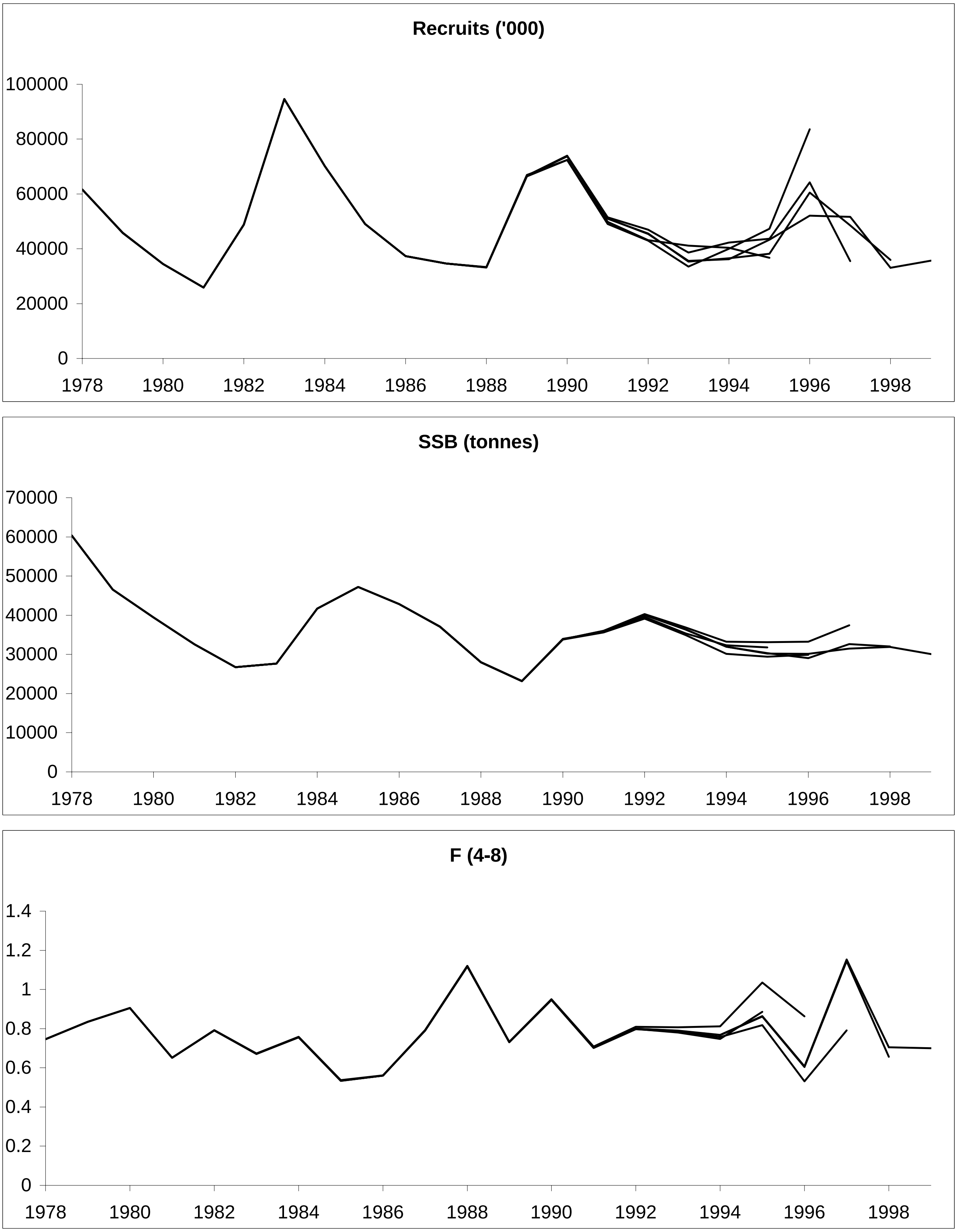


Figure 10.4.4. Plaice IIIa. Retrospective analysis (1995-1999) with shrinker set to 0.5. Run: XSAPAM06

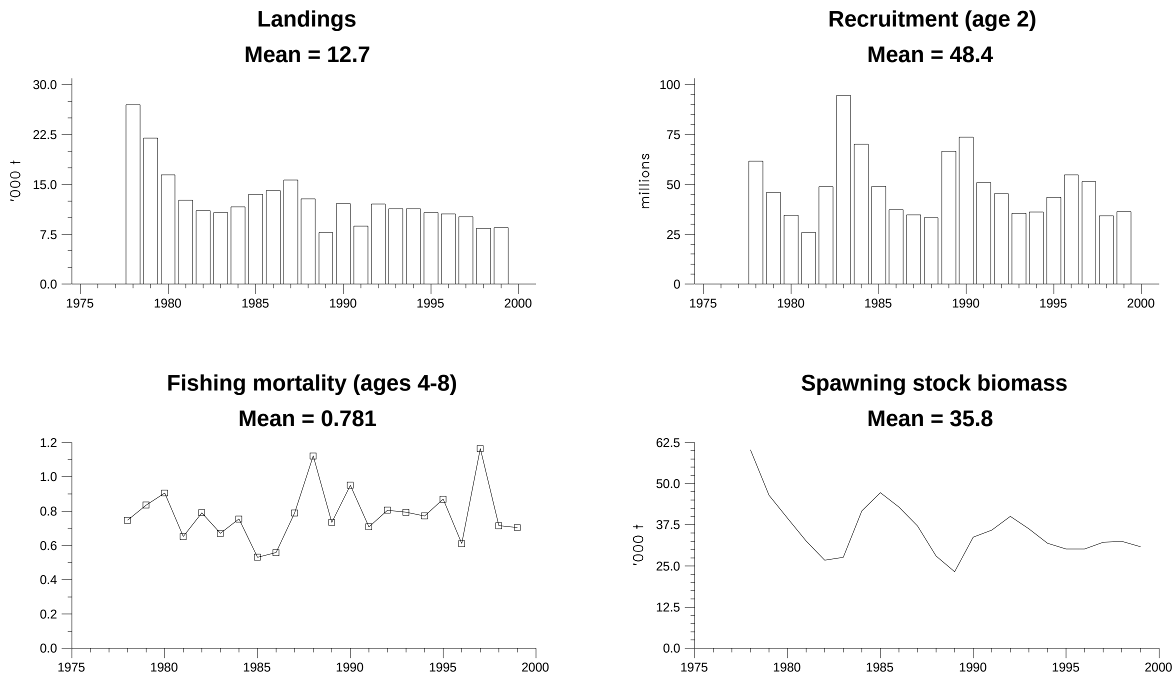
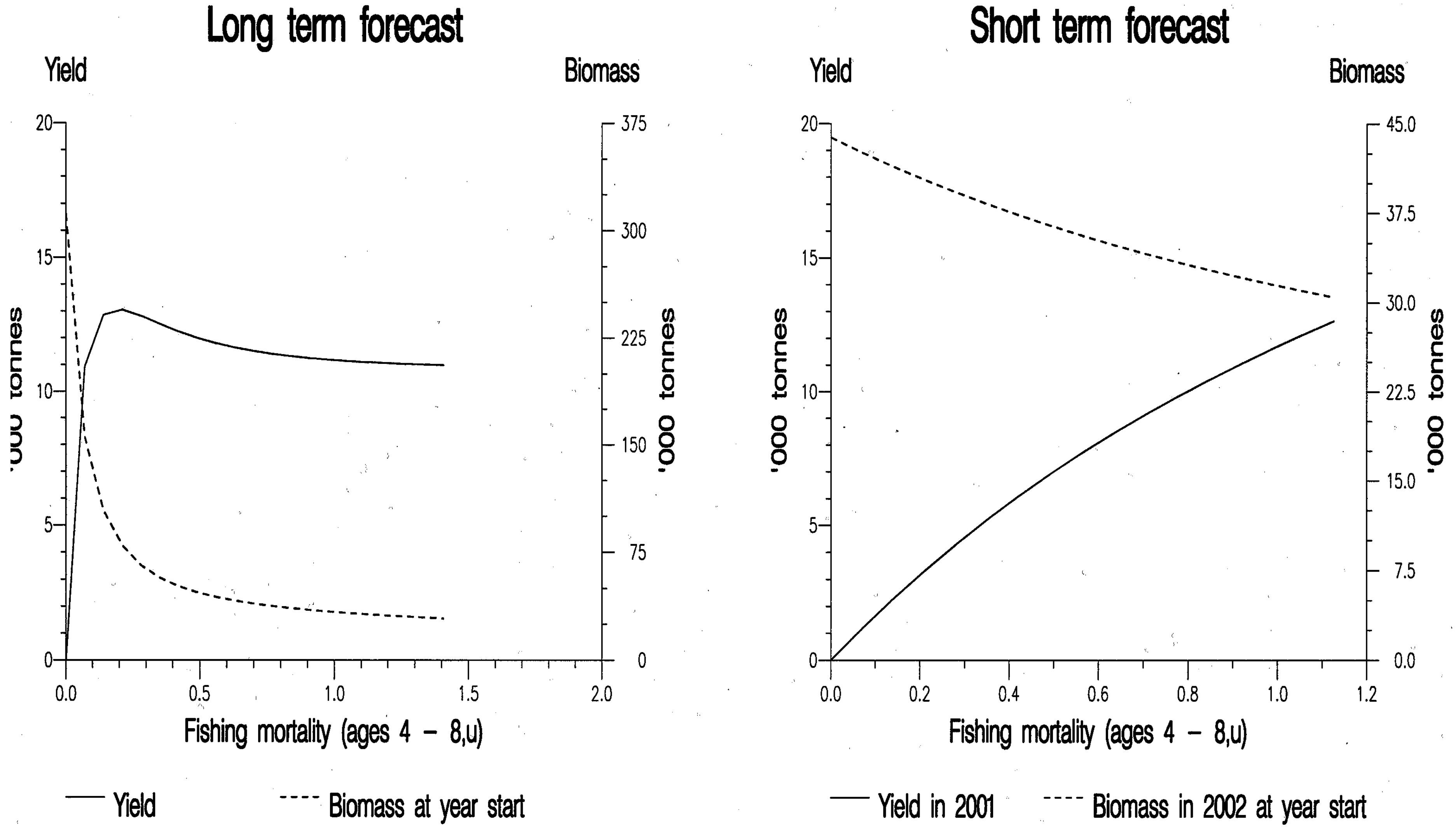


Figure 10.6.1 Plaice in Division IIIa

Figure 10.8.1

Fish Stock Summary
Plaice in Division IIIa
9–10–2000



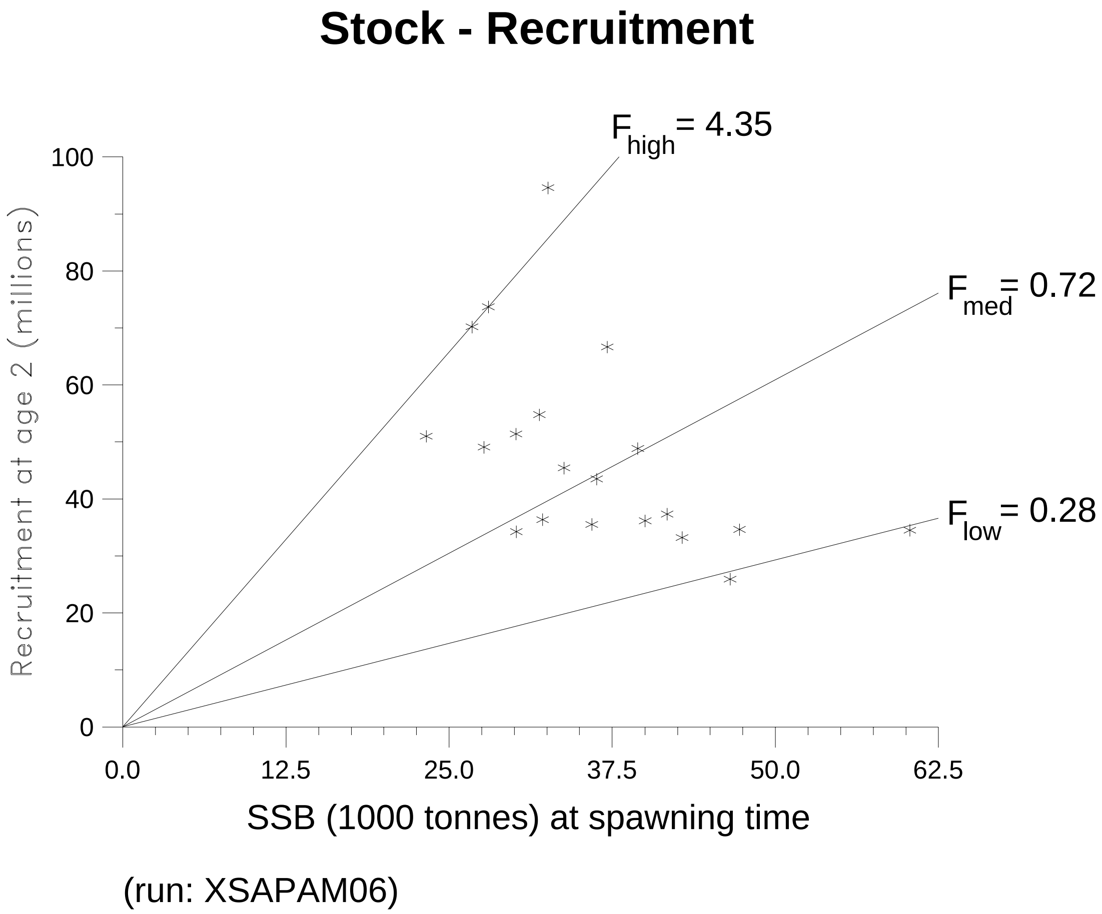


Figure 10.8.2 Plaice in Division IIIa

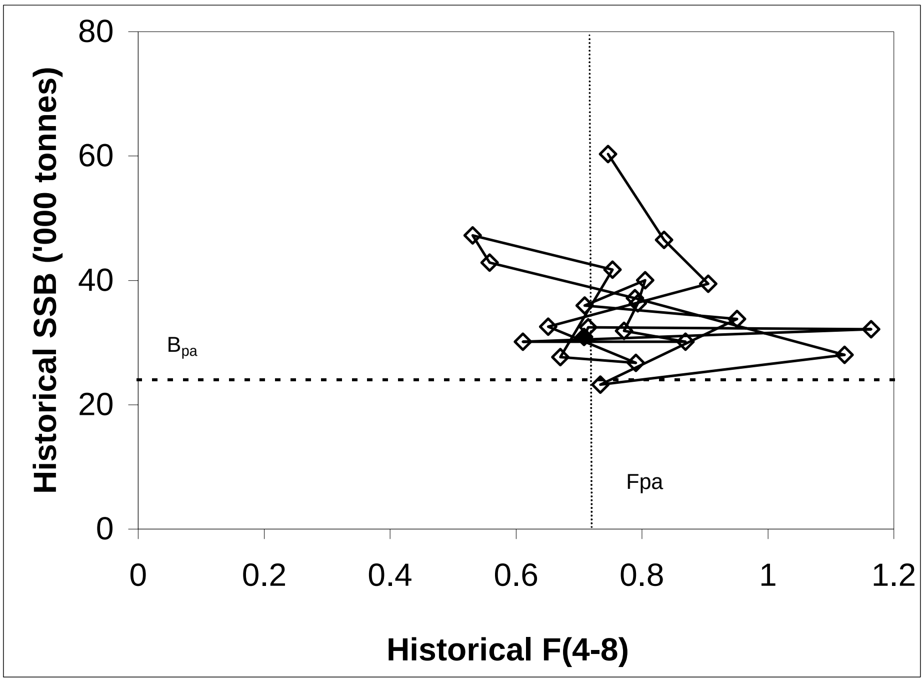


Figure 10.8.3. Plaice IIIa. Historical F and SSB in relation to Bpa and Fpa (The1999 value is highlighted)

11 PLAICE IN DIVISION VIID

11.1 The fishery

11.1.1 ACFM advice applicable to 1999 and 2000

Advice for 1999: the state of the stock was considered as uncertain but probably close to safe biological limits, and ACFM recommended that fishing mortality should not be allowed to increase, fishing at $\mathbf{F}_{pa}$ implied landings in 1999 of 6300 t.

Advice for 2000: the stock was considered as harvested outside safe biological limits and fishing mortality in 1998 was estimated to be well above F_{pa}. ICES recommended that fishing mortality in 2000 was reduced to less than the proposed F_{pa} corresponding to landings in 2000 of less than 4900 t.

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

B_{lim} = 5600 t, B_{pa} = 8000 t, F_{lim} = 0.54, F_{pa}= 0.45.

11.1.2 Management applicable in 1999 and 2000

There is no separate TAC for VIId plaice which at present is managed together with area VIIe. The TAC was set to 6500 t in both areas in 2000 (TAC_{99} was 7400 t). Technical conservation measures, including minimum mesh size of 80 mm for trawling and minimum landing size of 25 cm, are in force.

11.1.3 The fishery in 1999

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.

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.

For 1999 the French scientists were unable to obtain either the catch data by Division, size category (commercial category) and fleet, or the corresponding effort data from their national system of fisheries statistics. They could only provide catches by TAC areas as officially reported to the EU by the French Ministry of Agriculture and Fisheries (see section 1.3). The French data were corrected using the ratio official/estimate by WG used last year. Because official French data are combined for VIId and VIIe together, the ratio used is official French VIId+e against WG French estimate for VIId in 1998.

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 6326 t in 1999, which is just below the 6800 t predicted at status quo F in last year's assessment. France contributes 60 % of the official landings in 1999[1], followed by Belgium (26 %) and UK (15 %).

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 1980-99 were available for the UK and for 1981-99 for Belgium. France has 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 have been available from UK since 1980 and from Belgium since 1986. French catch weights have been collected since 1989.

[1] It is considered that the VIId part of the French landings is 90 %.

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 1999 international landings covered by sampling schemes under auctions represented the majority of the total landings. Stock weights at the 1st of January were calculated from a smoothed curve of catch weights (Table 11.2.4). The unrealistic value given by the model (polynomial regression) for age 1 in 1999 (0.004 kg) was replaced by the value from last year (0.072 kg). 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. Due to the problem already cited data were not available for the French trawlers in 1999. Trends in effort and CPUE are shown in Table 11.3.2 and Figure 11.3.1 (see also overview section 2.3). 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. In 1999 the three fleets available indicate an increase of the CPUE. Effort has increased in all fleets since 1983 to 1989 and remained thereafter at a high level except in 1998 and 1999 where some fleets switched to cod.

Effort and age compositions were available for three commercial fleets except French trawlers in 1999. 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).

All these data (including age 1) were used to tune the VPA, except the English YFS which was removed after preliminary analysis. 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 analyses

11.4.1 Exploration of data

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:

a) Input data: a separable VPA was made to check the input data (Table 11.4.1). High catch ratio residuals occur between ages 1/2 and 2/3 in 1997/1998 and for ages 2/3 in 1998/1999. 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.

b) Trends in catchability were examined for residual trends by fleet and age. Trends were examined from exploratory runs using XSA with single fleet tuning runs (Figure 11.4.1). We noticed a trend and big residuals for age 1 in the UK inshore trawl and for age 1 in the French trawlers which were removed from the final analysis. English YFS (age 1) which shows a trend for the recent period used in the tuning was also removed. Catchability residuals of the fleets from final XSA are presented in Figure 11.4.2.

c) 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 for age 6 in UK inshore trawl, and therefore age 1 was treated as recruit (as in the 1999 WG report (99WG)).

d) Time series. 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. 1989 corresponds also to the beginning of the UK BTS which has an important weight in this assessment.

e) Choice of age for which catchability can be assumed to be constant: age 7 was taken as an acceptable value (as in 99WG).

f) Survival estimates were shrunk towards the mean F of the final 5 years or the 3 oldest ages in the final run (as in 99WG).

g) Retrospective analysis was carried out using final XSA options with a strong shrinkage of 0.5 as in 99 WG. An unrealistic high value for F in 97 was noted as for last years assessment. The retrospective pattern showed no particular trend for the 4 years available with the short tuning range of 8 years used (Figure 11.4.3).

The following table summarises the final XSA configuration used for this year's assessment, along with last year's:

	1999 assessment		2000 assessment	
Calibration period, no taper	11 years		12 years	
Age range	1-10+		1-10+	
Catchability model	Power model for Age 1		Power model for Age 1	
Catchability plateau	Age 7		Age 7	
F shrinkage :				
SE	0.5		0.5	
Year range	5		5	
Age range	3		3	
Fleets used :	Ages	Years	Ages	Years
FLT01: UK inshore trawl	2-9	1988-98	2-9	1988-99
FLT02: BELGIAN BEAM	3-9	1988-98	2-9	1988-99
FLT03: French trawlers	2-9	1988-98	2-9	1988-99(*)
FLT04: UK BTS	1-6	1988-98	1-6	1988-99
FLT05: French GFS	1-5	1988-98	1-5	1988-99
FLT06: French YFS	1	1988-98	1	1988-99
FLT07: UK YFS	1	1988-98	Not included	Not included

(*) no data for 1999

11.4.2 Final assessment

The list of tuning fleets, input parameters and output from the final run are shown in Table 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 Recruitment 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 (English YFS excepted).

Additional data were available for 0 groups and for 2000 surveys, and RCT3 was used to predict recruitment at age 1 and age 2 in 2000 (English YFS 2000 indices which become available just at the end of the WG meeting were not used in this analysis). 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	GM_{80-97}	AM_{80-97}
Year-Class	Age in 2000	Weighted average (age*10-3)	Var Ratio	(age*10-3)		
1997	3	13487	.25	<u>13299</u>	13362	14847
1998	2	<u>21433</u>	.17	19594	20363	21846
1999	1	<u>24072</u>	.18	-	24266	26072

For the 1997 year-class the XSA estimation was accepted. For the 1998 year class results show no big differences between XSA and RCT3, and the estimate from the surveys was preferred to XSA which is influenced by F shrinkage (weight of .16). For the 1999 year class the estimate of RCT3 was used and for 2001 and 2002 the GM_{80-97} of 24.3 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 fluctuating 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 8000 t. Recruitment has been close to the GM level of 24.3 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 2000 were taken from the VPA for age 3 and older, RCT3 at age 1 and 2 and the GM of 24.3 million was used for age 1 in 2001 and 2002. For the exploitation pattern the standard procedure chosen this year by the WG was used, mean F over 3 years rescaled to reference F in 1999. Rescaled mean F over 5 years gave similar results despite the unrealistic high F in 1997. Catch and stock weights-at-age were the mean for the period 1997-99, and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Table 11.7.2 and Figure 11.7.1. The predicted catch in 2000 is estimated to be 6600 t with a SSB of 9000 t for the same year. This compares with a figure of 6800 t forecast for the catch and 8400 t for the SSB made last year. Continuing with the same level of F implies a decrease in catch with 5920 t in 2001 and a predicted SSB to 7900 t in 2001 and 7800 t in 2002. A detailed prediction output by age is shown in Table 11.7.3.

Figure 11.7.2 shows the contribution of different year classes to landings in 2001 and SSB in 2002 under *status quo* assumptions.

11.8 Medium-term predictions

No new medium-term prediction was carried out this year assuming that the results obtained last year were already valid due to the stability of the assessment from this year to the previous one.

11.9 Biological reference points

A stock-recruitment scatter plot is shown in Figure 11.9.1. The yield per recruit input values are given in Table 11.9.1 and the output summary in Table 11.9.2, catch and stock weights were the average for 1988-99 as for XSA tuning. The YPR and SSB/R curves are shown in Figure 11.7.1.

The current Fishing mortality is above F_{pa} and SSB in 2000 is above B_{pa}.

The available reference points are the following :

F_{lim}	F_{pa}	B_{lim}	B_{pa}	F_{max}	$F_{0.1}$	F_{low}	F_{high}	F_{med}	F_{SQ}
0.54	0.45	5 600 t	8 000 t	.18	.11	0.35	.97	0.59	0.66

11.10 Comments on the assessment

Due to the problems with the data provided by France in 1999 and because this country is dominating the landings for this stock, the WG considered that the estimation of F, particularly in the last year, is uncertain.

Nevertheless if we compare last year's assessment with this assessment the results are relatively consistent. Current F is close to that of last year and the retrospective pattern is very similar. The high F already observed for 1997 remain, certainly due to a data problem which has to be checked. Year class 1996 is now estimated at a higher level than previously.

An error was corrected for recruitment in the quality control diagram.

Table 11.1.1 PLAICE in Division VIId. Nominal landings (tonnes) as officially reported to ICES, 1976–1999.

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[2]	796	18	4,569	561	5,130
1996	1,112	-	2,630[2]	856	+	4,598	795	5,393
1997	1,161	-	3,077	1,078	+	5,316	991	6,307
1998	854	-	3,276[2]	700	+	4,830	932	5,762
1999	1,306	-	3,388[2]	743	+	5,439	887	6,326

[1]VIId part estimated by the Working Group from combined Division VIId+e.
[2]Includes Division VIIe.

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.

Run title : Plaice in VIId (run: XSAATT04/X04)
At 6/10/2000 15:17

Catch numbers at age Numbers*10**-3

	YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
	AGE										
	1,	53,	16,	265,	92,	350,	142,	679,	25,	16,	826,
	2,	2644,	2446,	1393,	3030,	1871,	5714,	4884,	8499,	5011,	3638,
	3,	1451,	6795,	6909,	3199,	7310,	6195,	7034,	7508,	18813,	7227,
	4,	540,	2398,	3302,	5908,	2814,	4883,	3663,	3472,	4900,	9453,
	5,	490,	290,	762,	931,	1874,	413,	1458,	1257,	1118,	2672,
	6,	75,	159,	206,	226,	533,	612,	562,	430,	541,	588,
	7,	45,	51,	96,	92,	236,	164,	254,	442,	439,	288,
	8,	44,	42,	62,	122,	101,	99,	69,	154,	127,	179,
	9,	4,	56,	21,	4,	34,	139,	19,	105,	105,	81,
	+gp,	103,	200,	88,	101,	100,	50,	34,	77,	174,	197,
0	TOTALNUM,	5449,	12453,	13104,	13705,	15223,	18411,	18656,	21969,	31244,	25149,
	TONSLAND,	2650,	4769,	4865,	5043,	5161,	6022,	6834,	8366,	10420,	8758,
	SOPCOF %,	100,	94,	92,	90,	86,	92,	100,	98,	92,	93,

Catch numbers at age Numbers*10**-3

	YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
	AGE										
	1,	1632,	1542,	1665,	740,	1242,	2592,	1119,	550,	464,	741,
	2,	2627,	5860,	6193,	7606,	3633,	4340,	4847,	4246,	4400,	1758,
	3,	8746,	5445,	4450,	3817,	6968,	2933,	3606,	7189,	8629,	12104,
	4,	5983,	4524,	1725,	1259,	3111,	2928,	1547,	3434,	3419,	6460,
	5,	3603,	2437,	1187,	542,	850,	922,	1436,	1080,	537,	1043,
	6,	801,	1681,	1044,	468,	419,	228,	488,	752,	143,	171,
	7,	243,	286,	698,	334,	312,	277,	179,	464,	136,	86,
	8,	203,	120,	200,	287,	267,	225,	176,	199,	81,	81,
	9,	178,	113,	116,	102,	275,	122,	165,	114,	52,	38,
	+gp,	231,	125,	118,	152,	312,	258,	347,	306,	188,	111,
0	TOTALNUM,	24247,	22133,	17396,	15307,	17389,	14825,	13910,	18334,	18049,	22593,
	TONSLAND,	9047,	7813,	6337,	5331,	6121,	5130,	5393,	6307,	5762,	6326,
	SOPCOF %,	98,	96,	98,	99,	99,	98,	102,	97,	102,	100,

Table 11.2.3.- Plaice in Division VIId. Catch weights-at-age.

Run title : Plaice in VIId (run: XSAATT04/X04)
At 6/10/2000 15:17

Catch weights-at-age (kg)

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.3090,	.2390,	.2450,	.2660,	.2330,	.2540,	.2260,	.2510,	.2920,	.2010,
2,	.3120,	.2990,	.2710,	.2960,	.2950,	.2780,	.3060,	.2820,	.2680,	.2680,
3,	.4990,	.3730,	.3530,	.3490,	.3360,	.3010,	.3310,	.3600,	.3210,	.3210,
4,	.6270,	.4640,	.4310,	.4200,	.4020,	.4270,	.4060,	.4770,	.4320,	.3700,
5,	.7870,	.7120,	.6400,	.5420,	.5080,	.5020,	.5460,	.5770,	.5600,	.4730,
6,	1.1390,	.8700,	.7950,	.8220,	.6890,	.5700,	.4860,	.7830,	.6570,	.6480,
7,	1.1790,	.8630,	1.1530,	.9530,	.7030,	.5570,	.6290,	.7350,	.7700,	.8370,
8,	1.2930,	.8970,	1.0670,	1.1440,	.9450,	1.0810,	.8710,	1.1420,	.9080,	.9070,
9,	1.4750,	.9920,	1.5040,	.9430,	1.0280,	.8490,	1.4460,	1.2680,	1.2180,	1.2040,
+gp,	1.5570,	1.1740,	1.3550,	1.5910,	1.4270,	1.4210,	1.5790,	1.5150,	1.3280,	1.5190,
0 SOPCOFAC,	.9995,	.9352,	.9208,	.9003,	.8632,	.9239,	1.0001,	.9757,	.9224,	.9314,

Catch weights-at-age (kg)

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	.2010,	.2250,	.1820,	.2200,	.2430,	.2180,	.2210,	.1990,	.1590,	.1970,
2,	.2560,	.2770,	.2770,	.2720,	.2700,	.2710,	.3000,	.2520,	.2440,	.2450,
3,	.3260,	.3110,	.3520,	.3360,	.2880,	.3130,	.2900,	.2980,	.2670,	.2350,
4,	.3780,	.3900,	.4290,	.4320,	.3560,	.3900,	.3960,	.3320,	.3810,	.3060,
5,	.4830,	.4540,	.5090,	.5070,	.4660,	.4850,	.4750,	.4420,	.5020,	.4610,
6,	.6100,	.5560,	.5850,	.5910,	.5760,	.6880,	.6430,	.5770,	.7620,	.7510,
7,	.7810,	.7450,	.7010,	.7410,	.6860,	.6120,	.7640,	.8010,	.8390,	.7680,
8,	.9630,	1.0870,	.8370,	.8200,	.9280,	.8060,	.9340,	.8940,	.9810,	.8680,
9,	1.1590,	.9240,	.8500,	.9340,	.9690,	1.1500,	1.0570,	1.0550,	.9860,	.8850,
+gp,	1.3100,	1.6020,	1.1950,	1.1560,	1.2870,	1.2980,	1.3120,	1.3950,	1.3790,	1.5080,
0 SOPCOFAC,	.9795,	.9625,	.9846,	.9940,	.9930,	.9806,	1.0202,	.9748,	1.0222,	.9971,

Table 11.2.4.- Plaice in Division VIId. Stock weights-at-age.

Run title : Plaice in VIId (run: XSAATT04/X04)
At 6/10/2000 15:17

Stock weights-at-age (kg)

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.1710,	.1100,	.1050,	.0970,	.0820,	.0840,	.1010,	.1220,	.0840,	.0790,
2,	.3320,	.2160,	.2080,	.1920,	.1640,	.1710,	.2050,	.2420,	.1680,	.1620,
3,	.4820,	.3170,	.3080,	.2860,	.2480,	.2590,	.3110,	.3610,	.2540,	.2500,
4,	.6220,	.4140,	.4060,	.3790,	.3330,	.3480,	.4200,	.4790,	.3400,	.3420,
5,	.7510,	.5060,	.5020,	.4700,	.4200,	.4400,	.5320,	.5960,	.4270,	.4390,
6,	.8700,	.5940,	.5960,	.5600,	.5070,	.5330,	.6460,	.7120,	.5140,	.5410,
7,	.9770,	.6770,	.6870,	.6480,	.5960,	.6280,	.7630,	.8260,	.6030,	.6480,
8,	1.0740,	.7560,	.7760,	.7350,	.6860,	.7250,	.8820,	.9390,	.6920,	.7590,
9,	1.1610,	.8300,	.8620,	.8210,	.7770,	.8240,	1.0040,	1.0510,	.7830,	.8740,
+gp,	1.3390,	1.0420,	1.1180,	1.1690,	1.0860,	1.2060,	1.3130,	1.3060,	.9520,	1.2110,

Stock weights-at-age (kg)

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	.0850,	.0650,	.0880,	.1080,	.1650,	.0580,	.1780,	.0590,	.0720,	.0720,
2,	.1720,	.1410,	.1770,	.2140,	.2150,	.1720,	.2380,	.1510,	.1630,	.1010,
3,	.2620,	.2270,	.2680,	.3150,	.2740,	.2840,	.3070,	.2460,	.2560,	.1980,
4,	.3550,	.3240,	.3610,	.4140,	.3440,	.3960,	.3850,	.3430,	.3520,	.2950,
5,	.4510,	.4320,	.4560,	.5090,	.4220,	.5060,	.4730,	.4430,	.4500,	.3920,
6,	.5490,	.5500,	.5520,	.6010,	.5110,	.6150,	.5690,	.5450,	.5500,	.4900,
7,	.6510,	.6790,	.6510,	.6900,	.6090,	.7230,	.6750,	.6490,	.6540,	.5870,
8,	.7550,	.8190,	.7510,	.7760,	.7160,	.8300,	.7900,	.7560,	.7590,	.6840,
9,	.8620,	.9690,	.8530,	.8580,	.8340,	.9350,	.9150,	.8650,	.8680,	.7820,
+gp,	1.1250,	1.4040,	1.1160,	1.0380,	1.1470,	1.1890,	1.2230,	1.1470,	1.1990,	1.0350,

Table 11.3.1.- Plaice in VIId. Tuning input file.

```
Plaice in Division VIId (Eastern English Channel) (run name: XSAATT04)
106
FLT01: UK inshore trawl METIER <40 trawl lands  all trawl age comps fleet (Catch: Unknown) (Effort:
Unknown)
1985 1999
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
     813   104.3    77.7    27.6     3.7     1.7     3.9     1.4     1.2     0.3
     861    53.4   222.2    27.0     8.7     1.2     0.4     1.4     0.5     0.4
FLT02: BELGIAN BEAM TRAWL( HP corr)  all gears age comp [rev: 27/7/00-WV] (Catch: Unknown) (Effort:
Unknown)
1981 1999
1 1 0.00 1.00
2 10
   24.4    285.9   1126.5    593.3     67.3     21.6      8.3      7.1     13.3     14.1
   29.8    147.8   1065.4    688.2    187.2     55.1     21.1      6.5      4.6      4.0
   26.4    476.7    654.3   1384.5    165.0     52.2     23.0     31.6      1.3      1.4
   35.4     92.0   1570.4    712.1    467.5    134.3     61.0     28.2      5.4      6.8
   33.4    557.2   1125.3   1115.1     93.9    197.2     52.9     31.9      5.3      6.1
   30.8    700.6   1141.8    667.8    269.9    145.9     60.3     11.3      5.6      6.4
   49.3   1944.8   1639.7    889.0    343.1     92.7    154.5     41.1     28.0     14.1
   48.9    773.0   4264.6   1301.8    237.1    109.9    113.2     35.8     25.4     24.0
   43.8     73.6   1733.7   2950.5    973.4    212.8    113.1     61.1     21.7      0.1
   38.5    372.1   2687.5   1942.8   1007.0    184.8     43.9     50.5     13.1     14.0
   32.8    595.4   1689.2   1149.4   1089.5    698.4     86.9     36.0     58.9      1.7
   30.9    889.8   1031.7    403.8    277.6    282.1    159.7     58.2     60.7      6.7
   28.2    488.8    684.2    274.3    197.6    121.6     74.7     62.8     10.6     19.3
   32.8    424.6   1259.2   1426.5    268.0    132.6    109.5     75.5     90.0     37.6
   31.7     39.8    591.9    925.2    396.5     82.0    140.1     82.6     26.1      0.7
   32.6    259.3    689.3    541.5    503.7    137.6     46.4     49.9     38.4     44.4
   39.7      0.0    287.3    931.8    570.2    295.7    143.7     37.3     27.7     11.2
   23.6    164.6    900.7    616.6    122.0     39.0     40.0     18.2     18.4     13.7
   27.6     40.7   1687.7   1366.6    370.5     67.5     25.4     13.5     14.0     12.7
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: 23/8/00-RM] (Catch: Unknown) (Effort: Unknown)
1988 1999
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
   1   11.3   14.1   15.9    2.9    1.0    0.2
```

Table 11.3.1. - Plaice in VIId. Tuning input file (continued)

```
FLT05: French GFS [option 2]  true age 5 [rev: 28/9/00-AT] (Catch: Unknown) (Effort: Unknown)
1988 1999
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    4.0    3.8    1.5    1.0    0.2
   1    4.9    3.0    0.4    0.2    0.2
   1   33.1    6.8    4.2    0.3    0.1
   1   10.0   11.6    2.6    0.5    0.0
   1   10.1    4.3    7.6    1.2    0.2
FLT06: French YFS [rev: 28/9/00-AT] (Catch: Unknown) (Effort: Unknown)
1987 1999
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
   1   1.3
```

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	86.2	25.9	181.9
1999	8.4	108.8	37.6	-

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	0.813	23.6	11707
1999	28.6	0.861	27.6	-

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	0.0	1.0	50.6	11.9
1999	11.3	14.1	15.9	2.9	1.0	0.2	0.1	0.3	0.1	0.9	46.8	21.4
2000	13.2	21.0	14.4	13.8	3.5	0.9	0.6	0.2	0.4	1.5	69.4	35.2

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	4.38
1994	17.23	3.27	11.32	11.90	4.20	5.47	1.03	7.39	5.42	4.06
1995	12.04	1.42	13.20	13.50	7.00	6.42	0.61	0.99	6.15	8.57
1996	2.48	0.42	33.10	27.30	15.9	6.40	1.28	17.33	37.56	13.34
1997	2.38	0.42	11.40	14.1	14.4	3.07	1.22	9.83	10.67	5.62
1998	7.19	0.2	11.3	21.0		5.36	1.25	5.92	12.98	
1999	6.46	1.71	13.2			2.98		1.06		
2000	0.59									

Table 11.4.1.- Plaice in Division VIId. Separable VPA.

At 28/09/2000 18:42

Separable analysis
from 1980 to 1999 on ages 1 to 14
with Terminal F of .500 on age 3 and Terminal S of .700

Initial sum of squared residuals was 540.575 and
final sum of squared residuals is 284.980 after 96 iterations

Matrix of Residuals

Years	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
Ages									
1/2	-1.947	-2.993	-1.17	-1.163	-1.816	-2.442	-0.806	-3.784	-3.837
2/3	0.051	-0.493	-0.482	-0.004	-1.162	0	0.394	-0.212	0.248
3/4	-0.237	0.478	-0.286	0.196	-0.446	-0.036	0.786	0.217	0.472
4/5	0.402	0.386	0.293	0.719	0.495	0.117	0.654	0.407	-0.13
5/6	0.756	-0.543	0.112	0.033	-0.404	-1.549	0.661	-0.003	-0.186
6/7	0.507	0.147	0.239	-0.048	0.239	0.169	0.192	-0.34	0.342
7/8	0.193	-0.552	-0.005	-0.099	-0.072	0.158	0.444	0.929	0.607
8/9	-0.256	0.197	2.033	1.141	-1.404	0.797	-0.614	-0.073	0.025
9/10	-2.353	0.657	0.251	-1.638	-0.182	1.307	-0.559	-0.19	0.265
10/11	1.231	0.431	-0.366	-0.628	1.337	4.343	1.75	-0.51	0.887
11/12	-1.624	-0.336	-0.191	-0.171	4.016	2.096	-5.801	-1.595	-0.608
12/13	0.318	1.488	0.116	0.298	4.029	-0.852	-3.191	2.818	-1.412
13/14	-0.492	-0.021	-0.633	-1.273	-1.055	-5.167	-3.428	0.019	-1.324
TOT	0.001	0.001	0	0	0	0	0	0	0
WTS	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Years	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	TOT	WTS
1/2	0.369	-0.023	-0.148	-0.467	0.093	-0.061	0.819	0.479	-1.206	-0.012	-0.001	0.181
2/3	-0.381	-0.513	0.507	0.585	0.811	0.441	0.678	0.378	-0.865	-0.642	-0.001	0.453
3/4	-0.206	-0.054	0.484	0.518	0.12	0.247	0.316	-0.062	-0.349	-0.165	-0.001	0.739
4/5	0.031	-0.39	0.107	-0.149	-0.201	0.042	-0.138	-0.252	0.148	0.196	0	0.818
5/6	0.214	-0.575	-0.452	-0.483	-0.439	0.042	-0.322	-0.017	0.265	0.044	0	0.502
6/7	0.462	0.296	0.167	0.297	0.236	-0.294	-0.175	-0.067	0.576	-0.042	0	1
7/8	-0.076	-0.034	-0.398	0.046	0.064	-0.392	0.036	-0.228	0.807	-0.033	0	0.61
8/9	-0.552	-0.29	-0.819	-0.313	-0.261	-0.066	-0.245	0.187	0.069	0.066	0	0.346
9/10	-0.344	0.607	0.334	0.134	-0.324	0.252	-0.564	0.442	0.041	-0.168	0	0.313
10/11	-0.638	0.439	-0.209	-1.148	-0.685	0.535	-0.348	0.502	-0.506	-0.189	0	0.204
11/12	-0.477	0.487	-0.429	-0.618	-0.102	0.096	-0.354	0.286	-0.372	0.35	0	0.14
12/13	0.777	0.09	-0.21	-0.263	-0.565	-0.36	0.82	-0.19	-0.898	0.624	-0.001	0.167
13/14	0.463	2.141	-0.332	-0.576	0.51	-0.113	-0.107	-0.697	-0.365	1.292	-0.001	0.162
TOT	0	0	0	0	0	0	0	0	0	0	-24.904	
WTS	0.001	0.001	0.001	0.001	0.001	1	1	1	1	1		

Fishing Mortalities (F)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
F-value	0.2741	0.4408	0.4764	0.4144	0.6777	0.4478	0.322	0.4412	0.5	0.6266
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
F-value	0.7604	0.6993	0.624	0.4431	0.6067	0.4996	0.5321	0.675	0.5348	0.5

Selection-at-age (S)

	1	2	3	4						
S-value	0.0824	0.4121	1	1.3693						
	5	6	7	8	9	10	11	12	13	14
S-value	1.1723	0.7756	0.7937	0.8216	0.7303	0.8938	0.7734	0.6394	0.5281	0.7

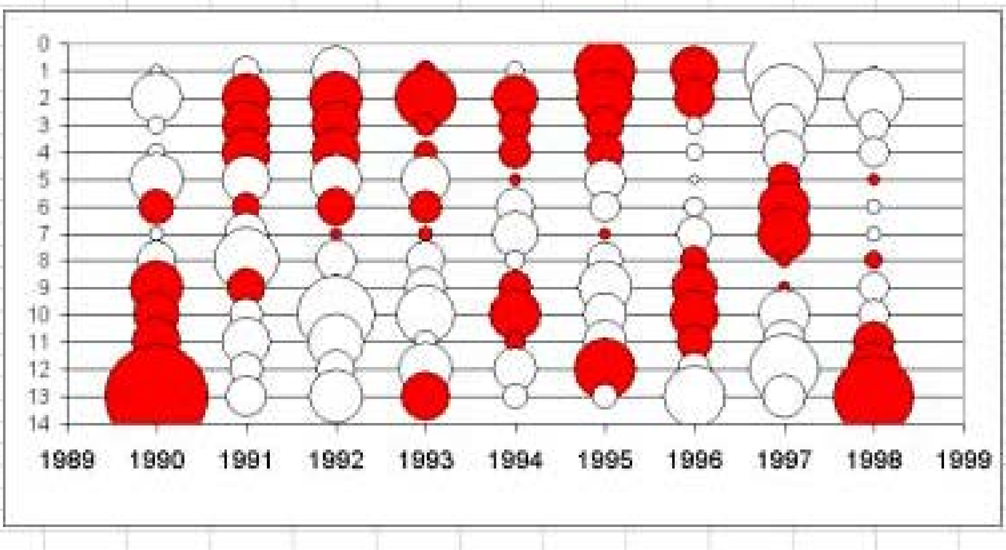


Table 11.4.2.- Plaice in Division VIId. Tuning diagnostics.

Lowestoft VPA Version 3.1
6/10/2000 15:15

Extended Survivors Analysis

Plaice in VIId (run: XSAATT04/X04)

CPUE data from file fleet

Catch data for 20 years. 1980 to 1999. Ages 1 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT01: UK INSHORE TR,	1988,	1999,	2,	9,	.000,	1.000
FLT02: BELGIAN BEAM ,	1988,	1999,	2,	9,	.000,	1.000
FLT03: FRENCH TRAWLE,	1989,	1999,	2,	9,	.000,	1.000
FLT04: UK BEAM TRAWL,	1988,	1999,	1,	6,	.500,	.750
FLT05: French GFS [o,	1988,	1999,	1,	5,	.750,	1.000
FLT06: French YFS [r,	1988,	1999,	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 converged after 30 iterations

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,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999
1,	.095,	.077,	.065,	.061,	.079,	.113,	.039,	.014,	.026,	.035
2,	.220,	.506,	.442,	.412,	.414,	.379,	.284,	.183,	.135,	.118
3,	.702,	.831,	.803,	.476,	.725,	.611,	.551,	.773,	.597,	.580
4,	.742,	.873,	.604,	.487,	.798,	.682,	.675,	1.488,	.949,	1.127
5,	.619,	.683,	.518,	.340,	.632,	.511,	.756,	1.360,	.897,	.764
6,	.575,	.584,	.624,	.350,	.424,	.303,	.494,	1.060,	.551,	.716
7,	.436,	.366,	.452,	.366,	.370,	.487,	.366,	1.114,	.473,	.671
8,	.506,	.355,	.418,	.301,	.495,	.441,	.581,	.783,	.503,	.508
9,	.651,	.520,	.606,	.346,	.465,	.391,	.597,	.831,	.420,	.414

XSA population numbers (Thousands)

	AGE								
YEAR ,	1,	2,	3,	4,	5,	6,	7,	8,	9,
1990 ,	1.89E+04,	1.40E+04,	1.82E+04,	1.20E+04,	8.20E+03,	1.93E+03,	7.22E+02,	5.37E+02,	3.91E+02,
1991 ,	2.17E+04,	1.55E+04,	1.01E+04,	8.17E+03,	5.17E+03,	4.00E+03,	9.81E+02,	4.23E+02,	2.93E+02,
1992 ,	2.79E+04,	1.82E+04,	8.47E+03,	4.00E+03,	3.09E+03,	2.36E+03,	2.02E+03,	6.16E+02,	2.68E+02,
1993 ,	1.32E+04,	2.37E+04,	1.06E+04,	3.43E+03,	1.98E+03,	1.66E+03,	1.15E+03,	1.16E+03,	3.67E+02,
1994 ,	1.73E+04,	1.13E+04,	1.42E+04,	5.95E+03,	1.91E+03,	1.27E+03,	1.06E+03,	7.19E+02,	7.77E+02,
1995 ,	2.55E+04,	1.44E+04,	6.75E+03,	6.22E+03,	2.42E+03,	9.18E+02,	7.55E+02,	6.63E+02,	3.97E+02,
1996 ,	3.07E+04,	2.06E+04,	8.94E+03,	3.31E+03,	2.85E+03,	1.32E+03,	6.14E+02,	4.20E+02,	3.86E+02,
1997 ,	4.10E+04,	2.68E+04,	1.40E+04,	4.66E+03,	1.53E+03,	1.21E+03,	7.26E+02,	3.85E+02,	2.12E+02,
1998 ,	1.88E+04,	3.66E+04,	2.02E+04,	5.86E+03,	9.53E+02,	3.55E+02,	3.79E+02,	2.16E+02,	1.59E+02,
1999 ,	2.24E+04,	1.65E+04,	2.89E+04,	1.00E+04,	2.05E+03,	3.51E+02,	1.85E+02,	2.14E+02,	1.18E+02,

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Estimated population abundance at 1st Jan 2000

, 0.00E+00, 1.96E+04, 1.33E+04, 1.46E+04, 2.94E+03, 8.65E+02, 1.55E+02, 8.56E+01, 1.16E+02,

Taper weighted geometric mean of the VPA populations:

, 2.39E+04, 2.08E+04, 1.42E+04, 6.34E+03, 2.44E+03, 1.09E+03, 5.92E+02, 3.42E+02, 1.58E+02,

Standard error of the weighted Log(VPA populations) :

, .3648, .3780, .4739, .5217, .5337, .6930, .7073, .6919, 1.1207,

Log catchability residuals.

Fleet : FLT01: UK INSHORE TR

Age	1988	1989
1	No data for this fleet at this age	
2	.17	-1.61
3	.23	-.38
4	-.12	.68
5	.26	.47
6	.11	.73
7	-.16	.49
8	-.50	-.40
9	.05	-.49

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	-.70	.51	.46	.23	.36	.29	.60	.24	-.30	-.24
3	-.35	.44	.52	-.06	-.01	.00	-.49	.21	-.37	.26
4	-.37	.46	.81	.18	.12	-.04	-.66	-.69	.09	-.46
5	.00	.02	.40	.12	.17	-.05	-.39	-.63	-.17	-.19
6	.26	.06	.37	-.01	-.12	-.21	-.39	-.25	-.12	-.44
7	.46	-.29	.38	.19	-.02	-.31	-.93	.19	.76	-.77
8	.48	-.36	.44	.30	-.22	-.10	-.23	.20	.32	.27
9	.43	-.64	-.26	.39	.39	.05	-.36	.25	.43	-.21

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	-12.1482	-11.5607	-11.6661	-11.6270	-11.6159	-11.7667	-11.7667	-11.7667
S.E(Log q)	.6325	.3406	.4925	.3187	.3357	.5134	.3543	.3851

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	1.54	-.615	13.37	.11	12	1.00	-12.15
3	1.04	-.186	11.64	.70	12	.37	-11.56
4	.86	.552	11.28	.62	12	.44	-11.67
5	.82	1.388	10.96	.86	12	.25	-11.63
6	.81	1.813	10.75	.90	12	.25	-11.62
7	.79	1.075	10.67	.72	12	.40	-11.77
8	1.01	-.046	11.81	.66	12	.38	-11.75
9	.82	.982	10.64	.74	12	.31	-11.76

Fleet : FLT02: BELGIAN BEAM

Age	1988	1989
1	No data for this fleet at this age	
2	.34	-1.75
3	-.08	-.29
4	-.57	-.20
5	-.99	.06
6	-.94	-.02
7	-.41	-.10
8	-.29	-.37
9	-.43	.03

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	.56	1.22	1.49	.71	1.16	-1.44	.01	99.99	-.77	-1.54
3	.52	.86	.59	-.09	.18	.16	-.03	-1.45	-.23	-.13
4	-.02	.05	-.34	-.53	.55	.06	.12	.46	.12	.30
5	-.38	.35	-.51	-.40	-.08	.06	.21	1.01	.27	.40
6	-.34	.42	.12	-.40	-.17	-.34	-.12	.77	.27	.75
7	-.69	-.19	-.20	-.34	-.03	.64	-.34	.75	.37	.56
8	-.22	-.23	-.04	-.56	.04	.22	.21	-.10	.16	-.29
9	-1.19	.70	.92	-1.17	.13	-.44	.04	.21	.43	.30

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	-7.6827	-5.7107	-5.0562	-5.0318	-5.3361	-5.5022	-5.5022	-5.5022
S.E(Log q)	1.1857	.5800	.3567	.5212	.5000	.4659	.2787	.6632

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	11.50	-.830	-15.19	.00	11	13.85	-7.68
3	1.39	-.851	4.20	.32	12	.82	-5.71
4	1.05	-.240	4.86	.68	12	.39	-5.06
5	1.39	-1.045	3.92	.42	12	.72	-5.03
6	1.27	-.972	4.86	.57	12	.63	-5.34
7	1.63	-1.839	4.78	.46	12	.69	-5.50
8	1.13	-.778	5.55	.77	12	.29	-5.63
9	1.82	-1.169	5.46	.17	12	1.19	-5.54

Fleet : FLT03: FRENCH TRAWLE

Age	1988	1989
1	No data for this fleet at this age	
2	99.99	.00
3	99.99	-.23
4	99.99	.06
5	99.99	.61
6	99.99	.20
7	99.99	.06
8	99.99	.40
9	99.99	1.27

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	-.15	.65	.41	.33	.31	.16	-.57	-.39	-.76	99.99
3	-.03	.13	.26	-.30	.19	-.47	-.31	.63	.13	99.99
4	.09	.39	-.34	-.53	-.41	-.47	-.49	.96	.74	99.99
5	.27	-.08	-.02	-1.19	.09	-.98	.01	.34	.95	99.99
6	.44	-.02	.44	-.45	-.24	-1.30	-.20	.96	.15	99.99
7	.32	-.29	.29	-.23	-.20	-.87	-.07	1.07	-.09	99.99
8	.40	-.30	-.45	-.69	.25	-.41	.14	1.02	.36	99.99
9	1.12	-.25	-.09	-.33	-.26	-.16	.27	.82	-.32	99.99

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-11.7244	-10.9054	-10.9669	-11.3902	-11.6899	-11.9337	-11.9337	-11.9337
S.E(Log q)	.4597	.3323	.5450	.6547	.6106	.5053	.5274	.6649

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	5.11	-2.245	19.35	.04	10	1.95	-11.72
3	.80	.872	10.61	.70	10	.27	-10.91
4	.80	.760	10.51	.64	10	.45	-10.97
5	1.03	-.085	11.50	.47	10	.72	-11.39
6	.87	.424	11.13	.59	10	.56	-11.69
7	.96	.112	11.71	.45	10	.51	-11.93
8	2.76	-1.860	21.70	.12	10	1.28	-11.86
9	1.69	-.910	15.87	.18	10	1.07	-11.73

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

```
 Fleet : FLT04: UK BEAM TRAWL
  Age  ,  1988,  1989
     1 ,   .27,  -.38
     2 ,   .59,  -.22
     3 ,   .84,   .41
     4 ,   .16,   .67
     5 ,   .77,   .03
     6 ,   .18,   .35
     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  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     1 ,  -.13,   .11,   .01,  -.01,   .17,  -.06,  -.20,  -.06,   .22,   .05
     2 ,  -.55,   .14,   .26,   .04,   .21,  -.66,  -.01,  -.21,   .15,   .27
     3 ,  -.35,   .51,   .16,  -.09,   .38,  -.07, -1.22,  -.37,  -.33,   .12
     4 ,   .04,   .28,   .59,  -.23,   .60,   .07,  -.97,  -.96,   .12,  -.38
     5 ,   .20,   .37,   .82,   .08,   .29,  -.26,  -.41,  -.88,  -.69,  -.34
     6 ,   .22,   .08,  1.05,   .11,  -.27,  -.30,  -.14,  -.80,  -.30,  -.18
     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,   -7.2035,   -7.2056,   -7.0111,   -6.7510,   -6.7791,
 S.E(Log q),     .3581,     .5392,     .5516,     .5346,     .4546,

 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,     .47,    2.850,      8.89,     .74,     12,     .19,   -7.61,

 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,     .77,     .937,      7.82,     .63,     12,     .28,   -7.20,
  3,     .70,    1.460,      7.91,     .71,     12,     .36,   -7.21,
  4,     .68,    1.617,      7.58,     .72,     12,     .35,   -7.01,
  5,     .68,    1.942,      7.12,     .78,     12,     .32,   -6.75,
  6,     .76,    1.736,      6.86,     .84,     12,     .32,   -6.78,

 Fleet : FLT05: French GFS [o

  Age  ,  1988,  1989
     1 ,  -.14,  -.30
     2 ,  1.08,   .35
     3 ,   .70,  -.11
     4 ,   .59,  -.36
     5 ,   .98, -1.16
     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  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     1 ,  -.46, -1.22,  1.15,   .79,   .15,  -.59,  -.66,   .62,   .41,   .25
     2 , -1.17, -1.44,   .02,   .26,   .19,   .37,  -.30,   .17,   .35,   .13
     3 ,   .08,  -.97,  -.59,   .29,  -.59,   .57, -1.09,  1.00,   .01,   .71
     4 ,   .34, -1.11,  -.63,   .11,  -.45,   .61,  -.38,   .39,   .20,   .70
     5 ,   .71,  -.65,  -.97,   .01,   .30,  -.04,   .01,   .47, 99.99,   .35
     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,   -8.1958,   -8.3571,   -8.6590,   -8.8275,
 S.E(Log q),     .6894,     .6910,     .5743,     .6773,
```

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

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,	.83,	.244,	8.25,	.17,	12,	.72,	-7.89,

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,	.51,	1.743,	9.03,	.56,	12,	.32,	-8.20,
3,	.63,	1.597,	8.81,	.65,	12,	.41,	-8.36,
4,	.86,	.472,	8.68,	.55,	12,	.51,	-8.66,
5,	1.55,	-.828,	9.29,	.20,	11,	1.07,	-8.83,

Fleet : FLT06: French YFS [r

Age	1988,	1989
1 ,	.85,	-1.37
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	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999
1 ,	-.12,	-.56,	1.67,	.42,	.18,	-.16,	-1.61,	-.18,	.44,	.45
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,	2.27,	-1.387,	9.68,	.11,	12,	.95,	-9.87,

-terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1998

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,	20497.,	.300,	.000,	.00,	1,	.439,	.034
FLT05: French GFS [o,	25162.,	.751,	.000,	.00,	1,	.070,	.028
FLT06: French YFS [r,	30850.,	.997,	.000,	.00,	1,	.040,	.023
P shrinkage mean ,	20751.,	.38,,,,				.287,	.033
F shrinkage mean ,	12638.,	.50,,,,				.164,	.054

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
19594.,	.20,	.12,	5,	.591,	.035

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Age 2 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
FLT01: UK INSHORE TR,	10475.,	.658,	.000,	.00,	1,	.077,	.148
FLT02: BELGIAN BEAM ,	2864.,	1.238,	.000,	.00,	1,	.022,	.460
FLT03: FRENCH TRAWLE,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: UK BEAM TRAWL,	16968.,	.234,	.023,	.10,	2,	.598,	.094
FLT05: French GFS [o,	17321.,	.519,	.141,	.27,	2,	.122,	.092
FLT06: French YFS [r,	20591.,	.990,	.000,	.00,	1,	.033,	.078
F shrinkage mean ,	5183.,	.50,,,,				.149,	.280

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
13299.,	.18,	.20,	8,	1.071,	.118

Age 3 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,	16901.,	.313,	.222,	.71,	2,	.204,	.520
FLT02: BELGIAN BEAM ,	11551.,	.543,	.241,	.44,	2,	.068,	.692
FLT03: FRENCH TRAWLE,	6854.,	.482,	.000,	.00,	1,	.077,	.986
FLT04: UK BEAM TRAWL,	15233.,	.216,	.072,	.33,	3,	.389,	.563
FLT05: French GFS [o,	25591.,	.434,	.113,	.26,	3,	.100,	.371
FLT06: French YFS [r,	12238.,	.995,	.000,	.00,	1,	.018,	.663
F shrinkage mean ,	12464.,	.50,,,,				.146,	.654

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
14633.,	.15,	.10,	13,	.654,	.580

Age 4 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,	2101.,	.280,	.149,	.53,	3,	.166,	1.367
FLT02: BELGIAN BEAM ,	3612.,	.324,	.199,	.61,	2,	.157,	.994
FLT03: FRENCH TRAWLE,	2857.,	.283,	.237,	.84,	2,	.117,	1.148
FLT04: UK BEAM TRAWL,	2271.,	.213,	.044,	.21,	4,	.233,	1.310
FLT05: French GFS [o,	3927.,	.368,	.276,	.75,	4,	.099,	.942
FLT06: French YFS [r,	586.,	1.060,	.000,	.00,	1,	.007,	2.441
F shrinkage mean ,	4049.,	.50,,,,				.221,	.923

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2944.,	.15,	.09,	17,	.637,	1.127

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

Age 5 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,	789.,	.257,	.107,	.42,	4,	.291,	.815
FLT02: BELGIAN BEAM ,	1003.,	.316,	.270,	.86,	4,	.161,	.688
FLT03: FRENCH TRAWLE,	1365.,	.276,	.341,	1.23,	3,	.077,	.546
FLT04: UK BEAM TRAWL,	728.,	.278,	.093,	.33,	5,	.172,	.860
FLT05: French GFS [o,	1135.,	.409,	.168,	.41,	5,	.092,	.628
FLT06: French YFS [r,	737.,	.987,	.000,	.00,	1,	.003,	.853
F shrinkage mean ,	760.,	.50,,,,				.204,	.835

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
865.,	.15,	.07,	23,	.486,	.764

Age 6 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,	108.,	.245,	.073,	.30,	5,	.354,	.920
FLT02: BELGIAN BEAM ,	276.,	.352,	.129,	.37,	5,	.164,	.463
FLT03: FRENCH TRAWLE,	273.,	.367,	.318,	.87,	4,	.048,	.467
FLT04: UK BEAM TRAWL,	111.,	.328,	.136,	.42,	6,	.191,	.903
FLT05: French GFS [o,	163.,	.374,	.341,	.91,	4,	.014,	.691
FLT06: French YFS [r,	186.,	.987,	.000,	.00,	1,	.001,	.628
F shrinkage mean ,	212.,	.50,,,,				.228,	.569

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
155.,	.17,	.09,	26,	.567,	.716

Age 7 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,	56.,	.248,	.142,	.57,	6,	.314,	.896
FLT02: BELGIAN BEAM ,	137.,	.313,	.096,	.31,	6,	.232,	.467
FLT03: FRENCH TRAWLE,	89.,	.393,	.147,	.37,	5,	.074,	.654
FLT04: UK BEAM TRAWL,	60.,	.324,	.131,	.40,	6,	.119,	.859
FLT05: French GFS [o,	106.,	.374,	.208,	.55,	5,	.021,	.571
FLT06: French YFS [r,	130.,	.988,	.000,	.00,	1,	.001,	.487
F shrinkage mean ,	108.,	.50,,,,				.240,	.564

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
86.,	.17,	.08,	30,	.499,	.671

Table 11.4.2.cont - Plaice in Division VIId. Tuning diagnostics.

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	146.,	.240,	.137,	.57,	7,	.314,	.425
FLT02: BELGIAN BEAM ,	105.,	.235,	.133,	.57,	7,	.381,	.549
FLT03: FRENCH TRAWLE,	127.,	.365,	.176,	.48,	6,	.084,	.475
FLT04: UK BEAM TRAWL,	72.,	.279,	.176,	.63,	6,	.045,	.724
FLT05: French GFS [o,	143.,	.387,	.211,	.55,	5,	.011,	.430
FLT06: French YFS [r,	618.,	1.138,	.000,	.00,	1,	.000,	.117
F shrinkage mean ,	102.,	.50,,,,				.165,	.563

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
116.,	.15,	.06,	33,	.438,	.508

Age 9 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,	70.,	.228,	.098,	.43,	8,	.381,	.418
FLT02: BELGIAN BEAM ,	88.,	.238,	.071,	.30,	8,	.305,	.343
FLT03: FRENCH TRAWLE,	100.,	.341,	.204,	.60,	7,	.099,	.310
FLT04: UK BEAM TRAWL,	68.,	.257,	.108,	.42,	6,	.033,	.426
FLT05: French GFS [o,	59.,	.383,	.173,	.45,	5,	.009,	.478
FLT06: French YFS [r,	40.,	1.002,	.000,	.00,	1,	.000,	.640
F shrinkage mean ,	41.,	.50,,,,				.173,	.635

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
71.,	.15,	.07,	36,	.457,	.414

Table 11.4.3.- Plaice in Division VIId. F at age.

Run title : Plaice in VIId (run: XSAATT04/X04)
At 6/10/2000 15:17

Fishing mortality (F) at age

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.0022,	.0013,	.0111,	.0049,	.0148,	.0050,	.0119,	.0008,	.0006,	.0547,
2,	.1674,	.1182,	.1348,	.1520,	.1159,	.3132,	.2125,	.1809,	.2057,	.1739,
3,	.2789,	.7292,	.4968,	.4559,	.5760,	.5970,	.6940,	.5148,	.6635,	.4527,
4,	.3371,	.8858,	.8591,	.9368,	.8245,	.8556,	.7628,	.7907,	.6647,	.7401,
5,	.6176,	.2717,	.6940,	.5518,	.7852,	.2328,	.5913,	.5691,	.5600,	.8413,
6,	.4144,	.3659,	.2812,	.3980,	.6272,	.5630,	.5014,	.3049,	.4537,	.5733,
7,	.3990,	.4875,	.3492,	.1746,	.8304,	.3519,	.4258,	.8343,	.5146,	.4121,
8,	.2537,	.7047,	1.8579,	.8844,	.2633,	.9163,	.2183,	.4396,	.5341,	.3614,
9,	.3567,	.5213,	.8335,	.4874,	.5759,	.6129,	.3830,	.5282,	.5379,	.6884,
+gp,	.3567,	.5213,	.8335,	.4874,	.5759,	.6129,	.3830,	.5282,	.5379,	.6884,
0 FBAR 2- 6,	.3631,	.4741,	.4932,	.4989,	.5857,	.5123,	.5524,	.4721,	.5095,	.5563,
FBAR 3- 6,	.4120,	.5631,	.5828,	.5856,	.7032,	.5621,	.6374,	.5449,	.5855,	.6518,

Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
1,	.0953,	.0775,	.0647,	.0606,	.0786,	.1130,	.0390,	.0142,	.0263,	.0353,	.0253,
2,	.2202,	.5056,	.4424,	.4117,	.4136,	.3795,	.2840,	.1825,	.1353,	.1184,	.1454,
3,	.7024,	.8306,	.8034,	.4765,	.7251,	.6107,	.5513,	.7730,	.5973,	.5805,	.6503,
4,	.7419,	.8730,	.6039,	.4871,	.7981,	.6823,	.6747,	1.4879,	.9494,	1.1273,	1.1882,
5,	.6194,	.6834,	.5179,	.3396,	.6316,	.5109,	.7558,	1.3599,	.8974,	.7638,	1.0071,
6,	.5747,	.5839,	.6242,	.3505,	.4239,	.3025,	.4943,	1.0601,	.5512,	.7163,	.7759,
7,	.4363,	.3660,	.4524,	.3659,	.3700,	.4872,	.3660,	1.1145,	.4734,	.6710,	.7530,
8,	.5063,	.3546,	.4178,	.3011,	.4949,	.4414,	.5813,	.7832,	.5027,	.5084,	.5981,
9,	.6508,	.5200,	.6063,	.3458,	.4653,	.3906,	.5973,	.8309,	.4204,	.4135,	.5549,
+gp,	.6508,	.5200,	.6063,	.3458,	.4653,	.3906,	.5973,	.8309,	.4204,	.4135,	
0 FBAR 2- 6,	.5717,	.6953,	.5984,	.4131,	.5985,	.4972,	.5520,	.9727,	.6261,	.6613,	
FBAR 3- 6,	.6596,	.7427,	.6374,	.4134,	.6447,	.5266,	.6190,	1.1702,	.7488,	.7970,	

Table 11.4.4.- Plaice in Division VIId. N at age.

Run title : Plaice in VIId (run: XSAATT04/X04)
At 6/10/2000 15:17

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	25556,	12854,	25237,	19966,	25055,	29784,	60397,	31337,	26499,	16312,
2,	18029,	23073,	11616,	22583,	17978,	22337,	26815,	54004,	28331,	23962,
3,	6267,	13798,	18551,	9185,	17552,	14487,	14776,	19617,	40780,	20869,
4,	1984,	4290,	6022,	10213,	5268,	8928,	7216,	6679,	10608,	19004,
5,	1118,	1281,	1601,	2308,	3622,	2090,	3434,	3045,	2741,	4938,
6,	232,	546,	884,	724,	1203,	1494,	1498,	1720,	1559,	1417,
7,	144,	139,	342,	604,	440,	581,	770,	821,	1147,	896,
8,	206,	87,	77,	218,	459,	173,	370,	455,	323,	620,
9,	14,	145,	39,	11,	82,	319,	63,	269,	265,	171,
+gp,	360,	515,	162,	274,	239,	114,	112,	196,	438,	414,
0 TOTAL,	53910,	56729,	64531,	66086,	71896,	80309,	115451,	118144,	112692,	88603,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 80-97	AMST 80-97
AGE													
1,	18871,	21747,	27936,	13239,	17273,	25501,	30749,	40984,	18773,	22433(*)	0(**)	24266,	26072,
2,	13974,	15523,	18210,	23693,	11275,	14448,	20609,	26758,	36561,	16545,	19594(***)	20363,	21846,
3,	18221,	10145,	8472,	10587,	14204,	6746,	8945,	14037,	20173,	28896,	13299,	13362,	14847,
4,	12008,	8168,	4000,	3433,	5948,	6224,	3314,	4663,	5863,	10045,	14633,	6202,	7110,
5,	8204,	5174,	3087,	1979,	1908,	2423,	2846,	1527,	953,	2053,	2944,	2600,	2963,
6,	1926,	3996,	2364,	1664,	1275,	918,	1315,	1210,	355,	351,	865,	1238,	1441,
7,	722,	981,	2016,	1146,	1061,	755,	614,	726,	379,	185,	155,	648,	773,
8,	537,	423,	616,	1161,	719,	663,	420,	385,	216,	214,	86,	360,	440,
9,	391,	293,	268,	367,	777,	397,	386,	212,	159,	118,	116,	160,	248,
+gp,	505,	323,	271,	545,	878,	836,	807,	566,	574,	343,	276,		
0 TOTAL,	75360,	66772,	67241,	57812,	55318,	58911,	70005,	91069,	84005,	81184,	51968,		

* replaced by RCT3 (24918)
** replaced by RCT3 (24072)
*** replaced by RCT3 (21433)

Table 11.5.1.- Plaice in Division VIId. RCT3 input files.

7D PLAICE - indices all * per 100

7	19	2							
'YEARCLASS'	VPA' Age 1	VPA' Age 2	'eyfs0'	'eyfs1'	'fyfs0'	'fyfs1'	'ebt1'	'fbt0'	'fbt1'
1981	25237	22583	337	45	1197	54	-11	-11	-11
1982	19966	17978	245	114	337	7	-11	-11	-11
1983	25055	22337	1447	73	547	-11	-11	-11	-11
1984	29784	26815	629	171	-11	-11	-11	-11	-11
1985	60397	54004	1090	208	-11	-11	-11	-11	-11
1986	31337	28331	2014	238	-11	175	-11	-11	-11
1987	26499	23962	2233	161	982	174	2647	-11	1033
1988	16312	13974	1298	147	250	49	231	19	408
1989	18871	15523	371	76	536	87	516	16	395
1990	21747	18210	645	64	234	77	1175	16	195
1991	27936	23693	268	145	683	235	1653	15	3361
1992	13239	11275	427	85	495	100	322	98	1168
1993	17273	14448	764	83	200	96	833	241	902
1994	25501	20609	1723	327	547	103	1132	739	542
1995	30749	26758	1204	142	642	61	1320	99	615
1996	40984	36561	248	42	640	128	3310	1733	3756
1997	-11	-11	238	42	307	122	1140	983	1067
1998	-11	-11	719	20	536	125	1130	592	1298
1999	-11	-11	646	-11	298	-11	1319	106	-11

Table 11.5.2.- Plaice in Division VIId. RCT3 output for Age 1.

```
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.

Year class =   1997

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error           Pts  Value   Value    Error   Weights

eyfs0     3.26 -11.31   2.58   .021     16   5.48    6.54    3.016     .003
eyfs1     2.66  -2.47   1.56   .056     16   3.76    7.53    1.865     .008
fyfs0     1.01   3.76    .48   .299     13   5.73    9.56     .555     .093
fyfs1     1.11   5.14    .92   .110     13   4.81   10.49    1.050     .026
ebt1       .45   6.96    .19   .785     10   7.04   10.10     .221     .588
fbt0       .45   7.99    .77   .195      9   6.89   11.11    1.012     .028
fbt1       .79   4.70    .70   .210     10   6.97   10.24     .820     .043

                                       VPA Mean =   10.13     .368     .211

Year class =   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

eyfs0     3.26 -11.31   2.58   .021     16   6.58   10.13    2.839     .004
eyfs1     2.66  -2.47   1.56   .056     16   3.04    5.63    2.126     .006
fyfs0     1.01   3.76    .48   .299     13   6.29   10.12     .539     .098
fyfs1     1.11   5.14    .92   .110     13   4.84   10.52    1.051     .026
ebt1       .45   6.96    .19   .785     10   7.03   10.09     .221     .585
fbt0       .45   7.99    .77   .195      9   6.39   10.88     .978     .030
fbt1       .79   4.70    .70   .210     10   7.17   10.39     .826     .042

                                       VPA Mean =   10.13     .368     .210

Year class =   1999

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error           Pts  Value   Value    Error   Weights

eyfs0     3.26 -11.31   2.58   .021     16   6.47    9.78    2.841     .004
eyfs1
fyfs0     1.01   3.76    .48   .299     13   5.70    9.53     .557     .100
fyfs1
ebt1       .45   6.96    .19   .785     10   7.19   10.16     .222     .631
fbt0       .45   7.99    .77   .195      9   4.67   10.11     .920     .037
fbt1

                                       VPA Mean =   10.13     .368     .229

Year     Weighted      Log     Int     Ext     Var     VPA      Log
Class    Average       WAP     Std     Std    Ratio             VPA
         Prediction           Error   Error

1997       23553     10.07     .17     .15      .77
1998       24918     10.12     .17     .15      .76
1999       24072     10.09     .18     .09      .29
```

Table 11.5.3.- Plaice in Division VIId. RCT3 output for Age 2.

```
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.

Year class =   1997

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

eyfs0     3.47 -12.86   2.75   .021     16   5.48    6.16    3.214     .003
eyfs1     3.00  -4.21   1.77   .049     16   3.76    7.06    2.110     .007
fyfs0     1.02   3.55    .47   .325     13   5.73    9.40     .549     .101
fyfs1     1.33   4.01   1.12   .085     13   4.81   10.43    1.276     .019
ebt1       .46   6.67    .19   .793     10   7.04    9.94     .226     .594
fbt0       .47   7.75    .80   .197      9   6.89   10.99    1.046     .028
fbt1       .79   4.57    .68   .233     10   6.97   10.07     .804     .047

                                       VPA Mean =    9.99     .387     .202

Year class =   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

eyfs0     3.47 -12.86   2.75   .021     16   6.58    9.99    3.026     .003
eyfs1     3.00  -4.21   1.77   .049     16   3.04    4.91    2.406     .005
fyfs0     1.02   3.55    .47   .325     13   6.29    9.97     .534     .106
fyfs1     1.33   4.01   1.12   .085     13   4.84   10.46    1.277     .018
ebt1       .46   6.67    .19   .793     10   7.03    9.94     .226     .591
fbt0       .47   7.75    .80   .197      9   6.39   10.75    1.012     .029
fbt1       .79   4.57    .68   .233     10   7.17   10.23     .810     .046

                                       VPA Mean =    9.99     .387     .201

Year class =   1999

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

eyfs0     3.47 -12.86   2.75   .021     16   6.47    9.62    3.028     .004
eyfs1
fyfs0     1.02   3.55    .47   .325     13   5.70    9.37     .551     .108
fyfs1
ebt1       .46   6.67    .19   .793     10   7.19   10.01     .227     .635
fbt0       .47   7.75    .80   .197      9   4.67    9.94     .951     .036
fbt1

                                       VPA Mean =    9.99     .387     .218

Year     Weighted       Log      Int      Ext      Var      VPA       Log
Class     Average       WAP      Std      Std     Ratio               VPA
         Prediction             Error    Error

1997       20150       9.91      .17      .15       .77
1998       21433       9.97      .17      .15       .76
1999       20601       9.93      .18      .10       .29
```

Table 11.6.1.- Plaice in Division VIId. Historical stock data.

Run title : Plaice in VIId (run: XSAATT04/X04) ,

At 6/10/2000 15:17
Table 16 Summary (without SOP correction)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 6,	FBAR 3- 6,
1980,	25556,	16512,	5585,	2650,	.4745,	.3631,	.4120,
1981,	12854,	14338,	6560,	4769,	.7269,	.4741,	.5631,
1982,	25237,	15065,	7578,	4865,	.6420,	.4932,	.5828,
1983,	19966,	15141,	8130,	5043,	.6203,	.4989,	.5856,
1984,	25055,	14140,	7464,	5161,	.6915,	.5857,	.7032,
1985,	29784,	15788,	8152,	6022,	.7388,	.5123,	.5621,
1986,	60397,	23142,	10088,	6834,	.6774,	.5524,	.6374,
1987,	31337,	31857,	13469,	8366,	.6211,	.4721,	.5449,
1988,	26499,	24462,	13178,	10420,	.7907,	.5095,	.5855,
1989,	16312,	21523,	14223,	8758,	.6158,	.5563,	.6518,
1990,	18871,	19583,	13521,	9047,	.6691,	.5717,	.6596,
1991,	21747,	14733,	10271,	7813,	.7607,	.6953,	.7427,
1992,	27936,	14415,	8092,	6337,	.7831,	.5984,	.6374,
1993,	13239,	15835,	8471,	5331,	.6293,	.4131,	.4134,
1994,	17273,	15485,	8663,	6121,	.7066,	.5985,	.6447,
1995,	25501,	12596,	8005,	5130,	.6408,	.4972,	.5266,
1996,	30749,	18581,	7597,	5393,	.7099,	.5520,	.6190,
1997,	40984,	14442,	6903,	6307,	.9137,	.9727,	1.1702,
1998,	18773,	16401,	7474,	5762,	.7710,	.6261,	.7488,
1999,	24918(*)	13650,	7807,	6326,	.8103,	.6613,	.7970,
2000,	24072(**)		9012(***)				
Arith. Mean ,	25525,	17384,	9062,	6323,	.6997,	.5602,	.6394,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

(*) rct3 estimate
(**) rct3 estimate
(***) short-term prediction (mean weight used of the last 3 years)

Table 11.7.1

11:04 Monday, October 16, 2000
Plaice in Division VIId (Eastern English Channel)

Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	24072	0.1000	0.0000	0.0000	0.0000	0.068	0.0222	0.185
2	21433	0.1000	0.1500	0.0000	0.0000	0.138	0.1276	0.247
3	13299	0.1000	0.5300	0.0000	0.0000	0.233	0.5708	0.267
4	14633	0.1000	0.9600	0.0000	0.0000	0.330	1.0430	0.340
5	2944	0.1000	1.0000	0.0000	0.0000	0.428	0.8840	0.468
6	865	0.1000	1.0000	0.0000	0.0000	0.528	0.6811	0.697
7	155	0.1000	1.0000	0.0000	0.0000	0.630	0.6610	0.803
8	86	0.1000	1.0000	0.0000	0.0000	0.733	0.5250	0.914
9	116	0.1000	1.0000	0.0000	0.0000	0.838	0.4871	0.975
10+	276	0.1000	1.0000	0.0000	0.0000	1.127	0.4871	1.427
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	24266	0.1000	0.0000	0.0000	0.0000	0.068	0.0222	0.185
2	-	0.1000	0.1500	0.0000	0.0000	0.138	0.1276	0.247
3	-	0.1000	0.5300	0.0000	0.0000	0.233	0.5708	0.267
4	-	0.1000	0.9600	0.0000	0.0000	0.330	1.0430	0.340
5	-	0.1000	1.0000	0.0000	0.0000	0.428	0.8840	0.468
6	-	0.1000	1.0000	0.0000	0.0000	0.528	0.6811	0.697
7	-	0.1000	1.0000	0.0000	0.0000	0.630	0.6610	0.803
8	-	0.1000	1.0000	0.0000	0.0000	0.733	0.5250	0.914
9	-	0.1000	1.0000	0.0000	0.0000	0.838	0.4871	0.975
10+	-	0.1000	1.0000	0.0000	0.0000	1.127	0.4871	1.427
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	24266	0.1000	0.0000	0.0000	0.0000	0.068	0.0222	0.185
2	-	0.1000	0.1500	0.0000	0.0000	0.138	0.1276	0.247
3	-	0.1000	0.5300	0.0000	0.0000	0.233	0.5708	0.267
4	-	0.1000	0.9600	0.0000	0.0000	0.330	1.0430	0.340
5	-	0.1000	1.0000	0.0000	0.0000	0.428	0.8840	0.468
6	-	0.1000	1.0000	0.0000	0.0000	0.528	0.6811	0.697
7	-	0.1000	1.0000	0.0000	0.0000	0.630	0.6610	0.803
8	-	0.1000	1.0000	0.0000	0.0000	0.733	0.5250	0.914
9	-	0.1000	1.0000	0.0000	0.0000	0.838	0.4871	0.975
10+	-	0.1000	1.0000	0.0000	0.0000	1.127	0.4871	1.427
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANATT04
Date and time: 09OCT00:09:02

Table 11.7.2

11:04 Monday, October 16, 2000
Plaice in Division VIId (Eastern English Channel)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.6613	14813	9012	6597	0.0000	0.0000	13983	7874	0	20354	13813
.	.	.	.	.	0.1000	0.0661	.	7874	794	19484	12986
.	.	.	.	.	0.2000	0.1323	.	7874	1533	18677	12222
.	.	.	.	.	0.3000	0.1984	.	7874	2222	17927	11515
.	.	.	.	.	0.4000	0.2645	.	7874	2863	17231	10859
.	.	.	.	.	0.5000	0.3307	.	7874	3462	16583	10252
.	.	.	.	.	0.6000	0.3968	.	7874	4021	15981	9688
.	.	.	.	.	0.7000	0.4629	.	7874	4544	15420	9166
.	.	.	.	.	0.8000	0.5290	.	7874	5032	14896	8680
.	.	.	.	.	0.9000	0.5952	.	7874	5490	14409	8229
.	.	.	.	.	1.0000	0.6613	.	7874	5919	13953	7810
.	.	.	.	.	1.1000	0.7274	.	7874	6321	13527	7420
.	.	.	.	.	1.2000	0.7936	.	7874	6698	13129	7057
.	.	.	.	.	1.3000	0.8597	.	7874	7053	12757	6719
.	.	.	.	.	1.4000	0.9258	.	7874	7387	12408	6403
.	.	.	.	.	1.5000	0.9920	.	7874	7701	12081	6109
.	.	.	.	.	1.6000	1.0581	.	7874	7997	11774	5835
.	.	.	.	.	1.7000	1.1242	.	7874	8276	11485	5578
.	.	.	.	.	1.8000	1.1903	.	7874	8539	11214	5339
.	.	.	.	.	1.9000	1.2565	.	7874	8788	10959	5114
.	.	.	.	.	2.0000	1.3226	.	7874	9024	10719	4905
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANATT04
Date and time : 09OCT00:09:02
Computation of ref. F: Simple mean, age 2 - 6
Basis for 2000 : F factors

Table 11.7.3

11:04 Monday, October 16, 2000
Plaice in Division VIId (Eastern English Channel)

Single option prediction: Detailed tables

Year: 2000 F-factor: 1.0000 Reference F: 0.6613

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	0.0222	503	93	24072	1629	0	0	0	0
2	0.1276	2446	604	21433	2965	3215	445	3215	445
3	0.5708	5530	1475	13299	3103	7048	1645	7048	1645
4	1.0430	9095	3089	14633	4829	14048	4636	14048	4636
5	0.8840	1656	776	2944	1261	2944	1261	2944	1261
6	0.6811	409	285	865	457	865	457	865	457
7	0.6610	72	58	155	98	155	98	155	98
8	0.5250	34	31	86	63	86	63	86	63
9	0.4871	43	42	116	97	116	97	116	97
10+	0.4871	102	145	276	311	276	311	276	311
Total		19889	6597	77879	14813	28753	9012	28753	9012
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.6613

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	0.0222	507	94	24266	1642	0	0	0	0
2	0.1276	2431	600	21303	2947	3195	442	3195	442
3	0.5708	7099	1893	17070	3983	9047	2111	9047	2111
4	1.0430	4226	1436	6800	2244	6528	2154	6528	2154
5	0.8840	2625	1229	4666	1999	4666	1999	4666	1999
6	0.6811	520	362	1101	581	1101	581	1101	581
7	0.6610	183	147	396	250	396	250	396	250
8	0.5250	28	26	72	53	72	53	72	53
9	0.4871	17	17	46	39	46	39	46	39
10+	0.4871	80	115	218	246	218	246	218	246
Total		17717	5919	75938	13983	25269	7874	25269	7874
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 1.0000 Reference F: 0.6613

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	0.0222	507	94	24266	1642	0	0	0	0
2	0.1276	2451	605	21475	2971	3221	446	3221	446
3	0.5708	7056	1881	16967	3959	8992	2098	8992	2098
4	1.0430	5425	1843	8728	2880	8379	2765	8379	2765
5	0.8840	1220	571	2168	929	2168	929	2168	929
6	0.6811	824	574	1744	922	1744	922	1744	922
7	0.6610	233	187	504	317	504	317	504	317
8	0.5250	72	66	185	136	185	136	185	136
9	0.4871	14	14	39	32	39	32	39	32
10+	0.4871	54	77	147	165	147	165	147	165
Total		17856	5913	76222	13953	25379	7810	25379	7810
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRATT01
Date and time : 09OCT00:19:14
Computation of ref. F: Simple mean, age 2 - 6
Prediction basis : F factors

Table 11.9.1

11:04 Monday, October 16, 2000
Plaice in Division VIId (Eastern English Channel)

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	0.093	0.0222	0.213
2	-	0.1000	0.1500	0.0000	0.0000	0.173	0.1276	0.267
3	-	0.1000	0.5300	0.0000	0.0000	0.262	0.5708	0.305
4	-	0.1000	0.9600	0.0000	0.0000	0.354	1.0430	0.383
5	-	0.1000	1.0000	0.0000	0.0000	0.450	0.8840	0.485
6	-	0.1000	1.0000	0.0000	0.0000	0.549	0.6811	0.637
7	-	0.1000	1.0000	0.0000	0.0000	0.652	0.6610	0.754
8	-	0.1000	1.0000	0.0000	0.0000	0.757	0.5250	0.911
9	-	0.1000	1.0000	0.0000	0.0000	0.867	0.4871	1.033
10+	-	0.1000	1.0000	0.0000	0.0000	1.149	0.4871	1.357
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDATT05
Date and time: 09OCT00:10:38

Table 11.9.2

11:04 Monday, October 16, 2000
Plaice in Division VIId (Eastern English Channel)

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	7391.598	8.325	7054.700	8.325	7054.700
0.1000	0.0661	0.329	237.590	7.223	4018.826	5.049	3684.450	5.049	3684.450
0.2000	0.1323	0.483	299.665	5.687	2561.347	3.523	2229.420	3.523	2229.420
0.3000	0.1984	0.569	311.222	4.831	1815.817	2.675	1486.268	2.675	1486.268
0.4000	0.2645	0.623	307.139	4.299	1392.769	2.152	1065.533	2.152	1065.533
0.5000	0.3307	0.659	298.818	3.943	1134.114	1.805	809.128	1.805	809.128
0.6000	0.3968	0.685	290.154	3.691	966.335	1.561	643.539	1.561	643.539
0.7000	0.4629	0.704	282.389	3.503	851.953	1.381	531.290	1.381	531.290
0.8000	0.5290	0.719	275.800	3.358	770.529	1.244	451.945	1.244	451.945
0.9000	0.5952	0.731	270.323	3.242	710.314	1.137	393.759	1.137	393.759
1.0000	0.6613	0.741	265.798	3.148	664.256	1.050	349.680	1.050	349.680
1.1000	0.7274	0.749	262.049	3.069	627.960	0.979	315.317	0.979	315.317
1.2000	0.7936	0.756	258.926	3.001	598.602	0.919	287.846	0.919	287.846
1.3000	0.8597	0.762	256.301	2.943	574.306	0.867	265.396	0.867	265.396
1.4000	0.9258	0.768	254.075	2.891	553.799	0.823	246.694	0.823	246.694
1.5000	0.9920	0.773	252.169	2.845	536.191	0.784	230.853	0.784	230.853
1.6000	1.0581	0.777	250.522	2.804	520.849	0.750	217.239	0.750	217.239
1.7000	1.1242	0.781	249.085	2.767	507.310	0.719	205.393	0.719	205.393
1.8000	1.1903	0.785	247.821	2.732	495.231	0.691	194.973	0.691	194.973
1.9000	1.2565	0.788	246.702	2.701	484.351	0.666	185.720	0.666	185.720
2.0000	1.3226	0.791	245.702	2.671	474.472	0.643	177.436	0.643	177.436
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDATT05
Date and time : 09OCT00:10:38
Computation of ref. F: Simple mean, age 2 - 6
F-0.1 factor : 0.1699
F-max factor : 0.3055
F-0.1 reference F : 0.1123
F-max reference F : 0.2020
Recruitment : Single recruit

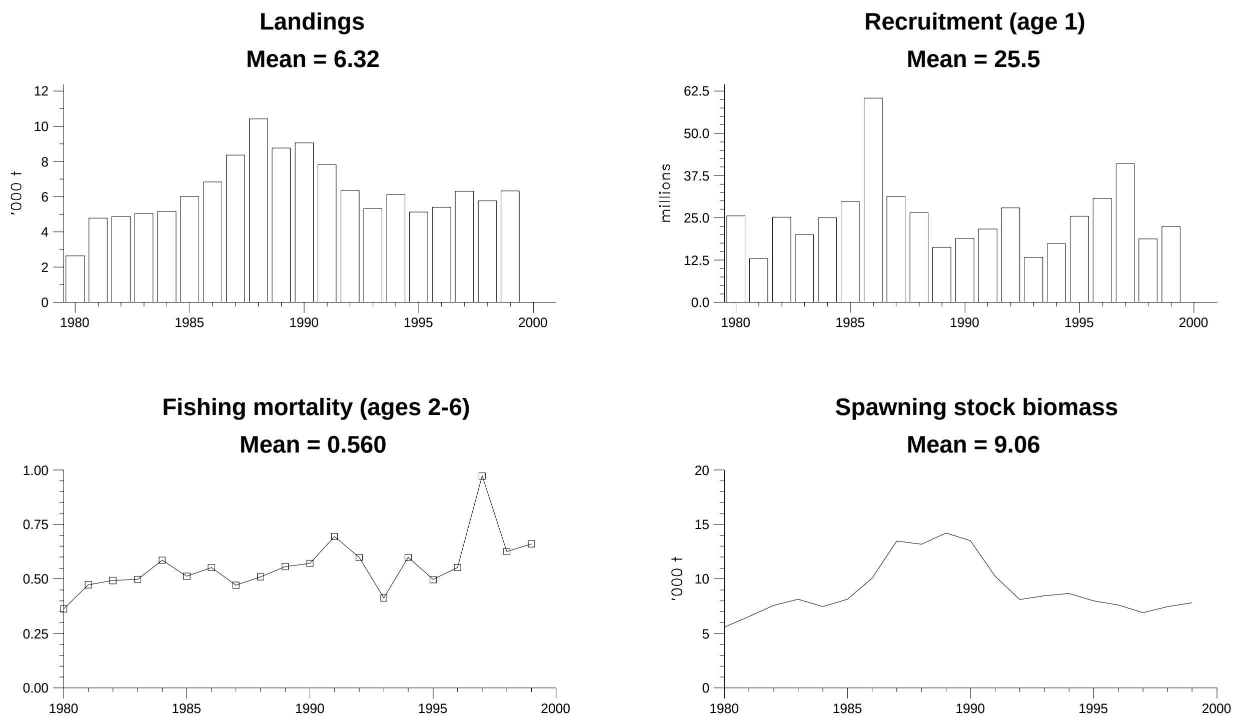
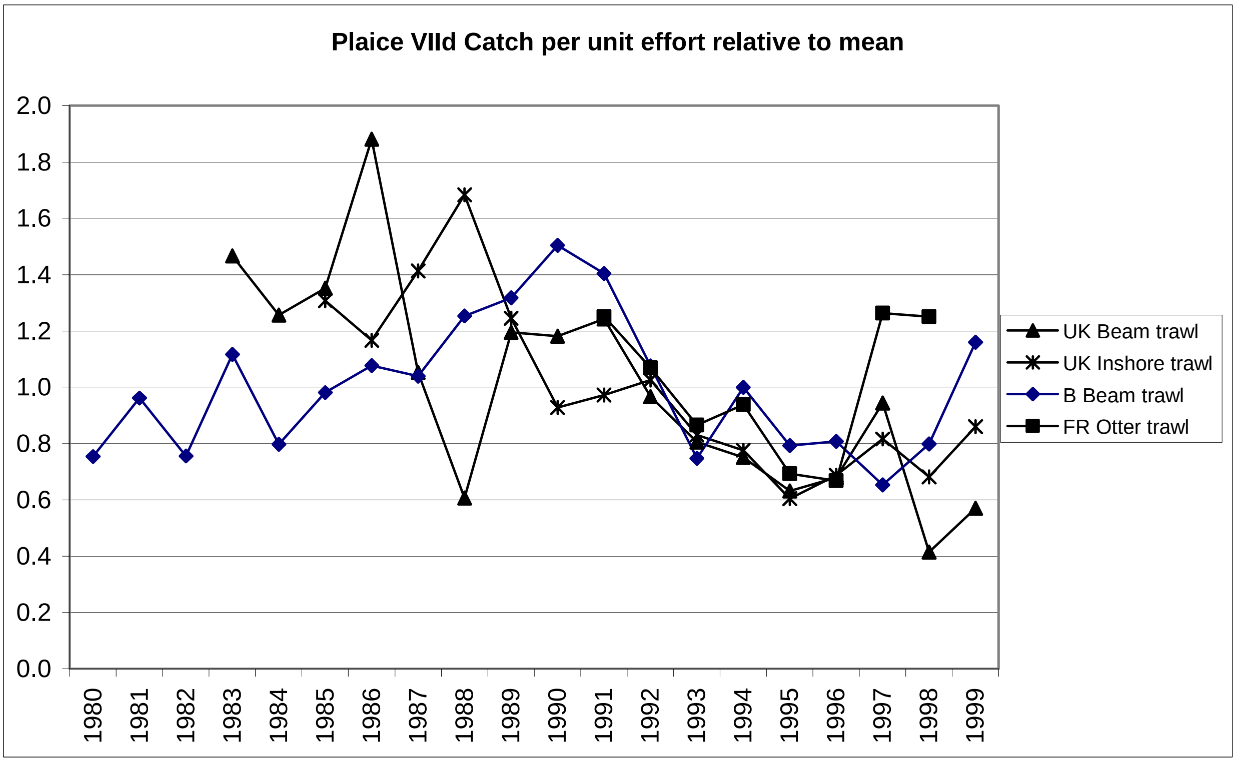


Figure 11.1.1 Plaice inDivision VIId (Eastern English Channel)



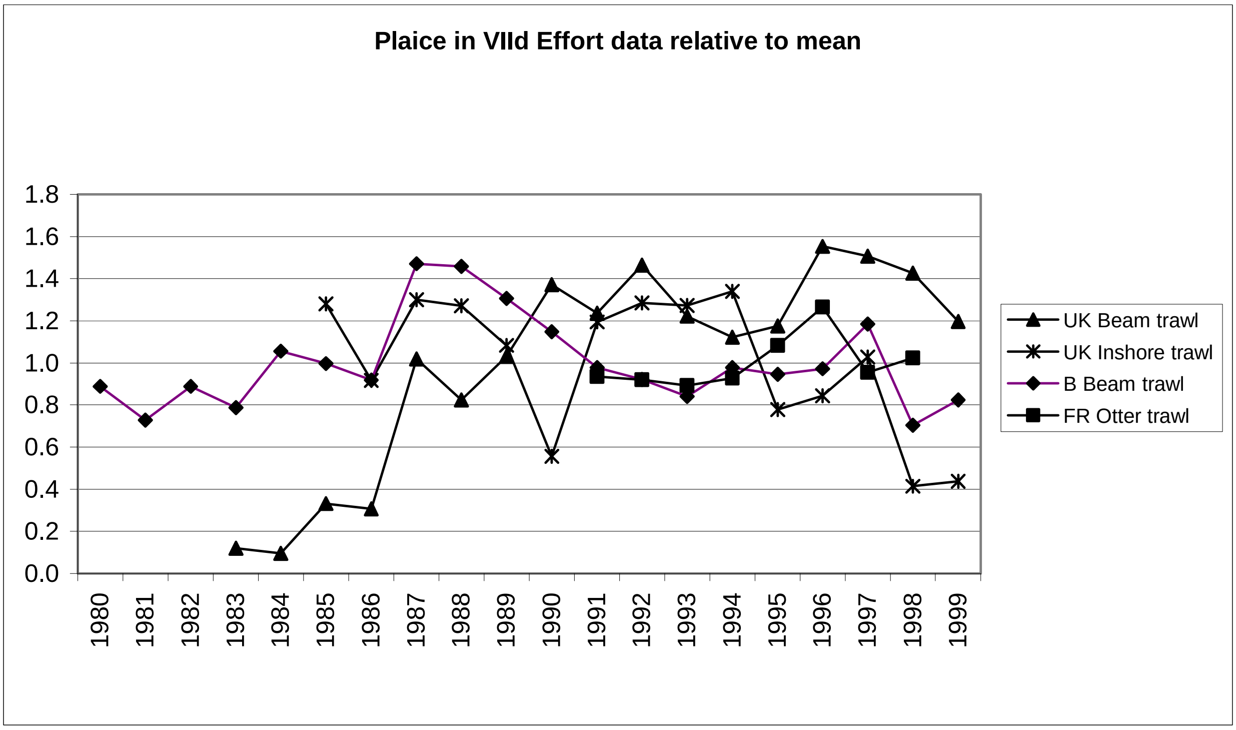


Figure 11.3.1.- Plaice in Division VIId. Cpue and effort.

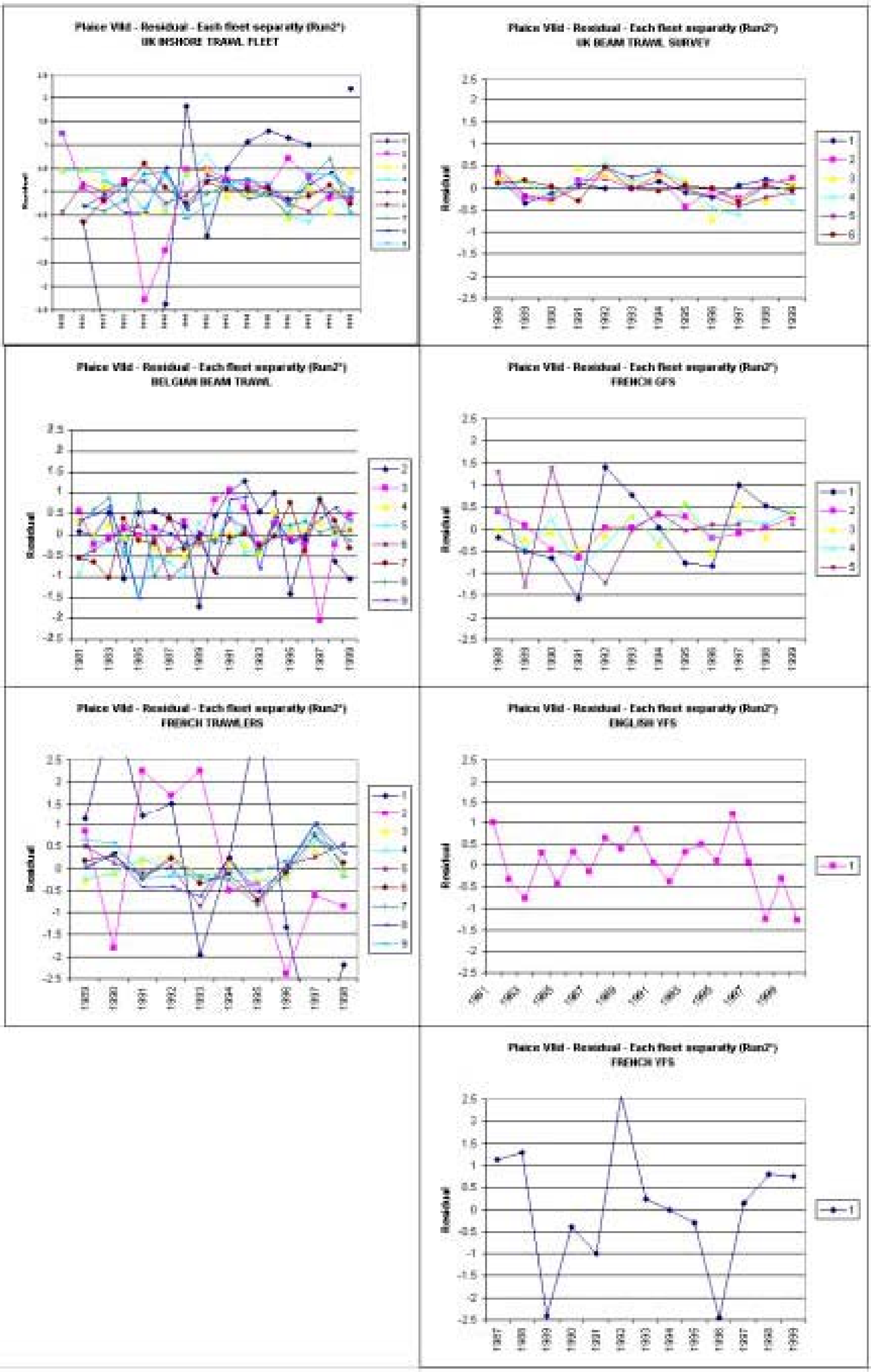
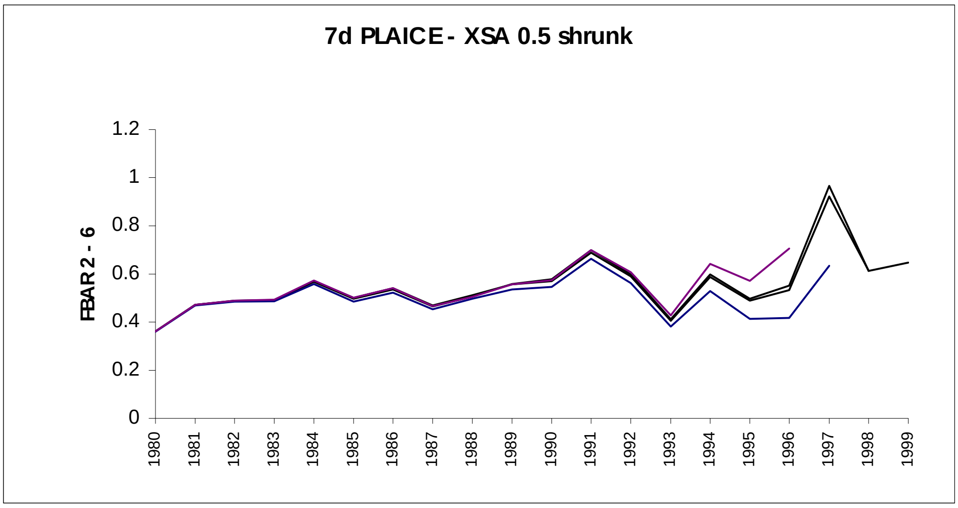
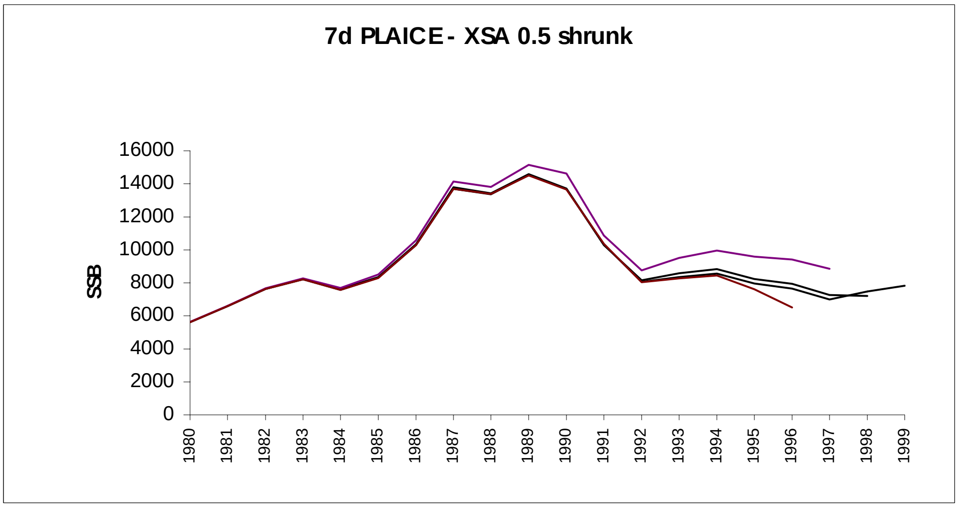


Figure 11.4.1.- Plaice in Division VIId. Log q residual per fleet and age (XSA, exploratory Run, each fleet weighted separatly to 1.

Figure 11.4.2.- Plaice in Division VIId. Log q residual per fleet and age (XSA, final Run, fleet together)





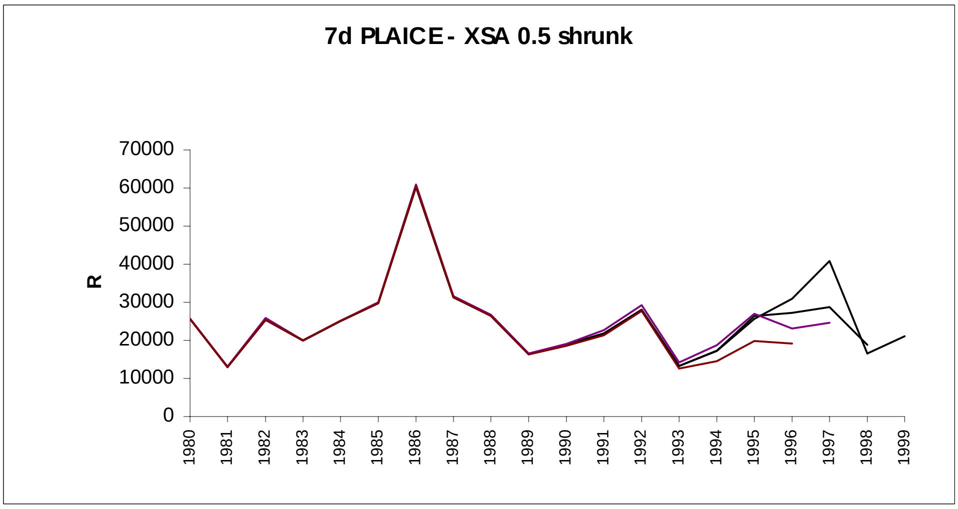


Figure 11.4.3.- Plaice in Division VIId. Retrospective analysis with final run (windows 8 years)

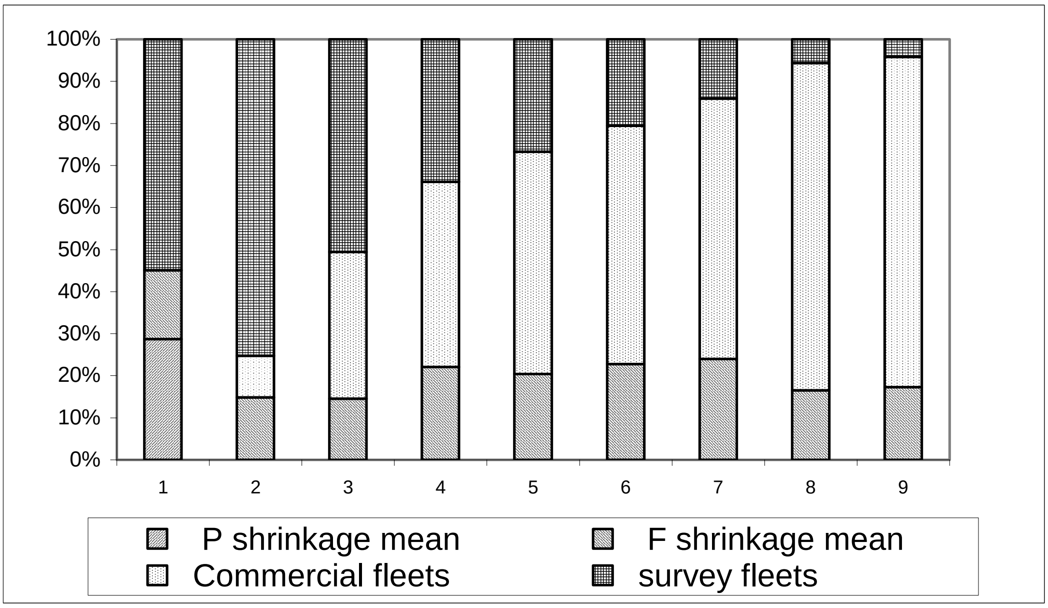


Figure 11.4.4.- Plaice in Division VIId. Weights of tuning categories in final assessment.

Yield and Spawning Stock Biomass

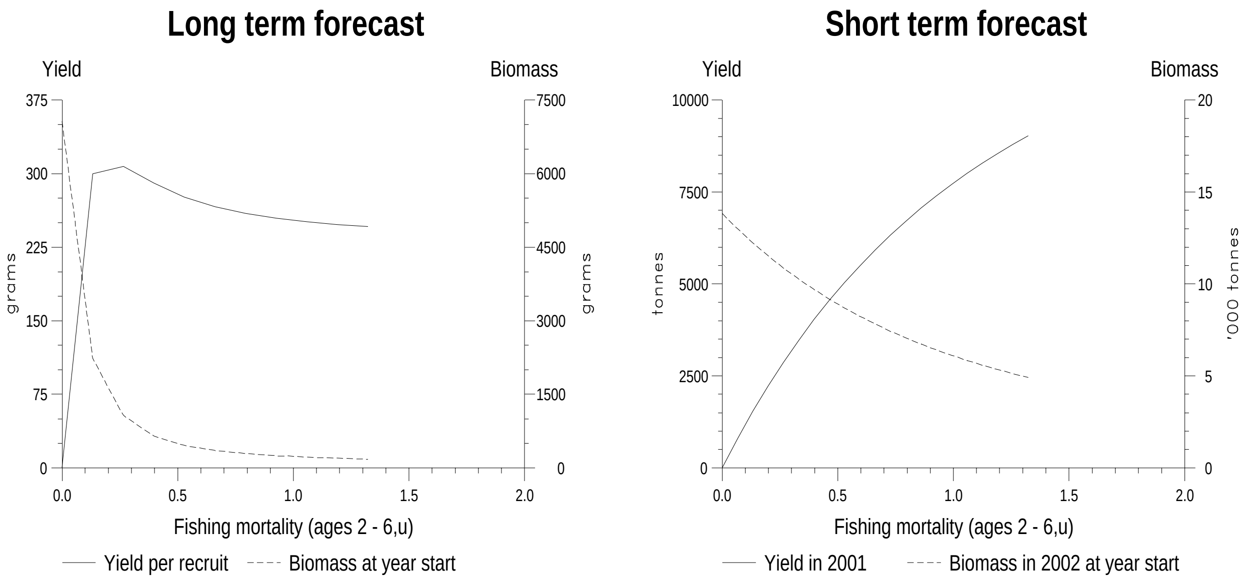


Figure 11.7.1 Fish Stock Summary. Plaice in Division VIId (Eastern English Channel)

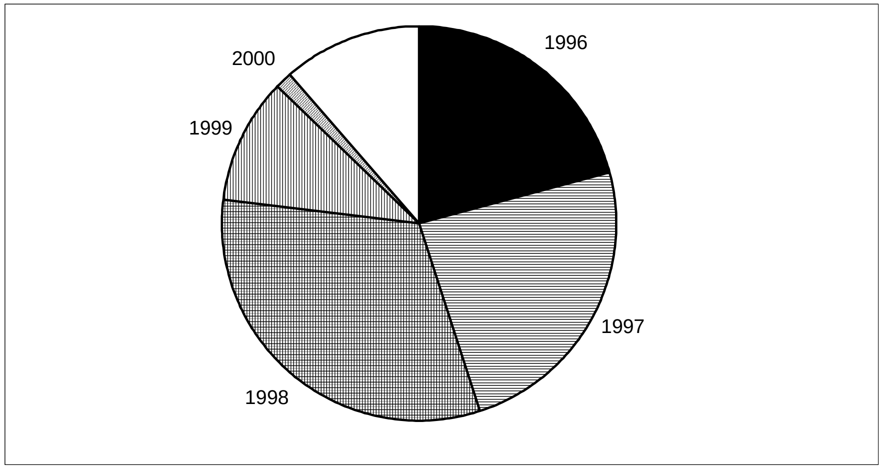
Figure 11.7.2 **Plaice in VIId**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1996	1997	1998	1999	2000
Stock No. (thousands) of 1 year-olds			40984	18773	24918	24072	24266
Source			VPA	VPA	RCT3	RCT3	GM
Status Quo F:							
% in	2000	landings	46.8	22.4	9.2	1.4	-
% in	2001		20.8	24.3	32.0	10.1	1.6
% in	2000	SSB	51.4	18.3	4.9	0.0	-
% in	2001	SSB	25.4	27.4	26.8	5.6	0.0
% in	2002	SSB	11.8	11.9	35.4	26.9	5.7

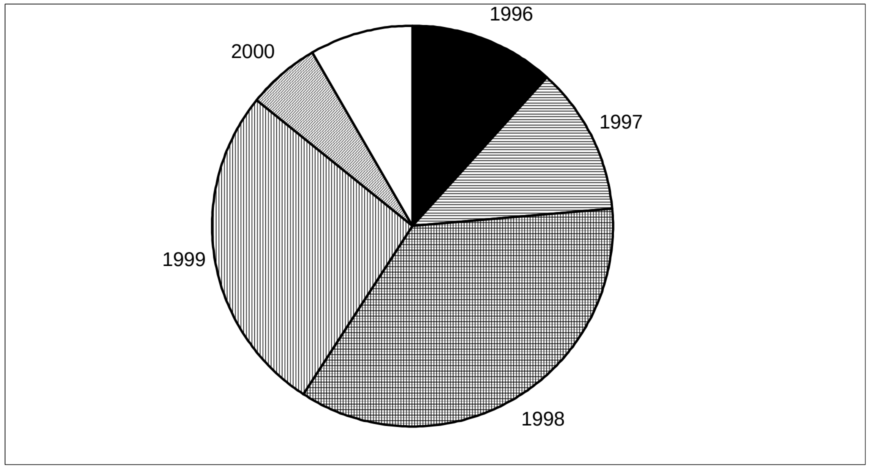
GM : geometric mean recruitment

Plaice in VIId : Year-class % contribution to

a) 2001 landings



b) 2002 SSB



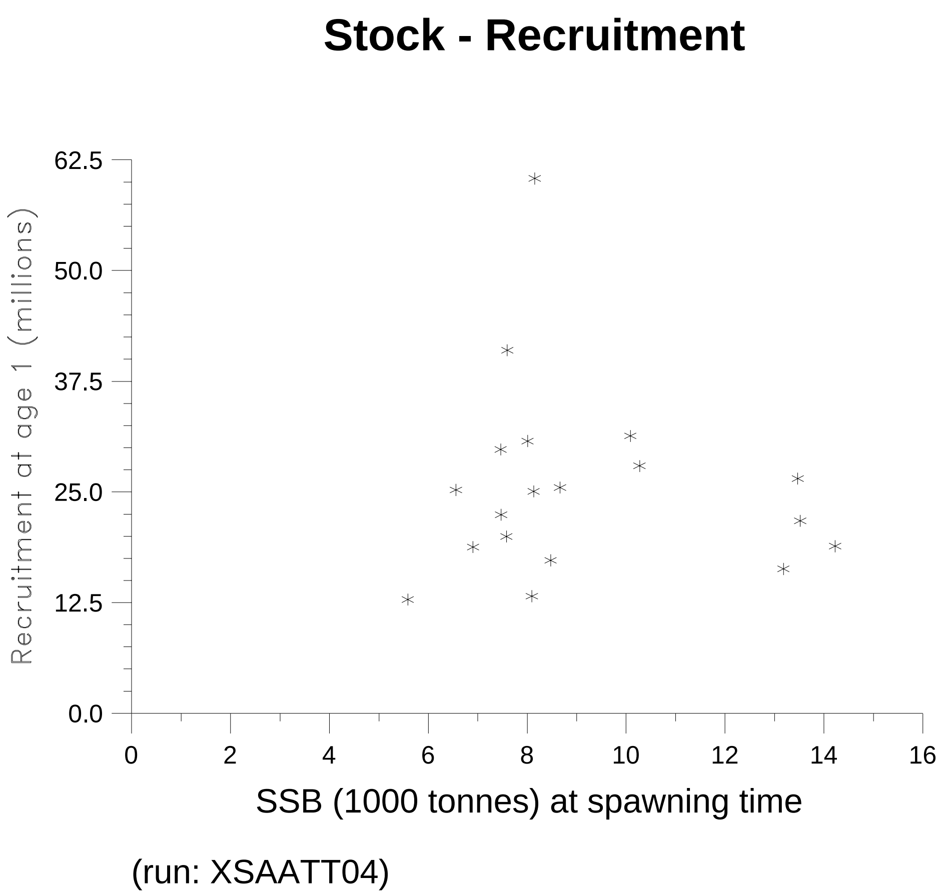


Figure 11.9.1 Plaice in Division VIId (Eastern EnglishChannel)

12 NORWAY POUT IN ICES SUB-AREA IV AND DIVISION IIIA

12.1 The Fishery

12.1.1 ICES advice applicable to 2000

There is no management objective set for this stock. With present fishing mortality levels the status of the stock is more determined by natural processes and less by the fishery. The ACFM advice for 2000 was that the stock was considered to be within safe biological limits and the stock could 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 and TSB rapidly due to the short life span of the species. Fishing mortality has generally been lower than the natural mortality and has generally 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 maintained.

12.1.2 Management applicable to 1999 and 2000

In 1997-2000 the TAC 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 Fleet developments

The fishing effort and number of vessels per vessel size category of the commercial trawlers participating in the Danish Norway pout fishery (Danish commercial tuning fleet) for the years 1996-2000 are shown in Table 12.3.1. The number of small vessels in the fleet is reduced in the latest years.

12.1.4 Landings in 1999 and 2000

Annual landings as provided by Working Group members are shown in Table 12.1.1 and trends in yield are shown in Figure 12.6.1.The total yearly landings in 1998-99 were between 80-100,000 t. The decrease in landings in 1998-99 is probably caused by the historically weak 1997 and 1998 year classes compared to the very strong 1996 year class (and 1999 year class). Highest catches in 1999 were taken in July to November, Table 12.1.2. The Danish landings by quarter compared to total yearly landings for each year in the period 1997-99 show that landings from Fladen Ground were relatively low in 3rd and 4th quarters in 1998 compared to the spatial distribution of landings from the other years, Figure 12.1.1. There are reports from Danish fishermen of increased Danish Norway pout fishery in the autumn 2000 in the North Sea (compared to 1998-99), mainly directed towards the relatively strong 1999 year class.

12.2 Natural Mortality, Maturity, Age Composition, and Mean Weight-at-age

Age compositions were available from Norway and Denmark. Catch-at-age is shown in 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. Norwegian input data of catch number and mean weight-at-age have been revised for 1998 and 1999 which has no significant effect on the assessment output. 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, proportion mature and natural mortality are used for all years, Table 12.2.3. Mean weight in catch is not used as an estimator of weight in the stock, partly because the smallest 0-group fish are not fully recruited to the fishery in 3rd quarter of the year. 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. Research projects are ongoing to revise the input data for natural mortality, maturity probability and mean weight by age, season and year. This is described in section 1.6, WD 11 and WD 12, of this Working Group.

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. Background descriptions of the commercial fishery tuning series used and the method of effort standardisation of the commercial fishery between different vessel size categories and national commercial fleets are given in section 1.3 of this report. 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). Furthermore, in the present assessment Norwegian average GRT and Effort data for 1998-99 were corrected because data from ICES Area IIa were included for these years in the 1998-99 assessments. Table 12.3.1 gives CPUE data by vessel size category and year for the Danish commercial fishery in Area IVa for fishing trips where the total catch included at least

70 % Norway pout and blue whiting per trip. Parameter estimates from yearly regression analyses on CPUE versus GRT for the different Danish vessel size categories used in the effort standardisation of the commercial fishery are shown in Table 12.3.2. Input data for average GRT and effort for the Norwegian commercial fleet to be effort standardised is given in Table 12.3.3. The resulting combined and standardised Danish and Norwegian effort for the commercial fishery used in the assessment is presented in Table 12.3.4, and combined CPUE indices by age and quarter for the commercial tuning fleet are shown in Table 12.3.7. Research vessel data: Survey indices series of abundance of Norway pout were available from the IBTS and the EGFS and SGFS, Table 12.3.5. Furthermore, research vessel indices from the 3rd quarter IBTS is given, Table 12.3.6, in order to follow abundance indices by age, especially the spawning stock indices, i.e. the 2+-group, in 1998-2000.

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 were the same this year as in the last year's assessment. In the SXSA the catchability, r, per age and quarter and fleet was assumed to be constant within the period 1983-2000 where the estimated catchability, rhat, is a geometric mean over years by age, quarter and tuning fleet. Tuning was performed over the period 1983 to 2000 producing log residual (log(Nhat/N)) stock numbers and survivor estimates by year, quarter, age and tuning fleet. The contributions from the various age groups to the survivor estimates by year and quarter and fleet were in the SXSA combined to an overall survivors estimate, shat, estimated as the geometric mean over years of log(shat) weighted by the exponential of the inverse cumulated fishing mortality as described in Skagen (1993). The three surveys and the commercial fleet were all used in the tuning, Table 12.4.1. The 3rd quarter IBTS was not used in tuning as it is not a independent tuning fleet like the SGFS and EGFS tuning fleets.

Table 12.4.1 contains the options used as well as the estimated stock numbers, fishing mortalities and additional output from the SXSA. The log residual stock numbers by year for each tuning fleet are plotted in Figure 12.4.1. Estimated weighting factors for computing survivors of the different tuning fleets as well as the SSQ residuals by season for the commercial fishery and the SSQ residuals by seasonal survey are shown in Figure 12.4.2. A summary of the SXSA results are shown in Table 12.6.1 and in Figures 12.6.1-12.6.3. Total stock biomass is given for 3rd quarter of the year because this is the biomass including 0-groups available for the commercial fishery.

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 (Figure 12.4.1). There are no apparent trends in the residuals with time. Figure 12.4.2 indicates large inter-annual variations with a large sum of squared residuals for commercial fishery in some years for 3rd and 4th quarter. For the surveys especially the EGFS shows large variations in SSQ, while the values for SGFS and 1Q IBTS are lower and more stable.

The weights in the tuning process in the final run 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 12.4.2. 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 was given to the IBTS and SGFS surveys as the weight given to the commercial fishery. Relatively high weight is given to SGFS age 3.

Retrospective analyses has been done for SSB, recruitment and fishing mortality, Figure 12.4.3. The method used was running the SXSA by sequential exclusion of the more recent assessment year. The analyses revealed a general tendency to overestimate SSB and recruitment values and underestimate fishing mortality in the last year. In nearly all cases the estimates converged rapidly. Especially the SXSA seems to estimate recruitment well.

By comparison of CPUE from the used tuning fleets as well as with the IBTS 3Q it appears that the CPUE in the commercial fishery has generally decreased in 1998-99 compared to the period 1994-97 (Tables 12.3.1 and 12.3.7), which is partly inconsistent with trends in CPUE from IBTS (1Q, 3Q), EGFS and SGFS surveys within the same period (Tables 12.3.5 and 12.3.6). Here it should be noted that most weight has been put on the commercial fishery and the EGFS in the assessment.

12.5 Recruitment Estimates

The long-term average recruitment is 135 billions (arithmetric mean) and 115 billions (geometric mean) for the period 1974-99 and 104 billions (arithmetric) for 1983-99.

Recruitment estimates are available from the EGFS and SGFS surveys carried out in August (Table 12.3.5) as well as the 3rd quarter IBTS (Table 12.3.6). As the current SXSA also includes catch-at-age data for the 1st and 2nd quarter of

2000 (Table 12.4.1), the EGFS and SGFS have been included in the VPA based on the assumption that survey-indices in August are representative for the stock situation on 1 July (after end of 2nd quarter). The SGFS recruitment indices from 1998-2000 should be used with caution as a new survey design (new vessel from 1998 and new gear and extended survey area from 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. This new time series seems to estimate 0-groups better than the EGFS alone and it gives a longer time series than the (new) SGFS alone, however, it is not independent of EGFS and SGFS (see 12.4) and has not this year been included in the assessment.

The retrospective analyses, Figure 12.4.3 indicate that the assessment with the above described input data estimate recruitment well. The SXSA show that recruitment in 1997-98 was well below the long-term averages while the 1996 and 1999 year classes were well above average. Recruitment data has not been used for (other) separate forecasts.

12.6 Historical Stock Trends

Historical trends in stock biomass (SSB, TSB), landings, recruitment, and fishing mortality of Norway pout for the period 1974–99 are presented in Table 12.6.1 and Figures 12.6.1-12.6.3.

Trends in annual landings are also shown in Table 12.1.1 for the period 1960-99. The total yearly landings in 1998-99 between 80-100,000 t is a decrease in yield from the 1989-1997-level between 150,000 and 300,000 t. 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 170,000 t in the period 1985-97. The seasonal distribution of the landings by country, Table 12.1.2, show that catches in all years are highest in July-November.

In the mid-1970'ies the fishing mortality for ages 1-2 was well above 1.0, and average fishing mortality was at a level of around 1.0 in the early 1980's up to 1986, but then declined to a level of approximately 0.7 until 1994 and then again to a level around 0.4 in 1995 to 1997. In 1998 the fishing mortality was historically low at approximately 0.25, but in 1999 it has increased to the level of 0.6. Also total effort was lower in 1998 than in 1997 and 1999 (Table 12.3.4).

Historically spawning stock biomass decreased in the mid-1980s after having reached peaks at above 350,000 t in 1983-84, but has since slowly increased again with a smaller drop in 1994 and 1995 to peak again at above 350 000 t in 1996. SSB in 1999-2000 is between 100-200 000 t; however, because of the strong 1999 year class TSB is in 2000 on the same high level as in 1994-1997.

12.7 Short-Term Forecasts

No forecast is given for this stock. Deterministic catch forecasts are uncertain for the youngest age groups. This is due to the few year classes contributing to the catch, the large dependence of the forecast on the strength of the recruiting 0-group year class which to some extent is uncertain, and the added uncertainty in the forecast arising from variations in natural mortality. The assessment indicates weak 1997 and 1998 year classes and a strong 1999 year class. Survey indices do not indicate a strong 2000 year class compared to the 1999 year class. The assessment indicates a low SSB in 1999; however, because of the strong 1999 year class the present TSB is high. Consequently, the relatively high spawning stock biomass level in recent years (except for 1999) will probably be maintained in 2001 because of the strong 1999 year class.

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

Figures 12.9.1 and 12.9.2 show recruitment-SSB-plots and pa-plots for Norway pout in the North Sea and Skagerrak.

B_{lim} = 90,000 t
B_{pa}= 150,000 t
F_{low} =0.23
F_{med} =0.65
F_{high} =1.22

In 1997-99 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. These points are advised to be maintained for year 2000 and 2001. An F-based reference point has been estimated based on a 50 %-quantile plot of SSB/R using mean weights and fishing mortalities from the period 1974-1999. This Fmed=0.65 represents the exploitation level where the stock has a 50 % chance of replacing itself (Figure 12.9.1). This is a little above the F-level in 1999 around 0.6. The F reference point is independent of the deterministic estimated Bpa. No F_{max} could be estimated based on a Y/R-plot shown in previous years assessments (ICES CM 1998/Assess:7).

It may be more appropriate to formulate reference points based on biomass (TSB or SSB) or of total mortality for use within management procedures using surveys and real time monitoring of catches. The stock size and catch possibilities are largely dependent on the size of a few year classes. Catch predictions for 0- and 1-groups are important as the fishery target the 0-group already in 3rd and 4th quarter of the year as well as the 1-group in the 1st quarter of the following year. The 0-group is most probably fully recruited to the 4th quarter commercial fishery which tends to predict strong year classes well. Survey indices in the 3rd quarter seems to predict strong 0-group year classes relatively well, however, the 0-group is probably not fully recruited in the 3rd quarter surveys, and it can not be predicted with the precision required for traditional catch prediction for traditional TAC-based management from this survey alone. Investigations on population dynamics (natural mortality, distribution, spawning, and maturity) of Norway pout in the North Sea are ongoing to contribute with knowledge to explore whether management procedures using surveys and “real time” monitoring of the fishery are more appropriate (section 1.6, WD 11 and WD 12 this report).

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 better than annual assessment for Norway pout.

It should be noted that there seems to be two levels of the stock-recruitment-relationship for the stock, Figure 12.9.1, a level well above and well below recruitment around 125 billion. There are no periodical and historical trends to explain these two levels. 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 Skagerrak, by country, for 1959–1999. (Data provided by Working Group members). (Norwegian landing data include landings of by-catch of other species).

Year	Denmark		Faroes	Norway	Sweden	UK (Scotland)	Others	Total
	North Sea	Skagerrak						
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	94.2	29.3	7.0	39.1	+	+	0.1	169.7
1998	39.8	13.2	4.7	22,1	-	-	+	79.8
1999	41.0	7.5	-	44.2	+	-	-	92.7

Table 12.1.2 Norway pout, North Sea and Skagerrak. National landings (t) by month 1995-2000.

Month	Denmark	Norway	Total	Denmark	Norway	Total	Denmark	Norway	Total
		1995			**1996**			**1997**	
Jan	6,501	1,195	7,696	3,410	458	3,868	6,490	1,151	7,641
Feb	6,501	8,966	15,467	3,402	3,304	6,706	3,344	1,513	4,857
Mar	8,345	5,360	13,705	4,362	6,842	11,204	1,303	1,519	2,822
Apr	3,448	2,646	6,094	6,724	1,802	8,526	6	2,137	2,143
May	6,695	5,326	12,021	2,458	1,351	3,809	3,319	3,391	6,710
Jun	7,191	2,667	9,858	1,087	1,128	2,215	2,516	2,938	5,454
Jul	19,833	1,671	21,504	3,170	6,739	9,909	11,425	10,351	21,776
Aug	11,620	471	12,091	14,846	9,053	23,899	19,890	8091	27,981
Sep	32,529	3,648	36,177	28,348	11,674	40,022	25,934	3,104	29,038
Oct	39,772	6,837	46,609	17,269	3,028	20,297	31,713	2,056	33,769
Nov	31,378	2,578	33,956	15,837	1,361	17,198	10,901	1,210	12,111
Dec	14,675	1,716	16,391	7,102	1,077	8,179	6,614	1,618	8,232
Total	188,488	43,081	231,569	108,015	47,817	155,832	123,455	39,079	162,534

Month	Denmark	Norway	Total	Denmark	Norway	Total	Denmark	Norway	Total
		1998			**1999**			**2000**	
Jan	4,702	1,040	5,742	566	307	873	2,205	864	3,069
Feb	2,696	3,470	6,166	1,124	1,089	2,213	1,281	1,735	3,016
Mar	3,121	4,403	7,524	2,330	1,625	3,955	1,278	2,841	4,119
Apr	2,894	2,086	4,980	1,615	2,639	4,254	564	911	1,475
May	322	2,985	3,307	678	1,674	2,352	381	2,992	3,373
Jun	924	2,814	3,738	1,007	6,008	7,015	917	5,805	6,722
Jul	3,804	2,143	5,947	5,992	11,225	17,217			
Aug	7,984	875	8,859	6,074	7,035	13,109			
Sep	5,520	541	6,061	4,821	6,189	11,010			
Oct	6,410	1,322	7,732	11,927	3,413	15,340			
Nov	10,442	171	10,613	8,944	2,446	11,390			
Dec	4,188	285	4,473	2,713	526	3,239			
Total	53,007	22,135	75,142	47,791	44,176	91,967	6,626	15,148	21,774

(Data provided by Working Group members).

Table 12.2.1 NORWAY POUT in the North Sea and Skagerrak. Catch in numbers at age by quarter (millions). + represents less than half a million. SOP is given in tons. 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	64224	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	261	210	411	531
2		772	201	1,002	333	325	131	372	207	690	310	332	215
3		14	38	37	0	79	119	105	35	47	18	2	13
4+		0	0	0	0	0	0	0	0	8	24	0	0
SOP		21888	13366	74631	46194	15320	8708	78809	54100	19562	12026	20866	22830
Age	Year	1999				2000							
0		0	0	41	1127	0	0						
1		202	318	1298	576	653	279						
2		128	220	338	160	185	208						
3		73	93	35	23	3	48						
4+		0	0	0	0	0	0						
SOP		7833	12535	41445	30497	10207	11590						

Table 12.2.2 Norway pout in North Sea and Skagerrak. Mean weights (grams) at age in catch, by quarter, 1983-2000, 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	22.16	34.84	42.40
1989	2	.00	13.49	28.70	44.39	.00	1998	2	.00	12.55	25.27	32.18	40.00
1989	3	7.48	26.58	35.44	.00	.00	1998	3	4.82	23.82	31.73	44.92	.00
1989	4	6.69	26.76	34.70	46.50	.00	1998	4	8.32	24.33	30.93	33.24	.00
1990	1	.00	6.51	25.47	37.72	68.00	1999	1	.00	8.98	25.84	36.66	46.57
1990	2	.00	13.75	25.30	40.35	0.00	1999	2	.00	12.40	24.15	35.24	46.57
1990	3	6.40	20.29	32.92	39.40	0.00	1999	3	2.84	22.16	32.66	43.98	.00
1990	4	6.67	28.70	38.90	52.94	0.00	1999	4	7.56	25.60	37.74	51.63	.00
1991	1	.00	7.85	20.54	35.43	44.30	2000	1	.00	10.05	19.21	32.10	.00
1991	2	.00	12.95	28.75	49.87	.00	2000	2	.00	15.68	25.13	41.30	.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. Mean weight-at-age in the stock, proportion mature and natural mortality.

Age	Weight (g)				Proportion mature	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 Danish CPUE data (tonnes/day fishing) and fishing activities by vessel category for 1985-99. (Commercial fleet used for tuning).

Vessel GRT	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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	12.43
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	26.69
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	23.98
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	31.00

Vessel	**1996**		**1997**		**1998**		**1999**		**2000**	
GRT	**No. fishing days**	**No. vessels participating**	**No. fishing days**	**No. vessels participating**	**No. fishing days**	**No. vessels participating**	**No. fishing days**	**No. vessels participating**	**No. fishing days**	**No. vessels participating**
51-100	0	0	2	1	0	0	0	0	0	0
101-150	88	4	48	3	0	0	0	0	0	0
151-200	136	3	143	4	71	5	7	2	0	0
201-250	256	9	220	8	86	5	89	6	18	2
251-300	556	11	488	13	215	10	294	10	118	4
301-	620	26	1481	30	910	28	873	32	187	17

Table 12.3.2 Danish CPUE-data. Parameter estimates from regressions of ln(CPUE) versus ln(Aver. GRT) by year together with estimates of standardized CPUE to the group of Danish 175 GRT industrial trawlers.

Regression models: $CPUE=b*GRT^a$ => ln(CPUE)=ln(b)+a*ln((GRT-50))

Year	Slope	Intercept	R-Square	CPUE(175 tonnes)
1987	0.38	3.63	0.98	22.72
1988	0.23	8.73	0.74	26.01
1989	0.29	5.90	0.99	23.38
1990	0.40	3.02	0.92	20.59
1991	0.40	3.78	0.96	25.97
1992	0.27	8.45	0.81	31.80
1993	0.29	6.77	0.98	27.13
1994	0.41	4.53	0.96	32.49
1995	0.20	15.87	0.78	41.12
1996	0.78	0.65	0.73	27.95
1997	0.30	7.18	0.94	29.98
1998	0.66	0.65	0.88	15.66
1999	1.05	0.09	0.92	14.22
2000	0.48	1.46	0.89	14.55

Table 12.3.3 Effort expressed in days fishing and average GRT of Norwegian vessels fishing for Norway pout by quarter, 1983-2000.

	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	211.0	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	267	173.0	735	180.1	1165	187.4	229	166.9
2000	294	197.1	348	180.7				

Table 12.3.4 Norway pout. Combined Danish and Norwegian fishing effort (standardised) 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	1540	4455	5995
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	562	456	1018	173	116	289	657	571	1228	158	905	1063	1550	2048	3598
1997	140	321	461	211	5	216	628	1444	2072	222	1413	1635	1201	3183	4384
1998	542	551	1093	325	16	341	265	528	793	223	962	1185	1355	2057	3412
1999	263	323	586	766	125	891	1287	783	2070	213	1649	1862	2529	2880	5409
2000	318	260	578	355	39	394							673	299	972

Table 12.3.5 Research vessel indices (CPUE in catch in number per trawl hour) of abundance for Norway pout.

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
2000	8,097	1,533	65	2,110	5,710	123	2	2,094	6,656	207	23

[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 12.3.6 **Research vessel indices of abundance of Norway pout. CPUE-data (kg/trawl hour). IBTS 3rd quarter of the year 1991-1999. (2000 estimates not yet available).**

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 12.3.7 CPUE indices (‘000s per fishing day) by age and quarter from Danish and Norwegian commercial fishery (CF) in the North Sea (Area IV, commercial tuning fleet).

Year	CF, 1st quarter				CF, 2nd quarter				CF, 3rd quarter				CF, 4th quarter			
	0-group	1-group	2-group	3-group	0-group	1-group	2-group	3-group	0-group	1-group	2-group	3-group	0-group	1-group	2-group	3-group
1982	.	2144.5	169.0	87.9	.	1705.7	144.3	12.1	30.3	1320.2	86.5	12.4	368.4	1050.5	16.0	0.0
1983	.	1524.2	470.0	5.4	.	1044.9	706.5	5.5	74.3	969.6	262.0	2.8	604.9	972.9	85.9	1.7
1984	.	1137.9	566.8	59.1	.	1518.0	784.9	181.1	0.2	990.2	314.9	1.5	462.0	723.1	152.1	0.0
1985	.	877.1	528.2	74.3	.	1310.5	221.5	20.3	2.6	599.0	339.0	8.3	183.6	809.5	47.2	0.0
1986	.	108.5	292.9	19.8	.	267.9	89.3	3.0	0.0	531.1	109.7	2.7	892.9	277.1	5.9	0.0
1987	.	1655.3	247.2	7.5	.	1936.8	108.3	0.0	5.2	1035.9	107.8	0.0	96.0	929.2	100.0	2.2
1988	.	200.5	569.7	16.0	.	561.6	489.0	0.0	44.0	339.9	464.6	0.0	1144.9	245.4	157.3	0.0
1989	.	2415.6	67.6	9.9	.	1240.6	261.4	11.7	2.8	453.9	81.9	0.0	1272.5	524.3	24.3	3.4
1990	.	1513.0	641.3	36.6	.	690.5	206.1	11.7	9.6	575.9	127.7	7.3	535.2	475.4	47.8	2.7
1991	.	823.6	740.4	51.5	.	492.9	466.3	22.4	49.2	654.4	43.1	0.9	1089.4	430.5	77.5	7.2
1992	.	1292.9	413.0	45.4	.	2176.2	502.2	43.2	14.6	1133.9	161.6	0.4	185.7	1076.6	103.4	1.0
1993	.	1109.4	399.1	7.8	.	655.6	410.6	50.2	3.9	377.3	322.5	6.8	423.0	470.3	201.3	0.8
1994	.	1183.0	366.4	35.0	.	688.2	526.6	53.4	98.0	541.8	211.8	37.2	1856.1	561.5	65.5	0.0
1995	.	3118.0	187.4	4.4	.	3360.4	767.6	95.2	162.5	2570.8	53.2	4.1	190.2	1632.9	31.6	1.6
1996	.	378.9	758.6	13.7	.	137.5	463.6	131.3	131.9	374.9	773.8	29.7	1378.5	611.9	313.4	0.3
1997	.	1138.9	552.1	168.8	.	443.0	604.0	550.6	1.7	1126.3	138.3	50.6	61.5	1102.4	125.1	21.2
1998	.	116.3	560.7	38.2	.	109.6	453.7	32.9	32.0	329.1	360.6	1.1	124.1	413.1	172.0	10.7
1999	.	342.0	218.8	124.7	.	250.4	205.5	104.4	0.0	550.9	162.1	16.7	558.6	265.3	85.8	12.4
2000		1129.8	319.5	4.7		622.0	461.5	122.8	.	.	.	.	.	.	.	.

Table 12.4.1 Seasonal extended survivor analysis (SXAS) of Norway Pout in the North Sea and Skagerrak

SURVIVORS ANALYSIS OF: Norway Pout 2000

The following parameters were used:
Year range: 1983 - 2000
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 - 2000)
Fleet 2: ibts_1q (1983 - 2000)
Fleet 3: egfs (1983 - 1999)
Fleet 4: sgfs (1983 - 1999)

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
(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

Stock numbers (at start of season)

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	153280.	102381.	*	*	78641.	52714.	*	*	57174.	38320.
1	108844.	69516.	45102.	25464.	66441.	42278.	26496.	13429.	33508.	20607.	13112.	7643.
2	13638.	8080.	4405.	1664.	13552.	7959.	4381.	1559.	6143.	3001.	1893.	620.
3	114.	64.	35.	10.	805.	422.	63.	36.	444.	141.	83.	40.
4+	6.	3.	0.	0.	1.	0.	0.	0.	24.	15.	10.	7.

Table 12.4.1 (Cont'd)

SSN	24643.				21001.				9962.			
SSB	381159.				376868.				177709.			
TSN	122602.	77662.	202823.	129520.	80798.	50659.	109581.	67738.	40120.	23765.	72274.	46630.
TSB	1066873.	1320806.	1932226.	1270427.	795448.	925881.	1169131.	692707.	388812.	419057.	642917.	434076.

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	110696.	74202.	*	*	32607.	21851.	*	*	89194.	59182.
1	25131.	16522.	10862.	6310.	45177.	28083.	17944.	10697.	14461.	9490.	6284.	4062.
2	2675.	917.	544.	164.	2764.	1524.	972.	512.	5409.	3053.	1986.	1127.
3	273.	124.	81.	49.	78.	42.	28.	19.	153.	86.	57.	39.
4+	32.	19.	13.	8.	39.	25.	17.	11.	16.	11.	7.	5.
SSN	5492.				7398.				7024.			
SSB	89114.				97702.				136124.			
TSN	28110.	17581.	122194.	80733.	48057.	29674.	51569.	33089.	20039.	12640.	97528.	64414.
TSB	247442.	286245.	742545.	600069.	382319.	476578.	622544.	399722.	227231.	251042.	602713.	498072.

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	100423.	67186.	*	*	94563.	63371.	*	*	165097.	110067.
1	37095.	23444.	15160.	8793.	41062.	26018.	15983.	9919.	41666.	26701.	17378.	10405.
2	2206.	1439.	856.	355.	4469.	2518.	1219.	666.	5682.	2715.	1490.	822.
3	424.	279.	182.	118.	162.	92.	46.	26.	351.	159.	91.	43.
4+	29.	19.	13.	9.	75.	42.	28.	19.	27.	13.	9.	6.
SSN	6368.				8812.				10227.			
SSB	93059.				137724.				169726.			
TSN	39753.	25182.	116634.	76462.	45768.	28670.	111840.	74001.	47726.	29588.	184064.	121343.
TSB	326760.	415635.	828412.	627149.	396417.	482830.	833046.	637846.	432223.	501531.	1164358.	936722.

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	77863.	51473.	*	*	61034.	40834.	*	*	237397.	158603.
1	70926.	44632.	28671.	16389.	33722.	21015.	13421.	8057.	26410.	16086.	10478.	6181.
2	6116.	3211.	1912.	963.	8706.	5264.	3142.	1359.	4541.	2560.	1483.	649.
3	398.	171.	98.	65.	427.	274.	136.	76.	547.	321.	191.	70.
4+	18.	10.	6.	4.	45.	30.	20.	13.	58.	39.	26.	18.
SSN	13625.				12550.				7787.			
SSB	201143.				234734.				143517.			
TSN	77459.	48022.	108550.	68894.	42901.	26583.	77753.	50339.	31556.	19006.	249575.	165521.
TSB	647978.	787700.	1116329.	729991.	447185.	509585.	722920.	491785.	309898.	346548.	1286759.	1125117.

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	*	*	70983.	47008.	*	*	158464.	105628.	*	*	47482.	31739.
1	102844.	65671.	42461.	26379.	30125.	19756.	12784.	7715.	68744.	45530.	30439.	17874.
2	3203.	1951.	1098.	698.	14941.	9383.	6125.	3286.	4639.	2843.	1799.	901.
3	326.	214.	117.	76.	419.	270.	150.	70.	1930.	1229.	726.	401.
4+	59.	39.	26.	18.	60.	41.	27.	18.	59.	40.	27.	18.
SSN	13872.				18433.				13502.			
SSB	158776.				369936.				230682.			
TSN	106432.	67874.	114685.	74178.	45546.	29449.	177550.	116718.	75372.	49642.	80472.	50934.
TSB	806696.	1064276.	1399685.	922477.	559726.	631103.	1225809.	953302.	663769.	843287.	1071827.	662657.

Year	1998				1999				2000	
Season	1	2	3	4	1	2	3	4	1	2
AGE										
0	*	*	72996.	48854.	*	*	165266.	110747.	*	*
1	20995.	13859.	9118.	5775.	32471.	21600.	14219.	8468.	73314.	48609.
2	10408.	6411.	4044.	2439.	3437.	2199.	1294.	591.	5204.	3337.
3	434.	253.	154.	102.	1459.	918.	539.	333.	265.	175.
4+	252.	163.	89.	60.	98.	65.	43.	29.	224.	150.
SSN	13194.				8240.				13025.	
SSB	275179.				162151.				188959.	
TSN	32090.	20686.	86402.	57230.	37464.	24782.	181361.	120168.	79007.	52271.
TSB	407447.	447622.	703101.	534314.	366716.	448295.	1104517.	903377.	650836.	859773.

Partial fishing mortality for fleet: 1
Commercial fisheries

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	0.053	*	*	0.000	0.022
1	0.048	0.032	0.169	0.226	0.052	0.067	0.272	0.368	0.085	0.052	0.138	0.605
2	0.122	0.202	0.540	0.316	0.130	0.193	0.591	0.771	0.307	0.060	0.660	0.404
3	0.170	0.196	0.790	1.566	0.240	1.188	0.168	0.000	0.687	0.121	0.323	0.000
4+	0.000	1.807	*	*	0.000	0.000	0.000	0.000	0.037	0.000	0.000	0.000
F (1- 2)	0.085	0.117	0.354	0.271	0.091	0.130	0.431	0.570	0.196	0.056	0.399	0.504

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.000	0.095	*	*	0.000	0.013	*	*	0.010	0.066
1	0.019	0.019	0.141	0.408	0.075	0.047	0.116	0.274	0.021	0.012	0.036	0.206
2	0.622	0.121	0.727	0.331	0.191	0.049	0.236	0.736	0.169	0.030	0.164	0.544
3	0.376	0.029	0.094	0.000	0.206	0.000	0.014	0.378	0.172	0.000	0.000	0.000
4+	0.122	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.321	0.070	0.434	0.370	0.133	0.048	0.176	0.505	0.095	0.021	0.100	0.375

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	*	*	0.002	0.091	*	*	0.000	0.019	*	*	0.005	0.039
1	0.058	0.036	0.142	0.270	0.056	0.086	0.076	0.155	0.045	0.029	0.111	0.129
2	0.027	0.118	0.456	0.370	0.171	0.315	0.201	0.234	0.328	0.196	0.191	0.315
3	0.017	0.026	0.031	0.142	0.160	0.281	0.169	0.203	0.376	0.155	0.344	0.658
4+	0.000	0.000	0.000	0.000	0.176	0.000	0.000	0.000	0.309	0.000	0.000	0.000
F (1- 2)	0.043	0.077	0.299	0.320	0.113	0.201	0.139	0.194	0.186	0.113	0.151	0.222

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.014	0.023	*	*	0.002	0.035	*	*	0.003	0.033
1	0.063	0.042	0.157	0.227	0.072	0.048	0.109	0.170	0.095	0.028	0.126	0.251
2	0.239	0.117	0.278	0.397	0.102	0.115	0.419	0.484	0.170	0.144	0.408	0.282
3	0.428	0.152	0.012	0.038	0.042	0.290	0.183	0.032	0.132	0.115	0.566	0.000
4+	0.223	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.151	0.079	0.217	0.312	0.087	0.081	0.264	0.327	0.132	0.086	0.267	0.267

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.012	0.045	*	*	0.006	0.029	*	*	0.003	0.013
1	0.048	0.036	0.075	0.166	0.022	0.035	0.104	0.107	0.012	0.003	0.130	0.139
2	0.095	0.172	0.053	0.108	0.065	0.026	0.218	0.130	0.089	0.057	0.283	0.320
3	0.021	0.197	0.031	0.049	0.041	0.185	0.342	0.005	0.051	0.124	0.190	0.110
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)	0.071	0.104	0.064	0.137	0.043	0.031	0.161	0.119	0.050	0.030	0.207	0.229

Year	1998				1999				2000	
Season	1	2	3	4	1	2	3	4	1	2
AGE										
0	*	*	0.002	0.008	*	*	0.000	0.012	*	*
1	0.015	0.019	0.056	0.117	0.008	0.018	0.117	0.086	0.011	0.007
2	0.084	0.060	0.104	0.112	0.046	0.128	0.370	0.386	0.044	0.078
3	0.140	0.091	0.013	0.170	0.062	0.130	0.080	0.087	0.012	0.394
4+	0.039	0.198	0.000	0.000	0.007	0.003	0.000	0.000	0.000	0.000
F (1- 2)	0.049	0.039	0.080	0.115	0.027	0.073	0.243	0.236	0.027	0.043

Log inverse catchabilities, fleet no: 1
Commercial fisheries

Year 1983 – 2000 (first half) (same for all years, held constant by year by the SXSA)

Season	1	2	3	4
AGE				
0	*	*	15.506	11.660
1	10.660	10.384	9.901	9.441
2	9.312	8.806	8.890	8.969
3	9.312	8.806	8.890	8.969

Table 12.4.1 (Cont'd)

Weighting factors for computing survivors:
Fleet no: 1
Commercial fishery

Year 1983 – 2000 (first half)

Season	1	2	3	4
AGE				
0	*	*	0.572	1.427
1	1.380	1.258	3.558	2.805
2	1.990	1.842	1.762	1.944
3	1.110	0.906	0.615	0.617

Weighting factors for computing survivors:
Fleet no: 2
ibts_1q

Year 1983 – 2000 (first half)

Season	1	2	3	4
AGE				
0	*	*	*	*
1	1.489	*	*	*
2	1.657	*	*	*
3	1.089	*	*	*

Weighting factors for computing survivors:
Fleet no: 3
egfs

Year 1983 – 2000 (first half)

Season	1	2	3	4
AGE				
0	*	*	0.782	*
1	*	*	1.264	*
2	*	*	1.009	*
3	*	*	0.677	*

Weighting factors for computing survivors:
Fleet no: 4
sgfs

Year 1983 – 2000 (first half)

Season	1	2	3	4
AGE				
0	*	*	*	*
1	*	*	1.222	*
2	*	*	1.194	*
3	*	*	1.598	*

Table 12.6.1 Trends in Yield, Average fishing mortality for 1- and 2-group, SSB (beginning of the year), TSB (beginning of 3rd quarter) and Recruitment (0-group beginning of 3rd quarter) for Norway Pout in the North Sea and Skagerrak[2]. 1974-2000.

Year	Yield ('000 tonnes)	$F_{av(1-2)}$	SSB ('000 tonnes)	TSB ('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	0.827	381	1932	153
1984	393.0	1.222	377	1169	79
1985	205.1	1.155	178	643	57
1986	178.4	1.195	89	743	111
1987	149.3	0.862	98	623	33
1988	109.5	0.591	136	603	89
1989	172.5	0.739	93	828	100
1990	151.6	0.647	138	833	95
1991	192.9	0.672	170	1164	165
1992	299.8	0.759	201	1116	78
1993	184.2	0.759	235	723	61
1994	182.3	0.752	144	1287	237
1995	241.0	0.376	159	1400	71
1996	166.2	0.354	370	1226	158
1997	169.7	0.516	231	1072	47
1998	79.8	0.283	275	703	73
1999	92.7	0.579	162	1105	165
2000	-	-	189	-	-
Average, Arithm. Average, Geom.	279.08	0.858	210	1010	135 115

[2] The estimates before 1983 are based on previous assessment runs which does not include data from Skagerrak

Figure 12.1.1

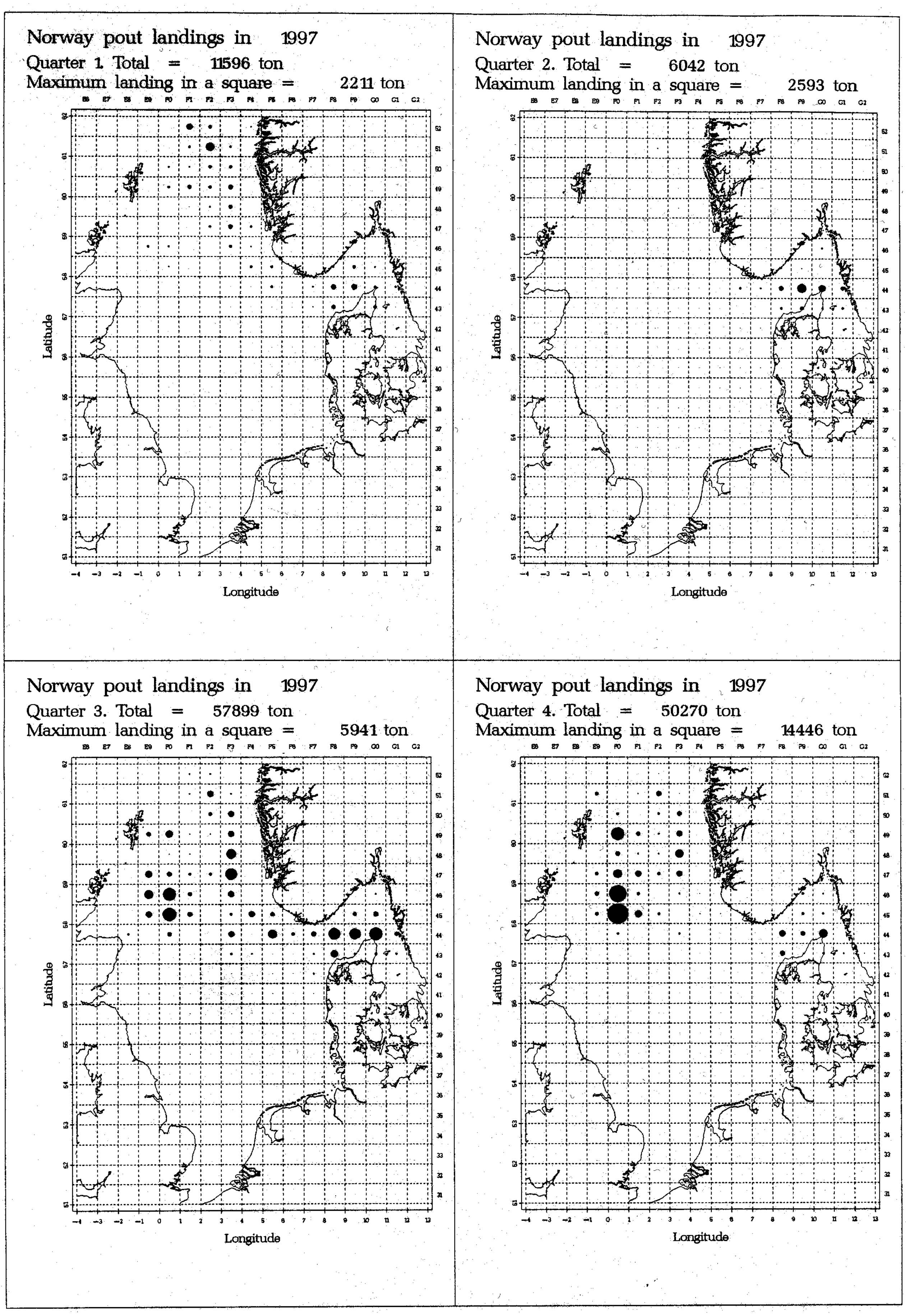

Norway pout landings in 1997
Quarter 1. Total = 11596 ton
Maximum landing in a square = 2211 ton
Latitude
Longitude
Norway pout landings in 1997
Quarter 2. Total = 6042 ton
Maximum landing in a square = 2593 ton
Latitude
Longitude
Norway pout landings in 1997
Quarter 3. Total = 57899 ton
Maximum landing in a square = 5941 ton
Latitude
Longitude
Norway pout landings in 1997
Quarter 4. Total = 50270 ton
Maximum landing in a square = 14446 ton
Latitude
Longitude

Figure 12.1.1 (Cont'd)

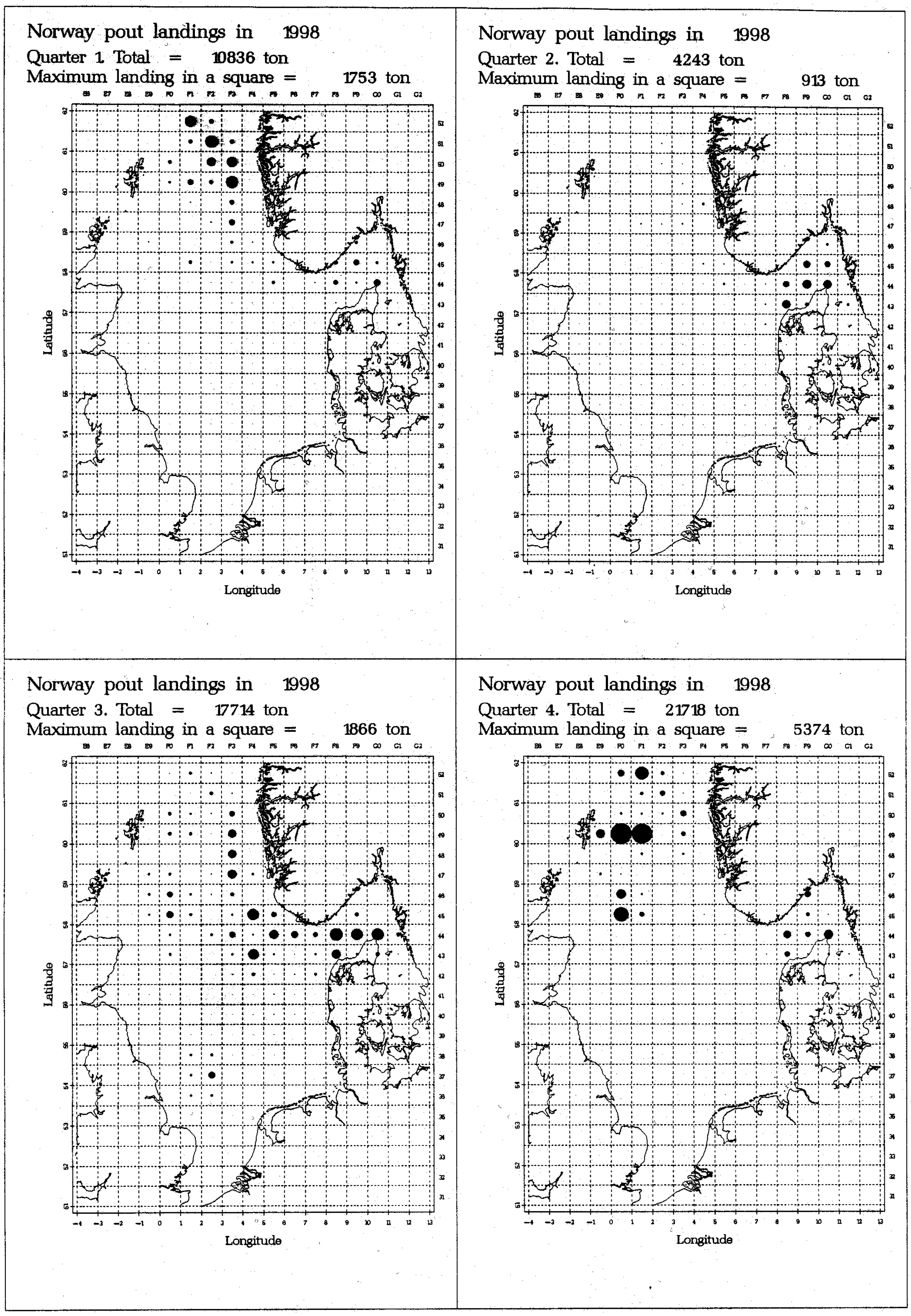
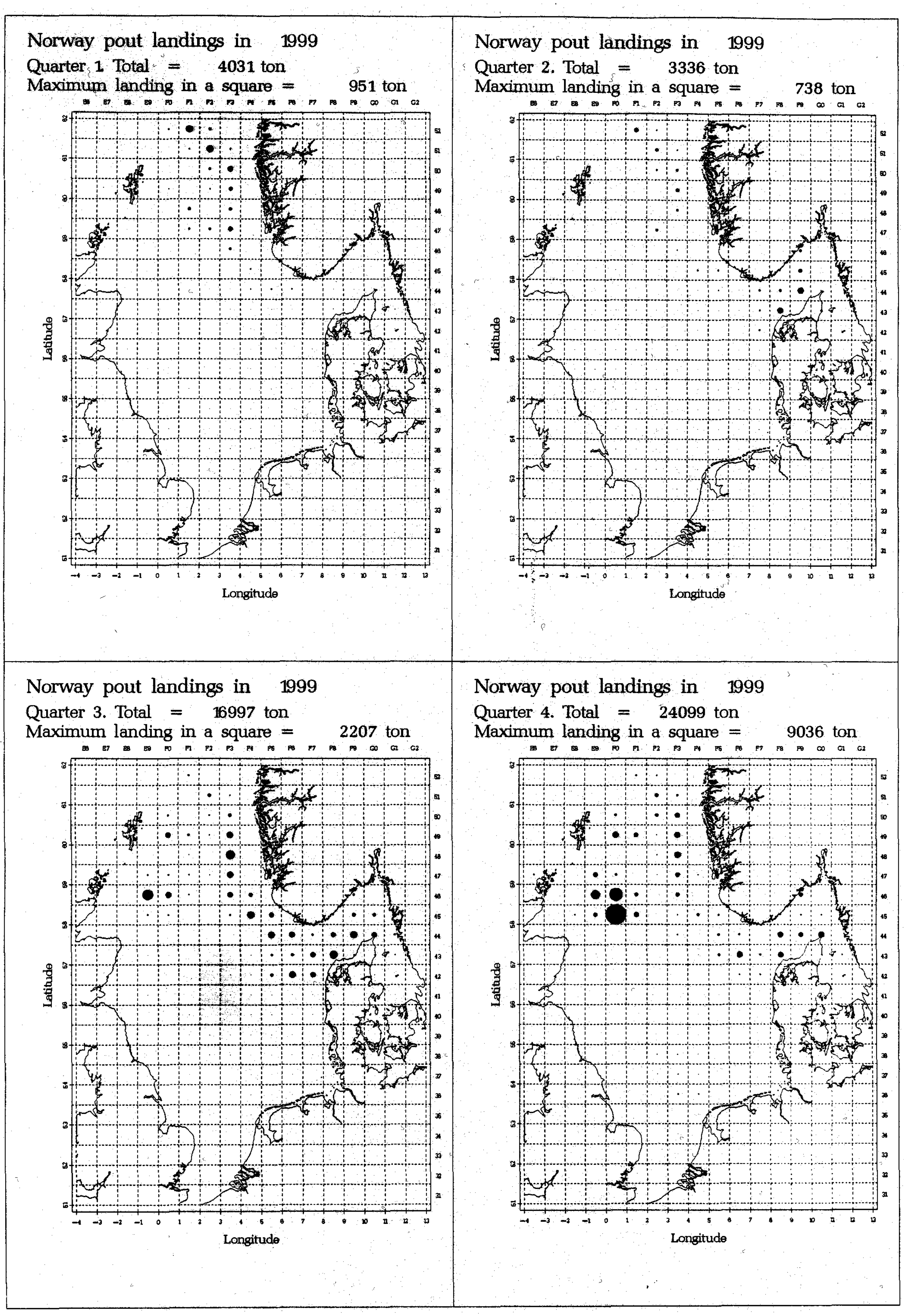


Figure 12.1.1 (Cont'd)



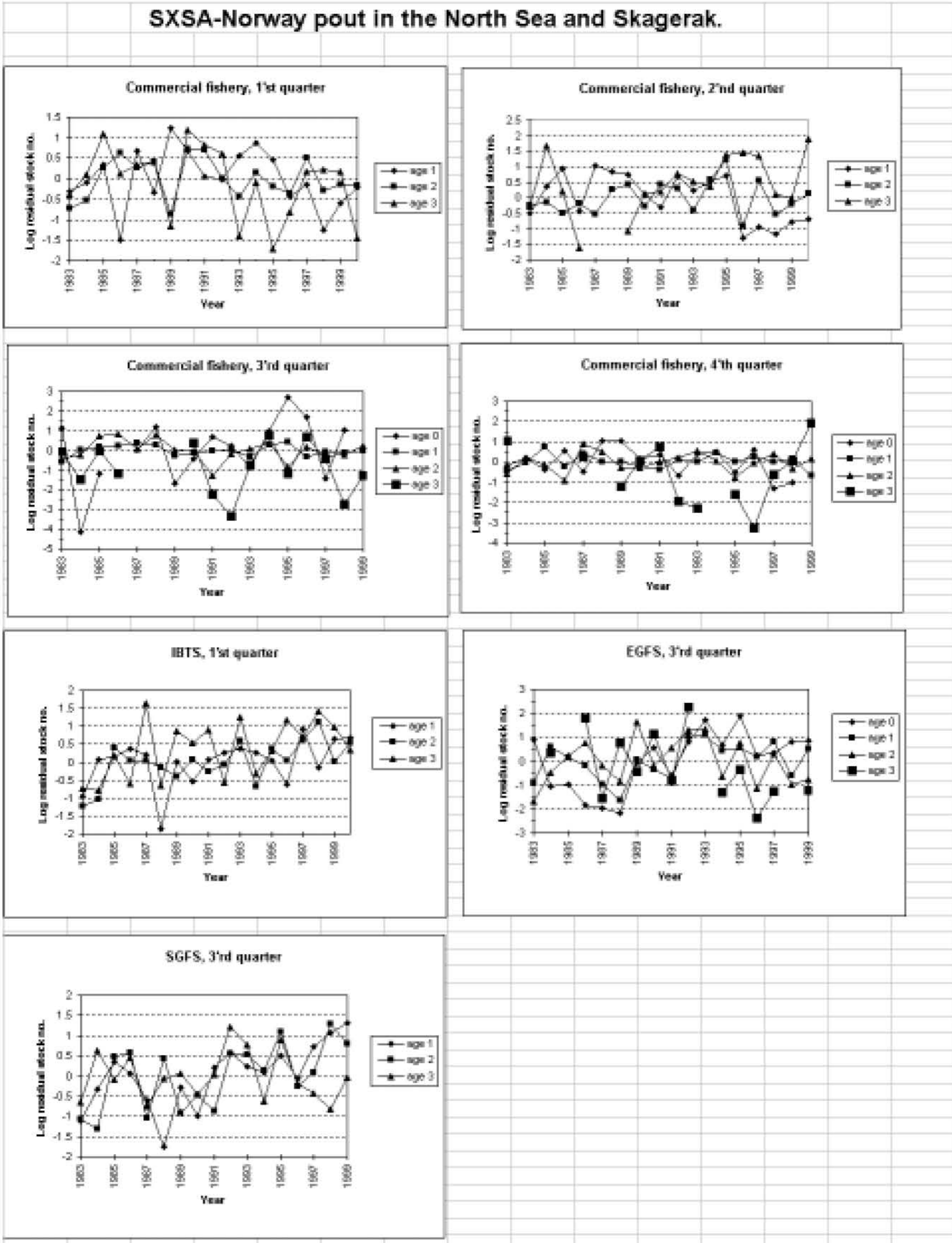
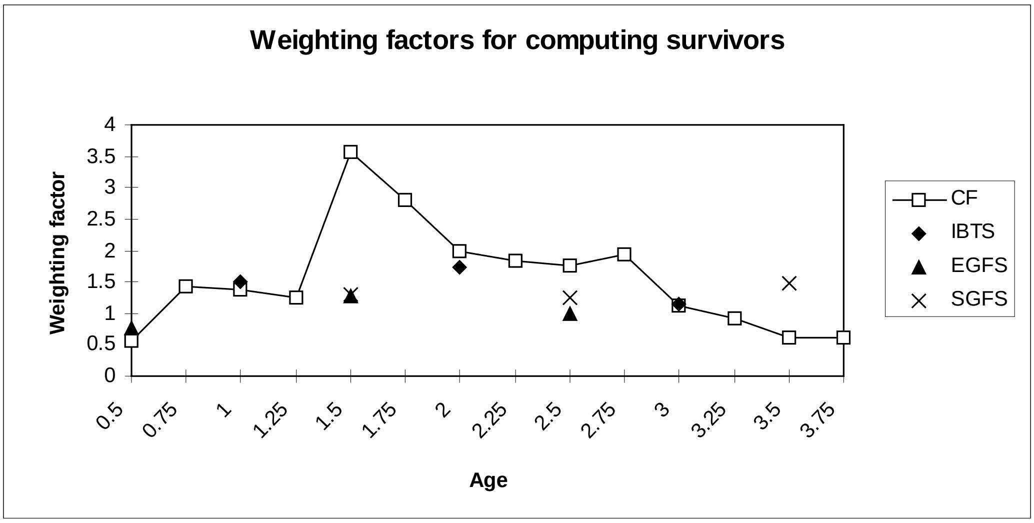
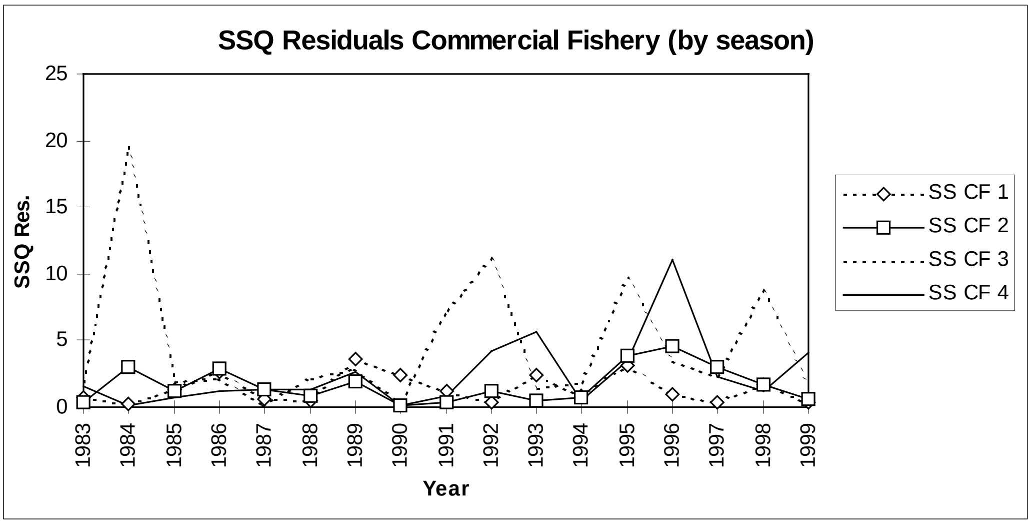


Figure 12.4.1 Log residual stock numbers (log (Nhat/N)) per age group divided by fleet and season.





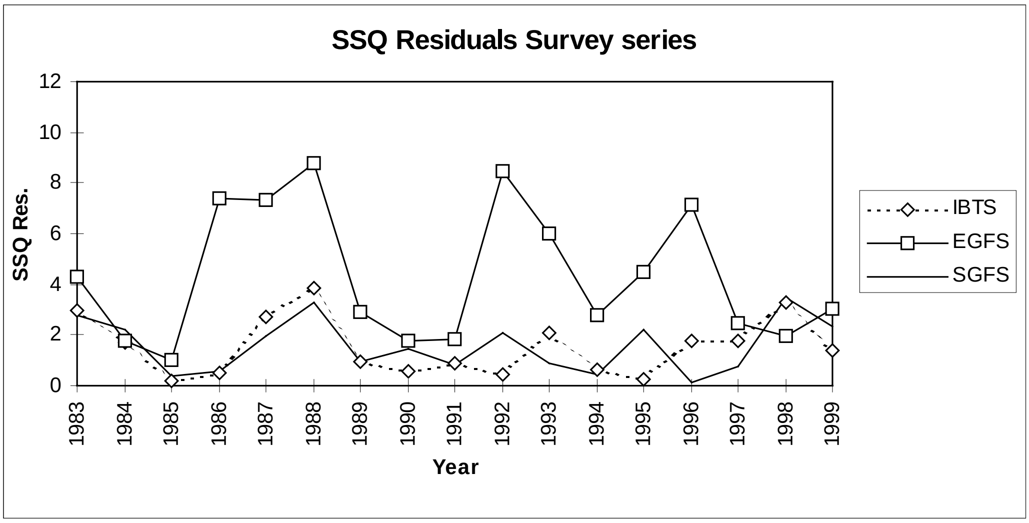


Figure 12.4.2 Weighting factors for computing survivors and summed of squared (SSQ) residual stock number for commercial fishery (by season) and for the survey series summed for all age groups. Output from seasonal extended survivors analysis (SXSA). Commercial fishery fleet (CF), IBTS, EGFS and SGFS.

SXSA – Norway pout in the North Sea and Skagerrak

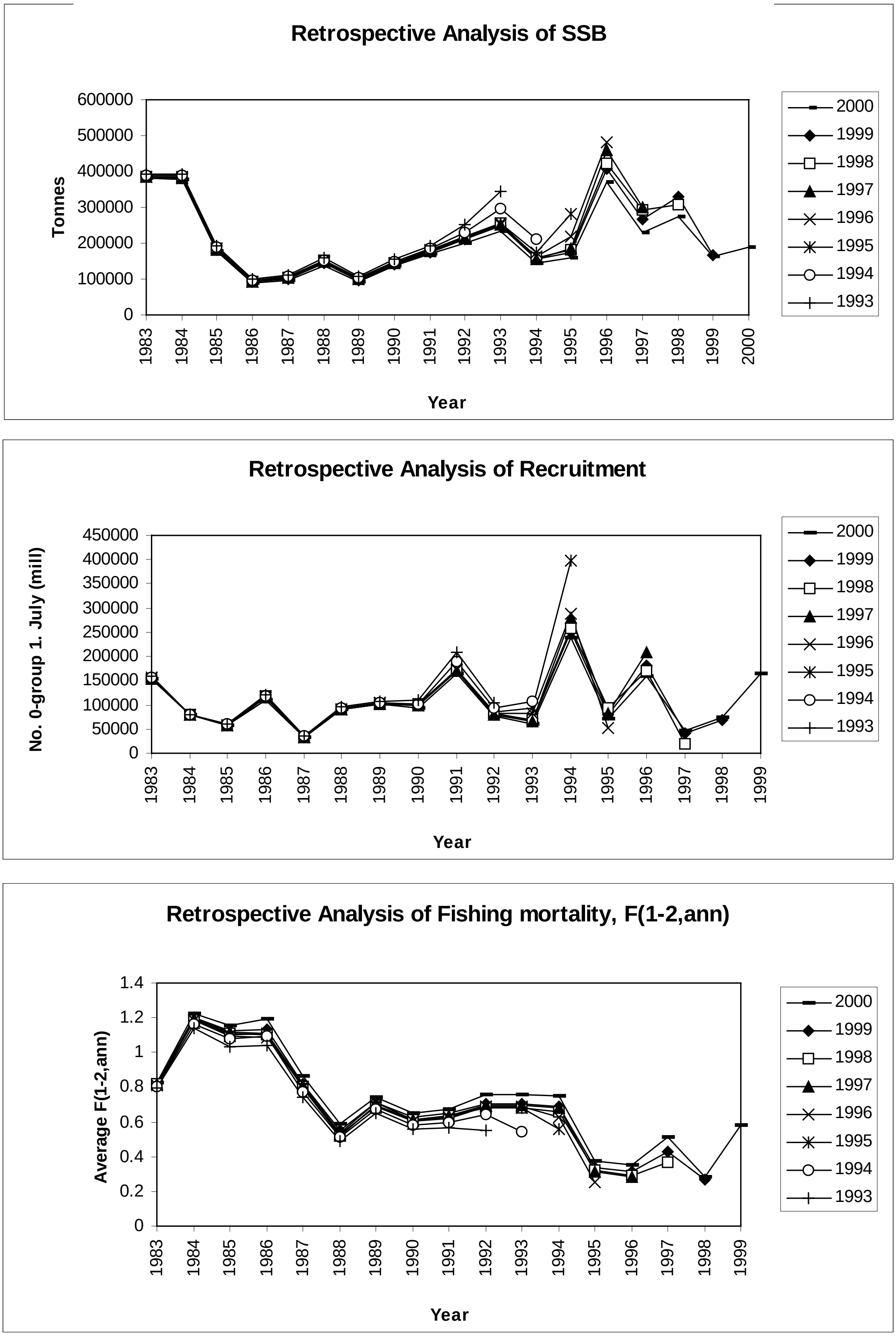


Figure 12.4.3 Retrospective analyses of SSB and Recruitment and $F_{ann(1-2)}$.
No shrinkage used.

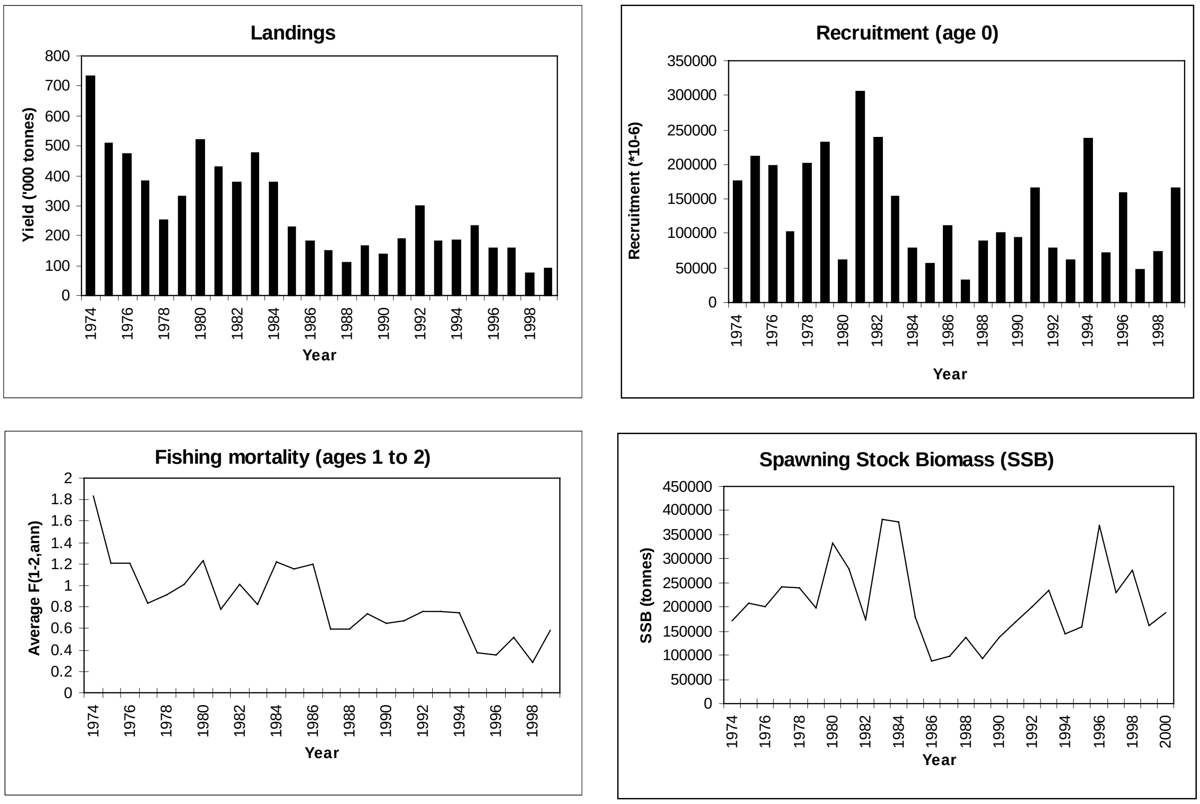


Figure 12.6.1 **Historical trends in landings (yield), recruitment at age 0 in 3rd quarter of the year, annual fishing mortality as average for age 1 and 2, and in spawning stock biomass .**

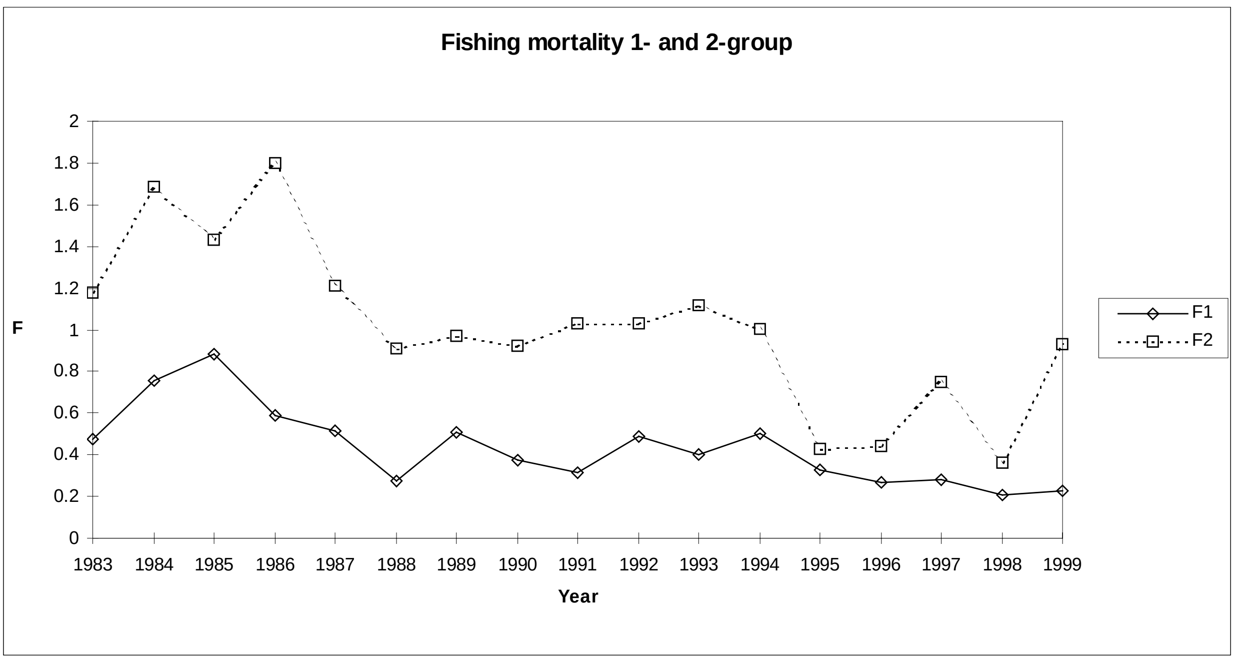


Figure 12.6.2 **Historical trends in fishing mortality for 1- and 2-group Norway pout**

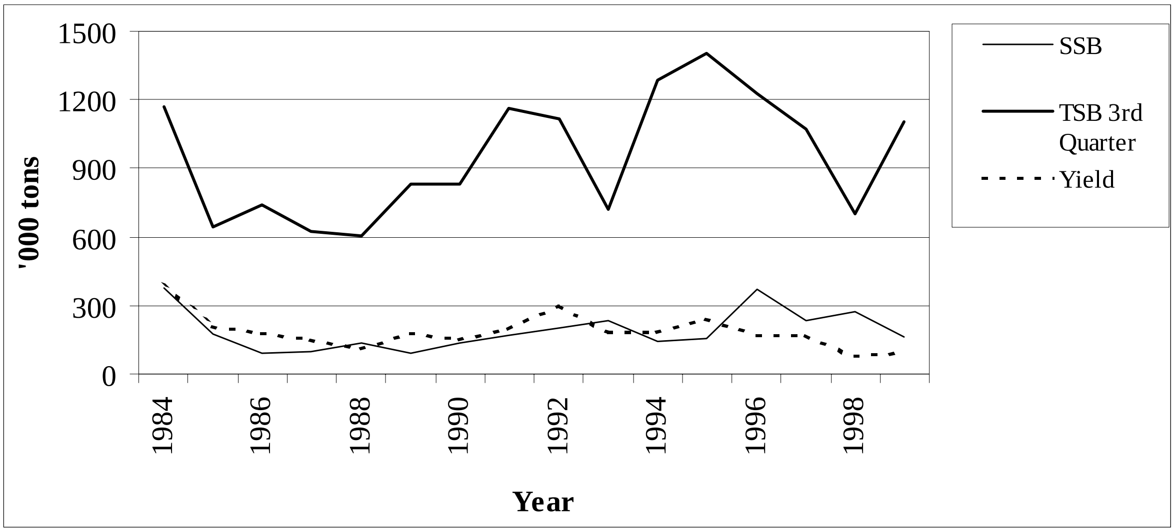


Figure 12.6.3 Trends in yield, spawning stock biomass and total stock biomass for Norway pout in the North Sea and Skagerrak during the period 1984-99.

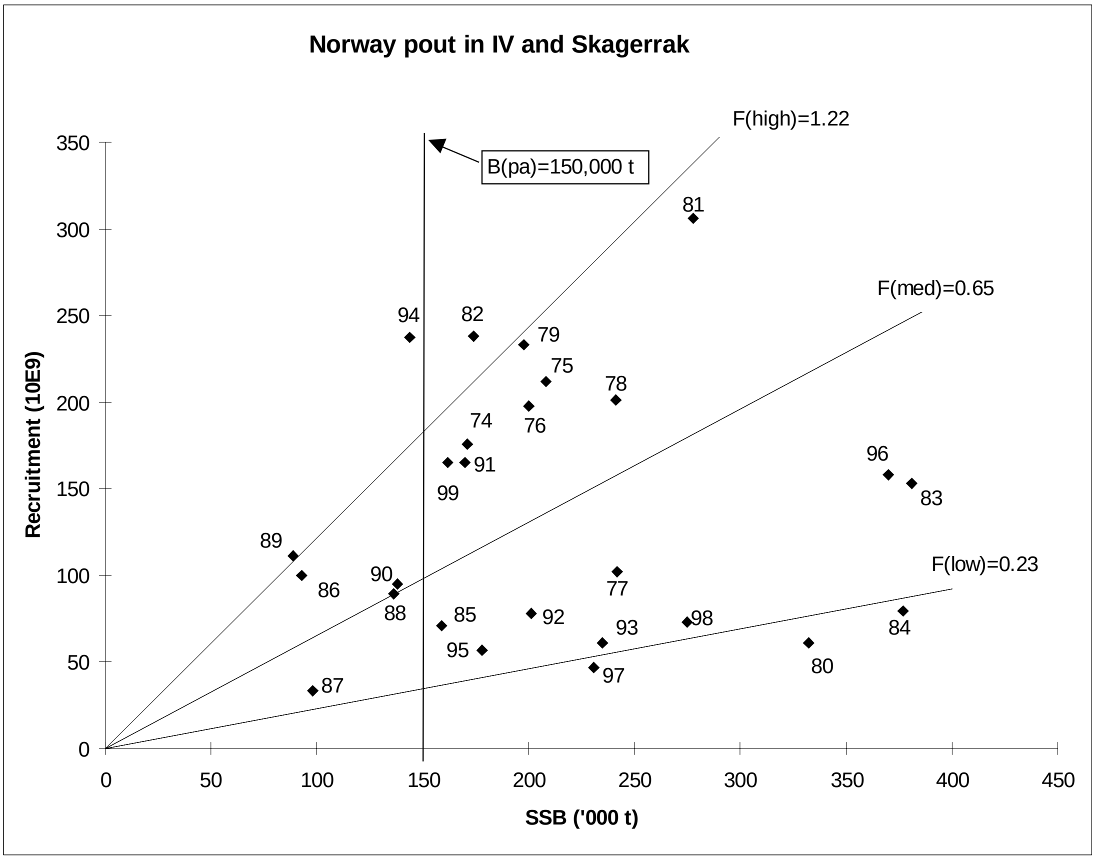


Figure 12.9.1 Recruitment / SSB plot used to calculate F(pa). SXSA - Norway pout in the North Sea and Skagerak. Period: 1974-1999.

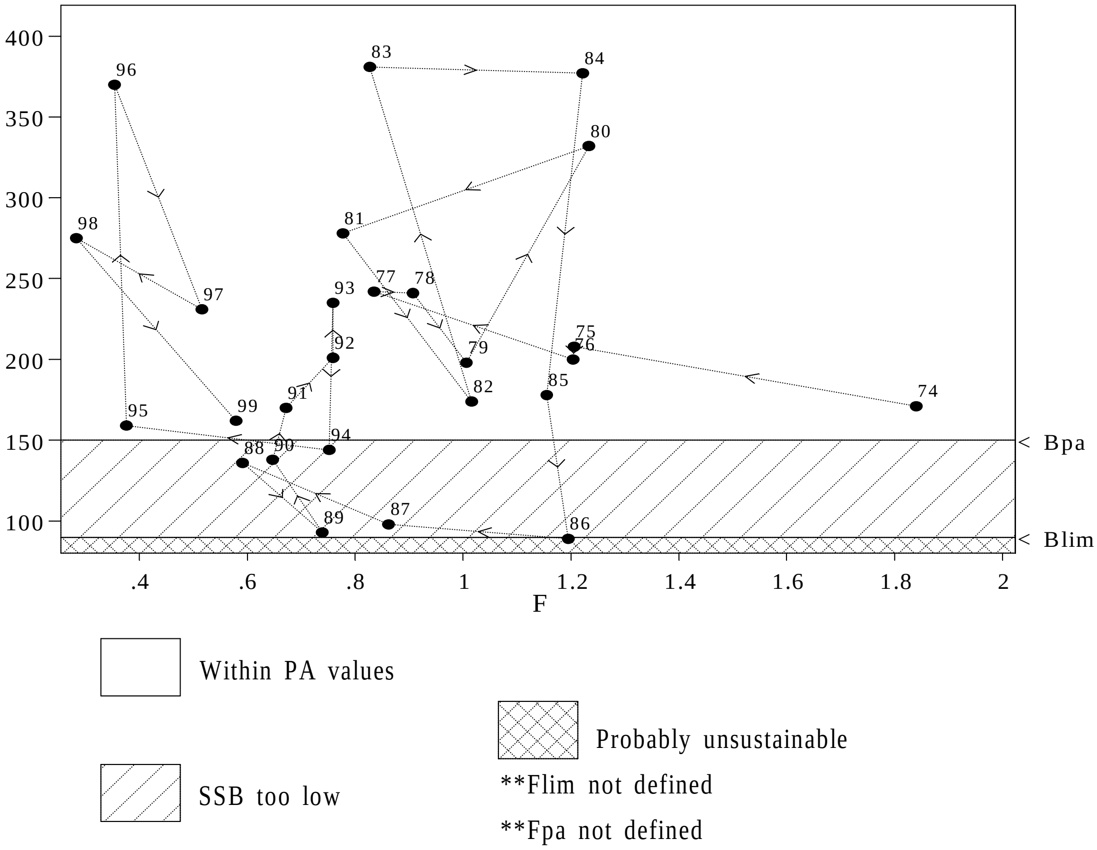


Figure 12.9.2 **SSB vs. annual fishing mortality, $F_{ann,\ 1\text{-}2}$, for Norway pout in the North Sea and the Skagerrak[3].**

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[3] Results and data previous to 1983 do not include Skagerrak.

13 SANDEEL IN SUB-AREA IV

13.1 The fishery

Sandeel is taken by trawlers using small mesh gear. The fishery is seasonal, taking place mostly in the spring and summer. Most of the sandeel portion of the catch consists of *Ammodytes marinus*, although small quantities of other *Ammodytoidei spp.* are caught as well. There is little by-catch of protected species. Sandeels are largely stationary after settlement and the North Sea sandeel fishery must be considered as exploiting a complex of local populations.

13.1.1 ACFM advice applicable to 2000

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 2000 was that the stock could sustain the current fishing mortality and that 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.

In the light of studies linking low sandeel availibility to poor breeding success of some seabird species, ICES advised for 1999 that a closure and re-opening of the sandeel fisheries in area 3 (Figure 13.1.1.1) should be linked to the breeding success of kittiwake. The area was defined as west of 1 ^{o}W (within sandeel area 3) which excluded all commercial fishing except for a maximum of 10 boat days in each of May and June for stock monitoring purposes. 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 was recommended.

B_{lim} is determined as 430,000 t and B_{pa} 600,000 t .

ICES recommended a TAC of 1 million tonnes for 2000.

13.1.2 Management applicable to 1999 and 2000

The TAC was set to 1,020,000 tonnes.
Technical measures include by-catch limits for gaddoids.

13.1.3 Catch trends

The overall landings of sandeel in the North Sea in 1999 was 721,000 t, of which 69% was landed by the Danish fishery, (Table 13.1.3.1). The catch history is shown in Figure 13.1.3.1 . The catches rose to a peak in 1997 (1.2 million t) and have steadily declined since. The catch in 1999 is smaller than the average of the period 1983-1999 (801,000 tonnes).

Figure 13.1.3.2 shows the areas for which catches are tabulated in Tables 13.1.3.2, 13.1.3.3 and 13.1.3.4. Figure 13.1.3.3 shows the distribution of catches by quarter and ICES statistical rectangle for 1999 and the first half of 2000 based on log book data from Danish, Norwegian and Scottish (1999 only) vessels.

The spatial distribution of the catch in 1999 changed from the pattern observed in the previous 5 years. A larger fraction of the catch was taken from area 2A, which is the highest catch from that area in the period.

Data used in the current assessment incorporate a revision of the catch at age data for the period back to 1996 although the changes are minor.

13.2 Natural mortality, maturity, age composition, mean weight-at-age

Estimates of natural mortality and maturity at age used in the assessment are given in Table 13.2.1.

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 (Table 13.2.1), weighted by catch in numbers. The catch and weight-at-age data for the southern and northern North Sea were worked up separately and are given in Tables 13.2.2-13.2.3.

The catch and weight-at-age data for the northern North Sea were constructed by combining Danish and Norwegian data. Prior to 1996, the Norwegian age composition data were based on Danish ALK's. Since 1997 the Norwegian age compositions are based on samples from their own fishery. Weights-at-age prior to 1987 are assumed to be constant in the absence of observations.

Catch numbers and weight-at-age for the southern North Sea were based on Danish age composition data, and weight-at-age values prior to 1989 are average values. The very low value of 5-year-old sandeels in the second half of 1999 (Table 13.2.3) is supported by data supplied to the Working Group. This value is possibly due to a small number of individuals. The weight-at-age for the 4+ group is an average value, weighted by the number of sampled individuals per age group, thus the effect on the weight for the 4+ group will have been minimal.

In general, weight-at-age increases from the first half of the year to the second. Occasionally (i.e. age 1 in 1995 & 1998, age 4 in 1999) weight-at-age *decreases*. 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 individuals of a sandeel year class remain in the water column for a longer time than the larger individuals. Thus the portion of the sandeel stock availible to the fishery may have a lower mean weight as the season progresses.

13.3 Catch, effort and research vessel data

13.3.1 Calculation of the total international effort in the sandeel fishery

The effort data from the southern and northern North Sea were treated as two independent fleets. The effort data for the southern North Sea prior to 1999 is only available for Danish vessels, although since 1999 Norwegian vessels have also provided effort data. The fleet in the northern North Sea has always been a mixture of Danish and Norwegian vessels. Total international standardised effort was estimated as described in the WG report from 1996, a résumé is provided in section 1.3.2. Input data for these calculations are given in the Tables 13.3.1.1 ,13.3.1.2, 13.3.1.4 and 13.3.1.5. Total international effort is given in Tables 13.3.1.3 and 13.3.1.6.

13.3.2 Research vessel data

There are no survey data available for this stock.

13.4 Catch-at-age analysis

13.4.1 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 the 1999 report (Table 13.4.1.1.). The resulting VPA stock estimates are given in Table 13.4.1.2. The residuals of log stock number are given in Figure 13.4.1. These residuals are equivalent to the log catchability residuals obtained from the standard XSA, and are calculated as:

$$residuals = \log\left(\frac{\hat{N}}{N}\right)$$

where N is the stock number at age derived from the VPA and $\hat{N}$ is the stock number at age derived from the CPUE index for each tuning fleet.

Tuning data for the years 1983-1999 were used, and weighting of catchability and survivor estimates was given as input (Table 13.4.1.1). Manual weighting of catchability is the only option availible under SXSA. Estimates of survivors are given a lower weighting in the second half of the year because the fishery inflicts the majority of the fishing mortality in the 1st half of the year and thus the signal from the fishery is considered less reliable in the second half. Down weighting the survivor estimates permits an increase in the range of log residuals for the 2nd half year (Figure 13.4.1).

The log stock number residuals were examined and no long-term trends were identified. The declining residual for the 1st half year fishery in the northern area observed in the 1999 assessment was-terminated in this year's assessment with an increase in log residual stock number. There has been increase in the log stock number residual for 2-year-olds in the northern area, 1st half year, but this remains within the range of previously observed values.

The high value of F for 1-year-olds in the southern area, 1st half of the year estimated in 1998 (0.4) has decreased to 0.33 in this assessment, although this remains the highest value (at age, area and season) in the series.

In addition to the main SXSA run, a second run was made in which the tuning data from 1990-1999 was used to look for further trends. The diagnostic residuals for the truncated run showed no difference, and the stock numbers differed by only 1%.

Estimates of natural mortality-at-age and season were available from the key run of MSVPA (1974-1995). This run indicated that the natural mortality on 0-group sandeels in the second half of the year could be increased from 0.8 as used presently, to 1.2. The figure for 3-year-olds in the same period also increased by 50% from 0.2 to 0.3. An additional SXSA run was made using these figures, and whilst the total biomass doubled at the start of the second half of the year, there was no discernible change in the number of 1-year-old sandeels the next season. The change in M on 3-year-olds had little effect on the SSB. The effect of these changes in M on the reference points should be evaluated before assessments using these values can be used.

The final run used the same settings as in the previous (1999) report.

13.4.2 Assessment

The retrospective analysis, Figure 13.4.2.1, indicates that the SXSA estimates of sandeel SSB converge rapidly and show no sign of a bias in the most recent estimates.

Recruitment in 1999 is estimated to be 874 billion, well above the average 684 billion (1983-1999). The assessment in 1999 estimated recruitment in 1998 to be 372 billion, and this value has increased to 440 billion in the current assessment.

The total stock biomass in the second half of the year should be treated with caution. Weight-at-age of the 0 group is taken as weight-at-age from the catch, and this is likely to over estimate the biomass of the 0 group. However the higher value of M given by the latest MSVPA run indicates that the size of the 0 group is grossly underestimated.

The stock-recruitment scatterplot is shown in Figure 13.4.2.2, indicating that there is no clearly defined relationship between stock and recruitment over the observed stock sizes.

Figure 13.4.2.3 shows the relationship between log stock numbers and log CPUE by age of the tuning fleets. Ages 1-3 give acceptable correlation coefficients (0.39-0.63), but the 0-group and 4+-groups are quite poor although this is not unexpected given the increased variability in catchability of 0-groups and the low numbers of the oldest ages.

13.5 Recruitment estimates

As no recruitment estimates from surveys are available, recruitment estimates are based exclusively on commercial catch-at-age data.

13.6 Historical stock trends

Average fishing mortality, recruitment at age 0 in the 2nd half and SSB in the 1st half for the period 1976-1999 are shown in Table 13.6.1 and Figure 13.1.3.1.

Fishing mortality in the period 1976-1991 appears to have been at a higher level (average 0.65) compared to the more recent period 1992-1999 (average 0.45).

Recruitment appears to fluctuate with either a 2 or 3 year period. High recruitement is generally followed by one year of poor recruitment. Very good recruitment is generally followed by two years of low recruitment. The 1996 year class is estimated to have been the largest in the time series while the 1997 and 1998 year classes were low. The 1999 recruitment value is above average.

Spawning stock biomass has fluctuated around a level of 1 million t. After the peak in 1998 (due to the 1996 year class) the SSB at the start of 2000 (706,000t) has fallen below the average level (average 1983-1999 = 1,005,000t).

13.7 Catch Forecasts

Because of high natural mortality and a few year classes in the fishery, traditional catch forecasts are not considered appropriate.

13.8 Biological reference points

In 1998 ACFM proposed that B_{lim} be set at 430,000 t, the lowest observed SSB. The B_{pa} was estimated at 600,000 t, approximately B_{lim} * 1.4. This means that if SSB is estimated to be at B_{pa} then the probability that the true SSB is less than B_{lim} will be less than 5% (assuming that estimated SSB is log normal distributed with a c.v. of 0.2).

Figure 13.8.1 shows the relationship between Fbar(1-2) and SSB in relation to Bpa for the period 1983-1999. SSB in 1999 is estimated to be twice the Bpa.

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.

13.9 Comments on the assessment

The assessment for this year appears to be internally consistent. The assessment in 2000 indicates that fishing mortality is below average and recruitment is above average. Although the SSB is slightly below average it is well above Bpa.

The relatively poor correlation between the tuning indices and the stock size is perhaps a reflection of the fact that we are assessing several sub-stocks as a single unit. In addition, the mobility of the sandeel fleet is such that vessels will rapidly change grounds to optimise CPUE.

A working paper giving preliminary results from the monitoring fishery in the closed area was presented at the Working Group meeting (Working Paper 16).

13.10 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 11,500 tonnes in 1999, well below the average of 30,000 tonnes.

13.11 Sandeel in Shetland

13.11.1 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 1999 were 4157 tonnes (Table 13.1.3.2), which is the slightly lower than in 1998, and short of the 7,000t. Provisional figures for 2000 indicate landings of 4315t.

13.11.2 Management in 1999-2000

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 and 2000 seasons and will be reviewed in advance of the 2001 season.

13.11.3 Assessment

Management of the Shetland fishery is on a three year basis, with management measures being agreed in advance of the fishing season and then reviewed every three years. As they are due to be reviewed in advance of the 2001 season, an attempt was made to provide an updated assessment of the stock.

Annual catch-at-age data are given in Table 13.11.3.1, and total effort data are given in Table 13.11.3.2. CPUE indices are available from a directed survey conducted at Shetland in August of each year. These are given in Table 13.11.3.3.

The data available for this stock present a number of problems. The catch-at-age data include a number of years when catches were zero due to the closure of the fishery; there are also missing years in the survey data, and the fleet exploiting the stock changed completely before and after the closure period, leading to problems with the effort data. The previous assessment of this stock was done by the 1997 WG (ICES CM 1998/Assess:7). This used a spreadsheet implementation of a separable model to try and overcome the problems with data sparsity etc. The results were very sensitive to the choice of input parameters, but the assessment was considered adequate to describe overall trends in the stock. This approach was again used with the updated data, but proved to be problematic, as over the range of input parameters which were investigated, the model fit did not provide a plausible description of the stock history. It was not possible to investigate this fully within the time available at the WG meeting, so no updated assessment was possible.

Although there is no assessment, the survey data (Table 13.11.3.3) do provide a more qualitative picture of the recent stock history. The year classes spawned in both 1997 and 1999 appear to have been very strong as they are the two highest 0-group indices in the series. However, there are indications from the subsequent 1-group indices of the same cohorts that survival has been poor, perhaps indicating increased natural mortality. Catch rates from the 2000 survey were very low at all ages, and this was consistent with reports from the fishery at about the same time. The index for the 2000 year class is an order of magnitude smaller than any previous 0-group index, and the survey found very few 0-group fish on grounds where they are usually abundant. It is likely that these recent changes in the stock implied by the survey indices are due to environmental rather than fishery effects, and these may also have led to the problems with the assessment model, as such environmental effects are likely to have a greater effect on the population than fishing has in recent years.

Table 13.1.3.1. Landings ('000 t) of sandeel from the North Sea, 1952-1999.
(Data provided by Working Group 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	-	2.0	-	12.2	0.2	37.0	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	-	12.0	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	601.6	-	5.0	-	160.7	-	9.7	776.9
1997	751.9	-	11.2	-	350.1	-	26.6	1139.8
1998	617.8	-	11.0	+	343.3	8.5	23.8	1004.4
1999	500.1	-	-	+	187.6	22.4	11.5	721.6

+ = less than half unit.

- = no information or no catch.

Table 13.1.3.2	Monthly landings of sandeels (t) by Denmark, Norway and Scotland from each area in Figure 13.1.3.2										
	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland
1995											
Mar	0	3769	0	317	14428	0	94	0	0	18	
Apr	64640	29155	17990	10529	26818	248	123	751	0	171	
May	105246	9646	25901	62345	47201	340	27795	2267	293	3539	
Jun	139864	1308	68056	3874	58920	369	16343	12261	4424	18676	
Jul	12612	0	104	8811	9605	0	7541	11301	367	25548	
Aug	0	0	34151	867	3242	0	6507	0	193	7801	
Sep	0	0	1234	4	1683	0	615	0	0	85	
Oct	0	0	0	0	7555	0	410	0	0	4	
Total	322362	43878	147436	86747	169452	957	59428	26580	5277	55842	1160
1996											
Mar	0	28	10	0	2379	0	0	0	0	0	
Apr	8792	35	1551	3944	21184	0	5438	247	0	534	
May	78847	13217	4595	13739	54993	611	18817	2509	455	3064	
Jun	112069	81	20441	12692	32264	489	25078	7097	1711	35186	
Jul	108624	1976	69	1282	9565	1	22477	2885	802	6034	
Aug	1313	461	3679	7153	8849	125	34315	0	0	5441	
Sep	875	43	767	1256	12586	3307	19781	0	0	2262	
Oct	0	2671	0	726	10252	0	8156	0	0	0	
Nov	0	48	0	0	879	0	0	0	0	0	
Total	310510	18560	31102	40792	152951	4533	134062	12738	2968	52521	1000
1997											
Mar	17	7562	2326	1402	25821		1220				0
Apr	23736	35036	5800	11404	42308	536	21745	588		180	892
Mai	117700	6326	584	24309	76216	487	36499	3074	1768	13636	503
Jun	132631	2751		37848	142941		36966	1121	51	29935	442
Jul	58429	1235	197	14212	42478		11632	11057	1278	31738	534
Aug	1660	293		1552	24113	15	3497	83	1602	12211	503
Sep				1024	23859	156	1230			666	0
Okt		140		859	12513		134			61	0
Total	334173	53343	8907	92610	390249	1193	112923	15923	4699	88427	2874
1998											
Mar	5631	6378	322	1176	8431	150	697	1275	0	0	0
Apr	55616	12943	589	34884	73929	351	11619	482	225	843	1073
May	80124	30002	1103	41509	85448	481	13613	8688	1173	10151	1224
Jun	129065	6115	0	7693	86544	0	9248	14485	1488	27392	0
Jul	6172	396	0	1675	43587	0	2490	6750	1188	23786	50
Aug	149	1477	0	964	55421	0	1852	642	0	473	2362
Sept	0	676	0	733	37012	0	1094	0	0	212	503
Oct	0	26	4	0	4472	0	0	0	0	16	0
Total	276757	58013	2018	88634	394844	982	40613	32322	4074	62873	5212
1999											
Mar	1448	2587	136	1047	9371	0	466	73	218	0	479
Apr	52524	3030	0	64273	17779	0	644	80	55	1360	1080
May	147573	15468	0	41522	45709	0	7299	1523	82	597	461
Jun	52605	9427	0	6188	8224	0	3304	12744	1097	18174	6
Jul	7816	1883	0	15142	13918	0	14841	2434	1270	5274	2043
Aug	1	0	0	1770	29621	0	15376	0	0	99	88
Sept	1	155	0	930	26486	0	4129	0	0	883	0
Oct	0	0	0	42	16440	0	1754	0	0	68	0
Dec	0	0	0	181	358	0	198	0	0	0	0
Total	261969	32551	136	131095	167905	0	48011	16854	2722	26454	4157
2000											
Mar	800	42	0	3257	5618	0	739	0	0	393	687
Apr	30931	19012	0	15259	71384	281	33583	479	0	595	1436
May	105872	6396	0	24911	42647	0	53911	6670	3089	662	1651
Jun	72514	3189	26	18558	16441	0	17287	11240	2503	28725	0
Total	210117	28638	26	61986	136090	281	105519	18389	5593	30375	3773

Table 13.1.3.3 Annual landings ('000 t) of Sandeels by area of the North Sea (Denmark, Norway and UK (Scotland)). Data provided by Working Group members.

	Area										Assessment area		
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	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	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	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	159.7	50.2		346.5	70.3		42.5	37.4	6.4	27.2	28.1	163	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	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	74.4	479.2
1983	197.4	-	2.8	59.4	17.7	-	57.7	87.6	8.0	66.0	37	78.2	419
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	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	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	1.3	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	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	2.4	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	5.2	497.2	480.7
1999	266.7	32.6	0.1	132.8	167.9	0.0	48.0	16.9	2.7	27.2	4.2	248.7	449.0
2000	210.1	28.6	0.0	62.0	136.1	0.3	105.5	18.4	5.6	30.4	0.0	270.6	332.1

Assessment areas: Northern - Areas 1B, 1C, 2B, 2C, 3.
Southern - Areas 1A, 2A, 4, 5, 6.

Only data from Denmark and Norway in the period January–June are included for year 2000.

Table 13.1.3.4 Sandeel North Sea. Monthly landings (t) by Denmark, Norway and Scotland, 1996-2000 (Data provided by Working Group members).

Year	Month	Denmark	Norway	Scotland	Total
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	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	71,951	8,029	288,627
	Jun	276,974	107,270	11,581	395,825
	Jul	136,708	35,369	2,396	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	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	343,373	18,538	979,670
1999	Mar	6,851	8,496	479	15,826
	Apr	115,596	24,149	1,854	141,599
	May	202,813	56,961	6,578	266,352
	Jun	97,284	14,478	434	112,197
	Jul	49,333	13,245	0	62,578
	Aug	19,044	27,823	2,043	48,910
	Sept	6,217	26,366	88	32,672
	Oct	2,567	15,738	0	18,305
	Nov	405	332		737
	Total	500,110	187,589	11,476	699,175
2000	Mar	7,524	3,325		10,849
	Apr	126,644	44,879	n/a	171,523
	May	195,866	48,292		244,158
	Jun	150,394	20,089		170,483
	Total	480,428	116,585		597,013

Table 13.2.1 Sandeel in the North Sea. Natural mortality, maturity and stock weight-at-age.

Age	Weight-at-age in the stock (g)			Maturity	Natural mortality	
	1999 Jan-Jun	1999 Jul-Dec	2000 Jan-Jun		Jan-Jun	Jul-Dec
0	-	3.15	-	0.0		0.8
1	5.58	8.29	6.40	0.0	1.0	0.2
2	8.88	10.49	8.56	1.0	0.4	0.2
3	13.42	17.14	13.29	1.0	0.4	0.2
4+	21.96	15.68	17.04	1.0	0.4	0.2

Table13.2.2 SANDEEL, North Sea. Northern area. Mean weight-at-age (g) in the catch for 1995-1999 and 2000, first half. Data from Denmark and Norway.

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	2.32	1.71
1	4.94	8.11
2	7.95	10.15
3	11.76	23.96
4+	24.64	17.19
1998	Half-year	
Age	1	2
0	1.68	2.45
1	4.24	3.91
2	8.73	11.13
3	14.21	20.15
4+	33.61	13.39
1999	Half-year	
Age	1	2
0	2.37	3.07
1	6.53	7.78
2	8.08	10.43
3	13.20	24.15
4+	25.68	-
2000	Half-year	
Age	1	2
0	-	
1	6.78	
2	7.90	
3	11.86	
4+	19.66	

Table 13.2.3 SANDEEL, North Sea. Southern area. Mean weight-at-age (g) in the catch for 1995–1999 and 2000 first half.

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	-	2.34
1	5.57	9.90
2	8.31	16.66
3	13.16	21.77
4	15.88	31.49
5	17.95	33.31
6	17.99	36.78
7		43.83

1997	Half-year	
Age	1	2
0	-	4.72
1	6.52	7.99
2	10.92	13.54
3	11.81	14.73
4	16.19	16.74
5		23.33
6	17.05	20.01

1998	Half-year	
Age	1	2
0	0.97	2.79
1	5.54	3.01
2	8.38	12.65
3	10.64	11.57
4	12.05	17.23
5	15.59	14.87
6	17.82	
7	18.28	

1999	Half-year	
Age	1	2
0		5.42
1	5.52	10.02
2	9.27	11.05
3	13.50	16.85
4	16.84	15.59
5	22.23	9.16
6	20.95	21.38
7		21.38

2000	Half-year
Age	1
0	1.72
1	6.16
2	9.56
3	14.42
4	15.41
5	16.66
6	19.82
7	18.69
8+	19.88

Table 13.3.1.1 Sandeel. Northern North Sea. Danish CPUE data (t/day fishing) by half year

First half year

	Vessel size (GRT)						
Year	0-50	50-100	100-150	150-200	200-250	250-300	>300
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	21.0	32.0	45.5	50.2	63.9	57.4	71.8
1987	23.7	37.8	67.0	66.5	78.6	79.9	113.0
1988	19.0	25.6	34.4	42.5	48.0	47.8	75.3
1989	16.3	25.2	36.7	41.0	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	32.0	53.9	61.8	75.0	87.9	102.5
1995	19.6	29.5	49.5	57.8	61.0	66.9	73.6
1996	16.5	21.1	35.9	39.1	36.7	40.0	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
2000	17.5	33.2	32.8	40.0	50.7	54.5	71.2

Second half year

	Vessel size (GRT)						
Year	0-50	50-100	100-150	150-200	200-250	250-300	>300
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	14.9	27.8	33.1	31.1	38.5
1999	17.4	29.5	17.3	31.9	39.8	37.3	42.3

Table 13.3.1.2 North Sea sandeel. Norwegian effort data.

Northern area

Year	Fishing days		Mean gross register tonnage (Av. GRT pr. trip)	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
1976	595		199	
1977	2212	457	172	185
1978	1747	806	203	204
1979	1407	1720	214	189
1980	2642	1099	216	210
1981	1740	404	217	191
1982	1206		209	
1983	304	66	255	191
1984	145		183	
1985	366		220	
1986	1562	567	201	187
1987	2123	1584	219	201
1988	3571	925	203	198
1989	4292	588	192	202
1990	2275	731	208	189
1991	1749	958	200	194
1992	1202	23	205	213
1993	1462	971	231	201
1994	2559	742	222	227
1995	3305	980	216	218
1996	1935	724	224	219
1997	3354	1484	218	221
1998	2479	2176	222	219
1999	2030	1540	240	241
2000	2045		254	

Southern area

Year	Fishing days		Mean gross register tonnage (Av. GRT pr. trip)	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
1999	521	10	262	316
2000	111		259	

Table 13.3.1.3 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	5.32
1988	3,599	143.8	40.0	158.1	46.4	43.3	332.0	7.66
1989	4,200	146.9	35.0	267.3	47.5	43.1	435.2	10.11
1990	2,304	58.6	25.4	94.9	29.4	27.9	148.7	5.34
1991	1,748	67.7	38.7	210.6	46.5	44.6	282.2	6.33
1992	1,217	53.7	44.1	124.0	47.0	46.1	151.2	3.28
1993	1,579	70.7	44.8	133.8	40.9	42.2	189.0	4.48
1994	2,709	130.1	48.0	299.6	70.3	63.6	413.4	6.50
1995	3,442	208.6	60.6	143.2	57.8	59.5	348.5	5.86
1996	2,034	100.9	49.6	107.1	38.9	44.1	203.1	4.61
1997	3,493	254.9	73.0	207.4	62.6	68.3	456.5	6.68
1998	2,623	220.8	84.2	144.2	45.9	69.1	364.8	5.28
1999	2,163	77.4	35.8	49.0	40.4	37.6	124.1	3.30
2000	2,299	104.5	45.5	162.7	47.9	47.0	271.1	5.78
				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	1.83
1988	922	26.9	29.2	41.5	33.9	32.0	71.4	2.23
1989	589	11.5	19.5	44.9	27.3	25.7	57.2	2.23
1990	718	22.8	31.8	65.8	37.3	35.9	70.8	1.97
1991	942	30.3	32.2	96.0	49.4	45.3	90.7	2.00
1992	24	1.5	63.6	48.0	43.7	44.3	25.5	0.58
1993	972	30.7	31.6	59.4	37.4	35.4	87.0	2.46
1994	785	35.7	45.5	90.8	56.1	53.1	76.4	1.44
1995	1018	53.3	52.3	77.6	55.5	54.2	72.6	1.34
1996	752	42.9	57.0	93.3	42.3	47.0	140.7	3.00
1997	1,545	95.7	61.9	25.7	35.6	56.4	121.5	2.16
1998	2,265	114.4	50.5	34.6	27.7	45.2	148.5	3.28
1999	1,638	77.8	47.5	43.7	33.2	42.3	125.2	2.96

Table 13.3.1.4 Sandeel. Southern North Sea. Danish CPUE data (t/day fishing) by half year

First half year

	Vessel size (GRT)						
Year	0-50	50-100	100-150	150-200	200-250	250-300	>300
1982	16.1	26.9	43.1	47.2	59.2	53.2	59.6
1983	17.0	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	60.0	56.6	82.8
1989	19.4	24.5	43.3	52.3	58.9	55.2	74.3
1990	20.0	20.8	30.4	33.7	39.8	35.7	49.1
1991	27.0	30.0	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	29.0	59.1	59.5	75.2	78.9	96.6
1995	23.6	33.2	63.7	63.5	68.0	80.0	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	20.0	27.1	40.7	44.7	58.0	60.9	87.7
1999	19.7	28.2	38.2	43.5	55.0	52.3	66.0
2000	21.6	26.9	33.9	36.1	56.7	59.1	74.9

Second half year

	Vessel size (GRT)						
Year	0-50	50-100	100-150	150-200	200-250	250-300	>300
1982	-	20.3	37.5	40.5	-	27.9	-
1983	15.1	21.3	25.1	32.4	45.4	34.0	34.7
1984	12.7	16.4	26.9	34.2	36.5	40.2	40.9
1985	13.2	19.5	26.0	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	44.0
1989	26.7	26.2	27.0	38.3	38.0	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	81.0	87.5	123.6
1997	22.9	25.9	35.5	41.7	54.8	51.0	74.9
1998	12.8	17.9	19.1	36.5	36.5	32.7	40.0
1999	-	-	-	26.2	34.3	33.9	37.2

CPUE for the 0-150 GRT groups in 1999 , second half year has not been used as effort has been less than totally 7 fishing days

Table 13.3.1.5 Danish CPUE data. Parameter estimates from regressions of ln(CPUE) versus ln(Av. GRT) by year together with estimates of standardized CPUE (200 GRT)

$$CPUE = b * GRT^{a}$$

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	3.72	0.95	38.9	0.43	4.30	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	0.33	5.75	0.79	33.2
2000	0.49	3.50	0.97	47.9				

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	30.9
1999	0.46	4.19	0.98	48.5	0.52	1.86	0.91	29.4
2000	0.47	3.99	0.93	48.7				

Table 13.3.1.6 Sandeels Southern North Sea. Derived standardized international effort calculated from total catches and standardized CPUE based on Danish and Norweigian data (from 1999-)

	First half year			Second half year		
Year	CPUE (t/day)	Total Int'l catch ('000 t)	Total int'l effort ('000 days)	CPUE (t/day)	Total Int'l catch ('000 t)	Total int'l effort ('000 days)
1982	48.2	427	8.9	35.7	52.6	1.5
1983	42.8	360	8.4	33.9	59.3	1.8
1984	50.5	461	9.1	32.9	71.1	2.2
1985	41.9	417	10.0	33.6	110.6	3.3
1986	53.7	386	7.2	44.1	75.5	1.7
1987	71.7	298	4.2	47.4	105.1	2.2
1988	54.7	462	8.5	34.4	33.4	1.0
1989	52.6	506	9.6	33.7	18.5	0.5
1990	35.8	342	9.5	41.8	24.0	0.6
1991	58.8	327	5.6	56.3	132.3	2.4
1992	70.6	621	8.8	42.5	73.0	1.7
1993	51.0	268	5.3	38.5	34.2	0.9
1994	67.8	226	3.3	55.6	47.6	0.9
1995	69.6	429	6.2	60.1	67.6	1.1
1996	53.3	293	5.5	73.8	138.7	1.9
1997	76.7	421	5.5	48.3	138.2	2.9
1998	54.1	448	8.29	30.9	42.8	1.39
1999	48.2	419	8.97	29.4	35.9	1.22
2000	48.9	356	7.27			

Table 13.4.1.1 Input for the seasonal survivors analysis

```
SURVIVORS ANALYSIS OF:
Sandeel in the North Sea
```

The following parameters were used:

```
Year range: 1983 - 2000
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:          0
  (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
```

Weighting factors for computing catchability for both fleets (Weighting for rhats)

Year 1983-1998 and 1999 first half year

Season	1	2
AGE		
0	1	1
1	1	1
2	1	1
3	1	1

Season	1999 second half year :	2000 first half year
AGE		
0	0.5	0.1
1	0.5	0.1
2	0.5	0.1
3	0.5	0.1

Weighting factors for computing survivors in all years (Weighting for shats)

Season	1	2
AGE		
0	*	0.02
1	1	0.1
2	1	0.1
3	1	0.1

Table 13.4.1.1 (continued) Input for the seasonal survivors analysis

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		2000
Season	1	2	1	2	1	2	1	2	1	2	1
AGE											
0	*	4046.	*	31817.	*	2431.	*	35220.	*	33653.	*
1	36140.	3374.	11524.	1706.	67038.	11346.	6667.	10005.	1916.	694.	22709.
2	3360.	338.	5385.	1772.	3640.	633.	33216.	1837.	3158.	551.	8766.
3	1091.	26.	761.	136.	5254.	25.	2039.	79.	4601.	58.	1411.
4+	145.	2.	301.	55.	1206.	2.	410.	1.	925.	0.	1459.
SOP	348280.	71351.	201546.	141902.	451606.	103226.	360999.	148508.	122523.	115849.	268641.

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		2000
Season	1	2	1	2	1	2	1	2	1	2	1
AGE											
0	*	0.	*	2088.	*	198.	*	1142.	*	1322.	*
1	39683.	3166.	10194.	2031.	52359.	15238.	9546.	738.	31944.	203.	35079.
2	6607.	2789.	16015.	4080.	3648.	536.	39553.	2673.	6497.	58.	5882.
3	1555.	307.	6403.	536.	2405.	406.	3188.	209.	13147.	1392.	1798.
4+	1226.	157.	1169.	1023.	683.	136.	2260.	65.	947.	166.	3474.
SOP	427820.	67591.	293882.	138796.	420729.	138483.	448116.	42753.	431399.	35899.	353593.

Table 13.4.1.2 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	*	870109.	*	228662.	*	1209799.	*	631172.	*	201494.	*	725159.
1	99333.	31741.	379429.	94574.	102744.	31442.	535360.	155969.	278766.	84000.	90032.	25719.
2	88513.	29658.	25496.	13894.	67813.	10584.	23929.	7907.	116452.	50530.	60754.	11254.
3	3455.	1479.	21457.	3392.	11184.	4638.	5527.	2228.	5781.	2640.	35161.	7823.
4+	498.	6.	732.	125.	2279.	918.	2167.	1428.	2759.	1587.	3238.	0.
SSN	92467.		47686.		81275.		31623.		124992.		99153.	
SSB	1211738.		716807.		1127341.		463886.		1643982.		1519557.	
TSN	191800.	932992.	427115.	340648.	184020.	1257381.	566983.	798704.	403758.	340252.	189185.	769954.
TSB	1711384.	1806625.	2272468.	1572095.	1557840.	2058034.	2701692.	2945241.	2954183.	2028093.	1915699.	1660074.

SSN	33001.		48032.		34132.		52553.		86518.		61650.	
SSB	519263.		676180.		490533.		733127.		1176628.		868892.	
TSN	349991.	399031.	195595.	699768.	319282.	912425.	410100.	437503.	228724.	715964.	329140.	971747.
TSB	1914016.	1187844.	1304802.	1450284.	1713824.	1815444.	2191921.	1782434.	1816557.	1932784.	2543377.	7363201.

Year	1995		1996		1997		1998		1999		2000
Season	1	2	1	2	1	2	1	2	1	2	1
AGE											
0	*	359702.	*	2078385.	*	348761.	*	440179.	*	874339.	*
1	395874.	99645.	158913.	45288.	911151.	262776.	154946.	47168.	173411.	43257.	369422.
2	49701.	25155.	75665.	33199.	33698.	16622.	191089.	68513.	28897.	11465.	34605.
3	9250.	4034.	17766.	6043.	21886.	8400.	12551.	4134.	52013.	20334.	8836.
4+	8236.	4398.	6459.	3126.	5924.	2424.	8347.	3409.	5855.	2392.	17144.
SSN	67188.		99890.		61508.		211987.		86765.		60585.
SSB	1123470.		1150135.		703715.		1919280.		1083199.		705786.
TSN	463061.	492935.	258802.	2166041.	972659.	638982.	366933.	563402.	260177.	951788.	430007.
TSB	3946050.	3346967.	2222794.	7257438.	5833495.	3157772.	2695559.	2217247.	2050833.	3619082.	3070083.

Log inverse catchabilities

fleet no: 1
Fishery in the Northern North Sea

Season	1	2
AGE		
0	*	4.791
1	3.694	4.076
2	3.486	4.506
3	3.486	4.506

Log inverse catchabilities, fleet no: 2
Fishery in the Southern North Sea

Season	1	2
AGE		
0	*	6.94
1	4.039	3.534
2	3.071	3.397
3	3.071	3.397

Table 13.4.1.2 (continued) Output from SXSA of sandeel in the North Sea

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	0.095	0.011	0.056	0.015	0.044	0.004	0.077	0.052	0.160	0.080	0.189	0.057
2	0.021	0.012	0.086	0.010	0.090	0.030	0.171	0.070	0.134	0.005	0.768	0.034
3	0.037	0.017	0.013	0.015	0.131	0.029	0.054	0.000	0.086	0.000	0.065	0.020
4+	0.051	0.000	0.011	0.000	0.312	0.016	0.000	0.000	0.073	0.000	0.023	*
F (1- 2)	0.058	0.012	0.071	0.012	0.067	0.017	0.124	0.061	0.147	0.042	0.478	0.045

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	0.163	0.057	0.268	0.016	0.050	0.001	0.192	0.028	0.192	0.014
2	0.166	0.040	0.164	0.039	0.152	0.004	0.136	0.000	0.054	0.004	0.337	0.110
3	0.651	0.000	0.162	0.038	0.176	0.003	0.121	0.000	0.105	0.007	0.349	0.045
4+	0.000	0.000	0.154	0.034	0.351	0.009	0.159	0.000	0.397	0.047	0.806	0.034
F (1- 2)	0.260	0.063	0.164	0.048	0.210	0.010	0.093	0.000	0.123	0.016	0.265	0.062

Year	1995		1996		1997		1998		1999		2000
Season	1	2	1	2	1	2	1	2	1	2	1
AGE											
0	*	0.016	*	0.022	*	0.010	*	0.122	*	0.057	*
1	0.164	0.039	0.125	0.043	0.127	0.050	0.073	0.266	0.020	0.018	0.108
2	0.092	0.016	0.102	0.065	0.149	0.044	0.267	0.031	0.162	0.055	0.401
3	0.170	0.007	0.067	0.026	0.361	0.003	0.256	0.022	0.132	0.003	0.242
4+	0.024	0.001	0.065	0.024	0.299	0.001	0.072	0.000	0.233	0.000	0.123
F (1- 2)	0.128	0.027	0.114	0.054	0.138	0.047	0.170	0.148	0.091	0.036	0.254

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	0.037	0.008	0.297	0.117	0.128	0.069	0.140	0.039	0.027	0.043	0.045	0.000
2	0.620	0.110	0.117	0.007	1.074	0.407	0.482	0.043	0.282	0.157	0.298	0.024
3	0.392	0.472	1.144	0.208	0.326	0.721	0.429	0.127	0.284	0.085	0.884	0.345
4+	1.655	0.485	1.103	0.474	0.172	0.435	0.017	0.014	0.078	0.036	2.501	*
F (1- 2)	0.329	0.059	0.207	0.062	0.601	0.238	0.311	0.041	0.154	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	*	0.021	*	0.001	*	0.002	*	0.000
1	0.277	0.034	0.252	0.049	0.129	0.207	0.304	0.050	0.044	0.029	0.167	0.071
2	0.339	0.024	0.701	0.055	0.597	0.053	0.335	0.024	0.298	0.033	0.121	0.029
3	0.184	0.017	0.692	0.053	0.255	0.039	0.250	0.069	0.382	0.052	0.155	0.022
4+	1.597	1.008	0.657	0.047	0.500	0.000	0.324	0.033	0.622	0.185	0.267	0.189
F (1- 2)	0.308	0.029	0.477	0.052	0.363	0.130	0.320	0.037	0.171	0.031	0.144	0.050

Year	1995		1996		1997		1998		1999		2000
Season	1	2	1	2	1	2	1	2	1	2	1
AGE											
0	*	0.000	*	0.001	*	0.001	*	0.004	*	0.002	*
1	0.180	0.036	0.111	0.052	0.099	0.068	0.104	0.020	0.332	0.005	0.166
2	0.181	0.131	0.304	0.149	0.149	0.037	0.318	0.045	0.334	0.006	0.269
3	0.242	0.088	0.562	0.104	0.165	0.055	0.400	0.058	0.378	0.078	0.308
4+	0.199	0.040	0.251	0.441	0.170	0.064	0.399	0.021	0.238	0.080	0.292
F (1- 2)	0.181	0.084	0.208	0.101	0.124	0.052	0.211	0.032	0.333	0.005	0.218

Table 13.6.1 North Sea sandeel. Average fishing mortality, recruitment and SSB 1976-2000

Year	Mean F (age 1-2)	Recruits age 0 Second half 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	0.485	871	1212
1984	0.349	229	717
1985	0.955	1210	1127
1986	0.555	631	464
1987	0.433	201	1644
1988	0.776	725	1520
1989	0.689	333	519
1990	0.785	654	676
1991	0.725	834	491
1992	0.478	327	733
1993	0.353	637	1177
1994	0.532	882	869
1995	0.420	360	1123
1996	0.468	2078	1150
1997	0.354	349	704
1998	0.534	440	1919
1999	0.499	874	1083
2000			706
Average 1983-1999	0.552	684	1008

Table 13.11.3.1 **Sandeel at Shetland**
Annual catch at age data (millions)

Age				1974	1975	1976	1977	1978	1979	1980
0				929	4309	4268	5970	5453	1403	6432
1				1318	242	1928	3508	4894	2665	739
2				148	708	399	768	1216	365	487
3				34	122	124	43	114	44	344
4				36	13	27	56	29	20	118
5				7	15	11	5	28	10	70
6				1	6	6	6	4	1	34
7+				1	3	7	3	1	0	17

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	13243	16851	5605	6773	2192	2226	419	530	33	14
1	2962	6182	3428	2324	1328	616	984	33	8	162
2	1216	1064	772	1218	470	377	69	154	7	22
3	389	385	243	437	249	351	45	108	199	14
4	142	107	111	144	75	152	46	49	96	60
5	55	81	33	47	28	61	23	28	34	29
6	25	26	18	15	9	15	5	15	14	5
7+	5	7	5	10	3	6	1	4	4	6

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	0	0	0	0	43	31	353	1564	998	15
1	0	0	0	0	185	169	621	21583	92	506
2	0	0	0	0	23	52	40	1029	311	121
3	0	0	0	0	11	4	20	33	69	125
4	0	0	0	0	6	2	2	9	11	57
5	0	0	0	0	2	3	12	2	3	14
6	0	0	0	0	0.1	0.1	0.3	1	1	4
7+	0	0	0	0	0.1	0.1	0.1	1	1	1

Table 13.11.3.2 Sandeel at Shetland, Annual Effort data (days absent)

Year	Effort
1974	460
1975	847
1976	1188
1977	1351
1978	1397
1979	592
1980	1006
1981	1806
1982	1937
1983	1410
1984	1391
1985	660
1986	561
1987	278
1988	272
1989	168
1990	102
1991	0
1992	0
1993	0
1994	0
1995	149
1996	133
1997	163
1998	364
1999	246
2000*	*250*

* provisional

Table 13.11.3.3
Sandeel at Shetland
Survey indices, Mean No. fish at age per 30 minute tow (thousands).

	0	1	2	3	4	5	6	7
1984	345.77	47.59	34.61	9.92	4.00	1.37	0.86	0.26
1985	121.91	74.51	38.84	23.46	10.87	1.96	0.96	0.12
1986	681.87	49.82	11.40	15.38	7.05	2.89	1.21	0.19
1987	-	-	-	-	-	-	-	-
1988	73.37	0.90	7.19	4.84	4.61	3.03	1.62	0.02
1989	813.75	9.06	0.98	3.82	3.89	2.02	0.46	0.09
1990	90.15	30.12	3.77	1.35	1.74	1.14	0.44	0.33
1991	1009.02	10.00	1.93	1.69	0.75	0.05	0.02	0.01
1992	199.30	465.96	1.22	0.35	0.17	0.04	0.01	0.01
1993	635.33	18.18	73.18	2.18	0.36	0.15	0.07	0.02
1994	98.65	135.16	14.27	41.30	3.37	0.30	0.01	0.02
1995	-	-	-	-	-	-	-	-
1996	589.37	23.06	12.51	1.84	1.19	1.39	0.52	0.07
1997	2953.35	88.58	6.52	8.94	1.21	1.35	1.16	0.36
1998	559.20	222.14	18.58	2.84	1.84	0.23	0.61	0.18
1999	1165.59	6.41	10.77	10.38	1.35	0.36	0.36	0.05
2000	7.92	26.17	2.74	6.21	2.00	0.30	0.24	0.02

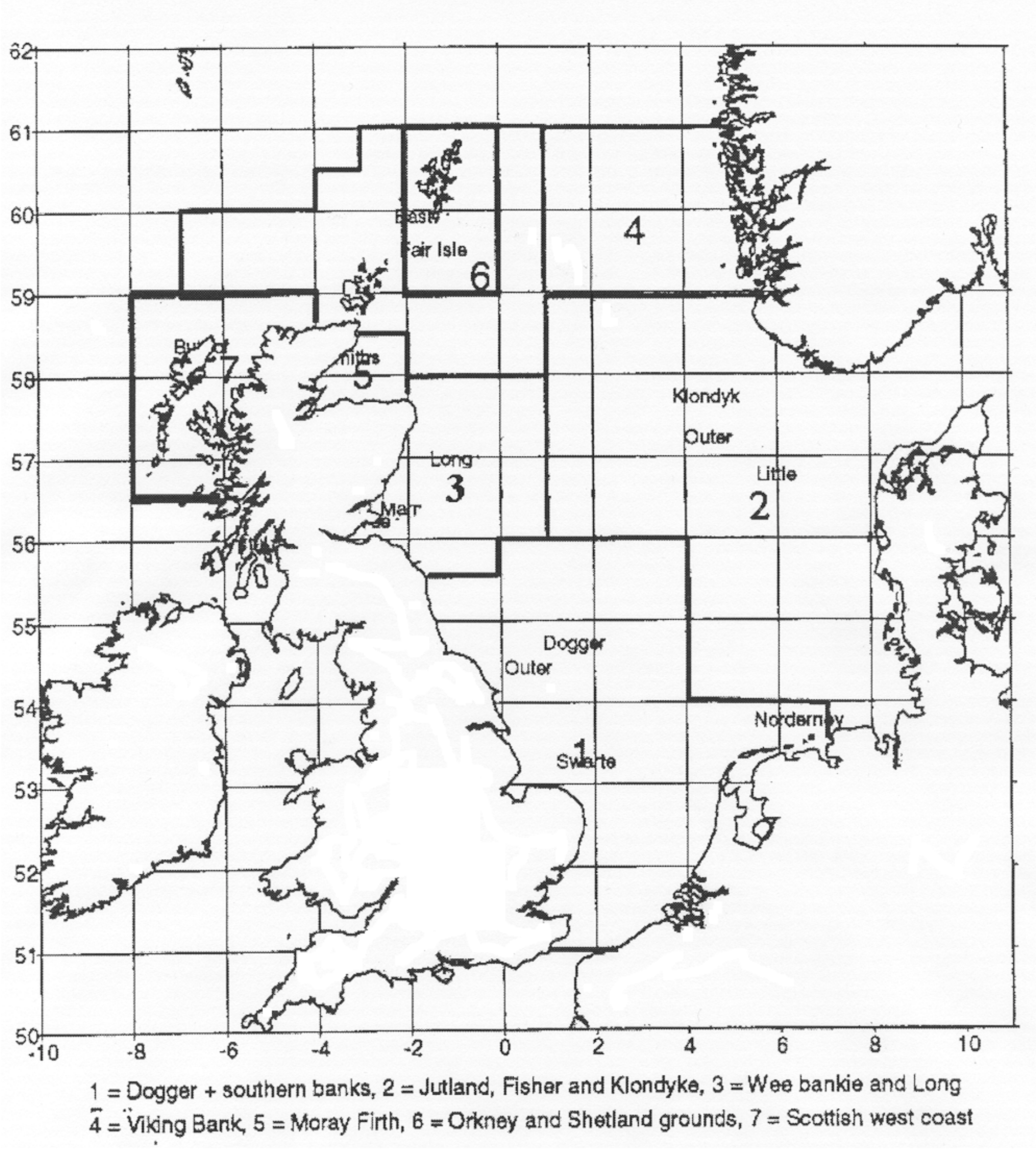
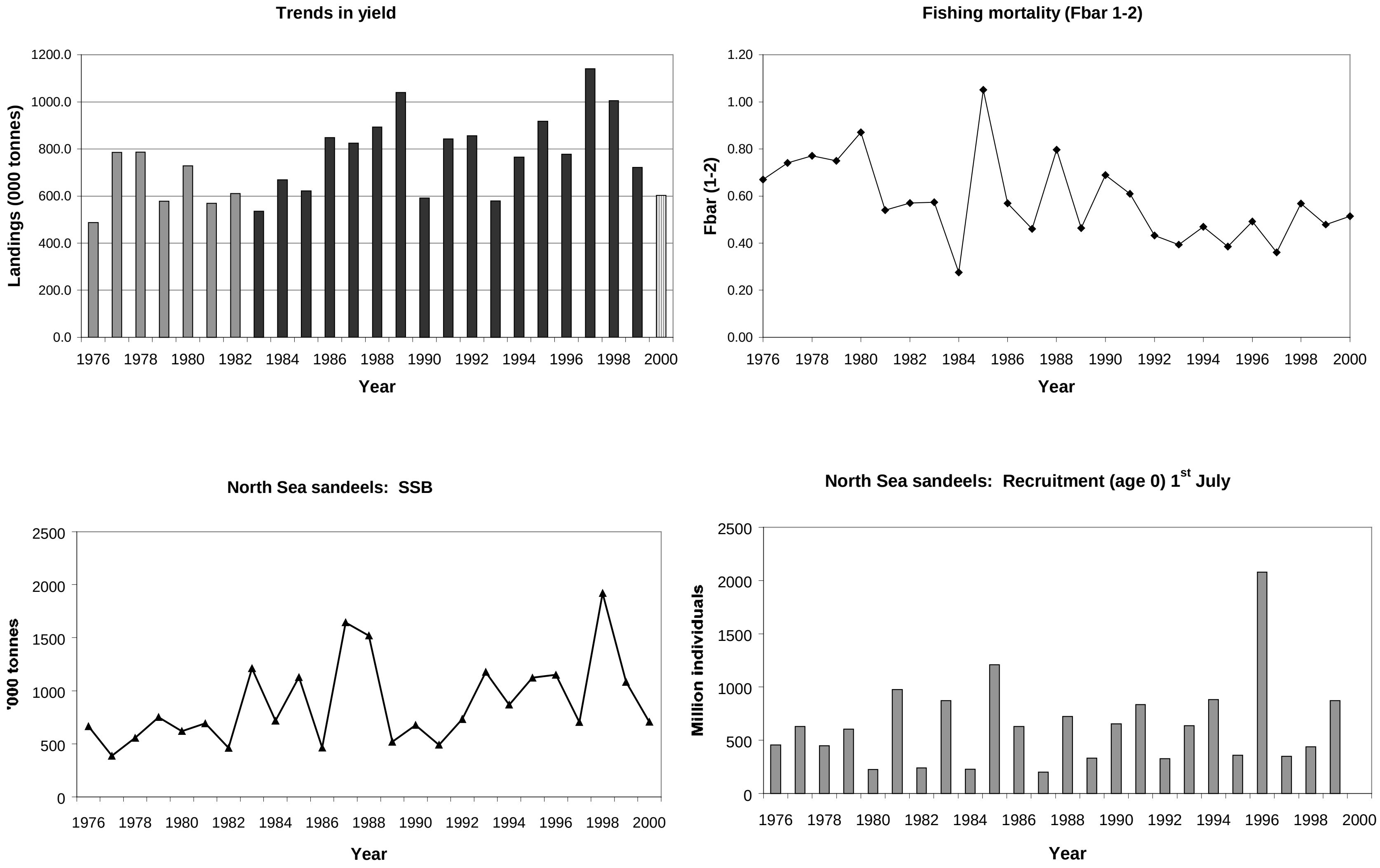


Figure 13.1.1.1 Proposed sandeel stock structure (Areas 1-7), based on particle drift analysis

Figure 13.1.3.1 Sandeels in the North Sea. trends in Yield, F, SSB and recruitment.



Yield plot. Black bars are values used in the current assessment. The value for 2000 are the landings up to 31.06.00.

Figure 13.1.3.1 (continued) Trends in mean F (age1 – 2) Northern and Southern areas.

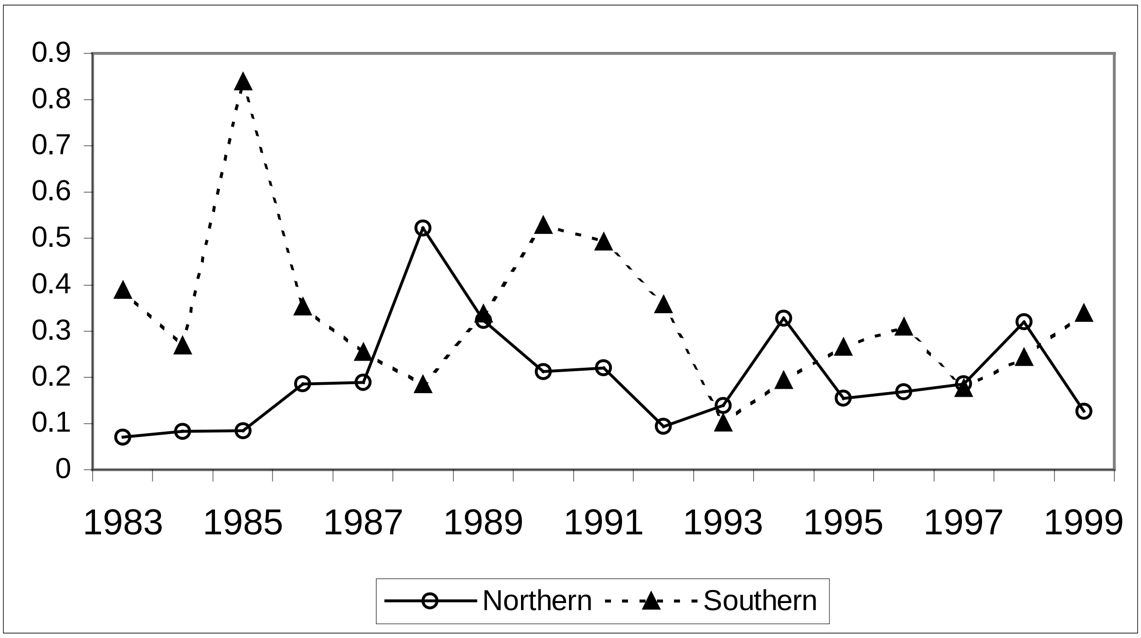


Figure 13.1.3.2 The North Sea showing Danish Sandeel sampling and assessment areas used by the Working Group

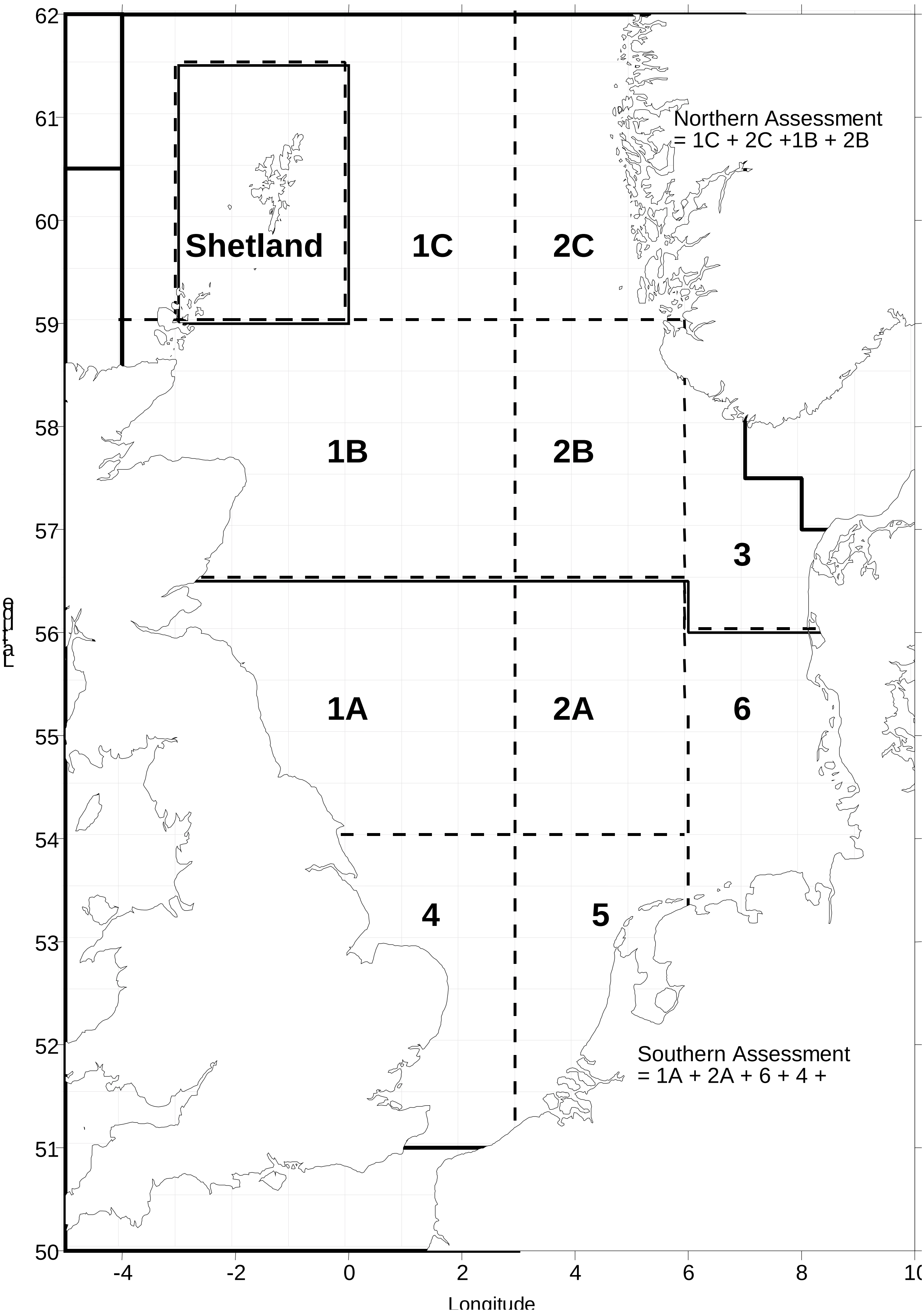
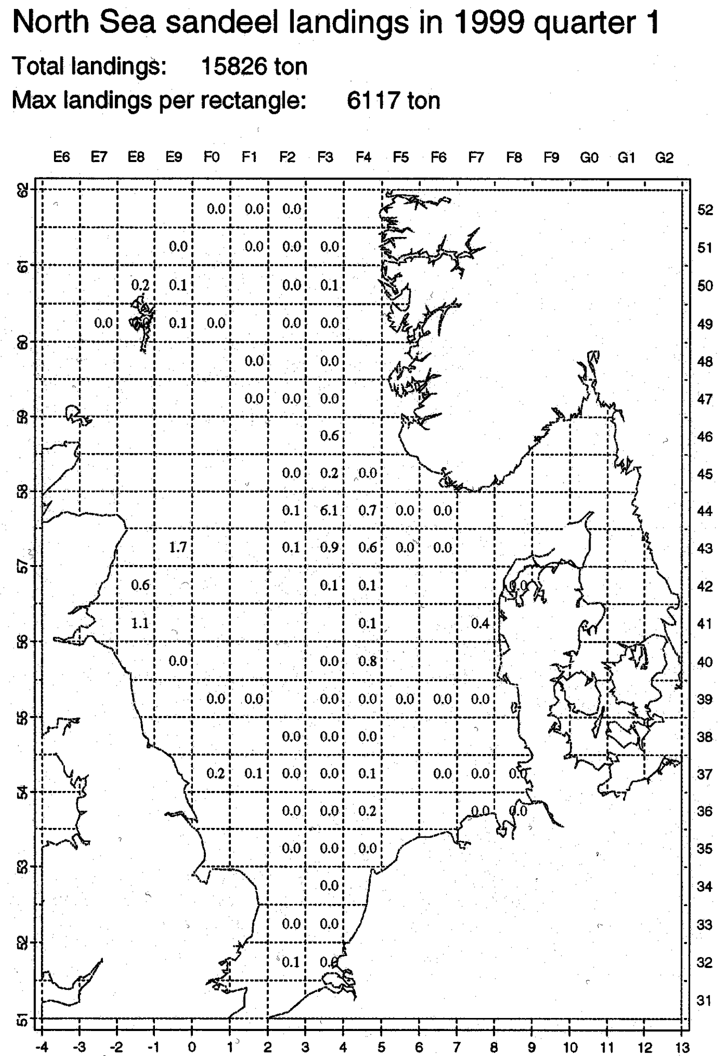
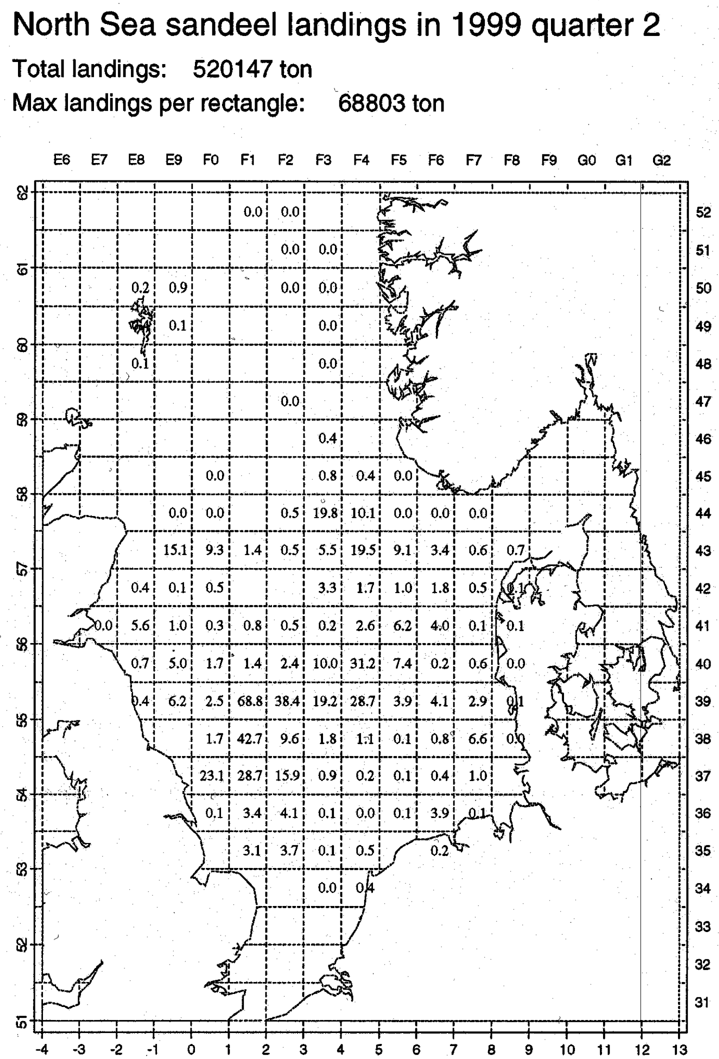


Figure 13.1.3.3 Quaterly catches of Sandeel by ICES rectangle ('000 tonnes).



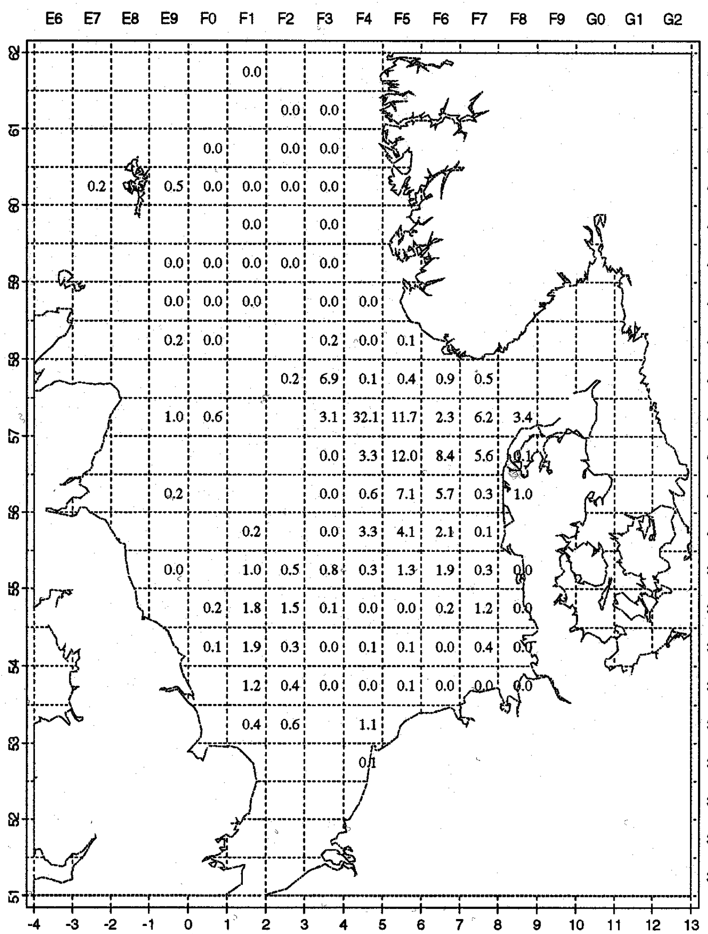


igure 13.1.3.3 (continued) Quaterly catches of Sandeel by ICES rectangle ('000 tonnes).

North Sea sandeel landings in 1999 quarter 3

Total landings: 144160 ton

Max landings per rectangle: 32139 ton



North Sea sandeel landings in 1999 quarter 4

Total landings: 19042 ton

Max landings per rectangle: 10936 ton

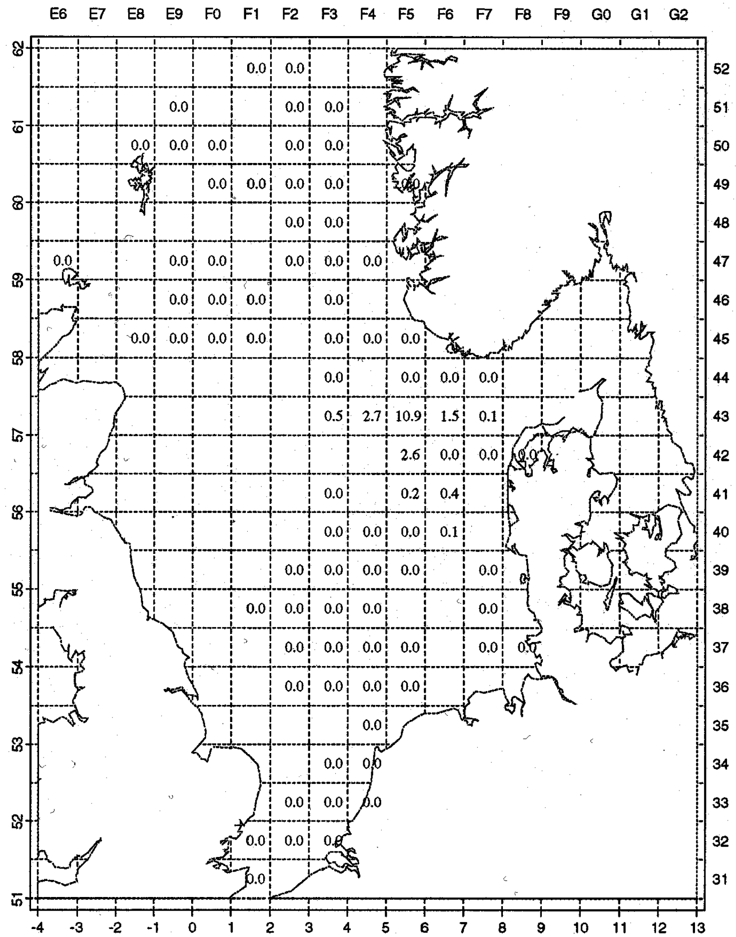
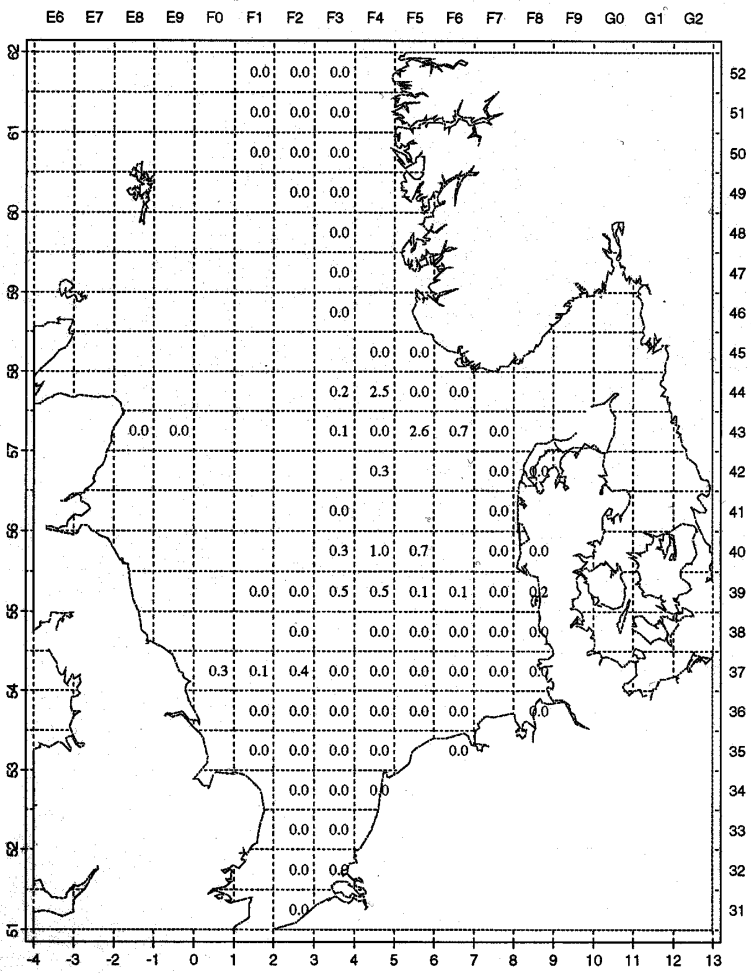


Figure 13.1.3.3 (continued) Quaterly catches of Sandeel by ICES rectangle ('000 tonnes).

North Sea sandeel landings in 2000 quarter 1

Total landings: 10854 ton

Max landings per rectangle: 2566 ton



North Sea sandeel landings in 2000 quarter 2

Total landings: 586164 ton

Max landings per rectangle: 74697 ton

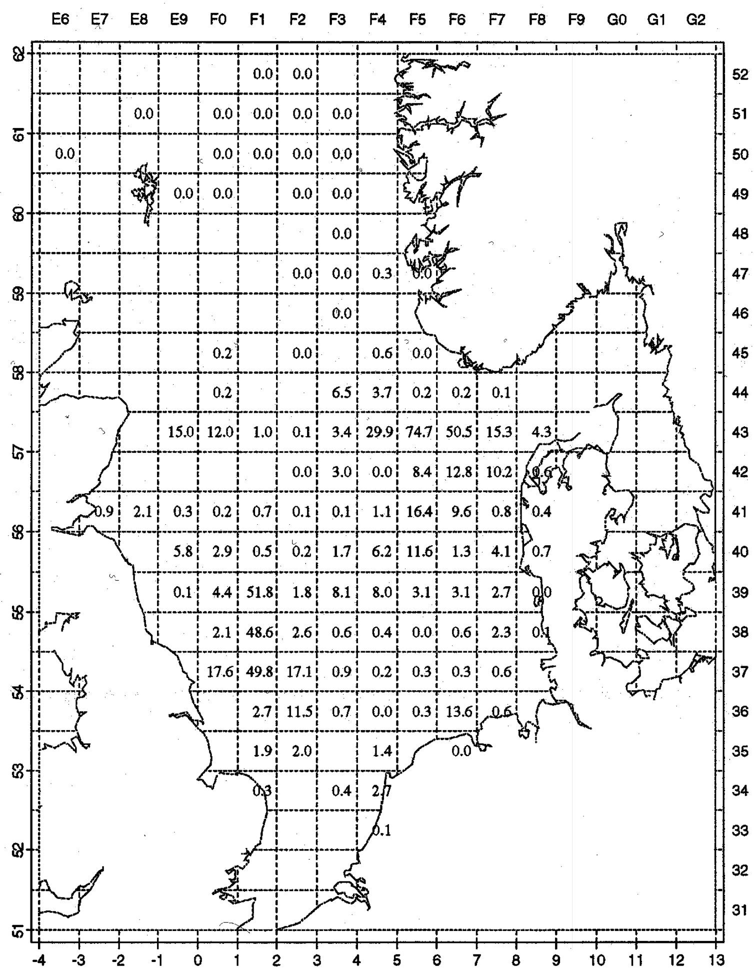
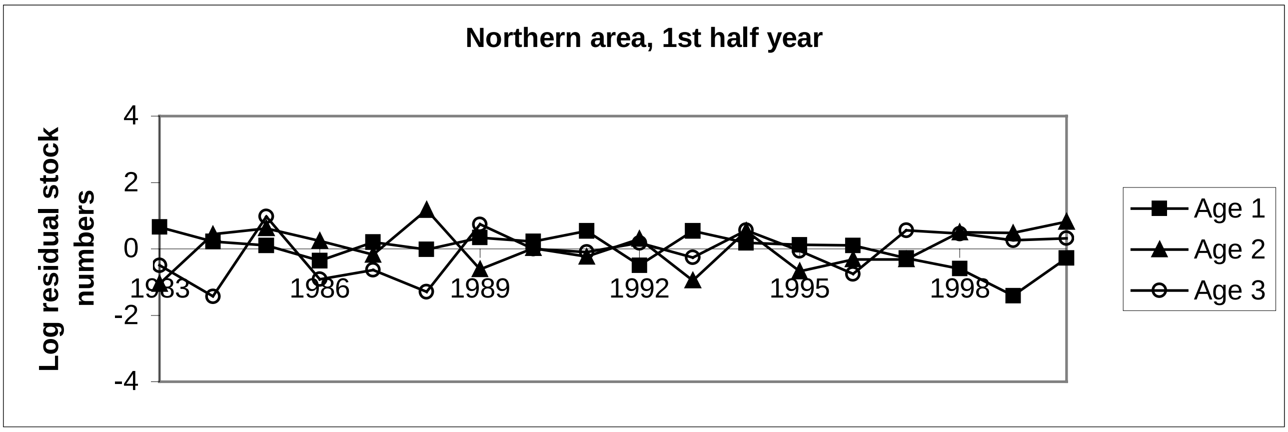
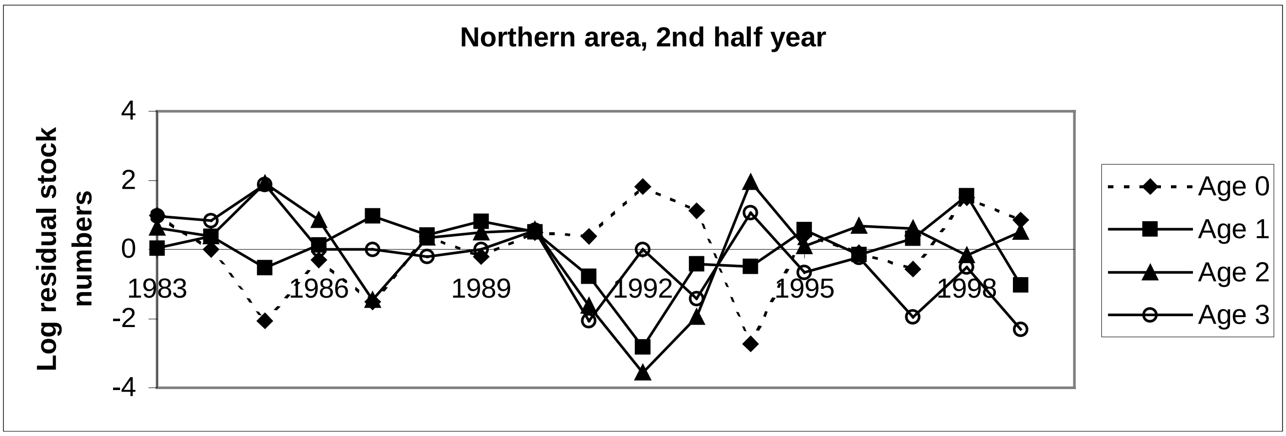
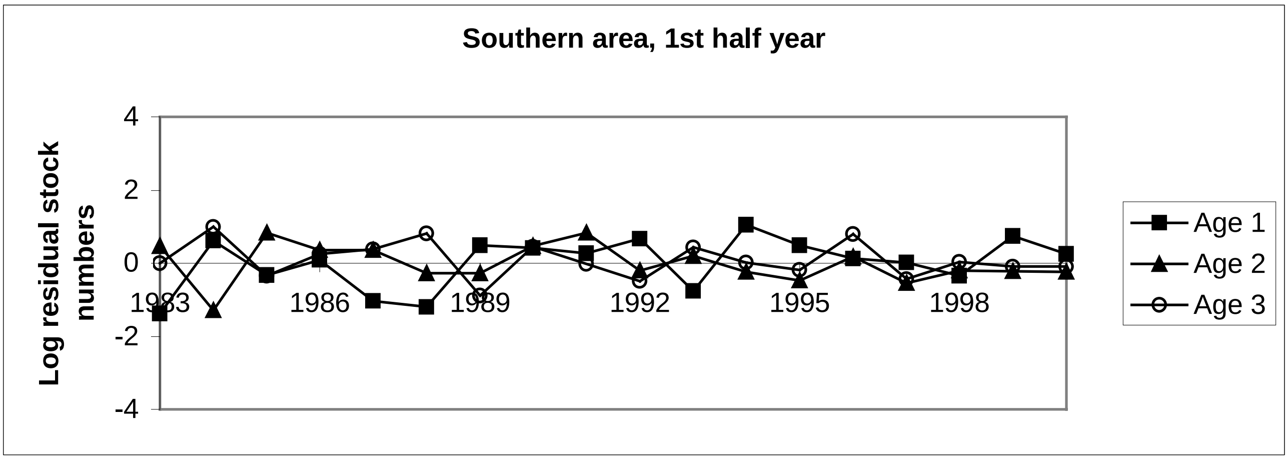
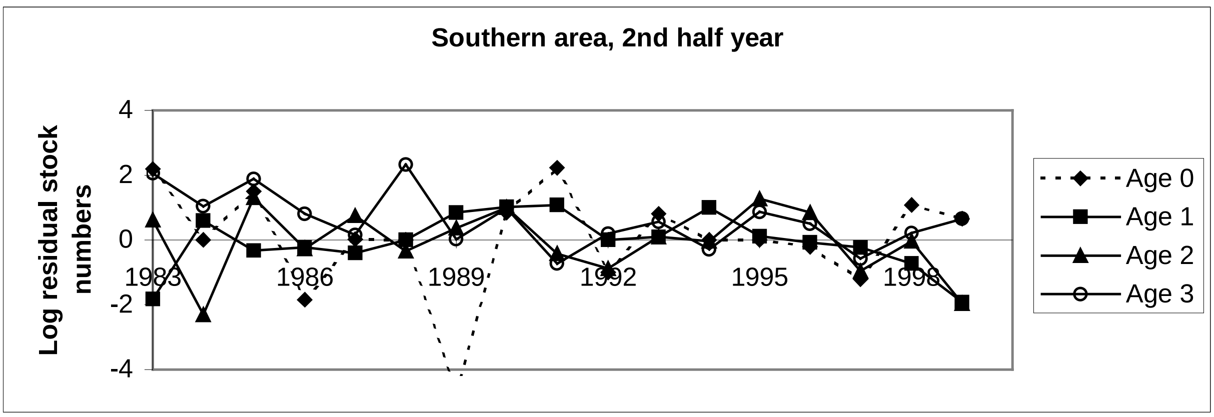


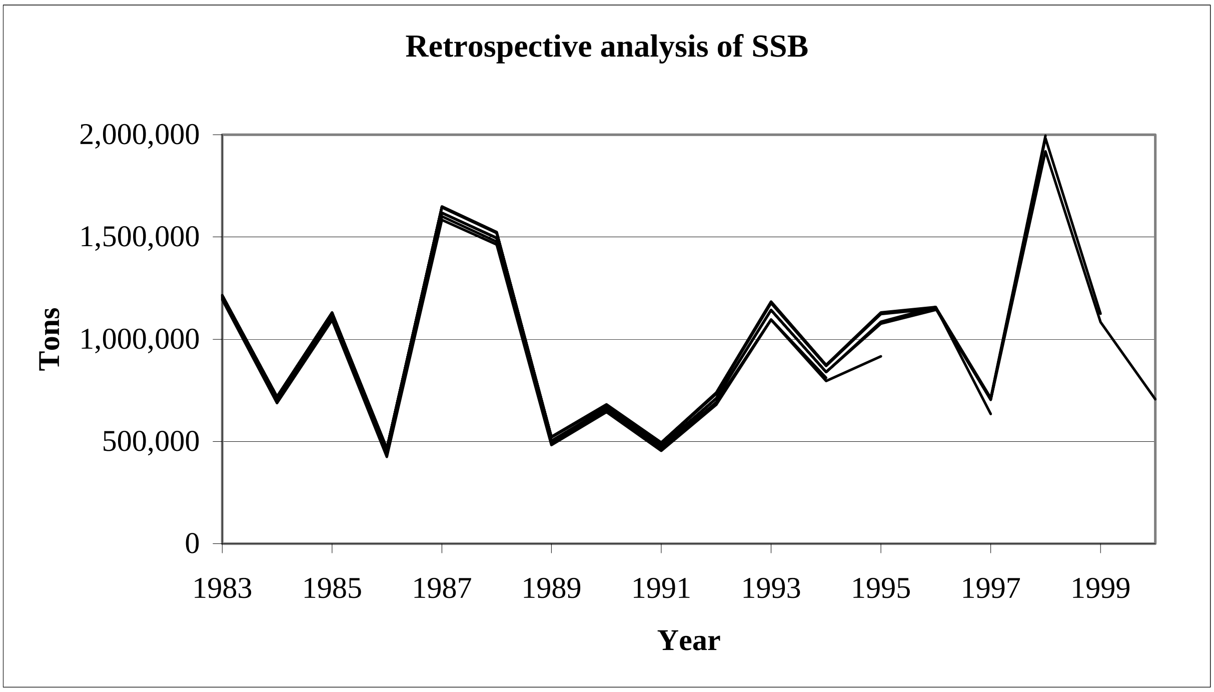
Figure 13.4.1 Log residual stock numbers by fleet and season











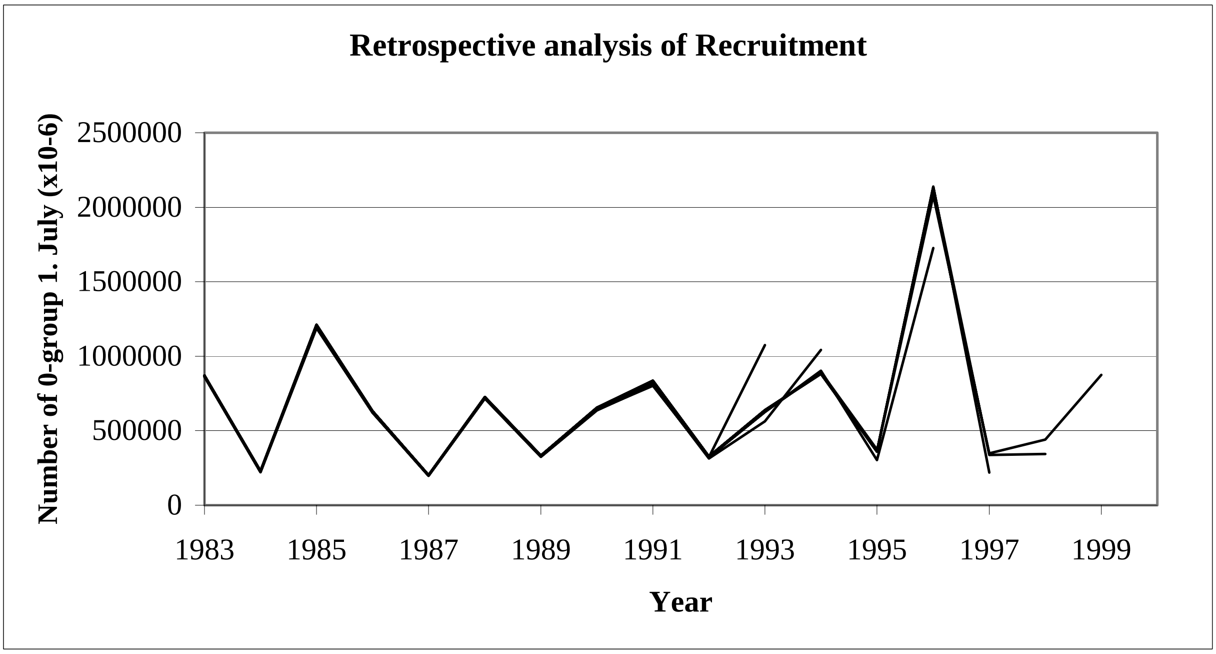


Figure 13.4.2.1 Retrospective analysis of SSB and Recruitment

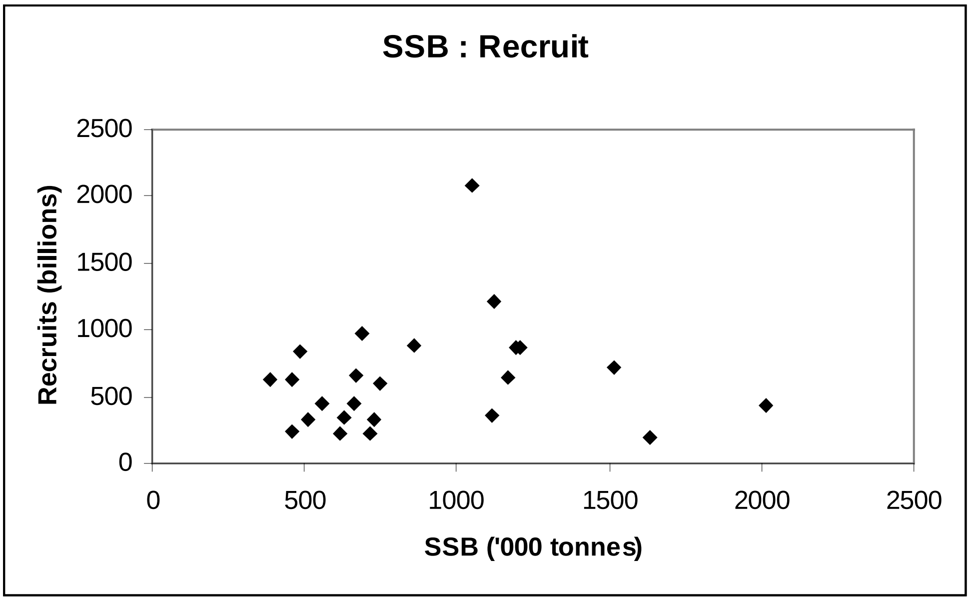


Figure 13.4.2.2 Stock Recruit relationship for North Sea Sandeels.

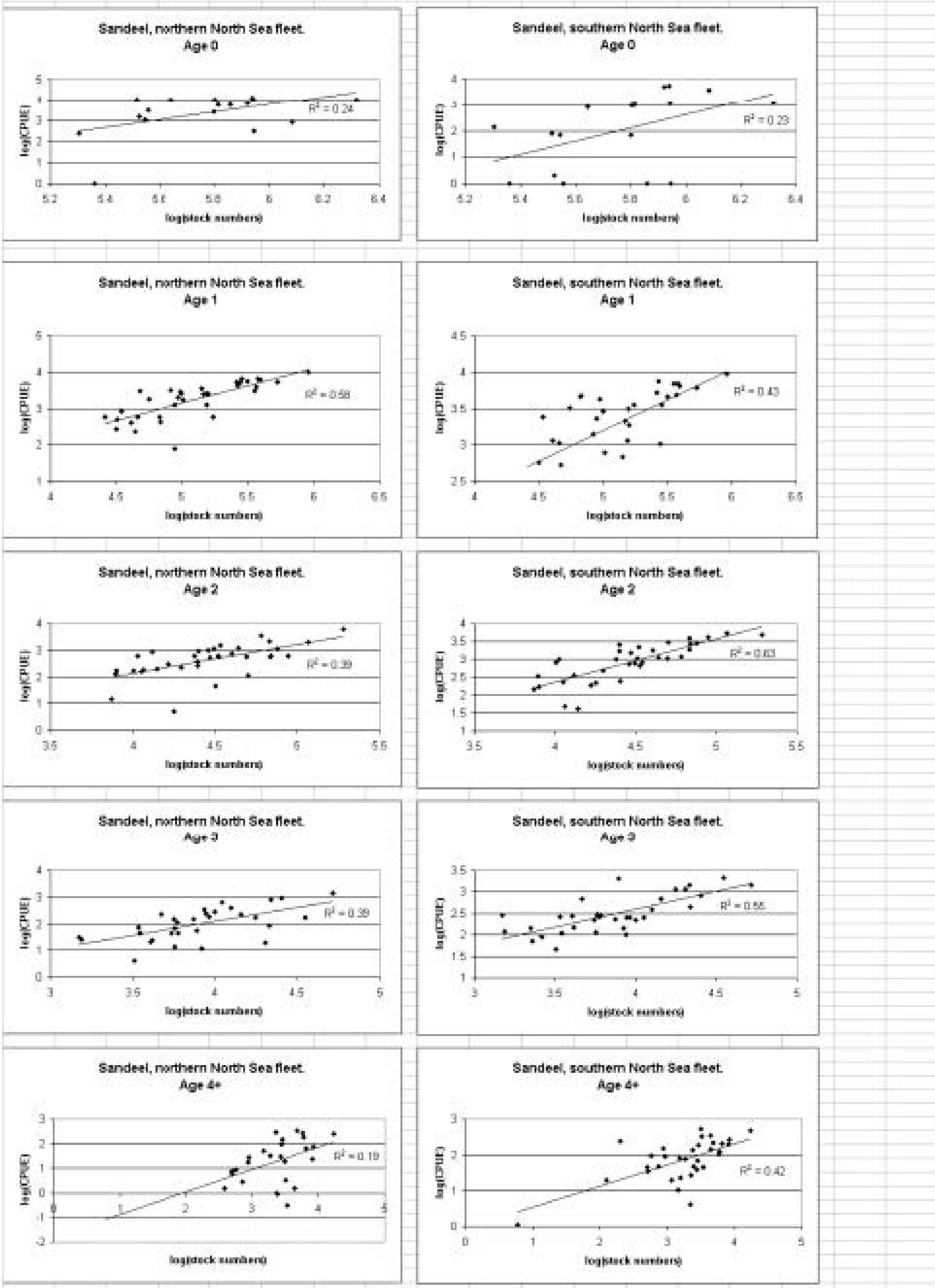


Figure 13.4.2.3. North Sea sandeel. Relationship between stock numbers estimated by SXSA and CPUE of tuning fleets

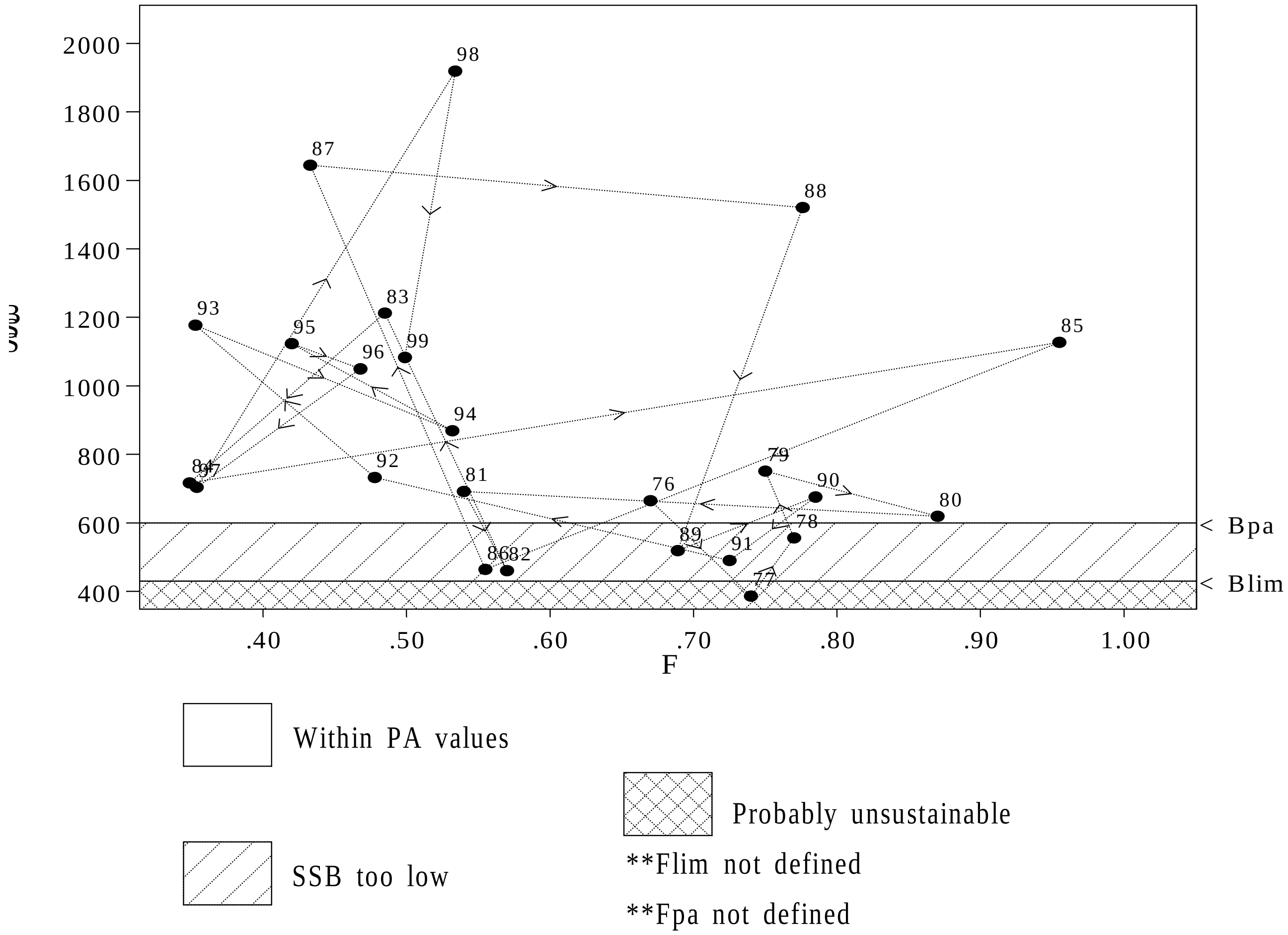


Figure 13.8.1 North Sea sandeel, SSB versus fishing mortality

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. Reported landings in 1999 were 4625 t, which is well below the series average of 11769t. 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 1999 landings continued the decline seen since 1996 with only 2,627t being caught. This is 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. The management arrangements for the fishery are due to be reviewed in advance of the 2001 season. Unfortunately, no age composition samples were obtained from the fishery during 1999 or 2000, so it is not possible to provide an updated assessment for this stock. Although this means that it is not possible to provide quantitative information on the current state of the stock, from the catch and effort data (Figure 14.3.1.1) it can be seen that the catch trends are closely related to the amount of annual effort, and the recent decrease in landings corresponds to a similar reduction in fishing effort. On this basis it seems likely that recent exploitation of this stock has been at a very low level.

Table 14.2.1; Norway Pout in Division VIa,

Annual Landings (t) as officially reported to ICES

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Denmark	28180	3316	4348	5147	7338	14147	24431	6175	9549	7186	4624
Faroes	11	-	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	1	-	-	-	-
Netherlands	-	-	-	10	-	-	7	7	-	-	1
Norway	-	-	-	-	-	-	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-	-	-	-
UK (E+W)	-	-	-	1	-	1	-	-	-	-	-
UK (Scotland)	5	-	-	-	-	+	-	140	13	-	-
Total	28196	3316	4348	5158	7338	14148	24439	6322	9562	7186	4625

Figure 14.2.1 Norway Pout in Division VIa, Catch trends.

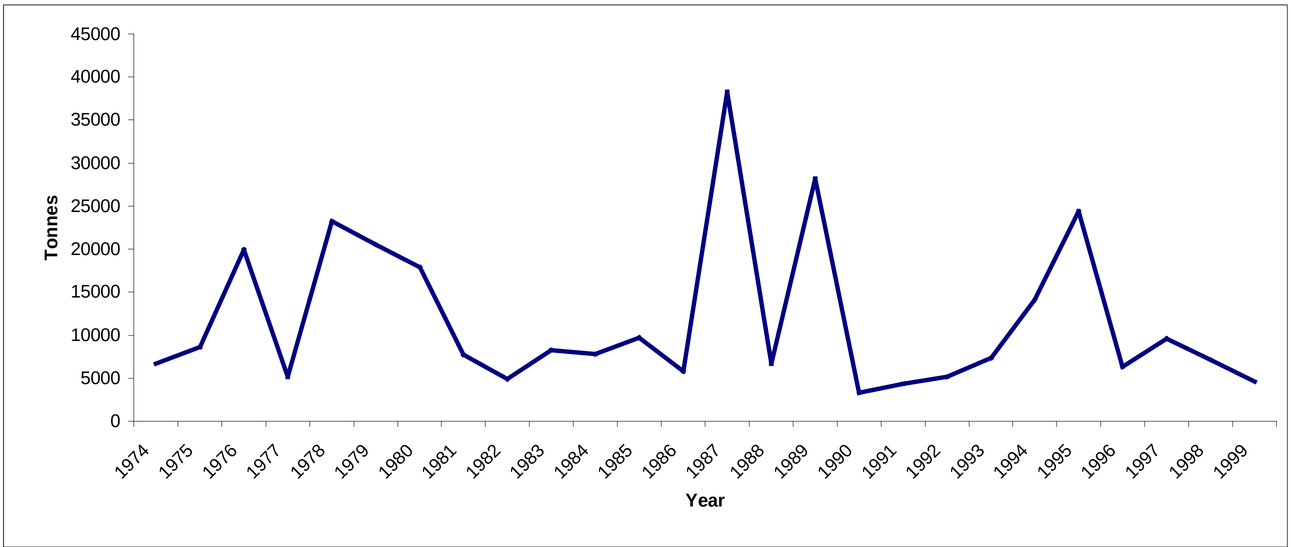
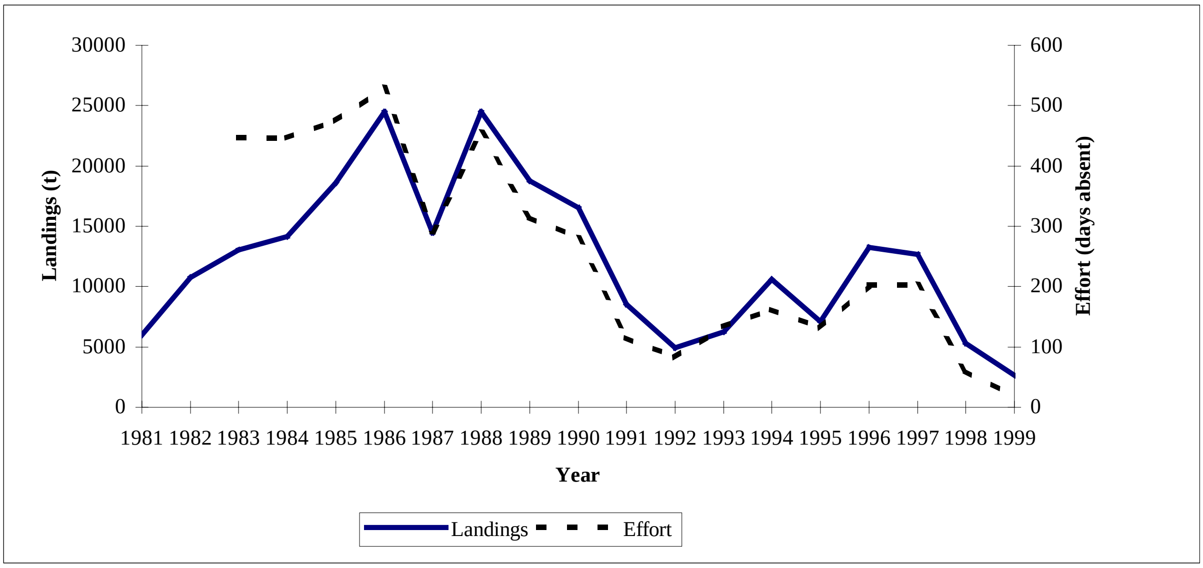


Table 14.3.1.1, Sandeel, Division VIa
Landings (tonnes), 1981-1999, as officially reported to ICES.

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	1999
Denmark	-	-	80	-	-	-	-	-	-
UK, Scotland	8532	4935	6156	10627	7111	13257	12679	5320	2627
Total	8532	4935	6236	10627	7111	13257	12679	5320	2627

Figure 14.3.1.1, Sandeel in Division VIa.
Trends in landings and effort



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