ICES Advisory Committee on Fishery Management
ICES CM 2005/ACFM:01

Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks (WGNSDS)

4 – 13 May 2004
ICES Headquarters, Copenhagen

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1.2 Terms of reference

The **Working Group on the Assessment of Northern Shelf Demersal Stocks** [WGNSDS] (Chair: R. Officer, Ireland) will meet at ICES Headquarters from 4–13 May 2004 to:

a) assess the status of and provide catch options for 2005 for the stocks of cod, haddock, whiting, anglerfish, and megrim in Subarea VI, and for cod, haddock, whiting, plaice, and sole in Division VIIa;

b) assess the status of anglerfish stocks in Subarea IV and Divisions IIIa and VIa and provide catch options for each management area;

c) review information on the stock structure of anglerfish in Divisions IIa, IIIa, Va, Vb, VIa and in Subarea IV and define appropriate stock areas for fish stock assessment usage;

d) consider and implement the proposed methodology for projection of yield by fisheries made by the Study Group on the Development of Fishery-based Forecasts based on the data compiled through this Study Group. The Group should present a limited set of fisheries-based catch options;

e) provide specific information on possible deficiencies in the 2004 assessments including, at least, any major inadequacies in the data on catches, effort or discards; any major inadequacies in research vessel surveys data, and any major difficulties in model formulation, including inadequacies in available software. The consequences of these deficiencies for the assessment of the status of the stocks and for the projection should be clarified;

f) comment on this meeting's assessments compared to the last assessment of the same stock, for stocks for which a full or update assessment is presented;

g) document fully the methods to be applied in subsequent update assessments and list factors that would warrant reconsideration of doing an update, and consider doing a benchmark ahead of schedule; for stocks for which benchmark assessments are done;

h) evaluate the effects of the existing recovery plans for cod in Division VIa and Irish Sea Cod.

Terms of Reference *a*, *b*, *e* and *f* are dealt with in Sections 3 – 12 giving the results of the assessments of individual stocks. The issue mixed fisheries interactions (ToR *d*) is dealt with in Section 13. Term of Reference *h* (evaluation of existing recovery plans for VIa & VIIa Cod) is dealt with in Sections 3 and 8, respectively. Medium term recovery plan evaluations are presented in Section 14. Term of Reference *c* (Anglerfish Stock Structure) is dealt with in Section 15. The Working Group's approach to implementing Term of Reference *g* is described in Section 1.4.

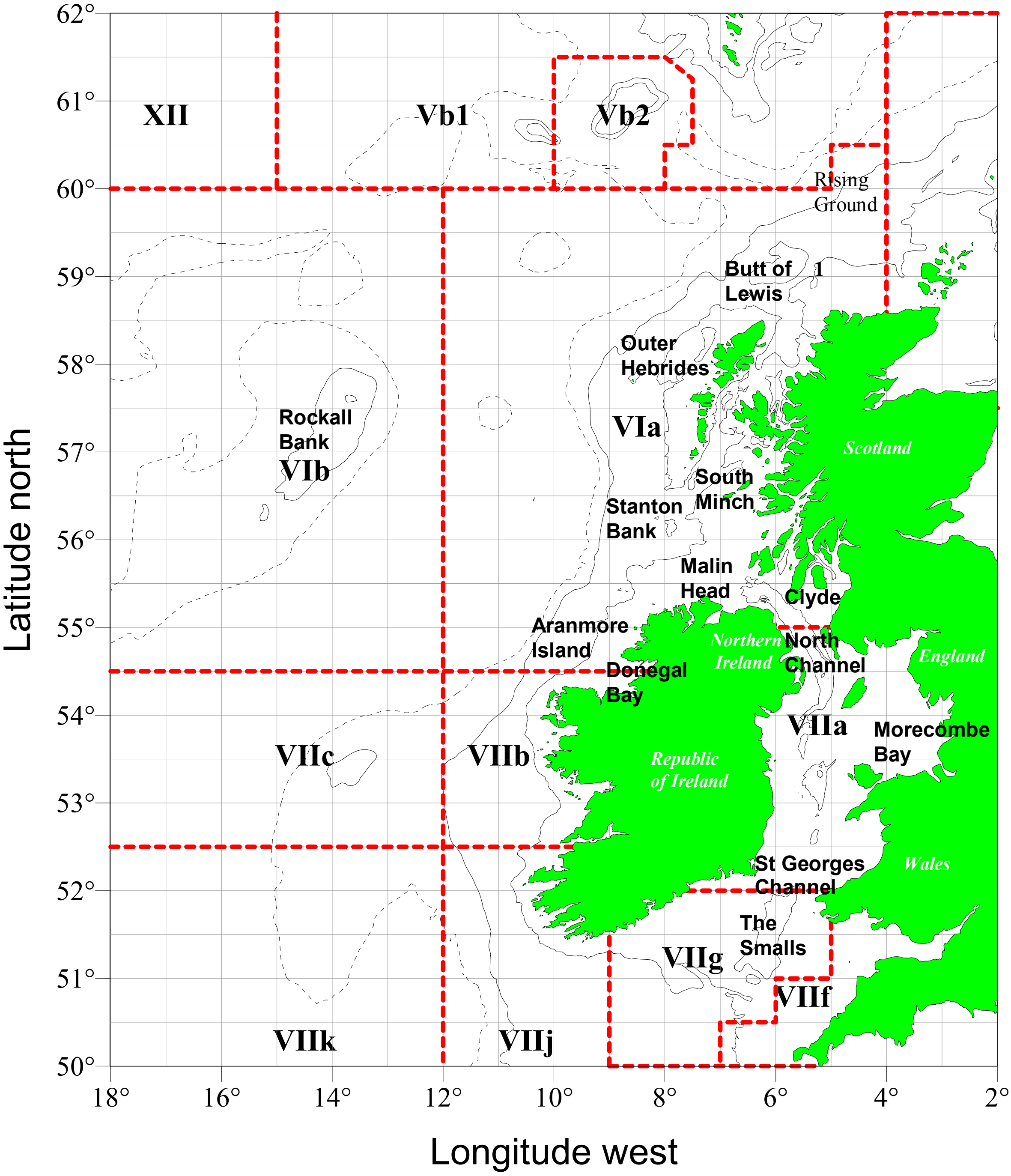

Figure 1.2.1. Map of the assessment areas showing the location of fishing grounds.

1.3 Working Documents Provided to WGNSDS 2004

1.3.1 WD1: The Precision of Irish Market Sampling for Rockall Haddock

Authors: R. Officer and S.-J. Moore

Summary: Preparation for the 2004 WGNSDS has involved a re-calculation of the time series of Rockall haddock assessment input data. An examination of the mean length-at-age of Rockall haddock sampled by Ireland, Scotland and Russia shows marked differences between countries. These differences were particularly apparent between the Scottish market sampling data and data from other sources. The precision of market sampling undertaken by Ireland was evaluated in order to determine whether the differences in mean length-at-age might be due to variability in the Irish sampling. Quarterly Irish market sampling data from 1995-2003 were analysed to obtain the precision of estimated catch numbers-at-age, catch-weight-at-age and mean length-at age.

1.3.2 WD2: Revised Estimates of Annual Discards-at-Age for Haddock in ICES Division VIa

Authors: R. Fryer and C. Millar

Summary: Previous studies have found that collapsing the sampling stratification provides more robust estimators of total species discards because the chance of getting an unrealistically high stratum ratio is reduced. These studies of simulated data showed that the collapsed ratio estimator had negligible bias, was more precise and also provided a means of estimating total discards in un-sampled strata. The Working Document presents provisional revised annual discards-at-age estimates for VIa haddock and compares these to the current estimates.

1.3.3 WD3: Revised Estimates of Annual Discards-at-Age for Haddock in ICES Division VIa: Resultant Effects on a TSA Assessment

Author: C. Millar

Introduction: This Working Document is intended as a supplement to Working Document 2. It presents the summary plots from two runs of TSA using the current and revised estimates of VIa haddock discards-at-age. The TSA was run as it has been utilised to assess VIa haddock for the last 3 years. Only the summary plots are presented in the Working Document. The intention is to show the likely effects of the revised discard estimates on the historical and current perceptions of the stock.

1.3.4 WD4: Bayesian Stock Assessment of Plaice in VIIa

Authors: R.M. Hillary and G.P. Kirkwood

Introduction: This alternative assessment of VIIa plaice is linked to the DEFRA project MO423. VIIa plaice are being used as a test stock for alternative stock assessment methods. The present assessment uses the same data available to the working group, but uses Bayesian state-space methods for estimation. This document contains the outline of the population dynamics model employed; the formulation of the Bayesian problem, given the data; the specifics of the MCMC (Markov chain Monte Carlo) method used in the estimation procedure; and the results of the assessment, and any predictive statements, congruous with the present WG methods.

1.3.5 WD5: Testing TSA with Simulated Data

Author: C. Needle

Abstract: The formulation of a fisheries data simulator is specified, and one realisation of this simulator is used to test the ability of three assessment methods (TSA, XSA, SURBA) to a) reflect reality and b) detect model misspecification. A general guide to setting up a TSA assessment is also included. None of the methods used performs particularly well in either test: all produce similar estimates of abundance which are wrong for much of the time-series, and none give sufficient diagnostics for misspecification detection. Firm conclusions would be unwise following a single test of this kind, but it is suggested that agreement between different assessment models does not necessarily indicate correct abundance estimates. Future work should investigate whether it is misspecification, data noise or incorrect model assumptions which cause these problems.

1.3.6 WD6: Rockall and the Haddock Fishery

Author: A. W. Newton, K. J. Peach, K. A. Coull, M. Gault and C. L. Needle

Summary: This Working Document presents the information that exists in the Marine Laboratory, Aberdeen concerning the haddock fishery at Rockall. The history of Rockall, the nature of the Plateau itself and the historical fishery are reviewed. Most of the information presented is based on historical data from a variety of sources and research vessel surveys but extra funding in 2001 has allowed some new information to be acquired.

1.3.7 WD7: Irish Sea Plaice Survey Tuning Indices

Author: R. Scott

Summary: The Working Document describes the VIIa plaice survey tuning indices that are available to the Working Group. There is no survey index that can be considered to be truly representative of the Irish Sea plaice stock as a whole since each series is derived from only a portion of the total assessment area. Tuning indices at age are compared by year and by year-class to evaluate trends throughout each time series and the ability to track year-classes.

1.3.8 WD8: Preliminary Assessment of the Rockall Haddock (*Melanogrammus aeglefinus*) Stock

Author: V.N. Khlivnoy

Summary: In recent years WGNSDS has repeatedly stated that a major impediment to making a reliable Rockall haddock assessment is the absence of information on discards and the lack of data on length-age composition of catches. A method for estimating historic discarded catch-at-age is presented. The Working Document also presents the results of a Rockall haddock stock assessment which takes account of discards and new data on length-age composition of catches.

1.3.9 WD9: Some Peculiarities of Distribution and Migration of Haddock (*Melanogrammus aeglefinus*) on the Rockall Bank

Authors: V. I. Vinnichenko and E. V. Sentyabov

Summary: The results of fisheries investigations on the Rockall Bank detailing the distribution of haddock are described. Changes in both biology and distribution of haddock are discussed with reference to their importance to the planning of stock assessments and, in particular, trawl surveys. The Working Document suggests the main environmental factors influencing the haddock distribution pattern and proposes improvements to demersal trawl surveys on the Rockall Bank.

1.3.10 WD10: Results from the Rockall Haddock (*Melanogrammus aeglefinus*) Research and Fishery by Russia in 2003

Authors: V.I. Vinnichenko and V.N. Khlivnoy

Summary: The Working Document shows results of the haddock research and fisheries on the Rockall Bank conducted by Russia in 2003. The aim is to summarise the fisheries and biological data collected and to present materials prepared for the Rockall haddock stock assessment.

1.3.11 WD11: Anglerfish in Norwegian Waters

Authors: O. Bjelland and K. H. Nedreaas

Summary: The Working Document details several aspects of the fishery for anglerfish in Norwegian waters: the type of vessels participating in the fishery, their gear and area of operation. Yield- and Spawning stock-per-recruit analyses are presented for the anglerfish caught in the Norwegian gillnet fishery, and total Norwegian fishery (including gillnet, trawl, and Danish seine).

1.3.12 WD12: Anglerfish (*Lophius* Spp.) in Nordic and European Waters: Status of Current Knowledge and Ongoing Research

Authors: T. Thangstad, J. E. Dyb, E. Jónsson, C. Laurenson, L. H. Ofstad and S. A. Reeves

Summary: The Working Document is a report prepared as a pilot study for a proposed 3-year research project aiming to co-ordinate a synoptic collection and analysis of anglerfish data in Nordic waters. The report describes the status with regard to research and knowledge about anglerfish in Nordic waters, as well as in other European regions. Proposed research topics and recommendations for a revised project application are given.

1.3.13 WD13: Information on Irish Sea Cod from the UK Fisheries Science Partnership

Authors: C. Bannister, J. Cotter, M. Armstrong, T. Boon, J. Keable and P. Witthames

Summary: The Working Document describes the results of a UK government/industry partnership project which has used chartered fishing vessels to carry out scientifically-monitored commercial fishing in a number of priority fishing areas nominated by industry. Data on the catch rate and size distribution of target and by-catch species caught during these trips is compared with data collected by market sampling and by research vessel surveys.

1.4 Report Structure and Implementation of the ICES Quality Control Handbook

In accordance with the guidelines in the ICES Quality Control Handbook the WGNSDS has:

- Drafted Stock Annexes for the stocks it assesses,
- Reduced the content of the Working Group report stock sections such that they concentrate more on the current assessment,
- Focussed attention on stocks designated as requiring full annual assessments, and,
- Attempted to apply update assessments to other stocks.

The WGNSDS notes that, of the stocks assessed by the WG, the 'observation list'[1] of stocks subject to a benchmark assessment every year only includes West of Scotland Cod and Irish Sea Cod. The WGNSDS considers only two stocks (Irish Sea plaice and sole) which are not on the observation list, and for which analytical assessments exist. Update assessments were therefore anticipated for VIIa plaice and sole at $WGNSDS_{2004}$. The Working Group intended to assess these stocks using the Same Procedure As Last Year (SPALY) with some exceptions (eg. tuning data alterations after preliminary analysis).

All of the other stocks considered by the WGNSDS were treated as experimental assessments at $WGNSDS_{2004}$. The justification of a more thorough analysis for each stock is as follows:

- III, IV & VI Anglerfish: The estimation of recruitment was questioned by ACFM last year and the WG was requested to consider using additional survey indices in the $WGNSDS_{2004}$ assessment. The very low credibility of the assessment was also raised prior to the WG at Industry meetings in two countries. Vessel logbook information was subsequently provided for consideration at this year's WG.

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[1] The 'observation list' published by ICES in 2002 was the most recent list available to $WGNSDS_{2004}$.

- VIa Whiting and VIa Haddock: These stocks are connected to the cod rebuilding plan by association in mixed fisheries. The questions raised by ACFM about the TSA assessments applied to VIa gadoid stocks required detailed analyses of the assessment models applied to these stocks.

- VI Megrim: There is no accepted assessment. ACFM urged the WG to experiment with alternative assessments of this stock.

- VIb Haddock: There is no accepted assessment. ACFM urged the WG to experiment with alternative assessments of this stock. Furthermore, the stock is subject to area closures designed to protect the stock and a potential rebuilding plan is under discussion. Survey-based analyses suggest that the stock is at a relatively low level, and indicate major changes in the stock status.

- VIIa Whiting: The stock is connected to the cod rebuilding plan by association in mixed fisheries. ACFM considered the $WGNSDS_{2003}$ assessment to be of poor quality but pragmatically adopted the assessment to facilitate management. Indications are that the stock is at very low level and a recovery plan was recommended by ACFM. Furthermore, the denial of access to samples in 2003, required increased scrutiny of the adequacy of input data at $WGNSDS_{2004}$.

- VIIa Haddock: Through association in mixed fisheries the stock is connected to the cod rebuilding plan and the whiting recovery plan recommended by ACFM. ACFM considered the $WGNSDS_{2003}$ assessment to be of poor quality but pragmatically adopted the assessment to facilitate management. Furthermore, the denial of access to samples in 2003, required increased scrutiny of the adequacy of input data at $WGNSDS_{2004}$.

Term of Reference *g* asks the Working Group to document fully the methods to be applied in subsequent update assessments. This documentation is provided for stocks subject to SPALY update assessments in the relevant Stock Annexes. For benchmark and experimental assessments it is not possible to describe the procedure to the same extent. Elements of such assessments that remain relevant from year to year have been included in the Stock Annex for each stock. Other information is given in the WG report.

Term of Reference *g* also asks the Working Group to list factors that would warrant reconsideration of doing an update, and consider doing a benchmark ahead of schedule. These considerations are presented in the "Quality of the Assessment" section for relevant stocks.

1.5 Recommendations

1. The major deficiency facing many assessments this year is the poor quality of the input data. This was caused mainly by sectors of the fishing industry in the UK (Northern Ireland) and Ireland denying access to samples. The WG recommends that efforts be made by Research Institutes and Industry organisations to improve cooperation.

2. The use of existing maturity ogives for the full historic series may not be appropriate, particularly in view of the large changes in stock size over time. The WG recommends that a comprehensive review of the biological parameters of the stocks is carried out, including analysis of recent survey data and an evaluation of the information (if available) on which historic estimates have been based.

3. The WG noted a general lack of uniformity in data management procedures between the participating nations. This was particularly apparent in the compilation of age based data sets where consistency had not been maintained in the age range of the data. In some cases where the plus group used in the assessment had been reduced, the data sets contained information only up to the revised plus group age and information regarding the older ages was no longer recorded. Considerable work would be required to re-calculate the data for older ages should the plus group be revised up again at any point in the future. Furthermore, the methods by which data had been compiled in earlier years, within individual institutes, was sometimes not apparent and the WG was unable to determine the quality and integrity of these data and, consequently, their applicability to various assessment methods. It is likely that this problem effects many Working Groups. It is recommended that ICES considers this issue and makes proposals for future protocols regarding consistency in data storage.

1.6 References

Anon. (2001). The distribution and biology of anglerfish and megrim in waters to the west of Scotland. EC Study Contract 98/096 Final Report August 2001.

Borges, L., Zuur, A., Rogan, E. and Officer, R. (Under review). Optimum sampling levels in discard sampling programmes. Submitted to the Canadian Journal of Fisheries and Aquatic Sciences.

Cook, R. M., P. A. Kunzlik and R. Fryer. 1991. On the quality of North Sea cod stock forecasts. ICES Journal of Marine Science, 48, 1-13.

Darby, C. and Flatman, S. (1994) Lowestoft VPA Suite Version 3.1 User Guide. MAFF: Lowestoft.

Hislop, J. R. G., J. C. Holst and D. Skagen. 2000. Near surface captures of post-juvenile anglerfish in the Northeast Atlantic – an unsolved mystery. Journal of Fish Biology, 57, 1083-1087.

Hislop, J. R. G., A. Gallego, M. R. Heath, F. M. Kennedy, S. A. Reeves and P. J. Wright. 2001. A synthesis of the early life history of anglerfish, *Lophius piscatorius* (Linnaeus, 1756) in northern British waters. ICES Journal of Marine Science, 58, 70-86.

ICES 2004. Report of an Expert Group on Rockall Haddock Recovery Plans following a request for advice made on behalf of the European Community and the Russian Federation. ICES CM 2004/ACFM:33.

ICES 2003. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 2002. ICES CM 2003/ACFM:02

ICES 2001. ACFM report - ICES Coop. Res. Rep. 246 (2) - Report of the ICES Advisory Committee on Fishery Management, 2001.

ICES 2001. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 2000. ICES CM 2001/ACFM:07.

ICES 2003. Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, 2003. ICES CM 2003/ACFM:04.

Kunzlik, P. (2003). Calculation of potential reduction in fishing mortality of North Sea and west of Scotland cod, haddock and whiting due to decommissioning of UK vessels in 2002. Working Document to the EU-Norway Expert Group Meeting, 28 May – 7 June 2003.

Kunzlik, P. A, A. W. Newton and S. Jermyn. 1995. Exploitation of monks (*Lophius* spp.) and megrims (*Lepidorhombus* spp.) by Scottish fishermen in ICES Division VIa (West of Scotland). EU FAR contract MA-2-250.

Mensil, B (March 2003). CSA Catch Survey Analysis Assessment Program Documentation. IFREMER - Laboratoire MAERHA Nantes (France).

Needle, C. L. (2003). Survey-based assessments with SURBA. Working Document to the ICES Working Group on Methods of Fish Stock Assessment, Copenhagen, Jan – Feb 2003.

Needle, C. L. (2004). Absolute abundance estimates and other developments in SURBA. Working Paper to the ICES Working Group on Methods of Fish Stock Assessment, IPIMAR, Lisbon, February 2004.

Sullivan, P. J., H-L Lai and V. F. Gallucci. 1990. A catch-at-length analysis that incorporates a stochastic model of growth. Can. J. Fish. Aquat. Sci. 47, 184-198.

Vinther, M, Reeves, S and Patterson, K (2003) From single-species advice to mixed-species management: taking the next step. ICES CM 2003/V:01

2 DATA AND METHODS

2.1 Stocks and Assessments

The stocks within the remit of this Working Group are tabulated in Table 2.1.1 along with the type of assessment carried out and an indication of whether this reflects a change to previous practices.

2.2 Sampling Data

Table 2.2.1 shows which countries provided assessment data to the Working Group for the year 2003, and the form of data provided. An increased amount of discard data was provided to the $WGNSDS_{2004}$ for several stocks. The level of sampling in 2003 for core assessment data (length measurements and age-length keys for landed catches) is indicated in Table 2.2.2, where data were available for individual countries. The data can be compared with the total international landings as used in the Working Group assessments. Deficiencies in sampling (if any) are discussed in the relevant stock Section.

2.3 Data compilation and aggregation

Institutes submitting data to the $WGNSDS_{2004}$ were asked to provide data in a format that may better support mixed-fisheries analyses and assessments. For stocks in Divisions VIa and VIIa (where mixed fisheries analyses may be possible) institutes were asked to submit their 2003 catch-at-age data by fleet/fishery and species rather than by stock (as has been done up until now). The fleet/fishery groupings to be used were those agreed by the $SGDFF_{2004}$ for demersal fisheries in VIa and VIIa. Institutes sometimes did not have sufficient sampling to support dis-aggregation into fleet specific catch-at-age datasets. In such cases the data co-ordinators allocated the most appropriate alternative age compositions and weights-at-age to the unsampled catch. The suitability of, and sensitivity to these allocations was assessed.

The stocks assessed by this Working Group have previously been split into three groups for which different data compilation and aggregation procedures were used. These groups were the Area VI gadoids, the Irish Sea gadoids and the Irish Sea flatfish. For the other stocks assessed by this WG, assessments are generally at a more preliminary stage and data compilation had been on a more *ad hoc* basis.

At the 2002 Working Group time was wasted correcting mistakes made in data collation for some stocks. It was thought that such problems would be best avoided if the data compilation and the assessment were co-ordinated by staff from the same laboratory. At the 2003 and 2004 Working Groups data compilation and the assessment of most stocks was co-ordinated by staff from the same laboratory, if not by the same person.

Much data was prepared in advance of the meeting but very late revisions to the Irish discard data, and Belgian and Scottish landings data necessitated a revision of input data at the Working Group. Revisions to the data are discussed in the appropriate stock Sections.

III, IV & VI Anglerfish

Data are supplied to the stock co-ordinators electronically. Data handling and aggregation is handled by standard spreadsheets that incorporate SOP checks at each stage. The files retain the full seasonal and gear disaggregation of the supplied data. Length compositions for landings where no length data are supplied are estimated using user-specified fill-in rules. Assessment files are updated manually and data are stored in spreadsheets with one worksheet per year.

Area VI Gadoids

Data are requested by the stock co-ordinator in electronic form in a specific format, although the format is not always adhered to by the Institutes submitting data. The data are then stored in ASCII files that retain the quarterly and gear disaggregation in which the data are supplied. At present the file handling and data aggregation are done by a series of BASIC programs. The programs do not perform any checks on the data. SOP-correction is optional, but is usually applied to ensure consistency given SOP discrepancies in some fleets in the early years of the data. Age compositions for landings where no age data are supplied, are normally estimated using the total age composition across all fleets for which age data are available. More appropriate age compositions and weights-at-age can be allocated to the unsampled catch but this process has to be done externally to the data aggregation program. The programs write a complete set of assessment data files so it is straightforward to update the assessment data each year.

Irish Sea Gadoids and Area VI Megrim

Data are supplied to the stock co-ordinators electronically. Data handling and aggregation is handled by standard spreadsheets which incorporate SOP checks at each stage. The files retain the full seasonal and gear disaggregation of the supplied data. Age compositions for landings where no age data are supplied are estimated using user-specified fill-in rules. Assessment data files are updated manually. Data are stored in spreadsheets, with one worksheet per year.

Irish Sea Flatfish

Data are supplied to co-ordinators electronically, and the data handling and aggregation is handled by a series of spreadsheet macros. Some SOP checking is included in these macros. Raw data are not routinely SOP corrected, although SOP corrections are applied to the combined and smoothed total international weights at age. The files retain the full seasonal and gear disaggregation of the supplied data. Age compositions for landings where no age data are supplied are estimated using user-specified fill-in rules. The data for one year are stored in an individual spreadsheet file, making it less straightforward to update data for all years. The process includes independent checking of the data by two people.

2.4 Database Revisions

The assessment data files are retained on the ICES network in the ASCII format used by the stand-alone assessment packages. All revisions to these files for individual stocks are discussed in the separate stock sections. Revisions to the data to incorporate estimates of misreported landings are described in the following Section.

WGNSDS$_{2004}$ made revisions to the 2002 Scottish landings used by the Working Group. Landings for particular gears and statistical rectangles had not been included in the previous extraction when effort was not reported for the strata. The revised landings amount to an increase of about 10% on the previous estimates.

2.5 Misreported Landings

ACFM has in the past expressed concern over the increasing amount of "unallocated" landings for stocks assessed by Working Groups, and asked for a more detailed explanation of the derivation of these figures. These unallocated landings represent adjustments to nominal landings figures to correct either for misreporting or for differences between official statistics and data obtained by national scientists. The general term misreporting is used throughout this report to include misreporting by area, misreporting of landings by species and under- or over-reporting of landings. The history of WG attempts to quantify misreporting is given in the 2000 WG report (ICES CM:2001/ACFM:01). A summary of current practices is given below.

Stocks in Sub-Area VI

Previous Working Groups have expressed a view that misreporting of area VI gadoids has not been significant in recent years because of low availability of fish relative to quotas. This year's Working Group was not able to make an informed judgement on misreporting of area VI gadoids. Values for misreported landings of VIa haddock in 1992 – 1994, inferred from survey data, are given in ICES CM 1996/Assess:1 and ICES CM 1997/Assess:2 and are included in the assessment files. The period 1992-95 has previously been treated explicitly in the TSA model for VIa cod as having unknown landings, which are estimated by the model conditional on the sample-based estimates of age compositions in the international landings and an assumption of no misreporting in 1996. Annual updates of the TSA assessment have made progressive downward estimates of these landings to levels very close to the reported values. The reported landings for these years are now included in the TSA assessment.

Misreporting of VIa whiting has historically not been considered a problem and no estimates are currently used. For anglerfish and megrim in Division VIa the existence of a restrictive precautionary TAC in Division VIa but no catch restrictions in the adjacent areas of the North Sea up until 1998 is suspected to have led to extensive reporting of catches from VIa into IVa. Such an effect is apparent in the reported distribution of catches by one nation where catches of anglerfish and megrim reported from the statistical rectangles immediately east of the 4^{o}W boundary (the E6 squares) have accounted for a disproportionate part of the combined VIa/North Sea catches of these species. This proportion has reached up to 57% in the case of anglerfish and 75% in the case of megrim. As it is strongly suspected that the large majority of catches reported from the E6 squares are actually taken in Division VIa the landings totals used in the assessments of these stocks have been corrected for this effect. The correction has been applied by first estimating a value for the true catch in each E6 square and then allocating the remainder of the catch into VIa squares in proportion to the reported catches in those squares. The 'true' catches in the E6 squares are estimated by replacing the reported values by the mean of the catches in the adjacent squares to the east and west. This mean is calculated iteratively to account for increases in catches in the VIa squares resulting from reallocation from the E6 squares.

Stocks in Division VIIa

Misreporting of cod, haddock and whiting in the Irish Sea has occurred during the 1990s due to restrictive quotas. This has mainly taken the form of misreporting between VIIa and surrounding regions (mainly from the Celtic Sea into the Irish Sea), and misreporting of species compositions (both over- and under-reporting). Reported (official) landings data from one country taking a significant part of the international catch have in the past been adjusted at source for area-misreporting based on local knowledge of fleet activities. Species-misreporting by another important national fleet has been estimated using a sampling method based on observations made by scientists taking length measurements in the ports. The mean observed weights of the three gadoid species per landing were calculated by port and gear type in 2002, and raised to the total number of landings for each port and gear in which at least one of the three species was recorded.

An analogous procedure was used for estimating haddock landings in 1993–2001 and landings of cod and whiting in 1998-2001. For cod and whiting in 1991–1997, observed and reported landings were compared and the mean proportion reported was calculated for different gear types. The mean proportions reported were used to correct the total reported landings for each species. Further details are given in ICES CM 1999/ACFM:1. The sample-based estimates of landings at official fish markets exclude any "black" landings made at non-designated ports or times and correct only for misreporting of species compositions. Possible increases in black landings may have occurred in the more recent years when some TACs have been set to achieve substantial reductions in fishing mortality without effective mechanisms for controlling fishing effort to the necessary extent. This is of concern not only for the accuracy of the assessments, but also for the appropriateness of assessment methods such as XSA in which survey and commercial CPUE data are evaluated against population numbers reconstructed from commercial catch data (see also Casey, J: Working Document 5; 2002 meeting of WGNSSK ICES CM 2003/ACFM:02).

2.6 Sequential population analysis and recruit estimation

Where a full analytical assessment was possible, the WG implemented either Extended Survivor's Analysis (XSA) with shrinkage and recruit calibration or time-series analysis (TSA) as the baseline method. This follows the practices adopted at the 1993–2003 Working Group meetings. In some cases both methods were applied to examine the effect of model choice on the assessment.

The full sequence of analysis for application of XSA to each stock is given below. A complete exploratory analysis to determine q-plateau and/or appropriate level of shrinkage is only carried out if the values used at previous Working Groups are no longer considered appropriate, or if new tuning series are included. The choice of catchability model for the younger age classes was reviewed for each stock following advice from ACFM that the youngest age class should not automatically be treated as recruits, particularly when the time series is short.

a) A separable VPA was carried out to screen the catch at age data in order to detect if large residuals or unusual patterns reveal anomalies in the data from year to year. The separable VPA was used to select the range of ages over which to run XSA, and to investigate the exploitation pattern.

b) Tuning fleets were scrutinised in detail to address the advice from the 2002 meeting of the Working Group on Methods of Fish Stock Assessment (WGMG) that "Working groups…should favour fewer data of good quality (as evaluated independently of the assessment model) instead of large quantities of data of unknown properties"; and that "The definition of fleets for tuning purposes should be improved, and stricter criteria should be used to select the catch and effort data retained for each fleet". Tuning fleets were evaluated independently of XSA or TSA as follows:

- The WG first considered if the survey or commercial CPUE fleet was potentially capable of providing an unbiased series of population indices for a given range of fish age classes. This was evaluated based on the distribution of fishing or survey stations relative to the known distribution of the stock; the type of fishing gear; the timing of a survey; whether or not changes in survey design or fishing gear over time, or in efficiency of fishing fleets, have been examined and their effect quantified; quality of sampling for length or age; and, in the case of commercial fleets, the absence of discards in the CPUE data at any age, the accuracy of the catch and effort data, and the targeting practices of the vessels. Where such evaluations were carried out in previous WG meetings, they were generally not repeated this year and any fleets previously excluded were not re-introduced unless there was a significant change in the data.

- The internal consistency of the data for each fleet was evaluated by examining the coherence of year-class effects at each age. For surveys with multiple ages, the separable model SURBA (survey based assessment) developed at the FRS Marine Laboratory in Aberdeen was run to examine how well the data conform to a simple model of separable year and age effects on mortality.

- The similarity of trends in the indices at each age was examined to check for consistency between fleets.

c) The consistency between the tuning data and the commercial catch at age data was examined by inspecting catchability residuals from single-fleet Laurec-Shepherd runs, or in some cases weakly-shrunk XSA (usually S.E. = 2.5), without taper and using the constant-catchability model for all ages. Age- and year- effects in log-catchability residuals over the entire time-series of data were examined. Based on the independent examination of tuning fleets, and the single-fleet L-S or XSA runs, a choice was then made on which fleets and age classes to be included in the multi-fleet XSA tuning. The period over which to tune the XSA was decided in such a way as to maximise the precision and minimise the bias in estimates of catchability in the final year, for those age classes where catchability was assumed constant. For a number of years the Working Group has avoided progressive down-weighting of data from earlier years using a tricubic taper and has instead used a fixed tuning window of 10 years. As many of the assessments are becoming more heavily dependent on survey data for tuning, the Working Group decided to abandon the 10-year fixed window approach and to use all years with data based on consistent survey methods. A further argument for this revised approach was to reduce variability introduced by the sudden exclusion of a year with influential catchability residuals. A 20-year tricubic taper was applied where progressive down-weighting of early year's data was considered advisable. Time-series estimates from SURBA and from the catch-at-age analysis of relative spawning stock biomass, catch, and mean fishing mortality were compared.

The working group was aware of a lack of consistency in the value of F shrinkage standard error chosen for "weakly shrunk" single fleet XSAs. A range of values between 2.0 and 3.0 were used at this year's meeting for exploratory analyses. Whilst it is accepted that the value chosen is very often subjective, the working group did not feel that standardisation to a fixed value would be an appropriate measure. The weighting applied to the F shrinkage estimates is also determined by the strength of the signal in the tuning data. For example the use of an F shrinkage standard error of 2.0 coupled with a tuning fleet which gives consistent information about year-class strength might result in very little weight being applied to shrinkage estimates and a weakly shrunk assessment. On the other hand, the use of the same level of F shrinkage with a tuning fleet that gives less consistent year-class signals would result in a greater weighting being given to the F shrinkage estimates and a strongly shrunk assessment. Clearly, the value of the F shrinkage standard error on its own cannot be used to denote an assessment as either weakly or strongly shrunk.

d) Once the tuning fleets and the age range for XSA had been chosen, ages for which recruit calibration (RCT3-type calibration) is appropriate were identified. These were typically the youngest ages tuned mainly by surveys and for which F-shrinkage gave unstable estimates of survivors. In these circumstances, the XSA fit for these age classes treated catchability as a power function of population size only if the relationship between Ln (adjusted survey indices) and Ln (XSA estimates) in singe-fleet runs was well defined, with an adequate number of observations.

The age above which catchability can be assumed fixed (the q-plateau) was as determined for each stock in previous Working Groups.

e) The XSA and TSA outputs were examined for retrospective patterns in estimates of fishing mortality, SSB and recruitment. The possible sources of such patterns were investigated. If such patterns could not be resolved, additional tuning runs were carried out to investigate if increased shrinkage could reduce the bias in estimates of terminal F. Appropriate levels of shrinkage were also considered in the light of recent trends in F or the presence of individual high values of F over the period to which shrinkage is applied.

f) The detailed diagnostic output of the XSA was inspected. This helped to determine which age groups in the final year should be replaced for input to prediction. Unless there was a good reason for doing otherwise, the XSA estimates for recruiting age groups were used for the stock predictions. In some cases, these values were overwritten using the geometric mean level of recruitment. The long term geometric mean was chosen unless strong recent trends in the recruitment time series indicated that this was inappropriate. In some cases including Irish Sea cod and plaice, where there was evidence of recent depression of recruitment (for example due to a stock-recruit relationship), the geometric mean was computed over a shorter recent period. If tuned values were to be overwritten and additional recent survey data were available, the RCT3 programme was used to calibrate recruitment levels using its default options. As XSA cannot incorporate survey indices collected after the last year of the catch-at-age data, previous WG's have treated some spring surveys as if they were carried out at the end of the preceding year. The age ranges were then shifted down by one year. A consequence of this is the loss of tuning data for the oldest true age in the survey, which can cause problems for stocks with no other tuning data for these ages. The 2002 meeting of the WG avoided this problem and retained the original age- and year-ranges. However, at the 2003 meeting the WG had been explicitly asked to use the most recent available data in the assessments. The WG therefore reverted to its previous practice of treating some spring surveys as if they were carried out at the end of the preceding year.

Minor exceptions to the implementation of the procedure outlined above are described in the Sections for each stock.

In view of ACFM concerns about the use of recruit calibration in XSA where the use of such a model may not be justified, all cases where this catchability model was used were reviewed closely by the Working Group using the criteria outlined in paragraph d) above. For consistency of notation in the individual stock sections, ages which have been treated as recruits in this manner, and thus where catchability has been treated as a power function of population size are referred to as using the power model, whereas ages where this option has not been used are referred to as ages using the mean-q model.

The 1999 WG noted an apparent problem in the convergence of XSA on data for VIIa plaice, and highlighted significant differences in catchability residuals between two runs with identical parameters, one of which had been allowed to iterate until "converged" (41 iterations), while the other had been stopped at 30 iterations. The XSA algorithm contains a feature in the fitting procedure which is intended to reduce the risk of finding a local minimum, and is invoked for the first of each set of ten iterations chosen after the default of 30 have been completed. Results from XSA convergence on 31, 41, 51 etc. iterations should be viewed with caution, as occasionally the feature can have the opposite effect. Carrying out more than 30 iterations is usually unlikely to be very fruitful.

Age-based analytical assessments were attempted on all stocks other than anglerfish and megrim. For anglerfish the time-series of age compositions were considered unreliable due to difficulties in ageing. At the 2000 meeting the WG commenced using a modified catch-at-size analysis (CASA) in which estimates of recruitment, selectivity parameters and overall fishing mortality were obtained by fitting predicted length compositions from a size-transition matrix model to the observed annual length distributions of anglerfish landings. The assessment is based on that described in Sullivan et al. (1990), and has been further developed at successive Working Groups.

ACFM in 2003 urged the Working Group to consider alternative assessment approaches for megrim. The survey data were examined as a simple time-series of survey biomass, separated into indices of smaller (pre-recruit) and larger fish. A proxy of exploitation history was derived by dividing the yield by the survey biomass. The utility of a Collie-Sissenwine Analysis (CSA) was also examined.

2.7 Short-term Predictions and Sensitivity Analyses

Short-term predictions and yield-per-recruit analyses were made for each stock subject to a full analytical assessment. These analyses were carried out using either the Marine Lab (Aberdeen) programmes (MLA), or the MFDP / MFYPR software (Multi-fleet Deterministic Projection / Multi-fleet Yield-Per-Recruit).

As in previous years, SSB calculations for all stocks are set at 1 January (proportion of F and M before spawning = 0).

Short-term predictions were made after deciding on the most appropriate value for recruitment in both the recent period and over the prediction period. Tuned estimates of recruiting year classes, if considered unreliable, were overwritten by a geometric mean value. In some cases, including where 2004 survey data were available, recruitment estimates from the RCT3 recruit calibration program were used. Where tuned values were overwritten for prediction purposes, they were either directly replaced with e.g., a RCT3 estimate, or in some cases the estimate at age 1 was adjusted to age 2 using the ratio of the population estimates of the relevant year class at those ages.

The WG estimates of landings for most stocks can differ substantially from the TAC due to partial uptake of national quotas, misreporting or discarding. Unless there was strong evidence that the catch in the interim year of the short-term forecast would be constrained by the TAC or other measures, the WG continued its normal practice of assuming *status quo* F in the interim year. In other cases, the value chosen as *status quo* F for each stock was considered in the light of recent variations or trends in the estimates of F, as recommended by ACFM. The estimate of *status quo* F used by default in short-term predictions was the unscaled mean F at age for the last three years. This procedure stems from the consideration that while the point estimate of terminal F represents the best available estimate of F_{2003}, it does not necessarily follow that it will also be appropriate as an estimate of F in 2004 and subsequent years. In the absence of any recent trends in F, an unscaled mean is considered a more appropriate estimate of *status quo* F than a scaled value.

The mean F vector was scaled to the mean F in the terminal year if there was clear evidence of a recent trend in F that is considered likely to continue or halt rather than increase again in the short term. A special case is a trend caused by retrospective bias. In this case, the true level of fishing mortality in the current year is essentially unknown, although it may still be possible to forecast the approximate *status quo* catch. To do this, the correlation between numbers and fishing mortality calculated from a given catch in the last year of the assessment must be retained otherwise the landings forecast may be seriously biased. In this case, a mean F over several years would be inappropriate. However, all forecasts based on assessments with strong retrospective bias must remain suspect.

Over-optimistic forecasts have been noted in some stocks assessed by ICES in which trends in weight-at-age are apparent and future weights are specified as an arithmetic mean of historic values. For most stocks assessed by the present Working Group, trends in weights at age were examined. For some stocks, the mean weights in the last year were used in forecasts if a recent trend was evident. Previous assessments of the VIIa haddock stock have taken year-class effects on growth into account when calculating stock weights for forecasts.

A detailed short-term prediction was made for each stock using the *status quo* F option. The contribution of recent year classes to future SSB and yields was tabulated, and the contribution of different sources of uncertainty to the variance of predicted SSB and yield was estimated where possible by means of sensitivity analysis. The sensitivity analysis programme WGFRAN4 gives estimates of the proportion of the total variance of predicted SSB and catch contributed by different inputs. The description of the abbreviated variable names on the Figures and Tables which show the results of sensitivity analyses for each stock is as follows (*a* is the age at recruitment, numerals indicate years):

Variable:	Description:
N*a*	Population number at age *a* in 2004
WS*a*	Stock weights at age *a* in prediction
WH*a*	Catch weights (landings) at age *a* in prediction
WD*a*	Catch weights (discards) at age *a* in prediction
M*a*	Natural mortality at age *a*
MT*a*	Proportion mature at age *a*
SH*a*	Selectivity (human consumption fleets) at age *a*
SD*a*	Selectivity (discards) at age *a*
sI*a*	Selectivity (bycatch) at age *a*
K04	Year effect on natural mortality in prediction in 2004
HF04	Year effect on (landings and discards) fishing mortality in 2004
R05	Recruitment in 2005

2.8 Reference Points

The terms of reference of the 1999 WG meeting requested the Group to review progress in determining reference points. This follows-on from the work done by the Group at its 1998 meeting, where following careful review, candidate reference points were proposed for each stock. These reference points were then considered, and in some cases revised, by ACFM, who have used them to frame management advice for the stocks for 1999 and subsequent years. $WGNSDS_{2004}$ was asked to comment on the PA reference points proposed by the Study Group on Precautionary Reference Points for Advice on Fishery Management ($SGPRP_{2004}$). The procedures used by the Working Group to select candidate reference points made use of the full time series of spawning stock, recruitment and fishing mortality estimates available for each stock.

The annual assessments made by the Working Group involve only the addition of a single year of data, and as a result would not normally result in a large change in the perception of the stock's dynamics. Furthermore, it is desirable that once reference points are defined for a stock, they should remain stable, and should not be redefined without a firm basis for doing so. While it may be desirable to review reference points if e.g., there is a major change in assessment data or methodology, or a substantial change in the perception of the relationship between spawning stock and recruitment, these cases represent the exception rather than the rule. Hence, a review of precautionary reference points was not undertaken at $WGNSDS_{2004}$.

2.9 Quality control

The terms of reference for the WG include identifying major deficiencies in assessments. The problems associated with individual assessments are discussed in the 'quality of assessment' sections within each individual stock section. In many cases, the problems are associated with data quality: e.g. due to misreporting; discard estimates of low precision; survey data with catchability problems, etc. For some stocks such as Irish Sea haddock and plaice, and Rockall haddock, there are clear deficiencies in the data due to the absence of time series of discard estimates particularly for young fish for which survey indices are available. For anglerfish, and to a lesser extent megrim, there are major deficiencies in the understanding of the basic biology of the species that impede the development of appropriate stock assessments. In Rockall haddock and megrim there are major components of the catch for which there is no length or age sampling or a discontinuous time series of such data.

A major problem that affects many of the assessments is retrospective bias and how it should be dealt with in catch at age analysis and short-term predictions. Where retrospective bias was evident, the Working Group considered possible causes with reference to both catch and survey data. However, no attempt was made to correct any forecasts for bias. In general arbitrary shrinking of the assessment was avoided, as this generally does not deal with the underlying problem, but merely hides it. However, there are some stocks for which there are few age-classes in the stock and a short time series. In such cases XSA requires relatively high levels of F shrinkage.

2.10 Biological parameters of stocks

Previous ACFM reviewers have commented on the different methods used by the WG to estimate stock weights, and have been particularly concerned at using catch weights as the proxy for stock weights. The declining abundance and age composition in heavily exploited gadoids means that weights at age may be poorly estimated for the older ages where few fish may be represented in the age length keys for the catches. This adds un-necessarily to the uncertainties in mean weight at age in the forecast, both for catch and stock. In cases where catch (or even worse, landings weights) for partially recruited ages are used as stock weights, the biomass will be over-estimated for these ages. This can lead to incorrect total biomass estimates in the VPA output. There is a pressing need for this (and presumably other WGs) to develop a consistent methodology for (a) dealing with the variability introduced by small numbers of fish at the older ages in ALKs and (b) to develop robust and consistent methods for estimating stock weights that are not influenced unduly by sampling error and that track real changes in growth of different year classes.

The interaction between maturity ogives and stock weights influences the estimation of reference points for spawning stock biomass. The maturity ogives for some of the stocks assessed by the WG have remained unchanged for many years and may no longer be appropriate. The ogives for Irish Sea cod, plaice and sole were revised following sampling carried out as part of an EU contract to estimate SSB using the annual egg production method. However, the use of these ogives for the full historic series may not be appropriate, particularly in view of the large changes in stock size over time. The WG recommends that a comprehensive review of the biological parameters of the stocks should be carried out, including analysis of recent survey data and an evaluation of the information (if available) on which historic estimates have been based.

2.11 Total Allowable Catches

The Total Allowable Catches (TAC) by species and management area for stocks assessed by the Working Group were as follows:

Stock	Management Area	2001 TAC	2002 TAC	2003 TAC	2004 TAC
Cod	Vb $^{\alpha}$, VI, XII, XIV	3,700	4,600	1,808	848
	VIIa	2,100	3,200	1,950	2,150
Megrim	Vb $^{\alpha}$, VI, XII, XIV	4,360	4,360	4,360	3,600
Anglerfish	IIa $^{\alpha}$, IV $^{\alpha}$	14,130	10,500	7,000	7,000
	Vb $^{\alpha}$, VI, XII, XIV	6,400	4,770	3,180	3,180
Haddock	Vb, VI $^{\alpha}$, XII, XIV	13,900	14,100	8,675	~
	Vb, VIa	~	~	~	6,503
	VIb $^{\alpha}$, XII, XIV	~	~	~	702
	VII, VIII, IX, X, CECAF 34.1.1.1 $^{\alpha}$	12,000	9,300	8,185	9,600
	VIIa $^{\beta}$	2,700	1,300	585	1,500
Whiting	Vb $^{\alpha}$, VI, XII, XIV	4,000	3,500	2,000	1,600
	VIIa	1,390	1,000	500	514
Plaice	VIIa	2,000	2,400	1,675	1,340
Sole	VIIa	1,100	1,100	1,010	800

$^{\alpha}$: European Community waters.

$^{\beta}$: Within the limits of the VII, VIII, IX, X and CECAF 34.1.1.1 TAC, no more than the quantity stated may be taken in Division VIIa.

2.12 Software

The main software and versions used were:

Software	Purpose	Program/Version	File Creation Date
VPA suite (Separable VPA, XSA, Laurec-Shepherd *ad hoc* tuning)	Historical assessment	VPA95.exe Version 3.2	8/6/1998
Retrospective XSA	Retrospective analysis	Retvpa02.exe Version 3.1	18/4/2002
MFDP	Short-term forecast	Visual basic installation	Setup: 29/4/1996 Config: 28/6/2000
MFYPR	Yield per recruit	Visual basic installation	Setup: 29/4/1996 Config: 28/6/2000
PASoft (EXCEL add-in)	PA reference points estimation	PASoft with Fishlab.dll	June 1999
MAKEVCF	Header file generator for stock (sensitivity etc.)	Makevcf90.exe	20/5/2002
INSENS	Creates sensitivity & medium-term input files	Insens90.exe	20/5/2002
WGFRANSW	Sensitivity analysis	Wgfransw.exe	22/5/2001
RECAN	Stock-Recruitment modelling	Recan22.exe	7/10/2003
RECRUIT	S/R estimation	Recruit.exe	4/2/2002
RECRUIT2	S/R estimation – small stocks (but limited years)	Recruit2.exe	24/10/1996
WGMTERMC	Medium-term analysis	Wgmtermc.exe	3/11/1999
MTMPLOT	Medium-term & contour plotting program	Mtmplot.exe	2/12/1998
Various other plotting routines (PLOTCONV, WPAPLOT, PAPLOT, etc.)	SSB/F trajectory with reference points	e.g. Wpaplot.exe; plotconv.exe etc.	4/2/2002; 20/11/2000
SURBA	Survey-Based Analysis	Version 2.20	6 May 2004
Collie-Sissenwine Analysis	Stage-based, Catch-Survey Analysis	Version 2.0.14	June 2003
TSA	Time Series Analysis	Versions compiled at $WGNSDS_{2004}$	Program recompiles on execution

SURBA is a development of the RCRV1A model of Cook (1997). It assumes a separable model of fishing mortality, and generates relative estimates for population abundance (and absolute estimates for fishing mortality) by minimising the sum-of-squares differences between observed and fitted survey-derived abundance. The method is described in detail in Needle (2003) and the software is available on the ICES network. SURBA has been used to produce comparative stock analyses in several ICES assessment Working Groups ($WGNSSK_{2002}$, $WGNSDS_{2002\ \&\ 2003}$), and has been scrutinised by the ICES Working Group on Methods of Fish Stock Assessment ($WGMG_{2003\ \&\ 2004}$).

2.13 Research vessel surveys used by Working Group

The majority of surveys and commercial CPUE fleets used for catch-at-age analysis tuning in the present Working Group are described in Appendix 1 and 2 of the report of the 1999 Northern Shelf Demersal Working Group. Some new series were described in the 2002 WG Report (ICES CM 2003/ACFM:04). Working Document 7 describes the surveys available for the assessment of Irish Sea plaice. The first year of new survey series for the Irish Sea (cod, haddock, whiting, plaice and sole) and West of Scotland (Cod, Haddock, Megrim and Whiting) were provided to the WG this year from the Irish (RV *Celtic Explorer*) Quarter 4 IBTS survey.

Table 2.1.1 2004 Working Group on the Assessment of Northern Shelf Demersal Stocks. Summary of past and current practices for stock assessment. SPALY denotes that the Same Procedure As Last Year was used.

Stock:	Working Group: 2001	2002	2003	2004
Division III, IV and VI				
Anglerfish	Catch-at-size analysis	SPALY	SPALY	No assessment
Division VIa				
Cod	TSA, short- & medium-term predictions	SPALY	SPALY	Modified TSA & XSA assessments
Haddock	TSA, short- & medium-term predictions (& discards)	SPALY	SPALY	Modified TSA & XSA assessments
Whiting	TSA, short- & medium-term predictions (& discards)	SPALY	SPALY	Modified TSA & XSA assessments
Megrim	No assessment	Separable VPA	SPALY	Collie-Sissenwine Analysis
Division VIb				
Haddock	XSA (no predictions)	XSA, short-term predictions	No assessment	No assessment
Division VIIa				
Cod	XSA, short- & medium-term predictions	SPALY	SPALY	XSA & TSA assessment
Whiting	XSA, short-term predictions (& discards)	SPALY	SPALY	No assessment
Haddock	XSA, short-term predictions	SPALY	SPALY	XSA, TSA, SURBA assessments
Plaice	XSA, short- & medium-term predictions	SPALY	SPALY	SPALY
Sole	XSA, short- & medium-term predictions	SPALY	SPALY	SPALY

Table 2.2.1 2004 Working Group on the Assessment of Northern Shelf Demersal Stocks. A summary of countries from which assessment data was provided in 2003 for the stocks covered by WGNSDS.

Data	Cod			Haddock			Whiting			Plaice	Sole	Megrim		Anglerfish			
	VIa	VIb	VIIa	VIa	VIb	VIIa	VIa	VIb	VIIa	VIIa	VIIa	VIa	VIb	VIa	VIb	IIIa	IV
Catch weight (main exploiters)	E&W Fr IR NI No Sc	E&W IR Sc Fr	B E&W Fr IR NI Sc	E&W Fr IR NI No Sc Sp	E&W IR No R Sc Fr	B E&W IR NI Sc	E&W Fr IR NI Sc	E&W IR Sc	B E&W IR NI Sc	B E&W Fr IR NI Sc	B E&W Fr IR NI Sc	E&W IR NI Sc Fr	IR Sc E+W	E&W Fr G IR NI Sc Sp	IR Sc Fr		B E&W Sc
Catch length	IR Sc		E&W IR NI	IR Sc	IR R Sc	IR	IR Sc		E&W IR NI	E&W IR NI	B E&W IR	IR Sc	IR	IR Sc	Sc		Sc
Catch ALK	IR Sc		E&W IR NI	IR Sc	IR R Sc	IR	IR Sc		IR NI	E&W IR	B IR	IR Sc	IR	Sc IR	Sc		Sc
Catch wt-at-age	IR Sc		E&W IR NI	IR Sc	IR R Sc	IR	IR Sc		IR NI	E&W IR	B IR	IR Sc	IR	Sc IR	Sc		Sc
Discard weight	Sc IR			Sc IR		IR	Sc IR		NI	IR E&W							
Discard length	Sc IR			Sc IR		IR	Sc IR		NI	IR E&W							
Discard ALK	Sc IR			Sc IR		IR	Sc IR		NI								
Effort	IR Sc		E&W IR NI	IR Sc	R IR Sc	IR	IR Sc		E&W IR NI	B E&W IR	B E&W IR	IR	IR	Sc NI	Sc		E&W Sc
CPUE	IR Sc		E&W IR NI	IR Sc	R IR Sc	IR	IR Sc		E&W IR NI	B E&W IR	B E&W IR	IR	IR				
Pre-recruit survey index	IR Sc		E&W IR NI Sc	IR Sc	Sc	IR NI Sc	IR Sc		E&W IR NI Sc	E&W IR	E&W	IR		Sc			Sc IBTS

B: Belgium, E&W: England and Wales, Fr: France, G: Germany, IBTS: Combined IBTS data, IR: Republic of Ireland, NI: Northern Ireland
No: Norway, NL: Netherlands, S: Scotland, Sp: Spain, R: Russian Federation

Table 2.2.2 2004 Working Group on the Assessment of Northern Shelf Demersal Stocks.
Biological sampling levels by stocks and country: number of fish measured and aged from catches in 2003.

		Belgium		England and Wales		Northern Ireland		Republic of Ireland		Russian Federation		Scotland			
		No. lengths	No. ages	No. lengths	No. ages	No. lengths	No. ages	No. lengths	No. ages	No. lengths	No. ages	No. lengths	No. ages	Total international catch numbers (thousands)	No. measured as % of annual no. caught
Cod	VIa (landings)							4,511	828			7,103	2,436	780	1.49%
	VIa (discards)							87	48			94	87		~
	VIb (landings)							57				167	104		~
	VIIa (landings)			4,529	673	1,322	102	2,652	863					884	0.96%
	VIIa (discards)			1,973				4	3						~
Haddock	VIa (landings)							4,967	1,066			21,104	2,536	Unc.	~
	VIa (discards)							3,181	251			17,807	1,426	Unc.	~
	VIb (landings)							3,204	1,040	16,569	638	5,936	605	Unc.	~
	VIb (discards)														~
	VIIa (landings)					664	74	2,259	618					Unc.	~
	VIIa (discards)							998	106					Unc.	~
Whiting	VIa (landings)							2,119	460			7,120	1,225	Unc.	~
	VIa (discards)							3,406	210			10,303	1,320	Unc.	~
	VIIa (landings)			6,093	418	115	21	777	807					Unc.	~
	VIIa (discards)			S	S	312	142	1,860	169					Unc.	~
Plaice	VIIa (landings)	7,917		8,894	1,099			2,307	416					4,121	0.46%
	VIIa (discards)	16,803		S	S			1,091	88					Unc.	~
Sole	VIIa (landings)	9,965	210	2,930	686			1,798	312					3,610	0.41%
	VIIa (discards)	2,643						11						Unc.	~
Megrim	VIa (landings)							2,315	633			8,504	304	Unc.	~
	VIa (discards)							759	267					Unc.	~
	VIb (landings)								488					Unc.	~
Anglerfish	VIa (landings)							721	*636*			7,731	*482*	Unc.	~
	VIa (discards)							656	*312*						~
	VIb (landings)											425		Unc.	~
	IV (landings)											17,177	*1,037*	Unc.	~

Bold type: Landings plus discards *Italic type* : Ageing of *Lophius piscatorius* only
S: Samples were collected and data presented to the WG, information on numbers of age & length sample not available
Unc.: 2003 total catch numbers at age uncertain

3 COD IN SUB-AREA VI

Cod in Division VIa are currently the subject of a recovery plan. Thus a detailed benchmark assessment is pe presented by the working group. In the ACFM Technical Minutes of the October 2003 meeting, ACFM commented on several aspects of previous assessments that it would like to see addressed. A summary of comments follows:

1. The use of discard estimates in the assessment for the first time in 2002 was questioned, the issue with inclusion concentrated on discard modelling of discards by TSA: discards seem to be interpreted as noise, their inclusion may have resulted in altering the perception that trend in F exists;

2. The allowance of persistent changes in survey catchability was criticised: in 2001 the estimate of persistent processes was 0.0, with all variance being attributed to transient changes. In 2003, the estimates flipped and all variance was attributed to persistent changes;

3. The apparent strong positive trend in catchability of the Scottish groundfish survey has been attributed to a "mismatch" in catch data and survey data. If there is no *a priori* reason to suspect a trend in survey catchability, and deteriorating quality of catch data is suspected, the recommendation would be to use survey data and catch data to tune the historical part of the time series and explore the use of survey data alone to tune in recent years;

Given the time devoted to this assessment, the WG has had insufficient time to develop a stock annex.

3.1 Cod in Division VIa

3.1.1 Stock definition and the fishery

Cod occur mainly in the central and northern areas of Division VIa. Young adult cod are distributed throughout the waters to the west of Scotland, but mainly occur in offshore areas where they can occasionally be found in large shoals. Tagging experiments have shown that in late summer and early autumn there is a movement of cod from west of the Hebrides to the north-coast areas. There is a return migration in the late winter and early spring. There is only a very limited movement of adult fish between the West Coast and the North Sea.

The demersal fisheries in Division VIa are predominantly conducted by otter-trawlers fishing for cod, haddock, anglerfish and whiting, with by-catches of saithe, megrim, lemon sole, ling and skate *sp*.. Since 1976, effort by Scottish heavy trawlers and seiners has decreased. Light trawler effort has declined rapidly since 1997 after a long-term increasing trend. The general features of the fishery are summarised in the report of the 2001 ACFM meeting (ICES Coop. Res. Rep. 246 (2)).

3.1.1.1 ICES advice applicable to 2003 and 2004

Following the ACFM meeting in October 2002, ICES recommended a closure of all fisheries for cod as a target or bycatch species. This advice was based on the very low estimated stock size, recent poor recruitments, and continued high fishing mortality. Those fisheries in which cod only appeared as an incidental catch were to be strictly monitored. These and other pertinent measures were to be kept in place until such time as there was good evidence of stock recovery to sustainable levels, allowing for the fact that population dynamics are difficult to predict at the current low stock levels.

In 2003 ICES recommended for 2004: *"Given the very low stock size, the recent poor recruitments and the continued high fishing mortality, a recovery plan which ensures a safe and rapid rebuilding of SSB to levels above* $\boldsymbol{B}_{pa}$ *should be implemented. Such a recovery plan must include a provision for zero catch until the estimate of SSB is above* $\boldsymbol{B}_{lim}$ *or other strong evidence of rebuilding is observed. In 2004 such a recovery plan would imply zero catch."*

3.1.1.2 Management applicable to 2003 and 2004

The 2003 and 2004 TACs for cod in ICES areas Vb (EC waters), VI, XII and XIV were 1,808 t and 848 t respectively. The minimum mesh size for vessels fishing for cod in the mixed demersal fishery in EC Zones 1 and 2 (West of Scotland and North Sea excluding Skagerrak) changed from 100 mm to 120 mm from the start of 2002. This came under EU regulations regarding the cod recovery plan (Commission Regulation EC 2056/2001), with a one-year derogation of 110 mm for vessels targeting species other than cod. This derogation was not extended beyond the end of 2002. Cod are a by-catch in *Nephrops* and anglerfish fisheries in Division VIa. These fisheries use a smaller mesh size of 80mm, but landings of cod are restricted through by-catch regulations. The minimum landing size of cod in the human consumption fishery in this area is 35 cm. Since mid-2000, UK vessels in this fishery have been required to include a 90 mm square mesh panel (SSI 227/2000), predominantly to reduce discarding of the large 1999 year class of haddock. Further unilateral legislation in 2001 (SSI 250/2001) banned the use of lifting bags in the Scottish fleet. Emergency measures were enacted in 2001, consisting of area closures from 6 March–30 April, in an attempt to maximise cod egg production. These measures have been retained into 2003 and 2004. Vessel decommissioning has been underway since 2002. Effort reductions for much of the international fleet to 16 days at sea per month have been imposed since February 2003 (EU 2003/0090).

Annex XVII to Council Regulation (EC) No 2341/2002 regulated the maximum number of days in any calendar month of 2003 for which a fishing vessel may be absent from port to the West of Scotland. The maximum number of days in any calendar month for which a fishing vessel may be absent from port to the West of Scotland in 2003 and 2004 varies for particular gears:

Gear:	Maximum days allowed:	
	2003:	2004:
Demersal trawls, seines or similar towed gears of mesh size ≥ 100 mm except beam trawls	9	10
Demersal trawls, seines or similar towed gears of mesh size between 70 mm & 99 mm except beam trawls[1];	25	22
Demersal trawls, seines or similar towed gears of mesh size between 16 mm & 31 mm except beam trawls.	23	20

[1] : With mesh size between 80 mm & 99 mm in 2004.

In 2003 and 2004 additional days may be allocated to Member States by the European Commission on the basis of the achieved results of decommissioning programmes.

A Commission Decision (C(2003) 762) in March 2003 allocated additional days absent from port to particular vessels and Member States. United Kingdom vessels were granted 4 additional days per month (based on evidence of decommissioning programmes). An additional two days was granted to demersal trawls, seines or similar towed gears (mesh ≥ 100mm, except beam trawls) to compensate for steaming time between home ports and fishing grounds and for the adjustment to the newly installed effort management scheme.

These new effort regulations provided an incentive for some vessels previously using >100 mesh in otter trawls to switch to smaller mesh gears to the avail of higher numbers of days-at-sea. This would also require these vessels to be targeting either *Nephrops* or anglerfish, megrim and whiting with various catch and by-catch composition limits after EC Regulation No 850/98. No detailed information was available to the Working Group to quantify how many vessels have switched to using smaller meshes as a result of effort regulation as this information is not reliably recorded in logbook information for some countries.

Council regulation (EC) No 423/2004 sets forth muti-annual recovery plans that will constrain effort to specified harvest control rules.

The following table summarises ICES management advice for cod in Division VIa during 2001–2004:

Year	Catches corresponding to ICES advice (t)	Basis	TAC for Vb (EC), VI, XII, XIV (t)	% change in *F* associated with TAC[1]	2003 WG estimate of landings (t)
2001	-	Lowest possible *F*, recovery plan	3,700	-50%	2,347
2002	-	Recovery plan or lowest possible *F*	4,600	-10%	2,062
2003	-	Closure	1,808	-60%	1,291

2004	-		848	-80%	

[1]Based on *F*-multipliers from forecast tables.

3.1.1.3 The fishery in 2003

Official catch data for each country participating in the fishery are presented in Table 3.1.1.1, together with the corresponding WG estimates. The WG estimate for total international catch in 2003 is 1,343 t, consisting of 1,291 t landed for human consumption and 52 t discarded. The total and human consumption estimates are both the lowest ever recorded. Revisions (~12%) have been made to WG estimates of landings in 2003. The reduction in fishing mortality of 80% implied by the TAC set for 2004 necessarily implies a reduction in effort of a similar magnitude, combined with the effective implementation of other technical measures. The Scottish effort figures indicate a decline in effort, but due to the non-mandatory reporting of effort these figures are not reliable. The Irish otter trawl fleet has maintained comparatively constant effort from year to year. Table 3.1.2.1 gives full details of effort and raised numbers caught at age and Figure 3.1.1.1 plots effort in hours and LPUE in kg per hour fishing, for each of the three preceding fleets. The reliability of this effort data is in doubt, however, due mainly to inconsistencies in reporting practices between boats. The actual decline in effort in 2003 is unlikely to be commensurate with that required to achieve the management target of a 80% reduction in fishing mortality. The probability that mis-reporting and under reporting takes place in this fishery is high, this can be attributed to restrictive TACs, proposed closure of the fishery, and effort restrictions based on by-catch composition.

From mid September 2003 to mid July 2004 the Irish trawl fishery off Greencastle, Co. Donegal that traditionally targets juvenile cod was closed. The closure was instigated by the local fishing industry to allow an assessment of seasonal closure as a potential management measure. Almost 8,000 cod were tagged and released during the closure. Most of the cod catch during the closed period is normally taken in the fourth quarter. During 2000-2002 50% of the Irish catch weight of cod in VIa (61% by number) was taken in the fourth quarter. The closure will have markedly reduced the Irish fishing mortality on cod that would otherwise have occurred in 2003. As the Greencastle codling fishery is a mixed demersal fishery, any benefits following from the closure are likely to extend to other demersal stocks.

3.1.2 Commercial catch-effort series and research vessels surveys

A number of commercial Scottish CPUE series have been made available in recent years for use in assessments of this stock, specifically, heavy trawlers (trawlers over 90 ft), light trawlers (ScoLTR), seiners (ScoSEI) and *Nephrops* trawlers. However, none have been used in the final assessment presented by the WG during any of its last six meetings, although they have been used in exploratory and comparative analyses. During preparations for the 2000 round of assessment WG meetings it became apparent that the 1999 effort data for the Scottish commercial fleets were not in accord with the historical series and specific concerns were outlined in the 2000 report of WGNSSK (ICES CM 2001/ACFM:07). Effort recording is still not mandatory for these fleets, and concerns remain about the validity of the historical and current estimates. Due to these concerns neither of the Scottish fleets are considered as possible tuning fleets.

Irish otter trawl CPUE data (IreOTR) were presented for the first time at the 2001 WG meeting. An updated series was presented to the 2002 and 2003 WG meetings. Given the current concerns about mis-reporting of catch and effort, this series is not considered further as a tuning fleet.

The commercial CPUE data available for this meeting consisted of the following:

- Scottish seiners (ScoSEI): ages 1–6, years 1978–2003.
- Scottish light trawlers (ScoLTR): ages 1–6, years 1978–2003.
- Irish otter trawlers (IreOTR): ages 1–7, years 1995–2003.

Two research vessel survey series for cod in Division VIa are available, namely the Scottish quarter one west coast ground fish survey (ScoGFS) and the Irish quarter four west coast ground fish survey (IreGFS). The Scottish ground fish survey has been conducted with a new vessel and gear since 1999. The catch rates for the series as presented are corrected for the change on the basis of comparative trawl haul data (Zuur *et al* 2001). The Irish quarter four survey was a comparatively short series, was discontinued in 2003 and has been replaced. The replacement survey (IRGFS) has only been running for one year and is not yet suitable for tuning.

- Scottish first-quarter west coast groundfish survey (ScoGFS): ages 1–7, years 1985–2004.

- Irish fourth-quarter west coast groundfish survey (IreGFS): ages 0–3, years 1993–2002.

Fleet and survey descriptions are given in Appendices 1 and 2 of the report of the 1999 meeting of this WG (ICES CM 2000/ACFM:1). All available commercial catch-effort and survey data are given in Table 3.1.2.1. Commercial effort and landings-per-unit effort are summarised in Figure 3.1.1.1. For all tuning series, the oldest age given represents a true age, rather than a plus group.

3.1.3 Age compositions and mean weights at age

Quarterly catch-at-age data were available from Scotland and Ireland. The countries that provide data are listed in Table 2.2.1, and sampling levels are shown in Table 2.2.2.

Age distributions were estimated from market samples. For Irish data, ALKs are occasionally augmented by samples collected during research vessel surveys. The procedures used to aggregate national data sets into total international landings are given in Section 2.3.

Total WG estimates of international landings-at-age are given in Table 3.1.3.1. Annual mean weights-at-age in landings are given in Table 3.1.3.2 and Figure 3.1.3.1. A summary of the available discard information from the Scottish and Irish sampling programme is given in Table 3.1.3.3. Total catch numbers and mean weights-at-age are given in Tables 3.1.3.4 and 3.1.3.5 respectively. Discard mean weights-at-age are plotted in Figure 3.1.3.2.

WG estimates of cod discards are presented in Table 3.1.3.3. WG estimates of discards are based on data collected in the Scottish and Irish discard programmes (raised by weighted average to the level of the total international discards). Work is underway to revise the Scottish discard estimates with an aim to reduce bias and increase precision. WD2 present the methodology of this work, and presents preliminary haddock discard estimates as an example.

Discard estimates have been excluded in the past because estimates were perceived to have been low in relation to landings in most years, particularly in relation to discards of haddock and whiting. However, it has become clear that this is not a tenable assumption. Given this, and following recommendation in the technical minutes of ACFM October 2003, the use of discard estimates was explored. The 2004 WG agreed the use of the discard estimates in the final assessment for cod in VIa (see 3.1.5.2 under “discards”).

3.1.4 Natural mortality and maturity at age

Values for natural mortality (0.2 for all ages and years) and the proportion of fish mature at age are unchanged from the last meeting. The proportion of F and M acting before spawning is set to zero. The maturity ogive used by the WG for this stock is as follows:

Age	0	1	2	3	4–15+
Mat	0.00	0.00	0.52	0.86	1.00

Survey-derived maturity ogives for gadoid stocks in Division VIa were presented as a Working Document to the 2002 WG (Burns and Reid, WGNSDS 2001 WD 1). These indicated proportion mature at age 2 of between 48% and 100%, and greater than 90% at age 3 (data coverage - 1995–2001), estimates were not disaggregated by sex. Sex-disaggregated estimates are now available, but have not yet been fully analysed. The validity and management implications of the use of such data have not yet fully evaluated, and therefore their use needs to be investigated.

3.1.5 Historical stock analyses

Section 2.6 outlines the general approach adopted at this year’s WG.

3.1.5.1 Data screening

Commercial landings and Research-vessel survey data

Log mean-standardised survey time-series by age and year-class are shown in Figure 3.1.5.1. The ScoGFS series appears to track well the development of relative year-class strength down cohorts, although this signal is degraded in older ages for some cohorts. The IreGFS series is less successful, giving quite contradictory pictures of year-class strength at different ages. The survey indices at age are compared directly in the bivariate scatterplots in Figure 3.1.5.2, which are shown with fitted linear regression lines. These show a high concordance at age 1, but rather weaker relationships at ages 2 and 3. The surveys are qualitatively similar at all ages where comparison is possible. Figure 3.1.5.3 shows proportions by number from three commercial fleets and two surveys – these data are independent of effort and therefore not marred by suspected misreporting. The three commercial fleets show a similar overall pattern of exploitation. Ages 2 and 3 make the bulk of the catch in recent years. What seems characteristic in all plots are the spikes in age one catches. ScoLTR and ScoSEI show a large proportion of age 1s from '82 to '87 and similar peaks in 2000 and 2002. The peaks in 2000 and 2002 are echoed in the IreOTB, the IreGFS and the ScoGFS. The ScoGFS has more representative proportions of ages in it catches, with the bulk being more evenly spread from ages 1 to5. Figure 3.1.5.4 shows mean standardised CPUE for all available fleets and surveys. Signals from these data are broadly consistent, but there is an intriguing period of discordance in the mid to late nineties.

A SURBA analysis was carried out on the Scottish ground fish survey initiated with catchabilities taken from a basic run of XSA tuned solely to this fleet (Needle, 2004). Figure 3.1.5.6 shows the summary output which indicates a highly variable temporal trend, reflected in the point estimates of mean F(2-5). The 50th percentile bootstrap estimates of F show no trend in F, apart from a strong dip in 2000. Raw log survey index plotted down cohorts (figure 3.1.5.7) shows a noisy picture but cohort Z seems to have remained consistent over the span of the survey. Figure 3.1.5.8 a) and b) show raw survey Z and raw survey relative SSB. No discernible trend is apparent in Z but relative SSB shows a declining trend in SSB. The hike in SSB in 2001 is due to a large single haul of cod. Survey scatterplots showing internal consistency from age to age are plotted in figure 3.1.5.9, it can be seen that by age five the survey looses the population signal. Smoothed cohort curves, survey Z and survey relative SSB are given in figure 3.1.5.10 and figure 3.1.5.11 a) and b), respectively.

3.1.5.2 Exploratory catch-at-age analyses

Surveys

The TSA assessments performed in 2002, both that in the WG report (ICES 2002b) and that presented subsequently to ACFM at it October meeting (Needle and Fryer 2002), used only the ScoGFS series for tuning. This was principally to ensure consistency with assessments presented in previous years: the inclusion of the IreGFS survey made little significant difference to estimated mean $F_{2\text{–}5}$ and SSB. The WG revisited this question this year, and decided not to use the IreGFS survey in catch-at-age analyses as the IreGFS series does not appear to track cohort strength particularly well for cod in Division VIa. (Figure 3.1.5.1). This survey has also been discontued.

Therefore, all subsequent analyses were carried out using only the ScoGFS series for tuning.

Discards

ACFM expressed concerns about the inclusion of discard estimates for cod, on the grounds that this merely led to a re-scaling of abundance estimates and the addition of noise. However, the WG decided to retain the inclusion, for the following reasons:

1. Discarding, particularly at age 1, is substantial for this stock, and to ignore it would lead to incorrect conclusions about the state of the stock.

2. The discard model fitted in TSA, like the survey catchability model, is allowed to have a combination of persistent trends and transient effects. For two of the three TSA runs presented here, both of these parameters were estimated to be significantly non-zero. There is thus evidence of a trend over time in cod discarding, which implies that the inclusion does not lead to a simple re-scaling. This evidence of a trend over time cannot be ignored.

Survey Catchability

ACFM highlighted concerns over the fitting of a persistent trend in survey catchability in the final runs of gadoid stocks in VIa. Their concern was that allowing a trend in survey catchability made *a priori* assumptions on the quality of survey data as compared to landings data. There have been concerns that the quality of landings data is deteriorating, giving a possible reason for some of the mismatch in catchability between the commercial fleet and the annual survey. Differing signals from catch data and survey data may be due several confounding factors. Mis-reporting (specifically under reporting) could cause this effect. Spatial and temporal differences in the effort distribution could also contribute. Commercial fleet effort is concentrated on areas of high abundance and is distributed throughout the year, whereas survey effort is concentrated on the first quarter only, and samples VIa entirely following a stratified design. Whatever may be the cause, it is known to manifest itself as a positive trend in catchability in the survey as compared to the commercial catch (figure 3.1.5.12 a - c). This phenomenon is also apparent in the other Division VIa and North Sea gadoid stocks. Given this discrepancy, several runs of TSA were undertaken to explore the effect on the model of the survey data signal, with and without persistent trend allowed. The three runs were as follows:

1. A TSA tuned to catch data (landings and discards) from 1978 to 2003.
2. A TSA tuned to catch data (landings and discards) from 1978 to 2003 and survey data from 1985 –2004, with an allowed trend in survey catchability.
3. A TSA tuned to catch data (landings and discards) from 1978 to 2003 and survey data from 1985 –2004, with a trend fixed at zero.

Figure 3.1.5.13 shows the fitted trajectories of landings, discards and catches. It can be seen in the plots that if a trend is allowed to develop in survey catchability, the trajectory of landings closely fits the catch only model. If the survey is given a fixed catchability, the landings try to diverge, noticeably in the prediction year, the landings are predicted to increase. Figure 3.1.5.14 shows fitted recruitment, mean F(2-5) and SSB. Run 3 predicts slightly higher recruitment in the final years, but apart from that the three runs remain similar. The greatest divergence can be seen in the predictions of mean F and SSB. Catch only TSA predicts an increasing but levelling off of F from 1995 to 2003. Inclusion of survey data undoubtedly forces a reduction in F. The allowance of a trend in survey data gives a trend in F very similar to the catches only F. When the trend is fixed in survey catchability, the F is drastically reduced, and diverges from the other two as far back as 1996. An equivalent trend is found in SSB, but the divergence occurs in 2000.

Removing catch data

It is clear from this that there is a strong mismatch in population signals. Surba estimates indicate a decline in SSB, but the trend in F is noisy. In light of recent concerns about the bias in reported catch data, and given all the above; further runs of TSA were carried out exploring the effect of removing years of catch data from the model. The runs are consistent with run 3 above, with catch data being progressively removed back to 1999. The seven runs are as follows:

4. TSA tuned to catch data from 1978 to **2002** and survey data from 1985-2004, with no trend permitted.
5. TSA tuned to catch data from 1978 to **2001** and survey data from 1985-2004, with no trend permitted.
6. TSA tuned to catch data from 1978 to **2000** and survey data from 1985-2004, with no trend permitted.
7. TSA tuned to catch data from 1978 to **1999** and survey data from 1985-2004, with no trend permitted.
8. TSA tuned to catch data from 1978 to **1998** and survey data from 1985-2004, with no trend permitted.
9. TSA tuned to catch data from 1978 to **1994** and survey data from 1985-2004, with no trend permitted.
10. TSA tuned to catch data from 1978 to **1989** and survey data from 1985-2004, with no trend permitted.

Figure 3.1.5.15 shows the fitted trajectories of landings, discards and catches, together with run 3. The obvious trend is that for every year of catch data that is removed, the TSA estimated landings are an upward revision of what was reported. All runs that exclude the reported landings for 2003 forecast a decline in landings. Runs 4, 5 and 6 have an initial rise in landings, followed by a parallel decline in landings to 2003. Run 7 is identical to run 6 from 2001. Run 8 shows greater initial divergence, but follows the same decline in landings from 2001 as runs 4 – 7 show. Run 9 shows a rise in landings, peaking in 1996, and again following a similar pattern of decline as runs 4 –9. Run 10 diverges from the all other runs quite substantially, the pattern of estimated landings mirrors run 9 in all years, except for 1994 where reported landings show a decline. Noteworthy is that run 10 has only 5 years of coincident data. Figure 3.1.5.16 shows fitted recruitment, mean F(2-5) and SSB. A common feature of runs 4 – 8 in the trend in SSB is an initial rise at the point where the catch data is removed followed by a steady decline. Runs 9 and 10 mirror their equivalent landings estimates. Trends in mean F are less well behaved in recent years, but the common trend is for a stable F at around 0.8 – this is the long term trend in the survey Z as shown by Surba (figure 3.1.5.8 and figure 3.1.5.11). Runs 4 – 10 are remarkably similar in the final year, far removed from the F trend estimated by run 3. Common to runs 4 – 8, is the upturn in mean F in the year that catch data is removed. This is marked in all runs, except run 4. Runs 9 and 10 estimate a downward revision in F, giving a stable exploitation pattern.

Possible bias in survey tuned TSA

It is apparent from the above that the landings in 2003 have high leverage in the estimation of F. But how TSA behaves in the absence of catch data, in terms of bias is not clear. Thus the following set of retrospective TSA runs were conducted:

11. Retrospective analysis of run 3, going back to 1993. Figure 3.1.5.17 (a-c)

12. Retrospective analysis of run 4, going back to 1992. Figure 3.1.5.18 (a-c)
13. Retrospective analysis of run 5, going back to 1992. Figure 3.1.5.19 (a-c)
14. Retrospective analysis of run 6, going back to 1991. Figure 3.1.5.20 (a-c)

All retrospective plots display the comparison between the model fit of the base run with a run using the same data, but with a year dropping off the catch and survey data. As such these retrospectives can be viewed not only as indications of estimation bias, but also as an indication of the correspondence between catch and survey data. Figure 3.1.5.17 reiterates the discrepancy between catch information and survey information. Looking at mean fishing mortality, the temporal exploitation pattern implicit in the catch data is an increasing F while the survey implies a long-term stable F. The perception of SSB given the catch data, is an under-estimate of that implied by the survey. The same pattern can be seen in figures 3.1.5.18 to 3.1.5.20.

Mismatch in Catch F and Survey Z

As the period over which TSA is required to estimate missing catch is increased, the TSA estimates of quantities of missing catches also increase. This is caused by the diverging signals from population estimates derived from commercial catches and those derived from surveys. Whilst an increase in mis-reporting in the 1990s may cause this to occur, other aspects of the catch and survey data could contribute to the apparent increase in survey catchability relative to catch-based population estimates. These could include procedures for raising sample length frequencies to catches in both the fishery and survey, aspects of survey design, and changes in fish behaviour and distribution. All these aspects require detailed investigation to determine the main factors affecting the discrepancy between catch and survey data for the three gadoid stocks in VIa.

Exploring further missing catch

The working group decided that the inclusion of a persistent survey trend caused information to be lost in the assessment, furthermore, landings data are suspect in recent years. It was decided that runs of TSA with catch data missing should be explored further. A systematic approach was taken to decide from which year catch data should be discounted. The approach reasoned was as follows:

- Use the residuals from a tuned XSA using the Scottish ground fish survey to identify the point of change in survey and catch signals (figure 3.1.5.12 b)
- Ensure that TSA has enough coincident survey and commercial catch data – figure3.1.5.15 can be used qualitatively to this end.
- Use patterns in TAC, and or TAC uptake, to attempt to identify when quotas became restrictive (figure 3.1.5.21).

TAC and TAC uptake are so highly correlated that it is very difficult to make a decision on this basis. However, there are two periods of steep (approximately exponential) decline: from 1986 to 1993, and from 1997 to the present. XSA residuals show a stepwise change over the period 1993 to 1994. Multiple runs of TSA lead us to the conclusion that TSA requires around 10 years of coincident survey and catch data. The decision was made, given the uncertainty, to run bracketing TSA runs removing catch data from years 1992, 1993, 1994 and 1995. These runs are presented in figure 3.1.5.22 and figure 3.1.5.23. The run chosen as the best estimate given all the assumptions that this section has highlighted is that labelled “summary.Ricker.1994”. This run excludes catch data from 1994, thus having overlap between survey data and commercial catch data for a period of 9 years. Excluding a further year of catch makes very little difference in terminal F and SSB, and so a greater period of overlap is preferred for the fitting of catchability. This result may also indicate that the catch data in 1993 is in concordance with the survey data. XSA residuals show a stepwise increase in catchability residuals beginning in 1993. No real conclusion can be drawn about the restrictiveness of TACs and so this information did not weight the preference for any particular run.

3.1.5.3 Final assessments

The WG moved not to accept a single final run. This is due to the extremely wide variability in the estimation of terminal F. The outcomes of all exploratory runs show how sensitive model formulations are, given the current data. With the lack of a full comparative exploration using appropriate simulated data to ascertain the properties of these assessment models, the WG feels it is not in a position to adopt to any one run. Similar situations exist for haddock and whiting in division VIa, however, the problem is less acute for haddock. As the VIa gadoid stocks represent a mixed fishery, and as advice is given on this basis, the WG decided to maintain a consistent approach across all three stocks.

This approach was to take the unusual step of presenting full output diagnostics and summaries for four runs. The four runs are as follows:

1. A TSA tuned to catch data (landings and discards) from 1978 to 2003 and survey data from 1985 –2004, with an allowed persistent trend in survey catchability (equivalent to last years SPALY run with the addition of 2003 data).
2. A TSA tuned to catch data (landings and discards) from 1978 to 2003 and survey data from 1985 –2004, with no persistent trend fixed at zero.
3. A TSA tuned to catch data (landings and discards) from 1978 to 1993 and survey data from 1985-2004, with no persistent trend permitted.
4. An XSA tuned to catch data (landings and discards) from 1978 to 2003 and survey data from 1985-2003.

The summary plots of the above runs are presented for comparison in figure 3.1.5.24 and figure 3.1.5.25. Discard data in run 3 is can be seen to be overestimated, with no discard or catch data to tune to. Run 3 also shows estimated landings and catch to be far above that officially reported, with runs 1 and 2 fitting closely to the catch data. The penalty for this though is manifested in trends in mean F.

The WG intend to investigate the properties of these methods closely in the months before ACFM in October, after which it should be possible to reach firmer conclusions. The assessments presented here are not discussed in detail as more exploratory work and data cleansing is required, the main thrust of this section is to present the diagnostics and summaries.

Table 3.1.5.1 gives the model settings for the three final TSA runs. Parameter estimates for the TSA runs (1-3) are given in table 3.1.5.2, alongside the 2002 WG and 2003 WG final run estimates.

Summary plots of **run 1** are plotted in figure 3.1.5.26. The underlying fitted stock recruit relationship (Ricker-model) is shown in figure 3.1.5.27. Table 3.1.5.3 gives the TSA population numbers-at-age and table 3.1.5.4 gives their associated standard errors. Estimated F at age is given in table 3.1.5.5 and standard errors on log fishing mortality are given in table 3.1.5.6. Full summary output for run one is given in table 3.1.5.7. Diagnostic outputs of standardised prediction errors on landings are plotted in figures 3.1.5.28 and figure 3.1.5.29. Standardised prediction errors on discards are plotted in figures 3.1.5.30 and figure 3.1.5.31, and standardised prediction errors on survey indices are plotted in figures 3.1.5.32 and figure 3.1.5.33. The developments of persistent and transitory changes in survey catchability are plotted against time in figure 3.1.5.34. The model fit to discard proportion at age is plotted in figure 3.1.5.35. And finally F and SSB retrospective plots are presented in figures 3.1.5.36 and 3.1.5.37, respectively.

Summary plots of **run 2** are plotted in figure 3.1.5.38. The underlying fitted stock recruit relationship (Ricker-model) is shown in figure 3.1.5.39. Table 3.1.5.8 gives the TSA population numbers-at-age and table 3.1.5.9 gives their associated standard errors. Estimated F at age is given in table 3.1.5.10 and standard errors on log fishing mortality are given in table 3.1.5.11. Full summary output for run one is given in table 3.1.5.12. Diagnostic outputs of prediction errors, as introduced in the above paragraph, are given in figures 3.1.5.40-3.1.5.47. F and SSB retrospective plots are presented in figures 3.1.5.48 and 3.1.5.49, respectively.

Summary plots of **run 3** are plotted in figure 3.1.5.50. The underlying fitted stock recruit relationship (Ricker-model) is shown in figure 3.1.5.51. Table 3.1.5.13 gives the TSA population numbers-at-age and table 3.1.5.14 gives their associated standard errors. Estimated F at age is given in table 3.1.5.15 and standard errors on log fishing mortality are given in table 3.1.5.16. Full summary output for run one is given in table 3.1.5.17. Diagnostic outputs of prediction errors are given in figures 3.1.5.52-3.1.5.58. F and SSB retrospective plots are presented in figures 3.1.5.59 and 3.1.5.60, respectively.

XSA summary plots for **run 4** can be found in figure 3.1.5.25. Diagnostic output is presented in table 3.1.5.18, and full summary output is presented in table 3.1.5.19. Retrospectives of F, recruitment and SSB are presented in figure 3.1.5.61.

3.1.6 Estimating recruiting year-class abundance

TSA produces projections of the abundance of recruitment in 2004 and 2005. The 2004 value is driven by a combination of the survey index values for 2004, some smoothing from earlier estimates, and the assumption of Ricker-based recruitment. The TSA value for 2005 is a Ricker prediction. Figures 3.1.5.27, 3.1.5.39 and 3.1.5.51 show that the fitted Ricker model is a reasonable approximation to the recent stock-recruit relationship for cod in Division VIa and the WG agreed to use the values of recruitment for these years for the TSA runs. Recruitment in 2006 was taken to be equal to that in 2005. For XSA forecasts recruitment was estimated as a geometric mean of the last ten years.

3.1.7 Historical trends in biomass, fishing mortality and recruitment

Historical trends in mean $F_{2\text{–}4}$, spawning-stock biomass, recruitment, total catch, landings and discards are shown in figure 3.1.5.24 and 3.1.5.25 for all final runs. The spawning stock biomass shows long-term decline in all runs. The 2003 estimate for SSB is close to or at the lowest estimated in each series. Recruitment is similar in all runs, apart from XSA, which predicts higher historical recruitment. Trends for recruitment are the same in all runs apart from in 1985, here all TSA runs predict a reduced recruitment, while XSA predicts quite markedly, the opposite. Trends in F for two runs (1 & 3) are consistent with the recent past, while the other two runs (2 & 4) estimate a sharp decline.

3.1.8 Short-term catch projections

Mean weights at age have been relatively stable over the recent past so a mean over the last three years was taken to represent the mean weights at age appropriate for a short term projection.

Numbers at age in 2004 were taken for the TSA derived forecasts, while XSA survivors from 2003 from ages 1 to 6 were taken as 2004 numbers at ages 2 to 7 for the XSA derived forecast. CVs were calculated from the standard errors on numbers at age for the TSA data, and from the larger of either the internal or external standard error on the survivors at age for the XSA data.

F at age was partitioned into landings and discard F by proportion weight in catch. See first paragraph section 4.1.8 for a description of how CVs were calculated on these data.

The predicted landings and SSB at *status quo F* are given below (coefficients of variation from WGFRANSW are in parentheses), together with figures for 2004:

Run 1

Year	Landings (t)	Source	Discards (t)	Source	SSB (t)	Source
2003	1,291	WG estimates	52	WG estimates	1,644	TSA
2004	627 (0.22)	SQ projection	276 (0.56)	SQ projection	1,450 (0.16)	SQ projection
2005	483 (0.26)	SQ projection	311 (0.70)	SQ projection	1,160 (0.26)	SQ projection
2006	-	-	-	-	930 (0.42)	SQ projection

Run 2

Year	Landings (t)	Source	Discards (t)	Source	SSB (t)	Source
2003	1,291	WG estimates	52	WG estimates	3,548	TSA
2004	1,590 (0.26)	SQ projection	490 (0.58)	SQ projection	5,100 (0.19)	SQ projection
2005	1,660 (0.60)	SQ projection	690 (0.67)	SQ projection	5,260 (0.21)	SQ projection
2006	-	-	-	-	5,430 (0.28)	SQ projection

Run 3

Year	Landings (t)	Source	Discards (t)	Source	SSB (t)	Source
2003	1,291	WG estimates	52	WG estimates	7,899	TSA
2004	2,890 (0.22)	SQ projection	2,650 (0.56)	SQ projection	7,680 (0.16)	SQ projection
2005	1,520 (0.23)	SQ projection	1,770 (0.62)	SQ projection	7,380 (0.25)	SQ projection
2006	-	-	-	-	7,230 (0.39)	SQ projection

Run 4

Year	Landings (t)	Source	Discards (t)	Source	SSB (t)	Source
2003	1,291	WG estimates	52	WG estimates	7,730	XSA
2004	1,560 (0.35)	SQ projection	600 (0.78)	SQ projection	11,700 (0.18)	SQ projection
2005	1,760 (0.39)	SQ projection	770 (0.93)	SQ projection	14,400 (0.21)	SQ projection
2006	-	-	-	-	16,300 (0.24)	SQ projection

Sensitivity analyses were carried out for the above projections. Inputs to this and the short term forecast is tabulated along with forecast summary files (in case required for further analysis) in tables 3.1.8.1–3.1.8.8. The full outputs of these analyses are given in tables 3.1.8.9-3.1.8.16, bold print should be interpreted as the level of fishing mortality to achieve a 30% increase in SSB in 2005. Sensitivity plots, probability profiles and a graphical summary of the short-term forecasts are presented in figures 3.1.8.1-3.1.8.12.

3.1.9 Medium-term stock projections

Medium term stock projections were carried out using the CS5 software. The results of the analysis can be found in section 14.

3.1.10 Yield and biomass per recruit

Yield and biomass per recruit plots alongside stock and recruit plots, with replacement lines analogous to fishing mortality reference points are shown in Figures 3.1.10.1-3.1.10.8.

3.1.11 Biological reference points

ICES has defined the following PA reference points:

Reference point	**Technical basis**
$\boldsymbol{B}_{pa}$ = 22,000 t	Previously set at 25,000 t, which was considered a level at which good recruitment is probable. This has since been reduced to 22,000 t due to an extended period of stock decline.
$\boldsymbol{B}_{lim}$ = 14,000 t	Smoothed estimate of $\boldsymbol{B}_{loss}$ (as estimated in 1998).
$\boldsymbol{F}_{pa}$ = 0.6	Consistent with $\boldsymbol{B}_{pa}$.
$\boldsymbol{F}_{lim}$ = 0.8	*F* values above 0.8 led to stock decline in the early 1980's.

3.1.12 Quality of the assessment

Discard estimates used in this assessment are calculated from Scottish and Irish sampling programs. The method used is to sample on a stratified basis and then raised by some auxiliary variable to, initially, total strata discards, and ultimately international discards. These estimates are prone to bias. WD 2 introduces a new method to raise discard data, using the same raw data, and which will reduce estimation bias. WD 3 shows that given less bias trends in F may be seen that were previously unseen due to noise. New estimates will be available for the 2005 WG for cod, haddock and whiting.

Biological responses of cod in VIa as a localised species to high exploitation and low population numbers are so far unknown to the working group. Morphological changes, changes in maturity and fecundity, and changes in distribution may all be causing systematic bias due to long-standing assumptions on mean weight at length and mean maturity at age. Work is under-way in the coming year to test the validity of the mean weight at length assumption. However, maturity at age is highly confounded with reduced fecundity at younger ages and low somatic index.

The survey used for this assessment changed vessel in 1999. The series has been corrected for this, but in light of the problems of diverging catch and survey signals this should be revisited. Furthermore, investigation into possible changes in raising practice would be of importance. An increase in raising precision over the years could feasibly augment any observed divergence.

In the recent past, though, the most significant problem is with commercial data. Incorrect reporting of landings - species and quantity - is known to occur and directly affects the perception of the stock. Furthermore, both TSA and XSA are strongly influenced by catch data. Survey based analyses are very useful and give us indications of the total mortality and relative biomass in the stock. TSA without catch data mirrored these trends, but gave an unrealistic estimate of landings (implying massive mis-reporting over time), ergo an unrealistic estimate of spawning stock biomass. With more time the WG might investigate the possibility of down-weighting (rather than completely excluding) catch data, this will have the benefit of using all available data, while implying uncertainty on reported landings figures.

3.1.13 Management considerations

Due to the sensitivity of F to recent catch data F is not discussed here. The point estimate of spawning biomass in 2003, however, is in every case below the ICES values for both $\boldsymbol{B}_{pa}$ (22,000 t) and $\boldsymbol{B}_{lim}$ (14,000 t). For *status quo* F during 2004, SSB in 2005 will lie below $\boldsymbol{B}_{pa}$.

Cod are taken in a mixed demersal fishery with haddock and whiting, and management advice needs to be considered in that context. Technical interactions between fisheries are discussed in Section 13.

The EU Cod Recovery Plan regulation implemented for 2004 (council regulation No. 423/2004) will impact the management measures for 2005, which will be formulated with reference to the estimates and forecasts of SSB in relation to limit and precautionary reference points. For stocks above $\mathbf{B}_{\mathrm{lim}}$, the harvest control rule (HCR) requires:

1. setting a TAC that achieves a 30% increase in the SSB from one year to the next,

2. limiting annual changes in TAC to ± 15% (except in the first year of application), and,

3. a rate of fishing mortality that does not exceed $\mathbf{F}_{\mathrm{pa}}$.

For stocks below $\mathbf{B}_{\mathrm{lim}}$ the Regulation specifies that:

4. conditions 1-3 will apply when they are expected to result in an increase in SSB above $\mathbf{B}_{\mathrm{lim}}$ in the year of application,

5. a TAC will be set lower than that calculated under conditions 1-3 when the application of conditions 1-3 is not expected to result in an increase in SSB above $\mathbf{B}_{\mathrm{lim}}$ in the year of application.

Cod in Division VIb

Officially reported catches are shown in Table 3.2.1.1. No analytical assessment of this stock has been carried out.

Table 3.1.1.1. Cod in Division VIa. Official catch statistics in 1984–2002, as reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*
Belgium	48	88	33	44	28	-	6	-	22	1	2	+	11	1	+	+	2	+	
Denmark	-	-	4	1	3	2	2	3	2	+	4	2	-	-	+	-	-	-	
Faroe Islands	-	-	-	11	26	-	-	-	-	-	-	-	-	-	-	-	-	-	
France	7,411	5,096	5,044	7,669	3,640	2,220	2,503	1,957	3,047	2,488	2,533	2,253	956	714*	842*[2]	236	391	256	164
Germany	66	53	12	25	281	586	60	5	94	100	18	63	5	6	8	6	4	+	+
Ireland	2,564	1,704	2,442	2,551	1,642	1,200	761	761	645	825	1,054	1,286	708	478	223	357	319	210	n/a
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-
Norway	204	174	77	186	207	150	40	171	72	51	61	137	36	36	79	114*	40*	89	46
Spain	28	-	-	-	85	-	-	-	-	-	16	+	6	42	45	14	3	11	n/a
UK (E., W., N.I.)	260	160	444	230	278	230	511	577	524	419	450	457	779	474	381	280	138	195	…
UK (Scotland)	8,032	4,251	11,143	8,465	9,236	7,389	6,751	5,543	6,069	5,247	5,522	5,382	4,489	3,919	2,711	2,057	1,544	1,519	…
UK																			942
Total landings	18,613	11,526	19,199	19,182	15,426	11,777	10,634	9,017	10,475	9,131	9,660	9,580	6,992	5,671	4,289	2,767	2,439	2,027	1,152
Unallocated landings	-6	294	-229	1,231	1,743	399	293	69	-161	-203	-222	-153	42	43	-88	210	-92	36	139
Discards as used by W.G.	8,825	1,200	8,788	1,133	2,818	314	910	2,902	185	186	258	86	354	423	98	607	224	169	49
Landings as used by W.G.	18,607	11,820	18,971	20,413	17,169	12,176	10,927	9,763[1]	11,778[1]	10,806[1]	9,600[1]	9,427	7,034	5,714	4,201	2,977	2,347	2,442	1,241
Total catches as used by W.G.	27,432	13,020	27,758	21,546	19,987	12,490	11,836	11,989	10,499	9,114	9,697	9,513	7,387	6,137	4,298	3,584	2,571	2,412	1,291

* Preliminary.

[1] Estimated by TSA (2003 Working Group meeting).

[2] Preliminary data taken from EU reporting form.

Table 3.1.2.1. Cod in Division VIa. Landings-effort and survey tuning series made available to the WG. Effort (first column) is given as reported hours fished per year, numbers landed are in thousands.

ScoSEI	Scottish seiners					
1978	2003					
1	1	0	1			
1	6					
33617	743.00	224.48	64.14	41.83	13.01	3.72
38465	120.91	128.90	197.32	25.17	19.13	5.03
38640	403.38	223.25	75.45	37.21	13.44	4.13
37208	26.53	473.12	129.81	42.39	7.95	0.88
36689	405.78	139.18	137.35	31.99	14.11	3.76
38080	1205.65	509.03	65.34	58.51	14.63	4.88
29561	275.95	56.40	78.78	25.58	17.39	10.23
26365	982.36	199.94	27.31	23.41	4.88	4.88
19960	348.05	84.78	30.70	6.35	4.23	1.06
26332	4461.36	552.51	48.68	67.56	18.88	4.97
21383	63.84	451.06	41.87	4.98	3.99	1.00
39350	560.31	138.71	152.45	31.07	6.74	4.16
23235	99.96	566.35	31.11	60.19	11.87	2.06
25787	364.64	132.65	164.98	16.25	28.93	8.39
20273	1390.05	228.60	35.92	46.85	4.09	5.01
24315	86.98	389.31	87.56	10.26	16.08	2.90
21305	175.94	138.49	145.48	23.03	5.90	4.96
21950	134.47	372.92	68.30	60.81	9.78	2.11
15205	82.21	318.54	106.62	17.28	15.61	1.30
11449	317.44	102.89	77.06	23.31	12.33	13.52
11166	98.32	656.93	28.31	12.89	3.30	1.31
8638	40.64	60.26	58.57	2.03	1.08	0.74
6431	243.84	32.99	13.49	7.36	0.39	0.35
5893	7.48	101.54	4.62	0.80	1.05	0.07
3817	32.15	25.07	26.48	2.02	0.62	0.30
2370	8.76	31.65	4.56	2.22	0.07	0.01

Table 3.1.2.1. contd. Cod in Division VIa. Landings-effort and survey tuning series made available to the WG. Effort (first column) is given as reported hours fished per year, numbers landed are in thousands.

ScoLTR Scottish light trawlers

1978	2003					
1	1	0	1			
1	6					
127387	2242.51	685.36	185.50	133.92	32.74	7.94
99803	161.44	212.39	485.00	57.12	31.06	6.01
121211	694.04	699.09	328.14	129.35	34.24	10.46
165002	123.59	1588.52	524.05	183.42	31.06	3.88
135280	1623.74	367.84	616.01	163.81	46.10	5.89
112332	1634.45	1408.23	196.00	163.65	51.38	18.08
132217	974.48	593.35	419.46	85.37	93.80	30.56
142815	6421.55	1734.74	218.21	131.35	21.19	22.25
126533	1403.22	376.19	384.35	67.13	30.32	3.25
131720	23524.40	1058.11	143.60	116.68	27.92	12.96
158191	319.66	2464.85	309.82	49.97	37.98	8.00
217443	1795.80	291.27	989.06	200.39	46.89	19.53
142502	195.62	1334.61	87.08	202.71	37.25	6.93
209901	2081.88	815.93	534.85	38.68	97.23	30.51
189288	2197.22	655.91	193.06	240.73	17.16	24.27
189925	246.98	1274.46	301.98	46.14	80.17	10.51
174879	348.87	458.79	463.67	88.90	16.55	22.76
175631	488.40	839.26	188.99	168.65	21.32	4.31
214159	133.75	790.18	355.22	79.78	83.08	9.88
179605	819.38	371.40	394.35	109.46	18.88	18.82
142457	181.66	1343.76	100.25	64.43	21.22	5.63
98993	129.77	226.02	433.87	20.55	19.74	11.62
76157	988.51	233.22	79.43	119.99	6.99	6.12
35698	95.85	461.23	51.31	26.92	24.54	1.39
15174	219.71	85.50	183.12	15.46	5.34	6.88
9357	31.84	192.04	37.63	49.04	2.22	0.82

IreOTR Irish otter trawlers

1995	2003						
1	1	0	1				
1	7						
56335	77	453	115	33	6	1	1
60709	72	200	95	30	15	4	1
62698	215	120	57	24	6	5	2
57403	28	138	16	16	7	3	0
53192	10	65	16	3	2	0	0
46913	131	42	17	6	1	0	0
48358	19	90	14	5	3	0	0
37231	39	32	22	2	1	0	0
42899	7	39	6	6	1	0	0

Table 3.1.2.1. contd. Cod in Division VIa. Landings-effort and survey tuning series made available to the WG. For ScoGFS, numbers are standardised to catch-rate per 10 hours. For IreGFS, effort is given as minutes towed, numbers are in units. For IreOTR, effort is given as reported hours fished per year, numbers landed are in thousands.

ScoGFS	**3.1.14**	**Scottish west coast groundfish survey**					
1985	**2004**						
1	**1**	**0**	**0.25**				
1	**7**						
10	**1.5**	**23.7**	**8.6**	**13.6**	**3.9**	**2.5**	**1.2**
10	**1.5**	**6.9**	**26.8**	**5.6**	**7.3**	**2.5**	**1.9**
10	**57.4**	**16.2**	**15.3**	**22.8**	**3.0**	**2.8**	**0.0**
10	**0.0**	**64.9**	**14.2**	**3.4**	**2.1**	**0.7**	**0.2**
10	**4.5**	**7.2**	**45.1**	**8.6**	**1.9**	**0.5**	**0.8**
10	**2.0**	**24.6**	**4.1**	**14.7**	**4.2**	**1.6**	**0.8**
10	**4.8**	**5.4**	**17.4**	**5.2**	**13.4**	**2.8**	**0.5**
10	**7.3**	**11.5**	**5.4**	**7.6**	**3.4**	**2.3**	**0.5**
10	**1.7**	**38.2**	**12.7**	**1.7**	**1.4**	**1.1**	**0.0**
10	**13.6**	**14.7**	**25.1**	**5.8**	**1.0**	**0.0**	**0.0**
10	**6.4**	**23.8**	**14.0**	**16.5**	**1.2**	**1.9**	**0.7**
10	**2.8**	**20.9**	**24.1**	**4.1**	**2.8**	**1.3**	**0.0**
10	**11.1**	**7.7**	**11.6**	**7.9**	**4.2**	**4.7**	**1.0**
10	**2.8**	**30.9**	**5.3**	**8.7**	**3.7**	**0.6**	**2.0**
10	**1.5**	**8.2**	**8.2**	**1.4**	**3.2**	**0.5**	**0.5**
10	**13.3**	**5.4**	**6.9**	**1.3**	**0.0**	**0.4**	**0.0**
10	**2.7**	**18.4**	**5.7**	**13.2**	**19.5**	**1.1**	**1.6**
10	**5.3**	**4.3**	**10.6**	**2.6**	**0.5**	**3.0**	**0.0**
10	**2.7**	**16.7**	**2.0**	**4.7**	**1.8**	**0.7**	**0.4**
10	**5.7**	**3.0**	**5.6**	**2.3**	**1.7**	**0.0**	**0.0**

IreGFS	Irish groundfish survey			
1993	2002			
1	1	0.75	0.79	
0	3			
1849	0.0	312.0	49.0	13.0
1610	20.0	999.0	56.0	13.0
1826	78.0	169.0	142.0	69.0
1765	0.0	214.0	89.0	18.0
1581	6.0	565.0	31.0	10.0
1639	0.0	83.0	53.0	6.0
1564	0.0	24.0	14.0	3.0
1556	0.0	124.0	4.0	1.0
755	3.0	82.0	28.0	2.0
798	0.0	50.6	2.2	1.2

IRGFS	Irish West Coast ground fish survey. (New for 2004)										
2003	2003										
1	1	0.79	0.92								
0	10										
1	0	11	12	0	0	0	0	0	0	0	0

Table 3.1.3.1. Cod in Division VIa. Landings at age (thousands).

Year	**Age 1**	**2**	**3**	**4**	**5**	**6**	**7+**
1966	384	2883	629	999	825	78	52
1967	261	2571	3705	670	442	264	67
1968	333	1364	3289	1838	215	171	151
1969	64	1974	1332	1943	759	149	170
1970	256	1176	1638	571	476	153	74
1971	254	1903	550	841	240	201	95
1972	735	2891	1591	409	501	108	110
1973	1015	1524	1442	583	161	193	104
1974	843	2318	778	1068	288	72	102
1975	1207	1898	1187	533	325	90	35
1976	970	3682	1467	638	256	215	56
1977	1265	1314	1639	624	269	87	79
1978	723	1761	999	695	286	97	75
1979	929	1612	2125	682	342	134	69
1980	1195	3294	2001	796	191	77	37
1981	461	7016	3220	904	182	29	20
1982	1827	1673	3206	1189	367	111	33
1983	2335	4515	1118	1400	468	148	60
1984	2143	2360	2564	448	555	185	59
1985	1355	5069	1269	1091	140	167	79
1986	792	1486	2055	411	191	40	30
1987	7873	4837	988	905	137	56	26
1988	1008	8336	2193	278	210	39	20
1989	2017	1082	3858	709	113	69	33
1990	513	4024	432	924	170	23	11
1991	1518	1728	1805	188	266	70	23
1992	1407	1868	575	720	69	58	24
1993	328	3596	1050	131	183	24	36
1994	942	1207	1545	280	56	51	20
1995	753	2750	700	630	70	15	11
1996	341	2331	1210	247	204	31	13
1997	1414	1067	989	281	66	62	7
1998	310	3318	293	174	57	16	9
1999	132	884	1047	64	48	24	9
2000	765	532	211	231	15	12	13
2001	96	1241	155	63	52	3	4
2002	337	340	522	41	13	14	4
2003	62	516	85	107	6	2	1

Table 3.1.3.2. Cod in Division VIa. Mean weight-at-age in landings (kg).

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1966	0.730	1.466	3.474	5.240	4.868	8.711	9.250
1967	0.681	1.470	2.906	4.560	6.116	7.394	8.058
1968	0.745	1.776	2.766	4.721	6.304	7.510	8.278
1969	0.860	1.284	2.821	4.259	6.169	6.374	7.928
1970	0.595	0.955	2.533	4.678	6.016	7.120	8.190
1971	0.674	1.046	2.536	4.167	6.023	6.835	8.100
1972	0.609	1.192	2.586	4.417	6.226	7.585	8.538
1973	0.597	1.181	2.784	4.601	5.625	7.049	8.611
1974	0.611	1.103	2.834	4.750	6.144	7.729	9.339
1975	0.603	1.369	3.078	5.302	6.846	8.572	10.328
1976	0.616	1.397	3.161	5.005	6.290	8.017	9.001
1977	0.629	1.160	2.605	4.715	6.269	7.525	9.511
1978	0.630	1.373	3.389	5.262	7.096	8.686	9.857
1979	0.693	1.373	2.828	4.853	6.433	7.784	9.636
1980	0.624	1.375	3.002	5.277	7.422	8.251	9.331
1981	0.550	1.166	2.839	4.923	7.518	9.314	10.328
1982	0.692	1.468	2.737	4.749	6.113	7.227	9.856
1983	0.583	1.265	2.995	4.398	6.305	8.084	9.744
1984	0.735	1.402	3.168	5.375	6.601	8.606	10.350
1985	0.628	1.183	2.597	4.892	6.872	8.344	9.766
1986	0.710	1.211	2.785	4.655	6.336	8.283	9.441
1987	0.531	1.312	2.783	4.574	6.161	7.989	10.062
1988	0.806	1.182	2.886	5.145	6.993	8.204	9.803
1989	0.704	1.298	2.425	4.737	7.027	7.520	9.594
1990	0.613	1.275	2.815	4.314	7.021	9.027	11.671
1991	0.640	1.095	2.618	4.346	6.475	8.134	10.076
1992	0.686	1.293	2.607	4.268	6.190	7.844	10.598
1993	0.775	1.316	2.940	4.646	6.244	7.802	8.409
1994	0.644	1.292	2.899	4.710	6.389	8.423	8.409
1995	0.606	1.148	2.857	4.956	6.771	8.539	9.505
1996	0.667	1.221	2.738	5.056	6.892	8.088	10.759
1997	0.595	1.210	2.571	4.805	6.952	7.821	9.630
1998	0.605	1.061	2.264	4.506	6.104	8.017	9.612
1999	0.691	1.039	2.194	4.688	6.486	8.252	9.439
2000	0.689	1.261	2.457	4.126	6.666	7.917	8.392
2001	0.654	0.988	2.679	4.568	5.860	7.741	9.386
2002	0.668	1.140	2.330	4.841	6.175	7.192	9.548
2003	0.671	1.016	2.312	3.854	6.220	8.075	8.839

Table 3.1.3.3. Cod in Division VIa. Discard data set from Scottish and Irish sampling programme, ages 1–3, years 1978–2003. Data from 1978-2001 raised from Scottish sampling only, 2003 data raised from both Irish and Scottish sampling)

a) Discards at age (thousands).

	Age		
Year	**1**	**2**	**3**
1978	8904	1203	0
1979	11	119	0
1980	2758	0	0
1981	289	1475	0
1982	5264	2	0
1983	7371	1005	0
1984	2117	10	0
1985	43508	3122	0
1986	4483	10	0
1987	52582	159	0
1988	714	3256	0
1989	8443	25	0
1990	1835	158	0
1991	3255	319	0
1992	12498	143	2
1993	595	51	0
1994	773	2	0
1995	1111	126	0
1996	233	86	0
1997	1074	27	0
1998	472	837	3
1999	283	16	0
2000	2081	53	0
2001	216	373	0
2002	508	32	0
2003	77	38	8

b) Mean weight-at-age in discards (kg).

	Age		
Year	**1**	**2**	**3**
1978	0.37	0.321	0
1979	0.276	0.43	0
1980	0.361	0	0
1981	0.135	0.326	0
1982	0.314	0.392	0
1983	0.223	0.374	0
1984	0.298	0.435	0
1985	0.178	0.346	0
1986	0.267	0.305	0
1987	0.166	0.37	0
1988	0.296	0.283	0
1989	0.332	0.59	0
1990	0.132	0.454	0
1991	0.245	0.351	0
1992	0.22	1.03	2.382
1993	0.239	0.812	3.723
1994	0.24	0.365	0
1995	0.203	0.256	0
1996	0.226	0.389	0
1997	0.321	0.328	0
1998	0.23	0.367	0.59
1999	0.294	0.299	0
2000	0.28	0.421	0
2001	0.248	0.417	0
2002	0.263	1.021	0
2003	0.272	0.57	0.39

Table 3.1.3.4. Cod in Division VIa. Total catch at age (thousands).

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	9627	2965	999	695	286	97	75
1979	940	1731	2125	682	342	134	69
1980	3953	3294	2001	796	191	77	37
1981	749	8491	3220	904	182	29	20
1982	7091	1676	3206	1189	367	111	33
1983	9706	5520	1118	1400	468	148	60
1984	4260	2371	2564	448	555	185	59
1985	44863	8191	1269	1091	140	167	79
1986	5275	1495	2055	411	191	40	30
1987	60456	4996	988	905	137	56	26
1988	1722	11592	2193	278	210	39	20
1989	10459	1107	3858	709	113	69	33
1990	2348	4182	432	924	170	23	11
1991	4773	2047	1805	188	266	70	23
1992	13905	2011	577	720	69	58	24
1993	923	3647	1050	131	183	24	36
1994	1715	1209	1545	280	56	51	20
1995	1864	2877	700	630	70	15	11
1996	574	2417	1210	247	204	31	13
1997	2488	1094	989	281	66	62	7
1998	783	4155	296	174	57	16	9
1999	415	900	1047	64	48	24	9
2000	2846	585	211	231	15	12	13
2001	312	1614	155	63	52	3	4
2002	845	372	522	41	13	14	4
2003	139	554	93	107	6	2	1

Table 3.1.3.5. Cod in Division VIa. Mean weight-at-age (kg) in total catch.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.389	0.946	3.389	5.262	7.096	8.686	9.857
1979	0.688	1.308	2.828	4.853	6.433	7.784	9.636
1980	0.440	1.375	3.002	5.277	7.422	8.251	9.331
1981	0.390	1.020	2.839	4.923	7.518	9.314	10.328
1982	0.411	1.467	2.737	4.749	6.113	7.227	9.856
1983	0.310	1.103	2.995	4.398	6.305	8.084	9.744
1984	0.518	1.398	3.168	5.375	6.601	8.606	10.350
1985	0.191	0.864	2.597	4.892	6.872	8.344	9.766
1986	0.334	1.205	2.785	4.655	6.336	8.283	9.441
1987	0.213	1.282	2.783	4.574	6.161	7.989	10.062
1988	0.595	0.929	2.886	5.145	6.993	8.204	9.803
1989	0.404	1.282	2.425	4.737	7.027	7.520	9.594
1990	0.237	1.244	2.815	4.314	7.021	9.027	11.671
1991	0.371	0.979	2.618	4.346	6.475	8.134	10.076
1992	0.267	1.274	2.606	4.268	6.190	7.844	10.598
1993	0.430	1.309	2.940	4.646	6.244	7.802	8.409
1994	0.462	1.291	2.899	4.710	6.389	8.423	8.409
1995	0.365	1.109	2.857	4.956	6.771	8.539	9.505
1996	0.487	1.191	2.738	5.056	6.892	8.088	10.759
1997	0.477	1.188	2.571	4.805	6.952	7.821	9.630
1998	0.379	0.921	2.248	4.506	6.104	8.017	9.612
1999	0.420	1.025	2.194	4.688	6.486	8.252	9.439
2000	0.390	1.186	2.457	4.126	6.666	7.917	8.392
2001	0.372	0.856	2.679	4.568	5.860	7.741	9.386
2002	0.424	1.130	2.330	4.841	6.175	7.192	9.548
2003	0.450	0.986	2.15	3.854	6.220	8.075	8.839

Table 3.1.5.1. Cod in Division VIa. TSA parameter settings for the three final assessment runs.

Parameter	*Setting*	*Justification*
Age of full selection.	$a_m = 4$	Based on inspection of previous XSA runs.
Multipliers on variance matrices of measurements.	$B_{\text{landings}}(a) = 2$ for ages 6, 7+ $B_{\text{survey}}(a) = 2$ for age 1, 5, 6	Allows extra measurement variability for poorly-sampled ages.
Multipliers on variances for fishing mortality estimates.	$H(1) = 4$	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points (implemented by multiplying the relevant q by 3)	Landings: age 2 in 1981 and 1987. Discards: age 1 in 1985 and 1992, age 2 in 1998. Survey: age 1 in 1987 and 2000, age 2 in 1993 and 1994, age 6 in 1995 and 2002, ages 4, 5, 6 in 2001 (the latter are from a single large haul, 24 fish > 75 cm in 30 mins.)	Large values indicated by exploratory prediction error plots.
Discards	Discards are allowed to evolve over time constrained by a trend. Ages 1 and 2 are modelled independently.	
Recruitment.	Modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean $\eta_1 S \exp(-\eta_2 S)$, where S is the spawning stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	
Large year classes.	The 1986 year class was large, and recruitment at age 1 in 1987 is not well modelled by the Ricker recruitment model. Instead, $N(1, 1980)$ is taken to be normally distributed with mean $5\eta_1 S \exp(-\eta_2 S)$. The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966-1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The coefficient of variation is again assumed to be constant.	

Table 3.1.5.2. Cod in Division VIa. TSA parameter estimates for 2002 & 2003 assessments and the 3 assessments presented this year.

Parameter	*Notation*	Description	2002 WG	2003 WG	This Year		
					Run1	Run2	Run3
Initial fishing mortality	F (1, 1978)	Fishing mortality at age *a* in year *y*	0.03	0.64	0.61	0.76	0.64
	F (2, 1978)		0.25	0.62	0.57	0.79	0.57
	F (4, 1978)		0.67	0.82	0.64	1.32	0.66
Survey selectivities	$\Phi(1)$	Survey selectivity at age *a*	0.83	0.33	0.42	0.81	0.47
	$\Phi(2)$		4.41	1.98	1.99	3.97	3.19
	$\Phi(4)$		18.28	10.65	11.06	20.3	14.92
Fishing mortality standard deviations	σ_F	Transitory changes in overall fishing mortality	0.10	0.04	0.07	0.11	0.07
	σ_U	Persistent changes in selection (age effect in F)	0.10	0.06	0.05	0.06	0.03
	σ_V	Transitory changes in the year effect in fishing mortality	0.00	0.07	0.08	0.00	0.10
	σ_Y	Persistent changes in the year effect in fishing mortality	0.16	0.07	0.04	0.20	0.00
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.24	0.00	0.0	0.24	0.00
	σ_β	Persistent changes in survey catchability	0.00	0.45	0.48	0.00	0.00
Measurement standard deviations	$\sigma_{landings}$	Standard error of landings-at-age data	0.12	0.13	0.11	0.12	0.10
	$\sigma_{discards}$	Standard error of discards-at-age data	n/a	0.94	0.96	0.99	1.42
	σ_{survey}	Standard error of survey data	0.36	0.56	0.43	0.46	0.35
Discards	$\sigma_{logit\ p}$	Transitory trends in discarding	n/a	0.30	0.28	0.15	0.00
	$\sigma_{persistent}$	Persistent trends in discarding	n/a	0.16	0.27	0.23	0.68
Recruitment	η_1	Ricker parameter (slope at the origin)	0.82	0.62	0.54	0.60	0.80
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.03	0.003	0.00	0.004	0.01
	cv_{rec}	Coefficient of variation of recruitment data	0.36	0.56	0.52	0.50	0.49

Table 3.1.5.3. Cod in Division VIa. TSA population numbers-at-age (millions). Run1.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	15.701	8.347	2.561	1.434	0.526	0.163	0.132
1979	23.886	9.065	4.155	1.119	0.529	0.185	0.102
1980	27.767	12.605	4.337	1.418	0.295	0.132	0.068
1981	9.242	15.310	6.065	1.799	0.507	0.102	0.070
1982	24.420	4.888	6.889	2.370	0.669	0.188	0.060
1983	16.779	11.532	2.142	2.606	0.845	0.236	0.088
1984	23.752	6.096	4.495	0.760	0.839	0.270	0.101
1985	10.598	11.978	2.260	1.470	0.229	0.233	0.107
1986	18.075	4.152	3.929	0.723	0.353	0.064	0.083
1987	52.618	9.556	1.762	1.367	0.246	0.118	0.049
1988	5.700	17.272	3.608	0.555	0.375	0.077	0.051
1989	18.779	2.619	5.719	1.156	0.186	0.119	0.042
1990	5.912	8.915	0.969	1.479	0.336	0.055	0.046
1991	9.884	3.113	3.399	0.349	0.487	0.116	0.035
1992	15.346	4.414	0.983	1.057	0.114	0.147	0.045
1993	5.747	7.831	1.653	0.286	0.299	0.036	0.060
1994	10.271	2.947	2.984	0.467	0.091	0.085	0.029
1995	8.271	5.480	1.189	1.019	0.138	0.028	0.034
1996	3.276	4.396	1.940	0.379	0.315	0.044	0.019
1997	11.748	1.614	1.303	0.464	0.101	0.083	0.016
1998	2.841	5.489	0.398	0.272	0.120	0.026	0.025
1999	1.789	1.430	1.495	0.095	0.078	0.037	0.015
2000	5.770	0.906	0.365	0.327	0.024	0.021	0.015
2001	1.160	2.589	0.239	0.088	0.077	0.006	0.009
2002	2.452	0.593	0.757	0.057	0.021	0.019	0.004
2003	0.750	1.128	0.153	0.166	0.011	0.004	0.004
2004*	1.439	0.388	0.362	0.042	0.046	0.003	0.002
2005*	0.788	0.716	0.114	0.091	0.011	0.012	0.001
GM(78-03)	8.397	4.573	1.737	0.599	0.192	0.066	0.036

*****2004 and 2005 values are TSA-derived projections of population numbers.

Table 3.1.5.4. Cod in Division VIa. Standard errors on TSA population numbers-at-age (millions). Run1.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	2.913	0.639	0.154	0.104	0.058	0.033	0.025
1979	2.279	0.644	0.223	0.076	0.050	0.033	0.021
1980	2.677	0.851	0.281	0.120	0.036	0.028	0.021
1981	1.057	1.338	0.406	0.122	0.046	0.015	0.014
1982	2.338	0.393	0.493	0.164	0.044	0.017	0.005
1983	2.156	0.956	0.162	0.207	0.077	0.027	0.010
1984	1.998	0.576	0.376	0.066	0.088	0.040	0.016
1985	1.526	0.851	0.199	0.146	0.029	0.044	0.022
1986	1.514	0.375	0.323	0.065	0.050	0.013	0.021
1987	8.342	0.717	0.123	0.126	0.024	0.021	0.010
1988	1.063	1.967	0.234	0.045	0.043	0.010	0.009
1989	2.118	0.212	0.608	0.085	0.015	0.017	0.005
1990	0.948	0.570	0.067	0.159	0.032	0.008	0.008
1991	1.355	0.231	0.227	0.021	0.047	0.013	0.004
1992	1.322	0.325	0.077	0.081	0.009	0.021	0.007
1993	0.545	0.397	0.110	0.025	0.029	0.004	0.009
1994	0.967	0.159	0.171	0.036	0.008	0.013	0.004
1995	0.763	0.324	0.067	0.061	0.013	0.004	0.005
1996	0.455	0.259	0.138	0.026	0.022	0.005	0.002
1997	1.056	0.133	0.110	0.043	0.009	0.010	0.003
1998	0.302	0.395	0.042	0.028	0.013	0.004	0.004
1999	0.188	0.107	0.132	0.009	0.008	0.005	0.002
2000	0.511	0.066	0.033	0.030	0.003	0.003	0.002
2001	0.137	0.197	0.019	0.008	0.009	0.001	0.001
2002	0.278	0.053	0.067	0.006	0.003	0.004	0.001
2003	0.270	0.143	0.020	0.025	0.003	0.001	0.002
2004*	0.405	0.150	0.078	0.010	0.012	0.001	0.001
2005*	0.431	0.221	0.048	0.027	0.003	0.004	0.001
GM(78-03)	0.991	0.348	0.132	0.050	0.020	0.010	0.006

*****2004 and 2005 values are standard errors on TSA-derived projections of population numbers.

Table 3.1.5.5. Cod in Division VIa. TSA estimates for fishing mortality-at-age. Run1.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.438	0.492	0.630	0.785	0.806	0.806	0.803
1979	0.435	0.542	0.809	0.991	0.981	0.964	0.954
1980	0.393	0.535	0.681	0.810	0.825	0.812	0.806
1981	0.415	0.590	0.741	0.756	0.714	0.747	0.751
1982	0.519	0.611	0.761	0.827	0.839	0.835	0.835
1983	0.624	0.688	0.820	0.909	0.918	0.937	0.942
1984	0.500	0.680	0.845	0.947	0.987	0.963	0.951
1985	0.622	0.852	0.894	1.088	1.020	1.067	1.061
1986	0.413	0.655	0.820	0.876	0.878	0.882	0.869
1987	0.726	0.777	0.933	1.043	0.964	0.980	0.986
1988	0.574	0.784	0.935	0.893	0.943	0.900	0.898
1989	0.545	0.783	1.020	1.020	1.015	1.028	1.045
1990	0.480	0.763	0.805	0.912	0.859	0.857	0.847
1991	0.614	0.926	0.965	0.919	0.988	0.995	1.000
1992	0.433	0.782	0.998	1.047	0.965	0.954	0.970
1993	0.448	0.760	1.055	0.945	1.030	1.000	0.991
1994	0.430	0.695	0.867	1.010	0.991	0.998	0.993
1995	0.429	0.834	0.943	0.967	0.939	0.958	0.940
1996	0.494	0.987	1.165	1.111	1.125	1.154	1.137
1997	0.559	1.083	1.261	1.107	1.120	1.151	1.109
1998	0.484	1.065	1.186	1.041	0.964	1.020	1.000
1999	0.480	1.130	1.279	1.141	1.117	1.087	1.100
2000	0.598	1.125	1.208	1.209	1.169	1.172	1.208
2001	0.472	1.025	1.205	1.205	1.167	1.107	1.096
2002	0.575	1.141	1.300	1.324	1.285	1.322	1.336
2003	0.458	0.936	1.095	1.094	1.070	1.065	1.066
2004*	0.499	1.022	1.184	1.155	1.158	1.160	1.158
2005*	0.502	1.022	1.182	1.158	1.158	1.158	1.158
GM(78-03)	0.500	0.794	0.951	0.990	0.980	0.983	0.980

*Estimates for 2004 and 2005 are TSA projections.

Table 3.1.5.6. Cod in Division VIa. Standard errors of TSA estimates for log fishing mortality-at-age. Run1.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.195	0.124	0.079	0.072	0.082	0.092	0.093
1979	0.194	0.123	0.072	0.063	0.073	0.085	0.087
1980	0.197	0.111	0.075	0.071	0.073	0.086	0.089
1981	0.199	0.111	0.072	0.072	0.081	0.091	0.093
1982	0.179	0.099	0.076	0.075	0.086	0.093	0.098
1983	0.173	0.093	0.075	0.071	0.080	0.090	0.093
1984	0.177	0.097	0.075	0.071	0.076	0.088	0.091
1985	0.179	0.078	0.078	0.068	0.078	0.085	0.089
1986	0.185	0.099	0.077	0.073	0.078	0.091	0.090
1987	0.151	0.097	0.070	0.068	0.078	0.087	0.092
1988	0.175	0.088	0.068	0.072	0.078	0.090	0.092
1989	0.161	0.087	0.075	0.068	0.079	0.086	0.092
1990	0.183	0.076	0.076	0.074	0.080	0.091	0.092
1991	0.157	0.071	0.071	0.070	0.076	0.088	0.093
1992	0.159	0.079	0.071	0.066	0.081	0.086	0.092
1993	0.178	0.070	0.065	0.073	0.076	0.091	0.089
1994	0.162	0.073	0.069	0.068	0.079	0.085	0.090
1995	0.169	0.071	0.066	0.064	0.077	0.089	0.088
1996	0.180	0.068	0.066	0.065	0.074	0.087	0.091
1997	0.158	0.071	0.066	0.068	0.077	0.083	0.091
1998	0.179	0.069	0.073	0.071	0.078	0.089	0.090
1999	0.185	0.068	0.068	0.070	0.076	0.086	0.091
2000	0.149	0.066	0.072	0.068	0.079	0.086	0.089
2001	0.189	0.075	0.072	0.073	0.082	0.095	0.094
2002	0.179	0.084	0.082	0.088	0.099	0.104	0.111
2003	0.220	0.134	0.131	0.138	0.141	0.144	0.144
2004*	0.247	0.162	0.161	0.163	0.163	0.163	0.163
2005*	0.256	0.176	0.175	0.177	0.177	0.177	0.177
GM(78-03)	0.177	0.086	0.074	0.072	0.081	0.091	0.093

*Estimates for 2004 and 2005 are standard errors of TSA projections of log *F*.

Table 3.1.5.7. Cod in Division VIa. TSA stock summary table. "Obs." denotes the sum-of-products of numbers and mean weights at age, rather than the reported caught, landed and discarded weight. * Estimates for 2004 and 2005 are TSA projections. Run1.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catch (000 tonnes)			Mean F (2–5)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment at age	
	Obs.	**Pred.**	**SE**	**Obs.**	**Pred.**	**SE**	**Obs.**	**Pred.**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
1978	13.521	13.651	0.668	3.681	2.008	0.627	17.201	15.540	1.079	0.678	0.034	25.563	0.909	36.684	1.661	15.701	2.913
1979	16.089	15.915	0.751	0.054	2.469	0.553	16.143	22.290	1.660	0.831	0.037	27.524	0.932	51.300	2.126	23.886	2.279
1980	17.879	17.327	0.944	0.996	2.544	0.667	18.875	21.913	1.552	0.713	0.034	31.603	1.253	53.976	2.165	27.767	2.677
1981	23.865	21.119	1.376	0.520	0.767	0.212	24.384	22.654	1.520	0.700	0.035	37.265	1.444	50.777	2.041	9.242	1.057
1982	21.511	22.292	1.227	1.654	2.211	0.617	23.165	24.902	1.557	0.760	0.038	37.239	1.455	53.364	1.988	24.420	2.338
1983	21.305	20.668	1.095	2.020	1.491	0.413	23.325	22.096	1.375	0.834	0.039	31.689	1.291	43.887	1.791	16.779	2.156
1984	21.272	19.515	1.192	0.636	2.149	0.541	21.907	23.153	1.630	0.865	0.040	29.668	1.408	48.051	2.093	23.752	1.998
1985	18.607	16.988	1.002	8.825	1.041	0.277	27.432	16.636	1.079	0.963	0.043	22.180	1.065	30.000	1.346	10.598	1.526
1986	11.820	11.789	0.812	1.200	1.343	0.309	13.020	13.394	0.968	0.807	0.039	18.924	0.971	28.886	1.301	18.075	1.514
1987	18.971	17.699	1.061	8.788	3.072	1.004	27.758	19.554	1.769	0.929	0.043	19.790	0.868	37.593	2.249	52.618	8.342
1988	20.413	18.759	1.476	1.133	0.808	0.246	21.546	18.822	1.585	0.889	0.040	23.901	1.219	36.453	2.190	5.700	1.063
1989	17.169	15.860	1.271	2.818	1.810	0.523	19.987	17.520	1.471	0.959	0.044	21.755	1.369	32.890	1.860	18.779	2.118
1990	12.176	12.068	0.745	0.314	0.389	0.113	12.490	12.605	0.837	0.835	0.039	17.875	0.849	24.981	1.102	5.912	0.948
1991	10.927	11.183	0.601	0.910	0.697	0.226	11.836	11.715	0.722	0.949	0.040	15.198	0.642	21.569	0.918	9.884	1.355
1992	9.086	8.966	0.475	2.902	1.012	0.245	11.989	9.633	0.579	0.948	0.042	11.975	0.503	19.133	0.745	15.346	1.322
1993	10.314	10.270	0.495	0.185	0.561	0.138	10.499	11.051	0.577	0.948	0.040	13.491	0.472	21.560	0.727	5.747	0.545
1994	8.928	9.013	0.470	0.186	0.601	0.166	9.114	10.055	0.585	0.891	0.039	13.162	0.509	20.942	0.761	10.271	0.967
1995	9.439	9.138	0.423	0.258	0.429	0.114	9.697	9.745	0.488	0.921	0.037	12.619	0.429	19.035	0.622	8.271	0.763
1996	9.427	9.396	0.468	0.086	0.250	0.070	9.513	9.863	0.507	1.097	0.043	11.940	0.440	16.796	0.610	3.276	0.455
1997	7.034	6.756	0.374	0.354	0.904	0.281	7.387	7.903	0.577	1.143	0.047	7.614	0.370	14.604	0.678	11.748	1.056
1998	5.714	5.438	0.370	0.418	0.247	0.066	6.131	5.419	0.366	1.064	0.046	5.809	0.273	9.438	0.445	2.841	0.302
1999	4.201	4.044	0.284	0.088	0.151	0.042	4.289	4.240	0.296	1.167	0.048	4.987	0.276	6.902	0.344	1.789	0.188
2000	2.977	3.020	0.162	0.605	0.431	0.129	3.582	3.338	0.231	1.178	0.050	3.126	0.159	6.017	0.274	5.770	0.511
2001	2.347	2.443	0.163	0.209	0.150	0.043	2.556	2.501	0.161	1.151	0.054	2.688	0.126	4.274	0.205	1.160	0.137
2002	2.243	2.204	0.138	0.166	0.201	0.058	2.409	2.415	0.165	1.263	0.076	2.442	0.157	4.051	0.231	2.452	0.278
2003	1.241	1.322	0.091	0.046	0.086	0.031	1.287	1.416	0.109	1.049	0.110	1.644	0.163	2.561	0.266	0.750	0.270
2004*		1.219	0.207		0.106	0.039		1.318	0.219	1.130	0.141	1.452	0.263	2.356	0.392	1.439	0.405
2005*		0.998	0.209		0.080	0.037		1.072	0.223	1.130	0.153	1.173	0.265	1.879	0.427	0.788	0.431
Min	1.241	1.322	0.091	0.046	0.086	0.031	1.287	1.416	0.109	0.678	0.034	1.644	0.126	2.561	0.205	0.750	0.137
GM	9.681	9.453	0.554	0.573	0.714	0.200	10.683	10.355	0.695	0.931	0.044	12.939	0.590	20.188	0.917	8.397	0.991
AM	12.249	11.802	0.697	1.502	1.070	0.297	13.751	13.091	0.902	0.943	0.045	17.372	0.752	26.759	1.182	12.790	1.503
Max	23.865	22.292	1.476	8.825	3.072	1.004	27.758	24.902	1.769	1.263	0.110	37.265	1.455	53.976	2.249	52.618	8.342

Table 3.1.5.8. Cod in Division VIa. TSA population numbers-at-age (millions). Run2.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	13.341	7.617	2.442	1.408	0.560	0.194	0.144
1979	21.203	8.398	3.972	1.057	0.510	0.196	0.115
1980	25.009	12.270	4.417	1.565	0.318	0.148	0.095
1981	8.439	14.562	6.027	1.872	0.561	0.103	0.084
1982	23.939	4.874	6.696	2.253	0.620	0.176	0.055
1983	18.780	11.248	2.170	2.585	0.841	0.229	0.085
1984	23.437	5.946	4.502	0.775	0.835	0.269	0.096
1985	10.411	11.626	2.165	1.394	0.225	0.203	0.096
1986	16.961	4.151	3.989	0.713	0.340	0.065	0.075
1987	57.100	8.888	1.768	1.410	0.225	0.106	0.044
1988	6.008	17.482	3.539	0.563	0.369	0.065	0.043
1989	18.247	2.529	6.102	1.068	0.173	0.105	0.031
1990	5.915	8.597	0.928	1.575	0.311	0.050	0.037
1991	10.711	3.141	3.305	0.332	0.493	0.108	0.031
1992	14.440	4.478	0.971	1.078	0.116	0.154	0.042
1993	5.497	7.459	1.687	0.280	0.298	0.037	0.063
1994	10.174	2.888	2.911	0.472	0.092	0.085	0.031
1995	8.217	5.563	1.221	1.036	0.137	0.028	0.034
1996	3.209	4.421	1.954	0.391	0.320	0.045	0.020
1997	12.582	1.553	1.267	0.448	0.101	0.082	0.016
1998	2.918	5.615	0.391	0.266	0.118	0.027	0.024
1999	1.793	1.475	1.519	0.093	0.076	0.040	0.016
2000	6.616	0.959	0.381	0.348	0.024	0.021	0.017
2001	1.372	2.957	0.289	0.111	0.102	0.007	0.011
2002	3.798	0.754	1.028	0.084	0.033	0.034	0.007
2003	1.535	2.151	0.297	0.379	0.032	0.013	0.016
2004*	3.426	1.013	1.163	0.150	0.205	0.017	0.016
2005*	3.021	2.249	0.539	0.586	0.081	0.111	0.018
GM(78-03)	8.767	4.681	1.808	0.633	0.205	0.070	0.039

*2004 and 2005 values are TSA-derived projections of population numbers.

Table 3.1.5.9. Cod in Division VIa. Standard errors on TSA population numbers-at-age (millions). Run2.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	2.822	0.630	0.138	0.081	0.038	0.020	0.013
1979	1.939	0.614	0.178	0.048	0.024	0.015	0.009
1980	2.566	0.842	0.276	0.112	0.030	0.021	0.014
1981	1.141	1.480	0.413	0.125	0.039	0.014	0.012
1982	2.102	0.380	0.428	0.137	0.031	0.011	0.003
1983	2.287	0.987	0.172	0.213	0.081	0.028	0.010
1984	2.042	0.627	0.378	0.065	0.086	0.043	0.016
1985	1.633	0.911	0.204	0.149	0.029	0.046	0.024
1986	1.584	0.389	0.292	0.054	0.039	0.010	0.016
1987	7.759	0.683	0.105	0.102	0.017	0.015	0.006
1988	1.259	1.951	0.201	0.040	0.034	0.009	0.006
1989	2.034	0.212	0.562	0.059	0.010	0.011	0.004
1990	1.134	0.473	0.063	0.148	0.021	0.005	0.005
1991	1.341	0.223	0.199	0.018	0.037	0.009	0.003
1992	1.270	0.334	0.079	0.077	0.009	0.021	0.006
1993	0.588	0.361	0.104	0.023	0.026	0.004	0.008
1994	0.910	0.159	0.170	0.036	0.008	0.013	0.004
1995	0.769	0.348	0.082	0.071	0.015	0.005	0.006
1996	0.468	0.293	0.159	0.032	0.028	0.007	0.003
1997	1.119	0.154	0.132	0.053	0.013	0.015	0.004
1998	0.334	0.449	0.047	0.034	0.016	0.006	0.006
1999	0.209	0.126	0.158	0.012	0.011	0.007	0.004
2000	0.592	0.084	0.044	0.042	0.004	0.005	0.003
2001	0.195	0.271	0.030	0.014	0.016	0.002	0.003
2002	0.494	0.118	0.169	0.019	0.010	0.011	0.002
2003	0.644	0.398	0.079	0.114	0.013	0.007	0.008
2004*	1.143	0.472	0.299	0.054	0.080	0.009	0.009
2005*	1.713	0.799	0.273	0.195	0.034	0.051	0.010
GM(78-03)	1.106	0.402	0.154	0.058	0.022	0.011	0.006

*2004 and 2005 values are standard errors on TSA-derived projections of population numbers.

Table 3.1.5.10. Cod in Division VIa. TSA estimates for fishing mortality-at-age. Run2.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.428	0.409	0.527	0.667	0.719	0.749	0.750
1979	0.355	0.442	0.723	0.979	1.014	0.974	0.936
1980	0.330	0.511	0.658	0.812	0.884	0.847	0.815
1981	0.367	0.588	0.752	0.721	0.644	0.711	0.704
1982	0.536	0.594	0.743	0.783	0.794	0.792	0.794
1983	0.785	0.694	0.823	0.922	0.932	0.978	0.993
1984	0.511	0.697	0.903	0.990	1.091	1.047	1.029
1985	0.693	0.873	0.911	1.192	1.045	1.168	1.154
1986	0.322	0.634	0.836	0.929	0.963	0.940	0.918
1987	0.899	0.691	0.944	1.140	1.038	1.052	1.058
1988	0.711	0.852	0.936	0.871	1.012	0.969	0.952
1989	0.524	0.802	1.138	1.013	1.008	1.092	1.057
1990	0.491	0.744	0.755	0.953	0.776	0.757	0.753
1991	0.678	0.967	0.918	0.841	0.961	0.975	1.007
1992	0.395	0.754	1.039	1.087	0.939	0.927	0.964
1993	0.417	0.727	1.074	0.903	1.051	0.984	0.967
1994	0.404	0.660	0.829	1.022	0.997	1.014	0.995
1995	0.420	0.831	0.936	0.975	0.916	0.947	0.912
1996	0.464	0.969	1.123	1.099	1.118	1.154	1.128
1997	0.600	1.016	1.187	1.041	1.063	1.116	1.048
1998	0.467	1.019	1.110	0.985	0.894	0.961	0.932
1999	0.415	1.036	1.145	1.034	1.018	0.989	0.993
2000	0.601	0.983	1.012	0.994	0.981	0.984	1.024
2001	0.369	0.806	0.908	0.860	0.815	0.780	0.771
2002	0.366	0.677	0.729	0.654	0.623	0.641	0.664
2003	0.212	0.413	0.479	0.412	0.396	0.398	0.396
2004*	0.221	0.432	0.486	0.412	0.413	0.413	0.412
2005*	0.222	0.432	0.485	0.412	0.412	0.412	0.412
GM(78-03)	0.467	0.721	0.869	0.900	0.892	0.901	0.894

*Estimates for 2004 and 2005 are TSA projections.

Table 3.1.5.11. Cod in Division VIa. Standard errors of TSA estimates for log fishing mortality-at-age. Run2.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.189	0.127	0.085	0.076	0.098	0.118	0.122
1979	0.186	0.138	0.087	0.077	0.104	0.121	0.126
1980	0.211	0.118	0.084	0.078	0.084	0.113	0.117
1981	0.218	0.124	0.080	0.083	0.098	0.123	0.125
1982	0.182	0.108	0.088	0.094	0.116	0.130	0.138
1983	0.163	0.100	0.085	0.082	0.099	0.119	0.126
1984	0.182	0.108	0.086	0.083	0.093	0.118	0.126
1985	0.186	0.081	0.093	0.078	0.094	0.112	0.122
1986	0.203	0.108	0.084	0.081	0.097	0.124	0.121
1987	0.137	0.104	0.073	0.074	0.104	0.118	0.129
1988	0.172	0.095	0.067	0.079	0.093	0.129	0.131
1989	0.146	0.092	0.079	0.070	0.095	0.109	0.128
1990	0.202	0.078	0.082	0.082	0.099	0.120	0.125
1991	0.154	0.076	0.078	0.083	0.098	0.119	0.130
1992	0.154	0.087	0.079	0.074	0.100	0.113	0.126
1993	0.200	0.076	0.070	0.087	0.096	0.125	0.120
1994	0.177	0.087	0.080	0.082	0.105	0.115	0.127
1995	0.183	0.081	0.079	0.077	0.099	0.123	0.121
1996	0.204	0.079	0.079	0.081	0.093	0.120	0.127
1997	0.165	0.085	0.080	0.086	0.098	0.113	0.127
1998	0.200	0.080	0.088	0.089	0.099	0.123	0.124
1999	0.212	0.082	0.084	0.089	0.098	0.120	0.129
2000	0.162	0.085	0.094	0.094	0.108	0.125	0.130
2001	0.228	0.111	0.113	0.126	0.135	0.156	0.154
2002	0.255	0.135	0.140	0.150	0.163	0.175	0.182
2003	0.294	0.192	0.195	0.203	0.210	0.219	0.219
2004*	0.396	0.295	0.297	0.299	0.299	0.299	0.299
2005*	0.448	0.361	0.363	0.364	0.364	0.364	0.364
GM(78-03)	0.199	0.107	0.096	0.096	0.113	0.134	0.140

*Estimates for 2004 and 2005 are standard errors of TSA projections of log *F*.

Table 3.1.5.12. Cod in Division VIa. TSA stock summary table. "Obs." denotes the sum-of-products of numbers and mean weights at age, rather than the reported caught, landed and discarded weight. * Estimates for 2004 and 2005 are TSA projections. Run2.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catch (000 tonnes)			Mean F (2–5)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment at age 1 (millions)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	13.521	12.401	0.614	3.681	1.559	0.531	17.201	13.627	0.926	0.580	0.030	25.346	0.795	35.160	1.555	13.341	2.822
1979	16.089	14.962	0.653	0.054	1.679	0.377	16.143	19.223	1.229	0.789	0.042	26.416	0.704	47.854	1.769	21.203	1.939
1980	17.879	17.925	0.999	0.996	1.888	0.520	18.875	21.424	1.416	0.716	0.035	32.905	1.223	53.876	2.091	25.009	2.566
1981	23.865	21.105	1.499	0.520	0.642	0.176	24.384	22.285	1.633	0.676	0.037	37.698	1.510	50.516	2.177	8.439	1.141
1982	21.511	20.972	1.155	1.654	2.261	0.589	23.165	23.634	1.446	0.729	0.043	35.774	1.251	51.618	1.737	23.939	2.102
1983	21.305	20.994	1.185	2.020	1.863	0.475	23.325	22.746	1.459	0.843	0.043	31.394	1.358	44.073	1.869	18.780	2.287
1984	21.272	20.308	1.295	0.636	2.116	0.531	21.907	23.821	1.686	0.920	0.047	29.572	1.433	47.694	2.125	23.437	2.042
1985	18.607	16.897	1.090	8.825	1.012	0.264	27.432	16.360	1.136	1.005	0.049	21.048	1.116	28.651	1.409	10.411	1.633
1986	11.820	12.005	0.776	1.200	0.983	0.252	13.020	13.114	0.886	0.840	0.044	18.865	0.858	28.478	1.194	16.961	1.584
1987	18.971	17.590	0.954	8.788	3.951	1.081	27.758	20.280	1.713	0.953	0.047	19.283	0.744	37.633	2.038	57.100	7.759
1988	20.413	19.594	1.552	1.133	0.891	0.266	21.546	19.548	1.603	0.918	0.043	23.664	1.140	36.465	2.131	6.008	1.259
1989	17.169	16.493	1.225	2.818	1.686	0.462	19.987	18.011	1.370	0.990	0.046	21.769	1.236	32.763	1.688	18.247	2.034
1990	12.176	11.813	0.696	0.314	0.364	0.102	12.490	12.274	0.755	0.807	0.039	17.674	0.760	24.575	0.971	5.915	1.134
1991	10.927	10.821	0.542	0.910	0.857	0.250	11.836	11.578	0.677	0.922	0.043	14.858	0.550	21.515	0.822	10.711	1.341
1992	9.086	9.080	0.490	2.902	0.855	0.200	11.989	9.570	0.560	0.955	0.045	12.121	0.498	19.072	0.728	14.440	1.270
1993	10.314	9.995	0.470	0.185	0.496	0.122	10.499	10.665	0.536	0.939	0.044	13.315	0.431	21.057	0.670	5.497	0.588
1994	8.928	8.704	0.477	0.186	0.560	0.155	9.114	9.670	0.577	0.877	0.045	12.980	0.501	20.649	0.732	10.174	0.910
1995	9.439	9.264	0.483	0.258	0.418	0.114	9.697	9.854	0.540	0.914	0.043	12.822	0.486	19.276	0.676	8.217	0.769
1996	9.427	9.372	0.544	0.086	0.239	0.069	9.513	9.820	0.580	1.077	0.049	12.098	0.510	16.941	0.690	3.209	0.468
1997	7.034	6.371	0.436	0.354	1.120	0.320	7.387	7.850	0.655	1.077	0.052	7.409	0.442	14.749	0.751	12.582	1.119
1998	5.714	5.312	0.421	0.418	0.249	0.065	6.131	5.299	0.417	1.002	0.050	5.808	0.312	9.519	0.505	2.918	0.334
1999	4.201	3.877	0.332	0.088	0.135	0.041	4.289	4.056	0.343	1.058	0.053	5.060	0.332	7.006	0.412	1.793	0.209
2000	2.977	2.928	0.194	0.605	0.525	0.147	3.582	3.372	0.273	0.992	0.058	3.294	0.229	6.550	0.360	6.616	0.592
2001	2.347	2.490	0.182	0.209	0.130	0.036	2.556	2.507	0.181	0.847	0.075	3.243	0.237	5.077	0.355	1.372	0.195
2002	2.243	2.136	0.199	0.166	0.215	0.063	2.409	2.371	0.218	0.671	0.077	3.422	0.502	5.778	0.691	3.798	0.494
2003	1.241	1.487	0.154	0.046	0.086	0.030	1.287	1.576	0.165	0.425	0.070	3.548	0.786	5.346	1.082	1.535	0.644
2004*		2.116	0.494		0.128	0.058		2.226	0.514	0.436	0.114	5.091	1.345	7.385	1.783	3.426	1.143
2005*		2.528	0.690		0.142	0.075		2.655	0.726	0.435	0.144	6.362	1.953	8.867	2.636	3.021	1.713
Min	1.241	1.487	0.154	0.046	0.086	0.030	1.287	1.576	0.165	0.425	0.030	3.243	0.229	5.077	0.355	1.372	0.195
GM	9.681	9.386	0.591	0.573	0.687	0.189	10.683	10.223	0.715	0.850	0.047	13.536	0.668	21.081	1.029	8.767	1.087
AM	12.249	11.727	0.716	1.502	1.030	0.278	13.751	12.867	0.884	0.866	0.048	17.361	0.767	26.611	1.201	12.756	1.509
Max	23.865	21.105	1.552	8.825	3.951	1.081	27.758	23.821	1.713	1.077	0.077	37.698	1.510	53.876	2.177	57.100	7.759

Table 3.1.5.13. Cod in Division VIa. TSA population numbers-at-age (millions). Run3.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	21.149	9.579	2.572	1.427	0.532	0.165	0.133
1979	29.143	10.344	4.213	1.115	0.528	0.189	0.105
1980	32.041	13.827	4.359	1.399	0.290	0.129	0.068
1981	11.035	16.368	6.110	1.794	0.498	0.100	0.068
1982	25.527	5.202	6.783	2.396	0.668	0.185	0.059
1983	15.104	12.030	2.152	2.587	0.851	0.235	0.087
1984	23.261	6.151	4.499	0.764	0.836	0.273	0.101
1985	11.646	11.678	2.236	1.473	0.230	0.230	0.108
1986	19.933	4.262	3.855	0.718	0.360	0.065	0.083
1987	56.643	10.513	1.763	1.380	0.245	0.122	0.050
1988	5.949	16.700	3.624	0.549	0.371	0.075	0.051
1989	19.656	2.569	5.447	1.176	0.186	0.118	0.043
1990	6.113	8.939	0.955	1.486	0.345	0.055	0.046
1991	11.265	2.898	3.520	0.362	0.500	0.124	0.037
1992	18.413	4.892	0.973	1.162	0.125	0.160	0.052
1993	10.200	8.816	1.932	0.301	0.377	0.043	0.073
1994	16.529	5.079	3.657	0.667	0.112	0.139	0.043
1995	13.923	8.133	2.022	1.254	0.241	0.041	0.066
1996	5.343	6.815	3.206	0.663	0.460	0.088	0.038
1997	18.129	2.380	2.529	0.983	0.232	0.162	0.044
1998	8.365	8.636	0.824	0.763	0.337	0.080	0.071
1999	5.302	3.872	3.040	0.226	0.257	0.113	0.051
2000	11.918	2.464	1.408	0.897	0.077	0.088	0.057
2001	4.249	5.898	0.954	0.458	0.330	0.028	0.053
2002	10.465	1.945	2.142	0.286	0.162	0.118	0.029
2003	4.556	5.077	0.695	0.640	0.101	0.057	0.052
2004*	8.682	2.104	1.813	0.206	0.221	0.035	0.038
2005*	5.869	4.231	0.782	0.559	0.074	0.079	0.026
GM(78-03)	13.006	6.333	2.432	0.866	0.299	0.106	0.060

*****2004 and 2005 values are TSA-derived projections of population numbers.

Table 3.1.5.14. Cod in Division VIa. Standard errors on TSA population numbers-at-age (millions). Run3.

Year	Age 1	2	3	4	5	6	7+
1978	2.892	0.634	0.139	0.091	0.051	0.029	0.021
1979	2.380	0.635	0.203	0.067	0.044	0.028	0.018
1980	2.771	0.854	0.256	0.110	0.032	0.024	0.018
1981	1.287	1.306	0.372	0.112	0.042	0.014	0.013
1982	2.351	0.420	0.432	0.153	0.040	0.015	0.005
1983	1.681	0.991	0.138	0.182	0.070	0.024	0.009
1984	1.812	0.563	0.317	0.057	0.076	0.036	0.014
1985	1.403	0.858	0.162	0.125	0.025	0.038	0.019
1986	1.265	0.342	0.257	0.054	0.042	0.011	0.018
1987	8.931	0.542	0.111	0.105	0.021	0.018	0.009
1988	1.003	1.705	0.221	0.041	0.038	0.009	0.008
1989	1.973	0.183	0.525	0.084	0.015	0.016	0.005
1990	1.141	0.516	0.056	0.144	0.031	0.007	0.007
1991	1.544	0.272	0.221	0.021	0.050	0.014	0.005
1992	1.905	0.416	0.098	0.089	0.010	0.023	0.007
1993	1.655	0.740	0.175	0.044	0.044	0.006	0.012
1994	2.718	0.772	0.447	0.103	0.022	0.025	0.008
1995	2.684	1.248	0.317	0.180	0.040	0.009	0.013
1996	1.859	1.250	0.519	0.123	0.072	0.017	0.009
1997	3.369	0.779	0.500	0.196	0.045	0.031	0.010
1998	2.068	1.573	0.287	0.173	0.075	0.019	0.018
1999	1.462	0.914	0.622	0.090	0.064	0.031	0.015
2000	2.202	0.599	0.341	0.204	0.031	0.025	0.017
2001	1.247	1.016	0.218	0.114	0.071	0.011	0.015
2002	2.039	0.542	0.418	0.071	0.042	0.028	0.009
2003	1.951	0.982	0.194	0.143	0.026	0.017	0.015
2004*	2.446	0.939	0.401	0.057	0.054	0.011	0.013
2005*	2.763	1.298	0.356	0.143	0.022	0.023	0.009
GM(78-03)	1.971	0.701	0.250	0.098	0.039	0.018	0.011

*****2004 and 2005 values are standard errors on TSA-derived projections of population numbers.

Table 3.1.5.15. Cod in Division VIa. TSA estimates for fishing mortality-at-age. Run3.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.525	0.638	0.638	0.785	0.808	0.809	0.806
1979	0.566	0.732	0.835	1.009	1.008	0.994	0.983
1980	0.491	0.666	0.689	0.813	0.833	0.820	0.814
1981	0.494	0.672	0.738	0.759	0.718	0.752	0.756
1982	0.564	0.683	0.756	0.831	0.844	0.840	0.841
1983	0.628	0.757	0.825	0.912	0.918	0.939	0.945
1984	0.552	0.756	0.865	0.959	1.005	0.976	0.964
1985	0.710	0.886	0.919	1.113	1.034	1.087	1.078
1986	0.467	0.679	0.806	0.870	0.866	0.869	0.856
1987	0.735	0.864	0.940	1.061	0.979	0.996	1.003
1988	0.581	0.778	0.910	0.882	0.931	0.888	0.883
1989	0.591	0.791	0.987	1.005	1.001	1.013	1.028
1990	0.524	0.728	0.769	0.872	0.822	0.816	0.806
1991	0.618	0.846	0.904	0.866	0.923	0.924	0.926
1992	0.526	0.730	0.931	0.919	0.863	0.858	0.865
1993	0.481	0.677	0.863	0.787	0.800	0.801	0.797
1994	0.500	0.721	0.871	0.819	0.813	0.817	0.815
1995	0.515	0.732	0.910	0.805	0.814	0.814	0.815
1996	0.554	0.784	0.972	0.853	0.841	0.851	0.852
1997	0.542	0.802	0.988	0.867	0.862	0.858	0.861
1998	0.560	0.825	1.023	0.883	0.883	0.880	0.880
1999	0.555	0.813	1.014	0.871	0.870	0.867	0.866
2000	0.496	0.749	0.923	0.783	0.790	0.791	0.791
2001	0.550	0.806	0.996	0.841	0.829	0.838	0.839
2002	0.523	0.808	1.002	0.842	0.840	0.837	0.840
2003	0.552	0.825	1.016	0.863	0.863	0.859	0.859
2004*	0.519	0.790	0.977	0.827	0.827	0.828	0.826
2005*	0.515	0.778	0.962	0.816	0.816	0.816	0.816
GM(78-03)	0.551	0.757	0.881	0.876	0.872	0.873	0.872

*Estimates for 2004 and 2005 are TSA projections.

Table 3.1.5.16. Cod in Division VIa. Standard errors of TSA estimates for log fishing mortality-at-age. Run3.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.194	0.121	0.070	0.065	0.075	0.084	0.084
1979	0.197	0.120	0.065	0.058	0.067	0.078	0.080
1980	0.198	0.114	0.068	0.065	0.067	0.080	0.082
1981	0.201	0.102	0.065	0.065	0.073	0.083	0.085
1982	0.195	0.102	0.068	0.068	0.077	0.085	0.089
1983	0.190	0.094	0.066	0.064	0.073	0.082	0.084
1984	0.190	0.099	0.066	0.064	0.069	0.080	0.083
1985	0.186	0.084	0.067	0.061	0.071	0.077	0.081
1986	0.197	0.093	0.067	0.065	0.071	0.083	0.082
1987	0.175	0.072	0.063	0.061	0.070	0.079	0.083
1988	0.197	0.077	0.063	0.066	0.071	0.082	0.084
1989	0.185	0.081	0.068	0.063	0.073	0.080	0.084
1990	0.195	0.073	0.068	0.068	0.074	0.085	0.086
1991	0.189	0.076	0.068	0.070	0.075	0.085	0.090
1992	0.180	0.085	0.077	0.078	0.087	0.092	0.096
1993	0.209	0.110	0.103	0.107	0.110	0.114	0.115
1994	0.219	0.135	0.129	0.130	0.132	0.132	0.132
1995	0.219	0.138	0.133	0.132	0.132	0.133	0.133
1996	0.222	0.142	0.136	0.134	0.135	0.136	0.136
1997	0.221	0.147	0.140	0.138	0.138	0.139	0.139
1998	0.225	0.147	0.144	0.140	0.141	0.142	0.142
1999	0.229	0.154	0.147	0.145	0.144	0.145	0.145
2000	0.231	0.159	0.154	0.148	0.149	0.149	0.149
2001	0.232	0.158	0.152	0.148	0.148	0.149	0.149
2002	0.234	0.162	0.154	0.152	0.152	0.153	0.153
2003	0.237	0.165	0.162	0.158	0.157	0.158	0.158
2004*	0.244	0.173	0.170	0.164	0.164	0.164	0.164
2005*	0.247	0.177	0.174	0.168	0.168	0.168	0.168
GM(78-03)	0.205	0.112	0.092	0.090	0.096	0.103	0.105

*Estimates for 2004 and 2005 are standard errors of TSA projections of log *F*.

Table 3.1.5.17. Cod in Division VIa. TSA stock summary table. "Obs." denotes the sum-of-products of numbers and mean weights at age, rather than the reported caught, landed and discarded weight. * Estimates for 2004 and 2005 are TSA projections. Run3.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catch (000 tonnes)			Mean F (2–5)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment at age 1 (millions)	
	Obs.	**Pred.**	**SE**	**Obs.**	**Pred.**	**SE**	**Obs.**	**Pred.**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
1978	13.521	13.420	0.645	3.681	3.488	0.846	17.201	17.823	1.254	0.717	0.036	26.237	0.837	40.045	1.612	21.149	2.892
1979	16.089	15.641	0.722	0.054	4.349	0.786	16.143	27.160	2.115	0.896	0.040	28.571	0.877	56.791	2.180	29.143	2.380
1980	17.879	17.733	0.882	0.996	3.719	0.884	18.875	25.204	1.849	0.750	0.036	32.366	1.196	57.437	2.197	32.041	2.771
1981	23.865	21.639	1.444	0.520	1.125	0.347	24.384	24.192	1.573	0.722	0.034	37.815	1.367	52.563	2.001	11.035	1.287
1982	21.511	22.608	1.125	1.654	2.492	0.711	23.165	25.684	1.593	0.779	0.038	37.315	1.330	54.078	1.908	25.527	2.351
1983	21.305	20.800	0.998	2.020	1.539	0.455	23.325	22.548	1.377	0.853	0.038	31.923	1.192	43.870	1.701	15.104	1.681
1984	21.272	19.693	1.051	0.636	2.423	0.616	21.907	23.940	1.611	0.896	0.041	29.745	1.243	47.912	1.939	23.261	1.812
1985	18.607	17.372	0.883	8.825	1.126	0.321	27.432	16.922	1.060	0.988	0.042	21.999	0.954	29.886	1.251	11.646	1.403
1986	11.820	11.758	0.680	1.200	1.671	0.387	13.020	13.745	0.908	0.805	0.037	18.845	0.799	29.463	1.096	19.933	1.265
1987	18.971	19.048	0.800	8.788	3.399	1.200	27.758	21.226	1.827	0.961	0.038	20.527	0.710	39.778	2.188	56.643	8.931
1988	20.413	18.647	1.415	1.133	0.750	0.253	21.546	18.450	1.427	0.875	0.037	23.597	1.094	36.048	1.940	5.949	1.003
1989	17.169	15.347	1.108	2.818	2.068	0.618	19.987	17.307	1.385	0.946	0.041	21.248	1.209	32.614	1.663	19.656	1.973
1990	12.176	11.885	0.666	0.314	0.377	0.139	12.490	12.349	0.759	0.798	0.035	17.967	0.774	25.130	1.021	6.113	1.141
1991	10.927	10.925	0.575	0.910	0.844	0.293	11.836	11.695	0.762	0.885	0.040	15.596	0.668	22.423	0.989	11.265	1.544
1992	9.086	9.061	0.473	2.902	1.485	0.389	11.989	10.325	0.664	0.861	0.047	12.958	0.633	21.225	0.987	18.413	1.905
1993	10.314	10.522	0.507	0.185	1.026	0.322	10.499	12.124	0.743	0.782	0.062	15.595	0.901	26.310	1.491	10.200	1.655
1994	8.928	11.757	1.462	0.186	1.315	0.387	9.114	14.266	1.751	0.806	0.082	17.913	1.614	30.178	2.439	16.529	2.718
1995	9.439	12.122	1.561	0.258	0.989	0.324	9.697	13.826	1.694	0.815	0.083	18.472	1.638	28.701	2.397	13.923	2.684
1996	9.427	13.004	1.788	0.086	0.526	0.256	9.513	14.105	1.893	0.862	0.088	19.414	1.863	27.147	2.663	5.343	1.859
1997	7.034	9.907	1.619	0.354	1.965	0.691	7.387	12.767	1.896	0.880	0.091	15.089	1.742	26.000	2.735	18.129	3.369
1998	5.714	9.347	1.615	0.418	0.800	0.356	6.131	10.117	1.528	0.904	0.094	12.547	1.452	19.793	2.181	8.365	2.068
1999	4.201	8.189	1.385	0.088	0.579	0.260	4.289	9.024	1.434	0.892	0.095	11.942	1.519	17.011	2.026	5.302	1.462
2000	2.977	6.368	1.174	0.605	1.078	0.412	3.582	7.681	1.163	0.811	0.089	9.879	1.248	16.412	1.783	11.918	2.202
2001	2.347	6.793	1.111	0.209	0.465	0.272	2.556	7.131	1.018	0.868	0.091	9.566	1.018	13.929	1.458	4.249	1.247
2002	2.243	6.114	1.138	0.166	0.979	0.406	2.409	7.511	1.126	0.873	0.093	8.939	1.079	15.133	1.635	10.465	2.039
2003	1.241	5.658	1.024	0.046	0.550	0.365	1.287	6.387	0.988	0.892	0.099	7.899	0.923	12.560	1.585	4.556	1.951
2004		5.314	1.092		0.790	0.358		6.347	1.051	0.855	0.099	7.672	1.132	12.887	1.880	8.682	2.446
2005		5.211	1.184		0.614	0.402		5.968	1.168	0.843	0.099	7.548	1.336	12.261	2.319	5.869	2.763
Min	1.241	5.658	0.473	0.046	0.377	0.139	1.287	6.387	0.664	0.717	0.034	7.899	0.633	12.560	0.987	4.249	1.003
GM	9.681	12.297	1.003	0.573	1.268	0.420	10.683	14.248	1.295	0.848	0.054	18.394	1.100	28.831	1.739	13.006	1.971
AM	12.249	13.283	1.071	1.502	1.582	0.473	13.751	15.520	1.361	0.851	0.059	20.152	1.149	31.632	1.810	15.994	2.215
Max	23.865	22.608	1.788	8.825	4.349	1.200	27.758	27.160	2.115	0.988	0.099	37.815	1.863	57.437	2.735	56.643	8.931

Table 3.1.5.18 Cod in Division VIa. XSA diagnostic output.

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Lowestoft VPA Version 3.1

    9/05/2004  14:53

 Extended Survivors Analysis

 COD 2003 IN AREA 6A

 CPUE data from file cod6aef.dat

 Catch data for  26 years. 1978 to 2003. Ages  1 to   7.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
  SCOGFS             ,   1985, 2003,   1,     6,   .000,   .250


 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years


 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    4


 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 =   2.000

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

      Prior weighting not applied


 Tuning converged after   32 iterations


 Regression weights
       ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000


 Fishing mortalities
    Age,  1994,  1995,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003

      1,  .248,  .319,  .234,  .275,  .370,  .254,  .546,  .295,  .189,  .065
      2,  .600,  .859,  .904,  .953, 1.041,  .991,  .689,  .701,  .693,  .183
      3,  .628,  .870, 1.199, 1.328,  .746,  .829,  .661,  .386,  .512,  .366
      4,  .750,  .572,  .913, 1.069,  .908,  .345,  .428,  .415,  .163,  .183
      5,  .293,  .417,  .363,  .662,  .639,  .683,  .129,  .158,  .143,  .034
      6,  .783,  .118,  .327,  .178,  .327,  .621,  .369,  .031,  .057,  .025
```

Table 3.1.5.18 (cont.)   Cod in Division VIa. XSA diagnostic output.

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
1994	8.63E+03	2.96E+03	3.66E+03	5.86E+02	2.45E+02	1.05E+02
1995	7.54E+03	5.52E+03	1.33E+03	1.60E+03	2.27E+02	1.50E+02
1996	3.04E+03	4.49E+03	1.91E+03	4.56E+02	7.40E+02	1.22E+02
1997	1.14E+04	1.97E+03	1.49E+03	4.73E+02	1.50E+02	4.21E+02
1998	2.80E+03	7.10E+03	6.22E+02	3.23E+02	1.33E+02	6.33E+01
1999	2.04E+03	1.58E+03	2.05E+03	2.41E+02	1.07E+02	5.74E+01
2000	7.47E+03	1.30E+03	4.81E+02	7.34E+02	1.40E+02	4.41E+01
2001	1.35E+03	3.54E+03	5.34E+02	2.04E+02	3.92E+02	1.01E+02
2002	5.42E+03	8.22E+02	1.44E+03	2.97E+02	1.10E+02	2.74E+02
2003	2.46E+03	3.67E+03	3.37E+02	7.06E+02	2.07E+02	7.80E+01

Estimated population abundance at 1st Jan 2004

0.00E+00	1.89E+03	2.50E+03	1.91E+02	4.81E+02	1.64E+02

Taper weighted geometric mean of the VPA populations:

5.17E+03	3.22E+03	1.22E+03	5.21E+02	2.25E+02	1.18E+02

Standard error of the weighted Log(VPA populations) :

.8717	.7572	.7887	.6505	.6107	.6700

1

Log catchability residuals.

Fleet : SCOGFS

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	-3.19	-2.37	-.20	99.99	-1.40	-1.10	-.61	-1.04	-.86
2	-.84	-.88	-.98	-.23	-.35	-.39	-1.01	-.48	.08
3	-.68	-.11	.08	-.76	-.01	-.66	-.39	-.49	-.08
4	-.13	-.20	.60	-.62	-.40	-.06	.19	-.34	-.93
5	.17	.54	.31	-.39	-.40	-.14	.92	.55	-.76
6	.09	.48	.37	.00	-.47	.13	.11	.03	.06

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	.60	-.01	.06	.12	.16	-.16	.76	.84	.11	.21
2	.18	.07	.15	-.02	.10	.27	.01	.24	.24	.04
3	-.10	.35	.57	.11	.13	-.62	.64	.31	-.05	-.28
4	.07	.09	-.01	.63	1.09	-.52	-1.69	1.91	-.13	-.40
5	-.88	-.60	-.94	1.10	1.09	1.17	99.99	1.61	-.78	-.15
6	99.99	.24	.09	.12	-.03	-.08	-.07	.08	.08	-.12

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	-9.2989	-7.6871	-7.0787	-6.8690	-6.8690	-6.8690
S.E(Log q)	.6447	.3211	.4123	.9128	.9718	.1428

Table 3.1.5.18 (cont.) Cod in Division VIa. XSA diagnostic output.

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,	1.53,	-1.671,	9.69,	.51,	18,	.91,	-9.30,
2,	1.15,	-1.036,	7.63,	.82,	19,	.37,	-7.69,
3,	1.18,	-.987,	7.07,	.74,	19,	.49,	-7.08,
4,	2.33,	-1.413,	7.68,	.10,	19,	2.04,	-6.87,
5,	1.54,	-.703,	7.35,	.16,	18,	1.50,	-6.69,
6,	.90,	1.993,	6.63,	.98,	18,	.11,	-6.84,

Terminal year survivor and F summaries :

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

Year class = 2002

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
SCOGFS ,	2340.,	.671,	.000,	.00,	1,	.893,	.052
F shrinkage mean ,	319.,	2.00,,,,				.107,	.333

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1890.,	.64,	.65,	2,	1.026,	.065

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

Year class = 2001

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
SCOGFS ,	2638.,	.300,	.028,	.09,	2,	.973,	.174
F shrinkage mean ,	387.,	2.00,,,,				.027,	.831

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2504.,	.30,	.22,	3,	.755,	.183

Table 3.1.5.18 (cont.) Cod in Division VIa. XSA diagnostic output.

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

 Year class = 2000

 Fleet,            Estimated,    Int,       Ext,    Var,    N, Scaled, Estimated
     ,             Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
  SCOGFS        ,       196.,   .263,       .243,    .92,   3,  .968,     .358
   F shrinkage mean  ,   96.,   2.00,,,,                        .032,     .632
Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       191.,       .26,      .21,    4,    .794,   .366



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

 Year class = 1999

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
  SCOGFS             ,       502.,   .267,       .155,    .58,   4,  .961,     .176

   F shrinkage mean  ,       168.,   2.00,,,,                        .039,     .455

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       481.,       .27,      .17,    5,    .634,   .183

 Age  5   Catchability constant w.r.t. time and age (fixed at the value for age)  4

 Year class = 1998

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
  SCOGFS             ,       177.,   .260,       .096,    .37,   5,  .969,     .031

   F shrinkage mean  ,        13.,   2.00,,,,                        .031,     .353

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       164.,       .26,      .22,    6,    .850,   .034

Age  6   Catchability constant w.r.t. time and age (fixed at the value for age)  4

 Year class = 1997

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
  SCOGFS             ,        64.,   .234,       .219,    .94,   6,  .984,     .024

   F shrinkage mean  ,         9.,   2.00,,,,                        .016,     .167

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        62.,       .23,      .22,    7,    .968,   .025
```

Table 3.1.5.18 Cod in Division VIa. XSA estimates.

Run title : COD 2003 IN AREA 6A

At 11/05/2004 11:37

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,
AGE						
1,	.7707,	.0698,	.1839,	.1338,	.4229,	.9593,
2,	.4942,	.2944,	.3700,	.7541,	.4962,	.6942,
3,	.5922,	.8198,	.6601,	.7649,	.7320,	.7415,
4,	.7228,	1.1205,	.8702,	.7254,	.7297,	.8576,
5,	.6169,	1.0163,	1.2234,	.4890,	.7531,	.7263,
6,	.6451,	.6703,	.6676,	.5783,	.6324,	.8039,
+gp,	.6451,	.6703,	.6676,	.5783,	.6324,	.8039,
0 FBAR 2- 5,	.6065,	.8128,	.7809,	.6834,	.6778,	.7549,

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	.2439,	2.4142,	.3727,	1.2967,	.4859,	.7274,	.4533,	.6712,	.9082,	.2484,
2,	.6545,	1.0464,	.5353,	.7390,	.9737,	.6759,	.7390,	.9430,	.6779,	.6425,
3,	.8405,	.9265,	.8347,	.8464,	.8833,	1.1081,	.6171,	.8595,	.7766,	.9635,
4,	.7710,	1.1551,	.9248,	1.2081,	.6128,	.8208,	.8993,	.6021,	1.0903,	.3950,
5,	1.0711,	.5866,	.6240,	.9625,	1.0970,	.5428,	.4655,	.7176,	.4630,	.9480,
6,	.7231,	1.2248,	.3275,	.3742,	.8165,	1.6014,	.2012,	.3577,	.3287,	.2871,
+gp,	.7231,	1.2248,	.3275,	.3742,	.8165,	1.6014,	.2012,	.3577,	.3287,	.2871,
0 FBAR 2- 5,	.8343,	.9286,	.7297,	.9390,	.8917,	.7869,	.6802,	.7806,	.7519,	.7372,

1

Run title : COD 2003 IN AREA 6A

At 11/05/2004 11:37

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	FBAR ** -**
AGE											
1,	.2479,	.3191,	.2342,	.2754,	.3698,	.2538,	.5464,	.2948,	.1891,	.0645,	.1828,
2,	.6003,	.8586,	.9042,	.9525,	1.0406,	.9906,	.6887,	.7008,	.6935,	.1826,	.5256,
3,	.6279,	.8705,	1.1987,	1.3276,	.7461,	.8287,	.6605,	.3860,	.5121,	.3656,	.4212,
4,	.7503,	.5716,	.9130,	1.0692,	.9082,	.3450,	.4277,	.4152,	.1634,	.1833,	.2539,
5,	.2926,	.4174,	.3631,	.6619,	.6392,	.6833,	.1290,	.1577,	.1435,	.0337,	.1116,
6,	.7834,	.1179,	.3267,	.177 7,	.3274,	.6212,	.3691,	.0308,	.0571,	.0245,	.0375,
+gp,	.7834,	.1179,	.3267,	.1777,	.3274,	.6212,	.3691,	.0308,	.0571,	.0245,	
0 FBAR 2- 5,	.5678,	.6795,	.8448,	1.0028,	.8335,	.7119,	.4765,	.4149,	.3781,	.1913,	

1

Table 3.1.5.18 (cont.) Cod in Division VIa. XSA estimates.

Run title : COD 2003 IN AREA 6A

At 11/05/2004 11:37

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,
AGE						
1,	19802,	15415,	26012,	6611,	22724,	17389,
2,	8402,	7502,	11770,	17720,	4735,	12188,
3,	2470,	4197,	4575,	6656,	6825,	2360,
4,	1492,	1119,	1514,	1936,	2536,	2688,
5,	686,	593,	299,	519,	767,	1001,
6,	226,	303,	176,	72,	261,	296,
+gp,	171,	155,	83,	50,	77,	117,
0 TOTAL,	33250,	29283,	44429,	33565,	37925,	36040,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	21751,	54451,	18738,	91959,	4946,	22366,	7120,	10789,	25753,	4636,
2,	5455,	13954,	3987,	10569,	20587,	2491,	8848,	3705,	4515,	8502,
3,	4984,	2321,	4012,	1911,	4132,	6366,	1037,	3460,	1181,	1877,
4,	921,	1761,	752,	1426,	671,	1399,	1721,	458,	1199,	445,
5,	933,	349,	454,	244,	349,	298,	504,	573,	205,	330,
6,	396,	262,	159,	199,	76,	95,	142,	259,	229,	106,
+gp,	124,	120,	117,	93,	40,	45,	65,	83,	92,	158,
0 TOTAL,	34565,	73218,	28221,	106401,	30801,	33060,	19438,	19327,	33175,	16054,

1

Table 3.1.5.18 (cont.) Cod in Division VIa. XSA estimates.

Run title : COD 2003 IN AREA 6A

At 11/05/2004 11:37

Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR,	1994,	1995,	1996,	1997,	1998,	1999 ,	2000,	2001,	2002,	2003,	2004,	GMST 78 -**	AMST 78-**
	AGE													
	1,	8634,	7541,	3038,	11422,	2799,	2044,	7470,	1349,	5418,	2462,	0,	10744,	17282,
	2,	2961,	5517,	4488,	1968,	7100,	1583,	1299,	3541,	822,	3671,	1890,	5661,	7224,
	3,	3662,	1330,	1914,	1487,	622,	2053,	481,	534,	1439,	337,	2504,	2289,	293 5,
	4,	586,	1600,	456,	473,	323,	241,	734,	204,	297,	706,	191,	885,	1111,
	5,	245,	227,	740,	150,	133,	107,	140,	392,	110,	207,	481,	356,	427,
	6,	105,	150,	122,	421,	63,	57,	44,	101,	274,	78,	164,	151,	180,
	+gp,	41,	104,	51,	47,	34,	22,	46,	130,	77,	67,	116,		
0	TOTAL,	16233,	16469,	10808,	15969,	11073,	6108,	10214,	6251,	8437,	7527,	5345,		
1														

Table 3.1.5.18 (cont.) Cod in Division VIa. XSA estimates.

Run title : COD 2003 IN AREA 6A ,

At 11/05/2004 11:37

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 5,
1978,	19802,	40389,	27699,	17199,	.6209,	.6065,
1979,	15415,	45380,	28403,	16141,	.5683,	.8128,
1980,	26012,	53790,	32653,	18875,	.5780,	.7809,
1981,	6611,	54172,	40272,	24386,	.6055,	.6834,
1982,	22724,	54347,	39058,	23162,	.5930,	.6778,
1983,	17389,	47570,	34737,	23331,	.6716,	.7549,
1984,	21751,	50486,	33348,	21906,	.6569,	.8343,
1985,	54451,	42854,	25823,	27420,	1.0618,	.9286,
1986,	18738,	31042,	20912,	13022,	.6227,	.7297,
1987,	91959,	49010,	22174,	27742,	1.2511,	.9390,
1988,	4946,	40902,	27110,	21629,	.7978,	.8917,
1989,	22366,	37535,	24805,	20004,	.8065,	.7869,
1990,	7120,	28619,	21239,	12503,	.5887,	.6802,
1991,	10789,	25334,	18322,	11843,	.6464,	.7806,
1992,	25753,	24872,	14805,	11983,	.8094,	.7519,
1993,	4636,	24926,	16818,	10507,	.6248,	.7372,
1994,	8634,	23981,	16671,	9115,	.5467,	.5678,
1995,	7541,	24408,	18186,	9696,	.5331,	.6795,
1996,	3038,	21003,	16224,	9513,	.5863,	.8448,
1997,	11422,	18674,	11568,	7387,	.6386,	1.0028,
1998,	2799,	12094,	7698,	6137,	.7971,	.8335,
1999,	2044,	9490,	7222,	4298,	.5952,	.7119,
2000,	7470,	10333,	6515,	3584,	.5502,	.4765,
2001,	1349,	10193,	8036,	2571,	.3200,	.4149,
2002,	5418,	11405,	8192,	2412,	.2944,	.3781,
2003,	2462,	10677,	7730,	1291,	.1670,	.1913,
Arith. Mean ,	16255,	30903,	20624,	13756,	.6359,	.7107,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 3.1.8.1 Cod in Division VIa. Run 1. Inputs to sensitivity analysis and short term forecast.

Table_____Cod,,,,,VIa,,,,

input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	1439	0.28	WS1	0.42	0.10
N2	388	0.39	WS2	0.99	0.14
N3	362	0.21	WS3	2.39	0.11
N4	42	0.23	WS4	4.42	0.12
N5	*46*	*0.27*	*WS5*	*6.08*	*0.03*
N6	3	0.35	WS6	7.67	0.06
N7	2	0.42	WS7	9.26	0.04
H.cons selectivity			Weight in the HC catch		
sH1	0.01	0.81	WH1	0.66	0.01
sH2	0.18	0.43	WH2	1.05	0.08
sH3	0.59	0.46	WH3	2.44	0.09
sH4	1.00	0.17	WH4	4.42	0.12
sH5	1.13	0.09	WH5	6.08	0.03
sH6	1.16	0.12	WH6	7.67	0.06
sH7	1.09	0.13	WH7	9.26	0.04
Discard selectivity			Weight in the discards		
sD1	0.49	0.81	WD1	0.26	0.27
sD2	0.85	0.43	WD2	0.67	0.80
sD3	0.61	0.46	WD3	0.13	0.20
sD4	0.21	0.17	WD4	0.00	0.00
sD5	0.04	0.09	WD5	0.00	0.00
sD6	0.00	0.12	WD6	0.00	0.00
sD7	0.07	0.13	WD7	0.00	0.00
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.52	0.10
M3	0.20	0.10	MT3	0.86	0.10
M4	0.20	0.10	MT4	1.00	0.10
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.06	K04	1.00	0.10
HF05	1.00	0.06	K05	1.00	0.10
HF06	1.00	0.06	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	787	0.55			
R06	787	0.55			

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

Stock numbers in 2004 are TSA survivors.

Table 3.1.8.2 Cod in Division VIa. Run 1. Stock summary (SUM) file.

Cod Division VIa

12

1 1 0

Year

1978 2003

Recruits age 0 (thousands)

0 1000

SSB (t)

1

TSB (t)

1

Catch Total (t)

1

Catch H.cons (t)

1

Catch Disc (t)

1

Not used

1

Mean F Total

2 5

Mean F H.cons

2 5

Mean F Disc

2 5

Not used

0 0

1978	15700.9	25562.6	36683.8	17179	2333	19512	0	0.678	0.628	0.05	0
1979	23886.4	27523.6	51299.8	14831	14016	28847	0	0.831	0.821	0.009	0
1980	27767.3	31602.7	53975.6	12763	4715	17478	0	0.713	0.713	0	0
1981	9242.1	37265	50777.2	18218	15088	33306	0	0.7	0.674	0.026	0
1982	24419.5	37238.6	53364.3	29613	10068	39681	0	0.76	0.759	0	0
1983	16778.7	31689.3	43886.8	29397	6890	36287	0	0.834	0.802	0.031	0
1984	23751.8	29667.9	48050.8	30019	16345	46364	0	0.865	0.864	0.001	0
1985	10598.3	22180.1	29999.7	24385	17451	41836	0	0.963	0.882	0.081	0
1986	18075.4	18923.5	28886.1	19575	7352	26926	0	0.807	0.806	0.001	0
1987	52617.5	19790.2	37593	27003	16218	43222	0	0.929	0.923	0.006	0
1988	5700.1	23900.8	36452.7	21137	10164	31301	0	0.889	0.834	0.055	0
1989	18779.1	21755.2	32889.9	16693	3178	19871	0	0.959	0.955	0.005	0
1990	5911.7	17874.9	24980.8	10136	5406	15542	0	0.835	0.827	0.007	0
1991	9884.3	15197.5	21569.1	10560	9192	19752	0	0.949	0.913	0.036	0
1992	15346.4	11975.1	19133.2	11353	9398	20752	0	0.948	0.933	0.015	0
1993	5746.5	13491.3	21560.2	19066	16905	35971	0	0.947	0.945	0.003	0
1994	10270.9	13161.5	20942.3	14243	11192	25435	0	0.891	0.89	0	0
1995	8270.7	12618.6	19035.1	12372	8794	21167	0	0.921	0.911	0.009	0
1996	3276	11940.2	16796.3	13453	11838	25290	0	1.097	1.088	0.009	0
1997	11748.4	7613.6	14603.5	12866	6623	19489	0	1.143	1.136	0.007	0
1998	2841.3	5809.2	9437.8	14402	5712	20114	0	1.064	1.007	0.057	0
1999	1788.8	4986.8	6902	10426	5132	15559	0	1.167	1.162	0.005	0
2000	5770.3	3126	6016.8	6949	8207	15156	0	1.178	1.152	0.025	0
2001	1160.4	2687.8	4273.5	6731	7247	13979	0	1.151	1.091	0.059	0
2002	2452.2	2442	4050.9	7093	8932	16025	0	1.263	1.238	0.024	0
2003	749.5	1643.5	2560.7	5330	4244	9575	0	1.049	1.01	0.039	0
Year	Recruits	SSB	TSB	Catch total	Catch Hcons	Catch disc	Not used	Mean total	F Mean Hcons	F Mean disc	F Not used

Table 3.1.8.3 Cod in Division VIa. Run 2. Inputs to sensitivity analysis and short term forecast

Table_____Cod,,,,,VIa,,,,
input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	3426	0.33	WS1	0.42	0.10
N2	1013	0.47	WS2	0.99	0.14
N3	1163	0.26	WS3	2.39	0.11
N4	150	0.36	WS4	4.42	0.12
N5	205	0.39	WS5	6.08	0.03
N6	17	0.52	WS6	7.67	0.06
N7	16	0.56	WS7	9.26	0.04
H.cons selectivity			Weight in the HC catch		
sH1	0.00	0.81	WH1	0.66	0.01
sH2	0.11	0.43	WH2	1.05	0.08
sH3	0.35	0.46	WH3	2.44	0.09
sH4	0.53	0.35	WH4	4.42	0.12
sH5	0.59	0.34	WH5	6.08	0.03
sH6	0.60	0.32	WH6	7.67	0.06
sH7	0.57	0.32	WH7	9.26	0.04
Discard selectivity			Weight in the discards		
sD1	0.31	0.81	WD1	0.26	0.27
sD2	0.52	0.43	WD2	0.67	0.80
sD3	0.36	0.46	WD3	0.13	0.20
sD4	0.11	0.35	WD4	0.00	0.00
sD5	0.02	0.34	WD5	0.00	0.00
sD6	0.00	0.32	WD6	0.00	0.00
sD7	0.04	0.32	WD7	0.00	0.00
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.52	0.10
M3	0.20	0.10	MT3	0.86	0.10
M4	0.20	0.10	MT4	1.00	0.10
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.06	K04	1.00	0.10
HF05	1.00	0.06	K05	1.00	0.10
HF06	1.00	0.06	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	3021	0.57			
R06	3021	0.57			

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

Stock numbers in 2004 are TSA survivors.

Table 3.1.8.4 Cod in Division VIa. Run 2. Stock summary (SUM) file

Stock Cod Division VIa
summary
12
1 1 0
Year
1978 2003
Recruits age 0 (thousands)
0 1000
SSB (t)
1
TSB (t)
1
Catch Total (t)
1
Catch H.cons (t)
1
Catch Disc (t)
1
Not used
1
Mean F Total
2 5
Mean F H.cons
2 5
Mean F Disc
2 5
Not used
0 0

Year	Recruits	SSB	TSB	Catch total	Catch Hcons	Catch disc	Not used	Mean F total	Mean F Hcons	Mean F disc	Not used
1978	13340.7	25346	35160.1	17179	2333	19512	0	0.58	0.539	0.041	0
1979	21203.4	26415.7	47854.2	14831	14016	28847	0	0.789	0.782	0.008	0
1980	25009.1	32905	53875.6	12763	4715	17478	0	0.716	0.716	0	0
1981	8439	37698.4	50516.2	18218	15088	33306	0	0.676	0.65	0.026	0
1982	23939.1	35773.5	51618.1	29613	10068	39681	0	0.729	0.728	0	0
1983	18780.4	31394.4	44072.7	29397	6890	36287	0	0.843	0.811	0.032	0
1984	23437.2	29572.2	47694.1	30019	16345	46364	0	0.92	0.919	0.001	0
1985	10411	21048	28651.2	24385	17451	41836	0	1.005	0.922	0.083	0
1986	16961.4	18864.6	28478.4	19575	7352	26926	0	0.84	0.839	0.001	0
1987	57099.8	19282.5	37633.1	27003	16218	43222	0	0.953	0.948	0.006	0
1988	6008.4	23664.1	36465.3	21137	10164	31301	0	0.918	0.858	0.06	0
1989	18246.6	21768.6	32762.9	16693	3178	19871	0	0.99	0.986	0.005	0
1990	5915.3	17673.5	24574.7	10136	5406	15542	0	0.807	0.8	0.007	0
1991	10711.1	14857.8	21514.7	10560	9192	19752	0	0.922	0.884	0.038	0
1992	14440.4	12120.9	19071.9	11353	9398	20752	0	0.955	0.94	0.014	0
1993	5496.9	13315.4	21057.3	19066	16905	35971	0	0.939	0.936	0.003	0
1994	10173.5	12980	20648.9	14243	11192	25435	0	0.877	0.877	0	0
1995	8216.7	12822	19275.8	12372	8794	21167	0	0.914	0.905	0.009	0
1996	3208.5	12097.8	16940.6	13453	11838	25290	0	1.077	1.068	0.009	0
1997	12582.4	7408.8	14748.5	12866	6623	19489	0	1.077	1.07	0.006	0
1998	2917.6	5807.7	9518.8	14402	5712	20114	0	1.002	0.948	0.054	0
1999	1793	5059.7	7006.1	10426	5132	15559	0	1.058	1.054	0.005	0
2000	6615.6	3293.6	6549.7	6949	8207	15156	0	0.992	0.97	0.022	0
2001	1371.8	3243.1	5077.1	6731	7247	13979	0	0.847	0.8	0.047	0
2002	3797.5	3422.4	5778.2	7093	8932	16025	0	0.671	0.656	0.015	0
2003	1534.8	3548.4	5345.9	5330	4244	9575	0	0.425	0.408	0.017	0

Table 3.1.8.5 Cod in Division VIa. Run 3. Inputs to sensitivity analysis and short term forecast

```
Table_____Cod,,,,,VIa,,,,
 input data for catch forecast and linear sensitivity analysis


 Label     Value     CV     Label     Value     CV

 Number at age              Weight in the stock
 N1         8682   0.28     WS1        0.42   0.10
 N2         2104   0.45     WS2        0.99   0.14
 N3         1813   0.22     WS3        2.39   0.11
 N4          206   0.28     WS4        4.42   0.12
 N5          221   0.25     WS5        6.08   0.03
 N6           35   0.32     WS6        7.67   0.06
 N7           38   0.34     WS7        9.26   0.04

 H.cons selectivity         Weight in the HC catch
 sH1        0.01   0.81     WH1        0.66   0.01
 sH2        0.15   0.43     WH2        1.05   0.08
 sH3        0.50   0.46     WH3        2.44   0.09
 sH4        0.70   0.17     WH4        4.42   0.12
 sH5        0.81   0.04     WH5        6.08   0.03
 sH6        0.84   0.01     WH6        7.67   0.06
 sH7        0.79   0.10     WH7        9.26   0.04

 Discard selectivity        Weight in the discards
 sD1        0.54   0.81     WD1        0.26   0.27
 sD2        0.67   0.43     WD2        0.67   0.80
 sD3        0.51   0.46     WD3        0.13   0.20
 sD4        0.15   0.17     WD4        0.00   0.00
 sD5        0.03   0.04     WD5        0.00   0.00
 sD6        0.00   0.01     WD6        0.00   0.00
 sD7        0.05   0.10     WD7        0.00   0.00

 Natural mortality          Proportion mature
 M1         0.20   0.10     MT1        0.00   0.10
 M2         0.20   0.10     MT2        0.52   0.10
 M3         0.20   0.10     MT3        0.86   0.10
 M4         0.20   0.10     MT4        1.00   0.10
 M5         0.20   0.10     MT5        1.00   0.00
 M6         0.20   0.10     MT6        1.00   0.00
 M7         0.20   0.10     MT7        1.00   0.00

 Relative effort            Year effect for natural mortality
 in HC fishery
 HF04       1.00   0.06     K04        1.00   0.10
 HF05       1.00   0.06     K05        1.00   0.10
 HF06       1.00   0.06     K06        1.00   0.10

 Recruitment in 2005 and 2006
 R05        5869   0.47
 R06        5869   0.47



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

Stock numbers in 2004 are TSA survivors.

Table 3.1.8.6 Cod in Division VIa. Run 3. Stock summary (SUM) file

Stock summary Cod Division VIa
12
1 1 0
Year
1978 2003
Recruits age 0 (thousands)
0 1000
SSB (t)
1
TSB (t)
1
Catch Total (t)
1
Catch H.cons (t)
1
Catch Disc (t)
1
Not used
1
Mean F Total
2 5
Mean F H.cons
2 5
Mean F Disc
2 5
Not used
0 0

1978	21149.4	26236.6	40044.6	17179	2333	19512	0	0.717	0.652	0.065	0
1979	29143	28571.2	56791.4	14831	14016	28847	0	0.896	0.883	0.013	0
1980	32040.8	32366.3	57437.1	12763	4715	17478	0	0.75	0.75	0	0
1981	11035.4	37814.5	52562.7	18218	15088	33306	0	0.722	0.693	0.029	0
1982	25526.6	37315.2	54077.5	29613	10068	39681	0	0.779	0.778	0	0
1983	15104	31923.4	43870.1	29397	6890	36287	0	0.853	0.818	0.034	0
1984	23261	29745	47912.1	30019	16345	46364	0	0.896	0.895	0.001	0
1985	11645.6	21998.5	29885.7	24385	17451	41836	0	0.988	0.904	0.084	0
1986	19933.2	18845.4	29462.6	19575	7352	26926	0	0.805	0.804	0.001	0
1987	56643	20526.9	39778.1	27003	16218	43222	0	0.961	0.954	0.007	0
1988	5948.7	23596.5	36047.7	21137	10164	31301	0	0.875	0.821	0.055	0
1989	19656.4	21248	32613.6	16693	3178	19871	0	0.946	0.942	0.005	0
1990	6112.7	17967.2	25129.7	10136	5406	15542	0	0.798	0.791	0.007	0
1991	11264.8	15596.4	22423.3	10560	9192	19752	0	0.885	0.852	0.033	0
1992	18412.9	12958.3	21224.5	11353	9398	20752	0	0.861	0.847	0.014	0
1993	10199.5	15594.7	26309.7	19066	16905	35971	0	0.782	0.779	0.002	0
1994	16529	17912.8	30177.6	14243	11192	25435	0	0.806	0.806	0	0
1995	13922.9	18472.3	28701.1	12372	8794	21167	0	0.815	0.807	0.008	0
1996	5342.8	19414.4	27147.4	13453	11838	25290	0	0.862	0.855	0.007	0
1997	18129.4	15088.9	25999.5	12866	6623	19489	0	0.88	0.875	0.005	0
1998	8365	12546.7	19792.8	14402	5712	20114	0	0.904	0.859	0.044	0
1999	5302.3	11942.4	17011.3	10426	5132	15559	0	0.892	0.888	0.004	0
2000	11917.6	9879.4	16411.6	6949	8207	15156	0	0.811	0.794	0.017	0
2001	4249.1	9565.7	13928.9	6731	7247	13979	0	0.868	0.821	0.047	0
2002	10465.4	8938.7	15133.2	7093	8932	16025	0	0.873	0.855	0.017	0
2003	4555.8	7898.5	12560	5330	4244	9575	0	0.892	0.856	0.036	0
Year	Recruits	SSB	TSB	Catch total	Catch Hcons	Catch disc	Not used	Mean F total	Mean F Hcons	Mean F disc	Not used

Table 3.1.8.7 Cod in Division VIa. Run 4. Inputs to sensitivity analysis and short term forecast

```
Table_____Cod,VIa
 input data for catch forecast and linear sensitivity analysis


 Label     Value     CV     Label     Value     CV

 Number at age              Weight in the stock
 N1         4207   0.77     WS1        0.42   0.10
 N2         1890   0.65     WS2        0.99   0.14
 N3         2504   0.30     WS3        2.39   0.11
 N4          191   0.26     WS4        4.42   0.12
 N5          481   0.27     WS5        6.08   0.03
 N6          164   0.26     WS6        7.67   0.06
 N7           62   0.23     WS7        9.26   0.04

 H.cons selectivity         Weight in the HC catch
 sH1        0.00   0.81     WH1        0.66   0.01
 sH2        0.09   0.56     WH2        1.05   0.08
 sH3        0.21   0.46     WH3        2.44   0.09
 sH4        0.21   0.55     WH4        4.42   0.12
 sH5        0.11   0.61     WH5        6.08   0.03
 sH6        0.04   0.46     WH6        7.67   0.06
 sH7        0.04   0.46     WH7        9.26   0.04

 Discard selectivity        Weight in the discards
 sD1        0.18   0.81     WD1        0.26   0.27
 sD2        0.43   0.56     WD2        0.67   0.80
 sD3        0.21   0.46     WD3        0.13   0.20
 sD4        0.04   0.55     WD4        0.00   0.00
 sD5        0.00   0.61     WD5        0.00   0.00
 sD6        0.00   0.46     WD6        0.00   0.00
 sD7        0.00   0.46     WD7        0.00   0.00

 Natural mortality          Proportion mature
 M1         0.20   0.10     MT1        0.00   0.10
 M2         0.20   0.10     MT2        0.52   0.10
 M3         0.20   0.10     MT3        0.86   0.10
 M4         0.20   0.10     MT4        1.00   0.10
 M5         0.20   0.10     MT5        1.00   0.00
 M6         0.20   0.10     MT6        1.00   0.00
 M7         0.20   0.10     MT7        1.00   0.00

 Relative effort            Year effect for natural mortality
 in HC fishery
 HF04       1.00   0.06     K04        1.00   0.10
 HF05       1.00   0.06     K05        1.00   0.10
 HF06       1.00   0.06     K06        1.00   0.10

 Recruitment in 2005 and 2006
 R05        4207   0.77
 R06        4207   0.77



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

Stock numbers in 2004 are XSA survivors.

Table 3.1.8.8. Cod in Division VIa. Run 4. Stock summary (SUM) file

Stock summary	Cod	Division VIa					
12							
1	1	0					
Year							
1978	2003						
Recruits age 0 (thousands)							
0	1000						
SSB (t)							
1							
TSB (t)							
1							
Catch (t)							
1							
Not used							
1							
Mean F							
2	5						
Not used							
0	0						
1978	19802	27699	40389	17199	0	0.607	0
1979	15415	28403	45380	16141	0	0.813	0
1980	26012	32653	53790	18875	0	0.781	0
1981	6611	40272	54172	24386	0	0.683	0
1982	22724	39058	54347	23162	0	0.678	0
1983	17389	34737	47570	23331	0	0.755	0
1984	21751	33348	50486	21906	0	0.834	0
1985	54451	25823	42854	27420	0	0.929	0
1986	18738	20912	31042	13022	0	0.73	0
1987	91959	22174	49010	27742	0	0.939	0
1988	4946	27110	40902	21629	0	0.892	0
1989	22366	24805	37535	20004	0	0.787	0
1990	7120	21239	28619	12503	0	0.68	0
1991	10789	18322	25334	11843	0	0.781	0
1992	25753	14805	24872	11983	0	0.752	0
1993	4636	16818	24926	10507	0	0.737	0
1994	8634	16671	23981	9115	0	0.568	0
1995	7541	18186	24408	9696	0	0.68	0
1996	3038	16224	21003	9513	0	0.845	0
1997	11422	11568	18674	7387	0	1.003	0
1998	2799	7698	12094	6137	0	0.834	0
1999	2044	7222	9490	4298	0	0.712	0
2000	7470	6515	10333	3584	0	0.476	0
2001	1349	8036	10193	2571	0	0.415	0
2002	5418	8192	11405	2412	0	0.378	0
2003	2462	7730	10677	1291	0	0.191	0
Year	Recruits	SSB	TSB	Catch	Not used	Mean F	Not used

Table 3.1.8.9 Cod in Division VIa. Run 1. Forecast output. Bold print indicates effort change to produce 30% increase in SSB.

Data from file:W:\2004\Personal\Colin\wgnsds 2004\forecasts\run 1\codvia1.sen on Table_____.Cod,,,,,VIa,,,,

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	2004	2005						
Mean F Ages								
H.cons 2 to 5	1.15	0.00	0.23	0.46	**0.69**	0.92	1.15	1.38
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	**0.60**	0.80	1.00	1.20
Biomass								
Total 1 January	2.35	1.86	1.86	1.86	**1.86**	1.86	1.86	1.86
SSB at spawning time	1.45	1.16	1.16	1.16	**1.16**	1.16	1.16	1.16
Catch weight (,000t)								
H.cons	0.627	0.000	0.144	0.259	**0.350**	0.424	0.483	0.530
Discards	0.276	0.000	0.086	0.157	**0.218**	0.268	0.311	0.347
Total Catch	0.902	0.000	0.229	0.416	**0.568**	0.692	0.794	0.877
Biomass in year.... 2006								
Total 1 January		3.38	2.84	2.40	**2.05**	1.75	1.52	1.32
SSB at spawning time		2.55	2.08	1.69	**1.39**	1.14	0.93	0.77

	Year							
	2004	2005						
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	**0.60**	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.14	0.25	0.25	0.25	**0.25**	0.25	0.25	0.25
SSB at spawning time	0.16	0.26	0.26	0.26	**0.26**	0.26	0.26	0.26
Catch weight								
H.cons	0.22	0.00	0.36	0.27	**0.26**	0.26	0.26	0.26
Discards	0.56	0.00	0.80	0.75	**0.73**	0.71	0.70	0.69
Biomass in year.... 2006								
Total 1 January		0.26	0.28	0.30	**0.32**	0.34	0.36	0.38
SSB at spawning time		0.28	0.31	0.33	**0.36**	0.39	0.42	0.46

Table 3.1.8.10 Cod in Division VIa. Run 1. Detailed forecast output.

```
Table_____.Cod,,,,,VIa,,,,
            Detailed forecast tables.


 Forecast for year 2004
 F multiplier H.cons=1.00

       Populations     Catch number
 +----+-----------+   +--------+--------+-------+
 | Age| Stock No. |   | H.Cons |Discards|  Total|
 +----+-----------+   +--------+--------+-------+
 |   1|       1439|   |       6|     512|    518|
 |   2|        388|   |      41|     189|    230|
 |   3|        362|   |     116|     118|    234|
 |   4|         42|   |      22|       5|     27|
 |   5|         46|   |      28|       1|     29|
 |   6|          3|   |       2|       0|      2|
 |   7|          2|   |       1|       0|      1|
 +----+-----------+   +--------+--------+-------+
 |  Wt|          2|   |       1|       0|      1|
 +----+-----------+   +--------+--------+-------+


 Forecast for year 2005
 F multiplier H.cons=1.00

       Populations     Catch number
 +----+-----------+   +--------+--------+-------+
 | Age| Stock No. |   | H.Cons |Discards|  Total|
 +----+-----------+   +--------+--------+-------+
 |   1|        788|   |       3|     280|    284|
 |   2|        714|   |      76|     348|    424|
 |   3|        113|   |      36|      37|     73|
 |   4|         89|   |      48|      10|     58|
 |   5|         10|   |       6|       0|      7|
 |   6|         12|   |       7|       0|      7|
 |   7|          1|   |       1|       0|      1|
 +----+-----------+   +--------+--------+-------+
 |  Wt|          2|   |       0|       0|      1|
 +----+-----------+   +--------+--------+-------+
```

Table 3.1.8.11 Cod in Division VIa. Run 2. Forecast output. Bold print indicates effort change to produce 30% increase in SSB.

Data from file:W:\2004\Personal\Colin\wgnsds 2004\forecasts\run 2\codvia2.sen on

Table_____.Cod,,,,,VIa,,,,
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	2004	2005						
Mean F Ages								
H.cons 2 to 5	0.65	0.00	0.13	0.26	**0.39**	0.52	0.65	0.78
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	**0.60**	0.80	1.00	1.20
Biomass								
Total 1 January	7.39	7.64	7.64	7.64	**7.64**	7.64	7.64	7.64
SSB at spawning time	5.10	5.26	5.26	5.26	**5.26**	5.26	5.26	5.26
Catch weight (,000t)								
H.cons	1.59	0.00	0.42	0.79	**1.12**	1.41	1.66	1.89
Discards	0.49	0.00	0.17	0.32	**0.45**	0.58	0.69	0.79
Total Catch	2.09	0.00	0.59	1.11	**1.57**	1.98	2.35	2.68
Biomass in year.... 2006								
Total 1 January		12.85	11.59	10.48	**9.49**	8.62	7.84	7.15
SSB at spawning time		9.86	8.74	7.75	**6.88**	6.11	5.43	4.83

	Year							
	2004	2005						
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	**0.60**	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.16	0.20	0.20	0.20	**0.20**	0.20	0.20	0.20
SSB at spawning time	0.19	0.21	0.21	0.21	**0.21**	0.21	0.21	0.21
Catch weight								
H.cons	0.26	0.00	0.37	0.27	**0.25**	0.24	0.24	0.23
Discards	0.60	0.00	0.76	0.71	**0.69**	0.68	0.67	0.67
Biomass in year.... 2006								
Total 1 January		0.21	0.22	0.23	**0.24**	0.25	0.26	0.28
SSB at spawning time		0.22	0.23	0.24	**0.25**	0.26	0.28	0.29

Table 3.1.8.12 Cod in Division VIa. Run 2. Detailed forecast output.

Table_____.Cod,,,,,VIa,,,,

Detailed forecast tables.

Forecast for year 2004

F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	3426	11	835	846
2	1013	78	357	435
3	1163	267	273	540
4	150	54	11	65
5	205	83	3	86
6	17	7	0	7
7	16	6	0	7
Wt	7	2	0	2

Forecast for year 2005

F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	3021	9	736	746
2	2045	157	721	877
3	441	101	104	205
4	470	168	36	204
5	65	26	1	27
6	91	38	0	38
7	15	6	0	6
Wt	8	2	1	2

Table 3.1.8.13 Cod in Division VIa. Run 3. Forecast output. Bold print indicates effort change to produce 30% increase in SSB.

Data from file:W:\2004\Personal\Colin\wgnsds 2004\forecasts\run 3\codvia3.sen on

Table_____.Cod,,,,,VIa,,,,

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 2004	2005						
Mean F Ages								
H.cons 2 to 5	0.88	0.00	0.18	0.35	**0.53**	0.70	0.88	1.05
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	**0.60**	0.80	1.00	1.20
Biomass								
Total 1 January	12.89	12.04	12.04	12.04	**12.04**	12.04	12.04	12.04
SSB at spawning time	7.68	7.38	7.38	7.38	**7.38**	7.38	7.38	7.38
Catch weight (,000t)								
H.cons	2.89	0.00	0.72	1.33	**1.84**	2.28	2.65	2.96
Discards	1.52	0.00	0.46	0.86	**1.20**	1.51	1.77	2.00
Total Catch	4.41	0.00	1.18	2.19	**3.05**	3.78	4.42	4.96
Biomass in year.... 2006								
Total 1 January		21.99	19.17	16.77	**14.73**	12.98	11.50	10.23
SSB at spawning time		16.14	13.72	11.68	**9.94**	8.47	7.23	6.17

	Year 2004	2005						
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	**0.60**	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.14	0.24	0.24	0.24	**0.24**	0.24	0.24	0.24
SSB at spawning time	0.16	0.25	0.25	0.25	**0.25**	0.25	0.25	0.25
Catch weight								
H.cons	0.22	0.00	0.35	0.25	**0.24**	0.23	0.23	0.23
Discards	0.56	0.00	0.71	0.66	**0.64**	0.63	0.62	0.62
Biomass in year.... 2006								
Total 1 January		0.25	0.26	0.28	**0.30**	0.32	0.34	0.35
SSB at spawning time		0.27	0.30	0.32	**0.34**	0.36	0.39	0.42

Table 3.1.8.14 Cod in Division VIa. Run 3. Detailed forecast output.

```
Table_____.Cod,,,,,VIa,,,,
            Detailed forecast tables.


 Forecast for year 2004
 F multiplier H.cons=1.00

       Populations     Catch number
 +----+-----------+   +--------+--------+-------+
 | Age| Stock No. |   | H.Cons |Discards|  Total|
 +----+-----------+   +--------+--------+-------+
 |   1|       8682|   |      37|    3281|   3317|
 |   2|       2104|   |     193|     882|   1075|
 |   3|       1813|   |     524|     535|   1059|
 |   4|        206|   |      89|      19|    108|
 |   5|        221|   |     112|       4|    116|
 |   6|         35|   |      18|       0|     18|
 |   7|         38|   |      19|       1|     20|
 +----+-----------+   +--------+--------+-------+
 |  Wt|         13|   |       3|       2|      4|
 +----+-----------+   +--------+--------+-------+


 Forecast for year 2005
 F multiplier H.cons=1.00

       Populations     Catch number
 +----+-----------+   +--------+--------+-------+
 | Age| Stock No. |   | H.Cons |Discards|  Total|
 +----+-----------+   +--------+--------+-------+
 |   1|       5869|   |      25|    2218|   2243|
 |   2|       4138|   |     380|    1735|   2115|
 |   3|        764|   |     221|     226|    446|
 |   4|        543|   |     236|      50|    286|
 |   5|         72|   |      37|       1|     38|
 |   6|         78|   |      41|       0|     41|
 |   7|         26|   |      13|       1|     13|
 +----+-----------+   +--------+--------+-------+
 |  Wt|         12|   |       3|       2|      4|
 +----+-----------+   +--------+--------+-------+
```

Table 3.1.8.15 Cod in Division VIa. Run 4. Forecast output. Bold print indicates effort change to produce 30% increase in SSB.

Data from file:W:\2004\Personal\Colin\wgnsds 2004\forecasts\run 4\codvia.run4.se

Table_____.Cod,VIa

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 2004	2005						
Mean F Ages								
H.cons 2 to 5	0.33	0.00	0.07	**0.13**	0.20	0.26	0.33	0.39
Effort relative to 2003								
H.cons	1.00	0.00	0.20	**0.40**	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	15.2	17.8	17.8	**17.8**	17.8	17.8	17.8	17.8
SSB at spawning time	11.7	14.4	14.4	**14.4**	14.4	14.4	14.4	14.4
Catch weight (,000t)								
H.cons	1.56	0.00	0.39	**0.77**	1.12	1.45	1.76	2.06
Discards	0.60	0.00	0.18	**0.35**	0.50	0.64	0.77	0.89
Total Catch	2.16	0.00	0.58	**1.12**	1.62	2.09	2.54	2.95
Biomass in year.... 2006								
Total 1 January		25.6	24.2	**23.0**	21.9	20.8	19.8	18.9
SSB at spawning time		21.4	20.2	**19.1**	18.1	17.1	16.3	15.4

	Year 2004	2005						
Effort relative to 2003								
H.cons	1.00	0.00	0.20	**0.40**	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.18	0.21	0.21	**0.21**	0.21	0.21	0.21	0.21
SSB at spawning time	0.18	0.21	0.21	**0.21**	0.21	0.21	0.21	0.21
Catch weight								
H.cons	0.35	0.00	0.50	**0.42**	0.41	0.40	0.39	0.39
Discards	0.78	0.00	1.02	**0.97**	0.95	0.94	0.93	0.92
Biomass in year.... 2006								
Total 1 January		0.25	0.25	**0.24**	0.24	0.24	0.24	0.24
SSB at spawning time		0.25	0.25	**0.24**	0.24	0.24	0.24	0.24

Table 3.1.8.16 Cod in Division VIa. Run 4. Detailed forecast output.

Table_____.Cod,VIa

Detailed forecast tables.

Forecast for year 2004

F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	4207	7	633	640
2	1890	126	579	706
3	2504	388	397	785
4	191	32	7	39
5	481	45	2	46
6	164	5	0	5
7	62	2	0	2
Wt	15	2	1	2

Forecast for year 2005

F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	4207	7	633	640
2	2868	192	879	1071
3	915	142	145	287
4	1346	227	48	275
5	121	11	0	12
6	352	12	0	12
7	178	6	0	6
Wt	18	2	1	3

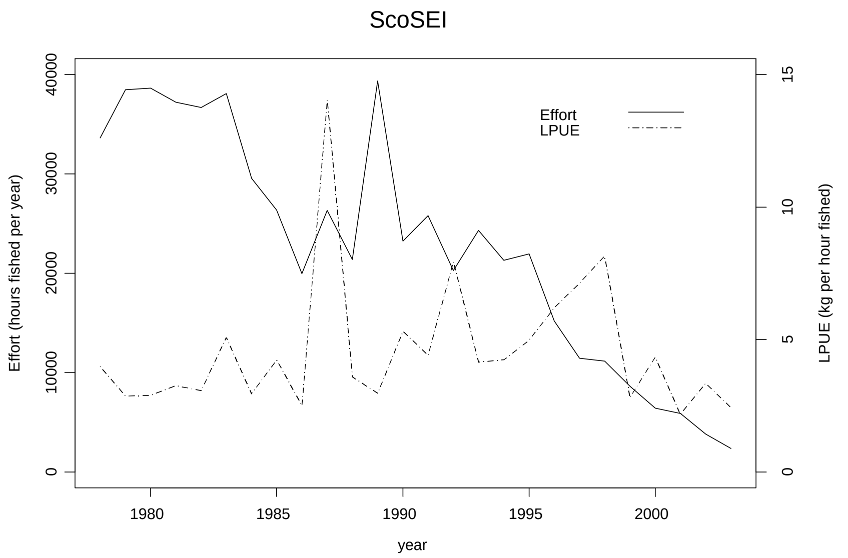
Table 3.2.1.1. Cod in Division VIb (Rockall). Official catch statistics.

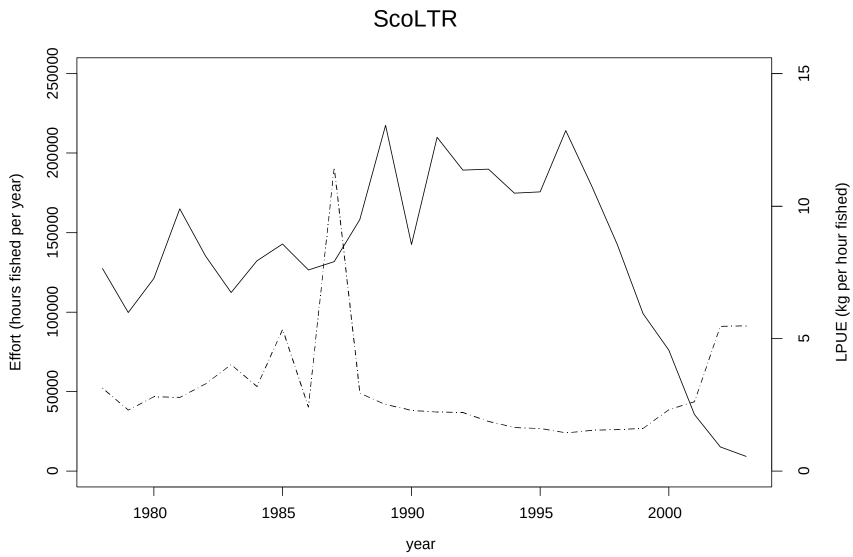
Country	1984	1985	1986	1987	1988	1989	1990	1991	1992
Faroes Islands	18	-	1	-	31	5	-	-	-
France	9	17	5	7	2	-	-	-	-
Germany	-	3	-	-	3	-	-	126	2
Ireland	-	-	-	-	-	-	400	236	235
Norway	373	202	95	130	195	148	119	312	199
Portugal	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-
Spain	241	1200	1219	808	1345	-	64	70	-
UK (E. & W. & N.I.)	161	114	93	69	56	131	8	23	26
UK (Scotland)	221	437	187	284	254	265	758	829	714
Total	1,023	1,973	1,600	1,298	1,886	549	1,349	1,596	1,176

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*
Faroes Islands	1	-	-	-	-	-	-	n/a	n/a	n/a	n/a
France	-	-	-	-	-	-	-	+	-	+	1
Germany	-	-	-	10	22	3	11	1	-	-	-
Ireland	472	280	477	436	153	227	148	119	40	18	
Norway	199	120	92	91	55*	51*	85*	152*	164*	28	25
Portugal	-	-	-	-	5	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	7	26	-	-
Spain	-	-	2	5	1	6	4	3	1	+	
UK (E. & W. & N.I.)	103	25	90	23	20	32	22	4	2	2	…
UK (Scotland)	322	236	370	210	706	341	389	286	176	67	…
UK											60
Total	1,097	661	1,031	775	962	661	659	572	409	115	98*

* Preliminary.

Figure 3.1.1.1 Cod in Division VIa. Effort and LPUE for the three available commercial fleets.





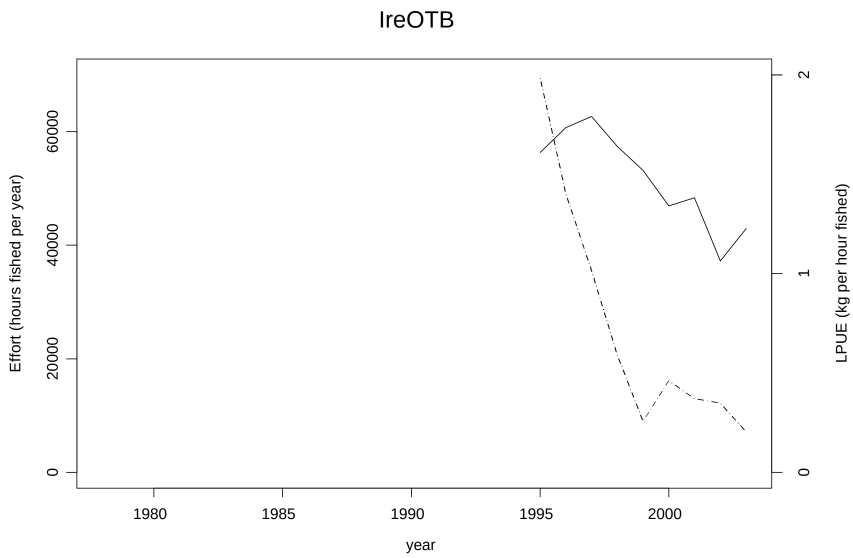


Figure 3.1.3.1 Cod in Division VIa. Mean weights at age in landings

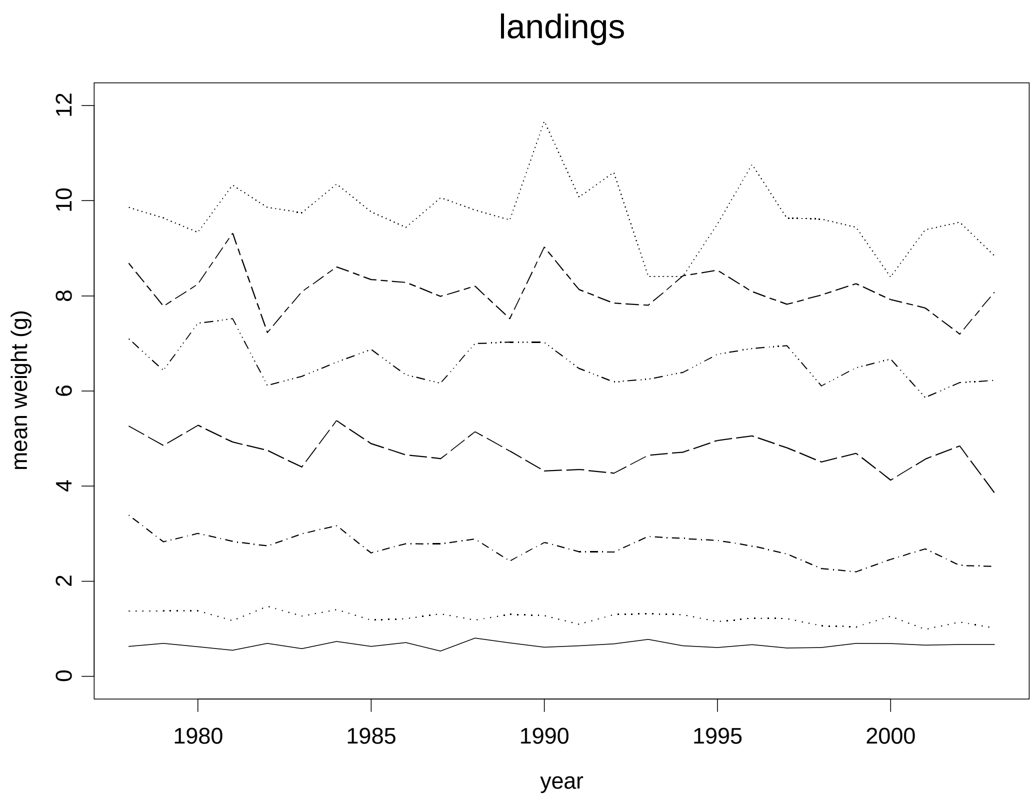


Figure 3.1.3.2 Cod in Division VIa. Mean weights at age in discards.

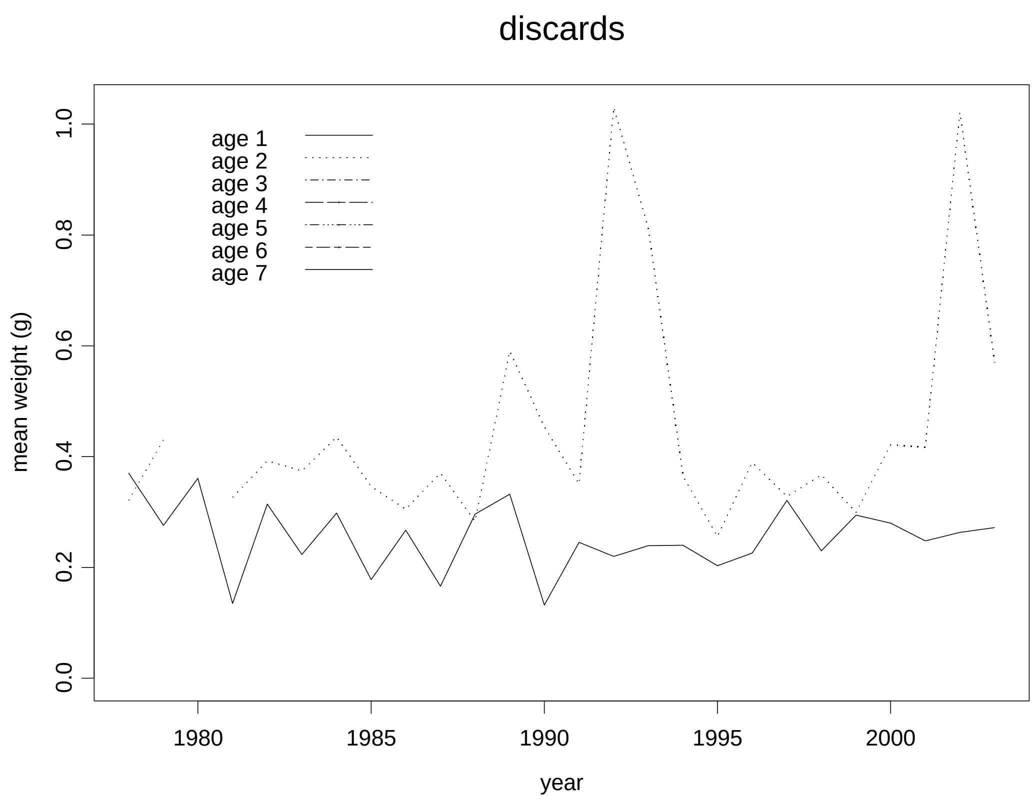


Figure 3.1.5.1 Cod in Division VIa. Log mean standardised survey index across all available ages. Scottish ground fish survey (ScoGFS) and Irish ground fish survey (IreGFS).

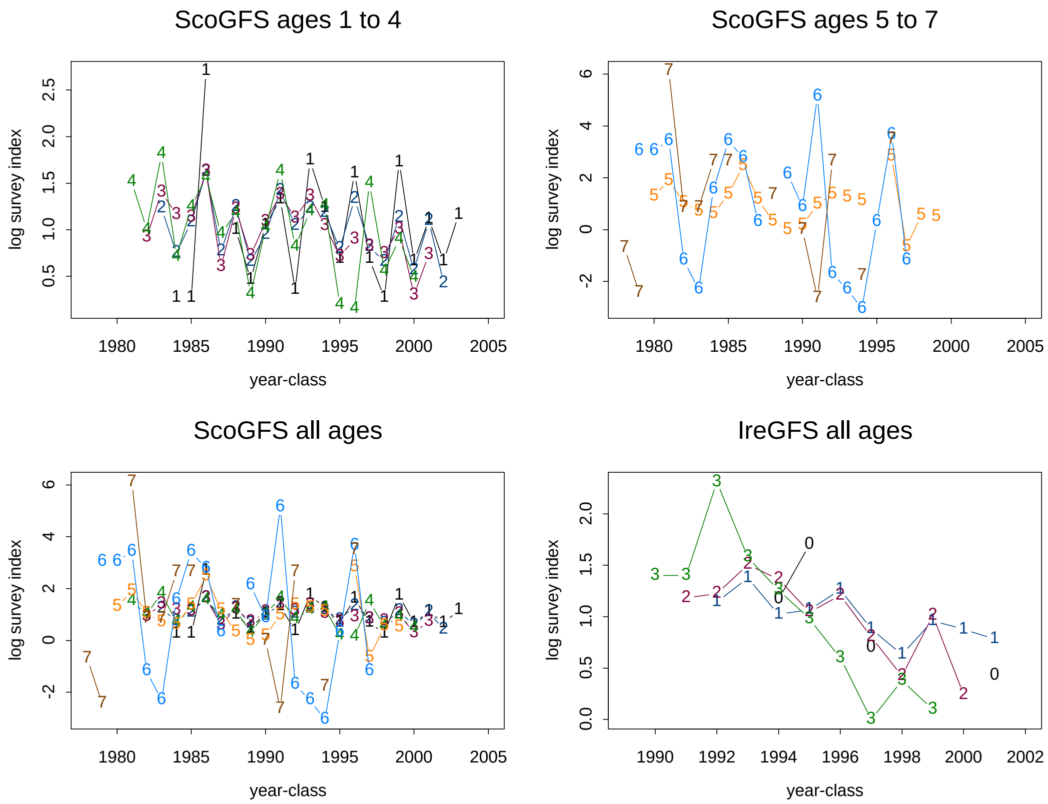


Figure 3.1.5.2 Cod in Division VIa. Bivariate scatterplots of survey indices from the Irish and Scottish ground fish surveys, by year. Year is denoted by the plotting symbol.

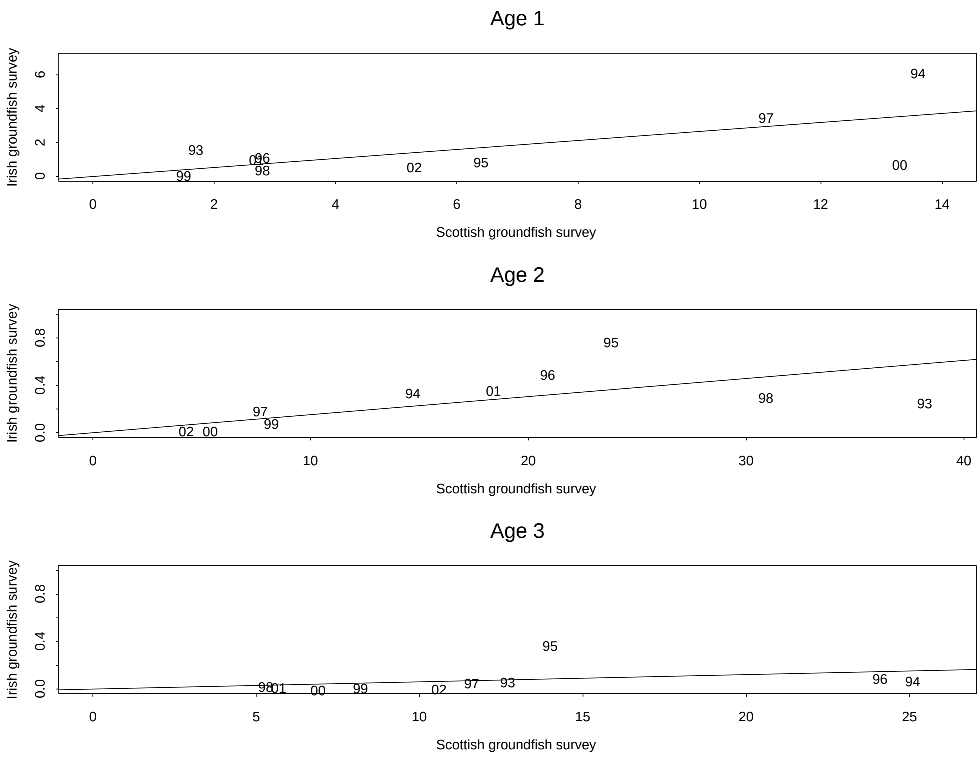


Figure 3.1.5.3 Proportions by number from three commercial fleets and two surveys. Fleets are - commercial: Scottish light trawls (ScoGFS), Scottish seine netters (ScoSEI), Irish Otter trawler (IreOTB), and surveys: Scottish ground fish survey (ScoGFS) and irish ground fish survay (IreGFS).

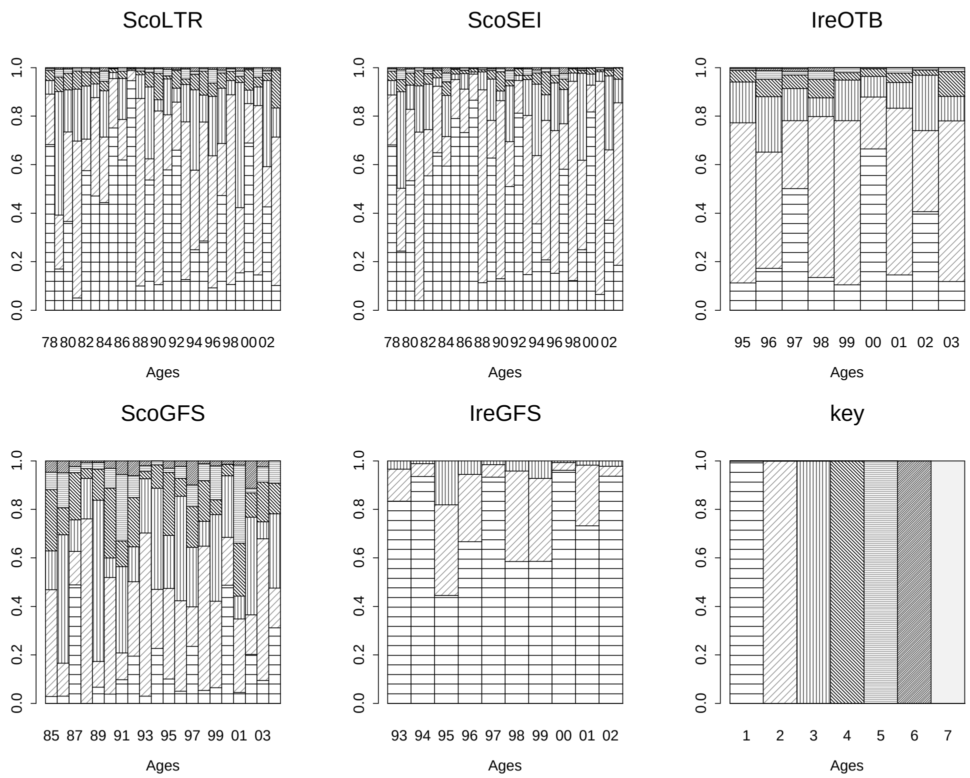


Figure 3.1.5.4 Cod in Division VIa. Survey and commercial indices by age and fleet.

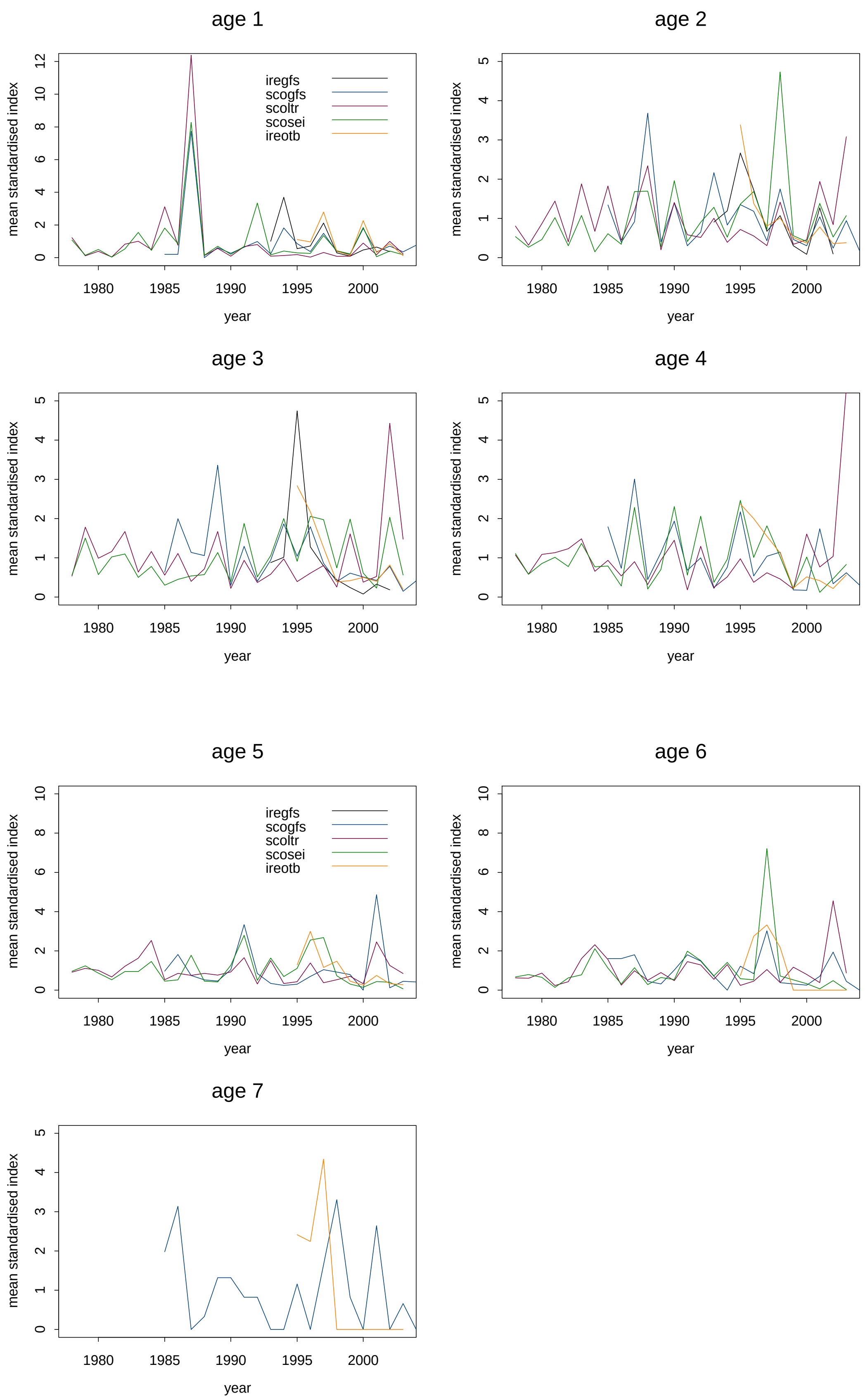


Figure 3.1.5.6 Cod in Division VIa. Summary plots from Surba analysis of Scottish ground fish survey.

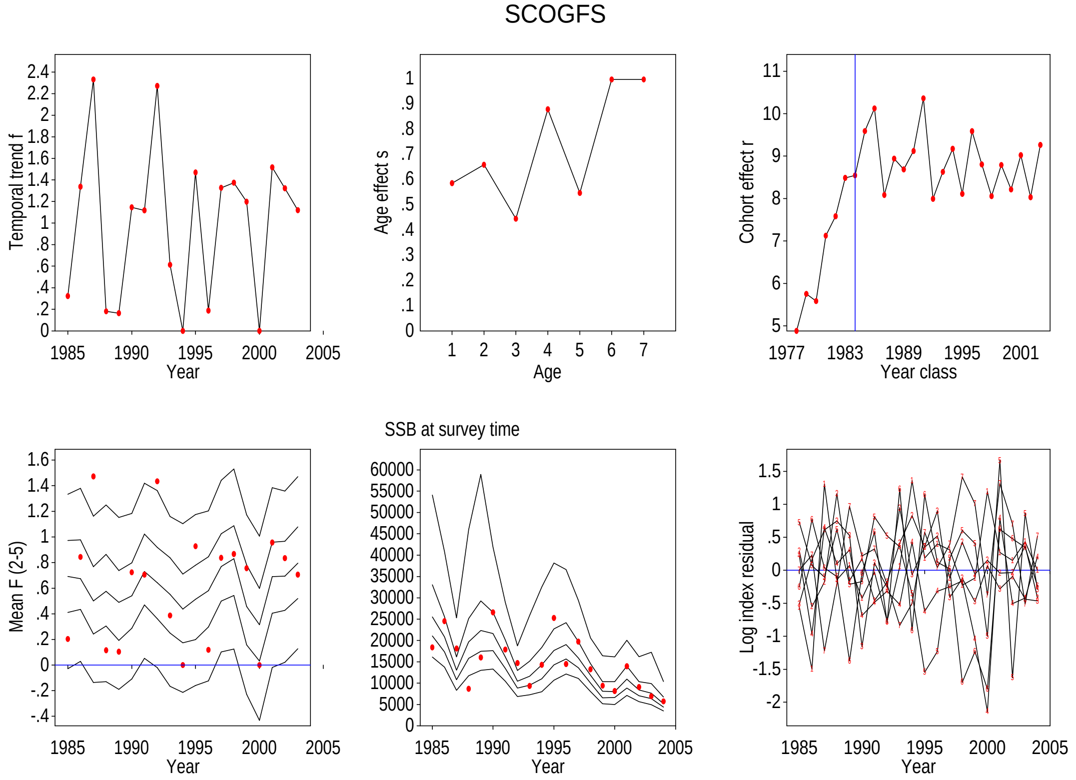


Figure 3.1.5.7 Cod in Division VIa. Log cohort abundance plots from Scottish ground fish survey raw indices.

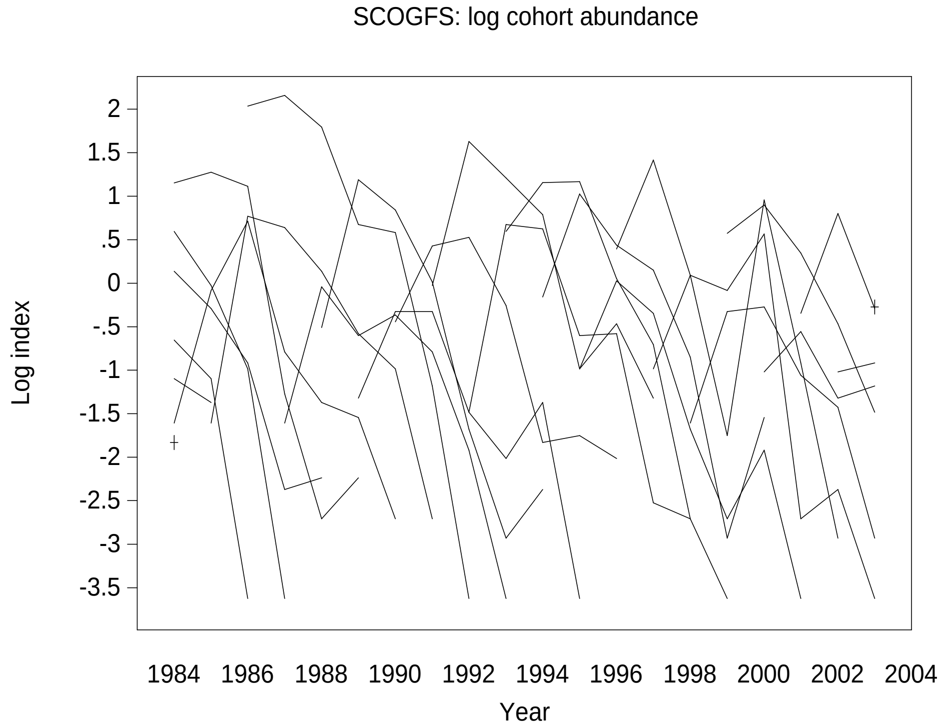
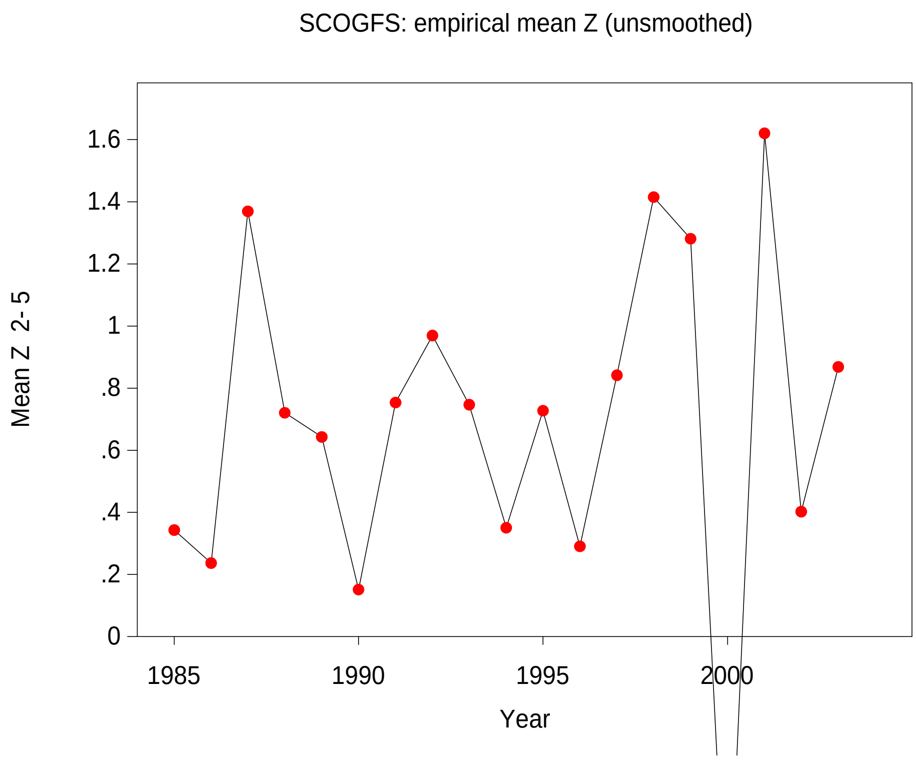


Figure 3.1.5.8 Cod in Division VIa. Scottish ground fish survey raw indices

a)



b)

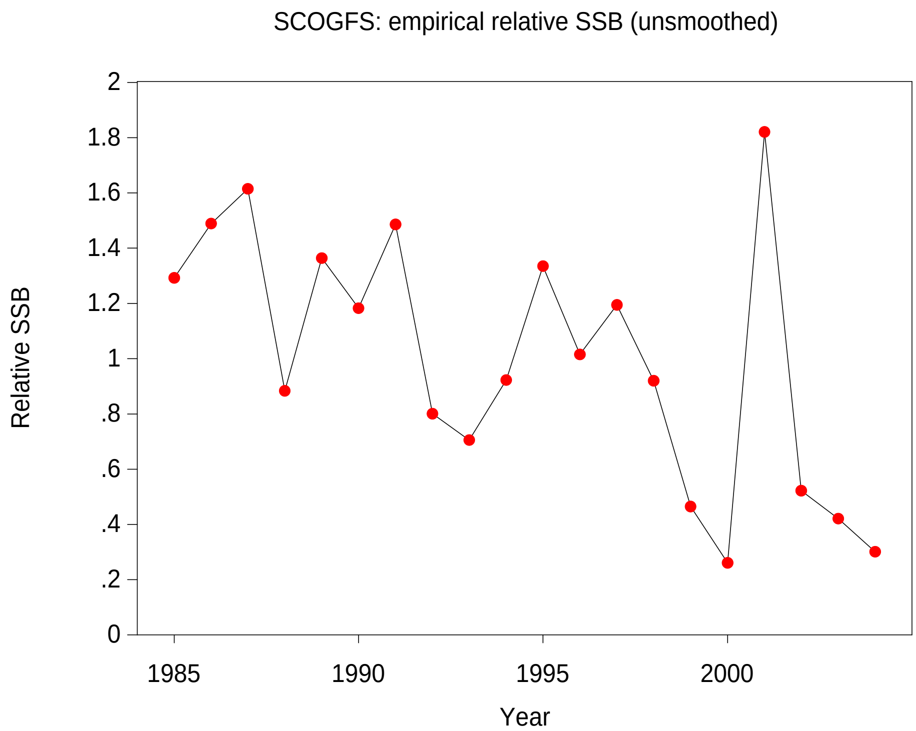


Figure 3.1.5.9 Cod in Division VIa. Scottish ground fish survey raw indices.

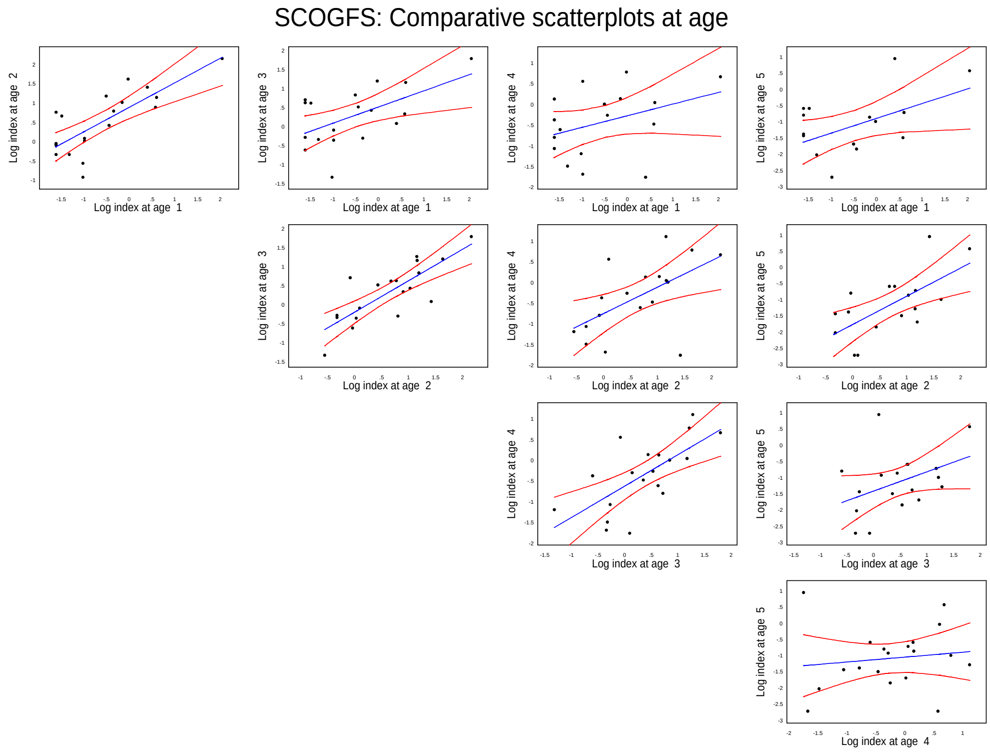


Figure 3.1.5.10 Cod in Division VIa. Log cohort abundance plots from Scottish ground fish survey smoothed indices.

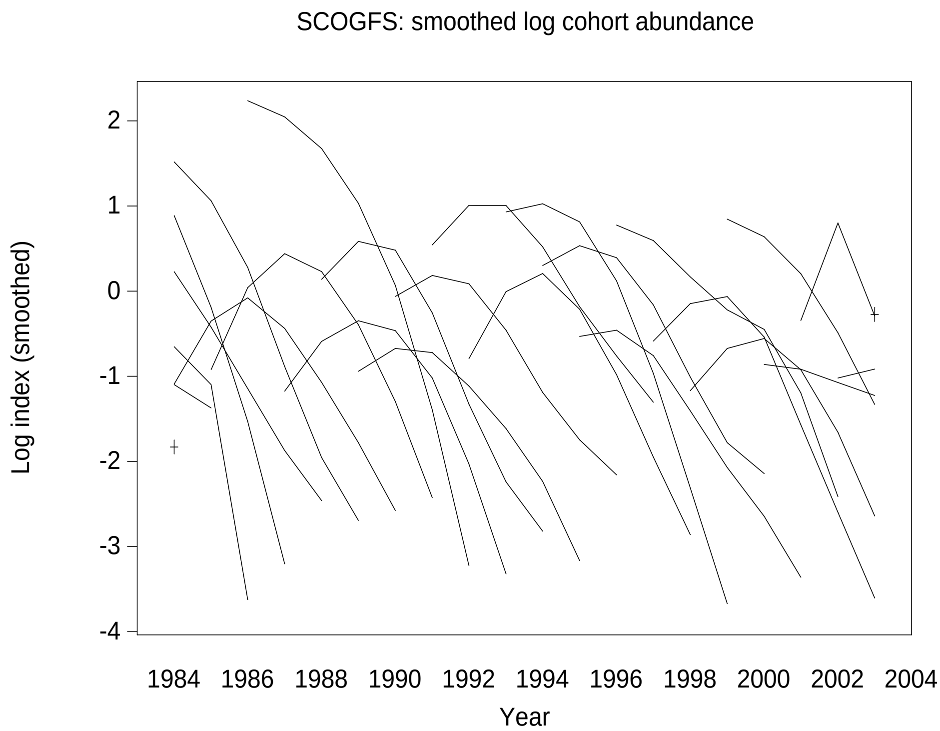
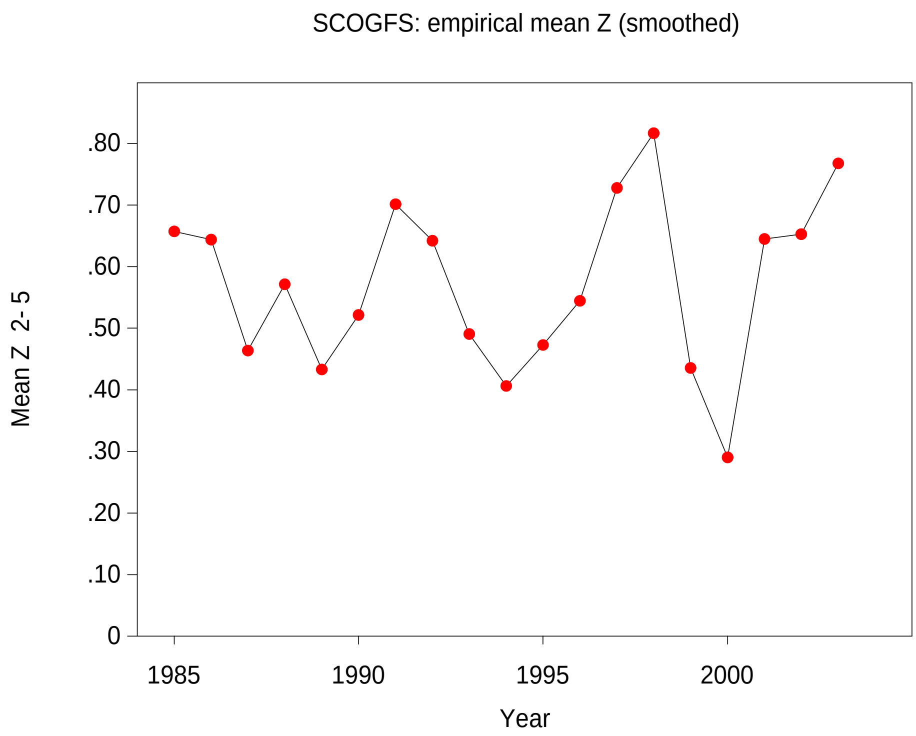


Figure 3.1.5.11 Cod in Division VIa. Scottish ground fish survey smoothed indices.

a)



b)

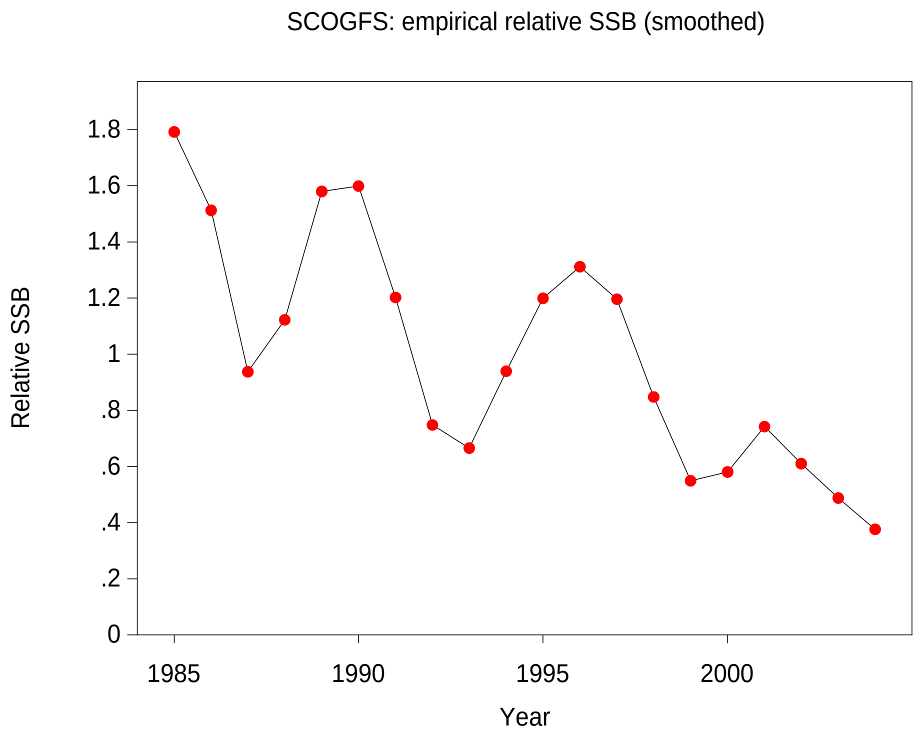
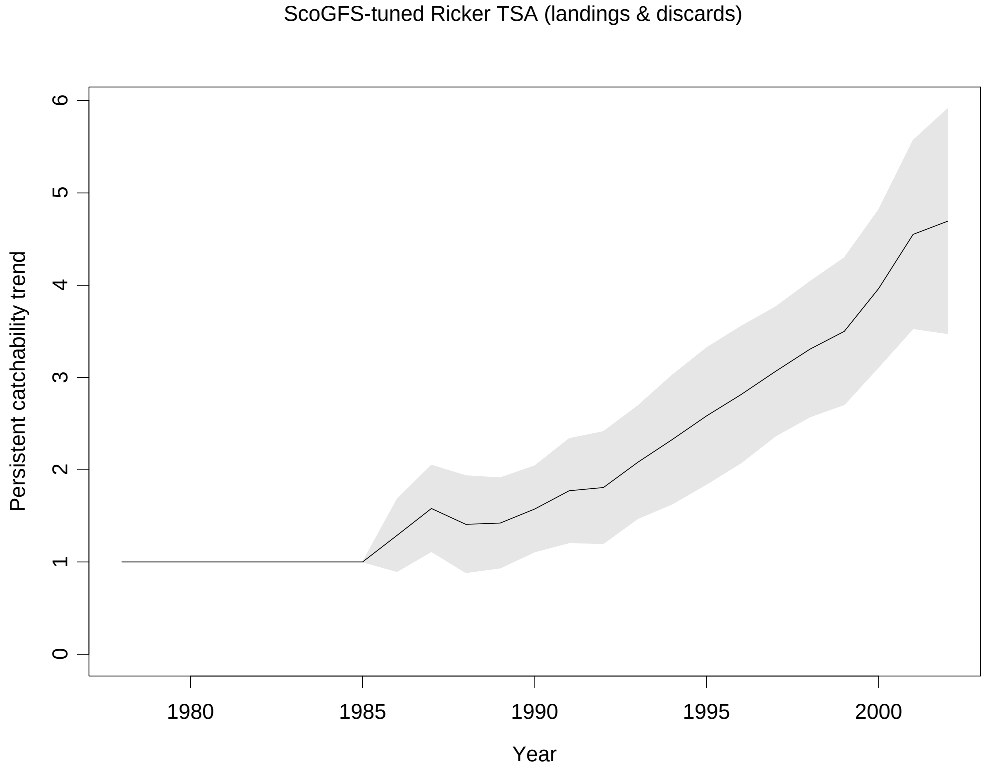


Figure 3.1.5.12 Cod in Division VIa. Trends in comparing the Scottish ground fish survey to commercial catch data.

a) Persistent trend in survey cathcability, as modelled by last years final run TSA.



b) Resdiuals from XSA tuned with the Scottish Ground fish survey (ScoGFS).

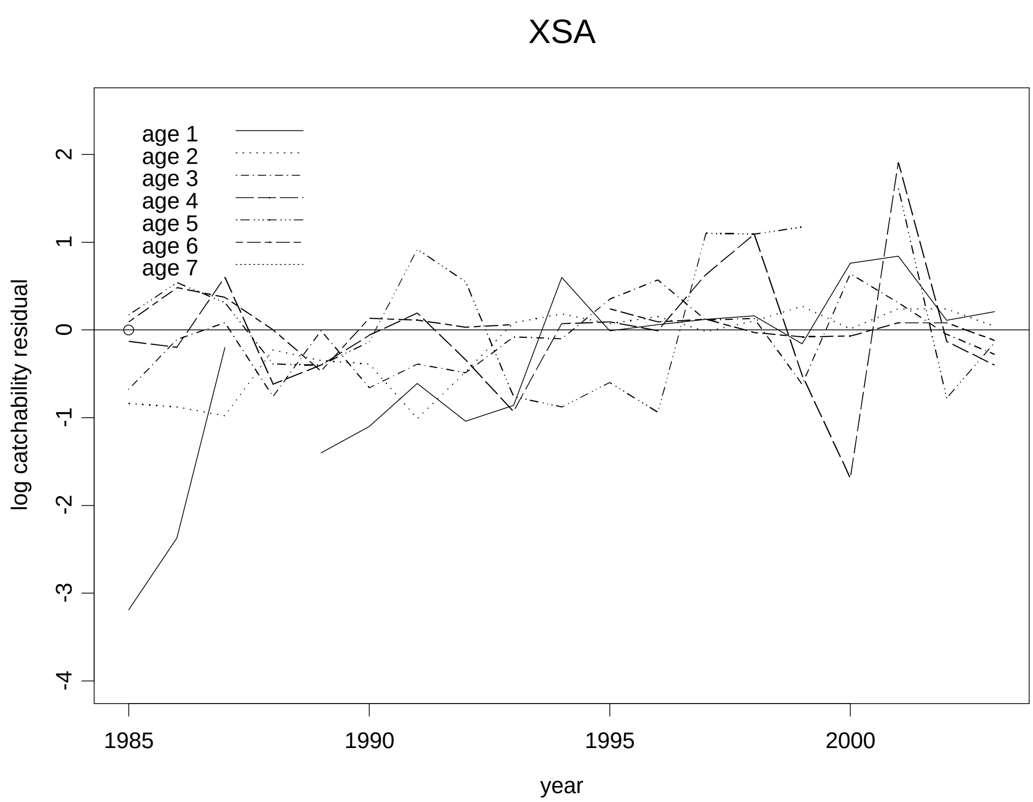


Figure 3.1.5.12 Cod in Division VIa. Trends in comparing the Scottish ground fish survey to commercial catch data.

c) Resdiuals from Laurec-Shepherd tuned with the Scottish Ground fish survey (ScoGFS).

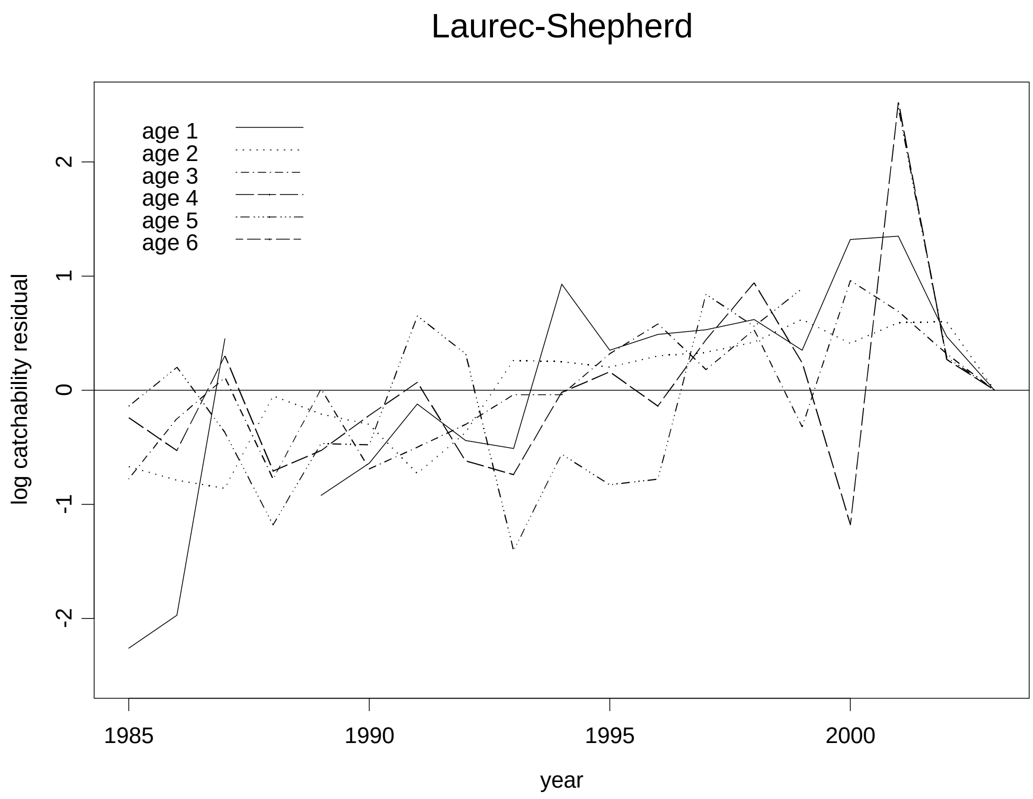
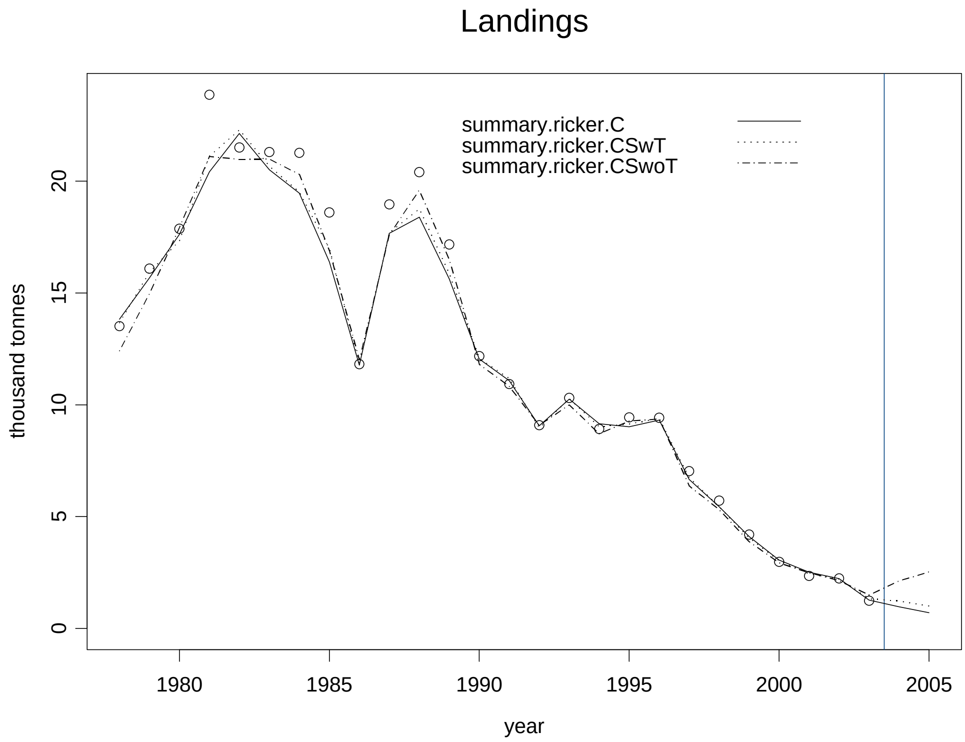


Figure 3.1.5.13 Cod in Division VIa. TSA comparisons: Catch only ("summary.Ricker.C"), Catch and Survey with a persistent trend allowed in survey catchability ("summary.Ricker.CSwT"), and Catch and Survey with a persistent trend set to zero ("summary.Ricker.CswoT").

a)



b)

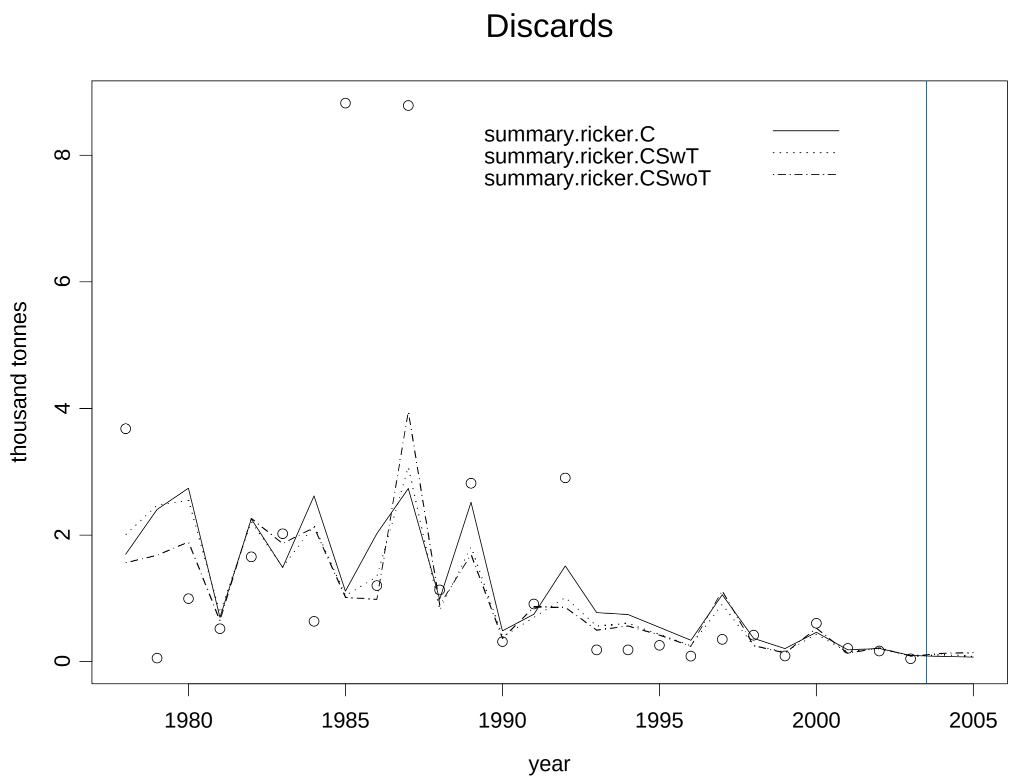


Figure 3.1.5.13 Cod in Division VIa. TSA comparisons: Catch only, Catch and Survey with a persistent trend allowed in survey catchability, and Catch and Survey with a persistent trend set to zero.

c)

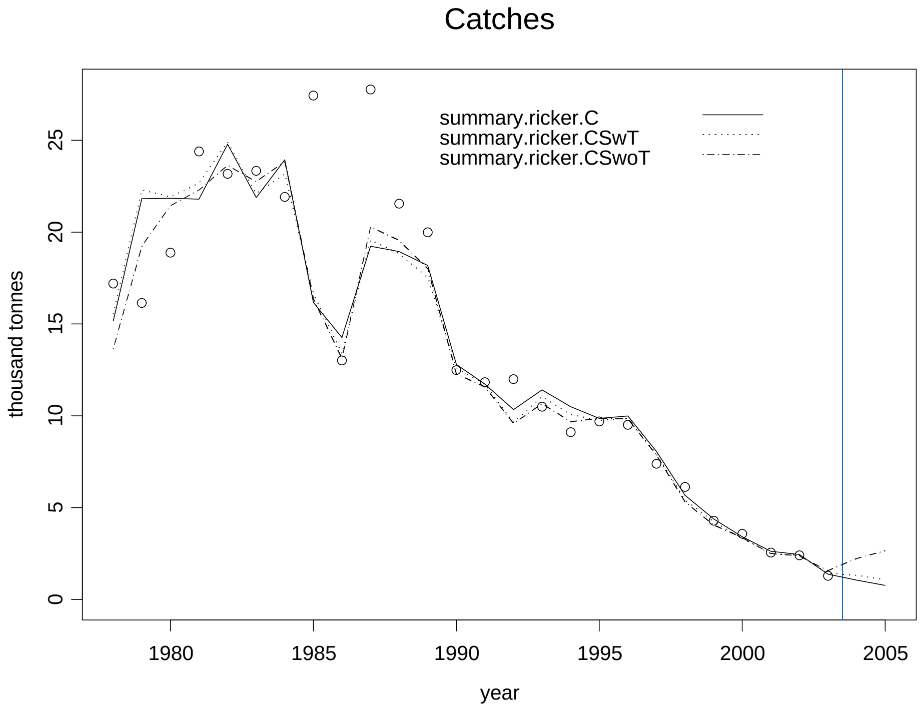
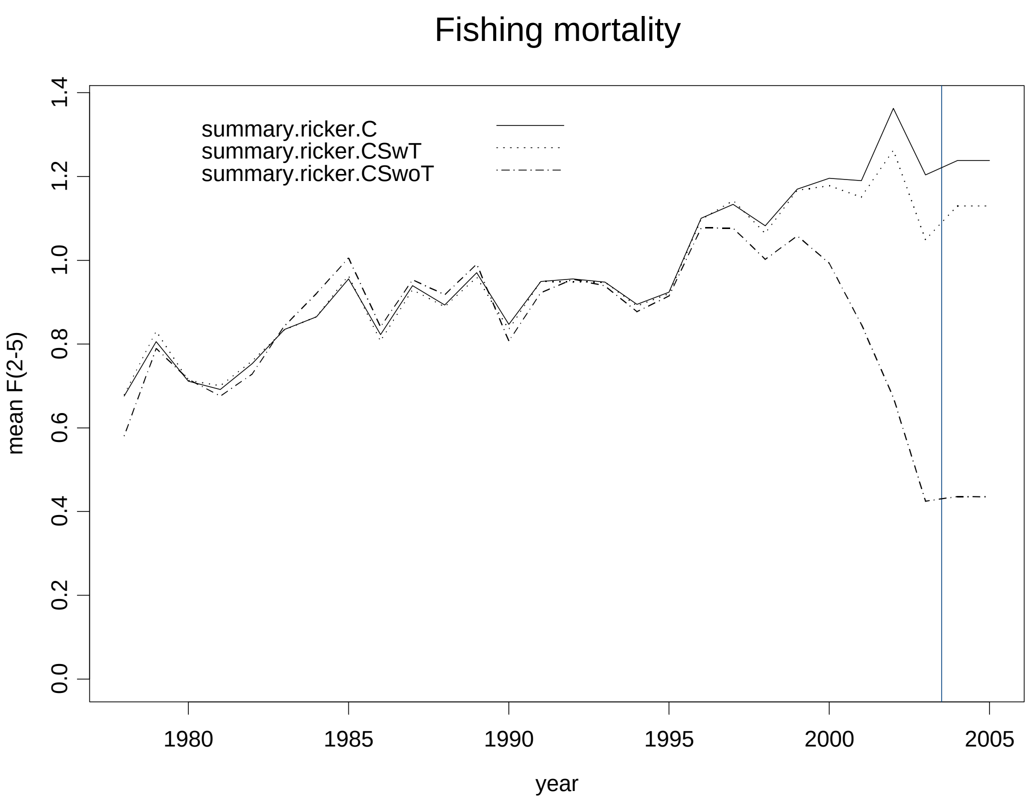


Figure 3.1.5.14 Cod in Division VIa. TSA comparisons: Catch only ("summary.Ricker.C"), Catch and Survey with a persistent trend allowed in survey catchability ("summary.Ricker.CSwT"), and Catch and Survey with a persistent trend set to zero ("summary.Ricker.CswoT").

a)

Figure 3.1.5.14 Cod in Division VIa. TSA comparisons: Catch only, Catch and Survey with a persistent trend allowed in survey catchability, and Catch and Survey with a persistent trend set to zero.

b)



c)

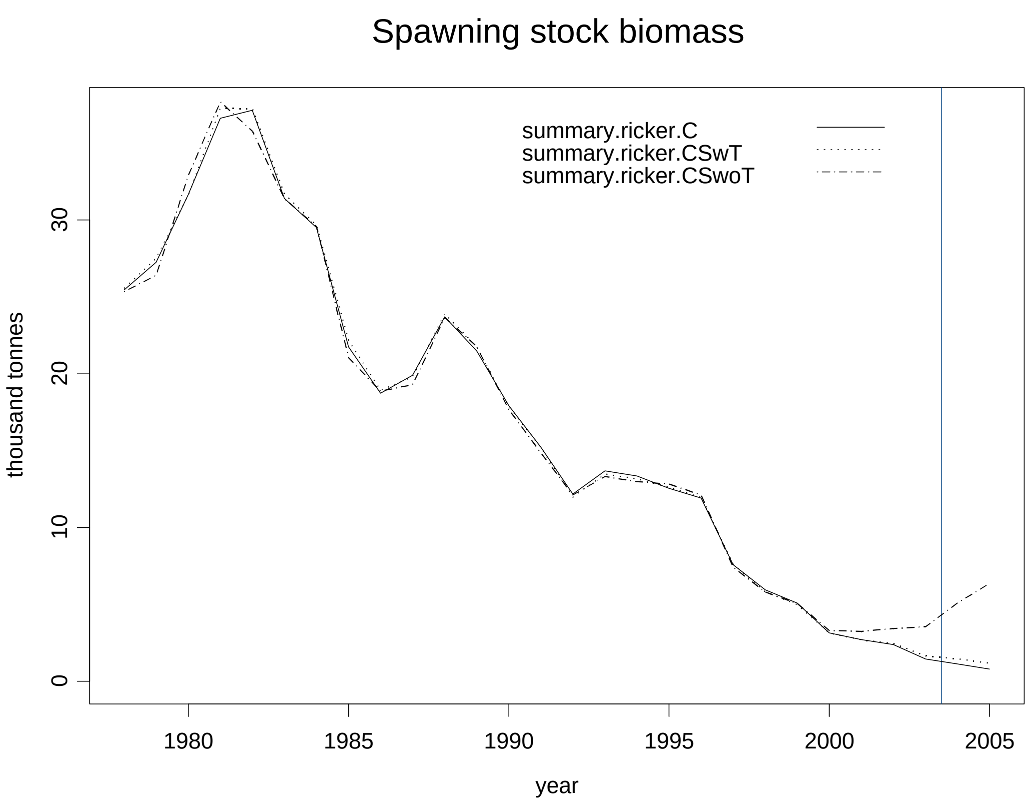
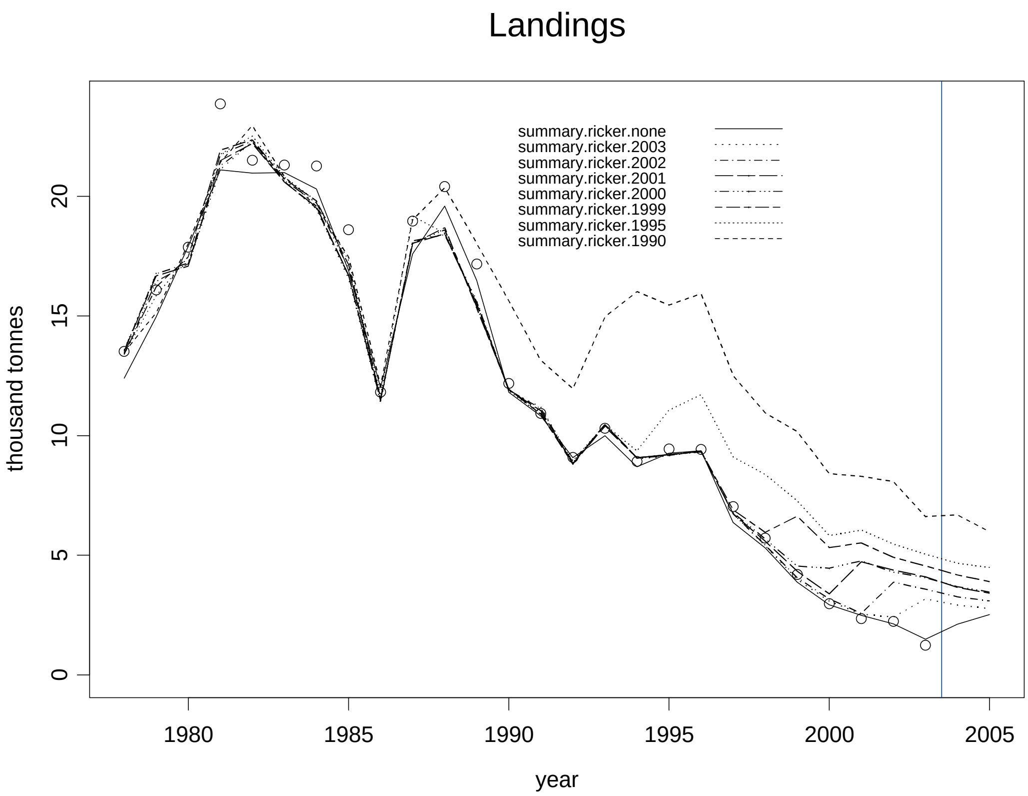


Figure 3.1.5.15 Cod in Division VIa. TSA comparisons of runs with successive years of catch data removed from the analysis. E.g "summary.Ricker.none" has no years of catch data removed and "summary. Ricker.1999" has catch data for 1999-2003 removed.

a)



b)

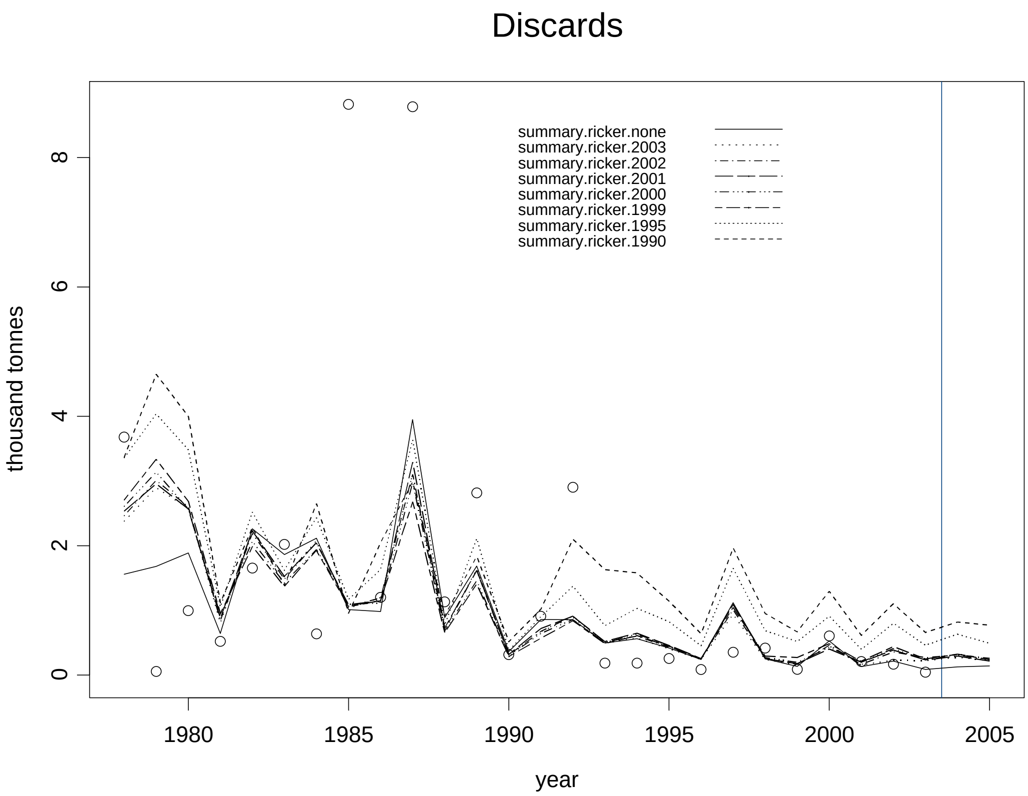


Figure 3.1.5.15 Cod in Division VIa. TSA comparisons of runs with successive years of catch data removed from the analysis.

c)

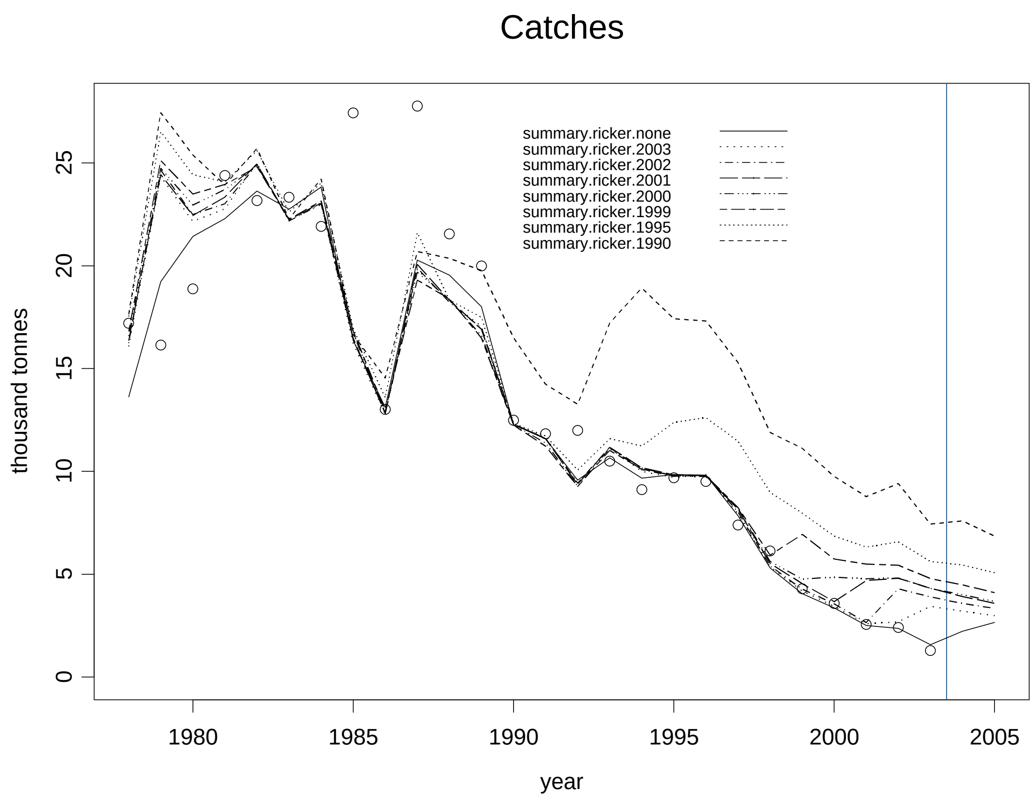
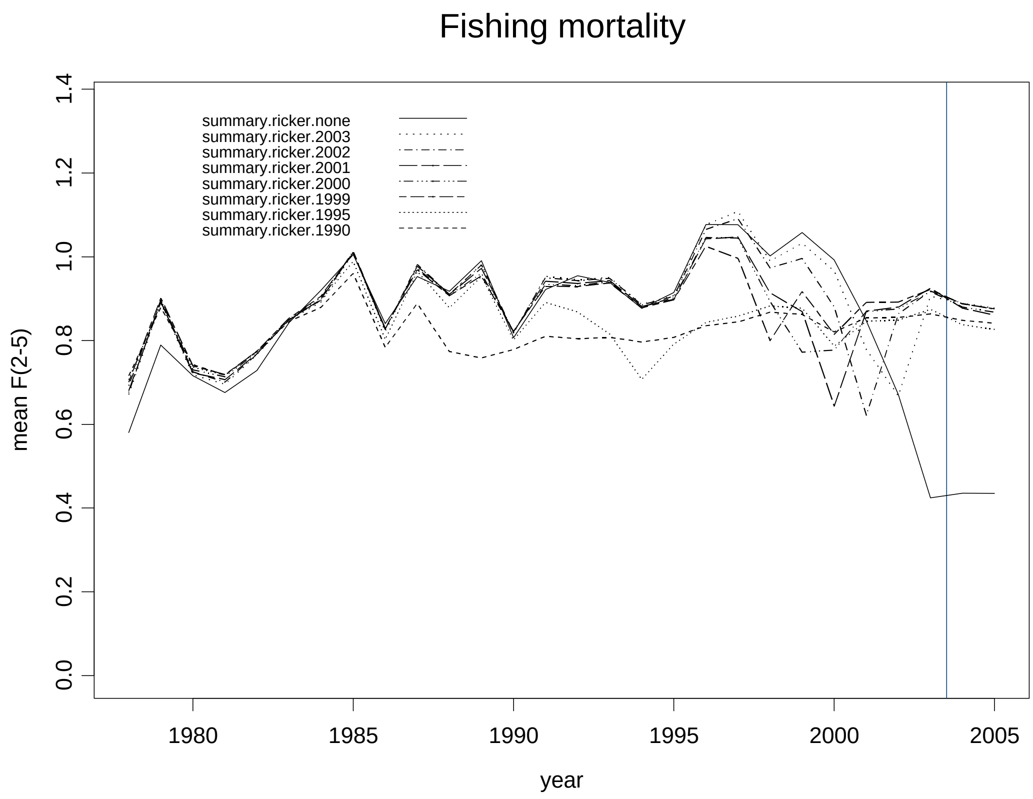


Figure 3.1.5.16 Cod in Division VIa. TSA comparisons of runs with successive years of catch data removed from the analysis. E.g "summary.Ricker.none" has no years of catch data removed and "summary.Ricker.1999" has catch data for 1999-2003 removed.

a)

Figure 3.1.5.16 Cod in Division VIa. TSA comparisons of runs with successive years of catch data removed from the analysis.

b)



c)

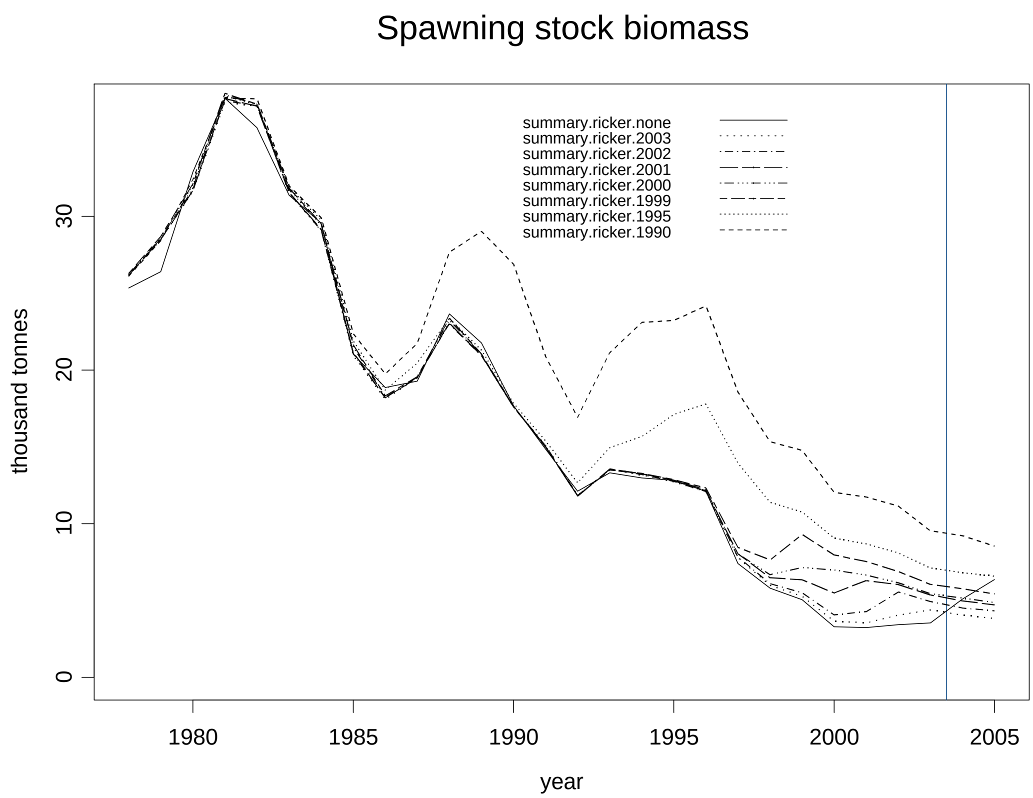
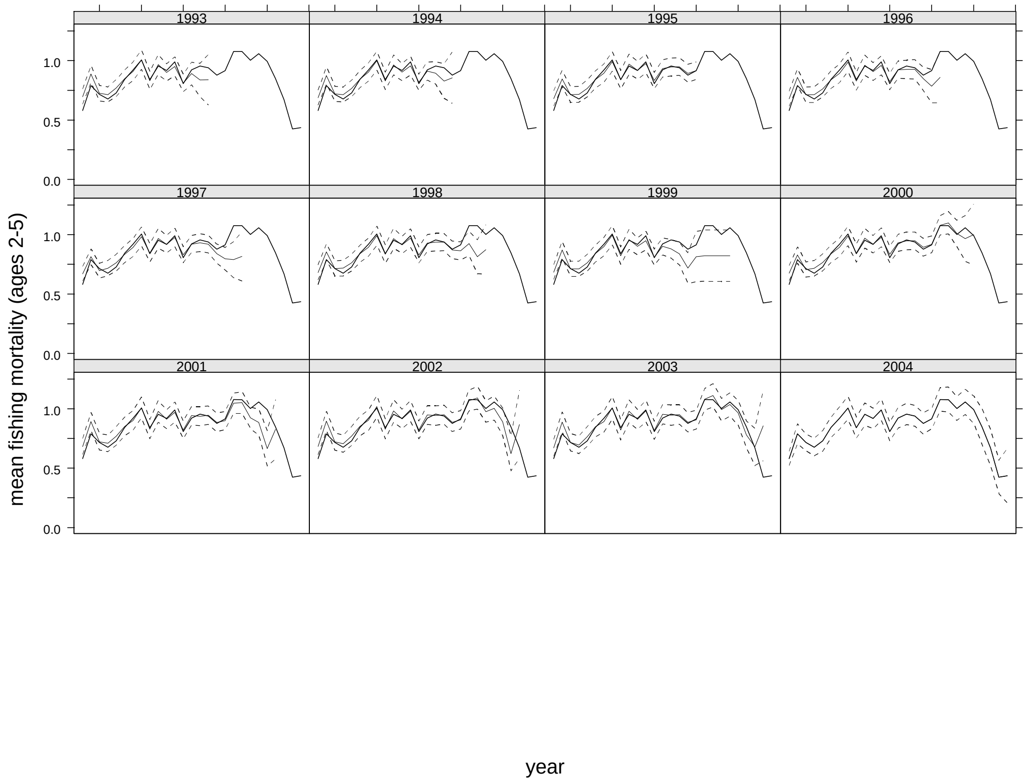
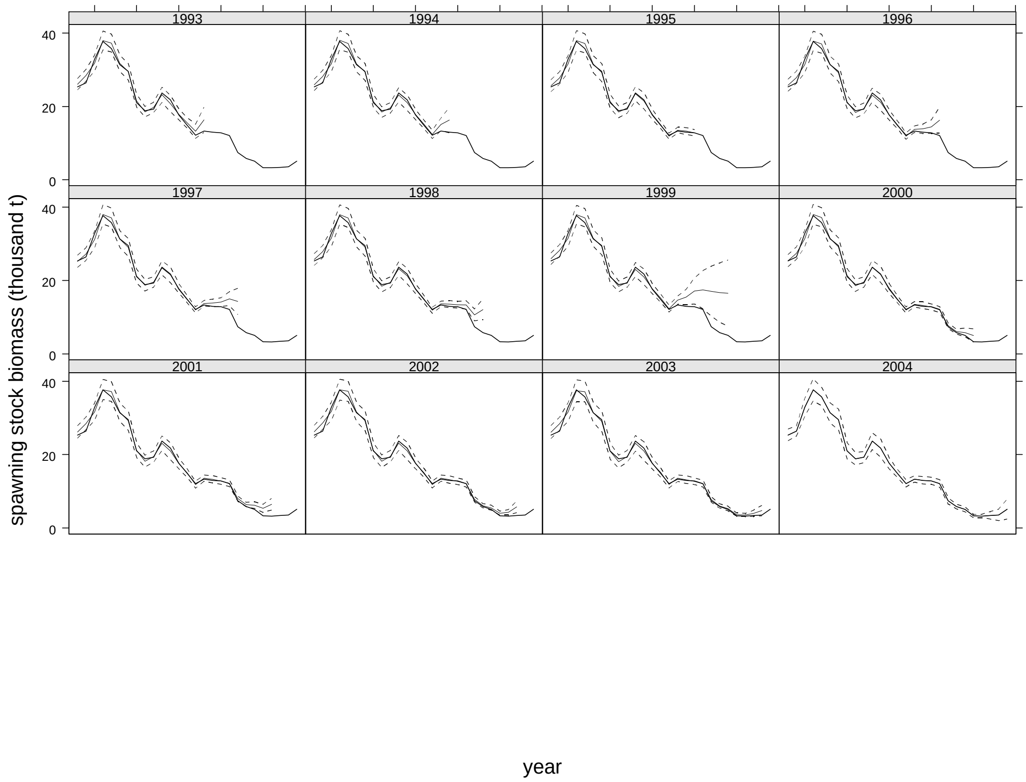


Figure 3.1.5.17 Cod in Division VIa. Retrospective TSA plots with survey data extending one year beyond catch data (normal situation). The title in each panel is the year from which catch data is removed.

a) Mean F(2-5)



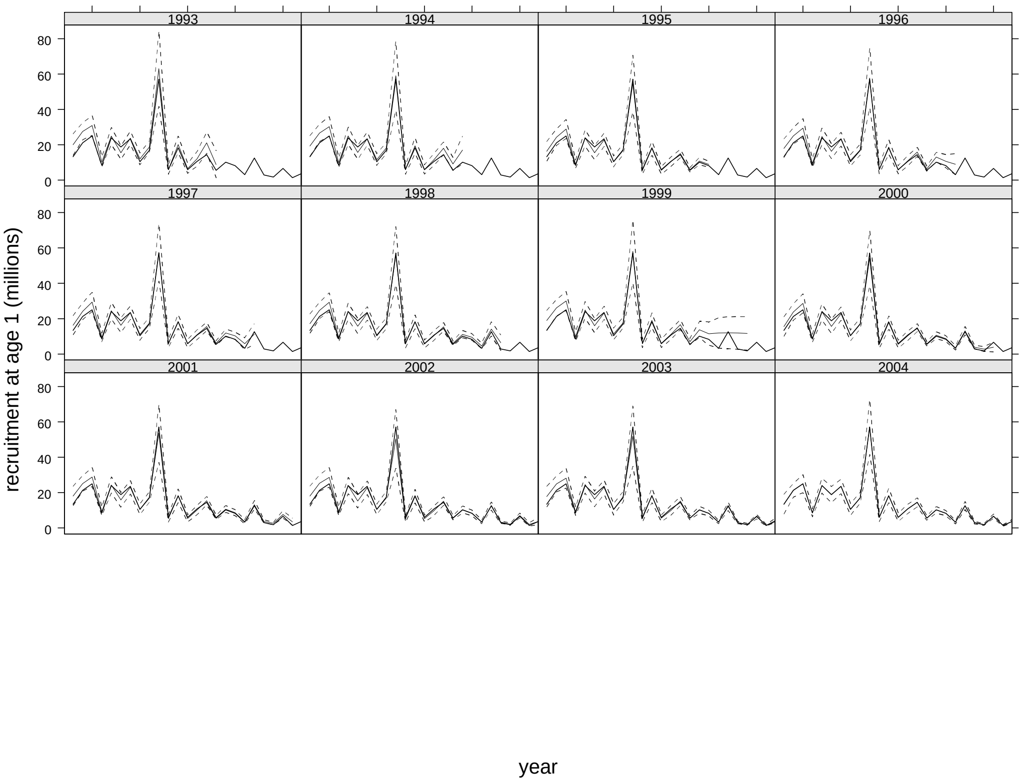
b) Spawning stock biomass (SSB)



NB i) for the above run the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 3.1.5.17 Cod in Division VIa

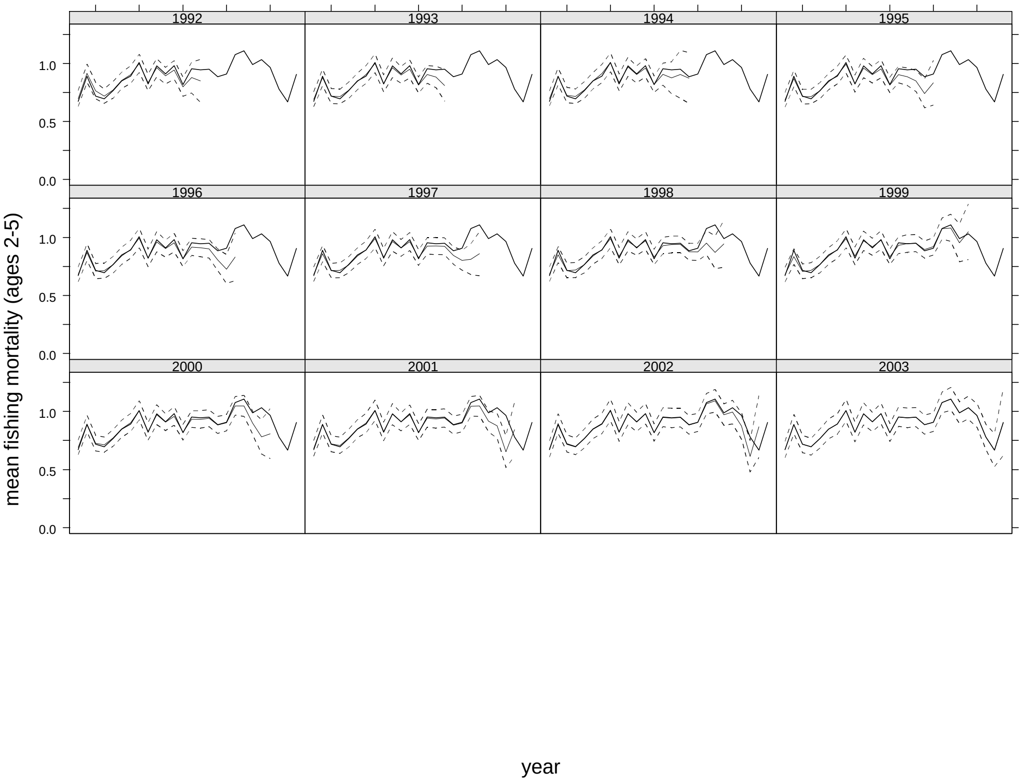
c) Recruitment



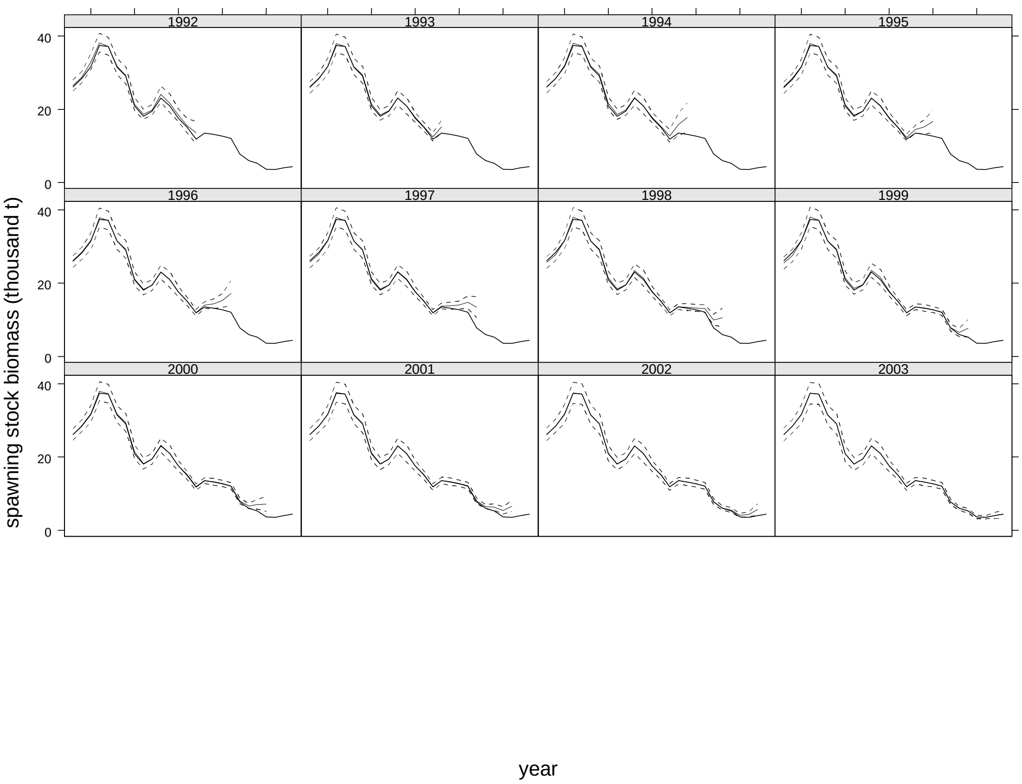
NB i) for the above runs the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 3.1.5.18 Cod in Division VIa. Retrospective TSA plots with survey data extending two years beyond catch data. The title in each panel is the year from which catch data is removed.

a) Mean F(2-5)



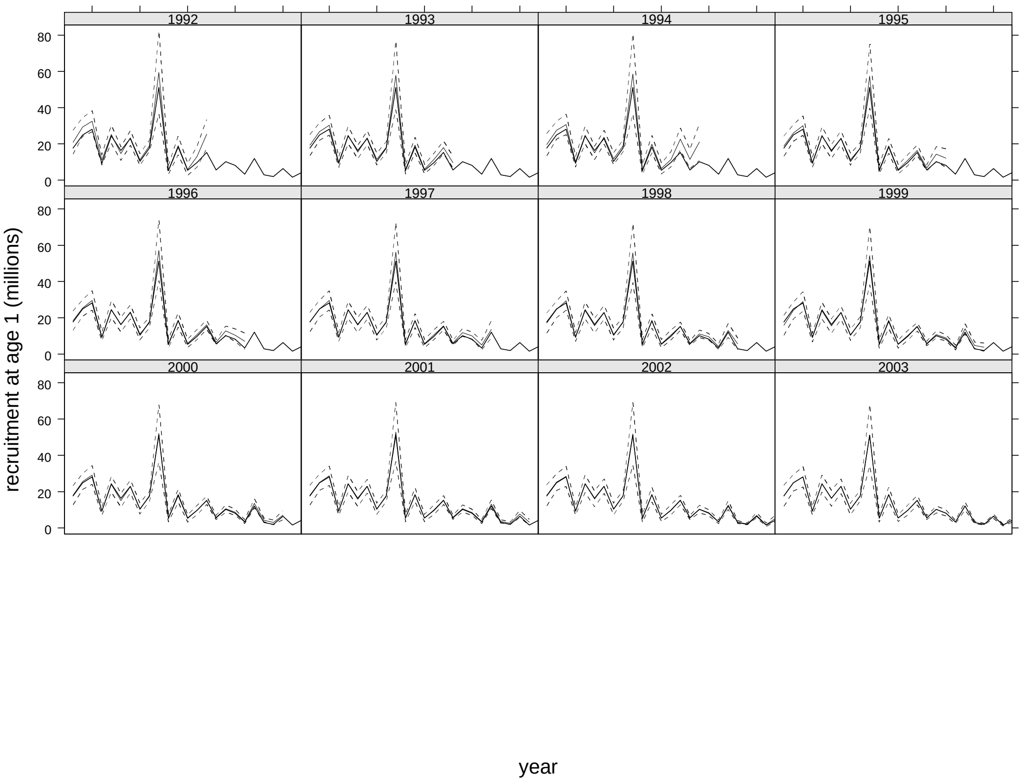
b) Spawning stock biomass



NB i) for the above run the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 3.1.5.18 Cod in Division VIa.

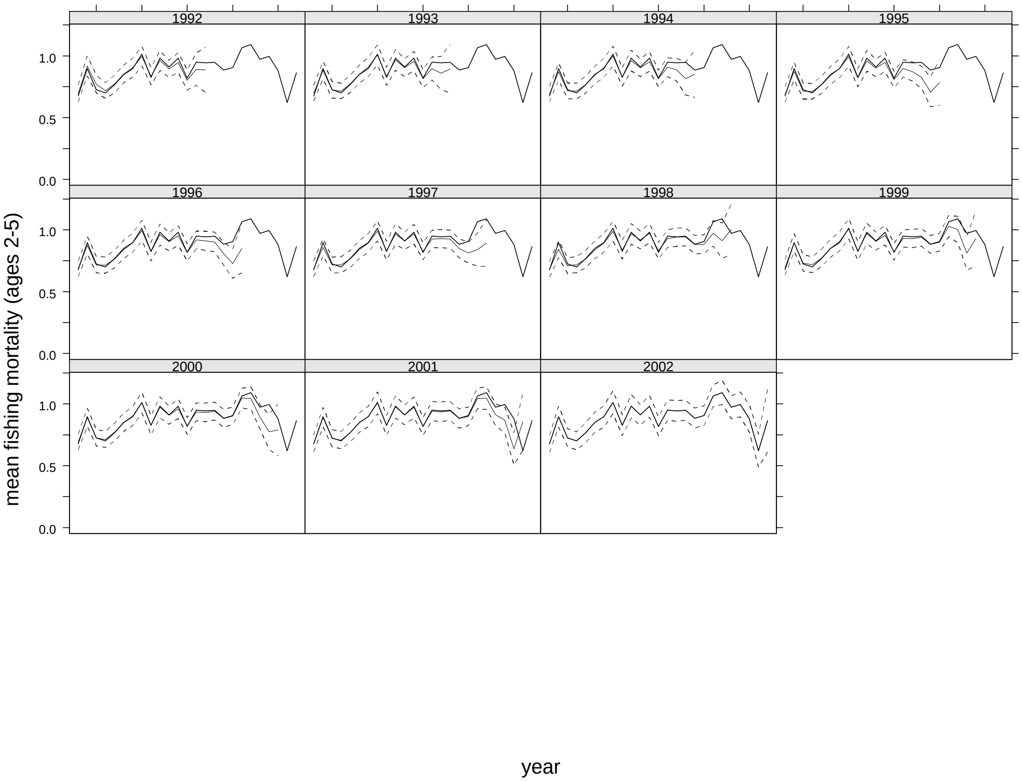
c) Recruitment



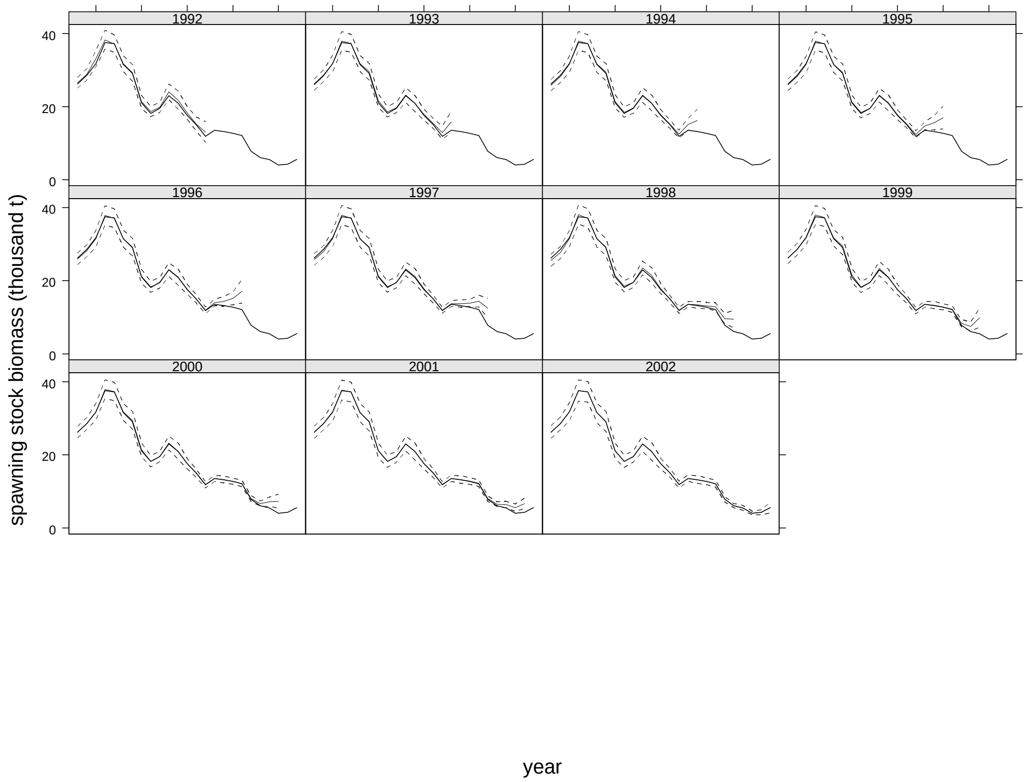
NB i) for the above runs the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 3.1.5.19 Cod in Division VIa. Retrospective TSA plots with survey data extending three years beyond catch data. The title in each panel is the year from which catch data is removed.

a) Mean F(2-5)



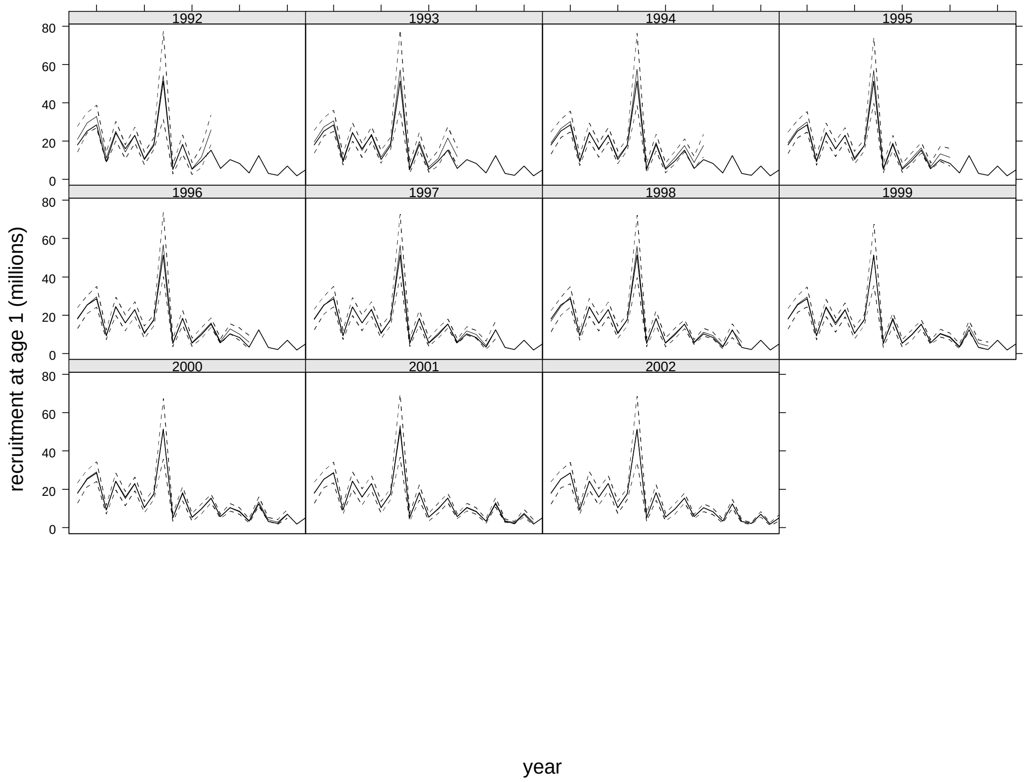
b) Spawning stock biomass



NB i) for the above runs the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 3.1.5.19 Cod in Division VIa.

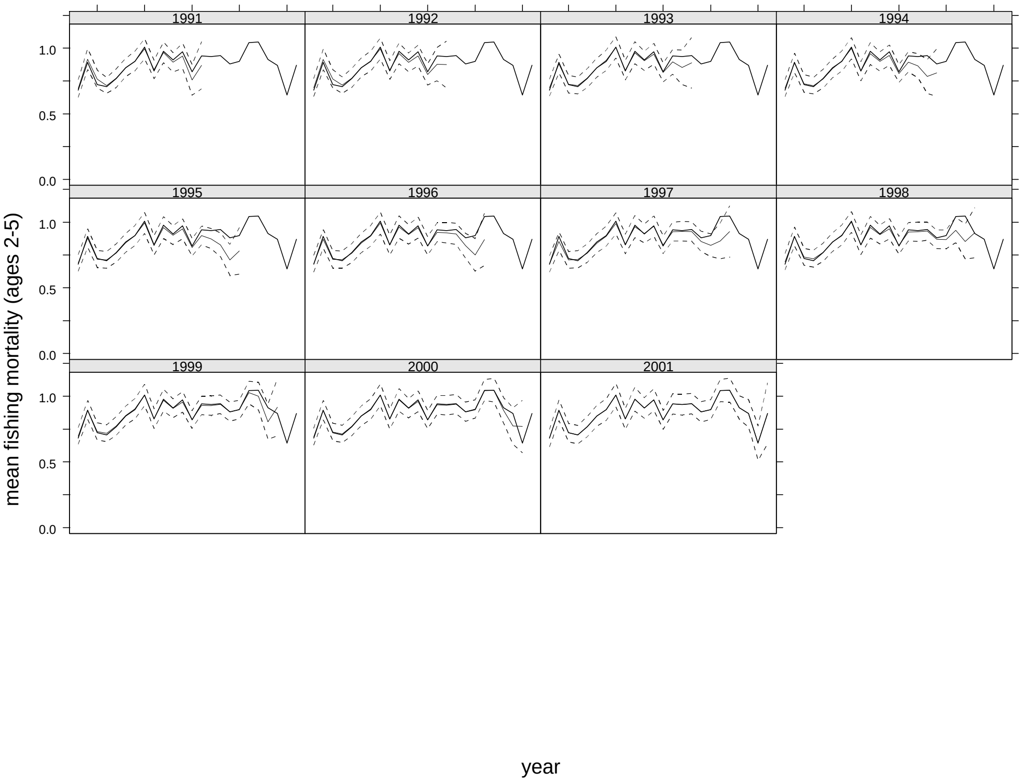
c) Recruitment



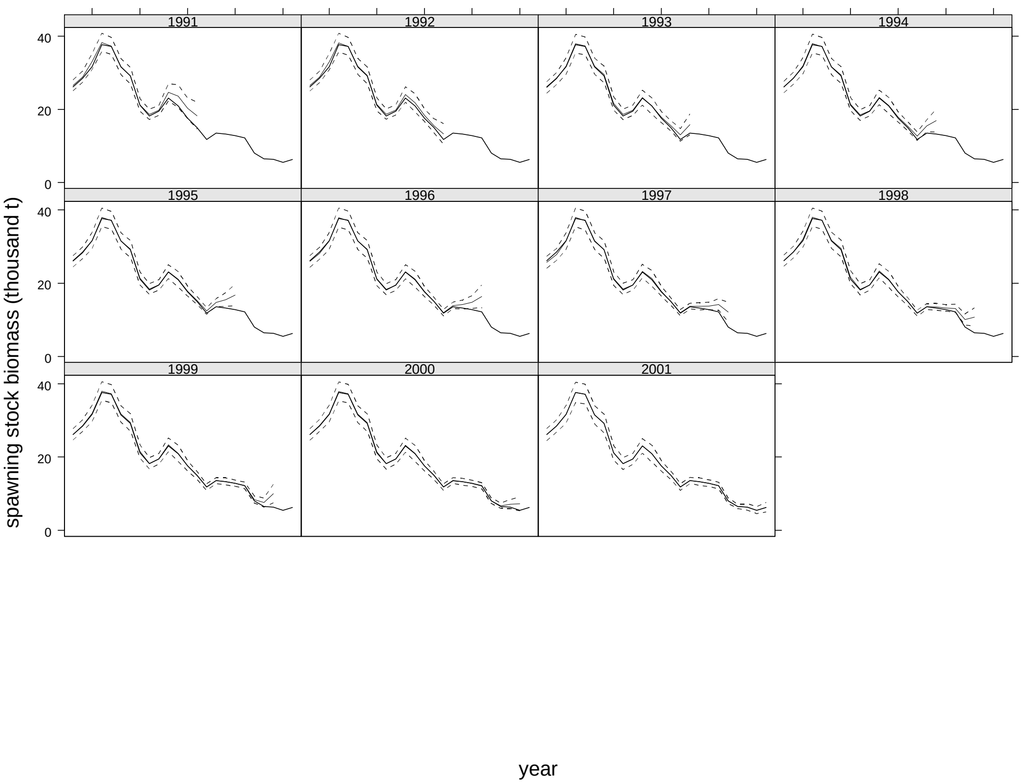
NB i) for the above runs the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 3.1.5.20 Cod in Division VIa. Retrospective TSA plots with survey data extending four years beyond catch data. The title in each panel is the year from which catch data is removed.

a) Mean F(2-5)



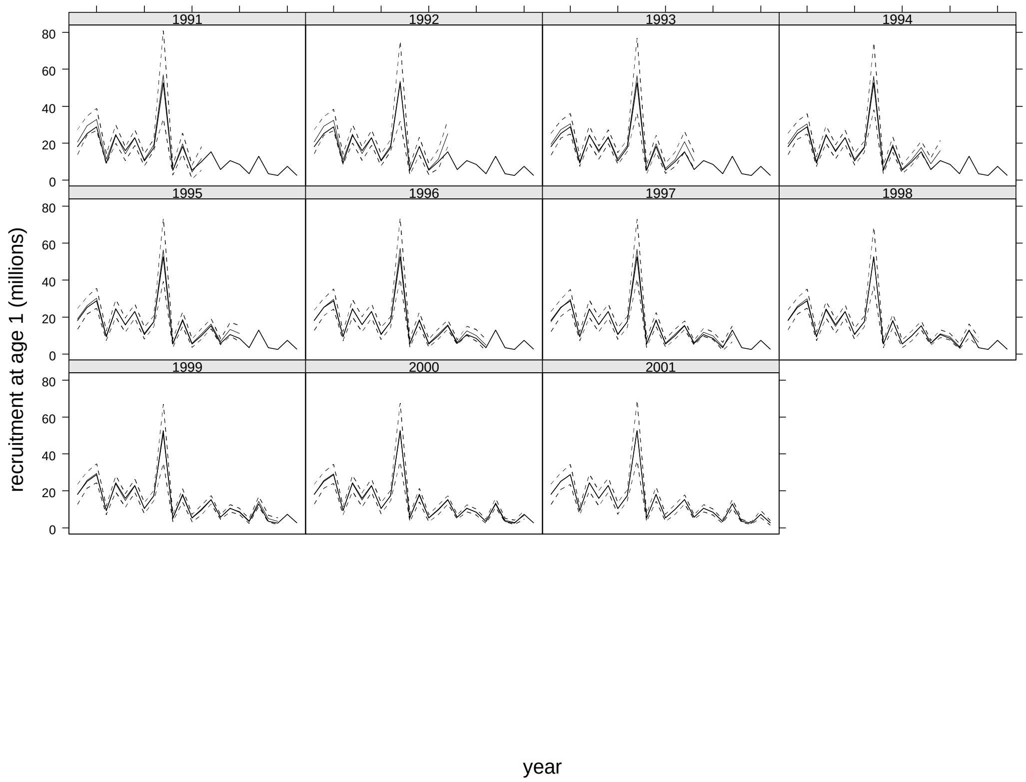
b) Spawning stock biomass



NB i) for the above runs the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 3.1.5.20 Cod in Division VIa.

c) Recruitment



NB i) for the above runs the terminal year in the analysis is defined by terminal year of survey data.
ii) the title of each panel in the above figure is the year, from which, catch data is unused.
iii) the last panel in each plot is the perception in 2004, given the model used.

Figure 5.1.5.21 Cod in Division VIa.

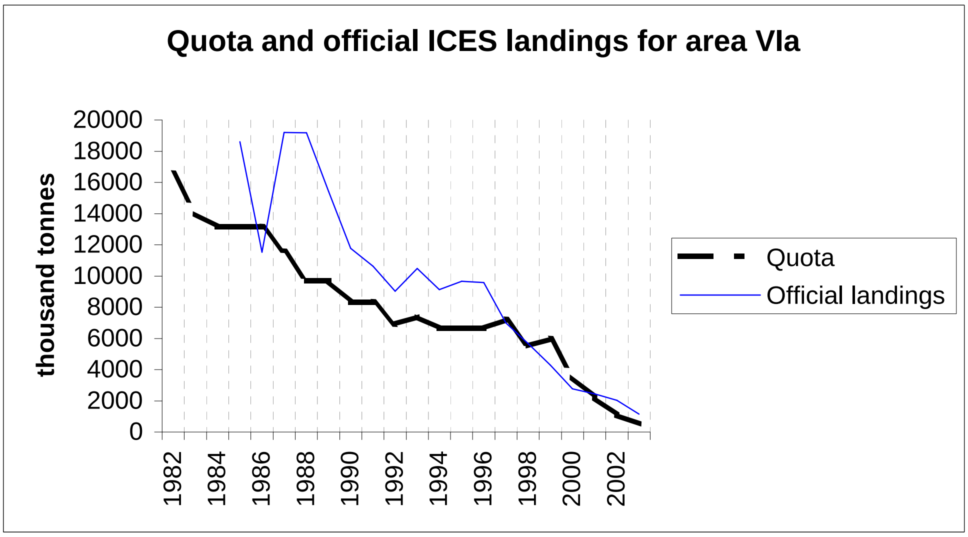
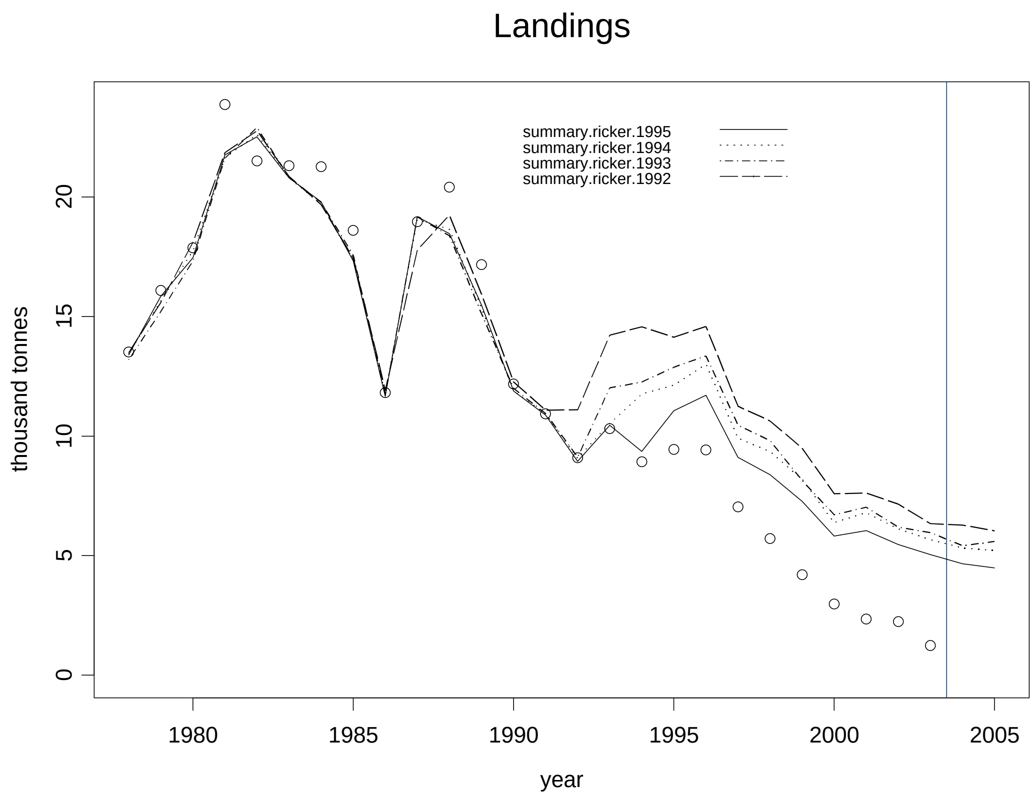


Figure 3.1.5.22 Cod in Division VIa. TSA comparison of runs with catch data removed from the time period that survey data and catch data is suspected to have diverged.

a)



b)

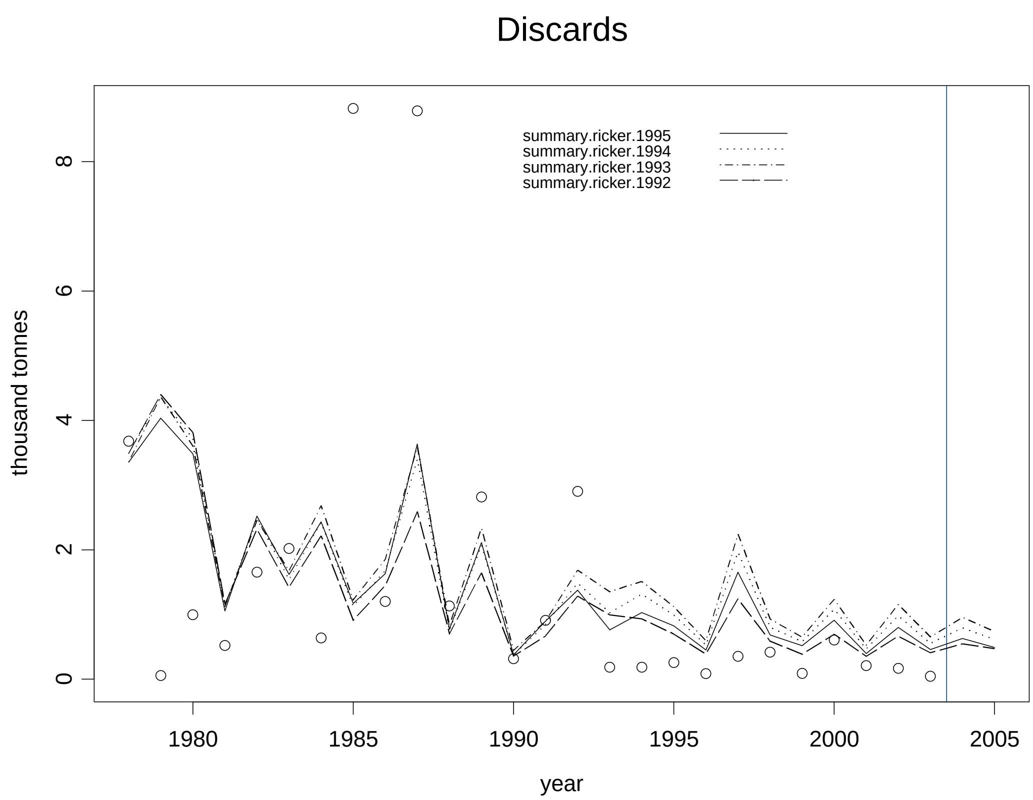


Figure 3.1.5.22 Cod in Division VIa. TSA comparison of runs with catch data removed from the time period that survey data and catch data is suspected to have diverged.

c)

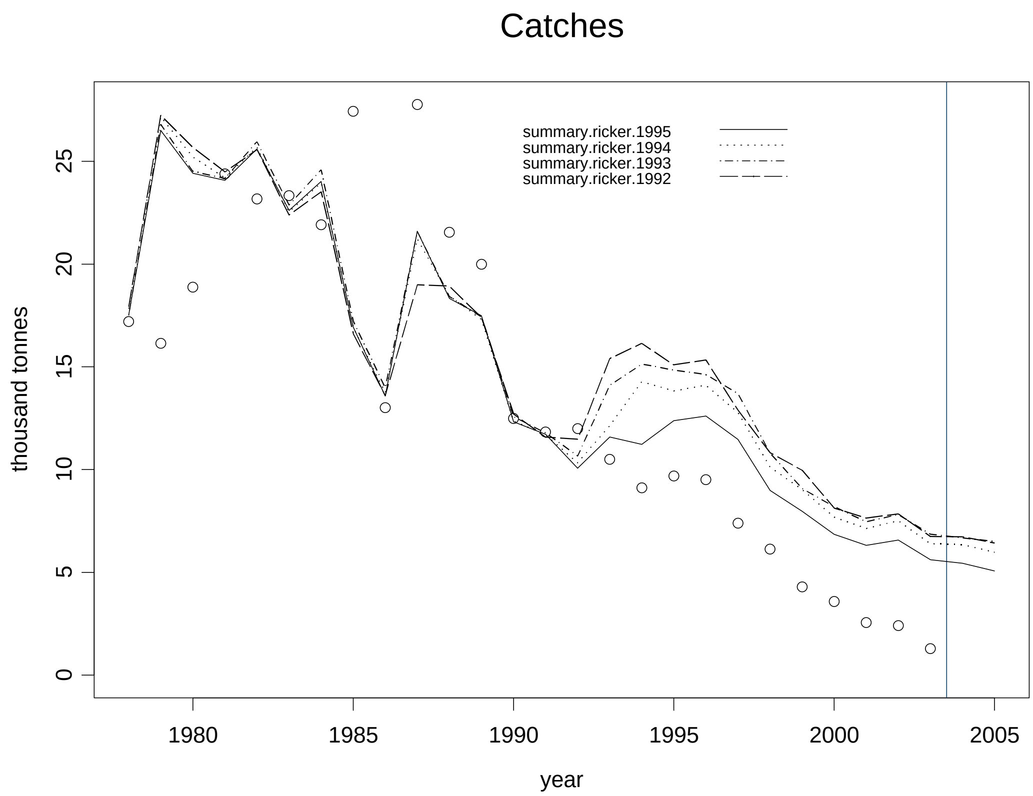
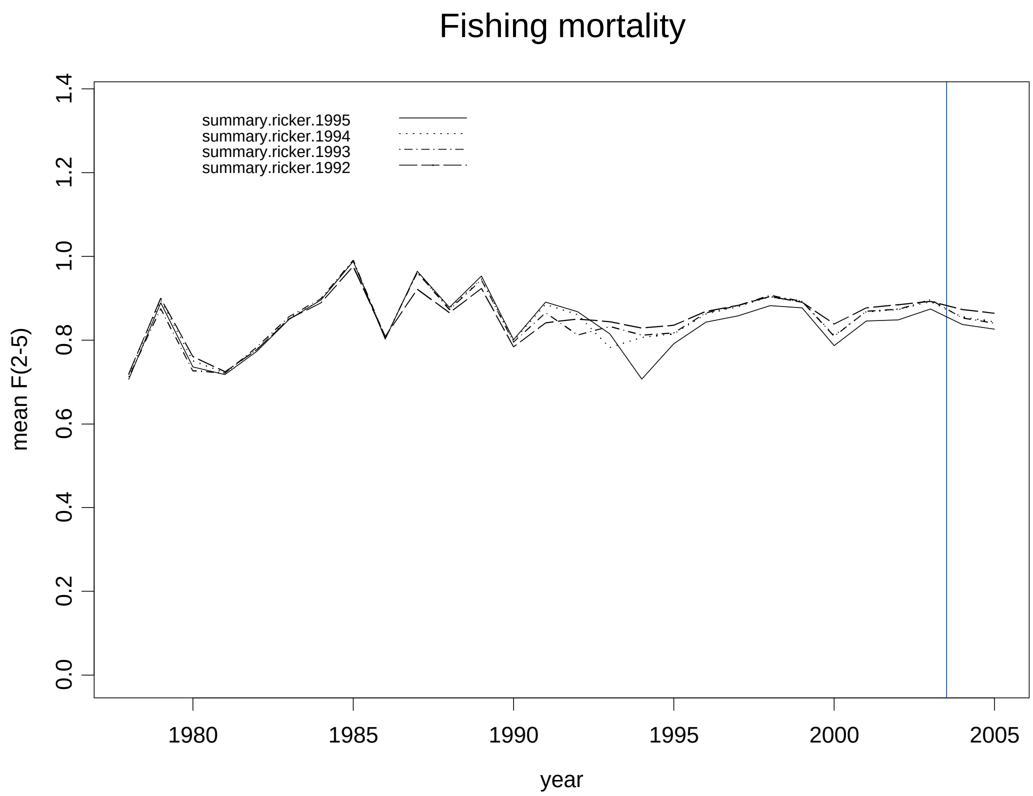


Figure 3.1.5.23 Cod in Division VIa. TSA comparison of runs with catch data removed from the time period that survey data and catch data is suspected to have diverged.

a)

Figure 3.1.5.23 Cod in Division VIa. TSA comparison of runs with catch data removed from the time period that survey data and catch data is suspected to have diverged.

b)



c)

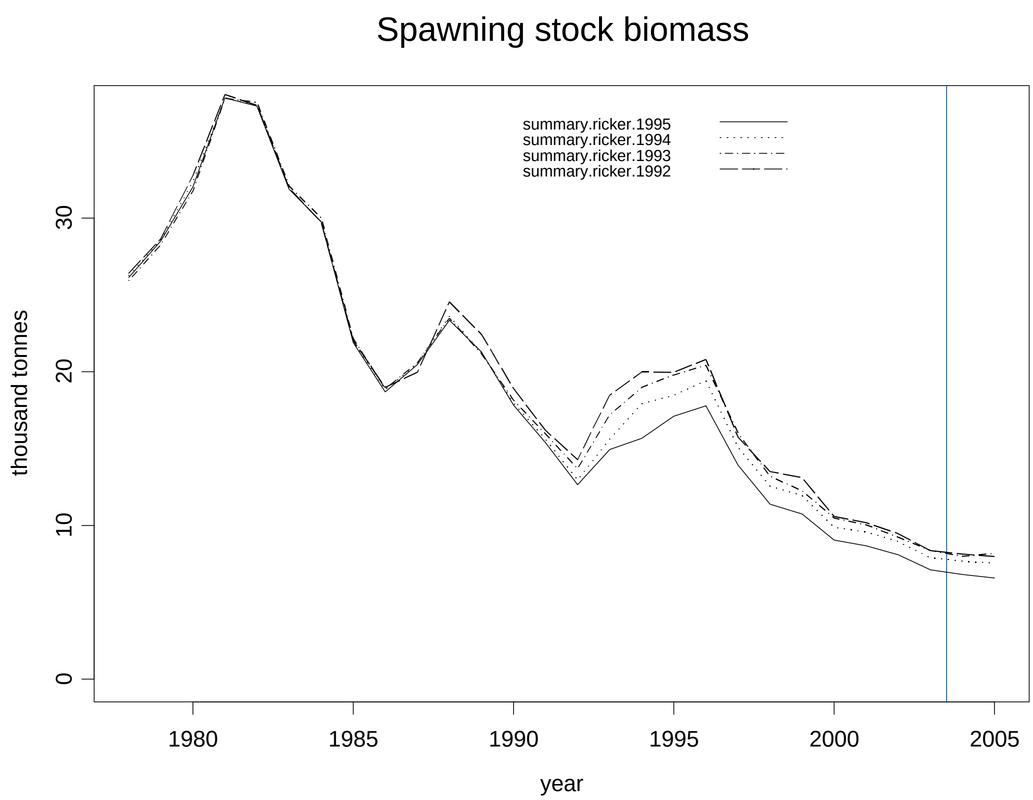
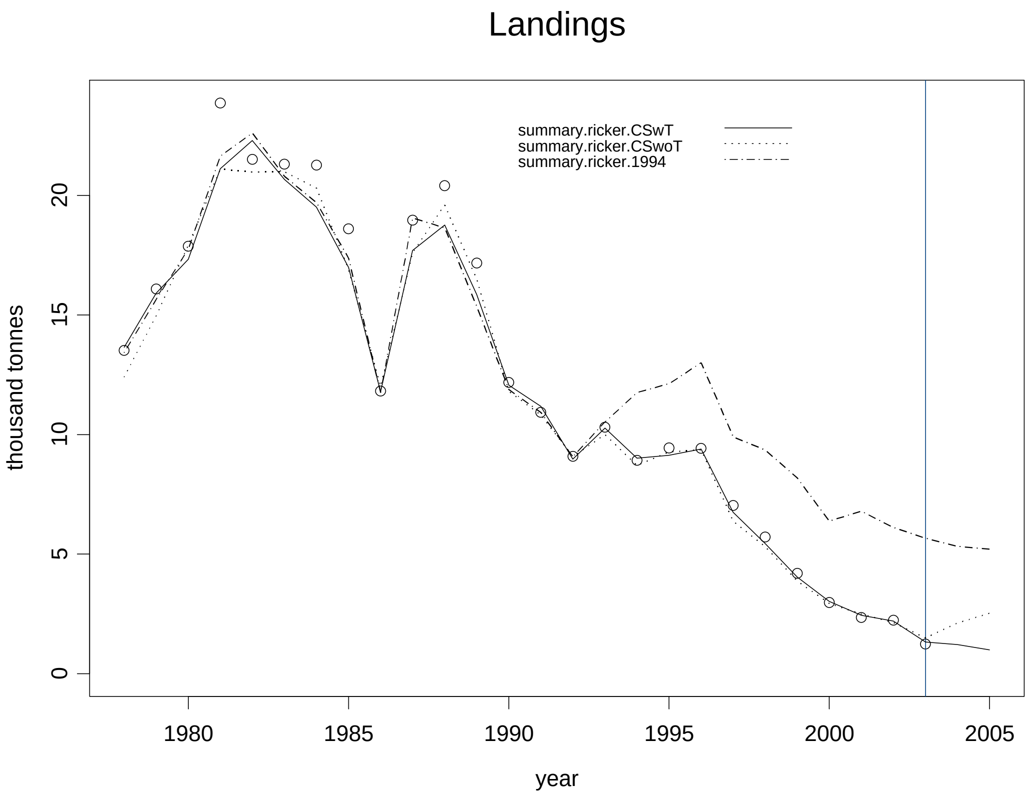


Figure 3.1.5.24 Cod in Division VIa. Comparison of TSA final runs.
a)



b)

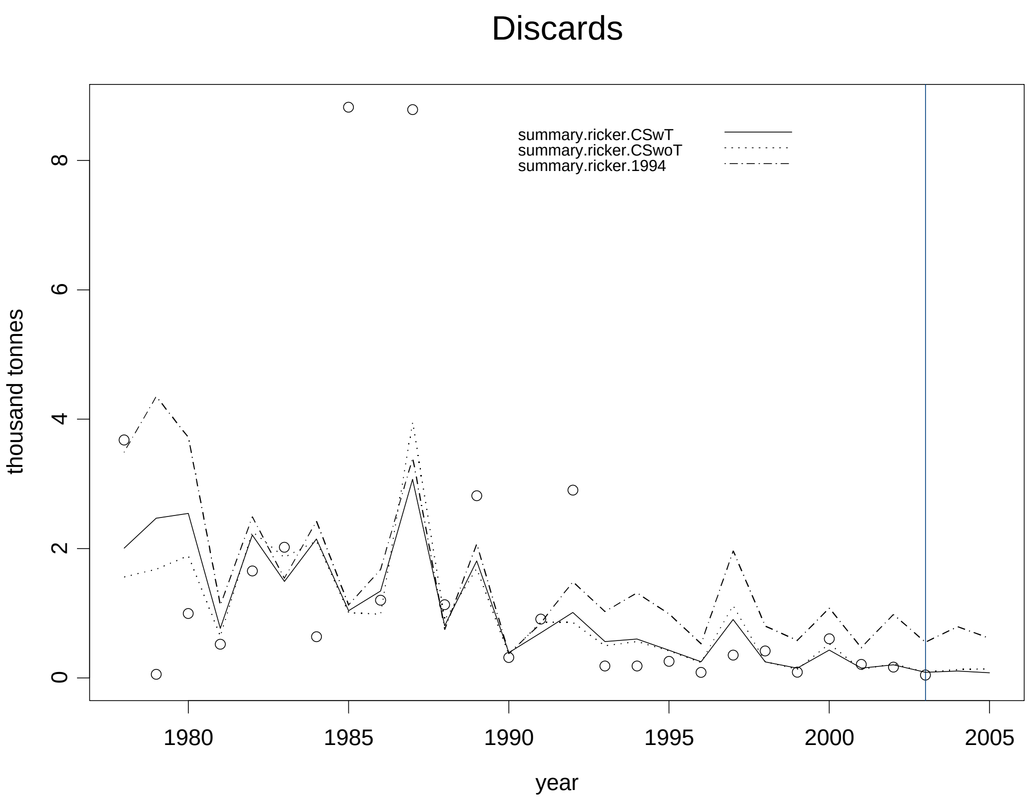


Figure 3.1.5.24 Cod in Division VIa. Comparison of TSA final runs.
c)

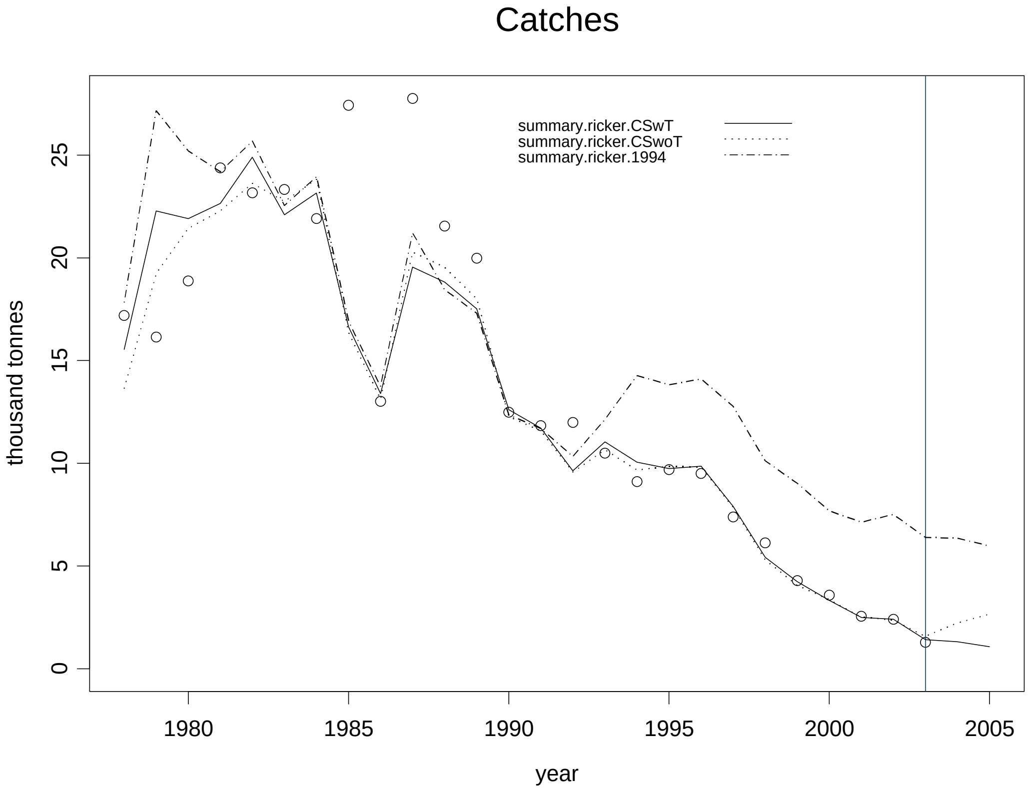
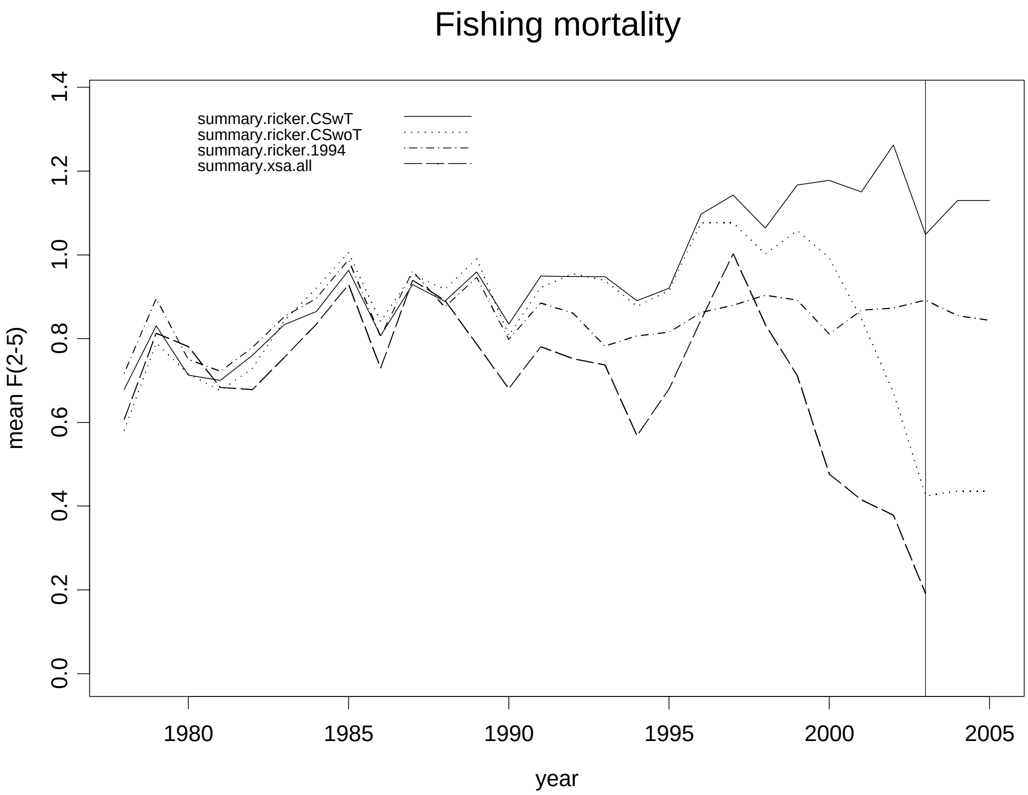


Figure 3.1.5.25 Cod in Division VIa. Comparison of estimates from the four final runs: 1) TSA with all catch data tuned with the scottish ground fish survey with an allowed trend in catchability ("summary.Ricker.CSwT"). 2) TSA with all catch data, tuned with the Scottish ground fish survey with no trend allowed in survey catchability ("summary.Ricker.CSwoT"). 3) TSA with catch data removed from 1994 tuned to the Scottish ground fish survey with no trend allowed in survey catchability ("summary.Ricker.1994"). 4) XSA with all catch data and survey data up to 2003 ("summary xsa.all").

a)

Figure 3.1.5.25 Cod in Division VIa. Comparison of estimates from the four final runs.
b)



c)

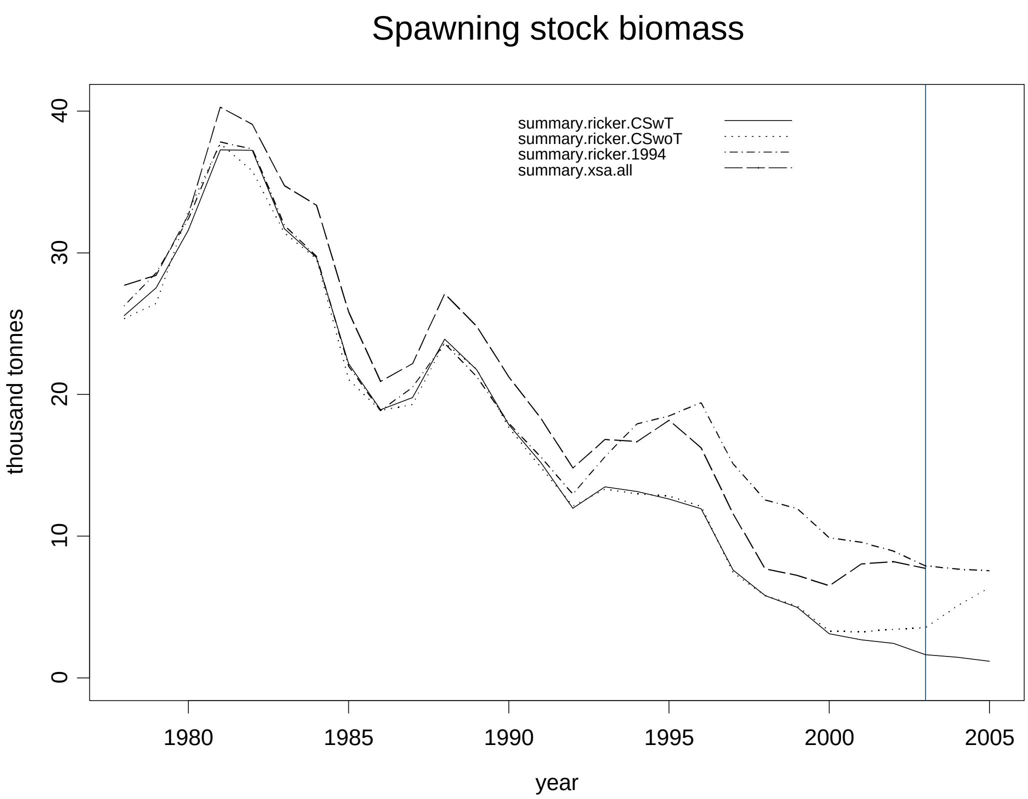


Figure 3.1.5.26 Cod in Division VIa. Summary output of final run 1. +/- 2 standard errors are plotted as dotted lines or bars.

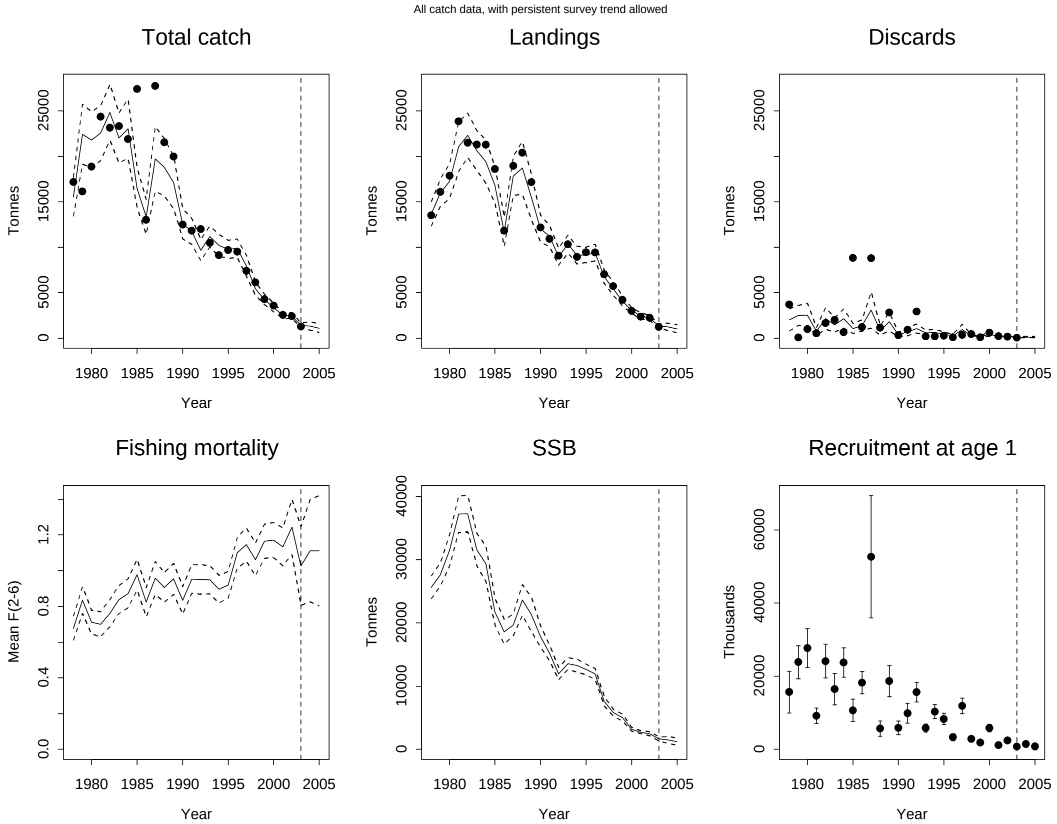


Figure 3.1.5.27 Cod in Division VIa. Final run 1. Fitted Ricker stock-recruit relationship.

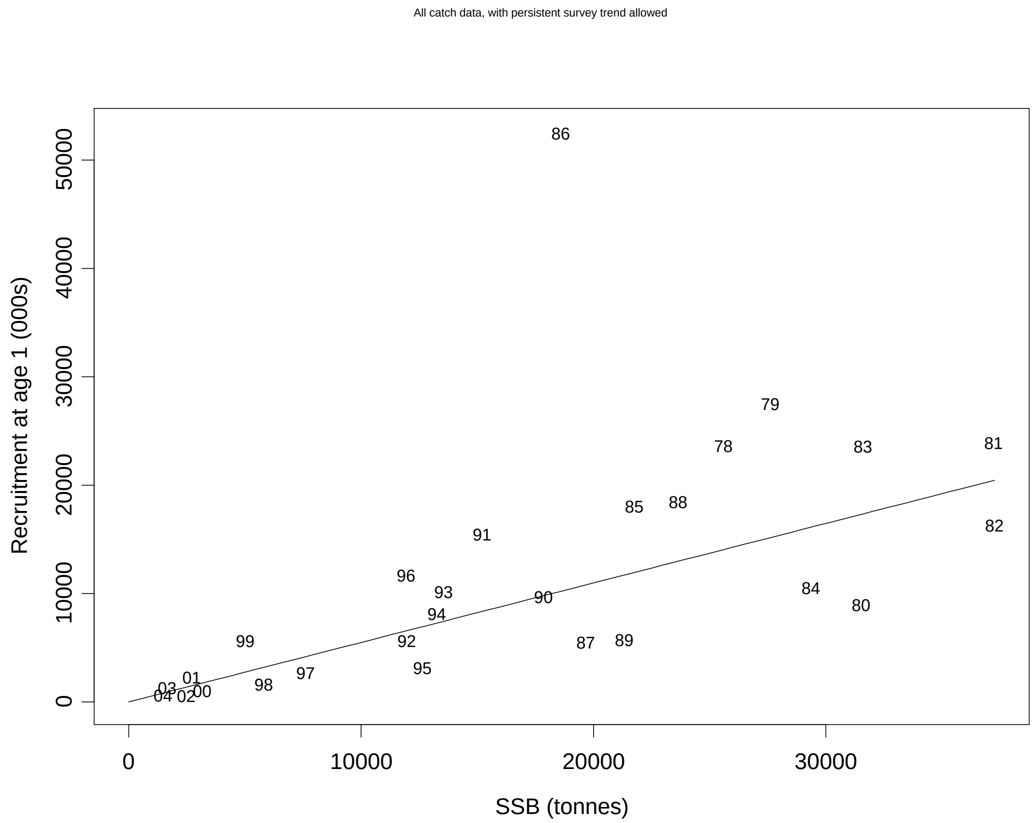


Figure 3.1.5.28 Cod in Division VIa. Final run 1 diagnostics.

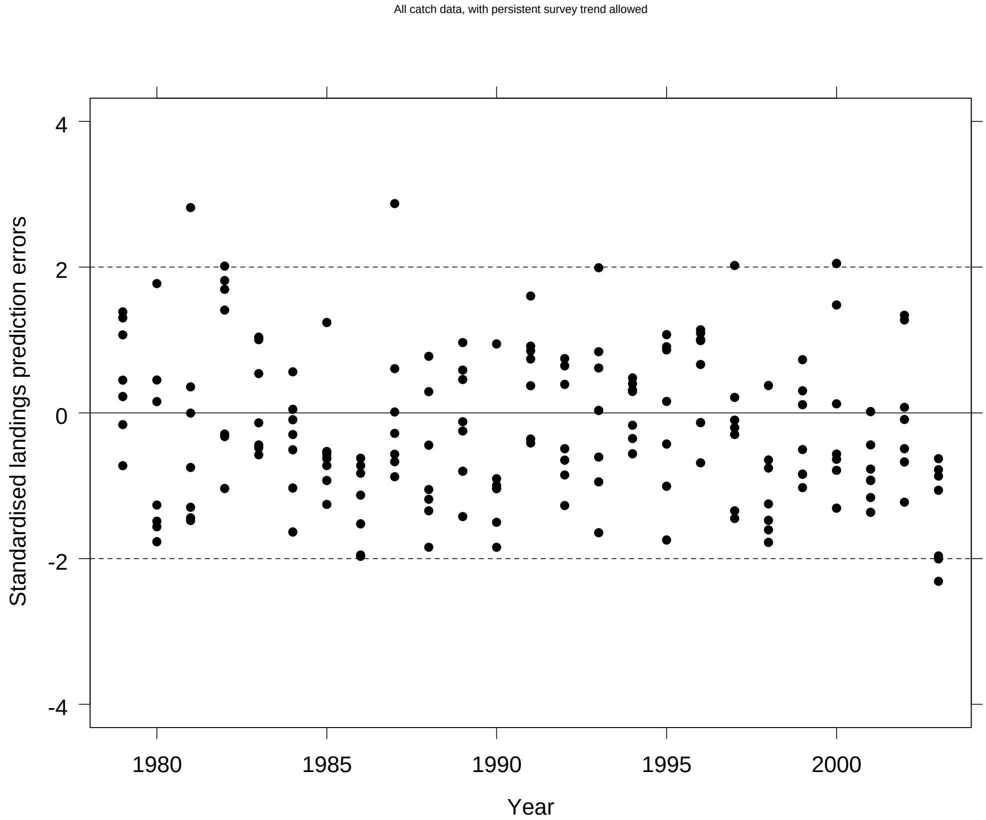


Figure 3.1.5.29 Cod in Division VIa. Final run 1 diagnostics.

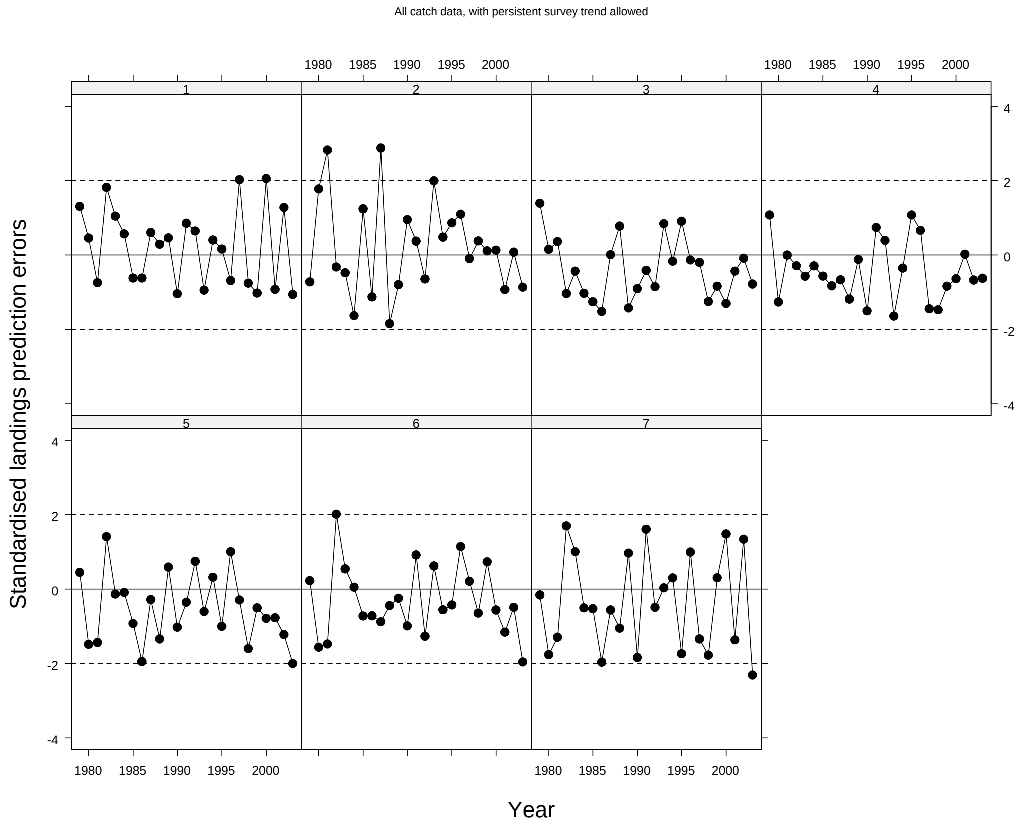


Figure 3.1.5.30 Cod in Division VIa. Final run 1 diagnostics.

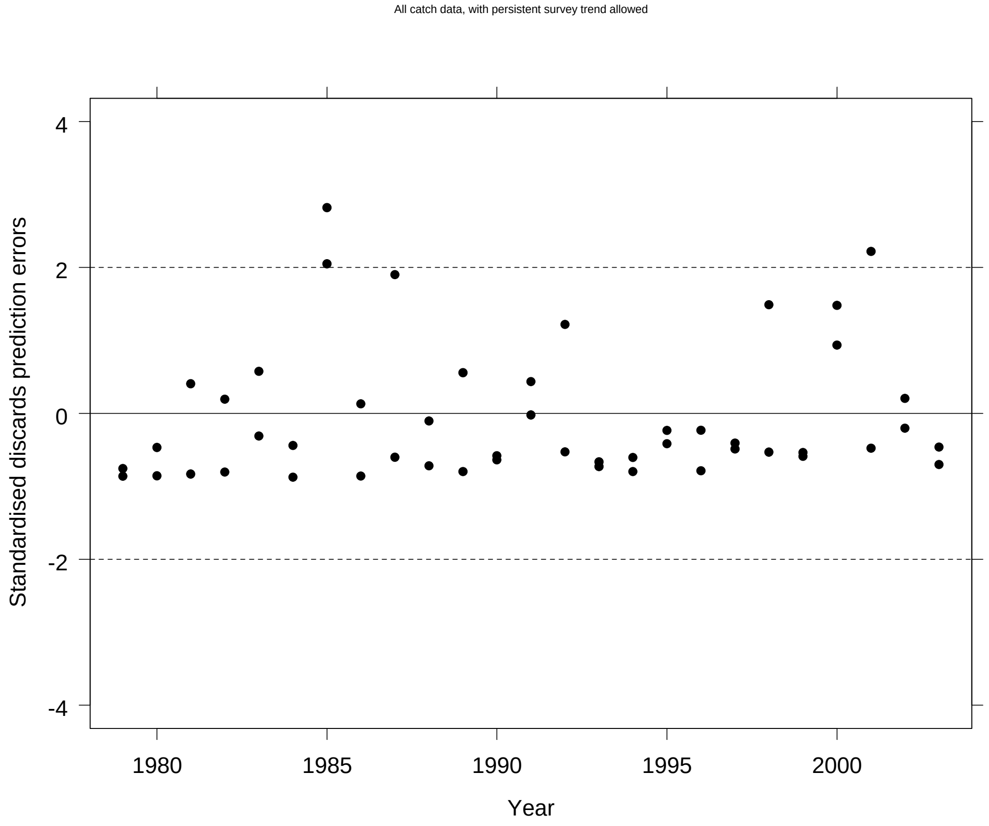


Figure 3.1.5.31 Cod in Division VIa. Final run 1 diagnostics.

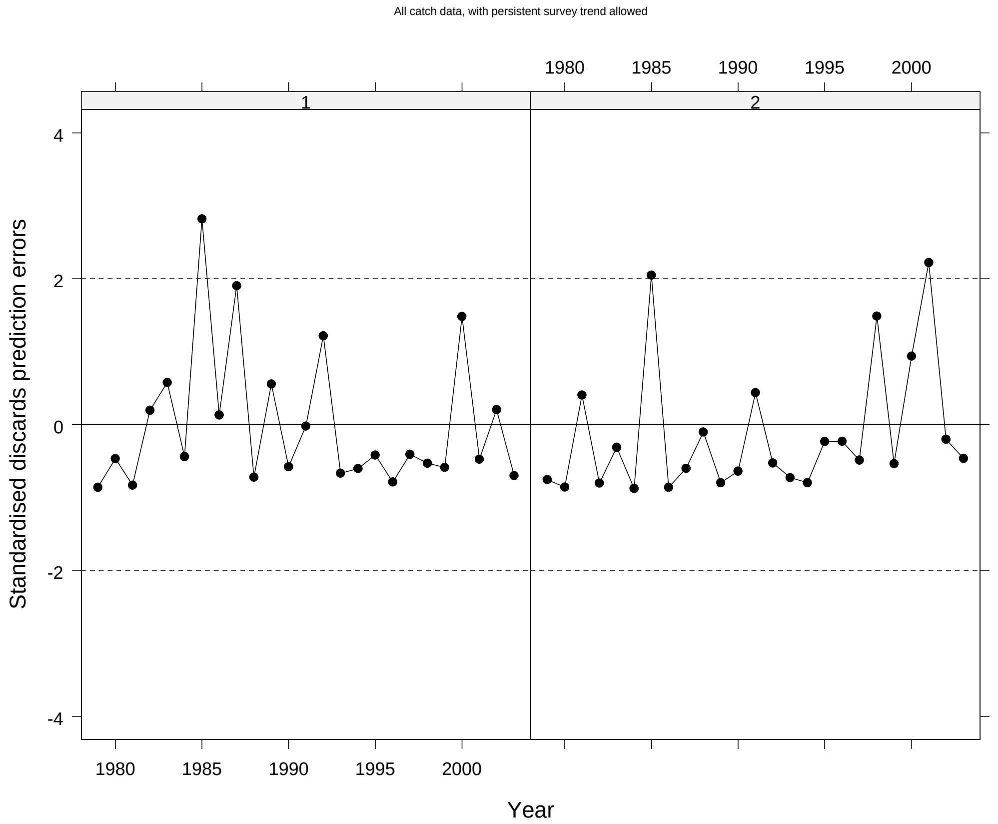


Figure 3.1.5.32 Cod in Division VIa. Final run 1 diagnostics.

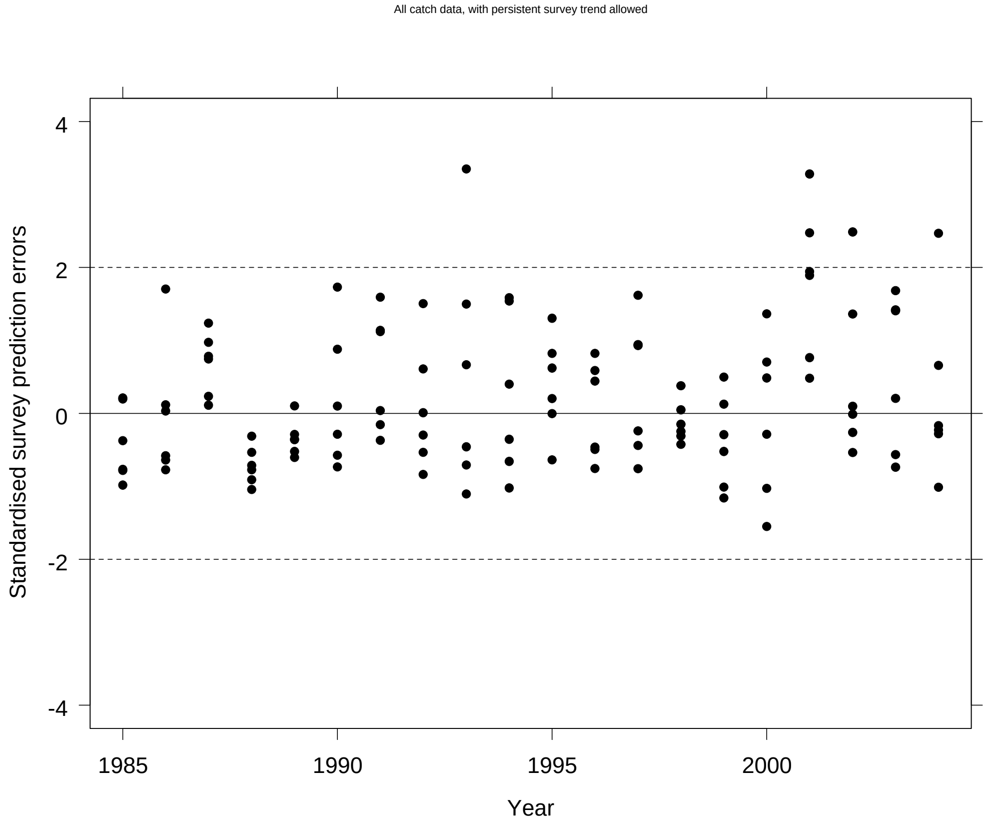


Figure 3.1.5.33 Cod in Division VIa. Final run 1 diagnostics.

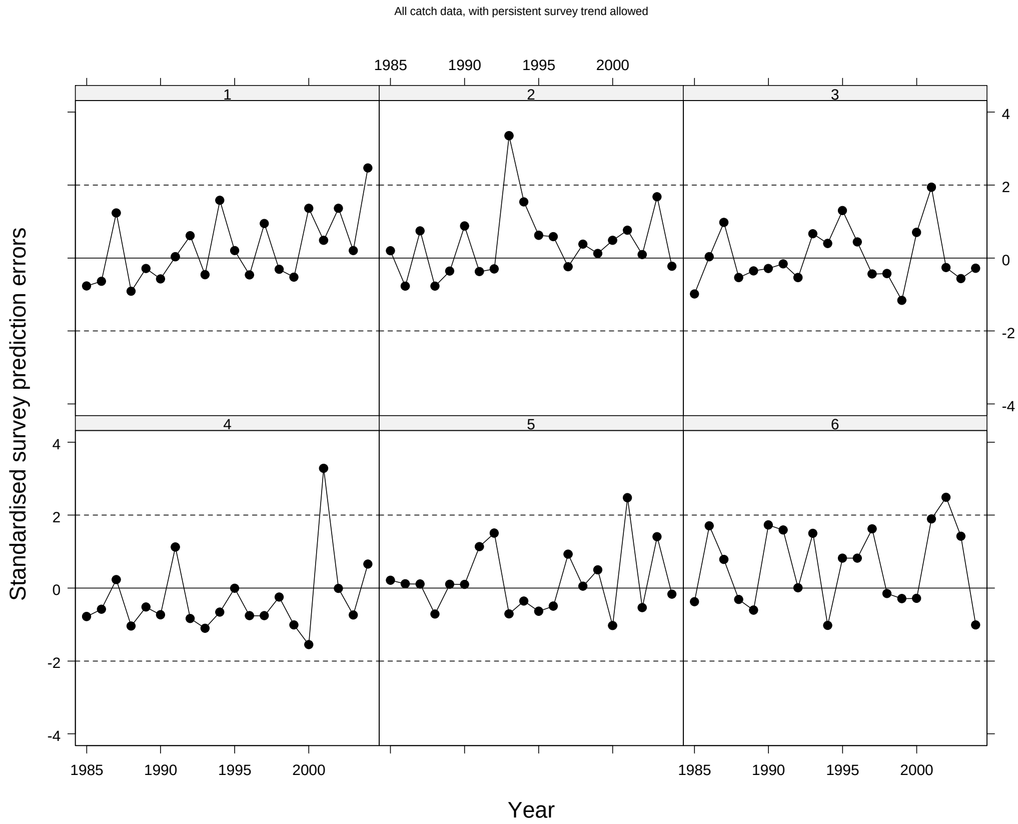


Figure 3.1.5.34 Cod in Division VIa. Final run 1 diagnostics. Estimated persistent and transient changes in survey catchability. Two standard errors are drawn around in dotted lines.

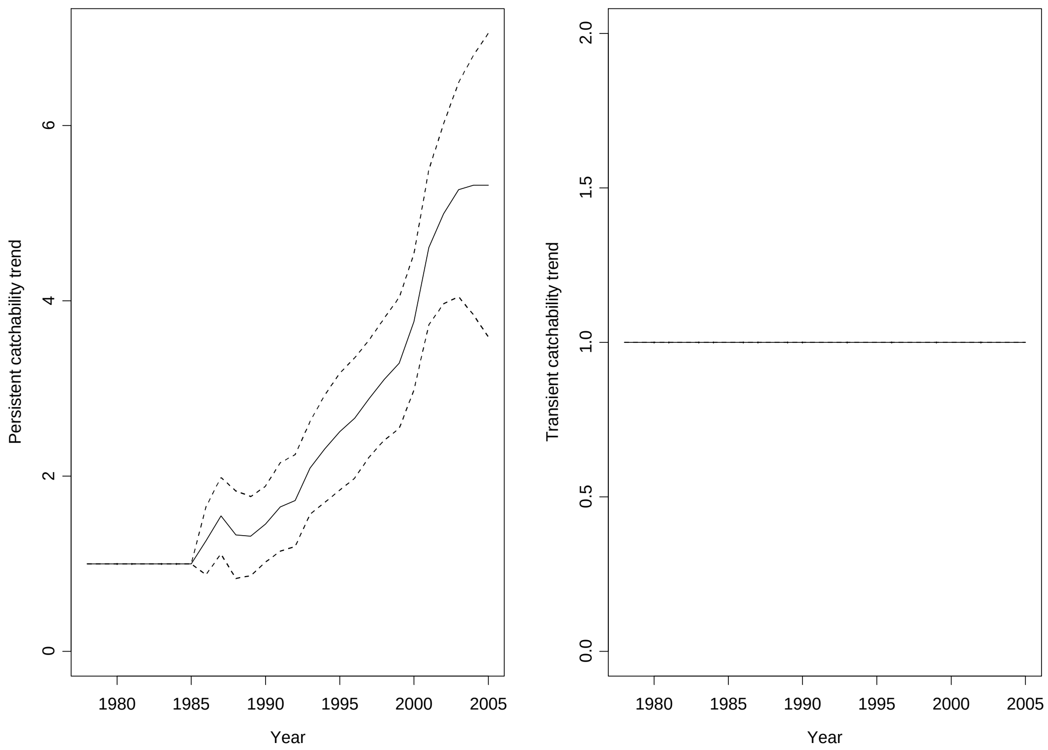


Figure 3.1.5.35 Cod in Division VIa. Final Run 1 diagnostics. TSA model fit to proportion discarded at ages one and two. Down-weighted points are filled black, and 2 standard errors are drawn around the fit.

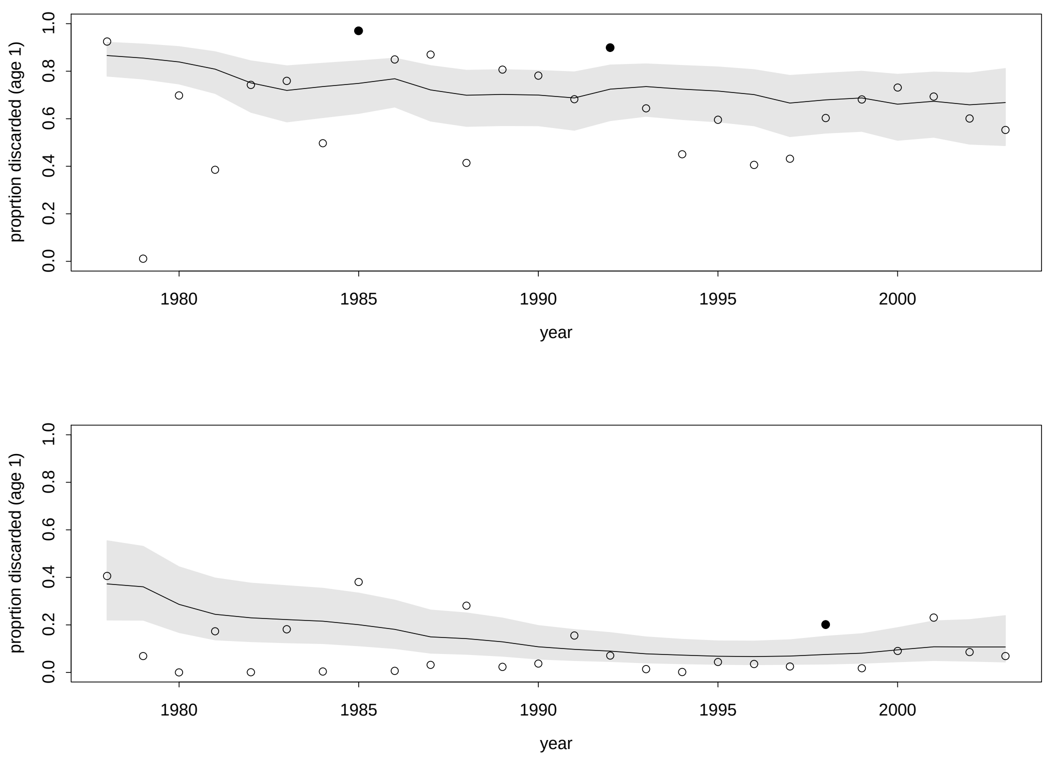


Figure 3.1.5.36 Cod in Division VIa. Final Run 1. F Retrospective plots.

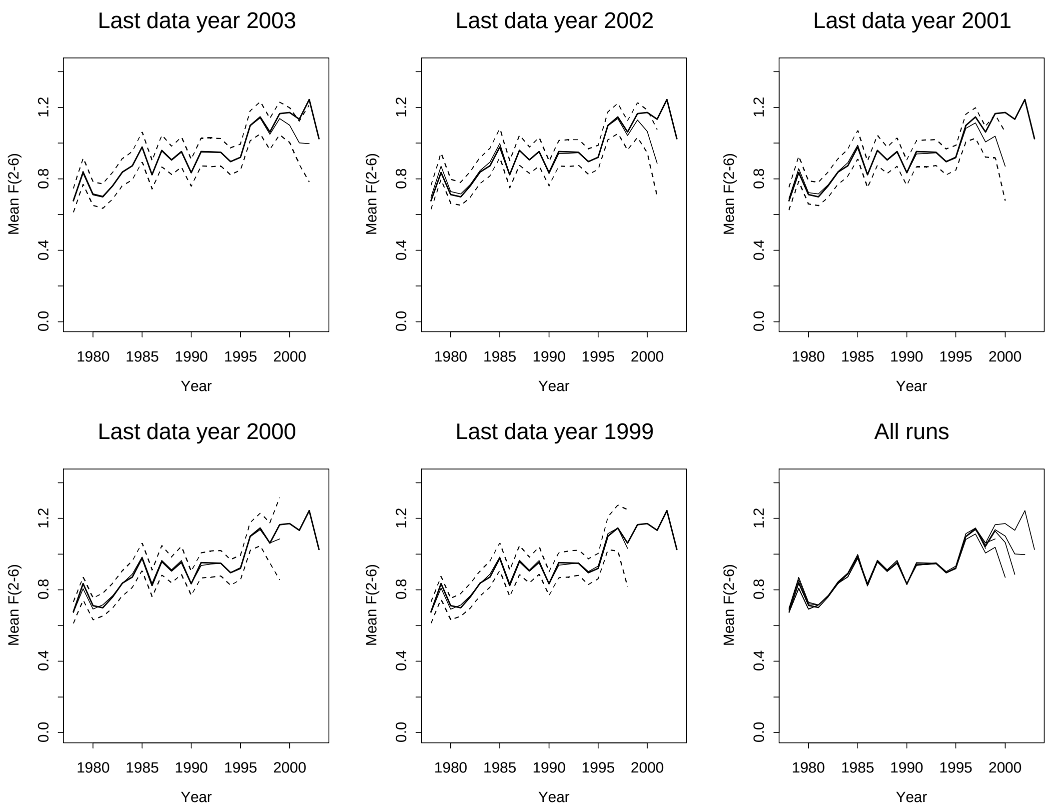


Figure 3.1.5.37 Cod in Division VIa. Final Run 1 diagnostics. Spawning stock biomass retrospective plots.

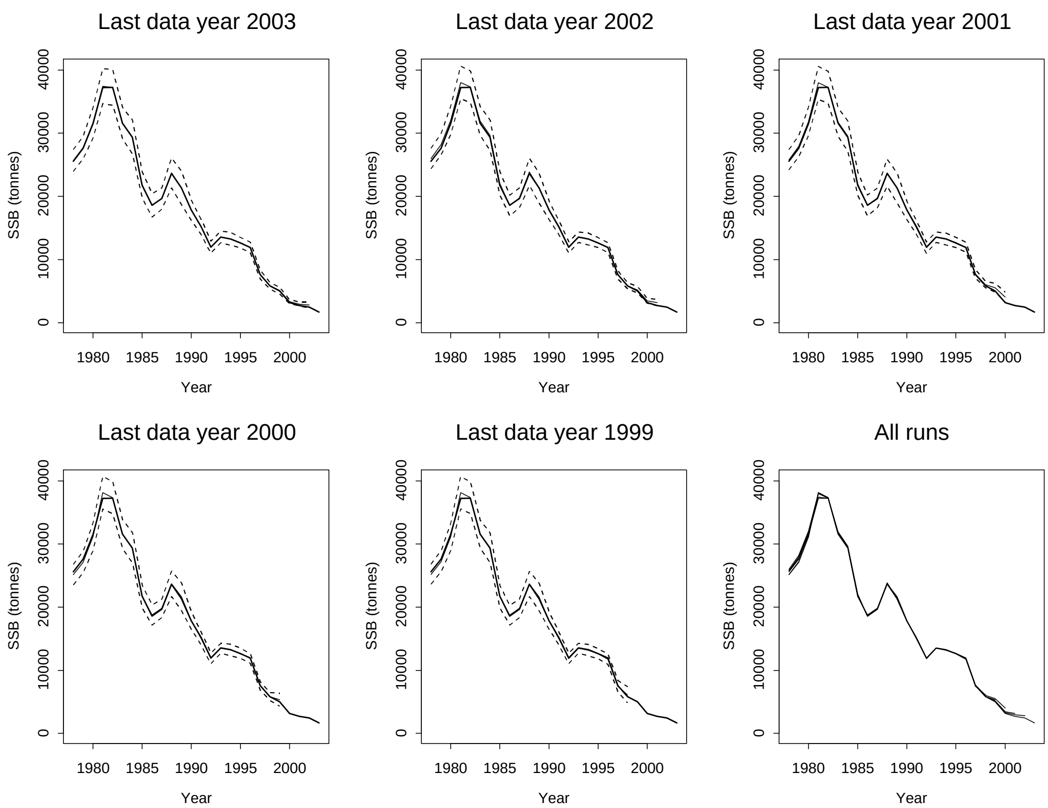


Figure 3.1.5.38 Cod in Division VIa. Summary output of final run 2. +/- 2 standard errors are plotted as dotted lines or bars.

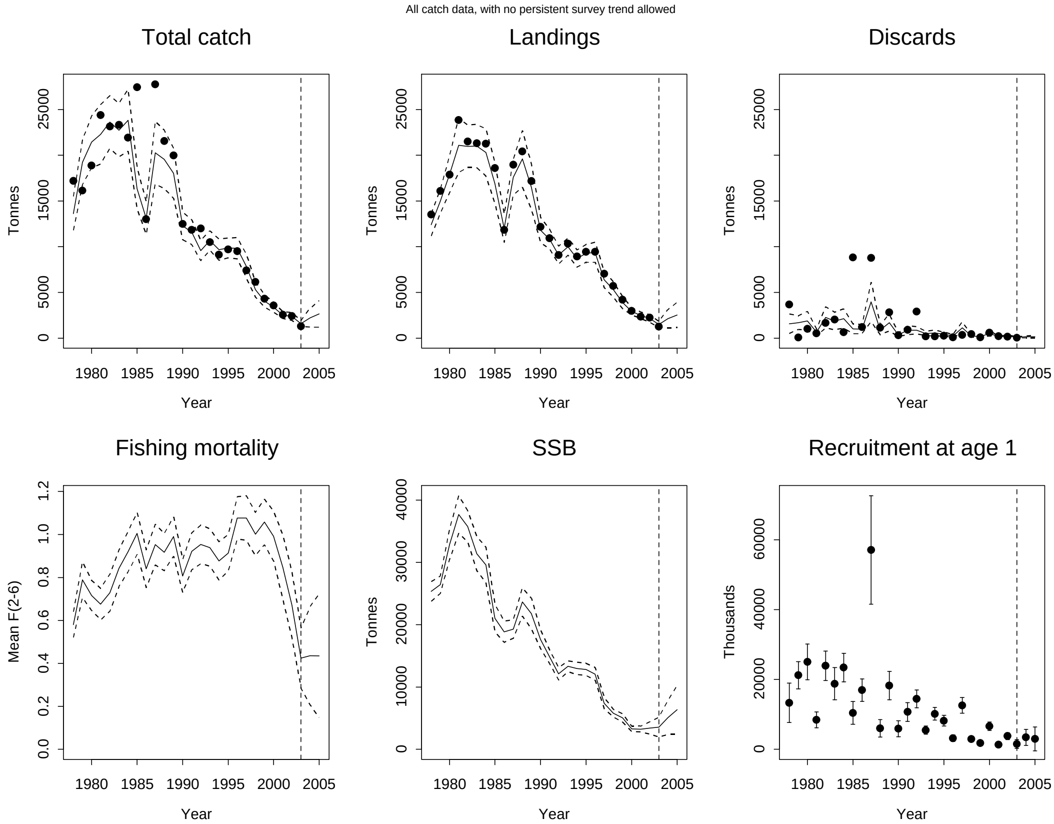


Figure 3.1.5.39 Cod in Division VIa. Final run 2. Fitted Ricker stock-recruit relationship.

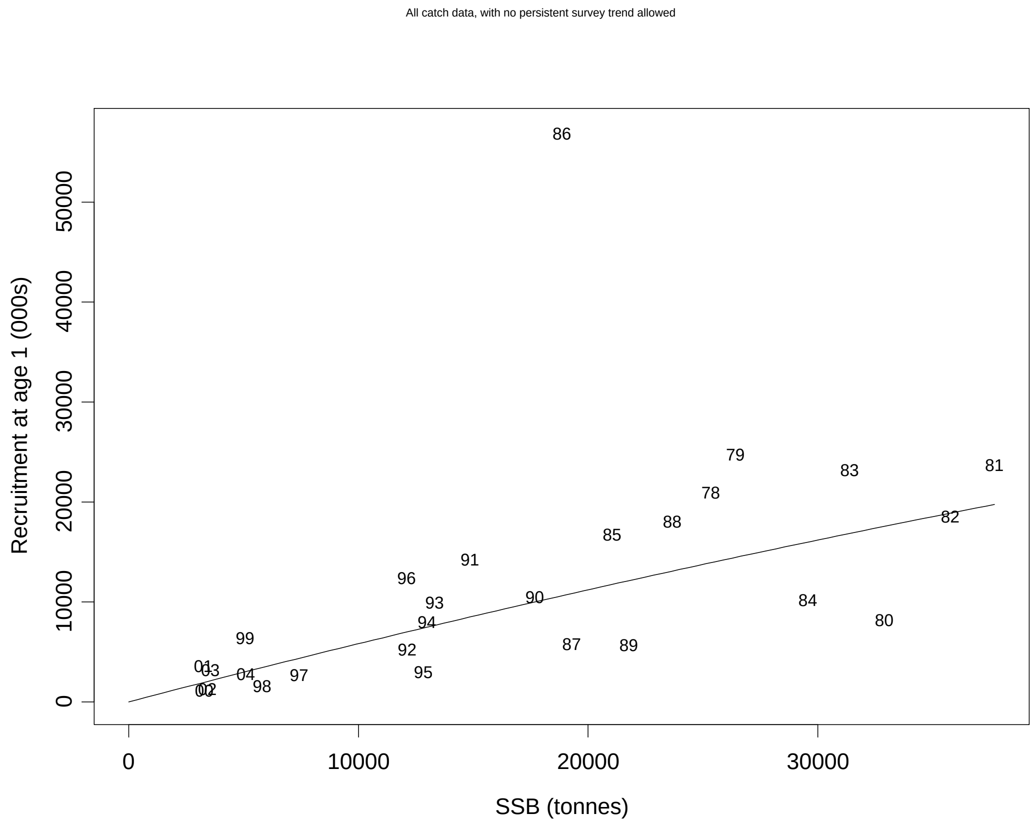


Figure 3.1.5.40 Cod in Division VIa. Final run 2 diagnostics.

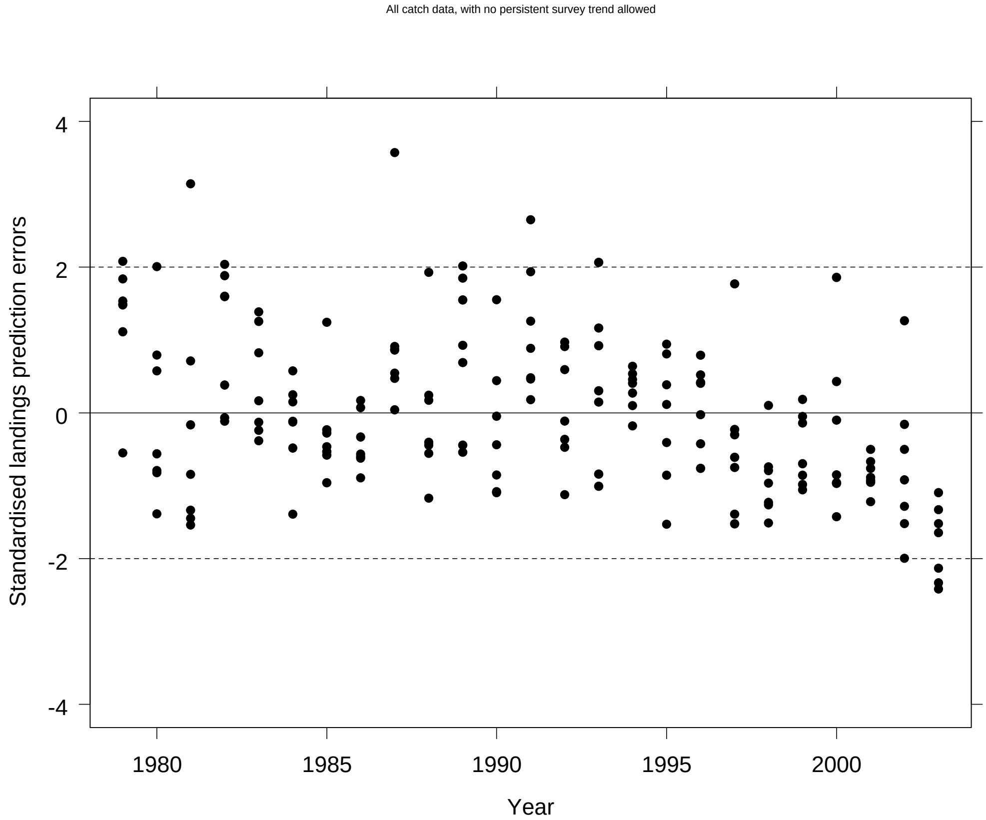


Figure 3.1.5.41 Cod in Division VIa. Final run 2 diagnostics.

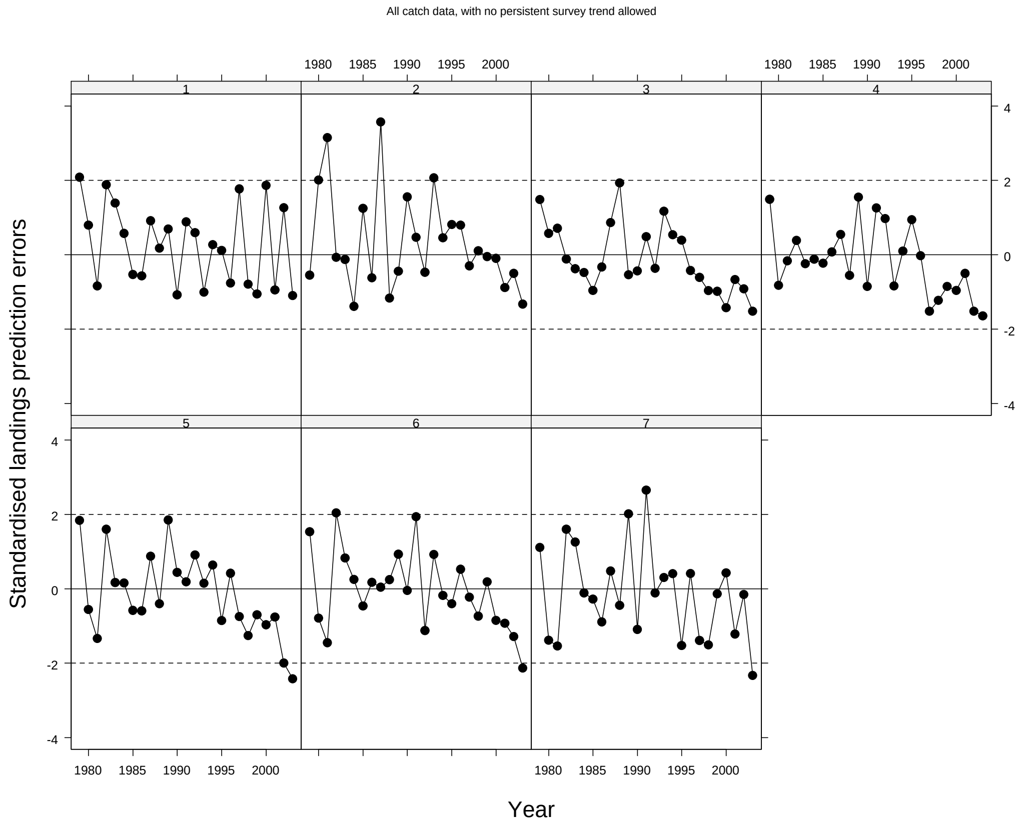


Figure 3.1.5.42 Cod in Division VIa. Final run 2 diagnostics.

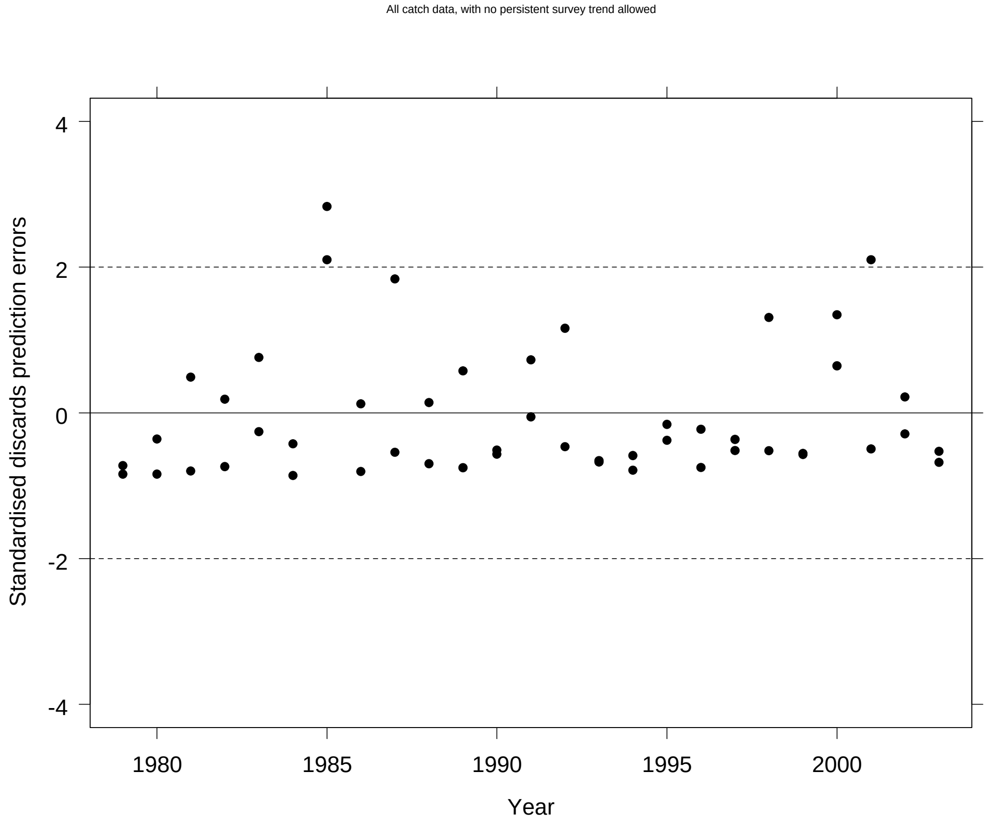


Figure 3.1.5.43 Cod in Division VIa. Final run 2 diagnostics.

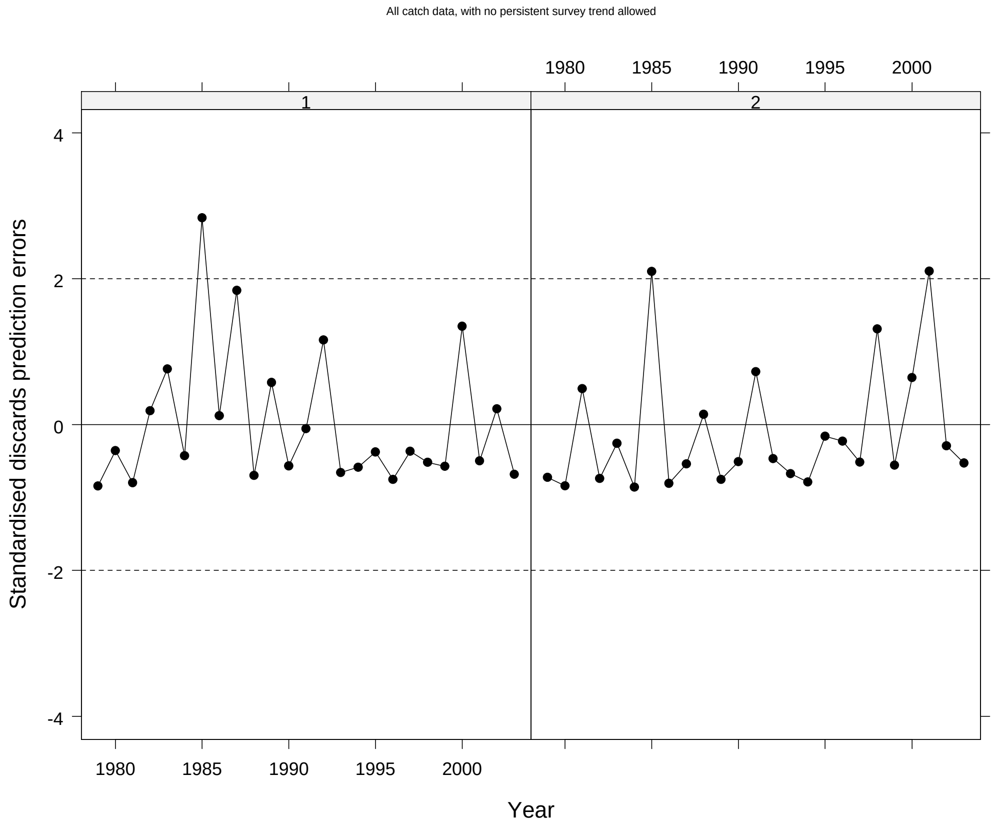


Figure 3.1.5.44 Cod in Division VIa. Final run 2 diagnostics.

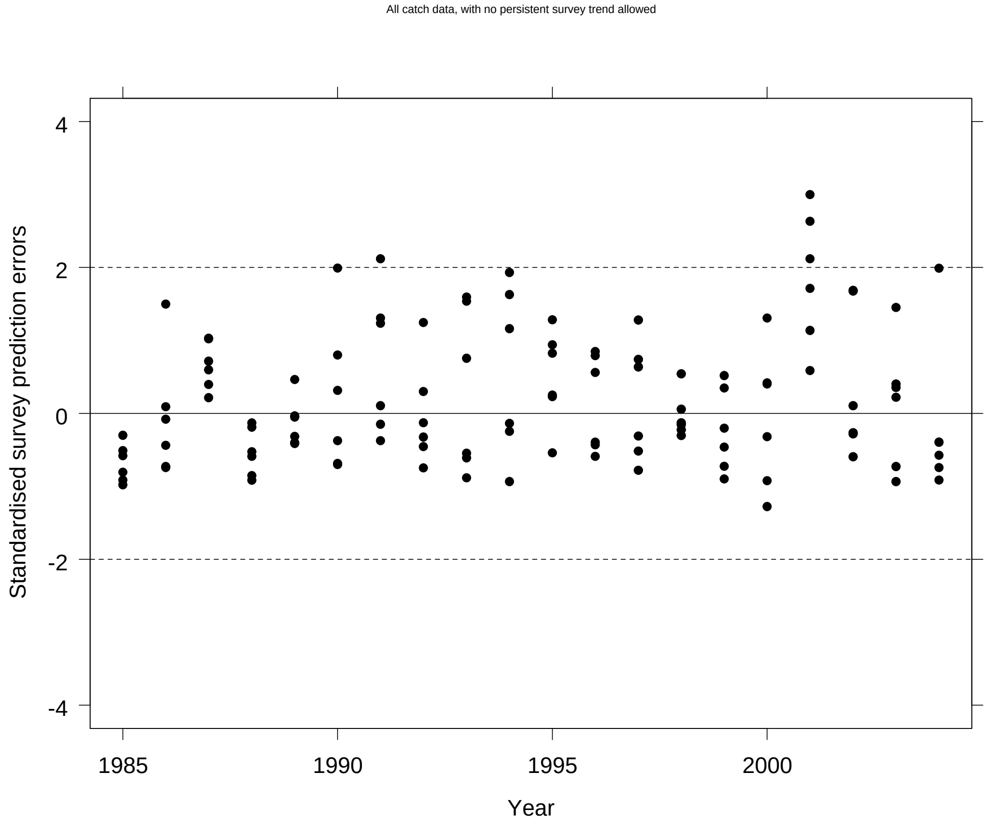


Figure 3.1.5.45 Cod in Division VIa. Final run 2 diagnostics.

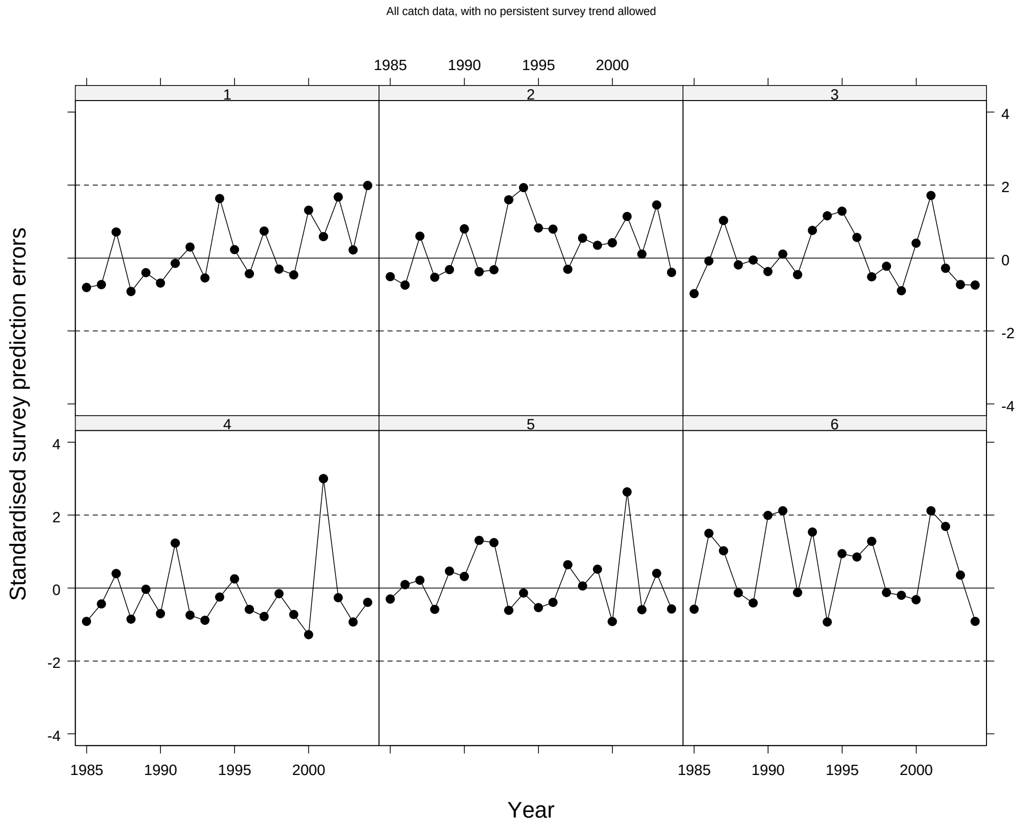


Figure 3.1.5.46 Cod in Division VIa. Final run 2 diagnostics. Estimated persistent and transient changes in survey catchability. Two standard errors are drawn in dotted lines.

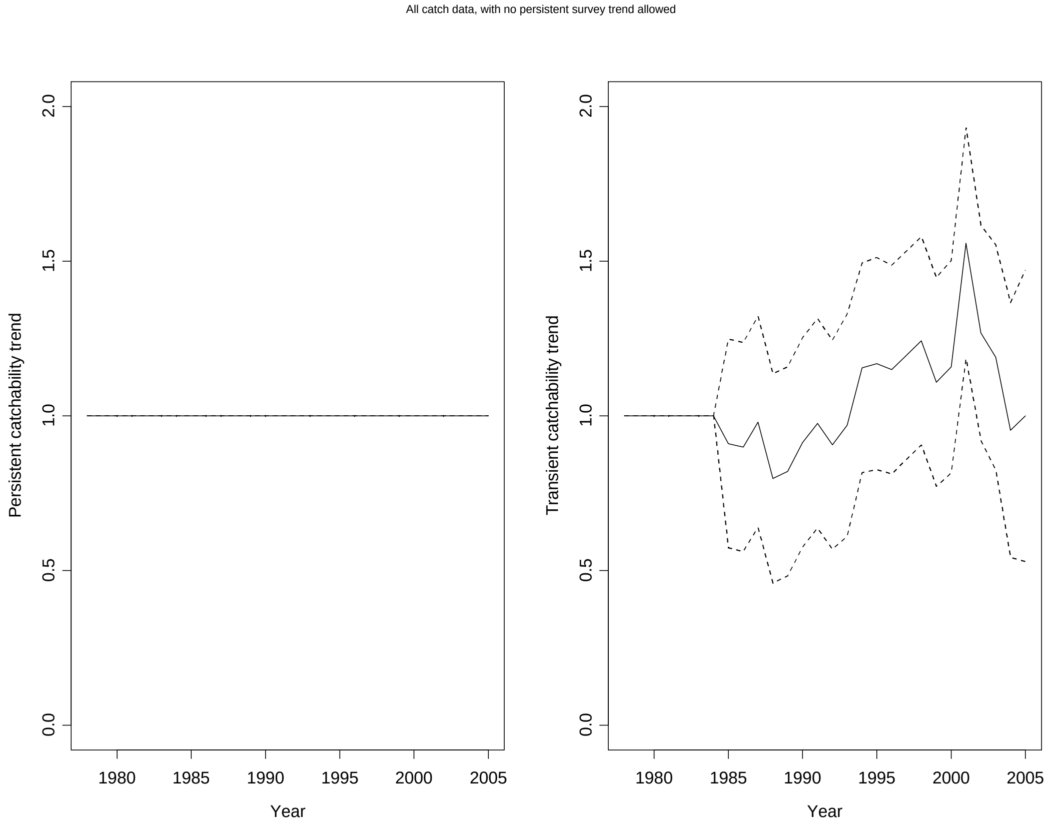


Figure 3.1.5.47 Cod in Division VIa. Final Run 2 diagnostics. TSA model fit to proportion discarded at ages one and two. Down-weighted points are filled black, and 2 standard errors are drawn around the fit.

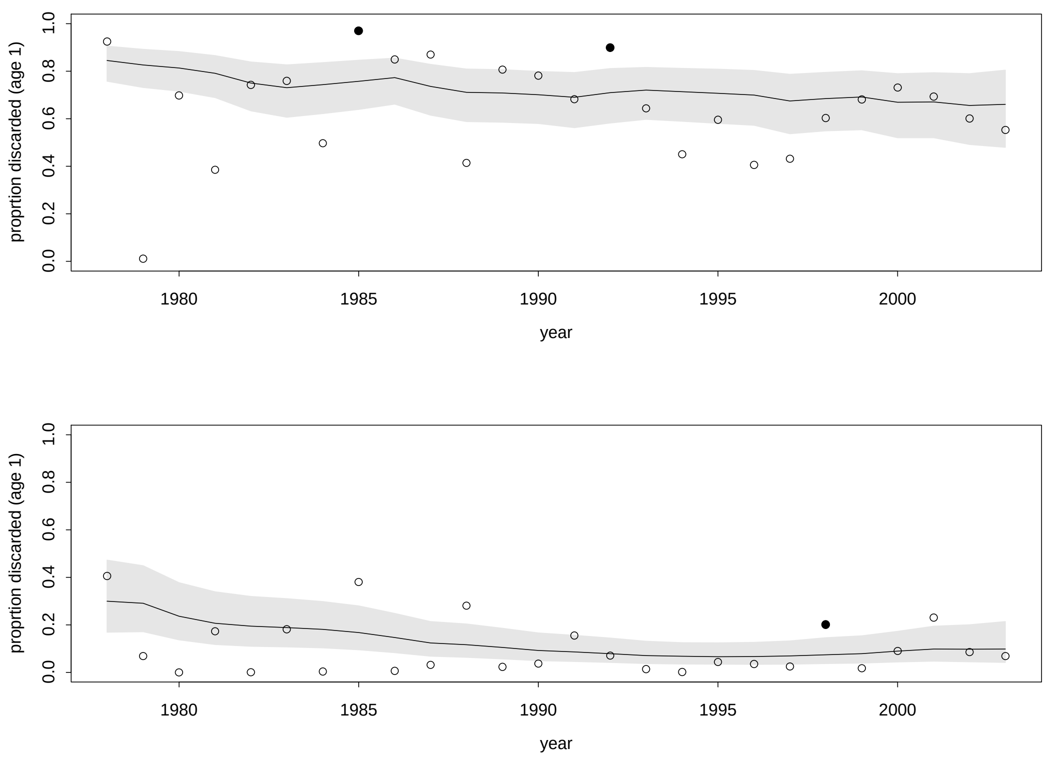


Figure 3.1.5.48 Cod in Division VIa. Final Run 2 diagnostics. Mean F(2-5) retrospective plots.

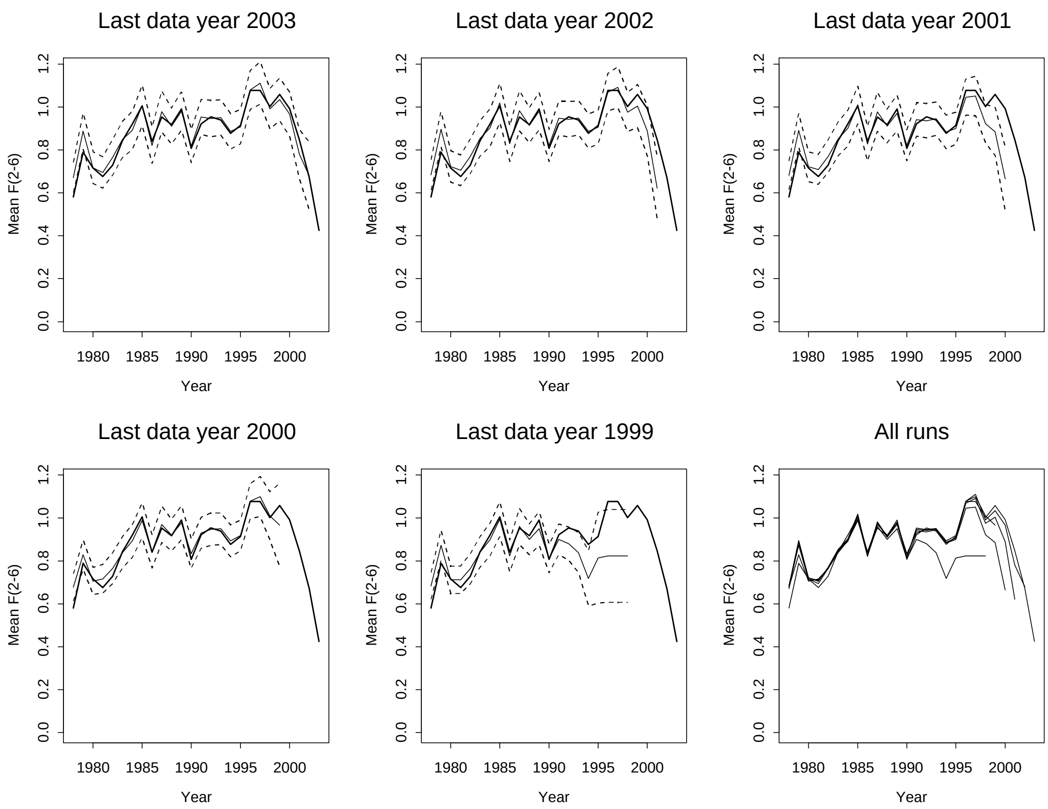


Figure 3.1.5.49 Cod in Division VIa. Final Run 2 diagnostics. Spawning stock biomass retrospective plots.

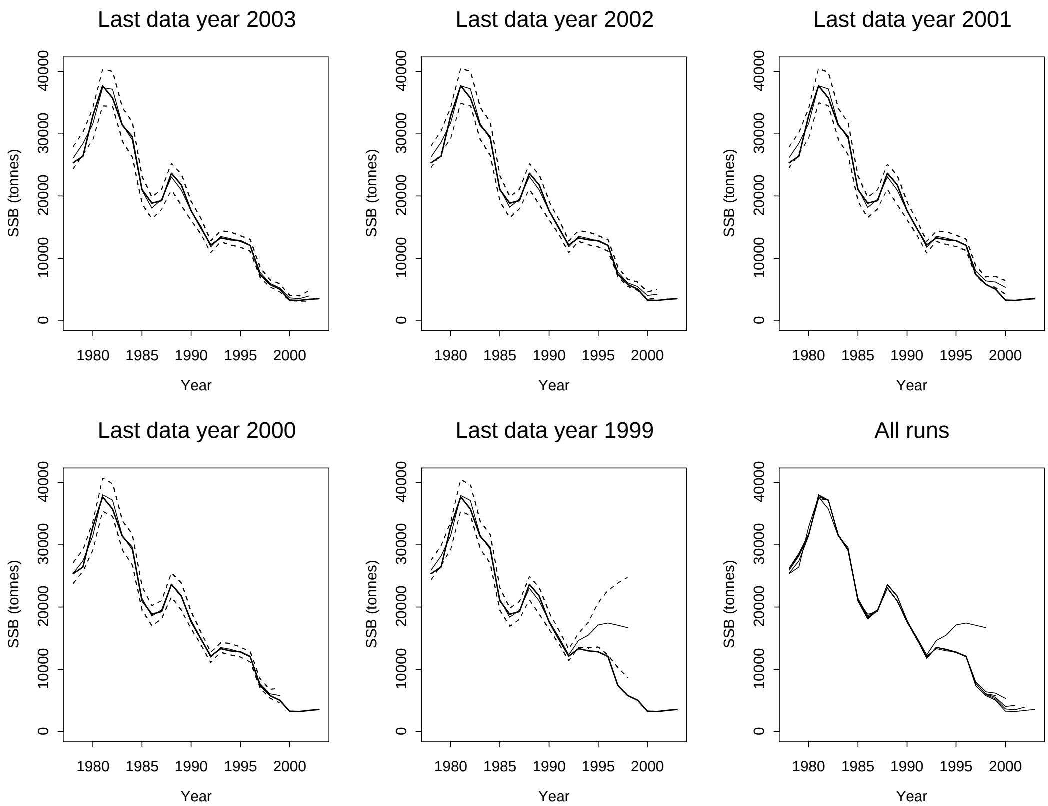


Figure 3.1.5.50 Cod in Division VIa. Summary output of final run 3. +/- 2 standard errors are plotted as dotted lines or bars.

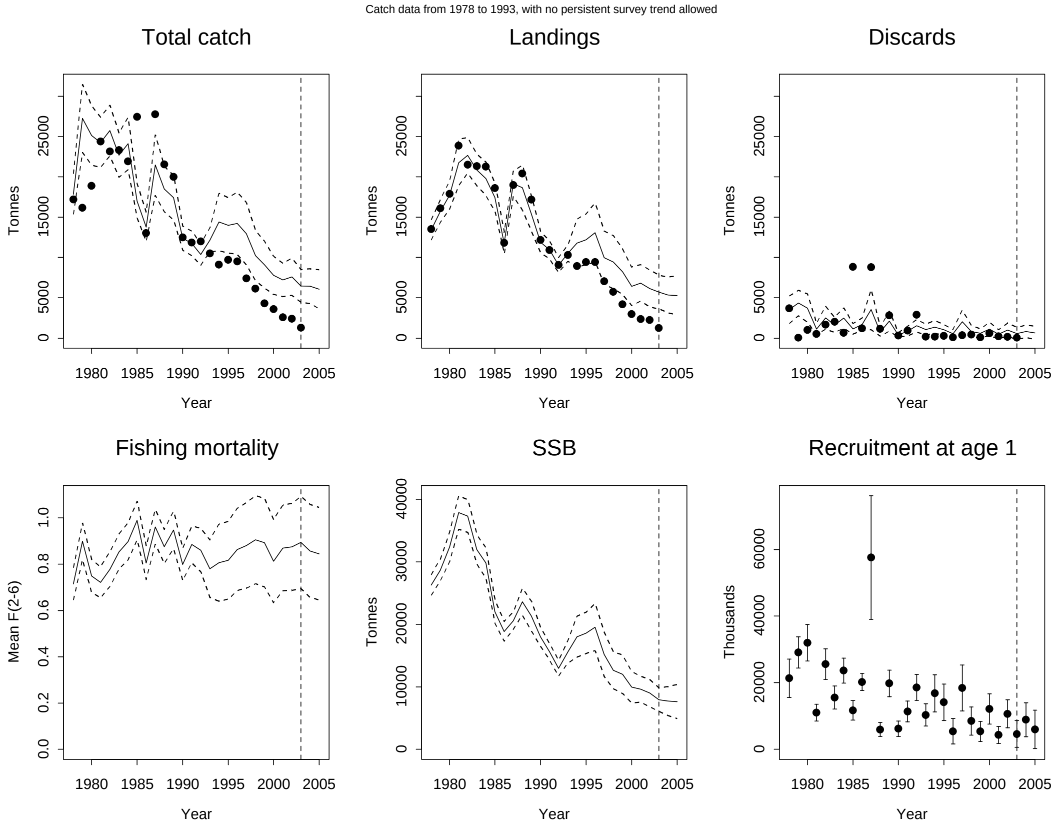


Figure 3.1.5.51 Cod in Division VIa. Final run 3. Fitted Ricker stock-recruit relationship.

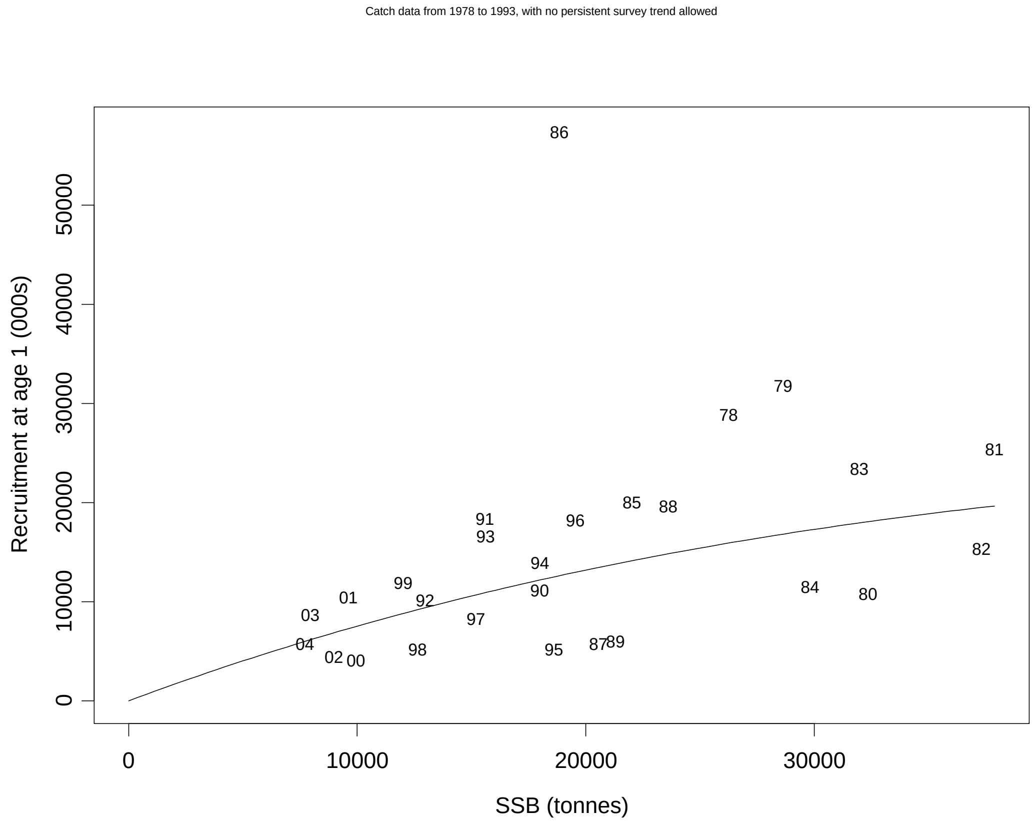


Figure 3.1.5.52 Cod in Division VIa. Final run 3 diagnostics.

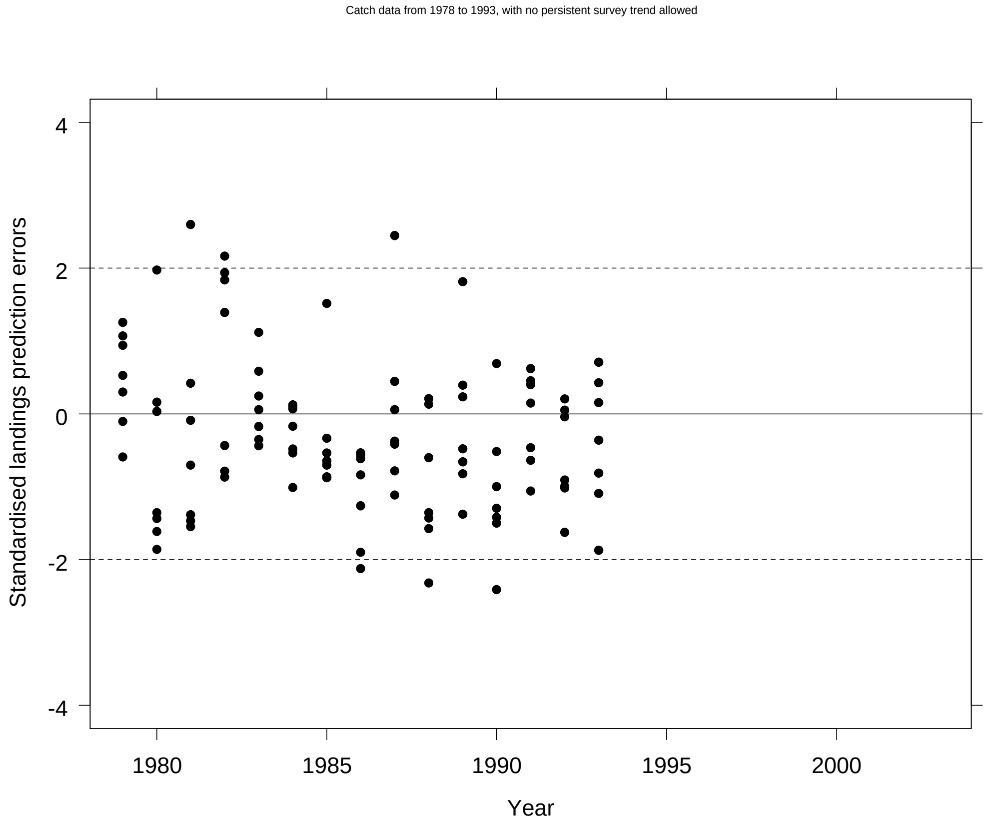


Figure 3.1.5.53 Cod in Division VIa. Final run 3 diagnostics.

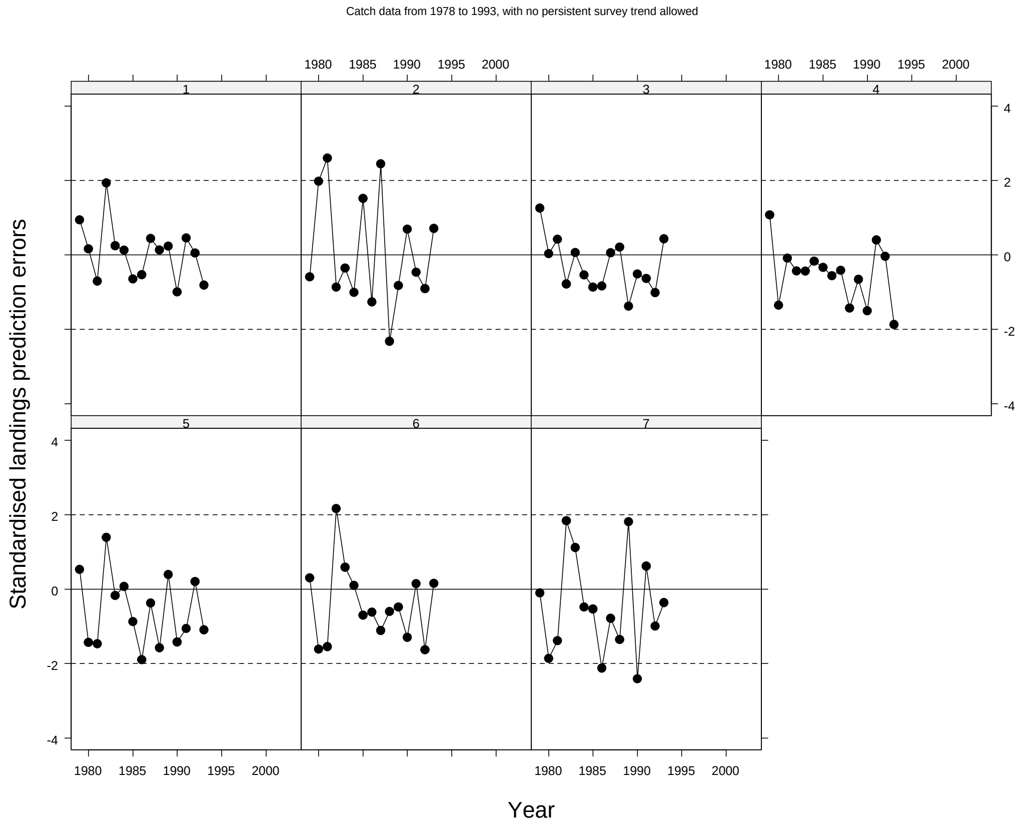


Figure 3.1.5.54 (a) Cod in Division VIa. Final run 3 diagnostics.

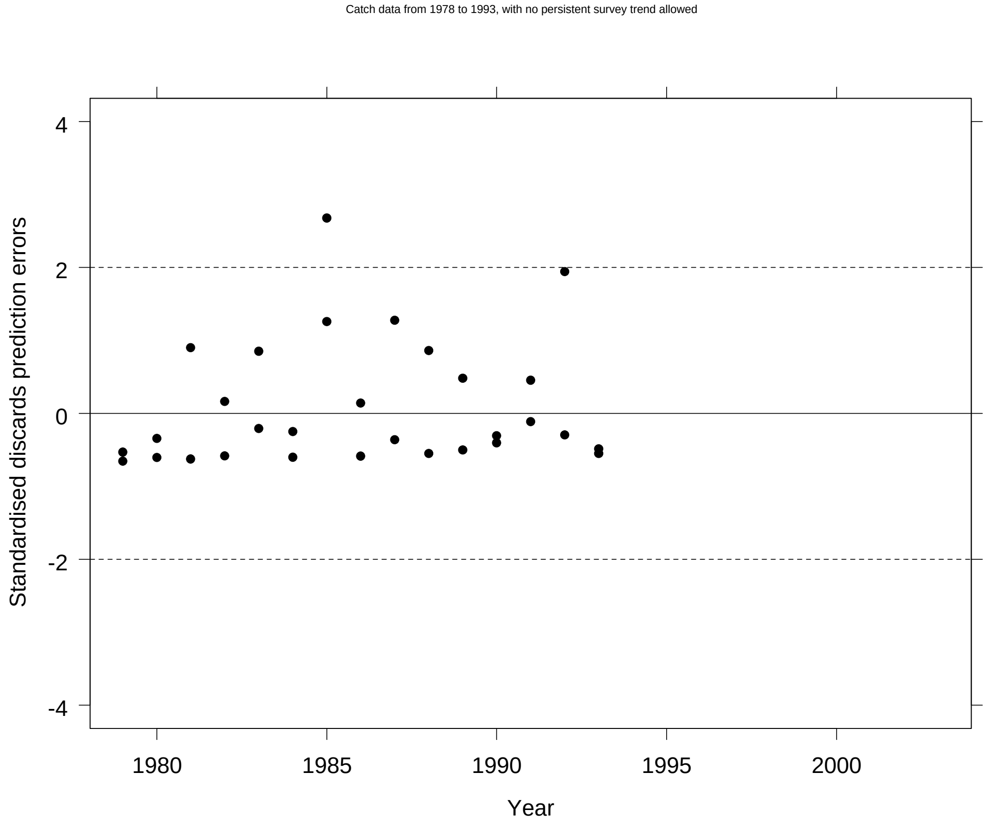


Figure 3.1.5.54 (b) Cod in Division VIa. Final run 3 diagnostics.

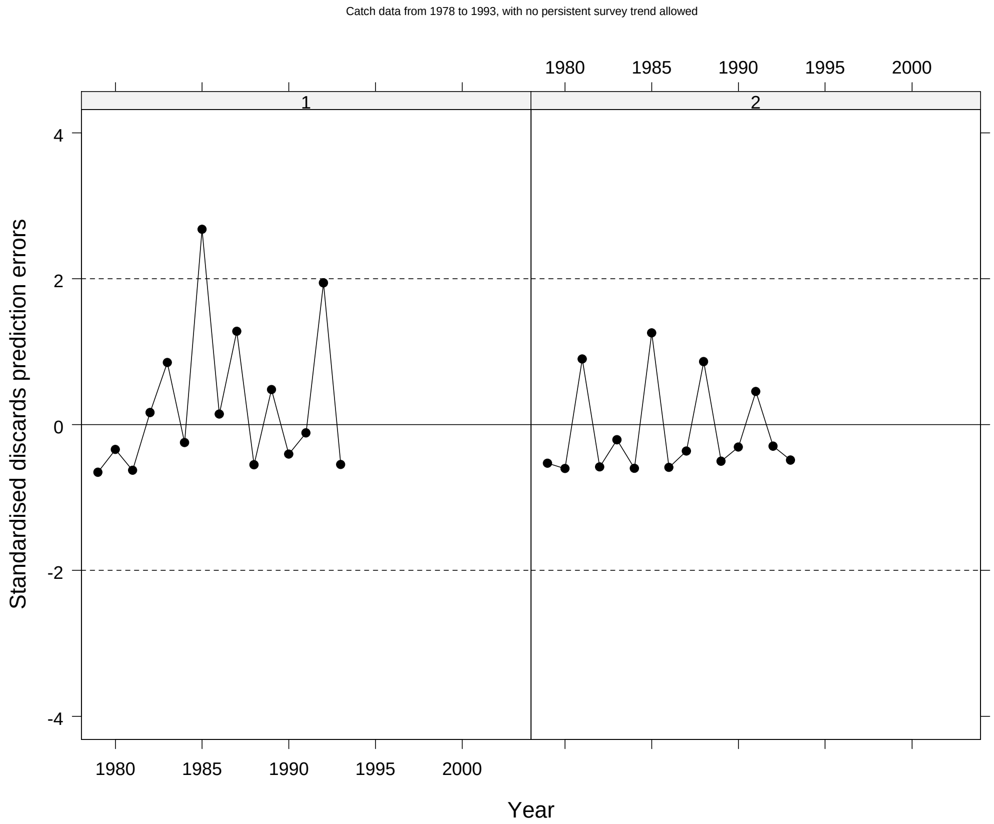


Figure 3.1.5.55 Cod in Division VIa. Final run 3 diagnostics.

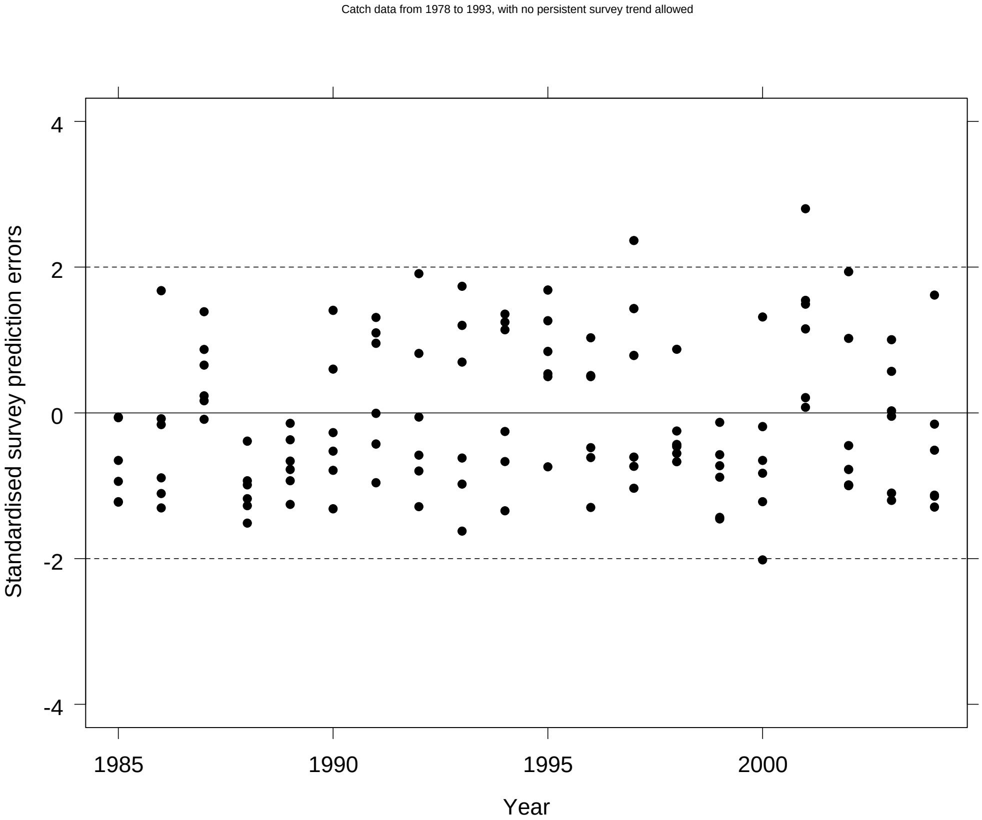


Figure 3.1.5.56 Cod in Division VIa. Final run 3 diagnostics.

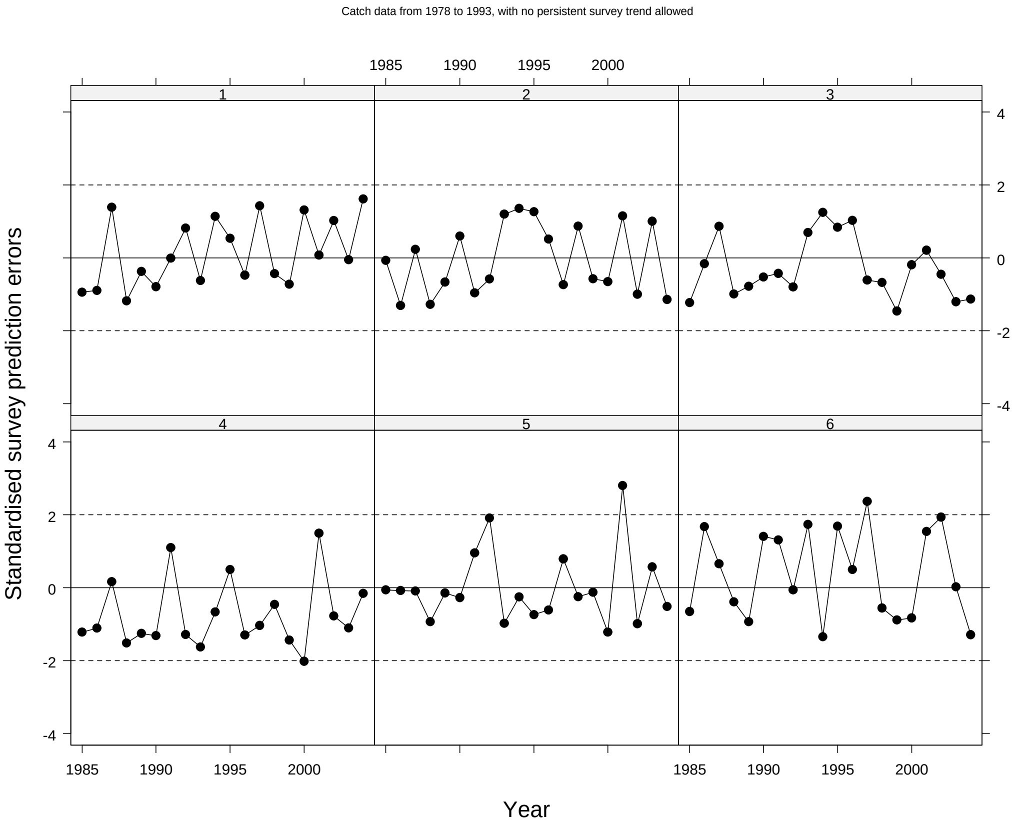


Figure 3.1.5.57 Cod in Division VIa. Final run 3 diagnostics. Note transient change includes persistent change.

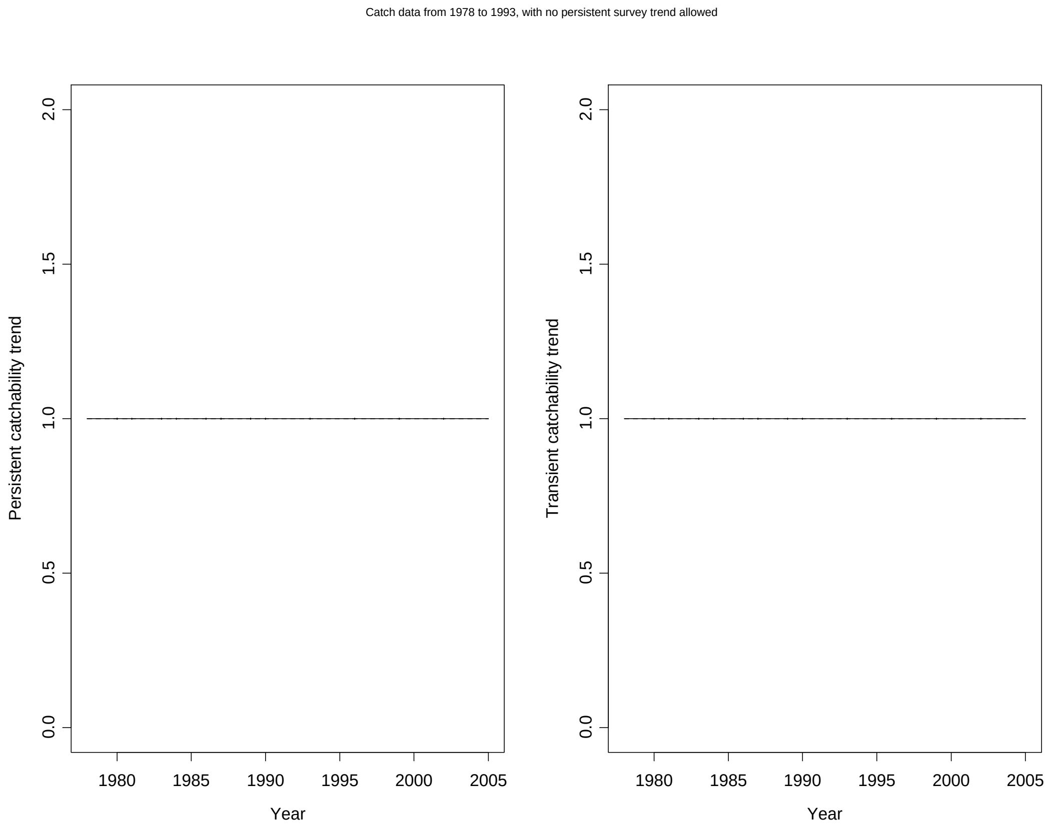


Figure 3.1.5.58 Cod in Division VIa. Final Run 3 diagnostics. TSA model fit to proportion discarded at ages one and two. Down-weighted points are filled black, and 2 standard errors are drawn around the fit.

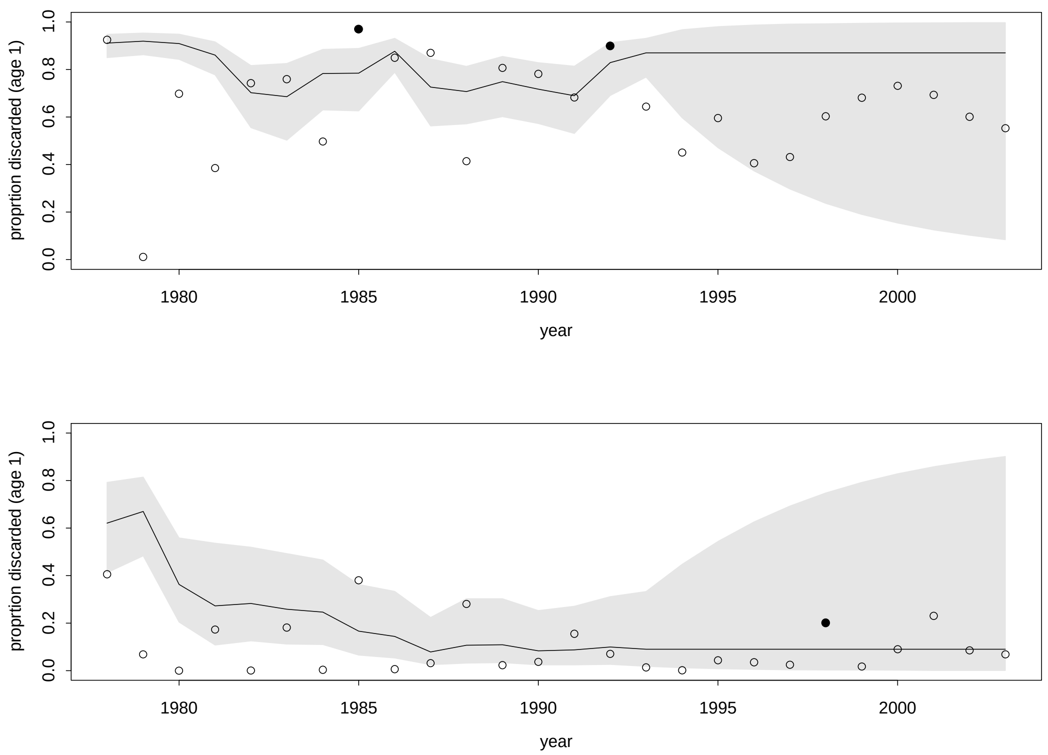


Figure 3.1.5.59 Cod in Division VIa. Final Run 3 diagnostics. Mean F(2-5) retrospective plots.

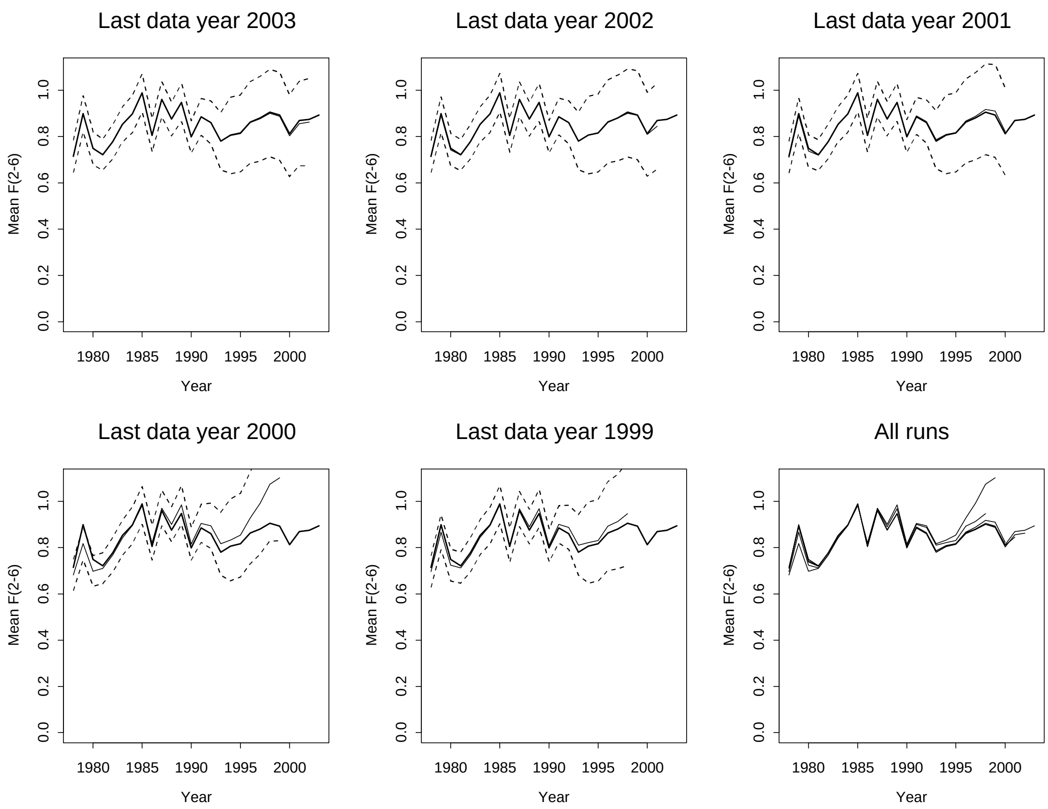


Figure 3.1.5.60 Cod in Division VIa. Final Run 3 diagnostics. Spawning stock biomass retrospective plots.

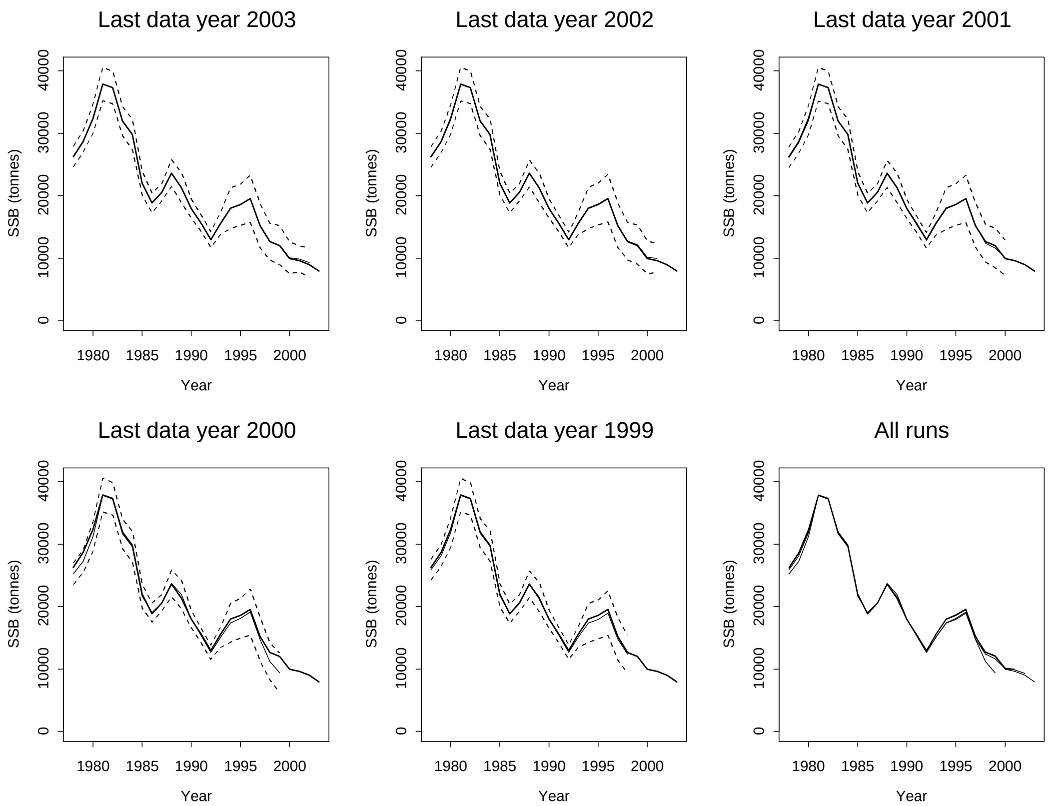


Figure 3.1.5.61 Cod in Division VIa. XSA retrospective plots.

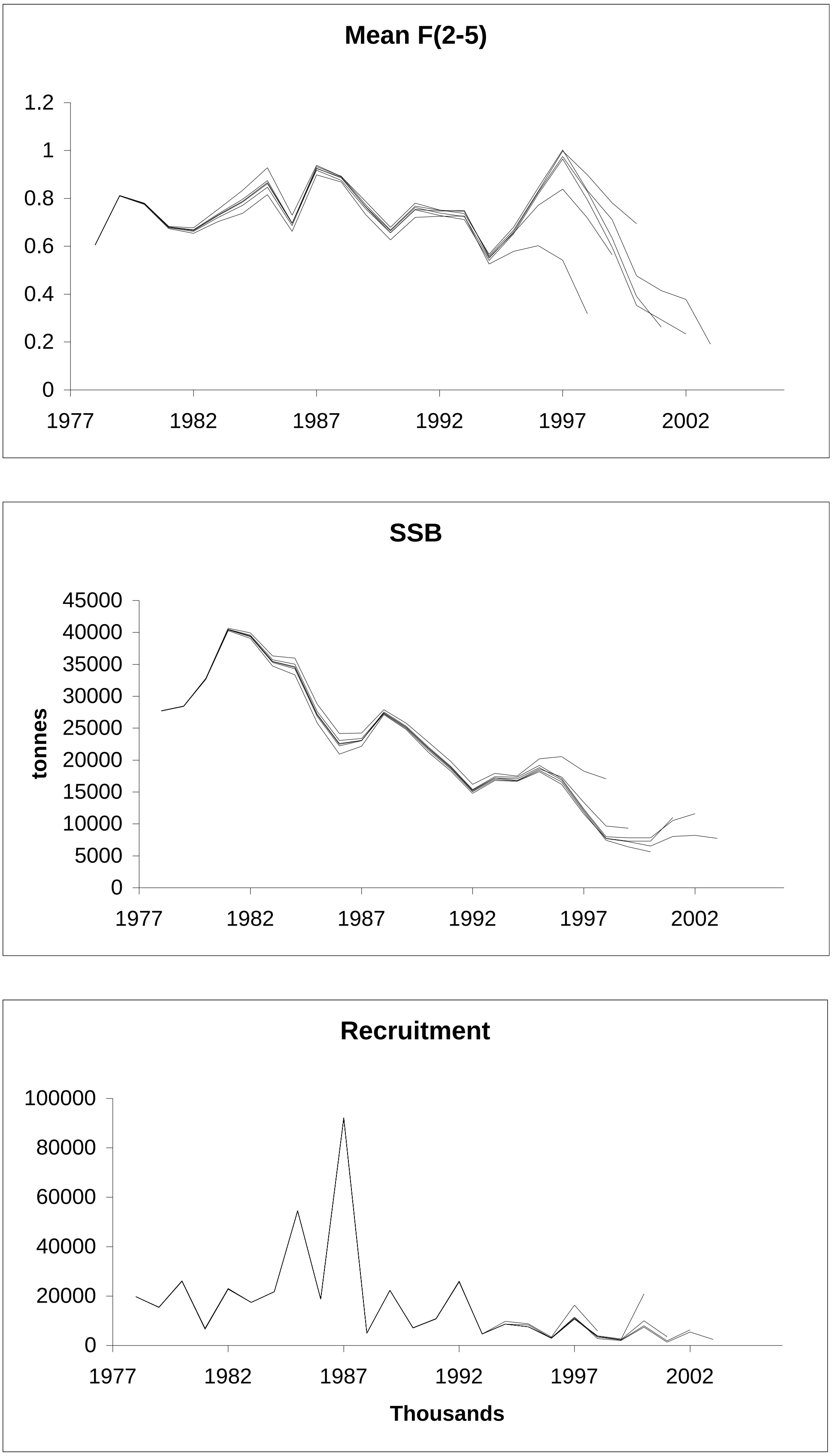
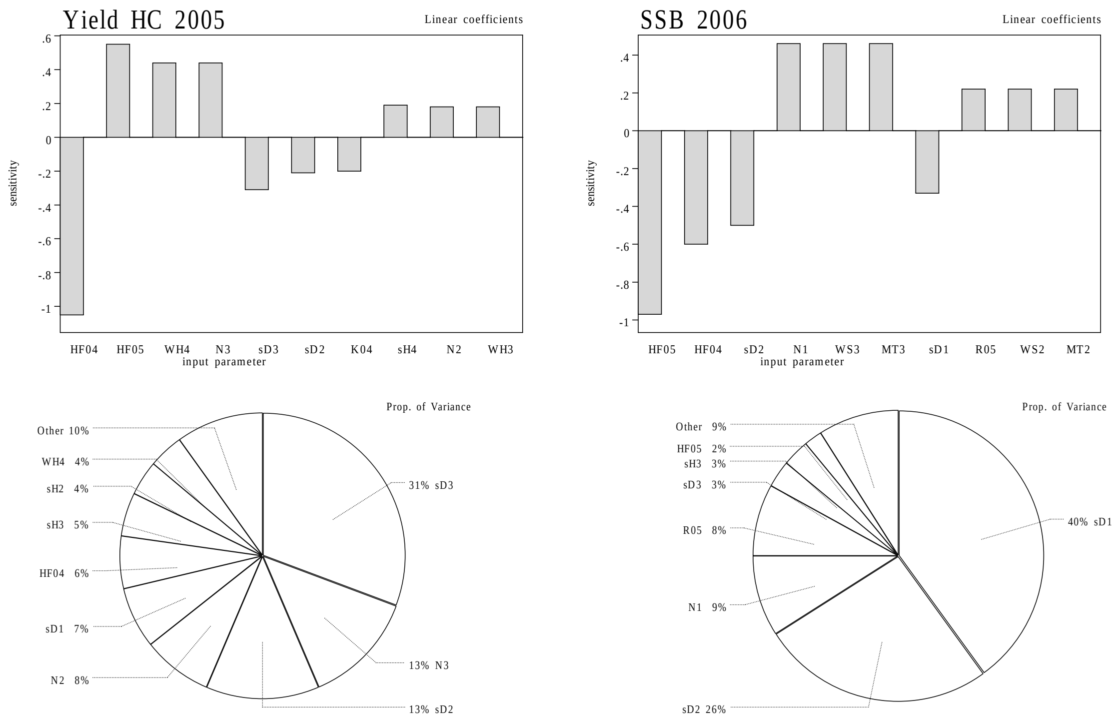


Figure 3.1.8.1 Cod in Division VIa. Final Run 1. Short term forecasts

Figure Cod,,,,VIa,,,,. Sensitivity analysis of short term forecast.



Data from file:W:\2004\Personal\Colin\wgnsds 2004\forecasts\run 1\codvia1.sen on

Figure 3.1.8.2 Cod in Division VIa. Final Run 1.

Figure Cod,,,,VIa,,,,. Probability profiles for short term forecast.

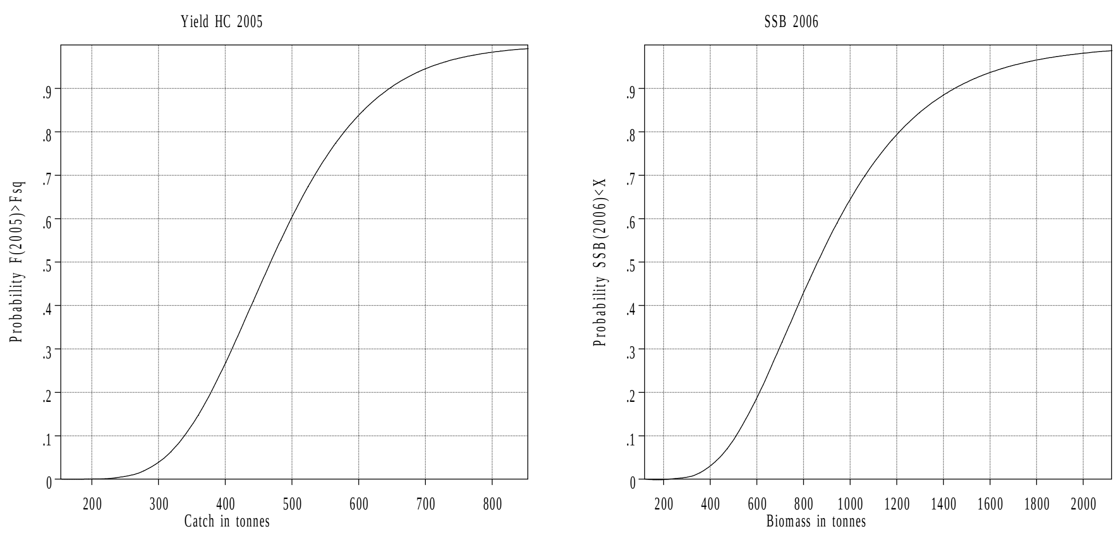


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Figure 3.1.8.3 Cod in Division VIa. Final Run 1.

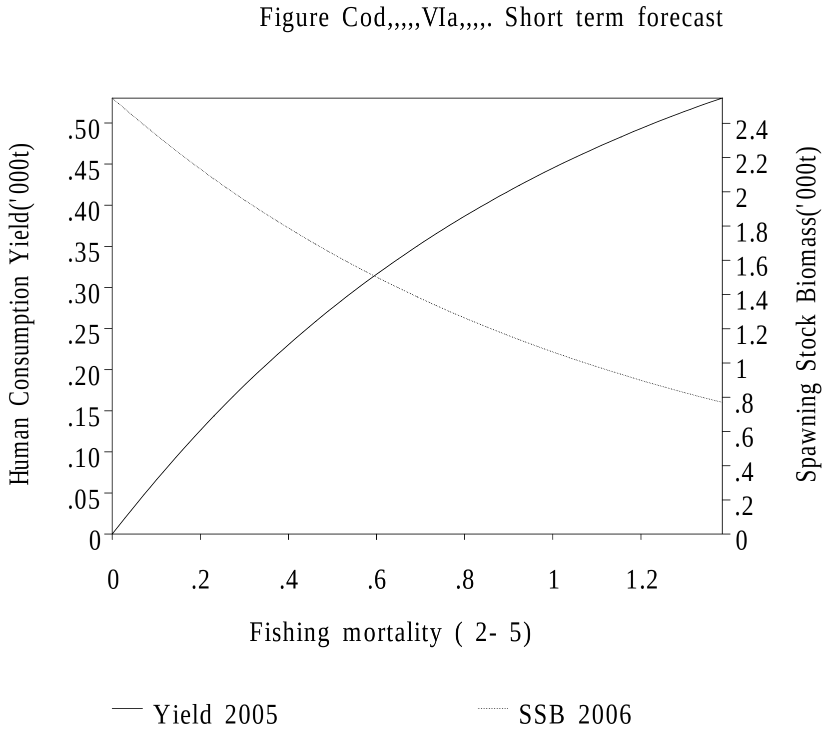

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Figure 3.1.8.4 Cod in Division VIa. Final Run 2.

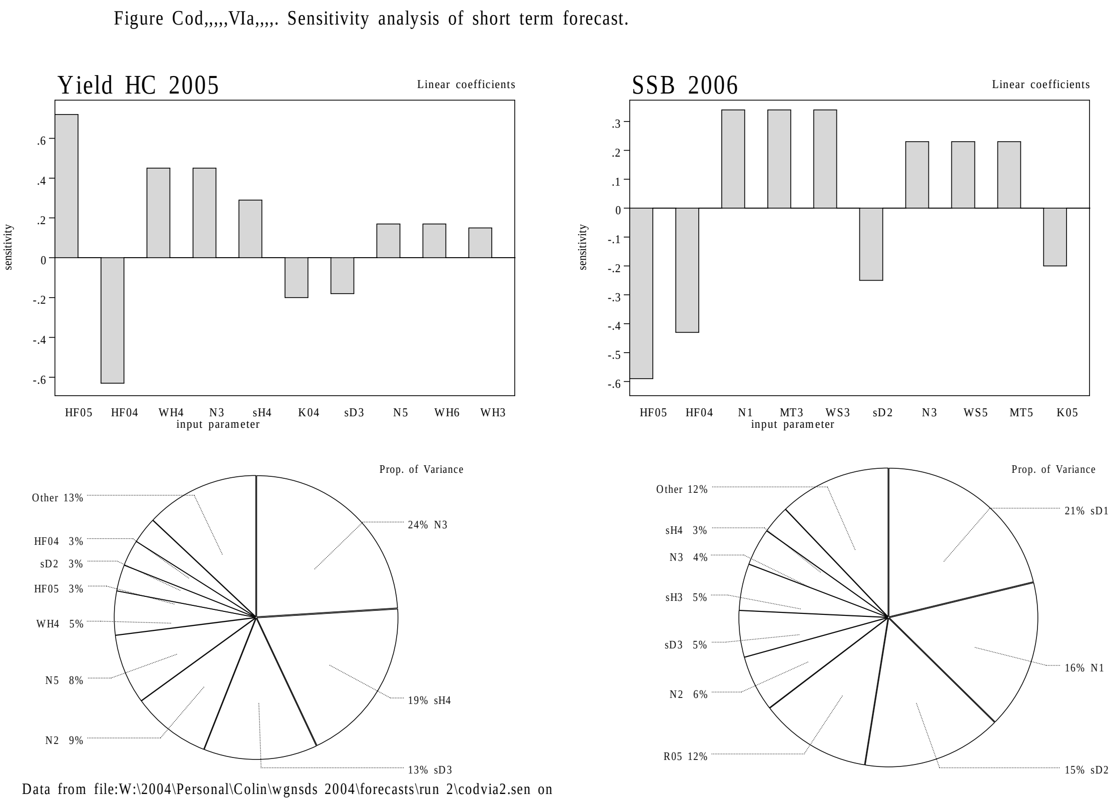

Figure 3.1.8.5 Cod in Division VIa. Final Run 2.

Figure Cod,,,,,VIa,,,,. Probability profiles for short term forecast.

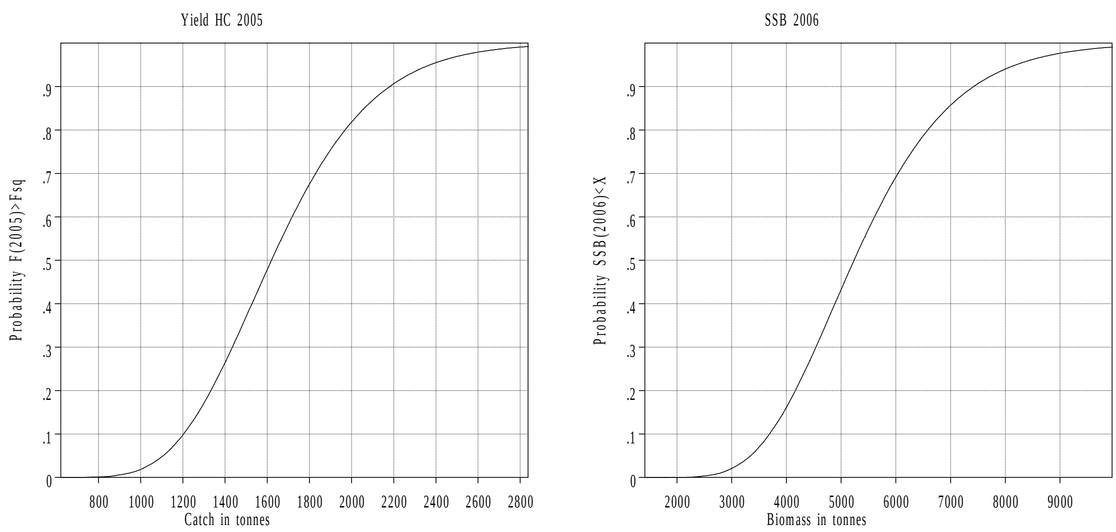

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Figure 3.1.8.6 Cod in Division VIa. Final Run 2.

Figure Cod,,,,,VIa,,,,. Short term forecast

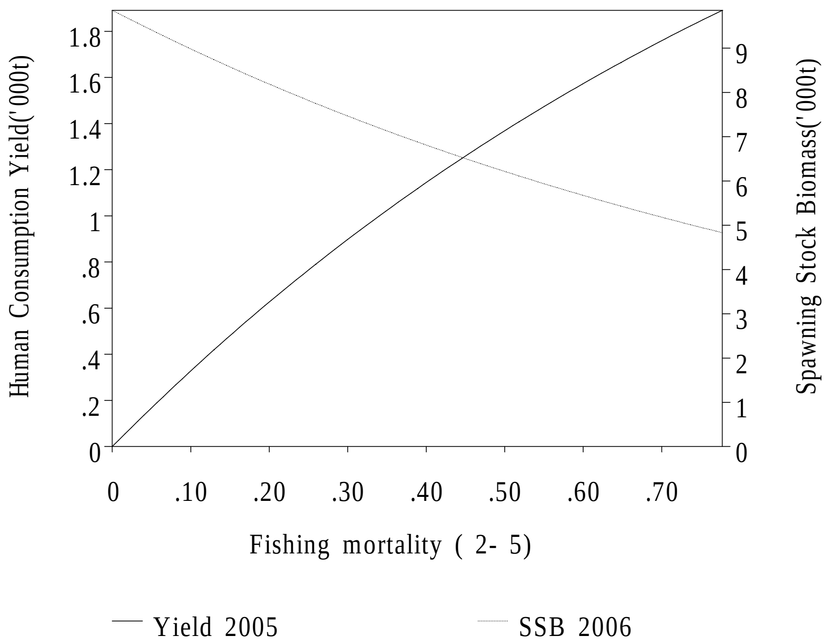

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Figure 3.1.8.7 Cod in Division VIa. Final Run 3.

Figure Cod,,,,,VIa,,,,. Sensitivity analysis of short term forecast.

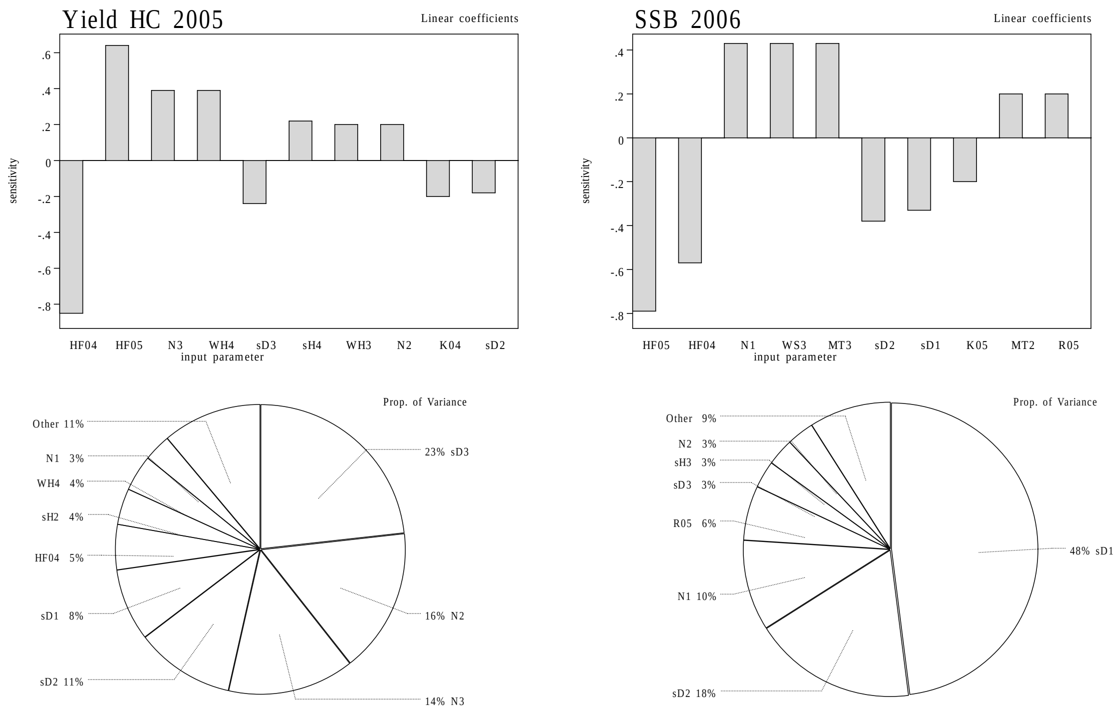

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Figure 3.1.8.8 Cod in Division VIa. Final Run 3.

Figure Cod,,,,,VIa,,,,. Probability profiles for short term forecast.

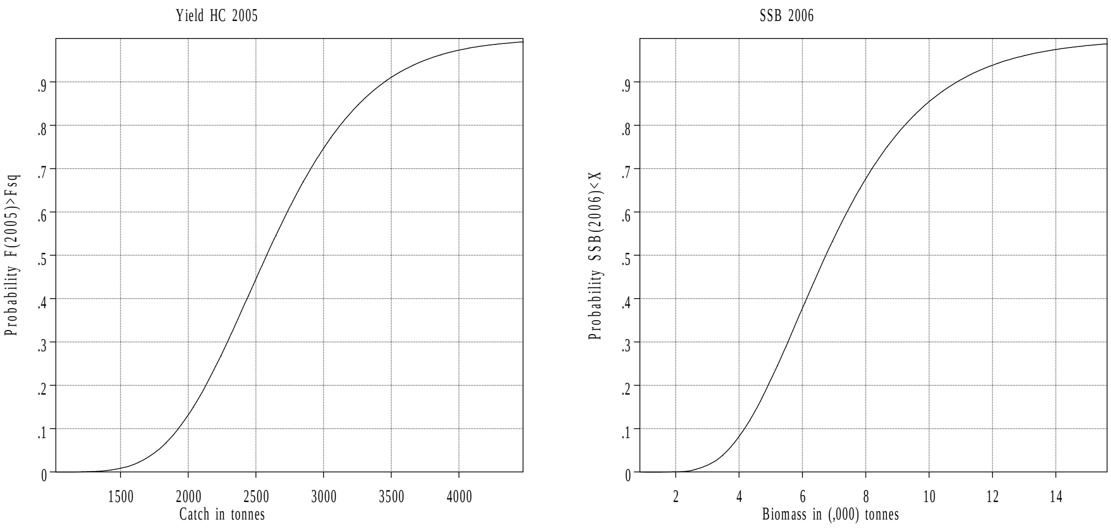

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Figure 3.1.8.9 Cod in Division VIa. Final Run 3.

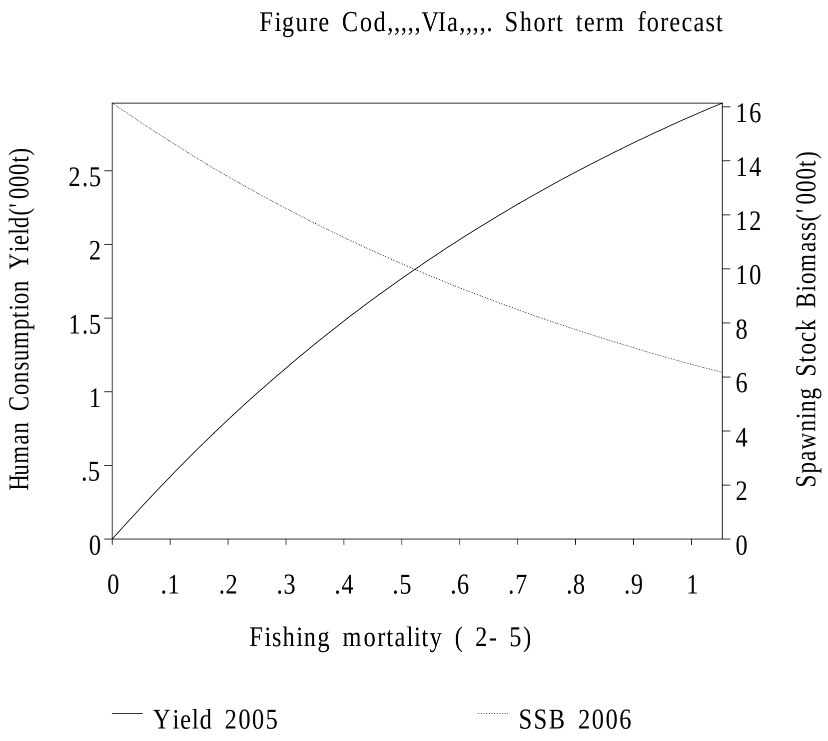

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Figure 3.1.8.10 Cod in Division VIa. Final Run 4.

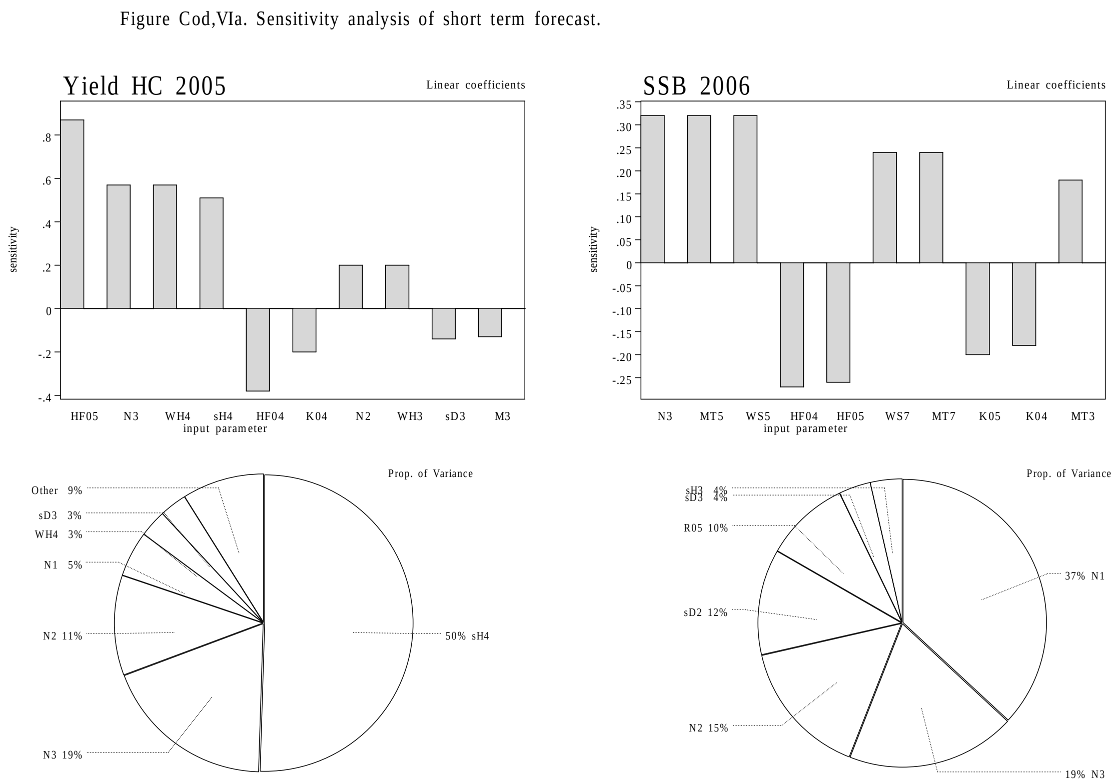

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Figure 3.1.8.11 Cod in Division VIa. Final Run 4.

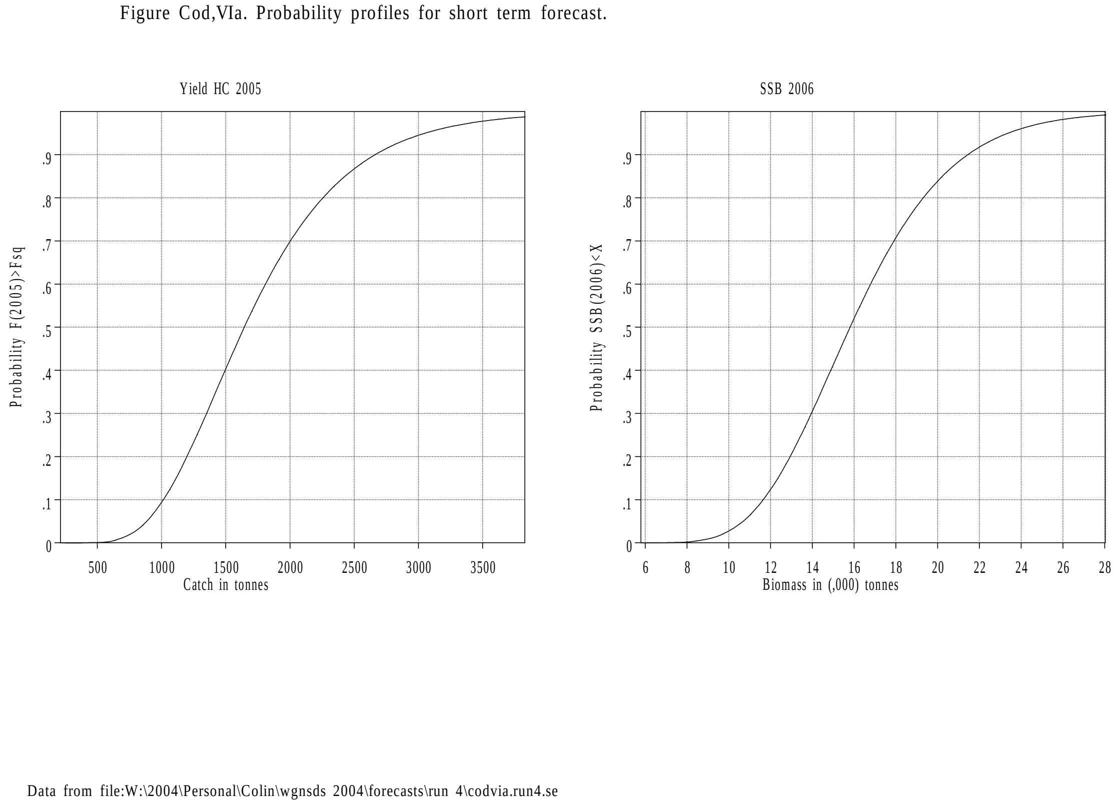


Figure 3.1.8.12 Cod in Division VIa. Final Run 4.

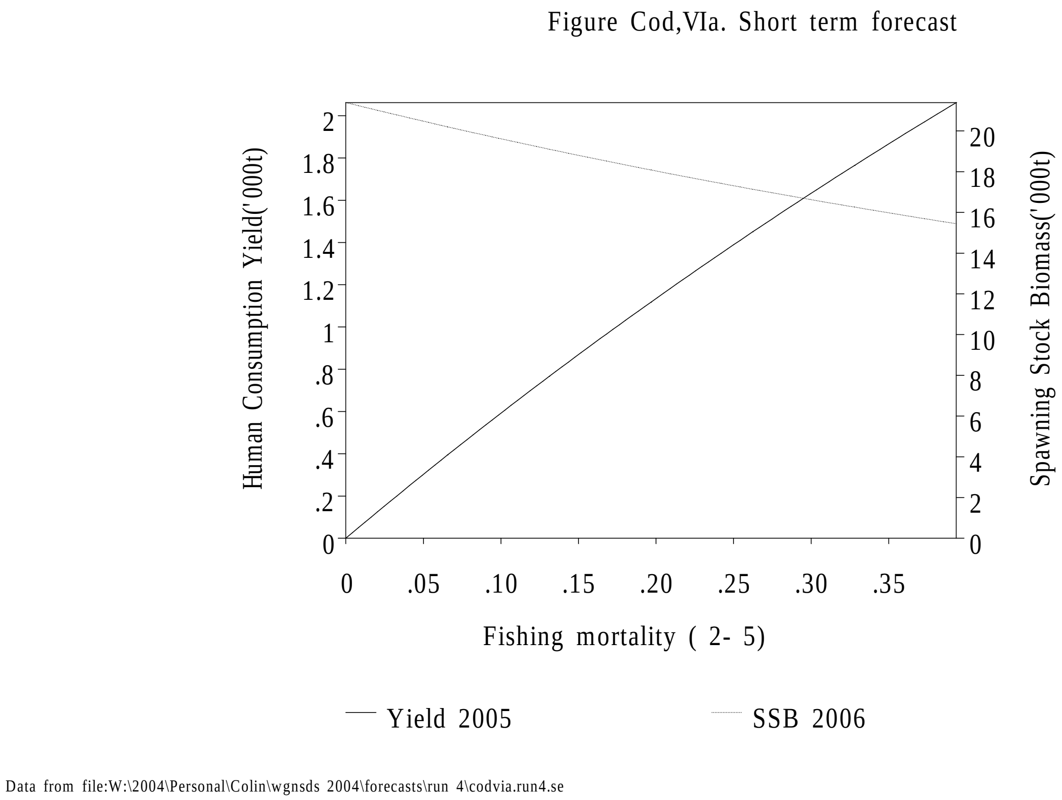


Figure 3.1.10.1 Cod in Division VIa. Final Run 1.

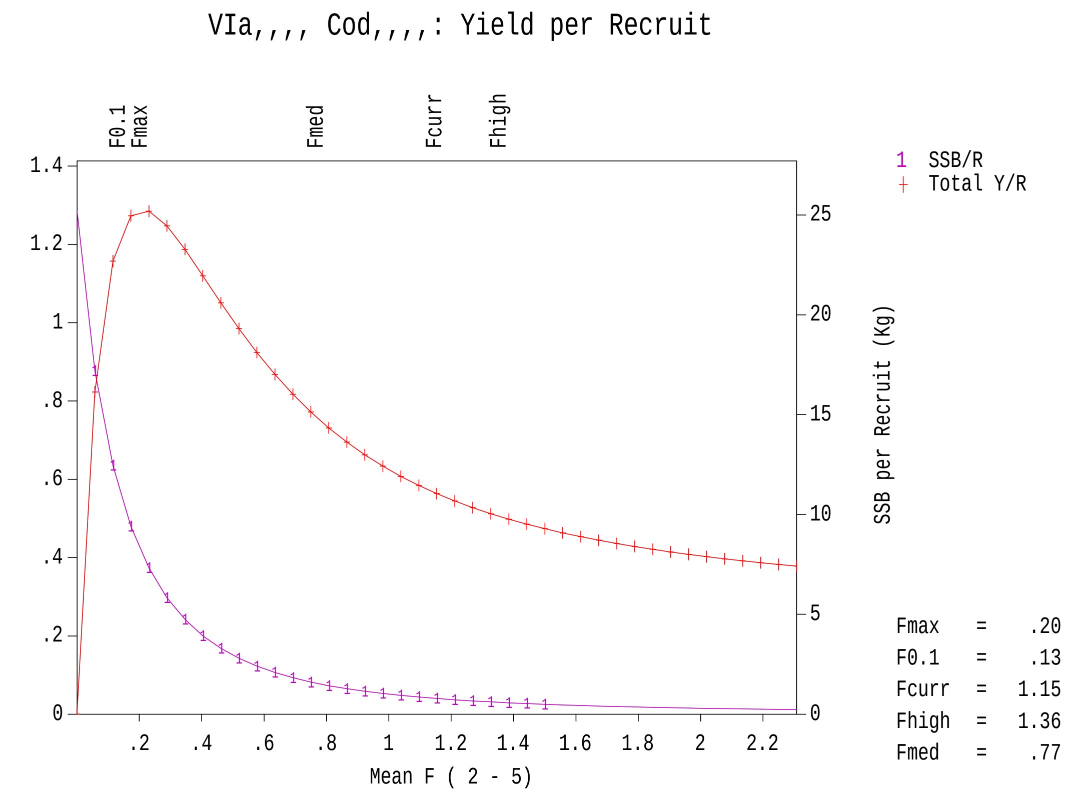


Figure 3.1.10.2 Cod in Division VIa. Final Run 1.

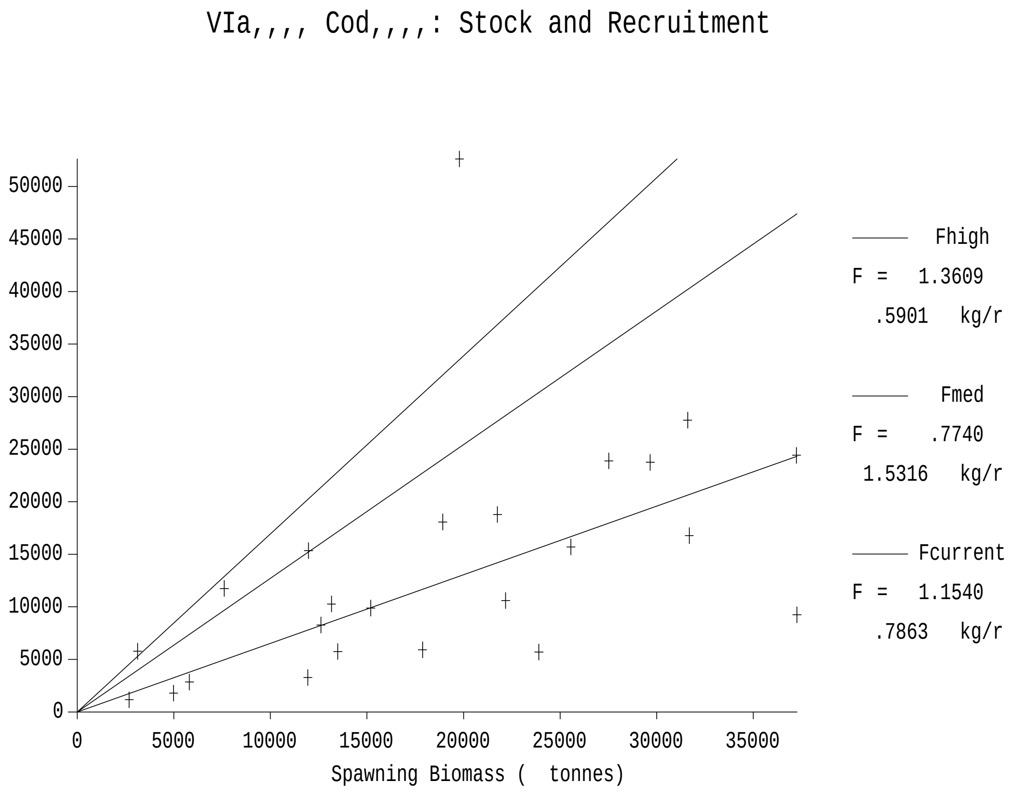


Figure 3.1.10.3 Cod in Division VIa. Final Run 2.

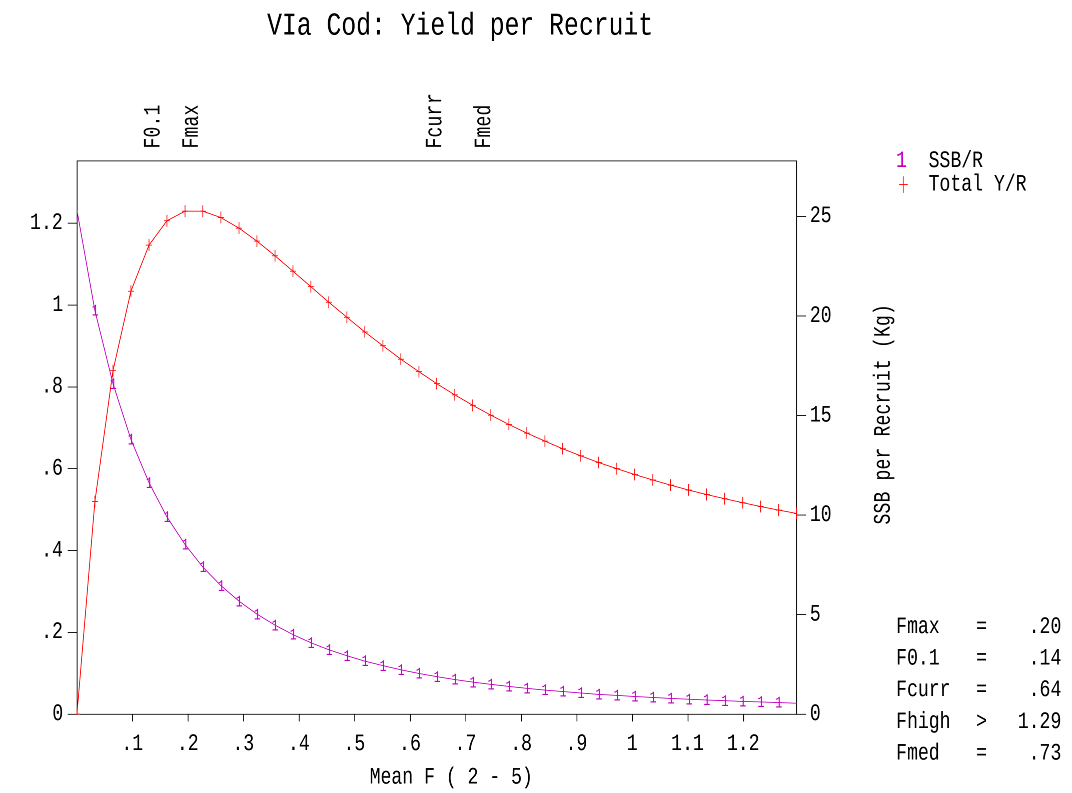


Figure 3.1.10.4 Cod in Division VIa. Final Run 2.

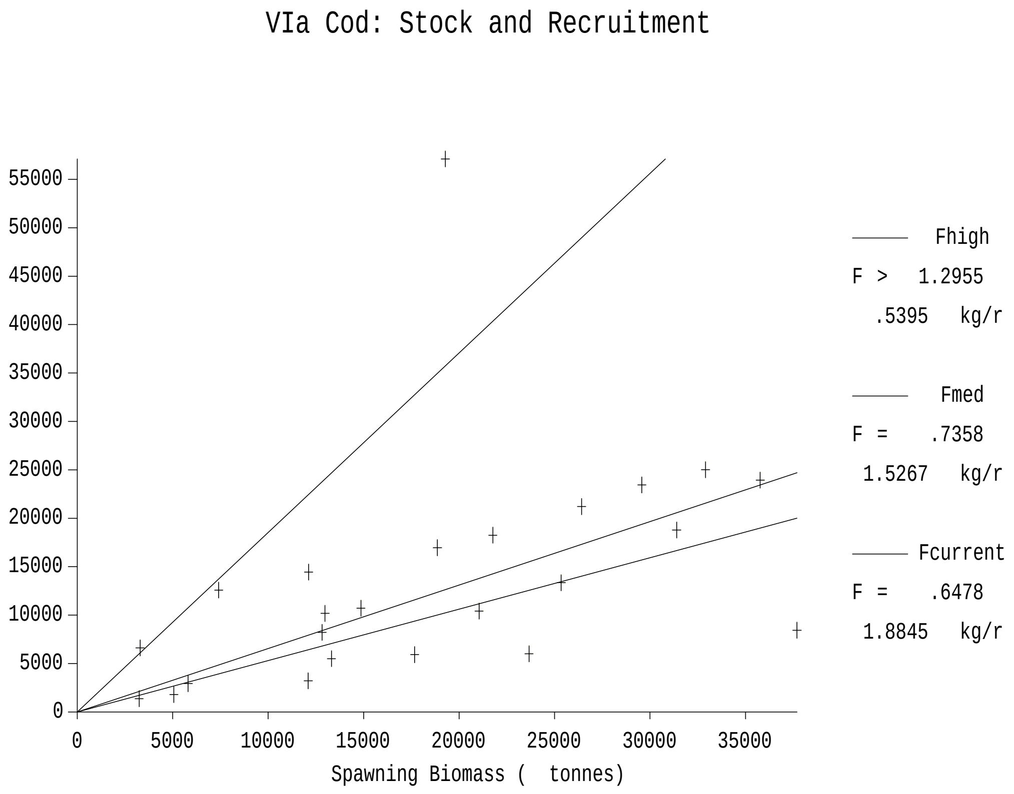


Figure 3.1.10.5 Cod in Division VIa. Final Run 3.

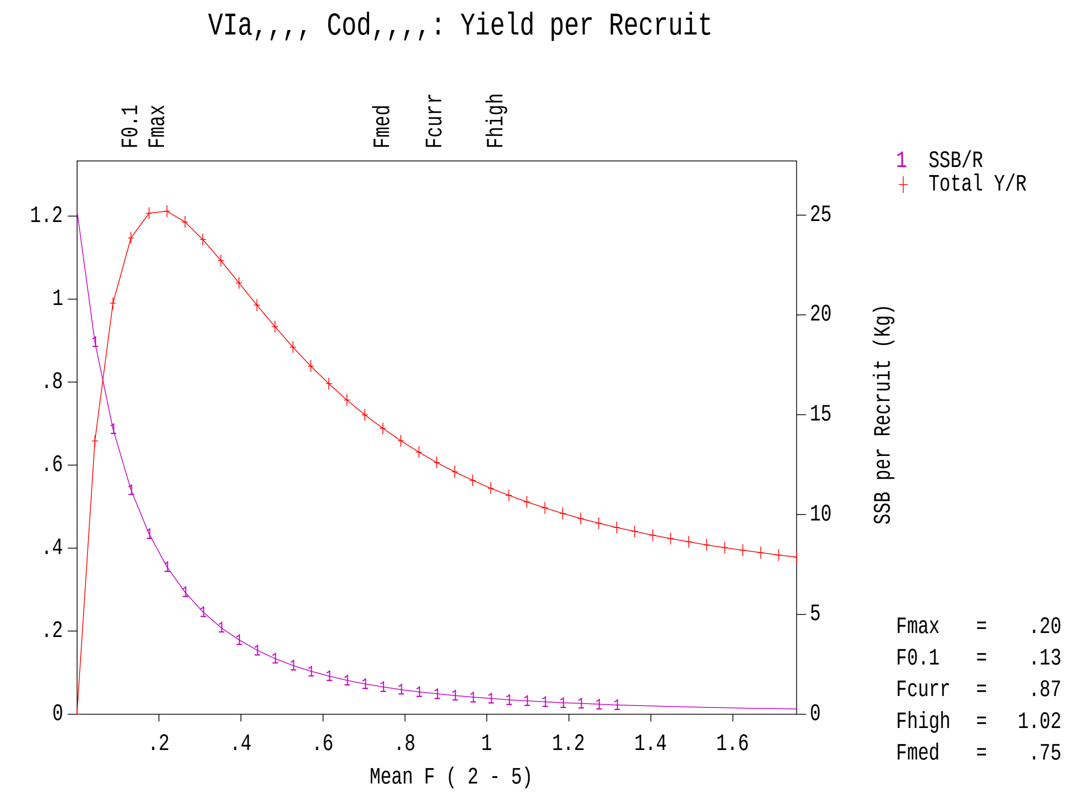


Figure 3.1.10.6 Cod in Division VIa. Final Run 3.

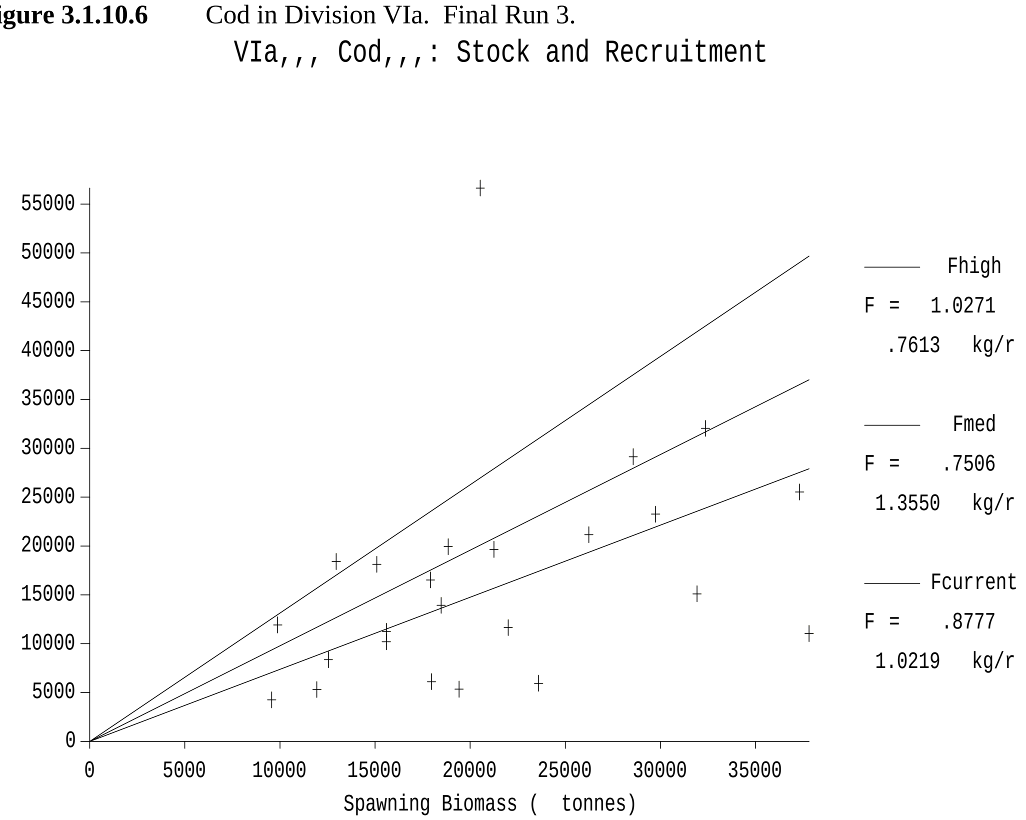


Figure 3.1.10.7 Cod in Division VIa. Final Run 4.

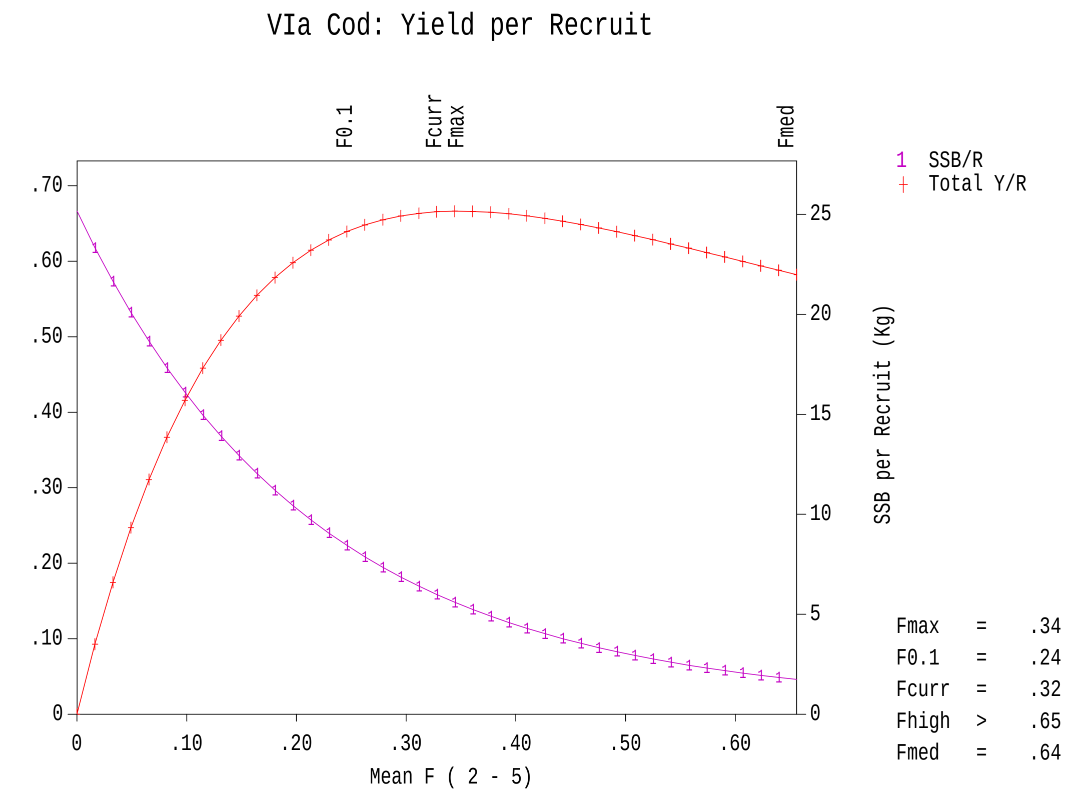
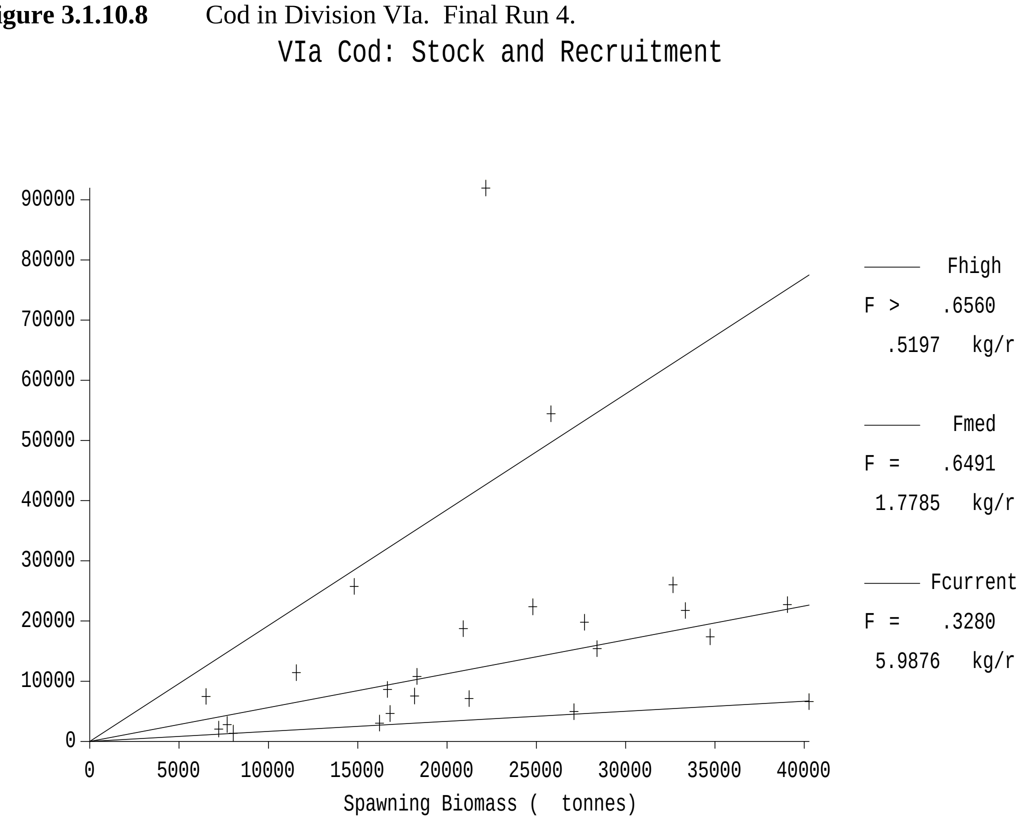


Figure 3.1.10.8 Cod in Division VIa. Final Run 4.



4 HADDOCK IN SUB-AREA VI

4.1 Haddock in Division VIa

The WG did not plan to produce a benchmark assessment in 2004 for Haddock in Division VIa. However, concerns were raised by ACFM in its October 2003 meeting about the assumptions and parameter settings implemented in the TSA method used to assess this stock, and the WG concluded that these were serious enough to warrant a full and detailed examination. ACFM also expressed the opinion that: "Given that many of the principal parameters that TSA estimates change substantially between years, it may not be appropriate to classify TSA assessments as updates."

Along with several technical aspects of the TSA implementation used for this stock, the aspects of last year's assessment about which ACFM were most concerned were as follows:

1. The practice of estimating persistent trends in survey catchability; and

2. The mismatch in population-dynamics signals between survey and catch information.

ACFM also specifically requested that comparative TSA runs be produced with missing catch data for a number of years at the end of the time-series. These issues are addressed below. A Stock Annex is available for this stock.

4.1.1 The fishery

General information on the fishery can be found in the Stock Annex (A.2).

4.1.1.1 ICES advice applicable to 2003 and 2004

Following the ACFM meeting in October 2002, ICES recommended the closure of all fisheries for cod as a target or bycatch species. This advice was based on very low estimated stock size, poor recent recruitments, and continued high fishing mortality. Haddock are a key component of the mixed whitefish demersal fishery in Division VIa which also targets cod, and advice for the two species has generally been linked in the past (although the nature and strength of the linkage is uncertain). For this reason, ICES advised that fishing for haddock in Division VIa should not be permitted unless ways to harvest haddock without incidental catch or discards of cod could be demonstrated.

The form of ICES' advice changed in 2003 to take more account of the mixed nature of the fisheries prosecuting haddock. The advice relating to the single-species exploitation boundary was that F should be below F_{pa} in 2004, while the advice in the context of mixed-species fisheries was as follows (ACFM report October 2003):

> "Demersal fisheries in Subarea VI should in 2004 be managed according to the following rules which should be applied simultaneously. They should fish:
>
> • without catch and discards of cod in Subarea VI;
>
> • in accordance with a recovery plan for northern hake or within an effectively implemented TAC for hake covering all areas where northern hake is caught;
>
> • within the biological exploitation limits for all other stocks;
>
> • no directed fishery for haddock in Division VIb;

• substantially reduce catches of hake in accordance with a recovery plan or such that the total catch of hake is less than 13 800 t over the distributional area of the stock.

Furthermore, unless ways can be found to harvest species caught in a mixed fisheries within precautionary limits for all those species individually then fishing should not be permitted."

4.1.1.2 Management applicable in 2003 and 2004

The 2003 TAC for haddock in ICES areas Vb (EC waters), VI, XII and XIV were 8,675 tonnes. The area covered by the TAC changed in 2004 to Vb and VIa only, and was 6,503 tonnes.

A history of regulations affecting the fisheries for haddock in Division VIa can be found in the Stock Annex. More recently, effort reductions for much of the international fleet to 16 days at sea per month were imposed in February 2003 (EU 2003/0090). This was subsequently reduced to 9 days for fleets fishing with > 100 mm mesh, although for 2003 a modification to the regulation was enacted that increased this to 11 days to allow for steaming time (Annex XVII to Council Regulation (EC) No 2341/2002)

The following table summarises ICES management advice for haddock in Division VIa during 2002–2004:

Year	Single-species exploitation boundary	Basis	TAC for Vb (EC), VI, XII, XIV	% change in *F* associated with TAC[1]	2004 WG estimate of landings
2002	14.1	Reduce F below F_{pa}	14.1[2]	-31%	7.09
2003	15.8	No cod catches	8.68[2]	-20%	5.33
2004	12.2	No cod catches	6.50[3]	-50%	-

Values are thousand tonnes. [1]Based on *F*-multipliers from forecast tables. [2]TAC for Vb (EC), VI, XII, XIV. [3]TAC for Vb (EC) and VIa only.

4.1.1.3 The fishery in 2003

Official (reported) catch data for each country participating in the fishery are given in Table 4.1.1.1, together with the corresponding WG estimates for landings, discards and total catch. The WG estimate for total international catch in 2003 is 9,575 tonnes, consisting of 5,330 tonnes landed and 4,244 tonnes discarded fish. These estimates for total catch and landings are the lowest in the available time-series, and the estimate for discards is the second-lowest. Revisions have been made to the WG estimates for 2002; these are discussed in Section 2.4. Discard data are discussed further in Section 4.1.3. Reported effort declined to very low levels in both Scottish fleets for which effort data are available to the WG (pair trawlers and light trawlers; see Figure 4.1.2.1 and Table 4.1.2.1). The recent mean levels of LPUE (landings-per-unit-effort) for these fleets were more constant, although variable. However, problems with effort recording (see Section 2.4) mean that these estimates are unlikely to be valid. The TAC for haddock in Division VIa in 2003 was intentionally restrictive, which would imply that the likelihood of misreporting may be high, but uncertainty about both recorded effort and recorded landings means that the WG has no quantitative basis on which to draw conclusions about the presence or extent of any misreporting. The predicted *status quo* landings and discards in 2003 were 12000 t and 5700 t respectively, which are considerably higher than the corresponding WG estimates.

4.1.2 Commercial catch-effort data and research vessel surveys

The available commercial and research-vessel CPUE data are described in the Stock Annex (Sections B.3 and B.4), and are tabulated in Table 4.1.2.1. The only tuning series used in the assessment was the Scottish Q1 groundfish survey (ScoGFS). The previous Irish groundfish survey (IR-WCGFS) has been examined in previous WG meetings and is not thought to be a good abundance index of haddock in Division VIa. It has also been discontinued. The replacement survey (IRGFS) has only been running for one year and is not yet suitable for tuning. The reasons for not using the available commercial tuning data are described in the Stock Annex (Section B.4).

Figure 4.1.2.2 shows mean-standardised log survey indices for ScoGFS, both by year-class and by year. The survey tracks cohort strengths well, except for a period in the mid-to-late 1990s when cohorts are less clearly defined. Log index values at different ages are compared in bivariate plots in Figure 4.1.2.3, which support the conclusion that the index value at age *a* of a cohort is a good indicator of the index value at age $a + 1$. R^2 values for the fitted lines on the lag-1 plots (along the main diagonal of Figure 4.1.2.3) are 87.63%, 68.34%, 87.32% and 74.71%.

Catch curves (Figure 4.1.2.4) are relatively linear and not very noisy, and indicate a fairly consistent drop in abundance from ages 2 to 3. The exception, as pointed out in the October 2003 ACFM Technical Minutes, is the 1999 year-class which shows a reduced decline in abundance between ages 2 and 3. ACFM concluded that this would have significant effects on the ability of the TSA method to assess this stock, suggesting that the lower *F* on age 2 for that year-class would be interpreted by TSA as a lower *F* on *all* ages. The WG do not concur with this view, particularly with the addition of two years' observations of that cohort in the survey during which it has declined in abundance in a similar way to other cohorts. As a time-series smoother, TSA is not expected to be overly sensitive to data features of this kind.

Figure 4.1.2.5 compares mean-standardised ScoGFS index values at age with the corresponding time-series of total catch. The over-riding tendency, particularly at ages 1–4, is for the catch level to be higher than the survey level in the early period (before ~1995), and lower in the late period. This "catchability mismatch" will be examined in more detail below.

Figures 4.1.2.6 and 4.1.2.7 give empirical estimates of relative SSB and mean *Z* from the ScoGFS series, for raw (unsmoothed) and smoothed data respectively. These plots were produced by the SURBA program (see Section 2.12), which smoothes index data along cohorts using a cubic spline. Empirical SSB is calculated as $\sum_a I_{a,y} W_{a,y} Mat_{a,y}$, where $I_{a,y}$ are index values, $W_{a,y}$ are mean weights-at-age, and $Mat_{a,y}$ are proportions mature-at-age, while empirical *Z* comes from $\ln\left(I_{a,y} / I_{a+1,y+1}\right)$. Both Figures indicate a general increase in SSB in recent years, along with a decline in *Z* to a constant or slightly rising level of about 0.9–1.0.

4.1.3 Age compositions and mean weights at age

Quarterly catch-at-age data were available from Scotland and Ireland. The countries that provide data are listed in Table 2.2.1, and sampling levels are shown in Table 2.2.2.

The sampling, raising and collation procedures for age-compositions and mean weights-at-age are described in the Stock Annex (Sections B.1 and B.2). Age-compositions for 2002 have been revised to account for Scottish effort recording problems (see Section 2.4). Data are presented in Tables 4.1.3.1–4.1.3.3 (estimated numbers-at-age in landings, discards, and total catch), and Tables 4.1.3.4–4.1.3.6 (mean weights-at-age in these catch components). Figures 4.1.3.1–4.1.3.3 show that mean weights-at-age in landings and total catches has declined in recent years over all ages; discard mean weights-at-age, although very variable, are possibly increasing in the recent period.

4.1.4 Natural mortality, maturity and stock weights at age

Natural mortality was assumed to be 0.2 for all ages and years, and maturity was as follows:

Age	1	2	3+
Proportion mature	0.00	0.57	1.0

The derivation of these values is discussed in the Stock Annex (Section B.2). Proportion *F* and *M* before spawning were both set to 0.0, in order to generate abundance (and hence SSB) estimates dated to January 1st.

4.1.5 Catch at age analysis

Section 2.6 outlines the general approach adopted at this year's WG meeting.

4.1.5.1 Data screening

Commercial catch data

A separable VPA (Lowestoft assessment suite; Darby and Flatman 1994) was run on the available catch-at-age dataset (years 1978–2003, ages 1–8+). This run used equal weighting of 1.0 on all ages and years, as the intention was to investigate data quality, rather than to produce the best separable model fit. Following exploratory runs, terminal *F* was set to 0.6 on age 3, and *S* was set to 1.0. The plot of separable model residuals in Figure 4.1.5.1 indicates only a few outlying residuals, and only on the youngest and oldest ages.

Tuning data

The SURBA model (Needle 2004) was applied to the ScoGFS survey series to determine the population signals given by the survey data (see Section 2.6). Standard SURBA settings were used for this run, except that relative abundance estimates were scaled to pseudo-absolute abundance estimates using catchabilities estimated in the XSA run described below (residuals for this XSA run are given in Figure 4.1.5.2). The 2003 estimates of natural mortality and maturity were also used for 2004, and a three-year (2001–2003) average was used for stock weights in 2004.

Figure 4.1.5.2 gives the stock summary for this SURBA run. Temporal-trend estimates (i.e., the year-effect in fishing mortality) are sensitive to variability in survey data and are hence noisy, while the age-effect is relatively smooth. The median (50th percentile) estimate of mean $F_{2–6}$ shows a decline from 1999 to 2002, followed by a small increase in 2003. The median SSB at survey time shows a rapid increase after a low point in 2000 as the large 1999 year-class has matured. Both of these model fits are consistent with the empirical estimates given in Figure 4.1.2.7. Residuals are reasonable for the most part, with the exception of the 1995–1997 period for which there are large outliers at age 7 and year-effects for other ages. This corresponds with the period for which the survey appears to be poor at tracking year-class strength (Figure 4.1.2.2), and also when there is a step-change in XSA residuals (Figure 4.1.5.3). In addition, the model does not fit the data particularly well for the 1995–1997 year-classes (Figure 4.1.5.2c). There is no retrospective bias or variability in stock summaries (Figure 4.1.5.2d).

XSA

The XSA method was applied to this stock, following the approach suggested by Darby and Flatman (1994). The ScoGFS series was used to tune the VPA. After exploratory runs, the following run settings were chosen: no tapered time-weighting, no power model, a catchability plateau at age 4, and light shrinkage (SE = 2.0) over 5 years and 5 ages. XSA diagnostics from this run are given in Table 4.1.5.1. Log catchability residuals for the ScoGFS series are plotted in Figure 4.1.5.3. These show a clear step-change, from mostly negative residuals before 1995 to mostly positive during 1995–1999. This is a feature common to all gadoid assessments in Division VIa, and has been attributed variously to changes in survey catchability, increased misreporting, or environmental effects. The WG notes that the step-change coincides with the three-year period when the ability of the survey to track year-class strength was reduced (Figure 4.1.2.2).

TSA

In response to the points raised by ACFM at its October 2003 meeting (see above), the WG decided to examine a series of exploratory TSA runs. The same model structure was used for each (given in Table 4.1.5.2), but modifications were made to the range of input data used and the number of parameters that were estimated, in order to answer the following questions:

1. What is the effect on the TSA model of using a survey tuning series, and should a persistent trend in survey catchability be allowed?

2. What is the effect of removing years at the end of the catch-data time-series?

Figure 4.1.5.4 compares stock summaries (mean $F_{2–6}$, SSB and recruitment) from three runs carried out to address the first of these questions. Three runs were produced: (1) using catch data only, (2) using catch and survey data allowing for a persistent trend in survey catchability, and (3) using catch and survey data not allowing for a persistent trend (the SPALY run, referred to hereafter as the "base case"). The right-hand column of Figure 4.1.5.4. plots the ratio of results from runs 1 and 2 to results from run 3. The principal influence of changing model settings occurs at the end of the time-series, although there are lesser effects in mean $F_{2–6}$ and SSB throughout. In summary, the catch data indicate a high terminal mean $F_{2–6}$ and a low terminal SSB and recruitment. Both runs with surveys indicate a much lower terminal mean $F_{2–6}$ and correspondingly higher SSB and recruitment. Whether a persistent trend in survey catchability is allowed or not does not make a great deal of difference to this assessment (which contrasts with the conclusions for cod and whiting in Division VIa; see Sections 3 and 5).

Figure 4.1.5.5 shows summaries from a series of TSA runs with different periods of missing catch data, to address the second of ACFM's questions. Three additional runs were produced, with missing catch data for 1990–2003, 1995–2003, and 2000–2003. All give a higher terminal mean $F_{2–6}$ than the base case TSA run, at around 0.5–0.6 (as opposed to 0.4). The two runs with most catch data removed also show a sharp peak in mean $F_{2–6}$ in 1999, which coincides with the peak in the empirical survey Z (Figure 4.1.2.7) and the SURBA-estimated mean $F_{2–6}$ (Figure 4.1.5.3). All three runs give a higher terminal SSB than the base case, and the two aforementioned runs also estimate high SSB during the period 1994–1999 (again agreeing with empirical and SURBA results). Recruitment estimates also tend to be larger in the missing-catch TSA runs, particularly in the second half of the time-series.

The final set of comparison plots (Figure 4.1.5.6) compares stock summaries from the base case TSA run with the results from the XSA and SURBA runs described above. XSA has a much lower terminal mean $F_{2–6}$ and higher SSB than the base case TSA run. The estimate of terminal mean $F_{2–6}$ from SURBA is a only little higher than that from the base case; most of the high SURBA-estimated terminal SSB would appear to derive from a period of large recruitments during the late 1990s.

4.1.5.2 Final runs

The outcomes of the exploratory runs described above can be broadly characterised as follows:

Hypothesised main driver of population signal	Model	Terminal mean $F_{2–6}$	Terminal SSB
Catch data	TSA catch only	High	Low
Mostly catch data, some survey data	TSA catch & survey, q trend	Low	Moderate
Catch and survey data	TSA catch & survey, no q trend	Low	Moderate
	XSA	Very low	High
Survey data	Empirical survey	Moderate	High
	SURBA	Low	High
	TSA missing catch, no q trend in survey	Moderate	High

The catch data when viewed separately indicate a high mean $F_{2–6}$ and a low SSB. The survey data when viewed separately indicate a low or moderate mean $F_{2–6}$ and a high SSB. When combined, they indicate a low or very low mean $F_{2–6}$ and a moderate or high SSB. However, the expected behaviours of the XSA and TSA methods are not clear, when confronted by data in which both misreporting and changes in survey catchability are possible. Therefore, it is not clear that the population signals from the methods using both catch and survey data are appropriate.

The problem is less acute for haddock in Division VIa than for cod and whiting (see Sections 3 and 5), which may be due to the fact that the catchability mismatch between catch and survey appears to be less severe for haddock. Taken at face value, the WG could have made a pragmatic choice for the TSA model with all catch and no survey q trend. This is intuitively appealing as (in theory) the signal from the survey data is not masked by allowing a trend in catchability, and this run remains the base case. However, the more serious discrepancies in the equivalent cod and whiting model runs indicate that any confidence the WG has in this conclusion may be misplaced. Given the lack of a full comparative exploration with appropriate simulated data of the properties of these assessment models, the WG does not feel able to choose between them with certainty.

For this reason, the WG took the unusual step of producing full output statistics and summaries for four runs:

A. TSA with all catch and survey data, no *q* trend allowed in survey data.

B. TSA with all catch and survey data, *q* trend allowed in survey data.

C. TSA with catch removed from 1995 onwards, all survey data, and no *q* trend. The cut-off year was selected with reference to the ability of the survey to track year-class strength (Figure 4.1.2.2), SURBA model residuals (Figure 4.1.5.2), and XSA log catchability residuals (Figure 4.1.5.3).

D. XSA.

The WG intend to investigate the properties of these methods closely in the months before ACFM in October, after which it should be more possible to reach firmer conclusions. The intention behind presenting all four models here is that the final model output will be available to ACFM no matter which one is chosen. To present only one set of results would have indicated much more confidence in the assessment than the WG feel is warranted.

Table 4.1.5.3 lists TSA parameter estimates from the three runs described above, along with the final-run estimates from the last three WG reports. Removing catch data from the analysis allows TSA to fit more closely to survey data, so the estimate of transient changes in survey catchability is much lower ($\sigma_{\Omega} = 0.08$ for run C, $\sigma_{\Omega} = 0.32$ for run A). TSA finds evidence for a persistent trend in catchability when allowed to do so ($\sigma_{\beta} = 0.19$ in run B), but the magnitude of the effect is quite low. Allowing the persistent catchability trend also leads to a poorer fit to discard data ($\sigma_{\text{discards}} = 0.90$), in general changes survey selectivity and the assignment of variability in the discard model, and significantly changes the slope at the origin of the underlying Ricker stock-recruitment model ($\alpha = 6.44$ with trend, $\alpha > 9.0$ without).

Population estimates from the four models are given in Tables 4.1.5.4a–d, while standard errors on TSA population estimates only are listed in Tables 4.1.5.5a–c. Fishing mortalities-at-age are given in Tables 4.1.5.6a–d, with log standard errors for the TSA estimates in Tables 4.1.5.7a–c. Tables 4.1.5.8a–d contain stock summaries, which are plotted in Figures 4.1.5.7a–d. Stock-recruit scatterplots from the four runs are presented in Figures 4.1.5.8a–d; the Ricker curve used in the TSA estimation process is included in the TSA plots. Standardised landings prediction errors for the TSA runs are given in Figures 4.1.5.9a–c. While these residuals lie mostly within the expected (-2,2) range, they do all show year-effects and trends in time. The equivalent plots for discards (Figures 4.1.5.10a–c) show less pattern, but those for the survey (Figures 4.1.5.11a–c) again contain a lot of time series structure. This is a concern, and may be by-product of the Kalman filter time-series smoothing used in TSA.

An empirical estimate of trends in catchability mismatch can be obtained by plotting the log ratio of the mean-standardised survey indices to mean-standardised TSA- or XSA-estimated abundance. The resultant time-series in Figure 4.1.5.12a–d demonstrate that there are considerable trends for all the models, particularly at younger ages. Persistent and transient catchability trends are plotted in Figures 4.1.5.13a–c for the TSA runs. The persistent trend in run B is quite clear. However, when a persistent trend is not permitted (run A) and all data are used, the fitted transient catchability trends look remarkably similar: hence the evidence for a catchability mismatch in the data must be quite strong (although the estimated persistent-trend parameter for run B is not large). This pattern in transient trends disappears when catch data from 1995–2003 are removed (run C).

Estimated discard ogives generally fit the observed data well for the TSA runs (Figure 4.1.5.14a–c). The exception is run C (missing catch), but here the discard data are removed from the analysis from 1995 onwards so these discard ogives are time-series projections rather than fitted models. It is notable that the projected discard proportions are higher than the observed proportions for most of these years, suggesting that the discarding may have been less (proportionally) between 1995 and 2001 than was expected.

Retrospective plots (terminal years 1999–2003) for all four runs are given in Figures 4.1.5.15a to 4.1.5.17.d. The two TSA runs with all catch data (runs A and B) show a similar pattern of some underestimation of mean $F_{2\text{–}6}$ and overestimation of SSB and recruitment, although the bias is not large. TSA run C (missing catch data) shows a retrospective pattern which is quite constant for three retrospective years, and then switches suddenly to a higher (for mean $F_{2\text{–}6}$) or lower (for SSB and recruitment) state. SSB estimates are particularly heavily revised by this process. Finally, XSA shows good retrospective performance for three years, but then becomes very erratic. Overall TSA run B (all catch data and survey trend allowed) shows the best retrospective performance.

4.1.6 Estimating recruiting year class abundance

TSA generates an estimate of recruitment at age 1 of the 2003 year-class (recruiting in 2004). This is derived principally from the 2004 survey datum, and can thus be used directly in forecasts. The stock-recruitment plots presented in Figures 4.1.5.8a–d show that the Ricker model does not fit these data very well. The use of the TSA-estimated values of recruitment for the 2004 year-class (recruiting in 2005), which are specified by the TSA-fitted Ricker curve, is therefore unlikely to be appropriate. A long-term (1978–2003) geometric mean was used instead for the 2004 and 2005 year-classes, recruiting at age 1 in 2005 and 2006: 90.6 millions (run A), 86.9 millions (run B), and 121.8 millions (run C). For the XSA run (D) the long-term (1978–2003) GM (93.9 millions) was used for the 2003–2005 year-classes recruiting at age 1 in 2004–2006.

4.1.7 Long-term trends in biomass, fishing mortality and recruitment

Historical trends in landings, discards, total catch, mean $F_{2–6}$, SSB, and recruitment are summarised in Tables 4.1.5.8a–d and Figures 4.1.5.7a–d. Mean $F_{2–6}$ for all four models is estimated to be at or near the lowest observed value, while all four runs also show that SSB appears to have recovered (in varying degrees) from a low point in 2000 (due to the maturation of the large 1999 year-class and lower *F*). Depending on the model used, recruitment in 2003 is estimated to be below, at, or above the long-term geometric mean.

4.1.8 Short-term catch predictions

ACFM (October 2003 Technical Minutes) expressed concerns about the use in last year's assessment of the TSA projections of fishing mortality in forecasts, on the grounds that the basis of these projections was not known. The WG understands that these projections are akin to ARIMA time-series projections, and will tend to converge towards a long-term average of some kind. However, the WG are not aware of the precise details and rationale of this process. The final-year estimates from TSA are very uncertain, with wide confidence intervals. Hence the WG decided to use a three-year (2001-2003) mean fishing mortality in the three short-term forecasts based on TSA runs. The sharp decline in mean $F_{2–6}$ in the XSA assessment may be an artefact of the model, rather than a reflection of the data, so an appropriate approach for that forecast also is to use a three-year mean. Partial *F*s for landings and discards components were calculated by applying 3-year mean landings and discard proportions to the 3-year total mean *F*. The larger of the CVs from the estimation of these two means was used as the CV in the forecast.

Estimates of survivors at ages 2 and older in 2004 were used as the starting point for the forecasts. The CVs estimated by TSA were used for the TSA-based forecasts, while the larger of the internal and external log standard errors from the XSA estimates of survivors were used for the XSA-based forecasts.

Mean weights-at-age have declined in recent years in landings and stock estimates, so the point estimates for 2003 were used in forecasts (so as not to overestimate future biomass). Mean weights-at-age in discards are poorly estimated, so a three-year mean was used for these to reduce possible sensitivity to noise.

There is now a full year of catch data available that post-dates the 110-mm derogation permitted in 2002, so the question (addressed in last year's WG report) of modifying forecasts to account for different levels of derogation uptake no longer applies. At the time of writing information on the number and type of vessels to have decommissioned in Division VIa was only available for the Scottish fleet, and only for 2001-2002, as follows:

	Total VIa Scottish	Decomm. 2001-2002	Percentage
Number of vessels > 10m	384	58	15.10%
Gross tonnage	59328	7273	12.26%
power (KW)	159006	20127	12.66%
days at sea	18174	2208	12.15%

haddock	5220	546	10.46%

Kunzlik (2003) used this information to estimate that the fishing mortality exerted by vessels decommissioned in 2001–2002 was of the order of 11%–12% for haddock in Division VIa, although a commensurate reduction could only be expected if these vessels' quota share was not redistributed. However, any such reduction in *F* (if it exists) will already be incorporated in the assessments presented above, and forecast *F* values need not therefore be modified. Information significant reductions in *F* due to vessels decommissioning during 2003 and 2004 would lead to such a modification, but such information was not available to the WG.

A short-term projection was produced for each of the assessment runs described in Section 4.1.5.2. Input data for these projections are given in Tables 4.1.8.1a–d. The results of the forecast assuming *status quo* F during 2004 are shown in Tables 4.1.8.2a–d (management options) and Tables 4.1.8.3a–d (detailed). Results of a sensitivity analysis of the *status quo* catch prediction are given in Figures 4.1.8.1a–d. Cumulative probability distributions are presented in Figures 4.1.8.2a–d. Short-term forecasts for landings and spawning stock biomass are presented in Figure 4.1.8.3a–d.

The following table summarises the results of the four short-term forecasts assuming *status quo F*:

Year	Run	Landings (000 t)	Discards (000 t)	SSB (000 t)
2003	A	5.3	4.2	33.7
	B			27.5
	C			66.8
	D			72.2
2004	A	12.6	5.5	40.1
	B	10.1	4.5	30.6
	C	20.2	9.0	67.8
	D	19.9	4.9	92.8
2005	A	10.1	4.0	28.5
	B	8.0	4.3	23.1
	C	17.0	7.6	54.3
	D	18.3	4.6	81.1
2006	A	-	-	26.0
	B			23.0
	C			44.9
	D			73.0

4.1.9 Medium-term projections

Due to model uncertainty (see Section 4.1.5), medium-term projections were not produced for this stock. The lack of a clear relationship between spawning-stock biomass and recruitment, and the reliance of the fishery on intermittent large year-classes, make the usefulness of medium-term projections questionable in any case.

4.1.10 Yield and biomass per recruit

Inputs to yield-per-recruit analyses are given in Tables 4.1.8.1a–d. Yield-per-recruit plots are given in Figures 4.1.10.1a–d, while Figures 4.1.10.2a–d present stock-recruitment scatterplots with estimated replacement lines analogous to fishing mortality reference points.

4.1.11 Reference points

B_{pa} is set at 30,000 tonnes and is defined as B_{lim}*1.4. B_{lim} is defined as the lowest observed SSB, considered to be 22,000 tonnes when the current reference points were established in 1998. F_{pa} is 0.5 on the technical basis of a high probability of avoiding SSB falling below B_{pa} in the long term. F_{lim} is not defined.

4.1.12 Quality of assessment

Discard estimates are used in the assessment of this stock, derived from Scottish and Irish sampling programmes. As discussed in the Stock Annex, there are currently problems with the Scottish sampling design which is significantly over-stratified. Work on the development of a new Scottish estimate-collation scheme is nearing completion, and modified discard estimates will be available in time for next year's WG meeting.

The extent of misreporting in the fisheries prosecuting this stock is unknown. No correction has been made to landings data to account for any misreporting. Abundance estimates are likely to be incorrect as a result. The effect of the inclusion of estimates of misreporting may not be straightforward, however, and it would be wrong to conclude that abundance estimates would necessarily increase should account be taken of misreporting.

There is also some concern about the utility of the Scottish groundfish survey indices as a good indicator of haddock abundance. The catchability mismatch trends evident in all the analyses presented above could be explained equally well by a change in survey catchability or by misreporting. The survey changed vessel in 1999, although this post-dates the apparent switch in catchability mismatch by several years, and there have also been modifications in on-board sampling procedures. The fact remains that it may be difficult to base advice on survey data alone without a full evaluation of survey design and implementation.

The WG remain uncertain about the appropriate assessment model to use for this stock. ACFM (October 2003) raised concerns about the estimation of persistent catchability trends for surveys in the TSA model, and requested an investigation into the utility of TSA runs with catch data removed in recent years. Survey-based analyses were also proposed. Having produced the required analyses, it has become clear that the principal assessment methods used (TSA, XSA, SURBA) do not behave as expected for this stock (and for cod and whiting in Division VIa). The WG do not feel able to determine the most suitable assessment method without a more complete evaluation of the expected behaviour of these three models using simulated data. The WG intend that this evaluation be carried out before the October 2004 ACFM meeting. In order to avoid having to revisit the assessment once a decision has been reached, the sections for cod, haddock and whiting in Division VIa include full results from four alternative assessments this year.

4.1.13 Management considerations

The point estimates of mean F_{2-6} in 2003 from the four candidate assessments presented above range from 0.13 to 0.49. The upper bound of this range lies just below F_{pa} (0.5). The range of estimated SSB in 2003 lies from 27 kt to 72 kt: all these estimates lie above B_{lim}, while all but one also lie above B_{pa}. This exception (run B, TSA with all catch and persistent trend in survey q) is from the only run which leads to SSB less than B_{pa} in the short term. Adoption of each of the assessment runs presented above would lead to the following forecasts of catch in 2005 at *status quo F*: 14.1 kt (run A), 12.3 kt (run B), 24.6 kt (run C), 22.9 kt (run D).

There have been several technical conservation measures introduced in the demersal fishery in Division VIa in recent years. These will have affected selectivity for haddock. There have also been a number of decommissioning rounds in the Scottish fleet, which will have reduced effective effort (although the extent of this reduction in 2003 and the early part of 2004 cannot yet be determined). The effect of recent effort regulations is also still to be ascertained. Management for haddock will be strongly linked to that for cod for which there is an ongoing recovery plan (Section 14).

Table 4.1.1.1 Haddock, Division VIa. Nominal catch (tonnes) of haddock, 1986–2001, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[1]
Belgium	-	29	8	9	-	9	1	7	1	+	1	3	2	2	1	2	+	+
Denmark	+	+	+	+	+	+	1	1	-	1	1	-	+	-	-	-	-	+
Faroe Islands	1	-	-	13	-	1	-	-	-	-	-	-	-	-	n/a	n/a		
France	4,956	5,456	3,001	1,335[1,2]	863[1,2]	761[1,2]	761	1,132	753	671	445	270	394[1]	788	282	159[1]	181	195
Germany, Fed.Rep.	25	21	4	4	15	1	2	9	19	14	2	1	1	2	1	1	+	-
Ireland	2,026	2,628	2,731	2,171	773	710	700	911	746	1,406	1,399	1447	1,352	1054	677	744	672	
Norway	45	13	54	74	46	12	72	40	7	13	16[1]	21[1]	28	18	70[1]	33[1]	31	23
Spain	-	-	-	-	-	-	-	-	-	-	-	-	2	4	9	4	4	
UK (E & W)[3]	222	425	114	235	164	137	132	155	254	322	448	493	458	315	199	201	237	
UK (N. Ireland)	155	1	35								...	...	…	...	…	…	…	
UK (Scotland)	12,955	18,503	15,151		10,964	8,434	5,263	10,423	7,421	10,367	10,790	10,352	12,125	8,630	5,933	5,886	5,988	
UK (total)				19,940														4,666
Total	20,385	27,076	21,098	23,781	12,825	10,065	6,932	12,678	9,201	12,794	13,102	12,587	14,360	10,813	7,163	7,030	7,113	4,884
Landings as used by WG	19,574	27,004	21,137	16,693	10,136	10,560	11,353	19,067	14,243	12,372	13,452	12,866	14,401	10,426	6,949	6,731	7,093	5,330
Discards	7,352	16,218	10,164	3,178	5,406	9,192	9,398	16,904	11,192	8,794	11,838	6,623	5,712	5,131	8,207	7,247	8,932	4,244
Unallocated landings	-811	-72	39	-7,088	-2,689	495	4,421	6,389	5,042	-423	350	279	41	-387	-299	-299	-20	446
Total as used by WG	26,926	43,222	31,301	19,871	15,542	19,752	20,752[1]	35,971	25,435	21,166	25,290	19,489	20,114	15,557	15,156	13,978	16,025	9,575

[1]Preliminary. [2]Includes Divisions Vb(EC) and VIb. [3]1989–2002 N. Ireland included with England and Wales. n/a = Not available.

Table 4.1.2.1. Haddock in Division VIa. Commercial and survey tuning series made available to the WG. Effort (first column) is given as reported hours fished per year, numbers landed are in thousands. Data used in the final assessment are highlighted in boldface.

ScoGFS		Scottish Groundfish Survey					
1985	2004						
1	1	0.00	0.25				
1	7						
10	**1104**	**4085**	**68**	**80**	**141**	**388**	**27**
10	**753**	**1669**	**1877**	**17**	**14**	**47**	**90**
10	**5518**	**446**	**460**	**690**	**25**	**34**	**25**
10	**571**	**3610**	**303**	**112**	**246**	**10**	**4**
10	**178**	**488**	**1701**	**98**	**49**	**69**	**5**
10	**2577**	**87**	**54**	**296**	**26**	**6**	**36**
10	**1591**	**1763**	**92**	**25**	**184**	**9**	**4**
10	**3618**	**1193**	**321**	**12**	**13**	**28**	**6**
10	**5371**	**5922**	**675**	**167**	**0**	**2**	**18**
10	**1151**	**2300**	**787**	**126**	**39**	**3**	**1**
10	**7112**	**1074**	**1697**	**485**	**65**	**30**	**10**
10	**4401**	**3742**	**315**	**456**	**125**	**20**	**11**
10	**4262**	**2018**	**1915**	**147**	**151**	**53**	**2**
10	**5034**	**2720**	**616**	**562**	**40**	**64**	**19**
10	**961**	**3038**	**701**	**171**	**131**	**15**	**12**
10	**8036**	**563**	**447**	**97**	**13**	**20**	**0**
10	**3421**	**5762**	**143**	**146**	**34**	**16**	**6**
10	**2339**	**3246**	**5293**	**56**	**70**	**24**	**9**
10	**2650**	**1696**	**1449**	**1874**	**23**	**34**	**18**
10	**1397**	**2765**	**869**	**1199**	**609**	**11**	**3**

IR-WCGFS									
1993	2002								
1	1	0.75	0.79						
0	8								
1849	143	2493	5691	1606	693	29	112	56	35
1610	76	1237	3538	3303	367	187	13	18	66
1826	967	3104	1149	4152	1663	187	149	29	14
1765	192	2536	3688	2155	627	254	126	45	24
1581	2900	8289	636	532	375	294	45	8	3
1639	96	1098	1538	1353	192	84	75	15	49
1564	7985	1028	1967	1530	679	237	118	25	34
1556	1454	8865	569	691	484	183	32	30	0
755	1951	2728	3548	136	187	151	36	4	0
798	6618	2541	2768	1788	67	90	32	5	2

Table 4.1.2.1. contd. Haddock in Division VIa.

ScoLTR

1978	2003			
1	1	0	1	
2	5			
127387	205.970	157.024	1412.263	205.040
99803	2419.532	162.972	32.994	802.863
121211	3869.366	1034.891	183.982	37.996
165002	14862.966	4468.331	423.043	40.004
135280	958.723	17379.104	1721.828	70.994
112332	5747.308	1345.070	10272.253	662.105
132217	2210.088	3687.112	809.840	6080.328
142815	16310.439	905.133	691.017	214.069
126533	2565.893	13292.803	408.899	163.349
131653	4040.797	2770.494	6465.250	249.058
158191	17326.463	2369.239	1008.226	2273.141
217443	1459.316	10332.354	934.040	394.722
131360	1293.654	541.378	3520.472	213.722
209901	8386.068	414.358	218.113	1814.306
189288	3850.242	2937.112	133.408	49.730
189925	17312.309	6469.671	1479.199	89.402
174879	7106.326	6307.283	1574.576	409.496
175631	4850.552	9835.464	2704.111	551.303
214159	15882.858	2665.141	4524.729	1511.694
179605	4231.875	9987.962	882.602	1119.138
142457	6845.462	3530.308	7753.948	573.554
98993	6266.816	4506.559	1124.841	2152.395
76157	2725.197	4725.382	2259.356	499.511
35698	14958.081	1246.235	2075.946	687.201
15174	4200.486	16918.947	400.382	421.166
9357	2114.331	2803.164	6108.682	76.951

IR-OTB

1995	2003						
1	1	0	1				
1	7						
56335	222	298	530	461	92	28	98
60709	165	531	670	281	175	33	12
62698	99	358	515	282	339	133	89
57403	51	1092	552	312	186	218	232
53192	98	315	437	266	198	109	123
46913	50	131	188	303	158	76	65
48358	14	304	144	101	126	100	44
37231	31	162	388	27	65	97	47
42899	4	36	108	231	29	36	29

Table 4.1.2.1. contd. Haddock in Division VIa.

SCOPTR

1987	2003			
1	1	0	1	
2	5			
67500	5664.559	3462.921	8254.314	386.953
73448	19333.629	2791.134	1561.027	3555.323
69051	622.245	6453.549	833.344	617.050
24365	1209.336	432.811	2413.249	161.210
33826	3815.610	267.760	165.980	1059.521
24141	1587.775	1068.706	80.518	28.226
23975	8049.086	3189.459	582.533	48.833
21003	2354.895	2614.523	861.390	226.916
22848	1573.402	3915.253	1501.480	365.819
22237	7475.948	1085.826	2281.053	1002.653
8552	1136.375	3876.218	340.837	523.864
8425	2137.106	1315.696	2734.416	232.941
2483	1936.938	1521.928	399.642	641.984
2335	394.239	620.963	319.038	45.263
1342	230.091	97.936	241.187	46.188
14	115.105	120.723	2.223	2.909
5	107.443	150.615	288.114	29.322

IRGFS (interim indices for new series)

2003	2003										
1	1	0.79	0.92								
0	10										
1	207	7588	2382	839	355	22	30	7	0	3	2

Table 4.1.3.1. Haddock in Division VIa. Landings at age (thousands).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	1030	1006	813	23620	2912	344	247	575
1979	2068	10448	1761	468	9810	833	114	221
1980	2505	12871	5341	915	143	3082	229	54
1981	200	20553	15695	1768	194	39	822	60
1982	250	1342	46283	8004	898	108	272	332
1983	568	4917	4585	34659	3387	597	41	444
1984	3341	4386	10754	5959	20352	2449	371	162
1985	939	19434	4437	4112	1782	11031	964	157
1986	603	4812	26770	1823	916	449	2611	409
1987	4254	7388	9206	23551	1452	1116	642	2203
1988	847	20687	6873	4091	9205	428	235	1167
1989	927	1414	18417	2744	1556	3633	255	666
1990	787	3198	1342	9450	848	279	519	85
1991	2145	10578	1217	834	5131	412	283	457
1992	691	10194	10010	553	236	1575	157	169
1993	745	15008	15975	4594	290	219	910	250
1994	1017	6326	15037	5240	1484	76	175	279
1995	540	3669	12774	6483	1472	387	34	203
1996	437	9457	4968	8626	3622	1007	324	80
1997	883	2831	16921	2125	2638	870	259	67
1998	1345	7129	5675	13387	1352	1036	377	175
1999	346	5501	7159	2960	4864	493	452	115
2000	759	2507	5864	3841	1054	1090	205	156
2001	245	8535	1822	3523	1393	533	314	104
2002	177	1227	13557	691	707	549	199	172
2003	21	1029	2150	8809	221	206	69	55

Table 4.1.3.2. Haddock in Division VIa. Discards at age (thousands).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	14911	1090	157	738	27	7	0	0
1979	68002	6833	104	2	53	0	0	0
1980	20224	9057	295	7	0	0	0	0
1981	51	63359	5002	0	0	0	0	0
1982	15241	3678	27393	163	0	0	0	0
1983	13957	15316	1456	1464	12	0	0	0
1984	95634	4240	2156	284	2438	0	0	0
1985	21882	59488	231	71	6	159	0	0
1986	7524	6423	18597	0	0	0	0	0
1987	84767	9436	944	306	0	0	0	0
1988	9160	37727	725	95	49	0	0	0
1989	4083	2007	7308	11	0	1	0	0
1990	36460	2658	542	2708	23	0	0	0
1991	34779	11413	42	0	1	0	0	0
1992	51148	8776	1322	12	0	2	0	0
1993	42914	45777	4787	74	16	0	5	0
1994	18467	26312	6490	432	94	0	0	0
1995	17040	12090	10825	382	0	0	0	0
1996	32907	30354	1674	1599	41	0	0	0
1997	22961	7676	4629	53	30	0	0	0
1998	10075	10872	2357	1728	0	0	0	0
1999	5834	12554	4410	44	54	86	0	0
2000	49383	4136	2731	372	1	14	0	0
2001	10778	24961	611	143	128	0	0	0
2002	16250	11168	18692	142	8	0	39	0
2003	6951	4564	4697	4021	2	2	1	0

Table 4.1.3.3. Haddock in Division VIa. Total catch at age (thousands).

Year	**Age 1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	15942	2095	971	24357	2938	351	247	575
1979	70070	17282	1865	470	9863	833	114	221
1980	22729	21927	5636	922	143	3082	229	54
1981	251	83911	20697	1768	194	39	822	60
1982	15492	5019	73676	8167	898	108	272	332
1983	14524	20233	6040	36122	3398	597	41	444
1984	98976	8626	12910	6242	22790	2449	371	162
1985	22820	78922	4667	4184	1789	11189	964	157
1986	8127	11235	45367	1823	916	449	2611	409
1987	89021	16824	10150	23857	1452	1116	642	2203
1988	10007	58414	7598	4185	9255	428	235	1167
1989	5010	3420	25724	2755	1556	3634	255	666
1990	37247	5856	1884	12158	871	279	519	85
1991	36924	21991	1259	834	5132	412	283	457
1992	51840	18971	11331	565	236	1577	157	169
1993	43659	60785	20763	4669	306	219	915	250
1994	19484	32638	21527	5671	1579	76	175	279
1995	17580	15759	23599	6865	1472	387	34	203
1996	33344	39812	6641	10225	3663	1007	324	80
1997	23843	10507	21550	2178	2668	870	259	67
1998	11421	18001	8032	15116	1352	1036	377	175
1999	6179	18055	11569	3004	4919	579	452	115
2000	50142	6642	8596	4213	1055	1104	205	156
2001	11023	33496	2432	3666	1521	533	314	104
2002	16427	12394	32248	833	714	549	238	172
2003	6972	5592	6848	12830	222	209	70	56

Table 4.1.3.4. Haddock in Division VIa. Mean weight-at-age in landings (kg).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.257	0.353	0.419	0.524	0.832	1.060	1.152	1.338
1979	0.269	0.386	0.467	0.732	0.779	1.040	1.491	1.754
1980	0.251	0.373	0.587	0.722	0.998	0.985	1.143	1.747
1981	0.289	0.357	0.502	0.887	0.975	1.376	1.294	1.379
1982	0.285	0.369	0.452	0.754	1.126	1.539	1.549	1.555
1983	0.479	0.424	0.518	0.568	1.004	1.370	1.716	1.572
1984	0.273	0.388	0.486	0.705	0.713	1.087	1.392	1.724
1985	0.283	0.346	0.494	0.641	0.803	0.875	1.272	1.694
1986	0.294	0.373	0.440	0.637	0.903	1.115	1.043	1.462
1987	0.276	0.337	0.435	0.570	0.880	1.105	1.250	1.183
1988	0.310	0.338	0.462	0.567	0.706	1.027	1.280	0.984
1989	0.372	0.406	0.468	0.625	0.749	0.894	1.115	1.108
1990	0.335	0.443	0.532	0.618	0.908	1.108	1.280	1.860
1991	0.287	0.382	0.556	0.618	0.678	0.931	1.053	1.200
1992	0.310	0.384	0.461	0.777	0.892	0.932	1.407	1.639
1993	0.313	0.395	0.509	0.655	0.889	0.898	1.026	1.483
1994	0.280	0.352	0.454	0.633	0.723	0.929	0.959	0.992
1995	0.293	0.375	0.415	0.567	0.833	0.978	1.322	1.020
1996	0.285	0.363	0.445	0.492	0.649	0.750	0.754	1.137
1997	0.275	0.365	0.425	0.621	0.735	0.925	1.057	1.020
1998	0.265	0.331	0.416	0.524	0.689	0.802	0.951	1.077
1999	0.313	0.353	0.420	0.496	0.614	0.820	0.840	1.172
2000	0.265	0.347	0.410	0.465	0.572	0.724	0.840	0.813
2001	0.243	0.332	0.457	0.439	0.538	0.657	0.808	1.016
2002	0.254	0.321	0.383	0.566	0.608	0.632	0.691	0.939
2003	0.240	0.311	0.389	0.428	0.654	0.651	0.917	1.091

Table 4.1.3.5. Haddock in Division VIa. Mean weight-at-age in discards (kg).

Year	Age 1	2	3	4	5	6	7	8+
1978	0.125	0.208	0.231	0.259	0.265	0.308	0.000	0.000
1979	0.180	0.230	0.272	0.266	0.303	0.000	0.000	0.000
1980	0.120	0.243	0.287	0.334	0.000	0.000	0.000	0.000
1981	0.106	0.209	0.360	0.000	0.000	0.000	0.000	0.000
1982	0.155	0.238	0.247	0.363	0.000	0.000	0.000	0.000
1983	0.165	0.237	0.283	0.298	0.536	0.000	0.000	0.000
1984	0.145	0.248	0.303	0.331	0.278	0.000	0.000	0.000
1985	0.132	0.242	0.326	0.362	0.423	0.353	0.000	0.000
1986	0.173	0.193	0.248	0.000	0.000	0.000	0.000	0.000
1987	0.163	0.218	0.247	0.281	0.000	0.000	0.000	0.000
1988	0.157	0.208	0.279	0.331	0.341	0.000	0.000	0.000
1989	0.193	0.226	0.237	0.491	0.961	1.423	0.000	2.810
1990	0.108	0.250	0.228	0.242	0.268	0.000	0.000	0.000
1991	0.178	0.218	0.278	0.000	0.263	0.000	0.000	0.000
1992	0.130	0.247	0.258	0.242	0.000	0.947	0.000	0.000
1993	0.105	0.238	0.287	0.382	0.348	0.000	0.430	0.000
1994	0.163	0.229	0.291	0.337	0.304	0.000	0.000	0.000
1995	0.144	0.243	0.281	0.310	0.000	0.000	0.000	0.000
1996	0.126	0.206	0.282	0.300	0.317	0.000	0.000	0.000
1997	0.148	0.226	0.283	0.340	0.317	0.000	0.000	0.000
1998	0.151	0.251	0.298	0.337	0.000	0.000	0.000	0.000
1999	0.163	0.213	0.276	0.318	0.311	0.206	0.000	0.000
2000	0.125	0.223	0.257	0.259	0.625	0.337	0.000	0.000
2001	0.109	0.211	0.243	0.254	0.245	0.000	0.000	0.000
2002	0.117	0.196	0.253	0.305	0.456	0.000	0.358	0.000
2003	0.123	0.223	0.233	0.282	0.462	0.439	0.496	0.493

Table 4.1.3.6. Haddock in Division VIa. Mean weight-at-age in total catch (kg).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.134	0.278	0.388	0.516	0.827	1.045	1.152	1.338
1979	0.182	0.325	0.457	0.730	0.777	1.040	1.491	1.754
1980	0.134	0.319	0.572	0.719	0.998	0.985	1.143	1.747
1981	0.252	0.245	0.467	0.887	0.975	1.376	1.294	1.379
1982	0.157	0.273	0.376	0.746	1.126	1.539	1.549	1.555
1983	0.178	0.282	0.461	0.557	1.002	1.370	1.716	1.572
1984	0.149	0.319	0.456	0.688	0.667	1.087	1.392	1.724
1985	0.138	0.268	0.486	0.636	0.802	0.868	1.272	1.694
1986	0.182	0.270	0.362	0.637	0.903	1.115	1.043	1.462
1987	0.168	0.270	0.418	0.566	0.880	1.105	1.250	1.183
1988	0.170	0.254	0.444	0.562	0.704	1.027	1.280	0.984
1989	0.226	0.301	0.402	0.625	0.749	0.894	1.115	1.109
1990	0.112	0.355	0.445	0.534	0.891	1.108	1.280	1.860
1991	0.184	0.297	0.547	0.618	0.678	0.931	1.053	1.200
1992	0.133	0.321	0.437	0.766	0.892	0.932	1.407	1.639
1993	0.108	0.277	0.458	0.650	0.861	0.898	1.022	1.483
1994	0.169	0.253	0.405	0.611	0.698	0.929	0.959	0.992
1995	0.149	0.274	0.354	0.553	0.833	0.978	1.322	1.020
1996	0.128	0.243	0.404	0.462	0.645	0.750	0.754	1.137
1997	0.153	0.263	0.394	0.614	0.730	0.925	1.057	1.020
1998	0.164	0.283	0.382	0.502	0.689	0.802	0.951	1.077
1999	0.172	0.255	0.365	0.494	0.611	0.729	0.840	1.172
2000	0.127	0.270	0.361	0.447	0.572	0.719	0.840	0.813
2001	0.112	0.242	0.403	0.432	0.514	0.657	0.808	1.016
2002	0.118	0.208	0.307	0.521	0.606	0.632	0.636	0.939
2003	0.124	0.239	0.282	0.382	0.652	0.648	0.908	1.086

Table 4.1.5.1. Haddock in Division VIa. XSA tuning report file.

Lowestoft VPA Version 3.1

4/05/2004 18:17

Extended Survivors Analysis

HADDOCK 2003 IN AREA 6A

CPUE data from file had6aef.dat

Catch data for 26 years. 1978 to 2003. Ages 1 to 8.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SCOGFS	1985	2003	1	7	0	0.25

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages
Catchability independent of age for ages >= 4

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 = 2.000

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

Prior weighting not applied

Tuning converged after 23 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.405	0.133	0.658	0.361	0.207	0.316	0.168	0.104	0.256	0.087
2	0.475	0.68	0.499	0.443	0.512	0.588	0.669	0.162	0.164	0.129
3	0.781	0.77	0.696	0.559	0.736	0.743	0.626	0.554	0.231	0.128
4	0.91	0.618	0.951	0.516	1.025	0.686	0.674	0.604	0.371	0.135
5	0.712	0.636	0.815	0.706	0.717	1.238	0.55	0.551	0.22	0.158
6	0.16	0.371	1.356	0.454	0.666	0.795	1.112	0.602	0.392	0.092
7	2.787	0.1	0.616	2.35	0.363	0.701	0.744	1.233	0.599	0.078

Table 4.1.5.1. cont'd. Haddock in Division VIa. XSA tuning report file.

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7
1994	6.46E+04	9.54E+04	4.39E+04	1.05E+04	3.43E+03	5.65E+02	2.06E+02
1995	1.56E+05	3.53E+04	4.86E+04	1.65E+04	3.46E+03	1.38E+03	3.94E+02
1996	7.65E+04	1.12E+05	1.46E+04	1.84E+04	7.27E+03	1.50E+03	7.78E+02
1997	8.70E+04	3.24E+04	5.56E+04	5.97E+03	5.83E+03	2.63E+03	3.16E+02
1998	6.74E+04	4.97E+04	1.70E+04	2.61E+04	2.92E+03	2.35E+03	1.37E+03
1999	2.52E+04	4.49E+04	2.44E+04	6.68E+03	7.66E+03	1.17E+03	9.91E+02
2000	3.58E+05	1.51E+04	2.04E+04	9.50E+03	2.76E+03	1.82E+03	4.32E+02
2001	1.23E+05	2.48E+05	6.32E+03	8.93E+03	3.96E+03	1.30E+03	4.90E+02
2002	8.04E+04	9.07E+04	1.73E+05	2.97E+03	4.00E+03	1.87E+03	5.83E+02
2003	9.21E+04	5.10E+04	6.30E+04	1.12E+05	1.68E+03	2.63E+03	1.03E+03

Estimated population abundance at 1st Jan 2004

0.00E+00	6.91E+04	3.67E+04	4.54E+04	8.02E+04	1.17E+03	1.96E+03

Taper weighted geometric mean of the VPA populations:

9.39E+04	5.11E+04	2.34E+04	1.03E+04	3.97E+03	1.71E+03	6.95E+02

Standard error of the weighted Log(VPA populations) :

0.8356	0.9718	1.1105	1.1531	1.0023	0.923	0.9008

Log catchability residuals.

Fleet : SCOGFS

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	-0.5	-0.64	-0.2	0.03	-1.01	-0.05	-0.65	-0.38	0.23
2	-0.51	0.35	-0.92	-0.14	0.54	-1.31	0.08	-0.53	0.5
3	-1.3	-0.22	0.06	-0.04	0.3	-0.57	0.14	-0.45	-0.07
4	-0.39	-1.54	-0.01	0.01	0.2	-0.21	-0.14	-0.85	0.23
5	0.57	-1.17	-0.43	-0.06	0.29	-0.16	0.28	0	99.99
6	0.31	0.1	0.45	-0.27	-0.31	-0.63	-0.39	-0.56	-1.27
7	-0.01	-0.06	-0.1	-0.08	0.06	0.09	-0.16	0.08	-0.01

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	-0.36	0.54	0.84	0.64	1.05	0.39	-0.16	0.05	0.11	0.08
2	-0.25	0.01	0.08	0.7	0.58	0.8	0.21	-0.32	0.11	0.03
3	-0.15	0.52	0.02	0.47	0.55	0.32	0.03	0.06	0.32	0.02
4	-0.16	0.7	0.57	0.51	0.44	0.57	-0.35	0.11	0.23	0.08
5	-0.24	0.26	0.19	0.59	-0.05	0.23	-1.14	-0.54	0.14	-0.12
6	-1.07	0.37	0	0.3	0.63	-0.11	-0.22	-0.17	-0.15	-0.18
7	-0.85	0.49	-0.03	-0.63	-0.08	-0.18	99.99	-0.1	0.05	0.11

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

Age	1	2	3	4	5	6	7
Mean Log q	-5.8933	-5.6963	-6.0533	-6.4304	-6.4304	-6.4304	-6.4304
S.E(Log q)	0.5371	0.5516	0.4344	0.5385	0.4992	0.5202	0.296

Table 4.1.5.1. cont'd. Haddock in Division VIa. XSA tuning report file.

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	0.95	0.344	6.19	0.71	19	0.52	-5.89
2	1.04	-0.243	5.5	0.72	19	0.59	-5.7
3	0.88	1.414	6.55	0.89	19	0.37	-6.05
4	0.87	1.247	6.8	0.84	19	0.46	-6.43
5	0.82	1.27	6.81	0.77	18	0.4	-6.51
6	0.77	2.556	6.8	0.88	19	0.33	-6.6
7	0.91	1.231	6.52	0.93	18	0.26	-6.51

Terminal year survivor and F summaries :

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

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	74709	0.551	0	0	1	0.923	0.081
F shrinkage mean	26820	2				0.077	0.211

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
69077	0.53	0.28	2	0.533	0.087

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

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	39201	0.398	0.039	0.1	2	0.952	0.121
F shrinkage mean	9647	2				0.048	0.422

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
36662	0.39	0.22	3	0.559	0.129

Table 4.1.5.1. cont'd. Haddock in Division VIa. XSA tuning report file.

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

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	47692	0.297	0.026	0.09	3	0.973	0.122
F shrinkage mean	7829	2				0.027	0.583

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
45414	0.29	0.17	4	0.588	0.128

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

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	84216	0.266	0.141	0.53	4	0.975	0.129
F shrinkage mean	11964	2				0.025	0.678

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
80239	0.26	0.2	5	0.74	0.135

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	1239	0.275	0.083	0.3	5	0.969	0.151
F shrinkage mean	215	2				0.031	0.661

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1174	0.27	0.16	6	0.57	0.158

Table 4.1.5.1. cont'd. Haddock in Division VIa. XSA tuning report file.

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	2096	0.266	0.126	0.47	6	0.973	0.086
F shrinkage mean	179	2				0.027	0.72

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1962	0.26	0.2	7	0.758	0.092

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	790	0.226	0.094	0.42	7	0.983	0.077
F shrinkage mean	462	2				0.017	0.129

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
783	0.22	0.09	8	0.403	0.078

Table 4.1.5.2. Haddock in VIa. TSA parameters settings. These same settings were used in all three final TSA runs.

Parameter	*Setting*	*Justification*
Age of full selection.	$a_m = 4$	Based on inspection of previous XSA runs.
Age below which all caught fish are discarded.	$a_{d1} = 1$	TSA assumes that all caught fish of age $a < a_{d1}$ are discarded. In this stock, many fish are landed at the lowest age (1).
Age above which all caught fish are landed.	$a_{d2} = 4$	TSA assumes that all caught fish of age $a > a_{d2}$ are landed. This setting of a_{d2} was made as there is believed to be negligible discarding of age 5 haddock in Division VIa.
Multipliers on variance matrices of measurements.	$B_{\text{landings}}(a) = 2$ for ages 7, 8+ $B_{\text{discards}}(a) = 2$ for age 5 $B_{\text{survey}}(a) = 2$ for age 6	Allows extra measurement variability for older ages.
Multipliers on variances for fishing mortality estimates.	$H(1) = 2$	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points at (year, age) (implemented by multiplying the relevant q by 3)	Landings: (1984,1), (1982,7) Discards: (1984,1), (1981,2), (1990,4) Survey: (1993,2), (2002,3), (2003,4), (2004,4), (1995,7)	Outliers in prediction error plots.
Discards	Discards are allowed to evolve over time constrained by a trend.	
Recruitment.	Recruitment is modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean $\eta_1 S \exp(-\eta_2 S)$, where S is the spawning stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation cv_{rec} is assumed.	
Large year classes.	The 1979, 1983, 1986, and 1999 year classes were large, and recruitment at age 1 in 1980, 1984, 1987, and 2000 is not well modelled by the Ricker recruitment model. Instead, $N(1, 1980)$, $N(1, 1984)$, $N(1, 1987)$, and $N(1, 2000)$ are taken to be normally distributed with mean $5\eta_1 S \exp(-\eta_2 S)$. The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966-1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The same coefficient of variation of recruitment was assumed as for the other year classes.	

Table 4.1.5.3. Haddock in Division VIa. TSA parameter estimates. Corresponding estimates from the last three years' assessments are given for comparison. Three estimates are given for the 2004 assessment: A = all catch & survey with no trend, B = all catch & survey with trend, C = catch 1978–1994 & survey with no trend. * = fixed parameter.

Parameter	Notation	Description	2001 estimate	2002 estimate	2003 estimate	2004 estimate run A	2004 estimate run B	2004 estimate run C
Initial fishing mortality	*F* (1, 1978)	Fishing mortality at age *a* in year *y*	0.27	0.27	0.42	0.33	0.34	0.28
	F (2, 1978)		0.50	0.50	0.67	0.50	0.51	0.50
	F (4, 1978)		0.79	0.79	0.53	0.50	0.51	0.51
Survey selectivities	$\Phi(1)$	Survey selectivity at age *a*	3.69	3.74	3.99	3.78	4.27	2.25
	$\Phi(2)$		4.53	4.77	4.84	4.07	4.20	2.71
	$\Phi(4)$		2.00	2.00	2.10	2.19	2.10	1.51
Fishing mortality standard deviations	σ_F	*Transitory changes in overall* F	0.14	0.14	0.00	0.00	0.00	0.11
	σ_U	Persistent changes in selection (age effect in *F*)	0.07	0.07	0.05	0.09	0.06	0.04
	σ_V	Transitory changes in the year effect in *F*	0.16	0.16	0.27	0.23	0.31	0.23
	σ_Y	Persistent changes in the year effect in *F*	0.12	0.12	0.00	0.00	0.00	0.14
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.27	0.26	0.00	0.32	0.00	0.08
	σ_β	Persistent changes in survey catchability	0.00	0.00	0.14	0.00*	0.19	0.00*
Measurement standard deviations	$\sigma_{landings}$	Standard error of landings-at-age data	0.20	0.20	0.22	0.19	0.19	0.25
	$\sigma_{discards}$	Standard error of discards-at-age data	0.43	0.43	0.51	0.56	0.90	0.43
	σ_{survey}	Standard error of survey data	0.38	0.38	0.40	0.32	0.37	0.34
Discard curve parameters	σ_P	Transitory changes in overall discard proportion	0.42	0.40	0.50	0.56	0.48	0.19
	$\sigma_{\alpha1}$	Transitory changes in discard-ogive intercept	0.00	0.00	0.00	0.01	0.00	0.15
	σ_{v1}	Persistent changes in discard-ogive intercept	0.27	0.26	0.26	0.21	0.20	0.21
	$\sigma_{\alpha2}$	Transitory changes in discard-ogive slope	0.00	0.00	0.34	0.35	0.38	0.01
	σ_{v2}	Persistent changes in discard-ogive slope	0.00	0.00	0.02	0.03	0.04	0.61
Trend parameters	θ_{v1}	Trend parameter for discard-ogive intercept	0.116	0.117	0.00*	0.00*	0.00*	0.00*
	θ_{v2}	Trend parameter for discard-ogive slope	0.014	0.010	0.00*	0.00*	0.00*	0.00*
Recruitment	η_1	Ricker parameter (slope at the origin)	9.37	8.84	9.10	9.37	6.44	9.63
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.35	0.34	0.33	0.32	0.26	0.29
	cv_{rec}	Standard error of recruitment data	0.38	0.37	0.52	0.88	0.89	0.89

Table 4.1.5.4.a. Haddock in Division VIa. TSA population numbers-at-age (thousands) from run A (all catch data & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	75678	8436	2357	67432	4304	579	532	1116
1979	162749	44682	4165	985	26643	1311	189	587
1980	503190	90512	18486	1586	335	9386	256	210
1981	61058	327238	45096	7254	619	122	3714	71
1982	69469	40711	192562	22278	3192	277	52	1634
1983	43245	45722	23541	104369	11121	1568	134	792
1984	345172	28956	26102	11815	51521	5570	781	492
1985	68589	196395	11853	10090	4636	19817	2145	488
1986	58088	40662	93588	5060	4165	1962	8386	1114
1987	250023	37508	22166	48074	2599	2141	1008	4884
1988	21441	137203	14755	7844	16302	875	715	1982
1989	14297	11732	57601	5599	2798	5831	314	963
1990	87829	7871	4743	22637	1994	971	2022	440
1991	117587	54236	3212	2097	9914	873	426	1078
1992	171598	70338	22918	1125	854	4012	354	610
1993	162306	109173	34266	9706	532	392	1859	446
1994	51597	94415	43231	10414	3261	178	131	771
1995	170804	31593	41969	15364	3610	1128	62	313
1996	70959	111934	16169	18480	6385	1499	468	155
1997	90497	41677	50514	6036	5792	1979	463	192
1998	83830	57792	20862	22795	2447	2314	789	261
1999	24237	49270	24181	7857	7434	809	755	341
2000	291301	13985	18841	8620	2509	2295	253	339
2001	105600	180036	5657	6982	3053	912	817	212
2002	64174	67216	86549	2258	2463	1114	334	375
2003	99098	42132	35610	41681	937	1022	464	295
2004*	6457	68163	25458	20658	22227	501	549	408
2005*	103535	4110	33954	11646	8140	8758	197	377
GM(78-03)	90633	51147	21750	9421	3485	1363	520	506

*Estimates for 2004 and 2005 are TSA forecasts, assuming 3-year mean weights-at-age and Ricker recruitment.

Table 4.1.5.4.b. Haddock in Division VIa. TSA population numbers-at-age (thousands) from run B (all catch data & persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	75120	8548	2376	66034	4428	594	532	1126
1979	164476	44038	4180	992	26055	1411	200	600
1980	491529	91804	18622	1611	340	9209	318	228
1981	61511	322139	46270	7445	636	126	3702	115
1982	68897	41497	192898	22514	3230	285	53	1661
1983	43594	45583	24481	104153	11048	1553	136	791
1984	348350	29193	26075	12191	51750	5571	781	486
1985	68749	199710	11981	9846	4694	19862	2141	487
1986	61280	40803	95365	5209	4193	1994	8438	1116
1987	263660	39742	23118	50615	2708	2171	1039	4991
1988	21924	143172	15441	8142	17119	915	733	2036
1989	14510	11966	59647	5786	2907	6131	329	993
1990	87205	8037	4846	22898	2037	998	2107	453
1991	116418	53110	3249	2134	9952	880	432	1104
1992	170974	69491	22221	1085	876	3939	352	611
1993	164721	108446	34091	9522	501	406	1823	446
1994	53963	93824	42368	10615	3188	169	138	764
1995	174941	31964	40532	14884	3609	1061	57	304
1996	69800	113468	16064	17599	6125	1472	428	145
1997	86505	40942	50065	5967	5654	1936	462	177
1998	75573	55375	20655	22608	2481	2310	788	260
1999	21851	44333	23177	7673	7364	818	753	340
2000	250127	12517	17339	8132	2446	2257	254	336
2001	85006	153224	5461	6693	2882	867	800	209
2002	52053	53229	72782	2145	2324	1026	309	358
2003	63769	33898	27988	34248	871	942	418	272
2004*	31913	44410	20474	15784	17747	452	490	358
2005*	90131	20401	22431	9241	6224	6998	178	335
GM(78-03)	86933	49736	21400	9318	3471	1360	522	514

*Estimates for 2004 and 2005 are TSA forecasts, assuming 3-year mean weights-at-age and Ricker recruitment.

Table 4.1.5.4.c. Haddock in Division VIa. TSA population numbers-at-age (thousands) from run C (missing catch data 1995–2003 & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	74987	7896	2410	66752	4365	604	517	1098
1979	181625	44927	4003	1036	26503	1392	212	601
1980	488256	94306	17787	1563	371	9306	353	242
1981	62184	326575	46302	6934	605	151	3812	174
1982	73582	42648	196723	22330	3174	289	74	1860
1983	49626	49397	25769	106309	11376	1636	148	976
1984	332968	29234	26863	12877	52389	5656	803	562
1985	73383	196954	11826	9858	5193	21593	2268	549
1986	59910	42989	98428	5143	4121	2338	9154	1226
1987	256568	39371	23285	50054	2600	2112	1215	5231
1988	21197	144183	15291	8292	17515	889	707	2220
1989	16353	11289	63309	5837	2992	6393	339	1081
1990	99880	8623	4744	24929	2137	1022	2239	498
1991	127197	58867	3396	2058	10348	885	432	1126
1992	206892	72026	25426	1271	848	3930	350	605
1993	212056	133050	36230	11444	563	400	1773	435
1994	75246	134627	58744	13499	4433	211	154	841
1995	317552	47141	70323	27626	5897	2020	98	449
1996	187163	197053	23285	31737	11690	2419	852	229
1997	196630	109704	90976	9649	12316	4472	912	413
1998	221872	115991	48761	36271	3592	4604	1654	489
1999	44101	120319	45493	16451	10859	1105	1402	647
2000	540823	21642	38950	12440	4086	2438	259	480
2001	195714	298133	8746	12799	3813	1243	747	227
2002	117708	129211	158067	4385	5805	1704	575	444
2003	142454	78301	72757	81352	2112	2794	836	496
2004*	69108	94551	43627	37424	39430	1013	1340	645
2005*	89713	45091	51461	21669	17507	18455	472	925
GM(78-03)	121765	66223	27703	11843	4360	1696	647	641

*Estimates for 2004 and 2005 are TSA forecasts, assuming 3-year mean weights-at-age and Ricker recruitment.

Table 4.1.5.4.d. Haddock in Division VIa. XSA population numbers-at-age (thousands).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	60451	7330	3856	50459	5263	700	569	1308
1979	179706	35069	4105	2279	19273	1650	255	487
1980	443882	83730	13075	1673	1440	6854	597	139
1981	41507	342853	48711	5605	536	1050	2823	206
1982	80847	33756	204778	21154	2989	264	824	997
1983	45113	52174	23095	100994	9930	1635	118	1268
1984	379687	23793	24409	13443	50002	5055	798	344
1985	71449	221305	11676	8303	5358	20317	1922	308
1986	54412	37848	109777	5336	3012	2768	6510	1009
1987	266021	37194	20822	48829	2719	1638	1861	6324
1988	22387	137250	15229	7863	18390	913	331	1603
1989	18944	9274	59515	5593	2651	6683	360	918
1990	106559	10977	4498	25451	2087	762	2184	354
1991	119762	53541	3688	1978	9837	920	372	581
1992	204830	64643	23937	1881	865	3410	381	406
1993	164769	120794	35760	9345	1028	494	1365	364
1994	64642	95398	43897	10491	3426	565	206	315
1995	156180	35295	48573	16462	3457	1377	394	2354
1996	76457	111962	14637	18415	7266	1499	778	190
1997	87032	32426	55644	5975	5825	2634	316	79
1998	67443	49681	17041	26058	2921	2355	1369	629
1999	25220	44883	24387	6685	7657	1168	991	249
2000	358201	15057	20411	9498	2755	1819	432	323
2001	122950	247900	6317	8933	3965	1301	490	159
2002	80395	90689	172656	2971	3997	1870	583	416
2003	92075	50958	63035	112179	1679	2626	1034	820
GM (78-03)	93907	51116	23416	10349	3971	1712	695	507

Table 4.1.5.5.a. Haddock in Division VIa. Standard error on TSA population numbers-at-age from run A (all catch data & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	7100	702	263	419	951	169	100	278
1979	13708	3874	356	135	1358	486	90	159
1980	34676	7964	1889	188	71	942	261	104
1981	4066	23123	4533	955	110	42	607	173
1982	7389	2703	14001	2397	525	68	26	448
1983	5608	4802	1518	7432	1275	290	39	260
1984	32685	3222	2352	699	3466	580	133	124
1985	6889	17369	1217	1085	317	1445	228	69
1986	5608	3706	7769	513	473	192	883	147
1987	28171	3363	1973	3999	261	253	112	569
1988	2955	13110	1244	778	1582	117	118	305
1989	2497	1170	5278	532	323	726	56	179
1990	9506	1178	428	2284	225	152	357	103
1991	10474	5515	393	181	997	107	73	199
1992	15549	5719	2138	148	73	453	51	108
1993	14978	9301	2609	977	61	34	221	64
1994	6512	8411	3642	913	313	21	14	97
1995	14948	3560	3546	1322	345	136	9	46
1996	8198	9996	1652	1593	603	171	69	26
1997	9969	4720	4295	552	593	253	76	37
1998	9832	6256	2163	1925	235	279	123	49
1999	3612	5862	2669	775	740	96	119	65
2000	36087	2118	2487	1007	276	323	44	72
2001	13472	22395	835	956	366	112	142	44
2002	11103	8846	10765	336	374	164	55	78
2003	11169	7389	5095	5753	168	198	91	63
2004*	38356	7730	4663	3387	3716	104	125	88
2005*	91629	24405	5998	2749	1999	2327	59	116
GM(78-03)	9799	5186	2112	861	388	191	95	110

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.5.b. Haddock in Division VIa. Standard error on TSA population numbers-at-age from run B (all catch data & persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	6886	696	255	379	909	160	94	261
1979	13134	3706	346	129	1305	459	84	147
1980	33428	7628	1838	185	67	896	246	96
1981	3955	22776	4483	982	109	41	585	166
1982	7084	2725	14447	2528	557	69	26	442
1983	5357	4738	1605	8007	1363	314	41	263
1984	31819	3081	2335	745	3793	640	150	132
1985	6980	17539	1202	1012	352	1665	275	85
1986	5762	3696	7616	464	384	178	851	147
1987	27323	3405	1962	3862	221	188	96	497
1988	2556	12171	1213	724	1433	95	86	248
1989	1971	1047	5190	554	319	701	48	152
1990	9090	1036	421	2397	256	164	376	99
1991	9830	5356	378	188	1104	128	84	226
1992	14933	5682	2233	151	86	542	66	137
1993	14347	9228	2682	1052	66	42	271	85
1994	5800	8194	3526	971	358	24	17	121
1995	14872	3272	3542	1373	406	168	12	62
1996	7574	10208	1608	1668	672	211	90	35
1997	9500	4288	4245	519	615	273	91	46
1998	8990	5893	1974	1875	228	287	132	56
1999	3391	5212	2455	687	707	89	116	65
2000	30131	1953	2178	899	237	296	40	65
2001	11868	17965	750	802	312	89	120	36
2002	11467	7810	9014	331	363	157	49	72
2003	14390	7804	4757	5185	184	215	96	65
2004*	31710	10204	5102	3260	3549	119	139	98
2005*	80851	20255	6028	2777	1846	2110	62	121
GM(78-03)	9343	4946	2047	846	392	195	98	114

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.5.c. Haddock in Division VIa. Standard error on TSA population numbers-at-age from run C (missing catch data 1995–2003 & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	7784	764	316	457	1196	220	138	354
1979	16410	4626	414	166	2019	633	124	208
1980	41422	10017	2390	219	88	1327	345	137
1981	4801	28402	6034	1248	133	55	853	227
1982	7635	3324	18565	3343	704	84	35	591
1983	5699	5383	2040	10369	1785	397	51	350
1984	37351	3325	2843	948	4977	854	194	177
1985	7606	20292	1551	1351	588	2836	505	148
1986	5734	4363	10667	650	600	339	1642	304
1987	29455	3594	2611	5660	330	323	206	993
1988	3435	14350	1575	1058	2272	148	168	508
1989	2928	1276	6628	681	450	1044	77	279
1990	11205	1330	536	3102	313	226	557	162
1991	12715	6483	489	217	1337	147	112	293
1992	18565	6894	3007	188	95	656	77	161
1993	20841	12448	3565	1408	77	48	340	97
1994	12271	14372	6107	1634	557	28	22	160
1995	32457	7432	8250	3477	878	301	16	89
1996	25437	23315	3895	4806	1924	489	178	57
1997	24996	16112	13633	1738	2220	925	241	109
1998	23184	16229	8165	6735	727	998	436	147
1999	12498	17258	8557	3479	2663	304	458	244
2000	117093	6879	9144	3314	1033	931	122	252
2001	32508	57614	2220	2729	746	239	256	95
2002	24567	17916	25224	731	846	233	96	109
2003	25614	14522	10223	13202	329	433	133	95
2004*	32337	16395	7729	6517	6631	181	262	128
2005*	80850	21306	11429	5346	4577	4776	129	265
GM(78-03)	15180	7997	3580	1506	686	333	168	194

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.6.a. Haddock in Division VIa. TSA estimates of fishing mortality-at-age from run A (all catch data & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.327	0.509	0.660	0.751	0.751	0.751	0.751	0.751
1979	0.372	0.611	0.751	0.800	0.800	0.800	0.800	0.800
1980	0.275	0.455	0.573	0.615	0.615	0.615	0.615	0.615
1981	0.227	0.358	0.461	0.500	0.500	0.500	0.500	0.500
1982	0.216	0.334	0.396	0.477	0.476	0.476	0.477	0.477
1983	0.230	0.377	0.385	0.472	0.472	0.472	0.472	0.472
1984	0.371	0.627	0.707	0.734	0.734	0.734	0.734	0.734
1985	0.322	0.549	0.630	0.654	0.654	0.654	0.654	0.654
1986	0.228	0.407	0.466	0.465	0.465	0.465	0.465	0.465
1987	0.397	0.733	0.829	0.872	0.872	0.872	0.872	0.872
1988	0.356	0.660	0.755	0.801	0.801	0.801	0.801	0.801
1989	0.339	0.652	0.713	0.793	0.793	0.793	0.793	0.793
1990	0.281	0.590	0.621	0.624	0.624	0.624	0.624	0.624
1991	0.310	0.656	0.751	0.701	0.701	0.701	0.701	0.701
1992	0.237	0.501	0.656	0.566	0.566	0.566	0.566	0.566
1993	0.342	0.724	0.991	0.894	0.894	0.894	0.894	0.894
1994	0.299	0.611	0.835	0.854	0.854	0.854	0.854	0.854
1995	0.223	0.471	0.620	0.676	0.676	0.676	0.676	0.676
1996	0.304	0.593	0.784	0.942	0.942	0.942	0.942	0.942
1997	0.244	0.479	0.596	0.708	0.708	0.708	0.708	0.708
1998	0.309	0.634	0.756	0.905	0.905	0.905	0.905	0.905
1999	0.310	0.663	0.774	0.921	0.921	0.921	0.921	0.921
2000	0.278	0.606	0.716	0.823	0.823	0.823	0.823	0.823
2001	0.260	0.539	0.666	0.805	0.805	0.805	0.805	0.805
2002	0.222	0.436	0.529	0.674	0.674	0.674	0.674	0.674
2003	0.143	0.282	0.331	0.416	0.416	0.416	0.416	0.416
2004*	0.252	0.497	0.582	0.731	0.731	0.731	0.731	0.731
2005*	0.263	0.518	0.607	0.763	0.763	0.763	0.763	0.763

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.6.b Haddock in Division VIa. TSA estimates of fishing mortality-at-age from run B (all catch data & persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.333	0.520	0.665	0.749	0.749	0.749	0.749	0.749
1979	0.369	0.596	0.740	0.799	0.799	0.799	0.799	0.799
1980	0.271	0.442	0.555	0.603	0.603	0.603	0.603	0.603
1981	0.219	0.352	0.446	0.485	0.485	0.485	0.485	0.485
1982	0.214	0.341	0.415	0.473	0.473	0.473	0.473	0.473
1983	0.226	0.372	0.418	0.480	0.480	0.480	0.480	0.480
1984	0.366	0.616	0.721	0.755	0.755	0.755	0.755	0.755
1985	0.317	0.540	0.631	0.656	0.656	0.656	0.656	0.656
1986	0.210	0.370	0.429	0.433	0.433	0.433	0.433	0.433
1987	0.410	0.742	0.844	0.884	0.884	0.884	0.884	0.884
1988	0.366	0.672	0.763	0.802	0.802	0.802	0.802	0.802
1989	0.344	0.650	0.715	0.764	0.764	0.764	0.764	0.764
1990	0.289	0.581	0.624	0.621	0.621	0.621	0.621	0.621
1991	0.317	0.643	0.733	0.692	0.692	0.692	0.692	0.692
1992	0.249	0.505	0.632	0.570	0.570	0.570	0.570	0.570
1993	0.363	0.740	0.963	0.886	0.886	0.886	0.886	0.886
1994	0.321	0.640	0.839	0.841	0.841	0.841	0.841	0.841
1995	0.238	0.482	0.623	0.663	0.663	0.663	0.663	0.663
1996	0.319	0.618	0.791	0.908	0.908	0.908	0.908	0.908
1997	0.246	0.480	0.594	0.685	0.685	0.685	0.685	0.685
1998	0.324	0.650	0.785	0.913	0.913	0.913	0.913	0.913
1999	0.333	0.685	0.820	0.947	0.947	0.947	0.947	0.947
2000	0.292	0.607	0.738	0.837	0.837	0.837	0.837	0.837
2001	0.276	0.551	0.695	0.827	0.827	0.827	0.827	0.827
2002	0.228	0.445	0.556	0.686	0.686	0.686	0.686	0.686
2003	0.153	0.299	0.369	0.453	0.453	0.453	0.453	0.453
2004*	0.247	0.483	0.596	0.731	0.731	0.731	0.731	0.731
2005*	0.262	0.511	0.630	0.773	0.773	0.773	0.773	0.773

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.6.c. Haddock in Division VIa. TSA estimates of fishing mortality-at-age from run C (missing catch data 1995–2003 & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.315	0.471	0.636	0.744	0.739	0.725	0.712	0.718
1979	0.432	0.643	0.733	0.785	0.808	0.791	0.803	0.799
1980	0.223	0.450	0.559	0.640	0.588	0.601	0.604	0.596
1981	0.190	0.330	0.448	0.457	0.463	0.453	0.467	0.463
1982	0.199	0.303	0.414	0.451	0.440	0.449	0.454	0.445
1983	0.307	0.415	0.401	0.482	0.486	0.494	0.491	0.503
1984	0.322	0.568	0.708	0.706	0.684	0.701	0.708	0.693
1985	0.333	0.492	0.586	0.627	0.589	0.642	0.618	0.611
1986	0.216	0.403	0.473	0.483	0.470	0.455	0.484	0.483
1987	0.375	0.746	0.811	0.838	0.865	0.871	0.852	0.848
1988	0.377	0.621	0.749	0.786	0.784	0.757	0.764	0.776
1989	0.372	0.608	0.704	0.757	0.785	0.786	0.781	0.778
1990	0.322	0.648	0.641	0.677	0.676	0.660	0.680	0.676
1991	0.370	0.626	0.709	0.691	0.748	0.723	0.743	0.730
1992	0.233	0.480	0.597	0.612	0.547	0.596	0.590	0.584
1993	0.256	0.609	0.787	0.749	0.759	0.726	0.761	0.760
1994	0.263	0.426	0.535	0.626	0.574	0.562	0.634	0.585
1995	0.280	0.513	0.601	0.665	0.686	0.664	0.663	0.667
1996	0.332	0.574	0.686	0.748	0.759	0.767	0.756	0.756
1997	0.329	0.607	0.717	0.786	0.782	0.789	0.791	0.788
1998	0.420	0.742	0.894	0.989	0.976	0.976	0.977	0.976
1999	0.487	0.911	1.076	1.172	1.199	1.183	1.175	1.174
2000	0.386	0.739	0.915	0.975	0.959	0.987	0.976	0.974
2001	0.225	0.421	0.544	0.605	0.571	0.580	0.590	0.589
2002	0.212	0.376	0.458	0.539	0.537	0.515	0.525	0.527
2003	0.208	0.383	0.464	0.518	0.536	0.537	0.526	0.529
2004*	0.227	0.408	0.500	0.560	0.559	0.563	0.564	0.562
2005*	0.234	0.423	0.518	0.580	0.580	0.580	0.580	0.580

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.6.d. Haddock in Division VIa. XSA estimates of fishing mortality-at-age.

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.345	0.380	0.326	0.763	0.960	0.810	0.654	0.654
1979	0.564	0.787	0.697	0.259	0.834	0.816	0.685	0.685
1980	0.058	0.342	0.647	0.939	0.116	0.687	0.551	0.551
1981	0.007	0.315	0.634	0.429	0.510	0.042	0.389	0.389
1982	0.238	0.180	0.507	0.556	0.404	0.601	0.453	0.453
1983	0.440	0.560	0.341	0.503	0.475	0.517	0.483	0.483
1984	0.340	0.512	0.878	0.720	0.701	0.767	0.722	0.722
1985	0.435	0.501	0.583	0.814	0.460	0.938	0.808	0.808
1986	0.180	0.398	0.610	0.474	0.409	0.197	0.586	0.586
1987	0.462	0.693	0.774	0.777	0.892	1.399	0.480	0.480
1988	0.681	0.636	0.802	0.887	0.812	0.730	1.531	1.531
1989	0.346	0.524	0.650	0.786	1.046	0.919	1.521	1.521
1990	0.488	0.891	0.622	0.751	0.619	0.519	0.305	0.305
1991	0.417	0.605	0.474	0.628	0.860	0.683	1.847	1.847
1992	0.328	0.392	0.741	0.404	0.360	0.716	0.608	0.608
1993	0.347	0.812	1.026	0.803	0.398	0.675	1.351	1.351
1994	0.405	0.475	0.781	0.910	0.712	0.160	2.787	2.787
1995	0.133	0.680	0.770	0.618	0.636	0.372	0.100	0.100
1996	0.658	0.499	0.696	0.951	0.815	1.356	0.616	0.616
1997	0.361	0.443	0.559	0.516	0.706	0.454	2.350	2.350
1998	0.207	0.512	0.736	1.025	0.717	0.666	0.363	0.363
1999	0.316	0.588	0.743	0.686	1.238	0.795	0.701	0.701
2000	0.168	0.669	0.626	0.674	0.550	1.112	0.744	0.744
2001	0.104	0.162	0.554	0.604	0.551	0.602	1.233	1.233
2002	0.256	0.164	0.231	0.371	0.220	0.392	0.599	0.599
2003	0.087	0.129	0.128	0.135	0.158	0.092	0.078	0.078

Table 4.1.5.7.a. Haddock in Division VIa. TSA estimates of standard errors of log fishing mortality-at-age from run A (all catch data & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.1793	0.1331	0.128	0.0819	0.0819	0.0819	0.0819	0.0819
1979	0.1656	0.1264	0.1113	0.0811	0.0811	0.0811	0.0811	0.0811
1980	0.1689	0.1342	0.12	0.0887	0.0887	0.0887	0.0887	0.0887
1981	0.1701	0.1428	0.1194	0.0948	0.0948	0.0948	0.0948	0.0948
1982	0.1665	0.1361	0.1151	0.0915	0.0914	0.0915	0.0915	0.0915
1983	0.1621	0.129	0.1136	0.0867	0.0867	0.0867	0.0867	0.0867
1984	0.166	0.1256	0.1058	0.0728	0.0728	0.0728	0.0728	0.0728
1985	0.1632	0.1307	0.1164	0.0892	0.0892	0.0892	0.0892	0.0892
1986	0.1659	0.1309	0.115	0.092	0.092	0.092	0.092	0.092
1987	0.1592	0.1134	0.1028	0.0741	0.0741	0.0741	0.0741	0.0741
1988	0.1614	0.1222	0.1027	0.078	0.078	0.078	0.078	0.078
1989	0.1632	0.1296	0.1103	0.0792	0.0792	0.0792	0.0792	0.0792
1990	0.1606	0.128	0.1177	0.0876	0.0876	0.0876	0.0876	0.0876
1991	0.1563	0.123	0.1152	0.0821	0.0821	0.0821	0.0821	0.0821
1992	0.1561	0.1223	0.1092	0.0869	0.0869	0.0869	0.0869	0.0869
1993	0.1493	0.1072	0.0876	0.0732	0.0732	0.0732	0.0732	0.0732
1994	0.1548	0.1197	0.1005	0.078	0.078	0.078	0.078	0.078
1995	0.1609	0.1312	0.1127	0.0864	0.0864	0.0864	0.0864	0.0864
1996	0.1586	0.1258	0.1111	0.076	0.076	0.076	0.076	0.076
1997	0.1634	0.1384	0.1193	0.0867	0.0867	0.0867	0.0867	0.0867
1998	0.1639	0.1347	0.1195	0.077	0.077	0.077	0.077	0.077
1999	0.1708	0.1367	0.1211	0.0817	0.0817	0.0817	0.0817	0.0817
2000	0.1774	0.1416	0.1268	0.089	0.089	0.089	0.089	0.089
2001	0.1844	0.152	0.1352	0.0959	0.0959	0.0959	0.0959	0.0959
2002	0.1995	0.173	0.1552	0.1199	0.1199	0.1199	0.1199	0.1199
2003	0.2343	0.2211	0.2111	0.1724	0.1724	0.1724	0.1724	0.1724
2004*	0.3009	0.2851	0.2809	0.2689	0.2689	0.2689	0.2689	0.2689
2005*	0.3122	0.2985	0.2948	0.2855	0.2855	0.2855	0.2855	0.2855

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.7.b. Haddock in Division VIa. TSA estimates of standard errors of log fishing mortality-at-age from run B (all catch data & persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.1707	0.127	0.1196	0.0792	0.0792	0.0792	0.0792	0.0792
1979	0.1583	0.1214	0.106	0.079	0.079	0.079	0.079	0.079
1980	0.1608	0.1281	0.1137	0.0875	0.0875	0.0875	0.0875	0.0875
1981	0.1616	0.1357	0.1143	0.0929	0.0929	0.0929	0.0929	0.0929
1982	0.1579	0.1289	0.1099	0.0893	0.0893	0.0893	0.0893	0.0893
1983	0.1529	0.1235	0.1077	0.0857	0.0857	0.0857	0.0857	0.0857
1984	0.1531	0.1181	0.0987	0.0721	0.0721	0.0721	0.0721	0.0721
1985	0.1521	0.122	0.108	0.0832	0.0832	0.0832	0.0832	0.0832
1986	0.155	0.1219	0.1066	0.089	0.089	0.089	0.089	0.089
1987	0.1462	0.1026	0.092	0.0696	0.0696	0.0696	0.0696	0.0696
1988	0.1489	0.1107	0.0949	0.0748	0.0748	0.0748	0.0748	0.0748
1989	0.1515	0.1192	0.1032	0.0788	0.0788	0.0788	0.0788	0.0788
1990	0.1493	0.1185	0.1098	0.0861	0.0861	0.0861	0.0861	0.0861
1991	0.1452	0.1168	0.1075	0.0816	0.0816	0.0816	0.0816	0.0816
1992	0.1452	0.1162	0.105	0.0857	0.0857	0.0857	0.0857	0.0857
1993	0.1362	0.1022	0.0856	0.0732	0.0732	0.0732	0.0732	0.0732
1994	0.1422	0.1129	0.0965	0.0785	0.0785	0.0785	0.0785	0.0785
1995	0.1497	0.1237	0.1086	0.0859	0.0859	0.0859	0.0859	0.0859
1996	0.1467	0.1189	0.1053	0.0761	0.0761	0.0761	0.0761	0.0761
1997	0.1531	0.1286	0.1129	0.0846	0.0846	0.0846	0.0846	0.0846
1998	0.1531	0.124	0.1084	0.0737	0.0737	0.0737	0.0737	0.0737
1999	0.1599	0.1262	0.1104	0.0779	0.0779	0.0779	0.0779	0.0779
2000	0.1675	0.1313	0.1159	0.0855	0.0855	0.0855	0.0855	0.0855
2001	0.1763	0.1433	0.1263	0.0978	0.0978	0.0978	0.0978	0.0978
2002	0.1965	0.1719	0.1541	0.1282	0.1282	0.1282	0.1282	0.1282
2003	0.2423	0.2299	0.2187	0.1889	0.1889	0.1889	0.1889	0.1889
2004*	0.3501	0.3369	0.3333	0.3251	0.3251	0.3251	0.3251	0.3251
2005*	0.359	0.3486	0.3449	0.3397	0.3397	0.3397	0.3397	0.3397

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.7.c. Haddock in Division VIa. TSA estimates of standard errors of log fishing mortality-at-age from run C (missing catch data 1995–2003 & no persistent survey trend).

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.206	0.143	0.143	0.121	0.133	0.145	0.150	0.148
1979	0.186	0.132	0.131	0.131	0.123	0.138	0.148	0.147
1980	0.217	0.144	0.145	0.135	0.143	0.137	0.153	0.154
1981	0.218	0.156	0.144	0.139	0.144	0.152	0.153	0.158
1982	0.206	0.145	0.138	0.134	0.138	0.144	0.156	0.150
1983	0.189	0.136	0.138	0.129	0.135	0.140	0.151	0.148
1984	0.250	0.137	0.128	0.119	0.125	0.139	0.148	0.149
1985	0.194	0.139	0.139	0.128	0.132	0.134	0.148	0.150
1986	0.211	0.142	0.139	0.136	0.138	0.143	0.150	0.153
1987	0.201	0.119	0.124	0.114	0.120	0.131	0.142	0.138
1988	0.209	0.131	0.126	0.121	0.123	0.135	0.145	0.143
1989	0.215	0.140	0.132	0.124	0.128	0.132	0.147	0.146
1990	0.200	0.135	0.142	0.130	0.132	0.139	0.147	0.150
1991	0.199	0.135	0.138	0.126	0.128	0.138	0.149	0.147
1992	0.206	0.140	0.139	0.132	0.134	0.140	0.152	0.152
1993	0.206	0.132	0.127	0.124	0.129	0.137	0.147	0.150
1994	0.232	0.170	0.164	0.151	0.155	0.164	0.169	0.170
1995	0.327	0.256	0.248	0.237	0.239	0.242	0.243	0.243
1996	0.318	0.239	0.241	0.223	0.226	0.230	0.231	0.231
1997	0.322	0.244	0.240	0.225	0.227	0.231	0.232	0.232
1998	0.320	0.245	0.244	0.225	0.229	0.232	0.234	0.234
1999	0.328	0.236	0.235	0.218	0.220	0.226	0.227	0.227
2000	0.330	0.246	0.237	0.227	0.230	0.232	0.235	0.235
2001	0.329	0.255	0.245	0.221	0.223	0.227	0.230	0.231
2002	0.349	0.267	0.267	0.237	0.237	0.242	0.244	0.244
2003	0.365	0.289	0.291	0.260	0.260	0.264	0.266	0.266
2004*	0.420	0.355	0.354	0.335	0.334	0.334	0.335	0.335
2005*	0.452	0.393	0.392	0.375	0.375	0.375	0.375	0.375

*Estimates for 2004 and 2005 are TSA forecasts.

Table 4.1.5.8.a. Haddock in Division VIa. TSA stock summary from run A. “Obs.” denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield; “Pred.” are fitted values; and “SE” denotes standard errors. *Estimates for 2004 and 2005 are TSA projections.

Year	Landings (tonnes)			Discards (tonnes)			Total catches (tonnes)			Mean F(2–6)		SSB (tonnes)		TSB (tonnes)		Rec. (000s at age 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	17178	20719	1279	2327	2959	565	19505	23726	1495	0.6844	0.0498	43313	942	54426	1379	75678	7100
1979	14820	17572	1234	13857	9930	1837	28678	27584	2561	0.7527	0.0534	34240	1697	70194	3548	162749	13708
1980	12590	13722	1338	4715	17605	2859	17474	33448	3867	0.5748	0.046	38413	2403	118489	6032	503190	34676
1981	18233	17824	2119	15048	16723	3245	33281	36306	4268	0.4634	0.0396	78946	4284	128823	6575	61058	4066
1982	29635	27322	3579	10063	8012	1820	39698	34441	3464	0.4318	0.0351	101961	5762	117654	5938	69469	7389
1983	29405	28733	2688	6787	4597	941	36192	33363	2890	0.4356	0.0335	91134	4630	104353	4954	43245	5608
1984	30012	32695	2214	16343	16341	3054	46355	48102	4247	0.7072	0.046	67612	3051	123128	6257	345172	32685
1985	24393	23196	1885	17444	15764	3125	41837	38731	4151	0.6282	0.0496	66599	3470	98679	5568	68589	6889
1986	19561	19675	1955	7153	4864	1019	26714	23448	2322	0.4537	0.037	59620	3398	74913	3864	58088	5608
1987	27012	29207	2167	16193	13914	2814	43205	43028	4051	0.8354	0.0539	53948	2875	100411	6067	250023	28171
1988	21136	20184	1808	9536	9323	2057	30672	29559	3165	0.7635	0.0527	46073	2704	64705	4142	21441	2955
1989	16688	16963	1868	2981	2768	0714	19669	19376	2048	0.7487	0.054	37411	2496	42159	2719	14297	2497
1990	10135	10365	1081	5387	2559	0512	15522	12046	1272	0.6166	0.0485	22057	1539	33167	2084	87829	9506
1991	10557	9920	0883	8691	7855	1397	19248	18086	2000	0.702	0.0518	21506	1359	50104	3055	117587	10474
1992	11350	10487	0984	9163	8539	1371	20513	19615	1958	0.5708	0.0435	29736	1666	62153	3380	171598	15549
1993	19060	18652	1646	16811	14809	2183	35871	33280	2756	0.8791	0.0528	42596	2256	73207	3834	162306	14978
1994	14243	14042	1528	11098	11898	1929	25342	26260	2433	0.8014	0.0543	40799	2267	59789	3373	51597	6512
1995	12368	12247	1140	8552	7874	1276	20920	19711	1864	0.6236	0.0483	32770	1834	61867	3332	170804	14948
1996	13453	13627	1172	11364	10758	1803	24817	24621	2433	0.8408	0.0575	36365	2070	57164	3428	70959	8198
1997	12874	12571	1161	6470	6745	1260	19344	19586	2078	0.6398	0.0509	36639	2239	55179	3325	90497	9969
1998	14401	13328	1206	5535	9178	1700	19936	23023	2352	0.8212	0.0589	33298	1978	54107	3497	83830	9832
1999	10430	10619	1005	4891	5743	1200	15321	16531	1898	0.8402	0.0633	26049	1790	35619	2591	24237	3612
2000	6952	7242	760	7899	9567	2001	14851	16760	2399	0.7581	0.0612	16385	1315	55037	5152	291301	36087
2001	6731	7509	835	6657	14807	3001	13389	23153	3632	0.7238	0.0627	33154	3321	63700	6142	105600	13472
2002	7097	8498	1326	8880	9459	1944	15977	17655	2282	0.5975	0.0647	38550	3826	52176	4837	64174	11103
2003	5334	7005	963	4104	5223	1020	9438	11878	1298	0.372	0.0595	33733	3668	50291	4877	99098	11169
2004*	NA	14216	3364	NA	6163	1940	NA	20342	4509	0.6546	0.161	40849	4938	48346	8403	6457	38356
2005*	NA	10996	3007	NA	4609	3062	NA	15525	4891	0.6827	0.1733	27963	6738	40579	13637	103535	91629
Min	5334	7005	760	2327	2559	512	9438	11878	1272	0.372	0.034	16385	942	33167	1379	14297	2497
GM	14405	14833	1421	8073	8348	1597	23214	24317	2510	0.647	0.050	40649	2425	66810	3972	90633	9799
AM	15993	16305	1532	9152	9531	1794	25145	25897	2661	0.664	0.051	44727	2648	71596	4229	125554	12568
Max	30012	32695	3579	17444	17605	3245	46355	48102	4268	0.879	0.065	101961	5762	128823	6575	503190	36087

Table 4.1.5.8.b. Haddock in Division VIa. TSA stock summary from run B. "Obs." denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield; "Pred." are fitted values; and "SE" denotes standard errors. *Estimates for 2004 and 2005 are TSA projections.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catches (000 tonnes)			Mean F(2–6)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment (millions at age 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	17178	20385	1224	2327	3006	557	19505	23455	1456	0.6863	0.0497	42748	902	53800	1327	75120	6886
1979	14820	17529	1204	13857	9754	1758	28678	27253	2500	0.7466	0.0532	33820	1630	69999	3418	164476	13134
1980	12759	13624	1298	4715	17010	2687	17474	32658	3692	0.561	0.0456	38676	2318	117362	5853	491529	33428
1981	18233	17917	2099	15048	16066	3124	33281	35572	4142	0.4507	0.0391	79019	4274	128472	6540	61511	3955
1982	29635	28355	3846	10063	8099	1984	39698	35427	3652	0.4347	0.0358	102486	5984	118181	6180	68897	7084
1983	29405	29348	2833	6787	4563	955	36192	33894	3085	0.4458	0.0351	91332	4959	104596	5271	43594	5357
1984	30012	33379	2350	16343	16339	2885	46355	48786	4234	0.7206	0.0479	68045	3225	124068	6214	348350	31819
1985	24393	23074	1897	17444	15921	3048	41837	38817	4095	0.628	0.0483	67088	3565	99571	5609	68749	6980
1986	19561	18778	1773	7153	4618	1007	26714	22323	2114	0.4193	0.0341	60497	3208	76387	3654	61280	5762
1987	27012	31008	2067	16193	14925	2792	43205	45790	3971	0.8478	0.052	56422	2722	105441	5830	263660	27323
1988	21136	20794	1719	9536	10086	2069	30672	31090	2999	0.7679	0.0517	48102	2504	67467	3832	21924	2556
1989	16688	17217	1894	2981	2968	791	19669	19930	2041	0.7315	0.0537	38789	2474	43616	2660	14510	1971
1990	10135	10586	1120	5387	2555	490	15522	12236	1305	0.6136	0.0487	22477	1621	33541	2117	87205	9090
1991	10557	9859	895	8691	7750	1329	19248	17881	1958	0.6904	0.0522	21428	1400	49668	2981	116418	9830
1992	11350	10313	1000	9163	8603	1353	20513	19482	1975	0.5694	0.0444	29197	1744	61415	3398	170974	14933
1993	19060	18608	1662	16811	15021	2178	35871	33388	2828	0.8722	0.0542	42233	2335	73019	3878	164721	14347
1994	14243	14019	1538	11098	12273	1956	25342	26603	2483	0.8006	0.0561	40427	2271	59753	3326	53963	5800
1995	12368	11983	1156	8552	8209	1293	20920	19779	1917	0.6188	0.0492	31974	1880	61729	3342	174941	14872
1996	13453	13104	1192	11364	11209	1842	24817	24634	2527	0.8266	0.0582	35899	2151	56710	3492	69800	7574
1997	12874	12416	1128	6470	6503	1214	19344	19134	2011	0.6257	0.05	36152	2194	54000	3204	86505	9500
1998	14401	13177	1229	5535	8982	1653	19936	22709	2223	0.8345	0.0583	32754	1890	51912	3273	75573	8990
1999	10430	10617	945	4891	5339	1111	15321	16050	1730	0.8692	0.0635	24833	1635	33452	2350	21851	3391
2000	6952	7049	681	7899	8523	1701	14851	15468	2065	0.7713	0.0608	15333	1170	48580	4353	250127	30131
2001	6731	6869	684	6657	12839	2412	13389	20454	2837	0.7452	0.0667	29121	2695	54573	5033	85006	11868
2002	7097	7601	1196	8880	7894	1676	15977	15197	1873	0.6117	0.073	32422	3355	43359	4423	52053	11467
2003	5334	6212	872	4104	4222	924	9438	10120	1147	0.4056	0.0737	27460	3650	38812	5159	63769	14390
2004*	NA	11389	3517	NA	4679	1857	NA	15927	4830	6540	2045	31145	5339	39296	8101	31913	31710
2005*	NA	8854	3000	NA	4691	2771	NA	13439	4835	6918	2233	22886	6175	35532	12338	90131	80851
Min	5334	6212	681	2327	2555	490	9438	10120	1147	0.406	0.034	15333	902	33452	1327	14510	1971
GM	14405	14647	1390	8073	8170	1544	23214	23873	2418	0.648	0.051	39769	2377	64957	3853	86933	9343
AM	15993	16301	1519	9152	9357	1723	25145	25697	2572	0.665	0.052	44182	2606	70365	4105	121404	12017
Max	30012	33379	3846	17444	17010	3124	46355	48786	4234	0.872	0.074	102486	5984	128472	6540	491529	33428

Table 4.1.5.8.c. Haddock in Division VIa. TSA stock summary from run B. "Obs." denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield; "Pred." are fitted values; and "SE" denotes standard errors. *Estimates for 2004 and 2005 are TSA projections.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catches (000 tonnes)			Mean F(2–6)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment (millions at age 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	17178	20513	1665	2327	2723	551	19505	23194	1842	0.6629	0.0601	42933	1179	53889	1578	74987	7784
1979	14820	16890	1632	13857	12722	2361	28678	30100	3182	0.7522	0.0642	34281	2178	73716	4140	181625	16410
1980	12759	13331	1640	4715	15358	2885	17474	30626	4076	0.5674	0.0549	38814	2962	117402	7098	488256	41422
1981	18233	19202	2617	15048	14337	2808	33281	34227	4523	0.4301	0.0448	79428	5332	129518	8031	62184	4801
1982	29635	29222	4329	10063	7558	1464	39698	35355	4409	0.4113	0.0399	104250	7652	120817	7792	73582	7635
1983	29405	30594	3711	6787	5624	987	36192	36178	3982	0.4555	0.0421	94496	6348	109293	6584	49626	5699
1984	30012	32315	3007	16343	14283	3581	46355	45653	5240	0.6735	0.0579	69565	4040	123296	7180	332968	37351
1985	24393	23559	2550	17444	14564	2757	41837	37763	4432	0.5871	0.0535	68771	4571	101577	6669	73383	7606
1986	19561	21139	2689	7153	4989	939	26714	24957	2981	0.4569	0.0443	63124	4623	79019	4977	59910	5734
1987	27012	29568	3013	16193	14096	3085	43205	43709	4786	0.8261	0.0644	56460	3926	104241	6699	256568	29455
1988	21136	21146	2285	9536	9206	1821	30672	30284	3419	0.7395	0.0618	48667	3137	68020	4562	21197	3435
1989	16688	18700	2382	2981	2725	606	19669	20802	2515	0.728	0.0636	40587	3099	45743	3291	16353	2928
1990	10135	11905	1560	5387	3265	693	15522	14154	1738	0.6603	0.0606	24001	2068	36585	2559	99880	11205
1991	10557	10154	1115	8691	9503	1773	19248	20147	2458	0.6995	0.0621	22734	1627	53696	3463	127197	12715
1992	11350	10263	1205	9163	9597	1529	20513	20600	2286	0.5664	0.0529	31159	2095	68481	3866	206892	18565
1993	19060	17171	1918	16811	16145	2286	35871	33606	3218	0.7259	0.0619	48323	2959	87176	4955	212056	20841
1994	14243	12272	1920	11098	14305	2308	25342	27703	3040	0.5447	0.0652	55698	3910	83060	5824	75246	12271
1995	12368	17102	5170	8552	18067	4959	20920	35689	7638	0.6256	0.1336	54962	4950	107692	7864	317552	32457
1996	13453	19819	6019	11364	21227	5379	24817	41707	8501	0.7069	0.1403	61654	5964	106242	9219	187163	25437
1997	12874	22493	8215	6470	21909	6508	19344	46766	9955	0.7361	0.1466	72807	8357	115260	11000	196630	24996
1998	14401	23313	9820	5535	26774	8118	19936	52566	10625	0.9153	0.1831	63783	7565	114364	10305	221872	23184
1999	10430	20672	8967	4891	18407	6367	15321	40889	8534	1.1083	0.2108	51633	6823	72418	8963	44101	12498
2000	6952	13067	5226	7899	23567	8466	14851	36532	10822	0.9148	0.1799	27661	5246	98920	16944	540823	117093
2001	6731	11020	5165	6657	20050	6238	13389	31741	8522	0.5443	0.1055	53757	8583	106675	15260	195714	32508
2002	7097	15127	10835	8880	15203	7645	15977	29339	7002	0.4852	0.1022	71643	8655	97166	10005	117708	24567
2003	5334	17752	14027	4104	11955	9107	9438	28580	6761	0.4878	0.1144	66777	7246	92402	8680	142454	25614
2004*	NA	20638	10063	NA	9242	5753	NA	29932	7707	0.5181	0.1613	69138	7838	86631	9584	69108	32337
2005*	NA	17599	8467	NA	7265	5136	NA	24942	6657	0.5362	0.1892	56155	10580	71191	14464	89713	80850
Min	5334	10154	1115	2327	2723	551	9438	14154	1738	0.411	0.040	22734	1179	36585	1578	16353	2928
GM	14405	18171	3351	8073	11384	2695	23214	31471	4555	0.635	0.077	51926	4226	86878	6351	121765	15180
AM	15993	19166	4334	9152	13391	3662	25145	32803	5250	0.654	0.087	55691	4811	91026	7212	168305	21700
Max	30012	32315	14027	17444	26774	9107	46355	52566	10822	1.108	0.211	104250	8655	129518	16944	540823	117093

Table 4.1.5.8.d. Haddock in Division VIa. XSA stock summary.

Year	Recruits at age 1	TSB	SSB	Catch	Yield/SSB	Mean F(2-6)
1978	60451	45159	36183	19512	0.5393	0.6476
1979	179706	65568	27960	28847	1.0317	0.6785
1980	443882	103987	33022	17478	0.5293	0.546
1981	41507	128083	81504	33306	0.4086	0.386
1982	80847	121285	104629	39681	0.3793	0.4495
1983	45113	104029	89672	36287	0.4047	0.4793
1984	379687	125093	65256	46364	0.7105	0.7155
1985	71449	105024	69660	41836	0.6006	0.6593
1986	54412	77331	63034	26926	0.4272	0.4177
1987	266021	105084	56074	43222	0.7708	0.9067
1988	22387	65734	46938	31301	0.6669	0.7733
1989	18944	43874	38392	19871	0.5176	0.7848
1990	106559	37580	23970	15542	0.6484	0.6801
1991	119762	49792	20918	19752	0.9442	0.6497
1992	204830	65044	28879	20752	0.7186	0.5223
1993	164769	76971	44788	35971	0.8032	0.7429
1994	64642	62675	41372	25435	0.6148	0.6076
1995	156180	66388	38959	21167	0.5433	0.6151
1996	76457	58027	36541	25290	0.6921	0.8634
1997	87032	54540	37557	19489	0.5189	0.5355
1998	67443	50592	33486	20114	0.6007	0.7309
1999	25220	34640	25381	15559	0.613	0.8099
2000	358201	64680	17440	15156	0.869	0.7262
2001	122950	83618	44051	13979	0.3173	0.4948
2002	80395	87269	69671	16025	0.23	0.2756
2003	92075	88851	72196	9575	0.1326	0.1285

Table 4.1.8.1.a. Haddock in Division VIa. Inputs to short-term predictions for run A (TSA, all catch data, no trend in survey *q*).

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	6457	5.94	WS1	0.12	0.05
N2	68163	0.11	WS2	0.24	0.08
N3	25458	0.18	WS3	0.28	0.19
N4	20658	0.16	WS4	0.38	0.16
N5	22227	0.17	WS5	0.65	0.12
N6	501	0.21	WS6	0.65	0.02
N7	549	0.23	WS7	0.91	0.18
N8	408	0.22	WS8	1.09	0.07
H.cons selectivity			Weight in the HC catch		
sH1	0.00	0.81	WH1	0.25	0.03
sH2	0.08	0.44	WH2	0.32	0.03
sH3	0.25	0.46	WH3	0.41	0.10
sH4	0.52	0.31	WH4	0.48	0.16
sH5	0.61	0.31	WH5	0.60	0.10
sH6	0.63	0.31	WH6	0.65	0.02
sH7	0.59	0.31	WH7	0.81	0.14
sH8	0.63	0.31	WH8	1.01	0.08
Discard selectivity			Weight in the discards		
sD1	0.21	0.81	WD1	0.12	0.06
sD2	0.34	0.44	WD2	0.21	0.06
sD3	0.26	0.46	WD3	0.24	0.04
sD4	0.11	0.31	WD4	0.28	0.09
sD5	0.02	0.31	WD5	0.39	0.32
sD6	0.00	0.31	WD6	0.15	1.73
sD7	0.04	0.31	WD7	0.28	0.90
sD8	0.00	0.31	WD8	0.16	1.73
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.57	0.10
M3	0.20	0.10	MT3	1.00	0.10
M4	0.20	0.10	MT4	1.00	0.00
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
M8	0.20	0.10	MT8	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.08	K04	1.00	0.10
HF05	1.00	0.08	K05	1.00	0.10
HF06	1.00	0.08	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	90633	1.24			
R06	90633	1.24			

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

Stock numbers in 2004 are TSA survivors.

Table 4.1.8.1.b. Haddock in Division VIa. Inputs to short-term predictions for run B (TSA, all catch data, trend in survey *q*).

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	31913	0.99	WS1	0.12	0.05
N2	44410	0.23	WS2	0.24	0.08
N3	20474	0.25	WS3	0.28	0.19
N4	15784	0.21	WS4	0.38	0.16
N5	17747	0.20	WS5	0.65	0.12
N6	452	0.26	WS6	0.65	0.02
N7	490	0.28	WS7	0.91	0.18
N8	358	0.27	WS8	1.09	0.07
H.cons selectivity			Weight in the HC catch		
sH1	0.00	0.80	WH1	0.25	0.03
sH2	0.08	0.44	WH2	0.32	0.03
sH3	0.27	0.46	WH3	0.41	0.10
sH4	0.54	0.29	WH4	0.48	0.16
sH5	0.63	0.29	WH5	0.60	0.10
sH6	*0.65*	*0.29*	*WH6*	*0.65*	*0.02*
sH7	0.62	0.29	WH7	0.81	0.14
sH8	0.65	0.29	WH8	1.02	0.07
Discard selectivity			Weight in the discards		
sD1	0.22	0.80	WD1	0.12	0.06
sD2	0.35	0.44	WD2	0.21	0.06
sD3	0.27	0.46	WD3	0.24	0.04
sD4	0.11	0.29	WD4	0.28	0.09
sD5	0.02	0.29	WD5	0.39	0.32
sD6	0.00	0.29	WD6	0.15	1.73
sD7	0.04	0.29	WD7	0.28	0.90
sD8	0.00	0.29	WD8	0.16	1.73
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.57	0.10
M3	0.20	0.10	MT3	1.00	0.10
M4	0.20	0.10	MT4	1.00	0.00
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
M8	0.20	0.10	MT8	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.08	K04	1.00	0.10
HF05	1.00	0.08	K05	1.00	0.10
HF06	1.00	0.08	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	86933	1.28			
R06	86933	1.28			

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

Stock numbers in 2004 are TSA survivors.,

Table 4.1.8.1.c. Haddock in Division VIa. Inputs to short-term predictions for run C (TSA, missing catch data 1995–2003, no trend in survey *q*).

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	69108	0.47	WS1	0.12	0.05
N2	94551	0.17	WS2	0.24	0.08
N3	43627	0.18	WS3	0.28	0.19
N4	37424	0.17	WS4	0.38	0.16
N5	39430	0.17	WS5	0.65	0.12
N6	1013	0.18	WS6	0.65	0.02
N7	1340	0.20	WS7	0.91	0.18
N8	645	0.20	WS8	1.09	0.07
H.cons selectivity			Weight in the HC catch		
sH1	0.00	0.80	WH1	0.25	0.03
sH2	0.07	0.44	WH2	0.32	0.03
sH3	0.24	0.46	WH3	0.41	0.10
sH4	0.46	0.17	WH4	0.48	0.16
sH5	0.53	0.04	WH5	0.60	0.10
sH6	*0.54*	*0.06*	*WH6*	*0.65*	*0.02*
sH7	0.51	0.09	WH7	0.81	0.14
sH8	0.55	0.06	WH8	1.02	0.07
Discard selectivity			Weight in the discards		
sD1	0.21	0.80	WD1	0.12	0.06
sD2	0.32	0.44	WD2	0.21	0.06
sD3	0.25	0.46	WD3	0.24	0.04
sD4	0.10	0.17	WD4	0.28	0.09
sD5	0.02	0.04	WD5	0.39	0.32
sD6	0.00	0.06	WD6	0.15	1.73
sD7	0.03	0.09	WD7	0.28	0.90
sD8	0.00	0.06	WD8	0.16	1.73
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.57	0.10
M3	0.20	0.10	MT3	1.00	0.10
M4	0.20	0.10	MT4	1.00	0.00
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
M8	0.20	0.10	MT8	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.08	K04	1.00	0.10
HF05	1.00	0.08	K05	1.00	0.10
HF06	1.00	0.08	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	121764	1.10			
R06	121764	1.10			

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

Stock numbers in 2004 are TSA survivors.,

Table 4.1.8.1.d. Haddock in Division VIa. Inputs to short-term predictions for run D (XSA).

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	93906	1.21	WS1	0.12	0.05
N2	69077	0.53	WS2	0.24	0.08
N3	*36662*	*0.39*	*WS3*	*0.28*	*0.19*
N4	45414	0.29	WS4	0.38	0.16
N5	80239	0.26	WS5	0.65	0.12
N6	1174	0.27	WS6	0.65	0.02
N7	1962	0.26	WS7	0.91	0.18
N8	783	0.22	WS8	1.09	0.07
H.cons selectivity			Weight in the HC catch		
sH1	0.00	0.80	WH1	0.25	0.03
sH2	0.03	0.44	WH2	0.32	0.03
sH3	0.15	0.73	WH3	0.41	0.10
sH4	0.31	0.63	WH4	0.48	0.16
sH5	0.30	0.68	WH5	0.60	0.10
sH6	0.36	0.71	WH6	0.65	0.02
sH7	0.60	0.91	WH7	0.81	0.14
sH8	0.63	0.91	WH8	1.02	0.07
Discard selectivity			Weight in the discards		
sD1	0.15	0.80	WD1	0.12	0.06
sD2	0.12	0.44	WD2	0.21	0.06
sD3	0.15	0.73	WD3	0.24	0.04
sD4	0.06	0.63	WD4	0.28	0.09
sD5	0.01	0.68	WD5	0.39	0.32
sD6	0.00	0.71	WD6	0.15	1.73
sD7	0.04	0.91	WD7	0.28	0.90
sD8	0.00	0.91	WD8	0.16	1.73
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.57	0.10
M3	0.20	0.10	MT3	1.00	0.10
M4	0.20	0.10	MT4	1.00	0.00
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
M8	0.20	0.10	MT8	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.08	K04	1.00	0.10
HF05	1.00	0.08	K05	1.00	0.10
HF06	1.00	0.08	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	93906	1.21			
R06	93906	1.21			

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

Stock numbers in 2004 are TSA survivors.,

Table 4.1.8.2.a. Haddock in Division VIa. Results of short-term forecasts for run A (TSA, all catch data, no trend in survey *q*). Management options.

	Year 2004	2005						
Mean F Ages 2 to 6 — H.cons	0.56	0.00	0.11	0.23	0.34	0.45	0.56	0.68
Effort relative to 2003 — H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	47.9	40.2	40.2	40.2	40.2	40.2	40.2	40.2
SSB at spawning time	40.1	28.5	28.5	28.5	28.5	28.5	28.5	28.5
Catch weight (,000t)								
H.cons	12.6	0.0	2.5	4.7	6.7	8.5	10.1	11.5
Discards	5.5	0.0	0.9	1.8	2.6	3.3	4.0	4.6
Total Catch	18.1	0.0	3.4	6.5	9.3	11.8	14.1	16.1
Biomass in year.... 2006								
Total 1 January		60.7	56.5	52.7	49.3	46.2	43.4	40.9
SSB at spawning time		41.8	37.9	34.4	31.3	28.5	26.0	23.7

	Year 2004	2005						
Effort relative to 2003 — H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.14	0.39	0.39	0.39	0.39	0.39	0.39	0.39
SSB at spawning time	0.11	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Catch weight								
H.cons	0.19	0.00	0.42	0.25	0.20	0.18	0.17	0.17
Discards	0.32	0.00	0.83	0.76	0.75	0.75	0.75	0.75
Biomass in year.... 2006								
Total 1 January		0.45	0.47	0.48	0.50	0.52	0.54	0.56
SSB at spawning time		0.35	0.37	0.39	0.41	0.43	0.45	0.47

Table 4.1.8.2.b. Haddock in Division VIa. Results of short-term forecasts for run B (TSA, all catch data, trend in survey *q*). Management options.

	2004	2005						
Mean F Ages 2 to 6								
H.cons	0.59	0.00	0.12	0.24	0.35	0.47	0.59	0.71
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	39.1	36.0	36.0	36.0	36.0	36.0	36.0	36.0
SSB at spawning time	30.6	23.1	23.1	23.1	23.1	23.1	23.1	23.1
Catch weight (,000t)								
H.cons	10.1	0.0	2.0	3.8	5.4	6.8	8.0	9.1
Discards	4.5	0.0	1.0	1.9	2.8	3.6	4.3	5.0
Total Catch	14.7	0.0	3.0	5.7	8.1	10.3	12.3	14.1
Biomass in year.... 2006								
Total 1 January		54.9	51.2	47.8	44.8	42.1	39.6	37.4
SSB at spawning time		36.8	33.4	30.4	27.6	25.2	23.0	21.0

	2004	2005						
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.15	0.42	0.42	0.42	0.42	0.42	0.42	0.42
SSB at spawning time	0.13	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Catch weight								
H.cons	0.20	0.00	0.42	0.25	0.20	0.19	0.18	0.17
Discards	0.32	0.00	0.75	0.67	0.66	0.66	0.66	0.67
Biomass in year.... 2006								
Total 1 January		0.48	0.50	0.52	0.54	0.56	0.58	0.60
SSB at spawning time		0.38	0.40	0.42	0.44	0.46	0.48	0.50

Table 4.1.8.2.c. Haddock in Division VIa. Results of short-term forecasts for run C (TSA, missing catch data 1985–2003, no trend in survey *q*). Management options.

	Year 2004	2005	2005	2005	2005	2005	2005	2005
Mean F Ages								
H.cons 2 to 6	0.51	0.00	0.10	0.20	0.30	0.40	0.51	0.61
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	86.0	74.1	74.1	74.1	74.1	74.1	74.1	74.1
SSB at spawning time	67.8	54.3	54.3	54.3	54.3	54.3	54.3	54.3
Catch weight (,000t)								
H.cons	20.2	0.0	4.1	7.8	11.2	14.3	17.0	19.5
Discards	9.0	0.0	1.7	3.4	4.9	6.3	7.6	8.8
Total Catch	29.3	0.0	5.9	11.2	16.1	20.5	24.6	28.3
Biomass in year.... 2006								
Total 1 January		102.0	94.9	88.4	82.6	77.2	72.4	67.9
SSB at spawning time		76.6	70.0	63.9	58.5	53.5	49.0	44.9

	Year 2004	2005	2005	2005	2005	2005	2005	2005
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.11	0.25	0.25	0.25	0.25	0.25	0.25	0.25
SSB at spawning time	0.11	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Catch weight								
H.cons	0.15	0.00	0.40	0.23	0.18	0.16	0.15	0.14
Discards	0.28	0.00	0.59	0.49	0.47	0.46	0.46	0.46
Biomass in year.... 2006								
Total 1 January		0.32	0.33	0.35	0.36	0.37	0.39	0.40
SSB at spawning time		0.23	0.24	0.25	0.27	0.28	0.29	0.30

Table 4.1.8.2.d. Haddock in Division VIa. Results of short-term forecasts for run D (XSA). Management options.

	2004	2005	2005	2005	2005	2005	2005	2005
Mean F Ages								
H.cons 2 to 6	0.30	0.00	0.06	0.12	0.18	0.24	0.30	0.36
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	111.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5
SSB at spawning time	92.8	81.1	81.1	81.1	81.1	81.1	81.1	81.1
Catch weight (,000t)								
H.cons	19.9	0.0	4.2	8.1	11.7	15.1	18.3	21.3
Discards	4.9	0.0	1.0	2.0	2.9	3.8	4.6	5.5
Total Catch	24.7	0.0	5.2	10.0	14.6	18.9	22.9	26.7
Biomass in year.... 2006								
Total 1 January		123.4	117.2	111.3	105.8	100.6	95.8	91.2
SSB at spawning time		103.9	97.9	92.2	86.9	82.0	77.3	73.0

	2004	2005	2005	2005	2005	2005	2005	2005
Effort relative to 2003								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.21	0.28	0.28	0.28	0.28	0.28	0.28	0.28
SSB at spawning time	0.19	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Catch weight								
H.cons	0.42	0.00	0.54	0.41	0.38	0.36	0.34	0.33
Discards	0.50	0.00	0.74	0.65	0.64	0.63	0.63	0.63
Biomass in year.... 2006								
Total 1 January		0.30	0.31	0.32	0.33	0.34	0.35	0.36
SSB at spawning time		0.28	0.29	0.30	0.31	0.32	0.33	0.34

Table 4.1.8.3.a. Haddock in Division VIa. Results of short-term forecasts for run A (TSA, all catch data, no trend in survey *q*). Detailed tables.

Forecast for year 2004
F multiplier H.cons=1.00

Age	Stock No.	H.Cons	Discards	Total
	Populations	Catch number		
1	6457	11	1092	1103
2	68163	3812	17483	21294
3	25458	4579	4689	9268
4	20658	7310	1543	8853
5	22227	9204	332	9536
6	501	214	1	215
7	549	221	15	236
8	408	174	1	175
Wt	48	13	6	18

Forecast for year 2005
F multiplier H.cons=1.00

Age	Stock No.	H.Cons	Discards	Total
	Populations	Catch number		
1	90633	149	15331	15480
2	4294	240	1101	1341
3	36705	6602	6760	13362
4	12541	4438	937	5375
5	8999	3727	134	3861
6	9673	4132	13	4145
7	218	88	6	94
8	416	178	1	179
Wt	40	10	4	14

Table 4.1.8.3.b. Haddock in Division VIa. Results of short-term forecasts for run B (TSA, all catch data, trend in survey *q*). Detailed tables.

Forecast for year 2004
F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	31913	69	5640	5709
2	44410	2547	11664	14211
3	20474	3862	3949	7811
4	15784	5740	1212	6952
5	17747	7550	266	7817
6	452	198	1	199
7	490	203	13	216
8	358	157	0	158
Wt	39	10	5	15

Forecast for year 2005
F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	86933	187	15364	15551
2	20990	1204	5513	6717
3	23614	4455	4554	9009
4	9769	3553	750	4303
5	6710	2855	101	2956
6	7545	3311	12	3323
7	192	79	5	85
8	361	158	0	159
Wt	36	8	4	12

Table 4.1.8.3.c. Haddock in Division VIa. Results of short-term forecasts for run C (TSA, missing catch data 1985–2003, no trend in survey *q*). Detailed tables.

Forecast for year 2004
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Discards	Total
1	69108	146	12000	12146
2	94551	5029	23027	28056
3	43627	7620	7791	15411
4	37424	12022	2538	14560
5	39430	14702	518	15220
6	1013	387	1	389
7	1340	485	32	517
8	645	248	1	249
Wt	86	20	9	29

Forecast for year 2005
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Discards	Total
1	121765	257	21143	21400
2	45648	2428	11117	13545
3	52233	9124	9328	18451
4	21909	7038	1486	8524
5	17607	6565	231	6796
6	18658	7134	27	7161
7	481	174	11	186
8	940	362	1	363
Wt	74	17	8	25

Table 4.1.8.3.d. Haddock in Division VIa. Results of short-term forecasts for run D (XSA). Detailed tables.

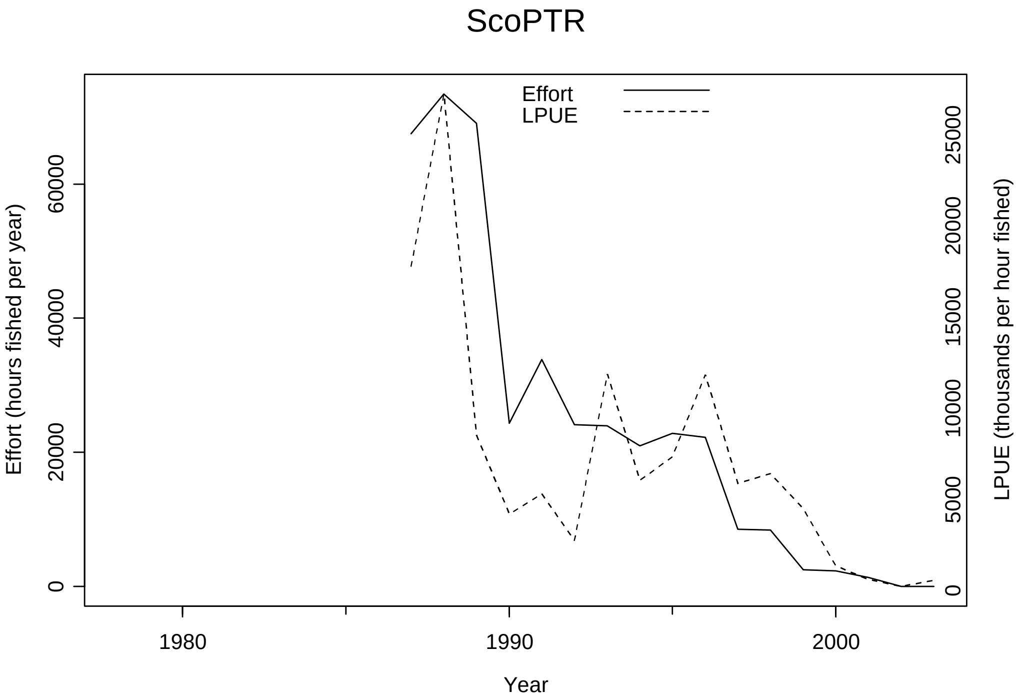
Forecast for year 2004
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Discards	Catch number: Total
1	93907	142	11684	11826
2	69077	1582	7245	8827
3	36662	4334	4431	8765
4	45414	10576	2233	12809
5	80239	18816	663	19480
6	1174	324	1	325
7	1962	794	52	846
8	783	337	1	338
Wt	112	20	5	25

Forecast for year 2005
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Discards	Catch number: Total
1	93907	142	11684	11826
2	66228	1517	6946	8463
3	48602	5746	5874	11620
4	22138	5156	1089	6244
5	25682	6022	212	6235
6	48188	13298	50	13348
7	669	271	18	289
8	1189	511	1	513
Wt	100	18	5	23

Figure 4.1.2.1. Haddock in Division VIa. Time-series of reported commercial effort and landings-per-unit-effort (LPUE) for the Scottish seiner (ScoSEI) and light trawler (ScoLTR) fleets.



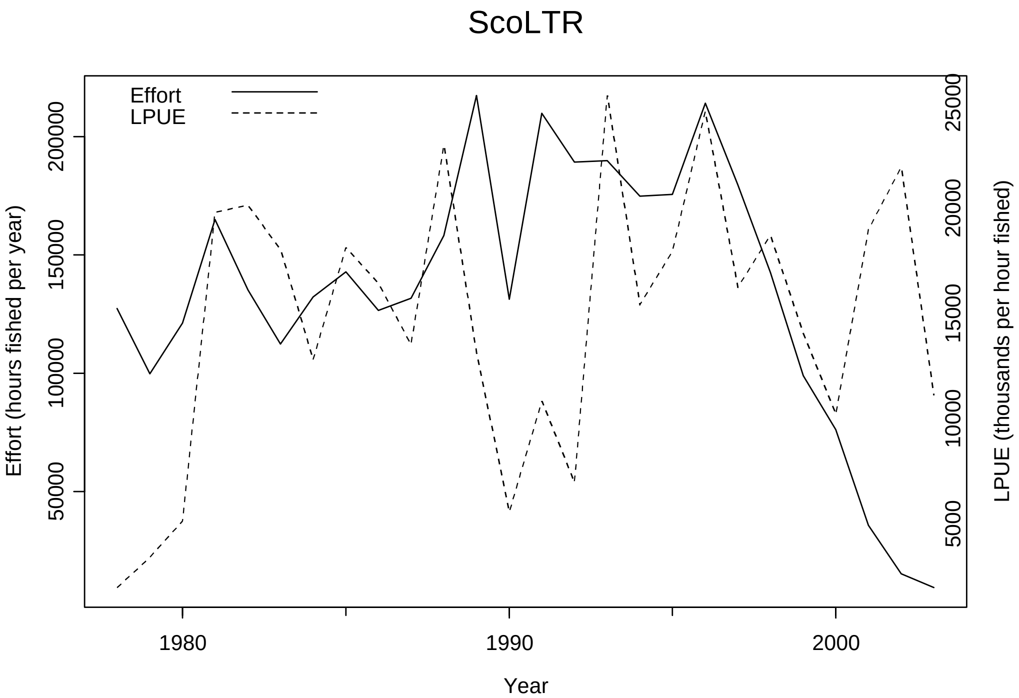
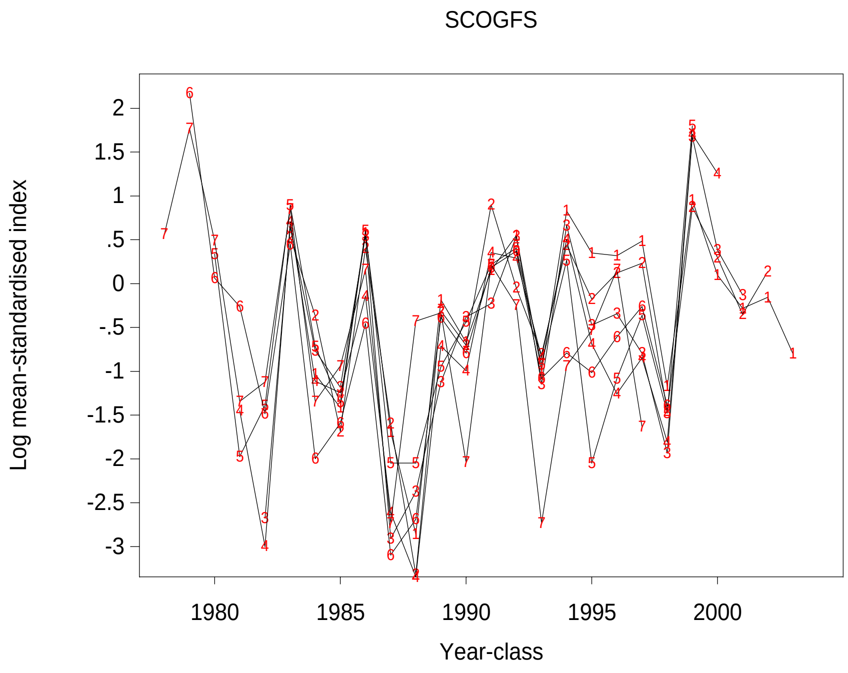


Figure 4.1.2.2. Haddock in Division VIa. Mean-standardised log survey indices, plotted by age and year-class (upper plot), and age and year (lower plot).



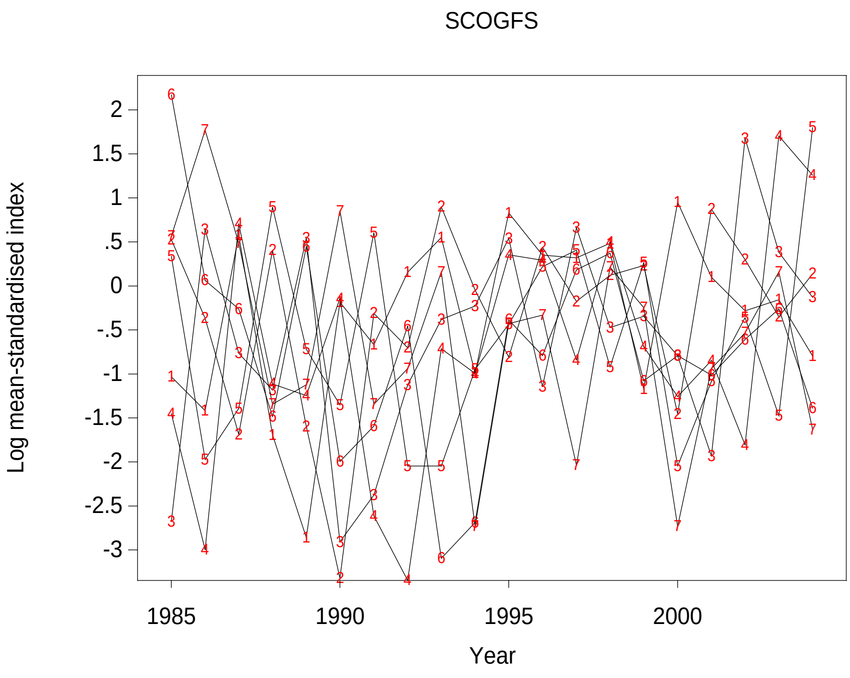


Figure 4.1.2.3. Haddock in Division VIa. Pairwise scatterplots of log ScoGFS survey indices at age, for ages 1–5. Lines give least-squares linear regression fits with approx. pointwise 95% confidence intervals.

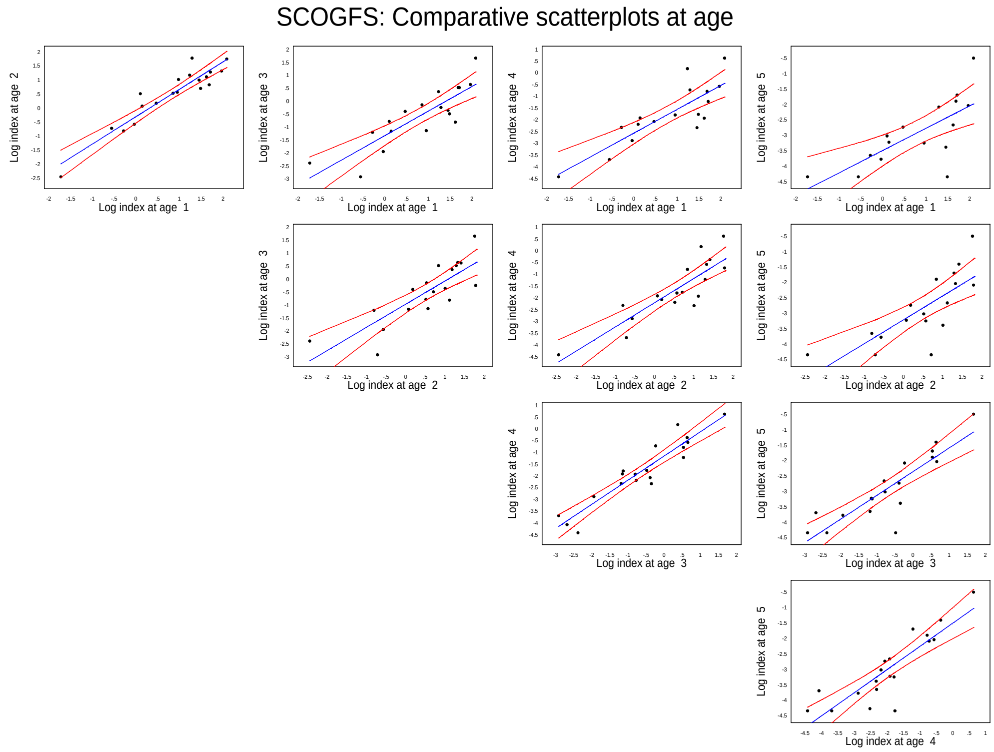


Figure 4.1.2.4. Haddock in Division VIa. ScoGFS catch curves (log abundance indices for each cohort).

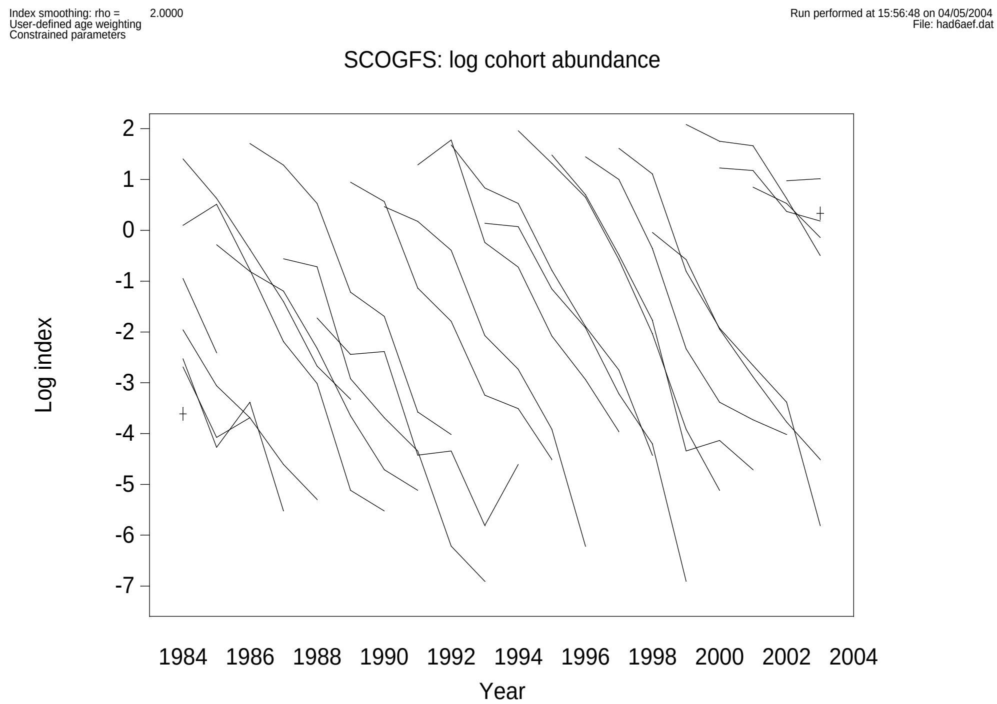


Figure 4.1.2.5. Haddock in Division VIa. Time-series plots by age of mean-standardised catch and survey data. Standardisation was performed by dividing through each series by the mean over the year range which all series have in common.

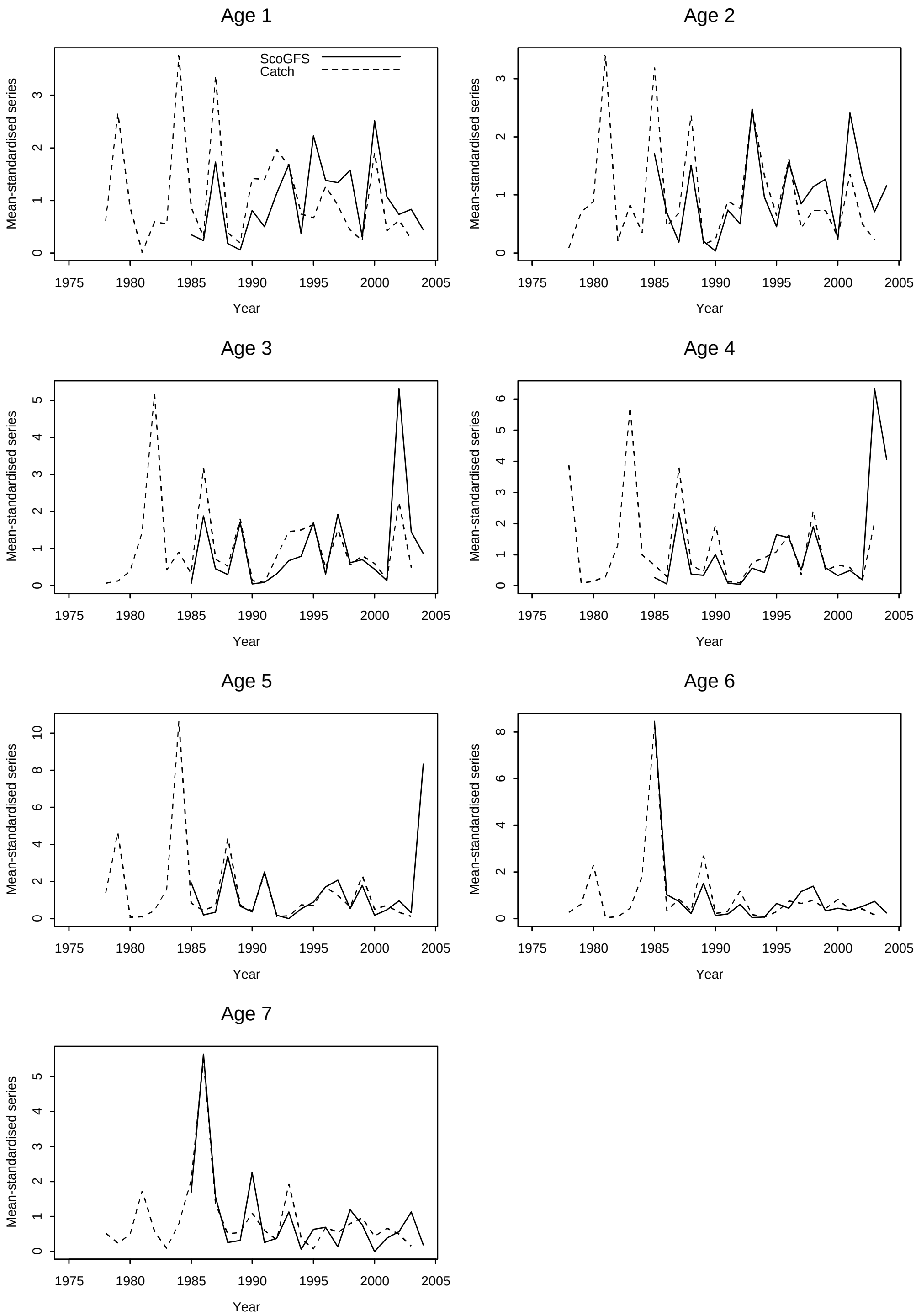
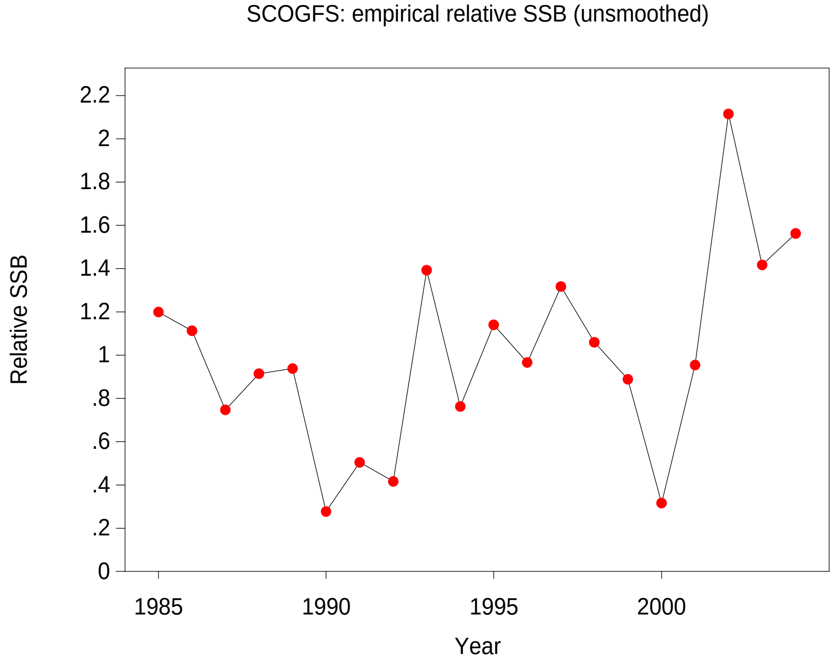


Figure 4.1.2.6. Haddock in Division VIa. Empirical relative SSB (upper) and mean Z_{2-6} from raw (unsmoothed) ScoGFS survey indices.



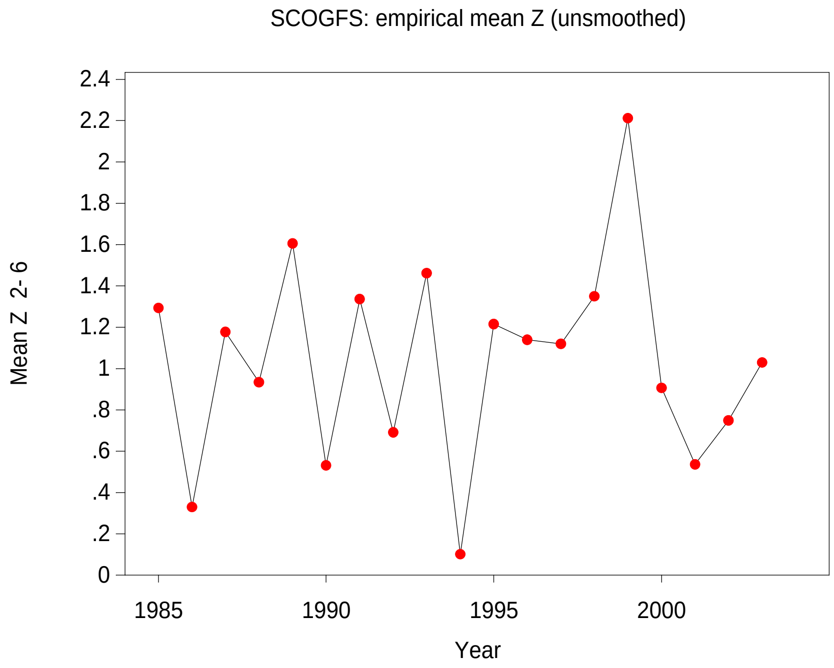
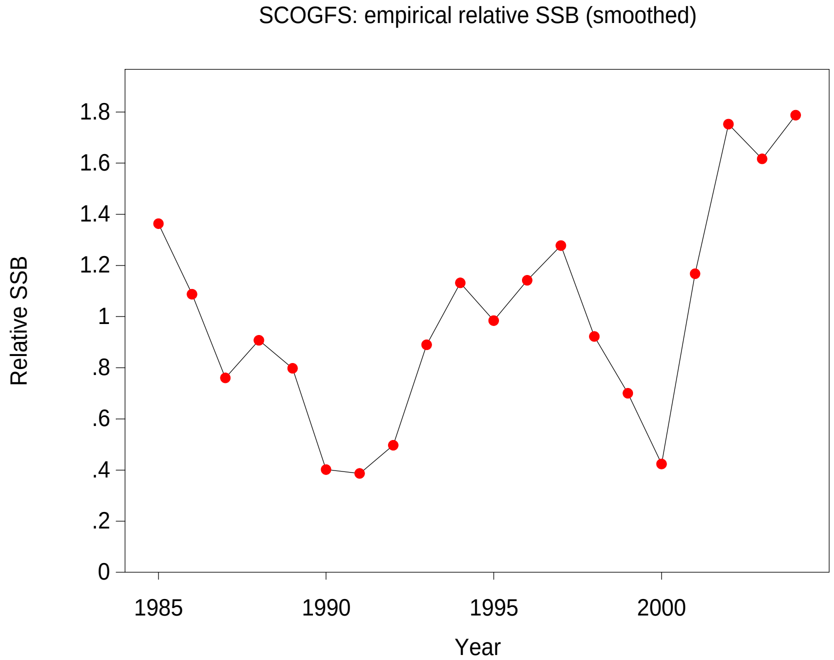


Figure 4.1.2.7. Haddock in Division VIa. Empirical relative SSB (upper) and mean Z_{2-6} from smoothed ScoGFS survey indices.



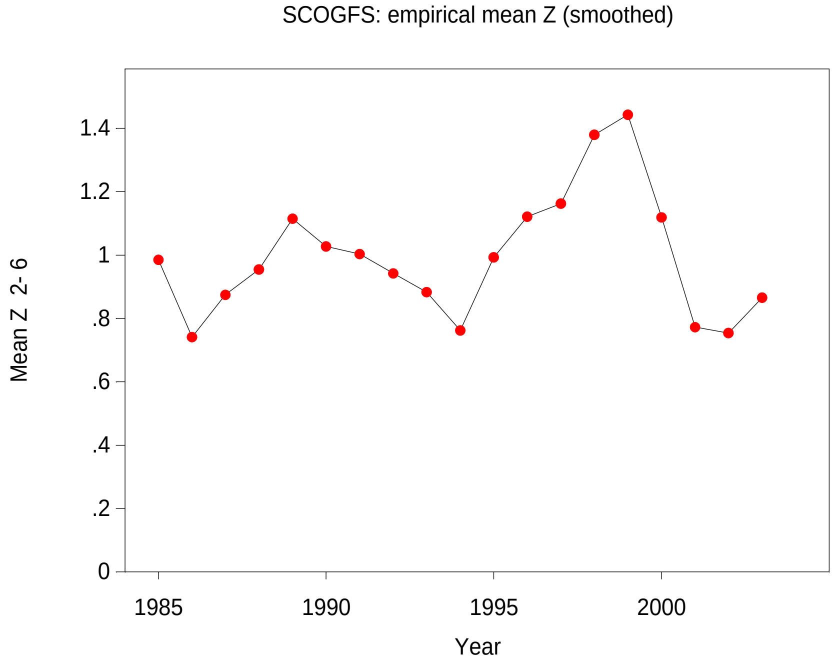


Figure 4.1.3.1. Haddock in Division VIa. Mean weights-at-age (kg) in landings for human consumption. Dotted lines show loess smoother fitted through each time-series at age.

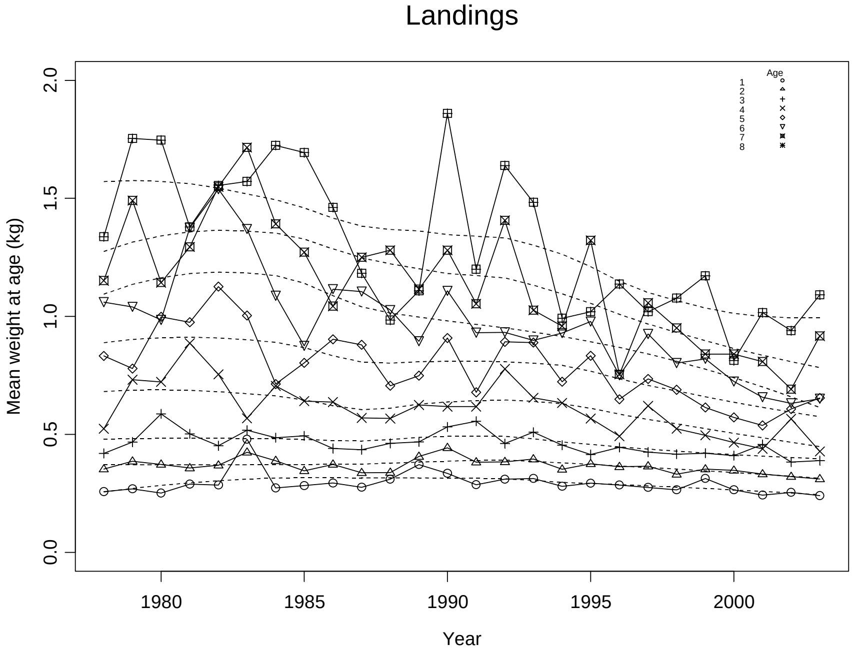


Figure 4.1.3.2. Haddock in Division VIa. Mean weights-at-age (kg) in discards (ages 1–4 only). Dotted lines show loess smoother fitted through each time-series at age.

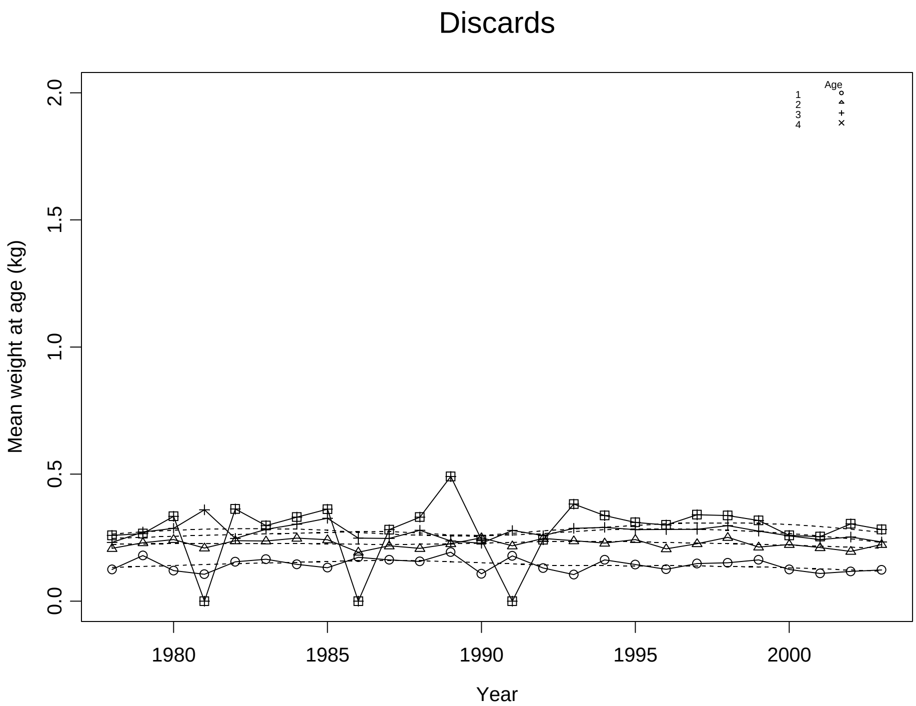


Figure 4.1.3.3. Haddock in Division VIa. Mean weights-at-age (kg) in total catch (also used for stock weights). Dotted lines show loess smoother fitted through each time-series at age.

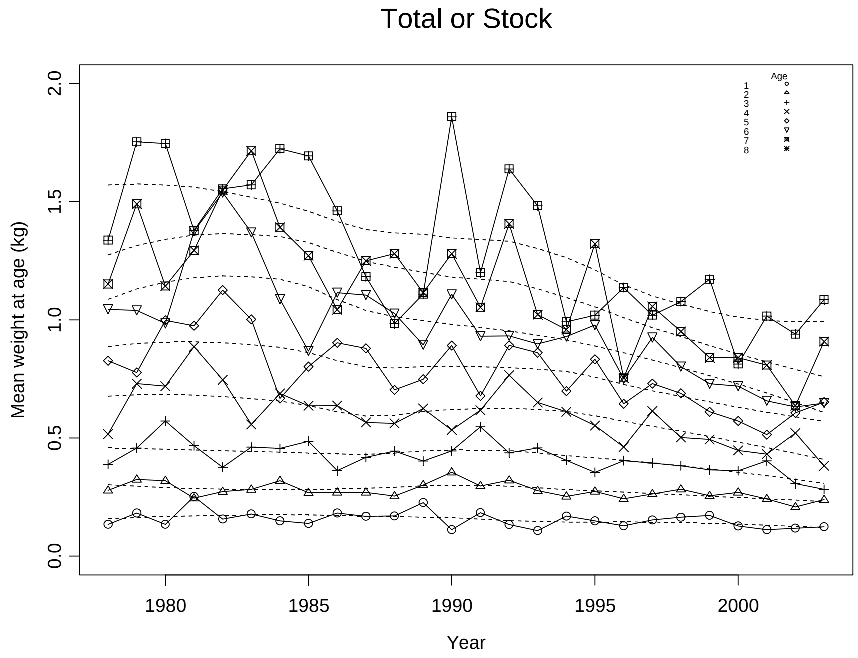
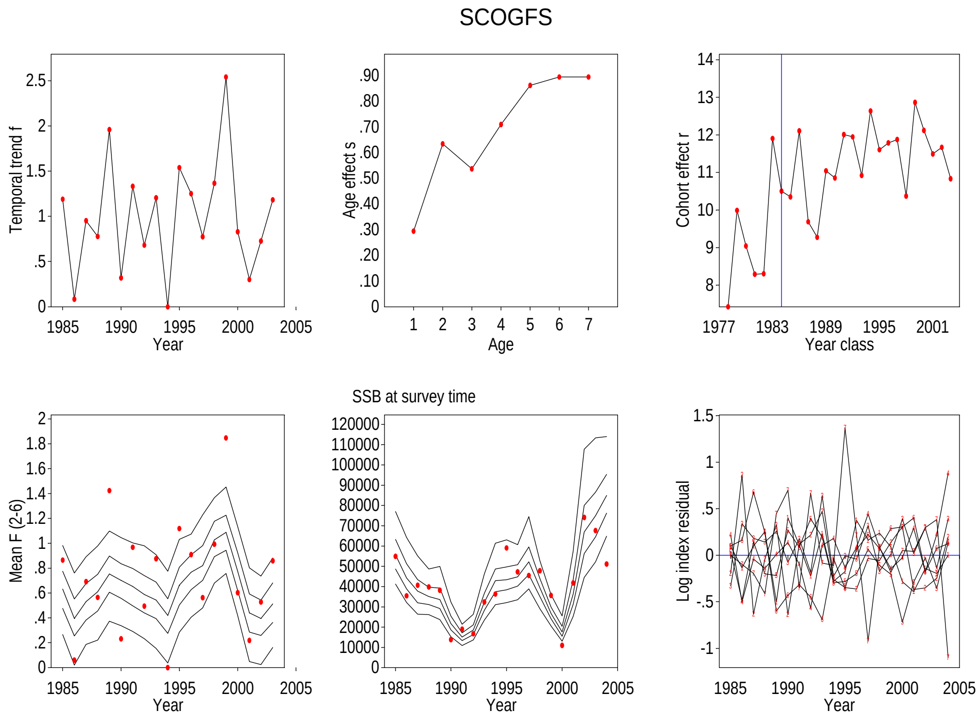


Figure 4.1.5.1. Haddock in Division VIa. Separable VPA residuals. Negative values are denoted by shaded bubbles.

Figure 4.1.5.2. Haddock in Division VIa. Summary of SURBA run on ScoGFS survey indices.

a. Stock summaries. Top row: fitted temporal trends, age effects and cohort effects. Bottom row: estimated mean F_{2-6} and SSB at survey time (both with empirical 2.5%, 25%, 50%, 75% and 97.5% uncertainty estimates), log residuals by age and year.



b. Bubble plot of log residuals to SURBA model fit.

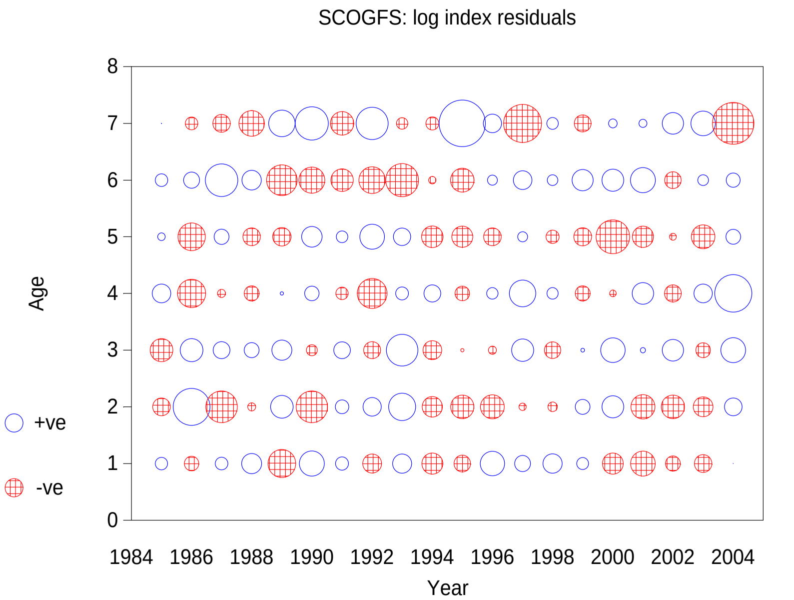
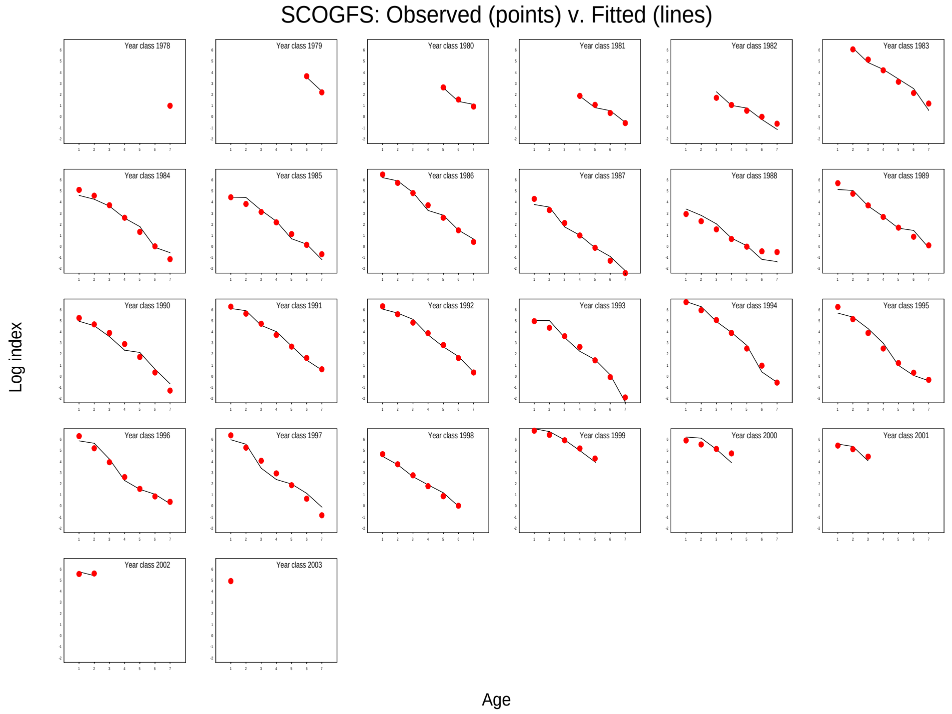


Figure 4.1.5.2. cont'd. Haddock in Division VIa.

c. Observed against fitted survey indices, on the log scale.



d. Retrospective analyses (10 runs).

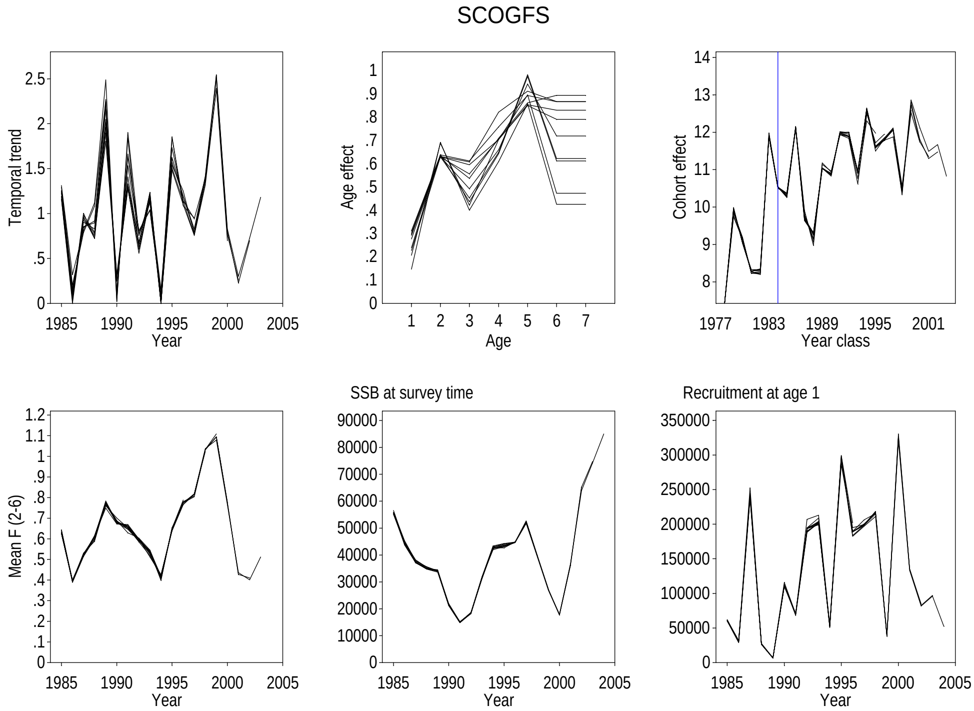


Figure 4.1.5.3. Haddock in Division VIa. XSA log ScoGFS catchability residuals.

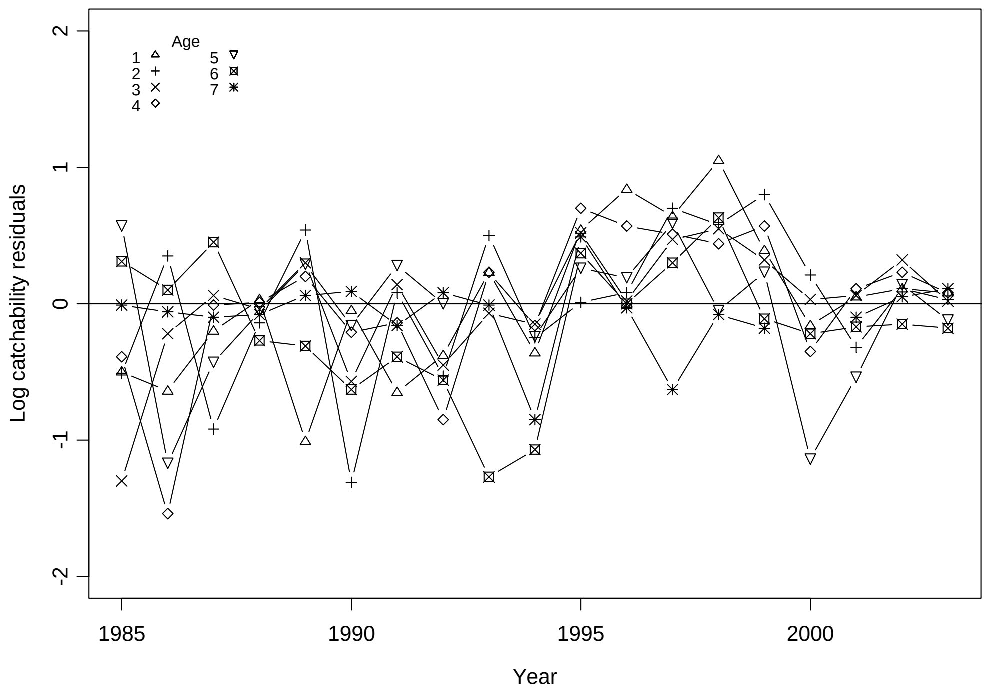


Figure 4.1.5.4. Haddock in Division VIa. Time-series plots of mean $F_{2\text{–}6}$ (upper), SSB (middle), and recruitment (lower) from exploratory TSA analysis to examine the effect of not allowing a persistent trend in survey catchability.

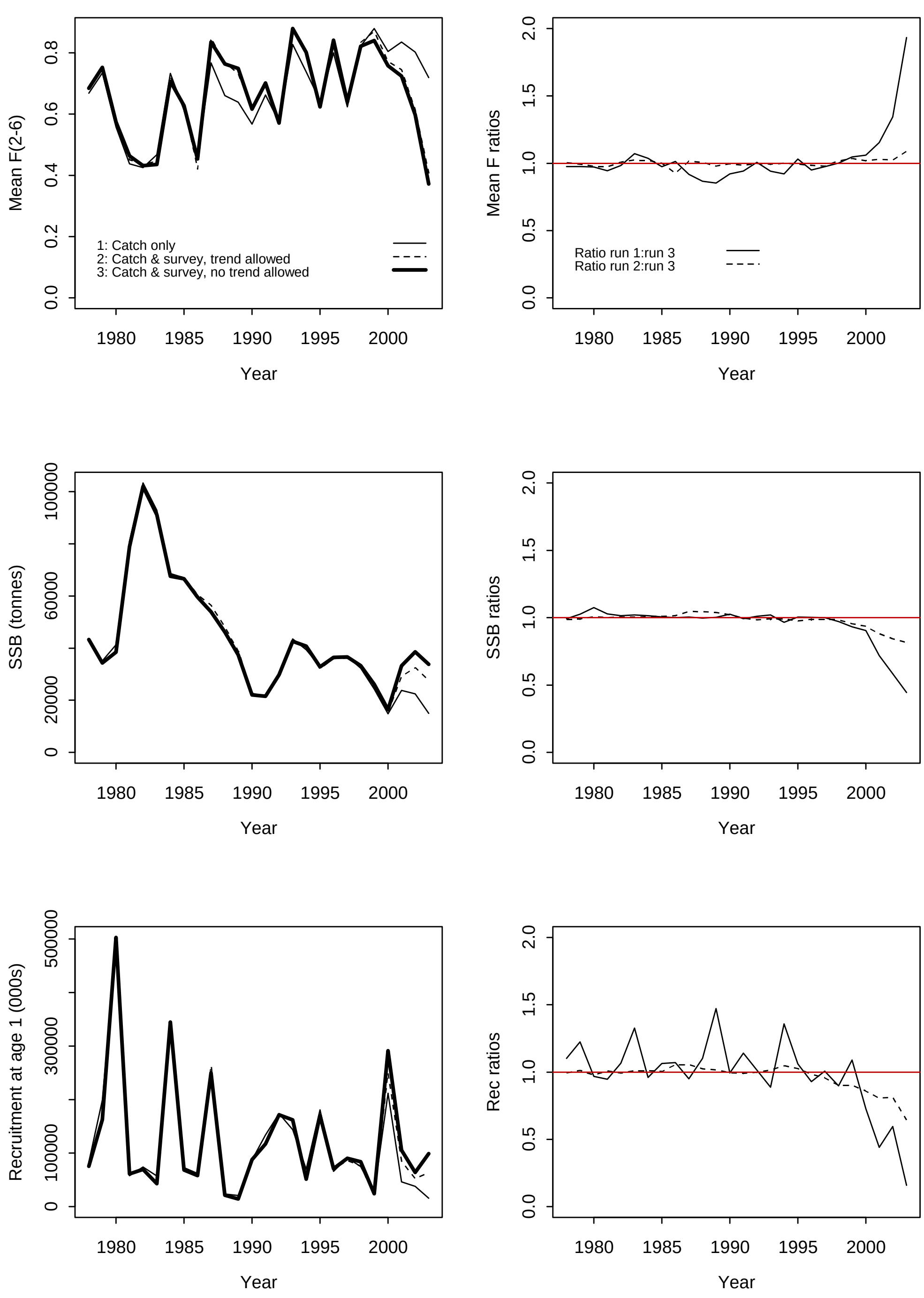


Figure 4.1.5.5. Haddock in Division VIa. Time-series plots of mean $F_{2\text{–}6}$ (upper), SSB (middle), and recruitment (lower) from exploratory TSA analysis to examine the effect of removing periods of catch-at-age data.

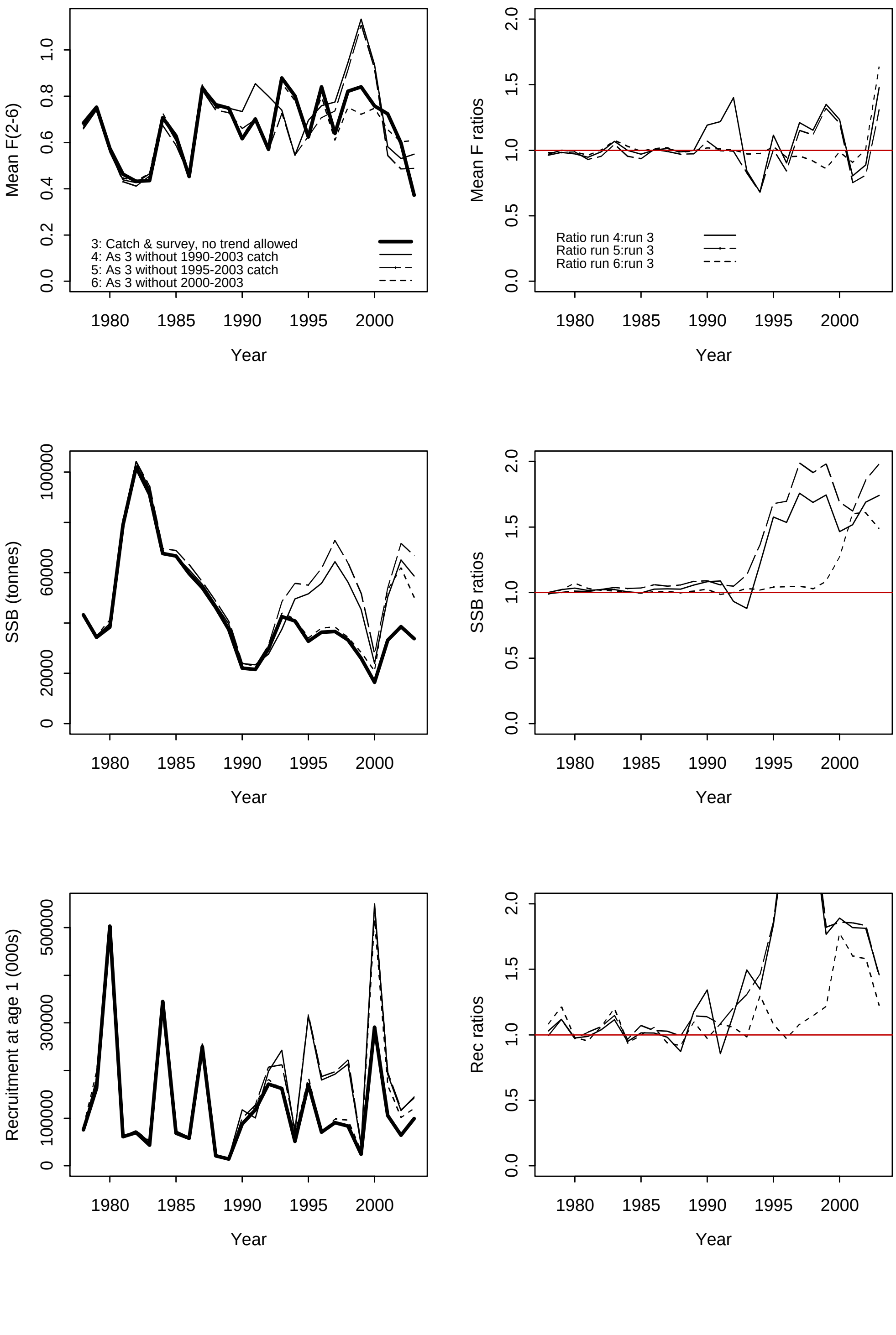


Figure 4.1.5.6. Haddock in Division VIa. Time-series plots of mean F_{2-6} (upper), SSB (middle), and recruitment (lower) from exploratory TSA, SURBA and XSA analyses.

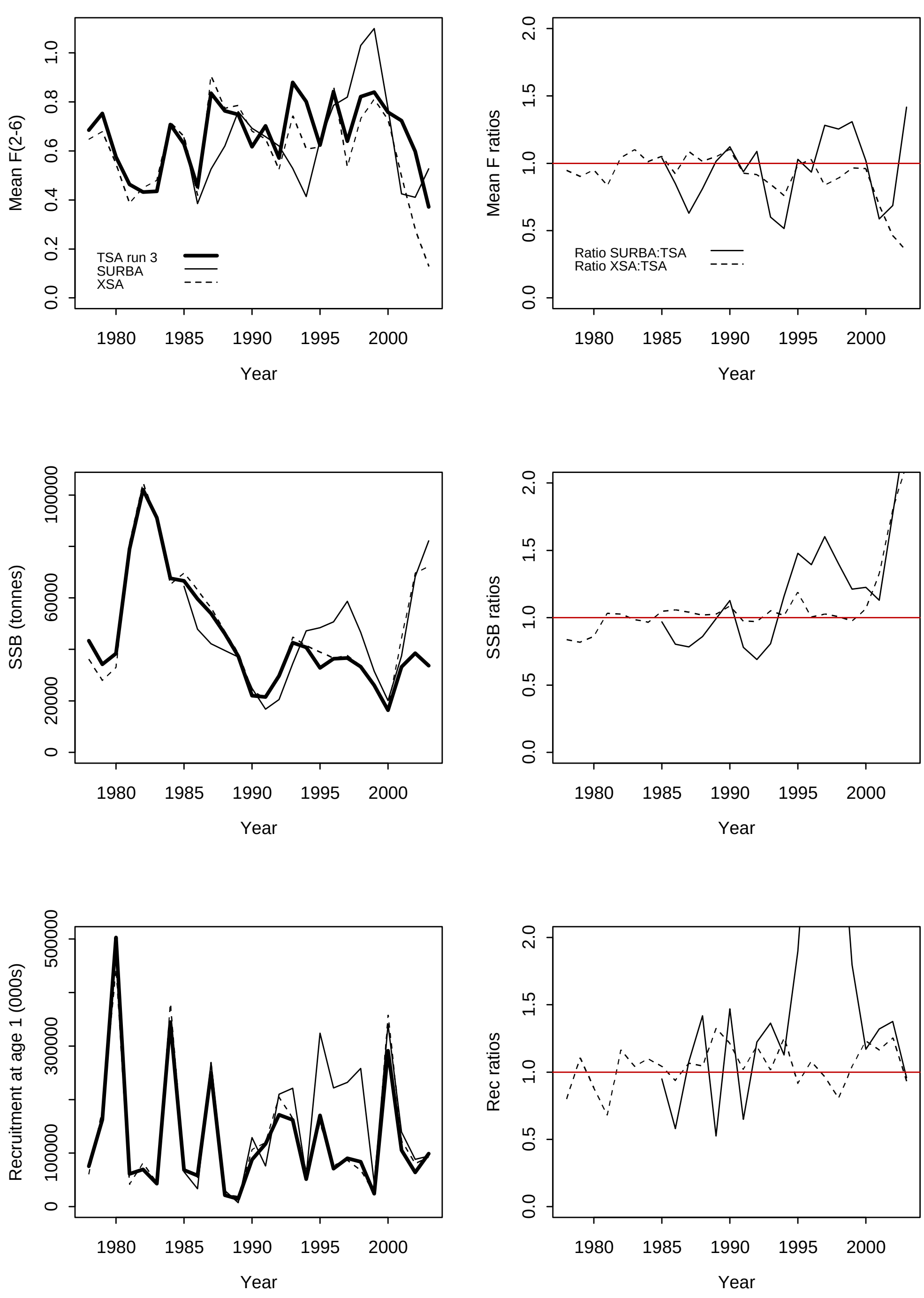


Figure 4.1.5.7.a. Haddock in Division VIa. TSA stock summary from run A (all catch & no survey trend). Estimates are plotted with approximate pointwise 95% confidence bounds. The dotted vertical line on each graph shows the last year of available catch data.

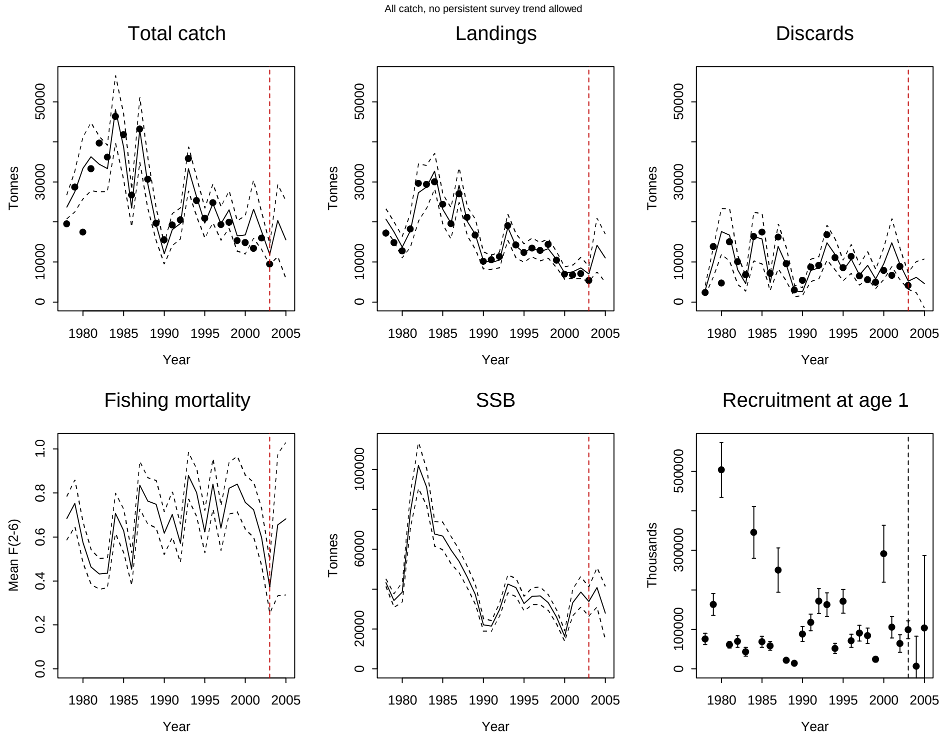


Figure 4.1.5.7.b. Haddock in Division VIa. TSA stock summary from run B (all catch & survey trend). Estimates are plotted with approximate pointwise 95% confidence bounds. The dotted vertical line on each graph shows the last year of available catch data.

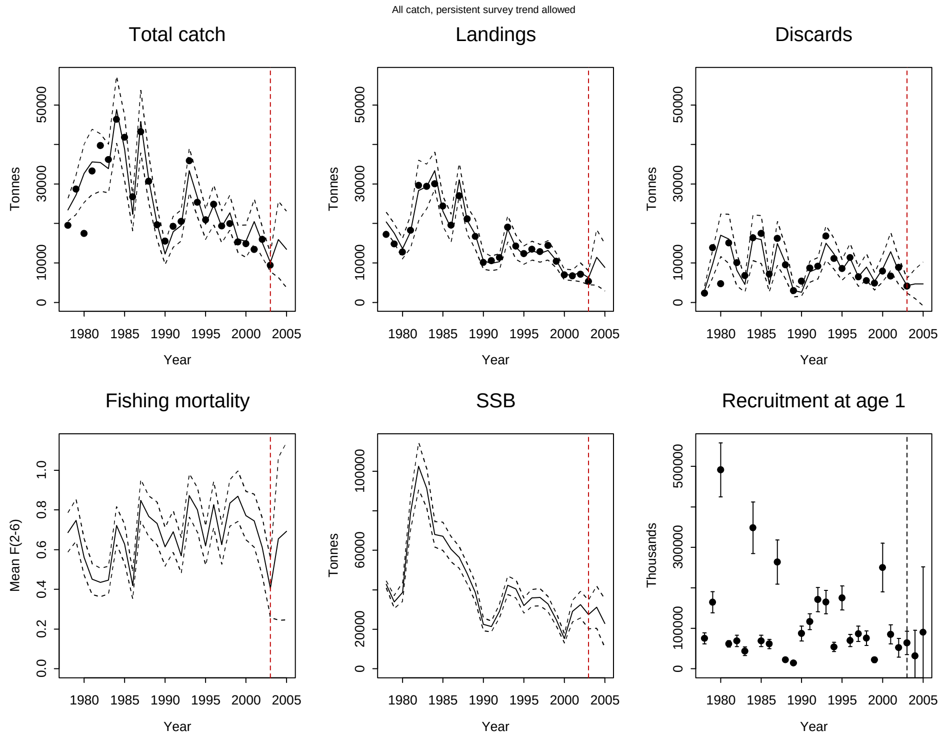


Figure 4.1.5.7.c. Haddock in Division VIa. TSA stock summary from run C (missing 1995–2033 catch & no survey trend). Estimates are plotted with approximate pointwise 95% confidence bounds. The dotted vertical line on each graph shows the last year of available catch data.

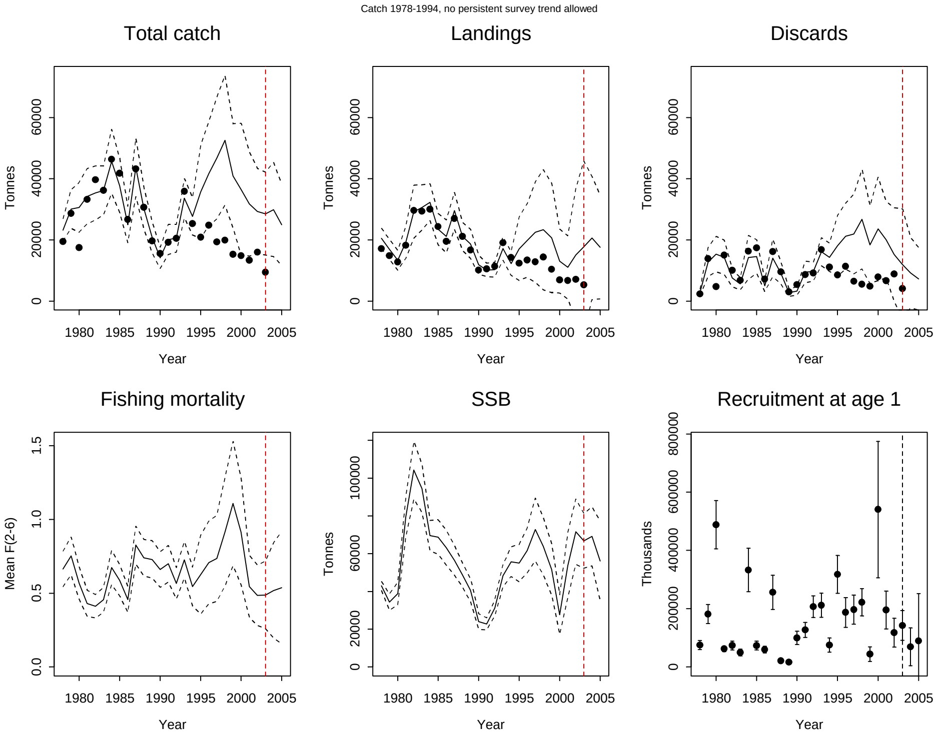


Figure 4.1.5.7.d. Haddock in Division VIa. XSA stock summary.

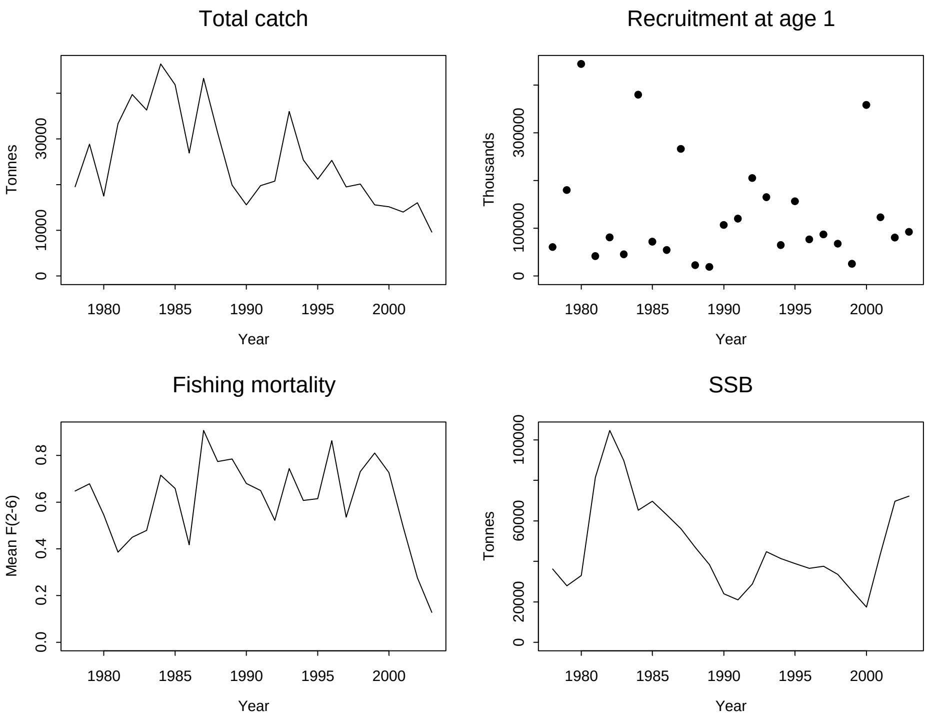


Figure 4.1.5.8.a. Haddock in Division VIa. TSA stock-recruitment scatterplot from run A (all catch & no survey trend). Line gives TSA-estimated Ricker curve. Labels denote year-classes. Forecasts beyond the last year of catch data are highlighted.

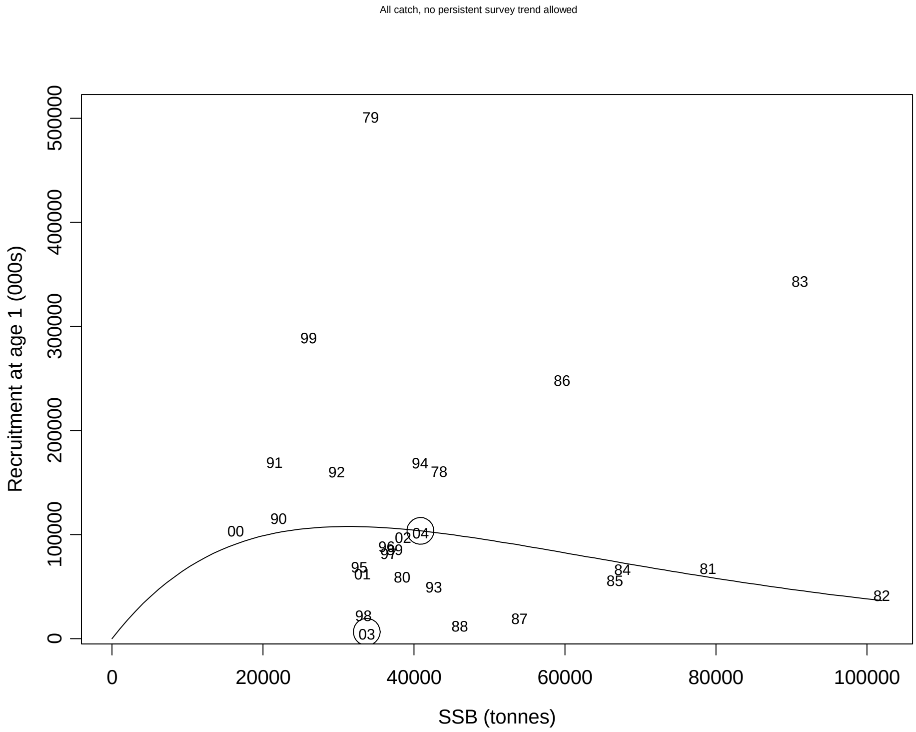


Figure 4.1.5.8.b. Haddock in Division VIa. TSA stock-recruitment scatterplot from run B (all catch & survey trend). Line gives TSA-estimated Ricker curve. Labels denote year-classes. Forecasts beyond the last year of catch data are highlighted.

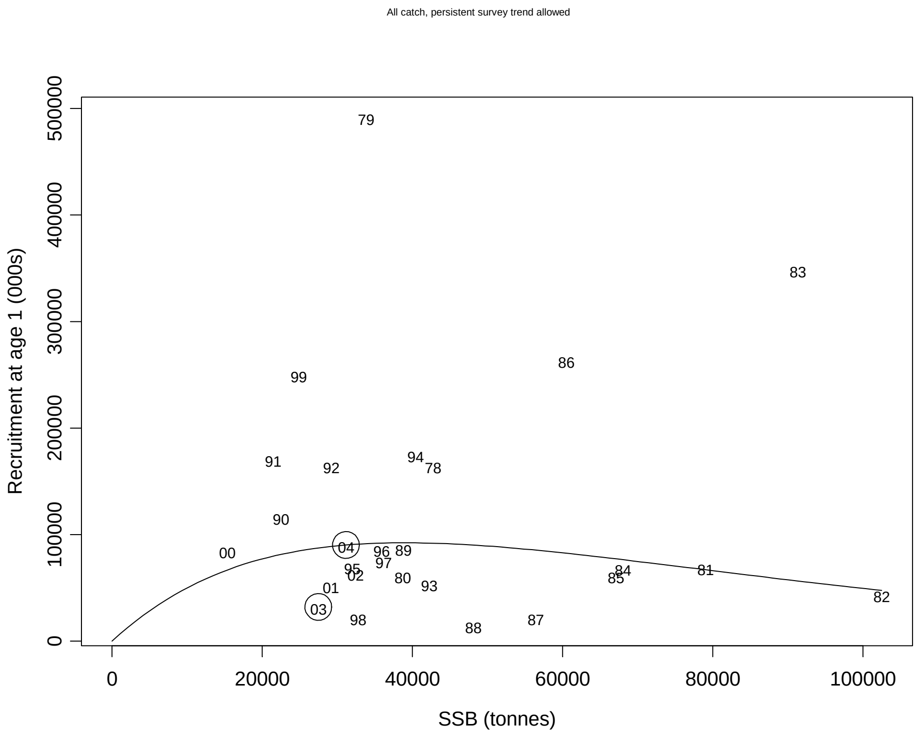


Figure 4.1.5.8.c. Haddock in Division VIa. TSA stock-recruitment scatterplot from run C (missing catch 1995–2003 & no survey trend). Line gives TSA-estimated Ricker curve. Labels denote year-classes. Forecasts beyond the last year of catch data are highlighted.

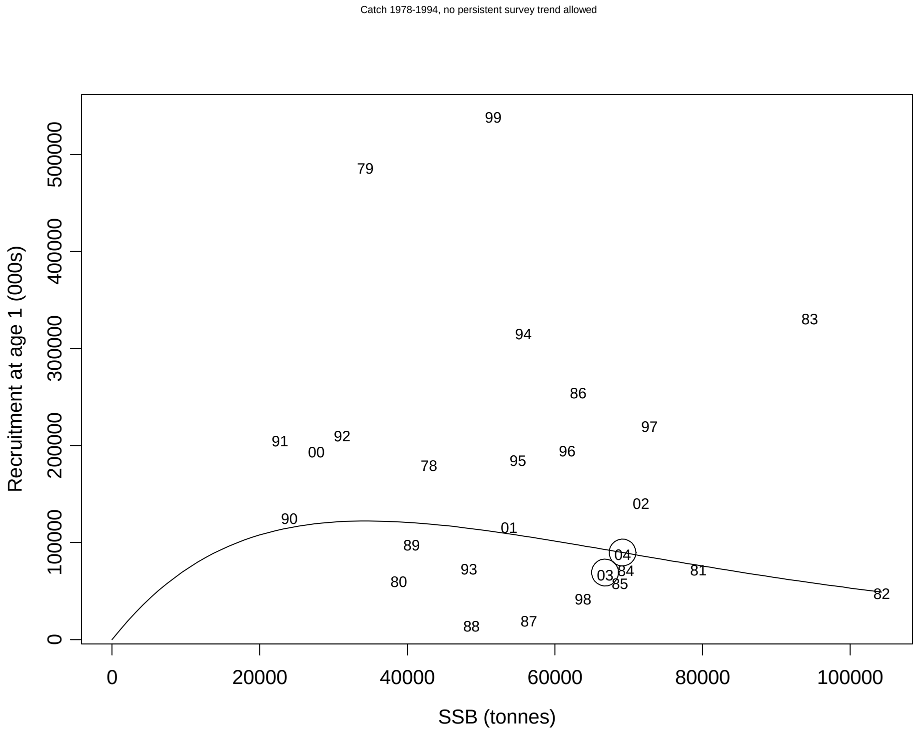


Figure 4.1.5.8.d. Haddock in Division VIa. XSA stock-recruitment scatterplot. Labels denote year-classes.

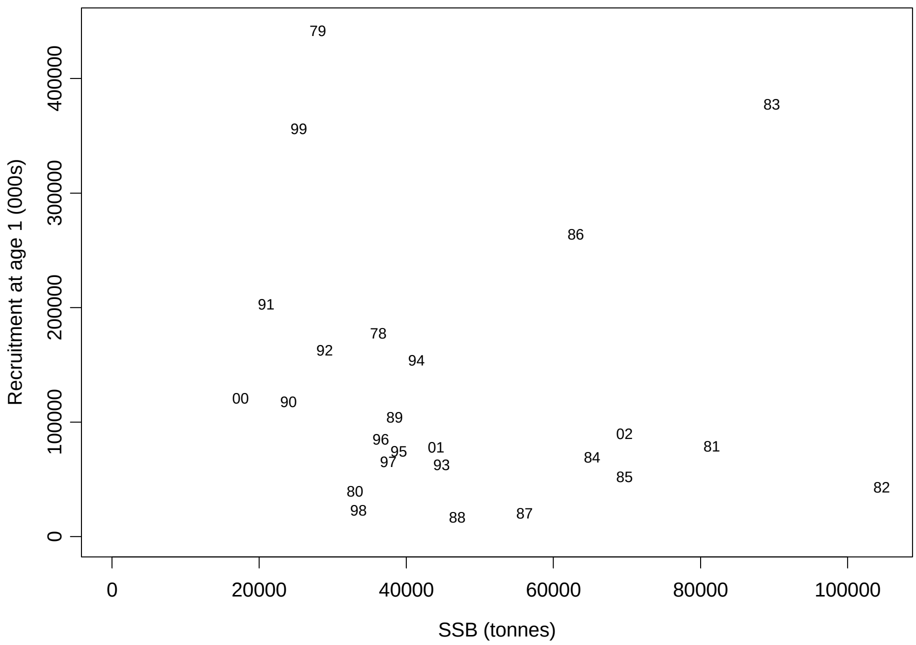
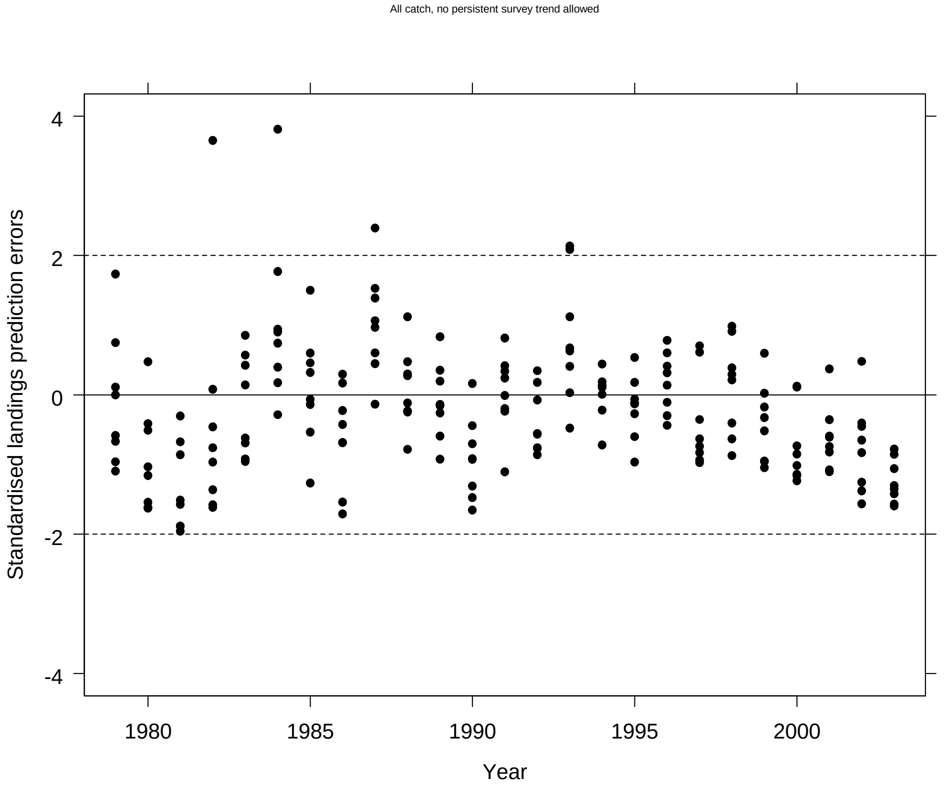


Figure 4.1.5.9.a. Haddock in Division VIa. Standardised landings prediction errors from TSA run A (all catch & no survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



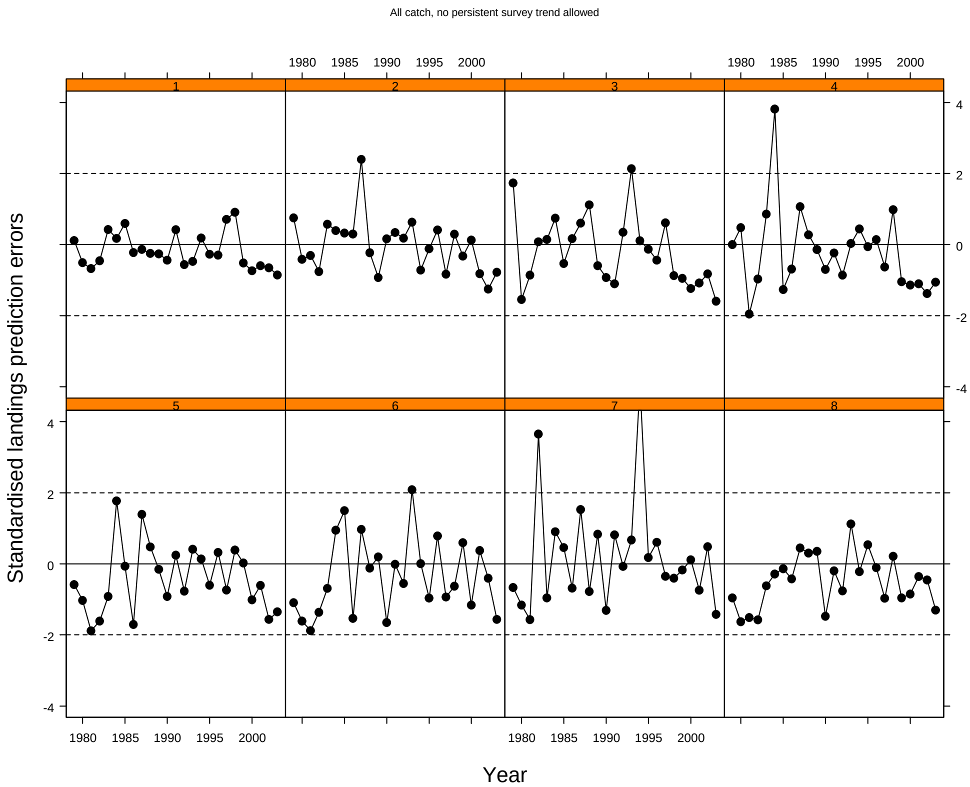
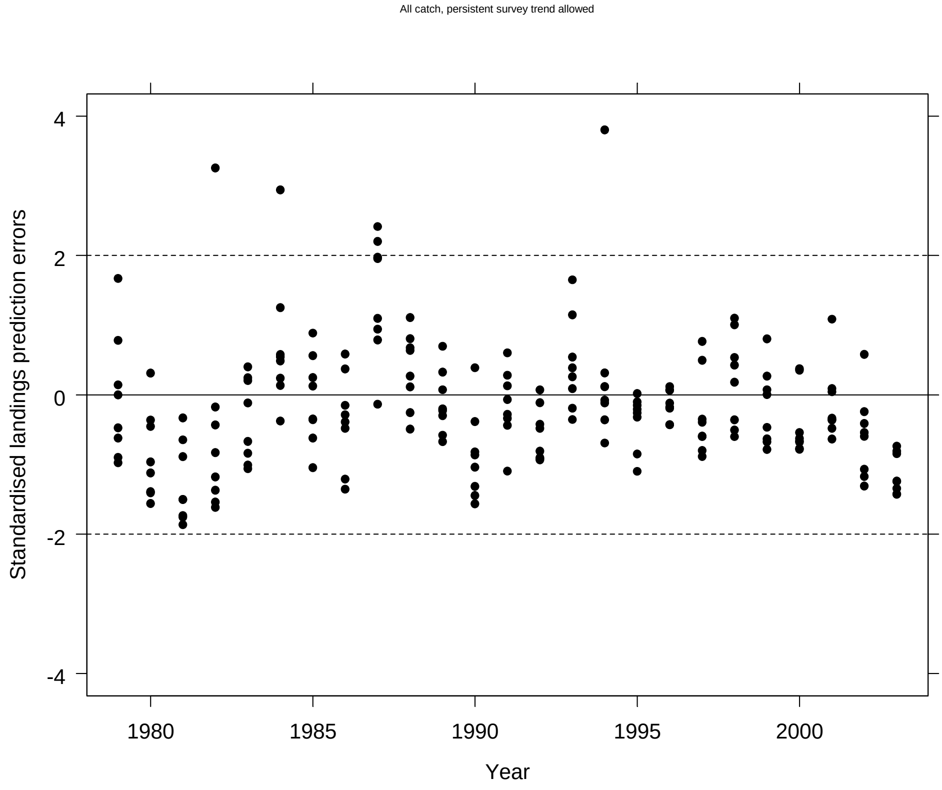


Figure 4.1.5.9.b. Haddock in Division VIa. Standardised landings prediction errors from TSA run B (all catch & survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



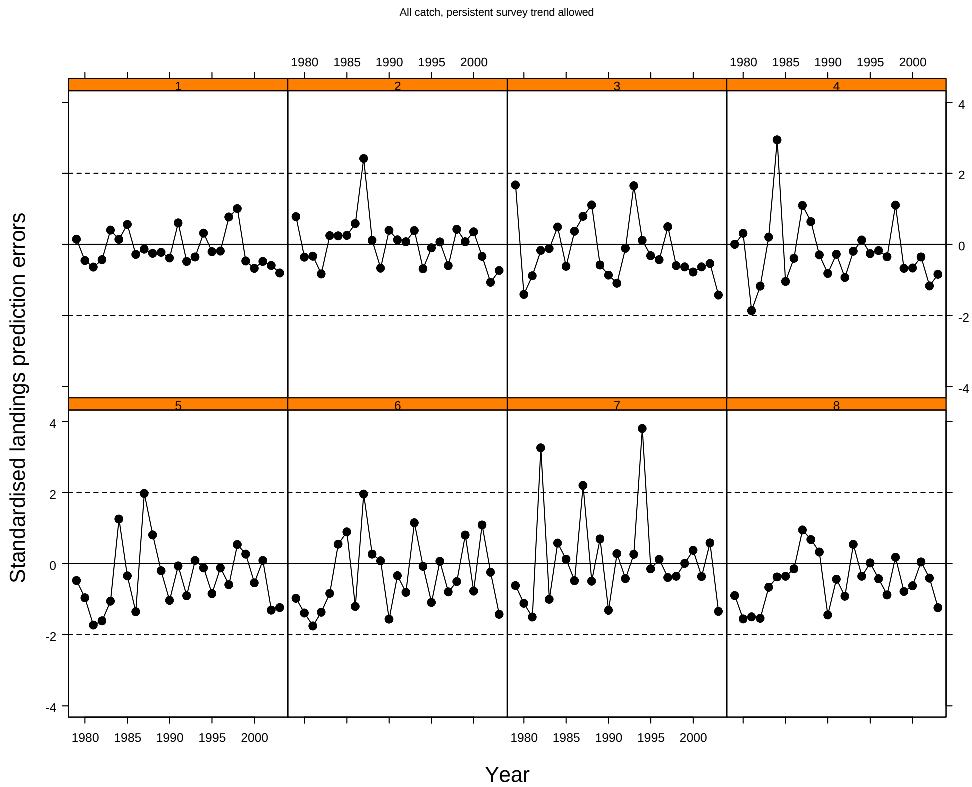
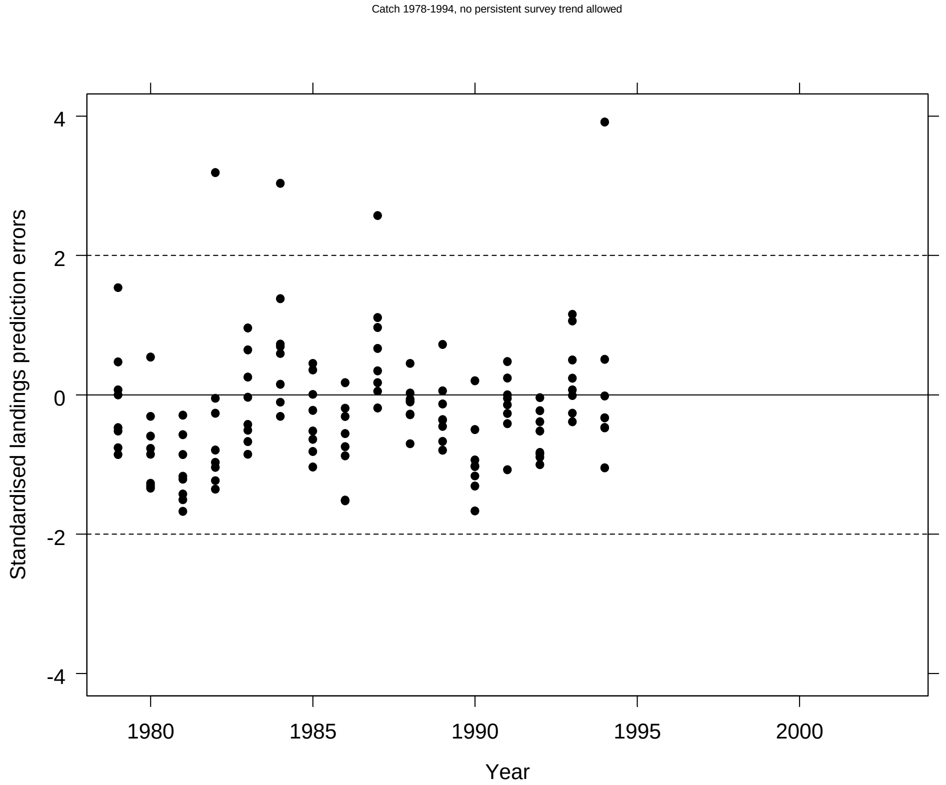


Figure 4.1.5.9.c. Haddock in Division VIa. Standardised landings prediction errors from TSA run C (missing catch 1995–2003 & no survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



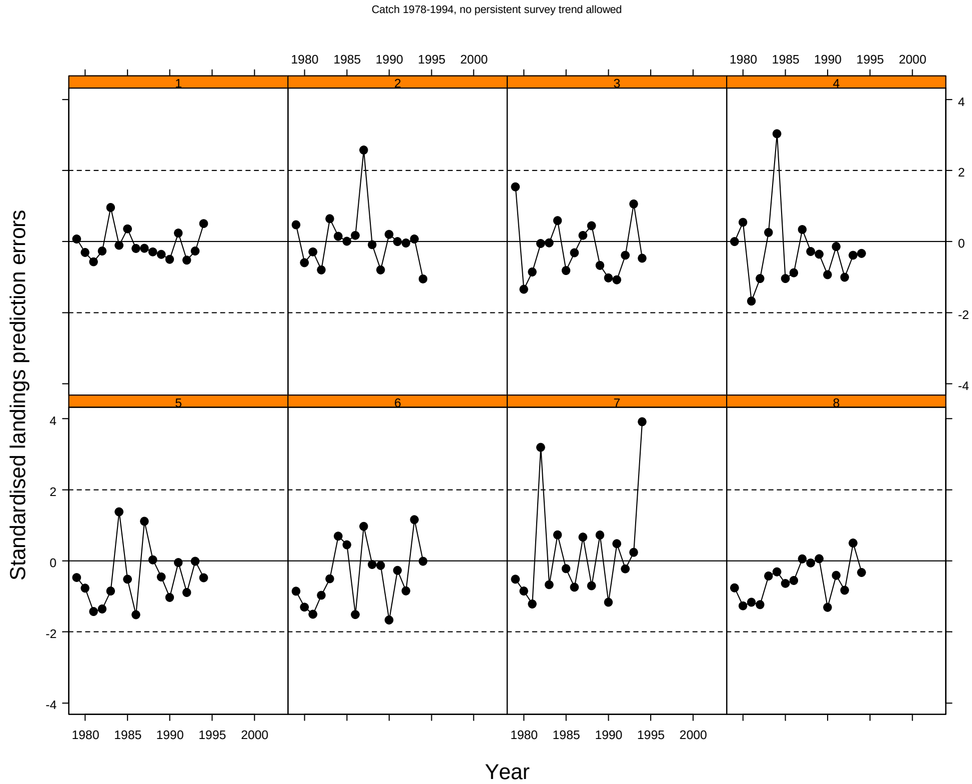
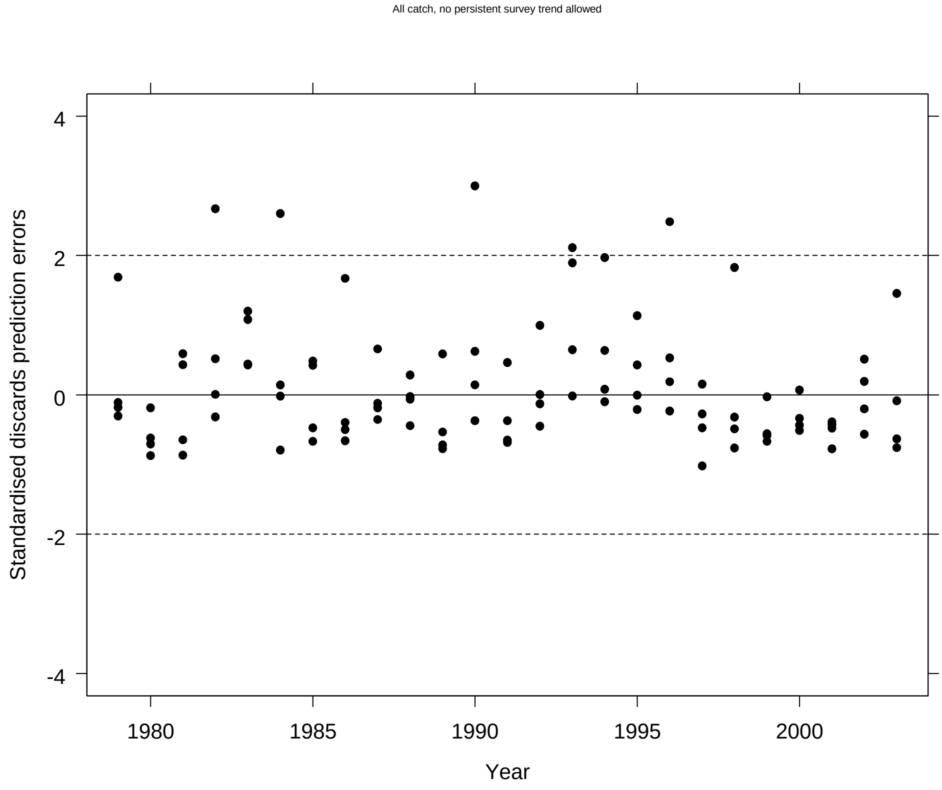


Figure 4.1.5.10.a. Haddock in Division VIa. Standardised discards prediction errors from TSA run A (all catch & no survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



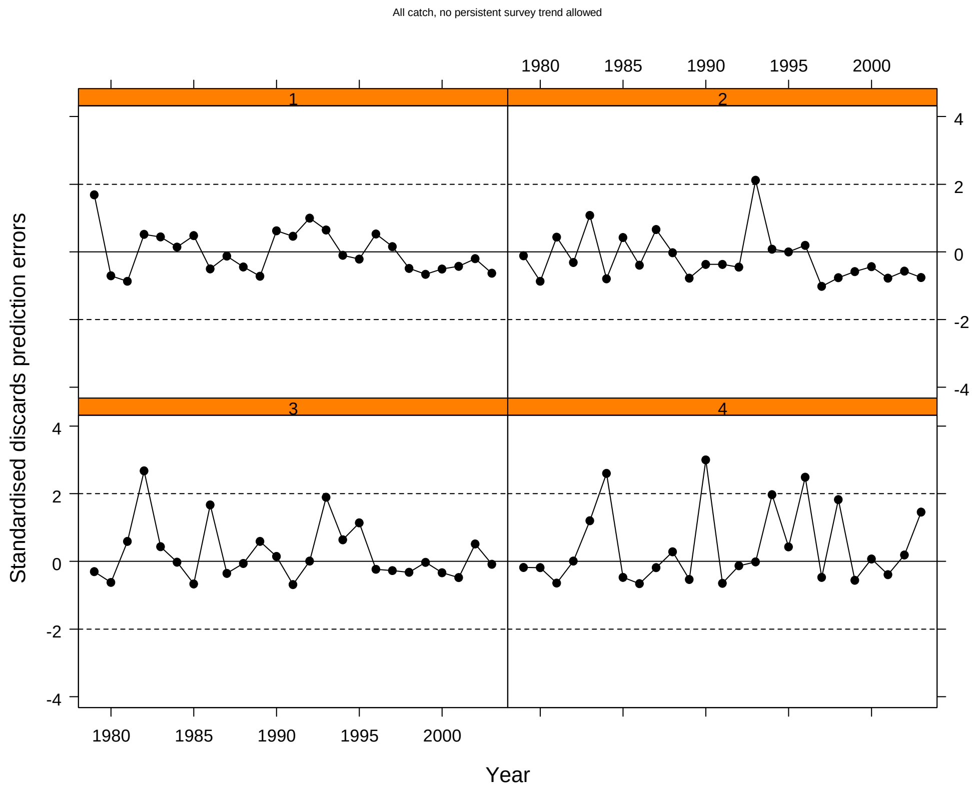
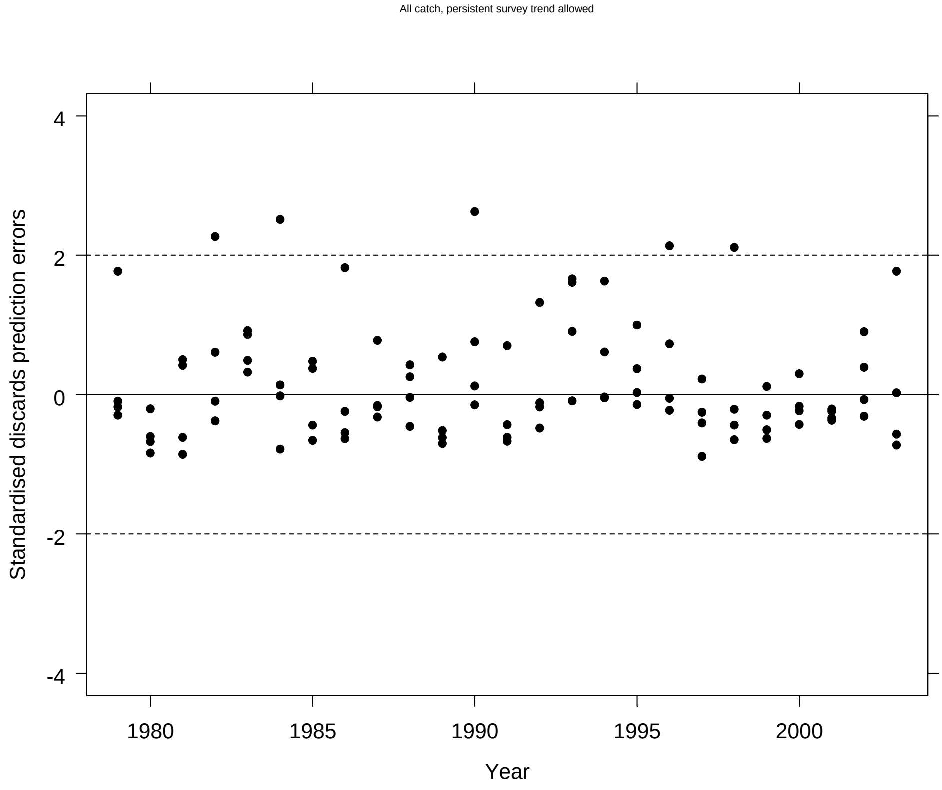


Figure 4.1.5.10.b. Haddock in Division VIa. Standardised discards prediction errors from TSA run B (all catch & survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



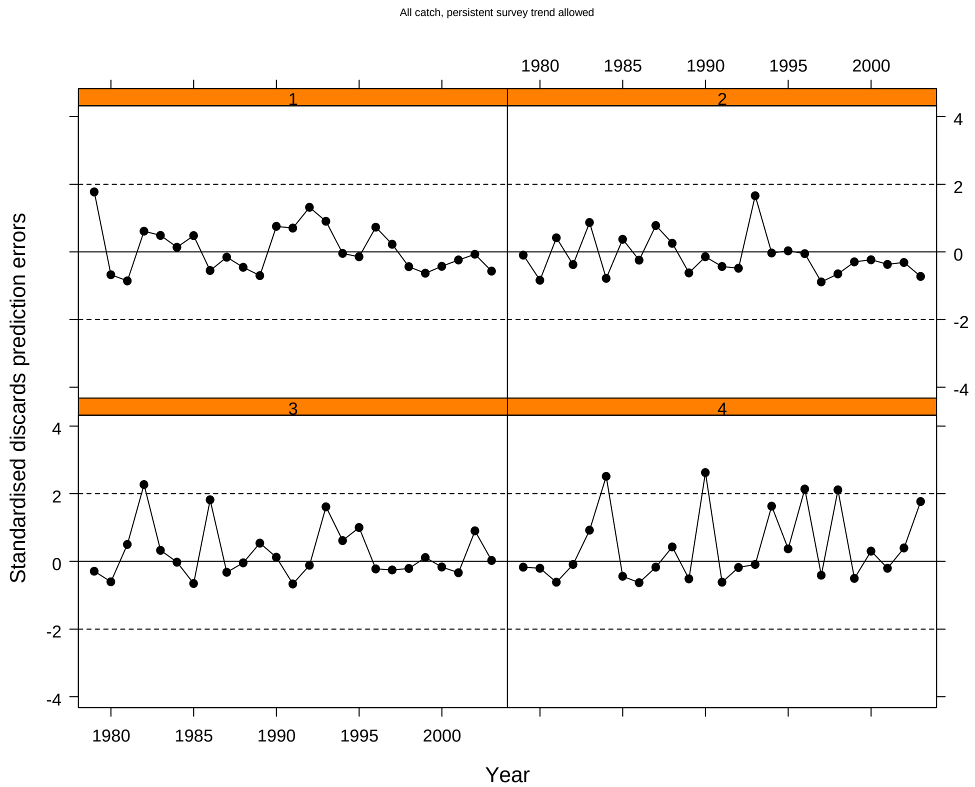
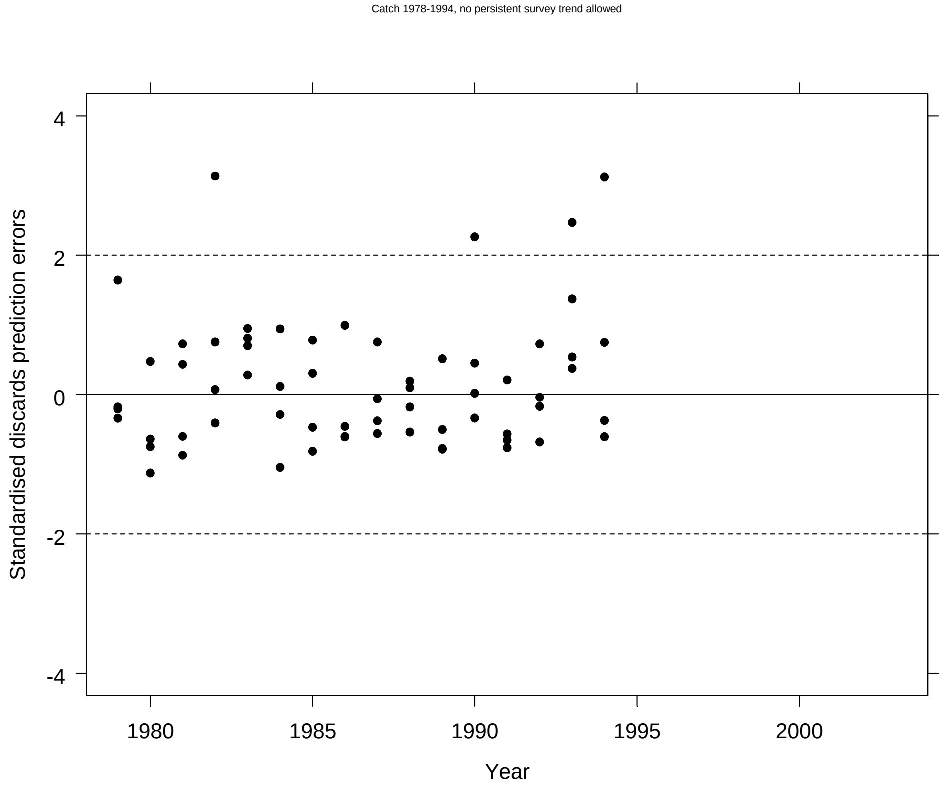


Figure 4.1.5.10.c. Haddock in Division VIa. Standardised discards prediction errors from TSA run C (missing catch 1995–2003 & no survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



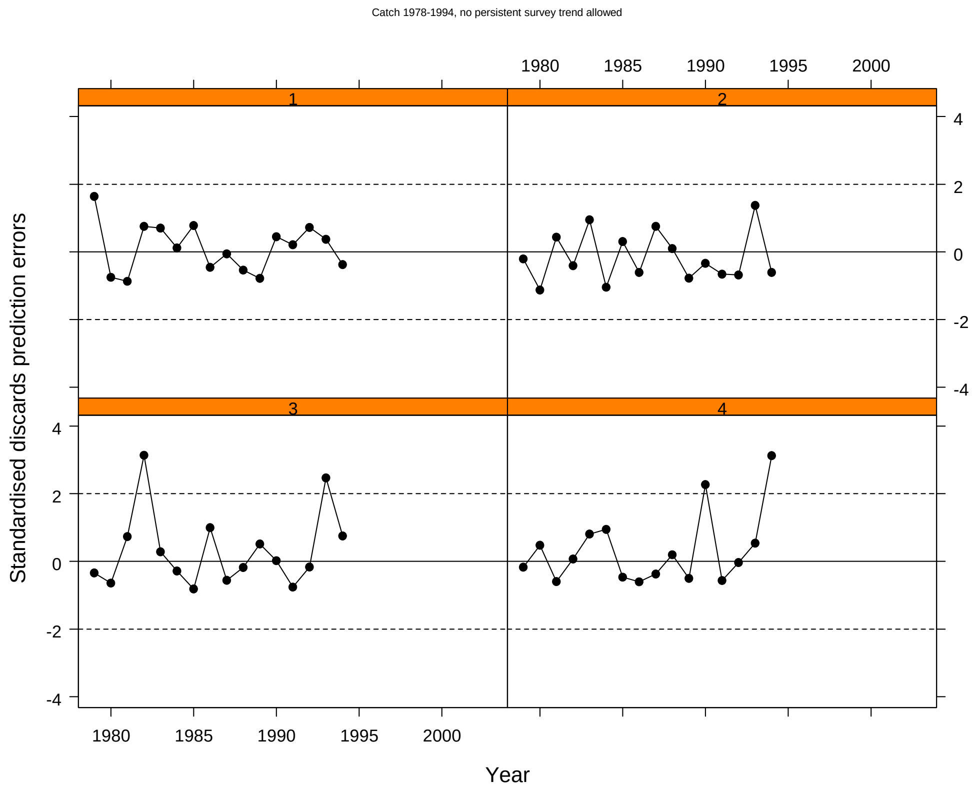
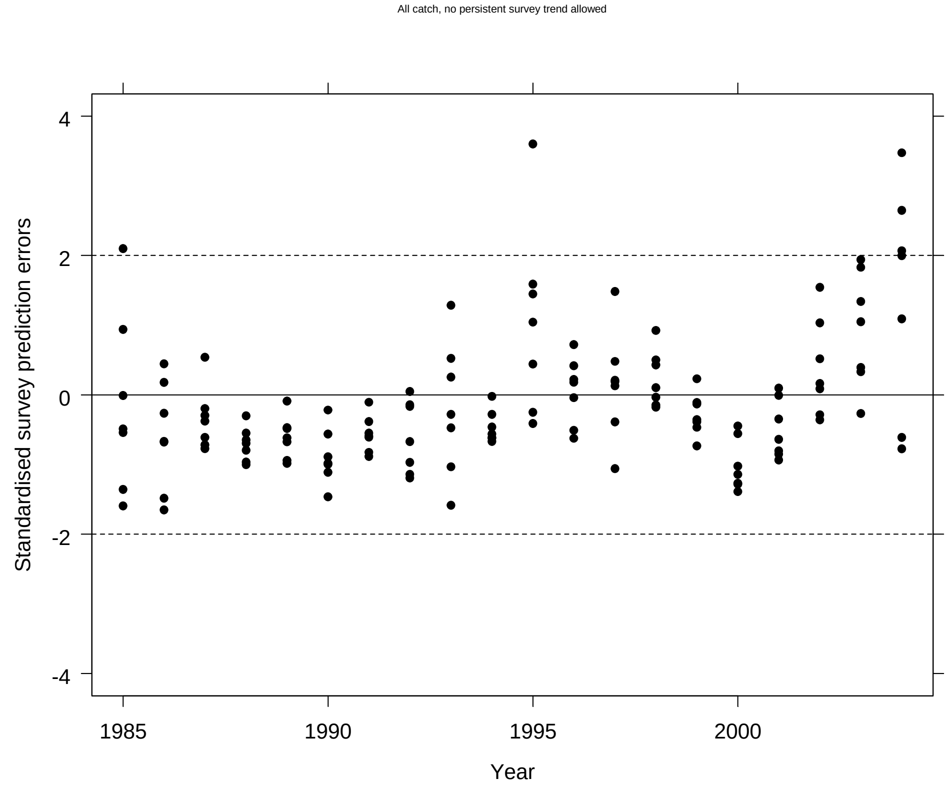


Figure 4.1.5.11.a. Haddock in Division VIa. Standardised survey prediction errors from TSA run A (all catch & no survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



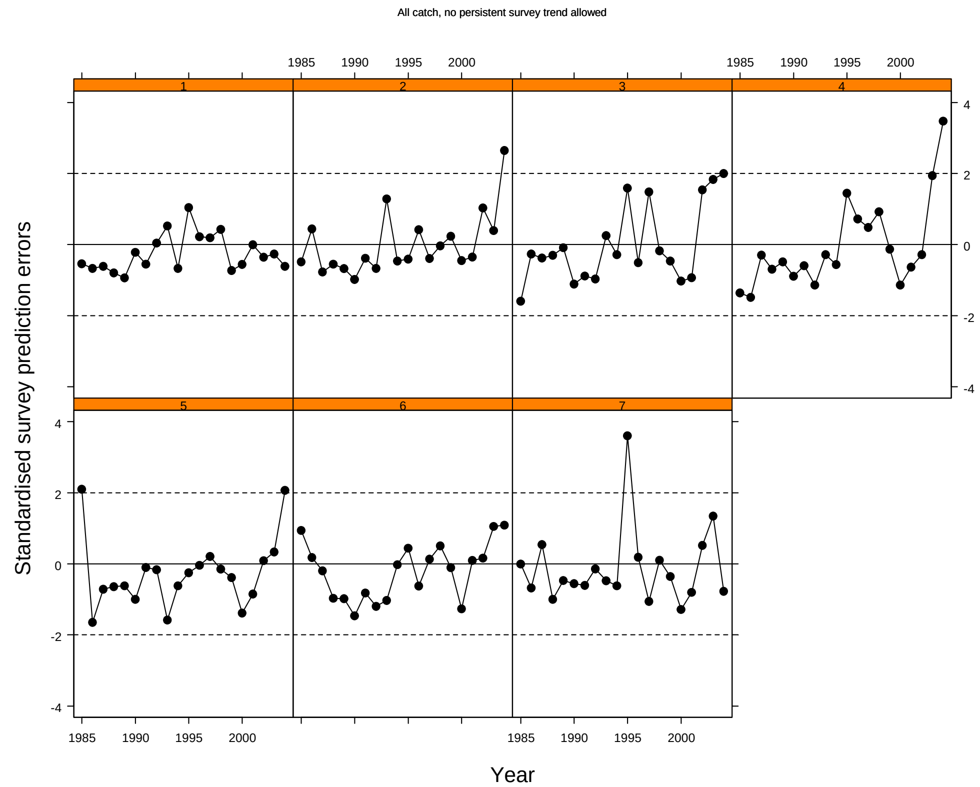
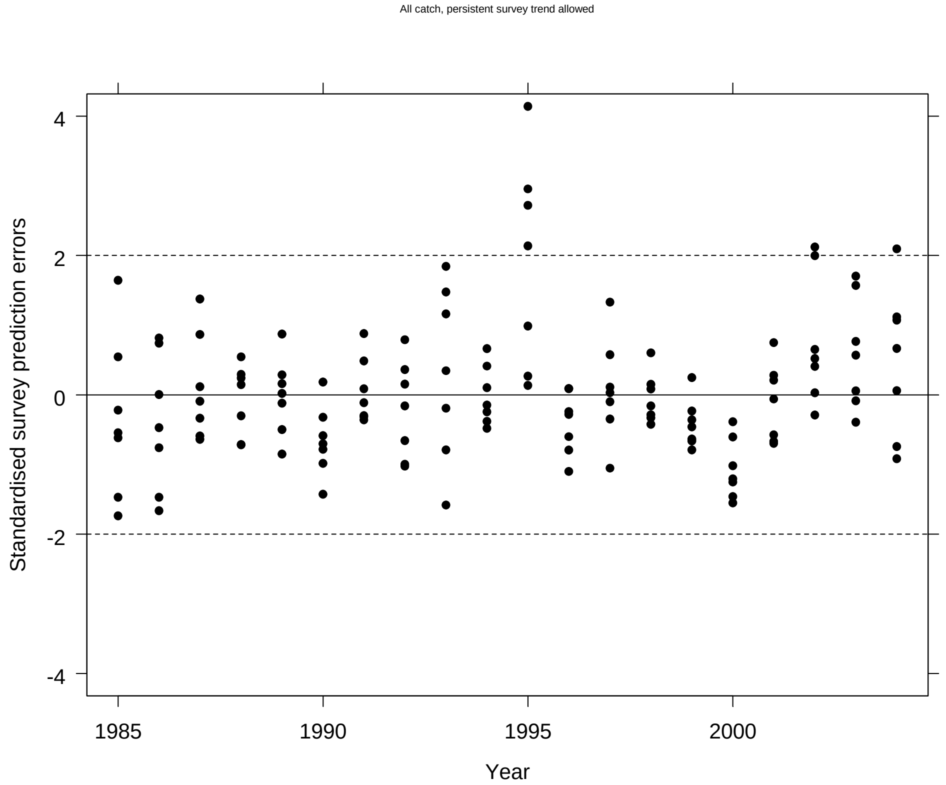


Figure 4.1.5.11.b. Haddock in Division VIa. Standardised survey prediction errors from TSA run B (all catch & survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.



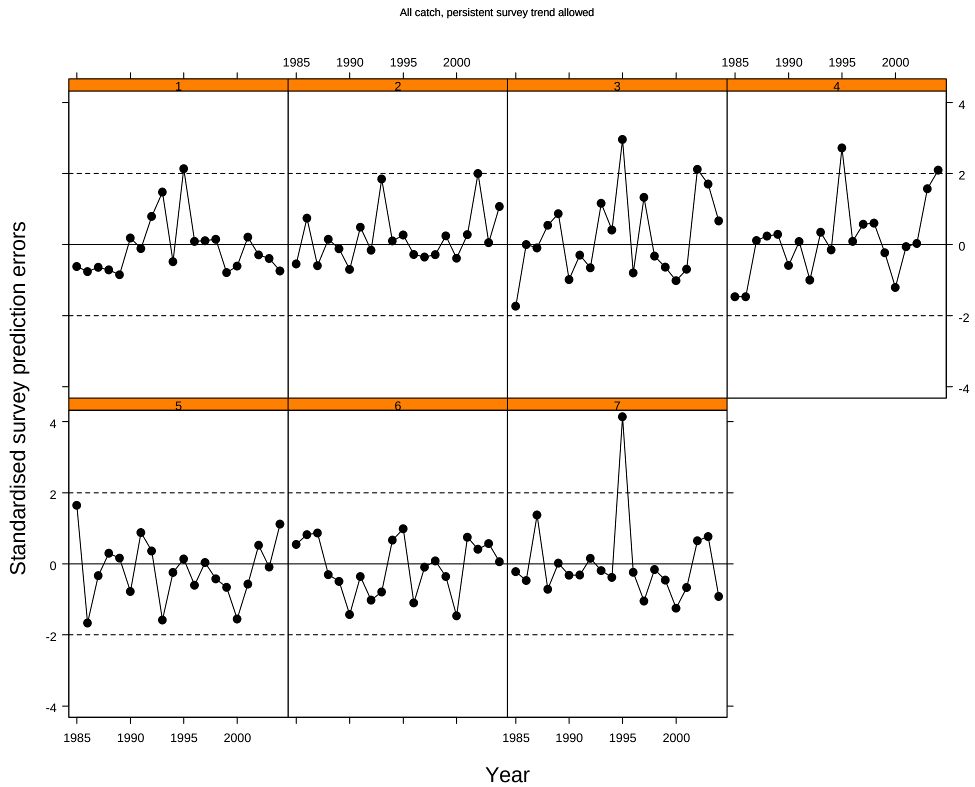
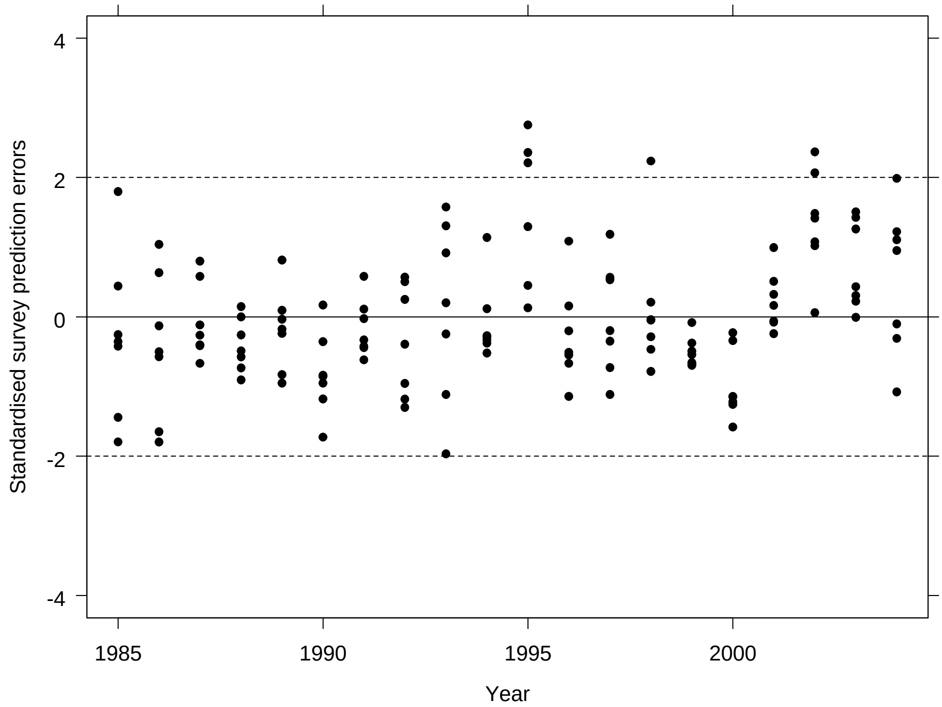


Figure 4.1.5.11.c. Haddock in Division VIa. Standardised survey prediction errors from TSA run C (missing catch 1995–2003 & no survey trend). Upper plot: ages aggregated. Lower plot: ages disaggregated.

Catch 1978-1994, no persistent survey trend allowed



Catch 1978-1994, no persistent survey trend allowed

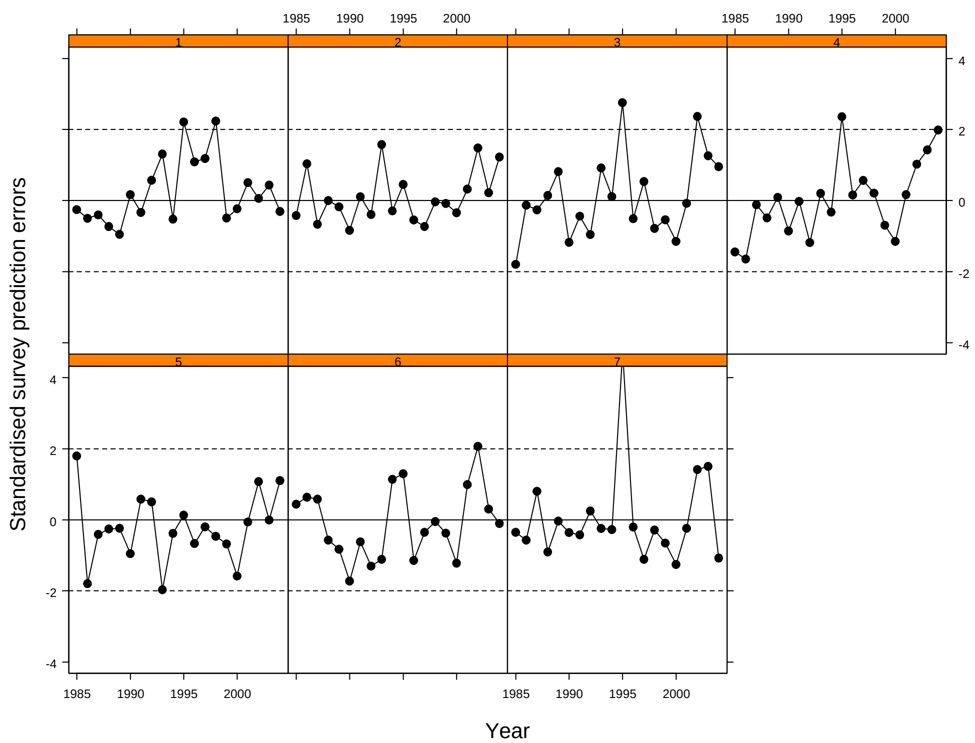


Figure 4.1.5.12.a. Haddock in Division VIa. Time-series by age of the log ratio of mean-standardised ScoGFS indices to mean-standardised abundance, as estimated by TSA run A (all catch & no survey trend). Lines give loess smoothers with 95% confidence intervals.

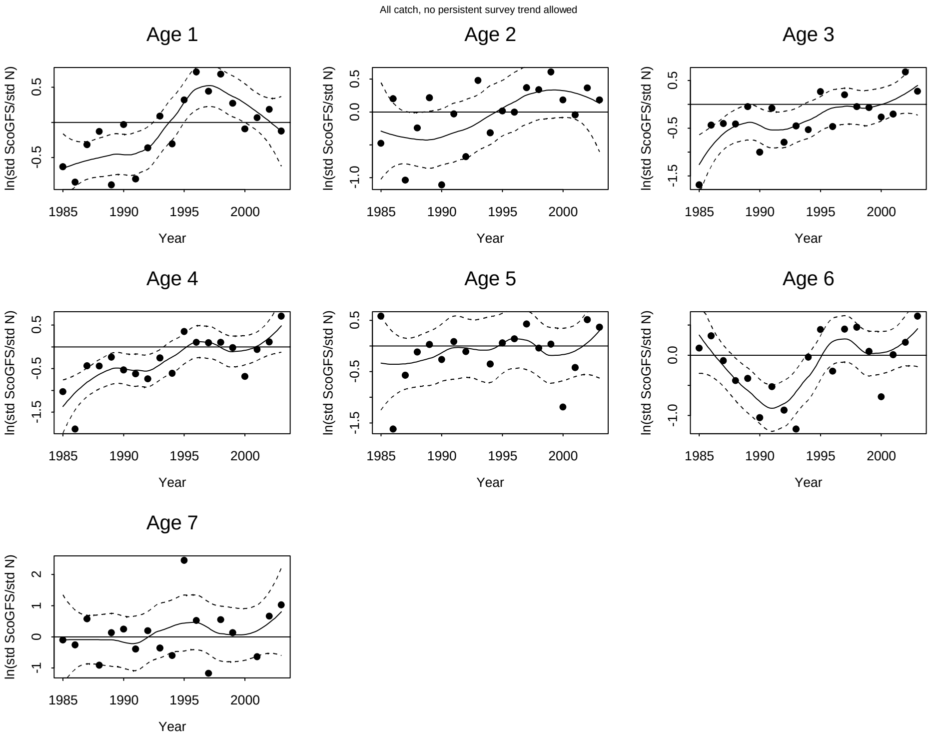


Figure 4.1.5.12.b. Haddock in Division VIa. Time-series by age of the log ratio of mean-standardised ScoGFS indices to mean-standardised abundance, as estimated by TSA run B (all catch & survey trend). Lines give loess smoothers with 95% confidence intervals.

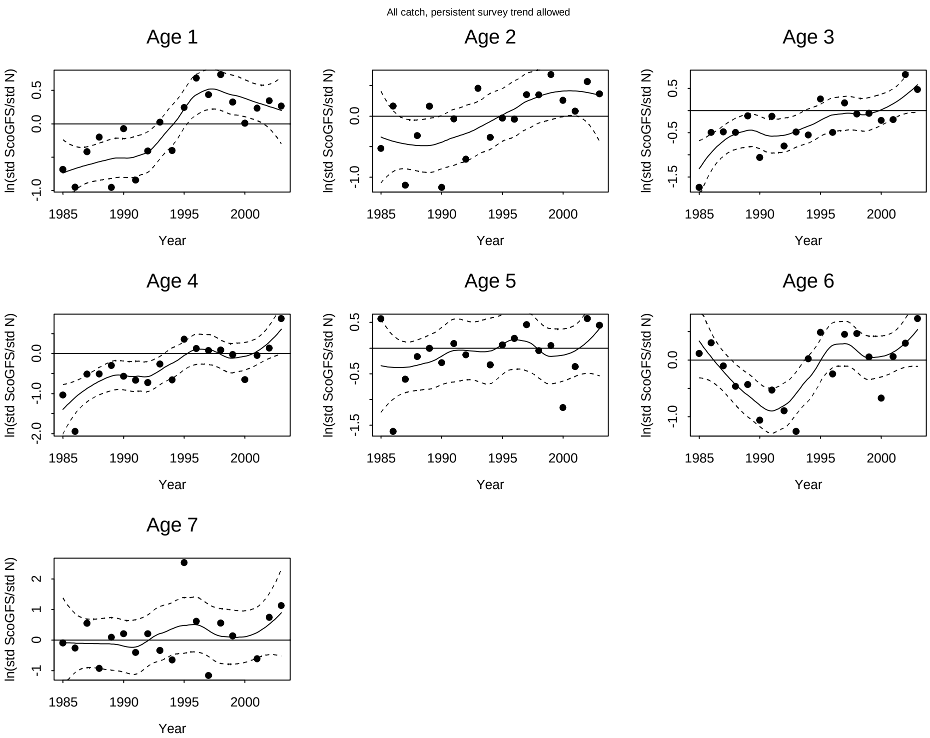


Figure 4.1.5.12.c. Haddock in Division VIa. Time-series by age of the log ratio of mean-standardised ScoGFS indices to mean-standardised abundance, as estimated by TSA run C (missing catch 1995–2003 & no survey trend). Lines give loess smoothers with 95% confidence intervals.

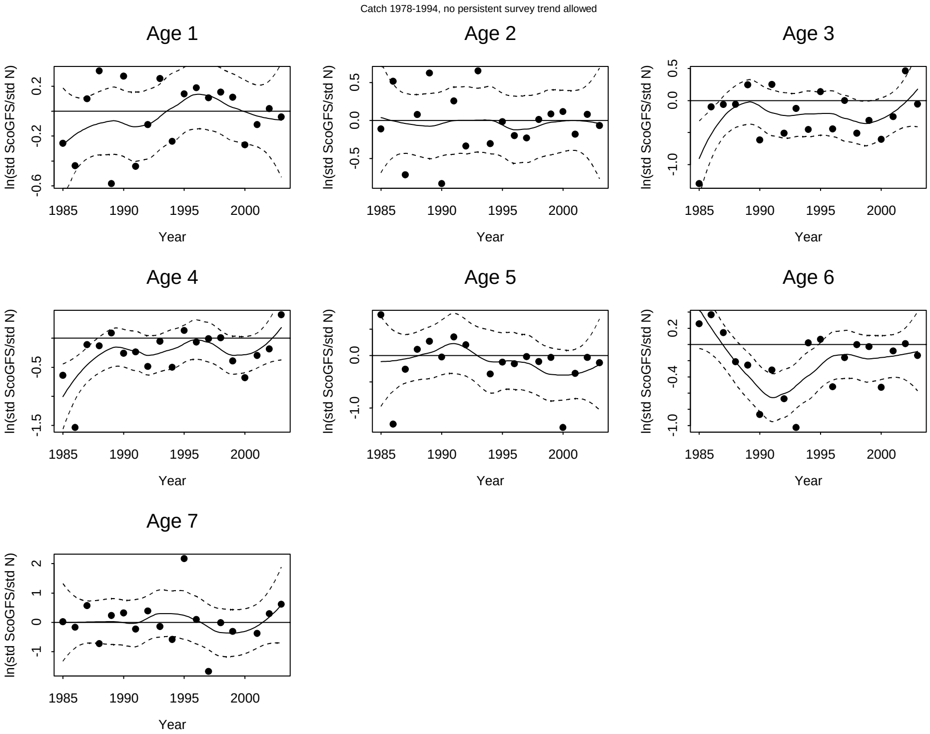


Figure 4.1.5.12.d. Haddock in Division VIa. Time-series by age of the log ratio of mean-standardised ScoGFS indices to mean-standardised abundance, as estimated by XSA. Lines give loess smoothers with 95% confidence intervals.

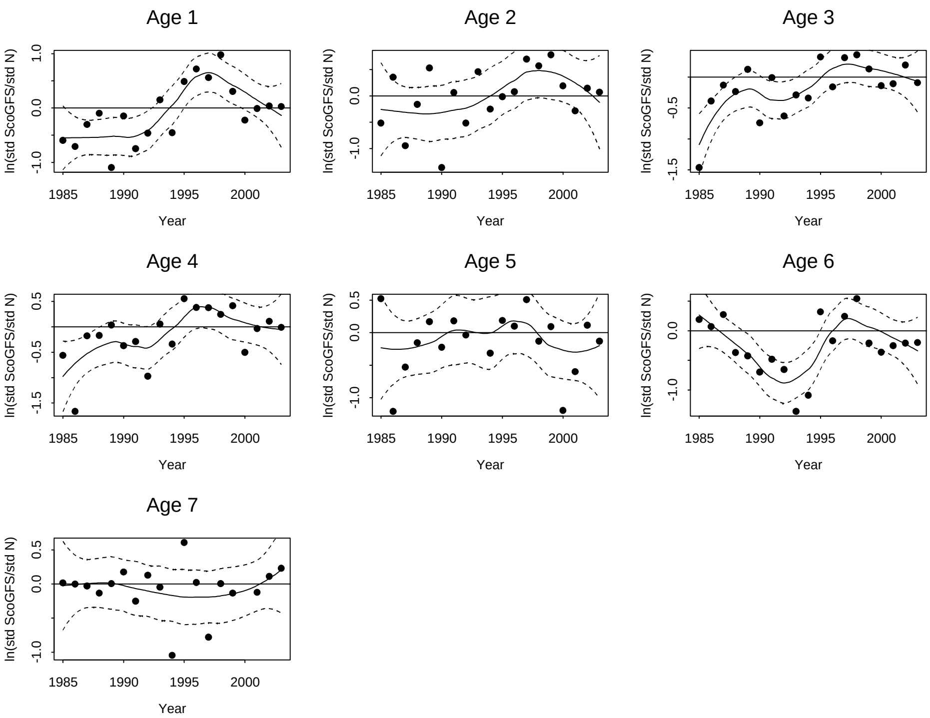


Figure 4.1.5.13.a. Haddock in Division VIa. Estimates of persistent (upper) and transient (lower) survey catchability trends from TSA run A (all catch & no survey trend). Dotted lines give 95% confidence intervals.

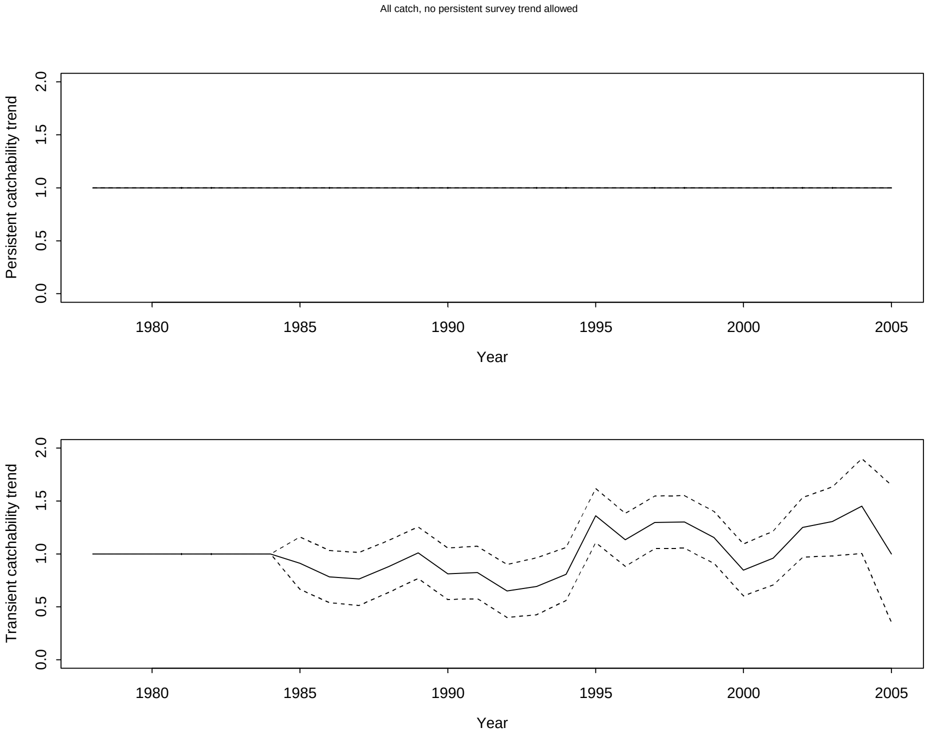


Figure 4.1.5.13.b. Haddock in Division VIa. Estimates of persistent (upper) and transient (lower) survey catchability trends from TSA run B (all catch & survey trend). Dotted lines give 95% confidence intervals.

Figure 4.1.5.13.c. Haddock in Division VIa. Estimates of persistent (upper) and transient (lower) survey catchability trends from TSA run C (missing catch 1995–2003 & no survey trend). Dotted lines give 95% confidence intervals.

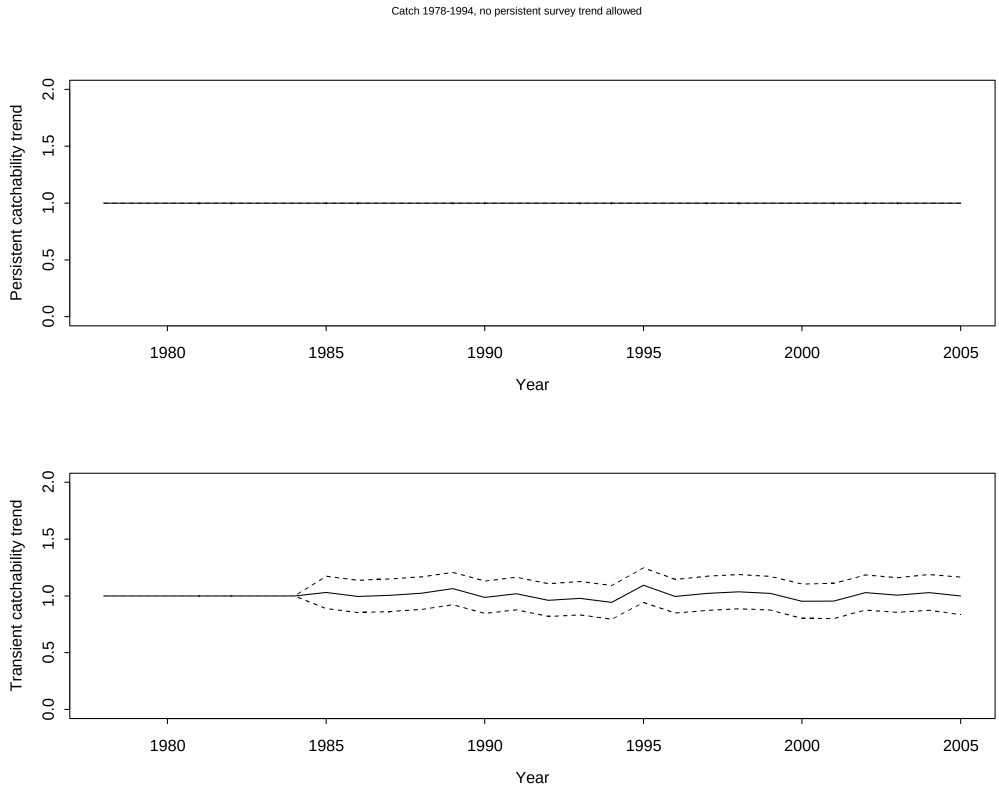


Figure 4.1.5.14.a. Haddock in Division VIa. Fitted discard ogives from TSA run A (all catch & no survey trend). Points show observed discard proportions at age.

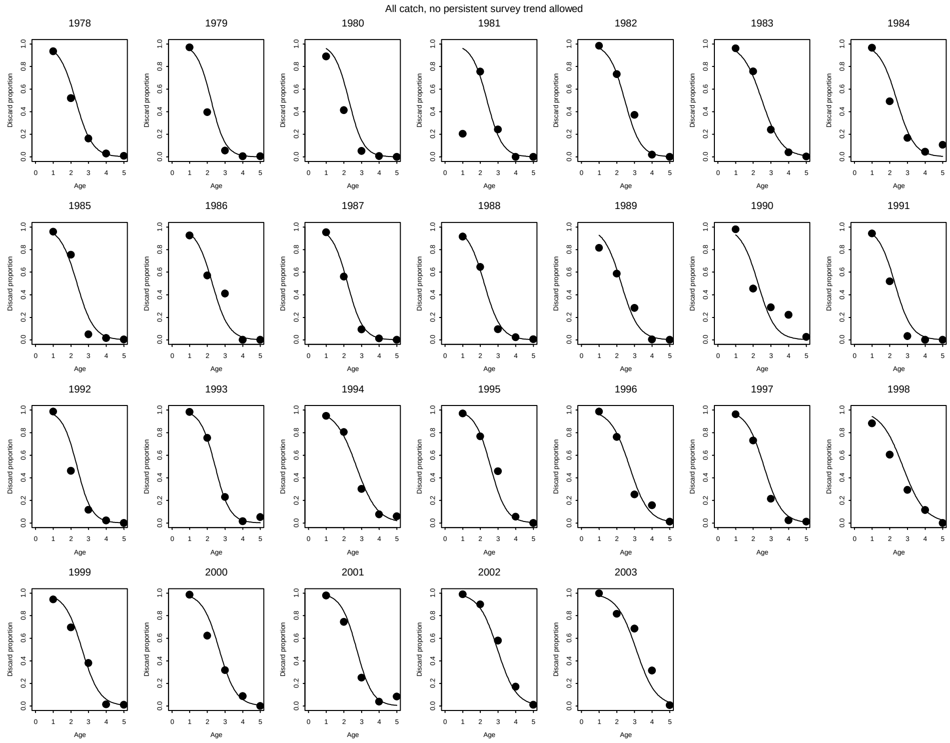


Figure 4.1.5.14.b. Haddock in Division VIa. Fitted discard ogives from TSA run B (all catch & survey trend). Points show observed discard proportions at age.

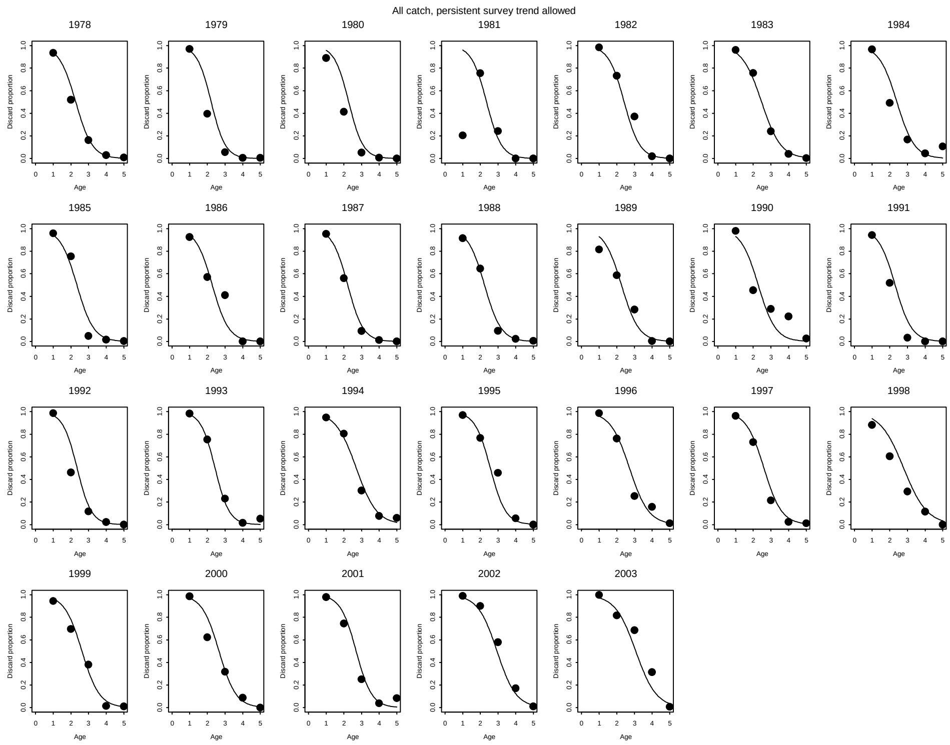


Figure 4.1.5.14.c. Haddock in Division VIa. Fitted discard ogives from TSA run C (missing catch 1995–2003 & no survey trend). Points show observed discard proportions at age.

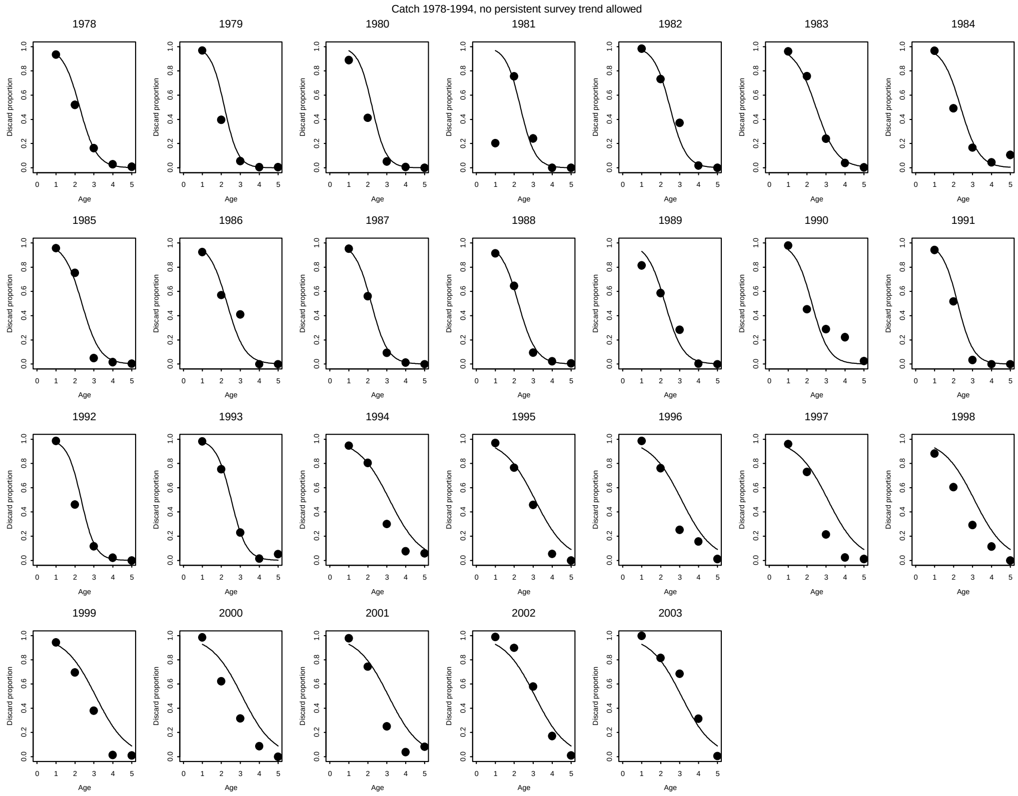


Figure 4.1.5.15.a. Haddock in Division VIa. Retrospective estimates of mean $F_{2\text{–}6}$ from TSA run A (all catch & no survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

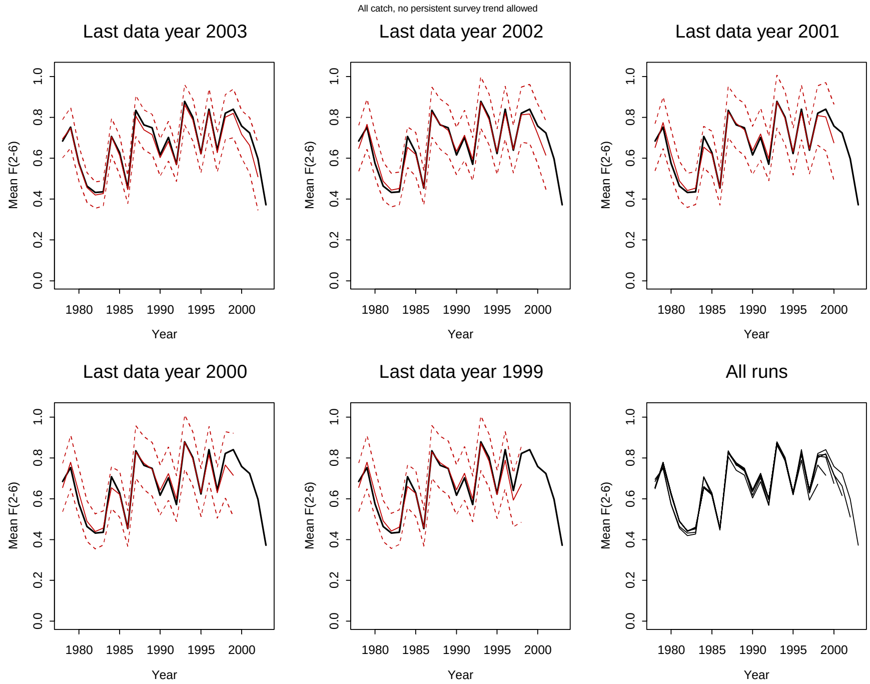


Figure 4.1.5.15.b. Haddock in Division VIa. Retrospective estimates of mean $F_{2\text{–}6}$ from TSA run B (all catch & survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

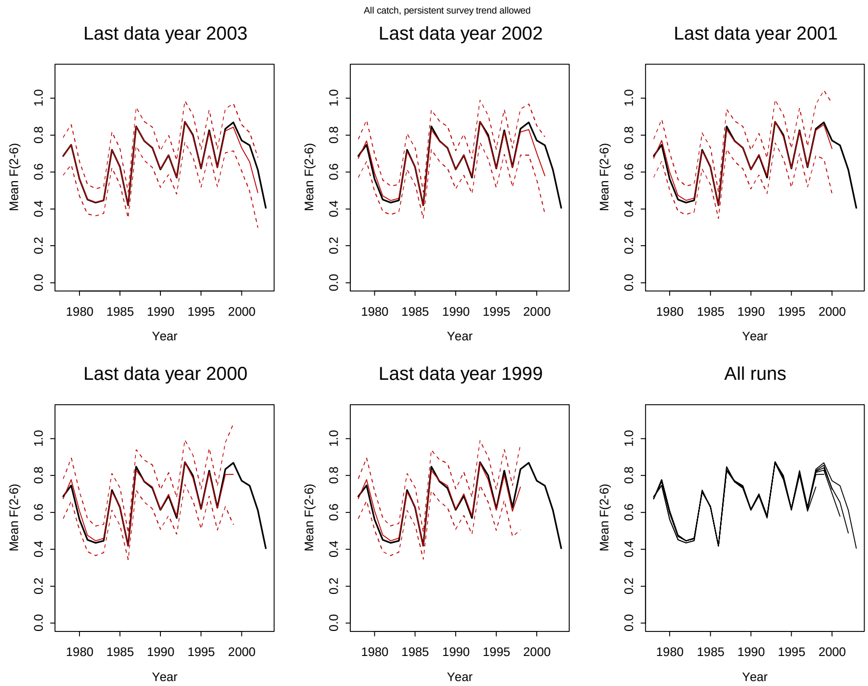


Figure 4.1.5.15.c. Haddock in Division VIa. Retrospective estimates of mean $F_{2\text{–}6}$ from TSA run C (missing catch 1995–2003 & no survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

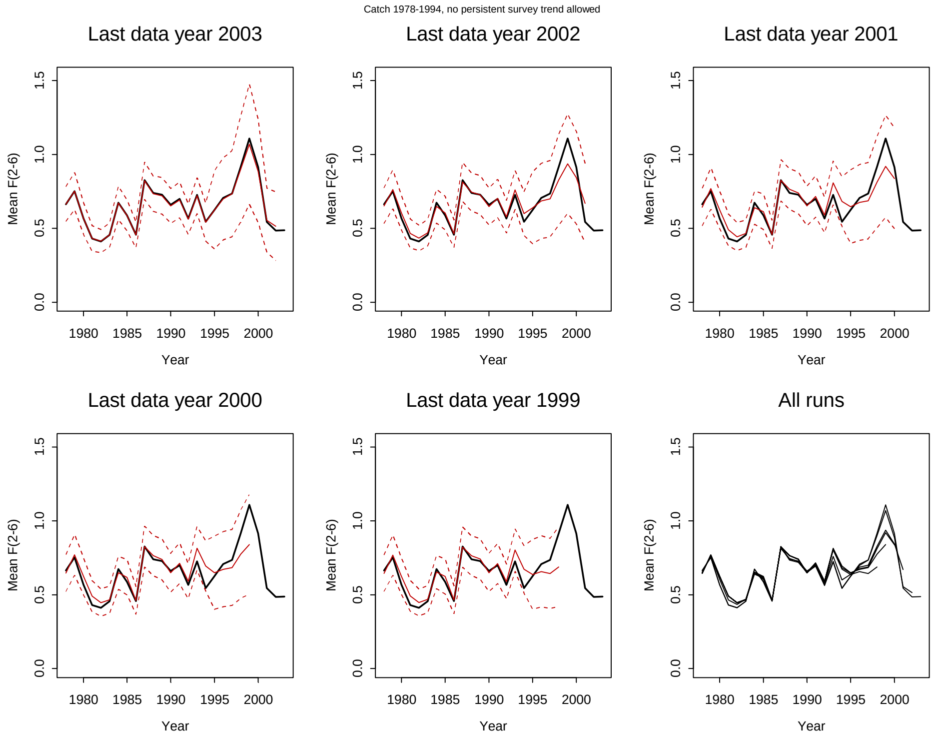


Figure 4.1.5.15.d. Haddock in Division VIa. Retrospective estimates of mean $F_{2\text{–}6}$ from XSA.

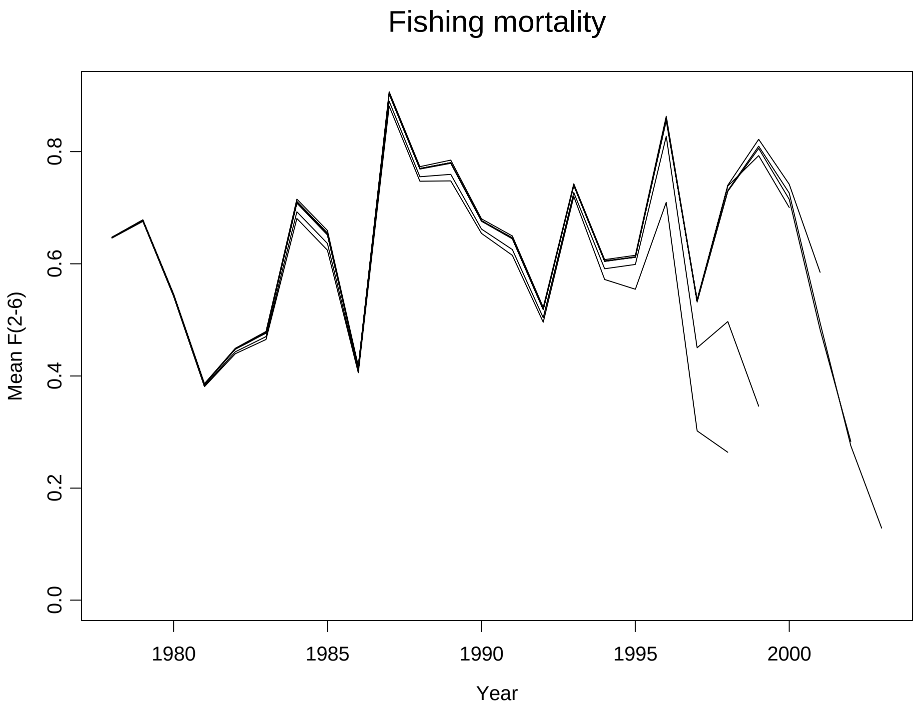


Figure 4.1.5.16.a. Haddock in Division VIa. Retrospective estimates of SSB from TSA run A (all catch & no survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

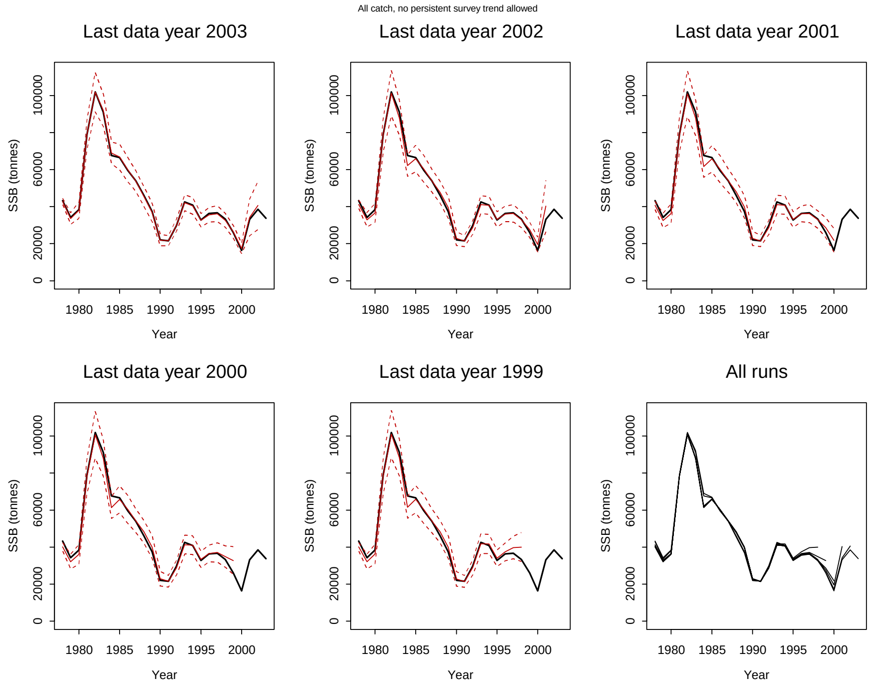


Figure 4.1.5.16.b. Haddock in Division VIa. Retrospective estimates of SSB from TSA run B (all catch & survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

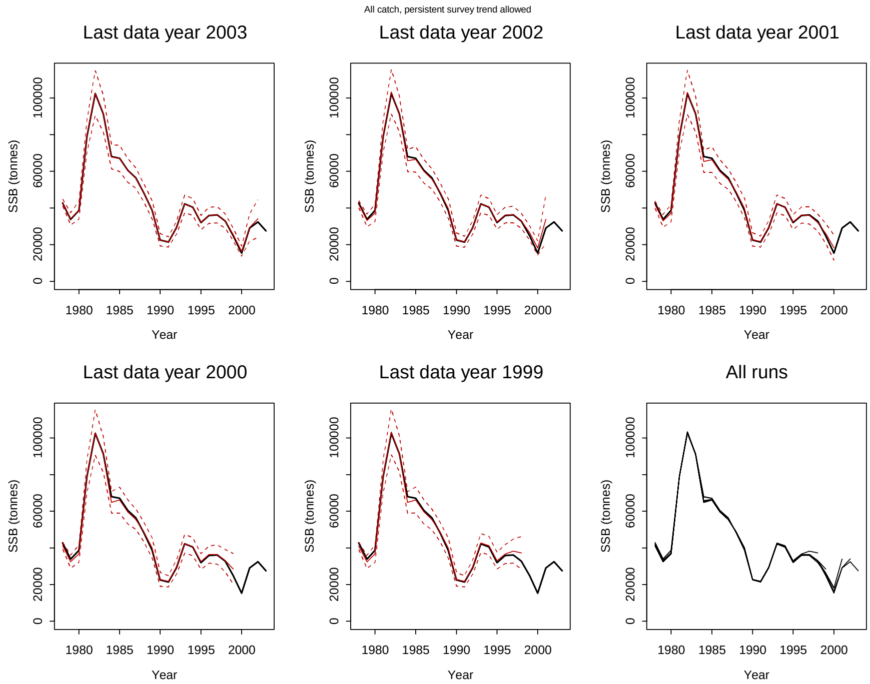


Figure 4.1.5.16.c. Haddock in Division VIa. Retrospective estimates of SSB from TSA run C (missing catch 1995–2003 & no survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

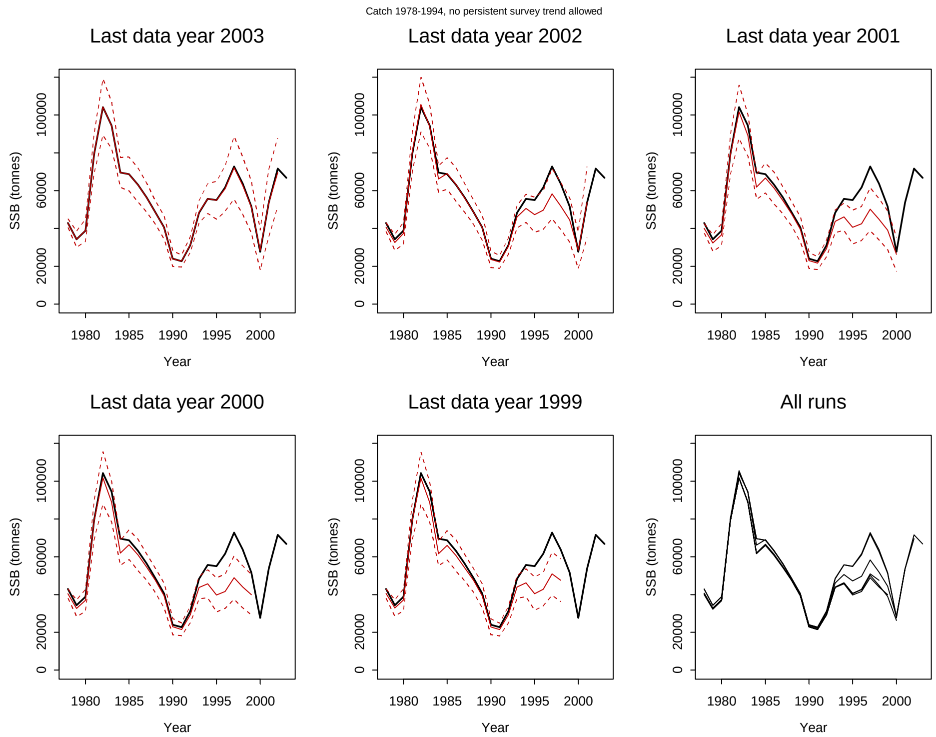


Figure 4.1.5.16.d. Haddock in Division VIa. Retrospective estimates of SSB from XSA.

Figure 4.1.5.17.a. Haddock in Division VIa. Retrospective estimates of recruitment at age 1 from TSA run A (all catch & no survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

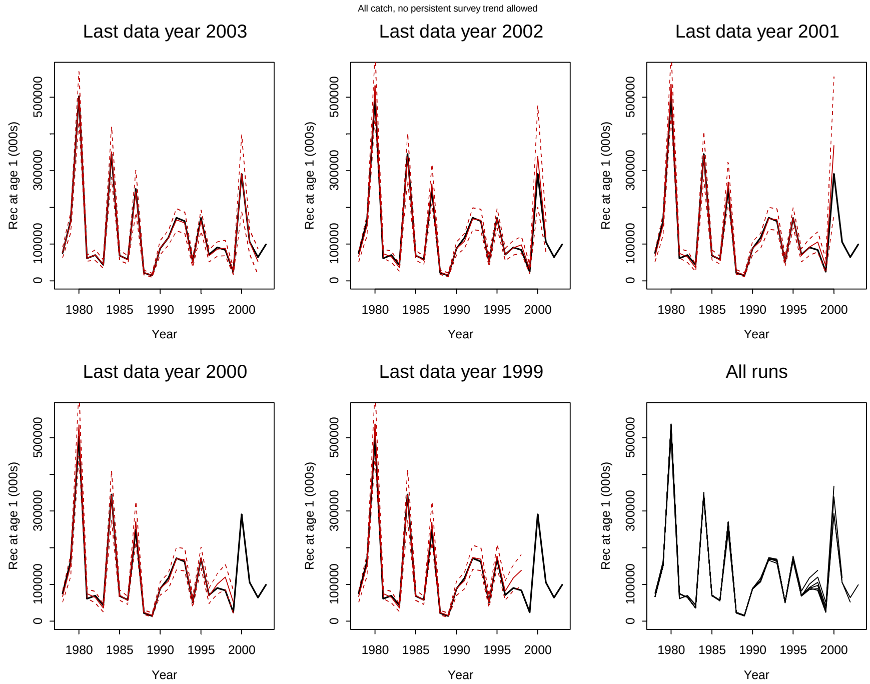


Figure 4.1.5.17.b. Haddock in Division VIa. Retrospective estimates of recruitment at age 1 from TSA run B (all catch & survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

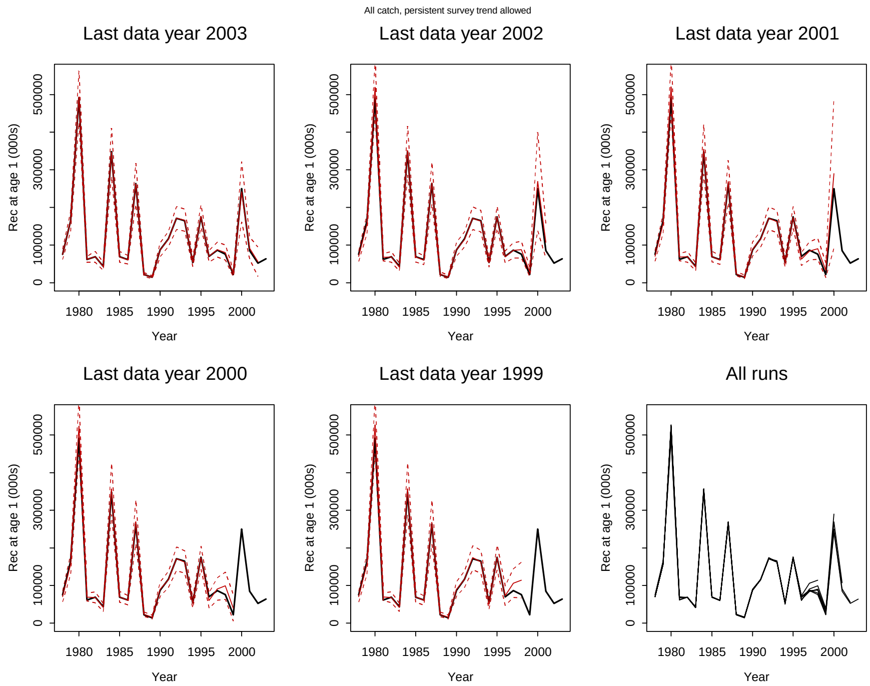


Figure 4.1.5.17.c. Haddock in Division VIa. Retrospective estimates of recruitment at age 1 from TSA run C (missing catch 1995–2003 & no survey trend). The thick line is the current assessment, the thin lines are the retrospective estimates, and the dotted lines are upper and lower approximate pointwise 95% confidence intervals for the retrospective estimates. All estimates are compared in the final plot.

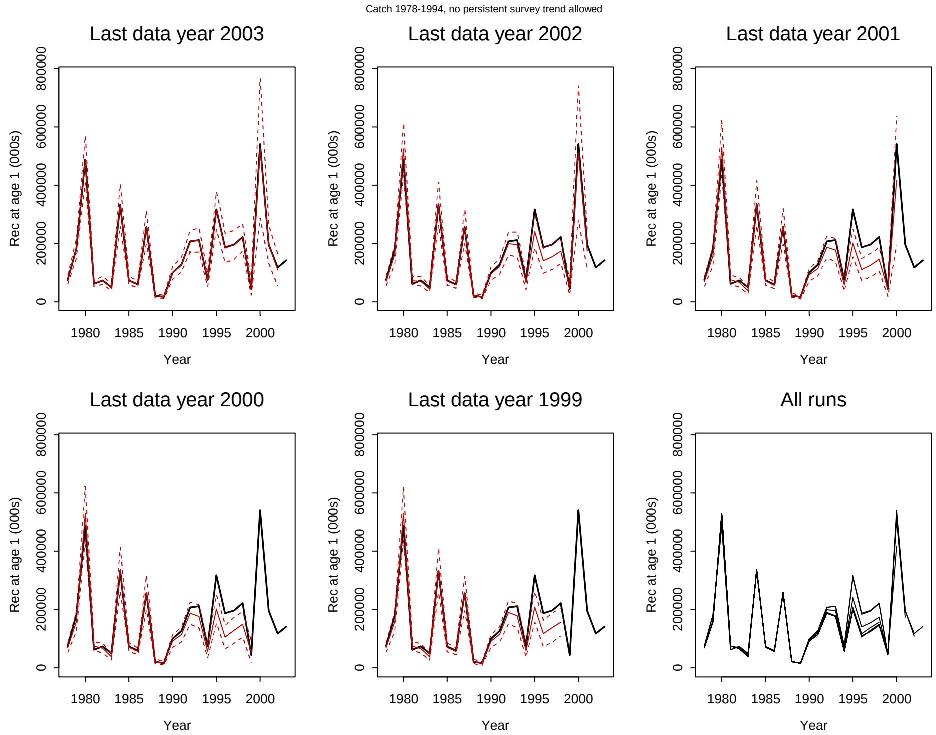


Figure 4.1.5.17.d. Haddock in Division VIa. Retrospective estimates of recruitment at age 1 from XSA

Figure 4.1.8.1.a. Sensitivity analysis of short-term forecast for run A (TSA, all catch, no trend in survey *q*).

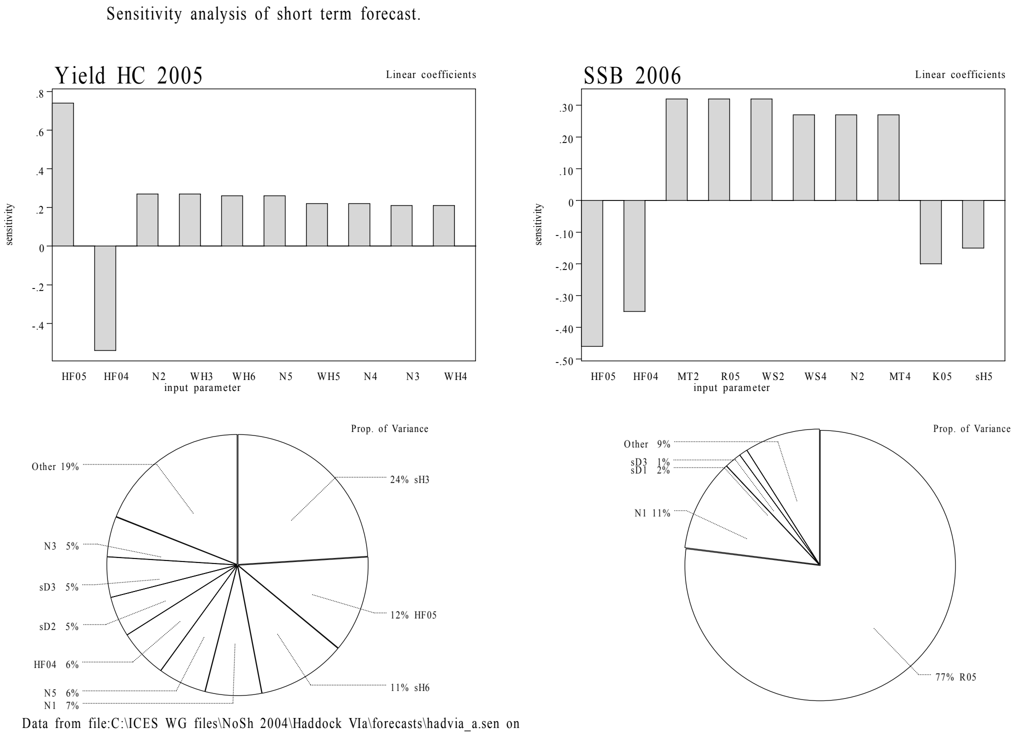


Figure 4.1.8.1.b. Sensitivity analysis of short-term forecast for run B (TSA, all catch, trend in survey *q*).

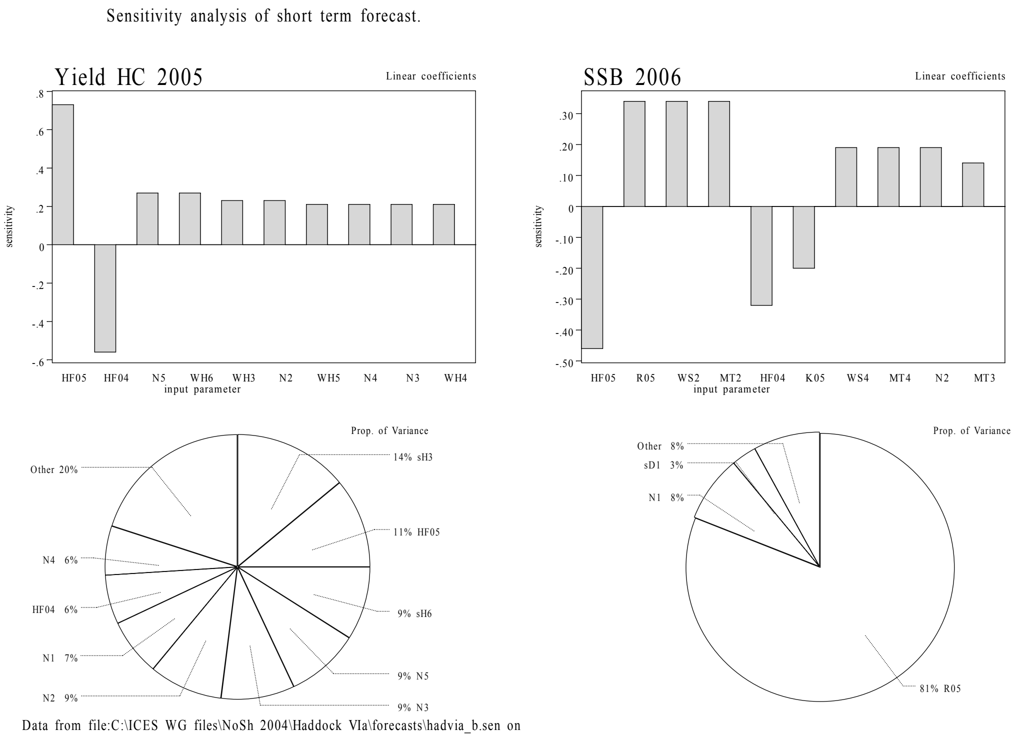


Figure 4.1.8.1.c. Sensitivity analysis of short-term forecast for run C (TSA, missing catch 1995–2003, no trend in survey *q*).

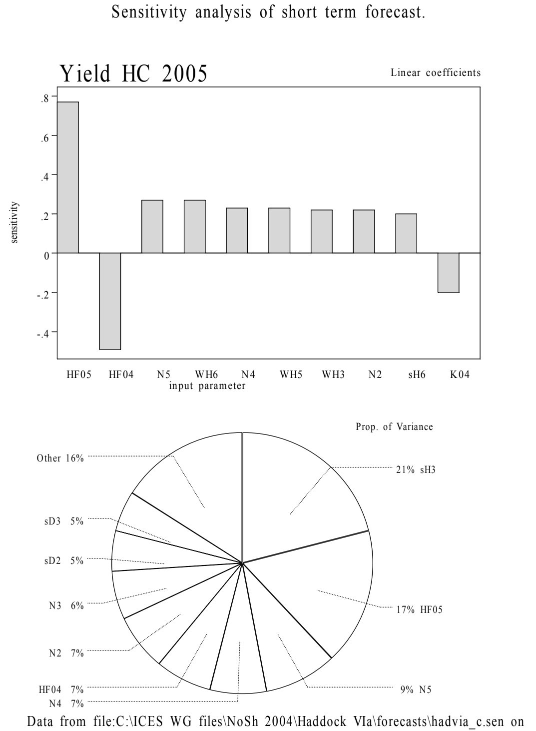


Figure 4.1.8.1.d. Sensitivity analysis of short-term forecast for run D (XSA).

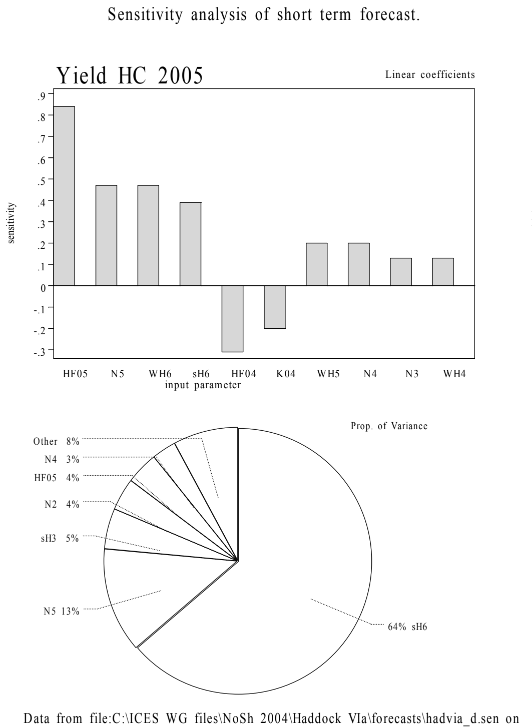


Figure 4.1.8.2.a. Probability profiles for short-term forecast for run A (TSA, all catch, no trend in survey *q*).

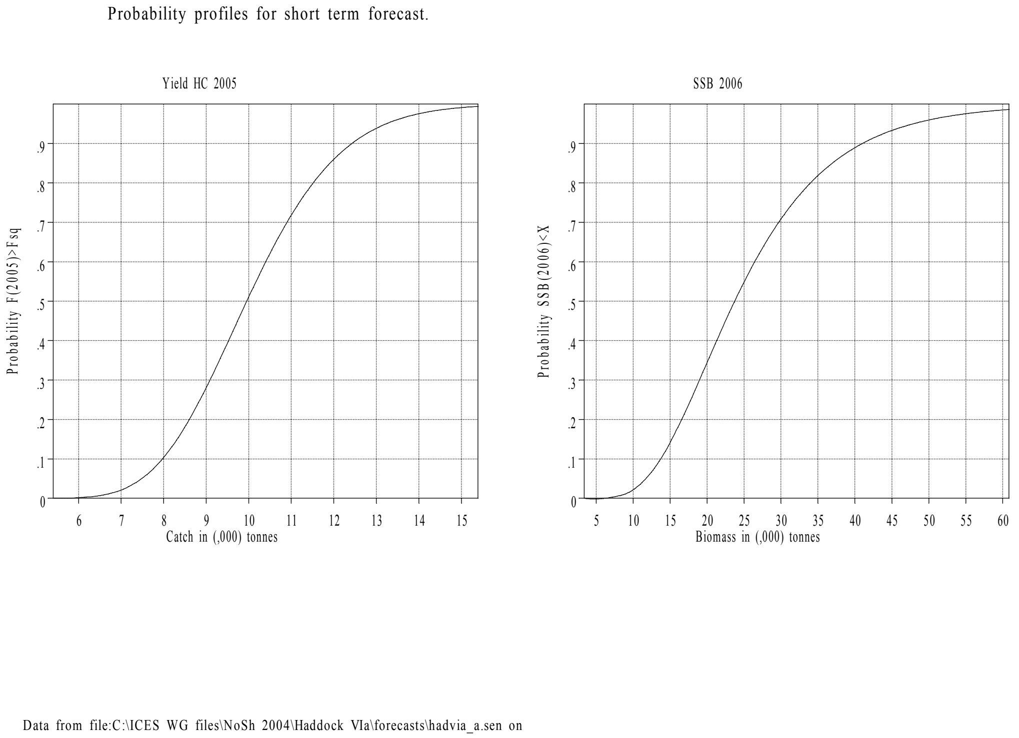


Figure 4.1.8.2.b. Probability profiles for short-term forecast for run B (TSA, all catch, trend in survey *q*).

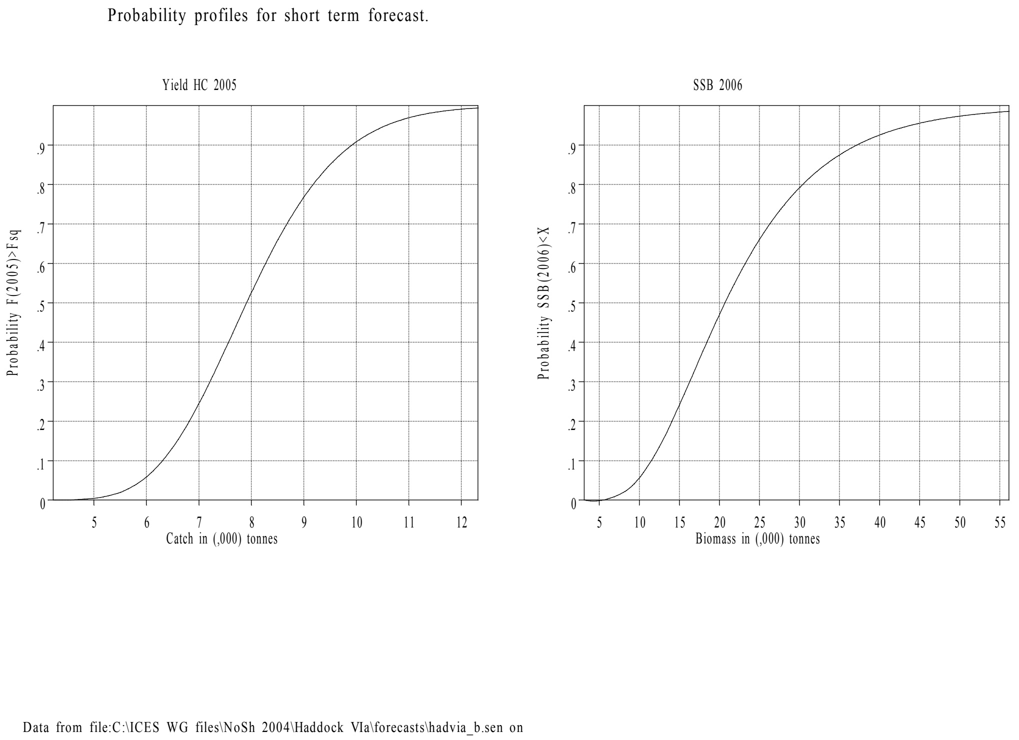


Figure 4.1.8.2.c. Probability profiles for short-term forecast for run C (TSA, missing catch 1995–2003, no trend in survey *q*).

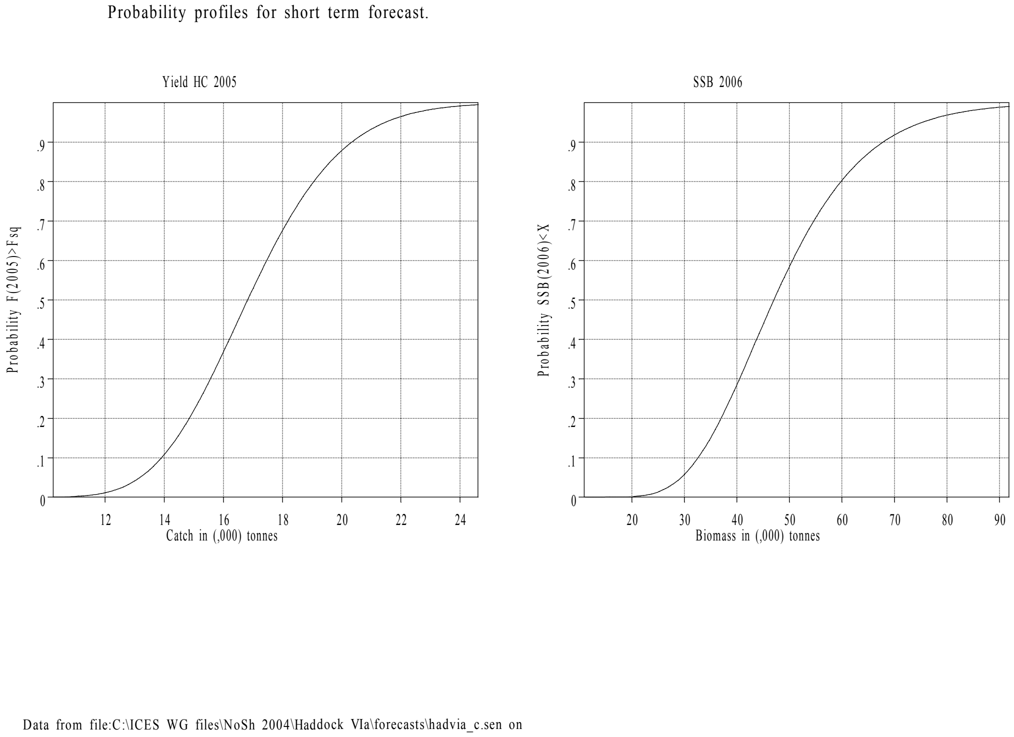


Figure 4.1.8.2.d. Probability profiles for short-term forecast for run D (XSA).

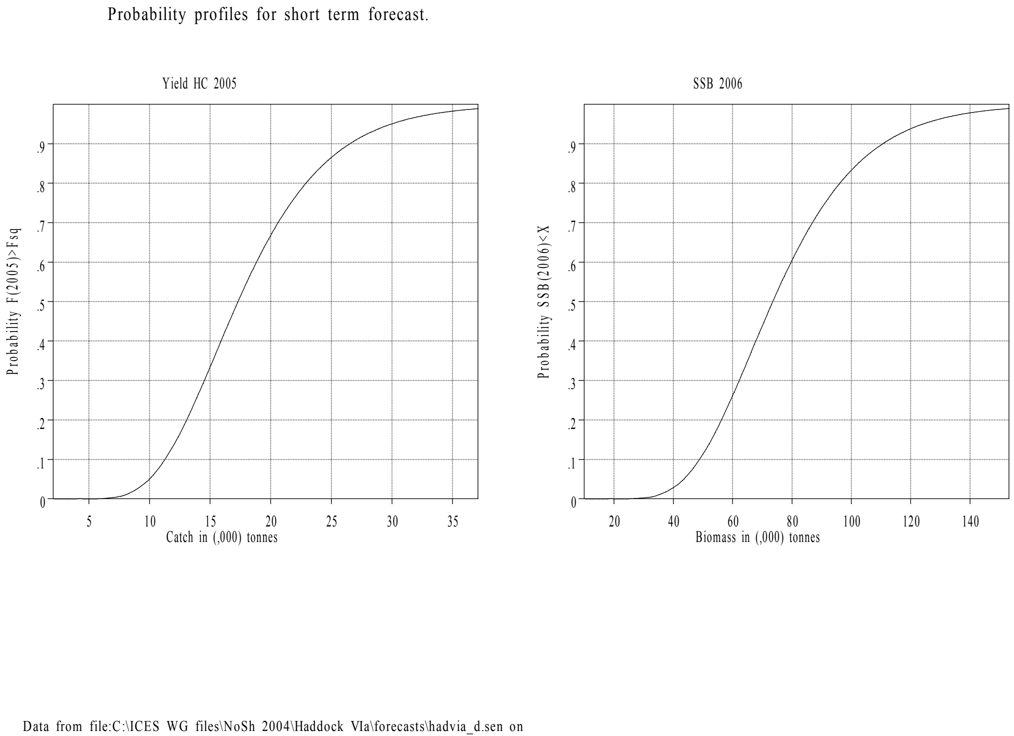


Figure 4.1.8.3.a. Short-term forecast for run A (TSA, all catch, no trend in survey *q*).

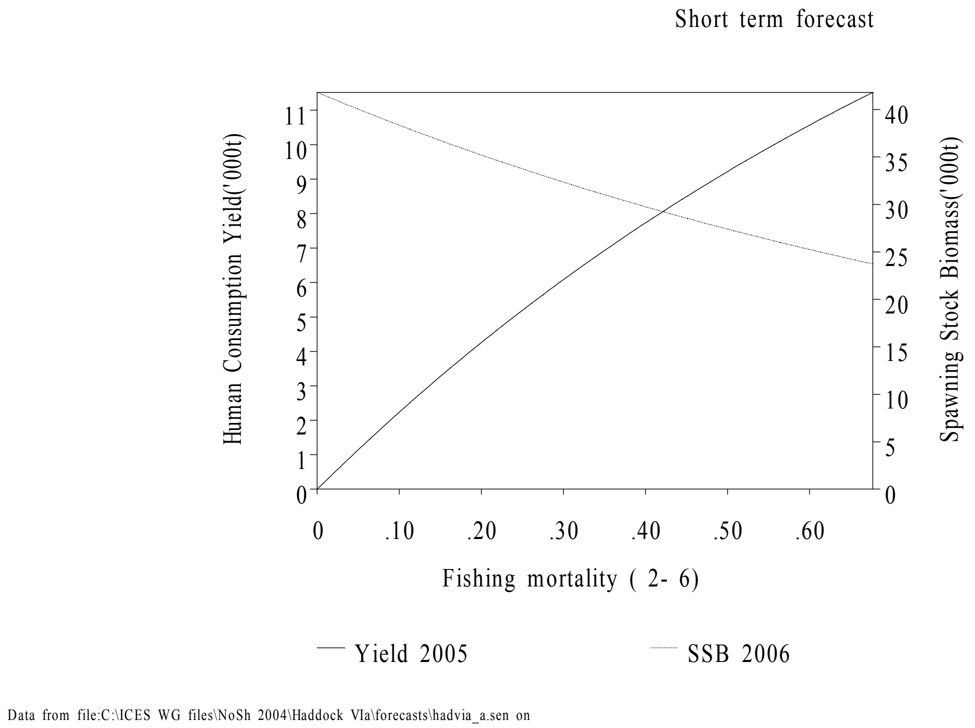


Figure 4.1.8.3.b. Short-term forecast for run B (TSA, all catch, trend in survey *q*).

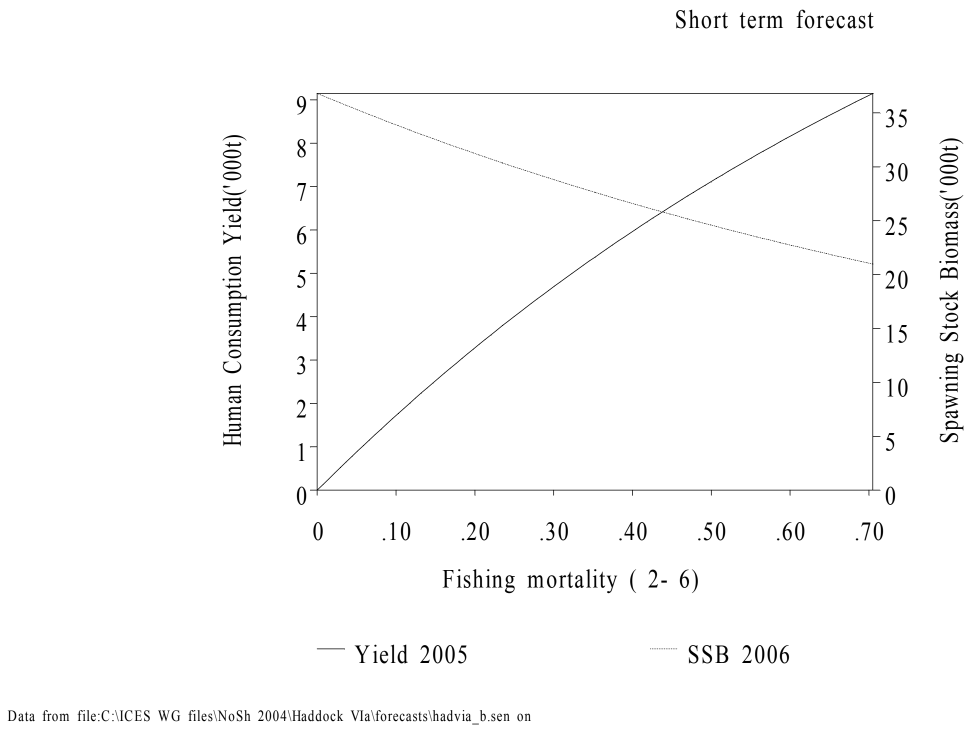


Figure 4.1.8.3.c. Short-term forecast for run C (TSA, missing catch 1995–2003, no trend in survey *q*).

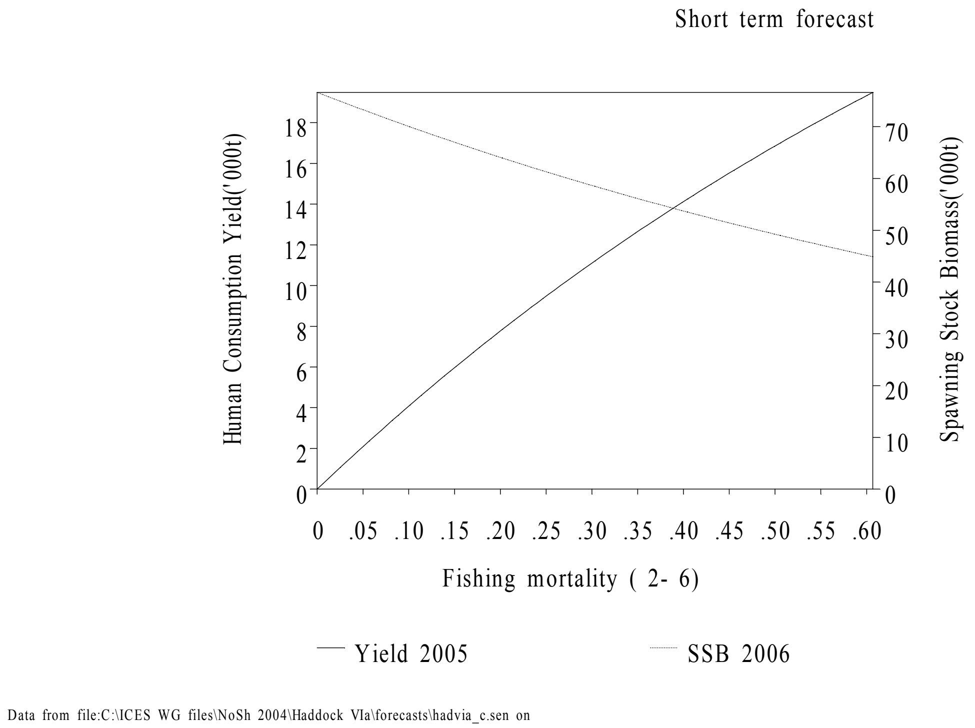


Figure 4.1.8.3.d. Short-term forecast for run D (XSA).

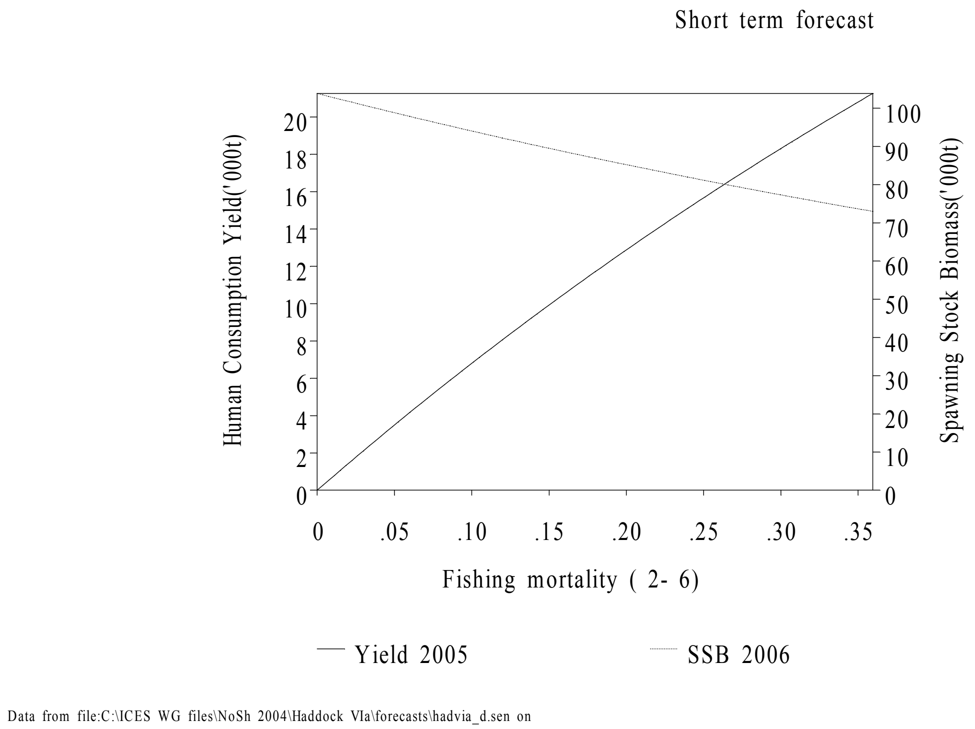


Figure 4.1.10.1.a. Yield-per-recruit for run A (TSA, all catch, no trend in survey *q*).

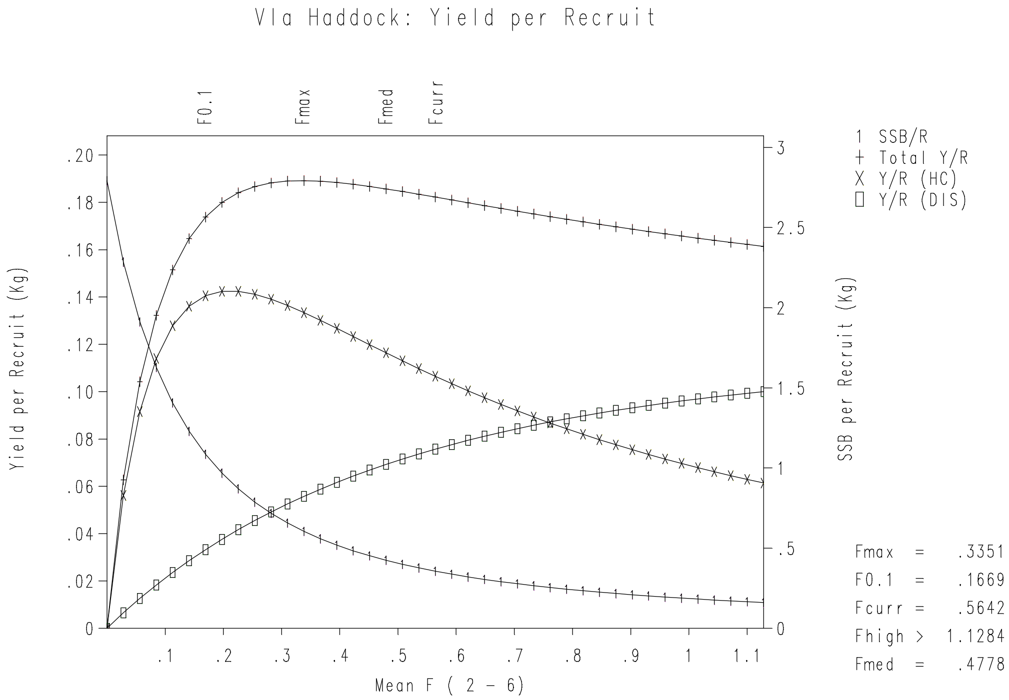


Figure 4.1.10.1.b. Yield-per-recruit for run B (TSA, all catch, trend in survey *q*).

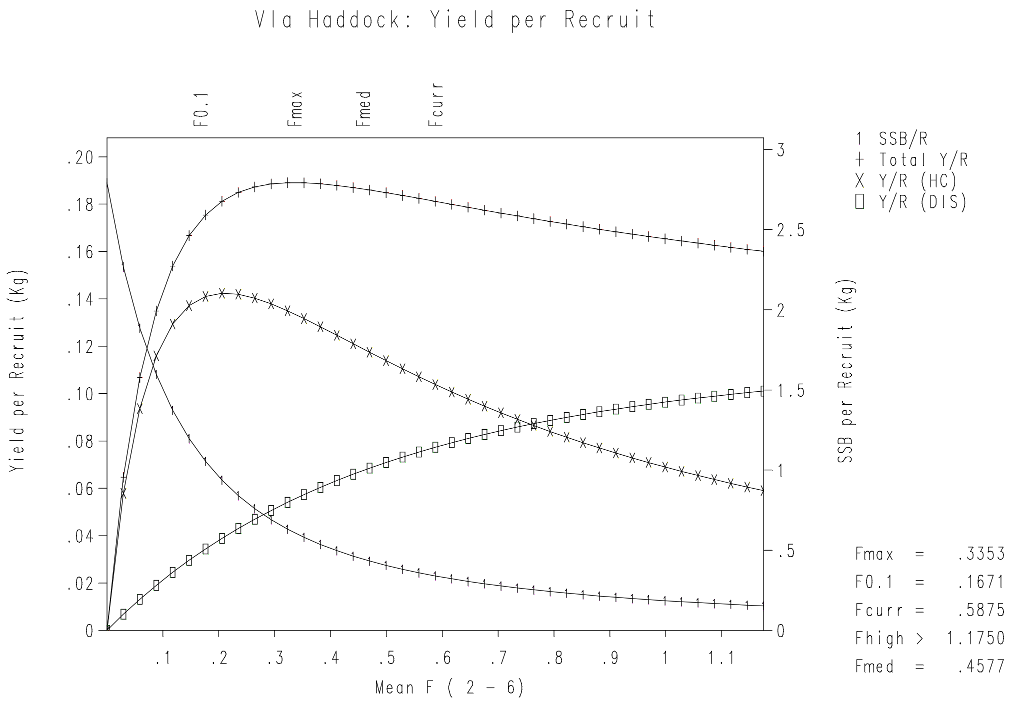


Figure 4.1.10.1.c. Yield-per-recruit for run C (TSA, missing catch 1995–2003, no trend in survey *q*).

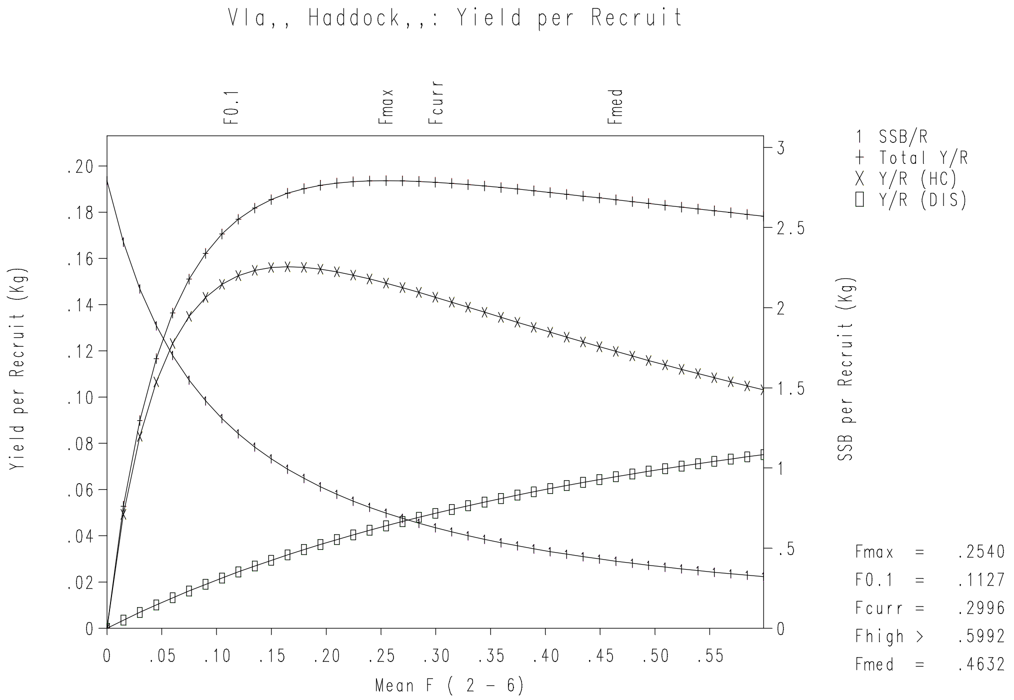


Figure 4.1.10.1.d. Yield-per-recruit for run D (XSA).

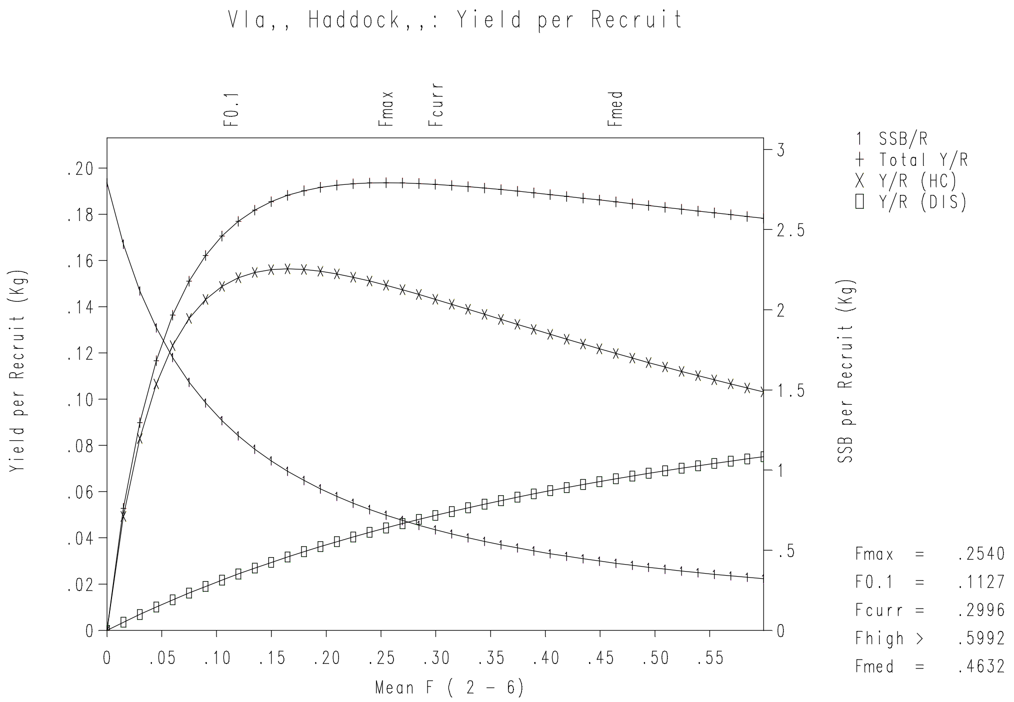


Figure 4.1.10.2.a. Stock-recruit scatterplot with replacement lines for run A (TSA, all catch, no trend in survey *q*).

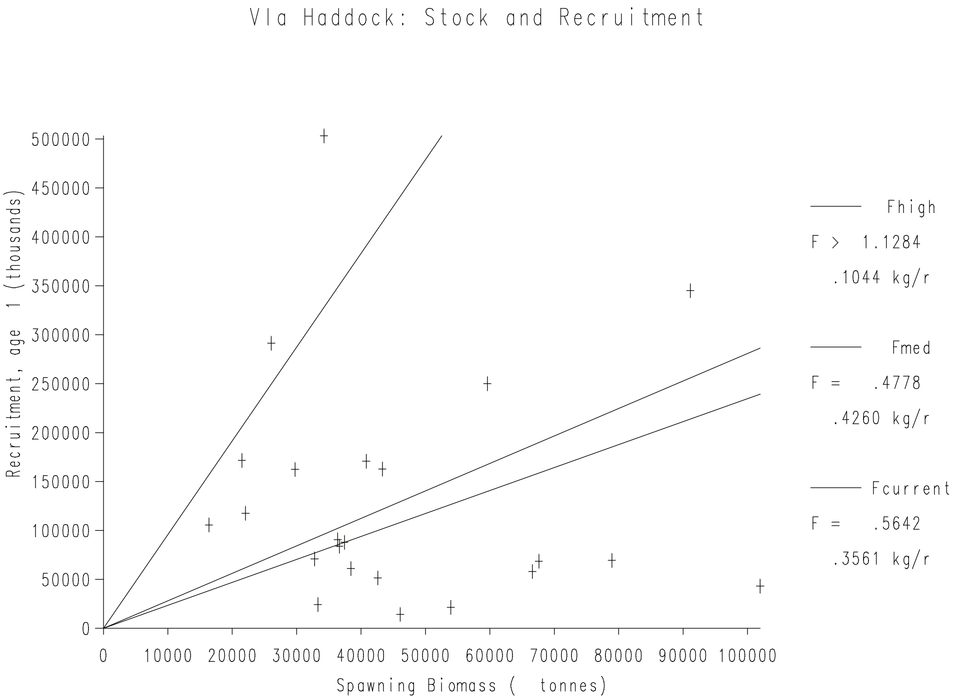


Figure 4.1.10.2.b. Stock-recruit scatterplot with replacement lines for run B (TSA, all catch, trend in survey *q*).

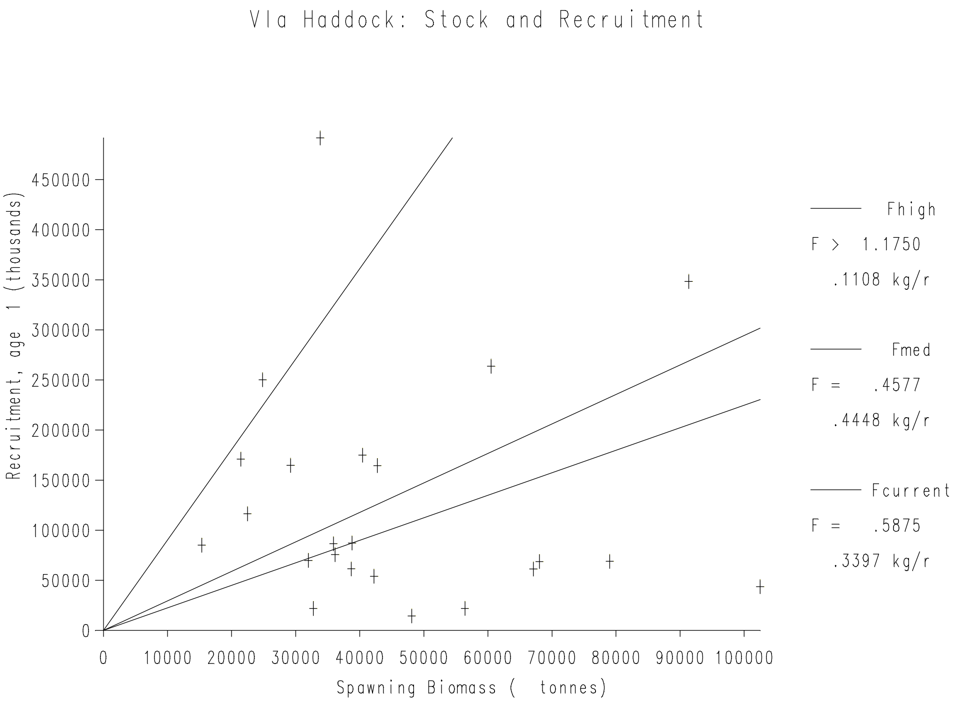


Figure 4.1.10.2.c. Stock-recruit scatterplot with replacement lines for run C (TSA, missing catch 1995–2003, no trend in survey q).

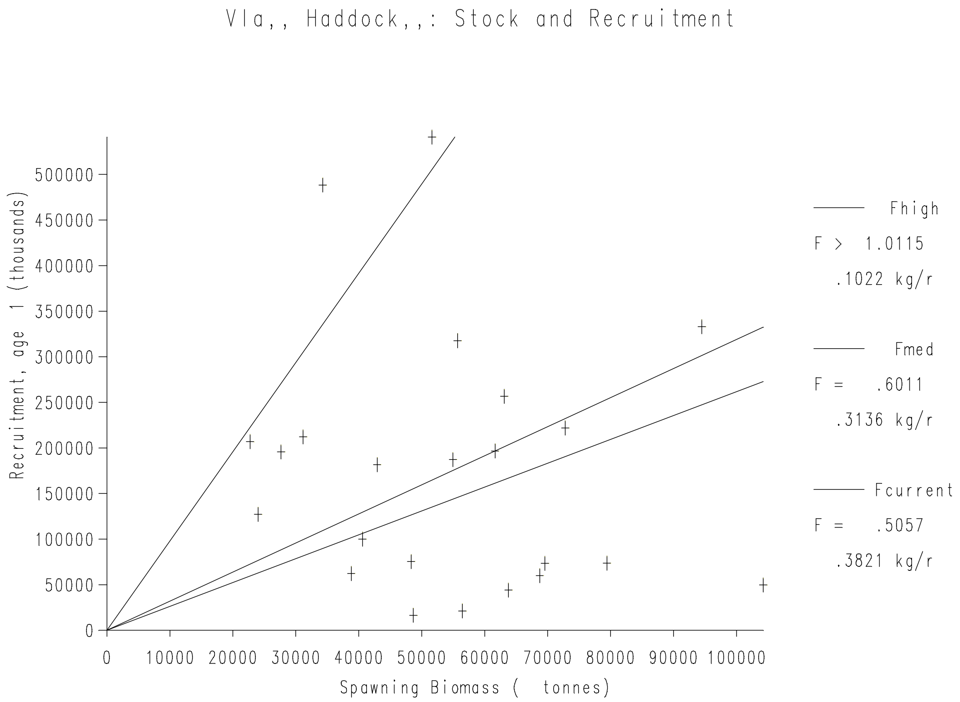
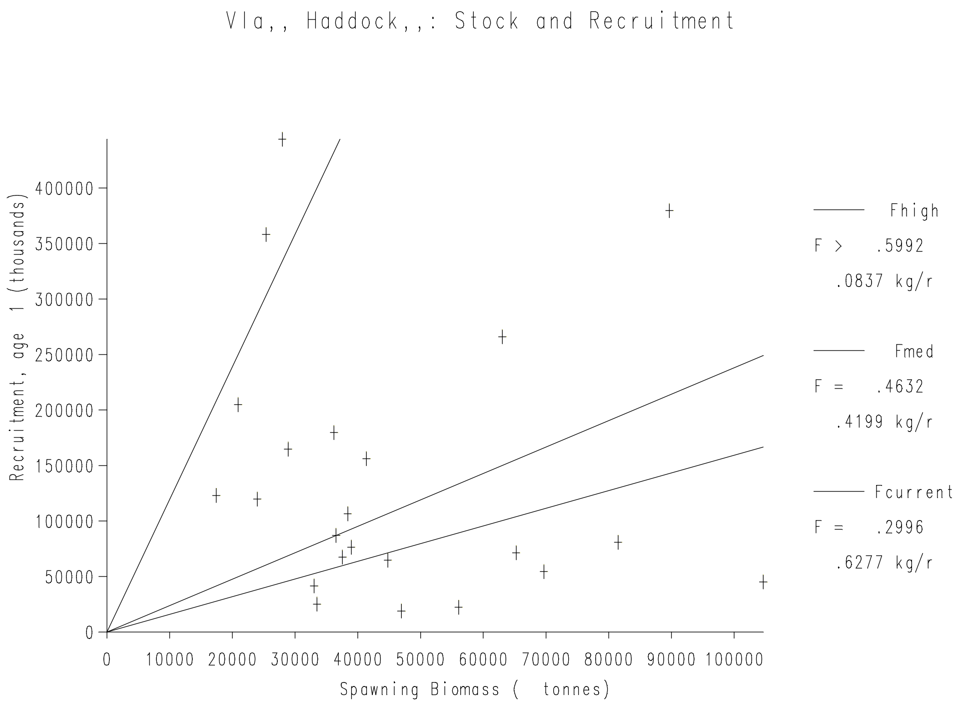


Figure 4.1.10.2.d. Stock-recruit scatterplot with replacement lines for run D (XSA).



4.2 Haddock in Division VIb

The lack of discarding information from the European fleets has required that recent assessments approximate the Russian Catch as EU landings equivalents above the EU minimum landing size. This approach was necessary to avoid the possible mis-interpretation of the sudden appearance of the Russian catch of smaller haddock as evidence of strong recruitment. However, the approach underestimates the total catch from the fishery.

$WGNSDS_{2004}$ was presented with an alternative assessment (WD 8) which allows the modelling of the total catch (including discards) of the Irish, Scottish and Russian fleets. The WG accepted the methodology presented but was concerned about the suitability of the parameterisation used. The WG decided to proceed with the assessment methodology presented in WD 8, but could not do so at the WG as insufficient time and data were available to address concerns over the implementation of the new method. The WG therefore agreed to conduct an assessment of Haddock in Division VIb prior to the ACFM meeting in October. To facilitate the potential use of different models for the assessment of Rockall haddock the WG collated separate Russian and EU catch-at-age matrices.

4.2.1 The fishery

The development of the Rockall haddock fishery is documented in the 2001 Working Group report, and in the report of the ICES Group meeting on Rockall haddock convened in January 2001. That meeting was set up to respond to a NEAFC request for information on the Rockall haddock fishery. NEAFC had agreed to consider regulation of the international fishery in 2001 and the report of the Expert Group was considered by ACFM working by correspondence prior to the NEAFC meeting.

The Rockall haddock fishery changed markedly in 1999 when a revision of the EU EEZ placed the southwestern part of the Rockall plateau in international waters. This has led to opportunities for other nations to exploit the fishery in this area, notably Russia. The table of Official Statistics (Table 4.2.1.1) now includes Russian catches from the Rockall area. The Russian fleet started fishing operations in international waters at Rockall in May-October 1999. Russian catches increased from 460t in 1999 to 2150t in 2000. The increased fishing activity in the area caused concern in the EU about the possible uncontrolled fishing for haddock in international waters of the bank. To conserve the immature portion of haddock stock, specific efforts were undertaken by ICES and NEAFC in order to introduce the fisheries management measures into the area situated outside the 200-mile zone. In 2001 Russian haddock catches were markedly reduced to 630 t due to the introduction of a closed area and low density of fish concentrations. Catches increased again in 2002 when Russian catches were 1,630 t. In 2003, Russian catches are estimated to be

4, 240 t. The Russian haddock fishery uses bottom trawls with cod-end mesh size of 40-100mm (mainly 40-70mm) and retains haddock of all length classes in the catch.

Prior to 1999 the UK and Ireland fisheries had been principally summer fisheries but in more recent years the Scottish and Irish fishery was conducted throughout the year with the peak in April-May. This shift in the fishery appears to have followed the discovery of concentrations of haddock in deeper water to the west of Rockall, at depths between 200m and 400m. High catch rates attracted effort into the area. However, catch rates in 2000 were reported to be poor in deeper water. Anecdotal evidence suggests that increased discarding has been associated with the deeper-water fishery compared to the traditional fishery at northern Rockall. Historical fishing patterns of the Scottish fleet in Rockall is presented in WD 6.

This pattern of fishing at Rockall, with vessels fishing on concentrations of haddock during spring, and increased activity by Russian vessels, is reported to have occurred in 2000, indicating a marked expansion of the fishery in 1999 and 2000. The Russian fishery targets concentrations of haddock mainly during the spring, and summer.
Preliminary results of a small number of Irish and Scottish discard sampling trips in recent years indicates that discard rates are highly variable with percentages discarded ranging from 12-75% by weight (Table 4.2.1.2-3). Reports from enforcement sources tend to confirm that misreporting of haddock from Rockall has occurred, but these also indicate misreporting of haddock caught in other areas as having been caught at Rockall.

Information on the Russian fishery and biological investigations from commercial vessels fishing in Rockall during 2003 are presented in WD 10.

An analysis of the spatial and depth distributions of Rockall haddock in association with oceanographic variables is presented in WD9. These changes in distribution have occurred over a period coincidental with changes in oceanographic variables. Changes in the distribution of haddock need to be considered in a final assessment for this stock.

4.2.1.1 ICES advice applicable to 2003 and 2004.

ICES advice for 2003:

ICES recommends that fishing mortality in 2003 should be reduced to the lowest possible level.

ICES advice for 2004:

ICES recommends that fishing mortality in 2004 should be reduced to the lowest possible level.

4.2.1.2 Management applicable in 2003 and 2004

The TAC for Haddock VIb has previously been set for Sub area Vb, VI, XII and XIV and was 8,675 t in 2003. In 2004, the TAC for Division VI was spilt and the VIb TAC for Haddock was included with XII and XIV. The TAC was set at 702 t for VIb, XII and XIV.

All fishing, except with longlines, is prohibited in Community and in international waters in the Rockall Haddock Box, bounded by the following coordinates (EC No 2287/2003):

Latitude Longitude

57 °00 'N 15 °00 'W

57 °00 'N 14 °00 'W

56 °30 'N 14 °00 'W

56 °30 'N 15 °00 'W

The minimum landing size of haddock taken by EU vessels in Rockall is 30cm. There is no minimum landing size for haddock taken by non-EU vessels in international waters.

The ICES advice, agreed TAC for EC waters and a comparison with 2002 and 2003 WG landings is summarised below.

Year	ICES advice	Basis	Agreed TAC	WG landings
2002	< 1.3	Reduce F below 0.2	1300[a]	3123
2003	-	Lowest possible F	701[a]	6055
2004	-	Lowest possible F	702[b]	

[a] TAC was set for Divisions VIa and VIb (plus Vb1, XII and XIV) combined with restrictions on quantity that can be taken in VIa and VIb. The quantity that can be taken in zones VIb, XII and XIV is shown here. [b]In 2004, the TAC for Division VI was spilt and the VIb TAC for Haddock was included with XII and XIV.

It is not possible to calculate the percentage change in F associated with TAC for this stock due to the lack of an assessment.

4.2.1.3 The fishery in 2003

Nominal landings as reported to ICES are given in Table 4.2.1.1, along with Working Group estimates of total estimated landings. The total Russian catch is accounted for unlike previous Working Groups where Russian catches had been multiplied by a conversion factor of 0.69 to convert them to EU landings equivalents. Reported international landings of Rockall haddock fluctuated around 5,000 t up to the year 2000. Landings declined sharply in 2001 to 2,036 t. The estimated 2003 landings indicate that landings have increased to 6,055 t. The Russian catch, estimated to be 4,239 t in 2003, accounts for almost 70% of these landings.

Russian fishery in 2003

In 2003, the Russian fishery was carried out by bottom trawls on the Rockall Bank from May to August. In early May haddock dominated catches (70%) and there were increased catches of blue whiting observed. In June and July haddock catch rates decreased and in August catches varied from 13-20 t for 10th class tonnage vessels (84m, 2000hp) and 5-10t for 9th class vessels (62m, 2400hp). The total catch constituted 7,370 t. Blue whiting *(Micromesistius poutassou)* comprised of the second highest catch (2,572 t) after haddock. Catch of haddock reached 4,239 t; approximately 40% higher than that of last year. The main part of the haddock catch was taken in May and June (Tables 4.2.1.4).

Besides haddock and blue whiting, the following fish species were found in catches in small numbers: grey gurnard *(Eutrigla gurnardus)*, flatfishes, redfishes *(Sebastes spp.)*, and argentine *(Argentina silus)*. The catch compositions by species and by month are given in Table 4.2.1.5.

Irish fishery in 2003

Irish fishing operations at Rockall have declined in recent years. Only three twin-rig vessels reported haddock landings from Rockall in 2003. Highest Irish landings occurred in Quarters 2 and 3. In Quarter 4 it is reported that the two main Irish vessels in Rockall ceased fishing. Almost 50% of the 2003 landings were from statistical rectangle 43D6 in the North western part of the Bank.

Scottish fishery in 2003

The number of Scottish vessels fishing at Rockall and the number of trips made to Rockall have declined substantially since 2000 (WD 6). Scottish landings are estimated to be 1,590 t in 2003 compared to 1,129 t in 2002.

4.2.2 Commercial catch-effort and research vessel surveys

Commercial CPUE series are available for Scottish trawlers, light trawlers, seiners, Irish otter trawlers and Russian trawlers fishing in VIb. The effort data for these five fleets are shown in Figure 4.2.2.1. Russian data shows a peak in effort for 2000, this is mainly due to the 10th class tonnage vessels targeting the large scale grey gurnard fishery. There was a substantial decrease in Scottish light trawl effort since 1996 and an increase in effort by larger Scottish heavy trawl vessels during 1999 and 2000 reflecting the change in fishing pattern noted in Section 4.2.1 In 2003 effort estimates for these heavy trawl Scottish vessels has increased. During preparations for the 2000 round of assessment working group meetings it became apparent that the 1999 effort data for the Scottish commercial fleets were not in accord with the historical series and specific concerns were outlined in the 2000 report of WGNSSK (CM 2001/ACFM:07). This is due to recent changes in reporting practices and non-mandatory reporting of effort.

The Irish otter trawl effort series indicated a reduction in effort in recent years however in 2003 the effort has increased. The majority of this effort is concentrated in Quarters 2 and 3.

The WG decided that the commercial CPUE data, which do not include discards and have not been corrected for changes in fishing power despite known changes in vessel size, engine power, fish-finding technology and net design, were unsuitable for catch-at-age tuning. A further problem is that the Scottish fleet takes a large fraction of the landings, and any errors due to sampling for length and age as well as misreporting, will be correlated with the catch at age data.

Figure 4.2.2.2 indicates an increasing trend of Russian CPUE since 1999. This effort data is for the target Spring and Summer fishery only. No changes in gear type of the Russian fishery have taken place since the beginning of the fishery.

There is only one research survey index available for this stock (Table 4.2.2.1). However, from 1997 onwards this Scottish survey is only conducted in September of alternate years. Due to recent concerns about the haddock stock at Rockall some extra time was allocated to conduct a partial survey in September 2002. The most recent survey was carried out in September 2003. The survey was conducted on 49 standard trawl stations however, the survey area and number of stations varied in different years. The majority of stations are within the 200m depth contour except for the spring survey in 2001 where stations were up to 400m deep. In 2002 the survey was carried out in the central and northern parts of the bank. In 1999 the survey switched from using an Aberdeen 48' bottom trawl to a GOVtrawl and from 60 min tows to 30 min tows. A 20mm mesh size is used on the survey.

A SURBA run was carried out to analyse the survey data. Previous working groups have concluded that the first three years of the survey should not be used in assessments and that age 0 data was a poor indicator of year class strength. These data were therefore removed from the present SURBA analysis. The settings used (catchability = 1.0 on all ages, age-weighting = 1.0 on all ages) were according to those in WD ACFM Oct2003. Stock weights used were as those calculated in Scenario 2 (see text below). SSB shows a declining trend since 1995(Figure 4.2.2.3). F (2-5) indicates a declining trend since 1999 (Figure 4.2.2.3). Residuals plotted by age show a positive age effect for age 6 from 1990 onwards (Figure 4.2.2.4). Recruitment indicates a strong 2001 year class. Retrospective analysis showed consistent estimation of SSB and F (2-5).

4.2.3 Age compositions and mean weights at age

One of the reasons stated for not producing an assessment of Rockall Haddock previously was the observed discrepancy between Irish and Scottish mean weights at age. The Irish data was revised for 1995-2002. Also some differences were observed between declared landings according to the logbook database and those Irish landings used in the past. These declaration landings are considered more defensible since they can be traced back to official logbook returns. Previous landings data were often obtained on paper from individual fisheries officers and may not have been entirely accurate. The landings data are not adjusted for misreporting although observer information indicates that at the individual trip level substantial misreporting did occur during this period. One of the main discrepancies between mean weights at age arose in the Scottish data for 2001 at age 4 which resulted in low landing numbers and high mean weights for this age in the combined international landings at age matrix. Differences in the mean weights-at-age between the Scottish and Irish sampling is possibly related to differences in the way that length-weight parameters are applied to the data differently in both countries. Details of the length –weight relationship used in Scottish raising is outlined in WD 6

Comparisons were made between the mean lengths at age for Irish, Scottish and Russian data for years available and some anomalies were noted. This prompted an analysis of the precision of Irish market sampling for Rockall haddock (WD 1). Results indicated relatively good precision in Irish catch numbers at age and suggests that it is unlikely that mis-ageing of haddock is occurring from year to year. An analysis of the age composition per quarter of Scottish and Irish catch numbers revealed that the Scottish age composition was not consistent from year to year. The Working group therefore decided to adopt three scenarios for collating the combined Irish and Scottish landings at age matrix.

1) the Irish landings raised using Irish sampling and the Scottish landings raised using Scottish sampling for 1995-2003 (Table 4.2.3.1a)

2) the Irish landings raised using Irish sampling for 1995-2003 and the Scottish length frequency raised using Irish length, weight and age data for 2000-2002. This is the only scenario that avoids the issue of an increase in mean weight at age four fish in 2001.(Table 4.2.3.1b)

3) The Irish and Scottish landings raised using the respective length weight and age information for 1995-2001. The 2002 and 2003 Scottish landings raised using the Irish sampling by quarter. As there was no quarter 1 sampling for Ireland these landings were raised by Quarter 2 sampling.(Table 4.2.3.1c)

All three scenarios are presented here so that the intersessional assessment of VIb Haddock will be facilitated by the existence of collated input data sets.

One of the other reasons for not producing an assessment was the lack of length frequency or age data for haddock caught by the Russian fleet in 2002. However these were presented at the 2004 Working Group (WG 8) and were obtained by interpolation between the 2001 and 2003 indices. As the majority of the Rockall haddock fishery is exploited by Russian vessels for which discarding does not occur, the Working Group decided to present the full catch at age matrix for 2000-2003 (Table 4.2.3.2).

4.2.4 Natural mortality and maturity at age

In the absence of any direct estimates of natural mortality, M has been set at 0.2 for all ages and years. MSVPA estimates for the North Sea haddock stock give estimates of M of 2.05 at age 0, 1.65 at age 1, 0.40 at age 2, 0.25 at ages 2 and 4, and 0.20 at ages 5+ (ICES CM 2003/ACFM:02). Similarly large values of M at the younger ages at Rockall would have implications for interpretation of fishing mortality patterns from survey-based methods such as SURBA which essentially estimate total mortality conditional upon assumptions regarding survey catchability at age.

Previous Working Groups have adopted a maturity ogive with knife-edge maturity at age 3 for this stock. ACFM in 2001 encouraged the WG to investigate a more realistic maturity ogive for this stock. At the 2002 Working Group combined sex maturity ogives were presented to the WG for Russian sampling in 2000, 2001 and Scottish sampling in 2002. In 2003 new sex disaggregated maturity data were supplied to the Working Group for Russian sampling (Table 4.2.4.1). The results of all these recent studies indicate that a high proportion of both females and males at age 2 were mature. No new Russian data was supplied to the 2004 Working group.

Maturity ogives are used in ICES assessments to calculate SSB as a proxy for spawning potential. As this refers essentially to the female component of the stock, revision of ogives should take into account the sex ratio in the population at each age and the maturity and mean weight at age in females. Calculation of proportion mature in the population also requires careful attention to sampling design, correct identification of mature individuals and methods of raising estimates from biological samples, which may not be random across lengths. Until such data are available for a stock, ICES should be wary of adopting new ogives. A further problem is that individuals in a number of declining stocks have been shown to mature progressively earlier over time. Data collected in recent years from such a stock may not reflect the historical trends. The WG retained the assumed knife-edge maturity at age 3, at which age it is probable that most females have been mature throughout the time series.

4.2.5 Catch at age analysis

Working Document 8 outlines a "Preliminary assessment of the Rockall haddock (*Melanogrammus aeglefinus*) stock". The basis of that assessment is the inclusion of the discarded component of the EU catch, which has previously not been included in assessments. The discard component is estimated using a selection pattern applied to Scottish research surveys and then a discard ogive which is used to fill in numbers for lengths that are not caught commercially. There are two main assumptions in the working document

- That the survey is fully selective of all lengths and that it is representative of the population that can be fished by bottom trawls.

- That the gear selectivity ogives are fixed and that they are appropriate for the years, gears and fleets for which they are applied.

Before the Working group considers this method of assessment for Rockall Haddock. There were a number of details that needed to be expanded on. These included;

- Whether there is overlap between the depths at which haddock are caught on the Scottish research survey and commercial trawling. If, as the anecdotal evidence suggests, there is increased discarding of haddock in deeper waters these discarded fish may not be covered by the depth distribution of the Scottish survey.

- How the lack of Scottish survey data was used to produce catch length frequencies for 1998 and 2000? These were obtained by interpolation of the 1997-1999 and 1999-2001 indices but the method of interpolation remains unclear to the working group.

- How the interpolation to determine the 2002 catch numbers and weights was carried out.

- Information on the area and gear for which the selection parameters S_1 and S_2 was derived. These constants were used in the theoretical selection ogive for Rockall Haddock.

- The derivation of the Irish discard ogive. This was produced using the theoretical method described in WD 8 using the length distribution and selection ogive from the Scottish survey and the Irish length distribution from the commercial catch. As Irish and Scottish fleets use similar gears it was presumed in the WD that the Scottish selection ogive could be used for Irish Commercial catches.

- The changes (eg mesh size) that have occurred in the EU commercial gears over time and whether such changes in selection are reflected in the selection pattern used the WD 8. Little was known about the Scottish and Irish gear changes at the time the WD was written so selection pattern changes were not taken into account in the assessment. Since the haddock population of the Rockall Bank consists mainly of small fish (<30cm) it was assumed that that the increase in mesh size would not alter the selection pattern. However a comparison of selection patterns in West of Scotland (WD 5, WGNSDS, 2003) revealed that there are different selection patterns in the recent gear regulations for that area. This could indicate that a fixed selection pattern used over the entire time series of the catch data for the Rockall haddock catch data may be unsuitable. Probably a more detailed examination of the gears exploiting the haddock fishery at Rockall each year would be more appropriate.

Recommendations for the further analysis for the assessment of Rockall Haddock were made at the 2004 Working Group. These include the application of the method used in WD 8 for Haddock VIa, where discards are already included in an assessment and to then compare the results. Secondly, to investigate other assessment methods where the selection pattern can be changed to account for the inclusion of the entire Russian catch. Thirdly, to use survey data to estimate the mortality of the younger ages and develop a model to estimate the mortality of the younger ages of the Scottish and Irish fleets.

The Working Group decided that the best approach was to carry out these investigations intersessionally and produce an assessment before the ACFM meeting in October. Should an acceptable assessment be produced intersessionally the recovery plan proposed could be evaluated.

4.2.6 Reference Points

Biological reference points for this stock are given below:

$\mathbf{B}_{lim}$: 6,000 t (lowest observed SSB)

$\mathbf{B}_{pa}$: 9,000 t ($\mathbf{B}_{loss}$ * 1.4)

$\mathbf{F}_{pa}$: 0.4 (by analogy with other Haddock stocks)

4.2.7 Management Considerations

The initial stage of co-ordinating the efforts directed on managing the haddock stocks was the ICES Meeting (February, 2001) of experts from the countries participating in the fishery for this species on the Rockall Bank (ACFM, 2001). In consideration of the report of the Expert Group, it was decided at the NEAFC Extraordinary Meeting (March, 2001) to prohibit the fishery (except for long-lines) in the shallow areas of the bank in the international waters from 01 May 2001. The purpose of the Rockall Haddock Recovery Plan is to secure the rapid recovery and long-term conservation of the stock to within safe biological limits as defined by ICES ($\mathbf{B}_{pa}$ and $\mathbf{F}_{pa}$) as well as attainment of long-term sustainable yield in accordance with principles of the precautionary approach. As recruitment to the Rockall Haddock stock appears to have fluctuated widely over the time-period of exploitation and given that this high fluctuation may preclude management to any particular target biomass, management using an exploitation-related target alone was chosen.

The proposed recovery plan is designed to be facilitated by a TAC and technical measures that include

a) A standard minimum mesh size, with options from 60mm to 120mm

b) Rigging with single 8mm or double 5mm twine;

c) Inclusion of a square-mesh panel of 50-90mm of minimum mesh size in trawls;

d) A minimum size for the landing or retention on board of haddock should be established that is compatible with the mesh characteristics referred to in (a) and (b), as well as with the length of a mass sex maturation of fish.

Also it is proposed that measures shall be put in place to record *inter alia* the entry, exit, time spent fishing, and principal vessel characteristics for demersal fishing activity within ICES Division VIb. Further information can be obtained in the Expert Group Report (ICES CM 2004/ACFM:33).

Countries participating in the negotiations concluded that the discussions on the management measures for haddock fishery on the Rockall Bank should be continued. In 2004, an ICES Expert group met to deal with a request for advice from the EU and Russia concerning Rockall haddock recovery plans. They concluded that the lack of alternative assessment approaches precluded the identification of potential alternative limits to exploitation that may be useful to long-term management. In addressing this term of reference the Expert Group considered alternative approaches to management.

The Expert Group acknowledged that the Precautionary Approach requires that management be implemented in data poor situations and that in other data-poor fisheries (such as deep-water) ICES has proceeded to develop management advice based on a division of fisheries into two separate categories:

1. Developing new fisheries: Fisheries on such species be permitted only when they expand very slowly, and are accompanied by programs to collect data, which allow evaluation of stock status.

2. Fully or overexploited fisheries: Immediate reduction unless these fisheries can be shown to be sustainable.

The Expert Group considered that the principles underpinning this advice may have application to Rockall haddock provided the implementation considers the particular biology of the target species and the way it is exploited.

For Rockall haddock the Expert Group considered that the fishing mortality should not be allowed to expand. Adoption of a TAC may actually allow increased fishing mortality if the stock is declining or there is significant unreported catch. Moreover, application of TACs implies that there is a simple relationship between a recorded landing of a species and the effort exerted on that species. Such an assumption is unlikely to be true for Rockall haddock. Furthermore, there are ways of evading TACs including mis-reporting, high grading and discarding. In the case of Rockall haddock these may occur to a large extent due to the remote nature of the fishery and the processing of catches at sea by some fleets. The Expert Group concluded that effort regulation rather than TACs may be a better means of controlling fishing mortality on Rockall haddock in the long-term but that TAC regulation could be used in the future if more objective and accurate biological and fishery information are routinely provided (ICES CM 2004/ACFM:33).

Table 4.2.1.1. Nominal catch (tonnes) of HADDOCK in Division VIb, 1986–2003, as officially reported to ICES.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[1]
Faroe Islands	5	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a		
France	5	…[2]	…[2]	…[2]	…[2]	…[2]	…[2]	…[2]	-	-	-[*]		5	2[*]	+	1
Germany, Fed.	4	1	-	-	-	-	-	-	-	-	-	-	-	-		
Iceland	-	-	-	-	-	-	-	-	-	+	-	167	-	-	-	
Ireland	-	-	620	640	571	692	956	677	747	895	704	1,021	824	357	n/a	
Norway	20	47	38	69	47	68	75	29	24	24	40	61	152[*]	70[*]	49	60
Portugal	-	-	-	-	-	-	-	-	-	-	4	-	-	-		
Russia	-	-	-	-	-	-	-	-	-	-	-	458	2,154	630	1,630	4,237
Spain	245	337	178	187	51	-	-	28	1	22	21	25	47	51		
UK (E, W & NI)	753	272	238	165	74	308	169	318	293	165	561	288	36	+	…	
UK (Scotland)	6,542	5,986	7,139	4,792	3,777	3,045	2,535	4,439	5,753	4,114	3,768	3,970	2,470	1,205	1,145[3]	
United Kingdom																1,663
Total	7,574	6,643	8,213	5,853	4,520	4,113	3,735	5,491	6,818	5,220	5,098	5,990	5,688	2,315	2,824	5,961
Unallocated catch	355	85	-4,329	-198	800	671	1,998	-379	-543	-591	-599	-851	-357	-279	299	94
WG estimate	7,929	6,728	3,884	5,655	5,320	4,784	5,733	5,112	6,275	4,629	4,499	5,139	5,331[4]	2,036[4]	3,123[4]	6,055[4]

[1]Preliminary.
[2]Included in Division VIa.
[3]Includes UK England, Wales and NI Landings
[4]includes the total Russian catch
n/a = Not available.

Table 4.2.1.2. Details of Scottish discard trips in the Rockall area. (Newton *et al*., 2003).

Trip no.	Date	Gear	No. of hauls	Hours fished	% (weight) haddock landed of catch	% (weight) discarded of haddock
1	May 85	Heavy Trawl	20	89.08	74	17.3
2	Jun 85	Heavy Trawl	28	127.17	74	18.6
3	Jun 99	Heavy Trawl	21	110.83	41	74.9
4	Apr 01	Heavy Trawl	11	47.33	96	12.4
5	Jun 01	Heavy Trawl	35	163.58	58	47.5
6	Aug 01	Heavy Trawl	26	130.08	31	69.7

Table 4.2.1.3. Landings and Discards haddock estimates at Rockall from discard observer trips conducted aboard Irish vessels between 1995 and 2001, and from an observer trip aboard the MFV *Grove* (February/March 2000). (ICES CM 2004/ACFM:33)

	FAT/KBG /00/4	FAT/KBG /01/12	FAT/KBG /95/1	FAT/KBG /95/2	FAT/KBG /97/7	FAT/KBG /97/8	FAT/KBG/098/4	Grove Feb 2000	Discard rate
Landing	3021	942	12727	6893	14258	25866	23805	4400	
Discards	1864	926	1146	1893	6625	17926	3687	6200	
%discarded	38,16	49,57	8,26	21,54	31,72	40,9	13,4	58,49	27%

Table 4.2.1.4. Details of Russian fleet operations in fishery for the haddock on the Rockall Bank (Div. VIb) in 2003 (preliminary data)

Month	Tonnage class	Number of vessel/fishing days	Number of trawling hours	Catch, tones	Catch per vessel/fishing day, tones	Catch per 1-hour trawling
May	10	36	642	670	18,6	1,04
	9	59	937	836	14,2	0,89
June	10	43	818	500	11,9	0,61
	9	104	1935	837	8,0	0,43
	8	24	500	117	4,9	0,23
July	10	19	335	126	6,6	0,38
	9	97	1766	692	7,1	0,39
	8	26	453	131	5,0	0,29
August	10	52	873	291	5,6	0,33
	9	10	123	39	3,9	0,31
Total				4239		

Table 4.2.1.5. Species composition of Russian catch (t) taken with bottom trawls on Rockall Bank (Div. VIb) in 2003 (preliminary data)

Species	May	June	July	August	Total
Haddock	1506	1454	949	330	4239
Grey gurnard	-	-	29	234	263
Blue whiting	550	615	720	687	2572
Redfishes	40	26	26	2	94
Flatfishes	31	16	3	4	54
Argentine	10	89	10	10	119
Saithe	-	1	3	2	6
Other species	4	11	4	4	23
Total	2141	2212	1744	1273	7370

Table 4.2.2.1. Haddock in VIb. Tuning data avaiable for Scottish groundfish survey in September.
HADDOCK WGNSDS 2003 ROCKALL
101
SCOGFS (Numbers per 10 hours fishing at Rockall)
1985 2003
1 1 0.66 0.75
0 6

1	489	51284	214	31	4218	676	1	2	145
1	3577	17309	62196	85	139	2568	225	0	52
1	698	11672	2917	8530	105	267	249	71	1
1	8640	8170	5799	810	2107	5	2	91	17
1	23580	10799	3531	1889	268	765	2	7	25
1	16388	10612	1231	388	307	39	140	2	5
1	14458	16398	4431	683	315	228	37	64	3
1	20336	44912	14631	6135	647	127	200	4	32
1	15220	37959	15689	3716	1104	183	38	73	21
1	23474	13287	11399	4314	696	203	30	12	4
1	16293	16971	6648	5993	1935	483	200	1	6
1	33578	19420	5903	1940	1317	325	69	6	1
1	28897	10693	2384	538	292	281	71	9	1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	10178	9969	2410	708	279	172	90	64	32
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	31813	7455	521	284	154	39	14	12	14
1	11704	20925	2464	173	105	65	20	10	15
1	2526	10114	10927	1656	138	97	100	26	6

Table 4.2.3.1a
Catch Numbers (‘000’s) and Catch Weights (Kg) at Age for Haddock VIb
Scenario 1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1995	0	1.04	143.10	5051.69	4613.25	1225.21	290.22	26.57	15.22	35.31	1.81	1.03	0.30	0.00	0.00	0.00
1996	0	7.36	4448.28	1663.99	3760.22	2052.66	448.19	103.41	13.11	13.10	4.05	2.02	0.95	0.00	0.00	0.00
1997	0	2.89	245.04	1973.42	2036.37	3449.03	1403.88	186.90	9.79	4.54	1.59	0.48	0.00	0.04	0.00	0.00
1998	0	30.78	348.96	1678.82	1232.92	1737.42	2079.08	802.45	353.66	10.73	2.32	0.07	0.05	0.00	0.00	0.00
1999	0	29.50	883.66	1892.73	1539.26	1103.60	1588.27	1653.94	439.59	89.68	1.01	0.02	1.37	0.00	0.00	0.00
2000	0	12.87	1163.77	959.58	1118.24	601.00	917.50	816.58	520.60	141.76	9.62	0.86	0.00	0.00	0.00	0.00
2001	0	17.63	466.75	617.33	229.16	831.05	368.94	245.50	126.70	32.73	10.52	0.05	0.03	1.21	0.00	0.00
2002	0	3.25	675.66	855.01	460.53	606.92	157.05	108.99	63.96	12.11	12.13	55.14	12.95	0.00	0.00	0.00
2003	0	0.12	151.13	2191.45	467.25	239.88	297.35	127.87	75.38	8.19	2.44	1.61	0.62	0.00	0.00	0.00

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1995	0	0.304	0.307	0.367	0.426	0.555	0.656	1.273	1.128	1.066	1.260	1.175	1.304	0.000	0.000	0.000
1996	0	0.248	0.378	0.451	0.429	0.536	0.645	0.916	1.256	1.003	1.379	1.283	1.333	0.000	0.000	0.000
1997	0	0.202	0.287	0.361	0.401	0.503	0.574	0.865	1.156	1.420	1.859	1.498	0.000	3.249	0.000	0.000
1998	0	0.208	0.304	0.432	0.449	0.472	0.517	0.584	0.574	1.154	1.186	0.737	1.662	0.000	0.000	0.000
1999	0	0.265	0.316	0.365	0.402	0.455	0.532	0.552	0.599	0.567	0.856	2.052	3.169	0.000	0.000	0.000
2000	0	0.245	0.373	0.443	0.412	0.465	0.464	0.526	0.666	0.748	1.403	3.517	0.000	0.000	0.000	0.000
2001	0	0.247	0.382	0.376	0.689	0.373	0.451	0.455	0.570	1.014	1.008	1.825	1.508	1.355	0.000	0.000
2002	0	0.241	0.375	0.364	0.472	0.490	0.568	0.699	0.733	1.031	1.269	0.553	0.639	0.000	0.000	0.000
2003	0	0.204	0.346	0.427	0.587	0.647	0.584	0.680	0.721	1.061	1.945	1.776	1.391	0.000	0.000	0.000

Table 4.2.3.1b
Catch Numbers ('000's) and Catch Weights (Kg) at Age for Haddock VIb
Scenario 2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1995	0.00	1.04	143.10	5051.69	4613.25	1225.21	290.22	26.57	15.22	35.31	1.81	1.03	0.30	0.00	0.00	0.00
1996	0.00	7.36	4448.28	1663.99	3760.22	2052.66	448.19	103.41	13.11	13.10	4.05	2.02	0.95	0.00	0.00	0.00
1997	0.00	2.89	245.04	1973.42	2036.37	3449.03	1403.88	186.90	9.79	4.54	1.59	0.48	0.00	0.04	0.00	0.00
1998	0.00	30.78	348.96	1678.82	1232.92	1737.42	2079.08	802.45	353.66	10.73	2.32	0.07	0.05	0.00	0.00	0.00
1999	0.00	29.50	883.66	1892.73	1539.26	1103.60	1588.27	1653.94	439.59	89.68	1.01	0.02	1.37	0.00	0.00	0.00
2000	0.00	33.42	1705.94	1840.87	856.62	439.18	249.35	133.13	89.99	57.69	31.34	0.86	0.00	0.00	0.00	0.00
2001	0.00	165.07	1028.70	634.79	321.37	182.65	89.68	44.41	31.60	28.84	20.37	0.05	0.03	1.29	0.00	0.00
2002	0.00	7.01	1159.43	621.83	276.95	226.17	104.79	49.66	29.70	17.23	13.04	8.94	0.24	0.00	0.00	0.00
2003	0.00	0.12	151.13	2191.45	467.25	239.88	297.35	127.87	75.38	8.19	2.44	1.61	0.62	0.00	0.00	0.00

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1995	0.000	0.304	0.307	0.367	0.426	0.555	0.656	1.273	1.128	1.066	1.260	1.175	1.304	0.000	0.000	0.000
1996	0.000	0.248	0.378	0.451	0.429	0.536	0.645	0.916	1.256	1.003	1.379	1.283	1.333	0.000	0.000	0.000
1997	0.000	0.202	0.287	0.361	0.401	0.503	0.574	0.865	1.156	1.420	1.859	1.498	0.000	3.249	0.000	0.000
1998	0.000	0.208	0.304	0.432	0.449	0.472	0.517	0.584	0.574	1.154	1.186	0.737	1.662	0.000	0.000	0.000
1999	0.000	0.265	0.316	0.365	0.402	0.455	0.532	0.552	0.599	0.567	0.856	2.052	3.169	0.000	0.000	0.000
2000	0.000	0.383	0.403	0.476	0.613	0.743	0.886	0.873	1.028	0.900	0.775	3.517	0.000	0.000	0.000	0.000
2001	0.000	0.273	0.377	0.506	0.656	0.698	0.797	0.873	0.866	1.169	0.832	1.825	1.508	1.359	0.000	0.000
2002	0.000	0.399	0.437	0.498	0.656	0.650	0.754	0.806	0.773	0.911	1.069	0.889	1.583	0.000	0.000	0.000
2003	0.000	0.204	0.346	0.427	0.587	0.647	0.584	0.680	0.721	1.061	1.945	1.776	1.391	0.000	0.000	0.000

Table 4.2.3.1c
Catch Numbers ('000's) and Catch Weights (Kg) at Age for Haddock VIb
Scenario 3

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1995	0.00	1.04	143.10	5051.69	4613.25	1225.21	290.22	26.57	15.22	35.31	1.81	1.03	0.30	0.00	0.00	0.00
1996	0.00	7.36	4448.28	1663.99	3760.22	2052.66	448.19	103.41	13.11	13.10	4.05	2.02	0.95	0.00	0.00	0.00
1997	0.00	2.89	245.04	1973.42	2036.37	3449.03	1403.88	186.90	9.79	4.54	1.59	0.48	0.00	0.04	0.00	0.00
1998	0.00	30.78	348.96	1678.82	1232.92	1737.42	2079.08	802.45	353.66	10.73	2.32	0.07	0.05	0.00	0.00	0.00
1999	0.00	29.50	883.66	1892.73	1539.26	1103.60	1588.27	1653.94	439.59	89.68	1.01	0.02	1.37	0.00	0.00	0.00
2000	0.00	12.87	1163.77	959.58	1118.24	601.00	917.50	816.58	520.60	141.76	9.62	0.86	0.00	0.00	0.00	0.00
2001	0.00	17.63	466.75	617.33	229.16	831.05	368.94	245.50	126.70	32.73	10.52	0.05	0.03	1.21	0.00	0.00
2002	0.00	17.49	844.39	541.07	273.08	241.37	124.79	65.43	24.82	17.63	17.79	8.63	0.16	0.00	0.00	0.00
2003	0.00	1.10	267.94	598.02	380.67	333.36	242.71	101.81	44.53	35.65	10.13	2.05	6.17	0.00	0.00	0.00

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1995	0	0.304	0.307	0.367	0.426	0.555	0.656	1.273	1.128	1.066	1.260	1.175	1.304	0.000	0.000	0.000
1996	0	0.248	0.378	0.451	0.429	0.536	0.645	0.916	1.256	1.003	1.379	1.283	1.333	0.000	0.000	0.000
1997	0	0.202	0.287	0.361	0.401	0.503	0.574	0.865	1.156	1.420	1.859	1.498	0.000	3.249	0.000	0.000
1998	0	0.208	0.304	0.432	0.449	0.472	0.517	0.584	0.574	1.154	1.186	0.737	1.662	0.000	0.000	0.000
1999	0	0.265	0.316	0.365	0.402	0.455	0.532	0.552	0.599	0.567	0.856	2.052	3.169	0.000	0.000	0.000
2000	0	0.245	0.373	0.443	0.412	0.465	0.464	0.526	0.666	0.748	1.403	3.517	0.000	0.000	0.000	0.000
2001	0	0.247	0.382	0.376	0.689	0.373	0.451	0.455	0.570	1.014	1.008	1.825	1.508	1.355	0.000	0.000
2002	0	0.241	0.443	0.564	0.762	0.778	0.901	0.959	0.864	1.104	1.243	1.119	1.610	0.000	0.000	0.000
2003	0	0.187	0.320	0.652	1.026	1.099	1.111	1.248	1.287	1.142	1.966	1.522	1.446	0.000	0.000	0.000

Table 4.2.3.2
Catch Numbers('000's) and Catch Weights (kg) at Age for Haddock VIb
Russian Data

	0	1	2	3	4	5	6	7	8	9	10
2000	0	27.58	2598.19	3654.81	1572.32	624.23	334.99	312.47	172.10	23.36	3.66
2001	0	385.59	547.98	524.43	333.95	178.69	95.74	77.64	40.05	20.05	5.02
2002	0	1066.05	1944.74	1316.81	569.69	447.62	261.01	324.13	179.78	86.27	15.76
2003	0	920.06	7950.06	8853.88	1391.57	951.69	586.26	260.43	94.16	20.99	3.15

	0	1	2	3	4	5	6	7	8	9	10
2000	0	0.078	0.141	0.189	0.255	0.348	0.409	0.576	0.815	0.696	0.840
2001	0	0.086	0.156	0.264	0.347	0.462	0.546	0.621	0.985	1.327	1.552
2002	0	0.089	0.150	0.240	0.382	0.493	0.565	0.643	0.808	0.995	1.119
2003	0	0.100	0.160	0.202	0.272	0.322	0.341	0.467	0.611	0.876	1.449

Figure 4.2.2.1 Rockall Haddock VIb: Irish and Scottish effort Since 1985

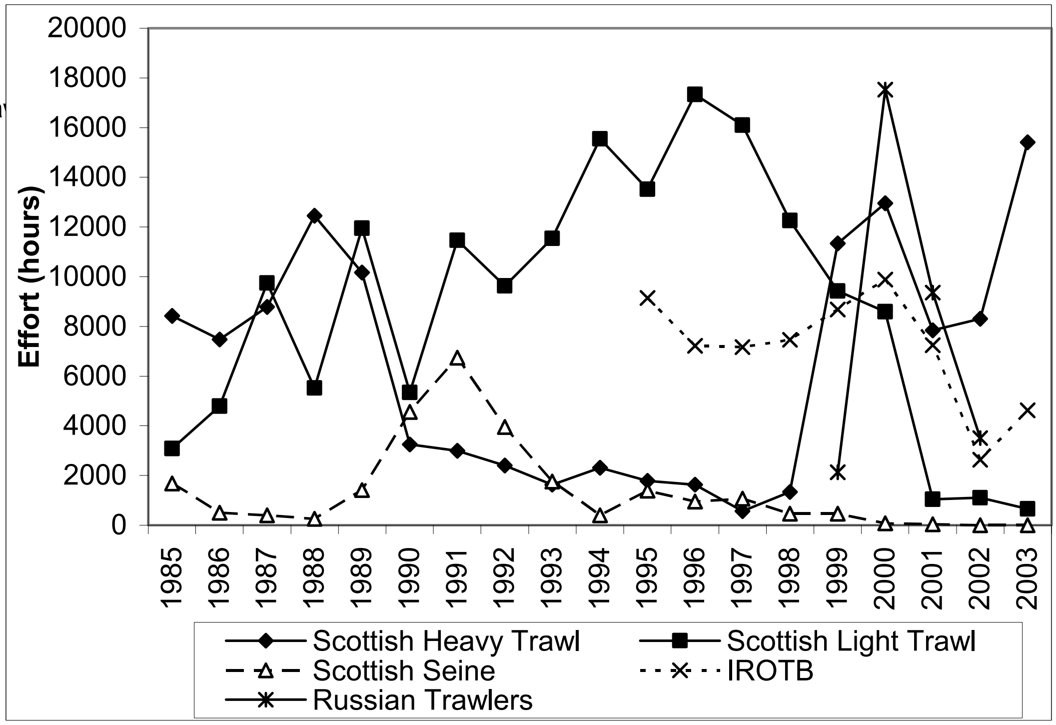


Figure 4.2.2.2. LPUE and CPUE of the fleets fishing for Haddock in VIb

1 – Scottish LPUE (all gears)
2 - Irish trawlers LPUE
3 – CPUE of Russian trawlers (BMRT type, 10 th tonnage class)

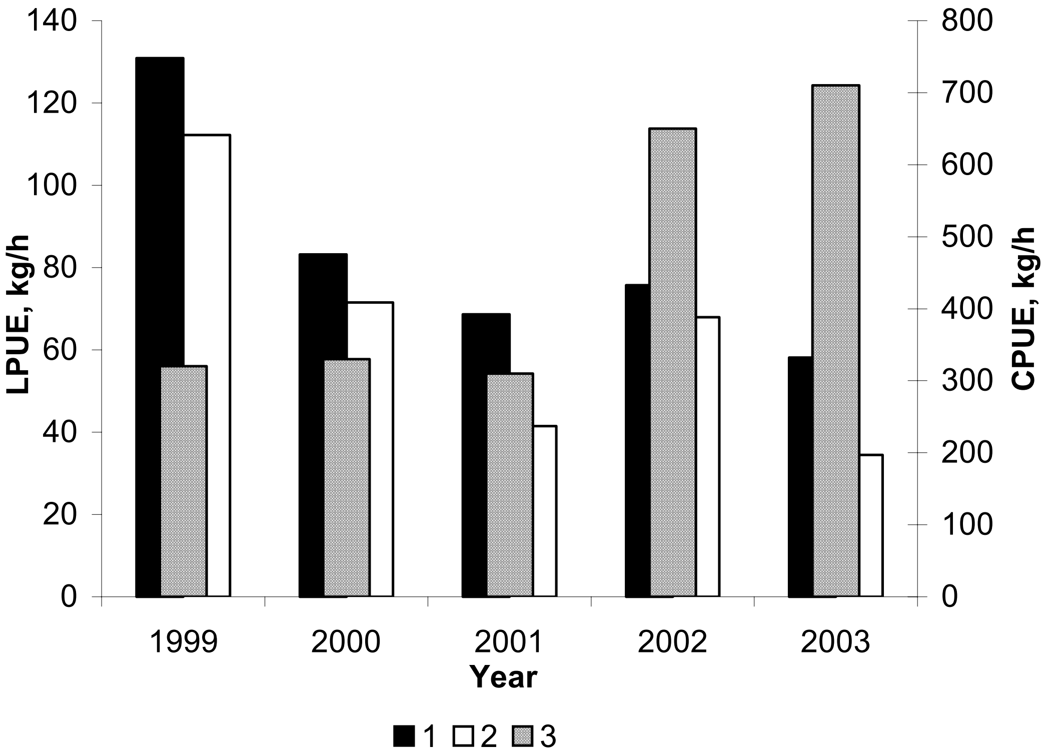


Figure 4.2.2.3 SURBA Analysis for Rockall Haddock

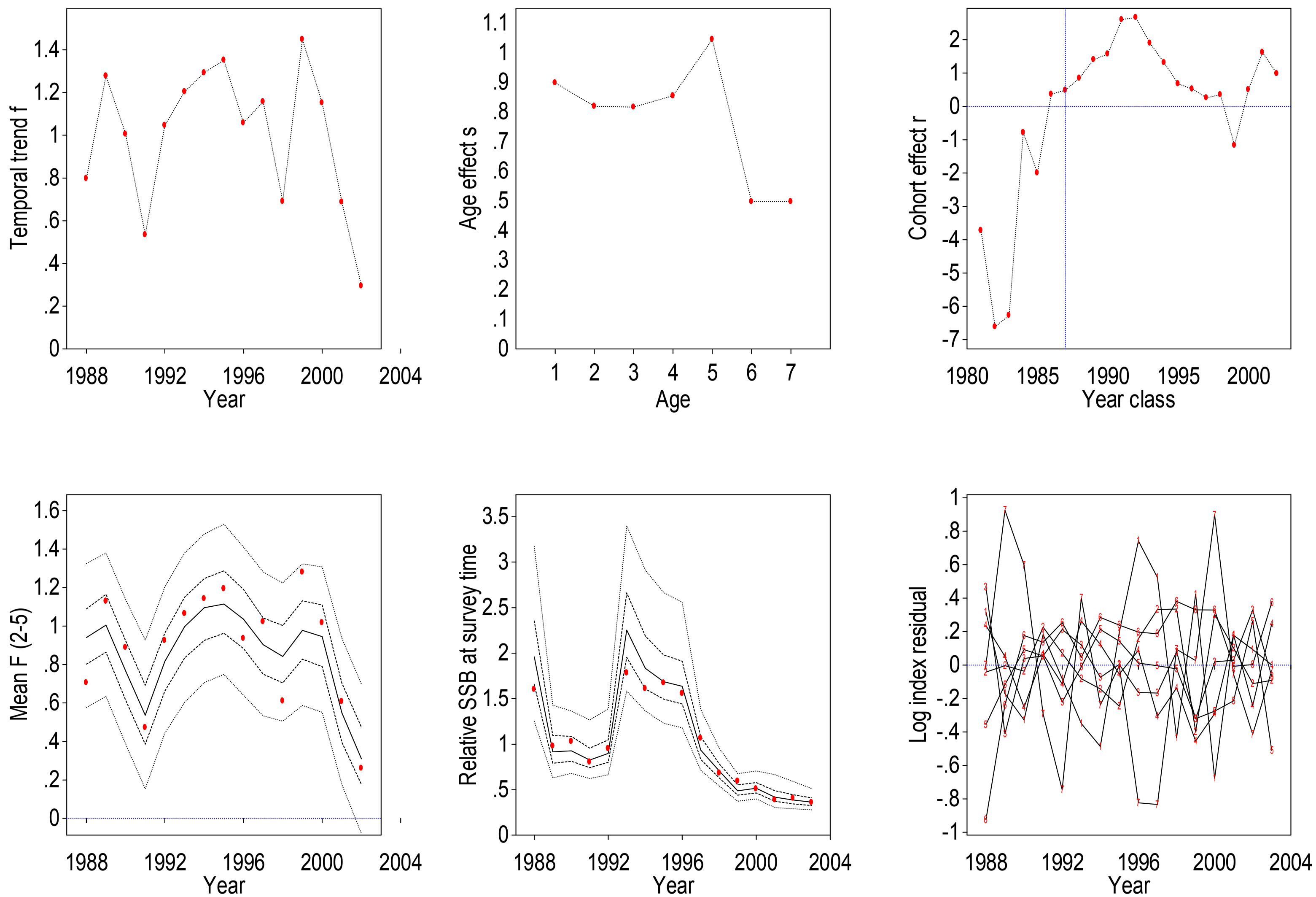


Figure 4.2.2.4 Haddock VIb SURBA Residuals plotted byage

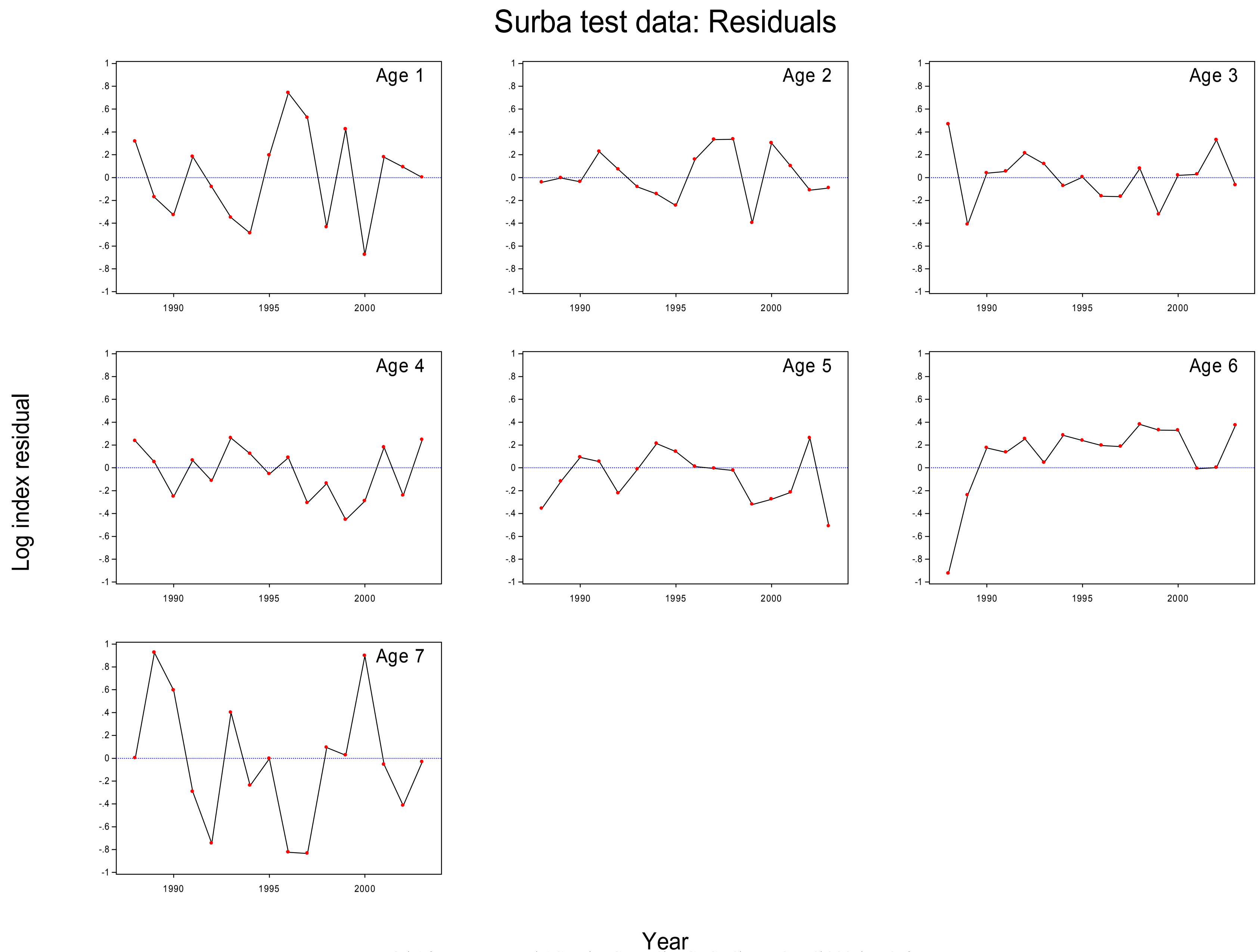


Figure 4.2.3.1 Mean Weights at Age for Haddock VIb for Scottish and Irish Data combined

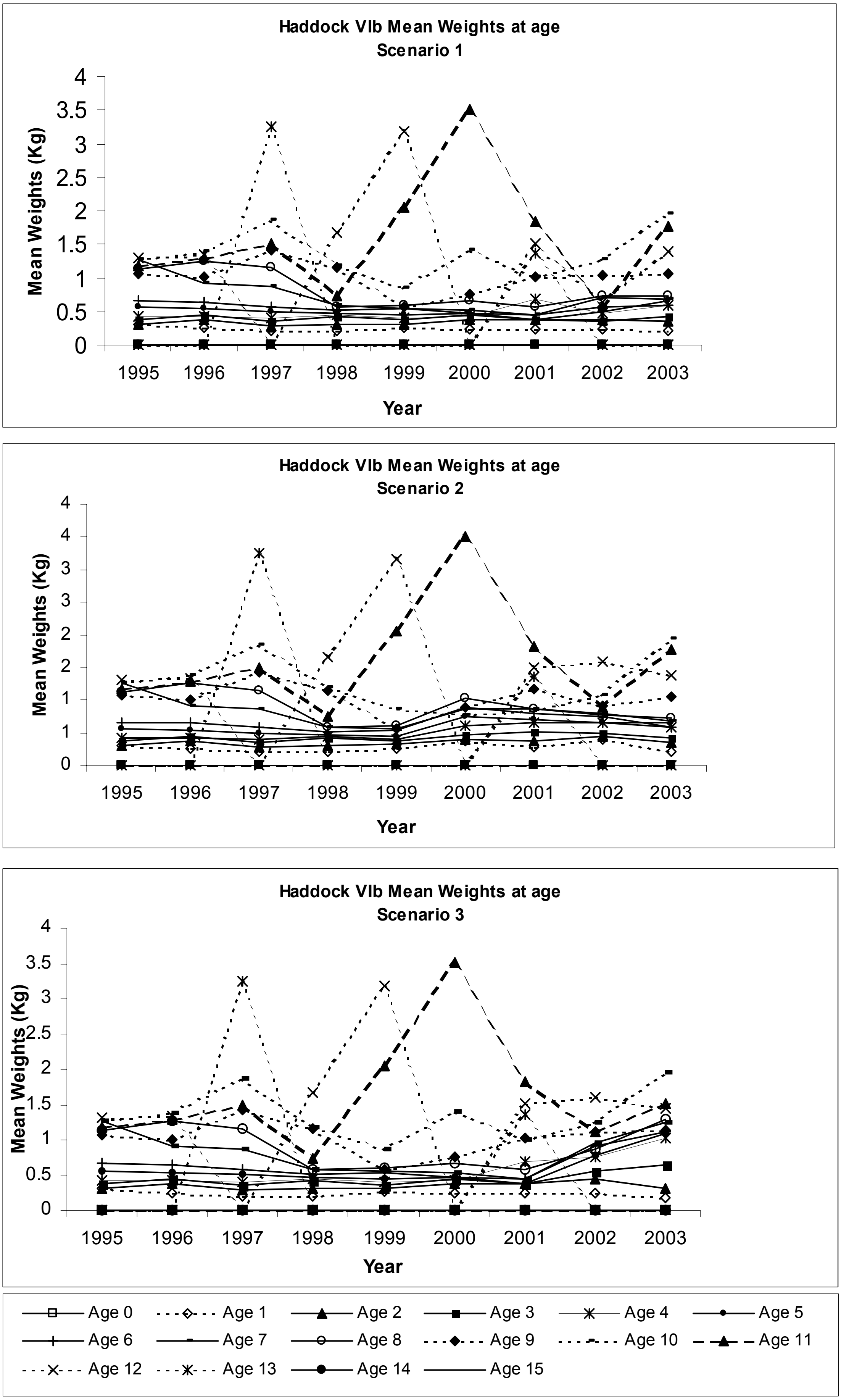
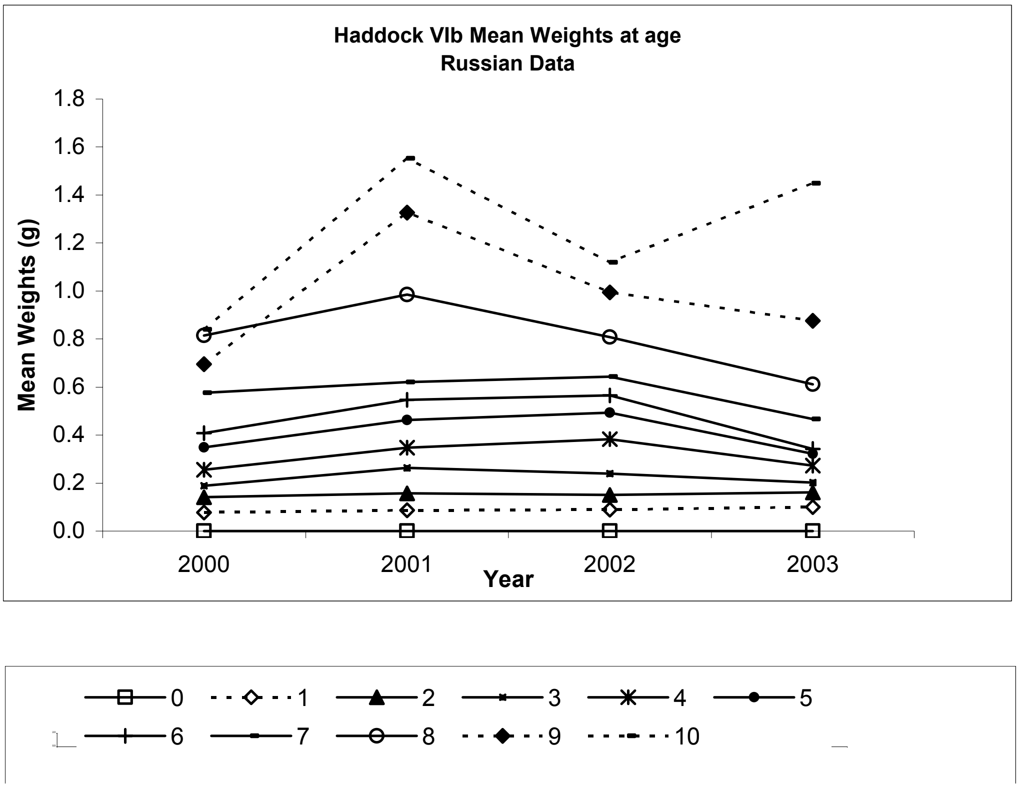


Figure 4.2.3.2 Mean Weights at Age for HaddockVIb for Russian Data



5 WHITING IN SUB-AREA VI

5.1 Whiting in Division VIa

In the ACFM Technical Minutes of the October 2003 meeting, ACFM commented on several aspects of previous assessments that it would like to see addressed. A summary of comments follows:

1. The use of discard estimates in the assessment for the first time in 2002 was questioned, the issue with inclusion concentrated on discard modelling of discards by TSA: discards seem to be interpreted as noise, their inclusion may have resulted in altering the perception that trend in F exists;

2. The allowance of persistent changes in survey catchability was criticised: in 2001 the estimate of persistent processes was 0.0, with all variance being attributed to transient changes. In 2003, the estimates changed suddenly and all variance was attributed to persistent changes;

3. The apparent strong positive trend in catchability of the Scottish groundfish survey is consistent with the idea that catch data and survey data do not exhibit similar trends. If there is no a priori reason to suspect a trend in survey catchability, and deteriorating quality of catch data is suspected, the recommendation would be to use survey data alone and catch data only to tune the historical part of the time series and explore the use of survey data alone to calibrate models in recent years;

5.1.1 Stock definition and the fishery

General information is now located in the stock annex.

5.1.1.1 ICES advice applicable to 2002 and 2003

The advice in 2002 for the fishery in 2003 was:

> "*Since whiting is mostly taken in demersal fisheries with cod and haddock, the advice for cod determines the advice for whiting. Unless ways to harvest whiting without by-catch of cod can be demonstrated, fishing for whiting should not be permitted.*
>
> *On the basis of whiting alone, ICES would recommend that to bring SSB above $\boldsymbol{B}_{pa}$ (22,000 t) in 2004, fishing mortality in 2003 should be below 0.14, corresponding to a human consumption landing of less than 900 t. If any fisheries on whiting are permitted, despite the advice on cod and haddock, then total catches should not exceed these values."*

The advice in 2003 for the fishery in 2004 was as follows:

Single Stock Exploitation Boundaries: *To bring SSB above $\boldsymbol{B}_{pa}$ in 2005, total fishing mortality in 2004 should be below 0.31, corresponding to human consumption landings of less than 2100.*

5.1.1.2 Management applicable in 2003 and 2004

The following table summarises ICES management advice for whiting in Division VIa during 2001–2003:

Year	Single species exploitation	Basis for single species	TAC for Vb, VI, XII, XIV (tonnes)	% change in F associated with TAC[1]	WG landings
2001	< 4,200	Reduce *F* below $\boldsymbol{F}_{pa}$	4,000	-40%	2,438
2002	< 2,000	SSB > $\boldsymbol{B}_{pa}$ in short	3,500	-40%	1,709

		term			
2003	-	SSB > B_{pa} in short term	2,000	-60%	1,356
2004	-	SSB > B_{pa} in 2005	1,600		

[1]Based on *F*-multipliers from forecast tables.

5.1.1.3 The fishery in 2003

Total international catches in 2003 were estimated to be 2,900 t, of which 1,360 t were human consumption landings and 1,600t were discards (tables 5.1.1.1 & table 5.1.1.2). The downward trend in landings is continuing and human consumption landings and discards were again the lowest in the series.

Slight revisions (<10%) were made to Working Group estimates of landings and discards in 2002. The reduction in fishing mortality of 40% associated with recent changes in F necessarily implies a reduction in effort. Reported effort in the Scottish light trawl fleet has declined steadily from 35,698h in 2001 to 15174h and 9357h in 2002 and 2003 respectively. The Scottish seine fleet reported declines in effort too and the 2003 figure (2370h) is the lowest in the series . The Scottish *Nephrops* fleets reported a more gradual decline in effort with 256,000h recorded in 2003 as opposed to 258,000h in 2002 (Table 5.1.2.1). Due to Scottish reporting problems, however, these effort data may be underestimates (see Section 5.1.2). The Working Group has no information to enable a determination of whether the activities of these fleets have been significantly affected in 2003 by recovery plans for cod and hake to the west of Scotland.

5.1.2 Commercial catch-effort and research vessel surveys

Four commercial catch-effort data series were available for the assessment period, uncorrected for changes in fishing power and incorporating discard estimates from the Scottish sampling program. As noted in the report of the WGNSSK for 2000 (ICES CM 2001/ACFM:07), the 1999 effort data for the Scottish commercial fleets are not commensurate with the historical series. This problem persists through to 2003, although the reporting and collation methodology was updated during 2001, future CPUE indices from Scottish commercial fleet may not be useable as effort reporting is still not mandatory. Therefore commercial CPUE data are not used in this assessment. They are presented here for completeness:

- Scottish light trawlers (ScoLTR): ages 1–7, years 1965–2003.
- Scottish seiners (ScoSEI): ages 1–6, years 1965–2003.
- Scottish Nephrops trawlers (ScoNTR): ages 1–6, years 1965–2003.
- Irish Otter Trawlers (IreOTB); ages1-7,years 1995-2002.

Two research survey indices for whiting in VIa were also available:

- Scottish west coast groundfish survey (ScoGFS): ages 1–7, years 1985-2004. For this survey, a new vessel and gear were used from 1999. The catch rates as presented are corrected for the change in vessel and gear. The basis for the correction is comparative trawl haul data (Zuur et al. 2001).

Irish west coast groundfish survey (IreGFS): ages 0–5, year 1993-2002. The Irish quarter four survey was a comparatively short series, was discontinued in 2003 and will be replaced by a new survey with a substantially different design in 200.

The survey series are described in Appendix 1 and the commercial fleets in Appendix 2 of the report for the 1999 meeting of the Working Group (ICES CM 2000/ACFM:1). For both survey series, the oldest age given represents a true age, rather than a plus group. The effort series for both commercial and survey tuning fleets are shown in Table 5.1.2.1 and plotted against time fig. 5.1.2.1e. Scottish survey time-series by age, year, year-class and cohort are shown in Figs 5.1.2.1a,b,c. The survey is reasonably consistent at following the development of year-class strength down cohorts.

5.1.3 Age composition and mean weights at age

Details on nations which supply data are given in table 2.2.1. Sampling levels are shown in table 2.2.2. Age distributions were estimated from market samples, with additional samples for age determination collected during research vessel surveys. Rates of discarding numbers at age were estimated for Scottish fleets by on-board sampling, and then extrapolated to all remaining fleets. As the remaining fleet accounts for less than 70% of annual landings, this extrapolation is likely to be reasonable. The total international numbers landed, discarded and total catch at age data are presented in Tables 5.1.3.1 – 5.1.3.3, and Figure 5.12.1d. Annual mean weights-at-age in the catches, landings and discards are given in Tables 5.1.3.4 – 5.1.3.6, and Figure 5.1.3.2a,b,c.

There are trends in mean weights-at-age in all three catch components. As in previous meetings, the catch mean weights-at-age were also used as stock mean weights-at-age (see stock annex).

5.1.4 Natural mortality and maturity at age

Values for natural mortality (0.2 for all ages, and years) and the proportion of fish mature at age (knife-edged at age 2 for all years) are unchanged from the last meeting. As last year, the proportion mature before spawning and the proportion fished before spawning, are both set to be zero. Time series of maturity ogive estimates do exist for VIa whiting which show temporal trends and it is possible that these could be incorporated into future assessments.

5.1.5 Catch-at-age analysis

The full commercial CPUE and research-survey data series available for catch-at-age analysis are shown in Table 5.1.2.1. As in last year's assessment of this stock, the age range used was 1 to 7+. The year range used for catch-at-age analyses was 1978–2003, because independent discard estimates for the pre-1978 period are not available. The entire 1985–2004 year range for the ScoGFS survey was used for the TSA runs.

5.1.5.1 Data screening

Commercial catch data

The catch-at-age data were screened using a separable VPA with all but the most recent 10 years heavily down-weighted (ages 0–7+, years 1978–2002), using a selection of 1.0 on the oldest true age (from exploratory runs) and terminal F (0.3 on age 3) as given by previous assessments. The results (Figure 5.1.5.1a) suggest that residuals are large on the 0:1 log catch ratios, and on the older log catch ratios. These consist of partially recruited age groups subject to discarding in the human consumption fishery. Catches of fish aged 8 and above are relatively small and, therefore, the plus group is set at 7+.

Research-vessel survey data

Consistent with the detaileed analyses conducted during WG2003 the WG again excluded the IreGFS data from the assessment which stopped in 2003 in any event.

5.1.5.2 Catch-at-age analyses

Time-series analysis

The TSA modelling of whiting followed the methods described in Fryer (2002) as was used last year.

Exploratory SURBA, XSA and TSA runs conducted for this stock and other VIa gadoid stocks indicated that the TSA model tended to behave in a manner difficult to explain when presented with divergent information from survey and commercial data sources. Because of the considerable uncertainty associated with terminal Fs and SSB for different model configurations the WG decided that no "final" assessment could be presented for VIa whiting this year. Instead a number of candidate assessments are proposed. Three TSA runs were done, the outputs of which were then compared to a single XSA run. However the WG was unable to decide which of these was the most appropriate. The decision that no final assessment could be accepted, was also made for similar reasons in the other two VIa gadoid stocks (cod & haddock). Further discussion on this decision can be found in section 4.1.4.2.

5.1.5.3 Final catch-at-age analyses

The following three TSA analyses were done:

A. A ScoGFS-tuned TSA analysis allowing a persistent trend in survey catchability (see Table 5.1.5.2.1a & 5.1.5.2.2a);

B. A ScoGFS-tuned TSA without persistent trend in catchability (see Table 5.1.5.2.1b & 5.1.5.2.2b);

C. A ScoGFS-tuned TSA without persistent trend and catch data missing from 1995 (see Table 5.1.5.2.1c &5.1.5.2.2c);

D. An XSA, tuned with only Scottish Groundfish survey data. The settings for this model are described in Table 5.1.5.2.1d and the output in Table 5.1.5.2.2d).

The input parameter settings for the TSA assessments (A,B&C) are detailed in Table 5.1.5.2.1. The TSA parameter estimates and XSA diagnostics are shown 5.1.5.2.2. Estimated TSA population numbers-at-age and their standard errors for runs A, B and C are given in Tables 5.1.5.3.1a,b,c and 5.1.5.3.2a,b,c respectively. Values of fishing mortality and their log-standard errors are given in tables 5.1.5.3.3a,b,c, and 5.1.5.3.4a,b,c respectively. The settings for these final runs are given in table 5.1.5.2.1 and the parameter estimates in table 5.1.5.2.2a,b,c. Similar output information for the final XSA run is given in Table 5.1.5.2.2d.

The following table shows terminal estimates of SSB and F(2-4) in 2003 as estimated in this year's assessments. F(2-4) estimates from all the TSA estimates range from 0.67 to 1.8 whereas the XSA estimate of F is substantially lower (0.16). TSA runs A and B gave similar estimates of F in 2003. These runs used the full time series of the catch data but differed in their assumptions about catchability trends in the survey. TSA run D, for which catch data were removed from 1999 gave the highest estimate of F in 2003 (1.08).

	WG 2003	**WG2004. A(survey with trend)**	**WG2004. B(no trend in catchability)**	**WG2004. C(TSA no trend no catch)**	**WG2004. D(XSA)**
SSB in 2003 (t)	-	6,430	4,953	17,690	11,842
F(2-4) in 2003	-	0.67	0.79	1.08	0.16

Estimates of SSB in 2003 range from just under 5000t to over 17,500t . TSA runs A and B provided estimates that were closer together. TSA run C, which was most heavily dependent on survey information, provided the highest estimate (17,690t). Whilst XSA estimates an increase in SSB in the most recent years the main affect of the marked reduction in catches in recent years appears to be in estimates of F, for which a dramatic reduction over the period 2001-2003 is apparent. The 2003 estimate of F is the lowest in the time series (1978-2003).

Retrospective plots (figure 5.1.5.3.6,a,b,c) for TSA runs A and B show a tendency to underestimate F(2-4) in recent years with a corresponding overestimate of SSB. TSA run C with no catch data from 1995 onwards, shows an improved retrospective pattern for both F and SSB in comparison to runs A and B. It was noted, however, that the standard errors around the predicted values were much larger in runs for which catch data were omitted. The retrospective plots for F similarly show a strong tendency to underestimate F and overestimate SSB. The results of the retrospective analysis would suggest that the predicted value of F in 2003 from XSA represents an underestimate.

5.1.6 Estimating recruiting year-class abundance

Estimates of recruitment are available from multifarious sources. Potential estimates of recruitment at age 1 of the 2003 year-class (recruiting in 2004) are generated by the TSA algorithm and this value can be used directly in forecasts. No estimate of the 2003 year-class is available from XSA. The 3 TSA runs give estimates of (52 million; 41 million & 122 million) respectively. The short-term geometric mean (1993-2003) estimate was 63 million individuals.

	XSA	XSA JUSTIFICATION	TSA WITH TREND	TSA WITHOUT TREND	TSA 1995-2003 NO CATCH	TSA JUSTIFICATION
Recruitment at age 1 (thousands) in:						
2004	68081	GM (92-02)	51973	36450	125892	TSA
2005	68081	GM (92-02)	59692	52300	117864	GM (94-04)
2006	68081	GM (92-02)	59692	52300	117864	GM (94-04)

TSA estimates are driven by a combination of the survey index for 2004, smoothing from earlier estimates, and the assumption of an underlying Ricker recruitment model. The Ricker model fits to the different TSA configurations show some variability. Whilst runs A and C are very similar, the fit for run B shows a shallower slope at the origin and predicts slightly higher recruitments at high SSB levels. All three fitted models have a tendency to overestimate recruitment at low biomass levels (figure 5.1.5.3.5a,b,c). Of the three TSA recruitment estimates, 2 are estimated from within the historical bounds of the data, whilst the estimate from run A is an extrapolation close the origin of the fitted curve. The largest departure from all the model fits is the large recruitment in 1979.

A recruitment estimate of *circa* 63 million was derived from the geometric mean (1992-2002) for the XSA estimates of number at age 1. This value is slightly below the long-term (1978-2003) geometric mean.

5.1.7 Long-term trends in biomass, fishing mortality and recruitment

The various model outputs of long-term trends in mean F(2-4), spawning-stock biomass, recruitment and landings are shown in tables 5.1.7.1a,b,c,d and figures 5.1.7.1a,b,c,d. Since 1978 F has increased steadily while spawning stock biomass and recruitment have fallen steadily. Depending on the model, spawning-stock biomass in 2003 is estimated to be either 6,428t, 4,953t, 17,693 or11,669t. Clearly the TSA model with no catch data suggests much higher spawning stock biomasses and recruitment. Mean F(2-4) in 2003 is estimated to be either 0.67, 0.79 or 1.08 or 0.16.

5.1.8 Short-term catch predictions

Population numbers at January 1, 2004 for the catch forecast were taken either directly from the TSA estimates of survivors or from calculated geometric means from XSA numbers at age 1. The F-at-age in 2005 was calculated by scaling the F-at-age from 2004 by the ratio between F(2-4) in 2004 and 2005. The selection pattern was assumed the same for 2006.

Three year mean weights-at-age for total catch, human consumption landings, and discards were taken as the arithmetic mean over the last three years.

Short-term forecast was calculated using the MFDP program. The various F-at-age values used for projection are given in table 5.1.8.2. The predicted landings and SSB at *status quo F* are given below:

A

Year	Landings (t)	Discards (t)	Source	SSB (t)	Source
2003	1,356	1,579	WG estimates	6,430	TSA
2004	2,889	3,028	SQ forecast	9,123	SQ forecast
2005	3,306	3,282	SQ forecast	9,982	SQ forecast
2006	3,697	3,460	SQ forecast	11,121	SQ forecast

B

Year	Landings (t)	Discards (t)	Source	SSB (t)	Source
2003	1,356	1,579	WG estimates	4,953	TSA
2004	2,132	2,265	SQ forecast	6,576	SQ forecast
2005	2,401	2,679	SQ forecast	6,880	SQ forecast
2006	2,804	3,021	SQ forecast	8,448	SQ forecast

C

Year	Landings (t)	Discards (t)	Source	SSB (t)	Source
2003	1,356	1,579	WG estimates	17,960	TSA
2004	6,323	7,528	SQ forecast	17,708	SQ forecast
2005	6,991	7,600	SQ forecast	19,588	SQ forecast
2006	7260	7,473	SQ forecast	19,685	SQ forecast

D

Year	Landings (t)	Discards (t)	Source	SSB (t)	Source
2003	1,356	1,579	WG estimates	11,842	XSA
2004	7,548	-	SQ forecast	17,557	SQ forecast
2005	7,563	-	SQ forecast	18,815	SQ forecast
2006	8,012	-	SQ forecast	20,082	SQ forecast

5.1.9 Medium-term predictions

Due to uncertainty about discarding rates population numbers at the youngest ages are probably poorly estimated due to high discard rates in this fishery. Any stock and recruitment relationship may therefore be weakly defined. Furthermore due to model uncertainty and lack of time, medium-term projections were not done for this stock.

5.1.10 Yield and biomass per recruit

Yield and biomass per recruit values are given in Figure 5.1.8.3a,b,c,d.

5.1.11 Reference points

ICES's PA reference points are:

$\mathbf{F}_{lim}$ = 1.00; $\mathbf{F}_{pa}$ = 0.60; $\mathbf{B}_{lim}$ = 16,000t; $\mathbf{B}_{pa}$ = 22,000t

5.1.12 Quality of the assessment

Assessments are based on catch-at-age data on one survey series. Biases in the various data sources means that the 2004WG was unable to assess the VIa whiting stock confidently. These biases arise both in the commercial and scientific (survey) datasets. The survey data have been subjected to changing gears and vessels (Scotia II replaced Scotia I in 1998). The length of tow duration done on survey was also changed from 1 to half an hour in 1991. Such a change could easily affect the age structure of the fish being caught. Problems arise in the commercial data from misreported landings and effort and the extrapolation of the discarding information to other fleets.

5.1.13 Management considerations

Since no final assessment was presented we cannot comment on management considerations. In two of the assessment models described in this report (TSA runs A,B&C) SSB is above $\mathbf{B}_{lim}$, while in the other two it is below. They are all, nevertheless, below $\mathbf{B}_{pa.}$

The EU Cod Recovery Plan regulation implemented for 2004 (council regulation No. 423/2004) will impact the management measures for 2005, which will be formulated with reference to the estimates and forecasts of SSB in relation to limit and precautionary reference points. For stocks above $\mathbf{B}_{lim}$, the harvest control rule (HCR) requires (1) setting a TAC that achieves a 30% increase in the SSB from one year to the next; (2) limiting annual changes in TAC to ± 15% (except in the first year of application), and (3) a rate of fishing mortality that does not exceed $\mathbf{F}_{pa}$.

For stocks below $\mathbf{B}_{lim}$ the Regulation specifies that conditions 1-3 will apply when they are expected to result in an increase in SSB above $\mathbf{B}_{lim}$ in the year of application or that a TAC will be set lower than that calculated under conditions 1-3 when the application of conditions 1-3 is not expected to result in an increase in SSB above $\mathbf{B}_{lim}$ in the year of application.

There have been several technical conservation measures introduced in the VIa gadoid fishery in recent years. The mandatory increases in mesh size to 120mm and the associated derogation for 2002 meant that variety short-term predictions were prepared with various uptake levels of this derogation. Whiting are caught in mixed fisheries with cod and whiting in VIa. Management of whiting will be strongly linked to that for cod for which there is an ongoing recovery plan.

5.2 Whiting in Division VIb

5.2.1 Catch trends

Officially reported catches are given in Table 5.2.1.

Table 5.1.1.1. Nominal catch (t) of WHITING in Division VIa, 1989–2003, as officially reported to ICES.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[1]
Belgium	1	-	+	-	+	+	+	-	1	1	+	+	-		-
Denmark	1	+	3	1	1	+	+	+	+	-	-	-	-		-
France	199[1,2]	180	352[1,2]	105	149	191	362	202	108	82[1]	300[1]	48	54[1]	56	33
Germany	+	+	+	1	1	+	-	+	-	-	+	-	-	+	+
Ireland	1,315	977	1,200	1,377	1,192	1,213	1,448	1,182	977	952	1,121	793	764	n/a	n/a
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	1	-	1	2	+	-	2	n/a	n/a
UK (E&W)[3]	44	50	218	196	184	233	204	237	453	251	210	104	71	…	…
UK (N.I.)	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
UK (Scot.)	6,109	4,819	5,135	4,330	5,224	4,149	4,263	5,021	4,638	3,369	3,046	2,258	1,654	…	…
UK (total)														1,137	771
Total landings	7,669	6,026	6,908	6,010	6,751	5,786	6,278	6,642	6,178	4,657	4,677	3,203	2,545	1,193	804
Unallocated landings	-138	-383	-248	-6	121	115	-202	514	107	-26	-64	-193	-107	516	552
Discards as used by W.G.	4,068	4,393	5,346	9,392	8,501	8,870	7,581	6,902	4,907	5,845	3,121	6,705	2,412	2,139	1,579
Landings as used by W.G.	7,531	5,643	6,660	6,004	6,872	5,901	6,076	7,156	6,285	4,631	4,613	3,010	2,438	1,709	1,356
Total catches as used by W.G.	11,598	10,036	12,006	15,396	15,373	14,771	13,657	14,057	11,193	10,476	7,734	9,714	4,850	3,848	2,935

[1]Preliminary.
[2]Includes Divisions Vb (EC) and VIb.
[3]1989–2002 N. Ireland included with England and Wales.
n/a = Not available.

Table 5.1.1.2. Whiting in Division VIa. Annual weight and numbers caught, years 1978–2003.

Year	Weight (tonnes)			Numbers (thousands)		
	Total	Human consumption	Discards	Total	Human consumption	Discards
1978	20452	14677	5775	93931	54369	39563
1979	20163	17081	3082	77794	61393	16401
1980	15108	12816	2292	57131	44562	12569
1981	16439	12203	4236	72113	46067	26046
1982	20064	13871	6193	87481	47883	39598
1983	21980	15970	6010	79114	49359	29755
1984	24118	16458	7660	125708	50218	75490
1985	23560	12893	10667	124683	43166	81517
1986	13413	8454	4959	64495	31273	33222
1987	18666	11544	7122	103485	41221	62264
1988	23135	11352	11784	141314	40681	100633
1989	11598	7531	4068	54634	26876	27757
1990	10036	5643	4393	42927	19201	23726
1991	12006	6660	5346	63112	25103	38009
1992	15396	6004	9392	86903	22266	64637
1993	15373	6872	8501	68350	23246	45105
1994	14771	5901	8870	87881	20060	67821
1995	13657	6076	7581	77932	18763	59169
1996	14057	7156	6902	71396	22329	49067
1997	11193	6285	4907	50459	19250	31209
1998	10476	4631	5845	56583	14387	42196
1999	7734	4613	3121	38260	15970	22290
2000	9714	3010	6705	78815	10118	68697
2001	4850	2438	2412	20803	8477	12325
2002	3848	1709	2120	25179	5765	19414
2003	2935	1356	1579	15403	4124	11279
Min	2935	1356	1579	15400	4124	11280
GM	12287	7116	5435	64017	24183	35794
AM	14872	8586	5210	71760	29470	42300
Max	24118	17081	11784	141314	61393	100633

Table 5.1.2.1. Whiting in VIa. Available catch-effort and survey tuning series.

ScoLTR : Scottish light trawl - Effort in hours - numbers at age (thousands) - Year

1965	2003							
1	1	0	1					
1	7							
37387	2012	469	3513	393	15	5	1	1965
40538	1036	926	163	5508	333	33	6	1966
80916	2540	4968	1637	101	2457	134	12	1967
65348	1931	3404	1868	677	51	844	59	1968
106856	47	8823	2212	578	279	28	517	1969
129741	95	5276	8515	713	143	36	3	1970
137728	1567	4472	1027	9818	338	63	25	1971
154288	13451	4637	1716	335	5435	310	30	1972
93992	4614	12778	680	149	43	479	39	1973
88651	7453	15917	1774	159	17	6	79	1974
132353	10598	6685	10432	837	80	12	3	1975
139225	10858	15482	3551	5483	413	13	5	1976
143574	18222	4277	5983	773	1127	75	2	1977
127387	9805	5888	1562	1815	128	244	4	1978
99803	1846	9530	2447	368	291	32	57	1979
121211	1857	4385	4359	1053	171	172	11	1980
165002	983	13544	4618	1331	505	153	63	1981
135280	8249	2593	10935	1900	317	75	62	1982
112332	4809	4323	2549	8292	1696	254	54	1983
132217	29865	4084	2582	1150	5207	593	221	1984
142815	9244	11578	2515	664	361	918	83	1985
126533	3187	6006	2694	622	98	51	94	1986
131720	12328	6005	2767	1229	148	43	32	1987
158191	5359	15325	2988	1334	317	47	3	1988
217443	3161	1641	5226	1473	435	130	14	1989
169667	4110	4152	972	1381	387	51	6	1990
209901	7019	2968	3982	337	423	73	6	1991
189288	9762	6549	1727	2100	114	102	11	1992
189925	2624	10106	4393	1170	1702	52	47	1993
174879	3251	6504	5364	1740	334	292	14	1994
175631	1776	5662	5311	1995	569	114	108	1995
214159	2738	8044	4648	2543	833	213	24	1996
179605	3107	3974	5099	1859	533	95	39	1997
142457	3998	3171	2548	2328	655	150	80	1998
98993	560	3274	1709	815	793	122	35	1999
76157	4363	2325	2203	627	170	202	9	2000
35698	575	2604	1359	783	118	38	5	2001
15174.000	390	848	1566	375	166	17	5	2002
9357.000	565	207	273	578	100	42	0.2	2003

Table 5.1.2.1. contd. Whiting in VIa. Available catch-effort and survey tuning series.

ScoSEI : Scottish seine - Effort in hours - numbers at age (thousands) - Year

1965	2003						
1	1	0	1				
1	6						
153103	8571	4535	19454	1413	62	15	1965
156511	2872	12671	1491	13028	736	68	1966
158208	7059	23605	5805	363	5529	305	1967
150094	11818	14129	4897	1410	135	1651	1968
140718	1314	19167	4024	1039	421	45	1969
95629	979	2065	9178	816	177	51	1970
98748	3281	6459	2467	14808	484	73	1971
70741	20564	7287	1144	589	3139	113	1972
59596	16428	16410	1995	373	97	886	1973
56448	8764	28089	3578	289	22	9	1974
56420	15931	9162	13094	585	38	9	1975
57090	7559	30719	6226	4888	284	18	1976
41920	14523	4874	6784	584	1036	43	1977
33599	9881	4708	812	1086	66	152	1978
38465	3779	13497	3740	473	392	16	1979
38700	2223	3686	4278	1081	273	119	1980
37208	790	9230	3128	1025	427	90	1981
36689	1146	1977	9664	1184	230	68	1982
38080	3804	3110	1943	5805	1182	138	1983
29561	3966	2170	1220	382	2025	219	1984
26365	18814	6473	1249	328	171	557	1985
19960	1424	4902	1816	359	54	25	1986
26332	8665	3706	2069	917	142	19	1987
21383	7392	8211	1658	1079	218	22	1988
39350	2182	1845	4489	1283	272	187	1989
27664	2699	2964	688	941	280	35	1990
25787	4160	2319	3286	306	291	53	1991
20273	7514	5371	1342	1623	102	101	1992
24315	1510	6046	2292	675	789	23	1993
21305	1725	3311	2499	701	108	140	1994
21950	722	2616	2261	970	299	83	1995
15205	1270	2354	1372	820	297	68	1996
11449	1096	1273	1933	696	187	34	1997
11166	4251	1659	1010	614	266	62	1998
8638	823	2152	707	295	179	43	1999
6431	2601	888	756	153	67	20	2000
5893	729	1007	454	241	40	22	2001
3817	319	554	457	126	39	3	2002
2370.000	3130	261	133	290	35	9	2003

Table 5.1.2.1. contd. Whiting in VIa. Available catch-effort and survey tuning series.

ScoNTR : Scottish nephrops trawl - Effort in hours - numbers at age (thousands) - Year

1965	2003						
1	1	0	1				
1	6						
101975	1660	454	1101	102	5	1	1965
116972	614	952	155	786	45	4	1966
135811	1789	2003	444	16	323	18	1967
166713	1761	1850	637	159	13	191	1968
155131	737	2707	437	155	44	4	1969
144704	439	645	1379	128	32	13	1970
127638	1072	444	236	1406	60	11	1971
185397	3745	1909	232	71	730	46	1972
186342	3463	5445	487	168	25	351	1973
186342	1934	5428	650	87	12	4	1974
203053	5917	2730	2847	319	35	9	1975
224347	4061	4343	894	1143	125	4	1976
196403	3574	1394	1431	168	290	17	1977
219562	6053	2596	418	571	110	109	1978
273713	660	3413	935	207	217	39	1979
254147	1439	1529	1378	282	45	46	1980
286461	1091	5251	1199	431	105	21	1981
288902	2882	422	2553	440	96	55	1982
293396	2703	1290	465	1258	206	48	1983
312947	15763	731	415	133	871	85	1984
384215	14885	3109	505	226	91	275	1985
368971	2231	1259	708	246	9	23	1986
395355	12049	1562	799	376	44	3	1987
397682	19927	12752	540	138	32	1	1988
379169	9855	485	444	152	72	13	1989
390391	7435	1408	59	64	9	1	1990
414817	13746	1280	295	27	44	5	1991
391325	15245	3122	453	212	20	30	1992
406753	6064	2833	611	159	113	2	1993
380688	22785	4821	2175	613	18	26	1994
333756	14759	5645	494	363	33	45	1995
345007	14700	1317	634	193	44	25	1996
354884	7854	1894	387	177	17	1	1997
350882	13269	1926	620	117	63	3	1998
337585	7208	1906	476	93	81	24	1999
332659	31208	935	360	101	29	11	2000
305743	1743	1272	189	80	15	15	2001
258169	7246	1285	481	30	8	1	2002
255729	4468	586	192	198	42	3	2003

Table 5.1.2.1. contd. Whiting in VIa. Available catch-effort and survey tuning series.

ScoGFS : Sottish groundfish survey - Effort in hours - numbers at age - Year

1985	2004						
1	1	0	0.25				
1	7						
10	3140	1792	380	85	23	156	18
10	1456	1526	403	68	10	9	10
10	6938	1054	584	143	36	2	1
10	567	3469	653	189	42	5	1
10	910	505	586	237	48	3	0
10	1818	572	122	216	61	4	1
10	3203	277	298	22	39	9	1
10	4777	1597	410	517	56	18	0
10	5532	6829	644	91	30	11	2
10	6614	2443	1487	174	56	15	6
10	5598	2831	1160	370	70	17	32
10	9384	2238	635	341	135	30	5
10	5663	2444	1531	355	102	17	4
10	9851	1352	294	195	50	14	1
10	6264	5065	500	105	16	1	0.5
10	13148	481	155	35	10	12	0
10	4653	1954	242	41	8	1	1
10	5542	1028	964	86	15	1	1
10	6934	746	436	300	32	2	4
10	5888	1566	189	131	44	9	1

IreGFS : Irish groundfish survey - Effort in hours - numbers at age - Year

1993	2002					
1	1	0.75	0.79			
0	5					
1849	14403	32643	11419	1464	231	13
1610	264	11969	4817	2812	78	57
1826	34584	5609	6406	734	186	80
1765	376	7457	3551	374	232	5
1581	1550	13865	8207	1022	524	50
1639	1829	4077	3361	663	121	5
1564	3337	3059	1965	322	11	12
1556	682	10102	2126	109	109	4
755	1118	5201	2903	149	70	3
798	594	8247	9348	820	280	0

Irish Groundfish survey 2003

AGE										
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1101	**12886**	**2894**	**512**	**290**	**102**	**1**	0	0	0	0

Table 5.1.2.1.cont. Whiting in VIa. Irish Otter Trawl Survey. Available catch-effort and survey tuning series.

Effort	0	1	2	3	4	5	6	7	8
42899	0	90.67	308.86	612.95	504.33	149.30	56.32	0.00	0

Table 5.1.3.1. Whiting in Division VIa. Landings at age (thousands)

	1965	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**
1	6938	1685	5169	7265	873	730	2387	16777	14078	9083
2	6085	10544	26023	16484	25174	6423	8617	12028	36142	51036
3	43530	2229	10619	9239	8644	28065	4122	4013	5592	10049
4	4803	28185	697	3656	2566	3241	34784	1363	1461	1166
5	388	1861	14574	324	1206	670	1338	14796	357	180
6	103	186	789	5036	118	214	240	793	4292	52
7+	22	52	143	369	2333	550	223	148	310	849

	1975	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
1	14917	8500	16120	17670	6334	11650	3593	2991	3418	7209
2	16778	46421	13376	18175	34221	11378	24395	5783	7094	12765
3	36318	15757	25144	6682	13282	14860	11297	29094	8040	8221
4	2819	17423	3127	9400	3407	4155	4611	6821	22757	4387
5	281	1508	4719	941	3488	1244	1518	2043	6070	14825
6	57	66	292	1433	276	1085	452	803	1439	1953
7+	245	57	24	68	384	190	201	348	540	858

	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
1	4139	2674	6430	1842	2529	3203	3294	2695	1051	909
2	19520	14824	13935	20587	5887	8028	8826	9440	10179	4889
3	8574	9770	13988	9638	11889	2393	10046	4473	6293	9158
4	3351	2653	5442	6168	4767	4009	1208	4782	2673	3607
5	1997	532	837	1949	1266	1326	1391	396	2738	712
6	4764	291	330	290	468	204	286	373	163	715
7+	822	529	259	207	71	37	51	106	147	69

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1	215	990	877	840	1013	484	461	62	170
2	4322	5410	3658	3504	6131	2952	3271	1624	710
3	6516	7675	8514	4277	4546	4211	2630	3018	1111
4	5654	5052	4316	3698	2040	1570	1567	779	1673
5	1397	2461	1441	1442	1774	485	401	227	347
6	376	583	338	338	355	328	131	23	111
7+	282	157	106	288	112	89	16	13	2

Table 5.1.3.2. Whiting in Division VIa. Discards at age (thousands).

	1965	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**
1	17205	4322	12237	16394	1983	1776	5505	39192	30521	23101
2	4968	8946	20791	12612	20494	6704	6719	8930	26995	40590
3	11437	515	2674	2137	2093	7494	969	850	1225	2362
4	531	3317	84	377	292	382	3906	152	147	123
5	14	79	629	13	51	33	57	610	14	7
6	2	3	12	82	2	4	4	14	77	1
7+	0	0	1	3	26	0	1	1	2	7

	1975	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
1	37295	24891	48148	27942	3450	2376	1017	17837	15069	68241
2	13541	35812	8675	10505	10722	6172	22014	4577	8173	3951
3	8485	3360	5432	889	1619	3206	2763	15938	1964	1085
4	310	1940	301	206	533	651	148	1189	4271	572
5	12	63	212	1	76	156	101	55	176	1577
6	1	1	5	20	0	9	4	1	102	59
7+	0	0	0	0	0	0	0	0	0	4

	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
1	59783	10459	46876	46421	17778	16406	30355	46463	14618	39697
2	17426	20085	13689	51395	3660	5791	2874	15041	22281	18403
3	3134	2491	1518	2472	5796	860	4432	2224	5966	7775
4	663	117	180	292	401	571	173	908	921	1634
5	61	6	1	54	111	95	140	0	1317	183
6	446	2	0	0	11	3	36	0	0	125
7+	3	61	0	0	0	0	0	0	2	4

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1	28557	28620	18182	31183	13623	63789	5514	14166	9331
2	20921	14617	9037	7304	7256	3556	5861	3236	1107
3	8483	4398	3431	2418	933	1206	738	1749	427
4	961	1395	466	991	369	117	208	130	371
5	246	18	93	184	79	15	4	124	34
6	0	1	0	51	29	14	0	8	7
7+	0	18	0	64	0	0	0	1	2

Table 5.1.3.3. Whiting in Division VIa. Total catch at age (thousands).

	1965	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**
1	24143	6007	17406	23659	2856	2506	7891	55969	44599	32185
2	11054	19490	46815	29096	45668	13128	15336	20958	63137	91625
3	54967	2744	13293	11376	10737	35559	5090	4863	6817	12412
4	5334	31502	781	4034	2858	3623	38690	1514	1608	1289
5	402	1940	15204	337	1257	703	1395	15406	371	188
6	105	189	801	5118	120	218	245	807	4369	53
7+	22	53	144	372	2358	550	224	149	313	856

	1975	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
1	52213	33392	64268	45612	9784	14026	4610	20829	18487	75450
2	30319	82233	22051	28680	44943	17551	46409	10360	15266	16716
3	44804	19117	30576	7571	14901	18065	14060	45032	10004	9306
4	3129	19363	3428	9606	3940	4806	4758	8010	27029	4959
5	293	1571	4931	942	3565	1400	1618	2098	6246	16403
6	58	67	297	1452	276	1093	456	804	1541	2011
7+	245	57	24	68	384	190	201	348	540	863

	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
1	63922	13133	53305	48263	20307	19609	33648	49158	15669	40606
2	36946	34909	27624	71982	9547	13819	11700	24481	32460	23292
3	11708	12260	15506	12110	17685	3252	14478	6697	12259	16933
4	4014	2770	5621	6460	5168	4580	1381	5691	3594	5241
5	2058	539	839	2002	1377	1421	1531	396	4055	896
6	5210	293	330	290	479	208	322	373	163	840
7+	825	591	259	207	71	37	51	106	149	73

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1	28772	29611	19059	32023	14636	64273	5975	14228	9501
2	25243	20027	12695	10808	13387	6508	9132	4859	1817
3	14999	12073	11946	6695	5479	5417	3368	4767	1538
4	6615	6447	4782	4689	2408	1687	1775	929	2044
5	1643	2479	1534	1626	1853	500	405	351	381
6	377	584	338	389	384	343	131	31	119
7+	283	175	106	352	112	89	17	13	4

Table 5.1.3.4. Whiting in Division VIa. Landings weights-at-age (kg).

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.218	0.238	0.204	0.206	0.178	0.205	0.209	0.211	0.196	0.193
2	0.249	0.243	0.24	0.263	0.223	0.203	0.247	0.258	0.235	0.215
3	0.308	0.325	0.319	0.366	0.335	0.274	0.276	0.345	0.362	0.317
4	0.452	0.374	0.424	0.444	0.5	0.382	0.316	0.368	0.479	0.444
5	1.208	0.61	0.412	0.554	0.57	0.519	0.426	0.426	0.485	0.591
6	0.72	0.72	0.639	0.538	0.649	0.619	0.551	0.494	0.532	0.641
7+	0.778	0.828	0.821	0.735	0.63	0.683	0.712	0.638	0.666	0.584

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	0.209	0.201	0.2	0.199	0.218	0.172	0.192	0.184	0.216	0.216
2	0.245	0.242	0.244	0.235	0.232	0.242	0.228	0.22	0.249	0.259
3	0.305	0.309	0.296	0.286	0.306	0.33	0.289	0.276	0.28	0.313
4	0.471	0.361	0.392	0.389	0.404	0.42	0.382	0.352	0.34	0.371
5	0.651	0.497	0.431	0.516	0.536	0.492	0.409	0.505	0.409	0.412
6	0.615	0.687	0.629	0.549	0.678	0.595	0.409	0.513	0.494	0.458
7+	0.717	0.856	0.819	0.612	0.693	0.817	0.547	0.526	0.51	0.458

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.185	0.174	0.188	0.176	0.171	0.225	0.199	0.193	0.186	0.161
2	0.238	0.236	0.237	0.215	0.22	0.251	0.22	0.23	0.242	0.217
3	0.306	0.294	0.304	0.301	0.279	0.324	0.291	0.288	0.314	0.29
4	0.402	0.365	0.373	0.4	0.348	0.359	0.354	0.349	0.361	0.371
5	0.43	0.468	0.511	0.483	0.459	0.417	0.391	0.388	0.412	0.451
6	0.461	0.482	0.52	0.567	0.425	0.582	0.442	0.397	0.452	0.482
7+	0.538	0.499	0.576	0.6	0.555	0.543	0.761	0.51	0.474	0.483

	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.19	0.195	0.198	0.215	0.181	0.205	0.173	0.213	0.228
2	0.225	0.245	0.245	0.236	0.225	0.241	0.234	0.258	0.264
3	0.296	0.288	0.297	0.301	0.28	0.298	0.303	0.303	0.309
4	0.381	0.365	0.384	0.364	0.365	0.336	0.37	0.364	0.362
5	0.469	0.483	0.522	0.438	0.44	0.419	0.395	0.462	0.374
6	0.473	0.526	0.629	0.5	0.524	0.488	0.376	0.648	0.436
7+	0.528	0.569	0.661	0.646	0.594	0.617	0.595	0.709	0.717

Table 5.1.3.5. Whiting in Division VIa. Discard weights-at-age (kg).

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.122	0.122	0.122	0.128	0.121	0.121	0.12	0.121	0.123	0.119
2	0.177	0.178	0.178	0.179	0.178	0.175	0.177	0.177	0.176	0.177
3	0.213	0.212	0.213	0.213	0.214	0.213	0.211	0.213	0.215	0.214
4	0.249	0.248	0.248	0.249	0.249	0.249	0.248	0.248	0.252	0.25
5	0.287	0.29	0.29	0.291	0.29	0.29	0.29	0.289	0.288	0.285
6	0.303	0.297	0.295	0.298	0.295	0.299	0.299	0.301	0.301	0.299
7+	0.287	0.286	0.289	0.287	0.285	0.284	0.284	0.281	0.285	0.288

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	0.119	0.116	0.118	0.135	0.173	0.14	0.108	0.096	0.141	0.087
2	0.176	0.177	0.177	0.167	0.188	0.179	0.16	0.18	0.186	0.199
3	0.213	0.213	0.214	0.199	0.208	0.208	0.195	0.209	0.228	0.246
4	0.25	0.249	0.249	0.288	0.215	0.22	0.298	0.243	0.237	0.26
5	0.286	0.288	0.289	0.32	0.281	0.271	0.286	0.283	0.267	0.259
6	0.301	0.3	0.299	0.238	0	0.386	0.295	0.44	0.267	0.303
7+	0.278	0.28	0.282	0	0	0	0	0	0	0.227

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.102	0.092	0.085	0.076	0.099	0.124	0.085	0.109	0.118	0.087
2	0.191	0.17	0.182	0.143	0.177	0.171	0.169	0.173	0.197	0.157
3	0.237	0.196	0.233	0.203	0.205	0.214	0.205	0.219	0.225	0.22
4	0.286	0.245	0.249	0.227	0.209	0.219	0.223	0.227	0.242	0.283
5	0.326	0.258	0.225	0.262	0.294	0.237	0.226	0	0.256	0.297
6	0.312	0.33	0	0	0.305	0.264	0.281	0	0	0.253
7+	0.316	0.263	0	0	0	0	0	0	0.436	0.299

	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.075	0.095	0.112	0.098	0.077	0.075	0.094	0.073	0.077
2	0.154	0.18	0.182	0.179	0.168	0.164	0.154	0.162	0.177
3	0.189	0.203	0.221	0.225	0.217	0.203	0.196	0.212	0.231
4	0.246	0.229	0.235	0.254	0.205	0.233	0.203	0.245	0.242
5	0.278	0.302	0.243	0.282	0.266	0.282	0.381	0.24	0.213
6	0.597	0.421	0.422	0.264	0.268	0.25	0	0.298	0.300
7+	0.493	0.26	0.819	0.245	0	0	0	0.276	0.78

Table 5.1.3.6. Whiting in Division VIa. Total catch weights-at-age (kg).

	1965	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**
1	0.15	0.155	0.146	0.152	0.138	0.146	0.147	0.148	0.146	0.14
2	0.217	0.213	0.212	0.226	0.203	0.189	0.216	0.223	0.21	0.198
3	0.288	0.304	0.297	0.337	0.311	0.261	0.264	0.322	0.335	0.297
4	0.432	0.361	0.405	0.425	0.474	0.368	0.309	0.356	0.459	0.425
5	1.177	0.596	0.407	0.544	0.559	0.508	0.421	0.42	0.477	0.579
6	0.713	0.713	0.633	0.534	0.643	0.613	0.547	0.491	0.528	0.636
7+	0.777	0.824	0.817	0.731	0.626	0.683	0.71	0.635	0.663	0.581

	1975	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
1	0.145	0.138	0.139	0.16	0.202	0.166	0.174	0.108	0.155	0.099
2	0.214	0.214	0.218	0.21	0.221	0.22	0.196	0.202	0.215	0.245
3	0.288	0.292	0.282	0.276	0.296	0.308	0.271	0.252	0.27	0.306
4	0.449	0.35	0.38	0.386	0.379	0.393	0.38	0.336	0.324	0.358
5	0.635	0.489	0.425	0.515	0.531	0.467	0.401	0.5	0.405	0.397
6	0.609	0.68	0.624	0.545	0.678	0.594	0.409	0.512	0.479	0.454
7+	0.717	0.855	0.816	0.612	0.693	0.817	0.547	0.526	0.51	0.457

	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
1	0.107	0.109	0.098	0.08	0.108	0.14	0.097	0.113	0.122	0.089
2	0.216	0.198	0.21	0.164	0.204	0.217	0.207	0.195	0.211	0.17
3	0.288	0.274	0.297	0.281	0.255	0.295	0.265	0.265	0.271	0.258
4	0.383	0.36	0.369	0.392	0.337	0.341	0.337	0.329	0.331	0.344
5	0.427	0.466	0.51	0.477	0.446	0.405	0.376	0.388	0.361	0.419
6	0.449	0.481	0.52	0.567	0.422	0.577	0.424	0.397	0.452	0.448
7+	0.537	0.475	0.576	0.6	0.555	0.543	0.761	0.51	0.474	0.474

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1	0.076	0.098	0.116	0.101	0.085	0.076	0.1	0.073	0.080
2	0.167	0.197	0.2	0.197	0.194	0.199	0.182	0.193	0.211
3	0.235	0.257	0.275	0.274	0.27	0.277	0.28	0.269	0.288
4	0.362	0.335	0.369	0.341	0.34	0.329	0.35	0.347	0.341
5	0.44	0.482	0.505	0.42	0.433	0.415	0.395	0.383	0.360
6	0.473	0.526	0.629	0.469	0.504	0.478	0.376	0.553	0.428
7+	0.528	0.537	0.662	0.572	0.593	0.617	0.589	0.686	0.526

Table 5.1.5.2.1. Whiting in VIa. TSA parameters settings for the three TSA models.

Parameter	*Setting*	*Justification*
Age of full selection.	$a_m = 4$	Based on inspection of previous XSA runs.
Multipliers on variance matrices of measurements.	**age** / **1** / **2** / **3** / **4** / **5** / **6** / **7+** Landings 1.0 1.0 1.0 1.0 1.0 2.0 2.0 Discards 2.0 1.0 1.0 1.0 2.0 - - ScoGFS 1.0 1.0 1.0 1.0 1.0 2.0 -	Allows extra measurement variability for noisy ages.
Multipliers on variances for fishing mortality estimates.	$H(1) = 4$	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points (implemented by multiplying the relevant *q* by 3)	Ages / **Years** Landings 5 83, 93 Discards 5 93, 02 ScoGFS 4, 5 92	Large values indicated by exploratory prediction error plots.
	Permanent / **Transitory**	
Survey trends TSA A	**Yes** / **Yes**	Trends in catchability not constrained
Survey trends TSA B	**No** / **Yes**	Trends in catchability constrained
Survey trend TSA C	**No** / **Yes**	No catch data from 1995
Discards	Discards are allowed to evolve over time constrained by a trend.	
Recruitment	Modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean $\eta_1 S \exp(-\eta_2 S)$, where S is the spawning stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	
Large year classes	The 1979 year class is large, and recruitment at age 1 in 1980 is not well modelled by the Ricker recruitment model. Instead, $N(1, 1980)$ is taken to be normally distributed with mean $5\eta_1 S \exp(-\eta_2 S)$. The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966-1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The coefficient of variation is again assumed to be constant.	

Table 5.1.5.2.2a Whiting in Division VIa. TSA parameter estimates for analysis with survey and trend in catchability with estimation bounds for 2004.

Parameter	Notation	Description	2003 Estimate	2004 Estimate
Initial fishing mortality	*F* (1, 1978)	Fishing mortality at age *a* in year *y*	0.31	0.29
	F (2, 1978)		0.56	0.53
	F (4, 1978)		0.87	0.84
Survey selectivities	$\Phi(1)$	Survey selectivity at age *a*	3.04	3.05
	$\Phi(2)$		2.53	2.46
	$\Phi(4)$		1.37	1.31
Fishing mortality standard deviations	σ_F	*Transitory changes in overall fishing mortality*	0.09	0.09
	σ_U	Persistent changes in selection (age effect in fishing mortality)	0.00	0.00
	σ_V	Transitory changes in the year effect in fishing mortality	0.22	0.21
	σ_Y	Persistent changes in the year effect in fishing mortality	0.03	0.025
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.00	0.00
	σ_β	Persistent changes in survey catchability	0.34	0.35
Measurement standard deviations	$\sigma_{landings}$	Standard error of landings-at-age data	0.10	0.10
	$\sigma_{discards}$	Standard error of discards-at-age data	0.36	0.36
	σ_{survey}	Standard error of survey data	0.47	0.47
Discard curve parameters	σ_P	Transitory changes in overall discard proportion	0.09	0.06
	$\sigma_{\alpha 1}$	Transitory changes in discard-ogive intercept	0.26	0.25
	σ_{v1}	Persistent changes in discard-ogive intercept	0.00	0.00
	$\sigma_{\alpha 2}$	Transitory changes in discard-ogive slope	0.00	0.00
	σ_{v2}	Persistent changes in discard-ogive slope	0.24	0.22
Trend parameters	θ_{v1}	Trend parameter for discard-ogive intercept	0.09	0.09
	θ_{v2}	Trend parameter for discard-ogive slope	-0.09	-0.09
Recruitment	η_1	Ricker parameter (slope at the origin)	9.72	9.07
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.34	0.31
	cv_{rec}	Standard error of recruitment data	0.30	0.31

Table 5.1.5.2.2b Whiting in Division VIa. TSA parameter estimates for analysis with survey and no trend in catchability with estimation bounds for 2004.

Parameter	Notation	Description	2003 Estimate	2004 Estimate
Initial fishing mortality	*F* (1, 1978)	Fishing mortality at age *a* in year *y*	0.31	0.28
	F (2, 1978)		0.56	0.49
	F (4, 1978)		0.87	0.81
Survey selectivities	Φ(1)	Survey selectivity at age *a*	3.04	3.43
	Φ(2)		2.53	2.59
	Φ(4)		1.37	1.82
Fishing mortality standard deviations	σ_F	*Transitory changes in overall fishing mortality*	0.09	0.09
	σ_U	Persistent changes in selection (age effect in fishing mortality)	0.00	0.00
	σ_V	Transitory changes in the year effect in fishing mortality	0.22	0.19
	σ_Y	Persistent changes in the year effect in fishing mortality	0.03	0.03
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.00	0.01
	σ_β	Persistent changes in survey catchability	0.34	*0.00*
Measurement standard deviations	$\sigma_{landings}$	Standard error of landings-at-age data	0.10	0.10
	$\sigma_{discards}$	Standard error of discards-at-age data	0.36	0.34
	σ_{survey}	Standard error of survey data	0.47	0.5
Discard curve parameters	σ_P	Transitory changes in overall discard proportion	0.09	0.00
	$\sigma_{\alpha 1}$	Transitory changes in discard-ogive intercept	0.26	0.27
	$\sigma_{\nu 1}$	Persistent changes in discard-ogive intercept	0.00	0.00
	$\sigma_{\alpha 2}$	Transitory changes in discard-ogive slope	0.00	0.00
	$\sigma_{\nu 2}$	Persistent changes in discard-ogive slope	0.24	0.22
Trend parameters	$\theta_{\nu 1}$	Trend parameter for discard-ogive intercept	0.09	0.08
	$\theta_{\nu 2}$	Trend parameter for discard-ogive slope	-0.09	-0.08
Recruitment	η_1	Ricker parameter (slope at the origin)	9.72	8.54
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.34	0.3
	cv_{rec}	Standard error of recruitment data	0.30	0.34

Table 5.1.5.2.2c Whiting in Division VIa. TSA parameter estimates for analysis with survey and no catch data betwem 1995 and 2003 with estimation bounds for 2004.

Parameter	Notation	Description	2003 Estimate	2004 Estimate
Initial fishing mortality	F (1, 1978)	Fishing mortality at age *a* in year *y*	0.31	0.45
	F (2, 1978)		0.56	0.81
	F (4, 1978)		0.87	1.01
Survey selectivities	$\Phi(1)$	Survey selectivity at age *a*	3.04	2.9
	$\Phi(2)$		2.53	2.64
	$\Phi(4)$		1.37	1.81
Fishing mortality standard deviations	σ_F	Transitory changes in overall fishing mortality	0.09	0.09
	σ_U	Persistent changes in selection (age effect in fishing mortality)	0.00	0.00
	σ_V	Transitory changes in the year effect in fishing mortality	0.22	0.28
	σ_Y	Persistent changes in the year effect in fishing mortality	0.03	0.07
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.00	0.00
	σ_β	Persistent changes in survey catchability	0.34	*0.00*
Measurement standard deviations	σ_{landings}	Standard error of landings-at-age data	0.10	0.11
	σ_{discards}	Standard error of discards-at-age data	0.36	0.36
	σ_{survey}	Standard error of survey data	0.47	0.42
Discard curve parameters	σ_P	Transitory changes in overall discard proportion	0.09	0.09
	$\sigma_{\alpha 1}$	Transitory changes in discard-ogive intercept	0.26	0.25
	$\sigma_{\nu 1}$	Persistent changes in discard-ogive intercept	0.00	0.00
	$\sigma_{\alpha 2}$	Transitory changes in discard-ogive slope	0.00	0.00
	$\sigma_{\nu 2}$	Persistent changes in discard-ogive slope	0.24	0.23
Trend parameters	$\theta_{\nu 1}$	Trend parameter for discard-ogive intercept	0.09	0.09
	$\theta_{\nu 2}$	Trend parameter for discard-ogive slope	-0.09	-0.1
Recruitment	η_1	Ricker parameter (slope at the origin)	9.72	16.84
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.34	0.49
	cv_{rec}	Standard error of recruitment data	0.30	0.27

Run title : WHITING 2003 IN AREA 6A

[d] XSA DIAGNOSTICS

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Lowestoft VPA Version 3.1

   11/05/2004  12:55

 Extended Survivors Analysis

 WHITING 2003 IN AREA 6A

 CPUE data from file Whi6aef.dat

 Catch data for  26 years. 1978 to 2003. Ages  1 to   7.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
  SCOGFS             ,   1985, 2003,   1,     6,   .000,   .250


 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years


 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    4


 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 =   2.000

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

      Prior weighting not applied


 Tuning converged after   20 iterations

1


 Regression weights
       ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000



 Fishing mortalities
    Age,  1994,  1995,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003

      1,  .502,  .414,  .664,  .558,  .745,  .609,  .965,  .233,  .606,  .197
      2,  .543,  .682,  .572,  .681,  .730,  .831,  .607,  .331,  .302,  .139
      3,  .830,  .838,  .847,  .826,  .990, 1.094, 1.024,  .751,  .288,  .147
      4,  .946,  .960, 1.166, 1.035,  .958, 1.357, 1.373, 1.253,  .474,  .192
      5,  .800,  .925, 1.339, 1.026, 1.404, 1.492, 1.312, 2.003,  .927,  .361
      6, 1.502,  .992, 1.082,  .632,  .809, 2.166, 1.503, 2.021,  .938,  .997



1
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XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
1994	1.14E+05	6.14E+04	3.32E+04	9.47E+03	1.80E+03	1.19E+03
1995	9.39E+04	5.64E+04	2.92E+04	1.18E+04	3.01E+03	6.61E+02
1996	6.74E+04	5.08E+04	2.34E+04	1.04E+04	3.71E+03	9.76E+02
1997	4.92E+04	2.84E+04	2.35E+04	8.19E+03	2.64E+03	7.97E+02
1998	6.74E+04	2.31E+04	1.18E+04	8.41E+03	2.38E+03	7.75E+02
1999	3.55E+04	2.62E+04	9.10E+03	3.58E+03	2.64E+03	4.79E+02
2000	1.15E+05	1.58E+04	9.34E+03	2.50E+03	7.56E+02	4.87E+02
2001	3.17E+04	3.58E+04	7.05E+03	2.75E+03	5.18E+02	1.67E+02
2002	3.46E+04	2.06E+04	2.10E+04	2.72E+03	6.43E+02	5.72E+01
2003	5.87E+04	1.55E+04	1.24E+04	1.29E+04	1.39E+03	2.08E+02

Estimated population abundance at 1st Jan 2004

0.00E+00	3.95E+04	1.10E+04	8.80E+03	8.72E+03	7.91E+02

Taper weighted geometric mean of the VPA populations:

6.65E+04	3.29E+04	1.62E+04	6.12E+03	1.71E+03	4.27E+02

Standard error of the weighted Log(VPA populations) :

.5042	.5594	.5468	.6524	.7291	.8628

1

Log catchability residuals.

Fleet : SCOGFS

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	-1.48	-1.68	-.93	-2.37	-2.17	-1.05	-1.08	-.99	-.40
2	-.62	-.81	-.97	-.39	-.54	-1.55	-1.68	-.53	.64
3	-.40	-.69	-.42	-.12	-.42	-.55	-1.24	-.14	-.20
4	-.44	-.50	-.47	-.10	.20	.12	-1.00	.45	-.45
5	-1.04	-1.09	.06	-.47	.14	.18	-.43	1.02	-1.48
6	-.10	-.40	-1.77	-.67	-1.56	-.63	-.37	.02	.34

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	-.40	-.38	.50	.29	.55	.73	.34	.50	.63	.27
2	-.18	.07	-.08	.61	.23	1.43	-.44	.11	.02	-.04
3	.36	.24	-.13	.74	-.20	.60	-.61	.09	.32	.03
4	-.24	.29	.37	.63	.00	.28	-.46	-.41	.25	-.09
5	.27	.00	.49	.51	-.05	-1.28	-.52	-.29	.00	-.08
6	-.55	.10	.29	-.13	-.27	-2.27	.12	-1.23	-.29	-.88

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	-4.6648	-5.2542	-5.6453	-5.9216	-5.9216	-5.9216
S.E(Log q)	.7692	.7125	.4784	.4165	.6576	.9147

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,	12.12,	-2.388,	-66.97,	.00,	19,	7.81,	-4.66,
2,	1.13,	-.295,	4.57,	.33,	19,	.84,	-5.25,
3,	.95,	.181,	5.84,	.59,	19,	.48,	-5.65,
4,	.77,	1.625,	6.55,	.84,	19,	.30,	-5.92,
5,	1.20,	-.620,	5.79,	.48,	19,	.79,	-6.07,
6,	.85,	.640,	6.36,	.65,	19,	.66,	-6.41,

1

Terminal year survivor and F summaries :

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

Year class = 2002

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOGFS ,	51984.,	.800,	.000,	.00,	1,	.837,	.153
F shrinkage mean ,	9646.,	2.00,,,,				.163,	.637

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
39489.,	.75,	.68,	2,	.913,	.197

1

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

Year class = 2001

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOGFS ,	13121.,	.566,	.311,	.55,	2,	.903,	.118
F shrinkage mean ,	2164.,	2.00,,,,				.097,	.565

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
11014.,	.55,	.45,	3,	.821,	.139

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

Year class = 2000

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOGFS ,	9700.,	.375,	.116,	.31,	3,	.956,	.134
F shrinkage mean ,	1061.,	2.00,,,,				.044,	.838

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
8800.,	.37,	.28,	4,	.768,	.147

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

Year class = 1999

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
SCOGFS ,	9358.,	.297,	.111,	.37,	4,	.970,	.180
F shrinkage mean ,	929.,	2.00,,,,				.030,	1.096

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
8722.,	.29,	.22,	5,	.758,	.192

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1998

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
SCOGFS ,	877.,	.304,	.099,	.33,	5,	.952,	.331
F shrinkage mean ,	106.,	2.00,,,,				.048,	1.446

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
791.,	.31,	.23,	6,	.738,	.361

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1997

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
SCOGFS ,	40.,	.446,	.191,	.43,	6,	.803,	1.311
F shrinkage mean ,	407.,	2.00,,,,				.197,	.235

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
63.,	.53,	.45,	7,	.844,	.997

Table 5.1.5.3.1 (a-d). Whiting in Division VIa. TSA population numbers-at-age (tens of millions) using model with survey data included [a]; with survey but with no trend in catchability and [c] without catch data between 1995 and 2003; [d] XSA population numbers-at-age (tens of thousands).

[a]

year	**Age1**	**Age2**	**Age3**	**Age4**	**Age5**	**Age6**	**Age7**
1978	17.7726	6.7987	1.7885	1.8347	0.1629	0.272	0.012
1979	10.9284	9.7057	3.0468	0.7492	0.6179	0.0513	0.0896
1980	33.2236	6.7269	3.8641	1.1201	0.2542	0.1894	0.0444
1981	6.7782	20.6809	3.652	1.5284	0.4182	0.0942	0.0844
1982	6.307	4.0912	11.7107	1.8251	0.6552	0.1819	0.0779
1983	7.7151	3.6278	2.2233	5.858	0.796	0.288	0.1106
1984	14.6839	4.3768	1.7372	0.927	2.3451	0.2844	0.1433
1985	12.8107	7.4118	1.7763	0.5842	0.2772	0.5992	0.1115
1986	9.9596	6.5042	2.4748	0.4548	0.1204	0.0484	0.1136
1987	18.3701	5.6925	2.8019	0.9627	0.1371	0.0419	0.048
1988	5.2672	8.8173	2.4514	0.954	0.2824	0.0389	0.0253
1989	10.6931	1.9634	2.7695	0.8051	0.1779	0.0517	0.011
1990	7.9624	5.641	0.6586	0.7975	0.2035	0.0303	0.01
1991	10.3742	3.4739	2.7364	0.2532	0.239	0.0578	0.0111
1992	13.5471	5.2425	1.4572	1.0451	0.0783	0.0687	0.0204
1993	9.65	7.7517	2.3499	0.59	0.3673	0.0265	0.0292
1994	9.8128	5.3382	3.3809	0.8814	0.1712	0.1135	0.0166
1995	9.1531	5.2399	2.4958	1.3098	0.2789	0.0576	0.0414
1996	6.6747	5.1177	2.3104	0.9404	0.4025	0.0827	0.0287
1997	5.7314	2.7227	2.2579	0.7907	0.2297	0.0993	0.0271
1998	7.4948	2.5278	1.1216	0.7895	0.2166	0.0571	0.0371
1999	6.3376	3.1468	0.9113	0.3311	0.2096	0.045	0.0184
2000	6.8286	2.0567	0.9504	0.2215	0.0636	0.0284	0.0088
2001	4.7045	2.7966	0.6684	0.2493	0.0412	0.0122	0.004
2002	2.4123	1.6842	1.0736	0.2023	0.0534	0.0053	0.0026
2003	5.2224	1.2366	0.713	0.4224	0.0682	0.0178	0.0022
2004	*5.1973*	*2.9051*	*0.592*	*0.3098*	*0.149*	*0.0235*	*0.0069*
2005	*6.2106*	*2.6329*	*1.2251*	*0.2116*	*0.0875*	*0.0419*	*0.0086*
GM (78-03)	8.7318	4.4760	1.9592	0.7520	0.2201	0.0649	0.0256

Forecasts are italicised

[b]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	17.9369	6.825	1.786	1.8412	0.1627	0.2775	0.012
1979	10.8724	9.76	3.0496	0.7502	0.6204	0.0511	0.0916
1980	32.5591	6.7458	3.8673	1.1183	0.2559	0.1908	0.0454
1981	6.7458	20.3776	3.6876	1.5179	0.4167	0.095	0.0854
1982	6.3751	4.073	11.5959	1.8425	0.6519	0.1814	0.0787
1983	7.6794	3.6492	2.2214	5.8064	0.8053	0.2866	0.1107
1984	14.6473	4.3388	1.7536	0.9211	2.3233	0.2863	0.1423
1985	12.6824	7.3889	1.7336	0.5862	0.273	0.5743	0.1098
1986	9.8979	6.4785	2.4676	0.4396	0.1258	0.0463	0.1066
1987	18.4844	5.6294	2.7923	0.9664	0.1344	0.045	0.0465
1988	5.661	8.8034	2.4329	0.9388	0.282	0.0378	0.0255
1989	11.2909	2.0183	2.7542	0.7878	0.1718	0.0512	0.0108
1990	8.7657	5.8818	0.6643	0.7948	0.1991	0.0298	0.0103
1991	10.7395	3.5754	2.8312	0.251	0.2376	0.0555	0.0111
1992	13.4596	5.3115	1.481	1.102	0.077	0.0669	0.0196
1993	9.5571	7.6586	2.383	0.5948	0.3901	0.0255	0.0281
1994	9.9378	5.2524	3.3335	0.893	0.1718	0.12	0.0158
1995	9.1345	5.2449	2.4756	1.299	0.2841	0.0579	0.0434
1996	6.373	5.0692	2.3489	0.9437	0.4097	0.0863	0.0301
1997	5.4854	2.6387	2.2529	0.8039	0.2312	0.103	0.029
1998	7.2348	2.5336	1.1625	0.802	0.2316	0.0618	0.0412
1999	5.9115	3.0603	0.9114	0.3379	0.2174	0.0485	0.0207
2000	5.7582	1.9892	0.9719	0.2232	0.0651	0.03	0.0099
2001	3.8429	2.4508	0.6457	0.2552	0.0386	0.0119	0.0037
2002	1.7787	1.3326	0.9387	0.1931	0.0548	0.0039	0.0021
2003	4.1134	0.9231	0.5294	0.3474	0.0611	0.0174	0.0015
2004	*3.645*	*2.1525*	*0.4101*	*0.205*	*0.104*	*0.018*	*0.0056*
2005	*4.6104*	*1.816*	*0.8968*	*0.1433*	*0.056*	*0.0284*	*0.0065*
GM (78-03)	8.43899	4.356	1.9309	0.7469	0.220	0.0645	0.0253

Forecasts are italicised

[c]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	16.5689	6.61	1.7783	1.754	0.1648	0.2462	0.0123
1979	11.3021	9.3269	2.939	0.724	0.6028	0.054	0.0844
1980	34.0786	6.7933	3.8449	1.1079	0.2473	0.1879	0.0441
1981	6.7182	21.0249	3.6	1.5653	0.4214	0.0924	0.0857
1982	6.0453	4.1157	11.8834	1.824	0.6816	0.1864	0.079
1983	7.8101	3.6043	2.226	5.9054	0.7943	0.3012	0.1141
1984	14.8934	4.5785	1.7568	0.9533	2.3811	0.2926	0.1543
1985	13.5141	7.7082	1.8787	0.6026	0.2899	0.6316	0.1231
1986	10.281	6.6172	2.4882	0.474	0.12	0.0505	0.1246
1987	18.9765	5.815	2.8735	0.9809	0.1489	0.0414	0.0563
1988	5.6369	9.323	2.4459	0.983	0.287	0.0426	0.0277
1989	11.0615	2.109	2.9106	0.7985	0.1924	0.0546	0.0134
1990	8.2249	5.6202	0.6824	0.8267	0.202	0.0359	0.0125
1991	11.0836	3.5655	2.6503	0.2539	0.2403	0.0564	0.0132
1992	15.5608	5.5789	1.4719	0.9906	0.0771	0.0694	0.0205
1993	11.3157	8.8738	2.4503	0.5836	0.3383	0.0259	0.0292
1994	11.6148	6.1928	3.8048	0.902	0.1673	0.1024	0.0162
1995	13.3265	6.429	2.811	1.4873	0.2847	0.0542	0.0368
1996	12.082	7.1333	2.6925	1.0392	0.4323	0.0832	0.0266
1997	9.6898	6.0194	2.9714	0.951	0.2925	0.119	0.0304
1998	14.0753	4.1444	1.7543	0.7796	0.1579	0.0475	0.0227
1999	11.4762	6.2049	1.2484	0.416	0.1439	0.025	0.0109
2000	16.8519	4.0515	1.1996	0.1841	0.0425	0.0215	0.0045
2001	8.9814	7.1489	1.189	0.2501	0.0283	0.0068	0.0043
2002	8.9342	4.1453	2.5292	0.3431	0.0565	0.0065	0.0024
2003	12.2387	4.4887	1.6737	0.8816	0.0934	0.0154	0.0024
2004	*12.5892*	*5.6022*	*1.5102*	*0.4857*	*0.1926*	*0.0208*	*0.0038*
2005	*12.4163*	*5.7482*	*1.8975*	*0.4233*	*0.1024*	*0.0405*	*0.0052*
GM (78-03)	11.5079	5.8333	2.2940	0.8055	0.2146	0.0620	0.0250

Forecasts are italicised

[d] (Tens of thousands)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1978	164268	68096	18354	18905	1707	2916	134
1979	98923	93219	29802	8176	6787	545	748
1980	268311	72139	35655	10917	3128	2331	400
1981	52164	206983	43182	12846	4589	1294	566
1982	69788	38537	127471	22632	6212	2293	985
1983	71132	38291	22177	63617	11282	3188	1101
1984	171511	41510	17536	9105	27629	3585	1511
1985	160627	72151	18860	5937	2968	7779	1203
1986	87196	73671	25642	4847	1229	568	1125
1987	200242	59507	28730	9900	1462	519	398
1988	76242	115711	23725	9491	3019	438	306
1989	89647	18751	29604	8467	1926	660	95
1990	59746	55022	6714	8236	2256	330	58
1991	107694	31173	32545	2554	2599	561	88
1992	147648	57726	14936	13545	842	742	208
1993	92350	76404	25111	6168	5940	330	297
1994	113788	61432	33183	9467	1798	1194	101
1995	93851	56420	29221	11846	3009	661	488
1996	67432	50805	23351	10353	3713	976	288
1997	49235	28416	23474	8194	2642	797	246
1998	67398	23065	11778	8410	2382	775	691
1999	35471	26205	9105	3585	2643	479	135
2000	114747	15798	9342	2497	756	487	123
2001	31733	35790	7045	2747	518	167	20
2002	34607	20574	21040	2721	643	57	24
2003	58732	15460	12448	12912	1387	208	6
2004	0	39489	11014	8800	8722	791	65
GM (78-03)	86101.28	45930.76	21258.63	8301.281	2541.795	761.1926	228.3985

Table 5.1.5.3.2 (a-c) Whiting in Division VIa. Standard error on TSA population numbers-at-age using model with survey data included [a]; with survey but with no trend in catchability[b] and [c] without catch data between 1995 and 2003.

[a]

year	**Age1**	**Age2**	**Age3**	**Age4**	**Age5**	**Age6**	**Age7**
1978	1.0493	0.3945	0.1011	0.0917	0.0172	0.0118	0.0028
1979	0.5427	0.5553	0.1869	0.0477	0.0456	0.0087	0.0088
1980	1.645	0.3369	0.268	0.0901	0.0234	0.0252	0.0065
1981	0.4288	1.0243	0.2055	0.1345	0.0448	0.014	0.0142
1982	0.454	0.2602	0.5694	0.1197	0.0634	0.0235	0.0105
1983	0.5314	0.247	0.1361	0.2941	0.0695	0.0322	0.0128
1984	0.892	0.2865	0.1241	0.0692	0.1536	0.0328	0.0184
1985	0.7948	0.4293	0.1239	0.0477	0.0285	0.0748	0.0184
1986	0.6422	0.3827	0.1747	0.0435	0.0166	0.0139	0.028
1987	1.1516	0.3327	0.1905	0.0736	0.0169	0.0074	0.012
1988	0.6265	0.5499	0.1353	0.0697	0.0244	0.0068	0.0046
1989	0.7214	0.1694	0.2055	0.054	0.0236	0.0113	0.0033
1990	0.7334	0.299	0.0542	0.0762	0.0219	0.0104	0.005
1991	0.805	0.2769	0.1365	0.0191	0.0256	0.0095	0.0041
1992	0.8734	0.3358	0.0974	0.0632	0.0059	0.0095	0.0033
1993	0.6764	0.4218	0.1429	0.0385	0.033	0.003	0.0039
1994	0.7394	0.3181	0.201	0.0599	0.0152	0.0117	0.0022
1995	0.6451	0.3443	0.1447	0.0865	0.0237	0.0073	0.0052
1996	0.6792	0.3117	0.1529	0.066	0.0358	0.0121	0.0044
1997	0.6395	0.2443	0.1341	0.06	0.0256	0.0164	0.0056
1998	0.763	0.243	0.0983	0.059	0.0239	0.0123	0.0073
1999	0.6934	0.2935	0.0853	0.0322	0.0206	0.0103	0.0056
2000	0.708	0.2089	0.0944	0.0246	0.009	0.0082	0.0041
2001	0.65	0.274	0.0638	0.0267	0.0063	0.0033	0.003
2002	0.631	0.2887	0.1128	0.0204	0.0076	0.0022	0.0013
2003	1.2228	0.3788	0.1575	0.0603	0.0091	0.0034	0.001
2004	*1.4592*	*0.8221*	*0.2228*	*0.0939*	*0.0397*	*0.0062*	*0.0021*
2005	*2.2067*	*0.8141*	*0.3924*	*0.0885*	*0.0339*	*0.0153*	*0.0031*
GM(78-03)	0.7331	0.3303	0.1400	0.0584	0.0227	0.0107	0.0056

Forecasts are italicised

[b]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	1.082	0.4074	0.106	0.0971	0.0181	0.0127	0.003
1979	0.5484	0.5798	0.1993	0.0513	0.0487	0.0094	0.0094
1980	1.6244	0.3468	0.2831	0.0959	0.0253	0.0272	0.0071
1981	0.433	1.0177	0.2142	0.1399	0.047	0.0151	0.0153
1982	0.4675	0.2627	0.568	0.1238	0.0644	0.0243	0.011
1983	0.5418	0.2507	0.1384	0.2939	0.0716	0.0323	0.0129
1984	0.9068	0.2911	0.1267	0.0716	0.1548	0.034	0.0187
1985	0.8202	0.4451	0.1289	0.0497	0.0308	0.0773	0.0194
1986	0.6822	0.4027	0.1843	0.045	0.0172	0.0155	0.0288
1987	1.2104	0.3473	0.1976	0.0757	0.0166	0.0074	0.0118
1988	0.7088	0.5592	0.1414	0.0723	0.0251	0.0066	0.0046
1989	0.8335	0.1922	0.2089	0.0544	0.0232	0.0114	0.0032
1990	0.8472	0.3369	0.0576	0.075	0.0209	0.0098	0.0048
1991	0.8668	0.3069	0.1495	0.0194	0.0241	0.0088	0.0037
1992	0.9387	0.3667	0.1099	0.0736	0.0064	0.0096	0.0033
1993	0.678	0.4278	0.1482	0.0393	0.035	0.0029	0.0036
1994	0.7872	0.3019	0.191	0.0598	0.0148	0.0119	0.002
1995	0.6755	0.3383	0.1337	0.0779	0.0218	0.0065	0.0048
1996	0.6898	0.3049	0.1465	0.0603	0.0314	0.011	0.0038
1997	0.6886	0.2314	0.1314	0.0585	0.0235	0.0146	0.0051
1998	0.7521	0.2407	0.089	0.0536	0.0211	0.0104	0.0058
1999	0.6654	0.2791	0.0865	0.0328	0.0209	0.0104	0.0052
2000	0.6423	0.2041	0.0936	0.026	0.01	0.009	0.0045
2001	0.6631	0.2574	0.0663	0.0285	0.007	0.004	0.0035
2002	0.665	0.3301	0.1143	0.0219	0.0082	0.0024	0.0016
2003	1.4396	0.3897	0.1812	0.0594	0.0089	0.0034	0.0009
2004	*1.5185*	*0.9163*	*0.2168*	*0.0997*	*0.0392*	*0.0065*	*0.0022*
2005	*2.1418*	*0.8209*	*0.423*	*0.0849*	*0.0329*	*0.0141*	*0.003*
GM(78-03)	0.7644	0.3381	0.1436	0.0595	0.0230	0.0108	0.006

Forecasts are italicised

[c]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	1.0995	0.4047	0.1019	0.0791	0.017	0.01	0.0028
1979	0.6708	0.5092	0.154	0.0389	0.0397	0.0074	0.0079
1980	1.9035	0.3773	0.2464	0.0814	0.0201	0.0218	0.0054
1981	0.4683	1.1492	0.2213	0.1342	0.0433	0.0126	0.0129
1982	0.4189	0.2916	0.6607	0.1379	0.0717	0.0251	0.0112
1983	0.5683	0.2466	0.1494	0.3315	0.0763	0.0366	0.0142
1984	0.9987	0.3057	0.1245	0.0709	0.1657	0.034	0.02
1985	0.9589	0.4489	0.12	0.043	0.0233	0.0705	0.0164
1986	0.7747	0.4069	0.1643	0.0379	0.0125	0.0098	0.0229
1987	1.4068	0.369	0.1898	0.0647	0.0135	0.0051	0.0089
1988	0.8022	0.624	0.1335	0.0648	0.02	0.0052	0.0034
1989	0.8531	0.2015	0.2298	0.0545	0.0232	0.0099	0.0028
1990	0.9029	0.3542	0.0634	0.086	0.0224	0.0105	0.0045
1991	1.1182	0.3549	0.1644	0.0225	0.0299	0.0099	0.0045
1992	1.3183	0.4738	0.1222	0.0696	0.0065	0.0103	0.0035
1993	1.3669	0.7662	0.2371	0.0565	0.0411	0.0037	0.0049
1994	1.7202	0.8652	0.4915	0.133	0.0289	0.0182	0.0034
1995	2.0366	1.2059	0.5802	0.3455	0.0839	0.0177	0.0116
1996	1.9862	1.2059	0.6004	0.256	0.1348	0.0308	0.01
1997	1.7033	1.1461	0.5604	0.2448	0.0909	0.0468	0.0132
1998	2.1614	0.9963	0.5223	0.243	0.0904	0.0337	0.0204
1999	2.0871	1.3002	0.3669	0.1493	0.0576	0.0231	0.0128
2000	2.6762	1.0644	0.5047	0.0991	0.0302	0.013	0.0075
2001	2.3942	1.507	0.333	0.1204	0.0166	0.0058	0.0037
2002	2.5464	1.101	0.5123	0.077	0.0185	0.0029	0.0014
2003	2.7609	1.3378	0.4088	0.1812	0.0199	0.0047	0.0009
2004	*2.998*	*1.5934*	*0.5677*	*0.1559*	*0.0667*	*0.0074*	*0.0017*
2005	*3.4356*	*1.8378*	*0.761*	*0.2147*	*0.0551*	*0.0225*	*0.0029*
GM(78-03)	1.2690	0.6158	0.2506	0.0976	0.0336	0.0133	0.0067

Forecasts are italicised

Table 5.1.5.3.3 (a-d) Whiting in Division VIa. TSA-estimated fishing mortality-at-age using model with survey data included [a]; with survey but with no trend in catchability[b] and [c] without catch data between 1995 and 2003; [d] XSA estimates of fishing mortality-at-age with F shrinkage.

[a]

year	**Age1**	**Age2**	**Age3**	**Age4**	**Age5**	**Age6**	**Age7**
1978	0.4071	0.5968	0.6703	0.8886	0.9441	0.9527	0.9243
1979	0.3103	0.6668	0.7584	0.8766	0.9613	0.9438	0.928
1980	0.2865	0.4136	0.6379	0.7425	0.7693	0.7745	0.7487
1981	0.2893	0.3656	0.4885	0.6376	0.632	0.6401	0.6184
1982	0.3292	0.4114	0.4785	0.6152	0.6151	0.65	0.649
1983	0.3619	0.5175	0.6646	0.7135	0.8289	0.8224	0.8097
1984	0.4995	0.685	0.858	0.9933	1.1444	1.114	1.084
1985	0.5026	0.8504	1.0471	1.2407	1.3467	1.3622	1.3084
1986	0.368	0.6266	0.723	0.9364	0.8478	0.9208	0.9155
1987	0.5414	0.642	0.8693	1.0249	1.0467	1.0874	1.0352
1988	0.632	0.8966	0.9124	1.3468	1.3714	1.3594	1.3706
1989	0.4452	0.7455	0.9228	1.1182	1.2012	1.2174	1.16
1990	0.5873	0.5096	0.7453	0.9664	1.0204	0.9794	0.953
1991	0.4824	0.6661	0.7466	0.966	1.0449	1.0196	1.0017
1992	0.3463	0.603	0.7044	0.831	0.8814	0.9207	0.9017
1993	0.3957	0.6296	0.779	1.0326	0.9726	1.0178	1.0013
1994	0.4316	0.5588	0.747	0.9489	0.8902	0.949	0.9109
1995	0.3878	0.6156	0.7728	0.9688	0.9973	1.0132	1.0166
1996	0.5946	0.6213	0.8587	1.1621	1.1437	1.1482	1.1193
1997	0.5188	0.6274	0.8348	1.0505	1.093	0.9888	1.0096
1998	0.5978	0.7416	0.945	1.1056	1.247	1.2315	1.2667
1999	0.7747	0.8554	1.0661	1.3169	1.531	1.414	1.3734
2000	0.6107	0.8017	1.0082	1.3056	1.3044	1.3872	1.3328
2001	0.7054	0.734	0.9471	1.2483	1.4196	1.3264	1.2609
2002	0.4103	0.6102	0.7248	0.8881	0.9011	0.965	0.9487
2003	0.3847	0.5323	0.6331	0.8404	0.8644	0.8748	0.8355
2004	*0.4801*	*0.6634*	*0.8288*	*1.0648*	*1.0681*	*1.0665*	*1.0667*
2005	*0.476*	*0.6548*	*0.8173*	*1.0542*	*1.0542*	*1.0542*	*1.0542*

Forecasts are italicised

[b]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	0.4073	0.591	0.6682	0.8866	0.9412	0.9493	0.9212
1979	0.3025	0.6527	0.7444	0.8668	0.9495	0.9296	0.9115
1980	0.2818	0.4073	0.6291	0.7361	0.763	0.7683	0.7406
1981	0.291	0.3595	0.4881	0.6369	0.6317	0.6397	0.6169
1982	0.3335	0.4078	0.4756	0.6102	0.6118	0.649	0.6469
1983	0.3656	0.5134	0.6693	0.7138	0.8338	0.8265	0.812
1984	0.5013	0.6894	0.8546	0.9936	1.1656	1.119	1.0893
1985	0.495	0.837	1.0287	1.1997	1.3252	1.3432	1.2839
1986	0.3678	0.6258	0.7203	0.9362	0.8331	0.9202	0.915
1987	0.55	0.6391	0.8796	1.0305	1.0603	1.0931	1.0461
1988	0.6381	0.9066	0.9278	1.3707	1.3897	1.3872	1.392
1989	0.448	0.7494	0.9412	1.141	1.2375	1.2494	1.1849
1990	0.6284	0.5174	0.765	0.9885	1.0572	1.0095	0.9786
1991	0.5015	0.6628	0.7354	0.9809	1.0612	1.024	1.006
1992	0.3494	0.6031	0.7113	0.7991	0.8944	0.9256	0.9069
1993	0.3941	0.6287	0.7816	1.0414	0.9702	1.0337	1.0103
1994	0.4415	0.538	0.739	0.9432	0.8785	0.9358	0.9033
1995	0.3878	0.603	0.7635	0.9538	0.9902	1.0139	1.0107
1996	0.615	0.6086	0.8684	1.1882	1.1613	1.1691	1.1308
1997	0.5093	0.6121	0.8327	1.0415	1.102	0.9598	0.9885
1998	0.6031	0.7456	0.9714	1.0943	1.2656	1.2533	1.2978
1999	0.7394	0.8345	1.0466	1.2939	1.5018	1.3871	1.3423
2000	0.592	0.7739	0.9875	1.2807	1.2719	1.3478	1.2953
2001	0.6886	0.7337	0.938	1.2254	1.3962	1.3079	1.2509
2002	0.4299	0.6608	0.7916	0.9499	0.9472	1.0411	1.0222
2003	0.4476	0.6114	0.7486	1.0062	1.0213	1.0194	0.9808
2004	*0.4967*	*0.6756*	*0.8517*	*1.0978*	*1.0978*	*1.0978*	*1.0978*
2005	*0.4967*	*0.6756*	*0.8517*	*1.0978*	*1.0978*	*1.0978*	*1.0978*

Forecasts are italicised

[c]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	0.363	0.588	0.6527	0.8586	0.914	0.9218	0.8866
1979	0.3207	0.682	0.7723	0.8726	0.9653	0.945	0.9405
1980	0.2893	0.4355	0.6591	0.7481	0.774	0.7781	0.7535
1981	0.2691	0.3711	0.4795	0.615	0.6107	0.6165	0.5969
1982	0.3119	0.4167	0.4854	0.6192	0.6127	0.6404	0.6392
1983	0.3361	0.5168	0.6472	0.7002	0.7981	0.7932	0.782
1984	0.4544	0.6881	0.871	0.9839	1.1259	1.1017	1.0687
1985	0.5267	0.9302	1.1651	1.3958	1.5121	1.5421	1.452
1986	0.3718	0.6342	0.7299	0.958	0.852	0.9347	0.9331
1987	0.5115	0.6471	0.8703	1.0089	1.0458	1.0868	1.0208
1988	0.6292	0.923	0.9209	1.378	1.4127	1.3886	1.3945
1989	0.4815	0.7803	0.9533	1.135	1.2377	1.2527	1.1891
1990	0.5555	0.5557	0.7648	0.9806	1.0292	0.9945	0.9688
1991	0.4812	0.6813	0.7691	0.98	1.0437	1.0273	1.007
1992	0.3607	0.6145	0.7191	0.8744	0.8893	0.9216	0.9091
1993	0.4026	0.6414	0.7872	1.0306	0.9956	1.0154	1.0042
1994	0.392	0.5899	0.7331	0.9431	0.9172	0.9682	0.9233
1995	0.4289	0.6652	0.7919	1.0261	1.0205	1.021	1.0213
1996	0.4835	0.6845	0.8399	1.0625	1.0771	1.0714	1.072
1997	0.6336	0.9398	1.1065	1.4283	1.4232	1.4278	1.426
1998	0.6274	0.9525	1.1546	1.442	1.4627	1.4569	1.4568
1999	0.8582	1.2989	1.5463	1.9612	1.9333	1.9533	1.9513
2000	0.6633	1.0283	1.279	1.6037	1.5981	1.5874	1.5925
2001	0.5872	0.8179	0.9936	1.3042	1.2979	1.289	1.2878
2002	0.5126	0.7121	0.8348	1.0469	1.0992	1.0905	1.0882
2003	0.5804	0.879	1.0412	1.3216	1.3044	1.3317	1.3284
2004	*0.5839*	*0.8826*	*1.072*	*1.3563*	*1.3592*	*1.3549*	*1.3584*
2005	*0.5654*	*0.8522*	*1.032*	*1.3143*	*1.3143*	*1.3143*	*1.3143*

Forecasts are italicised

[d]

	Age 1	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**
1978	0.3665	0.6263	0.6086	0.8244	0.9412	0.7995	0.7995
1979	0.1158	0.7611	0.8043	0.7607	0.8687	0.8195	0.8195
1980	0.0595	0.3132	0.8209	0.6666	0.6826	0.7304	0.7304
1981	0.1028	0.2848	0.446	0.5265	0.4938	0.4926	0.4926
1982	0.4002	0.3525	0.495	0.4962	0.4671	0.4899	0.4899
1983	0.3386	0.5809	0.6902	0.634	0.9465	0.7644	0.7644
1984	0.6659	0.5889	0.883	0.9211	1.0675	0.9679	0.9679
1985	0.5795	0.8345	1.1587	1.3749	1.4541	1.3479	1.3479
1986	0.1821	0.7417	0.7517	0.9987	0.6623	0.8468	0.8468
1987	0.3484	0.7196	0.9076	0.9875	1.0053	1.2154	1.2154
1988	1.2026	1.1632	0.8303	1.3951	1.32	1.3182	1.3182
1989	0.2881	0.8271	1.0794	1.1226	1.5625	1.6188	1.6188
1990	0.4505	0.3251	0.7665	0.9536	1.1909	1.1883	1.1883
1991	0.4236	0.5358	0.6766	0.9099	1.0529	1.0073	1.0073
1992	0.4588	0.6324	0.6843	0.6242	0.735	0.8111	0.8111
1993	0.2077	0.634	0.7755	1.0328	1.4041	0.7908	0.7908
1994	0.5015	0.5431	0.83	0.9463	0.7999	1.5022	1.5022
1995	0.4137	0.6822	0.8376	0.9602	0.9254	0.9919	0.9919
1996	0.6642	0.5721	0.8472	1.1656	1.3386	1.0817	1.0817
1997	0.5583	0.6807	0.8265	1.0355	1.0264	0.6322	0.6322
1998	0.7447	0.7295	0.9896	0.9576	1.4037	0.8092	0.8092
1999	0.6089	0.8315	1.0939	1.3568	1.4915	2.1659	2.1659
2000	0.9651	0.6075	1.024	1.3729	1.3121	1.5026	1.5026
2001	0.2333	0.3313	0.7514	1.2526	2.0028	2.0207	2.0207
2002	0.6058	0.3025	0.2882	0.4737	0.9269	0.9381	0.9381
2003	0.197	0.1391	0.1468	0.1923	0.3614	0.9973	0.9973

Table 5.1.5.3.4 (a-d) Whiting in Division VIa. Standard error on TSA-estimated fishing mortality-at-age using model with survey data included [a]; with survey but with no trend in catchability[b] and [c] without catch data between 1995 and 2003.

[a]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	0.1296	0.0739	0.0709	0.0692	0.0879	0.0927	0.1072
1979	0.1427	0.0712	0.07	0.0722	0.0814	0.1017	0.0992
1980	0.1431	0.0806	0.0737	0.0765	0.0892	0.0987	0.1044
1981	0.1432	0.0826	0.0795	0.079	0.0872	0.1031	0.1034
1982	0.1441	0.0823	0.0749	0.089	0.0885	0.1016	0.1058
1983	0.1475	0.0807	0.0727	0.0719	0.0979	0.1003	0.1047
1984	0.1319	0.0753	0.068	0.0694	0.0725	0.0959	0.0994
1985	0.139	0.069	0.0635	0.0642	0.0808	0.0834	0.0984
1986	0.1514	0.0771	0.0741	0.0738	0.0854	0.1023	0.0973
1987	0.1265	0.0767	0.0679	0.0683	0.0814	0.0999	0.0975
1988	0.1429	0.0689	0.065	0.0613	0.0763	0.0962	0.0994
1989	0.1479	0.0832	0.0703	0.0665	0.0774	0.096	0.1028
1990	0.1446	0.0876	0.0801	0.0744	0.0806	0.0999	0.1049
1991	0.1372	0.0826	0.0697	0.0706	0.079	0.0954	0.1045
1992	0.1439	0.0818	0.0757	0.0846	0.0884	0.0971	0.1062
1993	0.1532	0.0785	0.072	0.0687	0.0934	0.1021	0.1014
1994	0.1523	0.0839	0.0728	0.071	0.0867	0.0962	0.1054
1995	0.156	0.0853	0.0734	0.0709	0.0852	0.1009	0.103
1996	0.1479	0.0851	0.0728	0.0676	0.079	0.0973	0.103
1997	0.1509	0.092	0.0724	0.0718	0.0847	0.0994	0.1051
1998	0.1448	0.0904	0.0758	0.0697	0.0806	0.0986	0.1024
1999	0.1405	0.087	0.0747	0.069	0.0745	0.0965	0.102
2000	0.1438	0.0922	0.0797	0.0727	0.0817	0.0966	0.1044
2001	0.1489	0.0949	0.0819	0.075	0.0782	0.1005	0.1043
2002	0.1733	0.1098	0.0996	0.0947	0.104	0.1148	0.1197
2003	0.2239	0.167	0.1647	0.1652	0.1708	0.174	0.1747
2004	*0.2885*	*0.236*	*0.2355*	*0.2345*	*0.2345*	*0.2348*	*0.2349*
2005	*0.2933*	*0.2416*	*0.2411*	*0.2403*	*0.2403*	*0.2403*	*0.2403*

Forecasts are italicised

[b]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	0.1335	0.0761	0.0727	0.0713	0.0913	0.0964	0.1118
1979	0.1461	0.0737	0.0724	0.0748	0.0839	0.1058	0.1031
1980	0.1464	0.0826	0.0759	0.0786	0.0916	0.1021	0.1082
1981	0.1465	0.0847	0.0814	0.0811	0.0893	0.1067	0.107
1982	0.1476	0.0843	0.0763	0.0918	0.0909	0.105	0.1097
1983	0.1512	0.0827	0.0745	0.0734	0.1011	0.1039	0.1087
1984	0.1353	0.0771	0.0698	0.0721	0.0741	0.0995	0.1034
1985	0.1431	0.0713	0.0662	0.0666	0.0842	0.0867	0.1024
1986	0.1544	0.0789	0.0767	0.0764	0.088	0.1065	0.1014
1987	0.1286	0.0798	0.0697	0.0699	0.0842	0.1036	0.1014
1988	0.1435	0.0695	0.0667	0.0627	0.0783	0.0997	0.103
1989	0.1472	0.0856	0.0715	0.0676	0.0789	0.0987	0.1067
1990	0.1419	0.0906	0.0826	0.0759	0.0829	0.1031	0.1089
1991	0.1383	0.086	0.0741	0.0725	0.0814	0.0993	0.109
1992	0.146	0.0846	0.0793	0.0894	0.0898	0.1001	0.1104
1993	0.1586	0.0796	0.0733	0.0691	0.0946	0.1054	0.1045
1994	0.1549	0.0837	0.0723	0.071	0.0883	0.0972	0.1091
1995	0.1588	0.0853	0.0726	0.0699	0.0872	0.1036	0.1058
1996	0.1514	0.0851	0.072	0.0669	0.0797	0.0992	0.1063
1997	0.1516	0.0931	0.0714	0.0717	0.0866	0.1015	0.1084
1998	0.1468	0.0914	0.0733	0.07	0.0842	0.1019	0.1061
1999	0.146	0.0896	0.077	0.071	0.0779	0.1004	0.1061
2000	0.1521	0.0954	0.0814	0.0752	0.0853	0.1009	0.1085
2001	0.1587	0.0985	0.0863	0.0788	0.0812	0.1055	0.1092
2002	0.1845	0.1212	0.1094	0.1028	0.111	0.1231	0.1289
2003	0.275	0.229	0.2266	0.2259	0.2284	0.2286	0.229
2004	*0.2983*	*0.2419*	*0.2412*	*0.2402*	*0.2402*	*0.2402*	*0.2402*
2005	*0.3003*	*0.2443*	*0.2437*	*0.2427*	*0.2427*	*0.2427*	*0.2427*

Forecasts are italicised

[c]

year	Age1	Age2	Age3	Age4	Age5	Age6	Age7
1978	0.1368	0.0777	0.0748	0.0733	0.0919	0.0961	0.1102
1979	0.1577	0.0746	0.0748	0.0764	0.0882	0.1057	0.1033
1980	0.1563	0.0887	0.0802	0.0842	0.0978	0.1055	0.1107
1981	0.1558	0.0902	0.0887	0.0869	0.0959	0.1098	0.11
1982	0.1496	0.0896	0.0829	0.0941	0.0946	0.1071	0.1105
1983	0.1579	0.0861	0.0786	0.0784	0.1027	0.1048	0.1092
1984	0.1401	0.0788	0.0705	0.0712	0.0783	0.0983	0.1023
1985	0.1468	0.0683	0.0613	0.0616	0.0811	0.0831	0.1003
1986	0.1611	0.0808	0.0767	0.0754	0.09	0.1058	0.1004
1987	0.1373	0.0812	0.0704	0.0686	0.0856	0.1022	0.0998
1988	0.1542	0.0739	0.0687	0.0645	0.0818	0.0994	0.1026
1989	0.158	0.0909	0.0765	0.072	0.0845	0.101	0.1069
1990	0.1596	0.0955	0.0881	0.0814	0.0882	0.1057	0.1101
1991	0.1541	0.0923	0.0787	0.0797	0.0871	0.1022	0.1096
1992	0.1697	0.0994	0.0907	0.0999	0.1033	0.11	0.1176
1993	0.1847	0.1152	0.1044	0.1009	0.1223	0.1251	0.1248
1994	0.2212	0.1625	0.1572	0.159	0.1663	0.1703	0.1707
1995	0.2911	0.2409	0.2409	0.2378	0.2425	0.2437	0.2436
1996	0.2883	0.2449	0.2442	0.2414	0.2454	0.2466	0.2466
1997	0.2889	0.2367	0.2356	0.2339	0.2385	0.2395	0.2395
1998	0.2817	0.2345	0.2337	0.2299	0.2361	0.2369	0.2369
1999	0.2792	0.2284	0.2337	0.2336	0.2365	0.2368	0.2367
2000	0.2776	0.2337	0.2321	0.2343	0.2367	0.2376	0.2375
2001	0.276	0.2293	0.2319	0.2299	0.2329	0.2348	0.2348
2002	0.2786	0.2279	0.2254	0.2216	0.2276	0.2298	0.2299
2003	0.2941	0.2426	0.2404	0.2354	0.2412	0.2434	0.2435
2004	*0.3671*	*0.3256*	*0.3251*	*0.3241*	*0.3241*	*0.3246*	*0.3249*
2005	*0.3903*	*0.3516*	*0.3515*	*0.3509*	*0.3509*	*0.3509*	*0.3509*

Forecasts are italicised

Table 5.1.7.1 (a-d)Whiting in VIa. Stock summary file using TSA model with survey data included [a]; with survey but with no trend in catchability[b] and [c] without catch data between 1995 and 2003. NB. Figures in italics are forecasts. XSA output is displayed in [d].

[a]

Year	Landings(10,000 tonnes)			Discards(10,000 tonnes)			Catch(10,000 tonnes)		
	Obs.	Pred.	Se.	Obs.	Pred.	Se.	Obs.	Pred.	Se.
1978	1.4669	1.4663	0.0682	0.5768	0.7021	0.1225	2.0436	2.1944	0.1599
1979	1.7084	1.5893	0.0827	0.3086	0.6684	0.1016	2.017	2.3273	0.1491
1980	1.2819	1.3482	0.0756	0.2293	1.0661	0.1761	1.5112	2.5707	0.224
1981	1.2194	1.507	0.0925	0.4245	0.5589	0.0809	1.6438	2.1068	0.1448
1982	1.388	1.473	0.0855	0.6172	0.4695	0.0639	2.0053	1.9105	0.1138
1983	1.5962	1.5482	0.0816	0.5179	0.5032	0.0721	2.1142	2.0398	0.1203
1984	1.6459	1.5879	0.071	0.7566	0.6291	0.0905	2.4026	2.1907	0.1312
1985	1.2879	1.1943	0.0634	1.0519	0.9091	0.1169	2.3398	2.098	0.142
1986	0.8458	0.8065	0.0473	0.4912	0.5198	0.0728	1.337	1.337	0.1023
1987	1.1542	1.1614	0.0579	0.6875	0.774	0.1101	1.8417	1.9283	0.1425
1988	1.1349	1.1301	0.0578	1.146	0.6346	0.0852	2.2808	1.7203	0.1119
1989	0.7523	0.6866	0.0432	0.3716	0.5031	0.0747	1.1239	1.2005	0.0991
1990	0.5642	0.5885	0.0342	0.3357	0.5841	0.0931	0.8999	1.2131	0.1181
1991	0.6658	0.6403	0.0313	0.4055	0.4883	0.0721	1.0712	1.1413	0.0935
1992	0.6005	0.5852	0.0291	0.836	0.6524	0.0908	1.4365	1.2292	0.1036
1993	0.6872	0.6397	0.0365	0.8017	0.9383	0.1115	1.4889	1.5756	0.1213
1994	0.5901	0.5981	0.0336	0.8603	0.7127	0.0855	1.4504	1.2966	0.096
1995	0.6078	0.6277	0.033	0.7272	0.6204	0.0734	1.3351	1.2311	0.0866
1996	0.7158	0.7043	0.035	0.6573	0.6642	0.0876	1.3731	1.3716	0.1049
1997	0.629	0.6079	0.0327	0.4572	0.4788	0.0733	1.0862	1.0945	0.0929
1998	0.4627	0.4411	0.0259	0.524	0.5394	0.0808	0.9868	0.9822	0.0953
1999	0.4613	0.3958	0.0239	0.2575	0.4743	0.0726	0.7188	0.9011	0.0925
2000	0.3011	0.2413	0.018	0.5647	0.3925	0.0601	0.8658	0.6584	0.0743
2001	0.2439	0.2201	0.0157	0.1609	0.3911	0.0623	0.4049	0.6412	0.0759
2002	0.1767	0.1799	0.0135	0.1993	0.1925	0.0351	0.3761	0.38	0.0465
2003	0.1355	0.1634	0.0133	0.1113	0.224	0.0439	0.2468	0.4006	0.0542
2004	*NA*	*0.2109*	*0.0635*	*NA*	*0.3604*	*0.1029*	*NA*	*0.5991*	*0.1631*
2005	*NA*	*0.2342*	*0.074*	*NA*	*0.397*	*0.1165*	*NA*	*0.6622*	*0.1824*

Year	F(2-4)		SSB (10,000 tonnes)		Stock biomass(10,000 tonnes)		Recruitment(x10^6)	
	Est	**SE**	**Est**	**SE**	**Est**	**SE**	**Est**	**SE**
1978	0.7186	0.034	2.8708	0.0962	5.7108	0.2044	17.7726	1.0493
1979	0.7673	0.0365	3.7579	0.1432	5.9669	0.1888	10.9284	0.5427
1980	0.598	0.0317	3.3779	0.1222	8.9123	0.3068	33.2236	1.645
1981	0.4973	0.028	5.8685	0.217	7.0443	0.2355	6.7782	0.4288
1982	0.5017	0.0296	4.8565	0.165	5.5416	0.1749	6.307	0.454
1983	0.6319	0.0325	3.7939	0.1274	4.9887	0.1585	7.7151	0.5314
1984	0.8454	0.0402	3.0598	0.1144	4.5183	0.1568	14.6839	0.892
1985	1.0461	0.0454	2.7809	0.117	4.1565	0.1596	12.8107	0.7948
1986	0.762	0.0396	2.2632	0.0988	3.3458	0.1331	9.9596	0.6422
1987	0.8454	0.0403	2.501	0.1019	4.2907	0.1689	18.3701	1.1516
1988	1.0519	0.0453	2.6774	0.1097	3.0978	0.1324	5.2672	0.6265
1989	0.9288	0.0458	1.4838	0.0732	2.6383	0.1175	10.6931	0.7214
1990	0.7404	0.0418	1.7988	0.0773	2.9175	0.1439	7.9624	0.7334
1991	0.7929	0.0405	1.6532	0.0739	2.6508	0.1214	10.3742	0.805
1992	0.7128	0.0415	1.8209	0.079	3.3599	0.1437	13.5471	0.8734
1993	0.8137	0.0414	2.6261	0.1083	3.8088	0.1546	9.65	0.6764
1994	0.7516	0.0399	2.2104	0.0883	3.0804	0.1231	9.8128	0.7394
1995	0.7857	0.0423	2.1036	0.085	2.798	0.1093	9.1531	0.6451
1996	0.8807	0.0458	2.1733	0.0901	2.8297	0.1275	6.6747	0.6792
1997	0.8376	0.0462	1.6548	0.0776	2.3194	0.1226	5.7314	0.6395
1998	0.9307	0.0514	1.2141	0.0694	1.9716	0.1202	7.4948	0.763
1999	1.0795	0.0585	1.0932	0.0726	1.6268	0.1089	6.3376	0.6934
2000	1.0385	0.0609	0.7905	0.059	1.3094	0.0933	6.8286	0.708
2001	0.9765	0.0591	0.8082	0.0609	1.2791	0.1048	4.7045	0.65
2002	0.7411	0.06	0.7118	0.0759	0.8893	0.1044	2.4123	0.631
2003	0.6686	0.1005	0.6428	0.12	1.0591	0.1837	5.2224	1.2228
2004	*0.8523*	*0.1901*	*0.9125*	*0.2249*	*1.3515*	*0.2908*	*5.1973*	*1.4592*
2005	*0.8421*	*0.1928*	*0.9879*	*0.253*	*1.5125*	*0.3598*	*6.2106*	*2.2067*

[b]

Year	Landings(10000 tonnes)			Discards(10000 tonnes)			Catch(10000 tonnes)		
	Obs.	**Pred.**	**Se.**	**Obs.**	**Pred.**	**Se.**	**Obs.**	**Pred.**	**Se.**
1978	1.4669	1.4598	0.0699	0.5768	0.713	0.1282	2.0436	2.2021	0.1667
1979	1.7084	1.5665	0.085	0.3086	0.6613	0.1042	2.017	2.297	0.1535
1980	1.2819	1.3283	0.0772	0.2293	1.0373	0.1757	1.5112	2.5176	0.2236
1981	1.2194	1.4838	0.092	0.4245	0.5497	0.0819	1.6438	2.0759	0.1456
1982	1.388	1.4579	0.085	0.6172	0.4692	0.066	2.0053	1.8961	0.1146
1983	1.5962	1.5436	0.0817	0.5179	0.5047	0.0752	2.1142	2.0372	0.1225
1984	1.6459	1.5879	0.072	0.7566	0.6295	0.0942	2.4026	2.1904	0.1351
1985	1.2879	1.1636	0.0645	1.0519	0.8933	0.1209	2.3398	2.0516	0.1472
1986	0.8458	0.7972	0.0486	0.4912	0.5179	0.0766	1.337	1.3261	0.1074
1987	1.1542	1.1682	0.0596	0.6875	0.777	0.1163	1.8417	1.9368	0.1497
1988	1.1349	1.1306	0.0586	1.146	0.6521	0.092	2.2808	1.7389	0.1179
1989	0.7523	0.685	0.0439	0.3716	0.531	0.0829	1.1239	1.2298	0.1073
1990	0.5642	0.6112	0.0361	0.3357	0.6549	0.1088	0.8999	1.3135	0.1357
1991	0.6658	0.6469	0.033	0.4055	0.518	0.0797	1.0712	1.181	0.1026
1992	0.6005	0.5912	0.0313	0.836	0.66	0.0974	1.4365	1.2437	0.112
1993	0.6872	0.6413	0.037	0.8017	0.9337	0.1156	1.4889	1.5728	0.1247
1994	0.5901	0.5811	0.0323	0.8603	0.7139	0.089	1.4504	1.2833	0.0968
1995	0.6078	0.6104	0.0313	0.7272	0.6205	0.0753	1.3351	1.2177	0.0851
1996	0.7158	0.7161	0.0335	0.6573	0.6528	0.0897	1.3731	1.3713	0.1041
1997	0.629	0.6144	0.0315	0.4572	0.4526	0.0739	1.0862	1.0723	0.092
1998	0.4627	0.4596	0.0239	0.524	0.5338	0.0819	0.9868	0.9938	0.094
1999	0.4613	0.4023	0.0242	0.2575	0.4365	0.0703	0.7188	0.8649	0.0903
2000	0.3011	0.243	0.0183	0.5647	0.3458	0.0558	0.8658	0.6111	0.0707
2001	0.2439	0.2127	0.0161	0.1609	0.3269	0.058	0.4049	0.5636	0.0721
2002	0.1767	0.1695	0.0147	0.1993	0.1605	0.0369	0.3761	0.3353	0.0504
2003	0.1355	0.1462	0.0149	0.1113	0.1933	0.0488	0.2468	0.35	0.0611
2004	*NA*	*0.1565*	*0.063*	*NA*	*0.2604*	*0.0967*	*NA*	*0.4351*	*0.1582*
2005	*NA*	*0.1756*	*0.0755*	*NA*	*0.2893*	*0.1119*	*NA*	*0.485*	*0.1838*

Year	F(2-4)		SSB (10000 tonnes)		Stock biomass(10000 tonnes)		Recruitment(x10[6])	
	Est	**SE**	**Est**	**SE**	**Est**	**SE**	**Est**	**SE**
1978	0.7153	0.0346	2.8811	0.0996	5.7473	0.2123	17.9369	1.082
1979	0.7546	0.0371	3.7737	0.1503	5.9714	0.1963	10.8724	0.5484
1980	0.5909	0.032	3.3847	0.1278	8.8084	0.3074	32.5591	1.6244
1981	0.4948	0.0284	5.815	0.2173	6.9852	0.2367	6.7458	0.433
1982	0.4979	0.0299	4.8282	0.1652	5.5207	0.1763	6.3751	0.4675
1983	0.6322	0.033	3.7844	0.1281	4.9737	0.1611	7.6794	0.5418
1984	0.8458	0.0414	3.0452	0.1164	4.5	0.161	14.6473	0.9068
1985	1.0218	0.0461	2.7505	0.1218	4.1123	0.1673	12.6824	0.8202
1986	0.7608	0.0408	2.249	0.1039	3.3248	0.1419	9.8979	0.6822
1987	0.8497	0.0416	2.4856	0.1056	4.2864	0.1782	18.4844	1.2104
1988	1.0683	0.0468	2.6633	0.1122	3.1151	0.1405	5.661	0.7088
1989	0.9439	0.0471	1.4823	0.0766	2.7013	0.1313	11.2909	0.8335
1990	0.757	0.0436	1.8499	0.0845	3.0815	0.1645	8.7657	0.8472
1991	0.7931	0.0422	1.6972	0.0809	2.7299	0.1333	10.7395	0.8668
1992	0.7045	0.043	1.8578	0.0873	3.3869	0.1582	13.4596	0.9387
1993	0.8172	0.0419	2.6243	0.1105	3.7956	0.1588	9.5571	0.678
1994	0.7401	0.0389	2.1904	0.085	3.0715	0.125	9.9378	0.7872
1995	0.7734	0.0408	2.0993	0.0814	2.7922	0.1089	9.1345	0.6755
1996	0.8884	0.0453	2.1808	0.087	2.8076	0.127	6.373	0.6898
1997	0.8288	0.0452	1.6458	0.0744	2.2819	0.1254	5.4854	0.6886
1998	0.9371	0.0508	1.2415	0.0655	1.9728	0.1177	7.2348	0.7521
1999	1.0583	0.0593	1.0853	0.0708	1.583	0.1068	5.9115	0.6654
2000	1.014	0.0615	0.7856	0.0589	1.2231	0.0904	5.7582	0.6423
2001	0.9657	0.0622	0.7395	0.0601	1.1241	0.1089	3.8429	0.6631
2002	0.8007	0.0734	0.6034	0.0885	0.7343	0.1238	1.7787	0.665
2003	0.7887	0.1687	0.4953	0.1372	0.8232	0.2226	4.1134	1.4396
2004	*0.875*	*0.1994*	*0.6578*	*0.2564*	*0.9657*	*0.336*	*3.645*	*1.5185*
2005	*0.875*	*0.2017*	*0.6933*	*0.2731*	*1.0828*	*0.4006*	*4.6104*	*2.1418*

[c]

Year	Landings(10000 tonnes)			Discards(10000 tonnes)			Catch(10000 tonnes)		
	Obs.	**Pred.**	**Se.**	**Obs.**	**Pred.**	**Se.**	**Obs.**	**Pred.**	**Se.**
1978	1.4669	1.419	0.0713	0.5768	0.5773	0.1132	2.0436	1.9999	0.1516
1979	1.7084	1.6184	0.0828	0.3086	0.6391	0.1098	2.017	2.3183	0.1548
1980	1.2819	1.4113	0.0835	0.2293	1.0772	0.1986	1.5112	2.6448	0.2526
1981	1.2194	1.5471	0.1064	0.4245	0.5373	0.0857	1.6438	2.1086	0.1585
1982	1.388	1.5101	0.101	0.6172	0.459	0.067	2.0053	1.9337	0.1283
1983	1.5962	1.5373	0.0904	0.5179	0.4853	0.0734	2.1142	2.0095	0.1267
1984	1.6459	1.6412	0.0773	0.7566	0.5964	0.0926	2.4026	2.2024	0.1346
1985	1.2879	1.3057	0.068	1.0519	1.0126	0.1337	2.3398	2.3177	0.1516
1986	0.8458	0.8371	0.0492	0.4912	0.5308	0.0796	1.337	1.377	0.1081
1987	1.1542	1.192	0.0612	0.6875	0.7691	0.1201	1.8417	1.9547	0.1536
1988	1.1349	1.178	0.0638	1.146	0.6789	0.0974	2.2808	1.8103	0.1238
1989	0.7523	0.7228	0.0497	0.3716	0.5573	0.0879	1.1239	1.2949	0.1153
1990	0.5642	0.594	0.0396	0.3357	0.6088	0.1061	0.8999	1.2527	0.1362
1991	0.6658	0.6225	0.0374	0.4055	0.5287	0.0885	1.0712	1.1756	0.1165
1992	0.6005	0.5879	0.0347	0.836	0.7555	0.1177	1.4365	1.341	0.1353
1993	0.6872	0.6612	0.0446	0.8017	1.0979	0.1494	1.4889	1.7639	0.1658
1994	0.5901	0.6226	0.0439	0.8603	0.8286	0.1177	1.4504	1.444	0.1321
1995	0.6078	0.8126	0.2384	0.7272	0.7872	0.2053	1.3351	1.5482	0.3833
1996	0.7158	0.7837	0.2375	0.6573	0.9889	0.2611	1.3731	1.7901	0.4503
1997	0.629	0.8755	0.2514	0.4572	1.149	0.2958	1.0862	2.0822	0.4973
1998	0.4627	0.549	0.2004	0.524	1.0589	0.2839	0.9868	1.6339	0.4491
1999	0.4613	0.4878	0.166	0.2575	1.1402	0.2934	0.7188	1.7467	0.4488
2000	0.3011	0.3021	0.1268	0.5647	0.9666	0.2628	0.8658	1.3354	0.3841
2001	0.2439	0.3045	0.114	0.1609	0.8917	0.2536	0.4049	1.2983	0.3659
2002	0.1767	0.3377	0.111	0.1993	0.6688	0.1896	0.3761	1.0594	0.2779
2003	0.1355	0.4143	0.1302	0.1113	0.9173	0.2478	0.2468	1.4207	0.3589
2004	*NA*	*0.3619*	*0.1362*	*NA*	*0.9868*	*0.2938*	*NA*	*1.4513*	*0.4229*
2005	*NA*	*0.3615*	*0.1495*	*NA*	*0.9928*	*0.2956*	*NA*	*1.4617*	*0.4295*

Year	F(2-4)		SSB (10000 tonnes)		Stock biomass(10000 tonnes)		Recruitment(x10^6)	
	Est	**SE**	**Est**	**SE**	**Est**	**SE**	**Est**	**SE**
1978	0.6998	0.0355	2.7843	0.0975	5.4319	0.2122	16.5689	1.0995
1979	0.7756	0.0393	3.6228	0.1286	5.9073	0.1949	11.3021	0.6708
1980	0.6142	0.0365	3.3775	0.1228	9.0543	0.3435	34.0786	1.9035
1981	0.4885	0.0312	5.937	0.2388	7.1024	0.2565	6.7182	0.4683
1982	0.5071	0.0329	4.9207	0.1906	5.5775	0.1952	6.0453	0.4189
1983	0.6214	0.0353	3.8123	0.1394	5.0219	0.1673	7.8101	0.5683
1984	0.8477	0.0419	3.1477	0.1209	4.627	0.1658	14.8934	0.9987
1985	1.1637	0.0482	2.9075	0.1178	4.3586	0.1704	13.5141	0.9589
1986	0.774	0.0416	2.3023	0.1001	3.4198	0.1428	10.281	0.7747
1987	0.8421	0.0412	2.5652	0.106	4.414	0.1903	18.9765	1.4068
1988	1.074	0.0491	2.7757	0.1186	3.2256	0.1476	5.6369	0.8022
1989	0.9562	0.0521	1.5562	0.0826	2.7504	0.1352	11.0615	0.8531
1990	0.767	0.0486	1.8152	0.0913	2.9708	0.1735	8.2249	0.9029
1991	0.8101	0.0482	1.6512	0.0934	2.717	0.1603	11.0836	1.1182
1992	0.736	0.0549	1.8723	0.1089	3.6401	0.2085	15.5608	1.3183
1993	0.8197	0.0711	2.8773	0.2004	4.2641	0.2984	11.3157	1.3669
1994	0.7554	0.1086	2.4649	0.2611	3.4947	0.3379	11.6148	1.7202
1995	0.8278	0.1883	2.4381	0.4015	3.4491	0.4619	13.3265	2.0366
1996	0.8623	0.1994	2.7163	0.4293	3.9045	0.5242	12.082	1.9862
1997	1.1582	0.2583	2.6165	0.4223	3.7401	0.5259	9.6898	1.7033
1998	1.183	0.2602	1.6656	0.3844	3.0882	0.5047	14.0753	2.1614
1999	1.6021	0.3521	1.7635	0.3632	2.7298	0.4658	11.4762	2.0871
2000	1.3036	0.2881	1.2293	0.3357	2.5097	0.4496	16.8519	2.6762
2001	1.0385	0.2262	1.7421	0.3542	2.6411	0.4936	8.9814	2.3942
2002	0.8646	0.183	1.6325	0.3177	2.2901	0.42	8.9342	2.5464
2003	1.0806	0.2451	1.7693	0.3916	2.7448	0.5028	12.2387	2.7609
2004	*1.1036*	*0.3484*	*1.7711*	*0.4557*	*2.8345*	*0.5639*	*12.5892*	*2.998*
2005	*1.0661*	*0.3655*	*1.8617*	*0.5726*	*2.9104*	*0.6547*	*12.4163*	*3.4356*

Forecasts are italicised.

[d]

Terminal Fs derived using XSA (With F shrinkage)

Run title : WHITING 2003 IN AREA 6A ,

At 11/05/2004 12:57

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 4,
1978,	164268,	55497,	29214,	20452,	.7001,	.6865,
1979,	98923,	56996,	37013,	20163,	.5448,	.7753,
1980,	268311,	78854,	34315,	15108,	.4403,	.6002,
1981,	52164,	68908,	59832,	16439,	.2747,	.4191,
1982,	69788,	59847,	52310,	20064,	.3836,	.4479,
1983,	71132,	52515,	41490,	21980,	.5298,	.6351,
1984,	171511,	49062,	32082,	24118,	.7518,	.7977,
1985,	160627,	45883,	28696,	23560,	.8210,	1.1227,
1986,	87196,	34242,	24738,	13413,	.5422,	.8307,
1987,	200242,	45551,	25927,	18666,	.7199,	.8716,
1988,	76242,	37335,	31236,	23135,	.7407,	1.1295,
1989,	89647,	25100,	15418,	11598,	.7523,	1.0097,
1990,	59746,	26229,	17865,	10036,	.5618,	.6817,
1991,	107694,	27666,	17220,	12006,	.6972,	.7074,
1992,	147648,	37083,	20398,	15396,	.7548,	.6470,
1993,	92350,	38670,	27403,	15373,	.5610,	.8141,
1994,	113788,	33725,	23598,	14771,	.6260,	.7731,
1995,	93851,	29604,	22471,	13657,	.6078,	.8267,
1996,	67432,	28544,	21936,	14057,	.6408,	.8616,
1997,	49235,	22872,	17161,	11193,	.6522,	.8475,
1998,	67398,	19205,	12398,	10476,	.8450,	.8922,
1999,	35471,	13242,	10227,	7734,	.7562,	1.0941,
2000,	114747,	15896,	7175,	9714,	1.3540,	1.0015,
2001,	31733,	12901,	9727,	4850,	.4986,	.7784,
2002,	34607,	13470,	10909,	3890,	.3566,	.3548,
2003,	58732,	16540,	11842,	2936,	.2479,	.1594,
Arith. Mean ,	99403,	36363,	24715,	14415,	.6293,	.7602,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

Table 5.1.8.1 (a) Inputs to Short Term Predictions
MFDP version 1a
Run: WHG6aSCGFSMFDP
Time and date: 08:08 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004

Age	N	M	Mat	PF	PM	SWt
1	51973	0.2	0	0	0	0.085
2	29051	0.2	1	0	0	0.196
3	5920	0.2	1	0	0	0.279
4	3098	0.2	1	0	0	0.346
5	1490	0.2	1	0	0	0.380
6	235	0.2	1	0	0	0.453
7	69	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.021	0.205	0.479	0.081
2	0.225	0.252	0.401	0.164
3	0.552	0.305	0.216	0.213
4	0.851	0.365	0.141	0.230
5	0.925	0.411	0.136	0.278
6	0.950	0.487	0.105	0.198
7	0.874	0.673	0.141	0.185

2005

Age	N	M	Mat	PF	PM	SWt
1	59962	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

p

Total

Age	Sel	CWt	DSel	DCWt
1	0.021	0.205	0.479	0.081
2	0.225	0.252	0.401	0.164
3	0.552	0.305	0.216	0.213
4	0.851	0.365	0.141	0.230
5	0.925	0.411	0.136	0.278
6	0.950	0.487	0.105	0.198
7	0.874	0.673	0.141	0.185

2006

Age	N	M	Mat	PF	PM	SWt
1	59962	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.021	0.205	0.479	0.081
2	0.225	0.252	0.401	0.164
3	0.552	0.305	0.216	0.213
4	0.851	0.365	0.141	0.230
5	0.925	0.411	0.136	0.278
6	0.950	0.487	0.105	0.198
7	0.874	0.673	0.141	0.185

Input units are thousands and kg - output in tonnes

Table 5.1.8.1 (b) Inputs to Short Term Predictions
MFDP version 1a
Run: WHG6aSCGFSnotrendMDPP
Time and date: 08:21 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004

Age	N	M	Mat	PF	PM	SWt
1	36450	0.2	0	0	0	0.085
2	21525	0.2	1	0	0	0.196
3	4101	0.2	1	0	0	0.279
4	2050	0.2	1	0	0	0.346
5	1040	0.2	1	0	0	0.380
6	180	0.2	1	0	0	0.453
7	56	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.021	0.205	0.501	0.081
2	0.241	0.252	0.428	0.164
3	0.591	0.305	0.235	0.213
4	0.907	0.365	0.153	0.230
5	0.975	0.411	0.146	0.278
6	1.008	0.487	0.115	0.198
7	0.921	0.673	0.164	0.185

2005

Age	N	M	Mat	PF	PM	SWt
1	52300	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.021	0.205	0.501	0.081
2	0.241	0.252	0.428	0.164
3	0.591	0.305	0.235	0.213
4	0.907	0.365	0.153	0.230
5	0.975	0.411	0.146	0.278
6	1.008	0.487	0.115	0.198
7	0.921	0.673	0.164	0.185

2006

Age	N	M	Mat	PF	PM	SWt
1	52300	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.021	0.205	0.501	0.081
2	0.241	0.252	0.428	0.164
3	0.591	0.305	0.235	0.213
4	0.907	0.365	0.153	0.230
5	0.975	0.411	0.146	0.278
6	1.008	0.487	0.115	0.198
7	0.921	0.673	0.164	0.185

Input units are thousands and kg - output in tonnes

Table 5.1.8.1 (c) Inputs to Short Term Predictions

MFDP version 1a
Run: WHG6a1995-2003MFDP
Time and date: 08:30 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004

Age	N	M	Mat	PF	PM	SWt
1	125892	0.2	0	0	0	0.085
2	56022	0.2	1	0	0	0.196
3	15102	0.2	1	0	0	0.279
4	4857	0.2	1	0	0	0.346
5	1926	0.2	1	0	0	0.380
6	208	0.2	1	0	0	0.453
7	38	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.019	0.205	0.541	0.081
2	0.291	0.252	0.512	0.164
3	0.686	0.305	0.271	0.213
4	1.044	0.365	0.180	0.230
5	1.062	0.411	0.172	0.278
6	1.111	0.487	0.126	0.198
7	1.020	0.673	0.215	0.185

2005

Age	N	M	Mat	PF	PM	SWt
1	117864	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.019	0.205	0.541	0.081
2	0.291	0.252	0.512	0.164
3	0.686	0.305	0.271	0.213
4	1.044	0.365	0.180	0.230
5	1.062	0.411	0.172	0.278
6	1.111	0.487	0.126	0.198
7	1.020	0.673	0.215	0.185

2006

Age	N	M	Mat	PF	PM	SWt
1	117864	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.019	0.205	0.541	0.081
2	0.291	0.252	0.512	0.164
3	0.686	0.305	0.271	0.213
4	1.044	0.365	0.180	0.230
5	1.062	0.411	0.172	0.278
6	1.111	0.487	0.126	0.198
7	1.020	0.673	0.215	0.185

Input units are thousands and kg - output in tonnes

Table 5.1.8.1 (d) Inputs to Short Term Predictions
MFDP version 1a
Run: WHG 6a XSA NEW
Time and date: 07:28 5/13/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004

Age	N	M	Mat	PF	PM	SWt
1	68081	0.2	0	0	0	0.085
2	39489	0.2	1	0	0	0.196
3	11014	0.2	1	0	0	0.279
4	8800	0.2	1	0	0	0.346
5	8722	0.2	1	0	0	0.380
6	791	0.2	1	0	0	0.453
7	65	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.008	0.205	0.337	0.081
2	0.091	0.252	0.166	0.164
3	0.292	0.305	0.104	0.213
4	0.557	0.365	0.083	0.230
5	0.970	0.411	0.127	0.278
6	1.213	0.487	0.105	0.198
7	1.152	0.673	0.167	0.185

2005

Age	N	M	Mat	PF	PM	SWt
1	68081	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.008	0.205	0.337	0.081
2	0.091	0.252	0.166	0.164
3	0.292	0.305	0.104	0.213
4	0.557	0.365	0.083	0.230
5	0.970	0.411	0.127	0.278
6	1.213	0.487	0.105	0.198
7	1.152	0.673	0.167	0.185

2006

Age	N	M	Mat	PF	PM	SWt
1	68081	0.2	0	0	0	0.085
2	.	0.2	1	0	0	0.196
3	.	0.2	1	0	0	0.279
4	.	0.2	1	0	0	0.346
5	.	0.2	1	0	0	0.380
6	.	0.2	1	0	0	0.453
7	.	0.2	1	0	0	0.600

Total

Age	Sel	CWt	DSel	DCWt
1	0.008	0.205	0.337	0.081
2	0.091	0.252	0.166	0.164
3	0.292	0.305	0.104	0.213
4	0.557	0.365	0.083	0.230
5	0.970	0.411	0.127	0.278
6	1.213	0.487	0.105	0.198
7	1.152	0.673	0.167	0.185

Input units are thousands and kg - output in tonnes

Table 5.1.8.2 (a) Short Term Prediction Management Option Table
MFDP version 1a
Run: WHG6aSCGFSMFDP
Time and date: 08:08 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004							
		Total	Landings		Discards		
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Total Yield
13523	9123	1.0000	0.5427	2889	0.2527	3028	5917

2005								2006	
		Total	Landings		Discards				
Biomass	SSB	FMult	FBar	Landing Yield	FBar	Discard Yield	Total Yield	Biomass	SSB
15058	9982	0.0000	0.0000	0	0.0000	0	0	25484	20407
.	9982	0.1000	0.0543	451	0.0253	418	869	24265	19188
.	9982	0.2000	0.1085	870	0.0505	812	1682	23122	18046
.	9982	0.3000	0.1628	1258	0.0758	1185	2443	22052	16975
.	9982	0.4000	0.2171	1619	0.1011	1537	3156	21047	15971
.	9982	0.5000	0.2713	1954	0.1263	1870	3824	20105	15029
.	9982	0.6000	0.3256	2265	0.1516	2185	4450	19222	14145
.	9982	0.7000	0.3799	2554	0.1769	2482	5036	18393	13316
.	9982	0.8000	0.4342	2823	0.2021	2764	5587	17614	12537
.	9982	0.9000	0.4884	3073	0.2274	3030	6103	16884	11807
.	9982	1.0000	0.5427	3306	0.2527	3282	6588	16197	11121
.	9982	1.1000	0.5970	3522	0.2779	3520	7042	15553	10476
.	9982	1.2000	0.6512	3724	0.3032	3745	7469	14947	9871
.	9982	1.3000	0.7055	3912	0.3285	3958	7870	14378	9302
.	9982	1.4000	0.7598	4087	0.3537	4160	8247	13844	8767
.	9982	1.5000	0.8140	4250	0.3790	4352	8602	13341	8264
.	9982	1.6000	0.8683	4402	0.4043	4533	8935	12868	7791
.	9982	1.7000	0.9226	4544	0.4296	4704	9248	12424	7347
.	9982	1.8000	0.9768	4676	0.4548	4866	9542	12006	6929
.	9982	1.9000	1.0311	4800	0.4801	5020	9820	11612	6535
.	9982	2.0000	1.0854	4915	0.5054	5166	10081	11242	6165

Input units are thousands and kg - output in tonnes

Table 5.1.8.2 (b) Short Term Prediction Management Option Table
MFDP version 1a
Run: WHG6aSCGFSnotrendMDPP
Time and date: 08:21 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004

Biomass	SSB	Total FMult	Landings FBar	Yield	Discards FBar	Yield	Total Yield
9662	6576	1.0000	0.5799	2132	0.2718	2265	4397

2005								2006	
Biomass	SSB	Total FMult	Landings FBar	Landing Yield	Discards FBar	Discard Yield	Total Yield	Biomass	SSB
11308	6880	0.0000	0.0000	0	0.0000	0	0	20252	15823
.	6880	0.1000	0.0580	333	0.0272	344	677	19274	14846
.	6880	0.2000	0.1160	641	0.0544	668	1309	18361	13933
.	6880	0.3000	0.1740	925	0.0815	974	1899	17506	13078
.	6880	0.4000	0.2320	1188	0.1087	1262	2450	16707	12279
.	6880	0.5000	0.2900	1431	0.1359	1534	2965	15959	11531
.	6880	0.6000	0.3479	1656	0.1631	1790	3446	15259	10831
.	6880	0.7000	0.4059	1864	0.1903	2032	3896	14604	10176
.	6880	0.8000	0.4639	2057	0.2175	2260	4317	13990	9562
.	6880	0.9000	0.5219	2235	0.2446	2476	4711	13415	8987
.	6880	1.0000	0.5799	2401	0.2718	2679	5080	12876	8448
.	6880	1.1000	0.6379	2554	0.2990	2871	5425	12371	7943
.	6880	1.2000	0.6959	2696	0.3262	3052	5748	11898	7470
.	6880	1.3000	0.7539	2828	0.3534	3223	6051	11454	7026
.	6880	1.4000	0.8119	2950	0.3806	3385	6335	11038	6610
.	6880	1.5000	0.8699	3064	0.4077	3538	6602	10647	6219
.	6880	1.6000	0.9278	3169	0.4349	3682	6851	10281	5853
.	6880	1.7000	0.9858	3267	0.4621	3819	7086	9937	5509
.	6880	1.8000	1.0438	3359	0.4893	3948	7307	9614	5186
.	6880	1.9000	1.1018	3443	0.5165	4070	7513	9311	4883
.	6880	2.0000	1.1598	3522	0.5437	4185	7707	9026	4598

Input units are thousands and kg - output in tonnes

Table 5.1.8.2 (c) Short Term Prediction Management Option Table
MFDP version 1a
Run: WHG6a1995-2003MFDP
Time and date: 08:30 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004

Biomass	SSB	Total FMult	Landings FBar	Yield	Discards FBar	Yield	Total Yield
28367	17708	1.0000	0.6738	6323	0.3208	7528	13851

2005								2006	
Biomass	SSB	Total FMult	Landings FBar	Landing Yield	Discards FBar	Discard Yield	Total Yield	Biomass	SSB
29567	19588	0.0000	0.0000	0	0.0000	0	0	50305	40326
.	19588	0.1000	0.0674	1013	0.0321	1014	2027	47457	37478
.	19588	0.2000	0.1348	1938	0.0642	1961	3899	44823	34844
.	19588	0.3000	0.2021	2783	0.0962	2844	5627	42385	32406
.	19588	0.4000	0.2695	3555	0.1283	3669	7224	40128	30149
.	19588	0.5000	0.3369	4262	0.1604	4440	8702	38037	28058
.	19588	0.6000	0.4043	4908	0.1925	5160	10068	36101	26121
.	19588	0.7000	0.4717	5499	0.2245	5833	11332	34305	24326
.	19588	0.8000	0.5390	6040	0.2566	6462	12502	32641	22662
.	19588	0.9000	0.6064	6536	0.2887	7050	13586	31097	21118
.	19588	1.0000	0.6738	6991	0.3208	7600	14591	29664	19685
.	19588	1.1000	0.7412	7407	0.3529	8115	15522	28334	18355
.	19588	1.2000	0.8086	7790	0.3849	8598	16388	27099	17120
.	19588	1.3000	0.8759	8141	0.4170	9049	17190	25952	15973
.	19588	1.4000	0.9433	8463	0.4491	9472	17935	24886	14907
.	19588	1.5000	1.0107	8759	0.4812	9869	18628	23895	13916
.	19588	1.6000	1.0781	9031	0.5133	10240	19271	22974	12995
.	19588	1.7000	1.1455	9282	0.5453	10589	19871	22117	12137
.	19588	1.8000	1.2129	9512	0.5774	10915	20427	21319	11340
.	19588	1.9000	1.2802	9724	0.6095	11222	20946	20577	10597
.	19588	2.0000	1.3476	9919	0.6416	11510	21429	19885	9906

Input units are thousands and kg - output in tonnes

Table 5.1.8.2 (d) Short Term Prediction Management Option Table
MFDP version 1a
Run: WHG 6a XSA NEW
Time and date: 07:28 5/13/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2004							
		Total	Landings		Discards		
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Total Yield
23321	17557	1.0000	0.3133	4980	0.1176	2784	7764

2005								2006	
		Total	Landings		Discards				
Biomass	SSB	FMult	FBar	Landing Yield	FBar	Discard Yield	Total Yield	Biomass	SSB
25200	19436	0.0000	0.0000	0	0.0000	0	0	37328	31564
.	19436	0.1000	0.0313	660	0.0118	338	998	36035	30271
.	19436	0.2000	0.0627	1276	0.0235	665	1941	34812	29048
.	19436	0.3000	0.0940	1850	0.0353	980	2830	33655	27891
.	19436	0.4000	0.1253	2386	0.0470	1284	3670	32558	26794
.	19436	0.5000	0.1567	2888	0.0588	1578	4466	31517	25753
.	19436	0.6000	0.1880	3359	0.0705	1861	5220	30529	24765
.	19436	0.7000	0.2193	3801	0.0823	2135	5936	29589	23824
.	19436	0.8000	0.2507	4216	0.0940	2399	6615	28694	22929
.	19436	0.9000	0.2820	4607	0.1058	2655	7262	27841	22077
.	19436	1.0000	0.3133	4976	0.1176	2902	7878	27027	21263
.	19436	1.1000	0.3447	5324	0.1293	3142	8466	26251	20487
.	19436	1.2000	0.3760	5653	0.1411	3373	9026	25509	19745
.	19436	1.3000	0.4073	5964	0.1528	3596	9560	24800	19035
.	19436	1.4000	0.4387	6259	0.1646	3813	10072	24121	18357
.	19436	1.5000	0.4700	6538	0.1763	4022	10560	23471	17707
.	19436	1.6000	0.5013	6803	0.1881	4225	11028	22848	17084
.	19436	1.7000	0.5327	7055	0.1998	4421	11476	22251	16487
.	19436	1.8000	0.5640	7295	0.2116	4611	11906	21679	15914
.	19436	1.9000	0.5953	7524	0.2233	4795	12319	21129	15365
.	19436	2.0000	0.6267	7741	0.2351	4973	12714	20601	14837

Input units are thousands and kg - output in tonnes

Table 5.1.8.3 (a) Short Term Predictions Detailed Management Option Table

MFDP version 1a
Run: WHG6aSCGFSMFDP
Time and date: 08:08 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year:	**2004**	**F multiplie**	**1**	**Fleet1 HCI**	**0.5427**	**Fleet1 DFI**	**0.2527**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.021	786	161	0.4791	17906	1456	51973	4400	0	0	0	0
2	0.2249	4448	1119	0.4006	7923	1302	29051	5684	29051	5684	29051	5684
3	0.5519	2093	639	0.2164	821	175	5920	1654	5920	1654	5920	1654
4	0.8512	1540	562	0.141	255	59	3098	1071	3098	1071	3098	1071
5	0.9253	783	322	0.1364	115	32	1490	566	1490	566	1490	566
6	0.9503	127	62	0.1051	14	3	235	106	235	106	235	106
7	0.8736	35	23	0.1414	6	1	69	41	69	41	69	41
Total		9813	2889		27040	3028	91836	13523	39863	9123	39863	9123

Year:	**2005**	**F multiplie**	**1**	**Fleet1 HCI**	**0.5427**	**Fleet1 DFI**	**0.2527**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.021	907	186	0.4791	20659	1680	59962	5077	0	0	0	0
2	0.2249	3951	994	0.4006	7038	1157	25806	5049	25806	5049	25806	5049
3	0.5519	4499	1374	0.2164	1764	376	12725	3554	12725	3554	12725	3554
4	0.8512	1118	408	0.141	185	43	2248	777	2248	777	2248	777
5	0.9253	494	203	0.1364	73	20	940	357	940	357	940	357
6	0.9503	228	111	0.1051	25	5	422	191	422	191	422	191
7	0.8736	44	30	0.1414	7	1	87	52	87	52	87	52
Total		11242	3306		29751	3282	102190	15058	42228	9982	42228	9982

Year:	**2006**	**F multiplie**	**1**	**Fleet1 HCI**	**0.5427**	**Fleet1 DFI**	**0.2527**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.021	907	186	0.4791	20659	1680	59962	5077	0	0	0	0
2	0.2249	4558	1147	0.4006	8120	1334	29772	5825	29772	5825	29772	5825
3	0.5519	3996	1220	0.2164	1567	334	11303	3157	11303	3157	11303	3157
4	0.8512	2403	877	0.141	398	92	4832	1670	4832	1670	4832	1670
5	0.9253	359	147	0.1364	53	15	682	259	682	259	682	259
6	0.9503	144	70	0.1051	16	3	266	121	266	121	266	121
7	0.8736	74	50	0.1414	12	2	146	88	146	88	146	88
Total		12441	3697		30824	3460	106964	16197	47002	11121	47002	11121

Input units are thousands and kg - output in tonnes

Table 5.1.8.3 (b) Short Term Predictions Detailed Management Option Table
MFDP version 1a
Run: WHG6aSCGFSnotrendMDPP
Time and date: 08:21 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year:	**2004**	**F multiplie**	**1**	**Fleet1 HCI**	**0.5799**	**Fleet1 DFI**	**0.2718**						
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**	
1	0.021	545	112	0.501	13007	1058	36450	3086	0	0	0	0	
2	0.2408	3464	872	0.4278	6154	1011	21525	4212	21525	4212	21525	4212	
3	0.5915	1517	463	0.2346	602	128	4101	1146	4101	1146	4101	1146	
4	0.9074	1057	386	0.1531	178	41	2050	709	2050	709	2050	709	
5	0.9752	563	231	0.1464	84	23	1040	395	1040	395	1040	395	
6	1.0079	101	49	0.1149	11	2	180	81	180	81	180	81	
7	0.921	29	20	0.1637	5	1	56	34	56	34	56	34	
Total		7275	2132		20042	2265	65402	9662	28952	6576	28952	6576	

Year:	**2005**	**F multiplie**	**1**	**Fleet1 HCI**	**0.5799**	**Fleet1 DFI**	**0.2718**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.021	782	160	0.501	18663	1518	52300	4428	0	0	0	0
2	0.2408	2849	717	0.4278	5062	832	17706	3464	17706	3464	17706	3464
3	0.5915	3340	1020	0.2346	1325	282	9030	2522	9030	2522	9030	2522
4	0.9074	758	277	0.1531	128	29	1470	508	1470	508	1470	508
5	0.9752	314	129	0.1464	47	13	581	221	581	221	581	221
6	1.0079	155	76	0.1149	18	4	277	126	277	126	277	126
7	0.921	33	22	0.1637	6	1	63	38	63	38	63	38
Total		8232	2401		25248	2679	81428	11308	29128	6880	29128	6880

Year:	**2006**	**F multiplie**	**1**	**Fleet1 HCI**	**0.5799**	**Fleet1 DFI**	**0.2718**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.021	782	160	0.501	18663	1518	52300	4428	0	0	0	0
2	0.2408	4088	1029	0.4278	7264	1194	25405	4971	25405	4971	25405	4971
3	0.5915	2747	839	0.2346	1090	232	7428	2075	7428	2075	7428	2075
4	0.9074	1669	609	0.1531	282	65	3237	1119	3237	1119	3237	1119
5	0.9752	225	93	0.1464	34	9	417	158	417	158	417	158
6	1.0079	87	42	0.1149	10	2	155	70	155	70	155	70
7	0.921	47	32	0.1637	8	2	91	55	91	55	91	55
Total		9647	2804		27350	3021	89033	12876	36733	8448	36733	8448

Input units are thousands and kg - output in tonnes

Table 5.1.8.3 (c) Short Term Predictions Detailed Management Option Table
MFDP version 1a
Run: WHG6a1995-2003MFDP
Time and date: 08:30 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year:	**2004**	**F multiplie**	**1**	**Fleet1 HCI**	**0.6738**	**Fleet1 DFt**	**0.3208**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.0193	1702	348	0.5408	47683	3878	125892	10659	0	0	0	0
2	0.2914	10306	2594	0.5116	18094	2974	56022	10962	56022	10962	56022	10962
3	0.6855	6136	1873	0.271	2425	517	15102	4218	15102	4218	15102	4218
4	1.0445	2705	987	0.1798	465	107	4857	1679	4857	1679	4857	1679
5	1.0615	1086	446	0.1723	176	49	1926	732	1926	732	1926	732
6	1.1112	123	60	0.1259	14	3	208	94	208	94	208	94
7	1.0196	21	14	0.2152	4	1	38	23	38	23	38	23
Total		22078	6323		68862	7528	204045	28367	78153	17708	78153	17708

Year:	**2005**	**F multiplie**	**1**	**Fleet1 HCI**	**0.6738**	**Fleet1 DFt**	**0.3208**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.0193	1594	326	0.5408	44642	3631	117864	9979	0	0	0	0
2	0.2914	10831	2726	0.5116	19015	3125	58872	11519	58872	11519	58872	11519
3	0.6855	8348	2549	0.271	3300	703	20548	5740	20548	5740	20548	5740
4	1.0445	2645	966	0.1798	455	105	4751	1642	4751	1642	4751	1642
5	1.0615	659	271	0.1723	107	30	1169	444	1169	444	1169	444
6	1.1112	271	132	0.1259	31	6	459	208	459	208	459	208
7	1.0196	32	21	0.2152	7	1	58	35	58	35	58	35
Total		24380	6991		67556	7600	203721	29567	85857	19588	85857	19588

Year:	**2006**	**F multiplie**	**1**	**Fleet1 HCI**	**0.6738**	**Fleet1 DFt**	**0.3208**					
Age	**Total F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.0193	1594	326	0.5408	44642	3631	117864	9979	0	0	0	0
2	0.2914	10140	2552	0.5116	17802	2925	55117	10785	55117	10785	55117	10785
3	0.6855	8773	2679	0.271	3468	739	21593	6032	21593	6032	21593	6032
4	1.0445	3599	1314	0.1798	619	142	6464	2234	6464	2234	6464	2234
5	1.0615	645	265	0.1723	105	29	1143	435	1143	435	1143	435
6	1.1112	164	80	0.1259	19	4	279	126	279	126	279	126
7	1.0196	67	45	0.2152	14	3	123	74	123	74	123	74
Total		24982	7260		66669	7473	202583	29664	84719	19685	84719	19685

Input units are thousands and kg - output in tonnes

Table 5.1.8.3 (d) Short Term Predictions Detailed Management Option Table
MFDP version 1a
Run: WHG 6a XSA NEW
Time and date: 07:28 5/13/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year:	**2004**	**F multiplie**	**1**	**Fleet1 HCI**	**0.3133**	**Fleet1 DFI**	**0.1176**					
	Total											
Age	**F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.0081	422	86	0.3373	17701	1440	68081	5764	0	0	0	0
2	0.0914	2895	729	0.1663	5269	866	39489	7727	39489	7727	39489	7727
3	0.2918	2421	739	0.1037	861	183	11014	3077	11014	3077	11014	3077
4	0.5569	3316	1210	0.0827	492	113	8800	3042	8800	3042	8800	3042
5	0.9705	4742	1949	0.1266	618	172	8722	3314	8722	3314	8722	3314
6	1.2135	494	241	0.1052	43	8	791	358	791	358	791	358
7	1.1516	38	26	0.1671	6	1	65	39	65	39	65	39
Total		14329	4980		24990	2784	136962	23321	68881	17557	68881	17557

Year:	**2005**	**F multiplie**	**1**	**Fleet1 HCI**	**0.3133**	**Fleet1 DFI**	**0.1176**					
	Total											
Age	**F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.0081	422	86	0.3373	17701	1440	68081	5764	0	0	0	0
2	0.0914	2893	728	0.1663	5265	865	39462	7721	39462	7721	39462	7721
3	0.2918	5494	1677	0.1037	1953	416	24988	6980	24988	6980	24988	6980
4	0.5569	2288	835	0.0827	340	78	6072	2099	6072	2099	6072	2099
5	0.9705	2067	849	0.1266	270	75	3801	1444	3801	1444	3801	1444
6	1.2135	1488	725	0.1052	129	26	2384	1079	2384	1079	2384	1079
7	1.1516	111	75	0.1671	16	3	187	112	187	112	187	112
Total		14762	4976		25674	2902	144975	25200	76894	19436	76894	19436

Year:	**2006**	**F multiplie**	**1**	**Fleet1 HCI**	**0.3133**	**Fleet1 DFI**	**0.1176**					
	Total											
Age	**F**	**CatchNos**	**Yield**	**DF**	**DCatchNo**	**DYield**	**StockNos**	**Biomass**	**SSNos(Ja**	**SSB(Jan)**	**SSNos(ST**	**SSB(ST)**
1	0.0081	422	86	0.3373	17701	1440	68081	5764	0	0	0	0
2	0.0914	2893	728	0.1663	5265	865	39462	7721	39462	7721	39462	7721
3	0.2918	5490	1676	0.1037	1951	416	24971	6975	24971	6975	24971	6975
4	0.5569	5191	1895	0.0827	771	177	13776	4762	13776	4762	13776	4762
5	0.9705	1426	586	0.1266	186	52	2623	997	2623	997	2623	997
6	1.2135	648	316	0.1052	56	11	1039	470	1039	470	1039	470
7	1.1516	334	224	0.1671	48	9	563	338	563	338	563	338
Total		16404	5512		25979	2970	150514	27027	82433	21263	82433	21263

Input units are thousands and kg - output in tonnes

Table 5.1.8.4 (a) Detailed Yield Per Recruit Output Table

MFYPR version 2a
Run: WHG6aSCGFSYPR
Time and date: 08:10 5/12/2004
Yield per results

Total FMult	Landings Fbar	CatchNos	Landing Yield	Discards Fbar	CatchNos	Discard Yield	Total Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.5167	1.9560	4.5167	1.8714	4.5167	1.8714
0.1000	0.0543	0.1796	0.0818	0.0253	0.0951	0.0136	0.0954	4.1180	1.2224	3.1180	1.1378	3.1180	1.1378
0.2000	0.1085	0.2469	0.1031	0.0505	0.1728	0.0238	0.1269	3.4049	0.8808	2.4049	0.7961	2.4049	0.7961
0.3000	0.1628	0.2725	0.1060	0.0758	0.2381	0.0318	0.1378	2.9648	0.6881	1.9648	0.6034	1.9648	0.6034
0.4000	0.2171	0.2794	0.1026	0.1011	0.2942	0.0381	0.1407	2.6619	0.5660	1.6619	0.4813	1.6619	0.4813
0.5000	0.2713	0.2770	0.0970	0.1263	0.3432	0.0433	0.1403	2.4382	0.4823	1.4382	0.3977	1.4382	0.3977
0.6000	0.3256	0.2698	0.0909	0.1516	0.3865	0.0476	0.1385	2.2647	0.4215	1.2647	0.3369	1.2647	0.3369
0.7000	0.3799	0.2603	0.0849	0.1769	0.4251	0.0511	0.1360	2.1255	0.3753	1.1255	0.2907	1.1255	0.2907
0.8000	0.4342	0.2496	0.0791	0.2021	0.4598	0.0541	0.1332	2.0107	0.3390	1.0107	0.2544	1.0107	0.2544
0.9000	0.4884	0.2386	0.0738	0.2274	0.4911	0.0567	0.1305	1.9141	0.3097	0.9141	0.2251	0.9141	0.2251
1.0000	0.5427	0.2276	0.0690	0.2527	0.5194	0.0589	0.1279	1.8316	0.2856	0.8316	0.2009	0.8316	0.2009
1.1000	0.5970	0.2169	0.0645	0.2779	0.5453	0.0608	0.1253	1.7602	0.2653	0.7602	0.1806	0.7602	0.1806
1.2000	0.6512	0.2066	0.0604	0.3032	0.5688	0.0624	0.1228	1.6977	0.2480	0.6977	0.1633	0.6977	0.1633
1.3000	0.7055	0.1968	0.0567	0.3285	0.5905	0.0639	0.1206	1.6426	0.2331	0.6426	0.1485	0.6426	0.1485
1.4000	0.7598	0.1875	0.0533	0.3537	0.6103	0.0651	0.1184	1.5936	0.2202	0.5936	0.1355	0.5936	0.1355
1.5000	0.8140	0.1788	0.0501	0.3790	0.6286	0.0661	0.1162	1.5497	0.2088	0.5497	0.1242	0.5497	0.1242
1.6000	0.8683	0.1706	0.0472	0.4043	0.6454	0.0671	0.1143	1.5102	0.1988	0.5102	0.1141	0.5102	0.1141
1.7000	0.9226	0.1629	0.0446	0.4296	0.6610	0.0679	0.1125	1.4745	0.1898	0.4745	0.1052	0.4745	0.1052
1.8000	0.9768	0.1557	0.0422	0.4548	0.6755	0.0686	0.1108	1.4422	0.1819	0.4422	0.0972	0.4422	0.0972
1.9000	1.0311	0.1489	0.0399	0.4801	0.6889	0.0692	0.1091	1.4126	0.1747	0.4126	0.0900	0.4126	0.0900
2.0000	1.0854	0.1426	0.0379	0.5054	0.7013	0.0698	0.1077	1.3857	0.1682	0.3857	0.0835	0.3857	0.0835

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.5427
FMax	0.2798	0.1518
F0.1	0.1690	0.0917
F35%SPR	0.2680	0.1455

Weights in kilograms

Table 5.1.8.4 (b) Detailed Yield Per Recruit Output Table

MFYPR version 2a
Run: WHG6aSCGFSnotrendYPR
Time and date: 08:23 5/12/2004
Yield per results

Total	Landings			Discards									
FMult	**Fbar**	**CatchNos**	**Landing Yield**	**Fbar**	**CatchNos**	**Discard Yield**	**Total Yield**	**StockNos**	**Biomass**	**SpwnNosJan**	**SSBJan**	**SpwnNosSpwn**	**SSBSpwn**
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.5167	1.9560	4.5167	1.8714	4.5167	1.8714
0.1000	0.0580	0.1854	0.0838	0.0272	0.1006	0.0144	0.0982	4.0593	1.1928	3.0593	1.1082	3.0593	1.1082
0.2000	0.1160	0.2513	0.1037	0.0544	0.1816	0.0251	0.1288	3.3389	0.8503	2.3389	0.7657	2.3389	0.7657
0.3000	0.1740	0.2747	0.1054	0.0815	0.2490	0.0333	0.1387	2.9009	0.6609	1.9009	0.5762	1.9009	0.5762
0.4000	0.2320	0.2794	0.1012	0.1087	0.3065	0.0397	0.1409	2.6019	0.5424	1.6019	0.4577	1.6019	0.4577
0.5000	0.2900	0.2753	0.0951	0.1359	0.3565	0.0449	0.1400	2.3822	0.4617	1.3822	0.3770	1.3822	0.3770
0.6000	0.3479	0.2668	0.0886	0.1631	0.4004	0.0491	0.1377	2.2124	0.4033	1.2124	0.3186	1.2124	0.3186
0.7000	0.4059	0.2562	0.0824	0.1903	0.4394	0.0526	0.1350	2.0765	0.3591	1.0765	0.2744	1.0765	0.2744
0.8000	0.4639	0.2447	0.0766	0.2175	0.4743	0.0556	0.1322	1.9647	0.3244	0.9647	0.2398	0.9647	0.2398
0.9000	0.5219	0.2330	0.0712	0.2446	0.5058	0.0581	0.1293	1.8709	0.2965	0.8709	0.2118	0.8709	0.2118
1.0000	0.5799	0.2215	0.0663	0.2718	0.5341	0.0602	0.1265	1.7909	0.2735	0.7909	0.1888	0.7909	0.1888
1.1000	0.6379	0.2105	0.0619	0.2990	0.5599	0.0621	0.1240	1.7217	0.2542	0.7217	0.1695	0.7217	0.1695
1.2000	0.6959	0.1999	0.0578	0.3262	0.5834	0.0636	0.1214	1.6612	0.2377	0.6612	0.1531	0.6612	0.1531
1.3000	0.7539	0.1900	0.0541	0.3534	0.6048	0.0650	0.1191	1.6080	0.2236	0.6080	0.1389	0.6080	0.1389
1.4000	0.8119	0.1806	0.0507	0.3806	0.6244	0.0661	0.1168	1.5607	0.2113	0.5607	0.1267	0.5607	0.1267
1.5000	0.8699	0.1719	0.0477	0.4077	0.6424	0.0671	0.1148	1.5184	0.2005	0.5184	0.1159	0.5184	0.1159
1.6000	0.9278	0.1636	0.0449	0.4349	0.6590	0.0680	0.1129	1.4805	0.1910	0.4805	0.1064	0.4805	0.1064
1.7000	0.9858	0.1560	0.0423	0.4621	0.6743	0.0687	0.1110	1.4462	0.1826	0.4462	0.0979	0.4462	0.0979
1.8000	1.0438	0.1488	0.0399	0.4893	0.6885	0.0694	0.1093	1.4151	0.1750	0.4151	0.0904	0.4151	0.0904
1.9000	1.1018	0.1421	0.0378	0.5165	0.7016	0.0699	0.1077	1.3868	0.1682	0.3868	0.0836	0.3868	0.0836
2.0000	1.1598	0.1359	0.0358	0.5437	0.7138	0.0704	0.1062	1.3609	0.1621	0.3609	0.0775	0.3609	0.0775

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.5799
FMax	0.2647	0.1535
F0.1	0.1595	0.0925
F35%SPR	0.2520	0.1462

Weights in kilograms

Table 5.1.8.4 (c) Detailed Yield Per Recruit Output Table
MFYPR version 2a
Run: WHG6a1995-2003YPR
Time and date: 08:31 5/12/2004
Yield per results

Total FMult	Landings Fbar	CatchNos	Landing Yield	Discards Fbar	CatchNos	Discard Yield	Total Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.5167	1.9560	4.5167	1.8714	4.5167	1.8714
0.1000	0.0674	0.1972	0.0874	0.0321	0.1128	0.0164	0.1038	3.9349	1.1314	2.9349	1.0467	2.9349	1.0467
0.2000	0.1348	0.2597	0.1043	0.0642	0.2008	0.0279	0.1322	3.2011	0.7884	2.2011	0.7037	2.2011	0.7037
0.3000	0.2021	0.2783	0.1036	0.0962	0.2726	0.0365	0.1401	2.7680	0.6062	1.7680	0.5215	1.7680	0.5215
0.4000	0.2695	0.2787	0.0978	0.1283	0.3329	0.0431	0.1409	2.4776	0.4948	1.4776	0.4102	1.4776	0.4102
0.5000	0.3369	0.2711	0.0907	0.1604	0.3847	0.0483	0.1390	2.2667	0.4202	1.2667	0.3356	1.2667	0.3356
0.6000	0.4043	0.2599	0.0837	0.1925	0.4297	0.0525	0.1362	2.1053	0.3668	1.1053	0.2822	1.1053	0.2822
0.7000	0.4717	0.2472	0.0772	0.2245	0.4693	0.0559	0.1331	1.9770	0.3267	0.9770	0.2420	0.9770	0.2420
0.8000	0.5390	0.2341	0.0712	0.2566	0.5045	0.0587	0.1299	1.8721	0.2954	0.8721	0.2107	0.8721	0.2107
0.9000	0.6064	0.2213	0.0658	0.2887	0.5358	0.0611	0.1269	1.7845	0.2703	0.7845	0.1856	0.7845	0.1856
1.0000	0.6738	0.2090	0.0609	0.3208	0.5640	0.0631	0.1240	1.7102	0.2496	0.7102	0.1650	0.7102	0.1650
1.1000	0.7412	0.1973	0.0565	0.3529	0.5894	0.0647	0.1212	1.6462	0.2324	0.6462	0.1477	0.6462	0.1477
1.2000	0.8086	0.1864	0.0526	0.3849	0.6123	0.0661	0.1187	1.5905	0.2178	0.5905	0.1331	0.5905	0.1331
1.3000	0.8759	0.1762	0.0490	0.4170	0.6332	0.0673	0.1163	1.5415	0.2053	0.5415	0.1206	0.5415	0.1206
1.4000	0.9433	0.1668	0.0458	0.4491	0.6522	0.0683	0.1141	1.4982	0.1944	0.4982	0.1097	0.4982	0.1097
1.5000	1.0107	0.1580	0.0428	0.4812	0.6695	0.0692	0.1120	1.4596	0.1849	0.4596	0.1002	0.4596	0.1002
1.6000	1.0781	0.1498	0.0402	0.5133	0.6854	0.0699	0.1101	1.4250	0.1765	0.4250	0.0919	0.4250	0.0919
1.7000	1.1455	0.1422	0.0378	0.5453	0.7001	0.0705	0.1083	1.3939	0.1691	0.3939	0.0844	0.3939	0.0844
1.8000	1.2129	0.1352	0.0356	0.5774	0.7135	0.0711	0.1067	1.3657	0.1625	0.3657	0.0778	0.3657	0.0778
1.9000	1.2802	0.1287	0.0335	0.6095	0.7260	0.0715	0.1050	1.3401	0.1565	0.3401	0.0719	0.3401	0.0719
2.0000	1.3476	0.1227	0.0317	0.6416	0.7375	0.0719	0.1036	1.3167	0.1512	0.3167	0.0665	0.3167	0.0665

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.6738
FMax	0.2369	0.1596
F0.1	0.1422	0.0958
F35%SPR	0.2218	0.1494

Weights in kilograms

Table 5.1.8.4 (d) Detailed Yield Per Recruit Output Table
MFYPR version 2a
Run: WHG6aXSANEWYPR
Time and date: 07:29 5/13/2004
Yield per results

Total	Landings			Discards									
FMult	Fbar	CatchNos	Landing Yield	Fbar	CatchNos	Discard Yield	Total Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.5167	1.9560	4.5167	1.8714	4.5167	1.8714
0.1000	0.0313	0.1783	0.0897	0.0118	0.0608	0.0086	0.0983	4.2910	1.2856	3.2910	1.2010	3.2910	1.2010
0.2000	0.0627	0.2459	0.1142	0.0235	0.1126	0.0155	0.1297	3.7052	0.9914	2.7052	0.9067	2.7052	0.9067
0.3000	0.0940	0.2762	0.1202	0.0353	0.1580	0.0211	0.1413	3.3400	0.8231	2.3400	0.7384	2.3400	0.7384
0.4000	0.1253	0.2898	0.1196	0.0470	0.1988	0.0259	0.1455	3.0795	0.7121	2.0795	0.6274	2.0795	0.6274
0.5000	0.1567	0.2946	0.1164	0.0588	0.2359	0.0300	0.1464	2.8785	0.6321	1.8785	0.5474	1.8785	0.5474
0.6000	0.1880	0.2943	0.1121	0.0705	0.2701	0.0336	0.1457	2.7153	0.5709	1.7153	0.4862	1.7153	0.4862
0.7000	0.2193	0.2909	0.1075	0.0823	0.3019	0.0368	0.1443	2.5784	0.5220	1.5784	0.4374	1.5784	0.4374
0.8000	0.2507	0.2856	0.1028	0.0940	0.3315	0.0397	0.1425	2.4607	0.4817	1.4607	0.3971	1.4607	0.3971
0.9000	0.2820	0.2791	0.0982	0.1058	0.3592	0.0423	0.1405	2.3577	0.4477	1.3577	0.3630	1.3577	0.3630
1.0000	0.3133	0.2719	0.0938	0.1176	0.3852	0.0446	0.1384	2.2665	0.4184	1.2665	0.3338	1.2665	0.3338
1.1000	0.3447	0.2642	0.0896	0.1293	0.4098	0.0468	0.1364	2.1849	0.3929	1.1849	0.3083	1.1849	0.3083
1.2000	0.3760	0.2563	0.0856	0.1411	0.4329	0.0488	0.1344	2.1112	0.3704	1.1112	0.2857	1.1112	0.2857
1.3000	0.4073	0.2483	0.0818	0.1528	0.4548	0.0506	0.1324	2.0443	0.3504	1.0443	0.2657	1.0443	0.2657
1.4000	0.4387	0.2404	0.0782	0.1646	0.4754	0.0522	0.1304	1.9832	0.3324	0.9832	0.2477	0.9832	0.2477
1.5000	0.4700	0.2325	0.0747	0.1763	0.4950	0.0538	0.1285	1.9271	0.3162	0.9271	0.2315	0.9271	0.2315
1.6000	0.5013	0.2247	0.0715	0.1881	0.5135	0.0552	0.1267	1.8755	0.3014	0.8755	0.2168	0.8755	0.2168
1.7000	0.5327	0.2172	0.0684	0.1998	0.5311	0.0565	0.1249	1.8278	0.2880	0.8278	0.2033	0.8278	0.2033
1.8000	0.5640	0.2098	0.0654	0.2116	0.5478	0.0577	0.1231	1.7835	0.2757	0.7835	0.1910	0.7835	0.1910
1.9000	0.5953	0.2026	0.0626	0.2233	0.5636	0.0589	0.1215	1.7424	0.2644	0.7424	0.1797	0.7424	0.1797
2.0000	0.6267	0.1957	0.0600	0.2351	0.5787	0.0599	0.1199	1.7042	0.2540	0.7042	0.1693	0.7042	0.1693

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.3133
FMax	0.3316	0.1039
F0.1	0.1741	0.0545
F35%SPR	0.3716	0.1164

Weights in kilograms

Table 5.2.1.1. Nominal catch (t) of WHITING in Division VIb, 1986–2003, as officially reported to ICES.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[1]
France	-															
Ireland	-	-	-	-	-	32	10	4	23	3	1	-	-	10		
Spain	-	-	-	-	-	-	-	-	-	-	-	+	-	-		
UK (E.& W)[3]	-	16	6	1	5	10	2	5	26	49	20	+	+	-		
UK (N.Ireland)	-	…	…	…	…	…	…	…	…	…	…	…	…		…	
UK (Scotland)	23	18	482	459	283	86	68	53	36	65	23	44	58	4	…	
UK (all)															7	11
Total	23	34	488	460	288	128	80	62	85	117	44	44	58	14	7	11

[1]Preliminary.

Figure 5.1.2.1a. Whiting in Division VIa. Survey indices by age and year-class. The solid line is the raw data while the thick broken line is estimated using a smooth function (*supsmu*) which estimates the mean using cross-validation.

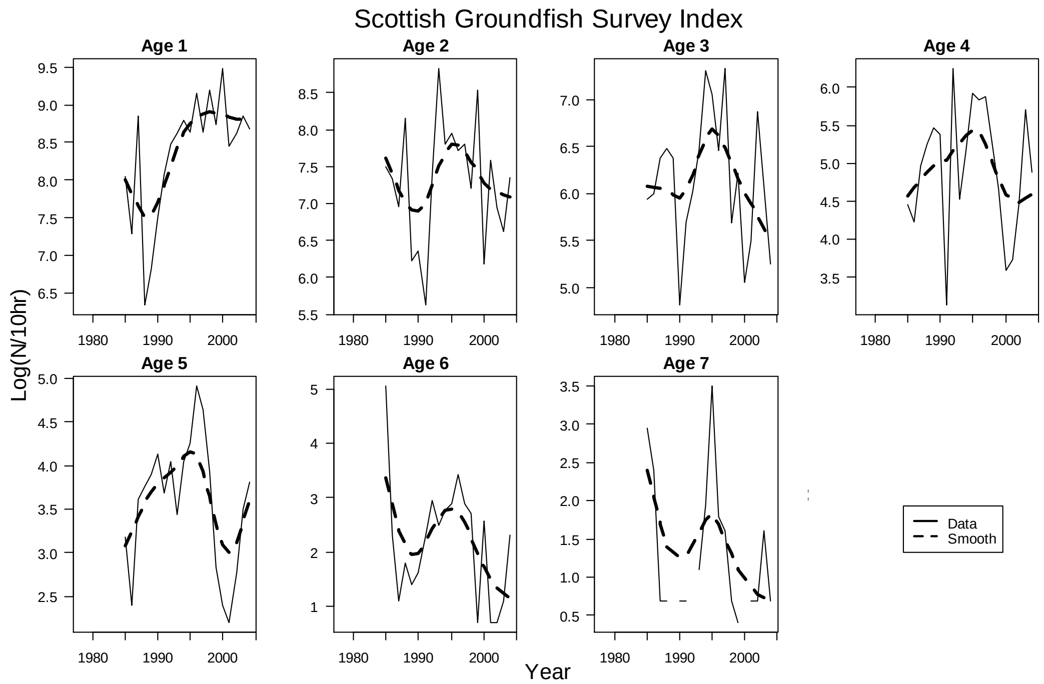


Figure 5.1.2.1b. Whiting in Division VIa. Survey indices by year-class from SURBA output.

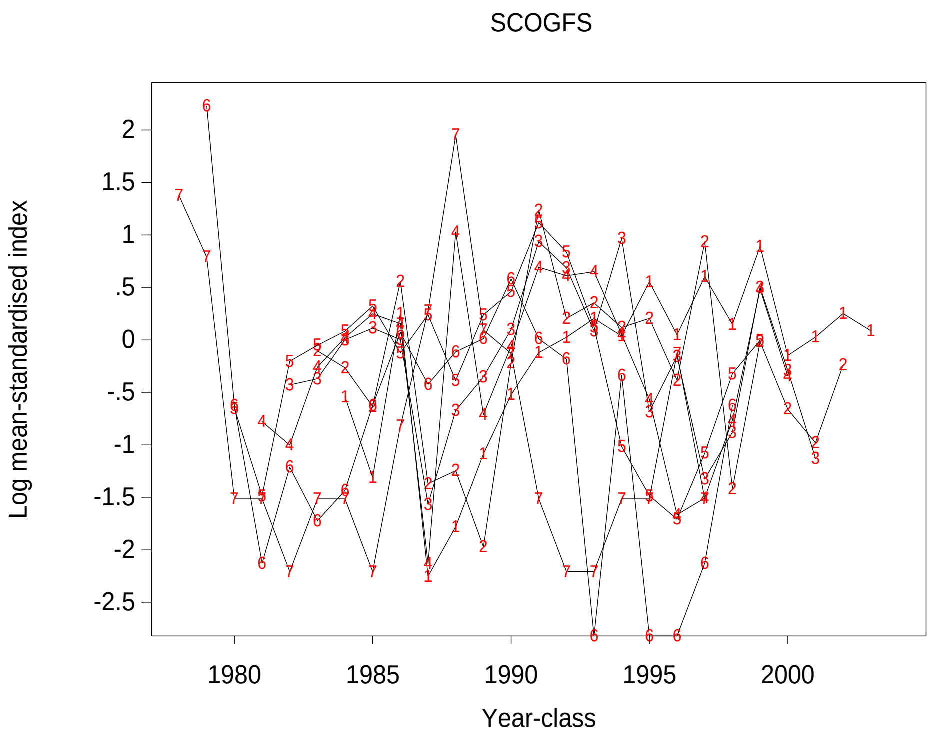


Figure 5.1.2.1 c. Whiting in Division VIa. Catch curves for log(Total Catch), Scottish Groundfish survey (top and bottom). Average weights by cohort are plotted in the bottom plot.

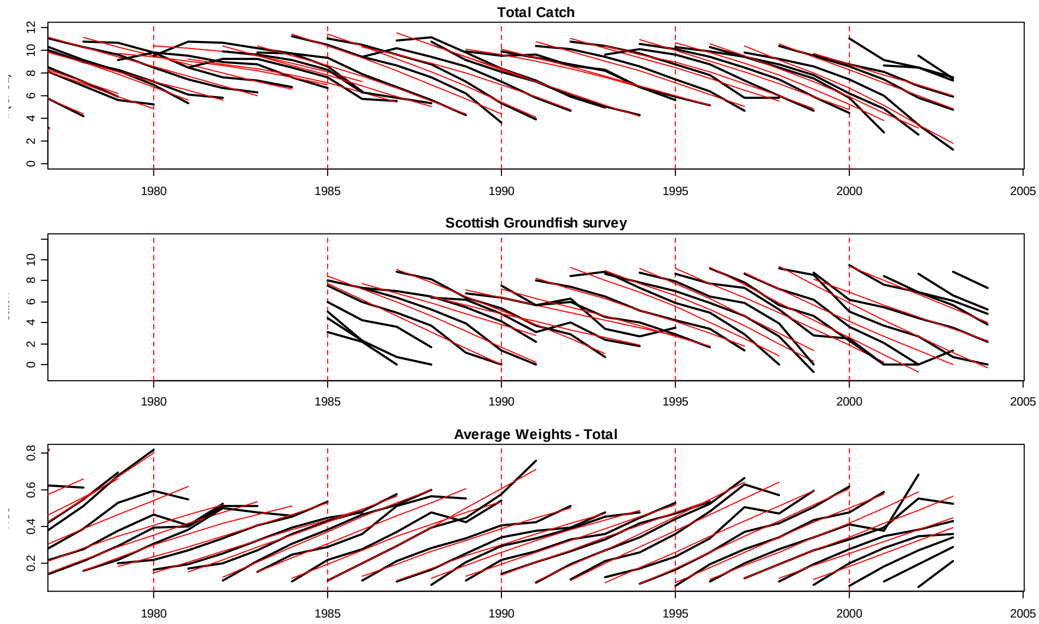


Figure 5.1.2.1 d. Whiting in Division VIa. Total landings by by age and year. The solid line is the raw data while the thick broken line is estimated using a smooth function (*supsmu*) which estimates using cross-validation.

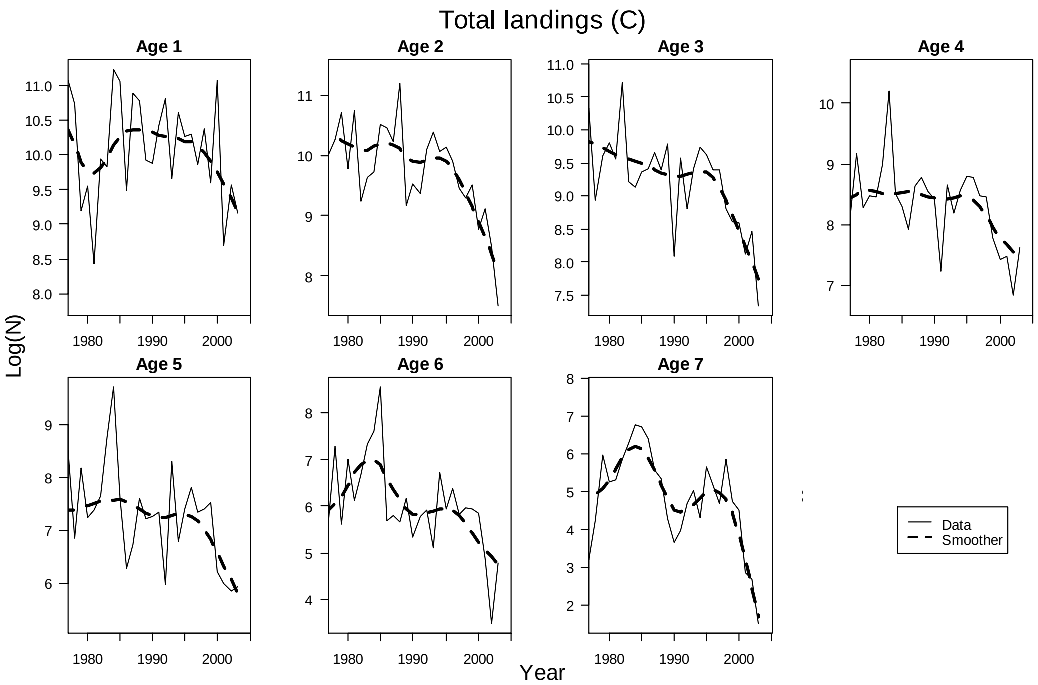


Figure 5.1.2.1e. Whiting in Division VIa. Effort (hours) and Landings per Unit Effort (kg/h) from the Scottish fleet. SCOLTR=Scottish Light Trawl, SCOSEI=Scottish Seine Net and SCONTR=Scottish Nephrops Trawl.

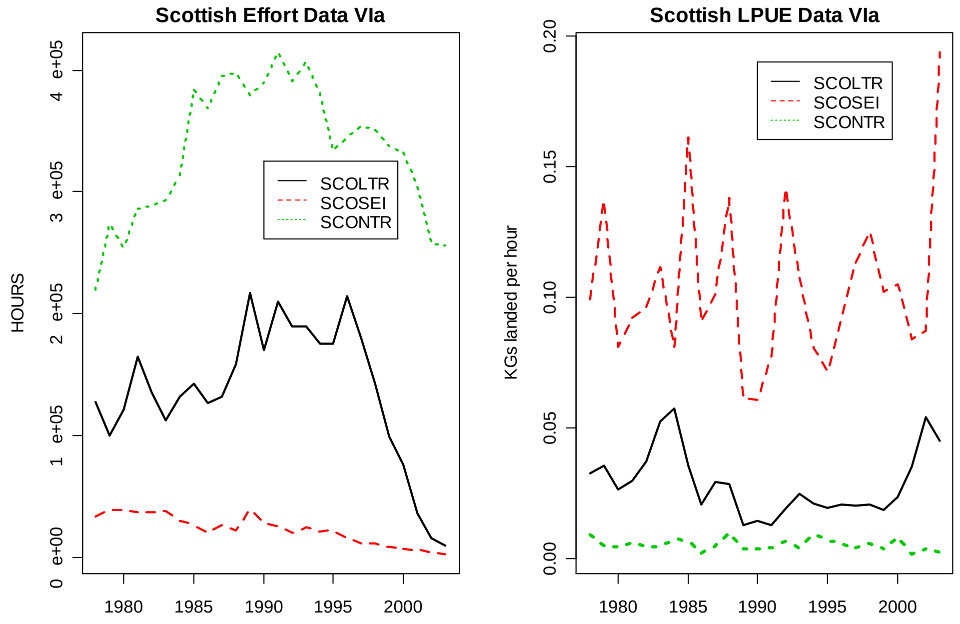
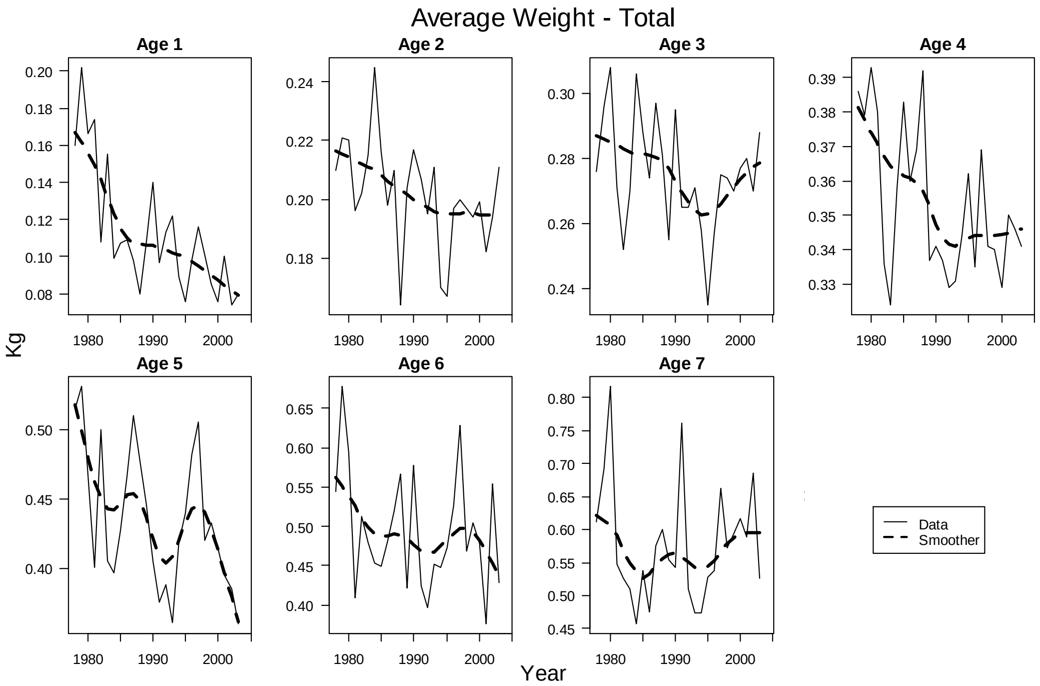
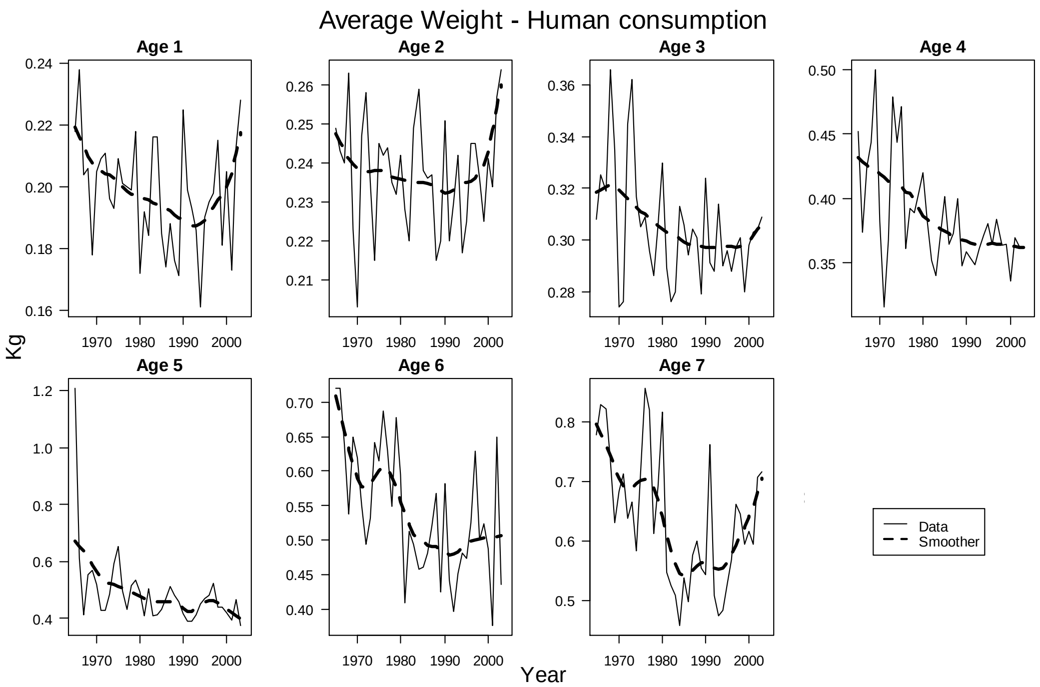


Figure 5.1.3.2 (a,b,c). Whiting in Division VIa. Mean weights at age for total catch (top), human consumption landings (middle) and discards (bottom). Trends are summarised using a smoothing algorithm (*supsmu*) which finds the mean by cross-validation.

[a]



[b]



[c]

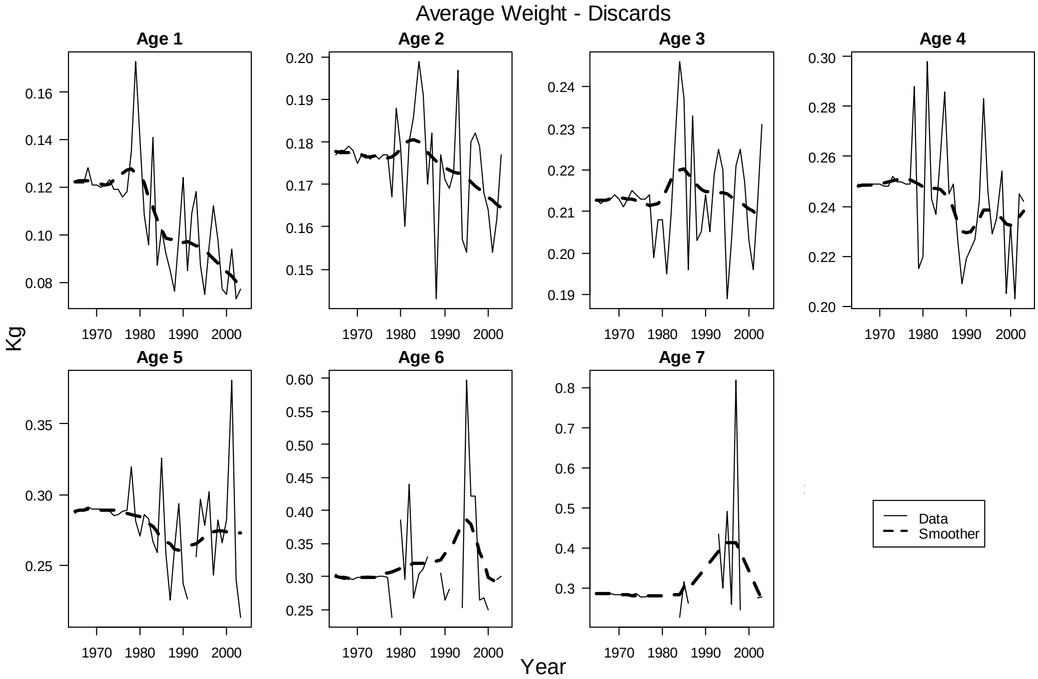

Average Weight - Discards
Age 1
Age 2
Age 3
Age 4
Age 5
Age 6
Age 7
Kg
Year
Data
Smoother

Figure 5.1.5.1a. Whiting in VIa. Residuals by age from separable VPA**.**

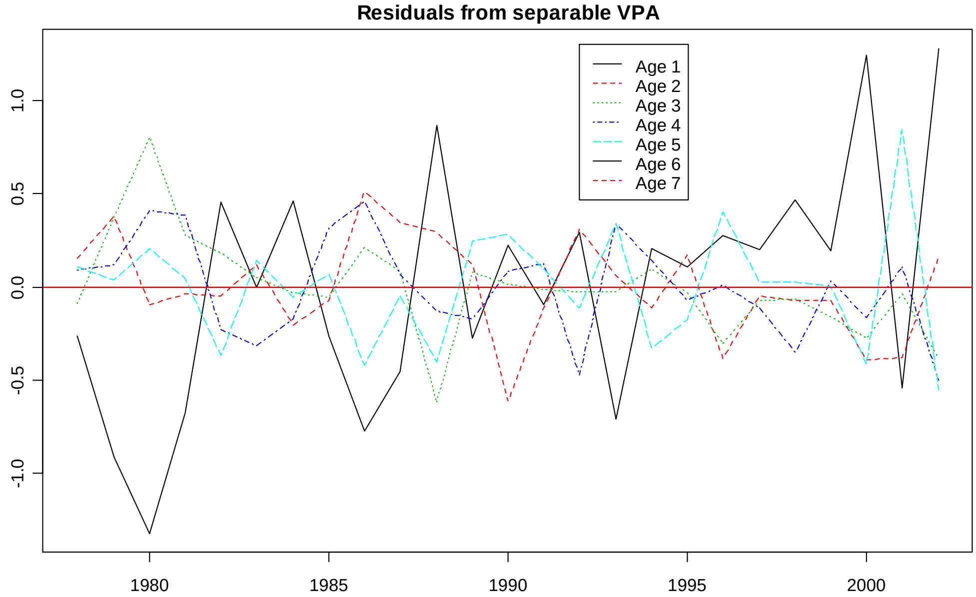


Figure 5.1.5.1.1d. Whiting in VIa. Residuals by age from XSA**.**

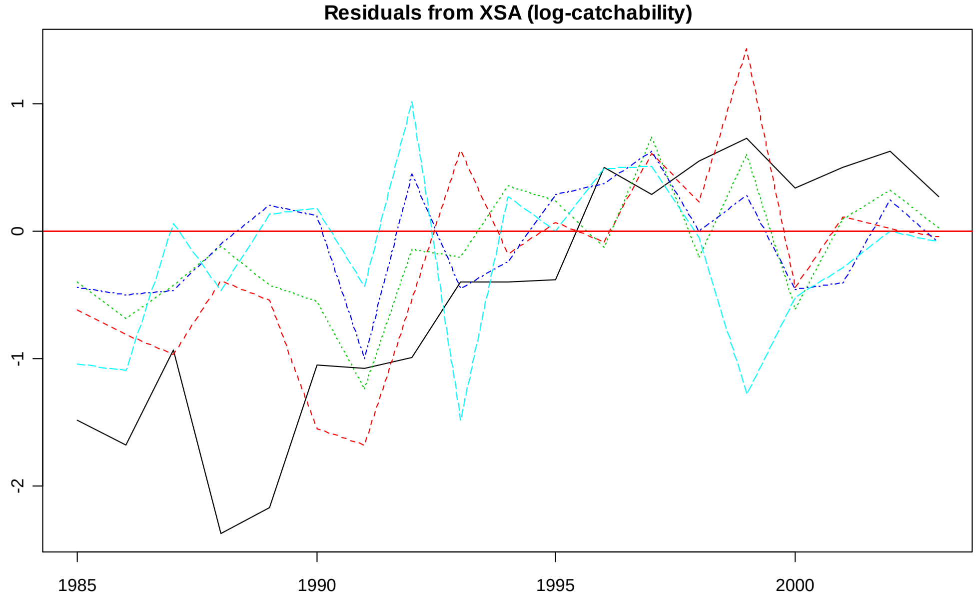


Figure 5.1.5.2a. Whiting in VIa. Comparison between F, Recruitment and SSB using the 3 different tsa runs, SURBA and XSA.

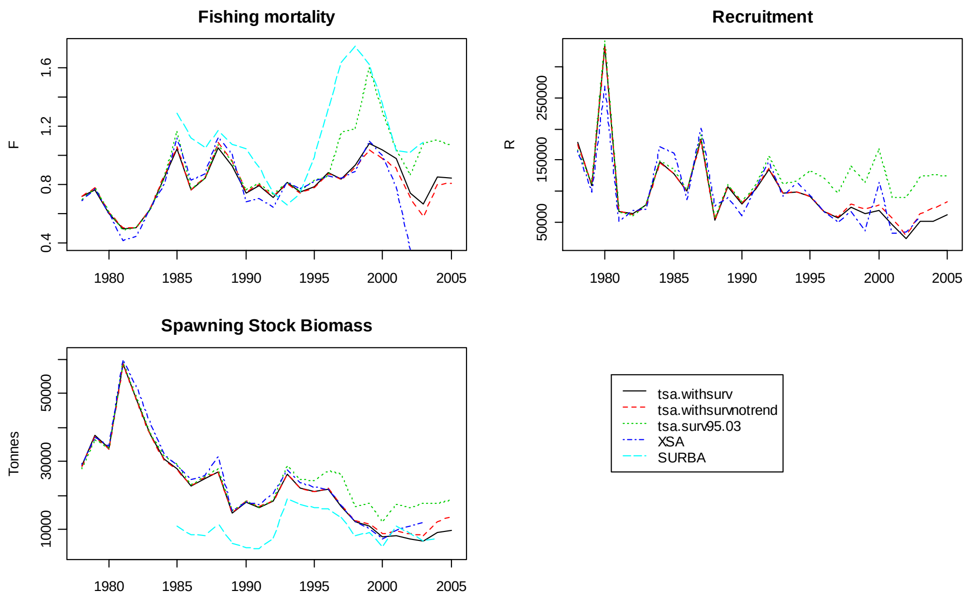


Figure 5.1.5.2.b. Whiting in VIa. Comparison between the three TSA runs**.**

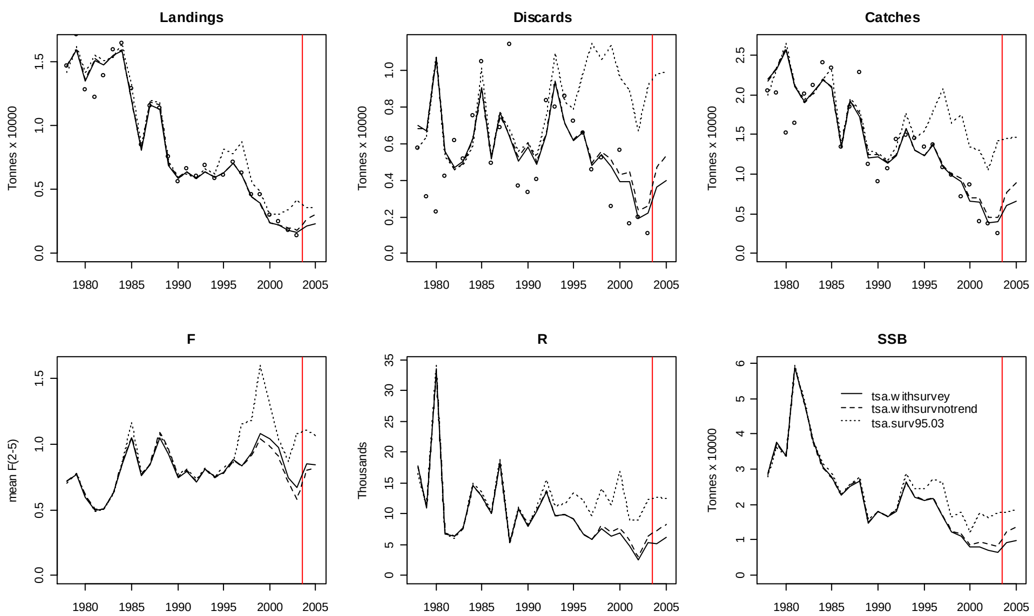


Figure 5.1.5.3.1a. Whiting in Division VIa. Standardised landings prediction errors from TSA analyses with: survey and trend in catchability. Broken line is a 'smoother' for highlighting poor performance.

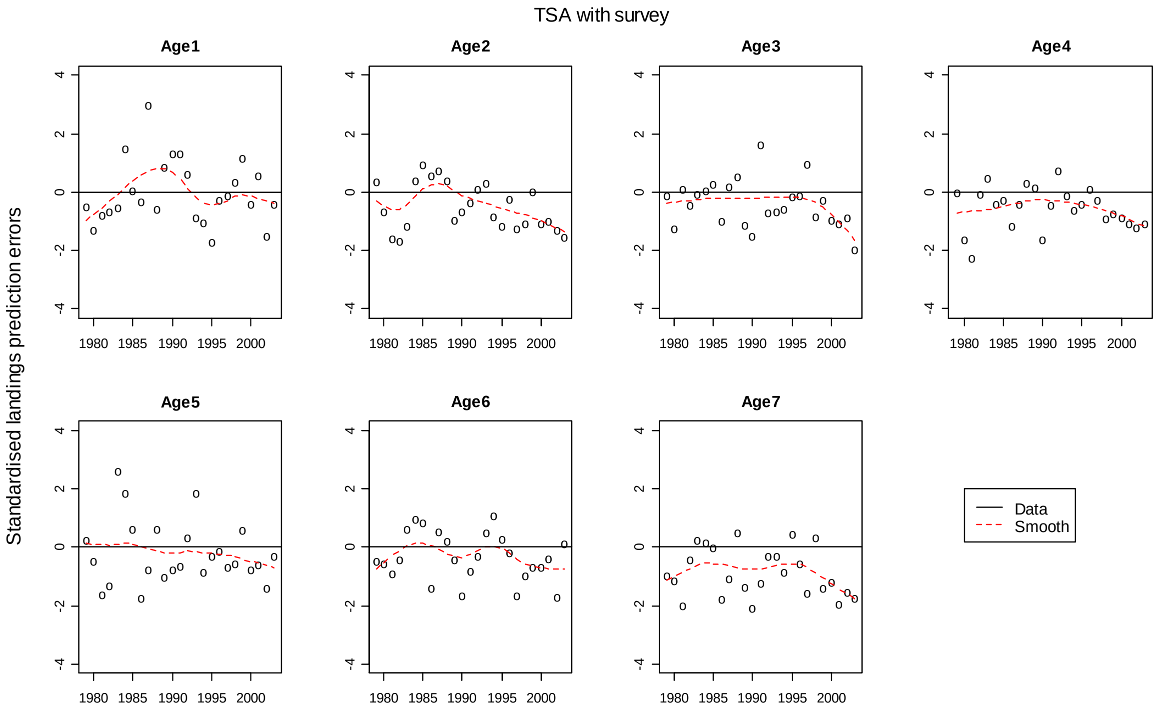


Figure 5.1.5.3.1b. Whiting in Division VIa. Standardised landings prediction errors from TSA analyses with survey and no trend in catchability.

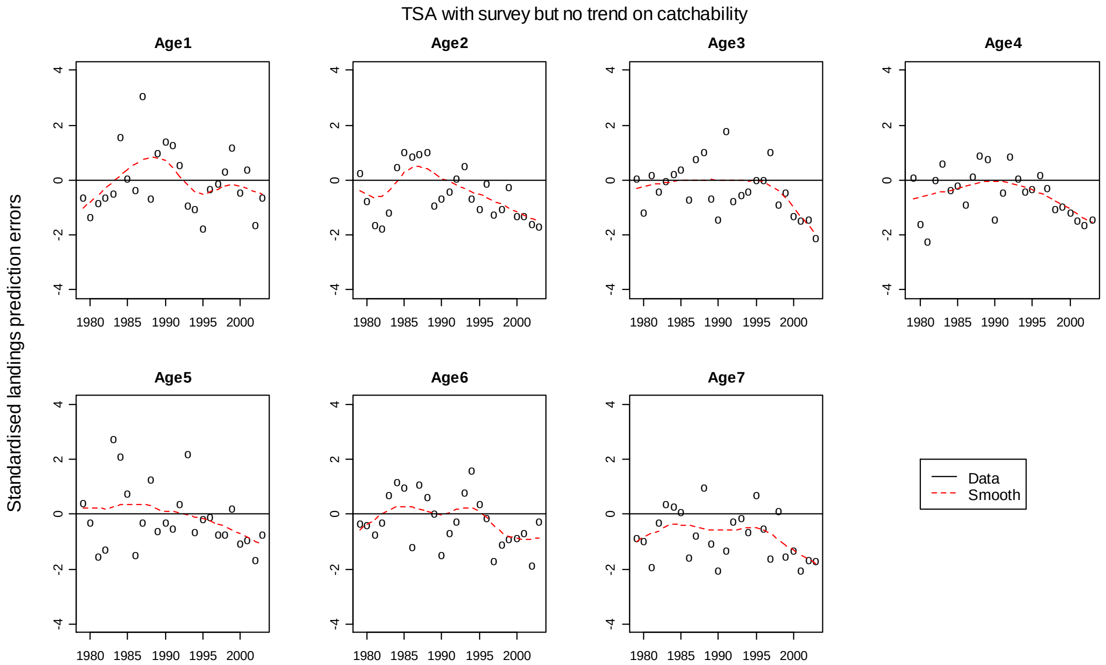


Figure 5.1.5.3.1c. Whiting in Division VIa. Standardised landings prediction errors from TSA analyses with no catch data between 1995 and 2003.

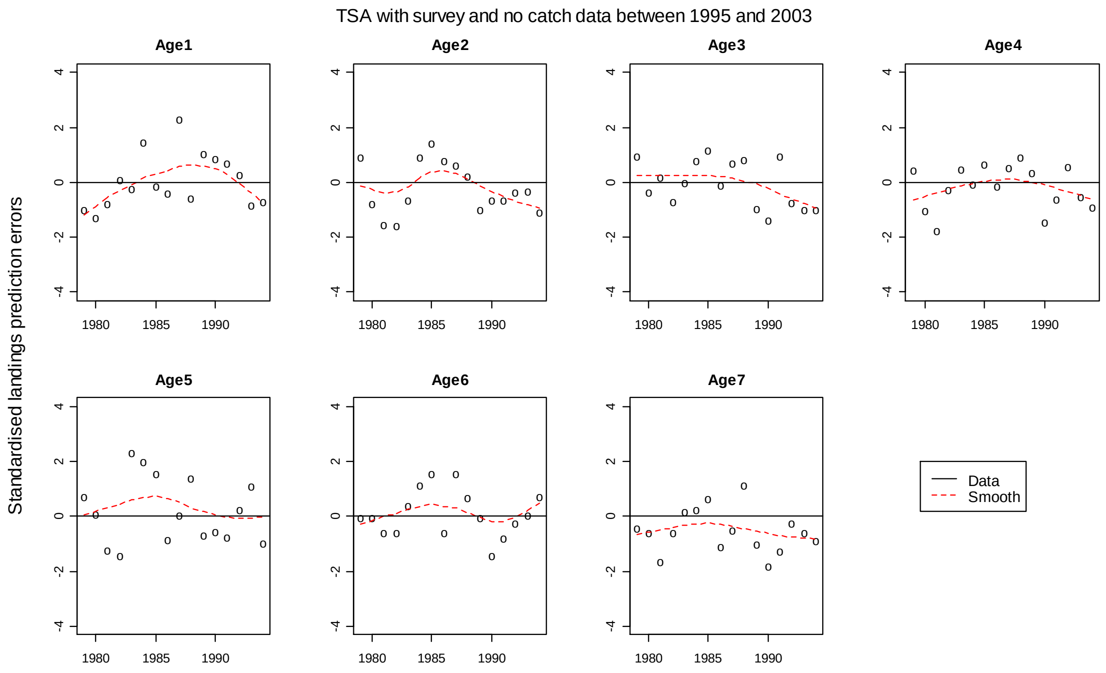


Figure 5.1.5.3.2a. Whiting in Division VIa. Standardised discard prediction errors from TSA analyses with: survey and trend in catchability. Broken line is a smoother used to highlight poor performance.

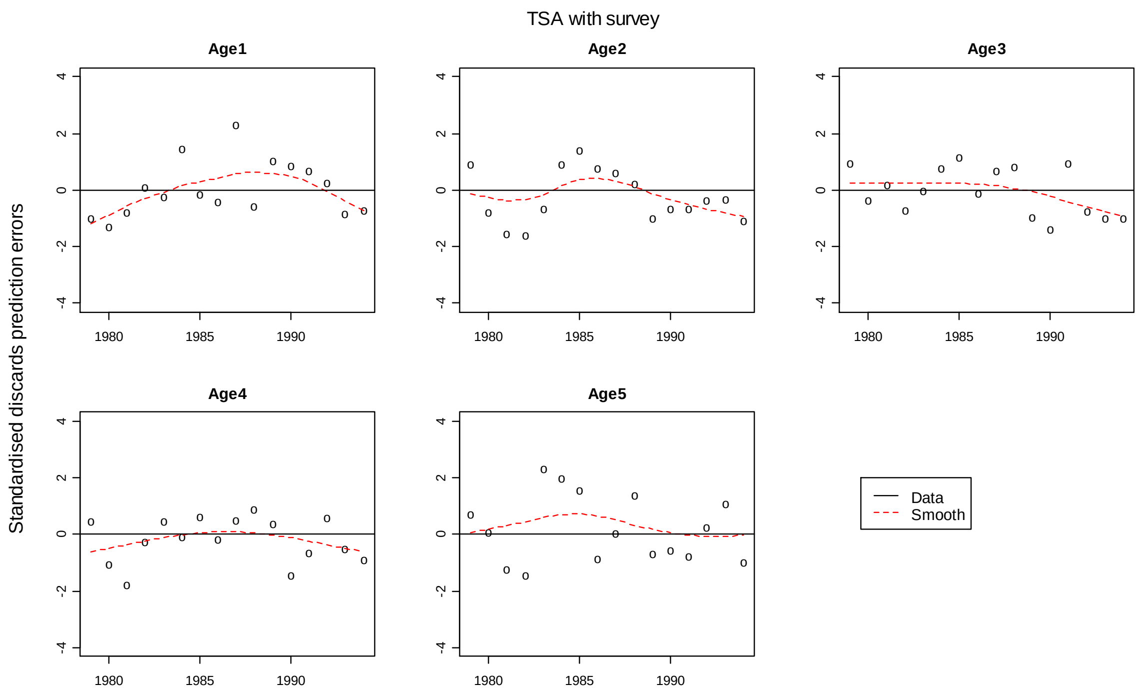


Figure 5.1.5.3.2b. Whiting in Division VIa. Standardised discard prediction errors from TSA analyses with survey and no trend in catchability.

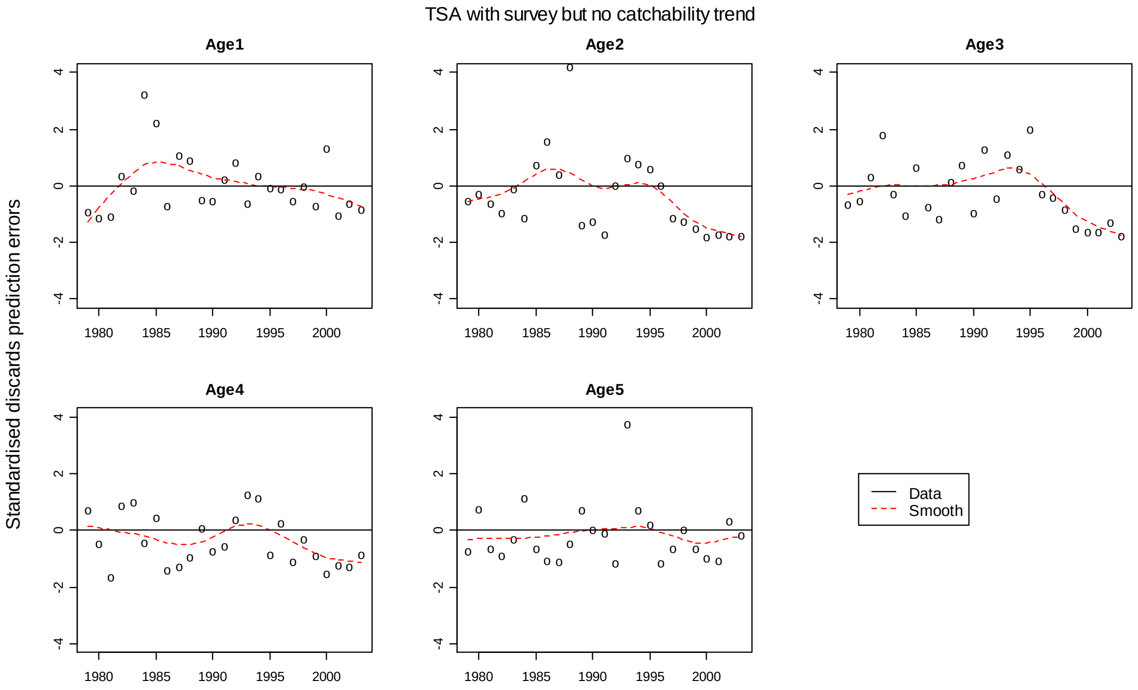


Figure 5.1.5.3.2c. Whiting in Division VIa. Standardised discard prediction errors from TSA analyses with survey and no catch data from 1995.

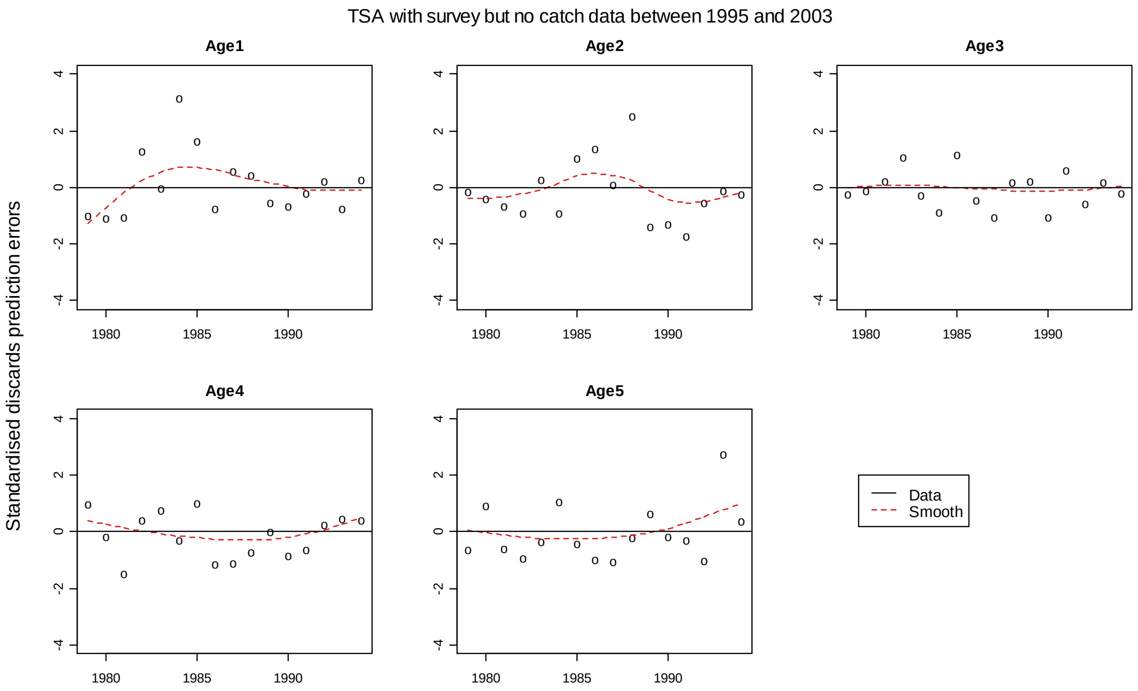


Figure 5.1.5.3.3a. Whiting in Division VIa. Standardised survey prediction errors from TSA analysis with survey and trend in catchability. Broken line is estimated by smoother to highlight trend.

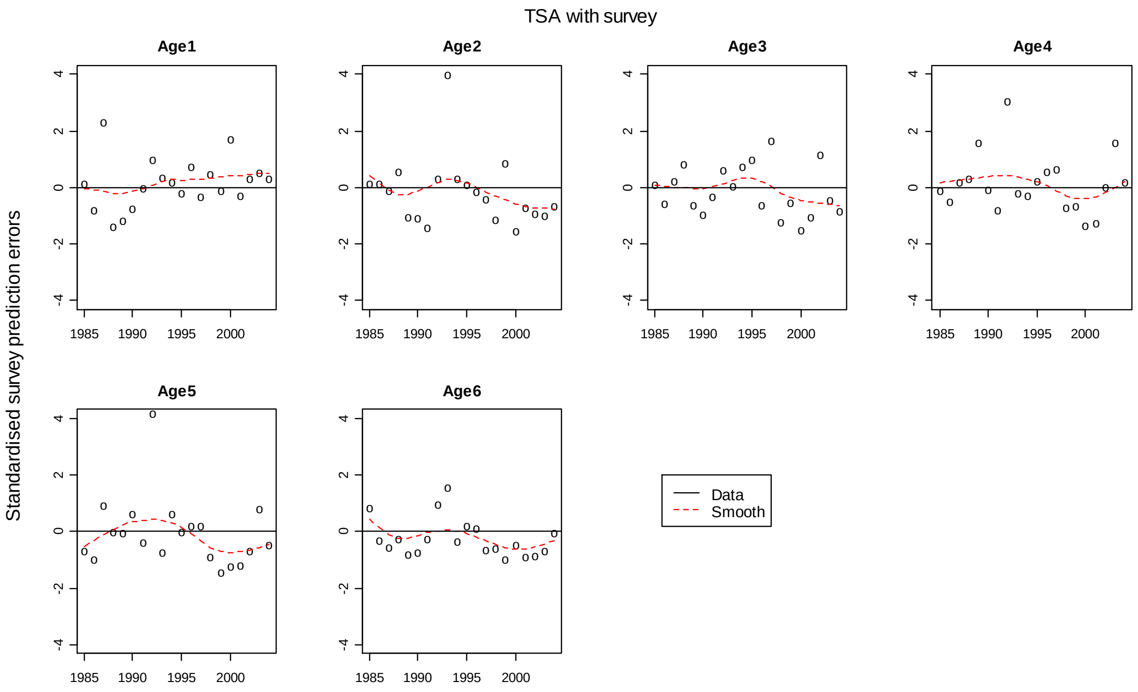


Figure 5.1.5.3.3ab Whiting in Division VIa. Standardised survey prediction errors from TSA analyses with no trend in survey catchability.

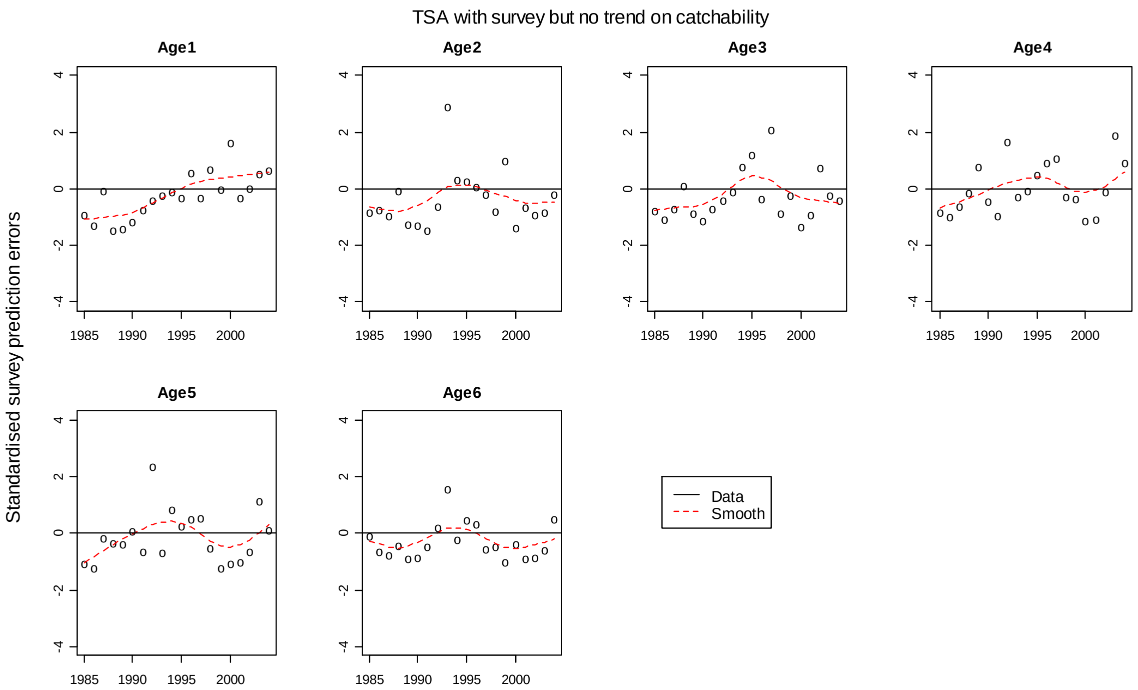


Figure 5.1.5.3.3c Whiting in Division VIa. Standardised survey prediction errors from TSA analyses with no catch data between 1995 and 2003.

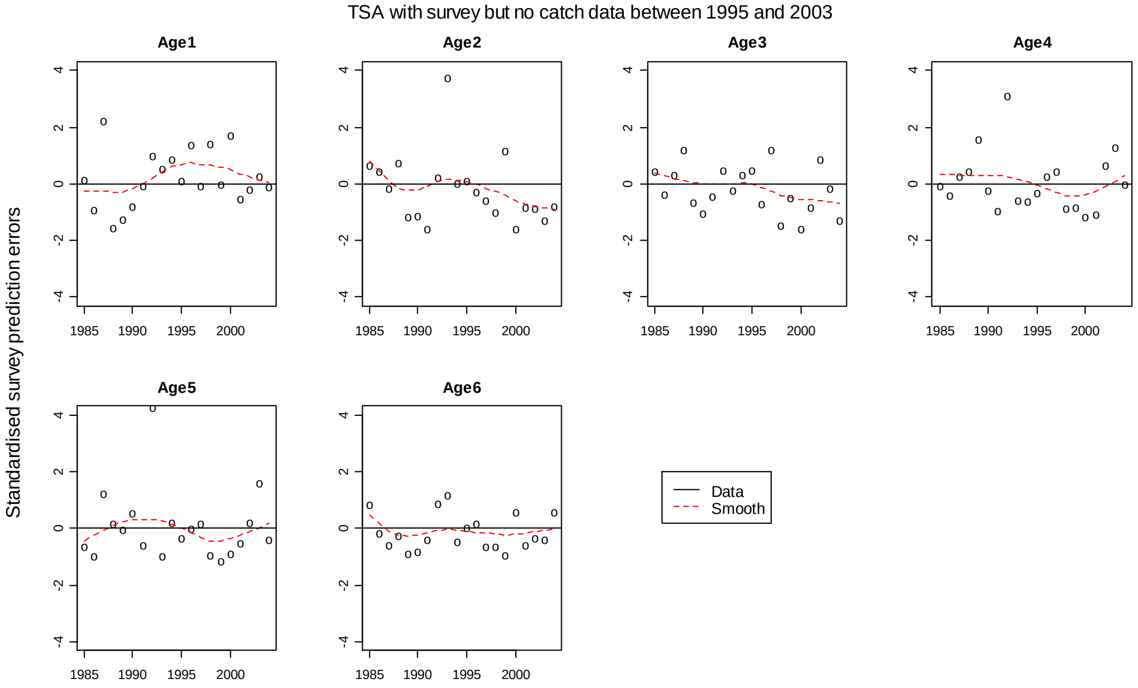
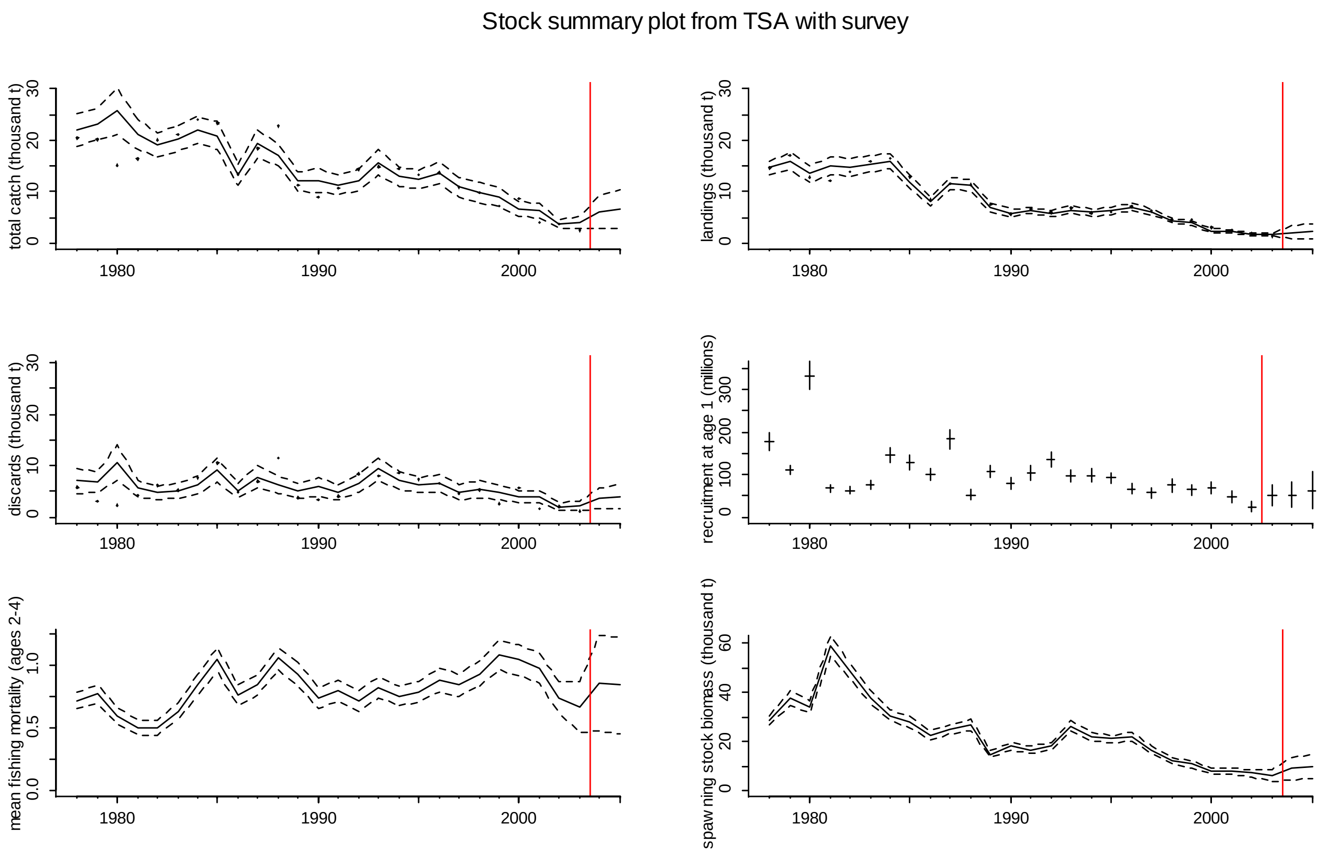


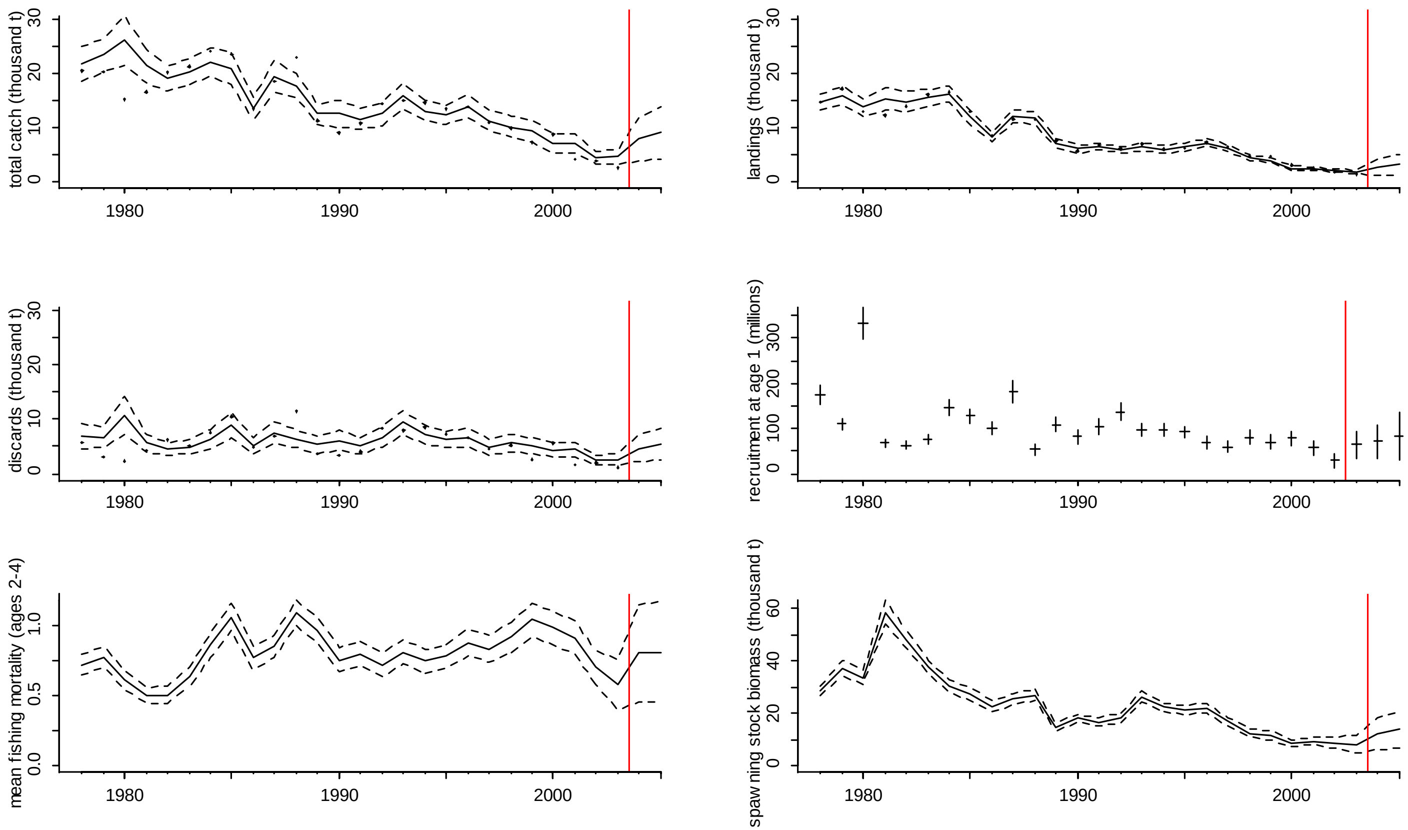
Figure 5.1.5.3.4 (a-d). Whiting in VIa. Figure showing stock summaries for the 3 TSA runs and the XSA runs.

[a]



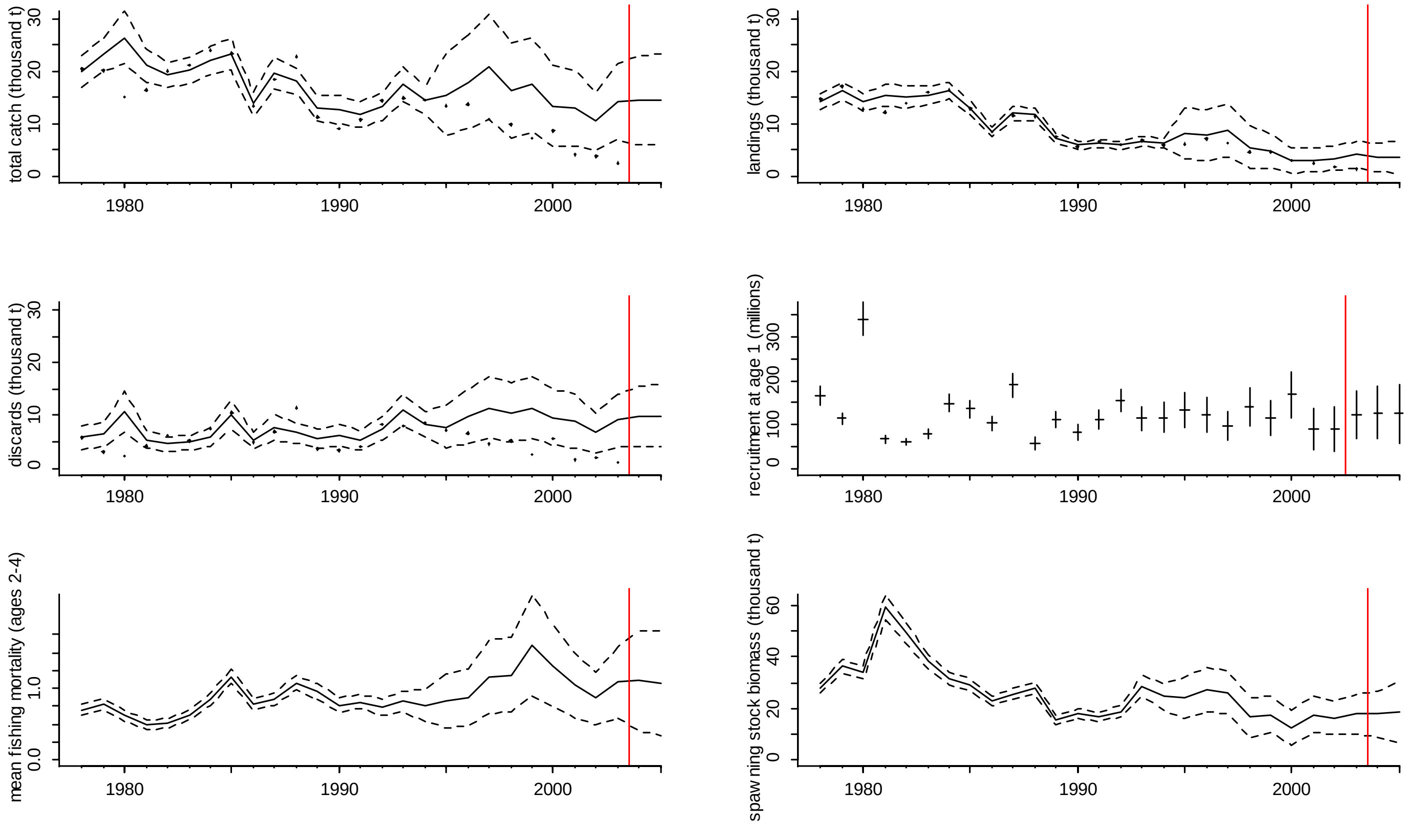
[b]

Stock summary plot from TSA with survey but no trend



[c]

Stock summary plot from TSA with no catch data 1995 - 2003



[d]

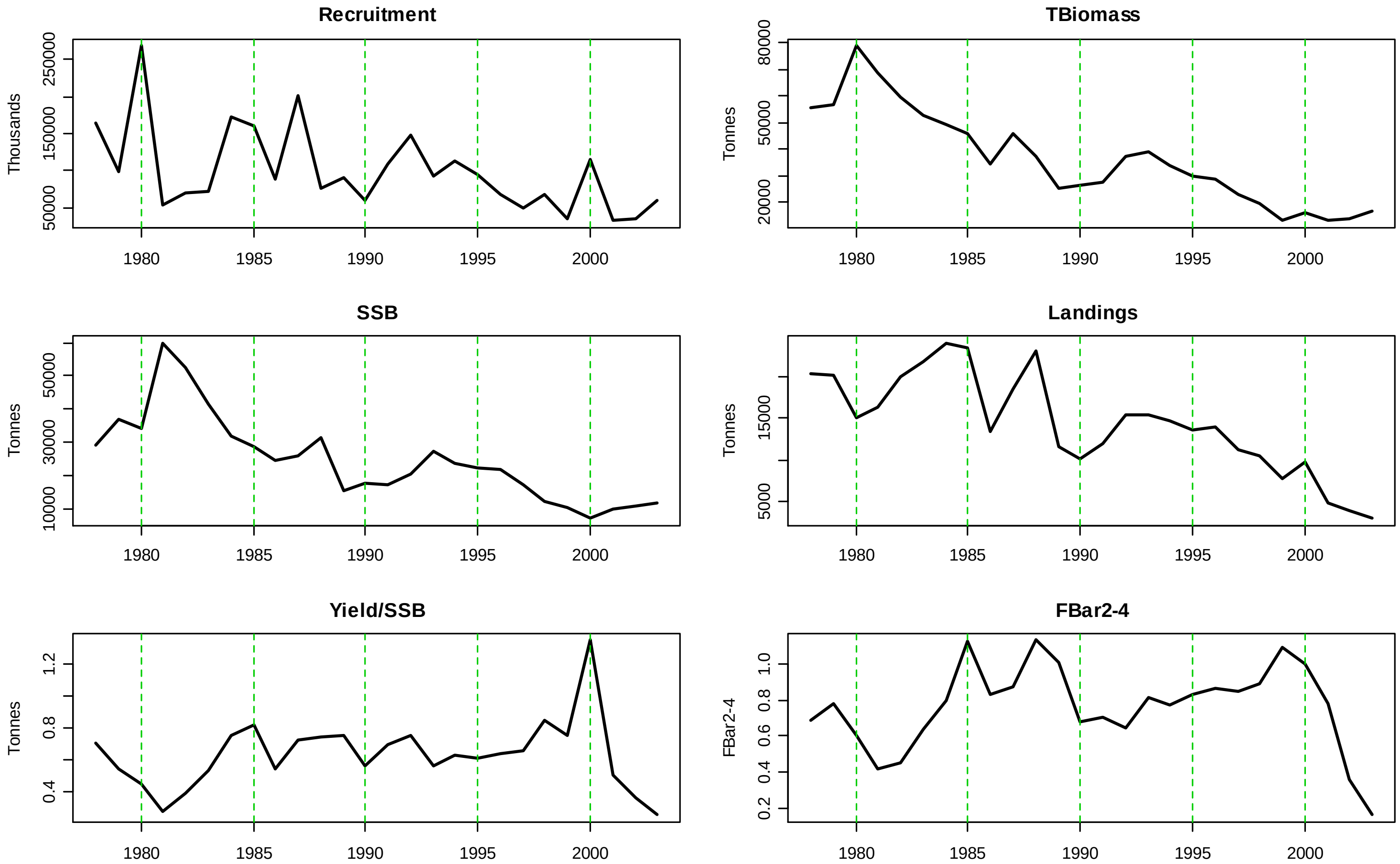

Recruitment
Thousands
50000
150000
250000
TBiomass
Tonnes
20000
50000
80000
SSB
Tonnes
10000
30000
50000
Landings
Tonnes
5000
15000
Yield/SSB
Tonnes
0.4
0.8
1.2
FBar2-4
FBar2-4
0.2
0.4
0.6
0.8
1.0
1980
1985
1990
1995
2000

Figure 5.1.5.3.5a Whiting in Division VIa. TSA-estimated Ricker stock-recruitment model fit for TSA analysis with survey and trend in catchability.The plotting symbols denote year-class.

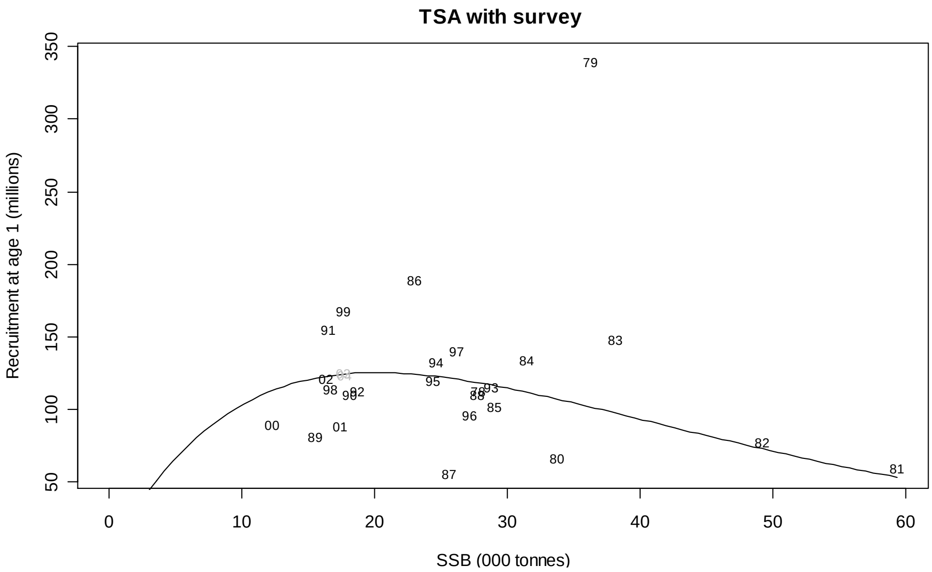


Figure 5.1.5.3.5b Whiting in Division VIa. TSA-estimated Ricker stock-recruitment model fit for TSA analysis from TSA analysis with no catch data between 1995 and 2003. The plotting symbols denote year-class.

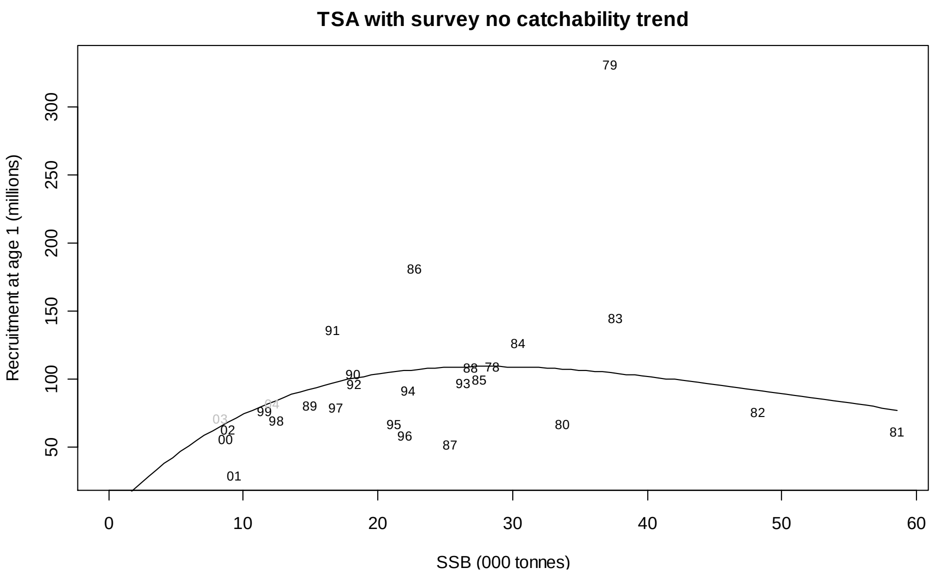


Figure 5.1.5.3.5c Whiting in Division VIa. TSA-estimated Ricker stock-recruitment model fit for TSA analysis from TSA analysis with no catch data between 1995 and 2003. The plotting symbols denote year-class.

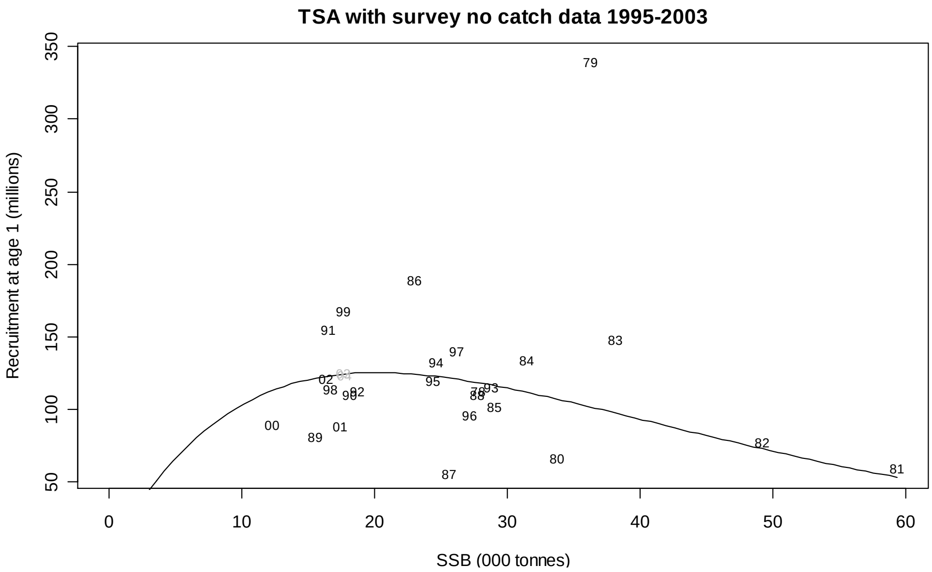


Figure 5.1.5.3.5a. Whiting in Division VIa. Proportion discarded-at-age by year, along with TSA-estimated discard ogive from TSA analyses with survey and trend in catchability.

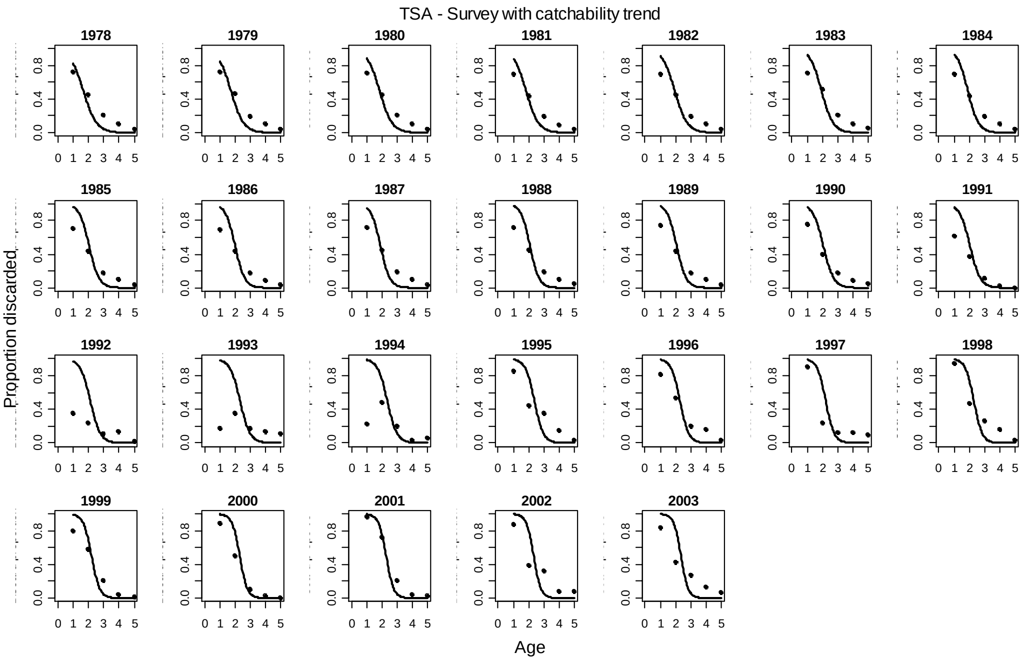


Figure 5.1.5.3.5b. Whiting in Division VIa. Proportion discarded-at-age by year, along with TSA-estimated discard ogive from TSA analyses with no trend in catchability.

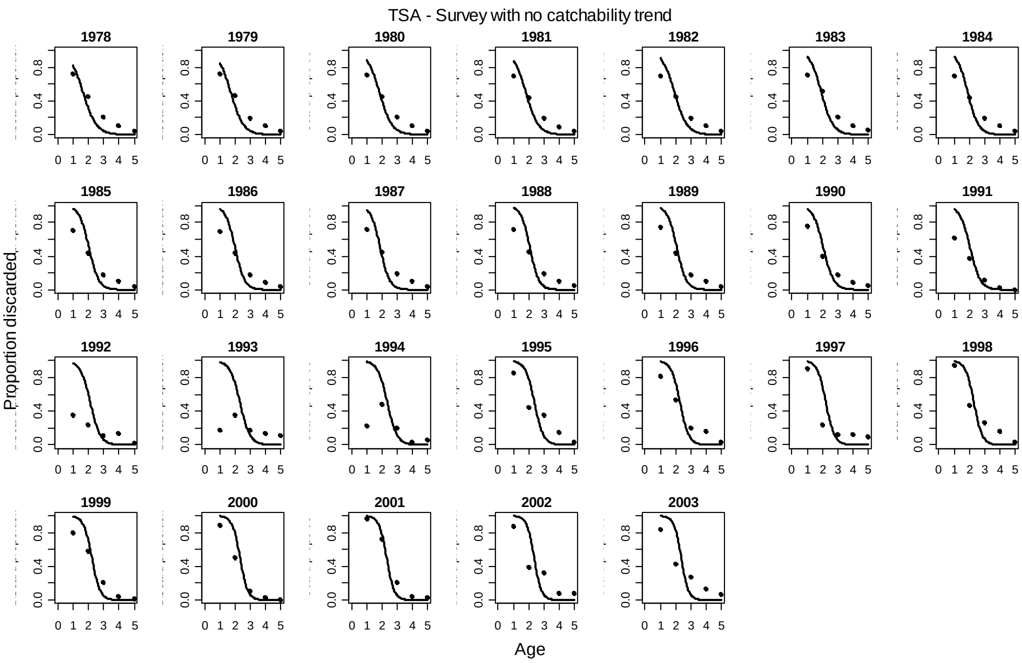


Figure 5.1.5.3.5c. Whiting in Division VIa. Proportion discarded-at-age by year, along with TSA-estimated discard ogive from TSA analyses with no catch data between 1995 and 2003.

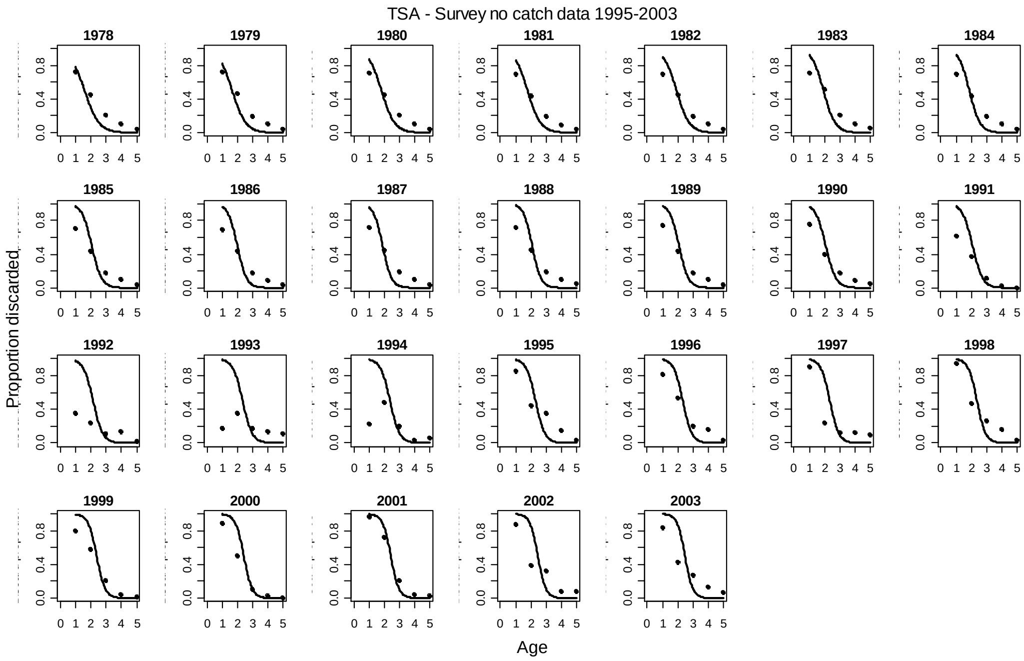
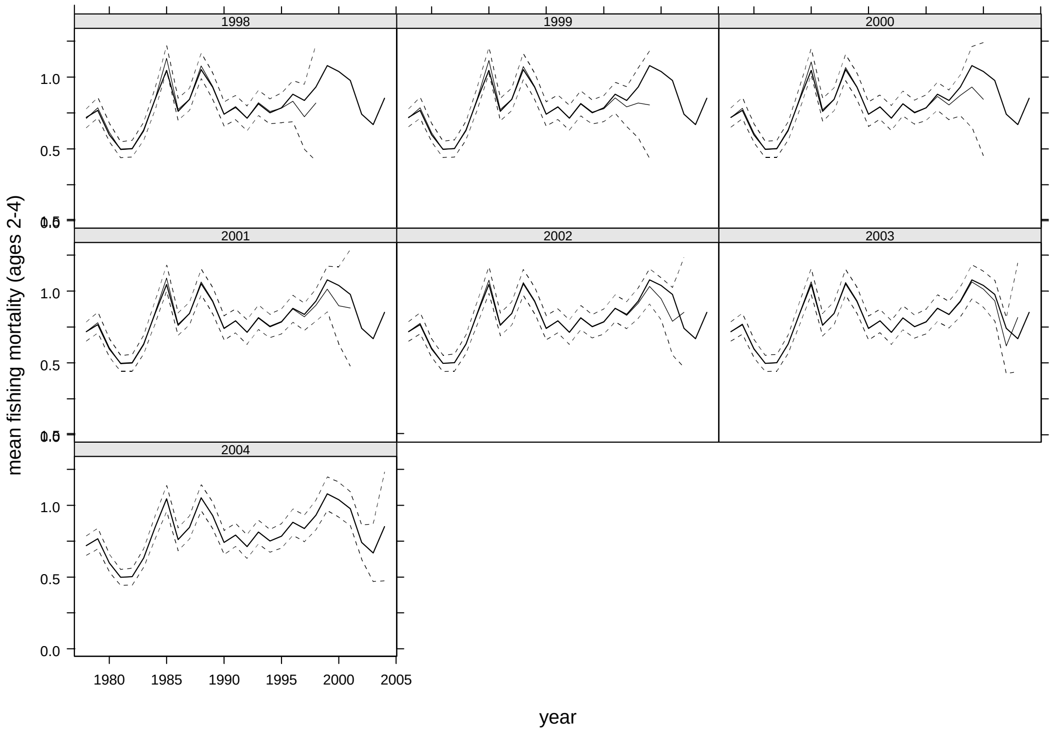
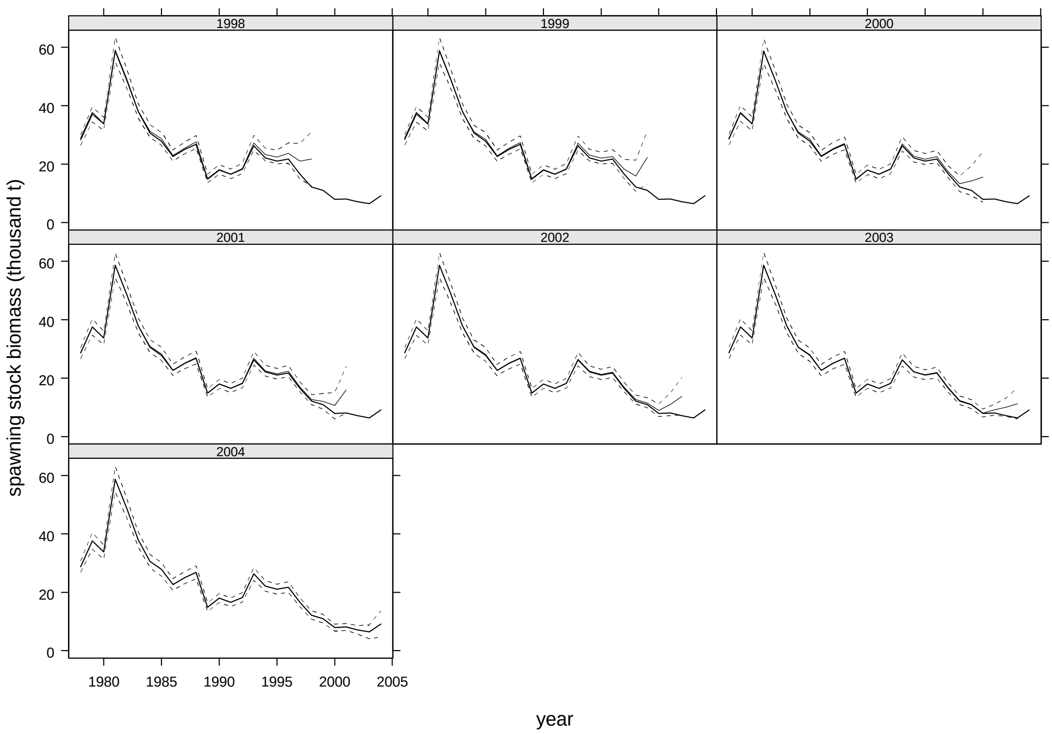


Figure 5.1.5.3.6a. Whiting in VIa. TSA retrospective plots for mean $F_{2\text{–}4}$ (top), SSB (middle) and Recruitment (bottom) from TSA analyses with: survey and trend in catchability





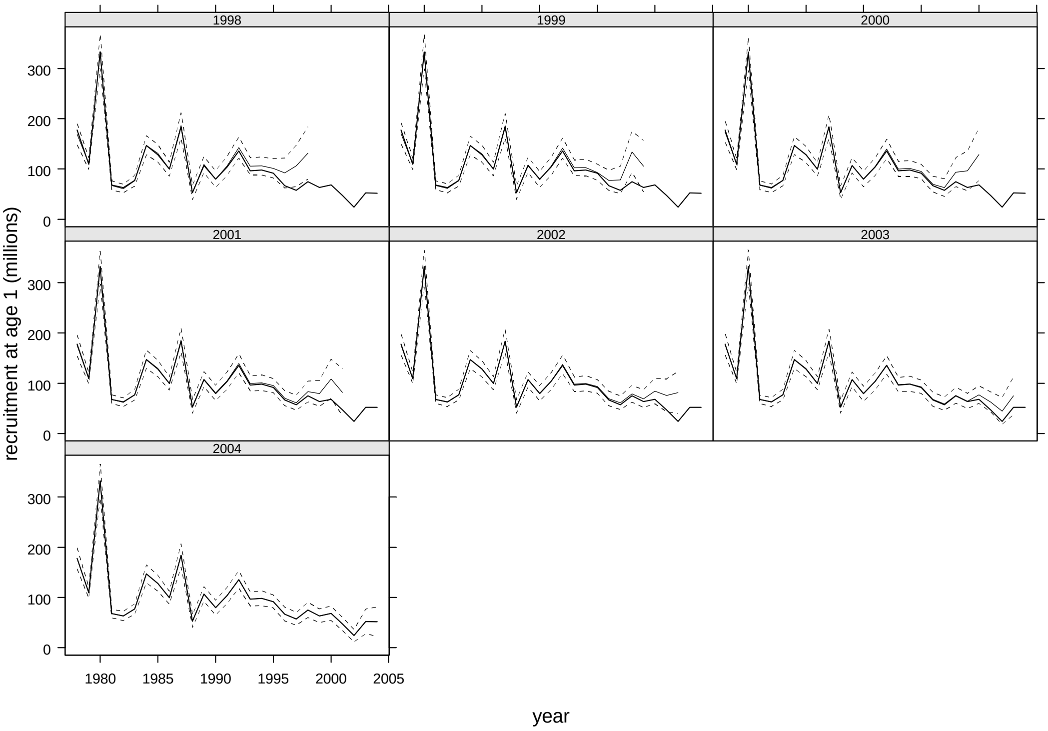
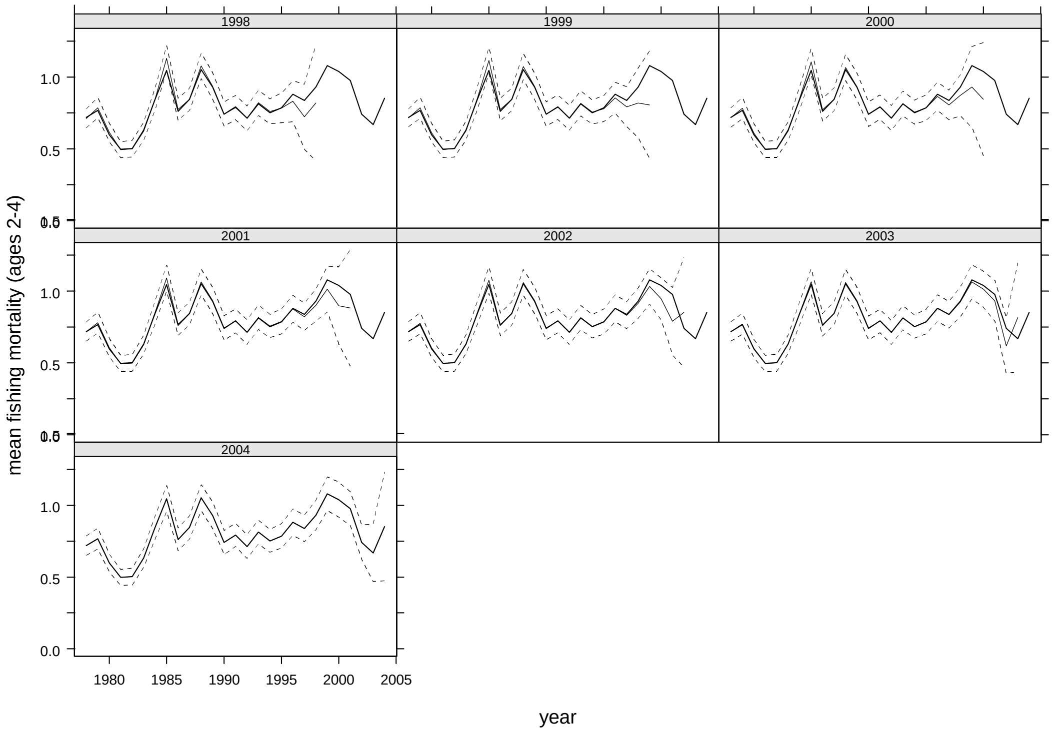
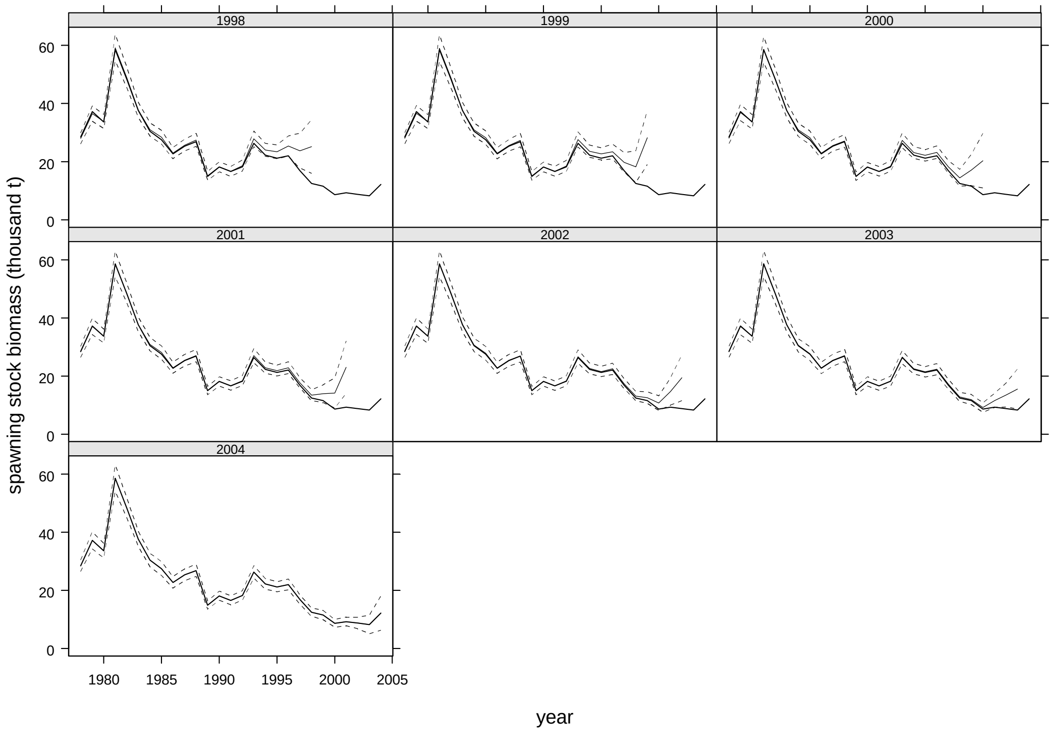
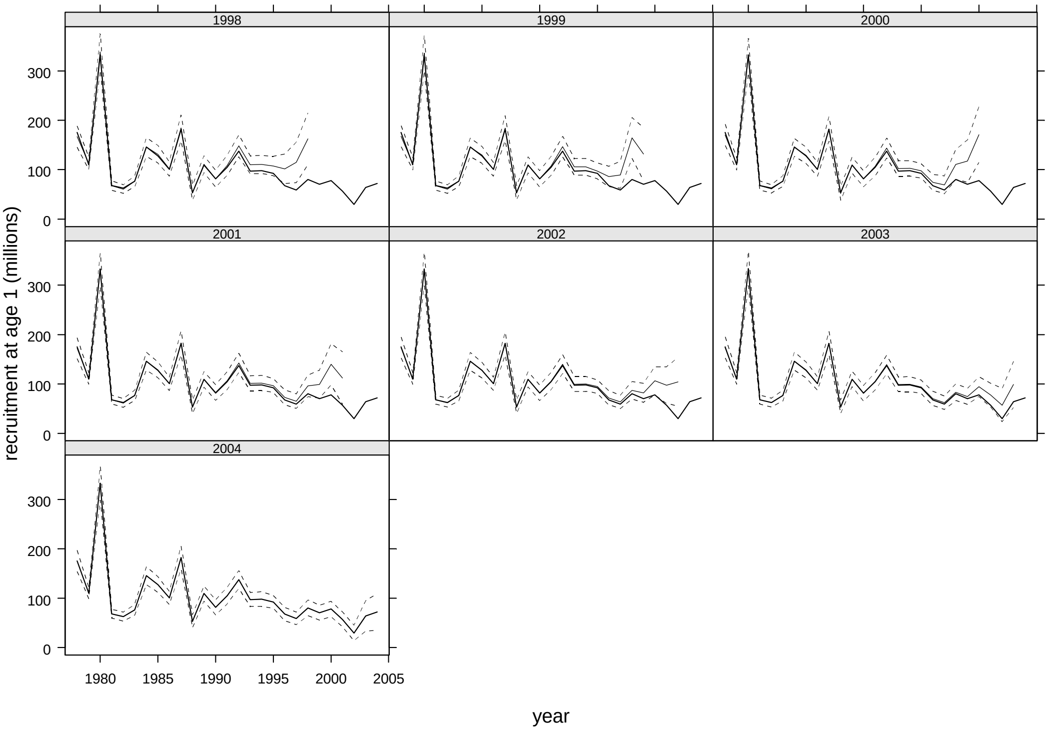

1998
1999
2000
2001
2002
2003
2004
recruitment at age 1 (millions)
0
100
200
300
1980
1985
1990
1995
2000
2005
year

Figure 5.1.5.3.6b Whiting in VIa. TSA retrospective plots for mean F_{2-4} (top), SSB (middle) and Recruitment (bottom) from TSA analyses with: survey and no trend in catchability

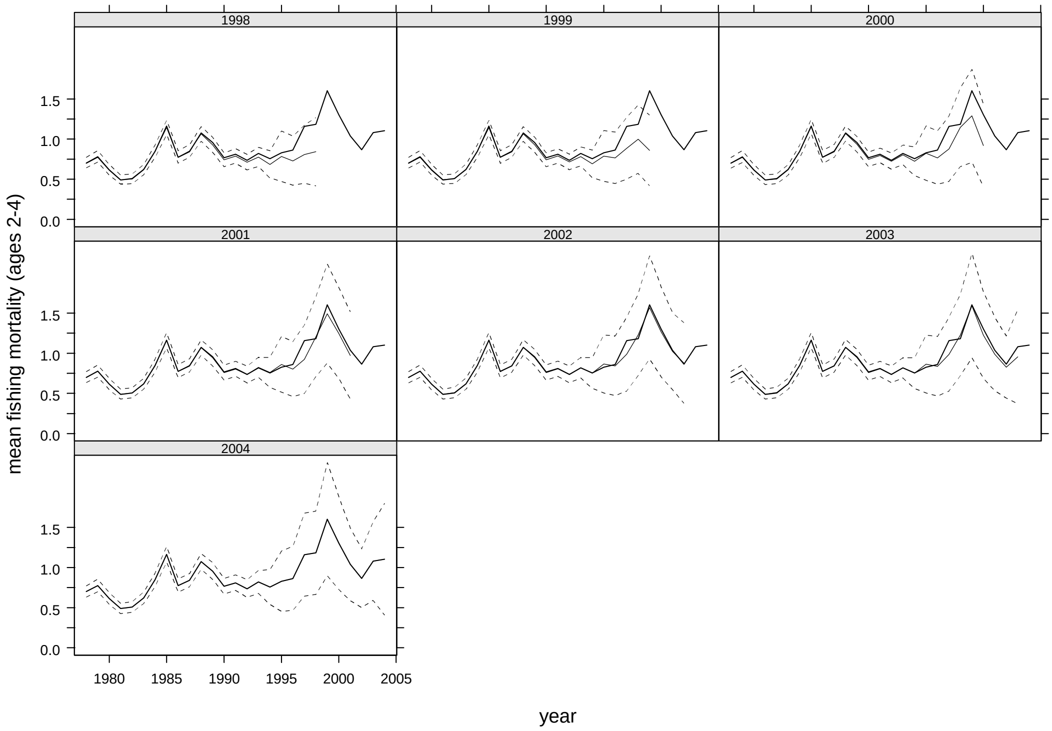


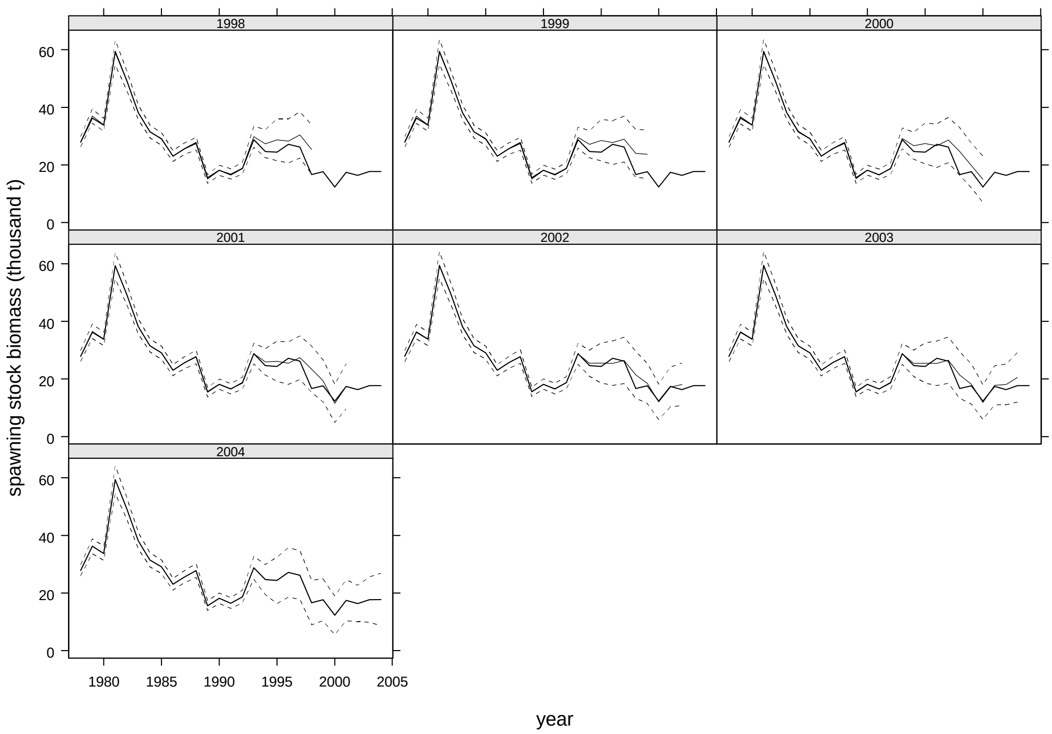


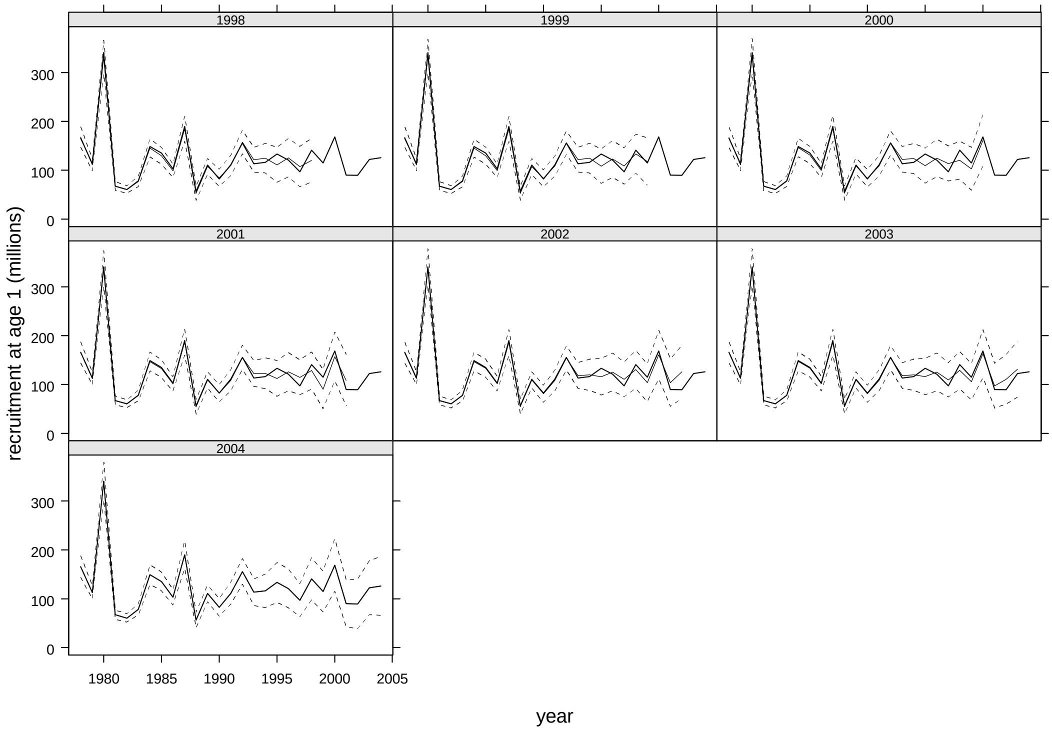


1998
1999
2000
2001
2002
2003
2004
recruitment at age 1 (millions)
0
100
200
300
1980
1985
1990
1995
2000
2005
year

Figure 5.1.5.3.6c. Whiting in VIa. TSA retrospective plots for mean F_{2-4} (top), SSB (middle) and Recruitment (bottom) from TSA analyses with catch data omitted since 1995.

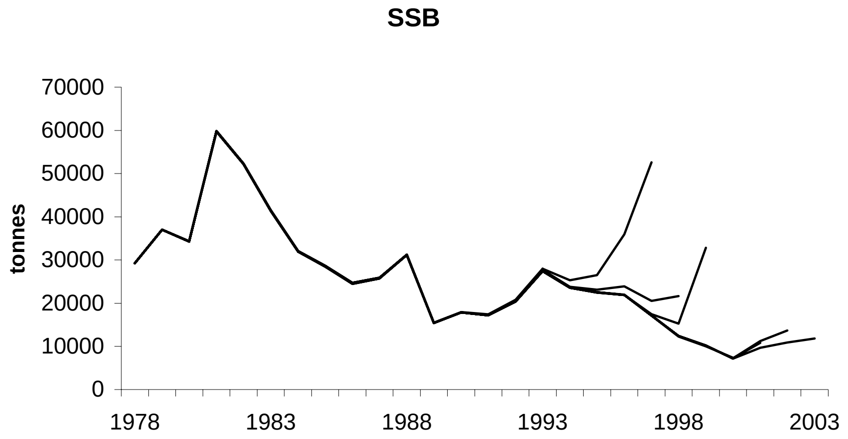


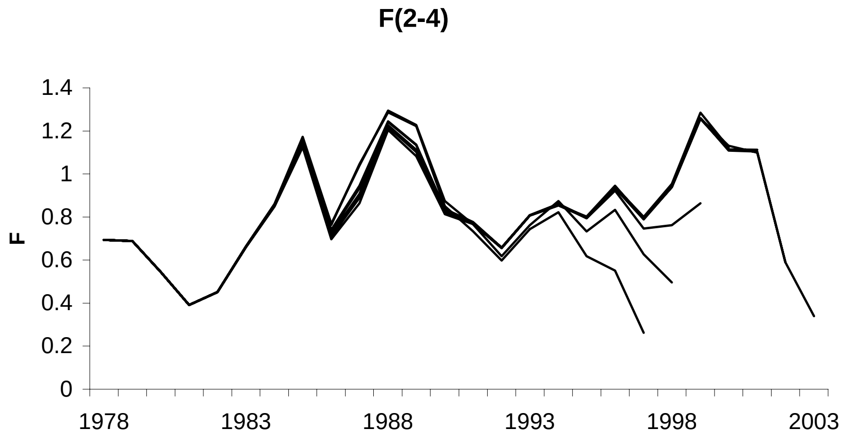


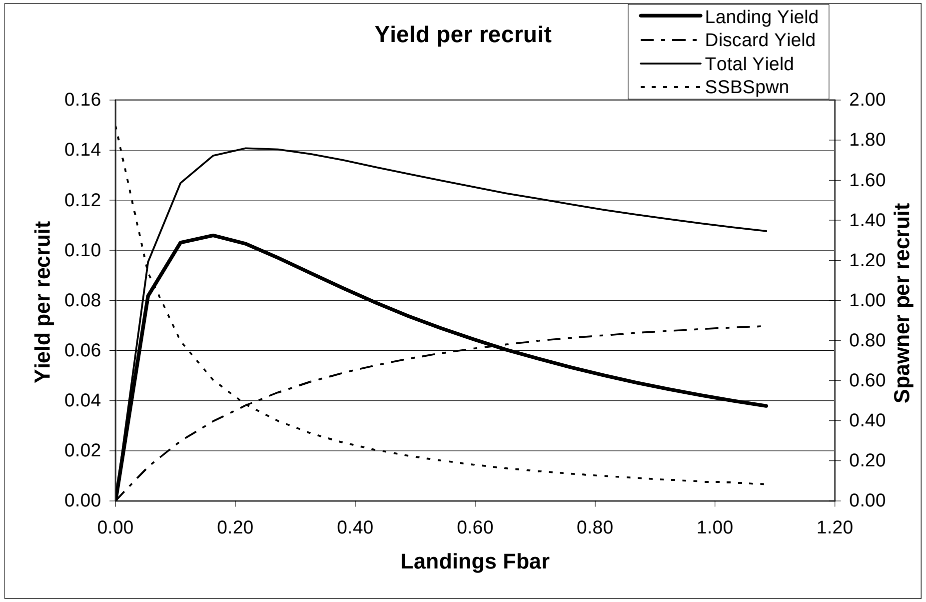


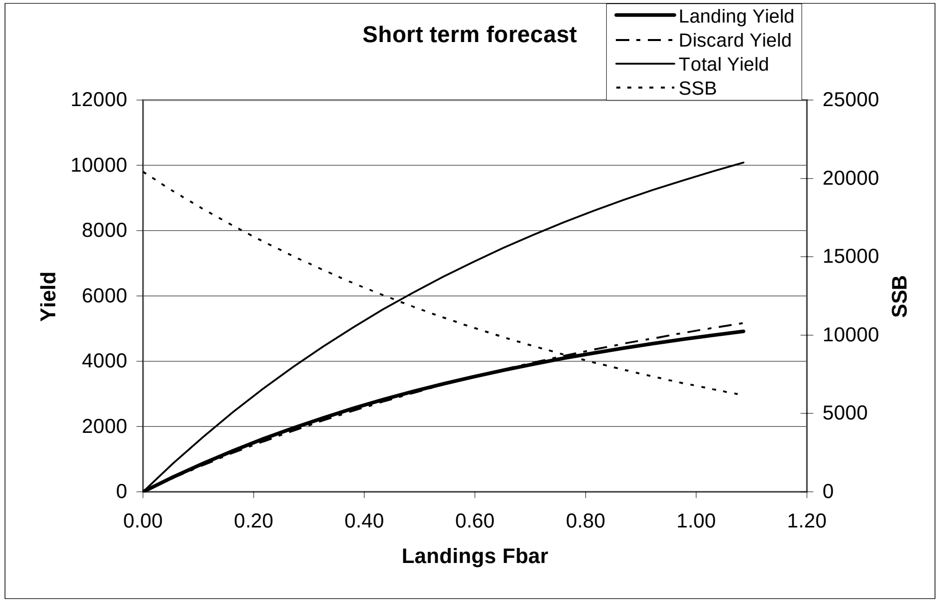
1998
1999
2000
2001
2002
2003
2004
300
200
100
0
recruitment at age 1 (millions)
1980
1985
1990
1995
2000
2005
year

Figure 5.1.5.3.6d. Whiting in VIa. XSA retrospective plots for fishing mortality, SSB and recruitment from the XSA analyss described in Table 5.1.5.2.2.









MFYPR version 2a
Run: WHG6aSCGFSYPR
Time and date: 08:10 5/12/2004

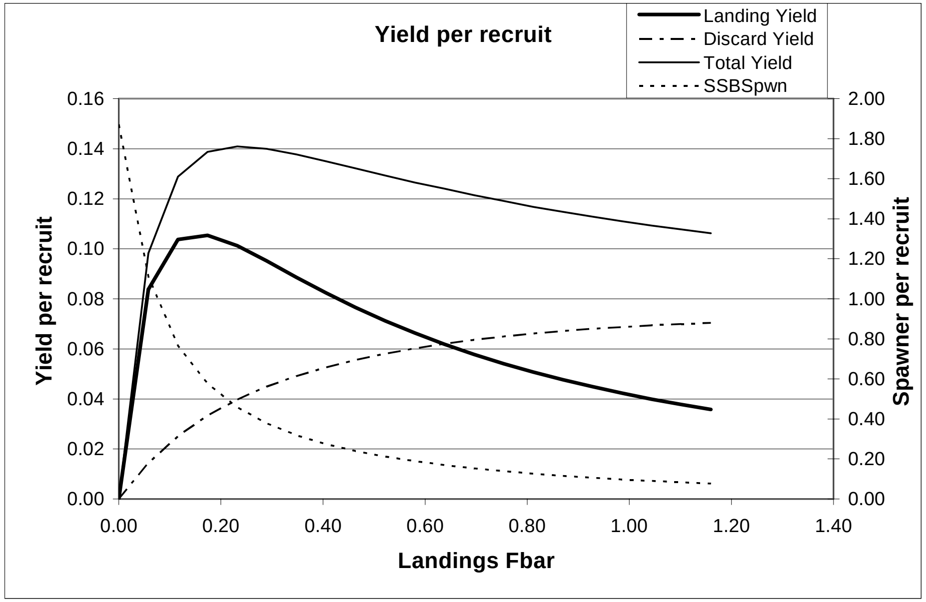
Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.5427
FMax	0.2798	0.1518
F0.1	0.1690	0.0917
F35%SPR	0.2680	0.1455

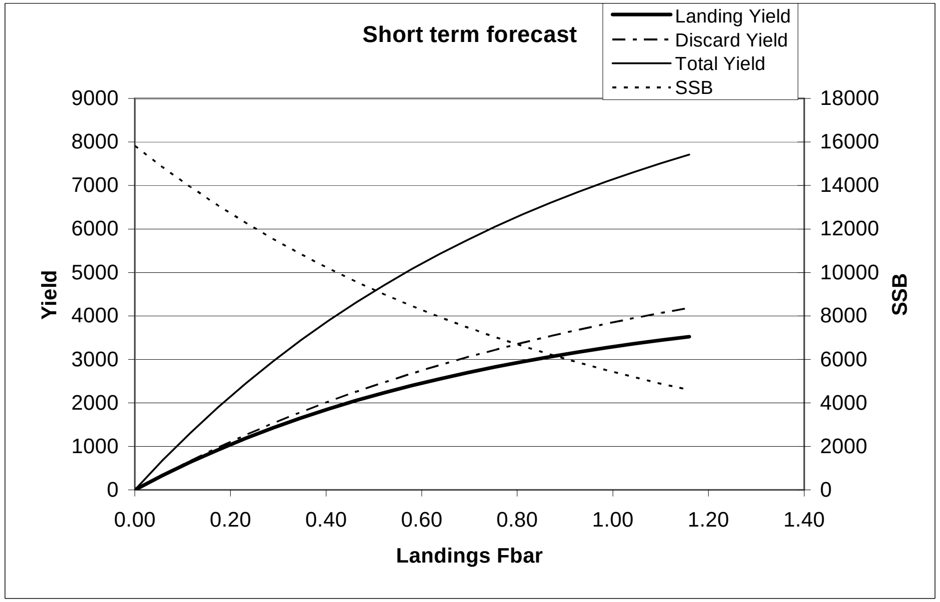
Weights in kilograms

MFDP version 1a
Run: WHG6aSCGFSMFDP
Time and date: 08:08 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

Figure 5.1.8.1 (a- Survey with trend) Whiting VIa. Yield Per Recruit





MFYPR version 2a
Run: WHG6aSCGFSnotrendYPR
Time and date: 08:23 5/12/2004

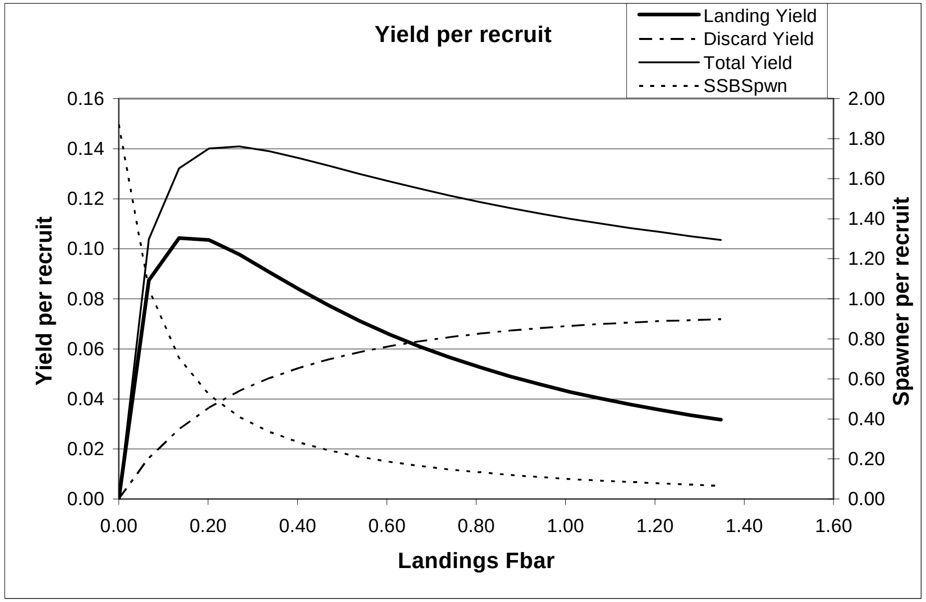
Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.5799
FMax	0.2647	0.1535
F0.1	0.1595	0.0925
F35%SPR	0.2520	0.1462

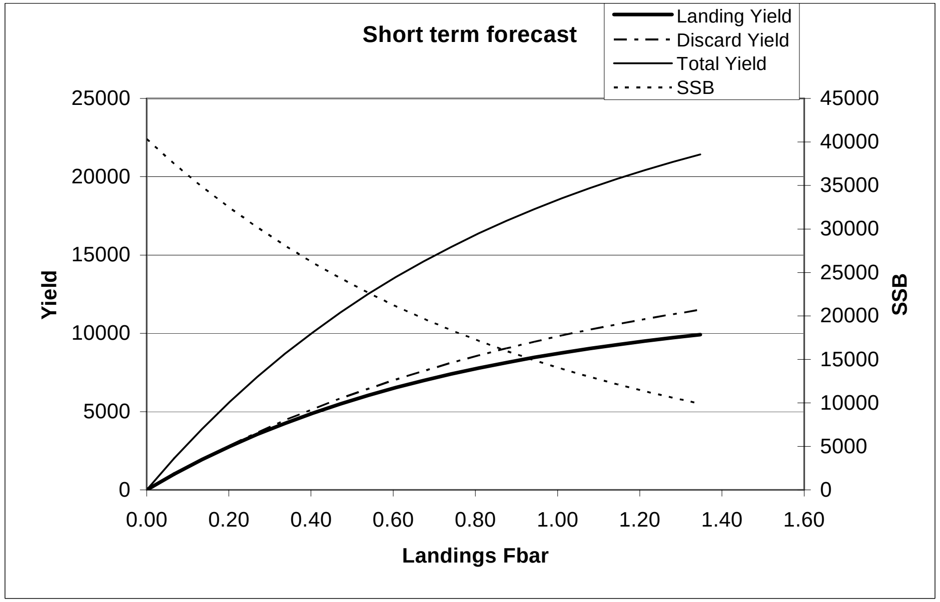
Weights in kilograms

MFDP version 1a
Run: WHG6aSCGFSnotrendMDPP
Time and date: 08:21 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

Figure 5.1.8.1 (b-Survey without trend) Whiting VIa. Yield Per Recruit





MFYPR version 2a
Run: WHG6a1995-2003YPR
Time and date: 08:31 5/12/2004

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.6738
FMax	0.2369	0.1596
F0.1	0.1422	0.0958
F35%SPR	0.2218	0.1494

Weights in kilograms

MFDP version 1a
Run: WHG6a1995-2003MFDP
Time and date: 08:30 5/12/2004
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

Figure 5.1.8.1 (c-without catch between 1995-2003) Whiting VIa. Yield Per Recruit

6 ANGLERFISH ON THE NORTHERN SHELF

For the purposes of this section, the Northern Shelf is considered to comprise Division IIIa (Skagerrak & Kattegat), Sub-area IV (the North Sea) and Sub-area VI (West of Scotland plus Rockall). Anglerfish in the North Sea and Skagerrak/Kattegat were considered by this Working Group for the first time in 1999. The fishery in the Northern North Sea at least, operates as an extension of the fishery to the west of Scotland. Descriptions of the fisheries and management advice applicable to the individual areas are given in Sections 6.1 to 6.3 below, and Section 6.4 contains details applicable to the combined Northern Shelf.

The decision to include descriptions of each area separately and then consider a combined area assessment, means that this chapter contains extensive text. Consequently, the WG wishes to highlight four specific issues at an early point:

- The rapid development of the fishery in Division VIa in terms of the increase in reported landings from 1991 to 1996, has since been almost matched by an equally rapid decline (Figure 6.1.1.1).

- It has previously been hypothesised that the deeper waters of the shelf edge to the west of Scotland may provide a refuge for mature female anglerfish. However, very few have been observed by scientific observers on commercial vessels fishing in this area in 1999 and 2000, or by targeted research vessel surveys undertaken during the same years. This work was part of an EU-funded research project entitled 'Distribution and biology of anglerfish and megrim in the waters to the West of Scotland' (EC study contract 98/096, Anon 2001).

- The *status quo* catch forecast for 2003 was 16,300 t, but there was a reduction of the TAC for 2003 to 10,180 t (2/3 of that in 2002) based on the advice that F should be below F_{pa}. This involves a large reduction in fishing mortality and anecdotal evidence from the fishery indicates that this TAC was particularly restrictive implying that reported landings are unlikely to reflect actual catches in 2003.

- Previous analyses and data highlight that fishing mortality on anglerfish in this area has been well above what may be considered sustainable.

In the Technical Minutes of its October 2003 meeting, ACFM made a number of comments on last year's assessment which it would like to see considered

1. Apparent overestimation of recent recruitment in the model; and

2. The possible use of the North Sea IBTS data as a further source of information on abundance.

The WG addressed these issues and on the basis of their findings (see Section 6.4) coupled with the degradation in commercial fishery information (Section 6.4.4), considered there was insufficient reliable information to be able to present an analytic assessment of Northern Shelf anglerfish this year.

6.1 Anglerfish in Sub-Area VI

6.1.1 The fishery

Details can now be found in Section A.2 of the Stock Annex.

6.1.1.1 ICES advice applicable to 2003 and 2004

The ICES advice for 2003 was as follows and applies to Sub-area VI and the North Sea:

"No explicit management objectives are set for this stock. However, for any management objectives to meet precautionary criteria their aim should be to reduce or maintain F below F_{pa}. ICES recommends that the fishing mortality be reduced to less than F_{pa}. This implies landings of less than 6700 t for the combined Division IIIa, Subarea IV, and Division VIa. The corresponding catch in Division VIb will be about 400 t, applying a cut proportional to that used in the other areas."

The ICES advice for 2004 (Single Stock Exploitation Boundaries) was as follows:

"Fishing mortality in 2004 should be reduced to less than F_{pa}. This implies landings of less than 8800 t for the combined Division IIIa, Subarea IV, and Division VIa and VIb. The exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits."

6.1.1.2 Management applicable in 2003 and 2004

Year	Single stock exploitation boundary (Vb(EC), VI, XII and XIV)	Basis	TAC (Vb(EC), VI, XII and XIV)	% change in F associated with TAC	WG landings
2002	4300	2/3 of the catches in 1973-1990	4770	-	4872
2003	<6700[1)]	Reduce F below F_{pa}	3180	49% reduction	4087
2004	<8800[2)]	Reduce F below F_{pa}[2)]	3180	48% reduction	

All values in tonnes.
[1)] Advice for Division IIIa, Subarea IV and Subarea VIa combined.
[2)] Advice for Division IIIa, Subarea IV and Subarea VI combined.
There is no minimum landing size for this species.

6.1.1.3 The fishery in 2003

The official landings for each country are shown in Table 6.1.1.1. The data have been updated to incorporate revised landings from France for 2001; and France, Spain and Ireland for 2002, in both Divisions VIa and VIb. Total landings (Sub-area VI) as reported to ICES in 2003 were 2,398 t, which is a reduction of about 600 t from the value for 2002. The reduction is due to the absence of officially reported landings from Spain and Ireland for 2003 and also to the reduction in UK landings in both Division VIa and VIb. The official landings from Division VIa account for approximately 80% of the total for Sub-area VI. Many of the official landings for 2003 are still preliminary.

For a number of years, anglerfish in Sub-areas VI, XII, XIV and Division Vb (EU zone) were subjected to a precautionary TAC (8600 t) based on average landings in earlier years. In 2002 the TAC was set at 4770 t and was further reduced to 3180 t in 2003. The TAC for 2004 has remained the same. Last year the Working Group highlighted that the reduction of the TAC in 2003 to just two-thirds of that in 2002 would likely imply an increased incentive to mis-report landings and increase discarding unless fishing effort was reduced accordingly (Section 6.4.6, ICES WGNSDS 2003). Although in recent years there has been decommissioning of Scottish boats exploiting this stock which is likely to have reduced fishing effort, it is not known to what extent effort has actually been reduced. Anecdotal information from the fishery in 2003 appears to suggest that the TAC in 2003 was particularly restrictive. The official statistics for 2003 are therefore likely to be especially unrepresentative of actual landings in 2003.

The absence of a TAC for the adjacent Sub-area IV prior to 1998, means that prior to then, landings in excess of the TAC in other areas were likely to be misreported into the North Sea. In 1999, a precautionary TAC was introduced for North Sea anglerfish, but unfortunately for current and future reporting purposes, the TAC was set in accord with recent catch levels from the North Sea which includes a substantial amount misreported from Sub-area VI. The area misreporting practices have thus become institutionalised. Working Group estimates of the actual Division VIa landings are also presented in Table 6.1.1.1. These are estimated by adjusting the reported data to include a proportion of the landings declared from Division IVa in the ICES statistical rectangles immediately east of the 4 degrees W line (see section 2.5). Such a re-allocation of catches may still inadvertently include some landings taken legally in Division IVa on the shelf-edge to the west of Shetland, but these are likely to comprise fish within the distribution of the Division VIa stock component. In addition to accounting for area misreporting, the 'unallocated' figure also includes differences between landings data officially reported to ICES and that provided to the Working Group by national scientists. Long-term trends in the Working Group estimates of landings are shown in Figure 6.1.1.1 and Figure 6.1.1.2. These estimates indicate that the percentages of the catch taken in (Division IIIa, Sub-area IV) and (Divisions VIa & VIb) over 1993-2003 average 60% and 40% respectively. Traditionally these values have been used as the basis to allocate the TAC between these areas (ICES, 2003). In recent years (2001-2003) the split between these two area has been more in the region of 70% (Division IIIa, Sub-area IV) to 30% (Sub-area VI).

6.1.2 Commercial catch-effort data and research vessel surveys

The Scottish 1st quarter ground fish survey routinely collects anglerfish length-frequency data and Figure 6.1.2.1 shows the total length frequencies obtained from this survey. The total numbers of anglerfish caught are relatively low and the length frequencies are particularly sparse between 1998 and 2002. A large proportion of the fish caught are small and previously a recruitment index has been calculated from this survey, consisting of numbers of anglerfish less than 30 cm per hour. This time series is illustrated in Figure 6.1.2.2.

Reliable effort data are not available from the Scottish trawl fleets due to changes in the practices of effort recording and non-mandatory effort recording in recent years. Further details can be found in Section B4 of the Stock Annex and the report of the 2000 WGNSSK (ICES, 2001). Information on fishing effort from the diaries of Scottish skippers operating throughout the Northern Shelf is currently being collated. If such information can be obtained from a representative sample of boats over a sufficient time period then it is anticipated this may be of some help in the assessment of this stock. Diaries from only 4 Scottish vessels were available ahead of this WG. The total effort of the two vessels fishing on the Shelf edge halved between 2002 and 2003 with an equivalent decrease in the total landings. An initial analysis of the individual vessel CPUE data was somewhat inconclusive due to the rather short time series of data (4 years maximum), although none indicated a significant downward trend in CPUE over the last 4 years.

No effort data were available for the Spanish and French fleets in Sub-area VI.

6.1.3 Length and age compositions and mean weights at age

Details of the procedure used to obtain international length and age compositions is given in Section B.1 of the Stock Annex. The countries supplying relevant data this year are shown in Table 2.2.1, with levels of sampling in Table 2.2.2. The raised catch-at-length frequency distributions are illustrated in Figure 6.1.3.1 for Division VIa and Figure 6.1.3.2 in Division VIb.

Scottish discard estimates from an EU funded study of the fishery (Kunzlik et al. 1995) were available for two complete years during 1992 QII to 1994 QI. Assessments both including and excluding the discard data were presented in ICES CM 1998/Assess:1. Due to a constant discard ogive being applied to each year's data, the difference in assessments was essentially a scaling factor on population and yield per recruit estimates. No such comparison is presented this year, and the length frequencies do not include information on discards. More recent observer trips aboard Scottish vessels fishing for anglerfish (Anon, 2001) indicate current very low levels of discarding.

6.1.4 Natural mortality and maturity

A value of 0.15 is assumed for natural mortality for all lengths and years. Length at 50% maturity is set at 93 cm for females and 57 cm for males. More details can be found in Section B2 of the Stock Annex.

6.2 Anglerfish in the North Sea

6.2.1 The fishery

Details can now be found in Section A.2 of the Stock Annex.

6.2.1.1 ICES advice applicable to 2003 and 2004

The ICES advice applicable to anglerfish in the North Sea in 2003 and 2004 has been the same as that for Sub-area VI: F should be reduced below F_{pa} which in 2003 implied landings of less than 6,700 t for combined Division IIIa, Subarea IV, and Division VIa .

The ICES advice for 2004 (Single Stock Exploitation Boundaries) was as follows:

" Fishing mortality in 2004 should be reduced to less than F_{pa}. This implies landings of less than 8800 t for the combined Division IIIa, Subarea IV, and Division VIa and VIb. The exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits."

6.2.1.2 Management applicable in 2003 and 2004

Year	Single stock exploitation boundaries (North Sea)	Basis	TAC (IIa(EC) & IV)	% change in F associated with TAC	WG landings
2002	5700	2/3 of the catches in 1973-1990	10500	-	10289
2003	<6700[1)]	Reduce F below F_{pa}	7000	49% reduction	8268
2004	<8800[2)]	Reduce F below F_{pa}[2)]	7000	48% reduction	

All values in tonnes.

[1)] Advice for Division IIIa, Subarea IV and Subarea VIa combined

[2)] Advice for Division IIIa, Subarea IV and Subarea VI combined.

6.2.1.3 The fishery in 2003

The official landings for each country are shown in Table 6.2.1.1. Landings in 2003 as reported to ICES for the total North Sea were 9347 t, which is almost 3000 t less than in 2002. This is largely due to a decrease in UK landings in the Northern North Sea (IVa). The official landings from the Northern North Sea account for approximately 90% of the total North Sea figure. The UK are still by far the largest exploiter of the Northern North Sea fishery accounting for over 70% of official landings in 2003. Denmark and Norway are the next most important exploiters of this stock, with landings of approximately 15% and 10% of the total reported to ICES.

There has been substantial misreporting of catches into the North Sea in recent years, due to the existence of a restrictive precautionary TAC in the adjacent VIa fishery (See section 6.1.1.3 and 2.5 for further details). A precautionary TAC was first set for the North Sea and Division IIa (EU) in 1999 and by 2002 had been reduced to 10500 t. The TAC for 2003 was set at 7000 t (a substantial reduction on 2002) and has remained at this level for 2004. Table 6.2.1.1 also includes the Working Group estimates of landings from Sub-area IV which have been adjusted to incorporate this misreporting from Division VIa. The unallocated catches do not just include misreportings by area, but also account for differences between landings statistics officially reported to ICES and those obtained by national scientists. The historical trend in WG estimates of landings in the North Sea is shown in Figure 6.2.1.1.

6.2.2 Commercial catch-effort data and research vessel surveys

At the request of ACFM, North Sea survey data for anglerfish is presented at this WG. Figure 6.2.2.1 shows length frequencies consisting of total numbers caught in the Q1 IBTS in Division IVa (only obtained up to 2000 ahead of this WG), while Figure 6.2.2.2 shows those data from the Scottish Q1 ground fish survey (a subset of the Q1 IBTS). Indices of small fish (< 30 cm) are extracted from these data and illustrated in Figure 6.2.2.3.

Reliable effort data were not available from the Scottish trawl fleets due to changes in the practices of effort recording and non-mandatory effort recording in recent years. Further details can be found in Section B4 of the Stock Annex and the report of the 2000 WGNSSK (ICES,2001). No effort data were available from the other main exploiters of North Sea anglerfish.

6.2.3 Length and age compositions and mean weights at age

Details of the procedure used to obtain international length and age compositions is given in Section B.1 of the Stock Annex. The countries supplying relevant data this year are shown in Table 2.2.1, with levels of sampling in Table 2.2.2. The raised catch-at-length frequency distributions for the North Sea are shown in Figure 6.2.3.1.

At the WG additional information on the length frequency of Norwegian and Danish landings in 2003 were provided (but not used in the calculation of the international length frequencies) and are illustrated in Figure 6.2.3.2 and Figure 6.2.3.3. The length distribution in Figure 6.2.3.2 was obtained by using data from the Norwegian Coastguard sampling Danish and Norwegian trawlers operating in the NEZ of Division IVa. Sampling took place during the three last quarters of 2003 and is raised to the officially reported landings from this area. Figure 6.2.3.3. is based on length measurements from the Norwegian directed gillnet fishery, again in the eastern part of IVa and raised to the reported landings of the fleet in 2003 in this area. It is recommended that in future, these length frequencies should be routinely collated along with the Scottish length frequencies ahead of the WG to obtain a more accurate picture of the total international catch-at-length distribution from this area. They were not received in time to be included in the calculation of international length frequency distribution this year.

6.2.4 Natural mortality and maturity

A value of 0.15 is assumed for natural mortality for all lengths and years. Length at 50% maturity is set to 93 cm for females and 57 cm for males. More details can be found in Section B2 of the Stock Annex.

6.3 Anglerfish in Division IIIa

Landings of Anglerfish in Division IIIa as officially reported to ICES are given in Table 6.3.1, with landings figures for a longer time period given in Figure 6.3.1. Over 1975-1990, annual landings were close to 550t. After this period there was a sharp increase to a peak of 938t in 1992, since when landings have gradually declined to 460 t in 2003. Denmark take the highest proportion of the landings (over 50%), followed by Norway. The post-1990 increase in landings is attributable to increases in the landings by both of these nations. Landings from Division IIIa represent only a small proportion of the total Northern Shelf landings, with the proportion varying between 1% and 9% over 1973-2003. No age or length frequency data are currently available from this area so landings from Division IIIa are assumed to have the same length distribution as the total from Sub-areas IV and VI combined.

6.4 Anglerfish on the Northern Shelf (combined IIIa, IV and VI)

6.4.1 The fishery

Working Group estimates of the total landings of anglerfish from the Northern Shelf are given in Figure 6.4.1.1 and Table 6.4.1.1. During the 1970s landings were fairly stable at around 9,000t, but from about 1983 they increased steadily to a peak of 35,100 t in 1996, since when there has been a sharp drop to the 2003 landings of 12,815 t. This overall trend is driven by the catches in the Northern North Sea and West of Scotland. Together these two areas account on average for 75% of the total landings over 1973-2003. The catch trends in these two areas are similar, with a steady increase in landings from 1984 onwards resulting from Scottish vessels starting to fish specifically for anglerfish where previously the species had only been taken as a bycatch. A more detailed description of the fishery and management advice for the separate Sub-areas can be found in sections 6.1 – 6.3 and Section A.2 of the Stock Annex.

6.4.2 Catch-at-length analysis

Currently, anglerfish on the Northern Shelf are split into Sub-area VI (including Vb(EC), XII and XIV) and the North Sea (& IIa (EC)) for management purposes. However, recent genetic studies have found no evidence of separate stocks over these 2 regions (including Rockall) and particle-tracking studies have indicated interchange of larvae between the two areas (Hislop et al. 2001). For the first time in 2000, enough data were available to conduct a preliminary assessment of the North Sea and VIa combined and therefore make comparisons of joint and individual area assessments. Similar results were obtained for the combined area assessments and individual area assessments. Although the link with anglerfish at Rockall (Division VIb) is less certain, the assessment presented last year was for the combined Northern Shelf, consisting of Division IIIa, Sub-area IV and Sub-area VI in order to facilitate the calculation of TACs.

The total catch-at-length distributions for the North Sea, Sub-area VI and Division IIIa are shown in Figure 6.4.2.1 and unsurprisingly these show features similar to the individual area distributions. Details of how total international catch-at-length distributions are obtained for this combined area are given in Section B1 of the Stock Annex.

6.4.2.1 Exploratory analysis

In 2000 an exploratory length-based approach (a modified catch-at-size analysis (CASA), Sullivan et al 1990) was presented for the first time and compared to the separable catch-at-age analysis (Cook et al, 1991) which had previously been used to obtain an exploitation pattern for use in yield per recruit analysis. This alternative length-based approach was investigated following concerns which had been raised by the WG about i) uncertainties in the anglerfish age readings and ii) the possibility that the age-based separability assumption may be violated in a rapidly developing fishery such as this. The two methods gave qualitatively similar results and the length-based approach has subsequently been further explored. A more complete description of the model and its implementation is given in Appendix 1 of ICES, 2001 and a Working Document submitted to the 2001 WG.

The model's minimum input data requirements are international catch-at-length distribution data, but in previous implementations it has also made use of auxiliary information in the form of:

- a recruitment index to constrain estimates of total annual recruitment

- trend in effort data to constrain the trend in the estimated temporal component of the fishing mortality

At the WG last year, the estimates of total annual recruitment were constrained by a recruitment index consisting of numbers of anglerfish <30cm caught per hour from the Scottish Q1 ground fish survey in Division VIa. It was noted by ACFM that the recruitment estimated by the model in recent years appears to have been overestimated when compared to the survey data (Figure 6.4.2.7 in ICES, 2003). This is due to the conflicting signals in the catch-at-length distribution data and recruitment index: the commercial catch data has shown increasing numbers of small fish in recent years (since 1997) which have not been apparent in the Scottish Q1 West Coast ground fish survey.

In respect of this, a number of other recruitment series were considered by the WG this year. Figure 6.4.2.2 shows the alternative recruitment indices (Scottish Q1 West Coast, Scottish Q1 Div IVa & IBTS Q1 Div IVa) plotted against each other. The indices appear to have few consistencies. In fact, even the IBTS Q1 Div IVa index and Scottish Q1 Div IVa index (a subset of the IBTS) show very little correlation. The catch rates of all three surveys are very poor and it seems likely that none are a good indicator of year class strength.

An assumption of the model is that the trend in the temporal component of the fishing mortality estimates is equal to the trend in the SCOLTR effort data. However, due to problems with effort recording in the Scottish fleets, this time series of SCOLTR effort data has not been updated for the past 4 years. Last year at the WG, it was assumed that effort had remained constant during this time. In recent years though, a significant number of vessels have been decommissioned and therefore it seems likely that a constant effort assumption for 2003 would be inappropriate. Unfortunately though there was no information available to the WG to suggest what amount of effort reduction may have occurred due to the decommissioning.

It is still possible to run a length-based assessment without these auxiliary data, but the results would then depend solely on the international catch-at-length distribution data. Due to the highly restrictive TAC in 2003, it is suspected that the raised international catch-at-length distribution as estimated by the WG is likely to be totally under-representative of the actual catch-at-length in 2003. Any assessment based on such data would therefore be of very poor quality and not give a reliable picture of the current status of the stock. For the above reasons combined no assessment is presented this year.

6.4.3 Reference points

ICES has proposed $F_{35\%SPR}$=0.3 be chosen as F_{pa}. All analysis conducted at previous WGs has indicated F to be well above this value.

6.4.4 Assessment considerations

This WG has previously attempted assessments of the anglerfish stock(s) within its remit using a number of different approaches. As yet none have proved entirely satisfactory. The catch at length analysis used in previous years appears to have addressed a number of the suspected problems with the data due to the rapid development of the fishery, and has also provided a satisfactory fit to the catch-at-length distribution data. However, this year the WG could present no assessment due to the lack of both reliable fishery and survey information. The most important points to be considered for a possible future assessment are highlighted below.

6.4.4.1 Data

For a number of years the WG has expressed concerns over the quality of the commercial catch-at-length data because of:-

- Lack of French length distribution data for Division VIa in recent years. French vessels now account for more than half of the officially reported landings from this area.

- Accuracy of landings statistics due to species and area misreporting

The accuracy of the landings statistics this year has become critical. The TAC has apparently been very restrictive in 2003, implying an increased incentive to misreport or discard catches. This situation is unlikely to change unless there is a significant reduction in fishing effort. Accurate commercial fishery information is imperative and efforts are currently underway to investigate how information obtained directly from Scottish fishermen's diaries may be used to improve the quality of the commercial fishery information.

In previous years, a recruitment index obtained from the Scottish Q1 west coast ground fish survey has been used to constrain estimates of recruitment within the model. The survey indices investigated in Section 6.4.2.1 show some rather inconsistent signals and the length-frequencies from which they are obtained (Figures 6.1.2.1, 6.2.2.1 & 6.2.2.2) are rather sparse in some years. It seems likely that due to the low catch rates, year class strengths are not picked out very well by these traditional ground fish surveys and additional fishery independent information on abundance is urgently required.

Unless the quality of anglerfish data is vastly improved, it seems unlikely that the WG will be able to provide an analytical assessment of this stock in the near future. The WG therefore wishes to highlight the data and research required in order to improve this situation. It is clear that industry involvement in the acquisition of commercial fishery data is essential if accurate values of catches and effort are to be obtained. This involvement could be in the form of a scheme of individual vessel diary collation, which would also provide information on the spatial development of the fishery. Furthermore, fishery independent information is lacking as traditional ground fish surveys are rather ineffective at catching anglerfish. The design and implementation of an appropriate survey should therefore be considered in collaboration with the fishing industry with reference to similar anglerfish surveys which have been conducted in the Northwest Atlantic.

6.4.4.2 Biological information

Despite a recent EU funded report, the biology and distribution of anglerfish on the Northern Shelf is still not well understood. It was highlighted last year that some of the basic biological parameters used in this assessment should be regarded as quite uncertain. New growth parameters obtained from a survey in Division VIa were used in the assessment last year and although these should still be regarded as uncertain, the analysis showed that the outcome of the assessment was relatively insensitive to the changes. A further discussion of the biology can be found in Section 6.4.5 below.

6.4.4.3 Stock Structure

Following the recent expansion of the anglerfish fishery in Nordic waters (see Section 16 and WD 12), the WG group was asked to consider the stock structure on the wider Northern European scale. (Tor c – addressed in Section 16). Although there is currently insufficient information to conclusively define new stock areas for assessment and further co-ordinated work is required, particle tracking models indicate a wide dispersal of larvae from the current Northern Shelf (Hislop et al, 2001) area into Nordic areas. Given that there may be an extension to the assessment area to include Nordic anglerfish in the near future, the likely spatial disaggregation of the stock (drift of larvae and possible migration of mature fish back into deeper water) means that any assessment model would need to be spatially structured. Given the problems with data quality in the current Northern Shelf anglerfish assessment, the WG wishes to highlight fundamentals required for a wider area assessment

- Accurate information on the spatial distribution of catch and effort

- Data on movement and migration of mature and immature individuals

- Internationally co-ordinated dedicated anglerfish survey over the wider Northern European area to include deeper waters and previously unsurveyed areas in order to obtain information on spatial abundance.

6.4.5 Management considerations

At the WG last year, F in 2002 was estimated to be well above $F_{35\%SPR}$, $F_{0.1}$ and F_{max}. However, this was lower than the estimated historical Fs and, coupled with the relatively high estimated recruitment in recent years meant that the model predicted an increase in SSB in both 2004 and 2005.

The landings for the total Northern Shelf (Division IIIa, North Sea and Sub-area VI combined) for 2003 were predicted to be 16,335 t compared to a TAC of 10,180 t for Vb(EC), VI, XII & XIV and IIa(EC) & IV combined. Actual landings were estimated by the WG to be 12,815 t.

The reduction of the TAC for 2003 to almost two thirds of that in 2002 (15,270 t) was based on the advice that F should be below F_{pa} Anecdotal information suggests that this reduced TAC was highly restrictive, with increased misreporting. The TAC for 2004 (same as 2003) appears to be proving equally restrictive.

In previous assessments of this stock, the SSB has always been estimated to be at a very low level. Very few individuals over 80 cm in length appear in the catch and therefore the model predicts very few in the population. Since females do not mature until they are over 90 cm in length the SSB is estimated to be very low. The fact that mature female anglerfish are rarely observed either on scientific surveys or by observers on board commercial vessels supports a very low estimate of biomass, yet there is little evidence of reduction in spatial distribution as fish are still recruiting to relatively inshore areas. It has been hypothesized that females may become pelagic when spawning as they produce a buoyant, gelatinous ribbon of eggs, and would therefore not appear in the catch of trawlers. (Anglerfish have been caught near the surface, Hislop et al., 2000). This would imply different exploitation patterns for males and females: a dome-shaped pattern (decreased exploitation at larger sizes) for females and a logistic pattern for males. It is also not known whether anglerfish are an iteroparous or semelparous species. The latter would also account for the almost complete absence of spawning females in commercial catches or research vessel surveys.

The key features of the species' life history in relation to its exploitation are the location of the main spawning areas in relation to the exploited areas, and whether or not there is any systematic migration of younger fish back into the deeper waters to spawn. At present, despite the large increase in catches over the last ten years, there is no apparent contraction in distribution; fish are still recruiting to relatively inshore areas such as the Moray Firth in the northern North Sea. The fact that spawning appears to occur largely in deep water off the edge of the continental shelf may offer the stock some degree of refuge. However, this assumes that the spawning component of the stock is resident in the deep water, and is thus not subject to exploitation. It is not known to what extent this is true, but if such a reservoir exists then the currently used assessment methods which make dynamic pool assumptions about the population are likely to be inappropriate. Nevertheless, it is clear that further expansion of the fishery into deeper water is undesirable and given the spatial development of the fishery, it cannot be ruled out that the serial depletion of fishing grounds has been occurring. In addition, some life-history characteristics of anglerfish suggest that it may be particularly vulnerable to high exploitation. A detailed discussion of the fishery development and biology can be found in Sections 7.5.4 and 7.5.5 of the 2000 report of this Working Group (ICES, 2001).

As the fishery operates primarily across VI and the North Sea, and there is no evidence to indicate that these comprise separate stocks (see EC 98/096), the WG suggests that in the future it provides assessments based only on the combined area stock unit. This does not necessarily preclude the use of assessment methods which may take account of finer-scale spatial effects, or of the setting of separate area TACs. A further discussion of anglerfish stock structure over a wider area can be found in Section 16 of this report.

Table 6.1.1.1 Anglerfish in Sub-area VI. Nominal landings (t) as officially reported to ICES.

Anglerfish in Division VIa (West of Scotland)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[*]
Belgium	-	3	2	9	6	5	+	5	2	+	+	+	+	+
Denmark	-	1	3	4	5	10	4	1	2	1	+	+	-	+
France	2,182	1,910	2,308	2,467	2,382	2,648	2,899	2,058	1,634[*]	1,814[1*]	1,132	943	732	1,166
Germany		1	2	60	67	77	35	72	137	50	39	11	3	27
Ireland	398	250	403	428	303	720	717	625	749	617	515	475	304	
Netherlands	-	-	-	-	-	-	-	27	1	-	-	-	-	-
Norway	8	6	14	8	6	4	4	1	3	1	3	2[*]	1[*]	+
Spain	35	7	11	8	1	37	33	63	86	53	82	70	101	
UK(E&W&NI)	71	270	351	223	370	320	201	156	119	60	44	40	32	…
UK(Scotland)	2,921	2,613	2,385	2,346	2,133	2533	2,515	2,322	1,773	1,688	1,496	1,119	1,100	…
UK (total)														743
Total	5,615	5,061	5,479	5,553	5,273	6,354	6,408	5,330	4,506	4,284	3,311	2,660	2,273	1,936
Unallocated	184	296	2,638	3,816	2,766	5,112	11,148	7,506	5,234	3,799	3,114	2,068	1,882	1,503
As used by WG	5,799	5,357	8,117	9,369	8,039	11,466	17,556	12,836	9,654	7,413	6,425	4,728	4,155	3,439

[*]Preliminary. [1]Includes Vib.

Anglerfish in Division VIb (Rockall)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[*]
Faroe Islands	-	-	2	-	-	-	15	4	2	2				
France	-	-	-	29	-	-	-	1	1	…[1*]	48	192	42	99
Germany	-	-	-	103	73	83	78	177	132	144	119	67	35	63
Ireland	400	272	417	96	135	133	90	139	130	75	81	134	51	
Norway	16	18	10	17	24	14	11	4	6	5	11	5[*]	3[*]	6
Portugal	-	-	-	-	-	-	-	-	+	-	20	18	8	-
Russia	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Spain	138	333	263	178	214	296	196	171	252	291	149	327	128	
UK(E&W&NI)	19	99	173	76	50	105	144	247	188	111	272	197	133	…
UK(Scotland)	249	201	224	182	281	199	68	156	189	344	374	367	317	…
UK (total)														294
Total	822	923	1,089	681	777	830	602	899	900	972	1074	1308	717	462
Unallocated										-9	17	-161	-40	186
As used by WG	822	923	1,089	681	777	830	602	899	900	963	1091	1147	717	648

[*]Preliminary. [1]Included in VIa.

Total Anglerfish in Sub-area VI (West of Scotland and Rockall)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[*]
Total official	6,437	5,984	6,568	6,234	6,050	7,184	7,010	6,229	5,406	5,256	4,385	3,968	2,990	2,398
Total ICES	6,621	6,280	9,206	10,050	8,816	12,296	18,158	13,735	10,554	8,376	7,519	5,875	4,872	4,087

*Preliminary.

Table 6.2.1.1 Nominal catch (t) of ANGLERFISH in the North Sea, 1989–2003, as officially reported to ICES.

Northern North Sea (IVa)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[*]
Belgium	8	2	9	3	3	2	8	4	1	5	12	-	8	1
Denmark	984	1,245	1265	946	1,157	732	1,239	1,155	1,024	1,128	1,087	1,289	1,308	1,518
Faroes	7	1	-	10	18	20	-	15	10	6	n/a			
France	-	124	151	69	28	18	7	7	3[*]	18[1*]	8	9	7	6
Germany	70	71	68	100	84	613	292	601	873	454	182	95	95	65
Netherlands	18	23	44	78	38	13	25	12	-	15	12	3	8	9
Norway	421	587	635	1,224	1,318	657	821	672	954	1,219	1,182	1,209[*]	875[*]	770
Sweden	5	14	7	7	7	2	1	2	8	8	78	44	56	6
UK(E, W&NI)	91	129	143	160	169	176	439	2,174	668	781	218	183	98	…
UK (Scotland)	6,788	7,039	7,887	9,712	11,683	15,658	22,344	18,783	13,319	9,710	9,559	10,024	8,539	…
UK (total)														6,110
Total	8,392	9,235	10,209	12,309	14,505	17,891	25,176	23,425	16,860	13,344	12,338	12,856	10,994	8,485

* Preliminary. [1]Includes IVb,c.

Central North Sea (IVb)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[*]
Belgium	216	357	538	558	713	579	287	336	371	270	449	579	435	178
Denmark	278	345	421	347	352[1]	295	225	334	432	368	260	251	255	194
Faroes	-	-	-	2	-	-	-	-	-	-	n/a			
France	-	-	1	-	2	-	-	-	-[*]	…[2*]	-	-	-	-
Germany	1	4	2	13	15	10	9	18	19	9	14	9	17	11
Netherlands	267	285	356	467	510	335	159	237	223	141	141	123	62	42
Norway	27	17	4	3	11	15	29	6	13	17	9[*]	15[*]	11[*]	13
Sweden	-	-	-	-	3	2	1	3	3	4	3	2	9	1
UK(E, W&NI)	754	669	998	1,285	1,277	919	662	664	603	364	423	475	236	…
UK (Scotland)	634	845	733	469	564	472	475	574	424	344	318	378	210	…
UK (total)														402
Total	2,177	2,522	3,053	3,144	3,447	2,627	1,847	2,172	2,088	1,517	1,617	1,832	1,235	841

* Preliminary. [1]Includes 2 tonnes reported as Sub-area IV. [2]Included in IVa.

Southern North Sea (IVc)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[*]
Belgium	21	13	12	34	37	26	28	17	17	11	15	15	16	9
Denmark	-	2	-	-	-	-	-	-	+	+	+	+	+	+
France	-	-	-	-	-	-	-	-	10	…[1*]	+	-	+	-
Germany	-	-	-	-	-	-	-	-	-	-	+	-	+	+
Netherlands	7	5	10	14	20	15	17	11	15	10	15	6	5	1
Norway						-	-	-	-	+	-[*]	+[*]	-[*]	-
UK(E&W&NI)	6	6	17	18	136	361	256	131	36	3	1	+	+	…
UK (Scotland)	-	-	-	-	17	-	3	1	+	+	+	+	+	…
														11
Total	34	26	39	66	210	402	304	160	78	24	31	21	21	21

* Preliminary. [1]Included in IVa.

Total North Sea

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[*]
Total	10,603	11,783	13,301	15,519	18,162	20,920	27,327	25,757	19,026	14,885	13,986	14,709	12,250	9,347
WG estimate	9,491	10,566	11,728	13,078	15,432	15,794	16,240	18,217	14,027	11,719	11,564	12,684	10,289	8,268
Unallocated	-1,112	-1,217	-1,573	-2,441	-2,730	-5,126	-11,087	-7,540	-4,999	-3,166	-2,422	-2,025	-1,961	-1,079

* Preliminary.

Table 6.3.1 Nominal catch (t) of Anglerfish in Division IIIa, 1990–2003, as officially reported to ICES.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*
Belgium	15	48	34	21	35	-	-	-	-	-	-	-	-
Denmark	493	658	565	459	312	367	550	415	362	377	375	371	217
Germany	-	-	1	-	-	1	1	1	2	1	+	1	+
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	3
Norway	64	170	154	263	440	309	186	177	260	197*	200*	241*	187
Sweden	23	62	89	68	36	25	39	33	36	27	46	55	53
Total	595	938	843	811	823	702	776	626	660	602	621	666	460

*Preliminary.

Table 6.4.1.1 Landings of Anglerfish by area from the Northern Shelf, 1973-2003.
Working Group estimates, tonnes.

	Skagerrak & Kattegat	**North Sea**				**Sub-Area VI**			**Total**
Year		Northern	Central	Southern	Total	W. Scotland	Rockall	Total	N shelf
	IIIa	IVa	IVb	IVc	IV	VIa	VIb	VI	
1973	140	2,127	726	41	2,894	9,221	127	9,348	12,382
1974	202	2,811	1,381	39	4,231	3,217	435	3,652	8,085
1975	291	2,887	2,160	59	5,106	3,122	76	3,198	8,595
1976	641	3,644	1,579	49	5,272	3,383	72	3,455	9,368
1977	643	3,264	1,536	54	4,854	3,876	78	3,954	9,451
1978	509	3,111	1,444	72	4,627	3,524	103	3,627	8,763
1979	687	2,972	1,787	112	4,871	3,166	29	3,195	8,753
1980	652	3,451	1,637	175	5,263	2,634	200	2,834	8,749
1981	549	2,472	958	132	3,562	1,387	331	1,718	5,829
1982	529	2,214	856	99	3,169	3,154	454	3,608	7,306
1983	506	2,467	1,757	181	4,405	3,417	433	3,850	8,761
1984	568	3,875	2,033	188	6,096	3,935	707	4,642	11,306
1985	578	4,570	2,154	77	6,801	4,043	1,013	5,056	12,435
1986	524	5,596	1,965	47	7,608	3,090	1,326	4,416	12,548
1987	589	7,379	1,768	66	9,213	4,311	1,294	5,605	15,407
1988	347	7,738	2,061	95	9,894	6,003	1,730	7,733	17,974
1989	334	7,135	2,121	86	9,342	6,979	313	7,292	16,967
1990	570	7,280	2,177	34	9,491	5,799	822	6,621	16,682
1991	595	8,018	2,522	26	10,566	5,357	923	6,280	17,441
1992	938	8,636	3,053	39	11,728	8,117	1,089	9,206	21,872
1993	843	9,868	3,144	66	13,078	9,369	681	10,050	23,971
1994	811	11,775	3,447	210	15,432	8,039	777	8,816	25,059
1995	823	12,765	2,627	402	15,794	11,466	830	12,296	28,913
1996	702	14,089	1,847	304	16,240	17,556	602	18,158	35,100
1997	774	15,885	2,172	160	18,217	12,836	899	13,735	32,726
1998	626	11,861	2,088	78	14,027	9,654	900	10,554	25,207
1999	660	10,178	1,517	24	11,719	7,413	963	8,376	20,755
2000	602	9,916	1,617	31	11,564	6,425	1,091	7,516	19,682
2001	621	10,831	1,832	21	12,684	4,728	1,147	5,875	19,180
2002	666	9,033	1,235	21	10,289	4,155	717	4,872	15,827
2003	460	7,406	841	21	8,268	3,439	648	4,087	12,815
Min	140	2,127	726	21	2,894	1,387	29	1,718	5,829
Mean	580	6,944	1,872	97	8,913	5,897	671	6,569	16,062
Max	938	15,885	3,447	402	18,217	17,556	1,730	18,158	35,100

Figure 6.1.1.1 **Landings of Anglerfish, Division VIa**

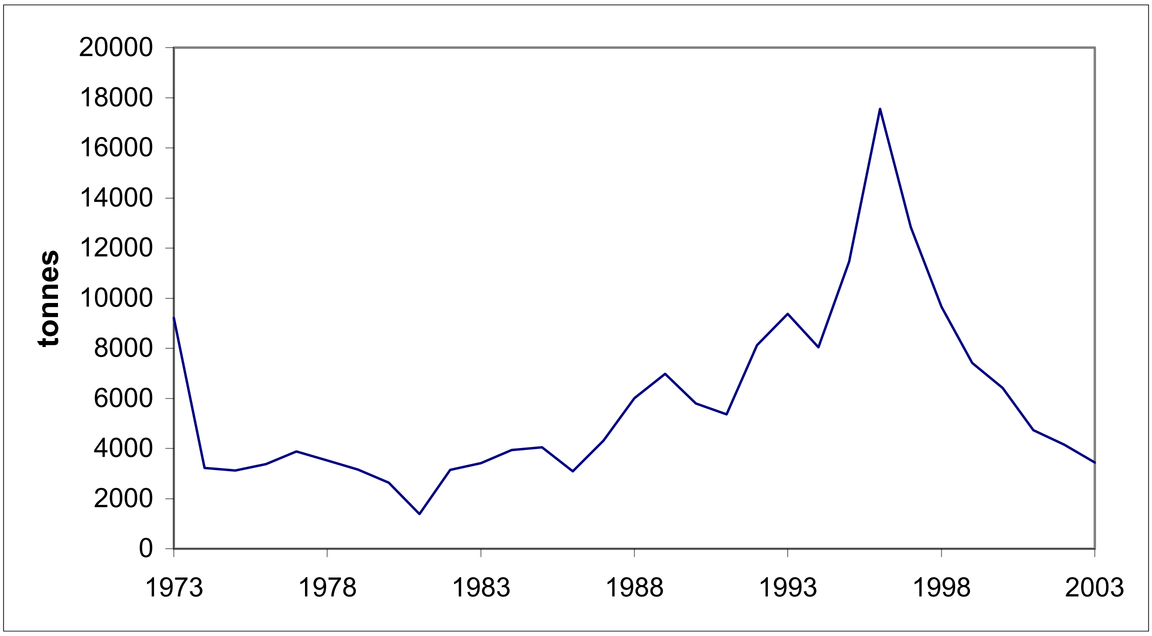


Figure 6.1.1.2 **Landings of Anglerfish, Division VIb (Rockall)**

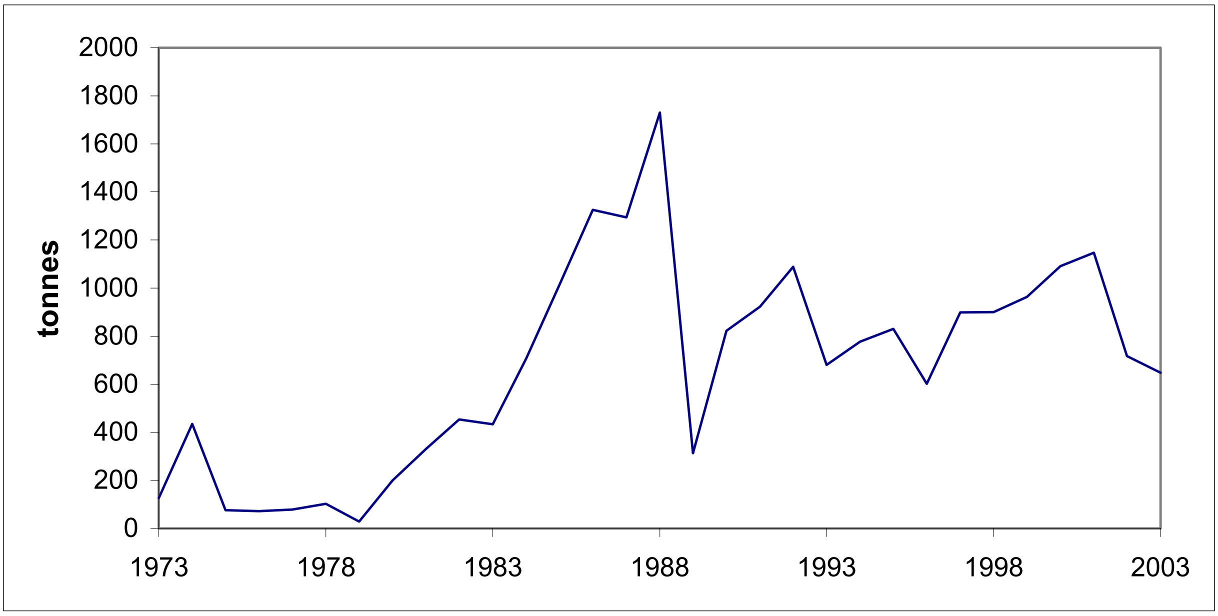


Figure 6.1.2.1. Anglerfish in Division VIa. Scottish Q1 Scottish West Coast ground fish survey length frequencies (total numbers caught – not standardised by effort).

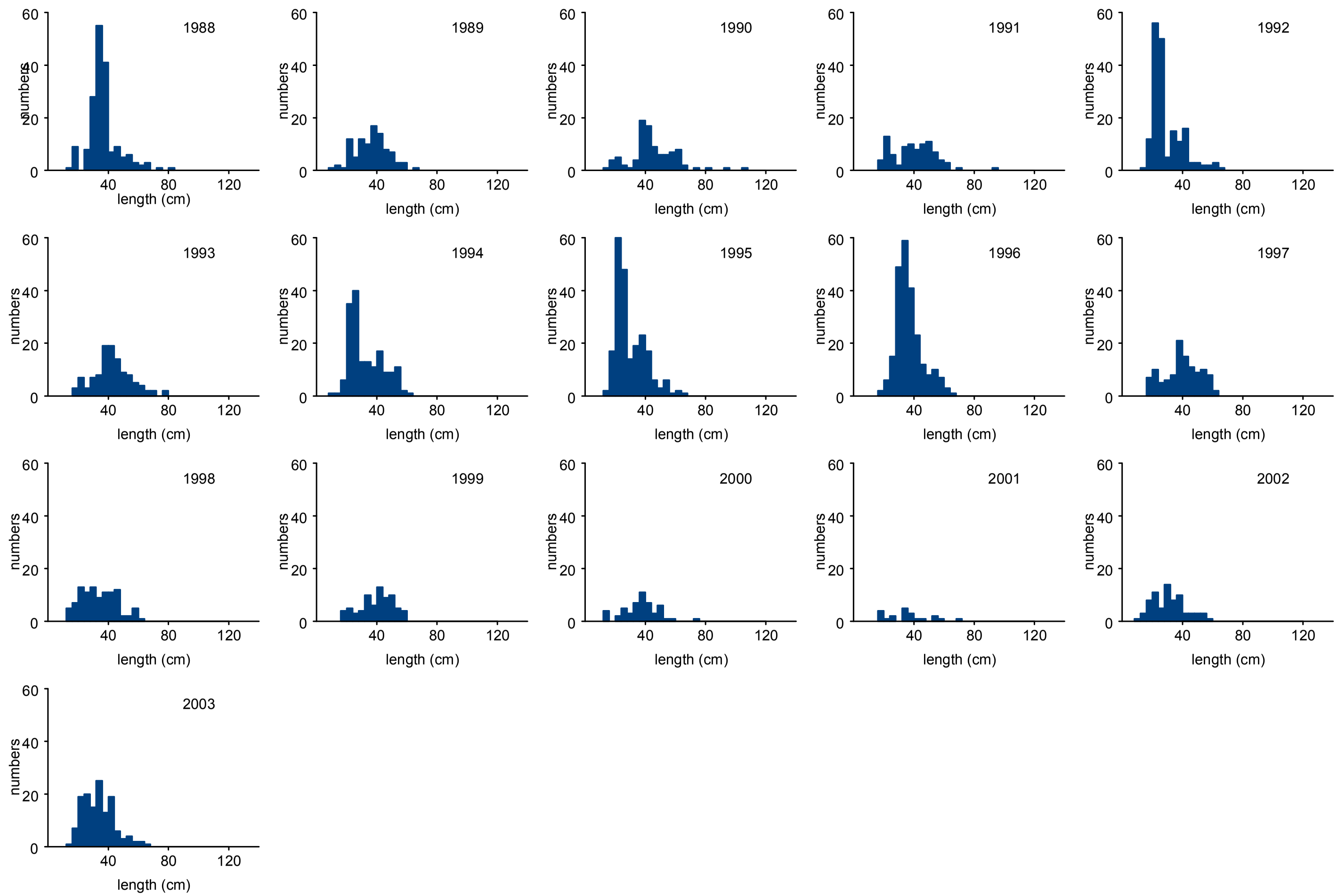


Figure 6.1.2.2 Recruitment index from Scottish Q1 West Coast ground fish survey. Numbers <=30cm per hour.

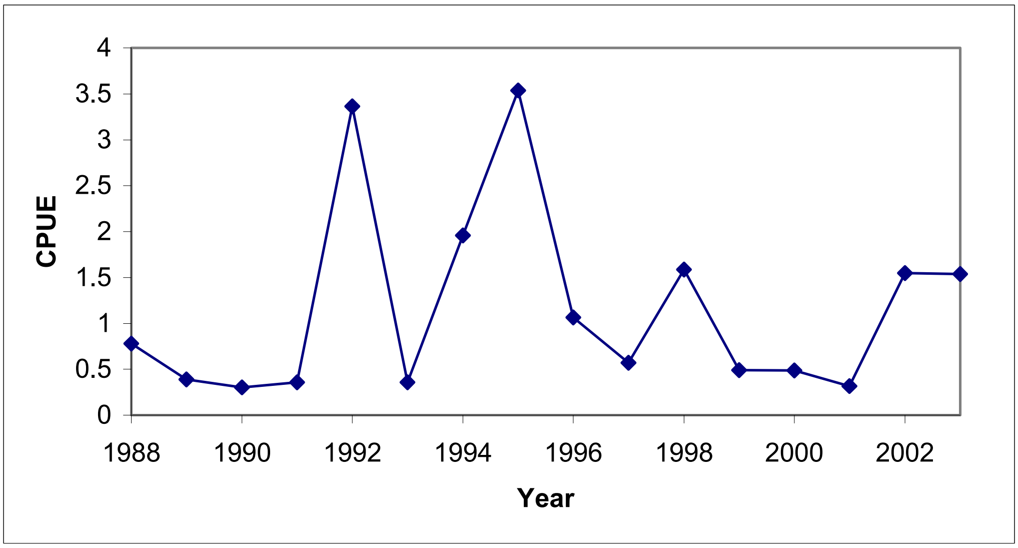


Figure 6.1.3.1. Anglerfish in Division VIa. Raised catch-at-length frequency distributions

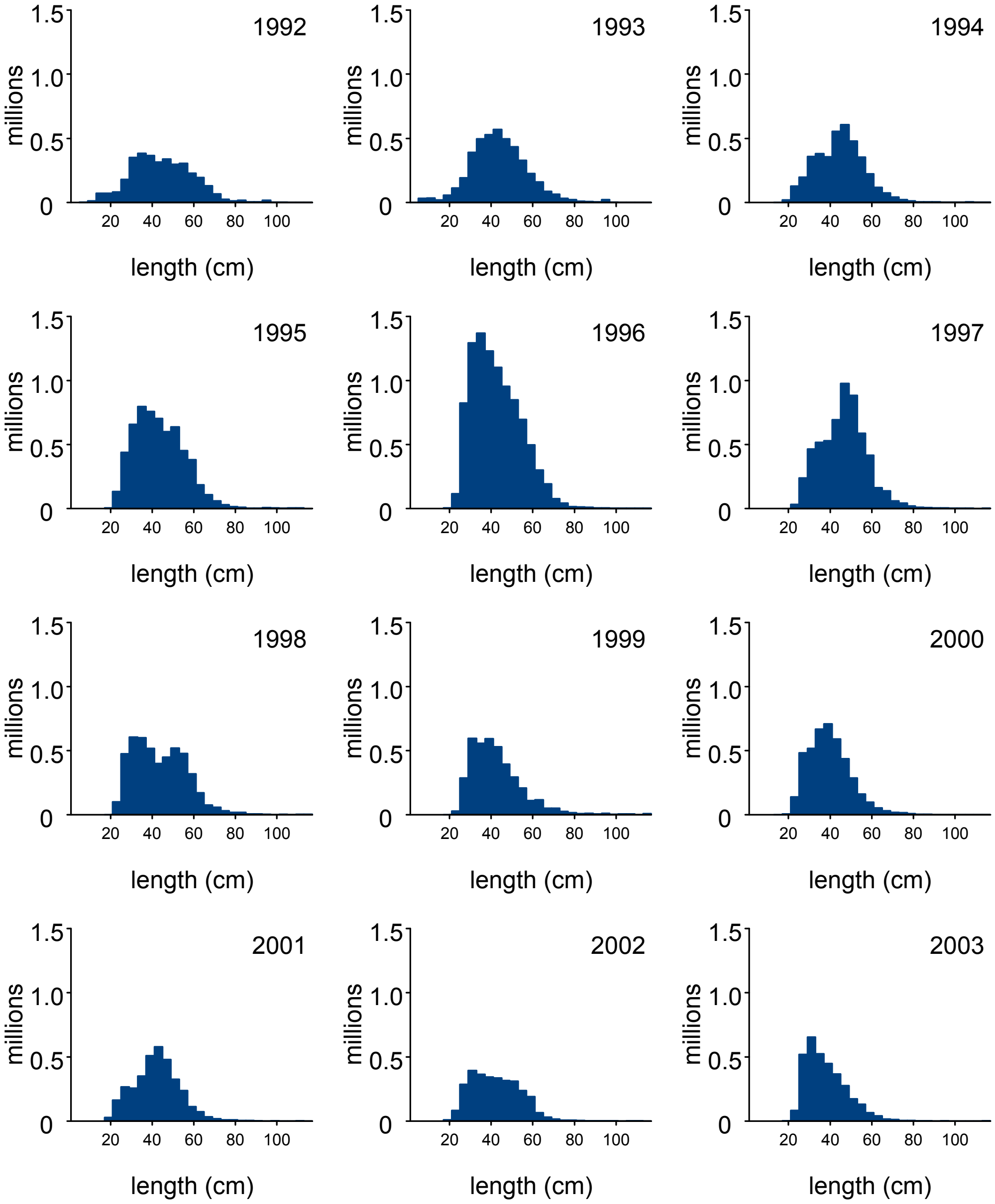


Figure 6.1.3.2. Anglerfish in Division VIb. Raised catch-at-length frequency distributions

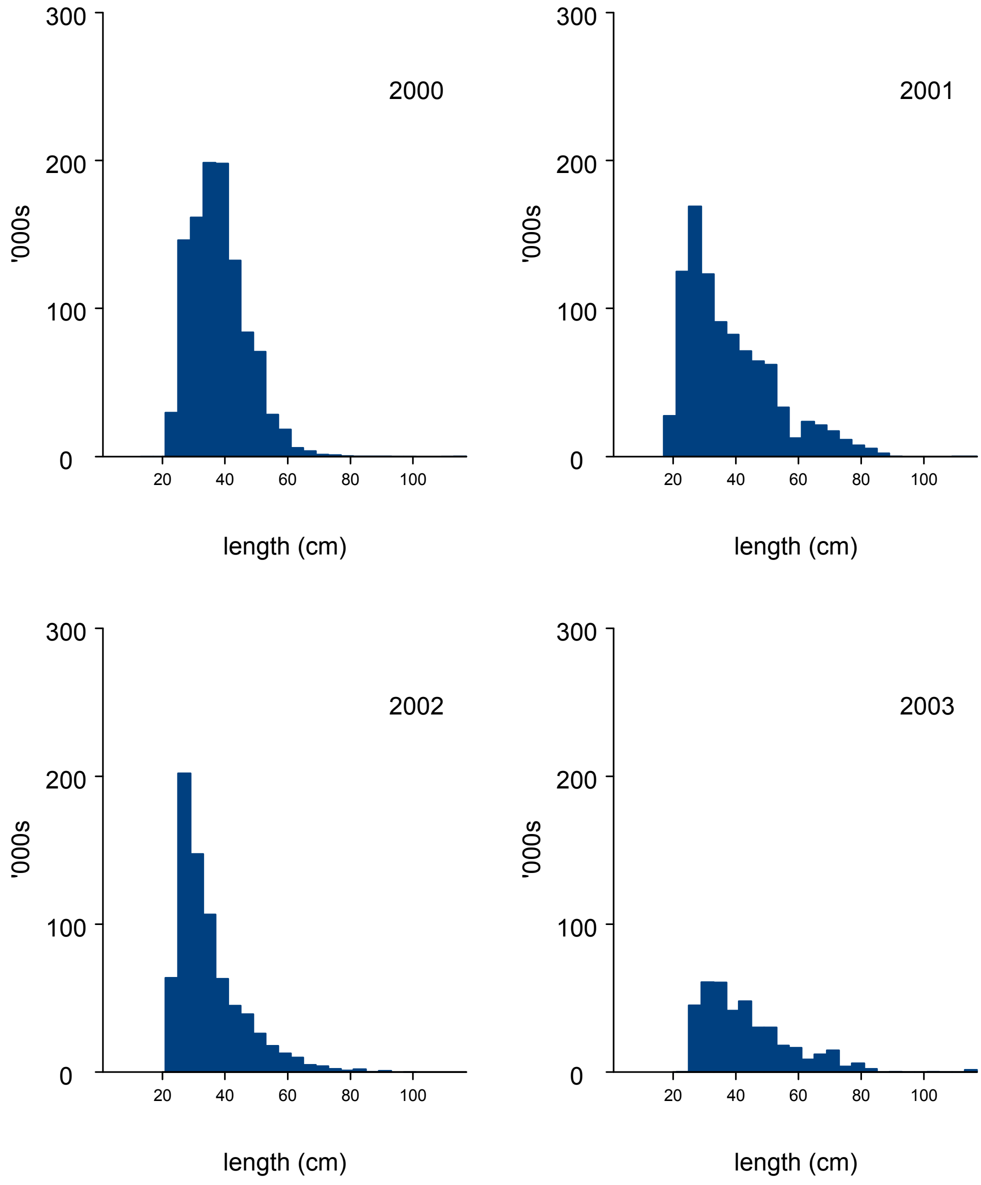


Figure 6.2.1.1 Landings of Anglerfish, North Sea

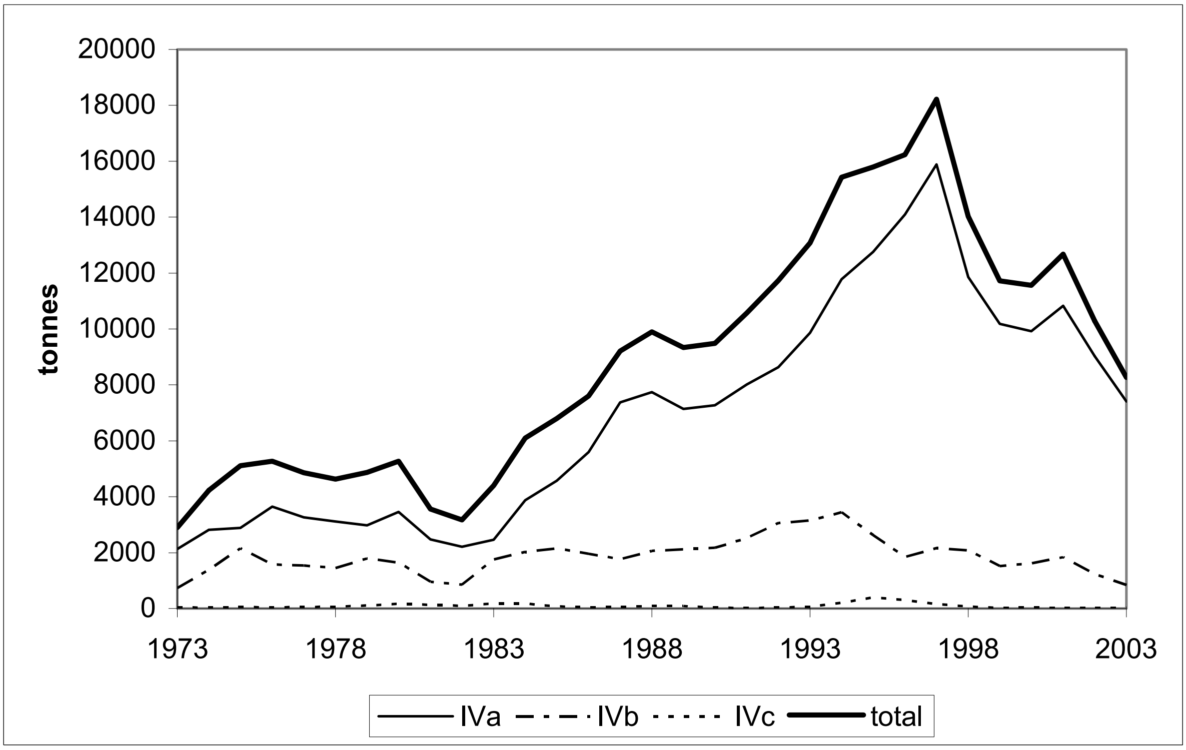


Figure 6.2.2.1. Anglerfish in Division IVa. IBTS length frequencies (total numbers – not standardised by effort).

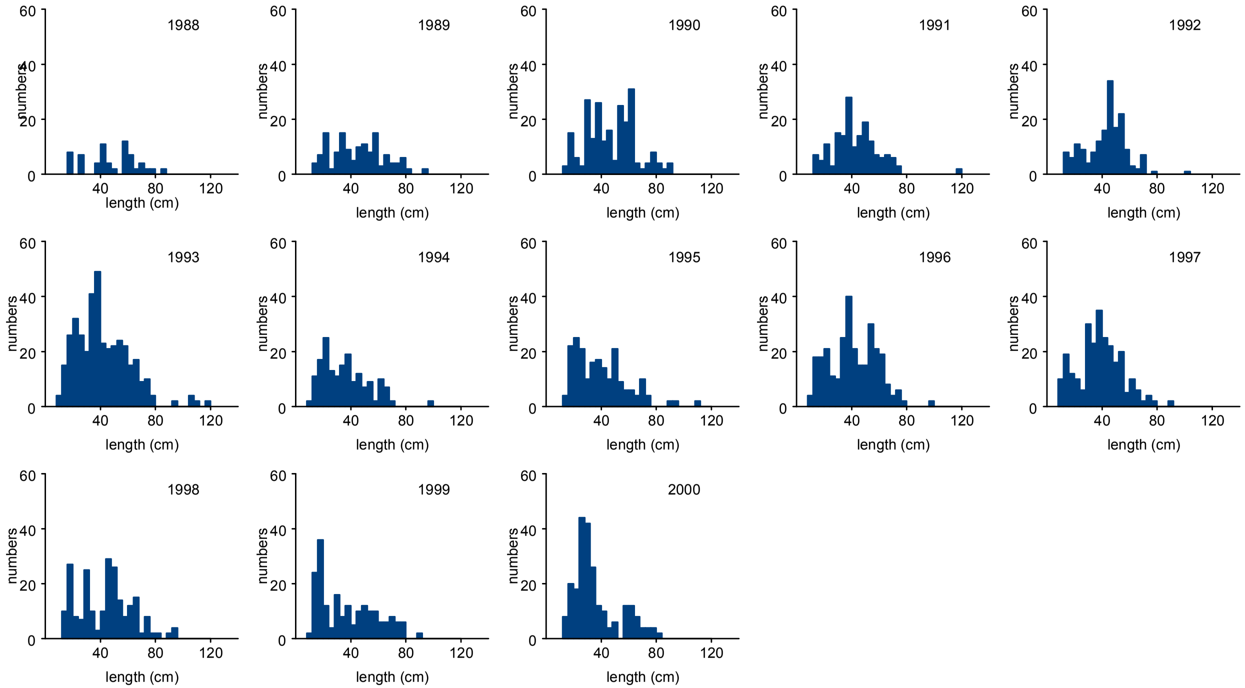


Figure 6.2.2.2. Anglerfish in Division IVa. Scottish Q1 ground fish survey length frequencies (total numbers caught – not standardised by effort).

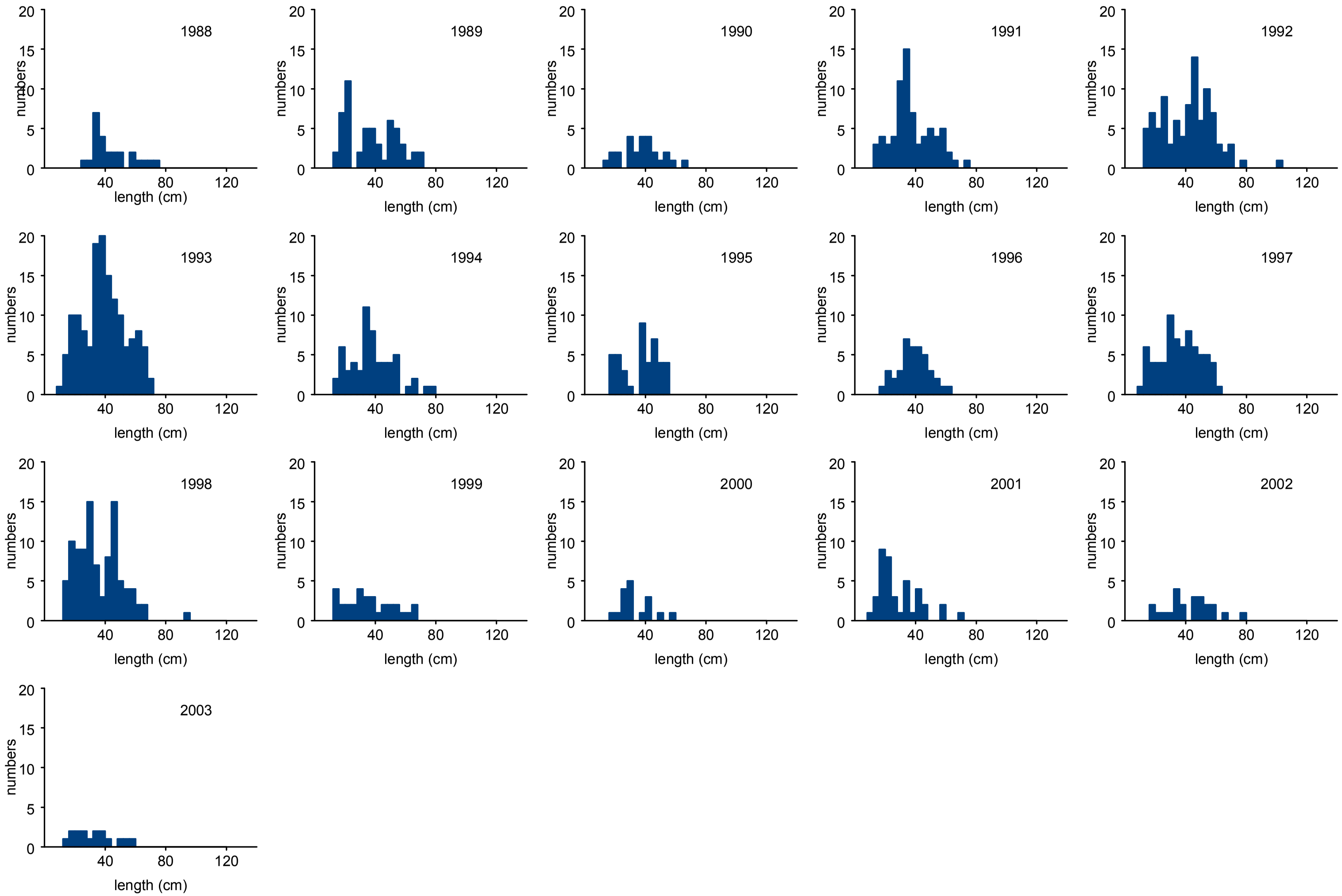
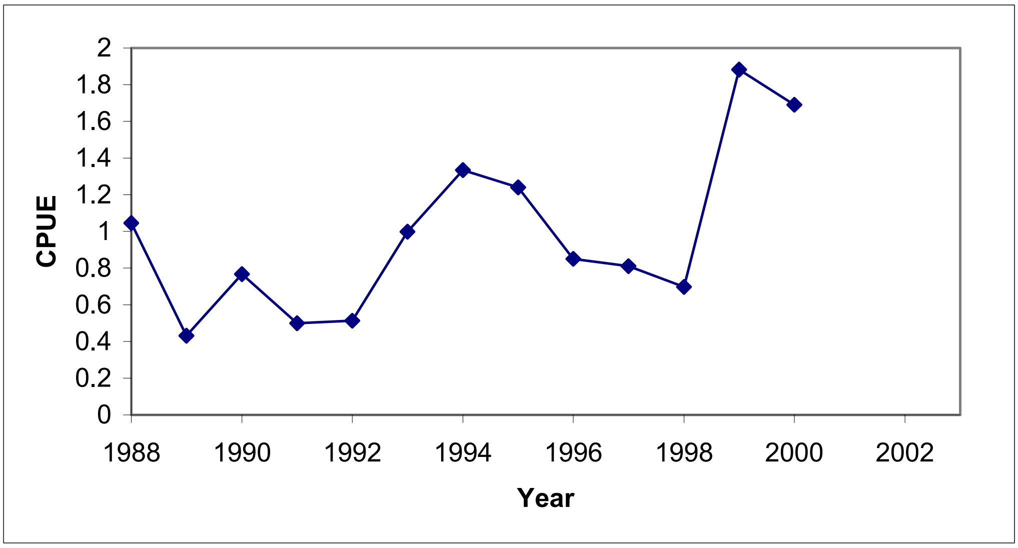


Figure 6.2.2.3. Recruitment index consisting of numbers <= 30cm per hour from a) Q1 IBTS data from Division IVa and b) Q1 Scottish ground fish survey.

a)



b)

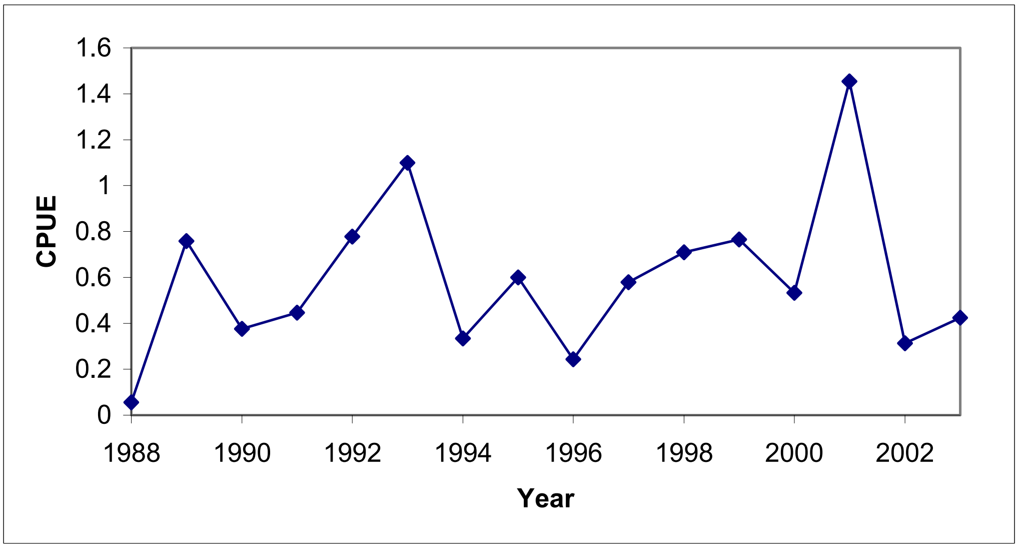


Figure 6.2.3.1 Anglerfish in the North Sea. International catch-at-length frequency distributions (raised to Scottish sampling only)

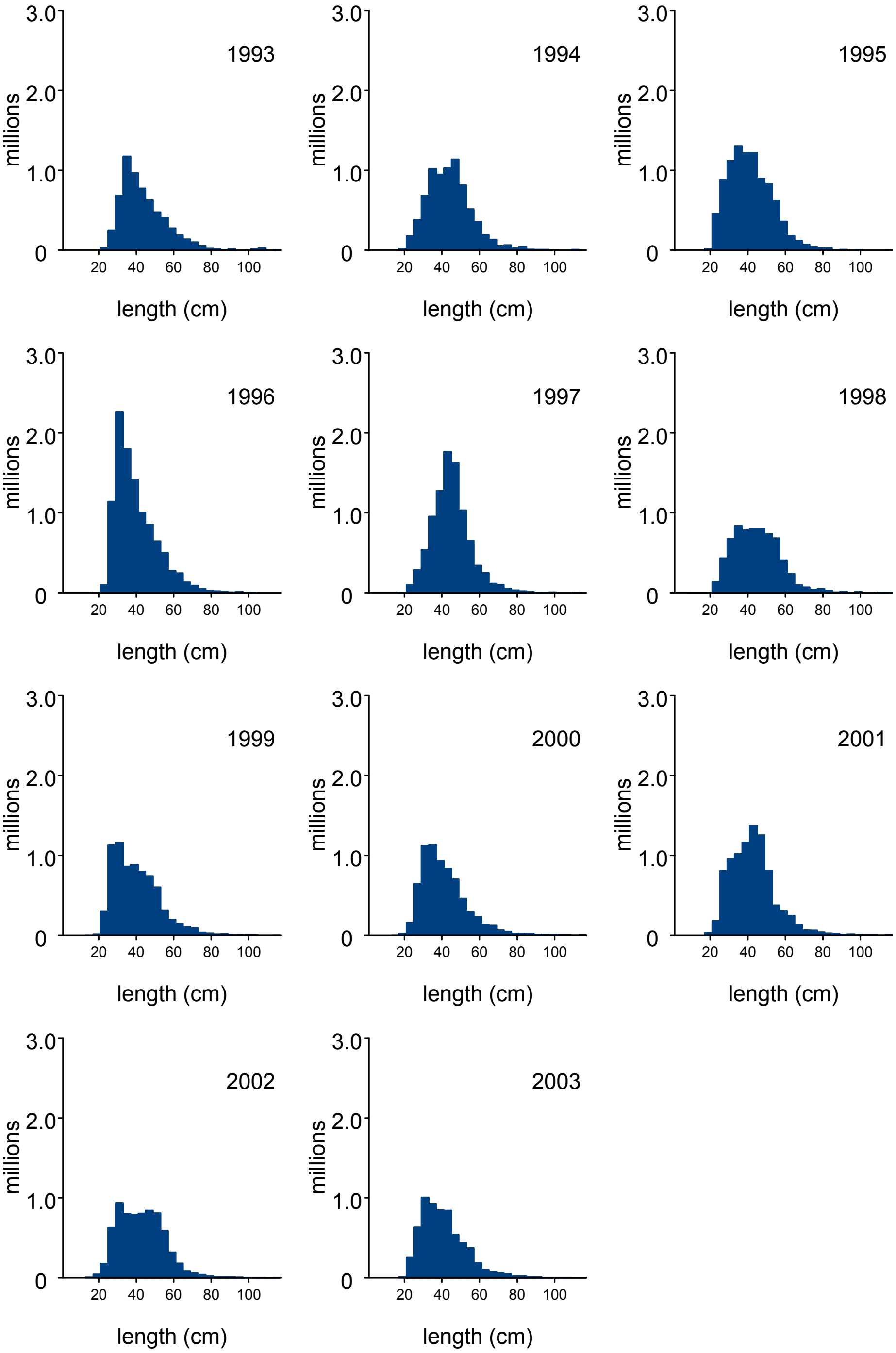


Figure 6.2.3.2. Anglerfish in the northern North Sea (NEZ). Raised catch-at-length frequency distributions from the Danish and Norwegian trawl fishery in 2003.

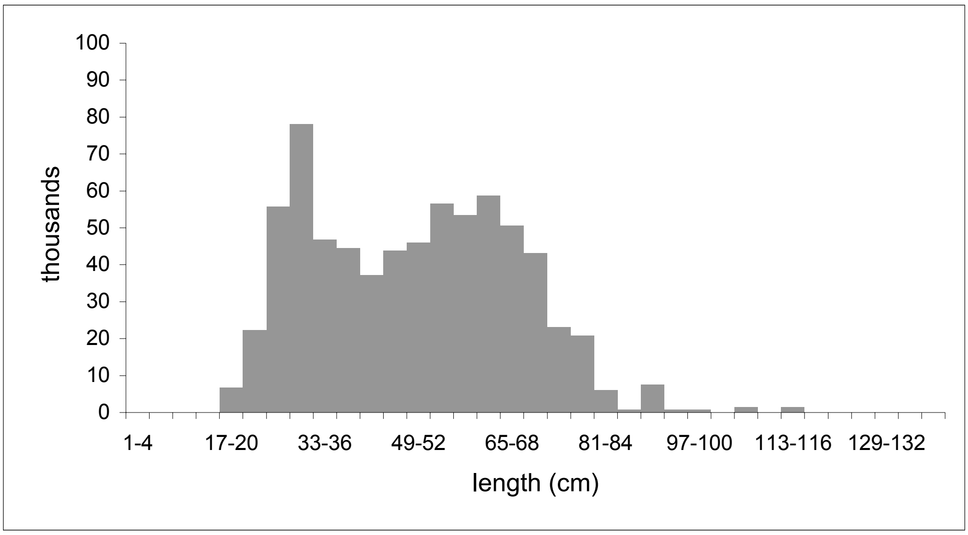


Figure 6.2.3.3. Anglerfish in the northern North Sea (NEZ). Raised catch-at-length frequency distributions from the directed Norwegian gillnet in fishery.

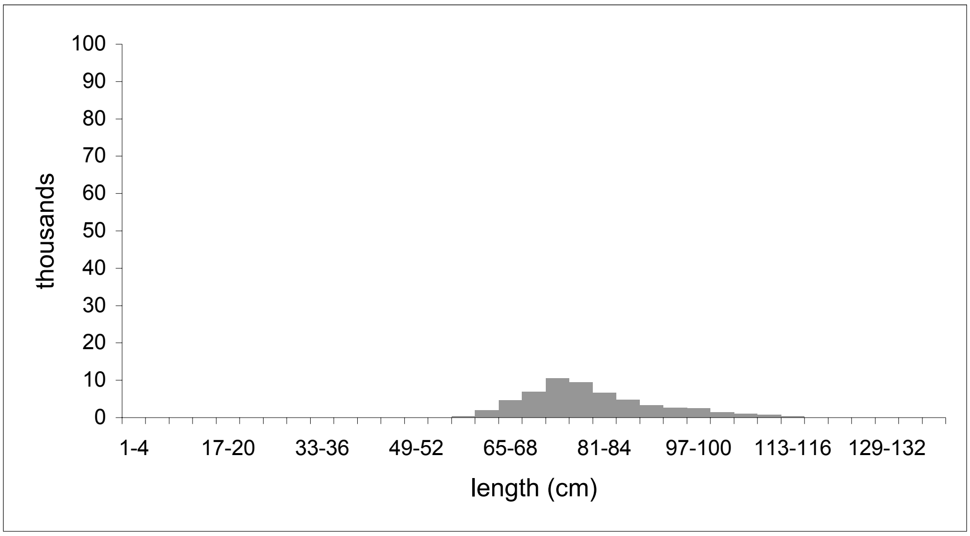


Figure 6.3.1 Landings of Anglerfish in Division IIIa

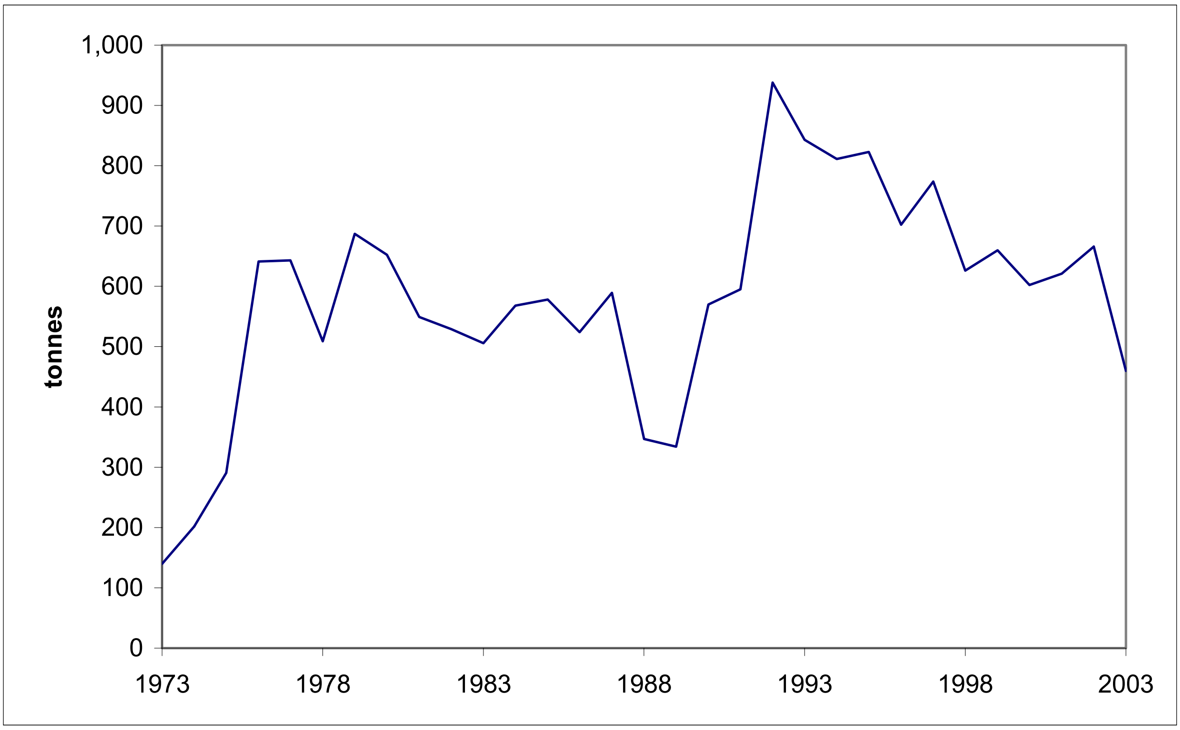


Figure 6.4.1.1 Landings of Anglerfish, Total Northern Shelf
(Division IIIa + Sub-area IV + Sub-area VI)

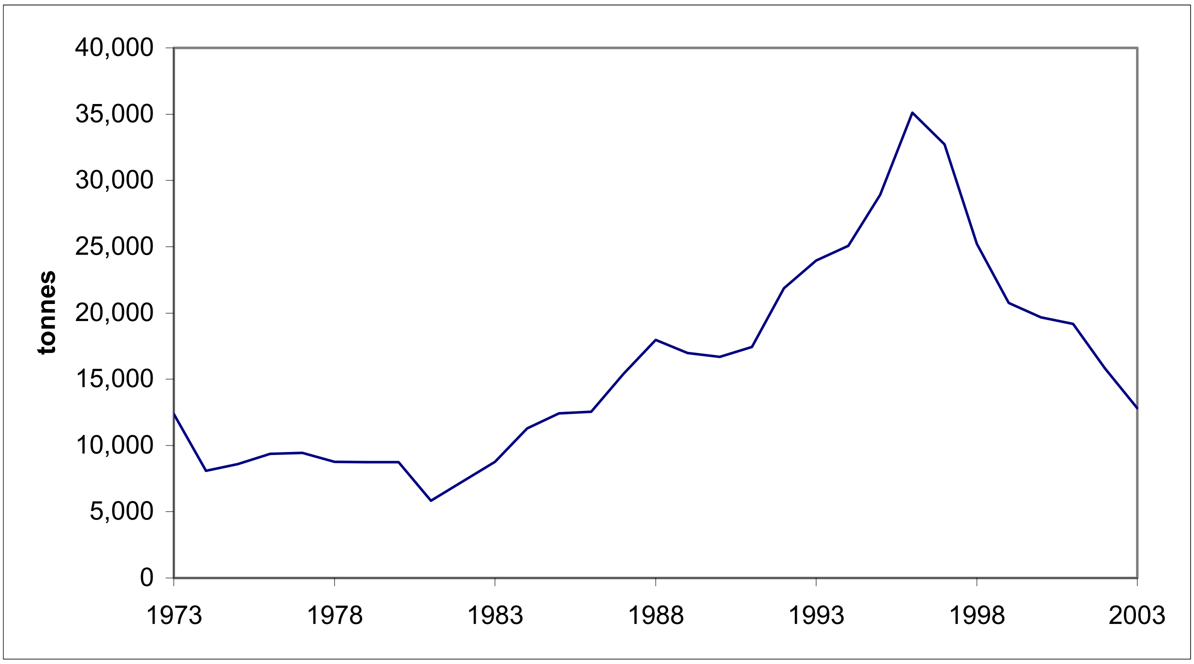


Figure 6.4.2.1. Anglerfish on the Northern Shelf (Sub-area VI, the North Sea & Division IIIa). Raised catch-at-length frequency distributions (excluding Norwegian and Danish length distribution information).

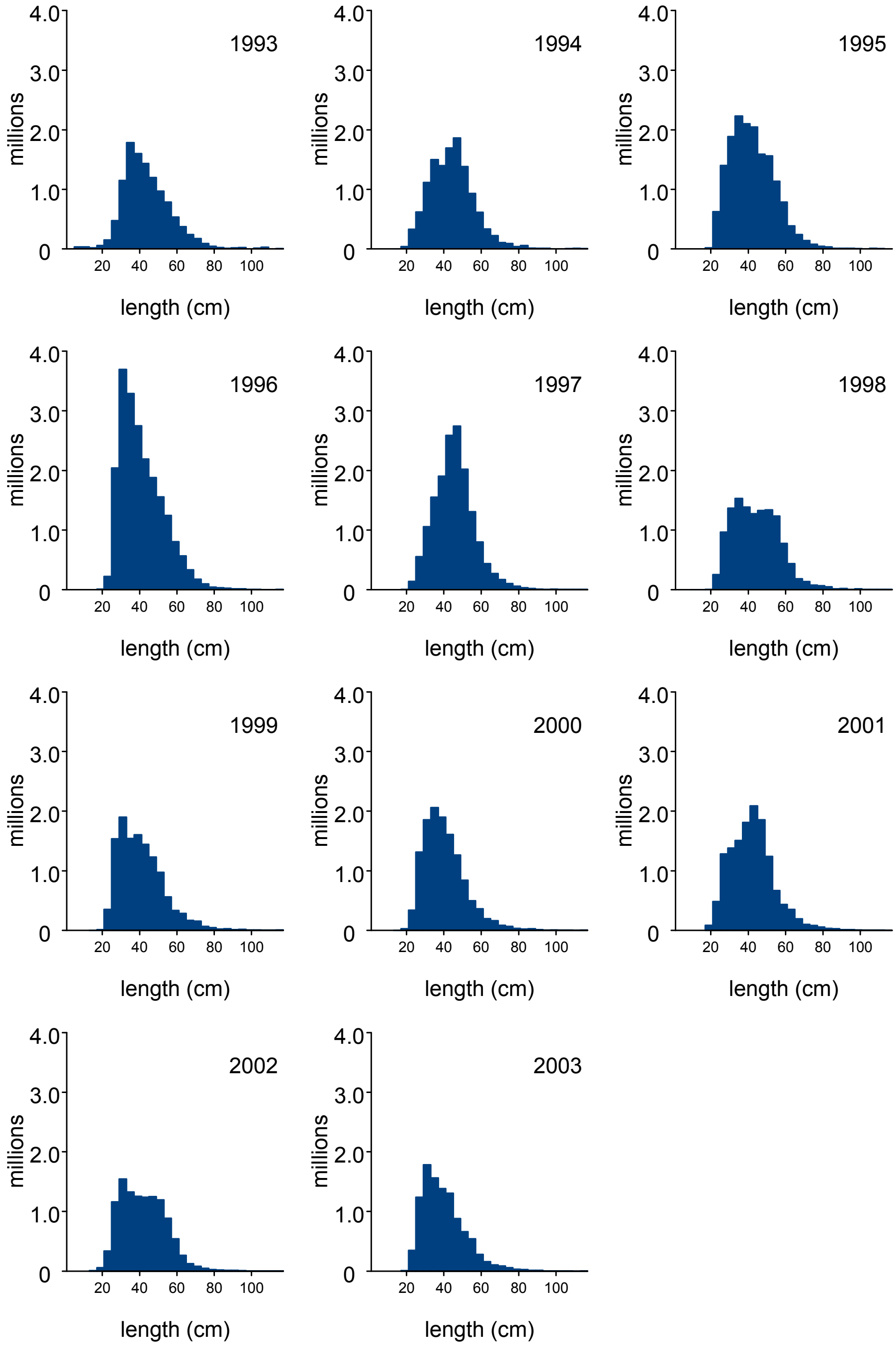


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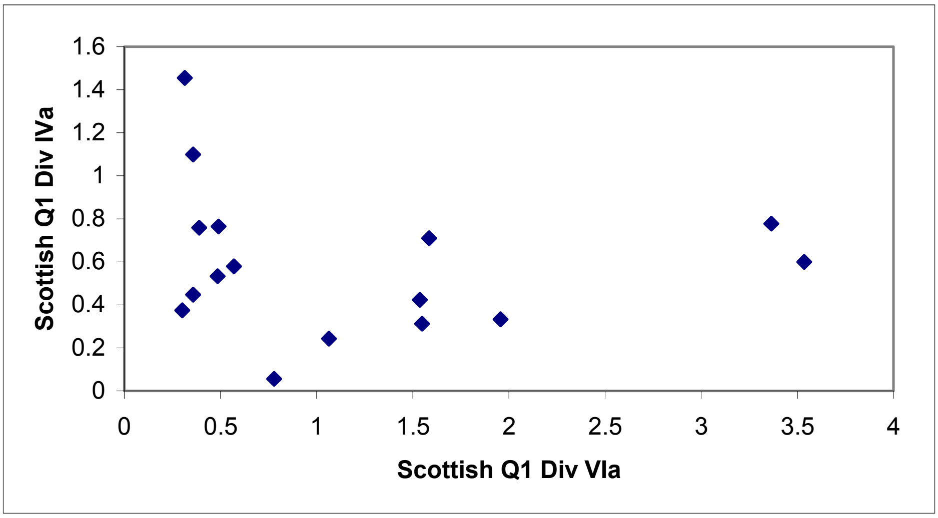
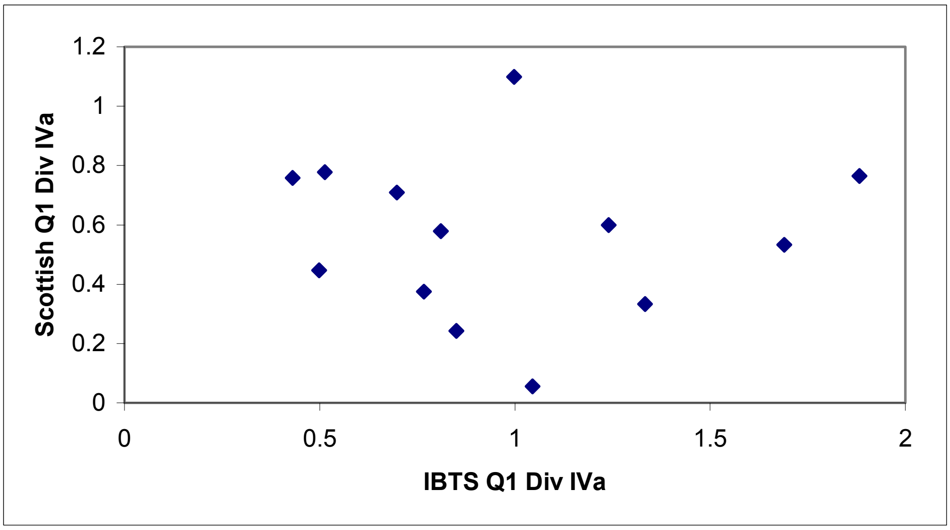
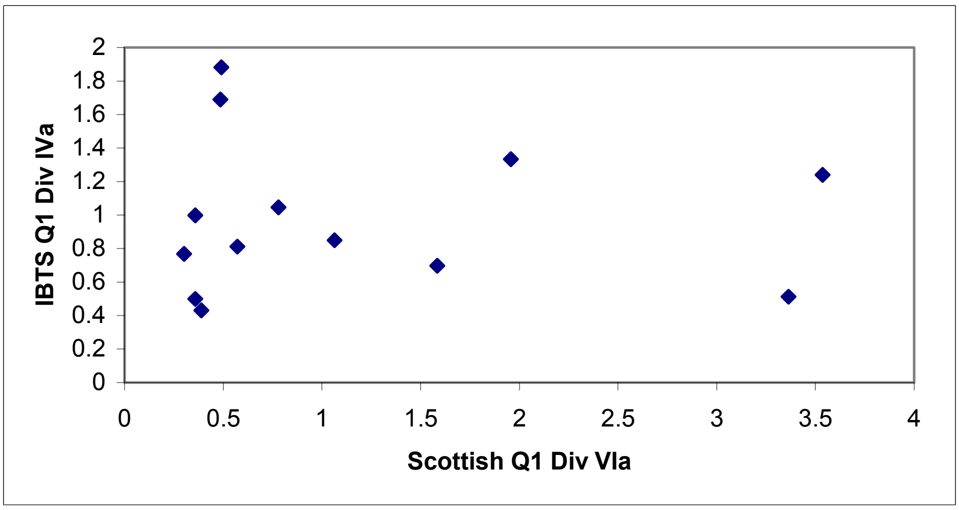
Figure 6.4.2.2. Comparison of recruitment indices between surveys. Numbers <= 30cm per hour.







7 MEGRIM IN SUB-AREA VI

This year the Working Group continued exploratory work to try and assess the VIa megrim stock taking onboard AFCM's suggestion on improved scrutiny of the input data and investigation of simple assessment approaches. Previously ACFM commented that 'information about this stock is sorely needed, no matter how meagre or incomplete' the Working Group shares that belief given the relative economic importance of this stock in the context of VI fisheries. Available data and the analysis preformed by the Working Group are presented and discussed below in Section 7.1 for VIa megrim, and 7.2 for VIb megrim.

7.1 Megrim in Division VIa

7.1.1 The stock structure and fishery

Catches of megrim from Sub-area VI comprise two species, *Lepidorhombus whiffiagonis* and *L. boscii*. Information available to the Working Group indicates that *L. boscii*, are a negligible proportion of the Scottish and Irish megrim catch (Kunzlik *et al.* 1995 and Anon, 2001) and other countries segregate landings data by species. In the past the Working Group has considered megrim populations in VIa and VIb as separate stocks. Information from the recent EC study contract (98/096) on the 'Distribution and biology of anglerfish and megrim in the waters to the West of Scotland' confirms this approach (Anon, 2001). Growth and population structure of megrim in VIa and VIb are significantly different as are the two fisheries (Anon, 2001).

Megrim are caught in association with anglerfish by some fleets and are area misreported along with anglerfish (See Section 6.1.1.3). The official statistics do not therefore reflect Working Group estimates in several recent years. As for anglerfish, the reported Sub-area VI landings have been adjusted to Working Groups estimates of catch by including landings declared from Sub-area IV in the ICES statistical rectangles immediately east of the 4 degree W line (see Section 2.5). Such a re-allocation of catches may still inadvertently include some landings taken legally in Sub-area IV on the shelf-edge to the west of Shetland, but these are likely to comprise fish within the distribution of the stock assessed as the Sub-area VI stock. Area misreporting peaked in 1996 and 1997 when around 50% of the estimated Working Group landings for Division VIa were area misreported (see Table 7.1.4.1).

The Scottish fleets take around 70% of the Working Group estimates of landings in recent years. There are two main Scottish fleets, the light trawl and heavy trawl, targeting mixed roundfish in VIa. The development of the directed fishery for anglerfish has led to considerable changes in the way this fleet operates. Part of this was a change in the distribution of fishing effort into deeper waters. There have also been changes in the gear used by the heavy trawl fleet with twin rigs and >100 mm meshes being used in deeper water for anglerfish. Megrim are also caught by vessels using 80 mm mesh to target *Nephrops* and other species on the shelf. Landings from the Scottish fleet come mainly from the Butt of Lewis, the slope North of the Hebrides and also include some landings from the Stanton Bank. In the past megrim landings have been linked to anglerfish however as the fishing pattern has changed the link may not be as strong in recent years.

The Irish fleet, which has accounted for around 20% of the total Division VIa landings in recent, is a light trawl fleet targeting megrim, anglerfish, hake and other gadoids. Although megrim and anglerfish are often landed together by this fleet there is no apparent relationship between the landings of both species caught. The majority of Irish Division VIa landings come from the Stanton Bank with some landings from Donegal Bay and the slope northwest of Ireland. Irish discarding studies since have shown that large numbers of megrim are discarded by this fleet at Stanton Bank and in Donegal Bay (see Section 7.1.3). Over the last six years there has been an increasing number of vessels using twin rigs in this fleet. There have also been changes to the fleet composition in the last three years with over ten vessels decommissioned and four new vessels joining the fleet. The ten decommissioned vessels accounted for around 50% of the total Irish landings between 1995-1999, the new vessels now account for around 80% of landings in the more recent years.

Between the mid-1970s and the late 1980s the French fleet landed large quantities (1,000-2,000 tonnes/year) of megrim from VIa (based on official landings statistics). During the early 1990s and up until 2003 French landings have declined continuously. This fleet alternated between the shelf and deepwater fisheries and targeted mixed roundfish.

No information was available to the working group on the gear, discarding practices or changes to the composition of this fleet in recent years.

Megrim are caught by Spanish (Basque) fleet targeting them in a mixed fishery for anglerfish, hake and *Nephrops* on the slope west of the Hebrides. In the past these fleets use 80 mm cod-end baka trawls. No information on discarding or recent changes to the composition or gears used by this fleet were available to the Working Group in 2004.

7.1.2 ICES advice applicable to 2003 and 2004

ICES advice for 2003: ICES advised that catches in 2003 should be no more than the current TAC of 4,360 t. There is not sufficient information to estimate appropriate references points for this stock.

ICES advice for 2004: Catches in 2004 should be no more than the recent (1999-2001) landings in Divisions VIa and VIb and unallocated landings in Subarea IV of about 3 600 t.

7.1.3 Management applicable in 2003 and 2004

For a number of years, megrim in Sub-areas VI, XII, XIV and Division Vb (EU zone) have been subjected to a precautionary TAC of 4,360 t. In 2004 this precautionary TAC was reduced to 3,600 t..

Year	ICES Advice	Basis	TAC[1]	% change in F associated with TAC	WG Landings
2002	4,360	Maintain current TAC	4,360	n/a	1,828
2003	4,360	Maintain current TAC	4,360	n/a	1,598
2004	3,600	Reduce TAC to recent landings	3,600	n/a	

[1]Vb(EC), VI, XII and XIV. [2] Incomplete data. [3] Landings in Sub-area VI. Landings in Vb (EC), XII, and XIV negligible. Weights in t.

Annex XVII to Council Regulation (EC) No 2341/2002 regulated the maximum number of days in any calendar month of 2003 for which a fishing vessel may be absent from port to the West of Scotland. Annex V to Council Regulation (EC) No 2287/2003 extended effort regulation a in 2004. The maximum number of days in any calendar month for which a fishing vessel may be absent from port to the West of Scotland in 2003 and 2004, varies for particular gear categories:

Gear:	Maximum days allowed:	
	2003:	2004:
Demersal trawls, seines or similar towed gears of mesh size ≥ 100 mm except beam trawls	9	10
Beam trawls of mesh size ≥ 80 mm;	15	14
Static demersal nets including gill nets, trammel nets and tangle nets;	16	14
Demersal longlines;	19	17
Demersal trawls, seines or similar towed gears of mesh size between 70 mm & 99 mm except beam trawls[1];	25	22
Demersal trawls, seines or similar towed gears of mesh size between 16 mm & 31 mm except beam trawls.	23	20

[1] : With mesh size between 80 mm & 99 mm in 2004.

No detailed information was available to the Working Group on which gear categories include vessels targeting megrim in VI but on the basis of the catch composition restrictions (EC Regulation No 850/98) it is likely that most of the vessels are in the 80-99mm mesh band and are therefore limited to 25 days at sea in 2003 and 22 in 2004. In 2003 and 2004 additional days may be allocated to Member States by the European Commission on the basis of the achieved results of decommissioning programmes.

A Commission Decision (C(2003) 762) in March 2003 allocated additional days absent from port to particular vessels and Member States. United Kingdom vessels were granted 4 additional days per month (based on evidence of decommissioning programmes). An additional two days was granted to demersal trawls, seines or similar towed gears (mesh ≥ 100mm, except beam trawls) to compensate for steaming time between homeports and fishing grounds and for the adjustment to the newly installed effort management scheme.

The minimum landings size of megrim was reduced in January 2000 to 20 cm EC Regulation No 850/98.

7.1.4 The fishery in 2003

Official landings data for each country together with Working Group best estimates of landings from VIa are shown in Table 7.1.4.1. These landings data have been modified somewhat since last year due to updated area misreporting estimates. Longer-term international landings are shown in Figure 7.1.4.1. Landings from VIa have fluctuated around 2,500t before increasing during the mid 1990s to around 4,000 t. Landings have declined since 1996 and the 2003 landings are the lowest in the time series (62% of the average).

The international megrim landings in recent years have been below the precautionary TAC. However, 2003 quota uptake by France (<5% of 2003 Quota) and Spain is very low, estimated uptake by Ireland is close to the quota (86%), whilst estimated uptake by the UK is in excess of the quota when area mis-reporting is included. Given the extent of this area misreporting, which was estimated to be 30-40% of the landings of this stock since 2000, even the precautionary TAC is unlikely to constrain fishing mortality.

These new effort regulations (Given in 7.1.3) provided an incentive for some vessels previously using >100 mesh in otter trawls to switch to smaller mesh gears to avail of higher numbers of days-at-sea. This would also require these vessels to be targeting either *Nephrops* or anglerfish, megrim, whiting with various catch and by-catch composition limits after EC Regulation No 850/98. No detailed information was available to the Working Group to quantify on how many vessels have switched to using smaller meshes as a result of effort regulation as this information is not reliably recorded in logbook information for some countries.

7.1.5 Commercial catch-effort data and research vessels survey

The available age disaggregated commercial and research tuning data for VIa megrim are presented in Table 7.1.5.1.

Commercial landings and effort data were available to the Working Group for the Irish otter trawl fleet (as described in Section 7.1.1) uncorrected for fishing power from 1995-2003 (Table 7.1.5.2). This fleet takes almost all the Irish megrim landings which amount to around a 20% of the total Working Group estimates of landings in VIa. Irish VIa otter trawl effort peaked in 1997 and has declined since due to recent vessel decommissioning (Section 7.1.1). The 2003 effort has increased slightly on the 2002 level which was the lowest in the short time period. Irish otter trawl LPUE has fluctuated considerably without obvious trend ranging from 6.3-9.0kg/hr over the time series. However LPUE in 2003 increased substantially to over 12.kg/hr. Due to recent changes in the fleet composition the WG had serious concerns about using this commercial fleet 'uncorrected for fishing power' as a tuning index. In addition this fleet operates mainly in the southern part of VIa and may not be representative index for the whole stock.

Reliable catch and effort data were not available from the Scottish trawl fleets due to changes in the practices of effort recording, non-mandatory effort recording and substantial area mis-reporting of catches in recent years. No effort data were available for the Spanish and French fleets in Sub-area VI.

Catch data were available for the Irish west coast groundfish survey (See section 2.13). This survey took place on a commercial vessel using commercial gear and only covers the southern part of VIa and is designed for roundfish not flatfish. There have been were changes in sampling protocol since 2000. Prior to this megrim may not have been adequately sampled due to the sub-sampling procedures used. This survey was discontinued in 2003 and replaced by a newly designed survey on RV Celtic Explorer. The index for this survey was also provided to the Working Group (Table 7.1.5.1).

Two Scottish groundfish surveys are carried out in VIa during the 1st and 4th quarter (Mackerel recruit). An extended time series of length frequency information were made available to the Working Group for the first time, summary data for these surveys are given in Table 7.1.5.3. The Q4 (Mackerel recruit) survey has considerably higher catch rates that the Q1 survey however. CPUE for the Q4 series has been below average since 1997 where as CPUE for the Q1 survey was higher at the start of the series but has been relatively stable in recent years. Last year the Working Group attempted unsuccessfully to use the Q4 Scottish surveys as an age-disaggregated tuning index for this stock by applying a commercial ALK to the survey length frequency data.

7.1.6 Catch age compositions and mean weights at age

For the years 1990 to 2003 quarterly landings-at-age and length frequency data from VIa were available for Scotland. These data were also available for Ireland from 1994 to 2003. These countries take around 80% of the landings in VIa and sampling levels are presented in Tables 2.2.1 and 2.2.2. For data prior to 2001 and for 2003 the combined Scottish and Irish landings-at-age data were raised to the international catch.

For 2002 length-frequency data were provided for the French landings from VIa and for Spanish landings for Sub-area VI in 2002 no 2003 data were provided by these countries. Investigation of the French length-frequency data indicated that the size structure of the French megrim landings was similar to that of the Scottish landings. The French vessels are known to mainly fish in deeper waters of VIa like many of the Scottish vessels. Therefore landings numbers-at-age for this French fleet were calculated using the Scottish 2002 ALK. Given that most of the Spanish landings in recent years have been from VIb and no length-frequency data disaggregated by Division were available to the Working Group these data were not used to calculate landings numbers-at-age for the Spanish fleet. The combined landings numbers-at-age were raised to the Working Groups best estimate of 2002 international catch.

Working Group estimates of international landings-at-age are presented in Table 7.1.6.1. There is an obvious decline in the older ages (9+) in recent years and younger ages are contributing higher proportions of the landings in recent years. Annual mean weights-at-age in the landings are given in Table 7.1.6.2. Mean weights vary over time with highest mean weights in the mid 1990s for most ages. The overall trend in mean weights-at-age is a slight downwards for ages 3-8 and upward for the older ages. The annual length frequency distributions available for the Irish and Scottish landings in 2002 are given in Figures 7.1.6.1 and Figure 7.1.6.2. No information was available to the Working Group on the precision of the length frequency data or landings-at-age data.

Estimates of discarding between 1996 and 2003 from the Irish otter trawl fleet were also available to the Working Group (discard length frequencies are also shown in Figure 7.1.6.2). Discard numbers at age were also available for the Irish otter trawl fleet. These data, although variable, indicated that discard rates were high and variable; 32% by number and 14% by weight. Since the Irish fleet accounts for around 20% of the international landings and because the precision of these discard data has not yet been quantified the use of Irish discard-at-age rates to calculate international catch numbers-at-age was considered inappropriate. Information on discarding practices in other fleets is urgently needed for this stock.

7.1.7 Natural mortality, maturity and stock weight at age

As in previous assessments of this stock the natural mortality rate 0.2 is used at all ages and years (there are no direct estimates of M in this stock). The proportion M and F before spawning was set at 0 for both. A maturity ogive was calculated for Division VIa during the EC study contract (98/096) (Anon, 2001) and used again by the Working Group this year. This VIa ogive was is presented below:

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
Prop. mature	0	0	0.53	0.71	0.85	0.92	0.96	0.98	0.99	1	1	1

The ogive is based on female maturity-at-age data collected during the spawning period in 1999. Given the differences in growth and maturity schedules it does not make biological sense to combine a male and female maturity ogive for megrim. In addition, females account for over 90% of the landed megrim in VIa therefore the Working Group decided to apply a female only maturity ogive to this stock. However, the Working Group also note that there is evidence that female maturity length-at-maturity varies from year to year in Sub-area VI and that large female megrim may not spawn every year (Anon, 2001).

Although first quarter catch weights are available for this stock these are variable therefore the Working Group have used annual mean weights-at-age as the stock weights this year.

7.1.8 Catch-at-age analysis

Last year the Working Group carried out an exploratory catch-at-age analysis using a Separable VPA. However, the indeterminancy of terminal F and terminal S meant that this could not be used as a basis for management advice. In addition the Working Group explored an XSA assessment tuned with age-disaggregated index based on the Scottish Q1 survey and Irish ALKs. This assessment proved unacceptable mainly because of poor internal consistency of the age-disaggregated index. This year there was considerable data screening of the country disaggregated catch numbers-at-age and a couple of simple exploitation proxies and assessment methods were explored for this stock these are described below. The Working Group also consider using a simple surplus production model such as ASPIC however the available data with no LPUEs for the main fleet exploiting the stock meant that this analysis could not be carried out.

7.1.8.1 Data screening

Commercial Catch Data

The Working Group conducted a comparative investigation of the catch numbers-at-age from Scotland and Ireland prior to aggregation. These investigations indicated some differences between the age compositions for these countries with two strong years classes (1992 & 1993) apparent in Scottish data but not so evident in the Irish data. This might be explained by spatio-temporal differences in the catches coming from the fleets rather than mis-specification in the age estimations. However, there was also evidence that when strong year classes occurred in the catch-at-age matrix there were inflated numbers-at-age in surrounding cohorts so inaccurate age estimation may be a problem in this stock.

Both data sets consistently show a decline in the older age classes (9+) since the mid 1990s. Cohort based catch curves indicated that the log numbers-at-age for Irish sampling were rather noisey declining faster than Scottish log numbers-at-age. This noise may simple be because the Irish fleet tend to land smaller fish than the Scottish fleet. Consequently the Irish sampling data would contain higher proportions of the slower growing males than the Scottish landings. The Working Group concluded that some intersessional work is required to investigate the precision and level of agreement between Irish and Scottish age sampling.

Despite the above concerns about the quality of the landings numbers-at-age the Working Group felt that running a user defined VPA based on these data would be instructive to at least elucidate the stock trends in earlier years when the VPA had converged. A user defined VPA was run in the Lowestoft Suite using the exact method. The resultant fishing mortality vectors-at-age are shown in Table 7.1.8.1. The $F_{(a,y)}$ fixed starting parameters for 2003 and age 11 (highlighted in bold in Table 7.1.8.1) were made by examining historical F-at-age patterns for this stock in a spreadsheet implementation of a VPA using Pope's approximation. The stock numbers-at-age from this user defined VPA are presented in Table 7.1.8.2. These indicate a decline in older ages in the stock over the time series. However this decline is probably not as marked as in the landings-at-age matrix. The summary table from this user defined VPA is given in Table 7.1.8.3 and Figure 7.1.8.1. The results suggest that F increased in the mid 1990s and was relatively high (around 0.6) in the late 1990s. More recent F estimates are likely to be unreliable. There appears to be evidence of a decline in SSB in since the mid 1990s but again the SSB in the most recent years will be unreliable. The strong 1992 and 1993 year classes are apparent and the 1995 year class may also be strong but again recent estimates of recruitment will be highly contingent on the $F_{(a,y)}$ fixed starting parameters for 2003.

Surveys and Commercial CPUE data

Following the recommendation of ACFM the Working Group explored the survey data in a simplistic analysis. Although data were made available on the length-frequency composition of catches for the two Scottish surveys there was insufficient time to evaluate the precision of these data or possible post stratification of the data. A simple evaluation of the 'spikey' length frequency distributions and the catch numbers data for the Q1 survey (Table 7.1.5.3 and Figure 7.1.8.2) indicates that catch numbers were low and the data are likely to be rather imprecise. The catch numbers from the Q4 survey were higher (on average ~2.5 times more megrim were caught in the Q4 survey than in Q1) and the length frequency distributions looked somewhat smoother (Table 7.1.5.3 and Figure 7.1.8.3). As in previous years Working Group concluded that the Q4 was more likely to be a better index for the stock than the Q1 survey.

Examining these length frequency data indicated that the modal size in most years for both surveys was substantially below that observed in the commercial landings length frequency suggesting that most of the fish caught in the survey would either not have been selected by commercial gears or discarded by the commercial fleets. In addition there was little evidence of the strong 1992, 1993 or 1995 year class appearing as modes in the survey length frequency data. Age data collected during RV and commercial vessels surveys during 1999 and 2002 as part of EC study contract (98/096) (Anon, 2001) suggests that these year classes should appear in the survey length frequency data at age 2 at around 22 cm in length (Text table below). The 22 cm length-class has been highlighted with a circle in Figure 7.1.8.2 and Figure 7.1.8.3. The Q1 survey indicates show highest catches at the size in 1990 and 1991 (i.e. strong 1998 and 1999 year classes). There is no corroborating evidence of these strong cohorts in the Q1 survey length frequency data. The sample numbers data below (N) indicate that numbers of 0-2 yr old megrim caught and sampled for age during surveys was relatively low compared with older fish. This appears to be confirmed by observed length frequencies with few fish caught less than around 22 cm. This probably indicates a rather shallow slope to the selection curve and that selection probably occurs across several age classes. The net effect is that recruiting cohorts of megrim may not be obviously in the survey length frequency data.

Age	Mean Length	Std Dev	N
0	0.0	0.0	
1	15.2	1.6	12
2	22.2	3.3	62
3	25.7	4.1	331
4	29.1	4.5	555
5	32.8	5.4	483
6	37.3	5.5	367
7	40.1	5.4	191
8	42.9	4.6	67
9	43.7	4.5	22

The first approach examined by the Working Group was to examine 'exploitation proxies' by plotting the survey CPUE of small (<29 cm) and large (>40 cm) megrim divided by the total commercial catch (Figure 7.1.8.4). Ideally the catch should also be standardised but no reliable effort data were available for the Scottish fleet. The cut-off lengths were chosen on the basis that individuals < 29 cm would not yet be landed in the commercial fisher where as individuals >40 cm would all be retained in commercial landings. The results are rather noisy and it is difficult to draw any firm conclusions about exploitation rates. The Working Group then examine CPUEs of different size classes in the Q1 and Q4 surveys. A length cut-off of 22 cm was chosen for this analysis since numbers below this would be of 1 and 2 year old individuals ('recruits') while ≥ 22 cm would mainly consist of ages 3 and above. The Q4 survey indicates a period of relatively high CPUE for both the 'recruits' and 'post recruits' from 1987 to 1996, CPUE has been relatively low in more recent years (Figure 7.1.8.5). The Q1 survey is more variable with some year effects apparent (Figure 7.1.8.6). The Working Group considered that this survey was not a used index for this stock for the follow reasons; low and variable catches and CPUEs and a pattern which is inconsistent with that observed in the commercial and other survey data.

Last year ACFM advised the Working Group that '*if reasonable recruitment estimators are available from the survey it may also be possible to explore the usefulness of a Catch-Survey Analysis*'. The Working Group examined this method for the Q4 survey although external examination of the survey data suggested that selection occurs over several ages and it was therefore difficult to objectively define a suitable length cut for the 'recruits'. As above the individuals < 22 cm were classified as 'recruits' while all larger individuals (≥ 22 cm) were put in the post recruit group. The input data are presented in Tables 7.1.8.4. Note commercial length-frequency data and consequently catch numbers were only available since 1990 and all the catch has been put in the fully recruited category. An implementation of CSA developed by Mensil (2003) and examined by WGMG ICES CM 2003/D:03 was used for this analysis. The 'S-ratio' i.e. the ratio of catchability coefficients 'q' for the recruits devided by the 'q' for post recruits was set 1.0.

The results of CSA for the Q4 survey are shown in Table 7.1.8.6 and Figure 7.1.8.7. Retrospective plots for the analysis are shown in Figure 7.1.8.8. All biomass and population number estimates in these plots are on a relative scale since there has been no attempt to estimate externally the S-ratio quantitatively. The relative biomass and recruit and post recruit results indicate a fairly similar pattern to that observed by simply plotting the CPUE from this index (Figure 7.1.8.5). Biomass is estimated to have trended downwards since 1994 to 60% below the average in 2003. Fishing mortality and the 'harvest rate' is estimated to have increased rapidly in the mid 1990s, F in recent years is estimated to be around 0.6. Recruitment estimates are below average in 1997, 2001, 2002 and 2003 and the proportion of post recruits have been below average since 1998.

7.1.8.2 Conclusions regarding a final assessment

Having examined all the available information the Working Group was unable to put forward a final assessment for this stock. Nevertheless progress has been made to investigate available data and examine alternative approaches and to assess this stock. The Q4 survey seems likely to be useful as a relative indicator of abundance. However, because selection occurs over several age-class this leads to problems identifying a recruit-post recruit cut-off and a suitable S-ratio for a method like CSA. This CSA method is therefore not a suitable basis to accurately describe historical stock development or future stock predictions.

7.1.9 Yield and Biomass per recruit

Last year the Working Group put forward a long-term yield and spawning biomass per recruit conditional on the present exploitation pattern from a separable analysis. F_{max} was estimated to be 0.65, and $F_{0.1}$ was estimated to be 0.26. This was not up dated this year.

7.1.10 Reference points

There is insufficient information to estimate appropriate references points for this stock.

7.1.11 Quality of the assessment

The current assessment remains a preliminary exploratory analysis for this stock. Having investigated the available data the Working Group concluded they could not put forward a final assessment.

The quality of the available landings data, specifically the area misreporting and lack of effort and LPUE data for the main fleet in the fishery, severely hampers the ability of the Working Group to carry out an assessment for this stock. It is unlikely that these data will improve in the near future. For stocks like megrim and anglerfish on the northern shelf there is a general need for improved spatio-temporal resolution of commercial catch and effort data since dynamic pool assumptions may be invalidated by size related changes in distribution of the stock in relation to the fishery.

Discard data should be included in future assessments. Irish data suggest that discarding may be substantial in this stock and that the discarding pattern may change over time. Only limited discard information were available to the Working Group this year. Discard data for the Scottish fleet should be worked up for future assessments.

Comparative investigation of the catch numbers-at-age from Scotland and Ireland prior to aggregation identified that age mis-specification could be a problem in this stock. This should be explored further and if possible attempts should be made to extent the time series of length-frequency back in time as some data prior to 1990 may be available.

Megrim exhibit considerable differences in distribution, growth and maturity schedules between the sexes. Consequently, length and catch-numbers-at-age data should be collected separately by sex and separate sex assessments should be carried out. Similarly, discard data should also be collected separately by sex. Males are more common in the discards than females and because males have slower growth than females the mean lengths and weights at age are significantly lower than in the landings. French and Spanish length frequency data have not been used to calculate the catch numbers at age for this stock but this is not thought to have compromised the present analysis since the sampled fleets have accounted for around 80% of the landings in the past. The Working Group did note however that recent landings from the French fleet in VIa exceed the threshold landings and TAC levels in the EU data collection regulation (Reg. EC 1639/2001) for collection of length frequency and age data.

7.1.12 Management considerations

The preliminary analyses carried by the Working Group using a user defined VPA and CSA using the Quarter 4 survey as an index suggests that this stock is in decline.

In the past management of the megrim stock has been linked to that for anglerfish on the assumption that landings were correlated in the fishery. It was thought that the anglerfish management would also constrain fishing mortality on megrim. This may no longer be true due to recent changes in the fishing pattern in the Scottish and Irish fleets. Landings in Division VIa have been declined continuously in recent years.

Although total landings are less than the TAC, some national quotas are restrictive and this may have led to under-reporting of catches. Area misreporting has been prevalent (Table 7.1.4.1) as megrim catches were misreported from Subarea VI into Subarea IV due to restrictive quotas for anglerfish and megrim (i.e. vessels targeting anglerfish misreported all landings including megrim from Subarea VI into Subarea IV). In order to avoid misreporting by area the TAC should include Subarea VI.

The minimum landings size of megrim was reduced in January 2000 to 20 cm EC Regulation No 850/98. Despite this extremely small size the catch is routinely high graded and large numbers of fish continue to be discarded above this MLS.

7.2 Megrim in Division VIb

7.2.1 The fishery

Longer-term international landings from VIb are shown in Figure 7.1.4.1 (note: historical data based on official figures are incomplete in some years i.e. 1973-76 and 1979). Landings fluctuated around 1,000 t between 1986-1999 since then landings have been declining.

Megrim are caught by Spanish fleets in a mixed fishery targeting anglerfish, hake, megrim and witch. Spain also catches four-spotted megrim (*Lepidorhombus boscii*) in VIb. In the past this fleet used 80 mm cod-end baka trawls. No information on current gears or recent changes to the composition this fleet were available to the Working Group.

Megrim are also caught by a Scottish heavy otter trawl fleet targeting haddock on the Rockall Bank. This fleet uses >110 mm mesh and twin-trawls have increasingly been used in recent years. Discarding of megrim by the fleet is not thought to be significant. No information was available to the working group on any recent changes to the composition of this fleet.

The Irish fleet otter trawl in Division VIb take megrim as a by-catch in the haddock fishery on the Rockall Bank. The fleet targeting haddock uses 100 mm mesh and twin rig trawls. Discarding of megrim from the fleet targeting haddock in Division VIb is not thought to be significant (Anon, 2001).

7.2.1.1 The fishery in 2003

Official landings data are presented by country in Table 7.1.4.1. Note 2003 landings data are incomplete. The Working Group's best estimate of landings 2003 was 536 t but this figure does not include estimated landings for Spain in 2003. The Working Group in had no information on mis-reporting in this fishery.

7.2.1.2 Management applicable to 2003 and 2004

See section 7.1.3.

7.2.2 Commercial catch-effort data and research vessels survey

Catch and effort data were available for the Irish otter trawl fleets from 1995-2003 (Table 7.1.5.2). This fleet takes between 15-20% of the international landings in recent years. The Irish effort for the fleet in VIb increased until 2000. Effort in 2002 has declined substantially due to vessel decommissioning. In 2003 effort has slightly increased. Irish LPUE in VIb is considerably higher than in VIa but it has fluctuated over the time series with high LPUEs in 1998 and 2002.

7.2.3 Catch age compositions and mean weights at age

Quarterly landings-at-age data for VIb were available to the Workings Group for Ireland from 2000 to 2003. However, since this country catches around 20% of the total landings in fishes in different areas to other fleets with more substantial landings the Working Group did not think it appropriate to use these data in even a simple assessment such as a catch curve and yield per recruit analysis.

The Working Group did note however that landings of both the UK and Spain exceed the threshold landings and TAC levels in the EU data collection regulation (Reg. EC 1639/2001) and are obliged to sample landings from VIb for both length and age since January 2002.

7.2.4 Management considerations

Megrim in are caught in a mixed species fisheries in VIb. Therefore management for haddock in VIb will impact on fleets catching megrim.

Table 7.1.4.1 Nominal catch (t) of MEGRIM in Sub-area VI (West of Scotland and Rockall), as officially reported to ICES and WG best estimates of landings for Division VIa.

Megrim in Division VIa (West of Scotland)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Belgium	1	1	-	1	-	-	1	-	-	-	-	-	+	-	-	-
Denmark	-	1	-	-	-	-	-	-	-	-	-		-	-	-	
France	1,295	457	398	455	504	517	408	618	462	192	172	203	135	**252**	82	103
Germany	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	685	474	317	260	317	329	304	535	460	438	433	438	417	509	280	
Spain	121	43	91	48	25	7	1	24	22	87	111	83	98	92	89	
UK(E&W&NI)	354	122	25	167	392	298	327	322	156	123	65	42	20	7	14	
UK(Scotland)	1,068	1,169	1,093	1,223	887	896	866	952	944	954	841	831	754	770	643	
UK																556
Total	3,526	2,267	1,924	2,154	2,125	2,047	1,907	2,451	2,044	1,794	1,622	1,597	1,424	1,630	1108	
Unallocated			286	278	424	674	786	1,047	2,010	1,478	1,083	1,051	823	843	720	
As used by WG	3,526	2,267	2,210	2,432	2,549	2,721	2,693	3,498	4,054	3,272	2,705	2,648	2,247	2,473	1,828	1,598
% of VIa landings estimated by WG to be mis reported into IV			15%	14%	18%	27%	32%	32%	51%	48%	43%	40%	39%	34%	40%	34%

Megrim in Division VIb (Rockall)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002*	2003
France	1	-	-	-	-	-	-	-	-	-	-	-	4	+	+	-
Ireland	-	-	196	240	139	128	176	117	124	141	218	127	167	176	87	
Spain	751	205	363	587	683	594	574	520	515	628	549	404	427	370	120	
UK(E&W&NI)	77	18	19	14	53	56	38	27	92	76	116	57	57	42	41	
UK(Scotland)	185	178	226	204	198	147	258	152	112	164	208	278	309	236	207	
UK																454
Total	1,014	401	804	1,045	1,073	925	1,046	816	843	1,009	1,091	866	964	824	456	454
As used by WG	1,014	401	804	1,045	1,073	925	1,046	816	843	1,009	1,091	866	964	824	445	536

Total Megrim in Sub-area VI (West of Scotland and Rockall)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002*	2003
Total	4,540	2,668	2,728	3,199	3,198	2,972	2,953	3,267	2,887	2,803	2,713	2,463	2,388	2,454	1,563	
As used by WG	4,540	2,688	3,041	3,477	3,622	3,646	3,739	4,313	4,897	4,281	3,796	3,514	3,211	3,297	2,243	2,134

* Preliminary.

Modifications from last year official data are shown in bold

Table 7.1.5.1 Megrim in VIa West of Scotland. Available catch-effort and survey tuning series.

Irish Megrim in VIa, WGNSDS May 2004, Tuning data.
103
Irish otter trawl
1995 2003
1 1 .00 1.00
2 10
57397.5 3.7 93.5 245.4 284.0 254.2 277.6 244.5 85.2 118.3 519.2 t 1995
61650.0 7.8 254.2 424.0 265.3 115.2 61.5 35.9 26.6 37.6 448.9 t 1996
65545.2 15.3 46.7 253.2 194.8 150.5 129.1 118.4 78.5 72.5 416.2 t 1997
58821.0 1.2 71.2 170.7 315.2 269.8 144.4 105.7 28.6 46.1 393.6 t 1998
54126.3 68.6 371.4 445.5 276.6 220.6 133.6 54.0 31.6 30.2 351.5 t 1999
52846.5 28.0 296.6 516.2 294.9 240.9 77.9 32.4 16.1 8.1 361.1 t 2000
48358.3 39.0 122.8 280.7 493.1 357.7 187.9 48.6 13.9 0.0 424 t 2001
37231.0 4.2 60.8 161.7 165.5 107.5 60.1 10.8 6.1 3.1 245.7 t 2002
42899 9.0 234.7 391.8 572.5 291.0 171.4 43.9 11.6 2.3 531.1 t 2003
IR-WCGFS
1993 2002
1 1 0.75 0.79
1 8
1849 229 283 238 183 92 59 17 9 1993
1610 13 64 67 36 60 43 10 0 1994
1826 31 267 102 72 57 53 8 21 1995
1765 280 290 164 112 77 32 11 8 1996
1581 433 771 390 260 40 40 11 7 1997
1639 53 409 258 75 44 30 9 0 1998
1564 80 36 230 265 239 68 7 5 1999
1556 0 50 230 257 162 38 18 1 2000
755 84 271 388 354 127 59 27 12 2001
798 96 157 133 119 120 63 17 9 2002
IR-IBTS Q4 Survey
2003 2003
1 1 0.79 0.92
1 10
1 23 33 36 42 21 12 9 4 2 1 2003

Table 7.1.5.2 Megrim effort and LPUE data for the Irish otter trawl fleet in Division VIa and Division VIb 1995-2002

Year	Effort (Hrs)		LPUE (Kg/Hr)	
	VIa	VIb	VIa	VIb
1995	57,398	9,142	9.0	15.2
1996	61,650	7,219	7.3	17.0
1997	65,545	7,169	6.3	19.6
1998	58,821	7,461	6.7	27.7
1999	54,126	8,680	6.5	15.5
2000	52,847	9,883	6.8	15.9
2001	48,358	7,244	8.8	22.9
2002	37,231	2,626	6.6	31.8
2002	42,899	4,618	12.4	17.5

Table 7.1.5.3 Megrim VIa: Summary data on megrim catch numbers, estimated weight, effort and CPUE for 2 Scottish groundfish surveys in VIa.

a) Quarter 4 Groundfish (Mackerel Recruitment) Survey

Year	No. Caught	Weight Caught	Effort	CPUE Kg/Hr
1985	322	69.3	30.0	2.31
1986	186	41.6	11.2	3.71
1987	204	54.4	45.2	1.20
1988	566	119.4	19.7	6.07
1989	607	100.8	11.4	8.83
1990	977	115.0	20.8	5.53
1991	848	116.8	21.2	5.51
1992	701	105.2	20.5	5.13
1993	782	122.0	19.3	6.32
1994	439	80.6	9.5	8.48
1995	579	97.2	18.5	5.25
1996	821	116.1	23.3	4.99
1997	368	74.5	40.8	1.83
1998	322	54.1	18.4	2.93
1999	406	53.9	19.6	2.75
2000	614	91.2	26.5	3.44
2001	341	63.3	29.0	2.18
2002	447	73.4	31.5	2.33
2003	318	54.6	31.3	1.74
Mean	518.3	84.4	23.6	4.2

a) Quarter 1 Groundfish Survey

Year	No. Caught	Weight Caught	Effort	LPUE Kg/Hr
1985	498	130.3	58.5	2.2
1986	230	60.9	33.0	1.8
1987	256	90.2	45.0	2.0
1988	400	111.7	40.5	2.8
1989	129	40.7	40.6	1.0
1990	117	39.1	37.1	1.1
1991	116	41.5	45.3	0.9
1992	120	29.1	38.4	0.8
1993	110	21.1	31.6	0.7
1994	277	58.4	38.8	1.5
1995	237	49.4	37.3	1.3
1996	354	65.4	36.6	1.8
1997	293	39.6	34.8	1.1
1998	216	33.9	29.5	1.1
1999	144	27.0	22.4	1.2
2000	194	36.2	23.0	1.6
2001	114	25.3	18.8	1.3
2002	173	31.6	20.7	1.5
2003	172	33.8	26.2	1.3
2004	113	25.1	22.8	1.1
Mean	213.2	49.5	34.0	1.4

7.1.6.1 - Megrim in VIa. Landings numbers at age.

Run title : Megrim in Via WGNSDS May 2004

At 10/05/2004 9:54

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

YEAR	1990	1991	1992	1993
AGE				
3	0	2	9	69
4	121	165	1053	946
5	451	1046	1282	1894
6	722	812	1066	773
7	795	1027	948	817
8	1112	936	588	680
9	648	526	445	490
10	231	376	107	332
11	175	97	74	178
+gp	130	75	63	81
0 TOTAL	4385	5061	5635	6261
TONSL	2210	2432	2549	2721
SOPCO	100	100	100	100

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

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
3	210	569	1129	185	269	545	380	160	132	152
4	925	1368	2739	2543	709	1572	1313	487	755	258
5	1612	2177	2766	2896	3056	1728	2227	1514	1387	519
6	1617	1713	1439	1065	2131	2220	1122	2210	860	671
7	805	1324	622	642	748	1205	1165	1282	1006	1196
8	387	634	296	337	316	397	483	818	299	740
9	357	410	255	165	137	148	129	191	129	267
10	269	277	85	117	66	84	55	102	25	135
11	126	140	101	83	44	29	9	18	10	36
+gp	115	80	97	16	20	33	8	6	15	25
0 TOTAL	6422	8692	9527	8050	7496	7961	6892	6787	4618	3999
TONSL	2693	3498	4054	3271	2705	2648	2247	2473	1828	1598
SOPCO	100	100	100	100	100	100	100	100	100	100

Table 7.1.6.2 - Megrim in VIa. Landings weights at age.

Run title : Megrim in Via WGNSDS May 2004

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Table 2 Catch weights at age (kg)

YEAR	1990	1991	1992	1993
AGE				
3	0.119	0.17	0.213	0.233
4	0.155	0.368	0.251	0.281
5	0.252	0.309	0.383	0.329
6	0.345	0.409	0.424	0.447
7	0.46	0.469	0.507	0.451
8	0.511	0.571	0.612	0.533
9	0.688	0.638	0.632	0.679
10	0.929	0.645	0.856	0.683
11	0.658	0.75	0.902	0.637
+gp	0.923	0.65	0.946	0.827
0 SOPC(	0.9995	1	1.0001	0.9997

Table 2 Catch weights at age (kg)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
3	0.163	0.16	0.218	0.175	0.163	0.139	0.17	0.157	0.157	0.197
4	0.228	0.242	0.297	0.263	0.231	0.197	0.221	0.214	0.22	0.23
5	0.303	0.318	0.393	0.354	0.285	0.272	0.28	0.27	0.326	0.266
6	0.42	0.409	0.549	0.489	0.383	0.349	0.347	0.314	0.417	0.322
7	0.518	0.51	0.656	0.664	0.52	0.453	0.403	0.43	0.493	0.38
8	0.568	0.561	0.761	0.742	0.621	0.592	0.542	0.54	0.673	0.51
9	0.66	0.586	0.682	0.771	0.756	0.674	0.614	0.704	0.631	0.634
10	0.696	0.747	1.048	0.979	0.828	0.734	0.764	0.801	0.916	0.722
11	0.839	0.862	1.052	1.014	0.991	0.997	1.174	0.958	1.05	0.841
+gp	0.982	0.92	1.149	1.213	1.196	1.035	1.157	1.262	1.081	0.993
0 SOPC(	1.0009	1.003	1.0013	1.0005	0.9998	1.0049	1.0026	1.003	1.0012	1.0004

Table 7.1.8.1 - Megrim in VIa. Fishing mortality at age from a user defined VPA.
Starting Guestimates of F(a,y) are highlighted in bold

Run title : Megrim in Via WGNSDS May 2004

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Table 8 Fishing mortality (F) at age

YEAR	1990	1991	1992	1993
AGE				
3	0	0.0001	0.0009	0.0068
4	0.0164	0.0232	0.1148	0.1253
5	0.0736	0.1915	0.2512	0.3099
6	0.1505	0.1835	0.3041	0.236
7	0.2337	0.3304	0.3376	0.4036
8	0.5488	0.4731	0.32	0.4329
9	0.655	0.5481	0.4337	0.4828
10	0.6313	1.0571	0.2012	0.6778
11	**0.6**	**0.6**	**0.6**	**0.6**
+gp	0.6	0.6	0.6	0.6
0 FBAR 5- 9	0.3323	0.3453	0.3293	0.373

Table 8 Fishing mortality (F) at age

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	FBAR **-**
AGE											
3	0.0183	0.0338	0.0604	0.0165	0.0165	0.044	0.0583	0.0444	0.0569	**0.05**	0.0504
4	0.1182	0.159	0.2252	0.1874	0.0805	0.1262	0.1416	0.0984	0.3018	**0.15**	0.1834
5	0.3242	0.4445	0.5499	0.3934	0.3592	0.2863	0.2642	0.2406	0.4429	**0.35**	0.3445
6	0.4743	0.6817	0.599	0.4238	0.5653	0.4823	0.3047	0.4549	0.2092	**0.4**	0.3547
7	0.4123	0.9229	0.5688	0.5924	0.6005	0.7415	0.506	0.682	0.3865	**0.5**	0.5228
8	0.3392	0.6706	0.5378	0.7064	0.6653	0.7601	0.7725	0.8251	0.3284	**0.55**	0.5678
9	0.4266	0.7329	0.6328	0.6621	0.7092	0.7712	0.6048	0.8272	0.2872	**0.55**	0.5548
10	0.5363	0.6967	0.3205	0.686	0.6141	1.4469	0.76	1.5589	0.2325	**0.55**	0.7804
11	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	0.6
+gp	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
0 FBAR 5- 9	0.3953	0.6905	0.5777	0.5556	0.5799	0.6083	0.4905	0.606	0.3308	0.47	

Table 7.1.8.2 - Megrim in VIa. Stock numbers at age from a user defined VPA.

Run title : Megrim in Via WGNSDS May 2004

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

	YEAR	1990	1991	1992	1993
	AGE				
	3	9685	13060	10811	11231
	4	8196	7929	10691	8843
	5	7004	6601	6343	7804
	6	5687	5327	4463	4040
	7	4193	4006	3631	2696
	8	2879	2717	2357	2121
	9	1471	1362	1386	1401
	10	539	626	644	736
	11	423	235	178	431
	+gp	315	182	153	197
0	TOT/	40393	42046	40657	39500

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

	YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	GMST 90-**	AMST 90-**
	AGE													
	3	12736	18869	21229	12531	18126	13973	7405	4063	2637	3425	0	11826	12810
	4	9134	10238	14934	16362	10092	14597	10948	5719	3182	2039	2667	10218	10640
	5	6388	6644	7150	9762	11107	7623	10534	7780	4244	1927	1437	7751	7895
	6	4687	3782	3488	3378	5393	6349	4687	6622	5008	2231	1112	4717	4825
	7	2612	2388	1566	1569	1810	2509	3209	2830	3440	3326	1224	2618	2751
	8	1474	1416	777	726	710	813	979	1584	1171	1914	1652	1363	1546
	9	1126	860	593	371	293	299	311	370	568	691	904	671	820
	10	708	602	338	258	157	118	113	139	132	349	326	331	415
	11	306	339	246	201	106	69	23	43	24	86	165	160	217
	+gp	278	194	234	39	49	80	20	14	37	61	66		
0	TOT/	39448	45332	50554	45197	47844	46430	38229	29165	20444	16048	9553		

Table 7.1.8.3 - Megrim in VIa. User Defined VPA Summary table.

Run title : Megrim in Via WGNSDS May 2004

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Table 16 Summary (without SOP correction)

	RECRUITS Age 3	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-
1990	9685	11633	10184	2210	0.217	0.3323
1991	13060	14354	11869	2432	0.2049	0.3453
1992	10811	14324	11836	2549	0.2154	0.3293
1993	11231	13713	11152	2721	0.244	0.373
1994	12736	12018	9912	2693	0.2717	0.3953
1995	18869	12593	9945	3498	0.3517	0.6905
1996	21229	16692	12599	4054	0.3218	0.5777
1997	12531	13974	10990	3271	0.2976	0.5556
1998	18126	12415	9662	2705	0.28	0.5799
1999	13973	11165	8873	2648	0.2984	0.6083
2000	7405	10406	8476	2247	0.2651	0.4905
2001	4063	8545	7340	2473	0.3369	0.606
2002	2637	7615	6756	1828	0.2706	0.3308
2003	3425	5437	4776	1598	0.3346	0.47
Arith. Mean	11413	11777	9598	2638	0.2793	0.4775
0 Units	(Thousar	(Tonnes)	(Tonnes)	(Tonnes)		

Table 7.1.8.4 - Megrim in VIa - CSA input data from Scottish Q4 (Mackerel recruit) groundfish survey

1990 2003

Year	CatRec	CatFull	urec	Ufull	Wrec	Wfull	Srat
1990	0	2617.1	22.84	24.13	0.0370	0.1587	1
1991	0	2875.9	13.90	26.06	0.0406	0.1548	1
1992	0	2654.8	12.15	22.05	0.0359	0.1721	1
1993	0	3332.5	14.97	25.54	0.0403	0.1839	1
1994	0	4302.8	11.16	35.05	0.0427	0.1930	1
1995	0	6200.5	11.46	19.84	0.0438	0.1948	1
1996	0	7999.7	13.11	22.17	0.0389	0.1664	1
1997	0	7153.8	3.33	5.68	0.0426	0.2484	1
1998	0	6450.9	7.59	9.87	0.0414	0.2124	1
1999	0	6970.1	10.45	10.24	0.0398	0.1876	1
2000	0	6045.8	11.28	11.89	0.0405	0.2045	1
2001	0	5687.9	3.93	7.83	0.0413	0.2166	1
2002	0	4503.8	5.99	8.18	0.0454	0.2069	1
2003	0	3602.2	3.90	6.27	0.0476	0.2009	1

0.2

CatRec = fishery's catch of recruits in number
CatFull = fishery's catch of fully recruited in number
Urec = recruits survey indices
Ufull = fully-recruited survey indices
Wrec = recruits mean weights in the stock
Wfull = fully-recruited mean weights in the stock
Srat = and relative variation in the recruits to fully-recruited survey catchability ratios s $s = q_r / q_n$

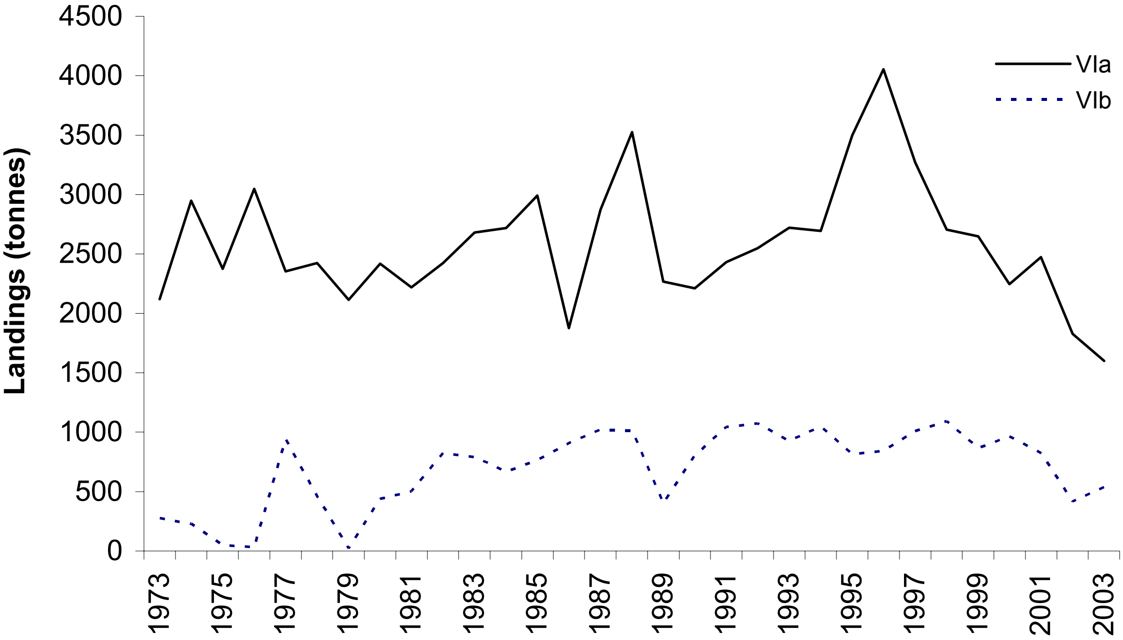
Table 7.1.8.5 - Megrim in VIa - CSA Population numbers, SSB, F and Harvest Rate estimates from the Scottish Q4 (Mackerel Recruit) groundfish survey.

Year	RecN	FullN	TSBiom	Fishing Mc	HRrec	Harvest Ra	CatRec	CatFull	Sratio	M
1990	13775.3	13653	2676.4	0.111	0	0.192	0	2617.1	1	0.2
1991	8953.2	20088.4	3473.2	0.116	0	0.143	0	2875.9	1	0.2
1992	8248.5	21175	3940.3	0.105	0	0.125	0	2654.8	1	0.2
1993	9745.4	21687.7	4381.1	0.125	0	0.154	0	3332.5	1	0.2
1994	7058.4	22719.9	4686.3	0.174	0	0.189	0	4302.8	1	0.2
1995	7464.3	20487.1	4317.8	0.281	0	0.303	0	6200.5	1	0.2
1996	7990.3	17274.3	3185.3	0.431	0	0.463	0	7999.7	1	0.2
1997	3078	13446.4	3471.2	0.651	0	0.532	0	7153.8	1	0.2
1998	8325.1	7056.1	1843.4	0.623	0	0.914	0	6450.9	1	0.2
1999	10485.5	6756	1684.8	0.592	0	1.032	0	6970.1	1	0.2
2000	9499.6	7809.3	1981.7	0.488	0	0.774	0	6045.8	1	0.2
2001	3849.3	8700.9	2043.6	0.695	0	0.654	0	5687.9	1	0.2
2002	5323.3	5128.6	1302.8	0.647	0	0.878	0	4503.8	1	0.2
2003	3219.9	4482.1	1053.7		0	0.804	0	3602.2	1	0.2

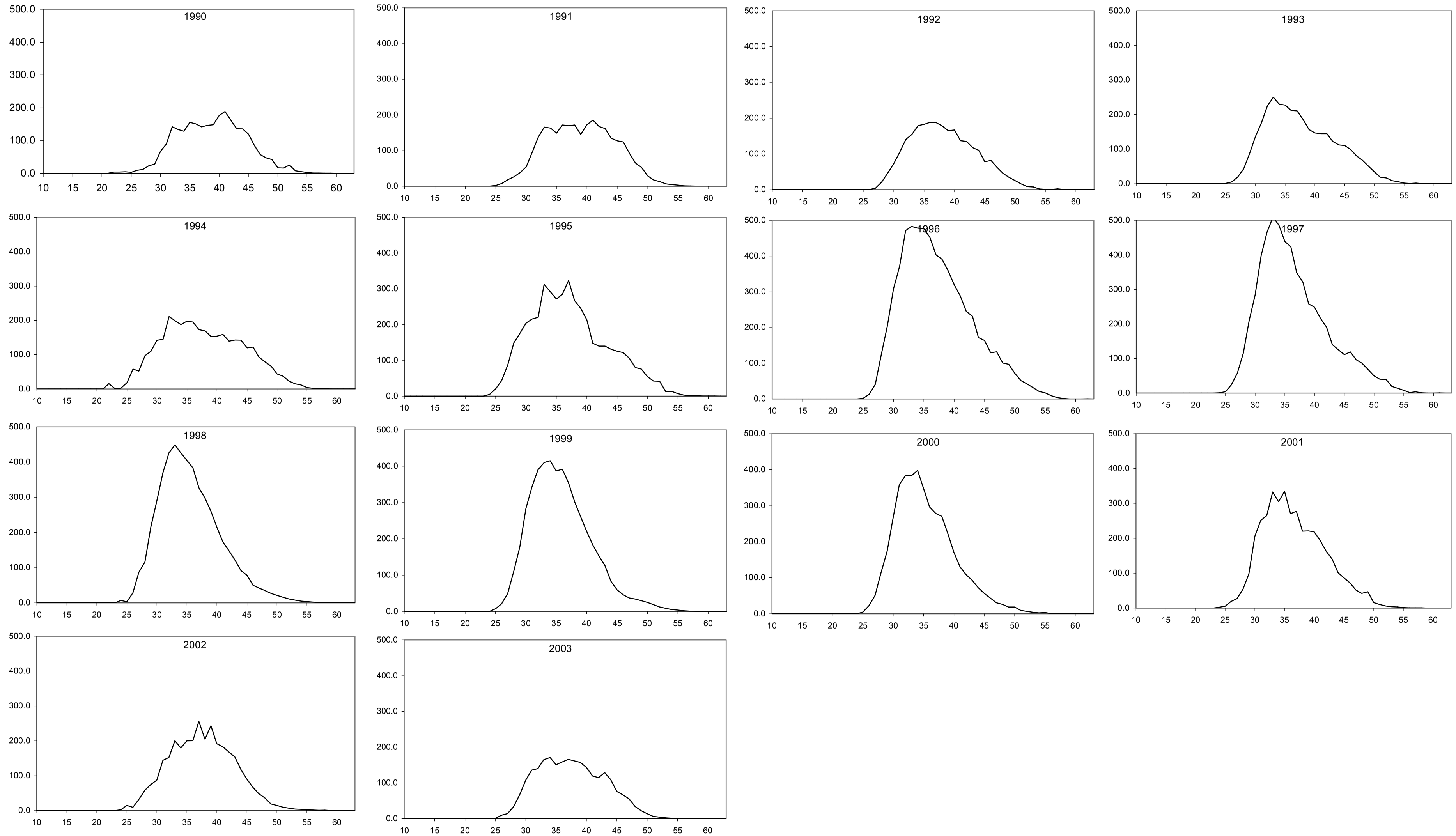
q = 0.001211

SSQ = 2.34
RMS = 0.195

Figure 7.1.4.1 Long term trends in Megrim landings in Sub area VI. 1973-1989 data are based on official landings 1990-2003 are WGNSDS best estimates of landings



Figures 7.1.6.1 Megrim VIa Length Frequency distributions of Scottish landings 1990-2003 (numbers on y-axis in '000s)



Figures 7.1.6.2 Megrim VIa Length Frequency distributions of Irish landings and discards 1990-2003 (numbers on y-axis in '000s) Discards length frequency distributions are shown with the red dashed.

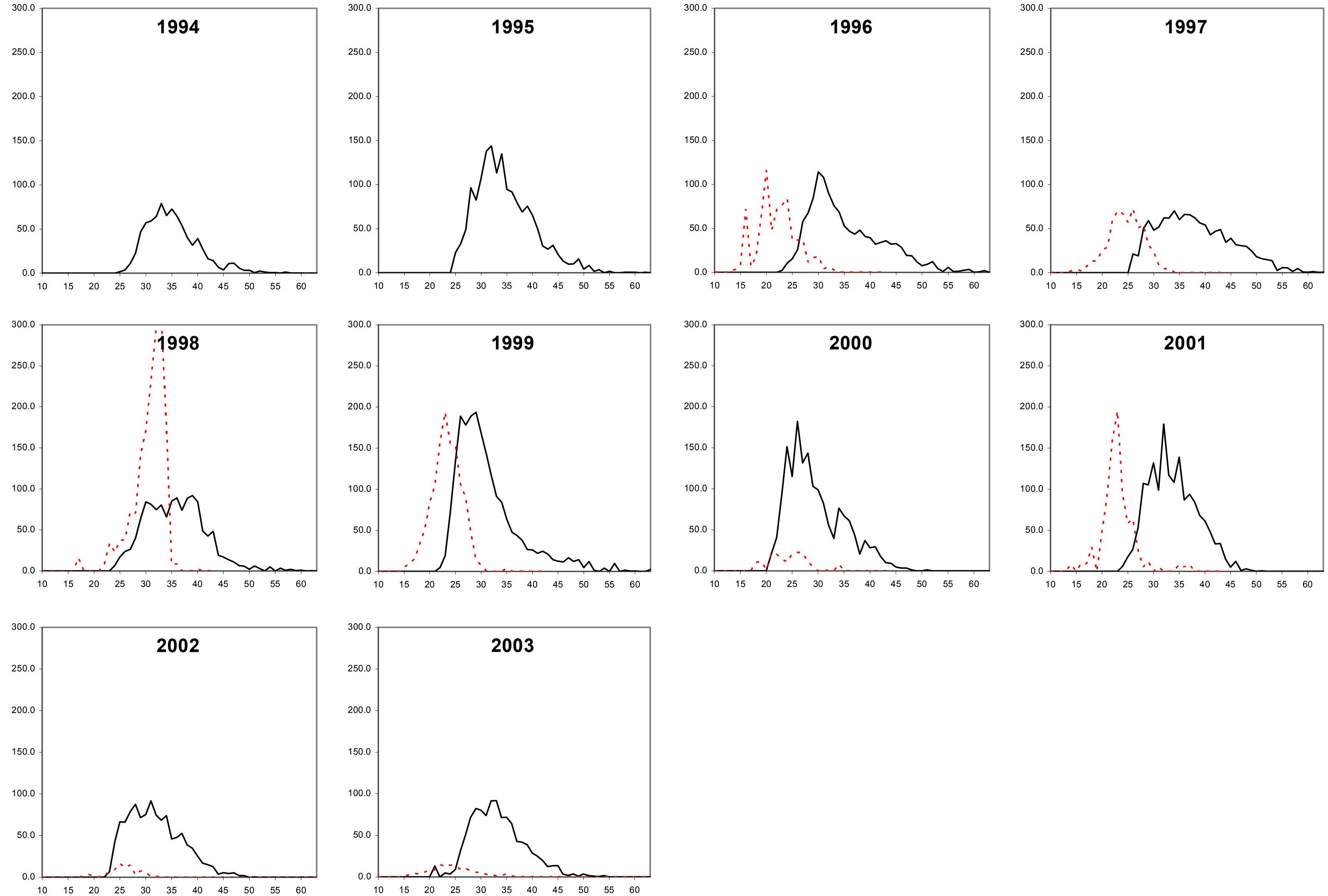


Figure 7.1.8.1 Megrim in VIa. User Defined VPA Summary plots

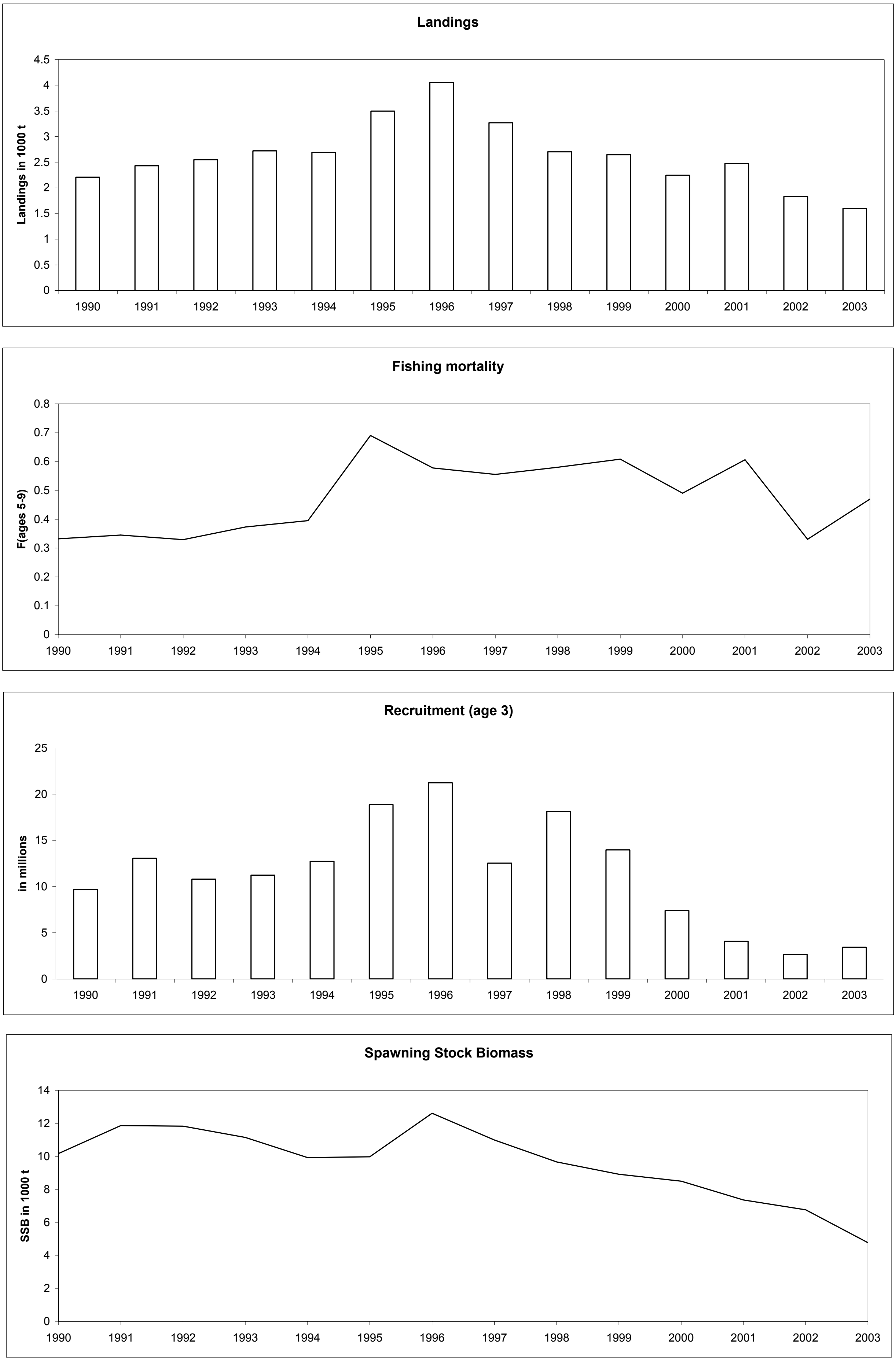


Figure 7.1.8.2 - Megrim in VIa - Lenght frequency distribution from Scottish Q1 groundfish survey.
(The 22 cm lenght class is highlighted with a circle)

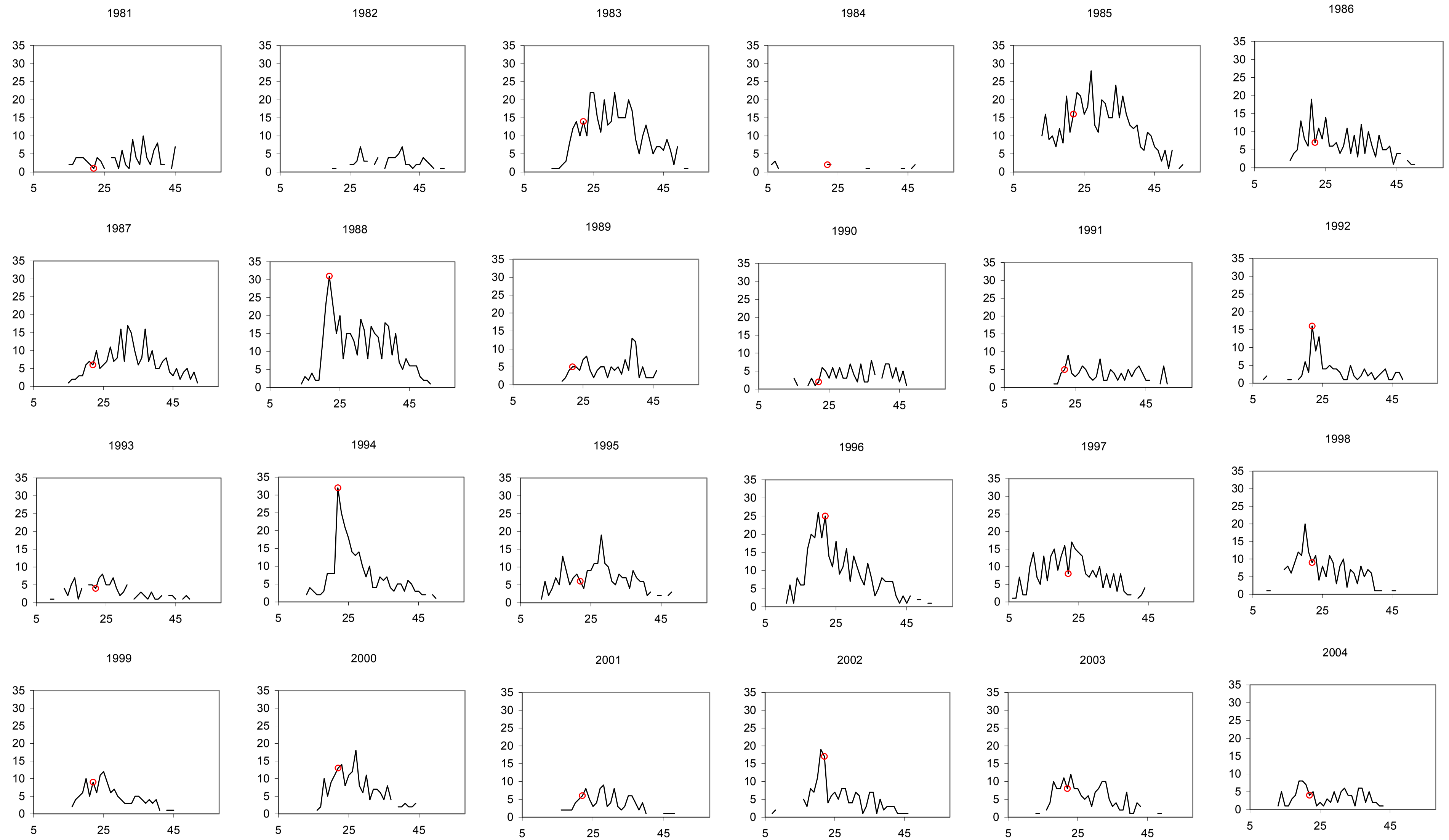


Figure 7.1.8.3 - Megrim in VIa - Lenght frequency distribution from Scottish Q4 (Mackerel recruit) groundfish survey. (The 22 cm length class is highlighted with a circle)

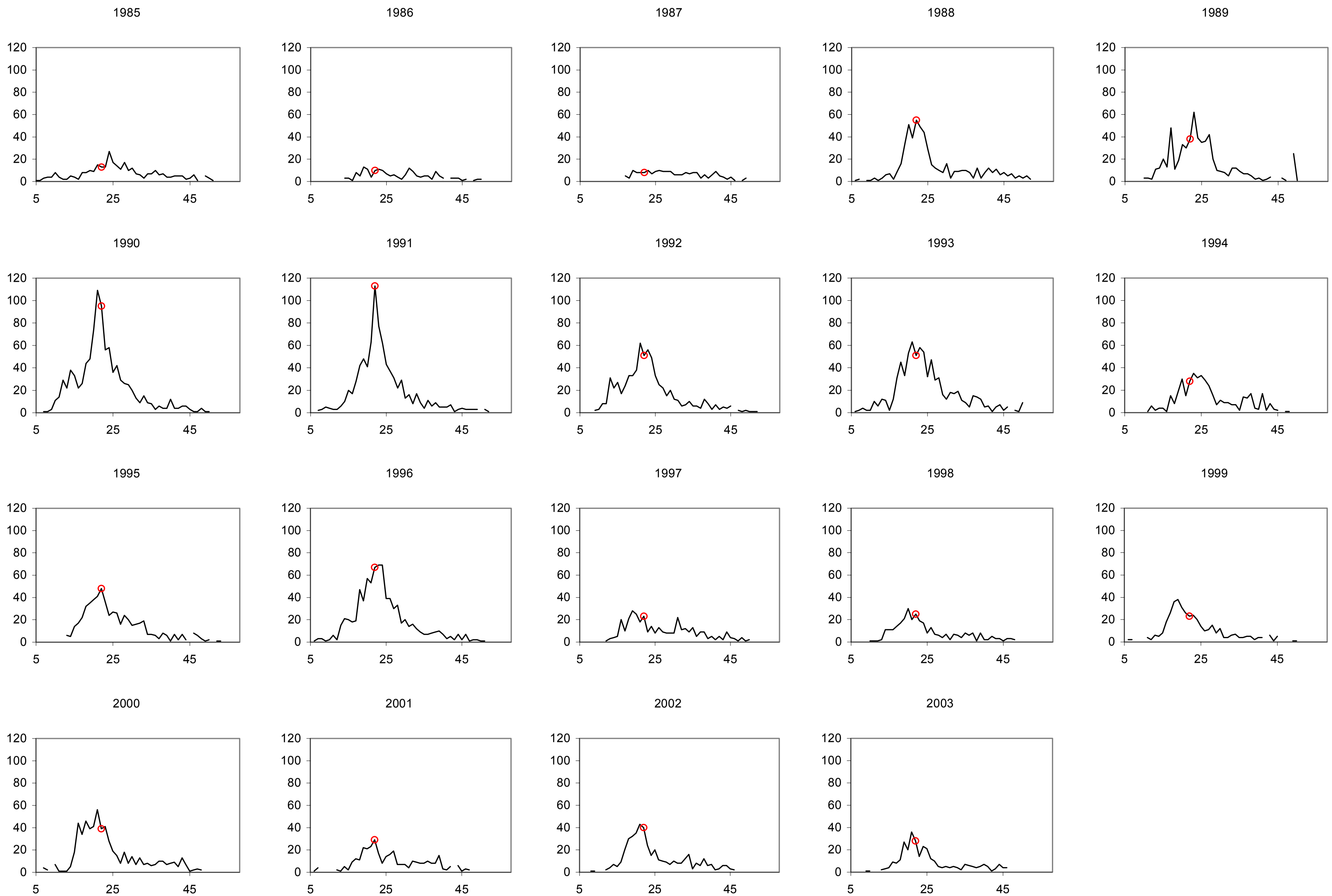


Figure 7.1.8.4 Megrim VIa - Exploitation proxies based on Q1 and Q4 Scottish survey mean standardised CPUE / total landings for small (< 29cm) and large (> 40 cm).

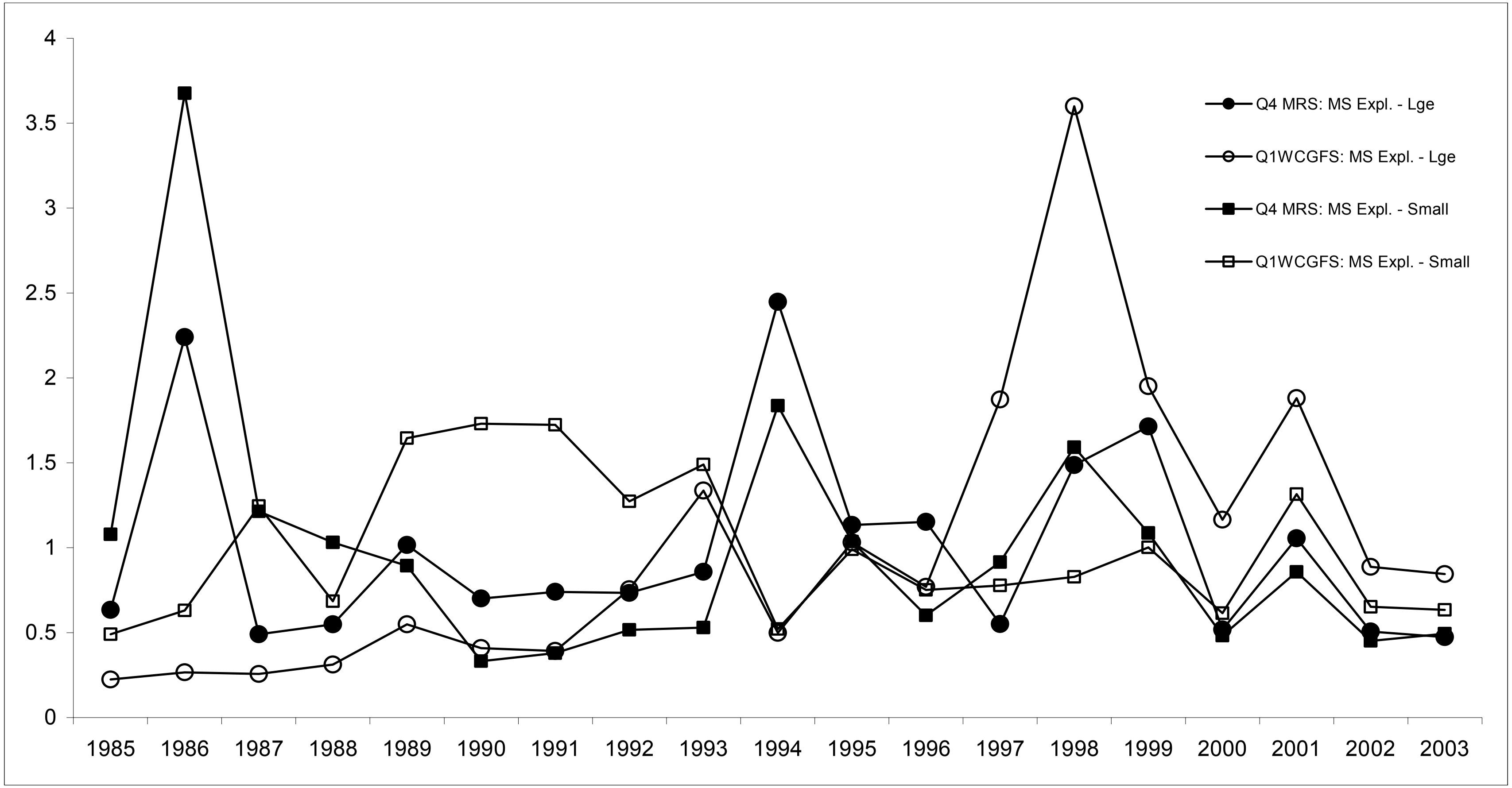


Figure 7.1.8.5 - Megrim VIa survey indices in kg/hr for recruits (< 22 cm) and post recruits (≥ 22 cm) for Scottish Q4 (Mackerel recruit) groundfish survey

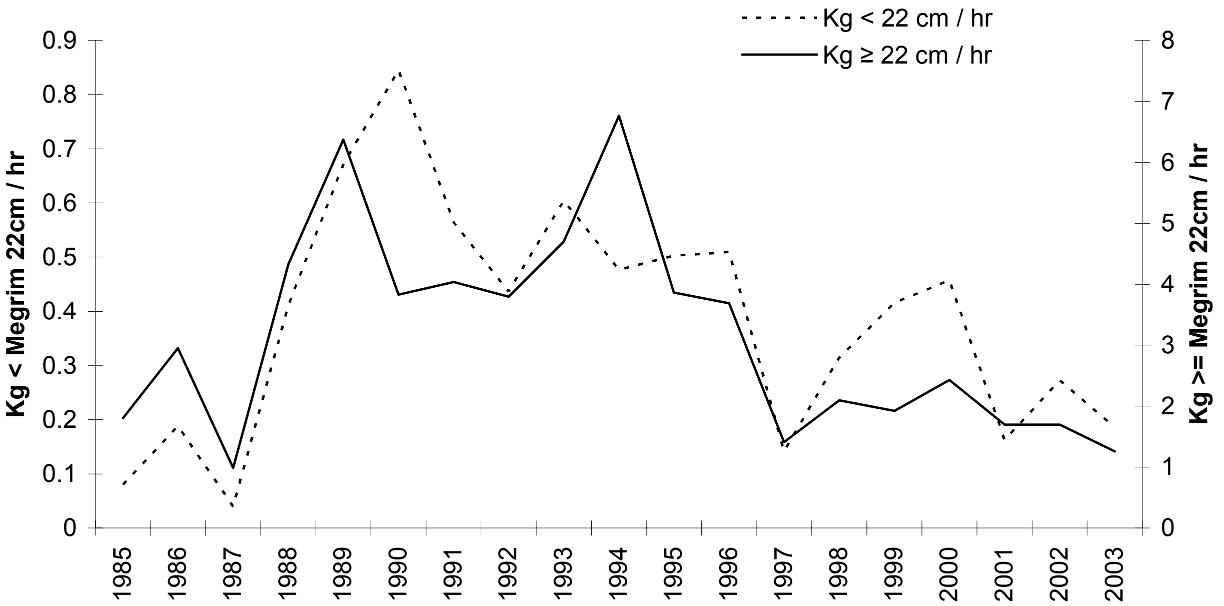


Figure 7.1.8.6 - Megrim VIa survey indices in kg/hr for recruits (< 22 cm) and post recruits (≥ 22 cm) for Scottish Q1 groundfish survey

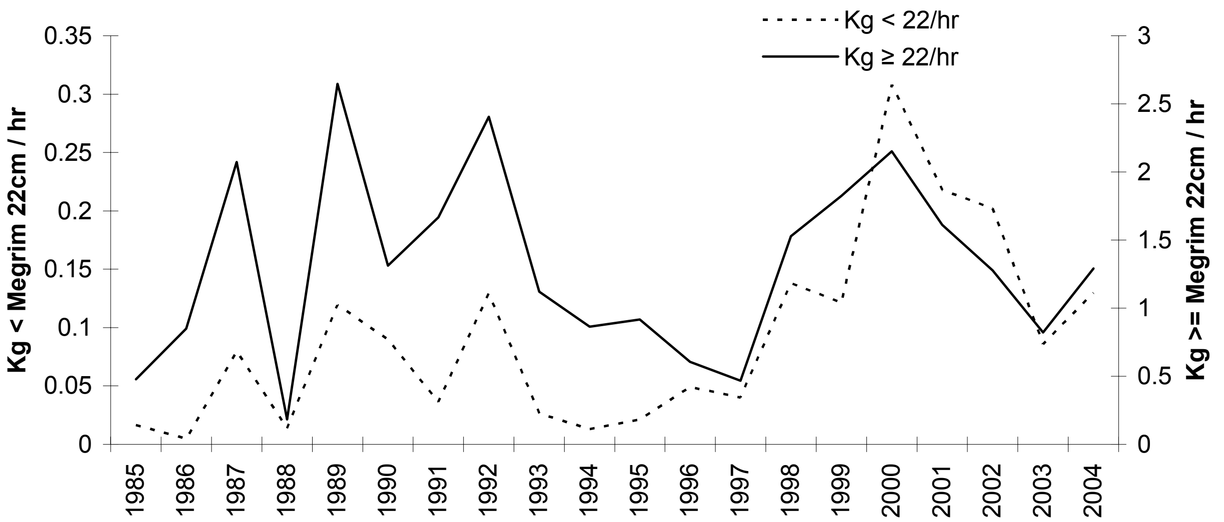


Figure 7.1.8.7 - Megrim in VIa - CSA relative numbers of recruits (< 22 cm), Post recruits(> 22cm), relative Total Stock Biomass (TSB) and fishing mortality (F) from the Scottish Q4 (Mackerel recruit) groundfish Survey

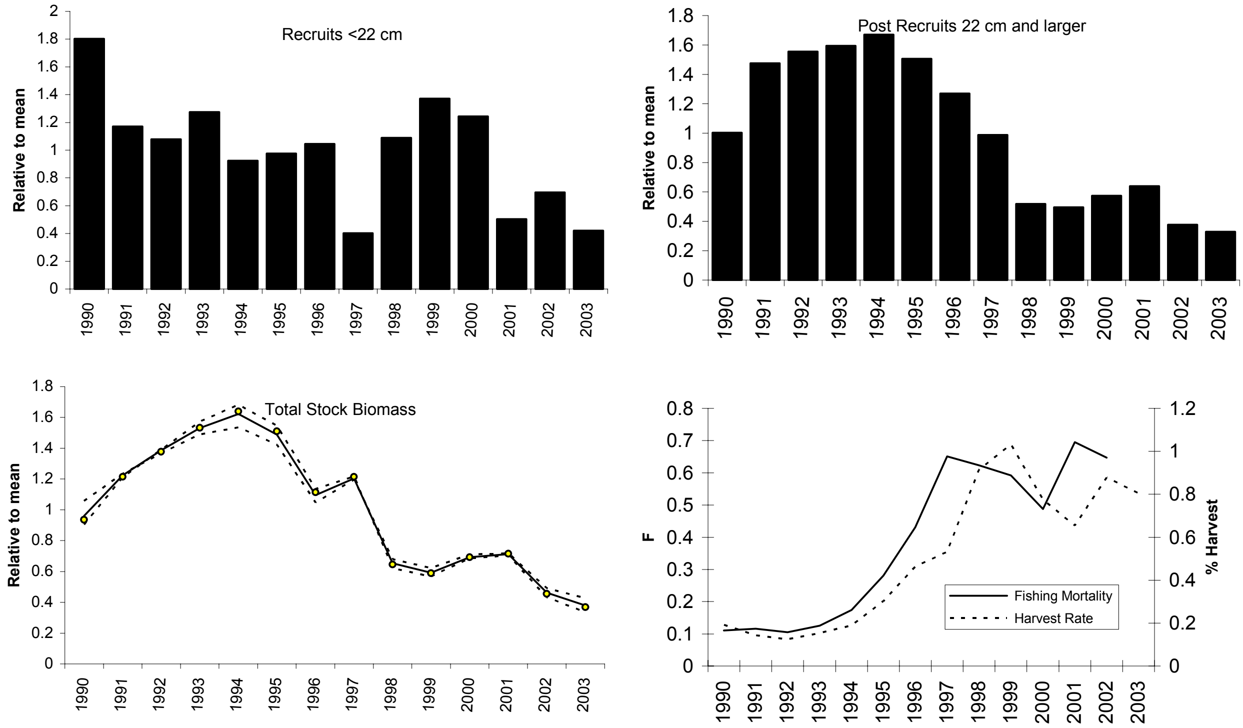
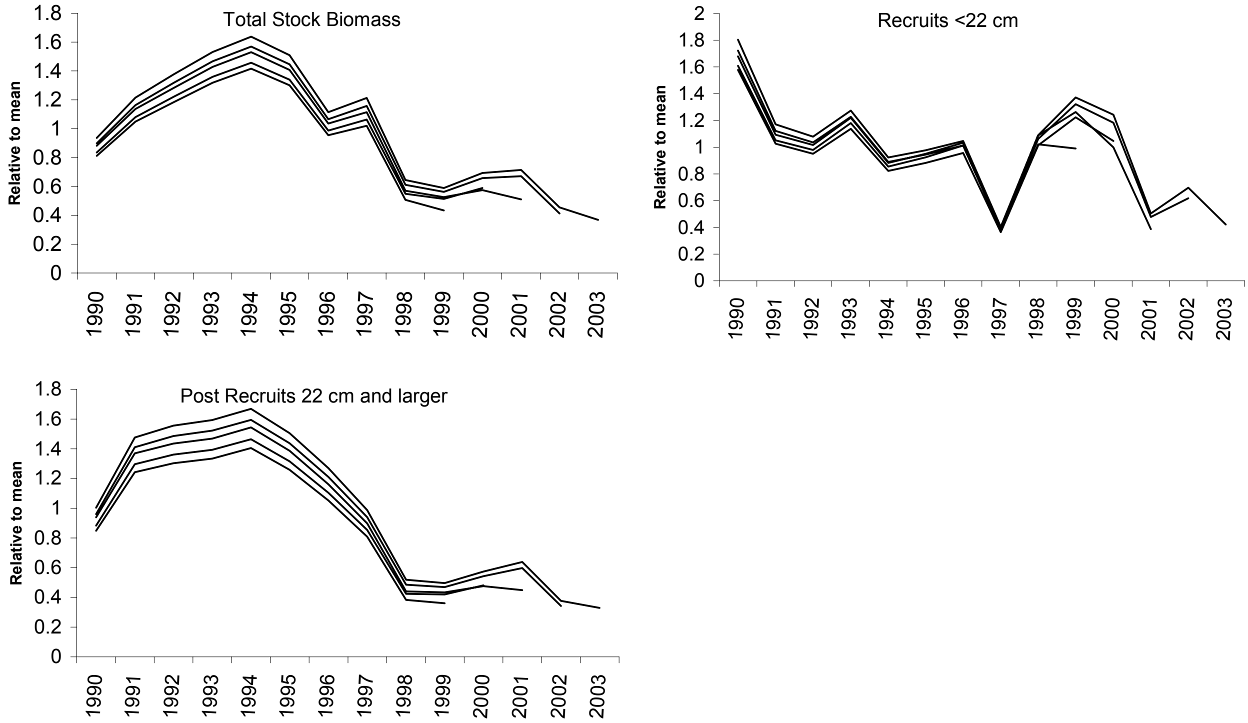


Figure 7.1.8.8 - Megrim in Via - CSA relative retrospective analysis for TSB, numbers of recruits (< 22 cm) and Post recruits (> 22cm) from the Scottish Q4 (Mackerel recruit) groundfish Survey



8 COD IN DIVISION VIIA

A benchmark assessment is presented for this stock, comprising a detailed evaluation of all catch and survey data available to the WG for evaluating the historical trends and current status of the stock.

8.1 The Fishery

The historical development of the fishery for cod in the Irish Sea is described in the Stock Annex. Currently the main fleets targeting cod include whitefish otter trawlers operating out of ports in UK(NI), UK(E&W) and Ireland, and midwater trawlers operating out of UK(NI). From 1 January 2000, these vessels have been required to use 100mm cod-ends when targeting cod. Prior to that, many vessels used 80mm cod-ends. By-catches of cod are taken in the *Nephrops* fisheries and in the beam trawl fisheries for flatfish.

8.1.1 ICES advice applicable to 2003 and 2004

The advice from ICES for 2003 was as follows:

Given the very low stock size, the recent poor recruitments, and continued high fishing mortality despite management efforts to promote stock recovery, ICES recommends a closure of all fisheries for cod as a targeted species or by-catch. In fisheries where cod comprises solely an incidental catch there should be stringent restrictions on the catch and discard rates of cod, with effective monitoring of compliance with those restrictions. These and other measures that may be implemented to promote stock recovery should be kept in place until there is clear evidence of the recovery of the stock to a size associated with a reasonable probability of good recruitment and there is evidence that productivity has improved. The current SSB is so far below historic stock sizes that both the biological dynamics of the stock and the operations of the fisheries are unknown, and therefore historic experience and data are not considered a reliable basis for medium-term forecasts of stock dynamics.

The advice from ICES for 2004 was as follows:

For cod the advice is for zero catch until SSB has been rebuilt above $\mathbf{B}_{lim.}$. ICES recommends that that mixed fisheries characteristics be taken into account when managing demersal fisheries in the Irish Sea. Only demersal fisheries which can demonstrate that they fish without catch or discards of cod and whiting may be permitted. ICES also stated that: unless ways can be found to harvest species caught in a mixed fisheries within precautionary limits for <u>all</u> those species individually then fishing should not be permitted.

In addition, ICES recommends that mixed fisheries characteristics be taken into account when managing demersal fisheries in the Irish Sea. The demersal fisheries in the Irish Sea should be managed such that the following three rules apply simultaneously:

1. The fishing of each species should be restricted within precautionary limits as indicated in the table of individual stock limits above;

2. The catch of cod and whiting is zero;

3. The total catch of sole is less than 790 t.

The precautionary fishing mortality and biomass reference points are as follows:

$\mathbf{B}_{lim}$ = 6,000 t; $\mathbf{B}_{pa}$ = 10,000t; $\mathbf{F}_{lim}$ = 1.0; $\mathbf{F}_{pa}$ = 0.72.

8.1.2 Management applicable in 2003 and 2004

Management of cod is by TAC and technical measures. The agreed TACs and associated implications for Cod in Division VIIa were as follows:

Year	Single stock exploitation boundary (t)	Basis	TAC (t)	% change in F associated with TAC[1]	WG landings (t)
2001	0	Lowest possible F	2100	- 75%	3598
2002	-	Establish recovery plan	3200	- 58%	4431
2003	-	Closure of all fisheries for cod	1950	- 64%	1811
2004	0	Zero catch	2150	- 65%	

[1] Calculated from F multipliers in status quo forecast

New technical regulations for EU waters came into force on 1 January 2000 (Council Regulation (EC) 850/98 and its amendments). The regulation prescribes the minimum target species' composition for different mesh size ranges. Since 2001, cod in Division VIIa have been a legitimate target species for towed gears with a minimum codend mesh size of 100 mm.

Due to the depleted state of the stock and following the advice from ICES, a recovery plan for cod in the Irish Sea was introduced in 2000. Commission regulation (EC) 304/2000 established emergency closed areas to fishing for cod between 14 February and 30 April in the western and eastern Irish Sea to protect spawning adults at spawning time. Council regulations (EC) 2549/2000, which came into force on 1 January 2001, with amendments in Council Regulation (EC) No 1456/2001, of 16 July 2001, established additional technical measures for the protection of juveniles.

The closed area and additional technical regulations were extended to 2001 in Council Regulation (EC) 300/2001 and to 2002 in Council Regulation (EC) 254.2002. The main difference in the recovery measures for 2002, 2003 and 2004 from those of 2001 is that a closed area remained only in the western Irish Sea. Derogations have existed for fleets targeting *Nephrops* in all years.

Council Regulation (EC) No 423/2004, of 26 February 2004, establishes measures for the recovery of cod stocks. These include: Multi-Annual processes for selection of TAC's, restriction of fishing effort, technical measures, control and enforcement, accompanying structural measures and market measures. Monthly effort limitation under this Regulation is as follows: 10 days for demersal trawls, seines and similar towed gears with mesh size >= 100mm, 14 days for beam trawls of mesh size >= 80mm and static demersal nets, 17 days for demersal longlines, and 22 days for demersal trawls, seines and similar towed gears with mesh size 70-99mm. Additional days are available for vessels meeting certain conditions such as track record of low cod catches. In particular, an additional two days are available for whitefish trawlers (mesh >= 100mm) and beam trawlers (mesh >=80mm) which spend more than half of their allocated days in a given management period fishing in the Irish Sea, in recognition of the area closure in the Irish Sea and the assumed reduction in fishing mortality on cod.

The minimum landing size for cod in the Irish Sea is 35 cm.

8.1.3 The fishery in 2003

Technical measures in the Irish Sea fisheries in 2003 remained more or less the same as in 2002, with a western Irish Sea cod closure from mid February to the end of April (with derogations for Nephrops trawlers) and minimum mesh size of 100mm for vessels targeting whitefish. A further round of decommissioning at the end of 2003 removed 19 out of 237 UK vessels that operated in the Irish Sea, representing a loss of 8% of the fleet by number and 9.3% by tonnage. The previous round of decommissioning removed 29 UK(NI) *Nephrops* and whitefish vessels and 4 UK(E&W) vessels registered in Irish Sea ports at the end of 2001.

The fishing grounds off the Firth of Clyde (area VIa south) were again closed in spring 2003 with resultant impact on UK(NI) whitefish trawlers excluded from the VIIa cod closure.

The nominal catches of cod in division VIIa as reported to ICES are given in Table 8.1.3.1. The figure for 2003 is incomplete. However, official catch statistics for 2003, plus unofficial estimates of landings into Ireland supplied to the WG, were only 1,225t, the lowest over the period with assessment data. The under-shoot of the 1,950 t TAC was largely due to Irish vessels taking only an estimated 363 t of their quota of 1,284 t, whilst UK vessels reported 525t compared with their quota of 612t.

In previous years it has been possible to estimate quantities of cod landed in some of the major Irish Sea ports by means of direct observations of landings rather than using log-sheet records. This has revealed a step-wise increase in under-reporting of cod more or less in line with reductions in TAC (Figure 8.1.3.1). During 2003, scientists were unable to gain access to several major ports during quarters 2 to 4, and there are no direct estimates of landings for those periods. However, differences between observed and reported landings during the first quarter were similar to observations in the first quarter of recent years. Given that the TAC has been at a similar value over 2000- 2002, that misreporting has been stable over this period (Figure 8.1.3.1) and that the TAC in 2003 was set to achieve a similar reduction in F (-60%) as intended in 2000 – 2002, the WG made an assumption that patterns of misreporting in quarters 2 to 4 in 2003 would have been similar to those observed in recent years. Applying this procedure gave WG estimates of international landings of 1,811 t in 2003, slightly below the TAC but well below 2003 WG estimate of 6,140 t based on a status quo forecast.

The WG estimate of total landings in 2002 were changed to account for small revisions to the UK(E&W) landings.

8.2 Commercial catch-effort data and research vessel surveys

A general decline in both reported fishing effort and age-aggregated catch per unit effort occurred during the 1990s (Tables 8.2.1a,b, and Figures 8.2.1a,b). The XSA assessment of VIIa cod in recent years has excluded commercial age-disaggregated LPUE data because of concerns over misreporting, changes in fishing patterns and correlation of errors with the catch at age data.

A more detailed breakdown of fishing effort by country and gear type (where available) shows a decline in total hours fished since the late 1990s in UK(NI) light otter trawlers, single *Nephrops* trawlers, Irish otter trawlers and UK(E&W) otter trawlers (Table 8.2.2). Effort of UK(NI) midwater trawlers, twin *Nephrops* trawlers and seine netters, and of UK(E&W) and Belgian beam trawlers, have shown no clear trend over the period shown. Fishing effort of UK(NI) pair trawlers increased after 2000 although their effort remains small (these vessels mainly target haddock). Irish beam trawl effort has doubled since 2000.

Age-structured abundance indices from surveys are given in Table 8.2.3 with the surveys and age ranges used to tune XSA shown in bold type. Otter-trawl surveys are presently undertaken in Division VIIa by UK(NI), UK(Scotland) and Ireland. The new Irish survey starting in 2003 is an IBTS-coordinated survey. The Scottish and Irish surveys in Division VIIa are extensions of surveys covering Divisions VI and VIIb-k, respectively. An index of abundance for 1 group from the UK(E&W) September beam trawl survey was provided for the first time.

Indices for the year 2004 from the March (UK)NI GFS and from the Spring(UK)Scotland GFS are given in Table 8.2.3. XSA presently cannot use indices for the year following the last year with commercial catch at age data. Hence, for the XSA runs, the tuning file in Table 8.2.3 was adjusted by shifting the indices from the two survey series back three months along the cohort to give indices at the next youngest age at the end of the previous year. Whilst this approach enables the most recent survey indices to be included in XSA, it results in age groups 4 – 6 having no tuning data in the final year. This was not found to be a drawback in practice as XSA runs using the adjusted and non-adjusted spring trawl series gave very similar results despite the loss of 2004 survey data in the non-adjusted data. TSA was run using the non-adjusted data, as it can use survey data in the year after the final year of commercial catch at age.

8.3 Age composition and mean weights-at-age

Quarterly age compositions of landed catches were provided by UK(E&W) and Ireland from sampling in 2003. Age compositions of UK(NI) landings were available only for quarter 1. Sampling details are given in Tables 2.2.1. and 2.2.2. Individual country's fleets sampled in each quarter landed only 44% of the total international landings in 2003, as estimated by the WG, compared with 87% in 2002.

The methods used in previous years for raising from sampled catches to total fleet landings are described in the Stock Annex. A different procedure was required in 2003. A comparison of quarterly age compositions of UK(NI) landings of cod in recent years showed a strong similarity between quarter 1 and quarter 2, which both overlap the period of the annual spawning run of cod. Hence, age compositions of sampled UK(NI) landings in quarter 1 were applied to the non-sampled quarter 2 landings into N. Ireland. Landings of all countries in quarters 3 and 4 contain progressively more young cod as the year progresses, and it was therefore necessary to apply the age compositions from sampled Irish landings in quarters 3 and 4 to the non-sampled landings into N. Ireland. The use of Irish sample data was considered more appropriate than UK(E&W) samples, which are mainly from vessels fishing in the eastern Irish Sea. UK(NI) and Irish vessels fish mainly in the western region. Figure 8.3.1 shows that the landings of all countries in 2003 were dominated by two-year-olds of the 2001 year class, and that the age compositions for sampled fleets and quarters were quite similar despite the limited sampling.

The percentage age composition of the forecasted and estimated landings at age for 2003 both show dominance by 2 – 4 year olds and negligible landings of 5 and 6 year olds from the weak 1997 and 1998 year classes:

	2004 WG estimate	2003 WG forecast
age 1	7.4%	6.4%
age 2	69.4%	54.8%
age 3	17.6%	25.3%
age 4	5.4%	13.5%
age 5	0.06%	0.05%
age 6	0.006%	0.00%
age 7+	0.003%	0.05%
landings	1,811t	6,150t

The age-range of the landings data for the assessment includes 0-gp cod despite the absence of landings at this age (Table 8.3.1). This is to allow the inclusion of NI GFS (Oct), UK(E&W) BTS and MIK net indices for 0-group cod in XSA tuning. Numbers of cod aged 4 years are increasingly scarce and in keeping with the practice established at the 2002 meeting, numbers at age for all age groups post 1996 in the XSA data files include one decimal place. The landings at age data for Irish Sea cod show a progressively steeper age profile over time (Figure 8.3.2), which is reflected in the progressive increase in estimates of fishing mortality from VPA.

Time series of weights-at-age in the landings, are given in Table 8.3.2 and Figure 8.3.3. Values have fluctuated by up to +- 20% of the mean for each age group but without any obvious trend over time. Constant mean weights-at-age in the landings were assumed for years up to 1981 but in subsequent years weights-at-age were revised annually. It has still not been possible to revise the pre-1981 data, and SOP values differ from 100% in those years. The estimates of constant weight at age prior to 1981 would appear to be under-estimates and may alter the perception of the stock's dynamics during this period. It is again recommended that inter-sessional work is undertaken to address this issue. The very variable mean weights for age 7+ cod in recent years probably reflect small numbers measured and aged.

The weights-at-age in the landings (Table 8.3.2) were also assumed to represent weights-at-age in the stock. As a result, stock weights for 1-year olds are over-estimated as cod of this age are mostly landed in the second half of the year. This does not influence estimates of spawning stock biomass (SSB) as all 1-year olds are assumed to be immature.

There are no time-series of discards estimates for inclusion in the VIIa cod assessment. The XSA assessment is based on landings only. The potential magnitude of discarding was investigated using limited data from the following fleets:

UK(NI) *Nephrops* fishery - The fisher self-sampling scheme that provides discards data for VIIa whiting was altered in 1996 to record quantities of other species in the samples. Length frequencies of cod in the samples were raised to numbers discarded quarterly and annually by the fleet. No otoliths were collected, but the length frequencies could be partitioned to age-class based on appearance of modes and comparison with length-at-age distributions in March and October surveys.

UK(NI) mid-water trawl and twin-trawl fleets - These fleets were sampled randomly by observers as part of an EU contract. Data were only available for the quarters and years shown in Tables 8.3.3 and 8.3.4.

Ireland has conducted a monitoring programme for discards from its otter trawl fleet since 1993. In the Irish Sea this programme has concentrated on discarding from the *Nephrops* fleet. Discard estimates within the Irish trawl fleet were not available to the Working Group.

Discard estimates from the UK(E&W) fleets conducted by the SEAFISH authority in 1993 indicated variable, and sometimes high, rates of discarding of 1-year old cod.

Data from UK(E&W) observer trips in 2003 (Table 8.3.3) were provided to the WG in the form of raised length compositions. Few cod were discarded, all below the MLS of 35 cm.

A summary of available discard information by age group since 1996, based solely on the sampling by UK(NI) is given in Table 8.3.3 and 8.3.4. Discarding took place for age groups 0-2 Although the data are limited there is some indication that fishing mortality on 1-year old cod may be significantly under-estimated by variable amounts by omitting numbers discarded from the stock assessment.

Until a time series of more rigorous estimates of discards are assembled, the WG is restricted to basing its assessment on landings at age only.

8.4 Natural mortality and maturity at age

Information on these variables is given in the Stock Annex. As in previous assessments, natural mortality was assumed at M=0.2 over all age classes. Proportions of M and F before spawning were set to zero. Proportion mature at age was assumed constant over the full time-series, based on mean values from UK(NI) trawl surveys in March 1992 – 1996 used by previous Working Groups:

Age:	1	2	3	4+
Proportion mature:	0	0.38	1.0	1.0

8.5 Catch-at-age analyses

Section 2.6 outlines the general approach adopted at this year's Working Group. The cod stock in Division VIIa has been assessed in previous years using XSA. Although XSA assumes catch at age data are exact, this assumption is only used in a weak way in order to calibrate the abundance indices (Shepherd, 1999). However, given the uncertainties with regard to recent misreporting and the poor sampling rate of VIIa cod in 2003, Shepherd's (1999) comment that the assumption of exact catches "would be inappropriate where the catch data are poorly sampled or otherwise defective, but where one or more sets of reliable survey data were nevertheless available" may be pertinent. In view of the potential problems with the 2003 data, the WG first applied the XSA model using the estimates of landings at age in 2003, and then explored the use of Time Series Analysis (TSA) for the same data set and also with the 2003 commercial catch data treated as missing.

8.5.1 Data screening and exploratory runs

8.5.1.1 Commercial catch data

A separable VPA was carried out using the international commercial landings at age data with the following inputs: reference age for unit selection = 3; Terminal selectivity = 1.0; fishing mortality = 1.2; age 0/1 weights = zero. Plots of the log catch ratio residuals are given in Figure 8.5.1.1.1 for a model fitted to the last 6 years. Trends in residuals indicate that the exploitation pattern has changed in recent years. The ratio for ages 1 and 2 has declined through the 1990s, suggesting either a reduction in the autumn fisheries for 1-year-old cod, or an increase in discarding of 1-year-olds. The decline in the UK(E&W) whitefish fleet during the 1990s may explain at least part of this trend (Table 8.2.1), but increased discarding is also possibility as catch quotas became more restrictive in the 1990s.

8.5.1.2 Survey data

Properties of the survey tuning data for VIIa cod were explored using time-series plots and diagnostics from SURBA (ver. 2.2) model fits to series with sufficient age classes.

The raw data indicate that the surveys give similar signals for age groups 0-3, with the exception of the new UK(EW) BTS index at age 1 (Figure 8.5.1.2.1). The WG considered that the 4-m beam trawl used in this survey was unlikely to be a suitable tool for capturing 1-year-old cod during autumn, and the data on 1-year-olds from this survey were not used for subsequent catch-at-age analyses. Scatterplots of the indices from one survey against another (Figure 8.5.1.2.2) show positive correlations in all cases. The NIGFS (Mar) and ScoGFs (spring) surveys were quite strongly correlated for cod at ages 2, 4 and 5, with the correlation at age 3 reduced by conflicting indices for the 2001 year-class at age 3 in 2004.

The international landings at age show quite similar patterns of year-class variation to the surveys (Figure 8.5.1.2.1), giving confidence in the combined ability of the surveys to track year classes through time. Beyond age 3 in the spring trawl surveys and age 2 in the autumn trawl surveys, catch rates of cod are small and reveal mainly the larger anomalies in year-class strength.

Mean-standardised survey indices by year class and by year, calculated by SURBA for the NIGFS (Mar), ScoGFS (Spr) and NIGFS (Oct) surveys, show good internal consistency in tracking weak and strong year classes, with no marked year-effects (Figure 8.5.1.2.3). The ScoGFS (autumn) survey was not analysed as it has few years, a high fraction of zero catches and poor internal consistency.

The SURBA model was fitted to the NIGFS (Mar) survey and the ScoGFS spring survey using ratios of survey index to population estimates from previous XSA runs to guide the choice of relative catchability at age (max = 1). Manual weighting of 1.0 for all age groups and smoother parameter rho = 2.0 were specified. The empirical catch curves for the unsmoothed and smoothed data show different selectivity patterns in the two surveys, the Scottish survey having relatively lower catchability at the younger ages than the NIGFS survey (Figure 8.5.1.2.4) causing more domed catch curves. The NIGFS survey shows a tendency for relatively lower catchability at age 1 in the second half of the series, as shown by a change in the shape of the catch curves (Figure 8.5.1.2.4) and in a trend of declining residuals at age 1 (Figure 8.5.1.2.5; bottom panels).

The fit of the model to the NIGFS survey is better than for the ScoGFS survey (Figs. 8.5.1.2.5 & 6). The NIGFS survey indicates declining mortality from 1992 to 2002 followed by a sharp increase in 2003 driven by the relatively low indices from the 2004 survey. The recent mortality estimates for ages 2-4 will be very unreliable because of the large model residuals at age 2 in the last two years (Figure 8.5.1.2.5).

Both the NIGFS (Mar) and ScoGFS (Spring) surveys show an increase in SSB in the late 1990s, followed by a sharp decline as the weak 1998 year class enters the spawning stock and a subsequent increase as the impact of this year class diminished (Figs. 8.5.1.2.5 & 6). The SSB estimates decline again from 2003 to 2004 due to the weak 2002 year class.

8.5.1.3 Exploratory assessment runs

Single-fleet runs

The following survey data were used for exploratory XSA runs:

Survey series	Acronym	Survey period	Duration	Age range	Start year – end year
UK E(+W) beam trawl survey	E/W BTS (Sep)	September	4 weeks	0-1	1988 2003
1st Quarter Northern Ireland Groundfish Survey	NI GFS (Mar)	March	2 weeks	0 - 3 (back-shifted)	1991-2003 (back-shifted)
4th QuarterNorthern Ireland Groundfish survey	NIGFS (Oct)	October	2 weeks	0 - 2	1991-2003
1st Quarter Scottish Groundfish Survey	Sco GFS (Spr)	March	3 weeks	0-3 (back-shifted)	1995-2003 (back-shifted)
Northern Ireland MIK net survey	MIK net	May-June	Two surveys of 4-5 days	0	1994-2003

The survey data were investigated by carrying out single-fleet XSA runs and by examining the temporal patterns in each series of indices. The following settings were adopted for each XSA run, based on the investigations carried out by the 2003 WG: full year-range of tuning data; catchability independent of age for age classes 1 and over; q-plateau at age 4; shrinkage over last 5 years and 3 oldest age classes; shrinkage SE=2.5.

The catchability residuals for each age-class are plotted in Figure 8.5.1.3.1.

UK(E&W) beam trawl survey (age 0-1 only): No trend in residuals was apparent at age 0. Larger residuals and missing data at age 1 support the WG's decision to exclude this age class from further analysis.

UK(NI) GFS, March: There appeared to be a tendency for residuals to increase during the 1990s at ages 1 and 2. A large negative residual at age 3 in 1995 is associated with the weak 1992 year-class.

UK(NI) GFS, October: No trends in residuals could be detected because of the relatively short series and highly variable q. A large negative residual at age 2 in 2000 is associated with the weak 1998 year class.

MIK net : XSA does not give reliable residuals when tuned with only an 0-gp index.

Sco GFS Spring: Residuals at age 0 (back-shifted 1-gp) are large. No trends in residuals could be detected because of the relatively short time series and variable q. There was some indication of year effects in 1998 and 2002.

The strong negative residuals apparent at ages 0 to 2 for most indices of the 1998 year-class have a major impact on estimates of fishing mortality on this year class, and are discussed further below.

The results in terms of F(2-4), SSB, F at individual ages and recruitment of the 2001 year class are given in Table 8.5.1.3.1. Surveys with few age classes only influence the survivors estimates at the younger age classes, allowing shrinkage to dominate the estimates for older age classes no matter how large the shrinkage SE is set. The mean F(2-4) is therefore very sensitive to the age range in the tuning fleets, and it is therefore difficult to compare how different surveys perform on their own in XSA.

An alternative approach was adopted using a simple spreadsheet tuned VPA with the following structure:

- F on age 6 = average of F on ages 3-5;
- Selectivity pattern (relative F) in 2003 set equal to the average for the period 1995-99 i.e. after the main period of change in separable VPA residuals
- Survey indices at each age adjusted to numbers at 1 January using alpha values and scaled to "VPA equivalents" using GM catchability in similar way to XSA procedure, based on the VPA populations according to the input F.
- Mean F(2-4) in 2003 was adjusted using Solver to minimize the sum of squared log catchability residuals.

The catchability trends for the ad-hoc VPA single fleet runs were broadly similar to those from XSA. All runs show a marked decline in F in 2003 associated with the large reduction in commercial catch. Key estimates are shown below:

Tuning fleet	SSB 2003	F(2-4) 2003	in 2001 y.c.
NIGFS Mar	4394	0.67	2906
NIGFS Oct	3212	0.847	2510
ScoGFS Spring	5873	0.532	3400
UK(EW)BTS	4851	0.62	3059
NIMIKNET	4543	0.65	2956

The SSB estimates are higher and more consistent than those from XSA, due to the absence of the shrinkage effects which generate large F's in the older ages in XSA. The consistency between surveys suggests that the predominant feature of the assessment data set this year is the large drop in landings in 2003. The different surveys provide quite consistent information on trends in abundance, and the small catch in 2003 is perceived as a reduction in fishing mortality rather than reduced abundance.

Multi-fleet runs

The baseline for multifleet XSA runs was the "same procedure as last year" (SPALY) run using the following data and model configuration:

Tuning fleets:

NIGFS (Mar) ages 0 – 3 (back-shifted)
NIGFS (Oct) ages 0 – 2
ScoGFS (Spring) ages 0 – 3 (back-shifted)

UK(EW) BTS age 0
NI MIK net age 0

Settings:

Power model at age 0; q-plateau at age 4; shrinkage SE 2.5 for 5 years and 3 ages; no taper; minimum fleet SE 0.3

The results of the SPALY run are shown together with retrospective estimates, in Figure 8.5.1.3.2 (summary data), Figure 8.5.1.3.3 (retrospective population estimates by age class) and Figure 8.5.1.3.4 (retrospective F's by age). The results are also shown in bold in Table 8.5.1.3.1. This run gives a very large drop in F(2-4) in 2003, apparent at each of the ages 2 to 4. This tendency is also marked in retrospective runs. The estimates of F(2-4) and SSB differ substantially from any of the single fleet XSA or ad-hoc VPA runs. This is due to the combined influence of the five surveys on survivors in all year classes contributing to the reference F age-range in 2003 despite the absence of tuning data for 4-year-olds in 2003. Whilst retrospective estimates of F are very poor, retrospective estimates of population size at each age are mostly very consistent, and this is also evident in the retrospective estimates of SSB (Figure 8.5.1.3.2).

The assessment of North Sea cod carried out at the 2003 meeting of the ICES Working Group on Demersal Stocks in the Skaggerak and North Sea (ICES CM:ACFM 07) also had to contend with a substantial reduction in landings (in 2001 and 2002) generating substantial retrospective bias in XSA. They found that applying shrinkage SE of 0.5 forced high estimates of F in the older age groups, which was considered undesirable for presentation to managers trying to reduce F, whilst retrospective estimates began to deteriorate at shrinkage SE of 1.5 and above. This problem also applies to the VIIa cod assessment, which is required for informing managers of recent changes in F related to recovery plan measures. The effect of applying stronger shrinkage was investigated by reducing the shrinkage SE in the SPALY run for Irish Sea cod from 2.5 to 1.0. The effect of this was to increase the Fs on ages 4 to 6 in particular, without removing the retrospective bias in F. As in the SPALY run, retrospective estimates of population numbers and SSB remain quite consistent. Reducing the shrinkage SE to 0.5 and 0.3 cause the estimates of F in 2003 to increase further, and the estimate of SSB in 2003 (and 2004) to decline further (Table 8.5.1.3.1).

Increasing the shrinkage causes a progressive downward adjustment of the strength of the 2001 year-class which is currently dominant in the stock and landings. The WG considered that increasing shrinkage merely obscures the underlying problems rather than provide a better specified and less biased model, and hence retained the SPALY run with shrinkage SE of 2.5 as the XSA final run.

The XSA results were generally insensitive to other changes to model settings. The behaviour of the multi-fleet XSA for this stock was explored in some detail by the 2003 WG, and the model configuration of the SPALY run was considered the most appropriate. The following sensitivity tests were carried out this year (results are given in Table 8.5.1.3.1.):

Constant-q model at age 0: This causes a small increase in F and SSB in 2003.
Spring surveys not back shifted: Negligible effect, despite loss of a year's data.
Reduction in plus group to 6+ Negligible effect. Some deterioration in retrospective estimates.
q plateau set to 3: No effect.

As in last year's exploratory runs, XSA diagnostics indicated that the use of the power model at age 0 was appropriate. Given evidence for relatively weak recruitment in recent years, P shrinkage was again disabled to avoid earlier larger recruitment estimates from biasing the recent estimates upwards.

The large reduction in catch in 2003, compared with the large forecast figure given by the 2003 WG, was considered to be a potential source of error given the absence of direct observations of quantities landed in quarters 2 to 4 in 2003 and the poor level of sampling for length and age. Two approaches were taken by the WG to investigate sensitivity of the assessment to the 2003 landings figure:

1. The 2003 landings estimate was inflated by a factor of two and three, and the SPALY XSA run repeated with the revised catches at age;

2. A TSA was carried out treating the 2003 landings and age compositions as missing whilst retaining the 2003 and 2004 survey data.

XSA with inflated 2003 landings

Increasing the landings at age estimates for 2003 causes the estimates of fishing mortality to decrease in 2002 and increase in 2003. The opposite effect is seen in estimates of SSB in 2003 and 2004 (Figure 8.5.1.3.5). This happens because the survey trends in abundance are fixed, and the XSA therefore interprets the increased landings as an increased fraction of the stock. To investigate the longer-term effects of the WG "adding in" estimates of misreporting (based on direct observations of landings), the baseline XSA was run up to 2002 (repeat of last year's run) but excluding all the WG estimates of misreporting from 1991 onwards (Figure 8.5.1.3.6). The result is a downward revision of SSB and recruitment in all years, but a sharp drop in F in 2002. Retrospective under-estimation of F is easily replicated in catch-at-age analysis applied to simulated data in which catches in a recent period are under-estimated due to mis-reporting or increases in non-observed discarding.

Time series analysis with missing 2003 catch data

The TSA model was set up to allow transitory but not persistent trends in survey catchability. As TSA cannot presently handle age class zero with no catch data, and requires a minimum of four age classes in a survey series, only the NIGFS(March) and ScoGFS(spring) survey data were used, with the ages and years not back-shifted. A baseline TSA was carried out with the settings given in Table 8.5.1.3.2, and including the WG estimate of landings at age in 2003. To examine the ability of TSA to estimate missing catches in the terminal year, retrospective runs were then carried out in which the final year's catch data were removed in each of the terminal years 2000 to 2003. All survey data up to and including the year following the year with missing catch were used in each retrospective run.

The parameter estimates for the baseline run and the run with missing 2003 catch data are given in Table 8.5.1.3.3. The summary plots, retrospective estimates and standardized prediction errors for the baseline run are given in Figures 8.5.1.3.7 – 8.5.1.3.9. Although the TSA model is able to fit historical landings estimates accurately, including the low 2000 landings figure, the WG landings figure for 2003 lies below the confidence limit for the TSA estimate for 2003 (Figure 8.5.1.3.7). Estimates of fishing mortality decline sharply between 2002 and 2003, as observed in XSA runs, the decline falling part way between the trends in the XSA with shrinkage SE's of 2.5 and 1.0. Retrospectives for the baseline TSA show some retrospective bias in F and SSB whilst landings are estimated accurately in the terminal year except for the years with small landings (19% overestimate of landings in 2000 and 38% overestimate in 2003; Figure 8.5.1.3.8). The standardized catch prediction errors show a tendency for negative residuals in recent years indicating that TSA expects more catch than is recorded (Figure 8.5.1.3.9).

It was noted that the Ricker stock-recruit parameters estimated internally by TSA tended to give over-optimistic predictions of recruitment at low SSB compared with a Ricker model fitted externally. The possibility that this may have contributed to prediction errors was examined by fixing the Ricker parameters in TSA at values estimated from converged XSA values of SSB and recruitment (adjusted to age 1). Differences in recruitment estimates from the two model configurations were zero on average with differences of 1% or less in most years.

The ability of TSA to estimate terminal catches when they are treated as missing is shown in Figure 8.5.1.3.10 as a retrospective plot. This shows substantial overestimates for the years with small catches (87% in 2000, 265% in 2003) and moderate overestimation (approx. 30%) for the other two years. These results indicate that TSA is unlikely to provide accurate forecasts of missing landings in 2003.

Choice of final assessment model

The key decision for this assessment is how a model handles the large reduction in landings in 2003, the potentially inaccurate age compositions of 2003 landings, and the absence of tuning data for the older age groups which include the very weak 1998 year-class. This year-class has been characterized in recent XSA assessments by very large estimates of F that can impact the F vectors used in forecasts. Whilst XSA appears to provide quite consistent estimates of population numbers for Irish Sea cod, the estimates of F are highly variable and can be altered substantially through changes in shrinkage. In contrast, TSA reduces the problems caused by weak year classes through smoothing of selection patterns, and appears to partition retrospective estimation errors more evenly between F and population numbers. However, it tends to favour the status quo and hence does not react rapidly to sudden large changes in data. As these changes may result from errors in the data, this reduction in sensitivity to such changes may be desirable in the light of the known deterioration in quality of commercial catch data for 2003, given that surveys appear to give fairly consistent information on year class strength in this stock.

The WG therefore decided to adopt the TSA run including the WG estimates of 2003 landings, noting that the WG landings figure includes an adjustment for misreporting that is consistent with patterns of catch reporting in the previous few years when catch restrictions were similar to those in 2003. Whilst TSA estimated the 2003 landings at 2,500t compared with the WG estimate of 1,811t, this difference is not unfeasible, representing a relatively small difference in catch in absolute terms. The results of the XSA multi-fleet run with shrinkage SE of 2.5 are presented in the next section for comparison with the TSA results.

8.5.1.4 Final assessment run

The configuration adopted for the final XSA are given below, together with that used in the 2002 and 2003 assessments. Changes are marked in bold and underlined

Year of assessment	2002	2003	2004
Assessment model	XSA	XSA	XSA
Tuning Fleet1	E/W BTS (September) 1988 – 2001; age 0	E/W BTS (September) 1988 – 2002; age 0	E/W BTS (September) 1988 – 2003; age 0
Tuning Fleet 2	NI GFS (October) 1992-2001; age 0-2	NI GFS (October) 1992-2002; age 0-2	NI GFS (October) 1992-2002; age 0-2
Tuning Fleet 3	NI GFS (Mar) 1992-2001; age 1-4	NI GFS (Mar) 1991-2002; age 0-3 back-shifted	NI GFS (Mar) 1991-2003; age 0-3 back-shifted
Tuning Fleet 4	MIK net (May-June) 1994-2001; ag 0	MIK net (May-June) 1994-2002; age 0	MIK net (May-June) 1994-2003; age 0
Tuning Fleet 5	NONE	ScoGFS Spring 1995-2002; age 0-3 back-shifted	ScoGFS Spring 1995-2003; age 0-3 back-shifted
Time series weights	Tricubic over 20 years	No Taper	No Taper
All surveys	1998 year-class indices EXCLUDED for all ages	1998 year-class indices included for all ages	1998 year-class indices included for all ages
Power model applied to ages	0	0	0
Catchability (q) plateau	5	4	4
Survey estimates shrunk towards mean of	5 years, 3 ages	5 years, 3 ages	5 years, 3 ages
SE of mean	2.0	2.5	2.5
Min fleet SE for population estimates	0.3	0.3	0.3
Prior weighting	None	None	None

The diagnostics for the final XSA run are given in Table 8.5.1.4.1 and the survivor estimates and scaled weights for each fleet are summarised in Figure 8.5.1.4.1. The survivor estimates at each of the ages 0 to 4 are estimated quite consistently by three or more surveys carrying similar weightings, whilst from age 5 onwards the very low survivors estimates are driven mainly by shrinkage. The XSA model generates retrospective under-estimation of fishing mortality, but consistent retrospective estimation of stock numbers, as discussed earlier (Figures 8.5.1.3.2 to 8.5.1.3.4). The fishing mortality estimates and stock numbers by age are given in Tables 8.5.1.4.2 and 8.5.1.4.3, and the summary output in Table 8.5.1.4.4.

Final TSA run

The input parameters for the final TSA run are given in Table 8.5.1.3.2, and the parameter estimates are given in Table 8.5.1.3.3. Estimates of fishing mortality at age and their cv's (standard errors of the log F's) are given in Tables 8.5.1.4.5 and 8.5.1.4.6. Estimates of stock numbers and standard errors are in Tables 8.5.1.4.7 and 8.5.1.4.8. Summary data are in Table 8.5.1.4.9. Trends in estimated landings, fishing mortality, recruitment and SSB are plotted in Figure 8.5.1.3.7, with standardized residuals plotted in Figure 8.5.1.3.9. The TSA model generates retrospective estimates of F and SSB lying beyond the point-wise confidence limits from the full series, and these appear biased downwards (F) or upwards (SSB) (Figure 8.5.1.3.8).

A comparison between the estimates given by TSA, XSA and SURBA is given in Figure 8.5.1.4.2 and 8.5.1.4.3. From this it is clear that TSA and XSA give near identical estimates of historical trends in SSB and recruitment, but diverge in estimates of F(2-4). The TSA estimates of F at age 1 are larger than from XSA since the 1990s (Figure 8.5.1.4.3), related to the mostly negative catch prediction errors at this age in the same period (Figure 8.5.1.3.9). At age 2, the XSA and TSA estimates of F are very similar apart from the larger decline in the XSA estimates from 2002 to 2003. This may simply reflect the TSA estimate of landings in 2003 (2,500t) being larger than the WG estimate of 1,811 t. At ages 3 and 4, the XSA estimates rise steeply above the TSA estimates from 1999 to 2002 before falling below the XSA estimates in 2003. This difference is due to the effects of shrinkage in XSA at ages 5 and 6 propagating high Fs backwards along the weak 1997 and 1998 year classes.

The TSA, XSA and survey-based estimates of SSB all show low values in 2000 and 2003, caused by the weak 1997 and 1998 year classes, and a subsequent recovery (Figure 8.5.1.4.2). The surveys indicate relatively smaller SSB in the mid 1990s compared with the XSA and TSA runs, and also give differing indications of the change in SSB from 2003 to 2004. The trends in these years are, however, very sensitive to changes in survey catchability.

8.5.1.5 Comparison with last years assessment

Changes from last year's assessment in estimates of F(2-4) and SSB in 2000, and in estimates of recent recruitment, are summarised below:

	2003 WG final XSA	2004 WG final TSA	2004 WG final XSA with all fleets	2004 WG XSA with same tuning data as TSA[2]
SSB(in 2002)	5,706	4,489	4,615	4,487
F(2-4) (in 2002)	1.231	1.133	1.758	1.807
F age 2 (in 2002)	0.707	0.954	0.990	1.032
F age 3 (in 2002)	0.967	1.388	1.475	1.586
F age 4 (in 2002)	2.020	1.056	2.809	2.804
R age 0(in 1999)	4929	5123[1]	4504	4,451
R age 0(in 2000)	3197	2389[1]	2677	2,626
R age 0(in 2001)	3879	3605[1]	3977	6,100
R age 0 (in 2002)	1523	1090[1]	1341	751

[1]TSA nos at age 1 in year y+1 multiplied by exp(M) to give nos. at age 0 [2] using NIGFS Mar and ScoGFS Oct tuning fleets, not back-shifted and excluding 2004 data.

The TSA run gives F(2-4) 8% below the 2003 WG XSA estimate, and similar estimates of recruitment in 1999 and 2001, but a 21% downward revision in SSB in 2002. The final XSA run from this year makes substantial upward adjustment to F's at ages 2-4 but more minor adjustments to recent recruitment estimates. The fourth column of the text table shows the estimates from an XSA run with the same input tuning data as used in the final TSA run. The results for 2002 are generally similar to the XSA run using all fleets including 2004 survey data (back-shifted) except for the estimate of recruitment of the 2001 year-class at age 0 which is about 50% larger than the full XSA run. This is due to the large survey index for this year class in the 2003 spring surveys which carries more weight in the absence of the 2004 survey data. The trial multifleet runs summarized in Table 8.5.1.3.1 show that the loss of the 2004 survey data has minor impact when the other survey data for ages 0 – 2 are included.

8.5.2 Estimating recruiting year class abundance

Estimates of numbers surviving at age classes 1 to 7+ are required for short term predictions of catch and SSB based on TSA. Prediction inputs were taken from the final TSA run. Year class estimates for use in the forecasts are as follows:

Year class 2003 : The TSA model was run using only the NIGFS(Mar) and ScoGFS(Spring) trawl surveys and therefore has only the indices at age 1 from these surveys in 2004 to estimate abundance of the 2003 year class in 2004. Population numbers at this age in 2004 were re-estimated using RCT3 to calibrate survey indices at ages 0 and 1 from the UK(EW)BTS, NIGFS March, NIGFS October and NIMIKnet surveys against TSA estimates at age 1. The ScoGFS Spr indices at age 1 were excluded after preliminary runs showed very high SEs. The UK(EW)BTS survey data for 1988-1990 were excluded due to a large catchability residual and also to restrict the "VPA mean" used in population shrinkage to the more recent period. The input data file is given in Table 8.5.2.1, and the results in Table 8.5.2.2. The RCT3 prediction of 1,472 thousand fish at age 1 in 2004 is close to the TSA estimate of 1,700 thousands, but is more precise (CV= 0.20 compared with 0.48 from TSA). The estimate is based on four survey series giving similar predictions of a weak year-class, with very little contribution of the VPA mean to the weighted average. The RCT3 estimate was adopted for forecasts.

Year classes 2004 to 2005: In keeping with the practice of previous assessments for this stock, short term geometric mean recruitment was calculated to take into account the apparent reduction in recruitment observed since the early 1990's. The reduced term (1993-03) geometric mean recruitment value (2,227 thousands) was used for the 2004, 2005 and 2006 year-classes.

Working group estimates of year-class strength are summarised below. Estimates used in the forecasts are shown in bold.

recruits at age 1	TSA	RCT3	GM(93-03)	GM (68-03)
2004 recruitment	1,700	1,472	2,227	4,410
2005 recruitment			2,227	4,410
2006 recruitment			2,227	4,410

8.5.3 Long-term trends in biomass, fishing mortality and recruitment

Summary plots of SSB, fishing mortality and recruitment estimates from TSA are shown in figure 8.5.3.1. Fishing mortality increased progressively from around 0.7 in the 1970s to over 1.0 in the 1990s. At such high F, the stock was unable to replace itself except following very strong recruitment, and entered a phase of decline, falling below the current limit reference point ($\mathbf{B}_{lim}$) of 6,000t by the early 1990s. A truncated age structure combined with a very weak year class in 1998 resulted in SSB declining rapidly in 2000 to less than 15% of the average recorded in the 1970s and 1980s. An improvement in recruitment in 2000 - 2002 (1999 – 2001 year classes) has allowed a recovery of SSB to just under $\mathbf{B}_{lim}$, however the 2002 and 2003 year classes appear to be weak.

8.5.4 Short-term catch predictions

Short term catch forecasts were produced using the following inputs:

Numbers at age 1 in 2005 and 2006: 2,227 thousand fish (geometric mean recruitment 93-03)
Numbers at age 1 in 2004: 1472 thousand fish (RCT3 prediction)
Numbers at age 2 to 7+ in 2004: survivor estimates from TSA
Catch and stock weights at age: arithmetic mean of 2001-2003 values
Fishing mortality at age: arithmetic mean of 2001-2003 unscaled

These and other inputs are given in Table 8.5.4.1 and 8.5.4.2.

The un-scaled mean F was used rather than the TSA estimates for 2003 as it cannot be assumed that the decline in estimates of F from 2002 to 2003, even if accurate, represent a persistent reduction. Substantial transient changes in F are evident historically, and this variation needs to be reflected in the forecasts. In addition, retrospective underestimation of terminal F would lead to over-optimistic forecasts if propagated into the forecast period. The extent to which F could be reduced in 2004 by management measures such as effort limitation and decommissioning of vessels in 2003 could not be reliably evaluated by the WG. Such an evaluation is likely to be carried out by national fishery departments with access to detailed records of historical catches and effort of decommissioned vessels and monthly fishing patterns of remaining vessels subject to the different effort regimes. The TSA results do not show any reduction in F following decommissioning of over 30 UK (mainly NI) vessels in 2001, and there is no evidence of a marked decline in reported fishing effort in the relevant whitefish sectors following the removal of these vessels (Table 8.2.2). The WG therefore decided to proceed with a status quo forecast, noting that the status quo F of 1.03 represents a reduction from the estimates of 1.1 – 1.4 for 1997 – 2002, potentially due to retrospective assessment bias.

The results of a status quo forecast are given in Tables 8.5.4.3 (management options) and 8.5.4.4 (detailed results). The status quo predicted catch for 2004 is 3,920 tonnes (the TAC for 2004 is 2,150 tonnes), with SSB predicted to be 5,230 tonnes in 2004 and 3,220 tonnes in 2005. The forecast for status quo F(2-4) = 1.03 is summarised below together with working group figures for 2003 and 2004. Approximate coefficients of variation for the estimates are given in parentheses (WGFRANSW estimates)..

Year	Landings (t)	Source	SSB (t)	Source
2003	1,810	WG Estimates	3,420	TSA
2004	3,920 (CV 0.24)	SQ Forecast	5,230	TSA
2005	2,800	SQ Forecast	3,220	SQ Forecast

	(CV 0.30)		(CV 0.32)	
2006	-		3,370 (CV 0.36)	SQ Forecast

The contribution of the estimates of recent year classes to forecasted landings and SSB in 2004-2005 are illustrated in Table 8.5.4.5. The 2001 year class is expected to dominate the 2004 landings (60%) and SSB (67%) but to have much less influence on landings in 2005 which are expected to have a fairly balanced contribution of the 2001 – 2003 year classes (81% in total) with GM recruits making up 13% of the forecast. The SSB forecast for 2006 comprises mainly the 2003 and 2004 year classes, estimated as RCT3 prediction and short term GM respectively.

The forecasted landings age compositions may be compared with the age compositions from two short charters using commercial vessels and commercial trawls that were carried out in the western and eastern Irish Sea in spring 2004 under the UK Fisheries Science Partnership to examine abundance and age structure of the cod stock (Bannister et al; WD 13). The MFV Beniah used a midwater trawl in the west (40 hauls), and the MFV Kiroan an otter trawl in the eastern Irish Sea (51 hauls). The age compositions of these catches could reflect the commercial fishery as a whole during spring 2004. The text table below compares the % age composition for age 2+ cod from this year's catch forecast for 2004 (few 1-year-olds are taken in spring) with the age compositions in the charter catches.

Age	WG forecast for 2004 ('000 fish)	WG forecast for 2004: % by number for 2+ fish	2004 Benaiah I Sea west %	2004 Kiroan I Sea east %
1	233	-	0	2
2	308	28	6	8
3	670	61	76	84
4	68	6	8	3
5	44	4	8	2
6	1	<0	<1	0

The charter catches confirm the WG forecast that the 2001 year class is likely to dominate the catches in 2004, with few survivors of earlier year classes.

Results of a linear sensitivity analysis of the WG status quo short term forecast, using the inputs given in Table 8.5.4.1, are given in Figure 8.5.4.1. The landings forecast in 2005 is most sensitive to the year effects in fishing mortality in 2004 and 2005.The forecast of SSB in 2006 is most sensitive to the F multiplier in 2005, with a balanced contribution from other sources of uncertainty. The largest contribution to the variance of the 2006 SSB forecast is recruitment in 2005 (2004 year class – short term GM) and the year effect in F in 2005.

Probability profiles of SSB in 2006 assuming status quo F, and the probability that F in 2005 will exceed the status quo value at different catch levels are given in figure 8.5.4.2. The probability that SSB in 2006 will be below $\mathbf{B}_{lim}$ (6,000t) is greater than 95%. Landings of around 1,800 tonnes or less in 2005 are required to ensure a probability of less than 10% of F exceeding $\mathbf{F}_{sq}$

8.5.5 Medium-term predictions

Figure 8.5.5.1 shows the stock recruit plot with $\mathbf{F}_{high}$ and $\mathbf{F}_{med}$ identified. A Ricker stock recruit curve was fitted to the data last year on the a priori assumption that cannibalism in cod could reduce recruitment at high stock sizes. The same procedure was adopted by this working group. The model and parameter estimates are given below.

Model R = a*SSB*exp(-b*SSB)

Parameters a = 0.7854 se = 0.1939
b = 0.0491 se = 0.0203

(SSB in '000 t; recruits at age 1 in millions. Note: recruitment in 2003 WG report was at age 0).

No medium term predictions are presented as they are considered in the context of the EU Commission's recovery plan simulations in Section 14. These simulations are based on the TSA outputs from this WG, together with Ricker curve parameters estimated external to TSA. The external estimates were used as they fit the recruitment values at low SSB better than the TSA internal Ricker model parameters.

8.5.6 Yield and biomass per recruit

Long term yield and spawning biomass per recruit conditional on the present exploitation pattern and long term (1982 – 2003) weights at age are shown in Table 8.5.6.2 and Figure 8.5.6.1, with inputs listed in Table 8.5.6.1. $\mathbf{F}_{max}$ is estimated to be 0.32 and $\mathbf{F}_{0.1}$ is estimated to be 0.18. These estimates have changed only slightly from those estimated last year and are well below the current estimate of status quo fishing mortality of 1.03.

8.5.7 Reference points

Spawning stock and recruitment data are plotted in Figure 8.5.7.1.

Previous assessment Working Groups have explored appropriate reference points for this stock based on stock-recruitment dynamics. The PA reference points proposed by ACFM for Irish Sea cod are:

$\mathbf{F}_{pa}$ = 0.72; $\mathbf{B}_{pa}$ = 10,000 t

$\mathbf{F}_{lim}$ = 1.0; $\mathbf{B}_{lim}$ = 6,000 t

It should be noted that since 1992, SSB has remained below the $\mathbf{B}_{lim}$ value of 6,000 t. Last year's assessment indicated SSB in 2002 (5,700t) approaching close to $\mathbf{B}_{lim}$ whereas this year's assessment has revised that figure down to 4,500t with an expected increase to 5,200 t in 2004 followed by a decline as fish in recent weak year classes reach maturity. Current F is above $\mathbf{F}_{pa}$.

The output of PA-Soft analyses are shown in Figure 8.5.7.1 and Table 8.5.7.1.

8.5.8 Quality of the assessment

The catch-at-age data for this stock are subject to errors associated with sampling for length and age, estimation of quantities landed, absence of discards estimates, and procedures for raising to include unsampled fleets. The errors for 2003 are likely to be relatively high because of the absence of samples for some major fleets from Quarter 2 to Quarter 4.

The Working Group continues to make attempts to quantify mis-reported landings for some fleets, and estimates of these are included in the assessment. However, information was only available for Quarter 1 in 2004, and misreporting had to be assumed to have continued at the same rate as in the recent few years when the TACs were set to achieve a similar reduction in F as in 2003.

The absence of discards data from the assessment will affect mainly the estimates of fishing mortality at age 1, which will be unreliable. The effect on population numbers calibrated against survey indices at this age may be comparatively small in most years unless there are large numbers discarded by fleets not sampled.

Commercial fleet tuning data have not been used in the previous 5 assessments for this stock. Whilst survivors estimates at ages 0 to 4 are tuned mainly by survey data, survivors at ages 5 and above are determined largely by F shrinkage in XSA. The use of TSA this year is partly to overcome the problems of applying XSA with a limited age-range in tuning data. The survey tuning data appear to track year class strengths with a high degree of consistency and are considered to be reliable indices for the younger age groups. The use of TSA has allowed inclusion of 2004 survey data without back-shifting the indices to the end of the previous year, but meant that several survey series had to be omitted as the software cannot at present handle 0-gp indices and series with few ages. These other surveys were used with RCT3 to estimate the 2003 year class, but their information on earlier year classes is effectively lost.

The very weak 1998 year class has caused persistent problems in this assessment since 2000, as estimates of F have been very high and therefore influence any shrunk estimates in which they are included. The smoothing algorithms in TSA reduce this effect, although not entirely.

The results of retrospective analyses of both TSA and XSA show retrospective under-estimation of F. However, the overall trends in biomass and recruitment appear quite well estimated.

A major concern to the working group is the absence of any significant level of stock biomass in the older ages of this stock. It is estimated that almost 70% of the spawning biomass in 2004 comprises 3-year olds of the 2001 year-class, with very few older fish. The effective identification of year class strengths and the ability to estimate stock abundance is seriously compromised by a lack of detailed information on age groups greater than 3 or 4. This has been a particular problem in 2004 because of the very weak 1997 and 1998 year classes.

8.5.9 Management considerations

The point estimate of current mean F (1.03) exceeds $\mathbf{F}_{0.1}$ and $\mathbf{F}_{max}$ and lies above the $\mathbf{F}_{pa}$ value of 0.72. The point estimate of current SSB in 2004 (5,200) is below the $\mathbf{B}_{pa}$ value of 10,000t and below the limit biomass threshold of 6,000t. SSB is predicted to decline to 3,400 t in 2006 at $\mathbf{F}_{sq}$.

The approximate 95% confidence limits for the 2004 status quo landing's forecast are 2,350t and 6,100t. The TAC for 2004 is 2,150t, consequently there is a continued risk of discarding and mis-reporting within the fishery in order to keep reported landings within the TAC.

The EU Cod Recovery Plan regulation implemented in the Irish Sea from 2004 will impact the management measures for 2005, which will be formulated with reference to the estimates and forecasts of SSB in relation to limit and precautionary reference points. For stocks above $\mathbf{B}_{lim}$, the harvest control rule (HCR) requires:

1. setting a TAC that achieves a 30% increase in the SSB from one year to the next,

2. limiting annual changes in TAC to ± 15% (except in the first year of application), and,

3. a rate of fishing mortality that does not exceed $\mathbf{F}_{pa}$.

For stocks below $\mathbf{B}_{lim}$ the Regulation specifies that:

4. conditions 1-3 will apply when they are expected to result in an increase in SSB above $\mathbf{B}_{lim}$ in the year of application,

5. a TAC will be set lower than that calculated under conditions 1-3 when the application of conditions 1-3 is not expected to result in an increase in SSB above $\mathbf{B}_{lim}$ in the year of application.

The present assessment indicates a high risk of SSB remaining below $\mathbf{B}_{lim}$ in the medium term, with a high probability of continued reduced recruitment. It is estimated that a reduction of fishing mortality in 2005 of about 80%, corresponding to landings of about 800 tonnes, is required to bring SSB in 2006 above $\mathbf{B}_{lim}$. A reduction in F of 30% from the $\mathbf{F}_{sq}$, corresponding to landings of about 2,170 tonnes, is required for a 30% increase in forecasted SSB from 2005 to 2006.

Table 8.1.3.1 Nominal catch (t) of COD in Division VIIa as officially reported to ICES, and Working Group estimates of annual landings.

Country	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	222	344	269	467	310	78	174	169
France	1,480	1,717	2,406	352[1]	201[1]	320[1]	916	686
Ireland	3,991	5,017	5,821	3,656	2,800	2,364	2,260	1,328
Netherlands	-	-	-	-	-	-	-	-
UK (England & Wales)[3]	847	1,922	2,667	6,320	4,752	3,562	3,529	3,244
UK (Isle of Man)	80	44	118	39	48	175	129	57
UK (N. Ireland)	2,992	3,565	4,080	…	…	…	…	…
UK (Scotland)	446	574	472	465	1,767	515	393	453
Total	10,058	13,183	15,833	11,299	9,878	7,014	7,401	5,937
Unallocated	-206	-289	-1,665	1,452	-2,499	81	334	1,618
Total figures used by Working Group for stock assessment	9,852	12,894	14,168	12,751	7,379	7,095	7,735	7,555

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[1]
Belgium	129	187	142	183	316	150	60	283	318	183
France	208	166	148	268	269[1]	85[1]	53	74	116	122
Ireland	1,506	1,414	2,476	1,492	1,739	966	455	751	1,111	n/a
Netherlands	-	-	25	29	20	5	1	-	-	-
UK (England & Wales)[3]	2,274	2,330	2,359	2,370	2,517	1,665	799	885	1,134[1]	…
UK (Isle of Man)	26	22	27	19	34	9	11	1	7	7
UK (N. Ireland)[3]	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	326	414	126	80	67	80	38	32	29	…
United Kingdom										525
Total	4,469	4,533	5,303	4,441	4,962	2,960	1,417	2,026	1,594	837
Unallocated	933	54	-339	1,418	348	1,824	762	1,572	2,837	974
Total figures used by Working Group for stock assessment	5,402	4,587	4,964	5,859	5,310	4,784	2,179	3,598	4,431[2]	1,811

[1]Preliminary.
[2]Revised.
[3]1989–2002 N. Ireland included with England and Wales.
n/a = not available.

Table 8.2.1 Cod VIIa (Irish Sea)
Effort and LPUE indices for >40' UK (E&W) otter trawlers, French otter trawlers, UK (NI) otter and pelagic trawlers, UK (E&W) beam trawlers and Irish otter trawlers.

a) LPUE indices

Year	UK (E&W) otter[1]	France otter[2]	UK (NI) otter[3]	UK (NI) pelagic[3]	UK (E&W) beam[1]	Ireland otter[2]
1972	18.08	6.66				
1973	15.01	6.03				
1974	16.41	6.62				
1975	11.5	6.45				
1976	12.01	6.66				
1977	9.95	5.38				
1978	8.61	5.44	1.24			
1979	8.66	6.47	5.22			
1980	16.34	7.08	7.11			
1981	20.46	9.18	2.97			
1982	15.74	9.38	6.81			
1983	11.51	5.43	3.4			
1984	11.73	8.17	5.96	28.21	4.48	
1985	9.35	9.94	7.16	27.84	1.74	
1986	11.62	6.58	8.73	28.72	2.63	
1987	14.21	8.7	6.69	29.4	5.11	
1988	14.57	10.85	8.38	27.61	12.53	
1989	18	6.53	5.21	26.02	9.19	
1990	10.67	4.21	4.87	23.72	3.32	
1991	11.32	5.15	4.93	15.19	4.42	
1992	9.74	7.59	4.78	19.88	3.93	
1993	9.75	n/a	9.16	29.84	4.31	
1994	8.2	n/a	5.95	20.9	1.88	
1995	9.91	n/a	5.41	26.42	2.36	13.26
1996	10.91	n/a	8.02	34.06	1.84	11.09
1997	14.96	n/a	4.63	30.39	1.81	7.07
1998	9.29	n/a	4.23	23.53	2.14	7.01
1999	6.5	n/a	3.15	27.8	1.68	5.38
2000	6.71	n/a	1.55	20.09	0.39	3.45
2001	4.25	n/a	3.81	17.83	3.71	6.05
2002	3.95	n/a	4.60	30.64	1.80	5.95
2003	3.37	n/a	n/a	n/a	0.83	4.35

Table 8.2.1 contd.

b) Fishing effort

Year	UK (E&W) otter[4]	UK (NI) otter[5]	UK (NI) pelagic[5]	UK (E&W) beam[4]	Ireland otter[2]
1972	128401				
1973	147642				
1974	115161				
1975	130733				
1976	122337				
1977	101881				
1978	89070			880	
1979	89864			1702	
1980	107026			4283	
1981	107063			6433	
1982	127194			5503	
1983	88088			2770	
1984	103109	143687	36173	4136	
1985	102856	160017	37469	7407	
1986	90327	153473	46515	17031	
1987	130597	164901	67766	21997	
1988	131950	172191	69375	18564	
1989	139521	194636	84354	25291	
1990	117058	196518	93471	31033	
1991	107288	207828	86385	25838	
1992	96802	203226	97363	23399	
1993	78945	195323	74014	21503	
1994	42995	191705	73778	20145	
1995	43146	161025	52773	20932	80314
1996	42239	154418	53083	13320	64824
1997	39886	165612	55863	10760	92178
1998	36902	149088	61153	10386	93533
1999	22903	146990	72859	11016	110275
2000	26967	130117	46412	6275	82690
2001	32960	131418	50302	12495	77541
2002	24760	108616	57754	8000	77863
2003	23870	115551	61539	14000	76368

[1] Weighted mean deseasonalised CPUE over ICES rectangle, GRT corrected (Kg/h)

[2] De-seasonalized CPUE

[3] Ratio of total landings to total hours fished in main fishing area: SINGLE RIG TRAWLS ONLY

[4] Total aggregate hours fished, corrected for vessel GRT

[5] Total aggregate hours fished in main fishing area: SINGLE RIG TRAWLS ONLY

n/a = not available

Table 8.2.2 Cod in VIIa (Irish Sea). Reported fishing effort of different national fleets and gear types 1997 to 2003.

Year	NILTR	NIPel	NI TNT	NI SNT	NI Sei	NI PTD	IR OTB	UK(EW) OTB	UK(EW) BT	Belgium BT	IR-BT	All towed gears
1997	24,434	56,529	20,142	141,198	390	279	92,178	39,886	10,760	29,300	9,859	424,955
1998	16,228	61,803	29,514	133,697	217	164	93,533	36,902	10,386	23,800	11,582	417,826
1999	18,725	73,278	29,117	129,117	1,948	225	110,275	22,903	11,016	22,100	14,667	433,371
2000	12,746	47,604	41,157	117,921	2,629	196	82,690	26,967	6,275	18,200	11,418	367,803
2001	11,073	51,090	35,652	120,483	816	2,665	77,541	32,960	12,495	28,500	13,129	386,404
2002	10,327	57,854	26,821	98,883	645	2,250	77,863	24,760	8,000	36,200	17,674	361,277
2003	11,897	61,899	31,738	102,726	1,104	1,189	76,368	23,870	14,000	23,000	21,837	369,628

NILTR: UK(NI) light otter trawl (100mm+ mesh); hours fished with no power correction.
NIPel UK(NI) midwater demersal (100mm+ mesh); hours fished with no power correction.
NI TNT UK(NI) twin Nephrops trawl (70-80mm); hours fished with no power correction.
NI SNT UK(NI) single Nephrops trawl (70mm); hours fished with no power correction.
NI Sei UK(NI) seine net (100mm +); hours fished with no power correction.
NI PTD UK(NI) pair trawl demersal (100mm+); hours fished with no power correction.
IR(OTB) Ireland otter trawls (single and twin Nephrops (70-80mm) and whitefish otter (100mm+)); hours fished with no power correction.
UK(EW)OTB UK(E&W) otter trawls (single Nephrops (70-80mm) and whitefish otter (100mm+)); hours fished, with power correction.
UK(EW) BT UK(E&W) beam trawl (80mm); hours fished, with power correction.
Belgium BT Belgium beam trawlers (80mm); hours fished, with power correction
IR BT Irish beam trawlers (80mm); hours fished with no power correction.

Table 8.2.3. Cod in VIIa: survey and commercial tuning data available to the WG in 2004. Data used in the assessment are in bold type.

IRISHSEA VIIA COD NSWG 2004 TUNING DATA "(effort,at" age)

109 (Updated IDH 29/04/04

BTS-Sept
1988 2003
1 1 0.75 0.79
0 0
1 **19** 8
1 **17** 6
1 **190** 6
1 **70** 20
1 **11** 55
1 **38** 1
1 **30** 3
1 **40** 3
1 **29** 4
1 **30** 14
1 **2** 0
1 **59** 0
1 **37** 29
1 **24** 4
1 **7** 8
1 **8** 0

UK(E+W)TRAWL FLEET (NEW)(thousand hours fishing, actual landings in thousands)

1987 2003
1 1 0 1
1 7
130.597 989.0 187.0 99.0 16.0 5.0 2.0 2.0
131.95 655.0 768.0 71.0 34.0 7.0 4.0 2.0
139.521 162.0 514.0 264.0 30.0 15.0 2.0 1.0
117.058 150.0 150.0 96.0 58.0 8.0 5.0 1.0
107.288 672.0 142.0 30.0 15.0 6.0 3.0 1.0
96.802 506.0 207.0 39.0 3.0 3.0 2.0 0.0
78.945 37.0 295.0 14.0 4.0 1.0 0.0 0.0
42.995 201.0 18.0 32.0 6.0 2.0 1.0 0.0
43.146 130.0 92.0 7.0 6.0 0.0 0.0 1.0
42.239 60.0 78.0 40.0 2.0 3.0 0.0 0.0
39.886 108.0 91.0 17.0 6.0 0.0 0.0 0.0
36.902 31.0 195.0 13.0 2.0 1.0 0.0 0.0
22.903 11.0 44.0 26.0 2.0 0.0 0.0 0.0
26.967 52.0 8.0 5.0 3.0 0.0 0.0 0.0
32.964 21.0 49.8 0.9 0.7 0.7 0.0 0.0
24.762 25.8 29.2 13.1 0.2 0.0 0.0 0.0
23.870 2.3 34.5 2.1 0.6 0.0 0.0 0.0

NIGFSOCT(0 2-gp)
1992 2003
1 1 0.83 0.88
0 2
1 **58 1109 50** 48 9 0 0 0
1 **781 553 146** 1 0 0 0 3
1 **1996 1672 25** 10 0 0 0 0
1 **789 1207 33** 0 0 0 0 0
1 **1481 487 50** 7 0 0 0 0
1 **420 1322 97** 0 0 0 0 0
1 **37 377 164** 6 0 0 0 0
1 **2022 58 32** 10 0 0 0 0
1 **724 302 2** 0 0 0 0 0
1 **841 507 110** 0 0 0 0 0
1 **90 488 38** 13 0 0 0 0
1 **276 161 29** 0 0 0 0 0

Table 8.2.3 contd.

```
NIGFSMAR(1 4-gp)
1992 2004
1    1    0.21 0.25
1    4
1    2326 500  196  24.8  0.0  3.1  1.7
1    138  649  45   10.4  1.4  2.8  0.0
1    1380 110  120   8.4  1.4  0.0  0.0
1    701  386  20   10.8  0.0  1.0  0.0
1    1106 329  112  1.4   8.8  0.0  1.3
1    537  416  67   21.4  1.4  0.0  0.0
1    169  769  57   12.0  0.0  0.0  0.0
1    49   253  242  15.3  2.8  0.0  0.0
1    630  101  35   33.0  0.0  2.3  0.0
1    407  561  18   5.8   4.0  0.0  0.0
1    662  253  334  0.0   0.0  1.1  0.0
1    74   1079 104  32.7  3.7  3.0  5.8
1       219    176     89     5.4   4.4  0.0  0.0
NIMIKNET
1994 2003
1    1    0.38 0.46
0    0
1    57.4
1    6.9
1    66.3
1    5.7
1    0.1
1    26.2
1    6.1
1    9.6
1    3.4
1    3.2
ScoGFS-Spring Survey (Nos per 10 hours fishing)
1996 2004
1    1    0.21 0.25
1    4
1    3    31   44   7    9    0    0
1    22   29   15   13   2    0    1
1    5    81   27   5    1    0    0
1    7    33   93   15   5    0    0
1    51   6    11   16   0    1    0
1    28   56   1    1    4    0    0
1    13   18   37   1    1    0    0
1    8    69   18   9    0    0    0
1    8    11   49   0    3    0    0
ScoGFS-Autumn Survey (Nos per 10 hours fishing)
1997 2003
1    1    0.83 0.92
0    2
1    3    28   19   1    2
1    0    8    42   5    0
1    164  2    24   6    2
1    24   136  4    0    0
1    0    0    7    0    0
1    0    18   15   9    0
1    2    0    27   0    0
Irish GFS (numbers at age)
2003 2003
1    1    0.89 0.91
0    5
1    16   29   31   3    1    0

IR-OTB : Irish Otter trawl - Effort in hours - VIIa Cod numbers at age - Year

1995 2003
1    1    0    1
1    6
80314     51   137  12   9    1    0    1995
64824     36   129  68   22   10   4    1996
92178     189  137  48   21   5    3    1997
93533     23   195  23   21   10   4    1998
93221     6    59   83   8    2    0    1999
82690     35   26   15   8    1    0    2000
77541     64   107  8    5    7    6    2001
77863     29   111  60   1    1    1    2002
76368     5    83   31   9    1    0    2003
```

Table 8.3.1. Cod in VIIa: Catch numbers at age (thousands)

Run title NSWG 20 COMBSE› PLUSGROUP"

At 8/05/2004 20:42

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

YEAR	1968	1969	1970	1971	1972	1973
AGE						
0	0	0	0	0	0	0
1	364	882	1317	2739	789	2263
2	1563	1481	1385	2022	3267	1091
3	1003	1050	352	904	824	1783
4	456	269	204	144	250	430
5	177	186	163	67	58	173
6	28	76	52	39	39	60
+gp	2	37	19	12	20	21
0 TOTAL	3593	3981	3492	5927	5247	5821
TONSL	8541	7991	6426	9246	9234	11819
SOPCC	87	81	94	97	86	91

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

YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	530	1699	1135	816	687	1762	2533	1299	345	814
2	3559	642	3007	511	1092	1288	2797	3635	2284	932
3	557	1407	363	1233	310	608	729	1448	1455	751
4	494	294	500	163	311	127	243	244	557	499
5	131	249	61	218	39	164	49	99	102	154
6	46	95	79	31	47	38	51	23	57	27
+gp	28	22	25	40	18	33	4	24	22	19
0 TOTAL	5345	4408	5170	3012	2504	4020	6406	6772	4822	3196
TONSL	10251	9863	10247	8054	6271	8371	10776	14907	13381	10015
SOPCC	86	93	97	99	113	113	102	108	99	98
1										

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

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	1577	1218	974	4323	2792	582	710	1973	1375	223
2	1195	2105	2248	1793	4734	2163	1075	1408	1243	2907
3	439	703	699	841	702	1886	545	442	664	403
4	240	158	203	252	263	231	372	127	132	119
5	161	84	64	75	71	86	70	98	42	16
6	56	51	33	19	27	21	23	15	46	6
+gp	19	26	32	24	11	16	7	7	3	7
0 TOTAL	3687	4345	4253	7327	8600	4985	2802	4070	3505	3681
TONSL	8383	10483	9852	12894	14168	12751	7379	7095	7735	7555
SOPCC	101	100	100	100	100	100	100	100	100	100

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

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	749	498	318	523	204	70	385	362	325	66
2	569	1283	1113	1149	1926	843	327	1348	834	614
3	848	180	700	501	335	871	201	115	675	156
4	68	163	38	213	80	66	84	25	11	48
5	20	7	39	17	28	21	7	22	2	1
6	9	3	4	12	7	6	2	1	2	0
+gp	1	3	2	5	1	0	0	6	1	0
0 TOTAL	2264	2137	2214	2418	2581	1877	1006	1879	1850	884
TONSL	5402	4587	4964	5859	5310	4784	2179	3598	4431	1811
SOPCC	100	100	100	100	100	100	100	100	100	100

Table 8.3.2. Cod in VIIa: mean weights at age in the international landings (also used as stock weights)

Run title NSWG 20 COMBSE› PLUSGROUP"

At 8/05/2004 20:42

Table 2 Catch weights at age (kg)

	YEAR	1968	1969	1970	1971	1972	1973
	AGE						
	0	0	0	0	0	0	0
	1	0.61	0.61	0.61	0.61	0.61	0.61
	2	1.66	1.66	1.66	1.66	1.66	1.66
	3	3.33	3.33	3.33	3.33	3.33	3.33
	4	5.09	5.09	5.09	5.09	5.09	5.09
	5	6.19	6.19	6.19	6.19	6.19	6.19
	6	6.76	6.76	6.76	6.76	6.76	6.76
	+gp	8.3	8.3	8.3	8.3	8.3	8.3
0	SOPC(	0.8734	0.8126	0.9407	0.9683	0.8622	0.9114

Table 2 Catch weights at age (kg)

	YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
	AGE										
	0	0	0	0	0	0	0	0	0	0	0
	1	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	1.01	0.995
	2	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.524	1.842
	3	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.488	3.988
	4	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.573	5.964
	5	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	7.592	7.966
	6	6.76	6.76	6.76	6.76	6.76	6.76	6.76	6.76	8.697	9.306
	+gp	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	10.18	10.925
0	SOPC(	0.8575	0.9261	0.9706	0.9855	1.1288	1.1267	1.023	1.0757	0.991	0.9835
	1										

Table 2 Catch weights at age (kg)

	YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	AGE										
	0	0	0	0	0	0	0	0	0	0	0
	1	0.679	0.783	0.805	0.713	0.607	0.936	0.842	0.856	0.813	0.847
	2	1.813	2.023	1.825	2.161	1.563	1.846	1.938	1.637	1.964	1.706
	3	3.808	4.244	3.862	3.91	3.756	3.223	3.572	3.542	3.993	3.666
	4	5.865	5.825	5.855	6.41	5.668	5.408	5.277	5.419	5.975	5.675
	5	7.475	7.5	7.391	7.821	8.017	6.571	7.531	6.39	6.923	7.365
	6	9.818	8.81	8.116	9.888	9.749	8.256	8.398	8.507	8.509	9.486
	+gp	10.748	9.504	9.471	10.658	10.208	11.052	12.699	10.397	11.1	10.761
0	SOPC(	1.0132	1.0039	1.0034	1.0002	1.0001	0.9977	0.9971	1.0029	1.0026	1.0005

Table 2 Catch weights at age (kg)

	YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	AGE										
	0	0	0	0	0	0	0	0	0	0	0
	1	0.798	0.9	0.98	0.846	0.925	0.853	0.859	0.952	0.974	1.25
	2	1.923	1.84	1.625	1.937	1.647	1.624	2.003	1.799	1.962	1.64
	3	3.608	4	3.256	3.624	3.729	3.179	3.528	4.097	3.513	2.985
	4	6.08	5.791	5.298	5.291	5.371	5.505	4.977	5.786	5.596	5.223
	5	7.68	8.452	7.721	6.115	7.033	7.517	6.664	7.07	7.789	10.203
	6	8.272	8.712	8.836	8.672	8.833	10.137	8.899	8.027	9.338	10.308
	+gp	11.258	9.56	12.256	11.263	12.155	12.618	7.351	9.352	10.761	13.696
0	SOPC(	0.9996	1	1.0004	1.0002	1.0002	0.9998	1.0001	0.9997	1.0007	0.9995
	1										

Table 8.3.3. Cod in VIIa. (a) Proportion of catch by number discarded by sampled UK(NI) fleets, based on limited observer trips (see Table 8.3.4 for numbers of trips). (b) Information from UK(EW) observer trips in 2003.

(a) UK(NI) fleets

		Proportion discarded			
Fleet	Period	age 0	age 1	age 2	age 3
Midwater trawl	Q2-Q4 1997	no catch	0.40	0.00	0.00
Midwater trawl	Q1-Q3 1998	no catch	0.26	0.00	0.00
Midwater trawl	Q3-Q4 1999	1.00	0.00	0.00	0.00
Midwater trawl	Q1 2000	no catch	0.90	0.00	0.00
Midwater trawl	Q1 2001	no catch	no catch	no catch	no catch
Single Nephrops	Q3-Q4 1999	no catch	0.00	0.00	no catch
Single Nephrops	Q1-Q3 2000	no catch	0.75	0.00	0.00
Single Nephrops	Q1 2001	no catch	no catch	no catch	no catch
Twin trawl	Q2-Q4 1997	1.00	0.94	0.01	0.00
Twin trawl	Q1-Q3 1998	no catch	0.94	0.08	0.00
Twin trawl	Q4 1999	1.00	0.29	0.00	no catch
Twin trawl	Q1 – Q4 2000	1.00	0.78	0.00	0.00
Twin trawl	Q1 2001	no catch	no catch	no catch	no catch

(b) UK(E&W) fleets in 2003

	Q1 2003	Q2 2003	Q3 2003	Q4 2003	Total
No trips	1	4	0	1	9
No hauls	19	37	0	5	61
No. cod caught	548	1415	0	10	1973
No. cod discarded	16	6	0	0	22
% discarded	2.9	0.4		0.0	1.1

Table 8.3.4 Cod in VIIa. Estimates of numbers discarded in 1996 - 2002. Data are numbers ('000 fish) discarded by each fleet, estimated from numbers per sampled trip raised to total fishing effort by each fleet, for the range of quarters indicated. Tables (b) and (d) represent estimates from limited observer sampling of N.Ireland vessels also included within the self-sampling estimates for N.Ireland trawlers catching Nephrops (Table (a)).

(a) Self sampling scheme: N.Ireland single trawl Nephrops vessels. Estimates are extrapolated to all N.Ireland vessels catching Nephrops (single and twin trawl) (approx 40 trips sampled per year).

Age	**1996 Q1-4**	**1997 Q1-4**	**1998 Q1-4**	**1999 Q1-4**	**2000 Q1-4**	**2001 Q1-4**	**2002 Q1-4**
0	56	3	0	70	32	4	0
1	82	63	14	83	397	31	22
2	0	0	0	0	0	0	0

(b) Observer scheme: N.Ireland vessels catching Nephrops (single trawl only)

	1999 Q3-4	**2000 Q1-3**	**2001 Q1**
Age	4 trips	6 trips	1 trip
0	0	0	0
1	0	53	0
2	0	0	0

(c) Observer scheme: N.Ireland midwater trawl ('000 fish)

	1997 Q2-4	**1998 Q1-3**	**1999 Q3-4**	**2000 Q1**	**2001 Q1**
Age			5 trips	4 trips	2 trips
0	0	0	1.6	0	0
1	17	4	0	0.8	0
2	0.5	2	0	0	0

(d) Observer scheme: N.Ireland twin trawl ('000 fish)

	1997 Q2-4	**1998 Q1-3**	**1999 Q4**	**2000 Q1-4**	**2001 Q1**
Age			1 trip	10 trips	2 trips
0	12	0	12	33	0
1	19	38	1	45	0
2	0.2	13	0	0	0

Table 8.5.1.3.1. Cod in VIIa. Summary of the results of different XSA tuning configurations explored. The multifleet run using the same fleets and settings as in last year's assessment is given in bold type throughout. Other model settings changed to examine sensitivity of the XSA results are also shown in bold type.

Fleet	March survey	q plateau	Power model	Shrink SE	plus gp	F(2-4)	F(1)	F(2)	F(3)	F(4)	F(5)	F(6)	SSB(2003)	2001 y.c.
NIGFS Mar XSA	adjusted	4	power	2.5	7	0.943	0.074	0.230	0.865	1.732	2.236	1.634	3288	5356
NIGFS Oct XSA		4	power	2.5	7	0.963	0.080	0.497	0.398	1.993	2.239	1.566	2975	3022
ScoGFS Spr XSA	adjusted	4	power	2.5	7	1.027	0.093	0.225	1.981	1.807	2.259	2.045	3034	5458
UK(EW)BTS XSA		4	power	2.5	7	1.321	0.080	0.473	1.558	1.934	2.249	1.940	2107	3126
NIMIKNET XSA		4	power	2.5	7	1.481	0.043	0.560	1.846	2.036	2.253	2.074	1924	2800
UK trawl (commercial)		4	power	2.5	7	1.583	0.455	0.692	2.039	2.018	2.190	2.103	1766	2465
IR-OTB (commercial)		4	power	2.5	7	0.605	0.223	0.672	0.469	0.673	0.073	0.020	2965	2507
combined surveys	**adjusted**	**4**	**power**	**2.5**	**7**	**0.391**	**0.069**	**0.337**	**0.488**	**0.348**	**2.204**	**1.024**	**3764**	**3977**
combined surveys	adjusted	4	**const q**	2.5	7	0.420	0.089	0.261	0.734	0.265	2.213	1.083	4028	4839
combined surveys	**not adj.**	4	power	2.5	7	0.380	0.064	0.320	0.427	0.393	2.173	1.005	3884	4131
combined surveys	adjusted	**3**	power	2.5	7	0.391	0.069	0.337	0.488	0.348	2.204	1.024	3764	3977
combined surveys	adjusted	4	power	**1.0**	7	1.238	0.073	0.363	1.401	1.950	2.249	1.893	2404	3765
combined surveys	adjusted	4	power	**0.5**	7	1.466	0.078	0.464	1.931	2.001	2.252	2.091	2068	3163
combined surveys	adjusted	4	power	**0.3**	7	1.599	0.101	0.775	2.012	2.010	2.253	2.121	1706	2315
combined surveys	adjusted	4	power	2.5	**6**	0.380	0.069	0.336	0.495	0.307	0.502		3865	3981

Table 8.5.1.3.2. Cod in Division VIIa. TSA parameter settings for TSA runs including or excluding 2003 catch at age data.

Parameter	*Setting*	*Justification*
Age of full selection.	$a_m = 4$	Based on inspection of previous XSA runs.
Multipliers on variance matrices of measurements.	$B_{\text{landings}}(a) = 2$ for ages 7+ $B_{\text{survey}}(a) = 2$ for age 4	Allows extra measurement variability for poorly-sampled ages.
Multipliers on variances for fishing mortality estimates.	$H(1) = 2$	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points (implemented by multiplying the relevant q by 3)	not implemented	
Discards	No discards included	
Recruitment.	Modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean $\eta_1 S \exp(-\eta_2 S)$, where S is the spawning stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	
Large year classes.	The 1986 year class was large, and recruitment at age 1 in 1987 is not well modelled by the Ricker recruitment model. Instead, $N(1, 1987)$ is taken to be normally distributed with mean $5\eta_1 S \exp(-\eta_2 S)$. The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966-1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The coefficient of variation is assumed to be constant.	

Table 8.5.1.3.3. Cod in Division VIIa. TSA parameter estimates for run including and excluding the 2003 catch at age data.

Parameter	Notation	Description	Including 2003 catch		Excluding 2003 catch	
Initial fishing mortality	F (1, 1968)	Fishing mortality at age a in year y	0.12		0.12	
	F (2, 1968)		0.43		0.44	
	F (4, 1968)		0.38		0.40	
			NIGFS	ScoGFS	NIGFS	ScoGFS
Survey selectivities	Φ(1)	Survey selectivity at age a	0.25	0.66	0.24	0.61
	Φ(2)		0.32	2.78	0.30	2.52
	Φ(4)		0.09	8.80	0.09	8.36
Fishing mortality standard deviations	σ_F	Transitory changes in overall fishing mortality	0.15		0.16	
	σ_U	Persistent changes in selection (age effect in F)	0.03		0.03	
	σ_V	Transitory changes in the year effect in fishing mortality	0.14		0.14	
	σ_Y	Persistent changes in the year effect in fishing mortality	0.13		0.11	
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.33	0.14	0.27	0.10
	σ_β	Persistent changes in survey catchability	0.00	0.00	0.00	0.00
Measurement standard deviations	$\sigma_{landings}$	Standard error of landings-at-age data	0.22		0.21	
	σ_{survey}	Standard error of survey data	0.42	0.36	0.39	0.36
Recruitment	η_1	Ricker parameter (slope at the origin)	1.150		1.335	
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.086		0.095	
	cv_{rec}	Standard error of recruitment data	0.51		0.52	

Table 8.5.1.4.1. Cod in VIIa. Diagnostics of final XSA run.

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Extended Survivors Analysis

"IRISH SEA COD, NSWG 2004, COMBSEX,PLUSGROUP"

CPUE data from file Cod7tun final.DAT

Catch data for 36 years. 1968 to 2003. Ages 0 to 7.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
BTS-Sept ,	1988,	2003,	0,	0,	.750,	.790
NIGFSOCT(0 2-gp) ,	1992,	2003,	0,	2,	.830,	.880
NIGFSMAR(0-3gp shift,	1991,	2003,	0,	3,	.960,	1.000
NIMIKNET ,	1994,	2003,	0,	0,	.380,	.460
ScoGFS-Spring Survey,	1995,	2003,	0,	3,	.950,	1.000

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 1

Regression type = C
Minimum of 5 points used for regression
Survivor estimates not shrunk to the population mean

Catchability independent of age for ages >= 4

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 = 2.500

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

Prior weighting not applied

Tuning had not converged after 70 iterations

Total absolute residual between iterations
69 and 70 = .00602

Final year F values

Age ,	0,	1,	2,	3,	4,	5,	6
Iteration 69,	.0000,	.0687,	.3364,	.4912,	.3473,	2.2039,	1.0253
Iteration 70,	.0000,	.0686,	.3368,	.4877,	.3477,	2.2037,	1.0239

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,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003
0,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000
1,	.218,	.196,	.145,	.127,	.138,	.111,	.123,	.202,	.117,	.069
2,	1.012,	.711,	.892,	1.164,	.940,	1.373,	1.126,	.816,	.990,	.337
3,	1.383,	1.130,	1.172,	1.565,	1.534,	1.974,	1.937,	2.225,	1.475,	.488
4,	1.530,	1.208,	.786,	1.752,	1.336,	2.046,	1.324,	2.382,	2.809,	.348
5,	1.494,	.607,	1.147,	.991,	1.455,	2.388,	2.459,	2.076,	2.395,	2.204
6,	1.488,	1.003,	1.023,	1.507,	1.690,	2.192,	1.930,	2.252,	2.252,	1.024

Table 8.5.1.4.1. contd.

1

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6
1994	3.78E+03	4.23E+03	9.88E+02	1.25E+03	9.59E+01	2.85E+01	1.28E+01
1995	3.18E+03	3.10E+03	2.79E+03	2.94E+02	2.57E+02	1.70E+01	5.24E+00
1996	5.92E+03	2.61E+03	2.08E+03	1.12E+03	7.77E+01	6.28E+01	7.59E+00
1997	2.14E+03	4.85E+03	1.85E+03	7.00E+02	2.84E+02	2.90E+01	1.63E+01
1998	8.93E+02	1.75E+03	3.49E+03	4.72E+02	1.20E+02	4.04E+01	8.81E+00
1999	4.50E+03	7.31E+02	1.25E+03	1.12E+03	8.34E+01	2.58E+01	7.71E+00
2000	2.68E+03	3.69E+03	5.36E+02	2.59E+02	1.27E+02	8.82E+00	1.94E+00
2001	3.98E+03	2.19E+03	2.67E+03	1.42E+02	3.06E+01	2.77E+01	6.18E-01
2002	1.34E+03	3.26E+03	1.47E+03	9.67E+02	1.26E+01	2.31E+00	2.84E+00
2003	2.03E+03	1.10E+03	2.37E+03	4.46E+02	1.81E+02	6.21E-01	1.72E-01

Estimated population abundance at 1st Jan 2004

0.00E+00	1.66E+03	8.40E+02	1.39E+03	2.26E+02	1.05E+02	5.62E-02

Taper weighted geometric mean of the VPA populations:

5.24E+03	4.39E+03	2.97E+03	1.09E+03	3.12E+02	9.18E+01	3.06E+01

Standard error of the weighted Log(VPA populations) :

.6961	.6773	.6075	.7097	1.0064	1.4796	1.6388

1

Log catchability residuals.

Fleet : BTS-Sept

Age	1988	1989	1990	1991	1992	1993
0	-.33	-.67	.91	-.24	.06	-.13
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					

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	.01	.39	-.46	.58	-.47	.32	.51	-.20	.02	-.30
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									

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	.71	1.511	5.73	.66	16	.45	-4.76

1

Fleet : NIGFSOCT(0 2-gp)

Age	1988	1989	1990	1991	1992	1993
0	99.99	99.99	99.99	99.99	-.51	-.37
1	99.99	99.99	99.99	99.99	-.19	.69
2	99.99	99.99	99.99	99.99	.19	.46
3	No data for this fleet at this age					

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	.37	.11	-.21	.22	-.03	.20	.25	-.08	-.03	.08
1	.75	.72	-.06	.31	.08	-.94	-.90	.20	-.30	-.36
2	.16	-.86	.00	1.02	.71	.48	-1.66	.48	.16	-1.15
3	No data for this fleet at this age									

Table 8.5.1.4.1. contd.

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,	-1.3256,	-2.7990,
S.E(Log q),	.5776,	.8036,

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,	.46,	3.688,	5.01,	.83,	12,	.28,	-1.65,

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,	.81,	.902,	2.59,	.68,	12,	.47,	-1.33,
2,	.64,	1.452,	4.52,	.62,	12,	.49,	-2.80,

1

Fleet : NIGFSMAR(0-3gp shift

Age ,	1988,	1989,	1990,	1991,	1992,	1993
0 ,	99.99,	99.99,	99.99,	-.03,	-.09,	.21
1 ,	99.99,	99.99,	99.99,	.22,	-.34,	-.55
2 ,	99.99,	99.99,	99.99,	.50,	-.47,	-.29
3 ,	99.99,	99.99,	99.99,	.47,	-.34,	.21

Age ,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003
0 ,	.12,	.56,	-.49,	-.16,	-.02,	-.12,	.14,	.03,	-.18,	.04
1 ,	-.33,	-.20,	.16,	.13,	.05,	-.02,	.09,	-.11,	.86,	.06
2 ,	-.63,	-.24,	-.29,	-.06,	.53,	.05,	-.01,	1.00,	.60,	-.68
3 ,	-.68,	-1.87,	-.13,	.17,	.76,	1.11,	.84,	99.99,	.77,	-1.31

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

Age ,	1,	2,	3
Mean Log q,	-1.6526,	-2.0809,	-2.5065,
S.E(Log q),	.3448,	.5154,	.9153,

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,	.59,	3.547,	4.35,	.87,	13,	.25,	-1.85,

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
1,	.97,	.217,	1.86,	.79,	13,	.35,	-1.65,
2,	.88,	.491,	2.72,	.62,	13,	.47,	-2.08,
3,	.71,	.780,	3.67,	.41,	12,	.66,	-2.51,

1

Fleet : NIMIKNET

Age ,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003
0 ,	.38,	-.18,	-.02,	.15,	-.37,	-.07,	-.05,	-.29,	.44,	.01
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									

Table 8.5.1.4.1. contd.

```
 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,     .34,    4.088,      7.19,     .83,     10,     .28,   -5.87,
1

 Fleet : ScoGFS-Spring Survey

  Age  ,  1994,  1995,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003
     0 , 99.99, -1.96,   .05,  -.88,   .43,  1.44,  1.17,  -.24,   .20,  -.21
     1 , 99.99,  -.17,  -.11,   .28,   .41,  -.45,   .18,  -.36,   .51,  -.29
     2 , 99.99,   .14,  -.47,   .51,   .89,   .20, -1.59,   .11,   .16,   .05
     3 , 99.99,   .28,  -.40,  -.50,   .96,   .60,  -.75,   .13,  -.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 ,         1,         2,         3
 Mean Log q,   -4.0516,   -3.4017,   -2.7222,
 S.E(Log q),     .3515,     .6972,     .5918,


 Regression statistics :

 Ages with q dependent on year class strength

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

  0,    1.32,    -.499,      4.40,     .26,      9,    1.09,   -5.24,

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

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

  1,     .74,    2.033,      5.01,     .90,      9,     .22,   -4.05,
  2,     .51,    3.383,      5.43,     .87,      9,     .23,   -3.40,
  3,    1.02,    -.071,      2.64,     .62,      8,     .65,   -2.72,
1



 Terminal year survivor and F summaries :

 Age  0   Catchability dependent on age and year class strength

 Year class = 2003

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 BTS-Sept             ,      1228.,   .482,       .000,    .00,   1,  .112,     .000
 NIGFSOCT(0 2-gp)     ,      1796.,   .300,       .000,    .00,   1,  .290,     .000
 NIGFSMAR(0-3gp shift,      1734.,   .300,       .000,    .00,   1,  .290,     .000
 NIMIKNET             ,      1669.,   .300,       .000,    .00,   1,  .290,     .000
 ScoGFS-Spring Survey,      1344.,  1.163,       .000,    .00,   1,  .019,     .000

   P shrinkage mean  ,      4390.,    .68,,,,                          .000,     .000

   F shrinkage mean  ,         0.,   2.50,,,,                          .000,     .000

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1659.,       .16,      .06,    5,    .359,   .000
```

Table 8.5.1.4.1. contd.

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

Year class = 2002

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BTS-Sept ,	854.,	.486,	.000,	.00,	1,	.076,	.068
NIGFSOCT(0 2-gp) ,	763.,	.271,	.136,	.50,	2,	.243,	.075
NIGFSMAR(0-3gp shift,	774.,	.230,	.120,	.52,	2,	.337,	.074
NIMIKNET ,	1303.,	.300,	.000,	.00,	1,	.198,	.045
ScoGFS-Spring Survey,	657.,	.353,	.142,	.40,	2,	.143,	.087
F shrinkage mean ,	401.,	2.50,,,,				.003,	.139

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
840.,	.13,	.09,	9,	.676,	.069

1

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

Year class = 2001

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BTS-Sept ,	1141.,	.466,	.000,	.00,	1,	.071,	.397
NIGFSOCT(0 2-gp) ,	1103.,	.256,	.229,	.89,	3,	.240,	.408
NIGFSMAR(0-3gp shift,	1681.,	.211,	.383,	1.81,	3,	.355,	.285
NIMIKNET ,	1039.,	.300,	.000,	.00,	1,	.173,	.428
ScoGFS-Spring Survey,	1980.,	.318,	.177,	.56,	3,	.157,	.247
F shrinkage mean ,	294.,	2.50,,,,				.004,	1.061

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1386.,	.13,	.14,	12,	1.104,	.337

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

Year class = 2000

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BTS-Sept ,	373.,	.469,	.000,	.00,	1,	.066,	.321
NIGFSOCT(0 2-gp) ,	282.,	.256,	.020,	.08,	3,	.226,	.405
NIGFSMAR(0-3gp shift,	212.,	.224,	.315,	1.41,	4,	.388,	.510
NIMIKNET ,	213.,	.300,	.000,	.00,	1,	.161,	.507
ScoGFS-Spring Survey,	194.,	.320,	.289,	.90,	3,	.148,	.545
F shrinkage mean ,	26.,	2.50,,,,				.012,	1.855

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
226.,	.13,	.14,	13,	1.056,	.488

1

Table 8.5.1.4.1. contd.

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

Year class = 1999

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BTS-Sept ,	144.,	.477,	.000,	.00,	1,	.058,	.264
NIGFSOCT(0 2-gp) ,	108.,	.258,	.316,	1.23,	3,	.203,	.338
NIGFSMAR(0-3gp shift,	129.,	.215,	.247,	1.15,	4,	.340,	.290
NIMIKNET ,	98.,	.300,	.000,	.00,	1,	.147,	.368
ScoGFS-Spring Survey,	106.,	.315,	.206,	.66,	4,	.218,	.343
F shrinkage mean ,	7.,	2.50,,,,				.034,	2.007

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
105.,	.15,	.18,	14,	1.187,	.348

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1998

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BTS-Sept ,	0.,	.541,	.000,	.00,	1,	.004,	.000
NIGFSOCT(0 2-gp) ,	0.,	.271,	.409,	1.51,	3,	.017,	.000
NIGFSMAR(0-3gp shift,	0.,	.211,	.002,	.01,	3,	.027,	.000
NIMIKNET ,	0.,	.362,	.000,	.00,	1,	.009,	.000
ScoGFS-Spring Survey,	0.,	.338,	.314,	.93,	4,	.023,	.000
F shrinkage mean ,	0.,	2.50,,,,				.920,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
0.,	2.30,	.08,	13,	.034,	2.204

1

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BTS-Sept ,	0.,	.467,	.000,	.00,	1,	.003,	.000
NIGFSOCT(0 2-gp) ,	0.,	.256,	.073,	.29,	3,	.009,	.000
NIGFSMAR(0-3gp shift,	0.,	.243,	.203,	.84,	4,	.016,	.000
NIMIKNET ,	0.,	.300,	.000,	.00,	1,	.006,	.000
ScoGFS-Spring Survey,	0.,	.366,	.323,	.88,	4,	.012,	.000
F shrinkage mean ,	0.,	2.50,,,,				.954,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
0.,	2.38,	.03,	14,	.013,	1.024

1

Table. 8.5.1.4.2. Cod in VIIa: Fishing mortality at age from final XSA

Run title : "IRIS NSWG 20(COMBSEX PLUSGROUP" At 11/05/2004 9:11

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR		1968	1969	1970	1971	1972	1973
AGE							
	0	0	0	0	0	0	0
	1	0.1141	0.1928	0.2256	0.2785	0.235	0.2455
	2	0.5936	0.918	0.5239	0.6434	0.631	0.5932
	3	0.8622	1.0939	0.5739	0.7962	0.5968	0.8824
	4	0.7903	0.5947	0.6372	0.49	0.5295	0.7347
	5	0.7485	0.9158	0.9195	0.4424	0.3726	0.8916
	6	0.8085	0.8774	0.717	0.5811	0.5035	0.845
+gp		0.8085	0.8774	0.717	0.5811	0.5035	0.845
0 FBAR 2- 4		0.7487	0.8688	0.5783	0.6432	0.5858	0.7367

Table 8 Fishing mortality (F) at age

YEAR		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE											
	0	0	0	0	0	0	0	0	0	0	0
	1	0.2457	0.2257	0.5513	0.2303	0.1813	0.219	0.2716	0.2448	0.1394	0.2292
	2	0.7644	0.531	0.7927	0.5184	0.5503	0.6073	0.6438	0.792	0.9058	0.6806
	3	0.703	0.8079	0.6615	0.9306	0.6998	0.6912	0.8616	0.8474	0.8929	0.8962
	4	0.6528	1.0714	0.7757	0.7221	0.641	0.7074	0.666	0.8182	0.9849	0.9266
	5	0.517	0.8369	0.6664	0.9787	0.3702	0.8643	0.6631	0.6367	1.0403	0.8358
	6	0.6298	0.9152	0.7079	0.8865	0.5752	0.7617	0.7373	0.7751	0.9836	0.8958
+gp		0.6298	0.9152	0.7079	0.8865	0.5752	0.7617	0.7373	0.7751	0.9836	0.8958
0 FBAR 2- 4		0.7067	0.8035	0.7433	0.7237	0.6304	0.6686	0.7238	0.8192	0.9278	0.8345
	1										

Table 8 Fishing mortality (F) at age

YEAR		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE											
	0	0	0	0	0	0	0	0	0	0	0
	1	0.3116	0.2278	0.2241	0.3702	0.5506	0.2273	0.2134	0.6239	0.233	0.1859
	2	0.6198	0.9065	0.8596	0.8322	0.9144	1.1869	0.8577	0.8585	1.0984	1.1323
	3	0.8233	0.9594	0.9127	0.974	0.9699	1.3006	1.2065	1.1451	1.5287	1.5689
	4	0.835	0.8251	0.839	1.0686	0.9935	1.0737	1.0318	1.0981	1.5214	1.5641
	5	0.9196	0.8159	1.006	0.8989	1.0721	1.1369	1.248	0.8702	1.6464	0.7547
	6	0.8684	0.876	0.9293	0.9916	1.0234	1.1847	1.1762	1.0498	1.5866	1.3123
+gp		0.8684	0.876	0.9293	0.9916	1.0234	1.1847	1.1762	1.0498	1.5866	1.3123
0 FBAR 2- 4		0.7593	0.897	0.8704	0.9583	0.9593	1.1871	1.032	1.0339	1.3829	1.4217

Table 8 Fishing mortality (F) at age

YEAR		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	FBAR '
AGE												
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0.2177	0.1957	0.1447	0.1271	0.1382	0.1112	0.1225	0.2015	0.1168	0.0686	0.129
	2	1.0123	0.7108	0.8917	1.1636	0.9396	1.3725	1.1258	0.8164	0.9904	0.3368	0.7145
	3	1.3831	1.1298	1.1725	1.5646	1.5339	1.9744	1.9367	2.2251	1.4754	0.4877	1.396
	4	1.5299	1.2083	0.7863	1.7515	1.3356	2.0462	1.3243	2.3823	2.8086	0.3477	1.8462
	5	1.4942	0.6067	1.1474	0.9914	1.455	2.3879	2.4592	2.0764	2.395	2.2037	2.225
	6	1.4883	1.0028	1.0232	1.5067	1.6902	2.1917	1.9295	2.2519	2.2517	1.0239	1.8425
+gp		1.4883	1.0028	1.0232	1.5067	1.6902	2.1917	1.9295	2.2519	2.2517	1.0239	
0 FBAR 2- 4		1.3084	1.0163	0.9502	1.4932	1.2697	1.7977	1.4623	1.8079	1.7581	0.3907	

Table. 8.5.1.4.3. Cod in VIIa: Stock numbers at age from final XSA

Run title : "IRIS NSWG 20(COMBSEX PLUSGROUP" At 11/05/2004 9:11

Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR	1968	1969	1970	1971	1972	1973
	AGE						
	0	6790	8803	15209	5085	14035	3285
	1	3730	5559	7208	12452	4163	11491
	2	3858	2725	3754	4709	7716	2695
	3	1919	1745	891	1820	2026	3361
	4	923	663	478	411	672	913
	5	371	343	300	207	206	324
	6	56	144	112	98	109	116
	+gp	4	69	40	30	55	40
0	TOTAL	17651	20051	27991	24812	28983	22225

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

	YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
	AGE										
	0	11350	3615	5355	5593	12093	14374	8074	3578	5364	7951
	1	2689	9293	2960	4385	4579	9901	11768	6611	2929	4392
	2	7360	1722	6071	1396	2852	3127	6512	7343	4237	2086
	3	1219	2806	829	2250	681	1347	1395	2800	2723	1402
	4	1139	494	1024	350	726	277	552	483	983	913
	5	359	485	139	386	139	313	112	232	174	300
	6	109	175	172	58	119	79	108	47	101	50
	+gp	65	40	54	74	45	67	8	48	38	35
0	TOTAL	24291	18630	16604	14492	21233	29485	28530	21143	16549	17130

1

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

	YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	AGE										
	0	8071	6548	18860	8901	3863	4987	5738	8928	1775	5169
	1	6510	6608	5361	15441	7288	3163	4083	4698	7310	1453
	2	2859	3903	4308	3508	8731	3440	2063	2701	2061	4741
	3	865	1259	1291	1493	1250	2865	860	716	937	563
	4	469	311	395	424	462	388	639	211	187	166
	5	296	166	112	140	119	140	109	186	57	33
	6	107	97	60	33	47	33	37	26	64	9
	+gp	36	48	57	41	19	25	11	12	4	10
0	TOTAL	19212	18940	30444	29982	21777	15041	13538	17477	12394	12144

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

	YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	AGE											
	0	3782	3183	5919	2137	893	4504	2677	3977	1341	2025	0
	1	4232	3096	2606	4846	1750	731	3687	2192	3256	1098	1659
	2	988	2787	2084	1846	3494	1248	536	2671	1467	2372	840
	3	1251	294	1121	700	472	1118	259	142	967	446	1386
	4	96	257	78	284	120	83	127	31	13	181	226
	5	28	17	63	29	40	26	9	28	2	1	105
	6	13	5	8	16	9	8	2	1	3	0	0
	+gp	1	5	3	6	2	0	1	7	1	0	0
0	TOTAL	10391	9645	11881	9865	6780	7718	7298	9048	7050	6124	4215

1

AGE	GMST 68-**	AMST 68-**
0		
1	5611	6778
2	4613	5564
3	3048	3592
4	1118	1373
5	349	463
6	119	176
+gp	38	65

Table. 8.5.1.4.4. Cod in VIIa: Stock numbers at age from final XSA

Run title : "IRIS NSWG 20(COMBSE› PLUSGROUP"

At 11/05/2004 9:11

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RE(Age 0	TOTALB	TOTSPB	LANDIN(	YIELD/S!	FBAR 2- 4
1968	6790	22473	16226	8541	0.5264	0.7487
1969	8803	20766	14570	7991	0.5485	0.8688
1970	15209	18979	10719	6426	0.5995	0.5783
1971	5085	25755	13313	9246	0.6945	0.6432
1972	14035	27988	17507	9234	0.5275	0.5858
1973	3285	30449	20667	11819	0.5719	0.7367
1974	11350	27213	17998	10251	0.5696	0.7067
1975	3615	24905	17464	9863	0.5648	0.8035
1976	5355	22324	14270	10247	0.7181	0.7433
1977	5593	17664	13553	8054	0.5943	0.7237
1978	12093	15529	9801	6271	0.6399	0.6304
1979	14374	20155	10897	8371	0.7682	0.6686
1980	8074	26936	13056	10776	0.8254	0.7238
1981	3578	30163	18573	14907	0.8026	0.8192
1982	5364	26976	20014	13381	0.6686	0.9278
1983	7951	22493	15741	10015	0.6362	0.8345
1984	8071	19286	11652	8383	0.7194	0.7593
1985	6548	22785	12716	10483	0.8244	0.897
1986	18860	21333	12143	9852	0.8113	0.8704
1987	8901	29012	13303	12894	0.9693	0.9583
1988	3863	26980	14096	14168	1.0051	0.9593
1989	4987	22113	15214	12751	0.8381	1.1871
1990	5738	15142	9225	7379	0.7999	1.032
1991	8928	13650	6888	7095	1.03	1.0339
1992	1775	15834	7382	7735	1.0479	1.3829
1993	5169	12768	6523	7555	1.1583	1.4217
1994	3782	10714	6159	5402	0.8771	1.3084
1995	3183	10817	4850	4587	0.9457	1.0163
1996	5919	10603	5949	4964	0.8345	0.9502
1997	2137	12104	5787	5859	1.0125	1.4932
1998	893	10159	4972	5310	1.068	1.2697
1999	4504	6939	5060	4784	0.9455	1.7977
2000	2677	5866	2033	2179	1.0717	1.4623
2001	3977	7916	2851	3598	1.2622	1.8079
2002	1341	9571	4615	4431	0.9602	1.7581
2003	2025	7549	3764	1811	0.4811	0.3907
Arith. Mean	6495	18664	11099	8239	0.8033	0.9861
0 Units	(Thousan	(Tonnes)	(Tonnes)	(Tonnes)		

1

Table 8.5.1.4.5. Cod in VIIa: TSA estimates of fishing mortality at age

	age 1	age 2	age 3	age 4	age 5	age 6	age 7+
1968	0.138	0.630	0.692	0.630	0.629	0.538	0.586
1969	0.262	0.830	0.908	0.644	0.718	0.727	0.792
1970	0.253	0.601	0.657	0.634	0.730	0.663	0.639
1971	0.325	0.614	0.713	0.546	0.568	0.594	0.602
1972	0.213	0.549	0.541	0.507	0.421	0.554	0.531
1973	0.243	0.674	0.877	0.764	0.871	0.933	0.760
1974	0.236	0.672	0.672	0.681	0.615	0.685	0.692
1975	0.229	0.656	0.827	0.940	0.852	0.914	0.805
1976	0.375	0.731	0.688	0.772	0.731	0.770	0.753
1977	0.237	0.695	0.867	0.728	0.875	0.804	0.798
1978	0.192	0.548	0.670	0.644	0.534	0.636	0.629
1979	0.207	0.642	0.725	0.737	0.806	0.886	0.784
1980	0.264	0.604	0.779	0.663	0.679	0.712	0.675
1981	0.232	0.708	0.775	0.749	0.646	0.746	0.720
1982	0.223	0.872	0.947	0.947	0.941	1.001	0.920
1983	0.226	0.696	0.865	0.840	0.807	0.790	0.805
1984	0.318	0.675	0.837	0.824	0.840	0.822	0.824
1985	0.230	0.834	0.916	0.830	0.835	0.832	0.848
1986	0.235	0.826	0.978	0.864	0.937	0.902	0.904
1987	0.312	0.829	0.998	1.003	0.921	0.950	0.963
1988	0.605	0.904	1.047	1.010	1.048	1.020	1.013
1989	0.277	1.075	1.217	1.150	1.162	1.157	1.185
1990	0.237	0.865	1.158	0.993	1.140	1.094	1.053
1991	0.530	0.880	1.125	1.078	0.985	1.130	1.099
1992	0.264	1.128	1.516	1.246	1.370	1.390	1.254
1993	0.275	1.087	1.348	1.210	1.007	1.146	1.158
1994	0.242	0.992	1.413	1.166	1.176	1.155	1.101
1995	0.241	0.757	1.088	1.061	0.838	0.909	0.935
1996	0.205	0.834	1.140	0.784	1.014	0.812	0.848
1997	0.167	1.079	1.454	1.380	0.994	1.247	1.280
1998	0.237	0.817	1.484	1.048	1.086	1.230	1.074
1999	0.256	1.236	1.640	1.317	1.084	1.058	1.105
2000	0.160	0.938	1.415	1.014	1.016	0.797	0.890
2001	0.238	0.894	1.654	1.169	1.155	1.080	1.234
2002	0.165	0.954	1.388	1.056	0.983	0.993	0.996
2003	0.172	0.528	0.937	0.669	0.678	0.690	0.688
2004	0.186	0.716	1.104	0.825	0.819	0.819	0.819
2005	0.185	0.716	1.116	0.820	0.820	0.820	0.820

Table 8.5.1.4.6. Cod in VIIa: TSA standard errors of estimates of log fishing mortality at age

	age 1	age 2	age 3	age 4	age 5	age 6	age 7+
1968	0.195	0.139	0.137	0.139	0.151	0.173	0.186
1969	0.187	0.114	0.124	0.144	0.143	0.158	0.175
1970	0.185	0.139	0.138	0.136	0.141	0.159	0.172
1971	0.172	0.132	0.123	0.136	0.144	0.157	0.174
1972	0.188	0.133	0.133	0.141	0.151	0.174	0.180
1973	0.179	0.132	0.117	0.125	0.139	0.165	0.173
1974	0.186	0.124	0.128	0.135	0.146	0.165	0.175
1975	0.185	0.138	0.124	0.120	0.137	0.161	0.173
1976	0.171	0.120	0.126	0.130	0.142	0.158	0.172
1977	0.185	0.142	0.123	0.128	0.140	0.170	0.172
1978	0.189	0.138	0.138	0.138	0.148	0.161	0.176
1979	0.187	0.133	0.127	0.130	0.137	0.168	0.171
1980	0.176	0.125	0.122	0.127	0.135	0.154	0.171
1981	0.186	0.123	0.119	0.129	0.138	0.171	0.171
1982	0.190	0.121	0.122	0.123	0.142	0.164	0.173
1983	0.186	0.132	0.130	0.130	0.140	0.162	0.173
1984	0.178	0.133	0.128	0.132	0.137	0.158	0.174
1985	0.187	0.126	0.119	0.127	0.137	0.160	0.172
1986	0.188	0.123	0.126	0.127	0.138	0.164	0.170
1987	0.181	0.126	0.124	0.124	0.136	0.164	0.169
1988	0.149	0.134	0.122	0.125	0.133	0.157	0.170
1989	0.188	0.126	0.116	0.120	0.134	0.164	0.172
1990	0.189	0.131	0.132	0.129	0.134	0.158	0.172
1991	0.158	0.123	0.122	0.137	0.136	0.158	0.171
1992	0.194	0.134	0.106	0.110	0.132	0.149	0.171
1993	0.191	0.119	0.132	0.128	0.140	0.161	0.167
1994	0.187	0.131	0.115	0.127	0.135	0.158	0.171
1995	0.188	0.129	0.118	0.123	0.142	0.160	0.171
1996	0.192	0.127	0.111	0.125	0.130	0.165	0.173
1997	0.190	0.111	0.100	0.104	0.123	0.150	0.170
1998	0.193	0.115	0.108	0.119	0.130	0.163	0.169
1999	0.193	0.115	0.102	0.120	0.131	0.155	0.172
2000	0.196	0.142	0.129	0.137	0.148	0.163	0.176
2001	0.191	0.137	0.127	0.141	0.142	0.173	0.178
2002	0.199	0.146	0.147	0.161	0.164	0.172	0.193
2003	0.208	0.195	0.205	0.219	0.231	0.234	0.235
2004	0.395	0.288	0.287	0.290	0.291	0.291	0.291
2005	0.418	0.320	0.322	0.322	0.322	0.322	0.322

Table 8.5.1.4.7. Cod in VIIa: TSA estimates of stock numbers at age (millions of fish).

	age 1	age 2	age 3	age 4	age 5	age 6	age 7+
1968	3.870	3.594	1.913	0.705	0.279	0.083	0.004
1969	6.163	2.767	1.484	0.651	0.224	0.090	0.041
1970	7.354	3.889	0.989	0.472	0.281	0.064	0.034
1971	12.220	4.677	1.724	0.419	0.200	0.100	0.029
1972	4.483	7.211	1.980	0.651	0.187	0.089	0.059
1973	10.546	2.965	3.351	0.896	0.313	0.095	0.070
1974	3.078	6.631	1.188	1.137	0.340	0.107	0.058
1975	8.617	1.992	2.748	0.485	0.471	0.150	0.068
1976	3.162	5.526	0.824	0.984	0.153	0.162	0.073
1977	4.561	1.722	2.157	0.325	0.370	0.060	0.090
1978	4.676	2.945	0.695	0.736	0.128	0.124	0.054
1979	9.361	3.151	1.379	0.291	0.316	0.059	0.077
1980	10.975	6.148	1.345	0.543	0.114	0.115	0.049
1981	6.398	6.826	2.577	0.483	0.210	0.044	0.063
1982	3.194	4.121	2.732	0.953	0.185	0.087	0.041
1983	4.499	2.091	1.390	0.855	0.297	0.058	0.039
1984	6.351	2.935	0.854	0.471	0.297	0.107	0.035
1985	6.439	3.785	1.201	0.300	0.169	0.105	0.051
1986	5.381	4.158	1.340	0.393	0.107	0.060	0.055
1987	15.696	3.471	1.490	0.408	0.135	0.034	0.038
1988	8.415	9.239	1.242	0.448	0.118	0.044	0.022
1989	3.501	3.718	3.046	0.351	0.132	0.034	0.020
1990	4.294	2.174	0.929	0.703	0.087	0.032	0.013
1991	4.787	2.765	0.752	0.200	0.205	0.020	0.011
1992	6.534	2.207	0.922	0.199	0.056	0.062	0.008
1993	1.516	4.110	0.512	0.135	0.043	0.008	0.012
1994	4.447	0.942	1.129	0.097	0.028	0.013	0.005
1995	2.994	2.857	0.286	0.220	0.024	0.007	0.005
1996	2.716	1.929	1.045	0.076	0.063	0.008	0.004
1997	4.985	1.802	0.680	0.273	0.028	0.019	0.004
1998	1.812	3.354	0.501	0.130	0.055	0.008	0.005
1999	0.625	1.165	1.203	0.088	0.037	0.015	0.003
2000	4.194	0.376	0.238	0.134	0.009	0.010	0.005
2001	1.956	2.919	0.108	0.030	0.028	0.001	0.005
2002	2.952	1.231	0.979	0.012	0.003	0.003	0.001
2003	0.893	2.040	0.375	0.187	0.003	0.001	0.001
2004	1.700	0.614	0.985	0.119	0.078	0.001	0.001
2005	3.836	1.156	0.246	0.267	0.043	0.028	0.001

Table 8.5.1.4.8. Cod in VIIa: TSA standard errors of estimates of stock numbers at age (millions of fish).

	age 1	age 2	age 3	age 4	age 5	age 6	age 7+
1968	0.379	0.383	0.237	0.152	0.088	0.022	0.003
1969	0.488	0.293	0.202	0.107	0.086	0.056	0.015
1970	0.647	0.405	0.100	0.058	0.052	0.046	0.035
1971	0.867	0.499	0.170	0.039	0.028	0.030	0.031
1972	0.460	0.697	0.174	0.057	0.017	0.012	0.018
1973	0.788	0.312	0.308	0.075	0.032	0.010	0.013
1974	0.315	0.573	0.110	0.123	0.039	0.018	0.011
1975	0.697	0.207	0.267	0.048	0.061	0.021	0.014
1976	0.381	0.507	0.076	0.112	0.023	0.032	0.017
1977	0.443	0.234	0.213	0.029	0.046	0.010	0.019
1978	0.464	0.301	0.088	0.093	0.014	0.025	0.013
1979	0.733	0.326	0.135	0.033	0.041	0.007	0.016
1980	0.819	0.546	0.143	0.055	0.014	0.021	0.011
1981	0.587	0.611	0.216	0.047	0.019	0.005	0.010
1982	0.335	0.401	0.270	0.093	0.021	0.010	0.006
1983	0.431	0.226	0.179	0.116	0.046	0.013	0.009
1984	0.614	0.310	0.099	0.066	0.047	0.022	0.009
1985	0.602	0.445	0.123	0.034	0.023	0.019	0.012
1986	0.535	0.422	0.173	0.046	0.014	0.010	0.011
1987	1.979	0.372	0.175	0.059	0.018	0.007	0.008
1988	0.727	1.308	0.151	0.062	0.021	0.008	0.006
1989	0.389	0.498	0.349	0.040	0.017	0.006	0.004
1990	0.436	0.253	0.161	0.107	0.017	0.008	0.004
1991	0.548	0.299	0.094	0.041	0.032	0.007	0.005
1992	0.585	0.327	0.094	0.023	0.010	0.009	0.003
1993	0.213	0.459	0.095	0.031	0.008	0.004	0.005
1994	0.444	0.129	0.156	0.018	0.007	0.002	0.002
1995	0.335	0.307	0.035	0.037	0.003	0.002	0.001
1996	0.273	0.216	0.092	0.008	0.009	0.001	0.001
1997	0.364	0.182	0.072	0.033	0.003	0.003	0.001
1998	0.182	0.246	0.057	0.016	0.009	0.001	0.002
1999	0.112	0.113	0.112	0.016	0.005	0.003	0.001
2000	0.439	0.071	0.046	0.036	0.005	0.002	0.002
2001	0.272	0.340	0.023	0.009	0.010	0.002	0.001
2002	0.313	0.205	0.138	0.004	0.002	0.003	0.001
2003	0.303	0.231	0.080	0.057	0.002	0.001	0.001
2004	0.808	0.217	0.167	0.041	0.032	0.001	0.001
2005	1.983	0.556	0.098	0.097	0.019	0.015	0.001

Table 8.5.1.4.9. Cod in VIIa: TSA stock summary table. Numbers of fish in millions; weights in thousands of tonnes.

year	landings			mean F		SSB		Total biomass		recruits; age 1	
	actual[1]	predicted	se	estimate	se	estimate	se	estimate	se	estimate	se
1968	9.779	8.245	0.930	0.651	0.058	14.545	1.169	20.604	1.347	3.870	0.379
1969	9.834	8.432	0.866	0.794	0.064	12.335	1.055	18.942	1.196	6.163	0.488
1970	6.831	7.209	0.687	0.631	0.057	10.604	0.713	19.092	1.040	7.354	0.647
1971	9.549	9.513	0.835	0.624	0.052	12.971	0.798	25.239	1.237	12.220	0.867
1972	10.710	9.606	0.918	0.532	0.047	16.701	0.844	26.857	1.407	4.483	0.460
1973	12.968	13.384	1.059	0.772	0.061	20.753	1.202	30.238	1.385	10.546	0.788
1974	11.955	11.123	0.941	0.675	0.056	17.233	0.934	25.935	1.313	3.078	0.315
1975	10.650	10.931	0.916	0.808	0.066	17.368	1.099	24.675	1.222	8.617	0.697
1976	10.557	9.922	0.861	0.730	0.059	13.888	0.826	21.504	1.174	3.162	0.381
1977	8.173	8.271	0.762	0.764	0.064	13.365	0.856	17.920	0.979	4.561	0.443
1978	5.556	5.856	0.573	0.621	0.057	9.997	0.667	15.880	0.871	4.676	0.464
1979	7.430	7.652	0.637	0.701	0.059	11.060	0.635	20.013	0.934	9.361	0.733
1980	10.534	9.965	0.832	0.682	0.055	13.006	0.724	26.028	1.231	10.975	0.819
1981	13.858	12.397	1.019	0.744	0.058	17.460	0.903	28.388	1.372	6.398	0.587
1982	13.503	13.766	1.133	0.922	0.072	19.805	1.186	26.924	1.377	3.194	0.335
1983	10.183	9.895	0.969	0.800	0.068	15.431	1.168	22.295	1.311	4.499	0.431
1984	8.274	8.480	0.739	0.779	0.066	11.689	0.774	19.301	1.031	6.351	0.614
1985	10.442	10.035	0.911	0.860	0.068	12.433	0.746	22.221	1.238	6.439	0.602
1986	9.819	9.934	0.921	0.889	0.072	12.154	0.840	21.191	1.211	5.381	0.535
1987	12.891	12.541	1.165	0.943	0.076	13.097	0.914	28.939	1.886	15.696	1.979
1988	14.166	15.254	1.811	0.987	0.080	14.289	1.100	28.350	2.277	8.415	0.727
1989	12.781	13.342	1.397	1.148	0.088	15.685	1.243	23.218	1.600	3.501	0.389
1990	7.400	7.864	0.889	1.005	0.086	9.714	0.900	15.943	1.104	4.294	0.436
1991	7.074	7.226	0.675	1.028	0.085	7.056	0.523	13.961	0.867	4.787	0.548
1992	7.715	7.969	0.766	1.297	0.096	7.518	0.512	15.518	0.962	6.534	0.585
1993	7.551	6.672	0.813	1.215	0.101	5.838	0.550	11.469	0.967	1.516	0.213
1994	5.404	5.219	0.609	1.191	0.095	5.733	0.609	10.405	0.763	4.447	0.444
1995	4.587	4.719	0.524	0.968	0.077	4.727	0.354	10.681	0.724	2.994	0.335
1996	4.962	4.762	0.424	0.919	0.071	5.599	0.352	10.204	0.571	2.716	0.273
1997	5.858	5.704	0.460	1.304	0.085	5.612	0.366	11.993	0.604	4.985	0.364
1998	5.309	5.235	0.441	1.116	0.081	5.189	0.307	10.289	0.533	1.812	0.182
1999	4.785	4.831	0.432	1.398	0.098	5.496	0.394	7.203	0.453	0.625	0.112
2000	2.179	1.986	0.276	1.122	0.099	1.976	0.273	6.045	0.498	4.194	0.439
2001	3.599	3.822	0.521	1.239	0.110	2.870	0.281	7.989	0.703	1.956	0.272
2002	4.428	4.235	0.526	1.133	0.119	4.489	0.522	8.861	0.744	2.952	0.313
2003	1.812	2.503	0.299	0.712	0.116	3.420	0.467	6.610	0.767	0.893	0.303
2004		3.627	0.757	0.882	0.219	5.230	0.884	7.715	1.452	1.700	0.808
2005		3.219	0.890	0.884	0.251	3.763	1.083	9.114	2.707	3.836	1.983
Arithmetic mean	8.608			0.914		11.077		18.695		5.507	

TSA values for 2004 and 2005 are forecasts.

[1] Sums-of-products estimates

Table 8.5.2.1. Cod in VIIa: Input data for RCT3 estimation of recruiting year classes ('year' = year class; survey titles are shortened). TSA recruits are at age 1.

```
Irish Sea cod recruits - age 1
5   13  2
'Year' 'TSA1' 'UKBTS' 'NIOct 0''NIOct1''NIMar1''MIK0'
1991   6534   70  -11 1109   2326   -11
1992   1516   11  58  553 138 -11
1993   4447   38  781 1672   1380   -11
1994   2994   30  1996   1207   701 57.4
1995   2716   40  789 487 1106   6.9
1996   4985   29  1481   1322   537 66.3
1997   1812   30  420 377 169 5.7
1998   625 2   37  58  49  0.1
1999   4194   59  2022   302 630 26.2
2000   1956   37  724 507 407 6.1
2001   2952   24  841 488 662 9.6
2002   893 7   90  161 74  3.4
2003   -11 8   276 -11 219 3.2
```

Table 8.5.2.2. Cod in VIIa. RCT3 output file. Recruits at age 1.

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

 c7a5f91.csv

 Irish Sea cod recruits - age 1,,,,,,

 Data for    5 surveys over   13 years :  1991 - 2003

 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 =   2002

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

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

 UKBTS      .87   5.01    .41   .746     11   2.08    6.81     .524     .150
 NIOct      .52   4.50    .35   .783     10   4.51    6.85     .459     .195
 NIOct1     .86   2.51    .50   .661     11   5.09    6.86     .632     .103
 NIMar1     .67   3.79    .33   .815     11   4.32    6.67     .442     .210
 MIK0       .53   6.47    .32   .830      8   1.48    7.26     .406     .249

                                       VPA Mean =    7.86     .660     .094


 Yearclass =   2003

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

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

 UKBTS      .87   5.01    .39   .785     12   2.20    6.91     .477     .174
 NIOct      .53   4.44    .33   .825     11   5.62    7.42     .391     .260
 NIOct1
 NIMar1     .65   3.88    .31   .851     12   5.39    7.41     .366     .296
 MIK0       .60   6.26    .37   .805      9   1.44    7.12     .456     .191

                                       VPA Mean =    7.75     .706     .080




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

 2002        1100      7.00      .20      .16       .59     894      6.80
 2003        1472      7.29      .20      .12       .35
```

Table 8.5.4.1 Cod,Irish Sea
input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	1472	0.20	WS1	1.06	0.16
N2	614	0.35	WS2	1.80	0.09
N3	985	0.17	WS3	3.53	0.16
N4	119	0.35	WS4	5.54	0.05
N5	78	0.41	WS5	8.35	0.20
N6	1	0.75	WS6	9.22	0.12
N7	1	1.14	WS7	11.27	0.20
H.cons selectivity			Weight in the HC catch		
sH1	0.19	0.21	WH1	1.06	0.16
sH2	0.79	0.29	WH2	1.80	0.09
sH3	1.33	0.27	WH3	3.53	0.16
sH4	0.97	0.27	WH4	5.54	0.05
sH5	0.94	0.26	WH5	8.35	0.20
sH6	0.92	0.22	WH6	9.22	0.12
sH7	0.97	0.28	WH7	11.27	0.20
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.38	0.10
M3	0.20	0.10	MT3	1.00	0.10
M4	0.20	0.10	MT4	1.00	0.00
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.27	K04	1.00	0.10
HF05	1.00	0.27	K05	1.00	0.10
HF06	1.00	0.27	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	2227	0.66			
R06	2227	0.66			

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

Stock numbers in 2004 are TSA survivors.

Data from file:F:\acfm\wgnsds\2004\Stock\cod-iris\final runs\XSA_ICA\MLA runs TS

table 8.5.4.2 Cod in division VIIa : short term forecast input data

MFDP version 1a
Run: cod7astp
Time and date: 21:19 11/05/2004
Fbar age range: 2-4

input F are mean $F_{01\text{-}03}$ unscaled
Catch and stock weights are mean $_{01\text{-}03}$
Recruitment at age 1 in 2005/6 are $GM_{93\text{-}02}$
Recruitment at age 1 in 2004 is RCT3 value

2004

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	1472	0.2	0	0	0	1.059	0.192	1.059
2	614	0.2	0.38	0	0	1.800	0.792	1.800
3	985	0.2	1	0	0	3.532	1.326	3.532
4	119	0.2	1	0	0	5.535	0.965	5.535
5	78	0.2	1	0	0	8.354	0.939	8.354
6	1	0.2	1	0	0	9.224	0.921	9.224
7	1	0.2	1	0	0	11.270	0.973	11.270

2005

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	2227	0.2	0	0	0	1.059	0.192	1.059
2	.	0.2	0.38	0	0	1.800	0.792	1.800
3	.	0.2	1	0	0	3.532	1.326	3.532
4	.	0.2	1	0	0	5.535	0.965	5.535
5	.	0.2	1	0	0	8.354	0.939	8.354
6	.	0.2	1	0	0	9.224	0.921	9.224
7	.	0.2	1	0	0	11.270	0.973	11.270

2006

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	2227	0.2	0	0	0	1.059	0.192	1.059
2	.	0.2	0.38	0	0	1.800	0.792	1.800
3	.	0.2	1	0	0	3.532	1.326	3.532
4	.	0.2	1	0	0	5.535	0.965	5.535
5	.	0.2	1	0	0	8.354	0.939	8.354
6	.	0.2	1	0	0	9.224	0.921	9.224
7	.	0.2	1	0	0	11.270	0.973	11.270

Input units are thousands and kg - output in tonnes

table 8.5.4.3 Cod in division VIIa : Results of short term forecast

MFDP version 1a
Run: cod7astp
"IRISH SEA COD, NSWG 2003, COMBSEX,PLUSGROUP"
Time and date: 21:19 11/05/2004
Fbar age range: 2-4

2004				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
7474	5231	1.0000	1.0277	3921

2005					2006	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
6686	**3218**	**0.0000**	**0.0000**	**0**	**11531**	**7138**
.	**3218**	**0.1000**	**0.1028**	**398**	**10940**	**6586**
.	**3218**	**0.2000**	**0.2055**	**763**	**10400**	**6084**
.	3218	0.3000	0.3083	1098	9906	5627
.	3218	0.4000	0.4111	1405	9453	5210
.	3218	0.5000	0.5138	1688	9037	4830
.	3218	0.6000	0.6166	1948	8655	4483
.	3218	0.7000	0.7194	2188	8303	4166
.	3218	0.8000	0.8221	2409	7980	3876
.	3218	0.9000	0.9249	2613	7682	3611
.	3218	1.0000	1.0277	2802	7407	3369
.	3218	1.1000	1.1304	2976	7152	3146
.	3218	1.2000	1.2332	3139	6917	2943
.	3218	1.3000	1.3360	3289	6700	2756
.	3218	1.4000	1.4387	3429	6498	2584
.	3218	1.5000	1.5415	3559	6311	2426
.	3218	1.6000	1.6443	3680	6137	2281
.	3218	1.7000	1.7470	3793	5974	2148
.	3218	1.8000	1.8498	3899	5823	2024
.	3218	1.9000	1.9526	3998	5683	1911
.	3218	2.0000	2.0553	4091	5551	1806
F = $\mathbf{F}_{pa}$	3218	0.7	0.7194	2188	8303	4166

Input units are thousands and kg - output in tonnes

F giving 30% increase in SSB in 2006:						
	3218	0.694	0.7132	2174	8324	4184

Fmult corresponding to Fpa = 0.7
Fmult corresponding to 30% increase of 2003 SSB by 2005 = 0.69
Bpa = 10,000t
Figures in bold = SSB > Blim (6,000t)

table 8.5.4.4 Detailed output of short term forecast

MFDP version 1a
Run: cod7astp
Time and date: 21:19 11/05/2004
Fbar age range: 2-4

Year:	2004	F multiplier:	1	Fbar:	1.0277				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
1	0.192	233	247	1472	1558	0	0	0	0
2	0.792	308	555	614	1105	233	420	233	420
3	1.326	670	2365	985	3478	985	3478	985	3478
4	0.965	68	375	119	659	119	659	119	659
5	0.939	44	367	78	655	78	655	78	655
6	0.921	1	6	1	11	1	11	1	11
7	0.973	0	5	1	8	1	8	1	8
Total		1324	3921	3270	7474	1417	5231	1417	5231

Year:	2005	F multiplier:	1	Fbar:	1.0277				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
1	0.192	353	374	2227	2358	0	0	0	0
2	0.792	500	900	995	1791	378	681	378	681
3	1.326	155	547	228	804	228	804	228	804
4	0.965	122	675	214	1185	214	1185	214	1185
5	0.939	21	174	37	310	37	310	37	310
6	0.921	14	128	25	232	25	232	25	232
7	0.973	0	4	1	7	1	7	1	7
Total		1165	2802	3727	6686	883	3218	883	3218

Year:	2006	F multiplier:	1	Fbar:	1.0277				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
1	0.192	353	374	2227	2358	0	0	0	0
2	0.792	756	1361	1505	2710	572	1030	572	1030
3	1.326	251	886	369	1303	369	1303	369	1303
4	0.965	28	156	49	274	49	274	49	274
5	0.939	37	313	67	558	67	558	67	558
6	0.921	7	61	12	110	12	110	12	110
7	0.973	5	54	8	94	8	94	8	94
Total		1437	3205	4238	7407	1078	3369	1078	3369

Input units are thousands and kg - output in tonnes

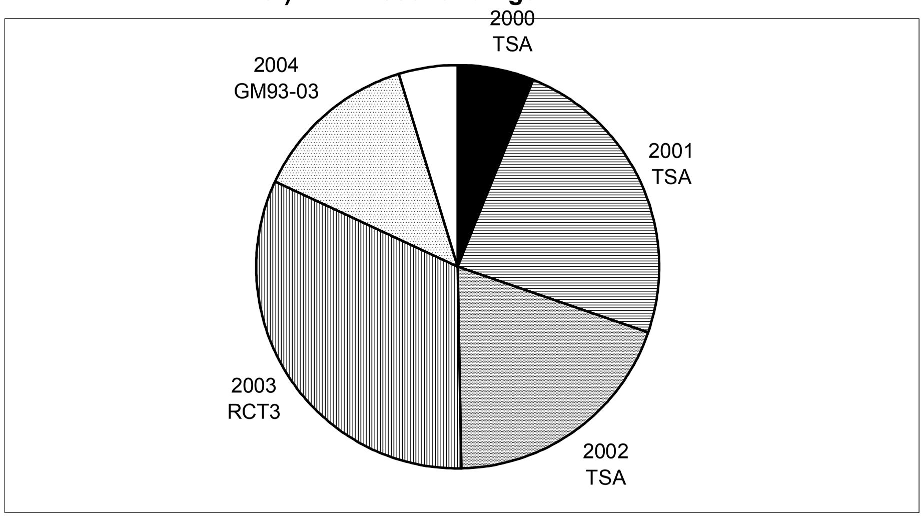
Table 8.5.4.5 Cod in division VIIa
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2000	2001	2002	2003	2004
Stock No. (thousands) of 1 year-olds	1956	2952	893	1472	2227
Source	TSA	TSA	TSA	RCT3	GM93-03
Status Quo F:					
% in 2004 landings	9.6	60.3	14.2	6.3	
% in 2005	6.2	24.1	19.5	32.1	13.3
% in 2004 SSB	12.6	66.5	8.0	0.0	
% in 2005 SSB	9.6	36.8	25.0	21.2	0.0
% in 2006 SSB	3.3	16.6	8.1	38.7	30.6

GM : geometric mean recruitment

Cod in division VIIa : Year-class % contribution to

a) 2005 landings



b) 2006 SSB

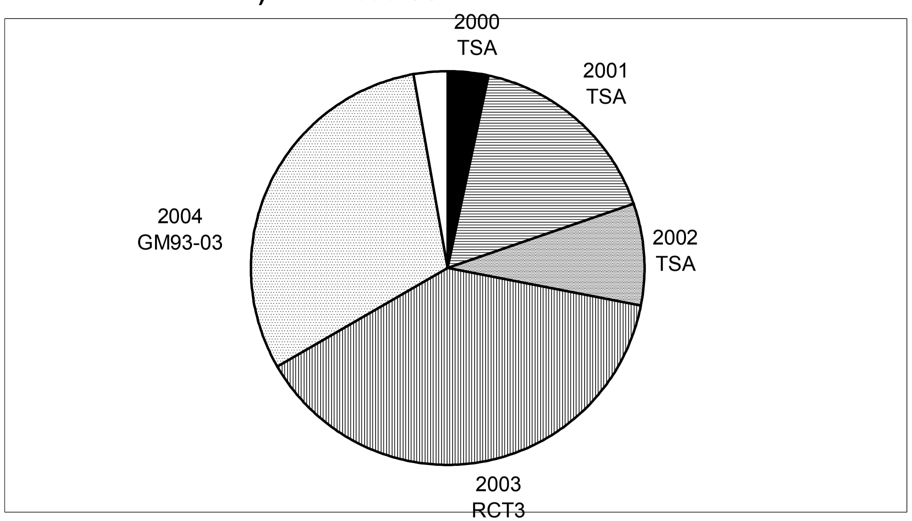


table 8.5.6.1 Cod in division VIIa : yield per recruit input data

MFYPR version 2a
Run: cod7aypr
"IRISH SEA COD, NSWG 2003, COMBSEX,PLUSGROUP"
Time and date: 21:21 11/05/2004 input F are mean F_{01-03} unscaled
Fbar age range: 2-4 Catch and stock weights are $mean_{82-02}$

Age	M	Mat	PF	PM	SWt	Sel	CWt
1	0.2	0	0	0	0.874	0.192	0.874
2	0.2	0.38	0	0	1.811	0.792	1.811
3	0.2	1	0	0	3.662	1.326	3.662
4	0.2	1	0	0	5.629	0.965	5.629
5	0.2	1	0	0	7.490	0.939	7.490
6	0.2	1	0	0	8.981	0.921	8.981
7	0.2	1	0	0	10.817	0.973	10.817

Weights in kilograms

Table 8.5.6.2 Cod in division VIIa Results of yield per recruit analyses

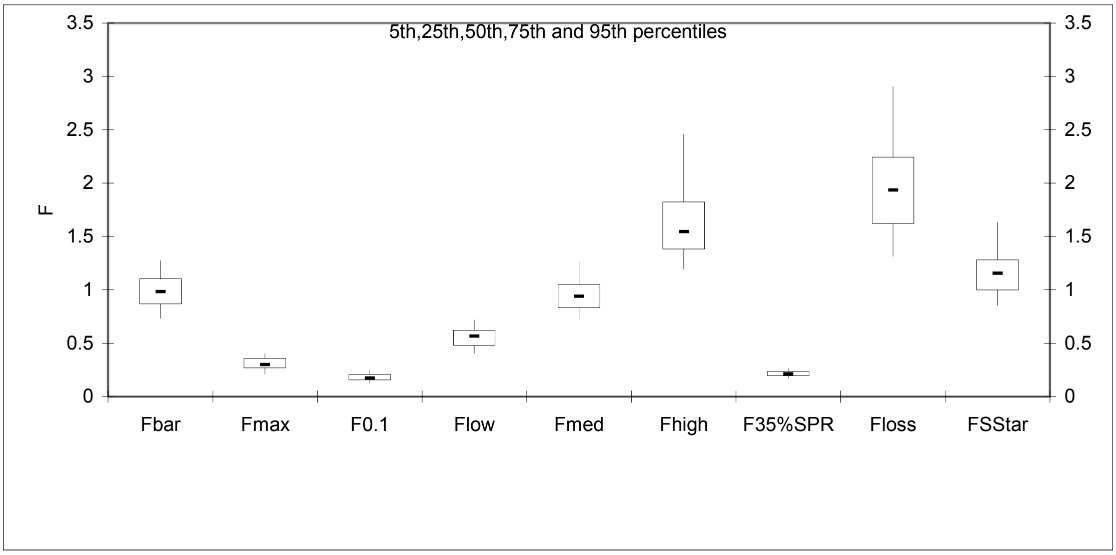
MFYPR version 2a
Run: cod7aypr
Time and date: 21:21 11/05/2004
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	5.5167	32.5432	4.0090	30.7501	4.0090	30.7501
0.1000	0.1028	0.2822	1.5797	4.1125	19.1807	2.6145	17.4051	2.6145	17.4051
0.2000	0.2055	0.4247	2.0229	3.4070	13.0133	1.9185	11.2548	1.9185	11.2548
0.3000	0.3083	0.5104	2.1156	2.9848	9.6369	1.5055	7.8952	1.5055	7.8952
0.4000	0.4111	0.5677	2.0872	2.7047	7.5890	1.2345	5.8637	1.2345	5.8637
0.5000	0.5138	0.6088	2.0181	2.5054	6.2555	1.0442	4.5464	1.0442	4.5464
0.6000	0.6166	0.6397	1.9388	2.3564	5.3395	0.9039	3.6463	0.9039	3.6463
0.7000	0.7194	0.6640	1.8612	2.2404	4.6826	0.7965	3.0050	0.7965	3.0050
0.8000	0.8221	0.6836	1.7894	2.1473	4.1945	0.7118	2.5321	0.7118	2.5321
0.9000	0.9249	0.6999	1.7247	2.0706	3.8206	0.6434	2.1732	0.6434	2.1732
1.0000	1.0277	0.7136	1.6669	2.0061	3.5265	0.5870	1.8938	0.5870	1.8938
1.1000	1.1304	0.7255	1.6153	1.9508	3.2898	0.5397	1.6715	0.5397	1.6715
1.2000	1.2332	0.7359	1.5692	1.9027	3.0955	0.4994	1.4913	0.4994	1.4913
1.3000	1.3360	0.7451	1.5280	1.8604	2.9331	0.4647	1.3427	0.4647	1.3427
1.4000	1.4387	0.7533	1.4909	1.8227	2.7952	0.4345	1.2185	0.4345	1.2185
1.5000	1.5415	0.7608	1.4575	1.7887	2.6765	0.4080	1.1131	0.4080	1.1131
1.6000	1.6443	0.7675	1.4271	1.7580	2.5732	0.3844	1.0229	0.3844	1.0229
1.7000	1.7470	0.7737	1.3995	1.7298	2.4822	0.3634	0.9448	0.3634	0.9448
1.8000	1.8498	0.7795	1.3743	1.7040	2.4014	0.3445	0.8766	0.3445	0.8766
1.9000	1.9526	0.7848	1.3512	1.6801	2.3290	0.3274	0.8166	0.3274	0.8166
2.0000	2.0553	0.7897	1.3299	1.6579	2.2637	0.3119	0.7634	0.3119	0.7634

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	1.0277
FMax	0.3112	0.3198
F0.1	0.1786	0.1835
F35%SPR	0.2116	0.2175

Weights in kilograms

Table 8.5.7.1 Cod in VIIa. PA reference point summary.



Reference point	Deterministic	Median	75th percentile	95th percentile	Hist SSB < ref pt %
MedianRecruits	4530	4561	4753	6258	
MBAL	6000				30.56
Bloss	1976				
SSB90%R90%Surv	10160	10131	11086	12374	41.67
SPR%ofVirgin	5.87	6.26	7.56	9.84	
VirginSPR	31.84	31.14	35.55	46.32	
SPRloss	1.00	0.81	0.94	1.23	
S*	10604	9553	11468	13908	44.44
	Deterministic	**Median**	**25th percentile**	**5th percentile**	**Hist F > ref pt %**
FBar	1.03	0.98	0.87	0.73	30.56
Fmax	0.31	0.30	0.27	0.21	100.00
F0.1	0.18	0.17	0.15	0.12	100.00
Flow	0.46	0.57	0.48	0.40	100.00
Fmed	0.97	0.94	0.83	0.71	38.89
Fhigh	1.64	1.55	1.38	1.20	0.00
F35%SPR	0.21	0.21	0.19	0.17	100.00
Floss	1.64	1.94	1.62	1.31	0.00
FS*	1.04	1.15	1.00	0.86	27.78

For estimation of Gloss and Floss:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
For estimation of the stock recruitment relationship used in equilibrium calculations:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

Irish Sea Cod

Steady state selection provided as input
FBar averaged from age 2 to 4

Number of iterations = 100
Random number seed = -99
Stock recruitment data Monte Carloed using residuals from the equilibrium LOWESS fit

Data source:
F:\acfm\wgnsds\2004\Stock\cod-iris\final runs\XSA_ICA\MLA runs TSA\CODVIIA.SEN
F:\acfm\wgnsds\2004\Stock\cod-iris\final runs\XSA_ICA\MLA runs TSA\CODVIIA.SUM

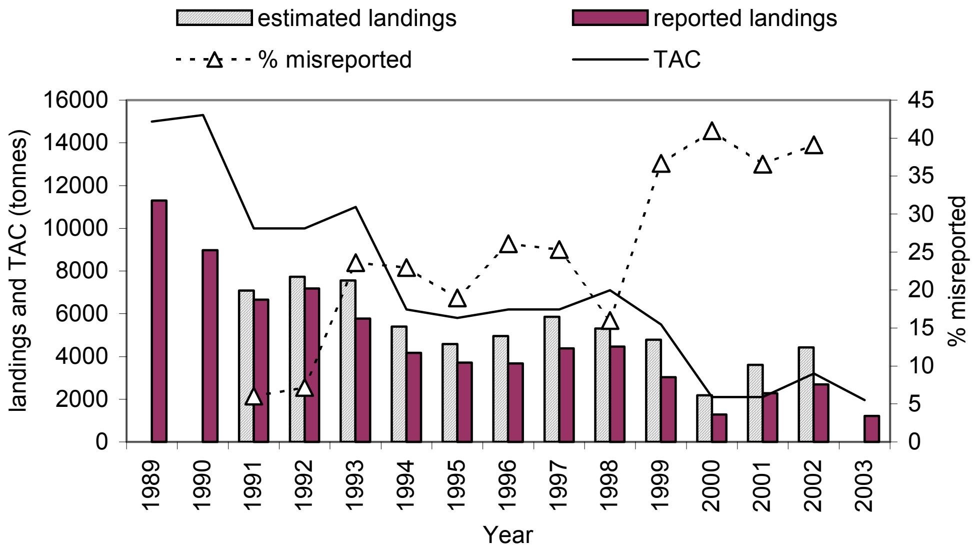
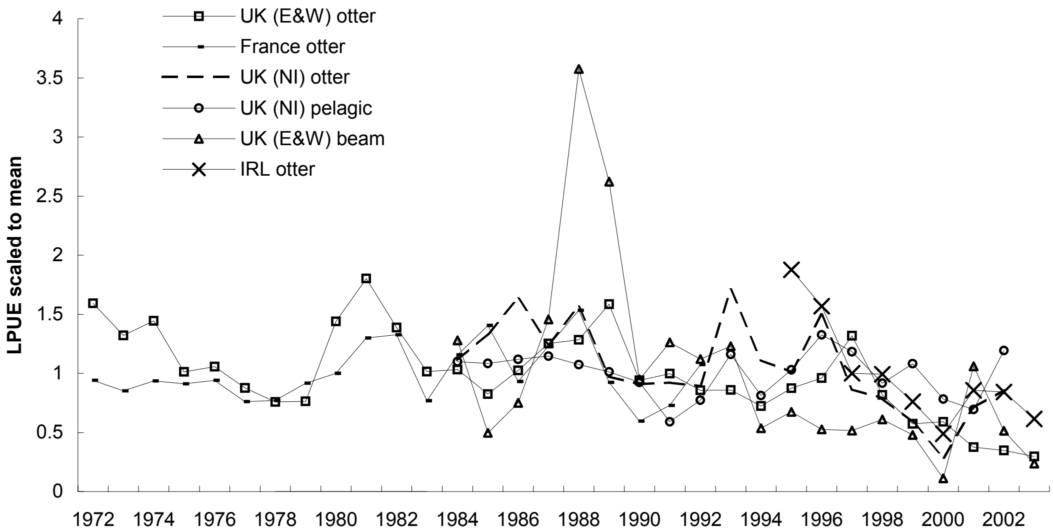


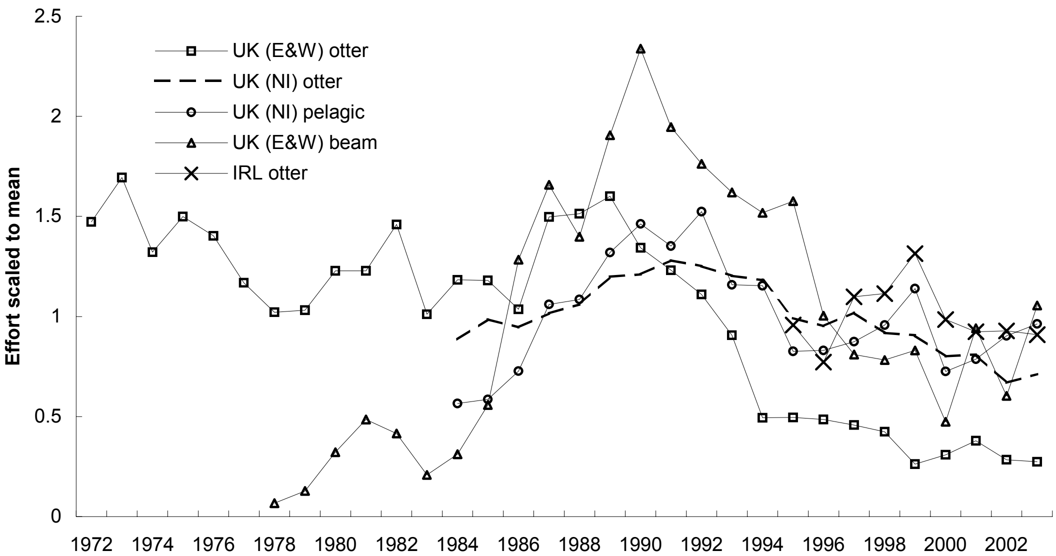
Fig. 8.1.3.1 Cod in VIIa: Estimated and reported international landings of cod from VIIa, and the percentage of the WG landings figures comprising estimates of misreporting.

Figure 8.2.1 Cod VIIa (Irish Sea)
Trends in LPUE and effort for commercial tuning fleets. All series are expressed relative to their series mean.

a)



b)



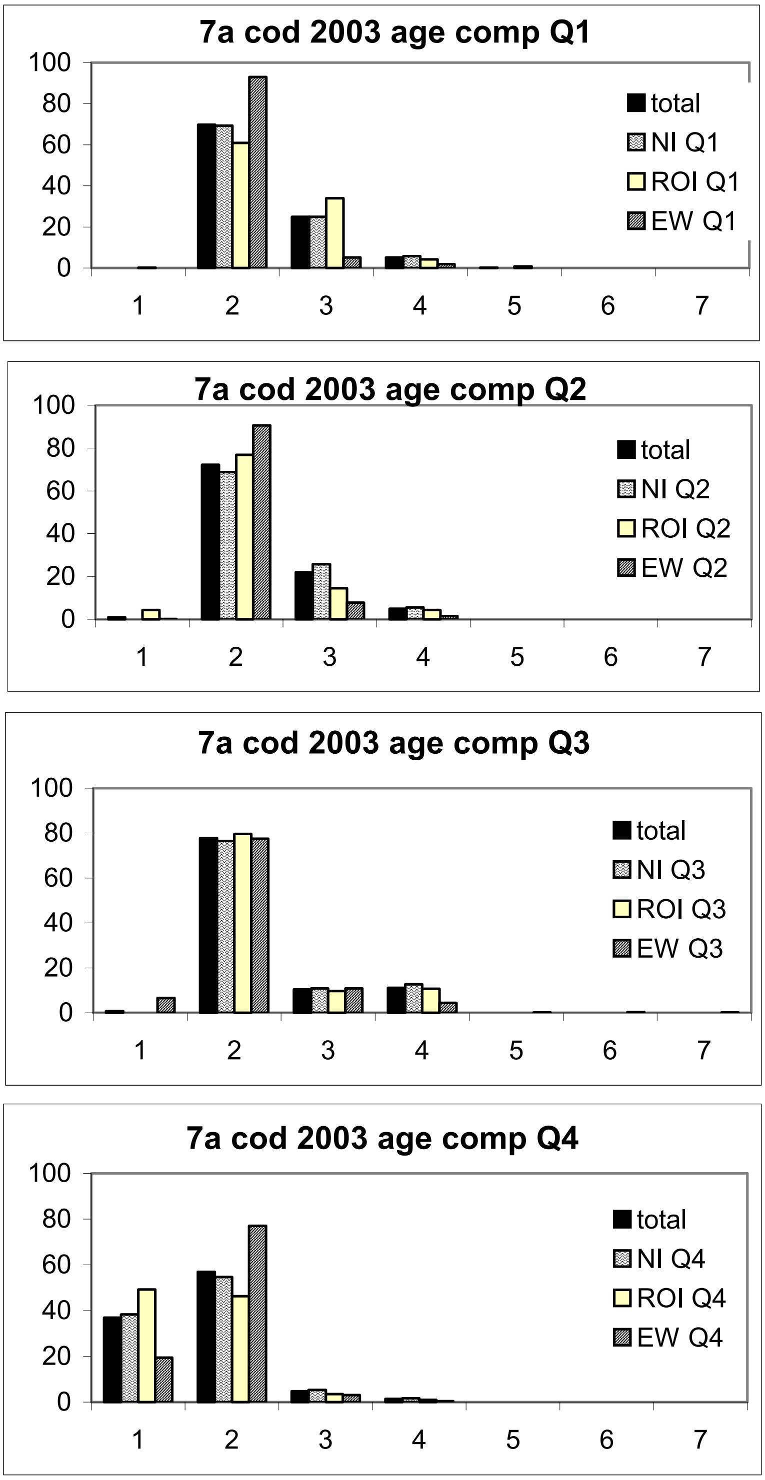


Figure 8.3.1. Cod in VIIa. Estimated percentage age compositions of landings by number during 2003.

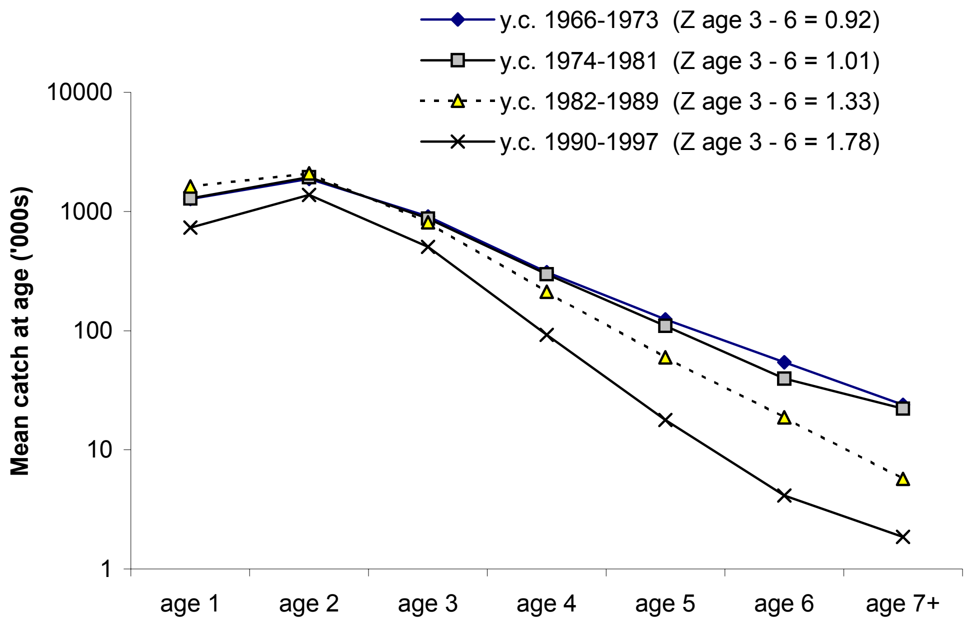


Fig. 8.3.2 Cod in VIIa: International numbers caught at age, grouped by year classes in four time periods and plotted on a log scale. Total mortality (Z) estimates are calculated from the slopes of the catch curves between ages 3 and 6.

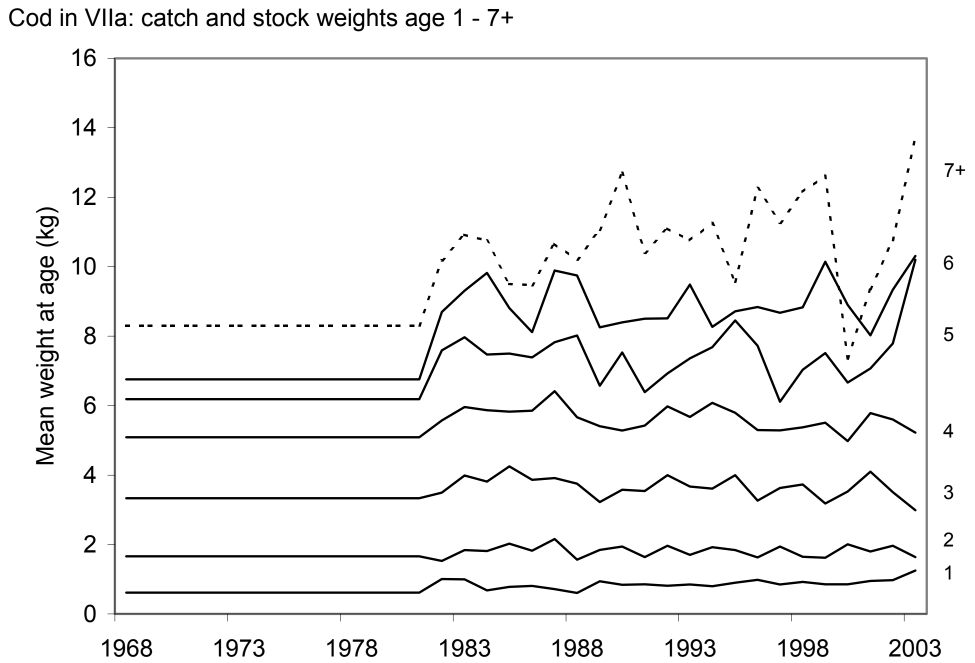


Fig. 8.3.3 Cod in VIIa. Mean weight at age in the catch and stock.

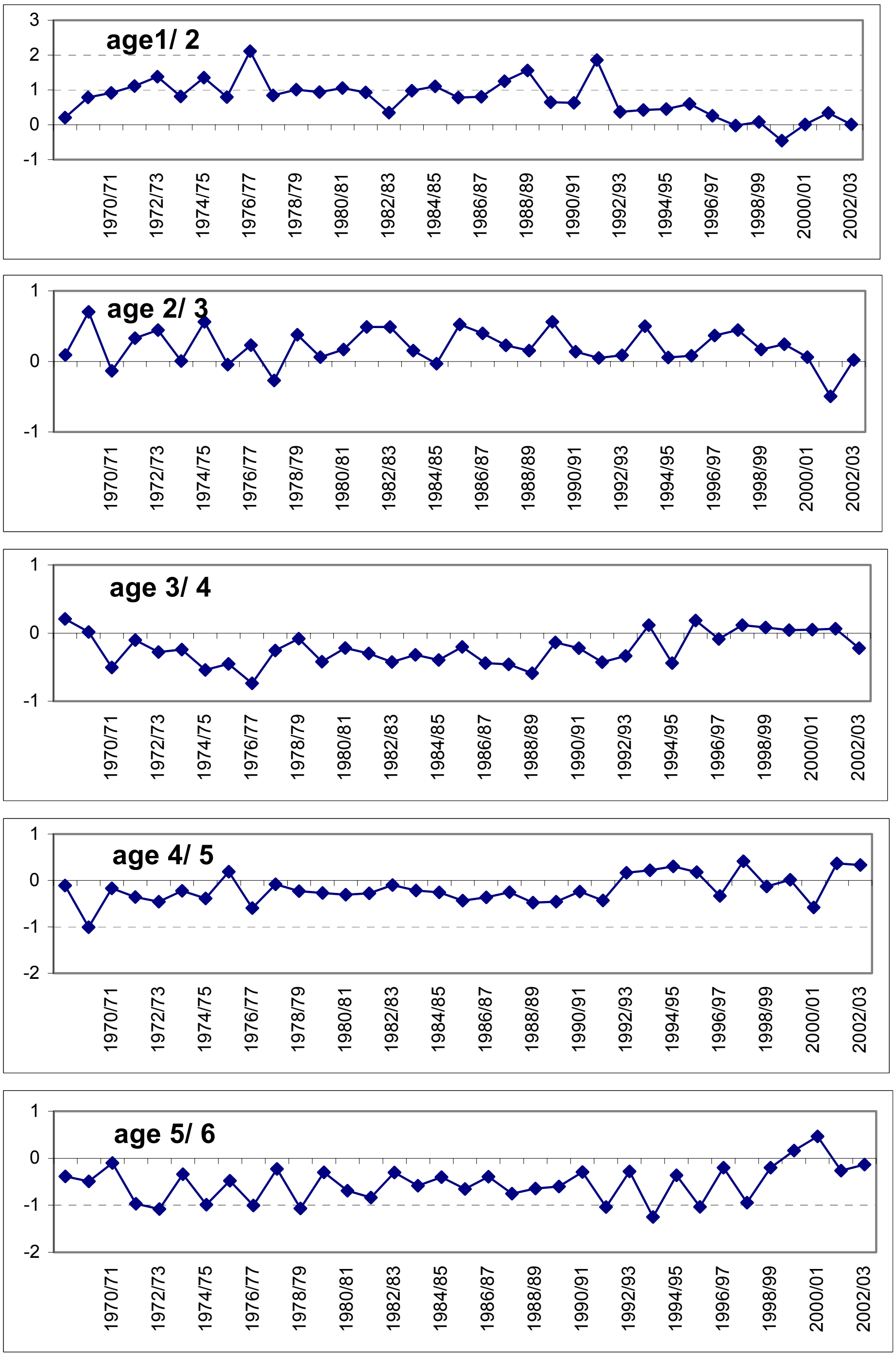


Fig. 8.5.1.1.1 Cod in VIIa: Log catch at age residuals from separable VPA with separable model fitted to the last 6 years data.

COD 7a Log of (survey index divided by series mean)

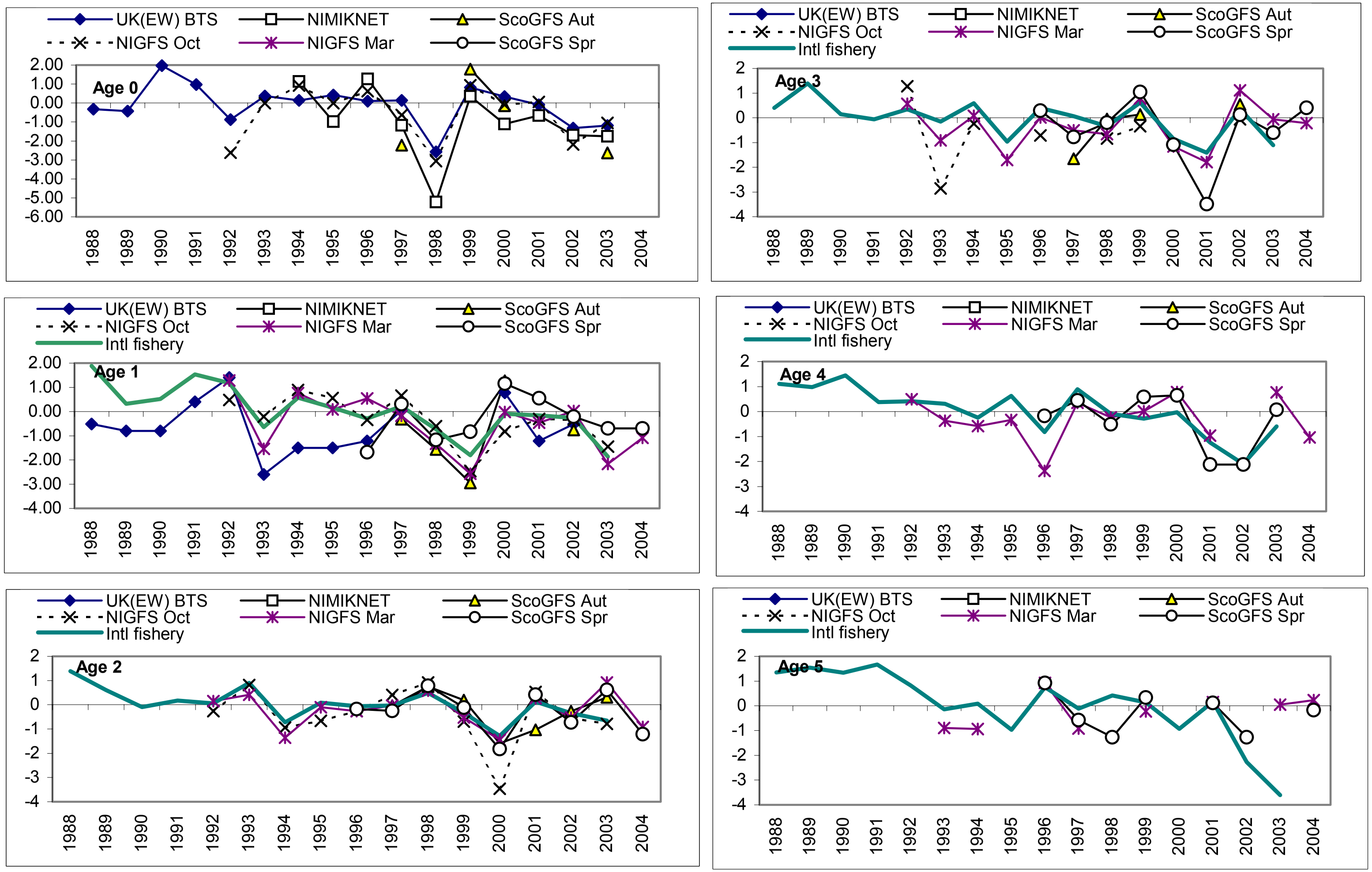
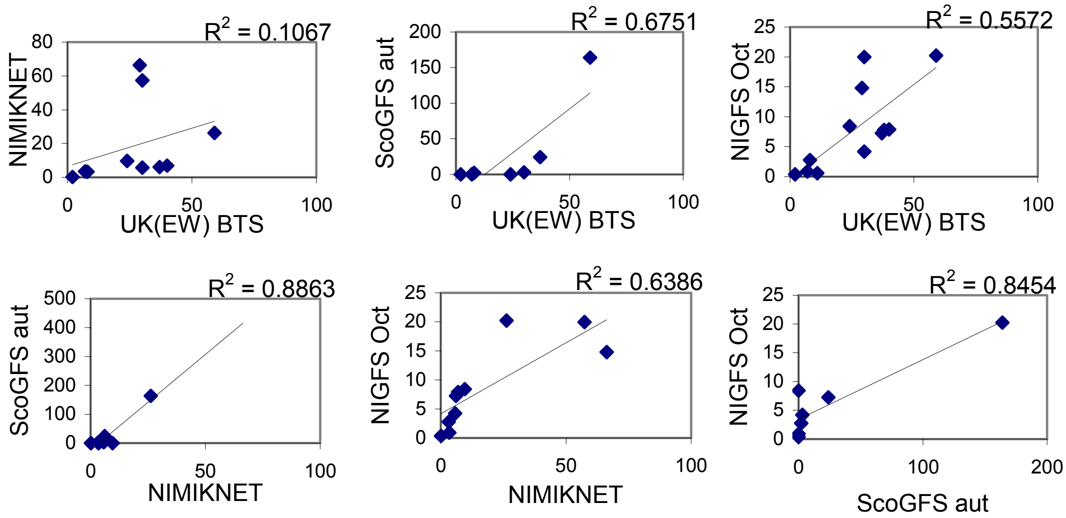


Fig. 8.5.1.2.1 Cod in VIIa. Time-series plots of the logarithms of survey indices at age after standardising by dividing by the series means (1992-2004). The international landings at age are also shown for comparison of trends.

Figure 8.5.1.2.2. Cod in VIIa. Correlation between survey series, by age class

Age Group 0



Age Group 1

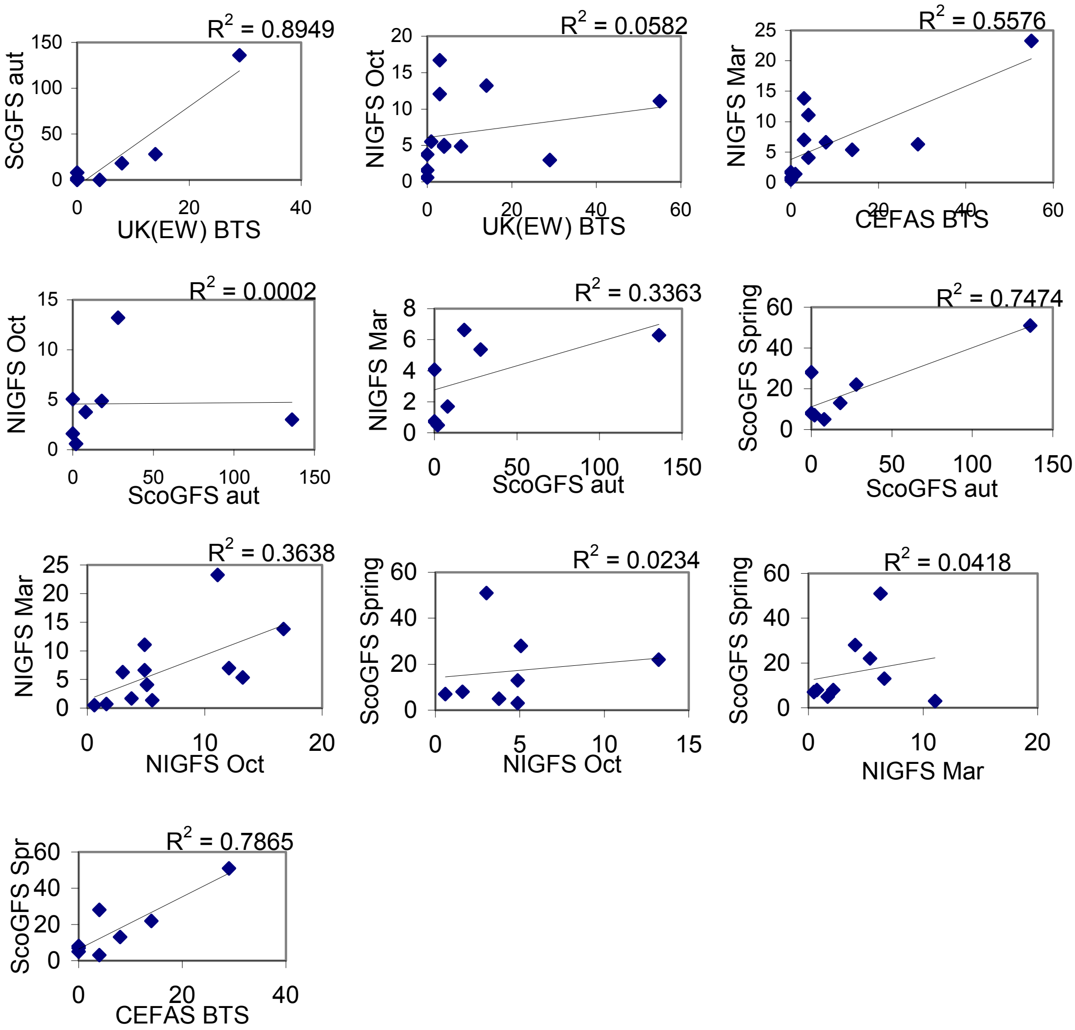
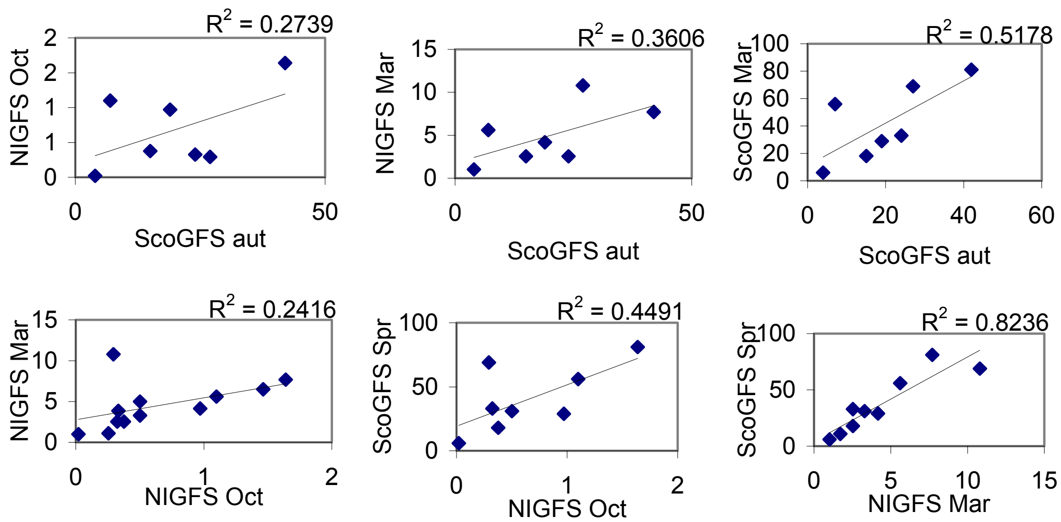
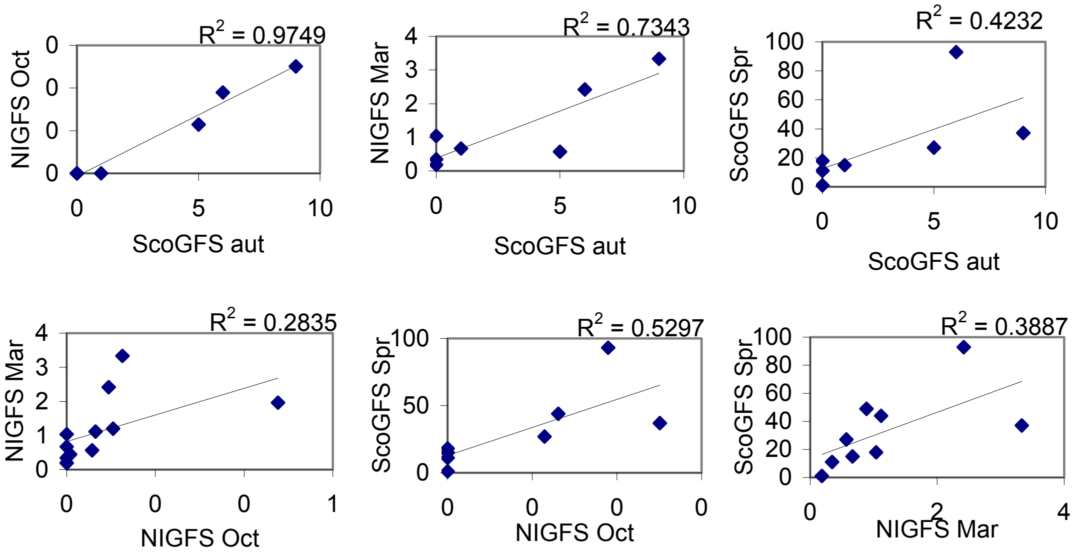


Figure 8.5.1.2.2 contd.. Cod in VIIa. Correlation between survey series, by age class

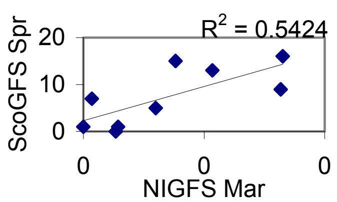
Age group 2



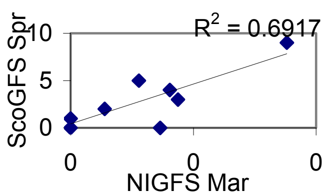
Age group 3



Age group 4



Age group 5



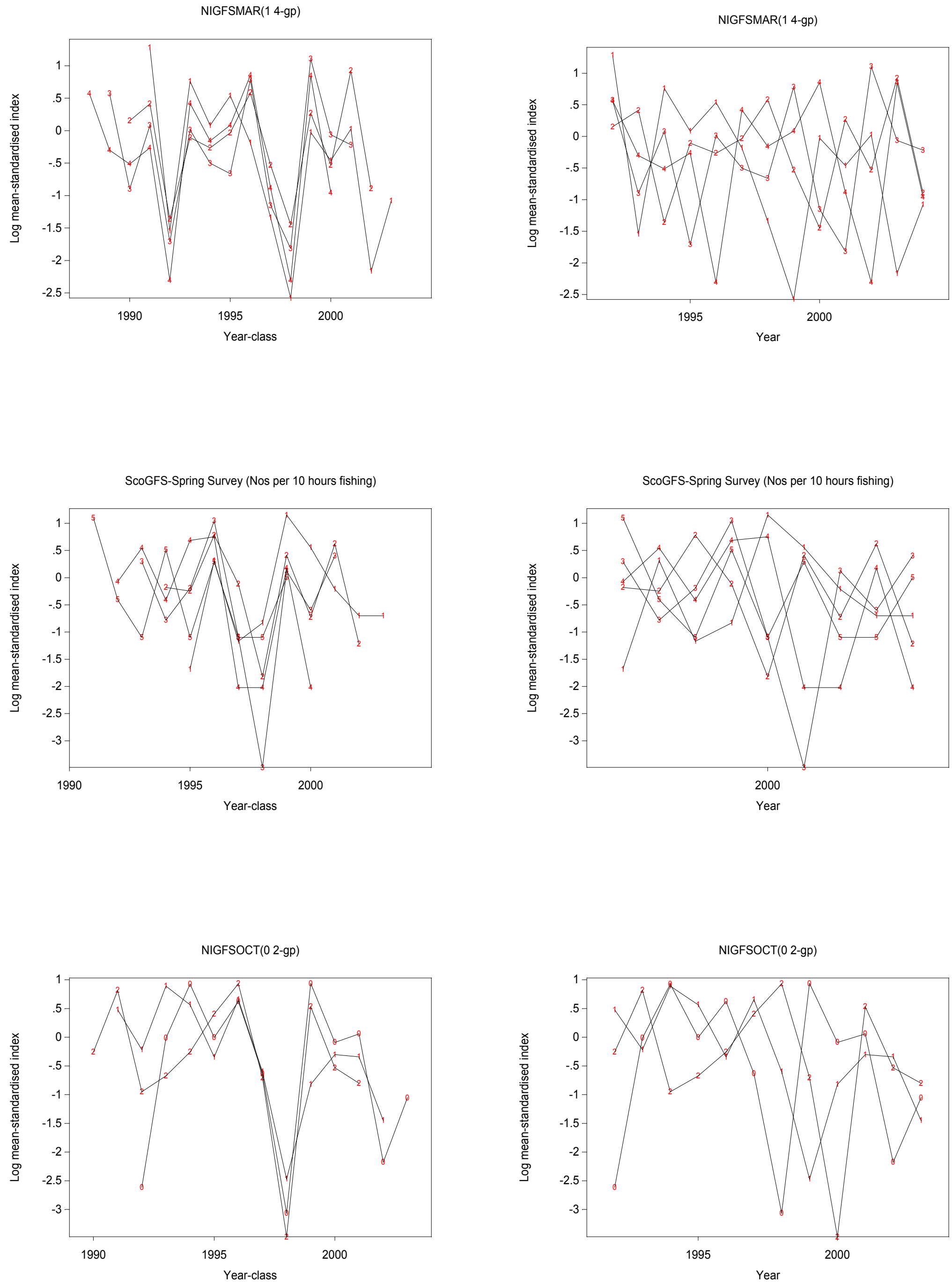


Figure 8.5.1.2.3. Cod in VIIa: Log mean-standardised indices for NIGFS(Mar), ScoGFS(Spring) and NIGFS(Oct) surveys, plotted by year class and by year.

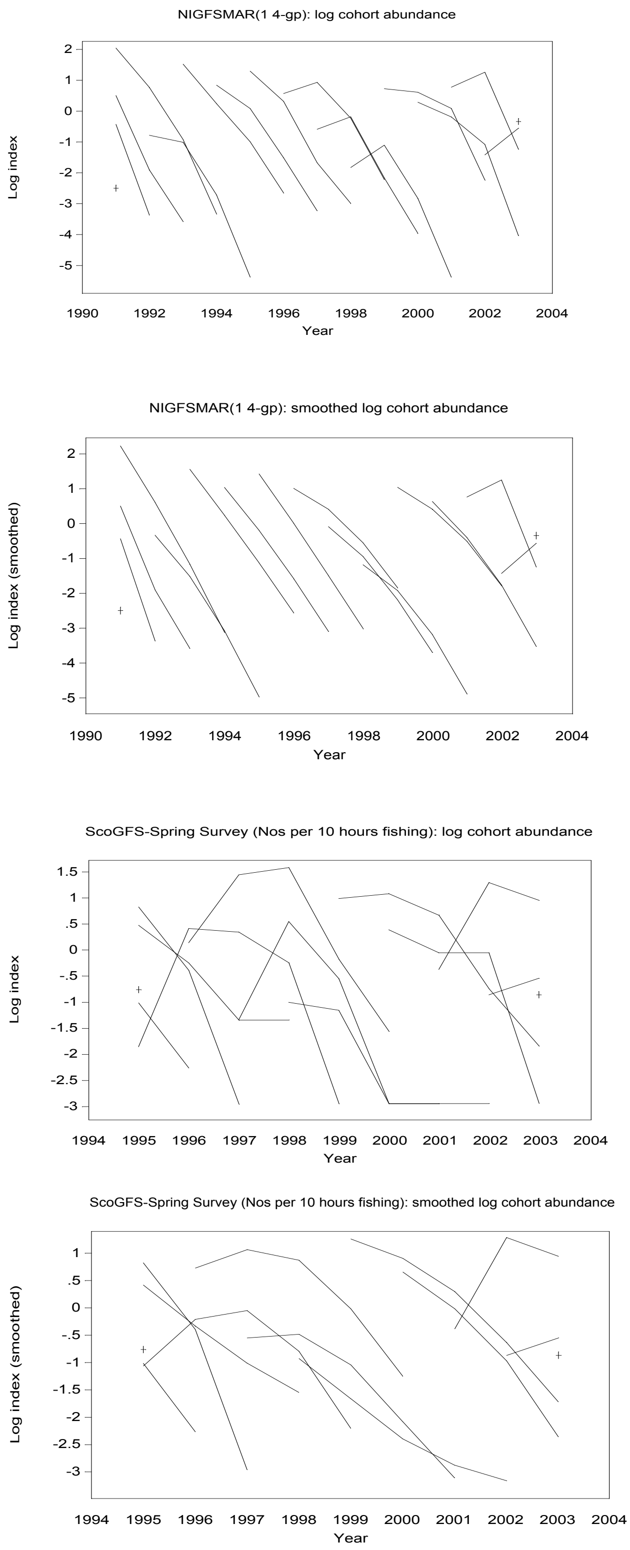
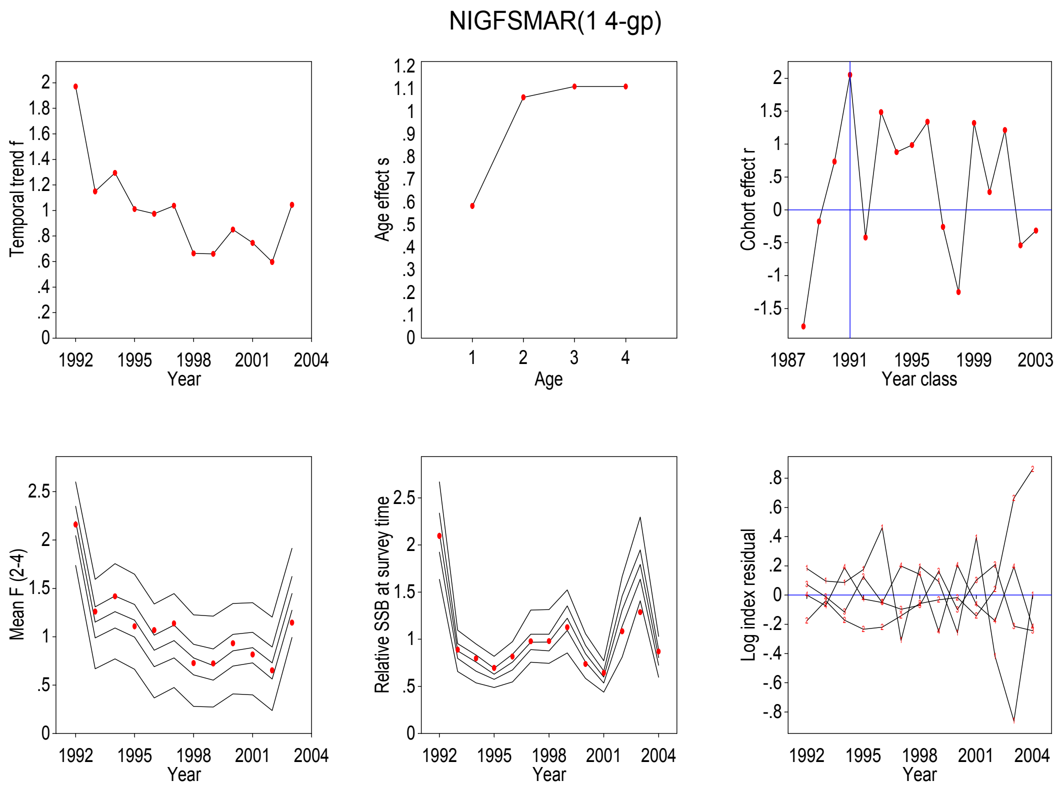


Figure 8.5.1.2.4. Cod in VIIa: Catch curves for NIGFS (Mar) and ScoGFS (Spr) from SURBA: unsmoothed and smoothed data.



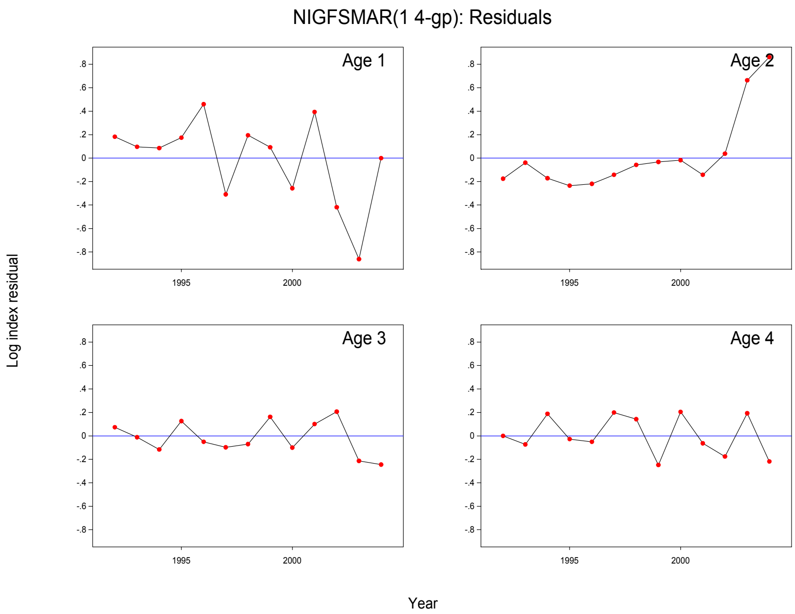
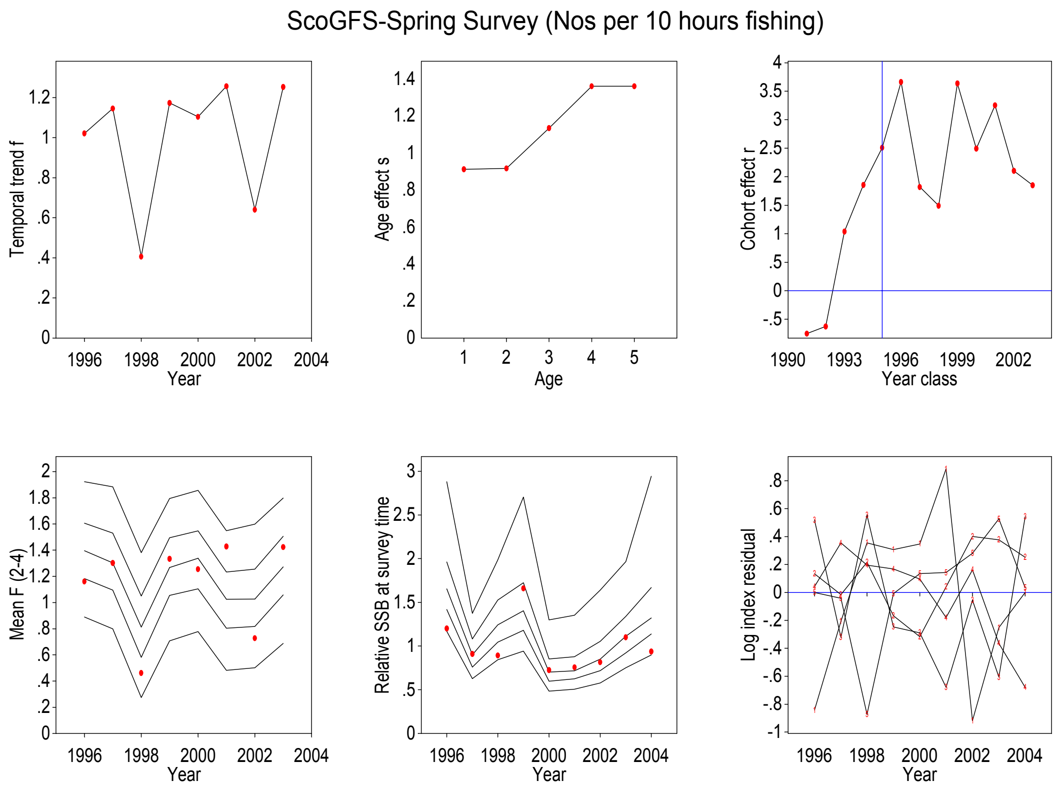


Figure 8.5.1.2.5. Cod in VIIa: Summary output from SURBA run using NIGFS(Mar) survey data. Residuals for each age class are shown in lower plots.



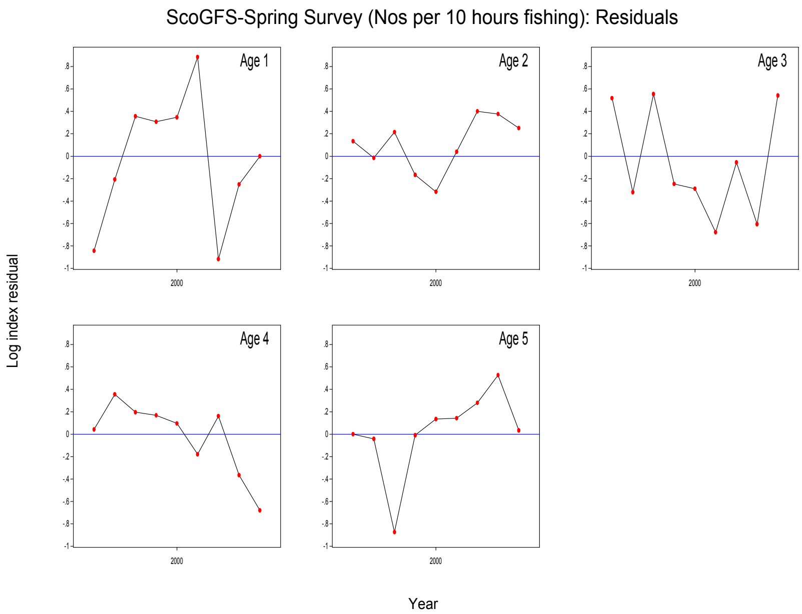


Figure 8.5.1.2.6. Cod in VIIa: Summary output from SURBA run using ScoGFS(Spring) survey data. Residuals for each age class are shown in lower plots.

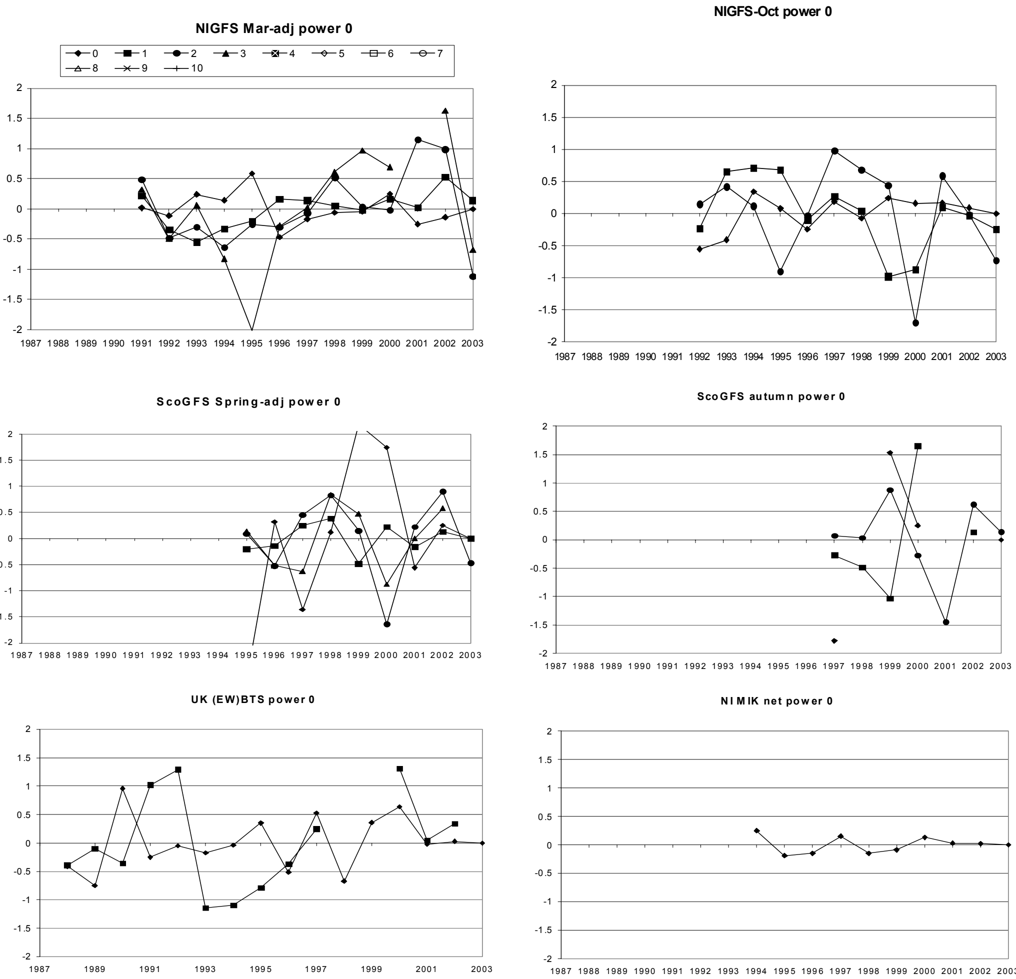


Fig. 8.5.1.3.1. Cod in VIIa: catchability residuals from single-fleet XSA runs with catchability independent of age from age 1; shrinkage SE = 2.5; q-plateau = 4; no taper.

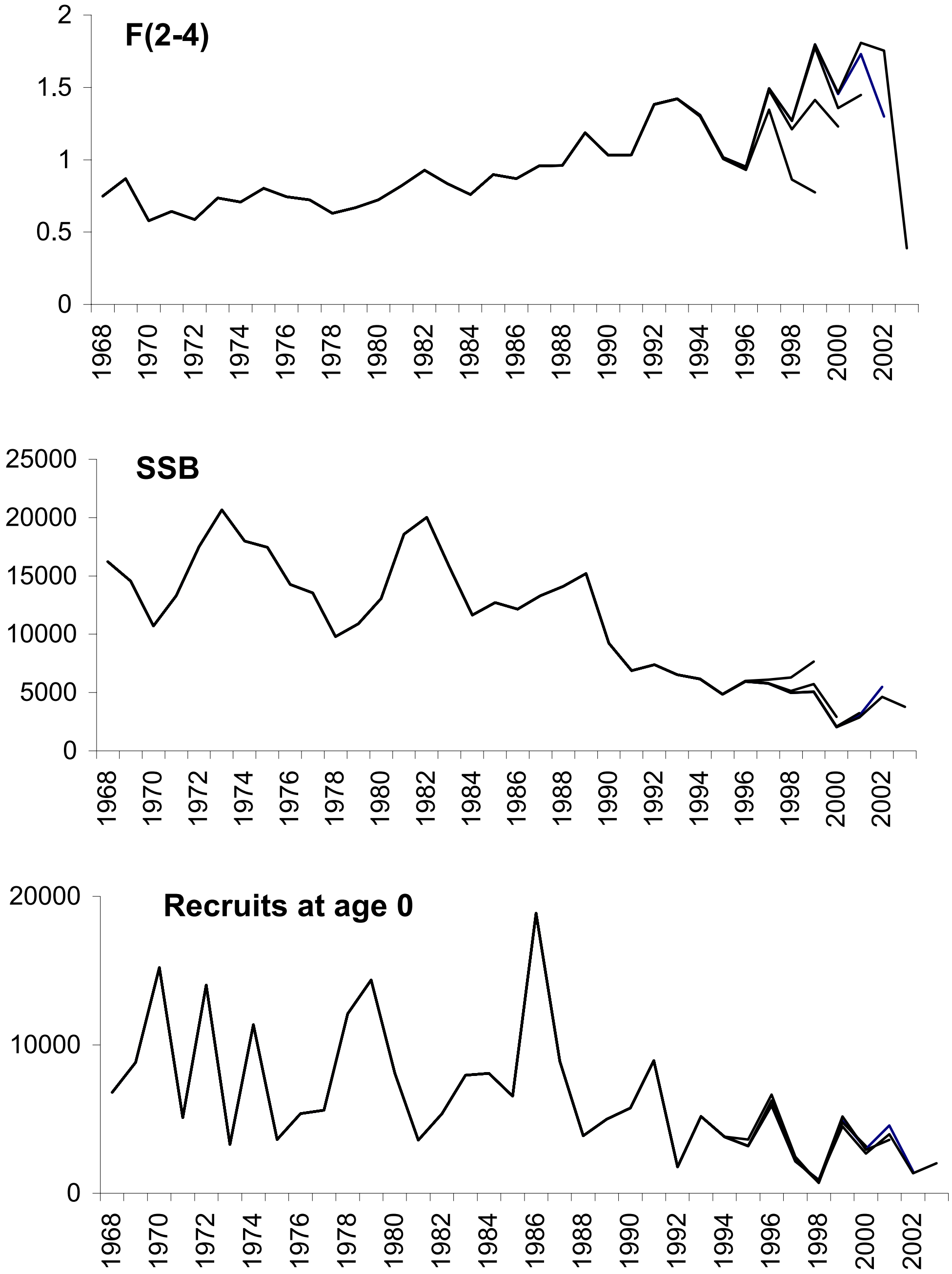


Fig: 8.5.1.3.2 Cod in VIIa: Retrospective estimates of F, SSB and R for baseline (SPALY) XSA run (five fleets: shrinkage SE = 2.5)

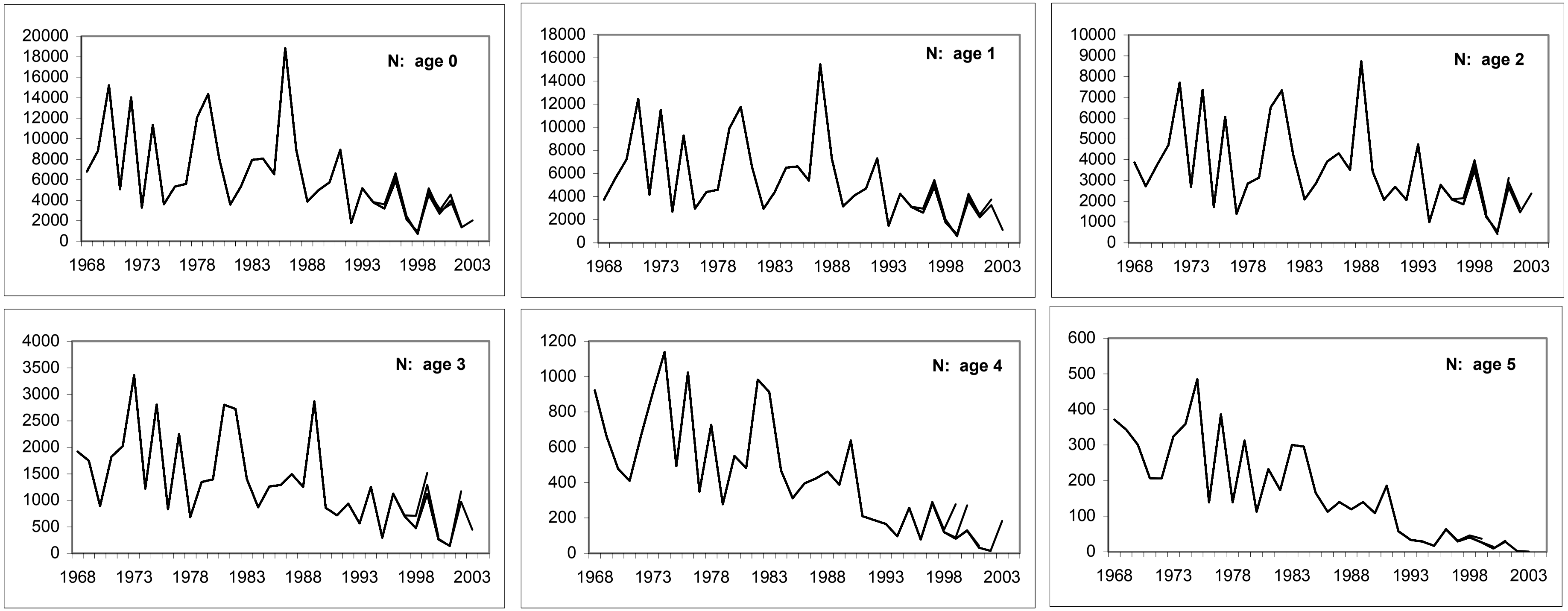


Fig: 8.5.1.3.3 Cod in VIIa: Retrospective estimates of N by age class for baseline (SPALY) XSA run (five fleets: shrinkage SE = 2.5) (thousands)

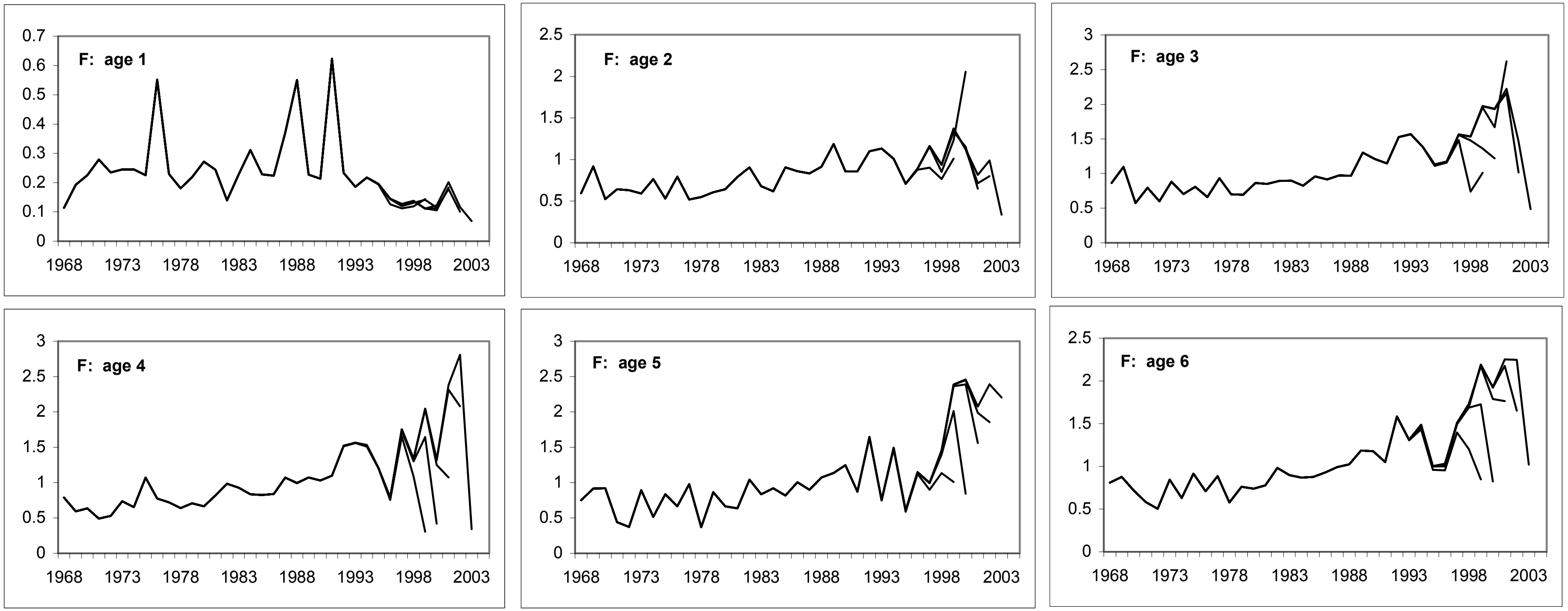


Fig: 8.5.1.3.4 Cod in VIIa: Retrospective estimates of F by age class for baseline (SPALY) XSA run (five fleets: shrinkage SE = 2.5)

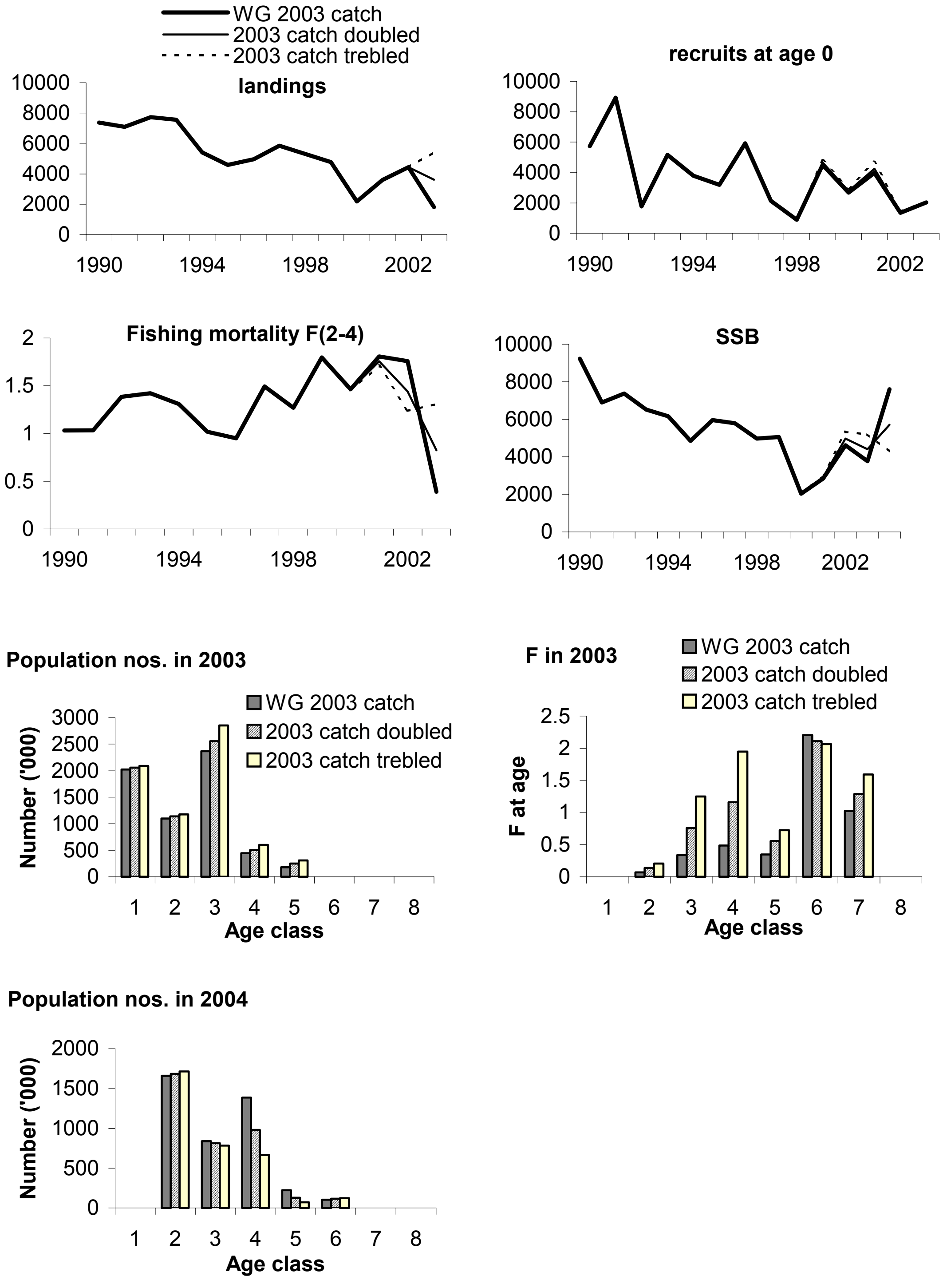


Fig. 8.5.1.3.5 Cod in VIIa: WG baseline multifleet XSA run compared with equivalent runs in which landings at age in 2003 are doubled or trebled.

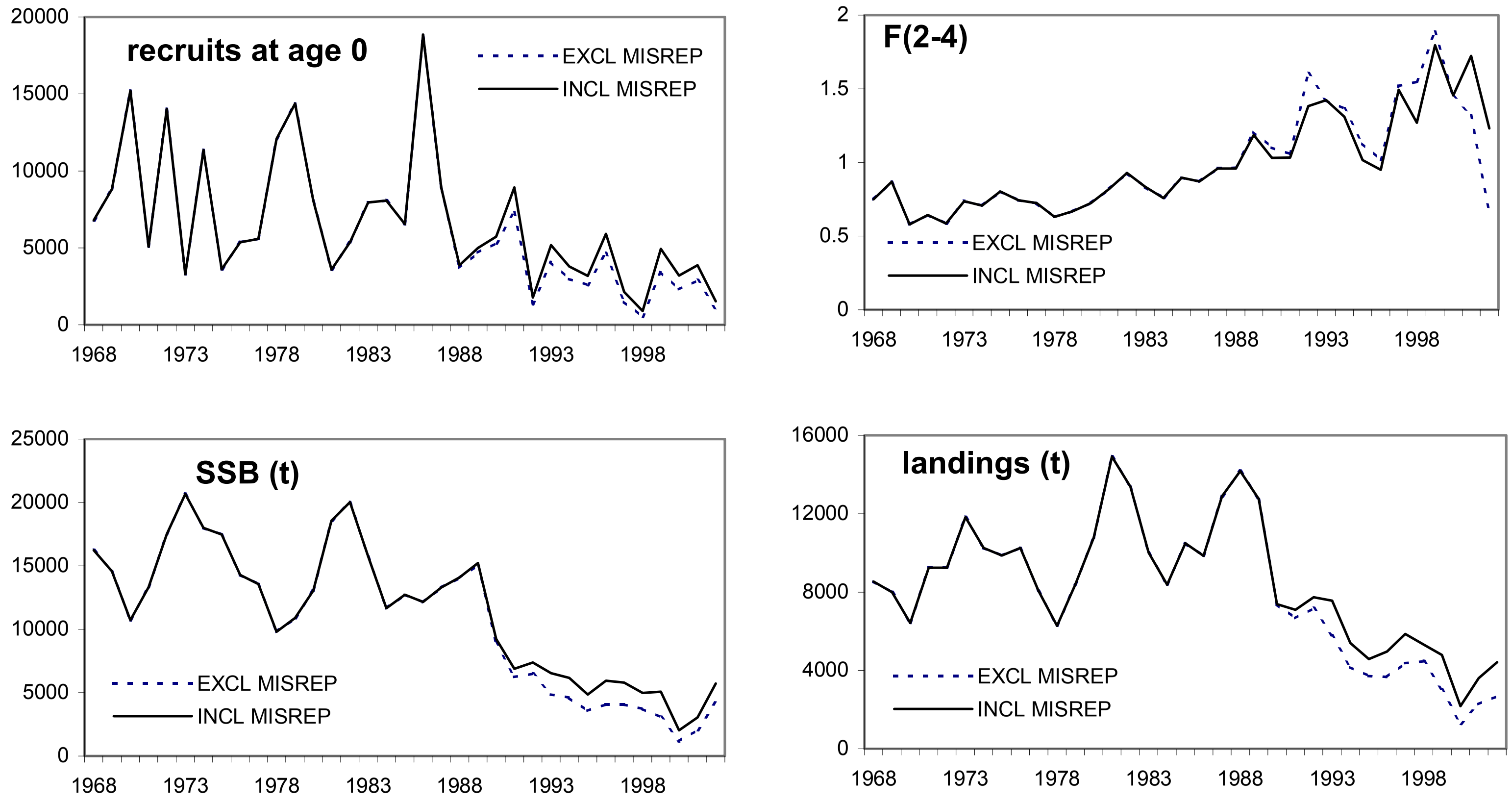


Fig. 8.5.1.3.6 Cod in VIIa: Comparison of cod XSA results including and excluding misreporting estimates from 1991-2002.

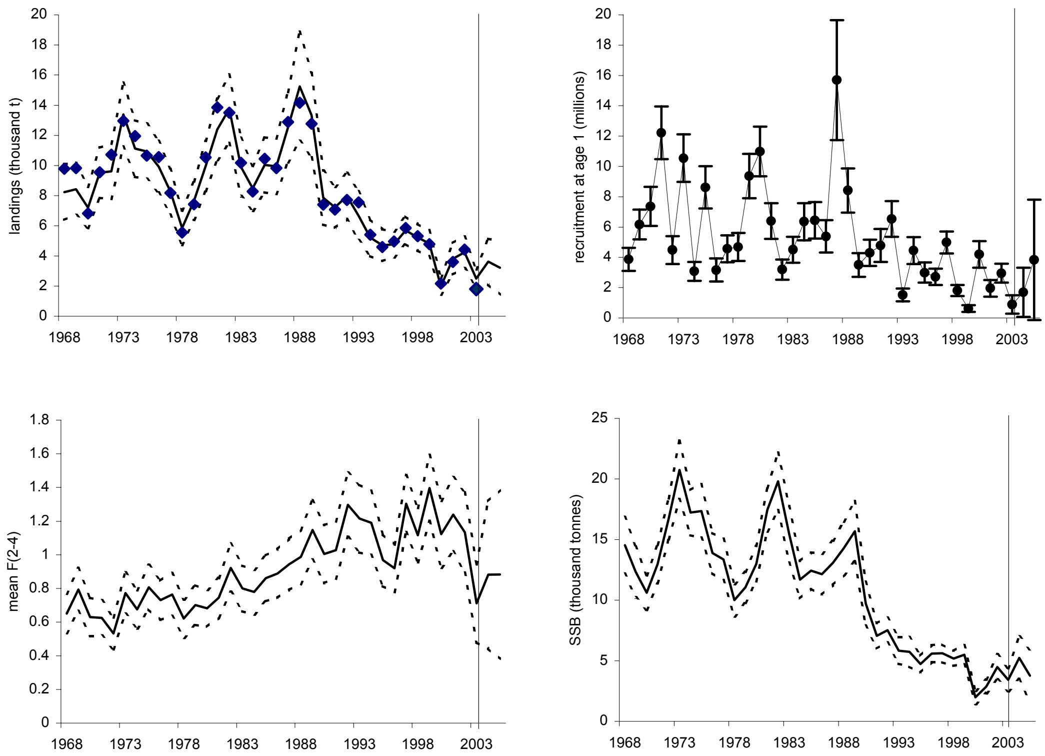


Fig. 8.5.1.3.7

Cod in VIIa. TSA summary plot of landings, recruitment, F(2-4) and SSB. Includes WG estimates of landings up to and including 2003 (diamonds in landings plot). Values to the right of the vertical line are TSA forecasts for 2004 and 2005.
Error lines are 2SE.

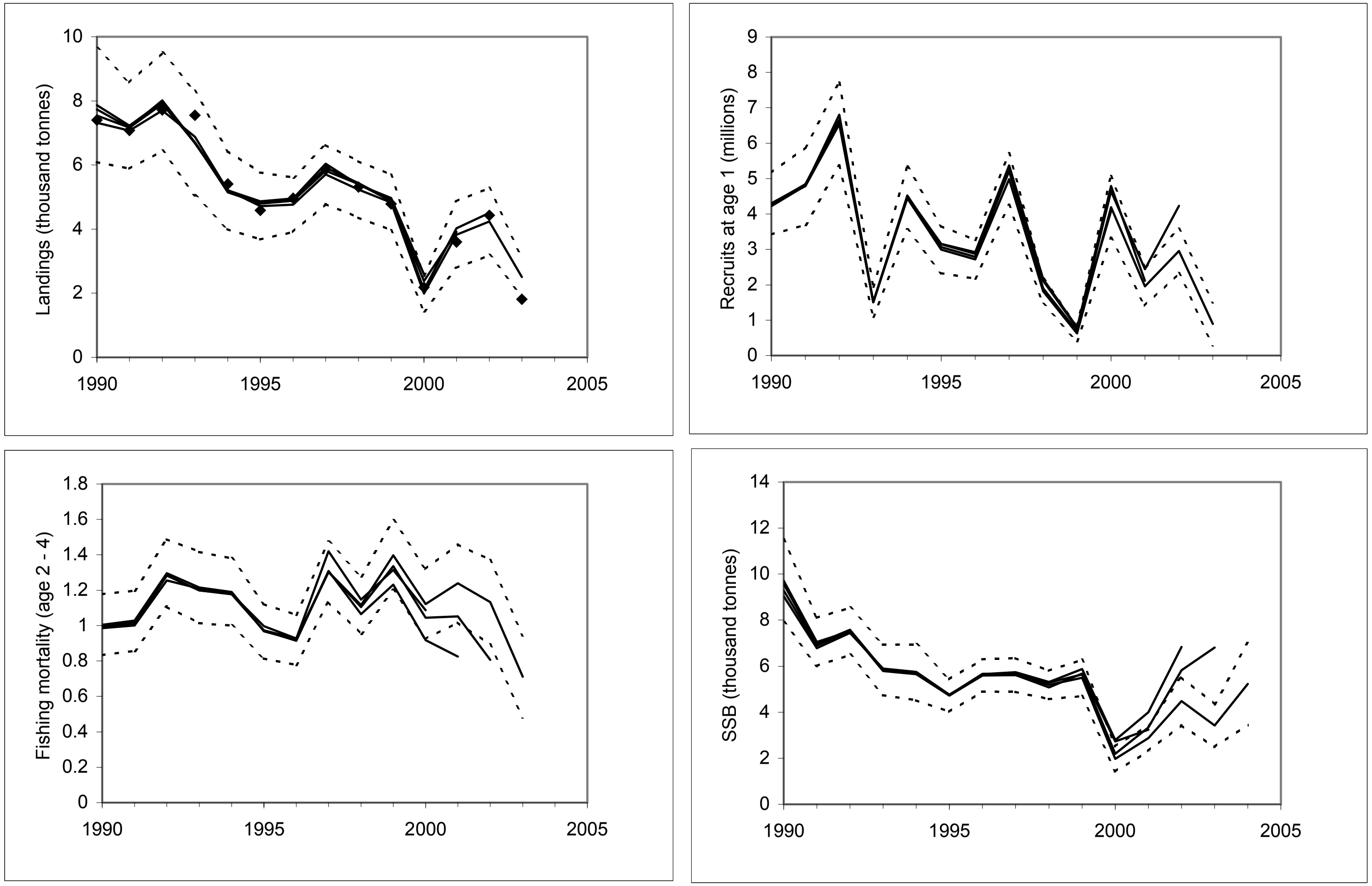
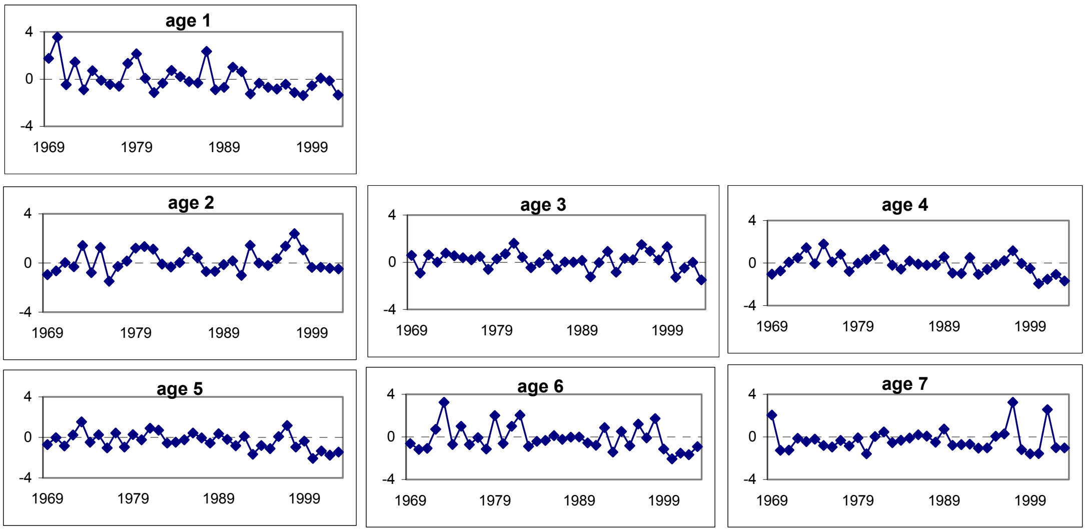
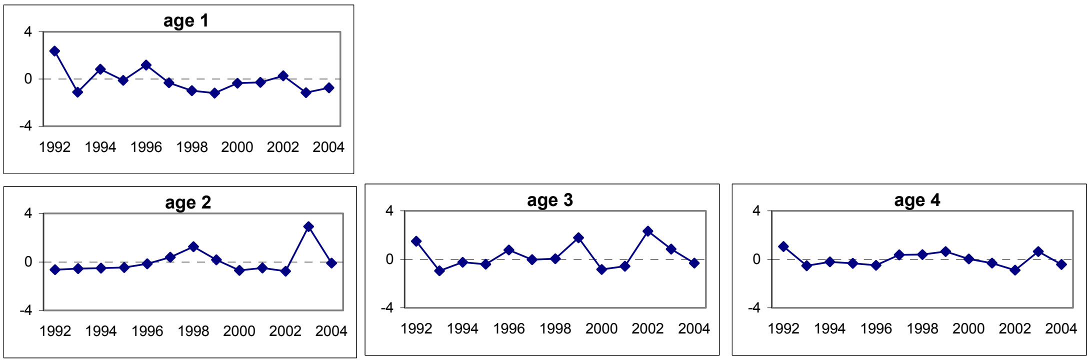


Fig. 8.5.1.3.8
Cod in VIIa. Retrospective TSA runs including WG landings estimate for 2003 and surveys to 2004 in the final run.
WG estimates of landings are given by the diamonds in the landings plot, and TSA estimates by the lines.
Dashed lines are TSA estimates from full series, plus or minus 2 SE.

VIIa cod catch standardised prediction errors



VIIa cod NIGFS March survey standardised prediction errors



VIIa cod ScoGFS Spring survey standardised prediction errors

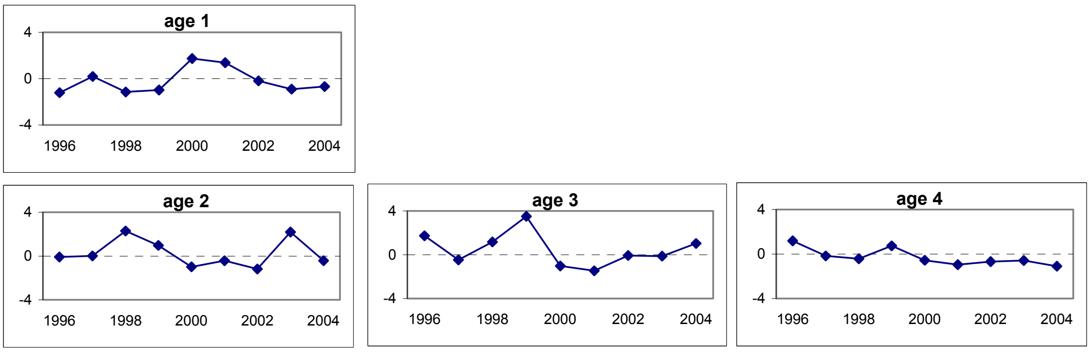
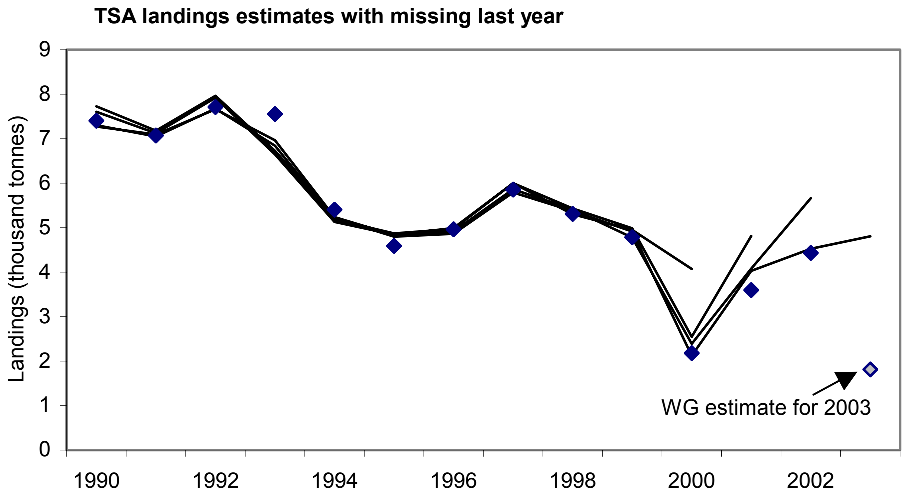


Fig. 8.5.1.3.9
Cod in VIIa: Standardised catch and survey prediction errors for TSA run including WG estimate of 2003 landings.



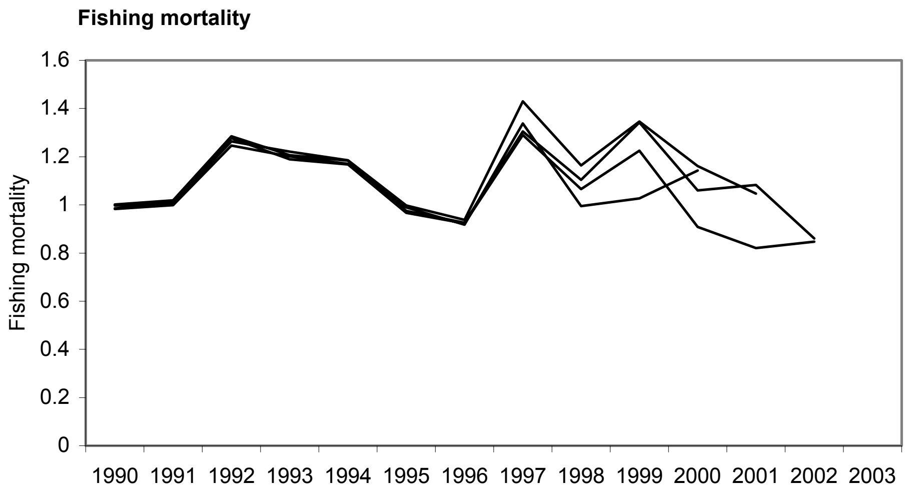
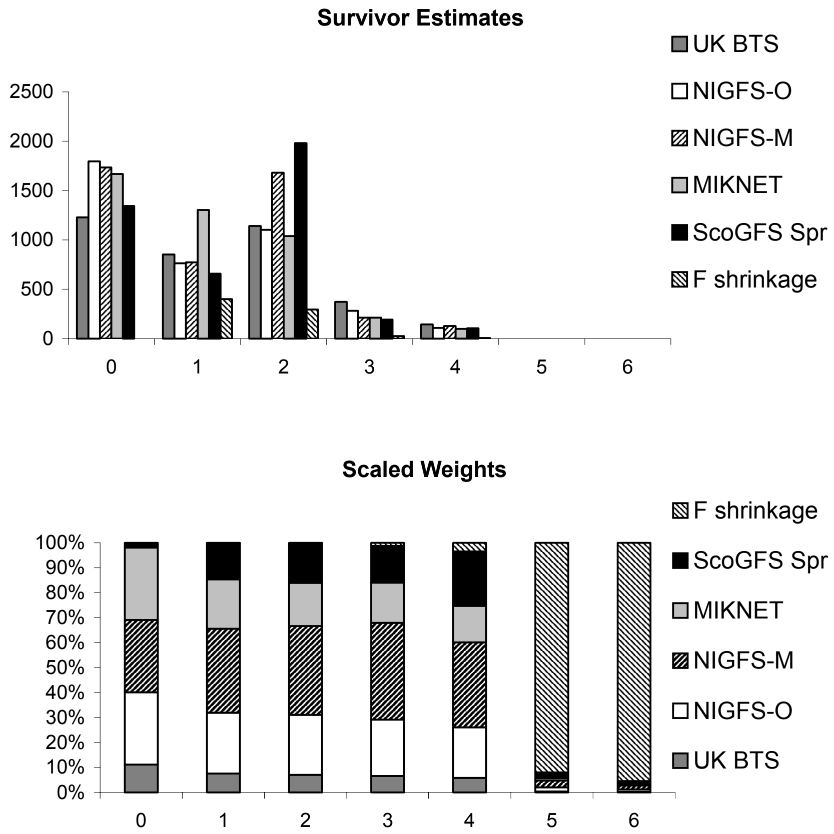


Fig. 8.5.1.3.10

Cod in VIIa. Retrospective TSA runs in which the landings in the terminal year in each run are treated as missing, with survey data available up to and including the year following the terminal year. Top figure shows TSA esimates of landings (lines) including the missing year, and WG estimates of landings (diamonds).

Figure 8.5.1.4.1 Cod in division VIIa:: Fleet based survivor estimatees and scaled weights by age from final XSA



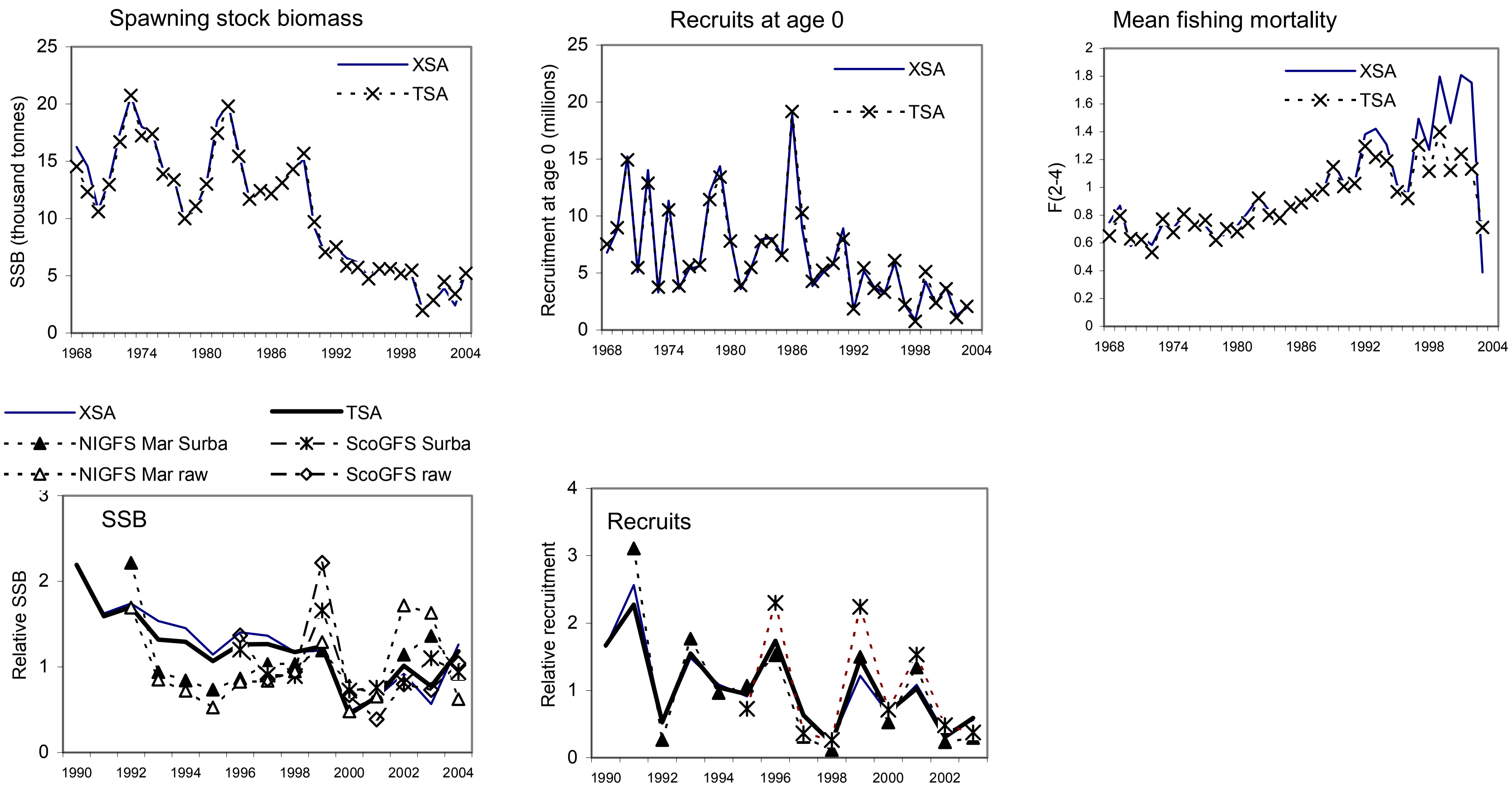


Fig. 8.5.1.4.2 Cod in VIIa. Comparison of XSA and TSA estimates of SSB, recruits and F(2-4). TSA recruits at age 1 have been adjusted to numbers at age 0, and are given by year class.
Bottom two plots show more recent trends in SSB and recruitment relative to the mean for years common to all series, and include raw survey data and SURBA estimates of relative SSB.

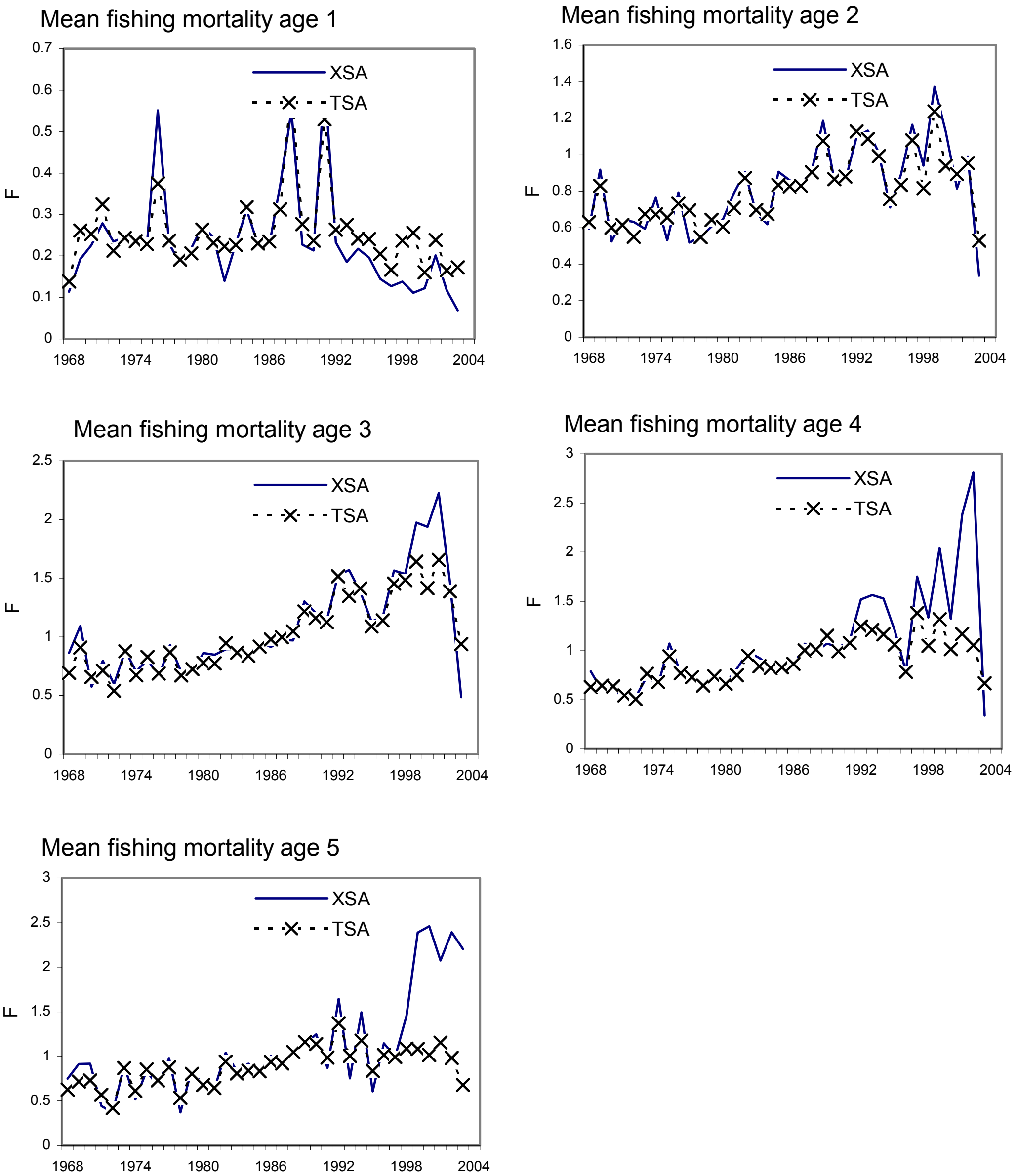


Fig. 8.5.1.4.3 Cod in VIIa. Comparison of XSA and TSA estimates of F at age

Figure 8.5.3.1 Cod in division VIIa : stock summary plot

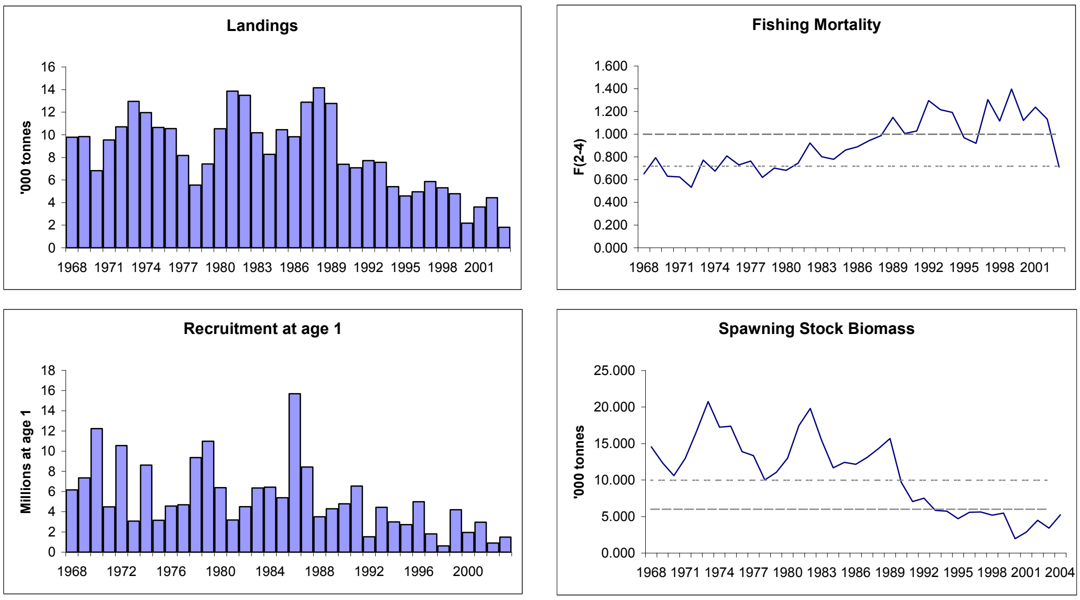
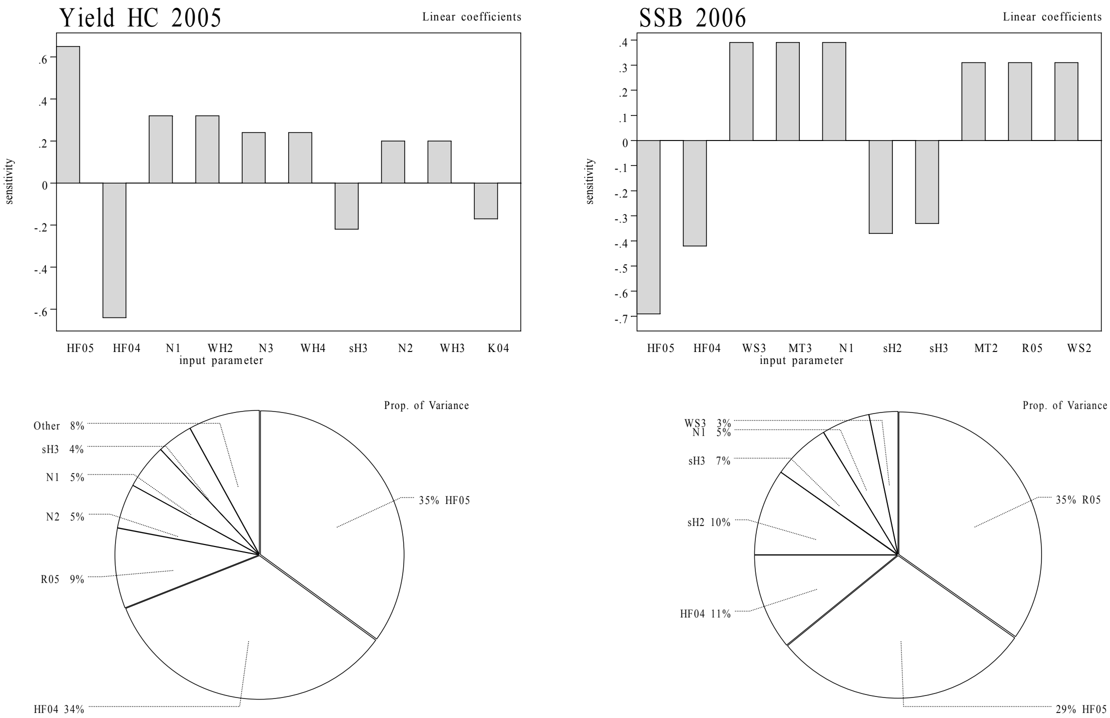
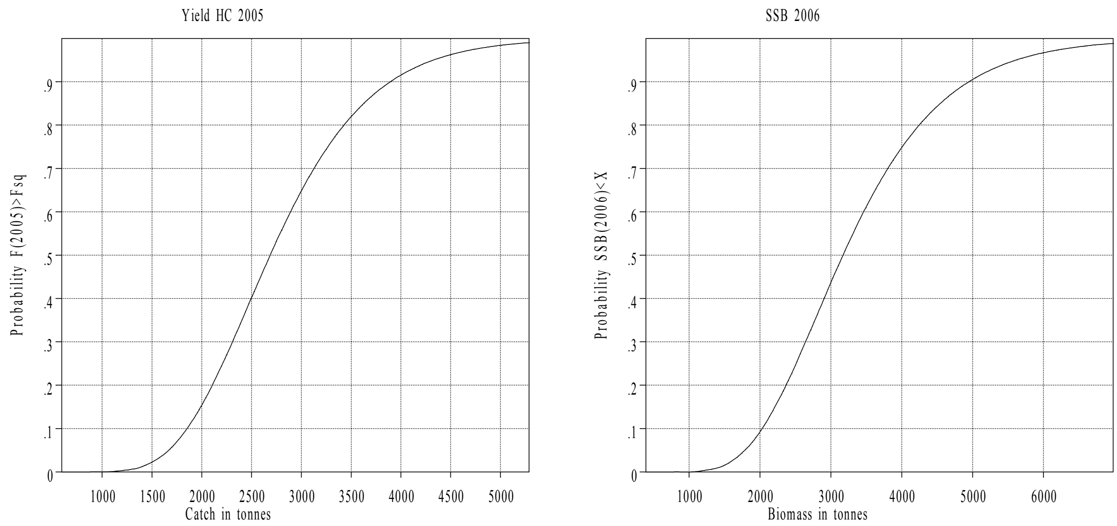


Figure 8.5.4.1 Cod,Irish Sea. Sensitivity analysis of short term forecast.



Data from file:F:\acfm\wgnsds\2004\Stock\cod-iris\final runs\XSA_ICA\MLA runs TS

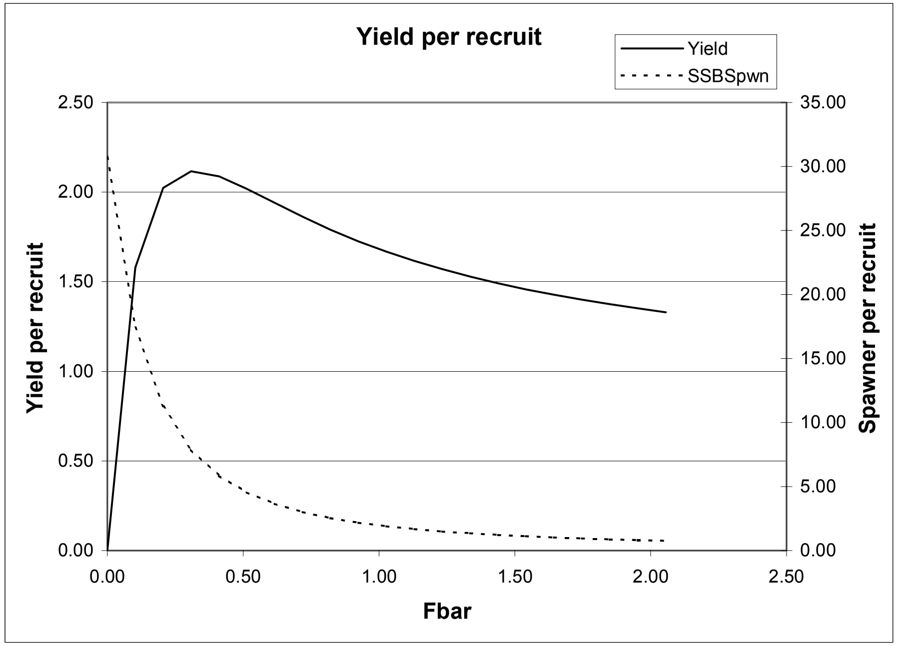
Figure 8.5.4.2 Cod,Irish Sea. Probability profiles for short term forecast.

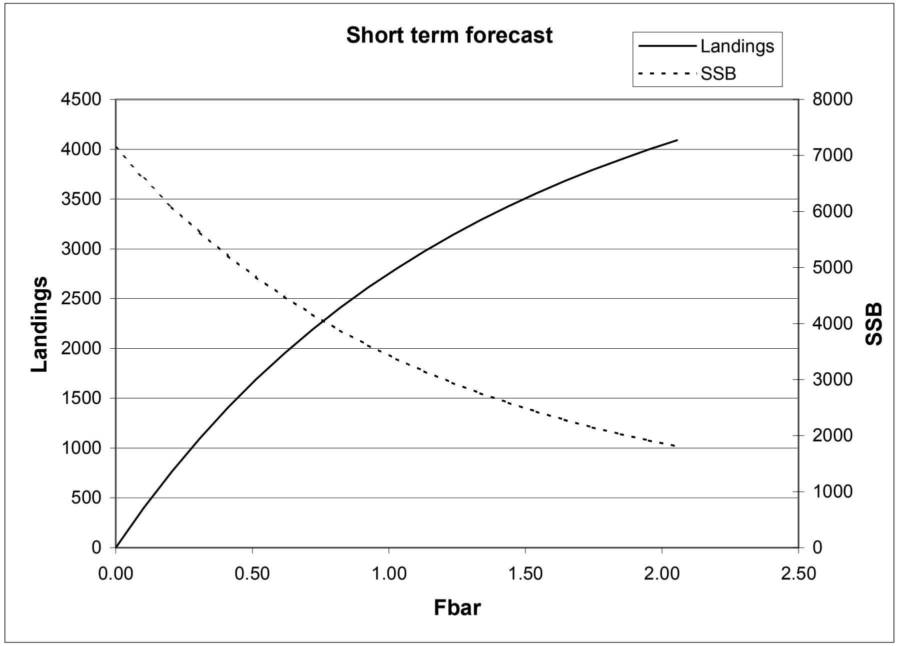


Data from file:F:\acfm\wgnsds\2004\Stock\cod-iris\final runs\XSA_ICA\MLA runs TS

Figure 8.5.5.1 Cod in VIIa. Stock recruit plot showing $\mathbf{F_{med}}$, Fcurrent and $\mathbf{F_{high}}$ with associated SSB per recruit values.

Figure 8.5.6.1 Cod in division VIIa   Results of short term forecast and yield per recruit analyses





MFYPR version 2a
Run: cod7aypr
Time and date: 21:21 11/05/2004

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	1.0277
FMax	0.3112	0.3198
F0.1	0.1786	0.1835
F35%SPR	0.2116	0.2175

Weights in kilograms

MFDP version 1a
Run: cod7astp
"IRISH SEA COD, NSWG 2003, COMBSEX,PLUSGROUP"
Time and date: 21:19 11/05/2004
Fbar age range: 2-4

Input units are thousands and kg - output in tonnes

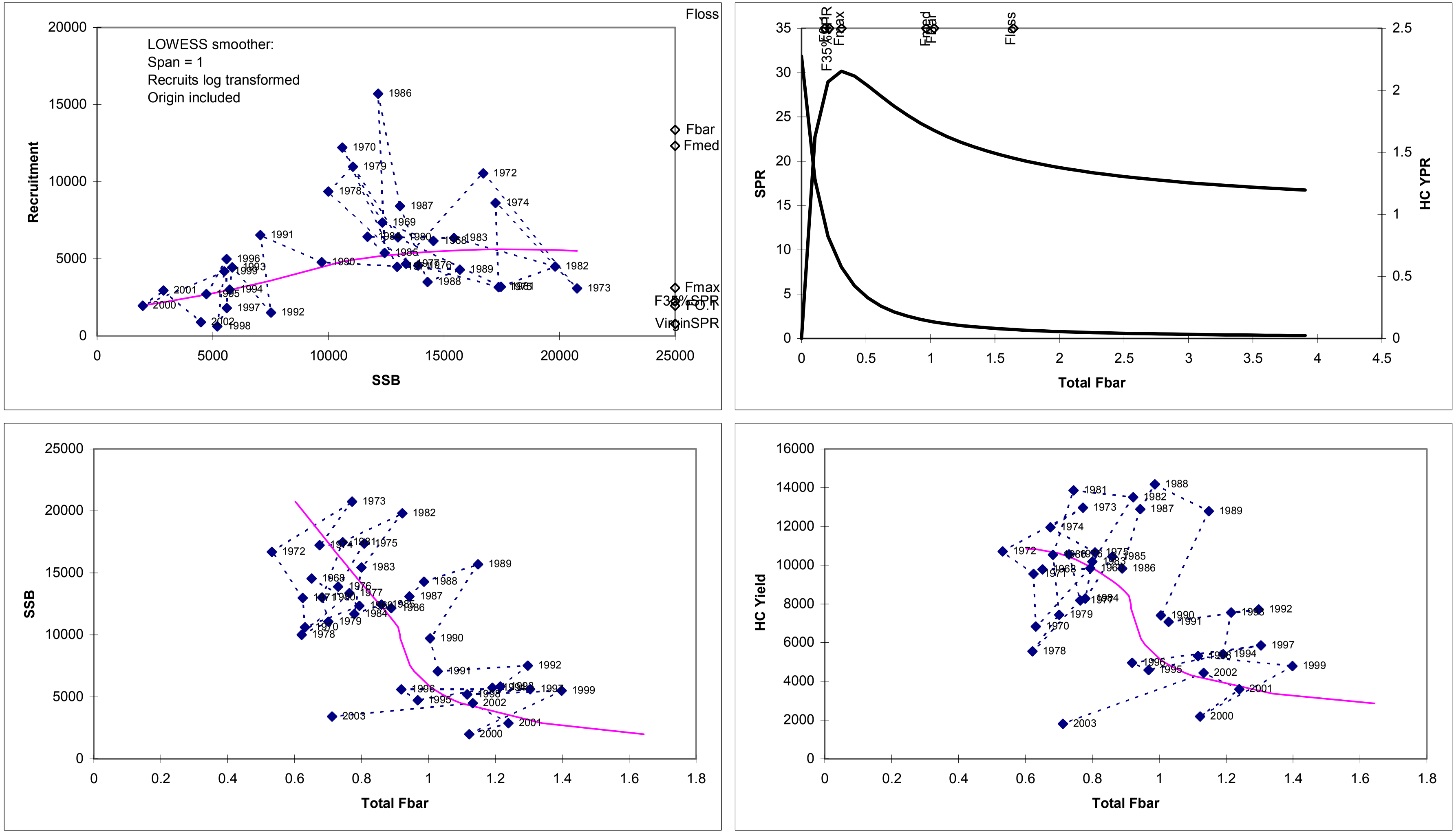


Fig. 8.5.7.1 Cod in VIIa. Precautionary plots showing S/R plot with Lowess smoother, and plots of SPR, SSB and landings as a function of F(2-4)

9 HADDOCK IN DIVISION VIIa

The Working Group attempted a benchmark assessment for this stock in 2004. After ACFM rejected the 2002 Working Group assessment because of apparent sensitivity of the results to F-shrinkage options, the 2003 Working Group revised the XSA model settings to those giving status quo forecasts closest to observed landings in recent years. The resultant model was more in line with the one used by the WG in 2001 and earlier years. The assessment was considered by ACFM to be of relatively poor quality but was accepted on pragmatic grounds. Due to unreliable landings estimates and catch numbers-at-age for 2003 (see Section 9.3), the current analysis focuses on a survey based assessment. Given the time involved in preparing a benchmark assessment, the WG was unable to prepare a stock annex for this stock.

9.1 The fishery

Directed fishing for haddock in the Irish Sea is mainly carried out by UK(Northern Ireland) midwater trawlers using 100mm mesh cod-ends, particularly targeting aggregations that can be detected acoustically. These conditions prevail mainly during winter and spring when the hours of darkness are longest, and the fish are aggregating on the spawning grounds in the western Irish Sea. Other demersal whitefish vessels from Northern Ireland, Ireland and to a lesser extent Scotland, using single or twin trawls with 100mm mesh, also target haddock when abundant. (Prior to the introduction of Council technical conservation Regulation 850/98 in 2001, most whitefish vessels in the Irish Sea used 80mm cod-ends.) By-catches of haddock are made in the UK(NI) and Irish *Nephrops* fisheries using single nets with 70mm cod-ends or twin trawls with 80mm cod-ends. The haddock stock is mainly distributed in the western Irish Sea and south of the Isle of Man, preferring the coarser seabed sediments around the periphery of the muddy *Nephrops* grounds. Juveniles are taken extensively in the otter trawl fisheries in these areas, leading to substantial discarding (see Section 9.3).

The nature of the fishery has been modified by the cod closure since 2000 (Council Regulation (EC) No 304/2000). Targeted fishing with whitefish trawls was prohibited inside the closure from mid February to the end of April. Derogations for *Nephrops* fishing were allowed. Irish *Nephrops* trawlers were involved in an experiment to test inclined separator panels in 2000 and 2001, the object being to minimise the by-catch of cod. Fishing inside a small area of the western Irish Sea closed to all fishing in spring 2000 and 2001 was permitted if separator panels were used. These panels would also have allowed escapement of part of the haddock catch. Closure of the main whitefish fishing grounds in spring 2000 resulted in a shift in fishing activities of mid-water trawlers and other UK(NI) whitefish vessels into the North Channel (area VIIa) and Firth of Clyde (VIa south). A subsequent closure of the Firth of Clyde in spring 2001 under the VIa cod recovery programme (Council Regulation (EC) No 456/2001) resulted in a reduction in reported fishing activity in this region. Several rounds of decommissioning in 1995-97, 2001 and 2003 have reduced the size of the commercial fleets. UK vessels decommissioned at the beginning of 2002 accounted for 17% of the haddock landings from the Irish Sea in 1999-2001. A further round of decommissioning in 2003 removed 19 out of 237 UK vessels that operated in the Irish Sea at the beginning of 2004, representing a loss of 8% of the fleet by number and 9.3% by tonnage.

9.1.1 ICES advice applicable in 2003 and 2004

ICES advice for 2003 was that given the nature of the haddock fishery, i.e., taken in demersal fisheries with cod, fishing for haddock should not be permitted unless ways to harvest haddock without by-catch or discards of cod can be demonstrated.

ICES advice for 2004 was that fishing mortality in 2004 should be reduced to below F_{pa}, corresponding to catches no higher than 1,500 t in 2004. The advice on the exploitation of this stock in 2004 is presented in the context of mixed fisheries protecting stocks outside safe biological limits.

No limit reference points have been set for this stock due to the short time series of assessment data. ICES has adopted a precautionary F_{pa} of 0.5 as this is the value for the neighbouring stock in VIa.

9.1.2 Management applicable in 2003 and 2004

Management advice and WG landings in 2003 and 2004 are summarised below:

Year	Single species exploitation boundary[1]	Basis	TAC	F multiplier associated with TAC[2]	WG landings	SQ catch landings forecast
2002	<1200	Reduce F below Fpa	1300	0.38	1972	2340
2003	0	Linked to cod	585	<0.1	617	5310
2004	<1500	Reduce F below Fpa	<1500	0.48		2350

[1] VIIa allocation for VII, VIII, IX, X. [2] From short term forecast.

Whilst management of VIIa haddock remains linked to the cod recovery plan because of the by-catch of cod in the haddock fishery, the TAC in 2003 was set on the basis of F-reductions calculated for North Sea haddock in relation to the needs for conserving North Sea cod. ACFM rejected the 2002 WGNSDS assessment and therefore provided the Commission with no analytical basis for setting an Irish Sea TAC. Previous WG forecasts have tended to overestimate catches.

Mesh size was increased from 80mm to 100mm in the directed whitefish fishery in 2001, together with other modifications to trawl designs incorporated in Community legislation as part of the recovery plan, may reduce by-catch of under-sized haddock.

Gear specific effort regulations (days at sea) have been introduced in the Irish Sea in 2004. Annex V to Council Regulation (EC) No 2341/2002 regulated the maximum number of days in any calendar month of 2004 for which a fishing vessel may be absent from port in the Irish Sea. Monthly effort limitation under this Regulation is as follows: 10 days for demersal trawls, seines and similar towed gears with mesh size >= 100mm, 14 days for beam trawls of mesh size >= 80mm and static demersal nets, 17 days for demersal longlines, and 22 days for demersal trawls, seines and similar towed gears with mesh size 70-99mm. Additional days are available for vessels meeting certain conditions such as track record of low cod catches. In particular, an additional two days are available for whitefish trawlers (mesh >= 100mm) and beam trawlers (mesh >=80mm) which spend more than half of their allocated days in a given management period fishing in the Irish Sea, in recognition of the area closure in the Irish Sea and the assumed reduction in fishing mortality on cod.

The minimum landing size for haddock in the Irish Sea is 30cm.

9.1.3 The fishery in 2003

The fishery in 2003 was prosecuted by the same fleets and gears as in recent years, with directed fishing prevented inside the cod closure in spring. The shift of whitefish vessels to the Clyde was less marked since 2001 because of the Clyde closure.

Table 9.1.3.1 gives nominal landings of haddock from the Irish Sea (Division VIIa) as reported by each country to ICES since 1984, together with Working Group estimates. Longer-term trends are given in Table 9.1.3.2. The Working Group estimate 2003 is incomplete. The catch statistics for 2003 supplied to the WG were only 617 t, which comparable to figures before the expansion of the haddock stock in the early 1990s. During the years 1993-2002 the annual landings of haddock into several major Irish Sea ports were estimated from observations made by scientists carrying out length measures. Sample based estimates of landings was not available for 2003, since scientists were unable to gain access to several major ports during quarters 2 to 4. Misreporting has been variable over the time series and considering the restrictive TAC for 2003, it was not possible to make an estimate of misreporting in 2003. The WG estimate of international landings for 2003 is slightly above the TAC of 585 t.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
% of WG landings comprising of misreporting estimates	10	37	51	60	45	36	42	-14	11	64

Approximately 62% of the interim year forecast given by last year's WG for 2003 (by number) comprised fish of the strong 2001 year-class.

9.2 Commercial catch-effort and research vessel surveys

Age-structured abundance indices are available from the following sources:

UK(NI) groundfish survey (NIGFS) in March (age classes 1 to 4, years 1992 - 2004)

UK(NI) groundfish survey (NIGFS) in October (age classes 0 to 3; years 1991 to 2003)

Republic of Ireland Irish Sea – Celtic Sea groundfish survey (IR-ISCSGFS) in November (ages 0 to 5; years 1997 – 2002)

Republic of Ireland groundfish survey (IR-GFS) in autumn (age classes 0 to 6, year 2003)

UK(NI) Methot-Isaacs Kidd (MIK) net survey in June (age 0; years 1994 – 2003)

UK(Scotland) groundfish survey (SCOGFS) in spring (age classes 1 to 4, years 1996 – 2004)

UK(Scotland) groundfish survey (SCOGFS) in autumn (age classes 0 to 3, years 1996 – 2003).

The SCOGFS spring and autumn surveys were two new survey series provided to the WG in 2003. The new Irish survey starting in 2003 is an IBTS-coordinated survey. The Scottish in Division VIIa is an extension of a survey covering Division VI and the Irish survey an extension of a survey covering Divisions VI and VIIb-k. The tuning files are given in Table 9.2.1.

9.3 Catch age composition and mean weights at age in the catch

Data on age compositions of landings and associated mean weights at age were provided by Northern Ireland and Ireland in 2003. The landings of the fleets sampled by quarter comprise only 22% of the international total in 2003 compared with 85% in 2002. Numbers measured and aged are given in Table 2.2.2. The series of international landings at age and mean weight at age are given in Tables 9.3.1 and 9.3.2.

Sampling levels and coverage were particularly poor in 2003. Age compositions of UK(NI) landings were available only for quarter 1. In addition, only patchy fleet specific sampling data were available from the Irish fleets, i.e., age composition data for all quarters from the beam trawl fleet and for quarter 2 and 3 only from the otter trawl fleet. Landings of these fleets comprised only 9% of the annual Irish landings. Comparing the proportion of numbers at age by country showed variable trends over years, quarters and countries. Given the low sampling levels and the variable proportions at-age by country, the WG considered that application of Irish age composition information to the UK(NI) fleets in quarters 2-4 as inappropriate. No representative international catch numbers-at-age could, thus be provided for 2003.

Previous analytical assessments have been based on landings only. The potential magnitude of discarding was evaluated using limited data from the following fleets:

- Northern Ireland *Nephrops* fishery. The fisher self-sampling scheme that provides discards data for VIIa whiting was altered in 1996 to record quantities of other species in the samples. Length frequencies of haddock in the samples were raised to numbers discarded quarterly and annually by the fleet. No otoliths were collected, but the length frequencies could be partitioned to age class based on appearance of modes and comparison with length-at-age distributions in March and October surveys. The age data from 2001and 2002 were derived using survey and commercial fleet ALKs. Only quarter one data are available from this fleet in 2003.

- Northern Ireland mid-water trawl and twin-trawl fleets. These fleets were sampled randomly by observers as part of two EU contracts. Data were available for quarters 2-4 in 1997, 1-3 in 1998, 3-4 in 1999, 1-4 in 2000 and 1 in 2001.

- Irish otter trawl fleet (IR-OTB). Discards are estimated by observers on Irish trawlers operating in VIIa. Estimates for this fleet are given in the report of the ICES Study Group on Discards and By-catch Information (ICES CM 2002 ACFM:09). The anomalous high estimate of discards for this fleet in 2001 was a result of an inappropriate raising procedure, and data for this year are not presented. No discard data were available for 2002 due to a very limited number of sampling trips (n=1). This sampling level has increased in 2003, but is still low (n=6).

Due to the poor levels of discard sampling in 2003, a reliable estimate could not be provided. Historically, discarding took place mainly at ages 0 to 2 in the otter trawl fisheries and at ages 1 to 2 in the mid-water trawl fishery (Table 9.3.4). The absence of 0-group discards in the mid-water trawl fishery reflects the deep-water distribution of fishing in this fishery. Discard rates could not be calculated from the *Nephrops* fishery self-sampling scheme as concomitant landings were not recorded or samples taken. Discarding in the mid-water trawl and twin trawl fishery was strongly influenced by the minimum landing size of 30cm. Proportions discarded at age are given in Table 9.3.5. These results indicate that discarding may account for a significant and potentially variable fishing mortality on age classes 1 and 2 in particular.

A time series of discard estimates for VIIa haddock was constructed by the 2003 WG for exploratory use only to determine if estimates of F(2-4) and SSB are sensitive to inclusion of discards data, and to investigate the magnitude of fishing mortality caused by discarding. The discard data in its present form are not considered to be reliable. Table 9.3.6 gives the total catch at age for 1993-2002 including the estimates of discards.

9.4 Natural mortality, maturity and stock weights at age

The proportion of F and M before spawning were set to zero to reflect a SSB calculation date of 1 January. In the absence of a direct estimate of natural mortality of Irish Sea haddock, a constant value of $M = 0.2$ was assumed for all age classes and years, as for other stocks of gadoids assessed by the Working Group.

Proportion mature haddock is assumed knife-edged at age 2 for all years. A preliminary study into the changes in maturity of the Irish Sea haddock stock was performed using the NIGFS-March survey data. GLM analysis on the effects of year, region, age, and length on the probability of being mature showed that maturity is determined differently for male and female haddock. Maturity was found to be predominantly a function of length in male haddock, while age was the main factor in females. Interannual variation in the proportion mature was mostly confined to the age 2 group, while other age groups were either fully immature or fully mature. Over 99% of 3-year-olds were mature.

There is evidence for a decline in mean length of adult haddock over time (Fig. 9.4.1), which needs to be reflected in the stock weights at age. Working Groups prior to 2001 used constant weights at age over years based on analysis of some early survey data. Since 2001 the WG calculated stock weights by fitting a Von Bertalanffy growth curve to all available survey estimates of mean length at age in March, with an additional vector of parameters estimated to allow for year-class effects in asymptotic length. To increase the number of observations for older age classes, the mean lengths at age in Northern Ireland first-quarter landings were included for age classes three and over. (Comparisons of survey and landings data showed that values from landings were larger than from the survey at ages 1 and 2 because of selectivity patterns in the fishery, but very similar for ages 3 and over.) Stock weights at age were calculated from the model-fitted mean lengths at age, using length-weight parameters calculated from all March survey samples (2001 WG) or annual length-weight parameters (2002-2004 WG). The procedure was updated this year using NIGFS-March data for 2004 only, no commercial mean length at age data for 2003 Q1 were included due to low sample numbers. The time series of length weight parameters indicate a reduction in weight at length over 1996-2000:

	Length-weight parameters		Expected weight at length	
Year	*a*	*b*	30cm	40cm
1993	0.01132	2.972	278	653
1994	0.00374	3.279	261	669
1995	0.00354	3.291	257	661
1996	0.00565	3.156	259	642
1997	0.00723	3.104	278	680
1998	0.00633	3.119	256	629
1999	0.00449	3.208	246	620
2000	0.00439	3.208	241	606
2001	0.00402	3.242	247	627
2002	0.00369	3.268	247	633
2003	0.00459	3.197	242	607

This decline coincides with the large growth in biomass of haddock in the Irish Sea.

The following model was fitted to the length at age data:

- $L_{t,yc} = LI_{yc} . (1-exp(-K(t-t_0)))$

where LI_{yc} is the estimated asymptotic length for year class yc. Parameters were estimated using Microsoft Solver in Excel by minimising $\Sigma(\ln(\text{observed } L_t \ / \text{ expected. } L_t))^2$.

The following parameter estimates were obtained (last year's estimates in parentheses):

Mean LI_{yc} = 71.8 cm (73.4); K = 0.269 (0.267); t_0 = -0.176 (-0.155)

Year class effects giving estimates of asymptotic length relative to the mean were as follows (2002 and 2003 data were combined as there is only one observation for the 2002 year-class)):

Year class	Effect	Year class	Effect
1990	1.198	1997	0.935
1991	1.103	1998	0.945
1992	1.038	1999	0.811
1993	1.058	2000	0.899
1994	1.074	2001	0.909
1995	1.042	2002/2003	0.957
1996	0.961		

The year-class effects show a smooth decline from the mid-1990s coincident with the rapid growth of the stock, and may represent density-dependent growth effects. The close fit of the model to observed length-at-age data is shown by year class in Figure 9.4.1. The year-class parameters effectively remove the temporal trend in residuals around a single Von Bertalanffy model fit without year class effects.

To estimate mean weight at age for year-classes prior to 1990, represented as older fish in the early part of the time-series, the year-class effect for the 1990 year-class and length-weight parameters for 1993 were assumed. The resultant stock weights at age are given in Table 9.3.3.

9.5 Catch-at-age analysis

The general approach adopted to catch-at-age analysis by the Working group is outlined in section 2.6. The VIIa haddock stock has been assessed in previous years using XSA. With no accurate landings estimate in 2003 and no catch at age data available for the terminal year, the WG explored the use of a Survey Based Assessment (SURBA) and Time Series Analysis (TSA) which allows the 2003 commercial catch data to be treated as missing.

9.5.1 Data screening

Tuning data

The tuning data for this stock are given in Table 9.2.1. The relative cpue data are plotted against time in Fig. 9.5.1.1. Strong 1994, 1996, 1999, 2001 and 2003 year-classes are indicated by the 0-group indices from the October NIGFS and MIK survey. These strong year classes were also evident for the older age groups in all surveys, indicating that all series were capturing the prominent year-class signals in this stock. The 2002 WG carried out extensive review of survey tuning data using cross-correlation of survey time series and application of the Survey-Based Assessment model (SURBA). These analyses showed high consistency within each fleet and patchy consistency between the fleets. However, it should be noted that the time series are short. Last year's WG excluded the ScoGFS autumn survey from any further analysis due to the small number of stations in the western Irish Sea where haddock are most abundant, and the poor internal consistency and consistency with other fleets. The first year of the ScoGFS spring survey (1996) was also excluded as there was only one station per ICES rectangle resulting in only a few stations covering the western Irish Sea.

Three tuning fleets, NIGFS-March, NIGFS-Oct and ScoGFS-Spring, were screened using SURBA (ver. 2.2) to examine for year, age and cohort effects. Survey catchability and weighting factors by age were all entered manually as 1.0. The residuals of the single fleet runs (Figs 9.5.1.2 to 9.5.1.4) showed no obvious year-effects. The age effects for the surveys are difficult to interpret because of the narrow range of ages.

A general tendency for the temporal trend in F to increase up to 1998 and then decline is evident in the fishing mortality estimates for the NIGFS series (Fig. 9.5.1.5), whilst the shorter ScoGFS series shows a decline over the time series. Both the NIGFS series show the growth in SSB in the mid 1990s, a decline to 2000 and a subsequent increase. The trend from 1997 onwards in the ScoGFS survey was similar to the NIGFS-March survey, and all three fleets showed very similar estimates of recruitment at age 1 (Fig. 9.5.1.5). The SURBA model runs indicated good internal consistency in the tuning data and similar year-class patterns between fleets.

Given the absence of catch-at-age data in the terminal year the WG examined the possibility of using survey based assessment and forecast for the VIIa haddock stock. The international landings at age (up to 2002) show similar patterns of year-class variation to the surveys (Fig. 9.5.1.1), giving confidence in the combined ability of the surveys to track year classes through time and providing a relative estimate of catch. Landings and survey data were also compared in terms of age composition (Fig. 9.5.1.6). Discard data were not included in this analysis, thus age 2 was the youngest age considered in the comparison. The landings by the UK(NI) fleets in quarter 1 and 4 were compared in terms of age composition trends with the NIGFS quarter 1 and 4 groundfish surveys (1995-2002). The estimated proportion numbers at age in the survey and commercial catches show very similar trends across years, with the exception of small deviations in ages 3 and 4 in some years where higher proportions are observed in the landings. The result indicates that a survey-based assessment could provide reliable short-term forecasts of catch.

Exploratory assessment runs

The TSA model settings are given in Table 9.5.1.1. Due to TSA input data constraints on the minimum age class range and not being able to handle age class 0 with no catch data, only the NIGFS-March survey data were included in the analysis. The parameter estimates for the run based on catch data only and the run including survey data are given in Table 9.5.1.2. No catch estimate for 2003 was included in the analyses.

Summary plots for the two TSA runs are given in Figures 9.5.1.7-9.5.1.8 and the standardised prediction errors for the run including survey data are given in Figure 9.5.1.9. Both TSA models are able to fit the historical landings estimate fairly accurately. The model based on catch data only gives very imprecise catch, SSB and recruitment estimates. The stock is characterised by highly variable recruitment, which introduce considerable variability into the forecast. Without survey data the model is unable to adjust for the variation in recruitment. Including survey data in the TSA improved the model fit and gives a substantially narrower error distribution around the terminal estimates. The stronger signal in recruitment in 2004 is also accounted for. The standardised catch prediction errors show negative residuals in earlier years for the NIGFS-March survey, which is probably related to the expanding trend in stock size. The WG decided to adopt the TSA run including the survey data series.

The tuning data screening showed good internal consistency within fleets and similar trends between survey indices. Given these results and the combined ability of the surveys to track year classes evident from the landings data through time, and the similarities in age composition between the landings and survey data, the WG concluded that a final assessment and forecast could be based on survey data. This can be achieved by scaling the survey-based predictions to historical landings.

9.5.2 Final assessment

Final SURBA

The SURBA fitted fishing mortality-at-age, survey indices and catch-at-age the NIGFS-Mar, NIGFS-Oct and ScoGFS-Spring are given in Table 9.5.2.1.

Final TSA run

The input parameters for the final TSA run are given in Table 9.5.1.1, and the parameter estimates are given in Table 9.5.1.2. Estimates of fishing mortality at age and their standard errors are given in Tables 9.5.2.3 and 9.5.2.4. Estimates of stock numbers and standard errors are in Tables 9.5.2.5 and 9.5.2.6. Summary data are in Table 9.5.2.7. Trends in estimated landings, fishing mortality, recruitment and SSB are plotted in Figure 9.5.1.8, with standardised residuals plotted in Fig. 9.5.1.9.

The time-series of numbers at age from the final TSA run are plotted as relative values in Fig. 9.5.2.1 together with the fitted survey indices from the SURBA runs. In general, the SURBA and TSA results capture similar year-class dynamics. The main exception is in the survivors of the 2001 year-class for which the SURBA model estimates very large values for 3-year-olds in 2004 compared with TSA which cannot adjust for large signals in the abundance. This may lead to a conservative TSA forecast of numbers of 5-year-olds in 2005. The SURBA and TSA estimates also closely follow the landings at age (data presented up to 2002), except for 1-year-olds in 2001 (Fig. 9.5.2.1). Samples from UK(NI) landings in the third and fourth quarter in 2001 contained relatively large numbers of small haddock. The 2003 WG, however, noted that a catch at age data set containing discards gives a relatively small total catch of 1-year-olds in 2001.

A comparison between the F, SSB and recruitment estimates given by TSA and SURBA is given in Figure 9.5.2.2. Both methods give similar estimates of historical trends in SSB and recruitment, but diverge in estimates of F(2-3). The majority of the SURBA estimates of mean F are higher than those from TSA. The estimates for 2002 are almost identical for both methods. The F estimates for 2003 shows similar upwards trends from the NIGFS-March survey and TSA, whereas the ScoGFS survey indicates a decrease in F. The combined F from the SURBA trends (including the 3-year mean F from the NIGFS-Oct survey) are taken forward to estimate catch for 2003 based on the SURBA fits and will be higher than the TSA estimate of F. This may indicate that the estimate of landings in 2003 from the SURBA fits will be larger than the TSA estimate.

9.5.3 Comparison with 2003 WG assessment

Figure 9.5.2.2 compares the relative trends between the SURBA fitted estimates, TSA and the 2003 WG XSA run. Both SURBA and TSA give higher estimates of SSB than the 2003 XSA run. The recuitment estimates for 2003 is similar for all three methods. Both the final TSA and SURBA runs give higher estimates of F(2-3) in 2002. Despite the different trends in F over the entire time series for the different assessment methods, it has relatively little effect on the SSB trends.

9.6 Estimating recruiting year class abundance

The SURBA runs give model estimates of relative abundance at age up to the 2003 year class from NIGFS-Oct at age 0 and NIGFS-Mar and ScoGFS-Spring at age 1. The survey-based forecast uses the geometric mean recruitment index from the NIGFS SURBA model fits for the year classes 1994 – 2003 (indices for earlier year classes are from a period of stock growth from very low population size and may not be representative of recruitment in the immediate future). The ScoGFS series is shorter, and a geometric mean could only be calculated for year classes 1996 – 2003. The GM values relative to historical values are given in Table 9.6.1.

Recruitment estimates for forecasts based on XSA are available from the 2003 WG final XSA run, giving numbers at age 0 in 2002 of 3,710 thousand fish. This is estimated from four research vessel series, which give a combined estimate of similar magnitude to the P-shrinkage value. Hence this estimate was accepted for forecasts. The 2003 WG used a GM mean of the XSA series 1993-2002 (5461 thousands) for subsequent year classes at age 0. This year, additional survey data were available to allow prediction of the 2003 year class using RCT3. Input data for RCT3 are given in Table 9.6.2 and output in Table 9.6.3. The XSA estimate for the 2002 year class was included in the calibration because of the short series of data available. The four survey series used were NIGFS-Oct at age 0, NIGFS-Mar at age 1, ScoGFS-Spring at age 1 and NI-MIKnet at age 0. The survey predictions carry 85% of the weighting. The different survey predictions for the 2003 year class are similar for the groundfish surveys with the MIKnet survey giving a lower prediction (Table 9.6.3)

The text table below summarises the values of recruitment available for use in the TSA and XSA-based forecasts, with the values used by the WG in bold.

Year class	Recruits at age 0 (thousands)			
	XSA	RCT3	$GM_{92\text{-}02}$	TSA
2002	**3,710**	4,118	5,461	15,307
2003		**8,487**	5,461	3,135
2004			**5,461**	9,284
2005			**5,461**	6,118

9.7 Long term trends of biomass, recruitment and fishing mortality

Detailed knowledge of the development of this stock is restricted to the recent period for which survey data are available. Figure 9.7.1 summarise the estimates of recruitment, spawning stock biomass, landings and F(2-3) for the period 1993 to 2003 from last year's VPA output and this year's final TSA. Longer-term trends in landings are given in Table 9.1.3.2. The spawning stock biomass increased substantially following entry of the strong 1994 and 1996 year-classes. High fishing mortality combined with weaker year classes in 1997 and 1998 resulted in a decline in abundance from 1999 to 2000. Stronger recruitment in 1999 and 2001 resulted in an increase in biomass since 2001. It is emphasized that the historical estimates of abundance are reconstructed from landings at age conditional on the estimates of fishing mortality which are essentially converged by the late 1990s. Inclusion of discards and any non-reported landings not already in the data sets would add additional biomass and numbers historically, as well as altering the survey calibration. Nonetheless, the general trend of development of SSB indicated by the survey-based SURBA runs (Fig. 9.5.2.2) is largely in accord with the trends given by the XSA in 2003 and the TSA in 2004. Stock numbers from the 2003 WG final XSA run are given in Table 9.7.1.

9.8 Short-term catch predictions

Catch predictions for 2004 and 2005 were carried out using three methods:

i) Survey-based forecasts using SURBA indices of abundance, mortality and catch;

ii) Extension of the 2003 WG XSA-based forecast updated to include more recent information on recruitment;

iii) Forecasts from the TSA model fitted to landings at age data up to 2002 (2003 treated as missing) and trawl survey data up to March 2004.

9.8.1 Survey based forecasts

The fitted survey indices from SURBA runs using NIGFS-Mar and ScoGFS(Spr) data were projected from the terminal year with survey data (2004), using GM survey indices for year classes 2004 onwards, and assuming the same total mortality (Z) as estimated for 2001-2003. The estimates of mean F-at age in these years were obtained as Z - 0.2, and applied to the forecasted indices of abundance to give indices of catch numbers at age. A similar procedure was followed for using the NIGFS-Oct data with terminal year (2003), assuming the same Z as estimated for 2000-2003. An index of landings numbers at age in the forecast years was obtained from the resultant indices of total catch by applying a mean discard ogive calculated from observed landings and discards over the period 2000 to 2002. The proportions discarded by age are listed in Table 9.5.2.2. The landings at age indices were converted to weight using mean weights at age. The weights at age for the forecast period were the stock weights at age calculated as described in Section 9.4, converted to landings-equivalents using a mean ratio of observed landings weights at age to modelled stock weights. This was done by applying the average ratio between observed catch weight-at-age and the stock weight-at-age by age group (1999-2002). The 4-year average period was selected to cover the age range normally considered in the assessment. This procedure allowed for trends in weights at age observed during development of the stock.

An historic trend of SURBA fitted survey indices by age were scaled to the historic WG landing estimates after applying the mean weight at age in the catch matrix (see section 9.3) and a discard ogive to the survey indices. Although the time series of discard estimates for this stock is not very reliable, it was necessary to apply a discard ogive to the survey indices to enable comparison with historical landing estimates. An average discard ogive (1996-2002) was applied to years with no sampling information. Figure 9.8.1.1 shows the scaled mean standardised fitted survey index from the SURBA runs for the NIGFS-March, NIGFS-Oct and ScoGFS-Spring plotted together with the mean standardised trend in historic WG landings estimates. The scaled indices for the two NI groundfish surveys slightly underestimate the estimated landings in the early and mid 1990s, but show similar trends. The landings are not well estimated by the surveys from 1997 to 1999, either underestimating or overestimating the WG landings. The two UK(NI) surveys estimate the WG landings estimates accurately for the last three years, whereas the Scottish survey slightly underestimates the landings but shows a similar trend. The catch estimates for 2003 are consistent between fleets and are indicated to be at similar levels to the 2001 estimates, or slightly higher. The estimated WG landings were regressed against the SURBA fitted catch indices to predict catches for 2003-2005.

Input data are given in Table 9.8.1.1 and the results presented in Table 9.8.1.2. The observed WG landings estimates were regressed against the SURBA fitted indices (Figure 9.8.2.2). These relationships for each survey were used to derive catch predictions for 2003-2005. Given the small number of observations, it was not possible to derive reliable weighting factors. The annual estimates of catch from SURBA were taken as the unscaled arithmetic mean of the individual survey estimates.

9.8.2 Extension of 2003 WG forecast

The 2003 WG final XSA estimates of survivors at ages 1 to 5+ at the start of 2003 were projected forwards at status quo F, using the RCT3 estimate of 8,487 thousand fish at age 0 for the 2003 year class. Fishing mortality in 2003 was mean F at age for 2000-2002 as used by the 2003 WG for the short term forecast rather than estimates for 2003, due to the absence of reliable WG landings for this year. Recruitment at age 0 in 2004 and subsequent years was the 1993-2002 geometric mean recruitment of 5,461 thousand fish at age 0, as used by the 2003 WG. These and other inputs are given in Table 9.8.2.1. The expected exploitation pattern for the years 2003 - 2005 was the unscaled arithmetic mean F at age for 2000-2002 from the 2003 WG XSA output table (Table 9.7.1). Stock weights were the average for the period 2000-2002.

The prediction with management options is given in Table 9.8.2.2 with detailed output at status quo F in Table 9.8.2.3. Short term yield and SSB plots are given in Figure 9.10.1. The predicted landings and SSB at status quo F are given below (with the equivalent 2003 WG forecasts), together with WG figures for 2002:

Year	Landings (t)	Source	SSB (t)	Source
2002	1,970	WG estimates	2,230	XSA
2003	2,021 (2,260)	SQ Forecast	2,363 (2,730)	SQ Forecast
2004	2,226 (2,350)	SQ Forecast	2,282 (2,610)	SQ Forecast
2005	2,303	SQ Forecast	2,630 (2,200)	SQ Forecast
2006		SQ Forecast	2,478	SQ Forecast

The differences between the forecasts carried out this year based on the 2003 WG XSA and the ones given by the 2003 WG are due to the use of an RCT3 estimate of recruitment for the 2003 year class of 8,487 thousand fish compared with the 1992 – 2002 GM value of 5,461 thousand used by the 2003 WG, and the up-dated stock weights and catch weights at age including data from surveys in 2004.

The relative contributions which recent year classes are expected to make to the 2004-2005 landings and 2004-2006 SSB are shown in Table 9.8.2.4. The landings in 2005 are expected to be composed mainly of the 2001 and 2002 year-classes, which were estimated by XSA, and the 2003 year-class, which was estimated using RCT3. Year classes for which GM recruitment was assumed make up less than 10% of the landings forecast for 2005, but would be expected to be the predominant year classes in discards (which are not included in the assessment and forecast). The 2003 (RCT3) and 2004 (GM) year-classes are expected to make up the bulk of the 2006 SSB, with the 2003 year-class contributing almost 50%.

The input values for a sensitivity analysis of the short-term prediction are given in Table 9.8.2.5 and the outputs are given in Figure 9.8.2.2. The .SEN file from the 2003 WG forecast was used for this analysis, amended to give numbers at ages 0 to 5+ in 2004 instead of 2003 as follows:

N(0,2004): 5,461 (GM)
N(1,2004): 6,949 (RCT3 estimate at age 0 in 2003 x exp(-M))
N(2 – 5+, 2004): XSA survivors in 2003 forecasted to 2004, as given by 2003 WG forecast.

The CV of the estimated number at age 1 in 2004 was the CV of the RCT3 prediction for the 2003 year class. For ages 2 – 5+ in 2004, the CVs were calculated from the CVs on the XSA survivors estimates for 2003 and the CV in the F's at ages 1 – 5+ as given in the 2003 WG .SEN file. These values are shown in Table 8.8.2.5. The resultant CVs on the landings forecast for 2005 and SSB forecasts for 2005 and 2006, calculated using WGFRANSW are given below:

Landings in 2005: 2,190 t (CV 0.27)
SSB in 2005: 2,430 t (CV 0.28)
SSB in 2006 2,490 t (CV 0.37)

The landings forecast for 2005 is most sensitive to the year effect in F in 2004 and 2005, which is likely to be more uncertain than assumed in the forecast because of the uncertainties in the outcome of the severe TAC constraint in 2004 (Fig. 9.8.2.2). The largest contribution to the variance of the 2005 landings forecast is the population numbers at ages 1 – 3. The SSB forecast is equally sensitive to several inputs related to the 2003 year class including year effects in F, starting population estimate at age 1 in 2004 and weight at age 3. The variance of the 2006 SSB estimated is dominated by the variance in N(0) in 2003, which is a GM value, and N(1) which is derived from the RCT3 prediction. The probability that F in 2005 will exceed the status quo estimate is shown in Figure 9.8.2 for different values of landings in 2005. The probability of SSB in the year 2006 falling below the series low of 1,300 t (1993) is negligible (Fig 9.8.2.3).

9.8.3 TSA based forecast

The TSA model gives forecasts as far ahead as 2005, using catch at age data to 2002 and survey data to 2004 (Table 9.5.2.7). The forecasted landings for 2003, 2004 and 2005 are summarised below:

2003 landings:	2,750 t	(SE 350 t)	SSB	5470	(SE 340)
2004 landings:	3,390 t	(SE 470 t)	SSB	4640	(SE 645)
2005 landings:	2,330 t	(SE 430 t)	SSB	4140	(SE 870)

The forecasted landings and SSB from the three methods are summarised below.

	Landings (t)			SSB		
	Survey based	Extension of 2003	TSA	Survey based	Extension of 2003	TSA
2003	3,131	2,021	2,750		2,363	5,473
2004	3,163	2,226	3,390		2,282	4,639
2005	3,144	2,303	2,330		2,630	4,135
2006					2,478	

9.9 Medium term predictions

Medium-term predictions were not carried out for this stock as the short time-series of stock and recruitment estimates precluded any meaningful prediction of the medium-term dynamics of the stock. The stock of haddock in the Irish Sea has historically exhibited short-lived periods of population growth, and the recruitment patterns over the time-series are may not represent the potential variability in the forthcoming decade.

9.10 Yield and biomass per recruit

The true exploitation pattern for this stock is not known because discards have not been included in the assessment. Yield per recruit (YPR) and SSB per recruit (SPR) for the Irish Sea stock were calculated as in previous years, conditional on the exploitation pattern for landings in 2000-2002 given for ages 0 to 5+ by XSA, using MFYPR software. Long-term (1993-2003) catch weights and stock weights at age were used. Input data are given in Table 9.10.1, and the summary output is given in Table 9.10.2. The YPR and SPR curves are plotted in Figure 9.10.1. The use of the 5+ group does not allow for expansion of the age composition at low fishing mortality. However, an independent analysis carried out by the 2001 WG, using weights at age in the stock and catch calculated from the Von Bertalanffy growth curve out to 20 years of age, gave qualitatively the same pattern of YPR and SPR relative to fishing mortality.

A reduction in F from the current status quo estimate of F(2-4) of 0.91 (XSA analysis) to the F_{max} value of 0.35 in this stock would be expected to result in approximate increases of about 15% in total landings per recruit and over 250% in SSB per recruit (dependent on any density-dependent reductions in growth).

9.11 Reference points

The ACFM view on this stock (ACFM, October 2002) is that there is currently no biological basis for defining appropriate reference points, in view of the rapid expansion of the stock size over a short period. ACFM proposes that F_{pa} be set at 0.5 by association with other haddock stocks. The absolute level of F in this stock at present is poorly known. The point estimate of F(2-4) for 2002 (0.89), however, is above F_{pa}.

9.12 Quality of the assessment

Landings data for this stock are uncertain because of species misreporting, which has been estimated from quayside observations in one country only. Restrictive quotas for some countries caused extensive misreporting during the 1990s prior to the introduction of a separate TAC allocation for the Irish Sea. Whilst species misreporting appears to have declined since 2000, the recent attempts to reduce fishing mortality substantially through low TACs whilst the stock has continued to grow has coincided with anecdotal information for increased unreported landings. The current assessment indicates status quo landings forecasts for 2003 of the order of 2,000t or more in 2003 compared with the TAC of only 585 t. If this is true, the reported landings estimates for 2003 of 617 t (official statistics plus landings estimates provided to the WG by Ireland) may be substantial under-estimates unless fishing mortality has declined substantially in 2003.

Sampling of landings for length and age appears adequate for years up to 2002 but was inadequate in 2003 to allow compilation of catch at age data. The absence of discard estimates from the assessment is also a potentially serious deficiency that must be addressed if management is to be based on catch-at-age analysis.

The survey data used in the assessment are quite consistent both internally and between fleets, probably due to the very large data contrast between year class strengths as well as the restricted distribution of the stock. The recruitment pattern for this stock since the early 1990s is relatively well established and can be tracked fairly consistently through both the surveys and commercial catches. Hence it can be established with some confidence how, qualitatively, the catch and stock is likely to be impacted in the short term by recent year classes.

The different forms of forecasts used this year all indicate a growth of the stock due to recent strong recruitment, and landings in 2005 at or above 2,000 t assuming status quo F since 2003. However, the individual forecasts are likely to have poor precision and are indicative of trends. The extent to which F could be reduced in 2004 by management measures such as effort limitation and decommissioning of vessels in 2003 could not be reliably evaluated by the WG. Such an evaluation is likely to be carried out by national fishery departments with access to detailed records of historical catches and effort of decommissioned vessels and monthly fishing patterns of remaining vessels subject to the different effort regimes.

Knowledge of basic biology of Irish Sea haddock is expanding through data on growth, maturity and distribution obtained during trawl surveys. Patterns of movement within the Irish Sea and between the Irish Sea and surrounding areas are poorly understood, and it is assumed that the Irish Sea stock is essentially self-sustaining at present. Trends in length and weight at age in the stock over time are apparent and reduced growth appears to have coincided with the growth of the stock.

The perception of the stock from this year's assessment does not differ qualitatively from that obtained last year.

9.12.1 Management considerations

This stock grew substantially in the 1990s following unusual pulses of recruitment, and has gone from a minor by-catch species to one of the most economically valuable target species in the Irish Sea. The recruitment signals are clearly revealed by surveys, but the steep age profile in the catches and the resultant dependence of the fishery on highly variable recent year classes means that catch and SSB forecasts are highly uncertain. The WG landings for 2001 and 2002 were 20% and 16% below the status quo forecast (see Section 9.1.2). The TACs in those years were expected to reduce fishing mortality by 20% and 62% respectively. The current assessment has insufficient accuracy to determine if F has reduced by these amounts in 2001 and 2002. The prevention of directed fishing for haddock during the cod closures in 2000-2003, other than during limited fishing experiments, will be expected to have curtailed the directed fisheries on mature haddock that occur in spring.

Haddock in the Irish Sea are taken as both a by-catch in *Nephrops* and cod fisheries, and in a directed fishery using mid-water trawls and otter trawls. The latter fishery also takes a by-catch of cod, which has been a matter of some concern in drawing up the Irish Sea cod recovery programme. The distribution of the haddock stock is largely encompassed by the cod closure, and the closure has impacted directed haddock fishing at a time of year when fishermen claim that haddock are most available. Experimental haddock fishing took place during the 2000 and 2001 cod closure periods to determine the ability of mid-water trawl fishermen to target haddock shoals using echosounders and hence to minimise the by-catch of cod. The results from 2000 were inconclusive in terms of the impact on cod, and the results from 2001 indicated a by-catch of cod of just over 15%. Hence the possibility of managing haddock fishing mortality in isolation from measures imposed for cod is not yet proven. An additional factor is the apparent reduction of the whiting stock in the western Irish Sea (see section 10), as whiting are also taken as a by-catch in cod and haddock fisheries although mainly on or near the *Nephrops* fishing grounds.

Whilst management of fishing mortality on this stock may not prevent it from declining again to low abundance due to natural causes, achieving a fishing mortality close to F_{max} would result in improved YPR and SPR and result in more persistent benefits from strong year classes. However, fishing patterns in the 1990s have shown that restrictive quotas for fleets fishing haddock in the Irish Sea have had little effect on actual landings, and have resulted in very uncertain data on quantities of fish caught by the fleet.

The EU Cod Recovery Plan regulation implemented in the Irish Sea from 2004 will impact the management measures for haddock in 2005 and the setting of a TAC for this stock.

Table 9.1.3.1 Nominal landings (t) of HADDOCK in Division VIIa, 1984–2003, as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992
Belgium	3	4	5	10	12	4	4	1	8
France	38	31	39	50	47	n/a	n/a	n/a	26
Ireland	199	341	275	797	363	215	80	254	251
Netherlands	-	-	-	-	-	-	-	-	-
UK (England & Wales)[1]	29	28	22	41	74	252	177	204	244
UK (Isle of Man)	2	5	4	3	3	3	5	14	13
UK (N. Ireland)	38	215	358	230	196	…	…	…	…
UK (Scotland)	78	104	23	156	52	86	316	143	114
Total	387	728	726	1,287	747	560	582	616	656
Unallocated	0	0	0	0	0	0	0	0	47
Total figures used by Working	387	728	726	1,287	747	560	582	616	703

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001
Belgium	18	22	32	34	55	104	53	22	68
France	41	22	58	105	74	86	n/a	49	183*
Ireland	252	246	320	798	1,005	1,699	759	1,238	652
Netherlands	-	-	-	1	14	10	5	2	-
UK (England & Wales)[1]	260	301	294	463	717	1,023	1,479	1,061	1,238
UK (Isle of Man)	19	24	27	38	9	13	7	19	1
UK (N. Ireland)	…	…	…	…	…	…	…	…	…
UK (Scotland)	140	66	110	14	51	80	67	56	86
Total	730	681	841	1,453	1,925	3,015	2,370	2,447	2,228
Unallocated	83	362	912	1,570	1,466	1,887	1,759	-	270
Total figures used by Working	813	1,043	1,753	3,023	3,391	4,902	4,129	1,380	2,498

Country	2002	2003
Belgium	44	20*
France	72	111*
Ireland	401	n/a
Netherlands	-	
UK (England & Wales)[1]		
UK (Isle of Man)		
UK (N. Ireland)		
UK (Scotland)		
United Kingdom	598	278*
Total	1,115	409
Unallocated	857	208
Total figures used by Working	1972	617

*Preliminary.
[1]1989–2001 Northern Ireland included with England and Wales.
n/a = not available.

Table 9.1.3.2 Haddock in VIIa.

Total international landings of haddock from the Irish Sea, 1972 – 2003, as officially reported to ICES. Working Group figures, assuming 1972 – 1992 official landings to be correct, are also given. (Landings in tonnes live weight).

Year	Official landings	WG landings
1972	2204	2204
1973	2169	2169
1974	683	683
1975	276	276
1976	345	345
1977	188	188
1978	131	131
1979	146	146
1980	418	418
1981	445	445
1982	303	303
1983	299	299
1984	387	387
1985	728	728
1986	726	726
1987	1287	1287
1988	747	747
1989	560	560
1990	582	582
1991	616	616
1992	656	656
1993	730	813
1994	681	1043
1995	841	1753
1996	1453	3023
1997	1925	3391
1998	3015	4902
1999	2370	4129
2000	2447	1380
2001	2228	2498
2002	1115	1972
2003	n/a	617

Table 9.2.1 Haddock in VIIa. Available XSA tuning data (file name: h7ani.tun). Ages used in assessment are in bold type

IRISH SEA haddock,2003 WG,ANON,COMBSEX,TUNING DATA(effort, nos at age)
107
NIGFS March [Northern Ireland March Groundfish Survey - Effort: numbers caught/3 nm]
1992 2004
1 1 0.21 0.25
1 4

1	**1525**	**23**	**0**	**0**	0	0
1	**139**	**569**	**31**	**0**	0	0
1	**644**	**58**	**183**	**0**	0	0
1	**24823**	**437**	**0**	**43**	0	0
1	**1065**	**3743**	**67**	**3**	1	0
1	**25118**	**474**	**1457**	**44**	0	2
1	**3913**	**8694**	**70**	**105**	1	0
1	**6058**	**680**	**2072**	**16**	11	0
1	**14028**	**1853**	**64**	**147**	2	3
1	**3277**	**6990**	**770**	**40**	20	0
1	**28755**	**842**	**1059**	**78**	1	0
1	**6966**	**14162**	**341**	**356**	26	0
1	**19945**	**2379**	**2206**	**45**	35	0

NIGFS Oct [Northern Ireland October Groundfish Survey - Effort: numbers caught/3 nm]
1991 2003
1 1 0.83 0.88
0 3

1	**15780**	**70**	**0**	**0**	0	0
1	**124**	**784**	**151**	**0**	0	0
1	**4462**	**101**	**375**	**3**	0	0
1	**56683**	**1137**	**12**	**79**	0	0
1	**1661**	**10153**	**74**	**0**	5	0
1	**143300**	**1167**	**1480**	**13**	0	0
1	**16400**	**39680**	**174**	**98**	1	0
1	**41820**	**1243**	**3778**	**22**	3	4
1	**80674**	**2835**	**71**	**145**	0	1
1	**6545**	**8598**	**763**	**31**	39	0
1	**75017**	**2003**	**2742**	**311**	0	20
1	**15116**	**10501**	**86**	**365**	0	0
1	**53922**	**7125**	**3080**	**59**	79	0

SGFS Spring [Scottish groundfish survey in Spring - Effort: numbers caught/10 hr]
1997 2004
1 1 0.15 0.21
1 4

1	**6581**	**65**	**213**	**9**	2	0
1	**564**	**472**	**4**	**9**	0	0
1	**246**	**21**	**137**	**2**	1	0
1	**819**	**338**	**8**	**15**	0	0
1	**62**	**299**	**71**	**6**	5	1
1	**944**	**72**	**111**	**16**	0	0
1	**318**	**1420**	**7**	**16**	3	0
1	**1591**	**242**	**355**	**0**	3	0

Fleets below not included in assessment
MIK net May/June [Northern Ireland Methot-Isaacs Kidd net survey in May/June - Effort: numbers/km^2]
1994 2003
1 1 0.38 0.47
0 0

1	47000
1	1700
1	47800
1	14500
1	2500
1	15400
1	1700
1	17100
1	1200
1	4250

Table 9.2.1 contd.

```
IRE OTB [Irish Otter trawl - Effort in hours numbers at age in 1000's]
1995 2002
1 1 0 1
2 5
   80314   262     29      15    1
   64824  1257     33       1    1
   92178    96    191       7    1
   93533  1341     95     110    3
  110275    56    471       7    1
   82690   118     17      31    3
   77541   232    251      10    5
   77863    97    174      22    1
IR-GFS Autumn [Irish groundfish survey in Autumn (Celtic Explorer)]
2003  2003
1 1 0.89 0.91
0 6
       1   5520  1069   406     3   4   0   1
SGFS Autumn [Scottish groundfish survey in Autumn – Effort: numbers caught/10 hr]
1997 2003
1 1 0.83  0.88
0 3
        1     104     437      4     27   1   0   0
        1     291      29     41      2   2   0   0
        1    4988     473      0     22   2   0   0
        1     790     332     38      2   4   0   0
        1    1647     389   1462     27  62  60   7
        1     178     189      2     13   2   0   0
        1     601      86    100      5   2   0   0
```

Table 9.3.1 Haddock in VIIa: catch numbers at age

	Table 1	Catch numbers at age				Numbers*10**-3						
	YEAR		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	AGE												
		0	0	0	0	0	0	0	0	0	0	0	n/a
		1	94	30	1341	109	1285	100	91	459	597	120	n/a
		2	1250	123	1322	4619	700	6427	519	915	2263	632	n/a
		3	18	861	107	735	2411	292	4462	238	1116	1853	n/a
		4	1	3	222	16	203	539	49	374	80	196	n/a
	+gp		1	2	5	30	16	35	72	28	127	28	n/a
0	TOTALNUM		1364	1019	2997	5509	4615	7393	5193	2014	4183	2829	n/a
	TONSLAND		813	1043	1753	3023	3391	4902	4129	1380	2498	1971	n/a
	SOPCOF %		100	100	100	100	95	100	100	97	100	100	n/a
		1											

Table 9.3.2 Haddock in VIIa: catch weights at age

	Table 2	Catch weights at age (kg)									
	YEAR		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	AGE											
		0	0	0	0	0	0	0	0	0	0	0
		1	0.351	0.346	0.361	0.346	0.348	0.19	0.325	0.329	0.3	0.279
		2	0.596	0.56	0.545	0.474	0.592	0.53	0.416	0.474	0.452	0.357
		3	1.688	1.103	0.898	0.917	1.002	1.13	0.802	0.786	0.859	0.749
		4	2.52	2.73	1.983	2.034	1.349	2	2.064	1.573	1.243	1.361
	+gp		2.52	2.522	2.178	2.682	1.955	2.55	2.854	2.365	1.869	2.107
0	SOPCOFAC		0.9995	1.0008	1.0007	1.0029	0.9465	0.9958	0.9996	0.9675	1.0002	0.9991
		1										

Table 9.3.3 Haddock in VIIa: stock weights at age

Table 3	Stock weights at age (kg)										
YEAR		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE												
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0.086	0.076	0.078	0.075	0.064	0.054	0.051	0.04	0.043	0.044	0.053
	2	0.443	0.357	0.375	0.391	0.38	0.273	0.24	0.243	0.198	0.211	0.215
	3	1.222	1.021	0.827	0.845	0.934	0.787	0.603	0.54	0.577	0.464	0.476
	4	1.971	2.266	1.717	1.322	1.468	1.43	1.308	0.989	0.94	0.986	0.748
+gp		2.713	3.224	3.327	2.598	2.149	1.977	2.087	2.032	1.706	1.592	1.446

Table 9.3.4 Estimates of Irish Sea haddock discards: 1995 - 2003. Data are numbers ('000 fish) discarded by the fleet, estimated from numbers per sampled trip raised to total fishing effort by each fleet, for the range of quarters indicated. Tables (b) and (d) represent estimates from limited observer sampling of N.Ireland vessels also included within the self-sampling estimates for N.Ireland trawlers catching *Nephrops* (Table (a)). Table (f) is the total for sampled fleets and quarters, excluding missing quarters or fleets.

(a) Self sampling scheme: N.Ireland single trawl Nephrops vessels. Estimates are extrapolated to all N.Ireland vessels catching *Nephrops* (single and twin trawl) (approx 40 trips sampled per year).

	1996 Q1-4	**1997 Q1-4**	**1998 Q1-4**	**1999 Q1-4**	**2000 Q1-4**	**2001 Q1-4**	**2002 Q1-4**	**2003 Q1**
Age	43 trips	39 trips	48 trips	39 trips	44 trips	43 trips	35 trips	8 trips
0	4485	100	1552	1274	110	1083	851	0
1	229	1209	318	342	2384	140	1073	62
2	179	88	210	69	253	199	37	28
3	0	0	0	0	0	0	11	0

(b) Observer scheme: N.Ireland vessels catching *Nephrops* (single trawl only)

	1999 Q3-4	**2000 Q1-3**	**2001 Q1**
Age	4 trips	6 trips	1 trip
0	2185	210	0
1	22	280	1677
2	0	57	1593

(c) Observer scheme: N.Ireland midwater trawl ('000 fish)

	1997 Q2-4	**1998 Q1-3**	**1999 Q3-4**	**2000 Q1**	**2001 Q1**
Age	n/a	n/a	5 trips	4 trips	2 trips
0	0	0	68	0	0
1	178	316	96	20	0.4
2	19	1342	35	83	19
3	4	0	2	5	0

(d) Observer scheme: N.Ireland twin trawl ('000 fish)

	1997 Q2-4	**1998 Q1-3**	**1999 Q4**	**2000 Q1-4**	**2001 Q1**
Age	n/a	n/a	1 trip	10 trips	2 trips
0	34	4	26	10	0
1	284	205	3	13	3
2	6	382	0	10	19
3	0.5	0	0	0	0

(e) Observer scheme: Republic of Ireland otter trawlers (‘000 fish)

	1995 Q1-4	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1-4
Age	2 trips	10 trips	11 trips	9 trips	7 trips	8 trips	n/a	n/a	6 trips
0	210	680	41	188	809	0	n/a	n/a	227
1	1408	903	2049	974	8361	9864	n/a	n/a	162
2	753	167	660	1631	879	228	n/a	n/a	108
3	904	0	43	112	55	0	n/a	n/a	1
4	118	0	7	3	0	0	n/a	n/a	0

(f) Total for sampled fleets and quarters: NI self sampling scheme (a); NI midwater trawl (c); ROI otter trawl (e). (‘000 fish)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Age	2 trips	53 trips	n/a	n/a	51 trips	56 trips	n/a	n/a	n/a
0	210	5165	141	1740	2151	110	n/a	n/a	n/a
1	1408	1132	3436	1608	8799	12268	n/a	n/a	n/a
2	753	346	767	3183	983	564	n/a	n/a	n/a
3	904	0	47	112	57	5	n/a	n/a	n/a
4	118	0	7	3	0	0	n/a	n/a	n/a

Table 9.3.5 Haddock in VIIa: Proportion by number at age discarded by sampled fleets.

		Proportion discarded			
Fleet	Period	age 0	age 1	age 2	age 3
Midwater trawl	Q2-Q4 1997		0.93	0.37	0.02
Midwater trawl	Q1-Q3 1998		0.99	0.16	0.00
Midwater trawl	Q3-Q4 1999	1.00	0.79	0.31	0.00
Midwater trawl	Q1 2000		1.00	0.44	0.04
Midwater trawl	Q1 2001		1.00	0.30	
Single Nephrops	Q3-Q4 1999	1.00	0.94		
Single Nephrops	Q1-Q3 2000	1.00	0.97	0.45	
Single Nephrops	Q1 2001		1.00	0.49	
Twin trawl	Q2-Q4 1997	1.00	1.00	0.61	0.04
Twin trawl	Q1-Q3 1998	1.00	1.00	0.76	0.00
Twin trawl	Q4 1999	1.00	1.00		
Twin trawl	Q1 – Q4 2000	1.00	0.96	0.28	
Twin trawl	Q1 2001		1.00	0.12	

Table 9.3.6 Haddock in VIIa: total catch numbers at age

Table 1	Catch numbers at age					Numbers*10**-3					
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE											
0	0	0	0	0	0	0	0	0	0	0	n/a
1	961	307	3034	1241	4543	1392	8794	12707	1429	6495	n/a
2	1953	192	2244	4965	1448	8268	1467	1396	3350	835	n/a
3	18	861	1011	735	2454	404	4517	238	1116	1864	n/a
4	1	3	222	16	203	539	49	374	80	196	n/a
+gp	1	2	5	30	16	35	72	28	127	28	n/a
0 TOTALNUM	2934	1365	6516	6987	8664	10638	14899	14743	6102	9418	
TONSLAND	813	1043	1753	3023	3391	4902	4129	1380	2498	1971	
SOPCOF %	53	89	48	85	65	78	56	24	77	51	

Table 9.5.1.1 Haddock in Division VIIa. TSA parameter settings for TSA runs for catch data only and including survey data (excluding 2003 catch at age data).

Parameter	*Setting*	*Justification*
Age of full selection.	$a_m = 3$	Based on inspection of previous XSA runs.
Multipliers on variance matrices of measurements.	$B_{\text{landings}}(a) = 2$ for ages 1, 4 and 5+ $B_{\text{survey}}(a) = 2$ for age 4	Allows extra measurement variability for poorly-sampled ages.
Multipliers on variances for fishing mortality estimates.	$H(1) = 2$	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points (implemented by multiplying the relevant q by 3)	not implemented	
Discards	No discards included	
Recruitment.	Modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean $\eta_1 S \exp(-\eta_2 S)$, where S is the spawning stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	
Large year classes.	The 1994 and 1996 year classes were large, and recruitment at age 1 in 1995 and 1997 are not well modelled by the Ricker recruitment model. Instead, $N(1, 1995)$ and $N(1, 1997)$ are taken to be normally distributed with mean $5\eta_1 S \exp(-\eta_2 S)$. The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966-1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The coefficient of variation is assumed to be constant.	

Table 9.5.1.2 Haddock in Division VIIa. TSA parameter estimates for TSA runs for catch data only and including survey data (excluding 2003 catch at age data).

Parameter	Notation	Description	Catch only	Including survey data
Initial fishing mortality	F (1, 1993)	Fishing mortality at age *a* in year *y*	0.14	0.21
	F (2, 1993)		0.73	0.77
	F (4, 1993)		0.72	0.73
				NIGFS-March
Survey selectivities	$\Phi(1)$	Survey selectivity at age *a*		0.28
	$\Phi(2)$			0.14
	$\Phi(4)$			0.08
Fishing mortality standard deviations	σ_F	Transitory changes in overall fishing mortality	0.00	0.00
	σ_U	Persistent changes in selection (age effect in F)	0.13	0.22
	σ_V	Transitory changes in the year effect in fishing mortality	0.30	0.00
	σ_Y	Persistent changes in the year effect in fishing mortality	0.17	0.10
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability		0.57
	σ_β	Persistent changes in survey catchability		0.00
Measurement standard deviations	$\sigma_{landings}$	Standard error of landings-at-age data	0.28	0.31
	σ_{survey}	Standard error of survey data		0.10
Recruitment	η_1	Ricker parameter (slope at the origin)	3.207	3.193
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.028	0.023
	cv_{rec}	Standard error of recruitment data	1.23	0.67

Table 9.5.2.1 Haddock in VIIa: SURBA fitted fishing mortality-at-age, survey indices and catch-at-age. Fitted survey indices are mean standardised over all years and ages for each survey

	NIGFS-March				NIGFS-Oct				ScoGFS-Spring			
	Fishing mortality-at-age				Fishing mortality-at-age				Fishing mortality-at-age			
	Age				Age				Age			
Year	1	2	3	4	0	1	2	3	1	2	3	4
1992	0.911	0.876	1.156	1.156	1.706	1.896	2.020	2.020				
1993	1.080	1.039	1.371	1.371	0.985	1.094	1.166	1.166				
1994	0.708	0.682	0.899	0.899	1.614	1.794	1.912	1.912				
1995	1.116	1.073	1.416	1.416	1.590	1.767	1.883	1.883				
1996	0.972	0.935	1.234	1.234	1.405	1.562	1.664	1.664				
1997	1.476	1.420	1.874	1.874	1.704	1.894	2.018	2.018	1.727	2.574	2.677	2.677
1998	1.288	1.239	1.635	1.635	2.024	2.250	2.397	2.397	0.945	1.408	1.464	1.464
1999	1.407	1.354	1.786	1.786	1.270	1.412	1.504	1.504	1.072	1.597	1.661	1.661
2000	1.035	0.995	1.313	1.313	1.208	1.343	1.430	1.430	0.474	0.706	0.734	0.734
2001	1.125	1.082	1.428	1.428	1.632	1.813	1.932	1.932	0.815	1.214	1.263	1.263
2002	0.928	0.893	1.178	1.178	0.962	1.069	1.139	1.139	0.672	1.002	1.042	1.042
2003	1.183	1.138	1.502	1.502					0.557	0.830	0.863	0.863
	Fitted survey index				Fitted survey index				Fitted survey index			
	Age				Age				Age			
Year	1	2	3	4	0	1	2	3	1	2	3	4
1992	0.451	0.012	0.005	0.001	0.030	0.210	0.004	0.000				
1993	0.050	0.149	0.004	0.001	0.250	0.004	0.026	0.000				
1994	0.253	0.014	0.043	0.001	4.276	0.076	0.001	0.007				
1995	4.304	0.102	0.006	0.014	0.402	0.697	0.010	0.000				
1996	0.368	1.155	0.029	0.001	11.562	0.067	0.097	0.001				
1997	9.448	0.114	0.371	0.007	0.852	2.322	0.012	0.015	9.084	0.189	0.393	0.019
1998	0.776	1.768	0.023	0.047	3.498	0.127	0.286	0.001	0.428	1.322	0.012	0.022
1999	2.304	0.175	0.419	0.004	4.850	0.378	0.011	0.021	1.235	0.136	0.265	0.002
2000	4.652	0.462	0.037	0.058	0.475	1.115	0.076	0.002	1.409	0.346	0.023	0.041
2001	0.903	1.354	0.140	0.008	5.921	0.116	0.238	0.015	0.171	0.719	0.140	0.009
2002	8.917	0.240	0.375	0.027	1.579	0.948	0.016	0.028	4.190	0.062	0.175	0.032
2003	2.267	2.887	0.081	0.095	4.590	0.494	0.267	0.004	0.862	1.751	0.019	0.050
2004	5.563	0.569	0.757	0.015					3.386	0.404	0.625	0.006
	Fitted catch-at-age				Fitted catch-at-age				Fitted catch-at-age			
	Age				Age				Age			
Year	1	2	3	4	0	1	2	3	1	2	3	4
1992	0.248	0.007	0.003	0.001	0.023	0.167	0.003	0.000				
1993	0.030	0.089	0.003	0.001	0.144	0.003	0.016	0.000				
1994	0.118	0.006	0.023	0.000	3.185	0.059	0.001	0.005				
1995	2.670	0.062	0.004	0.010	0.297	0.538	0.008	0.000				
1996	0.211	0.646	0.019	0.001	8.089	0.049	0.073	0.001				
1997	6.764	0.080	0.293	0.005	0.649	1.841	0.009	0.012	6.956	0.165	0.345	0.017
1998	0.520	1.161	0.017	0.035	2.839	0.106	0.244	0.001	0.241	0.926	0.008	0.016
1999	1.613	0.121	0.325	0.003	3.227	0.265	0.008	0.015	0.749	0.101	0.200	0.002
2000	2.764	0.268	0.025	0.039	0.308	0.763	0.053	0.001	0.486	0.161	0.011	0.020
2001	0.563	0.826	0.099	0.006	4.430	0.091	0.190	0.012	0.088	0.467	0.093	0.006
2002	4.961	0.130	0.240	0.018	0.898	0.574	0.010	0.018	1.880	0.036	0.104	0.019
2003	1.453	1.811	0.058	0.068					0.337	0.907	0.010	0.027

Table 9.5.2.2 Haddock in VIIa: Proportion discarded by age used in the SURBA analysis. A 1996-2002 average was applied to the additional years listed.

	age 1	age 2	age 3	age 4	age 5
1993	0.87	0.34	0.05	0	0
1994	0.87	0.34	0.05	0	0
1995	0.87	0.34	0.05	0	0
1996	0.91	0.07	0	0	0
1997	0.72	0.52	0.02	0	0
1998	0.93	0.22	0.28	0	0
1999	0.99	0.65	0.01	0	0
2000	0.96	0.35	0	0	0
2001	0.58	0.32	0	0	0
2002	0.98	0.24	0.01	0	0
2003	0.87	0.34	0.05	0	0
2004	0.87	0.34	0.05	0	0
2005	0.87	0.34	0.05	0	0

Table 9.5.2.3 Haddock in VIIa: TSA estimates of fishing mortality at age

	age 1	age 2	age 3	age 4	age 5
1993	0.1472	0.7476	0.8182	0.8182	0.8182
1994	0.1209	0.8026	1.1033	1.1033	1.1033
1995	0.1034	0.8774	1.3689	1.3689	1.3689
1996	0.0956	0.8783	1.3870	1.3870	1.3870
1997	0.0839	0.8981	1.5221	1.5221	1.5221
1998	0.0801	0.6894	1.7111	1.7111	1.7111
1999	0.0703	0.7247	1.5904	1.5904	1.5904
2000	0.0777	0.5074	1.5221	1.5221	1.5221
2001	0.0771	0.5342	1.4540	1.4540	1.4540
2002	0.0596	0.6210	1.4280	1.4280	1.4280
2003	0.0578	0.6026	1.6088	1.6088	1.6088
2004	0.0569	0.5714	1.7755	1.7755	1.7755
2005	0.0569	0.5714	1.7755	1.7755	1.7755

Table 9.5.2.4 Haddock in VIIa: TSA standard errors of estimates of log fishing mortality at age

	age 1	age 2	age 3	age 4	age 5
1993	0.3144	0.1326	0.1534	0.1534	0.1534
1994	0.2859	0.1502	0.1229	0.1229	0.1229
1995	0.2711	0.1304	0.1131	0.1131	0.1131
1996	0.2659	0.1382	0.1063	0.1063	0.1063
1997	0.2629	0.1417	0.1100	0.1100	0.1100
1998	0.2650	0.1308	0.1078	0.1078	0.1078
1999	0.2693	0.1504	0.0953	0.0953	0.0953
2000	0.2793	0.1411	0.1016	0.1016	0.1016
2001	0.2996	0.1598	0.1118	0.1118	0.1118
2002	0.3401	0.1687	0.1084	0.1084	0.1084
2003	0.4136	0.2490	0.1420	0.1420	0.1420
2004	0.4763	0.3426	0.2644	0.2644	0.2644
2005	0.5327	0.4174	0.3561	0.3561	0.3561

Table 9.5.2.5 Haddock in VIIa: TSA estimates of stock numbers at age (millions of fish)

	age 1	age 2	age 3	age 4	age 5
1993	0.399	2.702	0.034	0.003	0.002
1994	2.602	0.292	1.046	0.012	0.002
1995	18.873	1.896	0.107	0.284	0.004
1996	1.812	13.901	0.632	0.021	0.058
1997	15.827	1.339	4.58	0.132	0.016
1998	1.764	11.961	0.413	0.752	0.025
1999	3.921	1.339	4.98	0.06	0.113
2000	8.177	2.991	0.532	0.832	0.029
2001	1.659	6.188	1.395	0.078	0.127
2002	12.532	1.284	2.976	0.266	0.039
2003	2.567	9.664	0.551	0.56	0.057
2004	7.601	1.977	4.321	0.092	0.103
2005	5.009	5.879	0.914	0.599	0.027

Table 9.5.2.6 Haddock in VIIa: TSA standard errors of estimates of stock numbers at age (millions of fish)

	age 1	age 2	age 3	age 4	age 5
1993	0.061	0.216	0.007	0.001	0.001
1994	0.309	0.037	0.1	0.003	0.001
1995	1.878	0.22	0.015	0.044	0.001
1996	0.298	1.456	0.094	0.005	0.016
1997	1.681	0.225	0.691	0.024	0.005
1998	0.28	1.273	0.081	0.179	0.008
1999	0.323	0.21	0.494	0.013	0.035
2000	0.534	0.247	0.072	0.12	0.008
2001	0.198	0.416	0.097	0.006	0.016
2002	0.688	0.141	0.282	0.042	0.008
2003	0.284	0.577	0.058	0.073	0.011
2004	1.155	0.216	0.678	0.019	0.027
2005	3.376	0.888	0.224	0.305	0.016

Table 9.5.2.7 Haddock in VIIa: TSA standard errors of estimates of stock numbers at age (millions of fish)

year	landings			mean f		ssb		tsb		recruitment	
	actual	predicted	se	estimate	se	estimate	se	estimate	se	estimate	se
1993	0.813	0.832	0.109	0.783	0.076	1.682	0.13	1.822	0.132	0.399	0.061
1994	1.042	0.911	0.096	0.953	0.085	1.356	0.119	2.256	0.19	2.602	0.309
1995	1.752	1.624	0.207	1.123	0.092	1.701	0.18	8.514	0.788	18.873	1.878
1996	3.014	4.134	0.593	1.133	0.091	7.367	0.747	7.994	0.793	1.812	0.298
1997	3.583	4.318	0.64	1.21	0.099	5.592	0.758	11.1	1.121	15.827	1.681
1998	4.923	4.47	0.656	1.2	0.101	8.374	0.908	8.709	0.929	1.764	0.28
1999	4.131	3.629	0.4	1.158	0.089	4.998	0.466	6.272	0.519	3.921	0.323
2000	1.426	2.002	0.222	1.015	0.084	3.213	0.288	5.903	0.397	8.177	0.534
2001	2.497	2.181	0.187	0.994	0.089	4.329	0.244	4.827	0.27	1.659	0.198
2002	1.973	2.263	0.21	1.025	0.092	3.132	0.257	6.629	0.389	12.532	0.688
2003		2.749	0.348	1.106	0.149	5.473	0.34	6.25	0.38	2.567	0.284
2004		3.388	0.471	1.173	0.248	4.639	0.645	6.939	0.944	7.601	1.155
2005		2.332	0.432	1.173	0.322	4.135	0.87	5.651	1.333	5.009	3.376

Table 9.6.1. Haddock in VIIa. Summary of SURBA model fits of year class strength (relative indices) for the three surveys used in survey-based catch forecasts. Values for year classes 2004 to 2006 are GM values.

Year class	NIGFS Mar 1	ScoGFS Spr 1	NIGFS Oct 0
1991	0.451		
1992	0.050		0.030
1993	0.253		0.250
1994	4.304		4.276
1995	0.368		0.402
1996	9.448	9.084	11.562
1997	0.776	0.428	0.852
1998	2.304	1.235	3.498
1999	4.652	1.409	4.850
2000	0.903	0.171	0.475
2001	8.917	4.190	5.921
2002	2.267	0.862	1.579
2003	5.563	3.386	4.590
2004	2.572	1.393	2.381
2005	2.572	1.393	2.381
2006	2.572	1.393	2.381
GM 94-03	2.572	1.393	2.381
GM 96-03	3.075	1.393	2.764

Table 9.6.2 Haddock in VIIa. RCT3 input data

Irish Sea haddock recruits - age 0

4	12	2			
1992	600	139	124	-11	-11
1993	4339	644	4462	-11	-11
1994	15895	24823	56683	-11	47000
1995	2029	1065	1661	-11	1700
1996	22765	25118	143300	6581	47800
1997	1747	3913	16400	564	14500
1998	4676	6058	41820	246	2500
1999	10215	14028	80674	819	15400
2000	2804	3277	6545	62	1700
2001	8531	28755	75017	944	17100
2002	3710	6966	15116	318	1200
2003	-11	19945	53922	1591	4250

NIGFS mar 1
NIGFS Oct 0
ScoGFS 1
MIKnet 0

Table 9.6.3. Haddock in VIIa. RCT3 output file

Analysis by RCT3 ver3.1 of data from file :

had7ia1.csv

Irish Sea haddock recruits - age 0,,,,,

Data for 4 surveys over 12 years : 1992 - 2003

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	
NIGFS	.76	2.26	.78	.762	7	9.55	9.49	1.037	.317
NIGFS	.60	2.80	.77	.767	7	11.30	9.59	1.032	.320
ScoGFS	.94	2.17	1.35	.648	3	6.71	8.49	2.710	.046
MIKnet	1.01	-.75	1.27	.532	5	9.64	9.02	1.810	.104
					VPA Mean =		8.30	1.266	.213

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	
NIGFS	.74	2.32	.70	.778	8	8.09	8.35	.867	.347
NIGFS	.59	2.87	.70	.780	8	8.79	8.03	.866	.348
ScoGFS	1.04	1.71	1.16	.574	4	4.14	6.01	2.589	.039
MIKnet	1.04	-.93	1.13	.531	6	7.44	6.78	1.717	.088
					VPA Mean =		8.43	1.212	.178

Yearclass = 2001

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction		---------I	
NIGFS	.76	2.12	.68	.764	9	10.27	9.95	.887	.275
NIGFS	.59	2.79	.65	.778	9	11.23	9.46	.819	.322
ScoGFS	.79	3.67	1.01	.579	5	6.85	9.06	1.445	.104
MIKnet	.92	.28	.99	.563	7	9.75	9.26	1.281	.132
					VPA Mean =		8.38	1.137	.167

Yearclass = 2002

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction		---------I	
NIGFS	.73	2.30	.67	.749	10	8.85	8.75	.794	.279
NIGFS	.58	2.83	.61	.780	10	9.62	8.45	.727	.332
ScoGFS	.79	3.68	.87	.588	6	5.77	8.21	1.172	.128
MIKnet	.91	.34	.90	.570	8	7.09	6.81	1.260	.111
					VPA Mean =		8.46	1.081	.150

Table 9.6.3 contd.

Yearclass = 2003

Survey/ Series	I-----------Regression----------I Slope	Inter- cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
NIGFS	.74	2.11	.66	.728	11	9.90	9.47	.799	.246
NIGFS	.59	2.72	.58	.771	11	10.90	9.17	.700	.321
ScoGFS	.79	3.69	.78	.597	7	7.37	9.48	1.030	.148
MIKnet	.84	1.17	.90	.538	9	8.35	8.17	1.091	.132
						VPA Mean =	8.45	1.012	.153

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1999	9638	9.17	.58	.26	.20	10216	9.23
2000	3053	8.02	.51	.30	.35	2805	7.94
2001	11452	9.35	.47	.26	.31	8532	9.05
2002	4118	8.32	.42	.28	.45	3711	8.22
2003	8487	9.05	.40	.24	.37		

Table 9.7.1 Haddock in VIIa: VPA output from final XSA run.

Run title : IRISH SEA haddock 2002 WG 01-May ANON COMBSEX PLUSGROUP

At 18/05/2003 17:59

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 0	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2- 4
1993	4339	1381	1341	813	0.6063	1.2213
1994	15895	1732	1473	1043	0.7083	1.0352
1995	2029	2708	1732	1753	1.0119	1.3169
1996	22765	4887	4766	3023	0.6343	1.0824
1997	1747	5410	4255	3391	0.797	1.2869
1998	4676	5315	5240	4902	0.9355	1.3584
1999	10215	4168	3981	4129	1.0373	1.5779
2000	2804	2048	1705	1380	0.8092	0.8047
2001	8531	2848	2743	2498	0.9108	1.0227
2002	3710	2694	2324	1971	0.8482	0.8921
Arith. Mean	7671	3319	2956	2490	0.8299	1.1598
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 9.8.1.1 Haddock in VIIa. Prediction inputs for short term forecast from SURBA runs

2003	NIGFS-Mar	NIGFS-Oct	ScoGFS-Spring						NIGFS-Mar	NIGFS-Oct	ScoGFS-Spring	
Age		Survey index		M	Mat	PF	PM	SWt		Sel		CWt
0		4.590		0.2	0	0	0	0.000	0.000	0.000	0.000	0.000
1	2.267	0.494	0.862	0.2	0	0	0	0.053	0.156	0.167	0.074	0.367
2	2.887	0.267	1.751	0.2	1	0	0	0.215	0.753	0.932	0.549	0.411
3	0.081	0.004	0.019	0.2	1	0	0	0.476	1.435	1.433	0.824	0.700
4	0.095	0.007	0.050	0.2	1	0	0	0.748	1.502	1.500	0.863	1.098
5	0.007	0.000	0.009	0.2	1	0	0	1.446	1.274	1.470	0.750	1.789

2004												
Age		Survey index			M	Mat	PF	PM	SWt		Sel	
0		2.381		0.2	0	0	0	0.000	0.000	0.000	0.000	0.000
1	5.563		3.386	0.2	0	0	0	0.052	0.143	0.167	0.090	0.365
2	0.569		0.404	0.2	1	0	0	0.247	0.687	0.932	0.672	0.472
3	0.757		0.625	0.2	1	0	0	0.476	1.308	1.433	1.009	0.700
4	0.015		0.006	0.2	1	0	0	0.764	1.369	1.500	1.056	1.121
5	0.017		0.017	0.2	1	0	0	1.202	1.162	1.470	0.917	1.487

2005												
Age		Survey index			M	Mat	PF	PM	SWt		Sel	
0		2.381		0.2	0	0	0	0.000	0.000	0.000	0.000	0.000
1	2.572		1.393	0.2	0	0	0	0.047	0.143	0.167	0.090	0.325
2				0.2	1	0	0	0.256	0.687	0.932	0.672	0.490
3				0.2	1	0	0	0.589	1.308	1.433	1.009	0.868
4				0.2	1	0	0	0.837	1.369	1.500	1.056	1.229
5				0.2	1	0	0	1.258	1.162	1.470	0.917	1.557

2006												
Age		Survey index			M	Mat	PF	PM	SWt		Sel	
0		2.381		0.2	0	0	0	0.000	0.000	0.000	0.000	0.000
1	2.572		1.393	0.2	0	0	0	0.051	0.143	0.167	0.090	0.325
2				0.2	1	0	0	0.239	0.687	0.932	0.672	0.490
3				0.2	1	0	0	0.514	1.308	1.433	1.009	0.868
4				0.2	1	0	0	0.783	1.369	1.500	1.056	1.229
5				0.2	1	0	0	1.230	1.162	1.470	0.917	1.557

Input and output units are relative indices

Table 9.8.1.2 Catch forecast from SURBA fits

	Predicted landings by survey			
	NIGFS Mar	NIGFS Oct	ScoGFS Spring	Average
2003	3,640	2,783	2,969	3,131
2004	3,516	2,857	3,117	3,163
2005	3,355	2,871	3,207	3,144

Table 9.8.2.1 Haddock in VIIa. Prediction inputs for short term forecast.

MFDP version 1a
Run:
Had7a_2004WG
Time and date: 10:27 11/05/2004
Fbar age range: 2-4

2003

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	8487	0.2	0	0	0	0.000	0.000	0.000
1	3037	0.2	0	0	0	0.053	0.140	0.367
2	5610	0.2	1	0	0	0.215	0.544	0.411
3	525	0.2	1	0	0	0.476	1.118	0.700
4	958	0.2	1	0	0	0.748	1.057	1.098
5	132	0.2	1	0	0	1.446	1.057	1.789

2004

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	5461	0.2	0	0	0	0.000	0.000	0.000
1	.	0.2	0	0	0	0.052	0.140	0.365
2	.	0.2	1	0	0	0.247	0.544	0.472
3	.	0.2	1	0	0	0.476	1.118	0.700
4	.	0.2	1	0	0	0.764	1.057	1.121
5	.	0.2	1	0	0	1.202	1.057	1.487

2005

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	5461	0.2	0	0	0	0.000	0.000	0.000
1	.	0.2	0	0	0	0.047	0.140	0.325
2	.	0.2	1	0	0	0.256	0.544	0.490
3	.	0.2	1	0	0	0.589	1.118	0.868
4	.	0.2	1	0	0	0.837	1.057	1.229
5	.	0.2	1	0	0	1.258	1.057	1.557

2006

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	5461	0.2	0	0	0	0.000	0.000	0.000
1	.	0.2	0	0	0	0.051	0.140	0.325
2	.	0.2	1	0	0	0.239	0.544	0.490
3	.	0.2	1	0	0	0.514	1.118	0.868
4	.	0.2	1	0	0	0.783	1.057	1.229
5	.	0.2	1	0	0	1.230	1.057	1.557

Input units are thousands and kg - output in tonnes

Table 9.8.2.2 Haddock VIIa. Management option table from forecast based on 2003 WG XSA assessment

MFDP version 1a
Run: Had7a_2004WG
HAD7AdpMFDP Index file 20/05/2003
Time and date: 10:27 11/05/2004
Fbar age range: 2-4

2003				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
2523	2363	1	0.9065	2021

2004				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
2647	2282	1	0.9065	2226

2005					2006	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
2838	2630	0	0	0	4689	4462
.	2630	0.1	0.0906	318	4412	4185
.	2630	0.2	0.1813	612	4157	3930
.	2630	0.3	0.2719	884	3922	3695
.	2630	0.4	0.3626	1135	3705	3478
.	2630	0.5	0.4532	1367	3504	3277
.	2630	0.6	0.5439	1583	3319	3092
.	2630	0.7	0.6345	1783	3148	2921
.	2630	0.8	0.7252	1969	2989	2762
.	2630	0.9	0.8158	2142	2842	2615
.	2630	1	0.9065	2303	2705	2478
.	2630	1.1	0.9971	2453	2578	2352
.	2630	1.2	1.0878	2593	2461	2234
.	2630	1.3	1.1784	2724	2351	2124
.	2630	1.4	1.2691	2846	2249	2022
.	2630	1.5	1.3597	2961	2153	1926
.	2630	1.6	1.4503	3068	2064	1837
.	2630	1.7	1.541	3169	1981	1754
.	2630	1.8	1.6316	3264	1903	1676
.	2630	1.9	1.7223	3353	1830	1604
.	2630	2	1.8129	3437	1762	1535

Input units are thousands and kg - output in tonnes

Table 9.8.2.3 Haddock in VIIa. Detailed short term forecast based on 2003 WG XSA run.

MFDP version 1a
Run: Had7a_2004WG
Time and date: 10:27 11/05/2004
Fbar age range: 2-4

Year:	2003	F multiplier:	1	Fbar:	0.9065				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.000	0	0	8487	0	0	0	0	0
1	0.140	361	133	3037	160	0	0	0	0
2	0.544	2152	885	5610	1205	5610	1205	5610	1205
3	1.118	326	228	525	250	525	250	525	250
4	1.057	576	633	958	717	958	717	958	717
5	1.057	79	142	132	191	132	191	132	191
Total		3495	2021	18749	2523	7225	2363	7225	2363

Year:	2004	F multiplier:	1	Fbar:	0.9065				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.000	0	0	5461	0	0	0	0	0
1	0.140	826	301	6949	365	0	0	0	0
2	0.544	829	392	2161	534	2161	534	2161	534
3	1.118	1656	1160	2666	1269	2666	1269	2666	1269
4	1.057	85	95	140	107	140	107	140	107
5	1.057	187	278	310	373	310	373	310	373
Total		3582	2226	17687	2647	5278	2282	5278	2282

Year:	2005	F multiplier:	1	Fbar:	0.9065				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.000	0	0	5461	0	0	0	0	0
1	0.140	531	173	4471	209	0	0	0	0
2	0.544	1897	929	4945	1266	4945	1266	4945	1266
3	1.118	638	554	1027	605	1027	605	1027	605
4	1.057	429	528	713	597	713	597	713	597
5	1.057	77	120	128	161	128	161	128	161
Total		3573	2303	16746	2838	6814	2630	6814	2630

Year:	2006	F multiplier:	1	Fbar:	0.9065				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.000	0	0	5461	0	0	0	0	0
1	0.140	531	173	4471	227	0	0	0	0
2	0.544	1221	598	3182	761	3182	761	3182	761
3	1.118	1460	1267	2350	1207	2350	1207	2350	1207
4	1.057	165	203	275	215	275	215	275	215
5	1.057	144	224	239	294	239	294	239	294
Total		3522	2465	15978	2705	6046	2478	6046	2478

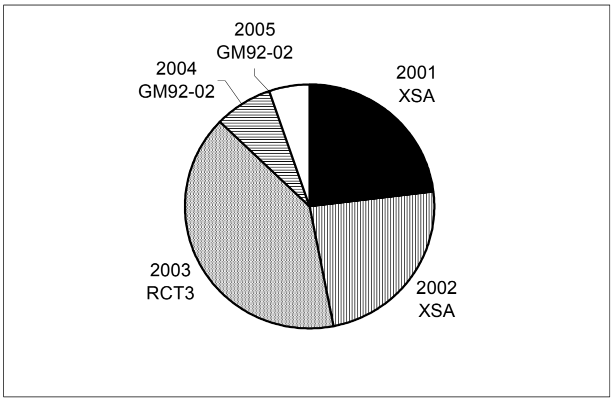
Table 9.8.2.4 **Haddock in VIIa. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes**

Year-class			2001	2002	2003	2004	2005
Stock No. (thousands)			8531	3710	8487	5461	5461
of	0 year-olds						
Source			XSA	XSA	RCT3	GM92-02	GM92-02
Status Quo F:							
% in	2004	landings	52.1	17.6	13.5	0.0	
% in	2005		22.9	24.0	40.3	7.5	0.0
% in	2004	SSB	55.6	23.4	0.0	0.0	
% in	2005	SSB	22.7	23.0	48.2	0.0	0.0
% in	2006	SSB	11.9	8.7	48.7	30.7	0.0

GM : geometric mean recruitment

Haddock in division VIIa : Year-class % contribution to

a) 2005 landings



b) 2006 SSB

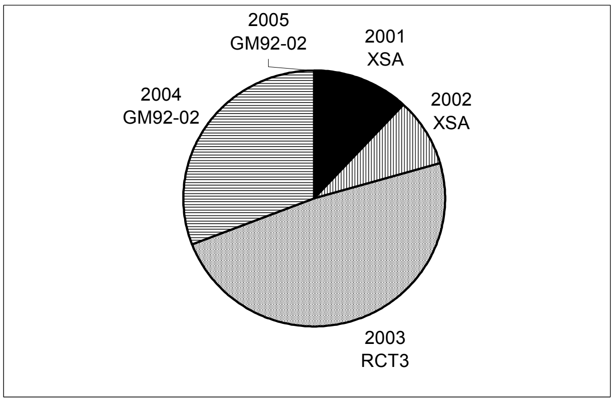


Table 9.8.2.5 Haddock,Irish Sea. Input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N0	5461	0.86	WS0	0.00	0.00
N1	6949	0.40	WS1	0.05	0.06
N2	2161	0.41	WS2	0.24	0.07
N3	2666	0.57	WS3	0.51	0.10
N4	140	0.27	WS4	0.78	0.05
N5	310	0.27	WS5	1.28	0.09
H.cons selectivity			Weight in the HC catch		
sH0	0.00	0.00	WH0	0.00	0.00
sH1	0.14	1.15	WH1	0.35	0.07
sH2	0.54	0.32	WH2	0.47	0.08
sH3	1.12	0.07	WH3	0.78	0.12
sH4	1.06	0.10	WH4	1.17	0.06
sH5	1.06	0.10	WH5	1.60	0.08
Natural mortality			Proportion mature		
M0	0.20	0.10	MT0	0.00	0.00
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	1.00	0.10
M3	0.20	0.10	MT3	1.00	0.00
M4	0.20	0.10	MT4	1.00	0.00
M5	0.20	0.10	MT5	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF04	1.00	0.12	K04	1.00	0.10
HF05	1.00	0.12	K05	1.00	0.10
HF06	1.00	0.12	K06	1.00	0.10
Recruitment in 2005 and 2006					
R05	5461	0.86			
R06	5461	0.86			

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

Stock numbers in 2003 are VPA survivors.

Table 9.10.1 - Haddock in VIIa - Input for yield / Recruit

MFYPR version 2a
Run: Had7a_2004WG_yield
Had7a_2004WG_yieldMFYPR Index file 11/05/2004
Time and date: 10:55 13/05/2004
Fbar age range: 2-4

Age	M	Mat	PF	PM	SWt	Sel	CWt
0	0.2	0	0	0	0.000	0.000	0.000
1	0.2	0	0	0	0.061	0.140	0.322
2	0.2	1	0	0	0.302	0.544	0.492
3	0.2	1	0	0	0.754	1.118	0.967
4	0.2	1	0	0	1.377	1.057	1.814
5	0.2	1	0	0	2.259	1.057	2.308

Weights in kilograms

Table 9.10.2. Haddock in VIIa. Yield per recruit output table.

MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	5.5167	5.8695	3.6979	5.8200	3.6979	5.8200
0.1000	0.0906	0.2211	0.3492	4.4167	3.5229	2.5980	3.4733	2.5980	3.4733
0.2000	0.1813	0.3298	0.4658	3.8781	2.4296	2.0593	2.3801	2.0593	2.3801
0.3000	0.2719	0.3951	0.5037	3.5564	1.8139	1.7377	1.7644	1.7377	1.7644
0.4000	0.3626	0.4390	0.5098	3.3412	1.4279	1.5225	1.3783	1.5225	1.3783
0.5000	0.4532	0.4709	0.5022	3.1861	1.1681	1.3674	1.1186	1.3674	1.1186
0.6000	0.5439	0.4952	0.4888	3.0683	0.9843	1.2496	0.9347	1.2496	0.9347
0.7000	0.6345	0.5146	0.4735	2.9752	0.8490	1.1564	0.7995	1.1564	0.7995
0.8000	0.7252	0.5305	0.4580	2.8993	0.7464	1.0805	0.6969	1.0805	0.6969
0.9000	0.8158	0.5438	0.4431	2.8358	0.6666	1.0171	0.6170	1.0171	0.6170
1.0000	0.9065	0.5552	0.4293	2.7818	0.6030	0.9631	0.5535	0.9631	0.5535
1.1000	0.9971	0.5651	0.4167	2.7350	0.5515	0.9163	0.5019	0.9163	0.5019
1.2000	1.0878	0.5739	0.4052	2.6939	0.5090	0.8751	0.4594	0.8751	0.4594
1.3000	1.1784	0.5817	0.3947	2.6573	0.4733	0.8386	0.4238	0.8386	0.4238
1.4000	1.2691	0.5887	0.3853	2.6245	0.4431	0.8057	0.3936	0.8057	0.3936
1.5000	1.3597	0.5951	0.3768	2.5947	0.4172	0.7760	0.3676	0.7760	0.3676
1.6000	1.4503	0.6009	0.3692	2.5676	0.3946	0.7489	0.3451	0.7489	0.3451
1.7000	1.5410	0.6063	0.3622	2.5427	0.3749	0.7240	0.3253	0.7240	0.3253
1.8000	1.6316	0.6113	0.3559	2.5197	0.3574	0.7010	0.3079	0.7010	0.3079
1.9000	1.7223	0.6159	0.3501	2.4983	0.3418	0.6796	0.2923	0.6796	0.2923
2.0000	1.8129	0.6202	0.3449	2.4784	0.3278	0.6597	0.2783	0.6597	0.2783

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.188
F35%SPR	0.2494	0.2261

Weights in kilograms

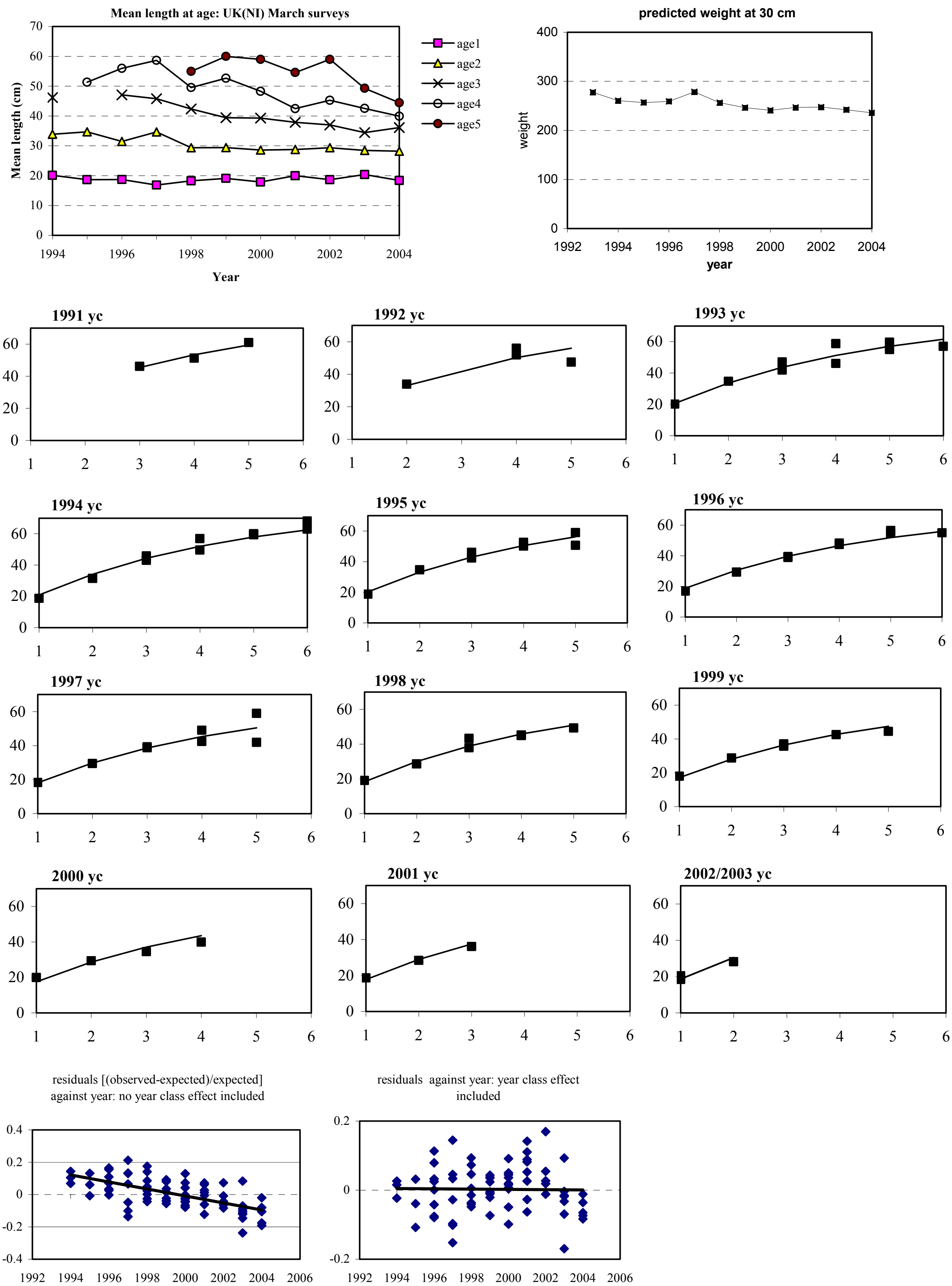


Fig. 9.4.1 Growth of haddock in the Irish Sea. Top two panels: mean length at age in N.Ireland groundfish surveys in March, by year and age, and expected mean weight at length based on length-weight parameters from each survey. Lower panels: mean length at age from March surveys, and from Quarter 1 commercial landings at age 3 and over, by year class. Lines are Von Bertalanffy model fits with year-class effect included. Model residuals are shown for the fit without year-class effects, and for the fit with year class effects.

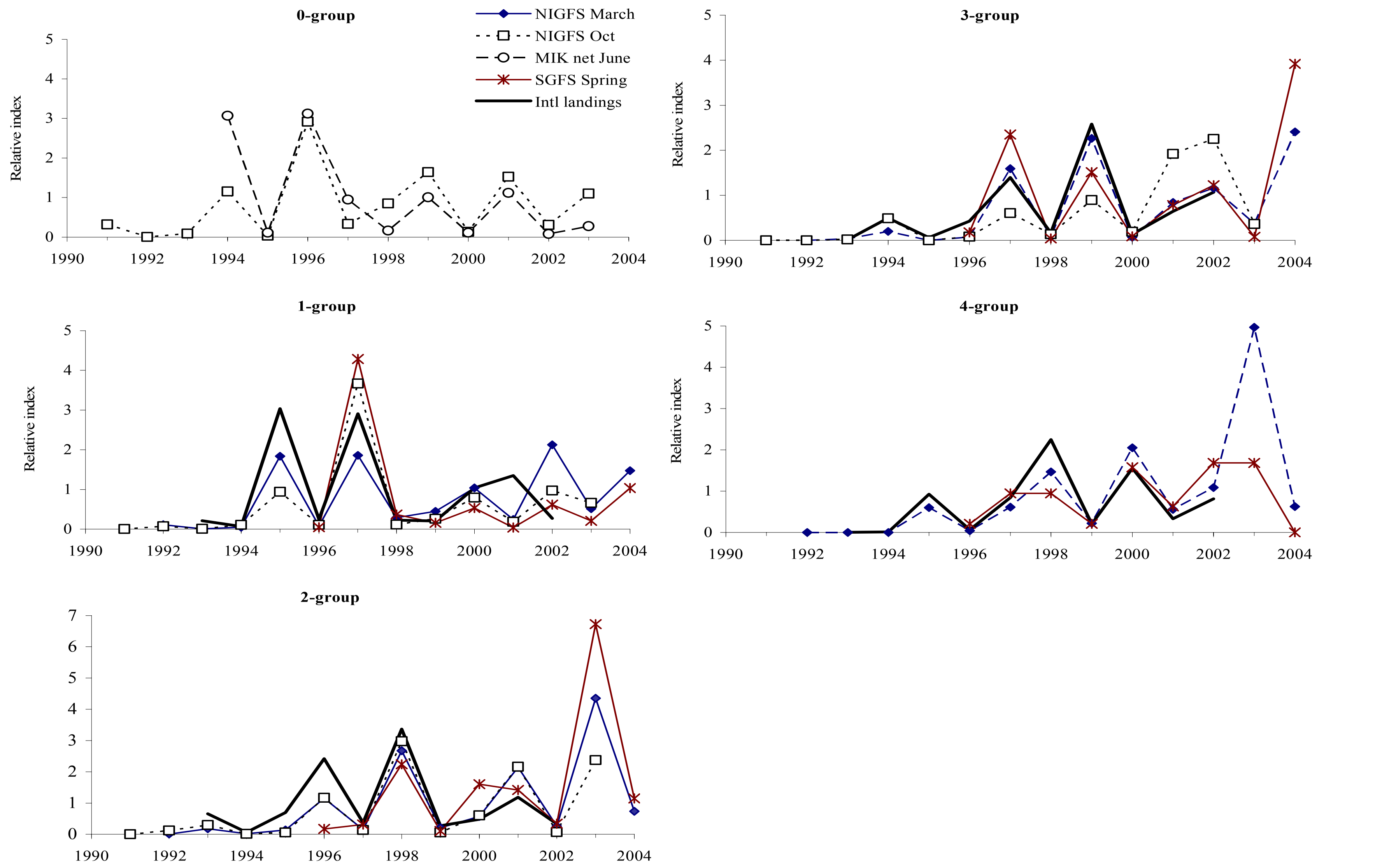
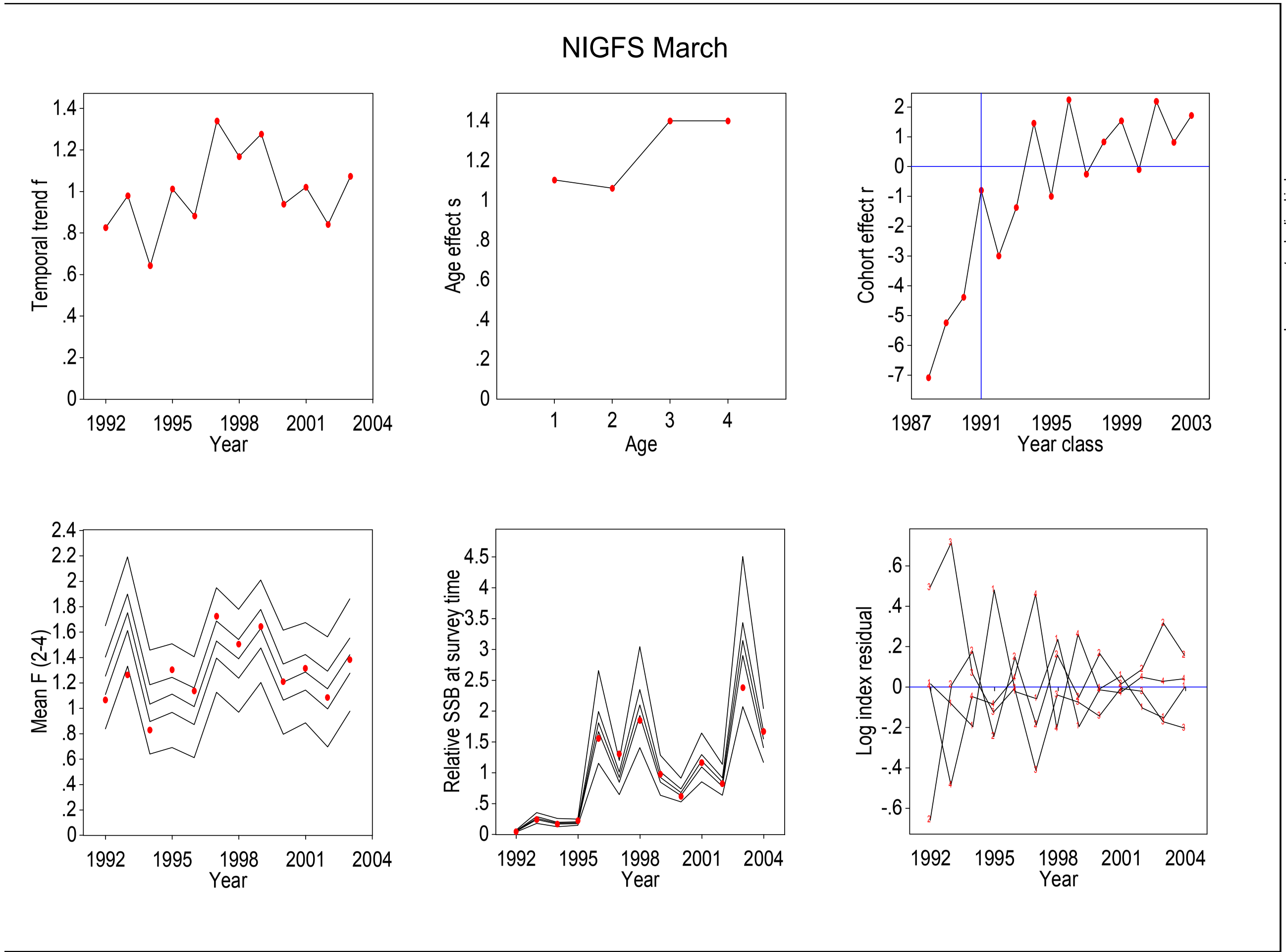


Figure 9.5.1.1 Haddock in VIIa: Trends in raw survey indices compared with international landings, by age class and year. All values are standardised to the mean for years common to all series in each plot.



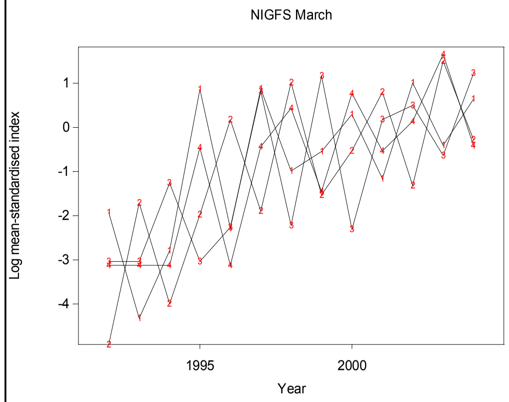
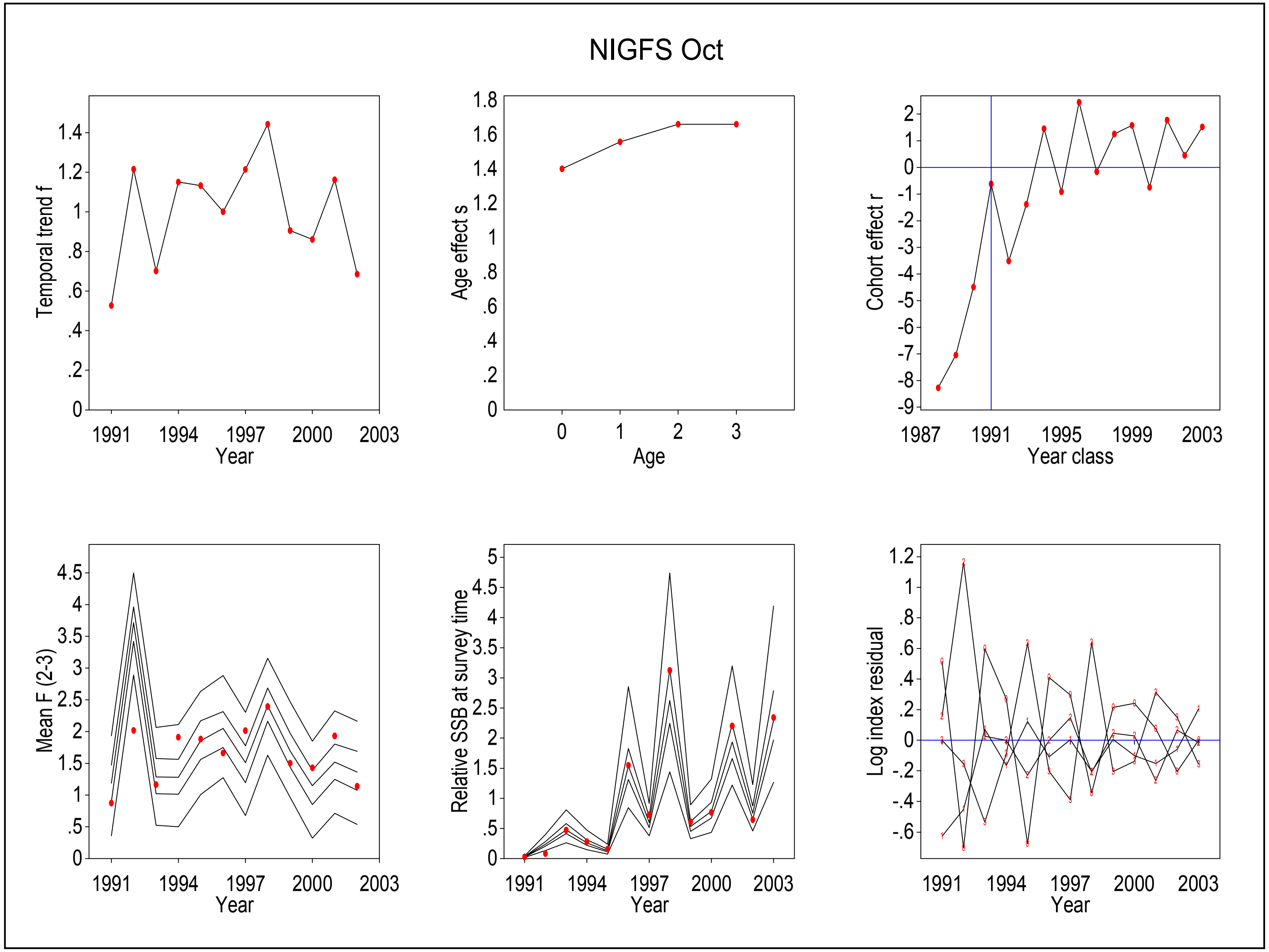


Fig. 9.5.1.2 Haddock in 7a. Diagnostic output from SURBA run using NIGFS-March survey (1992-2004) data for ages 1-4.



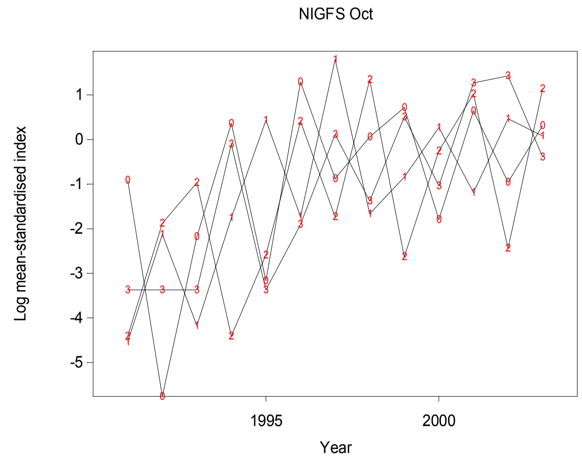
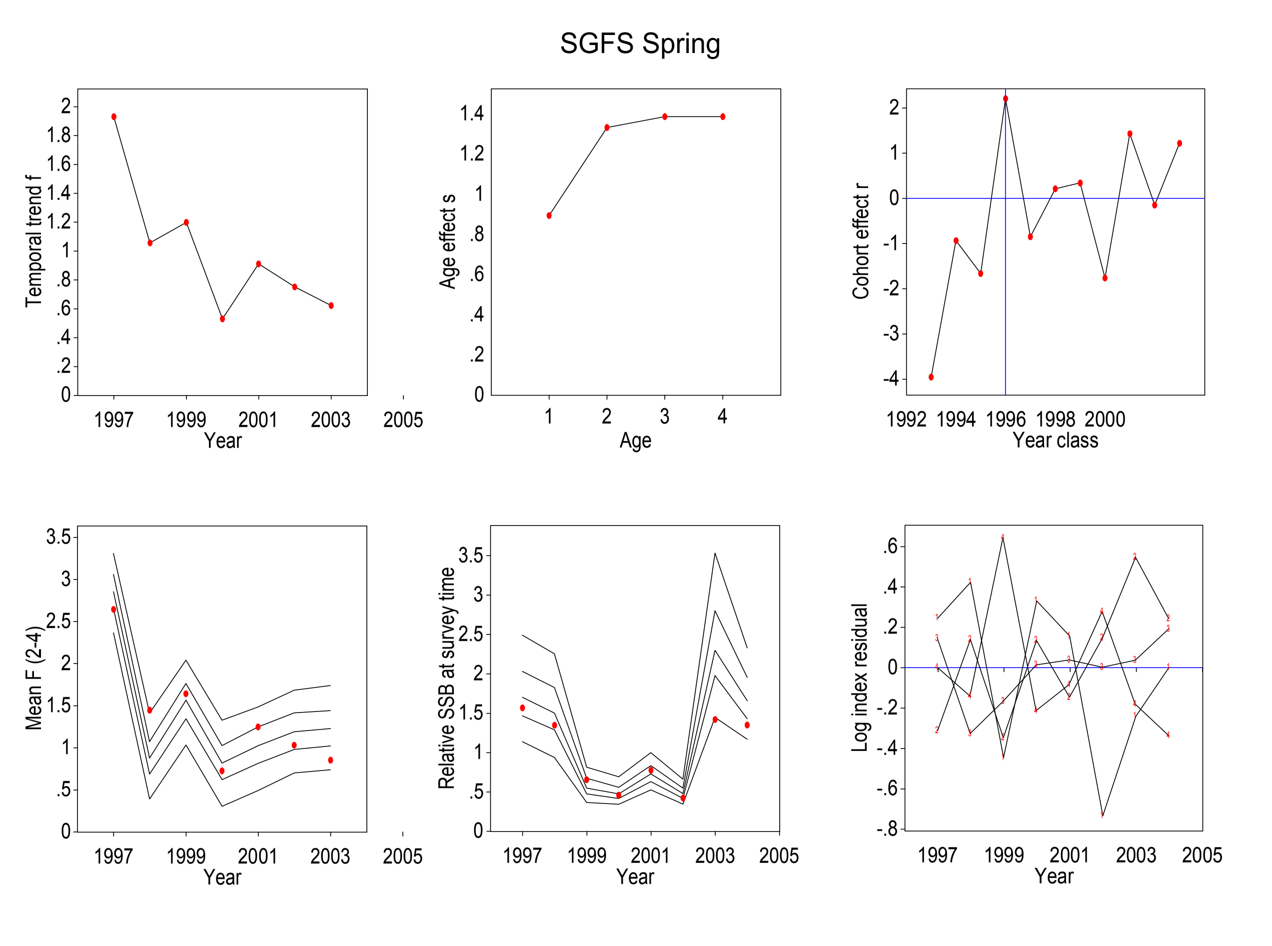


Figure 9.5.1.3 Haddock in 7a. Diagnostic output from SURBA run using NIGFS-October survey (1991-2003) data for ages 0-3.



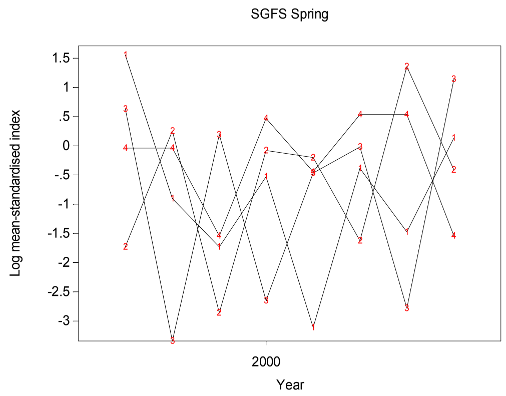
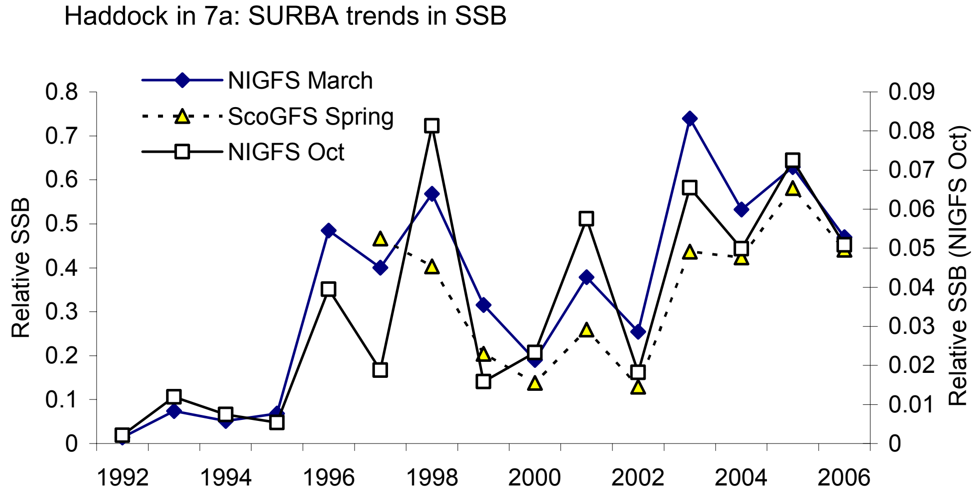
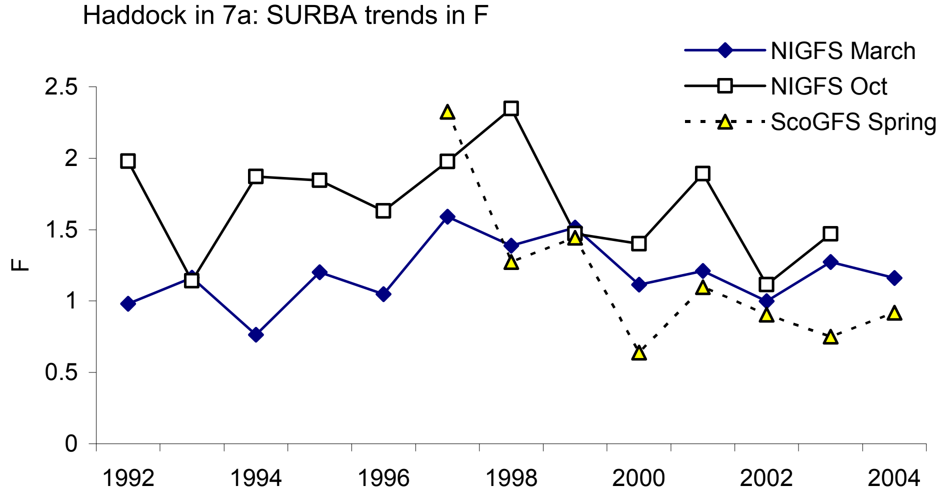


Figure 9.5.1.4 Haddock in 7a. Diagnostic output from SURBA run using SCOGFS-Spring survey (1997-2004) data for ages 1-4.





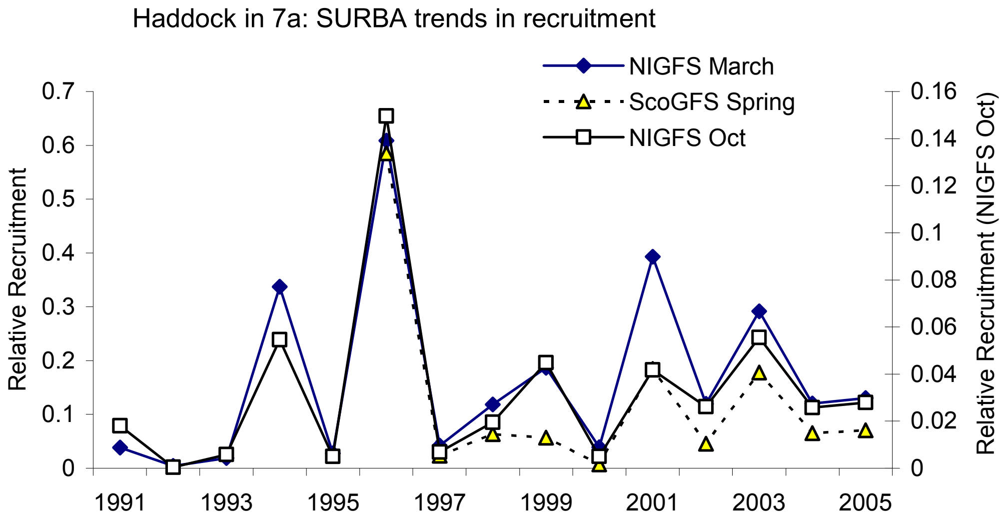


Figure 9.5.1.5 Haddock in 7a. Trends in relative SSB, F and recruitment

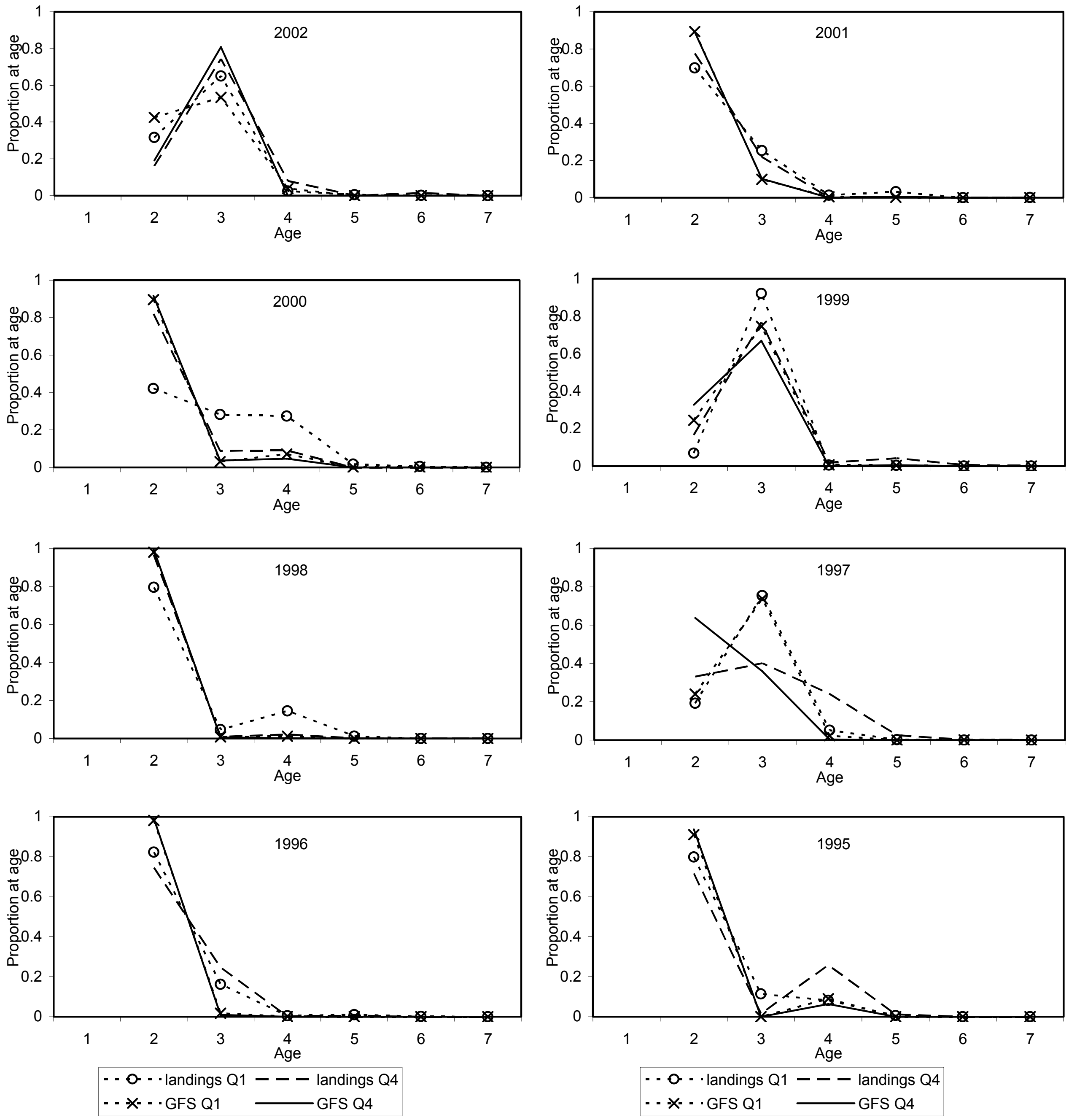


Figure 9.5.1.6 Haddock in VIIa. Estimated proportion age (2-7) compositions in quater 1 and 4 of landings by the UK(NI) fleets vs. the NI GFS during the relavant quarters (1995-2002).

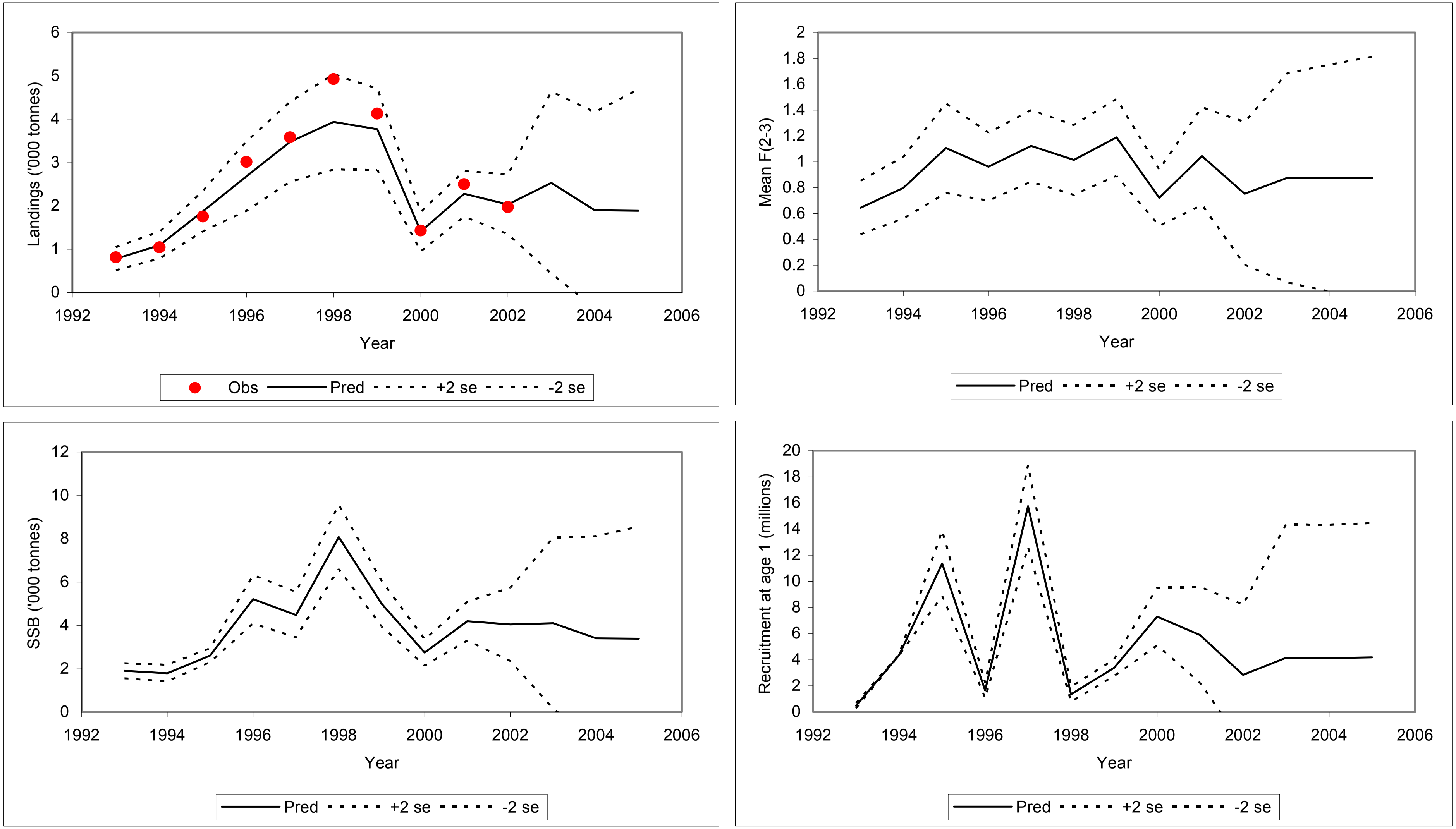


Figure 9.5.1.7 Haddock in VIIa. TSA summary plots of landings, F(2-3), SSB and recruitment for run including catch data only.

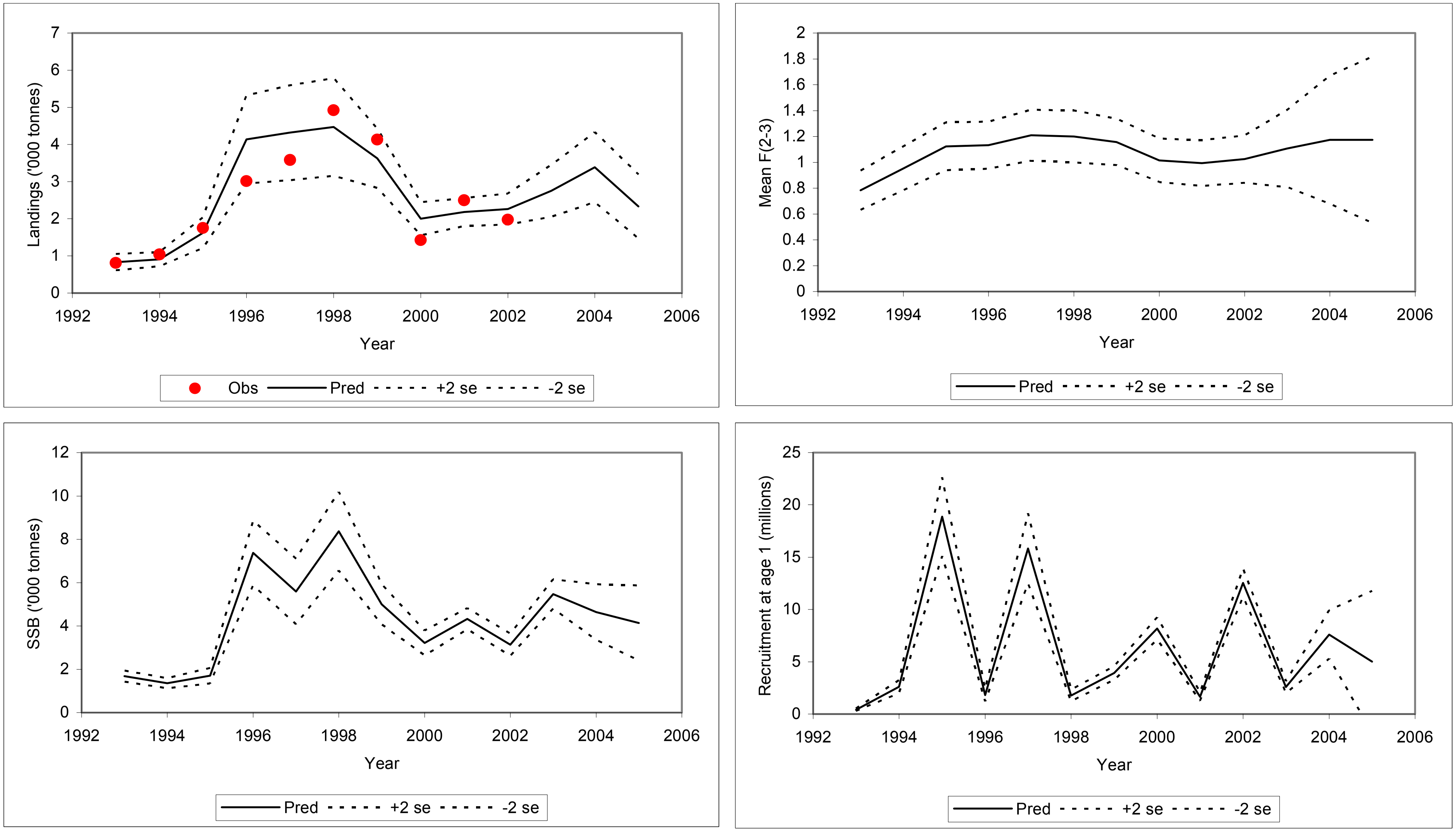
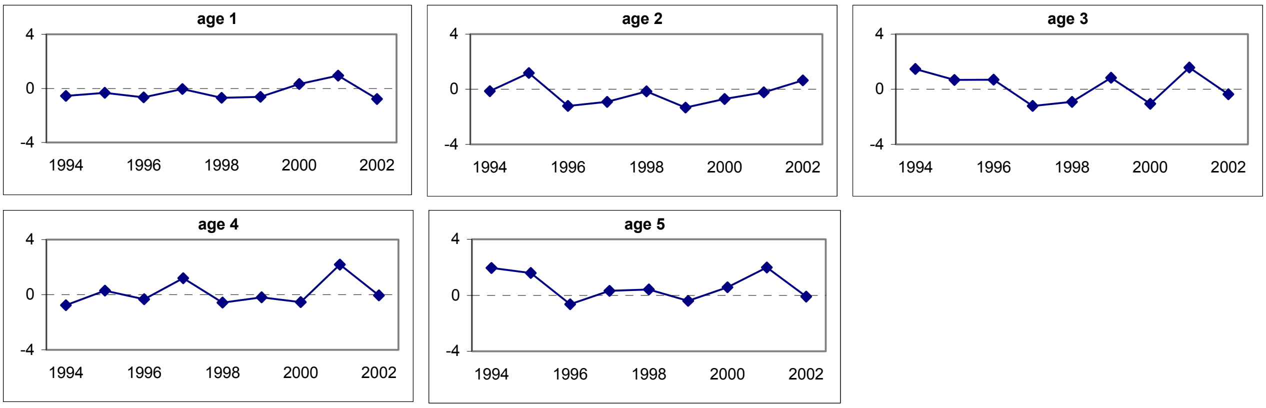


Figure 9.5.1.8 Haddock in VIIa. TSA summary plots of landings, F(2-3), SSB and recruitment for run including NIGFS March survey data.

VIIa haddock catch standardised prediction errors



VIIa haddock NIGFS March survey standardised prediction errors

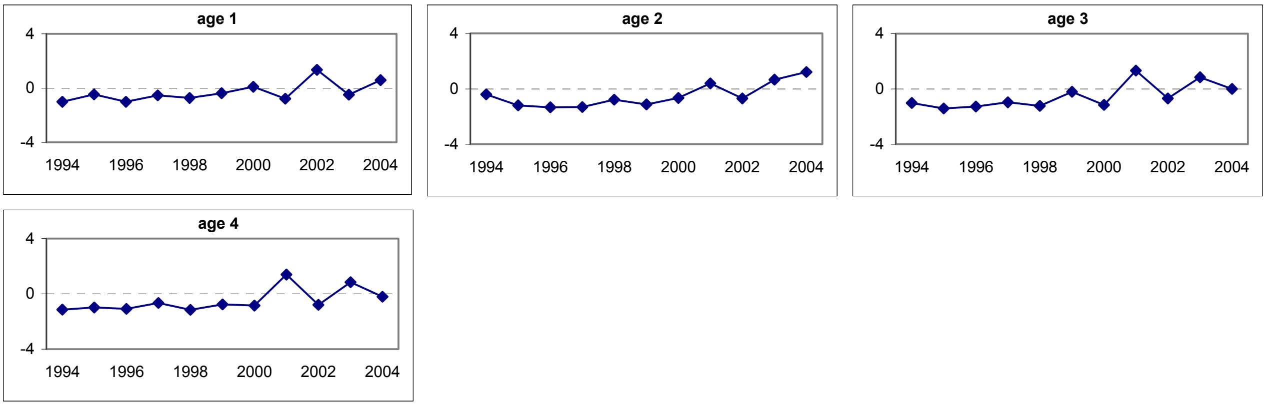


Figure 9.5.1.9 Haddock in VIIa. Standardised catch and survey prediction errors for TSA run including the NIGFS March survey data.

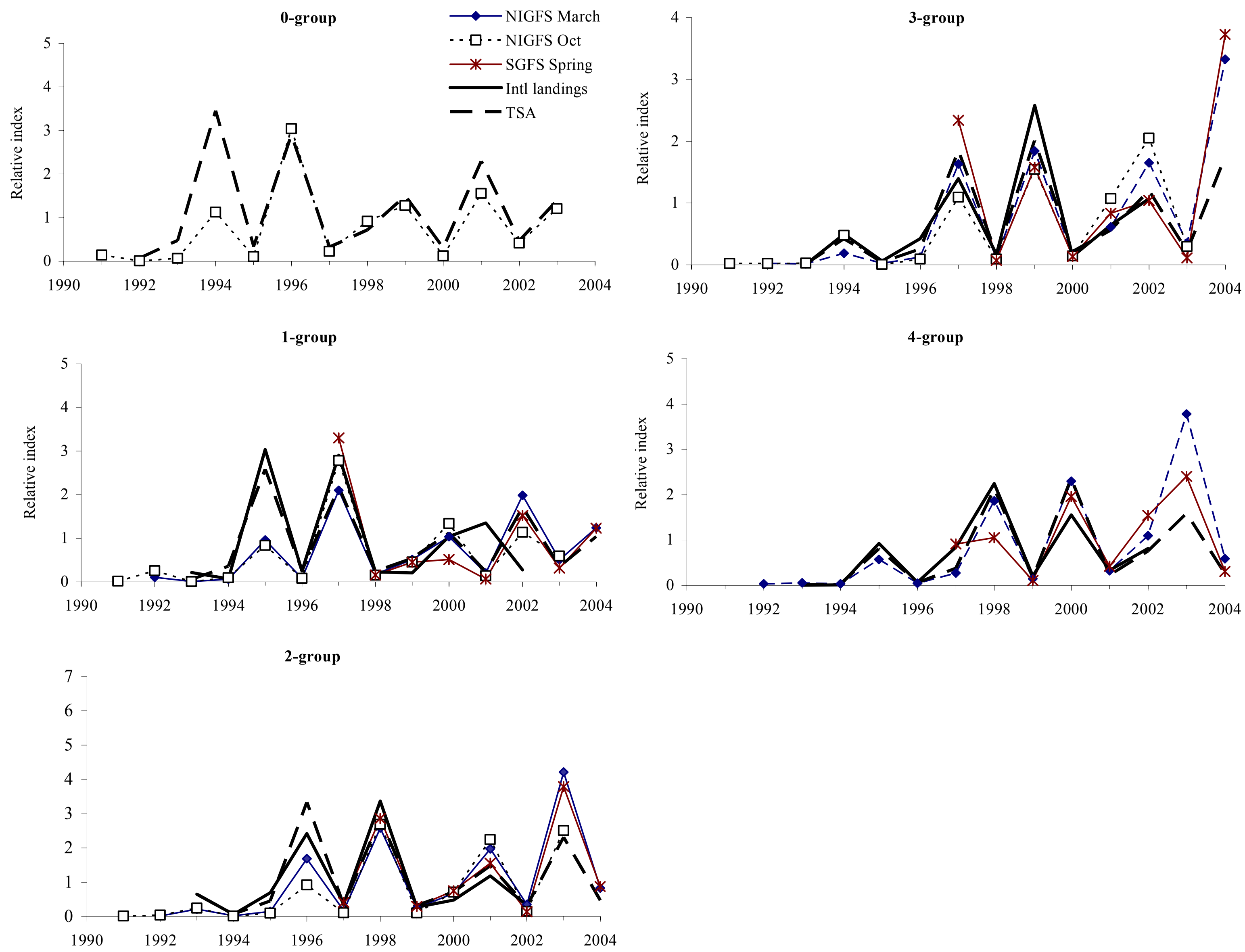


Figure 9.5.2.1 Haddock in VIIa: Trends in SURBA fitted indices compared with international landings and final TSA estimates, by age class and year. All values are standardised to the mean for years common to all series in each plot.

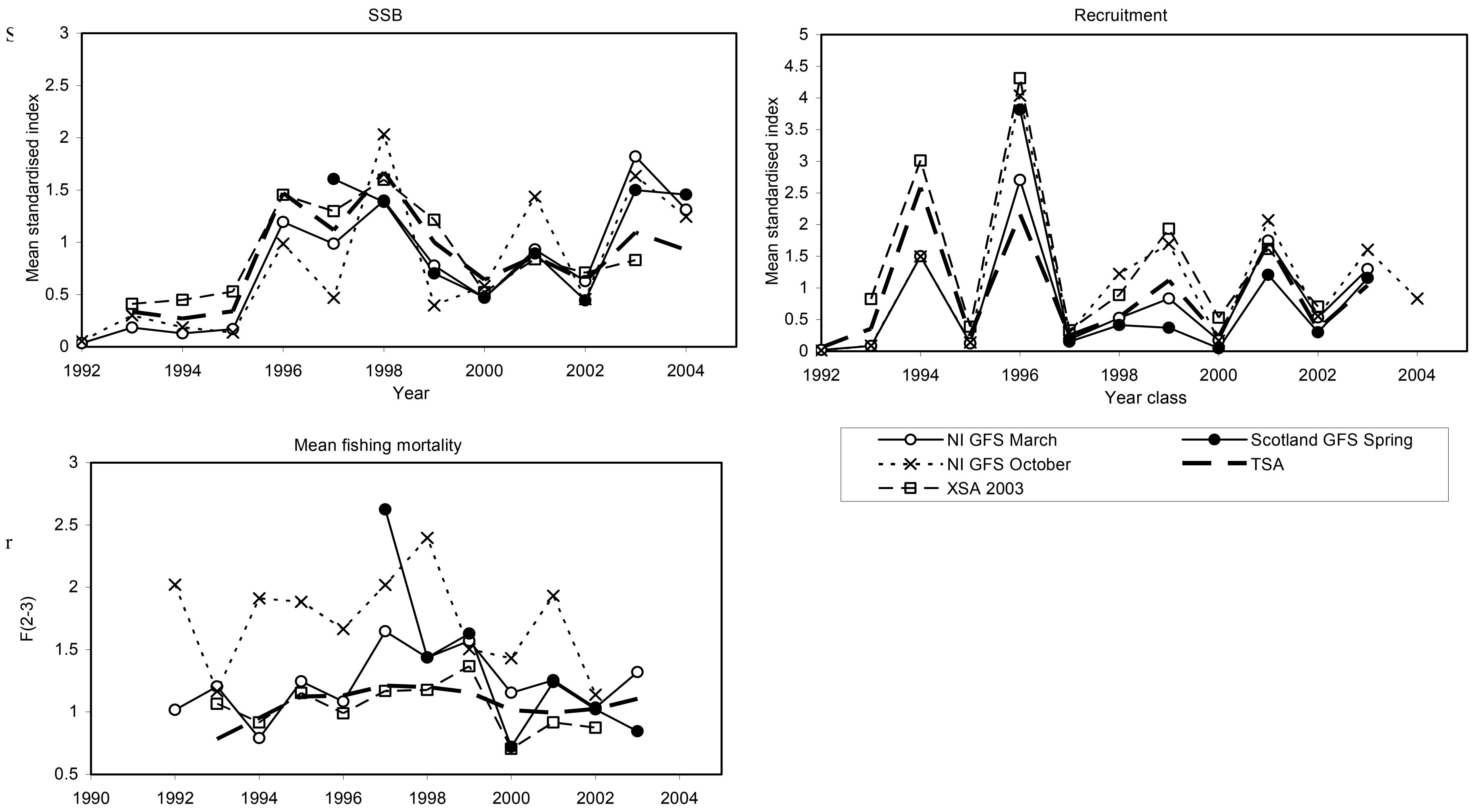


Figure 9.5.2.2 Haddock in VIIa: Trends in SSB, recruitment and F(2-3) from SURBA, TSA and XSA 2003 estimates SSB and recruitment are standardised to the mean for years common to all series in each plot.

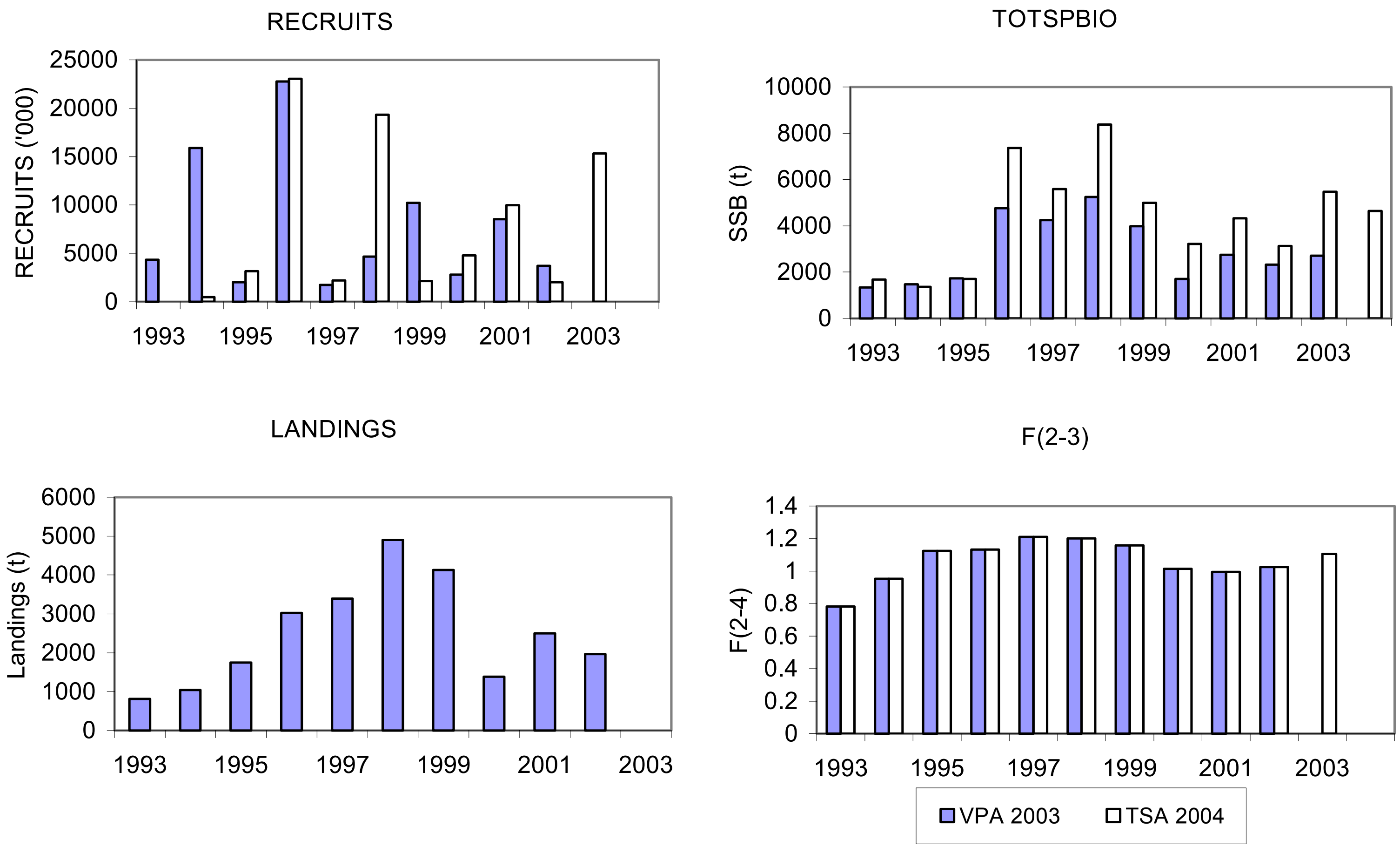


Figure 9.7.1 Haddock in VIIa: Trends in recruits, SSB, landings and F(2-3) from 2003 VPA output in TSA output

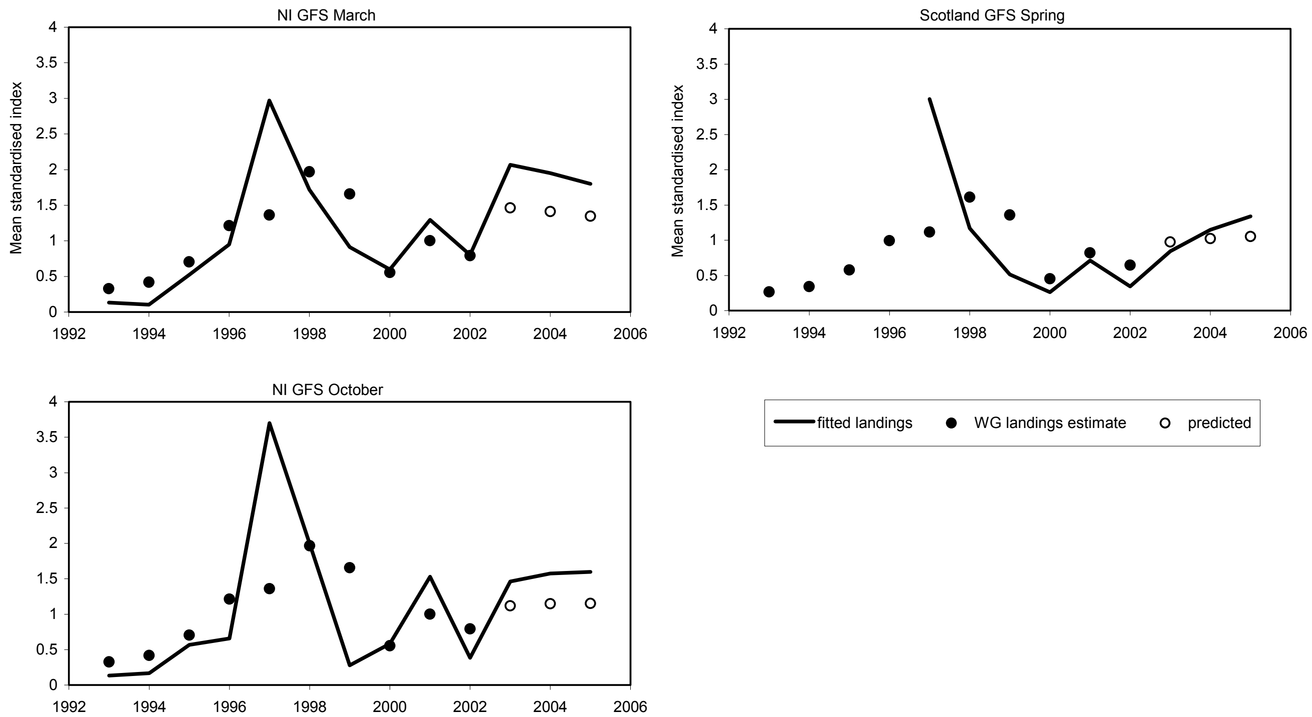


Figure 9.8.1.1 Mean standardised catch indices from the SURBA fitted survey indices (NIGFS March, NIGFS Oct and ScoGFS Spring), WG estimates of landings (1993-2002) and predicted landings estimates estimates (2003-2005)

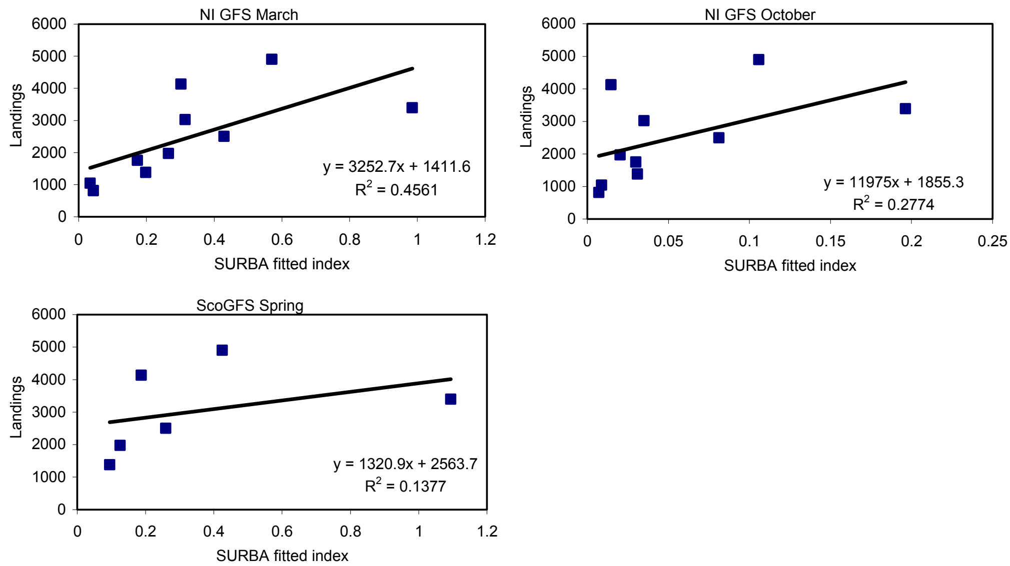
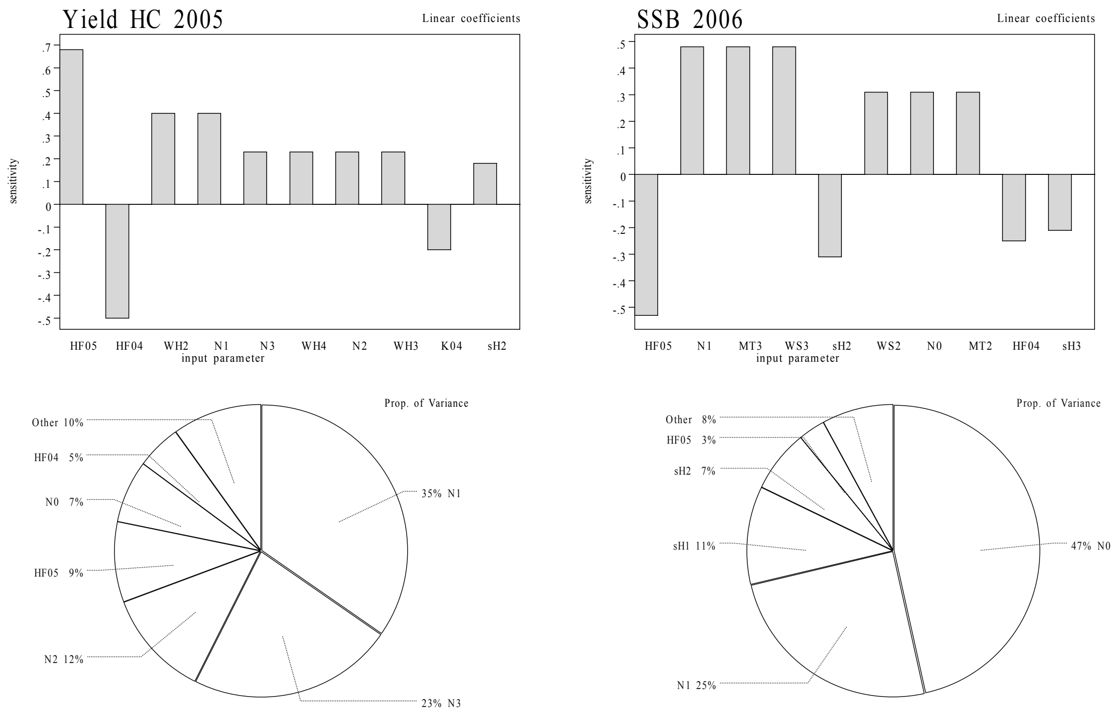


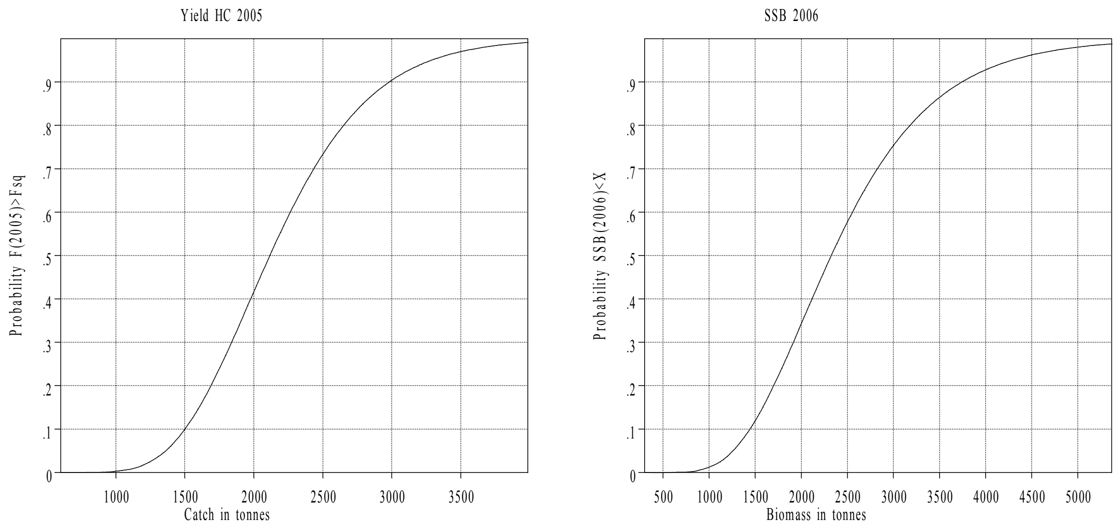
Figure 9.8.1.2 Relationship between SURBA fitted catch indices and WG estimated landings. The linear relationship between these series were used to predict the landings for 2003-2005.

Figure 9.8.2.2 Haddock,Irish Sea. Sensitivity analysis of short term forecast.



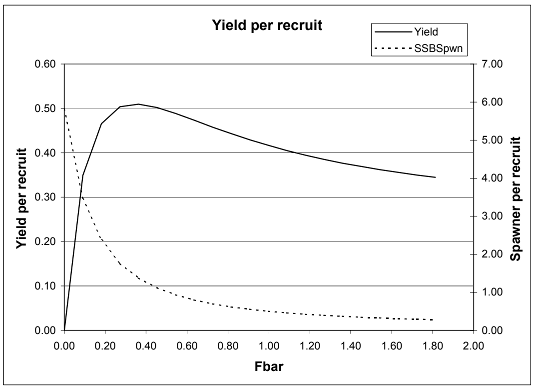
Data from file:F:\acfm\wgnsds\2004\Stock\had-iris\input data\mla\HADVIIA.SEN on

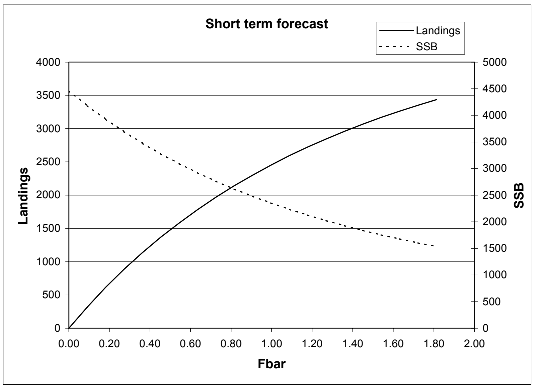
Figure 9.8.2.3 Haddock,Irish Sea. Probability profiles for short term forecast.



Data from file:F:\acfm\wgnsds\2004\Stock\had-iris\input data\mla\HADVIIA.SEN on

Figure 9.10.1 - Haddock in VIIa Yield per recruit and short forecast plots





MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.1880
F35%SPR	0.2494	0.2261

Weights in kilograms

MFDP version 1a
Run: Had7a_2004WG
HAD7AdpMFDP Index file 20/05/2003
Time and date: 10:27 11/05/2004
Fbar age range: 2-4

Input units are thousands and kg - output in tonnes

10 WHITING IN DIVISION VIIa

The Working Group have stated the principal weaknesses in this assessment were poor estimation of discards, difficulties in achieving comprehensive sampling of landings and discards, conflicting signals in tuning data and uncertain stock structure. In 2002 the Working Group was unable to provide an acceptable assessment and forecast. Last the year the Working Group focused on producing an assessment model formulation that gives status quo catch forecasts as close as possible to landings for recent years. This was accepted on pragmatic grounds as the output data could then be used in a mixed fisheries analysis to produce a TAC in line with that for cod in the Irish Sea. Unfortunately the sampling coverage has deteriorated further in 2003 to such an extent that the Working Group considered that the catch numbers-at-age and discards estimates were unreliable (See section 10.3). In addition there were considerable year effects in the terminal year for the two main surveys used to tune the assessment in 2003 (See section 10.2.2). The data problems described here meant that the Working Group was unable to produce with an acceptable quality assessment this year.

10.1 The Fishery

The characteristics of the fishery are described in the Stock Annex.

10.1.1 ICES advice applicable to 2003 and 2004

ICES advice for 2003: Fishing mortality on whiting should be reduced to the lowest possible level in 2003. A rebuilding plan, including provisions to effectively reduce directed harvest, discards and by-catch in other fisheries should be developed and implemented in order to rebuild SSB above B_{pa}.

ICES advice for 2004: Given the very low stock size, the recent poor recruitments and the continued substantial catch, a recovery plan which ensures a safe and rapid rebuilding of SSB to levels above B_{pa} should be implemented. Such a recovery plan must include a provision for zero catch until the estimate of SSB is above B_{lim} or other strong evidence of rebuilding is observed. In 2004 such a recovery plan would imply zero catch. The current high levels of discarding means that measures restricting landings alone will not be sufficient to allow recovery of this stock. The cornerstone of any recovery plan should therefore be measures that significantly reduce the discarding of whiting in the *Nephrops* fishery.

10.1.2 Management applicable in 2003 and 2004

Recent management advice is summarised below:

Year	ACFM advice	Basis	TAC	F-multiplier associated with TAC[b]	WG landings[a]
2002	0	Lowest possible F	1,000	No forecast	747
2003	0	Lowest possible F	500	0	401
2004	0	Zero catch	514	0	

[a]: Landings only, no discards included [b]: From forecast table

Previous WG predictions of catch at status quo F during the intermediate year have been well in excess of the realised catches, whilst the status quo F values have in most years been similar to the most recent accepted assessment WGNSDS 2003.

The 2003 Working Group prediction of status quo catch in 2003 was 2,371t, comprising 928t landed and 1,443t discarded. The Working Group estimates for 2003 were 43% of these predicted landings figures. Sufficiently reliable discard data were not available for 2003 (See section 10.3).

Square mesh panel legislation was introduced for both the UK and Irish vessels in 1994 specifically to reduce the fishing mortality on juvenile whiting in the *Nephrops* fishery. These measures have remained in place in 2003 and 2004. There are no specific recovery plans for whiting in VIIa, however, the technical measures for cod (closed season

& inclined separator panels) described in 8.1.2 will also impact of vessels catching whiting. The minimum landing size (MLS) for whiting is 27 cm.

Annex V to Council Regulation (EC) No 2287/2003 extended effort regulation to the Irish Sea in 2004. The maximum number of days in any calendar month of 2004 for which a fishing vessel may be absent from port in the Irish Sea given in the table below for each fishing gear band. The majority of the vessels catching whiting i.e. the *Nephrops* directed fleet are limited to 22 days per month.

Gear:	2004:
Demersal trawls, seines or similar towed gears of mesh size ≥ 100 mm except beam trawls	10
Beam trawls of mesh size ≥ 80 mm;	14
Static demersal nets including gill nets, trammel nets and tangle nets;	14
Demersal longlines;	17
Demersal trawls, seines or similar towed gears of mesh size between 70 mm & 99 mm except beam trawls[1];	22
Demersal trawls, seines or similar towed gears of mesh size between 16 mm & 31 mm except beam trawls.	20

[1] : With mesh size between 80 mm & 99 mm in 2004.

For the UK NI fleet a further round of decommissioning at the beginning of 2004 removed 19 out of 237 UK vessels that operated in the Irish Sea, representing a loss of 8% of the fleet by number and 9.3% by tonnage.

10.1.3 The Fishery in 2003

Table 10.1.3.1 gives the nominal landings of VIIa whiting as reported by each country to ICES. The Working Group catch figure of 1,490t for 2002 (revisions were negligible) is the lowest in the time series as are the estimated landings in 2003. The Working Group annual landings figures of averaging around 660t for 2000 to 2003 represent a more than ten-fold decline in fishery landings since the late 1980s. The estimated landings in 2003 (401t) represent 80% of the 2003 TAC (500t). The uptake of the quota by the Irish fleet and UK fleets was around 67% and 80% respectively. The majority (~72%) of Irish landings from VIIa in 2003 were taken in the southern Irish Sea in the first quarter from statistical rectangles (33E2 and 33E3). There has been evidence of misreporting of haddock catches as whiting catches by some countries, particularly during the haddock outburst in recent years. The landings data from into several Irish Sea ports have been adjusted for such misreporting. There was no information on 2003 misreporting levels available to the Working Group.

The 740t of whiting estimated to have been discarded from the *Nephrops* fishery in 2002 (Table 10.1.3.1) was based on UK (NI) sampling. The 2002 estimate represents 35% of the 1987–2001 average. It was not possible to reliably estimate 2003 discard volumes (see Section 10.3).

The closure of the western Irish Sea to whitefish fishing from mid February to the end of April, designed to protect cod, was continued in 2003 and 2004 but is unlikely to have affected whiting catches which are mainly by-caught in the derogated *Nephrops* fishery. The Irish and UK NI fishery also shows a peak in activity in the summer which is outside the time of the closed period for cod. Effort for Irish trawl vessels declined slightly in 2003 while effort for beam trawlers increased significantly (Table 10.1.3.2). Uncorrected effort for the UK NI fleet are given in Table 10.1.3.3 the combined effort for all towed gears are similar that in 2002.

10.2 Commercial catch-effort and research vessel surveys

10.2.1 Commercial catch and effort data

Commercial catch and effort series available to the Working Group are described in the stock Annex for 7a whiting (Section B:4). These data are not used in the assessment. Updated figures for 2003 are given in Table 10.2.1.1 and Fig 10.2.1.1. CPUE and fishing effort of the UK(E&W) otter trawl fleet were at or just above lowest values in the series. Fishing effort in the UK(NI) fleet of vessels using single otter trawls declined in 2002 to around half the peak values recorded in the early 1990s, whilst CPUE of whiting was the lowest in the series. The UK(NI) effort data in Table 10.2.1.1 differ slightly from the figures in Table 10.1.3.2 because the CPUE series exclude some ICES rectangles.

Updated effort and CPUE for the main fishing areas were not available in 2003 for this UK(NI) series. Irish effort has declined significantly since 1999, CPUE has remained at a low level in recent years.

10.2.2 Research vessel surveys

Survey series for whiting provided to the Working Group are described in the stock Annex for 7a whiting (SectionB.3). A new IBTS Q4 survey was commenced by Ireland on RV Celtic Explorer in 2003 and the indices have been provided to the WG for the first time Table 10.2.2.1.

Survey data screening

Having examined the various survey data last year's Working Group used the two Northern Ireland groundfish surveys with the March survey back-shifted to tune the final XSA assessment. This year given the problems with 2003 catch numbers-at-age the Working Group decided to examine whether a Survey-Based Assessment (SURBA) and forecast might be appropriate for this stock. The primary criteria evaluated were internal and external consistency. As last year these tests comprised plots of the effort corrected - mean standardised indices on a log scale for each age, and the results of single fleet Survey-Based Assessment (SURBA) runs. Surveys considered inappropriate for this stock are not reconsidered this year.

The following survey series, used in last year's assessment, were updated for use this year:

UK(Northern Ireland) Groundfish survey in March (NIGFS-March) – East, West and East and West

UK(Northern Ireland) Groundfish survey in October (NIGFS-Oct) - East, West and East and West

Scottish Groundfish survey in Spring (ScoGFS-Spring)

Scottish Groundfish survey in Autumn (ScoGFS-Autumn).

The Autumn ScoGFS data were not considered for SURBA exploration because of the short series, the small number of stations and the presence of anomalous low catch-rates at all ages in the 2001 survey. The abundance indices for the different surveys available to the WG are given in Table 10.2.2.1. This includes data for three different configurations of the NIGFS surveys; West, East and a combined East and West index. Last year the combined and the western index were examined separately, this year the eastern index was also examined.

The log-mean standardised indices for the UK Northern Ireland March groundfish survey appears to indicate a year effect in 2004 with an unusually low index at ages 2 and above (Figure10.2.2.1). This was most apparent in the east but was also apparent at ages 2 and 4 in the index from the western Irish Sea index. Scatter plots of log index-at-age or the UK NI March groundfish survey indicate a very poor correlation between the various age classes in the survey particularly between age 2 and older ages (Figure10.2.2.2). The area-disaggregated indices appears to have a marginally better correlearion than the combined index. Recruitment in this stock has been relatively weak during the survey time series. Despite the apparently poor internal consistency a full SURBA analysis was carried out. A relative SURBA analysis was carried out for the combined and eastern index where whereas the absolute catchabilities based on the 2003 XSA output were used in the SURBA western index. The results of this indicated a large increase in F and decrease in SSB in the terminal year probably an artefact of the large (2004) year effect in the separate and combined index (Figure 10.2.2.3).

The log mean-standardised survey indices for the UK Northern Ireland October groundfish Survey also appears to have a year effect in the last year with an unusually high index at ages one and above. This October survey appears to track of cohorts reasonably well particularly in the eastern index (Figure 10.2.2.4). The scatter plots of log index-at-age or the UK NI October groundfish survey indicated a positive correlation from most ages to the next (Figure 10.2.2.5). The eastern index appears to perform better than the western one which show negative correlations between the 0-groups and ages 3 and 4. A relative SURBA analysis was carried out for the combined and eastern index whereas for the western Irish Sea the SURBA analysis was carried out using absolute catchabilities based on the 2003 XSA outputs. The results of a SURBA are given in Figure 10.2.2.6. As one might expect because of the year effect in 2003 there is a sharp increase in SSB and sharp decrease in F in the terminal year. This year effect appears to occur in both the east and the western indices but the apparent decline in F is most obvious in the east.

Investigation of the log mean-standardised survey indices for the UK Scotland March groundfish Survey shows a relatively inconsistent pattern with no year-classes obvious and declines in older ages during the time period of the survey (Figure 10.2.2.7). Scatter plots of log index-at-age or the UK Scotland March groundfish survey indicated negative correlations between the 1 year old and older ages and mainly weak positive correlations at older ages Figure 10.2.2.8. A relative analysis was carried out with SURBA the results indicate a decline in SSB since the start of the series and very high and noisy mean F during the time series (Figure 10.2.2.9).

Given the year effects in both Northern Ireland surveys and the relatively poor internal consistency in all of the survey indices the Working Group concluded that it would not be possible to base a final assessment and forecast on the survey data.

The input files, output results and summary and diagnostic plots from all SURBA runs are on the ICES network.

10.3 Catch age compositions and mean weights at age

Sampling and raising methods previously used are described in the stock Annex for 7a whiting. Methods for estimating quantities and composition of whiting landings from VIIa are described in the Stock Annex (Section B1.1).

In 2003 only Q1 sampling was available for the UK Northern Ireland Fleet. This data was then applied to Q2 landings as Q2 have historically been of similar age composition to Q1. Landings into NI during Q2, Q3 and Q4 were not sampled. The majority (~72%) of Irish landings in VIIa were taken in the southern Irish Sea in the first quarter from statistical rectangles (33E2 and 33E3) which border with VIIg and may consist of fish from the VIIe-k stock. The low volume of Irish landings (<20 t) during the remaining quarters and from the area in the western Irish Sea where this stock used to be caught mean that 2003 quarterly sampling levels, particularly for the Irish otter trawl fleet, were extremely poor. Given these low sampling levels all the length frequency data for all four quarters and gears were combined to produce annual Irish catch numbers-at-age. The UK E&W sampling from the eastern Irish Sea was adequate in 2003 but this fleet only accounts for around 6% of the total landings.

Having investigated the historical proportions at-age by country the Working Group considered that applying poorly Irish sampling or UK E&W sampling to the Northern Ireland Fleet landings in Qs 3 and 4 was inappropriate (these data are on the ICES Network). Therefore the Working Group concluded that no representative international landings-numbers-at age could be provided for 2003.

Methods for estimating quantities and composition of discards from UK(NI) and Irish *Nephrops* trawlers are described in the Stock Annex section B1.2. Similarly in 2003 only Q1 discard estimates were available for UK NI and no estimates were available for Qs 2-4. New Irish discard estimates (1996-2003) raised according to the methods described in Borges *et. al* (In Press) were available to the Working Group. The discard rates in this series were very highly variable compared with previous estimates based on the UK NI self sampling scheme. In addition the 2003 annual estimate of 58 t was substantially below those estimated (144 t) using the NI discard sampling in Q1 2003 only. The Working Group therefore was unable to reliably estimate international discard volumes and numbers at age for 2003.

Landings, discards and total catch numbers and weights at age for the period 1980 to 2002 as estimated by last years Working Group are given in Tables 10.3.1 to 10.3.6. The proportion of the total catch comprising discards from the *Nephrops* fleets increased over time at ages 1 and over (Table 10.3.7) although this will also reflect trends in catch of vessels not sampled for discards. Since the mid 1990s, the weight of whiting estimated to have been discarded from *Nephrops* vessels has been similar to the international landings (Table 10.3.8).

The length frequency of landings and discards of sampled fleets in 2003 is given in Table 10.3.9. Irish Discard sampling in 2003 was based on 8 trips (51 hauls). The UK (E&W) supplied data on the raised length compositions of landed and discarded whiting from 6 trips and 61 hauls sampled in 2003, but not raised to the fleet. The total length frequency and discard ogive for the sampled UK(E&W) trips is given in Table 10.3.9. Length at 50% retention for this fleet was around 35cm, well above the MLS of 27cm. No age data were available for UK(E&W) discards, and the data were not included in the assessment. Table 10.3.10 gives tonnage discarded and ratios of tonnes discarded to tonnes of *Nephrops* landed by the UK (NI) fleet, as used for estimating the quantities discarded by Irish trawlers according to their reported landings of *Nephrops* (see stock Annex B1.2).

10.4 Natural mortality, maturity and stock weight at age

The derivation of these parameters and variables is described in the Stock Annex B.2. Natural mortality was assumed as 0.2 for all ages and years, and proportion mature knife-edged at age 2 for all years.

The stock weights used in last year's assessment are shown in Table 10.4.1. There has been a marked downward trend in stock weights in all ages over the period 1988 to 2002. Weights at age for ages 5 and 6+ are poorly estimated in recent years as these ages now represent less than 1% of the catch in number.

10.5 Catch-at-age analysis

Section 2.6 outlines the general approach adopted at this year's Working Group. Because of a further deterioration in sampling during 2003 the input data could not be updated and no catch at age analysis was possible this year.

10.5.1 Data Screening

Tuning data

The results of screening the survey data for internal consistency and consistency between fleets are described in Section 10.2.2.

10.5.2 Final Assessmen run

No final assessment was possible this year.

10.6 Estimating recruiting year class abundance

The general approach to estimating recruitment is described in Section 2.6. Despite the year effects in both UK NI fleets the indices of the 2003 year-class appear to be of similar magnitude to those observed in the raw indices during the survey time period (Table 10.2.2.1).

10.7 Long-term trends in biomass, fishing mortality and recruitment

Trends in catch, mean F, SSB, and recruitment from the final XSA run from last years Working Group are shown in Figure 10.7.1 and Table 10.7.1. The landings data in Fig. 10.7.1 are extended back to 1970 based on data for the Irish Sea in the reports of the ICES Irish Sea and Bristol Channel Working Group (prior to 1970, Irish Sea and Bristol Channel data are combined). No suitable discards estimates are available for years prior to 1980. The rise in landings in the 1970s may reflect either a growth in the stock or an increase in fishing effort. Effort in the UK(E&W) and French fleets was relatively stable during this period (Table 10.2.1.1). No data were available to the WG on trends in effort in the UK(NI) and Irish fleets prior to 1980, particularly in the *Nephrops* fleets.

The decline in fishery landings to under 1,000 t since 2000 is interpreted in all assessment model configurations as a collapse in biomass, with reduced recruitment since 1992. The recent trends in fishing mortality are poorly determined because of the problems with tuning the XSA.

10.8 Short-term catch predictions

No short-term catch predictions were possible this year.

10.9 Medium Term Projections

It was not possible to carry out medium term projections for this stock.

10.10 Yield and Biomass per Recruit

It was not possible to carry out medium term projections for this stock.

10.11 Reference Points

Biological reference points for this stock were considered in previous Working Group and ACFM reports, and are given below:

- B_{pa} = 7,000t
- B_{lim} = 5,000t (ACFM 1999)
- F_{pa} = 0.65
- F_{lim} = 0.95 (ACFM 1999)

Figure 10.11.1 shows the time series of F and SSB from last years Working Group final assessment in relation to domains considered precautionary or not precautionary according to the current F_{pa} and B_{pa} values. The plot shows that this stock has been subjected to high Fs and that SSB has continuously declined. The stock has been in the precautionary domain only once (1980).

10.12 Quality of the Assessment

Last year's Working Group considered that principal weaknesses in this assessment are:

- The poor estimation of discarding,
- Difficulties in achieving comprehensive sampling of the landings,
- An inability to resolve conflicting signals from the commercial catch data and survey data, and,
- Uncertainties over the stock structure.

The difficulties in achieving comprehensive sampling of landings and discards were exacerbated further in 2003 culminating in the Working Groups conclusion that reliable catch numbers and discard numbers-at-age could not be provided in 2003. Conflicting signals between the 2003 October and 2004 March UK NI ground fish survey meant that the Working Group was unable to do a survey based assessment.

10.13 Management considerations

The surveys show that juvenile (0-gp and 1-gp) whiting continue to be relatively abundant in the western Irish Sea, although the proportion of these fish derived from spawning in the eastern region is not known. These fish are subject to high rates of fishing mortality and are largely discarded from catches, particularly in the *Nephrops* fishery. Various technical measures have been introduced to reduce the numbers of discards in the *Nephrops* fisheries. However these measures have been introduce without defining targets or on going assessment and review of how effective they have been as implemented in the Irish Sea commercial fisheries.

The decline in abundance of adult whiting in the western Irish Sea may represent a local depletion of the overall Irish Sea stock, caused in part by high mortality of juveniles in different areas of the Irish Sea. In this case, effective technical conservation measures aimed at a substantial reduction in F on small whiting taken by *Nephrops* trawlers could facilitate recovery of the stock. This would require a radical re-design of *Nephrops* trawls to reduce whiting by-catch to the lowest possible level, as well as measures to reduce fishing mortality inflicted by white-fish trawlers targeting mixed gadoids and other demersal species.

The low market value and demand for whiting has resulted in discarded by some fleets of whiting well above the minimum landings size.

A number of studies on genetics and parasites are currently in progress to examine spatial differences in whiting stocks, and these may help resolve the stock structure question.

Table 10.1.3.1. Nominal catch (t) of WHITING in Division VIIa, 1987-2003, as officially reported to ICES, and Working Group estimates of human consumption and discards.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*
Belgium	109	90	92	142	53	78	50	80	92	80	47	52	46	30	27	22	13
France	826	1,063	533	528	611	509	255	163	169	78	86	81*	150*	59	25*	33	25
Ireland	4,067	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	1,119	1,260	509	353	482	347	n/a
Netherlands										17	14	7	6	1			
UK(Engl. & Wales)[a]	1,529	1,202	6,652	5,202	4,250	4,089	3,859	3,724	3,125	3,557	3,152	1,900	1,229	670	506	284	….
UK (Isle of Man)	14	15	26	75	74	44	55	44	41	28	24	33	5	2	1	1	1
UK (N.Ireland)	4,858	4,621															
UK (Scotland)	281	107	154	236	223	274	318	208	198	48	30	22	44	15	25	27	
UK																	161
Total human consumption	11,684	11,492	11,328	8,183	7,411	7,094	5,977	5,637	5,465	5,581	4,472	3,355	1,989	1,130	1,066	714	200
Estimated Nephrops fishery discards used by the WG[b]	3,899	1,611	2,103	2,444	2,598	4,203	2,707	1,173	2,151	3,631	1,928	1,304	1,092	2,118	1,012	740	n/a
Estimated landings used by the WG	10,519	10,245	11,305	8,212	7,348	8,588	6,523	6,763	4,893	4,335	2,277	2,229	1,670	762	733	747	401
Unallocated human consumption	-1,165	-1,247	-23	29	-63	1,494	546	1,126	-572	-1,246	-2,195	-1,126	-319	-368	-333	-33	-201
Total catch figures used by the WG	14,418	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205	3,533	2,762	2,880	1,745	1,487	n/a

[a] 1989-2002 Northern Ireland included with England and Wales
[b] Based on UK(N.Ireland) and Ireland data
* Preliminary

Table 10.1.3.2 Whiting VIIa (Irish Sea). Reported fishing effort of Irish trawlers and seiners landing from area VIIa over the period 1995 to 2003 (hours fished, not corrected for vessel power)

Year	Otter Trawlers	Seine Netters	Beam Trawlers
1995	80,314	23	8,639
1996	64,824	1,550	6,256
1997	92,178	2,218	9,859
1998	93,533	2,577	11,583
1999	110,275	1,450	14,667
2000	82,690	626	11,418
2001	77,541	673	13,129
2002	77,863	560	17,675
2003	76,368	762	21,837

Table 10.1.3.3 Whiting VIIa (Irish Sea). Reported fishing effort of UK(Northern Ireland) trawlers and seiners landing into Northern Ireland from area VIIa over the period 1997 to 2003 (hours fished, not corrected for vessel power)

Year	Light otter trawl	Pelagic trawl	Twin otter trawl	Single Nephrops trawl	Seine net	All towed gears
1997	24,434	56,529	20,142	141,198	390	242,693
1998	16,228	61,803	29,514	133,697	217	241,459
1999	18,725	73,278	29,117	129,117	1948	252,185
2000	12,746	47,604	41,157	117,921	2629	222,057
2001	11,073	51,090	35,652	120,483	816	219,114
2002	10,327	57,854	26,821	98,883	645	194,530
2003	11,897	61,899	31,738	102,726	1104	209,364

Table 10.2.1.1 Whiting VIIa (Irish Sea)
Effort and CPUE indices for >40' UK (E&W) otter trawlers, French otter trawlers,
UK (NI) otter and pelagic trawlers, UK (E&W) beam trawlers and Irish otter trawlers.

a) CPUE indices

Year	UK (E&W) otter[1]	France otter[2]	UK (NI) otter[3]	UK (NI) pelagic[3]	UK (E&W) beam[1]	Ireland otter[2]
1972	4.78	10.68				
1973	7.78	11.39				
1974	5.81	11.21				
1975	3.90	10.77				
1976	4.30	11.73				
1977	5.94	8.00				
1978	7.35	11.11			1.65	
1979	7.00	11.19			1.31	
1980	7.88	10.84			1.00	
1981	6.58	9.61			0.84	
1982	6.12	11.78			0.56	
1983	6.03	11.37			0.96	
1984	5.89	8.07	32.55	48.82	2.02	
1985	7.83	6.48	41.70	56.67	2.52	
1986	7.62	4.65	26.51	29.80	0.84	
1987	6.69	4.48	20.77	24.66	1.08	
1988	4.58	5.24	19.02	26.19	0.99	
1989	4.01	5.12	13.51	30.11	1.01	
1990	5.93	6.57	11.22	18.14	1.46	
1991	6.85	6.80	10.29	14.98	1.37	
1992	6.23	5.93	14.64	16.84	1.48	
1993	5.46	n/a	15.56	14.36	1.49	
1994	4.58	n/a	15.78	23.06	1.15	
1995	7.96	n/a	8.06	16.13	0.91	3.34
1996	5.97	n/a	9.88	19.63	0.92	10.13
1997	5.24	n/a	3.88	11.45	0.58	3.55
1998	7.53	n/a	2.85	4.44	0.55	3.76
1999	6.03	n/a	0.87	1.76	0.53	2.68
2000	4.80	n/a	0.77	0.82	0.34	1.45
2001	1.02	n/a	0.40	0.08	0.22	3.69
2002	0.82	n/a	0.39	2.71	0.21	2.51
2003	0.50	n/a	n/a	n/a	0.17	2.33

a) CPUE indices standardized to the mean

Year	((E&W) ot	France otte	UK (NI) otte	((NI) pelag	(E&W) be	IRL otter
	5.59	8.72	13.09	18.98	1.01	3.71
1972	0.854477	1.22544				
1973	1.39076	1.306906				
1974	1.038601	1.286253				
1975	0.697168	1.235767				
1976	0.768672	1.345918				
1977	1.06184	0.917932				
1978	1.313893	1.274779			1.639908	
1979	1.251327	1.283958			1.301988	
1980	1.408636	1.243798			0.993884	
1981	1.176247	1.102666			0.834862	
1982	1.094017	1.351656			0.556575	
1983	1.077929	1.304612			0.954128	
1984	1.052902	0.925964	2.487231	2.571967	2.007645	
1985	1.399698	0.743525	3.186407	2.985526	2.504587	
1986	1.362159	0.533548	2.025699	1.569943	0.834862	
1987	1.195911	0.514042	1.58709	1.299154	1.073394	
1988	0.818725	0.601246	1.453368	1.379759	0.983945	
1989	0.716831	0.587477	1.032335	1.586275	1.003823	
1990	1.060053	0.753852	0.85735	0.955663	1.45107	
1991	1.224513	0.780243	0.786286	0.789186	1.361621	
1992	1.113681	0.680417	1.118681	0.887176	1.470948	
1993	0.976035		1.18898	0.756523	1.480887	
1994	0.818725		1.205791	1.214862	1.142966	
1995	1.422937		0.615886	0.849771	0.904434	0.899757
1996	1.067203		0.754957	1.034161	0.914373	2.727167
1997	0.936707		0.296481	0.603216	0.576453	0.954606
1998	1.34607		0.217776	0.233911	0.546636	1.012879
1999	1.077929		0.066479	0.092721	0.526758	0.720076
2000	0.858053		0.058838	0.0432	0.33792	0.389878
2001	0.182336		0.030565	0.004215	0.218654	0.993367
2002	0.146584		0.029801	0.14277	0.208716	0.675655
2003	0.08938				0.16896	0.626616

b) Fishing effort

Year	UK (E&W) otter[4]	UK (NI) otter[5]	UK (NI) pelagic[5]	UK (E&W) beam[4]	Ireland otter[2]
1972	128401				
1973	147642				
1974	115161				
1975	130733				
1976	122337				
1977	101881				
1978	89070			880	
1979	89864			1702	
1980	107026			4283	
1981	107063			6433	
1982	127194			5503	
1983	88088			2770	
1984	103109	143687	36173	4136	
1985	102856	160017	37469	7407	
1986	90327	153473	46515	17031	
1987	130597	164901	67766	21997	
1988	131950	172191	69375	18564	
1989	139521	194636	84354	25291	
1990	117058	196518	93471	31033	
1991	107288	207828	86385	25838	
1992	96802	203226	97363	23399	
1993	78945	195323	74014	21503	
1994	42995	191705	73778	20145	
1995	43146	161025	52773	20932	80314
1996	42239	154418	53083	13320	64824
1997	39886	165612	55863	10760	92178
1998	36902	149088	61153	10386	93533
1999	22903	146990	72859	11016	110275
2000	26967	130117	46412	6275	82690
2001	32960	131418	50302	12495	77541
2002	24760	108616	57754	8020	77863
2003	23870	115551.00	61539	14000	76368

b) Fishing effort standardized to the mean

Year	((E&W) otter	UK (NI) otte	((NI) pelag	(E&W) be	IRL otter
1972	1.472942				
1973	1.693664				
1974	1.32106				
1975	1.499693				
1976	1.403379				
1977	1.16872				
1978	1.021759			0.066296	
1979	1.030868			0.128222	
1980	1.22774			0.322666	
1981	1.228165			0.484639	
1982	1.459096			0.414576	
1983	1.010495			0.208682	
1984	1.182807	0.885225	0.56591	0.311591	
1985	1.179905	0.98583	0.586185	0.558016	
1986	1.036179	0.945514	0.727706	1.283053	
1987	1.498133	1.015919	1.060168	1.657173	
1988	1.513654	1.060832	1.08534	1.398544	
1989	1.600504	1.19911	1.31968	1.905331	
1990	1.342822	1.210705	1.462311	2.337912	
1991	1.230746	1.280383	1.351454	1.94654	
1992	1.110457	1.252032	1.5232	1.762795	
1993	0.905611	1.203343	1.157915	1.619957	
1994	0.493214	1.181053	1.154223	1.51765	
1995	0.494946	0.99204	0.825609	1.57694	0.956643
1996	0.484541	0.951336	0.830459	1.00348	0.772141
1997	0.457549	1.0203	0.873951	0.810619	1.097959
1998	0.423318	0.918499	0.956711	0.782443	1.114102
1999	0.26273	0.905574	1.139846	0.829905	1.313519
2000	0.30935	0.801623	0.726095	0.472735	0.984943
2001	0.378098	0.809638	0.786952	0.941327	0.923609
2002	0.284032	0.66916	0.903535	0.604197	0.927449
2003	0.273823			1.054709	0.909636
	87173.16	162317	63920.05	13273.81	83954

[1] Weighted mean deseasonalised CPUE over ICES rectangle, GRT corrected (Kg/h)
[2] De-seasonalized CPUE
[3] Ratio of total landings to total hours fished in main fishing area
[4] Total aggregate hours fished, corrected for vessel GRT
[5] Total aggregate hours fished in main fishing area
n/a = not available

Table 10.2.2.1. Whiting in 7a. Tuning data available to the WG in 2004.. Tuning file name: w7atunall.txt

```
IRISH SEA WHITING, WGNSDS 2004, All TUNING DATA (effort; nos at age)
104
NIGFS West-October : Northern Ireland October Groundfish Survey - Irish Sea West
- Nos. per 3 nm
1994   2003
1  1  0.83   0.88
0  5
1  6077   1139   36  33.0   1.8 0.1 1994
1  4660   962 130 10.0   4.7 1.5 1995
1  5933   792 117 20.0   1.7 0.5 1996
1  8722   628 125 10.0   4.9 0.2 1997
1  8199   708 134 16.0   0.7 0.0 1998
1  7481   360 44  4.0 1.4 0.0 1999
1  4037   593 32  2.0 2.1 0.3 2000
1  15262  761 205 16.0   0.1 0.0 2001
1  7229   1712   114 11.7   0.9 0.5 2002
1  8487   1600   469 19.1   1.2 0.1 2003

NIGFS West-March : Northern Ireland March Groundfish Survey - Irish Sea West -
Nos. per 3 nm
1993   2004
1  1  0.21   0.25
1  5
1  4307   73  121 6   0      1994
1  3604   988 53  30  1      1995
1  2323   587 188 11  15     1996
1  3250   447 52  14  1      1997
1  3857   535 71  9   3      1998
1  2373   228 39  7   2      1999
1  4037   231 23  3   0      2000
1  1998   631 30  2   1      2001
1  3580   163 36  3   0      2002
1  2952   812 25  6   1      2003
1  3568   174 36  1   0      2004

NIGFS East-October : Northern Ireland October Groundfish Survey - Irish Sea East
- Nos. per 3 nm
1994   2003
1  1  0.83   0.88
0  5
1994   1  749 472 179 165.0   29.0   3.0 1994
1995   1  2515   259 178 41.0   47.0   9.0 1995
1996   1  1005   517 127 64.0   15.0   10.0   1996
1997   1  640 668 682 88.0   26.0   6.0 1997
1998   1  1446   277 178 95.0   11.0   4.0 1998
1999   1  2287   1388   260 102.0  79.0   3.0 1999
2000   1  1972   1288   216 26.0   22.0   9.0 2000
2001   1  2998   691 300 35.0   7.0 5.0 2001
2002   1  1296   1285   349 76.0   8.5 2.0 2002
2003   1  3783   1939   1104   155.4  25.0   3.2 2003

NIGFS East-March : Northern Ireland March Groundfish Survey - Irish Sea East -
Nos. per 3 nm
1993   2004
1  1  0.21   0.25
1  5
1994   1  611 290 390 47  12.0   1994
1995   1  448 522 142 109 25.0   1995
1996   1  1094   221 203 40  44.0   1996
1997   1  561 1054   91  33  2.0 1997
1998   1  409 903 522 32  11.0   1998
1999   1  1023   407 135 52  6.0 1999
```

2000 1 1481 524 229 35 4.0 2000
2001 1 631 739 162 15 9.0 2001
2002 1 869 1043 243 54 13.1 2002
2003 1 1118 1328 178 24 5.7 2003
2004 1 1026 302 69 4 1.6 2004

UKE&W-BTS : Corystes Irish Sea Beam Trawl Survey (Sept) - Prime stations only - Effort and numbers at age (per km towed)
1988 2003
1 1 0.75 0.79
0 1
1 205 84 1988
1 112 33 1989
1 157 120 1990
1 257 39 1991
1 227 300 1992
1 146 97 1993
1 157 106 1994
1 1570 60 1995
1 136 164 1996
1 306 208 1997
1 700 144 1998
1 464 122 1999
1 282 122 2000
1 468 155 2001
1 234 85 2002
1 438 154 2003

NIGFS-Oct E&W : Northern Ireland October Groundfish Survey - Irish Sea East & West - Nos. per 3 nm
1992 2003
1 1 0.83 0.88
0 5
1 1454 995 96 26.0 4.0 0.0 1992
1 1554 425 300 27.0 2.0 0.1 1993
1 2450 686 133 123.0 20.0 2.0 1994
1 3199 483 163 30.9 33.6 6.9 1995
1 2628 605 124 50.0 10.8 6.8 1996
1 3219 655 504 63.0 19.0 4.0 1997
1 3601 414 164 70.0 7.9 3.0 1998
1 3945 1060 191 70.0 54.1 1.7 1999
1 2631 1066 158 18.0 15.8 6.1 2000
1 6911 713 270 29.0 4.7 3.1 2001
1 3189 1421 274 55.4 6.1 1.5 2002
1 5284 1831 901 111.9 17.4 2.2 2003

NIGFS-March E&W : Northern Ireland March Groundfish Survey- Irish Sea East & West - Nos. per 3 nm
1992 2004
1 1 0.21 0.25
0 4
1 1477 456 94 29 5.0 0.0 1992
1 667 655 67 9 2.0 0.5 1993
1 1790 221 304 34 8.0 5.0 1994
1 1696 698 116 85 17.0 3.0 1995
1 1478 280 160 28 32.0 5.6 1996
1 1419 860 79 27 1.7 4.3 1997
1 1730 767 196 12 3.3 0.1 1998
1 1453 350 104 38 5.0 1.0 1999
1 2297 431 163 25 2.7 0.0 2000
1 1067 704 120 11 7 1.6 2001
1 1734 762 177 38 9 0.3 2002
1 1703 1163 129 18 4 0.0 2003
1 1837 261 59 3 1 0.1 2004

```
UKNI-MIK : Northern Ireland MIK Net Survey
1994   2003
1   1   0.46   0.50
0   0
1   778 1994
1   225 1995
1   397 1996
1   205 1997
1   59  1998
1   91  1999
1   40  2000
1   167 2001
1   19  2002
1   148 2003

ScoGFS Spring : Scottish groundfish survey in Spring
1996   2004
1       1      0.15  0.21
1       8
1   11610  4051   1898   362 229 59  3   4   1996
1   16322  16200  2953   964 250 105 39  1   1997
1   22145  8187   3817   137 110 0   5   0   1998
1   19815  6642   1706   282 11  0   27  0   1999
1   13019  1662   169 71  36  6   0   0   2000
1   9419   4541   407 40  2   0   0   0   2001
1   15605  3060   430 34  1   0   0   0   2002
1   14798  5404   375 45  0   4   0   0   2003
1   9199   2219   583 27  1   0   0   0   2004

ScoGFS Autumn : Scottish groundfish survey
1995   2003
1       1      0.83  0.91
0       6
1   30094  8827   2530   435 215 4   0   1997
1   18457  7166   1291   37  35  26  0   1998
1   73309  7357   2166   263 219 0   6   1999
1   16862  8677   503 242 25  12  0   2000
1   0   140 133 13  0   0   0   2001
1   30324  16655  1435   224 2   28  0   2002
1   26671  7170   1138   69  0   0   0   2003

IR-ISCSGFS : Irish Sea Celtic Sea GFS 4th Qtr - Effort min. towed - No. at age
1997   2002
1   1   0.8 0.9
0   5
540 1566   3330   793 154 23  12  1997
1020   48396  6534   2249   170 15  0   1998
1170   208494 3302   624 24  28  2   1999
1128   97502  4402   25  1   0   0   2000
1221   28881  29577  3123   177 1   0   2001
1035   12112  10237  1497   225 33  5   2002

IR-Q4 IBTS: IRISH GFS RV Celtic Explorer 2003: NUMBERS AT AGE
2003   2003
1   1   0.89   0.91
0   5
1   72340  19658  13391  1617   605 0   2003

IR-OTB : Irish Otter trawl - Effort in h - VIIa Whiting numbers at age - Year
1995   2002
1   1   0   1
1   6
80314      6   437 206 261 21  1   1995
```

```
64824	64	682	1528	266	71	4	1996
92178	3	368	494	418	55	19	1997
93533	20	395	838	117	27	30	1998
110275	34	398	531	130	19	3	1999
82690	40	192	155	58	8	0	2000
77541	13	397	444	42	22	3	2001
77863	21	173	383	88	8	8	2002

UKNI-Pelagic trawl : Northern Ireland Midwater trawlers - Effort in h - No per h fished
1993	2002
1	1	0	1
2	6
74014	3174	1060	172	29.5	4.8	1993
73778	1706	4340	574	72.8	16.2	1994
52773	1997	416	719	37.9	7.2	1995
53083	1432	2276	361	327.4	41.8	1996
55863	1241	660	549	12.3	17.5	1997
61153	438	423	98	45.8	2.7	1998
72859	162	185	57	13.5	11.6	1999
46412	67	53	11	7.9	1.1	2000
50302	7	4	2	0.5	0.2	2001
57754	189	316	90	11	15	2002

UKNI-Otter trawl : Northern Ireland single-rig otter trawlers - Effort in h - No per h fished - includes discards
1993	2002
1	1	0	1
0	6
195323	10308	9217	21444	2791	261	28	2	1993
191705	3172	11286	3957	9723	747	75	16	1994
161025	5228	10692	8874	987	1312	17	1	1995
154418	8663	20784	6748	4623	551	460	56	1996
165612	4344	12001	5864	1292	528	7	7	1997
149088	5869	11381	2368	1135	200	50	1	1998
146990	14625	3517	1202	344	59	12	8	1999
130117	4403	12613	3082	520	61	14	8	2000
131418	10658	6663	1833	228	64	13	10	2001
108616	4601	8586	1068	265	44	3	2	2002

UKE&W-Otter trawl : England/Wales Otter Trawl
1981	2000
1	1	0	1
2	6
107	906	766	162	103	4	1981
127	1984	893	340	67	49	1982
88	685	1065	227	67	21	1983
103	1395	439	475	80	29	1984
103	2077	889	148	125	25	1985
90	2246	1006	158	20	17	1986
131	2206	1505	316	58	5	1987
132	1885	827	161	30	6	1988
140	1344	1201	234	40	10	1989
117	2076	671	222	35	14	1990
107	2374	793	165	48	5	1991
97	2072	1020	177	42	3	1992
79	784	654	157	31	5	1993
43	110	454	91	15	3	1994
43	460	188	375	7	1	1995	Revised at NSWG 1997
42	260	604	102	90	10	1996
40	331	211	155	7	1	1997
37	311	355	81	28	1	1998
23	194	175	46	11	8	1999
27	186	134	47	36	4	2000
```

Table 10.3.1 Whiting in VIIa (Irish Sea)
International catch at age ('000) for human consumption
1980 to 2002. **No 2003 estimates were possible.**

Age	1980	1981
0	0	0
1	14520	11203
2	21811	29011
3	6468	16004
4	2548	2596
5	350	821
6+	621	339

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	41	0	0	0	0	0	0	0	0	102
1	5427	4886	18254	15540	6306	10149	6983	11645	9502	7426
2	18098	9943	12683	35324	16839	21563	25768	14029	17604	18406
3	19340	9100	5257	8687	10809	6968	6989	13011	4734	5829
4	6108	4530	2571	996	1877	1943	1513	3645	1477	993
5	813	1165	1045	675	285	242	396	490	318	311
6+	400	321	402	372	270	111	197	177	128	84

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0	38	0	0	129	0	0	1	0	0	0
1	8380	2742	3245	1124	1652	610	329	341	319	111	67
2	21907	21468	6983	10095	6162	4239	3287	2806	1364	1189	748
3	7959	7327	18509	3020	7432	2567	4727	2607	1002	1006	1480
4	1374	932	1801	4444	1263	1795	888	741	299	171	376
5	462	135	208	233	1082	87	261	160	115	53	48
6+	93	27	50	21	135	79	95	119	15	20	41

Table 10.3.2 Whiting in VIIa (Irish Sea)
International catch at age ('000) discarded, 1980 to 2002
No 2003 estimates were possible.

Age	1980	1981
0	12786	9865
1	32318	24935
2	6888	9162
3	65	162
4	26	26
5	0	0
6+	0	0

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	4047	23847	26394	12380	28364	16594	6922	17247	4216	20349
1	8489	7328	33900	26461	21111	40598	17958	20701	31810	29334
2	560	2036	1568	1859	1464	1875	1940	2476	3353	3823
3	19	9	11	9	33	0	0	26	72	146
4	0	0	0	0	0	0	0	0	0	1
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	1497	12639	3731	7118	12732	8163	6096	20851	7321	16940	8538
1	61451	13979	12063	17613	39647	25497	27131	7677	38922	12631	13412
2	10404	17707	1812	7015	8168	5352	2293	2117	4395	3150	1588
3	97	426	1702	492	1976	689	550	228	564	102	231
4	0	5	29	234	81	141	44	34	55	10	33
5	0	0	0	0	0	0	0	2	1	0	0
6+	0	0	0	0	0	0	0	2	10	0	1

Table 10.3.3 Whiting in VIIa (Irish Sea)
International catch at age ('000) landed and discarded, 1980 to 2002

No 2003 estimates were possible.

Age	1980	1981
0	12786	9865
1	46838	36138
2	28699	38173
3	6533	16166
4	2574	2622
5	350	821
6+	621	339

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	4088	23847	26394	12380	28364	16594	6922	17247	4216	20451
1	13916	12214	52154	42001	27417	50747	24941	32346	41312	36760
2	18658	11979	14251	37183	18303	23438	27708	16505	20957	22229
3	19359	9109	5268	8696	10842	6968	6989	13037	4806	5975
4	6108	4530	2571	996	1877	1943	1513	3645	1477	994
5	813	1165	1045	675	285	242	396	490	318	311
6+	400	321	402	372	270	111	197	177	128	84

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	1497	12677	3731	7118	12861	8163	6096	20852	7321	16940	8538
1	69831	16721	15308	18737	41299	26107	27460	8018	39242	12742	13479
2	32311	39175	8795	17110	14330	9591	5580	4923	5758	4338	2336
3	8056	7753	20211	3512	9408	3256	5277	2835	1566	1108	1711
4	1374	937	1830	4678	1344	1936	932	776	354	181	409
5	462	135	208	233	1082	87	261	161	115	53	48
6+	93	27	50	21	135	79	95	121	25	20	42

Table 10.3.4 Whiting in VIIa (Irish Sea)
International mean weight at age (kg) of the human consumption catch, 1980 to 2002.

No 2003 estimates were possible.

Age	1980	1981
0	0.133	0.133
1	0.216	0.216
2	0.269	0.269
3	0.365	0.365
4	0.533	0.533
5	0.630	0.630
6+	0.772	0.888

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.133	0	0.144	0	0.134	0	0	0	0	0.115
1	0.216	0.215	0.208	0.174	0.184	0.173	0.152	0.197	0.198	0.172
2	0.269	0.279	0.257	0.250	0.225	0.223	0.214	0.209	0.220	0.210
3	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269	0.313	0.266
4	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433	0.436	0.352
5	0.630	0.605	0.699	0.567	0.709	0.720	0.763	0.680	0.676	0.453
6+	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079	0.800	0.692

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0	0.117	0	0	0	0	0	0.120	0.064	0	0
1	0.160	0.151	0.169	0.188	0.196	0.171	0.169	0.166	0.179	0.182	0.145
2	0.198	0.186	0.198	0.219	0.217	0.219	0.202	0.218	0.216	0.250	0.214
3	0.274	0.233	0.227	0.273	0.244	0.244	0.240	0.255	0.269	0.319	0.273
4	0.361	0.332	0.304	0.334	0.288	0.296	0.274	0.328	0.317	0.346	0.356
5	0.513	0.454	0.378	0.551	0.365	0.396	0.350	0.352	0.347	0.538	0.449
6+	1.007	0.892	0.496	1.320	0.415	0.537	0.421	0.328	0.412	0.337	0.428

Table 10.3.5 Whiting in VIIa (Irish Sea)
International mean weight at age (kg) of the discarded catch, 1980 to 2002. **No 2003 estimates were possible.**

Age	1980	1981
0	0.034	0.034
1	0.062	0.062
2	0.125	0.125
3	0.230	0.230
4	0	0
5	0	0
6+	0	0

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.029	0.033	0.024	0.022	0.023	0.024	0.021	0.026	0.034	0.030
1	0.072	0.101	0.075	0.080	0.058	0.078	0.069	0.063	0.060	0.051
2	0.125	0.147	0.130	0.137	0.126	0.157	0.114	0.105	0.113	0.115
3	0.141	0.245	0	0	0.155	0	0.449	0.091	0.115	0.130
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.014	0.029	0.029	0.031	0.026	0.026	0.017	0.028	0.024	0.017	0.016
1	0.050	0.050	0.048	0.055	0.051	0.041	0.034	0.038	0.036	0.034	0.033
2	0.110	0.089	0.123	0.120	0.111	0.101	0.090	0.086	0.100	0.088	0.082
3	0.137	0.143	0.154	0.153	0.161	0.141	0.130	0.147	0.128	0.119	0.127
4	0	0.175	0.149	0.179	0.186	0.170	0.145	0.237	0.150	0.194	0.141
5	0	0	0	0	0	0	0	0.218	0.213	0	0
6+	0	0	0	0	0	0	0	0.174	0.152	0	0.213

Table 10.3.6 Whiting in VIIa (Irish Sea)
International mean weight at age (kg) of the total catch (landings plus discards) 1980 to 2002.
No 2003 estimates were possible.

Age	1980	1981
0	0.034	0.040
1	0.110	0.118
2	0.235	0.240
3	0.363	0.364
4	0.529	0.529
5	0.630	0.630
6+	0.772	0.888

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.031	0.033	0.032	0.021	0.025	0.024	0.021	0.026	0.036	0.031
1	0.135	0.146	0.125	0.107	0.100	0.101	0.088	0.111	0.094	0.077
2	0.265	0.256	0.244	0.245	0.217	0.217	0.201	0.193	0.204	0.194
3	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269	0.310	0.263
4	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433	0.436	0.352
5	0.630	0.605	0.700	0.567	0.709	0.720	0.763	0.680	0.676	0.453
6+	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079	0.800	0.692

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.014	0.029	0.030	0.031	0.027	0.026	0.017	0.028	0.024	0.017	0.016
1	0.063	0.067	0.074	0.063	0.057	0.044	0.035	0.044	0.038	0.036	0.033
2	0.170	0.142	0.183	0.179	0.159	0.153	0.156	0.161	0.127	0.132	0.124
3	0.272	0.228	0.221	0.257	0.230	0.222	0.228	0.246	0.218	0.301	0.253
4	0.361	0.331	0.301	0.326	0.284	0.287	0.268	0.324	0.291	0.338	0.339
5	0.513	0.454	0.378	0.551	0.364	0.396	0.350	0.351	0.347	0.538	0.449
6+	1.007	0.892	0.496	1.320	0.715	0.679	0.421	0.325	0.310	0.337	0.425

Table 10.3.7 Whiting in VIIa (Irish Sea)
Proportion of catch at age discarded
As estimated from UK NI sampling from the *Nephrops* fleet

Age	0	1	2	3	4	5
1981	1.000	0.690	0.240	0.010	0.010	0
1982	0.990	0.610	0.030	0.001	0	0
1983	1.000	0.600	0.170	0.001	0	0
1984	1.000	0.650	0.110	0.002	0	0
1985	1.000	0.630	0.050	0.001	0	0
1986	1.000	0.770	0.080	0.003	0	0
1987	1.000	0.800	0.080	0	0	0
1988	1.000	0.720	0.070	0	0	0
1989	1.000	0.640	0.150	0.002	0	0
1990	1.000	0.770	0.160	0.015	0	0
1991	0.995	0.798	0.172	0.024	0.001	0
1992	1.000	0.880	0.322	0.012	0	0
1993	0.997	0.836	0.452	0.055	0.005	0
1994	1.000	0.788	0.206	0.084	0.016	0
1995	1.000	0.940	0.410	0.140	0.050	0
1996	0.990	0.960	0.570	0.210	0.060	0
1997	1.000	0.977	0.558	0.212	0.073	0
1998	1.000	0.988	0.411	0.104	0.047	0
1999	1.000	0.957	0.430	0.081	0.044	0.009
2000	1.000	0.992	0.763	0.360	0.154	0.005
2001	1.000	0.991	0.726	0.092	0.055	0
2002	1.000	0.995	0.680	0.135	0.081	0.000
Mean 81-02	0.999	0.817	0.311	0.070	0.027	0.001

Table 10.3.8 Whiting in VIIa (Irish Sea)
Estimated landed and discarded catch and the proportion of the total catch estimated to have been discarded.

	Catch ('000 t)		
Year	Landed	Discarded	Discard proportion of total catch
1980	13461	3324	20%
1981	17646	2960	14%
1982	17304	808	4%
1983	10525	1820	15%
1984	11802	3433	23%
1985	15582	2654	15%
1986	10300	2115	17%
1987	10519	3899	27%
1988	10245	1611	14%
1989	11305	2103	16%
1990	8212	2444	23%
1991	7348	2598	26%
1992	8588	4203	33%
1993	6523	2707	29%
1994	6763	1173	15%
1995	4893	2151	31%
1996	4335	3631	46%
1997	2277	1928	46%
1998	2229	1304	37%
1999	1670	1092	40%
2000	762	2118	74%
2001	733	1012	58%
2002	747	740	50%
2003	401	n/a	n/a
Mean:	7990	2253	21%

Table 10.3.9 Whiting in VIIa (Irish Sea)
2003 Length Distributions ('000 fish) by Fleet

Length (cm)	Ireland All Gears **Landings**	Ireland *Nephrops* Otter **Discards**	UK (NI)* All Gears **Landings**	UK (NI)* *Nephrops* Otter **Discards**	UK (E&W) All Gears **Landings**	UK (E&W) **% Length freq. Discards**	UK (E&W) **Proportion retained**
5							
6		5					
7		27					
8		31					
9		58		12			
10		51		24			
11		26		84			
12		18		132			
13		16		312			
14		28		672		0.65	0.00
15		29		660		1.32	0.00
16		55		660		2.23	0.00
17		44		408		2.77	0.00
18		34		324		0.80	0.00
19		20		108		1.98	0.00
20		14		84		1.80	0.00
21		10		84		2.44	0.00
22		12		48		6.12	0.00
23		10	2	48		3.46	0.00
24		12	4	36		10.30	0.00
25		17	7	36	0	7.63	0.00
26	2	10	17		2	11.49	0.00
27	13	12	18		5	11.78	0.00
28	65	19	16	12	9	13.05	0.01
29	115	38	12		11	8.74	0.03
30	121	19	8		11	5.57	0.11
31	116	25	3		10	3.27	0.27
32	63	32	6		11	1.03	0.61
33	45	13	6		9	2.85	0.35
34	54	9	6		7	0.41	0.76
35	15	6	3		6	0.20	0.79
36	30	2	2		4	0.05	0.94
37	8	2	1		3	0.02	0.96
38	12	2			1	0.02	0.91
39	6				1	0.02	0.95
40	7		1		1		1.00
41	1				0		1.00
42	1				0		1.00
43	8				0		1.00
44					0		
45	2				0		1.00
46	1				0		1.00
47	2				0		
48	2				0		
49	2				0		
50	1				0		
51					0		
52					0		
53					0		
54							
55							
56							
57							
58							
59							
Total Numbers	**694**	**700**	**112**	**3,746**	**92**		

* Landings and discard length frequencies are based on Q1 sampling raise to Q1 and Q2 landings only.

Table 10.4.1 Whiting in VIIa (Irish Sea)
Mean weight at age (kg) in the stock
1980 to 2002.

Age	1980	1981
0	0.000	0.000
1	0.073	0.079
2	0.173	0.180
3	0.299	0.300
4	0.446	0.447
5	0.580	0.580
6+	0.720	0.714

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.084	0.085	0.079	0.070	0.064	0.060	0.062	0.061	0.061	0.055
2	0.187	0.194	0.192	0.181	0.169	0.157	0.150	0.150	0.147	0.142
3	0.311	0.321	0.316	0.304	0.291	0.286	0.266	0.253	0.240	0.239
4	0.441	0.450	0.447	0.446	0.434	0.439	0.425	0.396	0.355	0.332
5	0.576	0.581	0.574	0.583	0.589	0.620	0.626	0.606	0.538	0.477
6+	0.695	0.667	0.663	0.700	0.749	0.812	0.868	0.841	0.782	0.718

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.048	0.046	0.046	0.047	0.042	0.037	0.032	0.031	0.031	0.029	0.027
2	0.123	0.117	0.118	0.121	0.114	0.105	0.101	0.094	0.089	0.083	0.082
3	0.222	0.205	0.200	0.202	0.205	0.195	0.194	0.194	0.202	0.199	0.200
4	0.315	0.293	0.280	0.270	0.268	0.258	0.260	0.263	0.274	0.289	0.306
5	0.428	0.398	0.396	0.375	0.370	0.335	0.323	0.321	0.353	0.381	0.401
6+	0.706	0.636	0.676	0.652	0.668	0.521	0.423	0.359	0.337	0.385	0.435

Table 10.7.1 Whiting in VIIa. VPA summary data from final XSA run

Run title WGNSDS COMBSE› PLUSGROUP

At 16/05/2003 19:11

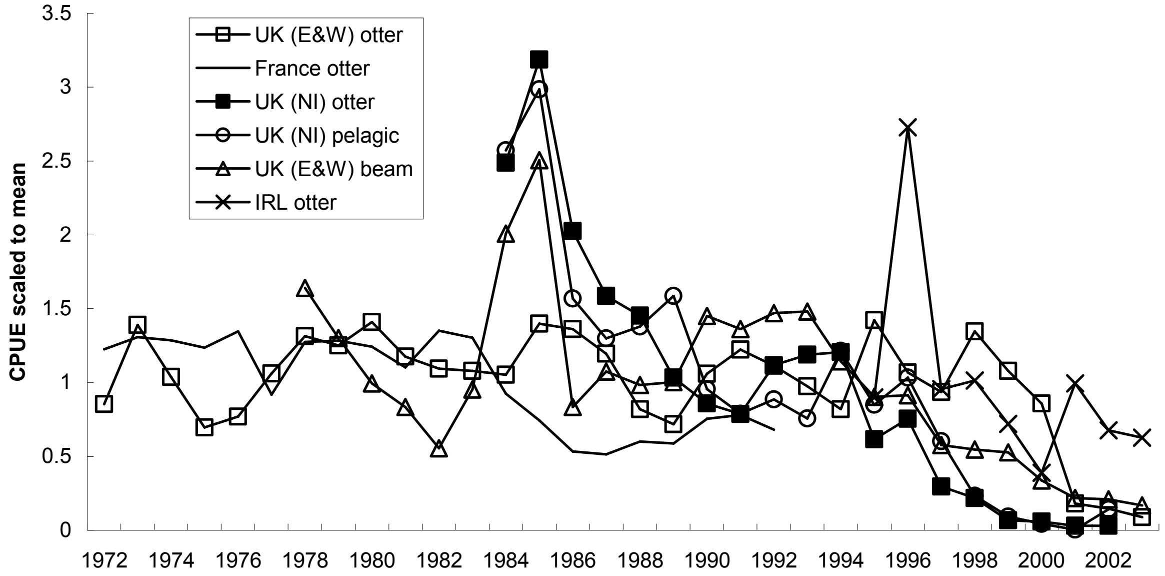
Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 0	TOTALBIO	TOTSPBIO	TOTAL CATCH	LANDINGS	DISCARDS	YIELD/SSB	FBAR 1- 3
1980	121108	29416	18578	16785	13461	3324	0.9035	0.6422
1981	63565	32859	25984	20606	17646	2960	0.793	0.7809
1982	67631	25291	21670	18112	17304	808	0.8358	0.8175
1983	186532	18153	13761	12345	10525	1820	0.8971	0.7606
1984	135506	21939	11579	15235	11802	3433	1.3158	0.8899
1985	113698	22481	16412	18236	15582	2654	1.1111	1.1084
1986	176769	17013	11748	12415	10300	2115	1.0568	0.9514
1987	92964	18483	11363	14418	10519	3899	1.2689	0.9544
1988	101819	16819	13050	11856	10245	1611	0.9085	0.7877
1989	130789	15531	10851	13408	11305	2103	1.2356	1.1834
1990	128650	13566	8004	10656	8212	2444	1.3313	1.0205
1991	237433	13882	8349	9946	7348	2598	1.1913	0.9927
1992	49441	17833	9390	12791	8588	4203	1.3622	1.2233
1993	87557	14146	12335	9230	6523	2707	0.7483	0.9179
1994	62473	11777	8995	7936	6763	1173	0.8823	0.828
1995	92389	9737	7477	7044	4893	2151	0.9421	0.8031
1996	65475	9277	6371	7966	4335	3631	1.2504	1.2641
1997	58000	5344	3804	4205	2277	1928	1.1055	1.0496
1998	30571	4259	2968	3533	2229	1304	1.1904	1.3273
1999	88190	2489	1880	2762	1670	1092	1.4688	1.1877
2000	32660	3062	1404	2880	762	2118	2.0517	1.5877
2001	54859	1781	1194	1745	733	1012	1.4614	1.0319
2002	47329	1977	1187	1486	746	740	1.2523	0.8658
Arith. Mean	96757	14223	9928	10243	7990	2253	1.155	0.999
0 Units	(Thousar	(Tonnes	(Tonnes	(Tonnes)				

1

Figure 10.2.1.1 Whiting VIIa (Irish Sea)
Trends in CPUE and effort for commercial tuning fleets. All series are expressed relative to their series mean.



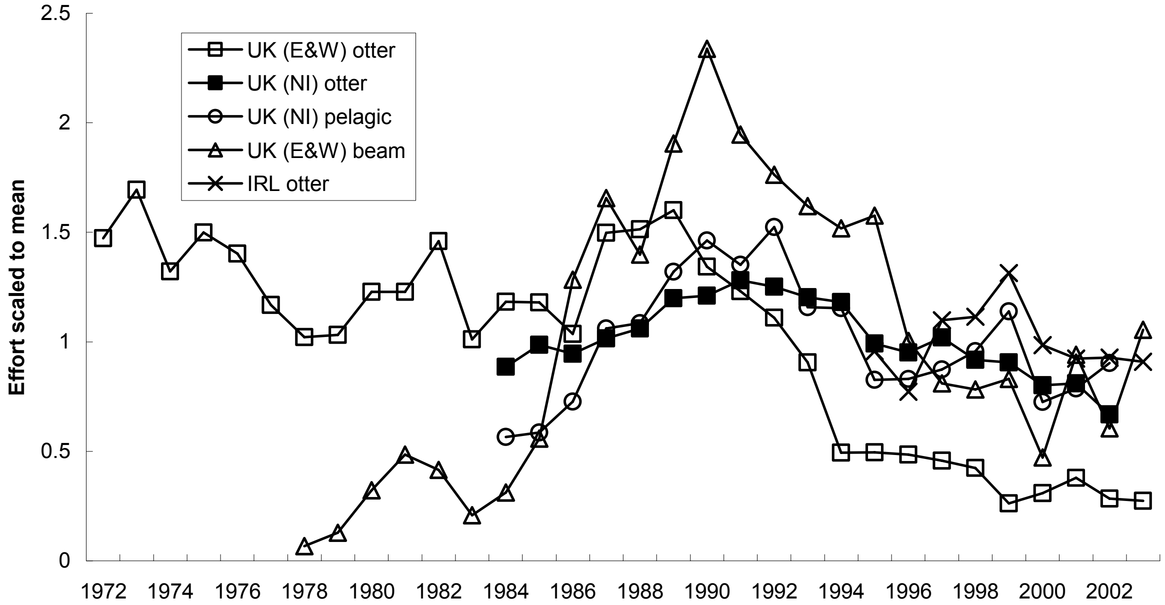
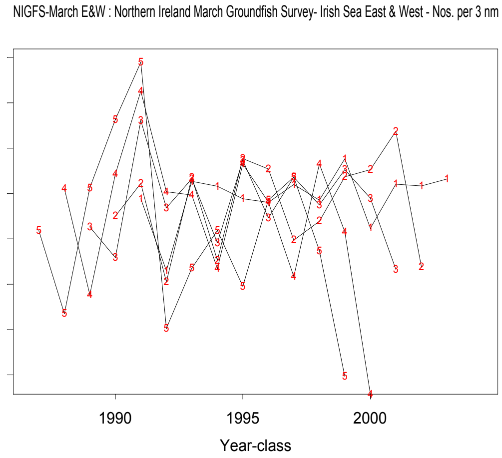
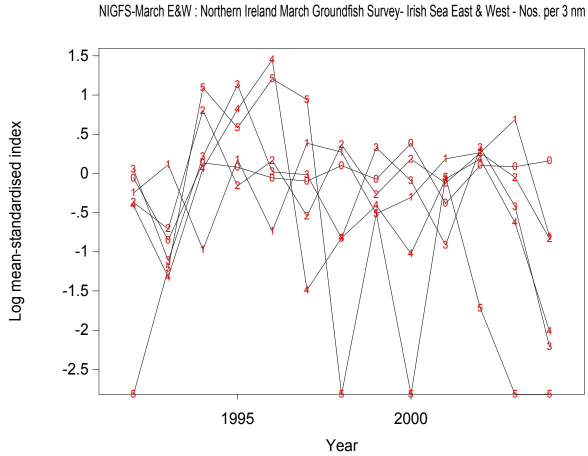


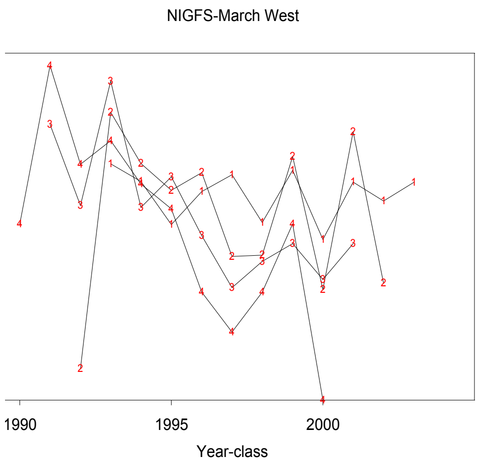
Figure 10.2.2.1: Log mean-standardised survey indices for the UK Northern Ireland March.

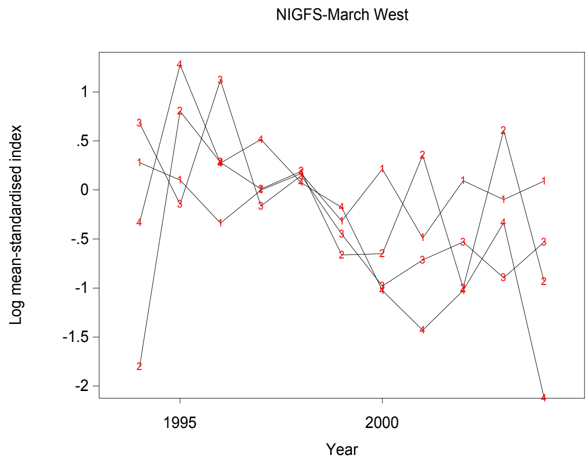
a) NIGFS –March East and West



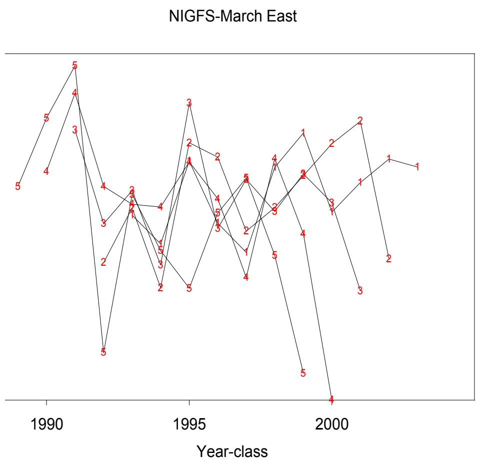


b) NIGFS –March West





c) NIGFS –March East



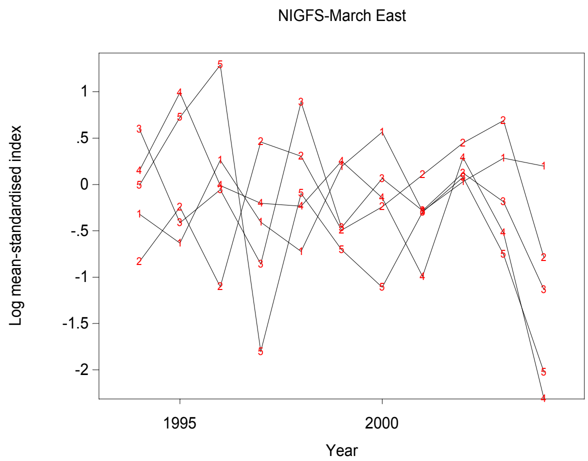
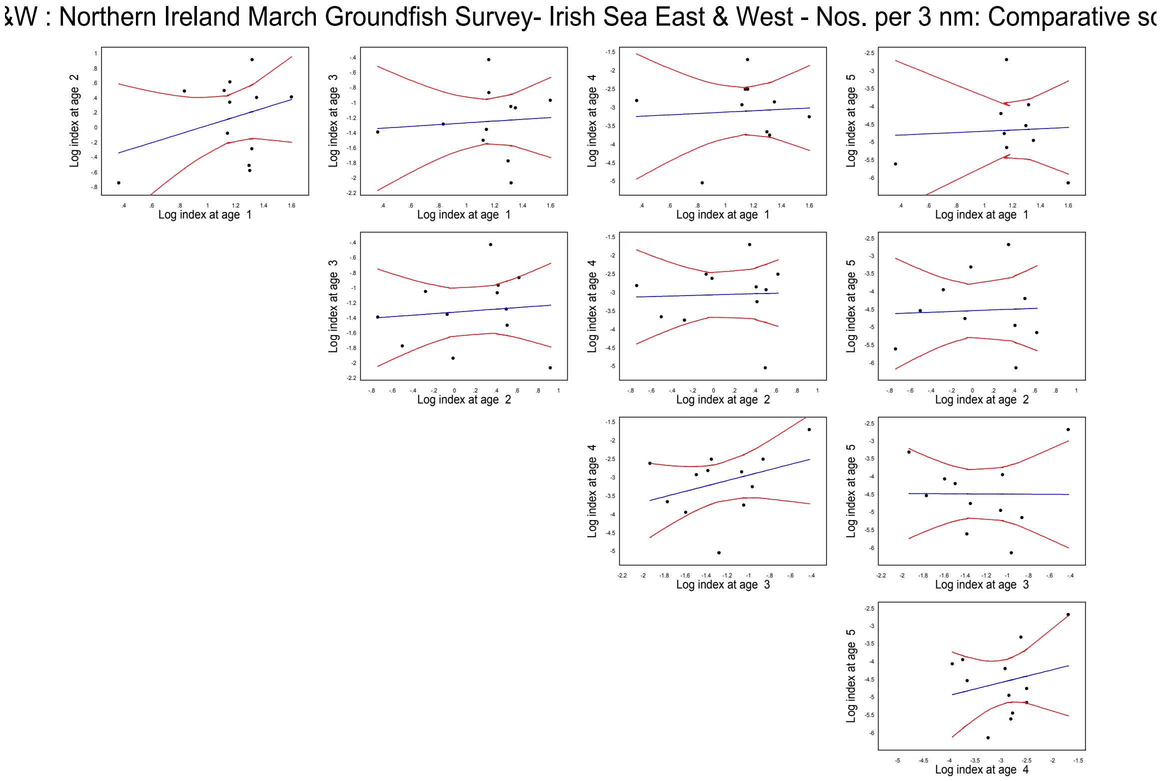
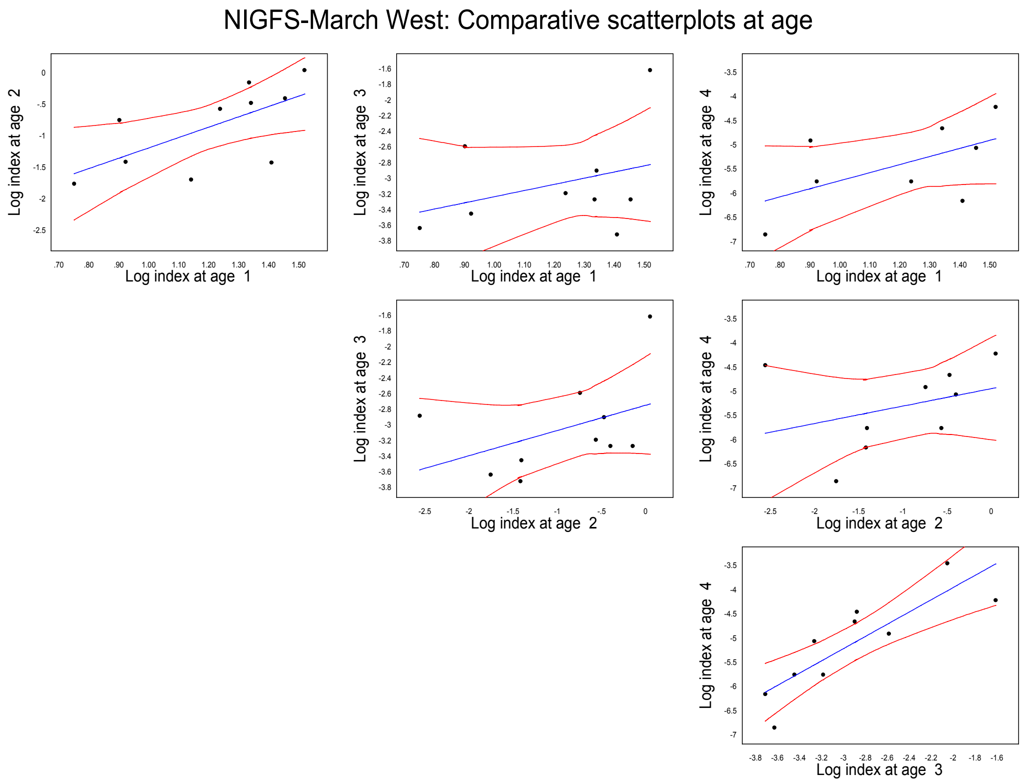


Figure 10.2.2.2: Scatter plots of log index-at-age or the UK NI March groundfish survey.

a) UK NIGFS March East & West Irish Sea



b) UK NIGFS March West Irish Sea



c) UK NIGFS March East Irish Sea

NIGFS-Oct East: Comparative scatterplots at age

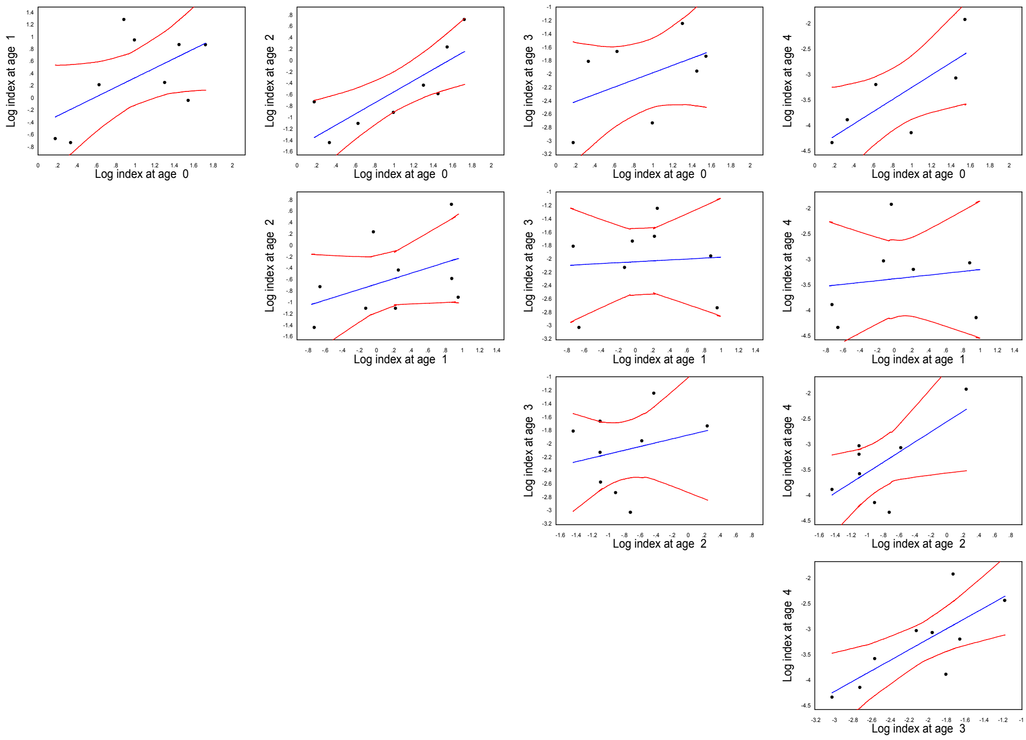
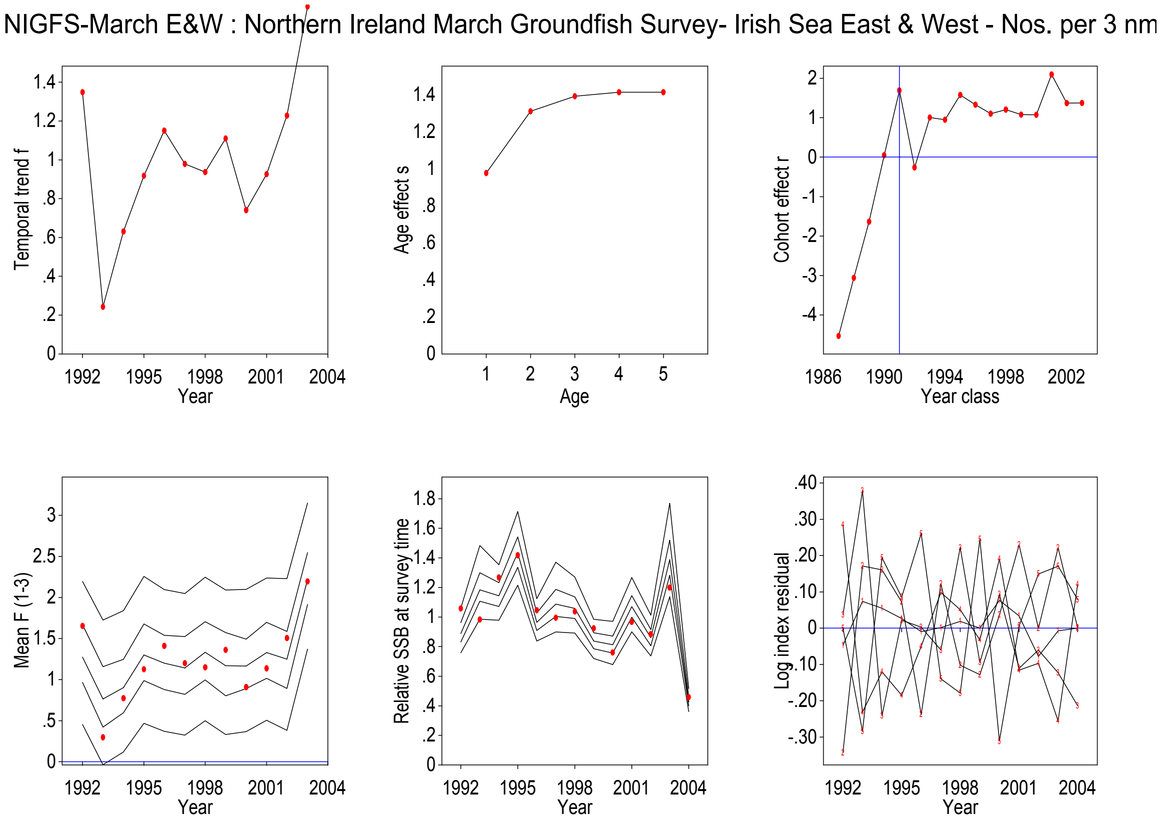
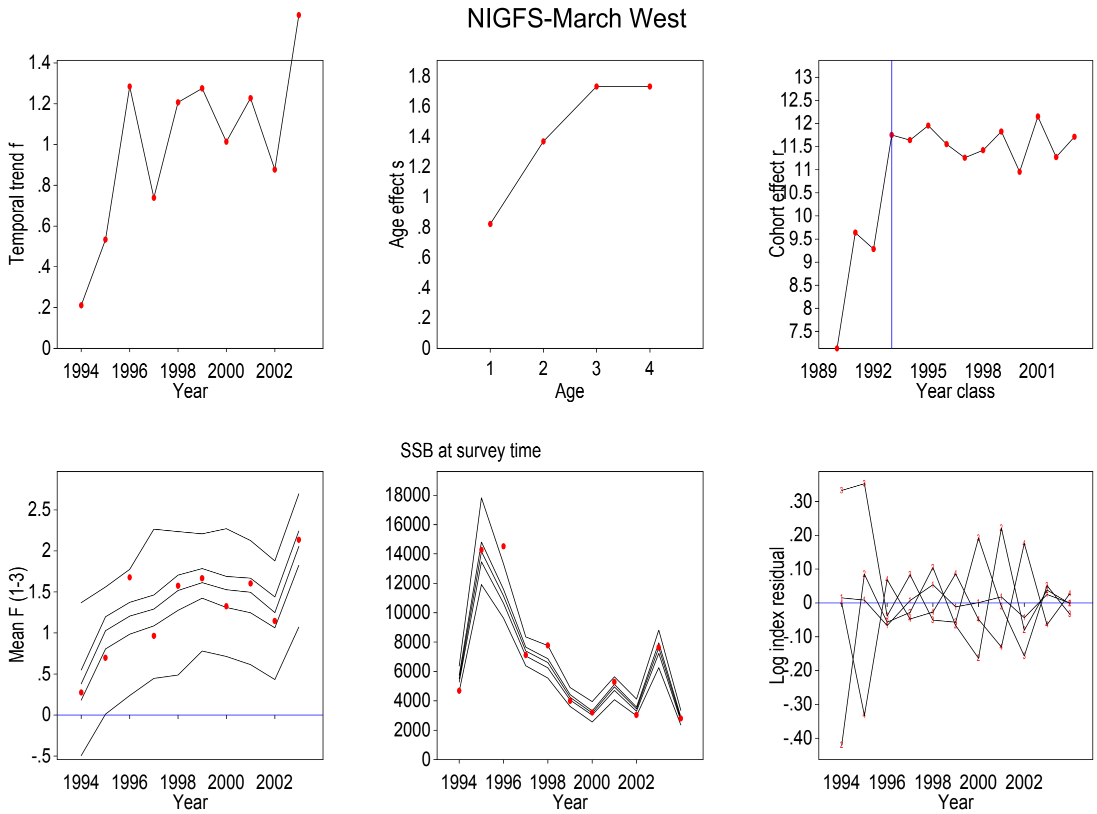


Figure 10.2.2.3: Summary plots from SURBA for the UK NI March groundfish Survey; a) is the combined index, b) is the west only and c) is the east only.

a) NIGFS March East and West



b) NIGFS March West



c) NIGFS March East

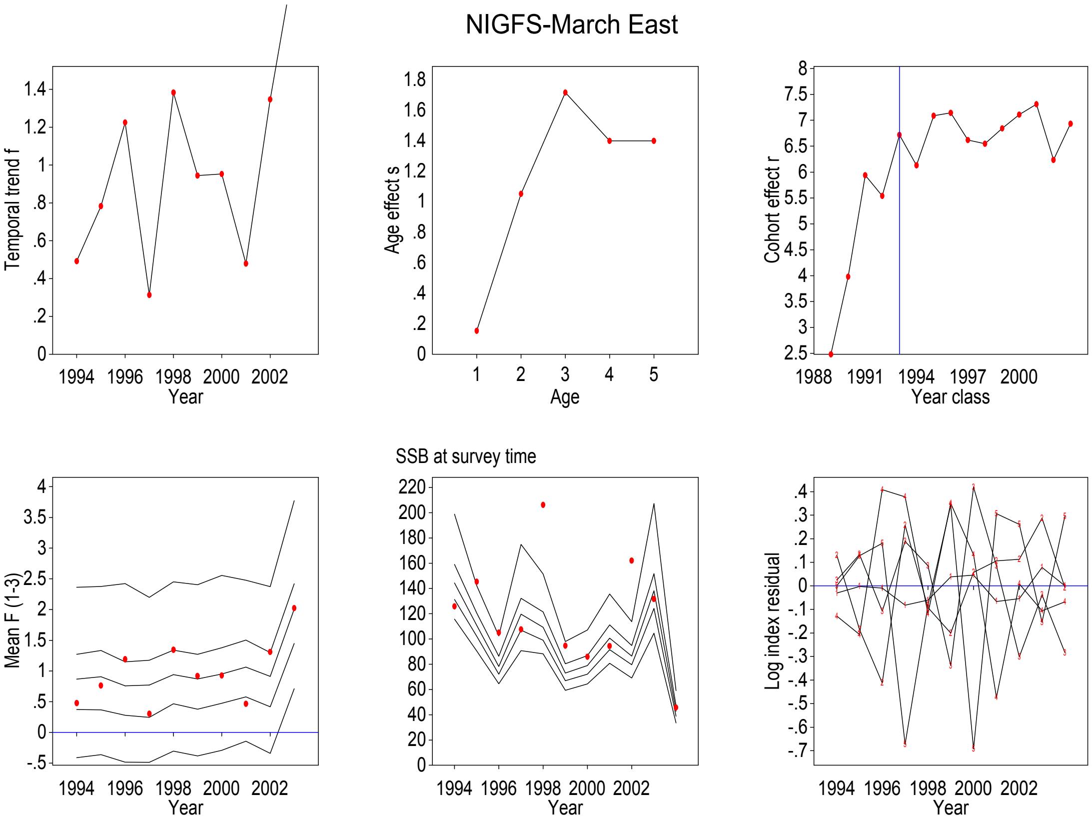
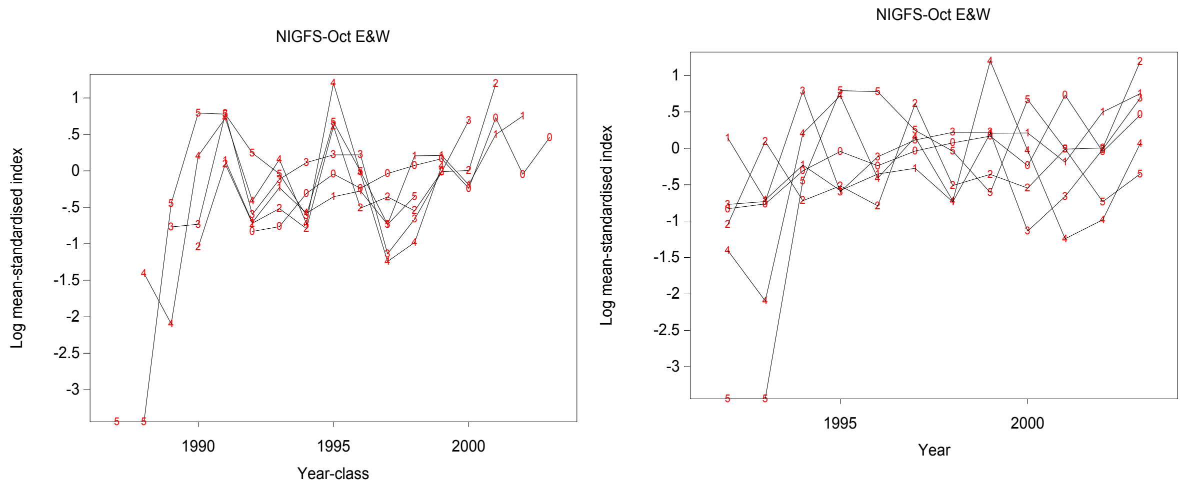
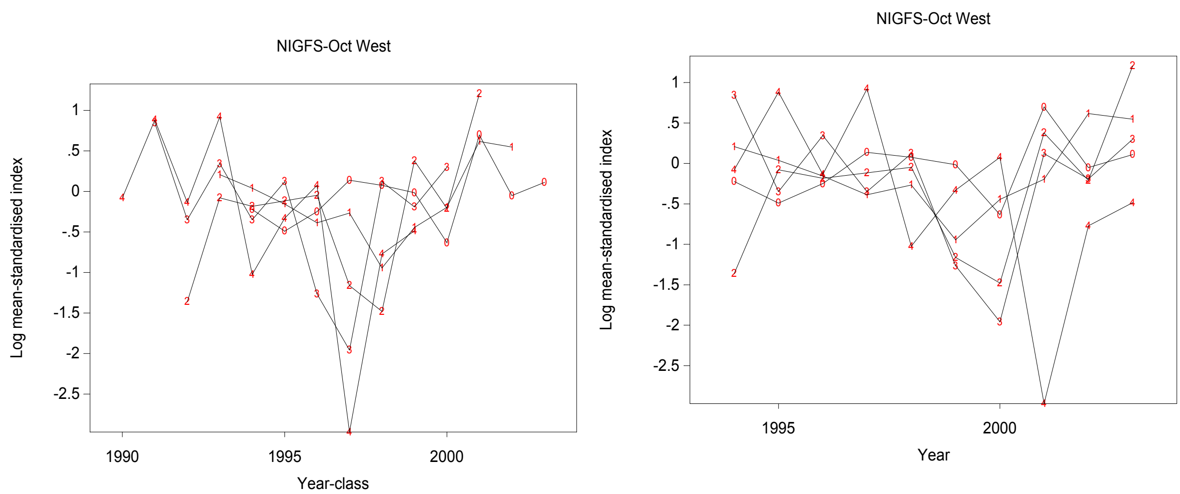


Figure 10.2.2.4: Log mean-standardised survey indices for the UK Northern Ireland October groundfish Survey.

a) NIGFS Oct East and West



b) NIGFS Oct West



c) NIGFS Oct East

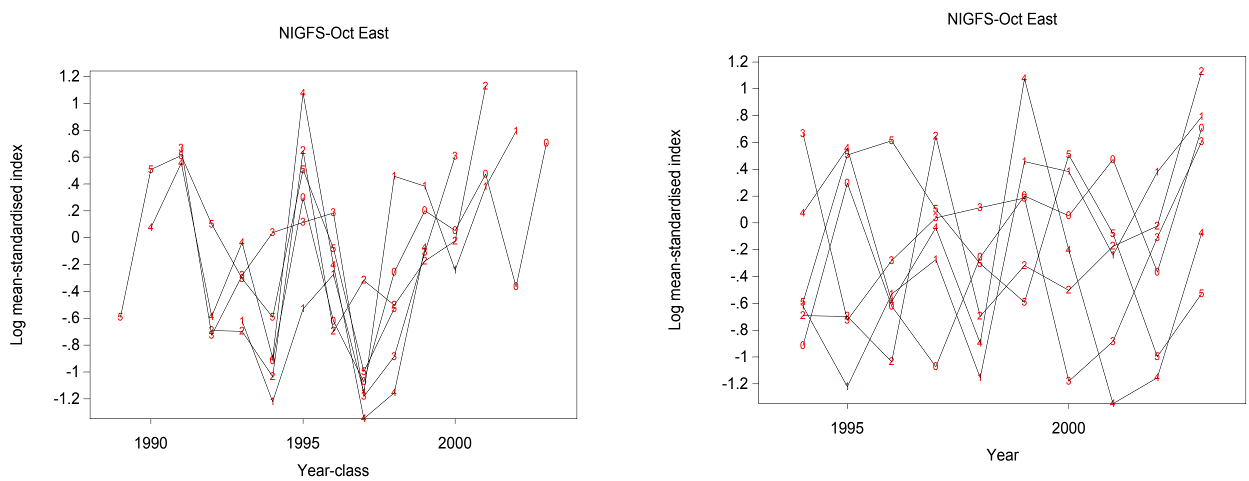
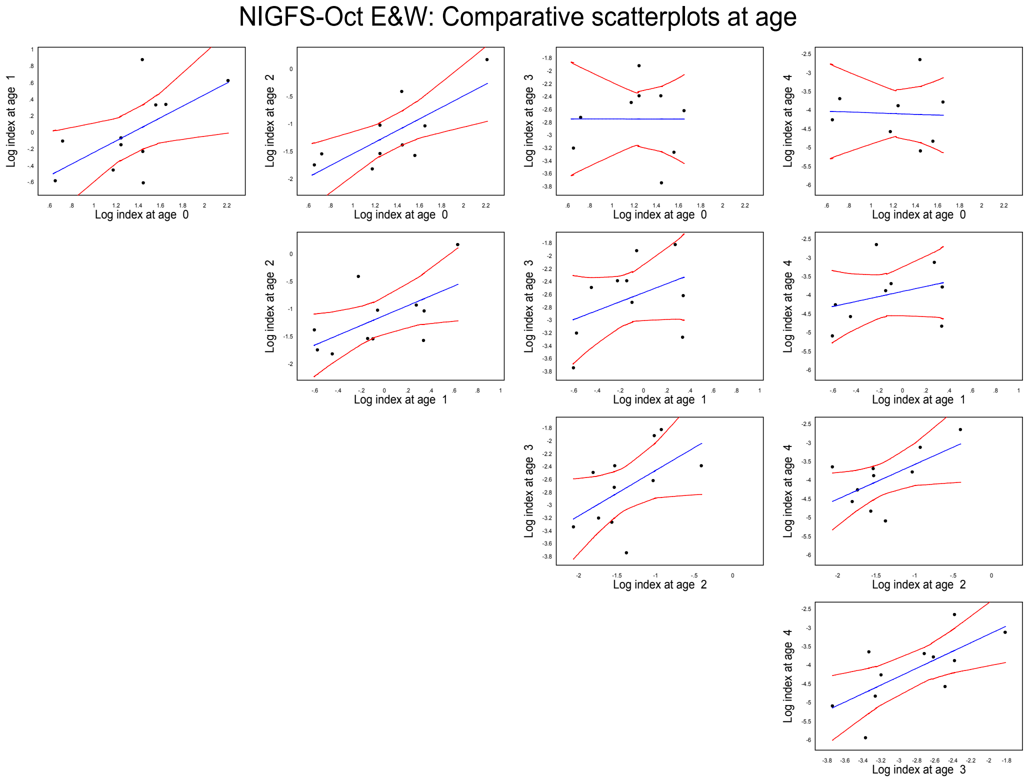
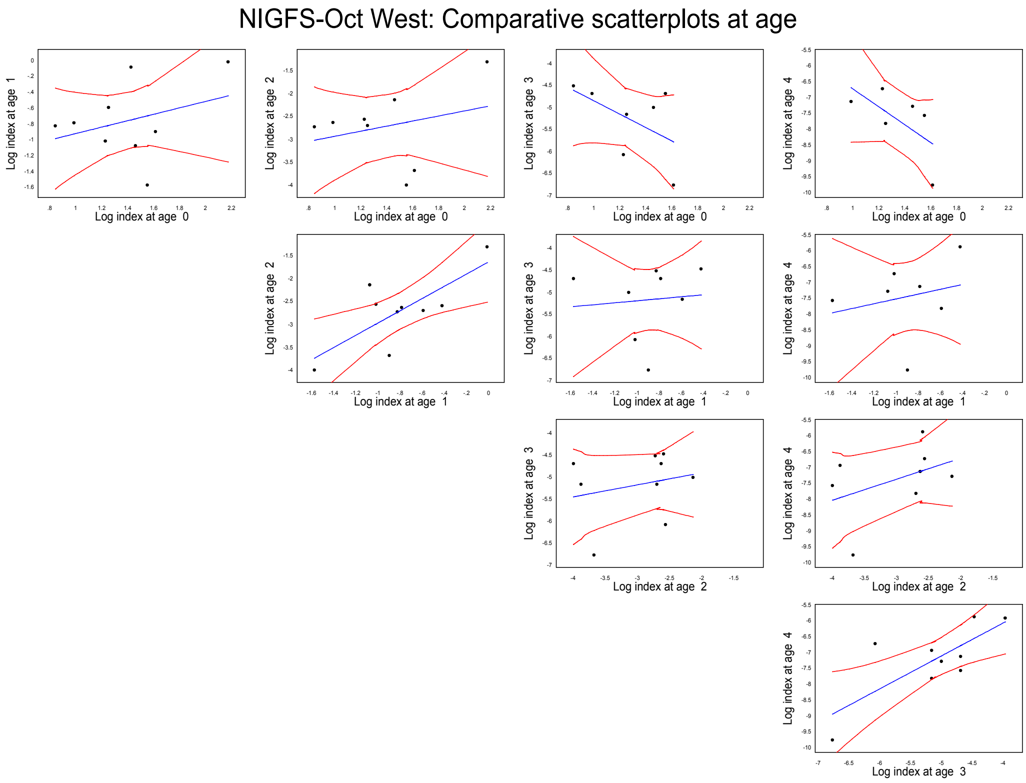


Figure 10.2.2.5: Scatter plots of log index-at-age or the UK NI October groundfish survey.

a) NIGFS Oct East and West



b) NIGFS Oct West



c) NIGFS Oct East

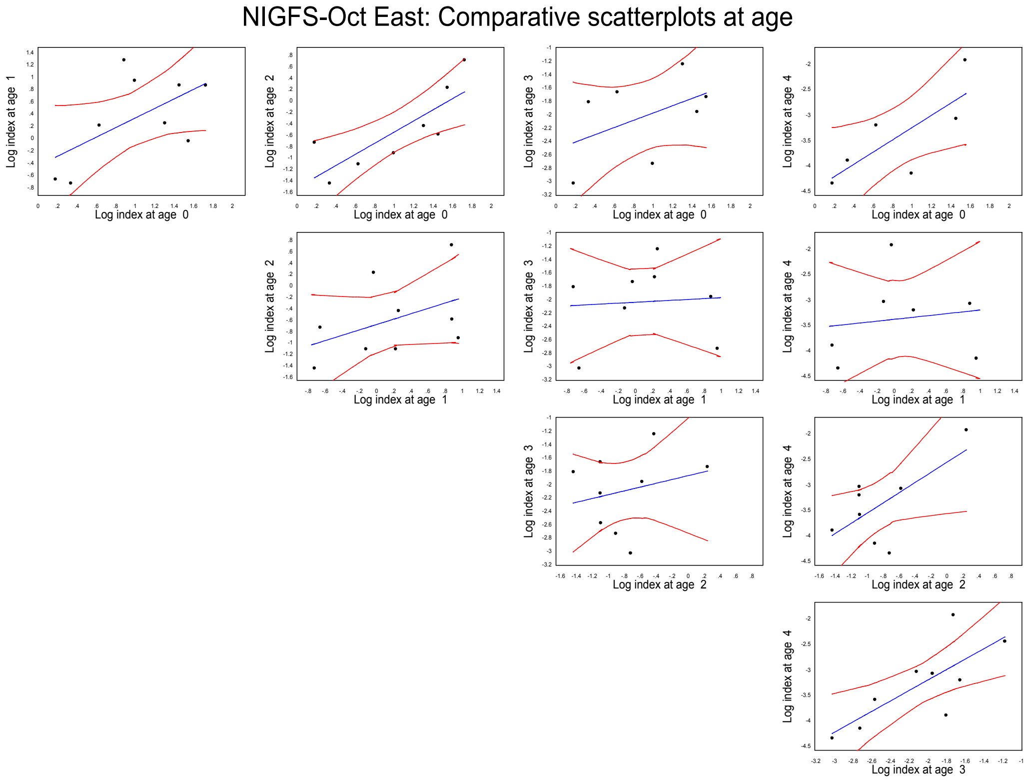
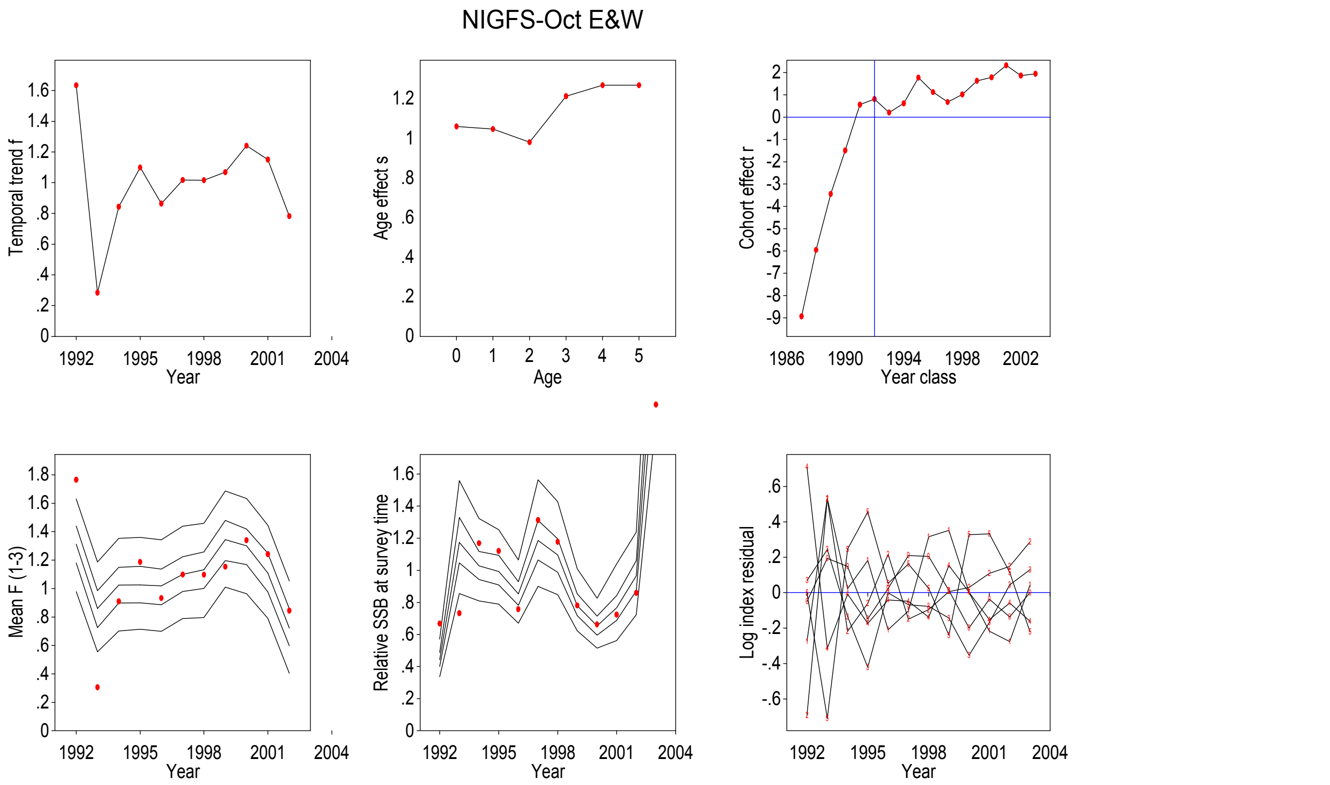
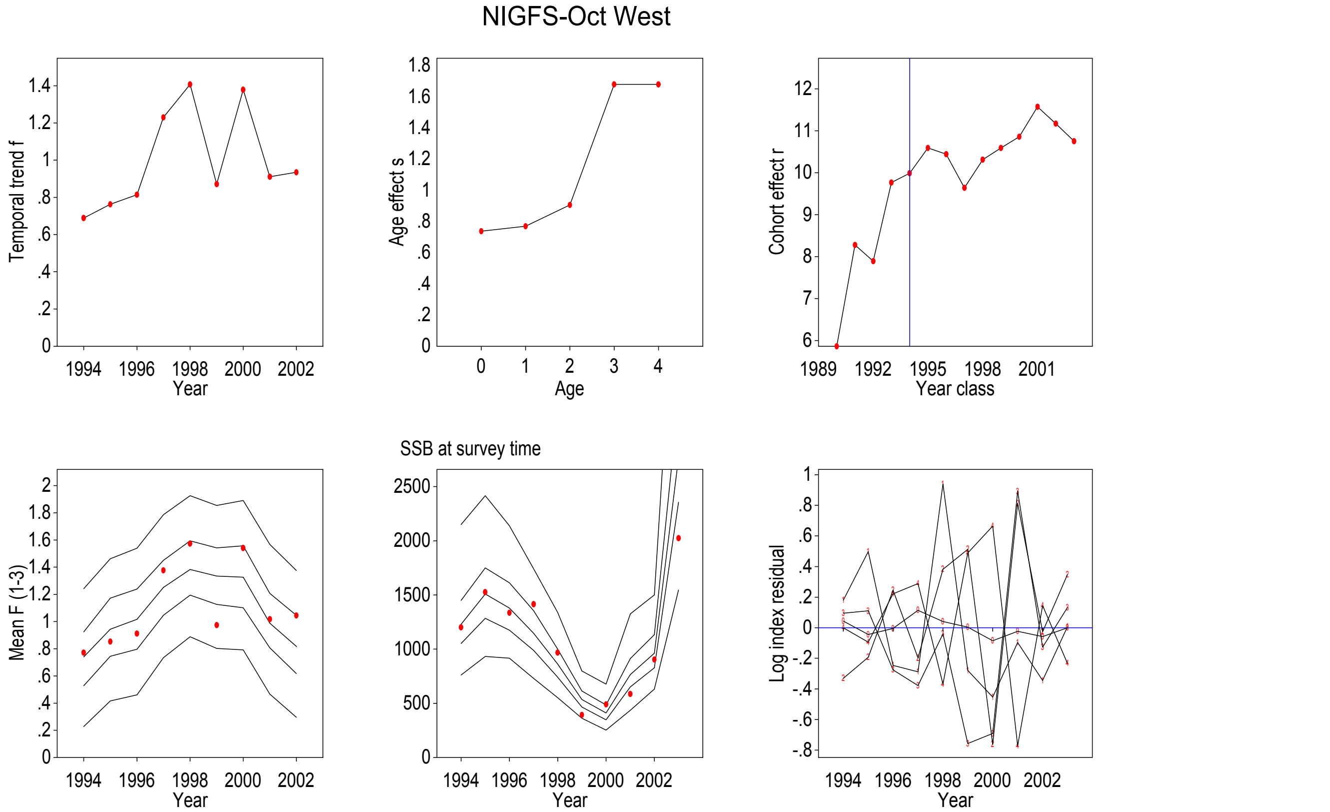


Figure 10.2.2.6: Summary plots from SURBA for the UK NI October groundfish Survey; a) is the combined index, b) is the west only and c) is the east only.

a) NIGFS Oct East and West



b) NIGFS Oct West



c) NIGFS Oct East

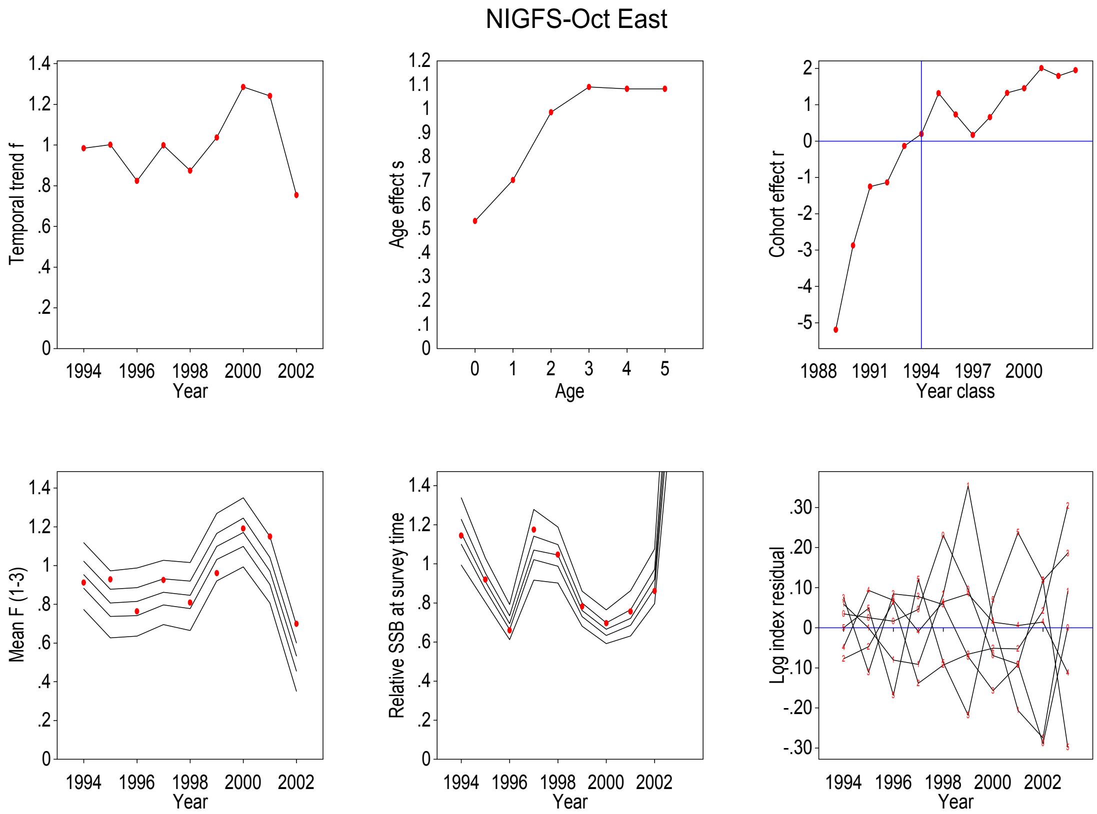
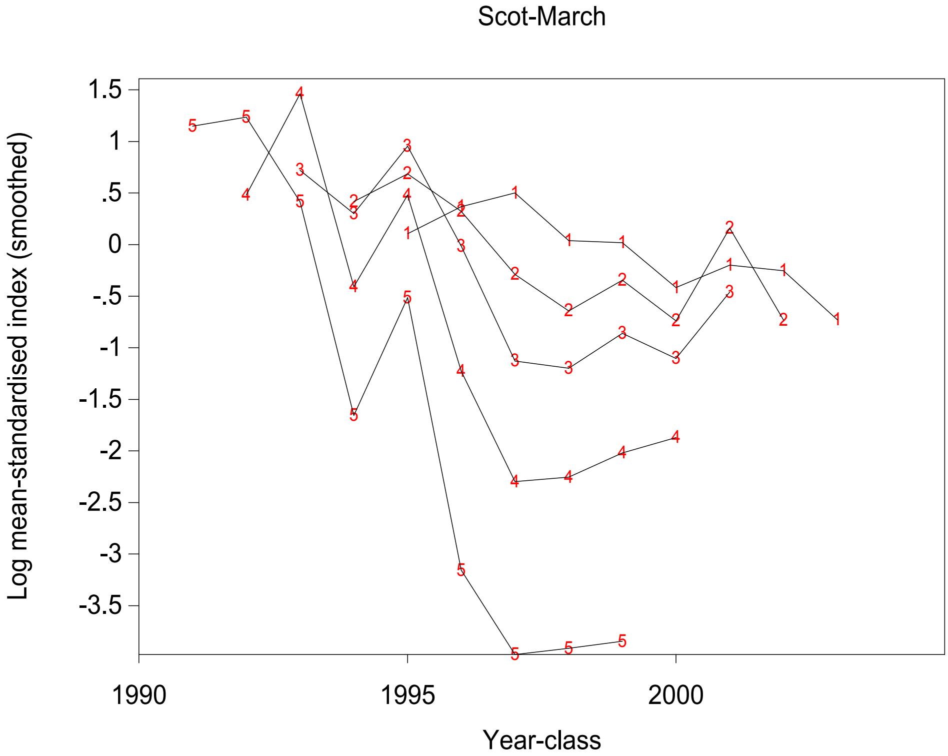


Figure 10.2.2.7: Log mean-standardised survey indices for the UK Scotland March groundfish Survey.



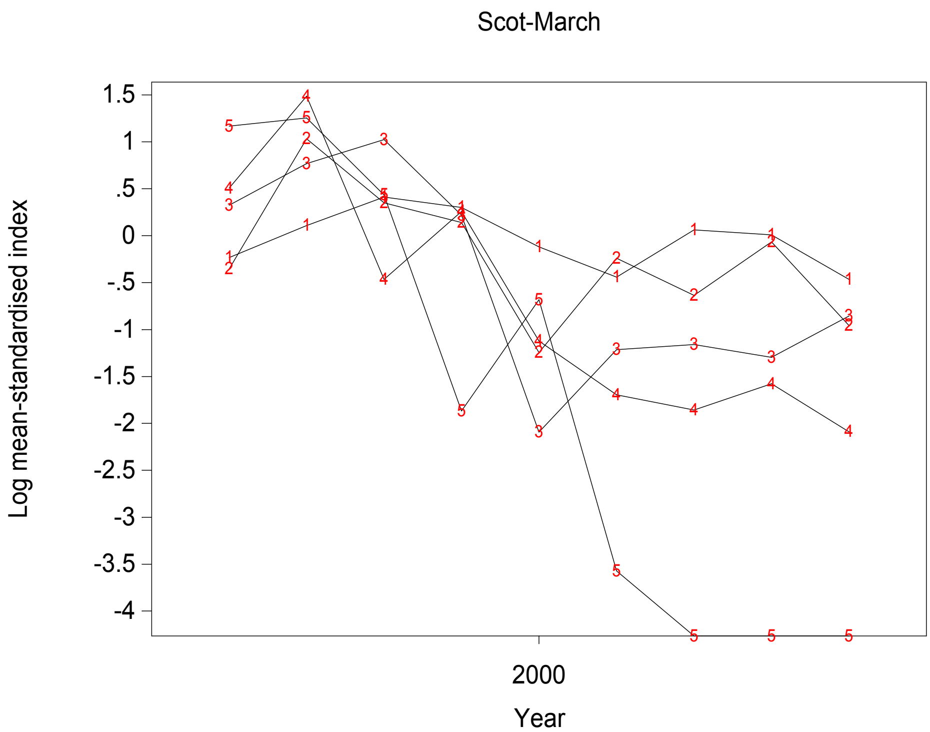


Figure 10.2.2.8: Scatter plots of log index-at-age or the UK Scotland March groundfish survey.

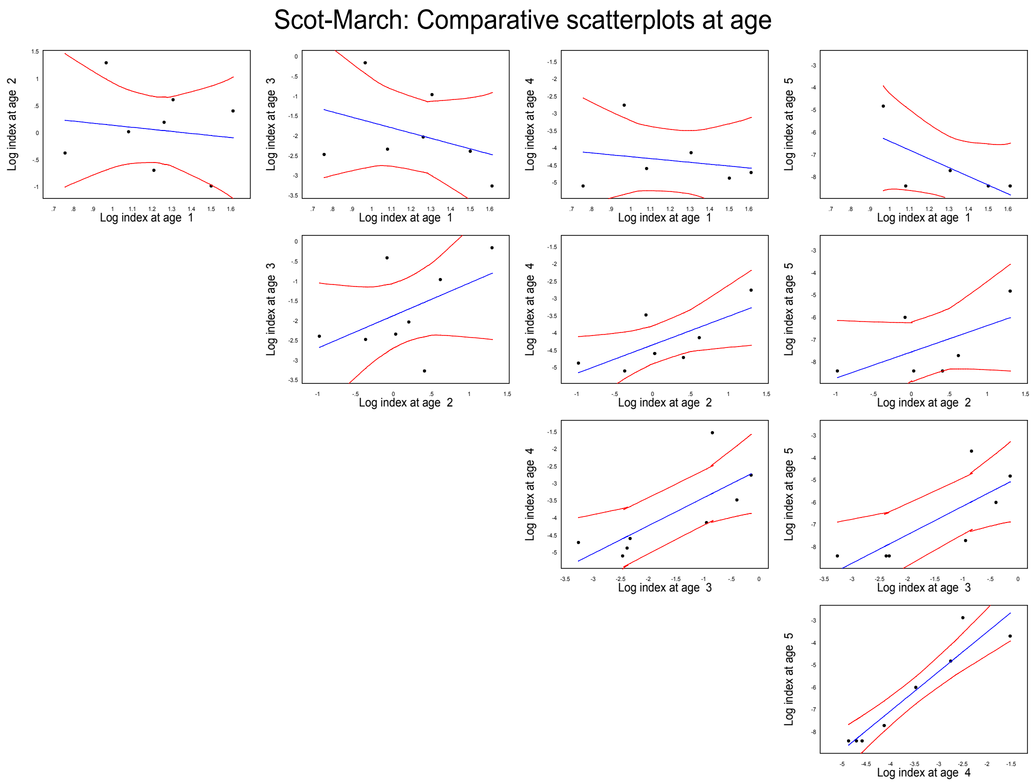


Figure 10.2.2.9: Summary plots from SURBA for the UK Scotland March groundfish survey.

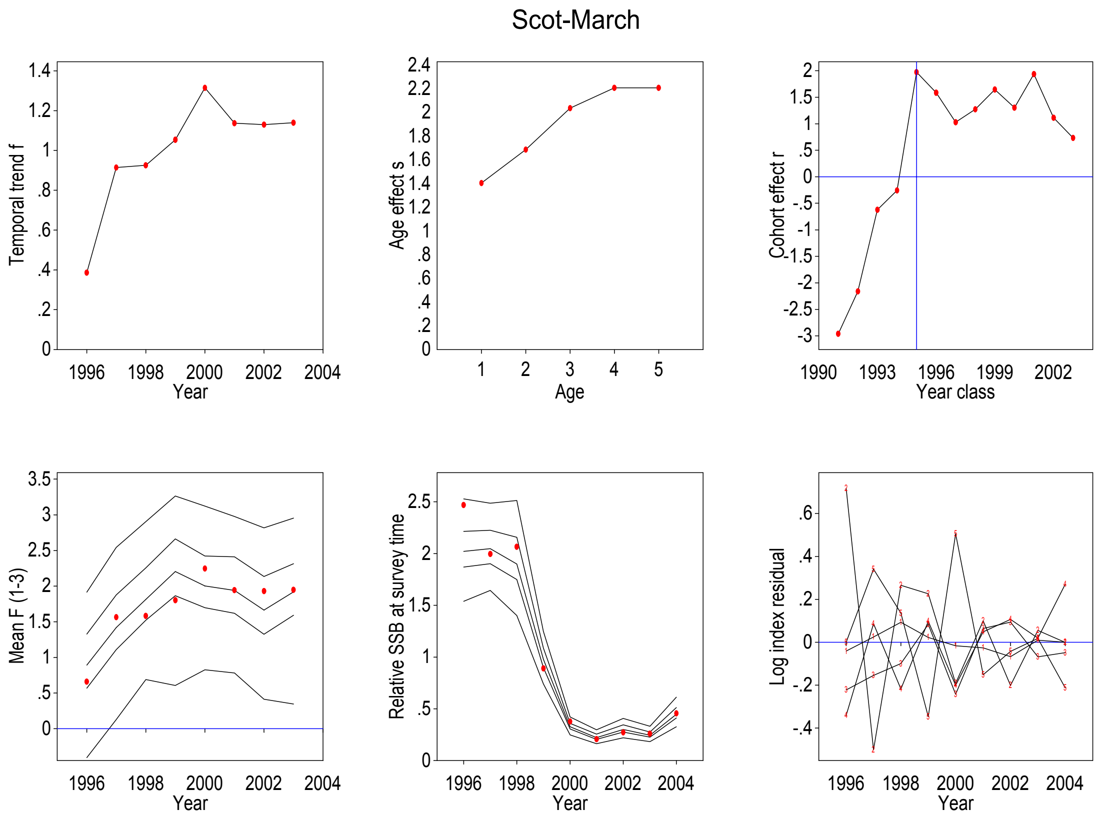


Figure 10.7.1 Whiting in Division VIIa (Irish Sea).
Stock summary of XSA final run. Discarded catch is shown as black bars.
Landings data are from 1970; other estimates are from 1980 onwards.

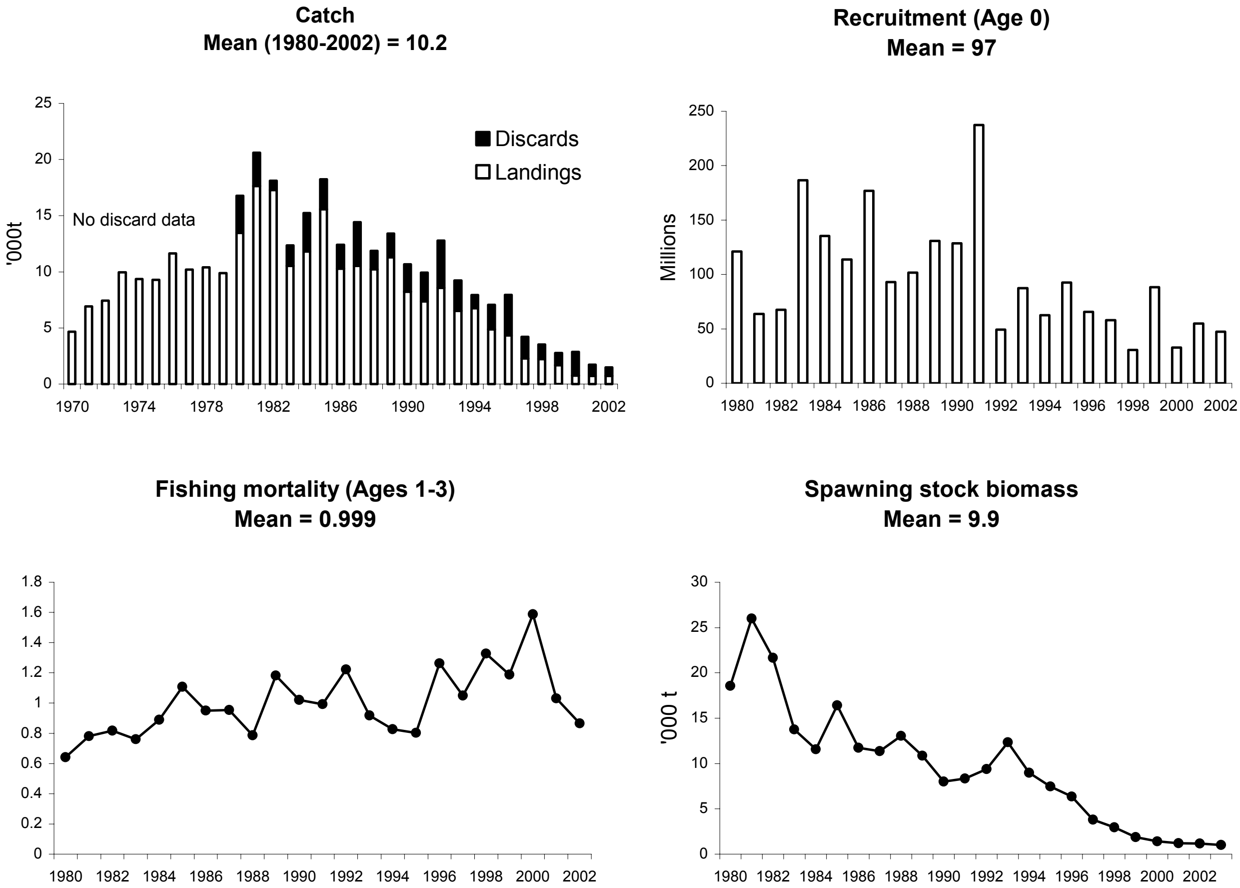
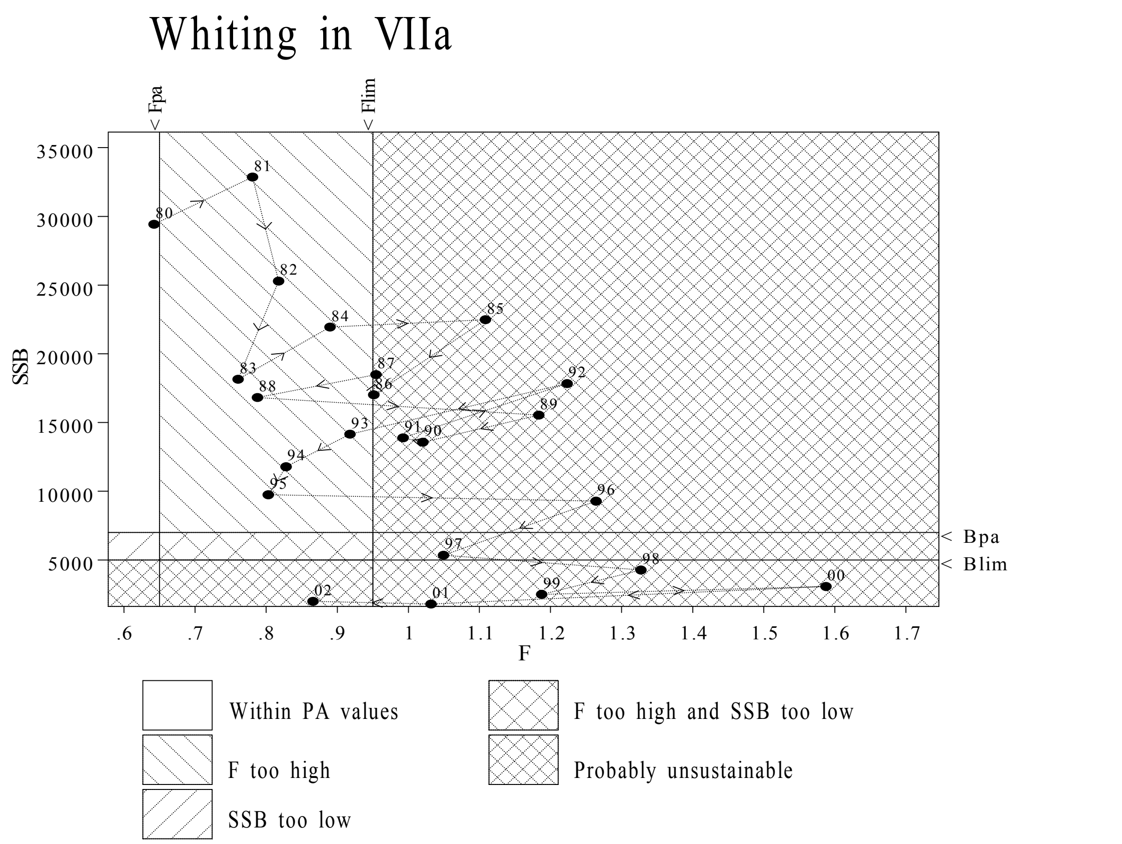


Figure 10.11.1. Whiting in VIIa. Plot of SSB and F against PA reference points



Data file(s):F:\Stock\whg-iris\input data\Short term predictions\whgviia.pa;F:\Stock\whg-iris\input data\Short term predictions\WHG7a SUM.csv
Plotted on 20/05/2003 at 20:46:31

11 PLAICE IN SUB-DIVISION VII

Plaice in Division VIIa

A benchmark assessment was scheduled by the working group for the assessment of this stock following difficulties encountered during the previous assessment relating to divergent survey tuning indices. Some new survey information has been made available (see WD.7), however, it was apparent that these new data, in their current format, would not resolve any of the existing problems. As such, the assessment presented here concentrates principally on minimising the effect of anomalous survey indices. The effects of specific model parameter settings, and other investigations associated with a benchmark assessment, have not been conducted. It is proposed that a survey tuning index, representative of the entire assessment area, be derived after the working group meeting and that a full benchmark assessment of this stock be submitted to ACFM before their October meeting.

11.1 The fishery

A general description of the fishery can now be found in the stock annex.

11.1.1 ICES advice applicable to 2003 and 2004

ICES advice for 2004

Single Stock Exploitation Boundaries: *Fishing mortality in 2004 should remain below* $\mathbf{F}_{pa}$ *corresponding to landings of less than 1600 t. In addition, ICES recommended that mixed fisheries characteristics be taken into account when managing demersal fisheries in the Irish Sea. The demersal fisheries in the Irish Sea should … be managed such that the following three rules apply simultaneously:*

1. *The fishing of each species should be restricted within precautionary limits as indicated in the table of individual stock limits above;*

2. *The catch of cod and whiting is zero;*

3. *The total catch of sole is less than 790 t.*

ICES advice for 2003

Fishing mortality on plaice in 2003 should not be allowed to increase above the current level, corresponding to landings of less than 1 900 t. This is consistent with the advice for sole, which is taken in the same fisheries. In addition there is no long-term gain in yield-per-recruit at higher fishing mortality.

11.1.2 Management applicable in 2003 and 2004

There is a minimum landing size in force for VIIa plaice of 27 cm.

WG Year	Single species exploitation	Basis	TAC	% change in F associated with TAC[2]	WG landings
2002	<2.8	Maintain F below $\mathbf{F}_{pa}$	2,400	+50%	1,620
2003	<1.9	Maintain F below $\mathbf{F}_{pa}$	1,675	-12%	1,520
2004[1]	<1.6	Maintain F below $\mathbf{F}_{pa}$	1,340	-2%	

[1] additional mixed fishery considerations
calculated from F multipliers in status quo forecast

11.1.3 The fishery in 2003

National landings data reported to ICES, and Working Group estimates of total landings, are given in Table 11.1.3.1. The 2002 working group estimate of landings has been amended following minor revisions by Scotland and France. Estimated total international landings in 2003 were 1,520 t, a decrease of 7% on those of 2002 and 16% higher than predicted from the status quo forecast. The TAC in 2003 was 1,675 t.

There are no data available on the extent of mis-reporting of landings from this stock. Whilst mis-reporting was considered to be occurring in this fishery during the late eighties and early nineties it has, in more recent years, been considered to be less of a problem. However, reductions in the TAC since 2002, made in line with the sole fishery, have resulted in a more restrictive plaice quota which may lead to an increase in the levels of misreporting in this stock.

Discards are not included in the assessment. Recent sampling studies for discards in the Irish Sea indicate that discarding of plaice may be substantial (figure 11.1.3.1.). There is still an insufficient time series of discards data to facilitate their inclusion in the assessment.

11.2 Commercial catch-effort data and research vessel surveys

Effort trends (reported hours fished, corrected for fishing power) for the main fleets are given in Table 11.2.1. and figure 11.2.1. Following a 27% increase in effort in 2002 by the Belgian beam trawl fleet, effort declined in 2003 to levels consistent with the recent time series. The UK otter trawl fleet and beam trawl fleet effort levels have been in gradual decline over the last decade and 2003 levels are consistent with this trend.

Irish otter trawl fleet effort levels appear variable over their short time series. A discrepancy was noted in the effort values for this fleet and the numbers re-calculated. The correct effort figures are shown in table 11.2.1. Those given in table 11.2.2. are the values used in the assessment. This discrepancy was noticed late in the meeting. A comparative assessment using the correct values resulted in only minor (<3%) changes to estimates of fishing mortality and SSB in the terminal year. The new figures indicate a reduction in effort levels for this fleet in the most recent years.

A description of the UK(E&W) September and March beam trawl surveys and the Irish juvenile plaice survey is given in WD.7 (Irish Sea Plaice Survey Tuning Indices) along with plots of the raw indices. The UK(E&W) March beam trawl survey was discontinued in 1999. The tuning fleet data available to the working group are shown in Table 11.2.2.

11.3 Age compositions and mean weights at age

Quarterly age compositions for 2003 were available for Ireland and UK(E+W). These fleets together represented 51 % of the total landings. No age composition data were available this year from Belgium as have been made available for previous Working Groups. The Belgian landings are a significant proportion of the total landings for this stock (42% in 2003), consequently, the effect of missing Belgian age composition data for years 2001 and 2002 was investigated.

International data for these two years was re-aggregated using the method adopted for 2003 data and the resulting international catch numbers and mean weights at age data compared to the original values calculated that included the Belgian age composition data. The results showed that in both years, the overall pattern of catches at age was altered by the exclusion of the Belgian data. The proportions at the main ages (2-5) were affected the most. In both years, it was evident that the age distributions were different in the Belgian data to that of the other contributing nations with the Belgian catch comprising a higher proportion of younger fish. The comparative age compositions for 2002 are shown in figures 11.3.1 and are further discussed in section 11.11.1 of this report.

The weights at age data for both years showed only minor differences in the youngest ages (1-9) but the older age (10+) showed larger differences, perhaps as a consequence of low sampling levels, with the exclusion of the Belgian data leading to slightly higher mean weights at age.

Sampling levels for those countries providing age compositions are given in Table 2.2.2. The aggregation procedure (as in previous years) was as follows:

- UK(E+W) catch numbers at age were raised to include Scotland and Isle of Man landings;
- Ireland catch at age data were raised to include N. Ireland and France landings;

Summation of the UK(E&W) and Ireland raised age compositions were raised to include the Belgian landings to give the total international age composition. Aggregation procedures are further discussed in section 2.3.

Catch weights at age were obtained from the weighted mean total international weights at age, smoothed using a quadratic fit and representing 1 July values (i.e. age = 1.5, 2.5 etc.) :

$$Wt = 0.1516 + 0.0317*(age) + 0.0025*(age^2) \qquad (R^2 = 0.8733)$$

and scaled to give a SOP of 100% Stock weights at age were derived from the same quadratic fit, but representing 1 January values (i.e. age = 1.0, 2.0 etc.), and scaled by the same SOP-correction factor as the catch weights.

Although age and length samples are available by quarter, the samples for Q1 for the time series have been considered insufficient to provide reliable stock weights at age, hence the use of smoothed annual values scaled back to 1 January. The smoothing of catch and stock weights is less than ideal as it masks information on the growth rates of specific cohorts. Given the extent of sexual size dimorphism in plaice there may be substantial differences in the weights at age of males and females at the older ages. The number of fish at these ages present in the sample may be low and the estimated weight at age will be biased by the sex ratio of the catch. Whilst smoothing will reduce the effects of poor sampling at older ages on the estimated weights of older fish it will also adjust the weights of younger fish. The derivation of the catch weights and stock weights matrices is described in the stock annex. More appropriate methods of determining combined sex weights at age are currently being investigated.

Catch numbers at age are given in Table 11.3.1, and weights at age in the catch and stock are given in Tables 11.3.2 and 11.3.3, with the raised length frequency distribution in 2003 provided in table 11.3.4.

11.4 Natural mortality and maturity at age

This section can now be found in the stock annex. Natural mortality is taken as 0.12 yr^{-1} and assumed constant across all ages and all years. Maturity at age was taken as

Age	1	2	3	4	5	6
Maturity	0	0.24	0.57	0.74	0.93	1.0

The proportion of F and M before spawning was taken as 0, such that SSB values are calculated as of the 1st January.

11.5 Catch-at-age analysis

See section 2.6 for the general approach adopted at the WG.

11.5.1 Data screening

Tuning data available for this assessment comprised 3 commercial fleets; the UK(E&W) otter trawl fleet (UK(E&W)OTB, 1987-2003), the UK(E&W) beam trawl fleet (UK(E&W)BT, 1989-2003) and the Irish otter trawl fleet (IR-OTB, 1995-2003), and 4 survey series; the UK beam trawl survey (September: 1989-2003), UK beam trawl survey (March: 1993-1999) and the Irish juvenile plaice survey (1976-2003). The Irish Sea Celtic Sea ground fish survey (1997-2002) has been considered for use as a tuning index for this stock by previous working groups where it was decided that since this survey was designed to provide a tuning index for gadoid stocks it may not be appropriate to use it as a tuning index for plaice. This survey has been replaced by the R.V. Celtic Explorer groundfish survey which began in 2003.

Commercial catch data

For catch data screening, a separable VPA was carried out using a reference age of 4 and F and S values set to 0.5 and 0.8 respectively, as used in previous working groups. Residuals for the partially recruited age 1 data were generally large. Ages comprising the bulk of the landings showed smaller residuals and no trends over time were apparent.

Tuning data

Figure 11.5.1 shows log CPUE indices plotted by cohort for both the commercial and survey tuning series. Both the UK(E&W) otter and beam trawl commercial fleets (fleets 1 and 2) show a relatively noisy pattern with a pronounced zig-zag. The precise reasons for this are currently unclear but indicate transient changes in catchability. The plots show the gradient of the curves decreasing for the most recent cohorts indicating that total mortality for these cohorts may be less than for those earlier in the time series. Some of these cohorts however are not complete and it is difficult to draw any clear conclusions from this.

The decrease in gradient for more recent cohorts is less apparent in the UK(E&W) September beam trawl survey (Fleet 3) though the catch rates at most ages appear to be rising throughout the series. The youngest age group appears to be fully selected in this survey in contrast to the earlier March survey (Fleet 4) which extends only until 1999.

The Irish juvenile plaice survey (Fleet 5) shows fairly consistent estimates of total mortality during the early part of the time series but becomes less informative in more recent years as a consequence of pronounced year-effects. The Irish otter trawl fleet (Fleet 6) shows a particularly noisy picture from which it is difficult to draw any firm conclusions although it is evident that plaice at the younger ages are not fully selected by this fleet.

Figures 11.5.2 and 11.5.3 show plots of mean standardised indices for the UK(E&W) September beam trawl survey and the Irish juvenile plaice survey. The UK(E&W) survey indicates a general trend of increasing catch rates throughout the time series which is particularly marked in the last 2 years. The series, however, shows a good ability to track individual year-classes in the middle part of the time series. The juvenile plaice survey, similarly, can identify individual year classes early on in the time series but shows strong year-effects in the more recent years. The effect in 1999 has been attributed to strong tides during the survey and these data have been excluded. The larger year effect in 2002, however, cannot be explained.

Exploratory catch at age analyses

XSA tuning runs (weak shrinkage S.E. = 2.5), mean q model for all ages, full time series and untapered) were carried out on each fleet individually, to screen the tuning data for catchability trends and exceptional residuals. The input parameters and age ranges were those used last year with the exception that tuning data for the UK(E&W) beam trawl surveys were included up to age 7 and the plus group for these single fleet runs reduced to age 8 so as to minimise the influence of F shrinkage on ages with no tuning information.

Log catchability residuals for the single fleet XSA runs are shown in Figures 11.5.4 and 11.5.5. No consistent trends in catchability were apparent for either the UK-OTB or the UK-BT fleets. Similarly the IR-OTB fleet showed no consistent trend in catchability though the residuals were noisy and the time series relatively short. The log catchability residuals for the UK(E&W) BTS September did not show any clear trend. Whilst the residuals for ages 2 to 6 in the last two years were all positive they were not excessively large in comparison with those earlier in the time series. Year effects in the IR-JPS, however, were much more pronounced with very large residuals switching from positive to negative across all ages in the last few years. A summary of the F-Bar (3-6) vs. SSB from the different individual and the multiple fleet tuned XSA runs is given in Figure 11.5.6. and 11.5.7. It shows the survey tuning fleets estimating higher SSB values and generally lower mean F values in the terminal year than the commercial fleets.

The raw indices of the UK(E&W) beam trawl survey indicate increasing catch rates at all ages throughout the survey. These are in contrast to landings from the fishery for which numbers are declining over time, particularly at the younger ages. Single fleet XSA analyses indicate an apparently good fit for this survey series as noted above, however, when additional fleets are included in the model a pronounced trend becomes evident in the residuals. Surba analyses conducted for this tuning index indicate a continuous decline in F(3-6) and a dramatic increase in SSB (Figure 11.5.8). Plots of the residuals at age for the Surba analysis are shown in Figure 11.5.9

The catchability at age values for the above Surba analyses were set to 1.0. Additional Surba analyses were conducted in which the catchabilities were determined from the geometric mean of the ratio of the sum of the catch numbers at age in the survey to the sum of the population numbers at age (summed over the year range of the survey). The results of this run did not differ substantially from those with constant catchability and the residuals about the fitted model were not improved. The results presented in figures 11.5.8 and 11.5.9. are based on catchability values of 1.0 at all ages.

Results from these runs are not shown but are available in ICES files as graphs and printed output. A number of trial multi-fleet XSA runs were conducted to investigate the sensitivity of the assessment to the inclusion or exclusion of different tuning fleets and tuning age ranges. The first run conducted was based on the same tuning fleet configuration and parameter settings as those used last year. The configuration of last years assessment is shown in the text table in Section 11.5.2. Subsequent runs investigated the effects of removing the IR-JPS; extending the tuning age range of the

UK-BTS September to age 7 and the removal of the UK-BTS March series. The results of these analyses are given in figure 11.5.10 and show remarkably little differences in terms of either fishing mortality or spawning stock biomass. The most noticeable difference is the increased estimate of recruitment in the terminal year that results as a consequence of the removal of the IR-JPS series. This recruitment estimate is now determined entirely by the UK-BTS September tuning index which, individually, gives higher estimates of survivors at almost all ages in comparison to other tuning fleets.

The UK(E&W) March beam trawl survey was discontinued after 1999 and now provides tuning information only for ages 5 and above. Whilst survivors estimates remain consistent with those of other tuning indices it attains relatively low weighting and it was decided that this tuning series could be removed from the assessment.

The removal of the IR-JPS fleet resulted in a reduced influence of survey tuning series in the assessment. The UK-BTS September series extends to age 8 and it was considered that useful tuning information was available to age 7. The inclusion of survey tuning information up to age 7 resulted in only a slight reduction in the weights received by the commercial fleets at older ages and had very little impact on estimates of total abundance and fishing mortality.

11.5.2 Final XSA run

Final XSA settings for this year and the previous two years assessments area shown in the text table below. Changes are shown in bold.

Assessment year	2002	2003	2004
Assessment model	XSA	XSA	XSA
Tuning fleets	UK(E&W)OTB 1987-2001 ages 2 – 8 UK(E&W)BTS Sept 1989-2001 ages 1 – 4 UK(E&W)BTS March 1993-1999 ages 1 – 4 UK(E&W)BT 1989 – 2001 ages 2 – 8 IR-OTB 1995-2001 ages 2-8 IR-JPS 1991 - 2001 ages 1 - 6	UK(E&W)OTB 1987 – 2002 ages 2-8 UK(E&W)BTS Sept 1989 – 2002 ages 1-4 UK(E&W)BTS March 1993-1999 ages 1-4 UK(E&W)BT 1989 – 2002 ages 2-8 IR-OTB 1995-2002 ages 2-8 IR-JPS 1991 - 2002 ages 1 - 6	UK(E&W)OTB 1987 – 2003 ages 2-8 UK(E&W)BTS Sept 1989 – 2003 **ages 1-7** **UK(E&W)BTS March** **Survey omitted** UK(E&W)BT 1989 – 2003 ages 2-8 IR-OTB 1995-2003 ages 2-8 **IR-JPS** **Survey omitted**
Time series weights	Full time series unweighted	full time series unweighted	full time series unweighted
Power model	none	none	None
Q plateau	age 5	age 5	age 5
Shrinkage yr and age range	5 years 4 ages	5 years 4 ages	5 years 4 ages
S.E. for shrinkage	1.5	1.5	1.5
Min S.E. for fleet estimates	0.3	0.3	0.3

The diagnostic output of the final run is displayed in Table 11.5.2.1. and summarised in figures 11.5.2.1. and 11.5.2.2. Log catchability residuals from the final run are shown in figures 11.5.2.3 and 11.5.2.4.

There is considerable variability in fleet estimates of survivors particularly at the younger ages. The UK-BTS September fleet estimates of survivors are high for all ages. Survivors estimates from other fleets show a good level of consistency particularly for ages 4 and above. Owing to the removal of the IR-JPS tuning index there is now a reduced influence of survey tuning information in the assessment. Whilst the UK-BTS September series attains all of the weighting in survivors estimates at age 1, it achieves just 34% of the weighting at age 2, with commercial tuning sources attaining 63%. F shrinkage receives low weighting at all ages (<4%).

The log catchability residuals illustrate the conflicting signals in the different tuning series. Whilst the UK-OTB fleet residuals are quite tight and centred around zero those for the UK-BT indicate declining catchability in recent years whilst those for the UK-BTS September indicate increasing catchability in the survey throughout the entire time series. The UK typically accounts for around 20 - 30% of the landings in this fishery, the bulk of which is by the otter trawl fleet. The UK-OTB tuning index would therefore be expected to have good compliance with the catch data and might be expected therefore to show a good fit to the model.

Estimates of survivors at age from the individual tuning fleets show considerable variability. Values at age 2 for example range from 1,031 thousands to 11,324 thousands and estimates from the two fleets attaining highest weighting differ greatly. There are strong conflicting signals in the tuning information for this stock and it is not currently clear which provides the best representation of the state of the stock. The overall estimate of survivors represents an averaged value which may bear little resemblance to true abundance at this age.

Retrospective analyses were run for 5 years (1999 to 2003) and the results are shown in figure 11.5.2.5. Whilst the results for the first two runs show very consistent estimates of F3-6 and SSB, subsequent runs indicate a retrospective bias with F3-6 being revised upwards and a corresponding downward revision of SSB. This pattern has been less evident in previous assessments and may indicate that either mis-reporting or increased levels of discarding have been occurring in recent years. The precise source of retrospective bias, however, remains obscure and other potential reasons cannot be ruled out.

F by age and numbers at age estimates for the final XSA run are presented in Table 11.5.2.2 and 11.5.2.3 respectively.

11.5.3 Comparison with last year's assessment

A comparison of this years assessment and last years is shown in figure 11.5.3.1. Whilst there has been a slight upward revesion of F(3-6) and a slight downward revision of SSB, the results are very similar to those of last year. Changes made this year to the tuning information used in the assessment have had little impact on the results of the assessment.

11.6 Estimating recruiting year-class abundance

XSA estimates the strength of the 2002 year-class at 10 million one year olds in 2003. However, given the increasing trend in catchability of the UK-BTS index, from which the recruitment estimate is derived, it might be expected that this figure represents an overestimate. The retrospective analysis supports this assumption and indicates a substantial downward revision of the most recent estimate of recruitment.

Previous working groups have identified that recruitment for this stock has been at a reduced and more constant level since 1989. This phenomenon remains apparent in the results of this years assessment though recruitment appears to be declining in recent years. Consequently it was decided that the short term geometric mean (89-02) recruitment (7,934 thousands) should be used as an estimate of recruitment for the short term forecasts and that this value should also be used to overwrite the XSA estimate of recruitment at age 1 in 2003.

11.7 Long-term trends in biomass, fishing mortality and recruitment

Trends in F, SSB, recruitment and landings, for the full time series, are shown in Table 11.7.1 and Figure 11.7.1

Between 1964 and 1988, the recruitment time series shows high variability, and includes several high recruitments. Recruitment since 1989 has been at a lower level and has shown less variation than earlier in the time series. The XSA estimates of recruitment in 2001 and 2002 are below even this reduced level of recruitment and suggest a continued decline in recruitment of this stock to lowest observed levels.

Following an initial increase to relatively high levels early in the time series, mean fishing mortality ($F_{3\text{-}6}$) has been in gradual decline for the last 20 years or so, interspersed with brief periods of higher fishing mortality. Estimates of fishing mortality in recent years (98-02) appear to be fluctuating around $\mathbf{F}_{pa}$ (0.45) and fishing mortality ($F_{3\text{-}6}$) in 2003 is estimated at 0.47.

SSB levels declined to low levels during the late 1970's increasing again over the following decade perhaps as a consequence of good recruitment during this period. SSB levels have declined since the early 1990's but have remained at a relatively constant level over the past decade.

11.8 Short-term catch predictions

Population numbers for short term forecasts were taken from the VPA output of survivors at ages 3 and above in 2004. Numbers at age 1 were taken as the short term (89-02) geometric mean. Because of the considerable uncertainty of the estimate of recruitment at age 1 in 2003, this value has also been overwritten with the short term geometric mean estimate and the number of 2 year old fish in 2004 calculated by carrying this estimate forward one year using a three year mean F and natural mortality estimate of 0.12. Recruitment estimates from various sources are shown below. Those used for the short term forecasts are shown in bold.

	XSA estimate	GM 89-02	GM 64-02
2003 recruitment (000's)	10,009	**7,934**	13.083
2004 recruitment (000's)		**7,934**	13,083
2005 recruitment (000's)		**7,934**	13,083

Fishing mortalities were the mean F's at age over the period 2001-2003. Estimates of fishing mortality show a general decline over the last 10 years or so with an increase in the most recent years. Fluctuations in the level of fishing mortality are evident earlier in the time series with sharp increases followed by similar declines. In the light of this a three year unscaled mean fishing mortality was considered most appropriate for the short term forecasts. No strong trends were evident in the weights at age and catch and stock weights at age were taken as three year mean values over 2001-2003. The smoothing of catch and stock weights at age has been commented on in section 11.3.

The short term forecast was run as a status quo projection. Input data are shown in Table 11.8.1 The predicted landings in 2004 and 2005 and SSB in 2004, 2005 and 2006 are given in table 11.8.2. and summarised in the table below (with coefficients of variation from WGFRAN4 in parenthesis). The detailed output is shown in table 11.8.3. and the results shown graphically in figure 11.8.1.

Year	Landings (t)	Source	SSB (t)	Source
2003	1,520	WG Estimate	3,562	XSA
2004	1,380 (0.16)	SQ Forecast	3,330 (0.12)	SQ Forecast
2005	1,400 (0.18)	SQ Forecast	3,410 (0.12)	SQ Forecast
2006	-	SQ Forecast	3,590 (0.12)	SQ Forecast

A sensitivity analysis of the short term forecast was conducted with inputs as given in table 11.8.1. Results are presented in figure 11.8.2. Yield in 2005 is most sensitive to the level of fishing mortality in that year (HF05). SSB in 2006 is shown to be sensitive to a number of variables at an approximately equal level. This is perhaps a consequence of the high dependency of SSB in 2006 on year classes for which recruitment estimates are based on geometric mean values.

Proportions that the 2000 to 2004 year-classes will contribute to landings and SSB in 2005 and 2006 are shown in table 11.8.4. Approximately 12% of the predicted landings in 2004 and 44% of the predicted landings in in 2005 rely on year-classes for which geometric mean recruitment has been assumed.

Probability profiles for yield in 2005 and SSB in 2006 are shown in figure 11.8.3. The 95% confidence limits for the 2005 status quo landings estimate are approximately 1,000 t and 1,900 t. The predicted catch for 2004 assuming status quo F is 1,380 t. The TAC for 2004 is 1,340 t. SSB is predicted to increase gradually to around 3,600 t. in 2006. The probability that SSB in 2006 will fall below 3,100 t. ($\mathbf{B}_{pa}$) is estimated to be less than 15%.

11.9 Medium-term projections

The stock and recruitment data for the time series are shown in Figures 11.9.1 and 11.9.2. The recent period of reduced recruitments, across a range of SSBs, that has been identified in earlier years remains apparent. Reduced recruitment has been observed in other plaice stocks around the UK over the same period suggesting that this anomaly is not specific to plaice in the Irish Sea.

Beverton & Holt parameters for the reduced time period were estimated to be:

Model: R = a*SSB/(1+(SSB/b))
Estimates: a: 2.7713 s.d. 1.1327
b: 9.9918 s.d. 13.7606
Units: Recruits in millions, SSB in kt.

The stock recruitment model fitted to the short time series is different to that of last year, having a steeper slope at the origin and giving lower estimates of recruitment at high SSB levels. The fit of the curve would appear to be quite sensitive to the addition of new data points particularly when SSB values for those points are low. The short time series fit, in comparison with a curve fitted to the full time series (figure 11.9.2), gives lower estimates of recruitment but the overall trajectories of the two curves are similar. Both curves continue to rise well beyond the limits of the data and may lead to over-optimistic estimates of biomass at low fishing mortalities.

Given the lack of any clear stock and recruitment relationship and the sensitivity of the fitted curve to the addition of new data points, the working group considered that the calculation of medium term projections was inappropriate for this stock. Particularly high discard rates result in very poor estimation of the both the overall level and the inter-annual variability of recruitment. Stock recruitment curves show a poor fit to the data as discussed above, there remains no clear explanation of the drop in recruitment levels in recent years and recent recruitment levels appear remarkably constant. The use of randomly re-sampled recruitment estimates from the recent time period would result in an underestimation of the confidence bounds on future SSB and F trajectories.

11.10 Yield and Biomass Per Recruit

Yield per recruit results, long-term yield and SSB (conditional on the current exploitation pattern) are shown in Table 11.10.1 and Figure 11.8.1. *Status quo* F (0.43) is around 20% above $\mathbf{F}_{max}$ (0.37) and is 3 times $\mathbf{F}_{0.1}$ (0.14). The stock-recruitment relationship is shown in Figures 11.9.1 and 11.9.2. The equilibrium yield and SSB at *status quo* F are estimated at 1,760 and 4,130 tonnes respectively, based on the recent GM recruitment (7.9 million).

11.11 Reference points

Biological reference point values for $\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$ were considered in detail in previous WG and ACFM reports, and are given below:

$\mathbf{B}_{pa}$ **= 3100t**, set on the basis of $\mathbf{B}_{loss}$, and evidence of high recruitment at the lowest biomass observed.

$\mathbf{F}_{pa}$ **= 0.45**, based on $\mathbf{F}_{med}$ and long-term considerations.

The current assessment provides no basis for altering the values currently adopted by ACFM for Irish Sea plaice. Estimates of the relevant biological reference points and their confidence limits are indicated in table 11.11.1. The current estimate of F(3-6) is slightly below the estimated value of $\mathbf{F}_{med}$ and lies within the confidence intervals of $\mathbf{F}_{max}$. Figure 11.11.1 shows the relationship between historical and predicted SSB on F values, plotted into zones according to the precautionary reference points identified. Values of $\mathbf{B}_{lim}$ and $\mathbf{F}_{lim}$ are not identified for plaice in VIIa. Figure 11.11.2 indicates the historic yield of the stock in terms of F in relation to F reference points, suggesting there have been some changes in the stock dynamics in the Irish Sea with productivity, recruitment and SSB appearing to be reduced in recent years.

11.11.1 Quality of the assessment

The performance of this assessment has been considered to be good in previous years. Landings predicted by the short term forecast have generally been close to those observed in the fishery. Although this situation remains apparent this year, aspects of the assessment appear to be deteriorating. For example, the commercial tuning indices and the surveys provide contradictory information, there appears to be little or no contrast in the strength of incoming year-classes and a retrospective bias has become apparent in estimates of F and SSB. A number of issues warrant discussion concerning the quality of this assessment, specifically with regards the derivation of the international catch numbers at age; the information used to tune the assessment; the biology of the stock; the performance of the forecasts and the relevance of the biological reference points.

Biological sampling levels for this stock have typically been high with 80 to 90% of the landings being represented by age compositions that are derived from market sampling at either a separate sex or combined sex level. This year, age compositions represented only 50% of the total landings and studies indicate there may be differences in the proportions at age in the landings of different fleets operating in the fishery. It is considered that the mean age of the catch may be overestimated in the landing estimates for 2003. This will reduce the ability of the assessment model to consistently estimate year-class strengths down a cohort. Consequently, the age structure of the population carried forward to the forecasts may be poorly estimated. Age determination is not considered to be a serious problem in plaice though mis-ageing may occur more often in older fish.

Discard levels in this fishery are estimated to be very high and fish at the younger ages may be subject to substantially higher mortality levels than currently estimated. The landings of young fish represent only a small proportion of those caught and the lack of adequate information on mortality rates at these ages seriously impairs the ability to estimate recruitment levels in the population. Information on discard levels have been routinely collected since 2000 by the UK(E&W), Belgium and Ireland and additional one-off studies have been conducted prior to this. There may now be sufficient information to allow the investigation of methods which can use this information. This should be investigated at the earliest opportunity

The stock is currently assessed using VPA, tuned by the XSA methodology, which assumes that the catch is known without error. Catches at age may be poorly estimated particularly in the most recent years for the reasons described above. In addition to high discarding levels it is also possible that mis-reporting levels may have increased as the TAC for plaice has been reduced in recent years in line with effort reductions required in the sole fishery. A mirror assessment was presented to the working group (WD.4) based on a Bayesian approach, which allows for observation error in both the catch and the surveys and incorporates uncertainty on F and SSB. The results show good correspondence with those of the XSA assessment. Overall levels and general trends of the posterior estimates of both F and SSB are very similar to those of the XSA assessment. Recruitment estimates follow a similar trend with the overall level slightly higher. The notable result of the mirror assessment is the degree of variability around the most probable estimates of recruitment, SSB, and F. The present data are not informative enough on these variables, and the results suggest any subsequent deductions and/or predictions (such as precautionary reference points) may be questionable.

The stock of plaice in the Irish Sea is considered to be separated into 2 components, one in the eastern Irish Sea the other in the west. A similar spatial separation of the fishing fleets exits with the UK(E&W) and Belgian vessels fishing predominantly on the eastern side and Irish vessels on the western side though vessels may travel further afield and shift their distribution on a seasonal basis. The tuning information available for this assessment is similarly regionalised and no single tuning series can be considered representative of the entire management area. The two available survey tuning series show a marked divergence from one another in recent years and the removal of the IR-JPS from the assessment reduces the influence of surveys in the assessment. A survey tuning series which covers the whole of the assessment area should be compiled. In addition the availability and utility of additional survey tuning information for this stock should be investigated.

The overwriting of recruitment estimates has led to an increased dependency of predicted landings and SSB values on year-classes for which geometric mean recruitment has been assumed. The full extent of this problem is hard to quantify as these fish may be subject to heavy discarding at ages up to 3 years.

Fishing mortality reference points estimated for this stock appear to be fairly consistent. The stock recruit relationship however, is particularly poorly defined and it might be expected that reference points based on this will be variable. $\mathbf{F}_{max}$ is determined from the yield per recruit curve and F(3-6) lies within the confidence bounds of this estimate.

This stock was scheduled for an update assessment in 2003 by the working group. However, complications associated with strong divergence of the most recent survey tuning indices necessitated a more comprehensive investigation. This problem could not be anticipated and resulted in last minute changes to the work schedule of the working group. Similarly changes in the levels of sampling and the derivation of the catch at age matrix or the introduction of technical conservation measures and other management actions may result in substantial changes in either the ability to assess the stock or the resulting perception of the state of the stock and may require that the type of assessment conducted should be reconsidered. It is proposed that a full benchmark analysis is completed prior to the review of this assessment by ACFM in October.

11.11.2 Management considerations

Status quo F (average 2001-2003) was estimated to have been 0.43; above $\mathbf{F}_{0.1}$, and $\mathbf{F}_{max}$ but below $\mathbf{F}_{pa}$. SSB in 2003 is estimated at 3,560 t, and at 3,330 t in 2004, both of which are above $\mathbf{B}_{pa}$ (3100 t). The stock is considered to be within safe biological limits.

The cumulative probability distributions from the sensitivity analysis (Figure 11.8.3) indicate that the probability of SSB falling below $\mathbf{B}_{pa}$ in 2006 is less than 15%.

The considerable level of discarding in this fishery indicates a mismatch between the minimum landing size and the mesh size of the gear being used. A decrease in the minimum landing size would not resolve the discarding problem as the market for small plaice is generally poor.

Table 11.1.3.1 Nominal landings (t) of PLAICE in Division VIIa as officially reported to ICES.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[1]
Belgium	301	138	321	128	332	327	344[3]	459	327	275	325	482	636	628
France	105	20	42	19	13	10	11	8	8	5	14	9[1]	8	6
Ireland	1,350	900	1,355	654	547	557	538	543	730	541	420	378	370	
Netherlands	-	-	-	-	-	-	69	110	27	30	47	-	-[1]	-[1]
UK (Eng.&Wales)[2]	1,959	1,584	1,381	1,119	1,082	1,050	878	798	679	687	610	607	569	
UK (Isle of Man)	27	51	24	13	14	20	16	11	14	5	6	1	1	1
UK (N. Ireland)	…	…	…	…	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	219	104	70	72	63	60	18	25	18	23	21	11	7	
UK (Total)														418
Total	3,961	2,797	3,193	2,005	2,051	2,024	1,874	1,954	1,803	1,566	1,443	1,488	1,591	1,053
Discards	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unallocated	-686	-243	74	-9	15	-150	-167	-83	-38	34	-72	-15	31	467
Total figures used by the Working Group for stock assessment	3,275	2,554	3,267	1,996	2,066	1,874	1,707	1,871	1,765	1,600	1,371	1,473	1,622	1,520

[1]Provisional.
[2]1989–1999 Northern Ireland included with England and Wales.
[3]Final Statlant 27a data.
{UK (Total) excludes Isle of Man data}.
n/a = not available.

Table 11.2.1 Irish Sea PLAICE. English standardized LPUE and effort, Belgian beam trawl LPUE and effort and Irish otter trawl LPUE and effort series

Year	LPUE						Effort ('000 hrs)			
			English[1]		Belgian[3]	Ireland	English[2]		Belgian[5]	Ireland
	Beam[4] trawl survey		Otter trawl	Beam trawl	Beam trawl	Otter Trawl	Otter trawl	Beam trawl	Beam trawl	Otter Trawl
	March	September								
1972	-	-	6.96	-	9.8	-	128.4	-	6.8	-
1973	-	-	6.33	-	9.0	-	147.6	-	16.5	-
1974	-	-	7.45	-	10.4	-	115.2	-	14.2	-
1975	-	-	7.71	-	10.7	-	130.7	-	16.2	-
1976	-	-	5.03	-	5.8	-	122.3	-	15.1	-
1977	-	-	4.82	-	5.3	-	101.9	-	13.4	-
1978	-	-	6.77	4.88	6.9	-	89.1	0.9	12.0	-
1979	-	-	7.18	15.23	8.0	-	89.9	1.7	13.7	-
1980	-	-	8.24	8.98	8.6	-	107.0	4.3	20.8	-
1981	-	-	6.87	4.91	7.1	-	107.1	6.4	26.7	-
1982	-	-	4.92	1.77	4.4	-	127.2	5.5	21.3	-
1983	-	-	5.32	3.08	7.8	-	88.1	2.8	18.5	-
1984	-	-	7.77	6.98	6.8	-	103.1	4.1	13.6	-
1985	-	-	9.97	25.70	8.8	-	102.9	7.4	21.9	-
1986	-	-	9.27	4.21	8.7	-	90.3	17.0	38.3	-
1987	-	-	7.20	3.57	8.2	-	130.6	22.0	43.2	-
1988	-	392	5.02	3.05	6.3	-	132.0	18.6	32.7	-
1989	-	253	5.51	13.59	6.2	-	139.5	25.3	36.7	-
1990	-	239	5.93	12.02	7.2	-	117.1	31.0	38.3	-
1991	-	157	4.79	10.56	7.5	-	107.3	25.8	15.4	-
1992	-	188	4.20	9.99	11.9	-	96.8	23.4	23.0	-
1993	91	235	3.97	9.50	5.0	-	78.9	21.5	24.4	-
1994	128	225	4.90	7.79	9.2	-	43.0	20.1	31.6	-
1995	134	169	5.08	7.69	9.5	3.18	43.1	20.9	27.1	80.3
1996	-[6]	210	5.37	12.96	11.8	4.24	42.2	13.3	22.2	64.8
1997	147	262	5.25	7.66	13.9	3.24	39.9	10.8	29.3	92.2
1998	113	249	5.00	5.66	12.3	3.86	36.9	10.4	23.8	93.5
1999	-[6]	264	5.38	7.76	12.0	2.32	22.9	11.0	22.1	110.3
2000	-[6]	357	5.02	13.04	11.6	2.09	27.0	6.3	18.2	82.7
2001	-	281	3.36	8.32	13.6	2.54	32.8	12.5	28.5	77.5
2002	-	340	5.66	5.46	10.7	2.78	24.8	8.0	36.2	77.9
2003	-	503	2.72	3.76	8.8	4.05	23.8	14.0	23.0	76.4

[1]Whole weight (kg) per corrected hour fished, weighted by area.
[2]Corrected for fishing power (GRT).
[3]Kg/hr.
[4]Kg/100 km.
[5]Corrected for fishing power (HP).
[6]Carhelmar survey, Kg/100km not available

Fishing power corrections are detailed in Appendix 2 of the 2000 working group report

Table 11.2.2 Irish Sea Plaice : tuning fleet data available to the WG. Figures shown in bold are those used in the assessment

Irish sea plaice : 2004 : Fleet data file
106 Updated idh 23/4/04
UK(E+W)TRAWL FLEET (revised 2/4/2004 - calculated using ABBT age compositions)
1987 2003 Effort (thousand hours fishing) and catch from CPUE program.
1 1 0 1 Numbers in thousands
1 14

130.597	24.4	**1475.8**	**1434.6**	**1593.3**	**409.0**	**291.2**	**31.4**	**46.8**	16.9	24.2	11.2	1.4	3.2	3.6
131.950	22.0	**1374.8**	**1421.0**	**455.0**	**295.5**	**142.5**	**78.9**	**8.1**	28.9	6.7	9.6	3.5	4.1	1.1
139.521	10.6	**771.5**	**2102.0**	**801.1**	**235.2**	**99.8**	**48.0**	**37.6**	13.7	11.0	6.3	6.7	3.2	1.7
117.058	8.2	**501.0**	**1094.3**	**983.9**	**217.0**	**82.8**	**60.0**	**17.5**	15.9	4.5	3.2	6.7	3.0	2.0
107.288	94.3	**949.9**	**451.3**	**419.5**	**245.0**	**99.7**	**35.2**	**38.7**	12.1	11.1	0.6	3.6	1.8	1.5
96.802	80.8	**851.1**	**907.2**	**181.3**	**114.6**	**82.4**	**28.6**	**8.3**	17.8	7.3	5.4	0.4	1.3	0.8
78.945	12.9	**387.7**	**519.1**	**367.7**	**63.5**	**55.7**	**69.5**	**21.8**	5.2	10.7	2.6	1.1	0.0	0.2
42.995	38.8	**408.3**	**534.9**	**142.5**	**92.5**	**18.2**	**12.3**	**15.9**	7.3	1.8	1.3	2.2	0.5	0.0
43.146	7.3	**350.1**	**512.5**	**255.7**	**88.9**	**46.1**	**10.9**	**4.8**	8.3	2.4	1.7	0.7	0.2	0.2
42.239	10.9	**326.5**	**280.3**	**198.7**	**80.5**	**32.9**	**15.3**	**4.8**	2.0	10.0	2.1	0.7	0.6	0.1
39.886	11.2	**250.6**	**214.7**	**125.2**	**74.2**	**37.5**	**12.8**	**12.4**	1.8	0.8	1.4	0.4	0.2	0.7
36.902	1.6	**202.7**	**318.6**	**105.3**	**40.6**	**37.6**	**16.5**	**9.8**	4.5	0.5	0.5	1.0	0.3	0.2
22.903	17.6	**139.2**	**200.5**	**120.0**	**35.0**	**14.0**	**9.0**	**5.4**	1.6	0.8	0.2	0.1	0.1	0.0
26.967	0.0	**107.1**	**233.3**	**185.0**	**95.5**	**18.5**	**14.4**	**9.8**	5.9	2.7	2.1	0.9	0.4	.01
32.964	5.5	**65.9**	**130.4**	**124.0**	**108.7**	**53.2**	**17.4**	**10.6**	7.1	3.0	0.5	0.7	0.1	0.1
24.762	0.5	**78.6**	**175.8**	**95.3**	**58.6**	**33.0**	**23.8**	**3.3**	2.5	1.4	0.4	0.4	0.0	0.1
23.851	0.0	**34.1**	**79.6**	**88.7**	**35.6**	**16.1**	**12.3**	**7.4**	2.3	0.4	0.3	0.2	0.0	0.2

UK(E+W)BEAM TRAWL FLEET
1987 2003 Effort (thousand hours fishing) and catch from CPUE program.
1 1 0 1 Numbers in thousands
1 14

21.997	0.0	1.1	27.1	113.1	36.0	31.3	2.9	6.7	1.9	3.1	0.6	0.1	0.2	0.1
18.564	0.0	2.0	48.0	23.7	24.4	13.2	8.5	1.4	2.6	1.6	1.5	0.6	0.8	0.3
25.291	3.1	**132.8**	**297.5**	**163.4**	**52.6**	**42.4**	**25.1**	**16.1**	4.3	5.3	3.3	5.7	2.6	1.1
31.003	2.2	**136.2**	**391.9**	**361.1**	**78.2**	**30.2**	**17.2**	**8.4**	3.6	1.5	1.9	3.8	1.4	0.5
25.838	17.3	**282.5**	**182.9**	**174.5**	**91.8**	**35.9**	**11.2**	**11.8**	3.5	4.7	0.2	1.0	0.6	0.3
23.399	3.9	**141.5**	**335.6**	**79.6**	**64.6**	**45.5**	**18.6**	**8.0**	12.2	7.1	4.0	0.2	0.7	1.0
21.503	0.6	**73.4**	**112.8**	**95.2**	**23.3**	**24.2**	**32.0**	**11.8**	4.5	7.1	2.2	1.2	0.0	0.4
20.145	13.4	**151.8**	**186.1**	**39.9**	**26.0**	**6.8**	**6.6**	**7.8**	3.5	1.2	0.9	1.2	0.2	0.0
20.932	5.2	**183.4**	**229.1**	**100.6**	**33.1**	**16.1**	**3.9**	**1.7**	3.3	1.0	0.9	0.5	0.1	0.2
13.320	13.4	**144.0**	**111.4**	**75.3**	**30.8**	**11.0**	**5.9**	**2.1**	1.2	2.7	0.5	0.2	0.4	0.3
10.760	0.9	**98.6**	**69.5**	**39.0**	**30.2**	**13.5**	**3.7**	**3.2**	0.5	0.4	0.3	0.2	0.1	0.1
10.386	0.3	**63.5**	**103.7**	**32.6**	**12.0**	**9.7**	**6.3**	**2.7**	1.8	0.3	0.2	0.5	0.2	0.0
11.016	4.8	**51.3**	**124.4**	**80.4**	**24.4**	**12.5**	**10.5**	**5.6**	0.9	0.8	0.2	0.2	0.2	0.1
6.275	0.0	**25.2**	**61.4**	**46.6**	**27.9**	**7.3**	**6.5**	**4.5**	1.9	0.7	0.7	0.7	0.1	0.1
12.495	1.5	**20.6**	**47.5**	**56.6**	**42.7**	**20.8**	**7.0**	**4.5**	2.5	1.2	0.4	0.1	0.1	0.0
8.017	0.0	**11.5**	**33.1**	**21.0**	**18.8**	**14.9**	**8.0**	**2.3**	1.3	1.4	0.4	0.4	0.0	0.0
13.997	10.0	**11.4**	**45.5**	**47.7**	**20.9**	**10.0**	**8.7**	**5.4**	1.7	0.3	0.0	0.3	0.0	0.1

UK BT SURVEY (Sept) - Prime stations only
1989 2003 Effort (km towed) and numbers at age.
1 1 0.75 0.85
1 8

129.710	**309**	**441**	**530**	**77**	**13**	**44**	**3**	0
128.969	**1688**	**405**	**176**	**90**	**54**	**30**	**3**	1
123.780	**591**	**481**	**68**	**47**	**4**	**4**	**24**	3
129.525	**1043**	**470**	**267**	**23**	**19**	**14**	**14**	3
131.192	**1106**	**812**	**136**	**101**	**16**	**8**	**21**	4
124.892	**815**	**608**	**307**	**68**	**33**	**12**	**17**	8
124.336	**1171**	**368**	**169**	**80**	**16**	**18**	**0**	1
127.486	**1645**	**582**	**123**	**71**	**45**	**9**	**11**	2
132.860	**1450**	**713**	**342**	**76**	**52**	**24**	**10**	9
129.339	**1181**	**808**	**221**	**103**	**35**	**24**	**14**	3
125.263	**1090**	**951**	**339**	**113**	**38**	**18**	**9**	6
123.225	**2002**	**635**	**288**	**141**	**69**	**22**	**7**	4
127.301	**1445**	**661**	**219**	**131**	**89**	**30**	**12**	8
120.260	**1644**	**1429**	**485**	**240**	**97**	**70**	**31**	13
121.001	**1354**	**1718**	**784**	**287**	**114**	**59**	**37**	10

```
UK BT SURVEY (March) - Prime stations only
1993 1999 Effort (km towed) and numbers at age.
1 1 0.15 0.25
1 8
126.931  480  662  141  71  12  8  11  3
115.442  361  662  370  98  47  5   7 10
126.189  859  647  340 120  29 28   0 10
134.343 1559  908  295  98  49 16   8  1      (Carhelmar)
121.742  967  905  351  63  39 31  10 13
130.081  648  957  217  82  24 23  12  1
130.822  570  770  389  98  26 11   9  6      (carhelmar)
```

```
IR-JPS : Irish Juvenile Plaice Survey 2nd Qtr - Effort min. towed - Plaice No. at age
1976 2003
1    1    0.37 0.43
1    7
570  342  241  48   13   6    1    1    1976 1981-1992 ALK used
540  690  240  68   16   5    0    0    1977 1981-1992 ALK used
570  300  147  31   8    3    0    0    1978 1981-1992 ALK used
555  707  176  52   19   5    1    0    1979 1981-1992 ALK used
540  201  307  88   19   6    1    1    1980 1981-1992 ALK used
540  144  248  82   9    2    0    1    1981 1991-2001 Length
555  841  218  47   20   15   7    3    1982 1991-2001 Length
555  972  579  35   14   10   6    2    1983 1991-2001 Length
570                                     1984 No data available
570  615  354  39   15   8    4    1    1985 1991-2001 Length
555  589  262  19   6    4    2    1    1986 1991-2001 Length
570  1032 316  12   6    4    2    1    1987 1991-2001 Length
570  1329 346  85   11   8    6    2    1988 1991-2001 Length
570  497  442  52   6    0    0    0    1989 1991-2001 Length
570  299  407  163  74   18   1    0    1990 Combined 1989 &
555  185  206  60   21   9    1    1    1991
570  1785 268  48   16   7    2    2    1992
600  643  630  189  45   8    21   3    1993
585  614  254  196  33   8    2    0    1994
570  840  321  110  86   18   5    2    1995
675  752  221  134  39   57   7    0    1996
675  665  303  105  41   22   17   5    1997
675  311  466  191  48   11   7    4    1998
660  -99(98)  -99(96)  -99(95)  -99(27)  -99(6)   -99(2)   0    1999 Strong tides
645  805  342  72   61   32   9    2    2000
675  743  739  213  88   43   14   5    2001
660  273  145  40   2    1    1    0    2002
660  346  322  152  78   20   9    7    2003
```

```
IR-OTB : Irish Otter trawl - Effort in hours - VIIa Plaice numbers at age - Year
1995 2003
1    1    0    1
2    8
70682    5    84   263  202  51   29   24
58166    4    94   157  227  97   26   8
75029    27   136  197  147  74   74   21
81073    49   140  176  124  104  128  64   29   21   10   5
93221    51   129  152  126  71   46   32   19   4    2    1
64320    11   92   98   88   24   10   8    3    1    4    0
77541    55   90   97   104  100  38   16   11   3    1    0
77863    6    67   179  122  90   53   22   11   6    1    0
76368    17   171  284  185  109  50   20   5    3    1    1
```

```
IR-GFS : Irish Groundfish survey - Celtic Explorer
2003    2003
1    1    0.89 0.91
0    12
1    3   76   396   377   219    71   31    21   6   4   0   0   0   1
```

Table 11.3.1 Irish Sea Plaice : catch numbers at age

Run title : IRISH SEA PLAICE,2004 WG,COMBSEX,PLUSGROUP. IDH 23/4/04

At 4/05/2004 15:00

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
1,	0,	28,	0,	0,	0,	59,	9,	0,	0,	0,
2,	997,	1416,	120,	164,	171,	430,	803,	427,	142,	925,
3,	1911,	3155,	4303,	1477,	1961,	2317,	2278,	3392,	3254,	4091,
4,	1680,	2841,	3605,	5593,	3410,	2932,	2179,	3882,	5136,	5233,
5,	446,	1115,	2182,	4217,	4641,	2080,	1877,	1683,	1461,	2682,
6,	851,	555,	620,	995,	1611,	2227,	1028,	1371,	752,	642,
7,	480,	309,	588,	642,	319,	779,	899,	491,	555,	345,
8,	140,	300,	386,	267,	113,	184,	239,	497,	627,	238,
+gp,	225,	47,	237,	519,	185,	274,	221,	426,	686,	632,
0 TOTALNUM,	6730,	9766,	12041,	13874,	12411,	11282,	9533,	12169,	12613,	14788,
TONSLAND,	2879,	3664,	4268,	5059,	4695,	4394,	3583,	4232,	5119,	5060,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
1,	7,	18,	23,	565,	22,	12,	3,	22,	27,	51,
2,	1200,	1370,	2553,	4124,	3063,	3380,	2783,	1742,	715,	2924,
3,	2530,	4313,	4333,	2767,	5169,	5679,	6738,	5939,	3288,	2494,
4,	2694,	1902,	2425,	2470,	1535,	1835,	2560,	2984,	3082,	3211,
5,	2125,	1158,	902,	839,	542,	363,	646,	837,	1358,	1521,
6,	1045,	933,	563,	236,	202,	187,	312,	222,	330,	648,
7,	191,	152,	391,	150,	98,	109,	125,	105,	137,	211,
8,	139,	119,	198,	112,	54,	61,	64,	53,	69,	110,
+gp,	253,	332,	281,	128,	124,	174,	124,	183,	144,	142,
0 TOTALNUM,	10184,	10297,	11669,	11391,	10809,	11800,	13355,	12087,	9150,	11312,
TONSLAND,	3715,	4063,	3473,	2904,	3231,	3428,	3903,	3906,	3237,	3639,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

1

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	41,	4,	31,	62,	46,	24,	15,	180,	151,	28,
2,	3159,	2357,	1652,	3717,	2923,	1735,	1019,	2008,	1958,	910,
3,	5179,	6152,	5280,	5317,	5040,	5945,	2715,	1506,	3209,	1649,
4,	1182,	3301,	2942,	5252,	2552,	2671,	2935,	1929,	1435,	1357,
5,	1054,	614,	1287,	1341,	1400,	854,	1132,	1205,	1358,	474,
6,	459,	429,	344,	1072,	750,	436,	465,	465,	903,	556,
7,	299,	262,	371,	123,	316,	214,	259,	182,	388,	377,
8,	113,	181,	112,	121,	84,	153,	98,	122,	118,	179,
+gp,	139,	159,	196,	217,	321,	211,	125,	104,	176,	123,
0 TOTALNUM,	11625,	13459,	12215,	17222,	13432,	12243,	8763,	7701,	9696,	5653,
TONSLAND,	4241,	5075,	4806,	6220,	5005,	4372,	3275,	2554,	3267,	1996,
SOPCOF %,	99,	100,	99,	100,	100,	100,	100,	100,	100,	100,

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

YEAR,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,
AGE										
1,	98,	21,	37,	28,	5,	68,	0,	14,	1,	0,
2,	1146,	961,	856,	830,	691,	803,	450,	374,	205,	286,
3,	2173,	1703,	1345,	1590,	1739,	1505,	1174,	1138,	939,	1005,
4,	1309,	1936,	1196,	1513,	1025,	1294,	1283,	1083,	1480,	1279,
5,	644,	764,	943,	1003,	612,	696,	685,	767,	841,	683,
6,	318,	318,	370,	482,	476,	280,	212,	408,	538,	403,
7,	245,	138,	128,	285,	403,	196,	219,	178,	317,	247,
8,	134,	70,	44,	139,	177,	117,	102,	90,	96,	125,
+gp,	129,	88,	91,	118,	207,	124,	101,	75,	72,	93,
0 TOTALNUM,	6196,	5999,	5010,	5988,	5335,	5083,	4226,	4127,	4489,	4121,
TONSLAND,	2066,	1874,	1707,	1871,	1765,	1600,	1371,	1473,	1622,	1520,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

1

Table 11.3.2 Irish Sea Plaice : catch weights at age

Table 2 Catch weights at age (kg)

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
1,	.0000,	.0700,	.0000,	.0000,	.0000,	.0560,	.0580,	.0000,	.0000,	.0000,
2,	.1900,	.1770,	.1520,	.1330,	.1490,	.1460,	.1490,	.1400,	.1430,	.1430,
3,	.2920,	.2690,	.2230,	.2180,	.2130,	.2150,	.2190,	.2070,	.2350,	.2180,
4,	.4130,	.3880,	.3160,	.2990,	.3130,	.3110,	.3240,	.2950,	.3320,	.3160,
5,	.4630,	.5560,	.4180,	.3820,	.4130,	.4050,	.4170,	.3960,	.4320,	.4150,
6,	.5970,	.6530,	.5320,	.5160,	.5090,	.5410,	.5230,	.4890,	.5600,	.4910,
7,	.8310,	.6900,	.6970,	.5180,	.5840,	.6430,	.6480,	.5950,	.7370,	.6450,
8,	1.0420,	.7190,	.6910,	.7590,	.7770,	.7870,	.6850,	.7530,	.7120,	.6940,
+gp,	.7913,	1.0627,	.9794,	.7431,	.9224,	.8221,	.8705,	.7553,	1.0520,	.8942,
0 SOPCOFAC,	1.0001,	.9998,	1.0001,	.9995,	1.0006,	.9999,	.9997,	1.0000,	.9999,	1.0002,

Table 2 Catch weights at age (kg)

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
1,	.0630,	.0720,	.0600,	.0590,	.0710,	.0690,	.0660,	.0690,	.2010,	.2320,
2,	.1580,	.1850,	.1500,	.1530,	.1850,	.1760,	.1770,	.1760,	.2740,	.2610,
3,	.2460,	.2750,	.2280,	.2260,	.2680,	.2620,	.2550,	.2670,	.2840,	.2900,
4,	.3340,	.3980,	.3230,	.3400,	.3910,	.3760,	.3650,	.3760,	.3480,	.3190,
5,	.4450,	.5310,	.4190,	.4300,	.5250,	.5570,	.4830,	.5120,	.4210,	.3680,
6,	.5140,	.6440,	.5250,	.5100,	.6720,	.6680,	.5170,	.5920,	.5450,	.4260,
7,	.6860,	.7490,	.5900,	.5920,	.7200,	.7940,	.6710,	.6780,	.6500,	.4840,
8,	.8470,	.9240,	.7190,	.7380,	.9100,	.9150,	.8840,	.8630,	.6510,	.5520,
+gp,	1.0720,	1.2778,	.9593,	.9709,	1.1205,	1.0678,	1.1640,	1.1488,	1.0026,	.8126,
0 SOPCOFAC,	1.0000,	1.0003,	1.0004,	.9992,	.9995,	.9998,	.9999,	1.0008,	.9998,	1.0007,

1

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	.2600,	.2900,	.2700,	.2600,	.2300,	.2270,	.2000,	.2470,	.1690,	.2600,
2,	.2900,	.3100,	.2800,	.2900,	.2600,	.2720,	.2570,	.2670,	.2180,	.2700,
3,	.3300,	.3400,	.3400,	.3150,	.3000,	.3210,	.3160,	.2950,	.2740,	.2920,
4,	.3800,	.3900,	.4200,	.3700,	.3700,	.3740,	.3760,	.3320,	.3370,	.3280,
5,	.4700,	.4700,	.5000,	.4400,	.4600,	.4300,	.4390,	.3770,	.4070,	.3750,
6,	.5600,	.5400,	.5400,	.5200,	.5500,	.4910,	.5040,	.4310,	.4840,	.4360,
7,	.6600,	.6300,	.6300,	.6100,	.6800,	.5550,	.5700,	.4940,	.5680,	.5080,
8,	.7600,	.7300,	.8300,	.7200,	.8200,	.6230,	.6390,	.5660,	.6580,	.5940,
+gp,	1.1291,	.9879,	1.0655,	1.0250,	1.3535,	.8604,	.8321,	.7534,	.8933,	.8293,
0 SOPCOFAC,	.9914,	.9980,	.9876,	.9961,	1.0007,	1.0024,	1.0009,	.9987,	1.0021,	.9982,

Table 2 Catch weights at age (kg)

YEAR,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,
AGE										
1,	.1560,	.2010,	.1440,	.1340,	.2020,	.1740,	.1930,	.1420,	.1850,	.2020,
2,	.2070,	.2290,	.2030,	.1840,	.2220,	.2130,	.2220,	.2050,	.2250,	.2430,
3,	.2680,	.2660,	.2680,	.2390,	.2520,	.2570,	.2570,	.2690,	.2710,	.2890,
4,	.3380,	.3120,	.3380,	.2990,	.2940,	.3090,	.3020,	.3370,	.3240,	.3400,
5,	.4160,	.3660,	.4140,	.3620,	.3460,	.3660,	.3570,	.4070,	.3830,	.3950,
6,	.5040,	.4290,	.4960,	.4300,	.4100,	.4300,	.4220,	.4790,	.4490,	.4560,
7,	.6000,	.5010,	.5840,	.5020,	.4840,	.5010,	.4970,	.5540,	.5210,	.5220,
8,	.7060,	.5810,	.6770,	.5790,	.5690,	.5770,	.5810,	.6320,	.6000,	.5920,
+gp,	.9294,	.7671,	.9245,	.7477,	.8041,	.7188,	.7865,	.7706,	.7292,	.7459,
0 SOPCOFAC,	.9995,	.9996,	1.0004,	1.0000,	1.0011,	1.0003,	1.0003,	1.0016,	1.0017,	.9996,

1

Table 11.3.3 Irish Sea Plaice : stock weights at age

Table 3 Stock weights at age (kg)

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
1,	.0240,	.0230,	.0190,	.0180,	.0180,	.0190,	.0190,	.0180,	.0200,	.0190,
2,	.1090,	.1050,	.0870,	.0820,	.0830,	.0840,	.0870,	.0820,	.0910,	.0850,
3,	.2260,	.2130,	.1770,	.1690,	.1680,	.1700,	.1750,	.1640,	.1860,	.1730,
4,	.3480,	.3270,	.2660,	.2510,	.2630,	.2610,	.2720,	.2490,	.2800,	.2670,
5,	.4120,	.4800,	.3660,	.3360,	.3600,	.3550,	.3650,	.3460,	.3790,	.3630,
6,	.5450,	.5870,	.4800,	.4640,	.4580,	.4850,	.4720,	.4420,	.5040,	.4450,
7,	.7670,	.6410,	.6430,	.4820,	.5410,	.5930,	.5990,	.5500,	.6780,	.5960,
8,	.9810,	.6800,	.6520,	.7160,	.7320,	.7420,	.6470,	.7090,	.6720,	.6550,
+gp,	.7670,	1.0240,	.9270,	.7125,	.8730,	.7902,	.8380,	.7262,	1.0038,	.8597,

Table 3 Stock weights at age (kg)

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
1,	.0210,	.0240,	.0200,	.0200,	.0240,	.0230,	.0220,	.0230,	.0200,	.0190,
2,	.0940,	.1090,	.0900,	.0890,	.1060,	.1040,	.0990,	.1030,	.0900,	.0870,
3,	.1920,	.2180,	.1810,	.1790,	.2130,	.2080,	.2010,	.2100,	.2090,	.2130,
4,	.2820,	.3360,	.2720,	.2860,	.3300,	.3170,	.3070,	.3180,	.3090,	.3000,
5,	.3900,	.4630,	.3680,	.3750,	.4570,	.4810,	.4220,	.4460,	.4080,	.3480,
6,	.4680,	.5820,	.4750,	.4610,	.6020,	.5990,	.4740,	.5370,	.4780,	.3970,
7,	.6340,	.6950,	.5480,	.5500,	.6680,	.7330,	.6230,	.6300,	.5680,	.4550,
8,	.7980,	.8730,	.6790,	.6960,	.8590,	.8620,	.8330,	.8140,	.6580,	.5230,
+gp,	1.0311,	1.2278,	.9273,	.9301,	1.0730,	1.0244,	1.1192,	1.1044,	.9540,	.7663,

1

Table 3 Stock weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	.0200,	.0200,	.0200,	.0200,	.2450,	.2060,	.1730,	.2410,	.1470,	.2590,
2,	.1000,	.1000,	.1200,	.1000,	.2580,	.2490,	.2290,	.2560,	.1930,	.2630,
3,	.2300,	.2400,	.2600,	.2400,	.2880,	.2960,	.2860,	.2800,	.2450,	.2800,
4,	.3500,	.3600,	.3800,	.3450,	.3350,	.3470,	.3460,	.3120,	.3050,	.3080,
5,	.4300,	.4300,	.4400,	.4050,	.4010,	.4020,	.4080,	.3530,	.3720,	.3500,
6,	.5200,	.5100,	.5200,	.4800,	.4840,	.4600,	.4710,	.4030,	.4450,	.4040,
7,	.6100,	.5900,	.6100,	.5600,	.5850,	.5220,	.5370,	.4620,	.5250,	.4700,
8,	.7100,	.6800,	.7200,	.6600,	.7040,	.5880,	.6040,	.5290,	.6120,	.5490,
+gp,	1.0609,	.9289,	.9879,	.9622,	1.2343,	.8202,	.7953,	.7074,	.8392,	.7717,

Table 3 Stock weights at age (kg)

YEAR,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,
AGE										
1,	.1330,	.1900,	.1170,	.1100,	.1970,	.1580,	.1830,	.1120,	.1670,	.1830,
2,	.1800,	.2140,	.1730,	.1580,	.2110,	.1930,	.2080,	.1730,	.2040,	.2220,
3,	.2360,	.2470,	.2340,	.2110,	.2360,	.2340,	.2380,	.2370,	.2470,	.2650,
4,	.3020,	.2880,	.3020,	.2680,	.2720,	.2820,	.2780,	.3030,	.2970,	.3130,
5,	.3760,	.3380,	.3750,	.3300,	.3190,	.3370,	.3280,	.3720,	.3530,	.3670,
6,	.4590,	.3960,	.4540,	.3960,	.3770,	.3970,	.3880,	.4430,	.4150,	.4250,
7,	.5510,	.4640,	.5390,	.4660,	.4450,	.4650,	.4580,	.5170,	.4840,	.4880,
8,	.6520,	.5400,	.6300,	.5400,	.5250,	.5380,	.5380,	.5930,	.5600,	.5560,
+gp,	.8670,	.7179,	.8705,	.7047,	.7483,	.6740,	.7331,	.7295,	.6840,	.7048,

1

Table 11.3.4 **IRISH SEA PLAICE.**

Annual length distribution by fleet 2003

Length (cm)*	UK (England & Wales) Beam trawl	UK (England & Wales) All gears (minus beam)	Ireland Beam trawl	Ireland Otter trawl
21			280	0
22		138	738	503
23	204	0	331	0
24	612	1098	2443	503
25	2673	10492	3724	3518
26	7340	49136	9822	9045
27	13886	118434	11257	4020
28	19592	118245	25834	31043
29	22411	104585	37824	67786
30	20634	94791	20860	67993
31	16224	80451	22771	76877
32	13705	57140	21186	73112
33	14037	45551	22588	46616
34	8293	39669	19529	30363
35	5793	34010	17841	20391
36	6415	26784	18819	10061
37	4588	22187	18923	7991
38	1911	13292	16371	6814
39	1317	8889	12554	4763
40	737	6179	8203	5025
41	552	3835	8477	2010
42	356	3327	8838	1005
43	409	1731	8206	0
44	267	1170	5403	1005
45	129	575	2287	2010
46	136	996	1550	2010
47	42	594	2522	1005
48	72	381	1079	0
49	73	147	1780	503
50	42	377	696	503
51	11	377	1304	0
52	12	47	907	503
53	16	308	137	0
54	46	18	946	503
55		9	335	0
56		3	255	0
57		9	0	0
58			48	0
59				
60			198	
Total	162535	844977	336865	477478

* Lower limit for UK nearest for Belgium.

Table 11.5.2.1 Irish Sea Plaice : final XSA

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 Lowestoft VPA Version 3.1

    8/05/2004  13:29

 Extended Survivors Analysis

 IRISH SEA PLAICE,2004 WG,COMBSEX,PLUSGROUP. IDH 23/4/04

 CPUE data from file p7atun-H.dat

 Catch data for  40 years. 1964 to 2003. Ages  1 to   9.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                  ,     year, year,  age ,  age
 UK(E+W)TRAWL FLEET  ,   1987, 2003,   2,     8,   .000,  1.000
 UK(E+W)BEAM TRAWL FL,   1989, 2003,   2,     8,   .000,  1.000
 UK BT SURVEY (Sept) ,   1989, 2003,   1,     7,   .750,   .850
 IR-OTB : Irish Otter,   1995, 2003,   2,     8,   .000,  1.000


 Time series weights :

      Tapered time weighting not applied


 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    5


 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   4 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =   1.500

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

      Prior weighting not applied


 Tuning converged after   30 iterations

1


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



 Fishing mortalities
    Age,  1994,  1995,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003

      1,  .013,  .003,  .004,  .003,  .001,  .010,  .000,  .003,  .000,  .000
      2,  .157,  .155,  .151,  .116,  .098,  .135,  .080,  .070,  .045,  .080
      3,  .347,  .336,  .308,  .419,  .344,  .293,  .273,  .273,  .230,  .291
      4,  .471,  .540,  .381,  .611,  .475,  .422,  .396,  .395,  .615,  .506
      5,  .517,  .504,  .499,  .577,  .484,  .627,  .376,  .397,  .552,  .584
      6,  .730,  .474,  .443,  .467,  .540,  .388,  .356,  .366,  .486,  .508
      7,  .998,  .747,  .321,  .662,  .822,  .404,  .541,  .519,  .490,  .392
      8,  .443,  .803,  .510,  .624, 1.070,  .541,  .346,  .404,  .534,  .330



1
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XSA population numbers (Thousands)

YEAR	1	2	3	4	5	6	7	8
1994	8.11E+03	8.35E+03	7.87E+03	3.70E+03	1.69E+03	6.52E+02	4.12E+02	3.98E+02
1995	7.32E+03	7.10E+03	6.33E+03	4.93E+03	2.05E+03	8.95E+02	2.78E+02	1.35E+02
1996	9.10E+03	6.47E+03	5.39E+03	4.01E+03	2.55E+03	1.10E+03	4.94E+02	1.17E+02
1997	8.86E+03	8.04E+03	4.93E+03	3.51E+03	2.43E+03	1.37E+03	6.25E+02	3.18E+02
1998	7.60E+03	7.83E+03	6.35E+03	2.88E+03	1.69E+03	1.21E+03	7.63E+02	2.86E+02
1999	7.05E+03	6.74E+03	6.30E+03	3.99E+03	1.59E+03	9.25E+02	6.26E+02	2.97E+02
2000	6.62E+03	6.19E+03	5.22E+03	4.17E+03	2.32E+03	7.51E+02	5.57E+02	3.70E+02
2001	5.64E+03	5.87E+03	5.06E+03	3.52E+03	2.49E+03	1.41E+03	4.67E+02	2.87E+02
2002	4.44E+03	4.99E+03	4.85E+03	3.42E+03	2.10E+03	1.48E+03	8.69E+02	2.46E+02
2003	1.00E+04	3.94E+03	4.23E+03	3.42E+03	1.64E+03	1.07E+03	8.09E+02	4.72E+02

Estimated population abundance at 1st Jan 2004

0.00E+00	8.88E+03	3.22E+03	2.81E+03	1.83E+03	8.10E+02	5.74E+02	4.85E+02

Taper weighted geometric mean of the VPA populations:

1.26E+04	1.14E+04	9.17E+03	5.37E+03	2.59E+03	1.29E+03	6.41E+02	3.11E+02

Standard error of the weighted Log(VPA populations) :

.4558	.4665	.4397	.4554	.5062	.5230	.5580	.6064

1

Log catchability residuals.

Fleet : UK(E+W)TRAWL FLEET

Age	1987	1988	1989	1990	1991	1992	1993
1	No data for this fleet at this age						
2	-.02	-.22	-.35	-.05	.27	.43	-.34
3	-.05	-.18	-.01	-.06	-.31	.22	-.07
4	.46	-.32	-.05	.14	-.32	-.42	.27
5	.26	-.02	.00	-.24	-.31	-.55	-.30
6	.36	.08	-.42	-.10	-.29	-.61	-.14
7	.10	-.12	-.16	-.13	-.07	-.74	.22
8	.05	-.19	-.25	-.24	.13	-.50	.13

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	No data for this fleet at this age									
2	.50	.51	.55	.11	-.01	.26	-.10	-.74	-.13	-.67
3	.28	.44	.01	-.06	.13	.12	.29	-.46	.15	-.44
4	-.21	.12	.02	-.15	-.10	.15	.37	-.06	.09	.00
5	.37	.13	-.17	-.12	-.32	.14	.48	.35	.26	.06
6	-.21	.28	-.25	-.28	-.04	-.35	-.04	.19	.00	-.34
7	-.03	.13	-.27	-.48	-.28	-.39	.09	.25	.21	-.38
8	.02	.06	.09	.15	.29	-.10	.03	.19	-.48	-.38

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

Age	2	3	4	5	6	7	8
Mean Log q	-7.1480	-6.5037	-6.5309	-6.7314	-6.7314	-6.7314	-6.7314
S.E(Log q)	.3938	.2517	.2439	.2914	.2896	.3033	.2486

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,	.89,	.472,	7.34,	.57,	17,	.36,	-7.15,
3,	.91,	.556,	6.72,	.71,	17,	.23,	-6.50,
4,	.76,	1.645,	6.96,	.76,	17,	.18,	-6.53,
5,	1.11,	-.341,	6.63,	.41,	17,	.33,	-6.73,
6,	.96,	.200,	6.87,	.59,	17,	.26,	-6.86,
7,	1.34,	-1.400,	7.03,	.53,	17,	.36,	-6.85,
8,	.97,	.227,	6.75,	.77,	17,	.24,	-6.79,

1

Fleet : UK(E+W)BEAM TRAWL FL

Age	1987,	1988,	1989,	1990,	1991,	1992,	1993
1	No data for this fleet at this age						
2	99.99,	99.99,	-.30,	.08,	.58,	.16,	-.61
3	99.99,	99.99,	-.32,	.18,	.15,	.58,	-.36
4	99.99,	99.99,	-.01,	.39,	.14,	.09,	.14
5	99.99,	99.99,	.05,	-.09,	-.02,	.14,	-.16
6	99.99,	99.99,	.27,	.07,	-.05,	.06,	.16
7	99.99,	99.99,	.75,	-.21,	.05,	.10,	.58
8	99.99,	99.99,	.45,	.20,	.21,	.72,	.66

Age	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003
1	No data for this fleet at this age									
2	.37,	.68,	.98,	.58,	.20,	.09,	.00,	-.84,	-.83,	-1.14
3	-.08,	.30,	.18,	.06,	.21,	.32,	.35,	-.56,	-.46,	-.53
4	-.80,	-.17,	.13,	-.08,	-.09,	.40,	.37,	.04,	-.38,	-.16
5	-.30,	-.30,	-.14,	.14,	-.43,	.35,	.55,	.23,	.09,	-.10
6	-.60,	-.20,	-.35,	-.15,	-.28,	.11,	.33,	.06,	.18,	-.45
7	-.06,	-.33,	-.23,	-.57,	-.13,	.34,	.60,	.15,	.09,	-.35
8	-.09,	-.41,	.26,	-.05,	.11,	.51,	.55,	.14,	.13,	-.32

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

Age ,	2,	3,	4,	5,	6,	7,	8
Mean Log q,	-7.2449,	-6.4404,	-6.4496,	-6.5730,	-6.5730,	-6.5730,	-6.5730,
S.E(Log q),	.6252,	.3625,	.3131,	.2618,	.2789,	.3861,	.3968,

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,	.51,	1.750,	8.05,	.49,	15,	.30,	-7.24,
3,	.87,	.438,	6.73,	.48,	15,	.33,	-6.44,
4,	.72,	1.203,	6.97,	.58,	15,	.22,	-6.45,
5,	.79,	.993,	6.80,	.64,	15,	.21,	-6.57,
6,	.80,	.975,	6.71,	.64,	15,	.22,	-6.63,
7,	.90,	.362,	6.50,	.48,	15,	.35,	-6.52,
8,	.96,	.164,	6.34,	.60,	15,	.34,	-6.37,

1

Fleet : UK BT SURVEY (Sept)

Age	1987	1988	1989	1990	1991	1992	1993
1	99.99	99.99	-1.25	.01	-.84	-.43	-.22
2	99.99	99.99	-.87	-.39	-.58	-.46	-.18
3	99.99	99.99	.07	-.66	-1.02	.11	-.61
4	99.99	99.99	-.51	-.56	-.89	-.94	.25
5	99.99	99.99	-.88	.21	-2.67	-.63	-.27
6	99.99	99.99	.73	.78	-1.76	-.69	-.57
7	99.99	99.99	-.90	-1.31	1.36	.26	.47
8	No data for this fleet at this age						

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	-.32	.14	.24	.10	.07	.11	.79	.59	1.01	.00
2	-.21	-.55	-.02	-.11	.06	.43	.09	.14	1.11	1.55
3	-.04	-.42	-.63	.53	-.19	.24	.26	-.01	.85	1.51
4	-.27	-.33	-.40	-.05	.37	.12	.30	.36	1.23	1.31
5	.18	-.74	.05	.26	.18	.47	.51	.67	1.11	1.54
6	.30	.18	-.76	-.03	.18	.07	.47	.13	1.08	1.24
7	1.32	99.99	.14	.04	.33	-.21	-.22	.44	.80	.97
8	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	7
Mean Log q	-6.7003	-7.0157	-7.6602	-8.0850	-8.4384	-8.4384	-8.4384
S.E(Log q)	.5801	.6377	.6477	.6675	.9864	.7904	.8033

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	-3.29	-2.591	16.55	.03	15	1.61	-6.70
2	-1.05	-6.105	10.84	.41	15	.35	-7.02
3	2.39	-1.013	6.18	.04	15	1.54	-7.66
4	-5.29	-1.814	9.38	.01	15	3.27	-8.09
5	-1.65	-1.719	6.35	.03	15	1.53	-8.44
6	4.56	-1.039	13.07	.01	15	3.57	-8.35
7	1.32	-.296	8.76	.07	14	1.04	-8.19

1

Fleet : IR-OTB : Irish Otter

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	No data for this fleet at this age									
2	99.99	-1.24	-1.18	.24	.78	.85	-.26	1.21	-.86	.46
3	99.99	-.34	.11	.36	.03	-.21	.00	-.17	-.45	.67
4	99.99	.24	.06	.27	.22	-.42	-.55	-.57	.16	.59
5	99.99	.42	.51	-.10	-.03	-.02	-.50	-.58	-.19	.51
6	99.99	-.15	.47	-.26	.16	-.16	-.68	-.07	-.18	.37
7	99.99	.58	-.10	.61	.95	-.20	-1.18	.14	-.17	-.18
8	99.99	1.14	.25	.01	1.34	.24	-1.08	-.29	.23	-.59

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

Age	2	3	4	5	6	7	8
Mean Log q	-17.0478	-14.9239	-14.0297	-13.6021	-13.6021	-13.6021	-13.6021
S.E(Log q)	.9215	.3520	.4132	.4079	.3547	.6240	.7794

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	.98	.014	16.87	.06	9	.96	-17.05
3	-2.63	-1.752	-8.10	.03	9	.83	-14.92
4	2.79	-.650	24.41	.02	9	1.20	-14.03
5	3.08	-.865	26.00	.02	9	1.28	-13.60
6	.68	.864	11.54	.51	9	.24	-13.66
7	1.30	-.349	15.74	.16	9	.86	-13.55
8	20.80	-1.798	169.99	.00	9	14.07	-13.46

1

Terminal year survivor and F summaries :

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

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W)TRAWL FLEET	1.	.000	.000	.00	0	.000	.000
UK(E+W)BEAM TRAWL FL	1.	.000	.000	.00	0	.000	.000
UK BT SURVEY (Sept)	8878.	.599	.000	.00	1	1.000	.000
IR-OTB : Irish Otter	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	0.	1.50,,,,				.000	.000

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
8878.	.60	.00	1	.000	.000

1

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

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W)TRAWL FLEET	1642.	.405	.000	.00	1	.403	.152
UK(E+W)BEAM TRAWL FL	1031.	.646	.000	.00	1	.159	.232
UK BT SURVEY (Sept)	11324.	.443	.268	.60	2	.337	.024
IR-OTB : Irish Otter	5094.	.971	.000	.00	1	.070	.052
F shrinkage mean	3004.	1.50,,,,				.032	.086

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3224.	.26	.44	6	1.702	.080

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

Year class = 2000

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK(E+W)TRAWL FLEET ,	2006.,	.241,	.148,	.62,	2,	.400,	.386
UK(E+W)BEAM TRAWL FL,	1533.,	.324,	.127,	.39,	2,	.223,	.481
UK BT SURVEY (Sept) ,	7937.,	.370,	.270,	.73,	3,	.168,	.113
IR-OTB : Irish Otter,	4550.,	.347,	.501,	1.44,	2,	.196,	.189
F shrinkage mean ,	2890.,	1.50,,,,				.014,	.283

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2807.,	.15,	.22,	10,	1.444,	.291

1

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

Year class = 1999

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK(E+W)TRAWL FLEET ,	1684.,	.189,	.227,	1.20,	3,	.396,	.540
UK(E+W)BEAM TRAWL FL,	1310.,	.231,	.155,	.67,	3,	.276,	.652
UK BT SURVEY (Sept) ,	4071.,	.328,	.238,	.73,	4,	.124,	.259
IR-OTB : Irish Otter,	2072.,	.273,	.412,	1.51,	3,	.192,	.458
F shrinkage mean ,	2047.,	1.50,,,,				.012,	.463

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1828.,	.12,	.14,	14,	1.169,	.506

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

Year class = 1998

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK(E+W)TRAWL FLEET ,	773.,	.172,	.120,	.69,	4,	.390,	.606
UK(E+W)BEAM TRAWL FL,	642.,	.195,	.107,	.55,	4,	.327,	.694
UK BT SURVEY (Sept) ,	1503.,	.331,	.328,	.99,	5,	.080,	.356
IR-OTB : Irish Otter,	1012.,	.248,	.171,	.69,	4,	.189,	.492
F shrinkage mean ,	1019.,	1.50,,,,				.013,	.489

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
810.,	.11,	.09,	18,	.827,	.584

1

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

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK(E+W)TRAWL FLEET ,	551.,	.158,	.140,	.89,	5,	.376,	.524
UK(E+W)BEAM TRAWL FL,	497.,	.172,	.146,	.85,	5,	.338,	.567
UK BT SURVEY (Sept) ,	1123.,	.337,	.211,	.63,	6,	.068,	.291
IR-OTB : Irish Otter,	618.,	.219,	.178,	.81,	5,	.208,	.479
F shrinkage mean ,	709.,	1.50,,,,				.010,	.429

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
574.,	.10,	.08,	22,	.825,	.508

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

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK(E+W)TRAWL FLEET ,	471.,	.150,	.133,	.89,	6,	.415,	.402
UK(E+W)BEAM TRAWL FL,	521.,	.165,	.122,	.74,	6,	.328,	.369
UK BT SURVEY (Sept) ,	914.,	.339,	.165,	.49,	7,	.070,	.227
IR-OTB : Irish Otter,	365.,	.214,	.100,	.47,	6,	.178,	.493
F shrinkage mean ,	311.,	1.50,,,,				.010,	.558

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
485.,	.09,	.07,	26,	.754,	.392

1

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK(E+W)TRAWL FLEET ,	303.,	.145,	.128,	.88,	7,	.465,	.328
UK(E+W)BEAM TRAWL FL,	326.,	.165,	.125,	.76,	7,	.326,	.308
UK BT SURVEY (Sept) ,	412.,	.334,	.144,	.43,	7,	.049,	.251
IR-OTB : Irish Otter,	233.,	.219,	.094,	.43,	7,	.151,	.409
F shrinkage mean ,	182.,	1.50,,,,				.010,	.500

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
301.,	.09,	.06,	29,	.660,	.330

1

Table 11.5.2.2 Irish Sea Plaice : Fishing mortality at age

Run title : IRISH SEA PLAICE,2004 WG,COMBSEX,PLUSGROUP. IDH 23/4/04

At 8/05/2004 13:30

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
1,	.0000,	.0018,	.0000,	.0000,	.0000,	.0030,	.0005,	.0000,	.0000,	.0000,
2,	.0499,	.0531,	.0085,	.0128,	.0167,	.0368,	.0467,	.0264,	.0127,	.1175,
3,	.1990,	.2016,	.2067,	.1266,	.1908,	.2970,	.2534,	.2581,	.2607,	.5359,
4,	.4029,	.4607,	.3393,	.4102,	.4328,	.4376,	.4567,	.8077,	.6984,	.7764,
5,	.1940,	.4641,	.7066,	.7610,	.6434,	.4659,	.5046,	.7015,	.7494,	.9039,
6,	.4510,	.3573,	.4625,	.7510,	.6758,	.6704,	.4015,	.7776,	.7179,	.8047,
7,	.3762,	.2657,	.7195,	1.1601,	.5184,	.7474,	.5703,	.3093,	.7697,	.7836,
8,	.3573,	.3884,	.5596,	.7750,	.5703,	.5831,	.4854,	.6524,	.7380,	.8220,
+gp,	.3573,	.3884,	.5596,	.7750,	.5703,	.5831,	.4854,	.6524,	.7380,	.8220,
0 FBAR 3- 6,	.3117,	.3709,	.4288,	.5122,	.4857,	.4677,	.4041,	.6362,	.6066,	.7552,

Table 8 Fishing mortality (F) at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
1,	.0006,	.0017,	.0014,	.0321,	.0010,	.0006,	.0002,	.0028,	.0013,	.0025,
2,	.1140,	.1334,	.3260,	.3408,	.2220,	.1942,	.1756,	.1424,	.1090,	.1786,
3,	.4855,	.6719,	.7111,	.6367,	.8530,	.7333,	.6575,	.6199,	.3939,	.6034,
4,	.7475,	.7545,	.9345,	1.0968,	.8138,	.7743,	.7983,	.6243,	.6981,	.7584,
5,	.7708,	.7738,	.9221,	.9241,	.6801,	.4080,	.6237,	.5986,	.5885,	.8255,
6,	1.0369,	.8557,	1.0225,	.5921,	.5319,	.4763,	.6700,	.4087,	.4531,	.5640,
7,	.5355,	.3546,	1.0197,	.7652,	.4751,	.5572,	.6160,	.4495,	.4328,	.5330,
8,	.7771,	.6883,	.9811,	.8496,	.6284,	.5566,	.6806,	.5226,	.5456,	.6738,
+gp,	.7771,	.6883,	.9811,	.8496,	.6284,	.5566,	.6806,	.5226,	.5456,	.6738,
0 FBAR 3- 6,	.7602,	.7640,	.8976,	.8124,	.7197,	.5980,	.6874,	.5629,	.5334,	.6878,

1

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	.0019,	.0003,	.0017,	.0031,	.0038,	.0034,	.0014,	.0192,	.0144,	.0032,
2,	.1954,	.1336,	.1297,	.2552,	.1772,	.1751,	.1792,	.2337,	.2710,	.1034,
3,	.4951,	.6423,	.4479,	.6982,	.5879,	.5880,	.4120,	.3960,	.6430,	.3504,
4,	.5846,	.6169,	.6650,	1.0044,	.7911,	.6504,	.5898,	.5250,	.7380,	.5624,
5,	.5448,	.6258,	.4701,	.6644,	.7341,	.6069,	.5760,	.4652,	.7941,	.5219,
6,	.5736,	.4040,	.7971,	.8292,	.9036,	.4788,	.7185,	.4475,	.6941,	.8203,
7,	.5011,	.6903,	.6643,	.6762,	.5608,	.6394,	.5300,	.6235,	.7570,	.6379,
8,	.5536,	.5871,	.6525,	.4259,	1.3632,	.5286,	.6205,	.4639,	1.0014,	.8885,
+gp,	.5536,	.5871,	.6525,	.4259,	1.3632,	.5286,	.6205,	.4639,	1.0014,	.8885,
0 FBAR 3- 6,	.5495,	.5722,	.5950,	.7991,	.7542,	.5810,	.5741,	.4584,	.7173,	.5637,

Table 8 Fishing mortality (F) at age

YEAR,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	FBAR **-**
AGE											
1,	.0129,	.0031,	.0043,	.0034,	.0007,	.0103,	.0000,	.0026,	.0002,	.0000,	.0010,
2,	.1574,	.1552,	.1514,	.1162,	.0984,	.1353,	.0804,	.0701,	.0446,	.0802,	.0650,
3,	.3472,	.3364,	.3078,	.4191,	.3438,	.2928,	.2729,	.2726,	.2300,	.2906,	.2644,
4,	.4710,	.5396,	.3808,	.6108,	.4754,	.4220,	.3959,	.3951,	.6154,	.5061,	.5055,
5,	.5173,	.5041,	.4990,	.5767,	.4844,	.6273,	.3760,	.3966,	.5521,	.5843,	.5110,
6,	.7303,	.4735,	.4430,	.4667,	.5403,	.3879,	.3562,	.3660,	.4861,	.5077,	.4533,
7,	.9985,	.7473,	.3214,	.6617,	.8225,	.4044,	.5410,	.5193,	.4897,	.3916,	.4669,
8,	.4426,	.8034,	.5100,	.6239,	1.0698,	.5408,	.3459,	.4043,	.5344,	.3298,	.4228,
+gp,	.4426,	.8034,	.5100,	.6239,	1.0698,	.5408,	.3459,	.4043,	.5344,	.3298,	
0 FBAR 3- 6,	.5165,	.4634,	.4076,	.5183,	.4610,	.4325,	.3503,	.3576,	.4709,	.4722,	

1

Table 11.5.2.3 Irish Sea Plaice : Stock numbers at age

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
1,	32801,	16941,	15435,	12377,	14252,	21154,	19664,	13481,	9987,	13337,
2,	21748,	29092,	14999,	13689,	10978,	12641,	18707,	17431,	11956,	8858,
3,	11243,	18350,	24469,	13190,	11987,	9575,	10806,	15835,	15058,	10471,
4,	5379,	8172,	13303,	17649,	10308,	8785,	6310,	7439,	10850,	10291,
5,	2685,	3189,	4573,	8404,	10386,	5931,	5030,	3545,	2942,	4786,
6,	2489,	1962,	1778,	2001,	3482,	4841,	3301,	2693,	1559,	1233,
7,	1626,	1406,	1217,	993,	837,	1571,	2196,	1960,	1098,	674,
8,	495,	990,	956,	526,	276,	442,	660,	1101,	1276,	451,
+gp,	792,	154,	584,	1013,	449,	654,	607,	937,	1385,	1187,
0 TOTAL,	79258,	80256,	77313,	69842,	62955,	65594,	67281,	64423,	56110,	51288,

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
1,	13141,	11006,	17121,	19018,	22946,	20697,	15720,	8310,	21433,	21359,
2,	11828,	11648,	9745,	15163,	16335,	20330,	18345,	13940,	7350,	18984,
3,	6985,	9361,	9041,	6238,	9565,	11603,	14848,	13650,	10723,	5845,
4,	5434,	3812,	4240,	3938,	2927,	3615,	4943,	6824,	6513,	6414,
5,	4199,	2282,	1590,	1477,	1166,	1150,	1478,	1973,	3242,	2874,
6,	1719,	1723,	934,	561,	520,	524,	678,	703,	962,	1596,
7,	489,	541,	649,	298,	275,	271,	289,	308,	414,	542,
8,	273,	254,	336,	208,	123,	152,	138,	138,	174,	238,
+gp,	493,	703,	472,	235,	280,	430,	265,	475,	361,	305,
0 TOTAL,	44562,	41330,	44129,	47136,	54137,	58773,	56704,	46320,	51172,	58157,

1

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	22605,	16264,	19788,	21616,	12979,	7463,	11553,	10065,	11248,	9448,
2,	18895,	20011,	14421,	17521,	19113,	11468,	6596,	10233,	8757,	9834,
3,	14083,	13784,	15528,	11235,	12039,	14199,	8537,	4891,	7184,	5923,
4,	2835,	7613,	6431,	8800,	4957,	5931,	6995,	5015,	2919,	3350,
5,	2665,	1402,	3644,	2933,	2858,	1993,	2745,	3440,	2631,	1238,
6,	1117,	1371,	665,	2020,	1339,	1217,	963,	1369,	1916,	1055,
7,	805,	558,	812,	266,	782,	481,	669,	417,	776,	849,
8,	282,	433,	248,	370,	120,	396,	225,	349,	198,	323,
+gp,	345,	378,	431,	661,	452,	543,	285,	296,	292,	220,
0 TOTAL,	63633,	61813,	61968,	65422,	54639,	43691,	38569,	36073,	35923,	32240,

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

YEAR,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	GMST 64-**	AMST 64-**
AGE													
1,	8108,	7317,	9101,	8861,	7601,	7048,	6617,	5641,	4442,	10009,	0,	13083,	14303,
2,	8354,	7099,	6469,	8037,	7833,	6737,	6187,	5869,	4989,	3939,	8878,	12018,	13084,
3,	7865,	6330,	5391,	4932,	6346,	6296,	5219,	5064,	4853,	4232,	3224,	9520,	10360,
4,	3700,	4929,	4010,	3515,	2877,	3991,	4167,	3523,	3419,	3420,	2807,	5499,	6124,
5,	1693,	2049,	2549,	2430,	1693,	1586,	2321,	2488,	2105,	1639,	1828,	2635,	3033,
6,	652,	895,	1098,	1372,	1211,	925,	751,	1413,	1484,	1075,	810,	1287,	1490,
7,	412,	278,	494,	625,	763,	626,	557,	467,	869,	809,	574,	631,	744,
8,	398,	135,	117,	318,	286,	297,	370,	287,	246,	472,	485,	309,	378,
+gp,	381,	168,	240,	268,	331,	313,	365,	238,	184,	350,	525,		
0 TOTAL,	31563,	29200,	29470,	30359,	28941,	27820,	26554,	24989,	22592,	25946,	19132,		

1

Table 11.7.1 Irish Sea Plaice : Summary

```
    Run title : IRISH SEA PLAICE,2004 WG,COMBSEX,PLUSGROUP. IDH 23/4/04                        ,

    At  8/05/2004  13:30

        Table 16    Summary     (without SOP correction)

                   Terminal Fs derived using XSA (With F shrinkage)

,            RECRUITS,    TOTALBIO,    TOTSPBIO,    LANDINGS,   YIELD/SSB,  FBAR  3- 6,
 ,             Age 1
    1964,        32801,       12373,        8128,        2879,       .3542,       .3117,
    1965,        16941,       14440,        9246,        3664,       .3963,       .3709,
    1966,        15435,       13942,        9757,        4268,       .4374,       .4288,
    1967,        12377,       13334,        9950,        5059,       .5085,       .5122,
    1968,        14252,       12273,        9492,        4695,       .4946,       .4857,
    1969,        21154,       11614,        8962,        4394,       .4903,       .4677,
    1970,        19664,       11254,        8255,        3583,       .4340,       .4041,
    1971,        13481,       11077,        8064,        4232,       .5248,       .6362,
    1972,         9987,       12019,        8920,        5119,       .5739,       .6066,
    1973,        13337,        9569,        7129,        5060,       .7098,       .7552,
    1974,        13141,        7740,        5529,        3715,       .6719,       .7602,
    1975,        11006,        8376,        5862,        4063,       .6931,       .7640,
    1976,        17121,        6060,        4007,        3473,       .8668,       .8976,
    1977,        19018,        5312,        3095,        2904,       .9384,       .8124,
    1978,        22946,        6722,        3690,        3231,       .8755,       .7197,
    1979,        20697,        7787,        4330,        3428,       .7917,       .5980,
    1980,        15720,        8200,        4753,        3903,       .8212,       .6874,
    1981,         8310,        8751,        5611,        3906,       .6962,       .5629,
    1982,        21433,        7821,        5310,        3237,       .6096,       .5334,
    1983,        21359,        7466,        4699,        3639,       .7744,       .6878,
    1984,        22605,        9357,        5738,        4241,       .7391,       .5495,
    1985,        16264,       10651,        6628,        5075,       .7657,       .5722,
    1986,        19788,       11656,        7462,        4806,       .6441,       .5950,
    1987,        21616,       11104,        7308,        6220,       .8512,       .7991,
    1988,        12979,       16132,        7202,        5005,       .6950,       .7542,
    1989,         7463,       12944,        6838,        4372,       .6394,       .5810,
    1990,        11553,       10667,        5762,        3275,       .5683,       .5741,
    1991,        10065,       10332,        4834,        2554,       .5283,       .4584,
    1992,        11248,        8600,        4605,        3267,       .7095,       .7173,
    1993,         9448,        9329,        3904,        1996,       .5112,       .5637,
    1994,         8108,        7308,        3954,        2066,       .5226,       .5165,
    1995,         7317,        7262,        3627,        1874,       .5167,       .4634,
    1996,         9101,        6660,        3821,        1707,       .4468,       .4076,
    1997,         8861,        6225,        3536,        1871,       .5291,       .5183,
    1998,         7601,        7164,        3525,        1765,       .5006,       .4610,
    1999,         7048,        6576,        3511,        1600,       .4557,       .4325,
    2000,         6617,        6673,        3595,        1371,       .3813,       .3503,
    2001,         5641,        6052,        3790,        1473,       .3887,       .3576,
    2002,         4442,        6017,        3670,        1622,       .4420,       .4709,
    2003,        10009,*       6861,        3562,        1520,       .4267,       .4722,

 Arith.
   Mean   ,      13949,        9343,        5792,        3403,       .5981,       .5654,
0 Units,   (Thousands),    (Tonnes),    (Tonnes),    (Tonnes),
1
```

* XSA estimate : value overwritten with short term geometric mean for short term forecast

Table 11.8.1 Irish Sea Plaice: inputs to short term forecasts

MFDP version 1a
Run: p7a-sq
Time and date: 19:52 10/05/04
Fbar age range: 3-6

Input F are mean 2001-2003 unscaled
Catch and stock weights are mean 01-03
Recruits age 1 in 2004/5/6 are GM 89-02
$N_{03,1}$ = GM 89-02
$N_{04,2} = N_{03,1}.exp(-F_{01-03,1}-M)$

2004

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	7934	0.12	0	0	0	0.154	0.001	0.176
2	7036	0.12	0.24	0	0	0.200	0.065	0.224
3	3224	0.12	0.57	0	0	0.250	0.264	0.276
4	2807	0.12	0.74	0	0	0.304	0.506	0.334
5	1828	0.12	0.93	0	0	0.364	0.511	0.395
6	810	0.12	1	0	0	0.428	0.453	0.461
7	574	0.12	1	0	0	0.496	0.467	0.532
8	485	0.12	1	0	0	0.570	0.423	0.608
9	525	0.12	1	0	0	0.706	0.423	0.749

2005

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	7934	0.12	0	0	0	0.154	0.001	0.176
2	.	0.12	0.24	0	0	0.200	0.065	0.224
3	.	0.12	0.57	0	0	0.250	0.264	0.276
4	.	0.12	0.74	0	0	0.304	0.506	0.334
5	.	0.12	0.93	0	0	0.364	0.511	0.395
6	.	0.12	1	0	0	0.428	0.453	0.461
7	.	0.12	1	0	0	0.496	0.467	0.532
8	.	0.12	1	0	0	0.570	0.423	0.608
9	.	0.12	1	0	0	0.706	0.423	0.749

2006

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	7934	0.12	0	0	0	0.154	0.001	0.176
2	.	0.12	0.24	0	0	0.200	0.065	0.224
3	.	0.12	0.57	0	0	0.250	0.264	0.276
4	.	0.12	0.74	0	0	0.304	0.506	0.334
5	.	0.12	0.93	0	0	0.364	0.511	0.395
6	.	0.12	1	0	0	0.428	0.453	0.461
7	.	0.12	1	0	0	0.496	0.467	0.532
8	.	0.12	1	0	0	0.570	0.423	0.608
9	.	0.12	1	0	0	0.706	0.423	0.749

Table 11.8.2. Irish Sea Plaice: short term forecast management options table

MFDP version 1a
Run: p7a-sq
p7a-sqMFDP Index file 10/05/04
Time and date: 19:52 10/05/04
Fbar age range: 3-6

2004

Biomass	SSB	FMult	FBar	Landings
6230	3325	1	0.4336	1377

2005					2006	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
6539	3411	0	0.000	0	8267	4848
.	3411	0.1	0.043	165	8099	4697
.	3411	0.2	0.087	324	7938	4553
.	3411	0.3	0.130	477	7783	4415
.	3411	0.4	0.173	624	7634	4283
.	3411	0.5	0.217	766	7491	4156
.	3411	0.6	0.260	902	7353	4034
.	3411	0.7	0.304	1033	7221	3917
.	3411	0.8	0.347	1159	7094	3804
.	3411	0.9	0.390	1280	6972	3696
.	3411	1	0.434	1397	6854	3593
.	3411	1.1	0.477	1509	6740	3493
.	3411	1.2	0.520	1618	6631	3398
.	3411	1.3	0.564	1722	6526	3306
.	3411	1.4	0.607	1823	6425	3218
.	3411	1.5	0.650	1920	6328	3133
.	3411	1.6	0.694	2013	6234	3052
.	3411	1.7	0.737	2104	6144	2973
.	3411	1.8	0.780	2191	6056	2898
.	3411	1.9	0.824	2274	5972	2826
.	3411	2	0.867	2355	5892	2756

Input units are thousands and kg - output in tonnes

Table 11.8.3 Irish Sea Plaice: results of short term forecast

MFDP version 1a
Run: p7a-sq
Time and date: 19:52 10/05/04
Fbar age range: 3-6

Year:	2004	F multiplier:	1	Fbar:	0.4336				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
1	0.001	7	1	7934	1222	0	0	0	0
2	0.065	417	94	7036	1405	1689	337	1689	337
3	0.264	708	196	3224	805	1838	459	1838	459
4	0.506	1055	352	2807	854	2077	632	2077	632
5	0.511	693	274	1828	665	1700	619	1700	619
6	0.453	279	129	810	346	810	346	810	346
7	0.467	203	108	574	285	574	285	574	285
8	0.423	158	96	485	276	485	276	485	276
9	0.423	171	128	525	371	525	371	525	371
Total		3691	1377	25223	6230	9698	3325	9698	3325

Year:	2005	F multiplier:	1	Fbar:	0.4336				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
1	0.001	7	1	7934	1222	0	0	0	0
2	0.065	417	94	7030	1404	1687	337	1687	337
3	0.264	1284	355	5848	1460	3333	832	3333	832
4	0.506	825	275	2195	668	1624	494	1624	494
5	0.511	569	225	1502	547	1397	508	1397	508
6	0.453	336	155	973	416	973	416	973	416
7	0.467	161	86	457	227	457	227	457	227
8	0.423	104	63	319	182	319	182	319	182
9	0.423	192	143	587	414	587	414	587	414
Total		3894	1397	26844	6539	10377	3411	10377	3411

Year:	2006	F multiplier:	1	Fbar:	0.4336				
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos(Jan)**	**SSB(Jan)**	**SSNos(ST)**	**SSB(ST)**
1	0.001	7	1	7934	1222	0	0	0	0
2	0.065	417	94	7030	1404	1687	337	1687	337
3	0.264	1283	354	5843	1459	3331	832	3331	832
4	0.506	1496	499	3982	1212	2946	897	2946	897
5	0.511	445	176	1174	427	1092	398	1092	398
6	0.453	276	127	799	342	799	342	799	342
7	0.467	194	103	548	272	548	272	548	272
8	0.423	83	50	254	145	254	145	254	145
9	0.423	172	129	527	372	527	372	527	372
Total		4372	1533	28091	6854	11184	3593	11184	3593

Table 11.8.4 Irish Sea Plaice: inputs to sensititvity analysis

Input to se	PLE	VIIA				
1	9	2004	3			
1	0	0				
	Value	c.v.			Value	c.v.
'N1'	7934	0.26		'WS1'	0.154	0.24
'N2'	7037	0.26		'WS2'	0.2	0.12
'N3'	3224	0.44		'WS3'	0.25	0.06
'N4'	2807	0.22		'WS4'	0.304	0.03
'N5'	1827	0.14		'WS5'	0.364	0.03
'N6'	810	0.11		'WS6'	0.428	0.03
'N7'	573	0.1		'WS7'	0.496	0.04
'N8'	484	0.09		'WS8'	0.57	0.04
'N9'	525	0.09		'WS9'	0.706	0.03
'sH1'	0.001	1.59		'M1'	0.12	0.1
'sH2'	0.065	0.34		'M2'	0.12	0.1
'sH3'	0.264	0.22		'M3'	0.12	0.1
'sH4'	0.506	0.11		'M4'	0.12	0.1
'sH5'	0.511	0.05		'M5'	0.12	0.1
'sH6'	0.453	0.03		'M6'	0.12	0.1
'sH7'	0.467	0.29		'M7'	0.12	0.1
'sH8'	0.423	0.25		'M8'	0.12	0.1
'sH9'	0.423	0.25		'M9'	0.12	0.1
'WH1'	0.176	0.18		'MT1'	0	0.1
'WH2'	0.224	0.08		'MT2'	0.24	0.1
'WH3'	0.276	0.04		'MT3'	0.57	0.1
'WH4'	0.334	0.03		'MT4'	0.74	0.1
'WH5'	0.395	0.03		'MT5'	0.93	0.1
'WH6'	0.461	0.03		'MT6'	1	0.1
'WH7'	0.532	0.04		'MT7'	1	0
'WH8'	0.608	0.03		'MT8'	1	0
'WH9'	0.749	0.03		'MT9'	1	0
				'R05'	7934	0.26
Plaice				'R06'	7934	0.26
Irish Sea				'HF04'	1	0.15
1				'HF05'	1	0.15
1 9 1				'HF06'	1	0.15
1				'K04'	1	0.1
H.cons.				'K05'	1	0.1
3 6				'K06'	1	0.1
1964 2003						
Stock numbers in 2004 are VPA survivors.						
These are overwritten at Age 2						
-1						

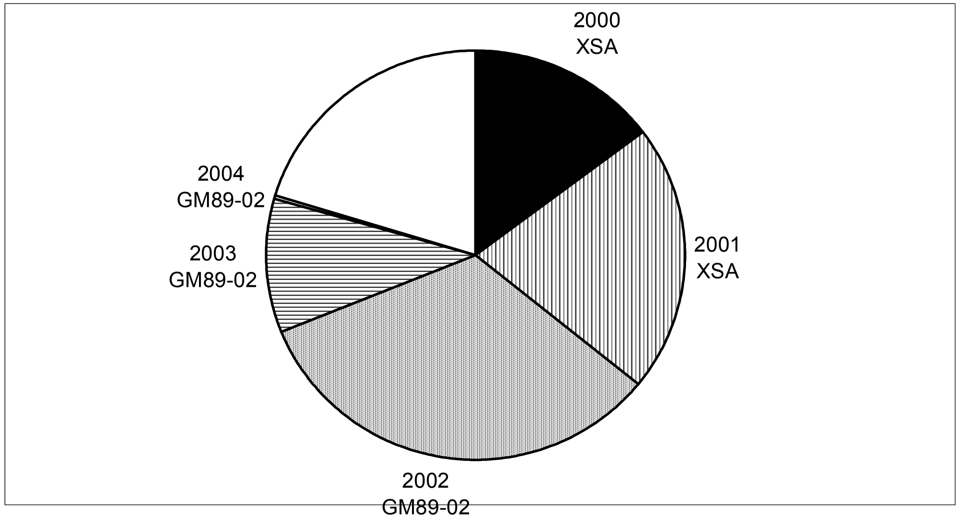
Table 11.8.5 **Plaice in VIIa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2000	2001	2002	2003	2004
Stock No. (thousands) of 1 year-olds	5641	4442	7934	7934	7934
Source	XSA	XSA	GM89-02	GM89-02	GM89-02
Status Quo F:					
% in 2004 landings	28.6	19.2	11.3	0.2	-
% in 2005	14.6	21.2	33.0	10.7	0.2
% in 2004 SSB	19.0	13.8	10.1	0.0	-
% in 2005 SSB	14.9	14.5	24.4	9.9	0.0
% in 2006 SSB	9.5	11.1	25.0	23.1	9.4

GM : geometric mean recruitment

Plaice in VIIa : Year-class % contribution to

a) 2005 landings



b) 2006 SSB

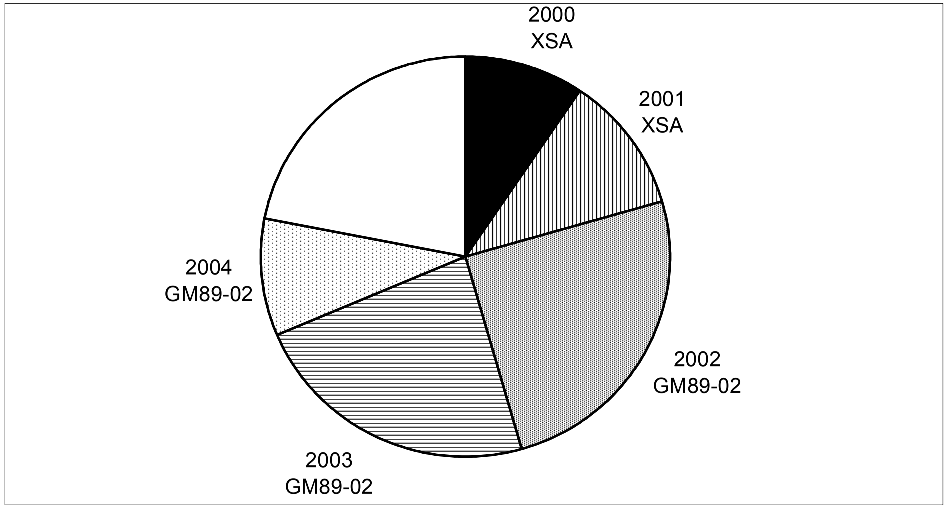


Table 11.10.1 Irish Sea Plaice: Yield per Recruit

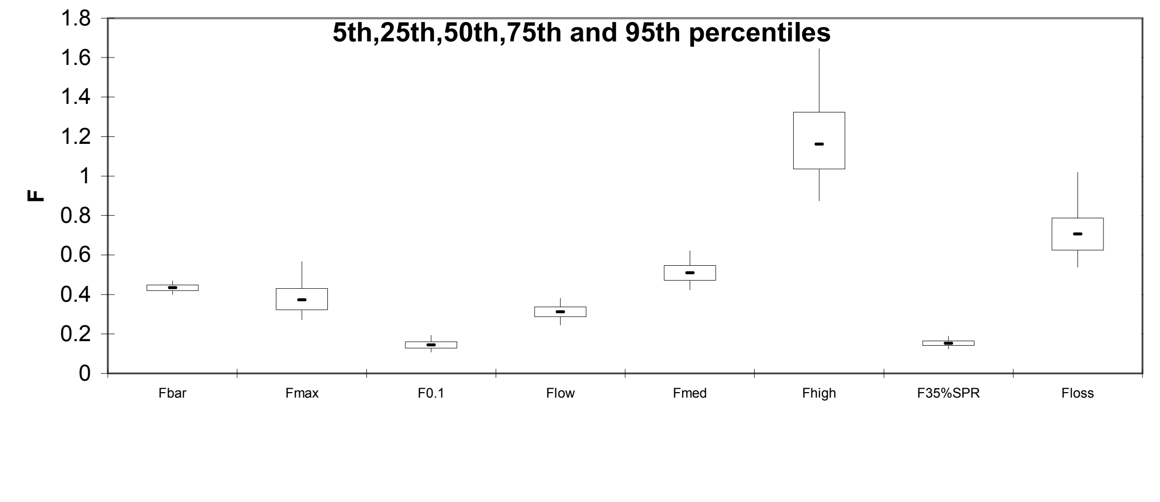
MFYPR version 2a
Run: test
Time and date: 19:08 10/05/04
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNos	SSBJan	SpwnNos	SSBSpwn
0	0.000	0.000	0.000	8.843	4.078	6.606	3.634	6.606	3.634
0.1	0.043	0.210	0.111	7.096	2.921	4.871	2.481	4.871	2.481
0.2	0.087	0.332	0.165	6.081	2.272	3.867	1.835	3.867	1.835
0.3	0.130	0.412	0.192	5.421	1.865	3.218	1.431	3.218	1.431
0.4	0.173	0.468	0.207	4.959	1.591	2.765	1.160	2.765	1.160
0.5	0.217	0.509	0.215	4.617	1.396	2.434	0.969	2.434	0.969
0.6	0.260	0.541	0.219	4.355	1.253	2.181	0.828	2.181	0.828
0.7	0.304	0.566	0.221	4.147	1.144	1.983	0.722	1.983	0.722
0.8	0.347	0.586	0.222	3.979	1.059	1.823	0.639	1.823	0.639
0.9	0.390	0.603	0.222	3.840	0.991	1.692	0.574	1.692	0.574
1	0.434	0.618	0.222	3.722	0.935	1.583	0.521	1.583	0.521
1.1	0.477	0.630	0.221	3.622	0.890	1.491	0.478	1.491	0.478
1.2	0.520	0.641	0.220	3.535	0.852	1.412	0.442	1.412	0.442
1.3	0.564	0.650	0.219	3.459	0.819	1.343	0.412	1.343	0.412
1.4	0.607	0.658	0.219	3.392	0.791	1.283	0.386	1.283	0.386
1.5	0.650	0.666	0.218	3.333	0.767	1.230	0.364	1.230	0.364
1.6	0.694	0.672	0.217	3.279	0.746	1.183	0.345	1.183	0.345
1.7	0.737	0.678	0.216	3.231	0.727	1.141	0.328	1.141	0.328
1.8	0.780	0.684	0.216	3.187	0.711	1.104	0.313	1.104	0.313
1.9	0.824	0.689	0.215	3.146	0.696	1.069	0.300	1.069	0.300
2	0.867	0.694	0.215	3.109	0.682	1.038	0.288	1.038	0.288

Reference point	F multiplier	Absolute F
Fbar(3-6)	1	0.4336
FMax	0.8551	0.3707
F0.1	0.3314	0.1437
F35%SPR	0.3542	0.1536

Weights in kilograms

Table 11.11.1 Irish Sea Plaice : PA reference point estimates



Reference point	Deterministic	Median	75th percentile	95th percentile	Hist SSB < ref pt %
MedianRecruits	13060	13060	13481	15442	
MBAL	0				0.00
Bloss	3095				
SSB90%R90%Surv	5151	5495	6026	6897	47.50
SPR%ofVirgin	14.35	14.26	15.59	17.34	
VirginSPR	3.63	3.69	4.15	4.87	
SPRloss	0.38	0.34	0.37	0.42	

	Deterministic	Median	25th percentile	5th percentile	Hist F > ref pt %
FBar	0.43	0.43	0.42	0.40	80.00
Fmax	0.37	0.37	0.32	0.27	92.50
F0.1	0.14	0.14	0.13	0.11	100.00
Flow	0.31	0.31	0.29	0.24	100.00
Fmed	0.47	0.51	0.47	0.42	65.00
Fhigh	1.10	1.16	1.04	0.87	0.00
F35%SPR	0.15	0.15	0.14	0.12	100.00
Floss	0.62	0.71	0.62	0.54	30.00

For estimation of Gloss and Floss:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
For estimation of the stock recruitment relationship used in equilibrium calculations:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

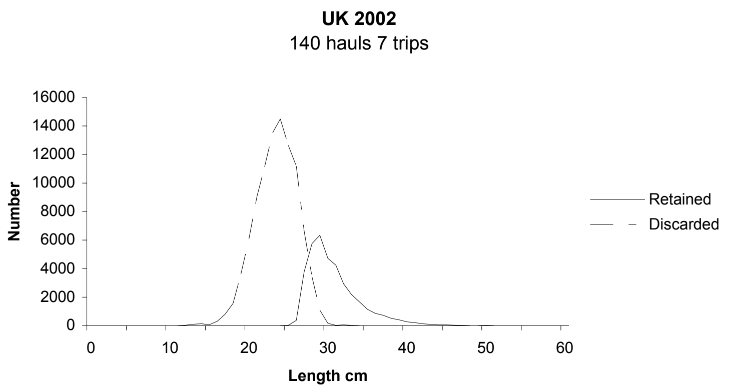
Irish Sea Plaice

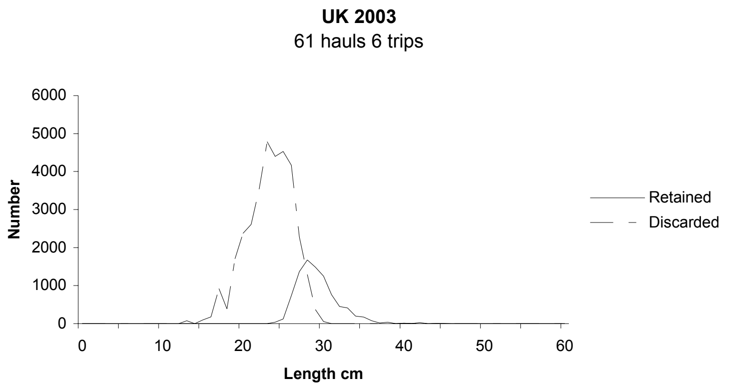
Steady state selection provided as input
FBar averaged from age 3 to 6

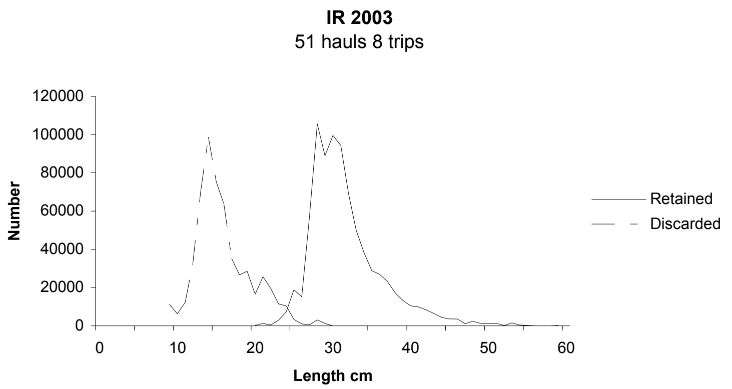
Number of iterations = 500
Random number seed = -99
Stock recruitment data Monte Carloed using residuals from the equilibrium LOWESS fit

Data source:
E:\med4\P7A.SEN
E:\med4\P7A.SUM

FishLab DLL used
FLVB32.DLL built on Jun 14 1999 at 11:53:37
PASoft 4 October 1999







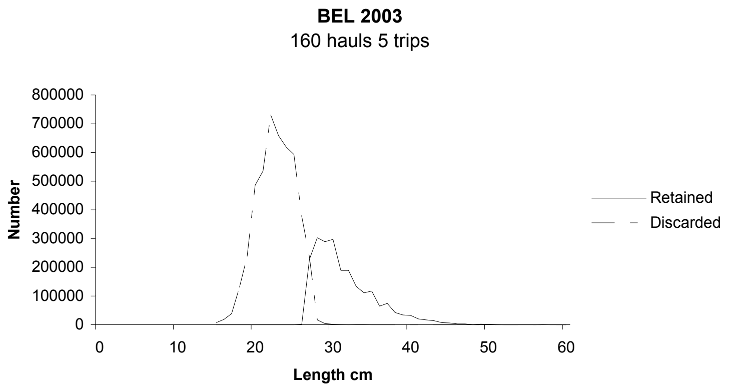
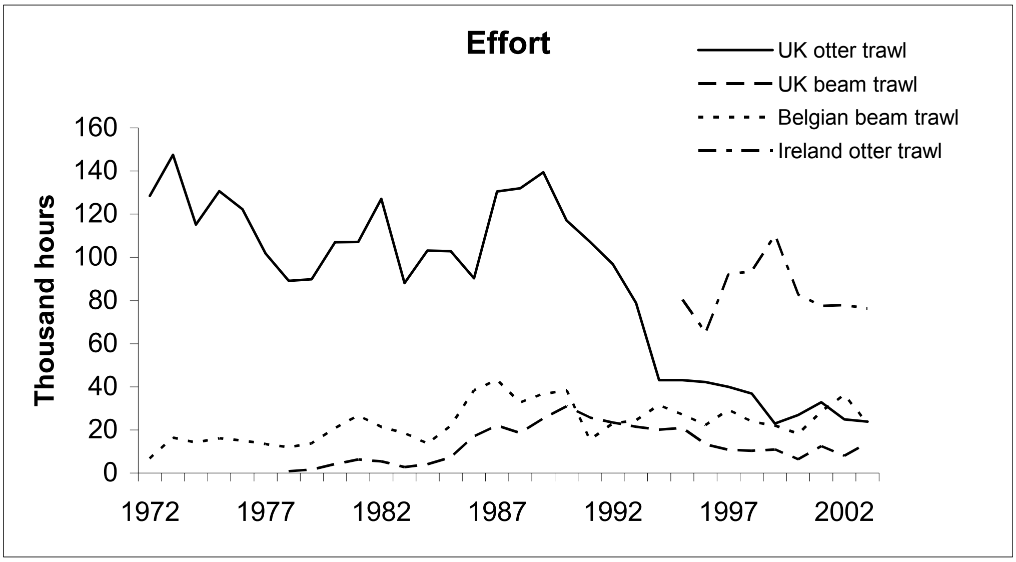
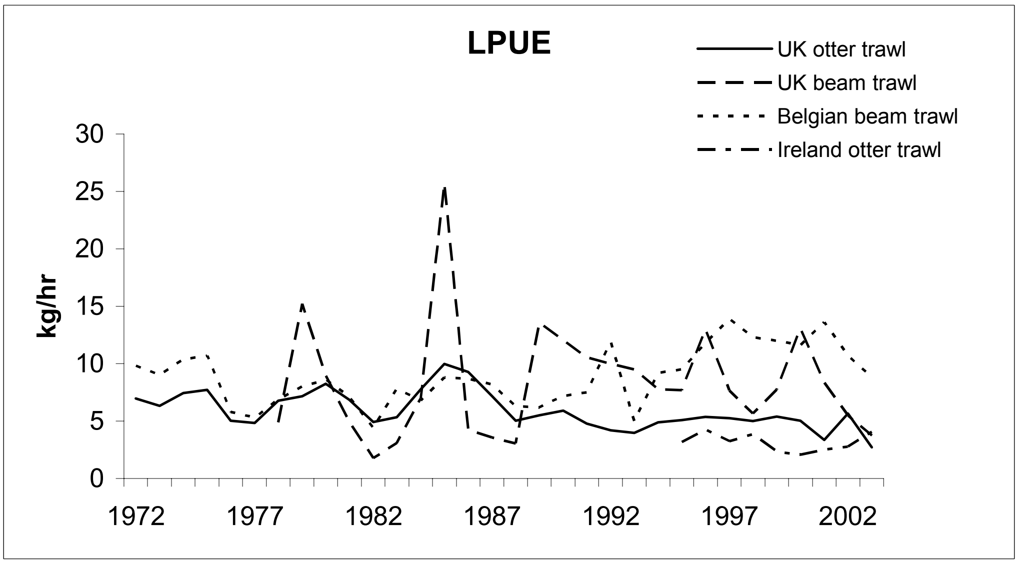
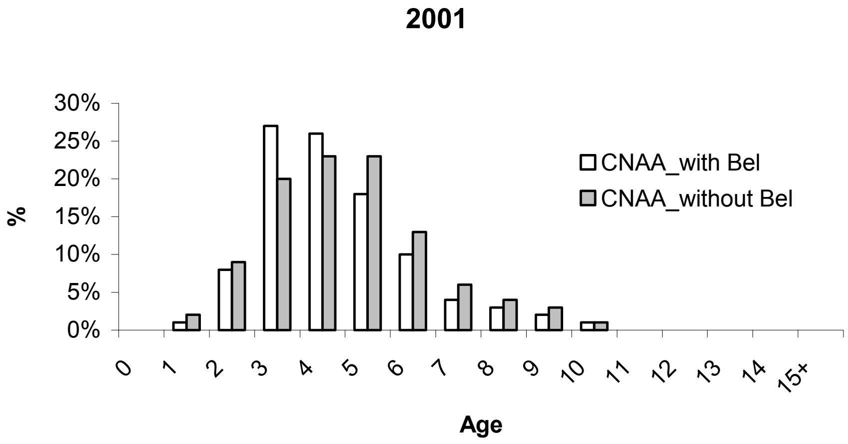


Figure 11.1.3.1 Length distributions of discarded and retained fish from discard sampling studies by the UK, Ireland and Belgium

Figure 11.2.1 Irish Sea plaice effort and LPUE for commercial fleets







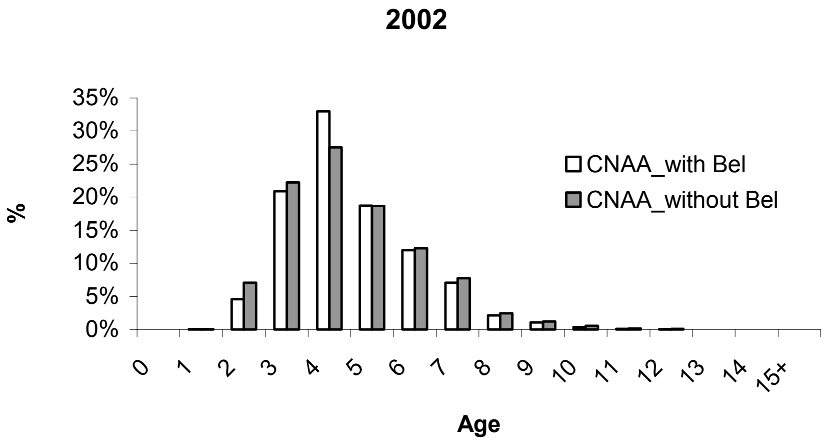


Figure 11.3.1 2001 and 2002 catch numbers at age calculated with and without Belgian age compositions

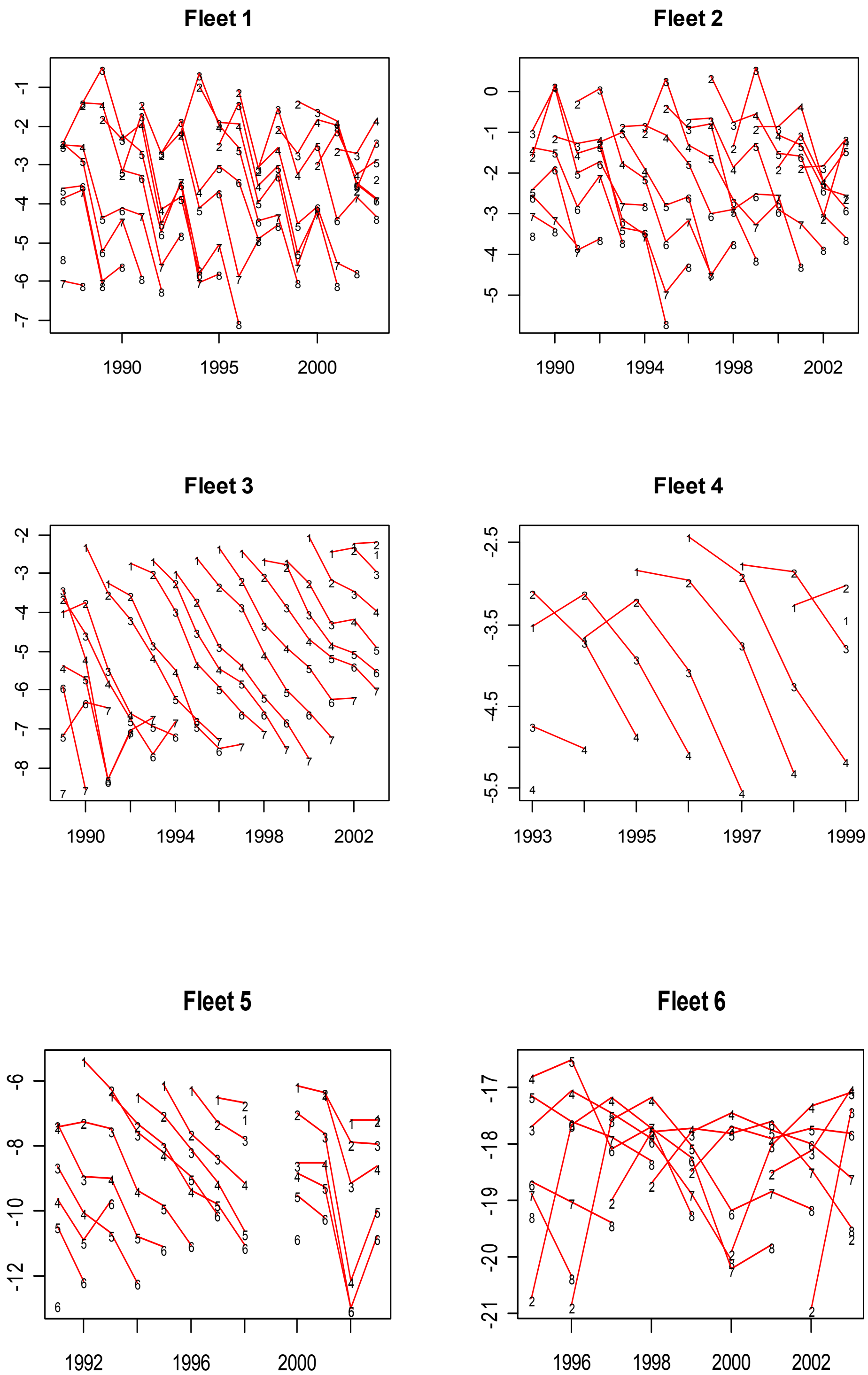
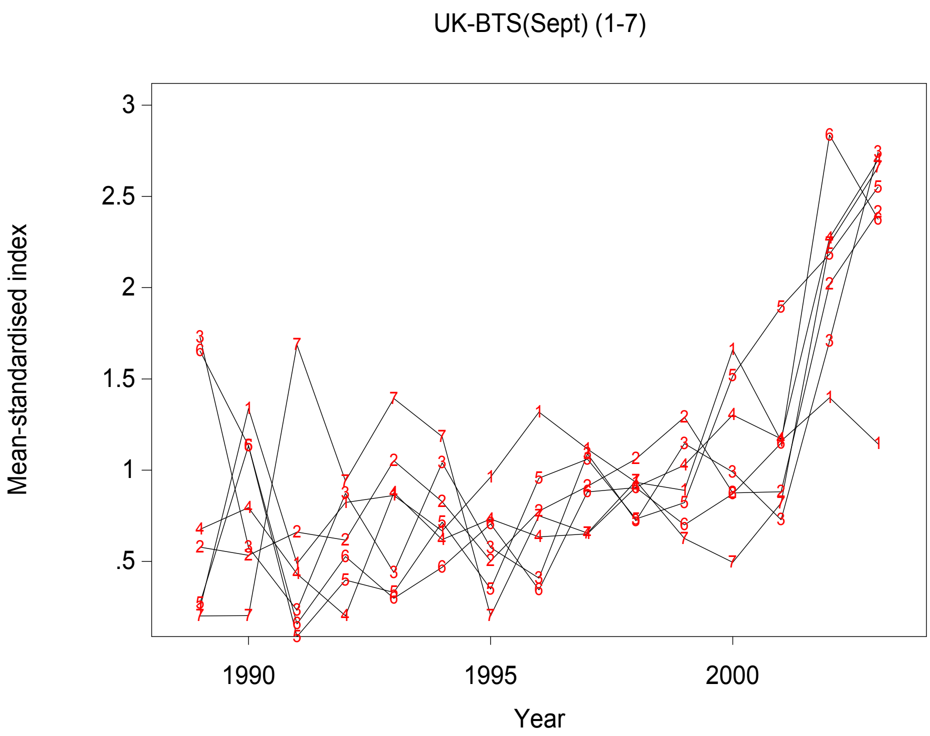


Figure 11.5.1 Log CPUE indices for available tuning indices: Fleet 1 UK(E&W) otter trawl; Fleet 2 UK(E&W) beam trawl; Fleet 3 UK(E&W) beam trawl survey September; Fleet 4 UK(E&W) beam trawl survey March; Fleet 5 Irish juvenile plaice survey; Fleet 6 Irish otter trawl.



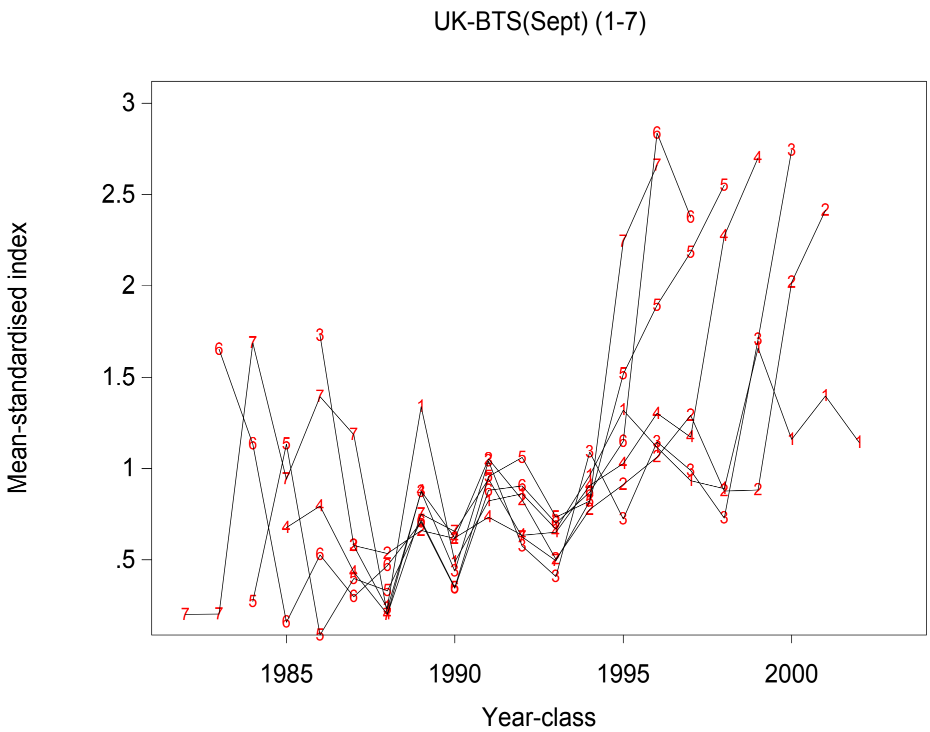
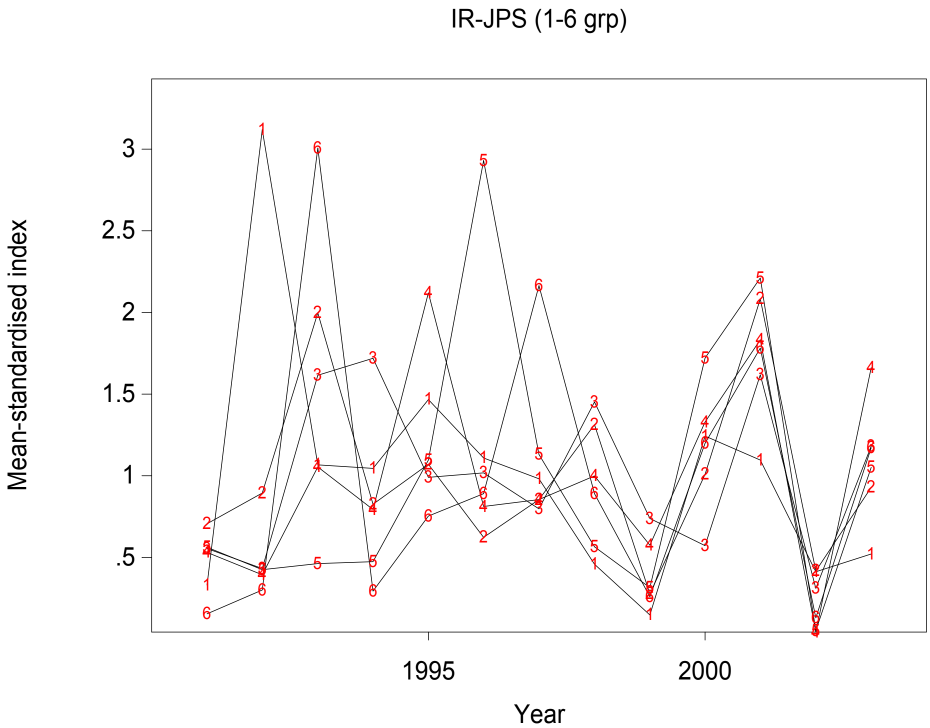


Figure 11.5.2. UK(E&W) beam trawl survey September: mean standardised tuning indices by year (upper) and by year-class (lower).



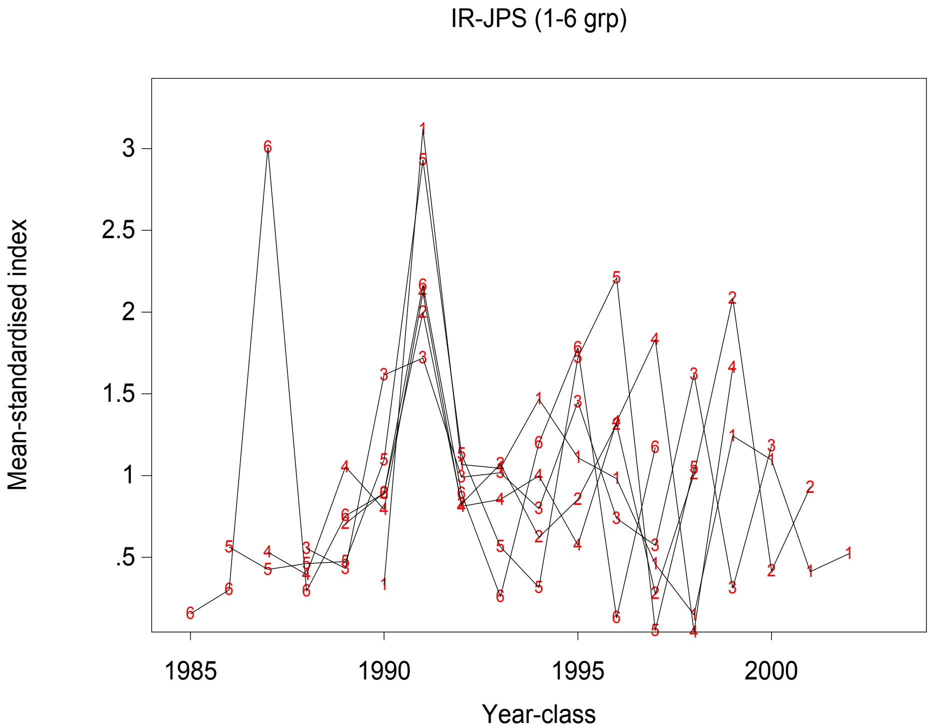


Figure 11.5.3. Irish juvenile plaice survey: mean standardised tuning indices by year (upper) and by year-class (lower).

Figure 11.5.4 VIIa PLAICE LOG CATCHABILITY RESIDUAL PLOTS

Figure 11.5.5. VIIa PLAICE LOG CATCHABILITY RESIDUAL PLOTS

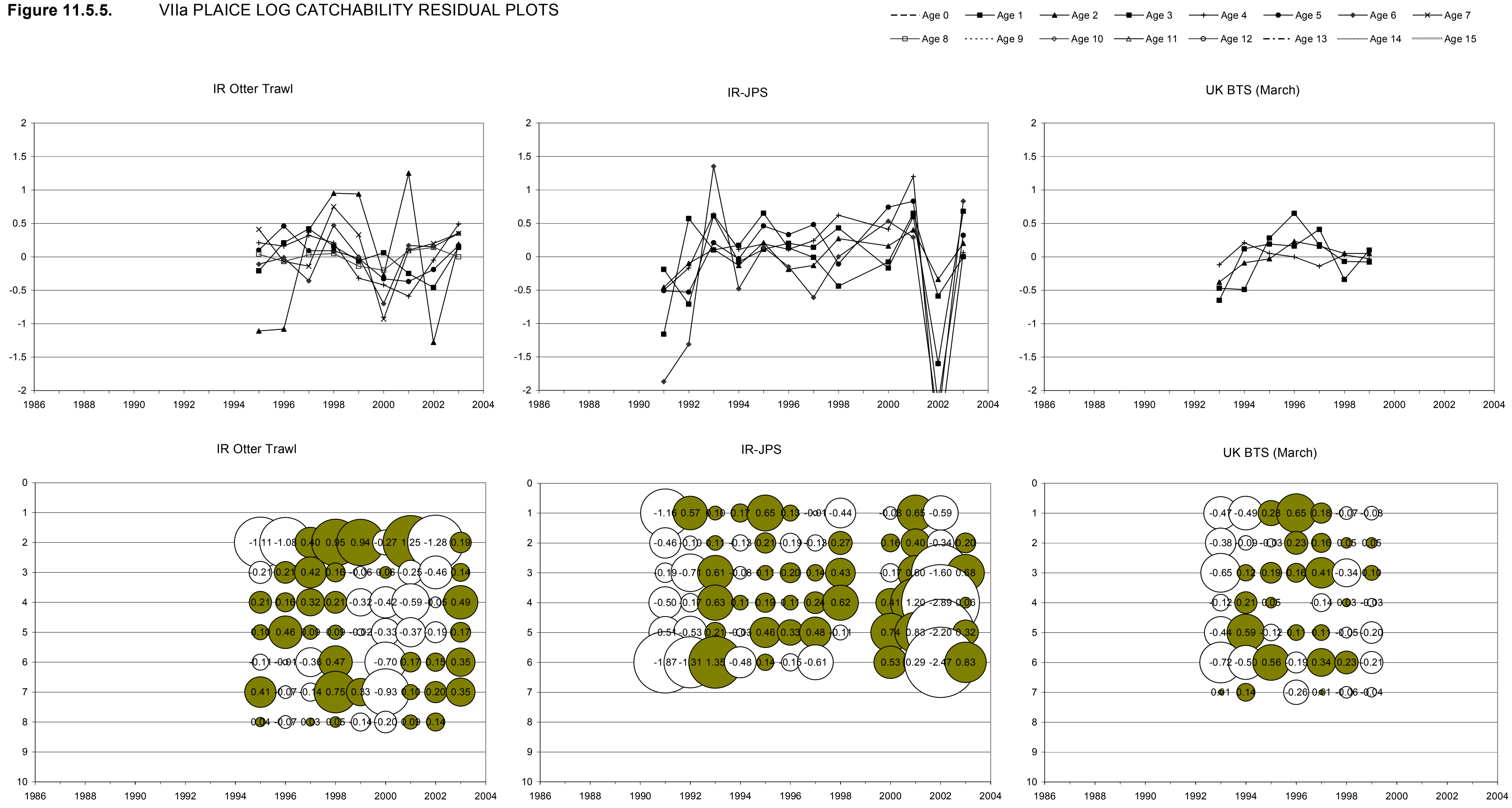


Figure 11.5.6. Results of single fleet XSA analyses

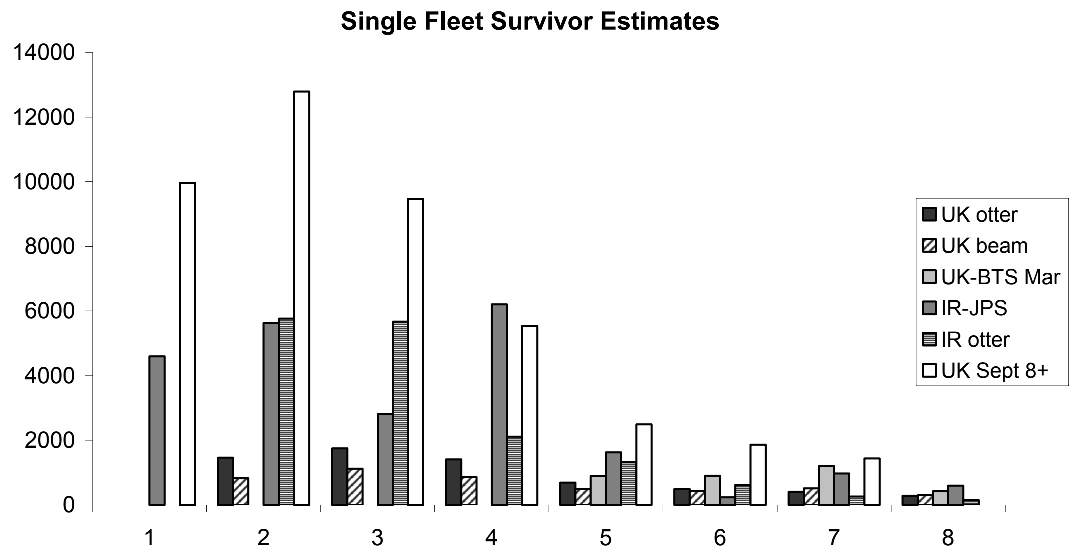
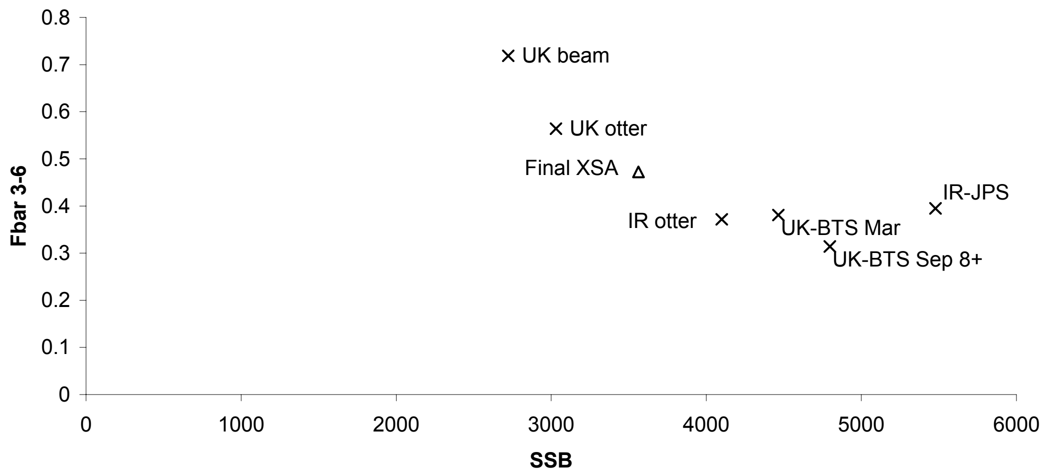


Figure 11.5.7 SSB and F(3-6) estimates from single fleet XSA analyses



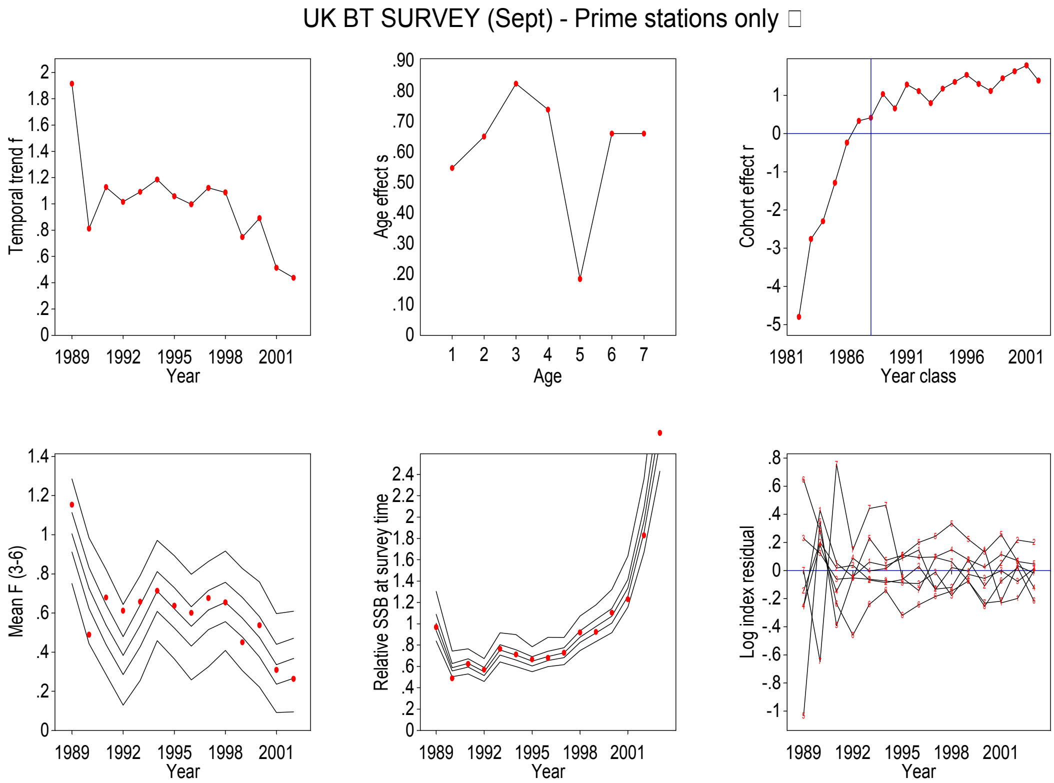


Figure 11.5.8 Results from Surba analyses for UK(E&W) September beam trawl survey

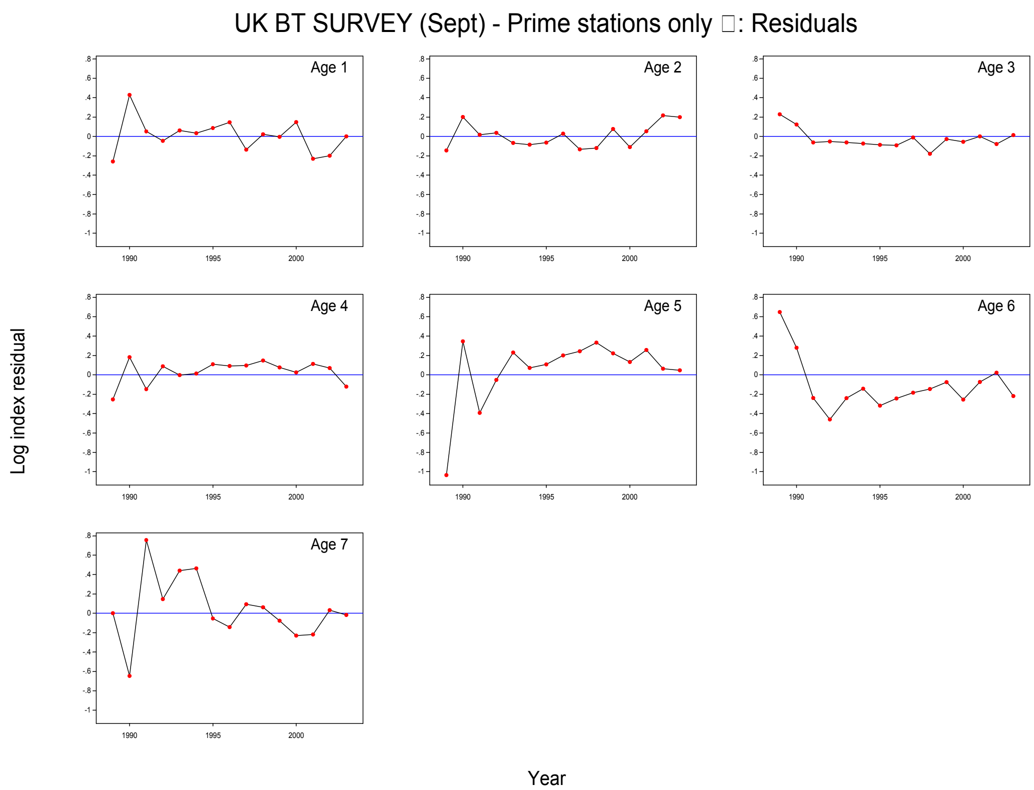


Figure 11.5.9 Surba log index residual at age for UK(E&W) September beam trawl survey

Figure 11.5.2.1

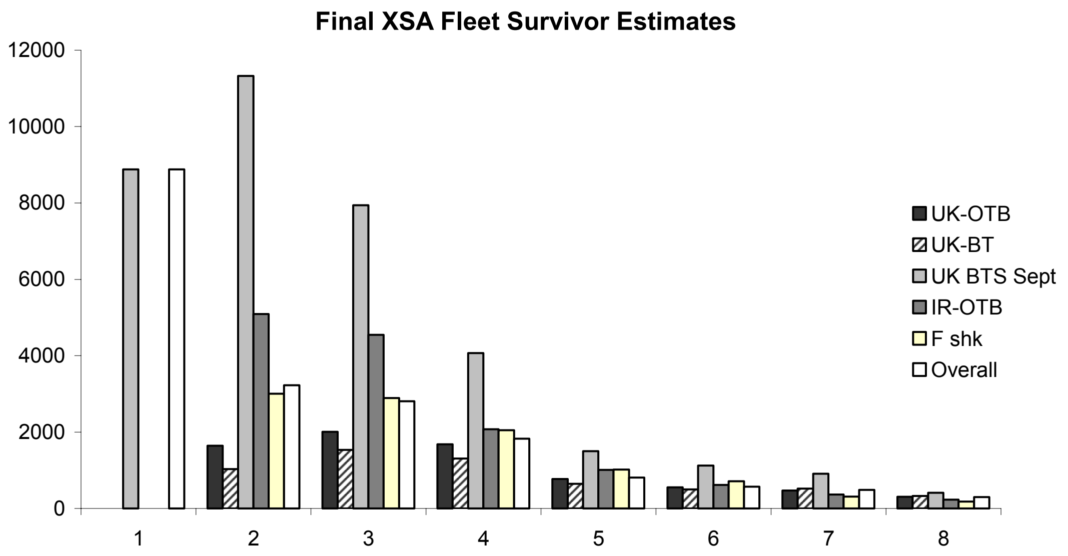


Figure 11.5.2.2

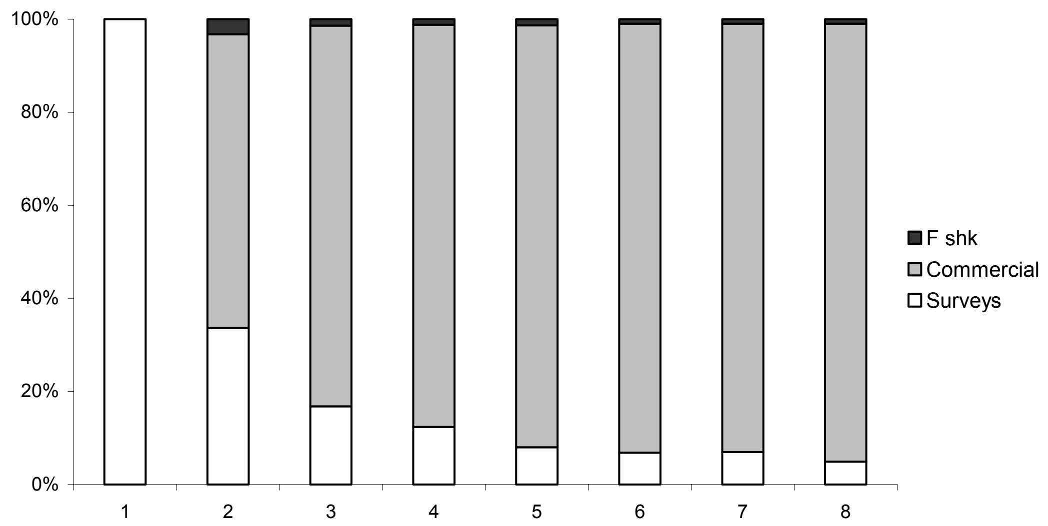


Figure 11.5.2.3 VIIa PLAICE LOG CATCHABILITY RESIDUAL PLOTS FINAL XSA

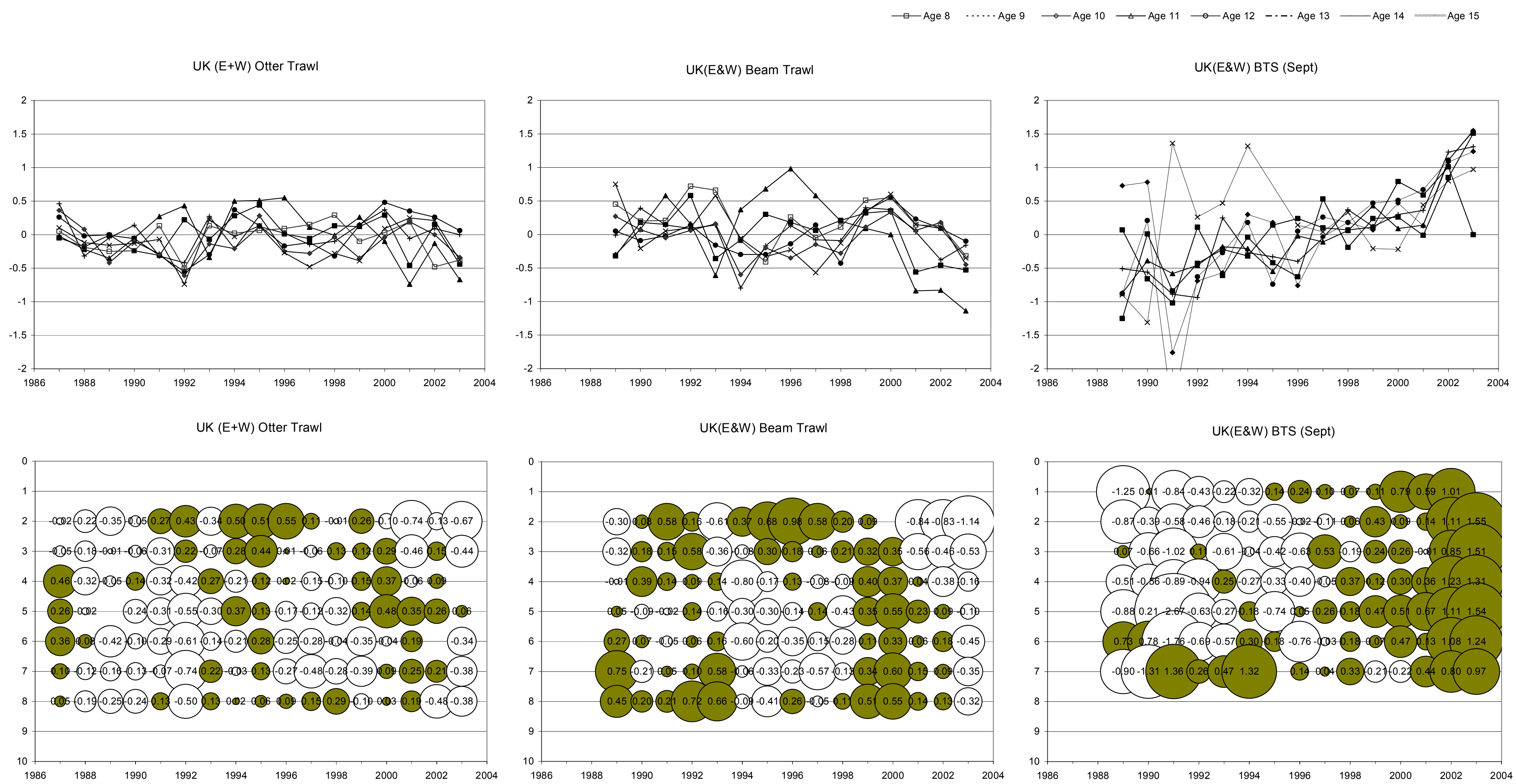
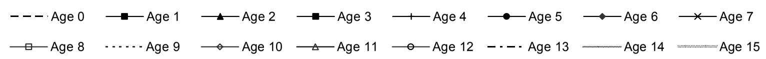


Figure 11.5.2.4 VIIa PLAICE LOG CATCHABILITY RESIDUAL PLOTS FINAL XSA



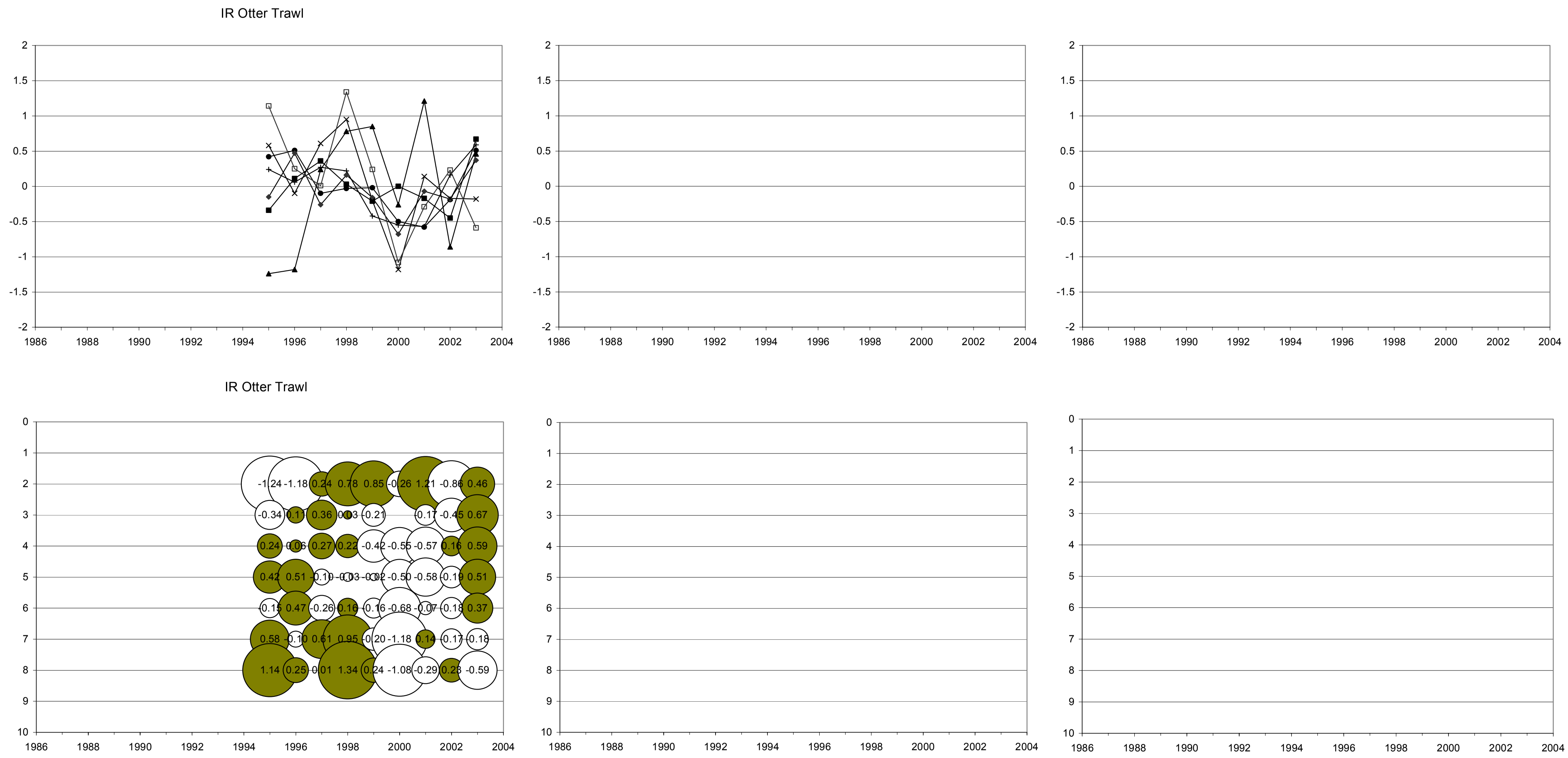


Figure 11.5.2.5 Irish Sea Plaice : Retrospective Analysis

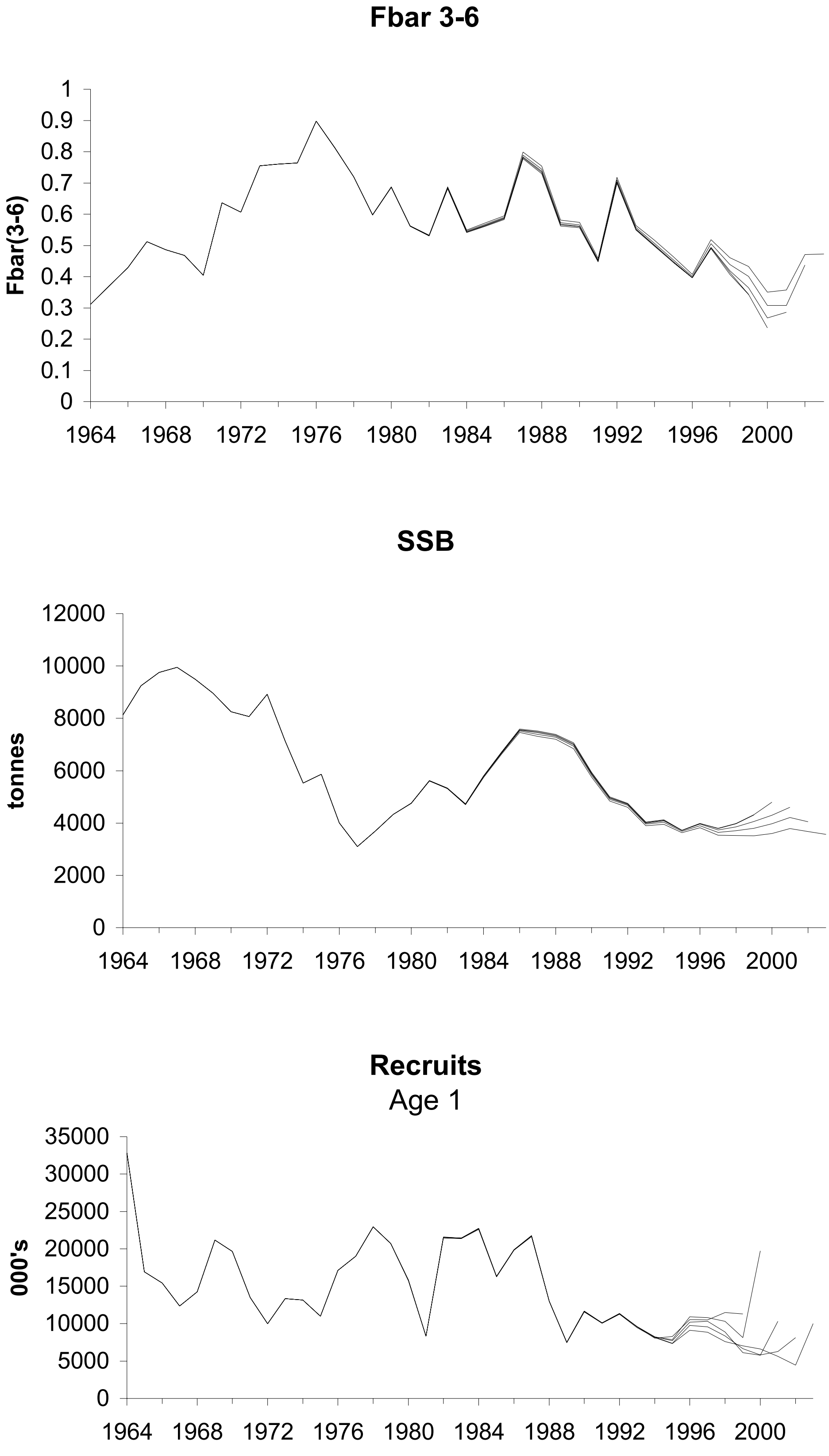


Figure 11.5.3.1. Irish Sea Plaice: Comparison with last years assessment

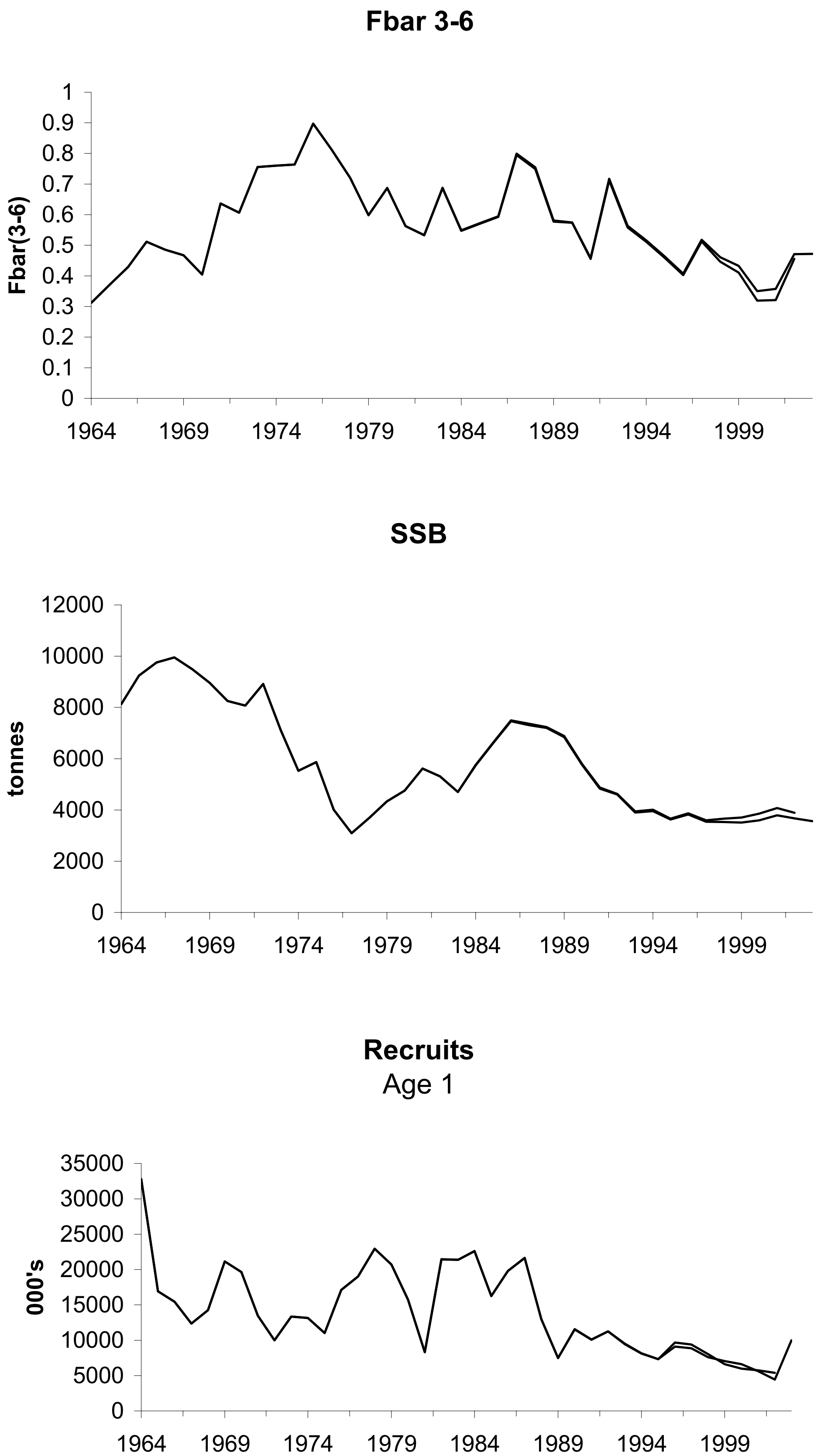
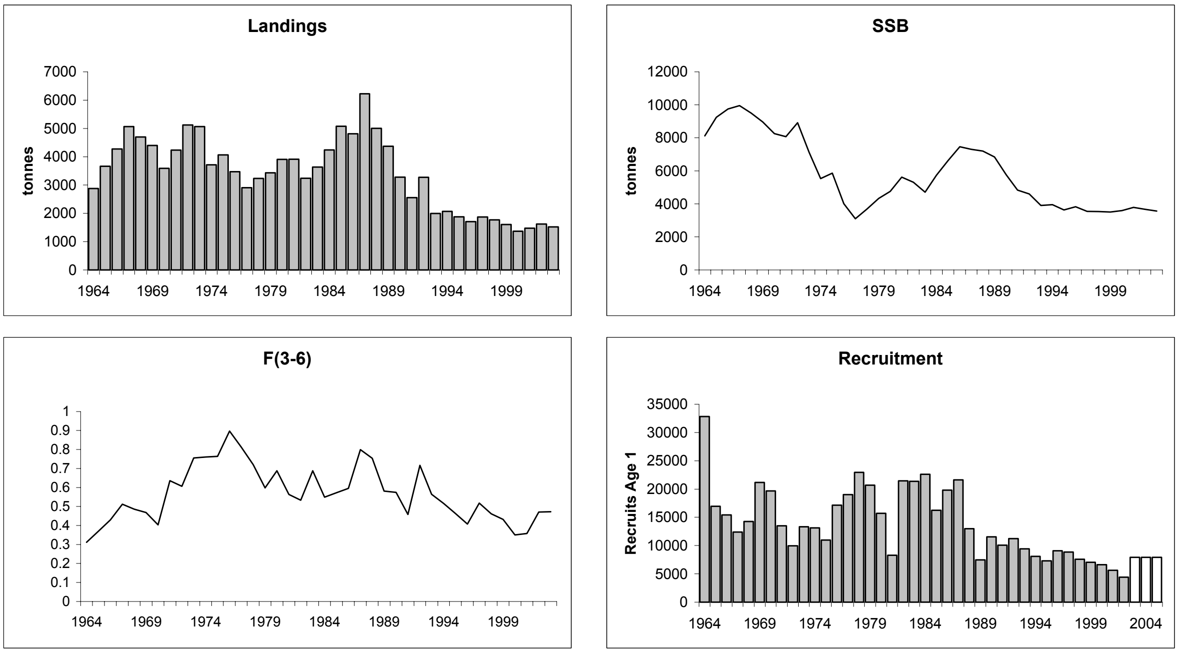
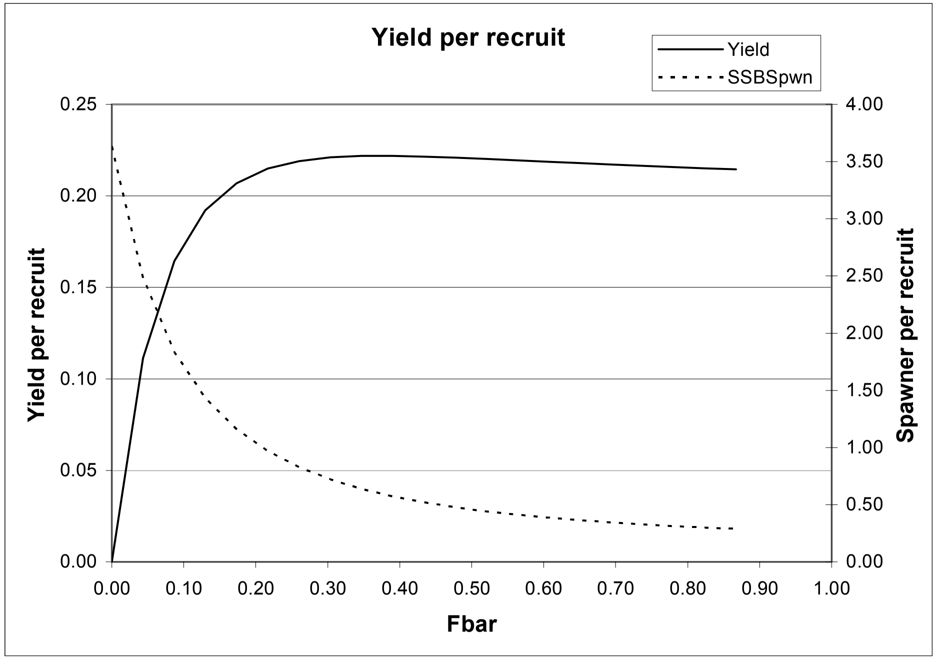
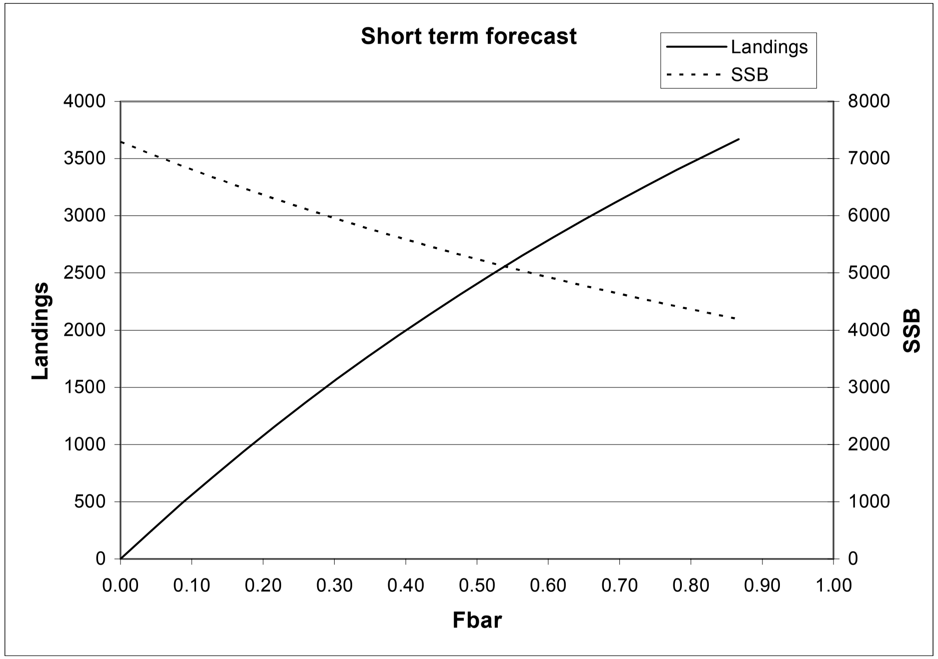


Figure 11.7.1 Irish Sea Plaice







MFYPR version 2a
Run: test
Time and date: 19:08 10/05/04

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.4336
FMax	0.8551	0.3707
F0.1	0.3314	0.1437
F35%SPR	0.3542	0.1536

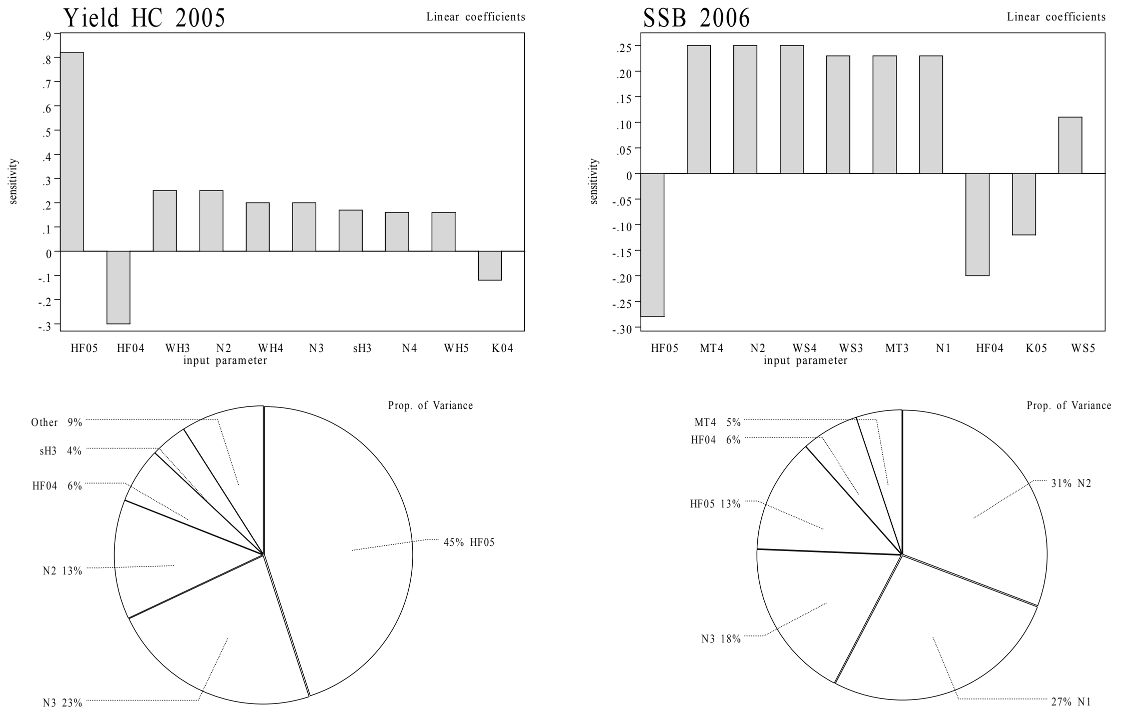
Weights in kilograms

MFDP version 1a
Run: p7a-sq
p7astquoMFDP Index file 20/05/03
Time and date: 18:58 10/05/04
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 11.8.1 Irish Sea Plaice: Results of short term forecast and yield per recruit analyses

Figure 11.8.2 Plaice,Irish Sea. Sensitivity analysis of short term forecast.



Data from file:E:\med4\P7a.sen on 11/05/2004 at 06:55:38

Figure 11.8.3 Plaice,Irish Sea. Probability profiles for short term forecast.

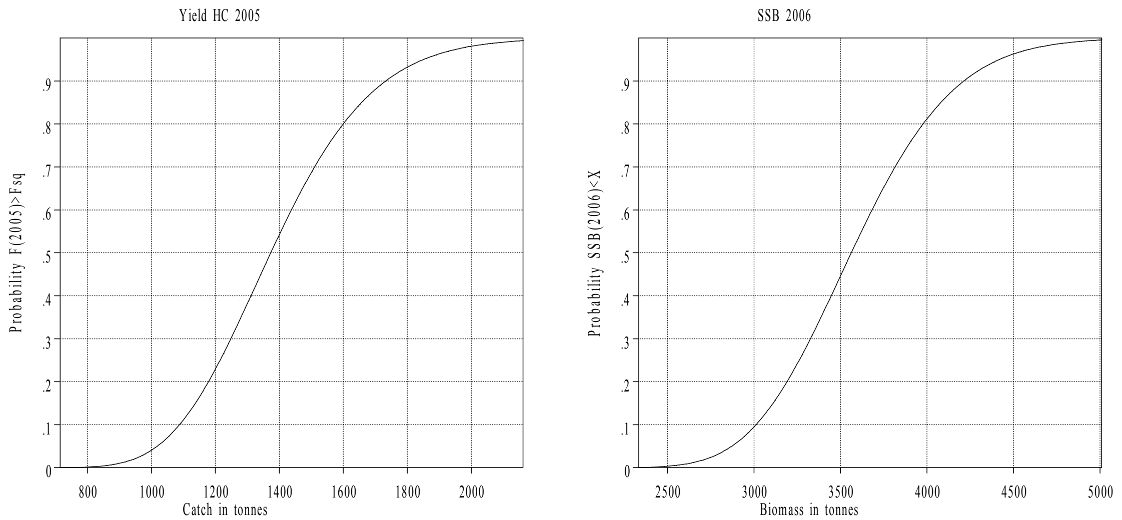


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Figure 11.9.1 Irish Sea Plaice: stock recruit scatter plot (full time series) and reference points

Figure 11.9.2 Stock recruit scatter plot for Irish Sea plaice (filled circles 1989-2002; open circles 1964-1988) showing the Beverton & Holt stock-recruit relationship fitted to the recruitment for the short time series (89-02) and the full time series (64-02).

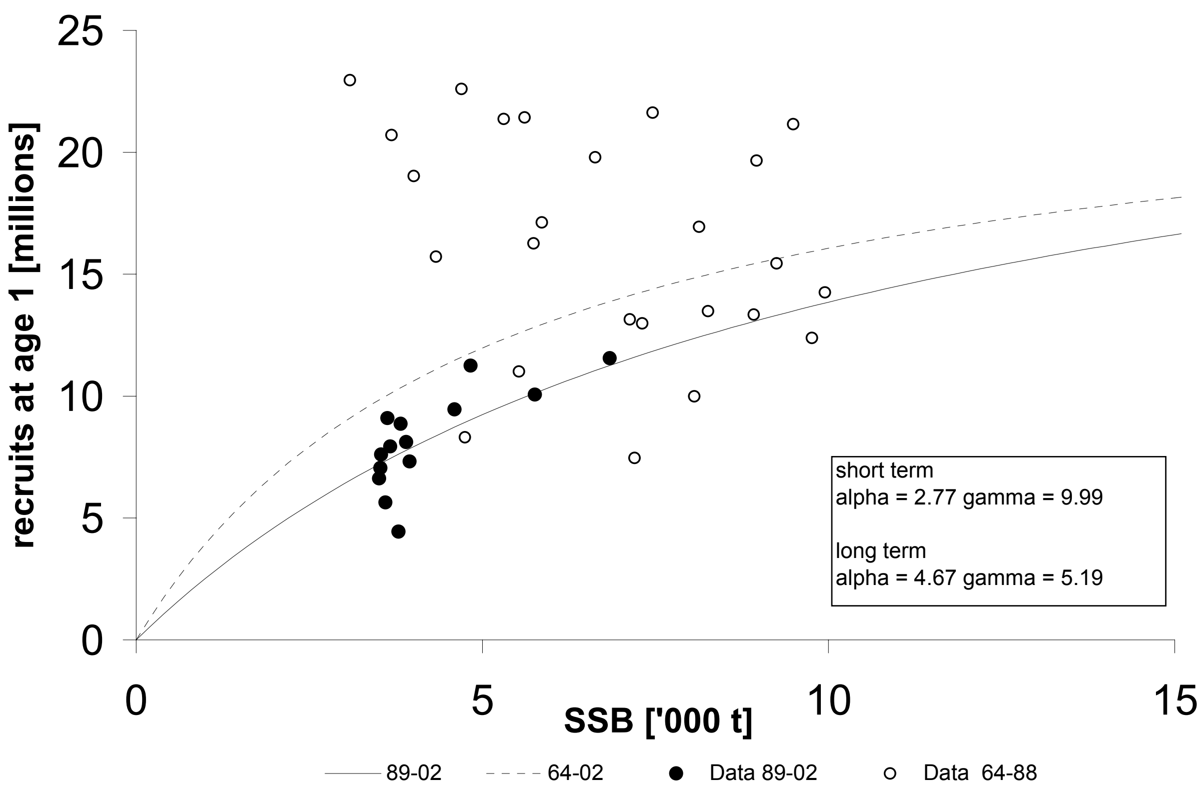


Figure 11.11.1 PA plot showing SSB against Fbar (3-6). Diamond showns 2003 estimate

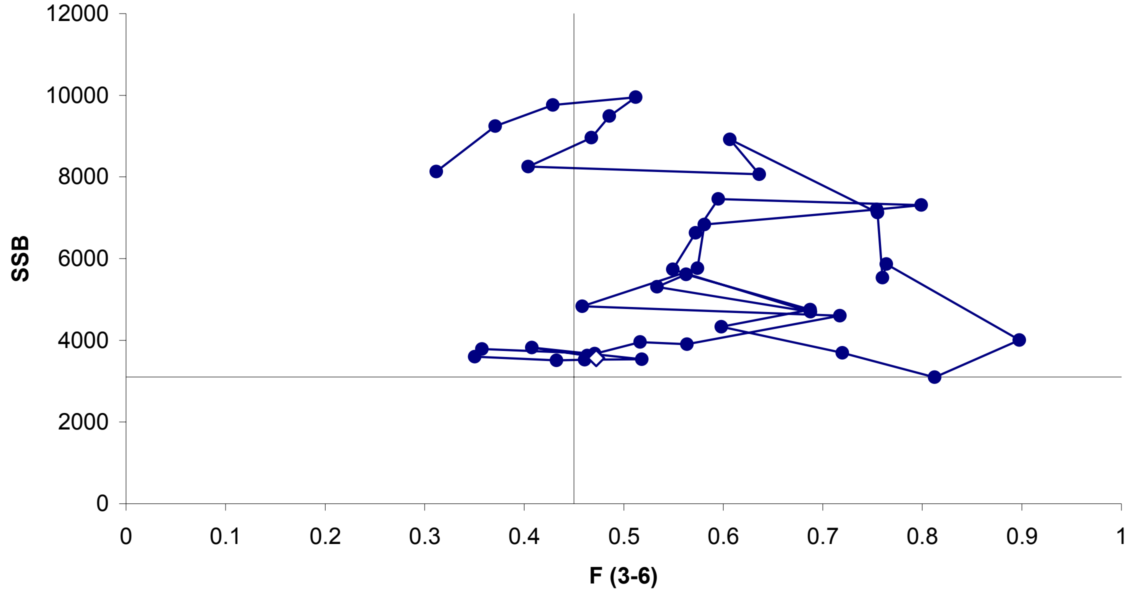
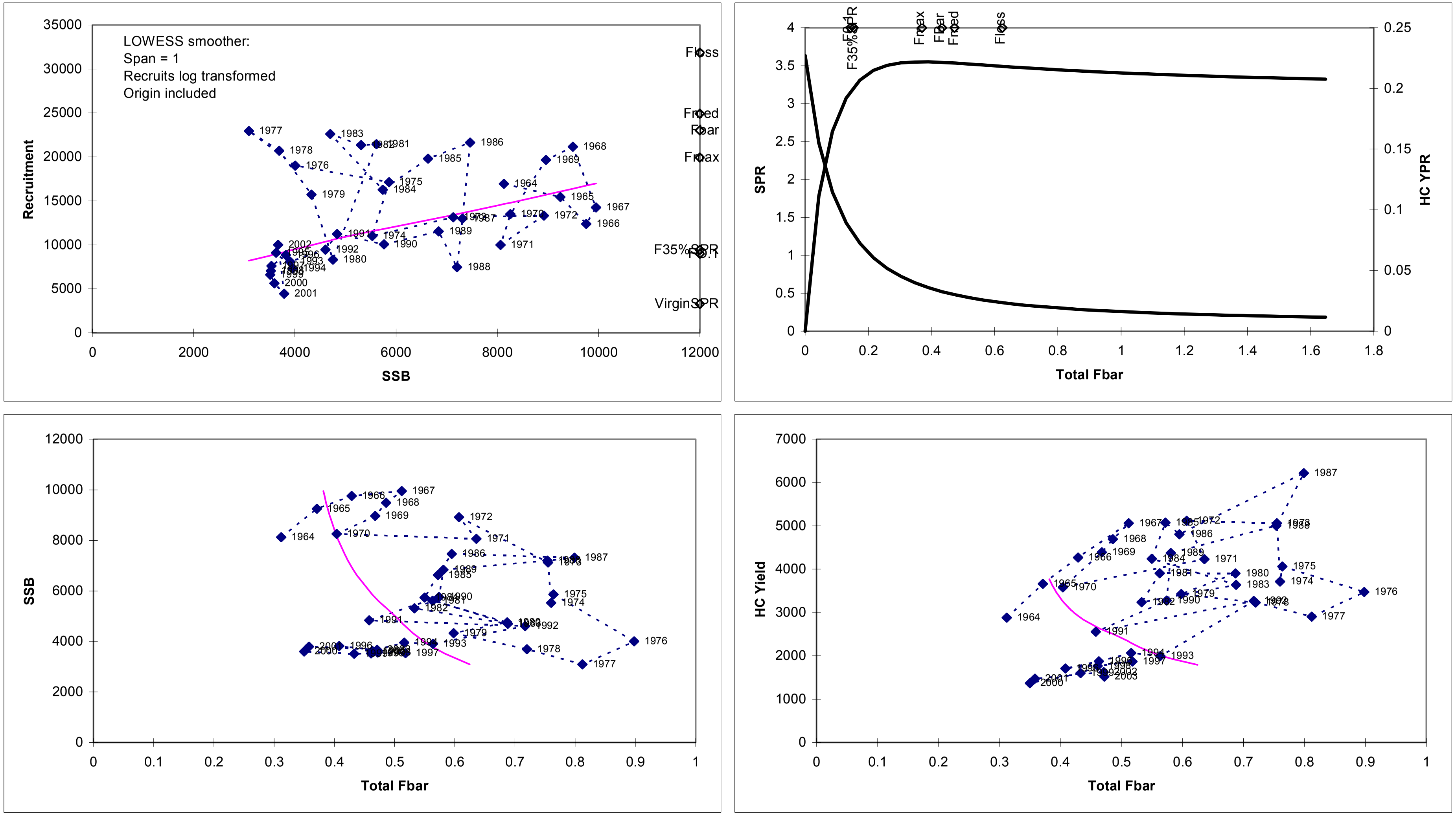


Figure 11.11.2



12 SOLE IN SUB-AREA VII – SOLE IN DIVISION VIIa

The assessment of sole in Division VIIa is a SPALY-assessment which means that there are no major changes in this years assessment compared to the one from last year.

12.1 The fishery

A description of the fishery is available in the stock annex file.

12.1.1 ICES advice applicable to 2003 and 2004

"*For 2003, ICES recommends that fishing mortality should remain below the proposed Fpa (0.3), corresponding to landings of less than 1010t in 2003*."

For 2004, ICES recommended to take the mixed fisheries characteristics into account and therefore that the demersal fisheries in the Irish Sea should be managed such that (a) fishing of each species is restricted within their precautionary limits, (b) the catch of cod and whiting is zero and (c) the total catch of sole is less than 790t.

The upper limit corresponding to the exploitation boundaries of sole in the Irish Sea is 790t in 2004. This implies a reduction of fishing mortality by 10%, and allows SSB to increase above Bpa in the short-term.

12.1.2 Management applicable in 2003 and 2004

The sole fisheries in the Irish Sea are managed by TAC (see text table below) and technical measures.

Year	Single stock exploitation bounderies	Basis	TAC	% change in F associated with TAC *	WG landings
2002	<1100t	Keep F below Fpa	1100t	0	1087t
2003	<1010t	Keep F below Fpa	1010t	+ 5	1010t
2004	<790t	SSB > Bpa in short-term	800t	- 10	-

* F calculated, based on a *Status quo* forecast

Technical measures in force are minimum mesh sizes and minimum landing size (24 cm). When fishing in VIIa it shall be prohibited to carry on board or deploy any beam trawl of mesh size equal to, or greater than, 80 mm unless the entire upper half of the anterior part of such a net consists of a panel of diamond-meshed netting material of which no individual mesh is of mesh size less than 180 mm attached directly to the headline or to no more than three rows of netting material of any mesh size attached directly to the headline (Reg 254/2002, Art. 3(2)).

Belgian vessels have been subject to trip catch controls throughout 2003. The Belgian fishery for sole in VIIa stopped on the 6th of December 2003.

The spawning closure for cod that has been in force since 2000 is unlikely to have had a big impact on the sole fishery. In 2000 the closure covered the Western and Eastern Irish Sea. Since then, closure has been mainly the Western part whereas the main sole fishery in taken place in the Eastern part of the Irish Sea.

12.1.3 The fishery in 2003

National landings data reported to ICES, and Working Group estimates of total landings are given in Table 12.1.3.1. The total international landings in 2003, as used by the Working Group, were 1010t, which equals the agreed TAC. The 2003WG predicted the landings to be 910t in 2003. No revisions have been made in the landing data for 2002.

Discarding of sole ranged between 0 and 5% by weight (based on 5 trips in 2003 with Belgian vessels).

No data are available on the extent of mis- or underreporting of landings from this stock.

12.2 Commercial catch-effort and research vessel surveys

CPUE and effort series were available from the Belgium beam trawlers, UK (E&W) beam and otter-trawlers, Irish beam and otter trawlers and from two UK beam trawl surveys (September and March) (Table 12.2.1 and Figure 12.2.1).

Effort from both Belgian and UK commercial beam trawl fleets increased from the early seventies until the late eighties. Since then UK beam trawl effort has declined to a minimum in 2000, and has increased in 2003 slightly up to the level of the late nineties. The Belgian beam trawl effort fluctuated in the nineties around a lower level than the late eighties. The sharp increase in effort in two consecutive years since 2000 was halted with a value around the lower level of the nineties in 2003. The short effort series from the Irish beam trawl fleet show a steady increase from the start of the series in 1995, reaching about twice its starting value in 2003.

CPUE for both UK and Belgian beam trawlers has declined since the beginning of the time series, but has remained relatively constant over the last decade. Irish CPUE has declined constantly since 1995 to a third of its initial value in 2003.

Available tuning data are given in Table 12.2.2.

12.3 Age compositions and mean weights at age

Quarterly age compositions for 2003 were available from UK (E&W) and Ireland as well as quarterly landings from Northern Ireland and France. For Belgium only ALK's for the fourth quarter were available. As the Belgian fleet operates more in the eastern part of the Irish Sea, in the area fished mainly by UK vessels, ALKs from the UK were applied to the length distribution of the Belgian landings in the first three quarters. The unavailability of ALK's in the first three quarters from the Belgian fleet was because Belgian vessels were fishing in different areas in one trip and therefore samples could not be conclusively traced to ICES area VIIa. This difficulty has been overcome since the 4th quarter by a different approach in obtaining age samples which will continue in the future.

Catch numbers-at-age data are given in Table 12.3.1. Table 2.2.1 shows the countries that provide data; Table 2.2.2 gives their sampling levels.

Catch weights at age for 2003 were calculated from Belgium, UK and Ireland data, weighted by national catch numbers at age, and then quadratically smoothed (using age = 1.5, 2.5 etc.) and SOP-corrected. The quadratic fit used was:

$$Wt = 0.0512 + (0.0544*(AGE+0.5)) - (0.0021*(AGE+0.5)^2)$$

Table 12.3.2 gives catch weights and SOP checks.

Stock weights at age were derived from the smoothed catch weight at age by setting age = 1.0, 2.0 etc. Stock weights-at-age are given in Table 12.3.3.

Annual length compositions for 2003 are given by fleet in Table 12.3.4.

12.4 Natural mortality, maturity

Natural mortality, maturity and proportions of natural mortality and fishing mortality before spawning were set as in previous years.

Natural mortality was set at 0.1 yr^{-1} (all ages and all years).

The maturity ogive used is as previously:

Age 1 2 3 4 5 6 and older

0.00	0.38	0.71	0.97	0.98	1.00

The proportions of natural mortality and fishing mortality before spawning were both set to 0 to reflect the SSB calculation date of 1 January.

12.5 Catch-at-age analysis

The results of exploratory XSA runs, which are not included in this report, are available in ICES files.

General approaches and methods are described in Section 2.6.

12.5.1 Data screening

Commercial catch data

A preliminary inspection of the quality of international catch-at-age data (for ages 2-15) was carried out using separable VPA, with a reference age of 4, terminal F = 0.5 and terminal S = 0.8 (Same settings as in previous WG's). There were large residuals for ages 2/3 caused by partial recruitment to the fisheries at age 2. The log-catch ratios for the fully recruited ages (up to 10) did not show large residuals. Some high residuals appeared at older ages (+10); therefore, ages were kept between 2 and 10+ in further XSA analysis.

Tuning data

This stock has been considered a stable stock by previous working groups and therefore the assessment was updated using identical settings and tuning fleets as in the previous year, with one year additional data for 2003.

12.5.2 Exploratory catch-at-age analyses

Tuning data were available for Belgium beam trawlers (1975-2003), a UK September beam-trawl survey (1988-2003), a UK March beam-trawl survey (1993-1999), UK (E&W) beam and otter trawlers (both 1991-2003), and Irish otter trawlers (1995-2003) and one year data from the Irish groundfish survey (Celtic Explorer) (Table 12.2.2).

Single fleet XSA runs were carried out for all available fleets (except for the UK (E&W) and Irish otter trawl fleets), to screen tuning data for catchability trends and high residuals. The UK (E&W) and Irish otter trawl fleets have never been used before in tuning as they are considered not to be representative for this stock. For this reason these fleets were not further explored. Since the late eighties, the Belgian beam trawl fleet has shown an increase of catchability for the younger ages, as well as a noisy pattern in the age 3 log q residuals. Therefore, the Working Group decided, as in previous years, to exclude age 3 from the Belgian beam trawl fleet.

There were no apparent trends in the surveys, and no reason to exclude any of them.

Retrospective trends in estimates of recruitment, SSB and F(4-7) are given in Figure 12.5.2.1. There is no detectable retrospective pattern. Retrospective runs for this assessment diverge at several points in the historical time-series. In theory these periods should be in the converged part of the VPA, which would imply that such divergence should not occur. However, it may be that small changes in estimated mean log catchability in each retrospective run have had an impact on estimated abundance in these early periods *via* feedback effects in *F* on the oldest true age (and hence the plus-group). These *F*s are calculated as an average over a range of younger ages. Because the VPA is a backwards-iterative process, apparently minor alterations in these *F*s can have significant effects further back in the time-series.

12.5.3 Final catch-at-age analysis

A comparison of the settings for the final assessments since the 2002 WG is given in the table below.

year of assessment	2002	2003	2004
Assessment model	XSA	XSA	XSA
Belgian beam trawl	1975-2001 4-9	1975-2002 4-9	1975-2003 4-9
UK beam trawl	1991-2001 2-9	1991-2002 2-9	1991-2003 2-9
UK September beam trawl survey	1988-2001 1-9	1988-2002 1-9	1988-2003 1-9
UK March beam trawl survey	1993-1999 1-9	1993-1999 1-9	1993-1999 1-9
Time series weights	tricubic 20 yrs	tricubic 20 yrs	tricubic 20 yrs
Power model used for catchability	none	none	none
Catchability plateau age	5	5	5
Surv. est. shrunk towards mean F	5 years / 5 ages	5 years / 5 ages	5 years / 5 ages
s.e. of the means	0.8	0.8	0.8
Min. stand. error for pop. estimates	0.3	0.3	0.3
Prior weighting	none	none	none
Fbar	4-7	4-7	4-7

Full diagnostics are given in Table 12.5.3.1. Estimates of fishing mortality and stock numbers at age from the final XSA run are given in Tables 12.5.3.2 and 12.5.3.3 The summary VPA outputs are given in Table 12.5.3.4.

The residuals of the final XSA-run are plotted in Figure 12.5.3.1.

Survivor estimates at age predicted by the different fleets, together with the scaled weights are shown in Figure 12.5.3.2. Highest weights at the younger ages are given to the UK September beam trawl survey (74% and 73% for ages 2 and 3 respectively); the commercial fleets get higher weights at the older ages. In general, F shrinkage gets low weight, varying from 12% and 10% at ages 2 and 3 and less than 4% at the older ages. Survivor estimates for all fleets were consistent apart from age 2 where the survey estimate is about 25% lower than the commercial fleet estimate.

12.6 Estimating recruiting year class abundance

The general approach to estimating recruitment is described in Section 2.6.

XSA estimates up to the 2000 year class were accepted by the WG.

The 2001 year class (recruitment at age 2 in 2003) was revised down by this year's assessment by 20%. In this year's assessment, the survivor estimates coming from XSA where the September beam trawl survey accounts for 74% of the final estimates. In last year's assessment the 2001 year class was estimated with RCT3 where the survey only had a 46% weight. The XSA estimate for the 2001 year class was used for further analysis.

Estimation of abundance of the 2002 year class was based on application of RCT3 (See Table 12.6.1. and 12.6.2. for input and output). The RCT3 estimate of the 2002 year class is 5.1 million 2-year olds, which is 21% under the long term GM recruitment (1970-2001). Although the RCT3 value for the 2002 year class is based on only one point, estimated by the UK September beam trawl survey, this estimate was used for further analysis. With the exception of the 1992 year class, indices of abundance of one year olds in this survey have proven to be good estimates of year class strength (ICES files).

No data were available to estimate the 2003 and 2004 year classes, and therefore the long term GM (6.5 million 2 year olds) was used as an estimate for these year classes.

The text table below gives an overview of the estimated recruits at age two by different methods. The numbers in bold are used for further prediction.

Year class	Recruits at age 2 (thousands)		
	XSA	RCT3	$GM_{70\text{-}01}$
2001	**4013**	4050	6470
2002	-	**5089**	6470
2003 and subsequent	-	-	**6470**

12.7 Comparison between 2003WG and 2004WG

No changes were made to the model settings or tuning fleets, so changes in the estimates of F, SSB and recruitment are merely the result of the addition of a further year of catch and tuning data. No revisions have been made to previous years catch data, so results of retrospective analysis are essentially the same as those performed last year.

The text table below compares SSB, fishing mortality and recruitment as estimated in the 2003 and 2004 WG assessments. In this year's assessment, the estimates of SSB in 2002 have been revised upwards by 2% and Fishing mortality downward by 3%. The retrospective analysis shows the same (Figure 12.5.2.1). Recruitment in 2001 and 2002 were revised upward with 23% and 53% respectively where the 2002 recruitment was revised downward by 20%.

	WG 2003	WG 2004
SSB (tonnes) in 2002	3945	4025
F (4-7) in 2002	0.31	0.30
Recruitment at age 2 (thousands) in:		
2001	4092	5024
2002	1207	1847
2003	5003	4013

12.8 Long-term trends

Time-series data of F, SSB, recruitment and landings are given in Table 12.5.3.4 and plotted in Figure 12.8.1. After the weak year classes of 1993 and 1994, SSB reached its lowest observed value in 1996. Since then, year classes have been around average apart from the 2000 year class which is the weakest in the time series. SSB has increased to an estimated value of 4657t in 2001, but has now decreased slightly to a value of 3875t in 2003, just above Bpa.

Fishing mortality was at an historical high level in 1987 (0.79), when high catch rates attracted beam trawlers into the Irish Sea, but declined to figures between 0.40 to 0.45 until 1996. Since 1997 estimated fishing mortality has decreased further to values around 0.3.

12.9 Short-term catch predictions

For the current prediction, population survivors at the start of 2004 estimated for ages 3 and older were taken from the XSA output. The RCT3 estimate was taken as the 2002 year class and GM recruitment ('70-'01) was assumed for the 2003 and 2004 year classes (2 year olds). Fishing mortalities at age were set to the mean of the period 2001-03 (unscaled, $F_{01\text{-}03} = 0.28$). Weights at age in the catch and in the stock are averages over the last three years. All the input data are shown in Table 12.9.1. The short-term prediction has been run using a *status quo* forecast in 2004 and 2005. The results are given in Tables 12.9.2 and 12.9.3 (management options and detailed output tables) and Figure 12.9.1.

Year	Landings (t)	Source	SSB (t)	Source
2003	1010	WG Estimate	3880	XSA
2004	950 (0.18)	SQ Forecast	3680 (0.08)	SQ Forecast
2005	940 (0.21)	SQ Forecast	3710 (0.14)	SQ Forecast

2006	-	-	3890 (0.19)	SQ Forecast

Assuming *status quo* F landings are predicted to be around 950t in 2004 and 940t in 2005 and SSB is predicted to be around 3710t in 2005 and 3890t in 2006.

The proportional contributions of recent year classes to catch in 2005 and SSB in 2006 are given in Table 12.9.4. The contribution of the 2003 year class for which GM recruitment is assumed for the landings in 2005 and the SSB in 2006 is 8% and 19% respectively. The 2002 year class, for which the RCT3 estimate used was based on one observation, and contributes of 22% to the landings in 2005 and 18% to the SSB in 2006.

A sensitivity analysis was carried out (see section 2.7). The input values are presented in Table 12.9.1. Figure 12.9.2 shows the sensitivity of the forecast of the predicted yields in 2005 and the predicted biomasses in 2006 to the input parameters. They also show the partial variances (proportions), and how the variability in the input parameters contributes to the variance of the predicted yield and biomasses. The variability of the year effect on fishing mortality for 2005 has a major effect on the sensitivity of the yield in 2005. The variance of the yield in 2005 is mostly determined by the uncertainty and magnitude of the year effect on the fishing mortality. The variability of the recruitment estimate in 2005, has a major influence on the variance of SSB in 2006.

Probability profiles of SSB in 2005 assuming *status quo* F, and the probability that F in 2005 will exceed *status quo* F at different 2005 catch levels are given in Figure 12.9.3. The probability that SSB in 2006 will fall below B_{lim} (2800t) is about 8%. But the probability to fall below B_{pa} (3800t) is around 50%.

12.10 Medium-term predictions

Medium term predictions were carried out for a period of 10 years to estimate percentiles of the distribution of the predicted yields, SSB and recruitment. Medium term projections have been usually run using a Beverton-Holt stock recruitment relationship; however, this stock/recruitment model has always been poorly defined for this stock. Therefore random recruitment about the full time series was used. Input values of the numbers at age for the medium term analysis are the numbers at age from 2005 and presented in Tables 12.9.1

WGMTERMC was run for a range of F multipliers. Results over the entire 10 year projection are given in Figure 12.10.1 for the *status quo* projection. Since the WGMTERMC program doesn't support recruitment at age 2, all input files were modified by replacing age X by X-1. Figure 12.10.1 shows that, at current fishing mortality, there is little probability of SSB falling below Bpa (3800t) in the medium term.

12.11 Yield and biomass per recruit

Input data are presented in Table 12.9.1. Yield-per-recruit results, long-term yield and spawning biomass, conditional on the present exploitation pattern and assuming a *status quo* F in 2004 and 2005 are given in Table 12.11.2 and Figure 12.9.1. The stock-recruitment plot is given in Figure 12.11.1.

12.12 Reference Points

Results from the PA software are shown in Figure 12.12.1 and the position of historical levels of fishing mortality and spawning stock biomass against F_{pa} and B_{pa} values is shown in Figure 12.12.2.

Biological reference points are:

B_{lim} = 2800t	Basis: $B_{lim} = B_{loss}$ The lowest observed spawning stock in an earlier assessment.
B_{pa} = 3800t	Basis: $B_{pa} \sim B_{lim}$ * 1.4
F_{lim} = 0.4	Basis: F_{lim} = **F**$_{loss}$ Although poorly defined, based that there is evidence that fishing mortality in excess of 0.4 has led to a general stock decline and is only sustainable during periods of above-average recruitment.
F_{pa} = 0.3	Basis: F_{pa} be set at 0.30. This F is considered to have a high probability of avoiding F_{lim}.

Estimated reference points are:

F_{sq} = 0.28 $F_{0.1}$ = 0.14 F_{med} = 0.27 F_{high} = 0.67

12.13 Quality of assessment

Although misreporting of sole catches by area is suspected, and fleets constrained by quotas are likely to have been declaring landings only in line with expected quota uptake, there is no information on whether this constitutes a serious problem for the assessment of this stock.

The absence of discard data is unlikely to affect the quality of the assessment as information from 2003 indicates that discarding ranges by weight between 0 and 5%.

Applying UK ALK's to the Belgian length distributions for the first 3 quarters should not undermine the assessment since both fleets are operating roughly in the same area of the Irish Sea, and using the same gear.

Sampling levels are considered to be sufficient for this stock.

The contribution of the 2003 year classes for which GM recruitment is assumed for the SSB in 2006 is 19%. The 2002 year class, for which the RCT3 estimate used was based on one observation only, and contributes 18% to the SSB in 2006. It should be noted that the UK(E&W) September beam trawl survey is dominating the estimates of the incoming year classes (74% of the weighting on the 2001 year class and 43% of the weighting of the 2002 year class). Up till now it has predicted the year class strength well.

The year class signals between tuning fleets showed good correspondence; apart for the 2001 year class where the commercial UK beam trawl fleet estimates the year class strength about 35% higher than the UK(E&W) September beam trawl survey.

F (4-7), SSB, and recruitment estimates have been consistent between successive assessments.

The Working Group considered that this stock would remain an update assessment for the next year.

12.14 Management considerations

Estimated mean F_{4-7} (0.28) in 2003 is just below F_{pa} (0.3). SSB is estimated to be close to Bpa.

The cumulative probability distribution from the sensitivity analysis (Figure 12.9.3, based on *status quo* F in 2004-2005) indicates the probability of the spawning biomass being below B_{pa} in 2006 is around 50%.

The *status quo* F medium term predictions indicate that the probability of SSB being below B_{pa} is low.

There is also no evidence to suggest that recruitment has been impaired at historically observed low levels of spawning biomass.

Table 12.1.3.1 Irish Sea Sole. Nominal landings (tonnes) as officially reported by ICES

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*
Belgium	930	987	915	1010	786	371	531	495	706	675	533	570	525	469	493	674	817	687
France	17	5	11	5	2	3	11	8	7	5	5	3	5 *	1 *	3	4	4	3
Ireland	235	312	366	155	170	198	164	98	226	176	133	130	134	120	135	135	96	n/a
Netherlands	-	-	-	-	-	-	-	-	-	-	149	123	60	46	60	-	-	-
UK (Engl.& Wales)[1]	637	599	507	613	569	581	477	338	409	424	194	189	161	165	133	...	...	...
UK (Isle of Man)	1	3	1	2	10	44	14	4	5	12	4	5	3	1	1	+	+	+
UK (N. Ireland)[1]	50	72	47															
UK (Scotland)	46	63	38	38	39	26	37	28	14	8	5	7	9	8	8	4	3	...
United Kingdom																195	165	220
Total	1,916	2,041	1,885	1,823	1,576	1,223	1,234	971	1,367	1,300	1,023	1,027	897	810	833	1,012	1,085	910
Unallocated	79	767	114	10	7	-11	25	52	7	-34	-21	-24	14	54	-15	41	2	100
Total used by Working Group in Assessment	1,995	2,808	1,999	1,833	1,583	1,212	1,259	1,023	1,374	1,266	1,002	1,003	911	863	818	1,053	1,087	1,010

* Preliminary

[1] 1989 onwards: N. Ireland included with England & Wales

Table 12.2.1 Sole in VIIa. Effort and CPUE series.

	CPUE							Effort				
	Belgium[1]	UK(E+W)[3]		UK[5]		Ireland		Belgium[2]	UK(E+W)[4]		Ireland[6]	
	beam	otter	beam	beam survey		otter	beam	beam	beam	otter	otter	beam
Year	Whole year	Whole year	Whole year	Sept	March	Whole year	Whole year	Whole year	Whole year	Whole year	Whole Year	Whole Year
1972	-	1.06	-	-	-	-	-	-	-	128.4	-	-
1973	-	1.06	-	-	-	-	-	-	-	147.6	-	-
1974	-	1.09	-	-	-	-	-	-	-	115.2	-	-
1975	49.2	1.39	-	-	-	-	-	12.3	-	130.7	-	-
1976	48.7	0.94	-	-	-	-	-	11.8	-	122.3	-	-
1977	40.8	0.80	-	-	-	-	-	10.7	-	101.9	-	-
1978	31.8	1.04	34.32	-	-	-	-	9.9	0.9	89.1	-	-
1979	60.6	1.43	32.01	-	-	-	-	11.2	1.7	89.9	-	-
1980	54.1	1.01	31.70	-	-	-	-	16.7	4.3	107.0	-	-
1981	35.8	0.75	21.32	-	-	-	-	22.6	6.4	107.1	-	-
1982	29.9	0.53	29.94	-	-	-	-	19.5	5.5	127.2	-	-
1983	19.4	0.57	37.31	-	-	-	-	20.5	2.8	88.1	-	-
1984	32.7	0.71	16.24	-	-	-	-	12.0	4.1	103.1	-	-
1985	28.3	0.56	17.34	-	-	-	-	19.6	7.4	102.9	-	-
1986	22.4	0.84	19.23	-	-	-	-	38.0	17.0	90.3	-	-
1987	21.2	0.77	14.82	-	-	-	-	43.2	22.0	130.6	-	-
1988	26.7	0.46	11.81	158.7	-	-	-	30.5	18.6	132.0	-	-
1989	27.2	0.70	9.17	145.9	-	-	-	34.0	25.3	139.5	-	-
1990	20.6	0.61	9.52	190.1	-	-	-	36.1	31.0	117.1	-	-
1991	23.2	1.12	10.43	170.5	-	-	-	13.8	25.8	107.3	-	-
1992	20.2	1.02	9.50	158.3	-	-	-	23.9	23.4	96.8	-	-
1993	19.5	0.54	7.60	97.3	104.7	-	-	24.5	21.5	78.9	-	-
1994	20.0	0.74	11.76	107.7	91.9		-	31.0	20.1	43.0	-	-
1995	19.7	0.95	14.96	89.5	79.3	0.38	12.69	26.2	20.9	43.1	80.3	8.64
1996	19.0	0.53	9.44	86.8	-	0.25	14.94	21.6	13.3	42.2	64.8	6.26
1997	17.9	0.73	10.49	151.2	63.3	0.23	8.53	28.5	10.8	39.9	92.2	9.86
1998	20.1	0.48	8.42	140.8	89.3	0.38	7.77	23.3	10.4	36.9	93.5	11.58
1999	20.4	0.60	9.94	107.3	-	0.29	9.22	21.7	11.0	22.9	110.3	14.67
2000	19.6	0.44	12.90	122.6	-	0.29	8.49	18.6	6.3	27.0	82.7	11.42
2001	18.2	0.15	11.72	96.9	-	0.38	7.86	30.5	12.5	32.8	77.5	13.13
2002	18.2	1.48	16.73	76.0	-	0.32	4.67	38.6	8.0	24.8	77.9	17.67
2003*	18.3	0.15	13.20	89.0	-	0.25	4.29	24.5	14.0	23.9	76.4	21.84

All CPUE values in Kg/hr except UK beam survey (Kg/100 km)

[1]Kg/000'hr corrected for fishing power using P = 0.000204 BHP^1.23

[2]000' hours fishing corrected for fishing power using P = 0.000204 BHP^1.23

[3]Kg/000'hr fished (GRT corrected > 40' vessels)

[4]000'hours fished (GRT corrected > 40' vessels)

[5]Kg/100km fished

[6] 000'hours

* Provisional

Table 12.2.2 Sole in VIIa. Available tuning data

Belgian beam trawl * Effort = hours fishing corrected for fishing power using P = 0.000204 BHP^1.23

1975	2003												
1	1	0	1										
3	14												
12.3	327	1045	275	393	69	105	94	61	72	11	15	64
11.8	62	568	1066	80	263	64	58	35	5	56	5	5
10.7	112	434	307	509	76	93	45	23	20	2	35	32
9.9	197	169	304	155	258	41	90	12	29	12	7	17
11.2	411	1455	510	323	193	162	37	36	9	41	0	0
16.7	403	958	1644	296	268	247	210	30	64	31	14	7
22.6	204	909	721	998	62	92	44	161	13	92	10	8
19.5	56	451	608	378	394	52	64	11	29	24	5	0
20.5	8	259	310	394	238	216	44	38	28	49	3	26
12.0	299	107	204	143	188	91	121	2	1	4	14	0
19.6	692	606	171	186	99	150	125	83	27	13	4	23
38.0	1221	1531	468	138	135	90	104	69	69	20	8	21
43.2	922	1527	881	297	167	69	39	54	59	40	13	9
30.5	118	2027	1012	480	21	33	37	34	42	35	0	7
34.0	242	376	2423	751	250	59	15	9	2	14	0	1
36.1	419	307	223	1263	276	142	13	9	11	11	8	5
13.8	120	253	78	60	588	115	40	16	1	1	11	3
23.9	951	298	330	68	40	203	93	36	12	0	0	0
24.5	196	862	253	149	89	79	160	66	77	0	0	0
31.0	336	680	786	164	103	39	117	58	19	15	0	7
26.2	324	729	366	410	52	27	6	28	15	6	11	3
21.6	247	537	334	241	219	53	13	11	14	9	7	2
28.5	350	270	376	180	162	134	28	27	15	9	8	1
23.3	916	248	146	142	89	73	62	20	20	9	10	3
21.7	578	693	199	65	50	37	21	17	9	6	4	6
18.6	542	685	220	107	31	15	33	13	7	9	0.6	8
30.5	655	600	284	248	39	35	44	33	1	3	0.2	4
38.6	379	1138	814	349	109	30	9	2	1	1	1	0
24.5	191	397	348	216	108	155	19	10	13	0	14	30

UK September beam trawl survey Effort = Total distance towed

1988	2003								
1	1	0.75	0.85						
1	9								
100.062	118	196	180	410	76	40	4	0	4
129.710	218	304	180	74	284	56	32	8	6
128.969	1712	534	122	42	88	194	40	20	6
123.780	148	1286	122	26	16	14	55	19	7
129.525	220	309	657	142	34	22	7	75	17
131.192	83	330	143	211	40	17	7	16	36
124.892	60	408	203	73	132	49	11	13	6
124.336	249	148	243	106	29	65	12	6	4
127.486	851	119	30	85	44	25	29	7	2
132.860	1158	593	75	23	57	27	16	30	8
129.339	538	706	291	18	6	23	23	5	18
125.263	285	247	242	194	28	8	26	5	6
123.225	265	454	158	210	114	35	13	2	14
127.301	83	241	200	91	90	70	32	4	8
120.260	183	64	105	107	57	59	54	28	0
119.889	204	191	47	90	76	36	38	26	1

UK March beam trawl survey Effort = Total distance towed

1993	1999								
1	1	0.15	0.25						
1	9								
126.931	18	337	147	332	73	15	17	10	41
115.442	8	354	208	69	151	51	14	11	9
126.189	24	96	186	140	30	104	27	10	8
134.343	651	114	49	110	78	32	54	10	12
121.742	130	417	33	17	69	23	11	46	17
130.081	47	421	330	39	19	48	27	12	37
130.822	45	227	284	177	14	4	34	12	7

Table 12.2.2 Sole in VIIa.Continued

UK Beam trawl Effort = hours fished (GRT corrected > 40' vessels)

1991	2003												
1	1	0	1										
2	14												
25.838	267	426	212	84	58	218	53	34	4	1	2	1	0
23.399	36	460	176	68	37	32	121	34	38	3	1	0	0
21.503	11	74	355	98	36	48	25	34	13	22	5	2	4
20.145	24	228	150	234	87	17	25	19	42	10	17	1	0
20.392	47	239	231	130	199	55	11	22	5	34	10	11	3
13.320	0	13	109	98	49	100	37	9	8	6	14	8	3
10.760	0	111	50	81	58	24	46	34	12	12	0	8	1
10.386	43	219	40	28	49	31	12	22	11	9	2	1	0
11.016	53	115	134	12	15	25	10	9	14	9	0	1	2
6.275	16	90	84	82	9	6	10	5	5	7	2	1	1
12.495	33	184	100	145	107	12	4	17	12	10	6	4	2
8.017	4	63	152	50	79	47	5	4	6	3	1	1	1
13.996	28	63	178	149	78	52	72	7	5	8	3	7	14

UK otter trawl ** Effort = hours fished (GRT corrected > 40' vessels)

1991	2003												
1	1	0	1										
2	14												
107.3	265.0	155.3	63.2	29.3	19.2	70.9	19.9	10.8	2.1	0.3	0.9	0.5	0.7
96.8	15.7	223.8	68.8	22.2	15.8	10.1	35.5	10.0	10.0	0.6	0.4	0.1	0.0
78.9	9.1	27.0	77.2	18.6	2.9	6.7	3.7	5.3	1.0	2.4	0.3	0.1	0.0
43.0	3.8	65.8	33.6	49.8	19.9	3.0	3.5	3.5	6.6	1.0	2.2	0.0	0.0
43.1	17.4	50.1	33.9	14.7	24.1	6.8	0.9	1.9	0.4	2.0	1.2	1.0	0.4
42.2	1.6	5.1	18.4	12.3	6.7	12.1	4.0	1.2	0.9	0.9	1.4	1.2	0.5
39.9	13.6	15.3	7.1	13.5	8.6	3.4	6.8	3.1	1.1	1.1	0.2	1.3	0.2
36.9	4.6	24.3	5.1	3.2	4.9	2.9	1.5	2.3	1.4	0.8	0.4	0.2	0.1
22.8	5.4	14.5	12.0	1.5	0.3	2.0	1.0	0.5	1.2	0.5	0.0	0.1	0.0
27.0	2.4	11.6	9.2	7.5	1.2	0.4	1.2	0.5	0.1	0.4	0.2	0.1	0.1
32.9	2.8	9.7	5.7	7.8	5.1	0.4	0.2	0.4	0.1	0.1	0.1	0.3	0.2
24.8	0.7	8.3	15.6	3.0	5.4	2.6	0.5	0.3	0.7	0.2	0.1	0.1	0.1
23.9	0.5	1.7	6.1	4.3	1.6	1.2	2.0	0.2	0.0	0.2	0.1	0.2	0.3

IR-OTB : Irish Otter trawl ** Effort =hours fished

1995	2003								
1	1	0	1						
2	10								
80314	6.8	17.7	25.5	9.2	25.8	3.6	0.8	1.5	1.9
64824	0.0	5.7	12.9	12.7	4.7	4.7	2.2	0.2	0.0
92178	27.8	10.2	4.1	9.2	6.4	3.5	3.9	1.0	0.2
93533	5.5	40.7	14.7	6.6	12.3	5.4	2.7	4.1	1.0
110275	26.6	36.8	30.9	5.1	3.8	5.3	2.4	0.5	1.2
82690	1.6	13.2	13.4	11.0	3.4	1.1	1.0	0.4	0.0
77541	0.2	6.1	18.6	18.6	10.8	2.1	4.1	1.3	0.3
77863	18.4	13.4	17.0	8.6	4.5	1.6	1.4	0.7	0.3
76368	0.9	32.1	18.4	8.3	2.5	0.4	0.6	0.2	0.1

IRGFS : Irish Groundfish Survey (Celtic Explorer) **

2003	2003										
1	1.0	0.9	0.9								
0	10.0										
1	1	8	18	12	7	5	2	2	3	0	2

*** Age 3 not used in final XSA tuning**
**** Tuning series not used in final XSA**

Tabel 12.3.1 Sole in VIIa. Catch numbers at age.

Run title : IRISH SEA SOLE 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:01

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

YEAR	1970	1971	1972	1973
AGE				
2	29	113	31	368
3	895	434	673	363
4	1009	2097	730	2195
5	467	1130	1537	557
6	1457	232	537	815
7	289	878	172	267
8	228	141	522	112
9	803	106	97	329
+gp	1506	1640	881	702
0 TOTALNUM	6683	6771	5180	5708
TONSLAND	1785	1882	1450	1428
SOPCOF %	100	100	100	100

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

YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE										
2	25	262	29	221	65	108	187	70	8	37
3	891	733	375	416	958	1027	939	580	346	165
4	576	2386	1332	1292	649	3433	1968	1668	1241	998
5	1713	539	2330	774	1009	829	3055	1480	1298	758
6	383	842	247	1066	442	637	521	1640	711	757
7	422	157	544	150	638	326	512	114	641	416
8	232	227	134	218	98	285	361	184	91	334
9	58	158	151	89	204	65	352	86	113	69
+gp	681	621	454	341	285	270	432	595	193	306
0 TOTALNUM	4981	5925	5596	4567	4348	6980	8327	6417	4642	3840
TONSLAND	1307	1441	1463	1147	1106	1614	1941	1667	1338	1169
SOPCOF %	100	100	100	100	100	100	100	100	100	100

1

Run title : IRISH SEA SOLE 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:01

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

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE										
2	651	154	141	189	32	179	564	1317	363	83
3	786	1601	3336	3348	444	771	1185	1270	2433	543
4	380	1086	3467	4105	4752	775	986	841	918	1966
5	610	343	961	3185	2102	3978	598	300	556	559
6	343	334	235	844	1310	1178	2319	226	190	251
7	424	164	277	307	203	552	592	1173	156	199
8	178	259	210	224	83	121	333	255	523	147
9	251	188	187	139	76	23	38	125	217	257
+gp	128	292	451	445	357	111	95	79	189	282
0 TOTALNUM	3751	4421	9265	12786	9359	7688	6710	5586	5545	4287
TONSLAND	1058	1146	1995	2808	1999	1833	1583	1212	1259	1023
SOPCOF %	100	100	100	100	100	100	100	100	100	100

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

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
2	122	132	60	789	167	301	88	442	108	287
3	1342	920	469	713	1728	1069	1013	995	549	572
4	1069	1444	1188	474	466	1258	1180	922	1498	911
5	1578	737	741	710	256	297	556	608	961	759
6	394	1010	430	408	315	115	190	475	486	381
7	133	179	509	258	191	136	66	69	177	223
8	98	62	142	295	126	82	53	62	46	283
9	141	48	49	85	150	37	63	73	17	37
+gp	285	240	156	151	147	113	108	97	26	157
0 TOTALNUM	5162	4772	3744	3883	3546	3408	3317	3743	3868	3610
TONSLAND	1374	1266	1002	1003	911	863	818	1053	1087	1010
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 12.3.2 Sole in VIIa. Catch weights at age.

Run title : IRISH SEA SOLE 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:01

Table 2 Catch weights at age (kg)

	YEAR	1970	1971	1972	1973
	AGE				
	2	0.13	0.152	0.126	0.151
	3	0.153	0.178	0.164	0.178
	4	0.178	0.204	0.201	0.204
	5	0.204	0.23	0.237	0.23
	6	0.232	0.257	0.272	0.256
	7	0.26	0.284	0.306	0.283
	8	0.29	0.312	0.338	0.309
	9	0.321	0.34	0.369	0.335
	+gp	0.4199	0.4338	0.469	0.4317
0	SOPCOF/	1	0.9997	1.0004	0.9999

Table 2 Catch weights at age (kg)

	YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
	AGE										
	2	0.138	0.13	0.12	0.085	0.093	0.134	0.146	0.162	0.112	0.189
	3	0.174	0.172	0.161	0.146	0.147	0.165	0.169	0.183	0.171	0.212
	4	0.209	0.21	0.2	0.202	0.197	0.199	0.193	0.207	0.225	0.238
	5	0.241	0.244	0.239	0.251	0.243	0.234	0.219	0.234	0.275	0.266
	6	0.272	0.275	0.276	0.293	0.286	0.271	0.247	0.264	0.321	0.298
	7	0.301	0.303	0.313	0.33	0.326	0.311	0.275	0.296	0.362	0.332
	8	0.328	0.327	0.348	0.36	0.361	0.352	0.305	0.331	0.399	0.369
	9	0.353	0.347	0.383	0.384	0.394	0.395	0.337	0.369	0.432	0.41
	+gp	0.4223	0.3869	0.5145	0.4051	0.4782	0.5683	0.478	0.5014	0.4977	0.5652
0	SOPCOF/	1	0.9999	0.9996	0.9996	0.9997	0.9997	1.0007	1.0002	1.0002	0.9997
	1										

Run title : IRISH SEA SOLE 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:01

Table 2 Catch weights at age (kg)

	YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	AGE										
	2	0.191	0.144	0.122	0.135	0.111	0.125	0.135	0.133	0.149	0.102
	3	0.225	0.189	0.164	0.164	0.147	0.163	0.162	0.172	0.177	0.156
	4	0.257	0.231	0.203	0.196	0.183	0.201	0.192	0.208	0.207	0.205
	5	0.288	0.272	0.241	0.231	0.218	0.237	0.227	0.241	0.239	0.248
	6	0.318	0.31	0.277	0.268	0.252	0.271	0.265	0.272	0.274	0.285
	7	0.347	0.346	0.311	0.308	0.286	0.304	0.307	0.3	0.31	0.318
	8	0.374	0.38	0.344	0.35	0.319	0.336	0.354	0.326	0.349	0.345
	9	0.4	0.412	0.375	0.395	0.352	0.366	0.404	0.349	0.39	0.366
	+gp	0.473	0.485	0.4497	0.5385	0.4562	0.4508	0.6281	0.4013	0.4485	0.387
0	SOPCOF/	0.9998	0.9994	0.9994	0.9998	0.999	1.0001	1.0004	0.9995	0.9992	0.9994

Table 2 Catch weights at age (kg)

	YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	AGE										
	2	0.175	0.129	0.156	0.154	0.187	0.179	0.143	0.2	0.127	0.175
	3	0.198	0.182	0.193	0.197	0.209	0.217	0.19	0.24	0.192	0.217
	4	0.227	0.232	0.228	0.237	0.234	0.252	0.235	0.276	0.253	0.256
	5	0.261	0.277	0.263	0.275	0.263	0.285	0.276	0.309	0.31	0.29
	6	0.301	0.318	0.296	0.311	0.295	0.314	0.315	0.338	0.361	0.32
	7	0.346	0.356	0.327	0.345	0.331	0.341	0.351	0.364	0.408	0.347
	8	0.397	0.389	0.358	0.376	0.369	0.365	0.384	0.387	0.451	0.369
	9	0.453	0.419	0.387	0.406	0.411	0.387	0.415	0.406	0.489	0.388
	+gp	0.5757	0.473	0.4654	0.4675	0.5302	0.4279	0.4888	0.4322	0.5475	0.4152
0	SOPCOF/	1.0007	0.9998	1.0003	1.0015	1	1.0005	0.9999	1.0021	1	0.9994

Table 12.3.3 Sole in VIIa. Stock weights at age.

Run title : IRISH SEA SOLE 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:01

Table 3 Stock weights at age (kg)

YEAR	1970	1971	1972	1973
AGE				
2	0.118	0.139	0.106	0.138
3	0.141	0.165	0.145	0.164
4	0.166	0.191	0.183	0.191
5	0.191	0.217	0.219	0.217
6	0.218	0.244	0.255	0.243
7	0.246	0.271	0.289	0.27
8	0.275	0.298	0.322	0.296
9	0.305	0.326	0.354	0.322
+gp	0.4025	0.4188	0.4559	0.4187

Table 3 Stock weights at age (kg)

YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE										
2	0.119	0.108	0.1	0.052	0.065	0.119	0.135	0.152	0.081	0.179
3	0.156	0.151	0.141	0.116	0.12	0.149	0.157	0.172	0.142	0.2
4	0.192	0.191	0.181	0.175	0.172	0.182	0.181	0.195	0.198	0.224
5	0.225	0.228	0.22	0.227	0.22	0.216	0.206	0.22	0.251	0.252
6	0.257	0.26	0.258	0.273	0.265	0.252	0.233	0.249	0.299	0.282
7	0.287	0.29	0.295	0.312	0.306	0.291	0.261	0.28	0.342	0.315
8	0.315	0.315	0.331	0.346	0.344	0.331	0.29	0.313	0.381	0.35
9	0.341	0.338	0.366	0.373	0.378	0.373	0.321	0.35	0.416	0.389
+gp	0.4126	0.3842	0.4997	0.4064	0.4697	0.5428	0.4588	0.4783	0.4877	0.5399
1										

Run title : IRISH SEA SOLE 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:01

Table 3 Stock weights at age (kg)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE										
2	0.174	0.121	0.101	0.121	0.093	0.105	0.123	0.113	0.135	0.073
3	0.208	0.167	0.143	0.149	0.129	0.144	0.148	0.153	0.162	0.13
4	0.241	0.21	0.183	0.18	0.165	0.182	0.176	0.19	0.192	0.181
5	0.273	0.252	0.222	0.213	0.2	0.219	0.209	0.225	0.223	0.227
6	0.303	0.291	0.259	0.249	0.235	0.254	0.245	0.257	0.256	0.267
7	0.332	0.328	0.294	0.287	0.269	0.288	0.286	0.286	0.292	0.302
8	0.36	0.363	0.328	0.328	0.302	0.32	0.33	0.313	0.33	0.332
9	0.387	0.396	0.36	0.372	0.335	0.351	0.378	0.337	0.369	0.356
+gp	0.4617	0.4727	0.4367	0.512	0.4409	0.4386	0.5958	0.3948	0.4262	0.3837

Table 3 Stock weights at age (kg)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
2	0.165	0.101	0.136	0.132	0.177	0.159	0.119	0.179	0.092	0.152
3	0.186	0.156	0.174	0.176	0.198	0.199	0.167	0.221	0.16	0.196
4	0.212	0.207	0.211	0.217	0.221	0.235	0.213	0.259	0.223	0.237
5	0.243	0.255	0.246	0.257	0.248	0.269	0.256	0.293	0.282	0.273
6	0.28	0.298	0.279	0.294	0.279	0.3	0.296	0.324	0.336	0.306
7	0.323	0.338	0.312	0.328	0.312	0.328	0.334	0.352	0.385	0.334
8	0.371	0.373	0.343	0.361	0.349	0.354	0.368	0.376	0.385	0.358
9	0.424	0.405	0.372	0.391	0.39	0.377	0.4	0.397	0.43	0.379
+gp	0.5416	0.4642	0.4534	0.456	0.5046	0.4213	0.4788	0.4273	0.5337	0.4144

Table 12.3.4 Sole in VIIa Annual lenght distributions by fleet (2003)

	UK (England & Wales)		Belgium	Ireland
Length (cm)*	Beam trawl	All gears (minus beam)	All gears	All gears
21				90
22	176	55		102
23	7001	453	24994	227
24	40734	1954	168194	2306
25	94651	2616	211871	4203
26	56199	4125	175752	6358
27	79057	5635	161464	6168
28	78141	6105	151170	4973
29	69329	7312	122960	9112
30	54524	7492	131364	5926
31	60985	9109	87419	3319
32	50852	7940	84701	5024
33	31560	4433	63139	3933
34	28091	1512	48343	9075
35	21422	1607	42270	3631
36	15294	470	36725	3788
37	13218	214	33475	13771
38	6899	72	21317	14192
39	5319	539	12445	21971
40	5360	32	12440	18885
41	2509	51	8953	11599
42	1819	10	6777	8569
43	824	82	3785	9584
44	425	0	2196	11194
45	684	0	1131	6955
46	329	0	635	7364
47	845	10	635	7963
48	141			4124
49	0			3996
50	0			1741
51	0			1156
52	10			574
53				344
54				230
55				560
56				367
57				361
58				423
Total	726398	61828	1614155	214159

* Lower limit for UK and Ireland, nearest for Belgium.

Table 12.5.3.1 Sole in VIIa. Tuning diagnostics.

```
Lowestoft VPA Version 3.1

   30/04/2004  12:00

 Extended Survivors Analysis

 IRISH SEA SOLE,2004 WG,COMBSEX,PLUSGROUP.

 CPUE data from file D:\2004\Northern Shelf\2004\VPA_XSA\sol7atn.dat

 Catch data for  34 years. 1970 to 2003. Ages  2 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,     year, year,  age ,  age
 BELGIUM BEAM TRAWL  ,   1975, 2003,   4,     9,   .000,  1.000
 UK Sept beam survey ,   1988, 2003,   1,     9,   .750,   .850
 UK March beam survey,   1993, 2003,   1,     9,   .150,   .250
 UK BEAM TRAWL       ,   1991, 2003,   2,     9,   .000,  1.000


 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years


 Catchability analysis :

      Catchability independent of stock size for all ages

      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 =    .800

      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 =     .00247

 Final year F values
 Age         ,      2,      3,      4,      5,      6,      7,      8,      9
 Iteration 29,  .0782,  .4836,  .3545,  .2883,  .3253,  .1556,  .2282,  .2948
 Iteration 30,  .0782,  .4834,  .3543,  .2880,  .3250,  .1554,  .2278,  .2940


 Regression weights
       ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000
```

Table 12.5.3.1 Sole in VIIa. Continued.

Fishing mortalities

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	.024	.063	.023	.097	.025	.052	.012	.097	.063	.078
3	.285	.226	.298	.373	.284	.193	.223	.170	.151	.483
4	.390	.499	.450	.490	.395	.307	.301	.290	.369	.354
5	.385	.451	.457	.471	.473	.418	.193	.223	.491	.288
6	.358	.404	.459	.435	.349	.357	.456	.224	.250	.325
7	.404	.244	.324	.488	.331	.223	.318	.264	.109	.155
8	.363	.296	.277	.281	.414	.206	.114	.492	.252	.228
9	.680	.271	.358	.237	.202	.182	.216	.202	.214	.294

XSA population numbers (Thousands)

	AGE							
YEAR	2	3	4	5	6	7	8	9
1994	5.41E+03	5.68E+03	3.48E+03	5.19E+03	1.38E+03	4.21E+02	3.38E+02	3.01E+02
1995	2.26E+03	4.78E+03	3.86E+03	2.13E+03	3.20E+03	8.70E+02	2.54E+02	2.13E+02
1996	2.72E+03	1.92E+03	3.45E+03	2.12E+03	1.23E+03	1.93E+03	6.17E+02	1.71E+02
1997	8.95E+03	2.41E+03	1.29E+03	1.99E+03	1.22E+03	7.03E+02	1.26E+03	4.23E+02
1998	7.24E+03	7.35E+03	1.50E+03	7.14E+02	1.12E+03	7.12E+02	3.91E+02	8.63E+02
1999	6.19E+03	6.40E+03	5.01E+03	9.15E+02	4.02E+02	7.17E+02	4.63E+02	2.34E+02
2000	7.48E+03	5.32E+03	4.77E+03	3.33E+03	5.45E+02	2.55E+02	5.19E+02	3.41E+02
2001	5.02E+03	6.68E+03	3.85E+03	3.19E+03	2.49E+03	3.12E+02	1.68E+02	4.19E+02
2002	1.85E+03	4.13E+03	5.10E+03	2.61E+03	2.31E+03	1.80E+03	2.17E+02	9.28E+01
2003	4.01E+03	1.57E+03	3.21E+03	3.19E+03	1.44E+03	1.63E+03	1.46E+03	1.53E+02

Estimated population abundance at 1st Jan 2004

	0.00E+00	3.36E+03	8.76E+02	2.04E+03	2.17E+03	9.45E+02	1.26E+03	1.05E+03

Taper weighted geometric mean of the VPA populations:

	4.97E+03	4.42E+03	3.50E+03	2.20E+03	1.31E+03	8.10E+02	4.94E+02	2.89E+02

Standard error of the weighted Log(VPA populations) :

	.5445	.5717	.5420	.6252	.6811	.7188	.7313	.7279

Log catchability residuals.

Fleet : BELGIUM BEAM TRAWL

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983
2	No data for this fleet at this age								
3	No data for this fleet at this age								
4	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
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Table 12.5.3.1 Sole in VIIa. Continued.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	-.23	.25	-.47	-.50	-.41	-.40	-.44	.28	-.46	-.30
5	.39	.15	-.15	-.50	.07	.19	-.47	-.29	.61	-.20
6	.54	.27	-.28	.06	.00	.27	.10	-.36	-.60	.39
7	.65	.10	-.22	.52	-1.34	-.10	-.20	.92	-.95	.10
8	.22	.42	-.15	-.34	.20	.31	-.10	.39	-.14	.13
9	.56	.42	-.10	-.35	.13	-.05	-.59	.17	.12	.05

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	.07	.25	.23	.27	.19	.04	.23	-.19	-.03	-.17
5	-.17	.15	.26	.17	.45	.56	-.58	-.76	.38	-.31
6	-.42	-.16	.48	-.09	-.08	.24	.63	-.65	-.46	.02
7	.32	-1.00	-.13	.38	-.10	-.67	.09	-.41	-1.44	-.87
8	-.45	-.40	-.43	-.49	.34	-.54	-1.45	.21	-.55	-.36
9	.90	-1.74	-.51	-.99	-.72	-.43	-.19	-.61	-.92	-.17

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	-4.9004	-4.9161	-4.9161	-4.9161	-4.9161	-4.9161
S.E(Log q)	.2583	.4456	.4092	.7246	.5829	.7571

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	1.24	-1.437	4.10	.77	20	.31	-4.90
5	1.64	-2.073	3.14	.51	20	.64	-4.92
6	1.40	-1.730	4.08	.65	20	.52	-4.96
7	1.23	-.684	4.93	.47	20	.80	-5.25
8	1.10	-.433	5.11	.65	20	.56	-5.21
9	.86	.610	5.39	.66	20	.54	-5.34

Fleet : UK Sept beam survey

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	99.99	99.99	99.99	.07	.12	.44	.55	.02	-.17
3	99.99	99.99	99.99	99.99	.59	.43	.02	-.23	.56	-.15
4	99.99	99.99	99.99	99.99	.21	.05	-.22	-.74	.52	.01
5	99.99	99.99	99.99	99.99	-.18	.24	.84	-.61	.20	-.25
6	99.99	99.99	99.99	99.99	-.10	-.13	.50	-.55	.04	.06
7	99.99	99.99	99.99	99.99	-.63	.04	.11	-.11	-.92	-.61
8	99.99	99.99	99.99	99.99	99.99	.57	.22	-.13	.67	.35
9	99.99	99.99	99.99	99.99	.26	1.18	.88	-.27	.25	.34

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	.26	.16	-.31	.13	.48	-.36	.05	-.15	-.45	-.12
3	.12	.43	-.72	-.01	.18	.10	-.10	-.17	-.29	.14
4	-.13	.23	.06	-.28	-.72	.41	.55	-.11	-.11	.17
5	.14	-.43	-.02	.27	-.93	.35	.30	.10	.11	.04
6	.46	-.06	-.04	-.02	-.14	-.13	1.14	.10	.08	.12
7	.19	-.58	-.45	.05	.30	.37	.80	1.42	.13	-.09
8	.54	.00	-.77	-.07	-.56	-.86	-1.95	.14	1.70	-.30
9	.14	-.25	-.68	-.33	-.24	-.01	.50	-.31	99.99	-1.25

Table 12.5.3.1 Sole in VIIa. Continued.

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-7.5741,	-7.9679,	-8.1668,	-8.2541,	-8.2541,	-8.2541,	-8.2541,	-8.2541,
S.E(Log q),	.3033,	.3237,	.3826,	.4092,	.4024,	.6213,	.9163,	.5844,

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,	.76,	2.161,	7.80,	.89,	16,	.20,	-7.57,
3,	.82,	1.284,	8.04,	.83,	16,	.26,	-7.97,
4,	.70,	2.334,	8.16,	.86,	16,	.23,	-8.17,
5,	.79,	1.355,	8.14,	.81,	16,	.31,	-8.25,
6,	1.10,	-.507,	8.24,	.73,	16,	.44,	-8.14,
7,	1.81,	-1.956,	9.34,	.37,	16,	.99,	-8.16,
8,	1.45,	-.802,	9.33,	.25,	15,	1.34,	-8.36,
9,	.90,	.393,	8.11,	.63,	15,	.54,	-8.38,

Fleet : UK March beam survey

Age ,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
2 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.09
3 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.02
4 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.43
5 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.29
6 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	-.21
7 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.14
8 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	-.22
9 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.42

Age ,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003
2 ,	.40,	-.11,	-.20,	.03,	.17,	-.30,	99.99,	99.99,	99.99,	99.99
3 ,	.24,	.20,	-.27,	-.78,	.32,	.29,	99.99,	99.99,	99.99,	99.99
4 ,	-.22,	.31,	.11,	-.66,	-.07,	.21,	99.99,	99.99,	99.99,	99.99
5 ,	.22,	-.58,	.32,	.36,	.03,	-.54,	99.99,	99.99,	99.99,	99.99
6 ,	.46,	.25,	-.03,	-.25,	.48,	-.98,	99.99,	99.99,	99.99,	99.99
7 ,	.36,	.17,	.02,	-.43,	.36,	.55,	99.99,	99.99,	99.99,	99.99
8 ,	.33,	.42,	-.54,	.37,	.16,	-.05,	99.99,	99.99,	99.99,	99.99
9 ,	.31,	.37,	.95,	.46,	.45,	.09,	99.99,	99.99,	99.99,	99.99

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-7.8543,	-8.2194,	-8.3476,	-8.4109,	-8.4109,	-8.4109,	-8.4109,	-8.4109,
S.E(Log q),	.2390,	.4208,	.3769,	.4169,	.5419,	.3821,	.3656,	.5467,

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,	.86,	.764,	7.95,	.88,	7,	.21,	-7.85,
3,	.59,	3.418,	8.28,	.95,	7,	.14,	-8.22,
4,	.67,	2.922,	8.24,	.95,	7,	.16,	-8.35,
5,	.80,	.845,	8.22,	.82,	7,	.34,	-8.41,
6,	.62,	2.251,	7.91,	.90,	7,	.25,	-8.47,
7,	1.21,	-.509,	8.58,	.59,	7,	.44,	-8.24,
8,	1.10,	-.279,	8.56,	.65,	7,	.44,	-8.34,
9,	1.06,	-.276,	8.09,	.86,	7,	.32,	-7.98,

Table 12.5.3.1 Sole in VIIa. Continued.

Fleet : UK BEAM TRAWL

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.62	-.34	-1.66
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.52	-.13	-1.01
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.24	-.20	-.30
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.12	-.22	-.29
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.29	-.46	-.17
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.02	-.42	.34
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.29	.09	-.16
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.11	-.14	-.64

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	-.64	.91	99.99	99.99	.31	.63	-.21	.26	-.42	.20
3	.00	.18	-1.36	.81	.37	-.24	.28	.05	-.11	.46
4	-.25	.12	-.12	.32	-.06	-.16	-.02	-.32	.30	.35
5	-.23	.09	.24	.34	.34	-.84	.24	.18	-.11	.13
6	.10	.09	.10	.48	.39	.17	-.03	.13	.36	.29
7	-.33	.03	.30	.17	.38	.05	.26	.04	.02	-.31
8	.26	-.32	.42	.14	.07	-.44	-.04	-.34	-.04	.15
9	.24	.54	.33	.91	-.22	.13	-.26	.06	.57	.11

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	-7.7156	-6.0346	-5.6649	-5.6436	-5.6436	-5.6436	-5.6436	-5.6436
S.E(Log q)	.6881	.5950	.2486	.3485	.2859	.2585	.2653	.4363

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	1.03	-.064	7.69	.37	11	.76	-7.72
3	.94	.184	6.18	.50	13	.59	-6.03
4	1.21	-1.137	5.13	.76	13	.30	-5.66
5	.87	.729	5.90	.79	13	.31	-5.64
6	.89	.942	5.68	.89	13	.22	-5.51
7	1.04	-.373	5.54	.89	13	.28	-5.59
8	.86	1.477	5.75	.93	13	.21	-5.68
9	1.51	-2.147	5.37	.67	13	.52	-5.49

Table 12.5.3.1 Sole in VIIa. Continued.

Terminal year survivor and F summaries :

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

Year class = 2001

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL ,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK Sept beam survey ,	2994.,	.316,	.000,	.00,	1,	.736,	.087
UK March beam survey,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK BEAM TRAWL ,	4099.,	.724,	.000,	.00,	1,	.140,	.064
F shrinkage mean ,	5322.,	.80,,,,				.124,	.050

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3360.,	.27,	.15,	3,	.556,	.078

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

Year class = 2000

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL E,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK Sept beam survey ,	743.,	.231,	.294,	1.27,	2,	.725,	.549
UK March beam survey,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK BEAM TRAWL ,	967.,	.472,	.432,	.92,	2,	.174,	.446
F shrinkage mean ,	2395.,	.80,,,,				.101,	.205

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
876.,	.20,	.24,	5,	1.184,	.483

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

Year class = 1999

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL E,	1723.,	.300,	.000,	.00,	1,	.223,	.407
UK Sept beam survey ,	1831.,	.201,	.132,	.66,	3,	.435,	.388
UK March beam survey,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK BEAM TRAWL ,	2682.,	.254,	.115,	.45,	3,	.297,	.280
F shrinkage mean ,	2190.,	.80,,,,				.045,	.333

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2040.,	.14,	.09,	8,	.653,	.354

Table 12.5.3.1 Sole in VIIa. Continued.

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

Year class = 1998

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL E,	1894.,	.256,	.136,	.53,	2,	.233,	.323
UK Sept beam survey ,	2076.,	.186,	.056,	.30,	4,	.391,	.299
UK March beam survey,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK BEAM TRAWL ,	2573.,	.213,	.077,	.36,	4,	.337,	.247
F shrinkage mean ,	1663.,	.80,,,,				.039,	.360

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2165.,	.12,	.06,	11,	.460,	.288

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

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL E,	963.,	.230,	.148,	.64,	3,	.223,	.319
UK Sept beam survey ,	903.,	.182,	.089,	.49,	5,	.307,	.337
UK March beam survey,	702.,	.304,	.000,	.00,	1,	.063,	.416
UK BEAM TRAWL ,	1021.,	.183,	.138,	.76,	5,	.371,	.304
F shrinkage mean ,	933.,	.80,,,,				.036,	.328

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
945.,	.11,	.06,	15,	.590,	.325

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

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL E,	913.,	.217,	.254,	1.17,	4,	.193,	.209
UK Sept beam survey ,	1548.,	.173,	.099,	.57,	6,	.274,	.128
UK March beam survey,	1548.,	.255,	.058,	.23,	2,	.079,	.128
UK BEAM TRAWL ,	1275.,	.156,	.126,	.81,	6,	.429,	.154
F shrinkage mean ,	748.,	.80,,,,				.025,	.250

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1264.,	.10,	.08,	19,	.871,	.155

Table 12.5.3.1 Sole in VIIa. Continued.

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL E,	664.,	.208,	.215,	1.04,	5,	.190,	.340
UK Sept beam survey ,	1251.,	.175,	.065,	.37,	7,	.227,	.195
UK March beam survey,	1230.,	.223,	.085,	.38,	3,	.086,	.198
UK BEAM TRAWL ,	1153.,	.142,	.054,	.38,	6,	.473,	.210
F shrinkage mean ,	781.,	.80,,,,				.024,	.296

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1054.,	.09,	.07,	22,	.770,	.228

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIUM BEAM TRAWL E,	107.,	.235,	.206,	.88,	6,	.177,	.283
UK Sept beam survey ,	123.,	.210,	.399,	1.90,	8,	.206,	.252
UK March beam survey,	72.,	.212,	.145,	.68,	4,	.069,	.396
UK BEAM TRAWL ,	99.,	.150,	.095,	.63,	7,	.510,	.304
F shrinkage mean ,	113.,	.80,,,,				.038,	.271

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
103.,	.10,	.11,	26,	1.091,	.294

Table 12.5.3.2 Sole in VIIa. Fishing mortality at age.

Run title : IRI 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:00

Table 8 Fishing mortality (F) at age

YEAR	1970	1971	1972	1973
AGE				
2	.0076	.0116	.0102	.0308
3	.1182	.1342	.0800	.1420
4	.2554	.3931	.3106	.3568
5	.4235	.4464	.4944	.3670
6	.3950	.3418	.3503	.4697
7	.4394	.3895	.4062	.2620
8	.4844	.3531	.3754	.4473
9	.4008	.3859	.3886	.3817
+gp	.4008	.3859	.3886	.3817
0 FBAR 4- 7	.3783	.3927	.3904	.3639

Table 8 Fishing mortality (F) at age

YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE										
2	.0043	.0414	.0073	.0143	.0072	.0132	.0378	.0167	.0035	.0067
3	.0873	.1487	.0692	.1241	.0716	.1355	.1361	.1416	.0964	.0838
4	.3114	.3147	.3885	.3188	.2586	.3479	.3672	.3371	.4460	.3894
5	.4618	.4745	.5093	.3637	.3916	.5387	.5263	.4600	.4228	.4770
6	.4109	.3839	.3675	.4092	.3241	.4071	.6848	.5293	.3713	.4143
7	.4202	.2617	.4068	.3539	.4071	.3740	.5913	.2716	.3587	.3435
8	.3392	.3717	.3314	.2514	.3662	.2851	.8097	.3860	.3219	.2856
9	.3899	.3623	.4019	.3403	.3505	.3918	.5983	.3980	.3853	.3831
+gp	.3899	.3623	.4019	.3403	.3505	.3918	.5983	.3980	.3853	.3831
0 FBAR 4- 7	.4011	.3587	.4180	.3614	.3453	.4169	.5424	.3995	.3997	.4061

1

Run title : IRI 2003 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:00

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE										
2	.0437	.0096	.0061	.0501	.0087	.0425	.1024	.1062	.0753	.0138
3	.1711	.1294	.2635	.1738	.1430	.2651	.3823	.3124	.2597	.1384
4	.2516	.3353	.4015	.5276	.3534	.3518	.5605	.4546	.3466	.3076
5	.3881	.3361	.4937	.6964	.4996	.4979	.4456	.2913	.5456	.3268
6	.3649	.3382	.3602	.9664	.6116	.5132	.5373	.2672	.2701	.4494
7	.3823	.2648	.4601	.9835	.5672	.4989	.4659	.5070	.2661	.4447
8	.2154	.3775	.5606	.7384	.6934	.6989	.5643	.3320	.3936	.3820
9	.3210	.3293	.4556	.7982	.5272	.3659	.4324	.3777	.4625	.3037
+gp	.3210	.3293	.4556	.7982	.5272	.3659	.4324	.3777	.4625	.3037
0 FBAR 4- 7	.3467	.3186	.4289	.7935	.5080	.4654	.5023	.3800	.3571	.3821

Table 8 Fishing mortality (F) at age

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	FBAR **-**
AGE											
2	.0240	.0635	.0234	.0972	.0245	.0524	.0125	.0971	.0634	.0782	.0795
3	.2854	.2263	.2976	.3729	.2838	.1932	.2234	.1703	.1507	.4834	.2681
4	.3899	.4989	.4501	.4895	.3952	.3066	.3012	.2901	.3694	.3543	.3379
5	.3849	.4514	.4572	.4708	.4732	.4176	.1927	.2233	.4905	.2880	.3340
6	.3583	.4036	.4587	.4349	.3493	.3572	.4564	.2240	.2498	.3250	.2662
7	.4039	.2438	.3242	.4876	.3311	.2225	.3179	.2642	.1091	.1554	.1762
8	.3635	.2962	.2771	.2814	.4143	.2061	.1136	.4919	.2520	.2278	.3239
9	.6796	.2709	.3583	.2373	.2017	.1822	.2161	.2022	.2139	.2940	.2367
+gp	.6796	.2709	.3583	.2373	.2017	.1822	.2161	.2022	.2139	.2940	
0 FBAR 4- 7	.3842	.3994	.4225	.4707	.3872	.3260	.3171	.2504	.3047	.2807	

Table 12.5.3.3 Sole in VIIa. Stock numbers at age

Run title : I 2004 WG COMBSEXPLUSGROUP.

At 30/04/2004 12:00

Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR	1970	1971	1972	1973
	AGE				
	2	4045	10292	3218	12771
	3	8437	3633	9205	2883
	4	4707	6782	2874	7689
	5	1422	3299	4142	1906
	6	4693	842	1910	2286
	7	854	2861	542	1218
	8	624	498	1753	326
	9	2557	348	317	1090
	+gp	4777	5365	2866	2317
0	TOTAL	32116	33921	26828	32486

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

	YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
	AGE										
	2	6191	6789	4172	16347	9484	8688	5299	4448	2393	5847
	3	11205	5578	5894	3747	14581	8520	7759	4617	3958	2158
	4	2263	9292	4350	4976	2995	12282	6732	6127	3626	3253
	5	4869	1500	6138	2669	3274	2092	7848	4219	3957	2100
	6	1195	2776	844	3337	1679	2002	1105	4195	2410	2346
	7	1293	717	1711	529	2006	1098	1206	504	2236	1504
	8	848	769	499	1031	336	1208	684	604	348	1413
	9	189	546	480	324	725	211	822	275	372	228
	+gp	2209	2141	1437	1239	1010	873	1003	1898	632	1007
0	TOTAL	30263	30107	25524	34199	36089	36975	32457	26888	19932	19857

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

	YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	AGE										
	2	16006	16894	24534	4070	3880	4521	6093	13745	5264	6366
	3	5255	13864	15140	22065	3503	3480	3921	4976	11184	4418
	4	1796	4007	11022	10526	16781	2747	2416	2420	3295	7806
	5	1994	1263	2593	6675	5619	10664	1749	1248	1390	2108
	6	1180	1224	817	1432	3010	3085	5865	1013	844	729
	7	1403	741	790	516	493	1477	1671	3101	702	583
	8	966	866	514	451	174	253	812	949	1690	487
	9	961	704	537	266	195	79	114	418	616	1032
	+gp	489	1091	1290	845	912	380	283	263	534	1129
0	TOTAL	30048	40654	57237	46845	34567	26686	22922	28133	25519	24656

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

	YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	GMST 70-**	AMST 70-**
	AGE													
	2	5406	2256	2724	8954	7244	6195	7476	5024	1847	4013	0	6470	7707
	3	5682	4775	1916	2408	7351	6395	5319	6681	4125	1569	3360	5790	6891
	4	3481	3864	3446	1287	1501	5008	4770	3849	5099	3210	876	4352	5249
	5	5193	2133	2123	1988	714	915	3335	3194	2606	3189	2040	2672	3260
	6	1376	3197	1229	1216	1123	402	545	2489	2311	1444	2165	1598	1950
	7	421	870	1932	703	712	717	255	312	1800	1629	945	924	1115
	8	338	254	617	1264	391	463	519	168	217	1460	1264	581	691
	9	301	213	171	423	863	234	341	419	93	153	1054	391	512
	+gp	604	1060	543	750	844	712	583	556	142	646	539		
0	TOTAL	22800	18623	14701	18993	20743	21040	23143	22691	18240	17313	12241		

Table 12.5.3.4 Sole in VIIa Summary table.

Run title : IRISH SEA SOLE 2004 WG COMBSEX PLUSGROUP.

At 30/04/2004 12:00

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 7
1970	4045	6827	6157	1785	0.2899	0.3783
1971	10292	7531	6417	1882	0.2933	0.3927
1972	3218	5736	5103	1450	0.2841	0.3904
1973	12771	6419	5137	1428	0.278	0.3639
1974	6191	5936	4938	1307	0.2647	0.4011
1975	6789	5871	5112	1441	0.2819	0.3587
1976	4172	5167	4617	1463	0.3169	0.418
1977	16347	4819	4127	1147	0.2779	0.3614
1978	9484	5524	4605	1106	0.2402	0.3453
1979	8688	6767	5682	1614	0.2841	0.4169
1980	5299	6263	5398	1941	0.3596	0.5424
1981	4448	5972	5268	1667	0.3164	0.3995
1982	2393	4548	4223	1338	0.3168	0.3997
1983	5847	4999	4192	1169	0.2789	0.4061
1984	16006	6623	4556	1058	0.2322	0.3467
1985	16894	7227	5257	1146	0.218	0.3186
1986	24534	8605	6369	1995	0.3132	0.4289
1987	4070	8281	6937	2808	0.4048	0.7935
1988	3880	6065	5605	1999	0.3566	0.508
1989	4521	5295	4794	1833	0.3823	0.4654
1990	6093	4515	3862	1583	0.4099	0.5023
1991	13745	4744	3541	1212	0.3423	0.38
1992	5264	4899	3908	1259	0.3222	0.3571
1993	6366	4263	3756	1023	0.2723	0.3821
1994	5406	5049	4143	1374	0.3317	0.3842
1995	2256	4237	3844	1266	0.3293	0.3994
1996	2724	3420	3062	1002	0.3273	0.4225
1997	8954	3948	3073	1003	0.3263	0.4707
1998	7244	4681	3451	911	0.264	0.3872
1999	6195	4588	3568	863	0.2419	0.326
2000	7476	4501	3644	818	0.2245	0.3171
2001	5024	5692	4657	1053	0.2261	0.2504
2002	1847	4370	4025	1087	0.2701	0.3047
2003	4013	4383	3875	1010	0.2607	0.2807
Arith. Mean	7426	5523	4615	1384	0.2982	0.4
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 12.6.1 Sole in VIIa. Input for RCT3

Irish Sea sole recruits - age 2

4	35	2			
1968	4045	-11	-11	-11	-11
1969	10292	-11	-11	-11	-11
1970	3218	-11	-11	-11	-11
1971	12771	-11	-11	-11	-11
1972	6191	-11	-11	-11	-11
1973	6789	-11	-11	-11	-11
1974	4172	-11	-11	-11	-11
1975	16347	-11	-11	-11	-11
1976	9484	-11	-11	-11	-11
1977	8688	-11	-11	-11	-11
1978	5299	-11	-11	-11	-11
1979	4448	-11	-11	-11	-11
1980	2393	-11	-11	-11	-11
1981	5847	-11	-11	-11	-11
1982	16006	-11	-11	-11	-11
1983	16894	-11	-11	-11	-11
1984	24534	-11	-11	-11	-11
1985	4070	-11	-11	-11	-11
1986	3880	-11	196	-11	-11
1987	4521	-11	234	-11	118
1988	6093	-11	414	-11	168
1989	13745	-11	1039	-11	1327
1990	5264	-11	239	-11	120
1991	6366	265	252	-11	170
1992	5406	307	327	14	63
1993	2256	76	119	7	48
1994	2724	85	93	19	200
1995	8954	343	446	485	668
1996	7244	324	546	107	872
1997	6195	174	197	36	416
1998	7476	-11	368	34	228
1999	5024	-11	189	-11	215
2000	-11	-11	53	-11	65
2001	-11	-11	159	-11	152
2002	-11	-11	-11	-11	170

M2
S2
M1
S1

Table 12.6.2 Sole in VIIa. RCT3 output data.

```
Analysis by RCT3 ver3.1 of data from file : S7REC.CSV

Irish Sea sole recruits - age 2

Data for    4 surveys over   35 years :  1968 - 2002

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 =   2000

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

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

M2
S2        .81   4.06    .22   .828     14   3.99    7.31     .323     .577       1495
M1
S1        .65   5.09    .45   .550     13   4.19    7.81     .557     .195       2465

                                       VPA Mean =     8.65     .514     .228       5710

Yearclass =   2001

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

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

M2
S2        .82   4.05    .23   .825     14   5.08    8.19     .273     .641       3604
M1
S1        .65   5.06    .46   .544     13   5.03    8.35     .537     .166       4230

                                       VPA Mean =    8.64     .497     .193       5653

Yearclass =   2002

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

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

M2
S2
M1
S1        .66   5.01    .47   .536     13   5.14    8.41     .552     .433       4492

                                       VPA Mean =    8.63     .482     .567       5597


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

2000        2236      7.71     .25     .39     2.48
2001        4050      8.31     .22     .12      .31
2002        5089      8.53     .36     .11      .09
```

Table 12.9.1 Sole in VIIa. Input data for catch forecast, yield,

Linear sensitivity and medium term analysis

```
Input:F mean 2001-2003 unscaled
   Catch and stock weights are mean 2001-2003
   Recruitment at age 2 in 2004 = RCT3 (5089)
     Recruitment at age 2 in 2005 & 2006 are GM(70-2001)
```

Label	Sens Value	Med Value	CV	Label	Value	CV
Number at age				Weight in the stock		
N2	5089	6470	0.59	WS2	0.141	0.32
N3	3360	4253	0.27	WS3	0.192	0.16
N4	876	2325	0.24	WS4	0.240	0.08
N5	2040	565	0.14	WS5	0.283	0.04
N6	2165	1322	0.12	WS6	0.322	0.05
N7	945	1501	0.11	WS7	0.357	0.07
N8	1264	717	0.10	WS8	0.373	0.04
N9	1054	827	0.09	WS9	0.402	0.06
N10	539	1138	0.11	WS10	0.458	0.14
H.cons selectivity				Weight in the HC catch		
sH2	0.080		0.31	WH2	0.167	0.22
sH3	0.268		0.69	WH3	0.216	0.11
sH4	0.338		0.04	WH4	0.262	0.05
sH5	0.334		0.32	WH5	0.303	0.04
sH6	0.266		0.19	WH6	0.340	0.06
sH7	0.176		0.55	WH7	0.373	0.08
sH8	0.324		0.55	WH8	0.402	0.11
sH9	0.237		0.21	WH9	0.428	0.13
sH10	0.237		0.21	WH10	0.465	0.15
Natural mortality				Proportion mature		
M2	0.10		0.10	MT2	0.38	0.10
M3	0.10		0.10	MT3	0.71	0.10
M4	0.10		0.10	MT4	0.97	0.10
M5	0.10		0.10	MT5	0.98	0.10
M6	0.10		0.10	MT6	1.00	0.10
M7	0.10		0.10	MT7	1.00	0.00
M8	0.10		0.10	MT8	1.00	0.00
M9	0.10		0.10	MT9	1.00	0.00
M10	0.10		0.10	MT10	1.00	0.00
Relative effort in HC fishery				Year effect for natural mortality		
HF04	1.00		0.10	K04	1.00	0.10
HF05	1.00		0.10	K05	1.00	0.10
HF06	1.00		0.10	K06	1.00	0.10
Recruitment in 2004 and 2005						
R05	6470		0.59			
R06	6470		0.59			

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

Stock numbers in 2004 are VPA survivors.
```

Table 12.9.2 Sole in VIIa. Management option table

MFDP version 1a
Run: SoleVIIa_Final
FinalMFDP Index file 05/05/2004
Time and date: 10:52 06/05/2004
Fbar age range: 4-7

F = Status quo

2004 Biomass	SSB	FMult	FBar	Landings
4327	3677	1.0000	0.2786	949

2005 Biomass	SSB	FMult	FBar	Landings	2006 Biomass	SSB
4530	3708	0.0000	0.0000	0	5729	4798
.	3708	0.1000	0.0279	105	5623	4695
.	3708	0.2000	0.0557	207	5520	4596
.	3708	0.3000	0.0836	307	5420	4499
.	3708	0.4000	0.1114	404	5322	4404
.	3708	0.5000	0.1393	499	5226	4312
.	3708	0.6000	0.1672	591	5133	4223
.	3708	0.7000	0.1950	681	5042	4135
.	3708	0.8000	0.2229	769	4954	4050
.	3708	0.9000	0.2507	854	4867	3967
.	3708	1.0000	0.2786	938	4783	3887
.	3708	1.1000	0.3065	1019	4701	3808
.	3708	1.2000	0.3343	1099	4622	3731
.	3708	1.3000	0.3622	1176	4544	3656
.	3708	1.4000	0.3900	1252	4468	3584
.	3708	1.5000	0.4179	1326	4394	3513
.	3708	1.6000	0.4457	1398	4321	3443
.	3708	1.7000	0.4736	1468	4251	3376
.	3708	1.8000	0.5015	1536	4182	3310
.	3708	1.9000	0.5293	1603	4115	3246
.	3708	2.0000	0.5572	1668	4050	3184

Input units are thousands and kg - output in tonnes

Fmult corresponding to Fpa = 0.300

.	3708	1.0770	0.300	1001	4720	3826

Bpa = 3800t

Table 12.9.3 Sole in VIIa. Detailed results

MFDP version 1a

F = Status quo

Run: SoleVIIa_Final
Time and date: 10:52 06/05/2004
Fbar age range: 4-7

Year:		2004	F multiplier:		1	Fbar:	0.2786			
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
	2	0.0796	371	62		5089	718	1934	273	1934	273
	3	0.2681	754	163		3360	646	2386	459	2386	459
	4	0.3379	240	63		876	210	850	204	850	204
	5	0.3339	553	167		2040	577	1999	565	1999	565
	6	0.2663	483	164		2165	697	2165	697	2165	697
	7	0.1762	146	54		945	337	945	337	945	337
	8	0.3239	334	134		1264	471	1264	471	1264	471
	9	0.2367	212	91		1054	424	1054	424	1054	424
	10	0.2367	108	50		539	247	539	247	539	247
Total			3199	949		17332	4327	13135	3677	13135	3677

Year:		2005	F multiplier:		1	Fbar:	0.2786			
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
	2	0.0796	471	79		6470	912	2459	347	2459	347
	3	0.2681	954	206		4253	818	3019	581	3019	581
	4	0.3379	636	166		2325	557	2255	541	2255	541
	5	0.3339	153	46		565	160	554	157	554	157
	6	0.2663	295	100		1322	426	1322	426	1322	426
	7	0.1762	231	86		1501	536	1501	536	1501	536
	8	0.3239	189	76		717	267	717	267	717	267
	9	0.2367	166	71		827	333	827	333	827	333
	10	0.2367	229	106		1138	522	1138	522	1138	522
Total			3325	938		19118	4530	13792	3708	13792	3708

Year:		2006	F multiplier:		1	Fbar:	0.2786			
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
	2	0.0796	471	79		6470	912	2459	347	2459	347
	3	0.2681	1213	262		5407	1040	3839	738	3839	738
	4	0.3379	805	211		2943	705	2855	684	2855	684
	5	0.3339	407	123		1501	424	1471	416	1471	416
	6	0.2663	82	28		366	118	366	118	366	118
	7	0.1762	141	53		916	327	916	327	916	327
	8	0.3239	301	121		1139	425	1139	425	1139	425
	9	0.2367	94	40		469	189	469	189	469	189
	10	0.2367	282	131		1403	643	1403	643	1403	643
Total			3796	1048		20614	4783	14916	3887	14916	3887

Input units are thousands and kg - output in tonnes

Table 12.9.4 Sole in VIIa

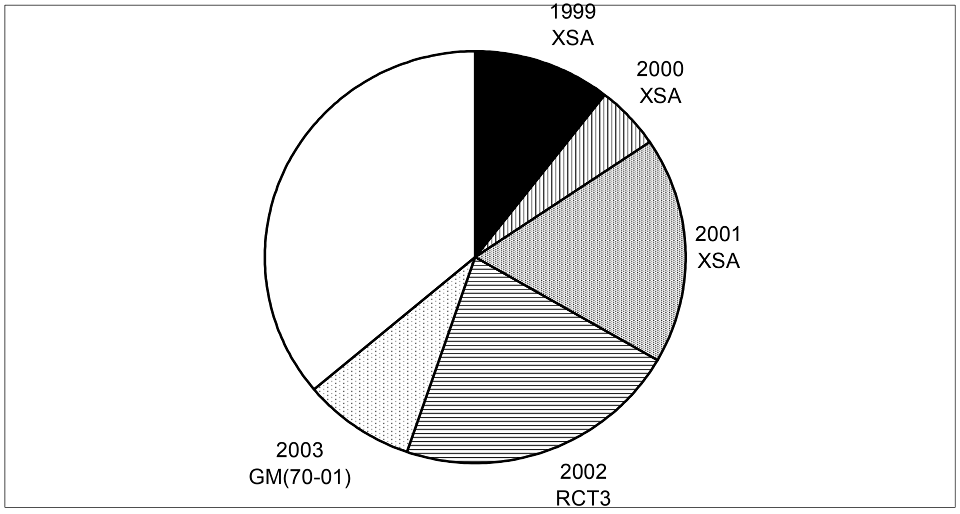
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	1999	2000	2001	2002	2003
Stock No. (thousands) of 2 year-olds	5024	1847	4013	5089	6470
Source	XSA	XSA	XSA	RCT3	GM(70-01)
Status Quo F:					
% in 2004 landings	17.6	6.6	17.2	6.5	-
% in 2005	10.7	4.9	17.7	22.0	8.4
% in 2004 SSB	15.4	5.5	12.5	7.4	-
% in 2005 SSB	11.5	4.2	14.6	15.7	9.4
% in 2006 SSB	8.4	3.0	10.7	17.6	19.0

GM : geometric mean recruitment

Sole in VIIa : Year-class % contribution to

a) 2005 landings



b) 2006 SSB

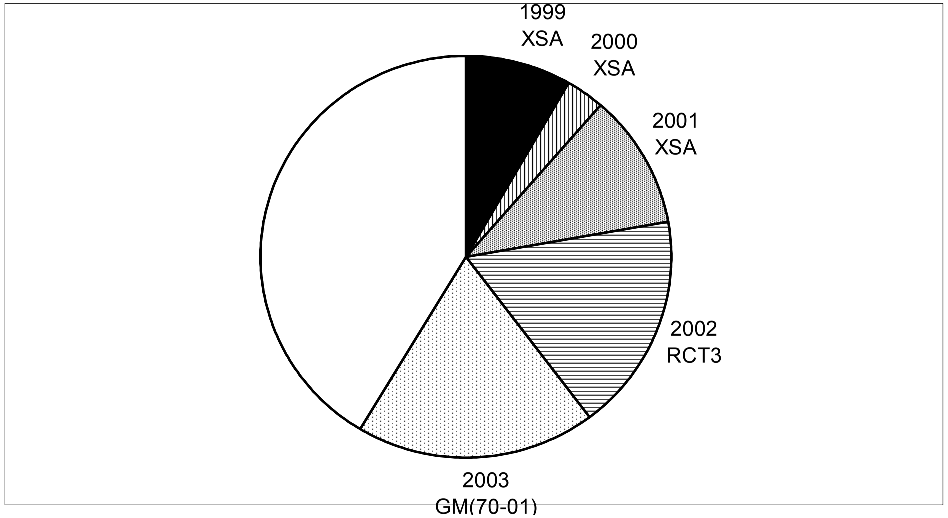


Table 12.11.1 - Sole in VIIa Input data for yield per recruit

MFYPR version 2a
Run: SoleVIIa_final
SoleVIIa_finalMFYPR Index file 08/05/2004
Time and date: 18:45 08/05/2004
Fbar age range: 4-7

Age	M	Mat	PF	PM	SWt	Sel	CWt
2	0.1	0.38	0	0	0.1412	7.96E-02	0.1625
3	0.1	0.71	0	0	0.1833	0.268133	0.2035
4	0.1	0.97	0	0	0.2235	0.337933	0.243
5	0.1	0.98	0	0	0.2622	0.333933	0.2809
6	0.1	1	0	0	0.2992	0.266267	0.3169
7	0.1	1	0	0	0.3346	0.176233	0.3516
8	0.1	1	0	0	0.3638	0.3239	0.3845
9	0.1	1	0	0	0.3965	0.2367	0.4161
10	0.1	1	0	0	0.46953	0.2367	0.4823

Weights in kilograms

Table 12.11.2 - Sole in VIIa Yield per recruit summery table

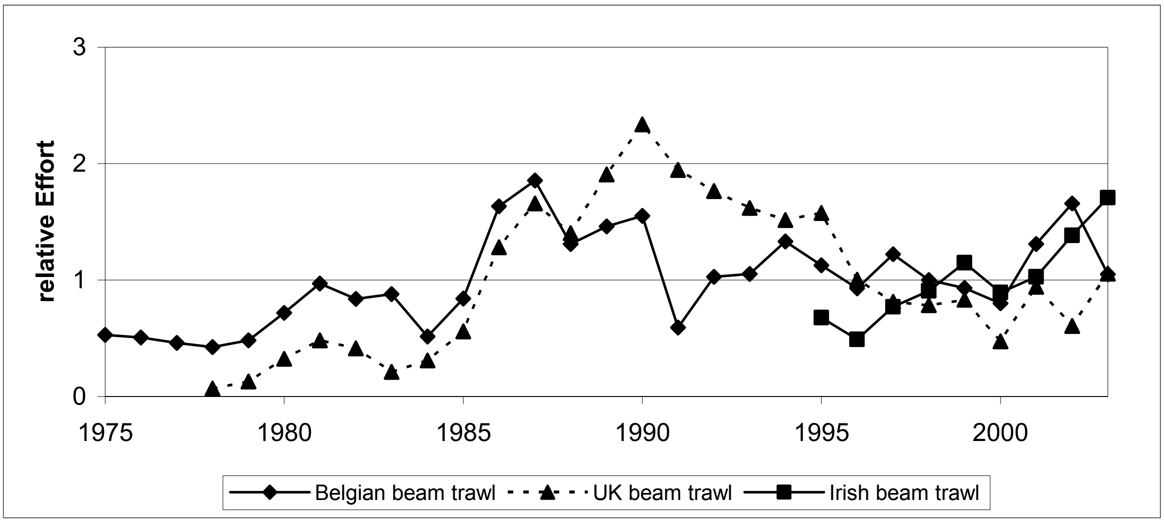
MFYPR version 2a
Run: SolVIIa_Final_yl
Time and date: 23:07 11/05/2004
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	10.5083	3.7201	9.5866	3.5722	9.5866	3.5722
0.1000	0.0279	0.1947	0.0701	8.5636	2.8732	7.6457	2.7262	7.6457	2.7262
0.2000	0.0557	0.3251	0.1127	7.2615	2.3164	6.3474	2.1702	6.3474	2.1702
0.3000	0.0836	0.4182	0.1399	6.3330	1.9270	5.4226	1.7817	5.4226	1.7817
0.4000	0.1114	0.4876	0.1579	5.6404	1.6424	4.7336	1.4979	4.7336	1.4979
0.5000	0.1393	0.5413	0.1701	5.1057	1.4273	4.2023	1.2835	4.2023	1.2835
0.6000	0.1672	0.5839	0.1785	4.6816	1.2602	3.7817	1.1172	3.7817	1.1172
0.7000	0.1950	0.6185	0.1842	4.3379	1.1277	3.4413	0.9854	3.4413	0.9854
0.8000	0.2229	0.6471	0.1882	4.0543	1.0206	3.1609	0.8790	3.1609	0.8790
0.9000	0.2507	0.6711	0.1910	3.8167	0.9328	2.9264	0.7919	2.9264	0.7919
1.0000	0.2786	0.6915	0.1928	3.6150	0.8597	2.7278	0.7195	2.7278	0.7195
1.1000	0.3065	0.7090	0.1940	3.4418	0.7983	2.5577	0.6587	2.5577	0.6587
1.2000	0.3343	0.7242	0.1947	3.2917	0.7460	2.4105	0.6071	2.4105	0.6071
1.3000	0.3622	0.7375	0.1951	3.1604	0.7012	2.2820	0.5629	2.2820	0.5629
1.4000	0.3900	0.7493	0.1953	3.0446	0.6625	2.1691	0.5247	2.1691	0.5247
1.5000	0.4179	0.7598	0.1952	2.9418	0.6287	2.0690	0.4915	2.0690	0.4915
1.6000	0.4457	0.7692	0.1950	2.8499	0.5990	1.9799	0.4624	1.9799	0.4624
1.7000	0.4736	0.7776	0.1948	2.7674	0.5728	1.8999	0.4368	1.8999	0.4368
1.8000	0.5015	0.7853	0.1944	2.6927	0.5494	1.8279	0.4140	1.8279	0.4140
1.9000	0.5293	0.7922	0.1940	2.6250	0.5286	1.7627	0.3937	1.7627	0.3937
2.0000	0.5572	0.7986	0.1936	2.5632	0.5099	1.7034	0.3755	1.7034	0.3755

Reference point	F multiplier	Absolute F
Fbar(4-7)	1.0000	0.2786
FMax	1.4219	0.3961
F0.1	0.5259	0.1465
F35%SPR	0.5181	0.1443

Weights in kilograms

Figure 12.2.1 Sole in VIIa. Relative CPUE and effort series for the commercial fleets used in tuning, and relative CPUE for the UK beam trawl survey



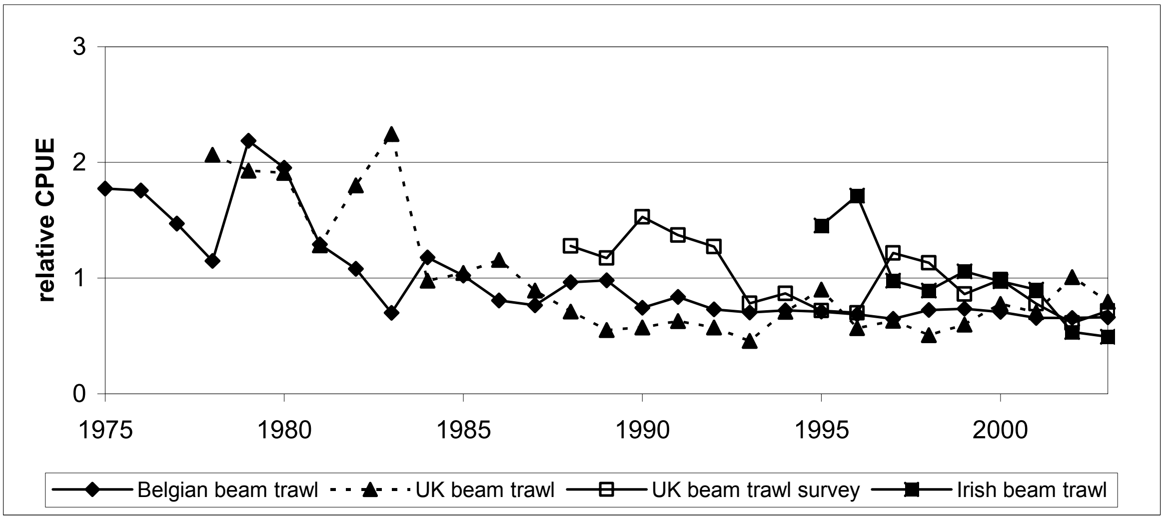
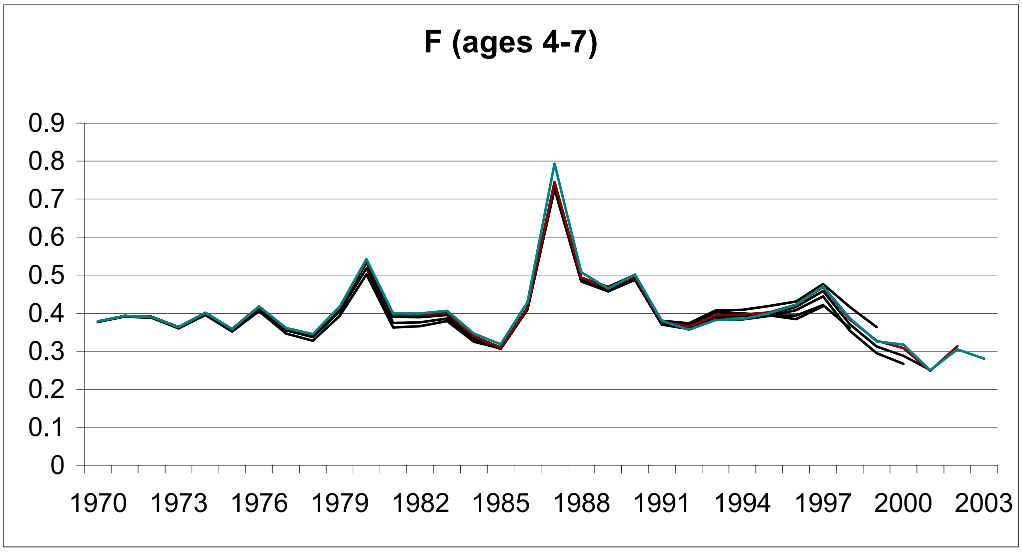
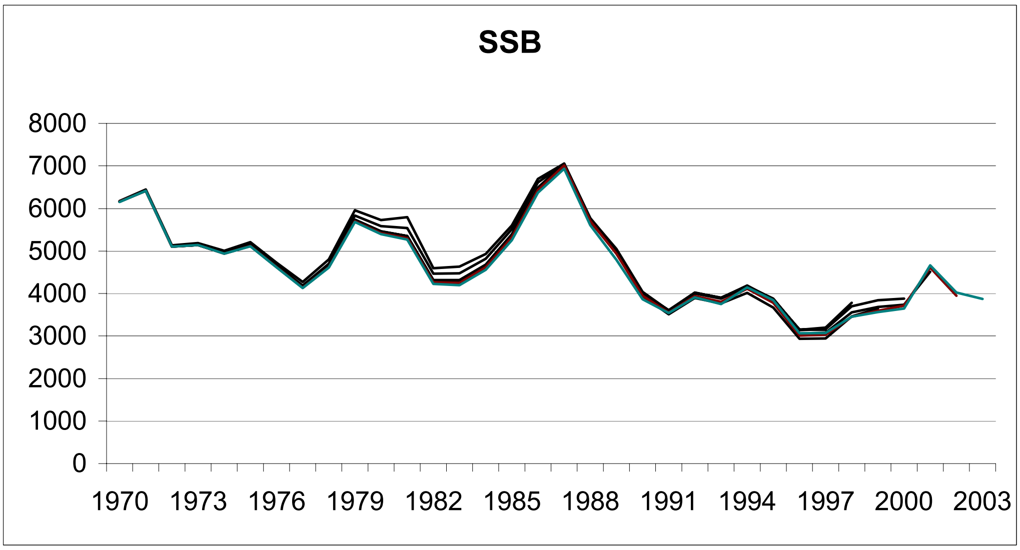


Figure 12.5.2.1 Sole in VIIa - Retrospective XSA results (Shrinkage SE = 0.8)





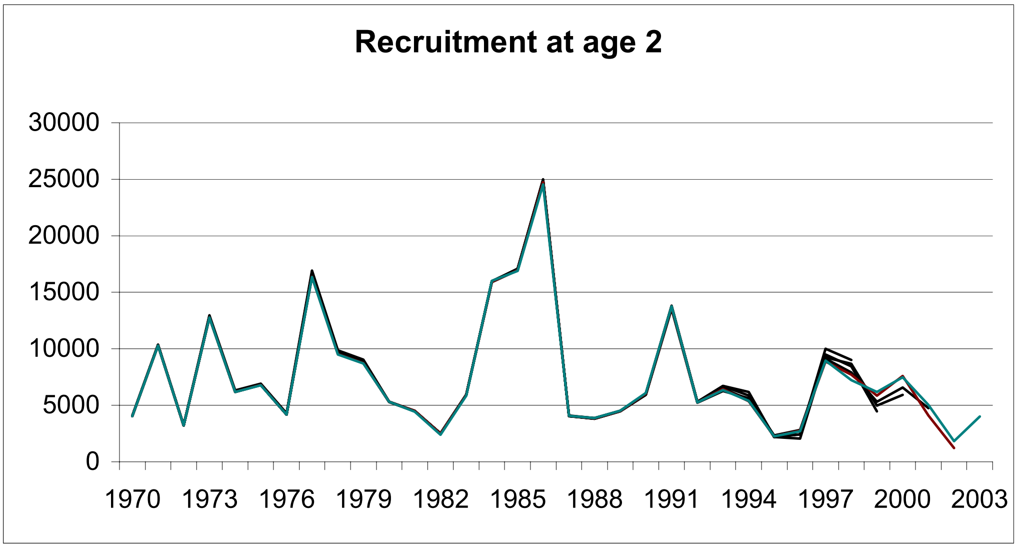


Figure 12.5.3.1 Sole VIIa. Log catchability residual plots for final XSA

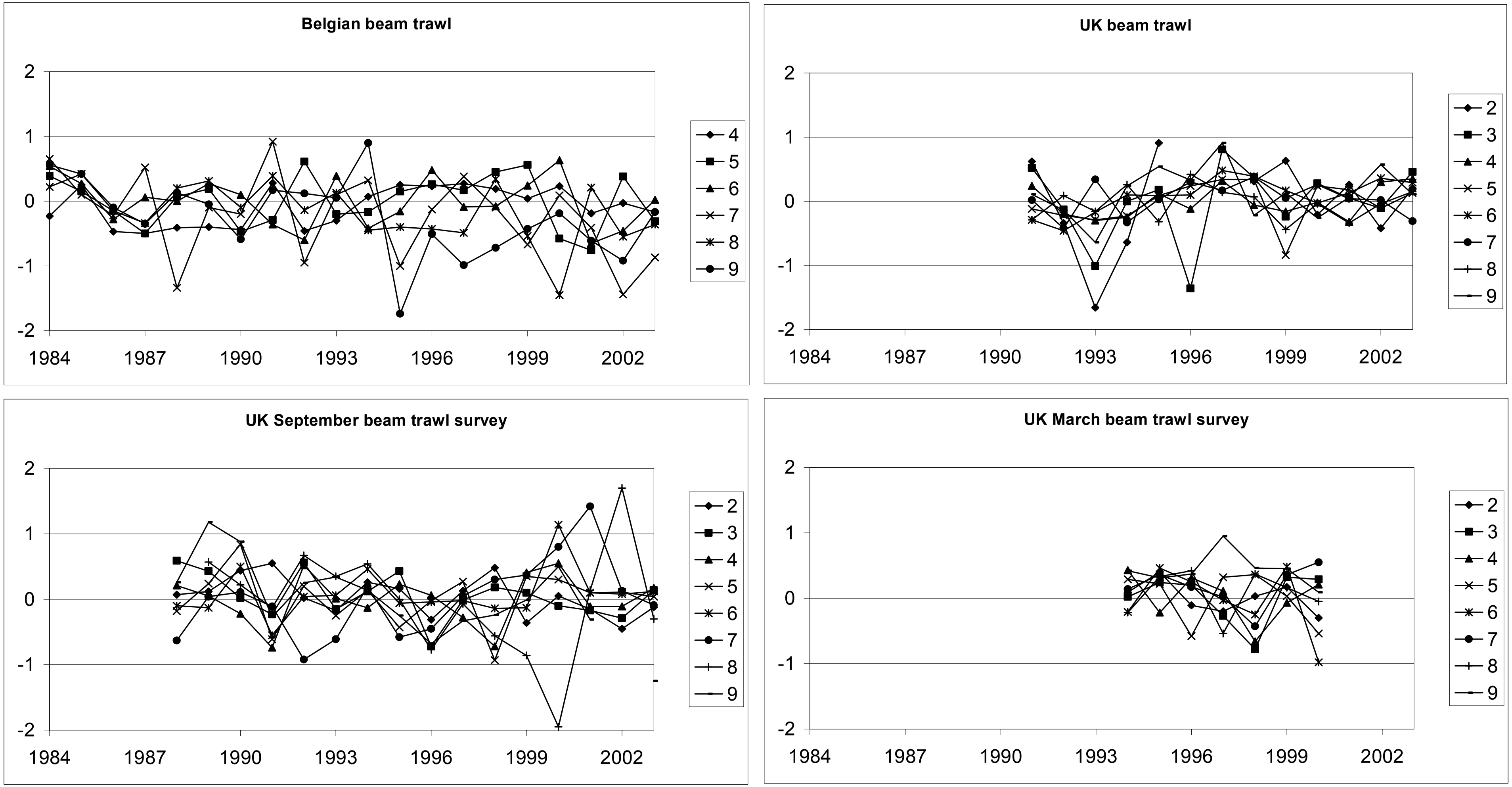
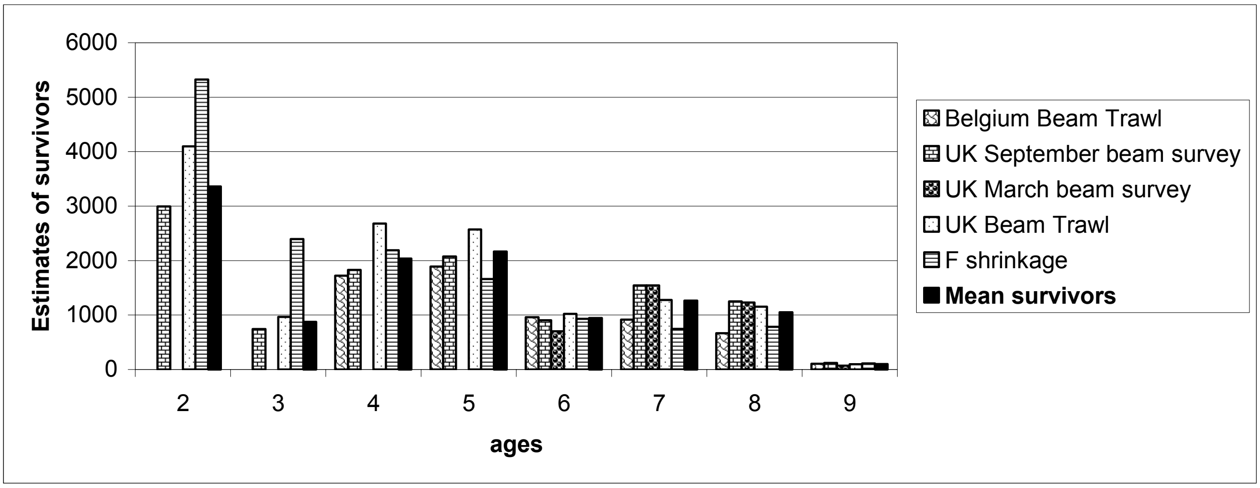


Figure 12.5.3.2 Sole in VIIa. Estimates of survivors from different fleets and shrinkage in final XSA-run.



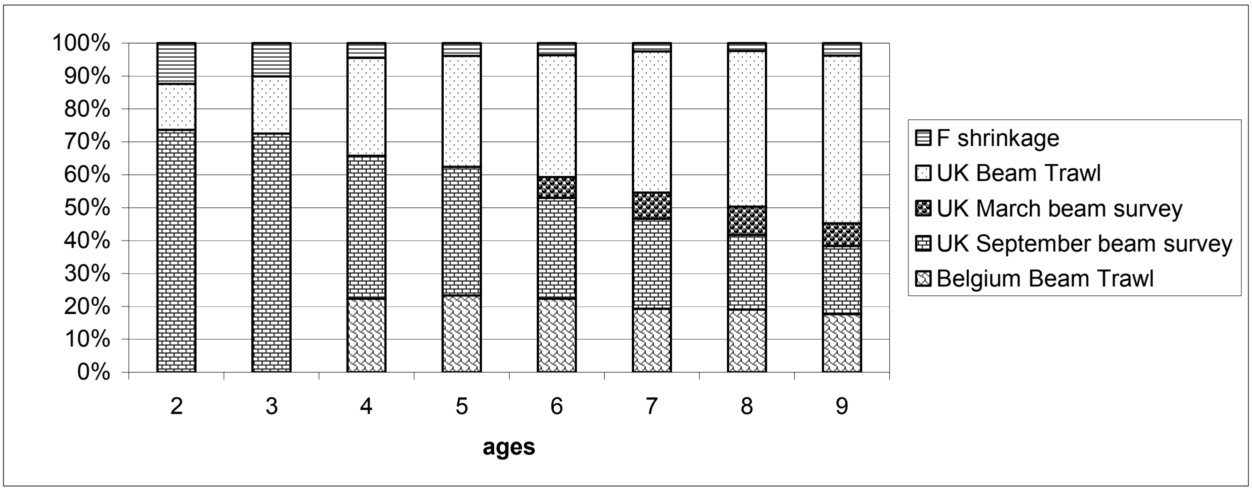
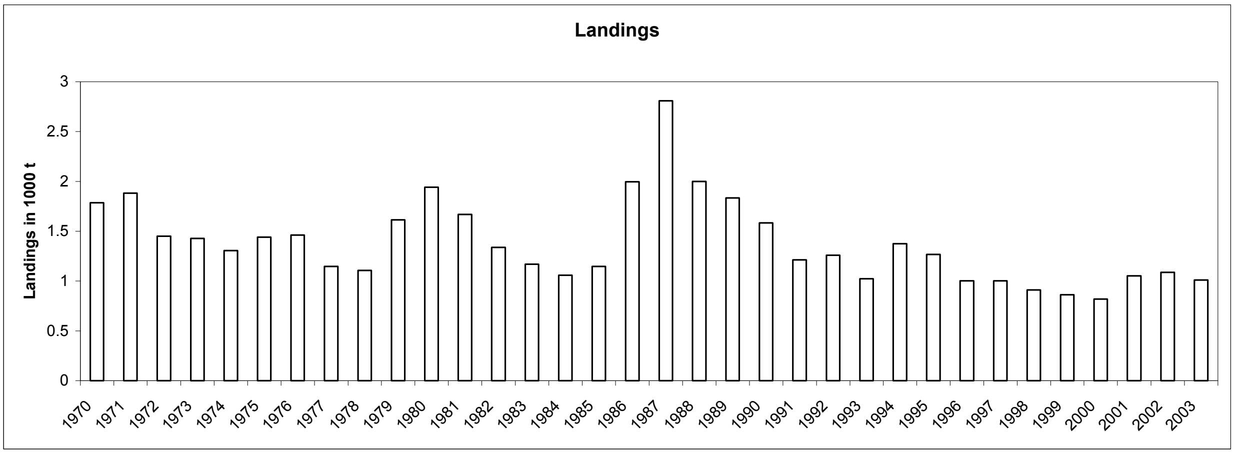
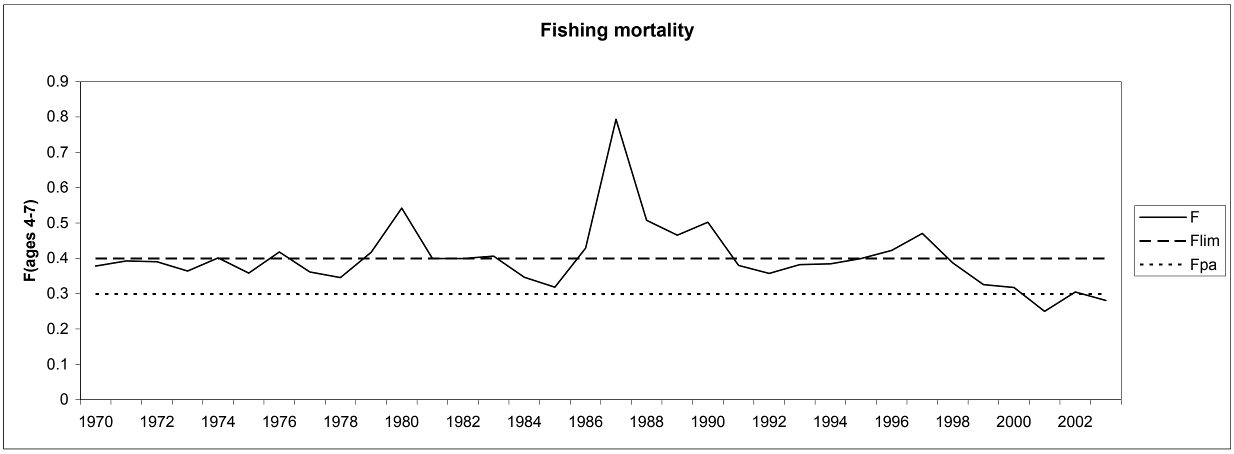
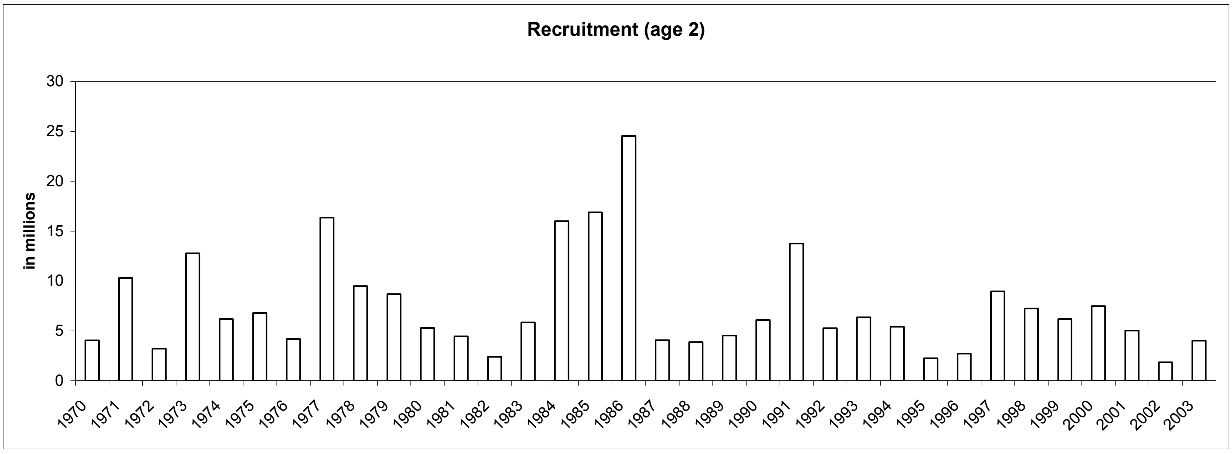


Figure 12.8.1 Sole in VIIa. Summery plots







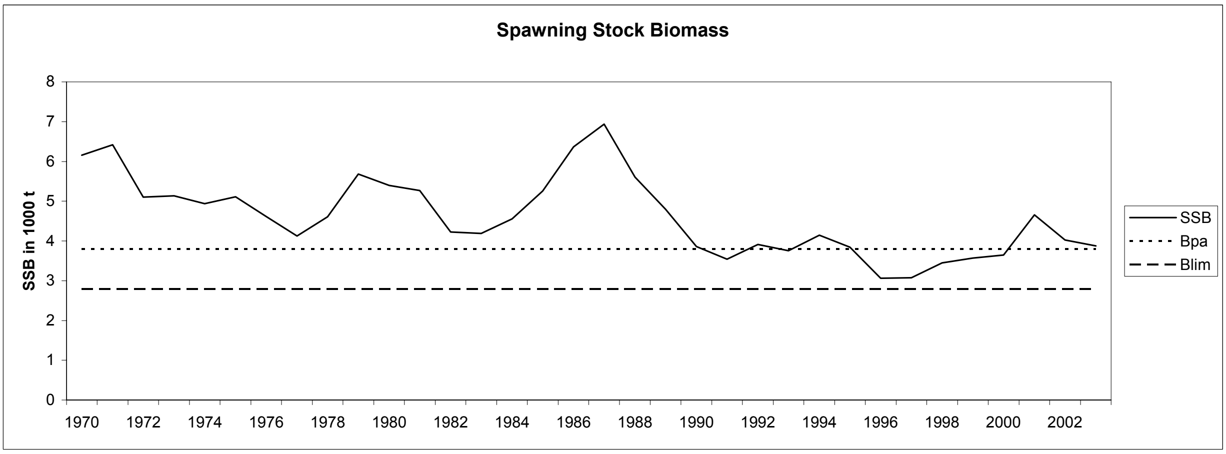
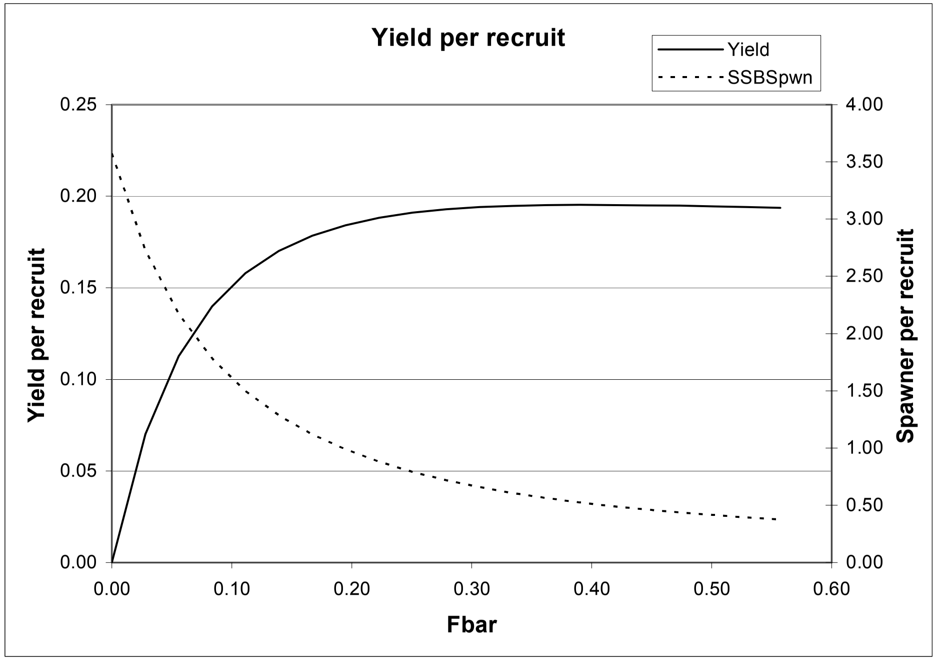


Figure 12.9.1 - Sole in VIIa Yield per recruit and short forecast plots



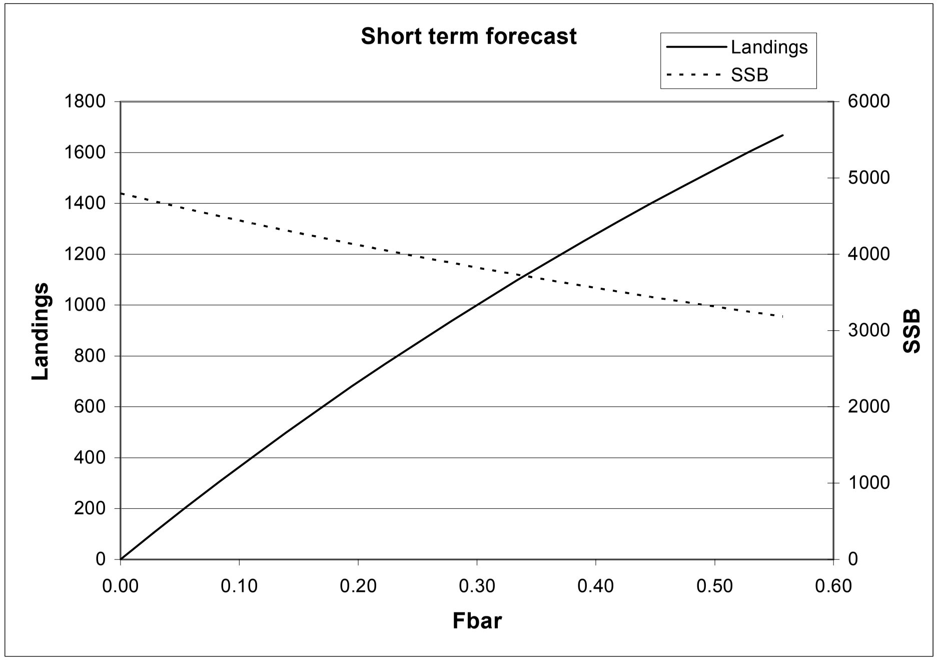
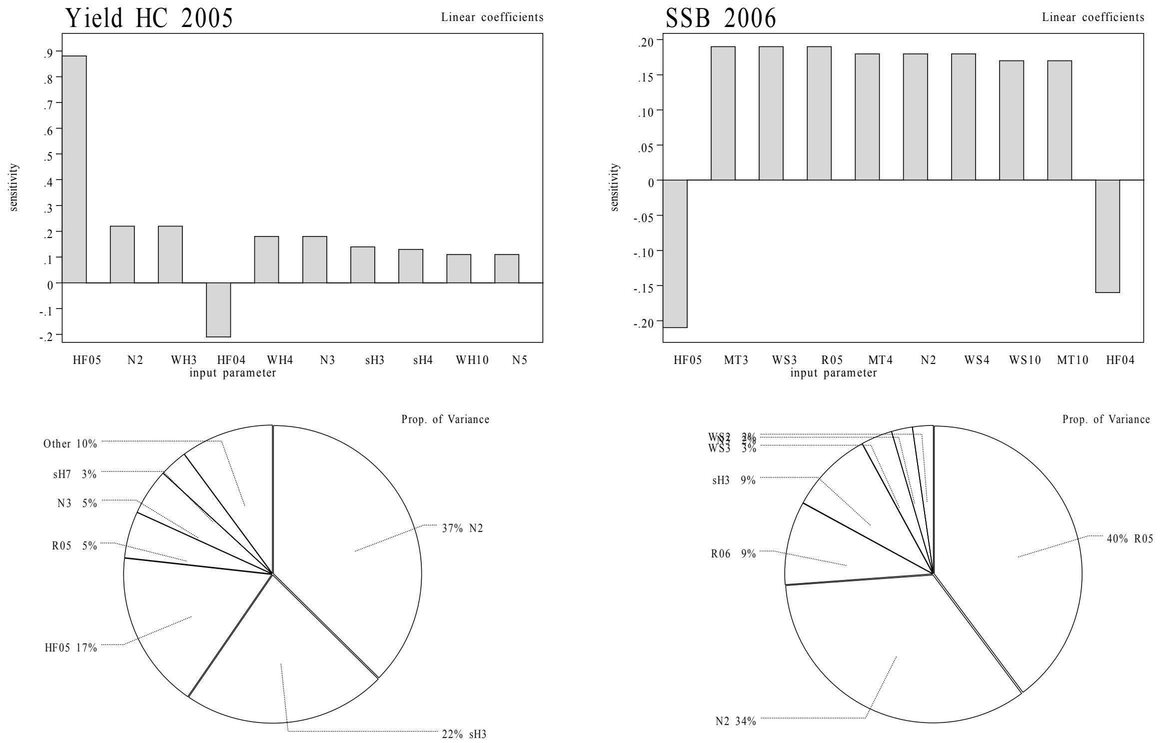
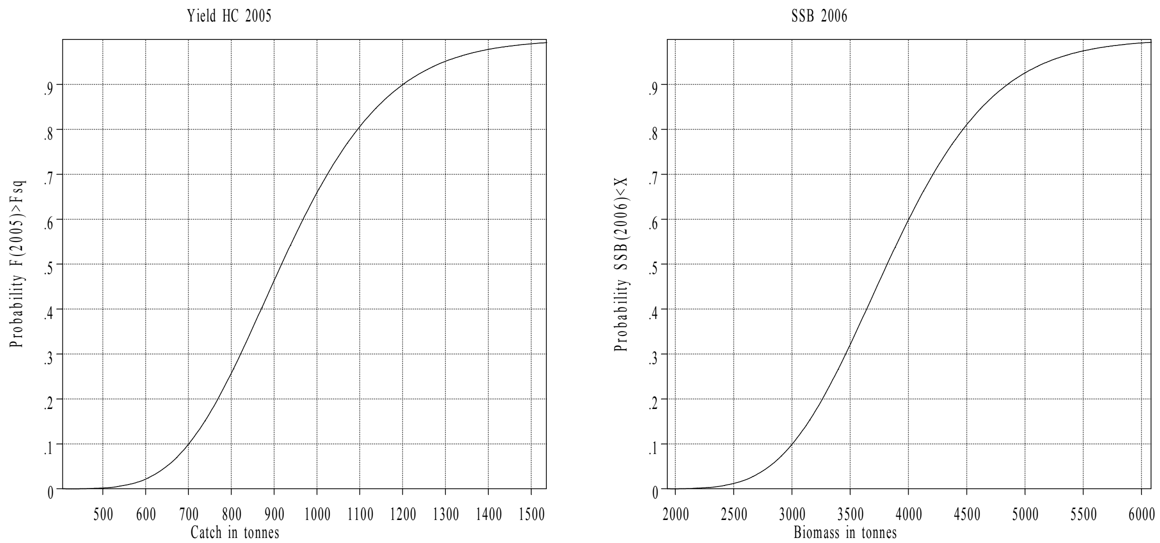


Figure 12.9.2 - Sole,Irish Sea. Sensitivity analysis of short term forecast.



Data from file:D:\WGSSDS\Sol_Pred & Med Runs\Sens\SOLVIIA.SEN on 05/05/2004 at 1

Figure 12.9.3 - Sole,Irish Sea. Probability profiles for short term forecast.



Data from file:D:\WGSSDS\Sol_Pred & Med Runs\Sens\SOLVIIA.SEN on 05/05/2004 at 1

Figure 12.10.1 Sole in VIIa (Irish Sea). Medium term projections. Solid lines show 10, 25, 50, 75 and 90th percentiles.
Stock-recruitment relationship estimated by random bootstrap
Number of simulations= 500 Relative H. Cons effort = 1.00

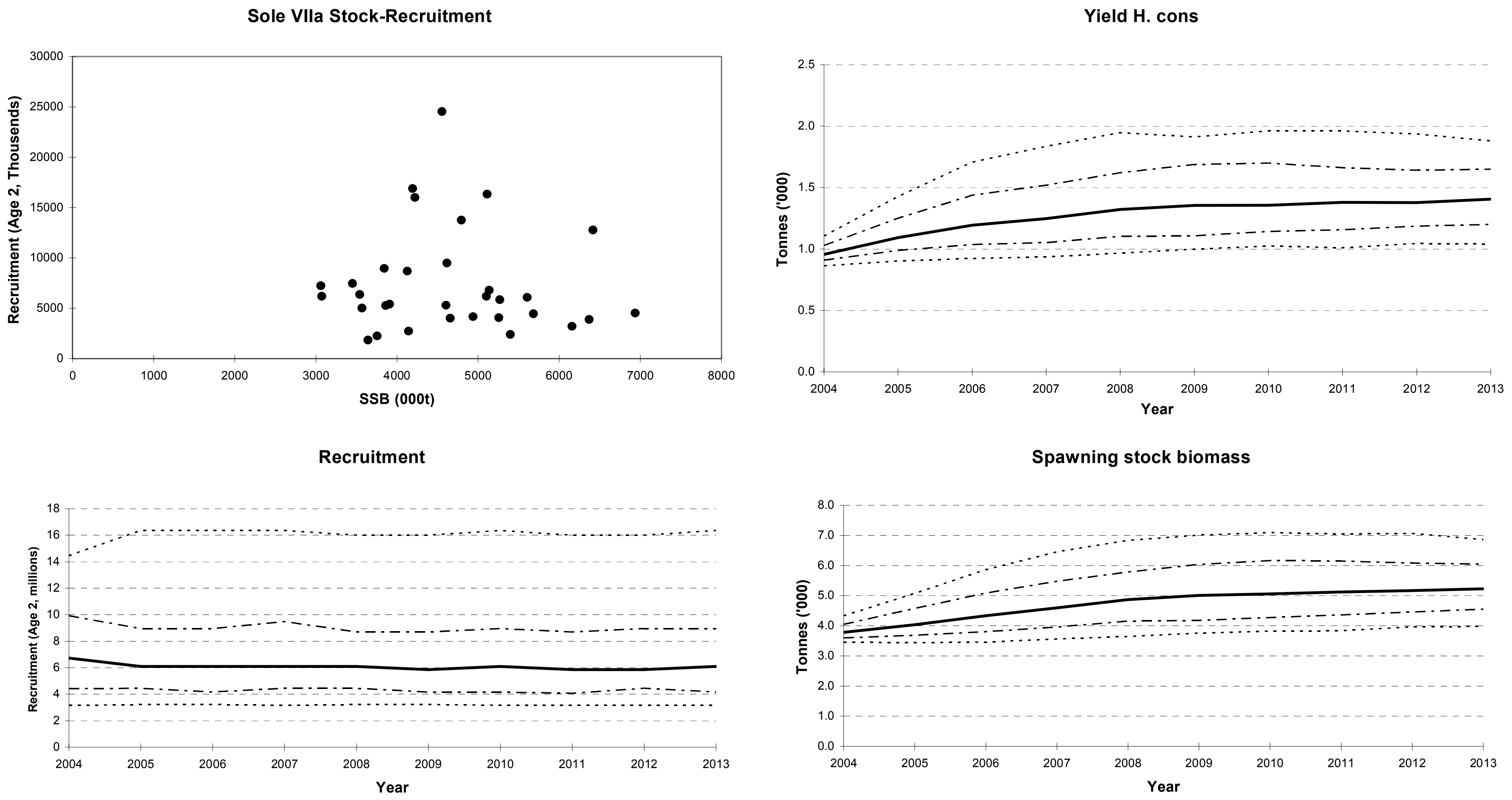


Figure 12.11.1 - Irish Sea Sole: Stock and Recruitment

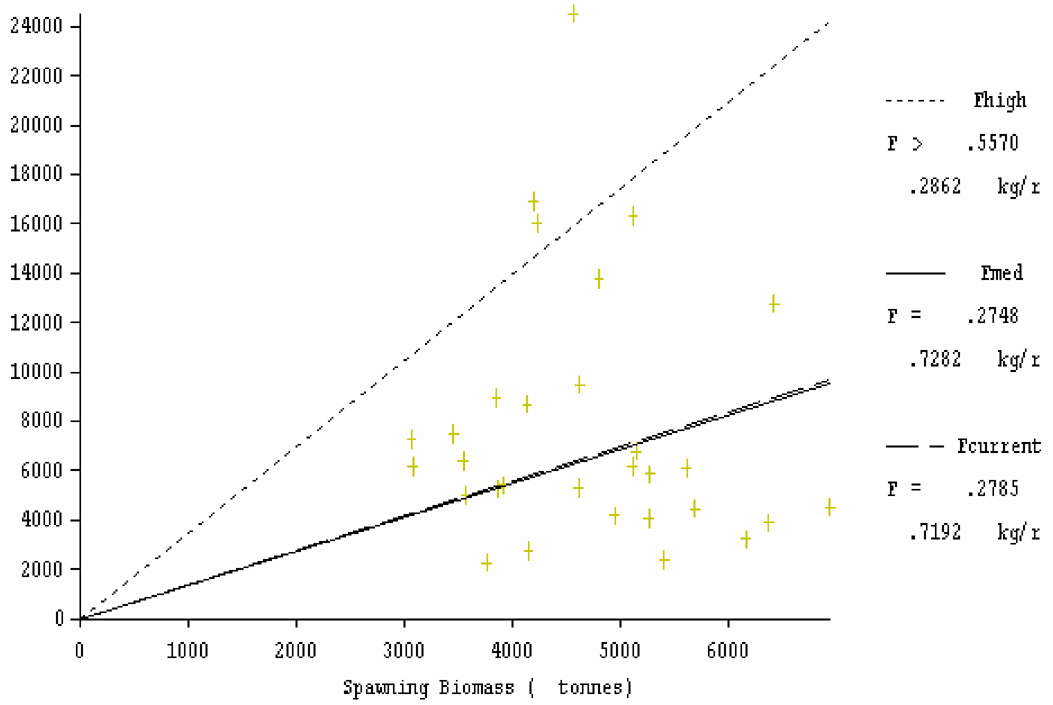
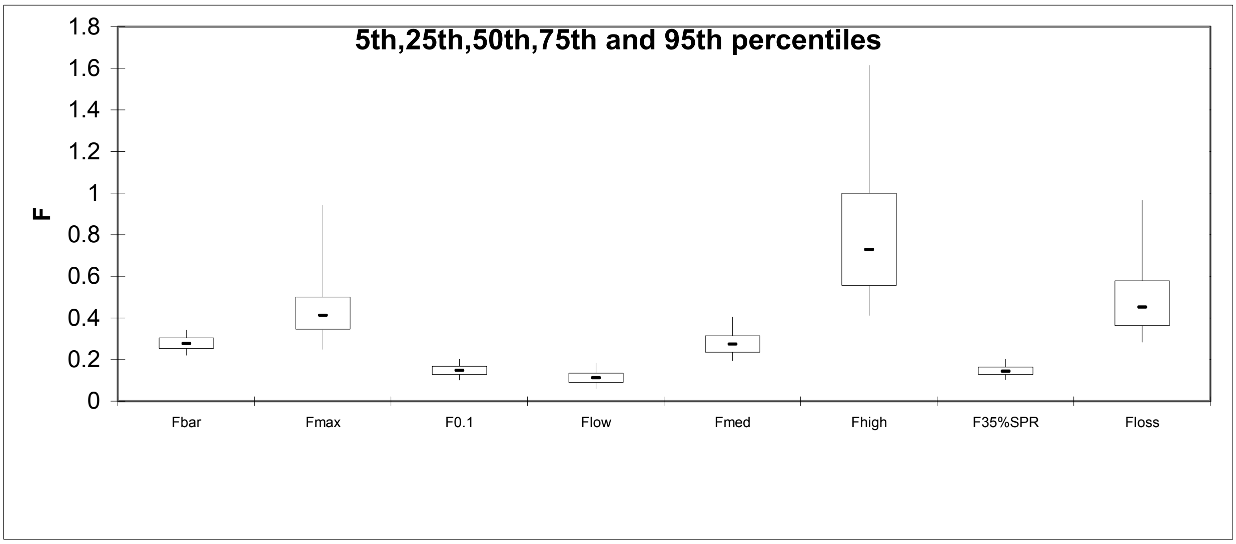


Figure 12.12.1 - Sole in VIIa PA reference points



Reference point	Deterministic	Median	75th percentile	95th percentile	Hist SSB < ref pt %
MedianRecruits	5970	5970	6193	6789	
MBAL	0				0.00
Bloss	3062				
SSB90%R90%Surv	4992	4306	4730	5228	64.71
SPR%ofVirgin	20.13	20.23	23.06	27.23	
VirginSPR	3.57	3.55	4.05	4.69	
SPRloss	0.49	0.46	0.54	0.65	

	Deterministic	Median	25th percentile	5th percentile	Hist F > ref pt %
FBar	0.28	0.28	0.25	0.22	97.06
Fmax	0.40	0.41	0.35	0.25	44.12
F0.1	0.15	0.15	0.13	0.10	100.00
Flow	0.09	0.11	0.09	0.06	100.00
Fmed	0.27	0.27	0.23	0.19	97.06
Fhigh	0.67	0.73	0.56	0.41	2.94
F35%SPR	0.14	0.14	0.13	0.10	100.00
Floss	0.42	0.45	0.36	0.28	23.53

For estimation of Gloss and Floss:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
For estimation of the stock recruitment relationship used in equilibrium calculations:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

Irish Sea Sole

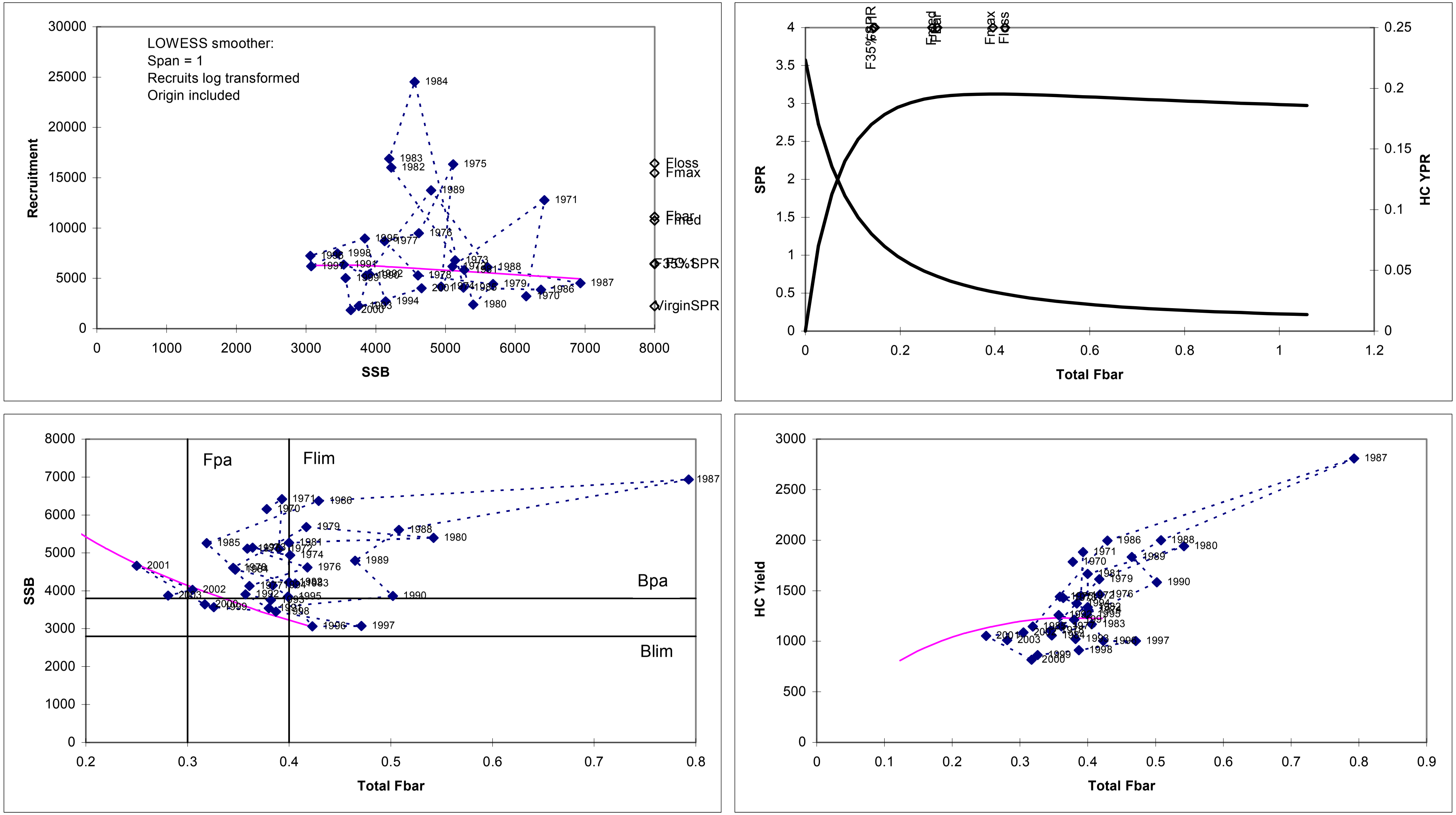
Steady state selection provided as input
FBar averaged from age 4 to 7

Number of iterations = 500
Random number seed = -99
Stock recruitment data Monte Carloed using residuals from the equilibrium LOWESS fit

Data source:
D:\2004_WGNSDS\2004\Northern Shelf\2004\Final\Sol_Pred & Med Runs\Sens\SOLVIIA.SEN
D:\2004_WGNSDS\2004\Northern Shelf\2004\Final\Sol_Pred & Med Runs\Sens\SOLVIIA.SUM

FishLab DLL used
FLVB32.DLL built on Jun 14 1999 at 11:53:37
PASoft 4 October 1999

Figure 12.12.2 - Sole in VIIa PA reference plots



13 MIXED FISHERIES INTERACTIONS

The fisheries descriptions in the Stock Annexes produced by the Working Group include a qualitative description of the species composition of catches from the major fleets exploiting each stock. In addition to this qualitative description the Working Group was asked to deal with the issue of mixed fishery interactions quantitatively. Term of Reference (*d*) asked the Working Group to consider and implement the proposed methodology for projection of yield by fisheries made by the Study Group on the Development of Fishery-based Forecasts. The Working Group was then asked to present a limited set of fisheries-based catch options.

Institutes submitting data to the $WGNSDS_{2004}$ were asked to provide data in a format that may better support mixed-fisheries analyses and assessments. For stocks in Divisions VIa and VIIa (where mixed fisheries analyses have previously been attempted) institutes were asked to submit their 2003 catch-at-age data by fleet/fishery and species rather than by stock (as has been done up until now). The fleet/fishery groupings used were those agreed by the $SGDFF_{2004}$ for demersal fisheries in VIa and VIIa.

The Working Group had intended to assemble the input data required to run the MTAC analysis (Vinther *et al*., 2003). Unfortunately, inadequacies in the 2003 catch-at-age data meant that the Working Group could not produce acceptable assessments for many stocks. For each of the West of Scotland gadoid stocks four possible assessments were presented. Without a single proposed final assessment for each of the West of Scotland stocks the Working Group did not proceed with the creation of West of Scotland MTAC input data sets. Reliable assessments could not be produced for Irish Sea haddock or whiting and the veracity of the cod assessment is questionable. Furthermore, there is no assessment for Irish Sea *Nephrops* with catch data up to, and including 2003, available to the Working Group. Therefore the Working Group did not proceed with the creation of Irish Sea MTAC input data sets.

14 EVALUATION OF MANAGEMENT MEASURES

Term of Reference (*h*) asks the Working Group to evaluate the effects of the existing recovery plans for Cod in Division VIa and Irish Sea Cod.

The European Commission has recently enacted a Council Regulation ((EC) No 423/2004) which establishes measures for the recovery of cod stocks.

For stocks above B_{lim}, the harvest control rule (HCR) requires:

1. setting a TAC that achieves a 30% increase in the SSB from one year to the next,

2. limiting annual changes in TAC to ± 15% (except in the first year of application), and,

3. a rate of fishing mortality that does not exceed F_{pa}.

For stocks below B_{lim} the Regulation specifies that:

4. conditions 1-3 will apply when they are expected to result in an increase in SSB above B_{lim} in the year of application,

5. a TAC will be set lower than that calculated under conditions 1-3 when the application of conditions 1-3 is not expected to result in an increase in SSB above B_{lim} in the year of application.

Short-term forecasts were carried out assuming that any recent changes in selectivity due to the adoption of less selective gear, and any reductions in F due to decommissioning will be incorporated in the *status quo* F-at-age vectors. The Working Group was unable to predict any potential reductions in F due to decommissioning at the end of 2003. Options giving SSB > B_{lim} for cod (6,000 t for Irish Sea cod; 14,000 t for West of Scotland cod) are highlighted on the tables, as are F-multipliers giving 30% increase in SSB between 2005 and 2006. These results are reported in the relevant stock Sections.

14.1 Medium term forecasts for cod using the CS5 software

Methods

The WG investigated scenarios that achieve the recovery objectives but also allow uncertainty in recruitment and bias in the estimation of initial population numbers to be incorporated in the simulations. As suggested in the draft $SGLTA_{2004}$ report, the WG conducted the simulations using the CS5 medium term prediction program. This program is a modified version of the CS4 program used by the STECF Subgroup on Review of Stocks (March 2002) to generate the recovery scenarios evaluated by ACFM in October 2002 (Section 3.5.18, (ICES Co-operative Research Report No. 255, 2002). An undesirable feature of the CS4 model implementation is that it allows F to decline continuously as stocks recover. This eventually leads to unfeasibly small Fs and very large SSBs. The CS5 program allows a target F to be specified, and models the stock development consistent with a specified F trajectory towards the target F.

The Working Group acknowledges that modelling the stock development associated with a specified F trajectory will not necessarily be consistent with the Regulation which gives primacy to a 30% inter-annual SSB increase and requires that F does not exceed F_{pa}. The Working Group therefore created input files for the CS5 program but switched off F trajectory modelling in favour of the HCR specified in the Regulation. Model parameters may be easily changed, and the newly created input files used, should modelling of alternative HCRs be required.

Discards are taken into account in the simulations for West of Scotland cod, but not for Irish Sea cod. The different scenarios for the forecasts are shown in the summary results Table 14.1.1. This table shows the percentage of the 1000 simulations for which stock recovery occurred over specified time spans. Recovery is defined consistent with the Regulation as two consecutive years of SSB>B_{pa} (10,000 t for Irish Sea cod and 22,000 t for west of Scotland cod).

The starting point for simulations was the stock data resulting from the $WGNSDS_{2004}$ assessments and used as inputs for short-term forecasts made by the WG (Input files are given in Appendix 1). The draft $SGLTA_{2004}$ report notes that whilst bias is an important problem both in simulations and forecasts, the issue of bias in forecasts has not been dealt with by WGMG and guidance is required. SGLTA suggested that default simulations should assume no bias and the WG presents unbiased simulations as the baseline simulations. The most recent accepted assessments suggest that biases exist in the assessments for both stocks (systematic over- or underestimation of the parameters). To examine the effect of a 10% bias on time to recovery, simulations were also run with a 10% bias included in the projections (results shown in Table 14.1.1).

Results of Simulations

The results of the evaluation of the individual scenarios are summarised graphically for all scenarios in Figures 14.1.1 – 14.1.12. The lay-out of these figures is as follows:

Panel A	*Panel D*
Panel B	*Panel X*
Panel C	Panel Y
Panel E	Panel F

Panels A, B, C and D present the 25, 50 and 75 percentiles (solid lines) and average (line with symbols) of the expected yield (panel A), spawning stock biomass and B_{PA} (panel B), fishing mortality (panel C), and recruitment (panel D) for the period of simulation. The number of years required to recover the stock to B_{PA} is presented as a frequency distribution (panel E) and as a cumulative frequency distribution (panel F). The column labelled –1 (if present in panel E) represents the frequency of no recovery within the period of simulation. Panels X and Y show the simulated SSB and F (respectively) as percentage interannual changes. The results presented allow the comparative performance of the harvest control rules to be evaluated, and should not be interpreted as absolute. Results are summarised in Table 14.1.1.

Discussion

The WG reiterates its 2003 comments and the conclusion of ACFM (ICES Co-operative Research Report No. 255, 2002) that predictions and simulations of this kind have had a tendency to be optimistic. This tendency has some potentially serious consequences:

- In practice, management constraints on harvesting may have to be kept in place much longer than forecast by the simulations in order to reach rebuilding targets; and,

- Harvest control strategies that are aimed at achieving gradual increments in SSB but allow harvesting of substantial portions of the annual stock production may prove ineffective. This is because the consequences of over-estimating the abundance or productivity of the stock are more severe if fishing mortality is reduced by relatively small increments.

The WG also notes that the theoretical gains in SSB indicated in these studies may not, in effect, be realised, as technical conservation measures are not always as effective as expected in their implementation, often because adjustments in fishing practices may undermine their effect. The effects of "technological creep" may also work against attempts to reduce F in small increments.

Appendix 1. Input data files for CS5 simulations undertaken by $WGNSDS_{2004.}$ Scenario names are as listed in Table 14.1.1.

IS1

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
1472 0.2  1    0.2  0    0.186    1.06 1.06
614  0.35 1    0.2  0.38 0.769    1.8  1.8
985  0.17 1    0.2  1    1.287    3.53 3.53
119  0.35 1    0.2  1    0.937    5.54 5.54
78   0.41 1    0.2  1    0.911    8.35 8.35
1    0.75 1    0.2  1    0.894    9.22 9.22
1    1.14 1    0.2  1    0.945    11.27    11.27
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.5708   1    0    4.91E-05 0.596    0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.72, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1812
Catch in the starting year, or (if negative) F constraint (Fsq=1.03, TAC(2004) = 2150)
-1.03
Ages for calculating reference F
2    4
Reference Biomass to calculate probabilities
10000
SSB  in StartingYear-1
3420
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 - Fixed TAC)
1    0.93 2004
1    0.88 2005
1    0.84 2006
1    0.80 2007
1    0.76 2008
1    0.72 2009
1    0.72 2010
1    0.72 2011
1    0.72 2012
1    0.72 2013
1    0.72 2014
1    0.72 2015
1    0.72 2016
1    0.72 2017
1    0.72 2018
1    0.72 2019
1    0.72 2020
1    0.72 2021
1    0.72 2022
1    0.72 2023
1    0.72 2024
COMMENTS

RUN id         : Irish Sea Cod\IS1
Stock          : Irish Sea Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=1.03 in Starting Year, then apply HCR.
```

IS2

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
1472 0.2  1    0.2  0    0.186    1.06 1.06
614  0.35 1    0.2  0.38 0.769    1.8  1.8
985  0.17 1    0.2  1    1.287    3.53 3.53
119  0.35 1    0.2  1    0.937    5.54 5.54
78   0.41 1    0.2  1    0.911    8.35 8.35
1    0.75 1    0.2  1    0.894    9.22 9.22
1    1.14 1    0.2  1    0.945    11.27    11.27
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.5708   1    0    4.91E-05 0.596    0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.72, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1812
Catch in the starting year, or (if negative) F constraint (Fsq=1.03, TAC(2004) = 2150)
2150
Ages for calculating reference F
2    4
Reference Biomass to calculate probabilities
10000
SSB  in StartingYear-1
3420
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    0.93 2004
1    0.88 2005
1    0.84 2006
1    0.80 2007
1    0.76 2008
1    0.72 2009
1    0.72 2010
1    0.72 2011
1    0.72 2012
1    0.72 2013
1    0.72 2014
1    0.72 2015
1    0.72 2016
1    0.72 2017
1    0.72 2018
1    0.72 2019
1    0.72 2020
1    0.72 2021
1    0.72 2022
1    0.72 2023
1    0.72 2024
COMMENTS
```

RUN id : Irish Sea Cod\IS2
Stock **: Irish Sea Cod**
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint **: TAC in Starting Year (2150 t)**, then apply HCR

IS3

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
1472 0.2  1.1  0.2  0    0.186    1.06 1.06
614  0.35 1.1  0.2  0.38 0.769    1.8  1.8
985  0.17 1.1  0.2  1    1.287    3.53 3.53
119  0.35 1.1  0.2  1    0.937    5.54 5.54
78   0.41 1.1  0.2  1    0.911    8.35 8.35
1    0.75 1.1  0.2  1    0.894    9.22 9.22
1    1.14 1.1  0.2  1    0.945    11.27    11.27
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.5708   1    0    4.91E-05 0.596    0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.72, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1812
Catch in the starting year, or (if negative) F constraint (Fsq=1.03, TAC(2004) = 2150)
```
-1.03
```
Ages for calculating reference F
2    4
Reference Biomass to calculate probabilities
10000
SSB  in StartingYear-1
3420
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 - Fixed TAC)
1    0.93 2004
1    0.88 2005
1    0.84 2006
1    0.80 2007
1    0.76 2008
1    0.72 2009
1    0.72 2010
1    0.72 2011
1    0.72 2012
1    0.72 2013
1    0.72 2014
1    0.72 2015
1    0.72 2016
1    0.72 2017
1    0.72 2018
1    0.72 2019
1    0.72 2020
1    0.72 2021
1    0.72 2022
1    0.72 2023
1    0.72 2024
COMMENTS

RUN id         : Irish Sea cod\IS3
Stock          : Irish Sea Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
```
Constraint : **Fsq =1.03 in Starting Year**, then apply HCR

IS4

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
1472 0.2  1.1  0.2  0    0.186    1.06 1.06
614  0.35 1.1  0.2  0.38 0.769    1.8  1.8
985  0.17 1.1  0.2  1    1.287    3.53 3.53
119  0.35 1.1  0.2  1    0.937    5.54 5.54
78   0.41 1.1  0.2  1    0.911    8.35 8.35
1    0.75 1.1  0.2  1    0.894    9.22 9.22
1    1.14 1.1  0.2  1    0.945    11.27    11.27
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.5708   1    0    4.91E-05 0.596    0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.72, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1812
Catch in the starting year, or (if negative) F constraint (Fsq=1.03, TAC(2004) = 2150)
2150
Ages for calculating reference F
2    4
Reference Biomass to calculate probabilities
10000
SSB  in StartingYear-1
3420
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    0.93 2004
1    0.88 2005
1    0.84 2006
1    0.80 2007
1    0.76 2008
1    0.72 2009
1    0.72 2010
1    0.72 2011
1    0.72 2012
1    0.72 2013
1    0.72 2014
1    0.72 2015
1    0.72 2016
1    0.72 2017
1    0.72 2018
1    0.72 2019
1    0.72 2020
1    0.72 2021
1    0.72 2022
1    0.72 2023
1    0.72 2024
COMMENTS

RUN id         : Irish Sea Cod\IS4
Stock          : Irish Sea Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : TAC in Starting Year, then apply HCR
```

WS1

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
1439 0.28 1.0  0.2  0    0.434    0.42 0.42
388  0.39 1.0  0.2  0.52 0.896    0.99 0.99
362  0.22 1.0  0.2  0.86 1.040    2.39 2.39
42   0.23 1.0  0.2  1    1.047    4.42 4.42
46   0.27 1.0  0.2  1    1.017    6.08 6.08
3    0.36 1.0  0.2  1    1.009    7.67 7.67
2    0.42 1.0  0.2  1    1.010    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.08 1   0    0.0  0.52 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1416
Catch in the starting year, or (if negative) F constraint (Fsq=1.15, TAC(2004) = 848)
-1.15
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
1644
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa cod\WS1
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq =1.15 in Starting Year, then apply HCR
```

WS2

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
1439 0.28 1.1  0.2  0    0.434    0.42 0.42
388  0.39 1.1  0.2  0.52 0.896    0.99 0.99
362  0.22 1.1  0.2  0.86 1.040    2.39 2.39
42   0.23 1.1  0.2  1    1.047    4.42 4.42
46   0.27 1.1  0.2  1    1.017    6.08 6.08
3    0.36 1.1  0.2  1    1.009    7.67 7.67
2    0.42 1.1  0.2  1    1.010    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.08 1   0    0.0  0.52 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1416
Catch in the starting year, or (if negative) F constraint (Fsq=1.15, TAC(2004) = 848)
-1.15
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
1644
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa Cod\WS2
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=1.15  in Starting Year, then apply HCR
```

WS3

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
3426 0.33 1.0  0.2  0    0.488    0.42 0.42
1013 0.47 1.0  0.2  0.52 0.976    0.99 0.99
1163 0.26 1.0  0.2  0.86 1.090    2.39 2.39
150  0.36 1.0  0.2  1    0.991    4.42 4.42
205  0.39 1.0  0.2  1    0.943    6.08 6.08
17   0.52 1.0  0.2  1    0.936    7.67 7.67
16   0.56 1.0  0.2  1    0.942    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.2  1   0   4.0e-06  0.50 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1576
Catch in the starting year, or (if negative) F constraint (Fsq=0.65, TAC(2004) = 848
-0.65
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
3548
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa Cod\WS3
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=0.65 in Starting Year, then apply HCR
```

WS4

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
3426 0.33 1.1  0.2  0    0.488    0.42 0.42
1013 0.47 1.1  0.2  0.52 0.976    0.99 0.99
1163 0.26 1.1  0.2  0.86 1.090    2.39 2.39
150  0.36 1.1  0.2  1    0.991    4.42 4.42
205  0.39 1.1  0.2  1    0.943    6.08 6.08
17   0.52 1.1  0.2  1    0.936    7.67 7.67
16   0.56 1.1  0.2  1    0.942    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.2  1    0    4.0e-06  0.50 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1576
Catch in the starting year, or (if negative) F constraint (Fsq=0.65, TAC(2004) = 848
-0.65
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
3548
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa Cod\WS4
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=0.65 in Starting Year, then apply HCR
```

WS5

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
8682 0.28 1.0  0.2  0    0.616    0.42 0.42
2104 0.45 1.0  0.2  0.52 0.926    0.99 0.99
1813 0.22 1.0  0.2  0.86 1.145    2.39 2.39
206  0.26 1.0  0.2  1    0.967    4.42 4.42
221  0.25 1.0  0.2  1    0.962    6.08 6.08
35   0.32 1.0  0.2  1    0.962    7.67 7.67
38   0.34 1.0  0.2  1    0.964    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.6  1   0   1.0e-05  0.49 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
6387
Catch in the starting year, or (if negative) F constraint (Fsq=0.88, TAC(2004) = 848
-0.88
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
7899
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 - Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa Cod\WS5
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=0.88 in Starting Year, then apply HCR
```

WS6

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
8682 0.28 1.1  0.2  0    0.616    0.42 0.42
2104 0.45 1.1  0.2  0.52 0.926    0.99 0.99
1813 0.22 1.1  0.2  0.86 1.145    2.39 2.39
206  0.26 1.1  0.2  1    0.967    4.42 4.42
221  0.25 1.1  0.2  1    0.962    6.08 6.08
35   0.32 1.1  0.2  1    0.962    7.67 7.67
38   0.34 1.1  0.2  1    0.964    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
1.6  1    0    1.0e-05  0.49 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
6387
Catch in the starting year, or (if negative) F constraint (Fsq=0.88, TAC(2004) = 848
-0.88
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
7899
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa Cod\WS6
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=0.88 in Starting Year, then apply HCR
```

WS7

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
4207 0.77 1.0  0.2  0    0.183    0.42 0.42
1890 0.65 1.0  0.2  0.52 0.525    0.99 0.99
2504 0.30 1.0  0.2  0.86 0.421    2.39 2.39
191  0.26 1.0  0.2  1    0.254    4.42 4.42
481  0.27 1.0  0.2  1    0.112    6.08 6.08
164  0.26 1.0  0.2  1    0.037    7.67 7.67
62   0.23 1.0  0.2  1    0.037    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
0.76 1   0   1.0e-05  0.76 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1287
Catch in the starting year, or (if negative) F constraint (Fsq=0.328, TAC(2004) = 848
-0.328
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
7730
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 - Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa Cod\WS7
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=0.328 in Starting Year, then apply HCR
```

WS8

```
Starting year, Last year, first age, last age
2004, 2024, 1, 7
N, se log(N hat), Bias(N hat), M,  Mat, Expl,    WEST,     WECA
4207 0.77 1.1  0.2  0    0.183    0.42 0.42
1890 0.65 1.1  0.2  0.52 0.525    0.99 0.99
2504 0.30 1.1  0.2  0.86 0.421    2.39 2.39
191  0.26 1.1  0.2  1    0.254    4.42 4.42
481  0.27 1.1  0.2  1    0.112    6.08 6.08
164  0.26 1.1  0.2  1    0.037    7.67 7.67
62   0.23 1.1  0.2  1    0.037    9.26 9.26
SRR parameters (if the last no. is -1 then use Ockham, otherwise Shepherd/Ricker)
0.76 1   0   1.0e-05  0.76 0
HCR % change (up, down), Fpa, SSBincr%
15, 15, 0.6, 30
Spawning Time as fraction  of year
0.0
Catch in StartingYear-1
1287
Catch in the starting year, or (if negative) F constraint (Fsq=0.328, TAC(2004) = 848
-0.328
Ages for calculating reference F
2    5
Reference Biomass to calculate probabilities
22000
SSB  in StartingYear-1
7730
Method For each year after starting year Rule, Target (1 - apply harvest rule, 2 - fixed F, 3 -
Fixed TAC)
1    1.04 2004
1    0.99 2005
1    0.94 2006
1    0.89 2007
1    0.85 2008
1    0.81 2009
1    0.77 2010
1    0.73 2011
1    0.69 2012
1    0.66 2013
1    0.63 2014
1    0.60 2015
1    0.60 2016
1    0.60 2017
1    0.60 2018
1    0.60 2019
1    0.60 2020
1    0.60 2021
1    0.60 2022
1    0.60 2023
1    0.60 2024
COMMENTS

RUN id         : VIa Cod\WS8
Stock          : VIa Cod
Starting Point : As WG Medium Term projections, as modified by WGNSDS 2004
Constraint     : Fsq=0.328 in Starting Year, then apply HCR
```

Table 14.1.1 Summary of results of cod recovery plan simulations.
Percentages indicate the proportion of 1000 simulations for which recovery was achieved in the specified number of years, and the number of simulations where recovery was not achieved. TAC indicate scenarios in which F in 2004 is constrained by the TAC. Scenarios where the cumulative probability of recovery exceeds 90% appear in black.

Stock	Scenario name	Bias	Assessment run	F basis 2004	No recovery	Years to recovery: 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Irish Sea																								
	IS1	No	n/a	Fsq	0%			0.5%	21%	51%	80%	93%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	IS2	No	n/a	TAC	0%		0.1%	10%	64%	92%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	IS3	10%	n/a	Fsq	0%			0.1%	14%	35%	65%	85%	94%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	IS4	10%	n/a	TAC	0%			11%	60%	90%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
West of Scotland																								
	WS1	No	Run1	Fsq	0%								0.5%	2.2%	14.2%	35%	62%	82%	92%	97%	99%	100%	100%	100%
	WS2	10%	Run1	Fsq	0.4%									1.4%	5.4%	16.9%	39%	60%	77%	88%	94%	98%	99%	100%
	WS3	No	Run2	Fsq	0%				0.1%	1.4%	10.3%	38%	68%	87%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%
	WS4	10%	Run2	Fsq	0.1%					0.9%	5.2%	20%	44%	68%	83%	91%	96%	98%	99%	100%	100%	100%	100%	100%
	WS5	No	Run3	Fsq	0.0%				1.6%	16.6%	47%	79%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	WS6	10%	Run3	Fsq	0.0%				0.4%	6.7%	27%	52%	75%	87%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%
	WS7	No	Run4	Fsq	0.0%		11.5%	56%	87%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	WS8	10%	Run4	Fsq	0.0%	0.1%	10%	53%	85%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Figure 14.1.1. CS5 outputs for Irish Sea cod. Run IS1: F_{sq} constraint in 2004. No bias.

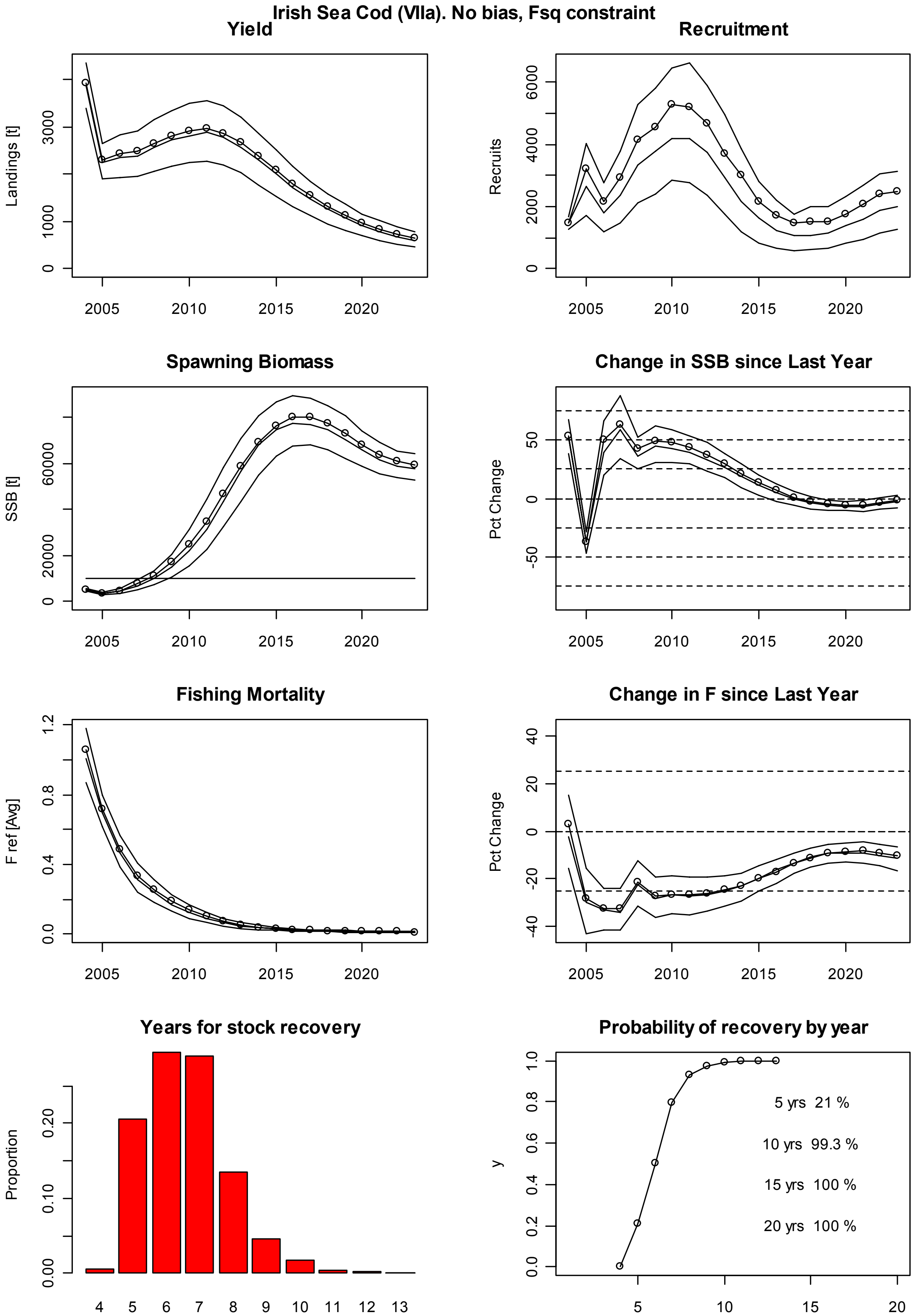


Figure 14.1.2. CS5 outputs for Irish Sea cod. Run IS2: TAC constraint in 2004. No bias.

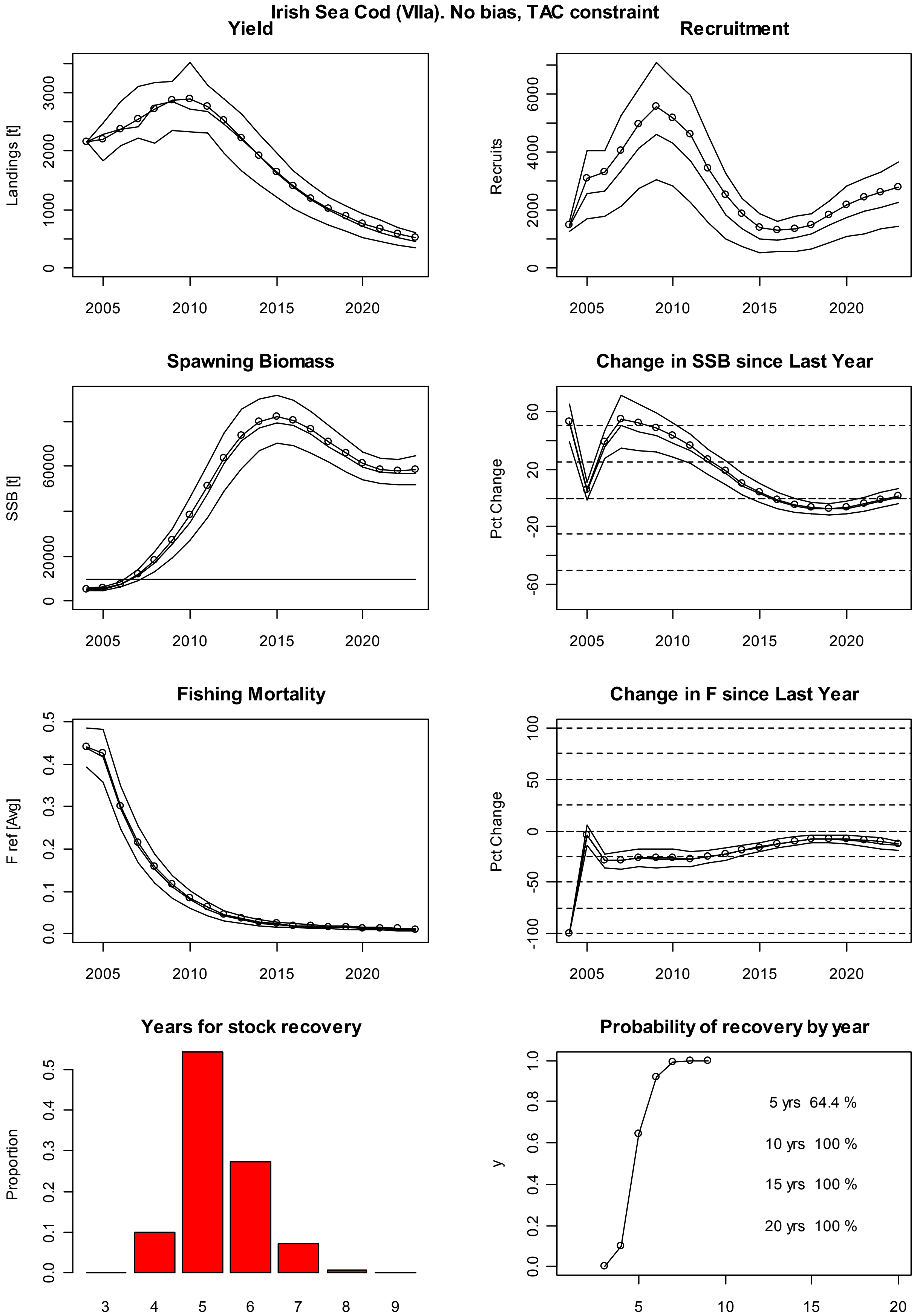


Figure 14.1.3. CS5 results for Irish Sea cod. Run IS3: F_{sq} constraint in 2004. 10% bias.

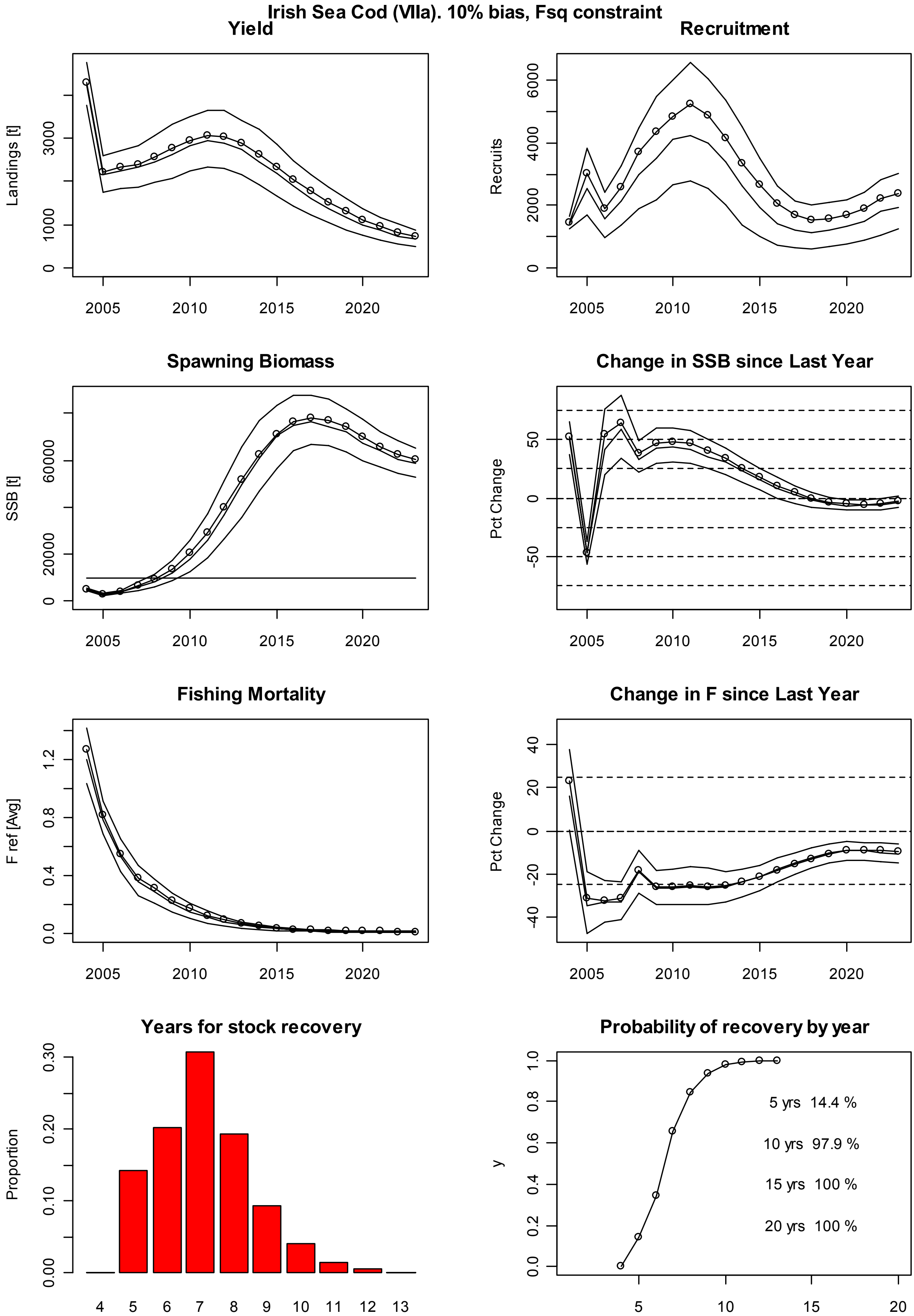


Figure 14.1.4. CS5 results for Irish Sea cod. Run IS4: TAC constraint in 2004. 10% bias.

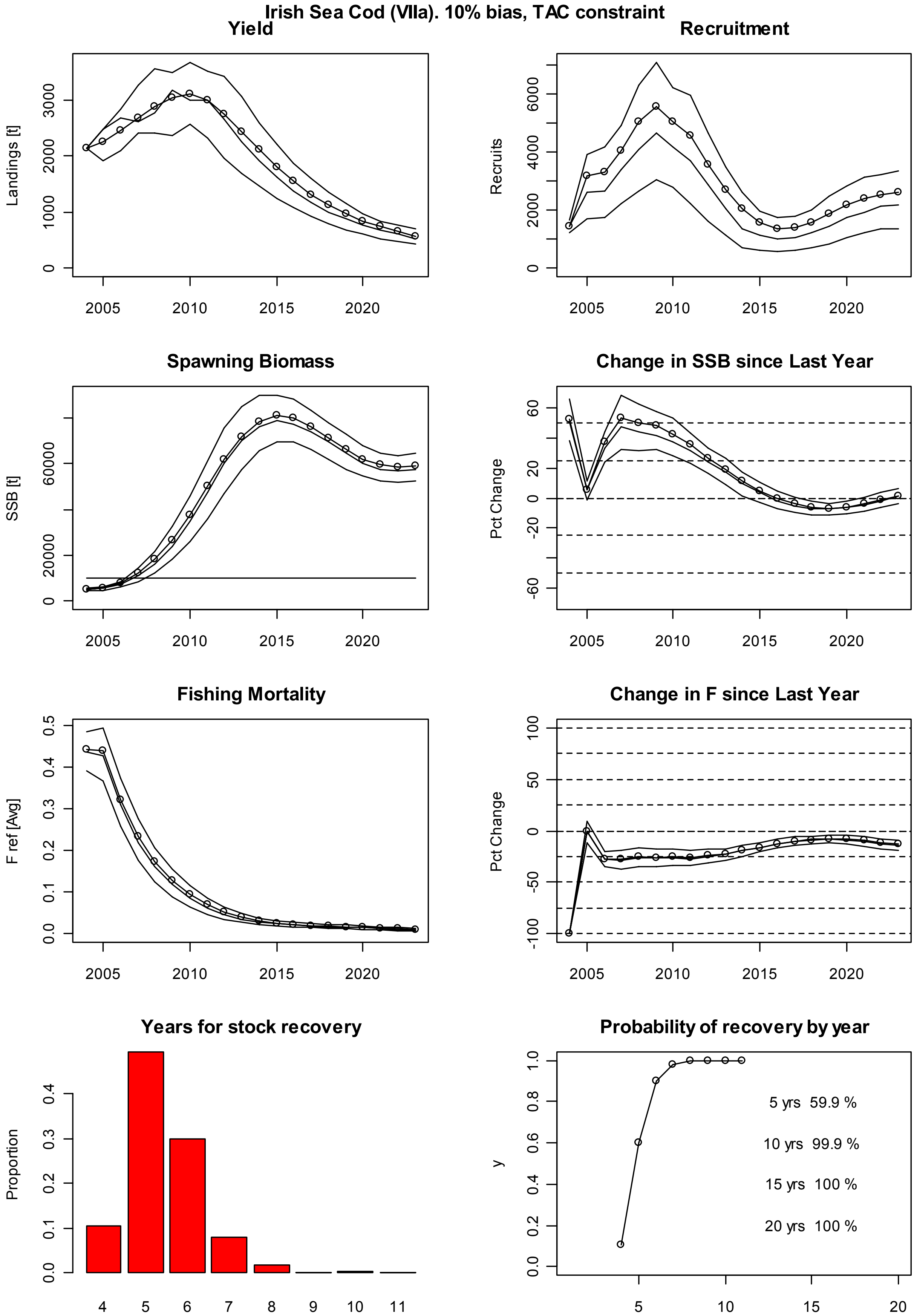


Figure 14.1.5. CS5 results for VIa cod. Run WS1: F_{sq} constraint in 2004. No bias. Input values from assessment Run1.

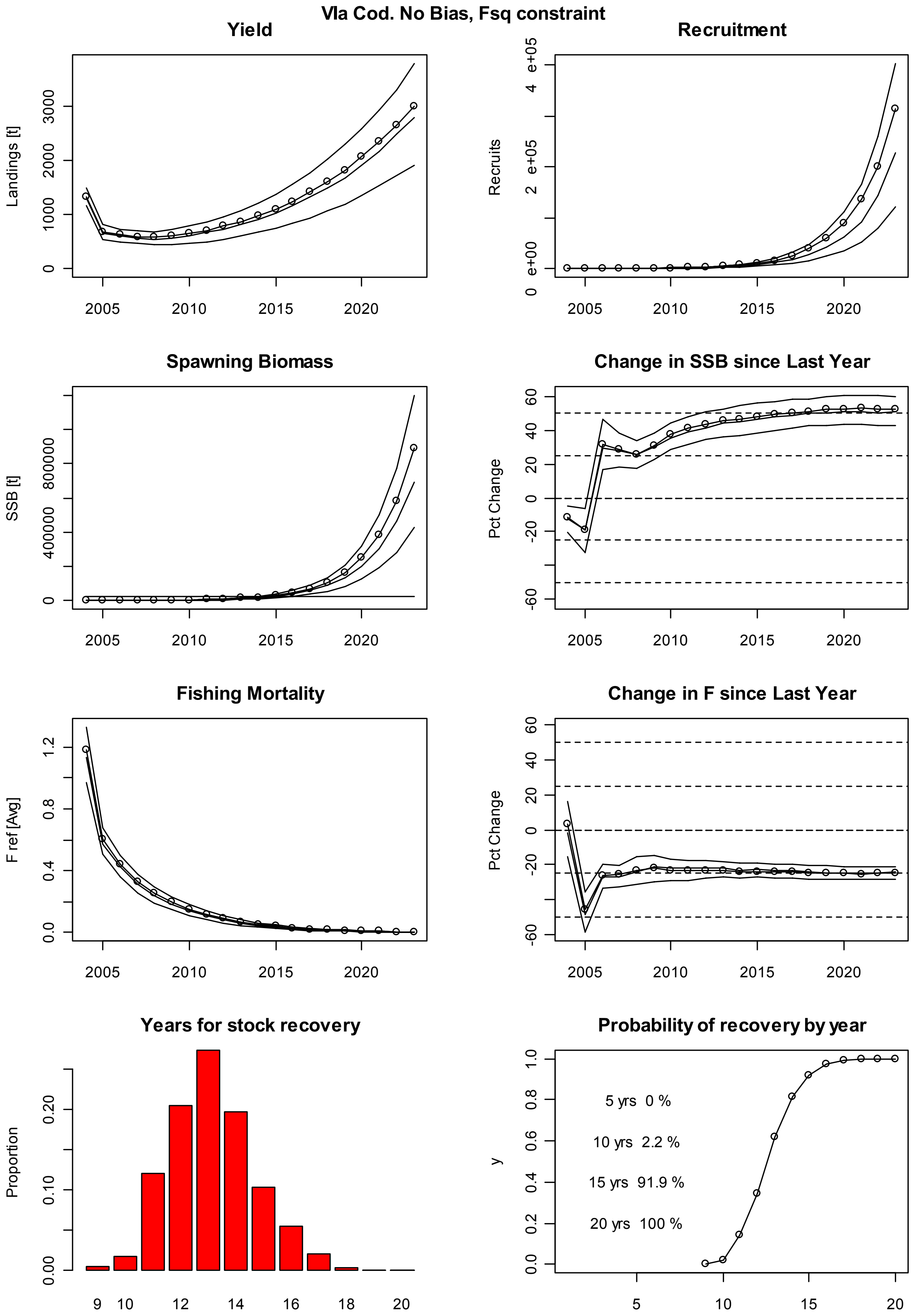


Figure 14.1.6. CS5 results for VIa cod. Run WS2: F_{sq} constraint in 2004. 10% bias. Input values from assessment Run1.

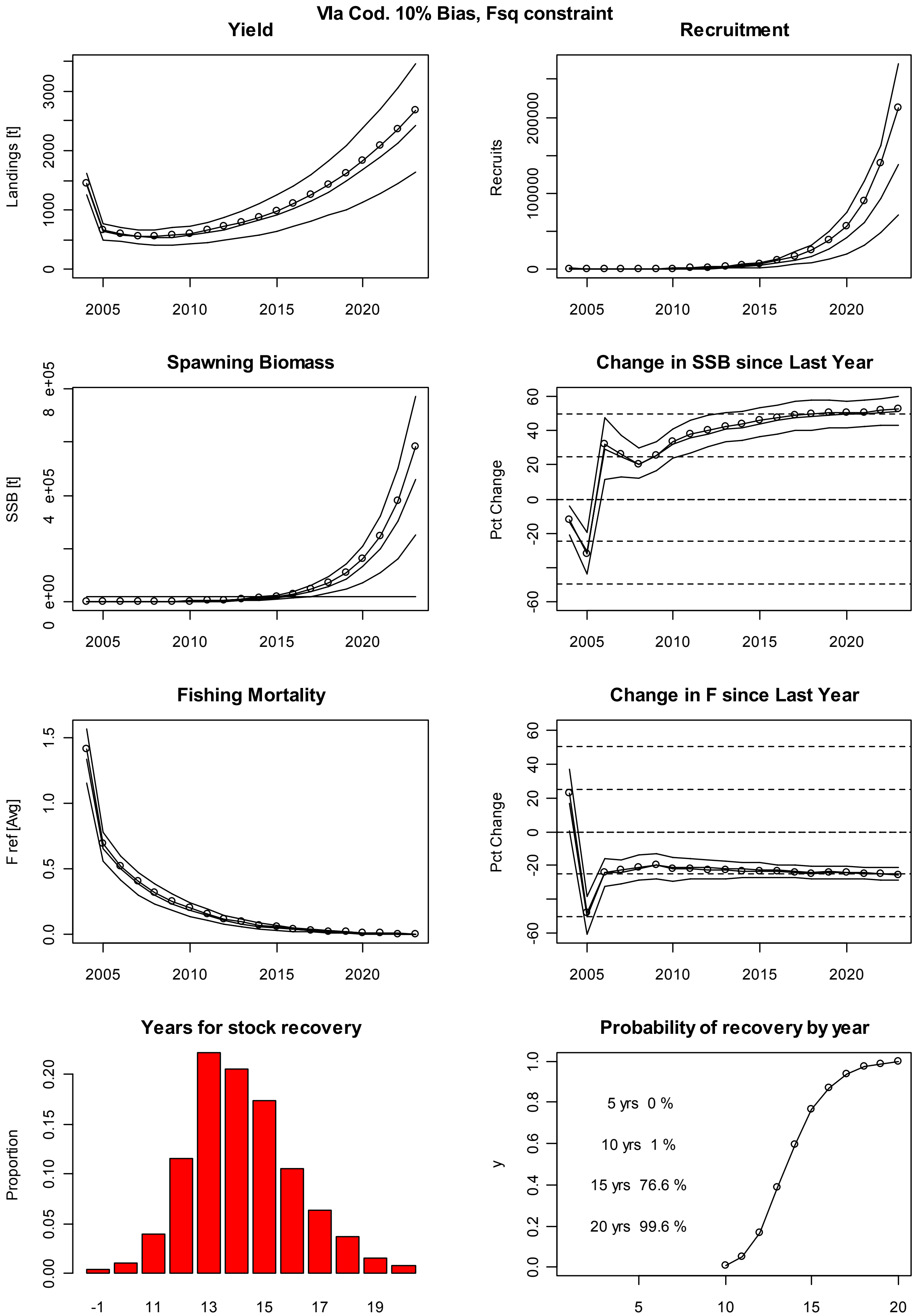


Figure 14.1.7. CS5 results for VIa cod. Run WS3: F_{sq} constraint in 2004. No bias. Input values from assessment Run2.

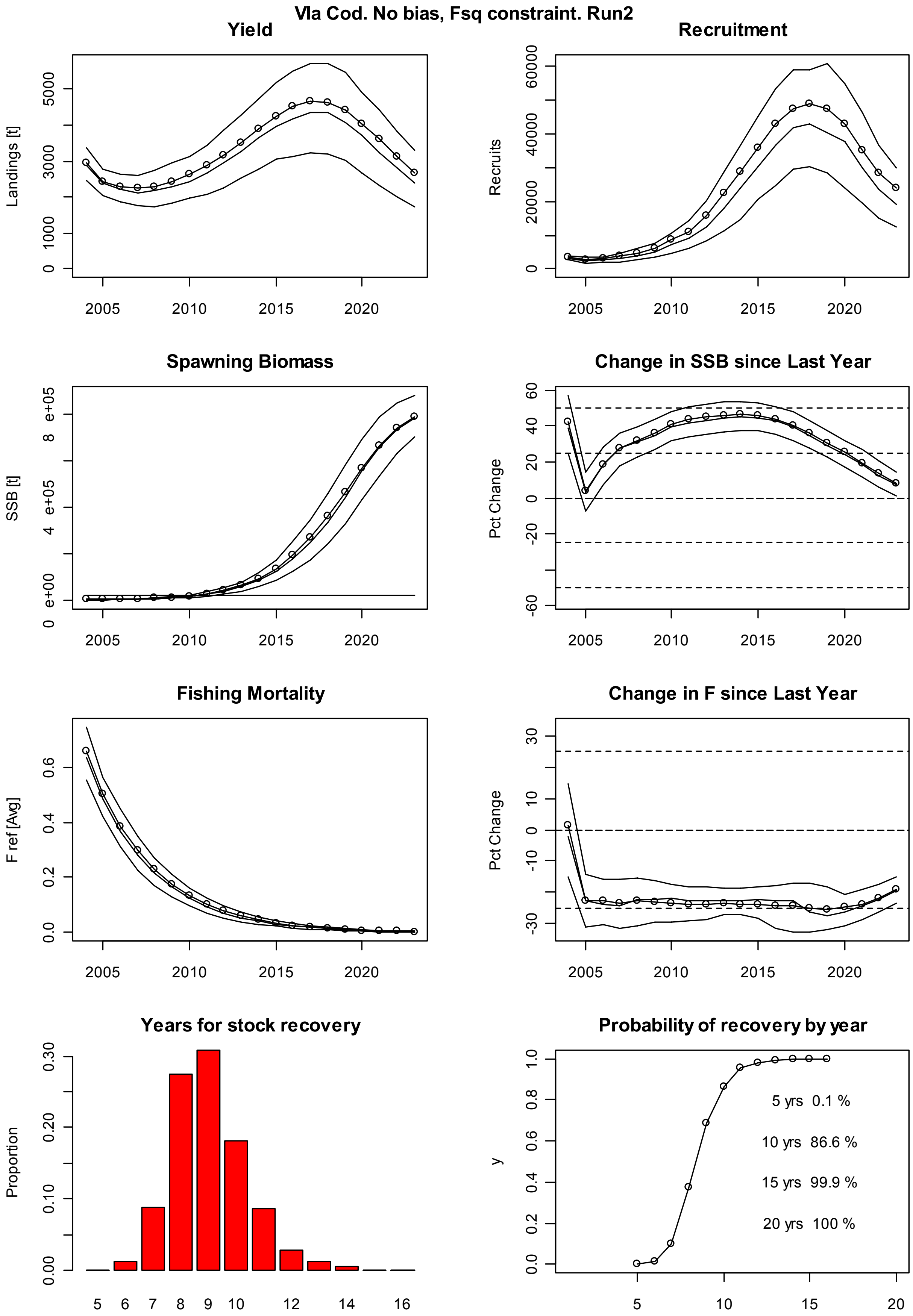


Figure 14.1.8. CS5 results for VIa cod. Run WS4: F_{sq} constraint in 2004. 10% bias. Input values from assessment Run2.

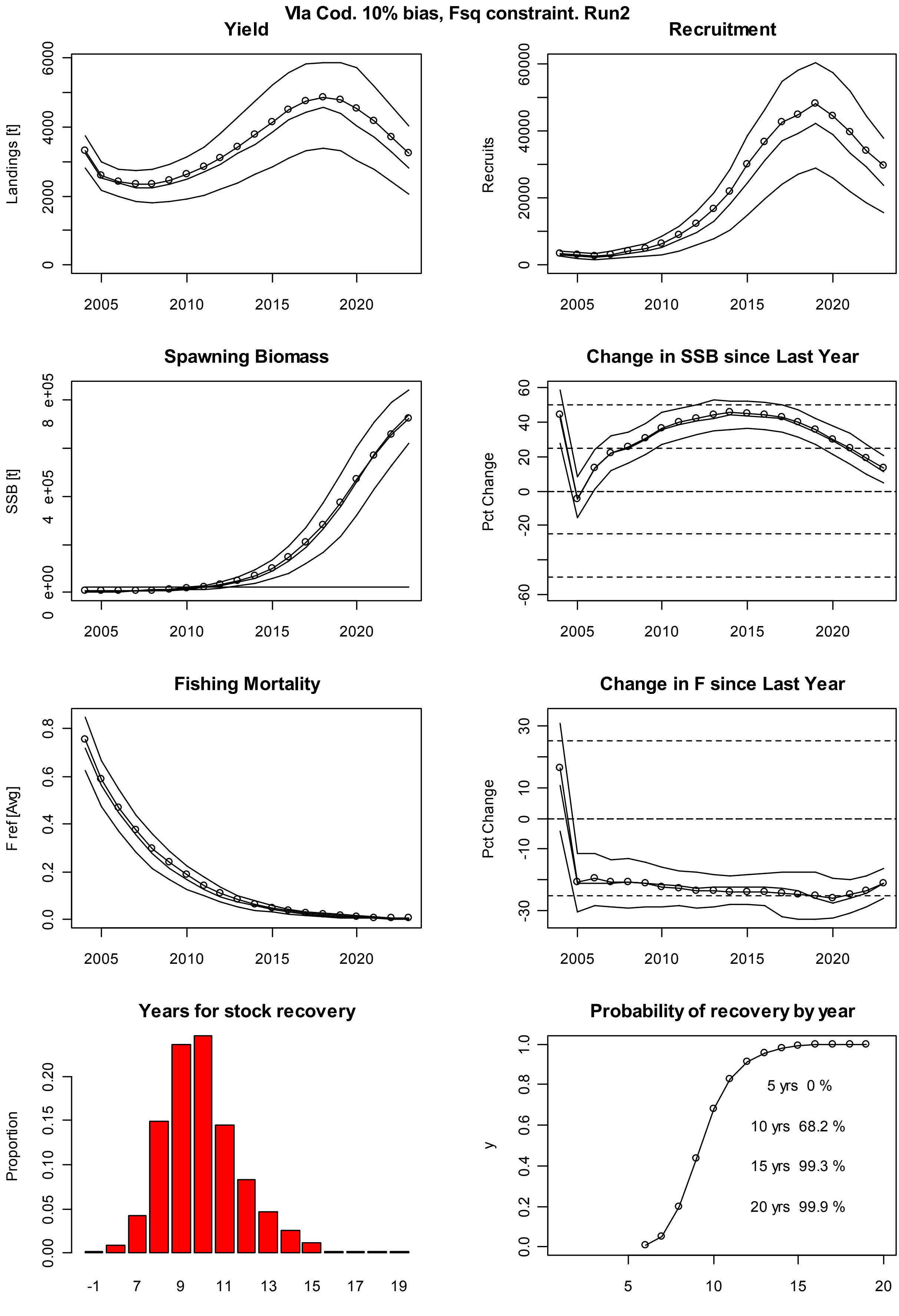


Figure 14.1.9. CS5 results for VIa cod. Run WS5: F_{sq} constraint in 2004. No bias. Input values from assessment Run3.

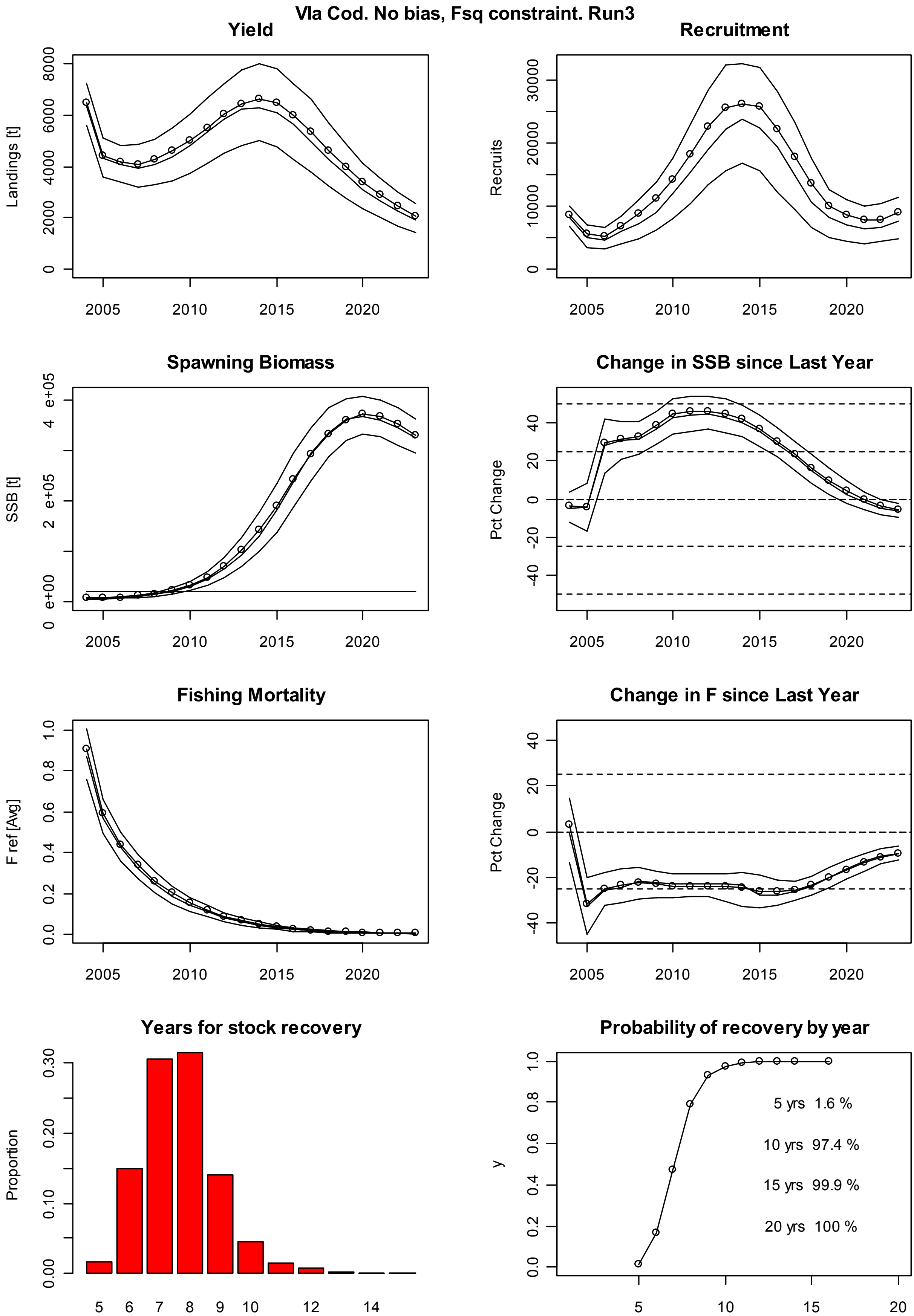


Figure 14.1.10. CS5 results for VIa cod. Run WS6: F_{sq} constraint in 2004. 10% bias. Input values from assessment Run3.

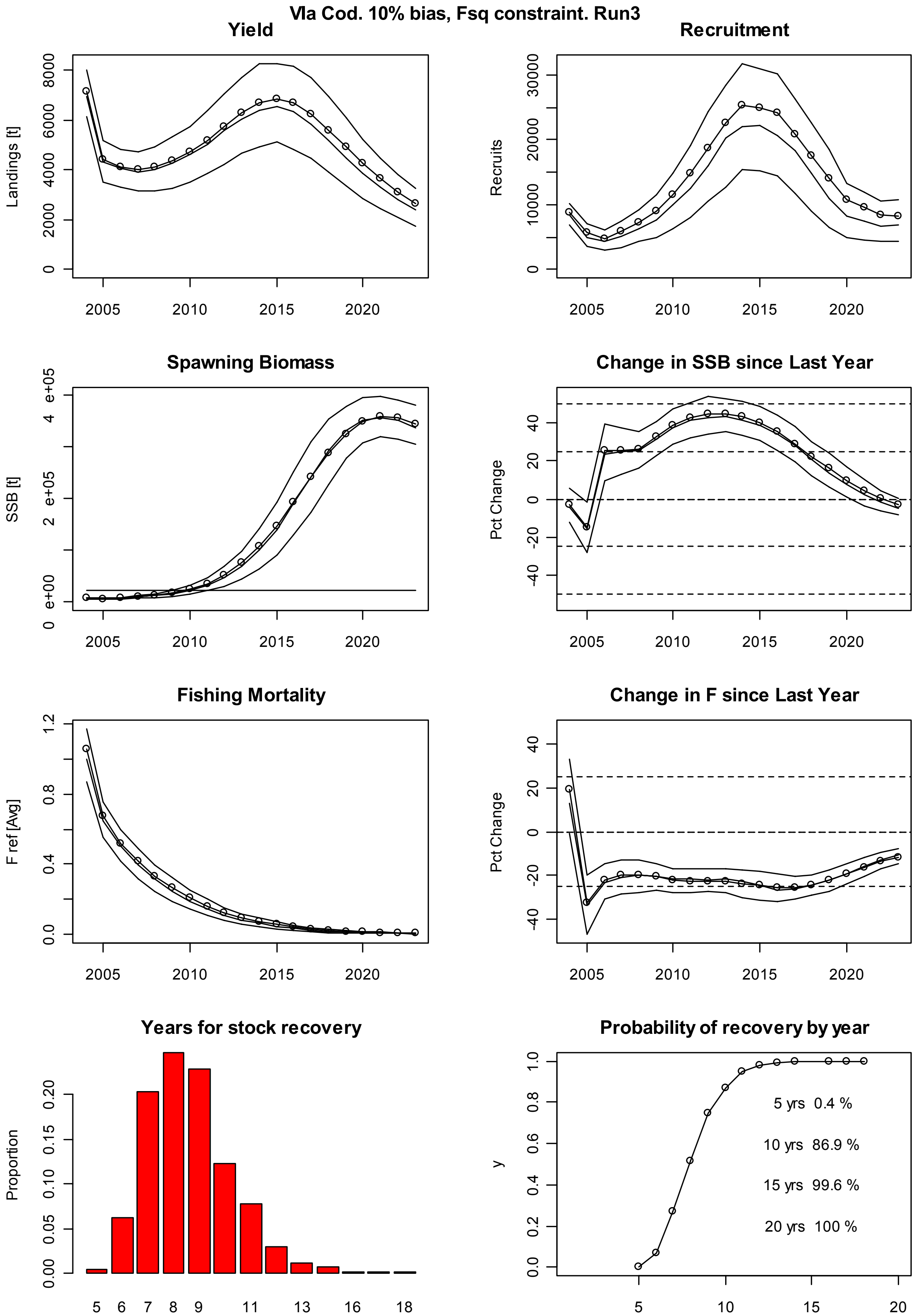


Figure 14.1.11. CS5 results for VIa cod. Run WS7: F_{sq} constraint in 2004. No bias. Input values from assessment Run4.

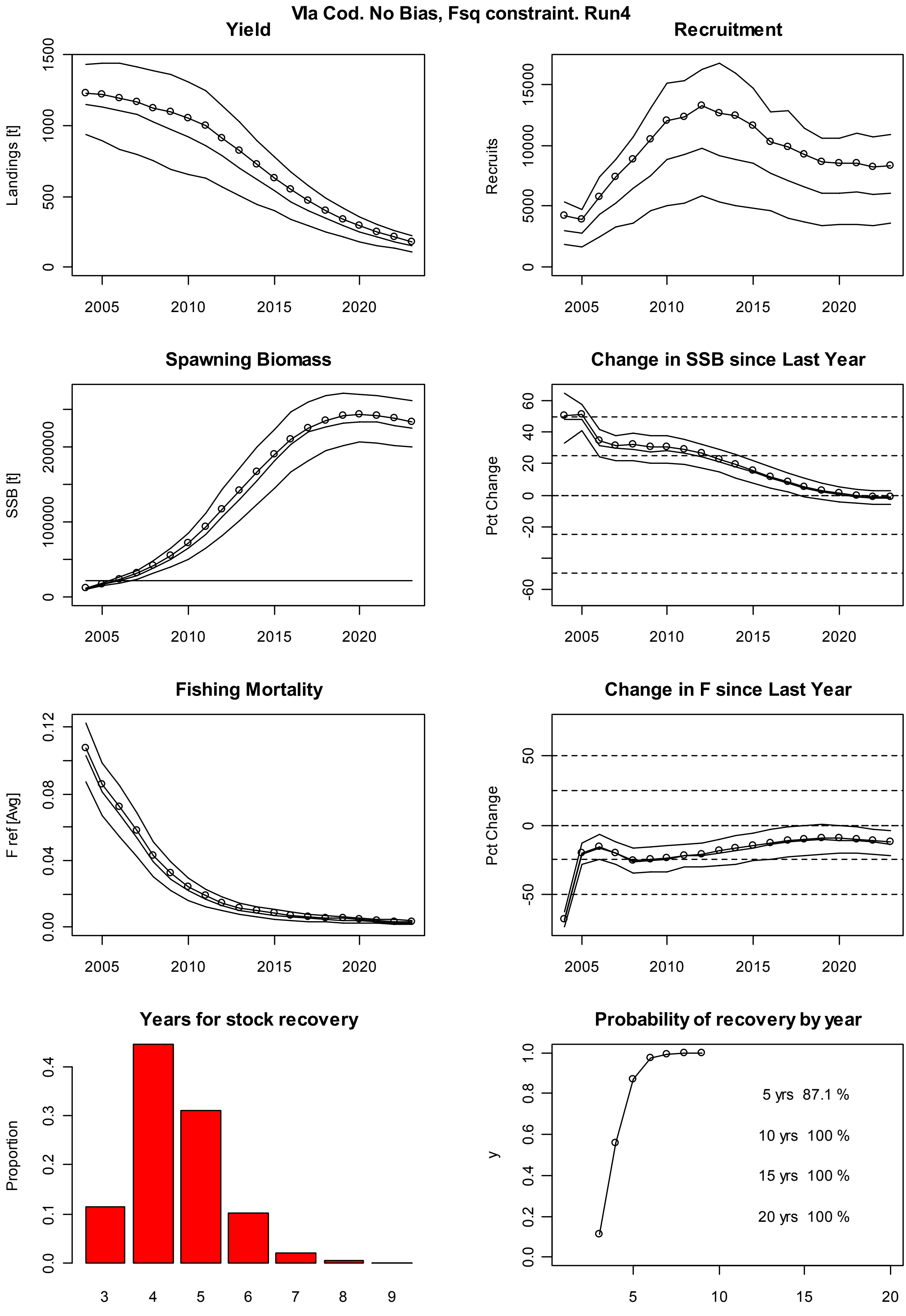
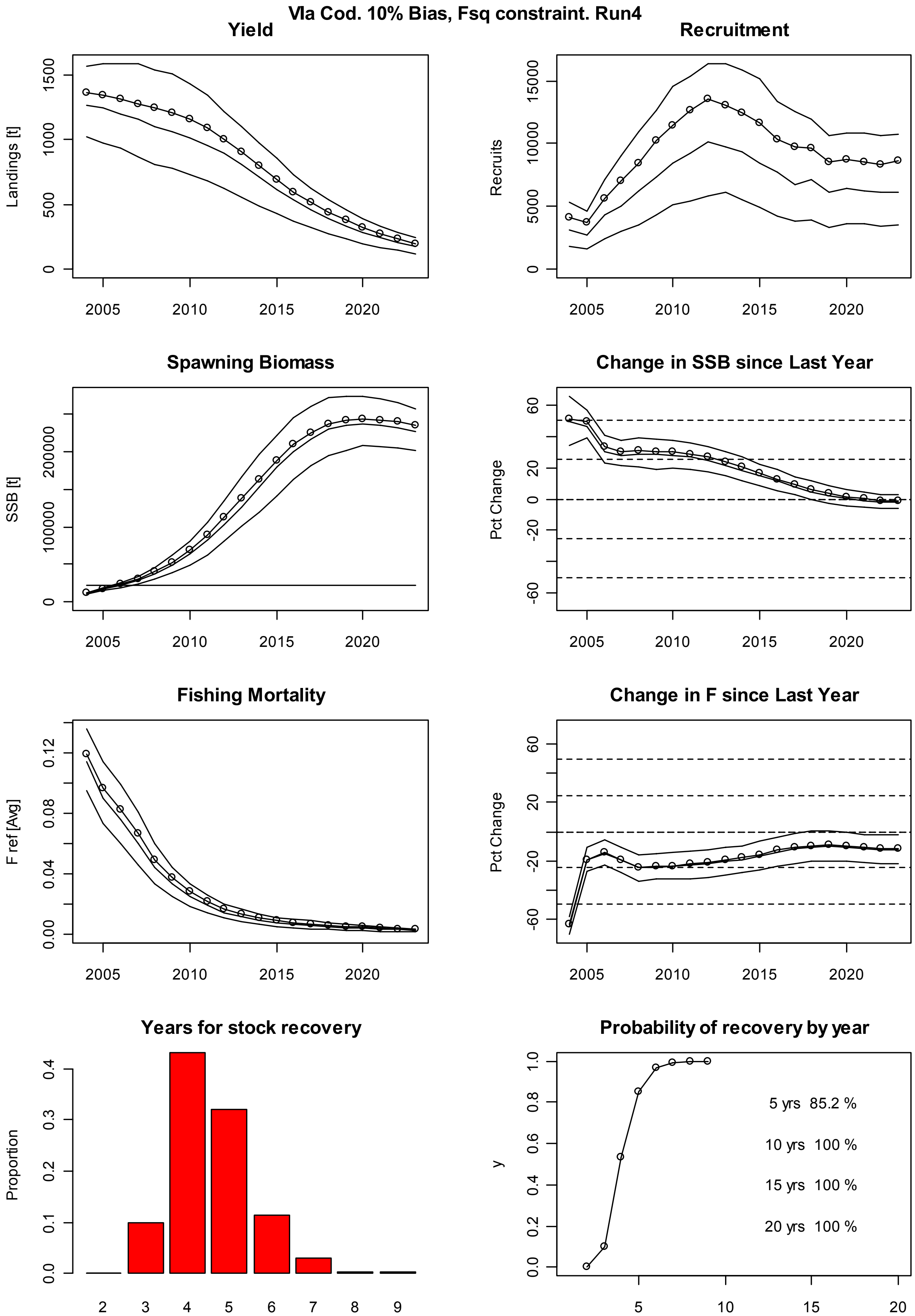


Figure 14.1.12. CS5 results for VIa cod. Run WS8: F_{sq} constraint in 2004. 10% bias. Input values from assessment Run4.



15 ANGLERFISH STOCK STRUCTURE

It was stated in the ToR for the WGNSDS that the working group should review information on the stock structure of anglerfish in Divisions IIa, IIIa, Va, Vb, VIa and in Subarea IV and define appropriate stock areas for fish stock assessment usage. The stock structure of anglerfish in northern European waters is unclear, mostly due to the fact that spawning anglerfish and their spawning products (eggs and larvae) are rarely caught. Characteristics of the anglerfish in Norwegian (IIa, NEZ north of N 62°), Faeroese (Vb) and Icelandic (Va) waters are discussed in relation to the current assessment area (IV and VI).

15.1 Anglerfish in Nordic waters

A comprehensive description of the knowledge and ongoing research on anglerfish in Nordic waters per December 2002 can be found in WD 12. *Nordic waters* were defined for the purposes of WD 12, comprising waters around Iceland (Va), the Faeroes (Vb) and Norway (IIa), as well as northern (IVa), eastern (IIIa) and central (IVb) parts of the North Sea (i.e. overlapping with the current assessment area). Brief descriptions of the development of the fisheries, typical length distributions from different fleets operating in Divisions IIa, Va and Vb and new information about the fisheries are given below.

15.1.1 Norwegian waters north of N 62° (Division IIa NEZ)

The fishery for anglerfish in Division IIa has, since the early 1990s, been dominated by a directed gillnet fishery (see WD 11 for further details) in the area between N 62° and N 64°, with landings peaking at close to 3000 tonnes in 1993. Landings from this area have varied between 1000-2000 tonnes since 1998, while a similar fishery developed north of N 64° in the same period (Figure 15.1.1.1). Total reported landings from Division IIa for 2003 were 2406 tonnes. New regulations of the directed fishery in 2003 included a closure during the months March through May and a maximum soaking time of 3 days. The minimum mesh size was kept at 360 mm. These regulations probably resulted in a reduced effort in the fishery. Length distributions from the main gillnet fishery during 1992-1996 and for 2002 are shown in Figure 15.1.1.2. Through time, increasingly smaller fish are being caught, but due to the selection pattern of the large meshed nets, still primarily fish larger than 60 cm are caught.

15.1.2 Faeroese waters (Division Vb)

Coinciding with the development of the Norwegian directed gillnet fishery in Division IIa, a similar fishery for anglerfish in Division Vb developed, peaking at just above 1000 tonnes in 2000 and 2001 (Figure 15.1.2.1). The directed gillnet fishery has, since 1999 been responsible for 40-50% of the anglerfish landings. Various Faeroese trawler fleets take the remaining landings in the area. Total reported landings from Division Vb for 2003 increased to about 2300 tonnes, which is the same level as the previous peak in 1999. The effort in 2003 is at the same level as the year before. Six gillnetters were allowed to fish anglerfish around the Faeroe Islands in 2003. Regulations of their fishery include minimum mesh size (300 mm), maximum number of gillnet and they are only allowed to set gillnets deeper than 380 m. There are also some areas closed for gillnet fisheries. The trawlers are regulated by fishing days and closed areas. Length distributions from the trawl and gillnet fishery in 2000 are shown in Figure 15.1.2.2. The length distribution from the gillnet fishery is similar to what is seen in the Norwegian gillnet fishery, whereas the trawlers are catching anglerfish of more comparable lengths to trawlers operating within the current Northern Shelf assessment area (e.g. Figure 6.1.3.1.).

15.1.3 Icelandic waters (Division Va)

A directed gillnet fishery for anglerfish has also developed in Division Va in recent years. This first started in 2000, raising the total annual landings in this area to about 1500 tonnes. The gillnet landings decreased during the following two years (Figure 15.1.3.1), but have increased considerably again in 2003. This raised the total landings to 1686 tonnes. Landings from various trawler fleets and Danish seines have been rather stable (at about 700-800 tonnes) during the last years. The increase during 2003 is due to an increased effort by the gillnetters following a rise in the quotas compared to 2001 and 2002. Both the spatial distribution of the fisheries in 2003 and the 2004 March survey results indicate that anglerfish have a more westerly distribution compared to earlier years, which possibly could be related to an observed warming of the waters west of Iceland. The gillnetters seem to catch anglerfish of similar lengths as the corresponding fisheries in Faeroese and Norwegian waters (Figure 15.1.3.2.), while the length distributions from other gears are heavily influenced by the very strong 1998 and 2001 year-classes. Preliminary results from the Icelandic 2004 March groundfish survey appear to indicate a high abundance of anglerfish smaller than 25cm, probably another strong year-class being recruited to Icelandic waters.

15.2 Spawning areas and drift of eggs and larvae

Hislop *et al*. (2001) hypothesised two main spawning areas, at Rockall and west of the Hebrides. Using a particle tracking model driven by hydrodynamic data, Hislop *et al*. (2001) simulated the dispersal of *Lophius* eggs and larvae, using estimates of the spawning depth and egg ribbon ascent rate towards the surface. Based on temperature and depth the potential spawning range of anglerfish was defined as the continental slope west of Ireland north to 63°N, the northern perimeter of the North Sea and the Rockall Plateau. These regions were used as a start grid in the model. The simulations indicate that eggs and larvae are carried eastwards, northwards and westwards, also into Nordic waters (Figure 15.2.1. and 15.2.2).

15.3 Recent tagging programmes

Tagging of anglerfish has been carried out since 2001 in the waters around Shetland, and has recently started in Norwegian, Faeroese and Icelandic waters. One recapture of an anglerfish tagged at Shetland has so far been made in Faeroese waters. As the other Nordic tagging programmes have just started, only a small number of recaptures from the Norwegian programme have been recorded so far. The two last recaptures reported were taken 40-50 nm north of the release site. These tagging programmes will hopefully give some further information on possible migrations between the different ICES areas.

15.4 Genetic studies

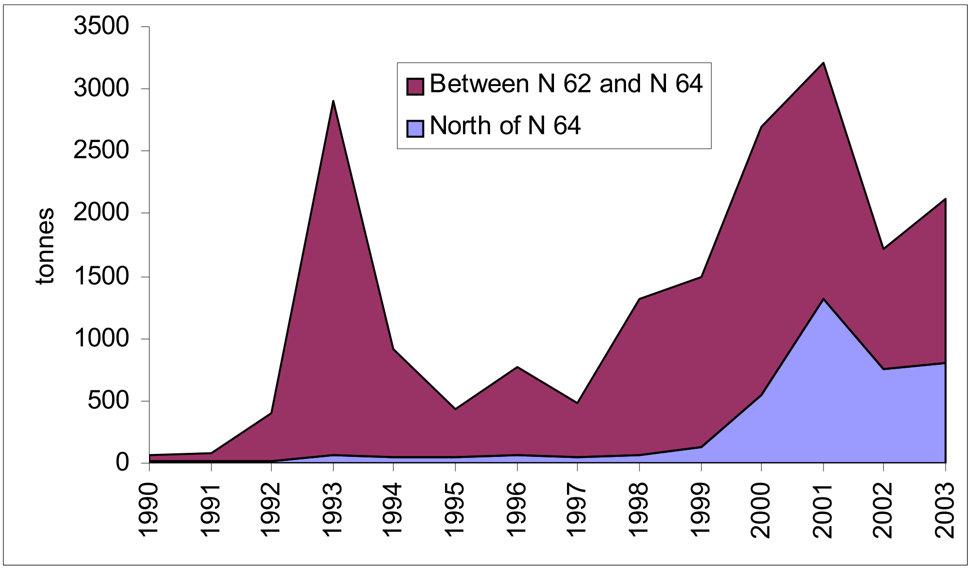
A pilot project on preliminary analysis on allozyme variation in anglerfish muscle samples was performed at the Institute of Marine Research in Bergen in 2002. No apparent genetic variation that can be used to distinguish between populations in Icelandic and Faeroese waters was found. Analysis of larger samples is needed. DNA was extracted for purposes of micro-satellite DNA analysis. The methods used in recent work on micro-satellite DNA done during the EU-funded project entitled “Distribution and biology of anglerfish and megrim in the waters to the West of Scotland” (EC study contract 98/096, Anon 2001) could be applied on material sampled in Nordic waters.

15.5 Discussion

No new information to conclusively define the stock structure is currently available. Despite studies on the Northern Shelf and in Nordic waters, many questions remain unresolved about anglerfish stock structure in North European waters. Whilst tagging studies are underway and may yield information on anglerfish migrations, a coordinated tagging program across the Northern Shelf and Nordic waters would be more useful. Existing tagging programmes are operating in only the northern part of the potential stock distribution area. Tagging may describe migration patterns, but not the genetic structure. A coordinated effort on genetic studies may accelerate the acquisition of useful information on the genetic stock structure. More immediately, useful information may be obtained from analysis of the occurrence of anglerfish recruits (<30 cm) in different groundfish surveys in North European waters in relation to oceanographic data. By comparing this with the simulations made by Hislop et al. (2001) some further knowledge on the recruitment mechanisms of anglerfish could be gained. Assessment considerations in relation to an extended stock area are discussed in section 6.4.4.3.

Figure 15.1.1.1. Norwegian landings from the directed gillnet fishery (A) and trawls and Danish seine (B) from Division IIa south and north of N 64°.

A. Gillnet.



B. Other gears.

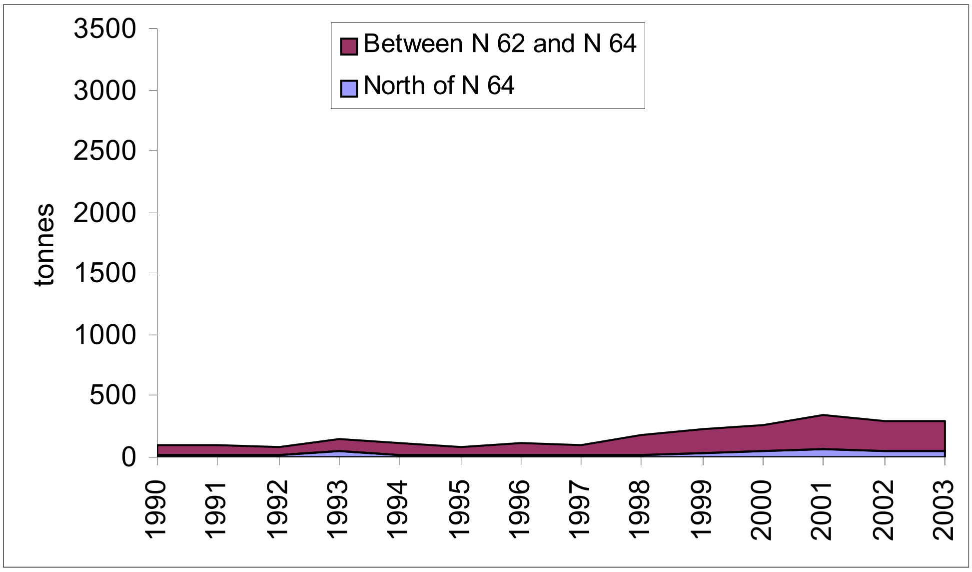


Figure 15.1.1.2. Length distributions of anglerfish caught in the Norwegian gillnet fishery between N 62° and N 64°.

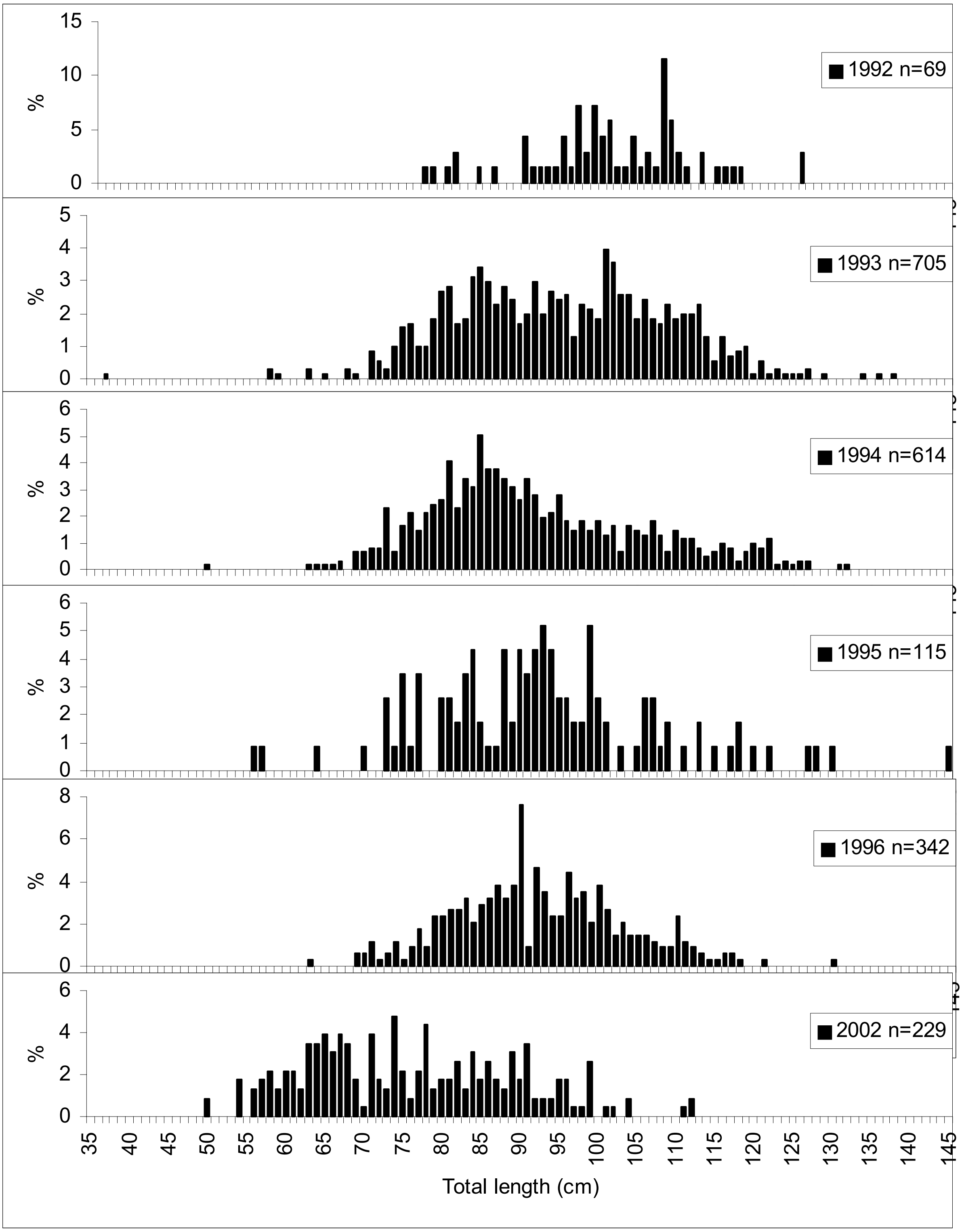


Figure 15.1.2.1. Faeroese landings by different gears during 1990-2003.

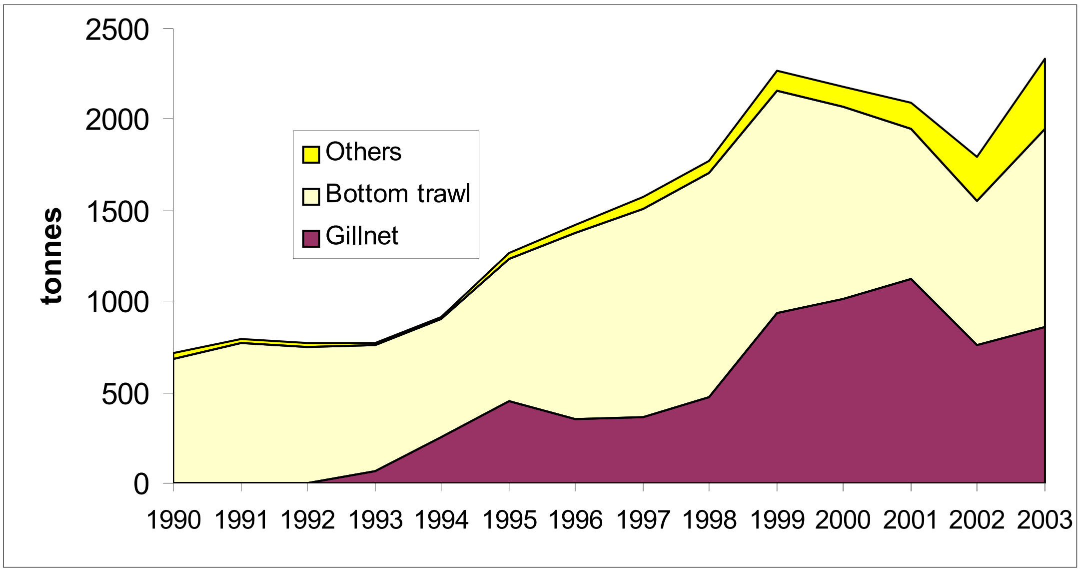


Figure 15.1.2.2. Length distributions of anglerfish caught by trawl and gillnets in the Faeroese fishery in 2000.

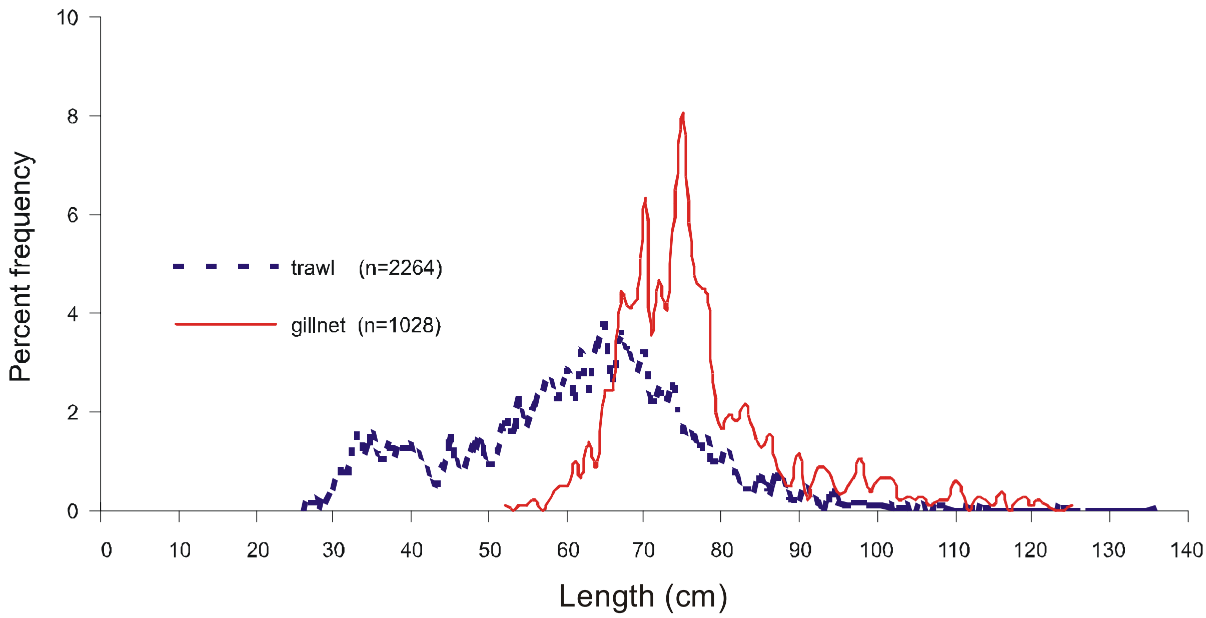


Figure 15.1.3.1. Icelandic landings by different gears during 1990-2003.

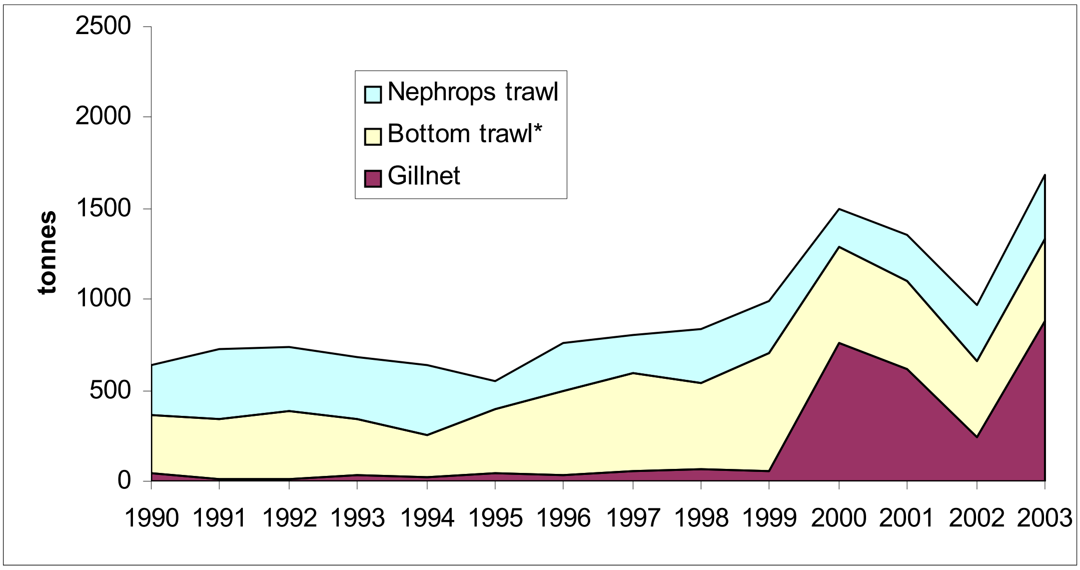


Figure 15.1.3.2. Length distributions of anglerfish caught in the Icelandic fishery during 2000-2002.

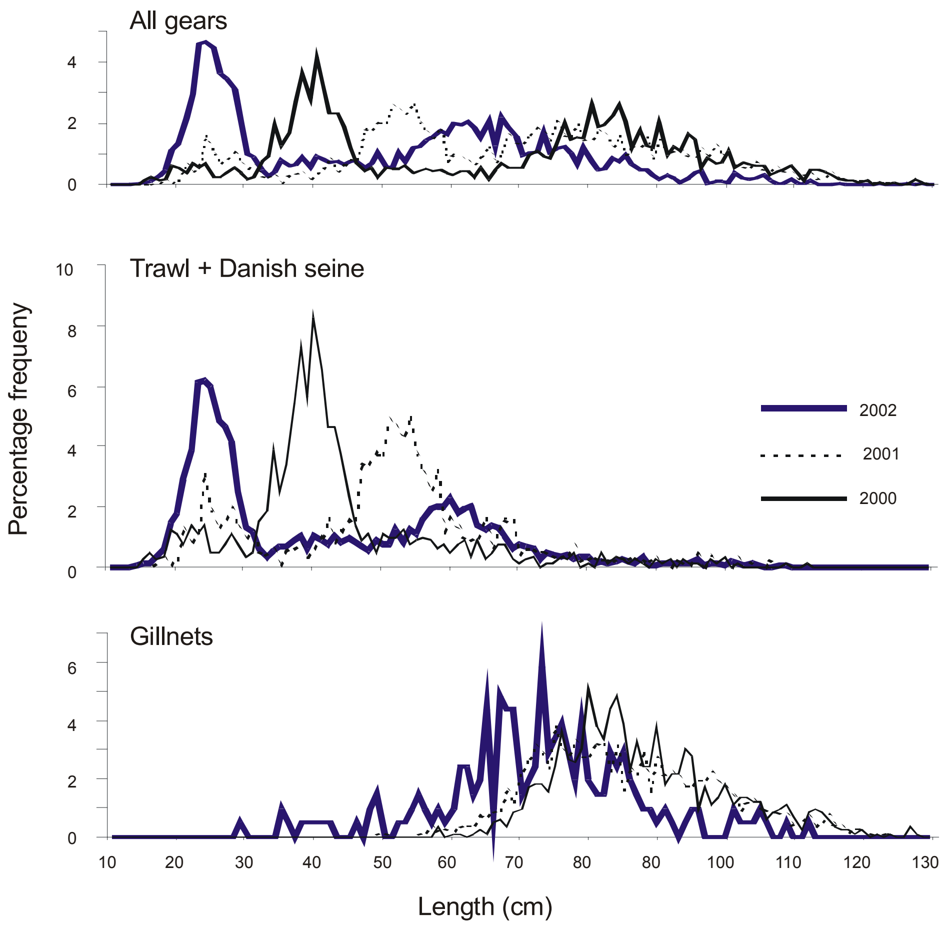


Figure 15.2.1. Simulation of the dispersal of *Lophius* eggs and larvae using a particle tracking model (Hislop *et al*. 2001): particles originating in the West of Hebrides source box. (a) Age 0; (b) age 30 days; (c) age 60 days; (d) age 90 days; (e) age 120 days. Source: Figure 11 from Hislop *et al*. (2001).

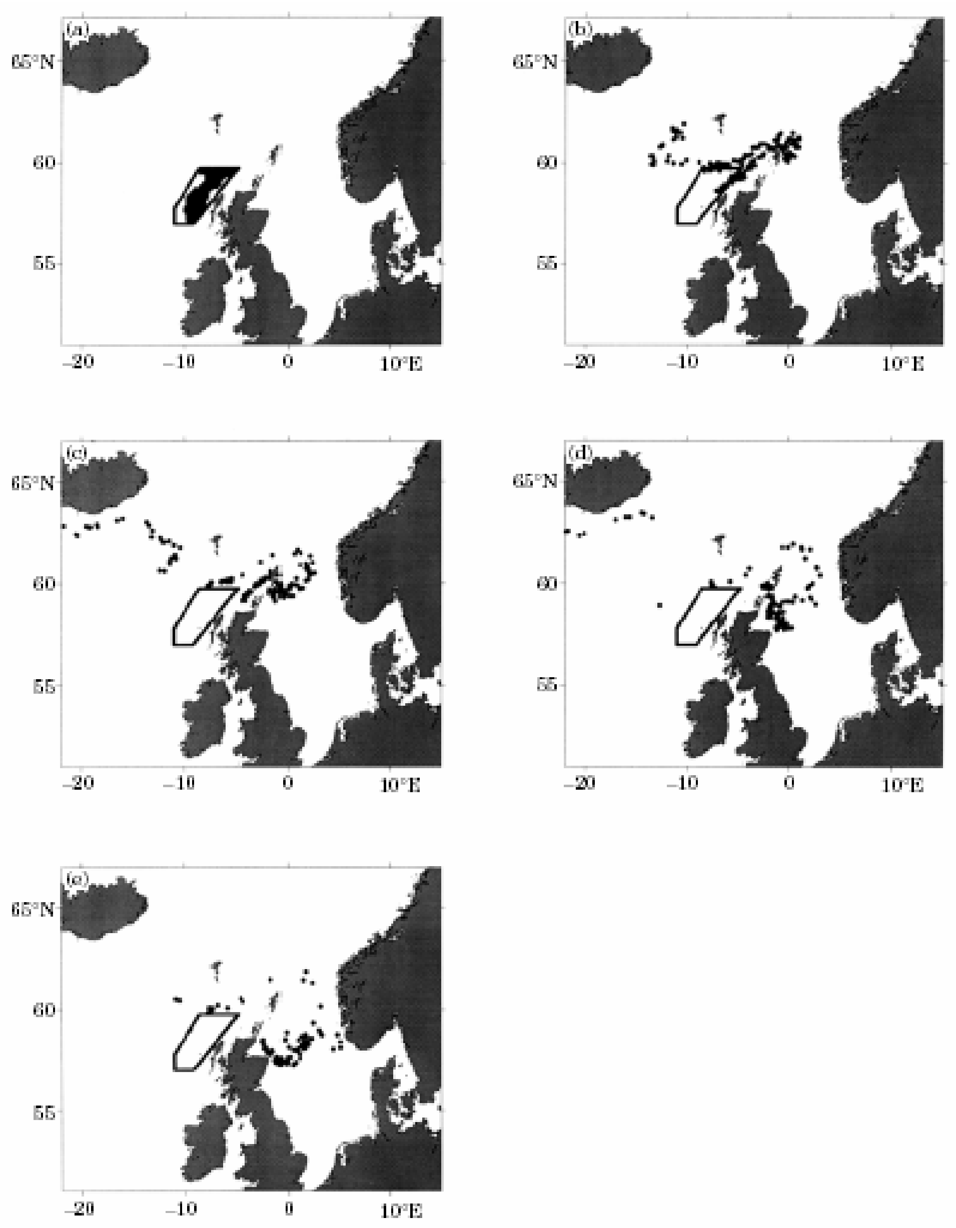


Figure 15.2.2. Simulation of the dispersal of *Lophius* eggs and larvae using a particle tracking model (Hislop *et al*. 2001) particles originating in the Rockall source box. (a) Age 0; (b) age 30 days; (c) age 60 days; (d) age 90 days; (e) age 120 days. Source: Figure 11 from Hislop *et al*. (2001).