Advisory Committee on Fishery Management

ICES CM 1996/Assess:6

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

ICES Headquarters, Copenhagen, Denmark

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PART I

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1. INTRODUCTION

1.1 Participants

The Working Group met in Copenhagen with the following participants:

Uli Damm	Germany
Poul Degnbol (Chairman)	Denmark
Henrik Gislason	Denmark
Henk Heessen	Netherlands
Holger Hovgaard	Denmark
Pieter de Jong	Netherlands
Knut Korsbrekke	Norway
Phil Kunzlik	Scotland
John Lahn-Johannessen	Norway
P.O.Larsson (part time)	Sweden
Peter Lewy	Denmark
Tim Macer	England
Capucine Mellon	France
Richard Millner	England
Stuart Reeves	Scotland
Adriaan Rijnsdorp	Netherlands
Stuart Rogers	England
Odd M.Smedstad	Norway
Axel Temming	Germany
Alain Tétard	France
Willy Vanhee	Belgium

1.2 Terms of reference

The Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (Chairman: Mr P. Degnbol, Denmark) will meet at ICES Headquarters from 2-10 October 1995 to:

a) assess the status of and provide catch options for 1996 for the stocks of cod, haddock, whiting, saithe, sole, and plaice in Sub-area IV, Division IIIa (excluding sole in Division IIIa and cod in the Kattegat), and Division VIId (excluding haddock and saithe), taking into account as far as possible the technical interactions among the stocks due to the mixed-species fisheries;

b) assess the status of Norway pout and sandeel stocks in Sub-area IV and Divisions IIIa and VIa and advise on the need for any management measures;

c) quantify the species composition of bycatches taken in the fisheries for Norway pout and sandeel in the North Sea and adjacent waters and make this information available to the Working Group on Ecosystem Effects of Fishing Activities;

d) for those stocks and/or fisheries where data permit, provide the information required to give advice or guidance on

i) medium-term management objectives (in terms of spawning stock biomass and mortality rates) and options

ii) the appropriateness of controls on catch (or landings) and fishing effort

iii) the potential for multispecies and multi-annual catch options

e) provide the data requested by the Multispecies Assessment Working Group (quarterly catches and mean weights at age in the catch and stock for 1994 for all species in the multispecies model that are assessed by this Working Group);

f) evaluate the stock units used in the assessment of stocks in the North Sea and adjacent areas (Divisions IIIa, VIId and VIa) and identify any changes required;

g) analyse the relevant data from the quarterly International Bottom Trawl Surveys in the North Sea and Division IIIa and evaluate the potential usefulness of the surveys in assessments.

The above terms of reference are set up to provide ACFM with the information required to respond to the requests for advice from the North-East Atlantic Fisheries Commission and the European Commission.

1.3 Data sources and sampling levels

1.3.1 Data sources: roundfish and flatfish

The data used in assessments are based on :

- Market sampling of market categories, sampled for weight, length and age
- Total landings as market units and/or total weight by nation
- Fleet data : effort and catch data by age derived from logbooks, landings sampling and market information
- Survey data : catch per effort unit by age, weight and maturity information

Details of the data sources are provided for each stock separately in the stock sections.

The working group estimates of total landings do for most stocks deviate from official Figures. This discrepancy is shown in the landings Tables under the heading 'unallocated landings'. These unallocated landings will in most cases include discrepancies which are due to differences in the calculation procedures, for instance that official landings figures use nominal box weights whereas the working group estimates are based on the box weights as measured during market sampling. These Sum Of Products differences are in most cases minor and the working group estimates have been used in assessments.

The unallocated landings do in some cases also include corrections for mis- or unreported landings as explained below. It will be evident from the stock sections whether such corrections have been included or not.

The mean weights at age used for stock biomasses are in some cases derived from catch at age weights. Such weights may not represent the stock due to selectivity. The biomasses for these stocks can therefore be used to investigate stock trends but may be biased relative to actual stocks sizes.

Maturity ogives are generally based on biological sampling. However, for some stocks a knife-edge maturity ogive is used and this may introduce errors in the trends in SSB developments - especially when exceptionally large or small year classes enter the spawning stock.

The maturity ogives are generally kept constant over the historical data range. Some of the stocks assessed here - for instance plaice in the North Sea - are known to exhibit relatively large differences in size-at-age over the historical time series. This is expected to result in differences in maturity and also in differences in the quality of spawning products. The SSB will therefore in effect be lower when growth diminishes than what is indicated by the time series based on a constant maturity-at-age matrix.

Adjustments for un- or misreported landings

The data for most stocks assessed by this working group have at some time or another been affected by problems with misreporting or nonreporting. Adjustments to the data used in assessments have been made in several cases. The basis of such adjustments may range from informed guesses to estimates based on independent sampling schemes. Any adjustments made should therefore be accompanied about a clear explanation about the sources and methods used for their estimation. However, the sources of information about mis- or nonreporting are in most cases sensitive and may not be available for future assessments if details are revealed. In order to provide the users of the report with some information about the quality of adjustments the Working Group decided to comment on the quality of the adjustments on basis of a general quality scheme. The quality of the adjustments are classified as follows :

Formal estimates - means that the adjustments applied are based on formal and independent sampling schemes.

Estimates from partial data - means that the adjustments are based on quantitative information covering part of the fisheries to which the problem may apply, but not covering the fisheries systematically.

Indirect estimates - means that the adjustments are based on quantitative information associated with mis- or nonreporting such as accounts or trade statistics.

Soft estimates - means that the adjustments are based on quantitative information obtained through interviews.

Guestimates - means that adjustments are the best guess by the biologists involved in the assessment. The basis for such guesses will normally be explained in the text.

1.3.2 Data sources : Norway pout and sandeel

The sampling systems applied differ between countries.

1.3.2.1 Norway

The sampling scheme has changed since 1993 :

Situation before 1993:

The catches landed at the fish meal plants were visually inspected by a controller of the fisheries directorate and classified into 4 categories:

cat. D12: 70% or more of the catch is Norway pout (NP) typical by catches are blue whiting, herring, haddock, whiting cod, saithe and flatfish;

cat. D13: 70% of more of the catch is blue whiting (BW) typical by catches are Norway pout, Argentines and deep water species;

cat. E02: 70% or more of the catch is sandeel (SE) by-catch levels are insignificant;

cat. M02: no dominant (70%) species (mostly mix of BW and NP) this category made up for only approx. 5% of the catches

information was also collected on the number of fishing days, GRT, depth and fishing ground

In addition to the above listed information from some of the catches samples are taken to estimate the species composition of the categories and the age and length composition of the target species.

Situation since 1993

The above mentioned control system was abandoned by the end of 1992 leading to a loss of the important information on the number of *fishing days*. There is no independent logbook system established in the Norwegian industrial fleet. This information can at present only be indirectly estimated from the number of fishing trips (which is estimated from the sales slips) and the relationship between the number of fishing days and fishing trips estimated from the data before 1993.

The catch classification has also changed, since it is now based on the coarse visual inspection of the landings by a member of the fishermen's sales organization, which is needed because the prices for the three species (NP, BW and SE) differ to some extent. The categories here are:

E02 (sandeel): if mainly Sandeel (visual inspection)

D13: (blue whiting): if it is not sandeel and the catch was taken west of 0°E

D12 (Norway pout): if it is not sandeel and the catch was taken east of 0°E

the category M02 is no longer used. The catch samples are still taken, and they are now used to estimate the species composition in these new categories. However, it is no longer an official controller, but an independent person. Anonymous treatment of the data is granted to the fishermen. Sampling intensity is 1-2 50kg sample for sandeel and 1-2 samples for Norway pout per week and landing port (3).

1.3.2.2 Denmark

The Danish sampling system was described in an earlier report of the Working Group on the Assessment of Norway Pout and Sandeel (CM 1994/Assess:7) and has basically not changed since then. This description is included below :

The Danish industrial landings are defined as all landings taken by fisheries using mesh size smaller than 32 mm and landed with the purpose of being converted to fish meal and oil.

Catches landed for human consumption, almost all taken by gears of mesh size equal to or greater than 31 mm, but for some reason (e.g. quality or price) used for reduction, are not included in this description.

The objectives of the Danish sampling scheme are:

- To collect data needed for estimation of the total landings taken in the Danish small meshed industrial fishery by species, statistical square and month.

- To collect information on age and length composition by species, month and area.

The basic sources of information are stored in four data bases:

- Sales-slip Database.
- Logbook Database.
- Species composition Database.
- Biological Database.

The sales-slip Database:

For all landings which are sold, first hand buyers are obliged to report to the Ministry of Fisheries (MF) information on target species, quantity, price and area (ICES Division) for each landing. The information is recorded in the MF's *Sales-slip Database.*

The information on species composition in the industrial sales-slip Database is not representative of the true species composition of the landings as only the target species is recorded (e.g. a landing of nominal Norway Pout may, and usually does, contain various quantities of other species taken as by-catch). Therefore, only information on total quantity of all species landed from each main area (ICES-Division) is used from this Database.

The logbook Database:

For the North Sea the general rule deals with vessels with an overall length of 17 m or more. In the Skagerrak and Kattegat the minimum length of vessels is set at 12 m. The logbooks contain information at least on a daily basis about, e.g., catch-data, catch-position (statistical rectangle), species and quantity. Information from these logbooks is recorded in the *Logbook Database* in the Ministry of Fisheries. The logbook information is used to estimate the relative distribution by ICES statistical rectangle of the landings identified as having been taken by the small meshed industrial fishery. In addition, catch per unit of effort is obtained from catches and fishing day according to this Database.

The landings used in this relative distribution are those in which the species composition is consistent with those species typically landed for industrial purposes.

Species composition Database:

The industrial landings are sampled for species composition on a routine basis by the Fishery Inspectors. One standard sample of 10 to 15 kg is taken from each landing sampled. The samples are sorted by species and total weight by species and the position of capture (ICES statistical rectangle) is recorded. The data are stored in the *Species composition Database* in the Ministry of Fisheries. The total number of samples of landings in the North Sea, Skagerrak and Kattegat in the years 1989 to 1992 are given in the text Table below.

Before the data are used to calculate the landings by species a quality check is carried out using information from research and commercial vessel surveys, historical data, the biological Database (see below) and informal contacts in the most important port.

The species composition of landings by other nations in Danish ports is also estimated and included in this Database.

Biological Database:

Separate biological samples from industrial landings are taken on a routine basis by the Fishery Inspectors and handed over to The Danish Institute for Fisheries and Marine Research (DIFRES). The sample size is about 10 kg. After sorting the sample by species the total weight by species, length composition and mean weight by length group are recorded. Otoliths are collected for age reading. The data, together with information on catch position, are stored in DIFRES' Biological Database.

The total number of samples taken in the North Sea, Skagerrak and Kattegat in the years 1989 to 1992 are given in the text Table below.

Number of landings from the North Sea, Skagerrak and Kattegat sampled in the period 1989 to 1992.

	1989	1990	1991	1992
Species composition data-base	1,388	1,162	824	1,109
Biological data-base	178	64	307	422
Total number of samples	1,566	1,226	1,131	1,531
Landings ('000 tonnes)	1,322	960	1,207	1,376

Estimation of landings by species:

The total industrial landing by month and ICES Division or Sub-area are calculated using the sales-slip Database. The landings are allocated to statistical rectangle using the relative geographical distribution from the logbook Database of landings identified as having been taken by the small meshed industrial fishery. The output is industrial landings by statistical rectangle and month.

The relative species composition by statistical rectangle and month is estimated using the information in the species composition and biological data base. An average composition by rectangle is estimated taking the mean of all samples from that rectangle. If more than one sample is taken from the same landing, a mean composition of the landing is calculated and treated as one sample.

After calculation of average composition by rectangle a new average composition is calculated taking into account the species composition in all neighbouring rectangles.

This is done by taking the mean species composition of the rectangles and all 8 surrounding rectangles.

The total landings by species, statistical rectangle and month are calculated using the estimated species composition and total landings by rectangle and month.

The reason for possible discrepancies between the species composition in the biological Database and that in the logbook Database is: 1) that the species composition in the logbook is based on a subjective estimate and, 2) that there is a general tendency by the fishermen to under-estimate the contents of protected by-catch species.

1.3.3 Sampling levels

Sampling levels for the various stocks are presented in Table 1.1

The Table presents samples taken, number of fish measured (length) and number of fish aged. The Figures given may not be entirely comparable across countries and stocks. Sample sizes are variable and the number of fish aged may not in all cases mean otoliths read. The age of especially young fish which are reasonably well separated in terms of length from neighboring age groups may in some cases be decided by taking otoliths from the transitions zones to neighboring age classes and then assigning all fish in between length classes for which only one age is found to one age group.

1.4 Methods and software

1.4.1 Analysis of catch-at-age data

Extended survivors analysis (XSA) has been used as the main tool for catch-at-age analysis for all stocks. Two implementations were used : version 3.1 of the Lowestoft VPA package was used for roundfish and flatfish stocks while the Seasonal XSA (Skagen 1993, 1994) was used for Norway Pout and sandeel to allow for quarterly data and missing data points. A seasonal separable VPA (Cook 1992, Cook and Reeves 1993) was used to analyze sandeel stocks in Sub-division VIa. This method was applied due to the catch levels having fallen to such a low level that VPA analysis has become unreliable.

The implementation of the various analysis tools is chosen on basis of explorations. The decision on such choices as ages to be treated as recruits, time taper and fleets to be included is based on inspection of diagnostic output including residuals plots and retrospective analysis for a range of options. Such analysis has been done for all stocks included in the present report, but is not repeated every year since the outcome is normally not expected to change over a few years. An analysis of tuning choices has therefore only been repeated for some of the stocks. Details of such analysis are included under the stocks to which the analysis applies or will be found in earlier reports of this working group if reference is made to the same choices being made as in last year's report.

Recruitment estimates has in several cases been made with RCT3. This is the case when recruitment indices from 1995 are available - and especially when indices are available from later than the first quarter. The present implementation of XSA can not accommodate survey data in the year following the last catch data year and RCT3 is therefore implemented to utilise this information. This does in itself create some inconsistencies in the approaches used. The survey indices may end up being used twice for recruitment estimation - once in the survivors analysis and then VIa the VPA recruitment again together with the same survey indices in RCT3. Another problem is the use of F-shrinkage for recruiting year classes in the present implementation of the XSA. This can not be turned off and has in some cases been seen to have strong influence on the recruitment estimates originating from XSA. The result of this feature is that the present implementation of XSA does *not* reproduce RCT3 for recruiting year classes.

1.4.2 Sensitivity analysis and medium-term projections

Sensitivity analysis, and medium term projections made at the current WG meeting used the same software as at the previous WG meeting apart from the minor changes detailed below. Details of the sensitivity analysis are given in Cook (1993), with an overview of the programs in Anon. (1995) and more detailed documentation in Reeves and Cook (1994).

The program 'INSENS' has again been used for manipulation of catch data for stocks where discard/industrial bycatch data are used in the assessment. The program has also been used for most stocks to calculate coefficients of variation (CVs) of the input parameters for sensitivity analysis of the short-term catch predictions. In the program overview in Anon. (1995), it was noted that care was needed in the interpretation of the sensitivity analyses, since the source of the CVs was still under development. In particular, it was noted that calculations of CVs for the year effect of F over the full year-range of the available data might not be appropriate, as such a practice would tend to overestimate the annual variability in fishing mortality, particularly if there was a trend in F. This aspect of the program has now been changed, and CVs of the year effect of F are now calculated over the year range used in calculating mean exploitation patterns for prediction. Typically this would be the three or five most recent years. This change means that the CV of the year effect of F is likely to provide a more proportionate measure of the annual variation in F. Compared to sensitivity analyses of predictions made at the previous WG meeting, the CVs on the year effect of F contribute less to the overall uncertainty of the predictions. It remains the case that care should be taken in the interpretation of the sensitivity analysis results.

The program WGFRANS has again been used for short-term catch prediction with sensitivity analysis. This program is unchanged from the previous WG meeting. In some cases the final prediction was run on IFAP and this output is presented in the Report in addition to the sensitivity analyses from WGFRANS.

The output from the sensitivity analysis refers to various input parameters by abbreviations :

Key to parameters used in short-term prediction with sensitivity analysis

(HC = Human consumption, Disc = discards, Ind BC = industrial bycatch)

Code	Parameter	Code	Parameter
N0	Numbers at age 0 in 1995	M0	Natural mortality, age 0
N1	Numbers at age 1 in 1995	M1	Natural mortality, age 1
N2	Numbers at age 2 in 1995	M2	Natural mortality, age 2
etc.			
WS0	Weight in stock at age 0	MT0	Proportion mature, age 0
WS1	Weight in stock at age 1	MT1	Proportion mature, age 1
WS2	Weight in stock at age 2	MT2	Proportion mature, age 2
etc.			
sH0	Selectivity, HC, age 0	WH0	Weight in HC catch, age 0
sH1	Selectivity, HC, age 1	WH0	Weight in HC catch, age 1
sH2	Selectivity, HC, age 2	WH0	Weight in HC catch, age 2
etc.			
sD0	Selectivity, Disc, age 0	WD0	Weight in Discards, age 0
sD1	Selectivity, Disc, age 1	WD0	Weight in Discards, age 1
sD2	Selectivity, Disc, age 2	WD0	Weight in Discards, age 2
etc.			
sI0	Selectivity, Ind BC, age 0	WI0	Weight in Ind Bycatch, age 0
sI1	Selectivity, Ind BC, age 1	WI0	Weight in Ind Bycatch, age 1
sI2	Selectivity, Ind BC, age 2	WI0	Weight in Ind Bycatch, age 2
etc.			
K95	Year effect on natural mortality, 1995		
K96	Year effect on natural mortality, 1996		
K97	Year effect on natural mortality, 1997		
HF95	Year effect on HC/discard fishing mortality, 1995		
HF96	Year effect on HC/discard fishing mortality, 1996		
HF97	Year effect on HC/discard fishing mortality, 1997		
IF95	Year effect on Ind. bycatch fishing mortality, 1995		
IF96	Year effect on Ind. bycatch fishing mortality, 1996		
IF97	Year effect on Ind. bycatch fishing mortality, 1997		
R96	Recruitment in 1996		
R97	Recruitment in 1997		

For medium term projections, stock-recruitment models were fitted using the program RECRUIT, which generates input data for the medium-term projection program WGMTERM. Both of these programs are as used at the previous WG meeting. As with the sensitivity analysis, caution should be used in the interpretation of the medium-term projections. The estimated probabilities are contingent upon the model and the assumptions used in this program, and should not be interpreted too literally.

For sole in the North Sea the SPLIR model (van Beek, 1994) was used to estimate the probability that SSB will decrease below a certain level in the long term. The model estimates the variability on the yield- and biomass per recruit curves due to the observed variability in recruitment.

1.4.3 ICES software

It has been the intention of the Working Group to use the IFAD/IFAP system as its main tool for assessments and predictions. It is recognized that it is essential that the assessments are available to ACFM in a form which is documented and which allows alternative or new assessments to be made by ACFM. The IFAD/IFAP system was developed to ensure exactly that and it is appreciated that the best way to ensure documentation and reproducibility would be to use the IFAP system. Preparations to transfer remaining assessments to the IFAP system were furthermore made during last year's meeting through a discussion with ICES staff on the modifications which had to be made to the IFAP system to enable all assessments to be run through IFAP.

It has, however, not been possible to use this system for several stocks this year due to the following problems :

1. Some assessments of the present working group are based on catch categories (Human consumption landings, discards and industrial by-catch). This means that fishing mortalities must be split into partial F's for the categories and this split should then be used as the basis for predictions. Such a split is not built into the present IFAP system as an automatic feature. A manual implementation where the categories are mimicked by fleets involves a risk of errors being introduced by the manual calculation of the historical F split by age and the prediction output becomes difficult to read. Assessments of those stocks for which this category split is relevant have therefore been made on stand-alone computers independent of the IFAP system. Identical files have however been left in ICES and it should be possible to reproduce these assessments on the IFAP system if the F-split calculated by the stand alone programme is used in the IFAP prediction.

2. The Norway Pout and sandeel assessments are based on an analysis of quarterly catch-at-age data. Data are missing in a single year for the North Sea stocks. The IFAP system is not geared to handle quarterly data and the XSA implementation available can not handle missing data. These assessments have therefore been made with programs specifically developed for the purpose.

Table 1.1 Sampling levels for 1994

	Section 3a			Section 4			Section 7d		
	# samples	measured	aged	# samples	measured	aged	# samples	measured	aged
COD									
Belgium									
Denmark	107	4321	4066	56	2530	2504			
England				570	76230	7033	61	1458	398
France				86	1680	762	27	119	119
Germany				15	20524	2930			
Netherlands				85	4661	2025			
Norway	39	343	53	233	2598	963			
Scotland					67388	13757			
Sweden		11604	984						
Total	146	16268	5103	1045	175611	29974	88	1577	517
HADDOCK									
Belgium									
Denmark	49	3636	3398	41	1259	1183			
England				327	44744	3971	3	133	0
France				24	1020	350			
Germany									
Netherlands									
Norway	32	573	25	329	20621	1238			
Scotland					214992	16892			
Sweden		26280	702						
Total	81	30489	4125	721	282636	23634	3	133	0
WHITING									
Belgium									
Denmark	66	1964	1852	64	625	550			
England				236	18623	2900	19	967	0
France				107	15547	1373	57	4240	1717
Germany									
Netherlands				93	7540	1100			
Norway	37	958	36	247	11331	684			
Scotland					108259	11034			
Sweden		14608	980						
Total	103	17530	2868	747	161925	17641	76	5207	1717
SAITHE									
Belgium									
Denmark				5	281	278			
England				56	2775	0			
France									
Germany				19	9306	3553			
Netherlands									
Norway	16	103	20	141	5814	1444			
Scotland					20190	8282			
Sweden		145	0						
Total	16	248	20	221	38366	13557	0	0	0

Table 1.1 Continued

	Section 3a			Section 4			Section 7d		
	# samples	measured	aged	# samples	measured	aged	# samples	measured	aged
<u>SOLE</u>									
Belgium				27	3306	650	21	2746	560
Denmark				2	729	727			
England				147	16291	1931	228	13634	3036
France				49	2538	0	100	5189	1048
Germany									
Netherlands				75	3750	3750			
Norway									
Scotland									
Sweden									
Total	0	0	0	300	26614	7058	349	21569	4644
<u>PLAICE</u>									
Belgium				24	1860	380	21	1420	300
Denmark	56	6073	5636	18	3121	3067			
England				142	24131	2404	185	9248	2446
France				125	2746	675	99	4485	1193
Germany									
Netherlands				79	4740	4740			
Norway	10	34		39	148				
Scotland					18424	0			
Sweden		2460							
Total	66	8567	5636	427	55170	11266	305	15153	3939
<u>NORWAY POUT</u>									
Belgium									
Denmark	27	594	499	32	3172	3172			
England									
France									
Germany									
Netherlands									
Norway	54	2432		372	29163	3161			
Scotland									
Sweden		6844	488						
Total	81	9870	987	404	32335	6333	0	0	0
<u>SANDEEL</u>									
Belgium									
Denmark	30	2878	623	57	5355	1712			
England									
France									
Germany									
Netherlands									
Norway	1	78		104	8635				
Scotland					375	182			
Sweden									
Total	31	2956	623	161	14365	1894	0	0	0

2. COD IN THE SKAGERRAK AND HADDOCK, WHITING, PLAICE, NORWAY POUT AND SANDEELS IN DIVISION IIIA

2.1 Overview

The stocks in Division IIIa to be assessed by the Working Group are the cod in the Skagerrak and haddock, whiting and plaice in the whole of Division IIIa.

The roundfish and flatfish stocks are mainly exploited by Danish and Swedish fleets consisting of bottom trawlers (*Nephrops* trawls with >70 mm meshes and bottom trawls with >90 mm mesh size), gill netters and Danish seiners. The total fishing effort in terms of the number of vessels operating in Division IIIa has decreased in recent years. This is partly an effect of the EU withdrawal programme which until now affected the Danish fleets only, but these fleets still dominate the fishery in Division IIIa.

The industrial fisheries is a fine-mesh trawl fishery (32 mm mesh-size) mainly carried out by vessels of a size above 20 m. This fleet component have also decreased over the last decade. The most important fisheries are those targeting Sandeel, Norway pout and mixed clupeids, i.e. sprat and herring.

The reported landings of cod decreased in 1994 to 13,300 tonnes, but the TAC was not reached. Haddock landings for human consumption, 1,830 tonnes, were about 100 tonnes below the 1993 reported landings and the lowest in the series. The total landings, i.e. including those for reduction, were 4,000 tonnes. Of the whiting TAC of 17,000 tonnes, only 460 tonnes were landed for human consumption. The by-catches in the Danish industrial fisheries added more than 5,000 tonnes to this Figure. The total reported catch is <50 % of the average for the previous ten years. The plaice TAC of 11,300 tonnes was hit in 1994. About 80 % of the plaice catch was reported from Skagerrak.

For assessments the time series of age samples from landings for industrial purposes is short, there are gaps in this series and discard data are lacking. Misreporting and non-reporting of catches has occurred in recent years, particularly for cod, but the amounts probably vary significantly between years.

The IBTS surveys in February (1979-1995), April (1991-1995), September (1991-1995) and November (1991-1994) provide abundance indices for the roundfish but not for plaice. The abundance indices from April, September and November are not yet available at ICES. There are also data available for 0-group cod from a Norwegian beach seine survey. The IBTS (February) and the Norwegian 0-group survey data are presented in Table 2.1.1.

Cod in the Skagerrak is probably not a unit stock. Apart from the so called fjord cod stocks, appearing along the Norwegian and Swedish coasts, the linkage of the Skagerrak cod to the Northern North Sea cod population has received further support (Munck *et al.*, 1995). Mis/non-reporting of landings has been a major problem in recent years. Nevertheless, an analytical assessment is presented in Section 2.2 although there are reasons to question the validity of this assessment.

Also for haddock in the Skagerrak, as for cod, there are doubts whether this is a unit stock (Larsson, 1995). The landings for industrial purposes were not adequately sampled between 1987 and 1990. The catch-at-age data available for haddock for these years are therefore not reliable for the youngest age groups. Because IBTS data can only be used to tune the younger age groups there are no relevant tuning indices available for that part of the catch-at-age matrices which is reliable. No analytical assessment of haddock can therefore be made.

Whiting catches are mainly (in 1994 >90 %) for reduction purposes and the lack of catch-at-age data for 1987-1990 prevents any analytical assessment.

For plaice in Division IIIa the age compositions available to the Working Group strongly suggested that the age determinations are not internally consistent. In 1994 this led to the decision not to do any analytical assessment. This year the age determinations for 1993 and earlier were revised but the 1994 age composition was found inconsistent. An assessment was made based on age information from the Northern North Sea for the 1994 catch.

The industrial fisheries yielded a total catch of 174,825 tons in 1994. Most of this catch is reported as Sandeels (85,000 tons) and Norway pout (23,000 tons) which are not regulated by catch quotas. However, the species composition derived from the sampling of the industrial fisheries indicate that these reported catches overestimates the actual catches of these species (Table 2.1.2). The total by-catch of non-clupeid human-consumption species amounted to 13,936 tons or 8 % of the total industrial landings. The dominant by-catch species were whiting (5,391 tons) and Haddock (2,180 tons). None of the remaining by-catch species accounted for more than 1,000 tons.

The available data on Sandeel and Norway pout did not allow an assessment to be carried out.

Table 2.1.1 ROUNDFISH in Division IIIa. Indices of 0–group cod from the Norwegian Skagerrak coast and indices of 1– and 2–groups from the IBTS in February, and 1–group whiting and haddock from the February IBTS.

Year class	Cod			Whiting	Haddock
	IBTS	IBTS	Norw.survey		
	1-gr	2-gr	0-gr	1-gr	1-gr
1974				499	
1975			6.1	236	
1976			11.4	99	
1977			3.4	392	
1978			6	561	
1979		85	21.4	722	40.4
1980	15	31	7.1	968	4.3
1981	36	30.4	5	690	47.7
1982	28.4	18.6	12.4	262	33.8
1983	23.4	51.8	1.9	500	71.7
1984	13.5	10.5	4.2	940	160.8
1985	77.9	113	20.3	1,379	57
1986	5.4	18.1	4.5	2,178	250.6
1987	77	23.8	10.1	2,978	125.2
1988	56	9.6	0.2	478	20.2
1989	30.9	25.3	15.9	2255	8
1990	9.3	5	1.9	1,363	74
1991	96	16	5.7	1,672	258
1992	110	7	6.6	1,359	405
1993	82	48	3.5	525	180
1994	97		6.0	1,105	233
1995			9.3		

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Table 2.1.2 Catches of the most important species in the industrial fisheries in Division IIIa ('000 t), 1974-1994[1].

Year	Sandeel	Sprat[2]	Herring[3]	Norway pout	Blue whiting	Total
1974	8	71	76	13	-	168
1975	17	101	57	19	-	194
1976	22	59	38	42	-	161
1977	7	67	32	21	-	127
1978	23	78	16	25	-	142
1979	34	96	13	25	6	174
1980	39	84	25	26	14	188
1981	59	76	63	30	+	228
1982	25	40	54	44	5	168
1983	29	26	89	30	16	190
1984	26	36	112	46	15	235
1985	6	20	116	9	19	170
1986	73	11	65	6	9	164
1987	5	14	72	3	25	119
1988	23	9	97	8	15	152
1989	18	10	52	6	9	95
1990	16	10	51	27	10	114
1991	23	14	22	32	11	102
1992	39	2	47	42	18	148
1993[4]	45	2	71	8	32	158
1994	55	58	30	7	12	162
Mean 1974-1994	27	41	58	23	14[5]	160

[1]Data from 1974-1984 from Anon. (1986), 1985-1993 provided by Working Group members.
[2]Total landings from all fisheries.
[3]For years 1974-1985, human consumption landings used for reduction are included in these data.
[4]Preliminary.
[5]Mean 1979-1994.

2.2 Cod in the Skagerrak (Northern part of Division IIIa)

2.2.1 Catch trends

Total reported catches in 1994 amounted to 14,161 tonnes compared to 14,735 tonnes in 1993 . Almost all of the catch were taken by Denmark and Sweden(84% and 13% of the total, respectively). The annual landings for 1971-1994 are given by country in Table 2.2.1 and shown in Figure. 2.2.1.A. The estimated total annual landings used by the Working Group are derived by multiplying the catch at age by the mean weight at age.

The fishery is partly a directed cod fishery and partly a mixed human consumption fishery. Both of these fisheries are carried out by trawl, seine and gill-net. Moreover, no table cod catches are taken as a by-catch in the *Nephrops* fishery. Except for the gill-netters the number of fishing vessels have declined over the most recent years.

The landing *Figures*, as well as the assessment presented below, do not include the Danish small-mesh trawl catches as catch-at-age data for this fishery were not available. The catch in this fishery amounted to 666 tons in 1994 (Table 2.2.2).

Also the Norwegian catches taken in the inshore areas are also excluded from the assessment as these cod are considered to belong to a separate stock (Anon., 1991).

It is known that a very significant amount of non-reporting of cod catches have taken place in the 1990's but it is not possible to provide an accurate estimate of the non-reporting. The control of the Danish regulation were tightened significantly during 1993 by comparing species compositions bought and later sold by plants and exporters. The amount of non-reporting is assumed to have diminished considerable in 1994. However, these measures do not enable a evaluation of the amount of catches being reported to other areas. In the most resent years the quota restrictions have been met earlier in the Baltic, Kattegat and the North Sea and catches from these areas are to an unknown extent being reported as taken in Skagerrak. The Danish control authorities assumes that 900 tons reported to Skagerrak were actually taken in Kattegat in 1994. The working group therefore reduced the official landings by 900 tons. It has not been possible to make similar corrections for the previous years.

2.2.2 Natural mortality, Maturity, Age composition, Mean weight at age.

Catch at age and mean weight at age information was only available from Denmark. The Danish age distribution and weight-at-age was applied to the total catch (Table 2.2.3, 2.2.4). Weight-at-ages in the stock are assumed to be identical to weight-at-age in the catches. Natural mortality is assumed to be 0.2 per year for all ages and years. Maturity-at-age were assumed equal to that of the North Sea stock (Table 2.2.5).

The sampling intensity of the Danish market sampling since 1988 is shown in Table 2.2.6.

2.2.3 Catch, Effort and Research Vessel data.

CPUE data for 1978-1994 are available for two Swedish fleets accounting for 50-80% of the total Swedish cod landings (Table 2.2.7). However, as the CPUE for these fleets are not given on an age dis aggregated form they can not be used in XSA tuning.

Four Danish fleets were used for tuning the XSA. CPUE by age were derived by merging landing slip information providing weight per market category with the age distribution per category as found in the market sampling . Only trips which could be classified as targeting cod or *Nephrops* were included in tuning fleets (Anon 1993). To circumvent differences in fishing power only vessels between 10- 20 GRT were included in the analysis. This fleet segment is the largest in the area and is overwhelmingly comprised of vessels just below 20 GRT. The estimates are based on about 8 thousand sales slips annually. The number of landings, the catch and the effort are shown by fleet in Table 2.2.8 while Table 2.2.9 shows CPUE by ages.

Since 1990 the IBTS surveys have been conducted on a quarterly basis. However, only the February IBTS survey are presently worked up for Division IIIa. Due to doubts on the survey age readings the age dis-aggregated abundance indices have been calculates applying modal separation of small cod combined with a use of Danish age-length keys for cod of commercial sizes (Hovgård, 1995). The results are given in Table 2.2.9.

2.2.4 Catch-at-age analysis

The number of fishing vessels as well as the annual effort have been decreasing in the Skagerrak in the most recent years (Anon 1994). Using F-shrinkage towards a historical average may hence bias the results and no F-shrinkage were therefore applied. No population shrinkage was used as it was thought unlikely that either the IBTS survey or the commercial fleet catchability would depend on year-class abundance. Initial XSA runs showed high residuals for the commercial tuning fleets for age 1 in 1987. Inspections of the age-length relationship for that year indicated that this may be caused by age readings errors. For this reason the 1987 age 1 CPUE for the four commercial tuning fleets were omitted from the analysis . The final XSA set-up and diagnostics are given in Table 2.2.10. The VPA output, based on the XSA tuning, are presented in Tables 2.2.11-2.2.12.

Plots of the log catchability residuals vs. time (Figure 2.2.2) show a positive slope for Gill-net, *Nephrops* trawl and cod trawl whereas no trends are seen for Seine and for the IBTS survey. For the commercial tuning fleets the log standard errors on the catchabilities varies between 0.3 and 0.5 corresponding to a CV of approximately 30-65% The standard errors are considerably higher for the IBTS survey.

The retrospective pattern of F(3-6) and of SSB is shown in Figure 2.2.3 and 2.2.4 For 1993 the 1994-VPA run indicate a fishery mortality of about 1.4 as compared to 0.8 estimated in the 1993 retrospective run. Similarly, the 1994 run estimate the 1993 SSB very considerable below the 1993 run. The respective runs therefore indicate a very considerable uncertainty in the estimation of the terminal fishing mortalities and in the population sizes for 1994.

2.2.5 Recruitment estimates

Information on the size of the 1994 year-class is only available from the IBTS survey 1 group index in 1995. The index of this year-class is the third highest on record (Table 2.2.9). A RCT3 analysis were carried out without shrinkage to match the VPA settings. The input and the result of this analysis is given in Tables 2.2.13 and 2.2.14. By this procedure the 1994 year-class were estimated at 29 million fish at age 1. This is about 70% above the long term geometric average and suggests the best recruitment since the strong 1985 year-class. The 1995 year-class also show up very strongly in the IBTS survey in Kattegat (Hovgaard, 1995) whereas it appears as about average in the IBTS survey in the North Sea (Section. 3.2.5).

Information on the size of the 1993 year-class is available at age 1 and 2 from the IBTS surveys in 1994-1995 and as age 1 cod in the four tuning fleet in 1994. In all six time series the 1993 year-class show up as considerable above average (Table 2.2.9). However, the RCT3 analysis for this year-class have been restricted to the IBTS survey catches as the time series from the commercial fleets is considered being to short (Table 2.2.13). The RCT3 estimate the year-class size at 18 million age 2 cod in 1995 (Table 2.2.15). This is 38% above the long time geometric average seen in the VPA and is the highest seen since the 1985 year-class. The surveys in the North Sea estimate the 1993 year-class as being the strongest since the 1985 Year-class (sec. 3.2.5). In contrast, the IBTS 1994 and 1995 surveys in Kattegat estimate the 1993 year-class as poor (Hovgaard, 1995).

2.2.6 Long term trends

The long term trends in the fisheries are given in Table 2.2.1 and Table 2.2.16. and shown in Figure. 2.2.1.

The landings increased from about 10 thousand tons in the early 1970's to about 20-25 thousand tons in the 1975-1990 period. This was followed by a decline to about 12-14 thousand tons in the most recent period.

The SSB peaked in 1982, caused by the strong 1979 year-class. Since then catches and stock size has declined while recruitment have fluctuated randomly between 10 and 20 millions except for two strong year-classes, 1979, 1985 and 1993 where recruitment exceeded 30 million. However, it must be noted that the recruitment Figure for the 1993 year-class is estimated with a very low accuracy.

2.2.7 Biological reference points

A yield per recruit and a spawning stock biomass per recruit is shown in Figure. 2.2.5 based on the input data also used for the projections (Table 2.2.17).

The stock recruitment plot is shown in Figure 2.2.6 which also show F-med (0.98 per year) and F-high (1.7 per year). It is not possible to identify a stock-recruitment relationship and hence it is difficult to establish an MBAL.

2.2.8 Catch forecast

Input for the predictions are given in Table 2.2.17.

Stock size of age 1 and age 2 in 1995 is estimated by the RCT3 analysis (Table 2.2.14 and 2.2.15) whereas the population numbers for the older ages are taken from the VPA.

Cod recruitment at age 1 in 1996 and in 1997 are estimated at 16.8 million from the geometric mean recruitment from the VPA for 1978-1992. Weight-at-ages are taken as the averages of the 1992-1994 period. The exploitation pattern is taken as the average from 1992-1994 scaled to the 1994 F-level.

The *status quo* catch prediction leads to catches of about 18.000 tons and 26,000 tons for 1995 and 1996, respectively. SSB is expected to increase from about 13,000 tons in 1995 to about 21.000 ton in 1996 and further to 30,000 tons in 1997. This increase is cause by the growth and maturation of the 1993 and 1994 year-classes which are both estimated at above average.

2.2.9 Medium term predictions

No medium term prediction was carried out this year.

2.2.10 Long-term considerations

The assessment indicates that yield and SSB have been declining over the period covered by the VPA whereas recruitment have fluctuated without trends (Figure. 2.2.1) and no relation between recruitment and SSB could be detected (Figure. 2.2.6). In the same period the fishing mortality has remained stable at a rather high level. This complies with the finding of a high F-med value which indicate that the stock may sustain a fishing mortality of 1.0 without affecting the recruitment.

2.2.11 Comments on the assessment

The assessment is carried out on the assumption that the cod in Skagerrak is a independent stock. However, a number of observations indicate that the cod population in Skagerrak interacts with cod stocks in both Kattegat and the North Sea. This issue is further described in section 6.

Both misreporting (mainly by area) and non-reporting of catches have occurred at a considerable scale in the early 1990's. Accurate estimates are not available but according to some sources up to half the amount landed may in some years be taken in the North Sea. More over some estimates the level of non-reporting of up to 20% of the catch in certain years. The validity of these estimates can however not be evaluated.

The assessment is based on incomplete data in so far as data on the small mesh catches and discards are not included.

The retrospective analysis (Figure. 2.2.3 and Figure 2.2.4) and the assessment quality diagrams (Table 2.2.19) show that the terminal F for 1994 and consequently also the population sizes are estimated with a very considerable uncertainty. This uncertainty is carried over into the short term predictions.

2.2.12 The use of Quarterly IBTS indices

Only the IBTS February survey for Skagerrak are presently available at ICES.

Table 2.2.1 Reported cod landings by country and estimated total landings used by the Working Group. 1995 preliminary.

Year	Open Skagerrak					Total	Landings used	Norwegian Coast
	Denmark	Sweden	Norway	Germany	Others		by the WG	Norway
1971	5,914	2,040	1,355	-	13	9,322	9,322	-
1972	6,959	1,925	1,201	-	22	10,107	10,107	-
1973	6,673	1,690	1,253	-	27	9,643	9,643	-
1974	6,694	1,380	1,197	-	92	9,363	9,363	-
1975	14,171	917	1,190	-	52	16,330	16,330	-
1976	18,847	873	1,241	-	466	21,427	21,427	-
1977	18,618	560	-	-	675	19,853	19,853	-
1978	23,614	592	-	-	260	24,466	23,406	1,305
1979	14,007	1,279	-	-	213	15,499	13,128	1,752
1980	21,551	1,712	402	-	341	24,006	25,110	1,580
1981	25,498	2,835	286	-	294	28,913	29,507	1,792
1982	23,377	2,378	314	-	41	26,110	27,775	1,466
1983	18,467	2,803	346	-	163	21,779	22,576	1,520
1984	17,443	1,981	311	-	156	19,891	20,126	1,187
1985	14,521	1,914	193	-	-	16,628	17,611	990
1986	18,424	1,505	174	-	-	20,103	21,142	917
1987	17,824	1,924	152	-	-	19,900	20,855	838
1988	14,806	1,648	392	-	106	16,952	16,945	769
1989	16,634	1,902	256	12	34	18,838	19,648	888
1990	15,788	1,694	143	110	65	17,800	18,589	846
1991	10,396	1,579	72	12	12	12,071	12,441	854
1992	11,194	2,436	270	-	102	14,002	14,794	923
1993	11,997	2,574	75	-	91	14,735	15,324	909
1994	11,953	1,821	60	301	25	14,161	13,910	760

Table 2.2.2 By-catches of Cod in the Skagerrak by the Danish small-meshed fishery (tonnes) as estimated by the Working Group.

Year	By-catch
1979	4,009
1980	4,036
1981	5,376
1982	9,119
1983	4,384
1984	1,084
1985	1,751
1986	997
1987	491
1988	1,103
1989	428
1990	687
1991	953
1992	1,360
1993	511
1994	666

Table 2.2.3 Catch at age , Cod in Skagerrak

Catch in Numbers (thousands)
1 2
1978 1994
1 8
1

4337	11174	2889	775	182	166	44	52
432	4325	2956	480	202	34	33	28
1066	6593	4821	1748	349	94	82	11
389	11030	6202	1169	288	44	49	6
1080	4448	6653	2009	242	175	73	27
1771	6020	3368	1609	290	85	32	69
341	7067	3107	731	280	70	22	17
928	5156	2773	856	207	124	33	9
3253	4101	3441	1748	347	60	39	21
165	12289	2245	503	137	69	17	19
1035	2645	5251	592	150	56	8	13
794	6237	3163	1564	172	104	18	12
846	5243	3326	529	432	49	50	33
432	2922	1763	871	194	81	32	15
1792	4793	1654	493	233	49	43	12
507	5557	2141	683	177	69	14	17
1208	3924	2147	307	82	22	7	6

Table 2.2.4 Weight at age, Cod in Skagerrak

Mean Weight of Catch (kilograms)
1 3
1978 1994
1 8
1

0.599	0.860	1.894	3.498	5.510	7.093	7.304	9.888
0.599	0.860	1.894	3.498	5.510	7.093	7.304	9.888
0.746	1.146	1.570	3.347	4.865	8.932	8.301	11.085
0.619	0.972	1.902	3.711	5.261	9.491	8.514	10.094
0.656	1.204	1.865	2.709	6.107	8.018	8.738	12.658
0.590	1.007	1.967	3.350	5.751	8.074	8.586	11.963
0.647	1.130	2.170	3.616	5.505	7.814	10.319	12.856
0.649	1.094	2.089	3.537	5.472	7.746	10.255	12.854
0.683	1.133	2.040	2.636	4.702	7.538	9.164	9.777
0.580	1.048	1.859	3.896	5.849	7.914	9.607	12.467
0.637	1.195	1.863	2.978	5.830	8.095	10.245	13.060
0.612	1.064	1.704	3.224	5.637	7.890	9.686	10.800
0.603	1.150	2.110	3.703	4.678	5.546	8.500	10.745
0.588	1.210	2.132	3.335	4.929	6.971	9.068	11.780
0.658	1.239	2.301	3.601	5.158	7.961	9.305	8.622
0.800	1.183	1.967	3.512	5.201	7.607	10.201	8.623
0.766	1.369	2.581	4.033	6.283	7.956	9.629	12.587

Table 2.2.5 Maturity at age and Natural mortality for cod in Skagerrak

Age	1	2	3	4	5	6+
%-mature	1	5	23	62	86	100
Natural mortality	0.2	0.2	0.2	0.2	0.2	0.2

Table 2.2.6 Cod in the Skagerrak. The Danish market sampling intensity 1988-1994.

Category	Industrial			Human consumption			Total		
	No. sampl.	No. aged	No. meas.	No. sampl. Market	No. aged	No. meas.	No. sampl. Market	No. aged	No. meas.
Year									
1988	13	212	212	15	1,316	1,317	28	1,528	1,529
1989	3	6	6	21	2,334	2,337	24	2,340	2,343
1990	11	57	94	20	2,007	2,041	31	2,064	2,135
1991	30	152	204	22	2,378	2,381	52	2,530	2,585
1992	58	314	323	29	2,462	2,466	87	2,776	2,789
1993	45	235	258	32	2,248	2,274	77	2,483	2,532
1994	26	132	146	30	2,013	2,207	56	2,145	2,353
Total	**186**	**1,108**	**1,243**	**169**	**14,758**	**15,023**	**355**	**15,866**	**16,266**

Table 2.2.7 COD in the Skagerrak. CPUE by gear type for the Swedish fishery CPUE as catch in kg/hour.

Year	Catch (t)	Effort	CPUE
	Bottom trawl		
1978	86	-	24.5
1979	104	-	28.4
1980	263	6,651	39.6
1981	318	7,297	43.6
1982	462	8,178	56.5
1983	329	8,478	38.8
1984	371	11,991	30.9
1985	392	13,168	29.8
1986	347	11,977	29.0
1987	503	13,527	37.7
1988	344	14,405	23.9
1989	178	11,310	28.2
1990	323	11,815	27.3
1991	249	9,561	26.6
1992	417	15,112	27.6
1993	335	14,977	22.4
1994	340	14,708	23.1
	Nephrops trawl (single trawl)		
1978	572	-	18.2
1979	936	-	27.2
1980	1,287	42,987	29.9
1981	1,619	43,785	37.0
1982	1,384	40,815	33.9
1983	1,239	52,536	23.6
1984	1,077	69,779	15.4
1985	1,149	70,869	16.2
1986	736	74,913	9.8
1987	1,062	91,875	11.5
1988	1,002	109,337	9.2
1989	1,243	85,833	12.8
1990	803	71,775	11.2
1991	508	71,854	8.1
1992	811	73,518	11.0
1993	858	72,800	11.8
1994	619	59,507	10.3

Table 2.2.8 Number of landings slips used, Catch (tons), Effort (days at sea) and CPUE (kg/day) for the four Danish fleets used for XSA tuning of cod in Skagerrak.

Year	Number of landings	Catch	Effort	CPUE
Gill-net				
1987	1,033	1,102	2,531	435
1988	1,437	1,211	2,202	550
1989	1,386	1,208	2,112	572
1990	1,627	1,367	2,398	570
1991	1,830	1,316	2,419	544
1992	1,951	1,415	2.532	559
1993	1,945	1,398	2,469	566
1994	2,521	1,821	3,064	594
Nephrops trawl				
1987	3,741	218	8,178	27
1988	4,836	234	7,424	32
1989	5,651	332	8,541	39
1990	5,781	384	8,494	45
1991	5,387	311	8,536	36
1992	3,912	243	5,975	41
1993	3,414	244	5,160	47
1994	3,468	213	5,064	42
Cod trawl				
1987	894	644	2,534	254
1988	962	472	1,429	330
1989	928	459	1,354	339
1990	1,538	614	2,132	288
1991	1,224	406	1,888	215
1992	1,315	455	2,002	227
1993	1,315	1,043	2,317	450
1994	1,314	1,583	2,434	650
Danish Seine				
1987	193	331	593	558
1988	257	305	534	571
1989	414	417	817	510
1990	332	314	574	547
1991	145	80	272	294
1992	294	251	521	482
1993	344	375	685	547
1994	357	355	633	561

Table 2.2.9 Tuning CPUE data for cod in Skagerrak

Cod in the Skagerrak (part of Fishing Area IIIa) (run name: RUN3)
105
FLT04: Danish gill-net (Catch and Effort given in tabel 2.2.8)
1987 1994
1 1 0.00 1.00
1 7

1	0.0	98.7	68.6	19.3	4.8	2.1	0.6
1	12.8	57.7	146.5	20.9	4.2	1.7	0.2
1	5.2	67.8	59.2	65.5	8.9	5.6	0.8
1	8.9	69.9	91.7	22.2	18.4	2.0	2.4
1	6.6	64.8	75.6	51.2	11.4	4.2	1.6
1	27.8	114.7	67.9	24.8	14.0	2.3	2.3
1	9.3	134.1	94.8	32.3	6.5	2.8	0.3
1	15.9	109.4	107.4	18.0	4.3	0.9	0.2

FLT05: Danish Nephrops tr. (Catch and Effort given in tabel 2.2.8)
1987 1994
1 1 0.00 1.00
1 7

1	0.00	18.00	3.00	0.80	0.20	0.10	0.02
1	1.90	5.50	11.70	1.30	0.40	0.20	0.03
1	2.30	17.90	7.40	2.50	0.30	0.20	0.03
1	2.00	16.30	9.60	1.40	1.20	0.10	0.10
1	2.20	13.20	5.90	2.30	0.50	0.20	0.10
1	8.10	15.00	4.40	1.30	0.70	0.10	0.10
1	1.90	25.10	6.70	1.90	0.60	0.20	0.04
1	4.50	14.10	6.70	1.10	0.30	0.10	0.03

FLT06: Danish trawlers (Catch and Effort given in tabel 2.2.8)
1987 1994
1 1 0.00 1.00
1 7

1	0.0	180.7	39.3	6.1	1.4	0.5	0.1
1	32.2	69.7	130.6	11.1	2.2	0.7	0.1
1	17.0	136.2	69.9	27.5	2.2	1.0	0.2
1	9.8	96.0	66.3	10.0	7.1	0.8	0.5
1	16.5	69.0	32.9	16.9	3.4	1.2	0.3
1	34.2	88.1	32.2	8.4	3.3	0.6	0.5
1	33.2	203.8	65.5	16.4	3.4	1.1	0.2
1	95.5	252.8	104.1	10.4	2.1	0.5	0.1

FLT09: Danish seiners (Catch and Effort given in tabel 2.2.8)
1987 1994
1 1 0.00 1.00
1 7

1	0.00	431.70	52.50	11.50	2.90	1.20	0.10
1	17.40	52.90	257.90	33.20	5.80	1.10	0.20
1	16.80	229.60	140.30	35.10	2.80	0.80	0.20
1	26.00	210.80	130.70	16.00	12.40	1.30	0.80
1	22.40	113.50	44.60	15.70	3.00	1.10	0.40
1	53.80	207.00	76.80	17.70	5.20	0.80	0.80
1	17.80	272.60	84.90	21.20	5.10	1.30	0.40
1	54.30	154.80	88.10	13.90	3.20	0.70	0.30

IBTS: IBTS Skagerrak (Catch: Number) (Effort: Unknown)
1983 1994
1 1 0.05 0.15
1 6

1	33.40	38.60	6.10	4.60	0.40	0.03
1	17.10	19.10	5.30	1.50	0.70	0.10
1	5.70	78.80	9.90	2.60	0.70	0.20
1	69.70	12.78	9.30	3.60	0.60	0.20
1	0.70	112.30	14.20	2.40	0.50	0.20
1	89.60	12.40	14.20	1.00	0.30	0.40
1	60.90	31.10	5.40	3.70	0.10	0.10
1	18.90	8.40	6.10	0.90	0.40	0.10
1	32.90	7.60	3.50	2.50	0.60	0.10
1	159.60	4.40	2.20	0.90	0.40	0.01
1	134.20	13.50	1.90	0.40	0.10	0.06
1	100.90	11.90	2.40	0.30	0.10	0.10

Table 2.2.10 XSA setup and output for the Cod in Skagerrak

```
Lowestoft VPA Version 3.1

   6-Oct-95   17:56:33

Extended Survivors Analysis

Cod Skagerrak IIIa (run: FIN94/AA)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/cod_skag/FLEET.AA

Catch data for  17 years. 1978 to 1994. Ages  1 to   8.

     Fleet,             First, Last, First, Last, Alpha,  Beta
                   ,    year,  year,  age ,  age
FLT04: Danish gill-n,    1987, 1994,    1,     7,   .000,  1.000
FLT05: Danish Nephro,    1987, 1994,    1,     7,   .000,  1.000
FLT06: Danish trawle,    1987, 1994,    1,     7,   .000,  1.000
FLT09: Danish seiner,    1987, 1994,    1,     7,   .000,  1.000
IBTS: IBTS Skagerrak,    1983, 1994,    1,     6,   .050,   .150


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 :

     Final estimates not shrunk towards mean F

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

     Prior weighting not applied


Tuning converged after   34 iterations

1

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

Table 2.2.10 Cont.

Fishing mortalities

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.088	.113	.017	.067	.073	.104	.041	.119	.035	.035
2	.651	.687	.808	.413	.714	.949	.624	.848	.654	.412
3	.748	1.377	1.080	1.048	1.372	1.138	1.050	.914	1.302	.572
4	.938	1.944	.753	.983	1.121	.919	1.133	1.006	1.399	.633
5	1.120	1.471	.852	.526	.901	1.195	1.124	1.164	1.432	.594
6	.558	1.311	1.685	1.111	.882	.711	.750	1.024	1.595	.661
7	2.682	.338	2.786	.973	1.606	1.777	1.748	1.290	.974	.667

1

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7
1985	1.22E+04	1.19E+04	5.82E+03	1.55E+03	3.40E+02	3.20E+02	3.91E+01
1986	3.35E+04	9.12E+03	5.09E+03	2.25E+03	4.98E+02	9.08E+01	1.50E+02
1987	1.07E+04	2.45E+04	3.76E+03	1.05E+03	2.64E+02	9.36E+01	2.00E+01
1988	1.76E+04	8.64E+03	8.94E+03	1.05E+03	4.05E+02	9.23E+01	1.42E+01
1989	1.24E+04	1.35E+04	4.68E+03	2.56E+03	3.20E+02	1.96E+02	2.49E+01
1990	9.43E+03	9.46E+03	5.41E+03	9.73E+02	6.85E+02	1.06E+02	6.65E+01
1991	1.18E+04	6.96E+03	3.00E+03	1.42E+03	3.18E+02	1.70E+02	4.28E+01
1992	1.76E+04	9.27E+03	3.05E+03	8.59E+02	3.74E+02	8.45E+01	6.56E+01
1993	1.62E+04	1.28E+04	3.25E+03	1.00E+03	2.57E+02	9.57E+01	2.49E+01
1994	3.90E+04	1.28E+04	5.44E+03	7.24E+02	2.02E+02	5.03E+01	1.59E+01

Estimated population abundance at 1st Jan 1995

	.00E+00	3.08E+04	6.96E+03	2.51E+03	3.15E+02	9.15E+01	2.12E+01

Taper weighted geometric mean of the VPA populations:

	1.67E+04	1.20E+04	4.98E+03	1.35E+03	3.85E+02	1.25E+02	4.18E+01

Standard error of the weighted Log(VPA populations) :

	.4358	.3570	.3862	.4499	.3905	.5319	.8152

Table 2.2.10 Cont.

Log catchability residuals.

Fleet : FLT04: Danish gill-n

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	.08	-.47	.36	-.19	.88	-.17	-.51
2	99.99	99.99	-.58	-.25	-.40	.08	.18	.56	.31	.00
3	99.99	99.99	-.06	-.18	-.31	-.11	.25	.07	.50	-.19
4	99.99	99.99	-.43	-.25	.05	-.15	.40	.12	.38	-.18
5	99.99	99.99	-.33	-1.03	.12	.20	.46	.52	.23	-.28
6	99.99	99.99	.20	-.21	.14	-.35	-.06	.15	.44	-.42
7	99.99	99.99	.84	-.53	.53	.71	.73	.50	-.69	-.77

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	-7.1800	-4.4708	-3.3716	-3.1242	-3.2001	-3.2001	-3.2001
S.E(Log q)	.4977	.3761	.2700	.2987	.5083	.3011	.7216

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	1.45	-.657	6.06	.31	7	.76	-7.18
2	2.50	-1.802	-2.82	.20	8	.81	-4.47
3	1.96	-2.219	-1.43	.48	8	.42	-3.37
4	.84	.614	3.75	.72	8	.26	-3.12
5	.87	.260	3.54	.41	8	.48	-3.20
6	.81	.851	3.49	.78	8	.25	-3.22
7	.58	1.965	3.19	.79	8	.34	-3.04

Table 2.2.10 cont.
Fleet : FLT05: Danish Nephro

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	-.49	.06	.21	.05	.99	-.42	-.43
2	99.99	99.99	-.51	-.83	.04	.40	.36	.30	.41	-.28
3	99.99	99.99	-.60	-.12	.19	.22	.29	-.08	.43	-.38
4	99.99	99.99	-.66	-.08	-.26	.04	.25	.13	.51	-.02
5	99.99	99.99	-.66	-.53	-.42	.32	.18	.37	.70	-.09
6	99.99	99.99	.01	.50	-.35	-.50	-.26	-.14	.65	.23
7	99.99	99.99	.29	.42	.10	.38	.81	.22	.15	.18

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	-8.5196	-6.2435	-5.9557	-6.0797	-6.0490	-6.0490	-6.0490
S.E(Log q)	.5247	.4684	.3524	.3438	.4843	.4124	.4108

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	1.63	-.793	7.79	.25	7	.88	-8.52
2	1.79	-.909	3.80	.19	8	.85	-6.24
3	1.33	-.648	5.17	.41	8	.49	-5.96
4	1.24	-.538	5.85	.46	8	.45	-6.08
5	.84	.362	6.01	.46	8	.43	-6.05
6	1.94	-1.382	7.34	.28	8	.75	-6.03
7	.91	.644	5.52	.90	8	.22	-5.73

Table 2.2.10 cont.

Fleet : FLT06: Danish trawle

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	.09	-.20	-.46	-.19	.18	.19	.37
2	99.99	99.99	-.33	-.41	-.06	.05	-.11	-.06	.37	.48
3	99.99	99.99	-.26	.06	.20	-.08	-.23	-.32	.48	.13
4	99.99	99.99	-.73	-.03	.03	-.09	.14	-.10	.56	.13
5	99.99	99.99	-.53	-.65	-.25	.28	.28	.10	.61	.03
6	99.99	99.99	-.20	-.07	-.56	-.24	-.28	-.17	.53	.02
7	99.99	99.99	.08	-.20	.18	.17	.09	.01	-.06	-.44

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	-6.2657	-4.1163	-3.7243	-3.9799	-4.2296	-4.2296	-4.2296
S.E(Log q)	.2880	.3098	.2757	.3538	.4281	.3414	.2120

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	.64	4.484	7.50	.97	7	.09	-6.27
2	.97	.102	4.29	.61	8	.32	-4.12
3	.86	.552	4.39	.73	8	.25	-3.72
4	.98	.065	4.05	.56	8	.37	-3.98
5	.98	.047	4.26	.44	8	.45	-4.23
6	1.67	-1.529	4.16	.48	8	.48	-4.35
7	.82	1.891	4.10	.95	8	.15	-4.25

Table 2.2.10 Cont.

Fleet : FLT09: Danish seiner

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	-.52	-.20	.53	.13	.64	-.43	-.19
2	99.99	99.99	.16	-1.07	.09	.45	.01	.41	.29	-.39
3	99.99	99.99	-.42	.29	.45	.15	-.37	.10	.29	-.49
4	99.99	99.99	-.55	.61	-.17	-.07	-.38	.19	.37	-.04
5	99.99	99.99	-.25	-.13	-.46	.39	-.29	.11	.57	.00
6	99.99	99.99	.22	-.06	-1.23	-.20	-.82	-.33	.25	-.09
7	99.99	99.99	-.37	.05	-.27	.19	-.07	.03	.18	.21

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	-6.2743	-3.7378	-3.2747	-3.5297	-3.7808	-3.7808	-3.7808
S.E(Log q)	.4526	.5012	.3697	.3783	.3527	.5943	.2164

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	1.52	-.813	4.51	.34	7	.71	-6.27
2	.82	.400	4.74	.46	8	.44	-3.74
3	.81	.577	4.23	.62	8	.32	-3.27
4	1.43	-.768	2.05	.36	8	.56	-3.53
5	.83	.546	4.13	.63	8	.31	-3.78
6	8.31	-2.618	-.04	.02	8	3.09	-4.07
7	.95	.341	3.76	.90	8	.22	-3.78

Table 2.2.10 Cont.

Fleet : IBTS: IBTS Skagerrak

Age	1983	1984
1	-.25	-.63
2	.68	-.14
3	.05	-.13
4	.47	.11
5	.01	.12
6	-1.21	-.07
7	No data for this fleet at this age	

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	-1.51	-.02	-3.49	.87	.83	-.06	.26	1.45	1.35	.19
2	1.49	-.06	1.14	-.06	.44	-.49	-.31	-1.12	-.34	-.50
3	.38	.51	1.21	.34	.05	.00	.03	-.47	-.64	-.99
4	.41	.46	.70	-.15	.28	-.19	.48	-.05	-.98	-1.02
5	.90	.39	.78	-.19	-1.01	-.36	.81	.24	-.74	-.58
6	-.35	.98	.99	1.64	-.52	.07	-.39	-1.97	-.25	.82
7	No data for this fleet at this age									

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

Age	1	2	3	4	5	6
Mean Log q	-6.1229	-6.4255	-6.6584	-6.6861	-6.9494	-6.9494
S.E(Log q)	1.3782	.7412	.5905	.5808	.6485	1.0286

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	.53	.864	7.79	.29	12	.75	-6.12
2	.45	1.972	8.04	.60	12	.29	-6.43
3	.76	.519	7.08	.36	12	.47	-6.66
4	.54	2.370	6.90	.76	12	.26	-6.69
5	.84	.335	6.78	.34	12	.57	-6.95
6	3.16	-.974	11.77	.02	12	3.26	-6.95

Table 2.2.10 Cont.

Terminal year survivor and F summaries :

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

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT04: Danish gill-n,	18521.,	.533,	.000,	.00,	1,	.160,	.057
FLT05: Danish Nephro,	20010.,	.562,	.000,	.00,	1,	.144,	.053
FLT06: Danish trawle,	44583.,	.308,	.000,	.00,	1,	.479,	.024
FLT09: Danish seiner,	25569.,	.485,	.000,	.00,	1,	.194,	.042
IBTS: IBTS Skagerrak,	37258.,	1.442,	.000,	.00,	1,	.022,	.029

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
30846.,	.21,	.19,	5,	.881,	.035

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT04: Danish gill-n,	6539.,	.320,	.079,	.25,	2,	.210,	.434
FLT05: Danish Nephro,	4955.,	.373,	.069,	.18,	2,	.155,	.540
FLT06: Danish trawle,	9649.,	.225,	.145,	.65,	2,	.422,	.313
FLT09: Danish seiner,	4621.,	.359,	.018,	.05,	2,	.166,	.570
IBTS: IBTS Skagerrak,	6336.,	.683,	.763,	1.12,	2,	.046,	.445

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
6959.,	.15,	.12,	10,	.821,	.412

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT04: Danish gill-n,	2562.,	.230,	.249,	1.08,	3,	.260,	.564
FLT05: Danish Nephro,	2415.,	.279,	.362,	1.30,	3,	.174,	.590
FLT06: Danish trawle,	3061.,	.192,	.070,	.36,	3,	.338,	.491
FLT09: Danish seiner,	2198.,	.281,	.335,	1.19,	3,	.167,	.633
IBTS: IBTS Skagerrak,	1256.,	.481,	.428,	.89,	3,	.060,	.935

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2514.,	.11,	.12,	15,	1.004,	.572

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT04: Danish gill-n,	315.,	.235,	.176,	.75,	4,	.286,	.632
FLT05: Danish Nephro,	341.,	.278,	.105,	.38,	4,	.209,	.596
FLT06: Danish trawle,	371.,	.232,	.117,	.51,	4,	.251,	.558
FLT09: Danish seiner,	334.,	.295,	.087,	.30,	4,	.180,	.606
IBTS: IBTS Skagerrak,	124.,	.467,	.123,	.26,	4,	.075,	1.176

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
315.,	.12,	.08,	20,	.657,	.633

Table 2.2.10 cont.

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: Danish gill-n,	94.,	.273,	.149,	.55,	5,	.209,	.583
FLT05: Danish Nephro,	101.,	.311,	.135,	.43,	5,	.187,	.553
FLT06: Danish trawle,	97.,	.269,	.147,	.55,	5,	.242,	.568
FLT09: Danish seiner,	99.,	.285,	.074,	.26,	5,	.271,	.559
IBTS: IBTS Skagerrak,	48.,	.480,	.092,	.19,	5,	.090,	.935

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
92.,	.14,	.07,	25,	.481,	.594

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: Danish gill-n,	15.,	.267,	.104,	.39,	6,	.334,	.827
FLT05: Danish Nephro,	28.,	.332,	.073,	.22,	6,	.198,	.535
FLT06: Danish trawle,	23.,	.284,	.091,	.32,	6,	.279,	.628
FLT09: Danish seiner,	25.,	.343,	.142,	.42,	6,	.141,	.590
IBTS: IBTS Skagerrak,	25.,	.584,	.307,	.53,	6,	.048,	.579

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
21.,	.15,	.07,	30,	.450,	.661

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: Danish gill-n,	6.,	.347,	.241,	.70,	7,	.114,	.699
FLT05: Danish Nephro,	9.,	.346,	.070,	.20,	7,	.183,	.549
FLT06: Danish trawle,	5.,	.256,	.131,	.51,	7,	.359,	.825
FLT09: Danish seiner,	8.,	.274,	.027,	.10,	7,	.333,	.573
IBTS: IBTS Skagerrak,	7.,	.547,	.129,	.24,	6,	.011,	.642

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7.,	.15,	.07,	34,	.441,	.667

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Table 2.2.11 Skagerrak cod. Fishing mortalities as estimated by the VPA.

Run title : Cod Skagerrak IIIa (run: FIN94/AA)

At 6-Oct-95 17:58:50

Terminal Fs derived using XSA (Without F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE							
1,	.2475,	.0195,	.0377,	.0307,	.0716,	.1020,	.0256,
2,	.9272,	.4185,	.4579,	.6648,	.5719,	.7039,	.7415,
3,	1.0610,	.6803,	1.2295,	1.1004,	1.1894,	1.2506,	1.0328,
4,	.8536,	.4835,	1.2168,	1.2607,	1.5769,	1.1240,	1.0810,
5,	.4754,	.5606,	.8034,	.6505,	1.0192,	1.1302,	.5825,
6,	1.0840,	.1495,	.5574,	.2106,	1.1400,	1.4263,	.9624,
7,	.6444,	.6444,	.6444,	.6444,	.6444,	.6444,	40.1146,
+gp,	.6444,	.6444,	.6444,	.6444,	.6444,	.6444,	40.1146,
0 FBAR 3- 6,	.8685,	.4685,	.9518,	.8055,	1.2314,	1.2328,	.9147,

Table 8 Fishing mortality (F) at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
1,	.0881,	.1135,	.0171,	.0671,	.0732,	.1044,	.0413,	.1194,	.0351,	.0348,	.0631,
2,	.6509,	.6869,	.8084,	.4128,	.7145,	.9489,	.6240,	.8478,	.6542,	.4123,	.6381,
3,	.7481,	1.3768,	1.0796,	1.0482,	1.3718,	1.1377,	1.0500,	.9137,	1.3021,	.5725,	.9294,
4,	.9384,	1.9442,	.7527,	.9833,	1.1208,	.9191,	1.1331,	1.0064,	1.3994,	.6327,	1.0129,
5,	1.1196,	1.4711,	.8515,	.5258,	.9010,	1.1953,	1.1239,	1.1643,	1.4319,	.5936,	1.0633,
6,	.5580,	1.3114,	1.6851,	1.1106,	.8817,	.7107,	.7504,	1.0236,	1.5947,	.6612,	1.0932,
7,	2.6824,	.3383,	2.7859,	.9732,	1.6063,	1.7771,	1.7484,	1.2901,	.9737,	.6667,	.9769,
+gp,	2.6824,	.3383,	2.7859,	.9732,	1.6063,	1.7771,	1.7484,	1.2901,	.9737,	.6667,	
0 FBAR 3- 6,	.8410,	1.5259,	1.0922,	.9170,	1.0688,	.9907,	1.0143,	1.0270,	1.4320,	.6150,	

1

Table 2.2.12 Skagerrak Cod. Population numbers as estimated by the VPA.

Run title : Cod Skagerrak IIIa (run: FIN94/AA)

At 6-Oct-95 17:58:50

Terminal Fs derived using XSA (Without F shrinkage)

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE							
1,	21865,	24702,	31836,	14215,	17274,	20176,	14925,
2,	20434,	13977,	19833,	25100,	11286,	13166,	14917,
3,	4883,	6619,	7530,	10272,	10570,	5216,	5332,
4,	1492,	1384,	2745,	1803,	2798,	2634,	1223,
5,	532,	520,	698,	666,	418,	473,	701,
6,	277,	271,	243,	256,	284,	124,	125,
7,	102,	77,	191,	114,	170,	74,	24,
+gp,	120,	64,	25,	14,	62,	159,	17,
0 TOTAL,	49705,	47614,	63102,	52440,	42864,	42022,	37264,

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 78-92	AMST 78-92
AGE													
1,	12167,	33514,	10740,	17634,	12426,	9432,	11796,	17603,	16239,	39010,	0,	16797,	18020,
2,	11911,	9122,	24496,	8644,	13501,	9455,	6957,	9267,	12790,	12836,	30846,	13134,	14138,
3,	5818,	5087,	3758,	8936,	4684,	5410,	2997,	3052,	3250,	5444,	6959,	5605,	6011,
4,	1554,	2254,	1051,	1045,	2565,	973,	1420,	859,	1002,	724,	2514,	1593,	1720,
5,	340,	498,	264,	405,	320,	685,	318,	374,	257,	202,	315,	459,	481,
6,	320,	91,	94,	92,	196,	106,	170,	85,	96,	50,	92,	163,	182,
7,	39,	150,	20,	14,	25,	67,	43,	66,	25,	16,	21,	59,	78,
+gp,	10,	80,	21,	23,	16,	43,	19,	18,	30,	13,	12,		
0 TOTAL,	32160,	50796,	40443,	36793,	33733,	26170,	23719,	31322,	33688,	58295,	40759,		

1

Table 2.2.13 Input to the RCT3 analysis for age 1 and age 2 cod in Skagerrak

Age 1 (used to estimate the 1994 year-class size in the prognoses)

1 13 2

'y-c'	'vpa'	'IBTS1'
1982	20176	33.4
1983	14925	17.1
1984	12167	5.7
1985	33514	69.7
1986	10740	0.7
1987	17634	89.6
1988	12426	60.9
1989	9432	18.9
1990	11796	32.9
1991	17603	159.6
1992	-11	134.2
1993	-11	100.9
1994	-11	113.3

Age 2 (used to estimate the 1993 year-class size in the prognoses)

2 13 2

'y-c'	'vpa'	'IBTS1'	'IBTS2'
1981	13166	-11	38.6
1982	14917	33.4	19.1
1983	11911	17.1	78.8
1984	9122	5.7	12.7
1985	24496	69.7	112.3
1986	8644	0.7	12.4
1987	13501	89.6	31.1
1988	9455	60.9	8.4
1989	6957	18.9	7.6
1990	9267	32.9	4.4
1991	-11	159.6	13.5
1992	-11	134.2	11.9
1993	-11	100.9	51.2

Table 2.2.14 RCT 3 recruitment estimates for age 1 cod in Skagerrak

Analysis by RCT3 ver3.1 of data from file :

g:\acfm\wgnssk96\cod_skag\rct3inp.ag1

Skagerrak cod as age 1

Data for 1 surveys over 13 years : 1982 - 1994

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 = 1992

	I---Regression---				I	I---Prediction---			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IBTS1	.50	7.92	.61	.300	10	4.91	10.38	.774	.190
					VPA Mean =		9.60	.375	.810

Yearclass = 1993

	I---Regression---				I	I---Prediction---			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IBTS1	.50	7.91	.61	.299	10	4.62	10.23	.768	.192
					VPA Mean =		9.60	.375	.808

Yearclass = 1994

	I---Regression---				I	I---Prediction---			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IBTS1	.50	7.91	.62	.298	10	4.74	10.27	.788	.185
					VPA Mean =		9.59	.375	.815

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	17168	9.75	.34	.30	.81		
1993	16641	9.72	.34	.25	.54		
1994	16620	9.72	.34	.26	.59		

Table 2.2.14. RCT3 recruitment estimate for age 1 cod in Skagerrak

Analysis by RCT3 ver3.1 of data from file :

g:\acfm\wgnssk96\cod_skag\rct3inp.ag1

Skagerrak cod as age 1

Data for 1 surveys over 13 years : 1982 - 1994

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied
Final estimates not shrunk towards mean
Estimates with S.E.'S greater than that of mean
+ included
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I------	----Regression	-------	---I	I------	--------	Prediction----	------	---I
IBTS1	.50	7.92	.61	.300	10	4.91	10.38	.774	1.000
					VPA Mean =		9.60	.375	.000

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I------	----Regression	-------	---I	I------	--------	Prediction----	------	---I
IBTS1	.50	7.91	.61	.299	10	4.62	10.23	.768	1.000
					VPA Mean =		9.60	.375	.000

Yearclass = 1994

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I------	----Regression	-------	---I	I------	--------	Prediction----	------	---I
IBTS1	.50	7.91	.62	.298	10	4.74	10.27	.788	1.000
					VPA Mean =		9.59	.375	.000

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	32179	10.38	.77	.00	.00		
1993	27587	10.23	.77	.00	.00		
1994	28752	10.27	.79	.00	.00		

Table 2.2.15 : RCT3 recruitment estimate for age 2 cod in Skagerrak.

Analysis by RCT3 ver3.1 of data from file :

g:\acfm\wgnssk96\cod_skag\rct3lewy.inp

Skagerrak cod as age 2

Data for 2 surveys over 13 years : 1981 - 1993

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied
Final estimates not shrunk towards mean
Estimates with S.E.'S greater than that of mean
+ included
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
IBTS1	.58	7.50	.69	.263	9	4.91	10.32	.923	.114
IBTS2	.44	8.00	.27	.673	10	2.56	9.13	.331	.886
					VPA Mean =		9.33	.367	.000

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
IBTS1	.58	7.48	.70	.258	9	4.62	10.16	.924	.124
IBTS2	.44	8.01	.27	.679	10	3.96	9.75	.347	.876
					VPA Mean =		9.32	.369	.000

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	10564	9.27	.31	.38	1.48		
1993	18036	9.80	.32	.13	.17		

Table 2.2.16 Skagerrak Cod. Long term trends in stock and fishery mortality.

Run title : Cod Skagerrak IIIa (run: FIN94/AA)

At 6-Oct-95 17:58:50

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (Without F shrinkage)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 6,
1978,	21865,	51962,	12787,	24466,	1.9133,	.8685,
1979,	24702,	50176,	12215,	15499,	1.2689,	.4685,
1980,	31836,	74921,	16747,	24006,	1.4335,	.9518,
1981,	14215,	66468,	16502,	28913,	1.7521,	.8055,
1982,	17274,	59320,	16774,	26110,	1.5566,	1.2314,
1983,	20176,	50503,	14489,	21784,	1.5035,	1.2328,
1984,	14925,	47811,	11109,	19891,	1.7906,	.9147,
1985,	12167,	43452,	11548,	16628,	1.4399,	.8410,
1986,	33514,	54731,	11675,	20103,	1.7219,	1.5259,
1987,	10740,	45726,	8021,	19900,	2.4811,	1.0922,
1988,	17634,	44874,	9609,	16952,	1.7642,	.9170,
1989,	12426,	41987,	11271,	18697,	1.6588,	1.0688,
1990,	9432,	36394,	9827,	17800,	1.8114,	.9907,
1991,	11796,	29845,	8042,	12059,	1.4994,	1.0143,
1992,	17603,	36547,	7320,	14002,	1.9128,	1.0270,
1993,	16239,	40608,	6926,	14737,	2.1279,	1.4320,
1994,	39010,	66417,	8035,	13261,	1.6505,	.6150,
Arith. Mean ,	19150,	49514,	11347,	19106,	1.7227,	.9998,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

Table 2.2.17 Input for catch predictions.

Cod in the Skagerrak (part of Fishing Area IIIa)

Prediction with management option table: Input data

Year: 1995								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	28752.000	0.2000	0.0100	0.0000	0.0000	0.741	0.0379	0.741
2	18036.000	0.2000	0.0500	0.0000	0.0000	1.264	0.3830	1.264
3	6959.000	0.2000	0.2300	0.0000	0.0000	2.283	0.5578	2.283
4	2514.000	0.2000	0.6200	0.0000	0.0000	3.715	0.6079	3.715
5	315.000	0.2000	0.8600	0.0000	0.0000	5.547	0.6382	5.547
6	92.000	0.2000	1.0000	0.0000	0.0000	7.841	0.6561	7.841
7	21.000	0.2000	1.0000	0.0000	0.0000	9.712	0.5863	9.712
8+	12.000	0.2000	1.0000	0.0000	0.0000	9.944	0.5863	9.944
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	16797.000	0.2000	0.0100	0.0000	0.0000	0.741	0.0379	0.741
2	.	0.2000	0.0500	0.0000	0.0000	1.264	0.3830	1.264
3	.	0.2000	0.2300	0.0000	0.0000	2.283	0.5578	2.283
4	.	0.2000	0.6200	0.0000	0.0000	3.715	0.6079	3.715
5	.	0.2000	0.8600	0.0000	0.0000	5.547	0.6382	5.547
6	.	0.2000	1.0000	0.0000	0.0000	7.841	0.6561	7.841
7	.	0.2000	1.0000	0.0000	0.0000	9.712	0.5863	9.712
8+	.	0.2000	1.0000	0.0000	0.0000	9.944	0.5863	9.944
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

(cont.)

Table 2.2.17 (Cont'd)

Cod in the Skagerrak (part of Fishing Area IIIa)

Prediction with management option table: Input data

(cont.)

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	16797.000	0.2000	0.0100	0.0000	0.0000	0.741	0.0379	0.741
2	.	0.2000	0.0500	0.0000	0.0000	1.264	0.3830	1.264
3	.	0.2000	0.2300	0.0000	0.0000	2.283	0.5578	2.283
4	.	0.2000	0.6200	0.0000	0.0000	3.715	0.6079	3.715
5	.	0.2000	0.8600	0.0000	0.0000	5.547	0.6382	5.547
6	.	0.2000	1.0000	0.0000	0.0000	7.841	0.6561	7.841
7	.	0.2000	1.0000	0.0000	0.0000	9.712	0.5863	9.712
8+	.	0.2000	1.0000	0.0000	0.0000	9.944	0.5863	9.944
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : RUN1
Date and time: 08OCT95:12:20

Stock numbers at age 1 and 2 in 1995 are RCT3 estimates.
Stock numbers at age in 1996 is the geometric mean of VPA for 1978-1992.

Table 2.2.18

Cod in the Skagerrak Catch forecast 11:38 Sunday, October 8, 1995

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.6150	72126	13345	18646	0.0000	0.0000	84011	21300	0	126353	51184
.	.	.	.	.	0.2000	0.1230	.	21300	6314	117124	45952
.	.	.	.	.	0.4000	0.2460	.	21300	12028	108788	41276
.	.	.	.	.	0.6000	0.3690	.	21300	17203	101254	37097
.	.	.	.	.	0.8000	0.4920	.	21300	21893	94440	33361
.	.	.	.	.	1.0000	0.6150	.	21300	26147	88274	30019
.	.	.	.	.	1.2000	0.7380	.	21300	30007	82692	27030
.	.	.	.	.	1.4000	0.8610	.	21300	33514	77635	24354
.	.	.	.	.	1.6000	0.9840	.	21300	36701	73051	21960
.	.	.	.	.	1.8000	1.1070	.	21300	39600	68894	19816
.	.	.	.	.	2.0000	1.2300	.	21300	42241	65120	17895
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : RUN1
Date and time : 08OCT95:12:20
Computation of ref. F: Simple mean, age 3 - 6
Basis for 1995 : F factors

Table 2.2.19 Stock: Cod in the Skagerrak (part of Division IIIa)

Assessment Quality Control Diagram 1

Average F(3-6,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	1.12	1.02						
1990	1.05	0.85	1.14					
1991	0.96	0.80	1.05	1.05				
1992	1.02	0.83	0.95	0.86	0.75			
1993	1.04	0.83	0.98	0.88	0.85	0.75		
1994	1.08	0.88	1.05	0.96	0.94	0.83	0.72	
1995	1.09	0.92	1.07	0.99	1.01	1.03	1.43	0.62

Remarks: Tuning without F-shrinkage in 1993.

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: millions								
Date of assessment	Year class							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	30.0	27.0						
1990	22.3	15.0	16.7					
1991	17.1	14.0	16.4	17.0				
1992	17.8	16.9	16.6[1]	10.2[1]	20.7[1]			
1993	18.0	12.7	16.7	9.8[1]	16.3[1]	20.0[1]		
1994	17.8	12.7	10.0	14.0	27.2	15.4[1]	18.4[1]	
1995	17.6	12.4	9.4	11.8	17.6	32.2[1]	27.6[1]	28.8[1]

[1]RCT3 estimates.

Remarks: Tuning without F-shrinkage in 1993.

Table 2.2.19 Stock: Cod in the Skagerrak (part of Division IIIa) (Cont'd)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	20.8	14.0	24.0[1]	27.2[1]						
1990	21.9	18.6	24.0	17.5[1]	15.6[1]					
1991	23.3	19.5	18.7	15.1	15.5[1]	16.1[1]				
1992	23.5	20.7	21.5	17.5	20.8	19.2[1]	25.9[1]			
1993	23.9	19.8	20.3	15.8	14.7	14.6	19.1[1]	26.4[1]		
1994	9.5	11.2	9.8	8.3	8.3	9.9	14.7	20.0[1]	21.0[1]	
1995	9.6	11.3	9.8	8.0	7.3	6.9	8.0	13.3	21.3[1]	30.0[1]

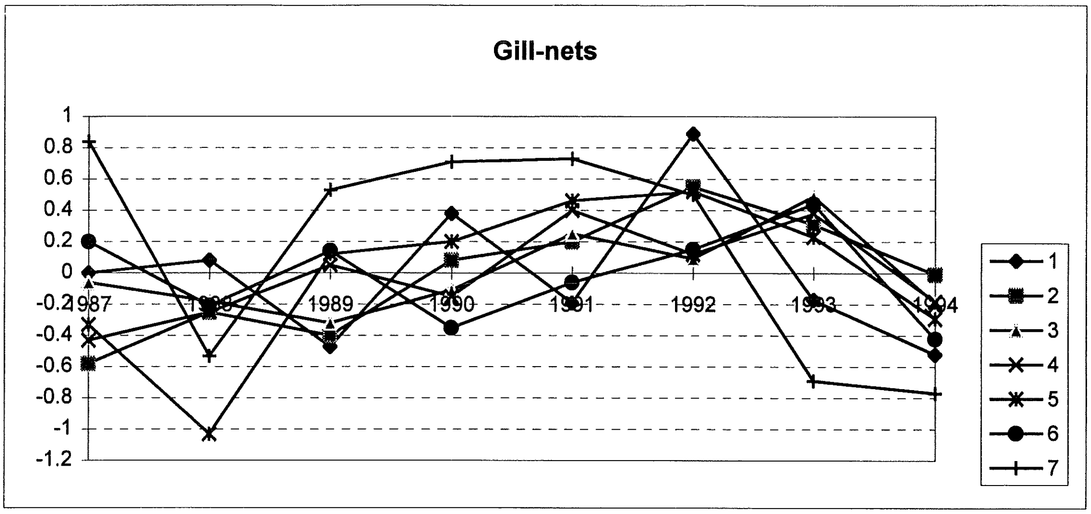
[1]Forecast.

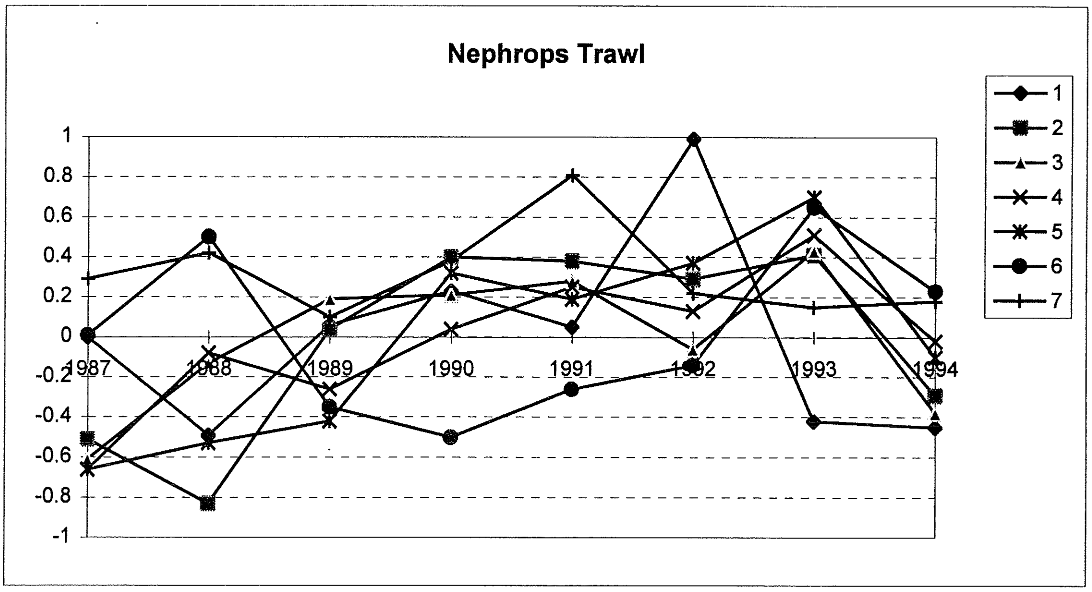
Remarks: New maturity ogive applied in 1993.

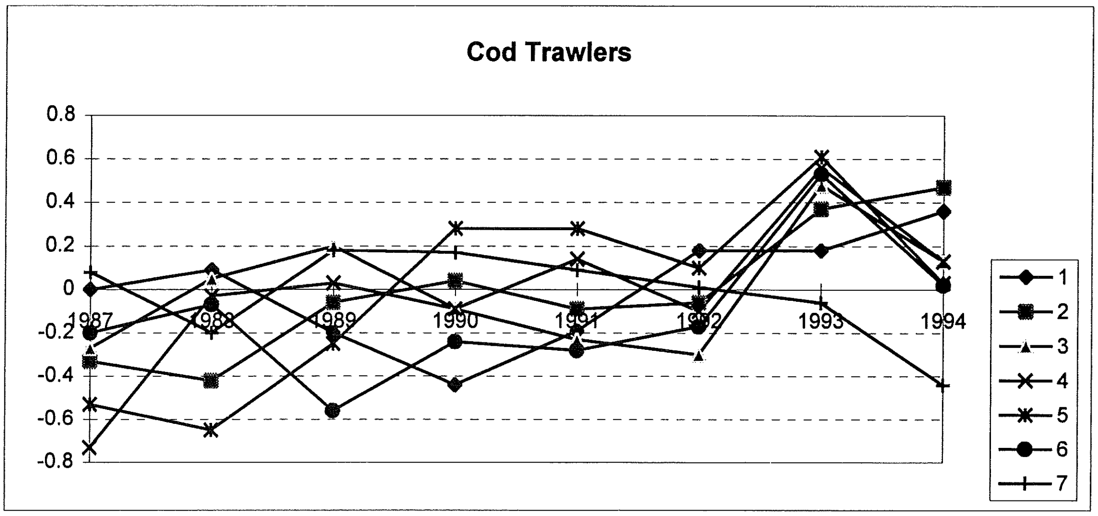
Figure 2.2.1 Cod in the Skagerrak, landings, recruitment, fishing mortality and spawning stock biomass.

Fish Stock Summary
Cod in the Skagerrak (part of Fishing Area IIIa)
6–10–1995

Figure 2.2.2 Cod in the Skagerrak. Log catchability residuals by tuning fleets.

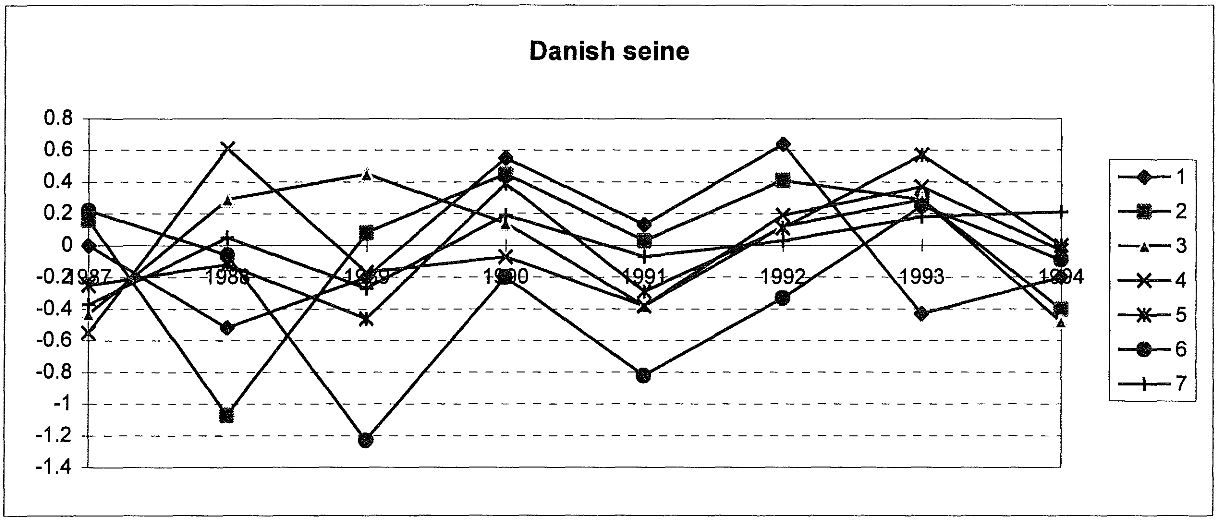






E:\acfm\wgnssk96\F-222.xls

Figure 2.2.2 (Cont'd)



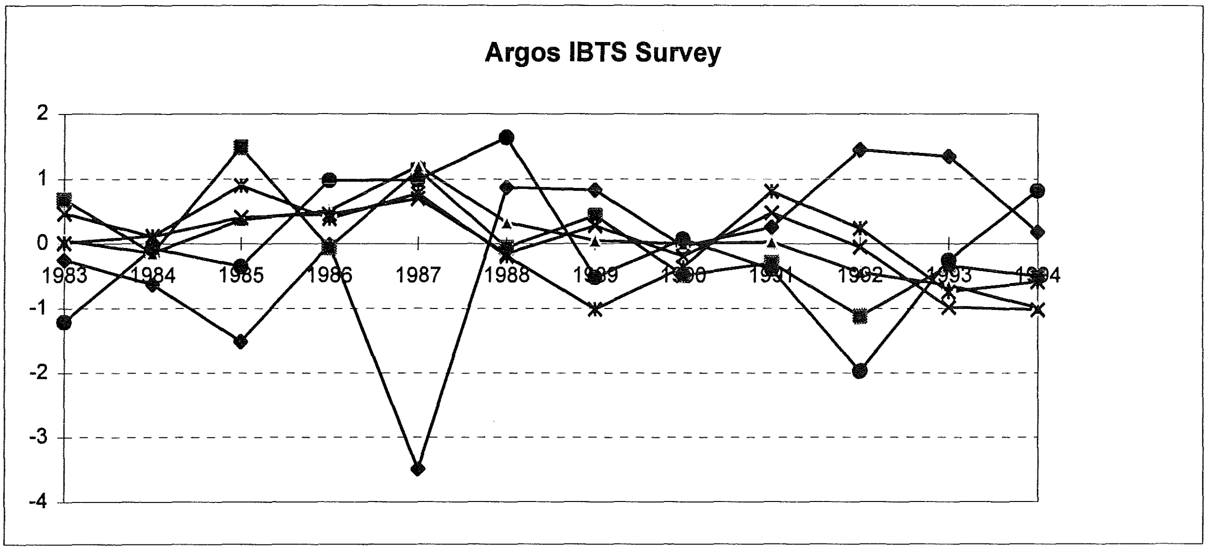


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Figure 2.2.3 Cod in the Skagerrak. Retrospective analyses of fishing mortality 1985 -1994

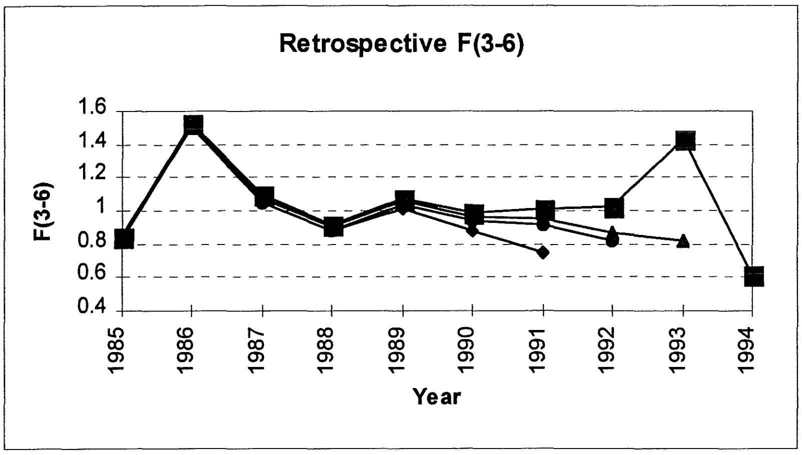


Figure 2.2.4 Cod in the Skagerrak. Retrospective analysis of spawning biomass 1985-1994.

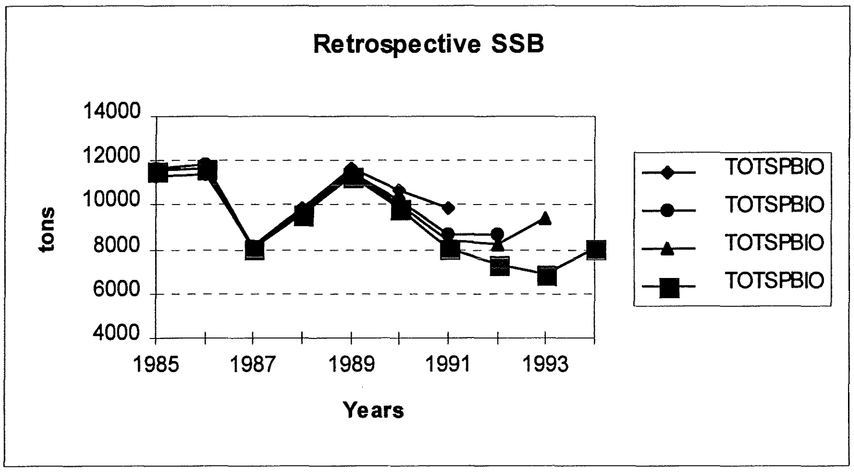


Figure 2.2.5 Long and short term predictions

Fish Stock Summary
Cod in the Skagerrak (part of Fishing Area IIIa)
8–10–1995

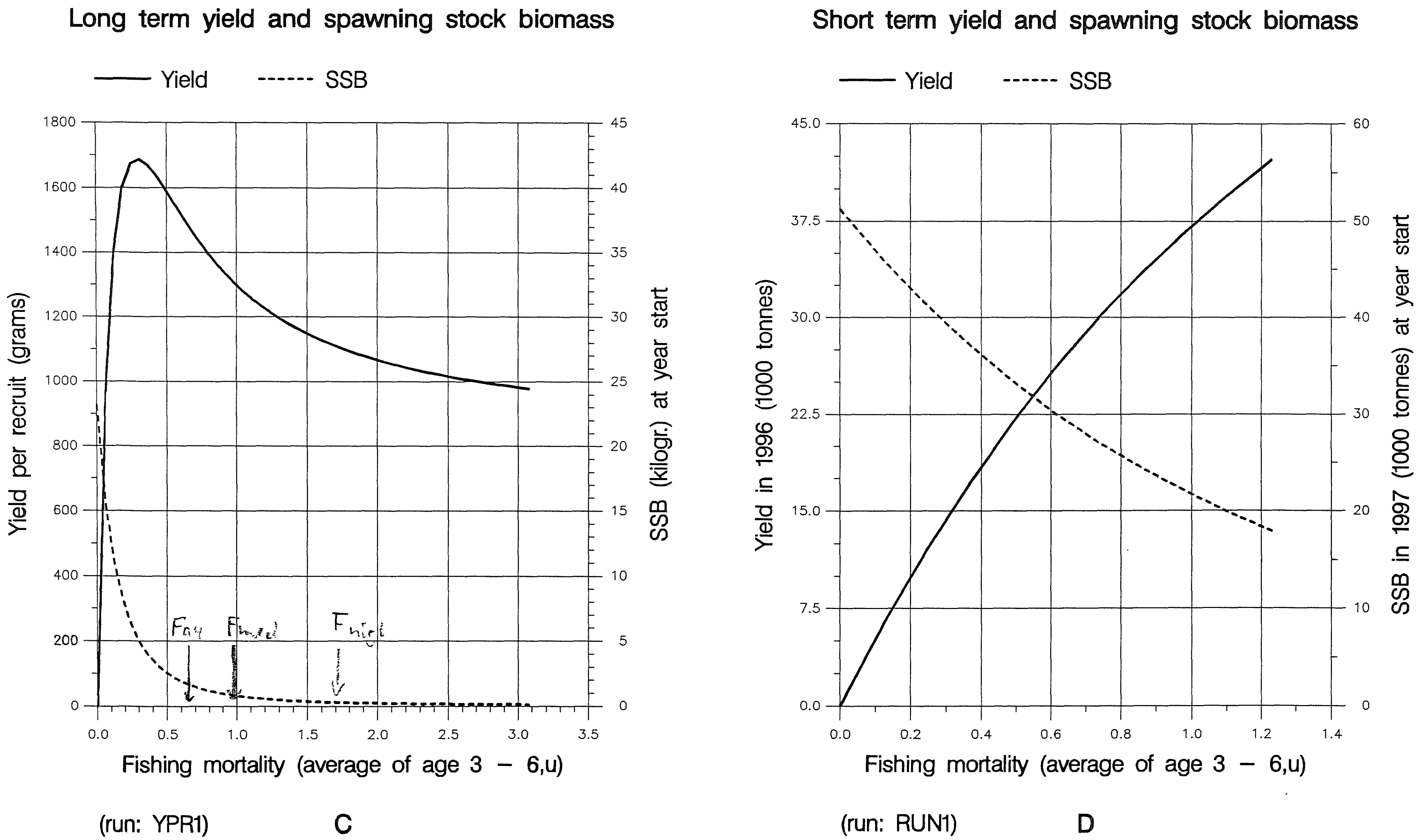
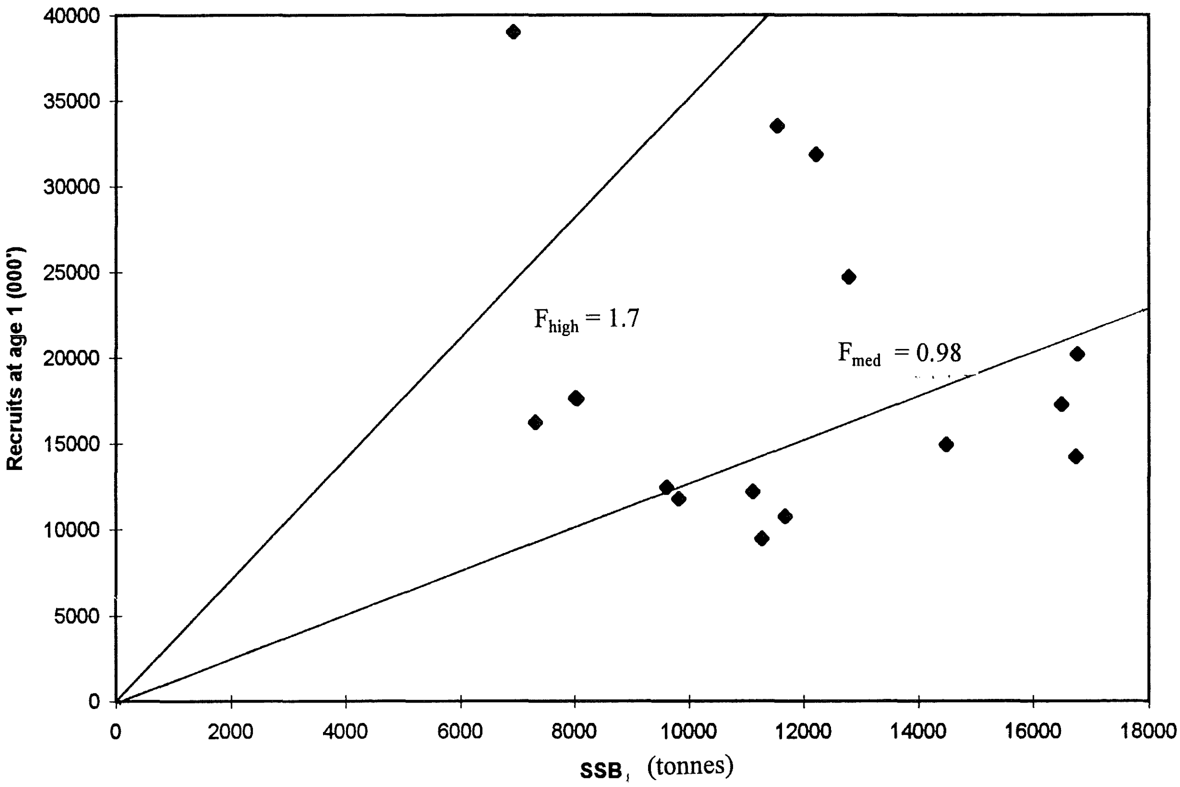


Figure 2.2.6 Cod in the Skagerrak. Recruitment vs. spawning stock biomass.



2.3 Haddock

2.3.1 Catch trends

Haddock is taken as a by-catch in the various human consumption fisheries and as a by-catch in the industrial fisheries for Norway pout.

The annual landings for the period 1975-1994 are presented in Table 2.3.1. After 1983 landings are given separately for landings for human consumption and landings used for reduction purposes. About 54 % of haddock catches in 1994 came from landings for reduction.

2.3.2 Age composition and weight at age

Age compositions (and weight at age) are available for Danish landings; for human consumption landings for the period 1981-1991 and for small-mesh landings from the periods 1981-1986 and 1991-1994. The age compositions are presented in Table 2.3.2.

The age distributions need to be re-evaluated. The 0-group have not been included in the distributions, and there is an unreasonable small number of 1-group in the years when the small-mesh fishery was sampled.

2.3.3 Survey indices and catch per unit of effort

An index for 1-group haddock in Division IIIa is available from the IBTS February survey (Table 2.1.1).

CPUE data for the commercial fisheries are not available.

2.3.4 Long-term trends

Total landings reached a maximum of more than 15,000 tonnes in 1983 which was associated with the large 1979 year class. In the last decade the catches have been about half this level. In 1993 and 1994 the catches were only 4,400 and 4,000 tonnes. The IBTS index for 1-group was well above average for the latest four year classes with the 1993 index as the highest in the series. The 1991 to 1994 year classes may thus be rich. In 1992 and 1994 0-group haddock were abundant in Danish industrial landings.

2.3.5 Comments on assessment

The data did not allow an assessment to be carried out.

The recruitment pattern of haddock in Div. IIIa and the North Sea are similar and the Div. IIIa stock is therefore assumed to be related to the North Sea haddock stock. This issue is taken up in section 6.

Table 2.3.1 Landings of HADDOCK in Division IIIa (in tonnes) as supplied by Working Group members.

Year	Denmark		Total	Norway	Sweden	Others	Total consumption	Total reduction and consumption
	Human consumption	Reduction		Human consumption				
1975	-	-	5,015	122	921	57	-	6,115
1976	-	-	7,488	191	1,075	301	-	9,055
1977	-	-	6,907	156	2,485	215	-	9,763
1978	-	-	4,978	168	1,435[2]	56	-	6,637
1979	-	-	4,120	248	361	56	-	4,785
1980	-	-	7,172	288	373	57	-	7,890
1981	-	-	9,568	271	391	120	-	10,350
1982	-	-	11,151	196	396	329	-	12,072
1983	6,425	7,225	13,65-	756	608	221	8,010	15,235
1984	5,516	2,707	08,223	321	499	30	6,366	9,073
1985	6,522	954	7,476	279	351	15	7,167	8,121
1986	3,265	1,682	4,947	226	151	5	3,647	5,329
1987	3,584	1,449	5,033	148	71	36	3,803	5,288
1988	2,543	1,480	4,023	245	64	48	2,852	4,380
1989	3,889	360	4,249	138	66	5	4,098	4,458
1990	3,887	1,968	5,855	84	102	27	4,100	6,068
1991	3,894	2,593	6,487	111	80	1	4,086	6,679
1992	3,811	4,254	8,065	177	744[2]	14	4,396	9,000
1993	1,570	2,215	3,785	153	436[3]		1,959	4,374
1994	1,446	2,180	3,626	130	256	1	1,833[1]	4,013[1]

[1]Preliminary.
[2]Includes ~ 350 tonnes landed for reduction.
[3]Includes ~ 200 tonnes landed for reduction.

Table 2.3.2 Haddock in Division IIIa. Catch in numbers ('000).
1987 - 1990 Human consumption fishery only.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1981	30	9903	4962	771	151	84	36	3
1982	314	2299	12055	1113	209	22	11	6
1983	1113	4624	2728	4004	525	63	11	6
1984	18	6554	4481	713	524	91	6	16
1985	0	8279	3687	1049	78	176	29	6
1986	51	903	3722	686	230	33	27	28
1987	381	3282	866	734	122	42	10	6
1988	375	1683	1863	303	158	43	14	16
1989	32	1540	2951	510	91	45	12	6
1990	1040	1347	1576	931	144	43	31	20
1991	7614	2453	1085	460	400	66	12	19
1992	16094	4572	905	284	107	48	7	6
1993	15019	6050	739	116	37	17	10	6
1994	2477	2015	760	140	16	4	1	2

2.4 Whiting

The landings have since 1981 been reported separately for human consumption and reduction purposes. The Danish landings for reduction purposes have been taken in a mixed clupeoid fishery and in an industrial fishery directed at Norway pout and sandeel. This fishery has a by-catch of small, mainly 0-group, whiting. The total catch was 5,850 tons in 1994 which is almost as low as in 1993. About 90% of the catches came from the industrial fishery. The total landings are shown in Table 2.4.1 and on Figure 2.4.1.

IBTS February indices for 1-group whiting have been very high in recent years, Figure 2.4.1, but this is not reflected in the landings. The 1995 index was above average.

No analytical assessment of the stock was possible.

Table 2.4.1 Nominal landings (in tonnes) of WHITING from Division IIIa as supplied by the Study Group on Division IIIa Demersal Stocks (Anon., 1992b) and updated by the Working Group.

Year	Denmark			Norway	Sweden	Others	Total
1975		19,018		57	611	4	19,690
1976		17,870		48	1,002	48	18,968
1977		18,116		46	975	41	19,178
1978		48,102		58	899	32	49,091
1979		16,971		63	1,033	16	18,083
1980		21,070		65	1,516	3	22,654
	Total consumption	Total industrial	Total				
1981	1,027	23,915	24,942	70	1,054	7	26,073
1982	1,183	39,758	40,941	40	670	13	41,664
1983	1,311	23,505	24,816	48	1,061	8	25,933
1984	1,036	12,102	13,138	51	1,168	60	14,417
1985	557	11,967	12,524	45	654	2	13,225
1986	484	11,979	12,463	64	477	1	13,005
1987	443	15,880	16,323	29	262	43	16,657
1988	391	10,872	11,263	42	435	24	11,764
1989	777	11,662	12,439	29	675	-	13,215
1990	1,016	17,829	18,845	46	435	73	19,333
1991	881	12,463	13,344	56	557	97	14,054
1992	538	10,675	11,213	67	959	1	12,240
1993	181	3,581	3,762	42	756	1	4,561
1994[1]	0	5,391	5,391	21	439	1	5,852

[1]Preliminary.

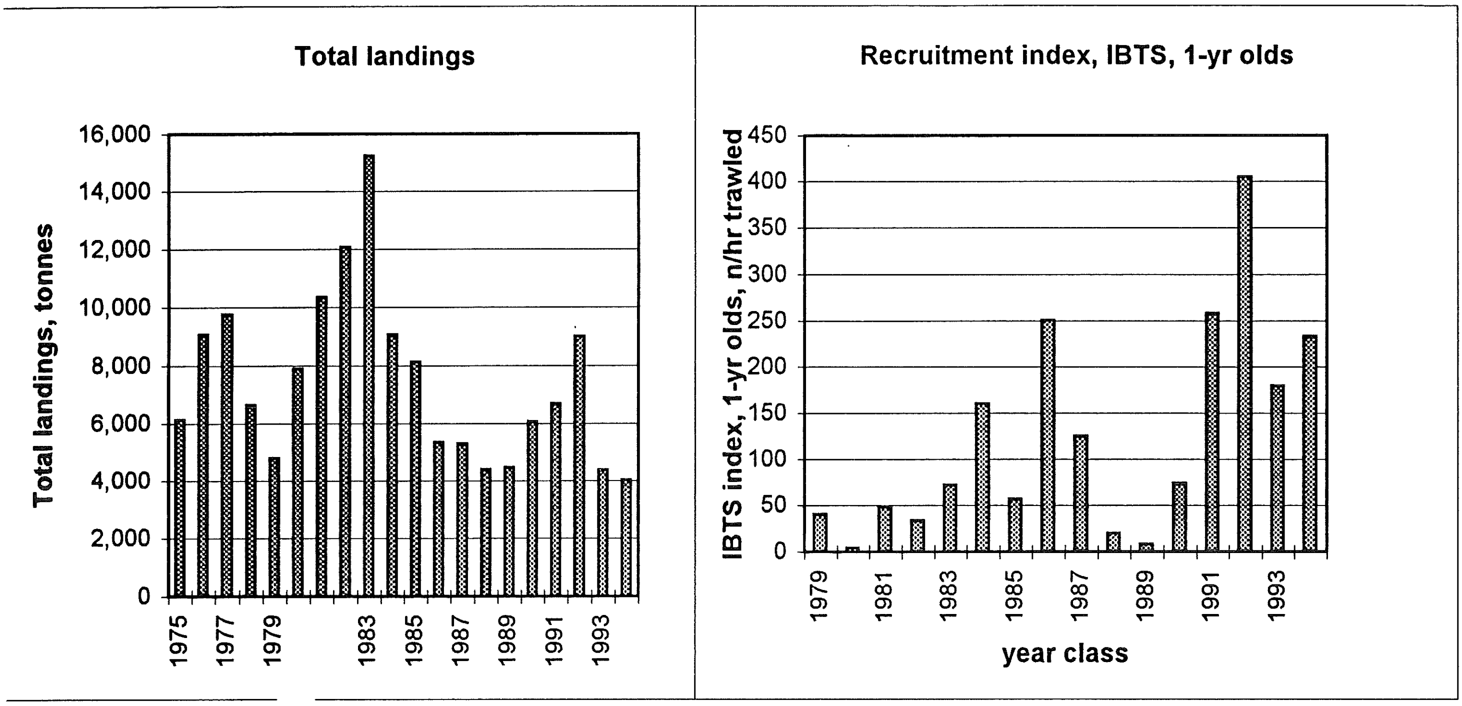


Fig. 2.3.1. HADDOCK in Div. IIIa. Total landings and recruitment index

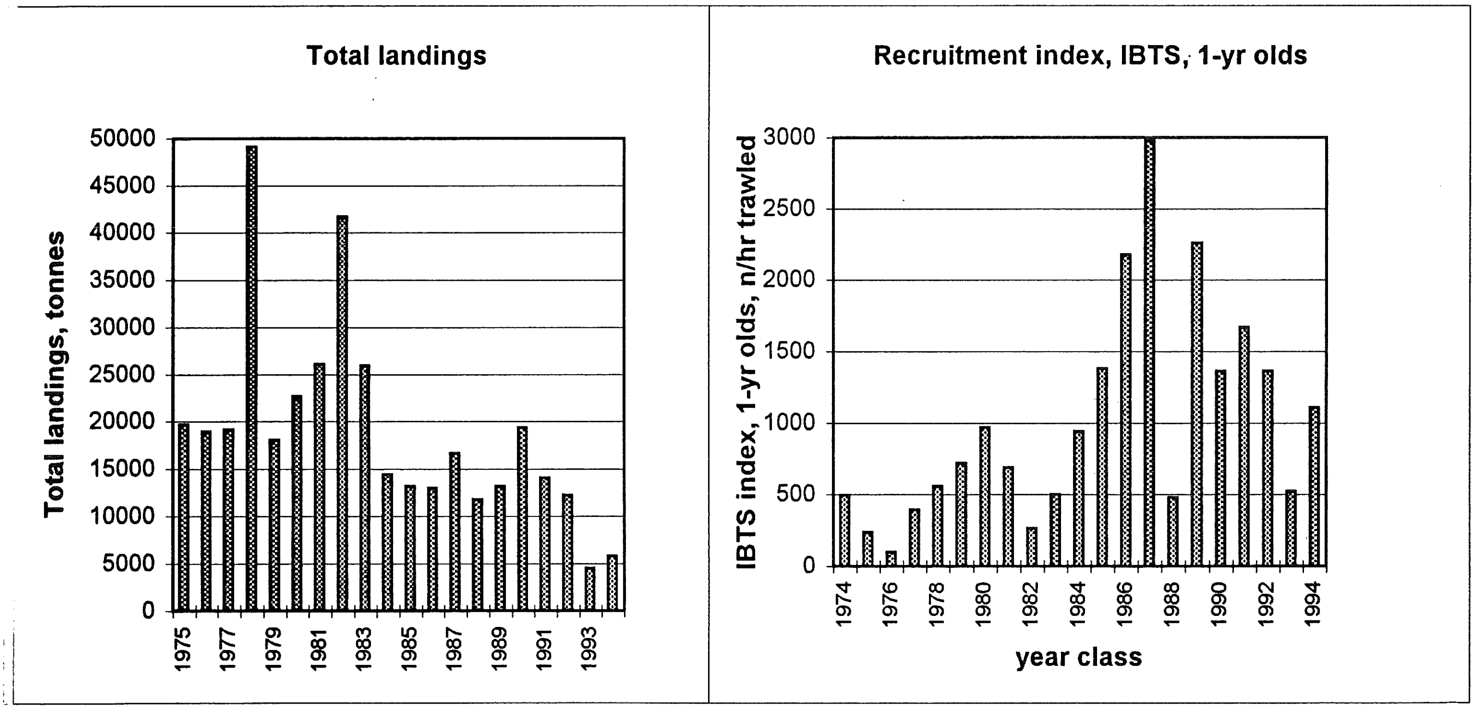


Fig. 2.4.1. WHITING in Div. IIIa. Total landings and recruitment index

2.5 Plaice in Division IIIa

2.5.1 Trends in catches and fisheries

The landing of plaice amounted to 11,300 tons in 1994. About 92 % of the catch were taken by Denmark.

The annual landings from 1972 to 1994 are given by country and separated on Kattegat and Skagerrak in Table 2.5.1. In the start of this period most catches were landed in Kattegat but from the mid 1970s Skagerrak have supplied the major proportion of the catch. In recent years more than 80% of the catch derives from Skagerrak. Moreover, most of the catches taken in Kattegat are reported from the northern part of the area. The estimated total annual landings used by the working group are derived by multiplying the catch at age with the mean weight at age. The long term yield is shown in Figure 2.5.1.

The landing data for 1983-1988 are considered uncertain and have been adjusted on the assumption that misreporting was a serious source of bias (Anon. 1991). In recent years no strong incentive have existed to omit the reporting of plaice catches as the catch quotas have not been restrictive. However, unreported place landings may have resulted in conjunction with non-legal fisheries for other species. Also misreporting by area as well as misreporting of other species as plaice may have taken place.

A directed plaice fishery is carried out by otter trawl, seine and gill-net with some beam trawlers being introduced in recent years. However, most of the catches are taken in mixed human consumption fisheries. A considerable number of vessels have been taken out of the fisheries in recent years (Anon. 1995).

2.5.2 Natural mortality, maturity, age compositions and mean weight at age

As in previous years catch at age data are provided by Denmark only. The annual number of Danish market samples and the numbers of plaice measured and aged are presented in Table 2.5.2.

Serious doubts have been raised on the quality of the Danish age readings at the recent Working Group meetings (Anon. 1994; Anon. 1995). For the 1993 Skagerrak age readings a difference of more than one year were found between different readers and for this reason the Working Group was not able to carry out an analytical assessment at its 1994 meeting. The 1993 age readings have been corrected prior to the present meeting. However, serious problems were discovered for the Skagerrak data for 1994 where plaice of age 7-8 were seen dominating as opposed to age 4-6 seen in the revised 1993 data. Also a pronounced difference was seen within 1994 with a drop in mean age from 7 years to 5 years between 3rd and 4th quarter. The 1994 age composition for Kattegat, which was provided by other age readers, showed a dominance of age 2-4 which were in accordance with what was seen for 1993.

To allow an assessment to be carried out the age reading problems were circumvented by breaking down the Skagerrak landings by using plaice age information from the Danish samples in the northernmost part of the North Sea (i.e. market sampling from Hvide Sande and Tyboroen) which were based on age readings by another group of readers. The result was that the Skagerrak catches were dominated by age 3-4 plaice. The 1994 catch at age for Division IIIa, were finally derived by raising the Danish age compositions with the international catch by quarter and area (Table 2.5.3). The Division IIIa age distribution for 1994, which is predominately influenced by the catch at age for Skagerrak show dominance of age 3-4 as opposed to age 4-5 in the previous years.

The 1994 mean weight at age were derived from the same data sources as were used for the estimation of the catch at age and are given in Table 5.2.4.

A natural mortality of 0.1 per year were assumed for all years and ages. A knife-edge maturity ogive was assumed: Age group 2 and younger was assumed as being immature whereas all age 3 and older plaice were assumed mature.

2.5.3 Catch, effort and Research vessel data

Catch per unit effort are available for Swedish fleets using *Nephrops* trawl (70 mm mesh) and fish trawls (90 mm mesh) for both Kattegat and Skagerrak (Table 2.5.5). However, as the CPUE is not disaggregated on ages this information cannot be used in XSA tuning.

Three Danish fleets, i.e. trawl , gill-net and seine, have been used for tuning. The age dis-aggregated indices were derived by merging landing/logbook statistics supplying catch weight per market category with the age distribution within these categories available from the market sampling.

Only trips where plaice was the most valuable component of the catch were included. The effect of size determined differences in fishing power is reduced by only using data for vessels between 10 and 20 GRT. As the market sampling are used to establish the CPUE's by age any biases in the age readings will be carried over into the tuning fleet indices. Considering the problems in the age readings in 1994 it was decided not to attempt to derive tuning fleet data for 1994. The annual landings, catch and effort for 1987 to 1993 are shown in Table 2.5.6. and the tuning files providing CPUE per age are shown in Table 2.5.7.

The IBTS February survey are available since 1981. However, as the survey plaice catches in general is low and no pre-recruits are caught the IBTS surveys is of little relevance XSA-tunings.

2.5.4 Catch at age analysis

The VPA have been tuned by XSA using default F shrinkage. No population shrinkage were applied as it was not thought likely that the fleet CPUE would depend on year-class strength. The XSA tuning setup and the tuning diagnostic is given in Table 2.5.8.

The VPA results are given in Tables 2.2.8 and 2.2.9. The fishing mortality of age 3 in 1994 is much higher than in 1993 whereas the fishing mortality of age 5 is below normal. These deviations may be artefacts caused by the way in which the 1994 catch at age data were derived. The age 3 abundance, which is the highest on record, may similarly be an artefact caused by the high number of age 3 plaice estimated caught in 1994.

Plots of the log catchability residuals (Figure 2.5.2) show little trends over time. The catchability of age 2 plaice is highly variable for all fleets. This is also reflected in the SE of log q which is estimated at levels of 1.2-1.5. This implies that little information on age 2 plaice abundance can be deducted from the catches from the commercial fleets.

Retrospective VPA runs are carried back to 1991 (Figure 2.5.3). There only seems to be small differences between assessments. No pattern was recognised.

2.5.5 Recruitment estimates

No indices of age 0 and 1 plaice are available and the young plaice are found in the shallow areas not covered by surveys. Moreover, the age 2 plaice indices of the three tuning fleets correlates rather poorly with VPA abundance. As no fleet indices are available after 1993 this implies that no reliable direct information are available on year-class sizes after the 1990 year-class.

2.5.6 Long term trends

The long term trends in the fisheries are presented in the Tables 2.5.1 and 2.5.11 and in Figure. 2.5.1

In the 1970's catches fluctuated between 14,000 and 27,000. Since then the catches have declined to the present levels of about 9,000 to 12,000 tons. Since 1978 the fishery mortality have fluctuated around 0.7 per year. Recruitment has varied between 30 and 90 million per year without trends.

2.5.7 Biological reference points

Input data to the Yield per recruit analysis are presented in Table 2.5.12 and the yield per recruit curve is shown in Figure. 2.5.4. It is not possible to identify a relation between SSB and recruitment (Figure. 2.5.5) and it therefore difficult to establish a MBAL. F-med is estimated at 0.64 per year which is also the level of the 1994 fishing mortality. F-high is estimated at 2.6 per year.

2.5.8 Catch forecast

The inputs used for the predictions are given in Table 2.5.12 Stock sizes for age 2 and 3 in 1995 are taken from the VPA as the geometric average for 1978-1992. The older age groups are taken as the survivors by 1 January as estimated by the VPA. The recruitment at age in 1996 and 1997 is assumed the same as in 1995. The mean weight at age are taken as the average for the years 1991-1994. The exploitation pattern in the prognosis are based on the average exploitation pattern over the 1991 to 1994 scaled to F level of 1994.

The *status quo* predictions result in catches of 13,000 and 13,500 tonnes in 1995 and 1996, respectively. Predicted catches for 1995 is a little higher than the TAC of 11,200 tonnes. The SSB is decreases from 40,000 tons in 1995 to 35,000 tons in 1997.

2.5.9 Medium term predictions

No medium term predictions were carried out.

2.5.10 Long term considerations

The assessment indicates the fishing mortality have fluctuated around a value of 0.7 per year. The estimated F-med of 0.64 per year suggest that the stock may sustain this level of fishery mortality without affecting the recruitment prospects.

2.5.11 Comments on the assessment

Due to the doubts raised on the quality of data mentioned in section 2.5.2 and 2.5.4 the assessments presented must be considered as unreliable.

2.5.12 Evaluation on the usefulness of IBTS surveys.

The IBTS data is not used in the assessment of the Div. IIIa plaice stock.

Table 2.5.1 Plaice landings from the Kattegat and Skagerrak (tonnes 1972-1994. Official figures, excluding misreported landings in the period 1983-1988. See Anon (1992).

Year	Denmark Kattegat	Denmark Skagerrak	Sweden Kattegat	Sweden Skagerrak	Germany Kattegat	Germany Skagerrak	Belgium Skagerrak	Norway Skagerrak	Total Kattegat	Total Skagerrak	Total Div. IIIa	Total used by WG
1972	15,504	5,095	348	70					15,852	5,165	21,017	21,017
1973	10,021	3,871	231	80					10,252	3,951	14,203	14,203
1974	11,401	3,429	255	70					11,656	3,499	15,155	15,155
1975	10,158	4,888	369	77					10,527	4,965	15,492	15,492
1976	9,487	9,251	271	81					9,758	9,332	19,090	19,090
1977	11,611	12,855	300	142					11,911	12,997	24,908	24,908
1978	12,685	13,383	368	94					13,053	13,477	26,530	27,269
1979	9,721	11,045	281	105					10,002	11,150	21,152	21,157
1980	5,582	9,514	289	92					5,871	9,606	15,477	15,541
1981	3,803	8,115	232	123					4,035	8,238	12,273	12,308
1982	2,717	7.789	201	140					2,918	7,929	10,847	11,376
1983	3,280	6,828	291	170			133	14	3,571	7,145	10,716	11,353
1984	3,252	7,560	323	356	32		27	22	3,607	7,965	11,572	11,984
1985	2,979	9,646	403	296	4		136	18	3,386	10,096	13,482	13,936
1986	2,468	10,653	170	215			505	24	2,638	11,397	14,035	14,985
1987	2,868	11,370	283	222	104		907	25	3,255	12,524	15,779	16,787
1988	1,818	9,781	210	281	2.8		716	41	2,030.8	10,819	12,850	13,215
1989	1,596	5,387	135	320	4	0.1	230	33	1,735	5,970.1	7,705	8,010
1990	1,831	8,726	201	777	2	0.7	471	69	2,034	10,043.7	12,078	12,420
1991	1,756	5,849	267	472	5.6	3.9	315	68	2,028.6	6,707.9	8,737	8,720
1992	2,071	8,522	208	381			537	107	2,279	9,547	11,826	12,445
1993	1,289	9,128	287	175			339	78	1,576	9,720	11,296	11,628
1994	1,553	8,790	315	227	4	33	325	65	1,872	9,440	11,312	11,885

Table 2.5.2 Plaice in Division IIIa. The Danish market sampling intensity by area 1988-1994.

The Skagerrak

Category	Industrial			Human consumption			Total		
	No. sampl. Market	No. aged	No. meas.	No. sampl. Market	No. aged	No. meas.	No. sampl. Market	No. aged	No. meas.
Year									
1988	2	360	383	16	4,606	4,891	18	4,966	5,724
1989	2		2	19	5,337	5,802	21	5,337	5,804
1990				19	5,378	5,771	19	5,378	5,771
1991	7		10	16	3,345	3,546	23	3,345	3,556
1992	6		7	11	1,878	1,949	17	1,878	1,956
1993	9		21	13	1,838	1,942	22	1,838	1,963
1994	6		10	13	1,636	1,882	19	1,637	1,892
Total	**32**	**361**	**433**	**107**	**24,018**	**25,783**	**139**	**24,379**	**26,216**

The Kattegat

Category	Industrial			Human consumption			Total		
	No. sampl. Market	No. aged	No. meas.	No. sampl. Market	No. aged	No. meas.	No. sampl. Market	No. aged	No. meas.
Year									
1988				29	4,949	5,147	29	4.949	5,147
1989	3		6	39	7,485	7,836	42	7,485	7,842
1990	1		1	32	6,494	6,768	33	6,494	6,769
1991	6		13	26	4,704	4,879	32	4,704	4,892
1992	10		14	28	4,025	4,239	38	4,025	4,253
1993	7		14	24	3,298	3,436	31	3,298	3,450
1994	4		4	33	3,999	4,177	37	3,999	4,181
Total	**31**		**52**	**211**	**34,954**	**36,482**	**242**	**34,954**	**36,534**

Table 2.5.3 . Plaice in Div. IIIa. International catch at age ('000) 1978-1994

Run title : Plaice in IIIa (run: RUN3/H03)

At 4-Oct-95 08:30:21

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE							
2,	503,	1105,	363,	191,	552,	1569,	2184,
3,	16129,	9791,	4792,	4059,	2168,	10292,	12880,
4,	40633,	29662,	16421,	13135,	9653,	9143,	12555,
5,	25613,	20812,	12627,	11001,	11119,	8503,	4590,
6,	8234,	7648,	6058,	4318,	5825,	2832,	2043,
7,	637,	2515,	2403,	1431,	1941,	980,	906,
8,	65,	170,	953,	548,	795,	563,	750,
9,	65,	75,	204,	214,	316,	272,	592,
10,	49,	50,	54,	119,	118,	102,	300,
+gp,	62,	55,	50,	97,	50,	112,	107,
0 TOTALNUM,	91990,	71883,	43925,	35113,	32537,	34368,	36907,
TONSLAND,	26530,	21152,	15477,	12273,	10847,	10716,	11572,
SOPCOF %,	97,	100,	100,	100,	95,	94,	97,

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	1462,	395,	592,	100,	1045,	3205,	2363,	934,	1130,	1636,
3,	8990,	4479,	4235,	3121,	3977,	8993,	8735,	3995,	3664,	15012,
4,	22548,	15549,	13081,	12374,	7365,	8905,	9602,	12219,	10304,	10530,
5,	6434,	20027,	18620,	14159,	6489,	10042,	4640,	18212,	13486,	4355,
6,	1767,	4915,	10691,	7055,	2813,	3333,	2878,	4493,	7038,	2330,
7,	725,	680,	2184,	2822,	1215,	1015,	888,	1078,	1707,	2060,
8,	275,	273,	386,	973,	568,	495,	304,	308,	388,	524,
9,	209,	130,	237,	331,	265,	360,	156,	119,	108,	365,
10,	175,	122,	126,	140,	140,	161,	86,	28,	50,	182,
+gp,	164,	84,	165,	162,	226,	256,	135,	119,	75,	216,
0 TOTALNUM,	42749,	46654,	50317,	41237,	24103,	36765,	29787,	41505,	37950,	37210,
TONSLAND,	13482,	14035,	15774,	12850,	7674,	12078,	8737,	11826,	11296,	11312,
SOPCOF %,	97,	94,	94,	97,	96,	97,	100,	95,	97,	95,

1

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Table 2.5.4 Plaice in Div IIIa. Mean weight at age (Kg.) 1978-1994

Run title : Plaice in IIIa (run: RUN3/H03)

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Table 2 Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE							
2,	.2360,	.2220,	.2610,	.2300,	.2700,	.2850,	.2770,
3,	.2480,	.2550,	.2740,	.2630,	.3010,	.2740,	.2930,
4,	.2680,	.2670,	.3060,	.2960,	.2860,	.2930,	.3090,
5,	.3220,	.2970,	.3450,	.3570,	.3180,	.3560,	.3770,
6,	.4170,	.3780,	.4140,	.4320,	.3860,	.4230,	.4200,
7,	.5980,	.4510,	.5790,	.5370,	.5440,	.4830,	.4190,
8,	.7520,	.6550,	.6400,	.6710,	.7040,	.5310,	.3900,
9,	.8180,	.9220,	.7530,	.8130,	.8130,	.6470,	.3600,
10,	.9140,	1.0200,	.8110,	.9120,	.9120,	.9860,	.4460,
+gp,	.8430,	1.0440,	.9100,	.9990,	.9860,	1.1840,	1.1060,
0 SOPCOFAC,	.9729,	.9998,	.9959,	.9972,	.9535,	.9439,	.9656,

Table 2 Catch weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	.2790,	.2520,	.3400,	.2490,	.2740,	.2910,	.2630,	.3090,	.2680,	.2670,
3,	.2840,	.2770,	.2850,	.2680,	.2630,	.2880,	.2700,	.3100,	.2730,	.2560,
4,	.3070,	.2840,	.2860,	.2690,	.2820,	.2940,	.2590,	.2730,	.2710,	.3190,
5,	.3520,	.3210,	.3030,	.2900,	.3200,	.3370,	.2740,	.2800,	.2950,	.3630,
6,	.4370,	.3980,	.3740,	.3500,	.3760,	.3970,	.3650,	.3360,	.3380,	.4150,
7,	.5470,	.5380,	.5380,	.4740,	.4660,	.4980,	.4920,	.5000,	.4400,	.4060,
8,	.6610,	.6740,	.7380,	.5670,	.6350,	.6850,	.5860,	.6460,	.5650,	.5110,
9,	.7420,	.7910,	.9440,	.7570,	.7390,	.7740,	.6710,	.8170,	.7150,	.6480,
10,	.7540,	.8620,	1.0230,	.8320,	.8260,	.9570,	.8690,	.8040,	.8020,	.7690,
+gp,	.9180,	1.0260,	1.1180,	1.1920,	1.0100,	1.1520,	1.0110,	.9710,	1.1710,	1.0070,
0 SOPCOFAC,	.9674,	.9366,	.9397,	.9724,	.9581,	.9724,	1.0020,	.9503,	.9714,	.9518,

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Table 2.5.5 Plaice in Division IIIa. CPUE in four Swedish fleets.

Year	*Nephrops* Trawl		Cod Bottom Trawl	
	Skagerrak	Kattegat	Skagerrak	Kattegat
1980	1.73	3.4	2.5	6.12
1981	1.74	4.04	1.74	7.69
1982	1.95	2.92	2.24	9.05
1983	1.98	3.75	2.63	10.25
1984	3.09	4.94	4.54	7.6
1985	3.1	7.93	3.55	9.47
1986	1.81	2.78	2.87	5.05
1987	1.39	4.27	1.9	7.5
1988	1.66	3.96	2.66	7.65
1989	2.36	2.52	3.39	4.72
1990	2.91	3.31	5.62	6.27
1991	1.36	3.82	3.42	6.27
1992	2.18	3.67	2.69	2.77
1993	1.55	1.97	2.69	2.98
1994	1.63	2.96	2.26	4.27

Table 2.5.6 : Number of landingslips, Catch (tons) Effort (days at sea) and CPUE (kg/day) for the three danish fleets used for tuning XSA for Plaice in Div. IIIa

YEAR	No.of Lan-dinggslips	Tons	Days at sea	CPUE
Gill-net				
1987	771	988	1888	523
1988	1095	775	1794	432
1989	688	360	887	406
1990	344	224	471	476
1991	332	209	429	487
1992	638	516	777	664
1993	941	615	1101	559
Trawl				
1987	1140	618	2551	242
1988	1050	461	1572	293
1989	442	134	729	184
1990	933	356	1349	264
1991	1117	320	1468	218
1992	1236	457	1557	294
1993	1043	518	1511	343
Danish Seine				
1987	1755	1570	3451	455
1988	1449	1089	2425	449
1989	1381	729	2220	328
1990	1660	1116	2625	425
1991	1845	846	2694	314
1992	1693	1191	2403	496
1993	1794	804	2510	320

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Table : 2.5.7 Tuning CPUE data for Plaice in Div. IIIa, 1987 to 1993. CPUE for age 1 not used.

Gill net

EFFORT	CPUE1	CPUE2	CPUE3	CPUE4	CPUE5	CPUE6	CPUE7	CPUE8	CPUE9	CPUE10
1	0.0	8.1	64.8	254.0	450.7	344.6	112.7	21.3	13.2	6.8
1	0.0	0.6	44.6	243.9	315.5	215.2	150.5	62.9	26.4	9.6
1	0.0	9.2	33.3	128.0	136.4	103.2	101.0	84.3	39.7	23.3
1	0.1	51.5	167.2	181.8	285.7	142.3	65.1	46.9	41.2	21.5
1	0.3	41.4	218.1	320.3	209.1	242.5	113.5	44.1	18.5	16.0
1	0.0	34.8	185.0	605.2	916.0	235.0	85.4	31.2	14.2	3.9
1	0.0	17.3	79.0	254.5	502.0	473.2	164.0	33.5	10.3	2.9

Trawl

EFFORT	CPUE1	CPUE2	CPUE3	CPUE4	CPUE5	CPUE6	CPUE7	CPUE8	CPUE9	CPUE10
1	0.0	4.5	59.4	212.6	319.7	157.9	20.4	2.2	1.1	0.7
1	0.1	2.1	80.2	359.6	415.3	165.3	40.5	8.6	1.9	1.2
1	0.1	20.0	72.5	186.4	225.6	89.5	23.1	8.2	3.3	1.2
1	0.1	84.4	236.8	244.7	248.5	72.9	17.8	6.5	3.0	1.0
1	0.1	51.1	231.9	283.9	138.5	75.7	17.2	5.6	3.4	1.5
1	0.0	17.9	96.5	286.2	468.2	126.6	33.5	8.6	1.1	0.1
1	0.0	15.5	130.2	413.1	393.8	175.5	36.5	6.5	1.6	1.0

Seine

EFFORT	CPUE1	CPUE2	CPUE3	CPUE4	CPUE5	CPUE6	CPUE7	CPUE8	CPUE9	CPUE10
1	0.0	9.6	93.9	351.1	607.4	329.2	40.3	5.3	3.2	1.6
1	0.1	3.3	145.4	495.9	582.1	269.7	83.8	19.9	4.6	1.8
1	0.2	41.4	183.3	323.4	329.1	142.5	53.9	17.1	6.9	3.2
1	0.1	108.8	350.4	358.1	402.1	121.7	31.7	10.6	6.3	2.1
1	0.7	95.3	341.3	376.3	201.2	133.3	36.5	10.7	4.7	1.5
1	0.0	26.7	134.4	555.6	845.8	210.4	35.6	7.4	2.3	0.4
1	0.0	28.4	80.9	242.2	405.5	258.8	60.4	12.1	2.8	0.7

Table 2.5.8 Tuning diagnostics for Plaice in Div. IIIa

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Lestoft VPA Version 3.1

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Extended Survivors Analysis

Plaice in IIIa (run: RUN3/H03)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/ple_kask/FLEET.H03

Catch data for  17 years. 1978 to 1994. Ages  2 to  11.

     Fleet,              First, Last, First, Last, Alpha,  Beta
                    ,     year, year,  age ,  age
FLT09: Danish Gill-n,     1987, 1994,   2,     10,   .000,  1.000
FLT10: Danish trawle,     1987, 1994,   2,     10,   .000,  1.000
FLT11: Danish Seiner,     1987, 1994,   2,     10,   .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 >=    7


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning converged after   25 iterations


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

Estimated population abundance at 1st Jan 1995

   ,      .00E+00, 4.00E+04, 6.62E+04, 1.51E+04, 5.42E+03, 2.33E+03, 1.65E+03, 5.22E+02, 2.00E+02,

Taper weighted geometric mean of the VPA populations:

   ,     4.97E+04, 4.43E+04, 3.27E+04, 1.86E+04, 7.19E+03, 2.60E+03, 1.03E+03, 4.71E+02, 1.99E+02,

Standard error of the weighted Log(VPA populations) :

   ,        .3796,    .4004,    .3459,    .4332,    .4425,    .3783,    .3775,    .4665,    .6277,
```

Table 2.5.8 Cont.

Log catchability residuals.

Fleet : FLT09: Danish Gill-net

Age	1987	1988	1989	1990	1991	1992	1993	1994
2	-.21	-2.77	-.70	1.23	1.50	1.18	-.46	99.99
3	-.29	-.60	-.85	.13	.65	.95	-.09	99.99
4	-.19	.12	-.62	-.14	-.30	.71	.36	99.99
5	-.12	.04	-.59	.00	-.36	.47	.51	99.99
6	-.19	-.09	-.31	-.10	.33	-.03	.34	99.99
7	-.45	-.06	.15	-.04	.31	-.22	.26	99.99
8	-.94	-.04	.42	.49	.60	-.27	-.47	99.99
9	-.47	.00	.46	.66	.87	.38	-.88	99.99
10	-.21	.26	.83	.83	.79	.53	-.27	99.99

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

Age	2	3	4	5	6	7	8	9	10
Mean Log q	-8.1422	-5.8789	-4.4915	-3.5733	-3.0615	-2.7246	-2.7246	-2.7246	-2.7246
S.E(Log q)	1.5027	.6528	.4491	.4087	.2517	.2676	.5643	.6596	.6491

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	1.31	-.142	7.32	.04	7	2.16	-8.14
3	.64	.513	7.57	.30	7	.45	-5.88
4	1.20	-.206	3.33	.18	7	.59	-4.49
5	.57	1.906	6.29	.81	7	.19	-3.57
6	.94	.225	3.39	.78	7	.26	-3.06
7	1.49	-1.117	.20	.52	7	.39	-2.72
8	3.03	-.981	-5.62	.05	7	1.71	-2.75
9	2.10	-.840	-1.24	.11	7	1.38	-2.57
10	.82	.594	2.80	.71	7	.42	-2.32

Table 2.5.8 Cont.

Fleet : FLT10: Danish trawlers

Age	1987	1988	1989	1990	1991	1992	1993	1994
2	-.99,	-1.72,	-.12,	1.53,	1.52,	.32,	-.76,	99.99
3	-.59,	-.23,	-.29,	.26,	.49,	.08,	.19,	99.99
4	-.44,	.44,	-.31,	.09,	-.49,	-.11,	.78,	99.99
5	-.31,	.47,	.07,	.01,	-.62,	-.05,	.42,	99.99
6	-.31,	.32,	.22,	-.10,	-.17,	.02,	.01,	99.99
7	-.71,	.06,	.11,	.11,	-.14,	.29,	.20,	99.99
8	-1.77,	-.59,	-.47,	-.05,	-.03,	-.12,	-.67,	99.99
9	-1.51,	-1.19,	-.59,	-.52,	.62,	-.73,	-1.30,	99.99
10	-1.05,	-.38,	-.69,	-.80,	-.13,	-1.69,	.11,	99.99

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9,	10
Mean Log q,	-7.9490,	-5.6618,	-4.4218,	-3.7258,	-3.7283,	-4.1668,	-4.1668,	-4.1668,	-4.1668,
S.E(Log q),	1.2437,	.3707,	.4767,	.3869,	.2127,	.3275,	.8091,	1.0674,	.9389,

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,	1.22,	-.128,	7.34,	.07,	7,	1.66,	-7.95,
3,	.55,	1.528,	7.84,	.71,	7,	.18,	-5.66,
4,	-2.36,	-2.546,	24.24,	.11,	7,	.81,	-4.42,
5,	.92,	.163,	4.19,	.50,	7,	.39,	-3.73,
6,	1.13,	-.548,	3.03,	.78,	7,	.26,	-3.73,
7,	1.54,	-.943,	2.17,	.39,	7,	.51,	-4.17,
8,	8.00,	-1.288,	-10.74,	.01,	7,	4.50,	-4.67,
9,	20.26,	-1.560,	-16.68,	.00,	7,	12.95,	-4.90,
10,	.77,	.669,	4.87,	.64,	7,	.49,	-4.82,

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Table 2.5.8 cont.

Fleet : FLT11: Danish Seiners

Age	1987	1988	1989	1990	1991	1992	1993	1994
2	-.77	-1.81	.07	1.25	1.60	.18	-.70	99.99
3	-.50	.00	.27	.29	.51	.04	-.65	99.99
4	-.24	.46	-.06	.16	-.51	.25	-.06	99.99
5	-.07	.41	.05	.09	-.65	.15	.05	99.99
6	-.09	.29	.16	-.11	-.12	.01	-.12	99.99
7	-.62	.20	.37	.10	.03	-.24	.12	99.99
8	-1.48	-.34	-.33	-.15	.03	-.85	-.63	99.99
9	-1.03	-.90	-.44	-.37	.35	-.58	-1.33	99.99
10	-.81	-.56	-.30	-.65	-.72	-.89	-.84	99.99

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

Age	2	3	4	5	6	7	8	9	10
Mean Log q	-7.4064	-5.2963	-4.1180	-3.3248	-3.2079	-3.5789	-3.5789	-3.5789	-3.5789
S.E(Log q)	1.1902	.4305	.3240	.3264	.1615	.3205	.7570	.8585	.7659

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	1.16	-.102	6.87	.08	7	1.52	-7.41
3	.58	1.053	7.47	.58	7	.25	-5.30
4	3.37	-1.442	-10.56	.07	7	1.00	-4.12
5	.75	.873	5.00	.71	7	.25	-3.32
6	1.04	-.239	2.97	.87	7	.18	-3.21
7	1.41	-.779	1.82	.43	7	.47	-3.58
8	1.81	-.704	1.87	.14	7	.95	-4.10
9	2.85	-1.300	.80	.10	7	1.49	-4.18
10	.81	2.132	4.41	.96	7	.13	-4.26

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Table 2.5.8 Cont.

Terminal year survivor and F summaries :

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT09: Danish Gill-n,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: Danish trawle,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT11: Danish Seiner,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	40030.,	.50,,,,				1.000,	.038

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
40030.,	.50,	.00,	1,	.000,	.038

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT09: Danish Gill-n,	41821.,	1.611,	.000,	.00,	1,	.059,	.294
FLT10: Danish trawle,	30887.,	1.333,	.000,	.00,	1,	.087,	.380
FLT11: Danish Seiner,	32893.,	1.276,	.000,	.00,	1,	.095,	.361
F shrinkage mean ,	81738.,	.50,,,,				.759,	.161

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
66223.,	.43,	.44,	4,	1.035,	.195

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT09: Danish Gill-n,	16746.,	.642,	.461,	.72,	2,	.109,	.469
FLT10: Danish trawle,	18429.,	.381,	.036,	.09,	2,	.312,	.434
FLT11: Danish Seiner,	8635.,	.434,	.263,	.61,	2,	.240,	.770
F shrinkage mean ,	18078.,	.50,,,,				.339,	.441

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
15107.,	.24,	.16,	7,	.649,	.509

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT09: Danish Gill-n,	9651.,	.387,	.233,	.60,	3,	.150,	.357
FLT10: Danish trawle,	8257.,	.307,	.292,	.95,	3,	.228,	.407
FLT11: Danish Seiner,	5615.,	.272,	.221,	.81,	3,	.301,	.553
F shrinkage mean ,	2963.,	.50,,,,				.321,	.875

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5417.,	.20,	.20,	10,	1.010,	.568

Table 2.5.8 Cont.

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

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT09: Danish Gill-n,	4241.,	.301,	.074,	.25,	4,	.141,	.420
FLT10: Danish trawle,	3325.,	.258,	.166,	.64,	4,	.181,	.511
FLT11: Danish Seiner,	2857.,	.223,	.125,	.56,	4,	.248,	.574
F shrinkage mean ,	1463.,	.50,,,,				.430,	.922

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2329.,	.23,	.17,	13,	.717,	.669

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

Year class = 1987

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT09: Danish Gill-n,	2200.,	.233,	.105,	.45,	5,	.207,	.637
FLT10: Danish trawle,	1638.,	.219,	.079,	.36,	5,	.224,	.787
FLT11: Danish Seiner,	1497.,	.201,	.106,	.53,	5,	.250,	.837
F shrinkage mean ,	1490.,	.50,,,,				.319,	.840

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1652.,	.18,	.06,	16,	.323,	.782

1

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

Year class = 1986

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT09: Danish Gill-n,	575.,	.203,	.123,	.61,	6,	.258,	.624
FLT10: Danish trawle,	536.,	.206,	.124,	.60,	6,	.225,	.658
FLT11: Danish Seiner,	517.,	.194,	.126,	.65,	6,	.246,	.675
F shrinkage mean ,	468.,	.50,,,,				.271,	.725

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
522.,	.16,	.06,	19,	.372,	.671

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

Year class = 1985

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT09: Danish Gill-n,	170.,	.213,	.118,	.56,	7,	.244,	1.112
FLT10: Danish trawle,	194.,	.223,	.139,	.63,	7,	.188,	1.027
FLT11: Danish Seiner,	158.,	.214,	.081,	.38,	7,	.204,	1.161
F shrinkage mean ,	257.,	.50,,,,				.364,	.854

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
200.,	.20,	.07,	22,	.368,	1.007

Table 2.5.8 cont.

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
,							
FLT09: Danish Gill-n,	90.,	.237,	.189,	.80,	7,	.247,	1.070
FLT10: Danish trawle,	82.,	.256,	.171,	.67,	7,	.164,	1.139
FLT11: Danish Seiner,	75.,	.249,	.225,	.90,	7,	.188,	1.198
F shrinkage mean ,	157.,	.50,,,,				.401,	.743

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
107.,	.22,	.12,	22,	.555,	.962

1

Table 2.5.9. Plaice in Div. IIIa. Fishing mortality 1978-1994 as estimated from XSA.

Run title : Plaice in IIIa (run: RUN3/H03)

At 4-Oct-95 08:31:14

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE							
2,	.0086,	.0252,	.0108,	.0075,	.0112,	.0170,	.0317,
3,	.2389,	.2048,	.1305,	.1442,	.0991,	.2631,	.1690,
4,	.7712,	.7954,	.5469,	.5489,	.5237,	.6642,	.5206,
5,	1.0916,	1.0729,	.8480,	.7741,	1.1526,	1.1086,	.7406,
6,	1.0360,	1.0586,	.9648,	.7022,	1.1515,	.9412,	.7745,
7,	.6059,	.9511,	1.0602,	.5516,	.7049,	.5145,	.8044,
8,	.2900,	.2819,	1.0944,	.6454,	.6014,	.3977,	.8417,
9,	.4958,	.5605,	.5654,	.6797,	.8624,	.3737,	.8382,
10,	.7070,	.7887,	.9112,	.6735,	.8992,	.6700,	.8037,
+gp,	.7070,	.7887,	.9112,	.6735,	.8992,	.6700,	.8037,
0 FBAR 4- 8,	.7589,	.8320,	.9028,	.6444,	.8268,	.7252,	.7363,

Table 8 Fishing mortality (F) at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
2,	.0307,	.0108,	.0173,	.0030,	.0164,	.0622,	.0745,	.0254,	.0120,	.0381,	.0252,
3,	.1582,	.1116,	.1375,	.1072,	.1429,	.1717,	.2150,	.1560,	.1183,	.1953,	.1565,
4,	.4406,	.3968,	.4795,	.6465,	.3497,	.4783,	.2497,	.4632,	.6563,	.5087,	.5427,
5,	.4891,	.7840,	1.0346,	1.3319,	.7481,	.9963,	.4357,	.9030,	1.2680,	.5680,	.9130,
6,	.6288,	.7605,	1.2112,	1.4253,	.9472,	.9990,	.7788,	.8778,	.9849,	.6687,	.8438,
7,	.6137,	.4657,	.8198,	1.1640,	.9194,	.9929,	.7035,	.6694,	.8921,	.7823,	.7812,
8,	.5351,	.4347,	.4654,	.9816,	.6733,	1.1361,	.8264,	.4964,	.4766,	.6707,	.5479,
9,	.5219,	.4615,	.7391,	.8248,	.6978,	1.1176,	1.3339,	.8117,	.2865,	1.0072,	.7018,
10,	.5599,	.5836,	.9894,	1.2525,	.9139,	1.1321,	.7835,	.8087,	.8706,	.9621,	.8805,
+gp,	.5599,	.5836,	.9894,	1.2525,	.9139,	1.1321,	.7835,	.8087,	.8706,	.9621,	
0 FBAR 4- 8,	.5414,	.5683,	.8021,	1.1099,	.7275,	.9205,	.5988,	.6820,	.8556,	.6397,	

1

Table 2.5.10. Plaice in Div.IIIa. Stock numbers 1978-1995 as estimated by XSA.

Run title : Plaice in IIIa (run: RUN3/H03)

At 4-Oct-95 08:31:14

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE							
2,	61959,	46656,	35502,	26910,	52264,	97864,	73696,
3,	79777,	55585,	41165,	31779,	24167,	46765,	87059,
4,	79464,	56843,	40981,	32690,	24894,	19805,	32525,
5,	40533,	33251,	23218,	21461,	17085,	13342,	9223,
6,	13418,	12312,	10290,	8998,	8955,	4882,	3984,
7,	1474,	4308,	3865,	3548,	4034,	2562,	1724,
8,	271,	728,	1506,	1211,	1849,	1804,	1386,
9,	175,	184,	497,	456,	575,	917,	1097,
10,	102,	96,	95,	255,	209,	220,	571,
+gp,	128,	105,	87,	207,	88,	240,	202,
TOTAL,	277300,	210068,	157207,	127515,	134119,	188400,	211466,

0

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 78-92	AMST 78-92
AGE													
2,	50836,	38707,	36298,	34804,	67338,	55839,	34618,	39152,	99514,	45960,	0,	47280,	50163,
3,	64606,	44608,	34647,	32281,	31397,	59936,	47476,	29076,	34537,	88969,	40030,	44186,	47355,
4,	66522,	49906,	36102,	27322,	26240,	24626,	45678,	34649,	22509,	27765,	66223,	36937,	39883,
5,	17487,	38744,	30366,	20224,	12951,	16737,	13812,	32197,	19729,	10565,	15107,	20743,	22709,
6,	3980,	9702,	16006,	9764,	4831,	5546,	5592,	8084,	11810,	5023,	5417,	7691,	8423,
7,	1662,	1920,	4104,	4314,	2124,	1695,	1848,	2322,	3040,	3991,	2329,	2563,	2767,
8,	698,	814,	1090,	1636,	1219,	766,	568,	827,	1076,	1127,	1652,	980,	1092,
9,	540,	370,	477,	619,	555,	562,	223,	225,	456,	605,	522,	436,	498,
10,	429,	290,	211,	206,	246,	250,	166,	53,	90,	310,	200,	192,	227,
+gp,	400,	199,	274,	236,	393,	393,	259,	224,	135,	364,	233,		
TOTAL,	207159,	185259,	159576,	131405,	147294,	166351,	150241,	146809,	192896,	184680,	131711,		

0
1

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Table 2.5.11. Plaice in Div. IIIa. Trends in stock parameters and fishing mortalities, 1978-1994.

Run title : Plaice in IIIa (run: RUN3/H03)

At 4-Oct-95 08:31:14

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 8,
1978,	61959,	75779,	61157,	26530,	.4338,	.7589,
1979,	46656,	57035,	46678,	21152,	.4532,	.8320,
1980,	35502,	49088,	39822,	15477,	.3887,	.9028,
1981,	26910,	39300,	33111,	12273,	.3707,	.6444,
1982,	52264,	41636,	27524,	10847,	.3941,	.8268,
1983,	97864,	56611,	28720,	10716,	.3731,	.7252,
1984,	73696,	63258,	42845,	11572,	.2701,	.7363,
1985,	50836,	63310,	49127,	13482,	.2744,	.5414,
1986,	38707,	54910,	45156,	14035,	.3108,	.5683,
1987,	36298,	51713,	39372,	15774,	.4006,	.8021,
1988,	34804,	37843,	29177,	12850,	.4404,	1.1099,
1989,	67338,	42842,	24392,	7674,	.3146,	.7275,
1990,	55839,	51089,	34840,	12078,	.3467,	.9205,
1991,	34618,	41378,	32273,	8737,	.2707,	.5988,
1992,	39152,	44442,	32344,	11826,	.3656,	.6820,
1993,	99514,	54512,	27842,	11296,	.4057,	.8556,
1994,	45960,	53018,	40746,	11312,	.2776,	.6397,
Arith. Mean ,	52819,	51633,	37360,	13390,	.3583,	.7572,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

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Table 2.5.12 Plaice in Division IIIa. Input for catch predictions. Stock size at age 2 and 3 in 1995 is the VPA geometric mean for 1978 - 1992.

Year: 1995

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47280.000	0.1000	0.0000	0.0000	0.0000	0.277	0.0346	0.277
3	44186.000	0.1000	1.0000	0.0000	0.0000	0.277	0.1577	0.277
4	66223.000	0.1000	1.0000	0.0000	0.0000	0.281	0.4327	0.281
5	15107.000	0.1000	1.0000	0.0000	0.0000	0.303	0.7316	0.303
6	5417.000	0.1000	1.0000	0.0000	0.0000	0.364	0.7628	0.364
7	2329.000	0.1000	1.0000	0.0000	0.0000	0.459	0.7022	0.459
8	1652.000	0.1000	1.0000	0.0000	0.0000	0.577	0.5692	0.577
9	522.000	0.1000	1.0000	0.0000	0.0000	0.713	0.7925	0.713
10	200.000	0.1000	1.0000	0.0000	0.0000	0.811	0.7892	0.811
11+	233.000	0.1000	1.0000	0.0000	0.0000	1.040	0.7892	1.040
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47280.000	0.1000	0.0000	0.0000	0.0000	0.277	0.0346	0.277
3	.	0.1000	1.0000	0.0000	0.0000	0.277	0.1577	0.277
4	.	0.1000	1.0000	0.0000	0.0000	0.281	0.4327	0.281
5	.	0.1000	1.0000	0.0000	0.0000	0.303	0.7316	0.303
6	.	0.1000	1.0000	0.0000	0.0000	0.364	0.7628	0.364
7	.	0.1000	1.0000	0.0000	0.0000	0.459	0.7022	0.459
8	.	0.1000	1.0000	0.0000	0.0000	0.577	0.5692	0.577
9	.	0.1000	1.0000	0.0000	0.0000	0.713	0.7925	0.713
10	.	0.1000	1.0000	0.0000	0.0000	0.811	0.7892	0.811
11+	.	0.1000	1.0000	0.0000	0.0000	1.040	0.7892	1.040
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47280.000	0.1000	0.0000	0.0000	0.0000	0.277	0.0346	0.277
3	.	0.1000	1.0000	0.0000	0.0000	0.277	0.1577	0.277
4	.	0.1000	1.0000	0.0000	0.0000	0.281	0.4327	0.281
5	.	0.1000	1.0000	0.0000	0.0000	0.303	0.7316	0.303
6	.	0.1000	1.0000	0.0000	0.0000	0.364	0.7628	0.364
7	.	0.1000	1.0000	0.0000	0.0000	0.459	0.7022	0.459
8	.	0.1000	1.0000	0.0000	0.0000	0.577	0.5692	0.577
9	.	0.1000	1.0000	0.0000	0.0000	0.713	0.7925	0.713
10	.	0.1000	1.0000	0.0000	0.0000	0.811	0.7892	0.811
11+	.	0.1000	1.0000	0.0000	0.0000	1.040	0.7892	1.040
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PLAIIIA
Date and time: 06OCT95:09:35

Table 2.5.13 Plaice in Division IIIa. Catch predictions.

Year: 1995					Year: 1996					Year: 1997	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.6397	53263	40178	12958	0.0000	0.0000	50912	37828	0	63180	50096
.	.	.	.	.	0.1000	0.0640	.	37828	1728	61282	48198
.	.	.	.	.	0.2000	0.1279	.	37828	3358	59495	46411
.	.	.	.	.	0.3000	0.1919	.	37828	4898	57812	44728
.	.	.	.	.	0.4000	0.2559	.	37828	6352	56226	43142
.	.	.	.	.	0.5000	0.3199	.	37828	7726	54731	41647
.	.	.	.	.	0.6000	0.3838	.	37828	9026	53321	40237
.	.	.	.	.	0.7000	0.4478	.	37828	10255	51991	38907
.	.	.	.	.	0.8000	0.5118	.	37828	11419	50735	37651
.	.	.	.	.	0.9000	0.5757	.	37828	12521	49549	36465
.	.	.	.	.	1.0000	0.6397	.	37828	13566	48428	35344
.	.	.	.	.	1.1000	0.7037	.	37828	14556	47368	34284
.	.	.	.	.	1.2000	0.7676	.	37828	15496	46365	33281
.	.	.	.	.	1.3000	0.8316	.	37828	16388	45416	32332
.	.	.	.	.	1.4000	0.8956	.	37828	17235	44517	31433
.	.	.	.	.	1.5000	0.9596	.	37828	18040	43665	30581
.	.	.	.	.	1.6000	1.0235	.	37828	18806	42857	29773
.	.	.	.	.	1.7000	1.0875	.	37828	19535	42091	29007
.	.	.	.	.	1.8000	1.1515	.	37828	20229	41363	28279
.	.	.	.	.	1.9000	1.2154	.	37828	20890	40672	27588
.	.	.	.	.	2.0000	1.2794	.	37828	21521	40015	26931
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PLAIIIA
Date and time : 06OCT95:09:35
Computation of ref. F: Simple mean, age 4 - 8
Basis for 1995 : F factors

Figure 2.5.1 Plaice in Division IIIa. Landings, recruitment, fishing mortality amd spawning stock biomass.

Fish Stock Summary
Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
4–10–1995

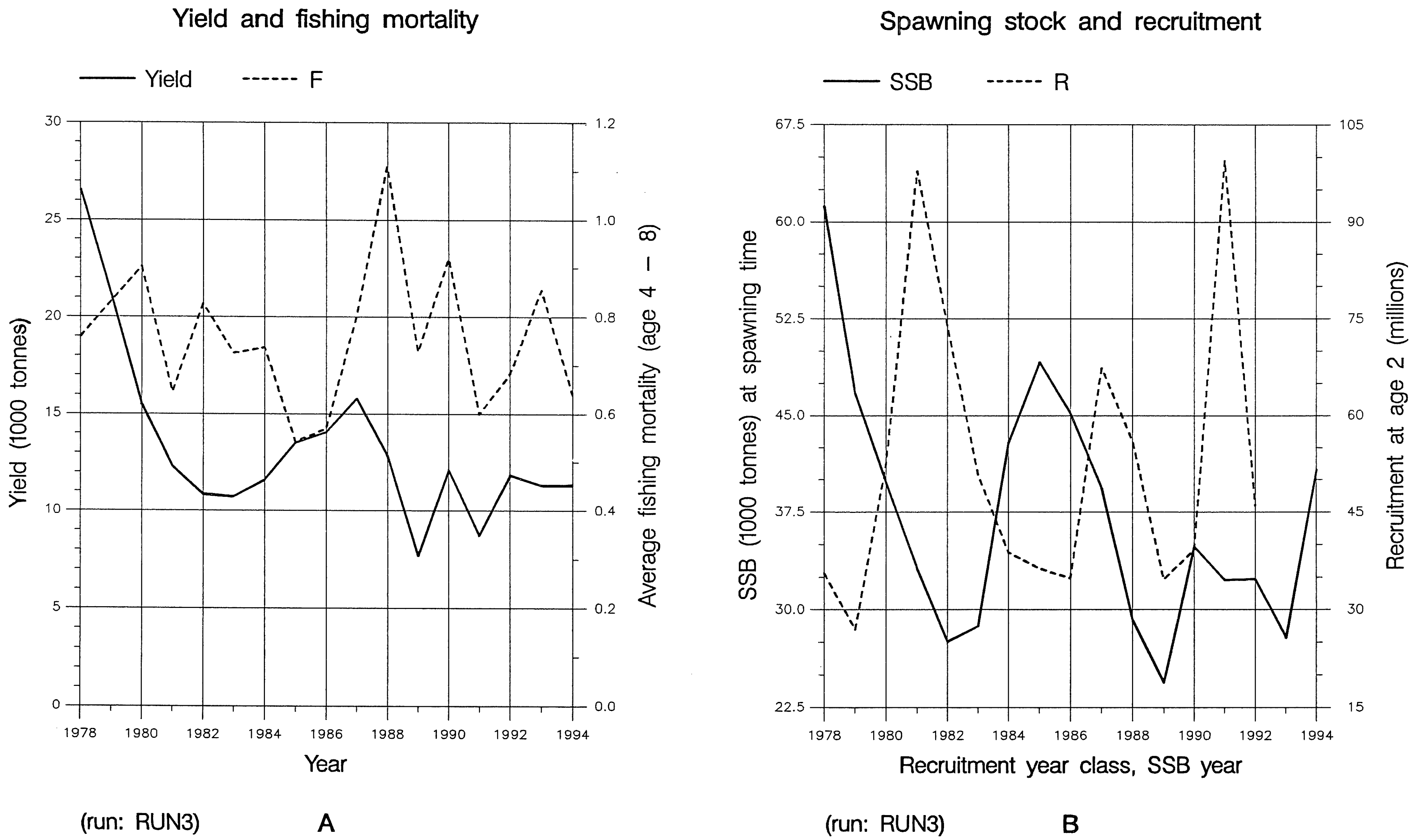
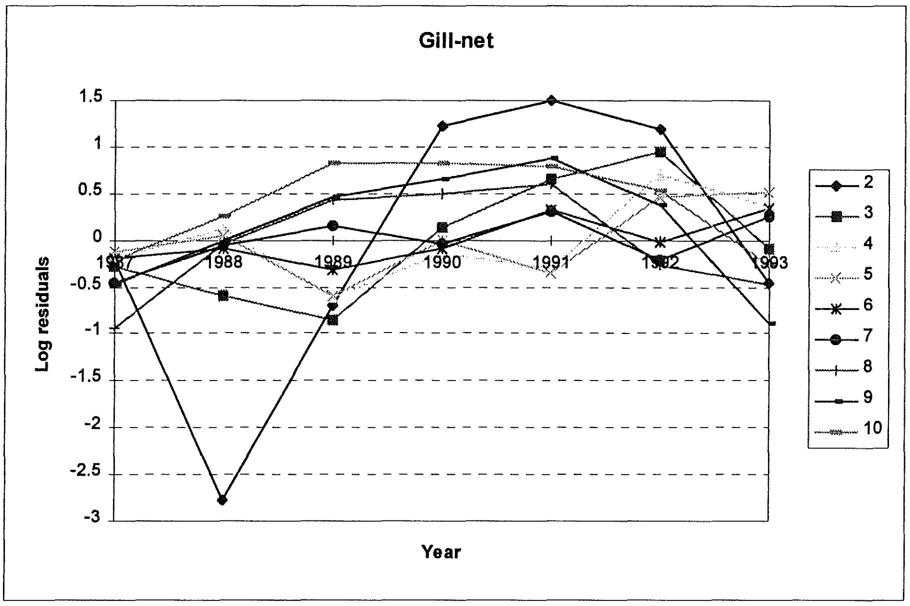
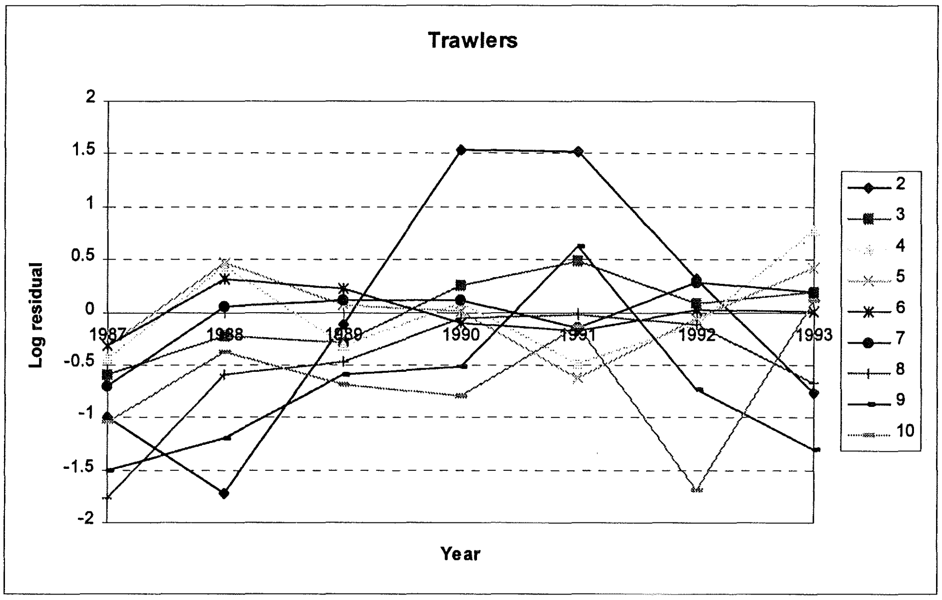


Figure 2.5.2 Plaice in Division IIIa. Log catchability. Residuals by timing fleets.





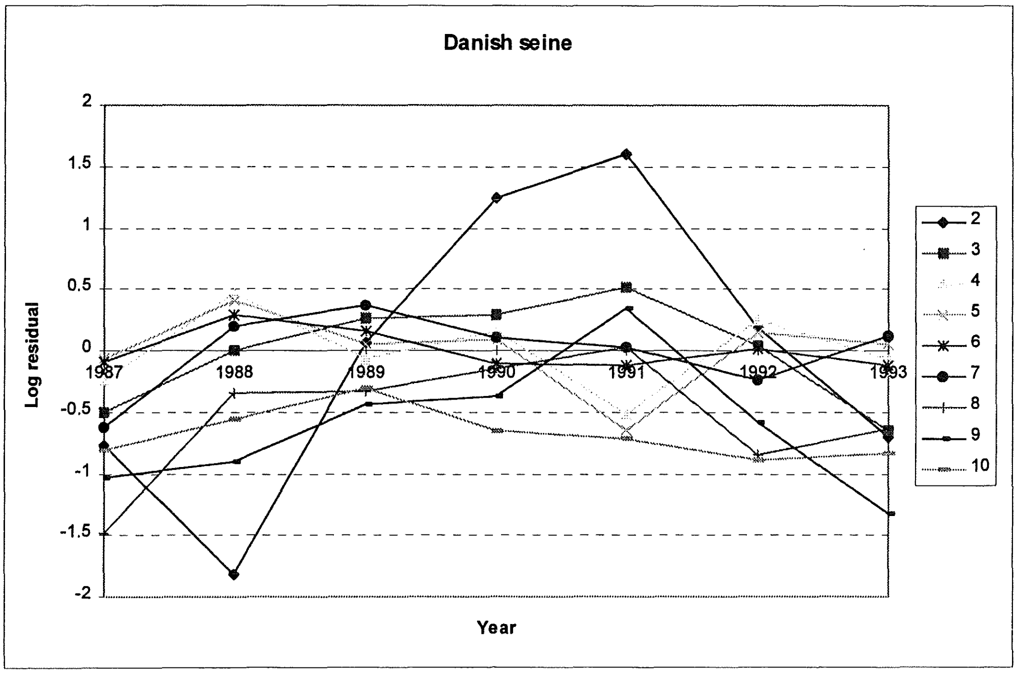


Figure 2.5.3 Plaice in Division IIIa. Retrospective analysis of fisheries mortality 1985-1994.

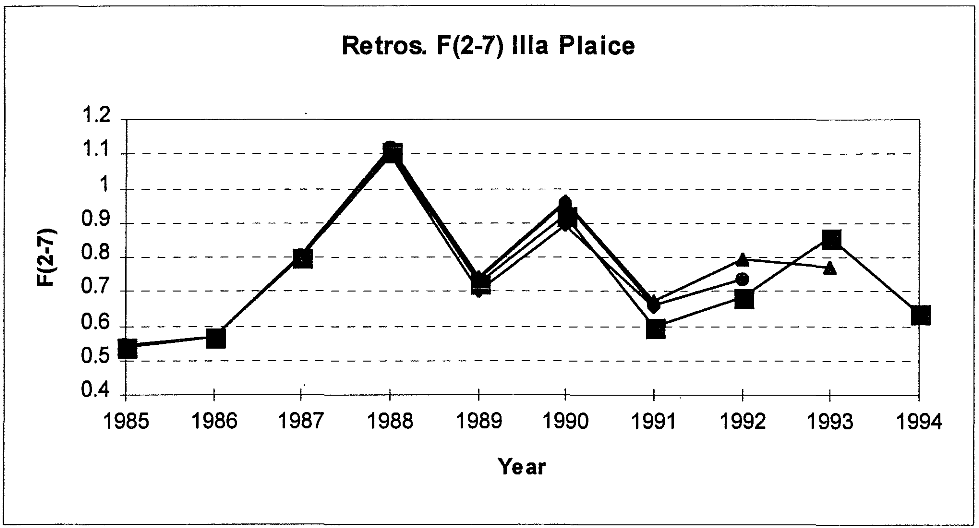


Figure 2.5.4 Plaice in Division IIIa. Long and short term predictions.

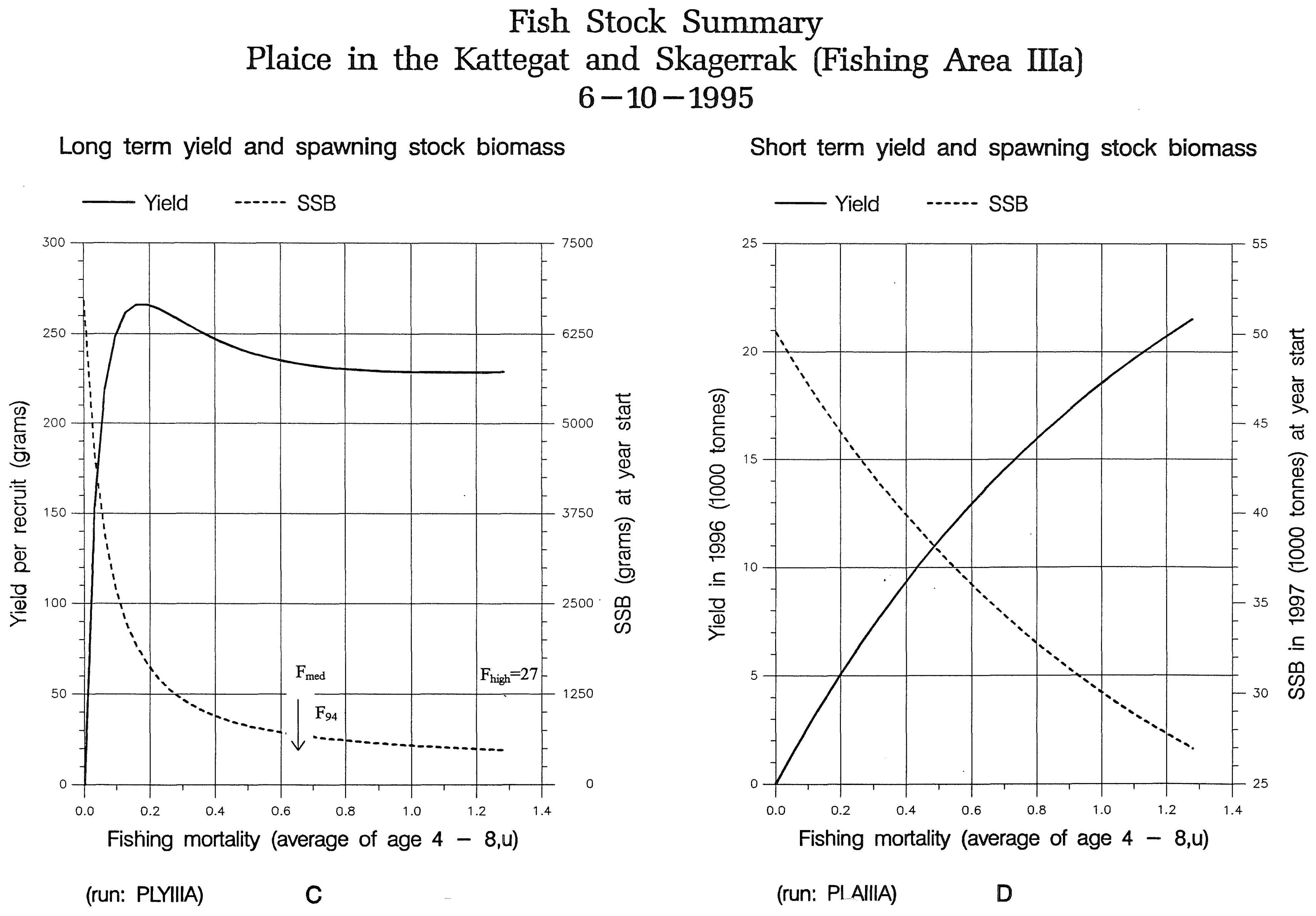
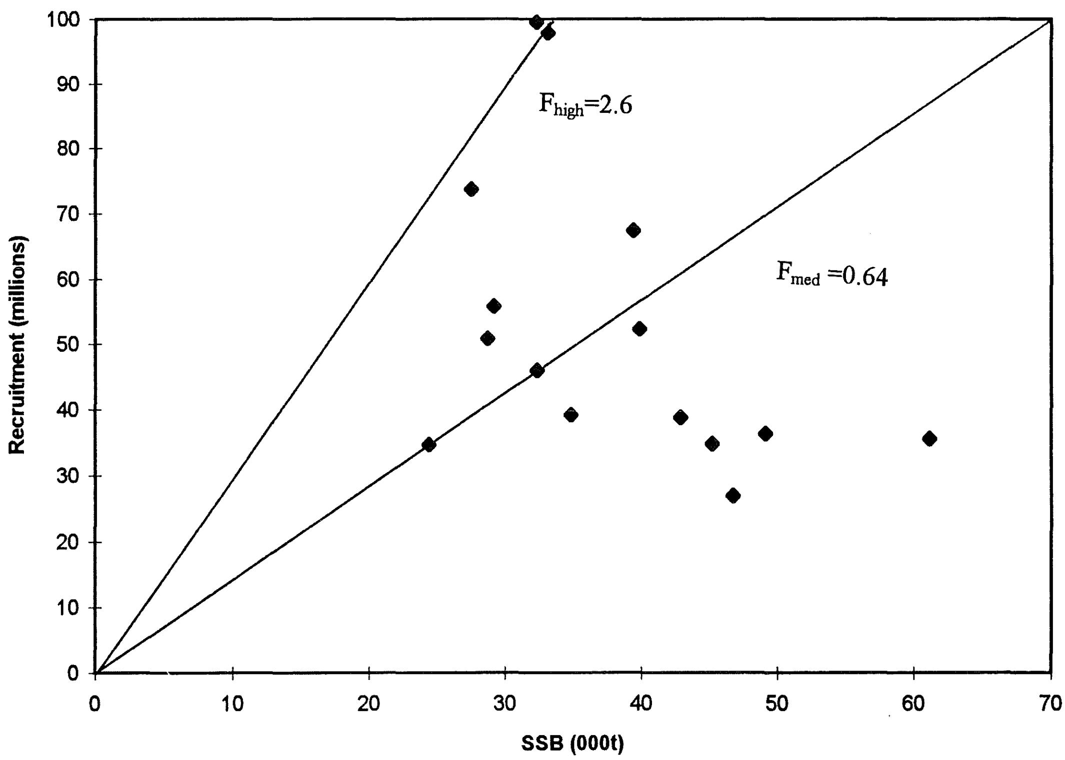


Figure 2.5.5 Plaice in the Skagerrak. Recruitment vs. spawning stock biomass.



2.6 Norway pout in Division IIIa

2.6.1 Catch trends

The nominal landings in 1994 amounted to 23,000 tons (Table 2.6.1.). However, as seen for previous years the Norway pout catches estimated by the Working Group is considerable below the nominal landings (Table 2.1.2). The estimated catch in 1994 are down to about a third of the long time average.

The fishery is carried out by Denmark.

2.6.2 Natural mortality, maturity, age compositions and mean weight at age

Catch at age information is provided by Denmark. Table 2.6.2 present the quarterly age compositions available since 1986. Age group 0 and 1 is seen to be dominating in the catches. Year-class size as judged by the age 1 group seems correlated with the concurrent year-class size in the North Sea.

Mean weight at age are presented in Table 2.6.3. The mean weight at age do no show systematic deviations from those obtained from the North Sea.

The sampling intensity is given in Table 2.6.4.

2.6.3 Catch, effort and research vessels data

No catch effort data available. No year-class indices have been worked up from the IBTS February surveys which have been carried out since 1981. The results of the quarterly IBTS surveys conducted since 1991 are not yet available at ICES.

2.6.4 Assessment

The data available does not allow an assessment to be carried out.

2.7 Sandeel in Division IIIa

2.7.1 Catch trends

The nominal sandeel catches are given in Table 2.7.1. The nominal catch in 1994 of 85,000 tons is significant above the catch of 54,000 tons estimated by the Working Group (Table 2.1.2).

Biological sampling by Denmark, available since 1992, indicate that the catches are a mixture of Greater Sandeel and Smooth Sandeel.

2.7.2 Natural mortality, maturity, age compositions and mean weight at age

No data available.

2.7.3 Catch, effort and research vessels data.

No data are available.

2.7.4 Assessment

The data available does not allow an assessment to be carried out.

Table 2.6.1 Norway pout. Annual landings (tonnes) in Division IIIa. (Data as officially reported to ICES).

Country	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993[1]	1994
Denmark	40,144	20,694	23,922	23,951	26,235	29,273	51,317	36,124	67,007	85,082	32,056	47,527	45,034	16,873	41,215	49,341	83,866	37,208	23,379[1]
Norway	50[2]	104	362	1,182	141	752	1,265	990	947	831	400	1,680	1,178	309	40	23	221[1]	-	5
Sweden	2,255	318	591[3]	32	39	60	60	52	+	-	+	-	-	+	+	3	5	-	-
Total	42,449	21,116	24,875	25,165	26,415	30,085	52,685	37,166	67,954	85,913	32,456	49,207	46,212	17,182	41,255	49,367	84,092	37,208	23,384

[1]Preliminary.
[2]Including by-catch.
[3]Includes North Sea.

Table 2.6.2 Norway Pout in Div. IIIa. Catch in numbers by quarter 1986-1994.

Year	Quarter	Age 0	Age 1	Age 2	Age 3	Age 4 +
1986	1	0.0	10.43	1.38	0.08	0.0
1986	2	0.0	229.65	8.33	0.0	0.0
1986	3	0.0	0.0	0.0	0.0	0.0
(1986	4	135.53	343.91	12.61	0.08	0.0)
(1987	1	0.0	0.0	0.0	0.0	0.0)
(1987	2	0.0	0.0	0.0	0.0	0.0)
1987	3	0.0	41.63	5.56	0.33	0.0
1987	4	5.70	12.74	2.98	0.0	0.0
1988	1	0.0	2.57	0.92	0.10	0.0
1988	2	0.0	13.11	2.82	0.0	0.0
(1988	3	0.0	0.0	0.0	0.0	0.0)
1988	4	196.19	0.0	0.0	0.0	0.0
1989	1	0.0	25.30	0.0	0.0	0.0
(1989	2	0.0	29.68	0.0	0.0	0.0)
1989	3	11.82	18.18	59.97	6.67	0.0
1989	4	268.52	21.69	2.93	0.0	0.0
1990	1	0.0	15.11	1.89	3.78	0.0
1990	2	0.56	523.27	30.65	2.79	0.0
(1990	3	0.0	0.0	0.0	0.0	0.0)
(1990	4	555.22	0.0	0.0	0.0	0.0)
1991	1	0.0	22.47	0.0	0.0	0.0
1991	2	0.0	216.65	6.70	0.0	0.0
1991	3	657.85	509.44	148.42	21.39	0.0
1991	4	878.77	17.99	1.8	0.90	0.0
1992	1	0.0	216.46	19.14	0.71	0.0
1992	2	0.0	525.28	62.94	0.0	0.0
1992	3	776.04	855.13	16.48	0.0	0.0
1992	4	483.55	142.63	13.43	0.0	0.0
1993	1	0.0	17.21	6.58	0.66	0.17
1993	2	0.0	59.36	0.84	0.0	0.0
1993	3	85.07	106.82	23.47	0.0	0.0
1993	4	252.87	16.60	2.72	0.0	0.0
1994	1	0.0	61.47	2.10	0.0	0.0
1994	2	0.0	0.31	0.06	0.0	0.0
1994	3	375.42	0.0	28.69	0.0	0.0
1994	4	426.64	0.0	0.0	0.0	0.0

(   ): Insufficient sampling

Table 2.6.3 Norway Pout in Div. IIIa. Weight at age in catch given by quarter 1986-1994.

Year	Quarter	Age 0	Age 1	Age 2	Age 3	Age 4 +
1986	1	0.0	8.4	24.1	46.3	0.0
1986	2	0.0	9.4	24.1	0.0	0.0
1986	3	0.0	0.0	0.0	0.0	0.0
(1986	4	5.2	30.6	45.8	0.0	0.0)
(1987	1	0.0	0.0	0.0	0.0	0.0)
(1987	2	0.0	0.0	0.0	0.0	0.0)
1987	3	0.0	28.9	50.5	56.4	0.0
1987	4	9.2	36.9	49.1	0.0	0.0
1988	1	0.0	9.6	29.8	50.0	0.0
1988	2	0.0	10.9	18.9	0.0	0.0
(1988	3	0.0	0.0	0.0	0.0	0.0)
1988	4	8.3	0.0	0.0	0.0	0.0
1989	1	0.0	10.3	0.0	0.0	0.0
(1989	2	0.0	10.3	0.0	0.0	0.0)
1989	3	6.1	22.7	26.0	31.2	0.0
1989	4	7.4	26.9	35.4	0.0	0.0
1990	1	0.0	13.5	20.0	30.5	0.0
1990	2	1.0	11.9	27.0	37.2	0.0
(1990	3	0.0	0.0	0.0	0.0	0.0)
(1990	4	8.1	0.0	0.0	0.0	0.0)
1991	1	0.0	8.5	0.0	0.0	0.0
1991	2	0.0	11.2	23.1	0.0	0.0
1991	3	6.3	30.5	43.4	49.2	0.0
1991	4	8.7	29.5	47.1	69.0	0.0
1992	1	0.0	10.4	32.5	58.0	0.0
1992	2	0.0	16.0	37.0	0.0	0.0
1992	3	3.5	23.0	47.0	0.0	0.0
1992	4	5.5	28.4	47.9	0.0	0.0
1993	1	0.0	7.8	27.0	45.5	50.0
1993	2	0.0	18.4	41.7	0.0	0.0
1993	3	3.6	26.1	45.3	0.0	0.0
1993	4	6.2	26.0	46.6	0.0	0.0
1994	1	0.0	8.5	22.6	-	-
1994	2	0.0	-[1]	-[1]	*	*
1994	3	3.0	*	35.0	*	*
1994	4	5.9	*	*	*	*

(   ): Insufficient sampling
*: No information
[1]Information available but strange values. Very small catch.

Table 2.6.4 Norway Pout in Div. IIIa. Landings in tonnes and number of samples by quarter and year.

Year		1. Quarter	2. Quarter	3. Quarter	4. Quarter	Total
1986	Tonnes	125	2,363	0	4,005	6,493
	No.samples	17	5	1	1	24
1987	Tonnes	281	35	1,502	669	2,487
	No.samples	0	0	6	3	9
1988	Tonnes	57	194	5,932	1,623	7,806
	No.samples	5	1	0	3	9
1989	Tonnes	260	305	2,207	2,682	5,454
	No.samples	1	0	4	3	8
1990	Tonnes	357	7,160	15,299	4,521	27,337
	No.samples	2	9	0	2	13
1991	Tonnes	191	2,572	27,199	8,306	38,268
	No.samples	2	6	49	28	85
1992	Tonnes	2,911	10,728	23,203	7,825	44,667
	No.samples	11	16	25	34	86
1993	Tonnes	350	1,129	4,160	2,133	7,772
	No.samples	20	8	37	22	87
1994	Tonnes	643	6	2,210	3,739	6,598
	No.samples	12	3	6	6	27

Table 2.7.1. Sandeels. Annual landings (tonnes) in Division IIIa. (Data as officially reported to ICES).

Country	1989	1990	1991	1992	1993[1]	1994
Denmark	17,178	16,109	25,094	52,563	51,224	84,783[1]
Faroe Islands	-	-	-	-	344	-[1]
Norway	40	99	-	49	-[1]	-[1]
Sweden	-	-	-	88	-	20
Total	17,218	16,208	25,094	52,700	51,568	84,803

[1]Preliminary.

3. NORTH SEA

3.1 Overview

Analytical assessments were performed on all four main roundfish stocks and the two principal flatfish stocks which are taken for human consumption. Only whiting are subject to a significant industrial by-catch. In addition assessments were made for two species which are targeted by the industrial fisheries: Norway pout and sandeel.

<u>**Human consumption fisheries**</u>

<u>Data</u>

The data available from scientific sources for the assessment of these stocks are relatively good. The level of biological sampling of most of the commercial landings has been maintained. Discard data are only available for haddock and whiting, but a historical series exists only for one country.

From the North Sea perspective there have been minor misreporting problems for haddock and cod between Division VIa and IVa which were due to quota restrictions in VIa.

Several series of research vessel survey indices are available for most species. This year, for the first time, data were partly available from the quarterly International Bottom Trawl Survey for quarters 2 and 4. For cod, haddock and whiting, inclusion of these data in the usual recruitment data files was investigated. Quarterly data were, however, only available for four years, and it was decided not to include the new indices in the final VPA runs.

<u>Effort</u>

Effort trends in the major demersal fleets in the North Sea are shown in Figure 3.1.1. A general upward trend can be seen in all beamtrawl fleets, in the Scottish light trawl fleet and the English gill netters. Most other effort series show a downward trend. Whether or not this is caused by poor economic results of the fishery is not clear.

<u>Stock impressions</u>

The roundfish stocks, particularly cod, haddock, and whiting are subjected to a high exploitation rate which removes approximately 60% of the biomass each year. This makes the fisheries on these stocks highly dependent on recruiting year classes and makes catch forecasting difficult.

The present situation for the stocks is as follows:

Landings of **cod** have decreased since 1981 and are now at pre-war low levels. Since the early 1980s, fishing mortality seems to have stabilised at a very high level, around 0.9. The SSB has for some years been stable at a level of approximately 60,000t, which is far below MBAL (150,000t). Short term forecasts are heavily influenced by the size of the 1993 year class, which is currently estimated to be strong, although this is uncertain at present. Medium term projections show a slight increase of landings and SSB at *status quo* F. For a reduction of F by 30%, significant increases in yield and SSB are predicted.

Although **haddock** have been more abundant in recent years due to a series of better than average year classes, the upturn of the stock has not been as strong as predicted and vessels have been unable to take their quotas. This means the fishery has been effectively unconstrained. The 1993 year class is poor, and is likely to diminish the rate of any recovery. All indications of the 1994 year class are that it is strong, and further recovery may occur in the future. The 1995 year class appears to be below average.

The assessment of **whiting** has always been of lower precision than the assessment for other stocks. Estimates of recruitment from surveys do not correlate well with the VPA. Total landings are gradually decreasing since 1976, and are on a record low level. Fishing mortalities have been highly variable with no clear trend. The human consumption landings component of F appears to have been stable since 1989. Recruitment in the 1980s is clearly at a lower level than in the 1970s.

The **saithe** stock is at a low level. Landings in 1994 were 97,000t, which was equal to the TAC. After a sharp increase of the fishing mortality in the period 1981-1986, F has decreased since then. SSB was at a historically low level of about 80,000t in 1990, but is slightly increasing.

Landings and fishing mortality of **sole** are at a record high level. Spawning stock biomass is well above MBAL (35,000t). Two recent year classes (1992-1993) are below average which will cause a considerable drop in SSB in 1995. However, at *status quo* fishing mortality, SSB will in the short term remain above MBAL.

Fishing mortality of **plaice** is at a record high level. Landings and spawning stock biomass have fallen since 1990. SSB is below MBAL (300,000t). The TAC for 1995 was set at a high level due to the high abundance of sole, and is not restrictive. At *status quo* levels of fishing mortality SSB is expected to decrease further. Due to a decrease in growth rate, the productivity of the stock is also expected to decrease.

The main demersal stocks harvested for human consumption purposes (cod, haddock, whiting, saithe, sole and plaice) are all intensively exploited. The recent fishing mortality rates for all stocks, except for saithe, are the highest in their respective historical series. In order to improve this situation, ACFM has, for a number of years, recommended to reduce the fishing effort in the directed roundfish fisheries significantly, except for saithe. A significant reduction, is understood to be, as a minimum, a reduction to 70% of the effort levels in the most recent years. However, the way in which this advice was implemented by the EU and Norway for the last few years, has been to set the TAC's at a level which would be achieved if *status quo* fishing mortality rate was reduced by 30%. This, however, has not led to a significant reduction in fishing mortality rate in any of the stocks concerned.

For North Sea plaice, ACFM recommended to reduce the fishing mortality by 20% in 1995 in order to allow the stock to return to safe level of the biological limits in the medium term. However, a high, non restrictive, TAC was set for plaice, due to the high sole stock. Fishing for plaice is therefore believed to be unrestricted in 1995.

Industrial fisheries

Definition of industrial fisheries

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

Data available

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

Trends in landings and effort

Trends in effort of the Danish and Norwegian fleets fishing for Norway pout and sandeel are shown in Figure 3.1.1. The effort of both fleets is gradually decreasing since 1989.

Stock impressions

The landings of **Norway pout** have been on a low level since 1985. In the period 1984-1988 fishing mortality has decreased and is since on a level of approximately 0.6. Although the SSB decreased from 1993 to 1994 this is expected to be reversed by the strong 1994 year class.

The yield of **sandeel** in 1994 was close to the mean value for the previous 10 years. Fishing mortality decreased since 1990. The spawning stock biomass has fluctuated around 1 million tonnes, due to large variations in recruitment. Problems with age reading in this species have in part been solved by a recent workshop.

By-catches of protected species

By catches of the major protected species, haddock, whiting and saithe, in the industrial fisheries are presented in Table 3.1.1 for the years 1974-1994. For the last two years quarterly data are presented. In 1994 the by-catch of haddock, whiting and saithe combined was 15,000 t which is the lowest on record and far below the long term average of 78,000 t. Detailed catches of the 'other species' mentioned in Table 3.1.1 are given in Table 3.1.2.

The distribution of industrial landings and the associated by-catches of a number of species for 1994 is shown in Table 3.1.3 for two areas, north and south of 57 degrees N. This Table is based on Danish and Norwegian estimates. In the northern area the 1994 figures show a similar pattern as in the 1993: the fishery for Norway pout is associated with by-catches of blue whiting and protected species, the sandeel fishery with a large by-catch of sprat and herring, and the sprat fishery with a large by-catch of herring and Norway pout and some blue whiting. In the southern area the sandeel fishery is associated with a large by-catch of sprat and comparatively small by-catches of herring and protected species, the sprat fishery with a large by-catch of herring and sandeel and some protected species.

Table 3.1.1 Species compositon in the industrial fisheries in the North Sea ('000 t). (Data provided by WG members)

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1974	525	314	-	736	62	48	130	42		1857
1975	428	641	-	560	42	41	86	38		1799
1976	488	622	12	435	36	48	150	67		1791
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1675
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1,039	63	146	162	28	2	36	1	59	1537
1990	591	71	115	140	22	3	50	8	40	1033
1991	843	110	131	155	28	5	38	1	38	1350
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1993 q1	26	16	23	36	1	2	3	0	6	114
1993 q2	430	5	5	28	6	4	4	0	6	487
1993 q3	88	72	51	59	4	3	7	1	7	293
1993 q4	33	61	23	51	5	1	6		8	189
Mean 1974-1993	690	214	72	303	55	16	52	10	44	1439
1994	769	281	40	172	11	5	10	-	19	1307
1994 q1	2	19	2	34	3	1	2	-	3	66
1994 q2	643	11	3	15	4	2	1	-	4	683
1994 q3	124	175	22	51	4	1	4	-	7	388
1994 q4	+	76	13	72	+	1	3	-	5	170

North Sea

Table 3.1.2 Sum of Danish and Norwegian by-catch by species (excluding those species accounted for in Table 3.1) and year in tonnes.

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gadus morhua	4175	544	710	1092	1404	2988	2948	570	1044	1052	876
Scomber scombrus	1278	4	534	2663	6414	8013	5212	7466	4631	4386	3576
Trachurus trachurus	133[3]	22789	16658	7391	18104	22723	14918	5704	6651	6169	4886
Trigla sp.	2168	0	888[2]	45342[2]	5394[2]	9391[2]	2598[2]	5622[2]	4209	1593	1139
Limanda limanda	149[3]	187	3209	4632	3781	7743	4706	5578	3986	4871	528
Argentina spp.	6977[3]	8714	5210	3033	1918	778	2801	3434	2024	2874	2209
Hippoglossoides platessoides	170[3]	59	718	1173	946	2160	1673	1024	1694	1428	529
Pleuronectes platessa	0	34	119	109	372	582	566	1305	218	128	143
Merluccius merluccius[3]	546	349	165	261	242	290	429	28	359	109	10
Trisopterus minutus	0	0	68[3]	0	5[2]	48[2]	121[2]	79[2]	111	36	0
Molva molva[3]	528	51	1	40	39	37	13	65	10	28	0
Glyptocephalus cynoglossus	241[3]	236[3]	132	341	44	255[3]	251[3]	1439[3]	195[3]	246	40
Gadiculus argenteus[3]	2690	1210	729	3043	2494	741	476	801	0	0	0
Others	29261	31715[1]	3853	3604	3670	3528	3154	4444	4553	4106	5141
Total	48316	65892	32994	72724	44827	59277	39866	37559	29685	27026	19077

[1]Danish cod and mackerel included.
[2]Only Danish catches.
[3]Norwegian catches. Danish catches included in "Others".

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Table 3.1.3 Distribution of landings and associated by-catches of selected species ('000 t) from industrial fisheries by Denmark and Norway by landing categories to the north and south of 57°N, respectively, in 1994.(Data provided by Working Group members.)

Area	Fishery (target species)	Species composition									Total
		Norway pout	Sandeel	Sprat	Herring	Haddock	Whiting	Saithe	Blue whiting	Other	
north	Norway pout	170	-	+	5	2	4	+	5	7	193
	Sandeel	-	442	16	4	1	1	-	-	1	465
	Sprat	10	+	63	14	+	2	+	4	2	95
	Other	2	+	+	+	+	+	-	2	2	6
	Sum	182	442	79	23	3	7	+	11	12	759
Area south	**Fishery (target species)**										
	Norway pout	-	-	-	-	-	-	-	-	-	-
	Sandeel	+	209	10	2	+	1	-	-	4	315
	Sprat	-	13	185	16	+	2	-	-	3	219
	Other	-	7	7	+	-	+	-	-	+	14
	Sum	-	318	202	18	+	3	-	-	7	548

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Figure 3.1.1 Fishing effort of demersal fleets in the North Sea

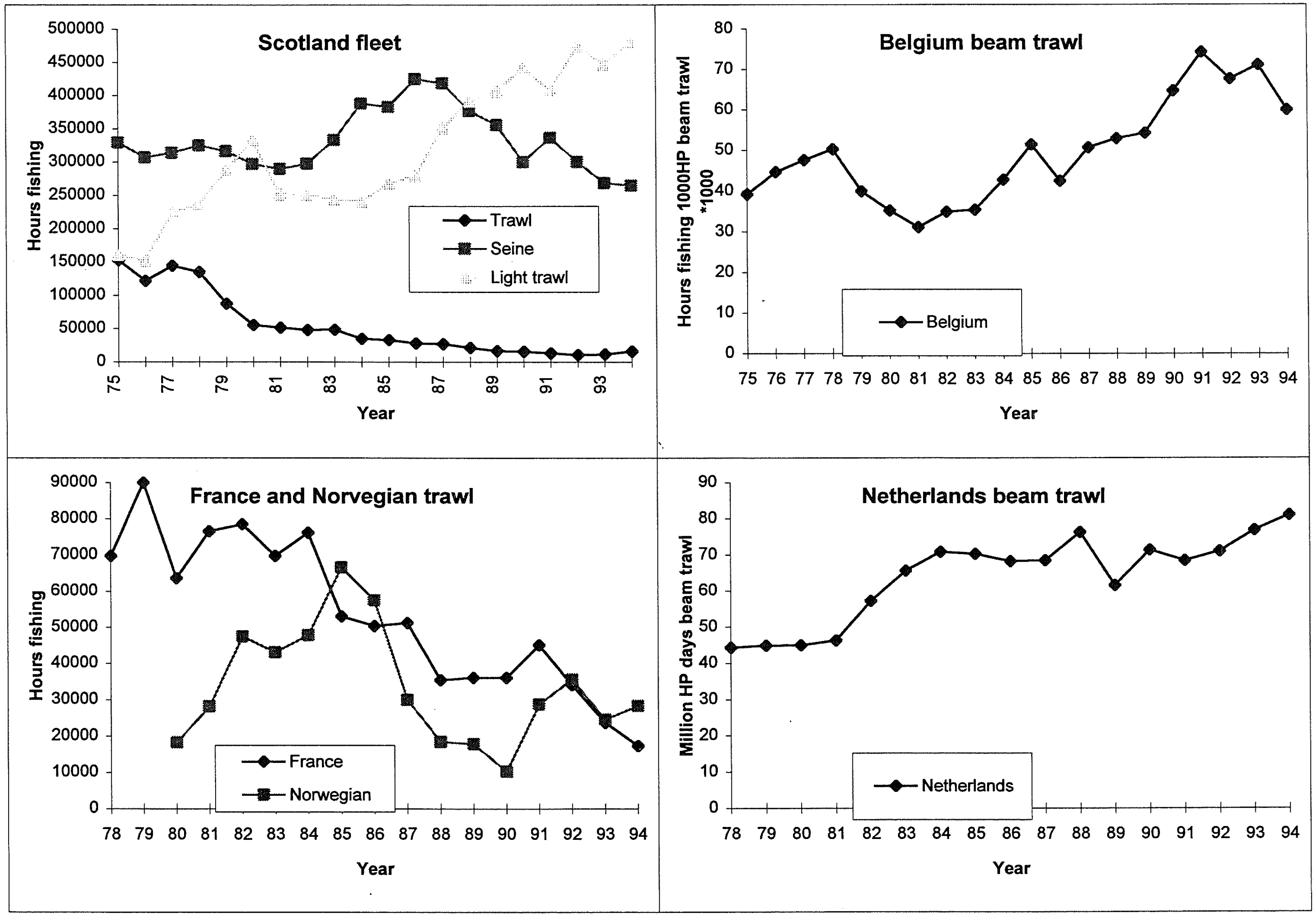

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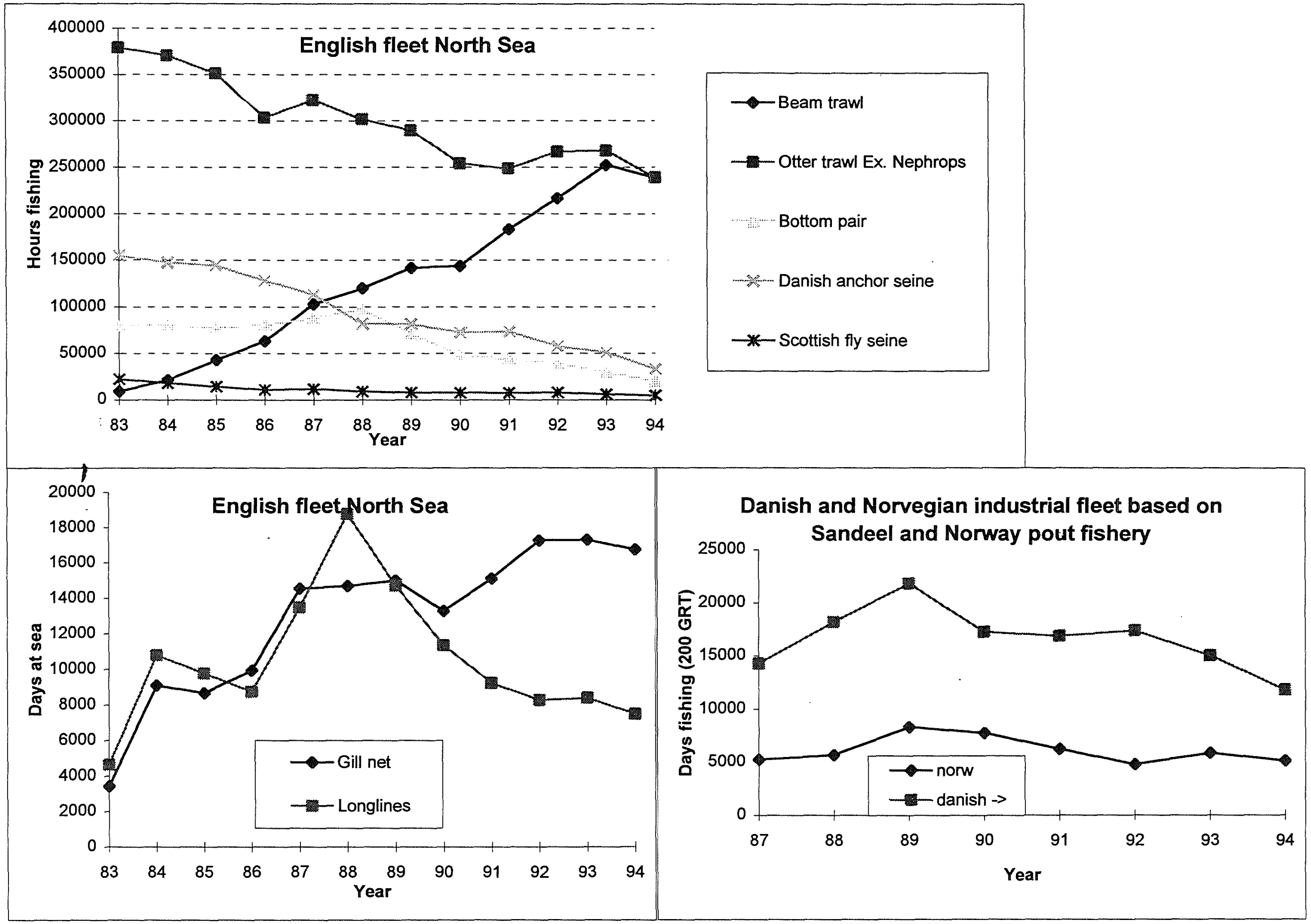
Figure 3.1.1 continued



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3.2 COD IN SUBAREA IV

3.2.1 Catch Trends

Landings data from human consumption fisheries for recent years as officially reported as well as those estimated by the Working Group are given in Table 3.2.1. A longer time series of landings from Working Group estimates is given in Table 3.2.2 and graphed in Figure 3.2.1. The Working Group estimate for landings in 1994, which includes 2,000 tonnes misreported, was 88,454 tonnes, a value which is close to the officially reported figure. The landings in 1994 were well short of the agreed TAC which was 102,000 tonnes. Landings increased in the 1960s and 1970s to reach a peak of 341,000 tonnes in 1972. After a further peak of 301,000 tonnes in 1981, landings have declined to levels below 100,000 tonnes, which are similar to the pre-war values. Estimates of total international discards are not available but it is known that discards of 1 year-old cod can be considerable for some fleets in some years. The industrial by-catch of cod, other than that which is sorted for human consumption, is small.

Cod are caught by virtually all the demersal gears in the North Sea, including trawls, seines, gill nets and lines. Most of these gears take a mixture of species, but some of the fixed gear fisheries are directed mainly towards cod. The fishing effort in some of the gill net fleets has increased in recent years.

3.2.2 Natural mortality, maturity, age compositions, and mean weight at age

Values for natural mortality and maturity are given in Table 3.2.3, and they are unchanged from those used last year. The sources of these data are multispecies VPA as performed by the Multispecies Working Group (natural mortality), and the International Young Fish Survey (maturity). The VPA catch input data are given in Table 3.2.4. They do not include discards or industrial fishery by-catches. Data for 1993 were updated with minor revisions, and data for 1994 were provided by Denmark, England, France, Germany, Norway, The Netherlands, and Scotland. Mean weight at age data for landings are given in Table 3.2.5. These values were also used as stock mean weights, and may not therefore be biologically meaningful. SOP corrections have not been applied.

3.2.3 Catch, Effort, and Research Vessel Data.

The fleets used for tuning the VPA are given in Table 3.2.6, and the tuning data are given in Table 3.2.7. The fleets included in the tuning file were those used in last year's assessment, but with the addition of the German survey. This had been excluded last year because there were no data for 1993. Data for two additional fleets were also available for the first time from the IBTS surveys; these were the Scottish survey for quarter 2 and the English survey for quarter 4. These data were included in preliminary tuning runs but were excluded from the final runs, as explained below.

3.2.4 Catch at Age Analysis

The method used to tune the VPA was XSA (v3.1), the same method as was used last year. All XSA settings were the same as those used last year, with tuning performed over a 20 year period, a shrinkage of 0.5 and a tricubic time taper. The recruiting age was set at age 1, and catchability was fixed for ages 6 and above. The age range used for VPA was 1 to 11 (the plus group).

Preliminary tuning included single fleet Laurec-Shepherd runs and an XSA run with all available fleet data included. The results (available in Working Group files) were inspected for evidence of marked trends in catchability and for high values for the residuals. For the FRATRB fleet there were high negative residuals for nearly all ages in 1994. The reason for this appears to be that the tuning file for this metier includes data for three fleets, and data for two of them were not available in 1994. The data for that year were therefore excluded. A similar effect was also apparent for the FRGGFS fleet in 1983 and 1984 but this was less serious due to the effect of the tricubic taper. There was some evidence for a trend in catchability for the ENGTRL and INTGFS fleets, probably due to some high residuals in the earlier years. However, trial runs with trimmed year ranges for these fleets did not have a marked influence on the estimated terminal populations. Trial runs in which poorly sampled older ages were trimmed also produced no marked effect. It was decided to exclude the data for the two new IBTS fleets, since there were only four years data and furthermore the indices were based on single fleets in each case. For some ages in the FRGGFS the residuals show a wide scatter, and a tuning run was made in which this fleet was excluded. This made little difference to the estimates of survivors, and it was decided not to exclude the fleet.

The diagnostics from the final XSA run are given in Table 3.2.8. and plots of the log catchability residuals for each fleet from this run are given in Figure 3.2.2. The plots show that some of the data are rather noisy for some ages, the most extreme example being for age 1 in the FRGGFS fleet. Some slight trends are apparent in the plots for some ages in some fleets, but it was decided that these were not so pronounced as to suggest that any of the fleets should be excluded. For the estimates of survivors at age 1, the highest weighting is received by the English and Dutch surveys. For ages two and three, the English survey also received high weight, but Scottish seine and light trawl, and English trawl for age 3, were also highly weighted. For older ages the commercial fleets receive the greatest weights, especially the Scottish fleets and English seiners.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and VPA are given in Tables 3.2.9. and 3.2.10. The results from a retrospective analysis using XSA with the options specified above are shown in Figure 3.2.3. There is reasonable agreement in the last four years but before that period there is a tendency for F values to be underestimated. However, there are no gross discrepancies and the results show reasonable agreement between successive estimates.

3.2.5 Recruitment Estimates

The research vessel indices which were used in program RCT3 to estimate recruitment at age 1 in 1995 and 1996 (1994 and 1995 year classes) and age 2 in 1995 (1993 year class) are given in Table 3.2.11. The same surveys were used as in last year's assessment but with the addition of the German groundfish survey, which had been resumed in 1994 after a break in 1993. Due to the short time series of 4 years the new IBTS indices were not included. The indices for the English groundfish surveys after 1991 have been corrected to take account of the change of gear to the GOV trawl in 1992. Plots of VPA number against survey indices are shown in Figure 3.2.4.

The results of the RCT3 analyses are given in Tables 3.2.12 (age 1) and 3.2.13 (age 2).

Last year the 1993 year class was estimated to be 406 millions at age 1 on the basis of survey data. In this year's assessment there is a discrepancy in the values estimated by XSA (293 millions) and by RCT3 (465 millions). A similar effect was noted last year in respect of the 1992 year class. As last year, it was decided to accept the RCT3 estimate, since (a) this includes the results from the 1995 surveys, and (b) as noted last year there is relatively little signal in the commercial CPUE indices for age 1 as compared to survey data. The value adopted for this year class was therefore 188 millions at age 2 in 1995 as estimated from RCT3, which compares with the XSA estimate of 124 millions.

The estimate for the 1994 year class at age 1 in 1995 is 256 millions, which compares with last year's preliminary estimate of 326 millions based on a single survey 0-group value and the shrunk VPA mean. The preliminary estimate for the 1995 year class at age 1 in 1996 is 162 millions, again based on a single survey 0-group value and strongly weighted towards the mean.

The 1996 year class was assumed to be 242 millions at age 1, the shrunk mean VPA value from RCT3.

3.2.6 Historical Stock Trends

Historical trends in mean fishing mortality, spawning stock biomass, and recruitment are shown in Table 3.2.14 and Figure 3.2.1. Mean fishing mortality increased over the period 1963 to 1982, but subsequently has stabilised at a value around 0.9. Spawning biomass decreased from a peak of 284,000 tonnes in 1968 to a historical low of 57,000 tonnes in 1993. Recruitment has fluctuated considerably over the period but the frequency of good year classes has become reduced in recent years. Only one year class (1993) spawned since 1985 has been above the long term geometric mean.

3.2.7 Biological Reference Points

The input data used for a stock-recruitment analysis are given in Table 3.2.14. and a scatter plot is shown in Figure 3.2.5, which also shows Fmed (0.81) and Fhigh (1.08). Fmax is estimated at 0.24 and F0.1 at 0.14. The minimum spawning stock level (MBAL) advised by ACFM is 150,000 tonnes, which is the lowest level of SSB from which the stock has been seen to recover. The probability that SSB could increase to this level in the next 10 years with the current F is extremely low (see Section 3.2.9).

A yield per recruit and spawning stock biomass per recruit plot is shown in Figure 3.2.6. Input data are given in Table 3.15. The fishing mortality is the mean for ages 2 to 8 for the period 1990-94. It can be seen that the current level of F is close to Fmed.

3.2.8 Short Term Forecast

The input data for catch predictions are given in Table 3.2.16, including estimated CVs and parameter labels for the sensitivity plots. The CVs used for the population numbers are the values associated with the RCT3 or XSA estimate as appropriate. For all other parameters, the values supplied by the program INSENS were used. The mean weight at age is the average for the period 1990-94. The fishing mortality is the mean for the same period calibrated to the mean F(2-8) in 1994. Population numbers in 1995 are XSA survivor estimates, except for ages 1 and 2 which are RCT3 estimates.

The results of a *status quo* landings prediction for 1995 and 1996 are given in Tables 3.2.17 and 3.2.18, and shown graphically in Figure 3.2.6. Landings of 169,000 tonnes are predicted for 1995, which is almost identical to the prediction of 170,000 tonnes from last year's assessment. The SQ landings for 1996 are predicted to be 165,000 tonnes. Spawning biomass is predicted to be 89,000 tonnes at the start of 1996, and 103,000 tonnes in 1997.

The agreed TAC for 1995 is 120,000 tonnes, and Table 3.2.19 and 3.2.20 indicate that this value implies a reduction in F of 37% relative to 1994, and an SSB of 119,000 tonnes at the start of 1996. The 1994 level of F in 1996 would produce landings of 204,000 tonnes, and SSB would reach 133,000 tonnes by the end of the year.

The results of sensitivity analyses of the *status quo* catch prediction are shown in Figures 3.2.7, 3.2.8, and 3.2.9. The input data are included in Table 3.2.16 (input to catch prediction).

Figure 3.2.7 shows the sensitivity of the predictions to the various input parameters used. It shows that the yield in 1995 is very dependent on the size of the 1993 year class (N2). This year class is also the most important in the prediction of yield for 1996, with the 1994 year class (N1) next in rank. The estimates for SSB are very sensitive to fishing mortality (HF95, HF96) in previous years. In addition, for 1996 the 1993 (N2) and 1991 (N4) year classes are important, and for 1997 the estimated SSB is again sensitive to the abundance of the 1993 year class (N2).

Figure 3.2.8 shows the proportion of the total variance of the estimated yields and spawning biomasses contributed by the input parameters. For yield in 1995, most of the variance is contributed by the estimates of relative fishing effort in 1995 (HF95), the 1993 year class (N2), and the selectivity for age 2 (sH2). For yield in 1996, the relative effort in 1995 (HF95) and 1996 (HF96) is important, together with the 1993 (N2) and 1994 year classes (N1). The variances of the SSB estimates have important contributions from relative fishing effort (HF) and from the selectivity at ages 2 and 3 (sH2, sH3).

Figure 3.2.9 shows probability profiles for yields and biomasses in 1995 and 1996. These show for example that there is virtually no possibility that the spawning biomass will reach a level of 150,000 tonnes in 1996 or in 1997.

3.2.9 Medium term projections.

The method used for these projections is explained in Section 1.3. The stock-recruitment relationship assumed was a Shepherd curve with a moving average term. The projections were run for *status quo* F and for a 30% reduction in F, and the results are shown in Figures 3.2.10 and 3.2.11. The line in the stock-recruitment plots is the trajectory of recruitment over time. For *status quo* F, both yield and spawning biomass are likely to increase slightly in the medium term. For a reduction in F of 30%, significant increases in yield and spawning biomass are predicted. There is a high probability that SSB will reach the MBAL level quite quickly. It should be noted that these results are dependent on the assumption used for the stock-recruitment curve.

3.2.10 Long Term Considerations

The state of this stock continues to give rise to concern. Landings and spawning biomass are at a relatively low level as compared to the recent past, and although fishing mortality has stabilised, it remains at a high level. The VPA data extend back only to 1963 but some indications of stock parameters in earlier years can be inferred from data on effort and landings (Daan *et. al.*, 1994). The recent levels of spawning biomass appear to be the lowest recorded in this century. However, it appears that the pre-war levels of spawning biomass and recruitment were similar to those now recorded. The fishing mortality appears to be significantly higher than that estimated for the pre-war period. At *status quo* fishing mortality, which is close to Fmed, the spawning biomass is predicted to increase slightly, both in the short term and in the medium term, although it is unlikely to reach the MBAL value of 150,000 tonnes. If fishing effort is reduced by 30% there is a high probability that SSB will reach MBAL quite rapidly.

3.2.11 Comments on Assessment

Quality control data are given in Table 3.2.21. The estimates for mean fishing mortality and spawning biomass are reasonably consistent between successive assessments. However, the estimates for recruitment show a marked tendency to reduce over time. This is mainly due to the switch from estimates derived from survey indices in RCT3 to those estimated from the tuned VPA which also includes the commercial CPUE data. A particular problem is the size of the 1993 year class, estimated by RCT3 to be 465 millions at age 1, and by XSA to be 293 millions. A similar problem with the size of the recruiting year class (1992) in the last data year (1993) was encountered at last year's meeting. Then it was decided to use the RCT3 estimate in preference to the XSA value, which was lower. This year's XSA estimate for the 1992 year class falls between the two previous estimates, but with the 1994 XSA estimate being closer. There is therefore a possibility that the RCT3 value adopted for the 1993 year class also could be an over-estimate relative to subsequent XSA estimates. If the XSA tuned value for the 1993 year class is adopted, the predicted *status quo* landings for 1995 are 137,000 tonnes and 140,000 tonnes for 1996. This would be a significant change from last year's prediction.

3.2.12 Evaluation of the usefulness of quarterly International Bottom Trawl Surveys in the assessment.

No final indices for the quarterly IBTS were available to the Working Group. In order to investigate the usefulness of the results of these surveys, preliminary data were used from the Scottish contribution to the surveys in quarter 2, and the English contribution to the quarter 4 surveys.

The quarter 2 and 4 indices were added to the fleet data used in the Extended Survivors Analysis, and in the RCT3 analysis. Table 3.2.22 gives the survivors at ages 1 to 4 in 1995 for the final XSA run in which the quarterly IBTS data are excluded, and also the survivors estimated from an XSA run that included these surveys.

The survivor estimates from the quarter 4 IBTS get a high weighting for age groups 2 to 4, whereas the quarter 2 IBTS only results in a high weighting of age group 4.

Figure 3.2.12 shows the relation between the survey indices and the number in the VPA (final run), both on a log-log and an arithmetic scale.

Considering the very short time series for the quarterly surveys, it is rather premature to draw any conclusions about the possible usefulness of these surveys in providing reliable recruitment indices.

Table 3.2.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1983-1994, as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	5,804	4,815	6,604	6,693	5,508	3,398	2,934	2,331	3,356	3,374	2,648
Denmark[2]	46,751	42,547	32,892	36,948	34,905	25,782	21,601	18,997	18,479	19,547	19,196[1]
Faroe Islands	-	71	15	57	46	35	96	23	109	46	80[1]
France	8,129	4,834	8,402	8,199	8,323	2,578[1,3]	1,641[1,3]	975[1,3]	2,146[1]	2,162[1,3]	1,830[1,4]
Germany	13,453	7,675	7,667	8,230	7,707	11,430	11,725	7,278	8,446	6,808	5,974
Netherlands	25,460	30,844	25,082	21,347	16,968[4]	12,028	8,445[1]	6,830[1]	11,133	10,220	6,512
Norway[2]	7,005	5,766	4,864	5,000	3,585	4,813	5,168	5,425	10,053[1]	8,760[1]	8,268[1]
Poland	7	-	10	13	19	24	53	15	-	-	-
Sweden	575	748	839	688	367	501	620	784	823	646	630
UK (Engl.& Wales)	35,605	29,692	25,361	29,960	23,496	18,250	15,596	14,481	14,836	14,894	13,942
UK (Isle of Man)	-	-	-	-	-	1	-	-	15	-	-
UK (N. Ireland)	-	-	-	-	-	124	26	70	72	47	54
UK (Scotland)	54,359	60,931	45,748	49,671	41,382	31,480	31,120	28,748	28,204	28,191	28,841
Russia	-	-								-	-
Total	197,148	187,923	157,484	166,806	142,306	110,444	99,025	85,957	97,672	94,687	87,975
Unallocated landings	7,723	5,043	5,745	8,671	7,815	5,180	5,726	2,554	332	10,009	479
Landings as used by Working Group	204,871	192,966	163,229	175,477	150,121	115,624	104,751	88,511	97,340	104,565	88,454

[1]Preliminary.
[2]Figures do not include cod caught as industrial by-catch, and not sorted for human consumption.
[3]Includes Division IIa (EC).
[4]Includes VIIe.

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Details of Program run, 19:25, 3/10/1995

Species : COD, Cod
Area : IV , North Sea
Age Range : 1 - 11+
Year Range : 1963 - 1994

Catch component Ref. F age range

1, H.cons 2 - 8

1

TABLE 3.2.2; Cod, North Sea
Annual weight and numbers caught, 1963 to 1994.

Year	Wt.('000 t)	Nos.(millions)
1963	108	63
1964	116	57
1965	173	99
1966	212	124
1967	242	135
1968	277	153
1969	194	80
1970	219	128
1971	315	232
1972	341	254
1973	228	132
1974	202	107
1975	185	109
1976	209	131
1977	182	140
1978	263	218
1979	249	173
1980	265	204
1981	301	244
1982	273	198
1983	234	184
1984	205	162
1985	193	150
1986	163	143
1987	175	148
1988	150	109
1989	116	76
1990	105	71
1991	89	53
1992	97	64
1993	105	65
1994	88	53

1

TABLE 3.2.3; Cod, North Sea
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.800	.010
2	.350	.050
3	.250	. 230
4	.200	. 620
5	.200	. 860
6	.200	1.000
7	.200	1.000
8	.200	1.000
9	.200	1.000
10	.200	1.000
11+	.200	1.000

1

TABLE 3.2.4; Cod, North Sea
International catch at age ('000), Total , 1963 to 1994.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	3326	4799	16458	19080	11186	5956	2865	53007	44637	4044
2	4923	22763	50636	63713	72833	83300	23136	33435	152155	188099
3	7104	20791	17837	29463	33405	42689	31342	18669	16777	47822
4	3538	4277	9461	6331	11133	12409	13683	13203	6787	5646
5	682	1872	2378	3484	3353	5925	4560	6236	7019	2787
6	1165	1711	959	1270	2000	1421	2827	1747	2663	3131
7	84	561	640	476	880	873	592	937	884	1642
8	464	110	293	366	357	305	418	210	445	599
9	14	88	52	123	139	149	147	184	222	378
10	6	13	74	58	42	109	48	97	77	111
11+	0	4	8	83	16	23	75	39	90	17

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	25720	15737	30891	5456	63760	26066	35074	61426	20309	67025
2	32923	57410	45769	96518	43641	164497	88778	98320	181522	61935
3	54846	11305	17838	17397	23837	13688	41508	30425	28738	55457
4	13764	15332	4426	6189	4309	8741	3448	10540	7957	7606
5	2154	4445	7010	1623	2114	2884	3207	1632	3894	3300
6	1098	924	1893	2820	770	964	692	1194	751	1934
7	1028	429	409	854	1043	375	374	420	560	364
8	478	380	179	123	342	381	133	195	135	226
9	81	318	211	63	239	144	148	73	65	76
10	57	78	87	60	24	34	40	55	36	26
11+	154	178	57	39	87	42	16	25	20	16

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	24397	65103	8127	86222	21932	18091	21989	10663	12985	23957
2	126068	59931	115145	19674	07796	49354	28679	45775	20287	26734
3	18125	28651	16236	29392	7357	35879	14816	8105	14676	6906
4	10487	3565	7072	3862	7971	2425	8266	3559	2366	4425
5	2573	3196	1176	2655	1388	2288	838	1890	1168	808
6	1196	963	1136	529	980	561	903	242	934	425
7	573	424	334	503	213	274	223	232	187	276
8	148	238	166	151	192	58	126	34	119	46
9	74	58	75	61	48	52	23	42	24	35
10	23	44	14	39	31	11	24	8	3	15
11+	20	20	23	20	11	16	10	3	8	8

Age	1993	1994
1	4114	11975
2	47188	19648
3	8881	17312
4	2455	2556
5	1362	744
6	353	468
7	183	124
8	92	51
9	15	28
10	8	6
11+	12	13

1

TABLE 3.2.5; Cod, North Sea

International mean weight at age (kg), Total catch, 1963 to 1994.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	.523	.505	.569	.579	.587	.676	.609	.586	.549	.591
2	.994	.875	.883	.998	1.037	1.016	.979	.926	.902	.841
3	2.572	2.399	2.162	2.433	2.386	2.323	2.286	2.035	2.124	2.134
4	4.288	4.624	4.363	4.145	3.182	4.545	4.191	3.953	4.105	4.057
5	6.287	6.578	6.813	7.023	6.766	6.304	6.297	6.069	6.279	6.009
6	8.714	8.729	8.963	9.585	9.574	8.290	8.271	7.860	8.328	8.255
7	11.308	10.872	10.742	11.728	11.981	9.917	9.697	9.663	10.058	9.803
8	10.959	11.045	11.049	11.954	12.464	11.705	11.405	10.066	10.758	10.268
9	13.210	12.658	12.373	14.048	13.497	12.630	12.800	11.685	12.247	11.919
10	12.755	12.537	13.186	14.725	14.175	14.566	13.751	12.472	12.457	12.565
11+	.000	7.090	14.308	15.556	19.014	14.830	14.867	14.215	14.683	14.078

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.547	.591	.580	.550	.542	.535	.543	.510	.552	.581
2	.909	1.028	.896	.989	1.019	.896	.910	.983	.729	.952
3	1.971	2.236	2.329	2.446	2.183	1.993	2.385	1.960	2.018	1.816
4	3.951	4.152	4.272	4.514	4.635	4.217	4.495	4.407	4.367	4.434
5	5.683	6.178	6.449	6.507	6.744	6.648	6.601	6.351	6.685	6.719
6	7.598	8.395	8.710	8.577	8.849	8.971	8.440	9.033	8.593	8.753
7	9.326	9.919	10.244	10.032	10.043	10.051	10.819	9.748	9.607	10.476
8	10.183	10.727	10.938	11.273	11.010	11.130	11.488	11.669	10.984	12.131
9	11.464	12.240	12.451	12.847	11.747	12.370	12.967	12.688	12.686	12.980
10	12.748	12.628	13.156	13.910	13.135	12.782	14.049	13.984	13.975	12.555
11+	13.767	14.008	14.617	14.342	14.259	14.141	15.202	15.189	16.052	14.676

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	.639	.596	.581	.564	.606	.618	.676	.748	.675	.692
2	.926	1.009	.918	.911	.937	1.034	1.065	.959	1.066	1.128
3	1.871	2.178	2.125	1.808	1.944	2.070	1.849	2.183	2.039	2.600
4	4.035	4.139	4.220	3.945	3.627	3.280	3.660	3.790	4.310	4.299
5	6.835	6.362	6.439	6.367	5.985	6.011	5.350	6.133	6.411	6.622
6	8.705	8.617	8.436	8.081	8.190	7.910	7.972	8.307	8.353	8.622
7	10.105	10.482	10.370	9.877	9.873	9.684	9.739	10.506	10.010	10.312
8	12.091	11.509	11.943	11.640	11.330	11.566	11.341	10.638	11.086	10.604
9	12.852	13.796	13.000	12.574	11.981	13.381	13.035	12.500	13.961	11.801
10	12.448	13.631	13.144	13.438	15.729	14.345	14.115	15.094	12.817	14.173
11+	14.234	13.678	14.288	12.987	15.735	15.709	14.349	14.585	13.715	15.579

Age	1993	1994
1	.681	.647
2	1.034	1.015
3	2.601	2.133
4	4.877	4.572
5	6.749	7.424
6	8.309	8.593
7	9.750	9.655
8	10.756	10.417
9	12.480	12.306
10	13.629	14.982
11+	14.516	12.512

Table 3.2.6. Tuning fleets

Fleet		First year	Last year	First age	Last age
SCOTRL	Scottish trawl	1975	1994	1	8
SCOSEI	Scottish seine	1975	1994	1	10
SCOLTR	Scottish light trawl	1975	1994	1	10
ENGTRL	English trawl	1975	1994	1	9
ENGSEI	English seine	1975	1994	1	8
FRATRB	French trawl	1976	1993	1	9
SCOGFS	Scottish groundfish survey	1982	1994	1	6
ENGGFS	English groundfish survey	1977	1994	1	5
NETGFS	Netherlands groundfish survey	1980	1994	1	2
INTGFS	International groundfish survey	1974	1994	1	6
FRGGFS	German groundfish survey	1983	1994	1	7

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Table 3.2.7 TUNING DATA NORTH SEA COD : 1963-1994 : 'FINAL' 3/10/95

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SCOTRL

1975 1994

1 1 .000 1.000

1 8

152977.000	366.513	1667.583	450.049	276.712	284.022	39.680	9.398	16.707
121841.000	131.192	1323.106	688.503	154.583	86.444	88.478	11.187	4.068
144348.000	440.259	603.784	880.519	238.998	73.377	32.495	32.495	6.289
135220.000	325.501	1525.784	306.228	194.872	68.526	17.132	12.849	7.495
87467.000	227.224	963.598	471.280	77.845	49.442	24.195	12.624	4.208
55475.000	162.000	894.000	399.000	134.000	21.000	21.000	8.000	7.000
51553.000	103.000	996.000	416.000	122.000	55.000	15.000	6.000	2.000
47889.000	570.000	334.000	425.000	80.000	19.000	7.000	3.000	1.000
48339.000	184.000	1473.000	215.000	116.000	24.000	10.000	2.000	.000
34574.000	338.000	826.000	370.000	35.000	18.000	8.000	1.000	1.000
33103.000	90.000	857.000	215.000	87.000	10.000	5.000	3.000	1.000
27839.000	265.000	201.000	270.000	21.000	11.000	1.000	1.000	.000
27208.000	290.000	646.000	41.000	42.000	9.000	2.000	.000	1.000
21559.000	27.000	343.000	158.000	8.000	8.000	4.000	1.000	1.000
16657.000	62.552	31.654	144.553	44.025	3.199	2.402	1.284	.201
14325.000	13.805	292.107	16.757	20.051	4.564	1.083	.895	.201
13495.000	44.018	92.605	101.429	7.543	6.828	1.676	.471	.000
10887.000	50.928	97.323	29.464	32.442	1.124	1.180	.117	.029
11657.000	4.513	119.250	29.888	4.089	6.053	.607	.053	.001
15671.000	54.450	40.468	123.945	9.384	1.699	1.643	.516	.370

SCOSEI

1975 1994

1 1 .000 1.000

1 11

329432.000	2316.706	11039.990	2269.608	707.741	599.543	100.560	11.456	6.365	16.548	5.092	.000
307165.000	690.154	18306.430	3715.522	475.525	230.051	145.228	47.553	12.852	5.141	11.567	.000
313913.000	3265.836	5140.535	3655.306	850.404	210.814	60.743	41.686	28.585	7.146	2.382	.000
325246.000	2068.410	17863.100	1682.404	1032.991	245.199	58.265	27.919	25.491	9.711	3.642	2.428
316419.000	2845.023	9048.144	3673.835	431.884	389.034	75.552	49.616	21.425	13.532	4.511	.000
297227.000	1228.000	6850.000	2692.000	953.000	166.000	103.000	38.000	17.000	10.000	5.000	1.000
289672.000	1036.000	16139.000	2852.000	846.000	248.000	22.000	13.000	15.000	4.000	.000	.000
297730.000	4866.000	5731.000	7201.000	983.000	348.000	181.000	30.000	25.000	14.000	1.000	2.000
333168.000	1570.000	15575.000	2121.000	1508.000	266.000	115.000	46.000	22.000	18.000	3.000	5.000
388085.000	5407.000	11123.000	4228.000	507.000	426.000	121.000	52.000	29.000	7.000	8.000	4.000
382910.000	603.000	20362.000	2770.000	926.000	141.000	119.000	29.000	27.000	11.000	4.000	4.000
425017.000	5828.000	2853.000	7374.000	886.000	307.000	46.000	41.000	15.000	8.000	3.000	3.000
418536.000	1489.000	14713.000	744.000	1557.000	310.000	204.000	27.000	39.000	17.000	5.000	2.000
377132.000	843.000	7092.000	4632.000	202.000	472.000	132.000	56.000	16.000	10.000	3.000	3.000
355735.000	1794.375	3724.773	3381.039	1163.871	97.129	197.193	47.576	19.923	2.548	8.251	2.785
270869.000	338.808	11282.500	979.909	600.105	260.588	34.679	45.046	10.307	3.306	1.602	.089
336675.000	1683.715	4677.835	2942.886	237.871	171.403	111.523	32.503	24.863	7.482	.562	.385
300217.000	1033.127	4028.890	921.556	604.523	95.735	57.940	31.101	8.656	8.230	3.163	.975
268413.000	256.256	5485.173	766.073	206.070	140.437	26.039	19.304	9.039	2.315	.795	.536
264738.000	1167.831	3116.481	2367.866	299.934	60.281	37.555	13.225	5.055	2.257	.869	.535

SCOLTR

1975 1994

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161009.000	1089.310	1759.828	875.963	135.458	127.557	6.773	1.129	2.258	1.129	.000	.000
152419.000	309.756	3856.045	488.778	118.956	44.756	45.933	11.778	1.178	1.178	.000	.000
224824.000	2311.478	2019.749	865.128	131.893	83.830	26.826	14.531	8.942	2.235	1.118	.000
236929.000	2738.441	6530.501	814.492	327.739	61.906	33.988	8.497	9.711	6.069	.000	1.214
207494.000	2370.702	7023.190	2172.443	213.880	73.296	18.024	3.605	4.806	2.403	.000	.000
333197.000	2098.000	6076.000	2383.000	623.000	81.000	18.000	5.000	4.000	1.000	.000	.000
251504.000	819.000	6207.000	1748.000	348.000	97.000	13.000	7.000	.000	.000	.000	1.000
250870.000	5260.000	3288.000	2574.000	422.000	123.000	44.000	9.000	7.000	4.000	6.000	.000
244349.000	1474.000	7021.000	1138.000	513.000	124.000	35.000	16.000	6.000	3.000	1.000	1.000
240725.000	3020.000	3352.000	1712.000	200.000	95.000	40.000	11.000	8.000	3.000	.000	.000
268136.000	471.000	6514.000	946.000	321.000	43.000	23.000	4.000	3.000	1.000	1.000	.000
279767.000	4372.000	1232.000	1951.000	265.000	101.000	13.000	9.000	5.000	2.000	1.000	.000
351131.000	2210.000	6119.000	573.000	506.000	49.000	34.000	11.000	6.000	1.000	1.000	.000
391988.000	402.000	3291.000	1907.000	133.000	148.000	33.000	14.000	2.000	1.000	.000	1.000
405883.000	1637.965	1254.487	1659.275	588.684	50.579	47.073	13.885	3.519	.930	.267	1.091
398153.000	289.110	5073.073	462.881	403.779	158.676	22.756	10.009	3.281	.883	.113	.014
408056.000	1791.573	1873.642	2090.660	135.800	92.660	47.319	8.066	8.344	1.186	.028	.000
473955.000	1370.129	2687.812	731.170	632.218	43.088	35.552	11.645	2.007	1.975	.215	.120
447064.000	244.623	4774.196	1232.046	160.045	78.198	9.648	5.037	3.703	.406	.206	.205
480400.000	713.296	1899.026	2333.818	365.744	46.693	41.817	5.716	2.315	.296	.221	.143

ENGTRL
1975 1994
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469958.000	1866.000	2623.000	1156.000	303.000	738.000	267.000	44.000	42.000	31.000
493436.000	480.000	6058.000	1508.000	727.000	163.000	395.000	100.000	27.000	10.000
509862.000	2570.000	1905.000	2013.000	616.000	320.000	98.000	127.000	48.000	14.000
559930.000	2029.000	10576.000	1093.000	987.000	338.000	117.000	57.000	60.000	22.000
553020.000	1329.000	7698.000	3341.000	393.000	403.000	99.000	54.000	15.000	30.000
442036.000	1881.000	3786.000	2106.000	865.000	122.000	114.000	38.000	16.000	6.000
423658.000	615.000	12703.000	1886.000	535.000	250.000	38.000	48.000	8.000	6.000
424272.000	4074.000	3063.000	3802.000	587.000	298.000	179.000	35.000	24.000	11.000
392364.000	711.000	14220.000	1185.000	907.000	127.000	87.000	49.000	16.000	4.000
358387.000	3469.000	3459.000	2656.000	267.000	217.000	42.000	32.000	16.000	3.000
342844.000	675.000	8212.000	1047.000	533.000	72.000	54.000	16.000	10.000	4.000
288867.000	9097.000	2107.000	2388.000	209.000	161.000	15.000	12.000	4.000	2.000
275899.000	447.000	10435.000	682.000	596.000	36.000	26.000	3.000	4.000	2.000
296092.000	1173.000	2102.000	2428.000	90.000	126.000	17.000	10.000	.000	2.000
310444.000	985.000	1958.000	718.000	501.000	25.000	34.000	5.000	4.000	.000
255314.000	573.000	3101.000	513.000	134.000	101.000	11.000	13.000	4.000	1.000
258037.000	880.000	1559.000	1092.000	88.000	25.000	17.000	2.000	2.000	.000
223702.000	1463.000	2171.000	481.000	234.000	19.000	5.000	5.000	.000	.000
209869.000	580.000	4054.000	442.000	96.000	55.000	5.000	3.000	2.000	.000
183034.000	1259.000	2425.000	1138.000	78.000	15.000	7.000	1.000	.000	1.000

ENGSEI
1975 1994
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208508.000	2585.000	2437.000	764.000	127.000	350.000	145.000	14.000	13.000
211284.000	281.000	8523.000	895.000	479.000	116.000	290.000	84.000	17.000
196103.000	2630.000	2453.000	1577.000	245.000	182.000	60.000	103.000	31.000
203382.000	898.000	12831.000	746.000	547.000	131.000	78.000	21.000	37.000
187180.000	1718.000	7004.000	2438.000	162.000	280.000	76.000	35.000	14.000
201169.000	2111.000	7760.000	1370.000	611.000	146.000	210.000	54.000	29.000
185423.000	343.000	12689.000	1053.000	398.000	359.000	61.000	74.000	12.000
183209.000	1486.000	3191.000	2473.000	330.000	294.000	189.000	38.000	31.000
177004.000	566.000	4741.000	573.000	557.000	207.000	150.000	104.000	18.000
167699.000	1232.000	1513.000	1215.000	147.000	290.000	72.000	50.000	32.000
157815.000	125.000	3242.000	326.000	241.000	72.000	117.000	40.000	27.000
136358.000	890.000	312.000	572.000	65.000	139.000	34.000	52.000	13.000
123281.000	262.000	2395.000	82.000	184.000	44.000	77.000	10.000	22.000
91178.000	297.000	879.000	594.000	19.000	80.000	19.000	12.000	3.000
88782.000	343.000	748.000	216.000	138.000	9.000	46.000	7.000	8.000
80537.000	176.000	1009.000	116.000	45.000	58.000	4.000	15.000	3.000
84346.000	129.000	262.000	207.000	33.000	26.000	38.000	6.000	16.000
67810.000	408.000	463.000	57.000	42.000	10.000	8.000	8.000	2.000
54574.000	44.000	497.000	41.000	19.000	22.000	4.000	3.000	2.000
39542.000	169.000	264.000	137.000	12.000	17.000	14.000	3.000	1.000

FRATRB

1976 1993

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64396.000	231.000	912.000	451.000	136.000	41.000	20.000	4.000	1.000	1.000
80107.000	347.000	308.000	389.000	116.000	31.000	5.000	3.000	1.000	.000
69739.000	276.000	680.000	130.000	163.000	51.000	12.000	3.000	2.000	.000
89974.000	263.000	639.000	397.000	67.000	41.000	7.000	1.000	.000	.000
63577.000	204.000	738.000	419.000	194.000	25.000	10.000	2.000	1.000	.000
76517.000	113.000	1529.000	413.000	219.000	65.000	7.000	3.000	1.000	.000
78523.000	420.000	358.000	491.000	245.000	75.000	17.000	3.000	1.000	.000
69720.000	379.000	1273.000	284.000	182.000	37.000	8.000	2.000	1.000	1.000
76149.000	974.000	865.000	604.000	121.000	59.000	11.000	3.000	1.000	.000
53003.000	192.000	752.000	239.000	133.000	17.000	6.000	1.000	.000	.000
50350.000	469.000	169.000	474.000	125.000	36.000	2.000	1.000	.000	.000
51234.000	415.000	758.000	58.000	118.000	19.000	5.000	.000	1.000	.000
35482.000	100.000	315.000	345.000	25.000	33.000	4.000	1.000	.000	.000
36133.000	349.150	151.951	131.981	78.384	3.212	2.160	.249	.053	.010
36097.000	45.839	352.149	51.215	28.645	7.475	.808	.374	.072	.014
45075.000	129.353	92.647	109.162	16.003	8.173	2.506	.343	.219	.021
34138.000	159.420	203.140	66.287	29.039	2.341	.721	.088	.027	.002
23721.000	79.229	315.897	34.581	9.293	4.253	.329	.095	.017	.002

SCOGFS

1982 1994

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100	0.614	0.351	0.571	0.181	0.092	0.060
100	0.325	0.781	0.181	0.197	0.075	0.023
100	0.820	0.390	0.254	0.050	0.057	0.016
100	0.066	1.142	0.196	0.112	0.030	0.024
100	0.801	0.105	0.396	0.058	0.040	0.019
100	0.219	0.749	0.034	0.092	0.029	0.007
100	0.163	0.288	0.165	0.026	0.033	0.012
100	0.562	0.135	0.169	0.094	0.020	0.008
100	0.114	0.491	0.059	0.074	0.026	0.009
100	0.303	0.154	0.133	0.013	0.006	0.004
100	0.643	0.193	0.072	0.067	0.029	0.018
100	0.347	0.749	0.101	0.025	0.011	0.003
100	1.158	0.334	0.288	0.031	0.012	0.007

```
ENGGFS
1977    1994
1       1       0.5     0.75
1       5
100     6.269   0.448   0.323   0.058   0.011
100     2.284   1.250   0.098   0.099   0.013
100     2.423   0.580   0.200   0.027   0.036
100     5.084   0.670   0.153   0.073   0.011
100     1.136   1.387   0.127   0.039   0.040
100     3.238   0.290   0.329   0.053   0.038
100     1.539   1.096   0.120   0.111   0.028
100     6.122   0.474   0.178   0.040   0.021
100     0.430   1.189   0.107   0.056   0.021
100     3.438   0.115   0.202   0.029   0.011
100     1.422   1.065   0.027   0.061   0.014
100     0.836   0.407   0.199   0.001   0.043
100     2.285   0.248   0.119   0.061   0.006
100     0.608   0.503   0.060   0.014   0.012
100     0.752   0.155   0.072   0.013   0.003
100     2.441   0.158   0.046   0.035   0.008
100     0.742   0.651   0.082   0.015   0.017
100     2.637   0.295   0.154   0.019   0.005
NETGFS
1980    1994
1       1       0.75    1
1       2
100     16.38   0.45
100     4.69    1.12
100     8.30    0.16
100     2.18    0.23
100     12.13   0.16
100     0.36    0.31
100     11.12   0.02
100     4.15    0.80
100     1.78    0.17
100     1.66    0.22
100     0.92    0.19
100     0.72    0.07
100     4.54    0.11
100     0.17    0.07
100     4.69    0.09
```

INTGFS							
1974	1994						
1	1	0	0.25				
1	6						
1	0.015	0.010	-1	-1	-1	-1	
1	0.040	0.006	-1	-1	-1	-1	
1	0.008	0.020	-1	-1	-1	-1	
1	0.037	0.003	-1	-1	-1	-1	
1	0.013	0.029	-1	-1	-1	-1	
1	0.010	0.009	-1	-1	-1	-1	
1	0.017	0.015	-1	-1	-1	-1	
1	0.003	0.026	-1	-1	-1	-1	
1	0.009	0.007	-1	-1	-1	-1	
1	0.004	0.016	0.003	0.002	0.001	0.002	
1	0.015	0.008	0.004	0.001	0.001	0.001	
1	0.001	0.018	0.004	0.002	0.001	0.001	
1	0.017	0.004	0.007	0.002	0.001	0.001	
1	0.009	0.029	0.001	0.002	0.001	0.001	
1	0.004	0.006	0.006	0.001	0.001	0.001	
1	0.013	0.006	0.005	0.002	0.000	0.001	
1	0.003	0.015	0.002	0.001	0.001	0.001	
1	0.002	0.004	0.003	0.007	0.003	0.008	
1	0.013	0.004	0.001	0.001	0.000	0.001	
1	0.013	0.020	0.002	0.001	0.001	0.000	
1	0.015	0.004	0.003	0.001	0.001	0.001	
FRGGFS							
1983	1994						
1	1	0.25	0.5				
1	7						
100	0.59	0.35	0.18	0.15	0.02	0.01	0.00
100	0.26	0.24	0.13	0.04	0.05	0.00	0.02
100	0.23	2.24	0.34	0.07	0.04	0.03	0.03
100	1.54	0.26	0.73	0.08	0.06	0.00	0.01
100	0.70	1.14	1.08	0.33	0.06	0.06	0.00
100	0.20	0.95	0.45	0.12	0.27	0.06	0.09
100	9.02	0.72	0.36	0.19	0.01	0.03	0.00
100	1.19	1.47	0.25	0.14	0.07	0.00	0.03
100	1.55	0.62	0.43	0.03	0.02	0.03	0.01
100	1.34	0.36	0.13	0.12	0.03	0.00	0.01
100	-1	-1	-1	-1	-1	-1	-1
100	3.08	0.45	0.27	0.04	0.02	0.01	0.00

Table 3.2.8 Tuning results.

Lowestoft VPA Version 3.1

3/10/1995 13:54

Extended Survivors Analysis

NORTH SEA COD : 1963-1994 : 'FINAL' 1/9/95

CPUE data from file CODIVEF5.TUN

Catch data for 32 years. 1963 to 1994. Ages 1 to 11.

Fleet,	,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
SCOTRL	,	1975,	1994,	1,	8,	.000,	1.000
SCOSEI	,	1975,	1994,	1,	10,	.000,	1.000
SCOLTR	,	1975,	1994,	1,	10,	.000,	1.000
ENGTRL	,	1975,	1994,	1,	9,	.000,	1.000
ENGSEI	,	1975,	1994,	1,	8,	.000,	1.000
FRATRB	,	1976,	1994,	1,	9,	.000,	1.000
SCOGFS	,	1982,	1994,	1,	6,	.500,	.750
ENGGFS	,	1977,	1994,	1,	5,	.500,	.750
NETGFS	,	1980,	1994,	1,	2,	.750,	1.000
INTGFS	,	1974,	1994,	1,	6,	.000,	.250
FRGGFS	,	1983,	1994,	1,	7,	.250,	.500

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 2

Catchability independent of age for ages >= 6

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 28 iterations

1

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

Fleet : SCOTRL

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.87,	.441,	17.03,	.53,	20,	.63,	-17.73,

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2,	.97,	.093,	15.37,	.57,	20,	.60,	-15.47,
3,	.94,	.268,	14.78,	.67,	20,	.43,	-15.06,
4,	.83,	.821,	14.26,	.70,	20,	.37,	-15.34,
5,	1.14,	-.577,	16.77,	.61,	20,	.45,	-15.67,
6,	1.32,	-.877,	18.56,	.43,	20,	.62,	-15.81,
7,	1.64,	-.765,	22.22,	.13,	19,	1.48,	-15.99,
8,	.96,	.039,	15.77,	.12,	17,	1.87,	-16.17,

1

Fleet : SCOSEI

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.86,	.774,	16.79,	.75,	20,	.39,	-17.52,

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,	1.10,	-.607,	15.11,	.78,	20,	.36,	-14.77,
3,	.86,	1.018,	14.10,	.84,	20,	.27,	-14.73,
4,	.87,	.839,	14.18,	.81,	20,	.27,	-14.92,
5,	1.07,	-.464,	15.57,	.80,	20,	.28,	-15.07,
6,	1.11,	-.322,	15.95,	.47,	20,	.57,	-15.10,
7,	5.37,	-3.963,	53.16,	.08,	20,	1.98,	-15.00,
8,	1.55,	-2.335,	20.02,	.64,	20,	.47,	-14.79,
9,	1.44,	-1.404,	19.36,	.50,	20,	.65,	-14.78,
10,	1.32,	-1.374,	18.41,	.66,	19,	.63,	-14.81,

1

Fleet : SCOLTR

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.69,	1.433,	16.04,	.67,	20,	.46,	-17.71,

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,	1.016,	15.13,	.90,	20,	.23,	-15.57,
3,	.95,	.346,	15.09,	.84,	20,	.27,	-15.33,
4,	.99,	.077,	15.50,	.77,	20,	.31,	-15.59,
5,	1.00,	.020,	16.01,	.83,	20,	.26,	-16.03,
6,	1.24,	-.805,	18.37,	.52,	20,	.51,	-16.18,
7,	2.02,	-2.212,	26.72,	.32,	20,	.83,	-16.37,
8,	.98,	.121,	16.01,	.78,	19,	.33,	-16.24,
9,	.92,	.255,	15.62,	.54,	19,	.61,	-16.55,
10,	.65,	1.384,	11.99,	.67,	12,	.61,	-16.75,

Fleet : ENGTRL

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	1.20,	-.536,	18.49,	.41,	20,	.81,	-17.45,

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,	1.29,	-1.154,	16.40,	.62,	20,	.54,	-15.30,
3,	1.08,	-.600,	15.69,	.86,	20,	.25,	-15.31,
4,	.80,	1.823,	14.37,	.90,	20,	.19,	-15.67,
5,	.70,	2.668,	13.66,	.89,	20,	.20,	-16.02,
6,	.66,	2.959,	13.19,	.88,	20,	.20,	-16.29,
7,	.60,	3.450,	12.30,	.88,	20,	.21,	-16.26,
8,	.92,	.287,	15.12,	.63,	17,	.39,	-15.99,
9,	1.45,	-1.033,	20.82,	.46,	16,	.64,	-15.83,

1

Fleet : ENGSEI

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.92,	.425,	17.33,	.75,	20,	.39,	-17.75,

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,	.83,	1.201,	14.78,	.83,	20,	.31,	-15.47,
3,	.66,	3.904,	13.84,	.93,	20,	.17,	-15.71,
4,	.67,	3.743,	13.53,	.93,	20,	.16,	-15.77,
5,	.72,	1.652,	13.17,	.77,	20,	.31,	-15.19,
6,	.57,	3.498,	11.59,	.87,	20,	.21,	-14.88,
7,	.88,	.781,	13.64,	.82,	20,	.27,	-14.61,
8,	.86,	.709,	13.13,	.73,	20,	.38,	-14.35,

1

Fleet : FRATRB

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	1.59,	-1.353,	20.33,	.36,	18,	.92,	-17.36,

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2,	1.02,	-.131,	15.91,	.77,	18,	.37,	-15.81,
3,	.84,	1.048,	14.59,	.83,	18,	.29,	-15.40,
4,	.76,	1.389,	13.82,	.79,	18,	.29,	-15.30,
5,	.63,	2.132,	12.94,	.78,	18,	.28,	-15.79,
6,	.69,	1.941,	13.59,	.81,	18,	.27,	-16.50,
7,	.71,	.902,	14.06,	.55,	17,	.46,	-17.17,
8,	.51,	2.328,	11.53,	.78,	14,	.34,	-17.37,
9,	.40,	1.595,	9.85,	.67,	7,	.44,	-18.53,

1

Fleet : SCOGFS

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.93,	.246,	17.02,	.59,	13,	.54,	-17.37,

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,	.85,	.983,	15.52,	.82,	13,	.30,	-16.28,
3,	.81,	1.120,	14.92,	.79,	13,	.31,	-16.01,
4,	.70,	2.141,	13.78,	.85,	13,	.23,	-15.84,
5,	1.04,	-.108,	16.02,	.45,	13,	.60,	-15.71,
6,	1.21,	-.422,	17.46,	.32,	13,	.79,	-15.69,

1

Fleet : ENGGFS

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.86,	1.241,	15.46,	.88,	18,	.25,	-15.98,

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,	.83,	1.508,	15.40,	.89,	18,	.24,	-16.19,
3,	.92,	.540,	15.92,	.83,	18,	.28,	-16.40,
4,	.61,	1.397,	13.70,	.56,	18,	.50,	-16.68,
5,	.92,	.260,	15.79,	.54,	18,	.52,	-16.42,

1

Fleet : NETGFS

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.51,	3.576,	13.89,	.84,	15,	.28,	-15.38,

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,	.79,	.812,	15.72,	.62,	15,	.54,	-16.83,

1

Fleet : INTGFS

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	1.10,	-.265,	17.72,	.40,	20,	.81,	-17.23,

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,	.130,	15.93,	.78,	20,	.36,	-16.03,
3,	.94,	.319,	15.54,	.75,	12,	.32,	-15.90,
4,	5.06,	-1.974,	40.98,	.03,	12,	3.23,	-15.29,
5,	-4.51,	-4.088,	-21.96,	.08,	10,	1.74,	-14.75,
6,	2.17,	-.962,	21.35,	.08,	11,	1.52,	-13.72,

1

Fleet : FRGGFS

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	2.72,	-.852,	23.81,	.03,	11,	3.34,	-16.55,

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,	1.71,	-1.184,	19.18,	.27,	11,	1.13,	-15.91,
3,	5.91,	-1.857,	41.34,	.02,	11,	4.12,	-15.49,
4,	.99,	.033,	15.49,	.43,	11,	.61,	-15.59,
5,	.93,	.157,	14.91,	.38,	11,	.71,	-15.45,
6,	26.33,	-.835,	212.79,	.00,	7,	22.42,	-15.17,
7,	8.34,	-.864,	73.98,	.00,	7,	7.61,	-14.46,

1

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOTRL	,	108426.,	.652,	.000,	.00,	1,	.044,	.071
SCOSEI	,	111048.,	.404,	.000,	.00,	1,	.115,	.070
SCOLTR	,	58855.,	.492,	.000,	.00,	1,	.078,	.128
ENGTRL	,	182288.,	.851,	.000,	.00,	1,	.026,	.043
ENGSEI	,	134289.,	.404,	.000,	.00,	1,	.115,	.058
FRATRB	,	1.,	.000,	.000,	.00,	0,	.000,	.000
SCOGFS	,	270439.,	.604,	.000,	.00,	1,	.051,	.029
ENGGFS	,	154265.,	.300,	.000,	.00,	1,	.209,	.051
NETGFS	,	140735.,	.300,	.000,	.00,	1,	.209,	.055
INTGFS	,	229970.,	.867,	.000,	.00,	1,	.025,	.034
FRGGFS	,	1700049.,	3.660,	.000,	.00,	1,	.001,	.005
P shrinkage mean	,	94143.,	.65,,,,				.047,	.082
F shrinkage mean	,	56674.,	.50,,,,				.080,	.132

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
123813.,	.14,	.13,	12,	.913,	.063

1

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

Year class = 1992

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOTRL	,	6723.,	.478,	.149,	.31,	2,	.039,	1.239
SCOSEI	,	14350.,	.268,	.240,	.90,	2,	.123,	.765
SCOLTR	,	12194.,	.261,	.096,	.37,	2,	.130,	.856
ENGTRL	,	29815.,	.392,	.178,	.46,	2,	.058,	.440
ENGSEI	,	14650.,	.298,	.337,	1.13,	2,	.099,	.754
FRATRB	,	21136.,	.970,	.000,	.00,	1,	.009,	.577
SCOGFS	,	27347.,	.307,	.066,	.21,	2,	.094,	.472
ENGGFS	,	19453.,	.217,	.081,	.37,	2,	.186,	.614
NETGFS	,	10131.,	.305,	.232,	.76,	2,	.092,	.966
INTGFS	,	18087.,	.339,	.552,	1.63,	2,	.078,	.648
FRGGFS	,	18637.,	.707,	.000,	.00,	1,	.018,	.634
F shrinkage mean	,	12065.,	.50,,,,				.074,	.862

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
15736.,	.10,	.09,	21,	.965,	.717

1

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL ,	15304.,	.343,	.104,	.30,	3,	.054,	.692
SCOSEI ,	12239.,	.218,	.057,	.26,	3,	.123,	.810
SCOLTR ,	12854.,	.208,	.027,	.13,	3,	.140,	.783
ENGTRL ,	16761.,	.250,	.045,	.18,	3,	.109,	.648
ENGSEI ,	14071.,	.254,	.202,	.79,	3,	.087,	.735
FRATRB ,	19718.,	.333,	.136,	.41,	2,	.033,	.574
SCOGFS ,	19436.,	.263,	.068,	.26,	3,	.084,	.580
ENGGFS ,	15767.,	.192,	.084,	.44,	3,	.154,	.678
NETGFS ,	13708.,	.276,	.496,	1.80,	2,	.044,	.749
INTGFS ,	14026.,	.256,	.318,	1.24,	3,	.097,	.737
FRGGFS ,	8021.,	.816,	.162,	.20,	2,	.011,	1.066
F shrinkage mean ,	9369.,	.50,,,,				.063,	.967

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
14299.,	.08,	.05,	31,	.644,	.727

1

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL ,	1642.,	.323,	.099,	.31,	4,	.065,	.879
SCOSEI ,	1801.,	.217,	.137,	.63,	4,	.140,	.826
SCOLTR ,	2370.,	.208,	.080,	.38,	4,	.151,	.681
ENGTRL ,	1600.,	.219,	.057,	.26,	4,	.147,	.894
ENGSEI ,	1196.,	.254,	.115,	.45,	4,	.104,	1.076
FRATRB ,	1518.,	.268,	.195,	.73,	3,	.039,	.926
SCOGFS ,	1670.,	.265,	.072,	.27,	4,	.093,	.869
ENGGFS ,	1877.,	.215,	.174,	.81,	4,	.076,	.803
NETGFS ,	1658.,	.280,	.086,	.31,	2,	.016,	.873
INTGFS ,	1689.,	.282,	.117,	.42,	4,	.057,	.862
FRGGFS ,	1235.,	.551,	.088,	.16,	3,	.027,	1.055
F shrinkage mean ,	1522.,	.50,,,,				.085,	.924

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1688.,	.09,	.04,	41,	.480,	.863

1

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL ,	377.,	.291,	.090,	.31,	5,	.089,	1.024
SCOSEI ,	440.,	.207,	.042,	.20,	5,	.170,	.928
SCOLTR ,	455.,	.202,	.059,	.29,	5,	.174,	.908
ENGTRL ,	463.,	.220,	.064,	.29,	5,	.135,	.898
ENGSEI ,	614.,	.265,	.221,	.83,	5,	.087,	.740
FRATRB ,	358.,	.258,	.169,	.66,	4,	.040,	1.058
SCOGFS ,	460.,	.286,	.064,	.22,	5,	.070,	.901
ENGGFS ,	442.,	.287,	.046,	.16,	5,	.066,	.925
NETGFS ,	592.,	.279,	.151,	.54,	2,	.008,	.759
INTGFS ,	581.,	.342,	.240,	.70,	5,	.045,	.770
FRGGFS ,	518.,	.629,	.101,	.16,	4,	.021,	.833
F shrinkage mean ,	576.,	.50,,,,				.095,	.773

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
470.,	.09,	.04,	51,	.397,	.888

1

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL ,	647.,	.282,	.143,	.51,	6,	.106,	.504
SCOSEI ,	429.,	.216,	.105,	.49,	6,	.147,	.687
SCOLTR ,	520.,	.209,	.095,	.46,	6,	.172,	.596
ENGTRL ,	406.,	.226,	.157,	.69,	6,	.156,	.714
ENGSEI ,	500.,	.284,	.108,	.38,	6,	.094,	.614
FRATRB ,	339.,	.284,	.099,	.35,	5,	.043,	.810
SCOGFS ,	343.,	.317,	.152,	.48,	6,	.070,	.805
ENGGFS ,	539.,	.292,	.152,	.52,	5,	.038,	.580
NETGFS ,	400.,	.282,	.138,	.49,	2,	.004,	.722
INTGFS ,	432.,	.390,	.092,	.24,	6,	.049,	.683
FRGGFS ,	313.,	.606,	.249,	.41,	5,	.024,	.855
F shrinkage mean ,	314.,	.50,,,,				.097,	.854

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
441.,	.09,	.05,	60,	.479,	.673

1

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

Year class = 1987

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL	,	55.,	.316,	.200,	.63,	7,	.076,	1.116
SCOSEI	,	61.,	.261,	.114,	.44,	7,	.128,	1.043
SCOLTR	,	44.,	.244,	.111,	.45,	7,	.152,	1.269
ENGTRL	,	36.,	.255,	.060,	.23,	7,	.152,	1.419
ENGSEI	,	72.,	.292,	.223,	.76,	7,	.146,	.942
FRATRB	,	29.,	.288,	.071,	.25,	6,	.054,	1.585
SCOGFS	,	41.,	.313,	.267,	.85,	6,	.038,	1.319
ENGGFS	,	59.,	.291,	.040,	.14,	5,	.020,	1.070
NETGFS	,	85.,	.287,	.220,	.77,	2,	.002,	.844
INTGFS	,	105.,	.287,	.472,	1.64,	4,	.008,	.729
FRGGFS	,	52.,	.464,	.223,	.48,	5,	.010,	1.148
F shrinkage mean	,	70.,	.50,,,,				.212,	.957

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
53.,	.13,	.06,	64,	.422,	1.136

1

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

Year class = 1986

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL	,	36.,	.369,	.365,	.99,	8,	.047,	.831
SCOSEI	,	39.,	.309,	.032,	.10,	8,	.158,	.790
SCOLTR	,	29.,	.253,	.081,	.32,	8,	.277,	.954
ENGTRL	,	21.,	.249,	.113,	.45,	7,	.079,	1.157
ENGSEI	,	30.,	.324,	.092,	.28,	8,	.118,	.942
FRATRB	,	18.,	.320,	.163,	.51,	7,	.038,	1.278
SCOGFS	,	38.,	.328,	.375,	1.14,	6,	.020,	.793
ENGGFS	,	18.,	.314,	.319,	1.02,	5,	.010,	1.283
NETGFS	,	39.,	.293,	.056,	.19,	2,	.001,	.779
INTGFS	,	47.,	.407,	.241,	.59,	6,	.014,	.689
FRGGFS	,	30.,	.477,	.244,	.51,	5,	.005,	.941
F shrinkage mean	,	32.,	.50,,,,				.232,	.897

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
30.,	.15,	.04,	71,	.293,	.928

1

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

Year class = 1985

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL	,	5.,	.391,	.625,	1.60,	8,	.022,	1.871
SCOSEI	,	16.,	.352,	.022,	.06,	9,	.166,	.952
SCOLTR	,	9.,	.285,	.224,	.79,	9,	.190,	1.356
ENGTRL	,	21.,	.361,	.150,	.41,	9,	.141,	.800
ENGSEI	,	15.,	.330,	.025,	.08,	8,	.059,	.975
FRATRB	,	4.,	.441,	.373,	.84,	8,	.024,	1.904
SCOGFS	,	7.,	.340,	.216,	.64,	6,	.009,	1.492
ENGGFS	,	11.,	.350,	.138,	.39,	5,	.004,	1.178
NETGFS	,	15.,	.317,	.385,	1.21,	2,	.000,	.991
INTGFS	,	27.,	.424,	.419,	.99,	6,	.006,	.665
FRGGFS	,	15.,	.581,	.039,	.07,	7,	.007,	.982
F shrinkage mean	,	14.,	.50,,,,				.373,	1.046

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
13.,	.21,	.06,	78,	.306,	1.077

1

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

Year class = 1984

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SCOTRL	,	4.,	.340,	.163,	.48,	8,	.019,	.885
SCOSEI	,	6.,	.350,	.077,	.22,	10,	.242,	.608
SCOLTR	,	3.,	.310,	.086,	.28,	10,	.170,	1.024
ENGTRL	,	3.,	.231,	.138,	.60,	7,	.032,	1.065
ENGSEI	,	3.,	.313,	.231,	.74,	8,	.044,	.913
FRATRB	,	2.,	.455,	.288,	.63,	9,	.024,	1.452
SCOGFS	,	4.,	.321,	.187,	.58,	6,	.009,	.840
ENGGFS	,	2.,	.290,	.330,	1.14,	5,	.005,	1.238
NETGFS	,	2.,	.331,	.499,	1.51,	2,	.001,	1.148
INTGFS	,	4.,	.458,	.190,	.42,	5,	.005,	.798
FRGGFS	,	5.,	.602,	.355,	.59,	6,	.004,	.744
F shrinkage mean	,	3.,	.50,,,,				.444,	.951

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4.,	.24,	.05,	77,	.202,	.879

1

1

TABLE 3.2.9; Cod, North Sea
International F at age, Total , 1963 to 1994.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	.025	.020	.060	.057	.035	.046	.021	.109	.077	.035
2	.543	.375	.468	.554	.510	.638	.395	.584	.886	.906
3	.373	.598	.658	.631	.742	.746	.604	.751	.771	.927
4	.455	.417	.628	.534	.539	.716	.589	.576	.712	.673
5	.453	.465	.433	.500	.610	.623	.635	.591	.704	.736
6	.559	.592	.463	.437	.606	.570	.702	.536	.545	.814
7	.166	.580	.460	.441	.622	.587	.496	.531	.576	.790
8	.766	.341	.697	.525	.710	.454	.629	.326	.521	1.036
9	.296	.308	.265	.729	.386	.753	.413	.637	.691	1.237
10	.451	.461	.467	.531	.592	.603	.580	.528	.613	.933
11+	.451	.461	.467	.531	.592	.603	.580	.528	.613	.933

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.134	.097	.105	.040	.132	.090	.116	.114	.111	.184
2	.733	.838	.751	.959	.866	1.038	.845	.956	1.005	1.013
3	.869	.696	.799	.854	.769	.874	.972	.953	1.001	1.253
4	.799	.664	.680	.757	.543	.759	.581	.739	.738	.844
5	.592	.660	.747	.573	.640	.889	.711	.609	.680	.804
6	.742	.551	.665	.788	.595	.692	.544	.638	.637	.894
7	.701	.744	.506	.735	.780	.661	.640	.770	.716	.750
8	.558	.614	.830	.278	.759	.749	.521	.848	.608	.723
9	.357	.933	.855	.800	1.425	.880	.756	.616	.773	.855
10	.595	.707	.728	.640	.847	.789	.641	.712	.710	.857
11+	.595	.707	.728	.640	.847	.789	.641	.712	.710	.857

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	.137	.188	.117	.241	.144	.197	.147	.153	.147	.136
2	1.130	1.020	1.054	.761	.932	.965	.951	.879	.816	.864
3	1.180	1.031	1.044	1.034	.858	1.176	1.074	.930	.940	.867
4	.897	.811	.815	.794	.956	.822	1.039	.866	.824	.889
5	.794	.777	.701	.861	.761	.824	.773	.714	.804	.764
6	.791	.807	.714	.817	.957	.828	.960	.529	.991	.796
7	.740	.738	.748	.831	.973	.794	.983	.706	1.081	.945
8	.805	.813	.741	.951	.928	.791	1.141	.377	1.030	.872
9	.558	.907	.655	.682	.957	.696	.848	1.976	.491	1.033
10	.680	.768	.563	.905	.933	.629	.865	.796	.839	.671
11+	.680	.768	.563	.905	.933	.629	.865	.796	.839	.671

Age	1993	1994
1	.058	.063
2	.714	.717
3	.957	.727
4	.952	.863
5	.773	.888
6	.949	.673
7	1.015	1.136
8	1.017	.928
9	.823	1.077
10	.767	.879
11+	.767	.879

TABLE 3.2.10; Cod, North Sea
Tuned Stock Numbers at age (10**-3), 1963 to 1995, (numbers in 1995 are VPA survivors)

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	197724	366651	421753	512133	484886	196728	204639	765667	903208	173983
2	127785	86614	161530	178474	217327	210375	84403	90030	308505	375916
3	25843	52338	41927	71322	72284	92007	78322	40056	35376	89672
4	10702	13857	22413	16912	29544	26815	33983	33338	14720	12745
5	8134	5560	7475	9790	8118	14116	10725	15442	15348	5910
6	3007	4232	2859	3969	4862	3613	6195	4656	7001	6215
7	609	1408	1916	1473	2100	2172	1672	2514	2231	3322
8	958	422	645	990	776	923	988	834	1211	1027
9	61	365	246	263	479	312	480	431	493	589
10	17	37	219	154	104	267	120	260	187	202
11+	0	12	23	221	40	55	186	104	215	30

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	306627	253195	460935	207870	770203	451486	475629	850711	288115	593618
2	75464	120536	103219	186405	89745	303335	185393	190204	341074	115845
3	107003	25541	36747	34316	50334	26607	75669	56119	51499	87971
4	27634	34932	9915	12876	11373	18164	8642	22300	16855	14746
5	5326	10171	14727	4112	4942	5412	6962	3956	8721	6600
6	2317	2411	4305	5715	1899	2134	1821	2798	1762	3617
7	2255	903	1138	1812	2127	858	875	865	1211	763
8	1235	916	351	562	711	798	363	378	328	484
9	298	578	406	126	348	272	309	176	132	146
10	140	171	186	141	46	69	93	119	78	50
11+	376	383	121	90	166	83	36	53	44	30

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	284962	565609	110004	600132	244107	150909	240353	112322	141847	280783
2	221802	111688	210505	43980	211860	94983	55681	93258	43322	55032
3	29643	50472	28396	51681	14476	58806	25503	15163	27292	13499
4	19571	7091	14023	7786	14311	4781	14134	6787	4657	8304
5	5191	6535	2579	5082	2881	4505	1720	4093	2336	1672
6	2417	1921	2459	1048	1759	1102	1618	650	1641	856
7	1211	897	702	985	379	553	394	507	313	498
8	295	473	351	272	352	117	205	121	205	87
9	192	108	172	137	86	114	44	54	68	60
10	51	90	36	73	57	27	46	15	6	34
11+	43	41	60	36	20	36	18	5	16	18

Age	1993	1994	1995
1	107925	293416	0
2	110105	45736	123813
3	16338	37977	15736
4	4418	4887	14299
5	2795	1396	1688
6	637	1056	470
7	316	202	441
8	159	94	53
9	30	47	30
10	17	11	13
11+	23	24	12

Table 3.2.11 Recruit indices.

COD IV RCT3 INPUT VALUES; AGE 1*100; final, Oct 7 1995

13	26	2													
Yr cl	VPA	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS1	SGFS2	DGFS0	DGFS1	DGFS2	FRGFS	GGFS1	GGFS2
1970	903	9830	3450	-1	-1	-1	-1	-1	-1	-1	-1	9040	-1	-1
1971	174	410	1060	-1	-1	-1	-1	-1	-1	-1	-1	130	-1	-1
1972	307	3800	950	-1	-1	-1	-1	-1	-1	-1	-1	160	-1	-1
1973	253	1470	620	-1	-1	-1	-1	-1	-1	-1	-1	360	-1	-1
1974	461	4030	1990	-1	-1	-1	-1	-1	-1	-1	-1	800	-1	-1
1975	208	790	320	-1	-1	447	-1	-1	-1	-1	-1	780	-1	-1
1976	770	3670	2930	-1	6270	1250	-1	-1	-1	-1	-1	2820	-1	-1
1977	451	1290	930	1389	2284	580	-1	-1	-1	-1	-1	2720	-1	-1
1978	476	990	1480	1256	2423	670	-1	-1	-1	-1	450	3110	-1	-1
1979	851	1690	2550	1855	5084	1386	-1	-1	-1	16380	1120	3550	-1	-1
1980	288	290	670	1023	1136	290	-1	351	4320	4690	160	1410	-1	-1
1981	594	920	1660	7424	3237	1096	614	78	17680	8300	230	2320	-1	350
1982	285	390	800	255	1540	475	325	391	2690	2180	160	900	590	240
1983	566	1520	1760	9510	6122	1189	819	1143	12150	12130	310	4300	260	2240
1984	110	90	360	38	430	115	66	104	130	360	20	90	230	260
1985	600	1700	2880	828	3438	1065	801	695	14360	11120	800	950	1540	1140
1986	244	880	610	121	1422	407	219	288	3700	4150	170	230	700	950
1987	151	360	630	38	836	248	162	135	3620	1780	220	210	200	720
1988	240	1310	1520	1678	2285	504	561	49	1660	1660	190	420	9020	1470
1989	112	340	410	598	608	155	114	154	1370	920	70	60	1190	620
1990	142	240	450	383	752	159	303	193	2350	720	110	-1	1550	360
1991	281	1300	1990	4840	2440	650	642	749	3980	4540	70	-1	1340	-1
1992	-1	1270	440	1684	742	295	347	334	1160	170	90	-1	-1	450
1993	-1	1480	2210	377	2637	1277	1158	1443	2410	4690	-1	-1	3080	1430
1994	-1	970	-1	2134	1028	-1	475	-1	6350	-1	-1	-1	430	-1
1995	-1	-1	-1	26	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

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Table 3.2.12 Analysis by RCT3 ver3.1 of data from file :

codrct1.dat

COD IV RCT3 INPUT VALUES; AGE 1*100; preliminary, oct 3 1995

Data for 13 surveys over 26 years : 1970 - 1995

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 = 1992

	I-----------Regression	----------I				I-----------Prediction	---------I		
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.87	-.02	.51	.647	22	7.15	6.19	.589	.047
IYFS2	1.03	-1.49	.39	.757	22	6.09	4.79	.464	.076
EGFS0	.55	2.04	.77	.441	15	7.43	6.10	.888	.021
EGFS1	.86	-.75	.25	.882	16	6.61	4.92	.300	.183
EGFS2	.84	.51	.20	.920	17	5.69	5.29	.234	.301
SGFS1	.86	.52	.39	.747	11	5.85	5.57	.456	.079
SGFS2	1.24	-1.31	1.11	.255	12	5.81	5.92	1.292	.010
DGFS0	.57	.89	.44	.684	12	7.06	4.94	.524	.060
DGFS1	.60	.84	.25	.886	13	5.14	3.90	.351	.134
DGFS2	.82	1.38	.52	.638	14	4.51	5.08	.603	.045
FRGSF									
GGFS1									
GGFS2	1.99	-7.48	1.42	.200	10	6.11	4.70	1.726	.006
					VPA Mean =		5.60	.654	.038

Yearclass = 1993

	I-----------Regression	----------I				I-----------Prediction	---------I		
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.87	-.03	.51	.645	22	7.30	6.31	.608	.047
IYFS2	1.02	-1.44	.39	.757	22	7.70	6.42	.473	.077
EGFS0	.55	2.03	.78	.430	15	5.93	5.27	.911	.021
EGFS1	.85	-.72	.25	.881	16	7.88	6.00	.296	.196
EGFS2	.83	.56	.20	.921	17	7.15	6.50	.250	.276
SGFS1	.86	.53	.39	.743	11	7.06	6.60	.518	.064
SGFS2	1.21	-1.16	1.08	.264	12	7.28	7.68	1.467	.008
DGFS0	.58	.83	.45	.675	12	7.79	5.35	.526	.062
DGFS1	.59	.85	.25	.884	13	8.45	5.87	.293	.202
DGFS2									
FRGSF									
GGFS1	4.19	-23.03	5.21	.015	10	8.03	10.59	6.618	.000
GGFS2	1.95	-7.20	1.37	.212	10	7.27	6.93	1.757	.006
					VPA Mean =		5.57	.650	.041

Yearclass = 1994

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

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.86	-.01	.51	.643	22	6.88	5.92	.602	.109
IYFS2									
EGFS0	.55	2.01	.80	.415	15	7.67	6.20	.966	.043
EGFS1	.84	-.67	.25	.881	16	6.94	5.19	.297	.449
EGFS2									
SGFS1	.86	.53	.40	.738	11	6.17	5.82	.479	.173
SGFS2									
DGFS0	.59	.76	.46	.666	12	8.76	5.92	.554	.129
DGFS1									
DGFS2									
FRGSF									
GGFS1	3.99	-21.78	5.01	.016	10	6.07	2.40	6.192	.001
GGFS2									
					VPA Mean =		5.53	.643	.096

Yearclass = 1995

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.55	1.99	.83	.397	15	3.30	3.79	1.138	.236
EGFS1									
EGFS2									
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
					VPA Mean =		5.49	.632	.764

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	158	5.06	.13	.17	1.81		
1993	465	6.14	.13	.13	.91		
1994	256	5.55	.20	.15	.56		
1995	162	5.09	.55	.72	1.70		

Table 3.2.13 Analysis by RCT3 ver3.1 of data from file :

codrct2.dat

COD IV RCT3 INPUT VALUES; AGE 2*100; oct 6 1995

Data for 13 surveys over 26 years : 1970 - 1995

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 = 1992

	I-----------Regression	----------I			I-----------Prediction	---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.87	-.90	.51	.663	21	7.15	5.29	.599	.047
IYFS2	1.03	-2.40	.36	.798	21	6.09	3.90	.430	.091
EGFS0	.54	1.21	.72	.492	14	7.43	5.25	.846	.024
EGFS1	.85	-1.61	.26	.887	15	6.61	4.01	.306	.180
EGFS2	.83	-.37	.20	.924	16	5.69	4.37	.238	.298
SGFS1	.85	-.31	.37	.773	10	5.85	4.67	.444	.086
SGFS2	1.28	-2.32	1.10	.263	11	5.81	5.12	1.322	.010
DGFS0	.56	.03	.48	.658	11	7.06	4.00	.576	.051
DGFS1	.59	-.03	.26	.882	12	5.14	2.99	.374	.120
DGFS2	.81	.44	.48	.685	13	4.51	4.07	.572	.052
FRGSF									
GGFS1									
GGFS2	1.97	-8.27	1.41	.189	10	6.11	3.75	1.716	.006
					VPA Mean =		4.65	.673	.037

Yearclass = 1993

	I-----------Regression	----------I			I-----------Prediction	---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.87	-.93	.51	.659	21	7.30	5.42	.626	.047
IYFS2	1.03	-2.37	.35	.802	21	7.70	5.55	.444	.093
EGFS0	.55	1.19	.74	.478	14	5.93	4.43	.867	.024
EGFS1	.84	-1.58	.25	.887	15	7.88	5.07	.304	.198
EGFS2	.82	-.32	.20	.926	16	7.15	5.57	.256	.279
SGFS1	.85	-.32	.38	.768	10	7.06	5.68	.520	.068
SGFS2	1.26	-2.23	1.09	.271	11	7.28	6.95	1.575	.007
DGFS0	.57	-.03	.49	.649	11	7.79	4.40	.582	.054
DGFS1	.59	-.02	.26	.879	12	8.45	4.93	.316	.184
DGFS2									
FRGSF									
GGFS1	4.45	-25.56	5.94	.012	9	8.03	10.15	7.771	.000
GGFS2	1.92	-7.98	1.36	.201	10	7.27	5.95	1.744	.006
					VPA Mean =		4.61	.670	.041

Yearclass = 1994

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

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.87	-.94	.52	.654	21	6.88	5.03	.626	.107
IYFS2									
EGFS0	.55	1.15	.76	.460	14	7.67	5.37	.948	.047
EGFS1	.84	-1.53	.25	.888	15	6.94	4.27	.304	.456
EGFS2									
SGFS1	.85	-.33	.38	.762	10	6.17	4.92	.478	.184
SGFS2									
DGFS0	.58	-.11	.50	.638	11	8.76	4.95	.620	.109
DGFS1									
DGFS2									
FRGSF									
GGFS1	4.20	-23.99	5.69	.013	9	6.07	1.47	7.211	.001
GGFS2									
						VPA Mean =	4.57	.664	.096

Yearclass = 1995

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.56	1.09	.80	.436	14	3.30	2.93	1.126	.252
EGFS1									
EGFS2									
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
						VPA Mean =	4.52	.654	.748

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	64	4.17	.13	.17	1.71		
1993	188	5.24	.14	.13	.88		
1994	101	4.62	.21	.15	.54		
1995	61	4.12	.57	.69	1.49		

TABLE 3.2.14; Cod, North Sea

Mean fishing mortality, biomass and recruitment, 1963 - 1994.

Year	Mean F Ages 2 to 8	Stock Biomass ('000 tonnes) Total	Spawning	Recruits Age 1 Yclass	Million
1963	.473	439	140	1962	198
1964	.481	549	168	1963	367
1965	.544	682	194	1964	422
1966	.517	864	231	1965	512
1967	.620	921	249	1966	485
1968	.619	842	284	1967	197
1969	.578	686	282	1968	205
1970	.556	918	269	1969	766
1971	.674	1111	262	1970	903
1972	.840	802	228	1971	174
1973	.714	648	209	1972	307
1974	.681	592	218	1973	253
1975	.711	645	197	1974	461
1976	.706	546	167	1975	208
1977	.707	758	148	1976	770
1978	.809	721	149	1977	451
1979	.688	727	151	1978	476
1980	.787	897	164	1979	851
1981	.769	677	168	1980	288
1982	.897	773	173	1981	594
1983	.905	598	145	1982	285
1984	.857	665	123	1983	566
1985	.831	429	111	1984	110
1986	.864	560	98	1985	600
1987	.909	468	89	1986	244
1988	.886	374	85	1987	151
1989	.989	350	76	1988	240
1990	.715	270	63	1989	112
1991	.927	253	62	1990	142
1992	.857	353	60	1991	281
1993	.911	281	57	1992	108
1994	.847	363	59	1993	465 * RCT3 estimate

Arithmetic mean recruits, age 1, 1963 to 1992: 387

Geometric mean recruits, age 1, 1963 to 1992: 327

Table 3.2.15

Cod in the North Sea (Fishing Area IV)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.8000	0.0100	0.0000	0.0000	0.690	0.1100	0.690
2	.	0.3500	0.0500	0.0000	0.0000	1.040	0.7900	1.040
3	.	0.2500	0.2300	0.0000	0.0000	2.310	0.8800	2.310
4	.	0.2000	0.6200	0.0000	0.0000	4.370	0.8800	4.370
5	.	0.2000	0.8600	0.0000	0.0000	6.670	0.7900	6.670
6	.	0.2000	1.0000	0.0000	0.0000	8.440	0.7800	8.440
7	.	0.2000	1.0000	0.0000	0.0000	10.050	0.9700	10.050
8	.	0.2000	1.0000	0.0000	0.0000	10.700	0.8400	10.700
9	.	0.2000	1.0000	0.0000	0.0000	12.610	1.0800	12.610
10	.	0.2000	1.0000	0.0000	0.0000	14.140	0.7900	14.140
11+	.	0.2000	1.0000	0.0000	0.0000	14.180	0.7900	14.180
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : HH2
Date and time: 07OCT95:12:41

Table 3.2.16 Cod North Sea
Input data for catch forecast and linear sensitivity analysis.

Populations in 1995			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	256000	.20	WS1	.69	.05	M1	.80	.13	MT1	.01	.10
N2	188000	.14	WS2	1.04	.06	M2	.35	.10	MT2	.05	.10
N3	15736	.10	WS3	2.31	.12	M3	.25	.18	MT3	.23	.10
N4	14299	.08	WS4	4.37	.09	M4	.20	.18	MT4	.62	.10
N5	1688	.09	WS5	6.67	.07	M5	.20	.18	MT5	.86	.10
N6	470	.09	WS6	8.44	.02	M6	.20	.18	MT6	1.00	.10
N7	440	.09	WS7	10.05	.04	M7	.20	.18	MT7	1.00	.00
N8	53	.13	WS8	10.70	.02	M8	.20	.18	MT8	1.00	.00
N9	29	.15	WS9	12.61	.06	M9	.20	.18	MT9	1.00	.00
N10	12	.21	WS10	14.14	.07	M10	.20	.18	MT10	1.00	.00
N11	11	.24	WS11	14.18	.08	M11	.20	.18	MT11	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.11	.47	WH1	.69	.05
sH2	.79	.19	WH2	1.04	.06
sH3	.88	.15	WH3	2.31	.12
sH4	.88	.11	WH4	4.37	.09
sH5	.79	.09	WH5	6.67	.07
sH6	.78	.16	WH6	8.44	.02
sH7	.97	.11	WH7	10.05	.04
sH8	.84	.26	WH8	10.70	.02
sH9	1.08	.64	WH9	12.61	.06
sH10	.79	.15	WH10	14.14	.07
sH11	.79	.15	WH11	14.18	.08

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K95	1.00	.10	HF95	1.00	.10
K96	1.00	.10	HF96	1.00	.10
K97	1.00	.10	HF97	1.00	.10

Recruitment		
Labl	Value	CV
R96	162000	.55
R97	242000	.63

Stock numbers in 1995 are VPA survivors.
These are overwritten at Age 1 and 2.

Table 3.2.17 Cod North Sea

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

	Year							
	1995	1996						
Mean F Ages								
H.cons 2 to 8	.85	.00	.34	.51	.59	.68	.85	1.02
Effort relative to 1994								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	492	420	420	420	420	420	420	420
Spawning	78	89	89	89	89	89	89	89
Catch weight (,000t)								
H.cons	169	0	81	113	127	141	165	185
Biomass at start of 1997								
Total		683	554	504	482	461	425	394
Spawning		236	169	144	132	122	103	88

	Year							
	1995	1996						
Effort relative to 1994								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.10	.19	.19	.19	.19	.19	.19	.19
Spawning	.09	.14	.14	.14	.14	.14	.14	.14
Catch weight								
H.cons	.14	.00	.26	.20	.18	.17	.16	.15
Biomass at start of 1997								
Total		.20	.24	.25	.26	.27	.29	.30
Spawning		.17	.20	.20	.20	.21	.21	.22

Table 3.2.18 Cod North Sea
Detailed forecast tables.

Forecast for year 1995
F multiplier H.cons=1.00

Age	Populations Stock No.	Catch number H.Cons	Catch number Total
1	256000	18649	18649
2	188000	88918	88918
3	15736	8296	8296
4	14299	7666	7666
5	1688	843	843
6	470	234	234
7	440	252	252
8	53	28	28
9	29	18	18
10	12	6	6
11	11	6	6
Wt	492	169	169

Forecast for year 1996
F multiplier H.cons=1.00

Age	Populations Stock No.	Catch number H.Cons	Catch number Total
1	162000	11801	11801
2	102943	48689	48689
3	59886	31572	31572
4	5083	2725	2725
5	4880	2437	2437
6	630	314	314
7	176	101	101
8	136	71	71
9	19	11	11
10	8	4	4
11	9	4	4
Wt	421	165	165

Table 3.2.19 Cod North Sea

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.
TAC constraint of 120000 tonnes applied.

	Year							
	1995	1996						
Mean F Ages								
H.cons 2 to 8	.53	.00	.34	.51	.59	.68	.85	1.02
Effort relative to 1994								
H.cons	.63	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	492	496	496	496	496	496	496	496
Spawning	78	119	119	119	119	119	119	119
Catch weight (,000t)								
H.cons	120	0	101	140	158	175	204	229
Biomass at start of 1997								
Total		786	627	565	538	513	469	431
Spawning		306	219	185	170	157	133	113

	Year							
	1995	1996						
Effort relative to 1994								
H.cons	.63	.00	.40	.60	.70	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.10	.17	.17	.17	.17	.17	.17	.17
Spawning	.09	.13	.13	.13	.13	.13	.13	.13
Catch weight								
H.cons	.18	.00	.26	.20	.18	.17	.16	.15
Biomass at start of 1997								
Total		.18	.22	.23	.24	.25	.26	.28
Spawning		.16	.18	.19	.19	.19	.20	.21

Table 3.2.20 Cod North Sea
Detailed forecast tables.

Forecast for year 1995
F multiplier H.cons= .63

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	256000	11976	11976
2	188000	63425	63425
3	15736	6001	6001
4	14299	5549	5549
5	1688	603	603
6	470	168	168
7	440	185	185
8	53	20	20
9	29	13	13
10	12	4	4
11	11	4	4
Wt	492	120	120

Forecast for year 1996
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	162000	11801	11801
2	107247	50724	50724
3	80270	42318	42318
4	7033	3771	3771
5	6740	3365	3365
6	842	420	420
7	235	134	134
8	195	102	102
9	26	16	16
10	12	6	6
11	11	6	6
Wt	497	204	204

Table 3.2.21 Stock: Cod in Sub-area IV (North Sea)

Assessment Quality Control Diagram 1

Average F(2-8,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	0.83	0.80						
1990	0.86	0.83	0.83					
1991	0.89	0.88	0.98	0.75				
1992	0.89	0.89	1.00	0.78	0.93			
1993	0.89	0.88	0.95	0.72	0.85	0.86		
1994	0.91	0.89	0.99	0.71	0.92	0.84	0.94	
1995	0.91	0.89	0.99	0.72	0.93	0.86	0.91	0.85

Remarks:

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: millions								
Date of assessment	Year class							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	193	329[1]						
1990	201	324	161[2]					
1991	142	316	140	216				
1992	143	246	137	155	345			
1993	150	257	113	150	410	199		
1994	150	242	112	143	300	165	406	
1995	151	240	112	142	281	100	465	256

[1]Amended by ACFM to 299. [2]As revised by ACFM.

Remarks:

Table 3.2.21 Stock: Cod in Sub-area IV (North Sea) (Cont'd)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	88	91	82[1]	80[1,2]						
1990	84	85	87	78[1]	71[1]					
1991	79	73	66	64	66[1]	68[1]				
1992	79	73	62	56	51	47[1]	52[1]			
1993	82	76	65	60	64	58	62[1]	66[1]		
1994	85	76	64	62	61	57	63	69[1]	74[1]	
1995	85	76	63	62	60	57	59	78	89[1]	103[1]

[1]Forecast. [2]Assuming TAC taken in 1988, F(89) = 0.7 F(87).

Remarks:

Table 3.2.22		North Sea cod. Inclusion of the IBTS quarterly survey data in single species assessment.						
		Estimates of survivors in tuning runs which include and exclude the new survey series.						
	Final XSA (which excludes IBTS)		XSA including quarterly IBTS					
Age	Survivors (age 1)	ext SE	Survivors	ext SE	IBTS Q2 Estimate	Weight	IBTS Q4 Estimate	Weight
1	123813	0.13	118597	0.11	27445	0.003	116025	0.17
2	15736	0.09	15078	0.08	12420	0.069	18499	0.145
3	14299	0.05	12644	0.05	11522	0.064	11181	0.103
4	1688	0.04	1544	0.04	1620	0.108	1316	0.055

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Figure 3.2.1 North Sea cod. Long term trends.

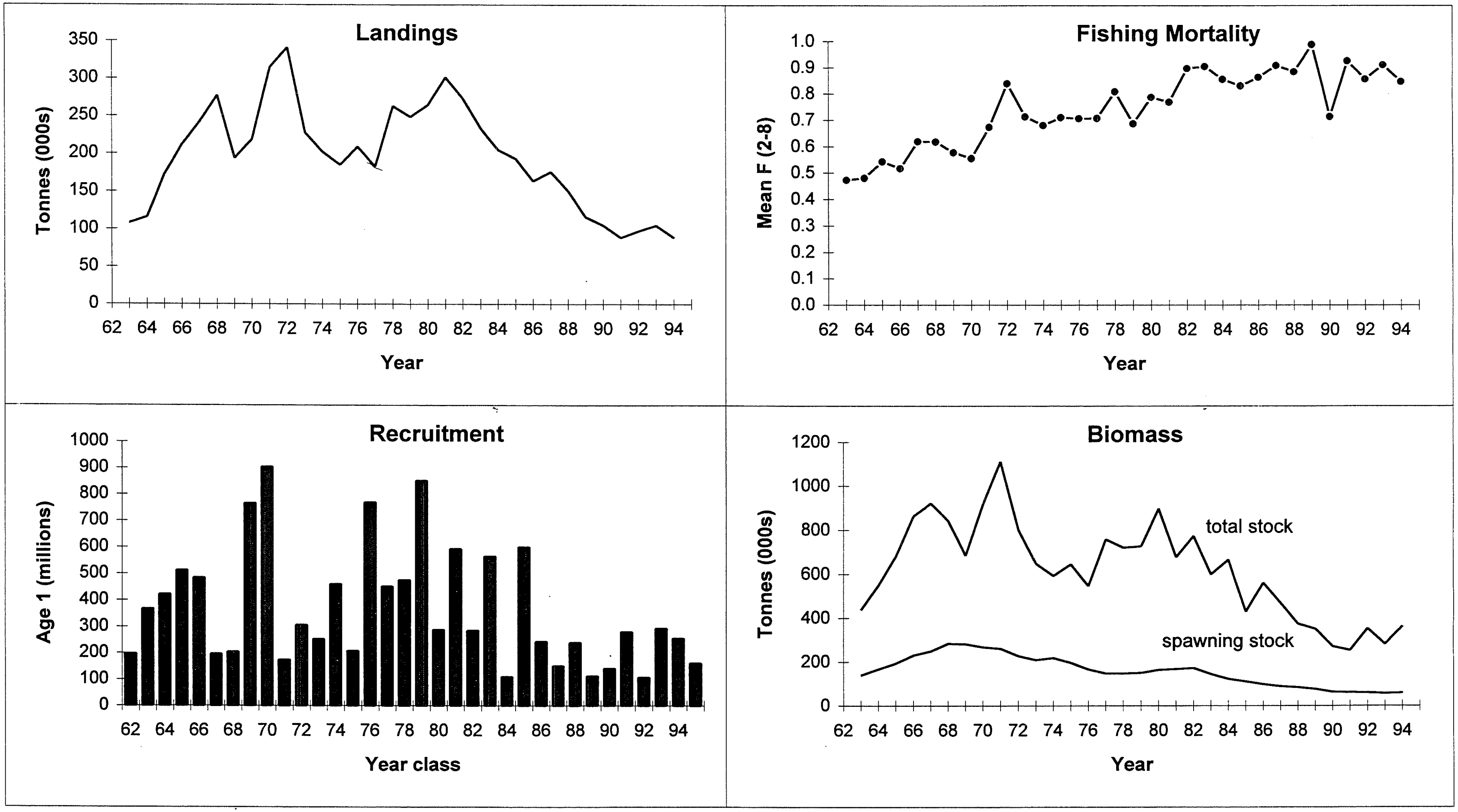

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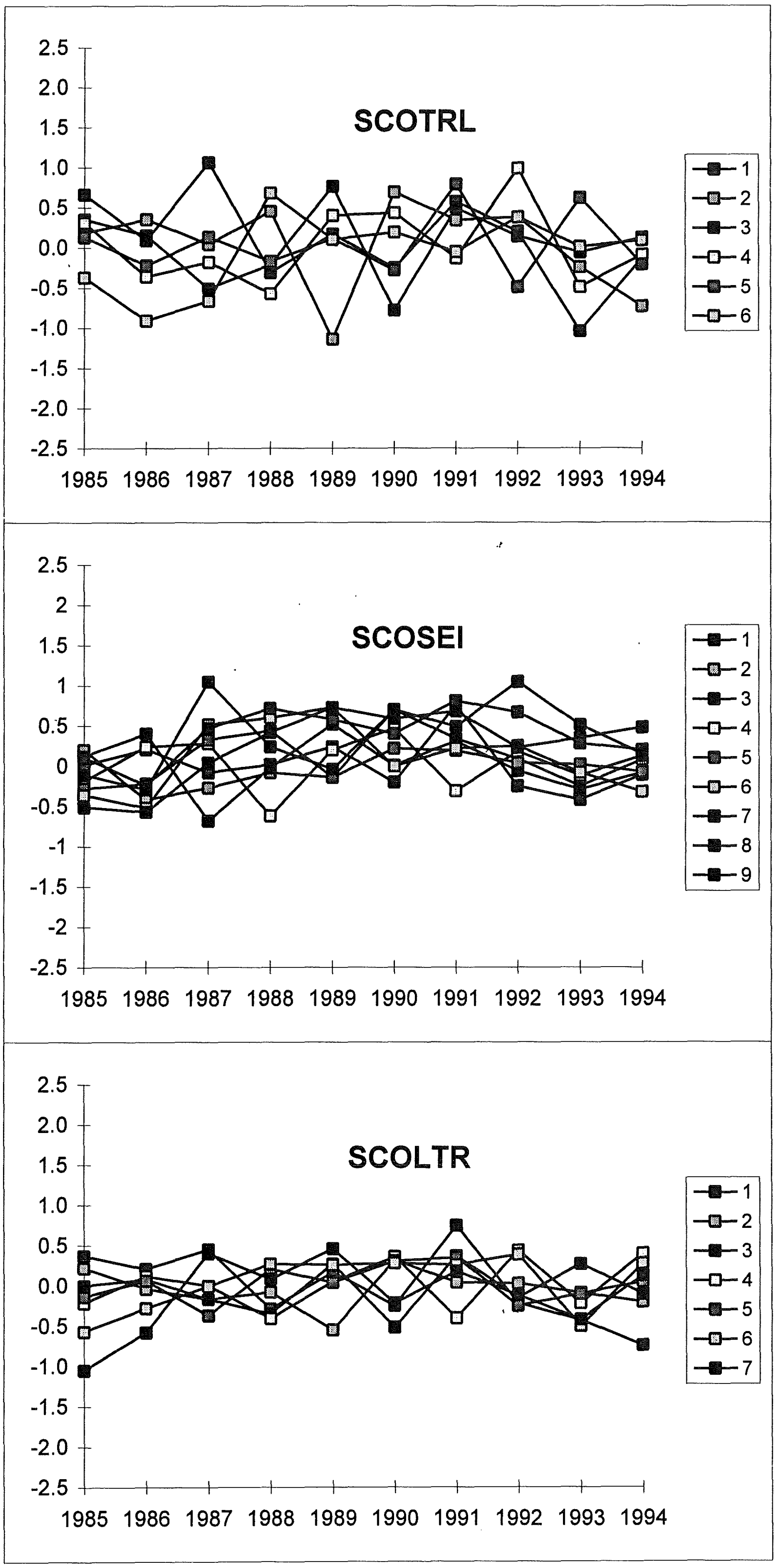
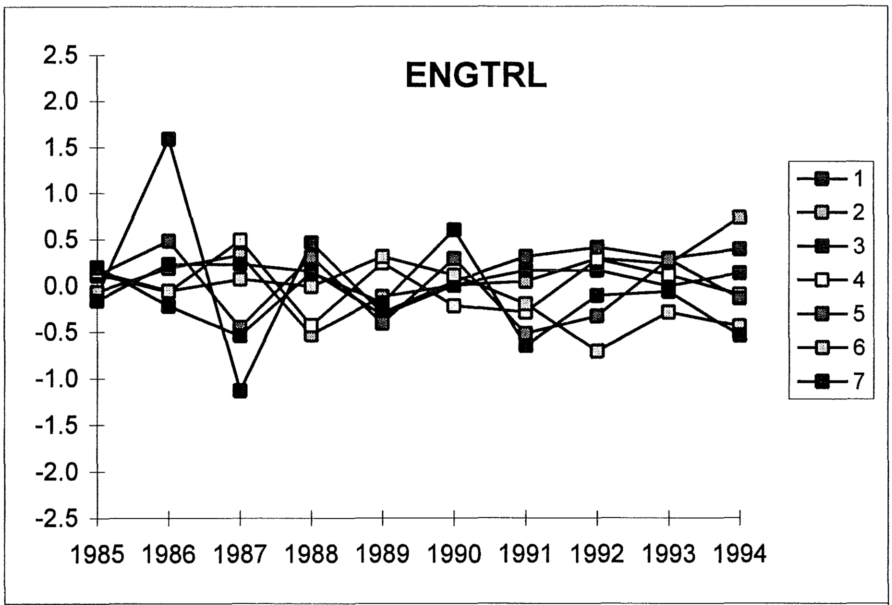
Figure 3.2.2 North Sea cod. Log catchability residuals.

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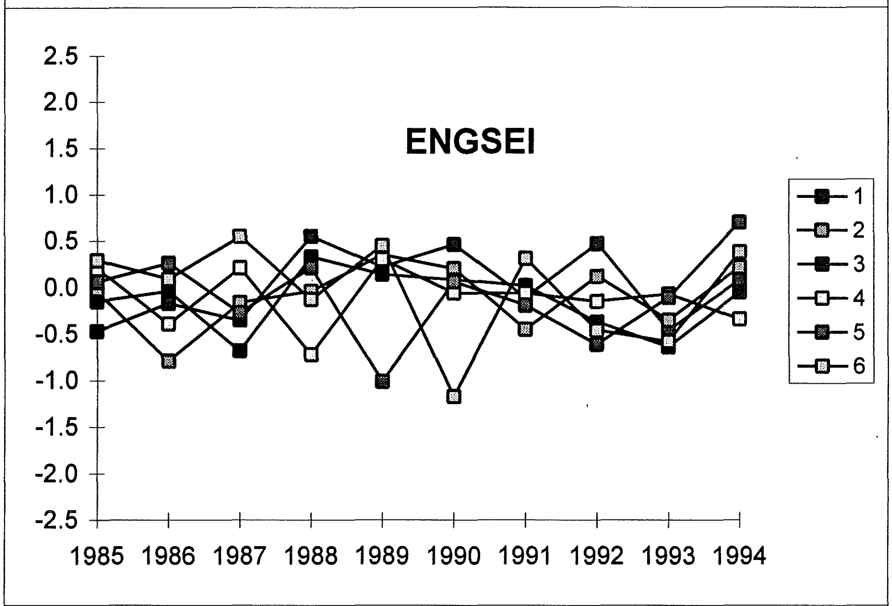
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2
3
4
5
6
7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0.0
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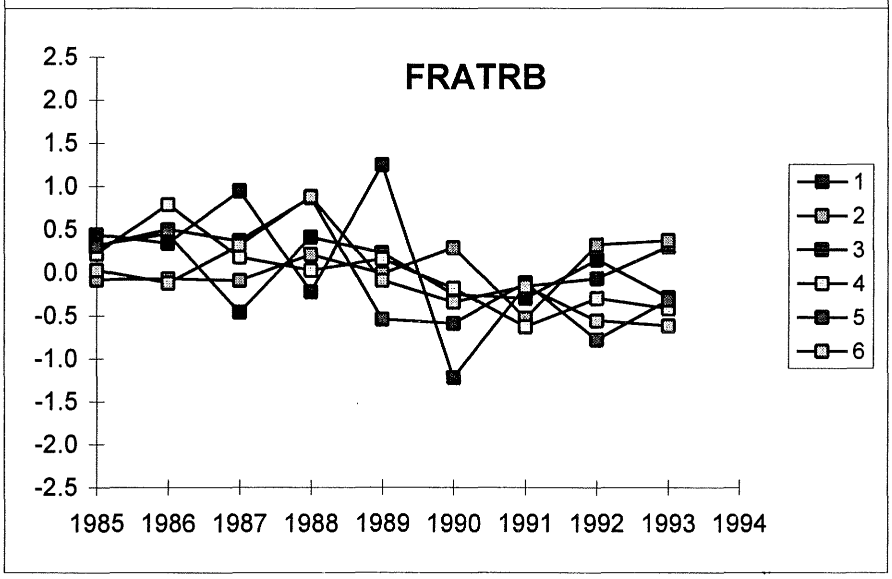
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2
3
4
5
6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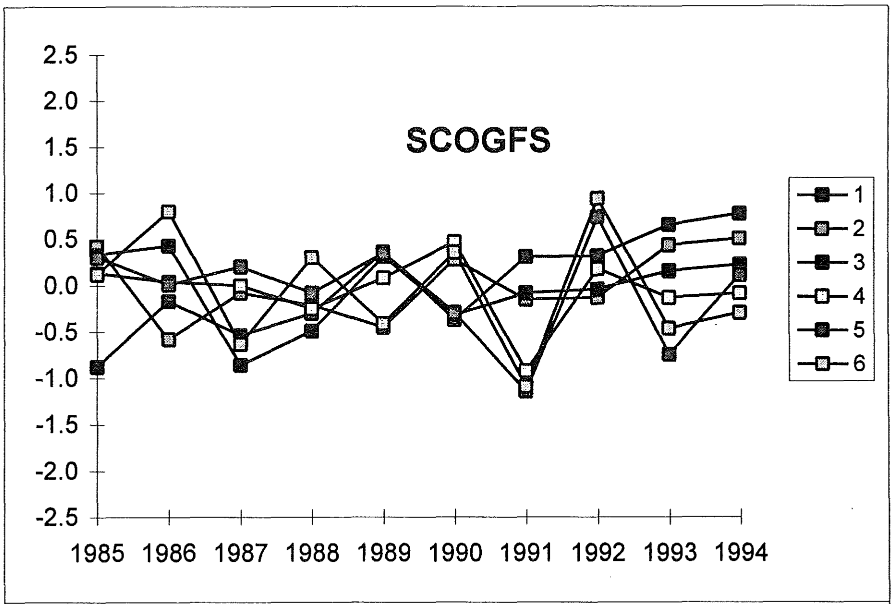
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2
3
4
5
6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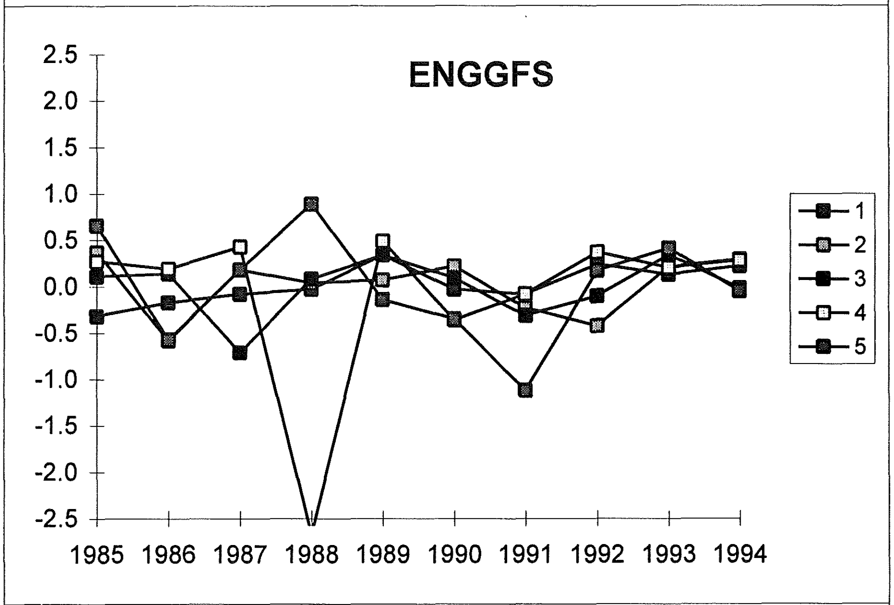
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2
3
4
5
6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1.5
1.0
0.5
0.0
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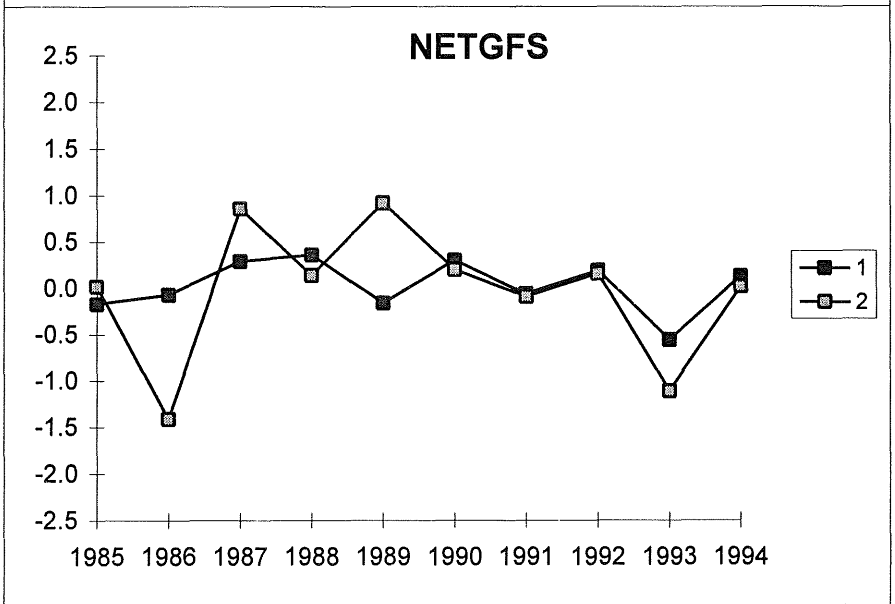
-1.5
-2.0
-2.5
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2
3
4
5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1.0
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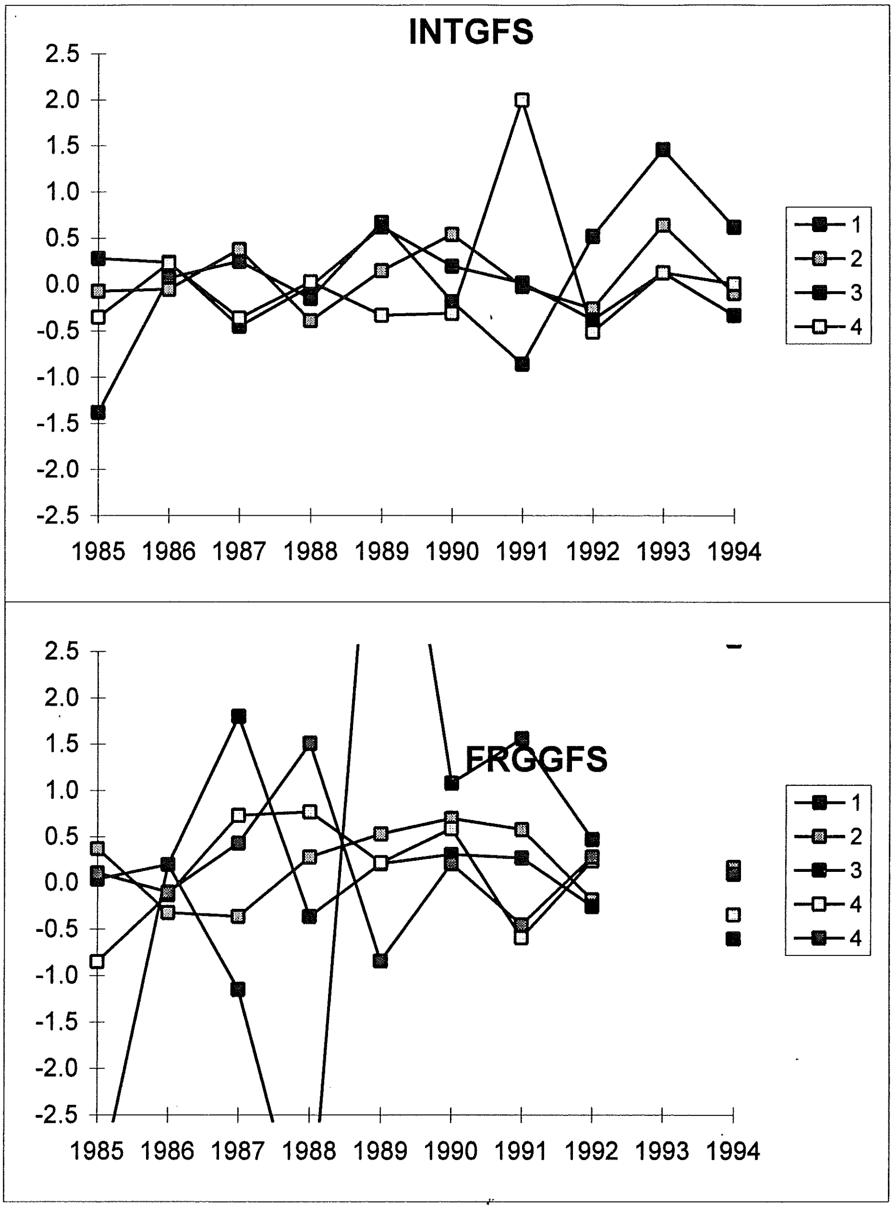
-1.5
-2.0
-2.5
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2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-1.0
-1.5
-2.0
-2.5
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2
3
4
FRGGFS
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1
2
3
4
4

Figure 3.2.3 North Sea cod. Retrospective analysis of mean F.

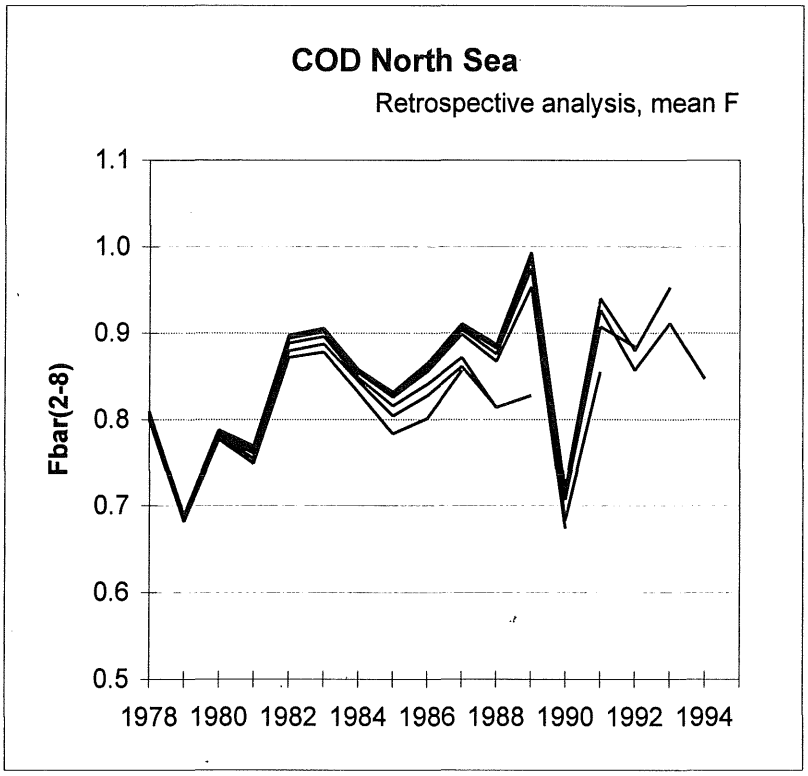

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Figure 3.2.4 North Sea cod. Survey recruitment indices versus VPA.

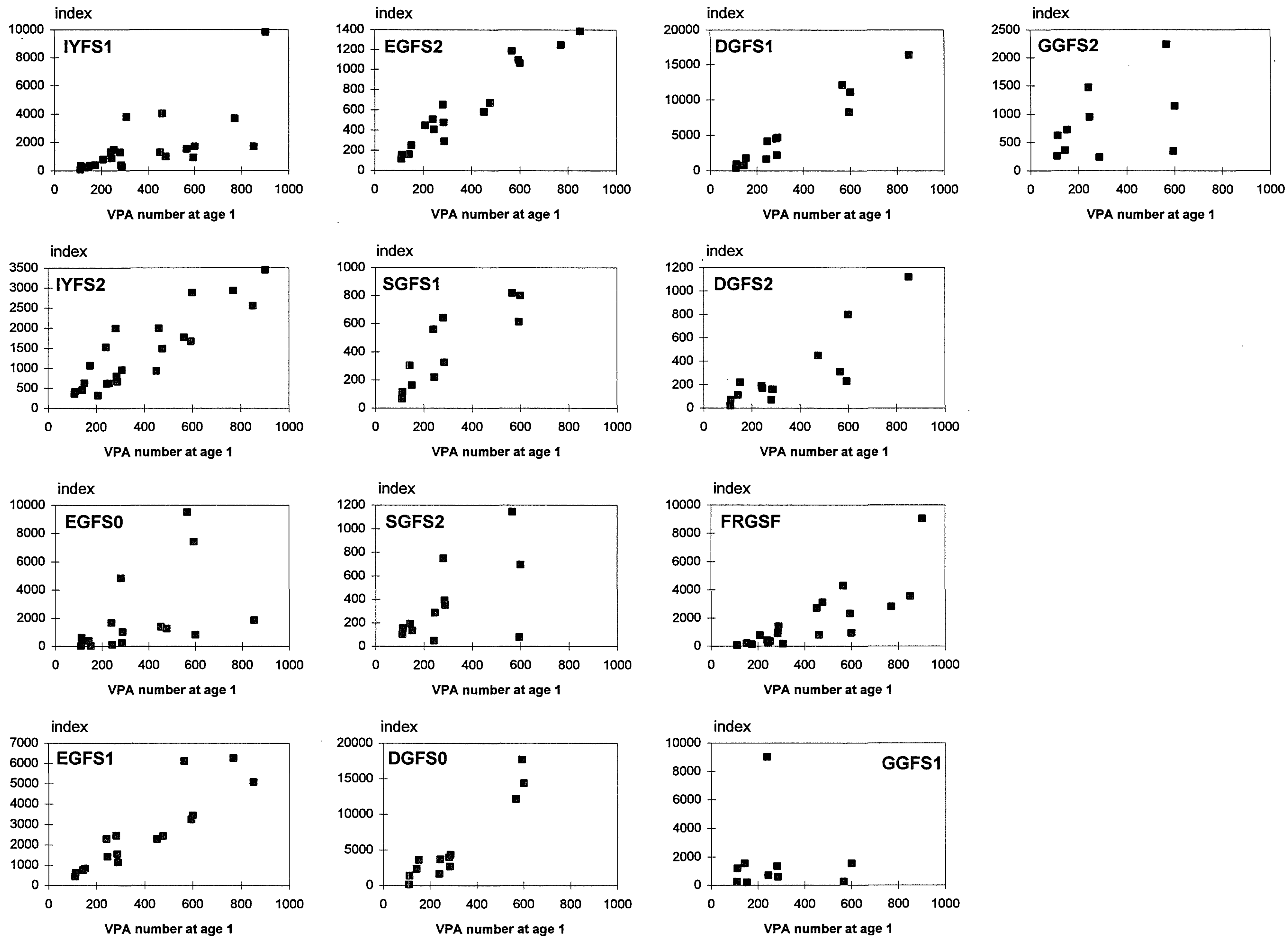

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Figure 3.2.5 Cod IV Stock-recruitment

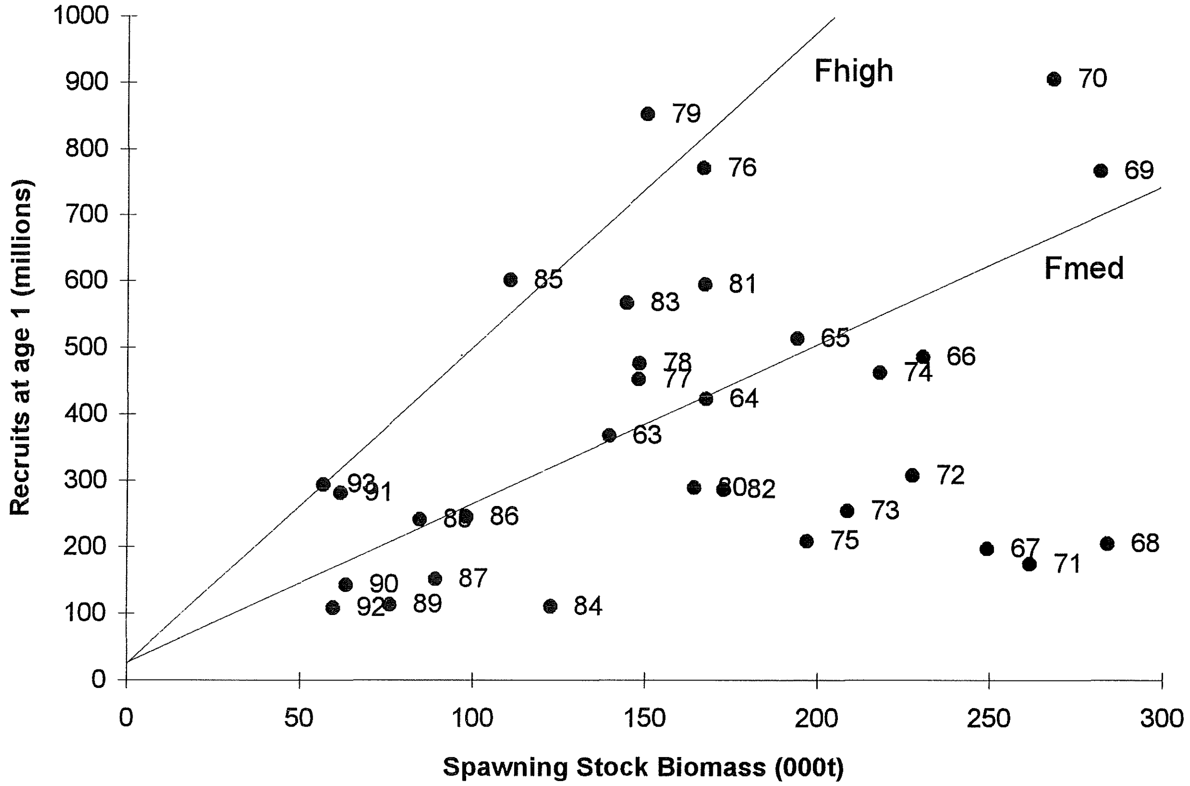

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Figure 3.2.5 Cod IV Stock-recruitment

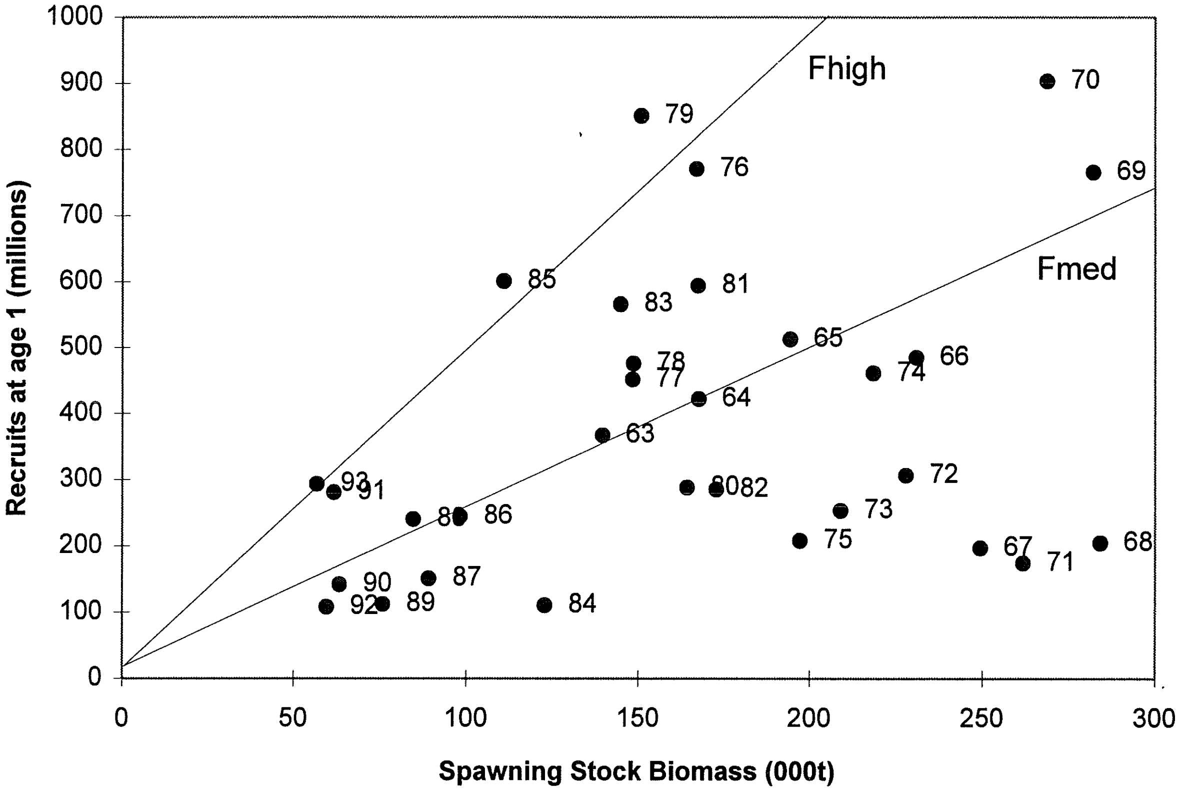

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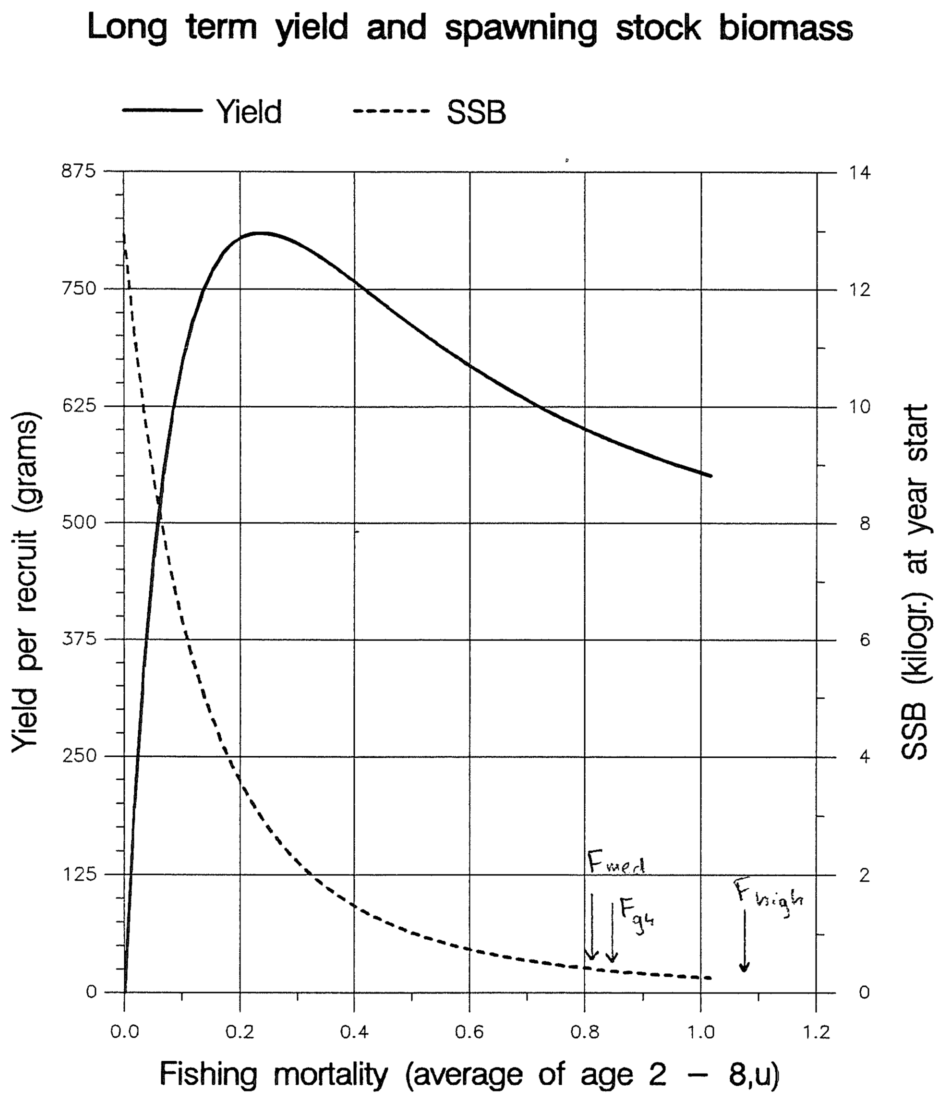
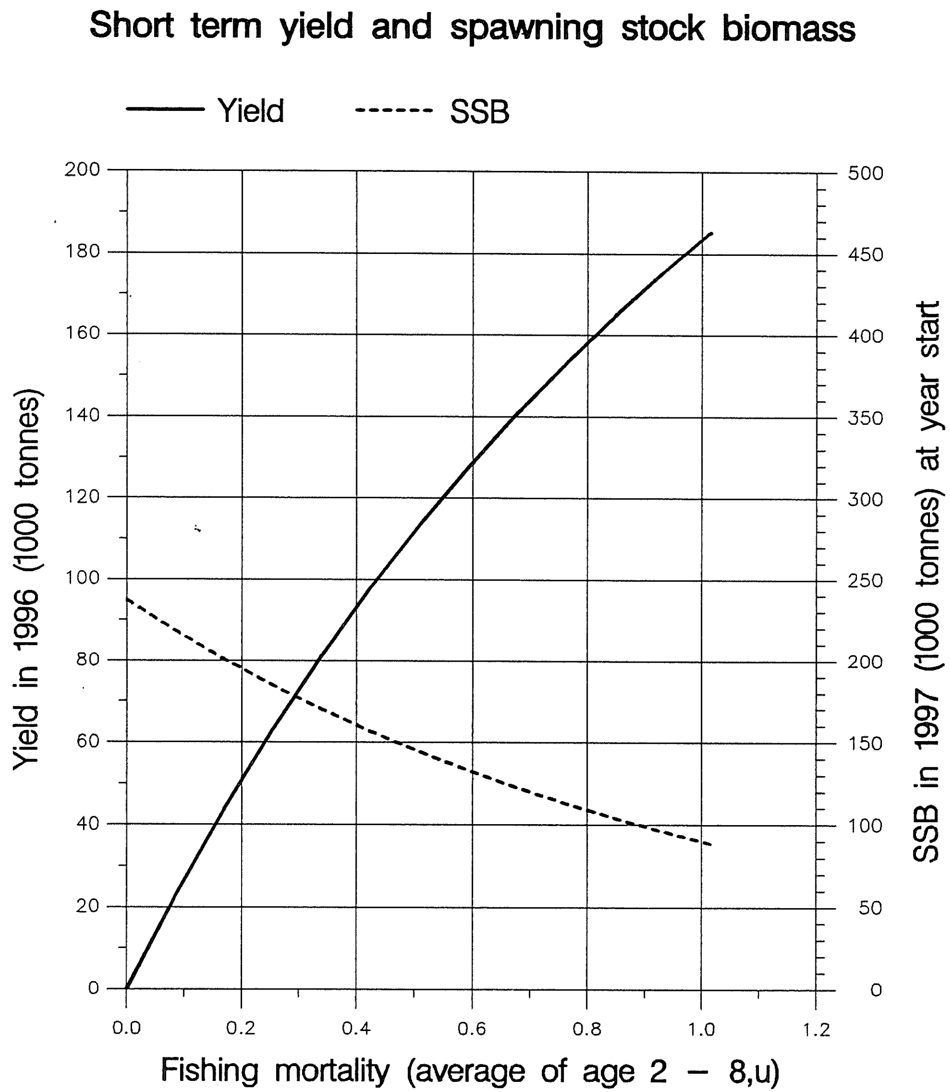
Table 3.2.6

Fish Stock Summary
Cod in the North Sea (Fishing Area IV)
7-10-1995



(run: HH2) C



(run: HH1) D

Figure 3.2.7 North Sea cod. Sensitivity analysis of short term forecast. Linear sensitivity coefficients (elasticities). Key to labels in Table 3.2.16.

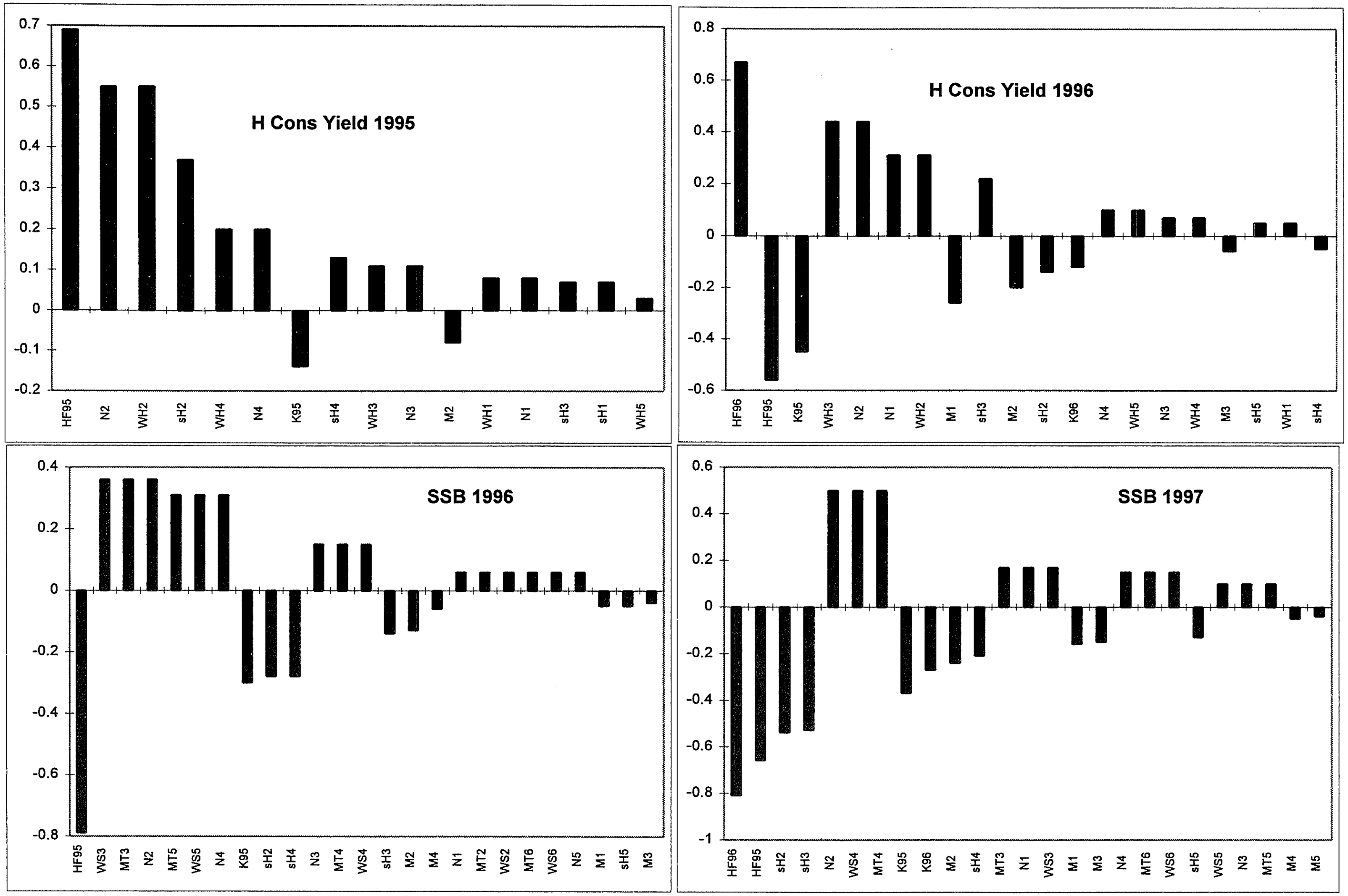


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Figure 3.2.8 North Sea cod. Sensitivity analysis of short term forecast. Proportion of total variance contributed by each input. Key to labels in Table 3.2.16.

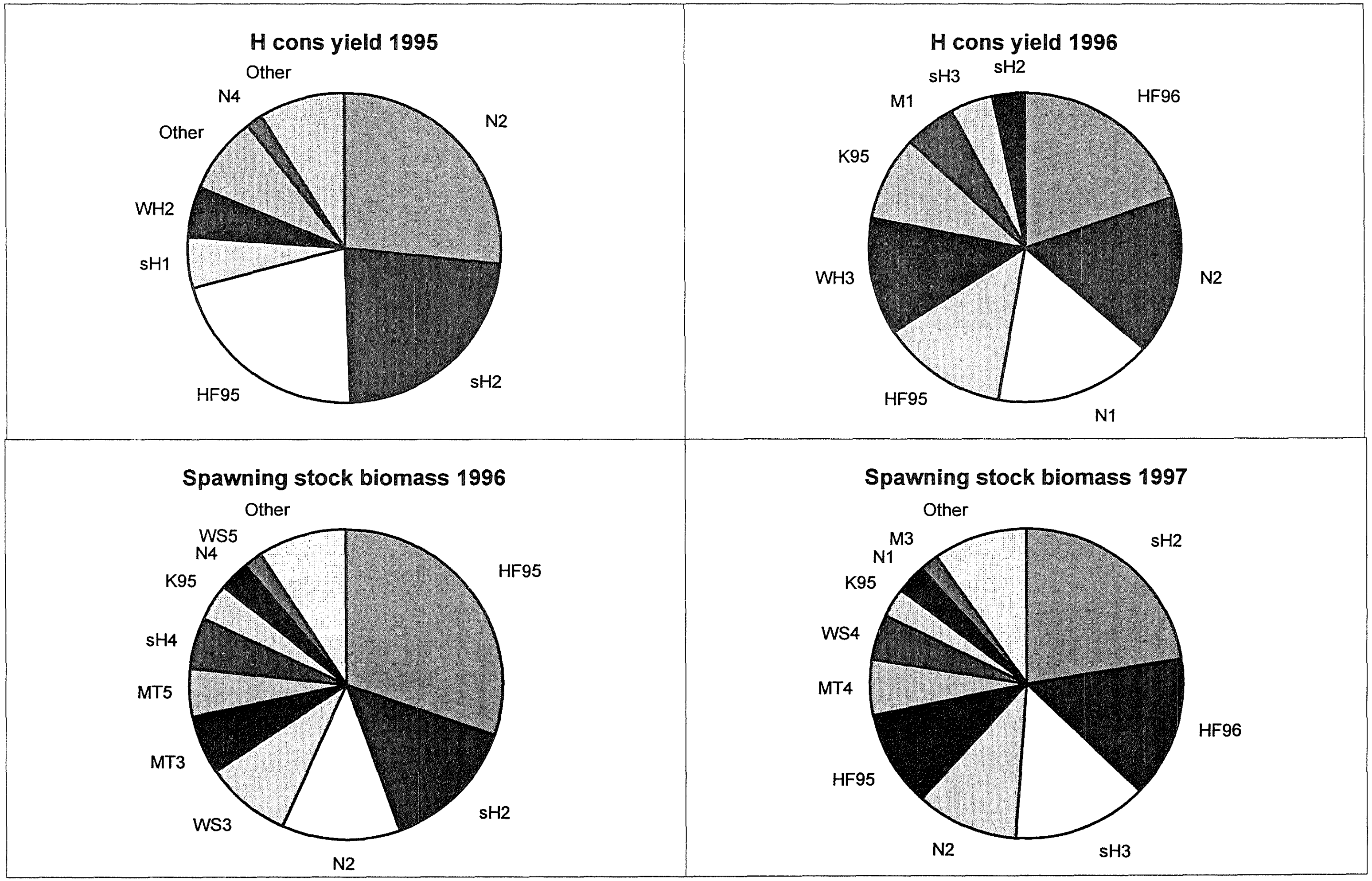

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Figure 3.2.9 Cod, North Sea. Sensitivity analysis of short term status quo forecast. Cumulative probability distributions.

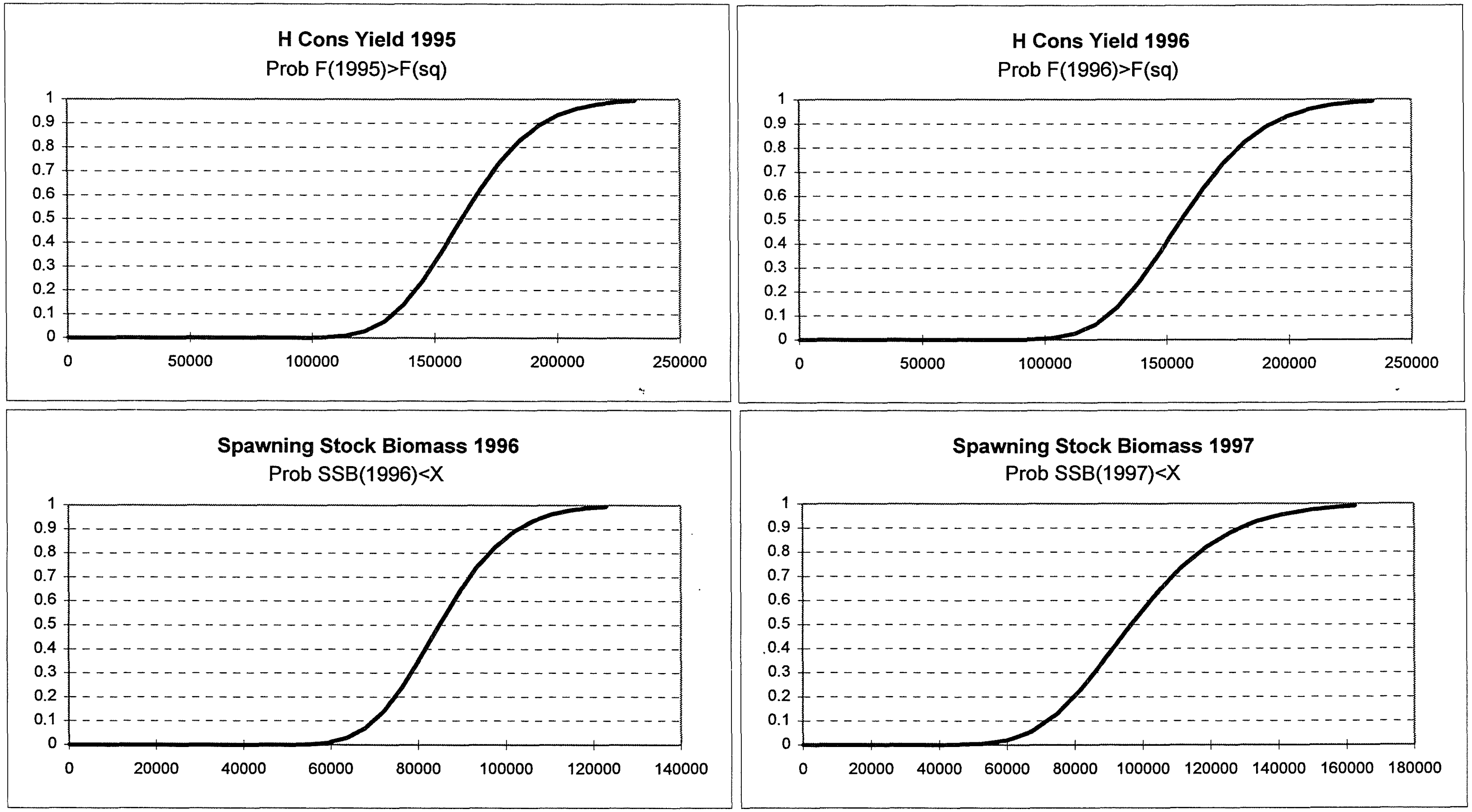

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Figure 3.2.10 North Sea Cod. Medium term projections. Bold lines show 5, 25, 50, 75 and 95 percentiles. Other lines show five sample trajectories.

Number of simulations = 500 Relative H. Cons effort = 1.00

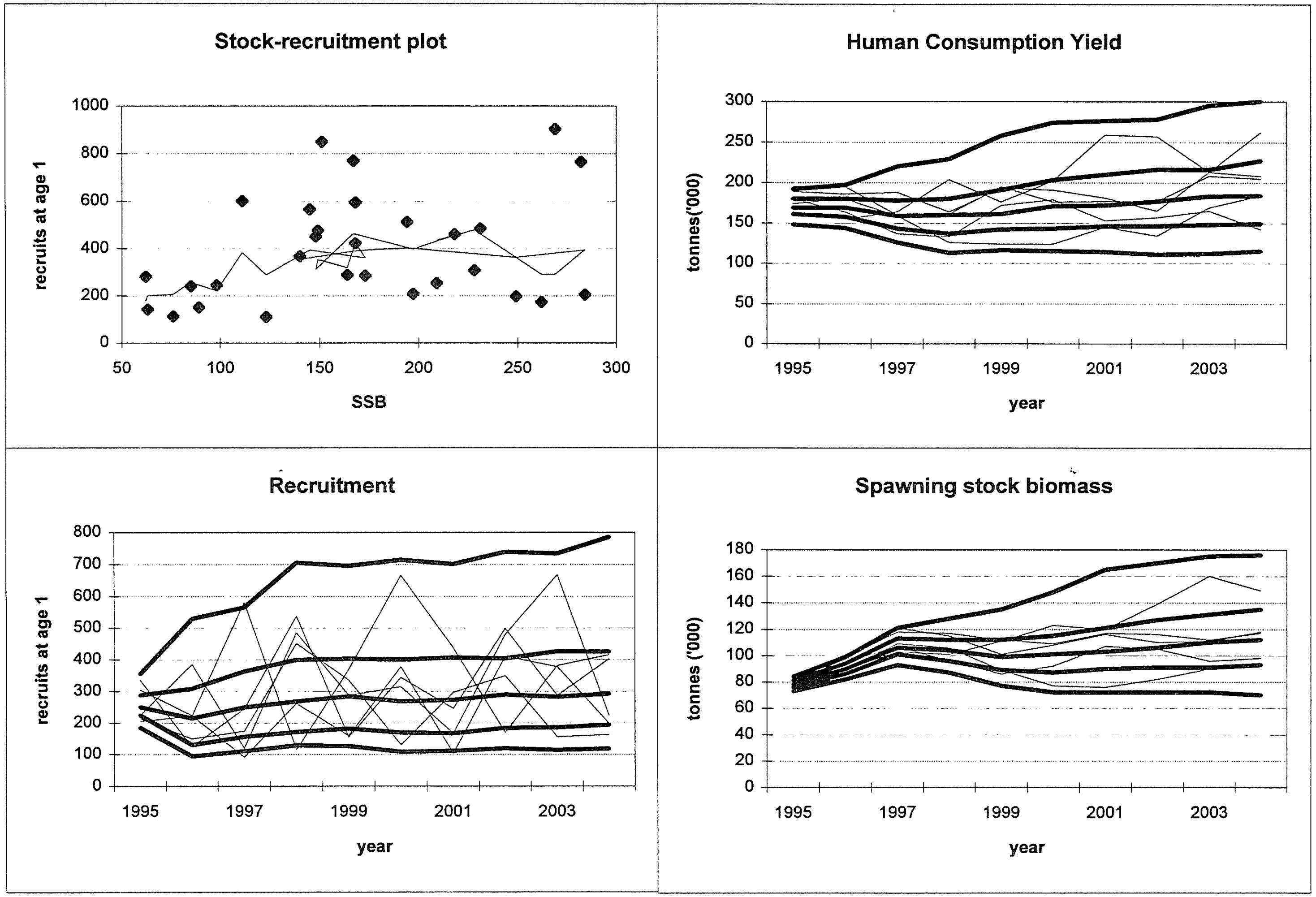

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Figure 3.2.11 North Sea Cod. Medium term projections. Bold lines show 5, 25, 50, 75 and 95 percentiles. Other lines show five sample trajectories.

Number of simulations = 500 Relative H. Cons effort = 0.70

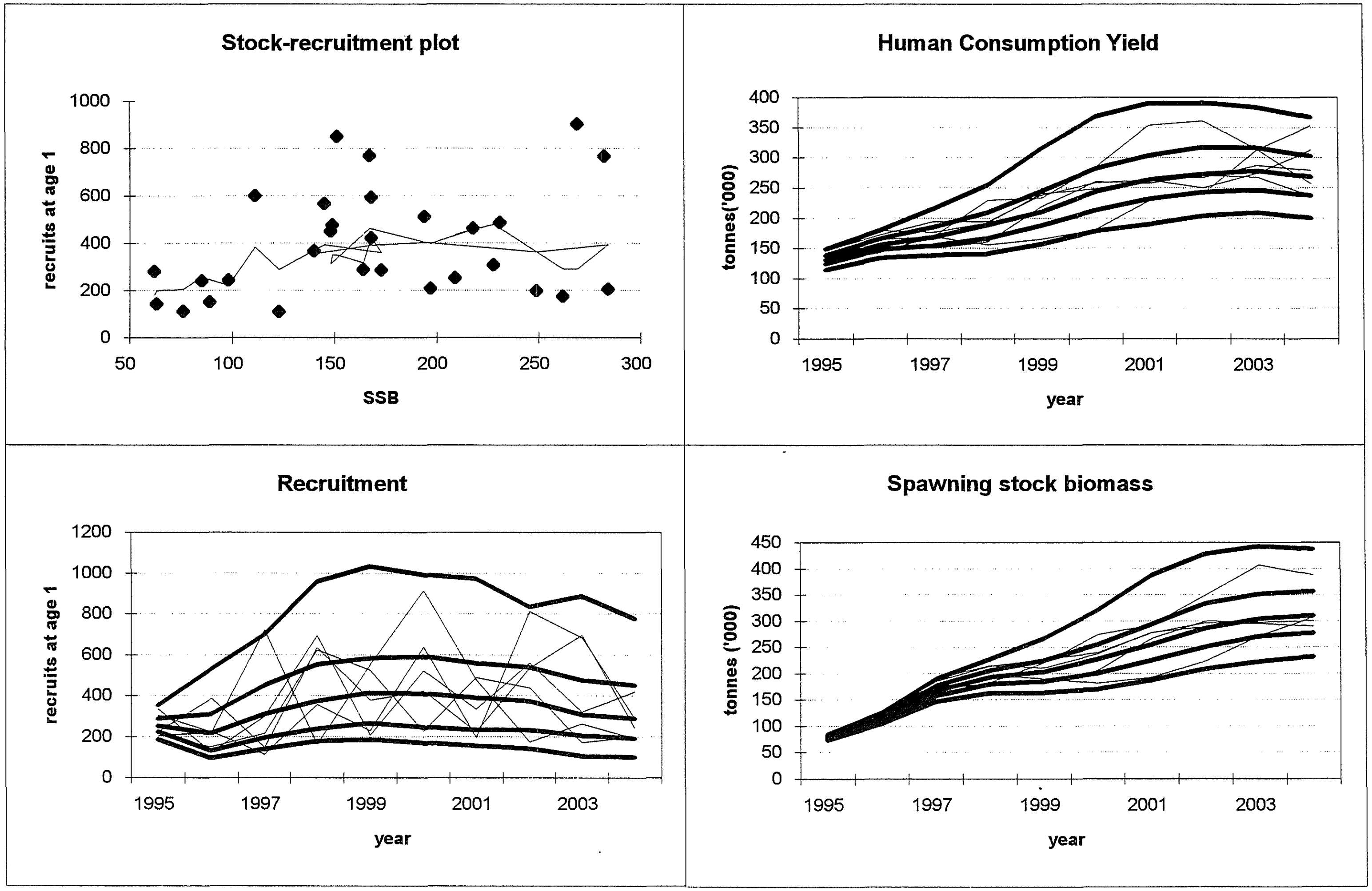

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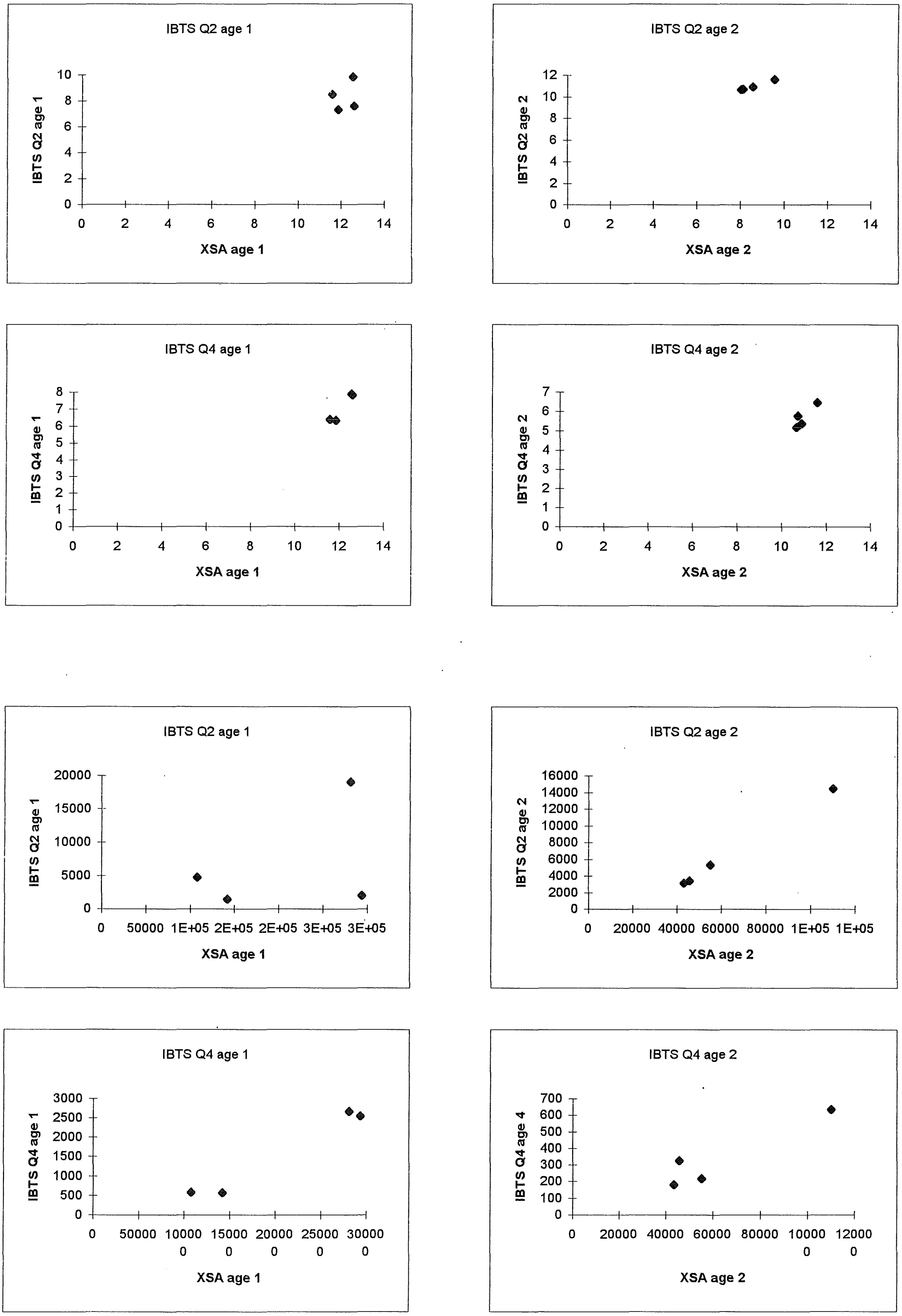
Figure 3.2.12 North Sea cod. IBTS Q2 and Q4 indices Vs XSA abundance



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3.3 Haddock in Sub-Area IV

3.3.1 Catch trends

Human consumption landings in 1994 were around 80 thousand tonnes. This level is similar to the 1993 figure, and as in 1993, it represents a substantial undershoot of the TAC (which was 117,700 t in 1994). Official estimates of human consumption landings are given along with Working Group estimates in Table 3.3.1, and Working Group estimates of human consumption landings, discards and industrial bycatch are given in Table 3.3.2. Levels of both discards and industrial bycatch dropped in 1994 compared to 1993. Long-term trends in catches for all categories are shown in Figure 3.3.1.

In Table 3.3.1 it can be seen that the official figure for human consumption landings in 1994 is rather larger than the Working Group estimate. This results largely from a correction made for misreporting in 1994. As the 1994 TAC for haddock in the North Sea proved to be unrestrictive, there was a tendency for boats catching haddock in Divisions VIa and VIb to report the catches as having come from the North Sea. An estimate available to the Working Group indicates that around 6,000 t were misreported in this way. This estimate is based on the aggregation of estimates of non-reporting and misreporting which are available on a month-port basis, and thus should be regarded as an estimate based on partial data. The corrections made are consistent with those used in the assessment of stocks of Haddock in Divisions VIa and VIb by the Northern Shelf Demersal Working Group, and the correction is discussed more fully in their Report (Anon. 1996)

Haddock is taken as part of a mixed demersal fishery, with the large majority of the catch being taken by Scottish light trawlers, seiners and pair trawlers. These gears have a minimum mesh size of 100mm. Smaller quantities of haddock are taken by other Scottish vessels, including *Nephrops* trawlers which use 70 mm mesh and thus discard higher quantities. The fishery is also exploited by vessels from countries including England, Denmark and Norway.

3.3.2 Natural mortality, maturity, age compositions, mean weight at age.

Natural mortality estimates are given in Table 3.3.3, along with the maturity ogive. Both are as used previously. The mortality estimates originate from MSVPA. The maturity ogive is based on IYFS data. Biomass totals are calculated as at the start of the year.

Age composition data for the human consumption catch were supplied by Denmark, England, France, and Scotland. Denmark supplied age compositions for industrial bycatch, and length compositions from the Norwegian industrial bycatch were converted to age using Scottish discard ALKs. The catch at age data are given in Table 3.3.4.

Catches in 1994 were dominated by 2 year-old fish. However, the total catch of 2-group fish (309 million) was substantially lower than that predicted by the 1994 WG (538 million). 1994 catches of 1 and 3 year-old fish were similar to the predicted catches, but catches of 4 year-old and older fish were all under-estimated by the previous assessment, typically by 15-20%.

The age composition data have not been SOP corrected. This follows the practice adopted at the previous WG meeting. SOP discrepancies ranged between, -6% and +21%. The uncorrected weights at age from the total catch (i.e. human consumption landings, plus discards plus industrial bycatch) are given in Table 3.3.5. These are also used as stock weights at age.

3.3.3 Catch, effort and research vessel data

The fleets used in tuning for this stock were reviewed closely in advance of the Working Group meeting, with the result that there have been some changes in the fleets used. This review is discussed in section 3.3.4. The fleets used are summarised in Table 3.3.6, and the tuning data are given in Table 3.3.7. In addition to the fleets listed in Table 3.3.7, CPUE data were also available for Scottish heavy trawlers, French trawlers, and from English and German groundfish surveys. The data from the International groundfish survey (first quarter) have been treated as if the survey was made at the very end of the previous year. This allows the 1995 survey indices to be included in the tuning, and follows the recommendation in the ACFM blue pages.

3.3.4 Catch-at-age analysis

The age ranges treated as recruits and as the Q-plateau for this stock were investigated thoroughly at the previous WG meeting, and have not been further considered here. Ages less than 2 are treated as recruits, and the Q-plateau age is set at 7. For the purposes of trial runs, all other XSA settings used were default values except where indicated. Results from exploratory runs are retained in the Working Group stock file.

Exploratory tuning runs were made using unshrunk Laurec-Shepherd tuning on each CPUE series individually, and the log catchability residuals were then plotted to permit inspection for catchability trends. These plots are retained in the Working Group file for reference. The plots indicate a clear catchability trend at all ages in the German groundfish survey. In addition, the residuals from the Scottish heavy trawlers showed higher variation than those from the other fleets. Effort by this fleet has declined considerably in recent years, with only a few older vessels now remaining, so it is unrealistic to expect catchability to have remained constant. Thus preliminary analysis gave clear indications that these two fleets should be removed from the analysis.

For the remaining fleets, the Laurec-Shepherd catchability plots did not show any obvious problems, although both the French trawlers and the English groundfish survey tend to show fairly large negative residuals in the most recent years, contrasting with positive residuals in earlier years. To investigate how these fleets contributed to survivor estimates, an XSA run was made using all fleets. The diagnostics from this run indicated that at virtually all ages these two fleets gave survivor estimates which were below the overall estimate at that age. No such pattern was apparent with the other fleets. As a further investigation of the influence of these fleets, comparative retrospective runs including and excluding these two fleets were made. The results (Figure 3.3.2) clearly indicate that excluding the English groundfish survey and the French trawlers from the XSA improves the retrospective performance of the assessment.

To summarise, the final XSA run used commercial CPUE data from Scottish seiners and light trawlers and survey data from the Scottish third-quarter survey and from the international first-quarter survey. Ages less than 2 were treated as recruits, with the q-plateau set at age 7. The SE for shrinkage was set at 0.5. All other XSA settings used default values. Relative to the assessment made at the previous WG meeting, this assessment differs in the fleets used in the tuning.

The diagnostics from this XSA run are given in Table 3.3.8. The diagnostics indicate that the indices from the international groundfish survey receive the highest weight in the estimates of survivors at ages 0-3, with the Scottish groundfish indices and the F-shrinkage mean also receiving relatively high weight at ages 0-1. At age 0, the individual fleet estimates of survivors are rather discrepant, but all are above the F and population shrinkage means. At age 1, the estimates from the two fleets which receive the most weight (The International and Scottish groundfish surveys), are similar, and both are close to the F-shrinkage mean. At age 2 and upwards, the commercial fleets begin to receive more weighting, and the individual fleet estimates for all fleets tend to be rather homogeneous. This is also reflected in the catchability residuals (Figure 3.3.3).

Stock numbers at age from the final XSA run are given in Table 3.3.9, and estimates of F at age are given in Table 3.3.10. Retrospective trends in mean F from this XSA run are given in Figure 3.3.2. For comparison, this figure also shows the retrospective trends if all available fleet data are included. The retrospective plots show that this assessment tends to over-estimate F in the most recent year. The present assessment indicates a mean total F in 1994 of 0.89, which is close to the long-term average of 0.93.

3.3.5 Recruitment estimates

A number of 1995 surveys are available for this stock, so it is appropriate to use RCT3 to utilise this additional information. The RCT3 input file for the run at age 0 is given in Table 3.3.11; the runs at ages 1 and 2 used the same recruitment indices but estimates of the strength of each year class at the appropriate age from the current XSA. Indices from the second and fourth quarter IBTS surveys are included in the file for information, although they are not included in the regression. Preliminary RCT3 runs indicated that the RCT3 estimate of the 1992 year class at age 1 was almost identical to the XSA estimate. For this reason, the 1992 estimate was assumed to have converged. This also has the advantage of extending the range of the RCT3 regression for some series for which the 1992 indices are amongst the highest. Output from the RCT3 runs for each age is given in Tables 3.3.12a-c. The survey indices used in the RCT3 run are compared with the converged portion of the VPA in Figure 3.3.4. The indices for the three most recent year classes are also indicated on this Figure.

Indices of the 1995 year class as 0-group are available from the English and Scottish Groundfish surveys. Both indices indicate that this year class is of below average strength, and both receive high weight in the RCT3 estimate. As both indices fall within the range covered by the RCT3 regression, it is appropriate to use the RCT3 estimate which is 20235 million (SE 0.90).

Previous assessments of this stock have had a tendency to over-estimate strong year classes so it is appropriate to be conservative in estimating the strength of the 1994 year class. Indices of the 1994 year class are available the from various surveys, the most important being the Scottish survey (ages 0 and 1); the English survey (ages 0 and 1) and the first quarter International survey (age 1). In the case of the Scottish survey, both indices are the highest in the series, and as can be seen in Figure 3.3.4, they fall well outside the range covered by the RCT3 regression. The IYFS age 1 index is also the highest in the series, but is much less of an outlier than the Scottish indices. The English indices are not the highest in the series. In view of this, RCT3 was run with the Scottish age 0 and 1 indices weighted out, but with the IYFS index included. This RCT3 run estimates the 1994 year class at the start of 1995 as 7314.7 million (SE 0.26). This compares with the XSA estimate of 5142.6 million (SE 0.37). The RCT3 estimate uses additional information, but is still relatively conservative given that the high Scottish indices have been excluded from the estimate. For this reason the RCT3 estimate has been used in the prediction.

For the long term trends in Figure 3.3.1 and Table 3.3.13, a RCT3 estimate of the 1994 year class at age 0 has been used. This estimate (78532 million) comes from a RCT3 run at age 0 with the Scottish age 0 and 1 indices weighted out. The output from this run is retained in the WG stock file.

The RCT3 estimate of the 1993 year class at age 2 is 279.3 million (SE 0.14), which compares with the XSA estimate of 253.8 million (SE 0.16). These estimates are similar, so the XSA estimate of this year class was used for the prediction. XSA estimates of numbers at age 3 and older at the start of 1995 were also used in the prediction. For numbers at age 0 in 1996, the long term geometric mean value of 25.5 billion was used.

3.3.6 Historical Stock Trends

Trends in spawning stock biomass, recruitment and mean F since 1963 are given in Table 3.3.13 and Figure 3.3.1. Human consumption reference F has fluctuated around a mean level of 0.76, and the present assessment indicates that it is currently slightly below this level. Recruitment shows considerable variation, with the current estimate of the 1994 year class indicating that it is the strongest since 1974. Spawning biomass has fluctuated, with occasional slight peaks corresponding to the maturation of strong year classes. SSB declined from 1985 to a historic low of 62,000 t in 1991, since when a slight increase is indicated.

3.3.7 Biological Reference Points

The stock-recruitment scatter plot is given in Figure 3.3.5. It is characterised by large variations in year class strength. Over the range of the spawning stock sizes for which data are available, there is no clear link between stock biomass and recruitment. The reference points F_{high}, F_{med}, and F_{low}, which are defined relative to the mean F (ages 2-6) of the human-consumption/discard fleet, are also indicated. Current human-consumption/discard mean F (0.848) is above F_{med}. A yield per recruit curve contingent upon the current exploitation pattern (prediction inputs, Table 3.3.14) is given in Figure 3.3.6 The reference points are also indicated on the yield per recruit curve and in the text table below.

Reference point	$F_{0.1}$	F_{max}	F_{low}	F_{med}	F_{high}
Value	0.161	0.386	0.080	0.573	>1.1

3.3.8 Short-term forecast

From comparison of the results of the previous prediction with the catches at age in 1994 it is apparent that the discard rates assumed for the previous prediction were largely over-estimates. At age 2 the prediction assumed that 56% of fish were discarded, with 18% being discarded at age 3. The 1994 catch and discard data indicate values of 77% and 30% respectively, for these ages. Recent retention rates and stock weights at age for the most important ages are given in Figure 3.3.7. It can be seen that there is a tendency for increased discarding at age in recent years. There is also some evidence of a decline in stock weights in recent year, but this is less clear.

In view of the apparent trend in discard rate, for weights at age and Fs at age in the prediction means have been taken over the years 1992 to 1994. This is a change from the previous practice of using a year-range of five years but it was considered that use of a narrower year range would give a better reflection of recent events in the fishery. Input parameters to the short-term catch prediction are given in Table 3.3.14, together with the CVs of these parameters. The population numbers used are described in Section 3.3.5. Full details of the Fs at age used in the prediction are given at the base of Table 3.3.14. Results of a prediction where mean Fs and weights were taken over a five-year range, are retained in the WG stock file for information.

The catch options table is given in Table 3.3.15. Assuming *status quo* F in 1995 and 1996, the forecast indicates human consumption (HC) landings of 111,000t in 1995 and 123,000t in 1996. The predicted 1995 catch compares with a TAC of 120,000t. SSB is predicted to increase from its 1995 level of 177,000t to 207,000t at the start of 1996 and 217,000t at the start of 1997. The estimate of *status quo* HC catch in 1996 has a CV of 27%.

Detailed forecast tables for the *status quo* option are given in Table 3.3.16. It can be seen that the 1992 year class is the most important component of the 1995 HC catch, whereas the 1994 year class becomes the most important year class in the 1996 landings. The short-term forecast is also summarised in Figure 3.3.8

The sensitivity analysis of the short-term catch prediction (Figures 3.3.9 - 3.3.11) also shows the relative importance of these two strong year classes. The linear sensitivity analysis (Figure 3.3.9) shows that the estimate of HC catch in 1995 is particularly sensitive to the level of fishing effort in 1995, and to population numbers, weights at age, and HC selectivity at age 3, i.e. the 1992 year class. In 1996, it is the 1994 year class and its survival and weight which are the most important inputs. In both 1996 and 1997, the estimates of SSB are most sensitive to factors influencing the survival and maturity of the 1994 year class.

The partial variances of the sensitivity analysis (Figure 3.3.10) again demonstrate the importance of the strong 1992 and 1994 year classes. Over 60% of the variance of the estimate of 1995 HC catch is associated with uncertainty in the estimates of the 1992 year class at the start of 1995, and the HC fishing mortality on that year class in 1995. The picture for the HC catch in 1996 is comparable, only with the 1994 year class contributing the large majority of the variance. It is the 1994 year class, together with factors affecting its survival and contribution to the spawning stock which contributes the largest proportion of the variance to the estimate of SSB in both 1996 and 1997. The cumulative probability distributions from the sensitivity analysis (Figure 3.3.11) indicate that the probability of the spawning stock falling below the lowest recorded level of 62,000t in either 1996 or 1997 is very low.

3.3.9 Medium term projections

A Beverton-Holt curve was fitted to the stock-recruitment data as the basis of the medium-term projections. The model, was a poor fit, accounting for very little of the variation in the data. The fitted curve is virtually flat, so the projections effectively used random recruitment. Projections were run assuming *status quo* HC effort (Figure 3.3.12a), and relative HC effort of 0.7 (Figure 3.3.12b). The current short term catch prediction indicates an increase in SSB over 1996 and 1997, due to the contribution of two strong year classes (1992 and 1994). After this period, the *status* *quo* projection indicates that on average SSB will remain at around the 1997 level whereas the projection assuming relative effort of 0.7 indicates that SSB will tend to increase slightly from the 1997 level. Even with the assumption of *status quo* effort, the projections indicate that SSB is unlikely to fall below the series low of 62,000 t in the next ten years.

3.3.10 Long term considerations

Mean total F for this stock has remained close to 1 for at least the last 20 years. This high level of exploitation means that strong year classes do not survive to make much contribution to the spawning stock, and the fishery will continue to depend on a few recent incoming year classes. The increase in spawning stock and landings indicated by the current assessment is the result of the presence of two strong year classes in the stock. This increased level of spawning stock is only likely to be maintained if the overall level of exploitation of this stock is decreased.

3.3.11 Comments on the assessment

Recent assessments of this stock have tended to predict catches which have been over-optimistic. This is a result of the assessment tending to over-estimate F in the most recent year, combined with a tendency to over-estimate the strength of large recruiting year classes. In the present assessment, changes have been made to the fleets used in tuning and this has resulted in an apparent improvement in the retrospective performance of the assessment. This may have reduced the tendency to over-estimate terminal F. Certainly, the current assessment indicates an F which is slightly below average. This contrasts with some previous assessments of this stock where the mean terminal F appeared anomalously high. This can be seen in the quality control diagrams in Table 3.3.17.

Another problem with recent assessments of this stock is the tendency to over-estimate strong recruiting year classes. This is the greatest source of uncertainty in the current assessment, due to the presence of two recent strong year classes in the stock. In addition, there is some evidence of recent changes in discard rates which adds additional uncertainty to the catch prediction.

Misreporting of landings is known to have occurred in 1994. In this case landings of haddock were reported as having been taken in the North Sea when they were actually caught elsewhere. Estimates of the extent of this problem are available from routine monitoring, and have been used to correct the 1994 catch data. This introduces some additional uncertainty into the assessment. However, the quantity involved amounts to only 8% of the total HC landings, so its influence on the result of the assessment is likely to be slight.

3.3.12 Evaluation of usefulness of quarterly International Bottom Trawl Surveys

As part of the exploratory tuning runs, consideration was made of whether indices from the second and fourth quarter IBTS surveys should be included in the tuning. In view of the short time series available for these surveys, close attention was paid to the minimum SE to be applied to these data. The XSA default value is 0.3. In an XSA run where these data were excluded, the fleet with the smallest SE at age 0 was the International groundfish survey with a value of 0.36. For this reason the minimum SE for fleets with high influence was set at 0.35. This reduced the influence given to the unproven fourth-quarter IBTS survey, without restricting the influence of the established first quarter survey. Runs were made including and excluding the new IBTS indices Some results of these comparative runs are summarised in Table 3.3.18. The XSA diagnostics from these runs indicated that the overall XSA results were similar whether or not the indices were included, but the standard errors of the survivor estimates were lower if they were included. This was largely because the IBTS Quarter-4 indices received high weighting at the youngest ages. The inclusion of these indices also decreased the weight given to the F-shrinkage mean at the younger ages.

The Q2 and Q4 IBTS indices were excluded from the final XSA run on the general grounds that the time series were too short. However, from these exploratory runs there was evidence that these indices are potentially useful in the assessment of this stock. Their inclusion led to improved precision of the survivor estimates, with the quarter 4 indices receiving high weight at the younger ages. The inclusion had relatively little effect on the overall survivor estimates, indicating that they are reflecting similar stock trends to the other indices.

Table 3.3.1 Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1983-1994, as officially reported to ICES.

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994[1]
Belgium	985	494	719	317	165	220	145	192	168	415	292	306
Denmark	25,653	16,368	23,821	16,397	7,767	9,174	2,789	1,993	1,330	1,476	3,582	3,190
Faroe Islands	51	-	5	4	23	35	16	6	15	13	25	43
France	11,250	8,103	5,389	4,802	3,889	2,193	1,702[1,3]	1,115[1,3]	631[1,3]	508[3]	1,215[3]	678[3]
Germany, Fed.Rep.	3,654	2,571	2,796	1,984	1,231	802	447	749	535	764	348	1,829
Netherlands	1,722	1,052	3,875	1,627	1,093	894	328	102	100	148	192	96
Norway[2]	3,862	3,959	3,498	5,190	2,610	1,590	1,697[1]	1,572	2,069	3,133	2,651	2,519
Poland	150	17	-	1	-	-	-	-	-	-	-	-
Sweden	1,360	1,518	1,942	1,550	937	614	1,051	900	957	1,289	908	551
UK (Engl.& Wales)	15,476	12,340	13,614	8,137	7,491	5,537	2,704	2,093	2,154	3,228	4,241	4,045
UK (Isle of Man)	-	-	-	-	-	-	-	-	-	11	-	-
UK (N. Ireland)	-	-	-	-	-	-	137	11	48	73	18	9
UK (Scotland)	100,390	87,479	112,549	126,650	84,063	84,104	53,252	34,459	36,443	39,512	66,732	73,746
Total	164,553	133,901	168,208	166,659	109,269	105,163	64,268	43,192	44,450	50,570	80,204	87,012
WG estimates human consumption landings	159,000	128,000	159,000	166,000	108,000	105,000	76,000	51,000	45,000	70,000	80,000	80,000
Unallocated landings	-5,553	-5,901	-9,208	-659	-1,269	-163	11,732	7,808	550	19,430	-203	-7,012

[1]Preliminary.
[2]Figures do not include haddock caught as industrial by-catch.
[3]Includes Division IIa (EC).
n/a = Not available.

TABLE 3.3.2 Haddock, North Sea
Annual weight and numbers caught, 1963 to 1994.

Year	Wt.('000 t)				Nos.(millions)			
	Total	H.cons	Disc.	Ind BC	Total	H.cons	Disc.	Ind BC
1963	271	68	189	14	1968	189	1246	532
1964	379	131	160	89	1507	375	644	488
1965	298	162	62	75	1104	391	254	460
1966	346	226	74	47	1873	420	490	963
1967	246	147	78	21	1936	272	448	1216
1968	302	105	162	34	1693	218	838	637
1969	929	331	260	338	3775	932	1203	1640
1970	806	525	101	180	2393	1229	515	649
1971	444	235	177	32	2401	478	1282	641
1972	351	193	128	30	1721	429	760	531
1973	305	179	115	11	1294	466	660	169
1974	364	150	167	48	2410	372	1091	947
1975	448	147	260	41	2972	375	1862	736
1976	368	166	154	48	1644	410	788	446
1977	217	137	44	35	910	334	226	350
1978	174	86	77	11	1039	199	418	422
1979	141	83	42	16	1484	189	286	1009
1980	216	99	95	22	1447	218	541	687
1981	207	130	60	17	1345	276	298	771
1982	226	166	41	19	987	317	181	489
1983	238	159	66	13	1287	297	388	601
1984	213	128	75	10	864	246	412	206
1985	251	159	86	6	967	354	458	155
1986	220	166	52	3	832	357	308	168
1987	172	108	59	4	650	222	333	95
1988	171	105	62	4	644	254	362	29
1989	106	76	27	2	336	162	156	18
1990	86	51	32	3	267	87	165	15
1991	90	45	40	5	461	96	218	146
1992	129	70	48	11	781	173	267	340
1993	170	80	80	11	857	167	441	249
1994	149	80	65	4	649	164	344	141

TABLE 3.3.3 Haddock, North Sea
Natural Mortality and proportion mature

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

TABLE 3.3.4 Haddock, North Sea
International catch at age ('000), Total , 1963 to 1994.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
0	2781	114447	276355	723597	525815	12666	63198	400927	234247	239684
1	1556144	6841	220366	694333	1126519	1162164	18467	163596	1640324	674770
2	365101	1236277	10847	22207	93043	448221	3366562	164774	68125	584783
3	22215	131176	560715	5998	4965	19660	294133	1600951	46627	40262
4	13456	9157	28788	14853	3591	1927	7672	54460	398542	20923
5	6064	5380	4366	9691	178917	2497	2407	1054	10274	155968
6	520	2487	1937	1042	2444	45248	2542	1142	456	3520
7	659	291	457	604	214	321	19651	249	194	188
8	584	243	109	168	216	40	204	5862	146	33
9	61	239	91	90	57	13	24	67	1573	26
10+	18	25	42	25	33	5	7	30	169	416

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	59336	607605	44831	166725	115057	286912	861724	375010	639159	284195
1	363600	1218616	2099168	167392	250643	455054	347973	659547	133370	278884
2	575284	177186	639756	1053760	105830	144842	198337	323135	414142	85023
3	243816	336815	58977	209277	387271	29664	39470	68716	138789	292608
4	6324	54893	108935	9827	39301	110365	7047	9837	14528	40927
5	4503	1888	15751	30934	4260	8342	26613	1784	1899	3234
6	39910	1350	968	4904	6097	1223	2124	7573	376	697
7	1279	11009	613	204	1265	1994	249	562	2451	269
8	111	242	2692	75	130	383	459	114	123	788
9	29	23	261	744	28	110	145	153	64	29
10+	165	41	80	62	199	90	74	113	62	27

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	662983	95101	140040	104239	9417	10806	12757	55522	125307	270820
1	158998	431642	179402	203053	276954	29023	66405	66499	221457	199983
2	249532	161447	523166	176032	243353	482631	38475	80937	74991	261043
3	72131	118166	74392	310545	45705	87429	194114	13857	21613	34471
4	124743	21300	36030	26095	65665	13155	17398	44923	3341	6830
5	16133	32019	5184	9180	4526	18434	2472	2945	11781	1250
6	1660	3684	7164	1169	2750	1547	3917	688	882	5282
7	289	588	939	1745	517	615	480	1069	377	488
8	59	76	207	227	748	152	189	157	584	320
9	191	37	54	98	126	135	79	60	135	314
10+	68	131	113	117	139	95	50	50	57	161

Age	1993	1994
0	140739	97269
1	345307	104185
2	254733	309305
3	105396	104850
4	6810	30121
5	1619	1915
6	421	562
7	1097	186
8	139	496
9	99	112
10+	201	86

TABLE 3.3.5 Haddock, North Sea

International mean weight at age (kg), Total catch, 1963 to 1994.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
0	.011	.011	.011	.011	.011	.010	.011	.017	.012	.024
1	.110	.125	.089	.110	.096	.121	.066	.093	.113	.116
2	.250	.244	.250	.261	.278	.251	.218	.235	.252	.244
3	.478	.421	.384	.376	.461	.514	.415	.361	.364	.401
4	.706	.694	.683	.545	.597	.742	.805	.755	.508	.517
5	.810	.852	.923	1.002	.641	.894	.908	.913	.902	.616
6	1.014	.935	1.272	1.316	1.065	.840	1.046	1.218	1.289	1.014
7	1.164	1.446	1.231	1.580	1.521	1.580	1.093	1.364	1.534	1.379
8	1.184	1.194	.545	1.979	1.969	2.226	2.018	1.445	1.344	2.302
9	1.576	1.516	1.794	1.796	2.123	2.598	2.995	2.523	1.295	2.029
10+	1.837	1.882	2.301	3.006	2.383	2.009	3.342	3.919	2.073	1.727

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	.044	.024	.021	.013	.019	.011	.009	.012	.009	.011
1	.112	.128	.101	.125	.108	.144	.095	.104	.074	.100
2	.244	.227	.244	.225	.243	.255	.290	.284	.262	.292
3	.380	.345	.360	.402	.347	.419	.441	.486	.476	.459
4	.598	.551	.455	.513	.603	.440	.634	.732	.745	.779
5	.664	.900	.694	.585	.613	.715	.662	1.046	1.149	1.154
6	.748	.905	1.306	.915	.804	.736	.927	.936	1.489	1.425
7	1.072	.960	1.175	1.931	1.187	.931	1.180	1.394	1.185	1.668
8	1.306	1.528	1.117	1.772	1.948	1.368	1.183	1.599	1.663	1.454
9	2.931	2.358	1.831	1.296	2.323	2.077	1.456	.593	1.773	2.608
10+	1.906	2.594	2.538	2.417	1.809	2.136	2.260	2.151	1.734	2.143

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	.022	.010	.013	.018	.008	.024	.033	.044	.029	.018
1	.134	.141	.149	.106	.126	.164	.198	.192	.177	.106
2	.296	.300	.277	.241	.265	.217	.290	.291	.319	.309
3	.447	.489	.476	.397	.404	.417	.362	.435	.472	.487
4	.649	.674	.663	.617	.613	.589	.600	.475	.641	.748
5	.913	.807	.856	.871	1.026	.747	.811	.778	.650	1.017
6	1.209	1.096	1.051	1.272	1.273	1.283	.983	.968	1.045	.894
7	1.152	1.098	1.466	1.213	1.426	1.424	1.376	1.163	1.231	1.391
8	1.910	1.876	1.846	1.738	1.526	1.543	1.662	1.533	1.480	1.518
9	1.371	2.454	2.135	1.554	1.862	1.612	1.697	2.031	1.772	1.894
10+	1.734	2.044	2.042	2.590	2.185	2.312	2.222	2.585	2.009	2.015

Age	1993	1994
0	.010	.015
1	.115	.110
2	.279	.245
3	.447	.420
4	.684	.596
5	.900	.935
6	1.189	1.200
7	1.108	1.571
8	1.597	1.472
9	1.737	1.628
10+	1.875	2.457

Table 3.3.6 Haddock, North Sea
Summary of fleets used in catch-at-age analysis

Fleet	Abbreviation	Year range			Age range
Scottish Seiners	SCOSEI	1975	-	1994	0 - 10
Scottish Light Trawlers	SCOLTR	1975	-	1994	0 - 10
Scottish Groundfish Survey (August)	SCOGFS	1982	-	1994	0 - 10
International Groundfish Survey (Quarter	INTGFS	1973	-	1994	0 - 10

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

Table 3.3.7

HAD-NSEA: Haddock in the North Sea (Fishing Area IV)

FLT02: SCOSEI

Year	Fishing effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5
1975	329432	227.000	481086.688	164257.469	16156.310	26984.020	3891.731
1976	307165	900.000	35867.852	334476.938	60741.051	2713.709	8661.450
1977	313913	4408.000	34038.508	38282.320	137965.297	13935.870	1821.004
1978	325246	1665.000	161079.203	70589.703	15041.160	46353.430	2497.527
1979	316419	543.000	83633.109	78818.398	17215.490	3040.091	8073.241
1980	297227	210.000	131314.000	128306.000	26205.000	3393.000	501.000
1981	289672	345.000	10372.517	135839.297	57004.672	5325.372	721.629
1982	297730	1445.000	31210.260	31675.920	122790.500	14820.180	708.566
1983	333168	18122.000	29138.000	78479.000	31059.000	51404.000	6560.000
1984	388085	422.000	120827.000	63301.000	49174.000	9403.000	14940.000
1985	382910	2055.000	29263.000	163148.000	32562.000	15661.000	2245.000
1986	425017	8204.000	33567.000	71027.000	150225.000	12350.000	3993.000
1987	418734	137.000	43346.000	96542.000	19393.000	28324.000	1950.000
1988	377132	498.000	11561.000	201347.000	37412.000	4735.000	7414.000
1989	355735	145.043	22005.551	20850.719	93743.344	8137.483	1047.946
1990	300076	573.835	28820.521	36924.770	7106.183	20906.977	1116.668
1991	336675	2229.712	65974.258	30122.641	9227.586	1435.867	4863.141
1992	300217	1229.842	30325.725	63639.801	8326.875	1459.706	279.996
1993	268413	2916.299	74586.641	87636.219	34139.770	2278.392	432.112
1994	264738	3225.099	26577.551	124337.180	33346.781	10236.021	403.251

Year	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1975	158.482	115.451	556.261	23.090	11.545
1976	1101.472	57.972	13.956	156.740	10.736
1977	1600.407	375.231	25.953	7.569	69.207
1978	506.182	710.412	90.781	30.612	3.167
1979	648.019	70.002	113.003	24.001	4.000
1980	2415.000	123.000	20.000	56.000	23.000
1981	104.856	595.213	15.420	22.616	1.028
1982	150.648	40.519	238.959	1.039	9.351
1983	597.000	122.000	15.000	71.000	27.000
1984	1590.000	253.000	18.000	8.000	38.000
1985	2787.000	302.000	46.000	19.000	9.000
1986	469.000	594.000	56.000	11.000	19.000
1987	1151.000	195.000	279.000	30.000	16.000
1988	718.000	290.000	80.000	70.000	27.000
1989	1546.961	214.023	84.910	37.906	12.827
1990	236.496	316.157	52.136	22.280	4.163
1991	297.413	118.372	177.000	41.013	10.325
1992	1139.677	76.306	54.721	51.436	17.337
1993	96.954	304.803	27.712	14.260	13.853
1994	135.361	40.556	92.037	9.122	6.500

Table 3.3.7 (Cont'd)

HAD-NSEA: Haddock in the North Sea (Fishing Area IV)

FLT03: SCOLTR

Year	Fishing effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5
1975	161009	51.000	128624.156	27964.420	2592.387	5536.114	554.374
1976	152419	92.000	3358.274	59847.742	11557.551	653.685	1802.970
1977	224824	3257.000	10150.526	6509.983	42301.469	3616.414	404.480
1978	236929	1692.000	45937.484	11850.253	3091.469	13107.290	833.748
1979	287494	465.000	44659.328	23158.441	4111.361	714.071	3644.370
1980	333197	180.000	92522.000	46283.000	8062.000	755.000	197.000
1981	251504	436.000	7982.088	58365.969	13787.230	1535.049	162.823
1982	250870	352.000	24595.646	10301.238	34027.961	4012.853	135.633
1983	244349	63648.000	19623.000	48607.000	6934.000	11768.000	1254.000
1984	240725	514.000	56731.000	22104.000	13254.000	2053.000	3357.000
1985	268136	3545.000	38815.000	57009.000	4845.000	2746.000	408.000
1986	279767	4382.000	26266.000	26197.000	30891.000	2643.000	958.000
1987	351128	97.000	26257.000	32847.000	6206.000	6843.000	471.000
1988	391988	209.000	2926.000	57523.000	14068.000	2366.000	2923.000
1989	405883	2093.652	19083.514	4042.493	29853.512	2797.031	522.405
1990	441084	162.056	9555.038	15313.901	2092.821	8041.234	525.268
1991	408056	1041.467	44104.211	12184.134	3249.607	545.417	2142.209
1992	473955	1837.141	20418.705	30454.070	3751.482	728.394	138.804
1993	447064	231.182	39858.457	38601.008	19433.563	1462.887	347.109
1994	480400	1484.627	8278.336	48736.449	23192.953	6184.662	465.748

Year	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1975	13.859	14.925	82.090	3.198	1.066
1976	336.591	7.183	5.131	46.179	1.026
1977	816.219	102.676	15.557	2.074	5.186
1978	117.333	179.891	25.853	4.309	0.000
1979	203.021	20.002	57.006	20.002	0.000
1980	1015.000	61.000	18.000	8.000	5.000
1981	20.228	323.647	12.137	6.068	7.080
1982	68.326	7.139	59.148	0.000	0.000
1983	124.000	27.000	4.000	25.000	7.000
1984	398.000	97.000	15.000	7.000	14.000
1985	859.000	126.000	27.000	2.000	0.000
1986	117.000	290.000	41.000	35.000	2.000
1987	358.000	68.000	113.000	26.000	2.000
1988	167.000	84.000	28.000	21.000	6.000
1989	607.394	104.723	28.976	20.497	6.720
1990	131.705	206.902	35.110	10.651	4.187
1991	218.492	76.933	140.938	36.777	15.332
1992	737.219	93.823	50.253	55.751	16.805
1993	80.072	262.039	28.057	25.616	24.448
1994	125.602	41.645	62.486	12.660	6.684

16:44 Monday, October 2, 19

HAD-NSEA: Haddock in the North Sea (Fishing Area IV)

FLT06: SCOGFS

Year	Fishing effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1982	100	12.347	24.882	9.961	13.361	1.155	0.073	0.019
1983	100	22.032	18.134	16.108	3.719	4.554	0.532	0.123
1984	100	8.733	43.713	7.880	3.359	0.546	0.654	0.094
1985	100	8.181	19.755	29.808	2.324	1.028	0.140	0.217
1986	100	15.881	21.168	5.217	5.438	0.324	0.242	0.034
1987	100	2.771	23.862	7.041	1.060	1.284	0.082	0.047
1988	100	4.058	4.673	19.820	1.699	0.273	0.226	0.023
1989	100	4.319	8.862	2.136	5.741	0.310	0.038	0.067
1990	100	31.631	10.020	2.400	0.320	1.031	0.071	0.011
1991	100	34.710	17.050	1.780	0.210	0.050	0.160	0.020
1992	100	82.651	38.351	9.630	0.480	0.080	0.030	0.080
1993	100	8.590	58.360	13.800	2.690	0.060	0.040	0.010
1994	100	137.620	12.650	20.800	2.100	0.530	0.020	0.004

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HAD-NSEA: Haddock in the North Sea (Fishing Area IV)

FLT07: INTGFS

Year	Fishing effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5
1973	1	1.092	0.110	-1.000	-1.000	-1.000	-1.000
1974	1	1.168	0.385	-1.000	-1.000	-1.000	-1.000
1975	1	0.177	0.670	-1.000	-1.000	-1.000	-1.000
1976	1	0.162	0.084	-1.000	-1.000	-1.000	-1.000
1977	1	0.385	0.108	-1.000	-1.000	-1.000	-1.000
1978	1	0.480	0.240	-1.000	-1.000	-1.000	-1.000
1979	1	0.896	0.402	-1.000	-1.000	-1.000	-1.000
1980	1	0.268	0.675	-1.000	-1.000	-1.000	-1.000
1981	1	0.526	0.252	-1.000	-1.000	-1.000	-1.000
1982	1	0.307	0.400	0.089	0.114	0.013	0.002
1983	1	1.057	0.219	0.134	0.022	0.022	0.005
1984	1	0.229	0.828	0.105	0.034	0.004	0.007
1985	1	0.579	0.244	0.294	0.018	0.006	0.002
1986	1	0.885	0.326	0.048	0.061	0.005	0.003
1987	1	0.092	0.688	0.098	0.013	0.014	0.002
1988	1	0.210	0.097	0.281	0.017	0.002	0.005
1989	1	0.220	0.110	0.031	0.051	0.003	0.002
1990	1	0.679	0.131	0.024	0.004	0.009	0.002
1991	1	1.115	0.371	0.019	0.003	0.001	0.002
1992	1	1.242	0.543	0.155	0.009	0.001	0.001
1993	1	0.229	0.504	0.098	0.023	0.002	0.001
1994	1	1.375	0.205	0.181	0.025	0.005	0.001

Table 3.3.8

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Lowestoft VPA Version 3.1

   3-Oct-95  14:45:13

Extended Survivors Analysis

Haddock in IV (run: NO QUART/WG3)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/had_nsea/FLEET.WG3

Catch data for  32 years. 1963 to 1994. Ages  0 to  10.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,   year, year,  age ,  age
FLT02: SCOSEI (Catch,   1975, 1994,   0,     9,   .000,  1.000
FLT03: SCOLTR (Catch,   1975, 1994,   0,     9,   .000,  1.000
FLT06: SCOGFS (Catch,   1982, 1994,   0,     6,   .500,   .750
FLT07: INTGFS (Catch,   1975, 1994,   0,     5,   .990,  1.000


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years


Catchability analysis :

     Catchability dependent on stock size for ages <    2

        Regression type = C
        Minimum of   5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  2


     Catchability independent of age for ages >=    7


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning converged after   22 iterations
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Table 3.3.8 (Cont'd)

Regression weights

.751	.820	.877	.921	.954	.976	.990	.997	1.000	1.000

Fishing mortalities

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	.016	.006	.007	.004	.004	.006	.013	.019	.032	.007
1	.211	.165	.107	.141	.169	.156	.151	.138	.166	.165
2	.622	1.033	.910	.797	.822	.984	.752	.765	.742	.601
3	.958	1.233	1.049	1.342	1.134	1.010	.966	1.252	1.029	.984
4	1.112	1.286	1.080	1.157	1.279	.984	.778	1.080	1.003	1.079
5	1.045	1.053	.841	1.150	.720	.799	.799	.802	.862	.935
6	1.073	.709	1.149	.799	.820	.444	.593	1.108	.706	.867
7	.958	.849	.816	.888	.623	.551	.469	.791	.722	.807
8	.713	.644	1.205	.603	.769	.424	.675	.967	.544	.880
9	1.035	.919	.948	.724	.744	.596	.808	1.002	.958	1.240

XSA population numbers (Thousands)

	AGE									
YEAR	0	1	2	3	4	5	6	7		
1985	2.41E+07	2.15E+06	1.38E+06	1.37E+05	6.08E+04	8.84E+03	1.20E+04	1.68E+03	4.49E+02	9.25E+01
1986	4.86E+07	3.05E+06	3.34E+05	4.97E+05	4.09E+04	1.56E+04	2.54E+03	3.37E+03	5.29E+02	1.80E+02
1987	3.93E+06	6.22E+06	4.97E+05	7.97E+04	1.13E+05	8.80E+03	4.45E+03	1.02E+03	1.18E+03	2.27E+02
1988	7.59E+06	5.03E+05	1.07E+06	1.34E+05	2.17E+04	2.98E+04	3.11E+03	1.16E+03	3.71E+02	2.90E+02
1989	8.22E+06	9.73E+05	8.38E+04	3.24E+05	2.73E+04	5.32E+03	7.73E+03	1.14E+03	3.89E+02	1.66E+02
1990	2.82E+07	1.05E+06	1.58E+05	2.47E+04	8.13E+04	5.92E+03	2.12E+03	2.79E+03	5.02E+02	1.48E+02
1991	2.79E+07	3.61E+06	1.73E+05	3.95E+04	7.00E+03	2.37E+04	2.18E+03	1.11E+03	1.32E+03	2.69E+02
1992	4.07E+07	3.55E+06	5.96E+05	5.47E+04	1.17E+04	2.50E+03	8.72E+03	9.87E+02	5.71E+02	5.48E+02
1993	1.25E+07	5.14E+06	5.94E+05	1.86E+05	1.22E+04	3.10E+03	9.19E+02	2.36E+03	3.66E+02	1.78E+02
1994	4.02E+07	1.56E+06	8.37E+05	1.90E+05	5.17E+04	3.48E+03	1.07E+03	3.71E+02	9.37E+02	1.74E+02

Estimated population abundance at 1st Jan 1995

.00E+00	5.14E+06	2.54E+05	3.08E+05	5.52E+04	1.37E+04	1.12E+03	3.68E+02	1.36E+02	3.18E+02

Taper weighted geometric mean of the VPA populations:

2.05E+07	2.49E+06	4.32E+05	1.28E+05	3.35E+04	8.79E+03	3.17E+03	1.24E+03	5.13E+02	1.86E+02

Standard error of the weighted Log(VPA populations) :

.8140	.8148	.8372	.9229	.9654	.9680	.8552	.6851	.6557	.6154

Table 3.3.8 (Cont'd)

Log catchability residuals.

Fleet : FLT02: SCOSEI (Catch

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	-.60	.16	.90	-.30	-1.73	-.86	-1.21	.33	.97	-.66
1	2.06	.75	.32	2.15	.68	.86	-1.32	-.47	-.29	.37
2	-.12	-.01	.31	.59	.27	.10	-.51	-.44	-.29	-.22
3	-.20	.01	-.07	.34	.21	.18	.04	-.11	.04	-.18
4	-.39	-.55	.15	.17	.18	.10	.01	-.13	.15	.05
5	-.22	.22	.41	.13	.03	-.03	.09	-.69	.45	.44
6	-.65	-.01	.05	.51	.35	.25	-.40	-.37	.10	.42
7	.26	-.60	.25	.60	-.24	.30	.18	-.31	.44	.23
8	-.09	-.29	-.77	-.10	.05	-.62	-.32	.45	-.36	-.71
9	-.83	-.12	.18	.31	-.30	.57	.48	-1.75	.31	-.12

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	.20	.47	-.11	.29	-.68	-.74	.21	-.53	1.40	.31
1	-.33	-.66	-1.00	-.27	.12	.69	.52	-.46	.69	.37
2	-.52	.13	.00	.03	.38	.55	.05	-.32	.11	.07
3	-.16	.09	-.19	.17	.18	.30	-.04	-.25	-.03	-.08
4	.02	.14	-.11	-.12	.30	.21	-.21	-.48	.01	.11
5	.23	.13	-.08	.26	-.09	.07	.04	-.45	-.09	-.23
6	.32	-.17	.37	.22	.14	-.44	-.28	.00	-.27	.00
7	.15	-.02	.06	.47	.13	-.24	-.45	-.52	.08	-.04
8	-.51	-.61	.44	.20	.34	-.38	-.13	-.23	-.53	-.11
9	.32	-1.05	-.25	.37	.38	.07	.05	-.24	-.30	-.60

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	-14.0038	-13.5911	-13.6270	-13.8933	-14.0650	-14.2010	-14.2010	-14.2010
S.E(Log q)	.3163	.1720	.2118	.2854	.2915	.3099	.4269	.5668

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	.76	.855	20.51	.55	20	.77	-21.68
1	1.49	-1.923	16.89	.61	20	.68	-16.19

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.32	-2.665	14.33	.87	20	.34	-14.00
3	1.01	-.249	13.62	.97	20	.18	-13.59
4	.91	1.648	13.33	.97	20	.18	-13.63
5	.83	3.093	13.07	.97	20	.18	-13.89
6	.82	2.670	12.98	.96	20	.19	-14.06
7	.97	.209	14.00	.84	20	.31	-14.20
8	.78	1.788	12.57	.86	20	.27	-14.38
9	.81	.853	12.62	.67	20	.45	-14.33

Table 3.3.8 (Cont'd)

Fleet : FLT03: SCOLTR (Catch

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	-.97	-.81	1.24	.25	-1.52	-.84	-.66	-.36	2.55	.12
1	.84	-.35	.05	1.09	.36	.37	-.27	.12	.37	.25
2	-.09	.06	-.05	.20	.23	.05	-.13	-.31	.62	.29
3	-.13	.24	.26	.26	.06	.07	-.05	-.03	.03	.17
4	-.12	-.14	.28	.36	-.03	-.38	.05	-.13	.13	.14
5	-.43	.37	.27	.37	.36	-.05	-.24	-1.15	.13	.45
6	-1.44	.44	.64	.30	.22	.20	-.98	-.05	-.23	.45
7	-.34	-1.25	.02	.28	-.66	.22	.44	-1.13	-.02	.48
8	-.55	.15	-.21	-.31	.20	-.10	.32	-.03	-.64	.32
9	-1.36	.09	-.05	-.60	.35	-.75	.05	99.99	.31	.96

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	1.20	.63	-.03	-.17	1.54	-1.77	-.24	-.29	-.68	-.45
1	1.12	.31	-.65	-.46	.76	-.11	.28	-.64	-.26	-.73
2	-.13	.63	.18	-.18	-.31	.37	.03	-.43	-.14	-.38
3	-.52	.11	.03	.33	.09	-.12	-.09	-.31	.08	.15
4	-.22	.16	-.21	.29	.24	.01	-.23	-.49	.20	.15
5	-.10	.15	-.30	.32	.11	-.04	.05	-.58	.20	.34
6	.43	-.20	.31	-.35	.01	-.47	.15	.04	-.03	.26
7	.37	.42	-.08	-.07	.02	-.31	-.34	-.03	.16	.13
8	.05	.23	.44	-.15	-.13	-.42	.19	-.03	-.29	-.36
9	-.84	1.26	.52	-.14	.36	-.32	.49	.12	.51	-.13

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-15.0863	-14.7761	-14.7682	-14.9175	-14.9965	-14.9373	-14.9373	-14.9373
S.E(Log q)	.3454	.2149	.2477	.3763	.3387	.3677	.3087	.5962

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	.79	.523	20.92	.37	20	1.11	-22.04
1	1.01	-.062	16.86	.67	20	.60	-16.83

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	1.08	-.610	15.26	.84	20	.39	-15.09
3	.92	1.325	14.53	.96	20	.19	-14.78
4	.95	.650	14.56	.95	20	.24	-14.77
5	.87	1.342	14.15	.91	20	.32	-14.92
6	.86	1.381	14.05	.91	20	.28	-15.00
7	.83	1.293	13.62	.85	20	.30	-14.94
8	.88	.947	13.97	.87	20	.27	-14.99
9	1.00	-.010	14.76	.50	19	.59	-14.73

Table 3.3.8 (Cont'd)

Fleet : FLT06: SCOGFS (Catch

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.18	-.91	-.31
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.08	-.03	-.16
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.38	.26	-.02
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.40	.79	.16
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.23	.81	.43
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.25	.90	.43
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.24	1.32	.61
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	-.72	-.89	.21	-.14	-.17	.22	.31	.64	-.01	1.06
1	.25	-.05	-.66	-.16	.00	.06	-.50	.52	.70	-.03
2	.05	-.02	-.20	.00	.33	-.08	-.62	-.16	.19	.17
3	.21	-.06	.02	.15	.36	-.03	-.95	-.27	.09	-.20
4	.51	-.14	.09	.24	.21	.14	-.56	-.42	-.79	-.01
5	.51	.49	-.15	-.16	-.49	.08	-.50	.08	.19	-.58
6	.76	.23	.27	-.30	-.13	-.88	-.22	.10	.03	-.94
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	2	3	4	5	6
Mean Log q	-14.7574	-15.0439	-15.2550	-15.3917	-15.4952
S.E(Log q)	.2694	.4064	.4441	.4364	.6020

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	.81	.814	17.27	.67	13	.61	-17.38
1	1.26	-1.630	15.41	.82	13	.41	-15.27

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	.97	.325	14.70	.91	13	.27	-14.76
3	.82	1.766	14.45	.91	13	.30	-15.04
4	.74	3.637	14.01	.96	13	.22	-15.25
5	.90	.790	14.74	.87	13	.40	-15.39
6	.74	1.669	13.55	.82	13	.41	-15.50

Table 3.3.8 (Cont'd)

Fleet : FLT07: INTGFS (Catch

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	-.40	-.82	-.41	-.61	-.57	-.23	-.29	-.38	-.33	-.54
1	-.66	-.78	-.77	-.18	-.24	-.18	.17	-.02	-.32	.06
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.05	-.05	.15
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.07	.18	.07
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.18	.02	.05
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.16	.13	-.21
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	.04	-.24	-.01	.16	.13	.04	.55	.29	-.22	.40
1	.01	-.05	.08	.24	-.23	-.11	-.07	.39	-.04	.06
2	-.11	-.10	.10	.27	.64	-.09	-.65	.23	-.25	-.12
3	-.17	.04	.14	.18	.19	.09	-.71	.35	-.16	-.14
4	-.11	.27	.08	-.14	.16	-.13	-.08	-.29	.29	-.17
5	.10	-.06	-.10	-.10	.28	.25	-1.13	.42	.27	.22
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	2	3	4	5
Mean Log q	-14.2317	-14.4759	-14.6630	-14.1577
S.E(Log q)	.3234	.2818	.1872	.4227

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	1.01	-.092	15.51	.86	20	.34	-15.53
1	1.22	-2.922	14.04	.94	20	.21	-14.17

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.04	-.310	14.29	.86	13	.35	-14.23
3	.95	.559	14.33	.93	13	.28	-14.48
4	.98	.247	14.60	.97	13	.19	-14.66
5	1.40	-2.584	16.20	.82	13	.47	-14.16

Table 3.3.8 (Cont'd)

Terminal year survivor and F summaries :

Age 0 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	7013040.,	.825,	.000,	.00,	1,	.088,	.000
FLT03: SCOLTR (Catch,	3264945.,	1.153,	.000,	.00,	1,	.045,	.000
FLT06: SCOGFS (Catch,	14776783.,	.718,	.000,	.00,	1,	.117,	.000
FLT07: INTGFS (Catch,	7641445.,	.380,	.000,	.00,	1,	.416,	.000
P shrinkage mean ,	2491384.,	.81,,,,				.091,	.014
F shrinkage mean ,	1998262.,	.50,,,,				.242,	.017

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5142558.,	.25,	.37,	6,	1.495,	.007

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	566980.,	.538,	.508,	.94,	2,	.088,	.077
FLT03: SCOLTR (Catch,	123210.,	.576,	.021,	.04,	2,	.077,	.315
FLT06: SCOGFS (Catch,	247773.,	.357,	.006,	.02,	2,	.201,	.169
FLT07: INTGFS (Catch,	240631.,	.233,	.137,	.59,	2,	.470,	.174
P shrinkage mean ,	431663.,	.84,,,,				.043,	.101
F shrinkage mean ,	237339.,	.50,,,,				.122,	.176

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
253776.,	.16,	.13,	10,	.777,	.165

Table 3.3.8 (Cont'd)

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	333176.,	.284,	.206,	.72,	3,	.170,	.565
FLT03: SCOLTR (Catch,	216692.,	.302,	.036,	.12,	3,	.149,	.774
FLT06: SCOGFS (Catch,	432759.,	.238,	.169,	.71,	3,	.237,	.461
FLT07: INTGFS (Catch,	311830.,	.193,	.115,	.59,	3,	.341,	.594
F shrinkage mean ,	195157.,	.50,,,,				.104,	.832

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
307508.,	.12,	.10,	13,	.788,	.601

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	53120.,	.219,	.076,	.35,	4,	.210,	1.009
FLT03: SCOLTR (Catch,	56449.,	.227,	.125,	.55,	4,	.201,	.970
FLT06: SCOGFS (Catch,	60477.,	.220,	.153,	.69,	4,	.173,	.928
FLT07: INTGFS (Catch,	57286.,	.177,	.173,	.98,	4,	.283,	.961
F shrinkage mean ,	46559.,	.50,,,,				.133,	1.094

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
55204.,	.11,	.06,	17,	.534,	.984

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	14199.,	.210,	.082,	.39,	5,	.230,	1.055
FLT03: SCOLTR (Catch,	14895.,	.213,	.105,	.49,	5,	.226,	1.024
FLT06: SCOGFS (Catch,	13016.,	.252,	.081,	.32,	5,	.129,	1.113
FLT07: INTGFS (Catch,	12198.,	.189,	.055,	.29,	5,	.258,	1.157
F shrinkage mean ,	14531.,	.50,,,,				.158,	1.040

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
13699.,	.12,	.04,	21,	.319,	1.079

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	948.,	.211,	.058,	.27,	6,	.288,	1.039
FLT03: SCOLTR (Catch,	1394.,	.233,	.090,	.39,	6,	.208,	.808
FLT06: SCOGFS (Catch,	626.,	.296,	.077,	.26,	6,	.135,	1.326
FLT07: INTGFS (Catch,	1381.,	.226,	.084,	.37,	6,	.196,	.813
F shrinkage mean ,	1402.,	.50,,,,				.173,	.805

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1119.,	.13,	.07,	25,	.512,	.935

Table 3.3.8 (Cont'd)

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	346.,	.201,	.060,	.30,	7,	.350,	.904
FLT03: SCOLTR (Catch,	425.,	.233,	.101,	.43,	7,	.257,	.787
FLT06: SCOGFS (Catch,	237.,	.319,	.212,	.66,	7,	.114,	1.146
FLT07: INTGFS (Catch,	343.,	.225,	.155,	.69,	6,	.094,	.909
F shrinkage mean ,	463.,	.50,,,,				.185,	.741

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
368.,	.14,	.06,	28,	.457,	.867

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	116.,	.188,	.063,	.34,	8,	.397,	.895
FLT03: SCOLTR (Catch,	131.,	.218,	.083,	.38,	8,	.288,	.825
FLT06: SCOGFS (Catch,	132.,	.295,	.094,	.32,	7,	.067,	.824
FLT07: INTGFS (Catch,	163.,	.206,	.108,	.52,	6,	.062,	.709
F shrinkage mean ,	189.,	.50,,,,				.186,	.637

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
136.,	.14,	.05,	30,	.360,	.807

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	316.,	.218,	.035,	.16,	9,	.323,	.884
FLT03: SCOLTR (Catch,	263.,	.224,	.081,	.36,	9,	.386,	.996
FLT06: SCOGFS (Catch,	284.,	.312,	.129,	.41,	7,	.025,	.948
FLT07: INTGFS (Catch,	191.,	.225,	.251,	1.12,	6,	.021,	1.210
F shrinkage mean ,	459.,	.50,,,,				.245,	.682

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
318.,	.17,	.06,	32,	.341,	.880

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: SCOSEI (Catch,	26.,	.216,	.069,	.32,	10,	.287,	1.581
FLT03: SCOLTR (Catch,	35.,	.216,	.053,	.24,	10,	.312,	1.352
FLT06: SCOGFS (Catch,	39.,	.339,	.069,	.20,	7,	.021,	1.276
FLT07: INTGFS (Catch,	50.,	.261,	.029,	.11,	6,	.016,	1.101
F shrinkage mean ,	67.,	.50,,,,				.364,	.923

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
41.,	.20,	.09,	34,	.425,	1.240

TABLE 3.3.9 Haddock, North Sea

Tuned Stock Numbers at age (10**-5), 1963 to 1995, (numbers in 1995 are VPA survivors)

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
0	20872	62984	199321	709757	3579971	143309	101869	833040	783255	214840
1	249988	2677	7698	24668	88774	458981	18403	12887	105803	99992
2	7676	41191	484	513	1695	12112	83054	3453	1758	13131
3	496	2156	17489	236	162	374	4449	28110	966	621
4	282	190	521	8672	131	82	118	869	7764	341
5	114	101	68	152	3093	70	47	24	197	2529
6	14	38	34	16	37	913	35	17	10	68
7	13	7	9	10	3	8	338	5	3	4
8	12	5	3	3	3	1	4	99	2	1
9	1	4	2	1	1	0	0	1	28	0
10+	0	0	1	0	1	0	0	1	3	8

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	724615	1317143	112834	160109	249152	385324	704934	152906	318450	198390
1	26797	93070	167382	14365	20013	31662	48575	87658	18339	38702
2	16246	3553	12534	22946	2025	2745	4086	7804	13944	2937
3	4014	6180	931	3164	6754	491	654	1115	2586	5956
4	128	975	1841	205	617	1842	121	161	262	789
5	81	44	275	472	73	134	461	32	39	76
6	659	25	19	82	107	21	34	137	10	15
7	24	179	9	7	23	32	6	9	43	5
8	2	8	47	1	4	7	8	3	2	13
9	1	0	4	14	1	2	3	3	1	1
10+	3	1	1	1	4	1	1	2	1	0

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	653094	169509	241058	486137	39313	75912	82204	281900	279246	407111
1	24520	81697	21480	30530	62209	5027	9734	10537	36091	35499
2	6211	4012	13798	3339	4973	10733	838	1578	1732	5961
3	1273	2120	1368	4966	797	1341	3243	247	395	547
4	2057	355	608	409	1127	217	273	813	70	117
5	253	501	88	156	88	298	53	59	237	25
6	33	61	120	25	45	31	77	21	22	87
7	6	12	17	34	10	12	11	28	11	10
8	1	2	4	5	12	4	4	5	13	6
9	4	1	1	2	2	3	2	1	3	5
10+	1	2	2	2	2	2	1	1	1	3

Age	1993	1994	1995
0	125035	402180	0
1	51438	15591	51426
2	5941	8365	2538
3	1858	1897	3075
4	122	517	552
5	31	35	137
6	9	11	11
7	24	4	4
8	4	9	1
9	2	2	3
10+	4	1	1

TABLE 3.3.10 Haddock, North Sea
International F at age, Total , 1963 to 1994.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
0	.004	.052	.039	.029	.004	.002	.017	.014	.008	.032
1	.153	.060	1.059	1.028	.342	.060	.023	.342	.437	.167
2	.870	.457	.320	.753	1.110	.601	.683	.874	.641	.785
3	.708	1.169	.451	.340	.427	.905	1.383	1.037	.792	1.328
4	.779	.787	.982	.781	.373	.309	1.336	1.237	.872	1.190
5	.892	.893	1.255	1.219	1.020	.501	.835	.659	.862	1.144
6	.518	1.279	1.007	1.311	1.323	.793	1.651	1.408	.679	.850
7	.818	.624	.872	1.085	1.140	.584	1.027	.701	1.025	.671
8	.781	.845	.505	.981	1.938	.664	.955	1.058	1.302	.464
9	.765	.895	.934	1.088	1.173	.575	1.175	1.024	.958	.873
10+	.765	.895	.934	1.088	1.173	.575	1.175	1.024	.958	.873

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	.002	.013	.011	.030	.013	.021	.035	.071	.058	.041
1	.370	.355	.337	.309	.337	.397	.178	.188	.182	.180
2	.567	.939	.977	.823	1.017	1.034	.899	.705	.451	.436
3	1.166	.961	1.265	1.385	1.049	1.154	1.151	1.198	.937	.813
4	.820	1.017	1.110	.786	1.279	1.136	1.084	1.176	.988	.887
5	.959	.644	1.005	1.287	1.045	1.169	1.017	.969	.780	.635
6	1.105	.888	.834	1.076	.998	1.041	1.172	.949	.546	.754
7	.902	1.141	1.579	.409	.938	1.151	.608	1.273	.984	1.008
8	1.171	.413	1.011	.856	.499	.855	.937	.630	1.161	1.072
9	1.003	.829	1.122	.893	.961	1.105	.982	.998	.920	.999
10+	1.003	.829	1.122	.893	.961	1.105	.982	.998	.920	.999

Age	1983	1984	985	1986	1987	1988	1989	1990	1991	1992
0	.029	.016	.016	.006	.007	.004	.004	.005	.013	.019
1	.160	.128	.211	.165	.107	.141	.169	.155	.151	.138
2	.675	.676	.622	1.033	.910	.797	.822	.984	.752	.766
3	1.028	.998	.958	1.233	1.049	1.342	.134	1.010	.966	1.252
4	1.163	1.140	1.112	1.286	1.080	1.157	1.280	.984	.778	1.080
5	1.219	1.226	1.045	1.053	.841	1.150	.720	.799	.799	.803
6	.813	1.092	1.073	.709	1.149	.799	.820	.444	.593	1.108
7	.845	.782	.958	.849	.816	.888	.623	.551	.469	.791
8	.628	.556	.713	.643	1.205	.603	.769	.424	.675	.967
9	.841	1.107	1.035	.919	.948	.724	.744	.596	.808	1.002
10+	.841	1.107	1.035	.919	.948	.724	.744	.596	.808	1.002

Age	1993	1994
0	.032	.007
1	.166	.165
2	.742	.601
3	1.029	.984
4	1.003	1.079
5	.862	.935
6	.706	.867
7	.722	.807
8	.544	.880
9	.958	1.240
10+	.958	1.240

Table 3.3.11

North Sea Haddock, RCT3 Input file

HADDOCK IN IV, RCT3 INPUT VALUES Age 0; Final indices; XSA run 'NO QUART'/WG3'

15 28 2

'YEARCLASS'	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS0'	'SGFS1'	'SGFS2'	'GGFS1'	'GGFS2'	'IBQ21'	'SCQ21'	'SCQ22'	'IBQ40'	'IBQ41'	'ENQ40'	'ENQ41'	'ENQ42'
1971	783255	740	971	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	214840	187	110	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	724615	1092	385	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	1317143	1168	670	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	33.319	177	84	-1	-1	32.1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1976	160109	162	108	-1	66.8	26.2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1977	33.288	385	240	534.8	136.9	54.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	385324	480	402	358.3	295.5	167.3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1979	704934	896	675	875.5	623.3	439.1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1980	152906	268	252	374	173.2	79.8	-1	-1	99.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1981	318450	526	400	1537.5	315.5	109.5	-1	248.8	161.1	-1	72.8	-1	-1	-1	-1	-1	-1	-1	-1
1982	198390	307	219	281.3	218.2	61.6	123.5	181.3	78.8	93.9	47.2	-1	-1	-1	-1	-1	-1	-1	-1
1983	653094	1057	828	831.9	599.3	238.2	220.3	436.7	298.1	272.9	259.6	-1	-1	-1	-1	-1	-1	-1	-1
1984	169509	229	244	228.5	186.6	44.7	87.3	197.6	57.4	129.7	38	-1	-1	-1	-1	-1	-1	-1	-1
1985	241058	579	326	245.9	149.7	43.1	81.8	232.9	70.4	142.3	154.4	-1	-1	-1	-1	-1	-1	-1	-1
1986	486137	885	688	266	281.9	183.5	174.7	239.3	198.2	307.4	179.9	-1	-1	-1	-1	-1	-1	-1	-1
1987	39313	92	97	22.4	28.6	14.5	27.7	46.7	21.4	68.6	45.3	-1	-1	-1	-1	-1	-1	-1	-1
1988	75912	210	114	60.7	81.7	19.8	40.6	88.6	24	135	54.7	-1	-1	-1	-1	-1	-1	-1	-1
1989	82204	219	131	94.3	66.4	9.6	43.2	100.2	17.8	180	54.9	-1	-1	493	-1	-1	-1	-1	5.094
1990	281900	679	371	281.9	115	97.7	316.3	170.5	96.3	601	129.2	502	4087	2854	-1	481	-1	57.818	22.977
1991	279246	1115	543	263.3	196.9	58.6	347.1	383.2	138	480.1	-1	772	8196	2680	1128	845.63	90.712	74.865	17.137
1992	407111	1242	504	827.7	246.1	90.2	827	583.6	208	-1	163.5	1276	11963	3838	2461.76	1005.92	198.232	75	22.192
1993	-1	229	205	135.8	80.7	44.5	85.9	126.5	73.4	186.8	69.4	495	1295	1186	636.18	673.3	42.168	185.26	-1
1994	-1	1375	-1	943	383.1	-1	1376.2	815.3	-1	526.6	-1	1549	12539	-1	3519.24	-1	137.483	-1	-1
1995	-1	-1	-1	180	-1	-1	156.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Yclass	VPA	IYFS1	IYFS2	egfs0	egfs1	egfs2	sgfs0	sgfs1	sgfs2	ggfs1	ggfs2	IBQ21	SCQ21	SCQ22	IBQ40	IBQ41	ENQ40	ENQ41	ENQ42

KEY

index	Survey	Quarter	Age
IYFS1	IBTS	1	1
IYFS2	IBTS	1	2
EGFS0	English GFS	3	0
EGFS1	English GFS	3	1
EGFS2	English GFS	3	2
SGFS0	Scottish GFS	3	0
SGFS1	Scottish GFS	3	1
SGFS2	Scottish GFS	3	2
GGFS1	German GFS	2	1
GGFS2	German GFS	2	2
IBQ21	IBTS (provisional, length-based)	2	1
SCQ21	IBTS (Scottish, age based)	2	1
SCQ22	IBTS (Scottish, age based)	2	2
IBQ40	IBTS (provisional, length-based)	4	0
IBQ41	IBTS (provisional, length-based)	4	1
ENQ40	IBTS (English, age based)	4	0
ENQ41	IBTS (English, age based)	4	1
ENQ42	IBTS (English, age based)	4	2

TABLE 3.3.12a, Haddock, North Sea, RCT3 output, age 0

Analysis by RCT3 ver3.1 of data from file :

hadiv0.rct

HADDOCK IN IV, RCT3 INPUT VALUES   Age 0; Final indices; XSA run 'NO QUART'/WG3

Data for 10 surveys over 25 years : 1971 - 1995

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 = 1995

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	1.47	4.20	1.31	.441	16	5.20	11.84	1.540	.132
EGFS1									
EGFS2									
SGFS0	.93	7.60	.60	.710	11	5.06	12.32	.716	.612
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		12.16	1.109	.255

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	202350	12.22	.56	.12	.04		

TABLE 3.3.12b, Haddock, North Sea, RCT3 output, age 1

Analysis by RCT3 ver3.1 of data from file :

hadiv1.rct

HADDOCK IN IV, RCT3 INPUT VALUES   Age 1; Final indices; XSA run 'NO QUART'/WG3

Data for 10 surveys over 25 years : 1971 - 1995

Regression type = C
Tapered time weighting applied
power = 3 over 20 years

Survey weighting applied :

SURVEY	WEIGHT
IYFS1	1.00
IYFS2	1.00
EGFS0	1.00
EGFS1	1.00
EGFS2	1.00
SGFS0	.00
SGFS1	.00
SGFS2	1.00
GGFS1	1.00
GGFS2	1.00

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 = 1994

	I-----------Regression	----------I			I-----------Prediction	---------I			
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.09	3.50	.37	.849	22	7.23	11.37	.465	.313
IYFS2									
EGFS0	.85	5.55	.46	.792	16	6.85	11.34	.561	.214
EGFS1	1.13	4.45	.37	.853	17	5.95	11.18	.447	.338
EGFS2									
SGFS0									
SGFS1									
SGFS2									
GGFS1	1.76	.66	.99	.477	10	6.27	11.72	1.314	.039
GGFS2									
					VPA Mean =		10.17	.840	.096

Yearclass = 1995

	I-----------Regression	----------I			I-----------Prediction	---------I			
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.84	5.58	.44	.805	16	5.20	9.96	.521	.727
EGFS1									
EGFS2									
SGFS0									
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		10.15	.850	.273

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1994	73147	11.20	.26	.18	.47		
1995	22308	10.01	.44	.08	.03		

TABLE 3.3.12c, Haddock, North Sea, RCT3 output, age 2

Analysis by RCT3 ver3.1 of data from file :

hadiv2.rct

HADDOCK IN IV, RCT3 INPUT VALUES   Age 2; Final indices; XSA run 'NO QUART'/WG3

Data for 10 surveys over 25 years : 1971 - 1995

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 = 1993

Survey/ Series	Regression: Slope	Regression: Inter- cept	Regression: Std Error	Regression: Rsquare	Regression: No. Pts	Prediction: Index Value	Prediction: Predicted Value	Prediction: Std Error	Prediction: WAP Weights
IYFS1	1.10	1.63	.36	.853	22	5.44	7.63	.427	.106
IYFS2	1.23	1.38	.23	.936	22	5.33	7.91	.264	.278
EGFS0	.86	3.62	.50	.758	16	4.92	7.87	.574	.059
EGFS1	1.13	2.63	.38	.845	17	4.40	7.61	.440	.100
EGFS2	.90	4.68	.37	.847	18	3.82	8.13	.425	.107
SGFS0	.97	3.57	.61	.696	11	4.46	7.92	.725	.037
SGFS1	1.28	1.58	.43	.814	12	4.85	7.80	.508	.075
SGFS2	.95	4.18	.30	.898	13	4.31	8.26	.342	.165
GGFS1	1.80	-1.32	1.00	.474	10	5.24	8.12	1.196	.014
GGFS2	1.61	1.02	.64	.689	11	4.25	7.89	.760	.033
					VPA Mean =		8.37	.837	.028

Yearclass = 1994

Survey/ Series	Regression: Slope	Regression: Inter- cept	Regression: Std Error	Regression: Rsquare	Regression: No. Pts	Prediction: Index Value	Prediction: Predicted Value	Prediction: Std Error	Prediction: WAP Weights
IYFS1	1.09	1.69	.36	.859	22	7.23	9.56	.449	.269
IYFS2									
EGFS0	.86	3.66	.49	.772	16	6.85	9.56	.599	.151
EGFS1	1.14	2.58	.38	.846	17	5.95	9.38	.463	.252
EGFS2									
SGFS0	.96	3.63	.61	.700	11	7.23	10.56	.881	.070
SGFS1	1.27	1.62	.44	.813	12	6.70	10.16	.600	.150
SGFS2									
GGFS1	1.78	-1.20	.99	.482	10	6.27	9.92	1.315	.031
GGFS2									
					VPA Mean =		8.36	.846	.076

Yearclass = 1995

Survey/ Series	Regression: Slope	Regression: Inter- cept	Regression: Std Error	Regression: Rsquare	Regression: No. Pts	Prediction: Index Value	Prediction: Predicted Value	Prediction: Std Error	Prediction: WAP Weights
IYFS1									
IYFS2									
EGFS0	.86	3.70	.47	.787	16	5.20	8.15	.554	.499
EGFS1									
EGFS2									
SGFS0	.94	3.70	.61	.706	11	5.06	8.46	.726	.291
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		8.34	.855	.210

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1993	2793	7.94	.14	.07	.26		
1994	14695	9.60	.23	.20	.75		
1995	3945	8.28	.39	.10	.06		

TABLE 3.3.13; Haddock, North Sea
Mean fishing mortality, biomass and recruitment, 1963 - 1994.

Year	Mean F H.cons Ages 2 to 6	Mean F Disc. Ages 2 to 6	Mean F Ind BC Ages 0 to 3	Stock Biomass ('000 tonnes) Total	Stock Biomass ('000 tonnes) Spawning	Recruits Age 0 Yclass	Recruits Age 0 Million	
1963	.587	.124	.054	2999	136	1963	2087	
1964	.728	.076	.114	1157	412	1964	6298	
1965	.675	.070	.177	801	525	1965	19932	
1966	.735	.108	.125	786	443	1966	70976	
1967	.675	.141	.087	1118	229	1967	357997	
1968	.479	.091	.065	5967	256	1968	14331	
1969	.882	.099	.184	2172	765	1969	10187	
1970	.824	.135	.117	1301	825	1970	83304	
1971	.632	.109	.055	1693	417	1971	78326	
1972	.890	.145	.050	1688	304	1972	21484	
1973	.787	.125	.033	915	303	1973	72462	
1974	.650	.140	.101	1564	261	1974	131714	
1975	.774	.205	.085	2143	239	1975	11283	
1976	.822	.156	.122	872	304	1976	16011	
1977	.819	.130	.169	554	234	1977	24915	
1978	.886	.192	.061	643	127	1978	38532	
1979	.943	.089	.057	652	104	1979	70493	
1980	.840	.082	.086	1218	147	1980	15291	
1981	.633	.088	.064	655	234	1981	31845	
1982	.587	.068	.067	822	292	1982	19839	
1983	.802	.149	.051	732	246	1983	65309	
1984	.906	.096	.032	1449	192	1984	16951	
1985	.859	.081	.018	832	230	1985	24106	
1986	.874	.183	.023	649	213	1986	48614	
1987	.854	.147	.015	1036	151	1987	3931	
1988	.872	.152	.020	414	155	1988	7591	
1989	.731	.199	.017	365	122	1989	8220	
1990	.599	.211	.018	309	69	1990	28190	
1991	.696	.066	.023	739	62	1991	27925	
1992	.889	.100	.031	610	103	1992	40711	
1993	.714	.137	.038	857	133	1993	12504	
1994	.677	.171	.043	494	158	1994	78532	*
Arithmetic mean recruits, age 0, 1963 to 1992						:	45629	
Geometric mean recruits, age 0, 1963 to 1992						:	25498	

* RCT3 estimate

Table 3.3.14; Haddock North Sea
Input data for catch forecast and linear sensitivity analysis.

Populations in 1995			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N0	20235000	.56	WS0	.01	.28	M0	2.05	.03	MT0	.00	.10
N1	7314700	.26	WS1	.11	.04	M1	1.65	.05	MT1	.01	.10
N2	253800	.16	WS2	.28	.12	M2	.40	.07	MT2	.32	.10
N3	307500	.12	WS3	.45	.07	M3	.25	.19	MT3	.71	.10
N4	55200	.11	WS4	.68	.11	M4	.25	.12	MT4	.87	.10
N5	13700	.12	WS5	.95	.06	M5	.20	.17	MT5	.95	.10
N6	1100	.13	WS6	1.09	.16	M6	.20	.10	MT6	1.00	.10
N7	400	.14	WS7	1.36	.17	M7	.20	.10	MT7	1.00	.00
N8	100	.14	WS8	1.53	.04	M8	.20	.10	MT8	1.00	.00
N9	300	.17	WS9	1.75	.08	M9	.20	.10	MT9	1.00	.00
N10	100	.20	WS10	2.12	.14	M10	.20	.10	MT10	1.00	.00

HC selectivity			HC.catch wt			Dis selectivity			Discrd catch wt		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
sH0	.00	.00	WH0	.00	.00	sD0	.00	.63	WD0	.04	.25
sH1	.00	.41	WH1	.32	.09	sD1	.10	.32	WD1	.14	.06
sH2	.21	.44	WH2	.39	.02	sD2	.41	.23	WD2	.23	.08
sH3	.80	.20	WH3	.49	.03	sD3	.19	.46	WD3	.28	.04
sH4	.95	.03	WH4	.69	.10	sD4	.03	1.33	WD4	.33	.07
sH5	.80	.13	WH5	.96	.06	sD5	.01	1.60	WD5	.22	.88
sH6	.81	.14	WH6	1.13	.18	sD6	.03	1.39	WD6	.23	.92
sH7	.73	.09	WH7	1.36	.17	sD7	.00	1.73	WD7	.12	1.73
sH8	.75	.24	WH8	1.53	.04	sD8	.00	.00	WD8	.00	.00
sH9	1.01	.19	WH9	1.75	.08	sD9	.00	.00	WD9	.00	.00
sH10	1.01	.19	WH10	2.12	.14	sD10	.00	.00	WD10	.00	.00

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI0	.02	.66	WI0	.01	.35
sI1	.06	.39	WI1	.05	.10
sI2	.05	.09	WI2	.20	.13
sI3	.05	.66	WI3	.42	.05
sI4	.03	1.03	WI4	.56	.07
sI5	.02	1.17	WI5	.63	.10
sI6	.01	.94	WI6	.75	.54
sI7	.01	1.73	WI7	.61	1.02
sI8	.00	1.73	WI8	.64	1.02
sI9	.00	1.73	WI9	.27	1.73
sI10	.00	.00	WI10	.00	.00

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K95	1.00	.10	HF95	1.00	.09	IF95	1.00	.15
K96	1.00	.10	HF96	1.00	.09	IF96	1.00	.15
K97	1.00	.10	HF97	1.00	.09	IF97	1.00	.15

Recruitment		
Labl	Value	CV
R96	25497600	1.09
R97	25497600	1.09

Stock numbers in 1995 are VPA survivors.
These are overwritten at Age 0 Age 1

Human consumption + discard Fs are obtained from mean exploitation pattern over 1992 to 1994.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1994, i.e. .848
Fs are distributed between consumption and discards by mean proportion retained over 1992 to 1994.
N.B. Above value for H.cons+Disc. ref F is value for both catch categories combined.

Bycatch Fs are obtained from mean exploitation pattern over 1992 to 1994.
This is scaled to give a value for mean F (ages 0 to 3) equal to that in 1994, i.e. .043

Table 3.3.15; Haddock North Sea
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	1995	1996						
Mean F Ages								
H.cons 2 to 6	.85	.00	.17	.34	.51	.68	.85	1.02
Ind BC 0 to 3	.04	.04	.04	.04	.04	.04	.04	.04
Effort relative to 1994								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Biomass at start of year								
Total	1067	732	732	732	732	732	732	732
Spawning	177	207	207	207	207	207	207	207
Catch weight (,000t)								
H.cons	111	0	32	60	84	105	123	139
Discards	71	0	22	41	59	75	90	103
Ind BC	18	18	17	17	16	15	15	14
Total Landings	128	18	50	77	100	120	138	153
Total Catch	198	18	71	118	159	195	227	256
Biomass at start of 1997								
Total		953	888	832	783	740	703	670
Spawning		406	356	313	276	244	217	193

	1995	1996						
Effort relative to 1994								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Est. Coeff. of Variation								
Biomass at start of year								
Total	.20	.30	.30	.30	.30	.30	.30	.30
Spawning	.11	.21	.21	.21	.21	.21	.21	.21
Catch weight								
H.cons	.14	.00	.49	.32	.29	.28	.27	.27
Discards	.29	.00	.55	.40	.36	.35	.34	.34
Ind BC	.36	.35	.35	.36	.36	.36	.37	.37
Biomass at start of 1997								
Total		.45	.48	.51	.54	.56	.59	.61
Spawning		.25	.26	.26	.27	.28	.29	.30

Table 3.3.16; Haddock North Sea
Detailed forecast tables.

Forecast for year 1995
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	20235000	0	17078	162240	179318
1	7314700	3384	338352	189477	531213
2	253800	33294	63943	7623	104860
3	307500	138432	32836	8296	179564
4	55200	29877	787	882	31546
5	13700	6862	69	129	7059
6	1100	555	19	3	578
7	400	189	0	1	191
8	100	49	0	0	49
9	300	176	0	0	176
10	100	59	0	0	59
Wt	1067	111	71	18	199

Forecast for year 1996
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	25497600	0	21519	204435	225954
1	2550817	1180	117992	66075	185247
2	1200678	157507	302502	36065	496073
3	86708	39035	9259	2339	50633
4	84730	45861	1208	1353	48422
5	15783	7905	79	148	8133
6	4925	2485	85	15	2586
7	386	183	0	1	184
8	157	76	0	0	76
9	39	23	0	0	23
10	119	70	0	0	70
Wt	732	123	90	15	227

Table 3.3.17

Stock: Haddock in Sub-area IV (North Sea)

Assessment Quality Control Diagram 1

Average F(2-6,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	1.00	1.00						
1990	1.00	1.05	0.95					
1991	1.02	1.05	0.91	0.98				
1992	1.01	1.03	0.91	1.10	1.23			
1993	0.99	0.99	0.87	0.99	0.92	1.31		
1994	1.01	1.06	0.97	0.86	0.81	1.07	1.02	
1995	1.01	1.05	0.96	0.84	0.78	1.00	0.87	0.89

Remarks: Laurec/Shepherd tuning used 1989-1992, XSA used in 1993.
Average total F(2-6)) i.e., Human consumption discards industial by-catch.

Assessment Quality Control Diagram 2

Recruitment (age 0) Unit: millions								
Date of assessment	Year class							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	7650							
1990	10512	1280						
1991	7802	7879	32729					
1992	7265	8351	33509	66763				
1993	8017	7927	25254	45919	83110	17559		
1994	7554	8141	27283	28631	51411	11813	45005	
1995	7591	8220	28190	27925	40711	12504	78532	17128

Remarks:

Table 3.3.17 (Cont'd)

Stock: Haddock in Sub-area IV (North Sea)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	134[2]	117[2]	79[1,2]	72[1,2]						
1990	149	122	86	81[1]	150[1]					
1991	150	122	76	64	99[1]	122[1]				
1992	149	119	71	55	105	201[1]	235[1]			
1993	155	125	77	58	89	165	248[1]	177[1]		
1994	154	121	68	61	99	130	194	158[1]	163[1]	
1995	155	122	69	62	103	133	158	178	230[1]	239[1]

[1]Forecast. [2]As revised by ACFM.

Remarks: 1993 XSA used, 1989-1992 Laurec/Shepherd tuning used.

Table 3.3.18 **Haddock, North Sea**
Comparison of XSA runs with and without IBTS Q2 and Q4 indices

	Final XSA (Excluding IBTS)		XSA with IBTS Q2 and Q4 indices					
Age	Survivors est.	ext. SE	Survivors est.	ext. SE	IBTS Quarter 2		IBTS Quarter 4	
					Estimate	weight	Estimate	weight
0	5142558	0.37	4819330	0.26	-	-	4529652	0.336
1	253776	0.16	224024	0.1	135072	0.063	203833	0.292
2	307508	0.1	306795	0.07	359540	0.116	293369	0.228
3	55204	0.06	51635	0.05	49448	0.09	48319	0.195
4	13699	0.12	13865	0.03	13945	0.138	14841	0.107

E:\acfm\wgnssk96\T-3318.xls

Figure 3.3.1

Haddock in the North sea. Stock trends 1963-1994

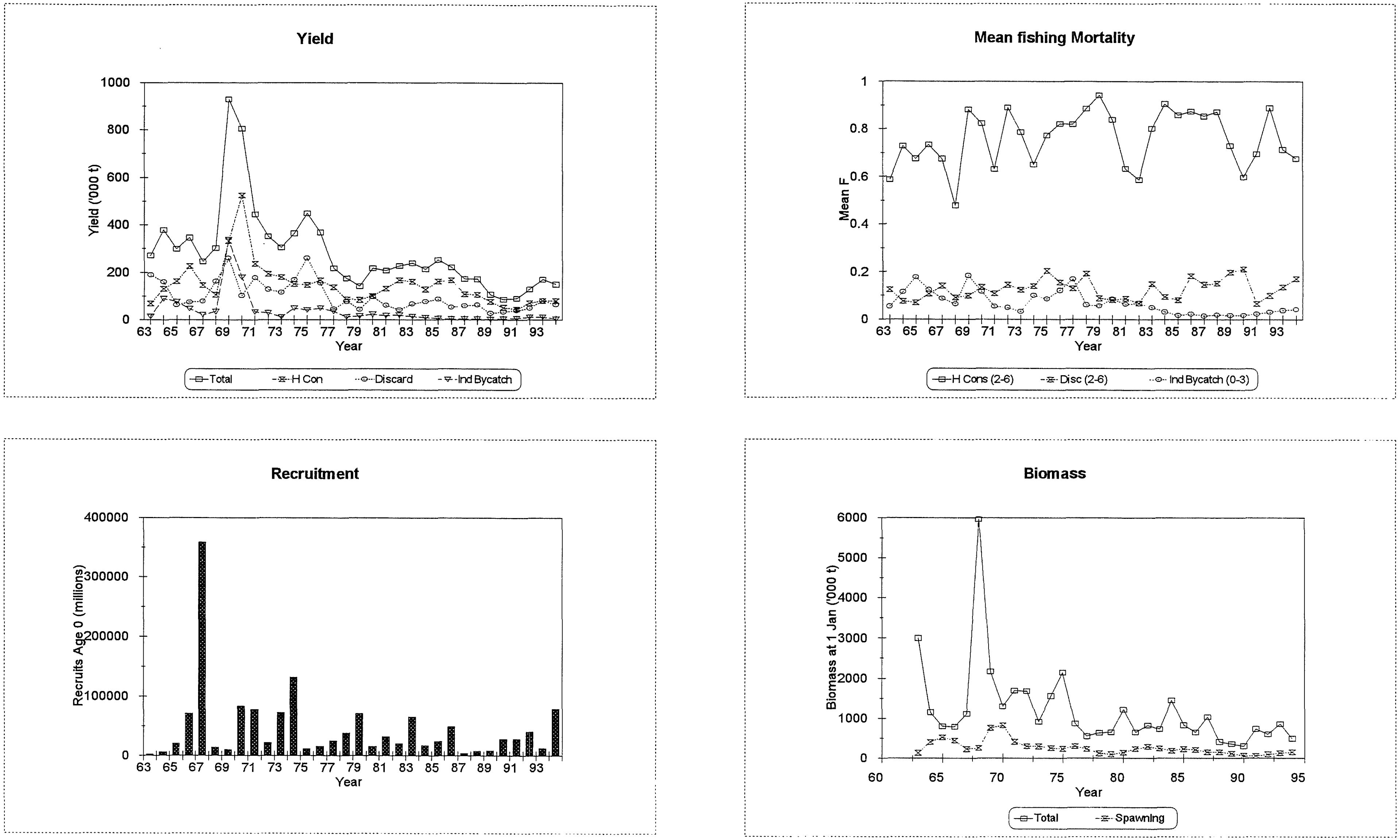
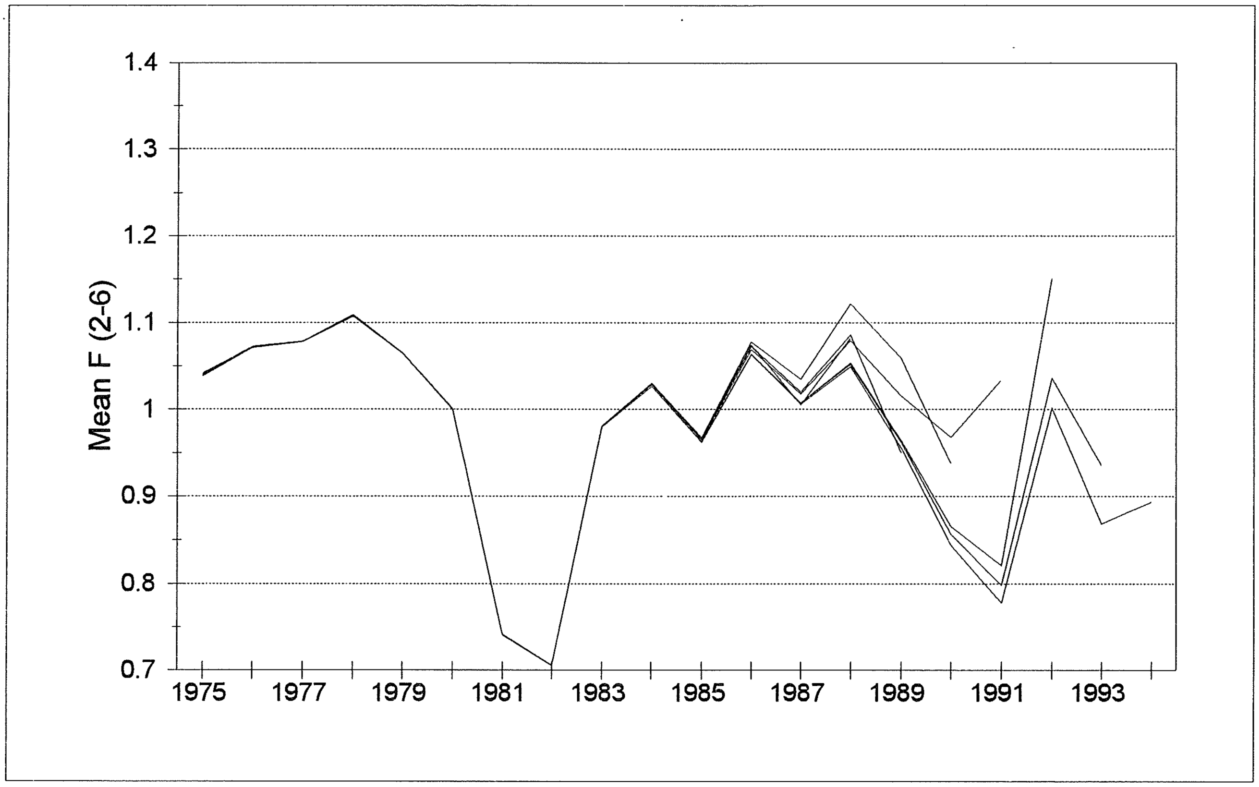


Figure 3.3.2; North Sea Haddock
Retrospective trends in mean F

a; Selected fleets (Final XSA)



b; All fleets (as 1994 WG)

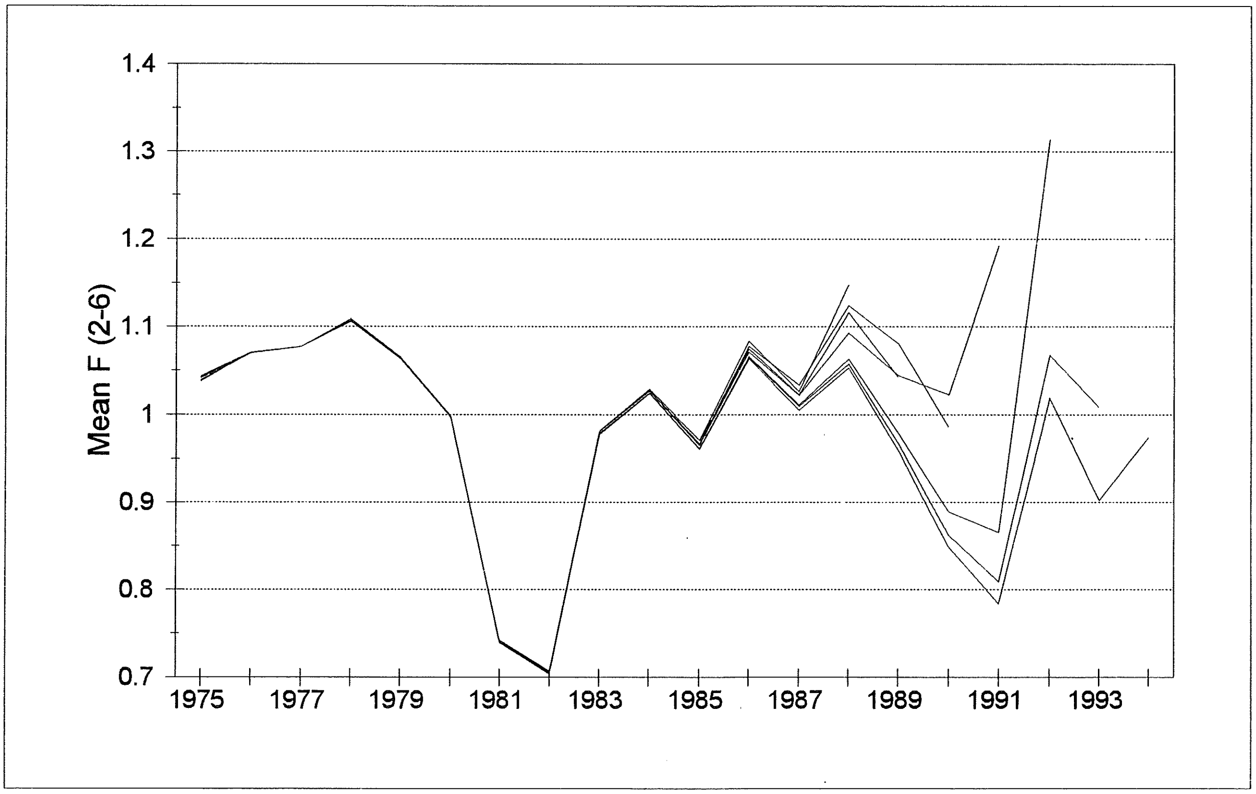
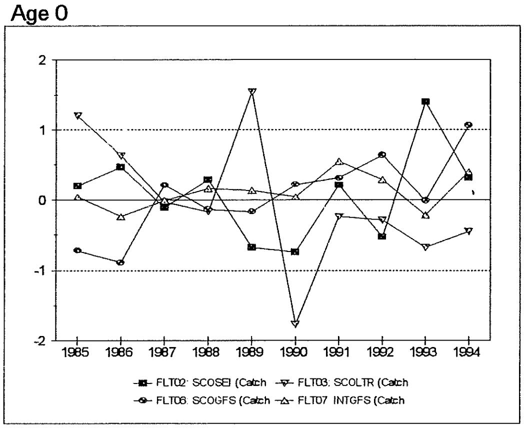
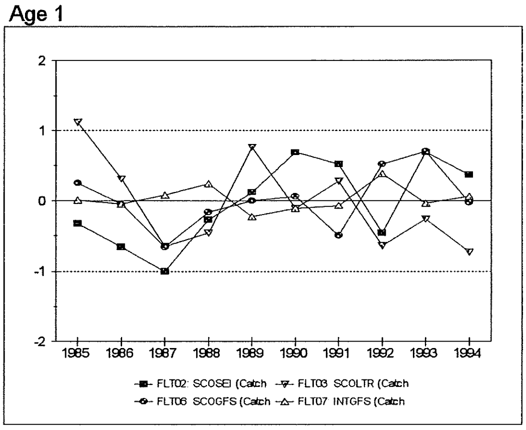


Figure 3.3.3
North Sea Haddock
Log catchability residuals, XSA run : NO QUART/WG3

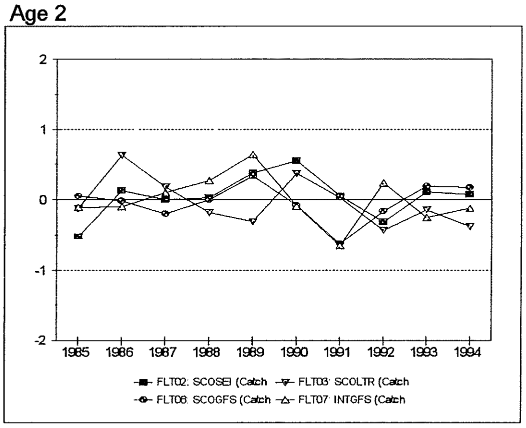
Age 0



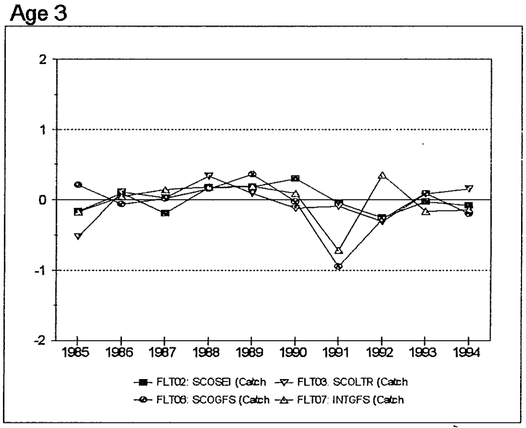
Age 1



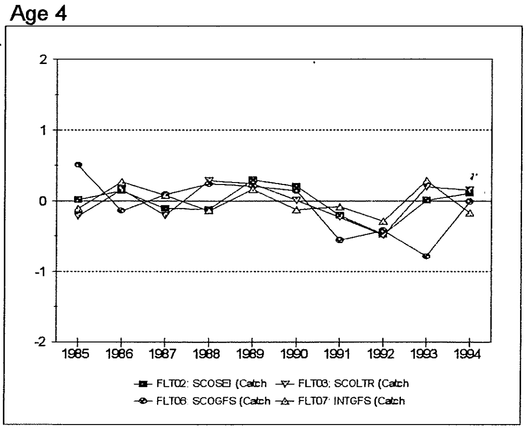
Age 2



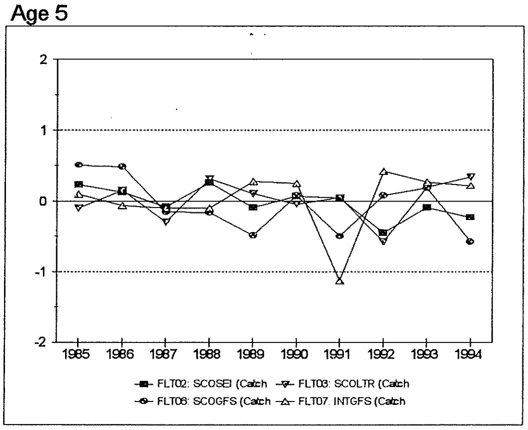
Age 3



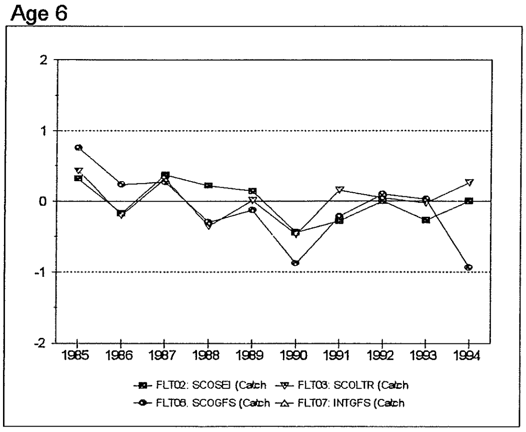
Age 4



Age 5



Age 6



Age 7

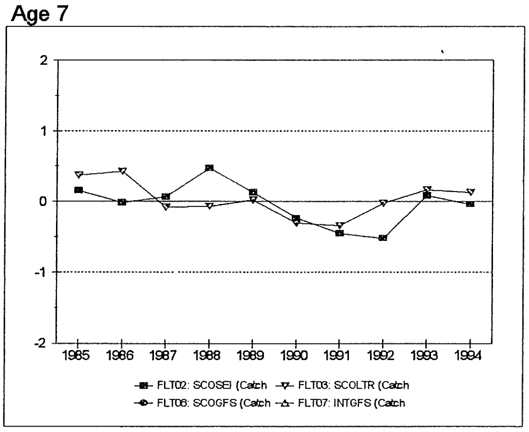


Figure 3.3.4 **Haddock, North Sea**
Correlation of survey indices with converged VPA (age 0)
Arrows indicate values for most recent indices

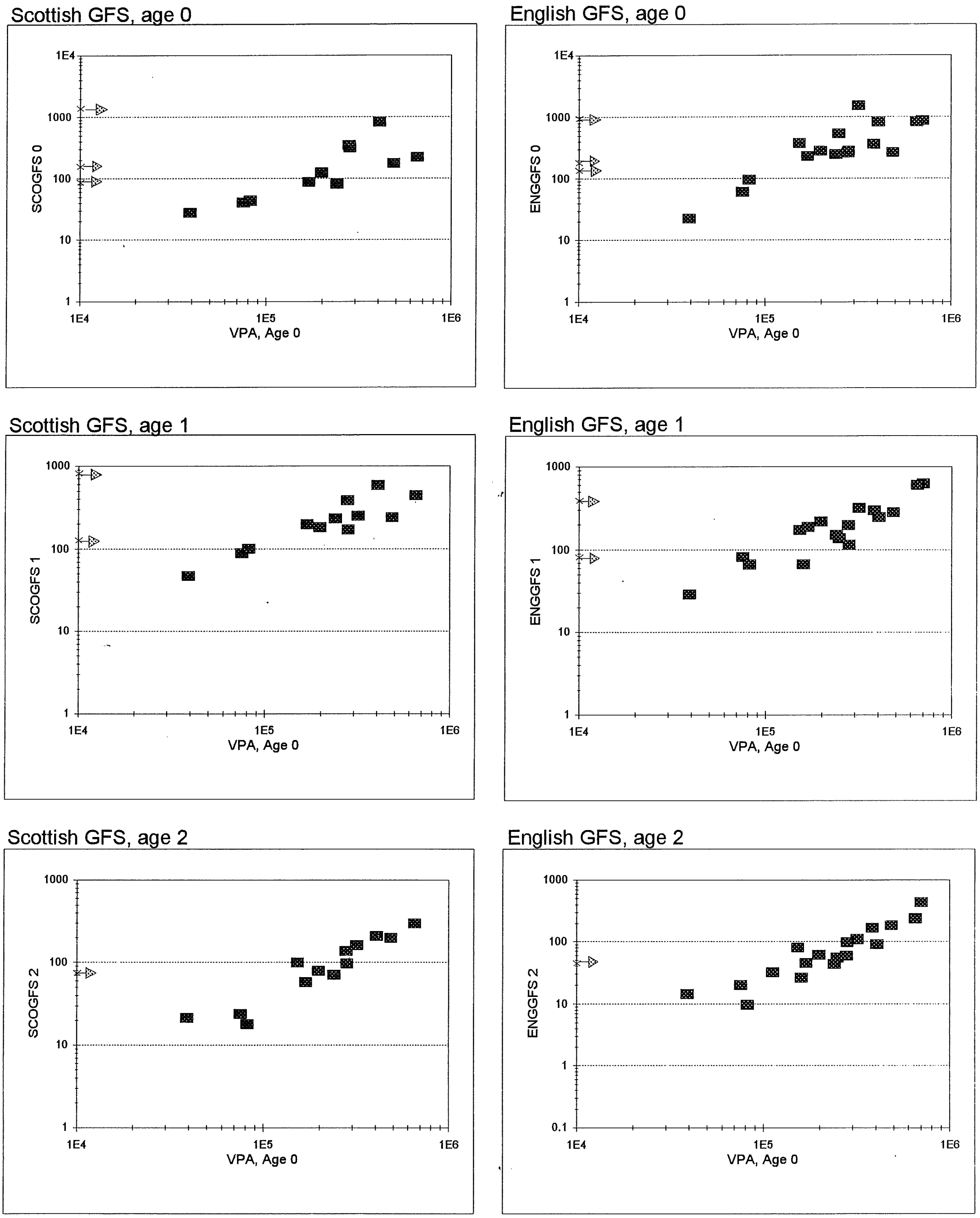


Figure 3.3.4 (Cont'd)

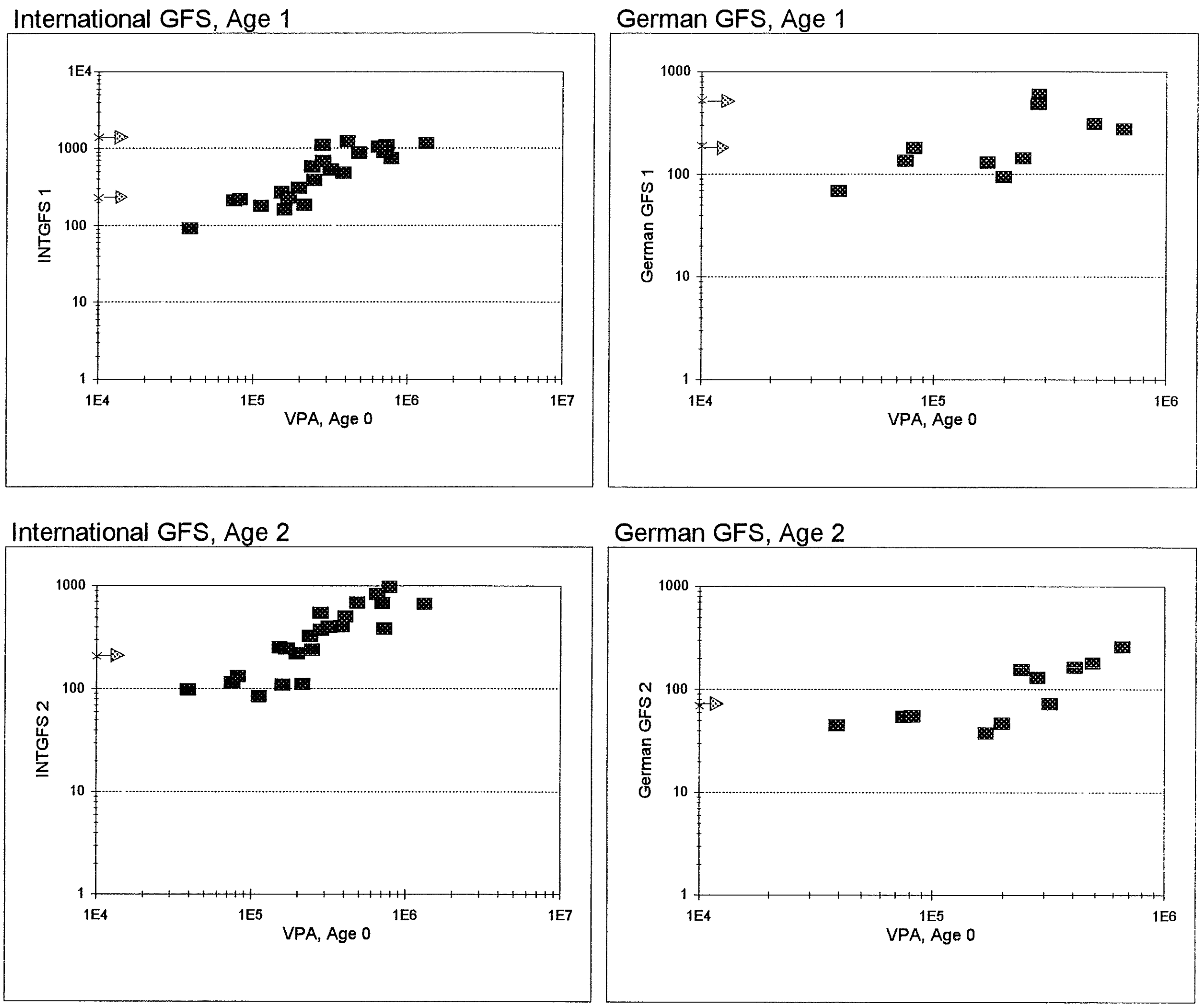
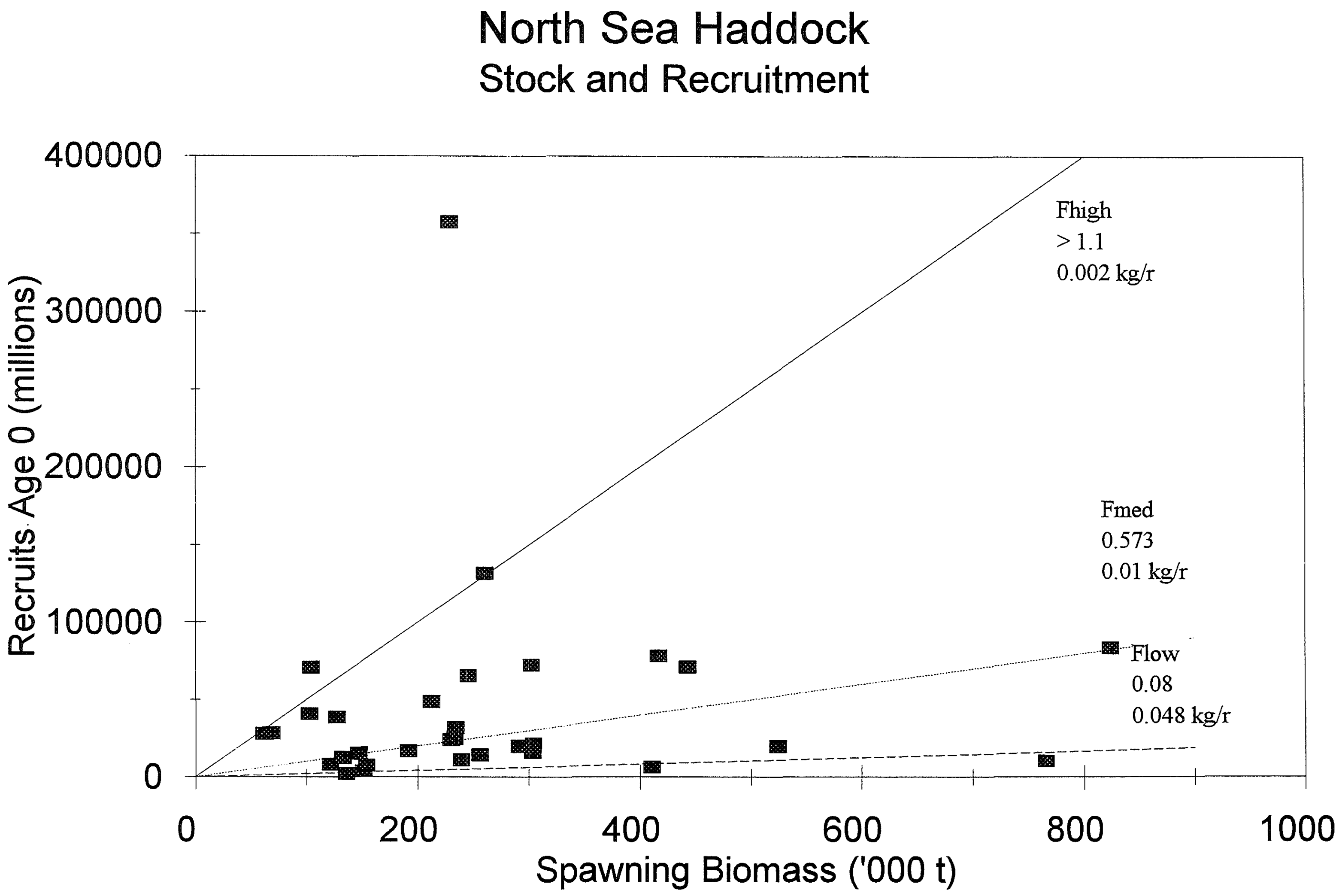
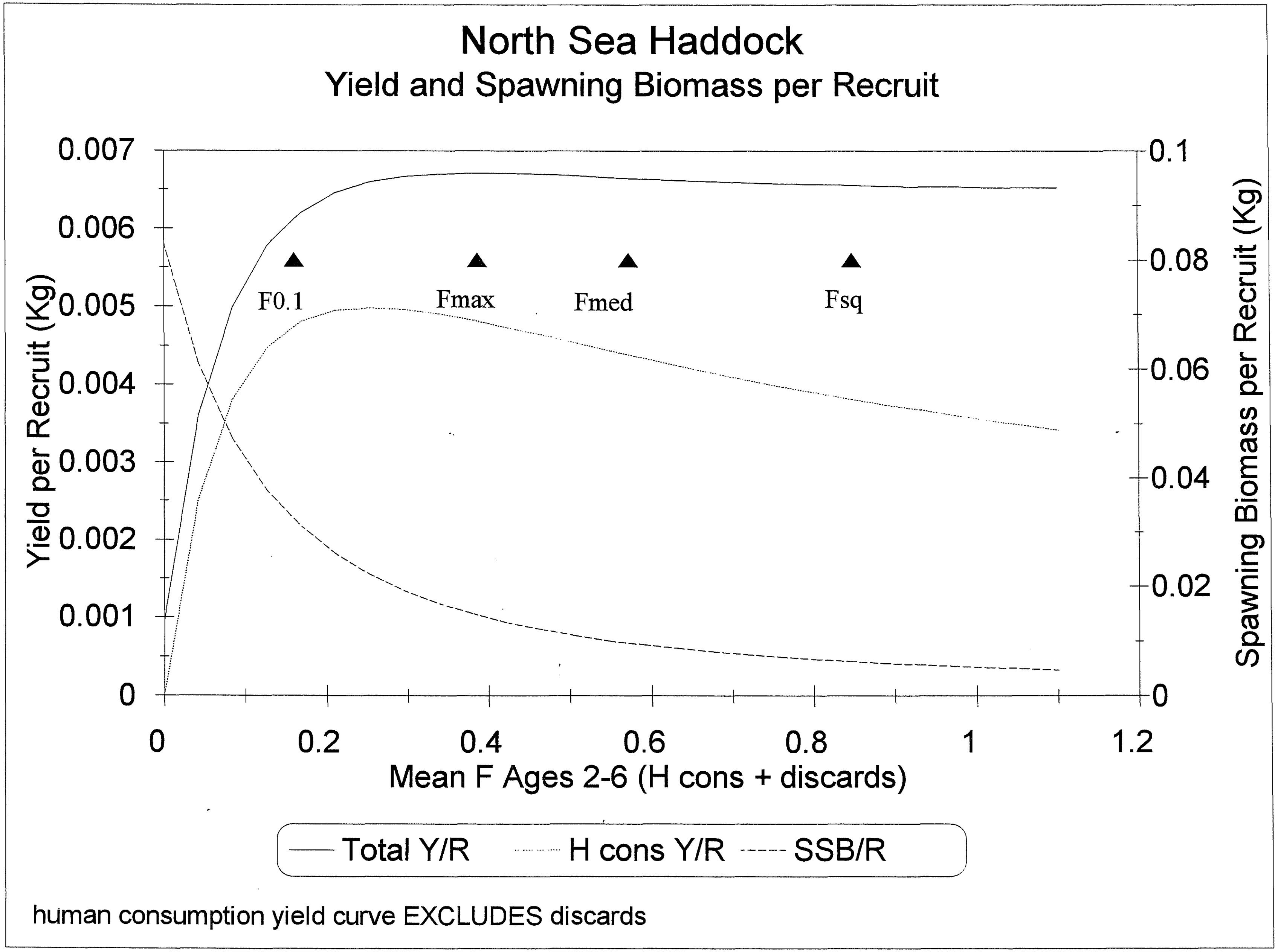


Figure 3.3.5



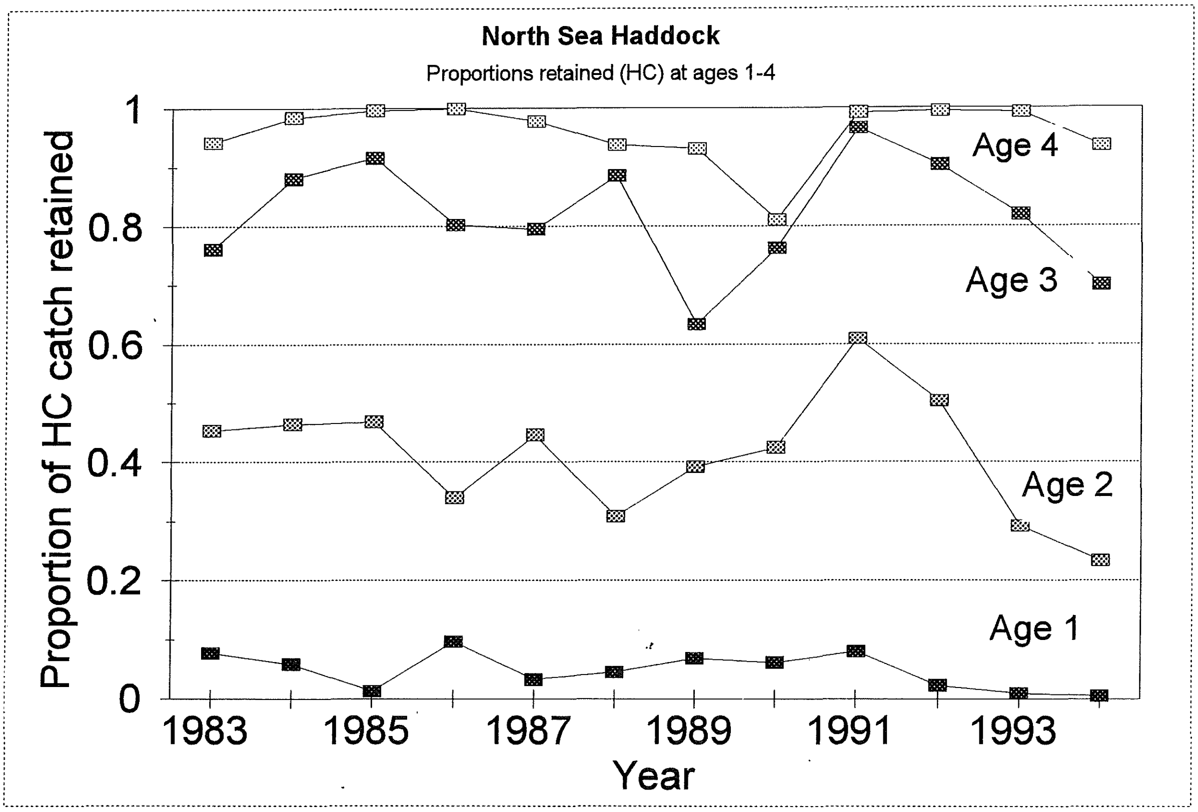
Reference Fs are defined relative to mean F ages 2-6 (Human consumption + Discards)

Figure 3.3.6



North Sea Haddock
Yield and Spawning Biomass per Recruit
Yield per Recruit (Kg)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Spawning Biomass per Recruit (Kg)
0.1
0.08
0.06
0.04
0.02
0
F0.1
Fmax
Fmed
Fsq
0
0.2
0.4
0.6
0.8
1
1.2
Mean F Ages 2-6 (H cons + discards)
Total Y/R
H cons Y/R
SSB/R
human consumption yield curve EXCLUDES discards

Figure 3.3.7 **Haddock, North Sea**
Proportions retained and stock weights at ages 1-4, 1983-1994



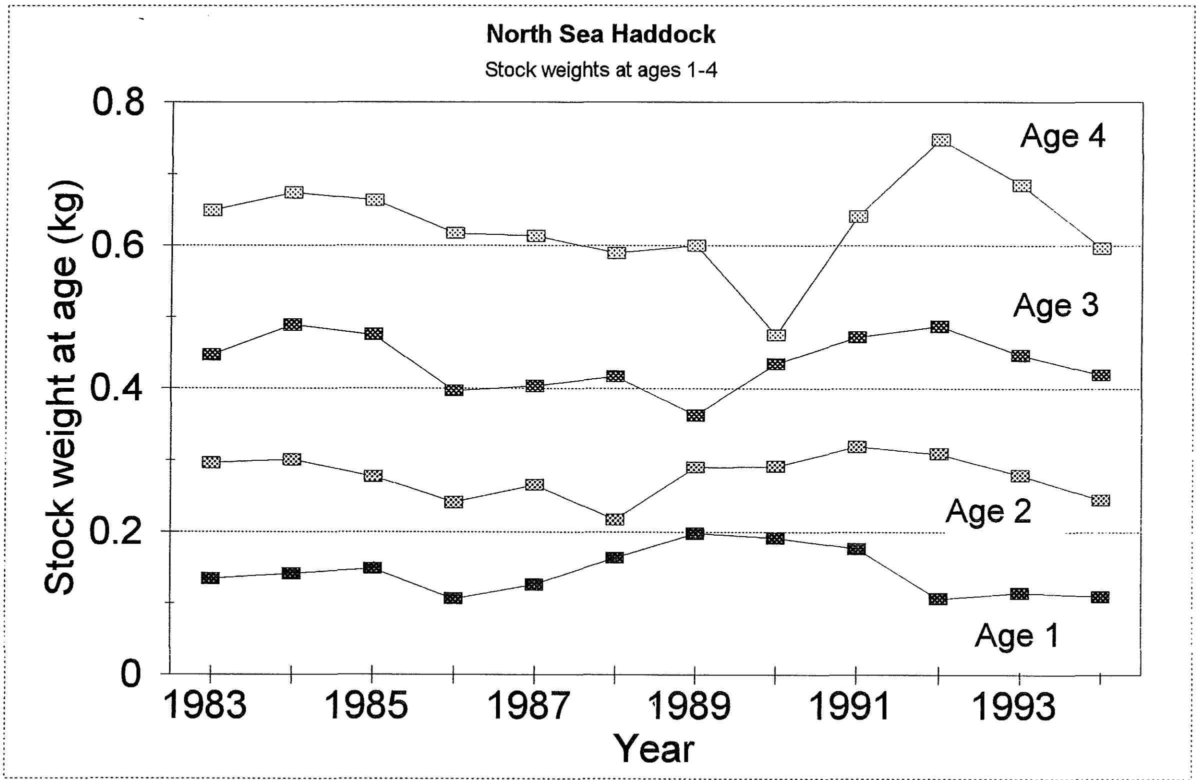
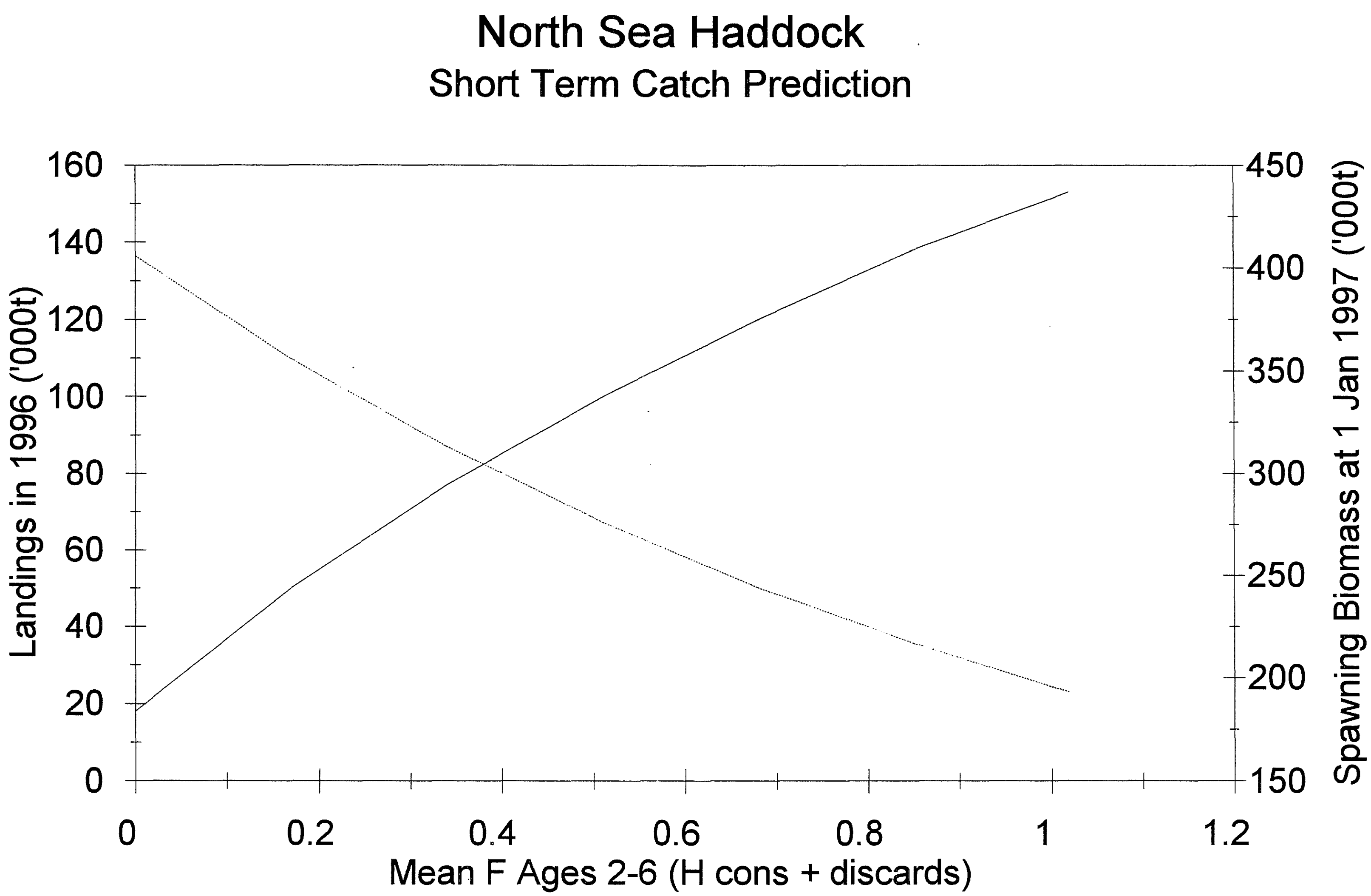


Figure 3.3.8



Landings = Human Consumption Landings + Industrial Bycatch

Figure 3.3.9 Haddock, North Sea

Sensitivity analysis of short-term forecast. Linear sensitivity coefficients (elasticities). Key to labels in Table 3.3.14

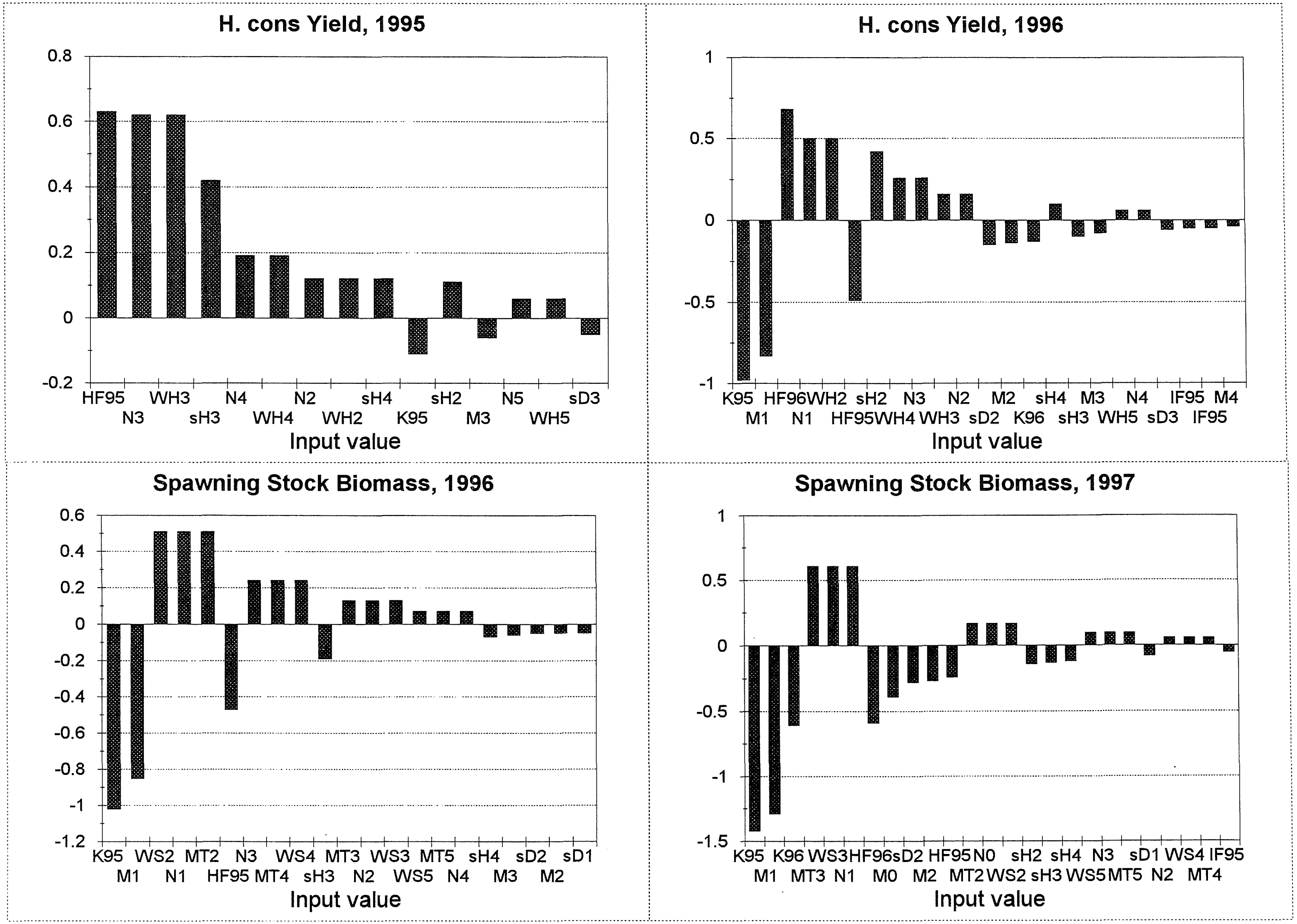


Figure 3.3.10 Haddock, North Sea
Sensitivity analysis of short-term forecast. Proportion of total variance contributed by each input value. Key to labels in Table 3.3.14

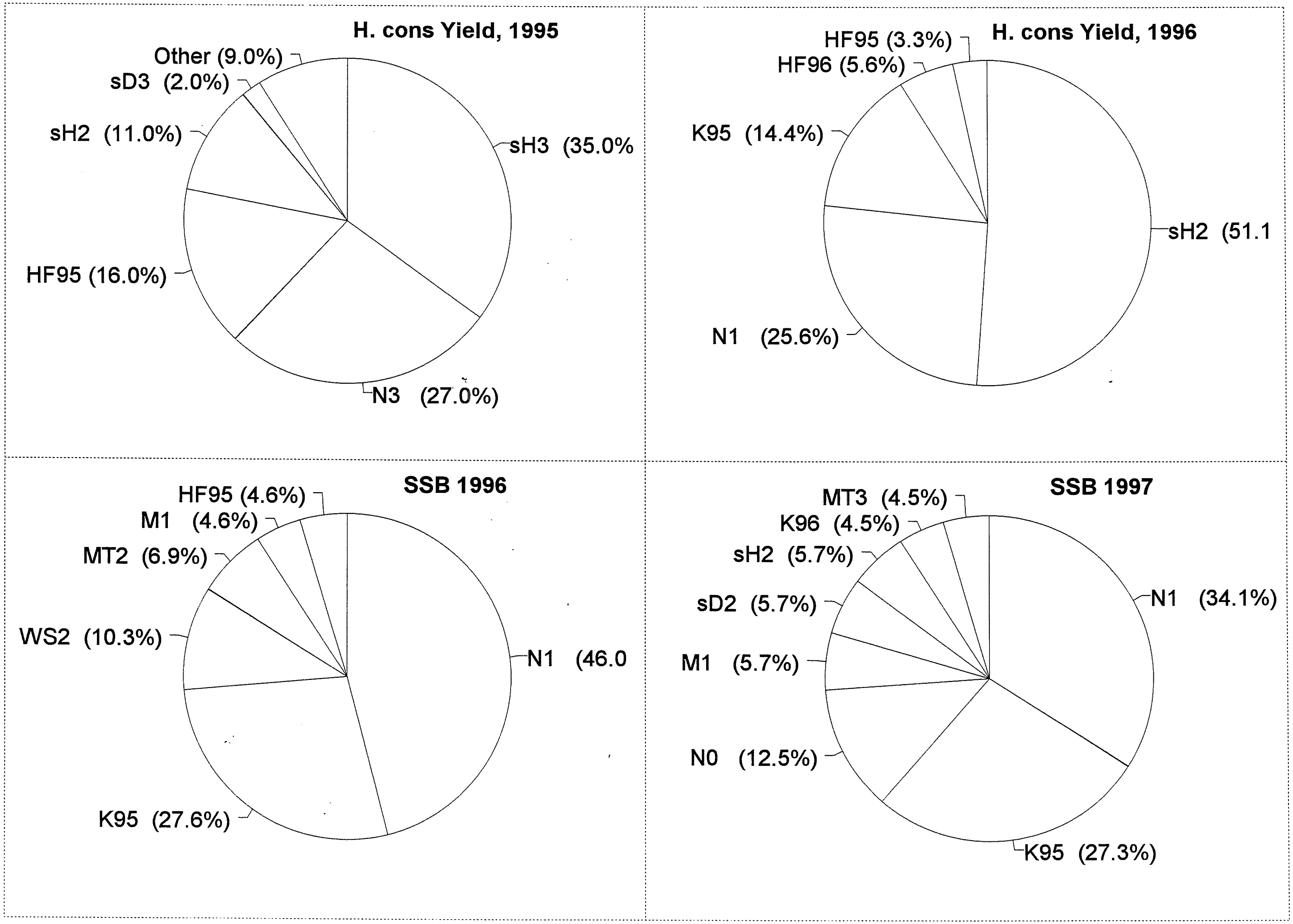


Figure 3.3.11 Haddock, North Sea
Sensitivity analysis of short-term forecast. Cumulative probability distributions.

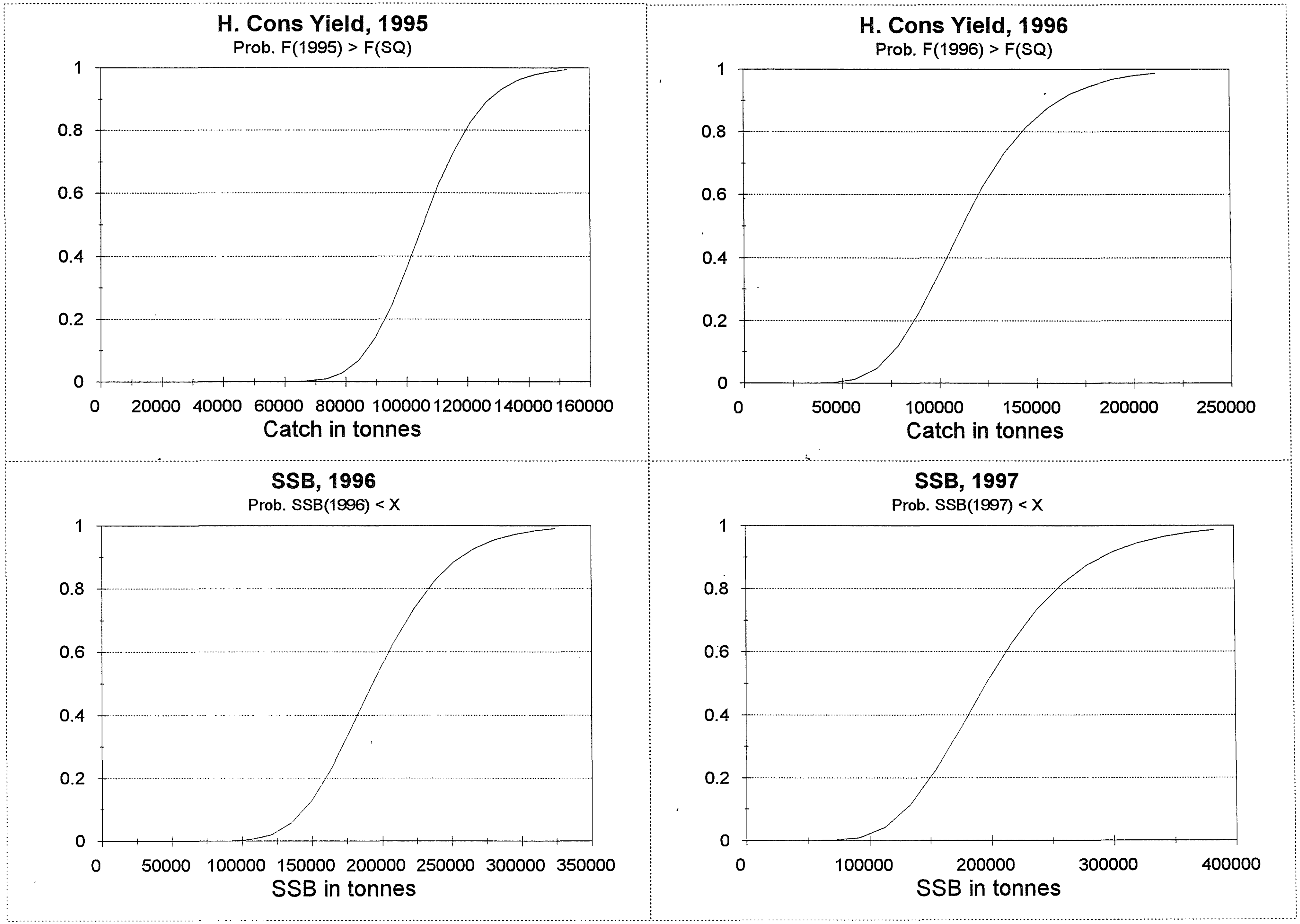


Figure 3.3.12A **North Sea Haddock, medium-term projections**
Solid lines show 5, 25, 50, 75 and 95 percentiles. Dashed lines show 5 sample trajectories.
Relative H.cons Effort = 1.00 Relative Industrial Effort = 1.00 1000 simulations

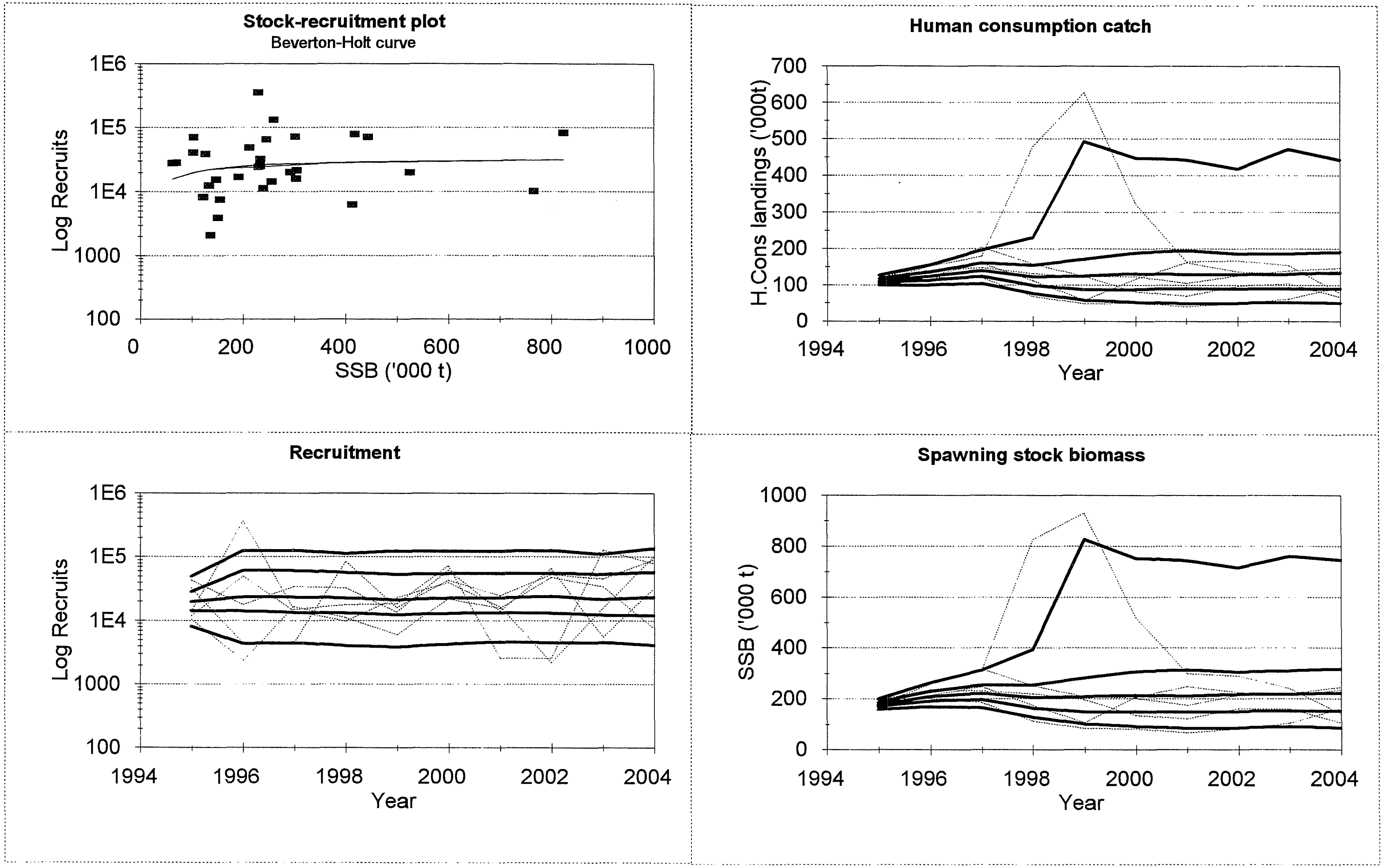


Figure 3.3.12B **North Sea Haddock, medium-term projections**
Solid lines show 5, 25, 50, 75 and 95 percentiles. Dashed lines show 5 sample trajectories.
Relative H.cons Effort = 0.7 Relative Industrial Effort = 1.00 1000 simulations