Advisory Committee on Fishery Management

ICES CM 1998/Assess:7

REPORT OF THE

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

ICES Headquarters
6–15 October 1997

PART 1 OF 3

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 on 6-15 October 1997 with the following participants:

Frans van Beek	Netherlands
Odd Aksel Bergstad	Norway
Bill Brodie	Canada
John Casey	England
Uli Damm	Germany
Poul Degnbol (Chairman)	Denmark
Michael Hartmann	Denmark
Holger Hovgaard	Denmark
Åge Høines	Norway
Laurence Kell	England
Phil Kunzlik	Scotland
Peter Lewy	Denmark
Capucine Mellon	France
Richard Millner	England
Coby Needle	Scotland
J.Rasmus Nielsen	Denmark
Martin Pastoors	Netherlands
Stuart Reeves	Scotland
Odd M. Smedstad	Norway
Alain Tétard	France
Willy Vanhee	Belgium
Wolfgang Weber	Germany

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 6-15 October 1997 to:

a) assess the status of and provide catch options for 1998 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, and provide catch forecasts for 1997 for, Norway pout and sandeel stocks in Sub-area IV and Divisions IIIa and Via, and identify any needs for management measures (including precautionary TAC's) required to safeguard the stocks;

c) define the information required to evaluate, and if possible, carry out an evaluation of, the effect of sandeel fisheries on local aggregations of sandeels in areas close to important wildlife assemblages such as seabird colonies, and the effects of seasonal and localised catch regulations;

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

e) Propose a definition of safe biological limits using target reference points based, where appropriate, on biomass, fishing mortality, maturity, growth, age structure, exploitation pattern, geographic distribution and other relevant parameters; based on the above parameters, propose limit reference points to be avoided with a high probability;

f) prepare medium term forecasts of yield and SSB, taking into account uncertainties in data and assessments and assuming a stock-recruitment relationship, to indicate the probability of attaining target reference points and avoiding limit reference points;

g) provide the data required to carry out multispecies assessments (quarterly catches and mean weights at age in the catch and stock for 1996 for all species in the multispecies model that are assessed by this Working Group);

h) provide information on quantities of discards by gear type and area for stocks of fish and fisheries considered by this group [OSPAR 1997/5.3] and report to WGECO;

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, the European Commission and the Government of the United Kingdom.

An additional request from EC and Norway regerading North Sea plaice has been aded to the terms of reference :

'...ICES is requested to provide information on :

a) short and medium levels of catches and spwaning stock biomass, taking into account the risk of reduced recruitment at low stock sizes, natural variability in recruitment and using the longest possible time series of recruitment. In particular, for the medium term analysis ICES is requested to provide 0-10 years stochstic projections of levels of F of 0.2, 0.25, 0.3, 0.35, 0.4 and 0.5 a plot of the spawning biomass in 10 years time for levels of F between 0.2 and 0.5 at percentiles of the distribution of 5, 10, 20, 30, 50, 80 and 90 %.

b) equilibrium spawning stock biomass and equilibrium yield for a full range of fishing mortality rates. These equilibrium calculations should be based on a stochastic stock.recruitment relationship using the longest possible data set.'

The above terms of reference refer to species and areas to be covered but do not explicitly state stock entities to be used. From 1996 (Anon 1996) the following stock entities have been used by this working group :

- Cod in Sub-area IV, Division VIId and the Skagerrak
- Whiting in Sub-area IV and Division VIId
- Haddock in Sub-area IV and Division IIIa
- Norway pout in Sub-area IV and Division IIIa

For other species the stock entities are defined on basis of a single Sub-area or Division.

Sandeel in Shetland is within the North Sea and has been assessed as a separate stock. This stock is also assessed in the present report, but due to the low level of fishing there does not seem to be any point in doing annual assessments. The Working Group does therefore not intend to continue updating this assessment on an annual basis unless specifically requested to do so.

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

Data for the French roundfish database for the North Sea and the English Channel have been revised from 1985 onwards. Reported landings to the Working Group have not been changed but the fleets were redefined based on a classification of trips based on the composition of the landings in combination of vessel and gear characteristics. A more detailed explanation of the procedure and a list of the fleet is given in Annex 1.

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. For all stocks except cod, haddock, saithe and whiting, SOP uncorrected estimates have been used in assessments. The reason the SOP corrected data have been used for roundfish stocks is that some data in the historical time series have been SOP corrected and that it has proven difficult to rectify this in a consistent manner.

The unallocated landings do in some cases also include corrections for mis- or unreported landings. Such corrections may be based on direct information such as estimation from alternative data sources, or may be based on softer information. 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 bias 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. The quality of spawning products has also been shown to be associated with fish size for some stocks. The spawning potential will therefore in effect be lower when growth diminishes or the SSB is dominated by young fish than what is indicated by the time series based on a constant maturity-at-age matrix.

1.3.2 Data sources : Norway pout and sandeel

The data sources for Norway pout and sandeel were described detail in the 1995 report of the Working Group (ICES CM 1996/Assess:6). The sampling system has not changed since then.

In Norway, the sampling system in recent years is based on catch samples from three market categories : E02 (if mainly sandeel), D13 (mainly blue whiting, if not sandeel and catch taken west of 0 deg. E) and D12 (mainly Norway pout, if not sandeel and catch taken east of 0 deg. E). The samples are raised to total landings on basis of sales slip information on landed categories. Effort is estimated from total number of trips and an estimate of average days absent from port per trip. For 1993 and onwards the estimation of average days absent per trip has been changed and the effort revised. The average days per trip is now estimated directly based on samples of vessel trips. This lead to substantial changes in effort in 1994 and 1995. In recent years there has been a considerable proportion of *H. lanceolatus* in the Norwegian sandeel catches. This component has been excluded from the data used in the assessment of the North Sea stock, which is *A. marinus*. The exclusion has been based on length frequencies in the samples with parallel observations of the length distributions of the two species as discussed in the stock Section (13.1).

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

1.3.3 Sampling levels

Sampling levels for the various stocks are presented in Table 1.4 and 1.5. The Danish data given in Table 1.5 are split by industrial and human consumption fisheries. In last years report the sampling from industrial fisheries were not included.

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 neighbouring age groups may in some cases be decided by taking otoliths from the transitions zones to neighbouring 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

1.4.1.1 XSA

Extended survivors analysis (XSA) has been used as the main tool for catch-at-age analysis for all stocks. Three implementations were used: version 3.1 of the Lowestoft VPA package was used for roundfish and flatfish stocks; the Seasonal XSA (Skagen 1993, 1994) was used for Norway pout and sandeel to allow for seasonal data and missing data points and the Lowestoft algorithm (implemented in Fishlab) modified to include seasonality, the estimation of missing data and the modelling of trends in catchability was used to perform projections for North Sea sandeel. A seasonal separable VPA (Cook 1992, Cook and Reeves 1993) was used to analyse sandeel stocks in Division VIa. This method was modified relative to earlier years as described in Section 13.

The implementation of the various analysis tools is chosen on basis of explorations. The decision on such choices as ages for which catchabilities are assumed dependent on stock size, time taper and fleets to be included 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 1997 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 thus in the VPA recruitment) and again with the same survey indices in RCT3. Another problem is the use of F-shrinkage for recruiting year classes in the present implementation of the XSA. This can not be turned off and has in some cases been seen to have strong influence on the recruitment estimates originating from XSA. The result of this feature is that the present implementation of XSA does not reproduce RCT3 for recruiting year classes.

1.4.1.2 ICA

Explorations on the use of ICA have been done for several stocks. The methods and results are presented in Section 20.

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

Short term forecasts are based on initial stock sizes as estimated by XSA (in some cases supplemented with separate recruitment estimates as described above), natural mortalities and maturity ogives as used in the XSA, mean weights at age averaged over recent years (normally 3) and fishing mortalities at age as a mean F-pattern over the last 3 years rescaled to the fishing mortality of 1996.

There have been suggestions in ACFM that fishing mortalities should not be rescaled – that is, a mean F level of recent years should be used in forecasts. The reasoning behind this suggestion is, that F estimates relating to the last data year are unsTable and often revised in subsequent assessments. It has therefore created problems in the understanding of the implications of short term predictions when apppaent reductions or increases in F's in the last data year has been brougth forward. However, the initial populations used in short term predictions have been estimated in the same proces as the F-level of the last data year and are closely associated with this value. If an F-level as an average of recent years should be used for short term forecasts the populations should be recalculated to be consistent with this revised F – for instance by running a VPA with the mean F as terminal F-input. The effect of going through this procedure will be a cancellation of F-levels versus population sizes and the change in the predicted catches will be negligble. The main effect of using mean F's will thus be cosmetic. The Working Group has on this background chosen to stick to the more transparent procedure of using F-levels and population structures as estimated by catch-at-age analysis in the last data year as inputs to forecasts.

Sensitivity analysis, and medium term projections made at the current Working Group meeting used the same software as at previous Working Group meetings. Details of the sensitivity analysis are given in Cook (1993), with an overview of the programs in ICES CM 1995/Assess:8 and more detailed documentation in Reeves and Cook (1994).

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

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

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
N0	Numbers at age 0 in 1997
M0	Natural mortality, age 0
N1	Numbers at age 1 in 1997
M1	Natural mortality, age 1
N2	Numbers at age 2 in 1997
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.

K96	Year effect on natural mortality, 1996
K97	Year effect on natural mortality, 1997
K98	Year effect on natural mortality, 1998
HF96	Year effect on HC/discard fishing mortality, 1996
HF97	Year effect on HC/discard fishing mortality, 1997
HF98	Year effect on HC/discard fishing mortality, 1998
IF96	Year effect on Ind. bycatch fishing mortality, 1996
IF97	Year effect on Ind. bycatch fishing mortality, 1997
IF98	Year effect on Ind. bycatch fishing mortality, 1998
R97	Recruitment in 1997
R98	Recruitment in 1998

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 basically as used at the previous Working Group meetings. 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.

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

1.4.3 Catch predictions and medium term projections, Norway pout and sandeel

Management issues relating to Norway pout and sandeel are discussed in Section 15. The types of forecasts which may be relevant must bee seen on the background of this discussion. In last year's report (ICES CM 1997/Assess:6, Section 1.4.3) the working group discussed the general problems and utility of short term forecasts for these stocks.

A model for projections for these stocks is presently under development. Given the large variability of basic biologic parameters (for instance growth and natural mortality) for these stocks it is crucial that a projection model includes a complete model of variance sources. The model has been implemented on sandeel in the present working group meeting.

1.4.3.1 Sandeel – stock projections

In the stock projections the Lowestoft seasonal XSA was used as this allowed future stock size to be estimated by projecting forward the terminal population estimates obtained from the bootstrapped seasonal XSA. The advantage of this approach compared to the deterministic XSA is that CV of estimated N and F is not underestimated (Anon. 1996) and because the correlation between F and N is included. Recruitment was modelled as a time series including autoregression. Uncertainty in growth, selectivity and natural mortality was included by the use of a non-parameteric Monte Carlo simulation where observed weights, partial Fs and natural mortality were randomly resampled from the observed historical values.

The time series of recruitment are displayed in Figure 1.4.1. There are differences, if annual Multi-Species Ms are assumed. Shown in the lower panel of Figure 1.4.1 are the corresponding time series of spawning stock biomass.

The following autoregressive recruitment model suggested by Schnute and Richards (1995) was used in the projections. The model is:

$$R_t = R^{1-\gamma} R_{t-1}^{\gamma} e^{\sigma_1 \delta_t} \qquad (1.4.1)$$

leading to recruitment equations derived from the log-normal autoregressive process

$$\ln R_t = \ln R + \gamma (\ln R_{t-1} - \ln R) + \sigma_1 \delta_t \qquad (1.4.2)$$

with parameters (R, γ, σ_1) where

R	Expected recruitment
γ	autocorrelation
σ_1	residual standard error

Noise is introduced by the independent standard normal variates δ_t. The equation (1.4.2) implies that ln R_t has the following conditional means and variances:

$$E[\ln R_t \mid R_{t-1}] = (1 - \gamma) \ln R + \gamma \ln R_{t-1}$$

$$var[\ln R_t \mid R_{t-1}] = \sigma_1^2$$

and unconditional means and variances:

$$E[\ln R_t] = \ln R$$

$$var[\ln R_t] = \sigma_1^2 / (1 - \gamma^2)$$

When γ=0, ln R_t is obviously independent of R_{t-1} and follows a normal distribution with mean ln R and variance σ_1^2. When γ=1, equation (1.4.2) corresponds to a random walk with finite conditional first-order and second-order moments but infinite unconditional variance.

The equation (1.4.2) provides a simple process for generating correlated recruitments; the nonstationary case γ=1 allows recruitments to drift toward high or low levels over long time periods.

The model represented by equation (1.4.2) would seem to be a suiTable tentative model from which to begin the process of time series model identification and fitting for North Sea sandeel recruitment. Let y_t denote the term ln R_t, y_{t-1} denote ln R_{t-1}, μ denote ln R and ε_t denote σ_1 δ_t in the equation (1.4.2). Then the equation (1.4.2) may be re-written in the familiar form of a *first-order autoregressive model*, abbreviated to AR(1), given by

$$y_t - \mu = \gamma \ (\ y_{t-1} - \mu \ ) + \varepsilon_t \qquad (1.4.3)$$

This is a simple example of a *stochastic process* in which the uncertainty in the time series derives from the variable ε_t - a purely random disturbance term with a mean of zero and a variance of σ_1^2. Under an assumption that the variable ε_t follows an independent normal distribution with the specified mean and variance then the parameters (μ, γ, σ_1) may be estimated by maximum likelihood.

In the case of recruitment generated under the three catch-at-age analyses this is the case and an AR(1) models seems to be appropriate for the time series of recruitment. Inspection of the standardized residuals did not reveal the presence of unexplained structure in the time series of recruitment and thus, seems an appropriate model with which to represent North Sea sandeel recruitment. Inclusion of higher-order terms does not significantly improve any of the model-fits.

The fitted levels of recruitment estimated under the time series model for the two series of recruitment generated under the Lowestoft-versions of SXSA are displayed in Figure 1.4.2. Under the Lowestoft-version of SXSA, the AR(1) model fitted to North Sea sandeel recruitment has an estimated value of -0.480 for the autoregressive parameter (with an estimated variance of 0.03) and the innovations have an estimated variance of 0.23. Exclusion of the extreme S-R pair identified earlier for the year 1974 has little effect on the estimates of parameters.

A line could be drawn from the origin of a S-R plot to the point corresponding to the estimated recruitment at the lowest observed spawning stock biomass enabling the simulation of recruitment at low values of spawning stock biomass.

For recruited ages the numbers in each season were generated by

$$N_{t+1} = N_t \exp(-F_t - M_t) \qquad (1.4.4)$$

except for the plus group at the start of the first season where

$$\text{Plus Group } N_t = (N_{t-1} + \text{Plus Group } N_t) \exp(-F_{t-1} - M_{t-1}) \qquad (1.4.5)$$

In the projection weight, F and M at age were sampled with replacement from the observed values between 1988 and 1997 whilst maturity was fixed. F was sampled from the bootstrapped XSA estimates in the current replicate and natural mortality was sampled from the multi-species Ms. Sampling was performed by year (i.e. all vectors were taken from the same year) to preserve correlations between variables and 100 iterations of the bootstrap were made. The only uncertainty in XSA was due to the catches.

By sampling from the Fs at random the projection F is the average of the last 10 years.

Before investigating stock trends under different management regimes the procedure was validated by making projections over the historical period from 1990 to 1996 and compared to the XSA estimates.

Figure 1.4.3 Compares the assessed and projected SSBs, there is good agreement between the two. The variance in the projection is greater than in the assessment and exhibits a smoother trend and appears to be well behaved.

The projection investigated the probability of SSB remaining above the 95^{th} percentile of the minimum SSB over a ten year period for different levels of F by applying multipliers of .5, .75, 1, 1.25 and 1.50.

1.5 Biological reference points

Well established biologcal reference points (F_{med}, F_{high}, $F_{0.1}$, F_{max}) have been estimated according to standard procedures.

F_{loss} has been estimated using the procedure described in last years report (ICES CM 1997/Assess:6, Section 16.2) as implemented in the programme GLOSS2.

The procedure for estimating precautionary reference points has been described in Section 17.

Table 1.4 Sampling levels for 1996.

	Section 3a			Section 4			Section 7d		
	# samples	measured	aged	# samples	measured	aged	# samples	measured	aged
COD									
Belgium					2020	1185			
Denmark	83	2543	2519	28	1014	992			
England				577	81655	9136	62	1599	457
France					2391	559		57	45
Germany				11	57547	2446			
Netherlands									
Norway	41	277	16	227	2562	1037			
Scotland					59628	12554			
Sweden	n/a	n/a	n/a						
Total	124	2820	2535		206817	27909		1656	502
HADDOCK									
Belgium					1758	840			
Denmark	80	4355	4230	49	1117	1106			
England				305	38259	4221			
France					3724	350			
Germany									
Netherlands									
Norway	30	647	24	343	21856	1139			
Scotland					138876	13311			
Sweden	n/a	n/a	n/a						
Total	110	5002	4254		205590	20967	0	0	0
WHITING									
Belgium					2183	1310			
Denmark	46	416	386	35	98	96			
England				218	19935	3450	13	723	0
France					17404	1392		3900	2159
Germany									
Netherlands									
Norway	36	493		243	11552	756			
Scotland					43234	4273			
Sweden	n/a	n/a	n/a						
Total	82	909	386		94406	11277		4623	2159
SAITHE									
Belgium									
Denmark	23	836	820	11	896	881			
England				50	2785	0			
France									
Germany				25	14712	4817			
Netherlands									
Norway	59	1163	107	179	9628	1251			
Scotland					18749	7359			
Sweden	n/a	n/a	n/a						
Total	82	1999	927		46770	14308	0	0	0

Table 1.4 Continued

	Section 3a			Section 4			Section 7d		
	# samples	measured	aged	# samples	measured	aged	# samples	measured	aged
SOLE									
Belgium					7173	1099		4978	830
Denmark	7	427	422						
England				183	16349	1487	212	13921	2864
France				56	3007	1102	146	7347	1102
Germany									
Netherlands					4129	4129			
Norway									
Scotland									
Sweden									
Total	7	427	422		30658	7817		26246	4796
PLAICE									
Belgium					4525	649		4550	469
Denmark	50	3797	3517	12	2868	2792			
England				166	26307	2748	182	10043	1887
France				32	1364	1017	114	5329	1017
Germany									
Netherlands					4731	4731			
Norway	6	23		69	369				
Scotland									
Sweden	n/a	n/a	n/a						
Total	56	3820	3517		40164	11937		19922	3373
NORWAY POUT									
Belgium									
Denmark	58	3895	3615	24	2169	2169			
England									
France									
Germany									
Netherlands									
Norway				355	35500	500			
Scotland									
Sweden	n/a	n/a	n/a						
Total	58	3895	3615	379	37669	2669			
SANDEEL									
Belgium									
Denmark	32	4568	1336	102	15422	9009			
England									
France									
Germany									
Netherlands									
Norway				220	22000	1000			
Scotland[1]				3	187	187			
Sweden									
Total	32	4568	1336	325	37609	10196			

[1] In addition 107 samples from the Shetlands (30265 measured, 748 aged)

Table 1.5 Danish samples from Skagerrak (IIIa) and the North Sea (IV) in 1996.

	Danish Sampling 1996	Section 3a				Section 4			
		Total samples	No. samples with specified species	No. aged	No. measured	Total samples	No. samples with specified species	No. aged	No. measured
Species	Fleet								
SAITHE	DK-small-meshed	403	18	0	2	374	8	0	0
	DK-human consumption	107	21	820	834	81	11	881	896
	DK-total fleet	510	39	820	836	455	19	881	896
HADDOCK	DK-small-meshed	539	387	653	737	431	278	257	264
	DK-human consumption	107	26	3,578	3,619	81	15	1,467	1,482
	DK-total fleet	646	413	4,231	4,356	512	293	1,724	1,746
PLAICE	DK-small-meshed	537	39	0	19	295	13	0	3
	DK-human consumption	150	29	3,970	4,216	81	18	4,216	4,304
	DK-total fleet	687	68	3,970	4,235	376	31	4,216	4,307
COD	DK-small-meshed	537	338	374	376	431	114	60	62
	DK-human consumption	150	60	3,410	3,437	81	35	1,985	2,021
	DK-total fleet	687	398	3,784	3,813	512	149	2,045	2,083
SOLE	DK-human consumption	115	14	1,436	1,447	42	2	670	675
WHITING	DK-small-meshed	539	334	687	717	431	281	96	98
Total Samplings	DK-small-meshed	2,555	1,116	1,714	1,851	1,962	694	413	427
	DK-human consumption	629	150	13,214	13,553	366	81	9,219	9,378
	DK-total fleet	3,184	1,266	14,928	15,404	2,328	775	9,632	9,805

Figure 1.4.1a A comparison between recruitment estimates from the Skagen Version of XSA and the Lowestoft version with WG Ms and annual multi-species Ms

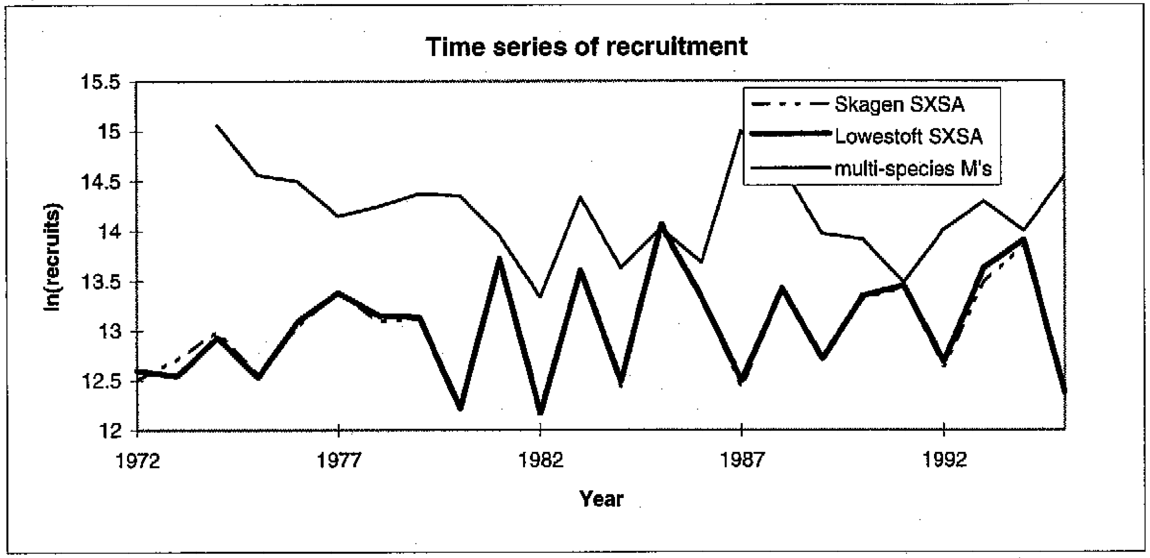

Figure 1.4.1b A comparison between SSB estimates from the Skagen Version of XSA and the Lowestoft version with WG Ms and annual multi-species Ms

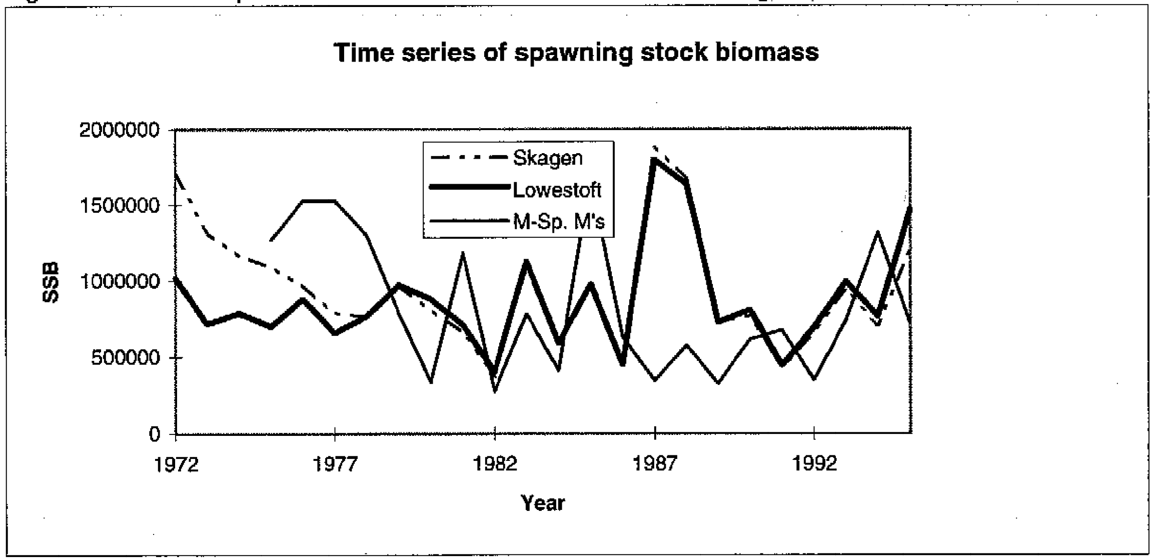

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Figure 1.4.2a A comparison between assessed recruitment and one step ahead projections using the recruit time series model, for WG Ms

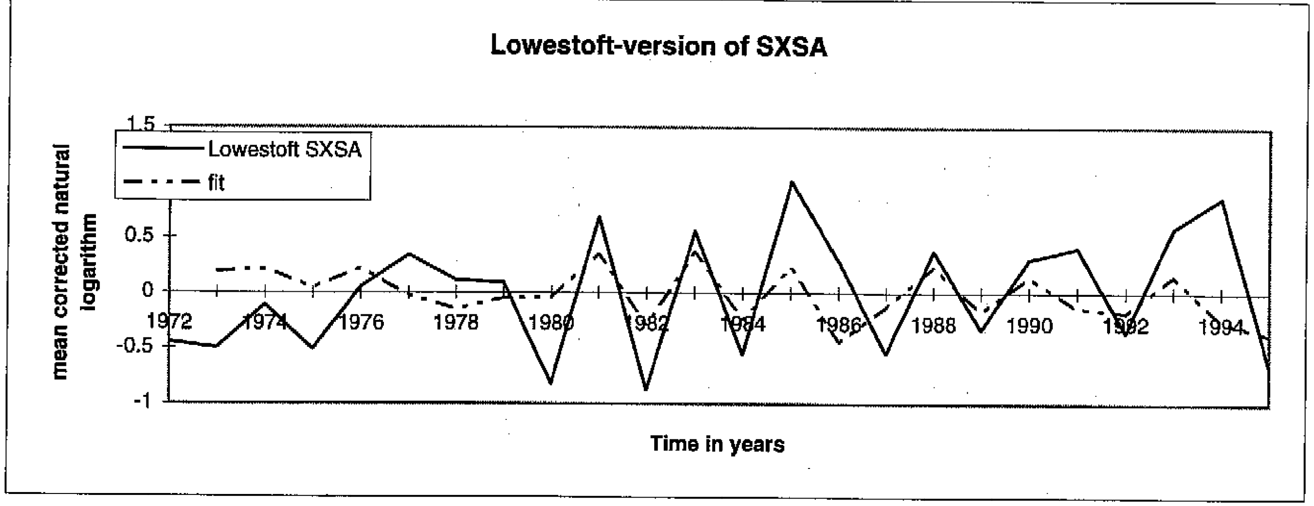

Figure 1.4.2b A comparison between assessed recruitment and one step ahead projections using the recruit time series model, for Mult-Species annual Ms

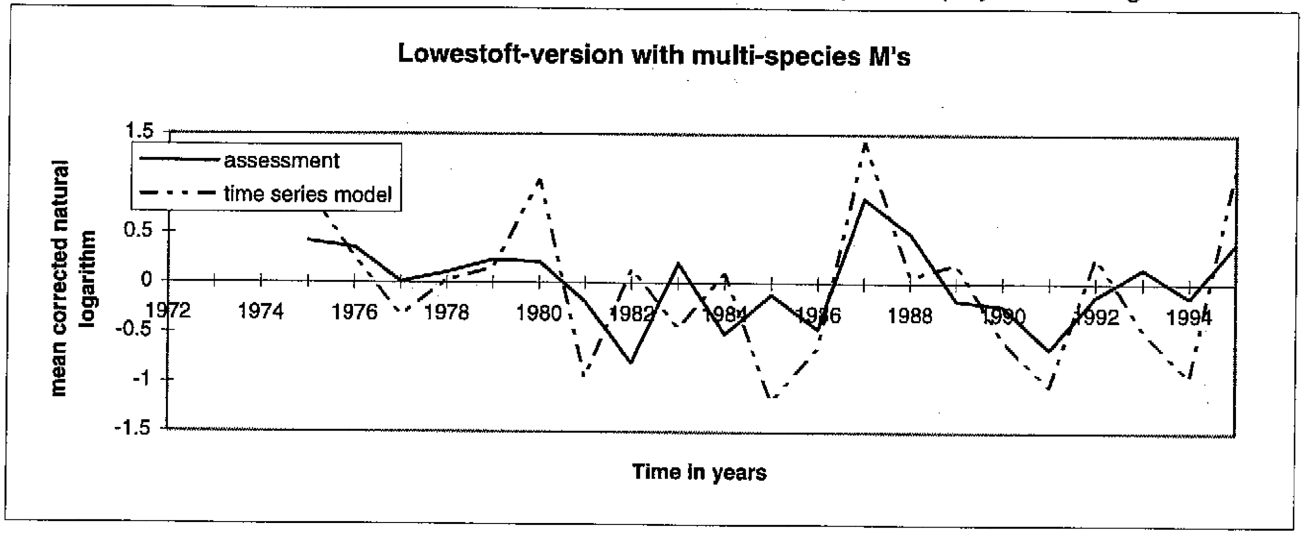

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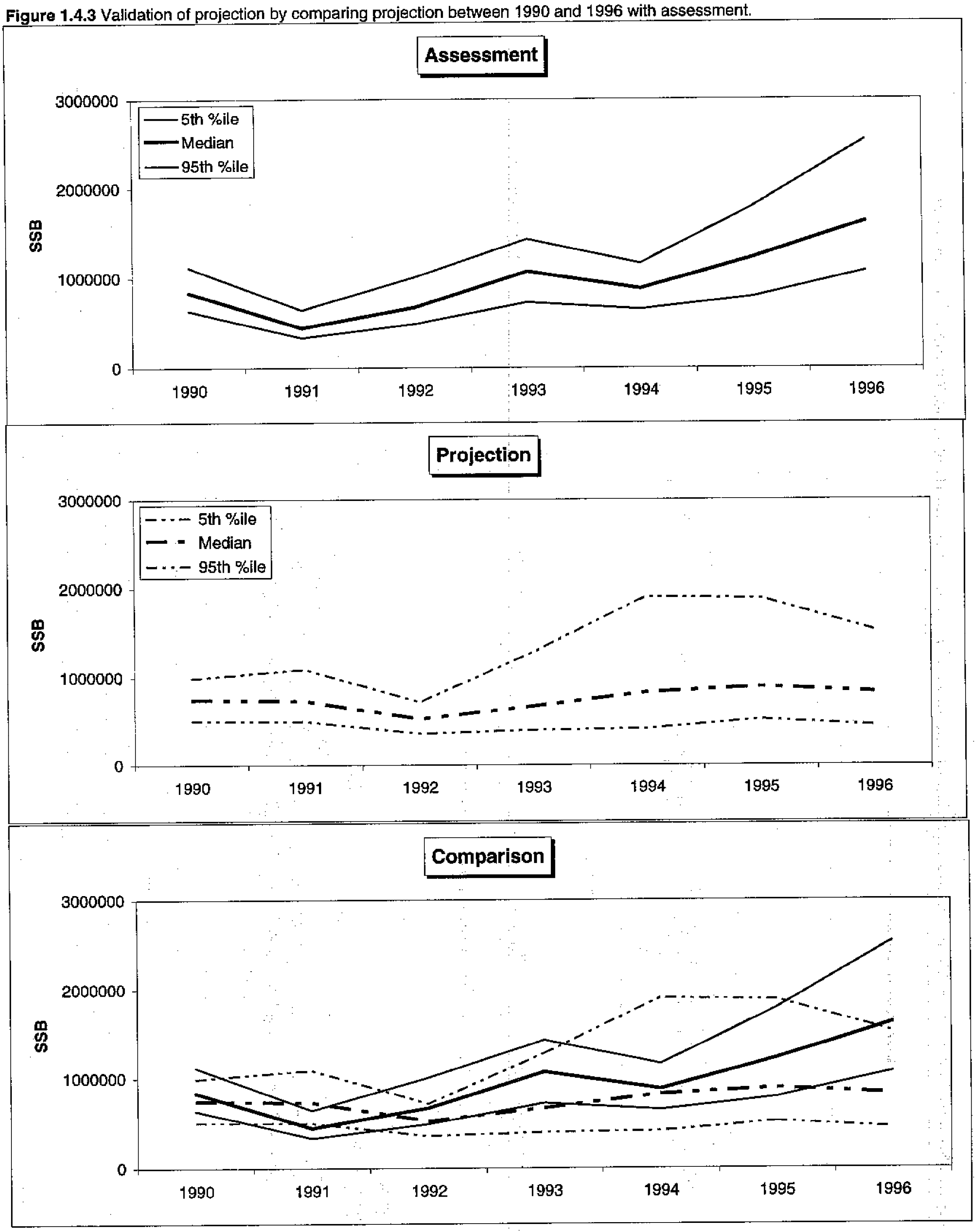
Figure 1.4.3 Validation of projection by comparing projection between 1990 and 1996 with assessment.



2 OVERVIEW

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

2.1.1 Description of the fisheries

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

Each fishery uses a variety of gears. Demersal fisheries: otter trawls, pair trawls, seines, gill nets, beam trawls. Industrial fisheries: small meshed otter trawls.

Some major technological developments changed the fisheries in the North Sea in the 1960s such as the development of the beam trawl fishery for flatfish.

Trends in effort of the major fleets are shown in Figure 2.1.1. The trends in landings of the most important species landed by these fleets during the last 25 years, together with the total international landings, are shown in Table 2.1.1 and in the Figure 2.1.2. The human consumption landings have steadily declined over the last 25 years. The landings of the industrial fisheries increased to approximately 1.8 million t in the early 1970's, but has fluctuated around 1 million t in recent years. These landings show the largest annual variations, probably due to the short life span of the species. The total landings from the North Sea reached 3 million t in 1974, and have been around 2.5 million t since the 1980's.

A general upward trend in effort can be seen in all beam trawl fleets, in the Scottish light trawl fleet and the English gill netters. Most other demersal effort series show a downward trend. Whether or not this is caused by poor economic results of the fishery is not clear. Effort in some fleets may vary between years because they visit other areas as well. The effort in the Danish and Norwegian fishery for Norway pout and sandeel has been gradually decreasing since 1989.

Most commercial species are managed by TAC/quota regulations that apply for Sub-area IV. For saithe the TAC is set for Sub-area IV and Division IIIa. The national management measures with regard to the implementation of the quota in the fisheries differs between species and countries. The industrial fisheries are subject to regulations for the by-catches of protected species.

2.1.2 Human consumption fisheries

2.1.2.1 Data

The data available from scientific sources for the assessment of roundfish and flatfish stocks are relatively good. The level of biological sampling of most of the commercial landings has been maintained. Discard data are only available for haddock and whiting, but a historical series exists only for one country. Regular discard sampling programmes are ongoing in four countries

In previous years there was misreporting of roundfish and flatfish landings associated to restrictive TAC's. This was not the case in 1996. The TACs for cod, haddock, whiting and sole where not taken in 1996.

Several series of research vessel survey indices are available for most species and were used in the final VPA runs in some stocks. Analytical assessments were performed on all four main roundfish stocks and the two principal flatfish stocks using XSA and for the first time with ICA for exploration. The historical results given by both models were in most cases identical but in some there are differences in the most recent years, which have to be further exploited.

Only whiting are subject to a significant by-catch in the industrial fisheries.

A combined assessment was made for the second time for cod in Sub-area IV, Division IIIa Skagerrak and Division VIId. Also combined assessments were made for whiting in Sub-area VI and Division VIId and for haddock in Sub-area IV and Division IIIa.

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

2.1.2.2 Stock impressions

In the North Sea all stocks of roundfish and flatfish species have been exposed to high levels of fishing mortality for a long period. For most of these stocks their lowest observed spawning stock size has been seen in recent years. This in itself is a clear indication of an excessive effort. The present assessments for roundfish indicate a decline in Fishing Mortality in recent years for cod, haddock and whiting. The reason of this decline is unclear. The decline is somewhat supported by an reduction in effort in some of the major fleets in the last few years and by a diverge of effort to *Nephrops* and anglerfish. However, this decline may also be artificial, since it appeared in the assessment for the first time. Fishing mortality on sole and plaice has been varying at a high level over a long period with no trend.

Information from several recruit surveys indicate that a number of stocks in the North Sea have simultaneously produced a strong year class 1996. These stocks are cod, plaice, sole, Norway pout, sandeel, mackerel and herring?. The expected high recruitment for these stocks may help to rebuild these stocks within safe biological limits.

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

Landings of **cod** in 1996 were 126,000 t. Recruitment has been well below average in most years since 1985 but the 1996 year class seems to be abundant. The cod spawning stock has been sTable in recent years but on a very low level. It has increased recently to about 100,000 t in 1996 due to the contribution of an average 1993 year class. The present assessment indicates a decrease in fishing mortality in the last few years.

The spawning stock of **saithe** is at a low level compared to the seventies when it was lightly exploited and recruitment was higher. In recent years it has slightly increased. Landings in 1996 were 110,000 t. Fishing mortality has declined considerable since 1986.

Human consumption landings of **haddock** in 1996 were 76,000 t. The present spawning stock size is close to the long term average. Historically the stock size has shown large variation due to the occasional occurrence of a very strong year class. It is by no means sure that the present stock size will be maintained in the medium term.

The assessment of **whiting** has always been of lower precision than the assessment for other stocks. Total landings are gradually decreasing since 1976, and are on a record low level; 41,000 t in 1996. Fishing mortalities have been highly variable with no clear trend although a downward shift is indicated for recent years. Estimates of recruitment form surveys do not correlate well with the VPA. In recent years recruitment is sTable, but at a level well below the long term geometric mean.

The spawning stock of **plaice** has been decreasing and the stock and was at its lowest observed level in 1996. Landings have fallen since 1990 to 83,000 t in 1996. There are no trends in fishing mortality and it varies on a historically high level. At its present level of exploitation there is a high probability that is will remain below the levels observed in the 70's and 80's in the medium term.

Landings of **sole** were at a high levels in recent years but decreased in 1996 to 22,500 t. There are no trends in fishing mortality and it varies on a historically high level. The stock seems also to have suffered from extra natural mortality in the 1995-1996 winter but the level mortality could not be quantified. Because of that the state of the stock is uncertain. However, there is a high probability that it has declined below an agreed MBAL of 35,000t in 1997.

2.1.3 Industrial fisheries

2.1.3.1 Definitions 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 efforts

The level of the sandeel catches in 1976-1986 of about 600000 tonnes has increased to about 800,000 t in 1987-1996. In the first half of 1997 combined Danish and Norwegian landings are the highest on record since 1976. The Norway pout catches showed a decreasing trend in the period 1974 - 1988. Thereafter the catches fluctuated around a level of 200,000 t.

Trends in effort of the Norwegian and Danish fleets fishing for Norway pout and sandeel are shown in Figure 2.1.1. The effort is gradually decreasing since 1989, but the Danish effort increased in 1996.

2.1.3.2 Stock impressions

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

Over the years, SSB of sandeel has been fluctuating around 1 million tonnes without a trend. There is a general pattern of large SSB being followed by a low SSB. This is caused by similar fluctuation in recruiting year classes. The 1996 year class appears to be strong.

2.1.3.3 By-catches of protected species

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

For four industrial fisheries the distribution of industrial landings and the associated by-catches of a number of species for 1996 is shown in Table 2.1.4 for two areas, north and south of 57 degrees N. This Table is based on Danish and Norwegian estimates. In the northern area, the Norway pout fishery is associated with by-catches of blue whiting and the protected species haddock and whiting, the sandeel fishery with a by-catch of sprat and herring, and the sprat fishery with a by-catch of herring. Overall the by-catches of protected species and herring were lower than in 1995 (Anon. 1997). In the southern area the sandeel fishery is associated with a by-catch of sprat and comparatively small by-catches of herring and whiting, the sprat fishery with a large by-catch of herring and sandeel and some protected species. Also in this area the by-catches were low in 1996 compared with 1995.

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

The fleets operating in the Skagerrak and Kattegat (Division IIIa) includes vessels targeting species for human consumption as well as vessel's engaged in fisheries for reduction purposes. The human consumption fleets are diverse including gillnetters and Danish seiners exploiting flatfish and cod and demersal trawlers involved in various human consumption fisheries (roundfish, flatfish, *Pandalus* and *Nephrops*). Demersal trawling is also used in the fisheries for Norway pout and sandeel which are landed for reduction purposes.

The roundfish, flatfish and *Nephrops* stocks are mainly exploited by Danish and Swedish fleets consisting of bottom trawlers (*Nephrops* trawls with >70 mm meshes and bottom trawls with >90 mm mesh size), gill netters and Danish seiners. 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 has affected the Danish fleets only, but these fleets still dominate the fishery in Division IIIa.

The industrial fishery is a small-mesh trawl fishery mainly carried out by vessels of a size above 20 m. This fleet component has also decreased over the last decade. The most important fisheries are those targeting sandeel and Norway pout. There is also a trawl fishery landing a mixture of species for reduction purposes. Landings in the industrial fisheries in Division IIIa are given in Table 2.2.1

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

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

The Skagerrak-Kattegat area is to a large extent a transition area between the North Sea and the Baltic - both in terms of hydrography, topology and the identity of stocks in the area. The exchange of water between the North Sea and the Baltic is the main hydrographic feature of the area.

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

The landings of cod in the Skagerrak in 1996 were 16,400 t in the human consumption fishery with a supplementary by-catch in the industrial fisheries of 900t. The catch in the human consumption fishery was above the landings taken in 1994 (12.100 t). The majority of catches were taken by Denmark and Sweden.

The landings of haddock in Div. IIIa in the human consumption fisheries amounted to 3200 t in 1996 as compared to 2,200 tons taken in 1995. To this must be added the catches from the industrial by-catch estimated at 2,900 t. Most of the catches are taken in The Skaggerak.

The catches of whiting for human consumption were about 300 t in 1996 which is about half of the reported landings in 1995. Besides this the fisheries for reduction purposes took an by-catch of whiting of about 2,600 t. The by-catches are taken by the mixed-clupeid fisheries and in the fisheries targeting Norway pout and Sandeel and mainly consist of small (age 0) whiting. Most of the catches are taken in the Skagerrak. No analytical assessment of the whiting in Division IIIa was possible.

The plaice catches in Div. IIIa amounted to 10.100 t in 1996 which is slightly below the catch level in 1995. About 75% of the catch were taken in Skagerrak.

The industrial fisheries yielded a total catch of 141,000 t in 1996. Most of the catches consisted of sandeel and Norway pout, which is not regulated with quotas, and herring and sprat. (Table 2.2.1).

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

2.3.1 Description of the fisheries

There are 5 main commercial fleets fishing in Division VIId. Belgian and English offshore beam trawlers (>300HP) which fish mainly for sole and also take plaice. These vessels are highly mobile and can switch effort to other areas leading to periodic changes in effort. The English vessels also switch to scalloping at some times of the year. The offshore French trawlers are the main fleet fishing for cod and whiting using high headline trawls and also take a range of other species. There are also numerous inshore boats mainly < 10m using fixed nets on the English and French coasts which fish with a variety of gears targeting sole in the spring and autumn and cod in the winter months. The minimum mesh size for trawls was increased from 75mm to 80mm in 1989. There is currently no EU mesh size for fixed nets.

Overall effort has more than doubled from the early 1980's to early 1990's but has since stabilised or declined in some fleets (Figure 2.3.1).

Data

a) Landings and discards : There is thought to be a low level of under-reporting on all species but some sole are known to be misreported to different areas by beam trawlers and there is under-reporting by inshore vessels. There is no discarding of cod or sole but whiting and plaice discards can be high especially from larger trawlers.

b) Catch at age : the main landings of cod and whiting are by French fleets who take 80% and 95% of the total international landings respectively. The level of sampling for age for cod is poor but has improved since 1994 for whiting. The French database has been revised and the revisions made are detailed in Annexe 1.

French fleets take around half the sole and plaice landings with Belgium and England taking most of the remaining catches. Quarterly sampling for age is taken, covering more than 95% of the landings.

2.3.2 State of the stocks

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

Sole : Fishing mortality has increased from 0.36 in 1995 to 0.48 in 1996. After an increase following strong recruitment in the period 1989-91 the spawning stock biomass has decreased for two years but stays above the historical minimum of 7000t. At the current level of fishing mortality there is a relatively hight probability (65%) of the SSB falling below the lowest observed value of 7800 t in 1999.

Plaice : Fishing mortality has reached its hightest level (0.68). The spawning stock has declined since the early 1990's following a similar trend to plaice in the North Sea. With the level of fishing mortality the SSB is expected to be very close to the minimum historical level of 5600 t in 1998 and under this value in 1999. Recruitment since 1985 has fluctuated around the average level. The stock is expected to remain close to current levels up to 1999.

Table 2.1.1 Landings of demersal and industrial species from the North Sea (Division IV). ('000 t) (Data compiled by working group members)

	cod	had hc	had lb	whit hc	whit lb	saithe hc	saithe lb	sole	plaice	N pout	sandeel	demersal total	industrial total	total
1970	226	525	180	83	115	163	59	20	130	238	191	1147	783	1930
1971	328	235	32	61	72	218	35	24	114	305	382	980	826	1806
1972	354	193	30	64	61	218	28	21	123	445	359	973	923	1896
1973	239	179	11	71	90	195	31	19	130	346	297	833	775	1608
1974	214	150	48	81	130	231	42	18	113	736	524	807	1480	2287
1975	205	147	41	84	86	240	38	21	108	560	428	805	1153	1958
1976	234	166	48	83	150	253	67	17	114	435	488	867	1188	2055
1977	209	137	35	78	106	190	6	18	119	390	786	751	1323	2074
1978	297	86	11	97	55	132	3	20	114	270	787	746	1126	1872
1979	270	83	16	107	59	113	2	23	145	329	578	741	984	1725
1980	294	99	22	101	46	120	0	16	140	483	729	770	1280	2050
1981	335	130	17	90	67	121	1	15	140	239	569	831	893	1724
1982	303	166	19	81	33	161	5	22	155	395	612	888	1064	1952
1983	259	159	13	88	24	167	1	25	144	451	537	842	1026	1868
1984	228	128	10	86	19	192	6	27	156	393	669	817	1097	1914
1985	213	159	6	62	15	192	8	24	160	205	623	810	857	1667
1986	196	166	3	64	18	163	1	18	165	178	848	772	1048	1820
1987	210	108	4	68	16	145	4	17	154	149	825	702	998	1700
1988	176	105	4	56	49	104	1	22	154	109	893	617	1056	1673
1989	140	76	2	45	43	90	2	22	170	173	1039	543	1259	1802
1990	125	51	3	47	51	86	2	35	156	152	591	500	799	1299
1991	102	45	5	53	38	98	1	34	148	193	843	480	1080	1560
1992	114	70	11	52	27	92	0	29	125	300	855	482	1193	1675
1993	122	80	11	53	20	104	1	31	117	182	579	507	793	1300
1994	111	80	4	50	10	97	0	33	110	179	766	481	959	1440
1995	139	75	8	47	27	114	0	30	98	241	918	503	1194	1697
1996	106	76	5	36	5	110	0	23	83	122	775	434	907	1341

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

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1974	525	314	-	736	62	48	130	42		1857
1975	428	641	-	560	42	41	86	38		1836
1976	488	622	12	435	36	48	150	67		1858
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1674
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1039	63	146	162	28	2	36	1	59	1536
1990	591	71	115	140	22	3	50	8	40	1040
1991	843	110	131	155	28	5	38	1	38	1349
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1994	769	281	40	172	11	5	10	-	19	1307
1995	911	278	66	181	64	8	27	1	15	1551
1996	761	81	39	122	93	5	5	0	13	1119
Mean 1974-1995	704	220	77	291	54	16	49	10	40	1438
1993 q1	26	16	23	36	1	2	3	0	6	113
1993 q2	430	5	5	28	6	4	4	0	6	488
1993 q3	88	72	51	59	4	3	7	1	7	292
1993 q4	33	61	23	51	5	1	6		8	188
1994 q1	2	19	2	34	3	1	2	-	3	66
1994 q2	643	11	3	15	4	2	1	-	4	683
1994 q3	124	175	22	51	4	1	4	-	7	388
1994 q4	+	76	13	72	+	1	3	-	5	170
1995 q1	18	20	1	36	-	2	2	-	2	81
1995 q2	752	6	1	17	4	1	3	-	2	786
1995 q3	132	157	49	48	48	2	16	1	7	460
1995 q4	8	96	15	79	11	3	6	1	4	223
1996 q1	3	34	5	21	4	0	1	0	0	68
1996 q2	479	3	1	7	28	1	1	0	1	521
1996 q3	256	7	11	54	30	2	1	0	1	362
1996 q4	22	37	22	41	31	1	1	0	1	156

North Sea

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

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

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

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Table 2.1.4 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 1996.(Data provided by Working Group members.)

Area north	Fishery (target species)	Species composition									Total
		Norway pout	Sandeel	Sprat	Herring	Haddock	Whiting	Saithe	Blue whiting	Other	
	Norway pout	118	3	0	2	2	2	+	91	7	225
	Sandeel	1	224	1	1	1	+	+	+	2	230
	Sprat	+	0	2	1	1	+	0	+	+	4
	Other	1	+	1	+	+	+	+	+	+	2
	Sum	120	227	4	4	4	2	+	91	9	461
Area south	Fishery (target species)										
	Norway pout	+	0	0	0	0	0	0	0	0	+
	Sandeel	1	531	5	9	1	2	+	1	3	552
	Sprat	+	1	64	10	+	+	0	0	+	75
	Other	+	2	8	17	+	+	0	0	+	27
	Sum	1	534	77	36	1	2	+	1	3	654

Table 2.2.1 Catches of the most important species in the industrial fisheries in Division IIIa ('000 t), 1974–1996[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
1995	12	41	21	50	10	134
1996	54	10	26	36	15	141
Mean 1974–1996	29	41	54	24	14[5]	158

[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 1979–1995.

Figure 2.1.1 Fishing effort of demersal fleets in the North Sea

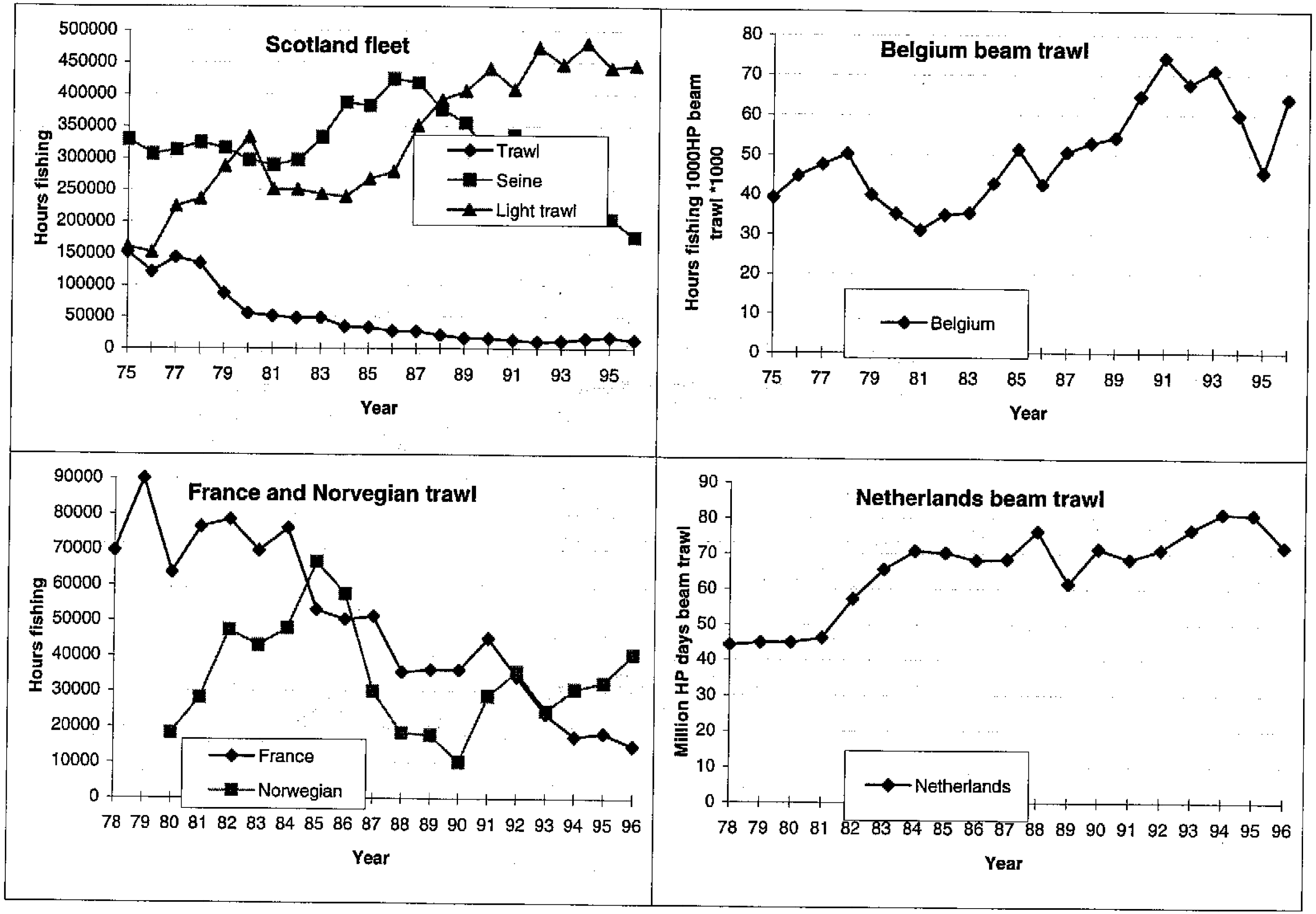

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Figure 2.1.1 continued

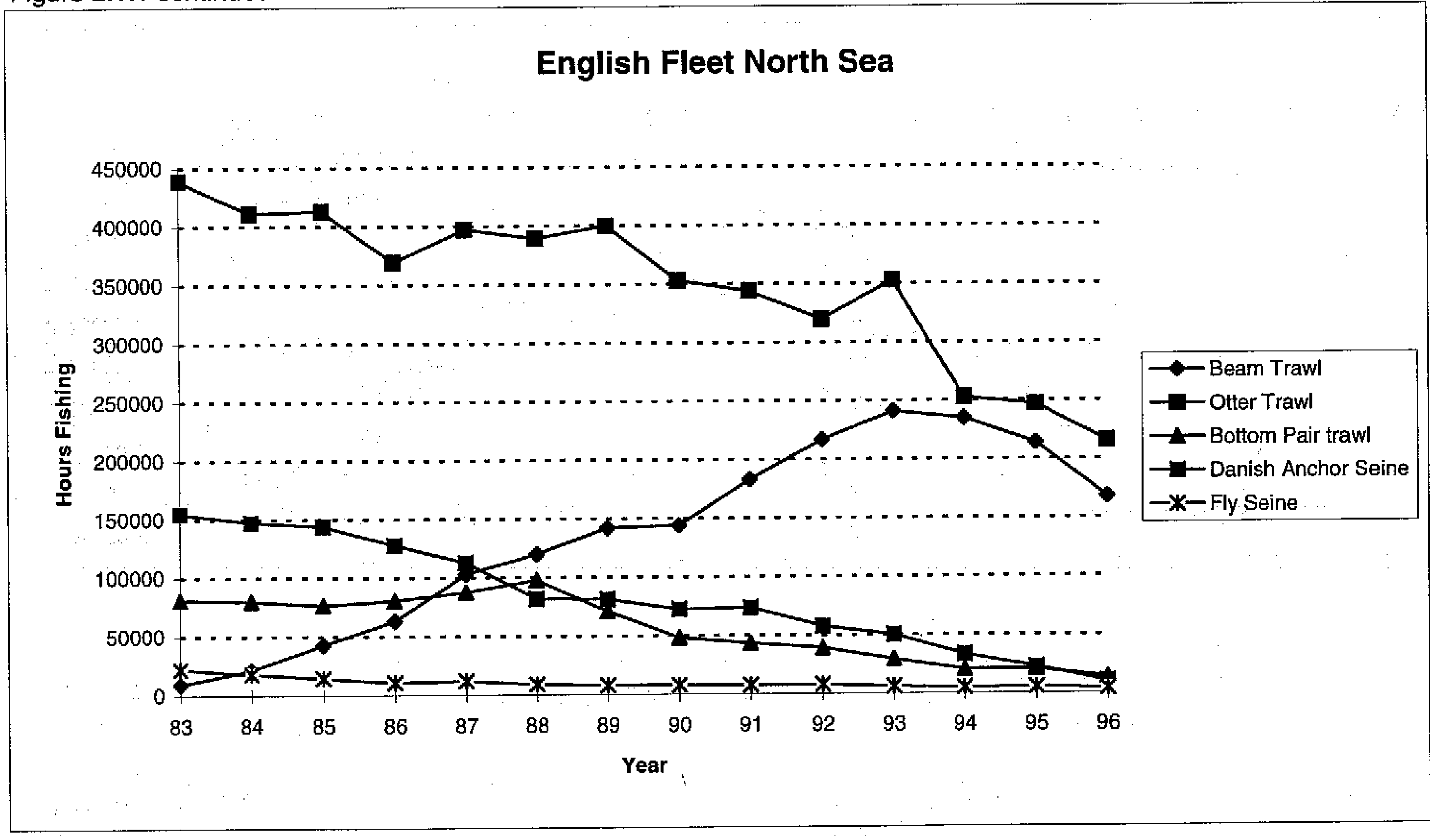

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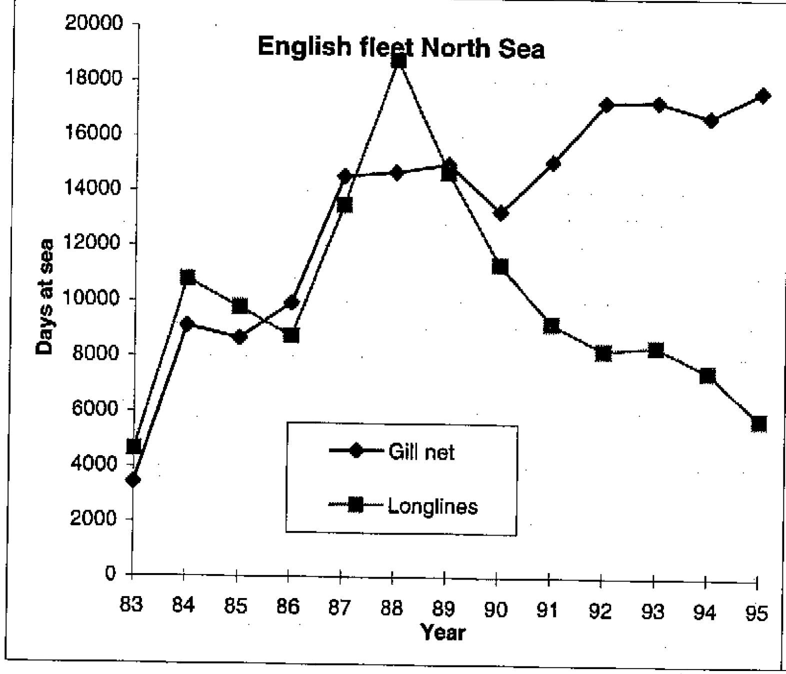
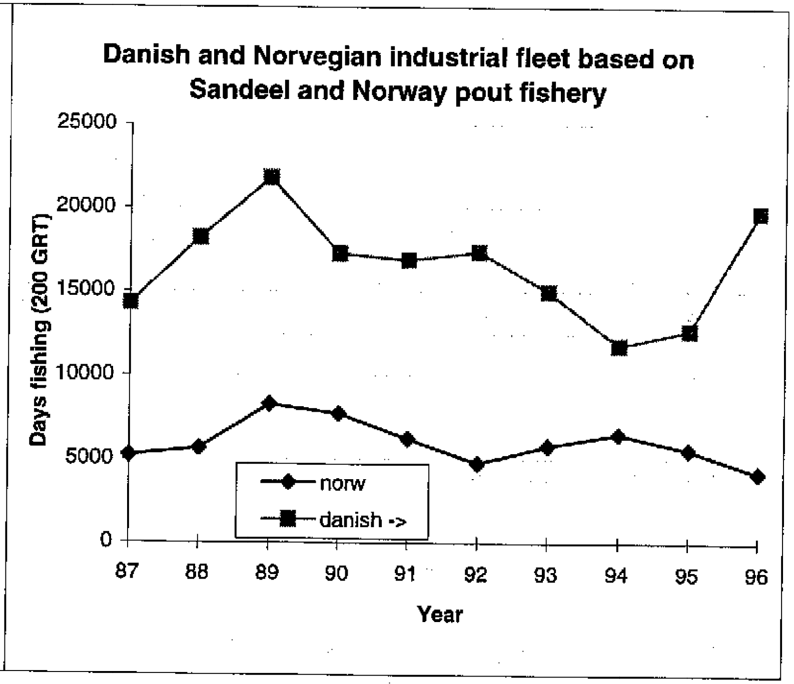
Figure 2.1.1 continued





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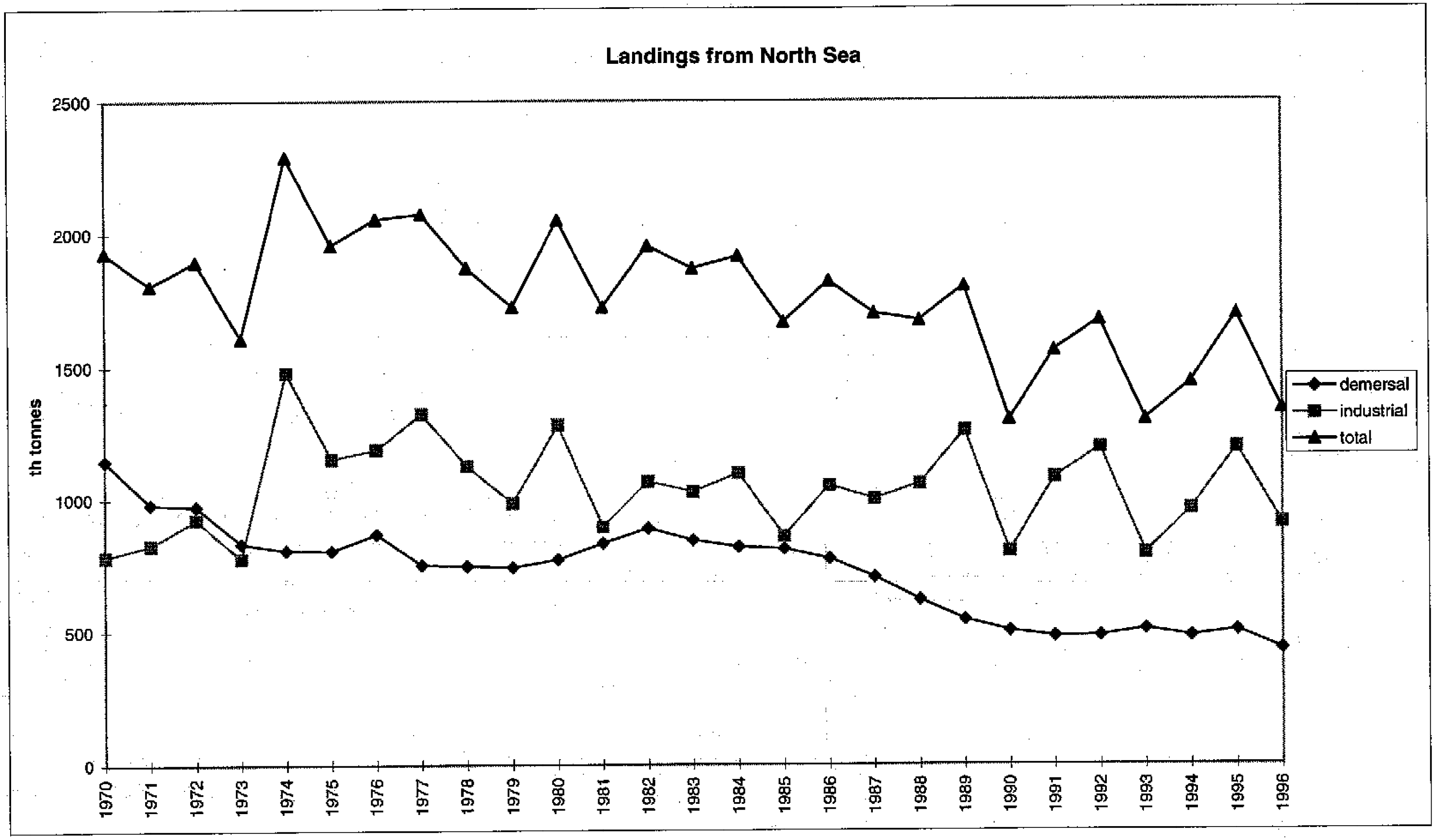

Figure 2.1.2 Landings from the stochs assessed by the WG

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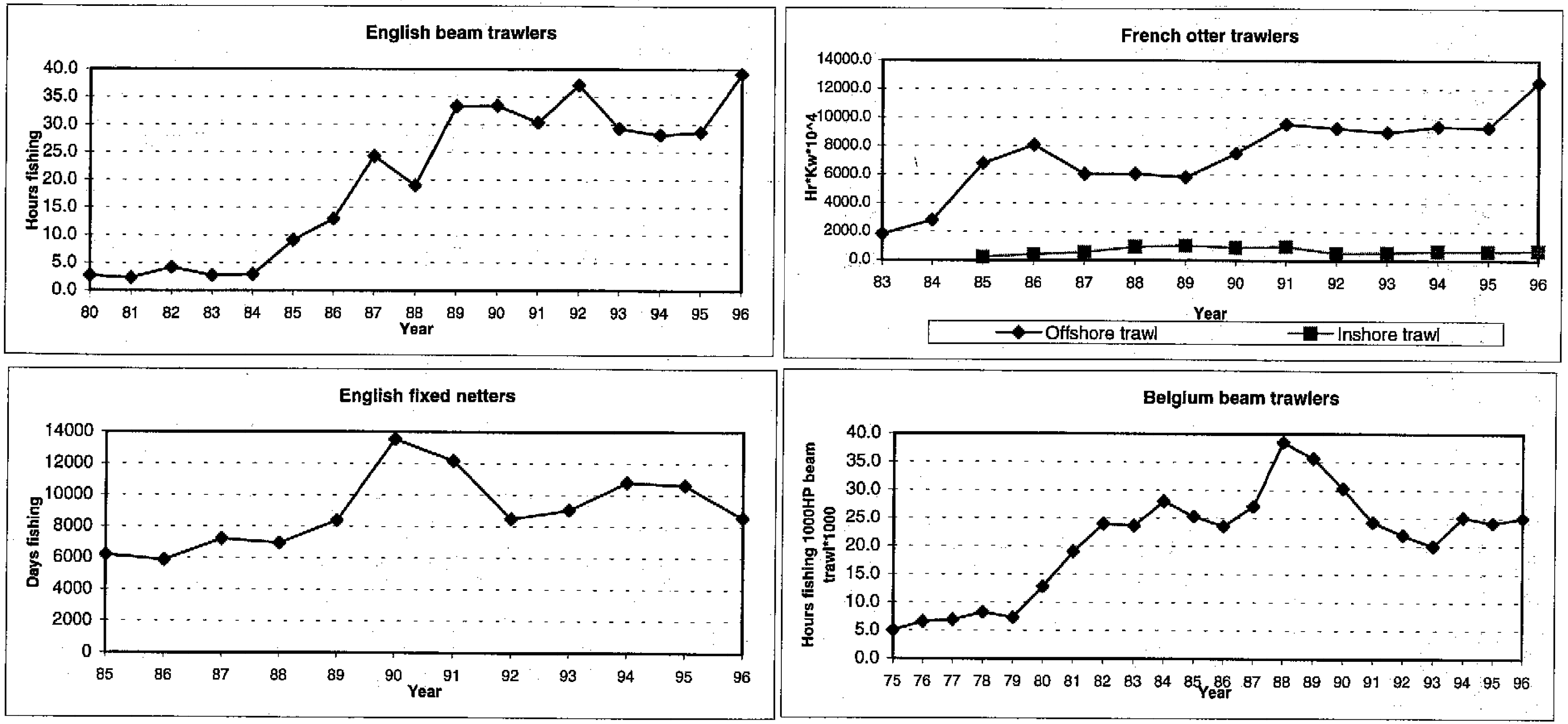
Figure 2.3.1 Fishing effort of demersal fleet in section VIId.



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

For the second time, this assessment refers to a combination of the Skagerrak, the North Sea, and the Eastern Channel. Prior to 1996 cod in these areas were assessed separately. A discussion of the implications of a combined assessment was presented in Section 1.3.3.4 of the 1996 report. No additional problems were identified with respect to the present analysis.

3.1 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 for each area separately in Tables 3.1.1 to 3.1.3. Working Group estimates of the landings for the combined areas are provided in Table 3.1.4, and the data are graphed in Figure 3.1.1. The Working Group estimate for combined landings in 1996 is 126423 t, a value which is close to the officially reported Figure with little more than 2,000 t of unallocated landings. The total is 9% less than in 1995. On the historical scale landings increased in the 1960s and early 1970s to reach a peak of 350,000 t in 1972. After a further peak of 335,000 t in 1981, landings have declined markedly to levels similar to those observed in the early 1960s.

The TACs for Cod in Division IIIa(Skagerrak)and Sub-area IV 1996 and respective landings estmates were as follows:

	TAC (t)	Landings (t)
IIIa	23,000	16,249
IV	130,000	104,374
Total	153,000	120,623

Hence the TAC in 1996 for Sub-area IV + Division IIIa was undershot by about 33,000 t (20%). No TAC is set specifically for Cod in Divsion VIId, but landings in 1996 were in line with the average over the recent time period. The reasons for the shortfall are not clear.

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 (Weber, 1995). 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 these areas, including trawls, seines, gill nets and lines. Most of these gears take a mixture of species, but some of the fixed gear fisheries are directed mainly towards cod.

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

Values for natural mortality and maturity are given in Table 3.2.1, and they are unchanged from those used last year for cod in the North Sea. The sources of these data are multispecies VPA as performed by the Multispecies Working Group in 1986 (natural mortality), and the International Young Fish Survey (maturity). These values were derived for the North Sea and are equally applied to the three stock components. Age compositions were provided by Denmark, England, France, Germany, Norway, Scotland, Sweden and, for the first time, Belgium, based on a total of more than 30 thousand age readings (Table 1.4). Mean weight at age data for landings are given in Table 3.2.3. These values were also used as stock mean weights.

3.3 Catch, Effort, and Research Vessel Data

The VPA catch input data are given in Table 3.2.2. SOP corrections have been applied. These catches do not include industrial fishery by-catches landed for reduction purposes, or discards. By-catch estimates are available for the total Danish and Norwegian small-meshed fishery in Sub-area IV (Table 2.1.3) and separately for the Skagerrak (Table 3.1.2.1). Data for 1996 were provided by Belgium, Denmark, England, Faroes, France, Germany, The Netherlands, Norway, Poland, Scotland and Sweden. Revisions of the landings data as given and used in the previous (1996) assessment came from France (IV and VIId since 1985, see Section 1.3.1). Updates for landings from Denmark and Sweden in IIIa for 1995 were provided during the meeting and were considered to be too small to justify a recalculation of catch numbers for a rerun of the analysis. The revision will be incorporated in next year's analysis.

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

Data for a total of 18 fleets were available, including 12 commercial and 6 survey fleets.

3.4 Catch at Age Analysis

New data for use in XSA tuning were presented for French fleets, which replace previous French commercial fleet-tuning data. In addition, revisions to the French landings of cod have been incorporated into the international landings data back to 1985. In order to investigate these modifications, a run of XSA was performed using the same input parameters as used in the 1996 assessment, with the terminal year set as 1995. This was done to evaluate whether the data revisions would have led to a different perception of the stock, had the changes been incorporated last year. The patterns of F at age in 1995 and mean F over the period 1986-1996 from these comparative runs are shown in Figure 3.4.1., which indicates that the data revisions have had little effect on last year's assessment results.

The complete set of fleet data available for tuning the VPA are given in Table 3.4.1

Preliminary tuning was an XSA run with all available fleet data included.

Tuning was performed over the 10 year period 1987-1996 with no time taper, and a shrinkage factor of 0.5 was applied to the terminal population estimate. The recruiting age was set at age 1, and catchability was fixed for ages 6 and above. The age range used for VPA was 1 to 11 (the plus group). This was exactly the same configuration as the final VPA in the 1996 assessment.

For the sake of quality and a more concise output an attempt was made to reduce the number of fleets included for tuning by applying criteria such as length of the time series, area coverage and quality of the diagnostics (see below).The results (available in Working Group files) were inspected for those fleets which contribute little to the tuning, and only introduce undesirable noise. As a result of this analysis it was decided to exclude 10 fleets, leaving 5 commercial and 3 survey data sets (Table 3.4.2). Furthermore, for 3 of these, the age range was reduced to exclude those age groups which were not well-represented in the catch.

The modifications to the full tuning data set and the respective reasons are briefly summarised below:

SCOTRL_IV - age groups 7-8 excluded ; many missing values

SCOLTR_IV - age groups 9-10 excluded; large residuals, nearly all negative

ENGTRL_IV - age groups 9-10 excluded; many missing values

FRATRB_IV - fleet excluded; large residuals and year effects, some large t-values,

FRATRO_IV - fleet excluded; large residuals and year effects, some large t-values,

IBTS Q2 - survey excluded; short time series, large residuals

IBTS Q4 - survey excluded; short time series, large residuals, year effects, survey series possibly ended

FRATRO_7d fleet excluded; large residuals and trends in catchability

4 Skagerrak commercial fleets excluded for; poor fits to catch data, and not thought to represent the stock as a whole

IBTS Skag - survey excluded ; already incorporated in IBTS Q1 index

A comparison of two XSA runs, one including the complete data set and tho other with the reduced set generated almost the same exploitation pattern in the final year (Figure 3.4.2), thus it was concluded that the reduced fleet data set should be accepted since no information was lost.

The diagnostics from the final XSA run are given in Table 3.4.1. and plots of the log catchability residuals for each fleet from this run are given in Figure 3.4.3. The relative importance for the result in terms of regression weights by type of fleet or shrinkage, respectively, are shown in Figure 3.4.4, indicating that for older age groups the commercial fleets have the greatest influence in tuning, whereas the surveys have more influence for the younger ages, as would be expected.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and VPA are given in Tables 3.4.4 and 3.4.5. The results from a retrospective analysis using XSA with the options specified above are shown in Figures 3.4.5. and 3.4.6. There does not appear to be any retrospective pattern.

3.5 Recruitment Estimates

Average recruitment in the period 1963-1994 was 393 million (arithmetic mean) or 348 million (geometric mean) 1- year old fish. The GM recruitment in the recent period 1987-1994 is 225 million 1- year old fish.

Using RCT3 , Research vessel survey data for 0-, 1- and 2-year old fish (Table 3.5.1) were regressed against VPA population numbers for year classes back to and including 1994, on the criterion of a minimum cumulative F of 1.0., to estimate recruitment at age 1 of the 1995, 1996 and 1997 year classes. The new IBTS indices for quarters 2 and 4 were also included, now representing a time range of six years. The indices for the English groundfish surveys after 1991 have been adjusted to take account of the change of gear to the GOV trawl in 1992. Plots of survey indices regressed against estimates of population numbers at age 1 from XSA are shown in Figure 3.5.1. The results are presented in Table 3.5.2.

Year class 1995: RCT3 predicts the 1995 year class at age 1 as 164 million, compared to the XSA estimate of 144 million. These values are similar, and it was decided to accept the XSA estimate, since this is the appropriate procedure for this tuning method.

Year class 1996 was estimated by six of the eight available series of recruitment indices to be well above recent average recruitment and two indices estimated it below. The weighted mean estimated by RCT3 was 528 milion 1-year olds. This estimate is the largest since the 1985 year class and about 50% higher than the long-term GM over the period 1963-1994. The RCT3 estimate was accepted by the Working Group. This large estimate of the 1996 year class has a major impact on the predicted catches in 1998 and on SSB in the near-medium-term.

Year class 1997 and 1998. The only recruitment estimate available for the 1997 year class is derived from the EGFSQ4 research vessel survey. A plot showing this estimate regressed against XSA 1-group estimates for corresponding year-classes is given in Figure 3.5.2. The RCT 3 output (Table 3.5.2) indicates that the survey has little influence on the 1997 year-class estimate of 195 million, with 84% of the estimate being derived from the long-term mean. However, the group considered that it would be appropriate to use an estimate from the recent time period and it was therefore decided to use the weighted VPA mean using a tri-cubic time series taper over 10 years, to take into account recent recruitment estimates. This gave a value of 259 millions for the 1997 year class at age 1.

The long-term GM (348 million at age 1) was chosen as the appropriate estimate of recruitment for the 1998 year class. This has no influence on the catch forecast for 1998 or for SSB in 1999, but will have an influence on medium-term projections.

Year class strength estimates used for the predictions can be summarised as follows

Year-class	Millions (age 1)	Basis
1995	144	XSA
1996	528	RCT3
1997	259	10-yr Tri-cubic weighted VPA mean
1998	348	Long-term GM

3.6 Historical Stock Trends

Historical trends in mean fishing mortality, landings, spawning stock biomass, and recruitment are shown in Table 3.6.1 and Figure 3.1.1. Mean fishing mortality has shown a more or less continuous increase over the whole period up to the early 90's and an apparent reduction over the last 2 years. Spawning biomass decreased from a peak of 277,000 t in 1971 to a historical low of 63,000 t in 1993 and 1994. Recruitment has fluctuated considerably over the period but the frequency of good year classes has become reduced in recent years. Until recently, only one year class (1993) spawned since 1985 has reached the long term arithmetic mean. However, the 1996 year class is estimated the largest since 1985.

3.7 Short Term Forecast

The input data for the catch prediction are given in Table 3.7.1, and the parameter lable values for the sensitivity plots are shown in Table 3.7.2. 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 1994-96. The fishing mortality is the mean for the same period calibrated to the mean F(2-8) in 1996. Population numbers in 1997 are XSA survivor estimates, except for age 1 which is the estimate from RCT3.

The results of a *status quo* landings prediction for 1996 and 1997 are given in Tables 3.7.3 and 3.7.4 and shown graphically in Figure 3.7.1D. The predicted *status quo* landings are 160,000 t for 1997, and 198,000 t for 1998. Spawning biomass is estimated to be 176,000 t at the start of 1998, and 183,000 t in 1999. The detailed output Tables (Table 3.7.4) confirm the importance of the estimate of the strength of the 1996 year class to predicted landings in 1998. About 43% of the predicted landings are accounted for by this year-class.

Since the TAC for 1997 has been set to ca. 135,000 t, i.e. less than the s.q. forecast of last year, another prediction was run with a corresponding TAC constraint. This reduces F in 1997 to 0.51, and leaves somewhat higher spawning stocks of 198,000 t in 1998 and 228,000 t in 1999, provided this F level were maintained also through 1998 (Table 3.7.5).

The group suggests that calculation of the area allocation of the overall catch in 1998, could be according to the ratio of officially reported landings from recent years (1992-1996), which are as follows

	Average (000 t)	% international landings
IV	99,233	85.1
IIIa	14251	12.2
VIId	3084	2.7

The results of sensitivity analyses of the *status quo* catch prediction are shown in Figures 3.7.2 and 3.7.3, with the input parameters given in Table 3.7.2. The sensitivity of the predictions (Figure 3.7.2) to the various input parameters shows that the predicted yield in 1998 is mostly dependent on the estimates of fishing effort (HF) in 1998 and the year effect for M (K) in 1997. 43% of the variance in the estimate of yield in 1998 is attributed to the assumption of F in that year, with a further 18% of the variance dependent on the variability of the estimate of the 1996 year class at age 1 in 1997.

The results also indicate that the estimate of SSB in 1999 is sensitive to the assumptions about fishing mortality in 1997 and 1998, with over 50% of the variance of the estimate of SSB dependent on their variability.

Figure 3.7.3 shows probability profiles for yield and spawning biomass in 1997 and 1998 respectively.

3.8 Medium term projections

Projections were run for *status quo* F for a 10 year period to estimate probabilities of predicted yields , SSB and recruitment. A Shepherd stock-recruitment relationship was assumed since this gave the a conservative estimate of recruits at low spawning stock. The results are shown in Figure 3.8.1. For *status quo* F, the simulation suggests that there is a high probability that both yield and spawning biomass will increase over the next 7 years and decline slightly thereafter.

3.9 Long Term Considerations

Compared to the period prior to the early 1990s, landings and spawning biomass remain at a relatively low level. Fishing mortality appears to have declined over the last 3 years and SSB has recovered slightly from the lowest recorded levels of the early 1990s.

3.10 Comments on the Assessment

The overall patterns of F, recruitment and SSB is relatively consistent with the assessment presented in last years report. However, the main difference is a substantial downward revision of fishing mortality for 1995 from about 0.8 to about 0.64, and slightly increased estimates of SSB for 1993-1995. The estimate of recruitment at age 1 (1994 yc) in 1995, remains the same at about 250 millions. F in 1996 is estimated to be about the same or slightly higher than the 1995 level.

The results of comparative runs presented in Figure 3.4.1. indicate that the reduction in the estimate of F for 1995, is not a consequence of the revisions made to the landings and fleet database.but rather a consequence of the assessment methodology which may not be sufficiently to detect sudden departures from existing trends.

It appears that for some fleets the TAC in 1996, was not restrictive since they did not exhaust their quota.

The group noted that the decline in F over the past 2 years is consistent with the declines in F for North Sea haddock and whiting over a similar period.It is possible therefor that the reduction in F represents a reduction in fishing effort. Trends in effort for some fleets are shown in Figure 3.10.1.

This assesment indicates that the stock is predicted to have increased beyond the MBAL limit of 150,00 t by the start of 1998. However the WG notes that over 40% of the landings in 1998 will consist of 2-year old fish of the 1996 year-class which at that time will still be immature.

Quality control data are given in Table *******.

3.11 Biological reference points

Input parameters for yield- and SSB-per-recruit analyses are given in Table 3.11.1. Input F at age are the mean values for the period 1994-1996 from XSA, rescaled to mean F (2-8) for 1996. Mean weights at age are the unweighted mean values for the same time period. The results are presented in Table 3.11.2 and Figure 3.7.1.

A variety of biological reference points referred to in the Report of the Study Group on the Precautionary approach were calculated by the group. These are presented in the text Table below:

Reference point	Value
Current F	0.64
F_{low}	0.56
F_{med}	0.82
F_{high}	1.09
F_{max}	0.25
$F_{0.1}$	0.15
F_{loss}	0.91
F 30% SPR	0.19
Virgin SPR (kg)	12.37
SPRCurrent (kg)	5.50
SSB 90% R 90% Surv ('000t)	168
B 50 % R ('000t)	96

Results for calculations of G(loss) and F(loss) are given in Figure 3.11.1. and a stock recriutment relationship is given in Figure 3.11.2.

3.12 Definition of safe biological limits

In responding to the ACFM request to provide candidates for precautionary reference points for cod the WG has interpreted ACFM's MBAL value of a spawning stock biomass of 150,000 t as the biomass limit reference point

(B_{lim}). The 5%, 10% and 20% probabilities of SSB falling to B_{lim} ($B_{pa,5}$, $B_{pa,10}$ and $B_{pa,20}$, respectively), were calculated from a medium term projection over 10 years using the software WGMTERM. The corresponding precautionary probability levels for F ($F_{pa,5}$, $F_{pa,10}$ and $F_{pa,20}$) were also calculated and the results are plotted in Figure 3.12.1 and presented in the text Table below.

B_{lim}	**F_{pa}**			**B_{pa}**		
MBAL	$F_{pa,5}$	F_{pa}	$F_{pa,20}$	$B_{pa,5}$	$B_{pa,10}$	$B_{pa,20}$
150,000t	0.73	0.76	0.81	221	205	183

These data indicate that at the current level of F, there is less than a 5% probability of SSB falling below B_{lim} in the medium term. However, examination of Figure 3.12.1 indicates that the steepness of the SSB curve around the level of Blim, means that the reference points are extremely close together and that the perception of the stock status in relation to precautionary reference points relies on precise estimates of F and SSB.

Table 3.1.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1984–1996, as officially reported to ICES, and estimated total landings used by the Working Group.

Year	Belgium	Denmark[2]	Faroe Islands	France	Germany	Netherlands	Norway[2]	Poland	Sweden	UK (E+W)	UK Isle of Man	UK (N.Ireland)	UK (Scotland)	Russia	Total	Unallocated landings	Landings as used by Working Group**
1984	5,804	46,751	-	8,129	13,453	25,460	7,005	7	575	35,605	-	-	54,359	-	197,148	7,723	204,871
1985	4,815	42,547	71	4,834	7,675	30,844	5,766	-	748	29,692	-	-	60,931	-	187,923	6,772	194,695
1986	6,604	32,892	45	8,402	7,667	25,082	4,864	10	839	25,361	-	-	45,748	-	157,484	11,322	168,806
1987	6,693	36,948	57	8,199	8,230	21,347	5,000	13	688	29,960	-	-	49,671	-	166,806	15,287	182,093
1988	5,508	34,905	46	8,323	7,707	16,968[4]	3,585	19	367	23,496	-	-	41,382	-	142,306	14,252	156,558
1989	3,398	25,782	35	2,578[1,3]	11,430	12,028	4,813	24	501	18,250	1	124	31,480	-	110,444	5,256	115,700
1990	2,934	21,601	96	1,641[1,3]	11,725	8,445[1]	5,168	53	620	15,596	-	26	31,120	-	99,025	5,726	104,751
1991	2,331	18,997	23	975[1,3]	7,278	6,830[1]	5,425	15	784	14,481	-	70	28,748	-	85,957	8,570	88,533
1992	3,356	18,479	109	2,146[1]	8,446	11,133	10,053[1]	-	823	14,836	15	72	28,204	-	97,672	-323	97,349
1993	3,374	19,547	46	1,858[1]	6,808	10,220	8,747	-	646	14,894	-	47	28,191	-	94,370	10,210	104,580
1994	2,648	19,234	80[1]	1,830[1,3]	5,974	6,512	8,268[1]	-	630	13,941	-	54	28,844	-	88,015	6,508	94,523
1995	4,827	24,067	219	3,040[1]	9,457	11,199	7,358	-	709	14,991	-	-	35,848	-	111,733	8,290	120,023
1996	3,458	23,573	44	1,920[1]	8,356[1]	9,271	5,884[1]	18	571[1]	15,930	-	-	35,349		104,374	2,163	106,537

[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.

**French data revised back to 1985.
UK (E + W) data revised for 1995.

Table 3.1.2 Cod in Sub-division IIIa (Skagerrak) Reported landings by country and estimated total landings used by the Working Group.

Year	Open Skagerrak					Total	Landings used by the WG	Norwegian Coast
	Denmark	Sweden	Norway	Germany	Others			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
1995	8,948	2,658	169	200	134	12,109	12,109	846
1996	13,573	2,208	265	203	-	16,249	16,383	748

Table 3.1.2.1 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
1995	749
1996	676

Table 3.1.3 COD in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, and Working Group estimates 1982 to 1996.

Year	Belgium	France	Denmark	Netherlands	UK (E+W)	UK (S)	Total	Unreported landings	Total as used by Working Group [2]
1982	251	2696	-	1	306	-	3254	727	3981
1983	368	2802	-	4	358	-	3532	309	3841
1984	331	2492	-	-	282	-	3105	419	3524
1985	501	2589	-	-	326	-	3416	-111	3305
1986	650	9938	4	-	830	-	11422	3722	15144
1987	815	7541	-	-	1044	-	9400	4819	14219
1988	486	8795	+	1	867	-	10149	580	10729
1989	173	n/a	+	1	562	-	n/a	-	5538
1990	237	n/a	-	-	420	7	n/a	-	2763
1991	182	n/a	-	-*	340	2	n/a	-	1886
1992	187	2079*	1	2	443	22	2734	-65	2669
1993	157	1771*	1[1]	-	530	2	2461	-29	2432
1994	228	n/a	9	-	312	+	n/a	-	2850
1995	377	3261*	-	-	336	+	3974	-10	3964
1996	321	2788*			414	+	3527	-24	3503

* Preliminary;

[1] Includes VIIe.

[2] French data revised back to 1985.

TABLE 3.1.4 : COD, SKAG+NSEA+CHAN

Annual weight and numbers caught, 1963 to 1995.*

Year	Wt.('000t)	Nos.(millions)
1963	116	61
1964	126	57
1965	181	99
1966	221	123
1967	253	132
1968	288	154
1969	201	80
1970	226	130
1971	328	236
1972	354	254
1973	239	132
1974	214	109
1975	205	115
1976	234	137
1977	209	162
1978	297	237
1979	270	180
1980	294	219
1981	335	259
1982	303	208
1983	259	194
1984	228	172
1985	213	156
1986	196	172
1987	210	172
1988	176	124
1989	140	90
1990	125	86
1991	102	60
1992	114	76
1993	122	77
1994	111	67
1995	139	100
1996	126	71
Min.	102	57
Mean	213	140
Max.	354	259

* Data prior to 1978, are for landing for Sub-area only

TABLE 3.2.1 ; North Sea COD, Skagerrak+North Sea+Eastern Channel

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

Table 3.2.2

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

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

YEAR,	1963,	1964,	1965,	1966,
AGE				
1,	3214,	5030,	15813,	18224,
2,	42591,	22493,	51888,	62516,
3,	7030,	20113,	17645,	29845,
4,	3536,	4308,	9182,	6184,
5,	2788,	1918,	2387,	3379,
6,	1213,	1818,	950,	1278,
7,	81,	599,	658,	477,
8,	492,	118,	298,	370,
9,	14,	94,	51,	126,
10,	6,	12,	75,	56,
+gp,	0,	4,	8,	83,
TOTALNUM,	60965,	56507,	98955,	122538,
TONSLAND,	116457,	126041,	181036,	221336,
SOPCOF %,	100,	100,	100,	100,

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	10803,	5829,	2947,	54493,	44824,	3832,	25966,	15562,	33378,	5724,
2,	70895,	83836,	22674,	33917,	155345,	187686,	31755,	58920,	47143,	100283,
3,	32693,	42586,	31578,	18488,	17219,	48126,	54931,	11404,	18944,	18574,
4,	11261,	12392,	13710,	13339,	6754,	5682,	14072,	15824,	4663,	6741,
5,	3271,	6076,	4565,	6297,	7101,	2726,	2206,	4624,	7563,	1741,
6,	1974,	1414,	2895,	1763,	2700,	3201,	1109,	961,	2067,	3071,
7,	888,	870,	588,	961,	893,	1680,	1060,	438,	449,	924,
8,	355,	309,	422,	209,	458,	612,	489,	395,	196,	131,
9,	138,	151,	147,	186,	228,	390,	80,	332,	229,	67,
10,	40,	111,	46,	98,	77,	113,	58,	81,	95,	63,
+gp,	17,	24,	78,	40,	94,	18,	162,	189,	63,	43,
TOTALNUM,	132335,	153598,	79650,	129791,	235693,	254066,	131888,	108730,	114790,	137362,
TONSLAND,	252977,	288368,	200760,	226124,	328098,	353976,	239052,	214279,	205245,	234169,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 3.2.2 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	75413,	29731,	34837,	62605,	20279,	66777,	25733,	64751,	8845,	100239,
2,	51118,	175727,	91697,	104708,	189007,	65299,	129632,	66428,	118047,	32437,
3,	25621,	17258,	44653,	35056,	34821,	60411,	21662,	31276,	18995,	34109,
4,	4615,	9440,	4035,	12316,	9019,	9567,	11900,	4264,	7823,	5814,
5,	2294,	3003,	3395,	1965,	4118,	3476,	2830,	3436,	1377,	2993,
6,	836,	1108,	712,	1273,	785,	2065,	1258,	1019,	1265,	604,
7,	1144,	410,	398,	495,	604,	428,	595,	437,	373,	556,
8,	371,	405,	140,	197,	134,	236,	181,	244,	173,	171,
9,	263,	153,	158,	74,	65,	78,	90,	60,	79,	69,
10,	26,	36,	42,	55,	37,	27,	28,	45,	16,	44,
+gp,	96,	44,	17,	25,	21,	16,	23,	20,	31,	23,
TOTALNUM,	161797,	237315,	180084,	218769,	258890,	208380,	193932,	171980,	157024,	177059,
TONSLAND,	209154,	297022,	269973,	293644,	335497,	303251,	259287,	228286,	214629,	204053,
SOPCOF %,	100,	100,	101,	100,	100,	99,	100,	100,	100,	101,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
1,	24915,	21480,	22239,	11738,	13466,	27668,	4783,	15557,	15717,	4942,
2,	128282,	55330,	36358,	54290,	23456,	32059,	55272,	25279,	63586,	36778,
3,	9800,	43955,	18193,	11906,	16776,	8682,	11360,	21144,	12943,	23347,
4,	8723,	3134,	9866,	4339,	3310,	5007,	3190,	3083,	5301,	3168,
5,	1534,	2557,	1002,	2468,	1390,	1060,	1577,	870,	802,	1858,
6,	1075,	655,	1036,	310,	1053,	491,	435,	519,	286,	398,
7,	235,	295,	251,	310,	225,	329,	204,	142,	151,	161,
8,	215,	66,	140,	54,	139,	52,	108,	58,	42,	88,
9,	55,	63,	27,	60,	28,	40,	18,	32,	15,	43,
10,	48,	23,	31,	12,	4,	17,	10,	7,	13,	4,
+gp,	12,	18,	10,	9,	10,	9,	13,	16,	5,	8,
TOTALNUM,	174894,	127576,	89153,	85496,	59857,	75414,	76970,	66707,	98861,	70795,
TONSLAND,	216213,	184240,	139936,	125314,	102478,	114020,	121749,	110634,	138623,	126423,
SOPCOF %,	100,	100,	100,	99,	100,	99,	99,	99,	100,	100,

Table 3.2.3

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

Table 2 Catch weights at age (kg)

YEAR,	1963,	1964,	1965,	1966,
AGE				
1,	.5380,	.4960,	.5810,	.5790,
2,	1.0040,	.8630,	.9650,	.9940,
3,	2.6570,	2.3770,	2.3040,	2.4420,
4,	4.4910,	4.5280,	4.5120,	4.1690,
5,	6.7940,	6.4470,	7.2740,	7.0270,
6,	9.4090,	8.5200,	9.4980,	9.5990,
7,	11.5620,	10.6060,	11.8980,	11.7660,
8,	11.9420,	10.7580,	12.0410,	11.9680,
9,	13.3830,	12.3400,	13.0530,	14.0590,
10,	13.7560,	12.5400,	14.4410,	14.7460,
+gp,	.0000,	14.9980,	15.6670,	15.6720,
SOPCOFAC,	.9998,	.9998,	1.0001,	1.0001,

Table 2 Catch weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	.5900,	.6400,	.5440,	.6260,	.5790,	.6160,	.5590,	.5940,	.6190,	.5680,
2,	1.0350,	.9730,	.9210,	.9610,	.9410,	.8360,	.8690,	1.0390,	.8990,	1.0290,
3,	2.4040,	2.2230,	2.1330,	2.0410,	2.1930,	2.0860,	1.9190,	2.2170,	2.3480,	2.4700,
4,	3.1530,	4.0940,	3.8520,	4.0010,	4.2580,	3.9680,	3.7760,	4.1560,	4.2260,	4.5770,
5,	6.8030,	5.3410,	5.7150,	6.1310,	6.5280,	6.0110,	5.4880,	6.1740,	6.4040,	6.4940,
6,	9.6100,	8.0200,	6.7220,	7.9450,	8.6460,	8.2460,	7.4530,	8.3330,	8.6910,	8.6200,
7,	12.0330,	8.5810,	9.2620,	9.9530,	10.3560,	9.7660,	9.0190,	9.8890,	10.1070,	10.1320,
8,	12.4810,	10.1620,	9.7490,	10.1310,	11.2190,	10.2280,	9.8100,	10.7900,	10.9100,	11.3410,
9,	13.5890,	10.7200,	10.3840,	11.9190,	12.8810,	11.8750,	11.0770,	12.1750,	12.3390,	12.8880,
10,	14.2710,	12.4970,	12.7430,	12.5540,	13.1470,	12.5300,	12.3590,	12.4250,	12.9760,	14.1400,
+gp,	19.0160,	11.5950,	11.5670,	14.3670,	15.5440,	14.3500,	12.8860,	13.7310,	14.4310,	14.5570,
SOPCOFAC,	1.0001,	.9999,	.9999,	1.0000,	.9998,	1.0001,	.9999,	.9999,	.9999,	1.0000,

Table 3.2.3 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

Table 2 Catch weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	.5420,	.5720,	.5500,	.5500,	.7230,	.5890,	.6320,	.5940,	.5900,	.5830,
2,	.9480,	.9370,	.9360,	1.0030,	.8370,	.9620,	.9190,	1.0070,	.9330,	.8560,
3,	2.1600,	2.0010,	2.4110,	1.9480,	2.1890,	1.8580,	1.8350,	2.1560,	2.1400,	1.8340,
4,	4.6070,	4.1460,	4.4230,	4.4010,	4.6150,	4.1300,	3.8800,	3.9720,	4.1640,	3.5040,
5,	6.7130,	6.5310,	6.5800,	6.1090,	7.0450,	6.7840,	6.4910,	6.1900,	6.3240,	6.2300,
6,	8.8280,	8.6670,	8.4750,	9.1200,	8.8840,	8.9030,	8.4230,	8.3620,	8.4300,	8.1400,
7,	10.0710,	9.6860,	10.6370,	9.5500,	9.9340,	10.3990,	9.8480,	10.3170,	10.3620,	9.8960,
8,	11.0520,	11.0990,	11.5500,	11.8670,	11.5190,	12.5000,	11.8370,	11.3520,	12.0730,	11.9400,
9,	11.8240,	12.4270,	13.0570,	12.7820,	13.3380,	13.4690,	12.7970,	13.5050,	13.0720,	12.9510,
10,	13.1340,	12.7780,	14.1480,	14.0810,	14.8970,	12.8900,	12.5620,	13.4080,	14.4430,	13.8590,
+gp,	14.3620,	13.9810,	15.4780,	15.3920,	16.6290,	14.6080,	14.4260,	13.4720,	16.5880,	14.7070,
SOPCOFAC,	.9999,	1.0035,	1.0087,	.9963,	.9985,	.9946,	.9968,	.9992,	.9951,	1.0098,

Table 2 Catch weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
1,	.6350,	.5860,	.6730,	.7370,	.6700,	.6990,	.6990,	.6780,	.7210,	.6980,
2,	.9760,	.8810,	1.0520,	.9760,	1.0780,	1.1460,	1.0650,	1.0750,	1.0200,	1.1170,
3,	1.9550,	1.9820,	1.8460,	2.1760,	2.0370,	2.5460,	2.4790,	2.2010,	2.2100,	2.1470,
4,	3.6500,	3.1870,	3.5850,	3.7910,	3.9710,	4.2230,	4.5500,	4.4710,	4.2920,	4.0330,
5,	6.0520,	5.9920,	5.2730,	5.9320,	6.0830,	6.2480,	6.5400,	7.1670,	7.2200,	6.6350,
6,	8.3070,	7.9140,	7.9210,	7.8890,	8.0340,	8.4830,	8.0940,	8.4360,	8.9800,	8.4930,
7,	10.2420,	9.7640,	9.7250,	10.2350,	9.5450,	10.1020,	9.6410,	9.5360,	10.2830,	9.7290,
8,	11.4610,	12.1270,	11.2110,	10.9240,	10.9490,	10.4810,	10.7350,	10.3230,	11.7430,	11.0800,
9,	12.4470,	14.2420,	12.5860,	12.8020,	13.4810,	11.8500,	12.3290,	12.2240,	13.1070,	12.2640,
10,	18.6910,	17.7870,	15.5570,	15.5250,	13.1700,	13.9050,	13.4430,	14.2470,	12.0520,	12.7570,
+gp,	16.6040,	16.4770,	14.6940,	23.2330,	14.9890,	15.7940,	13.9610,	12.5230,	13.9540,	11.3110,
SOPCOFAC,	.9969,	1.0001,	.9950,	.9945,	.9970,	.9929,	.9948,	.9940,	1.0018,	1.0006,

Table 3.4.1

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT26: SCOTRL_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1976	121841	128.856	1299.546	676.244	151.830	84.905	86.903
1977	144348	419.389	575.162	838.778	227.668	69.898	30.955
1978	135220	303.876	1424.419	285.883	181.926	63.974	15.993
1979	87467	215.635	914.453	447.243	73.875	46.921	22.961
1980	55475	154.012	849.920	379.327	127.393	19.965	19.965
1981	51553	95.989	928.202	387.683	113.695	51.256	13.979
1982	47889	521.806	305.760	389.066	73.236	17.394	6.408
1983	48339	178.337	1427.663	208.383	112.430	23.261	9.692
1984	34574	316.043	772.341	345.964	32.726	16.831	7.480
1985	33103	82.048	781.283	196.005	79.313	9.116	4.558
1986	27839	251.300	190.609	256.042	19.914	10.431	0.948
1987	27208	272.057	606.030	38.463	39.401	8.443	1.876
1988	21559	27.259	346.285	159.513	8.077	8.077	4.038
1989	16657	58.153	29.428	134.388	40.929	2.974	2.233
1990	14325	15.482	327.585	18.792	22.486	5.118	1.215
1991	13495	45.113	94.909	103.953	7.731	6.998	1.718
1992	10887	52.261	99.870	30.235	33.291	1.153	1.211
1993	11657	4.716	124.610	31.231	4.273	6.325	0.634
1994	15671	54.896	40.799	124.960	9.461	1.713	1.656
1995	17728	29.099	254.011	93.718	49.032	1.501	0.465
1996	13471	6.349	139.583	108.299	23.909	15.045	1.580

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT28: SCOLTR_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1976	152419	263.044	3274.549	415.069	101.017	38.006	39.007	10.002	1.000
1977	224824	2069.153	1808.008	774.432	118.066	75.042	24.013	13.007	8.004
1978	236929	2255.601	5379.048	670.881	269.952	50.991	27.995	6.999	7.999
1979	207494	1973.132	5845.391	1808.121	178.012	61.004	15.001	3.000	4.000
1980	333197	1849.470	5356.235	2100.709	549.199	71.405	15.868	4.408	3.526
1981	251504	690.987	5236.821	1474.781	293.606	81.839	10.968	5.906	0.000
1982	250870	4703.856	2940.357	2301.849	377.382	109.995	39.348	8.048	6.260
1983	244349	1321.201	6293.185	1020.032	459.821	111.146	31.372	14.341	5.378
1984	240725	2723.570	3022.983	1543.958	180.369	85.675	36.074	9.920	7.215
1985	268136	430.874	5959.050	865.407	293.653	39.337	21.041	3.659	2.744
1986	279767	4140.451	1166.751	1847.672	250.965	95.651	12.311	8.523	4.735
1987	351131	2045.224	5662.771	530.278	468.273	45.347	31.465	10.180	5.553
1988	391988	403.133	3300.276	1912.375	133.375	148.417	33.093	14.039	2.006
1989	405883	1574.048	1205.534	1594.526	565.712	48.605	45.236	13.343	3.382
1990	398153	327.094	5739.588	523.696	456.829	179.523	25.746	11.324	3.712
1991	408056	1821.110	1904.532	2125.128	138.039	94.188	48.099	8.199	8.482
1992	473955	1401.577	2749.504	747.952	646.729	44.077	36.368	11.912	2.053
1993	447064	250.643	4891.675	1262.363	163.983	80.122	9.885	5.161	3.794
1994	480400	722.752	1924.201	2364.757	370.592	47.312	42.371	5.792	2.346
1995	442010	879.046	5807.931	1579.502	797.169	73.989	8.577	6.861	0.637
1996	445995	448.536	4060.709	3048.116	424.148	296.499	31.730	9.559	5.477

Table 3.4.1 (Continued)

FLT27: SCOSEI_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1976	307165	536.740	14237.110	2889.603	369.821	178.913	112.945	36.982
1977	313913	2742.119	4316.187	3069.132	714.031	177.008	51.002	35.002
1978	325246	1703.941	14715.490	1385.952	850.971	201.993	47.998	22.999
1979	316419	2522.256	8021.633	3257.039	382.887	344.898	66.980	43.987
1980	297227	1067.994	5957.458	2341.237	828.826	144.370	89.579	33.049
1981	289672	855.604	13328.760	2355.389	698.688	204.816	18.169	10.736
1982	297730	4070.478	4794.063	6023.739	822.294	291.107	151.409	25.095
1983	333168	1342.728	13320.380	1813.966	1289.703	227.494	98.353	39.341
1984	388085	4839.125	9954.796	3783.950	453.752	381.259	108.292	46.539
1985	382910	543.929	18367.311	2498.646	835.287	127.187	107.343	26.159
1986	425017	5425.851	2656.135	6865.172	824.863	285.816	42.826	38.171
1987	418536	1361.396	13452.120	680.241	1423.568	283.434	186.518	24.686
1988	377132	842.968	7091.734	4631.826	201.992	471.982	131.995	55.998
1989	355735	1684.028	3495.714	3173.118	1092.297	91.156	185.066	44.650
1990	270869	379.134	12625.370	1096.540	671.531	291.604	38.807	50.407
1991	336675	1708.483	4746.648	2986.177	241.370	173.924	113.164	32.981
1992	300217	1056.525	4120.136	942.427	618.214	97.903	59.252	31.805
1993	268413	259.816	5561.367	776.714	208.932	142.388	26.401	19.572
1994	264738	1172.846	3129.865	2378.035	301.222	60.540	37.716	13.282
1995	204545	743.283	8029.209	912.815	496.574	84.516	21.557	16.616
1996	177092	303.656	3696.333	2598.453	239.201	165.108	19.699	8.662

Year	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13
1976	9.995	3.998	8.996	0.000	0.000	0.000
1977	24.001	6.000	2.000	0.000	0.000	0.000
1978	20.999	8.000	3.000	2.000	1.000	2.000
1979	18.994	11.996	3.999	0.000	1.999	0.000
1980	14.785	8.697	4.349	0.870	0.000	0.000
1981	12.388	3.303	0.000	0.000	0.000	0.000
1982	20.913	11.711	0.837	1.673	0.837	0.000
1983	18.815	15.394	2.566	4.276	0.000	0.000
1984	25.954	6.265	7.160	3.580	1.790	0.000
1985	24.355	9.922	3.608	3.608	0.000	0.000
1986	13.965	7.448	2.793	2.793	0.000	0.000
1987	35.658	15.543	4.572	1.829	0.914	0.000
1988	15.999	10.000	3.000	3.000	4.000	0.000
1989	18.698	2.391	7.744	2.614	0.591	0.000
1990	11.534	3.699	1.793	0.100	0.275	0.000
1991	25.229	7.592	0.570	0.391	0.142	0.000
1992	8.852	8.416	3.235	0.997	1.477	0.518
1993	9.165	2.347	0.806	0.543	0.077	0.000
1994	5.077	2.267	0.873	0.537	1.072	0.000
1995	0.914	0.967	0.903	1.267	0.220	0.132
1996	5.688	1.849	1.188	0.488	0.145	0.216

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT29: ENGTRL_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1976	493436	480.000	6058.000	1508.000	727.000	163.000	395.000	100.000	27.000
1977	509862	2570.000	1905.000	2013.000	616.000	320.000	98.000	127.000	48.000
1978	559930	2029.000	10576.000	1093.000	987.000	338.000	117.000	57.000	60.000
1979	553020	1329.000	7698.000	3341.000	393.000	403.000	99.000	54.000	15.000
1980	442036	1881.000	3786.000	2106.000	865.000	122.000	114.000	38.000	16.000
1981	423658	615.000	12703.000	1886.000	535.000	250.000	38.000	48.000	8.000
1982	424272	4074.000	3063.000	3802.000	587.000	298.000	179.000	35.000	24.000
1983	392364	711.000	14220.000	1185.000	907.000	127.000	87.000	49.000	16.000
1984	358387	3469.000	3459.000	2656.000	267.000	217.000	42.000	32.000	16.000
1985	342844	675.000	8212.000	1047.000	533.000	72.000	54.000	16.000	10.000
1986	288867	9097.000	2107.000	2388.000	209.000	161.000	15.000	12.000	4.000
1987	275899	447.000	10435.000	682.000	596.000	36.000	26.000	3.000	4.000
1988	296092	1173.000	2102.000	2428.000	90.000	126.000	17.000	10.000	0.000
1989	310444	985.000	1958.000	718.000	501.000	25.000	34.000	5.000	4.000
1990	255314	573.000	3101.000	513.000	134.000	101.000	11.000	13.000	4.000
1991	258037	880.000	1559.000	1092.000	88.000	25.000	17.000	2.000	2.000
1992	223702	1463.000	2171.000	481.000	234.000	19.000	5.000	5.000	0.000
1993	209869	580.000	4054.000	442.000	96.000	55.000	5.000	3.000	2.000
1994	184764	1264.802	2454.287	1146.382	78.190	14.284	7.036	1.762	0.673
1995	173463	821.392	3799.572	871.882	158.030	11.028	2.992	1.896	0.662
1996	156639	659.699	3177.667	1645.678	189.117	43.946	6.809	1.648	1.463

Table 3.4.1 (Continued)

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT30: ENGSEI_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1976	211284	281.000	8523.000	895.000	479.000	116.000	290.000
1977	196103	2630.000	2453.000	1577.000	245.000	182.000	60.000
1978	203382	898.000	12831.000	746.000	547.000	131.000	78.000
1979	187180	1718.000	7004.000	2438.000	162.000	280.000	76.000
1980	201169	2111.000	7760.000	1370.000	611.000	146.000	210.000
1981	185423	343.000	12689.000	1053.000	398.000	359.000	61.000
1982	183209	1486.000	3191.000	2473.000	330.000	294.000	189.000
1983	177004	566.000	4741.000	573.000	557.000	207.000	150.000
1984	167699	1232.000	1513.000	1215.000	147.000	290.000	72.000
1985	157815	125.000	3242.000	326.000	241.000	72.000	117.000
1986	136358	890.000	312.000	572.000	65.000	139.000	34.000
1987	123281	262.000	2395.000	82.000	184.000	44.000	77.000
1988	91178	297.000	879.000	594.000	19.000	80.000	19.000
1989	88782	343.000	748.000	216.000	138.000	9.000	46.000
1990	80537	176.000	1009.000	116.000	45.000	58.000	4.000
1991	84346	129.000	262.000	207.000	33.000	26.000	38.000
1992	67810	408.000	463.000	57.000	42.000	10.000	8.000
1993	54574	44.000	497.000	41.000	19.000	22.000	4.000
1994	39667	163.456	265.085	138.494	11.373	17.040	14.114
1995	28406	91.043	444.628	83.186	21.000	5.216	3.742
1996	14991	18.371	196.618	166.980	19.592	16.881	4.434

Year	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12
1976	84.000	17.000	6.000	5.000	4.000	2.000
1977	103.000	31.000	8.000	3.000	1.000	3.000
1978	21.000	37.000	9.000	1.000	1.000	2.000
1979	35.000	14.000	18.000	4.000	1.000	0.000
1980	54.000	29.000	9.000	12.000	4.000	0.000
1981	74.000	12.000	8.000	6.000	3.000	0.000
1982	38.000	31.000	9.000	3.000	2.000	0.000
1983	104.000	18.000	17.000	8.000	3.000	2.000
1984	50.000	32.000	6.000	5.000	1.000	0.000
1985	40.000	27.000	13.000	4.000	2.000	0.000
1986	52.000	13.000	7.000	7.000	2.000	1.000
1987	10.000	22.000	8.000	2.000	1.000	0.000
1988	12.000	3.000	3.000	1.000	0.000	0.000
1989	7.000	8.000	1.000	2.000	0.000	1.000
1990	15.000	3.000	1.000	1.000	0.000	0.000
1991	6.000	16.000	1.000	1.000	1.000	0.000
1992	8.000	2.000	3.000	0.000	0.000	0.000
1993	3.000	2.000	0.000	1.000	0.000	0.000
1994	3.077	0.889	0.519	0.070	0.278	0.071
1995	5.623	3.043	0.608	0.162	0.755	0.085
1996	1.542	1.136	0.148	0.240	0.000	0.000

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT31: FRATRB_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12
1985	25915	121.920	371.475	103.343	37.681	4.007	2.519	1.285	1.026	0.477	0.852	1.632	0.091
1986	28611	304.119	84.391	204.323	37.334	9.424	0.926	0.669	0.338	0.353	0.205	0.721	0.056
1987	28692	154.967	293.847	24.690	46.774	6.162	1.664	0.122	0.115	0.032	0.053	0.020	0.000
1988	25208	27.150	93.670	114.542	7.920	8.608	1.383	0.384	0.064	0.087	0.029	0.016	0.001
1989	25184	105.156	50.478	51.370	27.919	1.214	0.841	0.093	0.033	0.004	0.025	0.008	0.000
1990	21758	26.338	146.187	16.835	8.793	2.708	0.177	0.125	0.020	0.004	0.003	0.000	0.002
1991	19840	22.130	24.566	24.590	2.679	1.293	0.421	0.065	0.051	0.010	0.001	0.000	0.000
1992	15656	32.776	19.482	5.308	2.936	0.245	0.071	0.014	0.007	0.004	0.003	0.000	0.000
1993	19076	59.924	163.922	19.699	4.551	1.827	0.175	0.110	0.066	0.026	0.020	0.006	0.002
1994	17316	33.401	40.442	43.816	5.603	0.504	0.156	0.022	0.024	0.014	0.007	0.008	0.005
1995	17794	53.718	170.131	26.973	20.080	1.298	0.130	0.074	0.017	0.013	0.015	0.008	0.015
1996	18883	17.728	103.180	59.132	5.779	2.101	0.151	0.061	0.040	0.009	0.012	0.032	0.032

Table 3.4.1 (Continued)

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT32: FRATRO_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1986	56099	4279.538	2636.021	563.785	84.166	9.781	2.785	1.809	0.805	0.190
1987	71765	1313.864	4170.555	77.416	92.616	5.296	4.532	0.548	0.617	0.451
1988	84052	1282.939	1601.252	822.747	26.188	15.803	3.484	1.293	0.050	0.257
1989	88397	398.066	1274.181	323.765	93.127	3.391	5.448	1.607	0.839	0.308
1990	71078	115.836	485.955	167.552	44.272	24.320	2.576	2.334	0.366	0.061
1991	67846	97.672	97.461	92.563	13.867	4.164	3.977	0.416	0.510	0.094
1992	51240	1546.160	218.167	21.614	5.299	1.469	1.390	0.803	0.079	0.061
1993	62553	79.178	551.893	35.425	2.731	1.830	0.748	0.319	0.155	0.018
1994	51239	1259.308	75.587	42.734	2.410	1.432	0.893	0.365	0.131	0.091
1995	57823	1705.678	821.164	46.023	9.599	0.441	0.434	0.331	0.034	0.059
1996	50163	278.736	582.426	100.670	2.627	2.229	0.276	0.115	0.001	0.002

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT33: SCOGFS_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1982	100	0.614	0.351	0.571	0.181	0.092	0.060
1983	100	0.325	0.781	0.181	0.197	0.075	0.023
1984	100	0.820	0.390	0.254	0.050	0.057	0.016
1985	100	0.066	1.142	0.196	0.112	0.030	0.024
1986	100	0.801	0.105	0.396	0.058	0.040	0.019
1987	100	0.219	0.749	0.034	0.092	0.029	0.007
1988	100	0.163	0.288	0.165	0.026	0.033	0.012
1989	100	0.562	0.135	0.169	0.094	0.020	0.008
1990	100	0.114	0.491	0.059	0.074	0.026	0.009
1991	100	0.303	0.154	0.133	0.013	0.006	0.004
1992	100	0.643	0.193	0.072	0.067	0.029	0.018
1993	100	0.347	0.749	0.101	0.025	0.011	0.003
1994	100	1.158	0.334	0.288	0.031	0.012	0.007
1995	100	0.475	1.443	0.130	0.085	0.011	0.007
1996	100	0.318	0.356	0.542	0.074	0.034	0.004

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT34: ENGGFS_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5
1977	100	6.2690	0.4480	0.3230	0.0580	0.0110
1978	100	2.2840	1.2500	0.0980	0.0990	0.0130
1979	100	2.4230	0.5800	0.2000	0.0270	0.0360
1980	100	5.0840	0.6700	0.1530	0.0730	0.0110
1981	100	1.1360	1.3870	0.1270	0.0390	0.0400
1982	100	3.2380	0.2900	0.3290	0.0530	0.0380
1983	100	1.5390	1.0960	0.1200	0.1110	0.0280
1984	100	6.1220	0.4740	0.1780	0.0400	0.0210
1985	100	0.4300	1.1890	0.1070	0.0560	0.0210
1986	100	3.4380	0.1150	0.2020	0.0290	0.0110
1987	100	1.4220	1.0650	0.0270	0.0610	0.0140
1988	100	0.8360	0.4070	0.1990	0.0010	0.0430
1989	100	2.2850	0.2480	0.1190	0.0610	0.0060
1990	100	0.6080	0.5030	0.0600	0.0140	0.0120
1991	100	0.7520	0.1550	0.0720	0.0130	0.0030
1992	100	2.4410	0.1580	0.0460	0.0350	0.0080
1993	100	0.7420	0.6510	0.0820	0.0150	0.0170
1994	100	2.6370	0.2950	0.1540	0.0190	0.0050
1995	100	1.0280	1.2770	0.1190	0.0560	0.0020
1996	100	0.6190	0.6680	0.1620	0.0188	0.0196

Table 3.4.1 (Continued)

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT36: IBTS_Q2_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1991	10	14.9	31.4	39.4	6.1	4.9	2.2
1992	10	190.8	53.2	13.8	6.1	0.5	0.9
1993	10	48.2	144.6	22.4	4.0	2.2	0.3
1994	10	20.3	34.1	24.4	4.5	0.6	1.0
1995	10	42.7	204.7	29.0	9.3	3.0	1.2
1996	10	7.7	56.6	29.6	6.3	3.4	1.2

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT35: IBTS_Q1_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1976	1	7.9	19.9	-1.0	-1.0	-1.0	-1.0
1977	1	36.7	3.2	-1.0	-1.0	-1.0	-1.0
1978	1	12.9	29.3	-1.0	-1.0	-1.0	-1.0
1979	1	9.9	9.3	-1.0	-1.0	-1.0	-1.0
1980	1	16.9	14.8	-1.0	-1.0	-1.0	-1.0
1981	1	2.9	25.5	-1.0	-1.0	-1.0	-1.0
1982	1	9.2	6.7	-1.0	-1.0	-1.0	-1.0
1983	1	3.9	16.6	2.7	1.8	0.8	1.5
1984	1	15.2	8.0	3.9	0.9	1.0	0.9
1985	1	0.9	17.6	3.5	1.7	0.5	1.0
1986	1	17.0	3.6	6.8	2.3	1.3	1.1
1987	1	8.8	28.8	1.4	1.7	0.6	0.9
1988	1	3.6	6.1	5.8	0.6	0.9	1.1
1989	1	13.1	6.3	5.0	2.3	0.4	1.0
1990	1	3.4	15.2	2.0	1.0	1.0	0.8
1991	1	2.4	4.1	3.4	0.8	0.4	0.8
1992	1	13.0	4.5	1.2	1.0	0.3	0.5
1993	1	12.7	19.9	2.0	0.7	0.6	0.4
1994	1	14.8	4.4	3.0	0.8	0.5	0.5
1995	1	9.7	22.1	2.8	1.1	0.3	0.3
1996	1	3.5	8.0	6.0	0.7	0.6	0.4

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT37: IBTS_Q4_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1991	100	567	181	106	29	10	13
1992	100	2671	217	83	21	8	0
1993	100	586	635	95	26	13	5
1994	100	2552	327	121	7	9	2
1995	100	1489	1658	78	42	2	2
1996	100	791	455	92	18	13	2

Table 3.4.1 (Continued)

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT38: FRATRO_7d

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1986	257794	7166.948	5609.620	1279.560	204.337	41.900	14.340	11.257	7.180	1.805
1987	188236	1754.084	4674.962	185.627	260.015	34.358	39.335	6.796	12.688	3.869
1988	215422	717.923	1054.403	850.593	35.371	51.875	17.353	5.751	1.518	4.094
1989	320383	169.508	800.832	322.559	165.505	4.871	21.803	6.639	4.077	1.796
1990	236327	45.086	252.821	109.288	40.568	36.826	3.924	7.659	1.915	0.792
1991	300624	33.728	66.649	97.004	33.273	12.177	16.135	1.963	3.987	0.694
1992	285783	1308.228	252.290	29.763	8.906	4.465	4.755	4.191	0.064	0.131
1993	283999	23.002	350.974	55.043	5.964	5.394	3.086	1.613	1.465	0.076
1994	286019	1349.246	111.867	77.576	5.974	5.345	3.227	2.553	0.847	0.581
1995	268151	1356.050	837.575	61.548	22.578	2.086	2.187	2.056	0.506	0.907
1996	274495	145.492	438.529	150.399	5.207	11.785	1.505	1.256	0.204	0.106

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT39: Den_Gill_Skag

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1987	1	0.0	98.7	68.6	19.3	4.8	2.1	0.6
1988	1	12.8	57.7	146.5	20.9	4.2	1.7	0.2
1989	1	5.2	67.8	59.2	65.5	8.9	5.6	0.8
1990	1	8.9	69.9	91.7	22.2	18.4	2.0	2.4
1991	1	6.6	64.8	75.6	51.2	11.4	4.2	1.6
1992	1	27.8	114.7	67.9	24.8	14.0	2.3	2.3
1993	1	9.3	134.1	94.8	32.3	6.5	2.8	0.3
1994	1	15.9	109.4	107.4	18.0	4.3	0.9	0.2
1995	1	7.1	127.1	114.6	39.5	3.7	2.1	0.1
1996	1	2.4	107.9	159.8	39.1	13.7	2.2	1.0

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT40: Den_Neph_Skag

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1987	1	0.00	18.00	3.00	0.80	0.20	0.10	0.02
1988	1	1.90	5.50	11.70	1.30	0.40	0.20	0.03
1989	1	2.30	17.90	7.40	2.50	0.30	0.20	0.03
1990	1	2.00	16.30	9.60	1.40	1.20	0.10	0.10
1991	1	2.20	13.20	5.90	2.30	0.50	0.20	0.10
1992	1	8.10	15.00	4.40	1.30	0.70	0.10	0.10
1993	1	1.90	25.10	6.70	1.90	0.60	0.20	0.04
1994	1	4.50	14.10	6.70	1.10	0.30	0.10	0.03
1995	1	2.10	35.00	8.70	1.40	0.20	0.10	0.01
1996	1	0.50	18.10	9.90	2.30	1.10	0.30	0.10

Table 3.4.1 (Continued)

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT41: Den_Trawl_Skag

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1987	1	0.0	180.7	39.3	6.1	1.4	0.5	0.1
1988	1	32.2	69.7	130.6	11.1	2.2	0.7	0.1
1989	1	17.0	136.2	69.9	27.5	2.2	1.0	0.2
1990	1	9.8	96.0	66.3	10.0	7.1	0.8	0.5
1991	1	16.5	69.0	32.9	16.9	3.4	1.2	0.3
1992	1	34.2	88.1	32.2	8.4	3.3	0.6	0.5
1993	1	33.2	203.8	65.5	16.4	3.4	1.1	0.2
1994	1	95.5	252.8	104.1	10.4	2.1	0.5	0.1
1995	1	16.6	365.4	191.8	36.8	3.7	1.5	0.1
1996	1	5.3	254.3	160.8	21.9	6.0	1.6	0.5

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COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT42: Den_Sei_Skag

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1987	1	0.0	431.7	52.5	11.5	2.9	1.2	0.1
1988	1	17.4	52.9	257.9	33.2	5.8	1.1	0.2
1989	1	16.8	229.6	140.3	35.1	2.8	0.8	0.2
1990	1	26.0	210.8	130.7	16.0	12.4	1.3	0.8
1991	1	22.4	113.5	44.6	15.7	3.0	1.1	0.4
1992	1	53.8	207.0	76.8	17.7	5.2	0.8	0.8
1993	1	17.8	272.6	84.9	21.2	5.1	1.3	0.4
1994	1	54.3	154.8	88.1	13.9	3.2	0.7	0.3
1995	1	17.6	293.6	119.2	23.6	2.9	1.7	0.2
1996	1	5.4	175.1	169.0	37.4	13.5	3.0	1.0

The SAS System 06:55 Wednesday, October 15, 1997
COD-347D: Cod in Fishing Areas IV, Skagerrak and VIId

FLT43: IBTS_Skag

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1983	1	33.40	38.60	6.10	4.60	0.40	0.03
1984	1	17.10	19.10	5.30	1.50	0.70	0.10
1985	1	5.70	78.80	9.90	2.60	0.70	0.20
1986	1	69.70	12.78	9.30	3.60	0.60	0.20
1987	1	0.70	112.30	14.20	2.40	0.50	0.20
1988	1	89.60	12.40	14.20	1.00	0.30	0.40
1989	1	60.90	31.10	5.40	3.70	0.10	0.10
1990	1	18.90	8.40	6.10	0.90	0.40	0.10
1991	1	32.90	7.60	3.50	2.50	0.60	0.10
1992	1	159.60	4.40	2.20	0.90	0.40	0.01
1993	1	134.20	13.50	1.90	0.40	0.10	0.06
1994	1	100.90	11.90	2.40	0.30	0.10	0.10
1995	1	113.30	51.20	8.50	1.80	0.10	0.20
1996	1	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00

Table 3.4.2 Tuning fleets

Fleet		First year	Last year	First age	Last age
SCOTRL	Scottish trawl	1976	1995	1	10
SCOSEI	Scottish seine	1976	1995	1	10
SCOLTR	Scottish light trawl	1976	1995	1	10
ENGTRL	English trawl	1976	1995	1	10
ENGSEI	English seine	1976	1995	1	10
FRATRB	French trawl	1976	1995	1	10
SCOGFS	Scottish groundfish survey	1982	1995	1	6
ENGGFS	English groundfish survey	1977	1995	1	5
IBTS_Q1_IV	International groundfish survey Q1	1976	1995	1	6
IBTS_Q2_IV	International groundfish survey Q2	1991	1995	1	6
DANGIL_3a	Danish gill net	1987	1995	1	7
DANNEP_3a	Danish nephrops trawl	1987	1995	1	7
FRATRC_7d	French trawl	1985	1995	1	2

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Table 3.4.3

Lowestoft VPA Version 3.1

11-Oct-97 18:23:06

Extended Survivors Analysis

Cod in IV,IIIa,VIId (run: XSAJC05/X05)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/cod_347d/FLEET.X05

Catch data for 34 years. 1963 to 1996. Ages 1 to 11.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT18: SCOTRL_IV (Ca,	1987,	1996,	1,	6,	.000,	1.000
FLT19: SCOSEI_IV (Ca,	1987,	1996,	1,	10,	.000,	1.000
FLT20: SCOLTR_IV (Ca,	1987,	1996,	1,	8,	.000,	1.000
FLT21: ENGTRL_IV (Ca,	1987,	1996,	1,	8,	.000,	1.000
FLT22: ENGSEI_IV (Ca,	1987,	1996,	1,	10,	.000,	1.000
FLT23: SCOGFS_IV (Ca,	1987,	1996,	1,	6,	.500,	.750
FLT24: ENGGFS_IV (Ca,	1987,	1996,	1,	5,	.500,	.750
FLT25: IBTS_Q1_IV (C,	1987,	1996,	1,	6,	.000,	.250

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 2

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

Catchability independent of age for ages >= 6

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00027

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9,	10
Iteration 29,	.0525,	.5431,	.5408,	.4911,	.4904,	.7521,	.9298,	.6819,	1.1855,	.3586
Iteration 30,	.0525,	.5431,	.5408,	.4911,	.4904,	.7520,	.9298,	.6819,	1.1855,	.3584

Table 3.4.3 (Continued)

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	.141	.178	.129	.140	.127	.141	.046	.061	.096	.052
2	.917	.915	.879	.906	.764	.846	.773	.592	.611	.543
3	.891	1.185	1.090	.973	.955	.851	1.011	.922	.818	.541
4	.926	.858	1.016	.891	.852	.910	.962	.903	.645	.491
5	.721	.790	.756	.773	.828	.745	.847	.773	.627	.490
6	.934	.801	.905	.557	.937	.811	.809	.767	.632	.752
7	.900	.729	.855	.772	1.079	.897	1.007	.687	.527	.930
8	.804	.694	.973	.439	1.013	.794	.872	.925	.442	.682
9	.675	.583	.694	1.978	.429	.959	.719	.701	.655	1.185
10	.926	.677	.645	.784	.707	.507	.676	.694	.701	.358

XSA population numbers (Thousands)

	AGE									
YEAR	1	2	3	4	5	6	7	8		
1987	2.82E+05	2.55E+05	1.88E+04	1.60E+04	3.30E+03	1.96E+03	4.38E+02	4.30E+02	1.24E+02	8.79E+01
1988	1.97E+05	1.10E+05	7.18E+04	6.01E+03	5.17E+03	1.31E+03	6.30E+02	1.46E+02	1.58E+02	5.17E+01
1989	2.75E+05	7.41E+04	3.11E+04	1.71E+04	2.09E+03	1.92E+03	4.83E+02	2.49E+02	5.97E+01	7.20E+01
1990	1.34E+05	1.09E+05	2.17E+04	8.13E+03	5.07E+03	8.03E+02	6.37E+02	1.68E+02	7.70E+01	2.44E+01
1991	1.69E+05	5.23E+04	3.09E+04	6.38E+03	2.73E+03	1.91E+03	3.77E+02	2.41E+02	8.87E+01	8.72E+00
1992	3.13E+05	6.69E+04	1.72E+04	9.26E+03	2.23E+03	9.77E+02	6.14E+02	1.05E+02	7.17E+01	4.73E+01
1993	1.57E+05	1.22E+05	2.02E+04	5.71E+03	3.05E+03	8.66E+02	3.55E+02	2.05E+02	3.88E+01	2.25E+01
1994	3.92E+05	6.74E+04	3.98E+04	5.73E+03	1.79E+03	1.07E+03	3.16E+02	1.06E+02	7.02E+01	1.55E+01
1995	2.56E+05	1.66E+05	2.63E+04	1.23E+04	1.90E+03	6.75E+02	4.07E+02	1.30E+02	3.45E+01	2.85E+01
1996	1.44E+05	1.05E+05	6.33E+04	9.02E+03	5.30E+03	8.32E+02	2.94E+02	1.97E+02	6.84E+01	1.47E+01

Estimated population abundance at 1st Jan 1997

, .00E+00, 6.15E+04, 4.28E+04, 2.87E+04, 4.52E+03, 2.66E+03, 3.21E+02, 9.50E+01, 8.15E+01, 1.71E+01,

Taper weighted geometric mean of the VPA populations:

, 3.36E+05, 1.40E+05, 4.50E+04, 1.44E+04, 5.77E+03, 2.41E+03, 1.01E+03, 4.43E+02, 1.81E+02, 7.09E+01,

Standard error of the weighted Log(VPA populations) :

, .5690, .5367, .5118, .5325, .6045, .6546, .6783, .7359, .8182, .9084,

Table 3.4.3 (Continued)

Log catchability residuals.

Fleet : FLT18: SCOTRL_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	.54	-.10	.05	.21	.52	.08	-.45	-.31	-.25	-.29
2	.03	.54	-1.28	.91	.40	.45	-.03	-.92	-.10	.00
3	-.65	-.22	.67	-.83	.58	.10	-.03	.34	.31	-.27
4	-.33	-.73	.17	.41	-.37	.96	-.66	-.19	.46	.26
5	.03	-.20	-.05	-.24	.78	-.64	.72	-.38	-.76	.74
6	-.74	.60	-.07	.20	-.11	.38	-.22	.22	-.77	.52
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2	3	4	5	6
Mean Log q	-15.7157	-15.2385	-15.3783	-15.7843	-15.9044
S.E(Log q)	.6654	.4992	.5420	.5675	.4794

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	.48	1.553	15.11	.53	10	.37	-18.11

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	.407	15.02	.43	10	.58	-15.72
3	.90	.299	14.77	.55	10	.48	-15.24
4	.64	1.329	13.13	.63	10	.33	-15.38
5	.65	1.257	13.04	.61	10	.36	-15.78
6	1.21	-.411	17.74	.33	10	.61	-15.90

Table 3.4.3 (Continued)

Fleet : FLT19: SCOSEI_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.08	-.05	.28	-.11	.83	-.12	-.65	-.16	.10	-.04
2	-.40	-.09	-.36	.82	.30	.06	-.16	-.20	.11	-.09
3	-.79	.01	.50	.02	.44	-.05	-.23	.19	-.14	.05
4	.26	-.64	.12	.60	-.41	.29	-.17	.18	.06	-.28
5	.14	.33	-.36	.20	.11	-.19	.03	-.31	.16	-.11
6	.30	.41	.46	-.10	.04	.13	-.44	-.30	-.20	-.30
7	-.24	.25	.40	.49	.49	.01	.23	-.16	.00	-.01
8	.11	.45	.24	.20	.65	.46	-.03	.07	-1.80	-.13
9	.47	-.15	-.50	.44	.20	.85	.20	-.42	-.32	.00
10	-.31	-.20	.47	.42	.05	.12	-.34	.14	-.18	.75

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

Age	2	3	4	5	6	7	8	9	10
Mean Log q	-14.9224	-14.9619	-15.1080	-15.1151	-15.0847	-15.0847	-15.0847	-15.0847	-15.0847
S.E(Log q)	.3584	.3610	.3739	.2307	.3204	.3057	.6827	.4440	.3758

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	.225	17.33	.49	10	.40	-17.78

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.19	-.618	15.58	.56	10	.44	-14.92
3	.78	1.216	13.92	.79	10	.27	-14.96
4	.72	1.333	13.43	.74	10	.26	-15.11
5	.76	1.960	13.43	.90	10	.15	-15.12
6	.63	3.001	12.13	.89	10	.15	-15.08
7	.75	1.118	12.70	.71	10	.19	-14.94
8	.76	.586	12.68	.42	10	.54	-15.06
9	.82	.678	13.07	.64	10	.37	-15.01
10	1.14	-.745	16.63	.78	10	.42	-14.99

Table 3.4.3 (Continued)

Fleet : FLT20: SCOLTR_IV (Ca

Age	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996
1 ,	.75,	-.37,	.42,	-.19,	1.03,	.06,	-.71,	-.77,	-.09,	-.12
2 ,	-.14,	.05,	-.61,	.60,	.14,	.15,	.15,	-.33,	-.04,	.03
3 ,	-.28,	-.33,	.25,	-.53,	.49,	-.16,	.32,	.16,	.22,	-.13
4 ,	-.09,	-.51,	-.08,	.42,	-.57,	.47,	-.34,	.38,	.35,	-.04
5 ,	-.54,	.11,	-.15,	.30,	.27,	-.47,	-.09,	-.18,	.23,	.52
6 ,	-.15,	.13,	.07,	.25,	.14,	.34,	-.79,	.36,	-.75,	.40
7 ,	.20,	-.02,	.21,	-.25,	.06,	-.28,	-.47,	-.44,	-.51,	.31
8 ,	-.43,	-.52,	-.45,	-.17,	.51,	-.31,	-.28,	-.15,	-1.78,	.05
9 ,	No data for this fleet at this age									
10 ,	No data for this fleet at this age									

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

Age ,	2,	3,	4,	5,	6,	7,	8
Mean Log q,	-15.8698,	-15.5393,	-15.6981,	-16.0864,	-16.2314,	-16.2314,	-16.2314,
S.E(Log q),	.3216,	.3315,	.3921,	.3458,	.4361,	.3324,	.6934,

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,	.244,	17.36,	.28,	10,	.62,	-18.18,

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,	.95,	.207,	15.66,	.71,	10,	.32,	-15.87,
3,	1.04,	-.154,	15.74,	.68,	10,	.36,	-15.54,
4,	.81,	.733,	14.43,	.65,	10,	.33,	-15.70,
5,	.72,	1.504,	13.85,	.79,	10,	.23,	-16.09,
6,	.80,	.676,	14.38,	.58,	10,	.36,	-16.23,
7,	1.04,	-.098,	16.75,	.44,	10,	.34,	-16.35,
8,	.75,	.720,	13.75,	.51,	10,	.45,	-16.59,

Table 3.4.3 (Continued)

Fleet : FLT21: ENGTRL_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-1.70	.32	-.46	-.36	.16	.74	-.21	.54	.32	.65
2	.20	-.63	-.37	-.08	-.11	.15	.21	.35	-.04	.32
3	.04	.02	-.45	-.28	.11	-.02	-.15	.22	.39	.13
4	.53	-.48	.20	-.23	-.43	.34	.02	-.09	-.19	.33
5	-.23	.53	-.24	.47	-.29	-.26	.60	-.12	-.44	-.04
6	.29	.14	.45	.24	-.04	-.50	-.32	-.08	-.47	.30
7	-.38	.31	-.11	.73	-.50	.00	.14	-.28	-.47	-.01
8	-.12	99.99	.38	.74	-.08	99.99	.23	-.05	-.41	.17
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2	3	4	5	6	7	8
Mean Log q	-15.3583	-15.3676	-15.8329	-16.3916	-16.6263	-16.6263	-16.6263
S.E(Log q)	.3139	.2420	.3441	.3850	.3391	.3882	.3724

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	1.82	-1.177	21.78	.20	10	.77	-17.49

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.93	.300	15.11	.72	10	.31	-15.36
3	.90	.672	14.85	.85	10	.22	-15.37
4	.66	2.177	13.56	.84	10	.19	-15.83
5	.63	2.435	13.27	.84	10	.19	-16.39
6	.70	1.684	13.74	.80	10	.22	-16.63
7	.57	1.903	12.14	.71	10	.19	-16.68
8	.95	.157	15.96	.62	8	.36	-16.52

Table 3.4.3 (Continued)

Fleet : FLT22: ENGSEI_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.35	.36	.14	.42	-.10	.36	-.56	-.19	.05	-.14
2	-.14	.00	.25	.27	-.45	.13	-.22	-.01	-.05	.21
3	-.73	.33	.14	-.07	.10	-.42	-.64	.19	.39	.72
4	.35	-.67	.36	.03	-.10	.01	-.06	-.29	-.21	.60
5	-.11	.37	-.90	.19	-.02	-.59	.14	.71	-.26	.47
6	.61	-.15	.42	-1.19	.30	-.42	-.77	.58	-.01	.64
7	.05	.10	-.10	.45	.14	.08	-.09	.24	.85	.70
8	.81	.16	.75	.03	1.54	.42	.00	.19	1.34	.69
9	.99	.03	-.02	.31	-.48	1.28	99.99	-.03	1.15	-.09
10	.05	.09	.46	1.01	1.96	99.99	1.44	-.52	.04	1.59

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

Age	2	3	4	5	6	7	8	9	10
Mean Log q	-15.6850	-15.9072	-16.0230	-15.5052	-15.0491	-15.0491	-15.0491	-15.0491	-15.0491
S.E(Log q)	.2272	.4681	.3660	.4886	.6323	.4123	.8241	.7312	1.1148

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	.78	.690	16.69	.56	10	.34	-17.89

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.00	.014	15.68	.81	10	.24	-15.69
3	.57	3.882	13.49	.91	10	.17	-15.91
4	.65	2.158	13.60	.83	10	.20	-16.02
5	.67	1.367	13.00	.68	10	.31	-15.51
6	.56	1.647	11.51	.63	10	.32	-15.05
7	1.38	-.707	18.11	.30	10	.46	-14.81
8	.73	.911	11.91	.58	10	.39	-14.46
9	1.61	-.714	21.05	.16	9	1.05	-14.70
10	2.50	-1.724	30.98	.16	9	1.91	-14.37

Table 3.4.3 (Continued)

Fleet : FLT23: SCOGFS_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.58	-.42	.12	-.31	.16	.09	.30	.26	.06	.32
2	-.14	-.26	-.64	.28	-.24	-.21	.50	.18	.75	-.23
3	-.86	-.44	.36	-.40	.04	-.05	.23	.54	.10	.47
4	.10	-.23	.11	.54	-.99	.32	-.15	.02	.10	.18
5	.36	.08	.46	-.15	-.96	.76	-.46	.12	-.12	-.10
6	-.44	.42	-.30	.47	-.97	1.13	-.55	.06	.44	-.25
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2	3	4	5	6
Mean Log q	-16.4118	-16.2561	-16.0682	-16.0310	-16.0034
S.E(Log q)	.4197	.4498	.4087	.4864	.6198

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.73	.892	15.98	.57	10	.34	-17.38

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	.74	1.194	15.16	.73	10	.30	-16.41
3	.79	.877	15.00	.68	10	.36	-16.26
4	.72	1.230	14.09	.70	10	.29	-16.07
5	1.31	-.589	18.49	.32	10	.66	-16.03
6	5.39	-1.759	55.35	.02	10	3.01	-16.00

Table 3.4.3 (Continued)

Fleet : FLT24: ENGGFS_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.10	-.08	.24	.08	-.02	.16	.01	-.05	-.24	-.02
2	.07	-.05	-.17	.17	-.37	-.54	.22	-.08	.49	.26
3	-.74	.10	.37	-.03	-.21	-.14	.38	.27	.37	-.38
4	.61	-2.57	.60	-.21	-.07	.59	.26	.45	.61	-.27
5	.34	1.06	-.03	-.21	-.94	.19	.69	-.04	-1.11	.06
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2	3	4	5
Mean Log q	-16.2738	-16.6130	-16.9886	-16.7427
S.E(Log q)	.3105	.3725	.9676	.6602

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.67	2.551	14.90	.88	10	.14	-16.20

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	.69	2.764	14.78	.91	10	.16	-16.27
3	.95	.215	16.27	.67	10	.37	-16.61
4	.48	1.512	12.84	.51	10	.43	-16.99
5	.59	1.404	13.16	.59	10	.37	-16.74

Table 3.4.3 (Continued)

Fleet : FLT25: IBTS_Q1_IV (C

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.09	-.36	.22	-.02	-.50	.08	.75	-.06	.07	-.08
2	.23	-.49	-.06	.44	-.16	-.30	.57	-.36	.35	-.21
3	-.23	-.12	.56	-.01	.17	-.30	.06	-.22	.12	-.03
4	-.03	-.10	.21	.11	.12	-.02	.11	.24	-.24	-.40
5	.05	.02	.11	.14	-.15	-.25	.15	.49	-.10	-.45
6	-.14	.45	-.02	.59	-.23	-.04	-.15	-.14	-.21	-.11
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2	3	4	5	6
Mean Log q	-9.1581	-9.1332	-8.9788	-8.5511	-7.4097
S.E(Log q)	.3696	.2513	.2035	.2563	.2832

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	.71	.890	10.83	.54	10	.36	-10.24

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.70	1.884	9.87	.83	10	.23	-9.16
3	.97	.190	9.17	.81	10	.26	-9.13
4	1.09	-.488	8.97	.78	10	.23	-8.98
5	1.25	-1.001	8.69	.66	10	.32	-8.55
6	1.11	-.409	7.45	.62	10	.33	-7.41

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT18: SCOTRL_IV (Ca	46065.	.419	.000	.00	1	.104	.069
FLT19: SCOSEI_IV (Ca	59340.	.432	.000	.00	1	.098	.054
FLT20: SCOLTR_IV (Ca	54334.	.674	.000	.00	1	.040	.059
FLT21: ENGTRL_IV (Ca	117311.	.812	.000	.00	1	.028	.028
FLT22: ENGSEI_IV (Ca	53453.	.384	.000	.00	1	.124	.060
FLT23: SCOGFS_IV (Ca	84685.	.356	.000	.00	1	.143	.038
FLT24: ENGGFS_IV (Ca	60322.	.300	.000	.00	1	.203	.053
FLT25: IBTS_Q1_IV (C	56600.	.393	.000	.00	1	.118	.057
P shrinkage mean	139761.	.54				.067	.023
F shrinkage mean	32434.	.50				.077	.097

Weighted prediction :

Survivors, at end of year	Int s.e	Ext s.e	N	Var Ratio	F
61490.	.14	.11	10	.835	.052

Table 3.4.3 (Continued)

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT18: SCOTRL_IV (Ca,	35526.,	.336,	.109,	.32,	2,	.074,	.625
FLT19: SCOSEI_IV (Ca,	42285.,	.281,	.093,	.33,	2,	.109,	.548
FLT20: SCOLTR_IV (Ca,	42948.,	.300,	.048,	.16,	2,	.098,	.542
FLT21: ENGTRL_IV (Ca,	58762.,	.306,	.001,	.00,	2,	.095,	.422
FLT22: ENGSEI_IV (Ca,	49674.,	.232,	.074,	.32,	2,	.161,	.483
FLT23: SCOGFS_IV (Ca,	40157.,	.279,	.140,	.50,	2,	.109,	.570
FLT24: ENGGFS_IV (Ca,	43026.,	.221,	.250,	1.13,	2,	.175,	.541
FLT25: IBTS_Q1_IV (C,	39784.,	.271,	.141,	.52,	2,	.117,	.574
F shrinkage mean ,	28686.,	.50,,,,				.062,	.731

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
42801.,	.10,	.05,	17,	.562,	.543

Age 3 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
FLT18: SCOTRL_IV (Ca,	22006.,	.300,	.048,	.16,	3,	.068,	.661
FLT19: SCOSEI_IV (Ca,	29481.,	.238,	.068,	.29,	3,	.114,	.530
FLT20: SCOLTR_IV (Ca,	24615.,	.238,	.135,	.57,	3,	.119,	.608
FLT21: ENGTRL_IV (Ca,	31507.,	.224,	.082,	.37,	3,	.141,	.503
FLT22: ENGSEI_IV (Ca,	33269.,	.220,	.269,	1.22,	3,	.116,	.482
FLT23: SCOGFS_IV (Ca,	46734.,	.265,	.131,	.49,	3,	.087,	.365
FLT24: ENGGFS_IV (Ca,	28395.,	.202,	.251,	1.24,	3,	.146,	.546
FLT25: IBTS_Q1_IV (C,	29888.,	.213,	.111,	.52,	3,	.151,	.524
F shrinkage mean ,	13556.,	.50,,,,				.058,	.924

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
28720.,	.08,	.07,	25,	.840,	.541

Table 3.4.3 (Continued)

Age 4 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
FLT18: SCOTRL_IV (Ca,	4714.,	.317,	.231,	.73,	4,	.062,	.475
FLT19: SCOSEI_IV (Ca,	3474.,	.237,	.074,	.31,	4,	.119,	.602
FLT20: SCOLTR_IV (Ca,	4343.,	.235,	.131,	.56,	4,	.117,	.507
FLT21: ENGTRL_IV (Ca,	6353.,	.213,	.050,	.24,	4,	.146,	.372
FLT22: ENGSEI_IV (Ca,	6208.,	.231,	.221,	.96,	4,	.122,	.380
FLT23: SCOGFS_IV (Ca,	5446.,	.252,	.034,	.14,	4,	.101,	.423
FLT24: ENGGFS_IV (Ca,	4869.,	.211,	.128,	.61,	4,	.084,	.463
FLT25: IBTS_Q1_IV (C,	3806.,	.195,	.202,	1.04,	4,	.185,	.561
F shrinkage mean ,	2091.,	.50,,,,				.063,	.863

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
4520.,	.08,	.07,	33,	.824,	.491

Age 5 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
FLT18: SCOTRL_IV (Ca,	4499.,	.333,	.117,	.35,	5,	.059,	.317
FLT19: SCOSEI_IV (Ca,	2515.,	.213,	.051,	.24,	5,	.169,	.512
FLT20: SCOLTR_IV (Ca,	3988.,	.231,	.073,	.32,	5,	.133,	.352
FLT21: ENGTRL_IV (Ca,	2611.,	.220,	.083,	.38,	5,	.133,	.497
FLT22: ENGSEI_IV (Ca,	2981.,	.249,	.160,	.64,	5,	.097,	.447
FLT23: SCOGFS_IV (Ca,	2887.,	.272,	.109,	.40,	5,	.086,	.459
FLT24: ENGGFS_IV (Ca,	3245.,	.289,	.076,	.26,	5,	.057,	.417
FLT25: IBTS_Q1_IV (C,	1933.,	.188,	.102,	.54,	5,	.202,	.626
F shrinkage mean ,	1445.,	.50,,,,				.064,	.772

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2656.,	.09,	.06,	41,	.650,	.490

Table 3.4.3 (Continued)

Age 6 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
FLT18: SCOTRL_IV (Ca,	367.,	.332,	.238,	.72,	6,	.071,	.683
FLT19: SCOSEI_IV (Ca,	294.,	.205,	.109,	.53,	6,	.183,	.799
FLT20: SCOLTR_IV (Ca,	444.,	.243,	.044,	.18,	6,	.119,	.594
FLT21: ENGTRL_IV (Ca,	338.,	.226,	.138,	.61,	6,	.150,	.726
FLT22: ENGSEI_IV (Ca,	336.,	.288,	.198,	.69,	6,	.071,	.728
FLT23: SCOGFS_IV (Ca,	286.,	.305,	.064,	.21,	6,	.068,	.815
FLT24: ENGGFS_IV (Ca,	204.,	.336,	.329,	.98,	5,	.027,	1.017
FLT25: IBTS_Q1_IV (C,	300.,	.186,	.055,	.30,	6,	.221,	.788
F shrinkage mean ,	294.,	.50,,,,				.090,	.799

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
321.,	.09,	.05,	48,	.498,	.752

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT18: SCOTRL_IV (Ca,	52.,	.341,	.128,	.38,	6,	.041,	1.333
FLT19: SCOSEI_IV (Ca,	85.,	.197,	.049,	.25,	7,	.223,	.997
FLT20: SCOLTR_IV (Ca,	96.,	.232,	.169,	.73,	7,	.168,	.926
FLT21: ENGTRL_IV (Ca,	80.,	.225,	.086,	.38,	7,	.160,	1.035
FLT22: ENGSEI_IV (Ca,	155.,	.291,	.146,	.50,	7,	.105,	.663
FLT23: SCOGFS_IV (Ca,	113.,	.317,	.112,	.35,	6,	.038,	.830
FLT24: ENGGFS_IV (Ca,	89.,	.318,	.079,	.25,	5,	.015,	.972
FLT25: IBTS_Q1_IV (C,	96.,	.192,	.136,	.71,	6,	.126,	.925
F shrinkage mean ,	109.,	.50,,,,				.124,	.848

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
95.,	.10,	.05,	52,	.477,	.930

Table 3.4.3 (Continued)

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT18: SCOTRL_IV (Ca,	121.,	.348,	.123,	.35,	6,	.029,	.505
FLT19: SCOSEI_IV (Ca,	76.,	.208,	.060,	.29,	8,	.207,	.714
FLT20: SCOLTR_IV (Ca,	68.,	.242,	.138,	.57,	8,	.164,	.776
FLT21: ENGTRL_IV (Ca,	80.,	.225,	.116,	.52,	8,	.233,	.688
FLT22: ENGSEI_IV (Ca,	159.,	.305,	.100,	.33,	8,	.105,	.406
FLT23: SCOGFS_IV (Ca,	78.,	.324,	.127,	.39,	6,	.026,	.703
FLT24: ENGGFS_IV (Ca,	117.,	.335,	.181,	.54,	5,	.010,	.519
FLT25: IBTS_Q1_IV (C,	79.,	.195,	.062,	.32,	6,	.089,	.700
F shrinkage mean ,	63.,	.50,,,,				.137,	.818

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
81.,	.11,	.05,	56,	.444,	.682

Age 9 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
FLT18: SCOTRL_IV (Ca,	12.,	.338,	.099,	.29,	6,	.019,	1.444
FLT19: SCOSEI_IV (Ca,	13.,	.227,	.192,	.84,	9,	.237,	1.412
FLT20: SCOLTR_IV (Ca,	8.,	.247,	.206,	.83,	8,	.112,	1.798
FLT21: ENGTRL_IV (Ca,	12.,	.233,	.025,	.11,	8,	.167,	1.446
FLT22: ENGSEI_IV (Ca,	21.,	.327,	.206,	.63,	9,	.108,	1.053
FLT23: SCOGFS_IV (Ca,	14.,	.312,	.301,	.97,	6,	.018,	1.342
FLT24: ENGGFS_IV (Ca,	18.,	.329,	.070,	.21,	5,	.007,	1.160
FLT25: IBTS_Q1_IV (C,	15.,	.189,	.049,	.26,	6,	.060,	1.283
F shrinkage mean ,	38.,	.50,,,,				.272,	.699

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
17.,	.16,	.10,	58,	.616,	1.185

Age 10 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
FLT18: SCOTRL_IV (Ca,	14.,	.350,	.072,	.21,	6,	.009,	.237
FLT19: SCOSEI_IV (Ca,	13.,	.267,	.151,	.57,	10,	.450,	.250
FLT20: SCOLTR_IV (Ca,	7.,	.273,	.119,	.44,	8,	.057,	.417
FLT21: ENGTRL_IV (Ca,	8.,	.255,	.073,	.29,	8,	.095,	.385
FLT22: ENGSEI_IV (Ca,	20.,	.456,	.228,	.50,	10,	.106,	.167
FLT23: SCOGFS_IV (Ca,	11.,	.326,	.402,	1.23,	6,	.008,	.283
FLT24: ENGGFS_IV (Ca,	6.,	.351,	.268,	.76,	5,	.003,	.498
FLT25: IBTS_Q1_IV (C,	8.,	.195,	.063,	.32,	6,	.027,	.370
F shrinkage mean ,	3.,	.50,,,,				.245,	.816

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
8.,	.18,	.11,	60,	.614,	.358

Table 3.4.4

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1963,	1964,	1965,	1966,
AGE				
1,	.0249,	.0203,	.0585,	.0551,
2,	.5316,	.3759,	.4704,	.5499,
3,	.3677,	.5929,	.6601,	.6280,
4,	.4525,	.4171,	.6211,	.5283,
5,	.4543,	.4767,	.4312,	.4894,
6,	.5625,	.6126,	.4612,	.4346,
7,	.1602,	.6078,	.4678,	.4452,
8,	.7852,	.3700,	.7098,	.5271,
9,	.3115,	.3262,	.2696,	.7630,
10,	.4581,	.4823,	.4714,	.5362,
+gp,	.4581,	.4823,	.4714,	.5362,
FBAR 2- 8,	.4734,	.4933,	.5459,	.5147,

Table 8 Fishing mortality (F) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	.0335,	.0457,	.0213,	.1098,	.0763,	.0335,	.1292,	.0922,	.1080,	.0353,
2,	.4973,	.6353,	.3906,	.5787,	.8862,	.8906,	.6966,	.8121,	.7336,	.9390,
3,	.7287,	.7390,	.6001,	.7465,	.7701,	.9070,	.8384,	.6697,	.7844,	.8574,
4,	.5326,	.7113,	.5817,	.5710,	.7086,	.6528,	.7782,	.6416,	.6700,	.7568,
5,	.5972,	.6228,	.6282,	.5845,	.6945,	.7100,	.5739,	.6398,	.7446,	.5712,
6,	.5988,	.5646,	.6990,	.5316,	.5377,	.8030,	.7211,	.5318,	.6719,	.7949,
7,	.6200,	.5823,	.4867,	.5279,	.5693,	.7790,	.6900,	.7127,	.5118,	.7403,
8,	.7130,	.4542,	.6313,	.3177,	.5188,	1.0276,	.5434,	.6020,	.8397,	.2720,
9,	.3800,	.7773,	.4065,	.6420,	.6898,	1.2287,	.3375,	.9128,	.8788,	.7971,
10,	.5868,	.6055,	.5752,	.5249,	.6073,	.9196,	.5780,	.6862,	.7365,	.6408,
+gp,	.5868,	.6055,	.5752,	.5249,	.6073,	.9196,	.5780,	.6862,	.7365,	.6408,
FBAR 2- 8,	.6125,	.6156,	.5739,	.5511,	.6693,	.8243,	.6916,	.6585,	.7080,	.7045,

Table 3.4.4 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	.1439,	.0953,	.1041,	.1096,	.1010,	.1756,	.1258,	.1767,	.0868,	.2342,
2,	.8432,	1.0247,	.7938,	.8825,	.9714,	.9374,	1.0857,	.9538,	.9841,	.8946,
3,	.7702,	.9246,	.9485,	.9816,	1.0108,	1.2321,	1.1895,	1.0184,	.9568,	1.0598,
4,	.5486,	.7664,	.5893,	.7905,	.7715,	.9197,	.9140,	.8287,	.8075,	.9534,
5,	.6354,	.8694,	.7054,	.6491,	.6771,	.7929,	.7876,	.7487,	.7112,	.8686,
6,	.6013,	.7417,	.5128,	.6335,	.5904,	.8989,	.7652,	.7485,	.6952,	.8102,
7,	.8040,	.6809,	.6586,	.8415,	.7182,	.7677,	.7189,	.6688,	.6890,	.7746,
8,	.7716,	.7632,	.5224,	.8290,	.5734,	.6961,	.9075,	.7487,	.6166,	.8104,
9,	1.4542,	.8818,	.7888,	.5851,	.7346,	.7996,	.6321,	.9126,	.5810,	.5368,
10,	.8623,	.7954,	.6434,	.7144,	.6648,	.7991,	.7699,	.7731,	.6647,	.7677,
+gp,	.8623,	.7954,	.6434,	.7144,	.6648,	.7991,	.7699,	.7731,	.6647,	.7677,
FBAR 2- 8,	.7106,	.8244,	.6758,	.8011,	.7590,	.8921,	.9098,	.8165,	.7801,	.8817,

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	FBAR 94-96
AGE											
1,	.1414,	.1776,	.1287,	.1401,	.1266,	.1412,	.0465,	.0611,	.0960,	.0525,	.0698,
2,	.9166,	.9146,	.8786,	.9062,	.7641,	.8460,	.7729,	.5924,	.6113,	.5431,	.5823,
3,	.8912,	1.1847,	1.0903,	.9732,	.9550,	.8512,	1.0113,	.9217,	.8180,	.5408,	.7602,
4,	.9263,	.8579,	1.0161,	.8915,	.8515,	.9103,	.9617,	.9027,	.6447,	.4911,	.6795,
5,	.7212,	.7898,	.7559,	.7733,	.8277,	.7453,	.8469,	.7729,	.6271,	.4904,	.6301,
6,	.9339,	.8012,	.9047,	.5565,	.9367,	.8112,	.8094,	.7670,	.6315,	.7520,	.7169,
7,	.8995,	.7291,	.8553,	.7715,	1.0791,	.8967,	1.0070,	.6873,	.5274,	.9298,	.7148,
8,	.8039,	.6937,	.9731,	.4389,	1.0133,	.7945,	.8722,	.9247,	.4417,	.6819,	.6827,
9,	.6746,	.5829,	.6936,	1.9779,	.4292,	.9591,	.7195,	.7009,	.6548,	1.1855,	.8470,
10,	.9255,	.6772,	.6454,	.7839,	.7074,	.5067,	.6761,	.6938,	.7010,	.3584,	.5844,
+gp,	.9255,	.6772,	.6454,	.7839,	.7074,	.5067,	.6761,	.6938,	.7010,	.3584,	
FBAR 2- 8,	.8704,	.8530,	.9248,	.7587,	.9182,	.8365,	.8974,	.7955,	.6145,	.6327,	

Table 3.4.5

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1963,	1964,	1965,	1966,
AGE				
1,	195108,	374091,	415441,	506863,
2,	123043,	85513,	164718,	176070,
3,	25892,	50953,	41378,	72517,
4,	10736,	13961,	21933,	16654,
5,	8439,	5591,	7532,	9649,
6,	3116,	4386,	2842,	4007,
7,	605,	1453,	1946,	1467,
8,	1000,	422,	648,	998,
9,	58,	373,	238,	261,
10,	18,	35,	221,	149,
+gp,	0,	11,	23,	219,
TOTAL,	368013,	536789,	656920,	788853,

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	488808,	194595,	209057,	781993,	910798,	173513,	319652,	263657,	486380,	246433,
2,	215532,	212394,	83530,	91960,	314844,	379201,	75396,	126223,	108037,	196171,
3,	71595,	92370,	79295,	39829,	36331,	91462,	109664,	26474,	39487,	36558,
4,	30138,	26907,	34356,	33887,	14703,	13099,	28759,	36930,	10554,	14035,
5,	8039,	14486,	10816,	15723,	15675,	5926,	5583,	10813,	15918,	4421,
6,	4842,	3622,	6362,	4725,	7175,	6408,	2386,	2575,	4669,	6189,
7,	2124,	2178,	1686,	2589,	2273,	3431,	2350,	950,	1239,	1952,
8,	770,	936,	996,	849,	1250,	1053,	1289,	965,	381,	608,
9,	482,	309,	486,	434,	506,	609,	309,	613,	433,	135,
10,	100,	270,	116,	265,	187,	208,	146,	180,	201,	147,
+gp,	42,	58,	195,	107,	226,	33,	403,	415,	132,	99,
TOTAL,	822473,	548124,	426896,	972361,	1303968,	674944,	545937,	469796,	667431,	506748,

Table 3.4.5 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	839206,	488089,	525481,	899699,	314814,	618508,	324877,	596351,	158649,	716242,
2,	106893,	326529,	199383,	212762,	362295,	127862,	233151,	128727,	224554,	65357,
3,	54056,	32415,	82586,	63527,	62033,	96642,	35287,	55479,	34949,	59145,
4,	12080,	19488,	10014,	24912,	18538,	17582,	21952,	8365,	15606,	10455,
5,	5391,	5714,	7414,	4548,	9252,	7017,	5738,	7205,	2990,	5698,
6,	2045,	2338,	1961,	2998,	1946,	3849,	2600,	2137,	2790,	1202,
7,	2288,	918,	912,	962,	1303,	883,	1283,	990,	828,	1140,
8,	762,	838,	380,	386,	339,	520,	335,	512,	415,	340,
9,	379,	289,	320,	185,	138,	157,	212,	111,	198,	184,
10,	50,	73,	98,	119,	84,	54,	58,	92,	36,	91,
+gp,	181,	87,	39,	53,	47,	32,	47,	40,	70,	47,
TOTAL,	1023330,	876778,	828588,	1210150,	770789,	873105,	625540,	800010,	441086,	859900,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	GMST 63-94
AGE												
1,	281927,	196922,	274696,	133910,	168978,	313474,	157061,	391803,	256125,	144220,	0,	347834,
2,	254636,	109977,	74084,	108522,	52301,	66900,	122306,	67366,	165620,	104549,	61490,	140289,
3,	18827,	71752,	31052,	21685,	30900,	17166,	20232,	39789,	26251,	63333,	42801,	45312,
4,	15961,	6014,	17090,	8128,	6381,	9260,	5707,	5731,	12329,	9022,	28720,	14711,
5,	3299,	5175,	2088,	5065,	2729,	2230,	3051,	1786,	1903,	5297,	4520,	5992,
6,	1957,	1313,	1923,	803,	1914,	977,	866,	1071,	675,	832,	2656,	2596,
7,	438,	630,	483,	637,	377,	614,	355,	316,	407,	294,	321,	1081,
8,	430,	146,	249,	168,	241,	105,	205,	106,	130,	197,	95,	472,
9,	124,	158,	60,	77,	89,	72,	39,	70,	35,	68,	81,	197,
10,	88,	52,	72,	24,	9,	47,	22,	15,	29,	15,	17,	77,
+gp,	22,	40,	23,	18,	22,	25,	29,	35,	11,	29,	25,	
TOTAL,	577709,	392177,	401819,	279038,	263940,	410868,	309874,	508089,	463514,	327856,	140726,	

Table 3.5.1

COD IV RCT3 INPUT VALUI AGE 1*100; 9-Oct-97
20 28 2

'YEARCL	'VPA'	'IYFS1	'IYFS2	'EGFS	'EGFS	'EGFS	'SGFS	'SGFS	'DGFS	'DGFS	'DGFS	'FRGS	'GGFS	'GGFS	'IBQ21	'SCQ2	'SCQ2	'IBQ40	'IBQ41	'GGFS	'GGFSQ4'
1970	911	9830	3450	-1	-1	-1	-1	-1	-1	-1	-1	9040	-1	-1	-1	-1	-1	-1	-1	-1	-1
1971	174	410	1060	-1	-1	-1	-1	-1	-1	-1	-1	130	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	320	3800	950	-1	-1	-1	-1	-1	-1	-1	-1	160	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	264	1470	620	-1	-1	-1	-1	-1	-1	-1	-1	360	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	486	4030	1990	-1	-1	-1	-1	-1	-1	-1	-1	800	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	247	790	320	-1	-1	447	-1	-1	-1	-1	-1	780	-1	-1	-1	-1	-1	-1	-1	-1	-1
1976	839	3670	2930	-1	6270	1250	-1	-1	-1	-1	-1	2820	-1	-1	-1	-1	-1	-1	-1	-1	-1
1977	488	1290	930	1389	2284	580	-1	-1	-1	-1	-1	2720	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	525	990	1480	1256	2423	670	-1	-1	-1	-1	450	3110	-1	-1	-1	-1	-1	-1	-1	-1	-1
1979	899	1690	2550	1855	5084	1386	-1	-1	-1	16380	1120	3550	-1	-1	-1	-1	-1	-1	-1	-1	-1
1980	315	290	670	1023	1136	290	-1	351	4320	4690	160	1410	-1	-1	-1	-1	-1	-1	-1	-1	-1
1981	619	920	1660	7424	3237	1096	614	78	17680	8300	230	2320	-1	350	-1	-1	-1	-1	-1	678	-1
1982	325	390	800	255	1540	475	325	391	2690	2180	160	900	590	240	-1	-1	-1	-1	-1	66	303
1983	596	1520	1760	9510	6122	1189	819	1143	12150	12130	310	4300	260	2240	-1	-1	-1	-1	-1	406	566
1984	159	90	360	38	430	115	66	104	130	360	20	90	230	260	-1	-1	-1	-1	-1	10	2
1985	716	1700	2880	828	3438	1065	801	695	14360	11120	800	950	1540	1140	-1	-1	-1	-1	-1	197	725
1986	282	880	610	121	1422	407	219	288	3700	4150	170	230	700	950	-1	-1	-1	-1	-1	21	242
1987	197	360	630	38	836	248	162	135	3620	1780	220	210	200	720	-1	-1	-1	-1	-1	3	20
1988	275	1310	1520	1678	2285	504	561	49	1660	1660	190	420	9020	1470	-1	-1	-1	-1	-1	2	148
1989	134	340	410	598	608	155	114	154	1370	920	70	60	1190	620	-1	-1	3140	-1	-1	1	31
1990	169	240	450	383	752	159	303	193	2350	720	110	-1	1550	360	850	1490	5330	-1	567	35	34
1991	313	1300	1990	4840	2440	650	642	749	3980	4540	70	-1	1340	-1	3630	19080	14460	848	2671	-1	-1
1992	157	1270	440	1684	742	295	347	334	1160	170	90	-1	-1	450	1100	4820	3410	722	586	1	-1
1993	392	1480	2210	377	2637	1277	1158	1443	2410	4690	-1	-1	3080	1430	3200	2030	20470	358	2552	-1	8
1994	256	970	800	2134	1028	668	475	356	6350	-1	-1	-1	430	-1	1960	4270	5660	518	1489	32	133
1995	-1	350	690	26	619	295	318	278	-1	-1	-1	-1	-1	-1	370	770	1920	1085	791	25	41
1996	-1	4000	-1	4122	4091	-1	999	-1	-1	-1	-1	-1	-1	-1	7580	2830	-1	2206	-1	9	109
1997	-1	-1	-1	4.9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 3.5.2

Analysis by RCT3 ver3.1 of data from file :

c:\wgnssk\1997\allflts4.rct

COD IV RCT3 INPUT VALUES; AGE 1*100; 9-Oct-97

Data for 20 surveys over 28 years : 1970 - 1997

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1995

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.81	.25	.61	.486	25	5.86	4.99	.658	.024
IYFS2	.94	-.70	.36	.728	25	6.54	5.44	.386	.069
EGFS0	.70	1.11	.97	.266	18	3.30	3.41	1.187	.007
EGFS1	.80	-.14	.23	.874	19	6.43	5.00	.262	.150
EGFS2	.86	.45	.30	.794	20	5.69	5.35	.332	.093
SGFS1	.87	.54	.47	.583	14	5.77	5.54	.531	.036
SGFS2	1.28	-1.56	1.17	.175	15	5.63	5.63	1.299	.006
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
IBQ21	.65	.59	.16	.885	5	5.92	4.45	.351	.084
SCQ21	1.75	-9.07	1.94	.051	5	6.65	2.56	3.478	.001
SCQ22	.58	.26	.16	.901	6	7.56	4.65	.232	.162
IBQ40									
IBQ41	.53	1.70	.11	.942	5	6.67	5.24	.164	.257
GGFSQ1	.33	4.56	.37	.732	12	3.26	5.64	.417	.059
GGFSQ4	.44	3.72	.61	.460	11	3.74	5.38	.703	.021
						VPA Mean =	5.84	.577	.031

Yearclass = 1996

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.81	.25	.61	.486	25	8.29	6.95	.667	.054
IYFS2									
EGFS0	.70	1.11	.97	.266	18	8.32	6.92	1.087	.020
EGFS1	.80	-.14	.23	.874	19	8.32	6.50	.258	.363
EGFS2									
SGFS1	.87	.54	.47	.583	14	6.91	6.53	.559	.077
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
IBQ21	.65	.59	.16	.885	5	8.93	6.42	.328	.224
SCQ21	1.75	-9.07	1.94	.051	5	7.95	4.84	2.792	.003
SCQ22									
IBQ40									
IBQ41									
GGFSQ1	.33	4.56	.37	.732	12	2.30	5.32	.421	.136
GGFSQ4	.44	3.72	.61	.460	11	4.70	5.80	.701	.049
						VPA Mean =	5.84	.577	.072

Table 3.5.2 (Continued)

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I---Regression				---I	I---Prediction			---I
IYFS1									
IYFS2									
EGFS0	.70	1.11	.97	.266	18	1.77	2.35	1.314	.162
EGFS1									
EGFS2									
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
GGFSQ1									
GGFSQ4									
					VPA Mean =		5.84	.577	.838

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	164	5.11	.10	.11	1.18		
1996	528	6.27	.16	.16	1.12		
1997	195	5.27	.53	1.29	5.91		

Table 3.6.1

Run title : Cod in IV,IIIa,VIId (run: XSAJC05/X05)

At 11-Oct-97 18:24:30

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 8,
1963,	195108,	452114,	151517,	116457,	.7686,	.4734,
1964,	374091,	542256,	166128,	126041,	.7587,	.4933,
1965,	415441,	714022,	205376,	181036,	.8815,	.5459,
1966,	506863,	859768,	230735,	221336,	.9593,	.5147,
1967,	488808,	923776,	250047,	252977,	1.0117,	.6125,
1968,	194595,	788669,	258247,	288368,	1.1166,	.6156,
1969,	209057,	630832,	255981,	200760,	.7843,	.5739,
1970,	781993,	973121,	276923,	226124,	.8166,	.5511,
1971,	910798,	1180310,	277312,	328098,	1.1831,	.6693,
1972,	173513,	809718,	231095,	353976,	1.5317,	.8243,
1973,	319652,	655931,	209190,	239052,	1.1428,	.6916,
1974,	263657,	623364,	230866,	214279,	.9282,	.6585,
1975,	486380,	704564,	211626,	205245,	.9698,	.7080,
1976,	246433,	610371,	182071,	234169,	1.2861,	.7045,
1977,	839206,	822044,	159355,	209154,	1.3125,	.7106,
1978,	488089,	812317,	159391,	297022,	1.8635,	.8244,
1979,	525481,	804708,	164314,	269973,	1.6430,	.6758,
1980,	899698,	1015374,	181918,	293644,	1.6142,	.8011,
1981,	314814,	855391,	195784,	335497,	1.7136,	.7590,
1982,	618508,	840297,	190267,	303251,	1.5938,	.8921,
1983,	324877,	649374,	155113,	259287,	1.6716,	.9098,
1984,	596351,	718477,	133669,	228286,	1.7078,	.8165,
1985,	158649,	503183,	126553,	214629,	1.6960,	.7801,
1986,	716242,	683575,	114619,	204053,	1.7803,	.8817,
1987,	281928,	571797,	105190,	216213,	2.0554,	.8704,
1988,	196922,	426804,	99389,	184240,	1.8537,	.8530,
1989,	274696,	417331,	91308,	139936,	1.5326,	.9248,
1990,	133910,	329129,	78553,	125314,	1.5953,	.7587,
1991,	168978,	297724,	71659,	102478,	1.4301,	.9182,
1992,	313474,	410010,	69786,	114020,	1.6339,	.8365,
1993,	157061,	349938,	66227,	121749,	1.8384,	.8974,
1994,	391803,	478719,	67972,	110634,	1.6276,	.7955,
1995,	256125,	490988,	80981,	138623,	1.7118,	.6145,
1996,	144220,	438419,	104369,	126423,	1.2113,	.6327,
Arith. Mean ,	393159,	658365,	163339,	211245,	1.3890,	.7291,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 3.7.1

Cod in Fishing Areas IV, Skagerrak and VIId

Prediction with management option table: Input data

Year: 1997								
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	528000.00	0.8000	0.0100	0.0000	0.0000	0.699	0.0650	0.699
2	61490.000	0.3500	0.0500	0.0000	0.0000	1.071	0.5460	1.071
3	42801.000	0.2500	0.2300	0.0000	0.0000	2.186	0.7120	2.186
4	28720.000	0.2000	0.6200	0.0000	0.0000	4.265	0.6370	4.265
5	4520.000	0.2000	0.8600	0.0000	0.0000	7.007	0.5910	7.007
6	2656.000	0.2000	1.0000	0.0000	0.0000	8.636	0.6720	8.636
7	321.000	0.2000	1.0000	0.0000	0.0000	9.850	0.6700	9.850
8	95.000	0.2000	1.0000	0.0000	0.0000	11.049	0.6400	11.049
9	81.000	0.2000	1.0000	0.0000	0.0000	12.532	0.7940	12.532
10	17.000	0.2000	1.0000	0.0000	0.0000	13.019	0.5480	13.019
11+	25.000	0.2000	1.0000	0.0000	0.0000	12.946	0.5480	12.946
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
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	259000.00	0.8000	0.0100	0.0000	0.0000	0.699	0.0650	0.699
2	.	0.3500	0.0500	0.0000	0.0000	1.071	0.5460	1.071
3	.	0.2500	0.2300	0.0000	0.0000	2.186	0.7120	2.186
4	.	0.2000	0.6200	0.0000	0.0000	4.265	0.6370	4.265
5	.	0.2000	0.8600	0.0000	0.0000	7.007	0.5910	7.007
6	.	0.2000	1.0000	0.0000	0.0000	8.636	0.6720	8.636
7	.	0.2000	1.0000	0.0000	0.0000	9.850	0.6700	9.850
8	.	0.2000	1.0000	0.0000	0.0000	11.049	0.6400	11.049
9	.	0.2000	1.0000	0.0000	0.0000	12.532	0.7940	12.532
10	.	0.2000	1.0000	0.0000	0.0000	13.019	0.5480	13.019
11+	.	0.2000	1.0000	0.0000	0.0000	12.946	0.5480	12.946
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	.	0.8000	0.0100	0.0000	0.0000	0.699	0.0650	0.699
2	.	0.3500	0.0500	0.0000	0.0000	1.071	0.5460	1.071
3	.	0.2500	0.2300	0.0000	0.0000	2.186	0.7120	2.186
4	.	0.2000	0.6200	0.0000	0.0000	4.265	0.6370	4.265
5	.	0.2000	0.8600	0.0000	0.0000	7.007	0.5910	7.007
6	.	0.2000	1.0000	0.0000	0.0000	8.636	0.6720	8.636
7	.	0.2000	1.0000	0.0000	0.0000	9.850	0.6700	9.850
8	.	0.2000	1.0000	0.0000	0.0000	11.049	0.6400	11.049
9	.	0.2000	1.0000	0.0000	0.0000	12.532	0.7940	12.532
10	.	0.2000	1.0000	0.0000	0.0000	13.019	0.5480	13.019
11+	.	0.2000	1.0000	0.0000	0.0000	12.946	0.5480	12.946
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANJC02
Date and time: 12OCT97:11:03

Table 3.7.2. Cod IIIa,IV,VIId
input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	528000	.16	WS1	.70	.03
N2	61489	.14	WS2	1.07	.05
N3	42810	.10	WS3	2.19	.02
N4	28720	.08	WS4	4.26	.05
N5	4520	.08	WS5	7.01	.05
N6	2655	.09	WS6	8.64	.03
N7	321	.09	WS7	9.85	.04
N8	95	.10	WS8	11.05	.06
N9	80	.11	WS9	12.53	.04
N10	17	.16	WS10	13.02	.09
N11	24	.18	WS11	12.60	.11
H.cons selectivity			Weight in the HC catch		
sH1	.07	.42	WH1	.70	.03
sH2	.54	.14	WH2	1.07	.05
sH3	.71	.22	WH3	2.19	.02
sH4	.63	.19	WH4	4.26	.05
sH5	.59	.14	WH5	7.01	.05
sH6	.67	.11	WH6	8.64	.03
sH7	.67	.33	WH7	9.85	.04
sH8	.63	.23	WH8	11.05	.06
sH9	.77	.43	WH9	12.53	.04
sH10	.54	.35	WH10	13.02	.09
sH11	.54	.35	WH11	12.60	.11
Natural mortality			Proportion mature		
M1	.80	.10	MT1	.01	.10
M2	.35	.10	MT2	.05	.10
M3	.25	.10	MT3	.23	.10
M4	.20	.10	MT4	.62	.10
M5	.20	.10	MT5	.86	.10
M6	.20	.10	MT6	1.00	.10
M7	.20	.10	MT7	1.00	.00
M8	.20	.10	MT8	1.00	.00
M9	.20	.10	MT9	1.00	.00
M10	.20	.10	MT10	1.00	.00
M11	.20	.10	MT11	1.00	.00
Relative effort in HC fishery			Year effect for natural mortality		
HF97	1.00	.14	K97	1.00	.10
HF98	1.00	.14	K98	1.00	.10
HF99	1.00	.14	K99	1.00	.10
Recruitment in 1998 and 1999					
R98	258999	.50			
R99	347831	.56			

Table 3.7.3

The SAS System 11:56 Sunday, October 12, 1997

Cod in Fishing Areas IV, Skagerrak and VIId

Prediction with management option table

Year: 1997					Year: 1998					Year: 1999	
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	0.6383	711270	160400	161254	0.0000	0.0000	662093	175810	0	761123	334235
.	.	.	.	.	0.1000	0.0638	.	175810	25118	723680	314558
.	.	.	.	.	0.2000	0.1277	.	175810	48877	688371	296067
.	.	.	.	.	0.3000	0.1915	.	175810	71355	655071	278688
.	.	.	.	.	0.4000	0.2553	.	175810	92625	623662	262355
.	.	.	.	.	0.5000	0.3191	.	175810	112756	594035	247003
.	.	.	.	.	0.6000	0.3830	.	175810	131814	566085	232574
.	.	.	.	.	0.7000	0.4468	.	175810	149860	539713	219012
.	.	.	.	.	0.8000	0.5106	.	175810	166951	514829	206263
.	.	.	.	.	0.9000	0.5745	.	175810	183142	491344	194278
.	.	.	.	.	1.0000	0.6383	.	175810	198484	469178	183012
.	.	.	.	.	1.1000	0.7021	.	175810	213025	448254	172420
.	.	.	.	.	1.2000	0.7659	.	175810	226811	428500	162462
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANJC03
Date and time : 12OCT97:12:07
Computation of ref. F: Simple mean, age 2 - 8
Basis for 1997 : F factors

Table 3.7.4

The SAS System 15:58 Tuesday, October 14, 1997

Cod in Fishing Areas IV, Skagerrak and VIId

Single option prediction: Detailed tables

Year: 1997 F-factor: 1.0000 Reference F: 0.6383

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0650	22971	16053	528000	368988	5280	3690	5280	3690
2	0.5460	22175	23743	61490	65839	3075	3292	3075	3292
3	0.7120	19573	42785	42801	93561	9844	21519	9844	21519
4	0.6370	12393	52861	28720	122502	17806	75951	17806	75951
5	0.5910	1846	12935	4520	31673	3887	27239	3887	27239
6	0.6720	1191	10286	2656	22938	2656	22938	2656	22938
7	0.6700	144	1415	321	3162	321	3162	321	3162
8	0.6400	41	454	95	1050	95	1050	95	1050
9	0.7940	41	511	81	1015	81	1015	81	1015
10	0.5480	7	85	17	221	17	221	17	221
11+	0.5480	10	125	25	324	25	324	25	324
Total		80390	161254	668726	711270	43087	160400	43087	160400
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1998 F-factor: 1.0000 Reference F: 0.6383

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0650	11268	7874	259000	181000	2590	1810	2590	1810
2	0.5460	80173	85843	222315	238038	11116	11902	11116	11902
3	0.7120	11478	25091	25100	54868	5773	12620	5773	12620
4	0.6370	7058	30103	16355	69762	10140	43253	10140	43253
5	0.5910	5079	35589	12436	87142	10695	74942	10695	74942
6	0.6720	919	7936	2049	17698	2049	17698	2049	17698
7	0.6700	497	4894	1111	10938	1111	10938	1111	10938
8	0.6400	58	643	134	1486	134	1486	134	1486
9	0.7940	21	259	41	514	41	514	41	514
10	0.5480	12	151	30	390	30	390	30	390
11+	0.5480	8	99	20	257	20	257	20	257
Total		116570	198484	538592	662093	43699	175810	43699	175810
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1999 F-factor: 1.0000 Reference F: 0.6383

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0650	.	.	.	.	.	.	.	.
2	0.5460	39327	42109	109052	116765	5453	5838	5453	5838
3	0.7120	41500	90716	90749	198372	20872	45626	20872	45626
4	0.6370	4139	17654	9591	40911	5947	25365	5947	25365
5	0.5910	2892	20267	7082	49626	6091	42678	6091	42678
6	0.6720	2528	21836	5638	48694	5638	48694	5638	48694
7	0.6700	383	3777	857	8440	857	8440	857	8440
8	0.6400	201	2226	465	5140	465	5140	465	5140
9	0.7940	29	366	58	728	58	728	58	728
10	0.5480	6	76	15	198	15	198	15	198
11+	0.5480	9	118	24	305	24	305	24	305
Total		91016	199144	223532	469178	45419	183012	45419	183012
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRJC01
Date and time : 14OCT97:16:00
Computation of ref. F: Simple mean, age 2 - 8
Prediction basis : F factors

Table 3.7.5

Cod in Fishing Areas IV, Skagerrak and VIId

Prediction with management option table

Year: 1997					Year: 1998					Year: 1999	
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
0.7947	0.5072	711270	160400	135000	0.0000	0.0000	699256	199043	0	806644	370385
.	.	.	.	.	0.1000	0.0638	.	199043	27160	766403	348485
.	.	.	.	.	0.2000	0.1277	.	199043	52839	728469	327907
.	.	.	.	.	0.3000	0.1915	.	199043	77123	692706	308571
.	.	.	.	.	0.4000	0.2553	.	199043	100093	658988	290401
.	.	.	.	.	0.5000	0.3191	.	199043	121824	627193	273327
.	.	.	.	.	0.6000	0.3830	.	199043	142387	597209	257281
.	.	.	.	.	0.7000	0.4468	.	199043	161849	568929	242202
.	.	.	.	.	0.8000	0.5106	.	199043	180274	542254	228030
.	.	.	.	.	0.9000	0.5745	.	199043	197721	517090	214710
.	.	.	.	.	1.0000	0.6383	.	199043	214245	493348	202190
.	.	.	.	.	1.1000	0.7021	.	199043	229900	470944	190422
.	.	.	.	.	1.2000	0.7659	.	199043	244734	449802	179361
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANJC02
Date and time : 12OCT97:11:58
Computation of ref. F: Simple mean, age 2 - 8
Basis for 1997 : TAC constraints

Table 3.11.1

Cod in Fishing Areas IV, Skagerrak and VIId — The SAS System — 11:56 Sunday, October 12, 1997

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	0.699	0.0650	0.699
2	.	0.3500	0.0500	0.0000	0.0000	1.071	0.5460	1.071
3	.	0.2500	0.2300	0.0000	0.0000	2.186	0.7120	2.186
4	.	0.2000	0.6200	0.0000	0.0000	4.265	0.6370	4.265
5	.	0.2000	0.8600	0.0000	0.0000	7.007	0.5910	7.007
6	.	0.2000	1.0000	0.0000	0.0000	8.636	0.6720	8.636
7	.	0.2000	1.0000	0.0000	0.0000	9.850	0.6700	9.850
8	.	0.2000	1.0000	0.0000	0.0000	11.049	0.6400	11.049
9	.	0.2000	1.0000	0.0000	0.0000	12.532	0.7940	12.532
10	.	0.2000	1.0000	0.0000	0.0000	13.019	0.5480	13.019
11+	.	0.2000	1.0000	0.0000	0.0000	12.946	0.5480	12.946
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDJC02
Date and time: 12OCT97:12:10

Table 3.11.2

Cod in Fishing Areas IV, Skagerrak and VIId — The SAS System — 11:56 Sunday, October 12, 1997

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	3.126	14770.211	1.344	12490.594	1.344	12490.594
0.1000	0.0638	0.094	516.647	2.679	10048.785	0.930	7888.502	0.930	7888.502
0.2000	0.1277	0.154	722.115	2.403	7373.651	0.685	5318.397	0.685	5318.397
0.3000	0.1915	0.196	794.999	2.218	5721.475	0.527	3758.935	0.527	3758.935
0.4000	0.2553	0.227	808.469	2.084	4634.511	0.419	2754.059	0.419	2754.059
0.5000	0.3191	0.251	795.219	1.983	3883.625	0.342	2076.072	0.342	2076.072
0.6000	0.3830	0.270	770.646	1.905	3344.311	0.284	1601.689	0.284	1601.689
0.7000	0.4468	0.287	742.201	1.842	2944.457	0.241	1259.847	0.241	1259.847
0.8000	0.5106	0.301	713.498	1.790	2640.088	0.207	1007.463	0.207	1007.463
0.9000	0.5745	0.313	686.237	1.746	2403.204	0.180	817.302	0.180	817.302
1.0000	0.6383	0.324	661.145	1.709	2215.316	0.158	671.533	0.158	671.533
1.1000	0.7021	0.333	638.451	1.677	2063.827	0.140	558.122	0.140	558.122
1.2000	0.7659	0.342	618.134	1.650	1939.918	0.126	468.740	0.126	468.740
1.3000	0.8298	0.350	600.054	1.625	1837.272	0.114	397.487	0.114	397.487
1.4000	0.8936	0.358	584.019	1.603	1751.266	0.103	340.106	0.103	340.106
1.5000	0.9574	0.364	569.823	1.584	1678.458	0.095	293.468	0.095	293.468
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDJC02
Date and time : 12OCT97:12:10
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.2398
F-max factor : 0.3871
F-0.1 reference F : 0.1531
F-max reference F : 0.2471
Recruitment : Single recruit

Figure 3.1.1 Stock summary, Cod ,North Sea

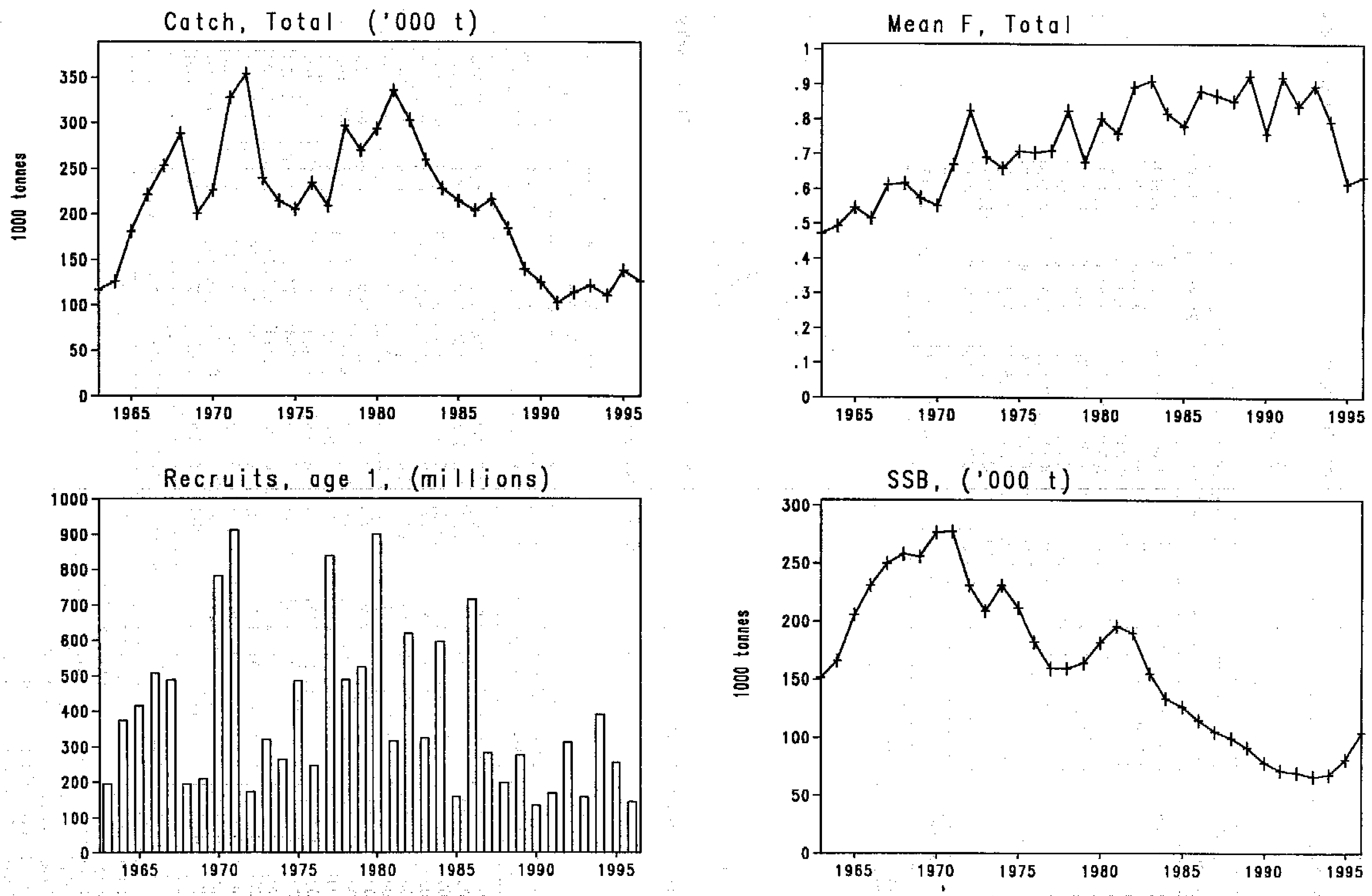
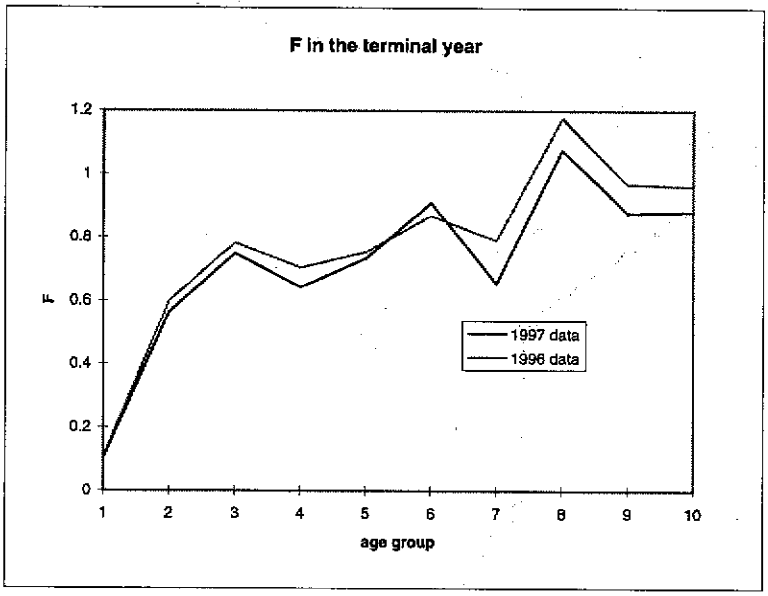


Figure 3.4.1. Comparison of F at age in 1995 and mean F(2-8)u between assessments starting using the 1996 and 1997 assessment data.



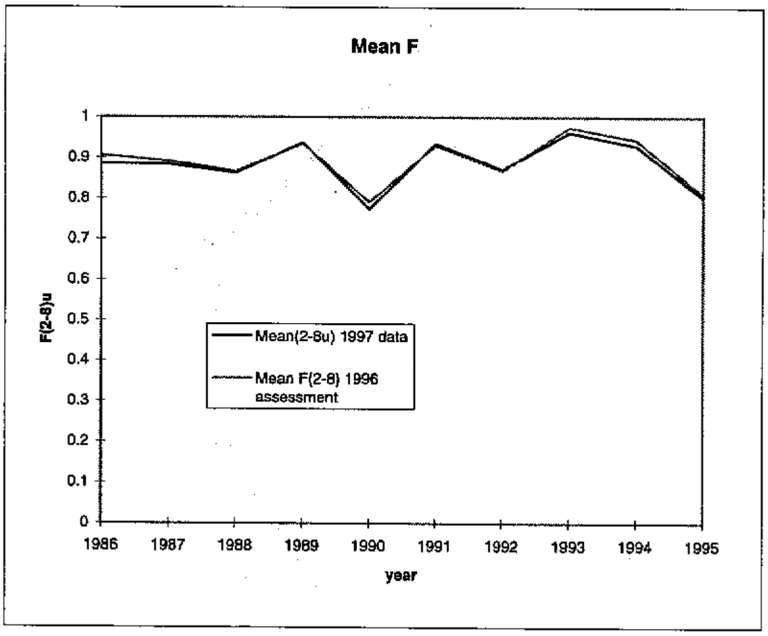


Figure 3.4.2 Comparison of terminal exploitation patterns for different XSA tuning runs

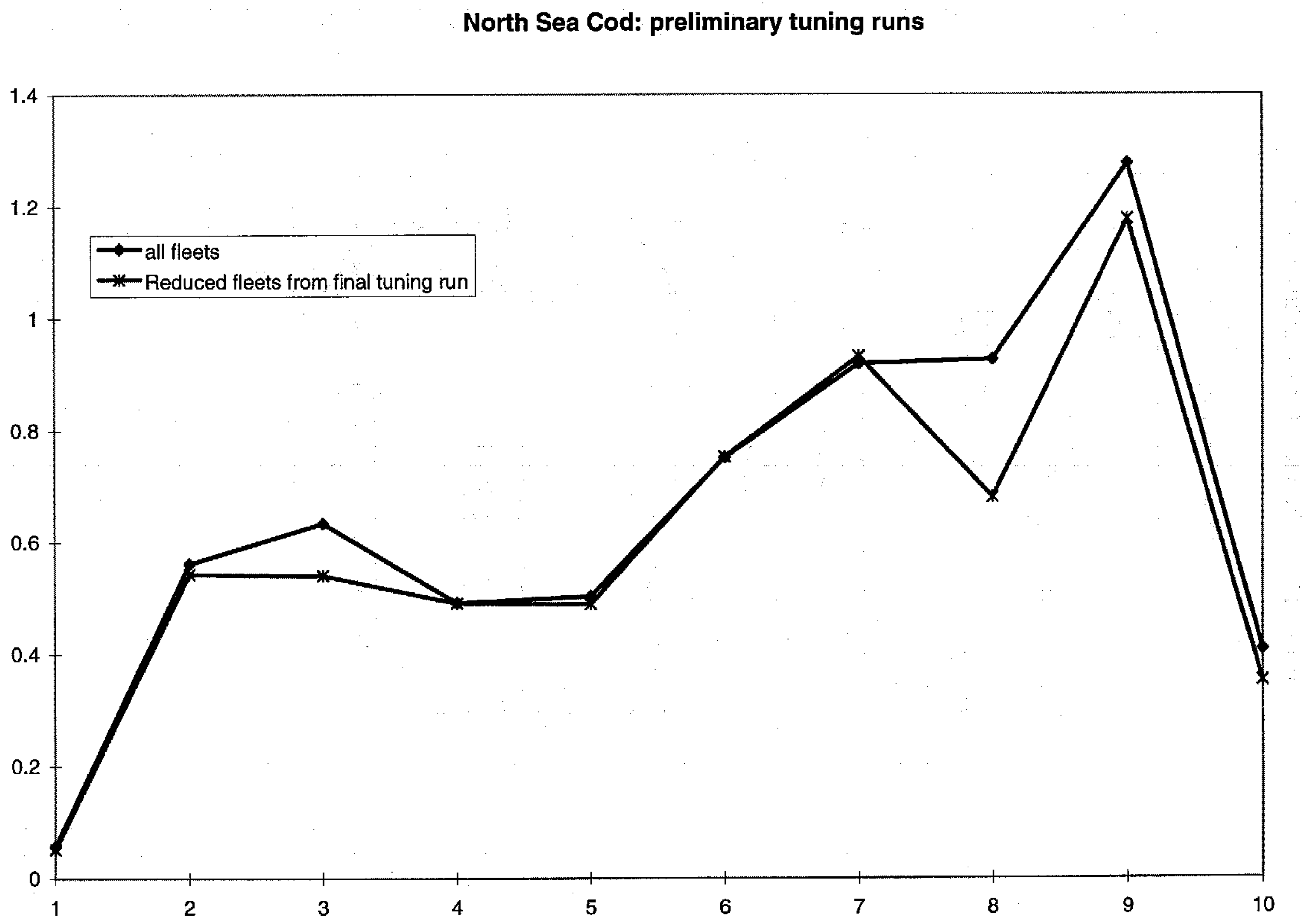


Figure 3.4.3

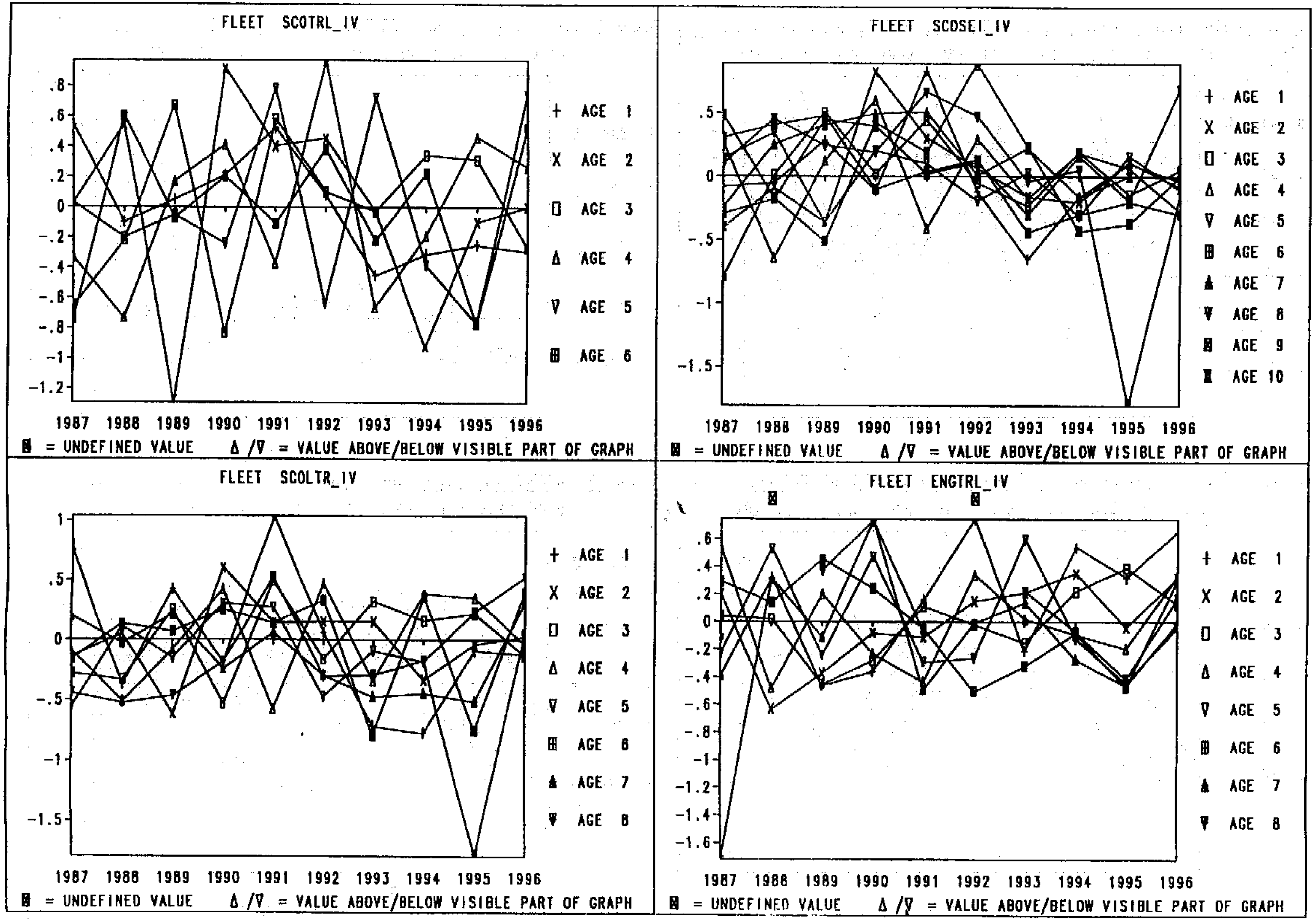

FLEET SCOTRL_IV
FLEET SCOSEI_IV
FLEET SCOLTR_IV
FLEET ENGTRL_IV
AGE 1
AGE 2
AGE 3
AGE 4
AGE 5
AGE 6
AGE 7
AGE 8
AGE 9
AGE 10
1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
= UNDEFINED VALUE
Δ /∇ = VALUE ABOVE/BELOW VISIBLE PART OF GRAPH

Figure 3.4.3 (Continued)

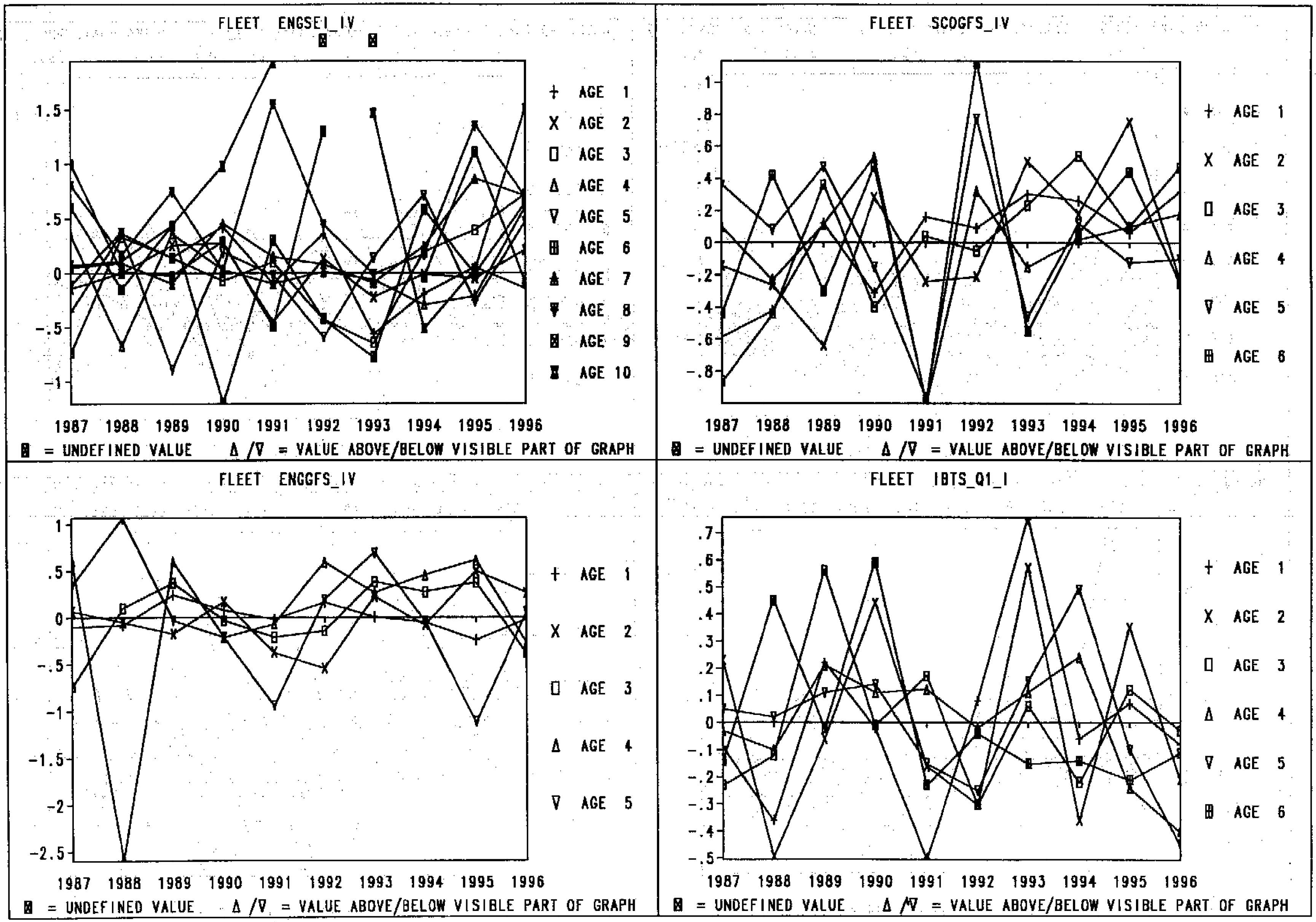


Figure 3.4.4. Contribution of Commercial fleets, survey indices and shrinkage to tuned XSA

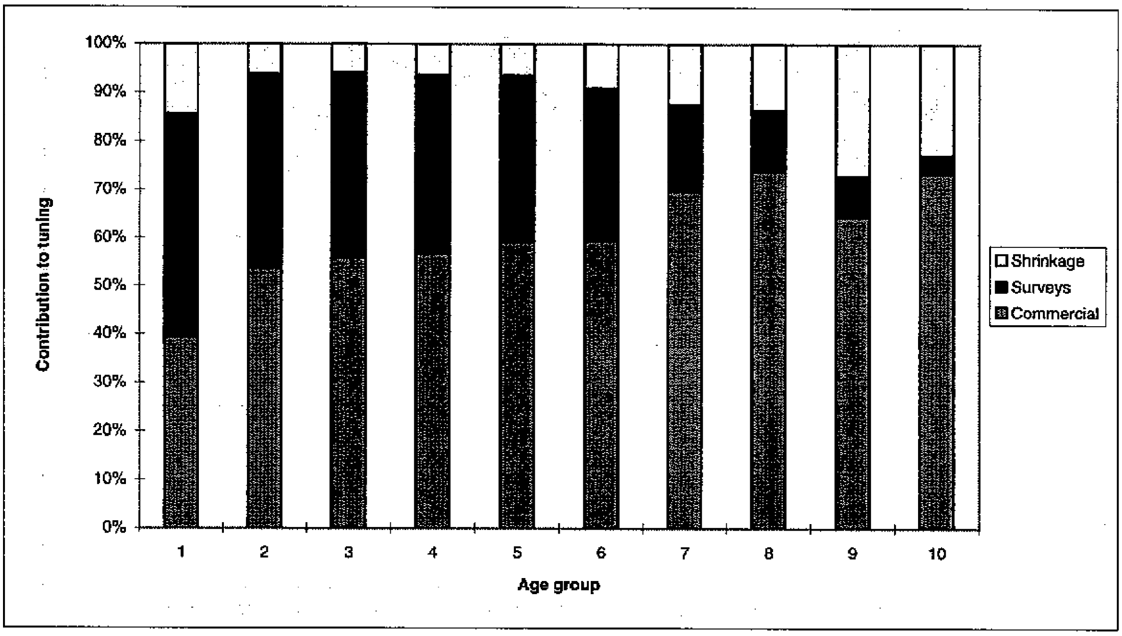


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Figure 3.4.5

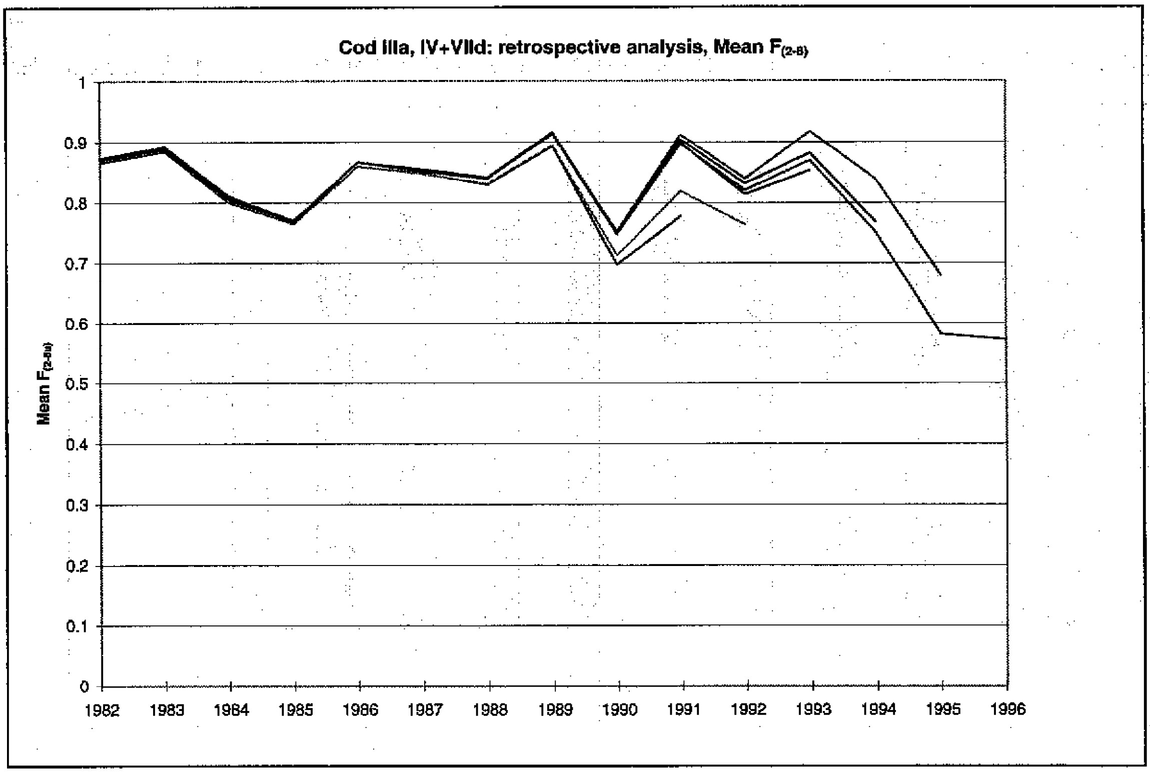

Figure 3.4.6

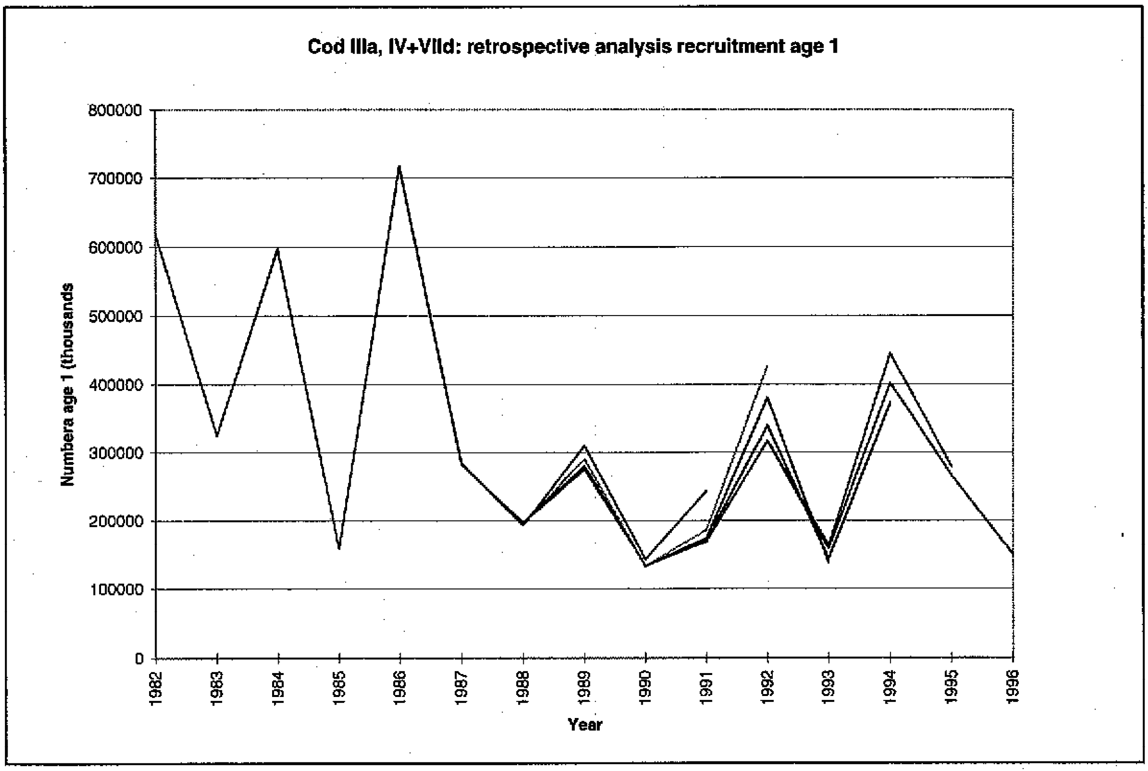

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Figure 3.5.1. Cod IIIa, IV+VIId. relationship between VPA 1-group population numbers and tuning fleet cpue for age group 1.

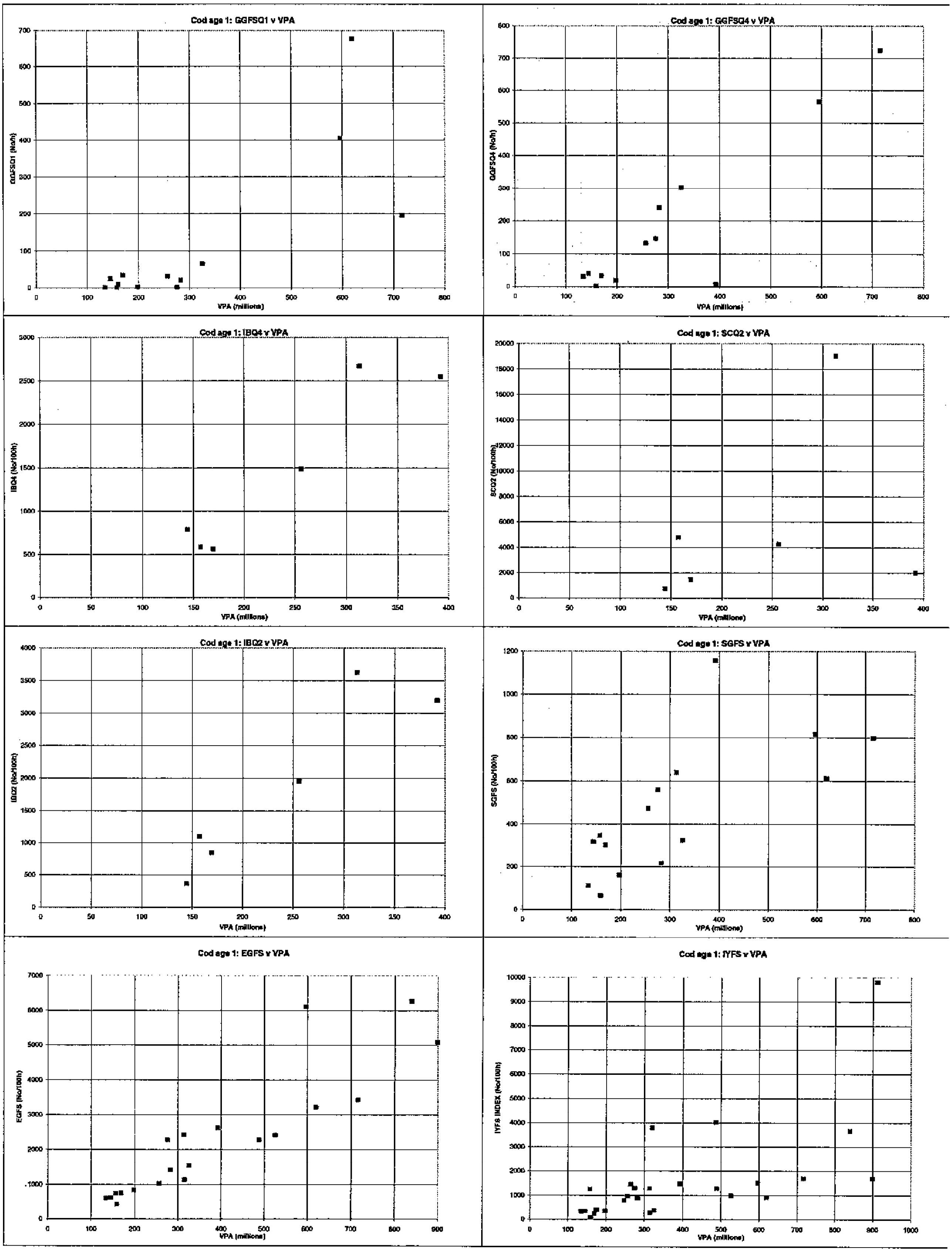

Figure 3.5.2. Cod IIIa, IV+VIId. relationship between VPA 1-group population numbers and EGFS survey index for age group 0.

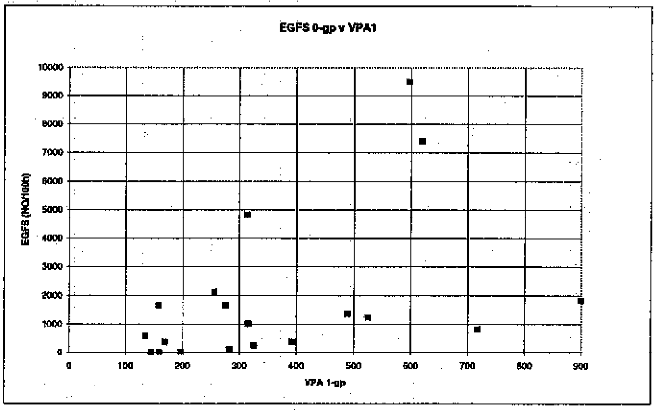

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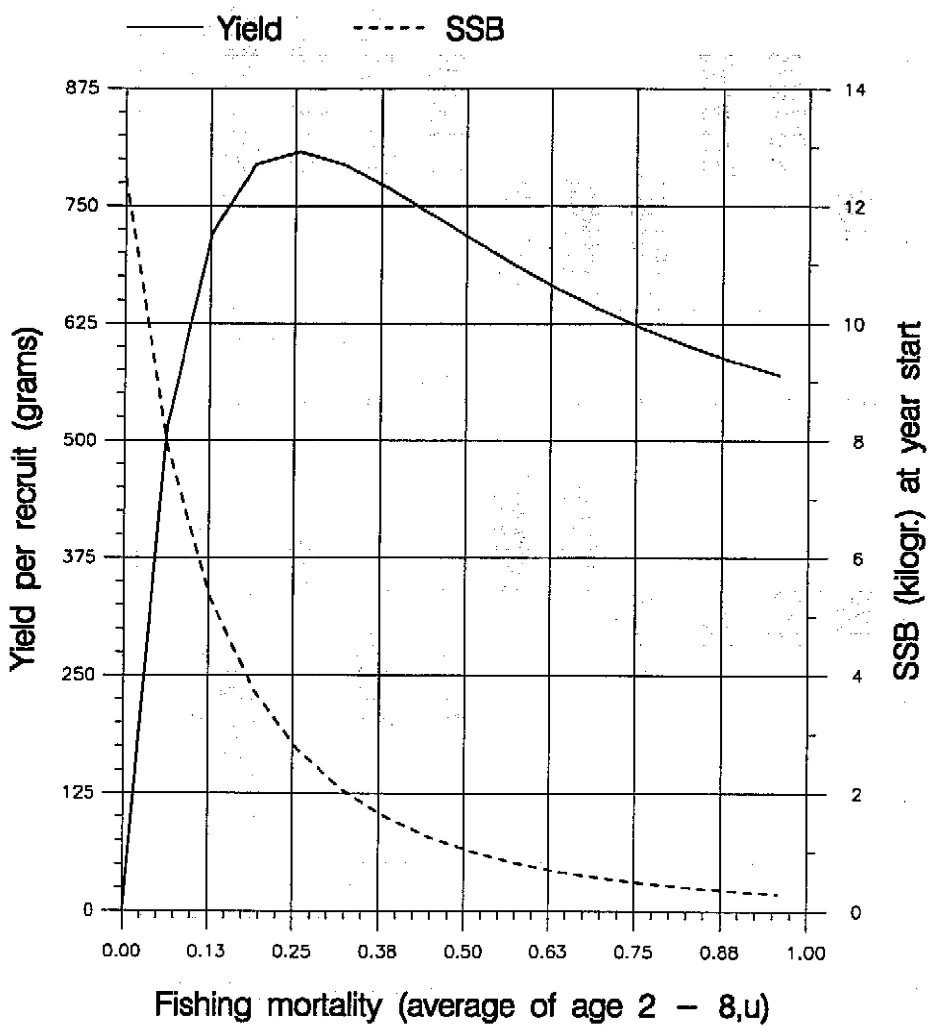
Figure 3.7.1

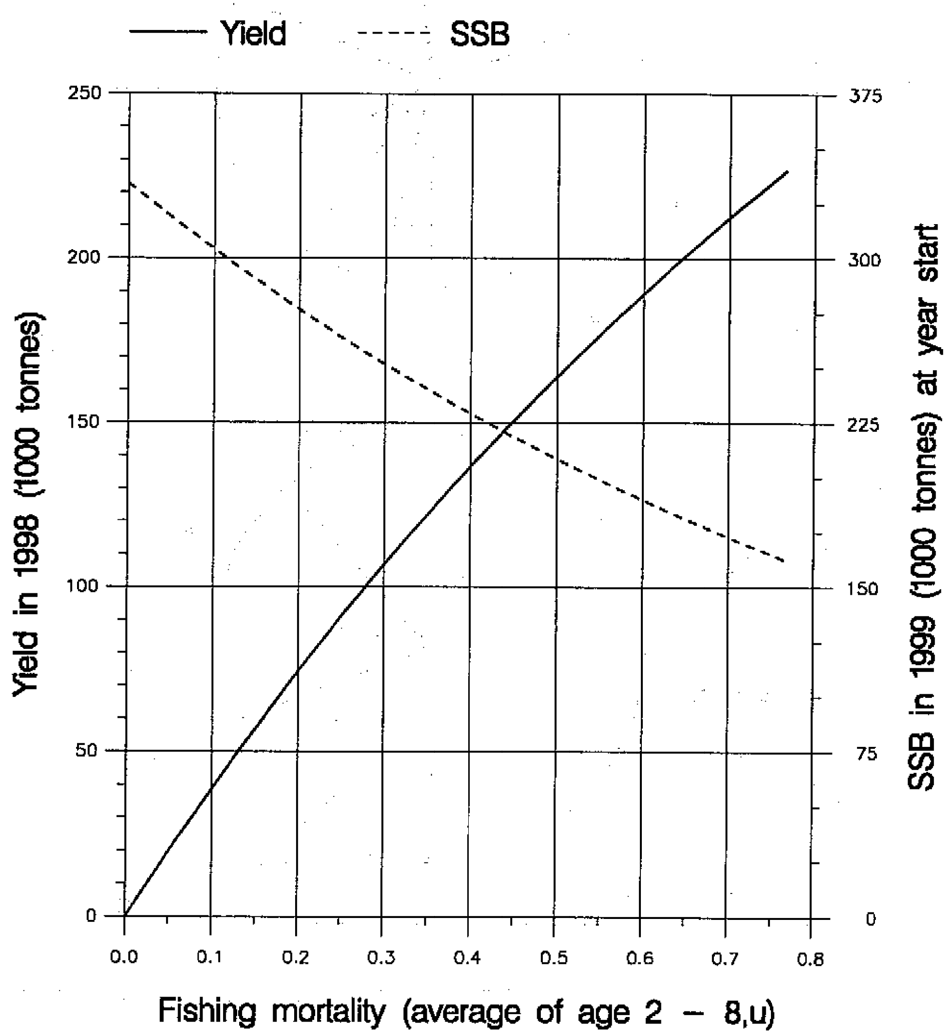
Fish Stock Summary
Cod in Fishing Areas IV, Skagerrak and VIId
12 – 10 – 1997

Long term yield and spawning stock biomass



(run: YLDJC02) C

Short term yield and spawning stock biomass



(run: MANJC03) D

Figure 3.7.2 North, N Sea, Skag, E Chann. Sensitivity analysis of short term forecast.

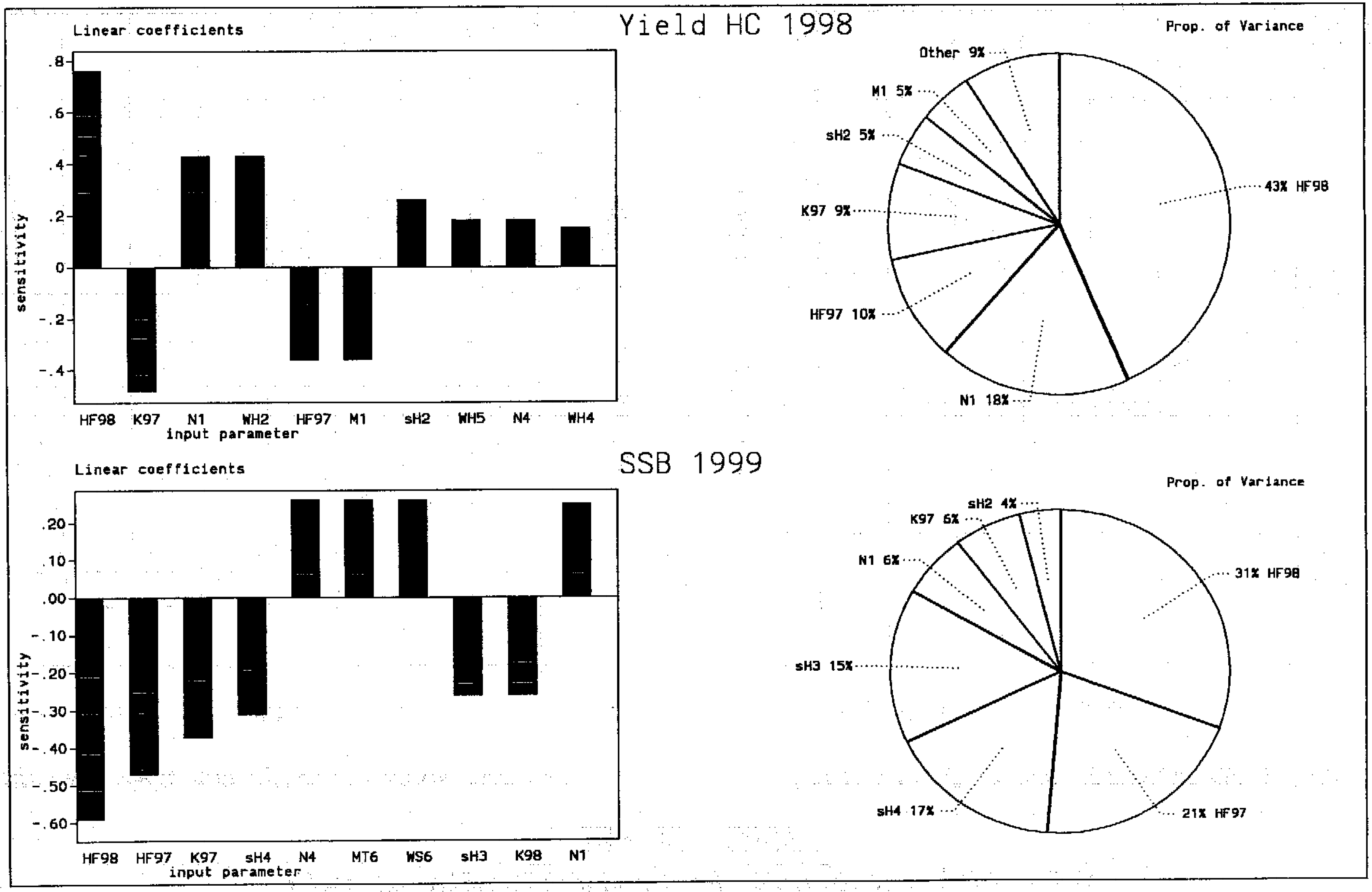
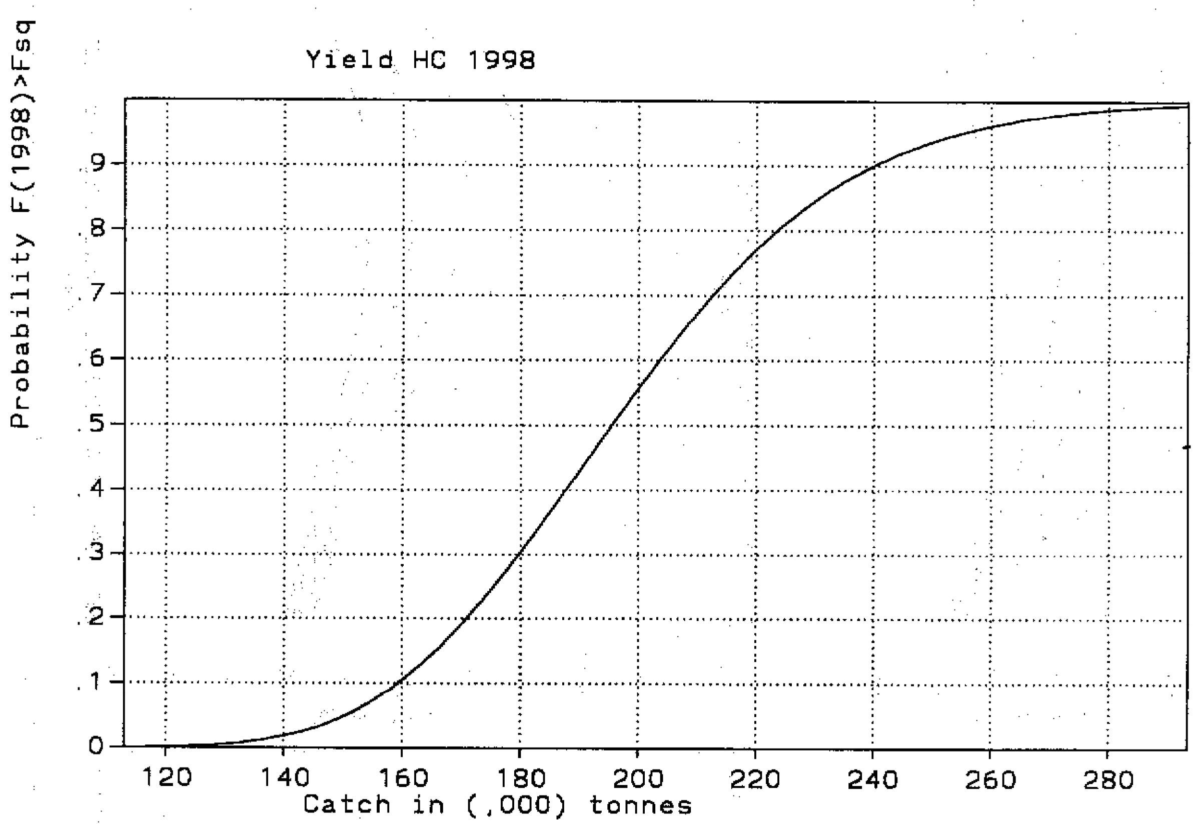
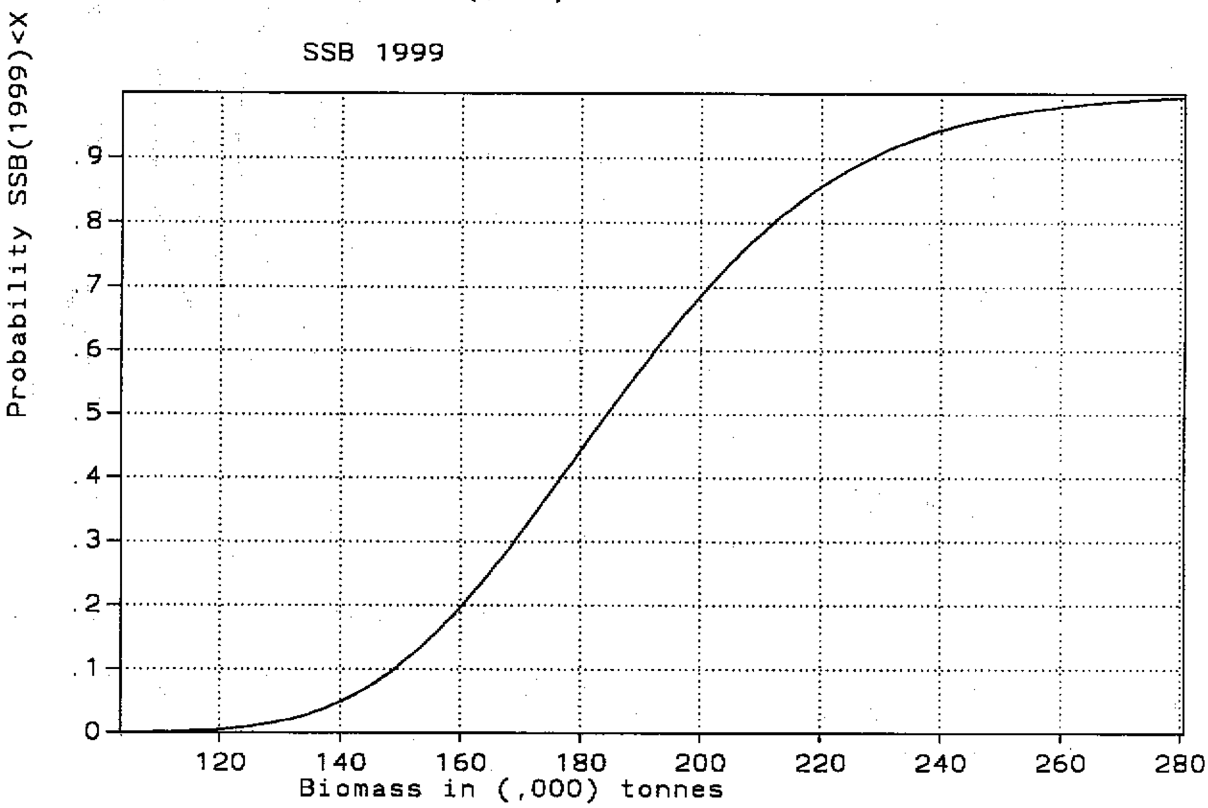


Figure 3.7.3 North,N Sea, Skag, E Chann. Probability profiles for short term forecast.





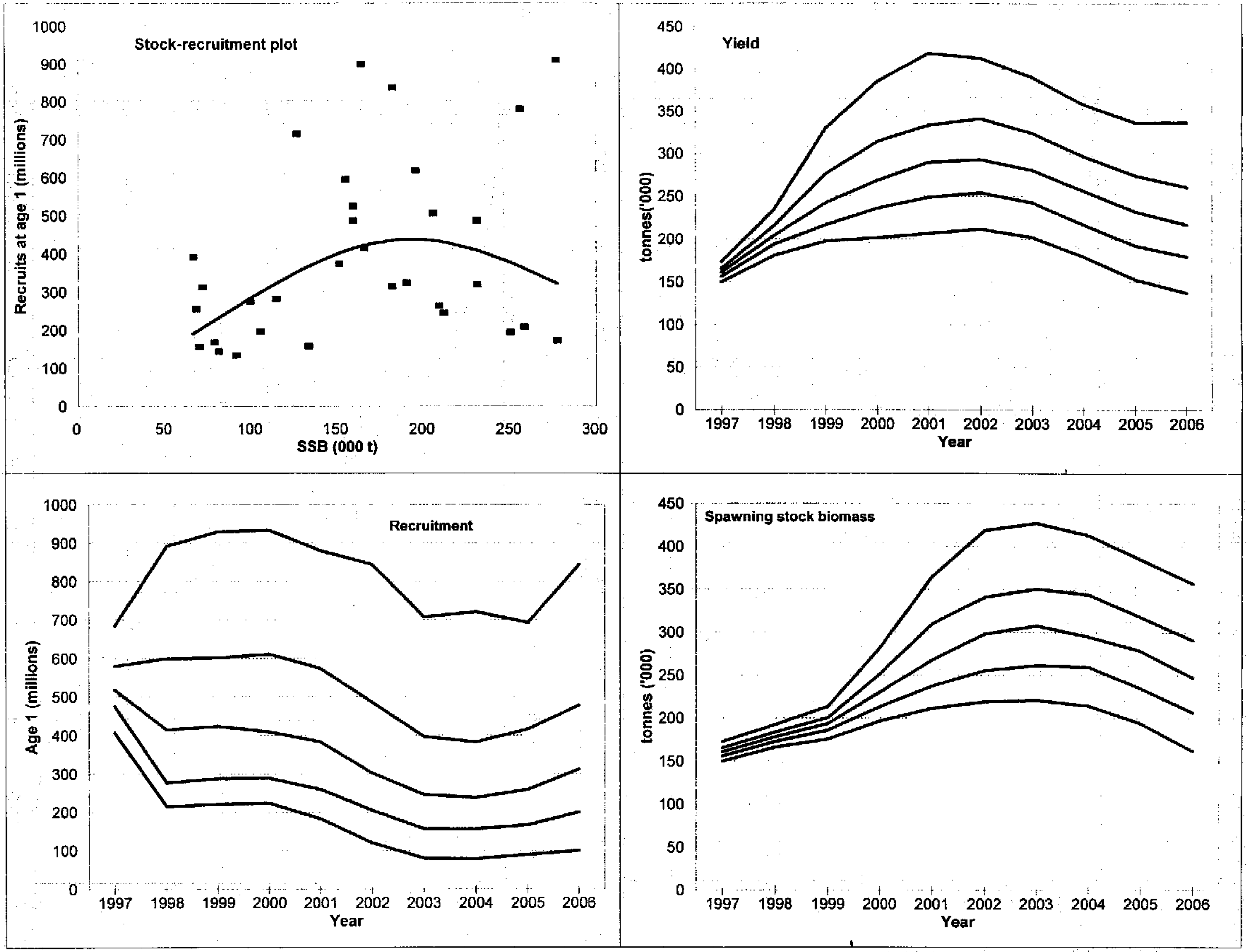


Figure 3.8.1 North Sea cod. Medium term projections. Solid lines show 5, 25 ,50, 75, and 95 percentiles. Status quo F. Shepherd stock-recruitment relationship. Number of simulations = 500.

Figure 3.10.1. N Sea demersal fleets, trends in effort

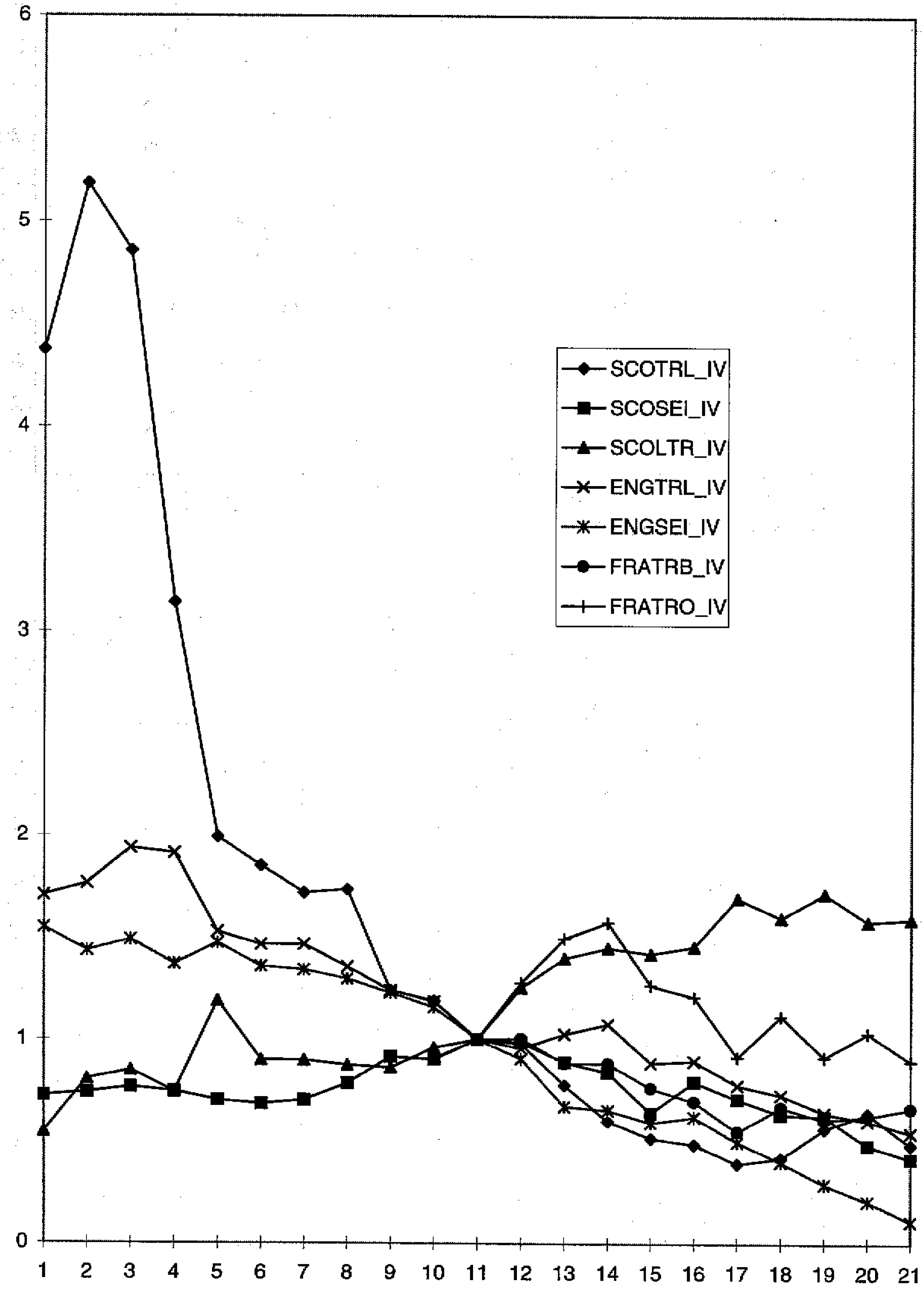


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Figure 3.11.1

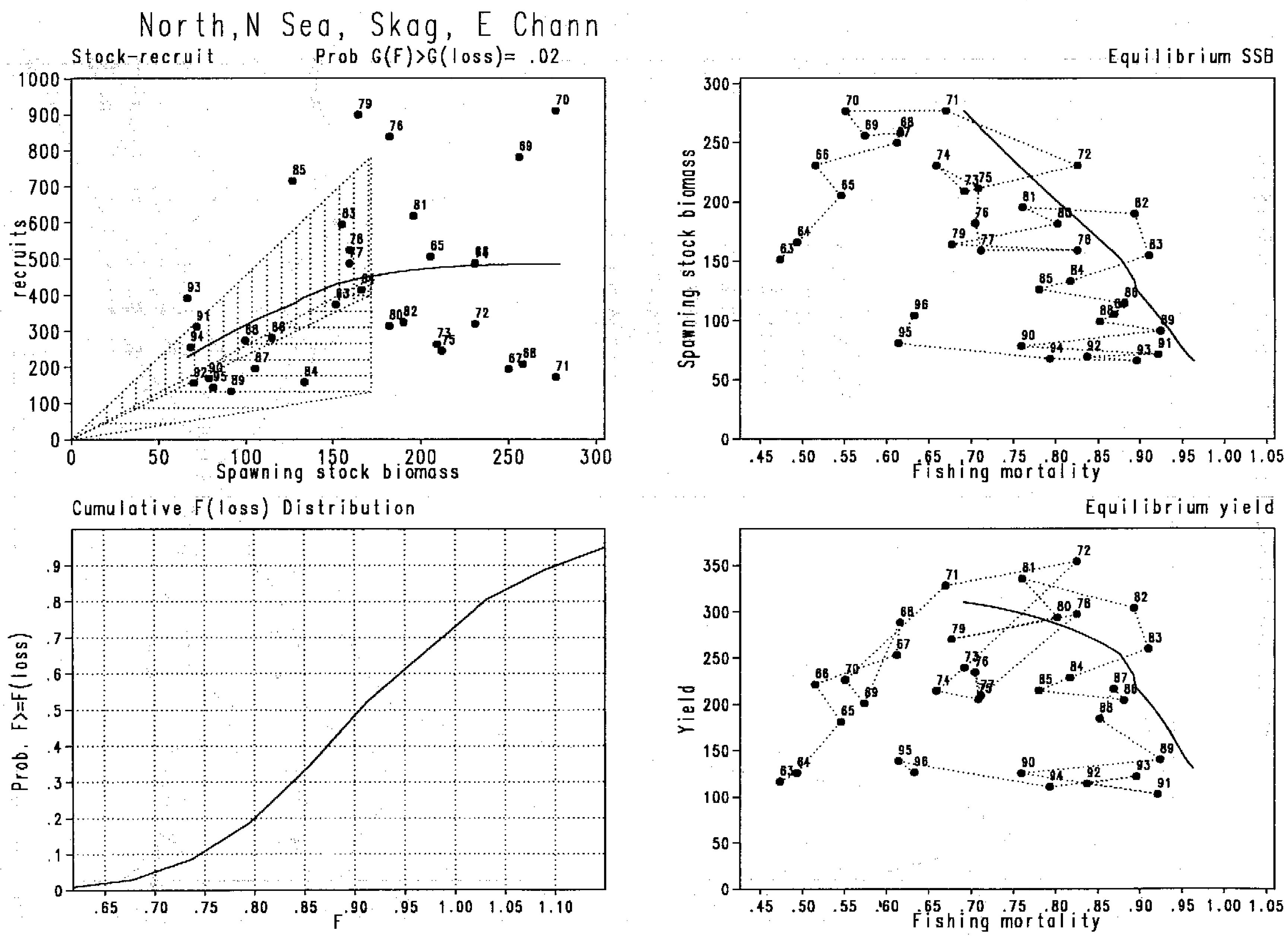
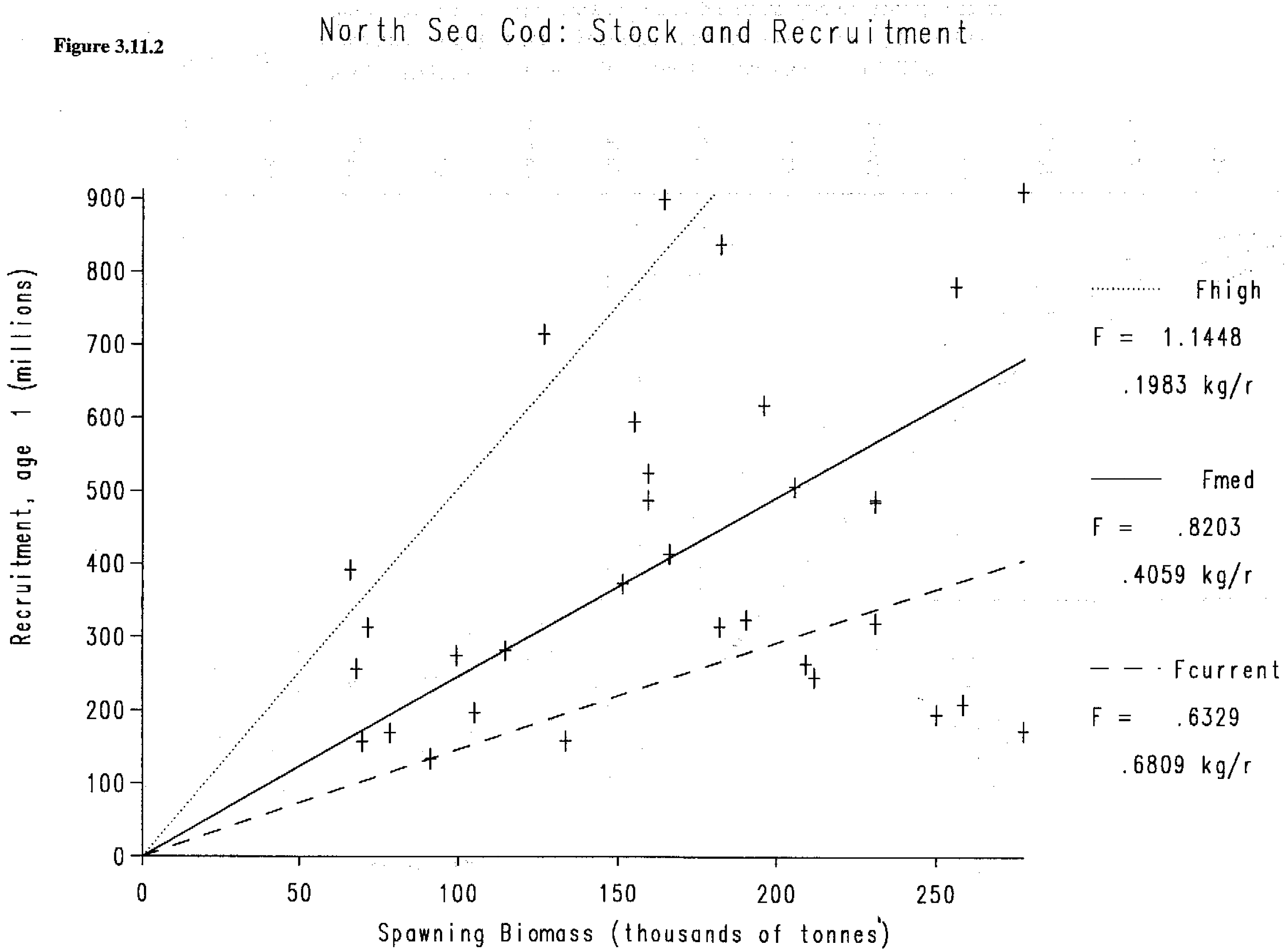

North,N Sea, Skag, E Chann
Stock-recruit
Prob G(F)>G(loss)= .02
recruits
Spawning stock biomass
Equilibrium SSB
Spawning stock biomass
Fishing mortality
Cumulative F(loss) Distribution
Prob. F>=F(loss)
F
Equilibrium yield
Yield
Fishing mortality

Figure 3.11.2



North Sea Cod: Stock and Recruitment
Recruitment, age 1 (millions)
900
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
Spawning Biomass (thousands of tonnes)
Fhigh
F = 1.1448
.1983 kg/r
Fmed
F = .8203
.4059 kg/r
Fcurrent
F = .6329
.6809 kg/r

mbal

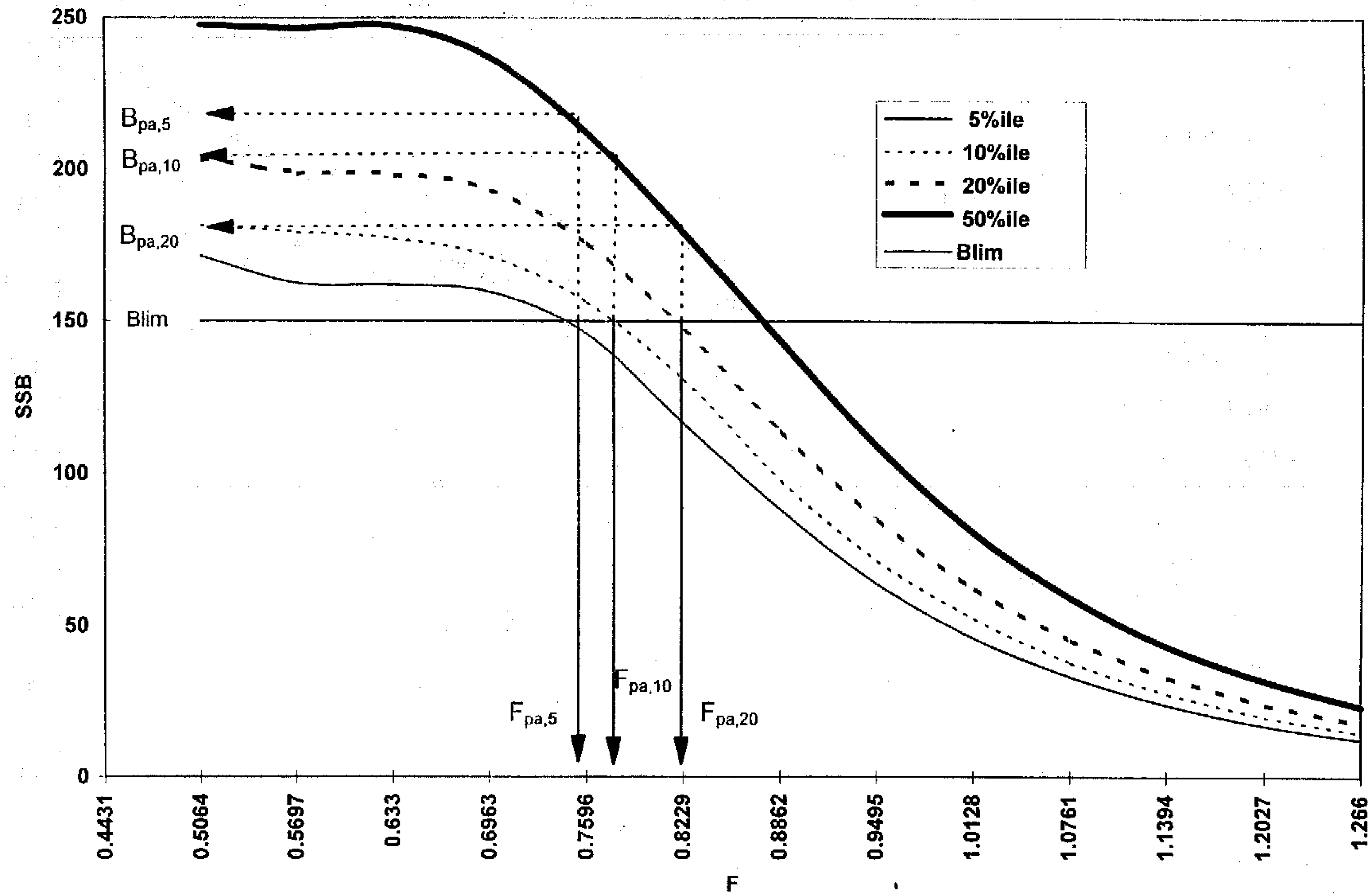


Figure 3.12.1 Cod IIIa,IV+VIId. Mediun-term predictions showing 5, 10 and 20 percentiles of SSB in tenth year (2007) for different levels of F, together with F and SSB precautionary reference points associated with B_{lim} set at MBAL (150,000t). Shepherd stock-recruitment realtionship, 500 simulations.

4 HADDOCK IN SUB-AREA IV AND DIVISION IIIA

4.1 Catch trends

In the North Sea, haddock is taken as part of a mixed demersal fishery, with the large majority of the catch being taken by Scottish light trawlers, seiners and pair trawlers. These gears have a minimum legal mesh size of 100 mm. Smaller quantities are taken by other Scottish vessels, including Nephrops trawlers which use 70 mm mesh and thus discard higher quantities. The fishery is also exploited by vessels from countries including England, Denmark and Norway. In Division IIIa, haddock are taken as a bycatch in a mixed demersal fishery, and in the industrial fishery. Landings from Division IIIa are small compared to the North Sea, amounting to between 2.5 and 6.9 % of the total catch over 1963-1996.

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

In Division IIIa total landings during 1996 amounted to about 6.1 thousand tonnes, with industrial bycatch accounting for about half of this total. This total is slightly above the series average and represents a slight increase over the previous three years.

In the North Sea, human consumption landings in 1996 were around 76 thousand tonnes, which is comparable to landings in the five preceding years during which landings varied between 70 and 81kt. The 1996 landing represents a considerable undershoot of the TAC of 120 kt. The level of discarding in 1996 was higher than in the two previous years, but the level of industrial bycatch decreased relative to 1995. Misreporting is not considered to have been a problem with this stock in 1996.

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

Natural mortality estimates are given in Table 4.2.1 along with the maturity ogive. The natural mortality estimates originate from an earlier MSVPA key run; the values from the 1997 key run have not been included. The maturities are based on IBTS data. Both natural mortality and maturity are assumed constant with time. Biomass totals are calculated as at the beginning of the year.

For Division IIIa in 1996, age composition data for the human consumption and industrial bycatches were supplied by Denmark, who accounted for around 70% of the human consumption landings and all of the industrial bycatch in this area in 1996. For the North Sea catches, age composition data for the human consumption landings were supplied by Denmark, England, France Scotland, and, for the first time, Belgium. These nations accounted for over 90% of the total landings. Industrial bycatch age compositions were supplied by Denmark and Norway. Discard totals and age compositions for the North Sea were estimated from Scottish data. No estimates of discards are available for Division IIIa. Catch-at-age data are given in Table 4.2.2. The catch-at-age data for the North Sea are SOP corrected; there are slight SOP discrepancies in the combined data arising from minor discrepancies in the Division IIIa data.

Fish from the 1996 and 1994 year classes were the most abundant in the total catches in 1996. In comparison with the short-term prediction made at the previous WG meeting, the numbers of three and five-year old fish are similar to the predicted catches, but the numbers of two and four-year old fish taken by the human consumption fleet (i.e. HC landings plus discards) were only 82 and 85% respectively of the predicted level. This is discussed further in Section 4.10.

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

4.3 Catch, Effort and Research Vessel data

The fleets used in tuning are listed in Table 4.3.1 along with the age and year ranges used in the tuning file. The fleets consist of two Scottish commercial fleets and four research vessel surveys. Definitions of the commercial fleets are the same as those given for the equivalent vessels working in Division VIa which are given in the

Report of the 1997 Working Group on the Assessment of Northern Shelf Demersal Stocks (C.M. 1998/Assess:1, Appendix 2). In order to include the most recent information from the IBTS quarter 1 survey, this survey is treated as if it takes place at the end of the preceding year, by appropriate adjustments of the age and year ranges, and of the alpha and beta parameters. The tuning file is given in Table 4.3.2.

4.4 Catch-at-age analysis

Initial exploratory XSA runs used the same settings and fleets as used in the final XSA run in the 1996 Working Group assessment of the stock. Catchability residuals from this preliminary run indicated a possible year-effects in the Scottish Groundfish survey for 1995 and 1996, as residuals at all ages in these years were positive. This was also reflected in the individual fleet estimates of survivors from this run which were consistently higher for this fleet than for the other fleets. A similar result was found in the 1996 Working Group assessment of this stock, when this survey was included. Comparative runs with this fleet included and excluded indicated that the exclusion of this fleet made relatively little difference to the overall XSA results (mean $F_{2\text{-}6}$ of 0.70 if excluded compared with 0.67 if included). In previous assessments the Scottish groundfish survey has tended to be one of the most important tuning fleets, so in view of the relatively small effect its exclusion had on the XSA results, this survey was retained in the assessment. The catchability residuals also showed an indication of a year effect in 1996 in the IBTS Q4 series. However at all ages the survivor estimates from this fleet were within the range of those for the other fleets, and excluding the fleet made very little difference to the XSA results, so this fleet was also retained in the XSA run. Thus the final run used all of the fleets.

No attempt was made to investigate the effects of varying the XSA settings on the results of the assessment. These have been investigated exhaustively during the course of previous assessments of this stock, and the assessment results have proved to be rather insensitive to the settings used.

To summarise, the final XSA run used the same seven fleets as in the previous assessment of the stock. The XSA assumed catchability at all ages was independent of stock size, with the q-plateau set at age 7. A uniform weighting over ten years was used, with the default shrinkage SE of 0.5. These settings are also unchanged from the previous assessment.

The diagnostics from this final XSA run are given in Table 4.4.1. The diagnostics indicate that the survey data, particularly the IBTS Q1 and Q4 surveys, receive the highest weight in the estimate of survivors from ages 0-2. Over ages 1 to 5 the survivor estimates from the individual survey series are rather homogeneous, although the estimate arising from the Scottish groundfish survey is consistently higher than the others. The commercial data begin to make a significant contribution to the survivor estimates from age 3 upwards, and they receive the majority of the weight from age 5 upwards. The F-shrinkage mean has little influence on the estimate of survivors from ages 1 to 6, but receives some weight at the older ages.

Log catchability residuals from the final run are given in Figure 4.4.1. As noted above, these indicate that there may be year effects in the Scottish groundfish data for 1995 and 1996. There is also evidence of year effects in the plot for the IBTS Q4 data. Retrospective trends in mean F from the final run are given in Figure 4.4.2; the retrospective runs excluded the IBTS Q2 and Q4 data as there series are too short to permit a useful retrospective analysis. The retrospective shows a general trend to over-estimate F in the terminal year.

Stock numbers at age from the final XSA run are given in Table 4.4.3, and Fs at age are given in Table 4.4.2. The present assessment indicates a mean F in 1996 of 0.66. The current XSA run has revised the estimate of F in 1995 down to 0.63, which is close to the lowest observed level for this stock (0.62 in 1968).

4.5 Recruitment estimation

A number of 1997 surveys are available for this stock, so it is appropriate to utilise RCT3 to use this additional information. The RCT3 input file for the run at age 0 is given in Table 4.5.1; 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, although as RCT3 was run allowing only series with 5 or more points to be included in the regression, not all of these indices contribute to the estimates. RCT3 was run without an time-taper applied to the data. Output from the RCT3 runs at ages 0-2 are given in Tables 4.5.2a-c, and the indices used are plotted against converged XSA estimates in Figure 4.5.1.

Indices for the 1997 year class at age 0 are available from Scottish and English August surveys. Both indices indicate that this year class is of below average strength, and both receive quite high weighting in the RCT3 estimate of this year class at age 0, so the RCT3 estimate of 15,484 million was used in the prediction. This estimate is below the GM value of 27,131 million.

The XSA estimate of the 1996 year class at age 1 (3,189 million) compares with the RCT3 estimate of 3,605 million. The RCT3 estimate was adopted as it receives most of its weight from 1997 survey indices which are not included in the XSA.

The RCT3 estimate of the 1995 year class at age 2 (380 million) is similar to the XSA estimate (303 million). The RCT3 estimate receives much of its weight from the IBTS Q2 data, which is undesirable given the short time-series for this fleet. Because of this, and because the two estimates are similar, the XSA estimate was adopted.

At ages 3 and older the XSA estimates of population numbers at the start of 1996 were used in the prediction. For numbers at age 0 in 1998 and 1999, the long term GM value of 27.1 billion was used.

4.6 Historical stock trends

Trends in spawning stock biomass, recruitment and mean F since 1963 are given in Table 4.6.1 and Figure 4.6.1. Total F has fluctuated around a mean level of 0.92, although the present assessment indicates that it declined to close to the lowest observed level of 0.63 in 1995 and has remained close to that level in 1996. Recruitment shows considerable variation, with the current estimate of the 1994 year class indicating that it is one of 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 63,000 t in 1991, since when an increase is indicated.

4.7 Short-term forecast

The short-term catch prediction for this stock considers three catch categories; human consumption landings, discards and industrial bycatch. The predicted HC landings and industrial bycatch each include a proportion which should be allocated to Division IIIa. Over 1963-1996, HC landings from IIIa have varied between 0.1 and 8.4% of the combined (North Sea + IIIa) HC landings, with a long-term mean of 3.3%, and a recent (1994-1996) mean of 3.0%. Information on the split of IIIa landings into industrial and human consumption components is only available for 1981 onwards. Over 1981-1996 the proportion of the combined-area industrial bycatch taken in Division IIIa has varied between 6.1 and 43.2%, with a long-term mean of 25.4%, and a recent mean of 32.2%.

Mean Fs at age for the human consumption/discard fleet were calculated by first obtaining partial Fs for this fleet over 1994-1996. The mean exploitation pattern over this period was then scaled to the mean F for this fleet in 1995. These Fs at age were then partitioned between the human consumption and discard components according to the mean proportion at each age over 1994-1996. Prediction Fs-at-age for the industrial bycatch were obtained using a similar procedure with the partial Fs for this fleet. It should be noted that the human consumption reference Fs are calculated over different age ranges, reflecting their different exploitation patterns. This means that the mean F obtained from combining the partial Fs across these two fleets may not correspond to the mean total F. Mean weights at age were calculated over 1994-1996. These procedures are performed automatically by the program 'Insens' and reflect recent practice for catch predictions for the North Sea stock.

The inputs to the prediction with sensitivity analysis are given in Table 4.7.1. The results of this prediction are given in Table 4.7.2, with more detailed output assuming *status quo* F in 1997 summarised in Table 4.7.3. The assumption of *status quo* F in 1997 and 1998 leads to predicted human consumption landings for the North Sea and IIIa of 126,000 t in 1997 falling to 98,000 t in 1998. SSB is predicted to decrease from its 1997 level of 257,000 t to 206,000 t at the start of 1998, with a further decline to 178,000 t at the start of 1999. For comparison, the total TAC for 1997 is 121,000 t (114,000 in the North Sea and 7,000 t in IIIa).

The predicted decrease in human consumption landings over 1997 and 1998 reflects the decreased contribution of the 1994 year class to the catches in 1998; this year class accounts for 51% of the predicted 1998 HC landings in weight, with no other year class contributing more than 20% to this total. This dependence upon the 1994 year class is apparent in the sensitivity analysis of the short term prediction (Figure 4.7.1) where it can be seen that the prediction is sensitive to the estimate of the strength of this year class at age 3, and to factors influencing the survival of this year class and its contribution to the catch and spawning stock. However, the sensitivity analysis also indicates that the prediction is most sensitive to the overall level of fishing and natural mortality during 1997 and 1998.

The cumulative probability distributions from the sensitivity analysis (Figure 4.7.2) indicate that the probability of the SSB falling below the lowest recorded value of 63,000 t by 1999 is very low.

4.8 Medium-term projections

The stock and recruitment data for this stock do not show any evidence of a stock-recruitment relationship, and in particular they do not show any evidence of a decline in recruitment at low stock sizes. As the basis for the medium-term projections, a Beverton-Holt SRR curve was fitted to the data, although for the above reasons the model fit was not significant. The fitted curve is shown in Figure 4.8.1, along with the results of a medium-term projection assuming *status quo* fishing mortality in 1997 and subsequent years. The median line from this projection indicates a decline in landings and SSB over the next three years or so reflecting the declining contribution of the 1994 year class, after which both are indicated to increase.

4.9 Long-term considerations

Figure 4.9.1 summarises the probabilities of SSB in 2006 falling below the lowest observed level of 63,000 t at various levels of F. The projections indicate that the probability of SSB falling below this level by 2006 is less than 5% at the current level of F. It should be noted that the F values on the X-axis of Figure 4.9.1 are mean F(2-6) of the human consumption+discard fleet; the projections also assume a constant industrial bycatch mean F(0-3) of 0.03.

Although it has apparently declined in recent years, 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 upon a few recent incoming year classes.

4.10 Comments on the assessment

Recent assessments for this stock have tended to result in over-optimistic catch forecasts, with recent North Sea TACs being around the 120 kt mark, but landings being closer to 80 kt. As noted in Section 4.2, this was again the case with the catch prediction for 1996. In this case, as previously, this discrepancy appears to have arisen from the over-estimation of strong year classes.

To consider this in more detail, 92% of the human consumption landings in 1996 consisted of 2-5 year-old fish, so only these year classes are of any real importance in the catch forecast. As noted in Section 4.2, the landed numbers of 3 and 5-year old fish in 1996 are close to the predicted numbers but those of 2 and 4 year-olds were markedly lower than forecast. These latter two year classes (1992 and 1994) account for 64% of the HC landed weight, so the shortfall of the catch relative to the TAC results largely from the over-estimation of these two year-classes, together with a higher level of discarding at these ages than was assumed for the prediction (79% instead of 70% at age 2, and 14% rather than 4% at age 4). Both of these year classes are of above average strength so it can be seen that the problem arises from over-estimation of large year classes.

The catch forecast made during the current assessment is again highly dependent upon the strong 1994 year class. The XSA estimate was used for this year class, and although the commercial fleets receive some weight, the estimate is largely driven by survey data. Recent problems with over-estimation of strong year classes appear to have arisen from using these same survey data in RCT3. The cumulative F on this year class to the end of 1996 is estimated to be 0.5, so this year class is not yet within the converged portion of the VPA. Taken together, these two factors make it likely that the 1994 year class has again been over-estimated so the catch forecast is again likely to be over-optimistic. This means that, as in other recent years, the fishery will be essentially unrestricted.
Another point of concern in relation to this assessment is the marked drop in F in recent years. To try and investigate this possible decline, trends in landings and effort for the most important fleets were investigated. As noted in Section 4.1, Scottish seiners, light trawlers and pair trawlers account for most of the landings of haddock from the North Sea.. Over 1987-1996, these fleets took on average 80% of the North Sea haddock landings. Trends in effort from these fleets are given in Figure 4.10.1a. Since 1987, effort by Scottish seiners has decreased, while effort by Scottish light trawlers has increased. Pair trawler effort has remained rather constant. Trends in landings per unit effort are given in Figure 4.10.1b. The three fleets show similar trends, with pair trawler LPUE being slightly lower than that of seiners, and light trawler LPUE being markedly lower. It is not

clear why light trawl LPUE is so much lower than the other vessels, but it may indicate that these vessels are more generalist and are able to target e.g *Nephrops* and Anglerfish as well as the roundfish species. Figure 4.10.1.c shows the LPUE trends of light trawlers and pair trawlers relative to that of seiners and it is apparent that these are rather constant. Over the period shown, pair trawl LPUE was, on average, 95% of that in seiners, and light trawl LPUE came to 32% of seiner LPUE on average. Using these values, a weighted index of overall effort was calculated for the period 1987 to 1996 (pair trawl effort data are not available prior to 1987). This is given in Figure 4.10.1d and 4.10.1e where it is compared with human consumption mean F over the same period. It can be seen that the two are well correlated (r = 0.91, 9df). Furthermore, the weighted effort shows a 39% decline over 1987-1996. Thus the available data on effort in the major fleets exploiting the North Sea haddock stock support the recent decline in F indicated by the current assessment.

4.11 Biological reference points

Figure 4.11.1 give the stock-recruitment scatter plot and associated reference points, with yield and SSB-per-recruit curves and their associated reference points given in Figure 4.11.2. The yield and SSB-per-recruit curves are based on the short-term prediction inputs given in Table 4.7.1. Figure 4.11.3 shows the distribution of F_{loss} in relation to the current estimate of F and its uncertainty arising from this assessment. The median of the F_{loss} distribution is 1.94. These Figures originate from a run of the program 'Gloss2' with prediction inputs assuming mean weights and Fs over the last ten years not scaled to current F.

The biological reference points estimated for this stock are given in the text-Table below. For comparison, current mean total F = 0.66, and the mean over 1963-1996 is 0.92, with current SSB being 208,000t and the long-term mean SSB being 265,000t.

Ref. point	Value
F_{med}	0.54
F_{high}	> 0.94
$F_{0.1}$	0.15
F_{max}	0.31
F_{loss}	1.94
B_{loss}	63,000t

In addition, Lewy and Lassen (1997) have recently estimated F_{crash} and F_{MSY} fro this stock assuming Ricker and Beverton-Holt SSR curves. Using a Ricker they estimated F_{crash} as 1.36 and F_{MSY} as 0.71, and with a Beverton-Holt the estimates were 4.87 and 0.26 respectively.

4.12 Definition of safe biological limits using target and limit reference points

F_{pa} and B_{pa} reference points were estimated from the medium-term projections summarised in Figure 4.9.1 using the procedure outlined in Section 1.5. For these purposes the B_{lim} value used was the lowest observed spawning stock, i.e. the 1991 SSB level of 63,000 t. The medium-term projections used a Beverton-Holt SRR model. These values are given in the text Table below.

Probability	0.05	0.1	0.2
F_{pa}	0.92	1.01	1.18
B_{pa}	154,000t	134,000t	102,000t

Using the $F_{pa,05}$ estimate given above indicates that by keeping human consumption/discard F below 0.92 should ensure that there is only a 5% probability of SSB falling below the lowest observed value of 63,000 t. Furthermore, if in addition SSB is maintained above the $B_{pa,05}$ level of 154,000 t, then exploitation of the stock could be regarded as consistent with the precautionary approach.

The value estimated for $F_{pa,05}$ is slightly above the long-term mean HC+D mean F of 0.87 and that the long-term mean SSB is above $B_{pa,05}$. However over 1963-1996, the combined criteria (i.e. HC+D F <= $F_{pa,05}$ and SSB >= $B_{pa,05}$) were only met in 13 of the 34 years.

Table 4.1.1 **Nominal catch of HADDOCK in Division IIIa, 1988-1996, as officially reported to ICES.**

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	19	5	13	4	14	9	4	18	-
Denmark	2558	3895	3885	2339	3812	1600	1458	1576	2523
Germany	-	-	3	-	-	+	1	1	5
Netherlands	8	-	-	-	-	-	-	-	-
Norway	245	84	100	110	184	153	130	134	114
Sweden	64	66	84	69	744	436	408	498	520
UK (Engl. & Wales)	-	-	-	-	-	+	-	-	-
Total	2894	4050	4085	2522	4754	2198	2001	2227	3162
WG estimate of H.cons. landings	2852	4098	4100	4086	4396	1959	1833	2191	3142
WG estimate of industrial bycatch	1480	360	1968	2593	4604	2415	2180	2162	2925
WG estimate of total catch	4332	4458	6068	6679	9000	4374	4013	4353	6067
Unallocated landings	-42	48	15	1564	-358	-239	-168	-36	-20

Table 4.1.2 **Nominal catch of HADDOCK in Sub-Area IV, 1988-1996, as officially reported to ICES.**

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	220	145	192	168	415	292	306	407	215
Denmark	9174	2789	1993	1330	1476	3582	3208	2902	2520
Faroe Islands	35	16	6	15	13	25	43	49	13
France	2193	1702	1115	631	508	960	678	441	368
Germany	802	447	749	535	764	348	1829	1284	1769
Netherlands	894	328	102	100	148	192	96	147	110
Norway	1590	1697	1572	2069	3273	2655	2519	2443	2297
Poland	-	-	-	-	-	-	-	-	18
Sweden	614	1051	900	957	1289	908	551	722	688
UK (Engl. & Wales)	5537	2507	2019	2173	2926	4259	4043	3616	3379
UK (Isle of Man)	-	-	-	-	11	-	-	-	-
UK (N. Ireland)	-	137	11	48	73	18	9	-	-
UK (Scotland)	84104	53587	34567	36474	39896	66799	73793	63411	63542
Total	105163	64406	43226	44500	50792	80038	87075	75422	74919
WG estimate of H.cons. landings	105126	76190	51458	44645	70218	79580	80897	75313	76034
WG estimate of discards	62062	25713	32603	40276	47967	79601	65392	57360	72521
WG estimate of industrial bycatch	3995	2410	2591	5421	10816	10741	3561	7747	5048
WG estimate of total catch	171183	104313	86652	90342	129001	169922	149850	140420	153603
Unallocated landings	-37	11784	8232	145	19426	-458	-6178	-109	1115

North Sea + Division IIIa

	1988	1989	1990	1991	1992	1993	1994	1995	1996
WG estimate of Total Catch	175515	108771	92720	97021	138001	174296	153863	144773	159670

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Table 4.1.3; Catches ('000t) of Haddock from the North Sea and Division IIIa, 1963-1996. Figures are Working Group estimates.

	North Sea				Division IIIa			Total
Year	H.cons	Disc	Ind. BC	Total	H. cons.	Ind. BC	Total	
1963	68.4	189.0	13.7	271.0	0.4	0.1	0.5	271.5
1964	130.5	160.3	88.6	379.4	0.4	0.3	0.7	380.2
1965	161.6	62.2	74.6	298.4	0.7	0.3	1.0	299.5
1966	225.8	73.6	46.7	346.0	0.6	0.1	0.7	346.7
1967	147.4	78.1	20.7	246.1	0.4	0.1	0.4	246.6
1968	105.4	161.9	34.2	301.5	0.4	0.1	0.5	302.0
1969	330.9	260.2	338.4	929.5	0.5	0.5	1.1	930.5
1970	524.6	101.4	179.7	805.7	0.7	0.2	0.9	806.7
1971	235.4	177.5	31.5	444.4	2.0	0.3	2.2	446.6
1972	192.9	128.1	29.6	350.6	2.6	0.4	3.0	353.6
1973	178.6	114.7	11.3	304.6	2.9	0.2	3.1	307.7
1974	149.6	166.8	47.8	364.2	3.5	1.1	4.6	368.8
1975	146.6	260.4	41.4	448.4	4.8	1.3	6.1	454.5
1976	165.6	154.3	48.2	368.1	7.0	2.0	9.1	377.1
1977	137.3	44.3	35.0	216.6	7.8	2.0	9.8	226.4
1978	85.8	76.9	10.8	173.5	5.9	0.7	6.6	180.1
1979	83.1	41.7	16.4	141.2	4.0	0.8	4.8	146.0
1980	98.6	94.7	22.3	215.7	6.4	1.5	7.9	223.6
1981	129.6	60.1	17.1	206.8	9.1	1.2	10.4	217.2
1982	165.8	40.5	19.4	225.8	10.8	1.3	12.1	237.8
1983	159.3	65.9	13.1	238.4	8.0	7.2	15.2	253.6
1984	128.1	75.3	10.1	213.5	6.4	2.7	9.1	222.6
1985	158.5	85.4	6.0	250.0	7.2	1.0	8.1	258.1
1986	165.5	52.2	2.6	220.4	3.6	1.7	5.3	225.7
1987	108.0	59.2	4.4	171.6	3.8	1.4	5.3	176.9
1988	105.1	62.1	4.0	171.2	2.9	1.5	4.3	175.5
1989	76.2	25.7	2.4	104.3	4.1	0.4	4.5	108.8
1990	51.5	32.6	2.6	86.7	4.1	2.0	6.1	92.7
1991	44.6	40.3	5.4	90.3	4.1	2.6	6.7	97.0
1992	70.2	48.0	10.8	129.0	4.4	4.6	9.0	138.0
1993	79.6	79.6	10.7	169.9	2.0	2.4	4.4	174.3
1994	80.9	65.4	3.6	149.9	1.8	2.2	4.0	153.9
1995	75.3	57.4	7.7	140.4	2.2	2.2	4.4	144.8
1996	76.0	72.5	5.0	153.6	3.1	2.9	6.1	159.7
Min	44.6	25.7	2.4	86.7	0.4	0.1	0.4	92.7
Mean	142.4	96.1	35.8	274.3	3.8	1.4	5.2	279.6
Max	524.6	260.4	338.4	929.5	10.8	7.2	15.2	930.5

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TABLE 4.2.1; Haddock, North Sea + Skagerrak
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 4.2.2; Haddock, North Sea + Skagerrak
International catch at age ('000), Total , 1963 to 1996.

Age	1963	1964	1965	1966
0	1367	140235	652537	1671205
1	1307178	7436	368593	1007322
2	335092	1296771	15184	25674
3	20963	135227	649840	6425
4	13026	9069	29496	412551
5	5781	5350	4662	9980
6	502	2405	1972	1045
7	653	287	452	601
8	566	236	107	165
9	59	231	90	90
10+	18	25	41	25

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
0	306037	11146	72670	925768	333396	244075	60545	614903	46388	174161
1	838189	1098748	20493	266379	1815054	679205	366830	1220855	2116937	170529
2	89083	439511	3578611	218480	71035	587590	570630	176342	641755	1062943
3	4863	19600	303489	1908736	47546	40604	240604	332967	58991	211544
4	3585	1947	7596	57435	400469	21213	6192	54314	109062	9952
5	177857	2529	2411	1178	10374	158000	4470	1875	15813	31311
6	2443	45973	2515	1197	462	3563	39459	1351	983	4996
7	215	325	19129	256	195	190	1257	10922	620	206
8	216	40	200	5954	147	34	108	242	2714	76
9	57	13	24	67	1592	27	29	23	266	759
10+	34	5	7	30	168	419	163	41	82	63

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	120798	305115	881823	399372	646419	278705	639814	95502	139579	56503
1	258923	463554	351451	678499	134470	275686	157259	432193	178878	160398
2	107675	146957	204046	333261	423059	86126	252258	168273	534269	178824
3	394175	30377	41297	73043	143151	299895	73920	122984	78726	323650
4	40185	113703	7406	10476	15228	41435	127250	22079	37445	27685
5	4318	8708	28024	1901	2034	3407	16480	32658	5306	9691
6	6275	1264	2237	8067	458	713	1708	3789	7355	1237
7	1300	2076	262	598	2498	279	297	596	965	1810
8	135	402	483	121	124	786	60	81	209	246
9	29	116	152	162	64	29	193	39	53	106
10+	204	94	78	119	61	26	67	139	114	136

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	13384	16535	12042	57702	123910	270758	141209	85966	273689	345874
1	314017	30044	47648	86819	228553	209879	359995	99260	301733	50379
2	250496	490706	35358	103021	78258	253286	262765	296776	85925	354372
3	47432	89940	182748	18947	23197	32494	108421	100476	167801	56347
4	67864	13431	18106	57830	3888	6552	7107	29609	25875	54723
5	4761	18579	2636	3905	12526	1250	1698	1920	7645	7887
6	2877	1602	4058	896	976	4861	450	573	511	3007
7	545	639	510	1380	401	454	1138	191	127	746
8	780	163	201	206	620	299	145	509	45	51
9	135	145	83	80	144	294	103	115	62	31
10+	144	103	53	68	64	154	210	89	36	42

TABLE 4.2.3; Haddock, North Sea + Skagerrak
International mean weight at age (kg), Total catch, 1963 to 1996.

Age	1963	1964	1965	1966
0	.012	.011	.010	.010
1	.123	.118	.069	.088
2	.253	.239	.225	.247
3	.473	.403	.366	.367
4	.695	.664	.648	.533
5	.807	.814	.844	.949
6	1.004	.908	1.193	1.266
7	1.131	1.382	1.173	1.525
8	1.173	1.148	1.482	1.938
9	1.576	1.470	1.707	1.727
10+	1.825	1.781	2.239	2.889

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
0	.011	.010	.011	.013	.011	.024	.044	.024	.020	.013
1	.115	.126	.063	.073	.107	.116	.112	.128	.101	.125
2	.281	.253	.216	.222	.247	.242	.240	.226	.241	.224
3	.461	.509	.406	.352	.362	.388	.372	.343	.356	.401
4	.594	.731	.799	.735	.506	.506	.586	.548	.449	.512
5	.639	.857	.891	.873	.887	.606	.649	.891	.680	.588
6	1.057	.837	1.031	1.191	1.267	1.000	.725	.895	1.245	.922
7	1.501	1.606	1.094	1.362	1.534	1.366	1.044	.952	1.124	1.933
8	1.922	2.260	2.040	1.437	1.337	2.241	1.302	1.513	1.093	1.784
9	2.069	2.702	3.034	2.571	1.275	2.006	2.796	2.315	1.720	1.306
10+	2.348	2.073	3.264	3.899	2.058	1.684	1.828	2.639	2.420	2.430

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.019	.011	.009	.012	.009	.011	.022	.010	.013	.025
1	.108	.144	.095	.104	.074	.100	.135	.141	.149	.124
2	.241	.253	.290	.283	.262	.292	.297	.300	.279	.242
3	.345	.418	.443	.486	.476	.460	.448	.489	.480	.397
4	.601	.441	.637	.732	.745	.784	.651	.670	.668	.613
5	.613	.719	.664	1.046	1.147	1.166	.915	.805	.857	.863
6	.802	.742	.933	.936	1.479	1.441	1.214	1.097	1.049	1.257
7	1.181	.955	1.187	1.394	1.180	1.672	1.162	1.100	1.459	1.195
8	1.943	1.398	1.187	1.599	1.634	1.456	1.920	1.868	1.833	1.715
9	2.322	2.124	1.468	1.593	1.764	2.634	1.376	2.425	2.124	1.525
10+	1.812	2.158	2.374	2.143	1.709	2.156	1.725	2.046	2.043	2.610

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	.008	.024	.027	.044	.029	.018	.010	.017	.013	.019
1	.126	.165	.197	.194	.177	.107	.115	.116	.102	.131
2	.265	.217	.300	.292	.320	.306	.280	.250	.297	.246
3	.406	.417	.372	.430	.472	.486	.447	.419	.363	.388
4	.615	.589	.605	.473	.639	.748	.680	.597	.592	.484
5	1.029	.748	.811	.771	.650	1.016	.894	.943	.763	.803
6	1.276	1.284	.982	.967	1.042	.896	1.173	1.208	1.099	.870
7	1.433	1.424	1.364	1.167	1.232	1.395	1.102	1.570	1.423	.845
8	1.529	1.551	1.655	1.529	1.481	1.537	1.592	1.469	1.685	1.830
9	1.877	1.627	1.684	2.037	1.776	1.912	1.737	1.620	1.873	2.019
10+	2.197	2.341	2.249	2.544	2.051	2.021	1.873	2.444	1.986	1.966

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

Fleet	Abbreviation	Year range First	Last	Age range Youngest	Oldest
Scottish Seiners	SCOSEI	1977	1996	0	10
Scottish Light Trawlers	SCOLTR	1977	1996	0	10
Scottish Groundfish Survey (August)	SCOGFS	1982	1996	0	6
English Groundfish Survey (August)	ENGGFS	1977	1996	0	7
International Bottom Trawl Survey, Quarter 1	IBTSQ1	1973	1996	0	5 [1]
International Bottom Trawl Survey, Quarter 2	IBTSQ2_SCO	1991	1996	1	6 [2]
International Bottom Trawl Survey, Quarter 4	IBTSQ4_ENG	1991	1996	0	7 [3]

- Data used as if survey takes place at end of previous year; ages 2-5 from 1981 onwards.
- Indices based on Scottish ALKs only
- Indices based on English ALKs only

Table 4.3.2

Haddock in Fishing Area IV and IIIa (run name: XSASAR03)
107
FLT05: IBTS_Q1 (Catch: Unknown) (Effort: Unknown)
1973 1996
1 1 0.99 1.00
0 5

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

FLT08: SCOSEI (Catch: Unknown) (Effort: Unknown)
1976 1996
1 1 0.00 1.00
0 10

307165	900.005	35831.207	329388.656	57468.820	2529.042	8069.133	1026.017	54.001	13.0
313913	4408.118	33809.840	37092.648	130091.234	12895.043	1684.006	1480.005	347.001	24.0
325246	1665.021	160842.859	69033.234	14339.891	44151.660	2365.977	481.996	672.993	85.9
316419	542.986	83630.891	78815.422	17214.719	3039.951	8072.871	647.990	69.999	112.9
297227	210.001	131314.297	128306.000	26204.932	3392.990	500.999	2414.993	123.000	20.0
289672	344.996	10366.878	134259.797	55726.172	5180.690	701.958	101.994	578.965	14.9
297730	1444.967	31143.318	30968.578	118897.859	14296.881	681.995	144.999	39.000	229.9
333168	18101.430	29021.006	77288.734	30413.863	50114.895	6394.235	582.521	118.749	14.6
388085	422.095	120868.211	63391.047	49285.750	9426.073	14976.844	1593.925	253.625	18.0
382910	2052.204	29238.559	164839.219	33202.645	15993.386	2292.755	2846.266	308.427	46.9
425017	8265.012	33999.168	72603.500	155836.391	12894.806	4169.091	489.713	620.234	58.4
418734	137.900	43645.945	97730.797	19730.920	28882.715	1989.147	1174.107	198.915	284.6
377132	498.662	11575.792	201533.422	37421.008	4735.789	7414.681	718.065	290.026	80.0
355735	122.757	19003.758	19274.379	91069.766	8388.754	1091.295	1611.435	223.083	88.5
300076	712.190	35843.578	46489.320	9055.270	26705.223	1434.486	302.388	407.550	67.2
336675	2225.837	66143.555	30754.680	9530.928	1484.518	5028.135	307.511	122.391	183.0
300217	1231.550	30384.277	64732.898	8588.196	1511.942	290.016	1179.738	79.037	56.6
268413	2912.944	74523.461	88375.047	34996.895	2349.233	445.716	100.011	314.410	28.5
264738	3230.533	26626.006	125357.344	34126.902	10522.028	415.035	138.226	41.743	94.7
204545	236.434	67772.078	32300.982	70290.070	8734.379	2180.770	116.890	39.103	13.4
177092	1333.347	9191.870	123828.508	18532.246	17077.139	2161.283	707.006	83.724	11.5

FLT09: SCOLTR updated 5/9/97 (Catch: Unknown) (Effort: Unknown)
1976 1996
1 1 0.00 1.00
0 10

152419	92.002	3355.072	59426.367	11342.737	636.974	1756.928	327.987	7.000	5.000	4
224824	3256.763	10101.391	6440.708	41122.020	3492.063	390.009	787.017	99.002	15.000	
236929	1691.974	45733.129	11470.503	2913.805	12279.115	773.938	109.992	166.987	23.998	
287494	463.914	44561.961	23134.695	4109.341	713.887	3643.626	202.981	19.998	56.995	1
333197	179.995	92519.258	46282.270	8061.933	754.994	196.998	1014.992	61.000	18.000	
251504	436.018	7979.309	58146.379	13652.977	1517.987	160.999	20.000	319.997	12.000	
250870	351.994	24574.580	10169.870	33462.625	3936.959	132.999	66.999	7.000	57.999	
244349	63675.969	19635.391	48680.480	6954.711	11807.154	1258.171	124.417	27.092	4.014	2
240725	514.080	56768.969	22191.479	13374.796	2074.455	3392.161	402.251	98.036	15.160	
268136	3547.814	38850.406	57422.219	4912.630	2787.082	414.117	871.881	127.894	27.406	
279767	4371.354	26322.217	26549.291	32339.221	2796.814	1013.775	123.812	306.884	43.387	3
351128	96.701	26220.209	33647.762	6464.323	7197.125	496.072	377.057	71.620	119.015	2
391988	209.356	2930.596	57588.922	14074.734	2366.963	2923.692	167.036	84.018	28.006	2
405883	1076.998	10415.017	2919.387	24894.512	2753.952	541.324	626.922	108.898	30.131	2
441084	201.380	11886.348	19204.623	2664.623	10237.385	669.340	168.189	264.216	44.836	1
408056	1040.658	44141.125	12393.733	3355.596	564.193	2213.164	226.034	79.589	145.803	3
473955	1838.052	20443.346	31073.281	3889.020	756.982	144.252	765.573	97.505	52.225	5
447064	231.101	39863.391	39175.809	20213.473	1526.971	362.312	83.586	273.529	29.288	2
480400	1482.199	8266.777	49046.742	23557.340	6304.283	474.420	128.143	42.488	63.750	1
442010	143.844	22873.541	13761.645	32063.371	5821.263	1658.212	96.772	14.662	12.648	1
445995	352.525	14280.547	72692.008	9859.966	13958.747	2041.165	955.313	303.994	9.761	1

FLT10: ENGGFS updated 5/9/97 (Catch: Unknown) (Effort: Unknown)
1977 1996
1 1 0.50 0.75
0 7

100	53.480	6.681	3.206	6.163	0.925	0.072	0.091	0.013

Table 4.3.2 (Continued)

100	35.827	13.688	2.617	0.239	2.220	0.214	0.005	0.074
100	87.551	29.554	5.461	0.872	0.109	0.437	0.035	0.004
100	37.402	62.331	16.731	2.570	0.273	0.043	0.142	0.022
100	153.746	17.319	43.910	7.557	0.742	0.064	0.003	0.060
100	28.134	31.547	7.979	11.800	1.026	0.236	0.098	0.014
100	83.193	21.821	10.952	2.143	2.174	0.266	0.041	0.014
100	22.846	59.933	6.159	3.078	0.417	0.478	0.103	0.013
100	24.587	18.656	23.819	2.111	0.698	0.196	0.128	0.041
100	26.600	14.973	4.472	3.383	0.278	0.175	0.038	0.036
100	2.241	28.193	4.310	0.533	0.687	0.048	0.033	0.003
100	6.074	2.856	18.353	1.549	0.160	0.279	0.040	0.012
100	9.429	8.168	1.446	3.968	0.252	0.030	0.060	0.014
100	28.188	6.645	1.983	0.286	0.878	0.048	0.027	0.013
100	26.333	11.505	0.961	0.231	0.048	0.219	0.005	0.006
100	82.774	19.688	9.774	0.584	0.049	0.012	0.084	0.004
100	13.578	24.609	5.859	1.665	0.059	0.017	0.000	0.009
100	94.297	8.066	9.020	0.839	0.283	0.020	0.001	0.001
100	17.993	38.310	4.452	3.403	0.278	0.092	0.007	0.000
100	19.917	8.310	14.570	1.217	0.830	0.071	0.054	0.000

FLT11: SCOGFS (Catch: Unknown) (Effort: Unknown)
1982 1996
1 1 0.50 0.75
0 6

100	12.35	24.88	9.96	13.36	1.15	0.07	0.02
100	22.03	18.13	16.11	3.72	4.55	0.53	0.12
100	8.73	43.71	7.88	3.36	0.55	0.65	0.09
100	8.18	19.76	29.81	2.32	1.03	0.14	0.22
100	17.47	23.29	5.74	5.98	0.36	0.27	0.04
100	2.77	23.86	7.04	1.06	1.28	0.08	0.05
100	4.06	4.67	19.82	1.70	0.27	0.23	0.02
100	4.32	8.86	2.14	5.74	0.31	0.04	0.07
100	31.63	10.02	2.40	0.32	1.03	0.07	0.01
100	34.71	17.05	1.78	0.21	0.05	0.16	0.02
100	82.65	38.35	9.63	0.48	0.08	0.03	0.08
100	8.59	58.36	13.80	2.69	0.06	0.04	0.01
100	137.62	12.65	20.80	2.10	0.53	0.02	0.00
100	15.66	81.53	7.34	9.26	0.74	0.28	0.02
100	19.80	22.31	47.05	2.31	2.06	0.22	0.06

FLT13: IBTS_Q2_SCO (Catch: Unknown) (Effort: Unknown)
1991 1996
1 1 0.25 0.50
1 6

100	40.870	4.930	0.760	0.150	0.460	0.030
100	81.960	28.540	1.770	0.270	0.030	0.100
100	119.630	26.800	9.250	0.360	0.040	0.004
100	12.950	38.380	3.410	1.090	0.030	0.004
100	125.390	11.860	15.490	0.880	0.400	0.010
100	19.220	68.890	3.020	2.820	0.120	0.100

FLT14: IBTS_Q4_ENG (Catch: Unknown) (Effort: Unknown)
1991 1996
1 1 0.75 1.00
0 7

100	90.71202	57.81787	5.09395	0.74694	0.23626	0.60002	0.10083	0.03151
100	198.23196	74.86508	22.97706	1.05200	0.27820	0.02467	0.13015	0.03271
100	42.16842	74.99970	17.13699	3.98047	0.11220	0.01646	0.01646	0.02340
100	137.48325	18.52648	22.19191	3.00297	0.90902	0.08438	0.00000	0.01157
100	51.54100	160.92800	17.99500	11.51700	0.94100	0.25700	0.00000	0.00000
100	65.67700	24.73500	55.91300	2.00000	1.64600	0.13600	0.06800	0.00400

Table 4.4.1

Lowestoft VPA Version 3.1

9-Oct-97 15:01:25

Extended Survivors Analysis

Haddock in IV, IIIa (run: XSASAR03/X03)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/had_34/FLEET.X03

Catch data for 34 years. 1963 to 1996. Ages 0 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT05: IBTS_Q1 (Catc,	1973,	1996,	0,	5,	.990,	1.000
FLT08: SCOSEI (Catch,	1976,	1996,	0,	9,	.000,	1.000
FLT09: SCOLTR upd,	1976,	1996,	0,	9,	.000,	1.000
FLT10: ENGGFS upd,	1977,	1996,	0,	7,	.500,	.750
FLT11: SCOGFS (Catch,	1982,	1996,	0,	6,	.500,	.750
FLT13: IBTS_Q2_SCO (,	1991,	1996,	1,	6,	.250,	.500
FLT14: IBTS_Q4_ENG (,	1991,	1996,	0,	7,	.750,	1.000

Time series weights :

Tapered time weighting applied
Power = 0 over 10 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 28 iterations

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

Fishing mortalities

Age,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996
0,	.009,	.005,	.004,	.006,	.012,	.018,	.031,	.004,	.056,	.038
1,	.119,	.137,	.106,	.195,	.155,	.145,	.165,	.149,	.097,	.070
2,	.903,	.796,	.654,	1.120,	.776,	.726,	.788,	.531,	.492,	.403
3,	1.047,	1.304,	.987,	1.155,	1.030,	1.122,	.999,	1.006,	.794,	.859
4,	1.082,	1.114,	1.184,	1.151,	.850,	1.060,	.871,	.921,	.853,	.709
5,	.832,	1.105,	.700,	.948,	.882,	.776,	.947,	.635,	.671,	.722
6,	1.130,	.762,	.774,	.546,	.659,	1.112,	.725,	1.052,	.340,	.614
7,	.793,	.840,	.587,	.664,	.506,	.754,	.875,	.802,	.702,	1.285
8,	1.165,	.584,	.705,	.500,	.728,	.914,	.579,	1.446,	.437,	.691
9,	.992,	.694,	.680,	.689,	.809,	.967,	.991,	1.424,	.660,	.619

Table 4.4.1 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6	7		
1987	4.21E+06	6.40E+06	5.15E+05	8.28E+04	1.16E+05	9.32E+03	4.70E+03	1.10E+03	1.25E+03	2.37E+02
1988	8.45E+06	5.37E+05	1.09E+06	1.40E+05	2.27E+04	3.07E+04	3.32E+03	1.24E+03	4.07E+02	3.20E+02
1989	8.73E+06	1.08E+06	9.00E+04	3.30E+05	2.96E+04	5.79E+03	8.33E+03	1.27E+03	4.39E+02	1.86E+02
1990	2.85E+07	1.12E+06	1.87E+05	3.13E+04	9.59E+04	7.05E+03	2.35E+03	3.14E+03	5.78E+02	1.78E+02
1991	2.79E+07	3.64E+06	1.77E+05	4.09E+04	7.69E+03	2.36E+04	2.24E+03	1.12E+03	1.33E+03	2.87E+02
1992	4.27E+07	3.54E+06	5.99E+05	5.46E+04	1.14E+04	2.56E+03	8.01E+03	9.47E+02	5.51E+02	5.24E+02
1993	1.31E+07	5.40E+06	5.89E+05	1.94E+05	1.38E+04	3.07E+03	9.65E+02	2.16E+03	3.65E+02	1.81E+02
1994	5.84E+07	1.63E+06	8.80E+05	1.79E+05	5.58E+04	4.51E+03	9.73E+02	3.83E+02	7.36E+02	1.67E+02
1995	1.39E+07	7.48E+06	2.70E+05	3.47E+05	5.11E+04	1.73E+04	1.96E+03	2.78E+02	1.40E+02	1.42E+02
1996	2.57E+07	1.69E+06	1.31E+06	1.11E+05	1.22E+05	1.70E+04	7.24E+03	1.14E+03	1.13E+02	7.42E+01

Estimated population abundance at 1st Jan 1997

	.00E+00	3.19E+06	3.03E+05	5.85E+05	3.66E+04	4.68E+04	6.74E+03	3.21E+03	2.58E+02	4.64E+01

Taper weighted geometric mean of the VPA populations:

	1.76E+07	2.39E+06	4.23E+05	1.14E+05	3.55E+04	8.82E+03	3.06E+03	1.04E+03	4.58E+02	2.03E+02

Standard error of the weighted Log(VPA populations) :

	.8187	.8800	.8818	.8344	1.0009	.8650	.8077	.7141	.8083	.5237

Table 4.4.1 (Continued)

Log catchability residuals.

Fleet : FLT05: IBTS_Q1 (Catc

Age	1973	1974	1975	1976
0	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99
6	No data for this fleet at this age			
7	No data for this fleet at this age			
8	No data for this fleet at this age			
9	No data for this fleet at this age			

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	-.15	-.02	-.01	-.06	.46	.14	-.35	-.08	-.23	.30
1	-.17	.36	-.24	-.01	-.19	.21	-.27	.01	-.18	.48
2	.08	.27	.42	-.10	-.62	.21	-.17	-.22	-.08	.22
3	.15	.15	.08	.05	-.62	.28	-.18	-.01	-.24	.33
4	.18	-.09	.12	.00	.03	-.15	.16	-.27	.18	-.16
5	-.03	-.03	.32	.37	-.91	.52	.51	-.19	-.37	-.20
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5
Mean Log q	-15.4411	-14.1139	-14.2544	-14.5311	-14.7919	-14.3027
S.E(Log q)	.2434	.2659	.3037	.2830	.1619	.4469

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	.89	1.253	15.57	.94	10	.21	-15.44
1	1.19	-1.760	14.01	.91	10	.28	-14.11
2	.95	.456	14.19	.91	10	.30	-14.25
3	.99	.068	14.51	.90	10	.30	-14.53
4	1.00	-.065	14.81	.97	10	.17	-14.79
5	1.62	-3.121	17.54	.76	10	.52	-14.30

Table 4.4.1 (Continued)

Fleet : FLT08: SCOSEI (Catch

Age	1973	1974	1975	1976
0	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	-.61	.08	-1.30	-.55	.50	-.41	1.75	.37	-.54	.71
1	-1.02	.25	.09	.89	.19	-.45	.15	.32	-.02	-.40
2	-.09	-.06	.09	.60	-.01	-.39	.07	-.07	-.01	-.13
3	-.26	.06	.03	.31	-.07	-.31	-.11	-.04	.20	.18
4	-.08	-.14	.25	.39	-.21	-.38	-.10	.04	.17	.05
5	-.06	.28	-.08	.27	.17	-.39	.05	-.53	.06	.24
6	.39	.20	.15	-.19	-.19	.18	-.21	.25	-.66	.09
7	-.03	.35	.02	-.09	-.44	-.49	.23	-.07	.39	.12
8	.35	.07	.20	-.27	-.11	-.21	-.51	.34	-.10	.22
9	-.29	.22	.25	.15	-.01	-.20	-.30	-.49	-.37	.29

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

Age	0	1	2	3	4	5	6	7	8	9
Mean Log q	-21.7982	-16.1588	-13.9339	-13.5446	-13.6634	-13.9544	-14.1249	-14.1684	-14.1684	-14.1684
S.E(Log q)	.8690	.5183	.2492	.1974	.2302	.2751	.3109	.2963	.2858	.3009

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	.79	.755	20.70	.61	10	.70	-21.80
1	1.43	-1.682	16.79	.66	10	.68	-16.16
2	1.17	-1.664	14.10	.93	10	.27	-13.93
3	.98	.297	13.50	.95	10	.20	-13.54
4	.87	2.282	13.26	.98	10	.17	-13.66
5	.82	2.648	13.09	.96	10	.17	-13.95
6	.86	1.319	13.27	.92	10	.26	-14.12
7	1.07	-.423	14.64	.84	10	.33	-14.17
8	.96	.294	13.89	.90	10	.29	-14.17
9	1.09	-.437	15.07	.74	10	.33	-14.24

Table 4.4.1 (Continued)

Fleet : FLT09: SCOLTR upd

Age	1973	1974	1975	1976
0	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	.17	.14	1.70	-1.24	.51	.50	-.33	-.04	-.84	-.58
1	-.28	-.10	.42	.47	.66	-.23	.08	-.38	-.82	.18
2	.39	.02	-.56	.70	.26	-.21	.12	-.24	-.26	-.22
3	.07	.31	-.14	-.03	-.04	-.30	.09	.26	-.10	-.12
4	-.18	.25	.13	.17	-.25	-.41	.08	.05	.11	.05
5	-.32	.26	.04	.08	.11	-.59	.28	-.04	-.03	.21
6	.31	-.42	-.04	-.28	.20	.18	-.02	.46	-.74	.35
7	-.15	-.20	-.11	-.18	-.33	-.01	.31	.08	-.63	1.22
8	.38	-.29	-.28	-.33	.20	-.02	-.27	.08	-.21	-.15
9	.51	-.29	.22	-.26	.42	.15	.51	-.04	.17	.59

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

Age	0	1	2	3	4	5	6	7	8	9
Mean Log q	-22.7625	-17.2247	-15.3038	-14.8060	-14.7828	-14.9079	-15.0086	-14.8957	-14.8957	-14.8957
S.E(Log q)	.8257	.4503	.3718	.1846	.2087	.2715	.3807	.4942	.2584	.3787

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	1.31	-.685	24.65	.38	10	1.12	-22.76
1	1.26	-1.224	17.87	.74	10	.55	-17.22
2	1.03	-.165	15.36	.84	10	.40	-15.30
3	.96	.540	14.68	.96	10	.18	-14.81
4	.93	1.174	14.46	.97	10	.19	-14.78
5	.88	1.433	14.18	.94	10	.22	-14.91
6	.94	.381	14.60	.84	10	.38	-15.01
7	.85	.745	13.70	.76	10	.43	-14.90
8	.84	2.325	13.58	.96	10	.17	-14.99
9	1.23	-.903	16.82	.67	10	.39	-14.70

Table 4.4.1 (Continued)

Fleet : FLT10: ENGGFS upd

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	-.66	-.36	.04	-.04	-.08	.64	.02	.45	.26	-.27
1	-.14	.06	.39	.20	-.45	.11	-.08	-.01	-.01	-.06
2	-.20	.43	.30	.17	-.71	.36	-.10	-.23	.22	-.22
3	-.27	.43	.32	.14	-.41	.28	-.02	-.62	-.01	.15
4	.03	.23	.46	.51	-.06	-.30	-.42	-.22	-.19	-.06
5	-.10	.63	-.18	.25	.52	-.23	.04	-.38	-.17	-.38
6	.47	.78	.27	.59	-.97	.86	99.99	-1.50	-.70	.21
7	-.53	.76	.74	-.20	-.03	-.12	-.06	-.57	99.99	99.99
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6	7
Mean Log q	-17.1161	-15.6983	-15.2839	-15.4814	-15.8497	-16.0361	-16.1110	-16.2678
S.E(Log q)	.3831	.2218	.3556	.3384	.3146	.3560	.8453	.5051

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	.75	2.994	17.01	.95	10	.21	-17.12
1	1.15	-1.647	15.85	.94	10	.23	-15.70
2	1.01	-.038	15.30	.86	10	.38	-15.28
3	.96	.267	15.34	.87	10	.34	-15.48
4	.91	.996	15.34	.93	10	.28	-15.85
5	.82	1.726	14.81	.92	10	.27	-16.04
6	.54	2.937	12.46	.85	9	.33	-16.11
7	.82	.669	14.64	.70	8	.43	-16.27

Table 4.4.1 (Continued)

Fleet : FLT11: SCOGFS (Catch

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	-.37	-.68	-.66	.16	.27	.72	-.36	.91	.20	-.19
1	-.80	.06	-.02	.12	-.55	.28	.29	-.05	.26	.43
2	-.22	-.01	.18	-.15	-.61	-.17	.24	.09	.21	.44
3	.01	.12	.28	-.14	-.91	-.31	.06	-.10	.59	.39
4	.20	.30	.21	.22	-.47	-.26	-.86	-.05	.33	.39
5	-.06	-.03	-.36	.16	-.27	.22	.43	-.84	.47	.28
6	.49	-.30	.04	-.79	.03	.42	.22	99.99	-.04	-.08
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6
Mean Log q	-17.1967	-15.2049	-14.7722	-15.0804	-15.3921	-15.5677	-15.7237
S.E(Log q)	.5445	.3923	.2994	.4157	.4117	.4052	.3853

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	.64	4.482	17.01	.95	10	.20	-17.20
1	1.11	-.625	15.26	.81	10	.45	-15.20
2	.90	1.039	14.58	.92	10	.27	-14.77
3	.73	3.110	14.15	.94	10	.22	-15.08
4	.77	2.996	14.26	.95	10	.23	-15.39
5	.98	.148	15.41	.83	10	.42	-15.57
6	.89	.626	14.92	.83	9	.36	-15.72

Table 4.4.1 (Continued)

Fleet : FLT13: IBTS_Q2_SCO (

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age									
1	99.99	99.99	99.99	99.99	-.24	.48	.45	-.59	.14	-.25
2	99.99	99.99	99.99	99.99	-.37	.15	.13	-.01	-.02	.13
3	99.99	99.99	99.99	99.99	-.44	.15	.49	-.43	.35	-.12
4	99.99	99.99	99.99	99.99	-.10	.18	.20	-.07	-.22	.02
5	99.99	99.99	99.99	99.99	.51	-.04	.13	-.65	.61	-.56
6	99.99	99.99	99.99	99.99	.53	.62	-.62	-.51	-.56	.54
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	1	2	3	4	5	6
Mean Log q	-15.0988	-14.2860	-14.5823	-14.9420	-15.5600	-16.0312
S.E(Log q)	.4284	.1962	.3931	.1637	.5271	.6189

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	.67	2.021	15.08	.90	6	.22	-15.10
2	.83	2.448	14.09	.98	6	.12	-14.29
3	.81	1.155	14.02	.90	6	.31	-14.58
4	1.06	-.780	15.21	.98	6	.18	-14.94
5	.85	.723	14.55	.85	6	.47	-15.56
6	.64	3.208	13.07	.95	6	.23	-16.03

Table 4.4.1 (Continued)

Fleet : FLT14: IBTS_Q4_ENG (

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	99.99	99.99	99.99	99.99	.00	.36	.01	-.33	.17	-.22
1	99.99	99.99	99.99	99.99	.01	.29	-.11	-.33	.27	-.14
2	99.99	99.99	99.99	99.99	-.10	.15	-.08	-.44	.49	-.02
3	99.99	99.99	99.99	99.99	-.06	.08	.03	-.17	.33	-.22
4	99.99	99.99	99.99	99.99	.56	.52	-.75	-.01	.06	-.38
5	99.99	99.99	99.99	99.99	.85	-.21	-.65	.33	.13	-.44
6	99.99	99.99	99.99	99.99	.79	.16	-.13	99.99	99.99	-.82
7	99.99	99.99	99.99	99.99	.26	.68	-.37	.59	99.99	-1.15
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6	7
Mean Log q	-15.4501	-14.1005	-13.9382	-14.3425	-14.6008	-15.0908	-14.6495	-14.7237
S.E(Log q)	.2512	.2432	.3089	.1986	.5100	.5490	.6671	.7632

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	1.12	-.545	15.25	.83	6	.30	-15.45
1	.79	1.886	14.30	.95	6	.16	-14.10
2	1.20	-.882	14.10	.83	6	.38	-13.94
3	.91	.870	14.11	.96	6	.19	-14.34
4	1.25	-.959	15.71	.78	6	.64	-14.60
5	.78	1.162	13.76	.88	6	.41	-15.09
6	1.27	-.482	16.42	.61	4	.98	-14.65
7	2.89	-1.089	29.47	.10	5	2.15	-14.72

Table 4.4.1 (Continued)

Terminal year survivor and F summaries :

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

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT05: IBTS_Q1 (Catc,	4324711.,	.300,	.000,	.00,	1,	.291,	.000
FLT08: SCOSEI (Catch,	6514996.,	.911,	.000,	.00,	1,	.032,	.000
FLT09: SCOLTR upd,	1794042.,	.866,	.000,	.00,	1,	.035,	.000
FLT10: ENGGFS upd,	2441381.,	.402,	.000,	.00,	1,	.162,	.000
FLT11: SCOGFS (Catch,	2630781.,	.571,	.000,	.00,	1,	.080,	.000
FLT13: IBTS_Q2_SCO (,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT14: IBTS_Q4_ENG (,	2564506.,	.300,	.000,	.00,	1,	.291,	.000
F shrinkage mean ,	4246392.,	.50,,,,				.109,	.029

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3189124.,	.16,	.12,	7,	.768,	.038

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT05: IBTS_Q1 (Catc,	346259.,	.212,	.355,	1.67,	2,	.245,	.062
FLT08: SCOSEI (Catch,	195915.,	.467,	.059,	.13,	2,	.051,	.107
FLT09: SCOLTR upd,	290173.,	.415,	.423,	1.02,	2,	.065,	.073
FLT10: ENGGFS upd,	317606.,	.240,	.153,	.64,	2,	.192,	.067
FLT11: SCOGFS (Catch,	431856.,	.334,	.109,	.33,	2,	.100,	.050
FLT13: IBTS_Q2_SCO (,	234829.,	.463,	.000,	.00,	1,	.053,	.090
FLT14: IBTS_Q4_ENG (,	306206.,	.212,	.156,	.73,	2,	.245,	.070
F shrinkage mean ,	127053.,	.50,,,,				.049,	.160

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
302624.,	.11,	.10,	14,	.924,	.070

Table 4.4.1 (Continued)

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT05: IBTS_Q1 (Catc,	575207.,	.177,	.120,	.68,	3,	.202,	.408
FLT08: SCOSEI (Catch,	542923.,	.253,	.091,	.36,	3,	.103,	.428
FLT09: SCOLTR upd,	389909.,	.284,	.213,	.75,	3,	.080,	.556
FLT10: ENGGFS upd,	606534.,	.202,	.178,	.88,	3,	.154,	.391
FLT11: SCOGFS (Catch,	921516.,	.229,	.146,	.64,	3,	.123,	.274
FLT13: IBTS_Q2_SCO (,	668900.,	.252,	.006,	.02,	2,	.103,	.360
FLT14: IBTS_Q4_ENG (,	568827.,	.179,	.175,	.98,	3,	.196,	.412
F shrinkage mean ,	300139.,	.50,,,,				.040,	.676

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
584707.,	.08,	.07,	21,	.883,	.403

Age 3 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
FLT05: IBTS_Q1 (Catc,	38199.,	.159,	.148,	.93,	4,	.183,	.834
FLT08: SCOSEI (Catch,	43589.,	.200,	.172,	.86,	4,	.129,	.761
FLT09: SCOLTR upd,	30226.,	.214,	.056,	.26,	4,	.116,	.973
FLT10: ENGGFS upd,	40435.,	.183,	.052,	.28,	4,	.136,	.802
FLT11: SCOGFS (Catch,	42974.,	.210,	.132,	.63,	4,	.103,	.769
FLT13: IBTS_Q2_SCO (,	31412.,	.224,	.141,	.63,	3,	.094,	.949
FLT14: IBTS_Q4_ENG (,	34588.,	.161,	.169,	1.05,	4,	.179,	.891
F shrinkage mean ,	28723.,	.50,,,,				.060,	1.005

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
36571.,	.07,	.05,	28,	.689,	.859

Table 4.4.1 (Continued)

Age 4 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
FLT05: IBTS_Q1 (Catc,	39740.,	.164,	.056,	.34,	5,	.175,	.795
FLT08: SCOSEI (Catch,	50116.,	.189,	.051,	.27,	5,	.149,	.675
FLT09: SCOLTR upd,	46453.,	.196,	.057,	.29,	5,	.142,	.713
FLT10: ENGGFS upd,	46017.,	.188,	.097,	.52,	5,	.137,	.718
FLT11: SCOGFS (Catch,	68014.,	.222,	.092,	.41,	5,	.092,	.537
FLT13: IBTS_Q2_SCO (,	51002.,	.207,	.086,	.42,	4,	.130,	.666
FLT14: IBTS_Q4_ENG (,	46759.,	.173,	.173,	1.00,	5,	.116,	.709
F shrinkage mean ,	31796.,	.50,,,,				.060,	.924

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
46819.,	.07,	.04,	35,	.564,	.709

Age 5 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
FLT05: IBTS_Q1 (Catc,	6880.,	.202,	.090,	.45,	6,	.131,	.712
FLT08: SCOSEI (Catch,	8076.,	.197,	.048,	.24,	6,	.187,	.633
FLT09: SCOLTR upd,	8082.,	.199,	.033,	.16,	6,	.184,	.633
FLT10: ENGGFS upd,	4973.,	.218,	.072,	.33,	6,	.139,	.890
FLT11: SCOGFS (Catch,	8746.,	.262,	.049,	.19,	6,	.099,	.597
FLT13: IBTS_Q2_SCO (,	5005.,	.236,	.121,	.51,	5,	.098,	.886
FLT14: IBTS_Q4_ENG (,	5717.,	.246,	.107,	.43,	6,	.080,	.810
F shrinkage mean ,	5929.,	.50,,,,				.082,	.790

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
6745.,	.09,	.04,	42,	.466,	.722

Table 4.4.1 (Continued)

Age 6 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
FLT05: IBTS_Q1 (Catc,	2496.,	.204,	.062,	.30,	6,	.081,	.737
FLT08: SCOSEI (Catch,	3393.,	.191,	.035,	.18,	7,	.235,	.589
FLT09: SCOLTR upd,	3703.,	.201,	.082,	.41,	7,	.194,	.551
FLT10: ENGGFS upd,	2889.,	.231,	.073,	.32,	7,	.103,	.664
FLT11: SCOGFS (Catch,	3420.,	.253,	.103,	.41,	7,	.138,	.585
FLT13: IBTS_Q2_SCO (,	4403.,	.268,	.136,	.51,	6,	.088,	.481
FLT14: IBTS_Q4_ENG (,	2564.,	.306,	.189,	.62,	6,	.068,	.723
F shrinkage mean ,	2281.,	.50,,,,				.093,	.785

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3207.,	.09,	.04,	47,	.444,	.614

Age 7 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
FLT05: IBTS_Q1 (Catc,	256.,	.209,	.101,	.48,	6,	.058,	1.291
FLT08: SCOSEI (Catch,	204.,	.172,	.136,	.79,	8,	.296,	1.462
FLT09: SCOLTR upd,	279.,	.198,	.277,	1.40,	8,	.185,	1.229
FLT10: ENGGFS upd,	178.,	.232,	.104,	.45,	7,	.074,	1.566
FLT11: SCOGFS (Catch,	179.,	.253,	.159,	.63,	7,	.098,	1.562
FLT13: IBTS_Q2_SCO (,	197.,	.270,	.191,	.71,	5,	.063,	1.486
FLT14: IBTS_Q4_ENG (,	167.,	.367,	.322,	.88,	5,	.047,	1.618
F shrinkage mean ,	622.,	.50,,,,				.179,	.735

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
258.,	.12,	.10,	47,	.818,	1.285

Table 4.4.1 (Continued)

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT05: IBTS_Q1 (Catc,	50.,	.225,	.180,	.80,	6,	.016,	.658
FLT08: SCOSEI (Catch,	60.,	.197,	.042,	.21,	9,	.415,	.573
FLT09: SCOLTR upd,	40.,	.231,	.091,	.39,	9,	.331,	.766
FLT10: ENGGFS upd,	32.,	.264,	.248,	.94,	7,	.023,	.895
FLT11: SCOGFS (Catch,	53.,	.286,	.191,	.67,	6,	.013,	.627
FLT13: IBTS_Q2_SCO (,	39.,	.329,	.191,	.58,	4,	.020,	.774
FLT14: IBTS_Q4_ENG (,	36.,	.345,	.332,	.96,	3,	.008,	.822
F shrinkage mean ,	36.,	.50,,,,				.174,	.829

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
46.,	.14,	.05,	45,	.331,	.691

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT05: IBTS_Q1 (Catc,	41.,	.205,	.108,	.53,	6,	.016,	.517
FLT08: SCOSEI (Catch,	35.,	.175,	.072,	.41,	10,	.431,	.592
FLT09: SCOLTR upd,	36.,	.203,	.131,	.65,	10,	.315,	.572
FLT10: ENGGFS upd,	23.,	.303,	.101,	.33,	7,	.036,	.803
FLT11: SCOGFS (Catch,	37.,	.259,	.088,	.34,	7,	.028,	.562
FLT13: IBTS_Q2_SCO (,	25.,	.312,	.189,	.61,	3,	.016,	.760
FLT14: IBTS_Q4_ENG (,	41.,	.438,	.215,	.49,	4,	.018,	.516
F shrinkage mean ,	22.,	.50,,,,				.141,	.812

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
33.,	.12,	.05,	48,	.403,	.619

TABLE 4.4.2; Haddock, North Sea + Skagerrak
International F at age, Total , 1963 to 1996.

Age	1963	1964	1965	1966
0	.002	.043	.072	.070
1	.124	.058	1.363	1.303
2	.805	.454	.416	.831
3	.670	1.175	.509	.360
4	.761	.756	.985	.779
5	.880	.884	1.299	1.240
6	.508	1.263	1.021	1.310
7	.827	.622	.872	1.082
8	.777	.839	.498	.970
9	.758	.882	.946	1.089
10+	.758	.882	.946	1.089

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
0	.002	.002	.017	.030	.012	.032	.002	.013	.011	.030
1	.263	.052	.022	.500	.474	.169	.374	.353	.335	.308
2	1.081	.578	.655	1.038	.659	.793	.565	.933	.969	.814
3	.415	.898	1.376	1.150	.798	1.339	1.158	.950	1.254	1.371
4	.372	.307	1.287	1.269	.871	1.201	.802	1.003	1.099	.781
5	1.014	.508	.814	.711	.864	1.158	.950	.628	.992	1.271
6	1.326	.808	1.626	1.437	.686	.859	1.098	.880	.820	1.064
7	1.139	.597	1.000	.709	1.017	.684	.882	1.125	1.567	.393
8	1.945	.659	.951	1.059	1.285	.471	1.146	.405	.998	.840
9	1.173	.581	1.149	1.049	.955	.884	.987	.817	1.108	.879
10+	1.173	.581	1.149	1.049	.955	.884	.987	.817	1.108	.879

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.013	.022	.035	.074	.057	.038	.027	.015	.016	.003
1	.338	.391	.176	.189	.179	.174	.151	.125	.206	.128
2	1.005	1.012	.882	.707	.450	.431	.660	.668	.614	1.018
3	1.037	1.128	1.141	1.209	.946	.815	1.020	.996	.957	1.240
4	1.262	1.123	1.062	1.185	.993	.879	1.160	1.139	1.102	1.287
5	1.031	1.163	1.023	.937	.803	.646	1.211	1.217	1.019	1.053
6	.989	1.036	1.171	.985	.610	.749	.813	1.084	1.059	.702
7	.924	1.146	.617	1.296	1.008	.982	.838	.765	.938	.836
8	.488	.853	.942	.657	1.115	1.105	.577	.575	.678	.662
9	.949	1.077	.974	1.023	.916	.882	.930	.967	.970	.918
10+	.949	1.077	.974	1.023	.916	.882	.930	.967	.970	.918

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	.009	.005	.004	.006	.013	.018	.031	.004	.056	.038
1	.119	.137	.106	.195	.154	.145	.165	.149	.097	.070
2	.903	.796	.654	1.120	.776	.726	.788	.531	.492	.403
3	1.047	1.304	.987	1.155	1.030	1.122	.999	1.006	.794	.859
4	1.082	1.114	1.184	1.151	.850	1.060	.871	.921	.853	.709
5	.832	1.105	.700	.948	.882	.776	.947	.635	.671	.722
6	1.130	.762	.774	.546	.659	1.112	.725	1.052	.340	.614
7	.793	.840	.587	.664	.506	.754	.875	.802	.701	1.285
8	1.164	.584	.705	.500	.728	.914	.579	1.446	.437	.691
9	.992	.694	.680	.689	.808	.967	.992	1.423	.660	.619
10+	.992	.694	.680	.689	.808	.967	.992	1.423	.660	.619

TABLE 4.4.3; Haddock, North Sea + Skagerrak
Tuned Stock Numbers at age (10**-5), 1963 to 1997, (numbers in 1997 are VPA survivors)

Age	1963	1964	1965	1966	1967
0	23383	91721	263363	689923	3881118
1	255640	3005	11304	31563	82821
2	7401	43367	545	556	1647
3	486	2217	18453	241	162
4	277	194	534	8636	131
5	109	101	71	155	3085
6	14	37	34	16	37
7	13	7	9	10	3
8	12	5	3	3	3
9	1	4	2	1	1
10+	0	0	1	0	1

Age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
0	171025	121955	877639	782847	215392	728983	1334931	115423	164836	257517
1	498537	21977	15439	109661	99584	26853	93628	169646	14693	20595
2	12233	90929	4131	1798	13106	16149	3549	12631	23303	2074
3	375	4601	31652	980	623	3975	6153	936	3213	6918
4	83	119	905	7806	344	127	972	1853	208	635
5	70	48	26	198	2545	81	44	278	481	74
6	917	35	17	10	68	654	26	19	84	110
7	8	334	6	3	4	24	179	9	7	24
8	1	4	101	2	1	2	8	48	1	4
9	0	0	1	29	1	1	0	4	14	1
10+	0	0	1	3	8	3	1	1	1	4

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	395504	721640	156568	324831	206179	669800	172694	240475	498882	42081
1	32718	49820	89736	18723	39498	25542	83931	21889	30457	64021
2	2821	4252	8028	14260	3006	6377	4216	14225	3420	5146
3	509	688	1180	2653	6095	1310	2210	1449	5161	828
4	1909	128	171	274	803	2100	368	635	433	1163
5	140	483	35	41	79	259	513	92	164	93
6	22	36	142	11	15	34	63	124	27	47
7	34	6	9	43	5	6	12	18	35	11
8	8	9	3	2	13	2	2	5	6	13
9	2	3	3	1	1	4	1	1	2	2
10+	2	1	2	1	0	1	2	2	2	2

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	84464	87332	284581	278752	427327	130841	583764	138961	257369	0
1	5369	10814	11200	36428	35440	54040	16337	74842	16907	31891
2	10919	900	1868	1770	5994	5887	8801	2703	13051	3026
3	1399	3302	313	409	546	1944	1795	3470	1108	5847
4	227	296	959	77	114	138	558	511	1221	366
5	307	58	70	236	26	31	45	173	170	468
6	33	83	24	22	80	10	10	20	72	67
7	12	13	31	11	9	22	4	3	11	32
8	4	4	6	13	6	4	7	1	1	3
9	3	2	2	3	5	2	2	1	1	0
10+	2	1	1	1	3	4	1	1	1	1

Table 4.5.1

HADDOCK IN IV, RCT3 INPUT VALUES Age0 ########

18 27 2

'YEARCLASS'	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS0'	'SGFS1'	'SGFS2'	'GGFS1'	'GGFS2'	'IBQ21'	'SCQ21'	'SCQ22'	'IBQ40'	'IBQ41'	'ENQ40'	'ENQ41'	'ENQ42'
1971	782847	740	971	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	215392	187	110	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	726983	1092	385	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	1334931	1168	670	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	115423	177	84	-1	-1	32.1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1976	164836	162	108	-1	66.8	26.2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1977	257517	385	240	534.8	136.9	54.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	395504	480	402	358.3	295.5	167.3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1979	721640	896	675	875.5	623.3	439.1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1980	156568	268	252	374	173.2	79.8	-1	-1	99.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1981	324831	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	206179	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	669800	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	172694	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	240475	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	498882	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	42081	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	84464	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	87332	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	284581	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	278752	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	427327	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	130841	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	17.995
1994	-1	1375	813.3	943	383.1	145.7	1376.2	815.3	470.5	526.6	-1	1549	12539	6889	3519.24	2190.92	137.483	160.928	55.913
1995	-1	267.4	366.4	180	83.1	43.7	156.6	223.1	84.9	-1	-1	790	1922	1472	598.78	-1	51.541	24.735	-1
1996	-1	860.2	-1	199	15.3	-1	198	277.9	-1	-1	-1	1463	3144	-1	-1	-1	65.677	-1	-1
1997	-1	-1	-1	137	-1	-1	97.2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Yclass	VPA	IBQ11	IBQ12	egfs0	egfs1	egfs2	sgfs0	sgfs1	sgfs2	ggfs1	ggfs2	IBQ21	SCQ21	SCQ22	IBQ40	IBQ41	ENQ40	ENQ41	ENQ42
Updated ?		Prov	Prov	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y	N	N	Y	Y	Y

KEY

index	Survey	Quarter	Age	
IBQ11	IBTS	1	1	Provisional (age based) for 97 survey
IBQ12	IBTS	1	2	Provisional (age based) for 97 survey
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	Survey discontinued
GGFS2	German GFS	2	2	Survey discontinued
IBQ21	IBTS (provisional, length-bas	2	1	
SCQ21	IBTS (Scottish, age based)	2	1	
SCQ22	IBTS (Scottish, age based)	2	2	
IBQ40	IBTS (provisional, length-bas	4	0	
IBQ41	IBTS (provisional, length-bas	4	1	
ENQ40	IBTS (English, age based)	4	0	
ENQ41	IBTS (English, age based)	4	1	
ENQ42	IBTS (English, age based)	4	2	

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Table 4.5.2.a

Analysis by RCT3 ver3.1 of data from file :
w:\acfm\wgnssk\had_34\hadrct0.inp

HADDOCK IN IV, RCT3 INPUT VALUES Age 0 05-Sep-97

Data for 18 surveys over 27 years : 1971 - 1997
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1995

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.22	5.05	.46	.777	23	5.59	11.89	.495	.058
IYFS2	1.30	5.12	.49	.757	23	5.91	12.77	.520	.052
EGFS0	.85	7.57	.46	.750	17	5.20	11.98	.501	.056
EGFS1	1.03	7.06	.33	.843	18	4.43	11.64	.368	.104
EGFS2	.85	8.77	.33	.842	19	3.80	12.00	.359	.109
SGFS0	.98	7.46	.57	.691	12	5.06	12.43	.648	.034
SGFS1	1.25	5.66	.37	.834	13	5.41	12.44	.414	.082
SGFS2	.95	8.05	.29	.878	14	4.45	12.25	.329	.130
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22	.79	6.36	.14	.966	5	7.30	12.10	.198	.353
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	12.48	.837	.020

Yearclass = 1996

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.22	5.05	.46	.777	23	6.76	13.32	.499	.160
IYFS2									
EGFS0	.85	7.57	.46	.750	17	5.30	12.06	.500	.159
EGFS1	1.03	7.06	.33	.843	18	5.04	12.26	.361	.304
EGFS2									
SGFS0	.98	7.46	.57	.691	12	5.29	12.66	.652	.093
SGFS1	1.25	5.66	.37	.834	13	5.63	12.71	.418	.227
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	12.48	.837	.057

Yearclass = 1997

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.85	7.57	.46	.750	17	4.93	11.75	.506	.507
EGFS1									
EGFS2									
SGFS0	.98	7.46	.57	.691	12	4.59	11.96	.648	.308
SGFS1									
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		12.48	.837	.185

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	184345	12.12	.12	.09	.54		
1996	282260	12.55	.20	.18	.83		
1997	154837	11.95	.36	.19	.28		

Table 4.5.2.b

Analysis by RCT3 ver3.1 of data from file :
w:\acfm\wgnssk\had_34\hadrct1.inp

HADDOCK IN IV, RCT3 INPUT VALUES Age 1 05-Sep-97

Data for 18 surveys over 27 years : 1971 - 1997
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1995

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.22	3.00	.45	.782	23	5.59	9.82	.489	.063
IYFS2	1.30	3.04	.49	.756	23	5.91	10.70	.521	.055
EGFS0	.85	5.47	.47	.734	17	5.20	9.90	.520	.055
EGFS1	1.04	4.97	.34	.834	18	4.43	9.56	.380	.104
EGFS2	.85	6.70	.34	.833	19	3.80	9.93	.369	.110
SGFS0	.98	5.41	.56	.692	12	5.06	10.36	.646	.036
SGFS1	1.25	3.62	.37	.833	13	5.41	10.37	.413	.087
SGFS2	.95	5.96	.31	.867	14	4.45	10.18	.346	.125
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22	.79	4.28	.15	.963	5	7.30	10.04	.209	.344
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	10.41	.838	.021

Yearclass = 1996

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.22	3.00	.45	.782	23	6.76	11.25	.493	.168
IYFS2									
EGFS0	.85	5.47	.47	.734	17	5.30	9.99	.519	.151
EGFS1	1.04	4.97	.34	.834	18	5.04	10.19	.372	.293
EGFS2									
SGFS0	.98	5.41	.56	.692	12	5.29	10.59	.650	.096
SGFS1	1.25	3.62	.37	.833	13	5.63	10.64	.417	.234
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	10.41	.838	.058

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression				----------I	I-----------Prediction			---------I
IYFS1									
IYFS2									
EGFS0	.85	5.47	.47	.734	17	4.93	9.67	.525	.487
EGFS1									
EGFS2									
SGFS0	.98	5.41	.56	.692	12	4.59	9.90	.646	.322
SGFS1									
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		10.41	.838	.191

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	23355	10.06	.12	.09	.53		
1996	36054	10.49	.20	.18	.82		
1997	19652	9.89	.37	.19	.28		

Table 4.5.2.c

Analysis by RCT3 ver3.1 of data from file :
w:\acfm\wgnssk\had_34\hadrct2.inp

HADDOCK IN IV, RCT3 INPUT VALUES Age 2 05-Sep-97

Data for 18 surveys over 27 years : 1971 - 1997
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	Regression					Prediction			
IYFS1	1.17	1.42	.39	.824	23	5.59	7.99	.422	.077
IYFS2	1.23	1.59	.39	.828	23	5.91	8.83	.413	.081
EGFS0	.87	3.53	.52	.698	17	5.20	8.07	.568	.043
EGFS1	1.03	3.17	.32	.851	18	4.43	7.74	.358	.108
EGFS2	.86	4.84	.33	.845	19	3.80	8.09	.358	.108
SGFS0	.99	3.55	.58	.681	12	5.06	8.57	.665	.031
SGFS1	1.26	1.75	.38	.822	13	5.41	8.57	.431	.074
SGFS2	.95	4.13	.31	.865	14	4.45	8.38	.349	.113
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22	.80	2.40	.13	.971	5	7.30	8.22	.185	.345
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		8.55	.828	.020

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	Regression					Prediction			
IYFS1	1.17	1.42	.39	.824	23	6.76	9.36	.426	.214
IYFS2									
EGFS0	.87	3.53	.52	.698	17	5.30	8.16	.567	.121
EGFS1	1.03	3.17	.32	.851	18	5.04	8.36	.351	.316
EGFS2									
SGFS0	.99	3.55	.58	.681	12	5.29	8.80	.670	.087
SGFS1	1.26	1.75	.38	.822	13	5.63	8.84	.435	.205
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		8.55	.828	.057

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I----------Regression				---------I	I----------Prediction			---------I
IYFS1									
IYFS2									
EGFS0	.87	3.53	.52	.698	17	4.93	7.84	.573	.450
EGFS1									
EGFS2									
SGFS0	.99	3.55	.58	.681	12	4.59	8.10	.666	.334
SGFS1									
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		8.55	.828	.216

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	3797	8.24	.12	.09	.64		
1996	5994	8.70	.20	.18	.88		
1997	3225	8.08	.38	.19	.25		

TABLE 4.6.1; Haddock, North Sea + Skagerrak
Mean fishing mortality, biomass and recruitment, 1963 - 1996.

	Mean F			Stock Biomass ('000 tonnes)		Recruits Age 0	
Year	H.cons. Ages 2 to 6	Disc. Ages 2 to 6	Ind BC Ages 0 to 3	Total	Spawning	Yclass	Million
1963	.579	.125	.026	3387	137	1963	2338
1964	.699	.073	.131	1188	420	1964	9172
1965	.647	.067	.343	812	526	1965	26336
1966	.715	.104	.263	780	432	1966	68992
1967	.678	.142	.052	1216	229	1967	388112
1968	.485	.089	.056	6700	265	1968	17103
1969	.843	.093	.198	2344	816	1969	12196
1970	.804	.123	.266	1405	900	1970	87764
1971	.629	.108	.078	1672	418	1971	78285
1972	.900	.145	.051	1677	301	1972	21539
1973	.777	.126	.034	900	294	1973	72898
1974	.639	.140	.101	1568	258	1974	133493
1975	.763	.203	.086	2163	238	1975	11542
1976	.812	.153	.125	885	308	1976	16484
1977	.807	.127	.173	567	239	1977	25752
1978	.879	.185	.062	665	132	1978	39550
1979	.939	.085	.056	673	109	1979	72164
1980	.847	.080	.088	1250	153	1980	15657
1981	.654	.086	.064	671	240	1981	32483
1982	.588	.067	.066	840	300	1982	20618
1983	.801	.145	.049	759	253	1983	66980
1984	.905	.091	.032	1493	199	1984	17269
1985	.851	.078	.018	860	241	1985	24048
1986	.878	.178	.012	715	222	1986	49888
1987	.852	.142	.019	1068	157	1987	4208
1988	.840	.147	.026	428	159	1988	8446
1989	.704	.132	.016	397	129	1989	8733
1990	.701	.232	.026	344	81	1990	28458
1991	.759	.065	.023	747	63	1991	27875
1992	.850	.098	.032	611	102	1992	42733
1993	.711	.138	.039	891	137	1993	13084
1994	.653	.169	.014	526	162	1994	58376
1995	.493	.133	.027	1016	165	1995	13896
1996	.506	.135	.028	666	208	1996	28226 [RCT3 estimate]
Min.	.485	.065	.012	344	63	Min.	2338
Mean	.741	.124	.079	1232	265	Gmean	27131
Max.	.939	.232	.343	6700	900	Max.	388112

Min, max and geo. mean recruitment calculated over years 1963 to 1994
(Arithmetic mean recruitment 1963 - 1994 = 46956)
Biomass totals calculated at start of year.

Table 4.7.1; Haddock,North Sea + Skagerrak, input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N0	15483700	.36	WS0	.02	.19
N1	3605400	.21	WS1	.12	.12
N2	302599	.11	WS2	.26	.11
N3	584700	.08	WS3	.39	.07
N4	36599	.07	WS4	.56	.11
N5	46798	.07	WS5	.84	.11
N6	6700	.09	WS6	1.06	.16
N7	3199	.09	WS7	1.28	.30
N8	299	.12	WS8	1.66	.11
N9	0	.14	WS9	1.84	.11
N10	100	.12	WS10	2.13	.13
H.cons selectivity			Weight in the HC catch		
sH0	.00	.00	WH0	.00	.00
sH1	.00	.36	WH1	.31	.09
sH2	.11	.40	WH2	.38	.05
sH3	.53	.06	WH3	.46	.07
sH4	.69	.17	WH4	.58	.10
sH5	.60	.19	WH5	.84	.13
sH6	.60	.36	WH6	1.09	.20
sH7	.86	.41	WH7	1.28	.30
sH8	.79	.46	WH8	1.66	.11
sH9	.83	.34	WH9	1.84	.11
sH10	.83	.34	WH10	2.13	.13
Discard selectivity			Weight in the discards		
sD0	.00	.22	WD0	.05	.21
sD1	.07	.35	WD1	.13	.05
sD2	.31	.03	WD2	.23	.09
sD3	.27	.17	WD3	.27	.02
sD4	.06	.58	WD4	.32	.11
sD5	.01	.96	WD5	.35	.12
sD6	.02	1.73	WD6	.09	1.73
sD7	.00	.00	WD7	.00	.00
sD8	.00	.00	WD8	.00	.00
sD9	.00	.00	WD9	.00	.00
sD10	.00	.00	WD10	.00	.00
Industrial selectivity			Weight in Ind. bycatch		
sI0	.04	.76	WI0	.01	.28
sI1	.03	.43	WI1	.06	.30
sI2	.01	.85	WI2	.16	.21
sI3	.03	.92	WI3	.29	.46
sI4	.00	.77	WI4	.52	.22
sI5	.02	1.50	WI5	.62	.94
sI6	.00	1.73	WI6	.16	1.73
sI7	.00	.00	WI7	.00	.00
sI8	.00	.00	WI8	.00	.00
sI9	.00	.00	WI9	.00	.00
sI10	.00	.00	WI10	.00	.00
Natural mortality			Proportion mature		
M0	2.05	.03	MT0	.00	.10
M1	1.65	.05	MT1	.01	.10
M2	.40	.07	MT2	.32	.10
M3	.25	.19	MT3	.71	.10
M4	.25	.12	MT4	.87	.10
M5	.20	.17	MT5	.95	.10
M6	.20	.10	MT6	1.00	.10
M7	.20	.10	MT7	1.00	.00
M8	.20	.10	MT8	1.00	.00
M9	.20	.10	MT9	1.00	.00
M10	.20	.10	MT10	1.00	.00
Relative effort in HC fishery			Year effect for natural mortality		
HF97	1.00	.16	K97	1.00	.21
HF98	1.00	.16	K98	1.00	.21
HF99	1.00	.16	K99	1.00	.21
Relative effort in industrial fishery					
IF97	1.00	.34			
IF98	1.00	.34			
IF99	1.00	.34			
Recruitment in 1998 and 1999					
R98	27131100	1.04			
R99	27131100	1.04			

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

Table 4.7.2; Haddock, North Sea + Skagerra
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	1997	1998						
Mean F Ages								
H.cons 2 to 6	.64	.00	.13	.26	.38	.51	.64	.77
Ind BC 0 to 3	.03	.03	.03	.03	.03	.03	.03	.03
Effort relative to 1996								
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	639	526	526	526	526	526	526	526
Spawning	257	206	206	206	206	206	206	206
Catch weight (,000t)								
H.cons	126	0	25	47	67	83	98	111
Discards	52	0	8	16	23	30	36	42
Ind BC	9	10	10	10	10	10	10	9
Total Landings	136	10	35	57	76	93	108	121
Total Catch	187	10	44	73	100	123	144	163
Biomass at start of 1999								
Total		807	766	731	700	672	648	627
Spawning		315	280	249	222	198	178	160

	Year							
	1997	1998						
Effort relative to 1996								
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	.11	.33	.33	.33	.33	.33	.33	.33
Spawning	.10	.18	.18	.18	.18	.18	.18	.18
Catch weight								
H.cons	.15	.00	.77	.39	.28	.24	.21	.20
Discards	.18	.00	.84	.51	.42	.39	.38	.37
Ind BC	.59	.90	.91	.92	.93	.93	.94	.95
Biomass at start of 1999								
Total		.59	.62	.65	.67	.70	.72	.74
Spawning		.23	.25	.26	.27	.27	.28	.29

Table 4.7.3; Haddock,North Sea + Skagerra
Detailed forecast tables.

Forecast for year 1997
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	15483700	0	6492	253193	259685
1	2237800	1055	75933	33748	110736
2	302600	23328	63845	3069	90242
3	584700	190120	95418	9327	294865
4	36600	15999	1450	92	17541
5	46799	19104	255	605	19963
6	6700	2740	78	0	2818
7	3200	1690	0	0	1690
8	300	150	0	0	150
9	0	0	0	0	0
10	100	52	0	0	52
Wt	639	126	52	9	187

Forecast for year 1998
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	27131100	0	11376	443655	455030
1	1915135	903	64984	28882	94769
2	386932	29829	81638	3925	115392
3	130505	42435	21297	2082	65814
4	200156	87494	7931	504	95929
5	13304	5431	72	172	5675
6	20468	8371	238	0	8609
7	2966	1567	0	0	1567
8	1114	559	0	0	559
9	111	58	0	0	58
10	36	19	0	0	19
Wt	526	98	36	10	144

Figure 4.4.1

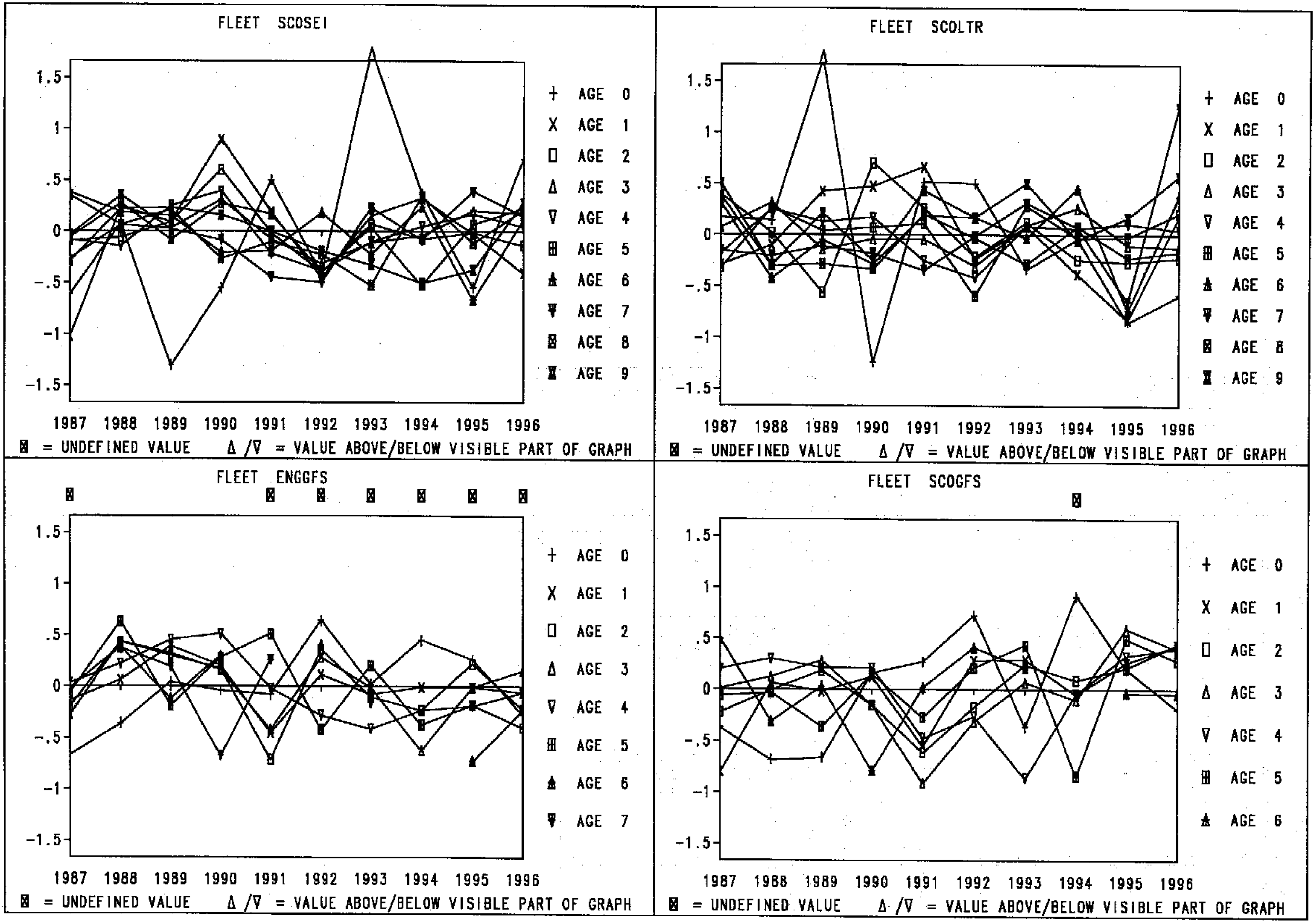
FLEET SCOSEI
1.5
1
.5
0
-.5
-1
-1.5
1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
AGE 0
AGE 1
AGE 2
AGE 3
AGE 4
AGE 5
AGE 6
AGE 7
AGE 8
AGE 9
= UNDEFINED VALUE Δ /∇ = VALUE ABOVE/BELOW VISIBLE PART OF GRAPH
FLEET SCOLTR
1.5
1
.5
0
-.5
-1
-1.5
1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
AGE 0
AGE 1
AGE 2
AGE 3
AGE 4
AGE 5
AGE 6
AGE 7
AGE 8
AGE 9
= UNDEFINED VALUE Δ /∇ = VALUE ABOVE/BELOW VISIBLE PART OF GRAPH
FLEET ENGGFS
1.5
1
.5
0
-.5
-1
-1.5
1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
AGE 0
AGE 1
AGE 2
AGE 3
AGE 4
AGE 5
AGE 6
AGE 7
= UNDEFINED VALUE Δ /∇ = VALUE ABOVE/BELOW VISIBLE PART OF GRAPH
FLEET SCOGFS
1.5
1
.5
0
-.5
-1
-1.5
1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
AGE 0
AGE 1
AGE 2
AGE 3
AGE 4
AGE 5
AGE 6
= UNDEFINED VALUE Δ /∇ = VALUE ABOVE/BELOW VISIBLE PART OF GRAPH

Figure 4.4.1 (Continued)

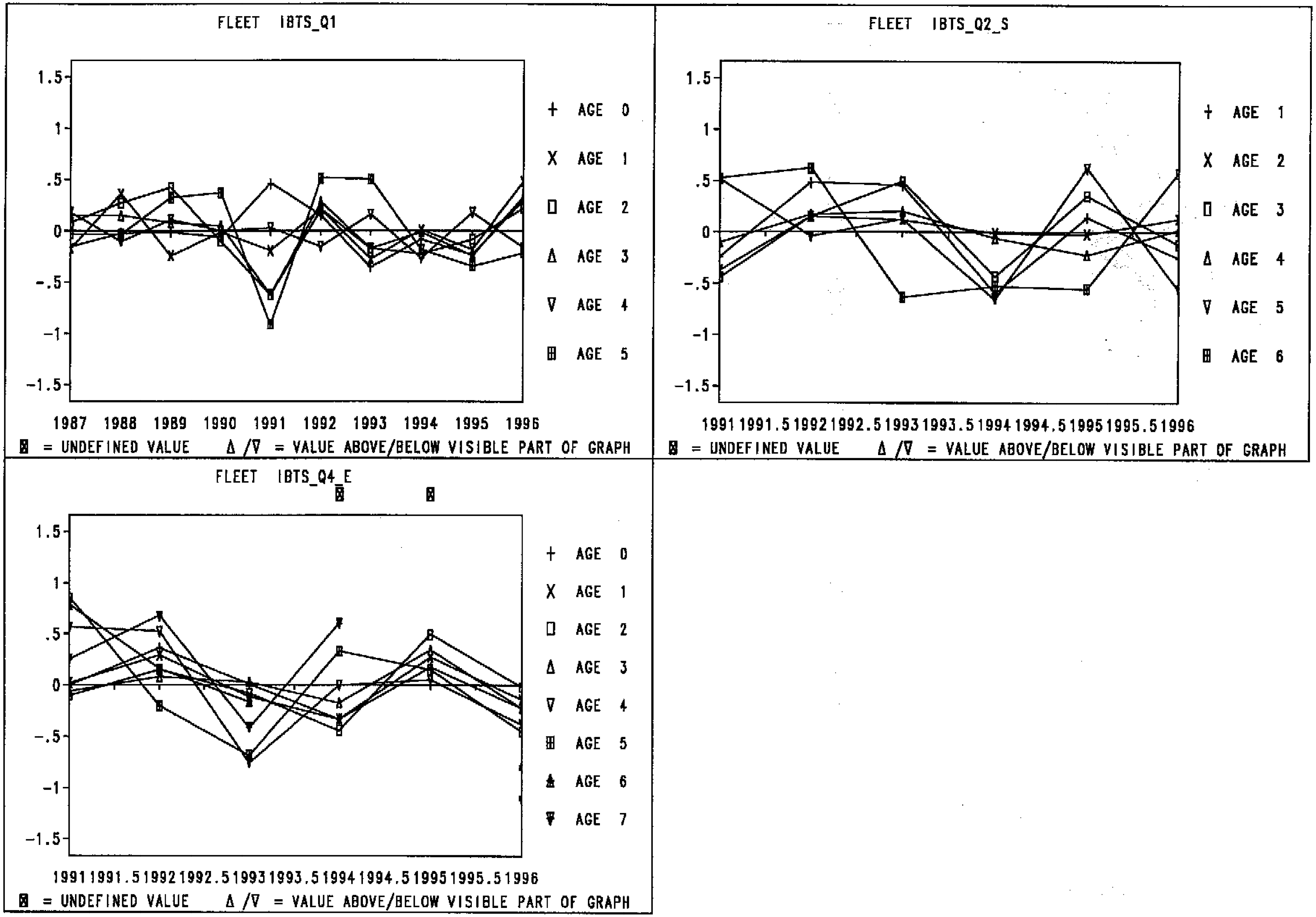

Figure 4.4.2, Haddock in the North Sea & Skagerrak
Retrospective trends in mean F

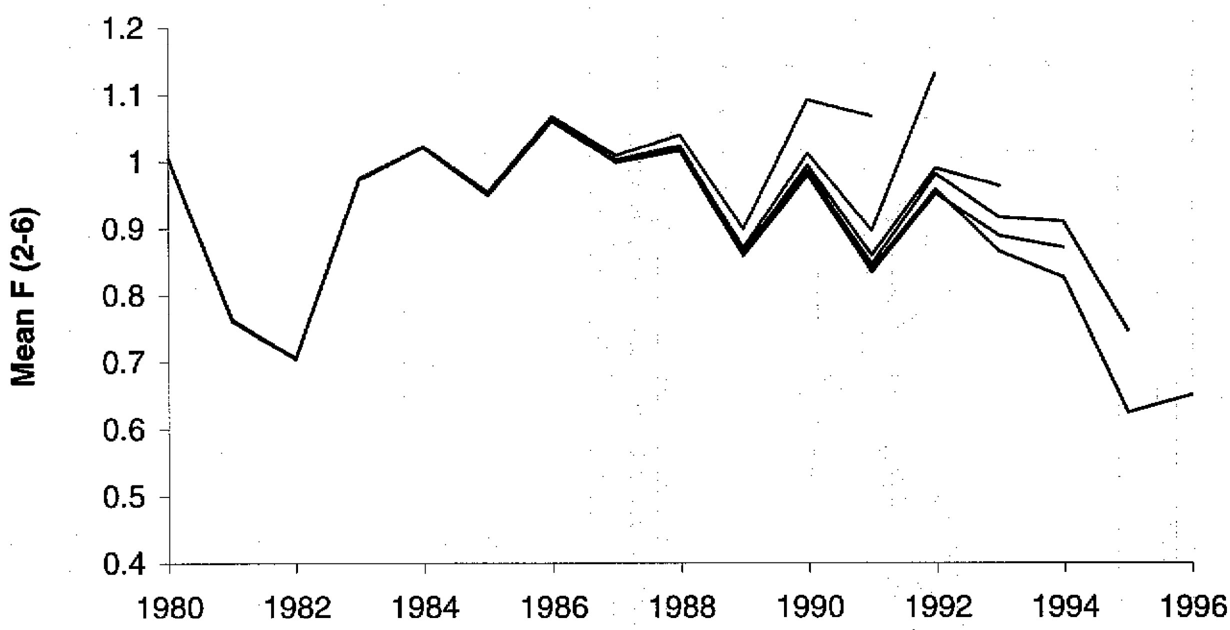

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Figure 4.5.1; Haddock in North Sea and Skagerrak
Plots of survey indices versus converged XSA estimates.

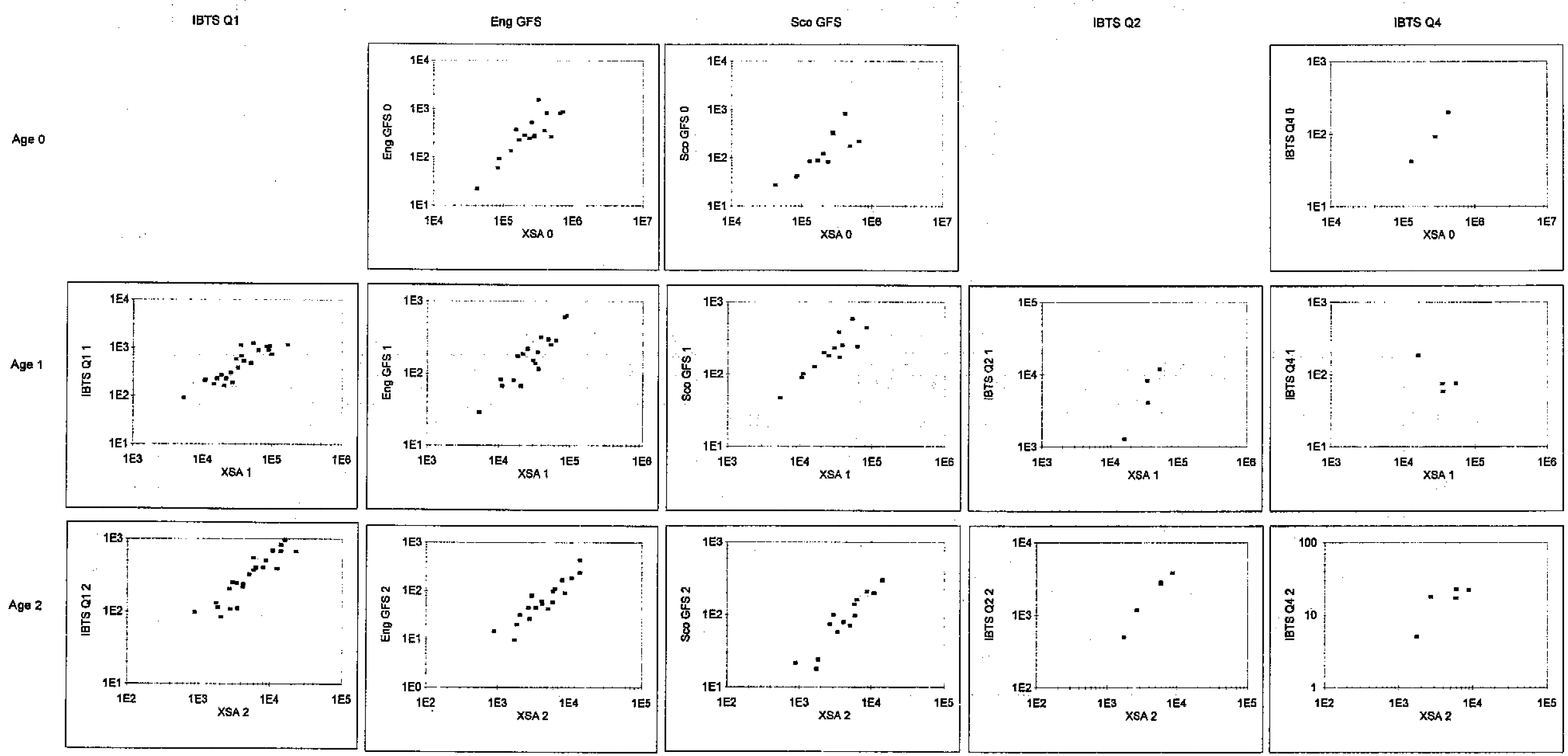


Figure 4.6.1 Stock summary, Haddock ,North Sea + Ska

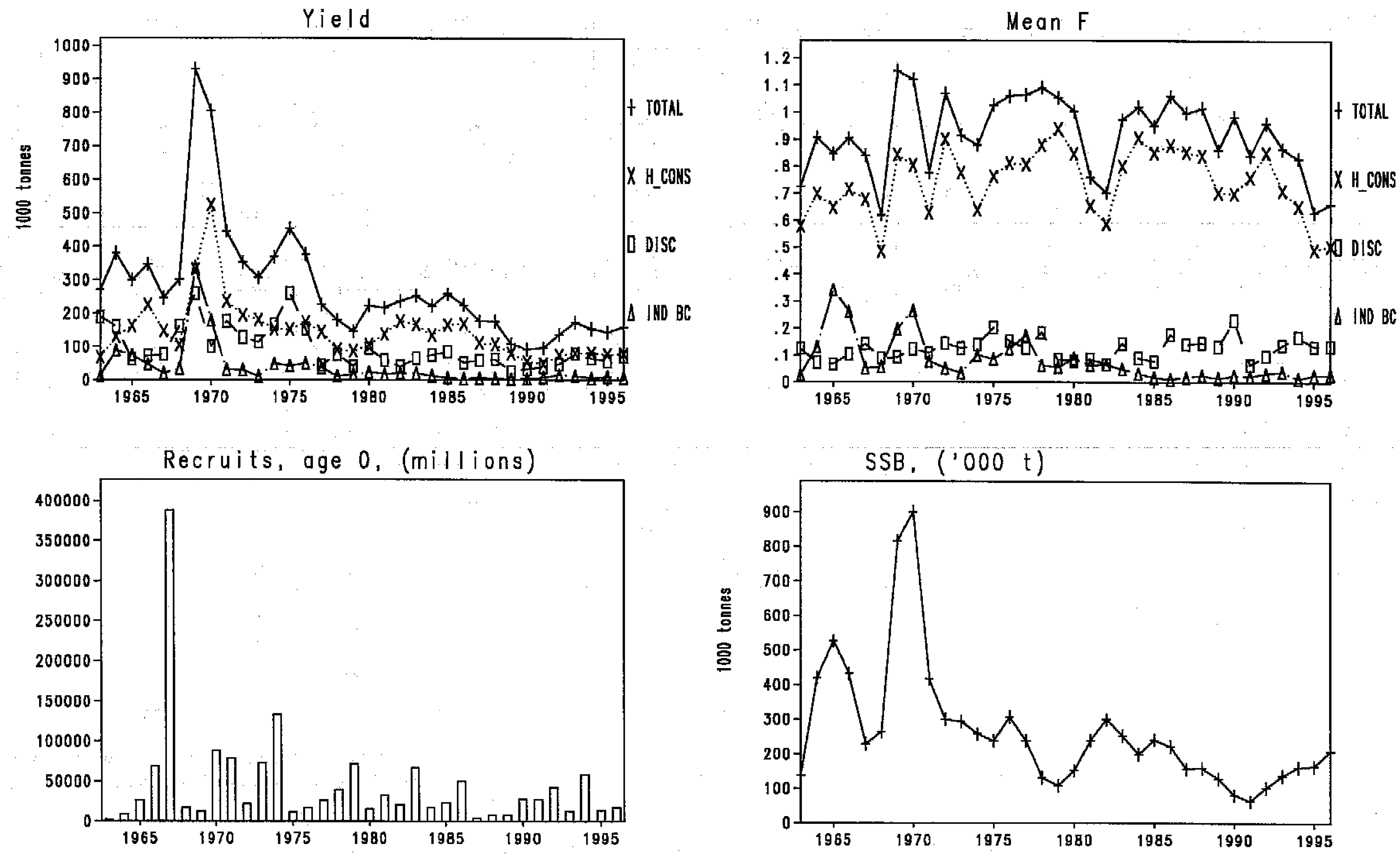


Figure 4.7.1 Haddock,North Sea + Skagerra. Sensitivity analysis of short term forecast.

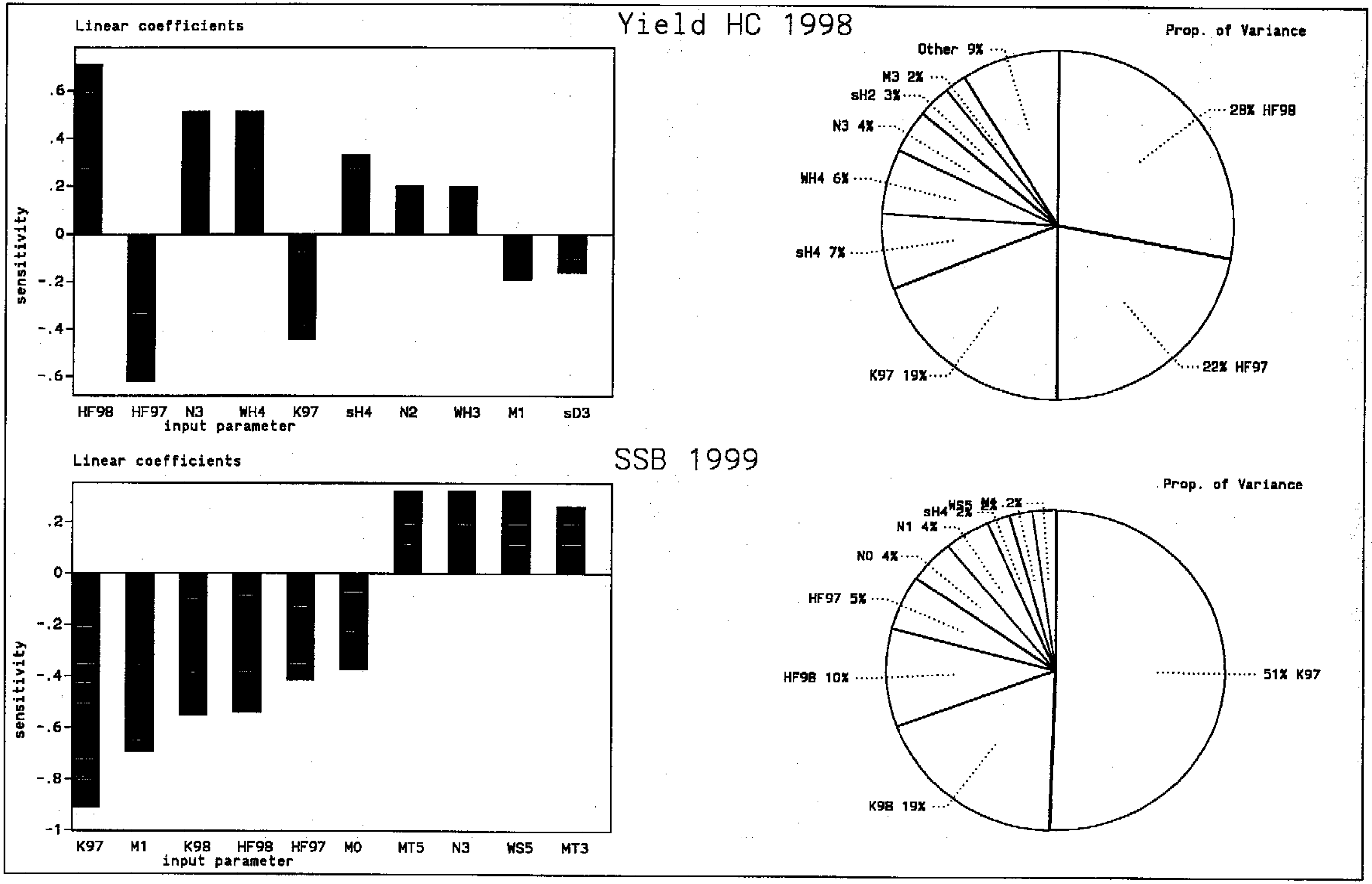
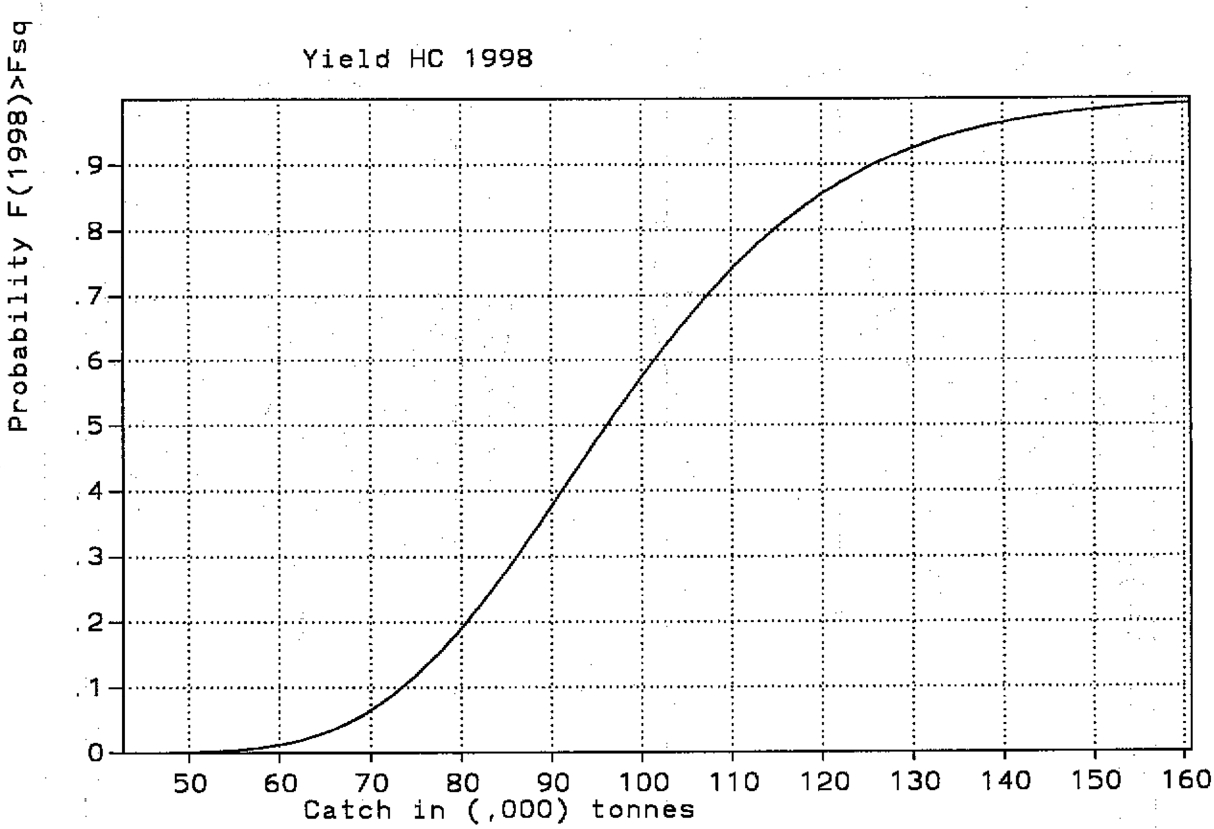


Figure 4.7.2 Haddock,North Sea + Skagerra. Probability profiles for short term forecast.



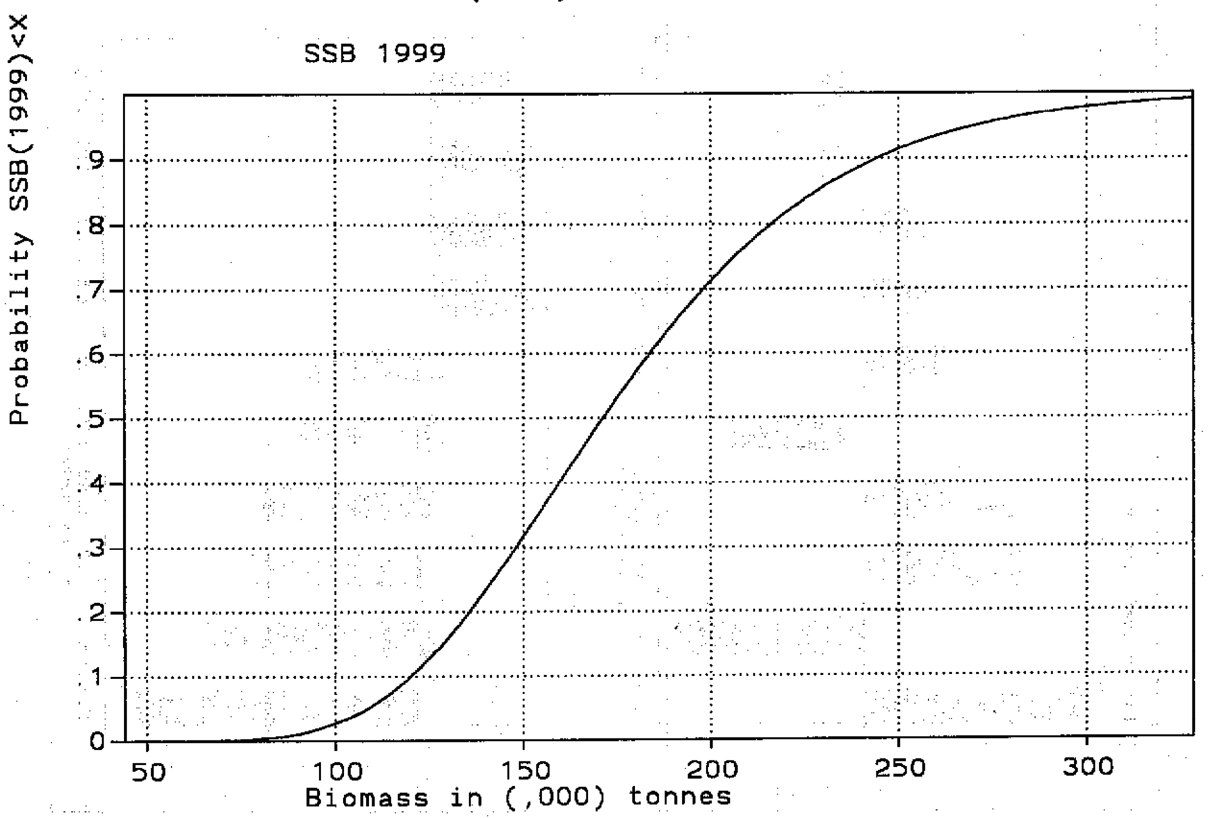


Figure 4.8.1; Haddock in the North Sea and Skagerrak, Medium term projection.
Assumes F multiplier of 1.0, i.e. H.cons + discard mean F97 = 0.64
Beverton-Holt SSR model used, lines show 5, 10, 20, 50 and 95 percentiles

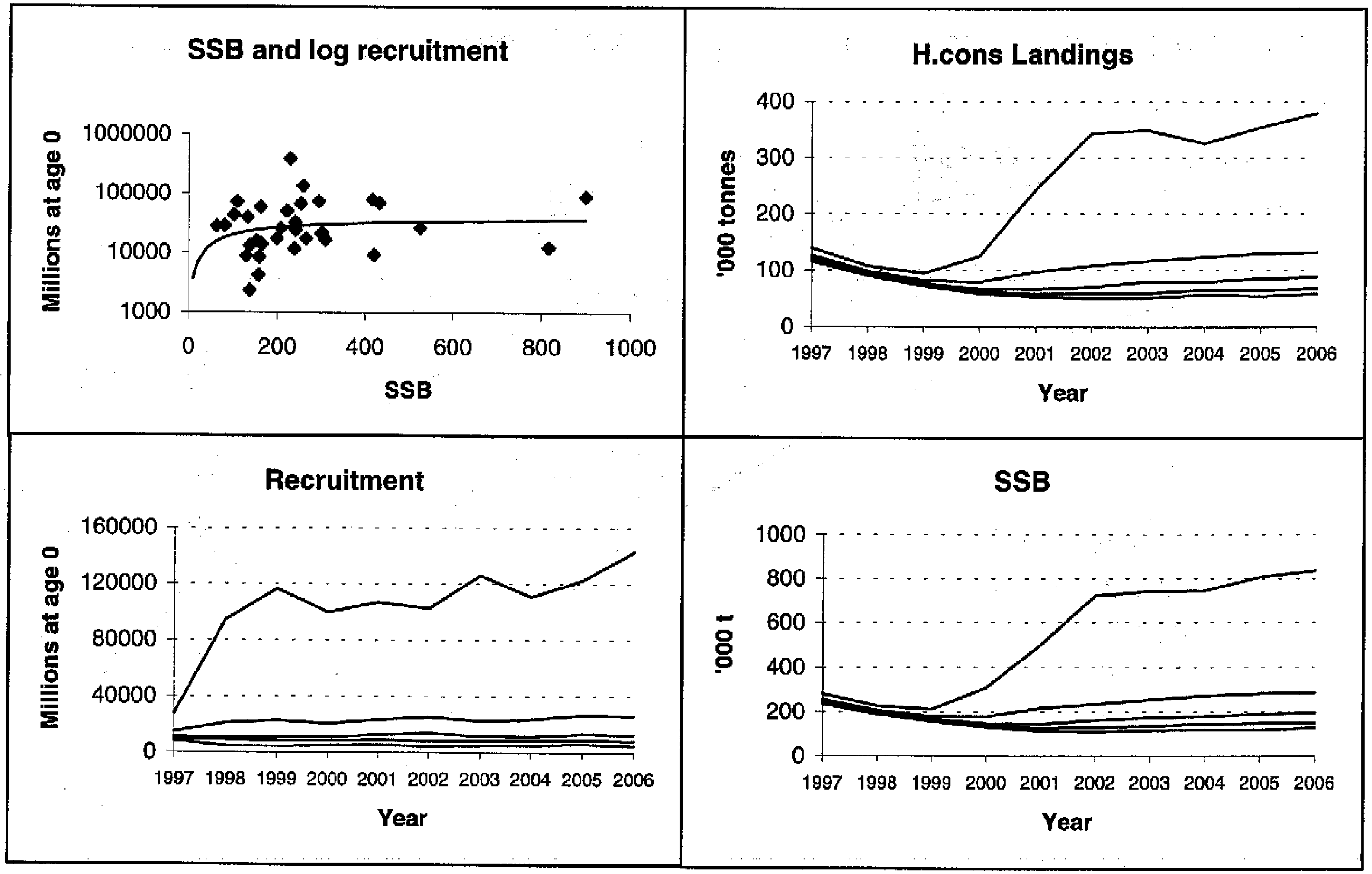


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Figure 4.9.1 , Haddock in the North Sea and Skagerrak
Medium-term projections of SSB in 2006 at different F Levels

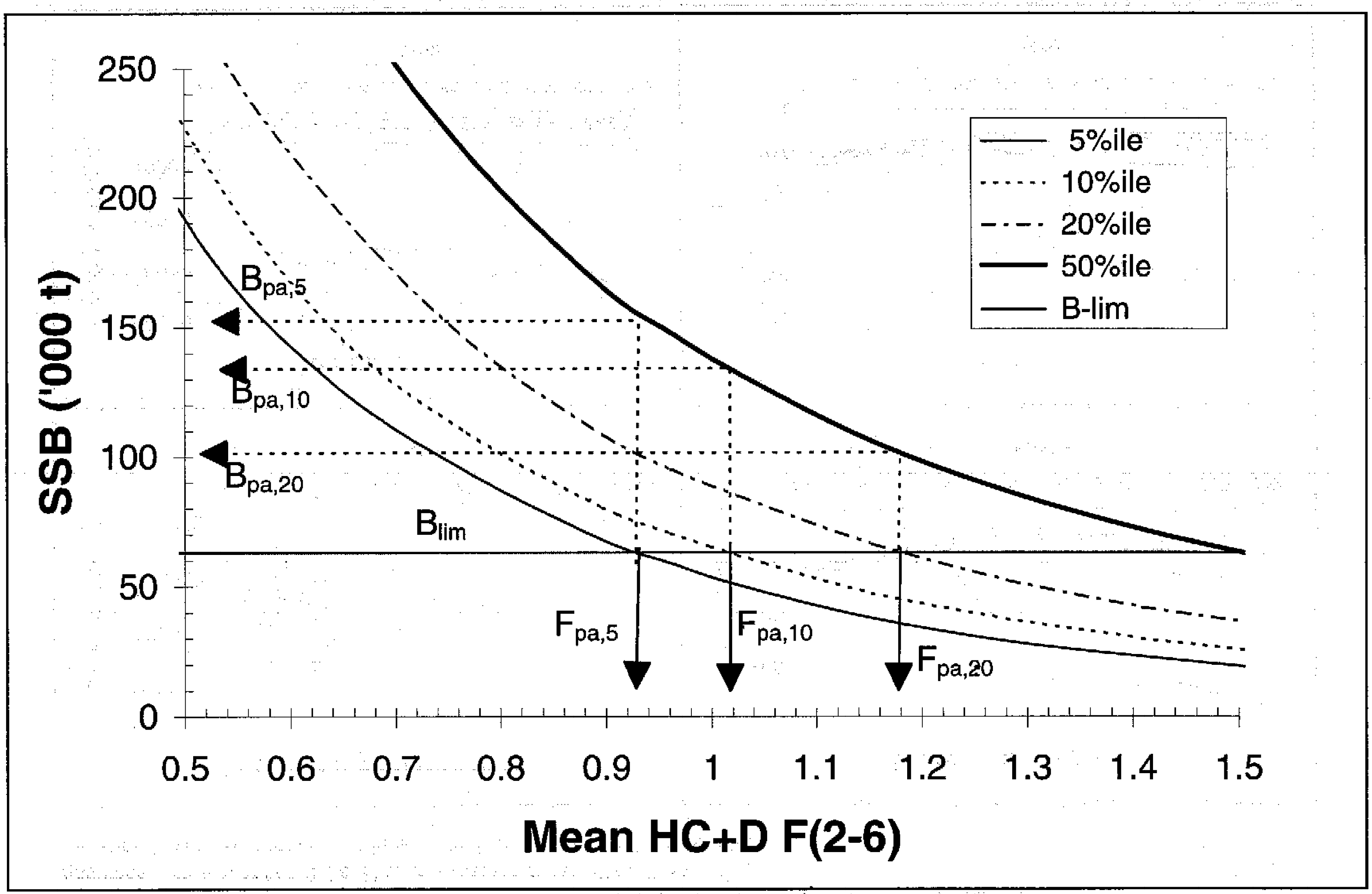

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Figure 4.10.1

North Sea Haddock
Trends in effort in main fleets, and relationship with mean F.

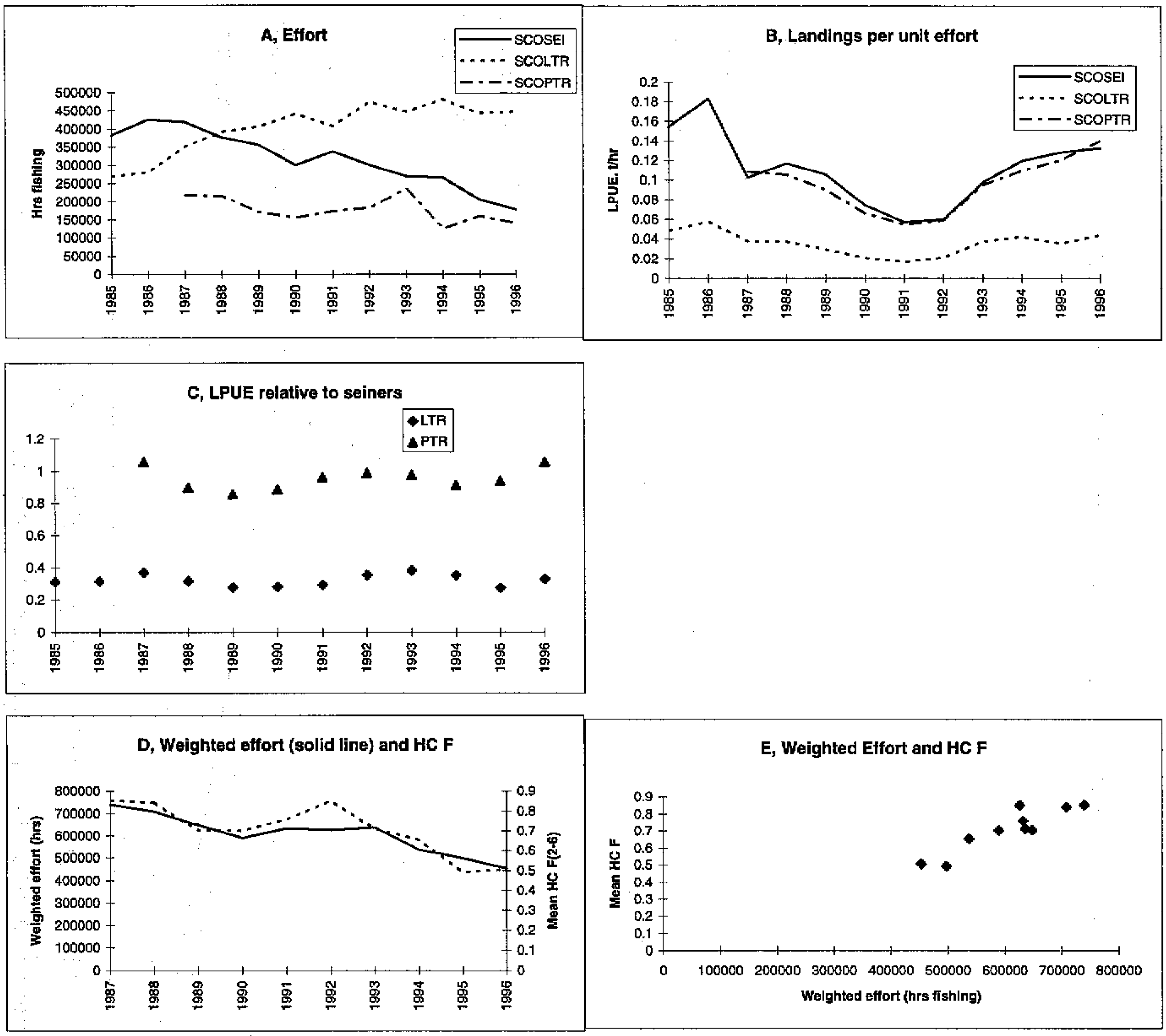

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Figure 4.11.1 North Sea + Ska Haddock: Stock and Recruitment

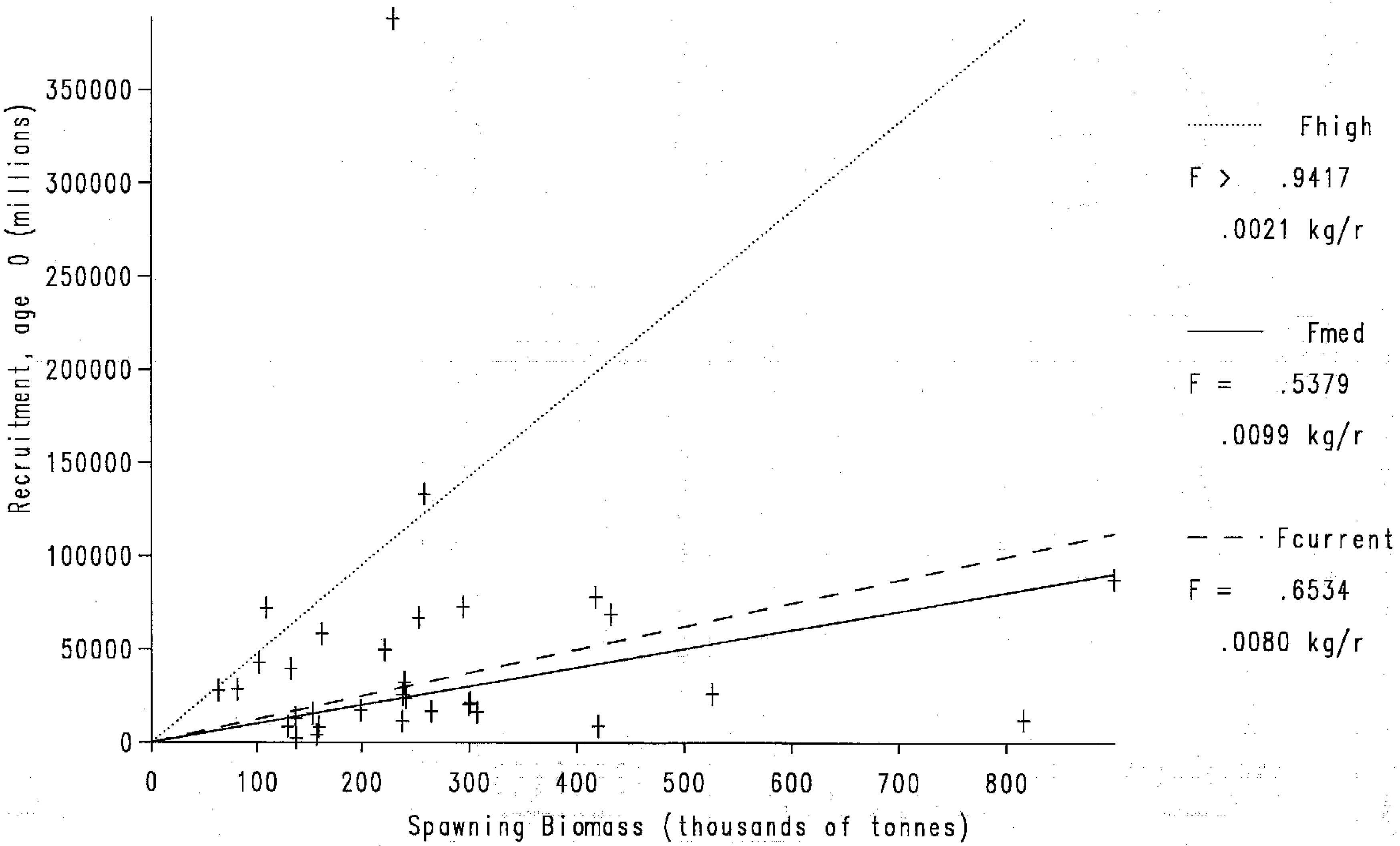


Figure 4.11.2 North Sea + Ska Haddock: Yield per Recruit

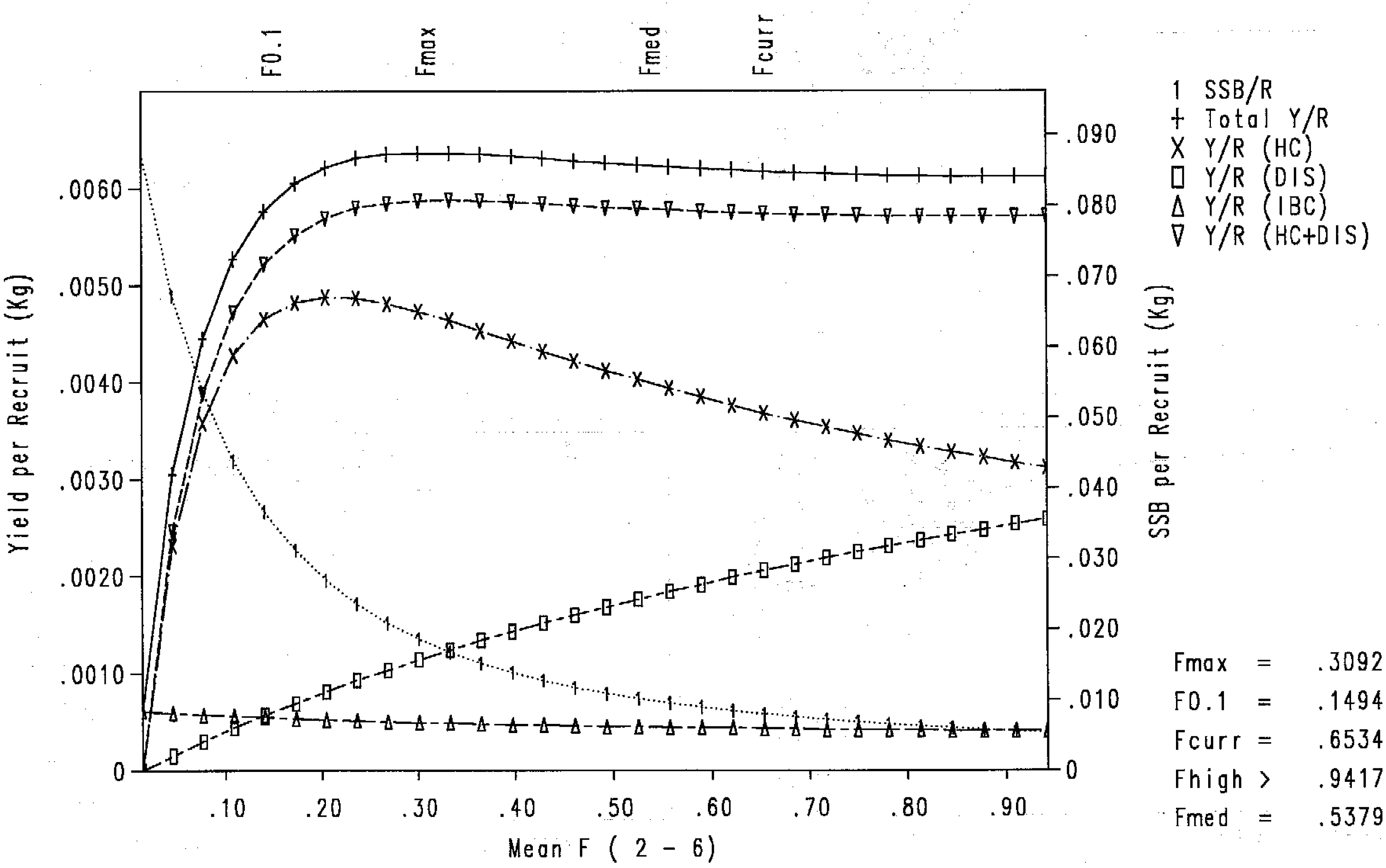
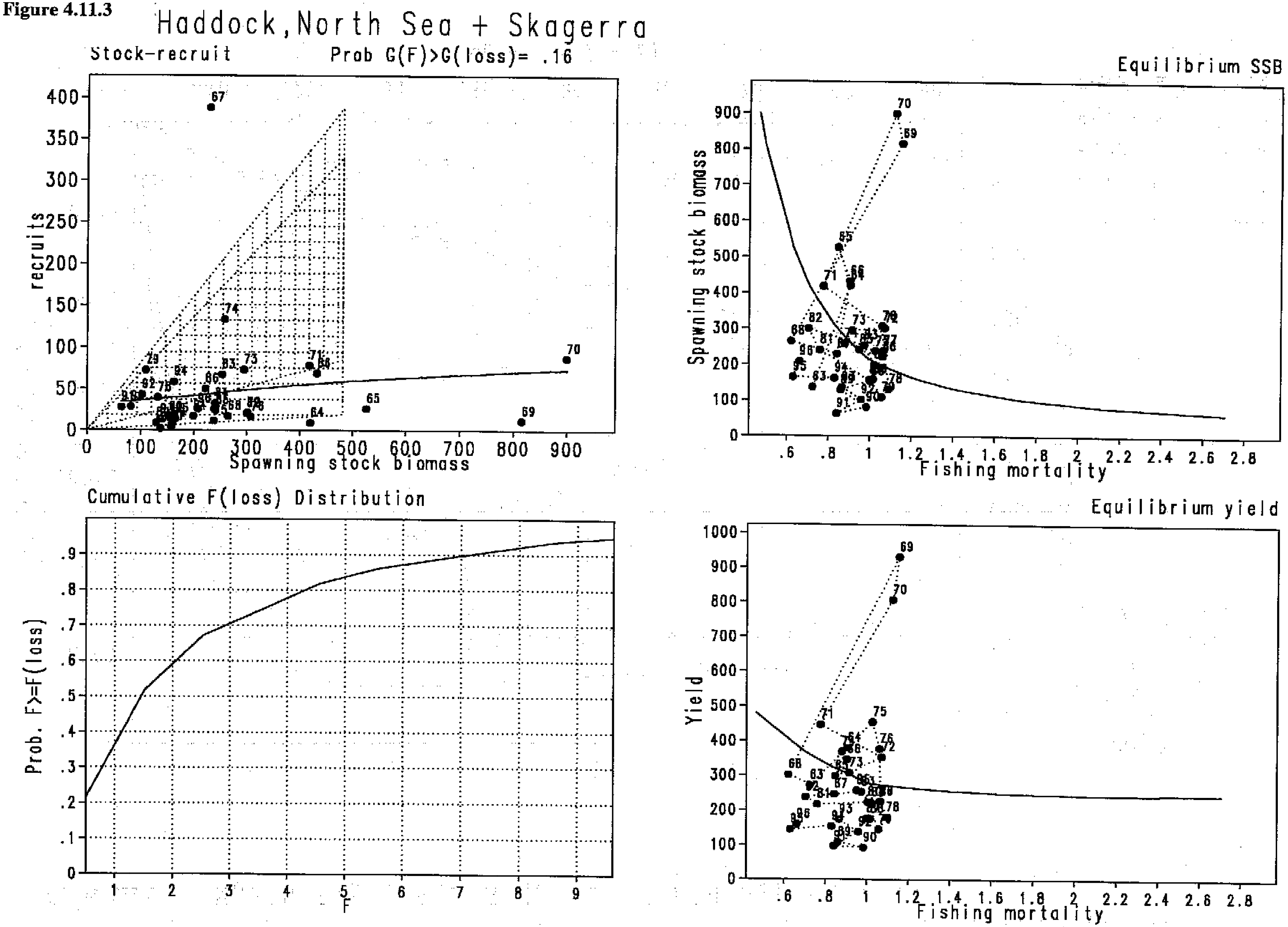


Figure 4.11.3


Haddock, North Sea + Skagerra
Stock-recruit
Prob G(F)>G(loss)= .16
recruits
Spawning stock biomass
Cumulative F(loss) Distribution
Prob. F>=F(loss)
F
Equilibrium SSB
Spawning stock biomass
Fishing mortality
Equilibrium yield
Yield
Fishing mortality

5 WHITING

5.1 Whiting in Sub-area IV and Division VIId

5.1.1 Catch trends

Total nominal landings are given in Tables 5.1.1 and 5.1.2 for the North Sea and eastern Channel respectively. Total international catches as estimated by the Working Group for the combined North Sea and eastern Channel are shown in Table 5.1.3. Eastern Channel catches as used by the Working Group are also shown separately in Table 5.1.4

For the North Sea, the total international catches were 69,000 t in 1996, of which 36,000 t were human consumption landings, 28,000 t discards and 5,000 t industrial by-catch. This represents a continued decrease in total landings since 1990 (149,000 t), and is 29,000 t less than the 1995 value (98,000 t). The 1996 human consumption landings were the lowest in the time series and 88% of the 1995 value. Discards were the third lowest on record (93% of the 1996 value) and industrial by-catch was also the lowest recorded (18% of the 1996 value). The low industrial by-catch of whiting in 1996 was confirmed by the industrial fishing nations.

The total North Sea landings of 41,000 t in 1996 were 52% of last year's *status quo* prediction of 79,000 t. The shortfall comprised 23,000 industrial by-catch and 15,000 human consumption landings. This is discussed further in Section 5.1.10.

The 1996 TAC was 67,000t.

In the eastern Channel recorded landings were 4,995 t in 1996 compared to the *status quo* prediction made last year of 7,000t

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

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

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

The natural mortality and maturity at age values as used are shown in Table 5.1.5. These are unchanged from last year.

The natural mortality values are rounded averages of the estimates produced by an earlier key run of the North Sea MSVPA. Information from the key run made in 1997 is not included.

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

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

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

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

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

Total international catch at age and mean weight at age in the catch (North Sea and Eastern Channel combined) are presented in Tables 5.1.6 and 5.1.7.

The catch mean weight at age was also used as the stock mean weight at age.

5.1.3 Catch, Effort and Research Vessel Data

Catch and effort data from commercial and survey vessels were used to tune the VPA. The fleets available for VPA tuning and the ages and number of years available for each fleet are listed in Table 5.1.8; their values are presented in Table 5.1.9. As final age-based data are not yet available for all the years of the second and fourth quarter International Bottom Trawl Survey (IBTS) surveys, the indices for the second quarter comprise age-based indices from the Scottish component of the survey, while the fourth quarter values comprise age-based indices from the English component of the survey. IBTS data from the first quarter (formerly IYFS) have been treated as if the survey took place at the very end of the previous year, by adjusting the parameter values of alpha and beta in the tuning file and offsetting the index age by one year. This allows some survey data, collected after the most recent commercial catch at age data, to be used in tuning. The IBTS series for the first quarter are available for a longer period for ages 1 and 2 than for the older ages due to lack of proper sampling/ageing of the older age groups in the earlier part of the time series.

The definitions of the French commercial fleets were modified, and data revised back to 1985. The basis for the revisions and the correspondence between old and new fleets are discussed in Annex I.

5.1.4 Catch-at-age analysis

As a preliminary investigation of the catch-at-age and tuning data, XSA runs were made that incorporated one tuning fleet at a time. Only weak shrinkage (SE = 1) was used, but in other respects the XSA configuration was identical to that used in the final run last year. From plots of the log-catchabilities, no strong trends were apparent for any fleet although many residuals for the extreme age groups were very noisy. Consequently, exploratory XSA runs were made that excluded 0-group, 9-group and 10-group data from some tuning fleets. There was little effect from excluding these data as the XSA had previously downweighted their contribution anyway. Results from these runs are on the ICES stock files. Due to the potential for excluding the older, noisy age groups from the tuning series, further exploratory XSA runs were made assuming plus groups at ages 8 and 9. (This required the age range for shrinking F at the oldest age to be reduced from 5 age groups to 3). Results from these runs are also on the ICES stock files and show that there is little, if any, effect on estimates of recruitment, SSB and mean F when truncating the age range in this way. Because of this, and the difficulty of aging older whiting that simply introduces noise into the catch-at-age data, the plus-group in the assessment was set to age 8.

The final tuning run assumed a plus-group at age 8, catchability plateau at age 6, shrinkage SE = 0.5, with shrinkage to the 5 most recent years, or 3 ages, and the catchability of all age groups was considered to be independent of year class strength. The tuning window used was 10 years untapered.

The log-catchability residual plots from the final run are shown in Figure 5.1.1. Although some noise is still apparent in the residual plots, notably for the FraTro fleet, and both the FraTrb fleet and ScoGfs survey show year effects for 1996 no further run were undertaken.

The retrospective plot for this XSA configuration and tuning data set is shown in Figure 5.1.2 for an assumed F shrinkage mean SE = 0.5. Because of the short time series of 3 survey index series (IBTS QII, IBTS QIV and FraGfs VIId) it was not possible to include them the retrospective analysis. Similarly, to make use of the relatively short French eastern Channel commercial fleet series (FraTro VIId) in the retrospective analysis, it was not possible to select a 'moving window' analysis. Consequently, the available data for each successive run diminished by one year, leading to only a five year tuning period for the retrospective run using 1990 as its terminal year.

From Figure 5.1.2, there is an indication that this analysis overestimates SSB in the most recent year and, similarly, underestimates mean F. Recruits are poorly estimated in the terminal year.

The basic parameter selections and tuning options of the final run are shown in Table 5.1.10. The diagnostics of the final run are also given in this Table and the log catchability residual plots are shown in Figure 5.1.1.

The relative weighting of the different tuning fleets to the survivors estimates are indicated in Figure 5.1.3, where the scaled weights are shown plotted by fleet and age. In general, it can be seen that the weighting of survivors estimates from the commercial fleets from the North Sea increases with the age of fish. The exception to this is the FraTro fleet that is most heavily weighted at age 1 and whose influence then declines with age. The weighting of survivors from the North Sea surveys either decline with age, or are least important at the extremes of the age range. Neither of the eastern Channel tuning fleets get more than 6.4% of the weighting in the final survivors estimates of any age group. The weighting of the F shrinkage mean is highest at the oldest and youngest ages (12% and 17% respectively).

The individual fleet estimates of survivors given in Table 5.1.10 are quite diverse at ages 0 and 1, appear less so at age 2, and are reasonably consistent for the older ages.

The fishing mortalities at age and stock numbers estimated from the final tuning run are presented in Tables 5.1.11 and 5.1.12

This year's final run was based on the following: 10 year untapered tuning, ages 0 - 8+, catchability assumed constant above age 6, all ages treated as abundance independent of year-class strength, shrinkage to 5 years or 3 ages. Fleets: ScoSei (1-7); ScoLtr (1-7); FraTrb (1-7); FraTro (0-7); FraTro(VIId) (1-5);. Surveys: ScoGfs (1-6); EngGfs (1-5); IBTS QI (0-4, age-shifted), IBTS QII (1-6); IBTS QIV (0-5); FraGfs(VIId) (0-3).

(Last year's equivalent was: 10 year untapered tuning, ages 0 - 10+, catchability assumed constant above age 6, all ages treated as abundance independent of year-class strength, shrinkage to 5 years or 5 ages. Fleets: ScoSei (0-9); ScoLtr (0-9); FraTrb (0-9); FraTrc (VIId) (1-5);. Surveys: ScoGfs (0-6); EngGfs (0-6); IBTS QI (0-5, age-shifted), IBTS QII (1-6); IBTS QIV (0-7); FraGfs (VIId) (0-3)).

5.1.5 Recruitment estimates

There has previously been an inconsistency between survey-based estimates of year class strength used in predictions and tuned values for the same year classes estimated by the Working Group at its subsequent meeting. The tuned values have consistently been lower than RCT3 estimates suggesting that, according to the tuned results, the previous year's predictions will have been based on overestimates of year class strength. This inconsistency was further indicated by the plots of survey indices and XSA estimates of recruitment presented in ICES 1996/Assess:6 where no clearly defined relationships were apparent. These plots were updated this year (Figure 5.1.4) and do not indicate any clear relationship.

Due to this lack of concordance, at the 3 previous meetings, it was decided to incorporate all the XSA estimates of survivors in to the input to catch prediction, including the estimates for recruiting year classes. However, the XSA estimate of the 1996 year-class (Table 5.1.12) shows by far the lowest observed recruitment in the available time series. The surveys (Table 5.1.9) do not support this indication and the retrospective analysis of the XSA indicates that it provides little, if any, information on the strength of the most recent year class. Because of this, it was decided to overwrite the XSA estimate of the 1996 year class for prediction.

In the previous assessments of this stock, because recruitment since 1979 had fluctuated around a lower level than in the preceding period a 20 year tapered geometric mean value of recruitment at age 0 was assumed for input to prediction. This was repeated this year for input to prediction at age 0 in 1997 and subsequent years (27,200 million), rather than using the long term geometric mean of 41,300 million. The tricubic taper-weighted GM was calculated externally to the XSA, using the XSA recruitment estimates, including the very low 1996 value. This tapered GM was used to overwrite the XSA estimate of 0-group in 1996 for input to prediction. This value was scaled to 1 year old survivors in 1997 by the ratio of XSA 2-year-olds in 1997 to XSA 1-year olds in 1996, giving 2,000 million 1-year olds in 1997. (With 0-group natural mortality of 2.55 and fishing mortality rarely exceeding 0.1, this is close to the equivalent 1-group tapered GM value of 2,200 million).

5.1.6 Historical stock trends

Long term trends in fishing mortality, recruitment and spawning biomass are given in Table 5.1.13 and plotted in Figure 5.1.5.

Fishing mortalities have been highly variable with no clear trend, although the human consumption landings component of F appears to have been reasonably sTable since 1989, but indicates a fall in 1996. Mean F of all catch categories combined is indicated to have declined continuously since 1993. To investigate this further, in particular to determine whether there is any basis for rejecting this apparent trend, fishing effort for all the commercial tuning fleets was standardised to the maximum of each individual series and is plotted in Figure 5.1.6a.

It can be seen that for ScoSei, FraTro and FraTrb, relative effort has diminished since the late 1980s/early 1990s, but for ScoLtr FraTro (VIId) relative effort has been sTable at a higher level in that period. Plots of relative effort versus mean F are also shown in Figure 5.1.6b-f from which it is apparent that the former 3 fleets demonstrate a positive relationship between mean F and relative effort, whilst the latter two do not. However, for ScoLtr (Figure 5.1.6c), a positive relationship is observed if the points since 1990 are excluded from consideration. Because the period 1991-1996 for this fleet is associated with a diversion of fishing effort from the mixed demersal fishery to a targeted monkfish fishery north and west of Shetland, ScoLtr effort data used in this assessment may overestimate true effort in the mixed demersal fishery in recent years. In other words, the apparent reduction in mean F in recent years appears to be consistent with trends in fishing effort for the commercial fleets, however, some doubt arises as to the validity of the ScoLtr effort series used in tuning the XSA.

Figure 5.1.7 shows the recent trends in mean F estimated from the single-fleet tuning runs used previously in the exploratory XSAs, and from the final XSA. It is likely that the trend in recent F is largely driven by the catch-at-age data, with effort tuning series modifying the rate of decline in F over that period. The position of the line corresponding to the XSA final run indicates a greater decline in F than demonstrated by the commercial tuning fleets, although it is difficult to interpret this due to the interaction between fleet catchability estimates when several tuning series are simultaneously included in the XSA.

Estimates of all year classes between 1989 and 1995 lie between 47% and 65% of the long term arithmetic mean (52%-71% of the long term geometric mean). The spawning stock biomass is estimated to have been sTable since 1983, fluctuating around 277,000t, compared with its lowest recorded value of 238,000t (in 1971) and below the long term average of 378,000t. Its estimated level at the start of 1996 is 265,000t.

5.1.7 Short term forecast

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

Input data for combined area short term catch predictions are given in Table 5.1.14, and assume tapered GM recruitment at age 0 for the 1996 and subsequent year-classes.

Calculation of the partial Fs at age and mean weights at age in the various catch categories used in prediction were averaged over a 3 year period, and mean F was scaled to its 1996 mean value. This was done because mean F appears to have declined consistently since 1993.

Results of a *status quo* catch forecast are given in Tables 5.1.15 (catch options) and 5.1.16 (detailed).

At *status quo*, the area-combined human consumption landings are predicted to be 51,000 t in 1998 compared to a forecast of 50,000t for 1997. This is predicted to result in a spawning biomass in 1998 of 285,000t and 1999 of 307,000t.

Although no area split prediction is given here, the following ratios of human consumption landings (by weight) have been calculated:

Period of average	IV	VIId
1960-96	92.8%	7.2%
1987-96	90.0%	10.0%
1992-96	88.5%	11.5%

Inputs to a sensitivity analysis of the *status quo* combined area forecast are given in Table 5.1.17 and results presented in Figures 5.1.8 and 5.1.9. The estimates of human consumption landings in 1998 are most sensitive to the overall level of fishing mortality in 1998 and the overall level of natural mortality in 1997. The estimate of spawning biomass at the start of 1999 is sensitive to the overall magnitude of natural mortality in both 1997 and 1998 as well as to the age-specific values of M at age 0 and 1. These sensitivities are very similar to those presented in last year's report, as are the partial variances in the prediction of human consumption landings in 1998 and spawning biomass in 1999 attributable to the uncertainties in the input values.

These results also indicate that the prediction of human consumption yield in 1998 and spawning biomass in 1999 is relatively insensitive to the estimates of 0- and 1-group fish used in prediction.

Probability profiles for the human consumption landings in 1998 and the spawning biomass in 1999 are shown in Figure 5.1.9. They indicate approximately a 30% probability, at *status quo* human consumption F, that the spawning biomass at the start of 1999 will fall below its previously lowest recorded value of 238,000 t (also defined as B_{loss}, see Section 5.1.9) in the short term.

5.1.8 Medium term predictions

The inputs to medium term projection are similar to those for the sensitivity analysis. Because of the scatter of points on the stock and recruitment plot, a non-parametric approach was chosen in previous assessments to generate recruitments in the medium term. However, to comply with ACFM's recommendation that a stock and recruitment relationship should be used to generate diminishing recruitment at low stock sizes, a Shepherd stock and recruitment model was fitted to the data. (Results of a Beverton-Holt and Ricker model fit are available on the ICES stock file).

The results of medium term projections corresponding to *status quo* human consumption F are presented in Figure 5.1.10. At the end of the 10 year projection, spawning biomass would, on average, be expected to increase as would the human consumption landings, although in both cases the 5% - 95% inter-percentile range is very broad. Several other projections were made for various multipliers of human consumption F. The outcome of these is summarised for the end of the 10 year projection period in Figure 5.1.11. According to these projections, a mean F of *ca.* 0.93 would result in a 5% probability of SSB falling below B_{loss}.

5.1.9 Long term considerations

Stock and recruitment reference points are shown in Figure 5.1.12.

5.1.10 Comments on the assessment

The overall pattern of stock size, fishing mortality and recruitment resulting from this assessment is reasonably consistent with the pattern observed from last year's assessment. The major difference being the estimate of the 1993, 1994 and 1995 year classes that were overestimated in last year's assessment by 36%-40% according to this year's final XSA. As currently assessed, cumulative F on these year classes is 0.87, 0.38 and 0.39 respectively, so convergence of the latter two at least is still unlikely.

The above differences contributed to last year's *status quo* catch prediction overestimating human consumption landings in 1996 by 15,000 t and the industrial by-catch by 23,000 t. However, for most ages, the *status quo* Fs used in prediction last year correspond well to those estimated at this meeting for 1996, and are given below:

F in 1996

Age	0	1	2	3	4	5	6
1996 SQ.	07	11	27	42	55	69	79
1997 XSA	04	09	23	40	51	68	80

There is clearly considerable doubt about the true size of recent year classes and, as the retrospective analysis indicates that XSA poorly estimates the recruiting year class. The true number of 0-group in 1996 remains unknown. For the catch prediction made at this meeting, year classes with assumed GM recruitment will account for 18% of the 1997 catch, 40% of the 1998 catch and 75% of the SSB in 1999 (Table 5.1.16).

Inspection of the prediction SE of log catchabilities at age for the revised French fleet FraTrb (Table 5.1.10) shows much improved values compared to last year's assessment. Similarly, the newly-defined FraTro fleet has lower prediction SEs than the former FraTrc fleet. The revision of these fleet definitions has improved their performance in the assessment.

Previous meetings have concluded that the survey data and commercial catch data contain different signals concerning the stock, and that there remain inconsistencies in the annual international catch age distributions. This was briefly investigated at the previous meeting, where the IBTS QI, EngGFS and ScoGFS survey series were used individually to reconstruct the recent history of whiting in Sub-area IV. It was apparent that there are inconsistencies indicated between the four data sets. XSA and the EngGFS generally followed the same spawning biomass trajectory, which differed from that suggested by both the ScoGFS and IBTS QI surveys. These inconsistencies are further apparent from the plots of survey indices against XSA abundance (Figure 5.1.4).

Discard data are available only for Scottish catches. Discards for other human consumption fleets are estimated by extrapolation from Scottish data, which account for nearly 70% of human consumption landings.

Some effort in the Scottish light trawl fleet has been diverted to a targeted monkfish fishery in recent years. Because this effort is included in the ScoLtr tuning series, it is likely to lead to incommensurate whiting CPUE values for these years compared to the earlier years (see Section 5.1.6), as whiting are less available to vessels prosecuting the monkfish fishery. An XSA tuning run that excluded this fleet showed little, if any, differences in the estimates of mean F, SSB or recruitment for recent years (on the stock file).

5.1.11 Biological reference points

Yield per recruit results are presented in Table 5.1.18 and Figure 5.1.13 contingent on variation in the human consumption component of the total international reference F, and a summary of F_{loss} calculations are shown in Figure 5.1.14.

Various reference points are listed below:

F_{SQ}	$F_{0.1}$	F_{max}	F_{med}	F_{high}	F_{loss}	B_{loss}
0.52	0.30	>1.03	0.97	>1.03	1.38	238,000t

There is a 35% probability that current F (0.52) exceeds F_{loss} (1.38). Given the relatively low value of the former and high value of the latter, this indicates considerable uncertainty in the estimation of one or both quantities. Figure 5.1.13 indicates a very wide percentile range of bootstrapped G_{loss} values, presumably due to the high contrast in observed recruitments at the lowest observed SSB levels

The *status quo* human consumption fishing mortality is 0.39. The *status quo* total mean F for ages 2-6 (human consumption landings + discards + industrial by-catch) is estimated to be 0.52.

5.1.12 Definition of safe biological limits using target and limit reference points

A discussion of the general approach taken in estimating B_{lim} and F_{lim} is given in Section 17. For whiting in IV and VIId, the stock and recruitment scatterplot generated by the XSA analysis (Figure 5.1.12) does not indicate that recruitment is reduced at the lower levels of observed spawning biomass. According to the historical series, stock growth has been seen from the lowest recorded spawning biomass of 238,000t. According to the criteria outlined in Section 17 this is taken as the estimate of B_{loss} and corresponds to B_{lim}

From the medium term projections, F=0.93 results in a 5% probability of breaching B_{lim} after 10 years, consequently, this is presented as the $F_{pa5\%}$ level. The corresponding $F_{pa10\%}$ level is F= 1.04. The 50%iles of SSB defined by these fishing mortalities at the end of 10 years is *ca.* 420,000t and 390,000t, representing $B_{pa5\%}$ and $B_{pa10\%}$ respectively.

$F_{pa5\%}$ has been exceeded in 13 out of 37 years, most recently in 1990, whilst a minimum SSB corresponding to $B_{pa5\%}$ has been attained in 13 out of 37 years, most recently in 1981.

$F_{pa10\%}$ has been exceeded in 8 out of 37 years, most recently in 1987, whilst a minimum SSB corresponding to $B_{pa10\%}$ has been attained in 15 out of 37 years, most recently in 1981.

An attempt was made to estimate F_{pa} and B_{pa} in the same way as undertaken by the WG on the Assessment of Northern Shelf Demersal Stocks. The fundamental difference between the North Sea and Northern Shelf approach is the former estimates a value of B_{lim}, and then calculates a value of F_{pa} that gives a low probability of breaching it and then selects a coherent estimate of B_{pa}. The latter estimates a value of F_{lim} from which it then estimates F_{pa} and a coherent estimate of B_{pa}.

To emulate the Northern Shelf approach, a value of F was calculated that gave a 10% probability of exceeding F_{loss}. This was taken as a candidate for $F_{pa10\%}$. The appropriate F-multiplier relative to the *status quo* F was then entered into the WGMTERM program using the same stock and recruitment relationship as assumed for the earlier medium term predictions. The 50%ile of SSB at the end of 10 years was then chosen as the $B_{pa10\%}$ level.

For whiting, this resulted in a value of $F_{pa10\%} = 0.076$, and $B_{pa10\%} = 966{,}000$t. These rather extreme values represent further the degree of uncertainty in the F_{loss} calculations mentioned in Section 5.1.11.

5.2 Whiting in Division IIIa

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

Total landings are shown in Table 5.2.1

No analytical assessment of this stock was possible.

Table 5.1.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1983-1996, as officially reported to ICES.

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	2,864	2,798	2,177	2,275	1,404	1,984	1,271	1,040	913	1,030	944	1,042	880	843
Denmark	18,054	19,771	16,152	9,076	2,047	12,112	803	1,207	1,529	1,377	1,418	549	368	189
Faroe Islands	18	-	6	-	12	222	1	26	-	16	7	2	21	-
France	21,263	19,209	10,853	8,250	10,493	10,569	5,277[1,2]	4,951[1]	5,188[1,2]	5,115[1]	5,502[1,2]	5020[2]	5,963[1,2]	4,704[1,2]
Germany, Fed.Rep.	317	286	226	313	274	454	415	692	865	511	441[1]	239	124	187
Netherlands	10,935	8,767	6,973	13,741	8,542	5,087[3]	3,860	3,272[1]	4,028[1]	5,390	4,799	3,864	3,640	3,388
Norway	39	88	103	103	74	52	32	55	103	232	130[1]	80	114	65
Poland	1	2	-	-	-	-	-	-	-	-	-	-	-	-
Sweden	44	53	22	33	17	5	17	16	48	22	18	10	1	1
UK (Engl.& Wales)[3]	4,366	5,017	5,024	3,805	4,485	4,008	2,178	2,338	2,676	2,528	2,774	2,722	2477	2,329
UK (Scotland)	41,248	42,967	30,398	29,113	37,630	31,804	26,271	27,486	31,257	30,821	31,268	28,974	27,811	23,409
Total	99,149	98,958	71,934	66,709	64,978	66,294	40,125	41,084	46,607	47,301	47,296	42,502	41,399	35,115
Total h.c. catch used by Working Group	81,000	79,000	55,000	59,000	64,000	52,000	41,000	43,000	47,000	46,000	48,000	43,000	41,000	36,000
Total discards	50,000	41,000	29,000	80,000	54,000	28,000	36,000	56,000	34,000	31,000	43,000	33,000	31,000	28,000
Total Ind. By-catch	24,000	19,000	15,000	18,000	16,000	49,000	43,000	51,000	38,000	27,000	20,000	10,000	27,000	5,000

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

Table 5.1.2 WHITING in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1982 to 1996.

Year	Belgium	France	Netherlands	UK (E+W)	UK (S)	Total	Unreported landings	Total as used by Working Group
1982	93	7,012	2	170	-	7,277	633	7,911
1983	84	5,057	1	198	-	5,340	1,600	6,936
1984	79	6,914	-	88	-	7,081	289	7,373
1985	82	7,563	-	186	-	7,831	491	7,390
1986	65	4,551	-	180	-	4,796	704	5,498
1987	136	6,730	-	287	-	7,153	2,463	4,671
1988	69	7,501	-	251	-	7,821	3,391	4,428
1989	38	n/a	-	231	-	n/a	-	4,156
1990	83	n/a	-	237	1	n/a	-	3,483
1991	83	n/a	-	292	1	n/a	-	5,718
1992	66	5,414	-	419	24	5,923	-	5,745
1993	74	5,032	-	321	2	5,429	-	5,215
1994	61	n/a	-	293	-	n/a	-	6,623
1995	68	5,202	-	280	1	5,551	-	5,390
1996[1]	84	4,772	1	199	1	5,057	-	4,955

[1]Preliminary

Table 5.1.3 Whiting, IV and VIId
Annual weight and numbers caught, 1960 to 1996.

Year	Wt. ('000t)				Nos. (millions)			
	Total	hco	dis	ibc	Total	hco	dis	ibc
1960	182	49	122	11	1070	198	763	109
1961	326	69	241	16	2173	296	1646	232
1962	222	58	157	8	1514	229	1185	100
1963	261	61	154	45	1560	226	854	480
1964	150	63	59	28	944	233	341	369
1965	187	88	77	22	970	319	490	161
1966	242	108	84	51	1343	374	546	422
1967	237	72	143	23	1592	258	1103	231
1968	265	93	115	58	1661	314	754	593
1969	328	61	115	152	2816	216	626	1974
1970	272	83	74	115	2519	284	381	1854
1971	195	61	63	72	2127	193	458	1475
1972	191	64	67	61	1938	188	398	1352
1973	271	71	110	90	2179	247	659	1273
1974	296	81	85	130	2594	271	477	1846
1975	305	84	135	86	1981	264	699	1018
1976	368	83	136	150	2311	275	641	1396
1977	347	78	163	106	2491	280	547	1663
1978	188	97	35	55	1769	363	241	1165
1979	244	107	78	59	1913	382	645	886
1980	224	101	77	46	1456	340	471	645
1981	192	90	36	67	1439	296	214	929
1982	140	81	27	33	778	271	173	333
1983	161	88	50	24	1357	290	370	697
1984	146	86	41	19	909	285	327	297
1985	106	62	29	15	688	176	231	280
1986	162	64	80	18	1206	225	583	399
1987	139	68	54	16	946	245	416	285
1988	133	56	28	49	1395	211	231	952
1989	124	45	36	43	883	172	280	431
1990	153	47	56	51	1294	177	539	578
1991	125	53	34	38	1611	199	242	1170
1992	110	52	31	27	863	182	216	465
1993	116	53	43	20	1231	174	343	714
1994	93	49	33	10	702	162	235	304
1995	103	46	30	27	2020	147	214	1659
1996	74	41	28	5	439	135	177	127
Min.	74	41	27	5	439	135	173	100
Mean	199	71	79	50	1532	246	506	780
Max.	368	108	241	152	2816	382	1646	1974

Table 5.1.4 Whiting in VIId. Annual weight and numbers caught, 1976-1996

Year	Wt ('000t)	Nos (millions)
1976	7.715	27
1977	4.954	21
1978	9.113	38
1979	8.910	36
1980	9.167	36
1981	8.932	34
1982	7.911	33
1983	6.936	29
1984	7.373	33
1985	7.390	20
1986	5.498	21
1987	4.671	18
1988	4.428	18
1989	4.156	17
1990	3.483	14
1991	5.718	18
1992	5.745	19
1993	5.215	18
1994	6.625	24
1995	5.390	18
1996	4.995	18

TABLE 5.1.5 Whiting, North Sea and VIId
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
0	2.550	.000
1	.950	.110
2	.450	.920
3	.350	1.000
4	.300	1.000
5	.250	1.000
6	.250	1.000
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

Table 5.1.6

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

At 11-Oct-97 14:33:25

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,
AGE							
0,	60828,	215700,	76257,	105982,	234479,	63912,	84279,
1,	482896,	1079197,	1022790,	549436,	137589,	342622,	517081,
2,	259440,	619965,	220148,	751817,	369668,	148166,	343402,
3,	215393,	219882,	156642,	96114,	164882,	330156,	93851,
4,	21460,	32745,	31722,	45332,	22843,	72200,	255875,
5,	23278,	1355,	5998,	9334,	10908,	8002,	37708,
6,	3634,	4099,	276,	1739,	2770,	3555,	8535,
7,	892,	385,	407,	9,	435,	765,	1520,
+gp,	2380,	369,	125,	142,	55,	134,	470,
TOTALNUM,	1070201,	2173697,	1514365,	1559905,	943629,	969512,	1342721,
TONSLAND,	182361,	326093,	222431,	260771,	149956,	186760,	242233,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
0,	177436,	104751,	1206087,	1187095,	1232837,	553711,	175647,	571476,	238839,	425081,
1,	973202,	830540,	374343,	606831,	621941,	939141,	1155304,	756260,	955910,	479610,
2,	216063,	523774,	1025996,	83064,	107933,	319094,	666563,	986441,	407207,	1129375,
3,	122955,	111755,	158808,	571696,	18786,	46392,	135507,	234063,	303537,	169610,
4,	23958,	49514,	28972,	52108,	128541,	7833,	19028,	33307,	56549,	88015,
5,	69081,	7494,	13240,	11463,	13640,	59313,	5739,	4977,	9273,	15988,
6,	7886,	31183,	1734,	3723,	2306,	8392,	18186,	1243,	8014,	3163,
7,	849,	1940,	5989,	1211,	730,	3486,	2504,	5856,	116,	495,
+gp,	164,	127,	697,	1514,	628,	1009,	546,	427,	1525,	675,
TOTALNUM,	1591594,	1661078,	2815866,	2518706,	2127342,	1938372,	2179025,	2594051,	1980969,	2312011,
TONSLAND,	236994,	265266,	327617,	271648,	195357,	191320,	270533,	296197,	305010,	368240,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 5.1.6 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

At 11-Oct-97 14:33:25

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
0,	666975,	687238,	476383,	332209,	516869,	101058,	668604,	157819,	186723,	225201,
1,	1006082,	418910,	615524,	265359,	162899,	192640,	205646,	323408,	203321,	576731,
2,	480939,	313391,	467537,	416008,	346343,	114444,	184746,	175965,	141716,	167077,
3,	279226,	242370,	218283,	286077,	266517,	245246,	118412,	124886,	82037,	169577,
4,	30130,	90047,	100975,	90718,	102295,	88137,	131508,	49505,	37847,	46517,
5,	21334,	7563,	29267,	52969,	27776,	26796,	37231,	59817,	14420,	13367,
6,	5561,	7565,	3111,	10751,	12297,	6909,	8688,	13860,	17445,	3487,
7,	532,	1851,	1657,	1152,	3540,	2082,	1780,	2964,	3328,	3975,
+gp,	419,	277,	304,	767,	326,	484,	930,	613,	904,	569,
TOTALNUM,	2491198,	1769212,	1913041,	1456011,	1438862,	777796,	1357545,	908837,	687741,	1206501,
TONSLAND,	347056,	188186,	243846,	223517,	192049,	140195,	161212,	145741,	106363,	161744,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	106,	100,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
0,	84863,	416924,	87325,	284755,	1035089,	252963,	622530,	216868,	1571419,	92120,
1,	267051,	430344,	331672,	253745,	128507,	239791,	217539,	163609,	137481,	68414,
2,	368229,	307429,	173676,	505010,	191193,	165354,	167577,	147177,	139010,	109842,
3,	122748,	179502,	191942,	129126,	187195,	89563,	124287,	90611,	111489,	97299,
4,	85240,	39635,	78464,	86324,	36830,	93636,	46543,	47533,	35728,	49842,
5,	11392,	17901,	14367,	32270,	26209,	11967,	46136,	17384,	15161,	14558,
6,	4556,	2175,	5050,	2002,	5519,	6878,	3946,	17264,	5159,	5016,
7,	928,	544,	516,	735,	542,	2609,	1519,	998,	4515,	1325,
+gp,	1035,	168,	334,	112,	273,	117,	771,	460,	474,	1118,
TOTALNUM,	946042,	1394622,	883346,	1294079,	1611357,	862878,	1230849,	701904,	2020436,	439534,
TONSLAND,	138775,	133470,	123753,	153453,	124975,	109704,	116165,	92606,	103268,	73959,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	99,	100,

Table 5.1.7

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

At 11-Oct-97 14:33:25

Table 3 Stock weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,
AGE							
0,	.0580,	.0420,	.0550,	.0490,	.0420,	.0580,	.0720,
1,	.1170,	.1190,	.1190,	.1120,	.1240,	.1240,	.1090,
2,	.1900,	.1930,	.1870,	.1950,	.1740,	.2090,	.1870,
3,	.2560,	.2590,	.2670,	.2720,	.2680,	.2420,	.2490,
4,	.3140,	.3030,	.3330,	.3530,	.3550,	.3320,	.2880,
5,	.3440,	.4120,	.4000,	.4120,	.4440,	.4210,	.3680,
6,	.3840,	.4200,	.5200,	.4720,	.4890,	.4990,	.4340,
7,	.5010,	.4930,	.5190,	.8200,	.5350,	.5420,	.4730,
+gp,	.4490,	.4420,	.5440,	.6130,	.7420,	.6420,	.6970,

Table 3 Stock weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
0,	.0620,	.0380,	.0430,	.0200,	.0360,	.0220,	.0270,	.0260,	.0300,	.0190,
1,	.1180,	.1120,	.0970,	.1100,	.1160,	.0710,	.0840,	.0710,	.1000,	.1070,
2,	.1990,	.1880,	.1730,	.2040,	.2190,	.2010,	.1660,	.1500,	.2150,	.1940,
3,	.2690,	.2950,	.2620,	.2410,	.2860,	.2840,	.2780,	.2590,	.2780,	.2940,
4,	.3320,	.3590,	.3630,	.3490,	.3190,	.3890,	.3720,	.3830,	.3760,	.3480,
5,	.3400,	.4840,	.4150,	.4550,	.4330,	.4190,	.4390,	.4710,	.4700,	.4390,
6,	.4250,	.4470,	.4190,	.4520,	.5310,	.5210,	.4630,	.5210,	.3560,	.5010,
7,	.4950,	.6200,	.5350,	.5120,	.6370,	.5750,	.5520,	.5440,	.8170,	.5140,
+gp,	.6220,	.7440,	.6770,	.6440,	.6820,	.8020,	.7770,	.8260,	.6060,	.7020,

Table 5.1.7 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

At 11-Oct-97 14:33:25

Table 3 Stock weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
0,	.0220,	.0100,	.0090,	.0130,	.0110,	.0290,	.0150,	.0200,	.0140,	.0150,
1,	.1170,	.0740,	.0980,	.0750,	.0830,	.0610,	.1070,	.0890,	.0940,	.1050,
2,	.2100,	.1820,	.1660,	.1760,	.1680,	.1840,	.1910,	.1880,	.1920,	.1830,
3,	.3190,	.2340,	.2590,	.2520,	.2420,	.2530,	.2730,	.2710,	.2840,	.2550,
4,	.3990,	.3220,	.3010,	.3280,	.3210,	.3140,	.3250,	.3370,	.3320,	.3180,
5,	.4440,	.4270,	.4110,	.3370,	.3790,	.3760,	.3840,	.3820,	.4020,	.3780,
6,	.4620,	.4280,	.4550,	.4580,	.4110,	.4780,	.4260,	.3910,	.4350,	.4750,
7,	.5470,	.4660,	.4920,	.4580,	.4440,	.5040,	.4520,	.4630,	.4940,	.4680,
+gp,	.4750,	.6490,	.5820,	.5720,	.7200,	.7350,	.5370,	.5670,	.4380,	.6250,

Table 3 Stock weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
0,	.0130,	.0130,	.0230,	.0150,	.0170,	.0130,	.0120,	.0130,	.0100,	.0160,
1,	.0770,	.0540,	.0700,	.0830,	.1030,	.0820,	.0730,	.0800,	.0870,	.0890,
2,	.1480,	.1460,	.1570,	.1370,	.1690,	.1850,	.1750,	.1700,	.1810,	.1680,
3,	.2470,	.2230,	.2250,	.2090,	.2180,	.2570,	.2520,	.2540,	.2580,	.2420,
4,	.2970,	.3010,	.2670,	.2500,	.2900,	.2770,	.3190,	.3230,	.3410,	.3100,
5,	.3750,	.3460,	.3180,	.2790,	.3070,	.3320,	.3290,	.3710,	.3850,	.3920,
6,	.3790,	.4230,	.3910,	.4080,	.3380,	.3460,	.3490,	.3670,	.4300,	.4280,
7,	.5420,	.5060,	.4310,	.4900,	.3650,	.3140,	.4030,	.4140,	.4340,	.4310,
+gp,	.5840,	.6940,	.3940,	.5990,	.4010,	.5030,	.3810,	.4160,	.4200,	.4300,

Table 5.1.8 North Sea and eastern Channel whiting. Fleets available for VPA tuning.

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

[1] Scottish sub-set of data
[2]English sub-set of data
[3]Formerly IYFS

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Table 5.1.9 Whiting in the North Sea/Eastern Channel, Available tuning data

SCOSEI_IV											
1976	1996										
1	1	0	1								
0	10										
307165	148.995	22192.289	67580.047	12456.698	10885.747	1889.95	263.994	42.999	0.000	72.998	1.000
313913	745.020	22193.598	50660.371	37036.020	3336.092	2528.069	371.010	31.001	10.000	1.000	6.000
325246	5345.922	14993.602	29307.939	43710.809	15390.197	1057.941	1408.921	200.989	35.998	0.000	7.000
316419	302.002	90749.852	41091.742	28124.234	14745.013	6083.678	676.915	155.750	2.995	0.000	0.000
297227	668.983	27032.330	73704.438	37657.648	11914.984	9367.982	2556.000	260.000	229.000	27.000	7.000
289672	92.998	8726.789	22243.637	25047.811	10551.986	2401.997	2084.002	374.000	41.000	4.000	1.000
297730	43.000	3720.987	7032.000	26194.137	13117.107	2713.028	539.005	277.003	81.001	5.000	0.000
333168	572.013	11565.390	14957.378	21690.016	34199.105	9830.623	2154.563	406.795	157.779	16.256	0.000
388035	296.722	4922.500	24015.609	20669.760	14985.589	21269.320	4715.242	959.961	87.283	49.593	6.943
381647	773.215	20067.844	20263.316	19695.992	8956.377	4795.861	8013.077	1362.788	333.952	17.890	5.963
425017	137.759	139498.172	48705.180	34509.258	11340.962	2624.396	1097.504	1771.080	215.940	7.271	0.000
418536	1358.848	13793.330	52715.141	38938.770	18440.258	3637.712	1096.908	297.738	348.416	15.879	3.970
377132	26.014	2502.074	28446.105	44869.258	12631.404	4071.612	678.724	63.973	20.991	16.993	1.999
355735	10.131	6878.804	15704.127	41407.430	23710.402	4769.041	1323.229	112.076	43.044	10.723	0.711
252732	184.877	14229.828	124635.820	27694.109	29920.980	14767.797	720.818	206.524	23.233	0.017	0.000
336675	886.651	11951.946	44964.258	63414.281	10436.101	8730.116	1742.927	195.190	93.627	0.000	0.247
300217	426.209	16613.691	19452.012	21217.148	27961.869	2804.536	1958.074	564.870	32.421	3.386	0.000
268413	599.768	9563.692	31623.355	26012.820	12457.879	14446.113	899.254	332.177	153.131	7.510	8.252
264738	82.710	9235.936	21451.654	22570.719	11778.492	5530.941	5611.981	203.907	115.772	14.689	0.000
204545	26.012	8287.879	22152.725	30006.961	9018.667	3874.625	1373.442	1270.024	86.009	14.990	18.127
177092	223.896	5732.241	26020.514	21430.221	10505.521	3483.373	1031.267	295.708	289.157	28.118	0.999
SCOLTR_IV											
1976	1996										
1	1	0	1								
0	10										
152419	28.998	5574.648	30121.129	5297.682	5247.686	875.948	194.988	17.999	1.000	43.997	5.000
224824	709.038	24587.139	29945.250	24840.408	1663.950	2418.911	459.981	33.999	17.999	0.000	4.000
236944	7158.392	8785.464	19909.945	30722.309	14472.604	956.038	1612.065	635.026	72.003	6.000	0.000
287494	367.996	171147.281	42910.398	23154.594	17995.664	4057.925	376.993	285.995	56.999	5.000	0.000
333197	868.998	20805.963	58381.992	38436.160	9525.058	9430.050	1864.014	144.001	145.001	3.000	0.000
251504	170.986	6576.457	19069.211	21549.754	9706.151	1777.022	1455.034	310.008	9.000	1.000	0.000
250870	6390.155	5214.103	8196.975	26680.535	12944.739	3333.924	646.980	338.988	73.997	15.999	3.000
244349	20191.061	37495.680	17925.867	12535.311	19234.307	6123.520	1216.612	182.797	140.848	25.969	0.999
240775	2553.165	38266.770	16048.092	10784.184	6306.822	9018.982	2371.186	478.594	13.127	30.293	5.049
267393	1221.645	28760.939	9368.367	7616.928	3085.792	1333.193	2901.185	443.130	173.087	13.847	0.000
279727	796.708	8138.433	8571.900	9577.941	4108.819	767.442	425.282	608.602	51.637	2.025	0.000
351131	599.518	18761.178	25933.338	16160.769	5954.478	1182.953	388.455	116.035	128.993	3.933	0.000
391988	59.996	2397.963	15778.771	22525.543	5127.725	1640.626	207.218	31.033	15.015	6.006	6.006
405883	491.803	20318.748	10051.615	21389.719	10836.808	2394.091	448.224	33.084	54.358	2.388	0.609
371493	371.478	3676.882	35321.988	7664.570	8960.094	3423.009	159.541	39.935	5.339	0.067	0.000
408056	688.421	8726.876	11908.029	22145.619	3192.247	2906.398	628.632	49.904	40.866	0.447	0.253
473955	1379.234	17580.582	14551.322	11822.715	15417.656	1500.403	1160.443	304.395	12.750	0.341	0.655
447064	614.447	16438.910	20513.145	14385.548	6590.755	10105.473	574.199	203.582	97.351	24.363	4.587
480400	1259.303	4132.650	15771.000	13004.648	6453.762	2710.229	2997.307	171.833	83.936	13.864	0.000
442010	208.066	9248.035	15886.830	19322.299	6261.604	2982.508	1092.214	1131.707	88.831	3.479	14.193
445995	188.320	6661.924	12461.079	13523.105	9223.331	3012.112	860.730	281.907	242.799	8.933	0.540

Table 5.1.9 (Cont'd)

```
FRATRB_IV
1985   1996
1      1       0.000   1.000
0      11
25915  422.811   7988.826   6080.829   3694.283   1373.809  603.428   638.480  120.487  12.318  4.228  1.134  0.480
28611  406.232   21523.615  9974.889   6207.954   1469.380  400.588   99.290   163.684  22.889  1.282  0.098  0.030
28692  526.297   8793.046   15485.727  5504.342   2667.237  527.680   168.704  47.911   47.424  3.042  0.083  0.016
25208  1035.122  3307.192   6951.075   7297.665   1410.190  570.750   100.931  31.077   3.273   4.169  1.457  0.000
25184  409.681   9249.401   4209.786   7942.546   3120.176  505.024   112.148  10.308   4.240   0.778  0.000  0.001
21758  7426.502  4209.567   16326.301  3818.226   3208.142  1233.704  67.700   17.894   1.064   0.137  0.000  0.000
19840  286.342   3648.856   5601.652   7060.812   1033.414  737.117   141.336  17.904   3.491   0.078  0.075  0.000
15656  281.776   4579.669   3967.500   2748.626   3070.322  303.026   201.910  92.884   2.893   0.058  0.000  0.000
19076  2109.509  5655.010   5665.811   4804.977   1551.388  1700.119  120.997  43.397   13.910  4.103  1.156  0.000
17316  373.053   3650.576   6242.765   3375.313   1906.924  547.662   530.348  30.148   8.242   1.336  0.000  0.000
17794  2047.005  2993.730   5845.789   6337.767   1962.861  1245.490  253.576  218.334  13.926  6.659  2.023  0.000
18883  102.260   1326.709   4179.847   3667.861   1914.219  573.655   208.352  45.503   30.160  10.285 0.067  0.004
FRATRO
1986   1996
1      1       0.000   1.000
0      10
56099  550.888   28532.693  9929.830   10046.431  4132.508  641.701   164.716  43.256  2.934   0.270  0.001
71765  665.537   12888.154  18221.742  3551.535   6353.250  450.678   261.126  91.790  71.817  0.716  0.000
84052  1818.968  8083.164   16419.734  7584.602   1205.629  1392.721  124.251  55.311  0.818   0.619  0.034
88397  629.409   16112.097  6946.142   10995.586  3511.830  494.745   289.427  47.945  11.942  0.243  0.003
71078  12439.884 9227.124   27029.047  6544.223   4435.991  1399.156  50.145   50.782  1.486   0.000  0.011
67846  716.684   8652.459   10222.363  8169.309   1876.420  982.894   119.532  9.056   1.905   6.763  0.000
51240  578.834   8112.166   8405.177   3787.494   2247.669  494.113   199.263  73.351  0.232   0.095  0.000
62553  3696.921  10689.630  10258.977  7199.083   1684.500  994.606   115.869  44.215  6.055   0.014  0.001
51239  545.209   9146.525   8509.438   3669.423   1696.087  389.240   159.098  20.764  2.729   0.001  0.000
57823  2819.695  7657.750   10861.378  6681.053   1458.819  313.351   51.629   9.231   1.729   0.000  0.000
50163  579.723   6265.570   10285.215  7078.639   2298.202  447.549   38.241   40.833  0.072   0.002  0.001
SCOGFS_IV
1982   1996
1      1       0.5     0.75
0      6
100    1.020   6.530   9.710   9.720   2.240  0.600  0.160
100    2.100   5.630   5.780   4.070   5.110  1.160  0.170
100    4.420   10.480  3.710   1.700   0.770  0.920  0.180
100    1.690   15.770  9.730   2.470   0.630  0.360  0.180
100    4.060   11.110  4.520   2.240   0.270  0.050  0.050
100    1.200   14.050  11.500  2.080   0.770  0.160  0.030
100    6.420   9.670   16.060  4.520   0.700  0.190  0.020
100    4.270   40.430  7.410   7.330   1.570  0.130  0.060
100    19.430  22.390  20.530  2.480   2.550  0.470  0.050
100    13.790  17.690  9.500   7.590   0.510  0.400  0.090
100    24.170  29.250  12.670  5.530   5.850  0.470  0.260
100    2.470   31.690  11.680  4.230   1.560  1.820  0.060
100    6.480   26.350  9.500   2.540   0.570  0.340  0.230
100    12.430  41.760  20.100  9.030   1.960  0.580  0.220
100    4.400   28.880  30.470  12.150  4.600  0.430  0.150
```

Table 5.1.9 (Cont'd)

ENGGFS_IV							
1977	1996						
1	1	0.5	0.75				
0	6						
100	28.428	21.953	7.441	1.109	0.216	0.091	0.080
100	18.441	24.714	5.151	1.055	0.345	0.051	0.022
100	35.476	20.064	7.117	1.899	0.843	0.057	0.029
100	19.903	35.327	12.508	4.810	1.205	0.314	0.058
100	34.942	18.314	28.804	16.052	0.618	0.616	0.080
100	6.932	27.722	7.934	8.590	2.220	0.340	0.049
100	71.673	11.853	10.803	1.906	1.696	0.242	0.067
100	17.252	50.613	10.818	3.012	0.889	0.769	0.378
100	19.990	15.878	17.043	1.673	0.981	0.182	0.153
100	16.334	15.162	6.592	3.847	0.406	0.104	0.014
100	13.731	22.763	13.036	2.687	2.009	0.352	0.118
100	38.169	18.806	13.160	4.546	0.645	0.174	0.018
100	116.948	29.474	11.760	7.694	1.674	0.345	0.019
100	87.532	19.009	12.836	3.854	2.318	0.325	0.046
100	16.732	33.304	7.665	3.818	1.086	0.371	0.042
100	45.505	26.555	13.070	3.046	2.610	0.493	0.589
100	25.243	25.104	9.629	3.750	1.161	0.742	0.188
100	21.143	30.546	10.594	2.439	1.124	0.333	0.114
100	36.282	35.506	23.738	7.361	1.870	0.251	0.144
100	10.259	7.169	9.554	5.759	3.065	0.689	0.201
IBTS_Q1_IV							
1973	1996						
1	1	0.99	1				
0	5						
1	0.322	0.496	-1	-1	-1	-1	
1	0.893	0.153	-1	-1	-1	-1	
1	0.679	0.535	-1	-1	-1	-1	
1	0.418	0.219	-1	-1	-1	-1	
1	0.513	0.293	-1	-1	-1	-1	
1	0.457	0.183	-1	-1	-1	-1	
1	0.692	0.391	-1	-1	-1	-1	
1	0.227	0.485	-1	-1	-1	-1	
1	0.161	0.232	-1	-1	-1	-1	
1	0.128	0.126	0.113	0.079	0.033	0.006	
1	0.436	0.179	0.091	0.031	0.026	0.011	
1	0.341	0.359	0.066	0.019	0.007	0.007	
1	0.456	0.261	0.198	0.033	0.007	0.004	
1	0.669	0.544	0.090	0.046	0.005	0.002	
1	0.394	0.862	0.315	0.034	0.012	0.001	
1	1.465	0.542	0.421	0.112	0.012	0.005	
1	0.509	0.887	0.202	0.093	0.017	0.004	
1	1.014	0.675	0.482	0.071	0.038	0.008	
1	0.916	0.748	0.261	0.169	0.016	0.014	
1	1.087	0.524	0.245	0.066	0.059	0.012	
1	0.721	0.637	0.180	0.067	0.012	0.009	
1	0.679	0.457	0.245	0.059	0.012	0.006	
1	0.502	0.486	0.245	0.070	0.023	0.010	
1	0.288	0.342	0.163	0.060	0.018	0.009	

Table 5.1.9 (Cont'd)

```
IBTS_Q2_SCO_IV
1991    1996
1       1       0.25    0.5
1       6
100     94.900  38.560  22.860  3.740   1.230   0.510
100     129.760 47.500  11.420  4.280   1.140   0.450
100     104.670 41.490  20.860  5.170   4.850   0.360
100     65.400  35.710  8.550   2.380   0.900   0.750
100     191.610 77.300  26.190  4.420   2.210   0.410
100     44.020  49.620  22.300  8.330   1.250   0.590
IBTS_Q4_ENG_IV
1991    1996
1       1       0.75    1
0       7
100     46.82647        55.27577        19.64171        15.09189        3.25460         1.85092         1.32901         0.03016
100     94.23306        45.08990        26.46158        5.37850         5.02968         0.64532         0.53430         0.12175
100     78.87058        54.20958        19.47387        7.16071         2.33451         0.82701         0.23715         0.00829
100     69.84756        61.33462        26.41324        4.14012         0.84180         0.62111         0.10636         0.07947
100     71.32800        107.99600       41.71500        11.18600        2.56000         0.52300         0.20400         0.07100
100     29.98300        36.55600        30.33000        8.65300         4.81500         1.62600         0.51500         0.32600
FRATRO_7D
1986    1996
1       1       0.00    1.00
1       7
257794  2586.585        2249.766        7740.579        4462.975        804.345         198.399         19.349
188236  1954.813        5050.154        907.041         4606.140        331.425         218.342         53.974
215422  2233.099        7957.348        2551.697        536.685         1192.832        127.343         61.148
320383  2577.841        3916.354        6005.556        1489.832        216.078         342.966         50.476
236327  2013.173        4696.564        2692.011        1716.129        234.678         29.785          50.594
300624  2265.000        5551.855        3282.110        2431.341        1400.581        186.438         4.143
285783  3289.819        7728.323        3574.314        1124.235        677.996         325.735         1.155
283999  1728.124        4636.445        6898.289        1952.174        409.877         132.079         67.925
286019  9119.202        5292.142        3325.417        3094.995        723.950         52.888          49.752
268151  3657.137        5652.435        4857.596        1822.177        450.327         87.227          8.344
274495  3999.207        4178.047        4679.394        2356.818        471.437         63.377          23.145
FRAGFS_7d
1988    1996
1       1       0.75    1
0       3
27      3186    -1      -1      -1
27      1512    -1      -1      -1
27      1674    -1      -1      -1
27      7155    1350    162     27
27      6291    1674    378     54
27      1566    675     216     54
27      1323    6993    837     135
27      1539    1836    216     27
27      2484    1782    405     81
```

Table 5.1.10

Lowestoft VPA Version 3.1

11-Oct-97 14:32:34

Extended Survivors Analysis

Whiting IV,IIIa,VIId (run: XSACLN02/X02)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/whg_347d/FLEET.X02

Catch data for 37 years. 1960 to 1996. Ages 0 to 8.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT12: SCOSEI_IV (Ca,	1987,	1996,	1,	7,	.000,	1.000
FLT13: SCOLTR_IV (Ca,	1987,	1996,	1,	7,	.000,	1.000
FLT14: FRATRB_IV (Ca,	1987,	1996,	1,	7,	.000,	1.000
FLT15: FRATRO (Catch,	1987,	1996,	0,	7,	.000,	1.000
FLT16: SCOGFS_IV (Ca,	1987,	1996,	1,	6,	.500,	.750
FLT17: ENGGFS_IV (Ca,	1987,	1996,	1,	5,	.500,	.750
FLT18: IBTS_Q1_IV (C,	1987,	1996,	0,	4,	.990,	1.000
FLT19: IBTS_Q2_SCO_I,	1991,	1996,	1,	6,	.250,	.500
FLT20: IBTS_Q4_ENG_I,	1991,	1996,	0,	5,	.750,	1.000
FLT21: FRATRO_7D (Ca,	1987,	1996,	1,	5,	.000,	1.000
FLT22: FRAGFS_7d (Ca,	1988,	1996,	0,	3,	.750,	1.000

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 6

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 31 iterations

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

Fishing mortalities

Age,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996
0,	.010,	.026,	.012,	.041,	.144,	.032,	.079,	.031,	.302,	.040
1,	.141,	.359,	.129,	.226,	.115,	.232,	.173,	.132,	.120,	.092
2,	.510,	.431,	.432,	.548,	.485,	.381,	.457,	.298,	.276,	.229
3,	.872,	.662,	.697,	.913,	.516,	.573,	.734,	.631,	.498,	.403
4,	1.250,	.974,	.840,	.988,	.888,	.631,	.813,	.851,	.653,	.510
5,	1.377,	1.166,	1.544,	1.247,	1.121,	.947,	.846,	.960,	.829,	.682
6,	1.784,	1.297,	1.612,	1.076,	.787,	1.193,	1.104,	1.018,	.953,	.795
7,	1.263,	1.349,	1.560,	1.315,	1.065,	1.234,	1.009,	1.017,	.865,	.719

Table 5.1.10 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6	7
1987	2.97E+07	3.27E+06	1.15E+06	2.51E+05	1.39E+05	1.73E+04	6.21E+03	1.43E+03
1988	5.80E+07	2.30E+06	1.10E+06	4.41E+05	7.40E+04	2.95E+04	3.39E+03	8.12E+02
1989	2.62E+07	4.41E+06	6.21E+05	4.55E+05	1.60E+05	2.07E+04	7.15E+03	7.22E+02
1990	2.53E+07	2.02E+06	1.50E+06	2.57E+05	1.60E+05	5.13E+04	3.44E+03	1.11E+03
1991	2.76E+07	1.90E+06	6.23E+05	5.53E+05	7.27E+04	4.41E+04	1.15E+04	9.14E+02
1992	2.91E+07	1.86E+06	6.54E+05	2.45E+05	2.32E+05	2.22E+04	1.12E+04	4.07E+03
1993	2.95E+07	2.20E+06	5.72E+05	2.85E+05	9.72E+04	9.16E+04	6.69E+03	2.64E+03
1994	2.58E+07	2.13E+06	7.15E+05	2.31E+05	9.64E+04	3.19E+04	3.06E+04	1.73E+03
1995	2.16E+07	1.96E+06	7.22E+05	3.39E+05	8.65E+04	3.05E+04	9.51E+03	8.62E+03
1996	8.46E+06	1.25E+06	6.71E+05	3.49E+05	1.45E+05	3.34E+04	1.04E+04	2.86E+03

Estimated population abundance at 1st Jan 1997

	.00E+00	6.35E+05	4.39E+05	3.40E+05	1.64E+05	6.45E+04	1.31E+04	3.64E+03

Taper weighted geometric mean of the VPA populations:

	3.89E+07	3.06E+06	9.17E+05	3.42E+05	1.04E+05	3.05E+04	8.58E+03	1.91E+03

Standard error of the weighted Log(VPA populations) :

	.5789	.5419	.5791	.5783	.6708	.8060	.9127	1.2350

Log catchability residuals.

Fleet : FLT12: SCOSEI_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age									
1	-.34	-1.50	-1.18	.71	.27	.78	.15	.14	.37	.59
2	-.20	-.70	-.66	.92	.46	-.35	.41	-.26	.01	.37
3	.18	-.22	-.26	.34	-.05	-.19	.04	.08	.18	-.08
4	-.19	.06	-.08	.56	-.03	-.20	.05	.03	.05	-.23
5	-.03	-.43	.28	.74	.03	-.38	-.09	.07	-.04	-.15
6	-.07	-.01	.08	.35	-.38	.04	-.15	.14	.14	-.15
7	-.11	-.94	-.13	.30	.06	-.19	-.27	-.32	.10	-.17

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

Age	1	2	3	4	5	6	7
Mean Log q	-17.5778	-15.3862	-14.4387	-14.0972	-13.7635	-13.7605	-13.7605
S.E(Log q)	.7794	.5295	.1976	.2260	.3304	.2002	.3746

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	-1.75	-2.655	9.40	.10	10	1.06	-17.58
2	.81	.418	15.04	.37	10	.45	-15.39
3	1.52	-1.757	15.35	.59	10	.27	-14.44
4	1.09	-.411	14.32	.71	10	.26	-14.10
5	.87	.667	13.31	.75	10	.30	-13.76
6	1.05	-.476	14.02	.90	10	.22	-13.76
7	.91	.691	13.35	.88	10	.31	-13.93

Table 5.1.10 (Continued)

Fleet : FLT13: SCOLTR_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age									
1	.55	-1.17	.18	-.62	.17	.79	.59	-.85	.12	.22
2	.29	-.30	-.22	.30	-.03	-.07	.49	-.13	-.06	-.26
3	.58	.15	.05	-.23	-.19	-.13	.04	.03	.07	-.37
4	-.01	.26	.14	.10	-.28	-.12	.04	-.03	.05	-.15
5	.14	-.26	.58	.01	-.14	-.34	.17	-.12	.05	-.10
6	.24	-.07	.04	-.38	-.42	.23	.06	.09	.31	-.09
7	.29	-.54	-.31	-.56	-.33	-.10	-.10	.08	.38	.03

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

Age	1	2	3	4	5	6	7
Mean Log q	-17.9873	-16.4125	-15.5411	-15.2335	-14.8851	-14.9278	-14.9278
S.E(Log q)	.6562	.2689	.2600	.1540	.2606	.2473	.3453

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	.93	.113	17.75	.24	10	.65	-17.99
2	.85	.646	15.97	.69	10	.24	-16.41
3	1.20	-.558	16.11	.50	10	.32	-15.54
4	1.03	-.212	15.34	.86	10	.17	-15.23
5	1.03	-.163	15.03	.77	10	.28	-14.89
6	.91	.778	14.38	.90	10	.23	-14.93
7	.78	2.865	13.35	.95	10	.19	-15.04

Table 5.1.10 (Continued)

Fleet : FLT14: FRATRB_IV (Ca

Age	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996
0 ,	No data for this fleet at this age									
1 ,	.01,	-.40,	-.11,	.07,	.03,	.56,	.39,	.06,	-.09,	-.52
2 ,	.20,	-.46,	-.39,	.28,	.16,	-.05,	.28,	.18,	.07,	-.27
3 ,	.13,	-.11,	-.04,	.03,	-.19,	-.06,	.22,	.13,	.29,	-.39
4 ,	-.07,	-.06,	-.09,	.15,	-.14,	-.09,	-.02,	.31,	.34,	-.33
5 ,	.16,	-.25,	.12,	.14,	-.18,	-.21,	-.14,	-.08,	.71,	-.28
6 ,	.21,	.26,	-.26,	-.09,	-.58,	.20,	-.03,	-.01,	.36,	-.04
7 ,	.22,	.51,	-.40,	-.22,	-.03,	.43,	-.19,	-.03,	.26,	-.33

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,	-15.6959,	-14.3310,	-13.6618,	-13.4689,	-13.2024,	-13.2332,	-13.2332,
S.E(Log q),	.3199,	.2780,	.2027,	.2056,	.2987,	.2804,	.3175,

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,	.91,	.310,	15.59,	.58,	10,	.31,	-15.70,
2,	.91,	.342,	14.26,	.63,	10,	.27,	-14.33,
3,	1.46,	-1.515,	14.11,	.58,	10,	.28,	-13.66,
4,	1.16,	-.764,	13.76,	.74,	10,	.24,	-13.47,
5,	1.12,	-.516,	13.55,	.69,	10,	.35,	-13.20,
6,	1.08,	-.489,	13.57,	.82,	10,	.32,	-13.23,
7,	.91,	.715,	12.70,	.89,	10,	.30,	-13.21,

Table 5.1.10 (Continued)

Fleet : FLT15: FRATRO (Catch

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	-.93	-.75	-1.07	2.17	-.69	-.71	.95	-.65	1.13	.55
1	-.20	-.38	-.48	.00	.00	.28	.17	.22	.01	.39
2	.00	-.24	-.58	.16	.09	.08	.25	-.03	.07	.21
3	-.30	-.35	-.05	.31	-.35	.00	.36	.05	.09	.22
4	.89	-.41	-.21	.30	.23	-.57	-.11	.12	-.13	-.11
5	.31	.67	.07	.32	.11	.32	-.64	-.27	-.62	-.27
6	1.22	.75	.91	-.09	-.50	.48	.22	-.82	-.92	-1.23
7	1.43	1.37	1.37	1.12	-.46	.49	.13	.00	-2.60	.07

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

Age	0	1	2	3	4	5	6	7
Mean Log q	-19.9330	-16.0265	-14.8911	-14.5892	-14.4803	-14.4317	-14.7158	-14.7158
S.E(Log q)	1.1148	.2830	.2471	.2636	.4129	.4349	.8462	1.2604

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	5.37	-1.033	32.46	.01	10	5.96	-19.93
1	3.11	-3.964	19.02	.31	10	.54	-16.03
2	.99	.048	14.87	.64	10	.26	-14.89
3	1.73	-1.575	15.97	.37	10	.42	-14.59
4	1.10	-.251	14.77	.42	10	.48	-14.48
5	1.68	-1.437	17.16	.36	10	.69	-14.43
6	3.41	-1.792	28.48	.06	10	2.59	-14.72
7	-6.86	-3.164	-39.94	.02	10	5.93	-14.42

Table 5.1.10 (Continued)

Fleet : FLT16: SCOGFS_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age									
1	-.95	-.84	-.20	.05	-.19	.40	.28	.10	.64	.71
2	-.49	-.15	-.35	-.15	-.08	.10	.20	-.33	.40	.86
3	-.46	-.38	.09	-.29	-.18	.36	.03	-.33	.47	.68
4	-.56	-.20	-.25	.33	-.55	.56	.23	-.75	.47	.72
5	-.01	-.50	-.30	-.10	-.19	.55	.42	-.13	.37	-.11
6	-.38	-.48	.07	.28	-.51	.83	-.18	-.41	.67	.11
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	-15.3338	-15.0371	-15.0830	-15.1801	-15.1730	-15.2054
S.E(Log q)	.5616	.4027	.3953	.5281	.3396	.4797

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	-28.58	-2.270	-6.21	.00	10	13.28	-15.33
2	1.87	-1.158	16.31	.18	10	.74	-15.04
3	.91	.213	14.87	.42	10	.38	-15.08
4	.63	1.339	13.89	.62	10	.32	-15.18
5	.88	.559	14.61	.73	10	.31	-15.17
6	1.01	-.021	15.24	.64	10	.51	-15.21

Table 5.1.10 (Continued)

Fleet : FLT17: ENGGFS_IV (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age									
1	-.42	-.13	-.47	-.07	.49	.35	.09	.29	.52	-.64
2	-.23	-.22	.24	-.48	-.16	.26	.14	-.09	.70	-.17
3	-.04	-.21	.31	.32	-.70	-.08	.08	-.20	.43	.10
4	.32	-.36	-.26	.16	.13	-.31	-.14	-.14	.35	.24
5	.78	-.59	.68	-.47	-.26	.60	-.47	-.15	-.47	.36
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	1	2	3	4	5
Mean Log q	-15.3775	-15.1714	-15.2475	-15.1076	-15.1735
S.E(Log q)	.4166	.3372	.3310	.2713	.5440

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	1.47	-.760	15.74	.25	10	.63	-15.38
2	2.72	-2.194	17.90	.17	10	.77	-15.17
3	1.54	-.961	16.62	.28	10	.51	-15.25
4	1.07	-.278	15.36	.64	10	.31	-15.11
5	5.06	-2.924	34.53	.06	10	2.03	-15.17

Table 5.1.10 (Continued)

Fleet : FLT18: IBTS_Q1_IV (C

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	-.75	-.09	-.37	.39	.30	.31	-.07	-.05	.10	.22
1	-.05	.06	-.33	.27	.33	.10	.08	-.26	-.13	-.06
2	-.08	.18	.01	.12	.32	.10	.01	-.07	-.10	-.48
3	-.29	.13	-.05	.46	.17	.10	.13	.11	-.24	-.52
4	-.20	.16	-.40	.55	.38	.26	-.28	-.23	.33	-.57
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	0	1	2	3	4
Mean Log q	-14.8411	-14.0133	-14.0739	-14.3095	-14.5232
S.E(Log q)	.3505	.2120	.2134	.2810	.3815

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	1.26	-.813	14.26	.55	10	.45	-14.84
1	1.37	-1.365	13.79	.63	10	.28	-14.01
2	.91	.431	14.03	.74	10	.20	-14.07
3	1.06	-.186	14.41	.51	10	.32	-14.31
4	1.16	-.399	14.98	.44	10	.46	-14.52

Table 5.1.10 (Continued)

Fleet : FLT19: IBTS_Q2_SCO_I

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age									
1	99.99	99.99	99.99	99.99	-.03	.34	-.06	-.51	.64	-.39
2	99.99	99.99	99.99	99.99	-.09	.03	.06	-.37	.38	-.01
3	99.99	99.99	99.99	99.99	-.29	-.15	.36	-.36	.33	.10
4	99.99	99.99	99.99	99.99	.33	-.79	.34	-.42	.24	.30
5	99.99	99.99	99.99	99.99	-.34	.21	.20	-.39	.51	-.20
6	99.99	99.99	99.99	99.99	-.02	.03	.29	-.53	.01	.23
7	No data for this fleet at this age									

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

Age	1	2	3	4	5	6
Mean Log q	-14.0815	-13.8569	-14.0858	-14.3695	-14.2462	-14.2190
S.E(Log q)	.4353	.2440	.3110	.4838	.3604	.2896

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	.66	.501	14.20	.35	6	.31	-14.08
2	.99	.006	13.85	.12	6	.27	-13.86
3	1.03	-.068	14.13	.49	6	.36	-14.09
4	4.34	-1.822	23.54	.07	6	1.74	-14.37
5	1.00	-.011	14.26	.64	6	.40	-14.25
6	2.18	-6.266	19.94	.88	6	.21	-14.22

Table 5.1.10 (Continued)

Fleet : FLT20: IBTS_Q4_ENG_I

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	99.99	99.99	99.99	99.99	-.46	.09	-.06	-.09	.34	.19
1	99.99	99.99	99.99	99.99	-.07	-.16	-.19	-.07	.57	-.08
2	99.99	99.99	99.99	99.99	-.13	.03	-.07	-.13	.30	.01
3	99.99	99.99	99.99	99.99	.07	-.10	.17	-.25	.24	-.13
4	99.99	99.99	99.99	99.99	.76	-.19	.07	-.91	.14	.13
5	99.99	99.99	99.99	99.99	.76	.25	-1.01	-.14	-.39	.53
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	0	1	2	3	4	5
Mean Log q	-15.0922	-14.0476	-14.0257	-14.4245	-14.3416	-14.2522
S.E(Log q)	.2770	.2841	.1602	.1917	.5438	.6515

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	1.35	-.995	14.47	.67	6	.37	-15.09
1	.91	.137	14.08	.39	6	.29	-14.05
2	.53	1.094	13.73	.58	6	.08	-14.03
3	.80	.933	14.07	.84	6	.15	-14.42
4	1.62	-.627	16.04	.20	6	.94	-14.34
5	3.78	-1.315	24.59	.05	6	2.30	-14.25

Table 5.1.10 (Continued)

Fleet : FLT21: FRATRO_7D (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age									
1	-.46,	-.02,	-1.02,	-.14,	-.25,	.24,	-.58,	1.09,	.32,	.82
2	-.05,	.28,	-.25,	-.60,	.18,	.47,	.13,	-.04,	.07,	-.20
3	-.64,	-.39,	.05,	.21,	-.76,	.21,	.79,	.22,	.23,	.09
4	1.25,	-.51,	-.72,	-.21,	.65,	-1.34,	.17,	.64,	.20,	-.14
5	.67,	1.20,	-.41,	-1.04,	.61,	.55,	-1.40,	.26,	-.16,	-.29
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age ,	1,	2,	3,	4,	5
Mean Log q,	-18.6117,	-17.0827,	-16.5752,	-16.1247,	-16.0642,
S.E(Log q),	.6406,	.3018,	.4690,	.7527,	.8144,

Regression statistics :

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	-2.68,	-3.001,	3.85,	.08,	10,	1.25,	-18.61,
2,	1.69,	-1.398,	19.51,	.34,	10,	.49,	-17.08,
3,	3.87,	-1.553,	27.72,	.04,	10,	1.69,	-16.58,
4,	55.39,	-1.649,	257.98,	.00,	10,	38.20,	-16.12,
5,	-11.95,	-2.409,	-57.21,	.00,	10,	7.86,	-16.06,

Table 5.1.10 (Continued)

Fleet : FLT22: FRAGFS_7d (Ca

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	99.99,	-.60,	-.56,	-.40,	1.05,	.78,	-.59,	-.67,	-.10,	1.09
1	99.99,	99.99,	99.99,	99.99,	-.34,	-.01,	-1.13,	1.20,	-.06,	.34
2	99.99,	99.99,	99.99,	99.99,	-.50,	.21,	-.15,	.85,	-.54,	.12
3	99.99,	99.99,	99.99,	99.99,	-1.27,	.29,	.28,	1.31,	-.80,	.19
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age ,	0,	1,	2,	3
Mean Log q,	-10.2685,	-9.2736,	-10.2385,	-11.1967,
S.E(Log q),	.7529,	.7695,	.5160,	.9125,

Regression statistics :

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
0,	5.35,	-1.677,	-19.23,	.02,	9,	3.64,	-10.27,
1,	5.53,	-.447,	-14.08,	.00,	6,	4.64,	-9.27,
2,	.36,	.644,	12.27,	.20,	6,	.20,	-10.24,
3,	-.66,	-3.565,	13.65,	.53,	6,	.33,	-11.20,

Terminal year survivor and F summaries :

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

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT12: SCOSEI_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT13: SCOLTR_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT14: FRATRB_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT15: FRATRO (Catch,	1101665.,	1.169,	.000,	.00,	1,	.029,	.000
FLT16: SCOGFS_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT17: ENGGFS_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT18: IBTS_Q1_IV (C,	792814.,	.368,	.000,	.00,	1,	.296,	.000
FLT19: IBTS_Q2_SCO_I,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT20: IBTS_Q4_ENG_I,	764201.,	.300,	.000,	.00,	1,	.445,	.000
FLT21: FRATRO_7D (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT22: FRAGFS_7d (Ca,	1884574.,	.794,	.000,	.00,	1,	.064,	.000
F shrinkage mean ,	156201.,	.50,,,,				.167,	.153

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
634828.,	.20,	.36,	5,	1.796,	.040

Table 5.1.10 (Continued)

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT12: SCOSEI_IV (Ca,	791063.,	.817,	.000,	.00,	1,	.018,	.052
FLT13: SCOLTR_IV (Ca,	549784.,	.688,	.000,	.00,	1,	.026,	.075
FLT14: FRATRB_IV (Ca,	261513.,	.336,	.000,	.00,	1,	.109,	.151
FLT15: FRATRO (Catch,	669818.,	.291,	.157,	.54,	2,	.143,	.062
FLT16: SCOGFS_IV (Ca,	889136.,	.589,	.000,	.00,	1,	.035,	.047
FLT17: ENGGFS_IV (Ca,	230571.,	.437,	.000,	.00,	1,	.064,	.169
FLT18: IBTS_Q1_IV (C,	437108.,	.235,	.075,	.32,	2,	.204,	.093
FLT19: IBTS_Q2_SCO_I,	298518.,	.470,	.000,	.00,	1,	.056,	.133
FLT20: IBTS_Q4_ENG_I,	486021.,	.217,	.211,	.97,	2,	.231,	.084
FLT21: FRATRO_7D (Ca,	1001213.,	.672,	.000,	.00,	1,	.027,	.042
FLT22: FRAGFS_7d (Ca,	505699.,	.580,	.218,	.38,	2,	.032,	.081
F shrinkage mean ,	242532.,	.50,,,,				.054,	.162

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
439184.,	.11,	.11,	16,	.992,	.092

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT12: SCOSEI_IV (Ca,	493718.,	.460,	.000,	.00,	2,	.026,	.164
FLT13: SCOLTR_IV (Ca,	276826.,	.275,	.135,	.49,	2,	.074,	.275
FLT14: FRATRB_IV (Ca,	279860.,	.224,	.093,	.41,	2,	.109,	.273
FLT15: FRATRO (Catch,	372972.,	.209,	.115,	.55,	3,	.124,	.211
FLT16: SCOGFS_IV (Ca,	747984.,	.344,	.100,	.29,	2,	.047,	.111
FLT17: ENGGFS_IV (Ca,	370000.,	.275,	.333,	1.21,	2,	.073,	.213
FLT18: IBTS_Q1_IV (C,	264146.,	.184,	.135,	.73,	3,	.157,	.287
FLT19: IBTS_Q2_SCO_I,	401446.,	.253,	.287,	1.13,	2,	.087,	.198
FLT20: IBTS_Q4_ENG_I,	396304.,	.175,	.202,	1.15,	3,	.173,	.200
FLT21: FRATRO_7D (Ca,	303663.,	.287,	.191,	.67,	2,	.069,	.254
FLT22: FRAGFS_7d (Ca,	307615.,	.401,	.226,	.56,	3,	.034,	.251
F shrinkage mean ,	185832.,	.50,,,,				.029,	.387

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
340174.,	.07,	.07,	27,	.906,	.229

Table 5.1.10 (Continued)

Age 3 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
FLT12: SCOSEI_IV (Ca,	156186.,	.254,	.045,	.18,	3,	.064,	.421
FLT13: SCOLTR_IV (Ca,	124849.,	.205,	.149,	.73,	3,	.092,	.503
FLT14: FRATRB_IV (Ca,	144088.,	.182,	.159,	.87,	3,	.112,	.449
FLT15: FRATRO (Catch,	198320.,	.174,	.069,	.40,	4,	.120,	.345
FLT16: SCOGFS_IV (Ca,	267620.,	.268,	.150,	.56,	3,	.053,	.266
FLT17: ENGGFS_IV (Ca,	230976.,	.219,	.188,	.86,	3,	.078,	.303
FLT18: IBTS_Q1_IV (C,	124048.,	.160,	.108,	.68,	4,	.138,	.506
FLT19: IBTS_Q2_SCO_I,	186716.,	.205,	.209,	1.02,	3,	.089,	.363
FLT20: IBTS_Q4_ENG_I,	165156.,	.154,	.099,	.64,	4,	.147,	.402
FLT21: FRATRO_7D (Ca,	199572.,	.250,	.224,	.90,	3,	.058,	.343
FLT22: FRAGFS_7d (Ca,	148931.,	.375,	.386,	1.03,	4,	.024,	.437
F shrinkage mean ,	99285.,	.50,,,,				.026,	.600

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
164437.,	.06,	.05,	38,	.889,	.403

Age 4 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
FLT12: SCOSEI_IV (Ca,	59317.,	.202,	.116,	.57,	4,	.096,	.544
FLT13: SCOLTR_IV (Ca,	60830.,	.178,	.090,	.51,	4,	.115,	.534
FLT14: FRATRB_IV (Ca,	65865.,	.165,	.175,	1.06,	4,	.127,	.502
FLT15: FRATRO (Catch,	65664.,	.170,	.066,	.39,	5,	.105,	.503
FLT16: SCOGFS_IV (Ca,	90228.,	.253,	.232,	.92,	4,	.050,	.389
FLT17: ENGGFS_IV (Ca,	80248.,	.187,	.097,	.52,	4,	.105,	.428
FLT18: IBTS_Q1_IV (C,	54139.,	.156,	.141,	.90,	5,	.121,	.584
FLT19: IBTS_Q2_SCO_I,	68317.,	.199,	.182,	.92,	4,	.076,	.487
FLT20: IBTS_Q4_ENG_I,	67255.,	.154,	.086,	.56,	5,	.110,	.493
FLT21: FRATRO_7D (Ca,	62413.,	.247,	.125,	.50,	4,	.046,	.523
FLT22: FRAGFS_7d (Ca,	76835.,	.376,	.498,	1.32,	4,	.016,	.444
F shrinkage mean ,	36338.,	.50,,,,				.032,	.780

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
64516.,	.06,	.04,	48,	.763,	.510

Table 5.1.10 (Continued)

Age 5 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
FLT12: SCOSEI_IV (Ca,	12882.,	.195,	.078,	.40,	5,	.118,	.692
FLT13: SCOLTR_IV (Ca,	13423.,	.176,	.093,	.53,	5,	.145,	.671
FLT14: FRATRB_IV (Ca,	13585.,	.172,	.150,	.87,	5,	.146,	.666
FLT15: FRATRO (Catch,	12546.,	.194,	.096,	.50,	6,	.093,	.705
FLT16: SCOGFS_IV (Ca,	12879.,	.244,	.122,	.50,	5,	.082,	.692
FLT17: ENGGFS_IV (Ca,	16625.,	.200,	.106,	.53,	5,	.087,	.573
FLT18: IBTS_Q1_IV (C,	15600.,	.167,	.063,	.38,	5,	.070,	.601
FLT19: IBTS_Q2_SCO_I,	11809.,	.218,	.107,	.49,	5,	.089,	.736
FLT20: IBTS_Q4_ENG_I,	12581.,	.184,	.140,	.76,	6,	.074,	.704
FLT21: FRATRO_7D (Ca,	13969.,	.291,	.104,	.36,	5,	.035,	.652
FLT22: FRAGFS_7d (Ca,	19510.,	.385,	.374,	.97,	4,	.008,	.506
F shrinkage mean ,	8050.,	.50,,,,				.052,	.954

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
13133.,	.07,	.04,	57,	.554,	.682

Age 6 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
FLT12: SCOSEI_IV (Ca,	3300.,	.201,	.037,	.18,	6,	.161,	.851
FLT13: SCOLTR_IV (Ca,	3497.,	.187,	.029,	.15,	6,	.176,	.818
FLT14: FRATRB_IV (Ca,	4354.,	.186,	.138,	.74,	6,	.176,	.701
FLT15: FRATRO (Catch,	2600.,	.238,	.240,	1.00,	7,	.059,	.994
FLT16: SCOGFS_IV (Ca,	4192.,	.263,	.123,	.47,	6,	.080,	.721
FLT17: ENGGFS_IV (Ca,	3231.,	.211,	.137,	.65,	5,	.044,	.863
FLT18: IBTS_Q1_IV (C,	3914.,	.165,	.111,	.67,	5,	.034,	.757
FLT19: IBTS_Q2_SCO_I,	4665.,	.221,	.085,	.39,	6,	.138,	.667
FLT20: IBTS_Q4_ENG_I,	3030.,	.219,	.182,	.83,	5,	.033,	.901
FLT21: FRATRO_7D (Ca,	5035.,	.314,	.195,	.62,	5,	.018,	.631
FLT22: FRAGFS_7d (Ca,	3700.,	.377,	.168,	.45,	4,	.004,	.787
F shrinkage mean ,	2474.,	.50,,,,				.079,	1.026

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3643.,	.08,	.04,	62,	.510,	.795

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT12: SCOSEI_IV (Ca,	1106.,	.219,	.062,	.28,	7,	.189,	.734
FLT13: SCOLTR_IV (Ca,	1241.,	.207,	.062,	.30,	7,	.214,	.676
FLT14: FRATRB_IV (Ca,	1040.,	.202,	.120,	.59,	7,	.234,	.767
FLT15: FRATRO (Catch,	922.,	.319,	.131,	.41,	8,	.043,	.833
FLT16: SCOGFS_IV (Ca,	1542.,	.269,	.165,	.61,	6,	.047,	.575
FLT17: ENGGFS_IV (Ca,	1002.,	.206,	.015,	.07,	5,	.025,	.787
FLT18: IBTS_Q1_IV (C,	1153.,	.165,	.129,	.78,	5,	.020,	.713
FLT19: IBTS_Q2_SCO_I,	1076.,	.227,	.084,	.37,	5,	.082,	.748
FLT20: IBTS_Q4_ENG_I,	1043.,	.242,	.042,	.18,	4,	.016,	.765
FLT21: FRATRO_7D (Ca,	1378.,	.302,	.044,	.14,	5,	.010,	.626
FLT22: FRAGFS_7d (Ca,	848.,	.428,	.253,	.59,	3,	.002,	.881
F shrinkage mean ,	1260.,	.50,,,,				.117,	.669

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1140.,	.10,	.03,	63,	.304,	.719

Table 5.1.11

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

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Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,
AGE							
0,	.0052,	.0103,	.0033,	.0205,	.0234,	.0072,	.0051,
1,	.2153,	.7628,	.3319,	.1458,	.1680,	.2216,	.4089,
2,	.4675,	.9702,	.6350,	.8740,	.2391,	.5053,	.6945,
3,	1.4903,	1.4009,	.9613,	.8620,	.6104,	.4462,	.9711,
4,	2.3428,	1.2854,	.9435,	1.0411,	.5977,	.7130,	.9243,
5,	1.5742,	1.5244,	.9967,	.9359,	.8686,	.4736,	1.2559,
6,	1.9538,	2.0047,	2.8062,	1.0115,	.8927,	.8651,	1.7693,
7,	1.9845,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,
+gp,	1.9845,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,
FBAR 2- 6,	1.5657,	1.4371,	1.2685,	.9449,	.6417,	.6006,	1.1230,

Table 8 Fishing mortality (F) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
0,	.0054,	.0267,	.1698,	.1035,	.0616,	.0206,	.0132,	.0208,	.0137,	.0252,
1,	.4106,	.1582,	.8141,	.7672,	.3989,	.3263,	.2881,	.4009,	.2261,	.1740,
2,	.5534,	.7992,	.5557,	.8249,	.5332,	.7060,	.8016,	.8535,	.7652,	.9250,
3,	.7669,	.8448,	.8065,	.9616,	.5664,	.6008,	1.0497,	1.0324,	.9642,	1.2525,
4,	.8670,	1.0291,	.6468,	.8281,	.6989,	.5793,	.6302,	.9988,	.9276,	1.0533,
5,	.7773,	.8397,	1.0029,	.6420,	.5874,	.9531,	1.4145,	.3600,	.9906,	.8414,
6,	1.1218,	1.1436,	.4957,	.9761,	.2647,	.9982,	.9874,	2.0110,	2.2622,	1.3526,
7,	.9321,	1.0156,	.7220,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,
+gp,	.9321,	1.0156,	.7220,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,
FBAR 2- 6,	.8173,	.9313,	.7015,	.8465,	.5301,	.7675,	.9767,	1.0511,	1.1819,	1.0849,

Table 5.1.11 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

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Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
0,	.0393,	.0395,	.0297,	.0526,	.0717,	.0161,	.0695,	.0231,	.0133,	.0191,
1,	.4265,	.1565,	.2326,	.1016,	.1652,	.1736,	.2105,	.2235,	.1903,	.2707,
2,	.4841,	.4059,	.4792,	.4408,	.3299,	.2932,	.4558,	.5171,	.2497,	.4260,
3,	.8240,	.6314,	.7344,	.8235,	.7539,	.5324,	.7464,	.8732,	.6368,	.7058,
4,	.9530,	.8465,	.7083,	.9772,	1.0016,	.7236,	.7376,	1.0269,	.8793,	1.1997,
5,	.9059,	.7477,	.8434,	1.2438,	1.1023,	.9017,	.8929,	1.0592,	1.1628,	1.0651,
6,	.8900,	1.1122,	.8853,	.9799,	1.3316,	1.0280,	.9400,	1.1693,	1.2227,	1.1481,
7,	.9263,	.9119,	.8207,	1.0795,	1.1590,	.8940,	.8659,	1.0980,	1.1012,	1.1513,
+gp,	.9263,	.9119,	.8207,	1.0795,	1.1590,	.8940,	.8659,	1.0980,	1.1012,	1.1513,
FBAR 2- 6,	.8114,	.7487,	.7301,	.8930,	.9039,	.6958,	.7545,	.9292,	.8303,	.9089,

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	FBAR 94-96
AGE											
0,	.0103,	.0261,	.0120,	.0411,	.1443,	.0316,	.0785,	.0305,	.3020,	.0397,	.1241,
1,	.1407,	.3586,	.1289,	.2258,	.1153,	.2318,	.1732,	.1319,	.1199,	.0925,	.1148,
2,	.5105,	.4312,	.4316,	.5478,	.4851,	.3809,	.4574,	.2980,	.2760,	.2294,	.2678,
3,	.8724,	.6624,	.6974,	.9128,	.5164,	.5732,	.7336,	.6307,	.4980,	.4033,	.5107,
4,	1.2499,	.9738,	.8400,	.9882,	.8883,	.6312,	.8132,	.8510,	.6533,	.5098,	.6714,
5,	1.3773,	1.1663,	1.5440,	1.2475,	1.1209,	.9472,	.8456,	.9603,	.8291,	.6822,	.8239,
6,	1.7838,	1.2970,	1.6123,	1.0759,	.7874,	1.1932,	1.1036,	1.0181,	.9530,	.7952,	.9221,
7,	1.2634,	1.3493,	1.5598,	1.3155,	1.0650,	1.2343,	1.0091,	1.0168,	.8652,	.7186,	.8668,
+gp,	1.2634,	1.3493,	1.5598,	1.3155,	1.0650,	1.2343,	1.0091,	1.0168,	.8652,	.7186,	
FBAR 2- 6,	1.1588,	.9061,	1.0250,	.9544,	.7596,	.7451,	.7907,	.7516,	.6419,	.5240,	

Table 5.1.12

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,
AGE							
0,	418661,	753409,	836669,	187021,	363404,	319604,	598136,
1,	40092,	32520,	58225,	65115,	14307,	27720,	24777,
2,	8700,	12502,	5865,	16157,	21766,	4677,	8590,
3,	3312,	3476,	3021,	1982,	4299,	10927,	1799,
4,	276,	526,	603,	814,	590,	1645,	4928,
5,	333,	20,	108,	174,	213,	240,	597,
6,	48,	54,	3,	31,	53,	70,	117,
7,	11,	5,	6,	0,	9,	17,	23,
+gp,	30,	5,	2,	2,	1,	3,	7,
TOTAL,	471464,	802516,	904501,	271298,	404641,	364903,	638974,

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
0,	1175464,	142165,	276448,	431881,	738870,	970349,	477829,	993440,	627078,	611981,
1,	46468,	91286,	10808,	18215,	30405,	54247,	74219,	36819,	75973,	48296,
2,	6366,	11919,	30139,	1852,	3271,	7891,	15139,	21519,	9536,	23437,
3,	2735,	2334,	3417,	11025,	517,	1224,	2484,	4331,	5844,	2829,
4,	480,	895,	707,	1075,	2970,	207,	473,	613,	1087,	1570,
5,	1449,	149,	237,	274,	348,	1094,	86,	187,	167,	318,
6,	133,	519,	50,	68,	112,	151,	328,	16,	101,	48,
7,	15,	34,	129,	24,	20,	67,	43,	95,	2,	8,
+gp,	3,	2,	15,	29,	17,	19,	9,	7,	22,	11,
TOTAL,	1233113,	249304,	321950,	464443,	776530,	1035248,	570611,	1057025,	719810,	688499,

Table 5.1.12 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSACLN02/X02)

At 11-Oct-97 14:33:25

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
0,	619459,	635307,	582885,	232194,	267453,	226702,	356514,	247281,	507441,	427051,
1,	46597,	46505,	47685,	44181,	17202,	19439,	17419,	25969,	18867,	39100,
2,	15695,	11764,	15380,	14614,	15437,	5640,	6320,	5458,	8032,	6032,
3,	5926,	6167,	4999,	6073,	5996,	7077,	2682,	2554,	2075,	3990,
4,	570,	1832,	2312,	1690,	1878,	1988,	2928,	896,	752,	773,
5,	406,	163,	582,	843,	471,	511,	714,	1038,	238,	231,
6,	107,	128,	60,	195,	189,	122,	162,	228,	280,	58,
7,	10,	34,	33,	19,	57,	39,	34,	49,	55,	64,
+gp,	8,	5,	6,	13,	5,	9,	17,	10,	15,	9,
TOTAL,	688776,	701905,	653941,	299824,	308689,	261527,	386791,	283483,	537754,	477310,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	GMST 60-94	AMST 60-94
AGE													
0,	297148,	579783,	261686,	253152,	275761,	290726,	295009,	258297,	215764,	(84600),	0,	413721,	472465,
1,	32716,	22965,	44105,	20189,	18971,	18640,	21994,	21295,	19562,	12456,	(6348),	31786,	36381,
2,	11535,	10992,	6205,	14995,	6230,	6538,	5717,	7153,	7218,	6711,	4392,	9320,	10945,
3,	2512,	4415,	4554,	2570,	5529,	2446,	2848,	2307,	3386,	3493,	3402,	3419,	4008,
4,	1388,	740,	1604,	1598,	727,	2324,	972,	964,	865,	1450,	1644,	1034,	1297,
5,	173,	295,	207,	513,	441,	222,	916,	319,	305,	334,	645,	304,	408,
6,	62,	34,	71,	34,	115,	112,	67,	306,	95,	104,	131,	85,	121,
7,	14,	8,	7,	11,	9,	41,	26,	17,	86,	29,	36,	18,	30,
+gp,	16,	2,	5,	2,	5,	2,	13,	8,	9,	24,	21,		
TOTAL,	345564,	619234,	318445,	293063,	307786,	321049,	327562,	290667,	247290,	109199,	16620,		

Table 5.1.13 Whiting, IV and VIId
Mean fishing mortality, biomass and recruitment, 1960 - 1996.

Year	Mean F hco Ages 2 to 6	Mean F dis Ages 2 to 6	Mean F ibc Ages 0 to 4	Stock Biomass ('000 tonnes) Total	Stock Biomass ('000 tonnes) Spawning	Recruits Age 0 Yclass	Recruits Age 0 Million
1960	1.106	.443	.015	743	312	1960	41866
1961	1.044	.386	.017	738	374	1961	75341
1962	.979	.267	.013	908	283	1962	83667
1963	.616	.290	.055	1136	461	1963	18702
1964	.489	.125	.039	705	517	1964	36340
1965	.429	.140	.033	775	461	1965	31961
1966	.848	.168	.128	646	393	1966	59814
1967	.600	.192	.032	820	322	1967	117547
1968	.664	.212	.071	1380	452	1968	14217
1969	.377	.180	.282	761	626	1969	27645
1970	.537	.217	.242	560	379	1970	43188
1971	.382	.127	.063	557	238	1971	73887
1972	.559	.134	.114	646	290	1972	97035
1973	.680	.161	.155	983	408	1973	47783
1974	.615	.130	.284	735	477	1974	99344
1975	.854	.207	.136	1181	488	1975	62708
1976	.674	.159	.261	1127	631	1976	61198
1977	.525	.108	.206	1110	599	1977	61946
1978	.595	.071	.096	776	452	1978	63531
1979	.569	.066	.098	950	514	1979	58289
1980	.624	.199	.088	836	521	1980	23219
1981	.674	.079	.163	636	488	1981	26745
1982	.488	.097	.094	491	378	1982	22670
1983	.563	.137	.066	512	337	1983	35652
1984	.745	.124	.065	485	271	1984	24728
1985	.695	.078	.053	441	270	1985	50744
1986	.710	.142	.052	662	288	1986	42705
1987	.951	.152	.068	536	299	1987	29715
1988	.703	.104	.157	417	294	1988	57978
1989	.612	.185	.136	561	279	1989	26169
1990	.480	.274	.178	483	317	1990	25315
1991	.518	.122	.112	460	278	1991	27576
1992	.539	.123	.092	414	268	1992	29073
1993	.503	.213	.076	397	246	1993	29501
1994	.539	.184	.039	406	244	1994	25830
1995	.499	.122	.094	438	276	1995	21576
1996	.384	.126	.021	373	265	1996	27212
Min.	.377	.066	.013	373	238	Min.	14217
Mean	.632	.169	.105	697	378	Gmean	41372
Max.	1.106	.443	.284	1380	631	Max.	117547

Min, max and geo. mean recruitment calculated over years 1960 to 1994
(Arithmetic mean recruitment 1960 - 1994 = 47246)
Biomass totals calculated at start of year.

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Table 5.1.14

Whiting in Fishing Areas IV, Skagerrak and VIId

Multi fleet prediction with mangement option table: Input data

1997	hco		dis		ibc							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.138	0.0020	0.034	0.0500	0.012	27211500	2.5500	0.0000	0.0000	0.0000	0.000
1	0.0090	0.178	0.0400	0.095	0.0230	0.057	2041800.0	0.9500	0.1100	0.0000	0.0000	0.085
2	0.0460	0.246	0.1440	0.155	0.0160	0.144	439199.00	0.4500	0.9200	0.0000	0.0000	0.173
3	0.2120	0.294	0.1870	0.202	0.0110	0.262	340199.00	0.3500	1.0000	0.0000	0.0000	0.251
4	0.4270	0.350	0.1150	0.229	0.0060	0.321	164400.00	0.3000	1.0000	0.0000	0.0000	0.325
5	0.5820	0.401	0.0910	0.257	0.0030	0.460	64499.000	0.2500	1.0000	0.0000	0.0000	0.383
6	0.6890	0.411	0.0560	0.255	0.0080	0.453	13099.000	0.2500	1.0000	0.0000	0.0000	0.408
7	0.6580	0.433	0.0390	0.323	0.0090	0.147	3599.000	0.2000	1.0000	0.0000	0.0000	0.426
8+	0.7030	0.421	0.0030	0.097	0.0040	0.185	2099.000	0.2000	1.0000	0.0000	0.0000	0.422
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

1998	hco		dis		ibc							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.138	0.0020	0.034	0.0500	0.012	27211500	2.5500	0.0000	0.0000	0.0000	0.000
1	0.0090	0.178	0.0400	0.095	0.0230	0.057	.	0.9500	0.1100	0.0000	0.0000	0.085
2	0.0460	0.246	0.1440	0.155	0.0160	0.144	.	0.4500	0.9200	0.0000	0.0000	0.173
3	0.2120	0.294	0.1870	0.202	0.0110	0.262	.	0.3500	1.0000	0.0000	0.0000	0.251
4	0.4270	0.350	0.1150	0.229	0.0060	0.321	.	0.3000	1.0000	0.0000	0.0000	0.325
5	0.5820	0.401	0.0910	0.257	0.0030	0.460	.	0.2500	1.0000	0.0000	0.0000	0.383
6	0.6890	0.411	0.0560	0.255	0.0080	0.453	.	0.2500	1.0000	0.0000	0.0000	0.408
7	0.6580	0.433	0.0390	0.323	0.0090	0.147	.	0.2000	1.0000	0.0000	0.0000	0.426
8+	0.7030	0.421	0.0030	0.097	0.0040	0.185	.	0.2000	1.0000	0.0000	0.0000	0.422
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

(cont.)

Table 5.1.14 (Continued)

Whiting in Fishing Areas IV, Skagerrak and VIId

Multi fleet prediction with mangement option table: Input data

(cont.)

1999	hco		dis		ibc							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.138	0.0020	0.034	0.0500	0.012	27211500	2.5500	0.0000	0.0000	0.0000	0.000
1	0.0090	0.178	0.0400	0.095	0.0230	0.057	.	0.9500	0.1100	0.0000	0.0000	0.085
2	0.0460	0.246	0.1440	0.155	0.0160	0.144	.	0.4500	0.9200	0.0000	0.0000	0.173
3	0.2120	0.294	0.1870	0.202	0.0110	0.262	.	0.3500	1.0000	0.0000	0.0000	0.251
4	0.4270	0.350	0.1150	0.229	0.0060	0.321	.	0.3000	1.0000	0.0000	0.0000	0.325
5	0.5820	0.401	0.0910	0.257	0.0030	0.460	.	0.2500	1.0000	0.0000	0.0000	0.383
6	0.6890	0.411	0.0560	0.255	0.0080	0.453	.	0.2500	1.0000	0.0000	0.0000	0.408
7	0.6580	0.433	0.0390	0.323	0.0090	0.147	.	0.2000	1.0000	0.0000	0.0000	0.426
8+	0.7030	0.421	0.0030	0.097	0.0040	0.185	.	0.2000	1.0000	0.0000	0.0000	0.422
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

Notes: Run name : MANPAK02
Date and time: 11OCT97:14:49

Table 5.1.15

Whiting in Fishing Areas IV, Skagerrak and VIId

Multi fleet prediction with mangement option table

Year: 1997											
hco			dis			ibc			Total		
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.3912	50351	1.0000	0.1186	25759	1.0000	0.0212	9221	85331	420821	260280
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes

Year: 1998												Year: 1999	
hco			dis			ibc			Total				
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	Stock biomass	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0212	9847	9847	447889	285130	549059	385613
0.1000	0.0391	6232	0.1000	0.0119	3093	1.0000	0.0212	9809	19134	.	285130	539596	376231
0.2000	0.0782	12168	0.2000	0.0237	6106	1.0000	0.0212	9771	28045	.	285130	530529	367246
0.3000	0.1174	17823	0.3000	0.0356	9043	1.0000	0.0212	9735	36601	.	285130	521838	358637
0.4000	0.1565	23213	0.4000	0.0474	11906	1.0000	0.0212	9699	44818	.	285130	513505	350385
0.5000	0.1956	28351	0.5000	0.0593	14698	1.0000	0.0212	9664	52714	.	285130	505511	342472
0.6000	0.2347	33253	0.6000	0.0712	17422	1.0000	0.0212	9630	60306	.	285130	497838	334880
0.7000	0.2738	37930	0.7000	0.0830	20081	1.0000	0.0212	9597	67608	.	285130	490471	327594
0.8000	0.3130	42395	0.8000	0.0949	22676	1.0000	0.0212	9564	74636	.	285130	483394	320597
0.9000	0.3521	46659	0.9000	0.1067	25210	1.0000	0.0212	9532	81402	.	285130	476593	313876
1.0000	0.3912	50733	1.0000	0.1186	27686	1.0000	0.0212	9501	87920	.	285130	470054	307417
1.1000	0.4303	54627	1.1000	0.1305	30105	1.0000	0.0212	9471	94202	.	285130	463763	301206
1.2000	0.4694	58350	1.2000	0.1423	32469	1.0000	0.0212	9441	100260	.	285130	457710	295232
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPAK02
Date and time : 11OCT97:14:49
Computation of ref. F: hco: Simple mean, age 2 - 6
dis: Simple mean, age 2 - 6
ibc: Simple mean, age 0 - 4
Basis for 1997 : F factors

Table 5.1.16

Whiting in Fishing Areas IV, Skagerrak and VIId — The SAS System — 14:31 Saturday, October 11, 1997

Multi fleet prediction: Detailed tables

Year 1997. hco	F-factor 1.0000	and reference F	0.3912
dis	F-factor 1.0000	and reference F	0.1186
ibc	F-factor 1.0000	and reference F	0.0212

	hco			dis			ibc		
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight
0	0.0000	0	0	0.0020	19365	658	0.0500	484136	5810
1	0.0090	11510	2049	0.0400	51155	4860	0.0230	29414	1677
2	0.0460	14816	3645	0.1440	46380	7189	0.0160	5153	742
3	0.2120	50517	14852	0.1870	44560	9001	0.0110	2621	687
4	0.4270	47329	16565	0.1150	12747	2919	0.0060	665	213
5	0.5820	24480	9816	0.0910	3828	984	0.0030	126	58
6	0.6890	5698	2342	0.0560	463	118	0.0080	66	30
7	0.6580	1557	674	0.0390	92	30	0.0090	21	3
8+	0.7030	969	408	0.0030	4	0	0.0040	6	1
Total		156876	50351		178594	25759		522209	9221
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes

	Total				1 January		Spawning time	
Age	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	503502	6468	27211500	0	0	0	0	0
1	92079	8585	2041800	173553	224598	19091	224598	19091
2	66350	11576	439199	75981	404063	69903	404063	69903
3	97698	24540	340199	85390	340199	85390	340199	85390
4	60740	19697	164400	53430	164400	53430	164400	53430
5	28433	10858	64499	24703	64499	24703	64499	24703
6	6227	2490	13099	5344	13099	5344	13099	5344
7	1671	707	3599	1533	3599	1533	3599	1533
8+	978	409	2099	886	2099	886	2099	886
Total	857679	85331	30280394	420821	1216556	260280	1216556	260280
Unit	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 5.1.16 (Continued)

Whiting in Fishing Areas IV, Skagerrak and VIId

Multi fleet prediction: Detailed tables

(cont.)

Year 1998. hco	F-factor 1.0000 and reference F	0.3912
dis	F-factor 1.0000 and reference F	0.1186
ibc	F-factor 1.0000 and reference F	0.0212

	hco			dis			ibc		
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight
0	0.0000	0	0	0.0020	19365	658	0.0500	484136	5810
1	0.0090	11370	2024	0.0400	50535	4801	0.0230	29058	1656
2	0.0460	24788	6098	0.1440	77596	12027	0.0160	8622	1242
3	0.2120	33843	9950	0.1870	29852	6030	0.0110	1756	460
4	0.4270	45803	16031	0.1150	12336	2825	0.0060	644	207
5	0.5820	26722	10716	0.0910	4178	1074	0.0030	138	63
6	0.6890	11114	4568	0.0560	903	230	0.0080	129	58
7	0.6580	2079	900	0.0390	123	40	0.0090	28	4
8+	0.7030	1061	447	0.0030	5	0	0.0040	6	1
Total		156780	50733		194893	27686		524516	9501
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes

	Total				1 January		Spawning time	
Age	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	503502	6468	27211500	0	0	0	0	0
1	90963	8481	2017057	171450	221876	18859	221876	18859
2	111005	19367	734792	127119	676008	116949	676008	116949
3	65451	16440	227910	57206	227910	57206	227910	57206
4	58782	19062	159100	51707	159100	51707	159100	51707
5	31038	11853	70408	26966	70408	26966	70408	26966
6	12146	4857	25550	10425	25550	10425	25550	10425
7	2231	944	4804	2047	4804	2047	4804	2047
8+	1072	448	2299	970	2299	970	2299	970
Total	876190	87920	30453421	447889	1387957	285130	1387957	285130
Unit	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 5.1.16 (Continued)

The SAS System 14:31 Saturday, October 11, 1997

Whiting in Fishing Areas IV, Skagerrak and VIId

Multi fleet prediction: Detailed tables

(cont.)

Year 1999. hco	F-factor 1.0000	and reference F	0.3912
dis	F-factor 1.0000	and reference F	0.1186
ibc	F-factor 1.0000	and reference F	0.0212

	hco			dis			ibc		
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight
0	0.0000	0	0	0.0020	19365	658	0.0500	484136	5810
1	0.0090	11370	2024	0.0400	50535	4801	0.0230	29058	1656
2	0.0460	24487	6024	0.1440	76655	11882	0.0160	8517	1226
3	0.2120	56620	16646	0.1870	49943	10089	0.0110	2938	770
4	0.4270	30685	10740	0.1150	8264	1892	0.0060	431	138
5	0.5820	25861	10370	0.0910	4044	1039	0.0030	133	61
6	0.6890	12132	4986	0.0560	986	251	0.0080	141	64
7	0.6580	4055	1756	0.0390	240	78	0.0090	55	8
8+	0.7030	1323	557	0.0030	6	1	0.0040	8	1
Total		166534	53103		210039	30691		525417	9735
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes

	Total				1 January		Spawning time	
Age	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	503502	6468	27211500	0	0	0	0	0
1	90963	8481	2017057	171450	221876	18859	221876	18859
2	109660	19132	725887	125579	667816	115532	667816	115532
3	109502	27505	381300	95706	381300	95706	381300	95706
4	39380	12771	106586	34640	106586	34640	106586	34640
5	30037	11471	68138	26097	68138	26097	68138	26097
6	13259	5302	27891	11380	27891	11380	27891	11380
7	4351	1842	9371	3992	9371	3992	9371	3992
8+	1337	559	2867	1210	2867	1210	2867	1210
Total	901991	93529	30550598	470054	1485846	307417	1485846	307417
Unit	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

```
Notes: Run name              : SPRPAK02
       Date and time         : 11OCT97:14:43
       Computation of ref. F: hco: Simple mean, age 2 - 6
                              dis: Simple mean, age 2 - 6
                              ibc: Simple mean, age 0 - 4
       Prediction basis      : F factors
```

Table 5.1.17 Whiting,IV and VIId
Input data for catch forecast and linear sensitivity analysis.

Populations in 1997			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N0	27211500	.46	WS0	.01	.23	M0	2.55	.09	MT0	.00	.10
N1	2041800	.36	WS1	.08	.06	M1	.95	.11	MT1	.11	.10
N2	439199	.11	WS2	.17	.04	M2	.45	.26	MT2	.92	.10
N3	340199	.07	WS3	.25	.03	M3	.35	.14	MT3	1.00	.10
N4	164400	.06	WS4	.32	.05	M4	.30	.14	MT4	1.00	.00
N5	64499	.06	WS5	.38	.03	M5	.25	.14	MT5	1.00	.00
N6	13099	.07	WS6	.41	.09	M6	.25	.14	MT6	1.00	.00
N7	3599	.08	WS7	.43	.03	M7	.20	.14	MT7	1.00	.00
N8	2099	.10	WS8	.42	.02	M8	.20	.14	MT8	1.00	.00

HC selectivity			HC.catch wt			Dis selectivity			Discrd catch wt		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
sH0	.00	1.33	WH0	.14	.04	sD0	.00	1.05	WD0	.03	.14
sH1	.01	.28	WH1	.18	.03	sD1	.04	.15	WD1	.09	.06
sH2	.05	.03	WH2	.25	.04	sD2	.14	.16	WD2	.16	.04
sH3	.21	.08	WH3	.29	.02	sD3	.19	.06	WD3	.20	.02
sH4	.43	.09	WH4	.35	.04	sD4	.12	.07	WD4	.23	.02
sH5	.58	.06	WH5	.40	.02	sD5	.09	.31	WD5	.26	.08
sH6	.69	.10	WH6	.41	.07	sD6	.06	.66	WD6	.25	.04
sH7	.66	.05	WH7	.43	.04	sD7	.04	1.25	WD7	.32	.05
sH8	.70	.02	WH8	.42	.02	sD8	.00	1.73	WD8	.10	1.73

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI0	.05	.63	WI0	.01	.25
sI1	.02	.41	WI1	.06	.24
sI2	.02	.31	WI2	.14	.09
sI3	.01	.91	WI3	.26	.16
sI4	.01	.55	WI4	.32	.29
sI5	.00	1.42	WI5	.46	.21
sI6	.01	1.38	WI6	.45	.91
sI7	.01	1.73	WI7	.15	1.73
sI8	.00	1.73	WI8	.18	1.73

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K97	1.00	.23	HF97	1.00	.17	IF97	1.00	.74
K98	1.00	.23	HF98	1.00	.17	IF98	1.00	.74
K99	1.00	.23	HF99	1.00	.17	IF99	1.00	.74

Recruitment		
Labl	Value	CV
R98	27211500	.46
R99	27211500	.46

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

Stock numbers in 1997 are VPA survivors.
These are overwritten at Age 0 Age 1
Human consumption + discard Fs are obtained from mean exploitation pattern over 1994 to 1996.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1996, i.e. .510
Fs are distributed between consumption and discards by mean proportion retained over 1994 to 1996.
N.B. Above value for hco +dis ref F is value for both catch categories combined.
Bycatch Fs are obtained from mean exploitation pattern over 1994 to 1996.
This is scaled to give a value for mean F (ages 0 to 4) equal to that in 1996, i.e. .021

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Table 5.1.18

Whiting in Fishing Areas IV, Skagerrak and VIId

The SAS System

14:31 Saturday, October 11, 1997

Multi fleet yield per recruit: Summary table

hco			dis			ibc			Total			1 January		Spawning time	
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0212	4	4	11776	383	1092	323	1092	323
0.1000	0.0391	10	0.1000	0.0119	2	1.0000	0.0212	4	16	11621	320	938	260	938	260
0.2000	0.0782	15	0.2000	0.0237	3	1.0000	0.0212	4	23	11526	282	843	222	843	222
0.3000	0.1174	19	0.3000	0.0356	5	1.0000	0.0212	4	27	11461	257	778	197	778	197
0.4000	0.1565	20	0.4000	0.0474	6	1.0000	0.0212	4	30	11412	238	729	178	729	178
0.5000	0.1956	22	0.5000	0.0593	7	1.0000	0.0212	4	33	11373	224	691	164	691	164
0.6000	0.2347	22	0.6000	0.0712	8	1.0000	0.0212	4	34	11342	212	660	153	660	153
0.7000	0.2738	23	0.7000	0.0830	9	1.0000	0.0212	4	36	11316	203	634	143	634	143
0.8000	0.3130	23	0.8000	0.0949	10	1.0000	0.0212	4	37	11294	195	612	136	612	136
0.9000	0.3521	23	0.9000	0.1067	11	1.0000	0.0212	4	38	11274	189	593	129	593	129
1.0000	0.3912	23	1.0000	0.1186	12	1.0000	0.0212	4	38	11257	183	576	123	576	123
1.1000	0.4303	23	1.1000	0.1305	12	1.0000	0.0212	4	39	11241	178	560	118	560	118
1.2000	0.4694	23	1.2000	0.1423	13	1.0000	0.0212	4	40	11227	173	546	114	546	114
1.3000	0.5086	23	1.3000	0.1542	14	1.0000	0.0212	4	40	11214	169	534	110	534	110
1.4000	0.5477	23	1.4000	0.1660	14	1.0000	0.0212	3	40	11202	166	522	106	522	106
1.5000	0.5868	22	1.5000	0.1779	15	1.0000	0.0212	3	41	11192	162	512	103	512	103
1.6000	0.6259	22	1.6000	0.1898	16	1.0000	0.0212	3	41	11181	159	502	100	502	100
1.7000	0.6650	22	1.7000	0.2016	16	1.0000	0.0212	3	42	11172	156	493	97	493	97
1.8000	0.7042	22	1.8000	0.2135	17	1.0000	0.0212	3	42	11163	154	484	94	484	94
1.9000	0.7433	22	1.9000	0.2253	17	1.0000	0.0212	3	42	11155	151	476	92	476	92
2.0000	0.7824	21	2.0000	0.2372	18	1.0000	0.0212	3	42	11147	149	468	90	468	90
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDPAK01
Date and time : 11OCT97:14:50
Computation of ref. F: hco: Simple mean, age 2 - 6
dis: Simple mean, age 2 - 6
ibc: Simple mean, age 0 - 4
Recruitment : 10000 (Thousands)

Table 5.2 Nominal landings (in tonnes) of WHITING from Division IIIa as supplied by the Study Group on Division IIIa Demersal Stocks (Anon., 1992b) and updated by the Working Group.

Year	Denmark			Norway	Sweden	Others	Total
1975		19,018		57	611	4	19,690
1976		17,870		48	1,002	48	18,968
1977		18,116		46	975	41	19,178
1978		48,102		58	899	32	49,091
1979		16,971		63	1,033	16	18,083
1980		21,070		65	1,516	3	22,654
	Total consumption	Total industrial	Total				
1981	1,027	23,915	24,942	70	1,054	7	26,073
1982	1,183	39,758	40,941	40	670	13	41,664
1983	1,311	23,505	24,816	48	1,061	8	25,933
1984	1,036	12,102	13,138	51	1,168	60	14,417
1985	557	11,967	12,524	45	654	2	13,225
1986	484	11,979	12,463	64	477	1	13,005
1987	443	15,880	16,323	29	262	43	16,657
1988	391	10,872	11,263	42	435	24	11,764
1989	917	11,662	12,579	29	675	-	13,283
1990	1,016	17,829	18,845	49	456	73	19,423
1991	871	12,463	13,344	56	527	97	14,041
1992	555	10,675	11,230	66	959	1	12,256
1993	261	3,581	3,565	42	756	1	4,641
1994	174	5,391	5,391	21	440	1	6,027
1995	85	9,029	9,114	24	431	1	9,570
1996	55	2,668	2,723	21	180	-	2,924

[1]Preliminary.

Figure 5.1.1 Whiting in IV and VIId. Log catchability residual plots

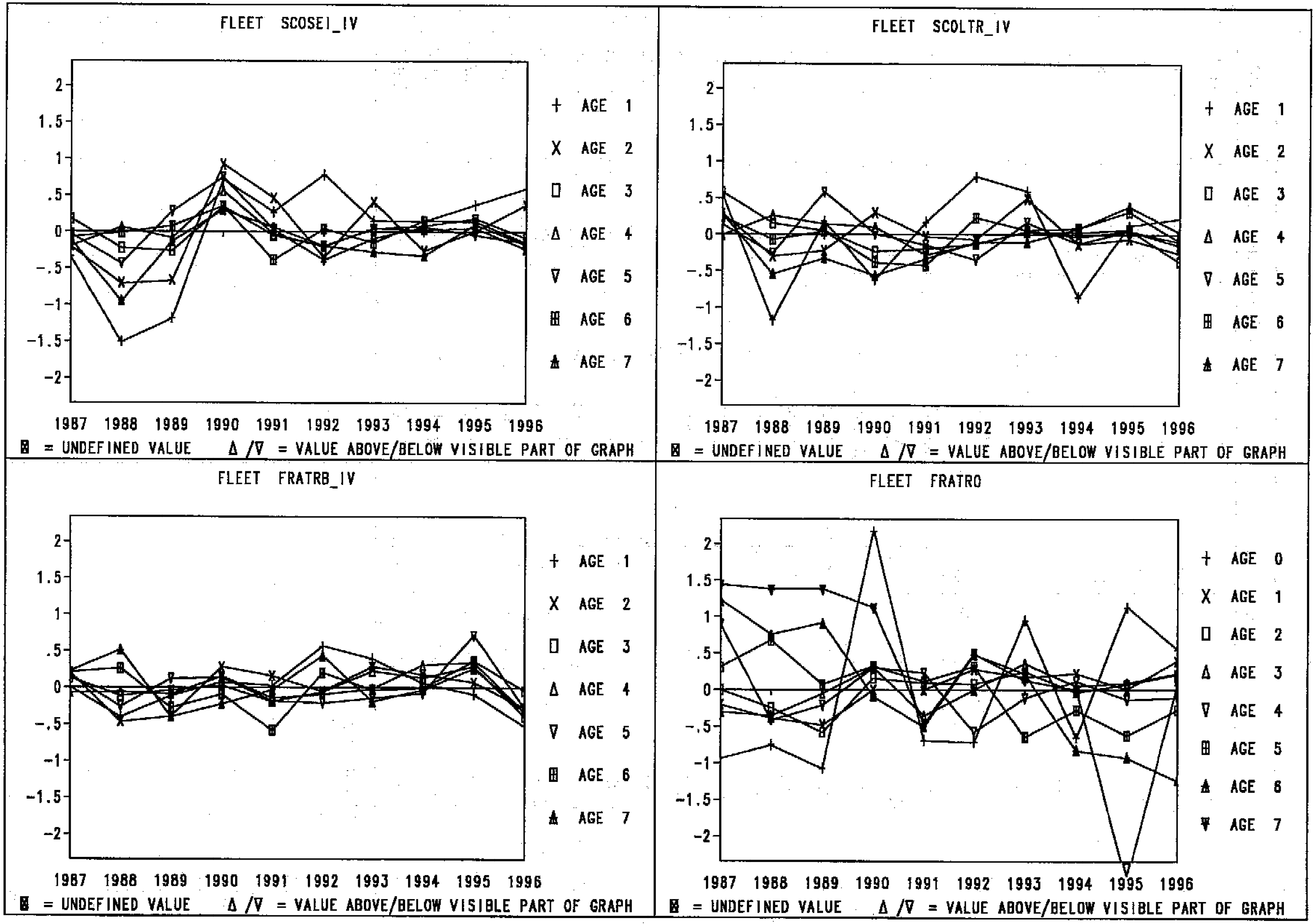


Figure 5.1.1 (Continued)

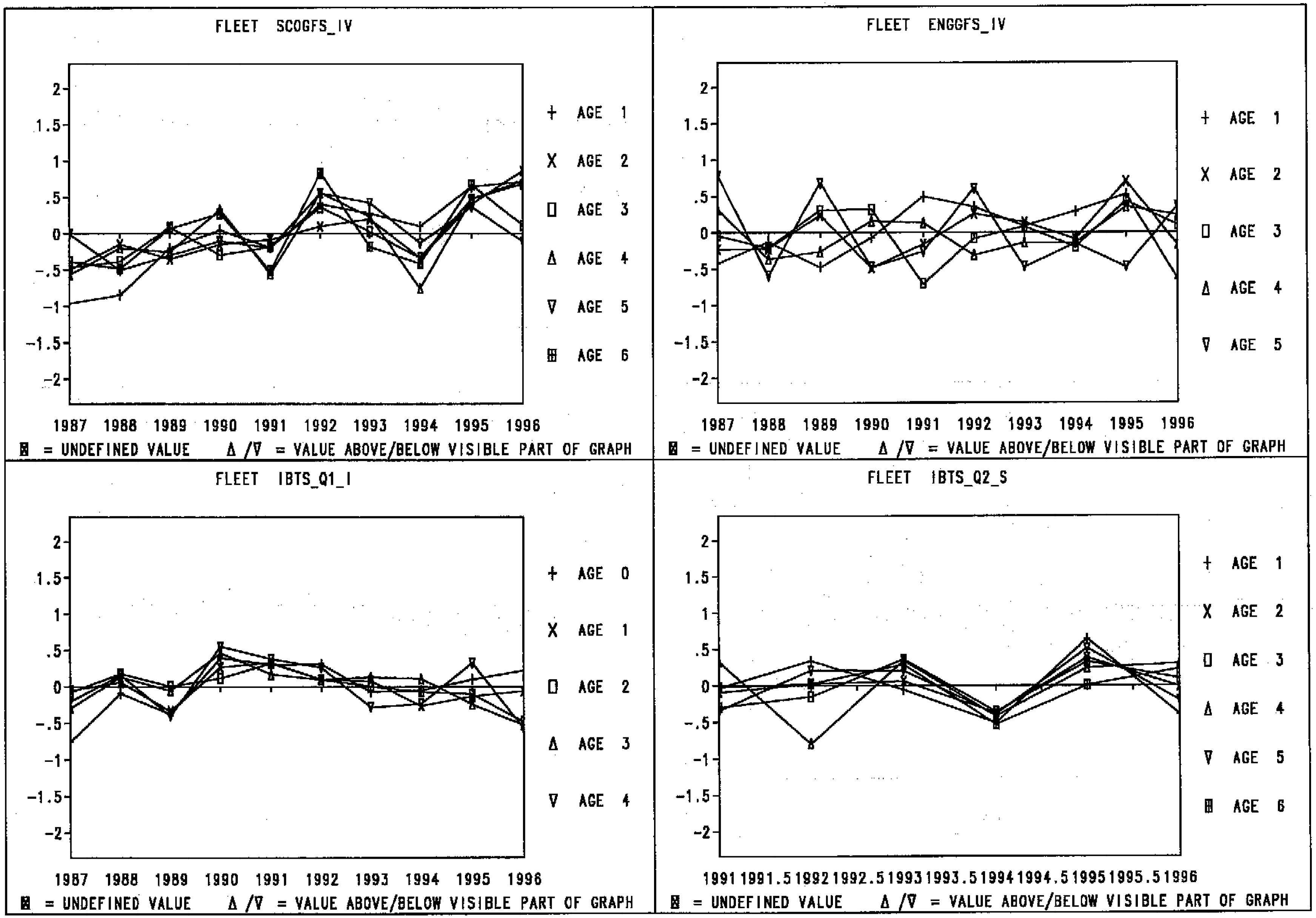
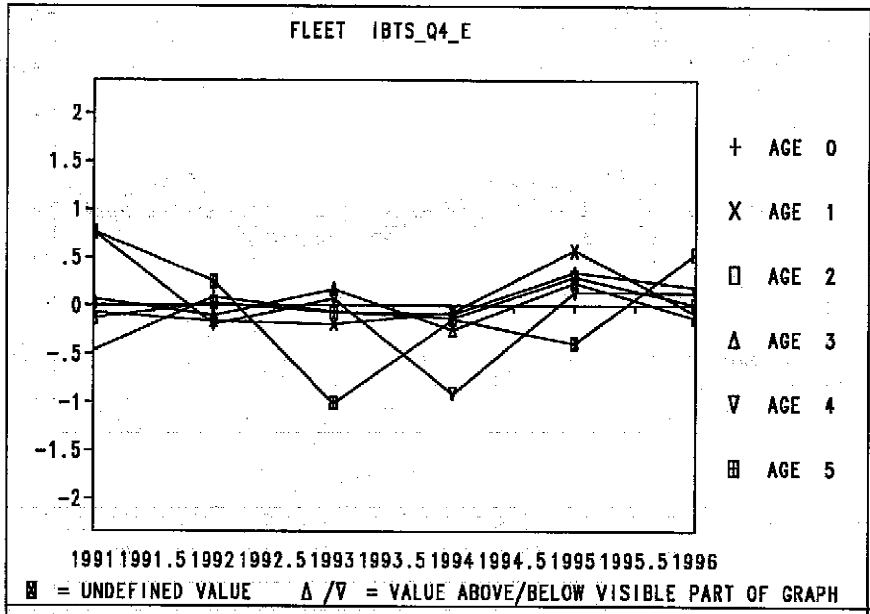
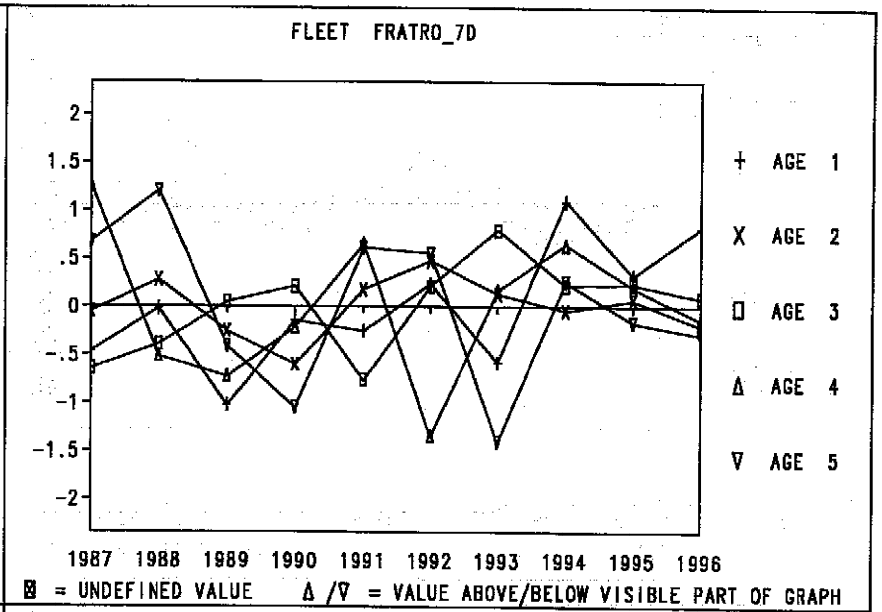


Figure 5.1.1 (Continued)





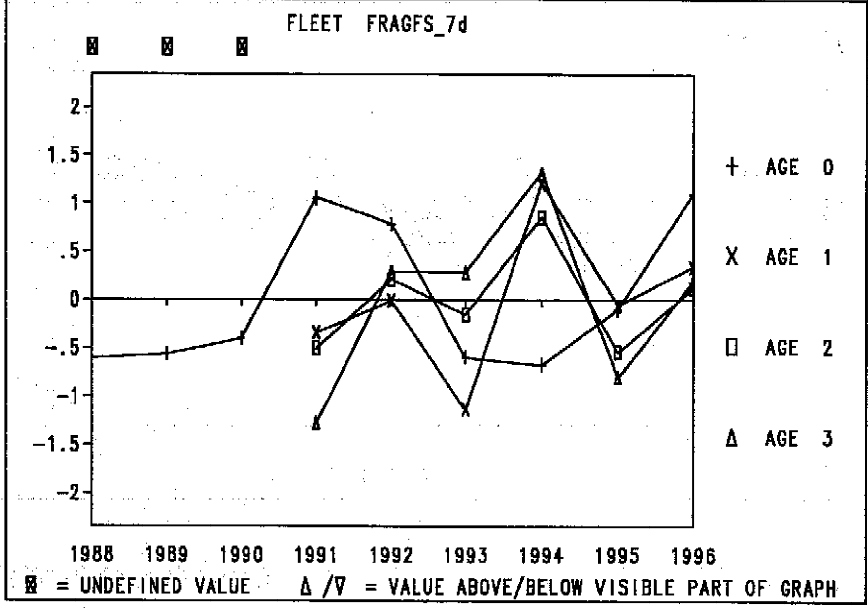


Figure 5.1.2

Whiting in IV and VIId. Retrospective patterns

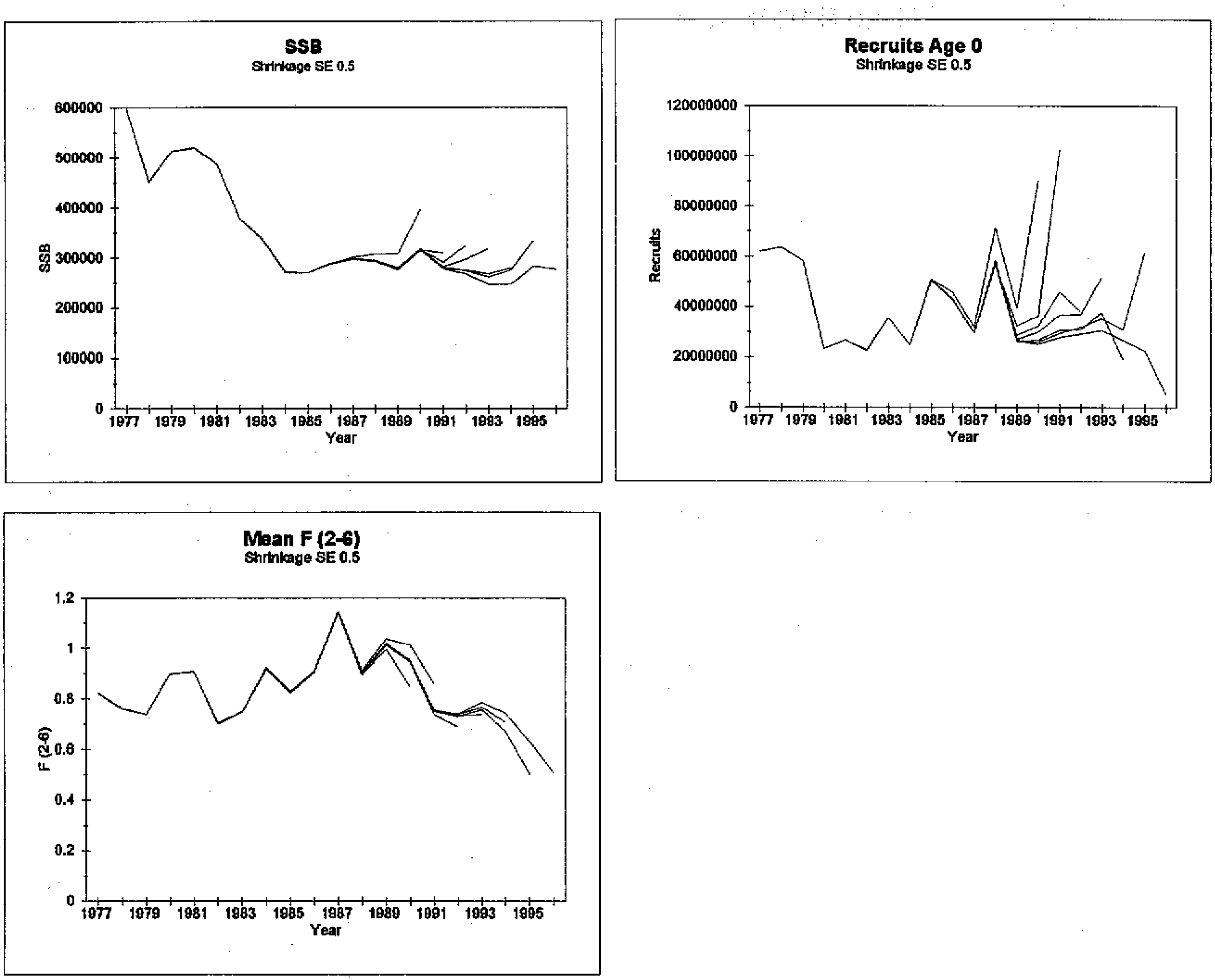


Figure 5.1.3

Whiting in IV and VIId. Tuning fleet scaled weights for estimating survivors

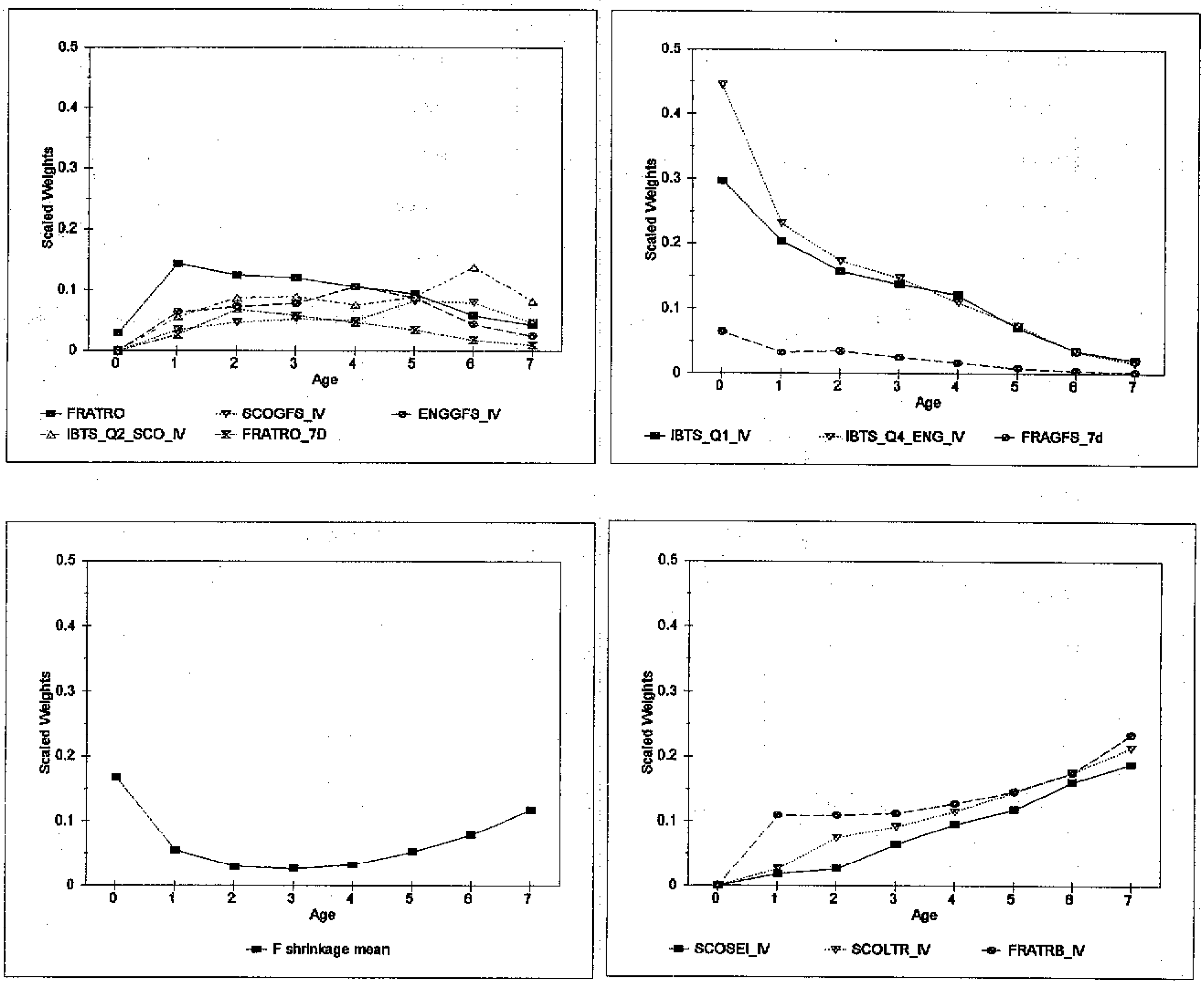


Figure 5.1.4

Whiting in IV and VIId. Log survey indices vs log XSA population estimates

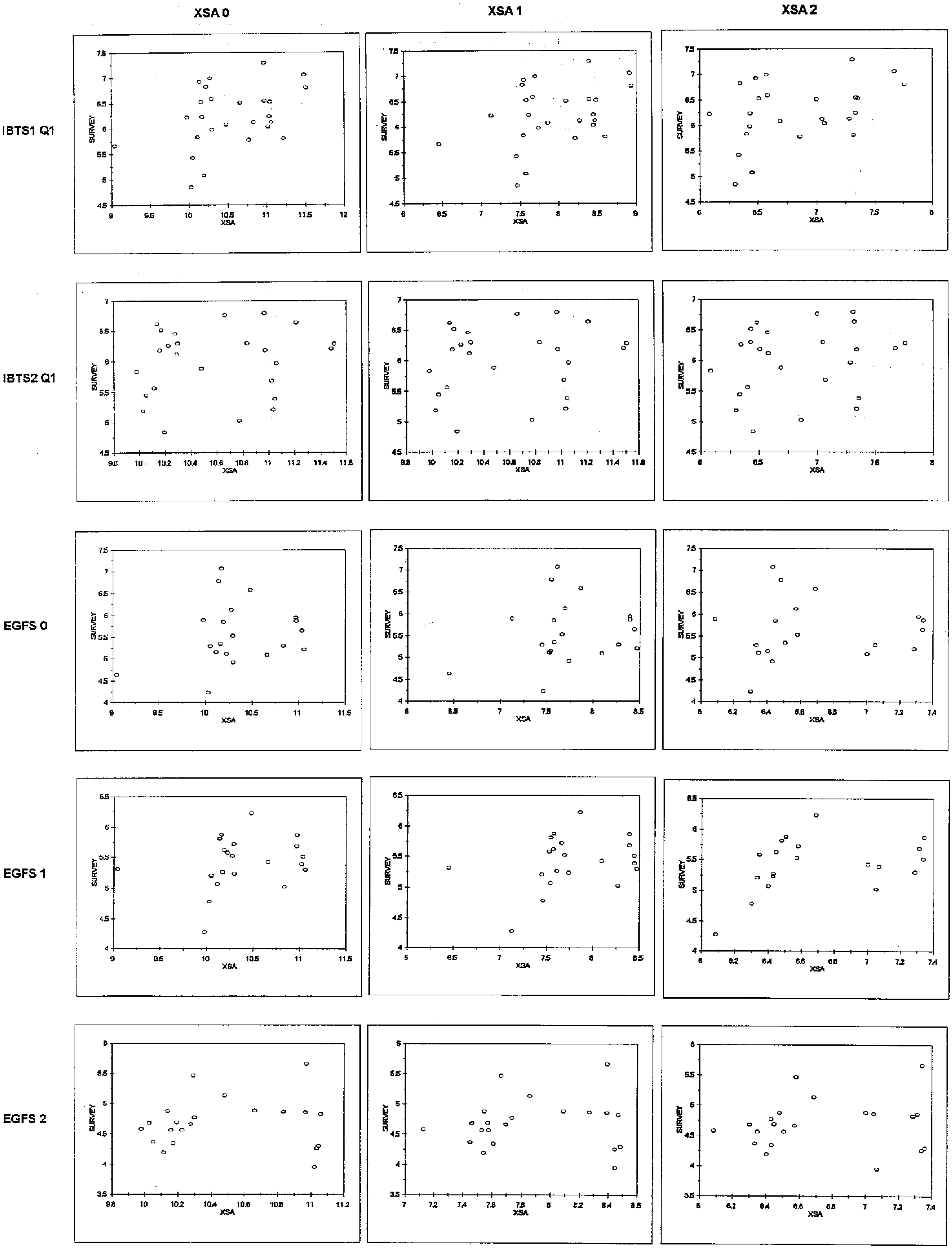


Figure 5.1.4 (Continued)

Whiting in IV and VIId. Log survey indices vs log XSA population estimates

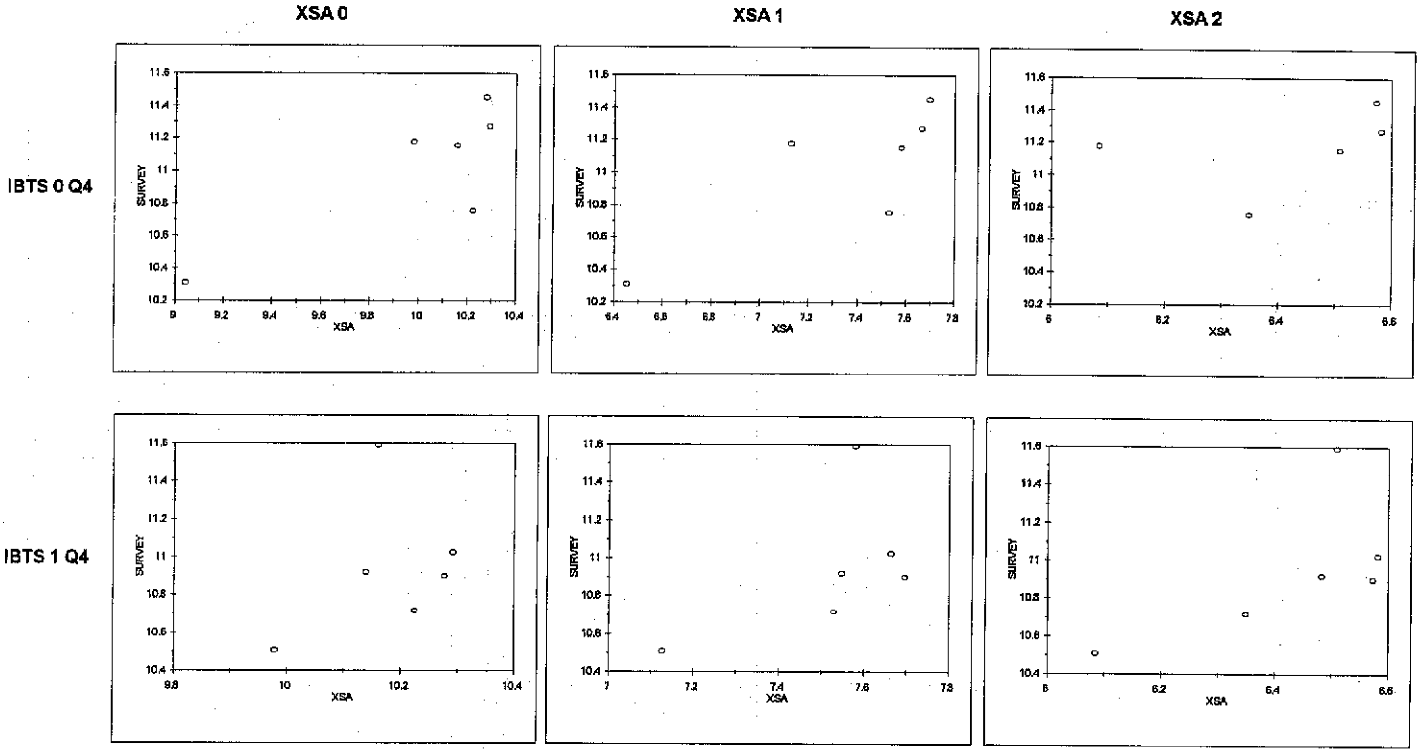


Figure 5.1.4 (Continued)

Whiting in IV and VIId. Log survey indices vs log XSA population estimates

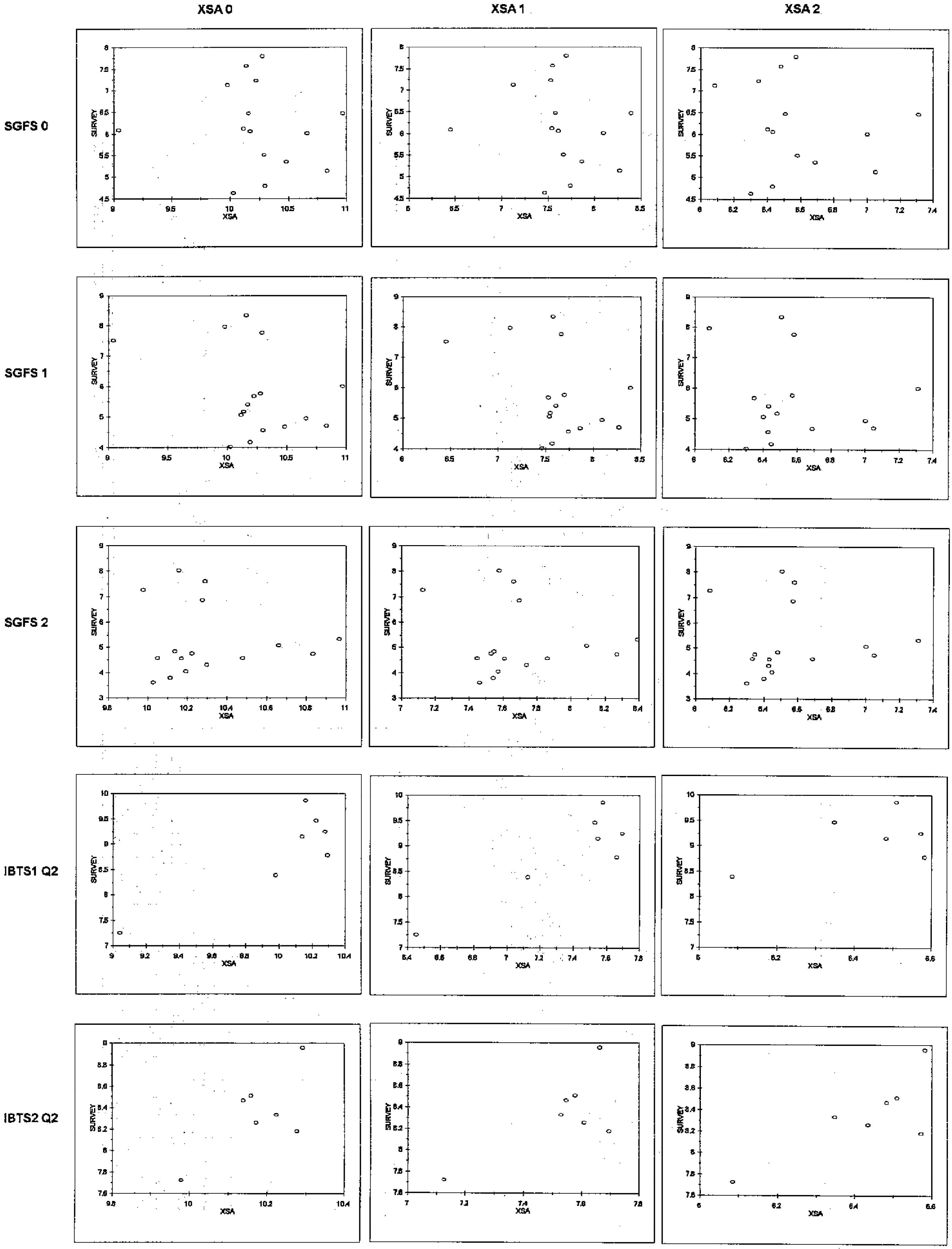


Figure 5.1.5 Stock summary, whiting ,IV and VIId

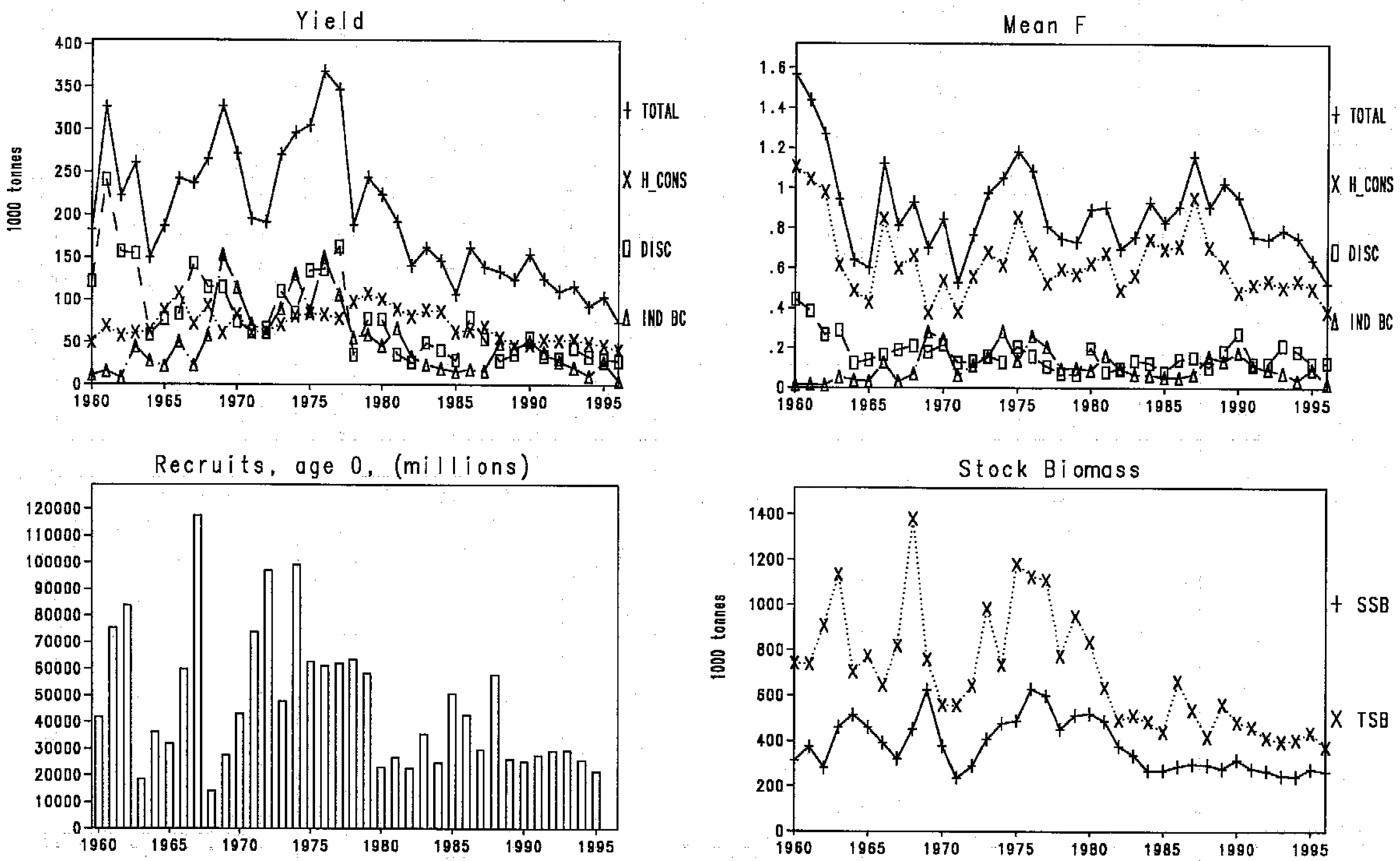
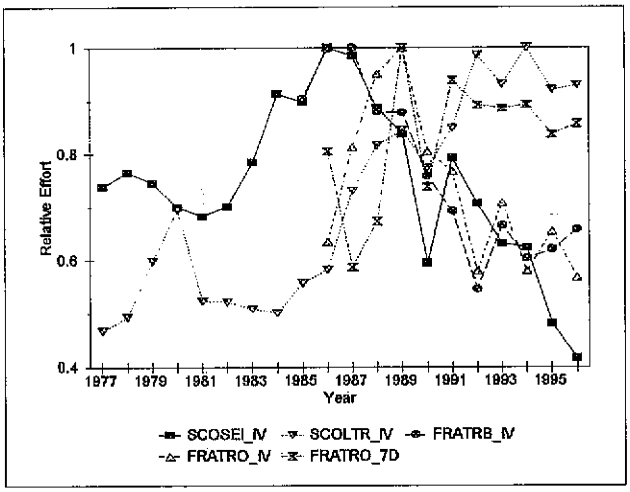


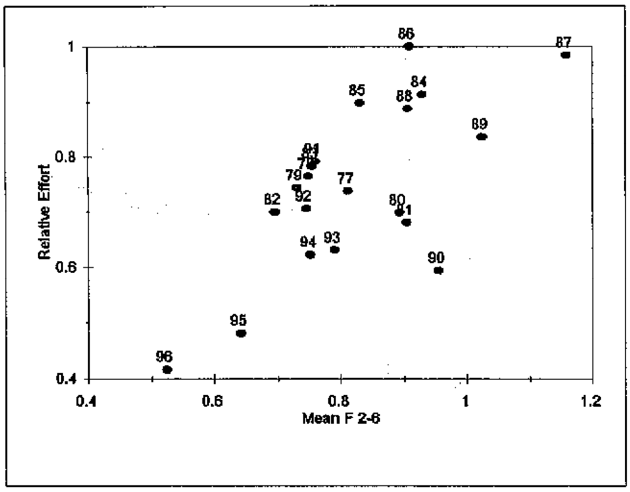
Figure 5.1.6

Whiting in IV and VIId

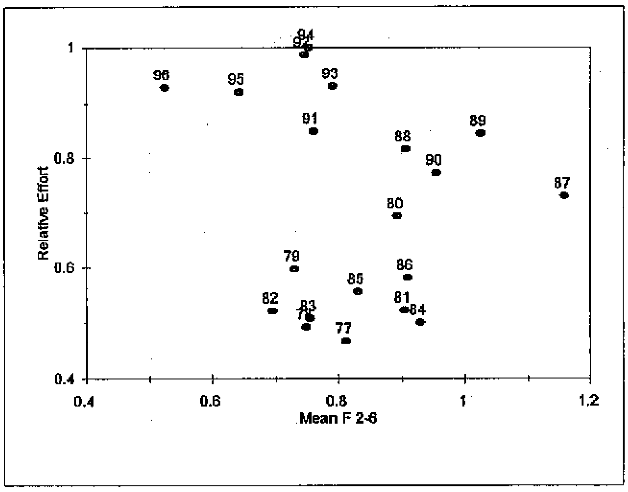
a) relative fishing effort (1997-1996)



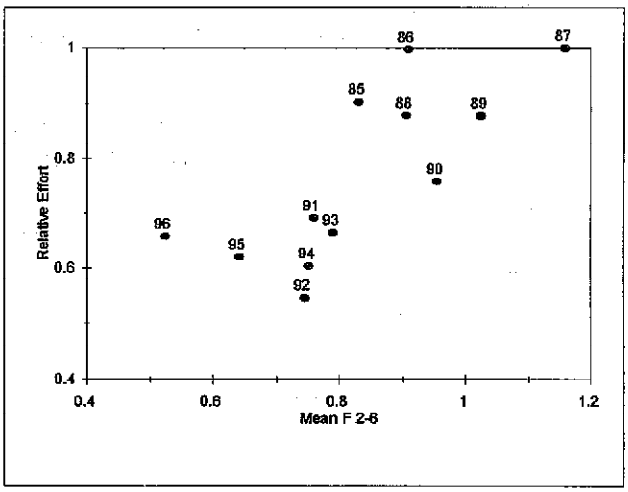
b) Relative effort vs mean F 2-6: ScoSei



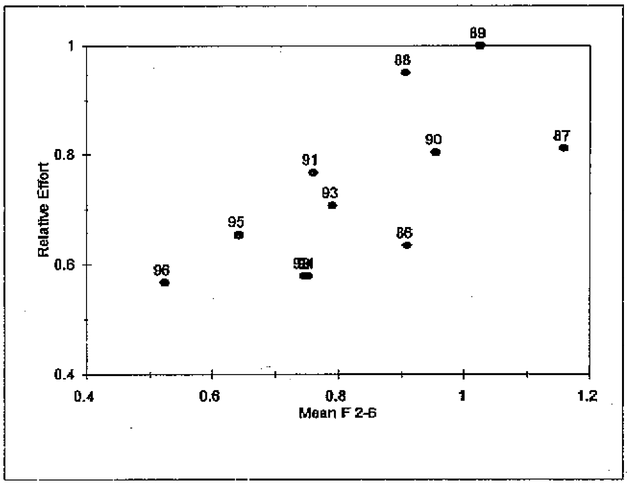
c) Relative effort vs mean F 2-6: ScoLtr



d) Relative effort vs mean F 2-6: FraTrb



e) Relative effort vs mean F 2-6: FraTro (IV)



f) Relative effort vs mean F 2-6: FraTro (VIId)

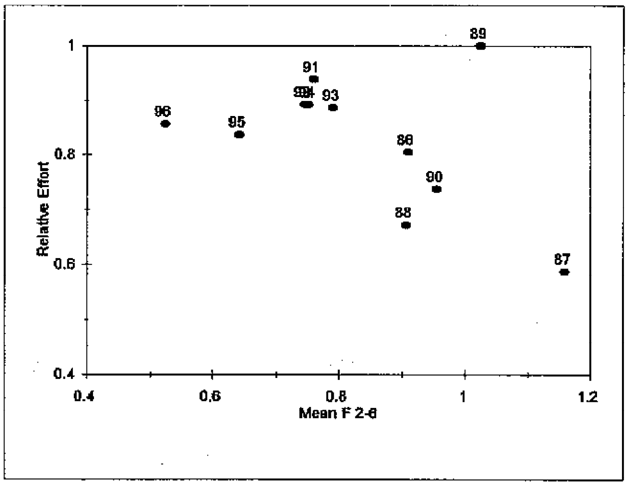
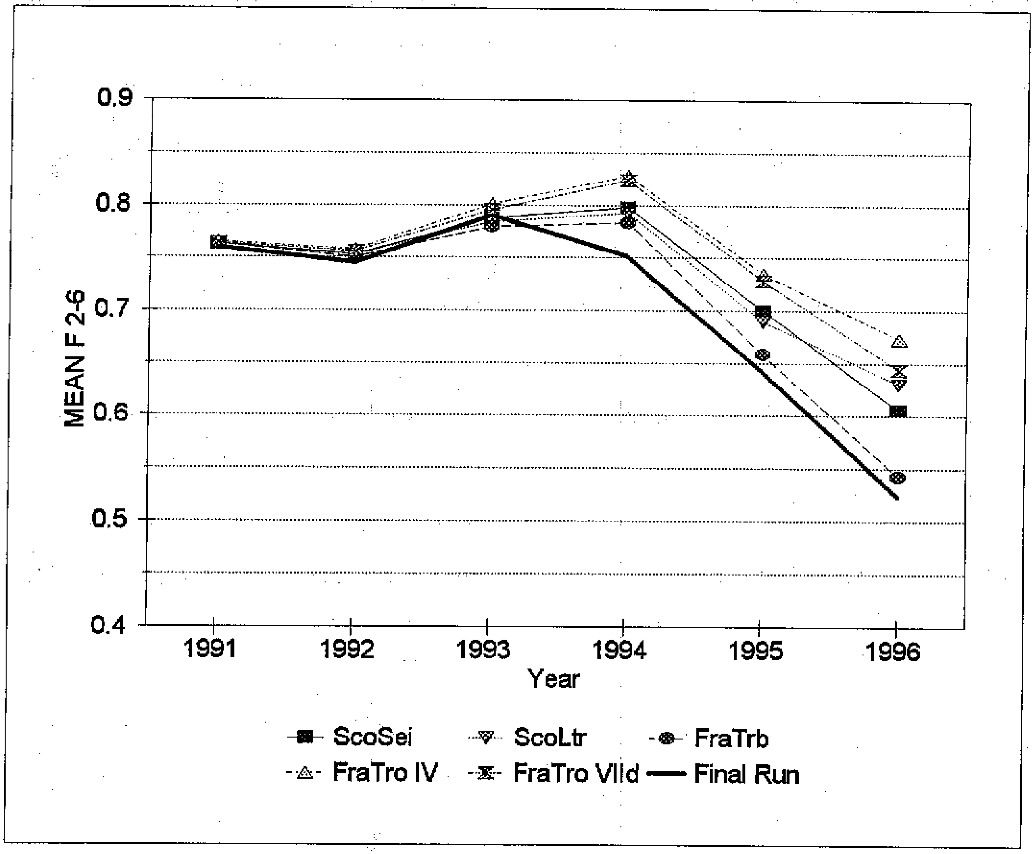


Figure 5.1.7

Trends in mean F 2-6 from XSA single fleet tuning (shrinkage SE = 1) and the final run (shrinkage SE = 0.5)

a) Commercial fleets and final run



b) Surveys

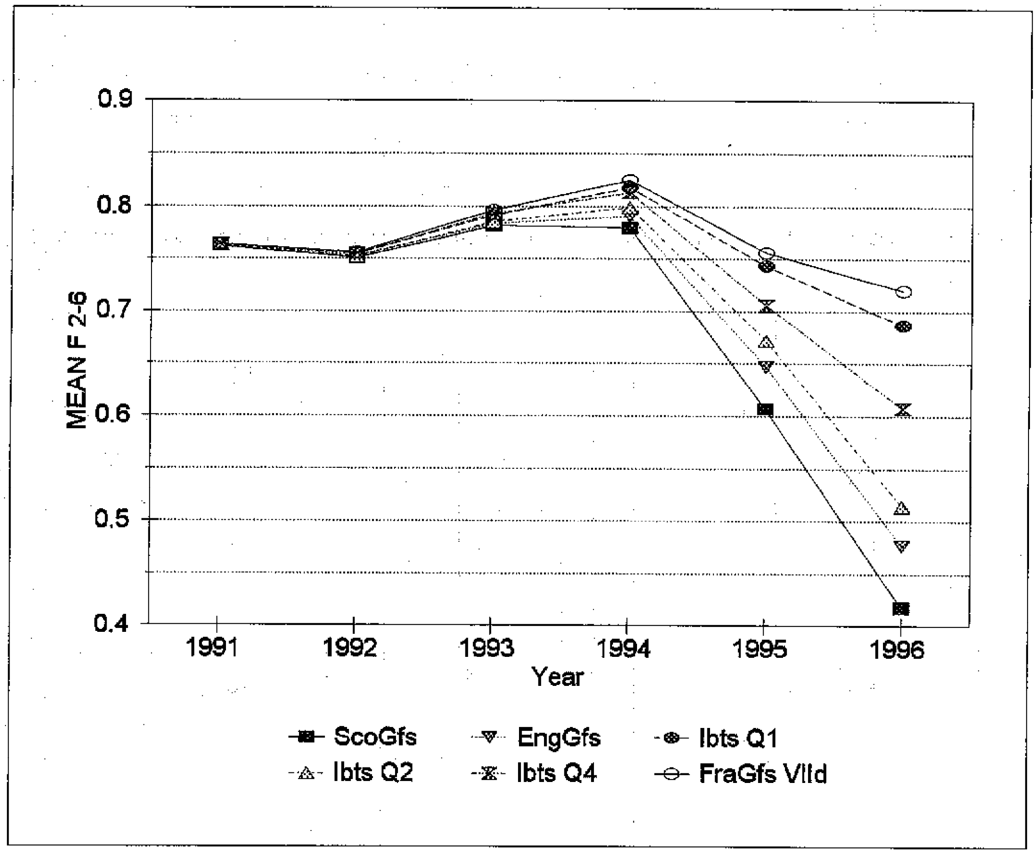


Figure 5.1.8 whiting, IV and VIId. Sensitivity analysis of short term forecast.

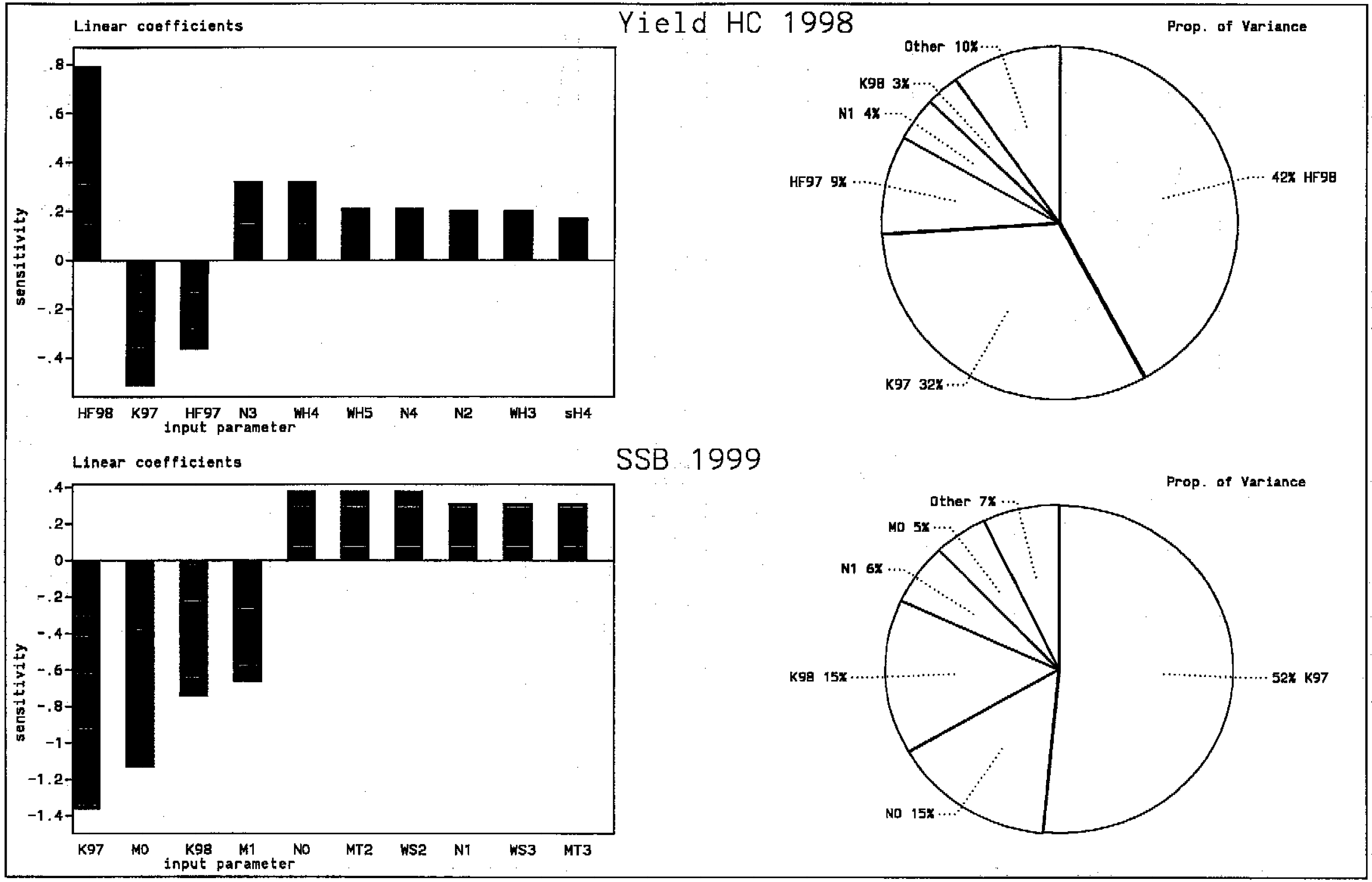
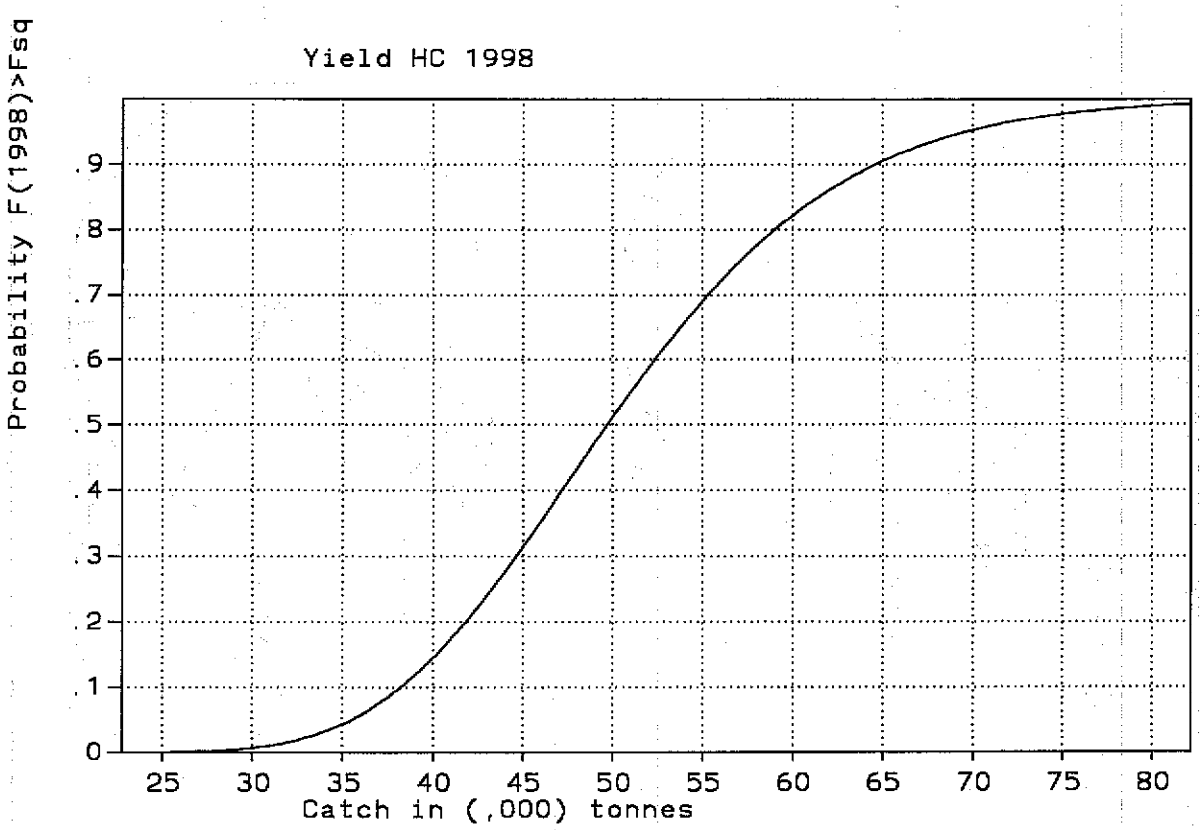


Figure 5.1.9 whiting,IV and VIId. Probability profiles for short term forecast.



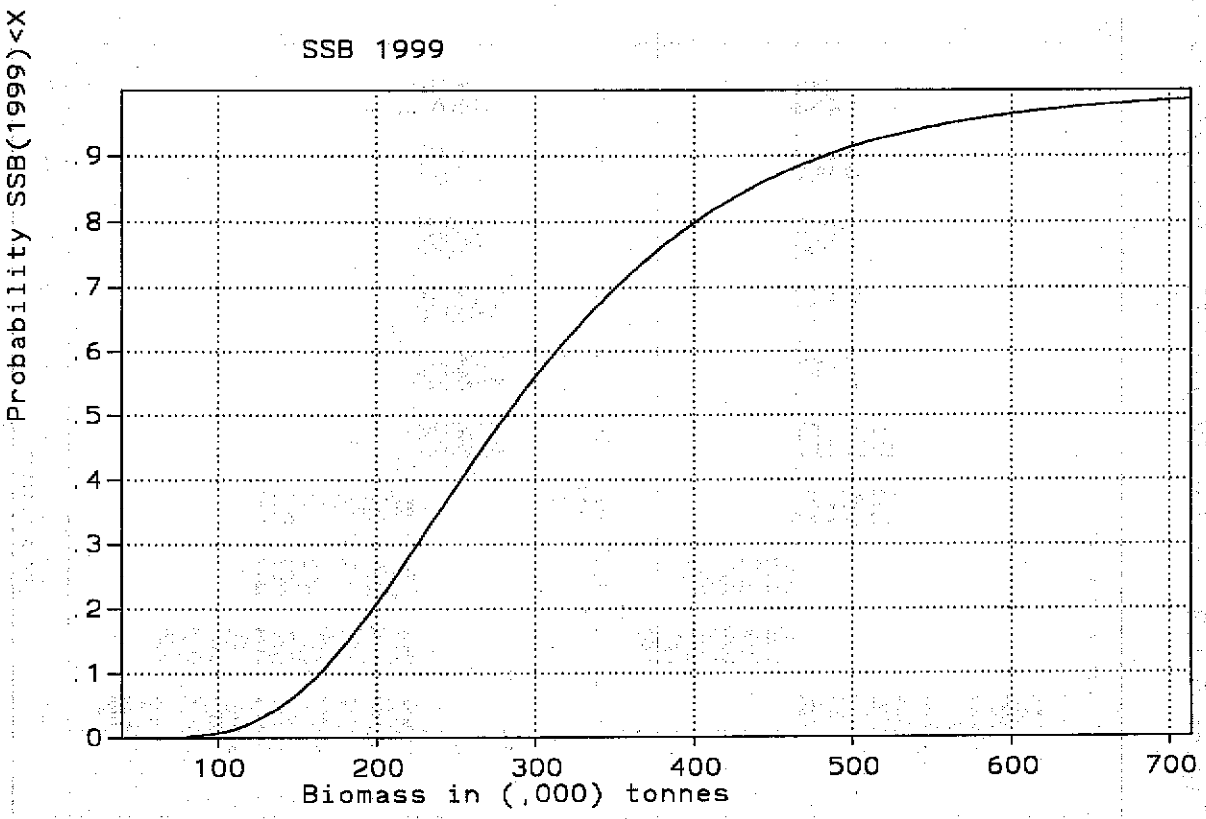
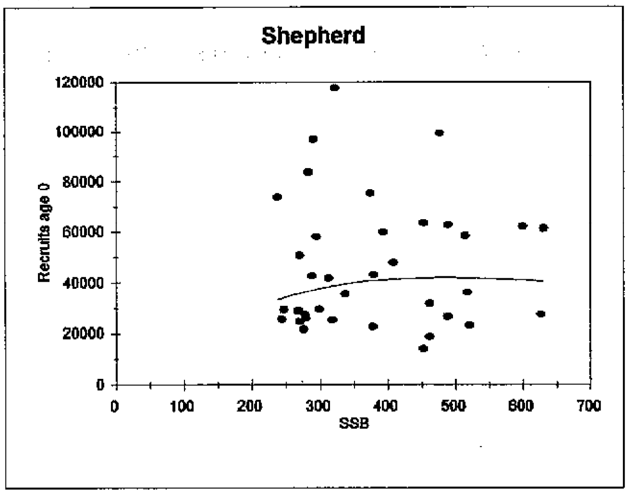


Figure 5.1.10

Whiting in IV and VIId. Medium term predictions.

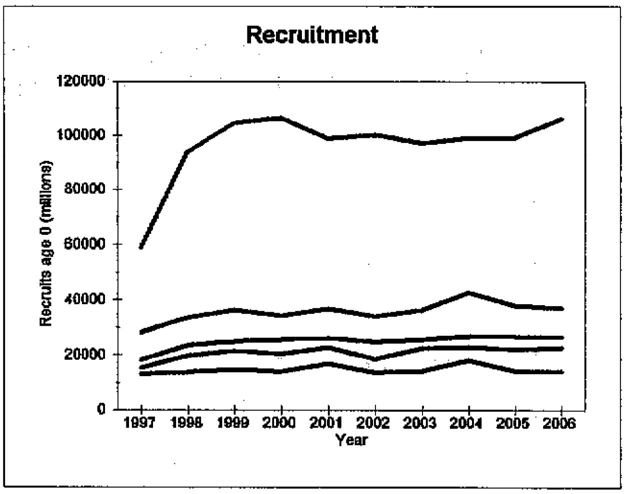
a)

stock and recruitment (Shepherd model)



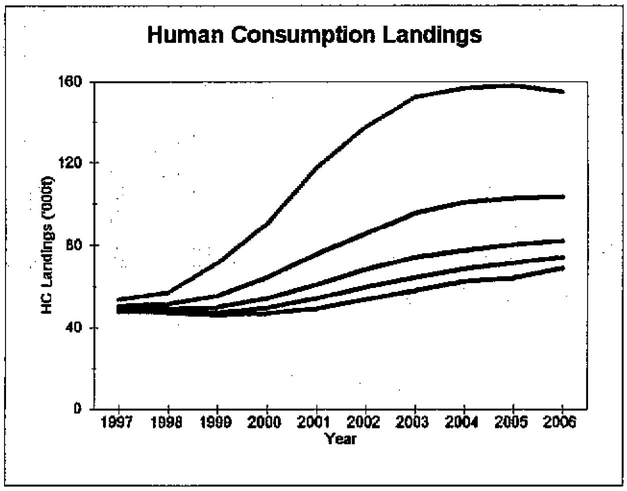
b)

percentiles of recruitment



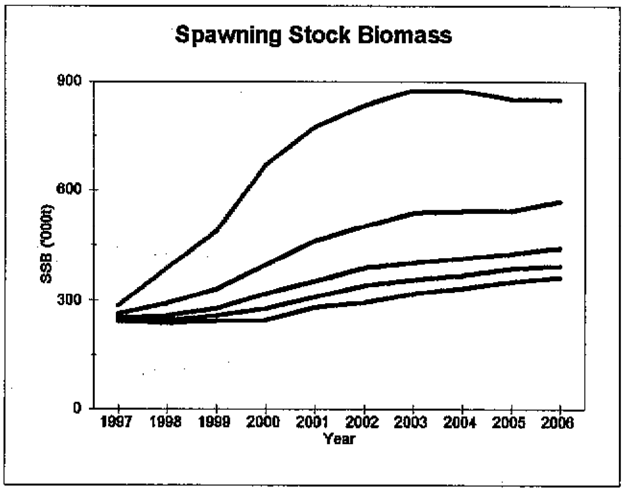
c)

percentiles of human consumption landings at status quo F in the human consumption fishery



d)

percentiles of spawning stock biomass at status quo F in the human consumption fishery



solid lines are 5, 10, 20, 50 and 95 percentiles

Figure 5.1.11

Whiting in IV and VIId. Medium term predictions.

Percentiles of SSB after 10 years for varying F multipliers of the human consumption fishery

Fpa is defined by the intersection of the appropriate percentile of SSB after 10 years and the SSB defined as Bloss. Bpa is defined by the intersection of Fpa and the 50%ile of SSB after 10 years.

(The Fpa value corresponding to the 20%ile was not defined within the F-multiplier range used here (0 - 2), and is, therefore, not presented)

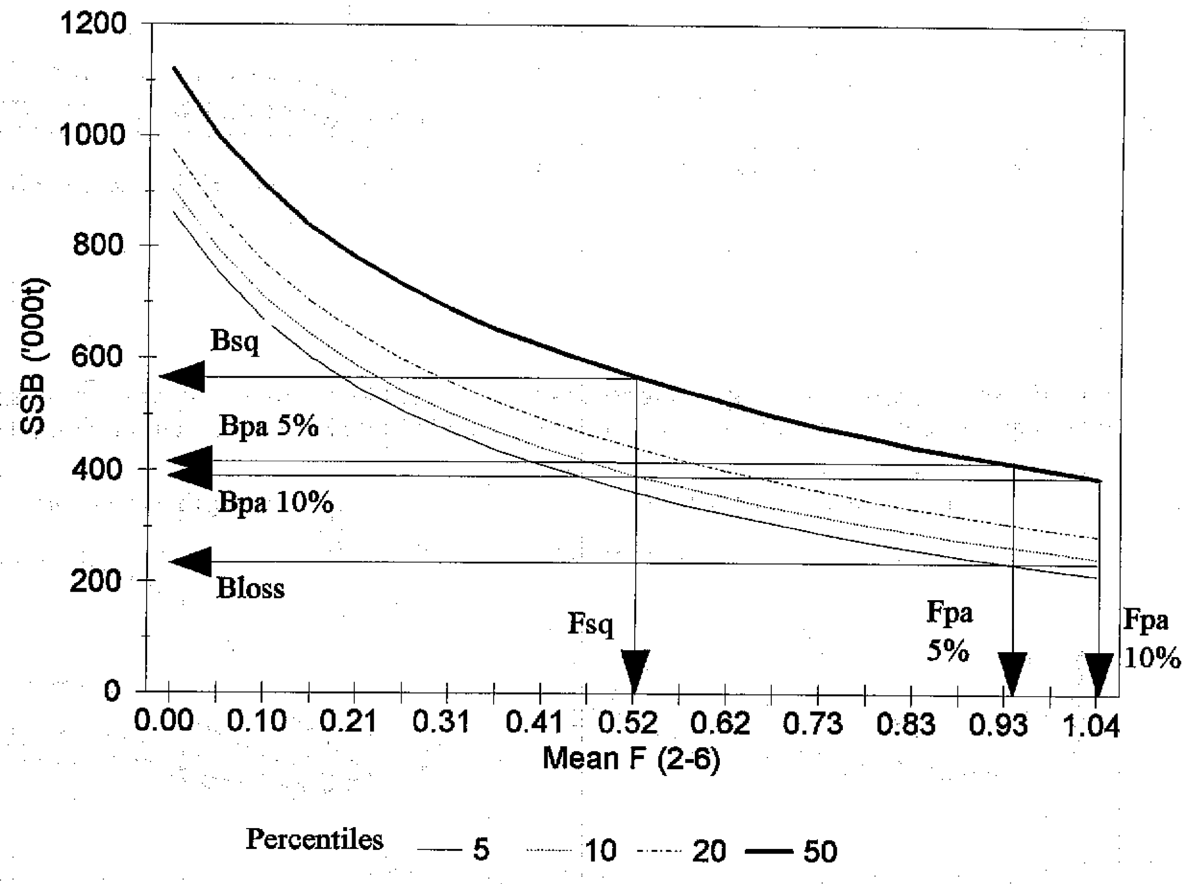
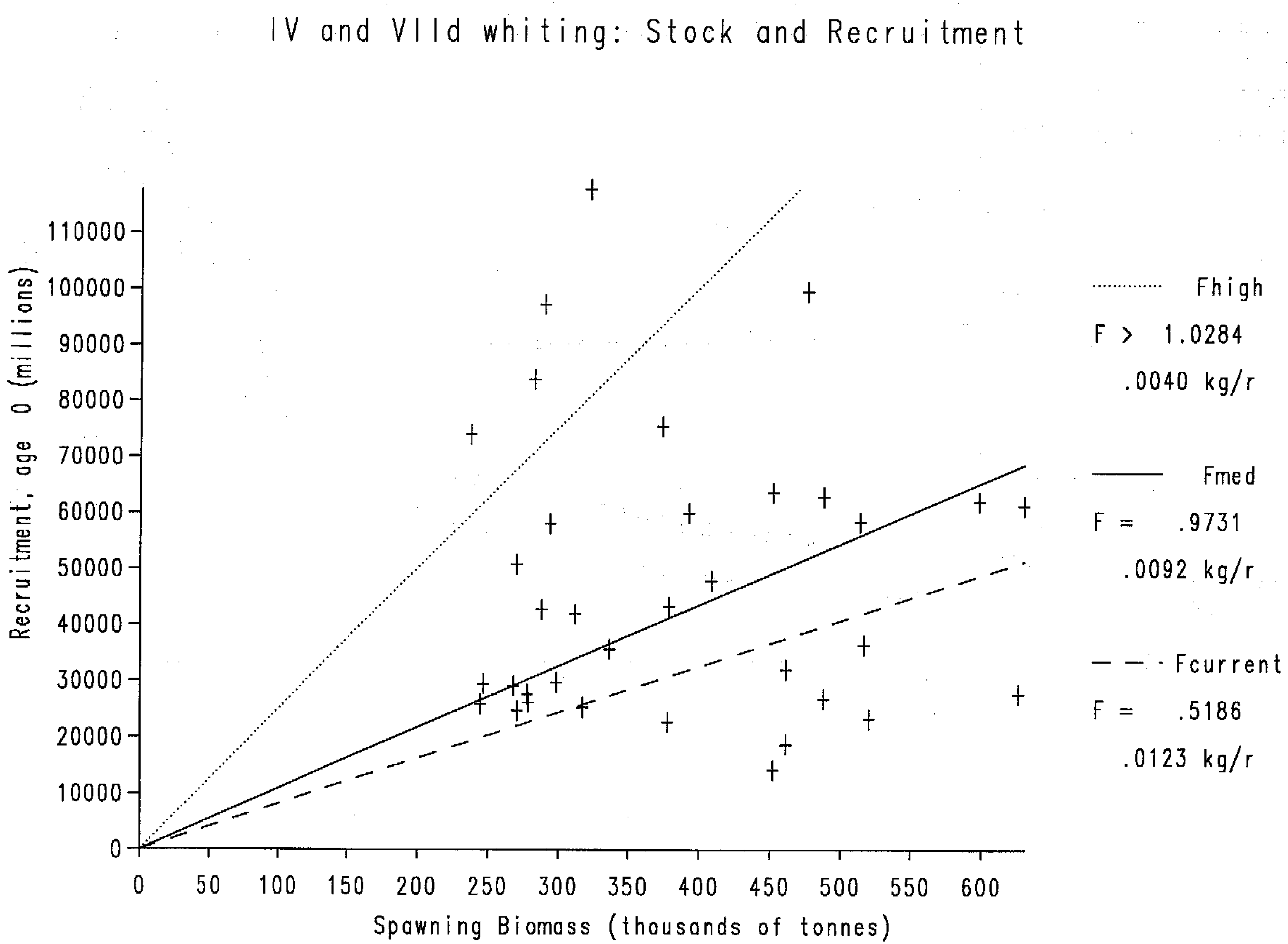


Figure 5.1.12



IV and VIId whiting: Stock and Recruitment
Recruitment, age 0 (millions)
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
50
100
150
200
250
300
350
400
450
500
550
600
Spawning Biomass (thousands of tonnes)
Fhigh
F > 1.0284
.0040 kg/r
Fmed
F = .9731
.0092 kg/r
Fcurrent
F = .5186
.0123 kg/r

Figure 5.1.13

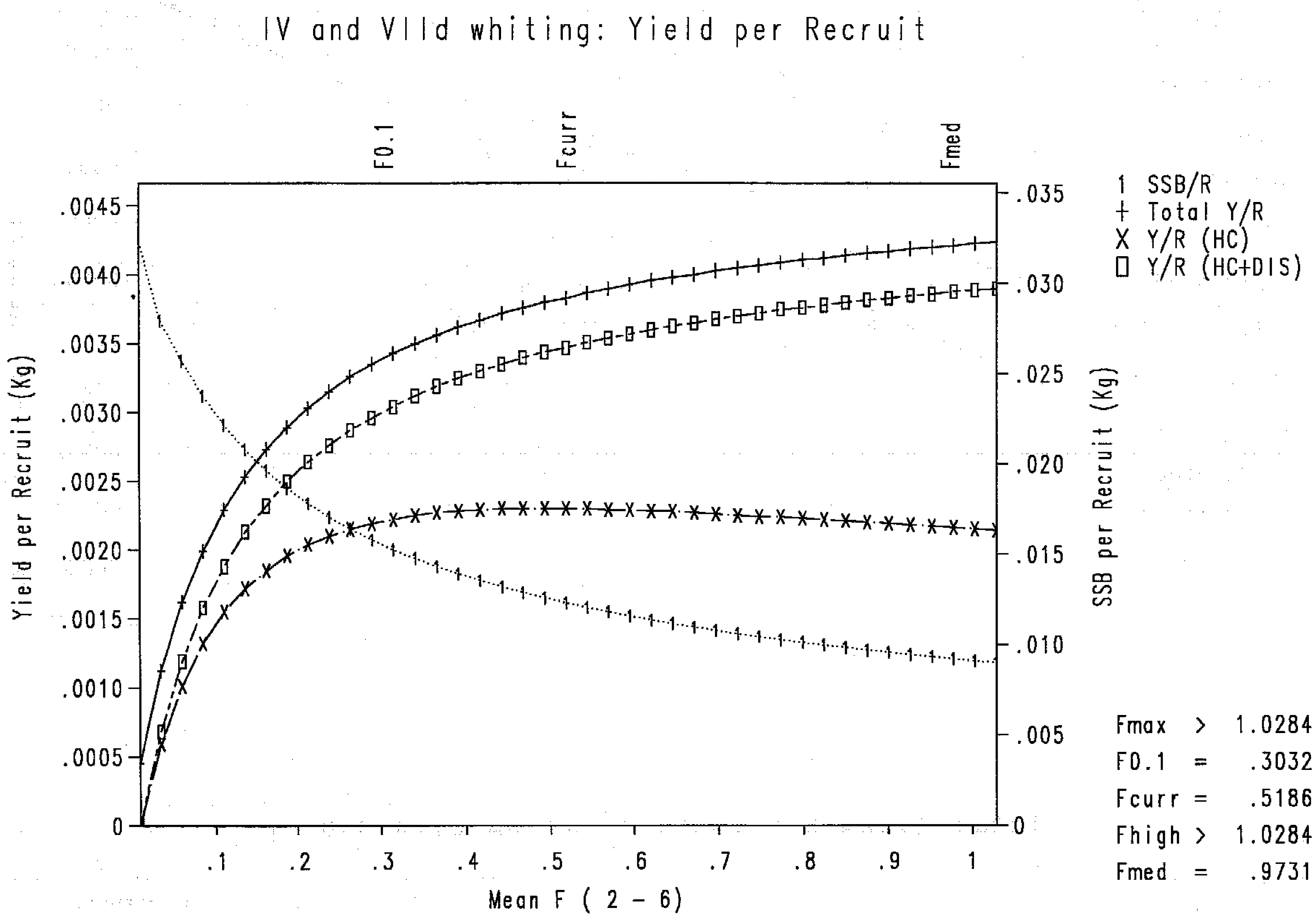
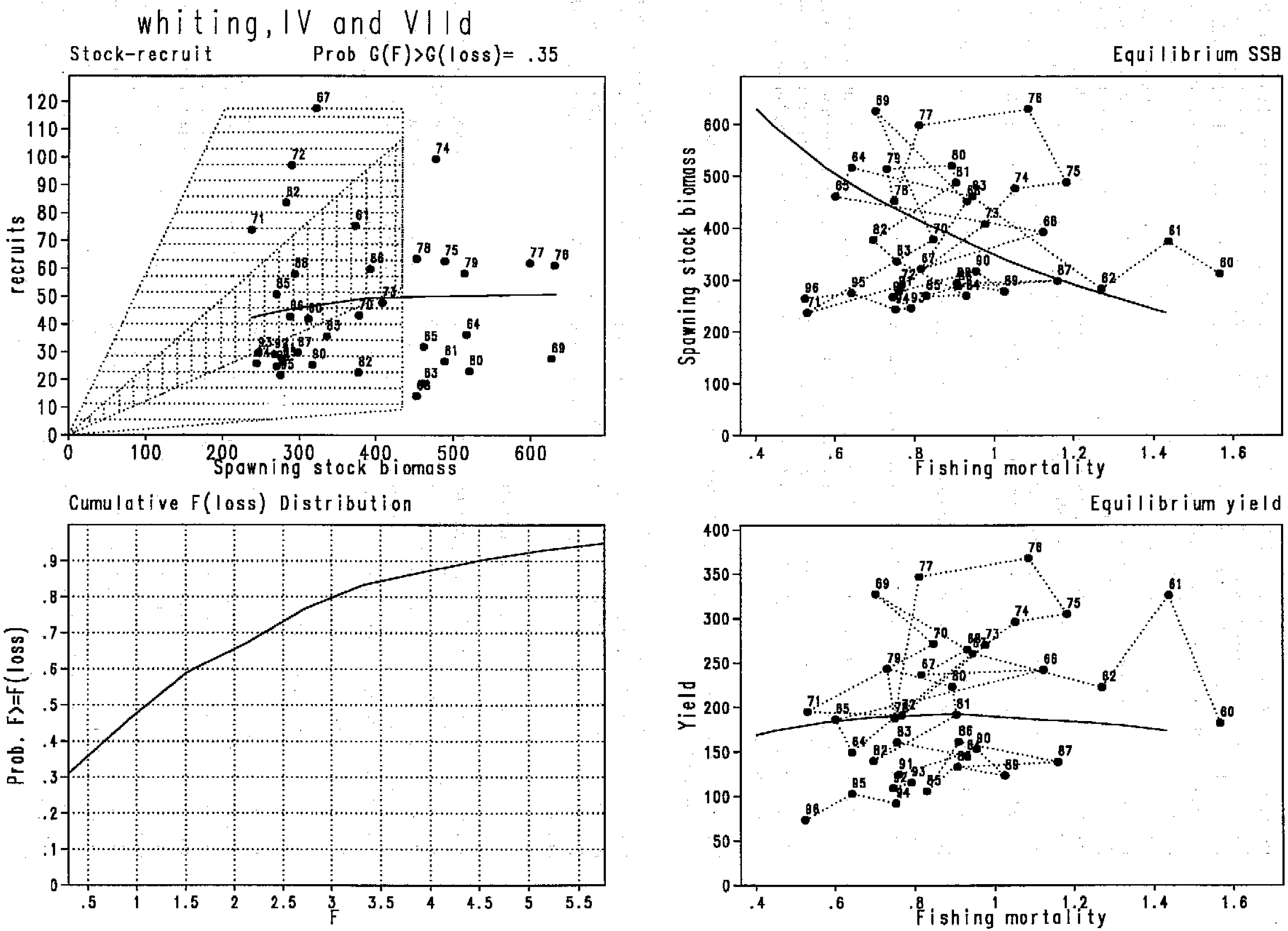

IV and VIId whiting: Yield per Recruit
F0.1
Fcurr
Fmed
Yield per Recruit (Kg)
.0045
.0040
.0035
.0030
.0025
.0020
.0015
.0010
.0005
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
Mean F (2 - 6)
SSB per Recruit (Kg)
.035
.030
.025
.020
.015
.010
.005
0
1 SSB/R
+ Total Y/R
X Y/R (HC)
□ Y/R (HC+DIS)
Fmax > 1.0284
F0.1 = .3032
Fcurr = .5186
Fhigh > 1.0284
Fmed = .9731

Figure 5.1.14


whiting, IV and VIId
Stock-recruit
Prob G(F)>G(loss)= .35
recruits
Spawning stock biomass
Equilibrium SSB
Spawning stock biomass
Fishing mortality
Cumulative F(loss) Distribution
Prob. F>=F(loss)
F
Equilibrium yield
Yield
Fishing mortality

6 SAITHE IN SUB-AREA IV AND DIVISION IIIA

6.1 Catch trends

Recent nominal landings are given in Table 6.1.1. Working group estimates are in Table 6.1.2 and are plotted in Figure 6.1.1. Landings were high in the early 1970s, reaching a maximum of 320,000 t in 1976. Subsequently, landings declined to 114,000 t in 1979, mainly due to the discontinuation in the fishery of the USSR. After that, the landings followed an increasing trend to reach 200,000 t in 1985. This increase is partly due to good year classes coming into the fishery. However, low cod quotas in the Barents Sea added extra fishing pressure to the saithe in the North Sea, especially from Norwegian trawlers. Since then, the cod stock in the Barents Sea has increased and Norwegian fishing effort for saithe in the North Sea has dropped. After 1985 the saithe landings decreased to 88,000 t in 1990, and since then the landings have increased. In 1995 and 1996, the landings are estimated to be 114,000 t and 110,000 t respectively. Small amounts of saithe are taken as industrial by-catch, but most of the saithe is sorted out and delivered for human consumption. Since 1977, the average industrial by-catch has been 2,400 t, but in the later years no bycatch was registrated. The catch trends do not include discards. The agreed TAC in 1996 was 111,000 t which is 1,000 t higher than the estimated catch.

Saithe is mainly taken in a directed trawl fishery which started in the beginning of the 1970s. The French, German and Norwegian catches make up about 80 % of the total international catch.

6.2 Natural mortality, maturity, age compositions, mean weight at age

Conventional values of natural mortality rate, and maturity at age based on biological sampling are given in Table 6.2.1. They are unchanged from those used last year. Total international age compositions are given in Table 6.2.2. Data for 1995 were updated with minor changes. Data for 1996 were supplied by Denmark, Germany, France, Norway, UK (England) and UK (Scotland) amounting to about 95 % of the landings. Discards are not included.

The mean weights at age in the landings are given in Table 6.2.3. These are also used as stock mean weights. SOP corrections have been applied.

The database contains data back to 1960, and VPA was run for the whole period to check if it was possible to have some more stock-recruitment points. However, this analysis gave unrealistic low spawning stock biomass in the beginning of the 1960s, and the mean weights at age was high for the ages 3 to 8 for the years 1960 to 1966. The data before 1967 are considered to be unreliable and it was therefore decided to use the data from 1967 and onwards.

6.3 Catch, effort and research vessel data

The fleets used for tuning the VPA are given in Table 6.3.1. The French fleet was this year split in two fleets (see sect. 1.3.1), and in addition the IBTS1q was added. The data from the French trawlers starts in 1985 and contains the age groups 3 - 10. The data from the Norwegian trawlers starts in 1980 and contains the age groups 3 - 10. After the drop in effort in the period 1985 to 1990, the effort in recent years seems to have stabilised on half the level of 1985. The Scottish research vessel indices start in 1982, and the English indices start in 1977. Both surveys contain age 1 and age 2.

6.4 Catch-at-age analysis

The method used to tune the VPA was XSA (v3.1), the same tuning configuration as last year. Preliminary runs were done with all fleets included. Plots of the residuals were inspected and both the IBTS-survey and one of the French fleets showed clear trends. It was therefore decided to exclude those two fleets. Plots of the residuals are shown in Figure 6.4.1. Runs were done with- and without taper, and the results were almost identical. It was decided to run the tuning with no taper over ten years. Catchability was dependent of stock size for the ages 1, 2 and 3, and catchability was fixed for ages 7 and above as last year. The age range used for VPA was 1 to 10 (the plus group), and F for the oldest ages was shrunk to the mean of the 3 younger ages. The tuning results are given in Table 6.4.1, Table 6.4.2 gives the values of fishing mortality rates, and Table 6.4.3 gives the stock numbers estimated by tuning. The F shrinkage mean gives a high weight for age 1 and 2. The surveys get some weight for the ages 3 and 4. For the ages 5 to 7 the commercial fleets got most of the weight while on older ages the two commercial fleets and the mean shrinker are sharing the weights (Figure 6.4.2).

A retrospective analysis was run for six years backwards. The results are plotted in Figure 6.4.3. There is reasonable agreement for all runs. However, it seems to be a tendency to underestimate recruitment.

6.5 Recruitment Estimates

As we have 0-group indices for 1996 and 1997 year classes and survey indices for age 2 and 3, a RCT3 analysis were used to estimate recruitment. The research vessel indices used in the RCT3 program for estimating recruitment are given in Table 6.5.1 and plotted in Figure 6.5.1. The results of the RCT3 analysis are given in Table 6.5.2. They were used as estimates for ages 1 and 2 in 1997 (year classes 1996 and 1995). The year class 1996 was estimated to 179 million at age 1, and the year class 1995 was estimated to 144 million at age 2. We have one preliminary index for the year class 1997, and the estimate of this year class was 167 millions. For the year class 1998 the VPA mean of 187 millions calculated by RCT3 was used. The VPA mean got the highest weights for all year classes in the RCT3 analysis.

6.6 Historical stock trends

Table 6.6.1 gives a summary of the trends in fishing mortality, biomass and recruitment as estimated by VPA. These data are also plotted in Figure 6.1.1.

Mean fishing mortality increased substantially from 1981 to 1986. Since then, it has decreased to a level of about 0.5. Total biomass and spawning biomass show a continuous downwards trend until 1990 when they were on historically low levels. The present assessment shows that the slight improvement of the stock observed between 1992 and 1995 has stopped.

6.7 Short term forecast

Input data for prediction are given in Table 6.7.1. Ages 1 and 2 are estimated from RCT3. The period for calculations of mean exploitation pattern and mean weights is 1994 to 1996. The 1997 year class is estimated by RCT3 while geometric mean is used for the 1998 year class. Results of the prediction are given in Table 6.7.3. and in Figure 6.7.1. Input data for a sensitivity analysis are shown in Table 6.7.1 and the results of this analysis are shown in Figures 6.7.2 and 6.7.3.

Maintenance of the 1996 level of fishing mortality in 1997 will lead to landings of 118,000 t in 1997 and 116,000 t in 1998. Spawning stock size is predicted to increase to 130,000 t in 1999.

The sensitivity analysis shows that the prediction of the yield in 1998 is dependent of the fishing mortality levels in 1998 and 1997 together with the numbers of the ages 2, 3 and 4, the weights of the ages 4 to 6, and the natural mortality in 1997. The prediction of the spawning stock in 1999 is dependent of the fishing mortality levels in 1998 and 1997 together with the numbers of age 3 and 5, the stock weights at age 5 and 7, the proportion mature at age 5 and 7 and the relative fishing mortalities of the ages 4 and 5 (Figure 6.7.2). The stock numbers of age 3 contributes to most of the variance in the prediction (Figure 6.7.2). It must be remembered that the ages 2 and 3 (year classes 1996 and 1995) are mostly determined by the VPA mean.

The probability plots show that there is about a 40 % probability that the spawning stock will drop below 125,000 t in 1999 if the current level of fishing mortality is maintained (Figure 6.7.3).

6.8 Medium term projections

The input for these analyses are shown in Table 6.7.1 and Table 6.8.1, and the results are presented in Figure 6.8.1. Using a Shepherd stock-recruitment relationship and the present low fishing mortality, the median landings is expected to increase and stabilise at about 150,000 t. The median spawning stock biomass will stay at the present level of about 130,000 t, and the probability for SSB to fall below 125,000 t is about 25 %.

6.9 Long term Considerations

Figure 6.9.1 shows the stock-recruitment plot. Since we this year have included the data from 1967 to 1969 (see sect. 6.2), F_{high} and F_{med} increased slightly from last years estimates. The current F is equal to F_{med}, which implies that average recruitment is required to sustain spawning stock biomass.

6.10 Comments on the Assessment.

When the old data series from 1960 to 1969 was included in the XSA, it was seen that the data before 1967 gave unreliable results. The results from 1967 and onwards were more realistic. However, the limit could have been put to 1968, 1969 or 1970 as before. The inclusion of the 1967 data point in the stock-recruitment plot results in a slight increase in the replacement lines. However, this data point have a greater influence on MBAL which was defined to 150,000 t, and now must be revised to 125,000 t (see Section 6.11 below).

This year's assessment is consistent with last years assessment of fishing mortality, but it gives lower SSBs for the most resent years. However, the F shrinkage mean is given a high weight in the tuning, and in the RCT3 analysis average recruitment gets a high weight. Because of the great influence of the mean, the forecast should be treated with caution.

6.11 Biological reference points

The input parameters for the yield and biomass per recruit are given in Table 6.11.1 and the results are shown in Table 6.11.2 and Figure 6.7.1. A summary of F_{loss} calculations are shown in Figure 6.11.1 Various reference points are listed below:

F_{sq}	$F_{0.1}$	F_{max}	F_{med}	F_{high}	F_{loss}
.50	.11	.20	.50	.74	.67

Status quo F is now equal to F_{med}, and stock replacement will in the long term be sustained with average recruitment.

6.12 Definition of safe biological limits using limit reference points

A discussion of the general approach taken in estimating Blim and Flim is given in Section 17. For saithe MBAL was defined to 150,000 t last year, but the inclusion of the 1967 data point (SSB=125,000 t, age 1=400 millions) results in a revision of MBAL to 125,000 t (Figure 6.9.1). This value is taken as the estimate for Blim. The results of the estimation of Fpa and Bpa are shown in Figure 6.12.1, and the results are listed below.

B_{lim}	$F_{pa,5}$	$F_{pa,10}$	$F_{la,20}$	$B_{pa,5}$	$B_{pa,10}$	$B_{lpa,20}$
125,000 t	0.49	0.51	0.52	175,000 t	160,000 t	150,000 t

Using the $F_{pa,5}$ estimate given above indicate that by keeping F below 0.49 should ensure that there is only a 5 % probability of SSB falling below B_{lim}. Furthermore, if in addition SSB is maintained above the $B_{pa,5}$ level of 175,000 t, then exploitation of the stock could be regarded as consistent with the precautionary approach.

Current F (0.50) is just above $F_{pa,5}$ (0.49), and current SSB (120,000 t) is well below $B_{pa,5}$ (175,000 t).

Table 6.1.1 Nominal catch (in tonnes) of Saithe in Sub-area IV and Division IIIa, 1985-1996, as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[1]
Belgium	31	16	4	60	13	23	29	70	113	130	228	157
Denmark	9,033	10,343	7,928	6,868	6,550	5,800	6,314	4,669	4,232	4,305[1]	4,388	4,705
Faroe Islands	895	224	691	276	739	1,650	671	2,480	2,875	1,780[1]	3,808	617
France	42,200	43,958	38,356	28,913	30,761[1,2]	29,892[1,2]	14,795[1,2]	9,061[1]	15,258[1]	18,220[1,2]	11,224[1]	12,227
Germany	22,551	22,277	22,400	18,528	14,339	15,006	19,574	13,177	14,814	10,013	12,093	11,567
Netherlands	233	134	334	345	257	206	199	180	79	18	9	17
Norway	101,808	67,341	66,400	40,021	24,737	19,122	36,240	48,205	47,669	50,282[1]	53,293	55,382
Poland	-	495	832	1,016	809	1,244	1,336	1,238	937[1]	151	592	365
Sweden	1,764	1,987	1,732	2,064	797	838	1,514	3,302	4,955	5,366	1,891	1,593
UK (Engl.& Wales)	5,455	4,480	3,233	3,790	4,012	3,397	4,070	2,893	2,429	2,354	2,522	2,864
UK (Scotland)	9,932	15,520	11,911	10,850	9,190	7,703	8,602	6,881	5,929	5,566	6,341	5,848
USSR	-	-	-	-	-	-	116[3]	-	-	-	-	-
Total reported to ICES	193,902	166,775	153,821	112,731	92,204	84,881	93,460	92,156	99,290	98,185	96,389	95,342
Unreported landings	5,632	-3,882	-4,414	-6,132	-172	3,199	5,093	343	5,316	4,408	17,171	14,922
Landings as used by WG	199,534	162,873	149,407	106,599	92,032	88,080	98,553	92,499	104,606	102,593	113,560	110,264

[1]Preliminary.
[2]Includes IIa(EC), IIIa-d(EC).
[3]Includes Estonia.

TABLE 6.1.2; Saithe, North Sea
Annual weight and numbers caught, 1967 to 1996.

Year	Wt.('000t)	Nos.(millions)
1967	78	54
1968	104	62
1969	115	66
1970	222	142
1971	253	176
1972	246	176
1973	226	168
1974	273	164
1975	278	188
1976	320	309
1977	196	120
1978	135	96
1979	114	67
1980	120	71
1981	123	68
1982	166	114
1983	169	111
1984	198	167
1985	200	208
1986	163	156
1987	149	166
1988	107	92
1989	92	75
1990	88	72
1991	99	93
1992	92	71
1993	105	78
1994	103	79
1995	114	75
1996	110	79
Min.	78	54
Mean	159	119
Max.	320	309

TABLE 6.2.1; Saithe, North Sea
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.200	.000
2	.200	.000
3	.200	.000
4	.200	.150
5	.200	.700
6	.200	.900
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

Table 6.2.2 Saithe in the North Sea. Catch numbers at age Numbers*10**-3

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
1	0	172	36	234	594	379	4416	3947	312	235
2	8494	3783	1764	2228	10773	20189	31275	16150	71766	31335
3	15277	20788	28252	34392	68424	40162	47388	61201	50672	199669
4	13335	18944	13063	74326	53348	62290	32955	31387	23406	50339
5	13597	11987	9559	13194	30846	23108	24967	12123	9005	9902
6	2035	5402	7103	11529	3650	20779	15228	20080	6706	5137
7	1141	281	5170	3654	3783	3363	7998	13734	12650	3317
8	200	116	685	1596	2481	2790	1689	4308	8650	4845
9	154	94	547	278	1574	1550	1165	988	3304	3003
+gp	108	87	79	144	536	1445	1927	1094	2347	2128
TOTALNUM	54342	61654	66257	141576	176011	176056	169008	165011	188819	309910
TONSLAND	78480	104002	114758	222100	252618	245879	225770	273466	278126	319933
SOPCOF %	100	100	100	100	100	100	100	100	100	100

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
1	2015	1215	907	1276	5309	1932	270	59	226	89
2	12891	16503	16787	23095	18195	28263	32798	34455	7191	6477
3	22890	30972	14504	14159	22267	27405	23363	75449	129042	48517
4	52270	24935	13022	11399	6362	38946	17980	29769	52613	82843
5	13082	16771	10031	8338	6151	7934	25161	12081	11827	11422
6	4753	2616	7991	6086	3265	5410	4903	12330	3543	3986
7	3218	849	2437	5189	2994	1761	4380	1357	2397	1549
8	3062	790	577	956	3173	1210	1333	1113	496	987
9	3522	607	349	418	504	846	929	279	295	260
+gp	3780	2165	1333	1486	1863	794	819	487	519	555
TOTALNUM	121484	97421	67938	72402	70083	114502	111936	167379	208147	156685
TONSLAND	196185	134829	114363	120293	122518	165977	168884	198001	199534	162873
SOPCOF %	100	100	100	100	100	100	100	100	100	100

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
1	786	10	3642	291	334	290	139	102	97	325
2	29143	5158	9125	4240	11761	5865	7578	6761	3012	7631
3	28906	26865	14870	35037	42313	16626	34742	16516	26588	9968
4	90314	22887	25063	15888	26941	30543	17978	38061	24379	38995
5	12037	32693	10934	10119	6293	11772	10758	12097	13409	10909
6	1789	2777	9552	3896	2974	2826	2798	3897	3204	6988
7	1031	1016	1182	2246	1286	1409	1407	821	3104	2902
8	786	406	481	495	706	631	1406	274	566	715
9	649	446	262	148	267	461	746	375	464	160
+gp	483	351	305	205	241	327	915	682	636	314
TOTALNUM	165925	92608	75415	72565	93116	70749	78468	79585	75459	78909
TONSLAND	149407	106599	92032	88080	98553	92499	104606	102593	113560	110264
SOPCOF %	100	100	100	100	100	100	100	100	100	100

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Table 6.2.3 Saithe in the North Sea. Catch weights at age (kg)

YEAR AGE	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	0.501	0.451	0.434	0.495	0.304	0.154	0.268	0.198	0.461
2	0.679	0.772	0.578	0.697	0.609	0.51	0.392	0.494	0.494	0.501
3	0.892	1.291	0.962	0.931	0.838	0.743	0.78	0.849	0.887	0.69
4	1.307	1.652	1.608	1.442	1.357	1.158	1.407	1.556	1.497	1.302
5	2.077	1.972	2.263	2.073	2.203	1.897	1.575	2.489	2.478	2.175
6	3.13	3.017	2.699	2.708	3.007	2.364	2.543	2.729	3.275	3.036
7	3.718	4.069	3.569	3.598	3.804	3.869	3.339	3.353	3.684	4.007
8	5.288	4.459	4.335	4.42	4.635	4.184	4.657	4.386	4.19	4.325
9	5.835	6.426	5.157	5.615	5.168	4.543	4.502	5.538	5.481	4.981
+gp	7.944	7.4973	6.1305	6.6594	5.6904	6.1192	6.0458	7.5245	7.4188	6.7678
SOPCOFAC	0.9998	1.0001	1.0001	0.9998	1.0001	0.9999	0.9999	1.0001	0.9999	1.0002

YEAR AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.429	0.353	0.434	0.253	0.274	0.249	0.418	0.181	0.143	0.518
2	0.416	0.52	0.389	0.411	0.585	0.498	0.455	0.482	0.508	0.525
3	0.753	0.781	1.08	0.905	0.937	1.087	0.982	0.772	0.648	0.669
4	1.251	1.294	1.59	1.812	1.859	1.566	1.701	1.6	1.242	1.005
5	1.9	2.12	2.219	2.37	2.694	2.497	2.118	2.27	1.869	1.67
6	3.097	3.21	3.071	2.975	3.529	3.144	3.058	2.645	2.611	2.269
7	4.146	4.466	3.966	4.047	4.47	3.958	3.533	3.715	3.176	3.543
8	4.551	4.784	5.128	5.044	5.424	4.908	4.432	4.524	4.555	4.24
9	4.779	5.309	5.947	5.812	6.907	5.606	5.336	5.897	5.331	5.754
+gp	6.2571	6.7475	7.17	7.3222	8.3493	7.748	6.9482	7.7199	7.8899	7.9858
SOPCOFAC	1	1.0001	1.0001	1.0001	1	1.0001	1	0.9999	1	0.9999

YEAR AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.371	0.429	0.426	0.216	0.441	0.629	0.33	0.28	0.514	0.253
2	0.406	0.612	0.727	0.699	0.526	0.613	0.719	0.691	0.775	0.474
3	0.651	0.731	0.9	0.845	0.778	0.951	0.893	0.907	1.025	0.951
4	0.852	0.931	1.022	1.203	1.151	1.176	1.24	1.113	1.275	1.187
5	1.788	1.362	1.401	1.561	1.742	1.574	1.731	1.575	1.787	1.77
6	2.942	2.632	1.933	2.195	2.359	2.184	2.612	2.378	2.531	2.353
7	3.82	3.669	3.831	3.158	3.124	3.628	3.132	3.534	3.529	2.907
8	4.868	4.627	4.822	4.584	4.07	4.261	3.943	4.65	4.648	4.696
9	5.484	5.654	6.311	6.044	5.896	5.284	5.009	6.566	5.093	5.904
+gp	7.0382	7.2013	8.4536	8.366	7.6651	6.2824	6.745	8.2193	7.569	8.2429
	1.0001	1	0.9999	1.0002	1	1	1.0001	0.9999	1.0001	0.9974

Table 6.3.1 Saithe in the North Sea. 1967 -1996. Tuning data

	104													
NORTRL														
	1980	1996												
	1	1	0	1										
	3	14												
	18317	186	1290	658	980	797	261	60	82	44	30	41	24	
	28229	88	844	1345	492	670	699	119	64	111	117	105	93	
	47412	6624	12016	2737	2112	341	234	19	77	7	12	0	71	
	43099	4401	4963	8176	1950	2367	481	357	84	110	43	52	3	
	47803	20576	7328	2207	3358	433	444	106	51	18	31	13	13	
	66607	27088	21401	5307	1569	637	56	46	4	5	4	1	1	
	57468	5297	2042	2214	141	157	74	134	43	0	13	0	18	
	17781	649	2126	835	694	309	154	65	7	0	19	0	8	
	10249	804	29612	3589	818	393	122	25	33	8	16	9	16	
	30008	2645	18454	2217	290	235	201	198	64	28	9	6	3	
	18402	3132	781	924	519	203	63	12	3	0	0	0	0	
	28768	14348	4968	1194	518	203	51	56	1	6	2	0	0	
	35621	3447	9532	4031	1087	465	165	109	6	0	21	0	0	
	24572	7635	4028	2878	1018	526	365	252	252	71	100	13	0	
	30628	3939	16098	4276	926	251	72	203	21	145	111	2	0	
	32489	4347	9366	5412	833	1644	273	203	104	51	74	1	7	
	40400	3790	14429	4414	2765	1144	189	16	13	2	2	9	6	
FRATRB														
	1985	1996												
	1	-1	0	1										
	3	15												
	25915	5281.644	4310.798	1509.202	448.289	267.927	24.519	28.316	21.824	14.702	17.803	5.407	9.495	20.04
	28611	4055.637	7070.781	1775.235	588.972	158.056	88.067	15.597	8.863	7.559	9.784	9.374	2.202	12.899
	28692	1309.565	7304.318	2025.032	244.229	96.101	35.404	16.628	4.304	3.556	1.984	1.952	1.712	1.974
	25208	1839.994	1960.061	5873.634	481.893	84.136	21.385	11.816	10.409	3.32	2.35	2.264	0.946	3.577
	25184	2628.746	3697.394	1719.062	1877.664	100.777	22.815	8.139	5.692	5.009	1.462	1.033	1.89	4.174
	21758	3750.51	2750.517	1559.397	339.298	323.542	36.389	16.576	6.929	7.272	6.91	1.845	2.421	5.76
	19840	1511.314	2738.521	778.045	392.695	136.431	68.053	11.595	5.888	6.71	6.085	3.881	1.997	5.904
	15656	821.481	1691.491	568.73	83.495	27.699	8.093	6.479	1.638	1.122	0.864	0.605	0.961	1.484
	19076	4523.532	2671.087	1442.443	130.891	10.284	10.704	7.578	11.747	4.14	1.816	2.522	1.699	3.592
	17316	1950.384	4007.201	1506.602	471.461	42.296	5.796	2.965	4.177	5.422	1.316	0.696	0.708	0.967
	17794	3438.61	1832.644	1009.722	247.143	76.84	26.504	14.65	15.325	14.338	24.514	5.067	1.533	3.271
	14811	811.191	3968.977	763.257	301.782	55.708	12.403	4.428	2.861	3.399	2.291	1.473	0.921	0.565

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Table 6.3.1 continued.

ENGGFS	1977	1996		
	1	1	0.5	0.75
	2	3		
	1	104.54	484.92	
	1	72.39	57.36	
	1	2.79	104.99	
	1	18.6	179.6	
	1	94.55	119.76	
	1	696.57	2121.11	
	1	4.18	547.22	
	1	2715.16	4643.56	
	1	210.52	2710.97	
	1	318.57	1708.74	
	1	24.94	225.12	
	1	84.74	786.6	
	1	68.73	178.41	
	1	580.69	872.71	
	1	202.96	426.47	
	1	16.14	94.23	
	1	183.42	1091.48	
	1	34.71	123.26	
	1	51.08	1366.47	
	1	298.02	296.65	
SCOGFS	1982	1996		
	1	1	0.5	0.75
	2	3		
	1	680	1370	
	1	500	370	
	1	8390	26470	
	1	50070	40140	
	1	3160	43180	
	1	170	1700	
	1	350	1430	
	1	290	1320	
	1	3130	4010	
	1	700	3180	
	1	310	1840	
	1	2010	7890	
	1	810	1390	
	1	270	13920	
	1	1630	4050	

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Table 6.4.1 SAITHE IN THE NORTH SEA : 1967-1996 : 24/9/97

CPUE data from file c:\ices\nsdem97\saiiveff.tun
Catch data for 30 years. 1967 to 1996. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
NORTRL	1987	1996	3	9	0	1
FRATRB	1987	1996	3	9	0	1
ENGGFS	1987	1996	2	3	0.5	0.75
SCOGFS	1987	1996	2	3	0.5	0.75

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 7

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 16 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.009	0	0.021	0.002	0.002	0.002	0.001	0.001	0.001	0.001
2	0.24	0.073	0.076	0.03	0.12	0.036	0.077	0.04	0.032	0.059
3	0.393	0.365	0.312	0.46	0.463	0.248	0.309	0.239	0.217	0.143
4	0.892	0.627	0.696	0.651	0.795	0.731	0.466	0.664	0.667	0.569
5	0.946	1.011	0.712	0.685	0.586	1.045	0.622	0.668	0.52	0.731
6	0.521	0.587	0.979	0.601	0.436	0.575	0.766	0.481	0.368	0.569
7	0.603	0.644	0.537	0.648	0.403	0.38	0.64	0.532	0.918	0.676
8	0.504	0.507	0.74	0.452	0.431	0.353	0.828	0.24	0.897	0.551
9	0.605	0.606	0.735	0.528	0.471	0.562	0.946	0.545	0.822	0.694

Table 6.4.1 continued
XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9
1987	9.92E+04	1.51E+05	9.82E+04	1.69E+05	2.17E+04	4.87E+03	2.52E+03	2.20E+03	1.58E+03
1988	1.69E+05	8.05E+04	9.72E+04	5.43E+04	5.68E+04	6.91E+03	2.37E+03	1.13E+03	1.09E+03
1989	1.98E+05	1.38E+05	6.13E+04	5.52E+04	2.37E+04	1.69E+04	3.14E+03	1.02E+03	5.56E+02
1990	1.41E+05	1.59E+05	1.05E+05	3.67E+04	2.25E+04	9.54E+03	5.20E+03	1.51E+03	3.98E+02
1991	2.24E+05	1.15E+05	1.26E+05	5.43E+04	1.57E+04	9.30E+03	4.28E+03	2.23E+03	7.85E+02
1992	1.39E+05	1.83E+05	8.36E+04	6.51E+04	2.01E+04	7.14E+03	4.93E+03	2.34E+03	1.18E+03
1993	2.34E+05	1.13E+05	1.44E+05	5.34E+04	2.57E+04	5.78E+03	3.29E+03	2.76E+03	1.35E+03
1994	1.27E+05	1.92E+05	8.58E+04	8.67E+04	2.74E+04	1.13E+04	2.20E+03	1.42E+03	9.86E+02
1995	1.79E+05	1.04E+05	1.51E+05	5.53E+04	3.66E+04	1.15E+04	5.71E+03	1.06E+03	9.14E+02
1996	2.50E+05	1.46E+05	8.26E+04	9.94E+04	2.32E+04	1.78E+04	6.53E+03	1.87E+03	3.53E+02

Estimated population abundance at 1st Jan 1997

0.00E+00	2.04E+05	1.13E+05	5.86E+04	4.61E+04	9.16E+03	8.24E+03	2.72E+03	8.81E+02

Taper weighted geometric mean of the VPA populations:

2.20E+05	1.76E+05	1.30E+05	7.41E+04	3.25E+04	1.42E+04	6.50E+03	3.01E+03	1.42E+03

Standard error of the weighted Log(VPA populations) :

0.4736	0.4796	0.5054	0.4935	0.5175	0.6905	0.7775	0.8343	0.892

1

Log catchability residuals.

Fleet : NORTRL

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	No data for this fleet at this age									
3	-0.14	0.19	-0.13	-0.25	0.49	0.03	0.08	0.14	-0.4	0
4	0.19	-0.5	-0.41	-0.47	0.01	0.24	-0.16	0.6	0.45	0.04
5	0.01	-0.44	-0.63	0.06	-0.39	0.56	0.17	0.3	0.12	0.24
6	-0.39	-0.95	-0.05	0.62	-0.46	0.4	1	-0.11	-0.35	0.29
7	-0.24	-0.07	0.31	-0.02	-0.96	-0.5	0.51	-0.09	0.94	0.12
8	-0.3	-0.15	0.83	-0.03	-1.68	-0.8	0.4	-1.03	0.82	-0.48
9	0.06	0.53	0.56	-0.33	-0.52	-0.44	0.8	0.5	0.64	-1.22

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

Age	4	5	6	7	8	9
Mean Log q	-12.2165	-12.0823	-12.397	-12.066	-12.066	-12.066
S.E(Log q)	0.3854	0.3718	0.5793	0.5277	0.8429	0.6646

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
3	0.5	1.557	12.43	0.55	10	0.27	-13.34

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.69	1.666	11.87	0.78	10	0.24	-12.22
5	1.23	-0.516	12.53	0.38	10	0.48	-12.08
6	0.98	0.044	12.33	0.37	10	0.6	-12.4
7	0.85	0.384	11.48	0.44	10	0.47	-12.07
8	-13.57	-1.566	-59.05	0	10	10.12	-12.31
9	0.59	1.833	9.81	0.71	10	0.34	-12.01

Table 6.4.1 continued
Fleet : FRATRB

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	No data for this fleet at this age									
3	-0.61	-0.19	0.56	0.52	-0.38	-0.38	0.42	0.26	0.16	-0.37
4	-0.3	-0.46	0.19	0.43	0.19	-0.27	0.08	0.18	-0.18	0.15
5	0.28	0.54	0.06	0.15	-0.13	-0.26	0.05	0.14	-0.64	-0.19
6	-0.01	0.48	1.11	-0.04	0.15	-0.84	-0.29	0.3	-0.45	-0.41
7	0.41	0.48	0.33	1.19	0.5	-1	-1.67	0.19	-0.03	-0.4
8	-0.5	-0.21	0.06	0.16	0.48	-1.5	-1.38	-1.49	0.59	-0.7
9	-0.88	-0.72	-0.37	0.74	-0.23	-0.95	-0.96	-1.66	0.11	-0.01

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

Age	4	5	6	7	8	9
Mean Log q	-12.6117	-12.3995	-12.909	-13.5599	-13.5599	-13.5599
S.E(Log q)	0.2823	0.3248	0.5501	0.8285	0.9285	0.8568

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
3	0.88	0.221	13.35	0.29	10	0.46	-13.61

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	1.3	-1.063	13.07	0.61	10	0.36	-12.61
5	0.79	0.831	11.94	0.67	10	0.26	-12.4
6	0.74	0.799	11.94	0.55	10	0.42	-12.91
7	1.37	-0.366	15.54	0.11	10	1.2	-13.56
8	-8.92	-1.654	-51.46	0	10	6.52	-14.01
9	24.3	-2.894	184.95	0	10	12.27	-14.05
1							

Fleet : ENGGFS

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	0.97	0.54	0.2	-1.93	-0.67	1.31	-0.53	0.54	0.79	-1.23
3	-0.16	0.32	0.21	0.3	-0.15	-0.36	0.03	-0.29	0.05	0.06
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	-0.95	-1.41	16.2	0.06	10	1.11	-7.16
3	0.38	2.079	9.16	0.58	10	0.25	-5.26

Table 6.4.1 continued
Fleet : SCOGFS

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	-2.39	-0.59	-1.48	2.85	0.43	-1.68	2.41	0.11	-1.39	1.73
3	-0.19	-0.26	0.15	0.12	-0.16	-0.04	0.05	-0.18	0.23	0.28
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	1.9	-0.375	-0.77	0.02	10	1.94	-5.2
3	0.43	2.321	7.98	0.67	10	0.21	-3.21
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1995

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	1	0	0	0	0	0	0
FRATRB	1	0	0	0	0	0	0
ENGGFS	1	0	0	0	0	0	0
SCOGFS	1	0	0	0	0	0	0
P shrinkage	176035	0.48				0.521	0.002
F shrinkage	239794	0.5				0.479	0.001

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
204136	0.35	12.23	2	35.329	0.001

1

Age 2 Catchability dependent on age and year class strength

Year class = 1994

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	1	0	0	0	0	0	0
FRATRB	1	0	0	0	0	0	0
ENGGFS	32881	1.23	0	0	1	0.071	0.191
SCOGFS	636298	2.132	0	0	1	0.024	0.011
P shrinkage	129559	0.51				0.448	0.052
F shrinkage	109462	0.5				0.457	0.061

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
112971	0.34	0.38	4	1.126	0.059

Table 6.4.1 continued

Age 3 Catchability dependent on age and year class strength

Year class = 1993

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	58736	0.3	0	0	1	0.234	0.143
FRATRB	40367	0.511	0	0	1	0.081	0.202
ENGGFS	64912	0.291	0.172	0.59	2	0.249	0.13
SCOGFS	75376	0.297	0.229	0.77	2	0.239	0.113
P shrinkag	74149	0.49				0.1	0.115
F shrinkag	26091	0.5				0.097	0.297

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
58645	0.15	0.13	8	0.899	0.143

1

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

Year class = 1992

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	36829	0.242	0.218	0.9	2	0.274	0.672
FRATRB	53589	0.26	0.006	0.02	2	0.258	0.506
ENGGFS	49749	0.291	0.113	0.39	2	0.173	0.536
SCOGFS	57655	0.297	0.017	0.06	2	0.166	0.477
F shrinkag	36922	0.5				0.129	0.671

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
46057	0.13	0.08	9	0.599	0.569

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

Year class = 1991

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	11865	0.223	0.08	0.36	3	0.297	0.605
FRATRB	7978	0.218	0.098	0.45	3	0.335	0.805
ENGGFS	6780	0.291	0.055	0.19	2	0.099	0.899
SCOGFS	7960	0.297	0.337	1.13	2	0.095	0.807
F shrinkag	9837	0.5				0.174	0.695

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
9156	0.14	0.08	11	0.562	0.731

Table 6.4.1.continued

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

Year class = 1990

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	10442	0.226	0.106	0.47	4	0.309	0.473
FRATRB	6172	0.219	0.221	1.01	4	0.346	0.705
ENGGFS	9054	0.292	0.278	0.95	2	0.074	0.53
SCOGFS	8408	0.297	0.24	0.81	2	0.072	0.561
F shrinkage	9061	0.5				0.199	0.529

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
8244	0.15	0.1	13	0.684	0.569

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

Year class = 1989

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	2790	0.228	0.109	0.48	5	0.334	0.663
FRATRB	2423	0.221	0.133	0.6	5	0.298	0.734
ENGGFS	1867	0.291	0.068	0.24	2	0.063	0.878
SCOGFS	2644	0.297	0.064	0.21	2	0.061	0.69
F shrinkage	3343	0.5				0.244	0.58

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
2717	0.16	0.07	15	0.427	0.676

1

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

Year class = 1988

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	1072	0.298	0.239	0.8	6	0.286	0.472
FRATRB	743	0.296	0.158	0.53	6	0.254	0.626
ENGGFS	693	0.292	0.38	1.3	2	0.027	0.659
SCOGFS	789	0.297	0.382	1.28	2	0.027	0.599
F shrinkage	873	0.5				0.406	0.555

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
881	0.23	0.09	17	0.404	0.551

Table 6.4.1 continued
Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1987

Fleet	Es St	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
NORTRL	95	0.381	0.352	0.92	7	0.271	0.926
FRATRB	153	0.429	0.112	0.26	7	0.189	0.664
ENGGFS	194	0.291	0.023	0.08	2	0.009	0.558
SCOGFS	158	0.297	0.217	0.73	2	0.008	0.649
F shrinkage	174	0.5				0.523	0.604

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
144	0.29	0.13	19	0.46	0.694

1
1

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Table 6.4.2 Fishing mortality (F) at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
1	0	0.0005	0.0001	0.0011	0.0029	0.0017	0.0182	0.0068	0.0017	0.0019
2	0.0793	0.012	0.006	0.0065	0.0645	0.1282	0.1935	0.0856	0.1638	0.2411
3	0.1619	0.2834	0.1162	0.1538	0.2804	0.3614	0.498	0.7142	0.4192	0.9287
4	0.2433	0.3096	0.2897	0.5043	0.3784	0.4461	0.5732	0.7384	0.6675	0.9994
5	0.3822	0.3602	0.2531	0.5353	0.4041	0.2788	0.3219	0.4273	0.4827	0.6743
6	0.5186	0.2561	0.3766	0.5522	0.2735	0.5271	0.2995	0.4669	0.4466	0.5661
7	0.3789	0.1216	0.4172	0.3387	0.3502	0.4369	0.3949	0.4855	0.6123	0.4157
8	0.2123	0.0589	0.4872	0.2172	0.407	0.4745	0.4094	0.3836	0.6554	0.5027
9	0.3724	0.1461	0.43	0.3718	0.3457	0.4831	0.3703	0.4486	0.5763	0.4987
+gp	0.3724	0.1461	0.43	0.3718	0.3457	0.4831	0.3703	0.4486	0.5763	0.4987
0 FBAR 3-	0.3265	0.3023	0.2589	0.4364	0.3341	0.4033	0.4231	0.5867	0.504	0.7921

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
1	0.0176	0.0129	0.0038	0.0087	0.0311	0.0067	0.0006	0.0002	0.0016	0.0005
2	0.1326	0.1956	0.2475	0.1245	0.1656	0.2295	0.151	0.1032	0.0247	0.0579
3	0.2787	0.538	0.2638	0.3415	0.1698	0.4026	0.3017	0.6123	0.6874	0.2307
4	0.6726	0.558	0.4557	0.3421	0.2528	0.503	0.5062	0.7944	1.2709	1.4923
5	0.7872	0.4715	0.4574	0.6004	0.3132	0.5764	0.7254	0.7783	0.8883	1.139
6	0.8311	0.3458	0.4316	0.5618	0.5002	0.5027	0.8879	1.0154	0.5479	0.8892
7	0.8736	0.3321	0.6352	0.5589	0.6032	0.5577	1.0382	0.6604	0.5412	0.4939
8	0.8701	0.5419	0.3962	0.5534	0.8189	0.5256	1.1726	0.8346	0.5401	0.4482
9	0.8673	0.4094	0.4915	0.5627	0.6466	0.533	1.0449	0.8456	0.5476	0.6158
+gp	0.8673	0.4094	0.4915	0.5627	0.6466	0.533	1.0449	0.8456	0.5476	0.6158
0 FBAR 3-	0.6424	0.4783	0.4021	0.4615	0.309	0.4962	0.6053	0.8001	0.8486	0.9378

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	FBAR 94-96
AGE											
1	0.0088	0.0001	0.0205	0.0023	0.0017	0.0023	0.0007	0.0009	0.0006	0.0014	0.001
2	0.2401	0.0734	0.0757	0.0299	0.1199	0.0361	0.0769	0.0398	0.0324	0.0593	0.0439
3	0.3933	0.3647	0.3123	0.46	0.4625	0.2483	0.3094	0.2391	0.2168	0.1431	0.1997
4	0.8916	0.6274	0.696	0.6508	0.7952	0.7308	0.4657	0.6638	0.6674	0.5688	0.6333
5	0.9463	1.0113	0.7117	0.6852	0.5864	1.0451	0.6222	0.6683	0.5199	0.7314	0.6399
6	0.5212	0.5871	0.9787	0.6006	0.4358	0.5751	0.7663	0.4809	0.3676	0.5693	0.4726
7	0.6029	0.6438	0.5366	0.6484	0.4034	0.3799	0.6404	0.5323	0.9185	0.6763	0.709
8	0.5039	0.5069	0.7395	0.4518	0.4311	0.3532	0.8284	0.24	0.897	0.5508	0.5626
9	0.6055	0.6059	0.7348	0.5276	0.471	0.562	0.9459	0.5448	0.8222	0.6941	0.687
+gp	0.6055	0.6059	0.7348	0.5276	0.471	0.562	0.9459	0.5448	0.8222	0.6941	
0 FBAR 3-	0.6881	0.6476	0.6747	0.5991	0.57	0.6498	0.5409	0.513	0.4429	0.5032	

Table 6.4.3 Stock number at age (start of year) Numbers*10**-3

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	1	429603	400311	464404	233131	227092	240327	270648	645422	197806	140378
	2	123084	351729	327592	380189	190660	185390	196420	217592	524856	161668
	3	112928	93086	284549	266613	309256	146351	133517	132517	163536	364779
	4	68238	78634	57402	207405	187165	191285	83482	66436	53118	88042
	5	47304	43803	47239	35177	102556	104966	100249	38530	25983	22311
	6	5558	26426	25016	30027	16862	56055	65030	59485	20577	13134
	7	3997	2709	16748	14055	14152	10502	27092	39463	30533	10779
	8	1158	2241	1964	9035	8201	8164	5555	14944	19883	13552
	9	548	766	1729	988	5953	4470	4159	3020	8338	8452
	+gp	381	705	248	510	2011	4127	6827	3315	5856	5930
0	TOTA	792799	1000411	1226892	1177130	1063909	951637	892978	1220725	1050496	829023

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	1	127638	104701	267283	162306	191903	318075	474778	398017	155552	184380
	2	114719	102678	84623	218013	131730	152313	258670	388471	325816	127150
	3	104010	82259	69133	54094	157596	91388	99130	182104	286877	260248
	4	117988	64444	39324	43478	31476	108881	50025	60021	80824	118113
	5	26534	49304	30200	20413	25282	20014	53904	24689	22205	18568
	6	9307	9887	25192	15649	9168	15133	9207	21367	9282	7478
	7	6105	3319	5728	13395	7305	4552	7495	3102	6337	4393
	8	5823	2087	1949	2485	6271	3272	2134	2173	1312	3020
	9	6712	1997	994	1074	1170	2264	1584	541	772	626
	+gp	7090	7060	3756	3774	4272	2103	1371	928	1345	1318
0	TOTA	525925	427736	528182	534679	566174	717996	958298	1081412	890321	725294

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	GMST 67-94	AMST 67-94
	AGE													
	1	99228	169006	198137	140860	223555	138593	234145	127472	178942	249691	0	220436	248741
	2	150877	80530	138361	158926	115063	182729	113208	191576	104273	146417	204136	180543	203380
	3	98241	97158	61265	105024	126281	83564	144299	85830	150731	82646	112971	130946	149844
	4	169174	54278	55238	36705	54284	65104	53372	86706	55327	99350	58645	74149	84666
	5	21743	56788	23731	22547	15675	20067	25666	27430	36550	23240	46057	32773	38317
	6	4867	6910	16912	9536	9304	7140	5777	11279	11512	17792	9156	14178	18627
	7	2516	2366	3145	5203	4282	4926	3289	2198	5709	6526	8244	6532	9275
	8	2195	1127	1017	1506	2227	2342	2759	1419	1057	1866	2717	3181	4636
	9	1579	1086	556	398	785	1185	1347	986	914	353	881	1520	2288
	+gp	1161	843	639	548	703	832	1625	1775	1235	685	424		
0	TOTA	551581	470092	499001	481251	552159	506481	585487	536672	546251	628565	443231		

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Table 6.5.1 North Sea Saithe : RCT3 input : Age 1

6	24	2					
'YEARCLASS'	'VPA'	'EGFS2'	'EGFS3'	'SGFS2'	'SGFS3'	'NORW0'	'IBQ13'
1974	198	-1	484.92	-1	-1	-1	-1
1975	140	104.54	57.36	-1	-1	-1	-1
1976	128	72.39	104.99	-1	-1	-1	-1
1977	105	2.79	179.6	-1	-1	-1	-1
1978	267	18.6	119.76	-1	-1	-1	-1
1979	162	94.55	2121.11	-1	1370	-1	-1
1980	192	696.57	547.22	680	370	-1	-1
1981	318	4.18	4643.56	500	26470	54	10
1982	475	2715.16	2710.97	8390	40140	76	3130
1983	398	210.52	1708.74	50070	43180	50	7820
1984	156	318.57	225.12	3160	1700	51	80
1985	184	24.94	786.6	170	1430	57	150
1986	99	84.74	178.41	350	1320	23	220
1987	169	68.73	872.71	290	4010	51	20
1988	198	580.69	426.47	3130	3180	43	550
1989	141	202.96	94.23	700	1840	39	60
1990	224	16.14	1091.48	310	7890	60	60
1991	139	183.42	123.26	2010	1390	73	410
1992	234	34.71	1366.47	810	13920	66	60
1993	127	51.08	296.65	270	4050	64	200
1994	-1	298.02	490.5	1630	3670	60	0
1995	-1	113.3	-1	200	-1	66	-1
1996	-1	-1	-1	-1	-1	47	-1
1997	-1	-1	-1	-1	-1	40	-1

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Table 6.5.2 Analysis by RCT3 ver3.1 of data from file :

c:\ices\nsdem97\sairct1.txt
North Sea Saithe : RCT3 input : Age 1, 07.10.97
Data for 6 surveys over 24 years : 1974 - 1997
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1994

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
EGFS2	1.14	.18	1.88	.051	19	5.70	6.66	2.067	.011
EGFS3	.47	2.35	.44	.486	20	6.20	5.27	.472	.207
SGFS2	.47	2.01	.63	.346	14	7.40	5.50	.704	.093
SGFS3	.37	2.18	.33	.647	15	8.21	5.25	.362	.353
NORW0	3.10	-7.04	.87	.232	13	4.11	5.71	.987	.048
IBQ13	.64	1.99	1.14	.149	13	.00	1.99	1.629	.017
					VPA Mean =		5.23	.414	.271

Yearclass = 1995

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
EGFS2	1.14	.18	1.88	.051	19	4.74	5.57	2.038	.027
EGFS3									
SGFS2	.47	2.01	.63	.346	14	5.30	4.51	.730	.210
SGFS3									
NORW0	3.10	-7.04	.87	.232	13	4.20	6.01	1.000	.112
IBQ13									
					VPA Mean =		5.23	.414	.652

Yearclass = 1996

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	3.10	-7.04	.87	.232	13	3.87	4.97	.984	.150
IBQ13									
					VPA Mean =		5.23	.414	.850

Yearclass = 1997

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	3.10	-7.04	.87	.232	13	3.71	4.48	1.007	.144
IBQ13									
					VPA Mean =		5.23	.414	.856

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1994	190	5.25	.22	.19	.80		
1995	176	5.17	.33	.24	.53		
1996	179	5.19	.38	.09	.06		
1997	167	5.12	.38	.26	.47		

Table 6.5.2 continued Analysis by RCT3 ver3.1 of data from file :

c:\ices\nsdem97\sairct2.txt
North Sea Saithe : RCT3 input : Age 2, 07.10.97
Data for 6 surveys over 24 years : 1974 - 1997
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

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
EGFS2	1.17	-.19	1.94	.048	19	5.70	6.51	2.138	.010
EGFS3	.47	2.14	.44	.486	20	6.20	5.07	.473	.202
SGFS2	.47	1.79	.63	.344	14	7.40	5.29	.708	.090
SGFS3	.37	2.01	.32	.663	15	8.21	5.04	.350	.370
NORW0	3.10	-7.22	.87	.233	13	4.11	5.51	.983	.047
IBQ13	.64	1.78	1.14	.149	13	.00	1.78	1.632	.017
					VPA Mean =		5.02	.414	.264

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
EGFS2	1.17	-.19	1.94	.048	19	4.74	5.38	2.107	.025
EGFS3									
SGFS2	.47	1.79	.63	.344	14	5.30	4.30	.734	.208
SGFS3									
NORW0	3.10	-7.22	.87	.233	13	4.20	5.80	.997	.113
IBQ13									
					VPA Mean =		5.02	.414	.653

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	3.10	-7.22	.87	.233	13	3.87	4.77	.981	.152
IBQ13									
					VPA Mean =		5.02	.414	.848

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	3.10	-7.22	.87	.233	13	3.71	4.28	1.004	.146
IBQ13									
					VPA Mean =		5.02	.414	.854

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1994	155	5.05	.21	.19	.80		
1995	144	4.97	.33	.24	.53		
1996	146	4.99	.38	.09	.06		
1997	136	4.92	.38	.26	.47		

Table 6.6.1 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1967	429603	416346	125016	78480	0.6278	0.3265
1968	400311	919499	182929	104002	0.5685	0.3023
1969	464404	1017980	228170	114758	0.5029	0.2589
1970	233131	1167146	268534	222100	0.8271	0.4364
1971	227092	1152354	375940	252618	0.672	0.3341
1972	240327	949842	412226	245879	0.5965	0.4033
1973	270648	839870	453306	225770	0.4981	0.4231
1974	645422	994118	468276	273466	0.584	0.5867
1975	197806	939759	402605	278126	0.6908	0.504
1976	140378	784470	271082	319933	1.1802	0.7921
1977	127638	535888	211620	196185	0.9271	0.6424
1978	104701	457296	197286	134829	0.6834	0.4783
1979	267283	496038	191469	114363	0.5973	0.4021
1980	162306	453956	188202	120293	0.6392	0.4615
1981	191903	546707	195990	122518	0.6251	0.309
1982	318075	585514	166440	165977	0.9972	0.4962
1983	474778	694827	171935	168884	0.9823	0.6053
1984	398017	640170	136209	198001	1.4537	0.8001
1985	155552	580604	106750	199534	1.8692	0.8486
1986	184380	545544	97278	162873	1.6743	0.9378
1987	99228	396482	98847	149407	1.5115	0.6881
1988	169006	364985	104199	106599	1.023	0.6476
1989	198137	388389	87027	92032	1.0575	0.6747
1990	140860	360861	80416	88080	1.0953	0.5991
1991	223555	401553	80700	98553	1.2212	0.57
1992	138593	441737	86968	92499	1.0636	0.6498
1993	234145	452109	93494	104606	1.1189	0.5409
1994	127472	447884	104294	102593	0.9837	0.513
1995	178942	531347	121591	113560	0.934	0.4429
1996	176000*	447558	119622	110264	0.9218	0.5032
Arith. Mean	246446	631694	194281	158559	0.9376	0.5393
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

* RCT3 estimate

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Table 6.7.1.Saithe,North Sea
Input data for catch forecast and linear sensitivity analysis.

Populations in 1997			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	178999	.38	WS1	.35	.41	M1	.20	.10	MT1	.00	.00
N2	144000	.33	WS2	.65	.24	M2	.20	.10	MT2	.00	.00
N3	112971	.38	WS3	.96	.06	M3	.20	.10	MT3	.00	.10
N4	58644	.15	WS4	1.19	.07	M4	.20	.10	MT4	.15	.10
N5	46057	.13	WS5	1.71	.07	M5	.20	.10	MT5	.70	.10
N6	9154	.14	WS6	2.42	.04	M6	.20	.10	MT6	.90	.10
N7	8244	.15	WS7	3.32	.11	M7	.20	.10	MT7	1.00	.10
N8	2716	.16	WS8	4.66	.01	M8	.20	.10	MT8	1.00	.00
N9	880	.23	WS9	5.85	.13	M9	.20	.10	MT9	1.00	.00
N10	424	.29	WS10	8.01	.05	M10	.20	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.38	WH1	.35	.41
sH2	.05	.28	WH2	.65	.24
sH3	.21	.27	WH3	.96	.06
sH4	.66	.14	WH4	1.19	.07
sH5	.66	.11	WH5	1.71	.07
sH6	.49	.16	WH6	2.42	.04
sH7	.73	.36	WH7	3.32	.11
sH8	.58	.66	WH8	4.66	.01
sH9	.71	.28	WH9	5.85	.13
sH10	.71	.28	WH10	8.01	.05

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K97	1.00	.10	HF97	1.00	.08
K98	1.00	.10	HF98	1.00	.08
K99	1.00	.10	HF99	1.00	.08

Recruitment		
Labl	Value	CV
R98	167000	.38
R99	186999	.41

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

Stock numbers in 1997 are VPA survivors.
These are overwritten at Age 1 Age 2

Table 6.7.2 Saithe,North Sea
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 1997	1998						
Mean F Ages H.cons 3 to 6	.50	.00	.10	.20	.30	.40	.50	.60
Effort relative to 1996 H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Biomass at start of year								
Total	484	483	483	483	483	483	483	483
Spawning	134	128	128	128	128	128	128	128
Catch weight (,000t) H.cons	118	0	28	54	77	97	116	133
Biomass at start of 1999								
Total		631	596	565	537	511	489	468
Spawning		232	207	184	164	146	130	116

	Year 1997	1998						
Effort relative to 1996 H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.14	.16	.16	.16	.16	.16	.16	.16
Spawning	.09	.12	.12	.12	.12	.12	.12	.12
Catch weight H.cons	.13	.00	.41	.24	.20	.18	.17	.16
Biomass at start of 1999								
Total		.15	.15	.16	.16	.16	.17	.17
Spawning		.16	.16	.17	.17	.17	.17	.18

Table 6.7.3 Saithe,North Sea
Detailed forecast tables.

Forecast for year 1997
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	179000	162	162
2	144000	5747	5747
3	112971	19211	19211
4	58645	25820	25820
5	46057	20433	20433
6	9155	3235	3235
7	8244	3933	3933
8	2717	1097	1097
9	881	411	411
10	424	198	198
Wt	484	118	118

Forecast for year 1998
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	167000	151	151
2	146406	5843	5843
3	112709	19167	19167
4	75198	33108	33108
5	24941	11065	11065
6	19451	6874	6874
7	4597	2193	2193
8	3240	1308	1308
9	1243	580	580
10	525	245	245
Wt	483	116	116

Table 6.8.1 Saithe in the North Sea. Model parameters for stock-recruitment

```
Data read from file finrecru.prn

Shepherd curve
Moving average term NOT fitted

IFAIL on exit from E04FDF =,   5

Residual sum of squares=,    5.3525

Number of observations=,  28

Number of parameters  =,   3

Residual mean square  =,     .2141

Coefficient of determination =,      .1099

Adj. coeff. of determination =,      .0387

IFAIL from E04YCF=,  0

Parameter  Correlation matrix

,  1.0000,
,  -.9931,  1.0000,
,  -.9394,   .9580,  1.0000,


 Parameter,s.d.

   2.8199,    2.2612,
 159.1284,  203.4846,
   1.3732,     .8988,
```

Table 6.11.1

The SAS System 08:19 Monday, October 13, 1997

Saithe in the North Sea Area (Fishing Areas IV and IIIa)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.2000	0.0000	0.0000	0.0000	0.349	0.0010	0.349
2	.	0.2000	0.0000	0.0000	0.0000	0.647	0.0450	0.647
3	.	0.2000	0.0000	0.0000	0.0000	0.961	0.2070	0.961
4	.	0.2000	0.1500	0.0000	0.0000	1.192	0.6550	1.192
5	.	0.2000	0.7000	0.0000	0.0000	1.711	0.6620	1.711
6	.	0.2000	0.9000	0.0000	0.0000	2.421	0.4890	2.421
7	.	0.2000	1.0000	0.0000	0.0000	3.323	0.7340	3.323
8	.	0.2000	1.0000	0.0000	0.0000	4.665	0.5820	4.665
9	.	0.2000	1.0000	0.0000	0.0000	5.854	0.7110	5.854
10+	.	0.2000	1.0000	0.0000	0.0000	8.010	0.7110	8.010
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDCMM02
Date and time: 13OCT97:08:31

Table 6.11.2

The SAS System 08:19 Monday, October 13, 1997

Saithe in the North Sea Area (Fishing Areas IV and IIIa)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	14473.711	2.390	12075.541	2.390	12075.541
0.2000	0.1007	0.236	687.810	4.343	7370.824	1.278	5068.378	1.278	5068.378
0.4000	0.2013	0.340	761.922	3.830	4906.325	0.819	2685.371	0.819	2685.371
0.6000	0.3020	0.399	739.348	3.537	3766.931	0.573	1616.102	0.573	1616.102
0.8000	0.4026	0.439	706.197	3.344	3147.741	0.423	1057.886	0.423	1057.886
1.0000	0.5033	0.467	678.238	3.207	2772.043	0.325	735.738	0.325	735.738
1.2000	0.6039	0.489	656.941	3.104	2524.604	0.256	535.774	0.256	535.774
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDCMM02
Date and time : 13OCT97:08:31
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.2226
F-max factor : 0.3969
F-0.1 reference F : 0.1120
F-max reference F : 0.1997
Recruitment : Single recruit

Figure 6.1.1 : Saithe in North Sea and Division IIIa

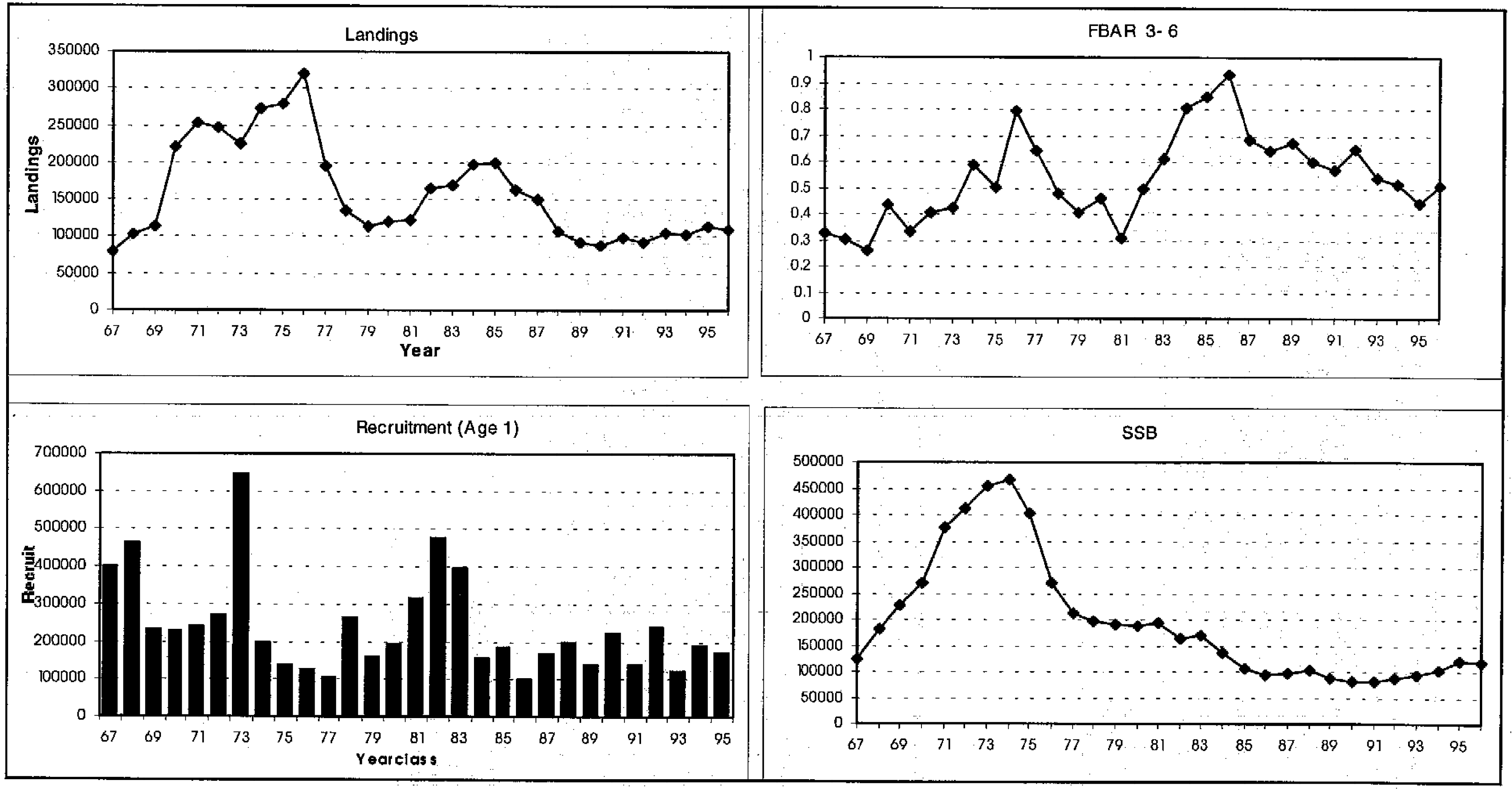

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Figure 6.4.1 Saithe in the North Sea. q residuals by fleet

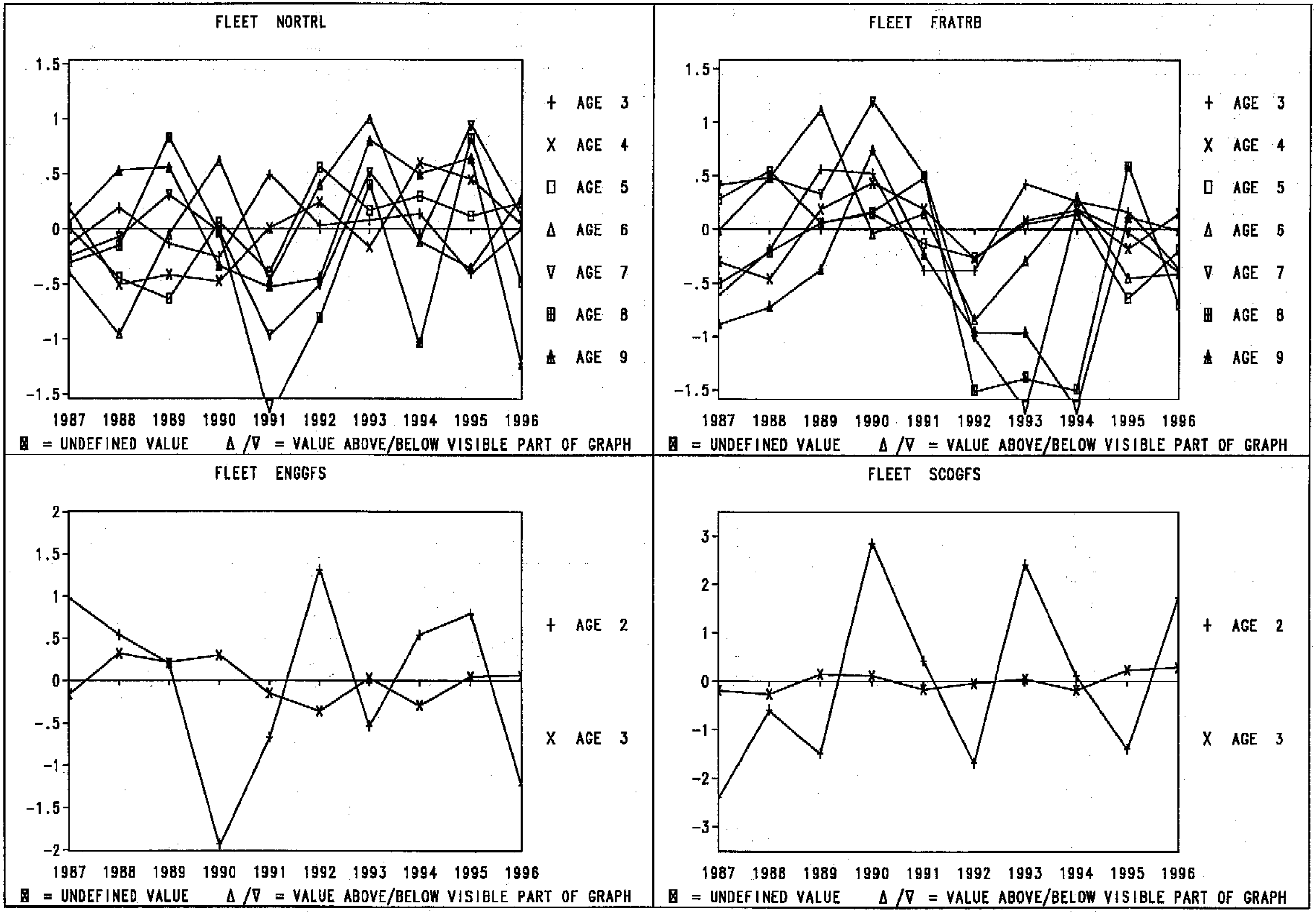
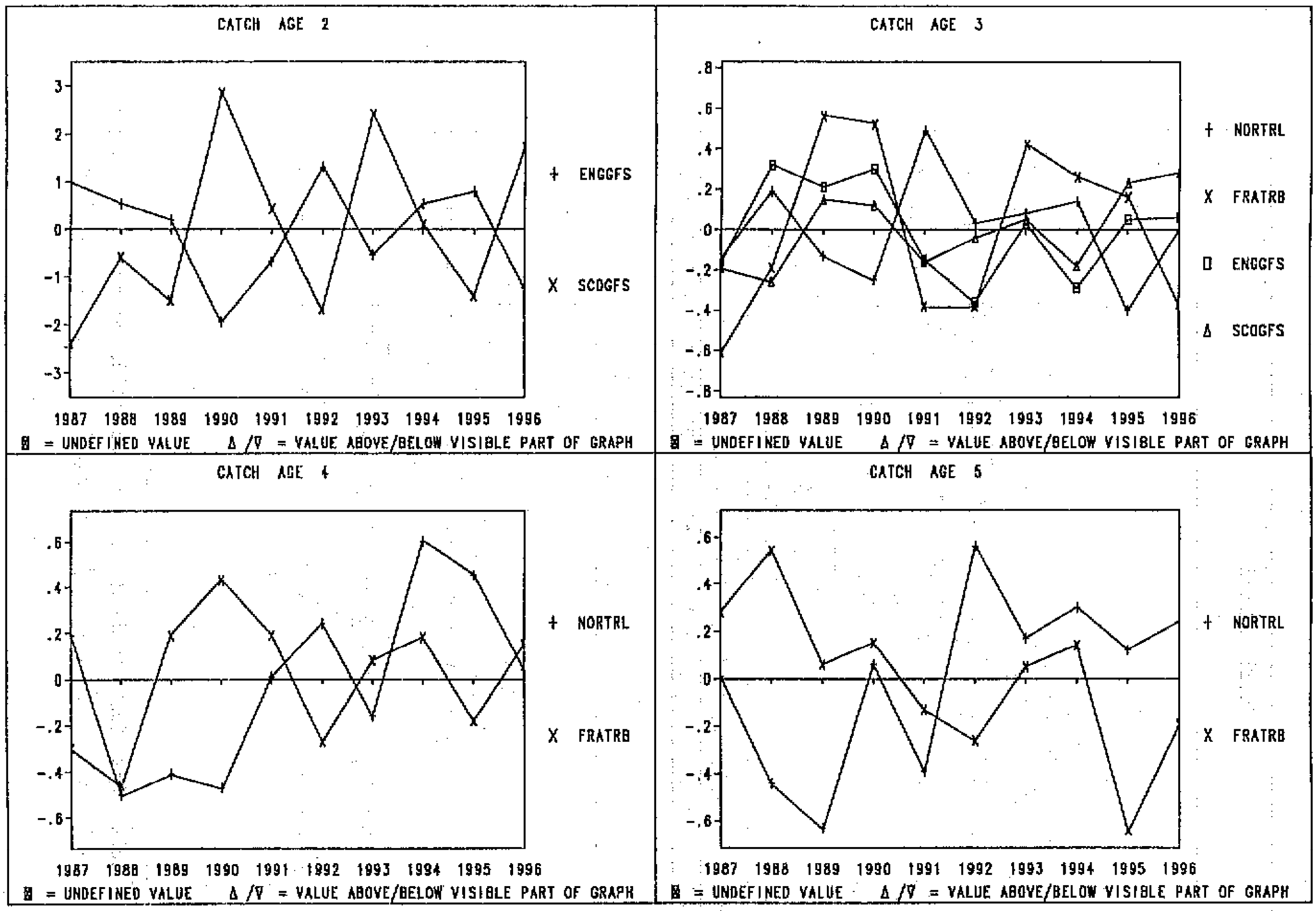


Figure 6.4.1 (Continued). q residuals by age



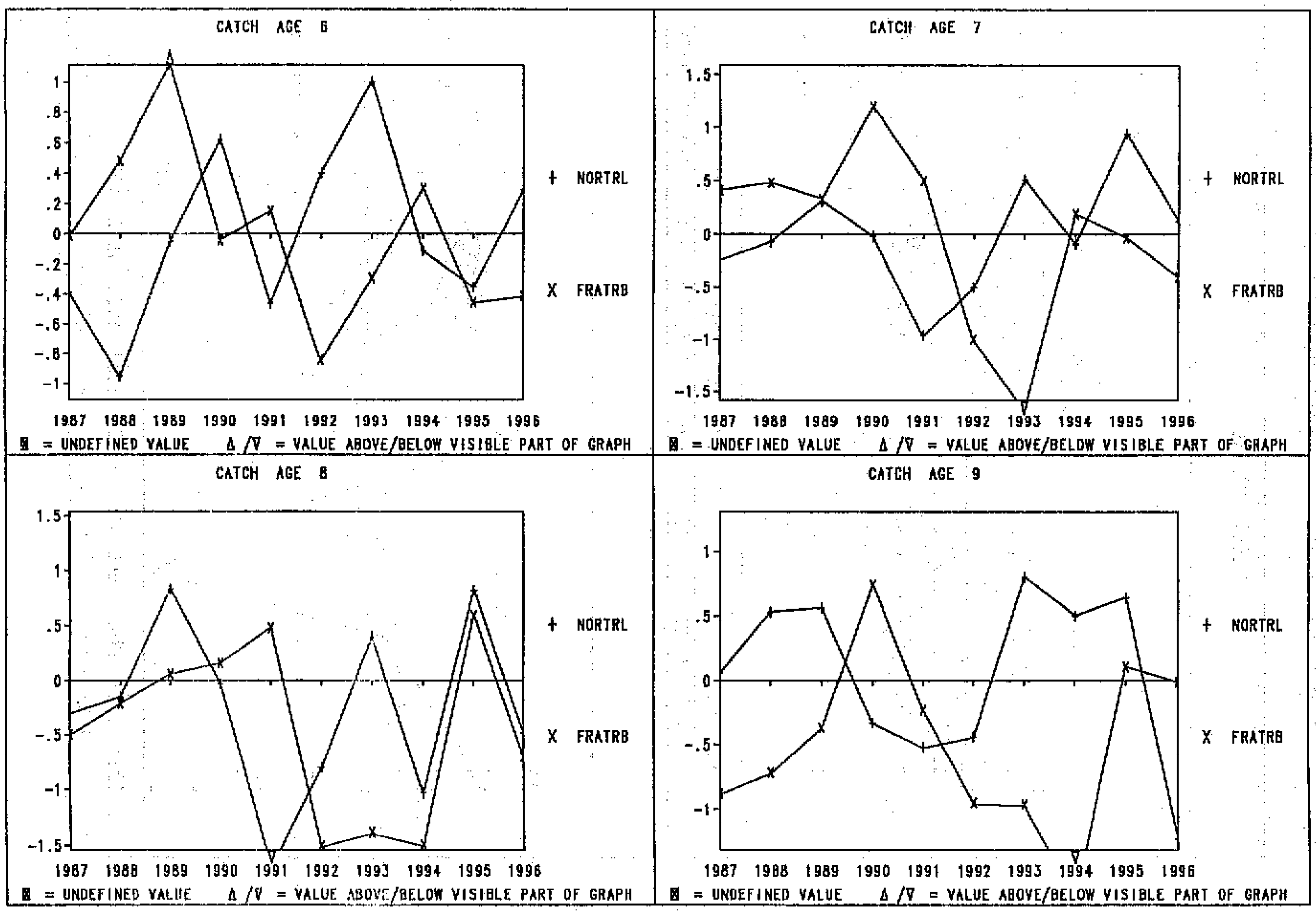


Figure 6.4.2 : Saithe IV, fleets weights in XSA

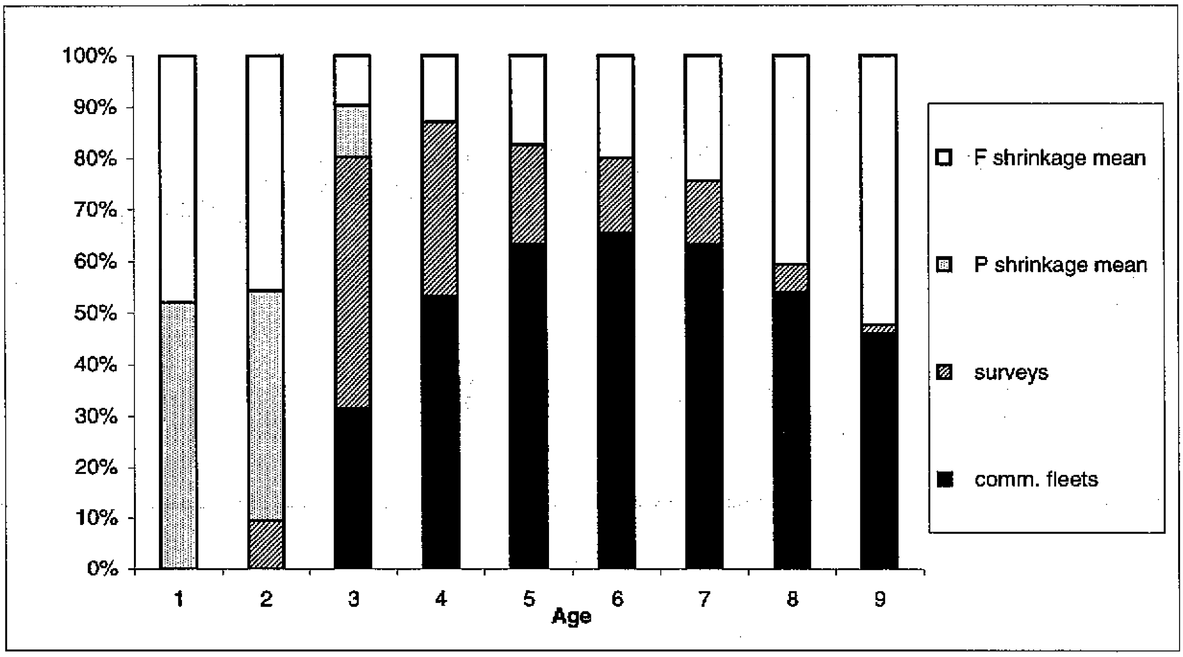


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Figure 6.4.3 Saithe North Sea. Retrospective analysis

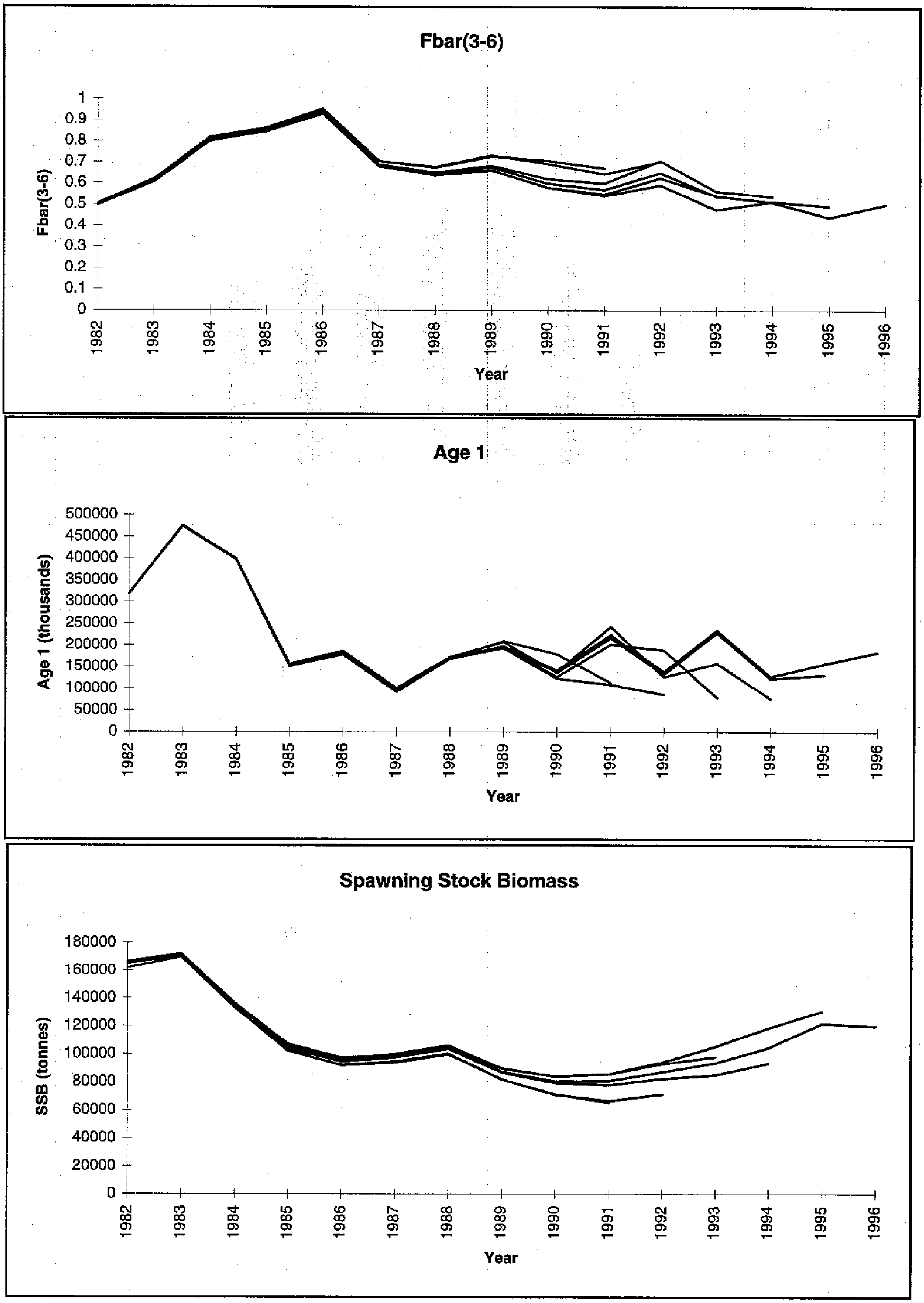

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Figure 6.5.1 Saithe in the North Sea. Survey indices versus VPA estimates

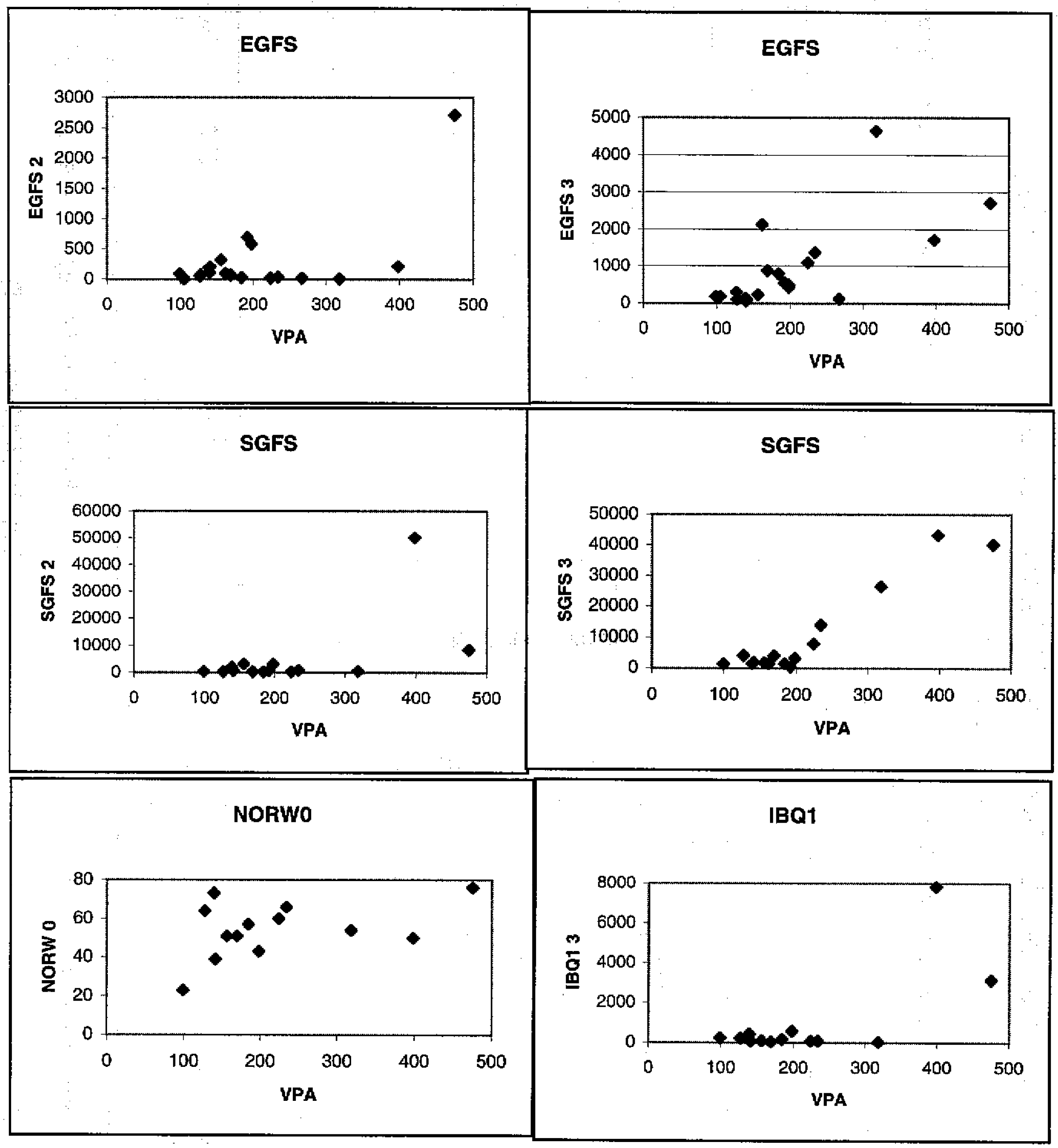

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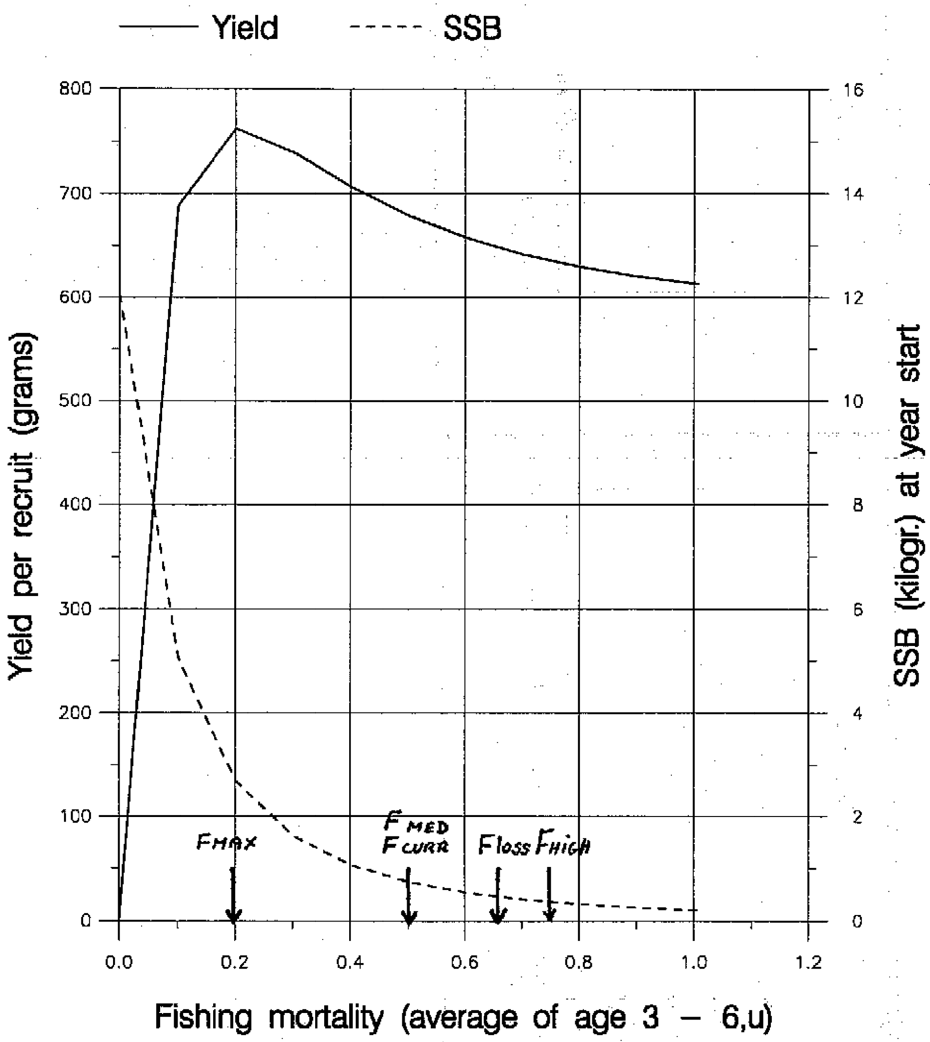
Figure 6.7.1

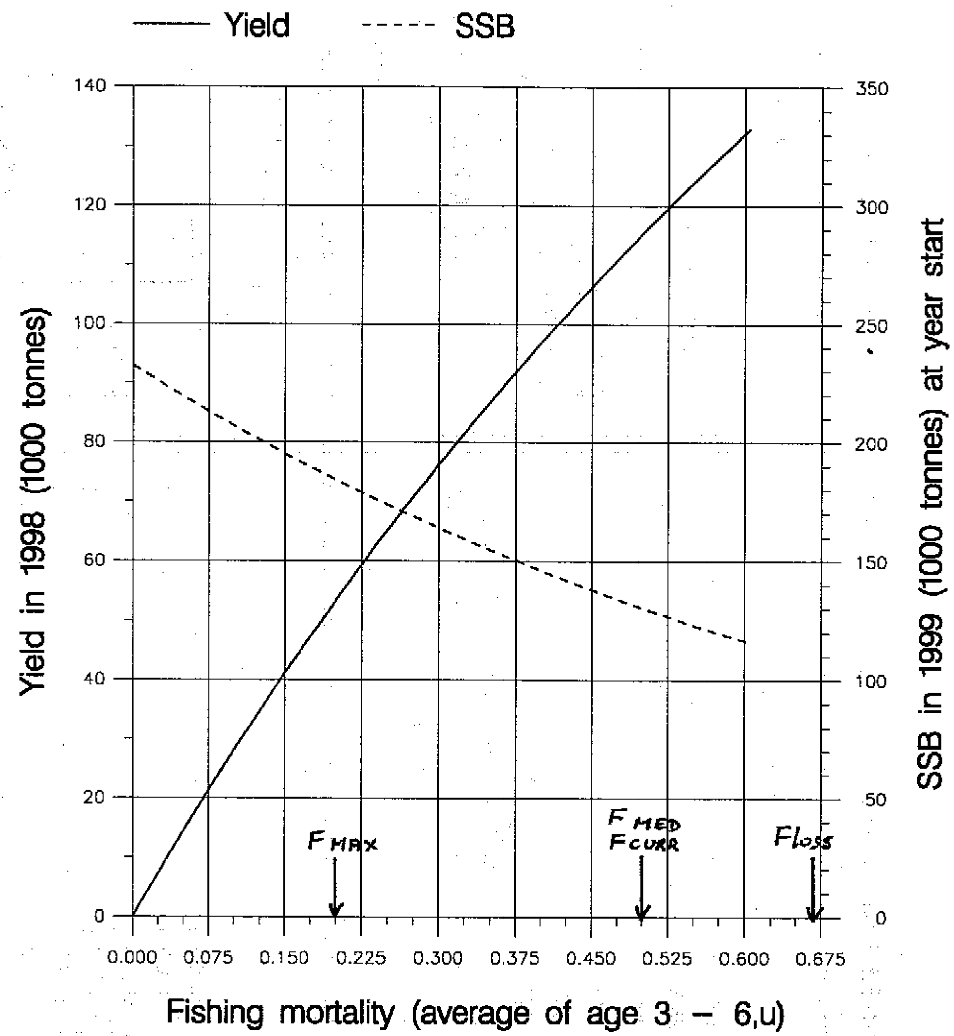
Fish Stock Summary
Saithe in the North Sea Area (Fishing Areas IV and IIIa)
14 – 10 – 1997

Long term yield and spawning stock biomass



(run: YLDCMM02) C

Short term yield and spawning stock biomass



(run: MANCMM02) D

Figure 6.7.2 Saithe, North Sea. Sensitivity analysis of short term forecast.

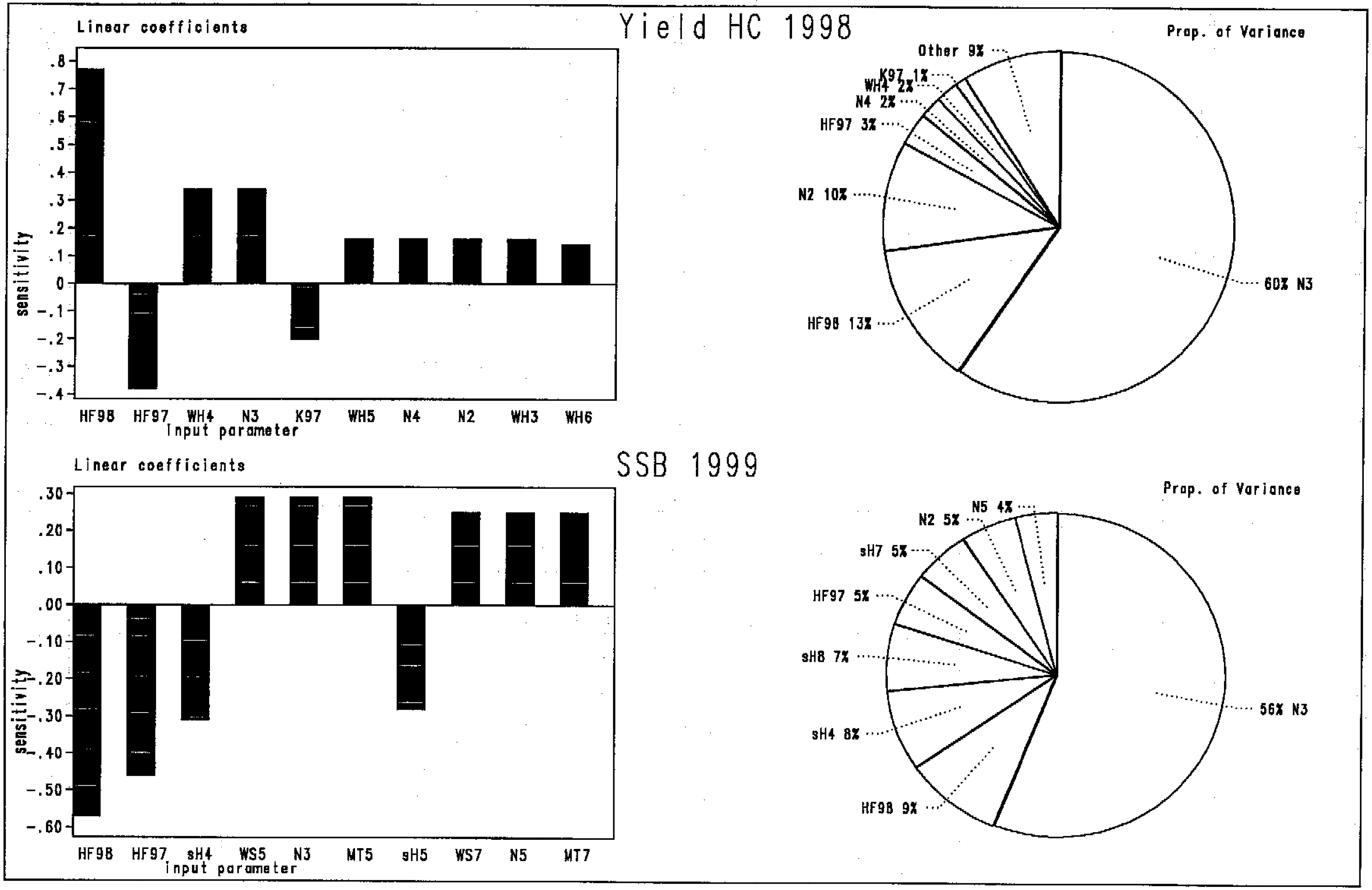


Figure 6.7.3 Saithe,North Sea. Probability profiles for short term forecast.

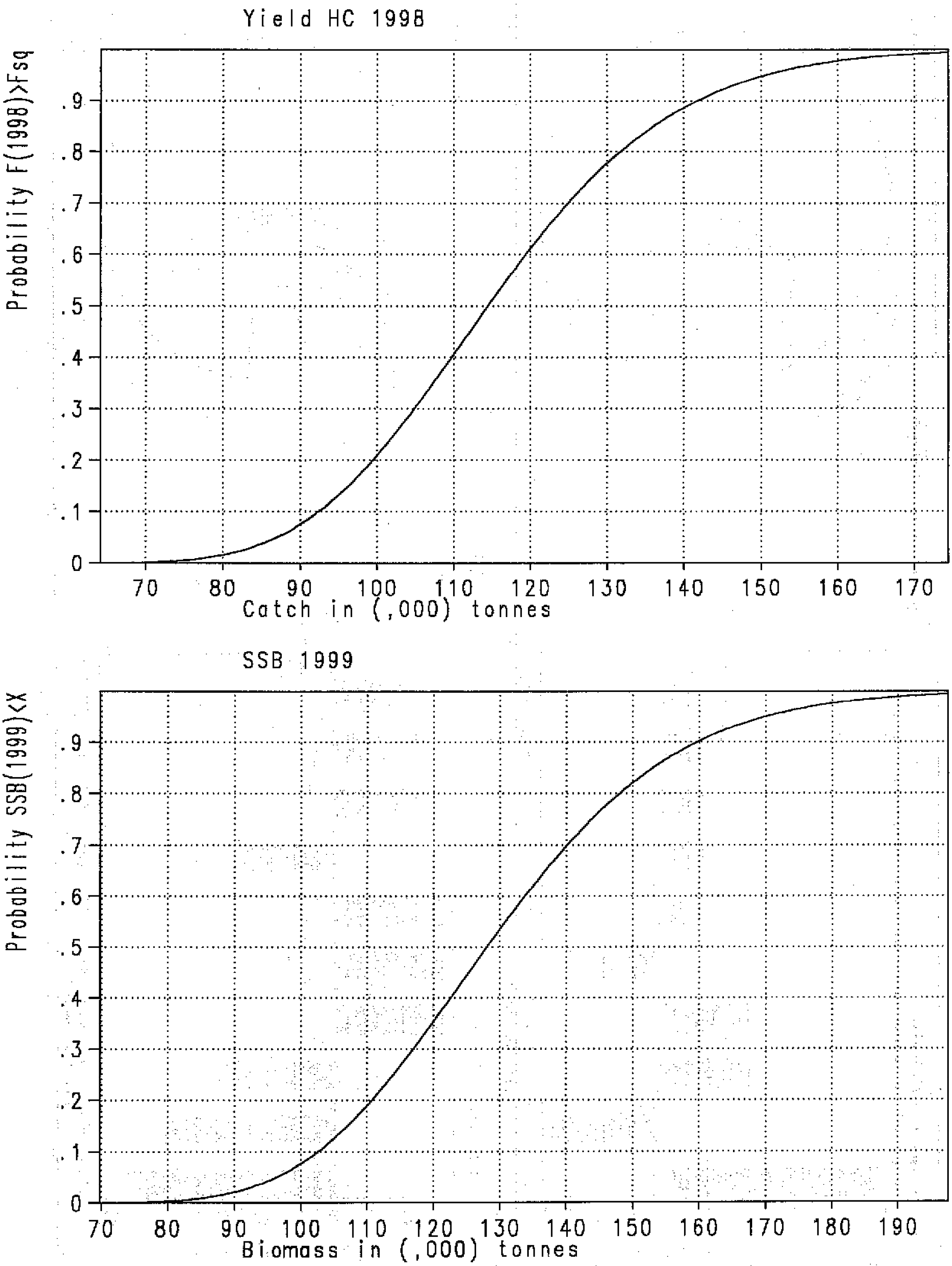


Figure 6.8.1. Saithe North Sea. Medium Term predictions. Status quo Fishing mortality. Solid lines show 5, 25, 50, 75, 95 %.
Number of simulations : 500 Model used : Sheperd

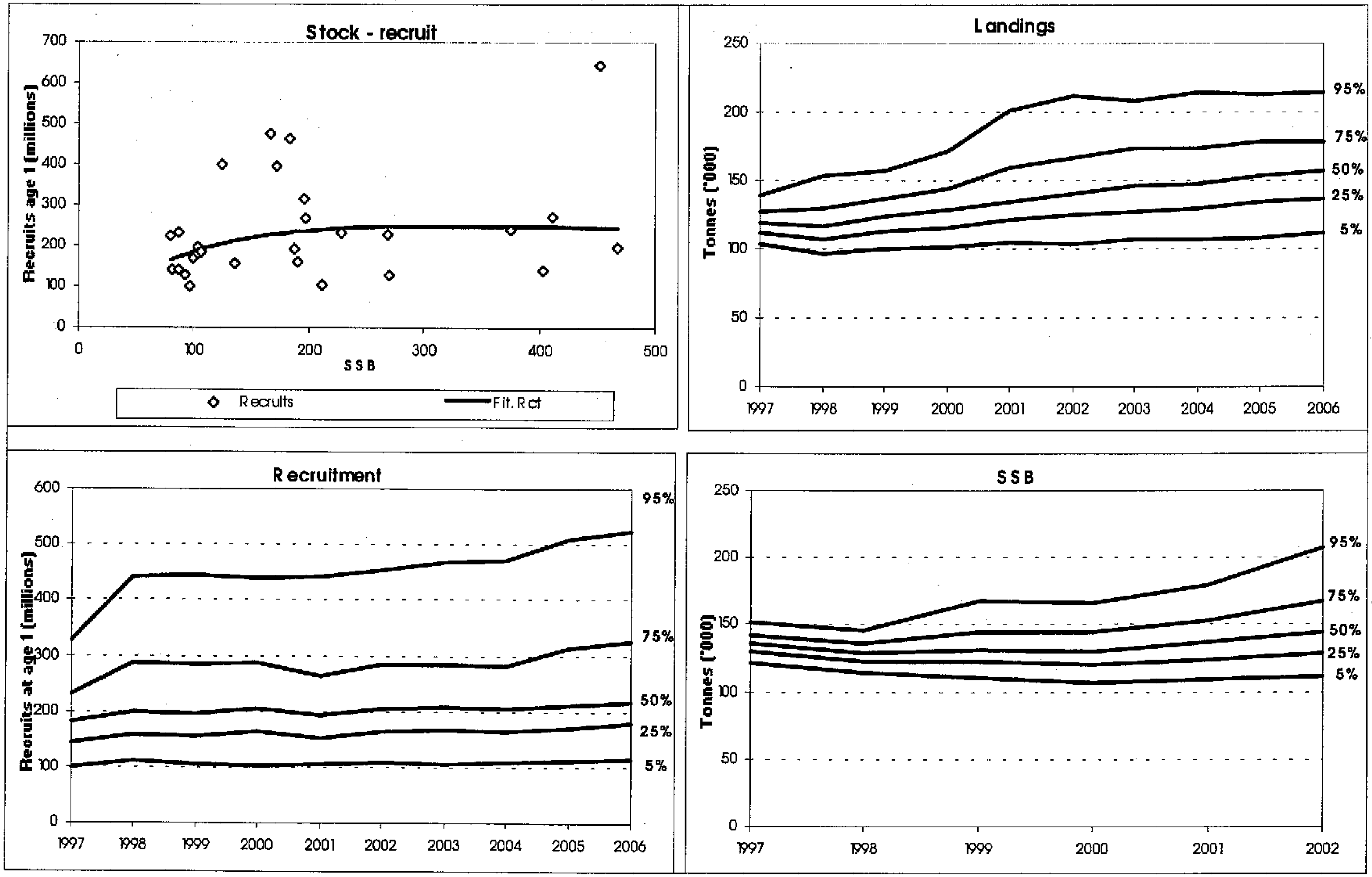


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Figure 6.9.1

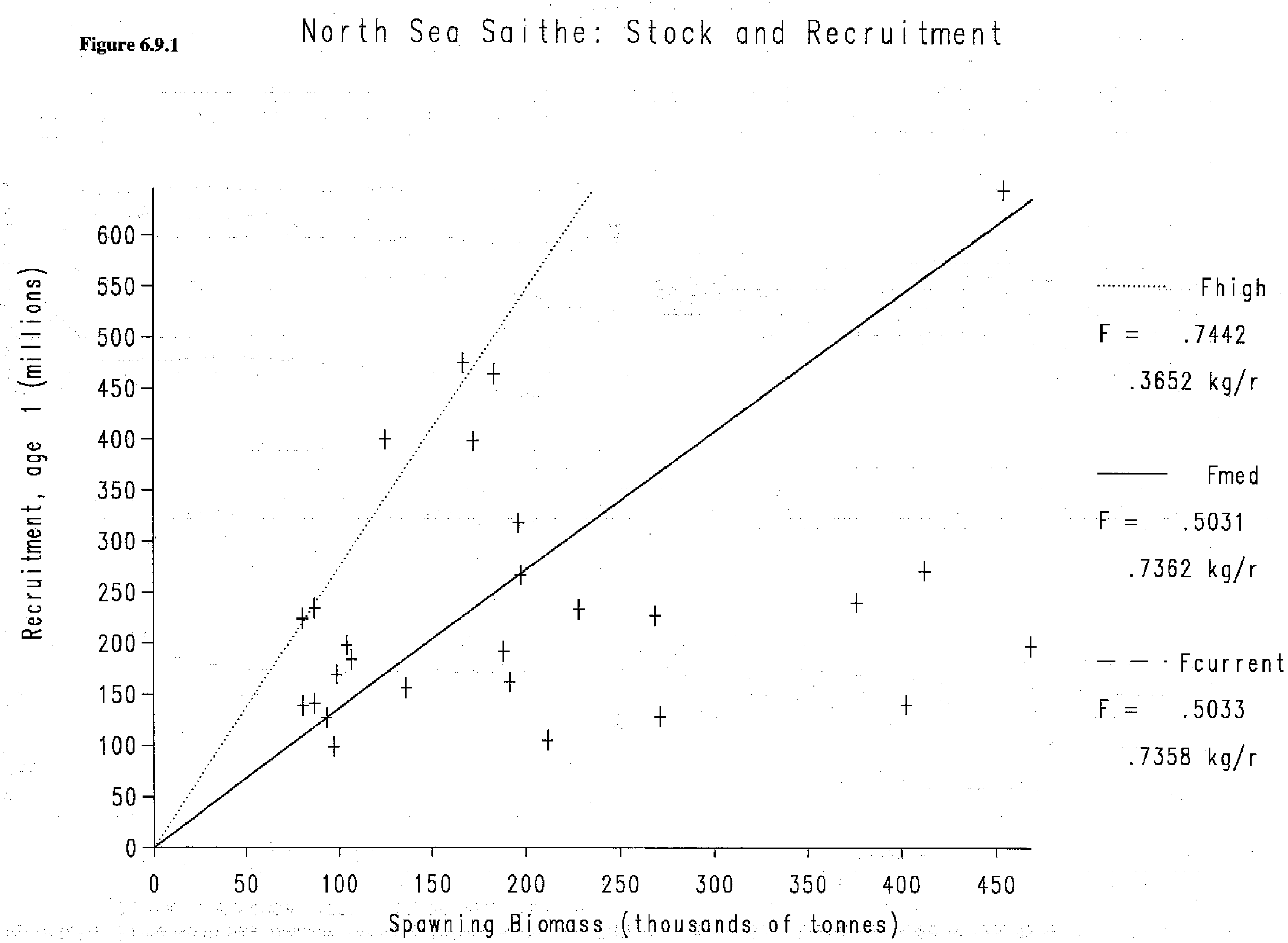

North Sea Saithe: Stock and Recruitment
Recruitment, age 1 (millions)
0
50
100
150
200
250
300
350
400
450
500
550
600
Spawning Biomass (thousands of tonnes)
Fhigh
F = .7442
.3652 kg/r
Fmed
F = .5031
.7362 kg/r
Fcurrent
F = .5033
.7358 kg/r

Figure 6.11.1

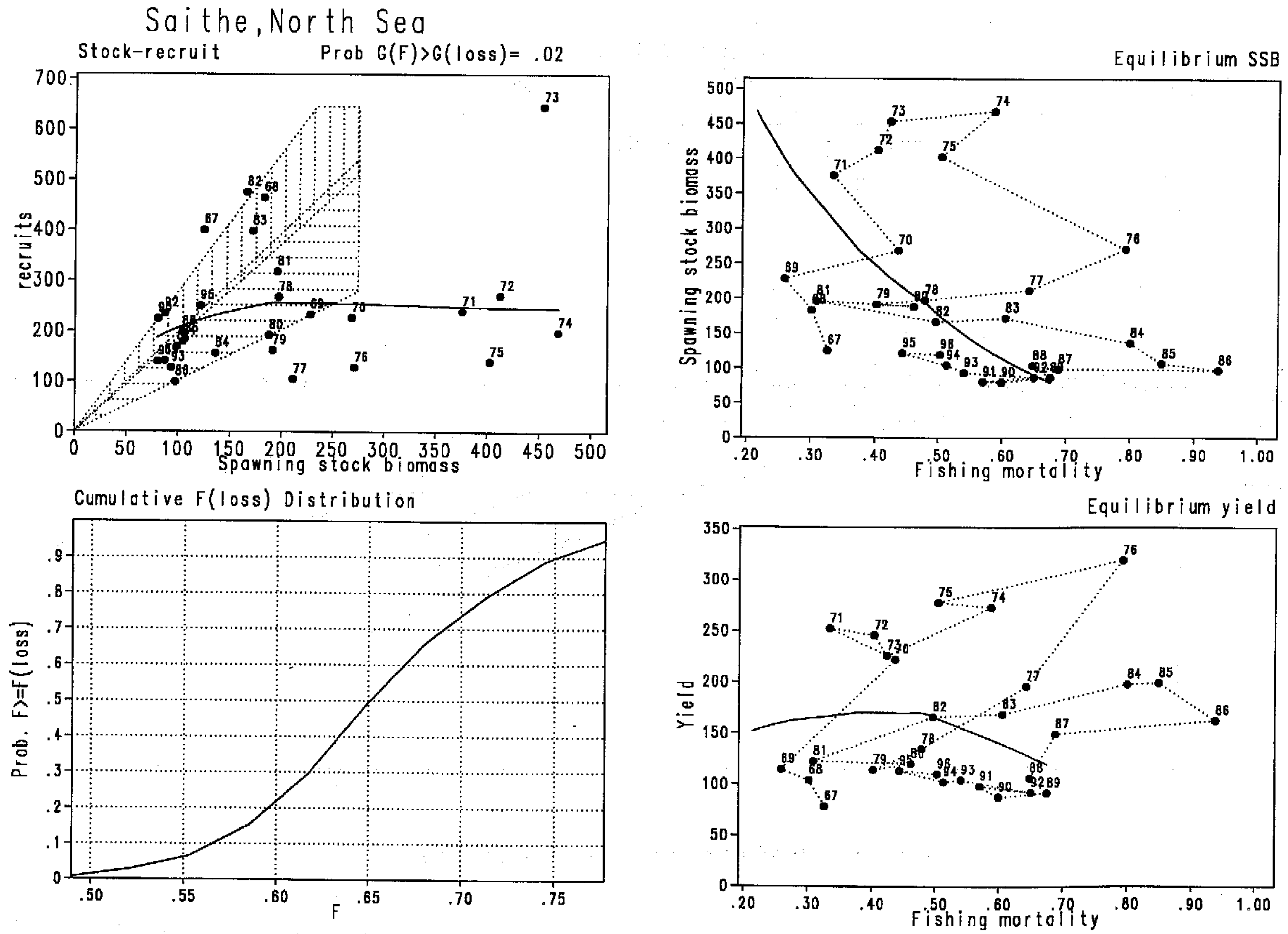
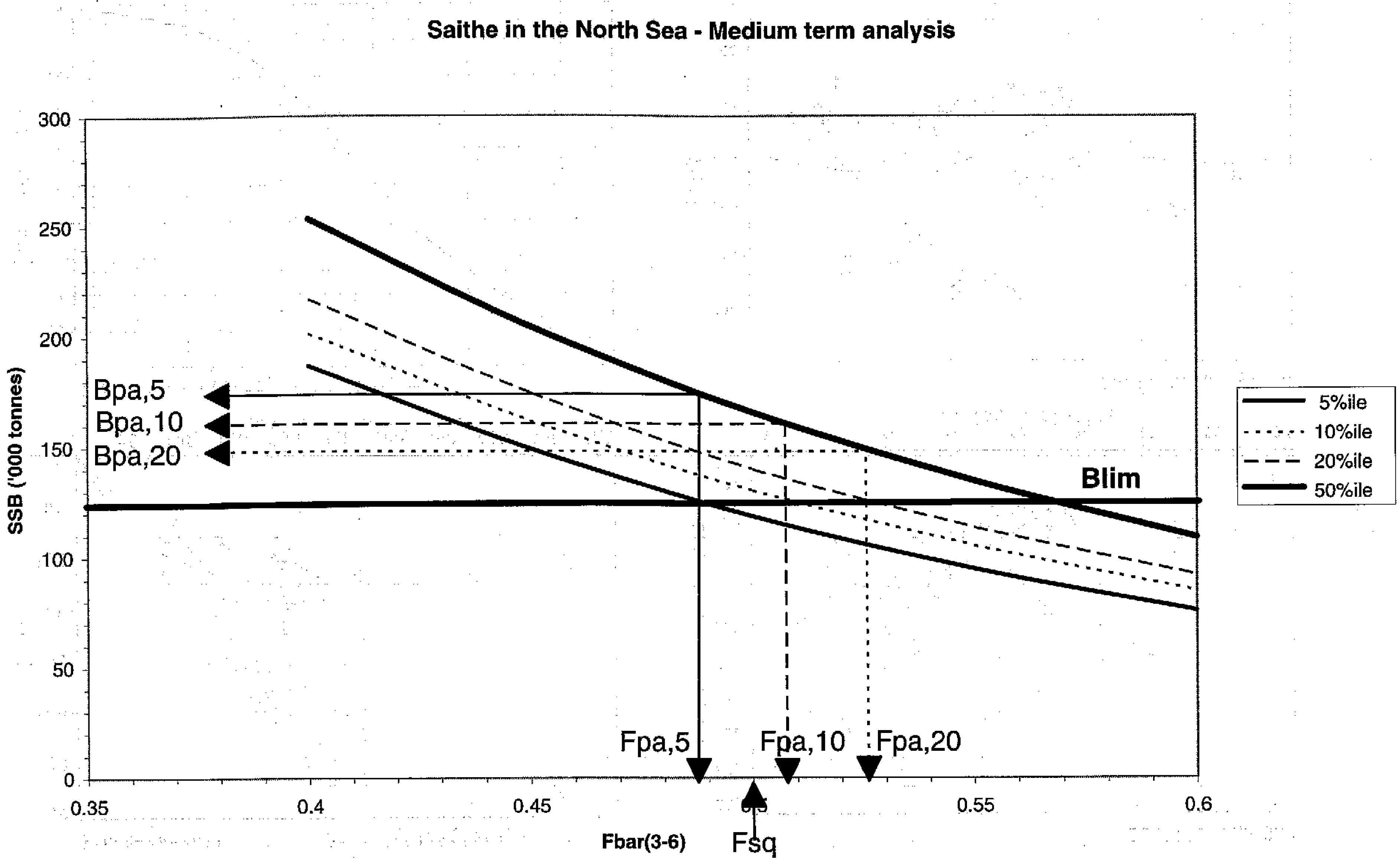

Saithe, North Sea
Stock-recruit
Prob G(F)>G(loss)= .02
recruits
Spawning stock biomass
Equilibrium SSB
Spawning stock biomass
Fishing mortality
Cumulative F(loss) Distribution
Prob. F>=F(loss)
F
Equilibrium yield
Yield
Fishing mortality

Figure 6.12.1 Saithe in the North Sea.
Medium-term projections of SSB in 2006 at different F levels



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