Advisory Committee on Fishery Management ICES CM 1999/ACFM:8

REPORT OF THE

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

ICES Headquarters
5 - 14 October 1998

PART 1 OF 3

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK-1261 Copenhagen K Denmark

TABLE OF CONTENTS

Section			Page
1	INTRODUCTION		1
	1.1	Participants	1
	1.2	Terms of reference	1
	1.3	Data	2
		1.3.1 Data sources roundfish and flatfish	2
		1.3.1.1 Data on landings, age compositions, weight at age, maturity-ogive	2
		1.3.1.2 Discard data used in the assessment	3
		1.3.1.3 Natural mortality	3
		1.3.1.4 Fleet and research vessel data	3
		1.3.2 Data sources Norway pout and sandeel	4
		1.3.3 Sampling levels and sampling procedures	4
		1.3.3.1 Sampling levels in 1997	4
		1.3.3.2 Sampling procedures	4
	1.4	Methods and software	7
		1.4.1 XSA	7
		1.4.2 Forecasts, sensitivity analysis and medium-term projections, Roundfish and flatfish	7
		1.4.3 Catch predictions and medium term projections, Norway pout and sandeel	9
	1.5	Stocks and assessments	9
	1.6	Biological reference points	9
	1.7	Summary of PA reference points	10
Tables 1.3.3.1.1 - 1.7.1			11
2	OVERVIEW		16
	2.1	Stocks in the North Sea (Sub-area IV)	16
		2.1.1 Human consumption fisheries	16
		2.1.2 Industrial fisheries	18
		2.1.2.1 Description of fisheries	18
		2.1.2.2 Stock impressions	18
		2.1.2.3 By-catches of protected species	18
	2.2	Overview of the stocks in the Skagerrak and Kattegat (Division IIIa)	18
	2.3	Stocks in the eastern Channel (Sub-area VIId)	19
Tables 2.1.1 - 2.2.1			21
Figures 2.1.1 - 2.3.1			26
3	COD IN AREAS IIIA (SKAGERRAK), IV AND VIID		28
	3.1	The Fishery	28
		3.1.1 ACFM advice applicable to 1997 and 1998	28
		3.1.2 Management applicable in 1997 and 1998	28
		3.1.3 The fishery in 1997	28
	3.2	Natural Mortality, Maturity, Age Compositions, and Mean Weight at Age.	29
	3.3	Catch, Effort, and Research Vessel Data	29
	3.4	Catch at Age Analysis	29
	3.5	Recruitment Estimates	30
	3.6	Historical Stock Trends	31
	3.7	Short Term Forecast	31
	3.8	Medium term projections	31
	3.9	Long Term Considerations	32
	3.10	Biological reference points	32
	3.11	Comments on the Assessment	32
Tables 3.1.1 - 3.10.4			34
Figures 3.1.1 - 3.10.3			78
4	HADDOCK IN SUB-AREA IV AND DIVISION IIIA		104
	4.1	The fishery	104
		4.1.1 ACFM advice applicable to 1997 and 1998	104

Section **Page**

4.1.2 Management applicable to 1998 104
4.1.3 Catches in 1997 104
4.2 Natural mortality, maturity, age composition, mean weight at age 104
4.3 Catch, Effort and Research Vessel data 105
4.4 Catch-at-age analysis 105
4.5 Recruitment estimation 106
4.6 Historical stock trends 106
4.7 Short-term forecast 106
4.8 Medium-term projections 107
4.9 Long term considerations 107
4.10 Biological reference points 108
4.10.1 Choice of B_{pa} 108
4.10.2 Choice of F_{pa} 108
4.11 Comments on the assessment 108

Tables 4.1.1 - 4.10.2 109
Figures 4.4.1a - 4.10.5 148

5 WHITING 168
5.1 Whiting in Sub-area IV and Division VIId 168
5.1.1 The fishery 168
5.1.1.1 ACFM advice applicable to 1998 168
5.1.1.2 Management applicable to 1998 168
5.1.1.3 Landings in 1997 168
5.1.2 Natural mortality, Maturity, Age compositions, Mean weight at age 169
5.1.3 Catch, Effort and Research Vessel Data 169
5.1.4 Catch-at-age analysis 169
5.1.5 Recruitment estimates 171
5.1.6 Historical stock trends 171
5.1.7 Short term forecast 172
5.1.8 Medium term predictions 173
5.1.9 Long term considerations 173
5.1.10 Biological reference points 173
5.1.11 Comments on the assessment 173
5.1.12 Definition of safe biological limits using target and limit reference points 174
5.2 Whiting in Division IIIa 174

Tables 5.1.1.1 - 5.2.1.1 175
Figures 5.1.4.1 - 5.1.12.2 215

PART 2

6 SAITHE IN SUB-AREA IV AND DIVISION IIIA 247
6.1 The fishery 247
6.1.1 ACFM advice applicable to 1998 247
6.1.2 Management applicable to 1998 247
6.1.3 Trends in landings 247
6.2 Natural mortality, maturity, age compositions, mean weight at age 247
6.3 Catch, effort and research vessel data 247
6.4 Catch-at-age analysis 248
6.5 Recruitment Estimates 248
6.6 Historical stock trends 248
6.7 Short term forecast 249
6.8 Medium term projections 249
6.9 Long term Considerations 249
6.10 Biological reference points 249
6.11 Comments on the Assessment 250

Tables 6.1.1 - 6.10.2 251
Figures 6.1.1 - 6.10.4 275

Section			Page
7	SOLE IN SUB-AREA IV 7		294
	7.1	The fishery	294
		7.1.1 ACFM advice applicable to 1997 and 1998	294
		7.1.2 Management applicable to 1997 and 1998	294
		7.1.3 Fleet developments	294
		7.1.4 Landings in 1997	294
	7.2	Natural mortality, maturity, age composition, mean weight at age	295
	7.3	Catch, effort and research vessel data	295
	7.4	Catch at age analysis	295
		7.4.1 Exploration of data	295
		7.4.2 Final XSA run	296
	7.5	Recruitment estimation	296
	7.6	Historical stock trends	297
	7.7	Short term forecast	297
		7.7.1 Additional natural mortality in the winter of 1995–1996	297
		7.7.2 Forecast	298
		7.7.3 Sensitivity analyses	298
	7.8	Medium term projections	298
	7.9	Long term considerations	299
	7.10	Biological reference points	299
	7.11	Comments on assessment	300
Tables 7.1 - 7.2.3			301
Figures 7.1 - 7.1.9			342
8	SOLE IN DIVISION VIID		361
	8.1	The fishery	361
		8.1.1 ACFM advice applicable to 1988	361
		8.1.2 Management applicable to 1998	361
		8.1.3 Landings in 1997	361
	8.2	Natural mortality. maturity, age compositions and weight at age	361
	8.3	Catch, effort and research vessel data	362
	8.4	Catch at age analysis	362
		8.4.1 Data screening	362
		8.4.2 Exploratory XSA runs	362
		8.4.3 Final XSA run	363
	8.5	Recruitment estimates	363
	8.6	Historical Stock trends	364
	8.7	Short term forecast	364
	8.8	Medium Term Projections	364
	8.9	Long Term Considerations	365
	8.10	Biological Reference Points	365
	8.11	Comments on the Assessment	365
Tables 8.1.1a - 8.10.3			366
Figures 8.1.1a - 8.10.2			409
9	NORTH SEA PLAICE		428
	9.1	The fishery	428
		9.1.1 ACFM advice applicable to 1997 and 1998	428
		9.1.2 Management applicable to 1997 and 1998	428
		9.1.3 Fleet developments	429
		9.1.4 Landings in 1997	429
	9.2	Age composition, natural mortality, maturity, weight at age	429
	9.3	Catch, effort and research vessel data	430
	9.4	Assessment	431
		9.4.1 Data exploration	431
		9.4.2 Final assessment	431
	9.5	Recruitment	431

9.6 Historic stock trends 432
9.7 Short term projection 432
9.8 Medium term projection 433
9.9 Long term considerations 433
9.10 Biological reference points 433
9.11 Comments on the assessment 433

Tables 9.1 - 9.30 436
Figures 9.1 - 9.19 473

PART 3

10 PLAICE IN DIVISION IIIA 493
10.1 The fishery 493
10.1.1 ACFM advice applicable to 1998 493
10.1.2 Management applicable to 1997 and 1998 493
10.1.3 Landings in 1997 493
10.2 Natural mortality, Maturity, Age Compositions and Mean Weight at Age 493
10.3 Catch, Effort and Research Vessel Data 493
10.4 Catch at Age Analysis 494
10.5 Recruitment estimates 495
10.6 Long-term trends 495
10.7 Short-term forecast 495
10.8 Medium-term projections 495
10.9 Long-term considerations 496
10.10 Biological Reference Points 496
10.11 Comments on the assessment 496

Tables 10.1.3 - 10.9.2 497
Figures 10.2.1 - 10.10.2 519

11 PLAICE IN DIVISION VIID 536
11.1 The fishery 536
11.1.1 ICES advice applicable to 1998 536
11.1.2 Management applicable to 1998 536
11.1.3 Trends in landings 536
11.2 Natural mortality, maturity, age compositions and mean weight at age 536
11.3 Catch, effort and research vessel data 536
11.4 Catch at age analysis 537
11.5 Recruit estimates 538
11.6 Historical Stock Trends 538
11.7 Short term forecast 538
11.8 Medium term predictions 539
11.9 Long term considerations 539
11.10 Biological reference points 539
11.11 Comments on the assessment 539

Tables 11.1.1 - 11.10.3 541
Figures 11.1.1 - 11.10.1 571

12 NORWAY POUT IN SUB-AREA IV AND DIVISION IIIA 592
12.1 The fishery 592
12.1.1 ICES advice applicable to 1998 592
12.1.2 Management applicable to 1997 and 1998 592
12.1.3 Catch trends 592
12.2 Natural Mortality, Maturity, Age Composition and Mean Weight at Age 592
12.3 Catch, Effort and Research Vessel Data 593
12.4 Catch-at-Age Analysis 593
12.5 Recruitment Estimates 594
12.6 Historical Stock Trends 594

Section **Page**

12.7 Short-Term Forecasts 594
12.8 Medium-Term Predictions 594
12.9 Long-Term Considerations 594
12.10 Biological Reference Points 594
12.11 Comments on the Assessment 595

Tables 12.1.1 - 12.6.1 596
Figures 12.4.1 - 12.8.3 614

13 SANDEEL 624
13.1 Sandeel in Sub-area IV and IIIa 624
13.1.1 The fishery 624
13.1.1.1 ACFM advice applicable to 1997 and 1998 624
13.1.1.2 Management applicable to 1997 and 1998 624
13.1.1.3 Catch trends 624
13.1.2 Natural mortality, maturity, age composition, mean weight at age 624
13.1.3 Catch, effort and research vessel data 625
13.1.3.1 Calculation of the total international effort in the sandeel fishery 625
13.1.3.2 Research vessel data 625
13.1.4 Catch-at-age analysis 625
13.1.5 Recruitment estimates 626
13.1.6 Historical stock trends 626
13.1.7 Stochastic short and median term forecast 626
13.1.8 Biological reference points 626
13.1.9 Comments on the assessment 627
13.2 Sandeel at Shetland 627
13.2.1 Catch trends 627
13.2.2 Assessment 627
13.2.3 Management in 1998 627

Tables 13.1.1.1 - 13.1.8.1 628
Figures 13.1.1.1 - 13.1.7.1 653

14 NORWAY POUT AND SANDEEL IN DIVISION VIA 669
14.1 Overview of industrial fisheries in Division VIa 669
14.2 Norway Pout in Division VIa 669
14.3 Sandeel in Division VIa 669
14.3.1 Catch Trends 669
14.3.2 Assessment 669

Tables 14.2.1 - 14.3.1.1 670
Figures 14.2.1 - 14.3.1.1 671

15 DISCARDS 672

Tables 15.1 - 15.2 673

16 WORKING DOCUMENTS 674
16.1 References 674

1 INTRODUCTION

1.1 Participants

The Working Group met in Copenhagen from 5–14 October 1998 with the following participants:

Frans van Beek (chairman)	Netherlands
Odd Aksel Bergstad	Norway
Loes Bolle	Netherlands
John Casey	England
Uli Damm	Germany
Laurence Kell	England
Phil Kunzlik	Scotland
Peter Lewy	Denmark
Paul Marchal	Denmark
Capucine Mellon	France
Richard Millner	England
Rasmus Nielsen	Denmark
Martin Pastoors	Netherlands
Stuart Reeves	Scotland
Anna Rindorf	Denmark
Odd M. Smedstad	Norway
Alain Tétard	France
Willy Vanhee	Belgium
Wolfgang Weber	Germany

The Working Group overlapped with the Working Group on Mackerel, Horse Mackerel, Sardine and Anchovy for the first three days. The Working Group found this situation very uncomfortable since it had to meet in a room which is not well accommodated for the number of participants. Also work was delayed in this period because of competition for PCs with participants of the other Working Group, lack of sufficiently fast stand-alone printing facilities and finding places in the building for having sub-group meetings. The Working Group appreciated the help of the ICES staff to make the pain bearable but strongly advises to ICES to avoid overlap in the meetings of large assessment Working Groups in the future.

1.2 Terms of reference

The Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak [WGNSSK] (Chairman: Mr F van Beek, Netherlands) will meet at ICES Headquarters from 5–14 October 1998 to:

a) assess the status of and provide catch options for 1999 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 1999 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) 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;

d) consider the reference points proposed by the SGPAFM, adopting those reference points or presenting alternatives with reasons for the alternative selection;

e) consider the harvest control rules proposed by the SGPAFM, taking into account uncertainties in the data, in the assessments and in the biological processes, and assuming a stock-recruitment relationship, to estimate the probability of avoiding limit reference points;

f) update information on quantities of discards by gear type for the stocks and fisheries considered by this group using the format proposed by the WGECO with a view to establishing a time series

g) provide the data required to carry out multispecies assessments (quarterly catches and mean weights at age in the catch and stock for 1997 for all species in the multispecies model that are assessed by this Working Group).

The Working Group dealt with all Terms of Reference except with e) (there are no control rules proposed by SGPAFM) and g) (data for multispecies assessments will be provided to after the meeting of the Working Group)

A number of working papers were made available to the Working Group. Some of these were presented and discussed. Others were only for information. The working papers are listed in Annex 1.

1.3 Data

1.3.1 Data sources roundfish and flatfish

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

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

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

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

Uncertainties on the data on landings is a serious matter of concern. 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 sources or softer information. However, there are also situations that signals of mis- or unreported landings exist but could not be verified or quantified. This contributes to the uncertainty in the assessments and catch forecasts.

Historical time series of age compositions, weight and length at age by fleet for most of the stocks, considered by the Working Group, are kept and maintained together at some national institutes. The roundfish stocks (cod, haddock, whiting and saithe) are kept in Aberdeen. North Sea plaice and sole are kept in IJmuiden, VIId sole in Lowestoft, VIId plaice in Port-en-Bessin and sandeel and Norway pout in Denmark. No major revisions have been made in the catch, and weight at age data in the roundfish and flatfish stocks for years before 1997. The revisions made, are indicated in the relevant stock sections.

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

Maturity ogives are generally based on historical biological information and kept constant over the whole time period of the assessment. For a number of stocks a knife-edge maturity has been assumed. Maturity at age data for some stocks from the samples of the landings in some fleets indicate that changes in age of first maturation occur. However, unbiased

estimates for the stock are not available. The assumption of constant maturity-ogives may introduce bias in the trends in SSB developments, especially when exceptional large or small year classes enter the spawning stock.

1.3.1.2 Discard data used in the assessment

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

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

1.3.1.3 Natural mortality

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

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

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

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

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

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

1.3.1.4 Fleet and research vessel data

Time series of CPUE and effort data from commercial fleets and research vessels have been used to 'tune' the assessments. The validity of many of these time series as indicators of stock size and fishing mortality in recent years has become more uncertain since enforcement of quota and technical measures are known to have led to changes in directivity of some fleets to other species. In general, there is a lack of representative effort and CPUE series for most stocks.

For one survey series, the Scottish groundfish survey, there was a change in survey practice this year due to the replacement of the previous research vessel, and also a changeover to a GOV Trawl and to a tow duration of 30 minutes. This means that indices from the 1998 survey are unlikely to be comparable with previous indices. Limited comparative fishing trials were performed to compare the performance of the old and new vessel/gear/haul length combinations, but these data have not yet been analysed fully, so it has not been possible to estimate correction factors for the new configuration. As a result, the 1998 indices have not been used in recruitment prediction for the relevant stocks this year.

1.3.2 Data sources Norway pout and sandeel

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

1.3.3 Sampling levels and sampling procedures

1.3.3.1 Sampling levels in 1997

Table 1.3.3.1.1. gives an overview of the contribution of the countries to the various categories of data in 1997. Sampling levels in that year for each stock are compared to landings in Table 1.3.3.1.2. This table provides different information given in previous years, since it now presents the actual measurements made by country. Last year it included only those which were used to construct the age composition.

1.3.3.2 Sampling procedures

The methods of data collection and processing vary between countries and stocks. As part of the uncertainty in the stock assessments originate from the applied sampling procedures, they should be critically evaluated. The current procedures are briefly outlined:

Industrial Fisheries

In **Norway**, the sampling system in recent years is based on catch samples from three market categories:

E02 - mainly sandeel
D13 - mainly blue whiting, no sandeel. Catches taken west of 0 ^{o} excluded
D12 - mainly Norway pout, no sandeel. Catches taken west of 0 ^{o} excluded

The samples are raised to total landings on basis of sales slip information on the three landing 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. Since 1997 the collection of biological samples of sandeel is increased. The aim is to collect in the period March-October two samples of 200 specimens per month for length and age determination from each port where sandeel is landed. Based on these samples, ALKs are derived that form the basis for estimation of the age composition of Norwegian catches.

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.

Human Consumption Fisheries

Belgium

The market sampling scheme on demersal fish in the North Sea and English Channel is done in two harbours: Oostende and Zeebrugge. Only cod, haddock and whiting are sampled from the North Sea; sole and plaice is sampled from both North Sea and Eastern Channel. From the 5 to 7 market categories depending on the harbour and the species, representative length measurements are taken covering the numbers per market category. Up to 10 otoliths per cm-group are taken for age determination. The aim is to sample each species and area at least three times per quarter.

The samples of the market categories are raised to the relevant quarterly landings. The quarterly age-length-keys are applied to the quarterly length compositions to give landings in numbers at age by quarter. For each species, the quarterly landings at age are summed to annual landings in numbers at age.

Denmark

The North Sea sampling scheme is a combination of harbour- and at-sea-sampling.

The landing part of the catch is sampled by harbour sampling. All major fishing harbours on the west coast are included and all relevant information is recorded by commercial size category. The sampling scheme is stratified by month, area and fishery. All major fisheries are sampled. Employees from DIFRES sample the most northern harbours, while the rest is sampled by the Danish Fishing Control. Otoliths are collected for the following species relevant to the WG: cod, plaice, saithe and haddock. All age determinations are made by DIFRES.

The sampling on discards is done as on board sampling. Observers employed at DIFRES participate in fishing trips made by commercial vessels. The sampling scheme is stratified by month, area and fishery. Each stratum is sampled in proportion to the number of landings. Within each stratum, the vessels are randomly chosen in order to reflect the fishery.

All data are recorded in a central database of DIFRES.

England

Length and age compositions of landings of cod, haddock, whiting, saithe, plaice and sole from the North Sea and Eastern Channel are sampled at all major ports. Sampling is undertaken by Sea Fisheries Inspectors who have a weekly target for the number of fish measurements and the number of otoliths required. Sampling is carried out on a boat/category basis. All size categories from a particular landing are sampled for length composition. These samples are then raised to the total catch for each category and then summed over categories to derive a length composition for the landing from each sampled vessel. The numbers at length for the sampled vessels are then summed and raised to the total weekly landings at the port. The totals for each port are then summed to give a weekly length composition of the landings which are the basis for monthly values. These are finally summed to give quarterly length compositions of the landings.

Problems are sometimes encountered when not all size categories are sold through the fish markets. Some vessels are contracted to supply fish merchants with a particular size category of fish, and in such cases, the fish are transported directly to the buyers and the landing cannot be sampled.

Otoliths for age determination are collected according to a weekly target, which is length stratified. These are then combined to provide a quarterly age-length-key, which is applied to the quarterly length compositions to give landings in numbers at age by quarter. For each species, the quarterly landings at age are then summed to give annual landings in number at age.

France

Flatfish: The size composition of the landings are sampled at various fish markets. Until 1996 in sub-division VIId there were 7 markets between Boulogne and Cherbourg (these ports included) but one (Honfleur) was closed in 1997. In sub-division IV two fish markets are available for length measurements. Sampling is based on commercial categories. The length distributions are raised to the respective quarterly landings. Those landings, which are marketed directly, are estimated by an enquiry scheme, which covers up to 30% of the total landings. Certain problems for the sampling scheme in 1997 derived from the mentioned closure of the most important harbour for inshore trawl catches (30% to 50% of the sole landings in fish markets during the period 1993–96). Another difficulty arises from possible gaps in the enquiry scheme. Discards are not investigated.

ALKs are gained also on a quarterly basis. Those fish are bought on a different scheme. Some additional information is applied from surveys. Coastal surveys on nurseries, however, as the French young fish survey (FYFS) are excluded having been found to bias the age distribution when applied to commercial landings. The results are the basis for splitting the landings of both sub-divisions VIId and IV.

Gadoid catches from the North Sea and Eastern Channel are mostly landed in only one port (Boulogne sur Mer) and are sorted in local categories. In the mid 70s a method was elaborated to obtain the mean length structure for these categories. Since then no regular sampling of gadoid fish is carried out.

Otolithes of whiting are sampled at the fish market and during surveys, those of cod are taken at surveys only. The ALKs are combined for Sub-divisions VIId and IVc and for IVa and IVb. These ALKs are amended with data from other countries if necessary. For haddock and saithe there are no French ALKs, the landings therefore are converted by ALKs gained by neighbouring countries. The quarterly ALKs are applied to the relevant length demographic structure. Age reading of whiting is carried out from slides of sectioned otoliths.

Germany

The German market sampling scheme on demersal fish in the North Sea is concentrated mainly at the port of Cuxhaven and covers cod and saithe only. The aim is to collect quarterly at least three samples each of the following stock categories:

Cod in IVa - Cod in IVb+c - Saithe in IVa.

The length measurements cover representative numbers per market category. They are amended by data from sea sampling. In these cases the length distribution normally is collected before the catch is assorted to market categories. Up to 10 otoliths per cm-group are taken. They are embedded in coloured resin, thin slices are taken, which are mounted on glass slides and again embedded in resin for age determination.

The quarterly landings figures (in tonnes) of the mentioned three stock categories are converted to numbers per length group by applying the relevant length frequencies. The age length keys by quarter are based on the respective samples. These are amended when necessary by material of research trips. The resulting numbers per age group for cod in the 2 subdivisions of the North Sea are added finally.

Data collection in Germany is hampered by the tendency among German fishermen to land their roundfish catch in Danish ports. In 1997, therefore, the German cod landings from sub-division IVb+c partly were converted by applying the results of Danish market sampling in Esbjerg.

The Netherlands

Plaice and Sole: Almost all of the plaice and sole landings in the Netherlands are caught by beam trawlers, fishing exclusively in the North Sea. Sampling is restricted to this fleet and the results are raised to total national landings. There are three levels of stratification: by harbour, quarter and market size category.

Sampling is restricted to 4 major landing ports (Den Helder, Stellendam, Urk and IJmuiden), which account for about 80% of the national landings. The number of samples are taken approximately in proportion to the expected landings in these ports and take account of differences in effort of various fleet components in different fishing areas.

Plaice landings are marketed in 4 and sole in 5 size categories. Samples consist of 15 (plaice) or 10 (sole) fish in each size category bought from the vessel selected. In addition, the total landings of the vessel, the amount landed in each size category, gear, fishing position, vessel name and vessel characteristics are recorded. No separate length samples are taken.

A total of about 80 samples for each species are planned annually. The fish are measured and weighed (gonads only during spawning time) in the laboratory. Sex and stage of maturity are recorded and both otoliths are removed for age determination. The age of the fish is determined by using the whole otolith (plaice) and the burnt and broken otolith (sole) respectively.

Cod and Whiting: Roundfish is sampled in the auctions of IJmuiden (all quarters) and Den Oever (first and fourth quarters). Cod is sorted in 6 market categories. Otolith samples and length measurements are taken in the auction. An age sample from an individual vessel consists of approximately 50 otoliths (1 per fish) and each length sample consists of at least 50 fish. Age is determined from broken otoliths

Whiting are usually sold unsorted. Length measurements are collected in the auction. The otolith samples are bought and processed in the laboratory. Each sample consists of 50 fish and both otoliths are collected. Age reading is carried out on transverse sections of broken otoliths. However, form 1997 onwards this is done from slides of sectioned otoliths.

Age and length sampling is intensified during 1st and 4 th quarter compared to 2 nd and 3rd quarter, because of extra sampling in Den Oever. Based on the samples, the quarterly length composition per market category is calculated. Age-length keys are also prepared for each quarter. Usually also samples collected during surveys are included in the keys.

The quarterly/monthly Dutch catches (in tonnes) are available by market categories and by area. They are converted to catches in numbers at age by area. ALK's are stratified by quarter, commercial category (and sex - for flatfish). Spatial stratification is assumed in the sampling scheme but not taken into account in the calculation of the ALK's. Quarterly

total catches by species are obtained from the Ministry of Agriculture, Nature and Fishery (LNV) where they are reported as tonnes live weight.

Norway

Human consumption fishery are only sampled for saithe. Length data are mainly obtained at the fishing harbour by local people. Some samples are taken by the coast guard at sea. Age data are mainly obtained by an observer that follow at least one fishing trip each quarter. In addition some age samples are obtained at the fishing harbour, some by research vessels and a few by the coast guard.

Length and age samples from the inshore purse seine fishery are taken two times a quarter if available in the vicinity of Bergen.

Otoliths are broken before they are read.

Scotland

The Scottish market sampling scheme is documented by Armstrong and Hall (1987). No major changes have been made since than.

1.4 Methods and software

1.4.1 XSA

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

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 for those stocks for which the settings were changed or will be found in earlier reports of this working group otherwise.

Recruitment estimates have in several cases been made with RCT3. This is the case when recruitment indices from 1998 are available and especially when indices are available from later than the first quarter. The present implementation of XSA cannot accommodate survey data in the year following the last catch data year and RCT3 is therefore implemented to utilise this information. This does in itself create some inconsistencies in the approaches used. The survey indices may end up being used twice for recruitment estimation - once in the survivors analysis (and thus in the VPA recruitment) and again with the same survey indices in RCT3. Another problem is the use of F-shrinkage for recruiting year classes in the present implementation of the XSA. This can not be turned off and has in some cases been seen to have strong influence on the recruitment estimates originating from XSA. The result of this feature is that the present implementation of XSA does not reproduce RCT3 values for recruiting year classes.

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

Short-term forecasts were made for each stock subject to a full analytical assessment. They are based on initial stock sizes as estimated by XSA (in 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. The value chosen as *status quo* F for each stock was considered in the light of recent variations or trends in the estimates of F, as recommended by ACFM. In a change from previous Working Group practice, the estimate of *status quo* F used by default in short-term predictions was the unscaled mean F at age for the last three years. This was only scaled to the mean F in the terminal year if there was clear evidence of a recent trend in F. This change in practice stemmed from the consideration that while the point estimate of terminal F represents the best available estimate of F in 1997, it does not necessarily follow that it will also be

appropriate as an estimate of F in 1998 and subsequent years. In the absence of any recent trends in F, an unscaled mean is considered a more appropriate estimate of *status quo* F than a scaled one

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

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

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

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 1998
M0	Natural mortality, age 0
N1	Numbers at age 1 in 1998
M1	Natural mortality, age 1
N2	Numbers at age 2 in 1998
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.	
K97	Year effect on natural mortality, 1997
K98	Year effect on natural mortality, 1998
K99	Year effect on natural mortality, 1999

HF97 Year effect on HC/discard fishing mortality, 1997
HF98 Year effect on HC/discard fishing mortality, 1998
HF99 Year effect on HC/discard fishing mortality, 1999
IF97 Year effect on Ind. bycatch fishing mortality, 1997
IF98 Year effect on Ind. bycatch fishing mortality, 1998
IF99 Year effect on Ind. bycatch fishing mortality, 1999
R98 Recruitment in 1998
R98 Recruitment in 1999

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 Sub-areas has been provided for these stocks.

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

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 last years Working Group meeting. A description of the model is given in last years report.

1.5 Stocks and assessments

The stocks which have been considered are listed in Table 1.5.1. This table also lists the type of assessment which has been applied by the Working Group and an indication of whether this reflects changes compared to the previous assessment.

1.6 Biological reference points

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

The Working Group considered the reference proposed by the ICES Study Group of the Precautionary approach to Fisheries Management (ICES CM 1998/ACFM:10) and where appropriate suggested alternatives with reasons.

SGPAFM defined limit- and precautionary reference points for fishing mortality and SSB (F_{lim}, F_{pa}, B_{lim} and B_{pa}). ACFM states that future management advice by ICES will be constrained by F_{pa} and B_{pa}, the precautionary thresholds which imply a reasonably high probability of remaining below a limit fishing mortality and above a limit spawning stock biomass.

F_{pa} and B_{pa} are thus the main devices to be used by ICES in providing Management Advice. Following the guidelines by SGPAFM the Working Group proposes a B_{pa} based on inspection of the Stock/ Recruitment plot. For most stocks B_{pa} was derived using the following equation:

$$B_{pa} = B_{lim}.\exp.1.645\ \sigma$$

where σ is an estimate of the coefficient of variation in the estimation of the stock biomass (usually taken as 0.2). For some of the stocks considered by the Working Group (VIId sole, sandeel), this approach was not considered appropriate and an alternative choice was made.

For a number of stocks an estimate of F_{pa} was derived giving a low probability (0.1 suggested by SGPAFM) that the stock would fall below B_{pa} in the medium term. The medium term was defined as the period 10 years after the last year in the assessment (2007).

Stock recruitment relationships were explored using Shepherd, Beverton & Holt or Ricker models. For (almost) all stocks the various these models show no significant relationships and a choice between them is rather arbitrary. Some of these models appear to be sensitive to a single point in the data series and are not robust to the addition of further data points. For some flatfish stocks a Butterworth and Berg (1993) stock recruit model was used. This model takes geometric mean recruitment for SSB levels where observations are available and recruitment declines linearly from the lowest observed to the origin. This SR relationship is robust. Also it was considered that the recruitment of species like plaice and sole is mainly restricted by the size of the nursery areas available to the stock and that therefore assuming a flat curve would be appropriate.

The proposed value of F_{pa} by the Working Group is based on the argument that it would give a low probability that SSB would decrease below (B_{pa}) in the medium term. For all stocks, the proposed F_{pa} is compared to a number of established reference points (Flow, F_{med}, Fhigh, F_{loss}, etc.) and a range of F-values observed within the historical period of exploitation.

It is evident that the F_{pa} and B_{pa} should take into account interactions between species. All reference points discussed by the Working Group, however, are based on a single species analyses, since no tools were available which take into account these interactions. Also the mixed exploitation of groups of species should be taken into consideration in defining the points.

Reference points suggested by this WG should be updated when new information: discards, maturity-ogives and estimates of weight at age and M changes the assessment in future.

For calculating the reference points the PA software, developed in Lowestoft and the "Aberdeen" programmes: INSENS, WGTERMA, RECRUIT, GLOSSC and REFPOINT were used. A new version of WGTERMA was compiled which included the Butterworth and Bergh stock recruit relationship.

1.7 Summary of PA reference points

In response to terms of reference d), the Working Group considered the precautionary reference points proposed by the SGPAFM. Table 1.7.1. lists the precautionary reference points proposed or suggested by this Working Group. The reasoning behind the Working Group proposals is dealt with in the relevant stock section.

Table 1.3.3.1.1: Countries providing assessment data for stocks covered by this Working Group

Data	Cod	Haddock	Whiting	Saithe	Sole	Sole	Plaice	Plaice	Plaice	N.Pout	Sandeel
	IV, VIId, IIIa	IV, IIIa	IV, VIId	IV, IIIa	IV	VIId	IV	VIId	IIIa	IV, IIIa	IV
Catch weight	BE-DK-EN-	BE-DK-EN-	BE-EN-FR-	DK-EN-FR-	BE-DK-EN-	BE-EN-FR	BE-DK-EN-	BE-EN-FR	DK-SW	DK-FA-NO	DK-FA-NO-
(main exploiters)	FR-GE-NL-	FR-GE-NL-	NL-SC	GE-NO-SC-	FR-GE-NL-		FR-GE-NL-				SC
	NO-SC-SW	NO-SC-SW		SW	SW		NO-SC				
Discard weight	(SC)	SC	SC	(SC)							
Catch length	BE-DK-EN-	BE-DK-EN-	BE-DK-EN-	DK-EN-FR-	BE-DK-EN-	BE-EN-FR	BE-DK-EN-	BE-EN-FR	DK	DK-NO	DK-NO
	FR-GE-NL-	FR-SC	FR-NL-SC	GE-NO-SC	FR-NL		FR-NL				
	SC										
Discard length	(SC)	SC	SC	(SC)							
Catch ALK	BE-DK-EN-	BE-DK-EN-	BE-DK-EN-	DK-EN-FR-	BE-DK-EN-	BE-EN-FR	BE-DK-EN-	BE-EN-FR	DK	DK-NO	DK-NO
	FR-GE-NL-	FR-SC	FR-NL-SC	GE-NO-SC	FR-NL		FR-NL				
	SC										
Discard ALK	(SC)	SC	SC	(SC)							
Catch wt-at-age	BE-DK-EN-	BE-DK-EN-	BE-DK-EN-	DK-EN-FR-	BE-DK-EN-	BE-EN-FR	BE-DK-EN-	BE-EN-FR	DK	DK-NO	DK-NO
	FR-GE-NL-	FR-SC	FR-NL-SC	GE-NO-SC	FR-NL		FR-NL				
	SC										
Effort	EN-FR-GE-	FR-SC	EN-FR-CS	EN-FR-GE-	EN-NL	BE-EN-FR	EN-NL	BE-EN-FR	DK	DK-NO	DK-NO
	SC			NO-SC							
CPUE	EN-FR-GE-	FR-SC	EN-FR-CS	EN-FR-GE-	EN-NL	BE-EN-FR	EN-NL	BE-EN-FR	DK	DK-NO	DK-NO
	SC			NO-SC							
Survey index	DK-FR-GE-	DK-FR-GE-	DK-FR-GE-	DK-FR-GE-	BE-GE-NL-	EN-FR	BE-GE-NL-	EN-FR	SW	DK-FR-GE-	
	NL-NO-SC-	NL-NO-SC-	NL-NO-SC-	NL-NO-SC-	EN		EN			NL-NO-SC-	
	SW	SW	SW	SW						SW	
Countries:	BE = Belgium		EN = England		FR = France		NL = Netherlands		SC = Scotland		
	DK = Denmark		FA = Faroes		GE = Germany		NO = Norway		SW = Sweden		

Table 1.3.3.1.2: Biological sampling level by stock and country: Official landings (t) and number of fish measured and aged to analyse commercial landings in 1997

	Cod in IV, IIIa, VIId			Haddock in IV, IIIa		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	4952	2303	786	437	2280	880
Denmark	37910	6025	5933	2553	5106	5032
England	13891	100655	9394	3330	44188	4455
Faroes	40	0	0	9	0	0
France***	3779	0	1304	804	1043	87
Germany	5260	5947	3495	1467	0	0
Netherlands	11807	3372	1992	480	0	0
Norway	7137	0	0	2538	0	0
Scotland	32347	57955	12263	61098	213591	16327
Sweden	5489	0	0	1461	0	0
others	31	0	0	8	0	0
Total	122643	176257	35167	74185	266208	26781
Total No. landed (1000 fish)**		80281			487855 **	
%o measured		2.20			0.55	

	Whiting in IV, VIId			Saithe in IV, IIIa		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	489	2518	1080	254	0	0
Denmark	103	0	0	4513	1515	1463
England	2785	26507	3660	2556	2722	0
Faroes	6	0	0	158	0	0
France***	3574	11799	2521	19658	0	0
Germany	196	0	0	12581	14840	3451
Netherlands	2540	6718	1200	40	0	0
Norway	75	0	0	46484	10779	1507
Scotland	22099	96929	8823	5329	14545	6685
Sweden	1	0	0	1592	0	0
others	0	0	0	822	0	0
Total	31868	144471	17284	93987	44401	13106
Total No. landed (1000 fish)**		281497 **			77794	
%o measured		0.51			0.57	

	Sole in IV			Sole in VIId		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	1519	8030	2080	1306	7445	1110
Denmark	689	381	376	0	0	0
England	479	11525	1538	933	11661	2791
Faroes	0	0	0	0	0	0
France*	315	1935	1081	1609	4830	1081
Germany	510	0	0	0	0	0
Netherlands	10241	4081	4081	0	0	0
Norway	0	0	0	0	0	0
Scotland	202	0	0	0	0	0
Sweden	3	0	0	0	0	0
Total	13958	25952	9156	3848	23936	4982
Total No. landed (1000 fish)		62258			20024	
%o measured		0.42			1.20	

* = Age data are applied in SD IV and VIId ** = incl. Scottish discards of haddock and whiting
*** = French official landings data on cod and whiting for SD VIId not available

Table 1.3.3.1.2 cont.: Biological sampling level by stock and country: Official landings (t) and number of fish measured and aged to analyse commercial landings in 1997

	Plaice in IV			Plaice in VIId		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	5223	5470	947	1161	5154	350
Denmark	13940	4246	4129	0	0	0
England	13789	27991	2900	1078	9442	1694
Faroes	0	0	0	0	0	0
France*	587	2610	1544	3336	4504	1544
Germany	4159	0	0	0	0	0
Netherlands	34143	4908	4908	0	0	0
Norway	1775	0	0	0	0	0
Scotland	8345	0	0	0	0	0
Sweden	4	0	0	0	0	0
others	0	0	0	0	0	0
Total	81965	45225	14428	5575	19100	3588
Total No. landed (1000 fish)		235214			18334	
%o measured		0.19			1.04	

	Plaice in IIIa		
	Landings (t)	Lengths (No)	Ages (No)
Belgium	0	0	0
Denmark	9505	4930	4720
England	0	0	0
Faroes	0	0	0
France	0	0	0
Germany	39	0	0
Netherlands	0	0	0
Norway	93	0	0
Scotland	0	0	0
Sweden	512	0	0
others	0	0	0
Total	10149	4930	4720
Total No. landed (1000 fish)		31218	
%o measured		0.16	

	N.Pout in IV, IIIa			Sandeel in IV		
	Landings (t)	Lengths (No)	Ages (No)	Landings (t)	Lengths (No)	Ages (No)
Belgium	0	0	0	0	0	0
Denmark	143498	7139	6797	760845	17792	11140
England	0	0	0	2575	0	0
Faroes	7033	0	0	11221	0	0
France	0	0	0	0	0	0
Germany	0	0	0	0	0	0
Netherlands	85	0	0	0	0	0
Norway	39006	2185	181	350563	8001	878
Scotland	0	0	0	24017	42603	1144
Sweden	2	0	0	0	0	0
Total	189624	9324	6978	1149221	68396	13162
Total No. landed (1000 fish)		11674275			1075866000	
%o measured		0.001			6.36E-05	

* = Age data are applied in SD IV and VIId

Table 1.5.1 Overview of types of analysis carried out by WGNSSK in 1997 and 1998 on the considered stocks

	1998 Working Group	1997 Working Group
Cod in IIIa, IV and VIId	XSA, CF, MT	as 1998
Haddock in IV and IIIa	XSA, CF, MT	as 1998
Whiting in IV and VIId	XSA, CF, MT	as 1998
Whiting in IIIa	no analysis	as 1998
Saithe in IV and IIIa	XSA, CF, MT	as 1998
Sole in IV	XSA, CF, MT	as 1998
Sole in VIId	XSA, CF, MT	as 1998
Plaice in IV	XSA, CF, MT	as 1998
Plaice in IIIa	XSA, CF, MT	as 1998
Plaice in VIId	XSA, CF, MT	as 1998
Norway Pout in IV and IIIa	SXSA	as 1998
Sandeel in IV	SXSA, probabilistic CF	as 1998

XSA: Extended Survivor Analysis
SXSA: Quarterly Extended Survivor Analysis
CF: Short term prediction
MT: Medium term predictions

Table 1.7.1: Biological reference points based on the precautionary approch criteria. Biomass in '000 tonnes

Stock	Blim	Bpa	Criteria	Flim	Fpa	Criteria
Cod in IIIa (Skagerrak), IV and VIId	70	150	b)	-	0.70	d)
Haddock in IIIa and IV	100	140	a)	-	0.70	d)
Whiting in IV and VIId	200	280	a)	-	-	g)
Saithe in IV and IIIa	-	150	b)	-	0.40	d)
Sole in IV	25	35	a)	-	0.40 - 0.45	d)
Sole in VIId	-	8.0	c)	-	0.50	d)
Plaice in IV	210	300	a)	-	0.30	d)
Plaice in VIId	5.6	7.8	a)	-	0.50	d)
Plaice in IIIa	-	24	c)	0.80	0.58	f)
Norway pout in IV and IIIa	-	150	b)	-	0.76	e)
Sandeel IV	330	460	a)	-	-	g)

a) Bpa = Blim * $e^{(1.645*cv)}$ and Blim = Bloss
b) Bpa based on decline in recruitment
c) Bpa = Bloss
d) Fpa = F at which P < 10%, where P = probablity of SSB < Bpa
e) Fpa = Fmed
f) Fpa = Flim * $e^{(-1.645*cv)}$ and Flim = Fmed
g) no value can be estimated

2 OVERVIEW

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

Description of the fisheries

The demersal fisheries in the North Sea can be grouped in human consumption fisheries and industrial fisheries which land their catch for reduction purposes. Demersal human consumption fisheries usually either target a mixture of roundfish species (cod, haddock, whiting), or a mixture of flatfish species (plaice and sole) with a by-catch of roundfish. A fishery directed at saithe exists along the shelf edge. The catch of 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 1970s, 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 1980s.

A general upward trend in effort has been observed 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.

2.1.1 Human consumption fisheries

Data

The data available from scientific sources for the assessment of roundfish and flatfish stocks are relatively good. The level of biological sampling of most of the commercial landings 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 recent years.

In previous years there was misreporting of roundfish and flatfish landings associated to restrictive TACs. This was not known to be the case in 1997.

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 the main roundfish stocks and the principal flatfish stocks using XSA.

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

Combined assessments were made 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.

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. Last year's indication of a decline in fishing mortality in the roundfish assessments has not been borne out consistently across stocks in this year's assessment. Fishing mortality on sole and plaice has been varying at a high level over a long period with no trend.

Information from several recruit surveys, and the catch-at-age analyses, indicate that a number of stocks in the North Sea have simultaneously produced a strong year class 1996. 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 1997 were 124,000 t. Recruitment has been well below average in most years since 1985 but the 1996 year class seems to be reasonably abundant and is estimated to be close to the aritmetic mean. The ongoing discard programmes indicate that 70-90% of the catch of this year class has been discarded in 1997. 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 and 1997 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 1997 were 103,000 t. Fishing mortality has declined considerably since 1986.

Human consumption landings of haddock in 1997 were 79,000 t. The present spawning stock size is below, but close to the long term average. Historically the stock size has shown large variation due to the occasional occurrence of a very strong year class. It is by no means sure that the present stock size will be maintained in the medium term.

The 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; 36,000 t in 1997. Fishing mortalities have been highly variable with no clear trend the downward shift indicated in last year's assessment is not supported in this year's assessment.. Different surveys give different signals about year-class strength, and do not always correlate with XSA estimates. In recent years recruitment has been stable, but at a level well below the long term geometric mean, and the 1996 yearclass is indicated to be the weakest on record.

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 1997. There are no trends in fishing mortality and it varies on a historically high level. Recent good recruitment from the 1996 year class is expected to increase the stock in the short term but at At its present level of exploitation there is a high probability that is will remain below the levels observed in the 1970s and 1980s in the medium term.

Landings of sole were at a high levels in recent years but decreased in 1997 to 18,000 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 of this mortality could not be quantified. The spawning stock in 1998 is estimated near a historically low but is expected to recover in 1999 because of an strong 1996 year class. 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.

2.1.2 Industrial fisheries

2.1.2.1 Description of fisheries

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

Data available

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

Trends in landings and efforts

The level of the sandeel catches in 1976–1986 of about 600,000 t has increased to about 800,000 t in 1987–1996. In 1997 the combined Danish and Norwegian landings are the highest on record since 1970. 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 of the Danish fleet is gradually decreasing from 1989 to 1994 and then remaining at the same level while there has been no trend in effort of the Norwegian fleet.

2.1.2.2 Stock impressions

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

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

2.1.2.3 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 1974–1997. For the last five years quarterly data are presented. In 1997 the combined by-catch of haddock, whiting and saithe was about 17,000 t, which is well below the average of 72,000 t in the period 1974 - 1996. 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 1997 is shown in Table 2.1.4 for two areas, north and south of 57° 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 herring and some sprat, and the sprat fishery with a by-catch of herring. Overall the by-catches of protected species and herring were at the same level as in 1996, and lower than in 1995 (Anon. 1997, 1998). 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 1996–1997 compared with 1995.

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

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

The roundfish, flatfish and *Nephrops* stocks are mainly exploited by Danish and Swedish fleets consisting of bottom trawlers (*Nephrops* trawls with > 70 mm mesh size and bottom trawls with > 90 mm mesh size), gill-netters and Danish

seiners. The number of vessels operating in IIIa has decreased in recent years. This is partly an effect of the EU withdrawal programme, which until now has affected the Danish fleets only, but these fleets still dominate the fishery in IIIa.

The industrial fishery is a small-mesh trawl fishery mainly carried out by vessels of a size above 20 m. This fleet component has also decreased over the past decade. The most important fisheries are those targeting sandeel and Norway pout. There is also a trawl fishery landing a mixture of species for reduction purposes. 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 have occurred in recent years, particularly for cod, but the amounts vary between years. There are no discards available for assessments. The time series of age samples from landings for industrial purposes is short and there are gaps in this series.

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

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

The landings of cod in the division IIIa were of 22,144 t in the human consumption fishery, of which 14,900 t were taken from Skagerrak. Landings have been stable since 1991. The majority of catches were taken by Denmark and Sweden.

The landings of haddock in division IIIa, in the human consumption fishery, amounted to 3,500 t in 1997, compared to 3,200 t taken in 1996. Most of the catches are taken in Skagerrak.

The catches of whiting for human consumption were about 200 tonnes in 1997, which is about two third of the reported landings in 1996. Most of the catches are taken in the Skagerrak. No analytical assessment of whiting in IIIa was possible.

The plaice catches in division IIIa amounted to 10,000 t in 1997, at about the same level as in 1996. About 75% of the catches were taken in Skagerrak.

The industrial fisheries yielded a total catch of 141,000 t in 1997, at about the same level as in 1996. Most of the catches consisted of sandeel, Norway pout, herring and sprat (Table 2.2.1.).

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

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. A mesh size of 100mm will be required from 1999.

Overall effort has more than doubled from the early 1980s to early 1990s and has remained at a high level in all the main fleets. (Figure 2.3.1).

Data

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

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

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

State of the stocks

General: As in the North Sea, the 1996 year class has been strong for the stocks cod, sole and plaice. The estimation of the strength of this year class has an important effect on the short and medium term prognosis for each of these stocks. For sole in particular, recent year classes have been slightly above the long term average and could be related to the general warming of water in the Channel in the first quarter of the year.

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

Sole: The stock appears to remain at a relatively high level following good recruitment in the late 1980s and early 1990s. However, fishing mortality has been increasing since 1993 and appears to be near a historically high level in 1997 (F3-8 = 0.54).

Plaice: Fishing mortality is variable and remains close to historically high levels at 0.59 in 1997. The spawning stock has declined since the early 1990s following a similar trend to plaice in the North Sea but has stabilized in recent years. The recruitment of the strong 1996 year class has resulted in a slight increase in CPUE in most fleets in 1997. With the current level of fishing mortality the SSB is expected to remain stable in the medium term. Recruitment since 1985 has fluctuated around the average level except for the strong 1996 year class which seems to be strong as in the North Sea.

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	48	20	104	0	31	117	184	579	502	794	1296
1994	111	80	4	43	10	97	0	33	110	182	766	474	962	1436
1995	139	75	8	41	27	114	0	30	98	241	918	497	1194	1691
1996	126	76	5	36	5	110	0	23	82	166	835	453	1011	1464
1997	124	79	7	31	6	103	0	18	83	201	1140	438	1354	1792

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

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1974	525	314	-	736	62	48	130	42		1857
1975	428	641	-	560	42	41	86	38		1836
1976	488	622	12	435	36	48	150	67		1858
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1674
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1039	63	146	162	28	2	36	1	59	1536
1990	591	71	115	140	22	3	50	8	40	1040
1991	843	110	131	155	28	5	38	1	38	1349
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1994	769	281	40	172	11	5	10	-	19	1307
1995	911	278	66	181	64	8	27	1	15	1551
1996	761	81	39	122	93	5	5	0	13	1119
1997	1091	99	15	126	46	7	7	3	21	1416
Mean 1974-1996	706	214	75	284	55	15	47	10	38	1424
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
1997 q1	37	7	1	11	4	0	1	0	2	65
1997 q2	802	1	2	7	11	3	2	0	4	833
1997 q3	238	28	5	59	16	3	2	2	11	363
1997 q4	13	63	7	49	14	1	1	0	5	155

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

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

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

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

Table 2.2.1 Catches of the most important species in the industrial fisheries in Division IIIa ('000 t), 1974–1996[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
1997	81	12	6	32	4	141
Mean 1974–1997	31	39	52	24	14[4]	157

[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]Mean 1979–1995.

Figure 2.1.1. Fishing effort of the Norwegian and Danish industrial trawlers targeting Norway pout and sandeel in the North Sea.

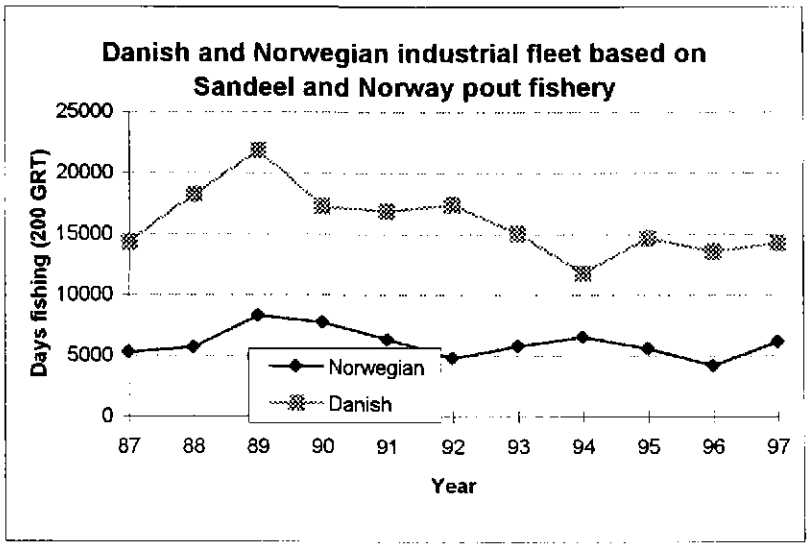
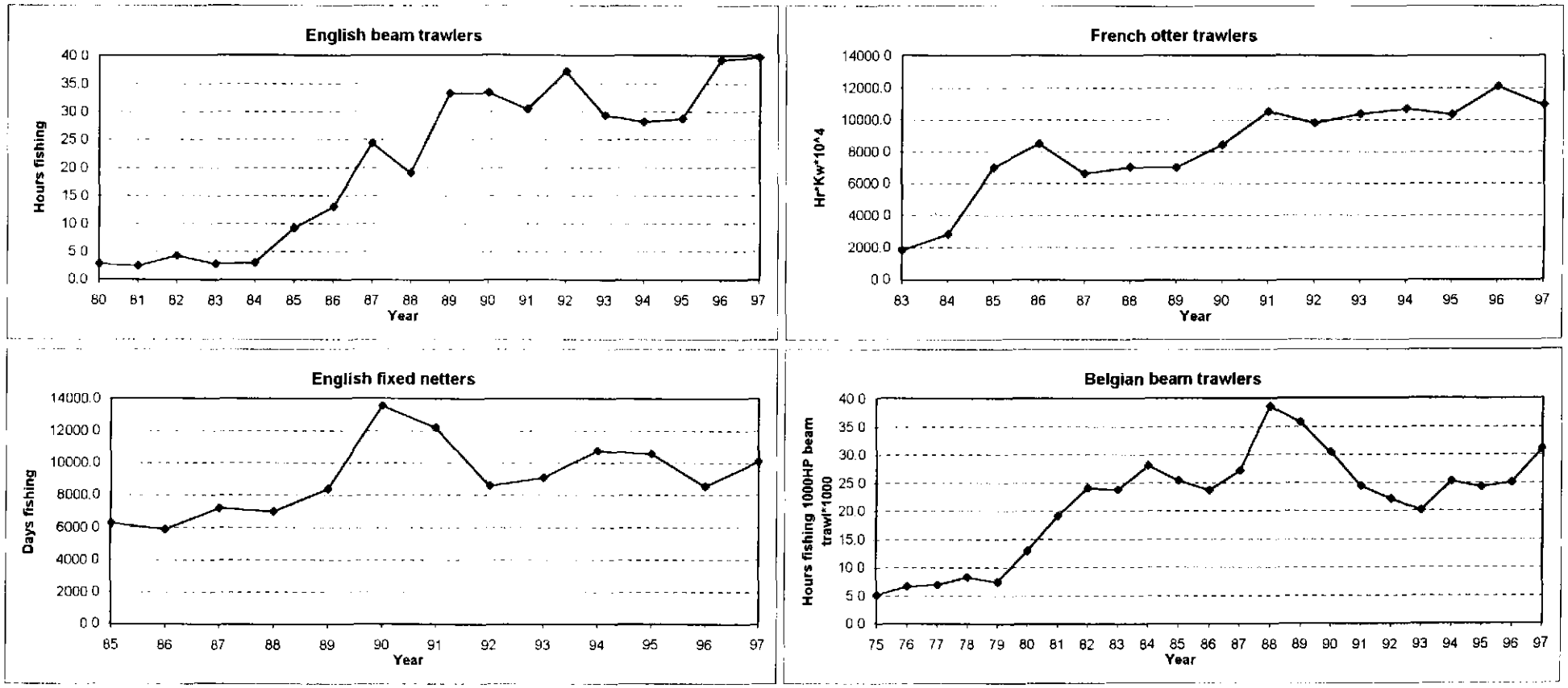


Figure 2.3.1 Fishing effort of demersal fleet in section VIId



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

For the third year in succession, this assessment relates to the cod stock in the Skagerrak (Division IIIa), the North Sea (Sub-area IV), and the Eastern Channel (Division VIId). Prior to 1996 cod in these areas were assessed as separate stocks. A discussion of the implications of a combined assessment was presented in Section 1.3.3.4 of the 1996 report of this working group (ICES 1997e).

3.1 The Fishery

3.1.1 ACFM advice applicable to 1997 and 1998

The advice for 1997 was for a reduction in mean F (2–8) by at least 20% compared to 1995. The catch corresponding to this advice for the three areas combined was 135,000 t.

The advice for 1998 was that fishing mortality should not exceed the 1996 (F = 0.64), which implied landings for Sub-area IV, Divisions IIIa and VIId combined of 180,000 t.

3.1.2 Management applicable in 1997 and 1998

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

	1997	1998
	Agreed TAC (000 t)	Agreed TAC (000 t)
IIIa(Skagerrak)	16,1	20
IIa + IV	115	140

There is no TAC for Cod set specifically for Division VIId separately..

The overall TAC for 1997 corresponded to ACFM advice whereas that for 1998 was set at a level lower than advised by ACFM. The EU minimum mesh size for towed gears, in Sub-area IV and Division IIIa is 100 mm, and 80 mm in Division VIId. Trawlers directed to Nephrops, are permitted to use a 70 mm codend mesh but have to use a 80 mm square mesh panel, and are also subject to whitefish by-catch limits. Trawlers fishing in Division IVc are permitted to use a 90 mm codend mesh in fisheries directed to whiting. The full EU technical measures legislation is available in Council regulation 3094/86 and its amendments. The minimum mesh size for towed gears in Norwegian waters is 100 mm. Minimum landing size for cod in all areas is 35 cm.

In response to a recommendation from the Intermediate Ministerial Meeting (IMM) of March 1997, An additional management measure, a temporary area closure, was implemented in 1998 by Germany. In an attempt to reduce the catch and discarding of undersized cod, the German Government implemented a closure in a restricted area (12 by 25 nm) in the German Bight for the month of February. This was in response to high discard estimates from the German fleet amounting to about 2 million young cod being discarded in the area over the period November 1997 to January 1998 (Ehrlich, *et al.*, Working document, No. 5)

3.1.3 The fishery in 1997

Landings data from human consumption fisheries for recent years as officially reported as well as those estimated by the Working Group are given for each area separately and combined in Table 3.1.1 and the data are plotted in Figure 3.1.1. The Working Group estimate for combined landings in 1997 is 124,151 t, and as follows for the separate areas.

	1997
	Landings 000 t)
IIIa(Skagerrak)	15
IV	102
VIId	7.0
Total	124

Landings from VIId in 1997 were 2 - 3 times higher than in any other year since 1989. The TAC in Sub-area IV and Division VIId was not taken in 1998. The reasons for the shortfall in these areas are not clear The 1996 year class of cod as 1-group was estimated at the 1997 WG meeting to be about the same strength as the 1985 year class. A plot of the catch at age by area in 1997 and 1986 is given in Figure 3.1.2. It is evident that in 1997 and 1986 1-group cod were represented in the landings from VIId in about the same numbers in both years but that in IV and IIIa the 1996 year class was less well represented than in 1986. The same feature can be seen in Figure 3.1.3, which shows the catch in number of 1-group cod by year and area. The WG recognises that the changes to minimum landing size and minimum mesh size introduced in the mid 1980s may explain part of the difference in 1-group catch, but the slower growth of the 1996 year class in Sub-area IV coupled with the increased minimum landing size, could have resulted in higher discarding of 1-group cod in 1997 compared to 1986.

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). Discard sampling carried out for some fleets indicate that between 70% and 90% of 1-year old cod caught in 1997 were discarded. The industrial by-catch of cod, other than that sorted for human consumption, is small.

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

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

Values for natural mortality and maturity are given in Table 3.2.1, and they are unchanged from those used in last year's assessment and are applied to all years. The sources of these data are multi-species VPA as performed by the Multi-species Working Group in 1986 (natural mortality, see Section 1.3.1.3), and the International Young Fish Survey (maturity). These values were derived for the North Sea and are equally applied to the three stock components. Age compositions were provided by Belgium, Denmark, England, France, Germany the Netherlands and Scotland, based on a total of more than 35 thousand age readings (Table 1.3.3.1.2). Mean weight at age data for landings are given in Table 3.2.3. These values were also used as stock mean weights.

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 3.1.1.), but as in previous years, these data were not included in the assessment. Minor revisions to the 1996 landings data were provided by UK (E+W) for Sub-area IV.

3.3 Catch, Effort, and Research Vessel Data

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

3.4 Catch at Age Analysis

Single fleet diagnostics from XSA tuning runs carried out over 20 years with no taper were examined for trends in catchability and fit to the catch data. At its 1997 meeting the WG carried out a thorough examination of tuning fleet data and excluded a number of fleets that contributed little to the tuning. This exercise carried out this year largely supported the decisions made at the 1997 meeting. However closer examination of the log catchability residuals revealed that the age group 1 should be excluded from both the Scottish trawl and English trawl fleets in Sub-area IV. Furthermore data for age 1 only, for the French offshore trawl fleet in VIId gave a good fit to the catch data. Coupled with the fact that this fleet mainly exploits 1-group cod, the WG agreed to include it as a tuning fleet. The effect of including these changes in the tuning was examined in a comparison with exactly the same tuning configuration used at the 1997 meeting of the WG. The results were unaffected.

The final XSA configuration therefore included the same eight fleets as in last years assessment, but excluded age group 1 in the English and Scottish trawl fleets in Sub-area IV, and included the French offshore trawl fleet in VIId.

The complete set of fleet data available for tuning the VPA are given in Table 3.4.1, and are stored on the ICES IFAP system, listed as fleets 1–18. The modified set used for the assessment are listed in Table 3.4.2, and are stored on IFAP as fleets 19–27.

Tuning was performed over the period 1988–1997 with no time taper, and a shrinkage factor of 0.5 was applied to the terminal population estimate. The recruiting age was set at age 1, and catchability was fixed for ages 6 and above. The age range used for VPA was 1 to 11 (the plus group). This was the same configuration as the final VPA in the 1997 assessment, except that the 10-year tuning window was advanced by one year.

The diagnostics from the final XSA run are given in Table 3.4.3. and plots of the log catchability residuals for each fleet from this run are given in Figure 3.4.3. 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. Plots of the log CPUE against log XSA population numbers by fleet and age are given in Figures 3.4.5 to 3.4.13.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and XSA are given in Tables 3.4.4 and 3.4.5 and are summarised in Table 3.4.6.. The results from a retrospective analysis using XSA with the options specified above are shown in Figure 3.4.14. The present assessment indicates that F for 1996 was underestimated in the 1997 assessment. Since it was only possible to carry out a retrospective run over 3 years using a 10-year tuning window, it was not possible to detect any pattern in the retrospective runs.

3.5 Recruitment Estimates

Average recruitment in the period 1963–1995 was 399 million (arithmetic mean) or 342 million (geometric mean) 1-year old fish. The GM recruitment in the recent period 1987–1995 is 250 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 1996, on the criterion of a minimum cumulative F of 1.0, to estimate recruitment at age 1 of the 1996, 1997 and 1998 year classes, and the 1996 year class at age 2 in 1998. The indices for the English groundfish surveys after 1991 have been adjusted to take account of the change of gear to the GOV trawl in 1992. Estimates from the Scottish GFS in 1998 were not included since this year the survey was carried out using a new vessel and different gear and comparability evaluations have not yet been undertaken. The results of survey indices regressed against XSA recruitment at age 1 are presented in Table 3.5.2.1 and those against age 2 are given in Table 3.5.2.2.

Year class 1996: RCT3 predicts the 1996 year class at age 1 as 557 million, compared to the XSA estimate of 390 million. The predicted recruitment of this year class in last years assessment from RCT3 was 528 million. The RCT3 estimate of the 1996 year class at age 2 in 1998 is 218 million compared to the XSA estimate of 160 million. Both XSA estimates are poorly defined and indicate that the 1996 year class is about average (AM). Evidence from surveys and the fishery in 1997 and 1998, points to a stronger than average 1996 year class. Furthermore, the RCT3 estimate is based on additional information from surveys in 1998. Hence for predictions, the XSA estimates was replaced with the RCT3 estimates of the 1996 year class both at age 1 and at age 2.

Year class 1997: The weighted mean estimated by RCT3 using 1 group recruitment from XSA was 71 million 1-year olds in 1997. The estimate using XSA 2-group estimates was 31 million at age 1 in 1998. Both of these estimates point to the 1997 year class being the lowest on record. The RCT3 v XSA 1-group estimate of 71 million was accepted by the Working Group.

Year classes 1998 and 1999. The only recruitment estimate available for the 1998 year class at age 1 in 1999, is derived from the EGFSQ4 research vessel survey 0-group index. The RCT 3 output (Table 3.5.2.1) indicates that the survey estimate (224 million) is less than the long-term GM (342, XSA: 330 million, RCT3). 70% of the RTC3 estimate of the 1998 year class is derived from the long-term mean. Since recruitment has been lower in the recent time period than in the earlier period, the WG decided to use the short-term mean XSA estimate of 250 million (1986–1995) for the 1998 year class, a value which is close to that predicted by the survey.

The short-term GM (250 million at age 1) was chosen as the appropriate estimate of recruitment for the 1999 year class.

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

Year-class	Millions (age 1)	Millions (age 2)	Basis
1996	557	218	RCT3
1997	71		RCT3
1998	250		Short-term GM
1999	250		Short-term GM

3.6 Historical Stock Trends

Historical trends in mean fishing mortality, landings, spawning stock biomass, and recruitment are shown in Table 3.4.6 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 overall decline since 1993. The estimate of reference F for 1996 on 2–8 year olds has been revised from 0.64 in the 1997 assessment to 0.73 in the current assessment. 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 still estimated the largest since 1985. Historically, landings increased in the 1960s and early 1970s to reach a peak of 350,000 t in 1972. After a further peak of about 335,000 t in 1981, landings have declined to levels similar to those observed in the early 1960s.

3.7 Short Term Forecast

The input data for the catch prediction are given in Table 3.7.1, and the parameter label values for the sensitivity plots are shown in Table 3.7.2. The CVs used for the population numbers are the values associated with the RCT3 estimates used. For all other parameters, the values supplied by the program INSENS were used. The mean weight at age is the average for the period 1995–97 The fishing mortality is the unscaled mean for the same period. Population numbers in 1998 are XSA survivor estimates, except for ages 1 and 2 which were derived using RCT3.

The results of a *status quo* landings prediction for 1998 and 1999 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 182,000 t for 1998, and 158,000 t for 1999. Spawning biomass is estimated to be 136,000 t at the start of 1998, and 145,000 t in 1999. Continued fishing at *status quo* gives an estimate of SSB in 2000 of 148,000 t. The detailed output tables (Table 3.7.4 and Figure 3.7.2) confirm the importance of the estimate of the strength of the 1996 year class to predicted landings in 1998. About 50% of the predicted landings in 1998 and 1999 are accounted for by this year class which is also predicted to contribute 45% to the spawning stock in 2000.

The results of sensitivity analyses of the *status quo* catch prediction are shown in Figures 3.7.3 and 3.7.4, with the input parameters given in Table 3.7.2. The sensitivity of the predictions (Figure 3.7.3) to the various input parameters shows that the predicted yield in 1999 is mostly dependent on the estimates of overall fishing mortality (HF) in 1998 and 1999 followed by the strength of the 1996 year class. 15% of the variance in the estimate of yield in 1999 is attributed to the assumption of F in that year, with a further 30% of the variance dependent on the variability of the estimate of the 1996 year class.

The results also indicate that the estimate of SSB in 2000 is sensitive to the assumptions about fishing mortality in 1998 and 1999, with 20% of the variance of the estimate of SSB in 2000 dependent on the variance of the 1996 year class estimate.

Figure 3.7.4 shows probability profiles for yield and spawning biomass in 1999 and 2000 respectively.

3.8 Medium term projections

Projections were run for *status quo* F for a 10 year period to estimate probabilities of predicted yields. The input values are given in Table 3.7.2. Four different stock-recruit relationships were fitted to the stock and recruit data (Shepherd, Ricker, Beverton and Holt and Gamma). None of the fits were significant. In an attempt to objectively choose the most appropriate fit, each was compared to a LOWESS smoother (span 0.75, log-transformed recruits) through the stock-recruit data, to test which of the models gave the closest match to the recruitment predicted by the smoother. It was clear that over the recent period (since the mid 1980s), the Shepherd model gave the closest match to the LOWESS estimates.

None of the curves gave a good match earlier than the 1980s. The Working Group, therefore, decided that for medium term projections, the Shepherd model was the most appropriate.

Medium term projections were carried out using the software WGMTERMA. The results of medium term projections are given in Figure 3.8.1. For *status quo* F, Spawning stock biomass is predicted to increase over the next 10 years.

The medium term trajectories differ markedly from those presented in the 1997 report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (ICES 1998, Figure 3.8.1). This is partly a visual perception since the percentiles plotted in the 2 figures are different. However it is probably also a function of the different starting values for the projections. The exploitation patterns differ; with a higher F on 2 and 3 year olds in the current projection; 0.67 and 0.84 compared to 0.57 and 0.71 in the previous projection respectively. The estimate of the size of the 1997 year class as 1 year olds has been revised downwards to 71 million from 259 million.

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 4 years and SSB has recovered slightly from the lowest recorded levels of the early 1990s. Inputs for long-term equilibrium yield and SSB-per-recruit analyses are given in Table 3.9.1 and results are presented in Table 3.9.2 and Figure 3.7.1C. The stock recruit relationship showing Fhigh, F_{med} and Fcurrent is given in Figure 3.9.1.

3.10 Biological reference points

Biological reference points were estimated using the PA software developed at CEFAS, Lowestoft. These are given in Figure 3.10.1 and the assumptions used for the calculations are given in Table 3.10.1. Graphical output from PA software calculations are shown in Figure 3.10.2

The Working Group proposes that B_{lim} be equated to B_{loss} for North Sea cod. The lowest observed SSB in the historic series is 66,000 t. Since there is a degree of uncertainty in this estimate, a value of 70,000 t therefore seems to be a suitable candidate for B_{lim}.

The Working Group suggests that B_{pa} be set as 150,000 t, the SSB below which there is evidence of impaired recruitment.

In an attempt to evaluate the suitability of different values of F that can be considered as precautionary, the software WGMTERMA, was used to estimate the probability of SSB being below B_{pa} in 2007. Based on the criteria outlined in Section 3.8, a Shepherd Stock-recruit relationship was assumed. The fitted parameters of the Shepherd model and residuals are given in Table 3.10.2. A comparative run was made assuming a Ricker stock-recruit model, and the fitted parameters and residuals are also given in Table 3.10.2. The results of the two runs are presented in Tables 3.10.3 and 3.10.4. The comparison highlights the sensitivity of the medium-term projections to the stock recruit model chosen. It appears for the Shepherd model, there is a 10% probability of SSB being below B_{pa} (150,000 t), by 2007 at a reference F (2–8) of 0.7, but a 95% probability if $F = F_{loss}$ (0.86). For the Ricker model however, these probabilities values are extremely different. The model predicts that the F associated with the 10% probability of being below B_{pa} in 2007 is F = 2.0, which is more than double the highest historic F. Clearly, the estimates derived using a Ricker fit are unrealistic.

The results from using the Shepherd model suggests that a value of about F = 0.7 could be a candidate for F_{pa}, and that this value is rather consistent with the history of the stock. Examination of Figure 3.10.3 indicates that as the exploitation level increased above about F = 0.7 in the 1970s and 1980s, the SSB declined to a historic low in the early 1990s. Since 1993, there has been a decline in F to about 0.7, and the SSB is recovering.

The Working Group therefore suggests that the results of projections carried out using the Shepherd model for stock and recruitment may be appropriate to use for the estimation of precautionary reference points and proposes that F_{pa} could be set in the region of F = 0.7, which suggests a 90% probability of the SSB being above the suggested B_{pa} value of 150,000 t by 2007.

3.11 Comments on the Assessment

The overall patterns of F, recruitment and SSB are relatively consistent with the assessment presented in last year's report. However, the main difference is an upward revision of reference fishing mortality for 1996 from 0.64 to about

0.73, and reduced estimates of SSB for 1995 and 1996 of 77,000 t and 91,000 t, compared to 81,000 t and 104,000 t estimated at the 1997 meeting.

It appears that for some fleets the TAC in 1997, was not restrictive since they did not exhaust their quota.

The analysis carried out comparing the use of different stock recruit relationships in medium term projections, indicated that the estimates of precautionary reference points are highly sensitive to the relationship used.

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

Sub-area IV

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

Division VIId

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

Division IIIa (Skagerrak)

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

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

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

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

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

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

Table 3.2.2

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)
At 10-Oct-98 14:59:39

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

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

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

	YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
	AGE										
	1,	5829,	2947,	54493,	44824,	3832,	25966,	15562,	33378,	5724,	75413,
	2,	83836,	22674,	33917,	155345,	187686,	31755,	58920,	47143,	100283,	51118,
	3,	42586,	31578,	18488,	17219,	48126,	54931,	11404,	18944,	18574,	25621,
	4,	12392,	13710,	13339,	6754,	5682,	14072,	15824,	4663,	6741,	4615,
	5,	6076,	4565,	6297,	7101,	2726,	2206,	4624,	7563,	1741,	2294,
	6,	1414,	2895,	1763,	2700,	3201,	1109,	961,	2067,	3071,	836,
	7,	870,	588,	961,	893,	1680,	1060,	438,	449,	924,	1144,
	8,	309,	422,	209,	458,	612,	489,	395,	196,	131,	371,
	9,	151,	147,	186,	228,	390,	80,	332,	229,	67,	263,
	10,	111,	46,	98,	77,	113,	58,	81,	95,	63,	26,
	+gp,	24,	78,	40,	94,	18,	162,	189,	63,	43,	96,
0	TOTALNUM,	153598,	79650,	129791,	235693,	254066,	131888,	108730,	114790,	137362,	161797,
	TONSLAND,	288368,	200760,	226124,	328098,	353976,	239052,	214279,	205245,	234169,	209154,
	SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 3.2.2 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)
At 10-Oct-98 14:59:39

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

	YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
	AGE										
	1,	29731,	34837,	62605,	20279,	66777,	25733,	64751,	8845,	100239,	24915,
	2,	175727,	91697,	104708,	189007,	65299,	129632,	66428,	118047,	32437,	128282,
	3,	17258,	44653,	35056,	34821,	60411,	21662,	31276,	18995,	34109,	9800,
	4,	9440,	4035,	12316,	9019,	9567,	11900,	4264,	7823,	5814,	8723,
	5,	3003,	3395,	1965,	4118,	3476,	2830,	3436,	1377,	2993,	1534,
	6,	1108,	712,	1273,	785,	2065,	1258,	1019,	1265,	604,	1075,
	7,	410,	398,	495,	604,	428,	595,	437,	373,	556,	235,
	8,	405,	140,	197,	134,	236,	181,	244,	173,	171,	215,
	9,	153,	158,	74,	65,	78,	90,	60,	79,	69,	55,
	10,	36,	42,	55,	37,	27,	28,	45,	16,	44,	48,
	+gp,	44,	17,	25,	21,	16,	23,	20,	31,	23,	12,
0	TOTALNUM,	237315,	180084,	218769,	258890,	208380,	193932,	171980,	157024,	177059,	174894,
	TONSLAND,	297022,	269973,	293644,	335497,	303251,	259287,	228286,	214629,	204053,	216213,
	SOPCOF %,	100,	101,	100,	100,	99,	100,	100,	100,	101,	100,

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

	YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
	AGE										
	1,	21480,	22239,	11738,	13466,	27668,	4783,	15557,	15717,	4938,	23768,
	2,	55330,	36358,	54290,	23456,	32059,	55272,	25279,	63586,	36805,	29191,
	3,	43955,	18193,	11906,	16776,	8682,	11360,	21144,	12943,	23364,	18645,
	4,	3134,	9866,	4339,	3310,	5007,	3190,	3083,	5301,	3169,	6498,
	5,	2557,	1002,	2468,	1390,	1060,	1577,	870,	802,	1860,	1238,
	6,	655,	1036,	310,	1053,	491,	435,	519,	286,	399,	700,
	7,	295,	251,	310,	225,	329,	204,	142,	151,	162,	153,
	8,	66,	140,	54,	139,	52,	108,	58,	42,	88,	47,
	9,	63,	27,	60,	28,	40,	18,	32,	15,	43,	14,
	10,	23,	31,	12,	4,	17,	10,	7,	13,	4,	15,
	+gp,	18,	10,	9,	10,	9,	13,	16,	5,	8,	10,
0	TOTALNUM,	127576,	89153,	85496,	59857,	75414,	76970,	66707,	98861,	70840,	80279,
	TONSLAND,	184240,	139936,	125314,	102478,	114020,	121749,	110634,	138623,	126454,	124151,
	SOPCOF %,	100,	100,	99,	100,	99,	99,	99,	100,	100,	100,

Table 3.2.3.

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)

At 10-Oct-98 14:59:39

Table 2 Catch weights at age (kg)

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

Table 2 Catch weights at age (kg)

	YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
	AGE										
	1,	.6400,	.5440,	.6260,	.5790,	.6160,	.5590,	.5940,	.6190,	.5680,	.5420,
	2,	.9730,	.9210,	.9610,	.9410,	.8360,	.8690,	1.0390,	.8990,	1.0290,	.9480,
	3,	2.2230,	2.1330,	2.0410,	2.1930,	2.0860,	1.9190,	2.2170,	2.3480,	2.4700,	2.1600,
	4,	4.0940,	3.8520,	4.0010,	4.2580,	3.9680,	3.7760,	4.1560,	4.2260,	4.5770,	4.6070,
	5,	5.3410,	5.7150,	6.1310,	6.5280,	6.0110,	5.4880,	6.1740,	6.4040,	6.4940,	6.7130,
	6,	8.0200,	6.7220,	7.9450,	8.6460,	8.2460,	7.4530,	8.3330,	8.6910,	8.6200,	8.8280,
	7,	8.5810,	9.2620,	9.9530,	10.3560,	9.7660,	9.0190,	9.8890,	10.1070,	10.1320,	10.0710,
	8,	10.1620,	9.7490,	10.1310,	11.2190,	10.2280,	9.8100,	10.7900,	10.9100,	11.3410,	11.0520,
	9,	10.7200,	10.3840,	11.9190,	12.8810,	11.8750,	11.0770,	12.1750,	12.3390,	12.8880,	11.8240,
	10,	12.4970,	12.7430,	12.5540,	13.1470,	12.5300,	12.3590,	12.4250,	12.9760,	14.1400,	13.1340,
	+gp,	11.5950,	11.5670,	14.3670,	15.5440,	14.3500,	12.8860,	13.7310,	14.4310,	14.5570,	14.3620,
0	SOPCOFAC,	.9999,	.9999,	1.0000,	.9998,	1.0001,	.9999,	.9999,	.9999,	1.0000,	.9999,

Table 3.2.3. (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)

At 10-Oct-98 14:59:39

Table 2 Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	.5720,	.5500,	.5500,	.7230,	.5890,	.6320,	.5940,	.5900,	.5830,	.6350,
2,	.9370,	.9360,	1.0030,	.8370,	.9620,	.9190,	1.0070,	.9330,	.8560,	.9760,
3,	2.0010,	2.4110,	1.9480,	2.1890,	1.8580,	1.8350,	2.1560,	2.1400,	1.8340,	1.9550,
4,	4.1460,	4.4230,	4.4010,	4.6150,	4.1300,	3.8800,	3.9720,	4.1640,	3.5040,	3.6500,
5,	6.5310,	6.5800,	6.1090,	7.0450,	6.7840,	6.4910,	6.1900,	6.3240,	6.2300,	6.0520,
6,	8.6670,	8.4750,	9.1200,	8.8840,	8.9030,	8.4230,	8.3620,	8.4300,	8.1400,	8.3070,
7,	9.6860,	10.6370,	9.5500,	9.9340,	10.3990,	9.8480,	10.3170,	10.3620,	9.8960,	10.2420,
8,	11.0990,	11.5500,	11.8670,	11.5190,	12.5000,	11.8370,	11.3520,	12.0730,	11.9400,	11.4610,
9,	12.4270,	13.0570,	12.7820,	13.3380,	13.4690,	12.7970,	13.5050,	13.0720,	12.9510,	12.4470,
10,	12.7780,	14.1480,	14.0810,	14.8970,	12.8900,	12.5620,	13.4080,	14.4430,	13.8590,	18.6910,
+gp,	13.9810,	15.4780,	15.3920,	16.6290,	14.6080,	14.4260,	13.4720,	16.5880,	14.7070,	16.6040,
SOPCOFAC,	1.0035,	1.0087,	.9963,	.9985,	.9946,	.9968,	.9992,	.9951,	1.0098,	.9969,

Table 2 Catch weights at age (kg)

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
1,	.5860,	.6730,	.7370,	.6700,	.6990,	.6990,	.6780,	.7210,	.6990,	.6560,
2,	.8810,	1.0520,	.9760,	1.0780,	1.1460,	1.0650,	1.0750,	1.0200,	1.1170,	.9610,
3,	1.9820,	1.8460,	2.1760,	2.0370,	2.5460,	2.4790,	2.2010,	2.2100,	2.1470,	2.1200,
4,	3.1870,	3.5850,	3.7910,	3.9710,	4.2230,	4.5500,	4.4710,	4.2920,	4.0340,	3.8220,
5,	5.9920,	5.2730,	5.9320,	6.0830,	6.2480,	6.5400,	7.1670,	7.2200,	6.6370,	6.2290,
6,	7.9140,	7.9210,	7.8890,	8.0340,	8.4830,	8.0940,	8.4360,	8.9800,	8.4940,	8.3950,
7,	9.7640,	9.7250,	10.2350,	9.5450,	10.1020,	9.6410,	9.5360,	10.2830,	9.7290,	9.9810,
8,	12.1270,	11.2110,	10.9240,	10.9490,	10.4810,	10.7350,	10.3230,	11.7430,	11.0800,	11.4270,
9,	14.2420,	12.5860,	12.8020,	13.4810,	11.8500,	12.3290,	12.2240,	13.1070,	12.2640,	12.3060,
10,	17.7870,	15.5570,	15.5250,	13.1700,	13.9050,	13.4430,	14.2470,	12.0520,	12.7560,	12.4680,
+gp,	16.4770,	14.6940,	23.2330,	14.9890,	15.7940,	13.9610,	12.5230,	13.9540,	11.3040,	13.1330,
SOPCOFAC,	1.0001,	.9950,	.9945,	.9970,	.9929,	.9948,	.9940,	1.0018,	.9999,	1.0000,

Table 3.4.1 Tuning fleets available for COD in IIIa (Skagerrak), IV and VIId

Fleet code	Fleet	First Year	Last Year	First Age	Last Age
SCOTRL_IV	Scottish trawl (IV)	1978	1997	1	10
SCOSEI_IV	Scottish seine (IV)	1978	1997	1	12
SCOLTR_IV	Scottish light trawl (IV)	1978	1997	1	11
ENGTRL_IV	English trawl (IV)	1978	1997	1	12
ENGSEI_IV	English seine (IV)	1978	1997	1	12
FRATRB_IV	French trawl (IV)	1978	1997	1	11
FRATRO_IV	French trawl offshore (IV)	1986	1997	1	7
SCOGFS_IV	Scottish groundfish survey (IV)	1982	1997	1	6
ENGGFS_IV	English groundfish survey (IV)	1977	1997	1	5
IBTS_Q1_IV	Int. bottom trawl survey Q1 (IV)	1976	1997	1	6
IBTS_Q2_IV	Int. bottom trawl survey Q2 (IV)	1991	1997	1	6
IBTS_Q4_IV	Int. bottom trawl survey Q4 (IV)	1991	1996	1	6
FRATRO_7d	French trawl offshore (VIId)	1986	1997	1	9
Den_Gill_Skag	Danish gill net (IIIa)	1987	1995	1	7
Den_Neph_Skag	Danish nephrops trawl	1987	1995	1	7
Den_Trawl_Skag	Danish trawl (IIIa)	1987	1995	1	7
Den_Sei_Skag	Danish seine (IIIa)	1987	1995	1	7
IBTS_Skag	Int. bottom trawl survey (IIIa)	1983	1995	1	6

Table 3.4.2 Tuning fleets used for COD in IIIa (Skagerrak), IV and VIID

```
Cod in Fishing Areas IV, Skagerrak and VIId (run name: XSALJB02)
109
FLT19: SCOTRL_IV (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
2 6
    135220   1424.419    285.883    181.926     63.974     15.993
     87467    914.453    447.243     73.875     46.921     22.961
     55475    849.920    379.327    127.393     19.965     19.965
     51553    928.202    387.683    113.695     51.256     13.979
     47889    305.760    389.066     73.236     17.394      6.408
     48339   1427.663    208.383    112.430     23.261      9.692
     34574    772.341    345.964     32.726     16.831      7.480
     33103    781.283    196.005     79.313      9.116      4.558
     27839    190.609    256.042     19.914     10.431      0.948
     27208    606.030     38.463     39.401      8.443      1.876
     21559    346.285    159.513      8.077      8.077      4.038
     16657     29.428    134.388     40.929      2.974      2.233
     14325    327.585     18.792     22.486      5.118      1.215
     13495     94.909    103.953      7.731      6.998      1.718
     10887     99.870     30.235     33.291      1.153      1.211
     11657    124.610     31.231      4.273      6.325      0.634
     15671     40.799    124.960      9.461      1.713      1.656
     17728    254.011     93.718     49.032      1.501      0.465
     13471    139.583    108.299     23.909     15.045      1.580
     12651     81.864     91.362     26.785      4.988      2.978


FLT20: SCOSEI_IV (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
1 10
    325246   1703.941  14715.490   1385.952    850.971    201.993     47.998     22.999     20.999      8.000      3.000
    316419   2522.256   8021.633   3257.039    382.887    344.898     66.980     43.987     18.994     11.996      3.999
    297227   1067.994   5957.458   2341.237    828.826    144.370     89.579     33.049     14.785      8.697      4.349
    289672    855.604  13328.760   2355.389    698.688    204.816     18.169     10.736     12.388      3.303      0.000
    297730   4070.478   4794.063   6023.739    822.294    291.107    151.409     25.095     20.913     11.711      0.837
    333168   1342.728  13320.380   1813.966   1289.703    227.494     98.353     39.341     18.815     15.394      2.566
    388085   4839.125   9954.796   3783.950    453.752    381.259    108.292     46.539     25.954      6.265      7.160
    382910    543.929  18367.311   2498.646    835.287    127.187    107.343     26.159     24.355      9.922      3.608
    425017   5425.851   2656.135   6865.172    824.863    285.816     42.826     38.171     13.965      7.448      2.793
```

Table 3.4.2. (Continued)

```
    418536    1361.396   13452.120     680.241    1423.568     283.434     186.518      24.686      35.658      15.543       4.572
    377132     842.968    7091.734    4631.826     201.992     471.982     131.995      55.998      15.999      10.000       3.000
    355735    1684.028    3495.714    3173.118    1092.297      91.156     185.066      44.650      18.698       2.391       7.744
    270869     379.134   12625.370    1096.540     671.531     291.604      38.807      50.407      11.534       3.699       1.793
    336675    1708.483    4746.648    2986.177     241.370     173.924     113.164      32.981      25.229       7.592       0.570
    300217    1056.525    4120.136     942.427     618.214      97.903      59.252      31.805       8.852       8.416       3.235
    268413     259.816    5561.367     776.714     208.932     142.388      26.401      19.572       9.165       2.347       0.806
    264738    1172.846    3129.865    2378.035     301.222      60.540      37.716      13.282       5.077       2.267       0.873
    204545     743.283    8029.209     912.815     496.574      84.516      21.557      16.616       0.914       0.967       0.903
    177092     303.656    3696.333    2598.453     239.201     165.108      19.699       8.662       5.688       1.849       1.188
    166817     740.271    2267.133    1581.460     687.769     118.726      71.214      17.325       6.006       2.108       0.850
FLT21: SCOLTR_IV (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
1 8
    236929    2255.601    5379.048     670.881     269.952      50.991      27.995       6.999       7.999
    207494    1973.132    5845.391    1808.121     178.012      61.004      15.001       3.000       4.000
    333197    1849.470    5356.235    2100.709     549.199      71.405      15.868       4.408       3.526
    251504     690.987    5236.821    1474.781     293.606      81.839      10.968       5.906       0.000
    250870    4703.856    2940.357    2301.849     377.382     109.995      39.348       8.048       6.260
    244349    1321.201    6293.185    1020.032     459.821     111.146      31.372      14.341       5.378
    240725    2723.570    3022.983    1543.958     180.369      85.675      36.074       9.920       7.215
    268136     430.874    5959.050     865.407     293.653      39.337      21.041       3.659       2.744
    279767    4140.451    1166.751    1847.672     250.965      95.651      12.311       8.523       4.735
    351131    2045.224    5662.771     530.278     468.273      45.347      31.465      10.180       5.553
    391988     403.133    3300.276    1912.375     133.375     148.417      33.093      14.039       2.006
    405883    1574.048    1205.534    1594.526     565.712      48.605      45.236      13.343       3.382
    398153     327.094    5739.588     523.696     456.829     179.523      25.746      11.324       3.712
    408056    1821.110    1904.532    2125.128     138.039      94.188      48.099       8.199       8.482
    473955    1401.577    2749.504     747.952     646.729      44.077      36.368      11.912       2.053
    447064     250.643    4891.675    1262.363     163.983      80.122       9.885       5.161       3.794
    480400     722.752    1924.201    2364.757     370.592      47.312      42.371       5.792       2.346
    442010     879.046    5807.931    1579.502     797.169      73.989       8.577       6.861       0.637
    445995     448.536    4060.709    3048.116     424.148     296.499      31.730       9.559       5.477
    479449    1477.022    2931.063    2805.271     808.326     112.982     114.511      10.293       0.947
FLT22: ENGTRL_IV (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
2 8
    559930   10576.000    1093.000     987.000     338.000     117.000      57.000      60.000
    553020    7698.000    3341.000     393.000     403.000      99.000      54.000      15.000
    442036    3786.000    2106.000     865.000     122.000     114.000      38.000      16.000
    423658   12703.000    1886.000     535.000     250.000      38.000      48.000       8.000
```

```
    424272    3063.000    3802.000     587.000     298.000     179.000      35.000      24.000
    392364   14220.000    1185.000     907.000     127.000      87.000      49.000      16.000
    358387    3459.000    2656.000     267.000     217.000      42.000      32.000      16.000
    342844    8212.000    1047.000     533.000      72.000      54.000      16.000      10.000
    288867    2107.000    2388.000     209.000     161.000      15.000      12.000       4.000
    275899   10435.000     682.000     596.000      36.000      26.000       3.000       4.000
    296092    2102.000    2428.000      90.000     126.000      17.000      10.000       0.000
    310444    1958.000     718.000     501.000      25.000      34.000       5.000       4.000
    255314    3101.000     513.000     134.000     101.000      11.000      13.000       4.000
    258037    1559.000    1092.000      88.000      25.000      17.000       2.000       2.000
    223702    2171.000     481.000     234.000      19.000       5.000       5.000       0.000
    209869    4054.000     442.000      96.000      55.000       5.000       3.000       2.000
    184764    2454.287    1146.382      78.190      14.284       7.036       1.762       0.673
    173463    3799.572     871.882     158.030      11.028       2.992       1.896       0.662
    159155    3179.345    1646.846     189.238      43.970       6.812       1.649       1.464
    152030    2752.811     890.250     334.563      41.120      14.836       2.063       0.781
FLT23: ENGSEI_IV (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
1 10
    203382     898.000   12831.000     746.000     547.000     131.000      78.000      21.000      37.000       9.000       1.000
    187180    1718.000    7004.000    2438.000     162.000     280.000      76.000      35.000      14.000      18.000       4.000
    201169    2111.000    7760.000    1370.000     611.000     146.000     210.000      54.000      29.000       9.000      12.000
    185423     343.000   12689.000    1053.000     398.000     359.000      61.000      74.000      12.000       8.000       6.000
    183209    1486.000    3191.000    2473.000     330.000     294.000     189.000      38.000      31.000       9.000       3.000
    177004     566.000    4741.000     573.000     557.000     207.000     150.000     104.000      18.000      17.000       8.000
    167699    1232.000    1513.000    1215.000     147.000     290.000      72.000      50.000      32.000       6.000       5.000
    157815     125.000    3242.000     326.000     241.000      72.000     117.000      40.000      27.000      13.000       4.000
    136358     890.000     312.000     572.000      65.000     139.000      34.000      52.000      13.000       7.000       7.000
    123281     262.000    2395.000      82.000     184.000      44.000      77.000      10.000      22.000       8.000       2.000
     91178     297.000     879.000     594.000      19.000      80.000      19.000      12.000       3.000       3.000       1.000
     88782     343.000     748.000     216.000     138.000       9.000      46.000       7.000       8.000       1.000       2.000
     80537     176.000    1009.000     116.000      45.000      58.000       4.000      15.000       3.000       1.000       1.000
     84346     129.000     262.000     207.000      33.000      26.000      38.000       6.000      16.000       1.000       1.000
     67810     408.000     463.000      57.000      42.000      10.000       8.000       8.000       2.000       3.000       0.000
     54574      44.000     497.000      41.000      19.000      22.000       4.000       3.000       2.000       0.000       1.000
     39667     163.456     265.085     138.494      11.373      17.040      14.114       3.077       0.889       0.519       0.070
     28406      91.043     444.628      83.186      21.000       5.216       3.742       5.623       3.043       0.608       0.162
     14991      18.371     196.618     166.980      19.592      16.881       4.434       1.542       1.136       0.148       0.240
     11823      23.430      76.342      35.304      27.906       6.115       5.284       1.700       0.333       0.357       0.260
FLT24: SCOGFS_IV (Catch: Unknown) (Effort: Unknown)
1982 1997
1 1 0.50 0.75
```

Table 3.4.2. (Continued)

```
1 6
   100   0.614285714   0.350649351   0.571428571   0.180519481   0.092207792   0.059740260
   100   0.325316456   0.781012658   0.181012658   0.197468354   0.074683544   0.022784810
   100   0.819512195   0.390243902   0.253658537   0.050000000   0.057317073   0.015853659
   100   0.066265060   1.142168675   0.196385542   0.112048193   0.030120482   0.024096386
   100   0.801250000   0.105000000   0.396250000   0.057500000   0.040000000   0.018750000
   100   0.219178082   0.749315068   0.034246575   0.091780822   0.028767123   0.006849315
   100   0.162790698   0.288372093   0.165116279   0.025581395   0.032558140   0.011627907
   100   0.561627907   0.134883721   0.168604651   0.094186047   0.019767442   0.008139535
   100   0.114117647   0.490588235   0.058823529   0.074117647   0.025882353   0.009411765
   100   0.303333333   0.154444444   0.133333333   0.013333333   0.005555556   0.004444444
   100   0.642528736   0.193103448   0.072413793   0.066666667   0.028735632   0.018390805
   100   0.347126437   0.749425287   0.101149425   0.025287356   0.011494253   0.003448276
   100   1.158000000   0.334000000   0.288000000   0.031000000   0.012000000   0.007000000
   100   0.475000000   1.443000000   0.130000000   0.085000000   0.011000000   0.007000000
   100   0.318000000   0.356000000   0.542000000   0.074000000   0.034000000   0.004000000
   100   0.999000000   0.278000000   0.224000000   0.102000000   0.022000000   0.010000000
FLT25: ENGGFS_IV (Catch: Unknown) (Effort: Unknown)
1977 1997
1 1 0.50 0.75
1 5
   100   6.269369369   0.447747748   0.323423423   0.057657658   0.010810811
   100   2.284070796   1.249557522   0.098230088   0.099115044   0.013274336
   100   2.423076923   0.580341880   0.200000000   0.027350427   0.035897436
   100   5.084347826   0.670434783   0.153043478   0.073043478   0.011304348
   100   1.135964912   1.386842105   0.127192982   0.038596491   0.040350877
   100   3.237500000   0.290277778   0.329166667   0.052777778   0.037500000
   100   1.539189189   1.095945946   0.120270270   0.110810811   0.028378378
   100   6.121951220   0.474390244   0.178048780   0.040243902   0.020731707
   100   0.430136986   1.189041096   0.106849315   0.056164384   0.020547945
   100   3.437804878   0.114634146   0.202439024   0.029268293   0.010975610
   100   1.422077922   1.064935065   0.027272727   0.061038961   0.014285714
   100   0.836000000   0.406666667   0.198666667   0.001333333   0.042666667
   100   2.284705882   0.248235294   0.118823529   0.061176471   0.005882353
   100   0.608139535   0.503488372   0.060465116   0.013953488   0.011627907
   100   0.751724138   0.155172414   0.072413793   0.012643678   0.003448276
   100   2.440540541   0.158108108   0.045945946   0.035135135   0.008108108
   100   0.742253521   0.650704225   0.081690141   0.015492958   0.016901408
   100   2.636970000   0.295300000   0.153850000   0.018690000   0.004990000
   100   1.028000000   1.277000000   0.119000000   0.056000000   0.002000000
   100   0.619000000   0.668000000   0.162000000   0.018800000   0.019600000
   100   4.044000000   0.284000000   0.054000000   0.025200000   0.001500000
FLT26: IBTS_Q1_IV (Catch: Unknown) (Effort: Unknown)
```

```
1976 1997
1 1 0.00 0.25
1 6
   1     7.9    19.9    -1.0    -1.0    -1.0    -1.0
   1    36.7     3.2    -1.0    -1.0    -1.0    -1.0
   1    12.9    29.3    -1.0    -1.0    -1.0    -1.0
   1     9.9     9.3    -1.0    -1.0    -1.0    -1.0
   1    16.9    14.8    -1.0    -1.0    -1.0    -1.0
   1     2.9    25.5    -1.0    -1.0    -1.0    -1.0
   1     9.2     6.7    -1.0    -1.0    -1.0    -1.0
   1     3.9    16.6     2.7     1.8     0.8     1.5
   1    15.2     8.0     3.9     0.9     1.0     0.9
   1     0.9    17.6     3.5     1.7     0.5     1.0
   1    17.0     3.6     6.8     2.3     1.3     1.1
   1     8.8    28.8     1.4     1.7     0.6     0.9
   1     3.6     6.1     5.8     0.6     0.9     1.1
   1    13.1     6.3     5.0     2.3     0.4     1.0
   1     3.4    15.2     2.0     1.0     1.0     0.8
   1     2.4     4.1     3.4     0.8     0.4     0.8
   1    13.0     4.5     1.2     1.0     0.3     0.5
   1    12.7    19.9     2.0     0.7     0.6     0.4
   1    14.8     4.4     3.0     0.8     0.5     0.5
   1     9.7    22.1     2.8     1.1     0.3     0.3
   1     3.5     8.0     6.0     0.7     0.6     0.4
   1    40.0     6.9     2.3     1.1     0.4     0.4
FLT27: FRATRO_7d (Catch: Unknown) (Effort: Unknown)
1986 1997
1 1 0.00 1.00
1 1
    257794   7166.948
    188236   1754.084
    215422    717.923
    320383    169.508
    236327     45.086
    300624     33.728
    285783   1308.228
    283999     23.002
    286019   1349.246
    268151   1356.050
    274495    145.115
    282216   6062.722
```

Table 3.4.3

```
Lowestoft VPA Version 3.1
  10-Oct-98  14:54:57
Extended Survivors Analysis
Cod in IV,IIIa,VIId (run: XSALJB02/X02)
CPUE data from file /users/fish/ifad/ifapwork/wgnssk/cod_347d/FLEET.X02
Catch data for  35 years. 1963 to 1997. Ages  1 to  11.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                     ,  year, year,  age ,  age
FLT19: SCOTRL_IV (Ca,  1988, 1997,   2,     6,   .000,  1.000
FLT20: SCOSEI_IV (Ca,  1988, 1997,   1,    10,   .000,  1.000
FLT21: SCOLTR_IV (Ca,  1988, 1997,   1,     8,   .000,  1.000
FLT22: ENGTRL_IV (Ca,  1988, 1997,   2,     8,   .000,  1.000
FLT23: ENGSEI_IV (Ca,  1988, 1997,   1,    10,   .000,  1.000
FLT24: SCOGFS_IV (Ca,  1988, 1997,   1,     6,   .500,   .750
FLT25: ENGGFS_IV (Ca,  1988, 1997,   1,     5,   .500,   .750
FLT26: IBTS_Q1_IV (C,  1988, 1997,   1,     6,   .000,   .250
FLT27: FRATRO_7d (Ca,  1988, 1997,   1,     1,   .000,  1.000


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 =      .00133

Final year F values
Age            ,      1,      2,      3,      4,      5,      6,      7,      8,      9,     10
Iteration 29,   .0951,  .6981,  .8417,  .4956,  .5143,  .4512,  .6182,  .7678,  .3898,  .8174
Iteration 30,   .0951,  .6981,  .8417,  .4956,  .5142,  .4511,  .6180,  .7674,  .3895,  .8170

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

Table 3.4.3 (Continued)

Fishing mortalities

Age,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1,	.177,	.129,	.140,	.126,	.143,	.048,	.069,	.104,	.047,	.095
2,	.914,	.877,	.908,	.764,	.843,	.787,	.624,	.726,	.605,	.698
3,	1.185,	1.090,	.969,	.961,	.851,	1.002,	.962,	.913,	.752,	.842
4,	.858,	1.016,	.890,	.843,	.925,	.960,	.881,	.708,	.611,	.496
5,	.790,	.755,	.773,	.825,	.729,	.881,	.770,	.597,	.582,	.514
6,	.801,	.906,	.556,	.936,	.806,	.771,	.839,	.626,	.685,	.451
7,	.729,	.855,	.774,	1.075,	.895,	.990,	.623,	.630,	.921,	.618
8,	.679,	.972,	.439,	1.021,	.787,	.869,	.886,	.374,	.978,	.767
9,	.552,	.664,	1.971,	.429,	.978,	.705,	.696,	.598,	.837,	.390
10,	.744,	.585,	.718,	.699,	.506,	.707,	.667,	.691,	.310,	.817

XSA population numbers (Thousands)

YEAR ,	AGE 1,	2,	3,	4,	5,	6,
1988 ,	1.97E+05,	1.10E+05,	7.18E+04,	6.02E+03,	5.17E+03,	1.31E+03,
1989 ,	2.74E+05,	7.42E+04,	3.11E+04,	1.71E+04,	2.09E+03,	1.92E+03,
1990 ,	1.34E+05,	1.08E+05,	2.17E+04,	8.13E+03,	5.07E+03,	8.04E+02,
1991 ,	1.69E+05,	5.23E+04,	3.08E+04,	6.42E+03,	2.73E+03,	1.91E+03,
1992 ,	3.10E+05,	6.71E+04,	1.72E+04,	9.17E+03,	2.26E+03,	9.81E+02,
1993 ,	1.52E+05,	1.21E+05,	2.03E+04,	5.71E+03,	2.98E+03,	8.94E+02,
1994 ,	3.50E+05,	6.49E+04,	3.88E+04,	5.82E+03,	1.79E+03,	1.01E+03,
1995 ,	2.38E+05,	1.47E+05,	2.45E+04,	1.15E+04,	1.97E+03,	6.79E+02,
1996 ,	1.61E+05,	9.65E+04,	5.01E+04,	7.66E+03,	4.66E+03,	8.89E+02,
1997 ,	3.91E+05,	6.92E+04,	3.71E+04,	1.84E+04,	3.40E+03,	2.13E+03,

7,	8,	9,	10,
6.30E+02,	1.48E+02,	1.64E+02,	4.84E+01,
4.83E+02,	2.49E+02,	6.15E+01,	7.74E+01,
6.36E+02,	1.68E+02,	7.70E+01,	2.59E+01,
3.77E+02,	2.40E+02,	8.87E+01,	8.79E+00,
6.15E+02,	1.05E+02,	7.08E+01,	4.73E+01,
3.59E+02,	2.06E+02,	3.93E+01,	2.18E+01,
3.39E+02,	1.09E+02,	7.05E+01,	1.59E+01,
3.57E+02,	1.49E+02,	3.68E+01,	2.88E+01,
2.97E+02,	1.56E+02,	8.38E+01,	1.66E+01,
3.67E+02,	9.70E+01,	4.80E+01,	2.97E+01,

Estimated population abundance at 1st Jan 1998

, .00E+00, 1.60E+05, 2.43E+04, 1.25E+04, 9.17E+03, 1.67E+03, 1.11E+03, 1.62E+02, 3.69E+01, 2.66E+01,

Taper weighted geometric mean of the VPA populations:

, 3.36E+05, 1.36E+05, 4.44E+04, 1.44E+04, 5.67E+03, 2.41E+03, 9.81E+02, 4.24E+02, 1.77E+02, 6.97E+01,

Standard error of the weighted Log(VPA populations) :

, .5585, .5439, .5043, .5311, .6010, .6423, .6907, .7691, .8258, .8996,

Log catchability residuals.

Fleet : FLT19: SCOTRL_IV (Ca

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1 ,	No data for this fleet at this age									
2 ,	.51,	-1.32,	.88,	.37,	.42,	-.04,	-.90,	.03,	.08,	-.02
3 ,	-.36,	.53,	-.98,	.44,	-.04,	-.18,	.25,	.28,	-.09,	.14
4 ,	-.76,	.14,	.38,	-.41,	.94,	-.69,	-.24,	.52,	.44,	-.30
5 ,	-.23,	-.08,	-.26,	.75,	-.69,	.73,	-.41,	-.83,	.88,	.12
6 ,	.51,	-.16,	.10,	-.20,	.28,	-.36,	.21,	-.87,	.38,	.10
7 ,	No data for this fleet at this age									
8 ,	No data for this fleet at this age									
9 ,	No data for this fleet at this age									
10 ,	No data for this fleet at this age									

Table 3.4.3 (Continued)

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

Age ,	2,	3,	4,	5,	6
Mean Log q,	-15.6840,	-15.0987,	-15.3439,	-15.7595,	-15.8125,
S.E(Log q),	.6576,	.4418,	.5679,	.6104,	.4089,

Regression statistics :

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.66,	.757,	14.22,	.38,	10,	.45,	-15.68,
3,	.93,	.196,	14.79,	.53,	10,	.44,	-15.10,
4,	.68,	1.059,	13.37,	.59,	10,	.39,	-15.34,
5,	.63,	1.183,	12.89,	.56,	10,	.38,	-15.76,
6,	.84,	.550,	14.41,	.59,	10,	.36,	-15.81,

Fleet : FLT20: SCOSEI_IV (Ca

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1 ,	-.05,	.26,	-.09,	.80,	-.12,	-.58,	-.07,	.16,	-.14,	-.17
2 ,	-.16,	-.43,	.76,	.23,	-.01,	-.21,	-.22,	.21,	-.05,	-.11
3 ,	-.14,	.34,	-.14,	.29,	-.21,	-.40,	.08,	-.18,	.23,	.12
4 ,	-.66,	.11,	.58,	-.44,	.29,	-.19,	.14,	.14,	-.08,	.11
5 ,	.33,	-.36,	.19,	.10,	-.22,	.06,	-.32,	.10,	.05,	.06
6 ,	.45,	.51,	-.06,	.08,	.17,	-.45,	-.17,	-.17,	-.36,	.01
7 ,	.29,	.44,	.53,	.53,	.05,	.25,	-.22,	.21,	.01,	.43
8 ,	.47,	.28,	.24,	.69,	.49,	.00,	.07,	-1.92,	.26,	.76
9 ,	-.16,	-.50,	.48,	.24,	.91,	.23,	-.38,	-.37,	-.30,	.26
10 ,	-.06,	.41,	.37,	.08,	.16,	-.25,	.14,	-.15,	.65,	.01

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,	-14.8531,	-14.8089,	-15.0923,	-15.1093,	-15.1251,	-15.1251,	-15.1251,	-15.1251,	-15.1251,
S.E(Log q),	.3320,	.2464,	.3591,	.2253,	.3135,	.3634,	.7767,	.4581,	.3104,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	.88,	.363,	17.11,	.53,	10,	.38,	-17.77,

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,	.601,	14.25,	.60,	10,	.29,	-14.85,
3,	.81,	1.320,	13.95,	.85,	10,	.19,	-14.81,
4,	.74,	1.294,	13.55,	.76,	10,	.26,	-15.09,
5,	.70,	3.287,	12.98,	.94,	10,	.11,	-15.11,
6,	.69,	2.074,	12.60,	.85,	10,	.18,	-15.13,
7,	.77,	1.023,	12.88,	.72,	10,	.19,	-14.87,
8,	1.05,	-.062,	15.52,	.15,	10,	.85,	-14.99,
9,	.99,	.015,	15.03,	.48,	10,	.48,	-15.09,
10,	.99,	.076,	14.85,	.84,	10,	.29,	-14.99,

Table 3.4.3 (Continued)

Fleet : FLT21: SCOLTR_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-.32	.54	-.15	1.15	.18	-.65	-.59	.06	-.19	-.04
2	-.01	-.67	.54	.09	.09	.11	-.34	.07	.07	.05
3	-.44	.14	-.64	.38	-.28	.20	.09	.21	.08	.26
4	-.53	-.10	.40	-.60	.47	-.36	.34	.43	.16	-.20
5	.05	-.21	.24	.21	-.55	-.11	-.24	.12	.63	-.12
6	.07	.01	.19	.08	.27	-.90	.39	-.82	.24	.47
7	-.08	.15	-.31	-.01	-.34	-.55	-.60	-.40	.23	-.10
8	-.60	-.51	-.24	.46	-.39	-.35	-.26	-2.01	.35	-1.09
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	-15.8115	-15.4271	-15.6783	-16.0255	-16.1694	-16.1694	-16.1694
S.E(Log q)	.3162	.3366	.4106	.3246	.4748	.3525	.8552

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	.91	.185	17.71	.33	10	.57	-18.26

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	.75	1.055	14.70	.69	10	.24	-15.81
3	1.01	-.023	15.46	.63	10	.36	-15.43
4	.86	.501	14.74	.61	10	.37	-15.68
5	.67	2.134	13.39	.84	10	.18	-16.03
6	.66	1.418	13.05	.68	10	.30	-16.17
7	1.02	-.055	16.57	.50	10	.31	-16.37
8	.59	.998	11.86	.42	10	.41	-16.63

Fleet : FLT22: ENGTRL_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	No data for this fleet at this age									
2	-.71	-.45	-.16	-.19	.07	.14	.32	.05	.33	.60
3	-.05	-.51	-.34	.05	-.09	-.22	.20	.43	.37	.14
4	-.48	.21	-.22	-.44	.36	.02	-.11	-.10	.54	.23
5	.46	-.31	.40	-.37	-.35	.57	-.19	-.56	.04	.31
6	.17	.48	.27	-.01	-.48	-.33	.04	-.44	.22	.07
7	.35	-.07	.77	-.47	.03	.16	-.34	-.26	.00	-.07
8	99.99	.41	.77	-.04	99.99	.26	-.06	-.54	.55	.35
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Table 3.4.3 (Continued)

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

Age ,	2,	3,	4,	5,	6,	7,	8
Mean Log q,	-15.2781,	-15.3061,	-15.8362,	-16.3195,	-16.6604,	-16.6604,	-16.6604,
S.E(Log q),	.3904,	.3026,	.3347,	.4075,	.3211,	.3575,	.4728,

Regression statistics :

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	1.22,	-.433,	16.13,	.33,	10,	.50,	-15.28,
3,	.82,	.930,	14.43,	.77,	10,	.25,	-15.31,
4,	.74,	1.443,	14.08,	.79,	10,	.23,	-15.84,
5,	.57,	3.167,	12.73,	.87,	10,	.16,	-16.32,
6,	.73,	1.463,	14.11,	.79,	10,	.22,	-16.66,
7,	.55,	2.482,	11.88,	.79,	10,	.16,	-16.65,
8,	.88,	.265,	15.14,	.47,	8,	.39,	-16.45,

Fleet : FLT23: ENGSEI_IV (Ca

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1 ,	.44,	.26,	.43,	-.15,	.56,	-.69,	.05,	.21,	-.35,	-.75
2 ,	-.04,	.20,	.23,	-.49,	.08,	-.25,	.00,	.08,	.27,	-.07
3 ,	.20,	.01,	-.20,	-.02,	-.55,	-.77,	.10,	.37,	.92,	-.06
4 ,	-.71,	.31,	-.02,	-.16,	-.02,	-.11,	-.35,	-.16,	.78,	.44
5 ,	.33,	-.93,	.15,	-.06,	-.65,	.14,	.67,	-.35,	.60,	.10
6 ,	-.08,	.49,	-1.13,	.37,	-.35,	-.75,	.73,	.05,	.61,	.05
7 ,	.17,	-.03,	.52,	.20,	.15,	-.04,	.21,	1.10,	.75,	.75
8 ,	.21,	.82,	.10,	1.62,	.48,	.07,	.21,	1.25,	1.11,	.51
9 ,	.05,	.01,	.37,	-.41,	1.36,	99.99,	.03,	1.13,	-.36,	1.12
10 ,	.25,	.44,	.99,	2.02,	99.99,	1.55,	-.49,	.10,	1.51,	1.47

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,	-15.6398,	-15.7804,	-15.9808,	-15.4673,	-15.1187,	-15.1187,	-15.1187,	-15.1187,	-15.1187,
S.E(Log q),	.2330,	.4689,	.4207,	.5155,	.6027,	.5521,	.8613,	.7782,	1.2453,

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,	.96,	.091,	17.70,	.39,	10,	.50,	-17.92,

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.80,	1.052,	14.80,	.78,	10,	.19,	-15.64,
3,	.58,	2.630,	13.49,	.83,	10,	.21,	-15.78,
4,	.65,	1.846,	13.59,	.78,	10,	.24,	-15.98,
5,	.63,	1.483,	12.67,	.66,	10,	.30,	-15.47,
6,	.64,	1.151,	12.23,	.56,	10,	.38,	-15.12,
7,	1.87,	-1.058,	22.27,	.16,	10,	.71,	-14.74,
8,	.63,	1.075,	11.04,	.52,	10,	.34,	-14.48,
9,	16.75,	-1.893,	179.75,	.00,	9,	9.81,	-14.75,
10,	2.31,	-1.267,	28.64,	.12,	9,	1.86,	-14.25,

Table 3.4.3 (Continued)

Fleet : FLT24: SCOGFS_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-.39	-.01	-.22	.11	-.05	.27	.15	.02	.16	-.04
2	-.32	-.70	.23	-.29	-.27	.47	.18	.89	-.17	-.02
3	-.61	.19	-.58	-.12	-.21	.05	.42	.06	.67	.14
4	-.25	.11	.53	-.98	.33	-.15	-.01	.21	.42	-.21
5	.10	.49	-.12	-1.01	.77	-.33	.15	-.14	.12	-.04
6	.37	-.30	.49	-.89	1.12	-.48	.15	.41	-.38	-.48
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	-16.3554	-16.0847	-16.0650	-16.0675	-15.9843
S.E(Log q)	.4558	.4026	.4346	.4749	.6073

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	.58	2.295	15.20	.79	10	.20	-17.25

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	.53	2.310	14.03	.75	10	.20	-16.36
3	.88	.412	15.41	.61	10	.37	-16.08
4	.83	.610	14.84	.60	10	.37	-16.06
5	1.23	-.459	17.96	.32	10	.61	-16.07
6	5.60	-1.871	57.05	.02	10	3.01	-15.98

Fleet : FLT25: ENGGFS_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-.08	.12	.11	-.01	.04	.07	-.06	-.18	-.09	.08
2	-.08	-.20	.15	-.39	-.57	.22	-.05	.66	.36	-.11
3	.05	.31	-.08	-.25	-.19	.31	.27	.44	-.06	-.81
4	-2.21	.67	-.14	-.04	.68	.36	.48	.78	.04	-.61
5	1.26	.17	-.02	-.59	.39	.95	.17	-.95	.46	-1.84
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	-16.2506	-16.5609	-17.0581	-16.9592
S.E(Log q)	.3613	.3692	.8923	.9157

Table 3.4.3 (Continued)

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	.55	4.664	14.41	.93	10	.11	-16.12

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	.53	4.131	13.94	.90	10	.11	-16.25
3	1.11	-.321	17.21	.54	10	.43	-16.56
4	.70	.616	14.62	.34	10	.64	-17.06
5	.63	.742	13.67	.34	10	.59	-16.96

Fleet : FLT26: IBTS_Q1_IV (C

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-.31	.05	.05	-.37	-.08	.62	-.14	.03	-.13	.28
2	-.50	-.08	.43	-.17	-.32	.57	-.33	.48	-.14	.06
3	-.13	.54	-.03	.15	-.32	.04	-.20	.18	.21	-.44
4	-.07	.25	.15	.15	.03	.15	.26	-.13	-.18	-.62
5	.05	.14	.18	-.12	-.23	.21	.52	-.11	-.27	-.37
6	.55	.08	.69	-.13	.05	-.08	.03	-.11	-.09	-.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									
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	-9.1459	-9.1156	-9.0180	-8.5867	-7.5107
S.E(Log q)	.3738	.2893	.2665	.2713	.4488

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	.53	1.746	11.14	.63	10	.30	-10.11

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	.60	2.114	10.04	.77	10	.19	-9.15
3	1.00	.005	9.12	.70	10	.31	-9.12
4	1.43	-1.577	8.99	.63	10	.35	-9.02
5	1.21	-.750	8.71	.61	10	.34	-8.59
6	1.92	-1.368	7.93	.22	10	.82	-7.51

Table 3.4.3 (Continued)

```
Fleet : FLT27: FRATRO_7d (Ca

 Age  ,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997
   1 ,   .38,  -.39,   .09,  -.28,   .00,  -.25,  -.12,   .29,   .13,   .14
   2 , No data for this fleet at this age
   3 , No data for this fleet at this age
   4 , No data for this fleet at this age
   5 , No data for this fleet at this age
   6 , No data for this fleet at this age
   7 , No data for this fleet at this age
   8 , No data for this fleet at this age
   9 , No data for this fleet at this age
  10 , No data for this fleet at this age

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,     .24,    3.209,     13.83,     .69,     10,     .27,  -18.67,



Terminal year survivor and F summaries :
Age  1   Catchability dependent on age and year class strength
Year class = 1996

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
   ,                   Survivors,    s.e,       s.e,    Ratio,   , Weights,    F
FLT19: SCOTRL_IV (Ca,        1.,    .000,      .000,     .00,   0,  .000,      .000
FLT20: SCOSEI_IV (Ca,   135210.,    .407,      .000,     .00,   1,  .100,      .111
FLT21: SCOLTR_IV (Ca,   153916.,    .614,      .000,     .00,   1,  .044,      .098
FLT22: ENGTRL_IV (Ca,        1.,    .000,      .000,     .00,   0,  .000,      .000
FLT23: ENGSEI_IV (Ca,    75169.,    .526,      .000,     .00,   1,  .060,      .192
FLT24: SCOGFS_IV (Ca,   153319.,    .300,      .000,     .00,   1,  .184,      .099
FLT25: ENGGFS_IV (Ca,   172074.,    .300,      .000,     .00,   1,  .184,      .089
FLT26: IBTS_Q1_IV (C,   211762.,    .367,      .000,     .00,   1,  .123,      .073
FLT27: FRATRO_7d (Ca,   182824.,    .313,      .000,     .00,   1,  .169,      .084

  P shrinkage mean  ,   136019.,     .54,,,,                        .062,      .111
  F shrinkage mean  ,   180627.,     .50,,,,                        .073,      .085
Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
   159631.,       .13,      .08,    9,    .632,   .095



Age  2   Catchability constant w.r.t. time and dependent on age
Year class = 1995

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
   ,                   Survivors,    s.e,       s.e,    Ratio,   , Weights,    F
FLT19: SCOTRL_IV (Ca,    23722.,    .690,      .000,     .00,   1,  .018,      .710
FLT20: SCOSEI_IV (Ca,    21489.,    .266,      .012,     .05,   2,  .122,      .761
FLT21: SCOLTR_IV (Ca,    24185.,    .292,      .097,     .33,   2,  .102,      .700
FLT22: ENGTRL_IV (Ca,    44233.,    .409,      .000,     .00,   1,  .052,      .441
FLT23: ENGSEI_IV (Ca,    21302.,    .264,      .116,     .44,   2,  .124,      .766
FLT24: SCOGFS_IV (Ca,    26945.,    .254,      .082,     .32,   2,  .131,      .647
FLT25: ENGGFS_IV (Ca,    21984.,    .235,      .006,     .03,   2,  .154,      .749
FLT26: IBTS_Q1_IV (C,    23150.,    .254,      .094,     .37,   2,  .132,      .722
FLT27: FRATRO_7d (Ca,    27728.,    .300,      .000,     .00,   1,  .093,      .633

  F shrinkage mean  ,    22787.,     .50,,,,                        .070,      .730
Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    24263.,       .10,      .05,   16,    .486,   .698
```

Table 3.4.3 (Continued)

Age 3 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
FLT19: SCOTRL_IV (Ca,	14186.,	.396,	.026,	.07,	2, .046,	.770
FLT20: SCOSEI_IV (Ca,	13595.,	.208,	.057,	.27,	3, .147,	.793
FLT21: SCOLTR_IV (Ca,	14883.,	.235,	.066,	.28,	3, .113,	.745
FLT22: ENGTRL_IV (Ca,	15017.,	.260,	.081,	.31,	2, .103,	.740
FLT23: ENGSEI_IV (Ca,	14422.,	.241,	.106,	.44,	3, .094,	.761
FLT24: SCOGFS_IV (Ca,	12950.,	.230,	.077,	.33,	3, .106,	.820
FLT25: ENGGFS_IV (Ca,	9098.,	.212,	.328,	1.55,	3, .125,	1.033
FLT26: IBTS_Q1_IV (C,	9541.,	.203,	.144,	.71,	3, .151,	1.002
FLT27: FRATRO_7d (Ca,	16604.,	.300,	.000,	.00,	1, .043,	.689
F shrinkage mean ,	11117.,	.50,,,,			.073,	.908

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
12463.,	.08,	.06,	24,	.701,	.842

Age 4 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
FLT19: SCOTRL_IV (Ca,	7594.,	.362,	.088,	.24,	3, .052,	.573
FLT20: SCOSEI_IV (Ca,	10611.,	.207,	.048,	.23,	4, .147,	.441
FLT21: SCOLTR_IV (Ca,	8446.,	.235,	.103,	.44,	4, .113,	.528
FLT22: ENGTRL_IV (Ca,	11863.,	.230,	.068,	.29,	3, .135,	.403
FLT23: ENGSEI_IV (Ca,	13872.,	.252,	.170,	.67,	4, .099,	.353
FLT24: SCOGFS_IV (Ca,	11029.,	.241,	.240,	1.00,	4, .103,	.427
FLT25: ENGGFS_IV (Ca,	9184.,	.227,	.215,	.95,	4, .078,	.495
FLT26: IBTS_Q1_IV (C,	6976.,	.192,	.240,	1.25,	4, .188,	.611
FLT27: FRATRO_7d (Ca,	8150.,	.300,	.000,	.00,	1, .023,	.543
F shrinkage mean ,	4582.,	.50,,,,			.063,	.826

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9166.,	.08,	.07,	32,	.864,	.496

Age 5 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
FLT19: SCOTRL_IV (Ca,	2034.,	.359,	.161,	.45,	4, .050,	.439
FLT20: SCOSEI_IV (Ca,	1619.,	.198,	.069,	.35,	5, .181,	.526
FLT21: SCOLTR_IV (Ca,	1580.,	.224,	.090,	.40,	5, .140,	.536
FLT22: ENGTRL_IV (Ca,	2507.,	.228,	.059,	.26,	4, .122,	.369
FLT23: ENGSEI_IV (Ca,	2254.,	.265,	.184,	.70,	5, .084,	.403
FLT24: SCOGFS_IV (Ca,	1931.,	.253,	.097,	.39,	5, .092,	.457
FLT25: ENGGFS_IV (Ca,	1305.,	.270,	.418,	1.55,	5, .050,	.620
FLT26: IBTS_Q1_IV (C,	1354.,	.182,	.128,	.71,	5, .205,	.603
FLT27: FRATRO_7d (Ca,	1298.,	.308,	.000,	.00,	1, .011,	.622
F shrinkage mean ,	1066.,	.50,,,,			.064,	.718

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1666.,	.08,	.06,	40,	.703,	.514

Table 3.4.3 (Continued)

Age 6 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
FLT19: SCOTRL_IV (Ca,	1468.,	.311,	.149,	.48,	5,	.087,	.359
FLT20: SCOSEI_IV (Ca,	1149.,	.190,	.025,	.13,	6,	.205,	.439
FLT21: SCOLTR_IV (Ca,	1809.,	.230,	.072,	.32,	6,	.125,	.300
FLT22: ENGTRL_IV (Ca,	1169.,	.217,	.036,	.17,	5,	.165,	.433
FLT23: ENGSEI_IV (Ca,	1287.,	.290,	.137,	.47,	6,	.074,	.400
FLT24: SCOGFS_IV (Ca,	1063.,	.280,	.149,	.53,	6,	.078,	.467
FLT25: ENGGFS_IV (Ca,	1553.,	.302,	.111,	.37,	5,	.026,	.342
FLT26: IBTS_Q1_IV (C,	726.,	.192,	.170,	.89,	6,	.167,	.627
FLT27: FRATRO_7d (Ca,	1115.,	.300,	.000,	.00,	1,	.005,	.450
F shrinkage mean ,	564.,	.50,,,,				.067,	.753

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1111.,	.09,	.06,	47,	.677,	.451

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6
Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT19: SCOTRL_IV (Ca,	178.,	.320,	.233,	.73,	5,	.054,	.575
FLT20: SCOSEI_IV (Ca,	179.,	.198,	.140,	.71,	7,	.221,	.574
FLT21: SCOLTR_IV (Ca,	166.,	.234,	.067,	.29,	7,	.176,	.606
FLT22: ENGTRL_IV (Ca,	156.,	.216,	.101,	.47,	6,	.199,	.636
FLT23: ENGSEI_IV (Ca,	236.,	.320,	.205,	.64,	7,	.085,	.462
FLT24: SCOGFS_IV (Ca,	135.,	.296,	.075,	.25,	6,	.047,	.707
FLT25: ENGGFS_IV (Ca,	132.,	.334,	.283,	.85,	5,	.014,	.718
FLT26: IBTS_Q1_IV (C,	156.,	.201,	.066,	.33,	6,	.100,	.635
FLT27: FRATRO_7d (Ca,	123.,	.302,	.000,	.00,	1,	.002,	.754
F shrinkage mean ,	109.,	.50,,,,				.101,	.820

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
162.,	.10,	.05,	51,	.492,	.618

Age 8 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
FLT19: SCOTRL_IV (Ca,	18.,	.329,	.127,	.39,	5,	.038,	1.228
FLT20: SCOSEI_IV (Ca,	39.,	.226,	.138,	.61,	8,	.186,	.739
FLT21: SCOLTR_IV (Ca,	28.,	.261,	.205,	.79,	8,	.149,	.921
FLT22: ENGTRL_IV (Ca,	39.,	.242,	.122,	.50,	7,	.230,	.744
FLT23: ENGSEI_IV (Ca,	58.,	.373,	.128,	.34,	8,	.086,	.547
FLT24: SCOGFS_IV (Ca,	43.,	.308,	.111,	.36,	6,	.031,	.686
FLT25: ENGGFS_IV (Ca,	37.,	.318,	.118,	.37,	5,	.009,	.767
FLT26: IBTS_Q1_IV (C,	44.,	.209,	.138,	.66,	6,	.065,	.681
FLT27: FRATRO_7d (Ca,	40.,	.300,	.000,	.00,	1,	.002,	.722
F shrinkage mean ,	36.,	.50,,,,				.204,	.787

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
37.,	.14,	.06,	55,	.407,	.767

Table 3.4.3 (Continued)

Age 9 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
FLT19: SCOTRL_IV (Ca,	38.,	.336,	.121,	.36,	5,	.024,	.290
FLT20: SCOSEI_IV (Ca,	32.,	.289,	.048,	.17,	9,	.298,	.330
FLT21: SCOLTR_IV (Ca,	24.,	.261,	.135,	.52,	8,	.107,	.420
FLT22: ENGTRL_IV (Ca,	31.,	.236,	.146,	.62,	7,	.158,	.341
FLT23: ENGSEI_IV (Ca,	72.,	.446,	.103,	.23,	9,	.117,	.161
FLT24: SCOGFS_IV (Ca,	27.,	.323,	.108,	.33,	6,	.019,	.387
FLT25: ENGGFS_IV (Ca,	37.,	.340,	.244,	.72,	5,	.005,	.292
FLT26: IBTS_Q1_IV (C,	30.,	.217,	.042,	.19,	6,	.040,	.355
FLT27: FRATRO_7d (Ca,	18.,	.300,	.000,	.00,	1,	.001,	.532
F shrinkage mean ,	11.,	.50,,,,				.230,	.771

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
27.,	.16,	.09,	57,	.556,	.390

Age 10 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
FLT19: SCOTRL_IV (Ca,	7.,	.325,	.094,	.29,	5,	.017,	1.093
FLT20: SCOSEI_IV (Ca,	9.,	.230,	.118,	.51,	10,	.421,	.898
FLT21: SCOLTR_IV (Ca,	5.,	.250,	.194,	.78,	8,	.069,	1.382
FLT22: ENGTRL_IV (Ca,	7.,	.229,	.040,	.17,	7,	.100,	1.070
FLT23: ENGSEI_IV (Ca,	16.,	.411,	.277,	.67,	10,	.075,	.624
FLT24: SCOGFS_IV (Ca,	9.,	.304,	.294,	.97,	6,	.014,	.923
FLT25: ENGGFS_IV (Ca,	11.,	.329,	.112,	.34,	5,	.004,	.791
FLT26: IBTS_Q1_IV (C,	10.,	.205,	.061,	.30,	6,	.030,	.874
FLT27: FRATRO_7d (Ca,	16.,	.300,	.000,	.00,	1,	.001,	.621
F shrinkage mean ,	18.,	.50,,,,				.270,	.553

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
11.,	.17,	.08,	59,	.446,	.817

Table 3.4.4

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)
At 10-Oct-98 14:59:39
Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1963,	1964,	1965,	1966,	1967,
AGE					
1,	.0249,	.0203,	.0585,	.0551,	.0335,
2,	.5316,	.3759,	.4704,	.5499,	.4973,
3,	.3677,	.5929,	.6601,	.6280,	.7287,
4,	.4525,	.4171,	.6211,	.5283,	.5326,
5,	.4543,	.4767,	.4312,	.4894,	.5972,
6,	.5625,	.6126,	.4612,	.4346,	.5988,
7,	.1602,	.6078,	.4678,	.4452,	.6200,
8,	.7852,	.3700,	.7098,	.5271,	.7130,
9,	.3115,	.3262,	.2696,	.7630,	.3800,
10,	.4581,	.4823,	.4714,	.5362,	.5868,
+gp,	.4581,	.4823,	.4714,	.5362,	.5868,
FBAR 2- 8,	.4734,	.4933,	.5459,	.5147,	.6125,
FBAR 2- 4,	.4506,	.4620,	.5839,	.5687,	.5862,

Table 8 Fishing mortality (F) at age YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	.0457,	.0213,	.1098,	.0763,	.0335,	.1292,	.0922,	.1080,	.0353,	.1439,
2,	.6353,	.3906,	.5787,	.8862,	.8906,	.6966,	.8121,	.7336,	.9390,	.8432,
3,	.7390,	.6001,	.7465,	.7701,	.9070,	.8384,	.6697,	.7844,	.8573,	.7702,
4,	.7113,	.5817,	.5710,	.7086,	.6528,	.7782,	.6416,	.6700,	.7568,	.5485,
5,	.6228,	.6282,	.5845,	.6945,	.7100,	.5739,	.6398,	.7446,	.5712,	.6354,
6,	.5646,	.6990,	.5316,	.5377,	.8030,	.7211,	.5318,	.6719,	.7949,	.6012,
7,	.5823,	.4867,	.5279,	.5693,	.7790,	.6900,	.7127,	.5118,	.7403,	.8040,
8,	.4542,	.6313,	.3177,	.5188,	1.0276,	.5434,	.6020,	.8397,	.2720,	.7716,
9,	.7773,	.4065,	.6420,	.6898,	1.2287,	.3375,	.9128,	.8788,	.7971,	1.4542,
10,	.6055,	.5752,	.5249,	.6073,	.9196,	.5780,	.6862,	.7365,	.6408,	.8623,
+gp,	.6055,	.5752,	.5249,	.6073,	.9196,	.5780,	.6862,	.7365,	.6408,	.8623,
FBAR 2- 8,	.6156,	.5739,	.5511,	.6693,	.8243,	.6916,	.6585,	.7080,	.7045,	.7106,
FBAR 2- 4,	.6952,	.5241,	.6321,	.7883,	.8168,	.7711,	.7078,	.7293,	.8510,	.7206,

Table 3.4.4 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)
At 10-Oct-98 14:59:39
Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	.0952,	.1041,	.1096,	.1010,	.1756,	.1258,	.1767,	.0868,	.2342,	.1414,
2,	1.0247,	.7935,	.8826,	.9713,	.9373,	1.0857,	.9538,	.9842,	.8945,	.9166,
3,	.9246,	.9485,	.9808,	1.0112,	1.2316,	1.1891,	1.0183,	.9568,	1.0599,	.8911,
4,	.7664,	.5893,	.7904,	.7700,	.9206,	.9128,	.8279,	.8074,	.9533,	.9265,
5,	.8693,	.7053,	.6490,	.6770,	.7895,	.7894,	.7465,	.7098,	.8686,	.7211,
6,	.7417,	.5128,	.6333,	.5903,	.8985,	.7581,	.7522,	.6910,	.8068,	.9338,
7,	.6809,	.6585,	.8413,	.7179,	.7673,	.7183,	.6563,	.6961,	.7648,	.8906,
8,	.7631,	.5224,	.8287,	.5731,	.6954,	.9064,	.7473,	.5952,	.8285,	.7818,
9,	.8817,	.7887,	.5850,	.7341,	.7988,	.6309,	.9098,	.5789,	.5045,	.7067,
10,	.7953,	.6433,	.7142,	.6645,	.7979,	.7682,	.7701,	.6603,	.7623,	.8154,
+gp,	.7953,	.6433,	.7142,	.6645,	.7979,	.7682,	.7701,	.6603,	.7623,	.8154,
FBAR 2- 8,	.8244,	.6757,	.8009,	.7587,	.8915,	.9085,	.8146,	.7772,	.8823,	.8659,
FBAR 2- 4,	.9052,	.7771,	.8846,	.9175,	1.0298,	1.0625,	.9334,	.9161,	.9693,	.9114,

Table 8 Fishing mortality (F) at age YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
1,	.1774,	.1289,	.1401,	.1263,	.1427,	.0482,	.0686,	.1036,	.0467,	.0951,	.0818,
2,	.9144,	.8771,	.9085,	.7638,	.8429,	.7867,	.6239,	.7256,	.6055,	.6981,	.6764,
3,	1.1847,	1.0898,	.9692,	.9611,	.8506,	1.0020,	.9616,	.9128,	.7524,	.8417,	.8356,
4,	.8576,	1.0160,	.8903,	.8428,	.9251,	.9599,	.8815,	.7079,	.6112,	.4956,	.6049,
5,	.7903,	.7552,	.7731,	.8252,	.7287,	.8809,	.7695,	.5968,	.5821,	.5142,	.5644,
6,	.8010,	.9059,	.5556,	.9362,	.8058,	.7712,	.8393,	.6259,	.6852,	.4511,	.5874,
7,	.7289,	.8550,	.7738,	1.0751,	.8955,	.9903,	.6226,	.6296,	.9210,	.6180,	.7229,
8,	.6788,	.9724,	.4386,	1.0209,	.7871,	.8693,	.8856,	.3740,	.9784,	.7674,	.7066,
9,	.5521,	.6645,	1.9708,	.4288,	.9784,	.7054,	.6959,	.5978,	.8374,	.3895,	.6082,
10,	.7438,	.5850,	.7178,	.6991,	.5059,	.7071,	.6670,	.6909,	.3098,	.8170,	.6059,
+gp,	.7438,	.5850,	.7178,	.6991,	.5059,	.7071,	.6670,	.6909,	.3098,	.8170,	
FBAR 2- 8,	.8508,	.9245,	.7585,	.9179,	.8337,	.8943,	.7977,	.6532,	.7337,	.6266,	
FBAR 2- 4,	.9856,	.9943,	.9227,	.8559,	.8729,	.9162,	.8223,	.7821,	.6563,	.6785,	

Table 3.4.5

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)

At 10-Oct-98 14:59:39

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year)					Numbers*10**-3
YEAR,	1963,	1964,	1965,	1966,	1967,
AGE					
1,	195108,	374091,	415441,	506863,	488808,
2,	123043,	85513,	164718,	176070,	215532,
3,	25892,	50953,	41378,	72517,	71595,
4,	10736,	13961,	21933,	16654,	30138,
5,	8439,	5591,	7532,	9649,	8039,
6,	3116,	4386,	2842,	4007,	4842,
7,	605,	1453,	1946,	1467,	2124,
8,	1000,	422,	648,	998,	770,
9,	58,	373,	238,	261,	482,
10,	18,	35,	221,	149,	100,
+gp,	0,	11,	23,	219,	42,
TOTAL,	368013,	536789,	656920,	788853,	822473,

Table 10 Stock number at age (start of year)						Numbers*10**-3				
YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	194595,	209057,	781993,	910798,	173514,	319653,	263658,	486383,	246435,	839211,
2,	212394,	83530,	91960,	314844,	379202,	75396,	126224,	108038,	196172,	106894,
3,	92370,	79295,	39829,	36331,	91462,	109664,	26474,	39487,	36558,	54057,
4,	26907,	34356,	33887,	14703,	13099,	28759,	36930,	10554,	14035,	12080,
5,	14486,	10816,	15723,	15675,	5927,	5583,	10813,	15918,	4421,	5391,
6,	3622,	6362,	4725,	7175,	6408,	2386,	2575,	4669,	6189,	2045,
7,	2178,	1686,	2589,	2273,	3431,	2350,	950,	1239,	1952,	2288,
8,	936,	996,	849,	1250,	1053,	1289,	965,	381,	608,	763,
9,	309,	486,	434,	506,	609,	309,	613,	433,	135,	379,
10,	270,	116,	265,	187,	208,	146,	180,	201,	147,	50,
+gp,	58,	195,	107,	226,	33,	403,	415,	132,	99,	181,
TOTAL,	548124,	426896,	972361,	1303969,	674945,	545938,	469798,	667435,	506753,	1023339,

Table 3.4.5 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)

At 10-Oct-98 14:59:39

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3										
YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	488187,	525438,	899770,	314834,	618509,	324878,	596342,	158655,	716245,	281953,
2,	326531,	199427,	212742,	362327,	127871,	233152,	128728,	224550,	65359,	254638,
3,	32415,	82587,	63558,	62019,	96664,	35293,	55479,	34949,	59142,	18828,
4,	19489,	10015,	24913,	18562,	17571,	21970,	8370,	15606,	10456,	15959,
5,	5715,	7415,	4548,	9253,	7037,	5729,	7220,	2994,	5699,	3300,
6,	2338,	1962,	2999,	1946,	3850,	2616,	2130,	2802,	1206,	1957,
7,	918,	912,	962,	1303,	883,	1283,	1004,	822,	1150,	441,
8,	839,	380,	386,	339,	520,	336,	512,	426,	336,	438,
9,	289,	320,	185,	138,	157,	213,	111,	199,	192,	120,
10,	73,	98,	119,	84,	54,	58,	93,	37,	91,	95,
+gp,	87,	39,	53,	47,	32,	47,	41,	70,	47,	23,
TOTAL,	876880,	828592,	1210236,	770854,	873148,	625574,	800028,	441109,	859923,	577752,

Table 10 Stock number at age (start of year) Numbers*10**-3													
YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 63-95	AMST 63-9
AGE													
1,	197091,	274327,	133936,	169322,	310308,	151532,	349919,	238287,	161384,	390721,	0,	342239,	398641,
2,	109989,	74160,	108356,	52313,	67055,	120884,	64881,	146800,	96534,	69204,	159631,	140283,	161797,
3,	71753,	31061,	21739,	30783,	17174,	20340,	38787,	24501,	50071,	37130,	24263,	44449,	50453,
4,	6015,	17091,	8135,	6423,	9169,	5713,	5816,	11548,	7659,	18377,	12463,	14610,	16714,
5,	5173,	2089,	5066,	2734,	2264,	2976,	1791,	1972,	4658,	3403,	9166,	5794,	6878,
6,	1313,	1922,	804,	1914,	981,	894,	1010,	679,	889,	2131,	1666,	2492,	2990,
7,	630,	483,	636,	377,	615,	359,	339,	357,	297,	367,	1111,	1048,	1273,
8,	148,	249,	168,	240,	105,	206,	109,	149,	156,	97,	162,	457,	570,
9,	164,	61,	77,	89,	71,	39,	71,	37,	84,	48,	37,	188,	247,
10,	48,	77,	26,	9,	47,	22,	16,	29,	17,	30,	27,	75,	102,
+gp,	37,	25,	19,	22,	25,	28,	36,	11,	33,	20,	18,		
TOTAL,	392362,	401544,	278961,	264227,	407814,	302994,	462775,	424370,	321781,	521527,	208544,		

Table 3.4.6

Run title : Cod in IV,IIIa,VIId (run: XSALJB02/X02)
Table 16 Summary (without SOP correction)
Terminal Fs derived using XSA (With F shrinkage)

YEAR	RECRUITS(Age1),	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 8,	FBAR 2- 4,
1963,	195108,	452114,	151517,	116457,	.7686,	.4734,	.4506,
1964,	374091,	542256,	166128,	126041,	.7587,	.4933,	.4620,
1965,	415441,	714022,	205376,	181036,	.8815,	.5459,	.5839,
1966,	506863,	859768,	230735,	221336,	.9593,	.5147,	.5687,
1967,	488808,	923776,	250047,	252977,	1.0117,	.6125,	.5862,
1968,	194595,	788669,	258247,	288368,	1.1166,	.6156,	.6952,
1969,	209057,	630832,	255981,	200760,	.7843,	.5739,	.5241,
1970,	781993,	973121,	276923,	226124,	.8166,	.5511,	.6321,
1971,	910798,	1180311,	277312,	328098,	1.1831,	.6693,	.7883,
1972,	173514,	809719,	231095,	353976,	1.5317,	.8243,	.8168,
1973,	319652,	655931,	209190,	239052,	1.1428,	.6916,	.7711,
1974,	263658,	623365,	230866,	214279,	.9282,	.6585,	.7078,
1975,	486383,	704568,	211626,	205245,	.9698,	.7080,	.7293,
1976,	246435,	610376,	182073,	234169,	1.2861,	.7045,	.8510,
1977,	839211,	822053,	159358,	209154,	1.3125,	.7106,	.7206,
1978,	488187,	812384,	159397,	297022,	1.8634,	.8244,	.9052,
1979,	525437,	804740,	164325,	269973,	1.6429,	.6757,	.7771,
1980,	899770,	1015471,	181946,	293644,	1.6139,	.8009,	.8846,
1981,	314834,	855533,	195865,	335497,	1.7129,	.7587,	.9175,
1982,	618509,	840457,	190384,	303251,	1.5928,	.8915,	1.0298,
1983,	324878,	649551,	155262,	259287,	1.6700,	.9085,	1.0625,
1984,	596341,	718673,	133850,	228286,	1.7055,	.8146,	.9334,
1985,	158655,	503394,	126760,	214629,	1.6932,	.7772,	.9161,
1986,	716246,	683766,	114809,	204053,	1.7773,	.8823,	.9693,
1987,	281953,	572048,	105424,	216213,	2.0509,	.8659,	.9114,
1988,	197091,	426932,	99407,	184240,	1.8534,	.8508,	.9856,
1989,	274327,	417308,	91441,	139936,	1.5303,	.9245,	.9943,
1990,	133936,	329177,	78637,	125314,	1.5936,	.7585,	.9227,
1991,	169322,	297932,	71744,	102478,	1.4284,	.9179,	.8559,
1992,	310308,	407864,	69762,	114020,	1.6344,	.8337,	.8729,
1993,	151532,	344619,	66023,	121749,	1.8440,	.8943,	.9162,
1994,	349919,	445618,	67071,	110634,	1.6495,	.7977,	.8223,
1995,	238287,	451994,	77137,	138623,	1.7971,	.6532,	.7821,
1996,	161384,	403733,	90772,	126454,	1.3931,	.7337,	.6563,
1997,	(390721)*,	516840,	109642,	124151,	1.1323,	.6266,	.6785,
Mean ,	391636,	651112,	161318,	208758,	1.3894,	.7297,	.7909,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

* replaced by RCT3 estimate of 1996 yearclass (557000)

Table 3.5.1

COD (IIIa, IV, VIId) RCT3 Input values Age group 1

20	29	2																			
Year class	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS1'	'SGFS2'	'DGFS0'	'DGFS1'	'DGFS2'	'FRGSF'	'GGFS1'	'GGFS2'	'IBQ21'	'SCQ21'	'SCQ22'	'IBQ40'	'IBQ41'	'GQ40'	'GQ11'
1970	911	9830	3450	-1	-1	-1	-1	-1	-1	-1	-1	9040	-1	-1	-1	-1	-1	-1	-1	-1	-1
1971	173	410	1060	-1	-1	-1	-1	-1	-1	-1	-1	130	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	320	3800	950	-1	-1	-1	-1	-1	-1	-1	-1	160	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	264	1470	620	-1	-1	-1	-1	-1	-1	-1	-1	360	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	486	4030	1990	-1	-1	-1	-1	-1	-1	-1	-1	800	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	246	790	320	-1	-1	447	-1	-1	-1	-1	-1	780	-1	-1	-1	-1	-1	-1	-1	-1	-1
1976	839	3670	2930	-1	6270	1250	-1	-1	-1	-1	-1	2820	-1	-1	-1	-1	-1	-1	-1	-1	-1
1977	488	1290	930	1389	2284	580	-1	-1	-1	-1	-1	2720	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	525	990	1480	1256	2423	670	-1	-1	-1	-1	450	3110	-1	-1	-1	-1	-1	-1	-1	-1	-1
1979	900	1690	2550	1855	5084	1386	-1	-1	-1	16380	1120	3550	-1	-1	-1	-1	-1	-1	-1	-1	-1
1980	315	290	670	1023	1136	290	-1	351	4320	4690	160	1410	-1	-1	-1	-1	-1	-1	-1	-1	-1
1981	619	920	1660	7424	3237	1096	614	78	17680	8300	230	2320	-1	350	-1	-1	-1	-1	-1	-1	678.3
1982	325	390	800	255	1540	475	325	391	2690	2180	160	900	590	240	-1	-1	-1	-1	-1	303	66.2
1983	596	1520	1760	9510	6122	1189	819	1143	12150	12130	310	4300	260	2240	-1	-1	-1	-1	-1	566	406
1984	159	90	360	38	430	115	66	104	130	360	20	90	230	260	-1	-1	-1	-1	-1	2	9.6
1985	716	1700	2880	828	3438	1065	801	695	14360	11120	800	950	1540	1140	-1	-1	-1	-1	-1	724.6	197
1986	282	880	610	121	1422	407	219	288	3700	4150	170	230	700	950	-1	-1	-1	-1	-1	242.3	20.8
1987	197	360	630	38	836	248	162	135	3620	1780	220	210	200	720	-1	-1	-1	-1	-1	20	2.6
1988	274	1310	1520	1678	2285	504	561	49	1660	1660	190	420	9020	1470	-1	-1	-1	-1	-1	148.2	2.2
1989	134	340	410	598	608	155	114	154	1370	920	70	60	1190	620	-1	-1	3140	-1	-1	31	1
1990	169	240	450	383	752	159	303	193	2350	720	110	-1	1550	360	850	1490	5330	-1	567	33.8	34.6
1991	310	1300	1990	4840	2440	650	642	749	3980	4540	70	-1	1340	-1	3630	19080	14460	-1	2671	-1	-1
1992	152	1270	440	1684	742	295	347	334	1160	170	90	-1	-1	450	1100	4820	3410	-1	586	-1	1.2
1993	350	1480	2210	377	2637	1277	1158	1443	2410	4690	-1	-1	3080	1430	3200	2030	20470	-1	2552	8.4	-1
1994	238	970	800	2134	1028	668	475	356	6350	-1	-1	-1	430	-1	1960	4270	5660	-1	1489	133.4	32
1995	161	350	690	26	619	284	318	278	-1	-1	-1	-1	-1	-1	370	770	1920	-1	791	41	25.4
1996	-1	4000	2640	4122	4044	1396	999	-1	-1	-1	-1	-1	-1	-1	7580	2830	-1	-1	-1	109.2	9.4
1997	-1	270	-1	4.9	118	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5.5	0.5
1998	-1	-1	-1	389	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 3.5.1 (Continued)

COD (IIIa, IV, VIId) RCT3 Input values Age group 2

20	29	2																			
Year class	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS1'	'SGFS2'	'DGFS0'	'DGFS1'	'DGFS2'	'FRGSF'	'GGFS1'	'GGFS2'	'IBQ21'	'SCQ21'	'SCQ22'	'IBQ40'	'IBQ41'	'GQ40'	'GQ11'
1970	379	9830	3450	-1	-1	-1	-1	-1	-1	-1	-1	9040	-1	-1	-1	-1	-1	-1	-1	-1	-1
1971	75	410	1060	-1	-1	-1	-1	-1	-1	-1	-1	130	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	126	3800	950	-1	-1	-1	-1	-1	-1	-1	-1	160	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	108	1470	620	-1	-1	-1	-1	-1	-1	-1	-1	360	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	196	4030	1990	-1	-1	-1	-1	-1	-1	-1	-1	800	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	107	790	320	-1	-1	447	-1	-1	-1	-1	-1	780	-1	-1	-1	-1	-1	-1	-1	-1	-1
1976	327	3670	2930	-1	6270	1250	-1	-1	-1	-1	-1	2820	-1	-1	-1	-1	-1	-1	-1	-1	-1
1977	199	1290	930	1389	2284	580	-1	-1	-1	-1	-1	2720	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	213	990	1480	1256	2423	670	-1	-1	-1	-1	450	3110	-1	-1	-1	-1	-1	-1	-1	-1	-1
1979	362	1690	2550	1855	5084	1386	-1	-1	-1	16380	1120	3550	-1	-1	-1	-1	-1	-1	-1	-1	-1
1980	128	290	670	1023	1136	290	-1	351	4320	4690	160	1410	-1	-1	-1	-1	-1	-1	-1	-1	-1
1981	233	920	1660	7424	3237	1096	614	78	17680	8300	230	2320	-1	350	-1	-1	-1	-1	-1	-1	678.3
1982	129	390	800	255	1540	475	325	391	2690	2180	160	900	590	240	-1	-1	-1	-1	-1	303	66.2
1983	225	1520	1760	9510	6122	1189	819	1143	12150	12130	310	4300	260	2240	-1	-1	-1	-1	-1	566	406
1984	65	90	360	38	430	115	66	104	130	360	20	90	230	260	-1	-1	-1	-1	-1	2	9.6
1985	255	1700	2880	828	3438	1065	801	695	14360	11120	800	950	1540	1140	-1	-1	-1	-1	-1	724.6	197
1986	110	880	610	121	1422	407	219	288	3700	4150	170	230	700	950	-1	-1	-1	-1	-1	242.3	20.8
1987	74	360	630	38	836	248	162	135	3620	1780	220	210	200	720	-1	-1	-1	-1	-1	20	2.6
1988	108	1310	1520	1678	2285	504	561	49	1660	1660	190	420	9020	1470	-1	-1	-1	-1	-1	148.2	2.2
1989	52	340	410	598	608	155	114	154	1370	920	70	60	1190	620	-1	-1	3140	-1	-1	31	1
1990	67	240	450	383	752	159	303	193	2350	720	110	-1	1550	360	850	1490	5330	-1	567	33.8	34.6
1991	121	1300	1990	4840	2440	650	642	749	3980	4540	70	-1	1340	-1	3630	19080	14460	-1	2671	-1	-1
1992	65	1270	440	1684	742	295	347	334	1160	170	90	-1	-1	450	1100	4820	3410	-1	586	-1	1.2
1993	147	1480	2210	377	2637	1277	1158	1443	2410	4690	-1	-1	3080	1430	3200	2030	20470	-1	2552	8.4	-1
1994	97	970	800	2134	1028	668	475	356	6350	-1	-1	-1	430	-1	1960	4270	5660	-1	1489	133.4	32
1995	69	350	690	26	619	284	318	278	-1	-1	-1	-1	-1	-1	370	770	1920	-1	791	41	25.4
1996	-1	4000	2640	4122	4044	1396	999	-1	-1	-1	-1	-1	-1	-1	7580	2830	-1	-1	-1	109.2	9.4
1997	-1	270	-1	4.9	118	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5.5	0.5
1998	-1	-1	-1	389	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 3.5.2.1

RCT3 output
COD in IIIa, IV and VIId
Age group 1

Data for 20 surveys over 29 years : 1970 - 1998

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

Finalestimates shrunk towards mean
Minimum S.E. for any survey taken as 0.2
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1996

	I----------Regression----------I					I----------Prediction----------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
IYFS1	0.81	0.21	0.6	0.497	26	8.29	6.96	0.663	0.044	1054
IYFS2	0.98	-1.02	0.39	0.708	26	7.88	6.72	0.422	0.108	829
EGFS0	0.6	1.85	0.87	0.317	19	8.32	6.82	0.971	0.02	916
EGFS1	0.8	-0.14	0.23	0.877	20	8.31	6.49	0.257	0.289	659
EGFS2	0.9	0.17	0.34	0.764	21	7.24	6.71	0.378	0.134	821
SGFS1	0.95	0	0.54	0.521	15	6.91	6.57	0.627	0.049	713
IBQ21	0.47	2.01	0.21	0.777	6	8.93	6.17	0.362	0.146	478
SCQ21	0.7	-0.23	0.78	0.209	6	7.95	5.32	1.027	0.018	204
GQ40	0.44	3.69	0.56	0.495	12	4.7	5.76	0.635	0.047	317
GQ11	0.36	4.42	0.41	0.684	13	2.34	5.26	0.464	0.089	192
						VPA Mean =	5.8	0.587	0.056	330

Yearclass = 1997

	I----------Regression----------I					I----------Prediction----------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
IYFS1	0.81	0.21	0.6	0.497	26	5.6	4.77	0.658	0.102	118
EGFS0	0.6	1.85	0.87	0.317	19	1.77	2.91	1.118	0.035	18
EGFS1	0.8	-0.14	0.23	0.877	20	4.78	3.67	0.311	0.459	39
GQ40	0.44	3.69	0.56	0.495	12	1.87	4.51	0.685	0.094	91
GQ11	0.36	4.42	0.41	0.684	13	0.41	4.57	0.496	0.18	97
						VPA Mean =	5.8	0.587	0.056	330

Table 3.5.2.1 (Continued)

Yearclass = 1998

	I----------Regression----------I					I----------Prediction----------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
EGFS0	0.6	1.85	0.87	0.317	19	5.97	5.41	0.946	0.278	224
					VPA Mean =	5.8	0.587	0.056	330	

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio
1996	557	6.32	0.14	0.15	1.16
1997	71	4.27	0.21	0.34	2.60
1998	296	5.69	0.5	0.18	0.12

Table 3.5.2.2

RCT3 output
COD in IIIa, IV and VIId
Age group 2

Data for 20 surveys over 29 years : 1970 - 1998

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 0.2
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1996

	I----------Regression----------I					I----------Prediction----------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
IYFS1	0.78	-0.44	0.57	0.513	26	8.29	5.99	0.622	0.047	399
IYFS2	0.96	-1.75	0.38	0.701	26	7.88	5.78	0.416	0.105	323
EGFS0	0.58	1.06	0.84	0.314	19	8.32	5.86	0.942	0.02	350
EGFS1	0.78	-0.89	0.23	0.869	20	8.31	5.55	0.258	0.273	257
EGFS2	0.86	-0.5	0.31	0.777	21	7.24	5.76	0.352	0.147	317
SGFS1	0.86	-0.36	0.46	0.564	15	6.91	5.55	0.539	0.063	257
IBQ21	0.46	1.19	0.23	0.739	6	8.93	5.28	0.385	0.123	196
SCQ21	0.74	-1.47	0.85	0.17	6	7.95	4.44	1.12	0.014	84
GQ40	0.43	2.81	0.56	0.466	12	4.7	4.84	0.637	0.045	126
GQ11	0.33	3.59	0.36	0.704	13	2.34	4.36	0.412	0.107	78
						VPA Mean =	4.89	0.569	0.056	133

Yearclass = 1997

	I----------Regression----------I					I----------Prediction----------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
IYFS1	0.78	-0.44	0.57	0.513	26	5.6	3.91	0.618	0.109	49
EGFS0	0.58	1.06	0.84	0.314	19	1.77	2.08	1.085	0.035	8
EGFS1	0.78	-0.89	0.23	0.869	20	4.78	2.82	0.312	0.427	16
GQ40	0.43	2.81	0.56	0.466	12	1.87	3.62	0.686	0.088	37
GQ11	0.33	3.59	0.36	0.704	13	0.41	3.72	0.441	0.213	41
						VPA Mean =	4.89	0.569	0.056	133

Table 3.5.2.2 (Continued)

Yearclass = 1998

	I----------Regression----------I					I----------Prediction----------I				
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
EGFS0	0.58	1.06	0.84	0.314	19	5.97	4.5	0.918	0.278	90
						VPA Mean =	4.89	0.569	0.056	133

Year Class Prediction	Weighted Average Error	Log WAP Error	Int Std	Ext Std	Var Ratio
1996	218	5.39	0.13	0.15	1.22
1997	31	3.44	0.2	0.33	2.63
1998	119	4.78	0.48	0.17	0.13

Table 3.7.1

Cod in Fishing Areas IV, Skagerrak and VIId

Single option prediction: Input data

Year: 1998								
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	71000.000	0.8000	0.0100	0.0000	0.0000	0.692	0.0818	0.692
2	218000.00	0.3500	0.0500	0.0000	0.0000	1.033	0.6764	1.033
3	24263.000	0.2500	0.2300	0.0000	0.0000	2.159	0.8356	2.159
4	12463.000	0.2000	0.6200	0.0000	0.0000	4.049	0.6049	4.049
5	9166.000	0.2000	0.8600	0.0000	0.0000	6.695	0.5644	6.695
6	1666.000	0.2000	1.0000	0.0000	0.0000	8.623	0.5874	8.623
7	1111.000	0.2000	1.0000	0.0000	0.0000	9.998	0.7229	9.998
8	162.000	0.2000	1.0000	0.0000	0.0000	11.417	0.7066	11.417
9	37.000	0.2000	1.0000	0.0000	0.0000	12.559	0.6082	12.559
10	27.000	0.2000	1.0000	0.0000	0.0000	12.425	0.6059	12.425
11+	18.000	0.2000	1.0000	0.0000	0.0000	12.797	0.6059	12.797
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	250000.00	0.8000	0.0100	0.0000	0.0000	0.692	0.0818	0.692
2	.	0.3500	0.0500	0.0000	0.0000	1.033	0.6764	1.033
3	.	0.2500	0.2300	0.0000	0.0000	2.159	0.8356	2.159
4	.	0.2000	0.6200	0.0000	0.0000	4.049	0.6049	4.049
5	.	0.2000	0.8600	0.0000	0.0000	6.695	0.5644	6.695
6	.	0.2000	1.0000	0.0000	0.0000	8.623	0.5874	8.623
7	.	0.2000	1.0000	0.0000	0.0000	9.998	0.7229	9.998
8	.	0.2000	1.0000	0.0000	0.0000	11.417	0.7066	11.417
9	.	0.2000	1.0000	0.0000	0.0000	12.559	0.6082	12.559
10	.	0.2000	1.0000	0.0000	0.0000	12.425	0.6059	12.425
11+	.	0.2000	1.0000	0.0000	0.0000	12.797	0.6059	12.797
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	250000.00	0.8000	0.0100	0.0000	0.0000	0.692	0.0818	0.692
2	.	0.3500	0.0500	0.0000	0.0000	1.033	0.6764	1.033
3	.	0.2500	0.2300	0.0000	0.0000	2.159	0.8356	2.159
4	.	0.2000	0.6200	0.0000	0.0000	4.049	0.6049	4.049
5	.	0.2000	0.8600	0.0000	0.0000	6.695	0.5644	6.695
6	.	0.2000	1.0000	0.0000	0.0000	8.623	0.5874	8.623
7	.	0.2000	1.0000	0.0000	0.0000	9.998	0.7229	9.998
8	.	0.2000	1.0000	0.0000	0.0000	11.417	0.7066	11.417
9	.	0.2000	1.0000	0.0000	0.0000	12.559	0.6082	12.559
10	.	0.2000	1.0000	0.0000	0.0000	12.425	0.6059	12.425
11+	.	0.2000	1.0000	0.0000	0.0000	12.797	0.6059	12.797
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SPRLJB04
Date and time: 140CT98:15:04

Table 3.7.2

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

Populations in 1998			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	70999	.34	WS1	.69	.05	M1	.80	.13	MT1	.01	.10
N2	217999	.15	WS2	1.03	.08	M2	.35	.10	MT2	.05	.10
N3	24263	.10	WS3	2.16	.02	M3	.25	.18	MT3	.23	.10
N4	12464	.08	WS4	4.05	.06	M4	.20	.18	MT4	.62	.10
N5	9169	.08	WS5	6.69	.07	M5	.20	.18	MT5	.86	.10
N6	1665	.08	WS6	8.62	.04	M6	.20	.18	MT6	1.00	.10
N7	1112	.09	WS7	10.00	.03	M7	.20	.18	MT7	1.00	.00
N8	160	.10	WS8	11.42	.03	M8	.20	.18	MT8	1.00	.00
N9	36	.13	WS9	12.56	.04	M9	.20	.18	MT9	1.00	.00
N10	26	.16	WS10	12.42	.03	M10	.20	.18	MT10	1.00	.00
N11	17	.17	WS11	12.80	.11	M11	.20	.18	MT11	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.08	.42	WH1	.69	.05
sH2	.68	.16	WH2	1.03	.08
sH3	.84	.16	WH3	2.16	.02
sH4	.60	.17	WH4	4.05	.06
sH5	.56	.07	WH5	6.69	.07
sH6	.59	.15	WH6	8.62	.04
sH7	.72	.15	WH7	10.00	.03
sH8	.70	.39	WH8	11.42	.03
sH9	.59	.30	WH9	12.56	.04
sH10	.60	.50	WH10	12.42	.03
sH11	.60	.50	WH11	12.80	.11

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K98	1.00	.10	HF98	1.00	.08
K99	1.00	.10	HF99	1.00	.08
K**	1.00	.10	HF**	1.00	.08

Recruitment		
Labl	Value	CV
R99	295999	.50
R**	342239	.56

Table 3.7.3

Cod in Fishing Areas IV, Skagerrak and VIId

Prediction with management option table

Year: 1998					Year: 1999					Year: 2000	
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	0.6712	466821	136219	182127	0.0000	0.0000	493234	145404	0	711937	296120
.	.	.	.	.	0.1000	0.0671	.	145404	21023	680665	275872
.	.	.	.	.	0.2000	0.1342	.	145404	40653	651622	257074
.	.	.	.	.	0.3000	0.2014	.	145404	58992	624642	239621
.	.	.	.	.	0.4000	0.2685	.	145404	76132	599571	223412
.	.	.	.	.	0.5000	0.3356	.	145404	92157	576268	208358
.	.	.	.	.	0.6000	0.4027	.	145404	107147	554602	194374
.	.	.	.	.	0.7000	0.4698	.	145404	121175	534452	181383
.	.	.	.	.	0.8000	0.5369	.	145404	134310	515707	169311
.	.	.	.	.	0.9000	0.6041	.	145404	146615	498263	158091
.	.	.	.	.	1.0000	0.6712	.	145404	158147	482024	147663
.	.	.	.	.	1.1000	0.7383	.	145404	168961	466901	137969
.	.	.	.	.	1.2000	0.8054	.	145404	179108	452814	128955
.	.	.	.	.	1.3000	0.8725	.	145404	188634	439686	120573
.	.	.	.	.	1.4000	0.9396	.	145404	197582	427448	112777
.	.	.	.	.	1.5000	1.0068	.	145404	205992	416033	105525
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANLJB04
Date and time : 14OCT98:15:05
Computation of ref. F: Simple mean, age 2 - 8
Basis for 1998 : F factors

Table 3.7.4

Cod in Fishing Areas IV, Skagerrak and VIId

Single option prediction: Detailed tables

Year: 1998 F-factor: 1.0000 Reference F: 0.6712

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0818	3859	2671	71000	49137	710	491	710	491
2	0.6764	92189	95191	218000	225099	10900	11255	10900	11255
3	0.8356	12369	26709	24263	52393	5580	12050	5580	12050
4	0.6049	5178	20969	12463	50468	7727	31290	7727	31290
5	0.5644	3617	24215	9166	61370	7883	52778	7883	52778
6	0.5874	677	5841	1666	14366	1666	14366	1666	14366
7	0.7229	524	5243	1111	11108	1111	11108	1111	11108
8	0.7066	75	859	162	1849	162	1849	162	1849
9	0.6082	15	194	37	465	37	465	37	465
10	0.6059	11	140	27	335	27	335	27	335
11+	0.6059	7	96	18	230	18	230	18	230
Total		118523	182127	337913	466821	35821	136219	35821	136219
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1999 F-factor: 1.0000 Reference F: 0.6712

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0818	13589	9405	250000	173019	2500	1730	2500	1730
2	0.6764	12431	12836	29397	30354	1470	1518	1470	1518
3	0.8356	39818	85982	78108	168665	17965	38793	17965	38793
4	0.6049	3404	13786	8194	33179	5080	20571	5080	20571
5	0.5644	2199	14722	5573	37311	4792	32087	4792	32087
6	0.5874	1735	14962	4268	36802	4268	36802	4268	36802
7	0.7229	358	3578	758	7579	758	7579	758	7579
8	0.7066	205	2342	441	5040	441	5040	441	5040
9	0.6082	27	343	65	822	65	822	65	822
10	0.6059	7	85	16	205	16	205	16	205
11+	0.6059	8	107	20	257	20	257	20	257
Total		73782	158147	376840	493234	37377	145404	37377	145404
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000 F-factor: 1.0000 Reference F: 0.6712

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0818	13589	9405	250000	173019	2500	1730	2500	1730
2	0.6764	43773	45198	103509	106880	5175	5344	5175	5344
3	0.8356	5369	11594	10533	22744	2423	5231	2423	5231
4	0.6049	10959	44379	26377	106811	16354	66223	16354	66223
5	0.5644	1446	9679	3664	24530	3151	21095	3151	21095
6	0.5874	1055	9096	2595	22374	2595	22374	2595	22374
7	0.7229	917	9165	1942	19415	1942	19415	1942	19415
8	0.7066	140	1598	301	3439	301	3439	301	3439
9	0.6082	74	934	178	2239	178	2239	178	2239
10	0.6059	12	151	29	362	29	362	29	362
11+	0.6059	7	87	16	209	16	209	16	209
Total		77341	141286	399144	482024	34664	147663	34664	147663
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLJB04
Date and time : 140CT98:15:04
Computation of ref. F: Simple mean, age 2 - 8
Prediction basis : F factors

Table 3.9.1

Cod in Fishing Areas IV, Skagerrak and VIId

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	0.692	0.0818	0.692
2	.	0.3500	0.0500	0.0000	0.0000	1.033	0.6764	1.033
3	.	0.2500	0.2300	0.0000	0.0000	2.159	0.8356	2.159
4	.	0.2000	0.6200	0.0000	0.0000	4.049	0.6049	4.049
5	.	0.2000	0.8600	0.0000	0.0000	6.695	0.5644	6.695
6	.	0.2000	1.0000	0.0000	0.0000	8.623	0.5874	8.623
7	.	0.2000	1.0000	0.0000	0.0000	9.998	0.7229	9.998
8	.	0.2000	1.0000	0.0000	0.0000	11.417	0.7066	11.417
9	.	0.2000	1.0000	0.0000	0.0000	12.559	0.6082	12.559
10	.	0.2000	1.0000	0.0000	0.0000	12.425	0.6059	12.425
11+	.	0.2000	1.0000	0.0000	0.0000	12.797	0.6059	12.797
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDLJB03
Date and time: 140CT98:14:57

Table 3.9.2

Cod in Fishing Areas IV, Skagerrak and VIId

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	14588.760	1.344	12367.655	1.344	12367.655
0.1000	0.0671	0.101	508.934	2.653	9720.998	0.911	7635.184	0.911	7635.184
0.2000	0.1342	0.164	697.428	2.364	7011.882	0.658	5042.913	0.658	5042.913
0.3000	0.2014	0.208	756.066	2.170	5358.443	0.497	3490.748	0.497	3490.748
0.4000	0.2685	0.241	759.393	2.032	4282.281	0.388	2502.683	0.388	2502.683
0.5000	0.3356	0.266	739.535	1.929	3547.334	0.310	1844.648	0.310	1844.648
0.6000	0.4027	0.287	711.082	1.849	3026.125	0.254	1390.838	0.254	1390.838
0.7000	0.4698	0.304	680.778	1.785	2645.017	0.212	1069.012	0.212	1069.012
0.8000	0.5369	0.319	651.682	1.733	2359.169	0.179	835.500	0.179	835.500
0.9000	0.6041	0.331	625.068	1.690	2140.078	0.154	662.786	0.154	662.786
1.0000	0.6712	0.343	601.344	1.653	1968.976	0.134	532.932	0.134	532.932
1.1000	0.7383	0.353	580.498	1.622	1833.130	0.117	433.906	0.117	433.906
1.2000	0.8054	0.362	562.334	1.595	1723.675	0.104	357.438	0.104	357.438
1.3000	0.8725	0.370	546.579	1.572	1634.303	0.094	297.725	0.094	297.725
1.4000	0.9396	0.377	532.947	1.551	1560.440	0.085	250.620	0.085	250.620
1.5000	1.0068	0.384	521.167	1.533	1498.709	0.078	213.113	0.078	213.113
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDLJB03
Date and time : 14OCT98:14:57
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.2230
F-max factor : 0.3563
F-0.1 reference F : 0.1497
F-max reference F : 0.2391
Recruitment : Single recruit

Table 3.10.1.

Introduction to PA Add-in outputs

Four sheets of results are included in this workbook:

RefPts - provides stochastic output in the form of a table of reference points and a chart summarising the distributions of some reference points.

Plots - provides 5 plots:
A stock recruitment plot with a LOWESS smoother as a possible stock recruitment relationship. Some reference points are also indicated.
A plot of YPR and SPR curves with some reference points indicated.
A plot of historical SSB against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship.
A plot of historical yield against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship.
A plot of the time series of stock and recruitment with expected recruits based on the LOWESS stock recruitment relationship.

PD - gives the value of the reference points during each iteration of the simulation and the percentiles plotted on the chart on RefPts.

SV - contains the steady state vectors and stock recruitment series used. These can be used as the basis for further runs.

For estimation of Gloss and Floss:
A LOWESS smoother with a span of 0.5 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

For estimation of the stock recruitment relationship used in equilibrium calculations:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were un-transformed
No point representing the origin was included in the stock recruit data.

North Sea cod

Steady state selection averaged over 0 years.
FBar averaged from age 2 to 8

Number of iterations = 1000

Data source:
D:\North Sea Demersal WG 98\Cod IV\CODIV.SEN
D:\North Sea Demersal WG 98\Cod IV\CODIV.SUM

FishLab DLL used
FLVB32.DLL built on Aug 18 1998 at 08:57:43

10/12/98 14:12

Table 3.10.2

cod North Sea

Data read from file codiv rec

Shepherd curve
Moving average term NOT fitted

IFAIL on exit from E04FDF =, 5

Residual sum of squares=, 8.2794

Number of observations=, 34

Number of parameters =, 3

Residual mean square =, .2671

Coefficient of determination =, .2129

Adj. coeff. of determination =, .1622

IFAIL from E04YCF=, 0

Parameter Correlation matrix

, 1.0000,
, -.7432, 1.0000,
, -.6452, .3571, 1.0000,

Parameter,s.d.

3.0343, .5061,
248.8117, 27.5282,
4.3531, 2.8213,

Y/Class	SSB	Recruits	Fit. rct	residuals	residuals	wt
1963,	151.50,	374.00,	412.15,	-.0971,	-.0971,	1.0000
1964,	166.10,	415.00,	429.96,	-.0354,	-.0354,	1.0000
1965,	205.40,	507.00,	434.61,	.1541,	.1541,	1.0000
1966,	230.80,	489.00,	406.92,	.1837,	.1837,	1.0000
1967,	250.00,	195.00,	375.35,	-.6549,	-.6549,	1.0000
1968,	258.20,	209.00,	360.22,	-.5444,	-.5444,	1.0000
1969,	255.90,	782.00,	364.53,	.7632,	.7632,	1.0000
1970,	276.80,	911.00,	324.22,	1.0331,	1.0331,	1.0000
1971,	277.20,	173.00,	323.44,	-.6257,	-.6257,	1.0000
1972,	231.00,	320.00,	406.63,	-.2396,	-.2396,	1.0000
1973,	209.10,	264.00,	431.88,	-.4922,	-.4922,	1.0000
1974,	230.80,	486.00,	406.92,	.1776,	.1776,	1.0000
1975,	211.70,	246.00,	429.67,	-.5577,	-.5577,	1.0000
1976,	182.10,	839.00,	439.58,	.6464,	.6464,	1.0000
1977,	159.30,	488.00,	422.69,	.1437,	.1437,	1.0000
1978,	159.40,	525.00,	422.81,	.2165,	.2165,	1.0000
1979,	164.30,	900.00,	428.21,	.7428,	.7428,	1.0000
1980,	181.90,	315.00,	439.53,	-.3331,	-.3331,	1.0000
1981,	195.80,	619.00,	439.31,	.3429,	.3429,	1.0000
1982,	190.40,	325.00,	440.34,	-.3037,	-.3037,	1.0000
1983,	155.30,	596.00,	417.57,	.3558,	.3558,	1.0000
1984,	133.90,	159.00,	380.64,	-.8729,	.8729,	1.0000
1985,	126.80,	716.00,	365.33,	.6729,	.6729,	1.0000
1986,	114.90,	282.00,	336.98,	-.1781,	-.1781,	1.0000
1987,	105.50,	197.00,	312.65,	-.4619,	-.4619,	1.0000
1988,	99.50,	274.00,	296.43,	-.0787,	-.0787,	1.0000
1989,	91.50,	134.00,	274.12,	-.7157,	-.7157,	1.0000
1990,	78.70,	169.00,	237.22,	-.3391,	-.3391,	1.0000
1991,	71.80,	310.00,	216.89,	.3572,	.3572,	1.0000
1992,	69.80,	152.00,	210.96,	-.3278,	-.3278,	1.0000
1993,	66.00,	350.00,	199.65,	.5614,	.5614,	1.0000
1994,	67.10,	238.00,	202.93,	.1594,	.1594,	1.0000
1995,	77.20,	161.00,	232.82,	-.3689,	-.3689,	1.0000
1996,	90.80,	557.00,	272.13,	.7163,	.7163,	1.0000

cod North Sea

Data read from file codiv.rec

Ricker curve
Moving average term NOT fitted

IFAIL on exit from E04FDF =, 5

Residual sum of squares=, 8.6716

Number of observations=, 34

Number of parameters =, 2

Residual mean square =, .2710

Coefficient of determination =, .1757

Adj coeff of determination =, .1499

IFAIL from E04YCF=, 0

Parameter Correlation matrix

, 1.0000,
, .9275, 1.0000,

Parameter,s.d.

4.4876, 1.0720,
.0040, .0014,

Y/Class	SSB	Recruits	Fit. rct	residuals	residuals	wt
1963,	151.50,	374.00,	369.20,	.0129,	.0129,	1.0000
1964,	166.10,	415.00,	381.65,	.0838,	.0838,	1.0000
1965,	205.40,	507.00,	402.82,	.2300,	.2300,	1.0000
1966,	230.80,	489.00,	408.60,	.1796,	.1796,	1.0000
1967,	250.00,	195.00,	409.63,	-.7423,	-.7423,	1.0000
1968,	258.20,	209.00,	409.32,	-.6722,	-.6722,	1.0000
1969,	255.90,	782.00,	409.45,	.6470,	.6470,	1.0000
1970,	276.80,	911.00,	407.11,	.8055,	.8055,	1.0000
1971,	277.20,	173.00,	407.04,	-.8556,	-.8556,	1.0000
1972,	231.00,	320.00,	408.62,	-.2445,	-.2445,	1.0000
1973,	209.10,	264.00,	404.01,	-.4255,	-.4255,	1.0000
1974,	230.80,	486.00,	408.60,	.1735,	.1735,	1.0000
1975,	211.70,	246.00,	404.77,	-.4980,	-.4980,	1.0000
1976,	182.10,	839.00,	392.29,	.7602,	.7602,	1.0000
1977,	159.30,	488.00,	376.20,	.2602,	.2602,	1.0000
1978,	159.40,	525.00,	376.28,	.3331,	.3331,	1.0000
1979,	164.30,	900.00,	380.27,	.8615,	.8615,	1.0000
1980,	181.90,	315.00,	392.17,	-.2191,	-.2191,	1.0000
1981,	195.80,	619.00,	399.14,	.4388,	.4388,	1.0000
1982,	190.40,	325.00,	396.68,	-.1993,	-.1993,	1.0000
1983,	155.30,	596.00,	372.71,	.4694,	.4694,	1.0000
1984,	133.90,	159.00,	350.30,	-.7899,	-.7899,	1.0000
1985,	126.80,	716.00,	341.35,	.7408,	.7408,	1.0000
1986,	114.90,	282.00,	324.51,	-.1404,	-.1404,	1.0000
1987,	105.50,	197.00,	309.47,	-.4517,	-.4517,	1.0000
1988,	99.50,	274.00,	299.01,	-.0874,	-.0874,	1.0000
1989,	91.50,	134.00,	283.98,	-.7511,	-.7511,	1.0000
1990,	78.70,	169.00,	257.18,	-.4199,	-.4199,	1.0000
1991,	71.80,	310.00,	241.25,	.2507,	.2507,	1.0000
1992,	69.80,	152.00,	236.43,	-.4418,	-.4418,	1.0000
1993,	66.00,	350.00,	227.01,	.4329,	.4329,	1.0000
1994,	67.10,	238.00,	229.77,	.0352,	.0352,	1.0000
1995,	77.20,	161.00,	253.81,	-.4552,	-.4552,	1.0000
1996,	90.80,	557.00,	282.60,	.6785,	.6785,	1.0000

Table 3.10.3 **North Sea cod** **: precautionary reference points**

BIOMASS

WGNSSK

Bloss (lowest observed SSB)	=	66,000 t	
Blim	=	70, 000t	
Bpa	=	150,000t	
MBAL	=	150,000t	

SGPAFM

Blim	=	66000 t	Lowest observed SSB
Bpa	=	150,000t	Decline in recruitment

Special comments regarding SSB

FISHING MORTALITY

Status quo Fbar (2-8) = 0.67 (Average 95-97)

	Estimate	Probability SSB<Bpa in 2007	% of historical F above precautionary F	Long-term SSB (t) at GM rec	
	0.10	0%	100%	2081598	
F0.1 5th %ile	0.11	0%	100%	1923012	
F35%SPR 5th %ile	0.13	0%	100%	1698247	
F0.1	0.15	0%	100%	1549588	
F35%SPR	0.16	0%	100%	1455283	
	0.20	0%	100%	1181856	
Fmax	0.24	0%	100%	967130	
Fmax 5th %ile	0.19	0%	100%	1230116	
	0.30	0%	100%	726170	
	0.40	0%	100%	471926	
	0.50	0%	94%	320236	
	0.60	0%	83%	225125	
Fmed 5th %ile	0.61	0%	83%	216764	
Floss x exp(-1.645*SE)	0.62	0%	77%	211950	
Floss x 5th %ile	0.67	0%	69%	179174	
	0.70	10%	60%	163144	
Fmed	0.76	30%	43%	136594	
Floss **	0.86	95%	20%	103327	
SGPAFM Flim	0.63		74%	4157953	= Floss
SGPAFM Fpa	0.40		100%	4157953	=Flim e-1.6

F range from the historic series 0.47 to 0.92
SSB range from the historical series 69800 to 277200
** A LOWESS smoother with a span of 0,5 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
Shepherd stock recruit model (alpha =3.0343, bet a = 4.3531, gamma = 2.488E-02)
Special comments regarding F
F(2-8) may not be a reliable statistic for this stock. The main ages exploited are ages 2-4 and the low catch of ages greater than 4 lead to a noisy exploitation patterns.

Table 3.10.4 **North Sea cod** **: precautionary reference points**

BIOMASS

WGNSSK

Bloss (lowest observed SSB)	=	66,000 t	
Blim	=	70, 000t	
Bpa	=	150,000t	
MBAL	=	150,000t	

SGPAFM

Blim	=	66000 t	Lowest observed SSB
Bpa	=	150,000t	Decline in recruitment

Special comments regarding SSB

FISHING MORTALITY

Status quo Fbar (2-8) = 0.67 (Average 95-97)

	Estimate	Probability SSB<Bpa in 2007	% of historical F above precautionary F	Long-term SSB (t) at GM rec	
	0.10	0%	100%	2081598	
F0.1 5th %ile	0.11	0%	100%	1923012	
F35%SPR 5th %ile	0.13	0%	100%	1698247	
F0.1	0.15	0%	100%	1549588	
F35%SPR	0.16	0%	100%	1455283	
	0.20	0%	100%	1181856	
Fmax	0.24	0%	100%	967130	
Fmax 5th %ile	0.19	0%	100%	1230116	
	0.30	0%	100%	726170	
	0.40	0%	100%	471926	
	0.50	0%	94%	320236	
	0.60	0%	83%	225125	
Fmed 5th %ile	0.61	0%	83%	216764	
Floss x exp(-1.645*SE)	0.62	0%	77%	211950	
Floss x 5th %ile	0.67	0%	69%	179174	
	0.70	0%	60%	163144	
Fmed	0.76	0%	43%	136594	
Floss **	0.86	0%	20%	103327	
	2.0	10%	0%		
SGPAFM Flim	0.63		74%	4157953	= Floss
SGPAFM Fpa	0.40		100%	4157953	=Flim e-1.6

F range from the historic series 0.47 to 0.92
SSB range from the historical series 69800 to 277200
** A LOWESS smoother with a span of 0,5 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
Ricker stock recruit model (alpha = 4.4876, beta = 0.004)
Special comments regarding F
F(2-8) may not be a reliable statistic for this stock. The main ages exploited are ages 2-4 and the low catch of ages greater than 4 lead to a noisy exploitation patterns.

Figure 3.1.1 Stock summary of Cod in IIIa (Skagerrak), IV and VIId

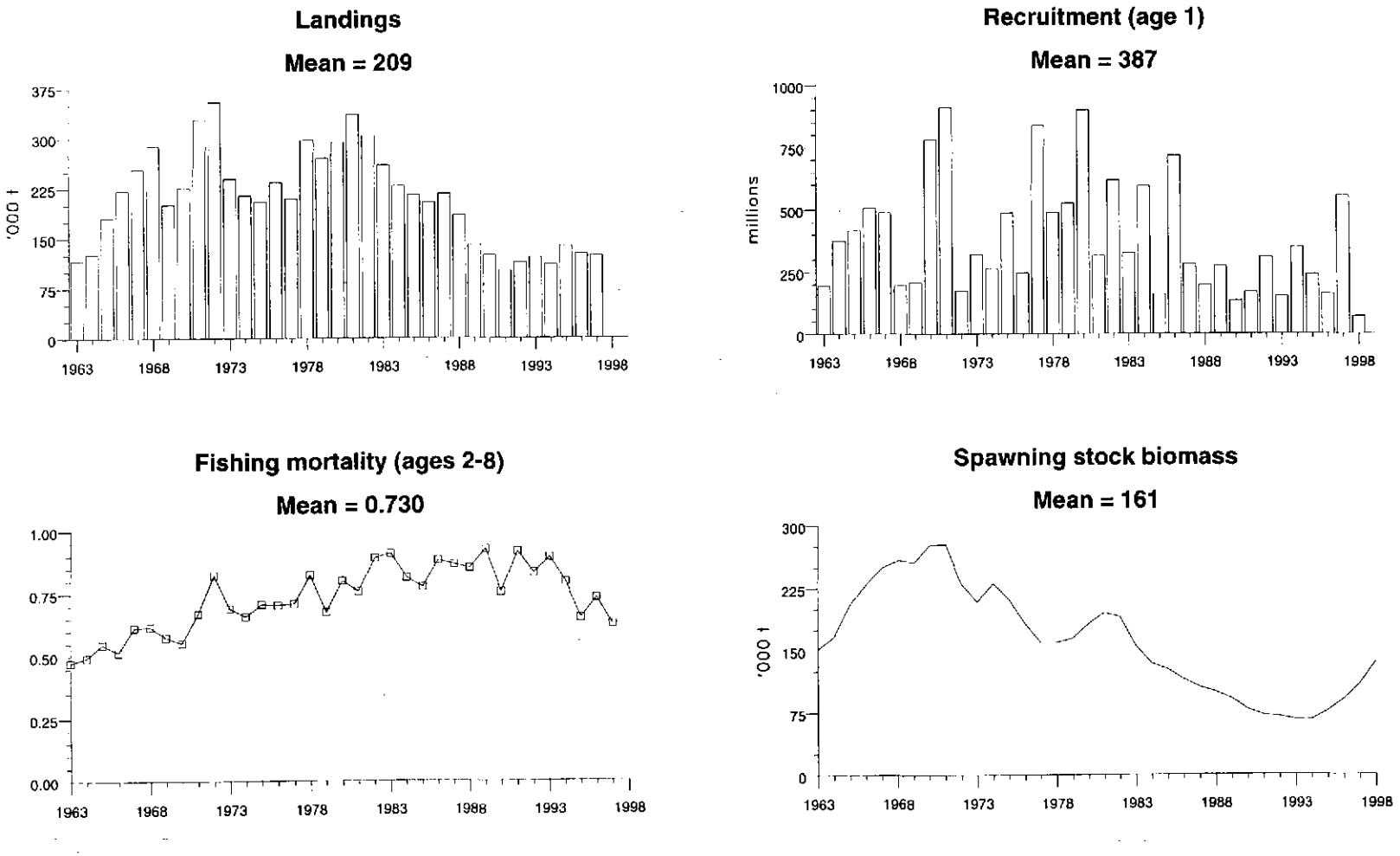


Figure 3.1.2. Catch in numbers at age for North Sea Cod in 1997 and 1986

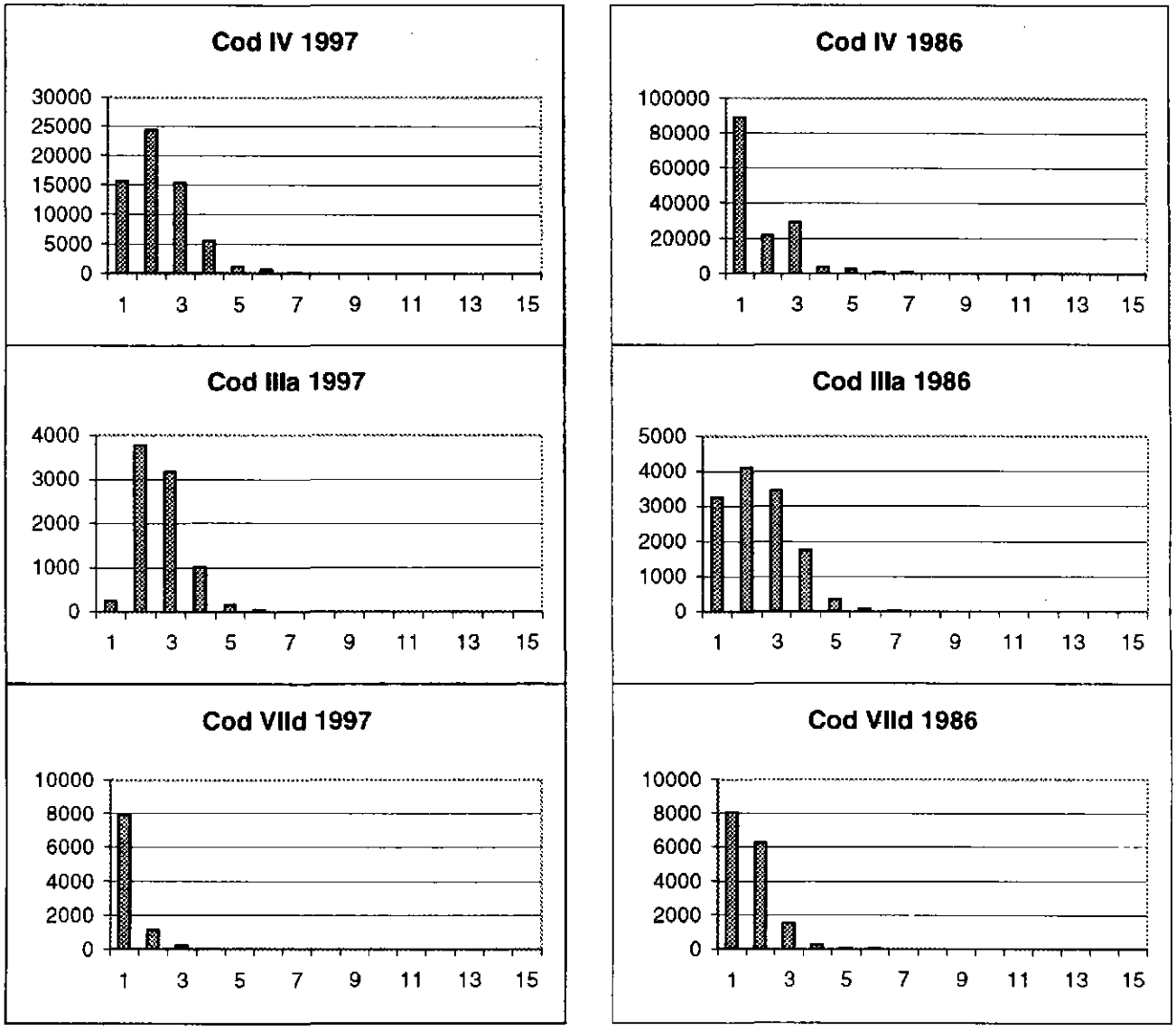


Figure 3.1.3 North Sea Cod: 1-group catch numbers by area in 1963-1997

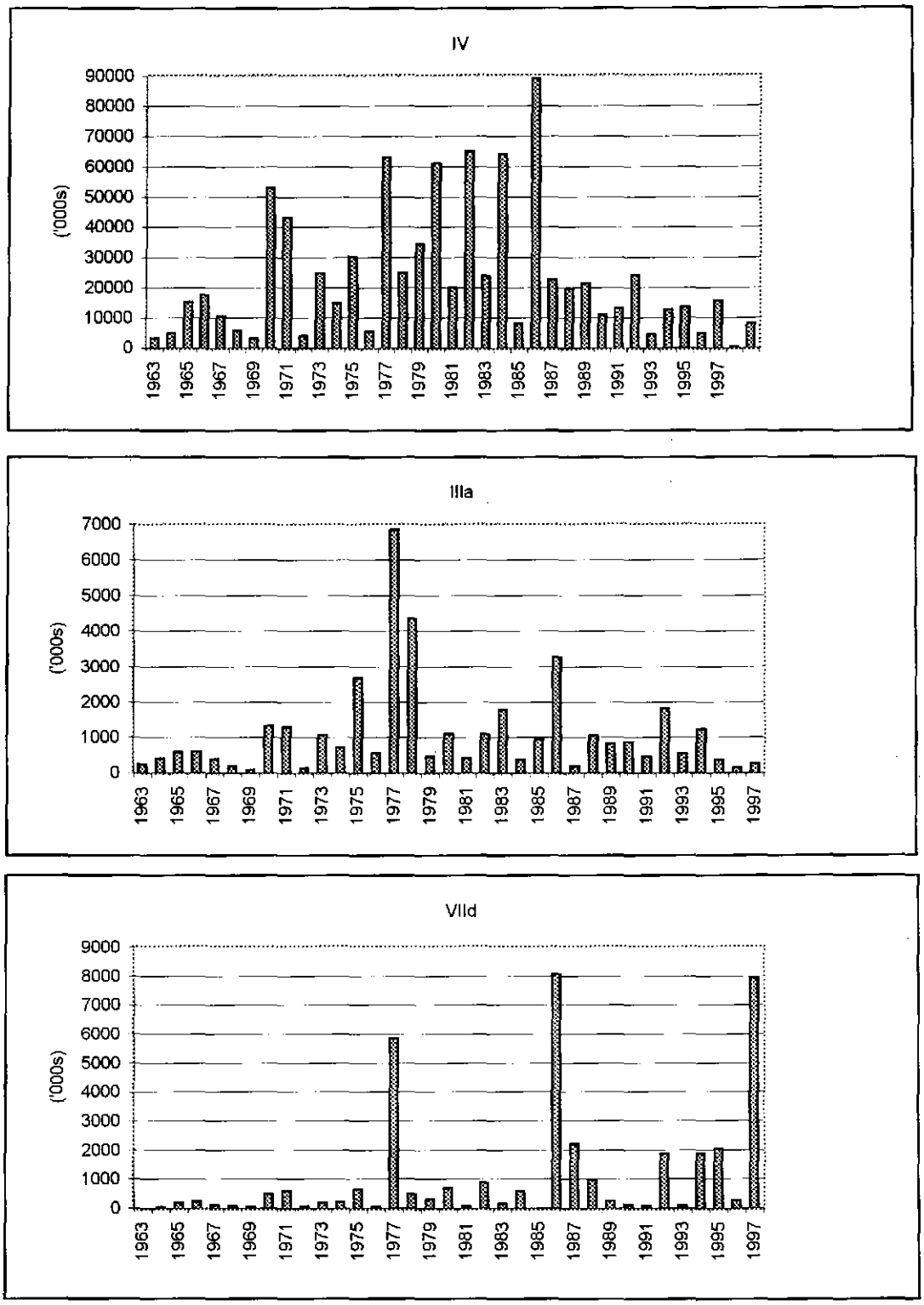


Figure 3.4.3

COD, IV, IIIa, VIId
LOG CATCHABILITY RESIDUAL PLOTS (XSA)

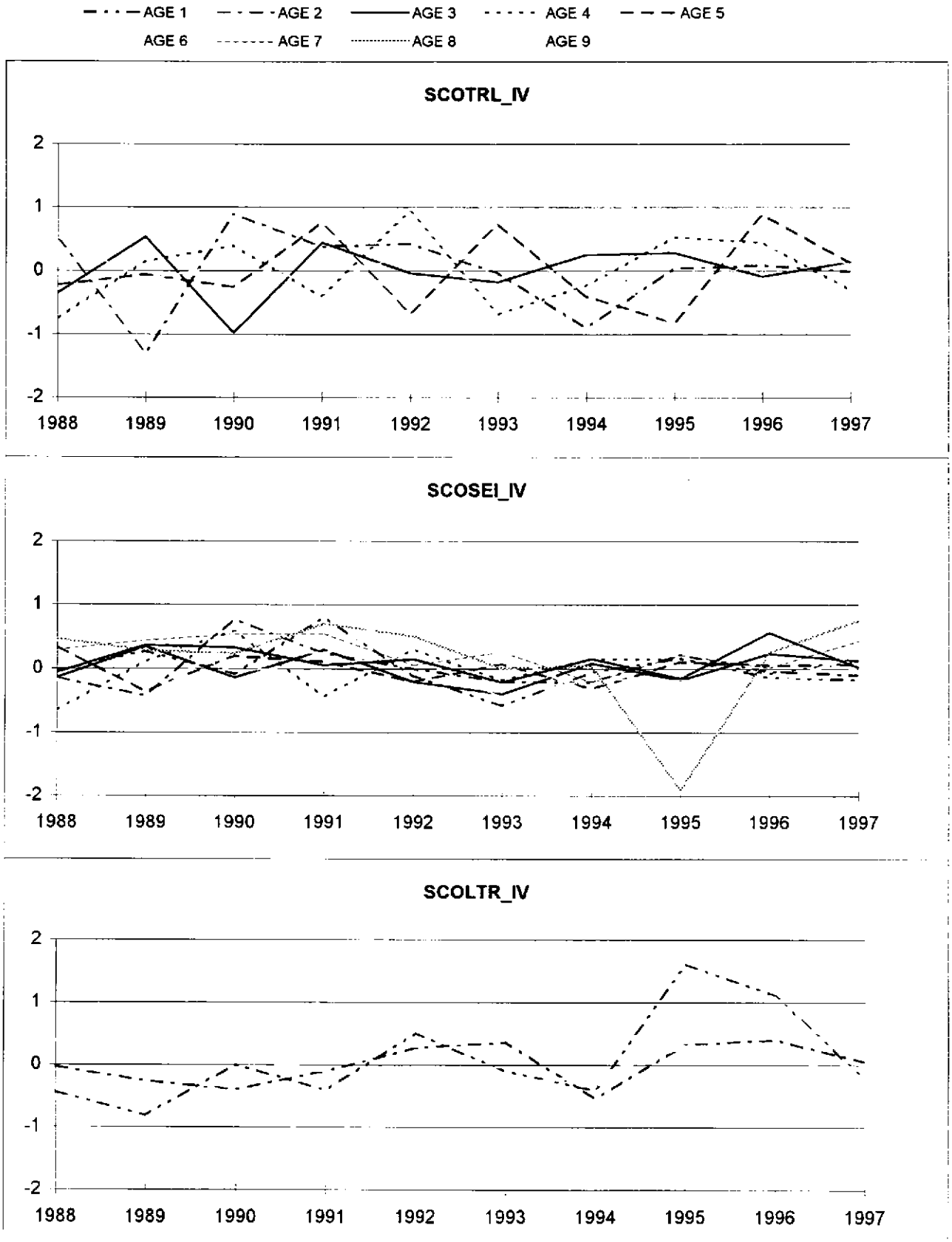


Figure 3.4.3 (Continued)

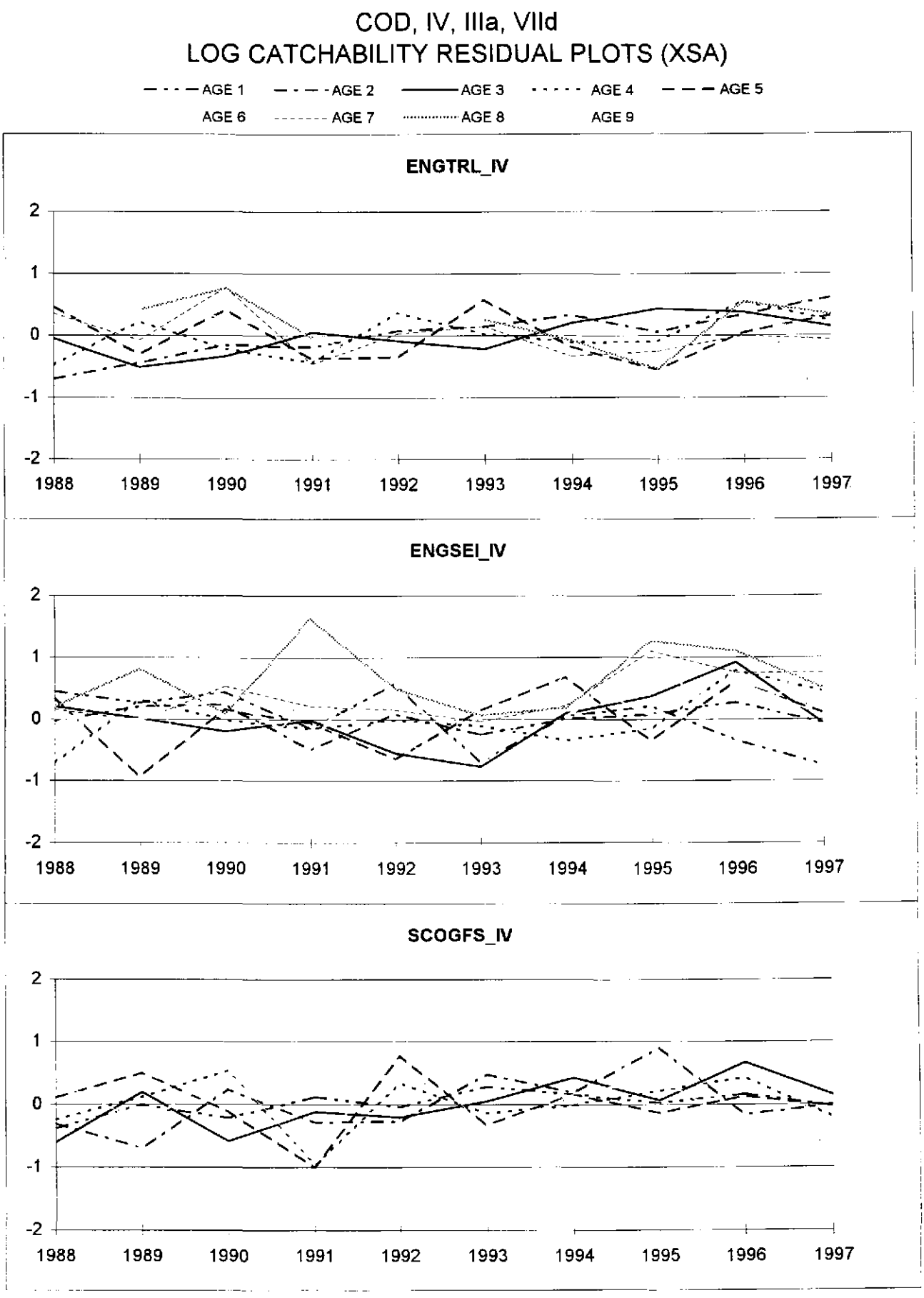


Figure 3.4.3 (Continued)

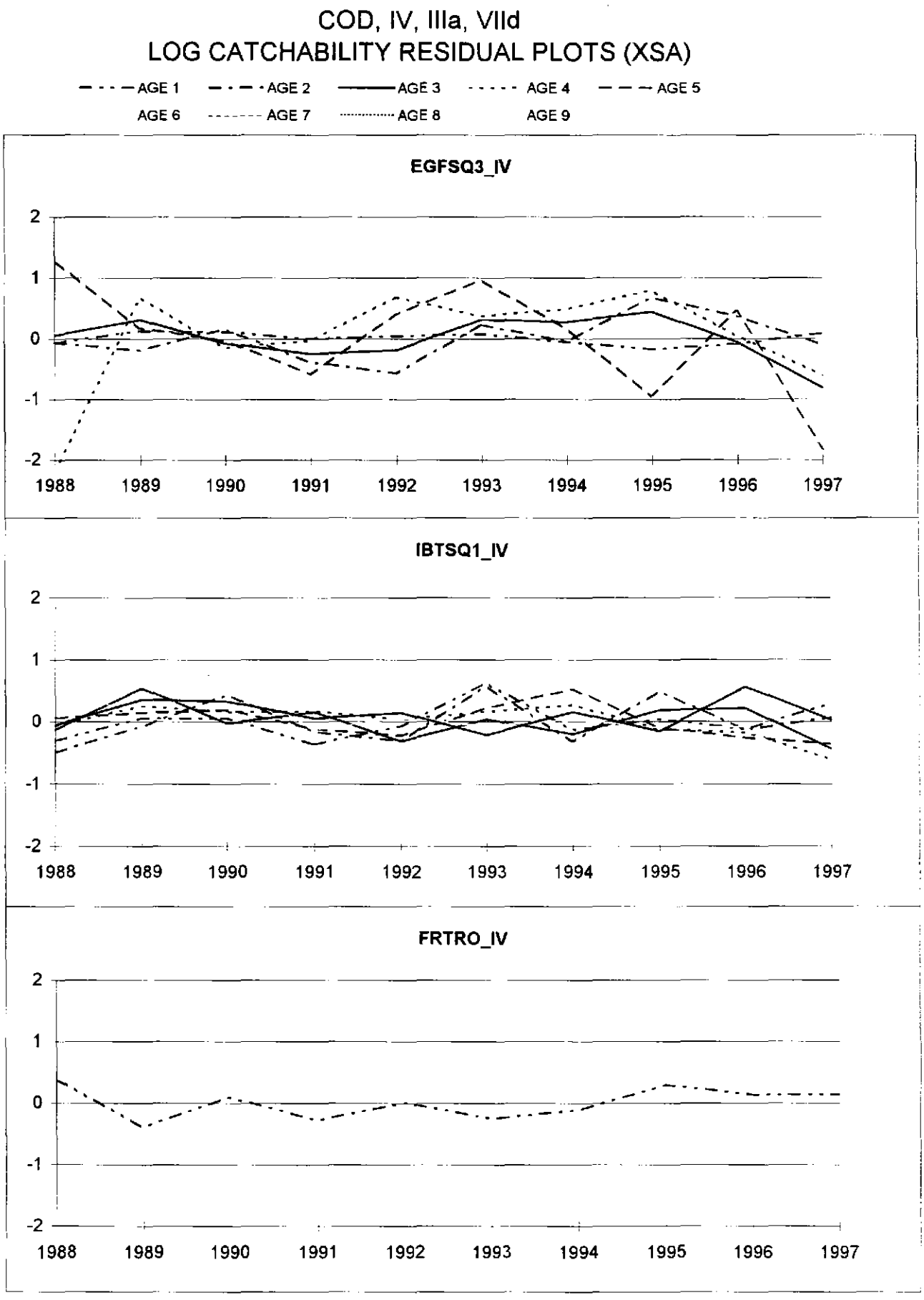


Figure 3.4.4. Relative contribution of commercial fleets, surveys and shrinkage to tuning XSA

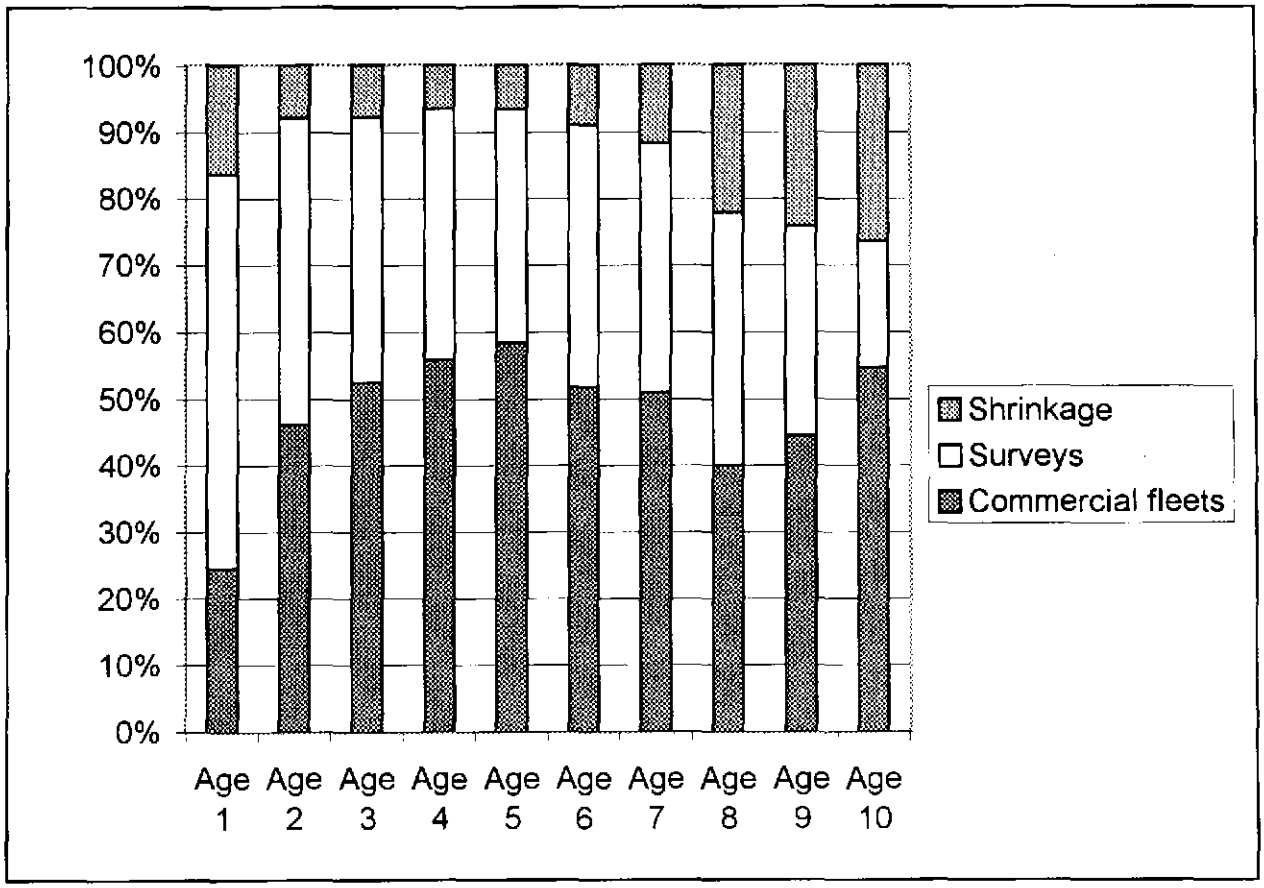
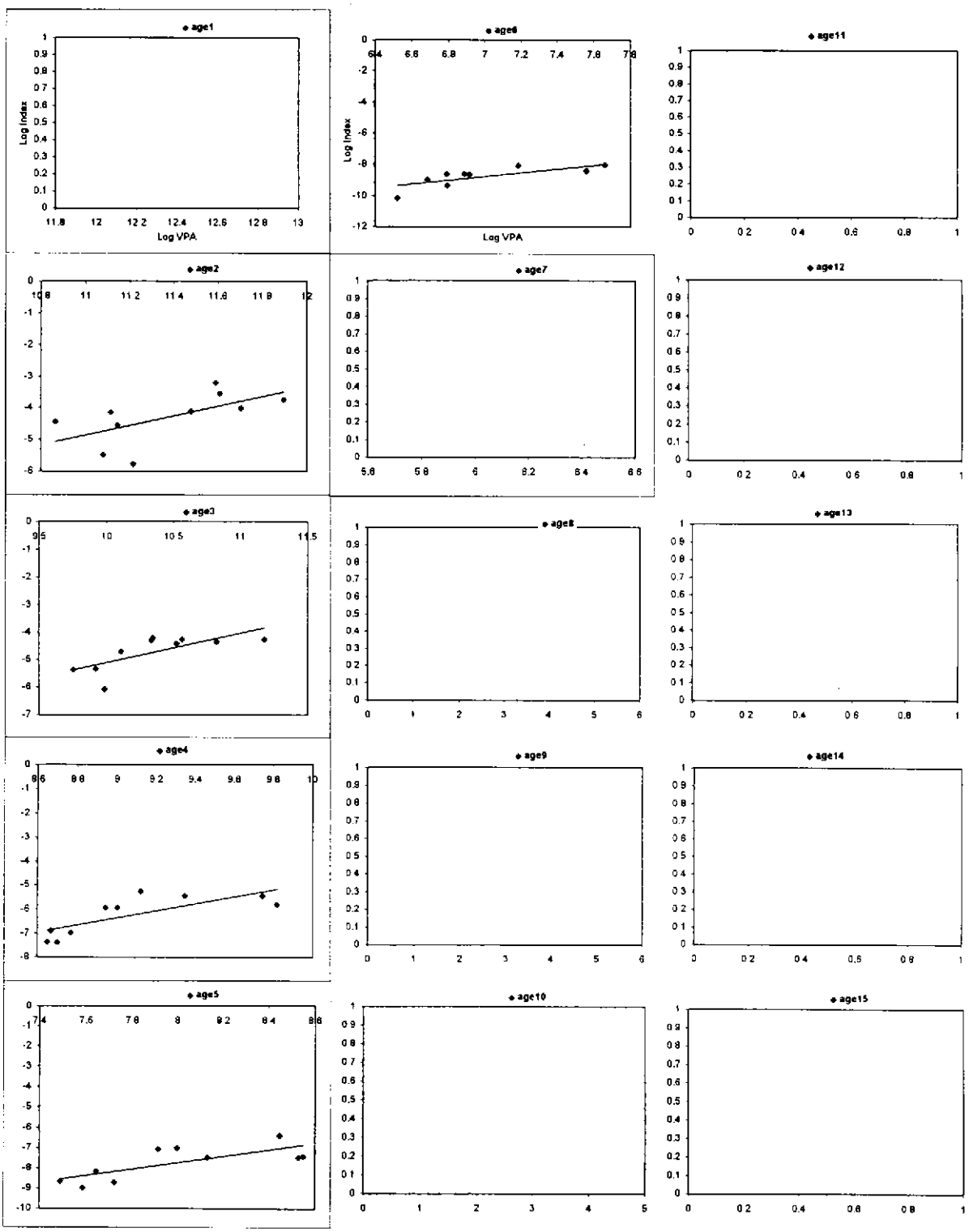
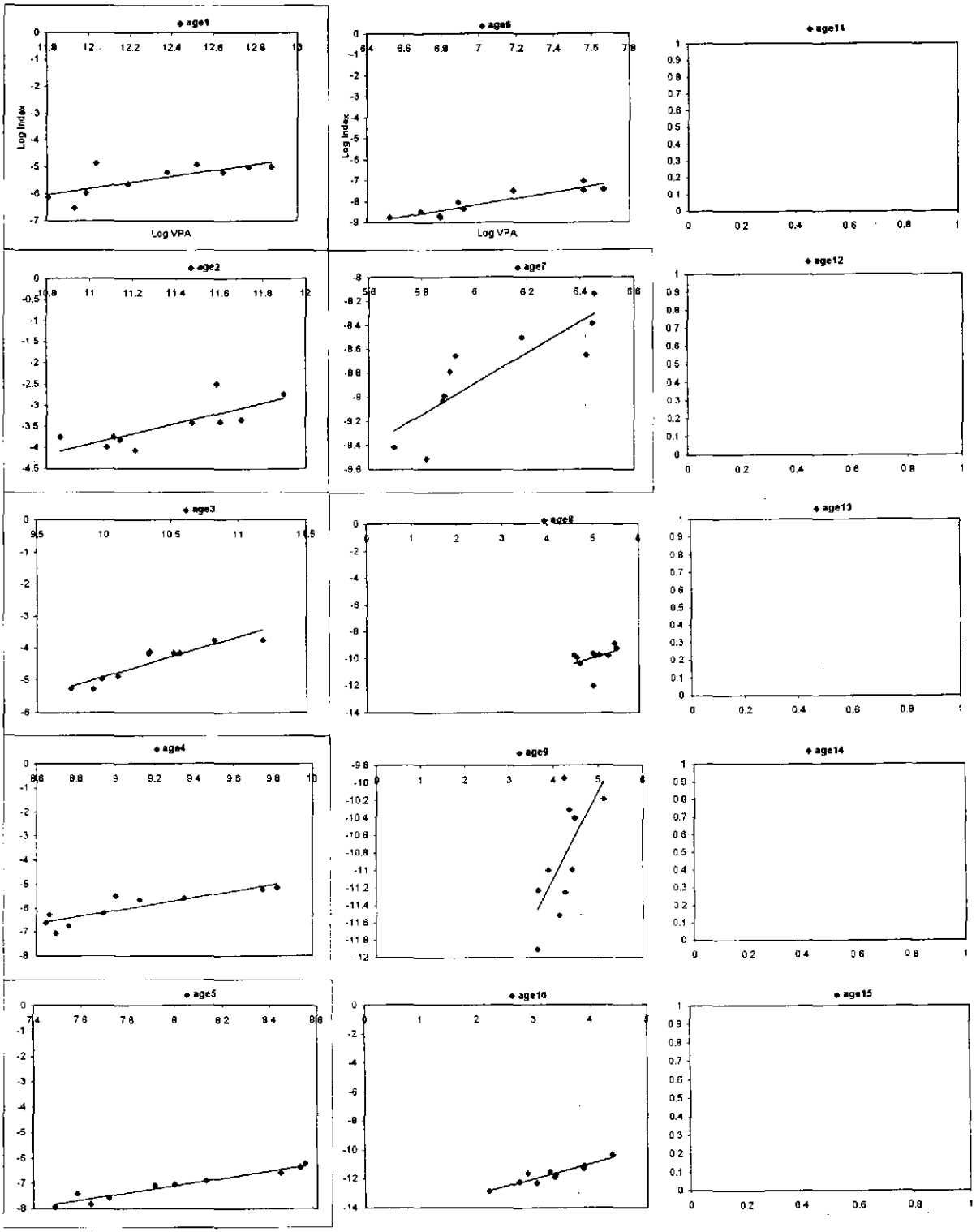


Figure **3.4.5**
Title **Log VPA vs. Log Index**
Stock **North Sea cod**
Index **SCOTRL_IV**
Yearrange **1988-1997**



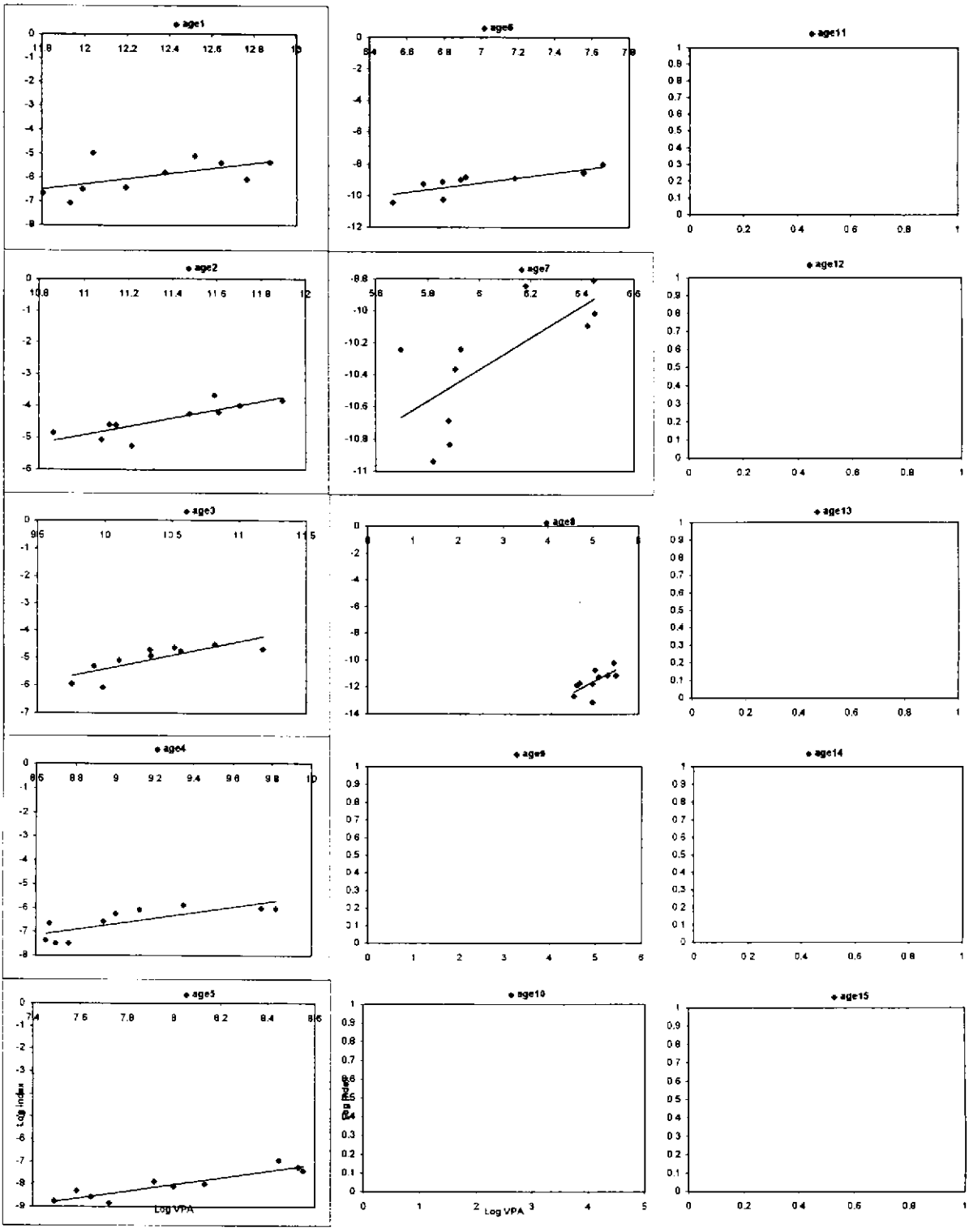
Source **tuning5R.out**

Figure **3.4.6**
Title **Log VPA vs. Log Index**
Stock **North Sea cod**
Index **SCOsei_IV**
Yearrange **1988-1997**



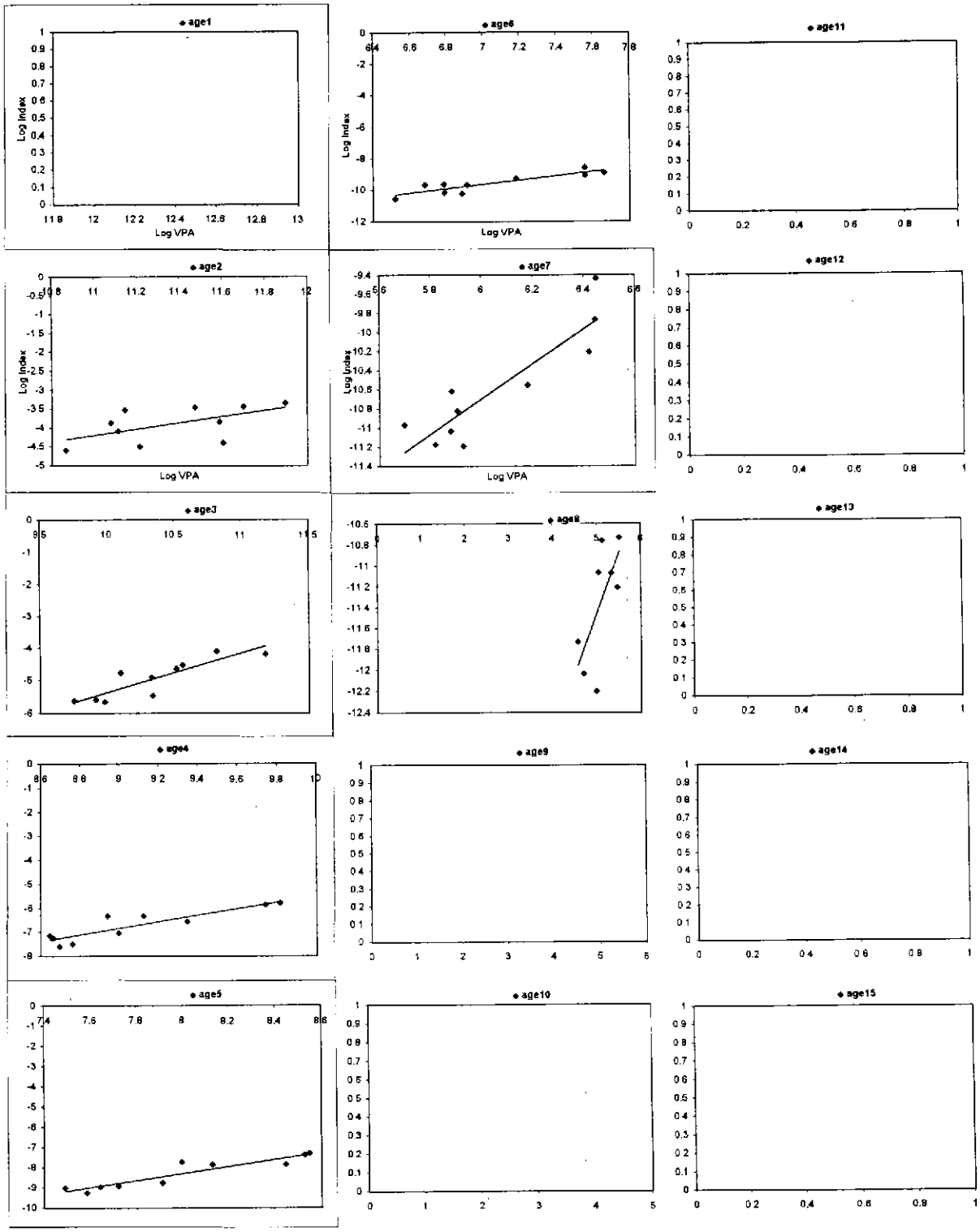
Source **tuning5R.out**

Figure **3.4.7**
Title **Log VPA vs. Log Index**
Stock **Nprth Sea cod**
Index **SCOLTR_IV**
Yearrange **1988-1997**



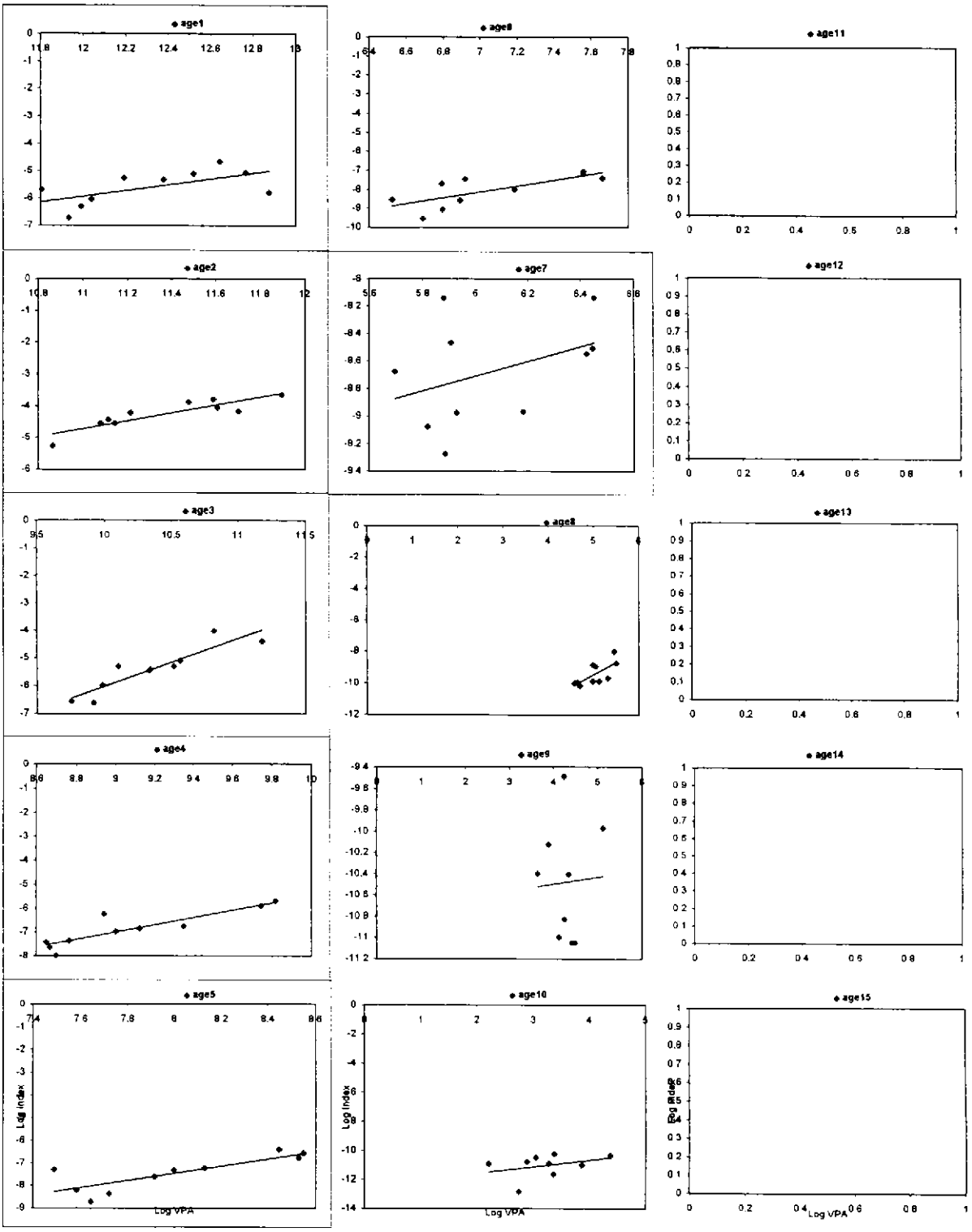
Source **tuning5R.out**

Figure **3.4.8**
Title **Log VPA vs. Log Index**
Stock **Nprth Sea cod**
Index **ENGTRL_IV**
Yearrange **1988-1997**



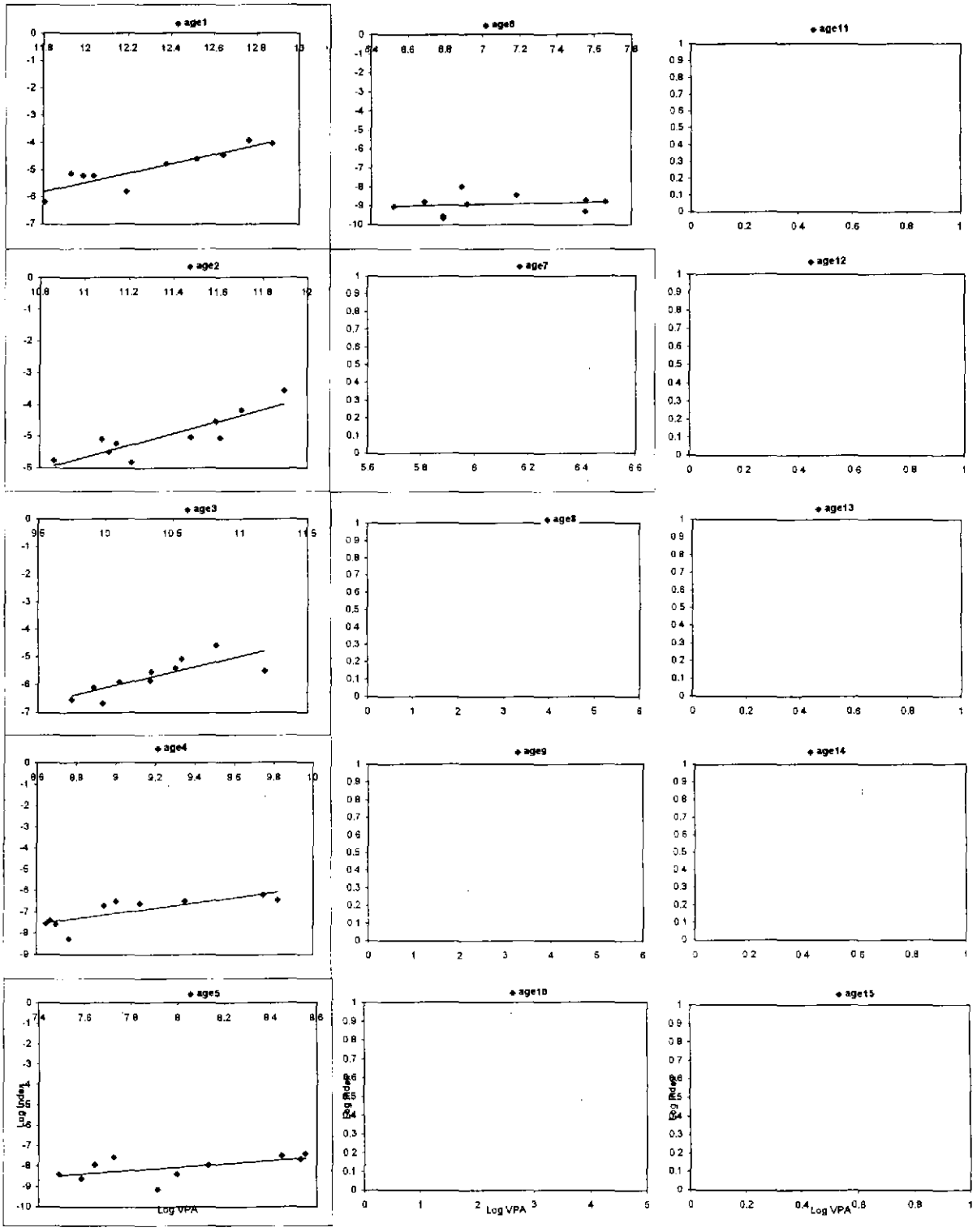
Source **tuning5R.out**

Figure **3.4.9**
Title **Log VPA vs. Log Index**
Stock **Nprth Sea cod**
Index **ENGSEI_IV**
Yearrange **1988-1997**



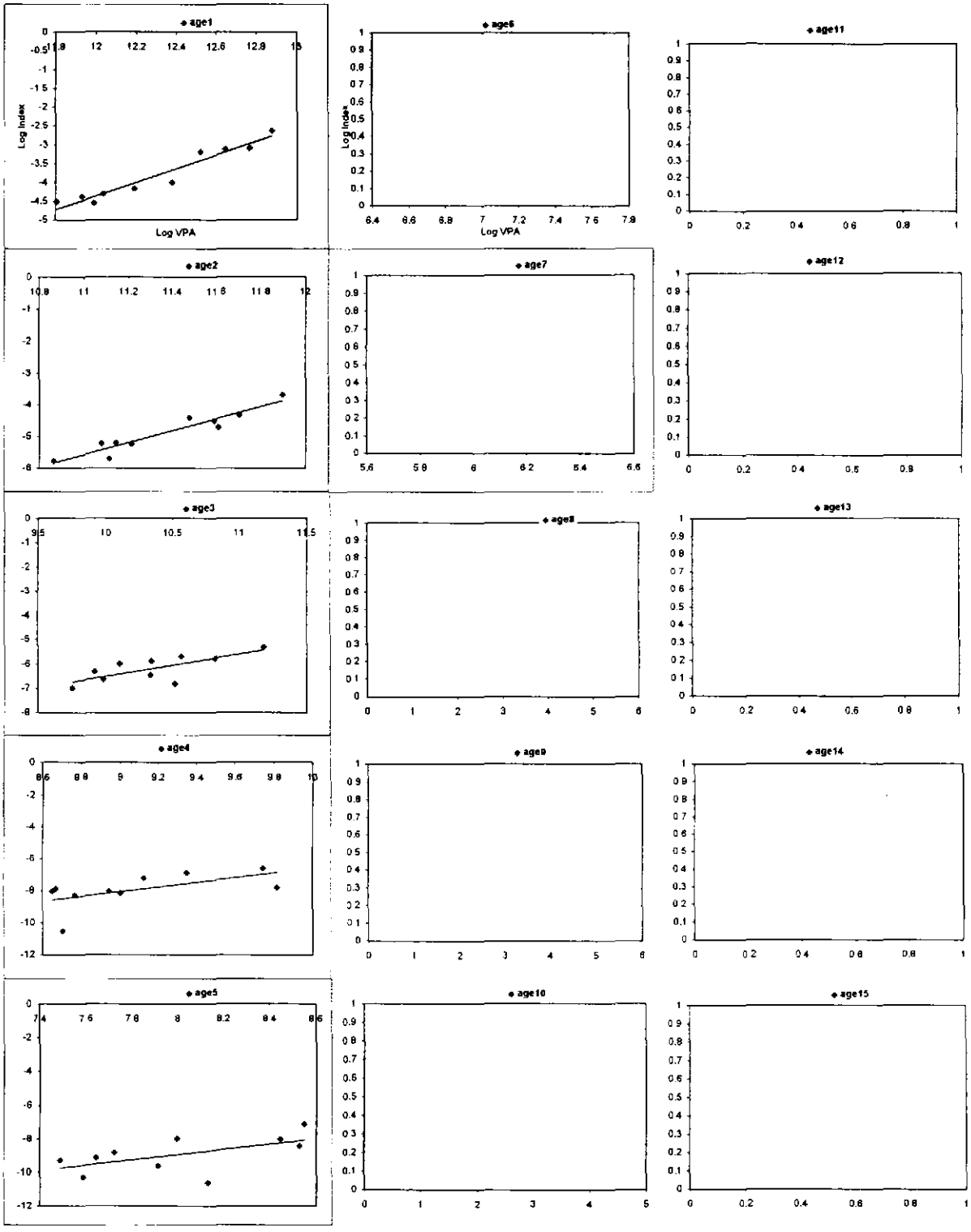
Source **tuning5R.out**

Figure **3.4.10**
Title **Log VPA vs. Log Index**
Stock **Nprth Sea cod**
Index **SCOGFS_IV**
Yearrange **1988-1997**



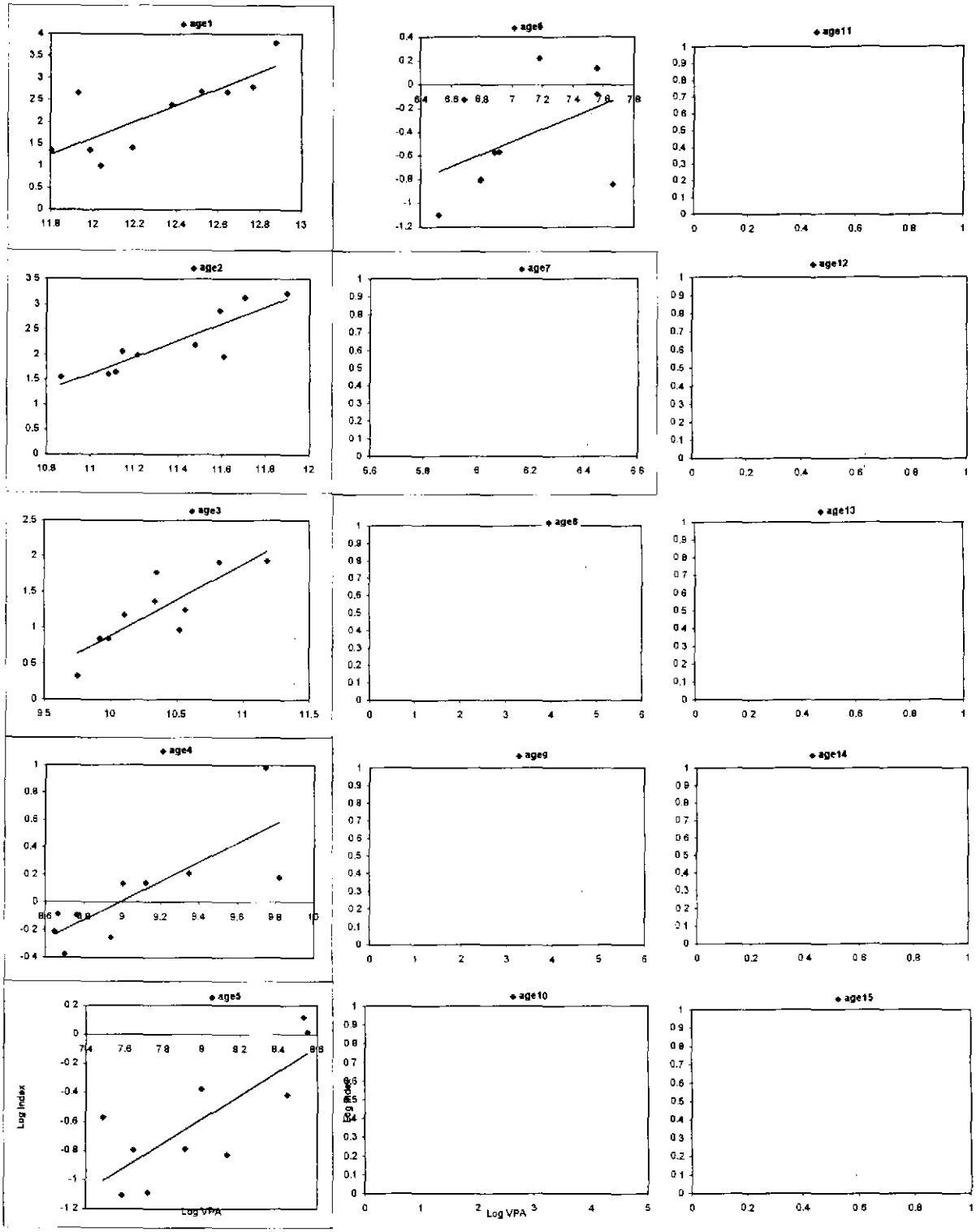
Source **tuning5R.out**

Figure **3.4.11**
Title **Log VPA vs. Log Index**
Stock **Nprth Sea cod**
Index **ENGGFS_IV**
Yearrange **1988-1997**



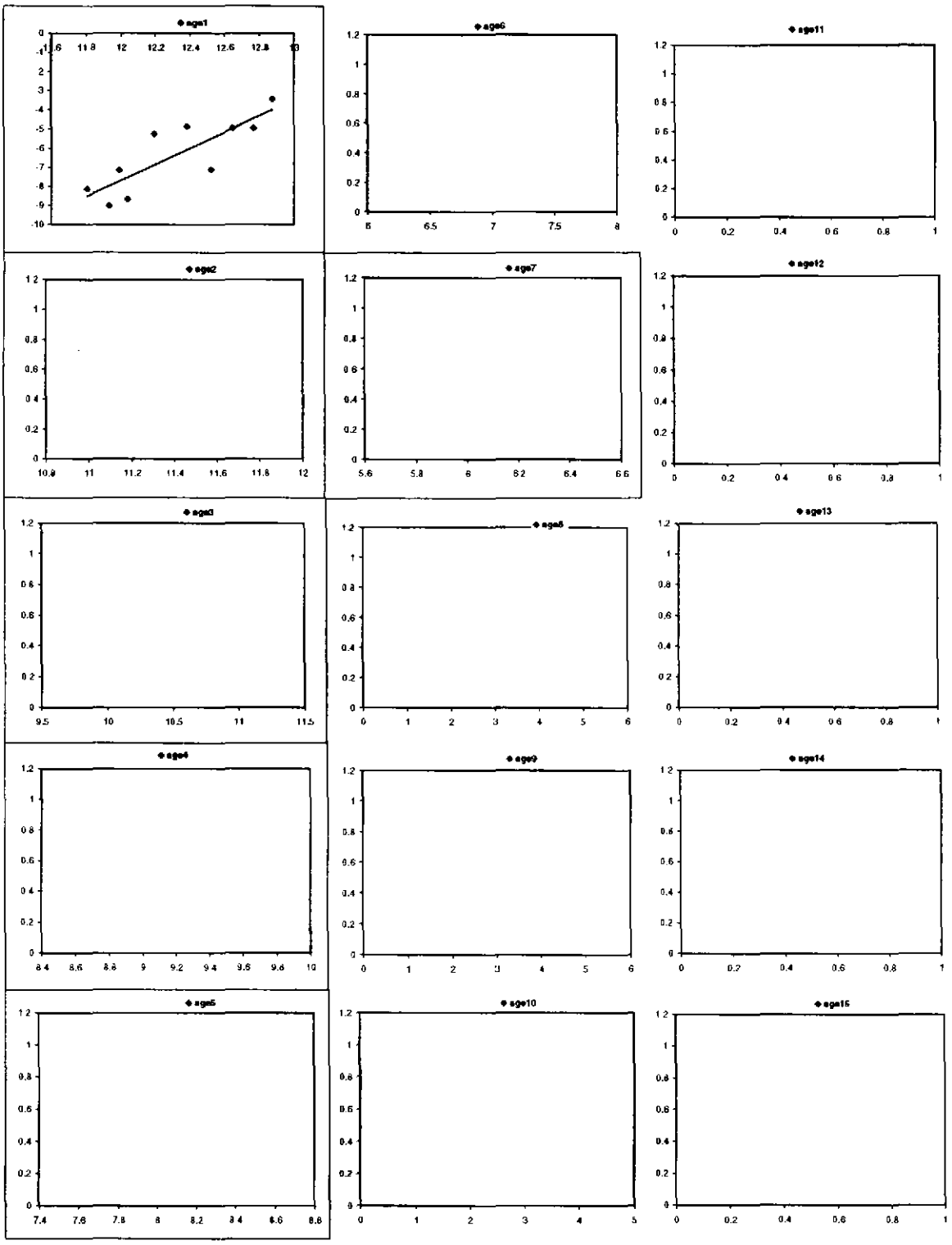
Source **tuning5R.out**

Figure **3.4.12**
Title **Log VPA vs. Log Index**
Stock **Nprth Sea cod**
Index **IBTS_Q1_IV**
Yearrange **1988-1997**



Source **tuning5R.out**

Figure **3.4.13**
Title **Log VPA vs. Log Index**
Stock **North Sea Cod**
Index **FRTRO_IV**
Yearrange **1988-1997**



Source **tuning5R.out**

Figure 3.4.14 North Sea Cod. Results of retrospective analyses

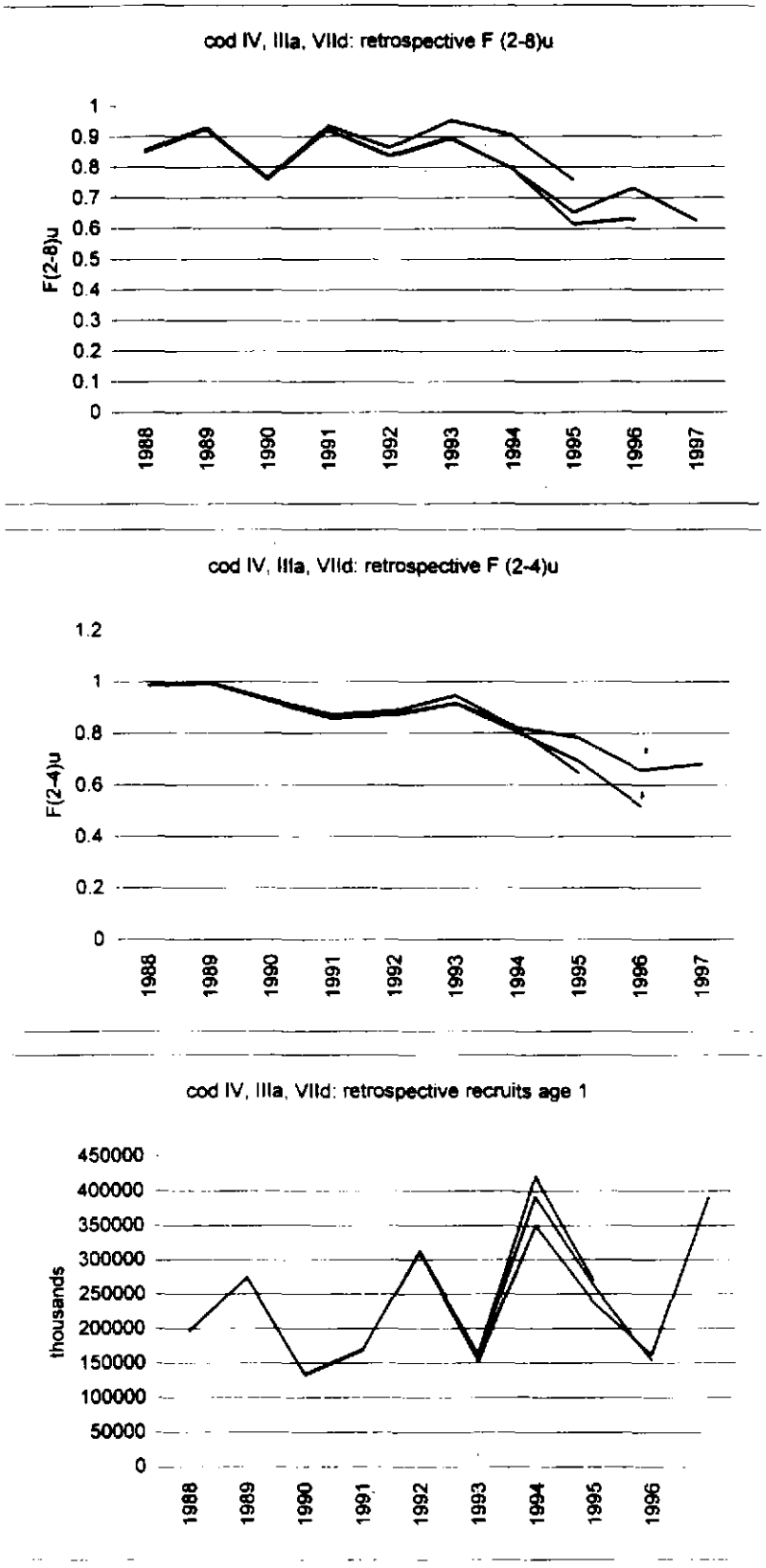
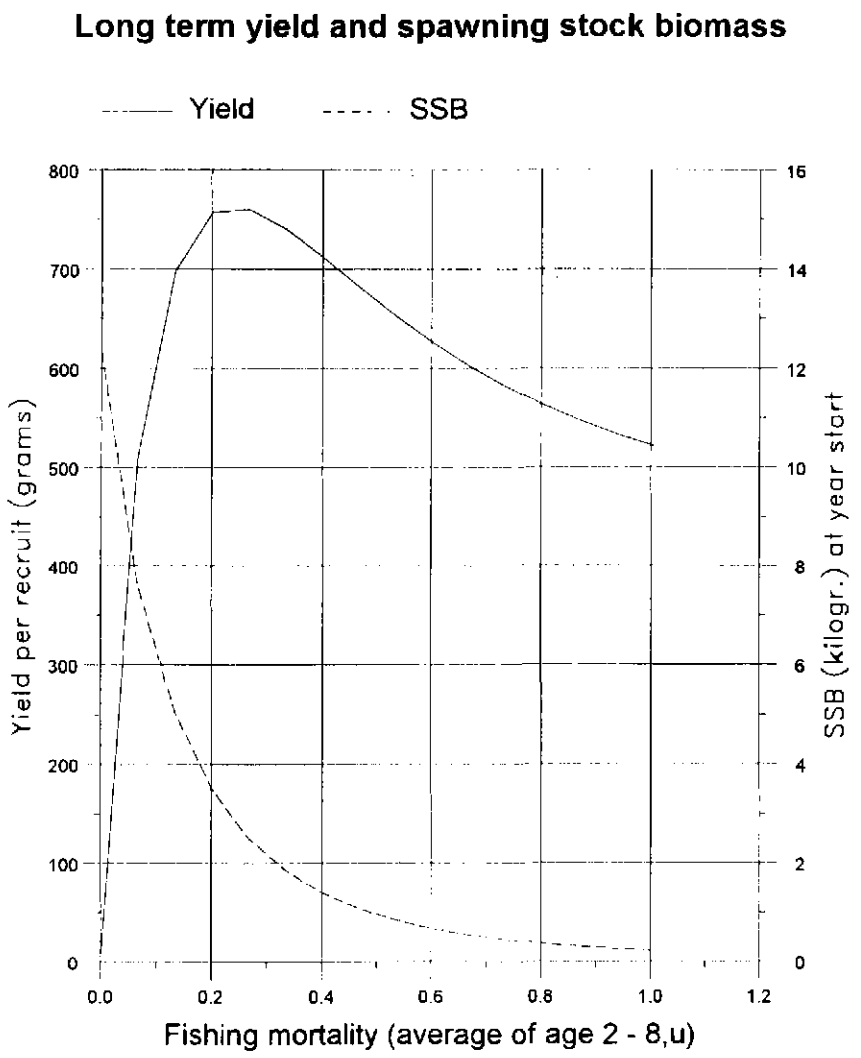
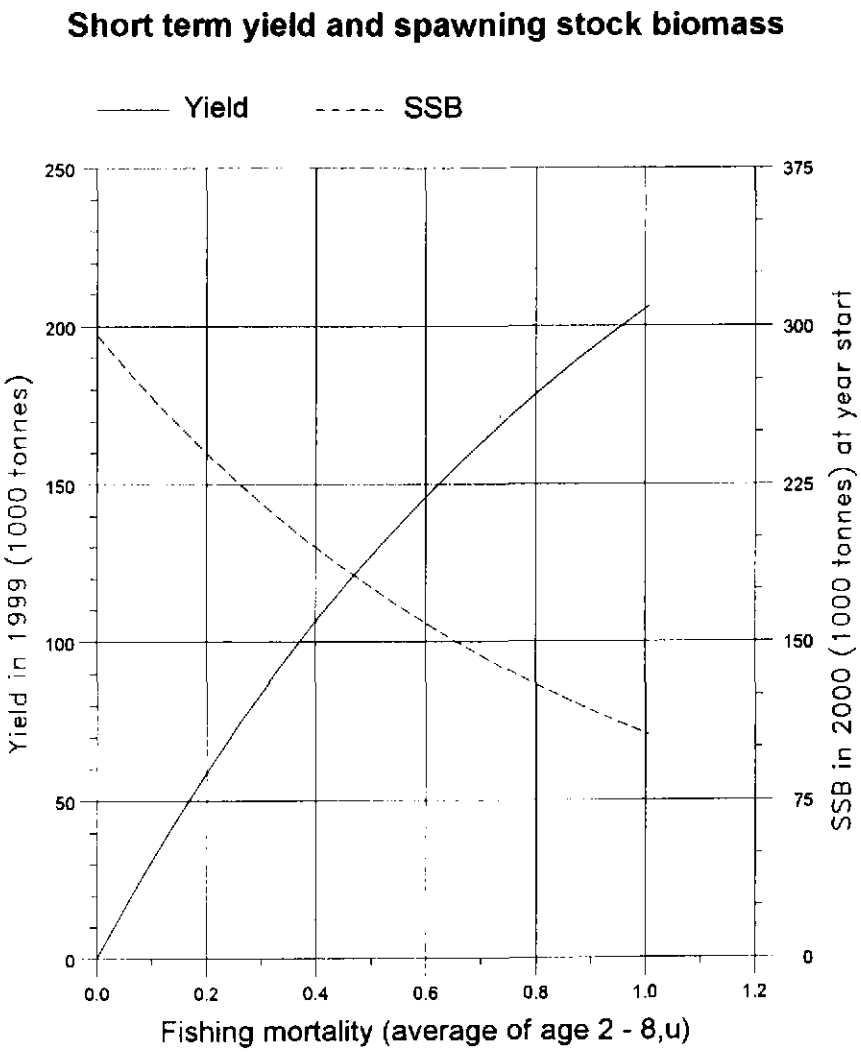


Figure 3.7.1. Fish Stock Summary. COD in fishing area's IV, IIIa (Skagerrak) and VIId



(run: YLDLJB03) **C**



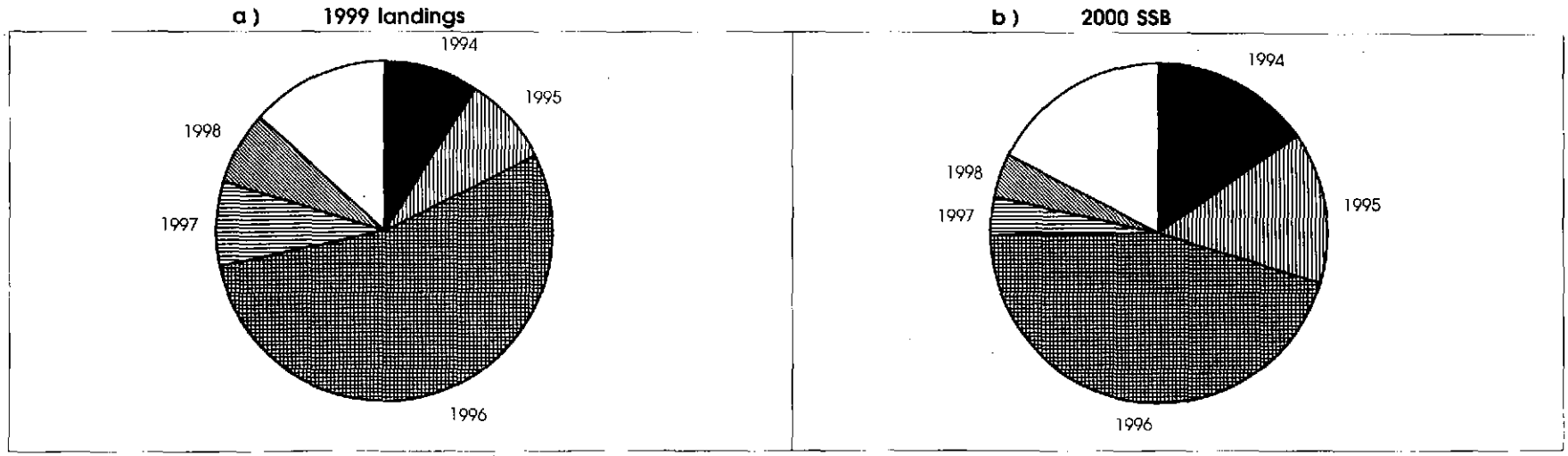
(run: MANLJB04) **D**

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

Year-class	1994	1995	1996	1997	1998
Stock No. (thousands) of 1 year-olds	238287	161384	557000	71000	250000
Source	VPA	VPA	RCT3	RCT3	st-GM
Status Quo F:					
% in 1998 landings	11.5	14.7	52.3	1.5	-
% in 1999	9.2	8.6	53.8	8.0	7.0
% in 1998 SSB	23.0	8.8	8.3	0.4	-
% in 1999 SSB	22.0	14.1	26.6	1.0	1.4
% in 2000 SSB	15.2	14.4	45.1	3.6	4.3

st-GM : short term geometric mean recruitment

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



F-372.XLS

Figure 3.7.3 cod,North Sea. Sensitivity analysis of short term forecast.

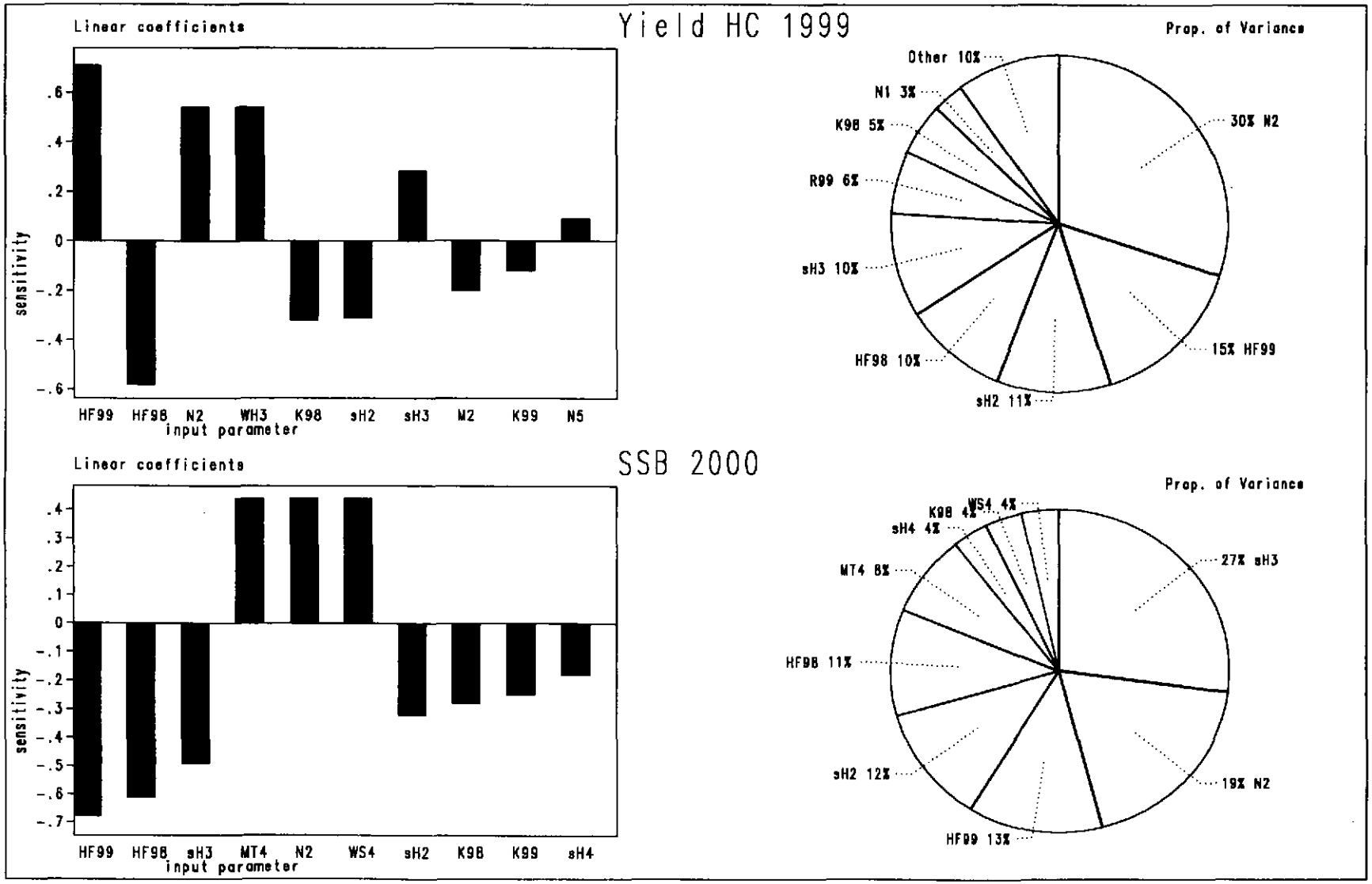


Figure 3.7.4 cod,North Sea. Probability profiles for short term forecast.

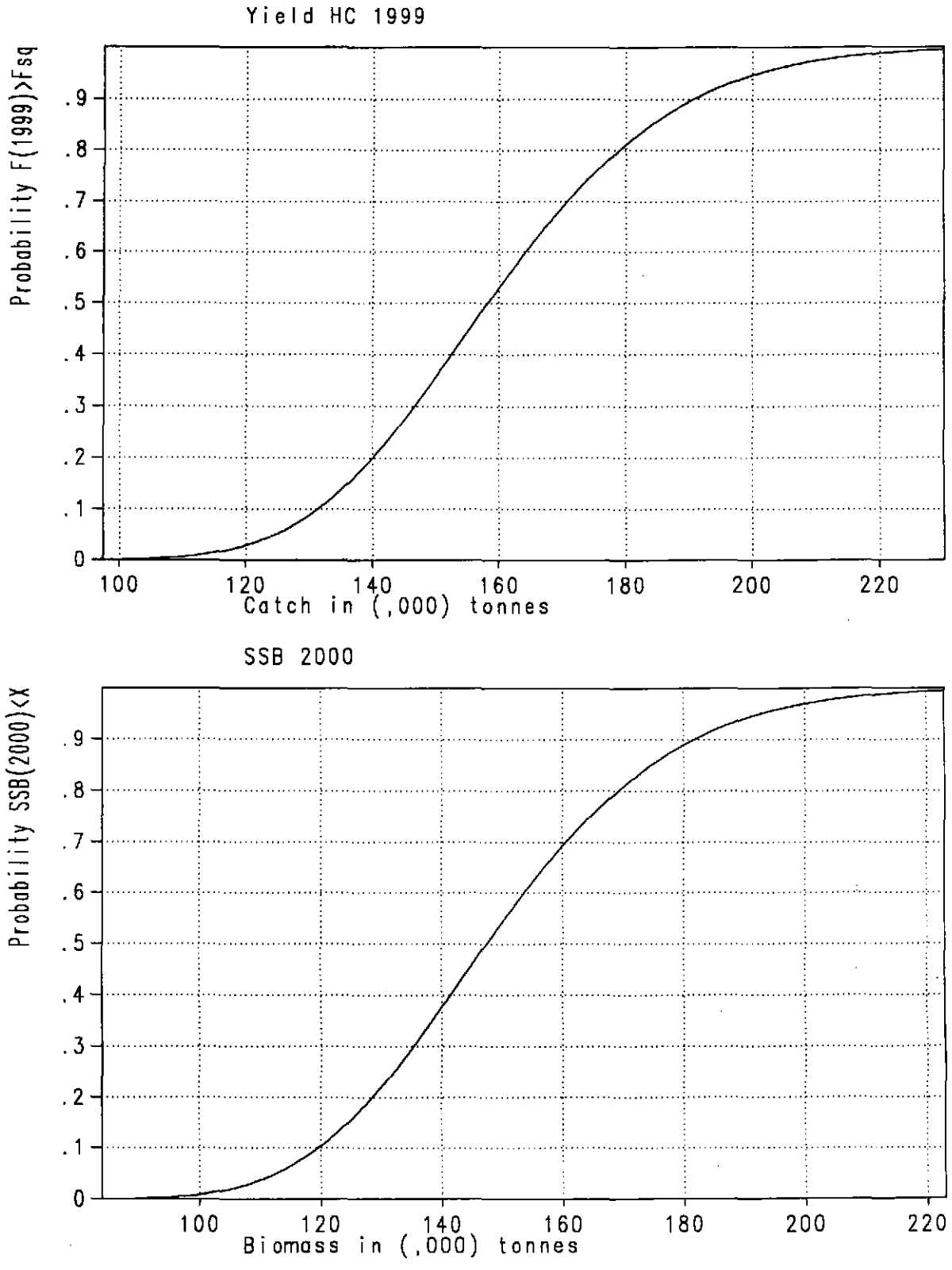


Figure 3.8.1 Cod in IIIa (Skagerrak), IV and VIId. Medium term projections. Solid lines show 5, 10, 20,50, and 95 percentiles
Shepherd stock-recruitment relationship
number of simulations 500

Relative Cons. effort = 1.00

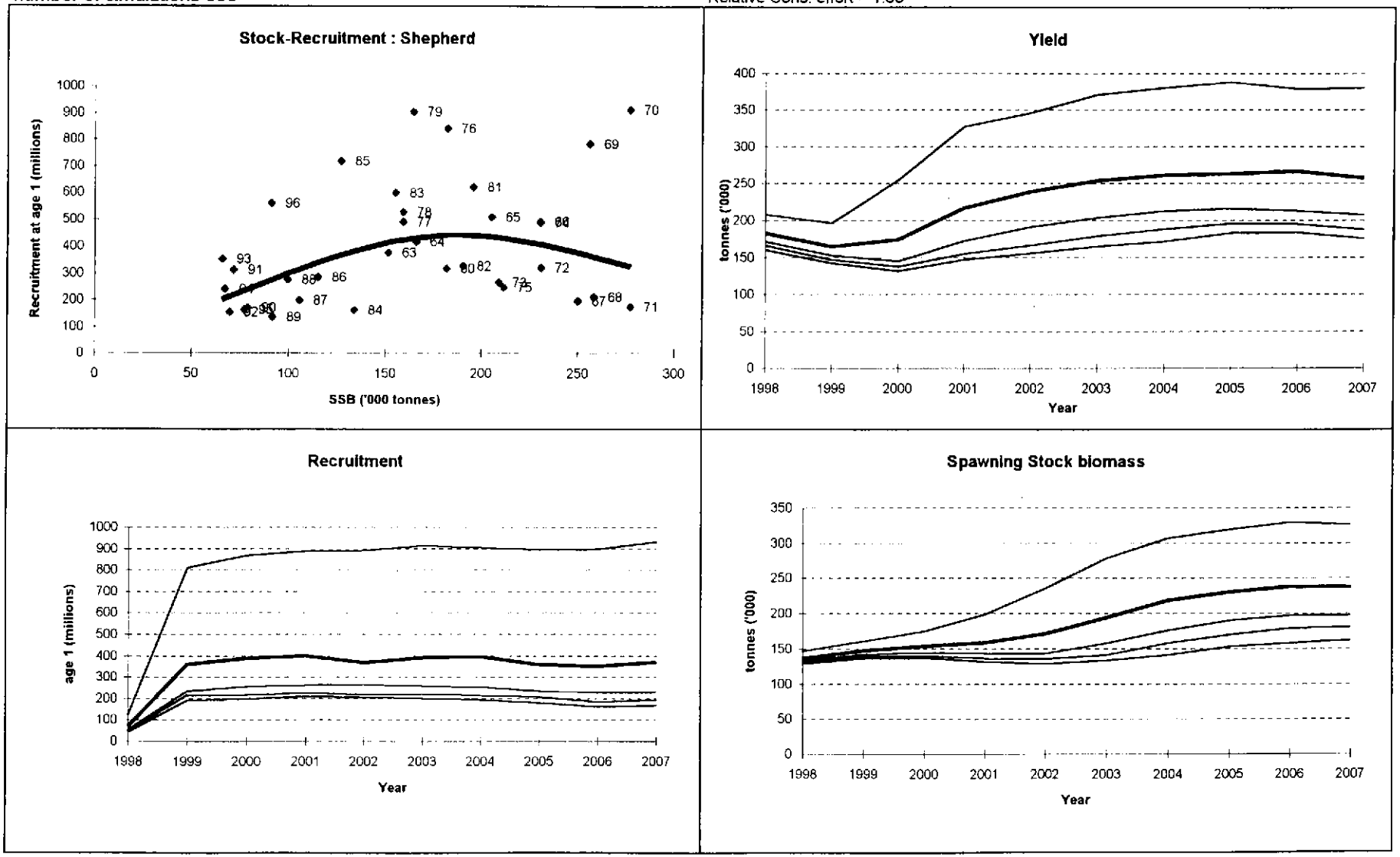


Figure 3.9.1

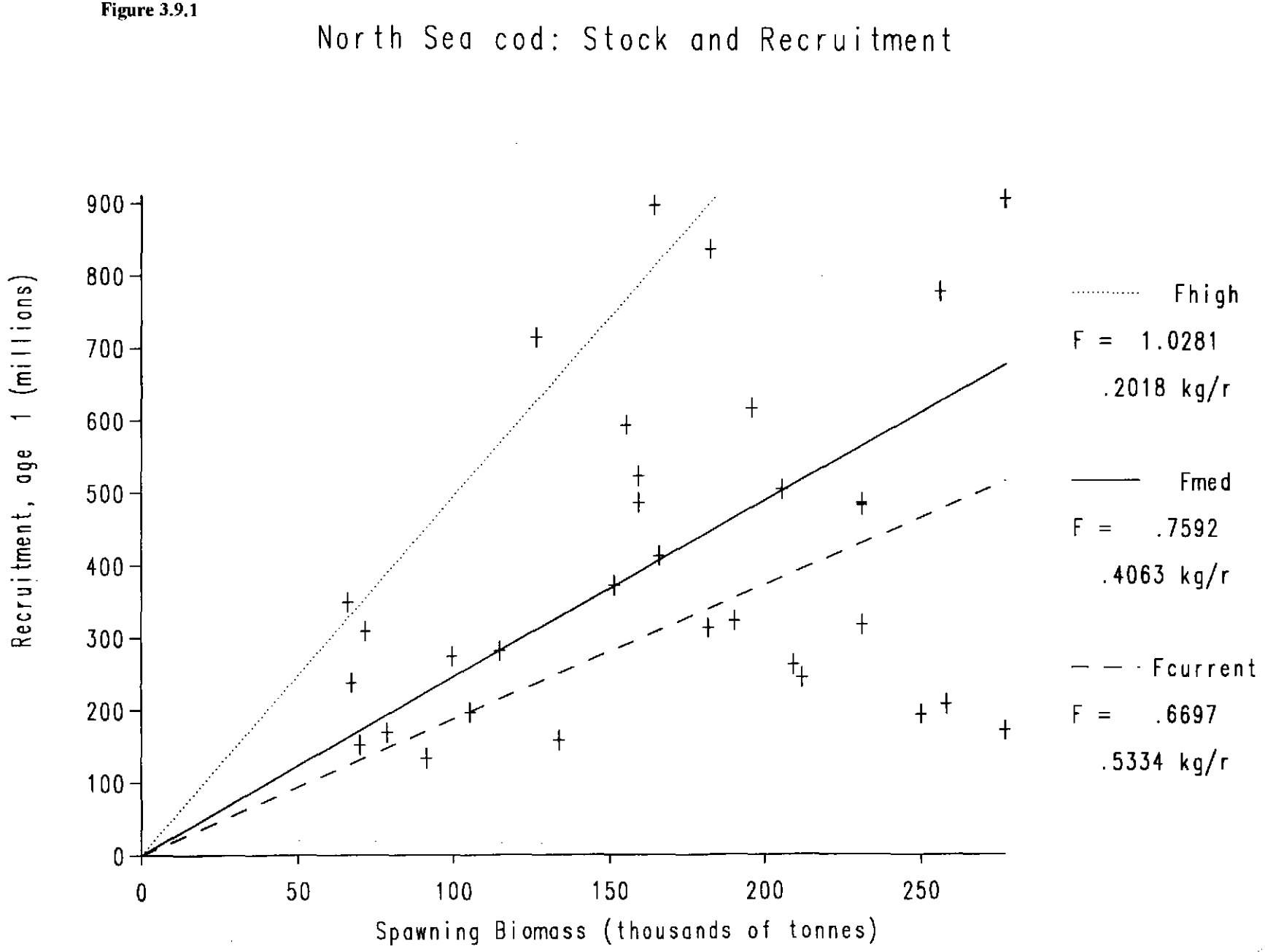
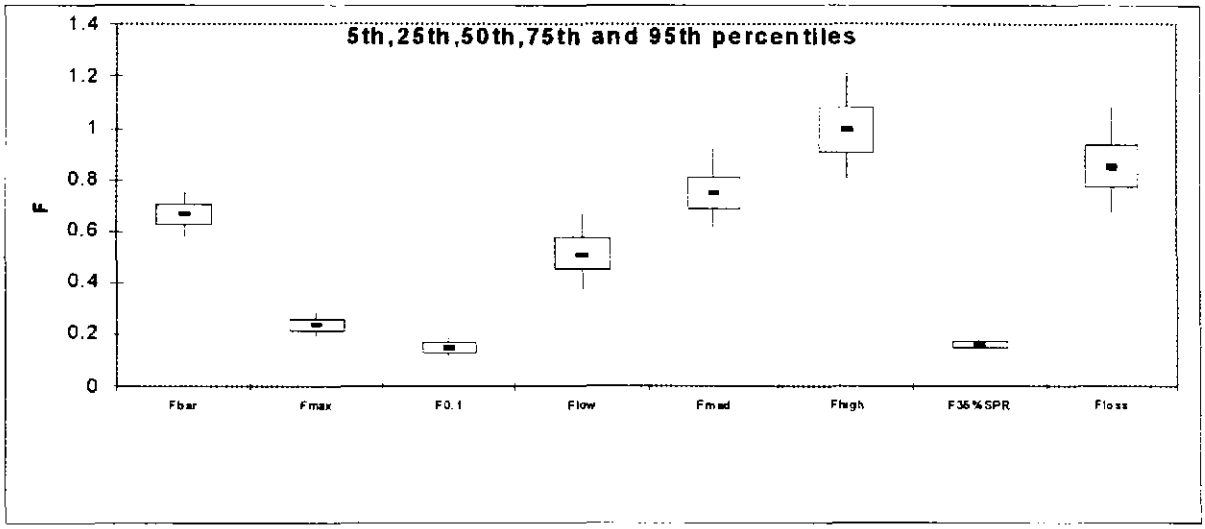

North Sea cod: Stock and Recruitment
Recruitment, age 1 (millions)
900
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
Spawning Biomass (thousands of tonnes)
Fhigh
F = 1.0281
.2018 kg/r
Fmed
F = .7592
.4063 kg/r
Fcurrent
F = .6697
.5334 kg/r

Figure 3.10.1. Cod in IIIa (Skagerrak), IV and VIId: Bological reference points from PA software



Reference point	Deterministic	Median	95th percentile	80th percentile
MedianRecruits	320000	320000	415000	350000
MBAL	0			
Bloss	66000			
SSB90%R90%Surv	168762	162007	207798	182100
SPR%ofVirgin	4.31	4.31	6.19	5.24
VirginSPR	12.37	12.39	21.06	16.11
SPRloss	0.31	0.31	0.44	0.37
	Deterministic	Median	5th percentile	20th percentile
FBar	0.67	0.67	0.58	0.62
Fmax	0.24	0.24	0.19	0.22
F0.1	0.15	0.15	0.11	0.13
Flow	0.53	0.51	0.37	0.44
Fmed	0.76	0.75	0.61	0.68
Fhigh	0.99	1.00	0.81	0.89
F35%SPR	0.16	0.16	0.13	0.15
Floss	0.86	0.86	0.67	0.75

Figure 3.10.2 Cod in IIIa (Skagerrak), IV and VIId. PA Software output

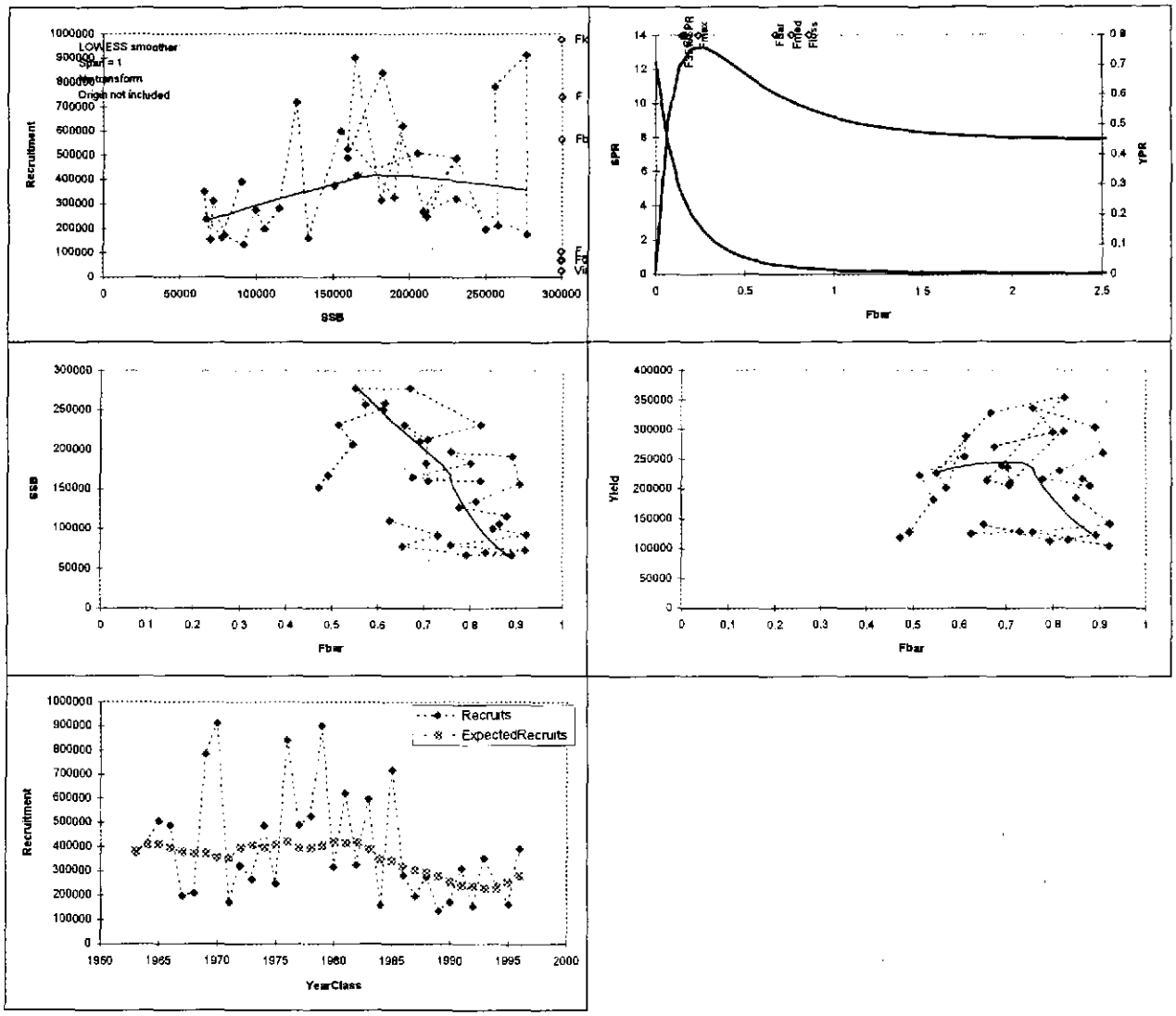
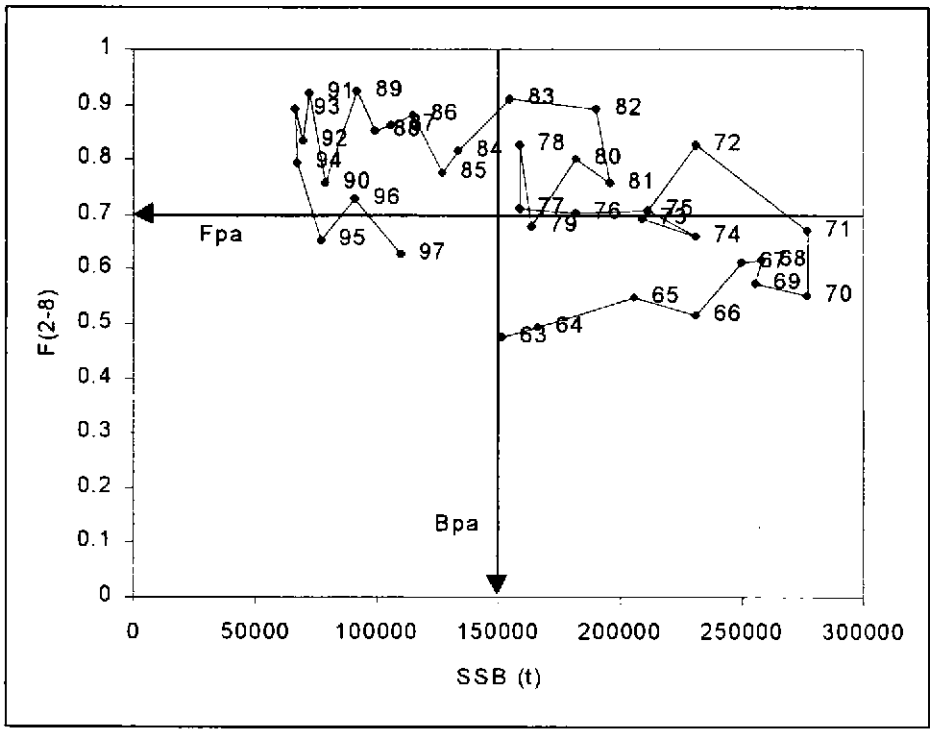


Figure 3.10.3. Cod IN IIIa (Skagerrak), IV and VIId: fishing mortality and SSB in relation to proposed precautionary reference points.



4 HADDOCK IN SUB-AREA IV AND DIVISION IIIA

4.1 The fishery

In the North Sea, haddock is taken as part of a mixed demersal fishery, with the large majority of the catch being taken by Scottish light trawlers, seiners and pair trawlers. These gears have a minimum legal mesh size of 100 mm. Smaller quantities are taken by other Scottish vessels, including Nephrops trawlers which use 70 mm mesh and thus discard higher quantities. Vessels from other countries including England, Denmark and Norway also participate in the fishery, and haddock are also taken as a bycatch by Danish and Norwegian vessels fishing for industrial species. In Division IIIa, haddock are taken as a bycatch in a mixed demersal fishery, and in the industrial fishery. Landings from Division IIIa are small compared to the North Sea, amounting to between 2.5 and 6.9% of the total catch over 1963–1997.

4.1.1 ACFM advice applicable to 1997 and 1998

Following the relatively low level of exploitation indicated by the 1997 assessment of this stock, ACFM advised that fishing mortality should not be allowed to increase above the present level (total $F_{2\text{-}6,\ 97} = 0.66$) in order to maintain a low probability of SSB being reduced to low levels and provide higher yields in the longer-term. For the previous two years, ACFM advice had been that any management of this fishery should take into account the mixed-species nature of the North Sea roundfish fishery.

4.1.2 Management applicable to 1998

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

In Division IIIa the 1998 TAC is 7,000 t and in the North Sea the 1998 TAC is 115 thousand tonnes.

4.1.3 Catches in 1997

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 1997 amounted to about 4 thousand tonnes, with industrial bycatch accounting for only 610 t of this total. This total is below the series average and represents a reduction compared to 1996, but the overall level is comparable to landings over the preceding three years. The level of industrial bycatch was rather low in 1997, but not exceptionally so.

In the North Sea, human consumption landings in 1997 were around 79,000 t, which is comparable to landings in the five preceding years during which landings have varied between 70 and 81 kt. The 1997 landing represents a considerable undershoot of the TAC of 114 kt. The level of discarding in 1996 was slightly lower than in recent years, but the level of industrial bycatch is comparable to that of recent years. The Working Group estimate of the 1997 catch includes a small correction for suspected under-reporting by one nation.

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

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

For Division IIIa in 1997, 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 1997. For the North Sea catches, age composition data for the human consumption landings were supplied by Denmark, England, France, Scotland and Belgium. These nations accounted for over 90% of the total landings. Industrial bycatch age compositions for the North Sea were supplied by 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.

As in 1996, fish from the 1996 and 1994 year classes were the most abundant in the total catches in 1997. In comparison with the short-term prediction made at the previous WG meeting, the numbers of all of the commercially important age classes are lower than predicted. On average, over the age range 2–6, the predicted catch numbers were 19% greater than the current estimates, with the effect being most marked on the strong 1994 year class where last years prediction over-estimated the 1997 catch by 39%.

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 three research vessel surveys. Definitions of the commercial fleets are the same as those given for the equivalent vessels working in Division VIa which are given in the Report of the 1998 Working Group on the Assessment of Northern Shelf Demersal Stocks (ICES 1999, Appendix 2). In order to include the most recent information from the IBTS quarter 1 survey, this survey is treated as if it takes place at the end of the preceding year, by appropriate adjustments of the age and year ranges, and of the alpha and beta parameters. The IBTS quarter four survey, which was used in tuning the 1997 assessment, was terminated in 1996, so was not included in the tuning data for this assessment. The tuning file is given in Table 4.3.2.

4.4 Catch-at-age analysis

As a baseline, the first XSA run made used the same settings as used in the final XSA run in the 1997 Working Group assessment of this stock. The fleets used were also the same, apart from the omission of the IBTS quarter four series. The population estimates from this run are plotted against the CPUE series' in Figure 4.4.1. These show negative slopes at age 6 in the Scottish and English surveys. For this reason this age was omitted from these series in subsequent runs. The diagnostics from the baseline run showed an indication of a year effect for recent years in the Scottish groundfish survey data, with residuals for most ages in the three most recent years all being positive. There is also some indication of a similar effect in the IBTS quarter 1 data. While such effects might be considered as grounds for removing these series from the tuning, this was not addressed here. In both cases, these series have previously proved to be important tuning fleets, and in the current tuning, their associated survivor estimates, although tending to be higher than those for other fleets, were neither extreme, nor received excessive weighting. Thus their removal is likely to have a relatively small result on the overall survivor estimates. Furthermore, this assessment shows a relatively high degree of inter-annual variation in fishing mortality, and also quite high retrospective variation (Figure 4.4.2). Given this degree of variation, there is not a compelling case for making such relatively minor changes to the XSA configuration. Similarly, given the apparent recent decrease in F, it may be appropriate to use weaker shrinkage than the default value of 0.5 used previously. This was investigated through retrospective runs (Figure 4.4.2). While the weaker shrinkage (0.9) resulted in a slight improvement in retrospective performance, it made only a 6% difference to the value of mean F in 1997, so again this change was not implemented.

The only differences in the configuration of this and the previous two assessments are the omission of the terminated IBTS Q4 series and minor truncations of the age-ranges used in other survey series. The settings are given in the text table below:

	1997 assessment	1998 assessment
Catch at age method	XSA	XSA
Fleets	2 commercial, 5 surveys	2 commercial, 4 surveys.
Taper	uniform over 10 years	uniform over 10 years
First age for constant q	0	0
q-plateau age	7	7
Shrinkage SE	0.5	0.5

Diagnostics from the final XSA run are given in Table 4.4.1, with log-catchability residuals in Figure 4.4.3. These show the possible year effects in recent years for the Scottish and IBTS Q1 survey series. The contribution of the survey and commercial tuning fleets and shrinkage to the survivor estimates at age is given in Figure 4.4.4. These show a smooth transition from estimates at younger ages based largely on survey data, to estimates at older ages where commercial data receive most of the weight. Retrospective trends in mean F are given in Figure 4.4.2; the retrospective runs excluded the IBTS Q2 data as this series is too short to permit a useful retrospective analysis. The retrospectives show quite a high degree of variation, with a general tendency to over-estimate F in the terminal year.

Estimates of fishing mortalities at age from the final XSA run are given in Table 4.4.2, and stock numbers at age are given in Table 4.4.3. The present assessment indicates a mean total F in 1997 of 0.63. The current XSA run has revised the estimate of F in 1996 from 0.66 to 0.79.

4.5 Recruitment estimation

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

The only available index of the 1998 year class comes from the English GFS in August. This indicates that the year class is well below average strength. This index receives high weight in the RCT3 estimate of this year class at age 0, so the RCT3 estimate of 8476 million was used in the prediction. This estimate is below the GM value of 26444 million.

The XSA estimate of the 1997 year class at age 1 (1351 million) compares with the RCT3 estimate of 1,852 million. The RCT3 estimate was adopted as the index which is given the highest weight in the estimate is the English GFS index at age 1 which is not included in the XSA. The estimate is below the long-term GM at age 1 of 3,616 million.

The RCT3 estimate of the 1996 year class at age 2 (502 million) is similar to the XSA estimate (481 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. The estimate indicates that this year class is slightly below average strength.

At ages 3 and older the XSA estimates of survivors at the start of 1998 were used in the prediction. For numbers at age 0 in 1999 and 2000, the long term GM value of 26.4 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 1997. Recruitment shows considerable variation, with the current estimate of the 1994 year class indicating that it is one of the strongest since 1974, but the three most recent year classes are all of below average strength. Spawning biomass has fluctuated, with occasional slight peaks corresponding to the maturation of strong year classes. SSB declined from 1985 to a series low of 63,300 t in 1991, since when an increase is indicated.

4.7 Short-term forecast

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

		Percentage taken in Division IIIa	
Catch category	Year range	Mean	Range
Human consumption landings	Full, 1963–1997	3.68%	0.2% - 8.4%
Human consumption landings	Recent, 1995–1997	3.66%	-
Industrial bycatch	Full, 1983–1997	26.8%	8.2% - 43.2%
Industrial bycatch	Recent, 1995–1997	22.2%	-

For prediction purposes unscaled mean Fs over 1995–1997 were used. The mean HC F(2–6) over this period is 0.54, which compares with a point estimate for 1997 of 0.45. For the industrial bycatch, the mean F(0–3) over 1995–1997 of 0.026 compares with a 1997 value of 0.019. The Fs at age for the human consumption/discard fleet were calculated by first obtaining partial Fs for this fleet over 1995–1997. The mean exploitation pattern over this period was then partitioned between the human consumption and discard components according to the mean proportion at each age over 1995–1997. This period was chosen after examination of the data showed no obvious recent trends in discard rate. 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 and bycatch 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 1995–1997, again following examination of the data to check for the presence of trends. The mean Fs-at-age and weights-at-age are calculated automatically by the program 'Insens' and reflect recent practice for catch predictions for the North Sea stock.

The inputs to the prediction are given in Table 4.7.1. The results of this prediction are given in Table 4.7.2, with more detailed output assuming *status quo* F in 1998 summarised in Table 4.7.3. The assumption of *status quo* F in 1998 and 1999 leads to predicted human consumption landings for the North Sea and IIIa of 102,000 t in 1998 falling to 81,000 t in 1999. SSB is predicted to decrease from its 1998 level of 213,000 t to 171,000 t at the start of 1999, with a further decline to 136,000 t at the start of 2000. For comparison, the total TAC for 1998 is 122,000 t (115,000 in the North Sea and 7,000 t in IIIa).

The predicted decrease in human consumption landings over 1998 and 1999 reflects the decreased contribution of the 1994 year class to the catches. This year class accounts for 56% of the predicted 1998 HC landings in weight, with no other year class contributing more than 16% to this total (Table 4.7.4). For the 1999 landings, the 1994 and 1996 year classes each provide about 30% of the predicted catch in weight, even though the 1996 year class is estimated to be of slightly below average strength. The relative importance of the 1994 and 1996 year classes is partly reflected 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 these year classes at ages 2 and 4 respectively, and to factors influencing the survival of these year classes and their contribution to the catch and spawning stock. However, the sensitivity analysis also indicates that the prediction, and particularly the variance of the prediction, is most sensitive to the overall level of fishing and natural mortality during 1998 and 1999.

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 2000 is low. The input values to the catch prediction with sensitivity analysis of are given in Table 4.7.5.

4.8 Medium-term projections

The input values for the medium-term projections were the same as those used for the short-term prediction (Table 4.7.1) except that the weights at age were taken as means over the 1988–1997 instead of just 1995–1997. As a result, the weights at age are slightly higher than those used in the short-term prediction.

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. A Ricker curve was also investigated. This was very similar in shape to the Beverton-Holt, and again the fit was not significant. Given the large variation in recruitment and the wide range of SSB values in the data, the results of the projections are likely to be rather insensitive to the SRR model chosen. The fitted Beverton-Holt curve is shown in Figure 4.8.1, along with the results of a medium-term projection assuming *status quo* fishing mortality in 1998 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 strong 1994 year class, after which both are indicated to increase.

4.9 Long term considerations

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 Biological reference points

A yield per-recruit curve based on the inputs to the medium term projections (i.e., as Table 4.7.1, but with mean weights taken over 1988–1997) is given in Figure 4.10.1, and the stock-recruitment plot is given in Figure 4.10.2. The reference points given on Figure 4.10.1 are based on the total yield-per-recruit curve. Output from the program GLOSSC, used to estimate F_{loss}, is given in Figure 4.10.3. The settings used are given in Table 4.10.1.

4.10.1 Choice of B_{pa}

This stock has shown high variation in spawning stock size, with the lowest observed SSB (63,300 t) representing just 7% of the size of the largest observed SSB (Figure 4.10.2). As this is the case, B_{loss} is an obvious candidate for B_{lim} for this stock. As the point estimate of B_{loss} represents such an extreme in the stock's history, it is more appropriate to use a smoothed estimate of B_{loss} as B_{lim}. The SRR plot (Figure 4.10.2) shows a cluster of points around the 100,000 t mark, including one reasonably strong year class resulting from this low level of SSB, so 100,000 t is suggested as B_{lim}. From this we have $B_{pa} = B_{loss}.\exp(1.645\sigma)$. With σ taken as 0.2, this gives a B_{pa} value of 140,000 t.

4.10.2 Choice of F_{pa}

A range of candidate values for F_{pa} are given in Table 4.10.1. The probabilities given in this Table were interpolated from Figure 4.10.4, which shows the percentiles of medium term projections after 10 years (details as in Section 4.8) run with different F-multipliers.

The stock has sustained levels of total F around 1.0 over a long period and many of the candidate values for F_{pa} fall well below the minimum F observed for this stock. Any value of 0.7 or less gives a probability of less than 10% that SSB will be below B_{pa} after 10 years. In addition, F_{lpg}, (defined as the F which has only a 10% risk of exceeding the F associated with G_{loss}.) is close to 0.7, so a value of F = 0.7 also has only a 10% risk of exceeding F_{loss}, hence a value of around 0.7 is suggested for F_{pa}.

Although the medium-term probability of SSB being below B_{pa} after ten years, if F is maintained at F_{pa} is around 10%, it should be noted that *status quo* F (0.70) is at F_{pa}, and the *status quo* forecast gives a probability of about 60% that the 2000 SSB will be below B_{pa} (Figure 4.7.2). This decrease is due to a series of three year classes of below average strength. This decrease is also apparent in the plot of mean F against SSB in relation to the proposed PA reference points. (Figure 4.10.5).

4.11 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 4.1.3, this was again the case with the catch prediction for 1997. This discrepancy can be partly attributed to the over-estimation of the strong 1994 year class, but in this case there is also a more general problem of over-estimating catches at all ages. This may be associated with the low level of F in 1996 indicated by the previous assessment. The present assessment has resulted in a marked upward revision of this value.

Table 4.1.1 **Nominal catch (t) of HADDOCK in Division IIIa, 1988-1997, as officially reported to ICES.**

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

Table 4.1.2 **Nominal catch (t) of HADDOCK in Sub-Area IV, 1988-1997, as officially reported to ICES.**

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	220	145	192	168	415	292	306	407	215	436
Denmark	9174	2789	1993	1330	1476	3582	3208	2902	2520	2722
Faroe Islands	35	16	6	15	13	25	43	49	13	9
France	2193	1702	1115	631	508	960	678	441	368	804
Germany	802	447	749	535	764	348	1829	1284	1769	1462
Netherlands	894	328	102	100	148	192	96	147	110	480
Norway	1590	1697	1572	2069	3273	2655	2355	2443	2297	2353
Poland	-	-	-	-	-	-	-	-	18	8
Sweden	614	1051	900	957	1289	908	551	722	689	654
UK (Engl. & Wales)	5537	2507	2019	2173	2926	4259	4043	3616	3379	3330
UK (Isle of Man)	-	-	-	-	11	-	-	-	-	-
UK (N. Ireland)	-	137	11	48	73	18	9	-	-	-
UK (Scotland)	84104	53587	34567	36474	39896	66799	73793	63411	63542	61098
Total	105163	64406	43226	44500	50792	80038	86911	75422	74920	73356
WG estimate of H.cons. landings	105126	76190	51458	44645	70218	79580	80897	75313	76034	79094
WG estimate of discards	62062	25713	32603	40276	47967	79601	65392	57360	72522	52104
WG estimate of industrial bycatch	3995	2410	2591	5421	10816	10741	3561	7747	5048	6689
WG estimate of total catch	171183	104313	86652	90342	129001	169922	149850	140420	153604	137887
Unallocated landings	-37	11784	8232	145	19426	-458	-6014	-109	1114	5738

North Sea + Division IIIa

WG estimate of Total Catch	175515	108771	92720	97021	138001	174296	153863	144773	159671	141898

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	3.2	2.9	6.1	159.7
1997	79.1	52.1	6.7	137.9	3.4	0.6	4.0	141.9
Min	44.6	25.7	2.4	86.7	0.4	0.1	0.4	92.7
Mean	140.6	94.9	34.9	270.4	3.8	1.4	5.2	275.6
Max	524.6	260.4	338.4	929.5	10.8	7.2	15.2	930.5

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

Age	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

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 12-Oct-98 17:25:38

Table 1 Catch numbers at age Numbers*10**-3 YEAR,	1963,	1964,	1965,	1966,	1967,
AGE					
0,	1367,	140235,	652537,	1671206,	306037,
1,	1307177,	7436,	368593,	1007323,	838189,
2,	335092,	1296771,	15184,	25674,	89083,
3,	20963,	135227,	649840,	6425,	4863,
4,	13026,	9069,	29496,	412551,	3585,
5,	5781,	5350,	4662,	9980,	177857,
6,	502,	2405,	1972,	1045,	2443,
7,	653,	287,	452,	601,	215,
8,	566,	236,	107,	165,	216,
9,	59,	231,	90,	90,	57,
+gp,	18,	25,	41,	25,	34,
TOTALNUM,	1685205,	1597272,	1722975,	3135083,	1422579,
TONSLAND,	271531,	380158,	299464,	346726,	246589,
SOPCOF %,	100,	100,	100,	100,	100,

Table 1 Catch numbers at age Numbers*10**-3 YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	11146,	72670,	925768,	333396,	244075,	60545,	614903,	46388,	174161,	120798,
1,	1098748,	20493,	266379,	1815054,	679205,	366830,	1220855,	2116938,	170529,	258923,
2,	439511,	3578612,	218480,	71035,	587590,	570630,	176342,	641755,	1062943,	107675,
3,	19600,	303489,	1908737,	47546,	40604,	240604,	332967,	58991,	211544,	394175,
4,	1947,	7596,	57435,	400469,	21213,	6192,	54314,	109062,	9952,	40185,
5,	2529,	2411,	1178,	10374,	158000,	4470,	1875,	15813,	31311,	4318,
6,	45973,	2515,	1197,	462,	3563,	39459,	1351,	983,	4996,	6275,
7,	325,	19129,	256,	195,	190,	1257,	10922,	620,	206,	1300,
8,	40,	200,	5954,	147,	34,	108,	242,	2714,	76,	135,
9,	13,	24,	67,	1592,	27,	29,	23,	266,	759,	29,
+gp,	5,	7,	30,	168,	419,	163,	41,	82,	63,	204,
TOTALNUM,	1619837,	4007145,	3385481,	2680438,	1734921,	1290287,	2413836,	2993612,	1666541,	934017,
TONSLAND,	302043,	930538,	806674,	446634,	353606,	307688,	368797,	454536,	377118,	226411,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 4.2.2 (Cont'd)

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 12-Oct-98 17:25:38

Table 1 Catch numbers at age Numbers*10**-3 YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	305115,	881823,	399372,	646419,	278705,	639814,	95502,	139579,	56503,	13384,
1,	463554,	351451,	678499,	134470,	275686,	157259,	432193,	178878,	160398,	314017,
2,	146957,	204046,	333261,	423059,	86126,	252258,	168273,	534269,	178824,	250496,
3,	30377,	41297,	73043,	143151,	299895,	73920,	122984,	78726,	323650,	47432,
4,	113703,	7406,	10476,	15228,	41435,	127250,	22079,	37645,	27685,	67864,
5,	8708,	28024,	1901,	2034,	3407,	16480,	32658,	5306,	9691,	4761,
6,	1264,	2237,	8067,	458,	713,	1708,	3789,	7355,	1237,	2877,
7,	2076,	262,	598,	2498,	279,	297,	596,	965,	1810,	545,
8,	402,	483,	121,	124,	786,	60,	81,	209,	246,	780,
9,	116,	152,	162,	64,	29,	193,	39,	53,	106,	135,
+gp,	94,	78,	119,	61,	26,	67,	139,	114,	137,	152,
TOTALNUM,	1072366,	1517259,	1505618,	1367566,	987087,	1269306,	878333,	982899,	760287,	702443,
TONSLAND,	180144,	146001,	223610,	217151,	237842,	253594,	222563,	258117,	225697,	176880,
SOPCOF %,	100,	100,	100,	102,	102,	104,	102,	101,	101,	99,

Table 1 Catch numbers at age Numbers*10**-3 YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
0,	16535,	12042,	57702,	123910,	270758,	141209,	85966,	273689,	345874,	39940,
1,	30044,	47648,	86819,	228553,	209879,	359995,	99260,	301733,	50387,	120696,
2,	490706,	35358,	103021,	78258,	253286,	262765,	296776,	85925,	355215,	80237,
3,	89940,	182748,	18947,	23197,	32494,	108421,	100476,	167801,	56792,	211577,
4,	13431,	18106,	57830,	3888,	6552,	7107,	29609,	25875,	55326,	15900,
5,	18579,	2636,	3905,	12526,	1250,	1698,	1920,	7645,	7989,	16131,
6,	1602,	4058,	896,	976,	4861,	450,	573,	511,	3052,	2592,
7,	639,	510,	1380,	401,	454,	1138,	191,	127,	756,	679,
8,	163,	201,	206,	620,	299,	145,	509,	45,	52,	62,
9,	145,	83,	80,	144,	294,	103,	115,	62,	31,	15,
+gp,	104,	54,	70,	65,	154,	210,	89,	36,	42,	26,
TOTALNUM,	661888,	303444,	330856,	472538,	780281,	883241,	615484,	863449,	875516,	487855,
TONSLAND,	175516,	108772,	92720,	97021,	138001,	174296,	153864,	144773,	159671,	141897,
SOPCOF %,	100,	102,	102,	104,	104,	100,	102,	101,	100,	101,

Table 4.2.3

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 12-Oct-98 17:25:38

Table 3 Stock weights at age (kg)

YEAR,	1963,	1964,	1965,	1966,	1967,
AGE					
0,	.0120,	.0110,	.0100,	.0100,	.0110,
1,	.1230,	.1180,	.0690,	.0880,	.1150,
2,	.2530,	.2390,	.2250,	.2470,	.2810,
3,	.4730,	.4030,	.3660,	.3670,	.4610,
4,	.6950,	.6640,	.6480,	.5330,	.5940,
5,	.8070,	.8140,	.8440,	.9490,	.6390,
6,	1.0040,	.9080,	1.1930,	1.2660,	1.0570,
7,	1.1310,	1.3820,	1.1730,	1.5250,	1.5010,
8,	1.1730,	1.1480,	1.4820,	1.9380,	1.9220,
9,	1.5760,	1.4700,	1.7070,	1.7270,	2.0690,
+gp,	1.8250,	1.7810,	2.2390,	2.8890,	2.3480,

Table 3 Stock weights at age (kg)

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	.0100,	.0110,	.0130,	.0110,	.0240,	.0440,	.0240,	.0200,	.0130,	.0190,
1,	.1260,	.0630,	.0730,	.1070,	.1160,	.1120,	.1280,	.1010,	.1250,	.1080,
2,	.2530,	.2160,	.2220,	.2470,	.2420,	.2400,	.2260,	.2410,	.2240,	.2410,
3,	.5090,	.4060,	.3520,	.3620,	.3880,	.3720,	.3430,	.3560,	.4010,	.3450,
4,	.7310,	.7990,	.7350,	.5060,	.5060,	.5860,	.5480,	.4490,	.5120,	.6010,
5,	.8570,	.8910,	.8730,	.8870,	.6060,	.6490,	.8910,	.6800,	.5880,	.6130,
6,	.8370,	1.0310,	1.1910,	1.2670,	1.0000,	.7250,	.8950,	1.2450,	.9220,	.8020,
7,	1.6060,	1.0940,	1.3620,	1.5340,	1.3660,	1.0440,	.9520,	1.1240,	1.9330,	1.1810,
8,	2.2600,	2.0400,	1.4370,	1.3370,	2.2410,	1.3020,	1.5130,	1.0930,	1.7840,	1.9430,
9,	2.7020,	3.0340,	2.5710,	1.2750,	2.0060,	2.7960,	2.3150,	1.7200,	1.3060,	2.3220,
+gp,	2.0730,	3.2640,	3.8990,	2.0580,	1.6840,	1.8280,	2.6390,	2.4200,	2.4300,	1.8120,

Table 4.2.3 (Cont'd)

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 12-Oct-98 17:25:38

Table 3 Stock weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	.0110,	.0090,	.0120,	.0090,	.0110,	.0220,	.0100,	.0130,	.0250,	.0080,
1,	.1440,	.0950,	.1040,	.0740,	.1000,	.1350,	.1410,	.1490,	.1240,	.1260,
2,	.2530,	.2900,	.2830,	.2620,	.2920,	.2970,	.3000,	.2790,	.2420,	.2650,
3,	.4180,	.4430,	.4860,	.4760,	.4600,	.4480,	.4890,	.4800,	.3970,	.4060,
4,	.4410,	.6370,	.7320,	.7450,	.7840,	.6510,	.6700,	.6680,	.6130,	.6150,
5,	.7190,	.6640,	1.0460,	1.1470,	1.1660,	.9150,	.8050,	.8570,	.8630,	1.0290,
6,	.7420,	.9330,	.9360,	1.4790,	1.4410,	1.2140,	1.0970,	1.0490,	1.2570,	1.2760,
7,	.9550,	1.1870,	1.3940,	1.1800,	1.6720,	1.1620,	1.1000,	1.4590,	1.1950,	1.4330,
8,	1.3980,	1.1870,	1.5990,	1.6340,	1.4560,	1.9200,	1.8680,	1.8330,	1.7150,	1.5290,
9,	2.1240,	1.4680,	1.5930,	1.7640,	2.6340,	1.3760,	2.4250,	2.1240,	1.5250,	1.8770,
+gp,	2.1580,	2.3740,	2.1430,	1.7090,	2.1560,	1.7250,	2.0460,	2.0430,	2.6120,	2.2200,

Table 3 Stock weights at age (kg)

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
0,	.0240,	.0270,	.0440,	.0290,	.0180,	.0100,	.0170,	.0130,	.0190,	.0210,
1,	.1650,	.1970,	.1940,	.1770,	.1070,	.1150,	.1160,	.1020,	.1310,	.1400,
2,	.2170,	.3000,	.2920,	.3200,	.3060,	.2800,	.2500,	.2970,	.2470,	.2870,
3,	.4170,	.3720,	.4300,	.4720,	.4860,	.4470,	.4190,	.3630,	.3890,	.3590,
4,	.5890,	.6050,	.4730,	.6390,	.7480,	.6800,	.5970,	.5920,	.4840,	.6060,
5,	.7480,	.8110,	.7710,	.6500,	1.0160,	.8940,	.9430,	.7630,	.8030,	.6390,
6,	1.2840,	.9820,	.9670,	1.0420,	.8960,	1.1730,	1.2080,	1.0990,	.8700,	.9690,
7,	1.4240,	1.3640,	1.1670,	1.2320,	1.3950,	1.1020,	1.5700,	1.4230,	.8460,	.9660,
8,	1.5510,	1.6550,	1.5290,	1.4810,	1.5370,	1.5920,	1.4690,	1.6850,	1.8330,	1.6470,
9,	1.6270,	1.6840,	2.0370,	1.7760,	1.9120,	1.7370,	1.6200,	1.8730,	2.0250,	2.2470,
+gp,	2.3460,	2.2290,	2.6060,	2.0640,	2.0210,	1.8730,	2.4440,	1.9860,	1.9700,	2.3880,

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

Fleet	Abbreviation	Year range		Age range		
		First	Last	Youngest	Oldest	
Scottish Seiners	SCOSEI	1978	1997	0	10	
Scottish Light Trawlers	SCOLTR	1978	1997	0	10	
Scottish Groundfish Survey (August)	SCOGFS	1982	1997	0	6	
English Groundfish Survey (August)	ENGGFS	1978	1997	0	7	
International Bottom Trawl Survey, Quarter 1	IBTSQ1	1978	1997	0	5	1
International Bottom Trawl Survey, Quarter 2	IBTSQ2_SCO	1991	1997	1	6	2

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

2 - Indices based on Scottish ALKs only

Table 4.3.2

```
Haddock in Fishing Area IV and IIIa (run name: XSASAR01)
106
FLT01: SCOSEI (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
0 10
    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
    166817     3108.574    30046.252    19165.139    59308.570     3917.753     4082.625      495.431      194.737          9.5
FLT02: SCOLTR (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.00 1.00
0 10
    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
    479449      459.847    15907.054    13450.542    49548.469     3536.682     4510.573      553.205      162.645       12.541
FLT03: ENGGFS (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.50 0.75
0 5
   100     35.830     13.690      2.620      0.240      2.220      0.210
   100     87.550     29.550      5.460      0.870      0.110      0.440
   100     37.400     62.330     16.730      2.570      0.270      0.040
   100    153.750     17.320     43.910      7.560      0.740      0.060
   100     28.130     31.550      7.980     11.800      1.030      0.240
   100     83.190     21.820     10.950      2.140      2.170      0.270
   100     22.850     59.930      6.160      3.080      0.420      0.480
   100     24.590     18.660     23.820      2.110      0.700      0.200
   100     26.600     14.970      4.470      3.380      0.280      0.180
   100      2.240     28.190      4.310      0.530      0.690      0.050
   100      6.070      2.860     18.350      1.550      0.160      0.280
   100      9.430      8.170      1.450      3.970      0.250      0.030
   100     28.190      6.650      1.980      0.290      0.880      0.050
   100     26.330     11.500      0.960      0.230      0.050      0.220
   100     82.770     19.690      9.770      0.580      0.050      0.010
   100     13.580     24.610      5.860      1.660      0.060      0.020
   100     94.300      8.070      9.020      0.840      0.280      0.020
   100     17.990     38.310      4.450      3.400      0.280      0.090
   100     19.920      8.310     14.570      1.220      0.830      0.070
   100     13.030     14.860      4.330      6.607      0.227      0.216
```

Table 4.3.2 (Cont'd)

```
FLT04: SCOGFS (Catch: Unknown) (Effort: Unknown)
1982 1997
1 1 0.50 0.75
0 5
   100    12.35    24.88     9.96    13.36     1.15     0.07
   100    22.03    18.13    16.11     3.72     4.55     0.53
   100     8.73    43.71     7.88     3.36     0.55     0.65
   100     8.18    19.76    29.81     2.32     1.03     0.14
   100    17.47    23.29     5.74     5.98     0.36     0.27
   100     2.77    23.86     7.04     1.06     1.28     0.08
   100     4.06     4.67    19.82     1.70     0.27     0.23

   100     4.32     8.86     2.14     5.74     0.31     0.04
   100    31.63    10.02     2.40     0.32     1.03     0.07
   100    34.71    17.05     1.78     0.21     0.05     0.16
   100    82.65    38.35     9.63     0.48     0.08     0.03
   100     8.59    58.36    13.80     2.69     0.06     0.04
   100   137.62    12.65    20.80     2.10     0.53     0.02
   100    15.66    81.53     7.34     9.26     0.74     0.28
   100    19.80    22.31    47.05     2.31     2.06     0.22
   100     9.72    27.79     8.49    13.97     0.66     0.56
FLT05: IBTS_Q1 (Catch: Unknown) (Effort: Unknown)
1978 1997
1 1 0.99 1.00
0 5
   1   0.4800   0.2400  -1.0000  -1.0000  -1.0000  -1.0000
   1   0.8960   0.4020  -1.0000  -1.0000  -1.0000  -1.0000
   1   0.2680   0.6750  -1.0000  -1.0000  -1.0000  -1.0000
   1   0.5260   0.2520  -1.0000  -1.0000  -1.0000  -1.0000
   1   0.3070   0.4000   0.0890   0.1140   0.0130   0.0020
   1   1.0570   0.2190   0.1340   0.0220   0.0220   0.0050
   1   0.2290   0.8280   0.1050   0.0340   0.0040   0.0070
   1   0.5790   0.2440   0.2940   0.0180   0.0060   0.0020
   1   0.8850   0.3260   0.0480   0.0610   0.0050   0.0030
   1   0.0920   0.6880   0.0980   0.0130   0.0140   0.0020
   1   0.2100   0.0970   0.2810   0.0170   0.0020   0.0050
   1   0.2200   0.1100   0.0310   0.0510   0.0030   0.0020
   1   0.6790   0.1310   0.0240   0.0040   0.0090   0.0020
   1   1.1150   0.3710   0.0190   0.0030   0.0010   0.0020
   1   1.2420   0.5430   0.1550   0.0090   0.0010   0.0010
   1   0.2290   0.5040   0.0980   0.0230   0.0020   0.0010
   1   1.3750   0.2050   0.1810   0.0250   0.0050   0.0010
   1   0.2670   0.8130   0.0660   0.0470   0.0077   0.0031
   1   0.8600   0.3660   0.4710   0.0250   0.0151   0.0034
   1   0.3740   0.4230   0.1060   0.1140   0.0087   0.0054
FLT06: IBTS_Q2_SCD (Catch: Unknown) (Effort: Unknown)
1991 1997
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
   100   31.440   14.720   22.130    0.730    0.650    0.030
```

Table 4.4.1

```
Lowestoft VPA Version 3.1

  10-Oct-98  16:11:59

Extended Survivors Analysis

Haddock in IV, IIIa (run: XSASAR01/X01)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/had_34/FLEET.X01

Catch data for  35 years. 1963 to 1997. Ages  0 to  10.

     Fleet,           First, Last, First, Last, Alpha,  Beta
                       year, year,  age ,  age
FLT01: SCOSEI (Catch,  1978, 1997,   0,     9,   .000,  1.000
FLT02: SCOLTR (Catch,  1978, 1997,   0,     9,   .000,  1.000
FLT03: ENGGFS (Catch,  1978, 1997,   0,     5,   .500,   .750
FLT04: SCOGFS (Catch,  1982, 1997,   0,     5,   .500,   .750
FLT05: IBTS_Q1 (Catc,  1978, 1997,   0,     5,   .990,  1.000
FLT06: IBTS_Q2_SCO (,  1991, 1997,   1,     6,   .250,   .500


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   22 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,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997

      0,  .005,  .004,  .006,  .013,  .018,  .031,  .004,  .060,  .044,  .011
      1,  .137,  .106,  .195,  .156,  .146,  .168,  .151,  .104,  .075,  .104
      2,  .796,  .655, 1.120,  .780,  .735,  .795,  .548,  .500,  .444,  .427
      3, 1.304,  .987, 1.158, 1.032, 1.137, 1.032, 1.029,  .845,  .899,  .618
      4, 1.115, 1.184, 1.151,  .857, 1.064,  .904, 1.003,  .902,  .826,  .742
      5, 1.106,  .700,  .948,  .883,  .790,  .958,  .687,  .817,  .836,  .633
      6,  .771,  .776,  .546,  .659, 1.114,  .753, 1.084,  .387,  .959,  .730
      7,  .866,  .602,  .668,  .507,  .756,  .880,  .874,  .754, 1.927,  .575
      8,  .617,  .753,  .523,  .736,  .918,  .580, 1.473,  .513,  .828,  .886
      9,  .851,  .757,  .790,  .883,  .995, 1.003, 1.436,  .693,  .832,  .605
```

Table 4.4.1 (Cont'd)

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6	7
1988	8.44E+06	5.37E+05	1.09E+06	1.40E+05	2.26E+04	3.07E+04	3.29E+03	1.22E+03	3.91E+02	2.80E+02
1989	8.71E+06	1.08E+06	8.99E+04	3.30E+05	2.96E+04	5.79E+03	8.31E+03	1.25E+03	4.20E+02	1.73E+02
1990	2.82E+07	1.12E+06	1.87E+05	3.13E+04	9.58E+04	7.04E+03	2.35E+03	3.13E+03	5.59E+02	1.62E+02
1991	2.77E+07	3.62E+06	1.76E+05	4.08E+04	7.65E+03	2.36E+04	2.23E+03	1.11E+03	1.31E+03	2.71E+02
1992	4.19E+07	3.53E+06	5.94E+05	5.42E+04	1.13E+04	2.53E+03	8.00E+03	9.46E+02	5.50E+02	5.16E+02
1993	1.29E+07	5.30E+06	5.85E+05	1.91E+05	1.35E+04	3.05E+03	9.40E+02	2.15E+03	3.64E+02	1.80E+02
1994	5.45E+07	1.62E+06	8.60E+05	1.77E+05	5.30E+04	4.27E+03	9.57E+02	3.62E+02	7.30E+02	1.67E+02
1995	1.31E+07	6.99E+06	2.67E+05	3.33E+05	4.93E+04	1.51E+04	1.76E+03	2.65E+02	1.24E+02	1.37E+02
1996	2.25E+07	1.58E+06	1.21E+06	1.09E+05	1.11E+05	1.56E+04	5.47E+03	9.78E+02	1.02E+02	6.07E+01
1997	1.06E+07	2.78E+06	2.82E+05	5.20E+05	3.44E+04	3.80E+04	5.53E+03	1.72E+03	1.17E+02	3.65E+01

Estimated population abundance at 1st Jan 1998

	.00E+00	1.35E+06	4.81E+05	1.23E+05	2.18E+05	1.28E+04	1.65E+04	2.18E+03	7.91E+02	3.94E+01

Taper weighted geometric mean of the VPA populations:

	1.87E+07	2.16E+06	3.93E+05	1.35E+05	3.07E+04	9.86E+03	2.98E+03	1.06E+03	3.48E+02	1.58E+02

Standard error of the weighted Log(VPA populations) :

	.6631	.8018	.8744	.9473	.8933	.9771	.8045	.7488	.8543	.7548

Log catchability residuals.

Fleet : FLT01: SCOSEI (Catch

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	-.26	-1.64	-.89	.16	-.73	1.42	.09	-.82	.51	2.16
1	.09	-.07	.74	.04	-.60	.01	.18	-.11	-.49	.20
2	-.04	.11	.61	.01	-.37	.10	-.03	.02	-.02	-.38
3	.05	.01	.30	-.08	-.31	-.10	-.03	.24	.20	-.27
4	-.17	.22	.36	-.23	-.41	-.10	.09	.19	.16	-.11
5	.22	-.14	.21	.12	-.43	.00	-.51	.20	.31	.03
6	.17	.11	-.23	-.22	.15	-.21	.24	-.57	.48	.08
7	.28	-.06	-.18	-.53	-.58	.14	-.09	.37	.41	.23
8	.02	.17	-.32	-.20	-.31	-.61	.27	-.04	.28	.04
9	.33	.25	.19	-.02	-.27	-.39	-.58	-.42	.49	.72

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	-21.4558	-16.0022	-13.9473	-13.5269	-13.6303	-13.8957	-14.0877	-14.0716	-14.0716	-14.0716
S.E(Log q)	1.1401	.3708	.2742	.2035	.2412	.2798	.3046	.3533	.2953	.4357

Table 4.4.1 (Cont'd)

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,	1.21,	-.287,	22.45,	.19,	10,	1.46,	-21.46,
1,	1.16,	-.884,	16.23,	.79,	10,	.44,	-16.00,
2,	1.11,	-.981,	14.07,	.90,	10,	.31,	-13.95,
3,	1.03,	-.439,	13.59,	.95,	10,	.22,	-13.53,
4,	.82,	4.149,	13.03,	.98,	10,	.12,	13.63,
5,	.84,	2.494,	13.15,	.97,	10,	.19,	3.90,
6,	.85,	1.467,	13.18,	.92,	10,	.24,	4.09,
7,	1.08,	-.434,	14.62,	.80,	10,	.40,	4.07,
8,	1.12,	-.935,	15.11,	.89,	10,	.32,	-4.14,
9,	1.48,	-1.934,	18.36,	.67,	10,	.56,	-14.04,

Fleet : FLT02: SCOLTR (Catch

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
0 ,	.07,	1.64,	-1.29,	.45,	.46,	-.38,	-.04,	-.84,	-.50,	.43
1 ,	-.12,	.40,	.45,	.65,	-.25,	.08,	-.39,	-.77,	.23,	-.29
2 ,	.09,	-.49,	.76,	.33,	-.14,	.19,	-.14,	-.18,	-.06,	-.37
3 ,	.32,	-.13,	-.02,	-.03,	-.27,	.14,	.29,	-.02,	-.07,	-.21
4 ,	.21,	.09,	.13,	-.28,	-.44,	.07,	.10,	.13,	.15,	-.16
5 ,	.18,	-.04,	-.01,	.03,	-.66,	.21,	-.05,	.08,	.26,	.00
6 ,	-.44,	-.08,	-.31,	.16,	.14,	-.02,	.45,	-.65,	.74,	.02
7 ,	-.23,	-.14,	-.23,	-.39,	-.06,	.26,	.10,	-.62,	1.54,	-.24
8 ,	-.30,	-.27,	-.34,	.15,	-.08,	-.33,	.04,	-.11,	-.05,	.02
9 ,	-.15,	.27,	-.18,	.45,	.12,	.46,	-.09,	.16,	.82,	-.69

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,	-22.6989,	-17.2039,	-15.3693,	-14.8179,	-14.7442,	-14.8235,	-14.9700,	-14.8380,	-14.8380,	-14.8380,
S.E(Log q),	.8219,	.4391,	.3626,	.1958,	.2170,	.2540,	.4114,	.5937,	.2188,	.4400,

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,	1.46,	-.739,	25.41,	.25,	10,	1.23,	-22.70,
1,	1.22,	-.994,	17.78,	.72,	10,	.54,	-17.20,
2,	1.00,	.020,	15.36,	.85,	10,	.38,	-15.37,
3,	.99,	.072,	14.80,	.96,	10,	.21,	-14.82,
4,	.86,	2.439,	14.14,	.98,	10,	.15,	-14.74,
5,	.89,	1.579,	14.19,	.96,	10,	.21,	-14.82,
6,	.94,	.342,	14.57,	.81,	10,	.41,	-14.97,
7,	.93,	.266,	14.29,	.65,	10,	.58,	-14.84,
8,	.99,	.162,	14.86,	.96,	10,	.18,	-14.96,
9,	.90,	.578,	13.75,	.80,	10,	.39,	-14.72,

Table 4.4.1 (Cont'd)

Fleet : FLT03: ENGGFS (Catch

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	-.48	-.07	-.15	-.19	.54	-.08	.40	.21	-.25	.06
1	.02	.35	.17	-.48	.07	-.10	-.04	.03	-.03	.00
2	.38	.25	.12	-.76	.32	-.14	-.25	.19	-.17	.06
3	.37	.25	.10	-.48	.23	-.04	-.65	.00	.13	.08
4	.20	.42	.48	-.04	-.31	-.40	-.16	-.15	.07	-.10
5	.59	-.23	.24	.47	-.44	.17	-.34	-.02	-.28	-.17
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	-17.0009	-15.6600	-15.2341	-15.4189	-15.8138	-15.9888
S.E(Log q)	.3092	.2117	.3410	.3232	.2918	.3545

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	1.913	16.95	.91	10	.22	-17.00
1	1.12	-1.274	15.79	.93	10	.23	-15.66
2	.98	.142	15.19	.87	10	.35	-15.23
3	.96	.357	15.27	.90	10	.33	-15.42
4	.87	1.465	15.10	.94	10	.24	-15.81
5	.86	1.462	15.02	.93	10	.29	-15.99

Table 4.4.1 (Cont'd)

Fleet : FLT04: SCOGFS (Catch

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	-.75	-.72	.10	.21	.67	-.41	.91	.20	-.12	-.10
1	-.06	-.14	.01	-.66	.17	.19	-.16	.21	.38	.06
2	-.07	.11	-.22	-.67	-.22	.19	.06	.16	.47	.20
3	.05	.22	-.21	-.97	-.37	.03	-.14	.60	.36	.42
4	.22	.14	.14	-.54	-.33	-.90	-.02	.32	.48	.47
5	-.12	-.45	.07	-.36	.14	.35	-.85	.61	.35	.26
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	-17.1320	-15.0876	-14.7042	-15.0122	-15.3186	-15.4754
S.E(Log q)	.5417	.2882	.3149	.4553	.4533	.4438

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	.58	5.695	16.97	.96	10	.15	-17.13
1	.95	.390	15.06	.90	10	.29	-15.09
2	.89	1.089	14.50	.92	10	.28	-14.70
3	.73	3.453	14.15	.95	10	.22	-15.01
4	.73	3.166	13.95	.94	10	.23	-15.32
5	.93	.477	15.03	.85	10	.43	-15.48

Table 4.4.1 (Cont'd)

Fleet : FLT05: IBTS_Q1 (Catc

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	-.10	-.09	-.14	.38	.08	-.42	-.09	-.24	.36	.25
1	.31	-.29	-.06	-.24	.16	-.30	-.03	-.16	.50	.11
2	.23	.38	-.14	-.66	.18	-.20	-.22	-.11	.29	.24
3	.14	.06	.04	-.64	.28	-.14	.01	-.17	.37	.04
4	-.18	.03	-.09	-.05	-.23	.12	-.23	.18	-.04	.50
5	-.03	.32	.37	-.91	.54	.52	-.08	-.09	-.01	-.64
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	-15.3613	-14.0603	-14.2118	-14.5134	-14.7014	-14.3004
S.E(Log q)	.2645	.2673	.3212	.2793	.2227	.4769

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	.91	.710	15.48	.89	10	.25	-15.36
1	1.16	-1.307	13.98	.89	10	.30	-14.06
2	.94	.475	14.14	.90	10	.32	-14.21
3	.97	.334	14.42	.93	10	.28	-14.51
4	.98	.188	14.63	.94	10	.23	-14.70
5	1.62	-3.604	17.48	.81	10	.51	-14.30

Table 4.4.1 (Cont'd)

```
Fleet : FLT06: IBTS_Q2_SCO (

 Age  ,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997
    0 , No data for this fleet at this age
    1 , 99.99, 99.99, 99.99,  -.22,   .50,   .48,  -.57,   .22,  -.18,  -.24
    2 , 99.99, 99.99, 99.99,  -.41,   .12,   .09,  -.02,  -.05,   .18,   .09
    3 , 99.99, 99.99, 99.99,  -.50,   .11,   .46,  -.46,   .35,  -.14,   .18
    4 , 99.99, 99.99, 99.99,  -.13,   .14,   .19,  -.03,  -.21,   .12,  -.09
    5 , 99.99, 99.99, 99.99,   .41,  -.12,   .04,  -.68,   .69,  -.53,   .19
    6 , 99.99, 99.99, 99.99,   .49,   .59,  -.62,  -.52,  -.47,   .91,  -.39
    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, -15.1074, -14.2444, -14.5256, -14.9046, -15.4590, -15.9957,
S.E(Log q),    .4043,    .1964,    .3785,    .1523,    .4915,    .6383,


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,    2.351,     15.06,     .90,      7,     .20,  -15.11,
 2,     .83,    2.276,     14.04,     .97,      7,     .13,  -14.24,
 3,     .82,    1.416,     14.05,     .93,      7,     .29,  -14.53,
 4,    1.02,    -.242,     14.98,     .98,      7,     .17,  -14.90,
 5,     .84,    1.052,     14.43,     .89,      7,     .41,  -15.46,
 6,     .67,    2.122,     13.28,     .89,      7,     .34,  -16.00,

 Terminal year survivor and F summaries :

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

 Year class = 1997

 Fleet,                 Estimated,    Int,      Ext,     Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,      s.e,   Ratio,    , Weights,     F
 FLT01: SCOSEI (Catch,  11660672.,  1.196,      .000,     .00,   1,  .023,      .000
 FLT02: SCOLTR (Catch,   2080440.,   .862,      .000,     .00,   1,  .045,      .000
 FLT03: ENGGFS (Catch,   1438717.,   .324,      .000,     .00,   1,  .319,      .000
 FLT04: SCOGFS (Catch,   1223533.,   .568,      .000,     .00,   1,  .104,      .000
 FLT05: IBTS_Q1 (Catc,   1736599.,   .300,      .000,     .00,   1,  .373,      .000
 FLT06: IBTS_Q2_SCO (,         1.,   .000,      .000,     .00,   0,  .000,      .000

   F shrinkage mean  ,    376528.,    .50,,,,                        .136,      .037

 Weighted prediction :

 Survivors,        Int,      Ext,    N,     Var,      F
 at end of year,   s.e,      s.e,      ,   Ratio,
   1351217.,       .18,      .28,    6,   1.552,    .011
```

Table 4.4.1 (Cont'd)

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

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	605391.,	.370,	.088,	.24,	2,	.092,	.084
FLT02: SCOLTR (Catch,	344230.,	.406,	.089,	.22,	2,	.076,	.143
FLT03: ENGGFS (Catch,	431295.,	.220,	.125,	.57,	2,	.256,	.116
FLT04: SCOGFS (Catch,	490369.,	.267,	.074,	.28,	2,	.176,	.102
FLT05: IBTS_Q1 (Catc,	606552.,	.212,	.127,	.60,	2,	.275,	.084
FLT06: IBTS_Q2_SCO (,	379194.,	.432,	.000,	.00,	1,	.068,	.131
F shrinkage mean ,	338251.,	.50,,,,				.056,	.145

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
480616.,	.11,	.07,	12,	.621,	.104

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	79967.,	.233,	.063,	.27,	3,	.138,	.600
FLT02: SCOLTR (Catch,	100612.,	.278,	.244,	.88,	3,	.096,	.503
FLT03: ENGGFS (Catch,	132317.,	.188,	.071,	.38,	3,	.204,	.403
FLT04: SCOGFS (Catch,	164109.,	.208,	.064,	.31,	3,	.170,	.337
FLT05: IBTS_Q1 (Catc,	145997.,	.180,	.221,	1.23,	3,	.222,	.372
FLT06: IBTS_Q2_SCO (,	123983.,	.247,	.122,	.50,	2,	.124,	.425
F shrinkage mean ,	77067.,	.50,,,,				.047,	.616

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
123275.,	.09,	.08,	18,	.890,	.427

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	186690.,	.190,	.066,	.35,	4,	.162,	.693
FLT02: SCOLTR (Catch,	170404.,	.210,	.128,	.61,	4,	.137,	.740
FLT03: ENGGFS (Catch,	238046.,	.169,	.108,	.64,	4,	.184,	.579
FLT04: SCOGFS (Catch,	329750.,	.195,	.114,	.58,	4,	.132,	.449
FLT05: IBTS_Q1 (Catc,	222219.,	.159,	.090,	.57,	4,	.213,	.610
FLT06: IBTS_Q2_SCO (,	263475.,	.216,	.012,	.06,	3,	.118,	.536
F shrinkage mean ,	108195.,	.50,,,,				.053,	1.003

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
218227.,	.08,	.06,	24,	.831,	.618

Table 4.4.1 (Cont'd)

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

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	12861.,	.188,	.090,	.48,	5,	.168,	.738
FLT02: SCOLTR (Catch,	10954.,	.198,	.037,	.19,	5,	.157,	.825
FLT03: ENGGFS (Catch,	12443.,	.180,	.055,	.31,	5,	.172,	.755
FLT04: SCOGFS (Catch,	15813.,	.220,	.141,	.64,	5,	.096,	.635
FLT05: IBTS_Q1 (Catc,	16641.,	.169,	.157,	.93,	5,	.189,	.612
FLT06: IBTS_Q2_SCO (,	11286.,	.207,	.069,	.33,	4,	.147,	.808
F shrinkage mean ,	8801.,	.50,,,,				.071,	.953

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
12755.,	.08,	.05,	30,	.612,	.742

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	17820.,	.186,	.042,	.22,	6,	.203,	.598
FLT02: SCOLTR (Catch,	17080.,	.192,	.037,	.19,	6,	.198,	.618
FLT03: ENGGFS (Catch,	15741.,	.193,	.080,	.41,	6,	.166,	.656
FLT04: SCOGFS (Catch,	22741.,	.250,	.072,	.29,	6,	.099,	.496
FLT05: IBTS_Q1 (Catc,	12807.,	.187,	.116,	.62,	6,	.142,	.761
FLT06: IBTS_Q2_SCO (,	19441.,	.219,	.057,	.26,	5,	.116,	.560
F shrinkage mean ,	11364.,	.50,,,,				.077,	.826

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
16509.,	.09,	.04,	36,	.475,	.633

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	2519.,	.197,	.052,	.26,	7,	.292,	.658
FLT02: SCOLTR (Catch,	2500.,	.213,	.048,	.23,	7,	.217,	.662
FLT03: ENGGFS (Catch,	1692.,	.210,	.067,	.32,	6,	.103,	.870
FLT04: SCOGFS (Catch,	2878.,	.278,	.060,	.21,	6,	.060,	.596
FLT05: IBTS_Q1 (Catc,	2372.,	.208,	.056,	.27,	6,	.085,	.688
FLT06: IBTS_Q2_SCO (,	1565.,	.276,	.089,	.32,	6,	.107,	.916
F shrinkage mean ,	1695.,	.50,,,,				.136,	.869

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2179.,	.11,	.04,	39,	.364,	.730

Table 4.4.1 (Cont'd)

Age 7 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
FLT01: SCOSEI (Catch,	1042.,	.215,	.055,	.26,	8,	.382,	.464
FLT02: SCOLTR (Catch,	923.,	.255,	.148,	.58,	8,	.206,	.510
FLT03: ENGGFS (Catch,	736.,	.215,	.058,	.27,	6,	.064,	.607
FLT04: SCOGFS (Catch,	1048.,	.285,	.182,	.64,	6,	.037,	.462
FLT05: IBTS_Q1 (Catc,	686.,	.213,	.043,	.20,	6,	.052,	.640
FLT06: IBTS_Q2_SCO (,	1309.,	.281,	.181,	.64,	6,	.066,	.385
F shrinkage mean ,	331.,	.50,,,,				.193,	1.050

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
791.,	.14,	.09,	41,	.623,	.575

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	39.,	.245,	.080,	.33,	9,	.348,	.886
FLT02: SCOLTR (Catch,	41.,	.260,	.105,	.40,	9,	.337,	.865
FLT03: ENGGFS (Catch,	29.,	.214,	.093,	.43,	6,	.018,	1.070
FLT04: SCOGFS (Catch,	18.,	.285,	.108,	.38,	6,	.011,	1.395
FLT05: IBTS_Q1 (Catc,	40.,	.214,	.087,	.41,	6,	.015,	.876
FLT06: IBTS_Q2_SCO (,	30.,	.271,	.184,	.68,	5,	.018,	1.055
F shrinkage mean ,	40.,	.50,,,,				.253,	.872

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
39.,	.18,	.04,	42,	.220,	.886

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	26.,	.223,	.079,	.36,	10,	.381,	.425
FLT02: SCOLTR (Catch,	12.,	.242,	.118,	.49,	10,	.347,	.769
FLT03: ENGGFS (Catch,	16.,	.226,	.119,	.53,	6,	.011,	.619
FLT04: SCOGFS (Catch,	17.,	.303,	.187,	.62,	6,	.006,	.583
FLT05: IBTS_Q1 (Catc,	17.,	.227,	.192,	.84,	6,	.009,	.600
FLT06: IBTS_Q2_SCO (,	14.,	.321,	.177,	.55,	4,	.012,	.694
F shrinkage mean ,	13.,	.50,,,,				.233,	.720

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
16.,	.17,	.07,	43,	.418,	.605

Table 4.4.2

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 10-Oct-98 16:13:09

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1963,	1964,	1965,	1966,	1967,
AGE					
0,	.0016,	.0435,	.0716,	.0699,	.0022,
1,	.1241,	.0581,	1.3627,	1.3029,	.2626,
2,	.8053,	.4545,	.4164,	.8308,	1.0805,
3,	.6704,	1.1746,	.5093,	.3602,	.4148,
4,	.7614,	.7560,	.9848,	.7794,	.3720,
5,	.8802,	.8843,	1.2993,	1.2403,	1.0137,
6,	.5085,	1.2628,	1.0212,	1.3097,	1.3260,
7,	.8268,	.6215,	.8722,	1.0825,	1.1388,
8,	.7773,	.8385,	.4982,	.9695,	1.9446,
9,	.7582,	.8819,	.9455,	1.0890,	1.1731,
+gp,	.7582,	.8819,	.9455,	1.0890,	1.1731,
FBAR 2- 6,	.7251,	.9064,	.8462,	.9041,	.8414,

Table 8 Fishing mortality (F) at age YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	.0018,	.0167,	.0298,	.0119,	.0321,	.0023,	.0129,	.0113,	.0299,	.0132,
1,	.0516,	.0215,	.5004,	.4743,	.1692,	.3736,	.3532,	.3351,	.3077,	.3381,
2,	.5778,	.6553,	1.0385,	.6590,	.7932,	.5649,	.9334,	.9691,	.8145,	1.0051,
3,	.8979,	1.3759,	1.1499,	.7977,	1.3394,	1.1582,	.9499,	1.2536,	1.3710,	1.0375,
4,	.3069,	1.2867,	1.2693,	.8706,	1.2012,	.8019,	1.0028,	1.0991,	.7813,	1.2621,
5,	.5076,	.8141,	.7114,	.8645,	1.1583,	.9500,	.6280,	.9922,	1.2713,	1.0313,
6,	.8082,	1.6261,	1.4369,	.6864,	.8587,	1.0978,	.8804,	.8201,	1.0639,	.9889,
7,	.5968,	1.0000,	.7088,	1.0169,	.6843,	.8819,	1.1249,	1.5674,	.3934,	.9242,
8,	.6586,	.9509,	1.0592,	1.2854,	.4712,	1.1459,	.4048,	.9978,	.8395,	.4875,
9,	.5805,	1.1493,	1.0491,	.9552,	.8841,	.9865,	.8165,	1.1083,	.8792,	.9492,
+gp,	.5805,	1.1493,	1.0491,	.9552,	.8841,	.9865,	.8165,	1.1083,	.8792,	.9492,
FBAR 2- 6,	.6197,	1.1516,	1.1212,	.7756,	1.0701,	.9146,	.8789,	1.0268,	1.0604,	1.0650,

Table 4.4.2 (Cont'd)

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 10-Oct-98 16:13:09

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	.0217,	.0347,	.0738,	.0571,	.0384,	.0270,	.0155,	.0163,	.0032,	.0089,
1,	.3905,	.1755,	.1894,	.1790,	.1735,	.1514,	.1250,	.2064,	.1280,	.1187,
2,	1.0116,	.8822,	.7074,	.4501,	.4308,	.6601,	.6686,	.6139,	1.0180,	.9027,
3,	1.1281,	1.1414,	1.2096,	.9456,	.8157,	1.0205,	.9966,	.9574,	1.2401,	1.0467,
4,	1.1235,	1.0619,	1.1849,	.9932,	.8798,	1.1611,	1.1412,	1.1031,	1.2897,	1.0825,
5,	1.1628,	1.0234,	.9369,	.8030,	.6468,	1.2122,	1.2206,	1.0250,	1.0572,	.8365,
6,	1.0363,	1.1708,	.9855,	.6102,	.7498,	.8139,	1.0876,	1.0708,	.7111,	1.1428,
7,	1.1463,	.6171,	1.2960,	1.0081,	.9822,	.8396,	.7671,	.9465,	.8590,	.8156,
8,	.8534,	.9416,	.6567,	1.1157,	1.1053,	.5776,	.5765,	.6813,	.6751,	1.2596,
9,	1.0769,	.9737,	1.0236,	.9159,	.8821,	.9310,	.9693,	.9761,	.9285,	1.0392,
+gp,	1.0769,	.9737,	1.0236,	.9159,	.8821,	.9310,	.9693,	.9761,	.9285,	1.0392,
FBAR 2- 6,	1.0925,	1.0560,	1.0048,	.7604,	.7046,	.9735,	1.0229,	.9540,	1.0632,	1.0022,

Table 8 Fishing mortality (F) at age YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
0,	.0055,	.0039,	.0057,	.0125,	.0182,	.0309,	.0044,	.0602,	.0437,	.0105,	.0381,
1,	.1367,	.1060,	.1953,	.1558,	.1460,	.1685,	.1510,	.1037,	.0754,	.1044,	.0945,
2,	.7961,	.6549,	1.1201,	.7803,	.7354,	.7949,	.5476,	.4997,	.4443,	.4272,	.4570,
3,	1.3042,	.9868,	1.1584,	1.0318,	1.1373,	1.0318,	1.0288,	.8452,	.8990,	.6182,	.7875,
4,	1.1147,	1.1842,	1.1510,	.8572,	1.0642,	.9037,	1.0032,	.9025,	.8264,	.7420,	.8236,
5,	1.1063,	.7002,	.9483,	.8826,	.7900,	.9576,	.6869,	.8174,	.8364,	.6334,	.7624,
6,	.7714,	.7760,	.5465,	.6592,	1.1140,	.7532,	1.0839,	.3872,	.9588,	.7305,	.6922,
7,	.8659,	.6017,	.6676,	.5067,	.7555,	.8799,	.8736,	.7542,	1.9267,	.5747,	1.0852,
8,	.6171,	.7532,	.5228,	.7363,	.9184,	.5804,	1.4727,	.5135,	.8279,	.8859,	.7424,
9,	.8512,	.7567,	.7902,	.8829,	.9949,	1.0034,	1.4358,	.6932,	.8316,	.6051,	.7100,
+gp,	.8512,	.7567,	.7902,	.8829,	.9949,	1.0034,	1.4358,	.6932,	.8316,	.6051,	
FBAR 2- 6,	1.0185,	.8604,	.9849,	.8422,	.9682,	.8882,	.8701,	.6904,	.7930,	.6303,	

Table 4.4.3

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 10-Oct-98 16:13:09

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year)					Numbers*10**-5
YEAR,	1963,	1964,	1965,	1966,	1967,
AGE					
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,
+gp,	0,	0,	1,	0,	1,
TOTAL,	287336,	140658,	294317,	731104,	3969013,

Table 10 Stock number at age (start of year)							Numbers*10**-5			
YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	171025,	121955,	877639,	782847,	215392,	728983,	1334931,	115423,	164835,	257514,
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,
+gp,	0,	0,	1,	3,	8,	3,	1,	1,	1,	4,
TOTAL,	683249,	240002,	929917,	903339,	331677,	776850,	1439490,	300848,	206840,	287953,

Table 4.4.3 (Cont'd)

Run title : Haddock in IV, IIIa (run: XSASAR01/X01)

At 10-Oct-98 16:13:09

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	395490,	721551,	156539,	324796,	206144,	669781,	172691,	240473,	498871,	42051,
1,	32718,	49819,	89725,	18719,	39493,	25538,	83929,	21889,	30457,	64019,
2,	2821,	4252,	8027,	14258,	3006,	6377,	4215,	14224,	3420,	5146,
3,	509,	688,	1180,	2652,	6094,	1310,	2209,	1448,	5161,	828,
4,	1909,	128,	171,	274,	802,	2099,	368,	635,	433,	1163,
5,	140,	483,	35,	41,	79,	259,	512,	91,	164,	93,
6,	22,	36,	142,	11,	15,	34,	63,	124,	27,	47,
7,	34,	6,	9,	43,	5,	6,	12,	17,	35,	11,
8,	8,	9,	3,	2,	13,	2,	2,	5,	6,	12,
9,	2,	3,	3,	1,	1,	4,	1,	1,	2,	2,
+gp,	2,	1,	2,	1,	0,	1,	2,	2,	2,	3,
TOTAL,	433652,	776975,	255836,	360800,	255652,	705410,	264005,	278909,	538577,	113375,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 63-95	AMST 63-95
AGE													
0,	84444,	87092,	282429,	277384,	419074,	129458,	545108,	130583,	225430,	(106074),	(0),	264437,	457697,
1,	5365,	10812,	11169,	36151,	35264,	52978,	16159,	69866,	15829,	27780,	(13512),	36162,	65122,
2,	10919,	899,	1868,	1764,	5941,	5853,	8597,	2668,	12095,	2819,	4806,	5203,	10233,
3,	1399,	3302,	313,	408,	542,	1909,	1772,	3333,	1085,	5200,	1233,	1602,	3516,
4,	226,	296,	958,	77,	113,	135,	530,	493,	1115,	344,	2182,	434,	1019,
5,	307,	58,	70,	236,	25,	30,	43,	151,	156,	380,	128,	124,	309,
6,	33,	83,	24,	22,	80,	9,	10,	18,	55,	55,	165,	38,	87,
7,	12,	12,	31,	11,	9,	21,	4,	3,	10,	17,	22,	12,	28,
8,	4,	4,	6,	13,	5,	4,	7,	1,	1,	1,	8,	5,	9,
9,	3,	2,	2,	3,	5,	2,	2,	1,	1,	0,	0,	2,	3,
+gp,	2,	1,	1,	1,	3,	4,	1,	1,	1,	1,	0,		
TOTAL,	102714,	102560,	296870,	316071,	461063,	190404,	572232,	207118,	255776,	142671,	22057,		

( ) Overwritten in the prediction

TABLE 4.5.1

HADDOCK IN IV, RCT3 INPUT VALUES Age 0 17-Oct-98

13 28 2

YEARCLASS	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS0'	'SGFS1'	'SGFS2'	'SCQ21'	'SCQ22'	'ENQ40'	'ENQ41'	'ENQ42'
1971	782847	740	971	-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
1973	728983	1092	385	-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
1975	115423	177	84	-1	-1	32.1	-1	-1	-1	-1	-1	-1	-1	-1
1976	164835	162	108	-1	66.8	26.2	-1	-1	-1	-1	-1	-1	-1	-1
1977	257514	385	240	534.8	136.9	54.6	-1	-1	-1	-1	-1	-1	-1	-1
1978	395490	480	402	358.3	295.5	167.3	-1	-1	-1	-1	-1	-1	-1	-1
1979	721551	896	675	875.5	623.3	439.1	-1	-1	-1	-1	-1	-1	-1	-1
1980	156539	268	252	374	173.2	79.8	-1	-1	99.6	-1	-1	-1	-1	-1
1981	324796	526	400	1537.5	315.5	109.5	-1	248.8	161.1	-1	-1	-1	-1	-1
1982	206144	307	219	281.3	218.2	61.6	123.5	181.3	78.8	-1	-1	-1	-1	-1
1983	669781	1057	828	831.9	599.3	238.2	220.3	436.7	298.1	-1	-1	-1	-1	-1
1984	172691	229	244	228.5	186.6	44.7	87.3	197.6	57.4	-1	-1	-1	-1	-1
1985	240473	579	326	245.9	149.7	43.1	81.8	232.9	70.4	-1	-1	-1	-1	-1
1986	498871	885	688	266	281.9	183.5	174.7	239.3	198.2	-1	-1	-1	-1	-1
1987	42051	92	97	22.4	28.6	14.5	27.7	46.7	21.4	-1	-1	-1	-1	-1
1988	84444	210	114	60.7	81.7	19.8	40.6	88.6	24	-1	-1	-1	-1	-1
1989	87092	219	131	94.3	66.4	9.6	43.2	100.2	17.8	-1	493	-1	-1	5.094
1990	282429	679	371	281.9	115	97.7	316.3	170.5	96.3	4087	2854	-1	57.818	22.977
1991	277384	1115	543	263.3	196.9	58.6	347.1	383.2	138	8196	2680	90.712	74.865	17.137
1992	419074	1242	504	827.7	246.1	90.2	827	583.6	208	11963	3838	198.232	75	22.192
1993	129458	229	205	135.8	80.7	44.5	85.9	126.5	73.4	1295	1186	42.168	185.26	17.995
1994	545108	1375	813.3	943	383.1	145.7	1376.2	815.3	470.5	12539	6889	137.483	160.928	55.913
1995	130583	267.4	366.4	180	83.1	43.3	156.6	223.1	84.9	1922	1472	51.541	24.735	-1
1996	-1	860.2	423.3	199	149	56.8	198	277.9	192.4	3144	-1	65.677	-1	-1
1997	-1	373.6	-1	130	89	-1	97.2	634.9	-1	-1	-1	-1	-1	-1
1998	-1	-1	-1	53	-1	-1	328	-1	-1	-1	-1	-1	-1	-1

Yclass	VPA	IBQ11	IBQ12	egfs0	egfs1	egfs2	sgfs0	sgfs1	sgfs2	SCQ21	SCQ22	ENQ40	ENQ41	ENQ42
Updated ?		Y	Y	Y	Y	Y	N	N	N	N/A	N/A	N/A	N/A	N/A
							****	Handle with care	****					

KEY

NB indices from Scottish 1998 GFS (boxed) included here for comparison, but not included in RCT3 runs

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	New gear & vessel in 98
SGFS1	Scottish GFS	3	1	New gear & vessel in 98
SGFS2	Scottish GFS	3	2	New gear & vessel in 98
SCQ21	IBTS (Scottish, age based)	2	1	Survey discontinued
SCQ22	IBTS (Scottish, age based)	2	2	Survey discontinued
ENQ40	IBTS (English, age based)	4	0	Survey discontinued
ENQ41	IBTS (English, age based)	4	1	Survey discontinued
ENQ42	IBTS (English, age based)	4	2	Survey discontinued

TABLE 4.5.2a; Haddock in North Sea & IIIa, RCT output, age 0

Analysis by RCT3 ver3.1 of data from file :

hadiv0.rct

HADDOCK IN IV, RCT3 INPUT VALUES Age 0 10-Oct-98

Data for 13 surveys over 28 years : 1971 - 1998

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1997

	I----------Regression----------				I I----------Prediction----------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.19	5.19	.45	.778	25	5.93	12.27	.481	.204
IYFS2									
EGFS0	.85	7.56	.43	.767	19	4.88	11.68	.475	.209
EGFS1	1.02	7.11	.31	.859	20	4.50	11.72	.339	.409
EGFS2									
SGFS0	.88	7.84	.58	.672	14	4.59	11.86	.655	.110
SGFS1									
SGFS2									
SCQ21									
SCQ22									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	12.48	.828	.069

Yearclass = 1998

	I----------Regression----------				I I----------Prediction----------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.85	7.56	.43	.767	19	3.99	10.94	.500	.733
EGFS1									
EGFS2									
SGFS0									
SGFS1									
SGFS2									
SCQ21									
SCQ22									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	12.48	.828	.267

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1997	146129	11.89	.22	.14	.40		
1998	84757	11.35	.43	.68	2.55		

TABLE 4.5.2b; Haddock in North Sea & IIIa, RCT output, age 1

Analysis by RCT3 ver3.1 of data from file :

hadiv1.rct

HADDOCK IN IV, RCT3 INPUT VALUES Age 1 10-Oct-98

Data for 13 surveys over 28 years : 1971 - 1998

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1997

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.20	3.12	.45	.783	25	5.93	10.20	.476	.216
IYFS2									
EGFS0	.85	5.44	.45	.752	19	4.88	9.60	.495	.200
EGFS1	1.03	5.01	.32	.851	20	4.50	9.64	.350	.399
EGFS2									
SGFS0	.88	5.76	.59	.670	14	4.59	9.79	.658	.113
SGFS1									
SGFS2									
SCQ21									
SCQ22									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	10.41	.830	.071

Yearclass = 1998

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.85	5.44	.45	.752	19	3.99	8.85	.521	.718
EGFS1									
EGFS2									
SGFS0									
SGFS1									
SGFS2									
SCQ21									
SCQ22									
ENQ40									
ENQ41									
ENQ42									
						VPA Mean =	10.41	.830	.282

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1997	18516	9.83	.22	.14	.40		
1998	10803	9.29	.44	.70	2.53		

TABLE 4.5.2c; Haddock in North Sea & IIIa, RCT output, age 2

Analysis by RCT3 ver3.1 of data from file :

hadiv2.rct

HADDOCK IN IV, RCT3 INPUT VALUES Age 2 10-Oct-98

Data for 13 surveys over 28 years : 1971 - 1998

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1996

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.15	1.56	.38	.828	25	6.76	9.32	.412	.104
IYFS2	1.24	1.44	.42	.796	25	6.05	8.96	.452	.086
EGFS0	.87	3.54	.48	.722	19	5.30	8.15	.528	.063
EGFS1	1.03	3.20	.30	.864	20	5.01	8.35	.329	.163
EGFS2	.88	4.73	.33	.847	21	4.06	8.31	.352	.142
SGFS0	.88	3.95	.58	.674	14	5.29	8.63	.655	.041
SGFS1	1.19	2.02	.41	.795	15	5.63	8.73	.460	.083
SGFS2									
SCQ21	.66	3.05	.22	.906	6	8.05	8.33	.291	.208
SCQ22									
ENQ40	1.13	3.52	.32	.852	5	4.20	8.26	.465	.082
ENQ41									
ENQ42									
						VPA Mean =	8.56	.821	.026

Yearclass = 1997

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.15	1.56	.38	.828	25	5.93	8.36	.407	.271
IYFS2									
EGFS0	.87	3.54	.48	.722	19	4.88	7.78	.534	.157
EGFS1	1.03	3.20	.30	.864	20	4.50	7.82	.334	.402
EGFS2									
SGFS0	.88	3.95	.58	.674	14	4.59	8.00	.657	.104
SGFS1									
SGFS2									
						VPA Mean =	8.56	.821	.067

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	5021	8.52	.13	.12	.75		
1997	3068	8.03	.21	.14	.42		
1998	1814	7.50	.46	.72	2.43		

TABLE 4.6.1 ; Haddock, North Sea + Skagerrak

Mean fishing mortality, biomass and recruitment, 1963 - 1997.

	Mean F			Stock Biomass		Recruits	
	H.cons	Disc	Ind BC	('000 tonnes)		Age 0	
	Ages	Ages	Ages				
Year	2 to 6	2 to 6	0 to 3	Total	Spawning	Yclass	Million
1963	.579	.125	.026	3387	137	1963	2338
1964	.699	.073	.131	1188	420	1964	9172
1965	.647	.067	.343	812	526	1965	26336
1966	.715	.104	.263	780	432	1966	68992
1967	.678	.142	.052	1216	229	1967	388112
1968	.485	.089	.056	6700	265	1968	17103
1969	.843	.093	.198	2344	816	1969	12196
1970	.804	.123	.266	1405	900	1970	87764
1971	.629	.108	.078	1672	418	1971	78285
1972	.900	.145	.051	1677	301	1972	21539
1973	.777	.126	.034	900	294	1973	72898
1974	.639	.140	.101	1568	258	1974	133493
1975	.763	.203	.086	2163	238	1975	11542
1976	.812	.153	.125	885	308	1976	16484
1977	.807	.127	.173	567	239	1977	25751
1978	.879	.185	.062	665	132	1978	39549
1979	.939	.085	.056	673	109	1979	72155
1980	.847	.080	.088	1250	153	1980	15654
1981	.654	.086	.064	671	240	1981	32480
1982	.588	.067	.066	840	300	1982	20614
1983	.802	.145	.049	759	253	1983	66978
1984	.907	.091	.032	1493	199	1984	17269
1985	.855	.078	.018	860	241	1985	24047
1986	.881	.178	.012	715	222	1986	49887
1987	.855	.142	.019	1068	157	1987	4205
1988	.843	.147	.026	428	159	1988	8444
1989	.705	.132	.016	396	129	1989	8709
1990	.702	.233	.026	343	81	1990	28243
1991	.762	.065	.023	742	63	1991	27738
1992	.858	.099	.032	607	101	1992	41907
1993	.731	.140	.040	875	135	1993	12946
1994	.688	.175	.014	516	158	1994	54511
1995	.548	.138	.029	957	158	1995	13058
1996	.625	.146	.030	621	193	1996	22543
1997	.454	.116	.019	709	211	1997	14613*
Min.	.454	.065	.012	343	63	Min.	2338
Mean	.740	.124	.077	1213	262	Gmean	26444
Max.	.939	.233	.343	6700	900	Max.	388112

Min, max and geo. mean recruitment calculated over years 1963 to 1995
(Arithmetic mean recruitment 1963 - 1995 = 45770)
Biomass totals calculated at start of year.
* RCT3 estimate

Haddock in Fishing Area IV and IIIa

Multi fleet prediction with mangement option table: Input data

1998	H.cons		Disc		Ind BC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.000	0.0010	0.058	0.0370	0.012	8475700.0	2.0500	0.0000	0.0000	0.0000	0.018
1	0.0010	0.329	0.0640	0.143	0.0290	0.068	1851600.0	1.6500	0.0100	0.0000	0.0000	0.124
2	0.1300	0.384	0.3110	0.241	0.0160	0.157	480600.00	0.4000	0.3200	0.0000	0.0000	0.277
3	0.4810	0.432	0.2850	0.280	0.0210	0.253	123300.00	0.2500	0.7100	0.0000	0.0000	0.370
4	0.7400	0.573	0.0690	0.327	0.0150	0.671	218200.00	0.2500	0.8700	0.0000	0.0000	0.561
5	0.7300	0.722	0.0060	0.376	0.0270	0.760	12800.000	0.2000	0.9500	0.0000	0.0000	0.735
6	0.6260	0.959	0.0000	0.000	0.0660	0.376	16500.000	0.2000	1.0000	0.0000	0.0000	0.979
7	1.0850	1.078	0.0000	0.000	0.0000	0.000	2200.000	0.2000	1.0000	0.0000	0.0000	1.078
8	0.7420	1.722	0.0000	0.000	0.0000	0.000	800.000	0.2000	1.0000	0.0000	0.0000	1.722
9	0.7100	2.048	0.0000	0.000	0.0000	0.000	40.000	0.2000	1.0000	0.0000	0.0000	2.048
10+	0.7100	2.115	0.0000	0.000	0.0000	0.000	0.000	0.2000	1.0000	0.0000	0.0000	2.115
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

1999	H.cons		Disc		Ind BC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.000	0.0010	0.058	0.0370	0.012	26443700	2.0500	0.0000	0.0000	0.0000	0.018
1	0.0010	0.329	0.0640	0.143	0.0290	0.068	.	1.6500	0.0100	0.0000	0.0000	0.124
2	0.1300	0.384	0.3110	0.241	0.0160	0.157	.	0.4000	0.3200	0.0000	0.0000	0.277
3	0.4810	0.432	0.2850	0.280	0.0210	0.253	.	0.2500	0.7100	0.0000	0.0000	0.370
4	0.7400	0.573	0.0690	0.327	0.0150	0.671	.	0.2500	0.8700	0.0000	0.0000	0.561
5	0.7300	0.722	0.0060	0.376	0.0270	0.760	.	0.2000	0.9500	0.0000	0.0000	0.735
6	0.6260	0.959	0.0000	0.000	0.0660	0.376	.	0.2000	1.0000	0.0000	0.0000	0.979
7	1.0850	1.078	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	1.078
8	0.7420	1.722	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	1.722
9	0.7100	2.048	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.048
10+	0.7100	2.115	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.115
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

(cont.)

Table 4.7.1 (Cont'd)

Haddock in Fishing Area IV and IIIa

Multi fleet prediction with mangement option table: Input data

(cont.)

2000	H.cons		Disc		Ind BC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.000	0.0010	0.058	0.0370	0.012	26443700	2.0500	0.0000	0.0000	0.0000	0.018
1	0.0010	0.329	0.0640	0.143	0.0290	0.068	.	1.6500	0.0100	0.0000	0.0000	0.124
2	0.1300	0.384	0.3110	0.241	0.0160	0.157	.	0.4000	0.3200	0.0000	0.0000	0.277
3	0.4810	0.432	0.2850	0.280	0.0210	0.253	.	0.2500	0.7100	0.0000	0.0000	0.370
4	0.7400	0.573	0.0690	0.327	0.0150	0.671	.	0.2500	0.8700	0.0000	0.0000	0.561
5	0.7300	0.722	0.0060	0.376	0.0270	0.760	.	0.2000	0.9500	0.0000	0.0000	0.735
6	0.6260	0.959	0.0000	0.000	0.0660	0.376	.	0.2000	1.0000	0.0000	0.0000	0.979
7	1.0850	1.078	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	1.078
8	0.7420	1.722	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	1.722
9	0.7100	2.048	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.048
10+	0.7100	2.115	0.0000	0.000	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	2.115
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

Notes: Run name : MANSAR04
Date and time: 140CT98:09:55

Table 4.7.2

Haddock in Fishing Area IV and IIIa

Multi fleet prediction with mangement option table

Year: 1998												
H.cons			Disc			Ind BC			Total			
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	
1.0000	0.5414	102098	1.0000	0.1342	41577	1.0000	0.0258	6311	149986	710477	212684	
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	

Year: 1999												Year: 2000	
H.cons			Disc			Ind BC			Total				
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	Stock biomass	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0258	9407	9407	856078	170804	1193624	250230
0.1000	0.0541	10893	0.1000	0.0134	3947	1.0000	0.0258	9293	24132	.	170804	1176008	234815
0.2000	0.1083	21044	0.2000	0.0268	7709	1.0000	0.0258	9183	37936	.	170804	1159581	220475
0.3000	0.1624	30507	0.3000	0.0403	11297	1.0000	0.0258	9078	50882	.	170804	1144257	207132
0.4000	0.2166	39331	0.4000	0.0537	14723	1.0000	0.0258	8977	63031	.	170804	1129958	194714
0.5000	0.2707	47561	0.5000	0.0671	17994	1.0000	0.0258	8881	74436	.	170804	1116609	183153
0.6000	0.3248	55241	0.6000	0.0805	21120	1.0000	0.0258	8790	85150	.	170804	1104145	172388
0.7000	0.3790	62409	0.7000	0.0939	24109	1.0000	0.0258	8701	95220	.	170804	1092500	162360
0.8000	0.4331	69103	0.8000	0.1074	26969	1.0000	0.0258	8617	104689	.	170804	1081619	153017
0.9000	0.4873	75355	0.9000	0.1208	29708	1.0000	0.0258	8536	113599	.	170804	1071446	144310
1.0000	0.5414	81196	1.0000	0.1342	32331	1.0000	0.0258	8459	121986	.	170804	1061931	136193
1.1000	0.5955	86656	1.1000	0.1476	34846	1.0000	0.0258	8385	129887	.	170804	1053030	128623
1.2000	0.6497	91761	1.2000	0.1610	37258	1.0000	0.0258	8313	137333	.	170804	1044698	121563
1.3000	0.7038	96537	1.3000	0.1745	39574	1.0000	0.0258	8245	144356	.	170804	1036896	114975
1.4000	0.7580	101006	1.4000	0.1879	41798	1.0000	0.0258	8179	150983	.	170804	1029587	108826
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSAR04
Date and time : 14OCT98:09:55
Computation of ref. F: H.cons: Simple mean, age 2 - 6
Disc: Simple mean, age 2 - 6
Ind BC: Simple mean, age 0 - 3
Basis for 1998 : F factors

Table 4.7.3

Haddock in Fishing Area IV and IIIa

The SAS System

10:47 Sunday, October 11, 1998

Multi fleet prediction: Detailed tables

Year 1998.	H.cons	F-factor 1.0000 and reference F	0.5414
	Disc	F-factor 1.0000 and reference F	0.1342
	Ind BC	F-factor 1.0000 and reference F	0.0258

	H.cons			Disc			Ind BC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0000	0	0	0.0010	3556	206	0.0370	131578	1579	135134	1785	8475700	149737	0	0	0	0
1	0.0010	876	288	0.0640	56070	8018	0.0290	25407	1728	82353	10034	1851600	230216	18516	2302	18516	2302
2	0.1300	41961	16113	0.3110	100383	24192	0.0160	5164	811	147508	41116	480600	133126	153792	42600	153792	42600
3	0.4810	36916	15948	0.2850	21873	6125	0.0210	1612	408	60401	22480	123300	45662	87543	32420	87543	32420
4	0.7400	98980	56715	0.0690	9229	3018	0.0150	2006	1346	110215	61080	218200	122337	189834	106434	189834	106434
5	0.7300	5999	4331	0.0060	49	19	0.0270	222	169	6270	4518	12800	9408	12160	8938	12160	8938
6	0.6260	6834	6554	0.0000	0	0	0.0660	721	271	7554	6825	16500	16159	16500	16159	16500	16159
7	1.0850	1344	1448	0.0000	0	0	0.0000	0	0	1344	1448	2200	2372	2200	2372	2200	2372
8	0.7420	384	662	0.0000	0	0	0.0000	0	0	384	662	800	1377	800	1377	800	1377
9	0.7100	19	38	0.0000	0	0	0.0000	0	0	19	38	40	82	40	82	40	82
10+	0.7100	0	0	0.0000	0	0	0.0000	0	0	0	0	0	0	0	0	0	0
Total		193312	102098		191161	41577		166709	6311	551182	149986	11181740	710477	481385	212684	481385	212684
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.7.3 (Cont'd)

Multi fleet prediction: Detailed tables

(cont.)

Year 1999.	H.cons	F-factor 1.0000 and reference F	0.5414
	Disc	F-factor 1.0000 and reference F	0.1342
	Ind BC	F-factor 1.0000 and reference F	0.0258

	H.cons			Disc			Ind BC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0000	0	0	0.0010	11095	644	0.0370	410516	4926	421611	5570	26443700	467172	0	0	0	0
1	0.0010	497	164	0.0640	31809	4549	0.0290	14413	980	46720	5692	1050434	130604	10504	1306	10504	1306
2	0.1300	28262	10852	0.3110	67610	16294	0.0160	3478	546	99350	27693	323696	89664	103583	28692	103583	28692
3	0.4810	61072	26383	0.2850	36186	10132	0.0210	2666	675	99925	37190	203983	75542	144828	53635	144828	53635
4	0.7400	19829	11362	0.0690	1849	605	0.0150	402	270	22079	12236	43712	24508	38029	21322	38029	21322
5	0.7300	34937	25225	0.0060	287	108	0.0270	1292	982	36516	26315	74546	54791	70818	52052	70818	52052
6	0.6260	2024	1941	0.0000	0	0	0.0660	213	80	2237	2021	4886	4785	4886	4785	4886	4785
7	1.0850	4130	4452	0.0000	0	0	0.0000	0	0	4130	4452	6762	7292	6762	7292	6762	7292
8	0.7420	293	504	0.0000	0	0	0.0000	0	0	293	504	609	1048	609	1048	609	1048
9	0.7100	145	298	0.0000	0	0	0.0000	0	0	145	298	312	639	312	639	312	639
10+	0.7100	8	16	0.0000	0	0	0.0000	0	0	8	16	16	34	16	34	16	34
Total		151196	81196		148837	32331		432982	8459	733014	121986	28152656	856078	380348	170804	380348	170804
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.7.3 (Cont'd)

Haddock in Fishing Area IV and IIIa

The SAS System

10:47 Sunday, October 11, 1998

Multi fleet prediction: Detailed tables

(cont.)

Year 2000. H.cons	F-factor 1.0000 and reference F	0.5414
Disc	F-factor 1.0000 and reference F	0.1342
Ind BC	F-factor 1.0000 and reference F	0.0258

	H.cons			Disc			Ind BC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0000	0	0	0.0010	11095	644	0.0370	410516	4926	421611	5570	26443700	467172	0	0	0	0
1	0.0010	1551	510	0.0640	99242	14192	0.0290	44969	3058	145762	17760	3277294	407477	32773	4075	32773	4075
2	0.1300	16033	6157	0.3110	38356	9244	0.0160	1973	310	56362	15710	183637	50867	58764	16278	58764	16278
3	0.4810	41134	17770	0.2850	24372	6824	0.0210	1796	454	67302	25048	137388	50879	97545	36124	97545	36124
4	0.7400	32804	18796	0.0690	3059	1000	0.0150	665	446	36527	20243	72315	40545	62914	35274	62914	35274
5	0.7300	6999	5053	0.0060	58	22	0.0270	259	197	7315	5272	14934	10976	14187	10427	14187	10427
6	0.6260	11786	11303	0.0000	0	0	0.0660	1243	467	13029	11770	28458	27869	28458	27869	28458	27869
7	1.0850	1223	1319	0.0000	0	0	0.0000	0	0	1223	1319	2003	2159	2003	2159	2003	2159
8	0.7420	899	1548	0.0000	0	0	0.0000	0	0	899	1548	1871	3221	1871	3221	1871	3221
9	0.7100	111	227	0.0000	0	0	0.0000	0	0	111	227	237	486	237	486	237	486
10+	0.7100	62	130	0.0000	0	0	0.0000	0	0	62	130	132	279	132	279	132	279
Total		112601	62813		176182	31925		461421	9858	750204	104596	30161967	1061931	298883	136193	298883	136193
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSAR03
Date and time : 11OCT98:11:05
Computation of ref. F: H.cons: Simple mean, age 2 - 6
Disc: Simple mean, age 2 - 6
Ind BC: Simple mean, age 0 - 3
Prediction basis : F factors

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

Year-class	1994	1995	1996	1997	1998	1999
Stock No. (thousands) of 0 year-olds	54510816	13058260	22542954	14612900	8475700	26443700
Source	VPA	VPA	VPA	RCT3	RCT3	GM
Status Quo F:						
% in 1998 landings	55.6	15.6	15.8	0.3	0.0	-
% in 1999	31.1	14.0	32.5	13.4	0.2	0.0
% in 1998 SSB	50.0	15.2	20.0	1.1	0.0	-
% in 1999 SSB	30.5	12.5	31.4	16.8	0.8	0.0
% in 2000 SSB	20.5	7.7	25.9	26.5	12.0	3.0

GM : geometric mean recruitment

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

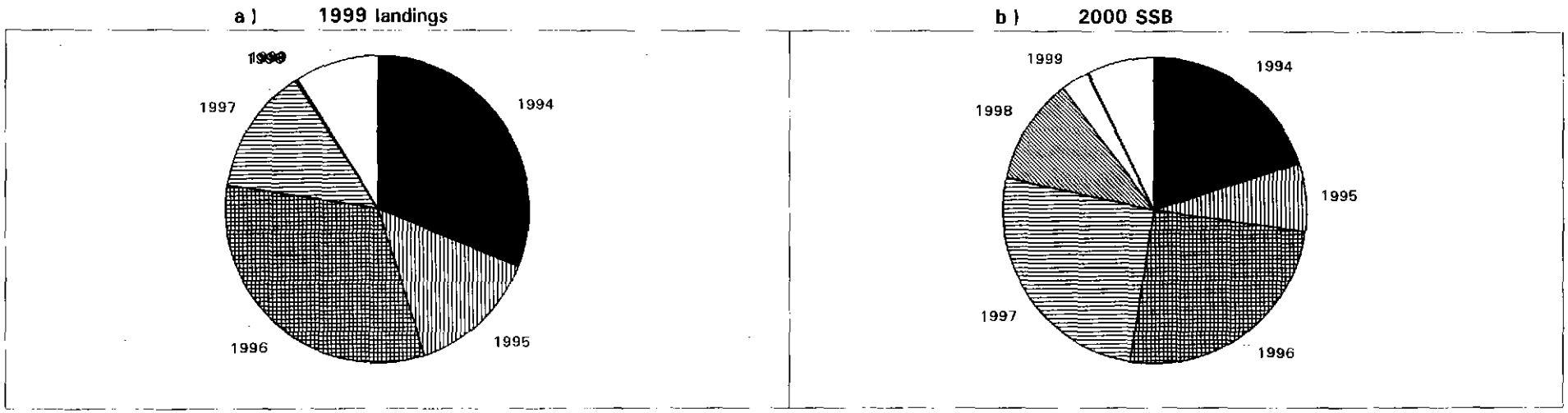


Table 4.7.5 Haddock, North Sea and Skagerrak
Input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV	Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock			H.cons selectivity			Weight in the HC catch		
N0	8475700	0.68	WS0	0.02	0.24	sH0	0	0	WH0	0	0
N1	1851600	0.22	WS1	0.12	0.16	sH1	0	0.4	WH1	0.33	0.05
N2	480599	0.11	WS2	0.28	0.1	sH2	0.13	0.34	WH2	0.38	0.06
N3	123300	0.09	WS3	0.37	0.04	sH3	0.48	0.1	WH3	0.43	0.06
N4	218198	0.08	WS4	0.56	0.12	sH4	0.74	0.16	WH4	0.57	0.09
N5	12799	0.08	WS5	0.74	0.12	sH5	0.73	0.08	WH5	0.72	0.12
N6	16499	0.09	WS6	0.98	0.12	sH6	0.63	0.37	WH6	0.96	0.13
N7	2199	0.11	WS7	1.08	0.28	sH7	1.09	0.54	WH7	1.08	0.28
N8	800	0.14	WS8	1.72	0.06	sH8	0.74	0.36	WH8	1.72	0.06
N9	0	0.18	WS9	2.05	0.09	sH9	0.71	0.03	WH9	2.05	0.09
N10	0	0.17	WS10	2.12	0.11	sH10	0.71	0.03	WH10	2.12	0.11
Discard selectivity			Weight in discards			Industrial selectivity			Weight in Ind bycatch		
sD0	0	0.86	WD0	0.06	0.18	sI0	0.04	0.61	WI0	0.01	0.45
sD1	0.06	0.31	WD1	0.14	0.11	sI1	0.03	0.37	WI1	0.07	0.29
sD2	0.31	0.03	WD2	0.24	0.08	sI2	0.02	0.97	WI2	0.16	0.22
sD3	0.28	0.16	WD3	0.28	0.02	sI3	0.02	1.07	WI3	0.25	0.31
sD4	0.07	0.5	WD4	0.33	0.1	sI4	0.01	1.48	WI4	0.67	0.52
sD5	0.01	0.84	WD5	0.38	0.04	sI5	0.03	0.87	WI5	0.76	0.87
sD6	0	0	WD6	0	0	sI6	0.07	1.73	WI6	0.38	1.73
sD7	0	0	WD7	0	0	sI7	0	0	WI7	0	0
sD8	0	0	WD8	0	0	sI8	0	0	WI8	0	0
sD9	0	0	WD9	0	0	sI9	0	0	WI9	0	0
sD10	0	0	WD10	0	0	sI10	0	0	WI10	0	0

Table 4.7.5 (Cont'd)

Natural mortality			Proportion mature		
M0	2.05	0.03	MT0	0	0.1
M1	1.65	0.05	MT1	0.01	0.1
M2	0.4	0.07	MT2	0.32	0.1
M3	0.25	0.19	MT3	0.71	0.1
M4	0.25	0.12	MT4	0.87	0.1
M5	0.2	0.17	MT5	0.95	0.1
M6	0.2	0.1	MT6	1	0.1
M7	0.2	0.1	MT7	1	0
M8	0.2	0.1	MT8	1	0
M9	0.2	0.1	MT9	1	0
M10	0.2	0.1	MT10	1	0
Relative effort in HC fishery			Year effect for natural mortality		
HF98	1	0.15	K98	1	0.21
HF99	1	0.15	K99	1	0.21
HF**	1	0.15	K**	1	0.21

Table 4.10.1; Haddock in the North Sea and IIIa, Precautionary reference points

BIOMASS (all weights in '000t)

WGNSSK

B_{lim} = 100 Basis : Smoothed estimate of B_{loss}

B_{pa} = 140 Basis : $B_{loss}.\exp(1.645\sigma)$, $\sigma = 0.2$.

SGPAFM

B_{lim} = 60 Basis : B_{loss}

B_{pa} = 150 Basis : Decline in recruitment (?)

FISHING MORTALITY

Status quo Total F(2-6) 0.71, = Basis Unscaled mean 1995-1997

Possible F_{Pa}	Estimate	Probability SSB < B_{Pa} in 2007	% of historical $F > F_{pa}$
$F_{0.1}$	0.18	<5%	100
$F_{30\%SPR}$	0.23	<5%	100
F_{max}	0.40	<5%	100
F_{med}	0.54	<5%	100
-	0.60	~5%	100
F_{lpg} [a,b]	0.68	~ 10%	94
-	0.7	~ 10%	91
-	0.8	~ 20%	77
-	0.9	~>20%	57
-	1.0	~ 50%	37
$F_{loss}.\exp(-1.645\sigma)$ [c]	1.6	> 50%	0
F_{loss} [a]	2.2	> 50%	0
SGPAFM F_{pa} [d]	0.64	~ 5%	94

[a]; Includes point at origin, correction for log transformation, span = 1.0

[b]; lpg = Low probability $G(F) > G_{loss}$, probability = 0.1.

[c], $\sigma = 0.2$

[d]; Basis : consistent with SGPAFM B_{pa}

Figure : 4.4.1 a
Haddock in the North Sea & Skagerrak
Log VPA vs. log Index
Scottish Seiners
Year range : 1988-1997

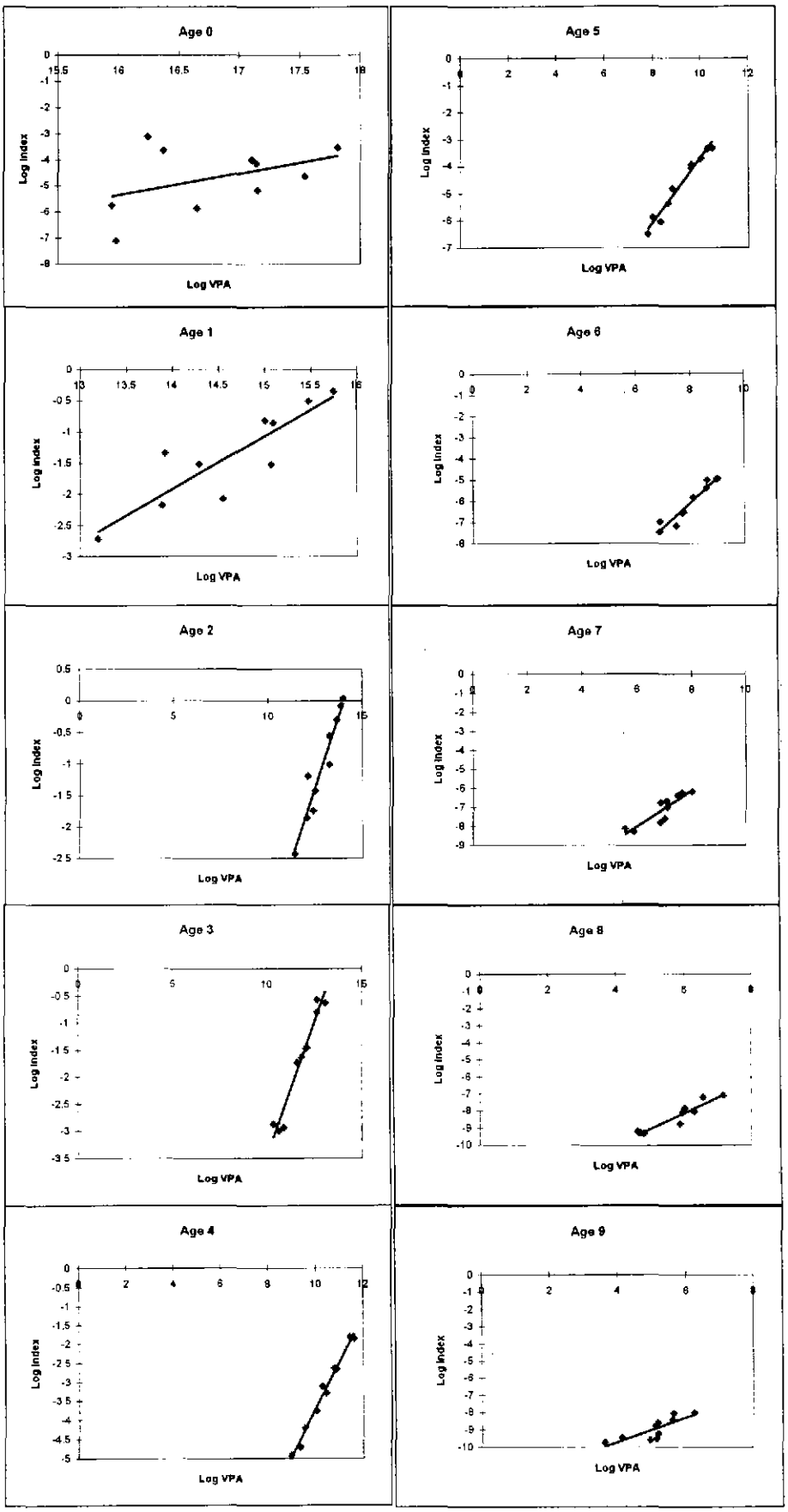


Figure : 4.4.1 b
Haddock in the North Sea & Skagerrak
Log VPA vs. log Index
Scottish Light Trawlers
Year range : 1988-1997

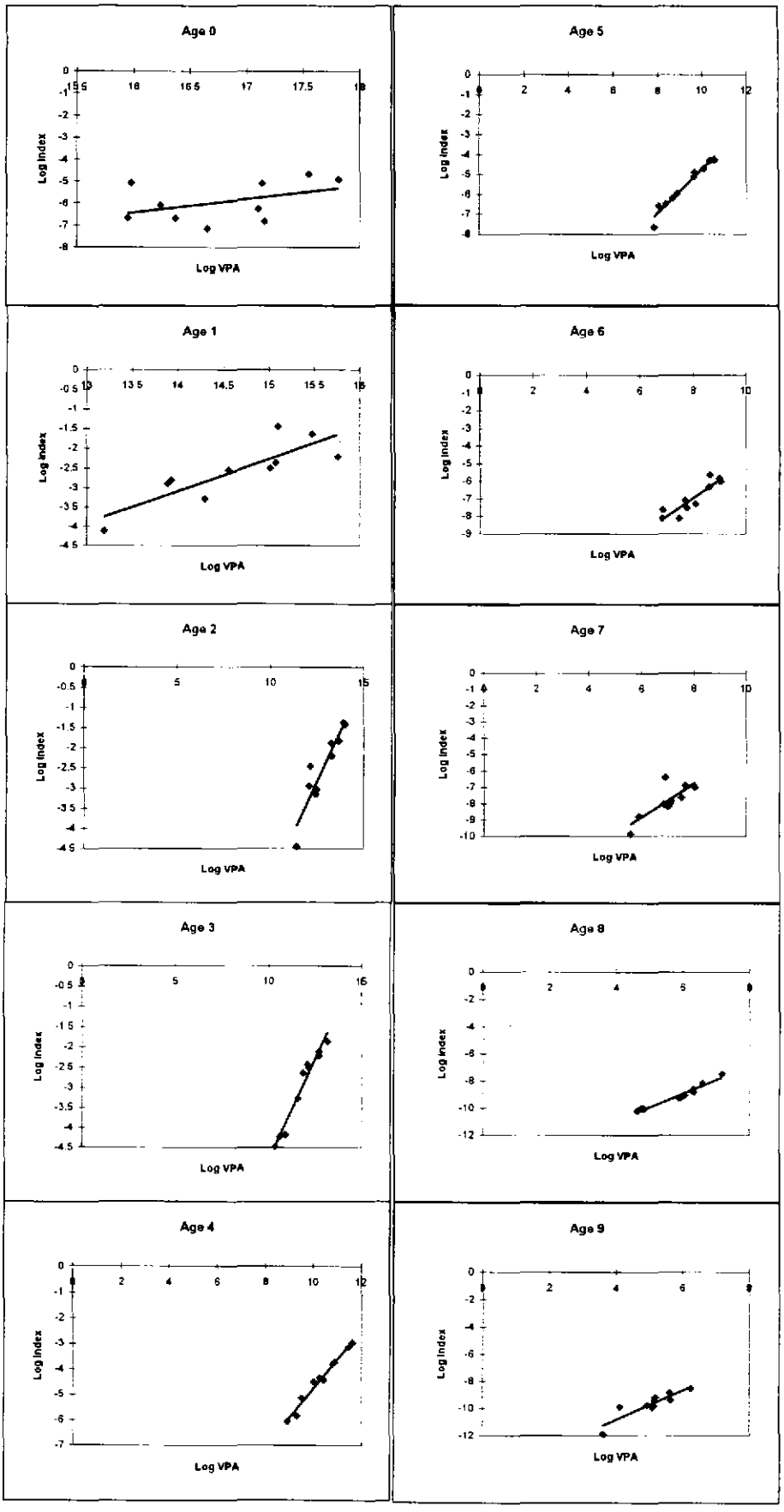


Figure : 4.4.1 c
Haddock in the North Sea & Skagerrak
Log VPA vs. log Index
Scottish GFS
Year range : 1988-1997

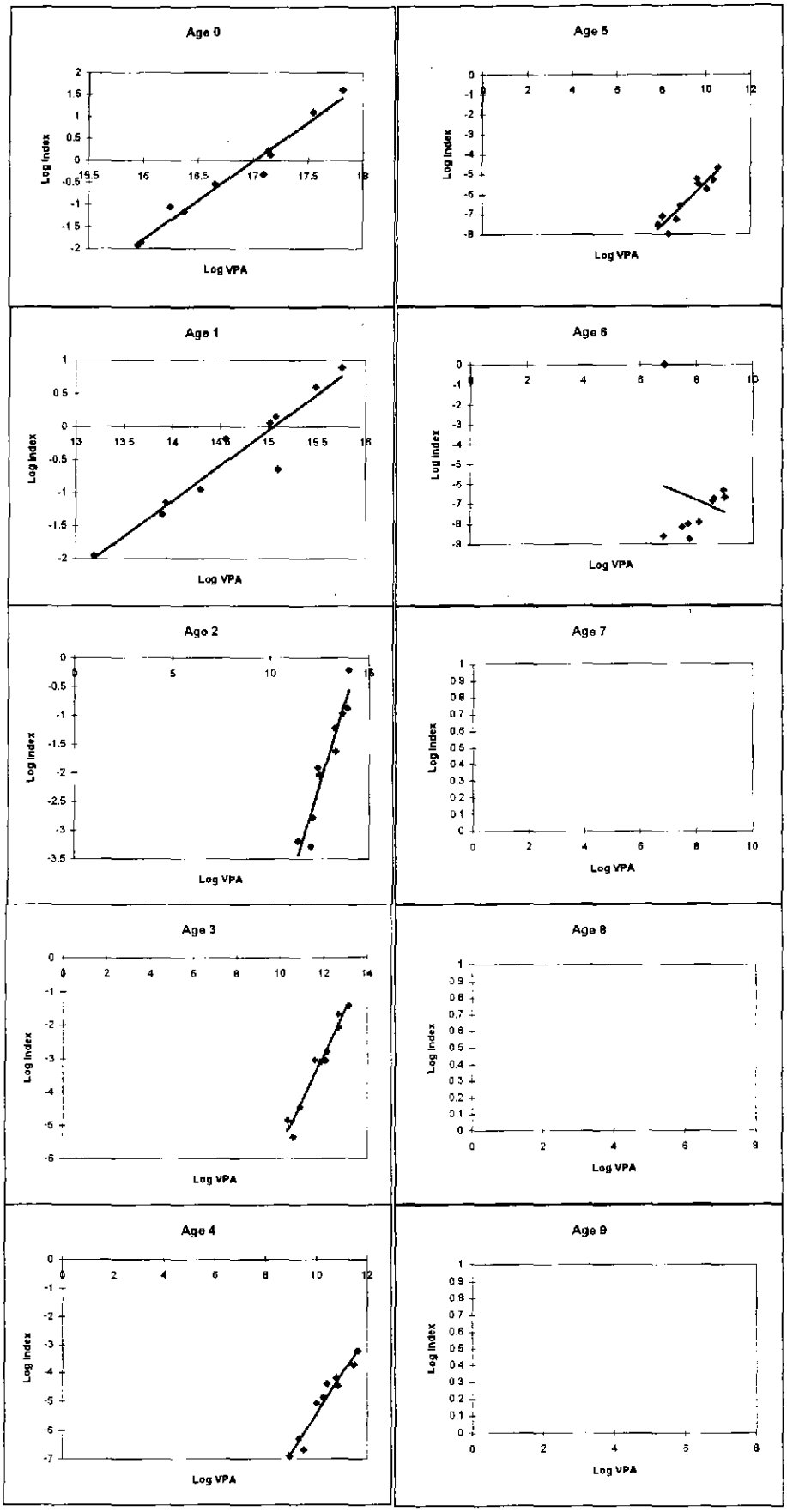


Figure : 4.4.1 d
Haddock in the North Sea & Skagerrak
Log VPA vs. log Index
English GFS
Year range : 1988-1997

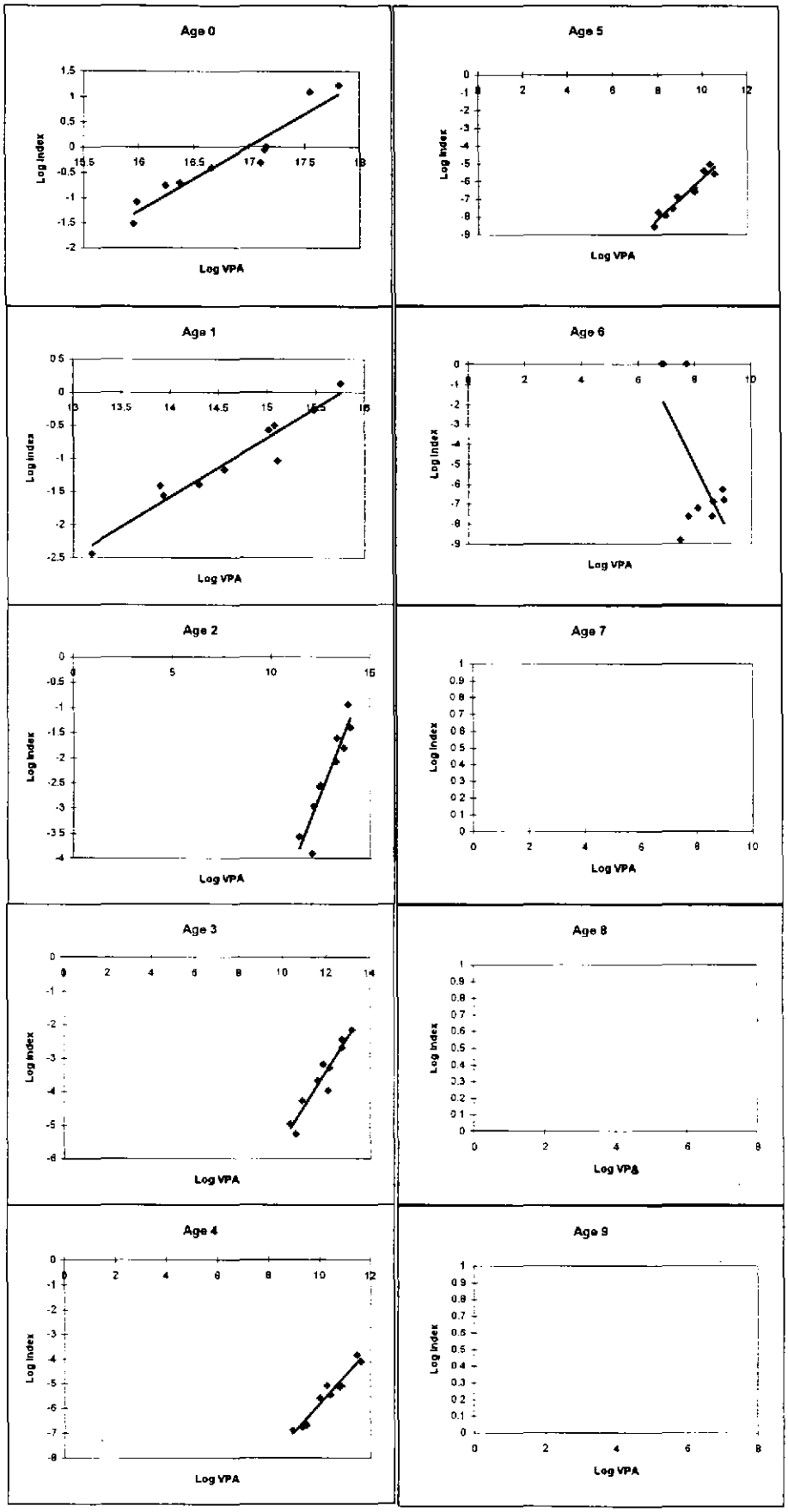


Figure : 4.4.1 e
Haddock in the North Sea & Skagerrak
Log VPA vs. log Index
International Bottom Trawl Survey, Quarter 1
Year range : 1988-1997

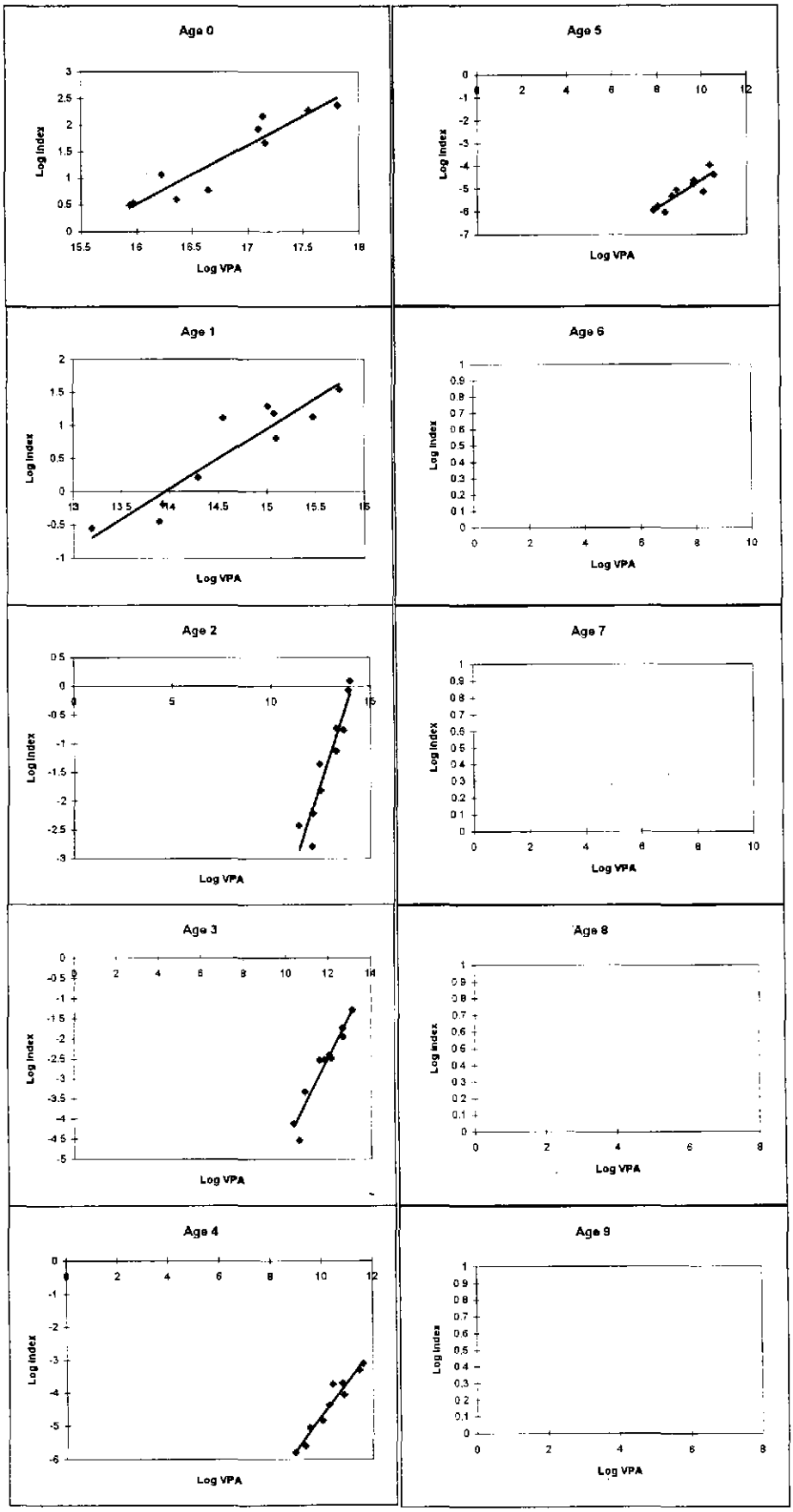


Figure : 4.4.1 f
Haddock in the North Sea & Skagerrak
Log VPA vs. log Index
International Bottom Trawl Survey, Quarter 2
Year range : 1988-1997

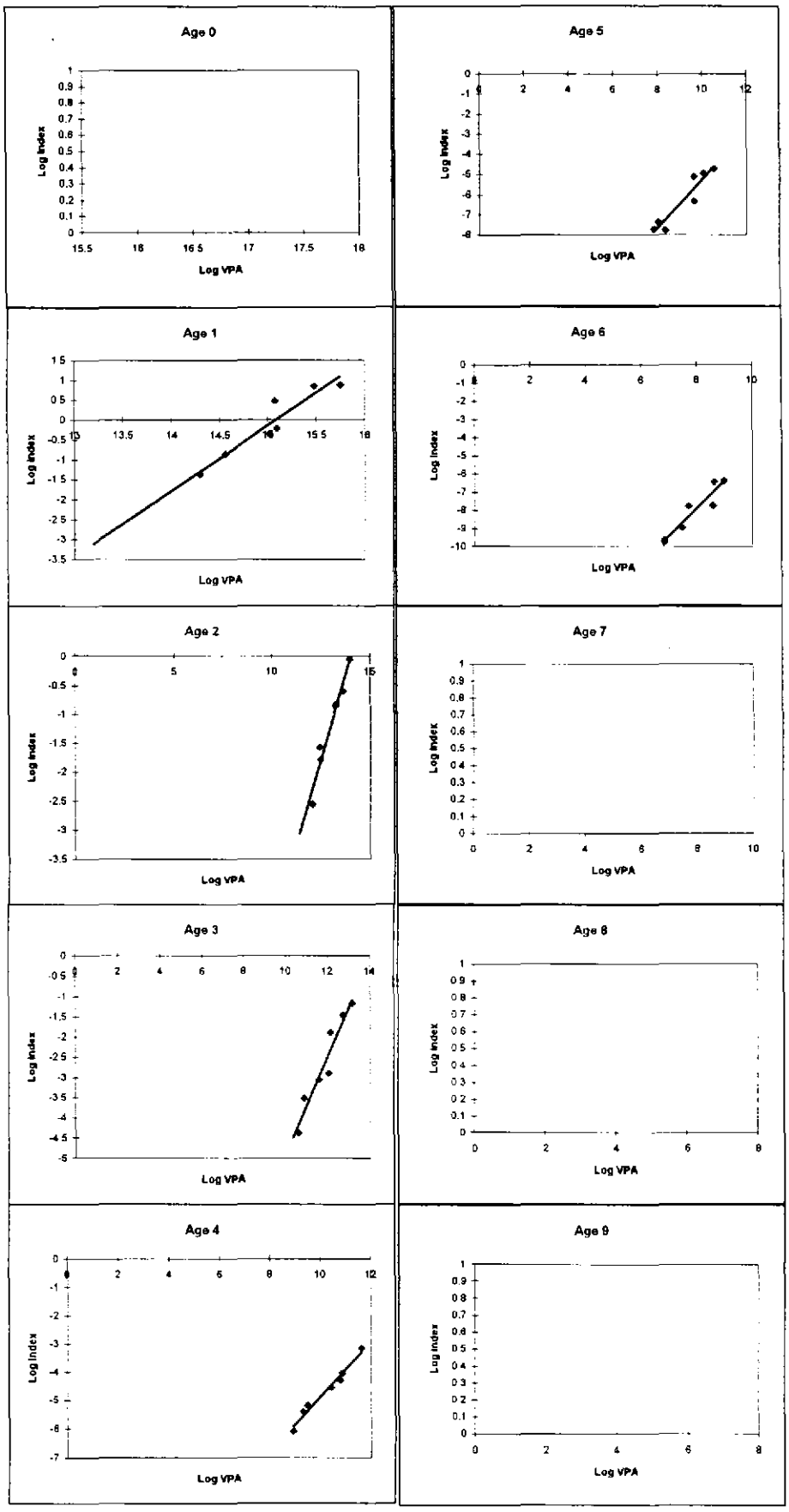
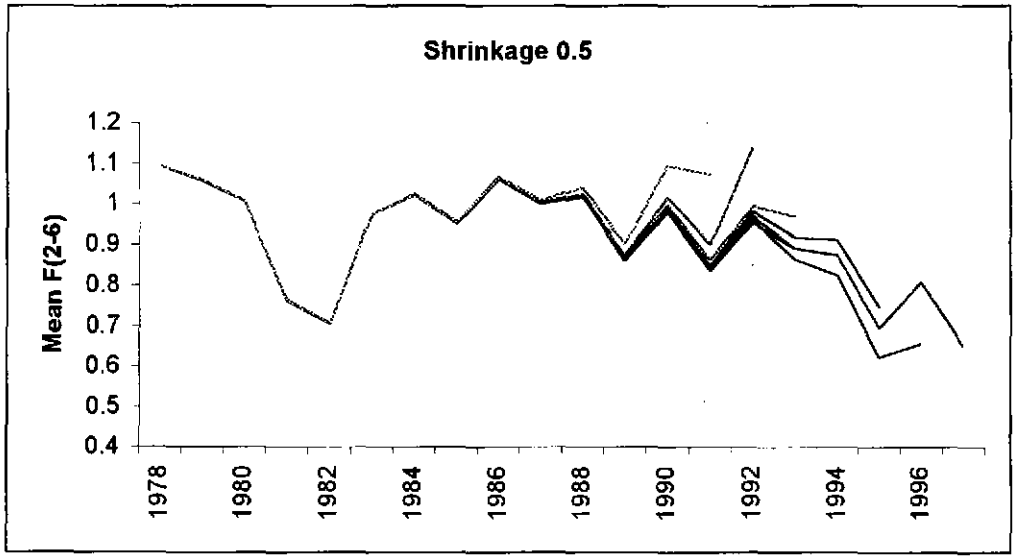
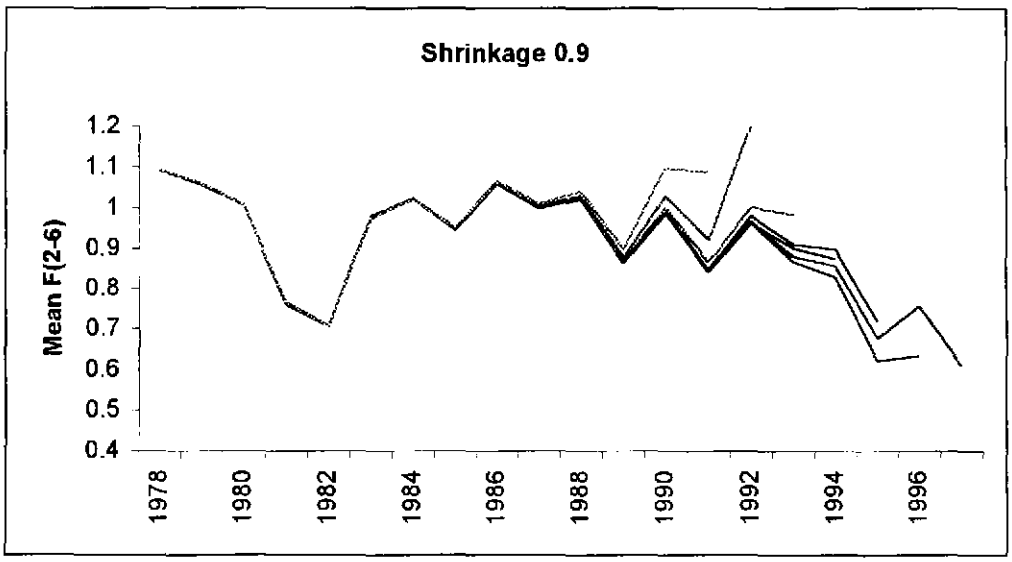


Figure 4.4.2
Haddock in North Sea/Skagerrak. Retrospective trends in mean F





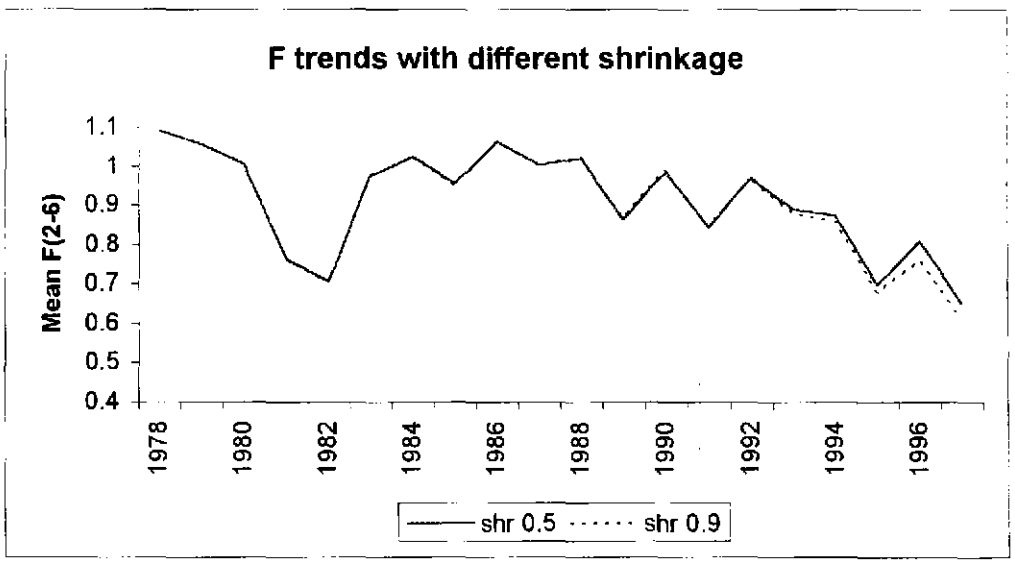


Figure 4.4.3 Haddock in Divisions IV and IIIa. Log Catchability residuals

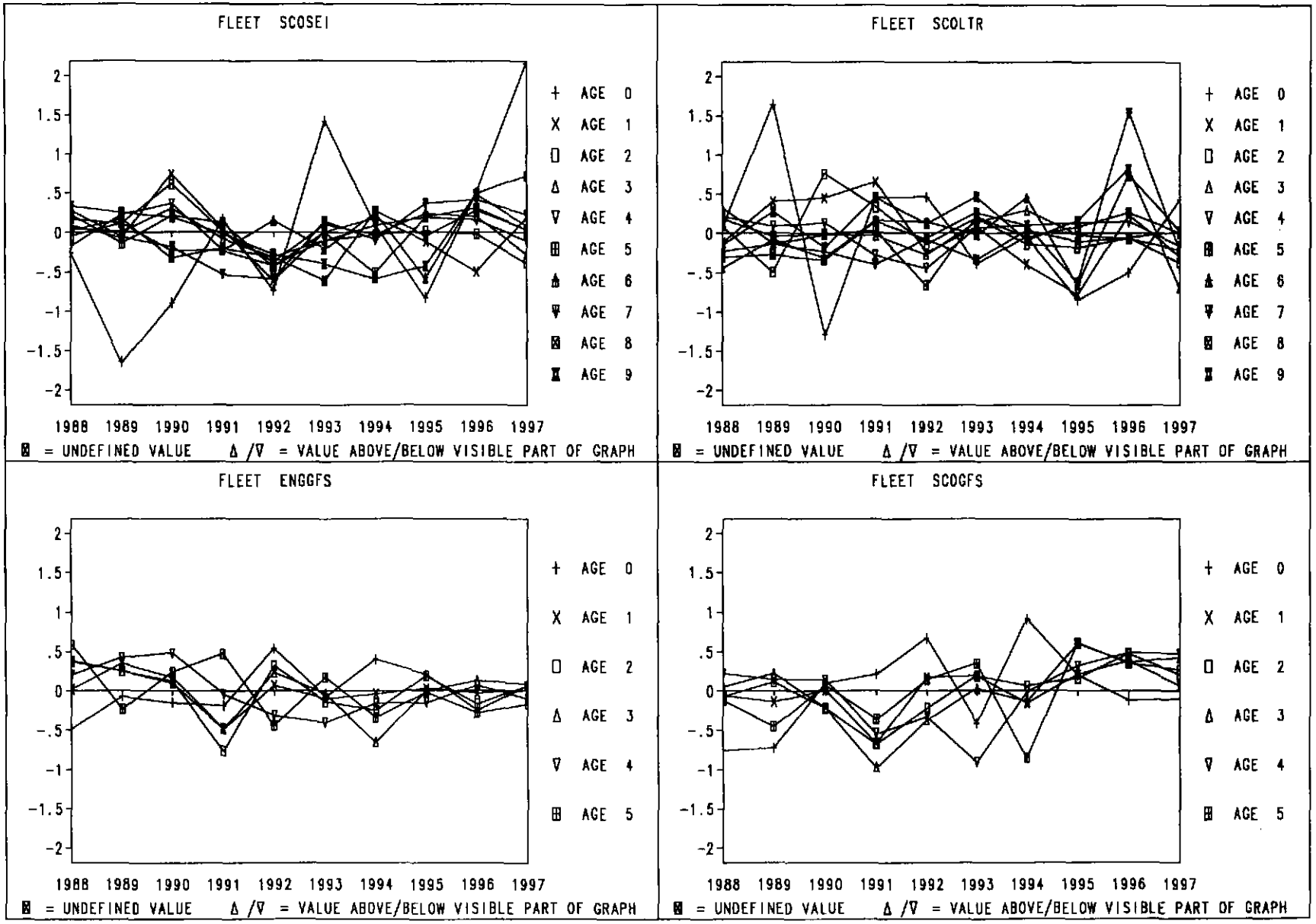


Figure 4.4.3 (Cont'd)

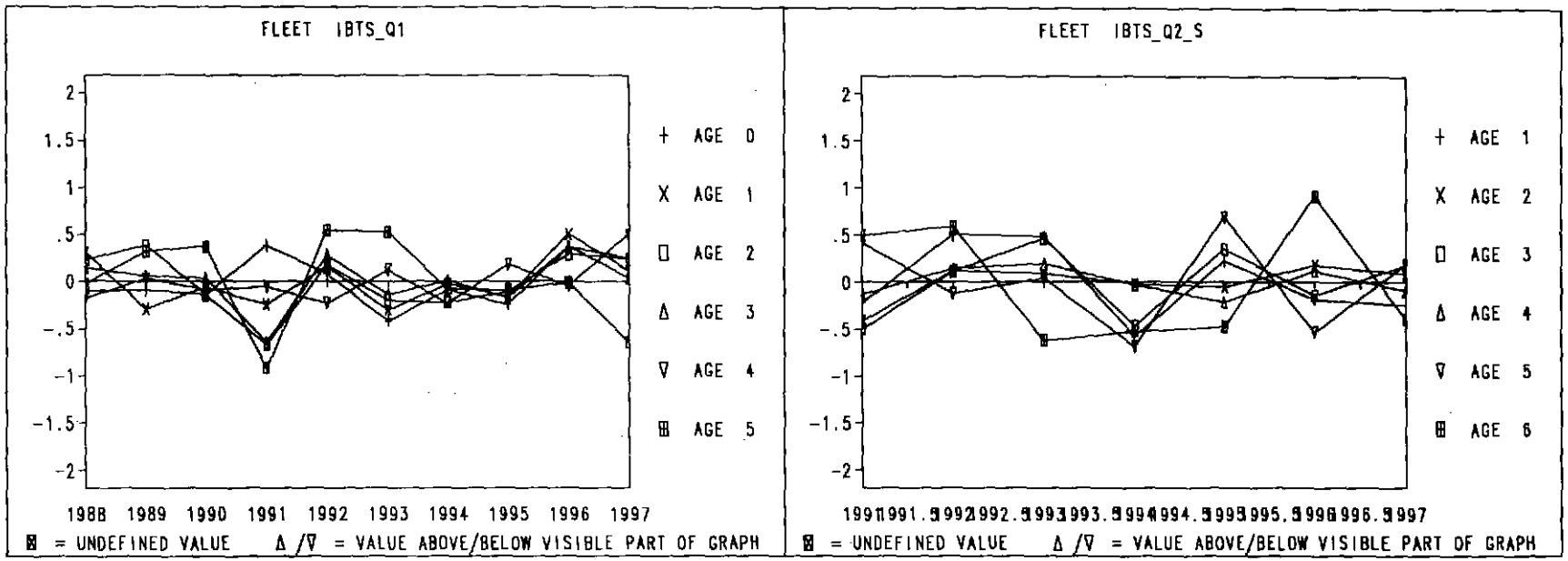


Figure 4.4.4
Haddock in the North Sea & Skagerrak
Contributions of commercial and survey fleets to survivor estimates

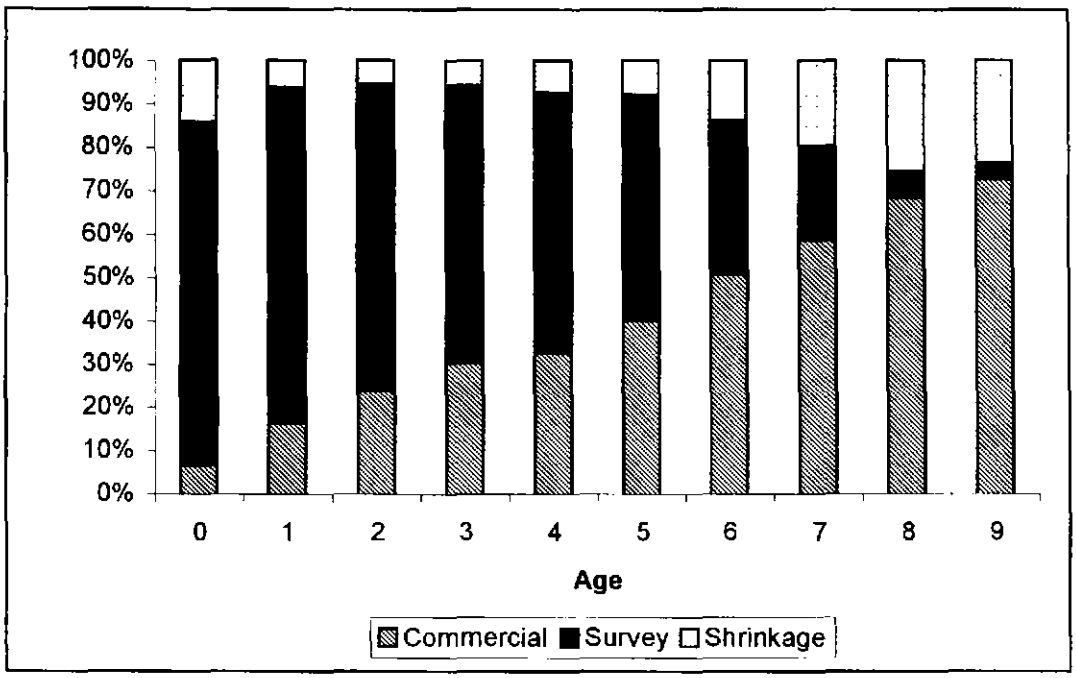


Figure 4.5.1 **Haddock in the North Sea & IIIa**
Plots of recruitment indices vs. converged XSA

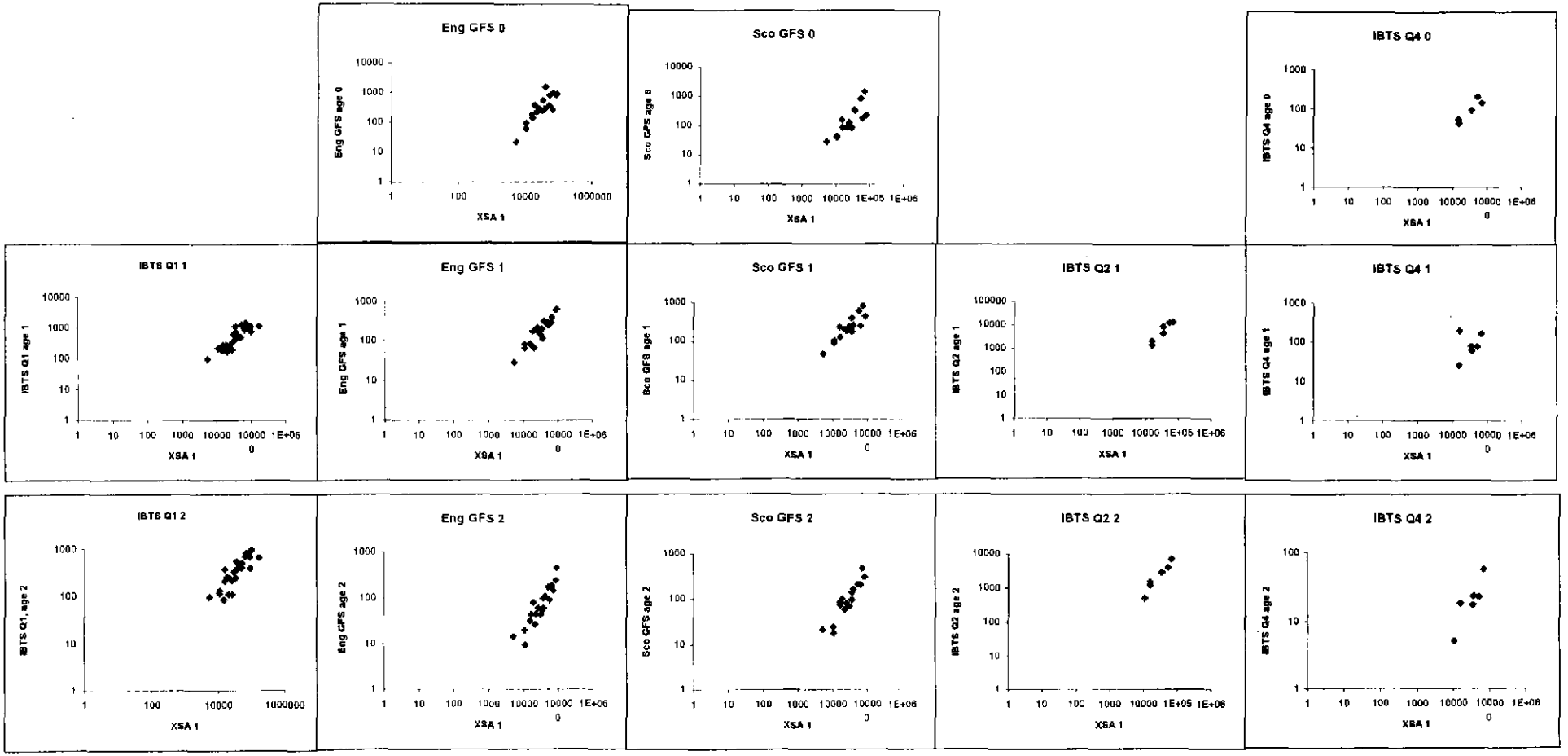


Figure 4.6.1 Stock summary, Haddock ,North Sea + Ska

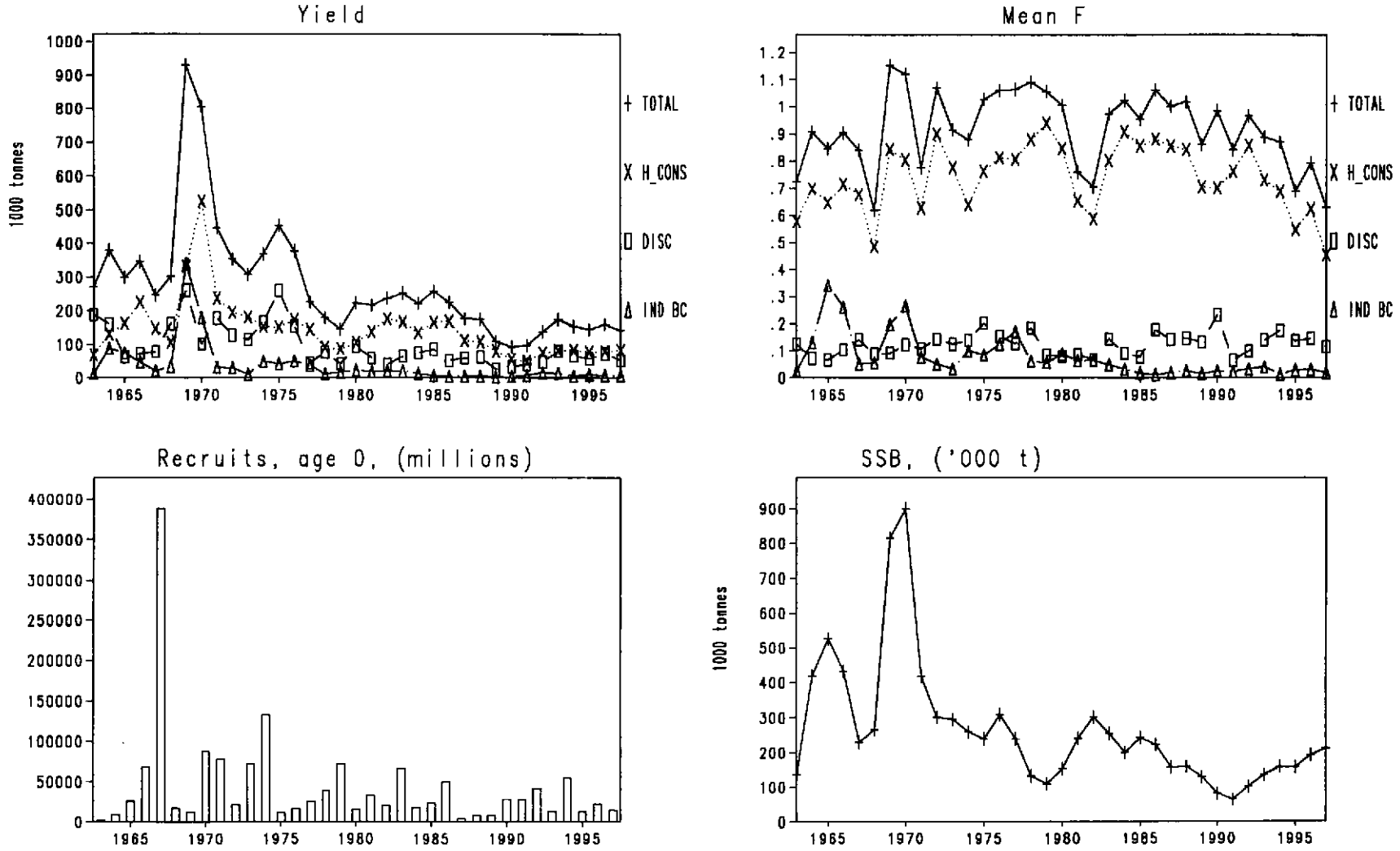


Figure 4.7.1 Haddock,North Sea + Skagerra. Sensitivity analysis of short term forecast.

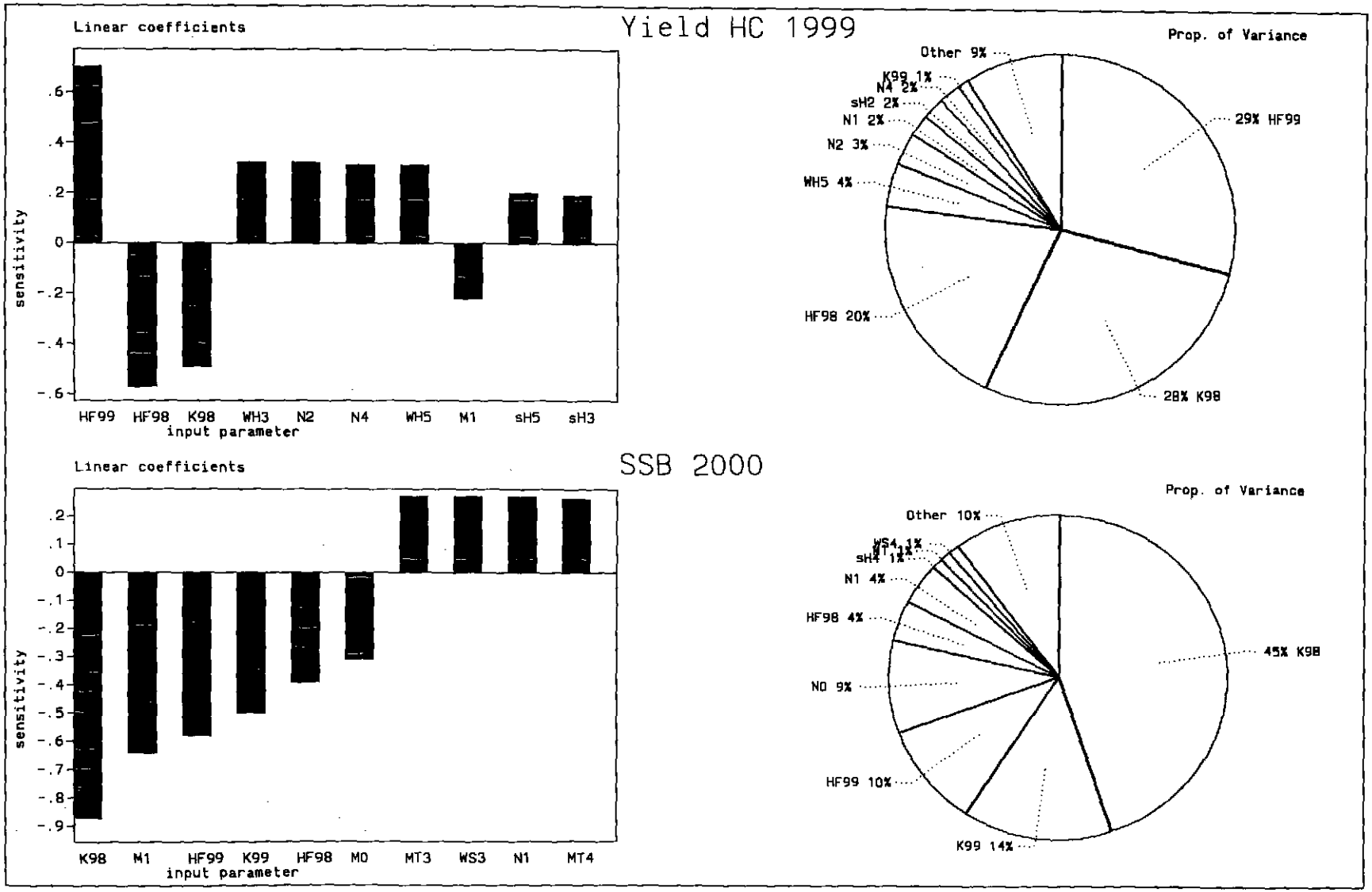
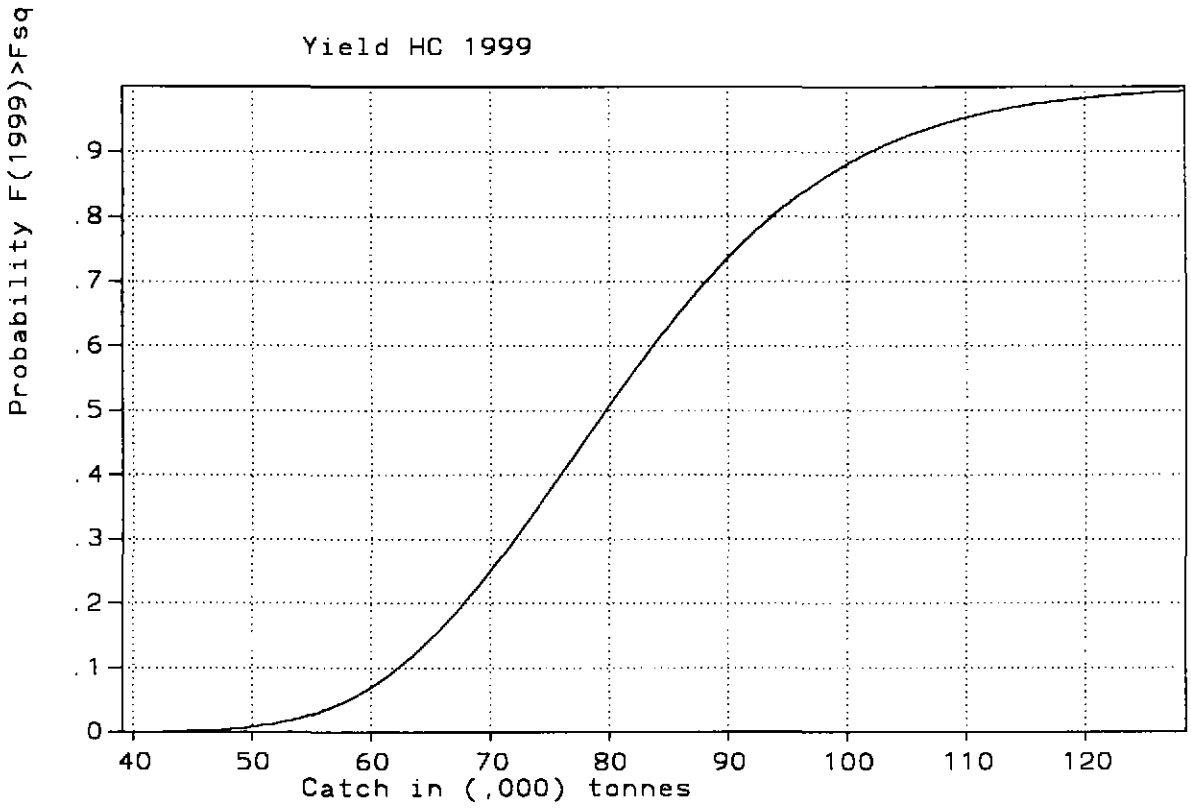


Figure 4.7.2 Haddock,North Sea + Skagerra. Probability profiles for short term forecast.



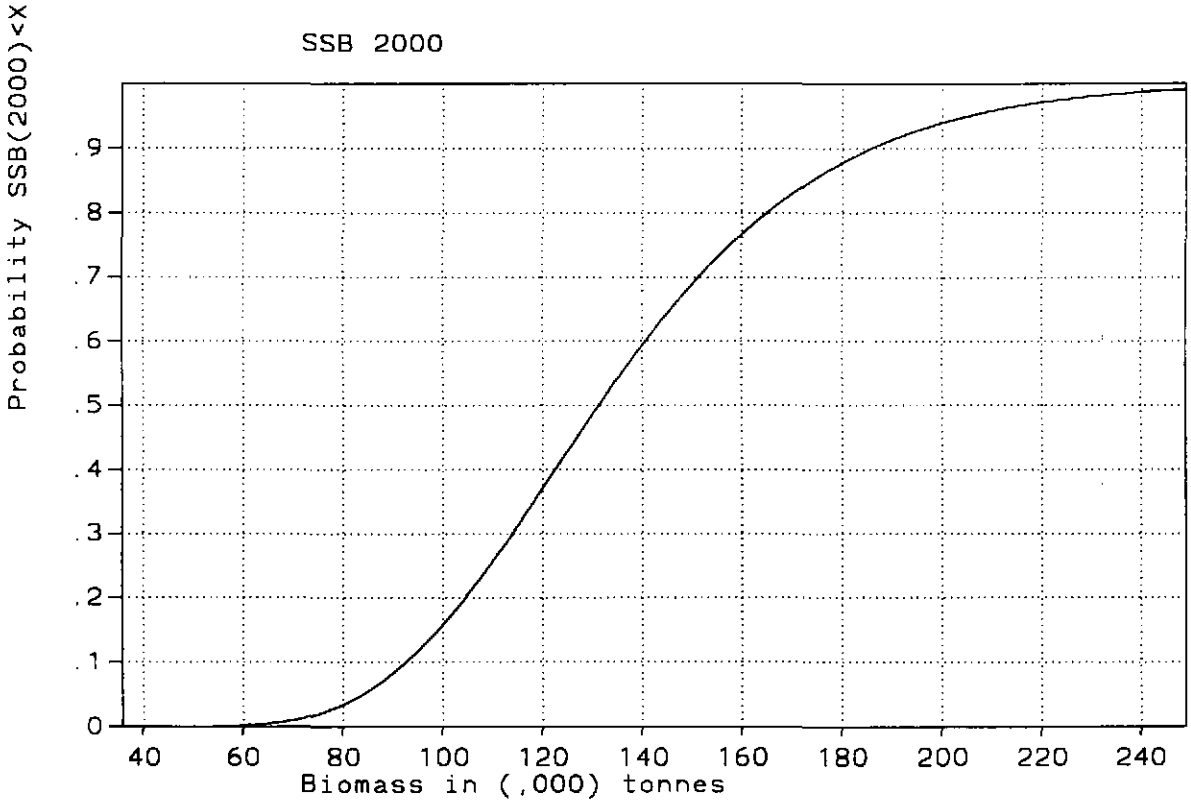


Figure 4.8.1; Haddock in the North Sea and Skagerrak, Medium term projection.
Assumes F multiplier of 1.0, i.e. H.cons + discard mean F98 = 0.68
Beverton-Holt SSR model used, lines show 5, 10, 20, 50 and 95 percentiles

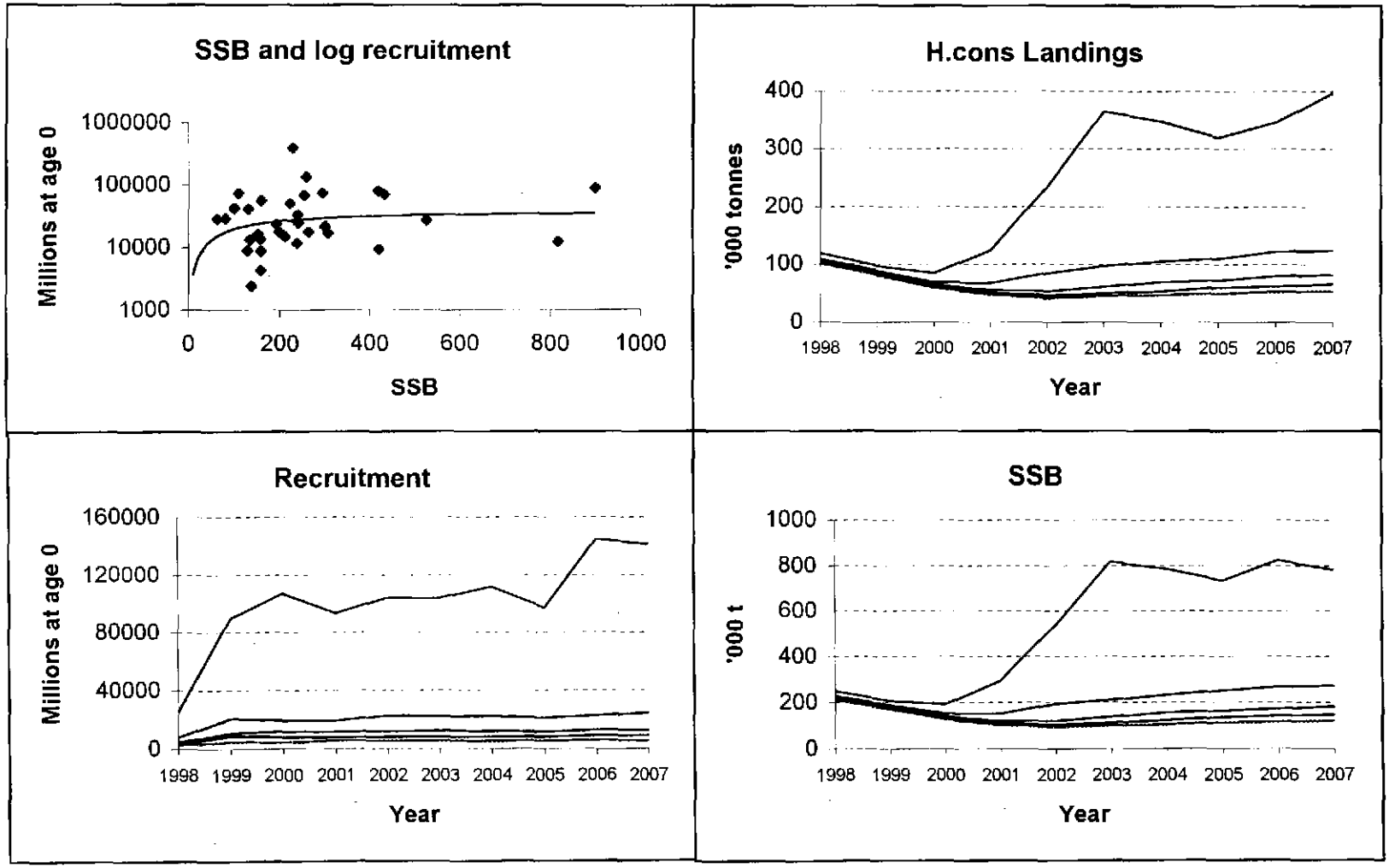


Figure 4.10.1 North Sea + Ska Haddock: Yield per Recruit

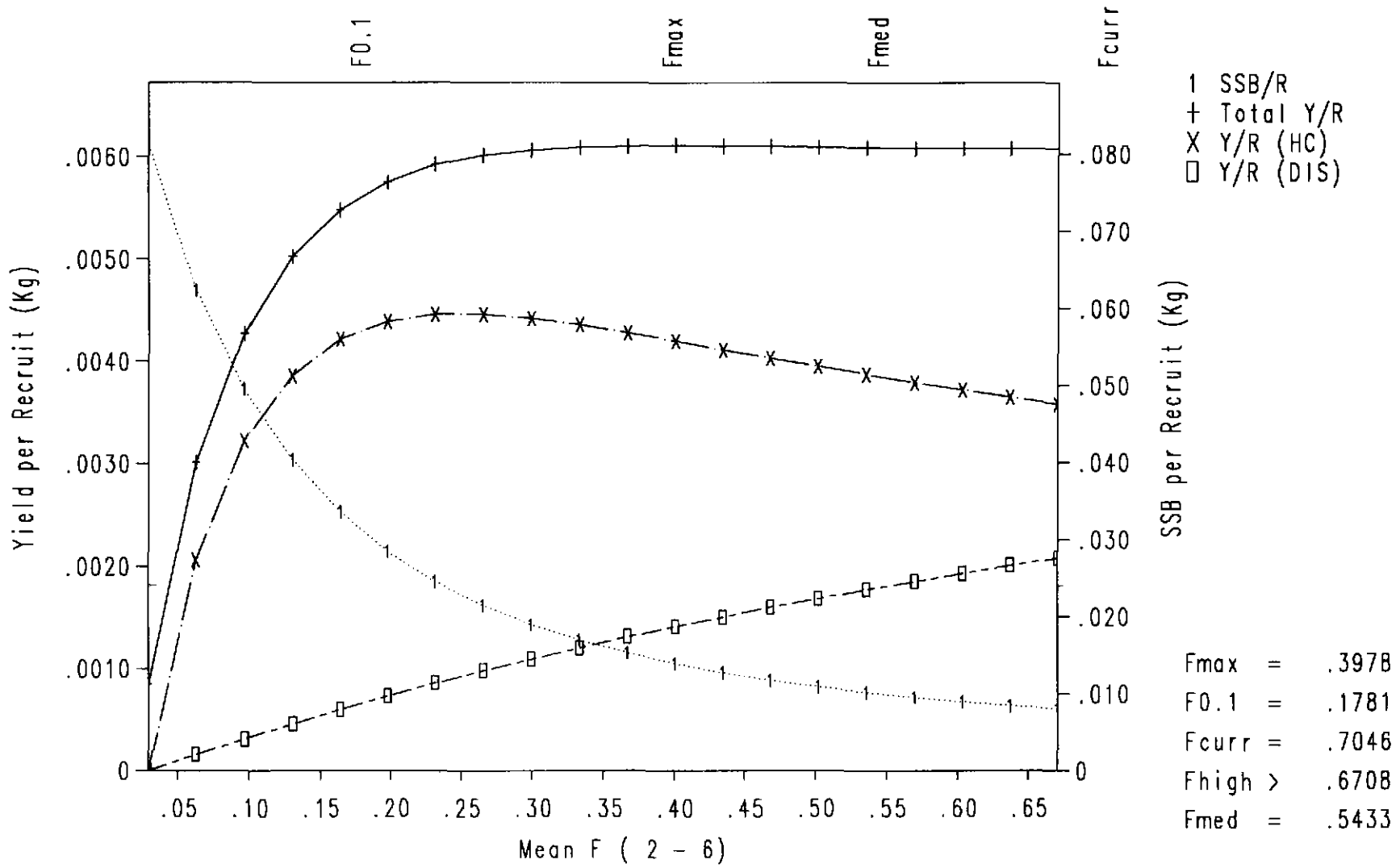


Figure 4.10.2 North Sea + Ska Haddock: Stock and Recruitment

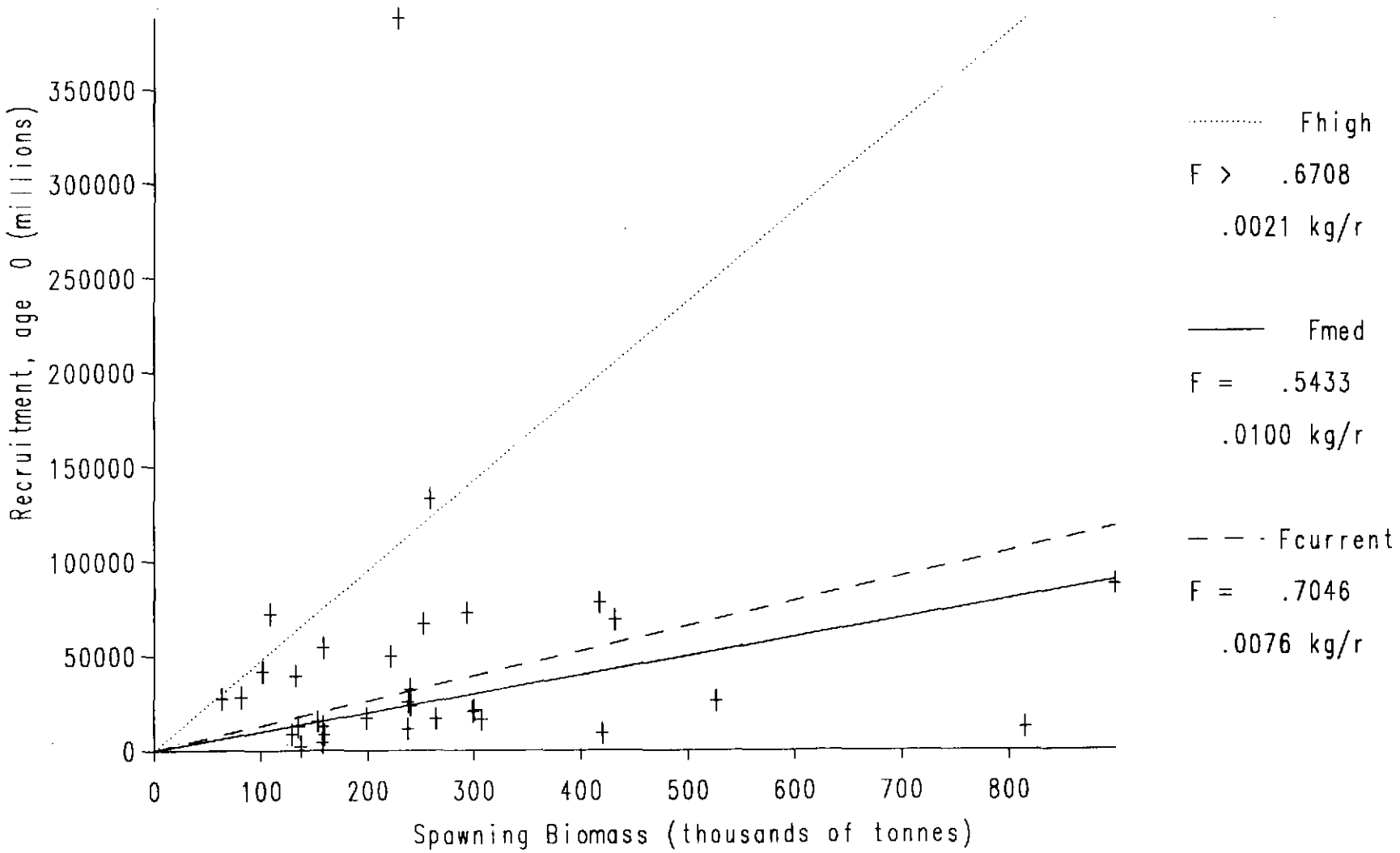


Figure 4.10.3

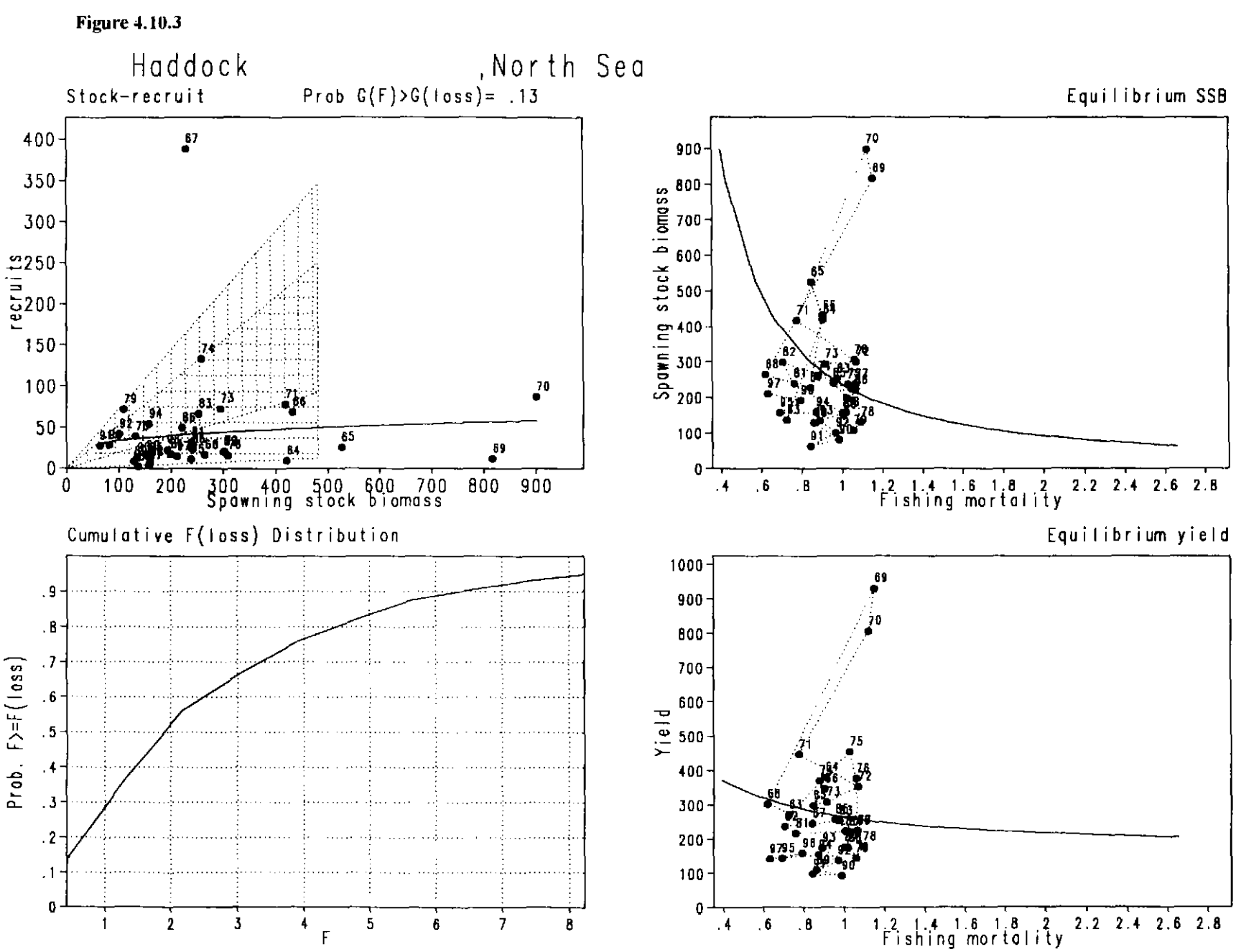
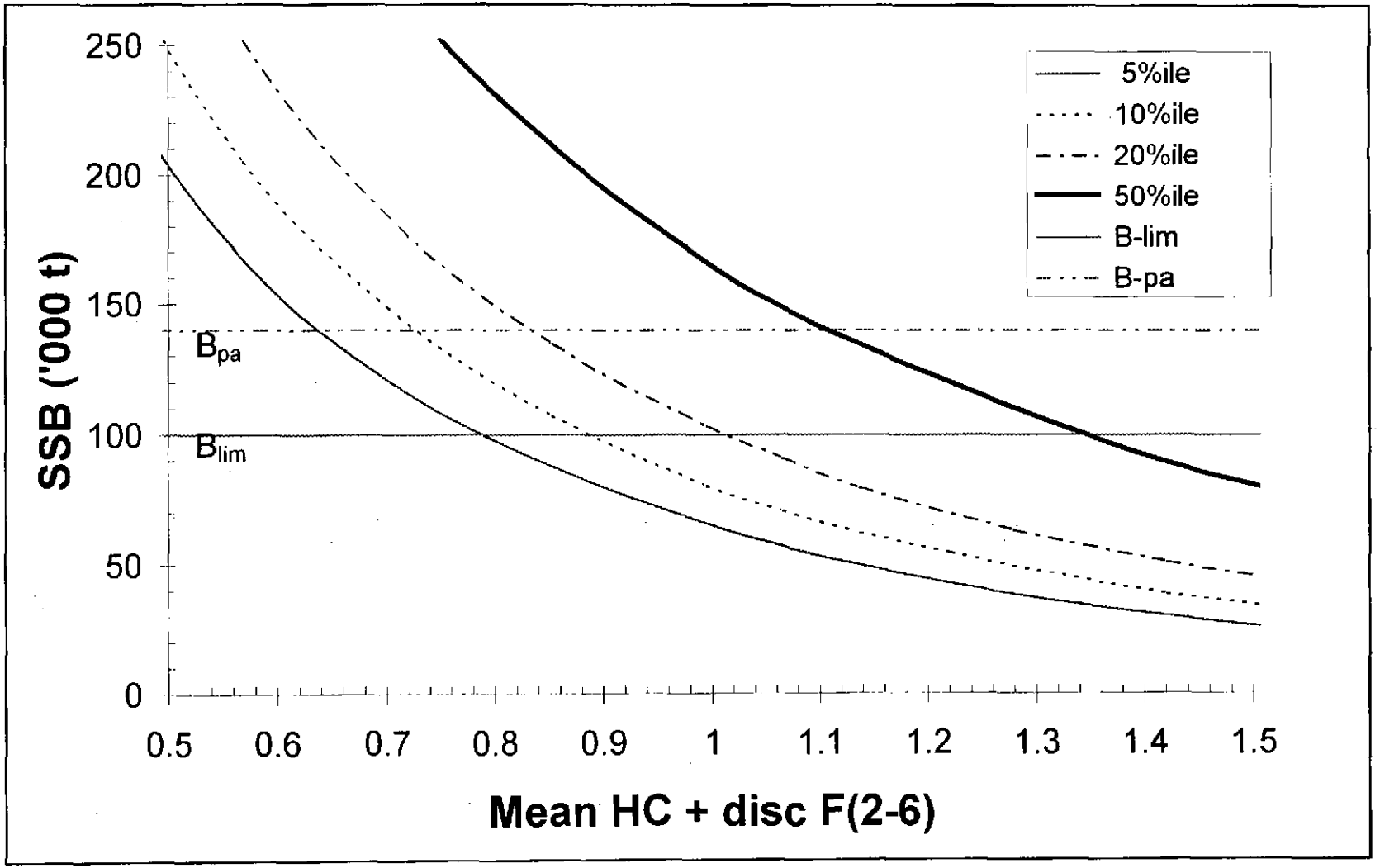
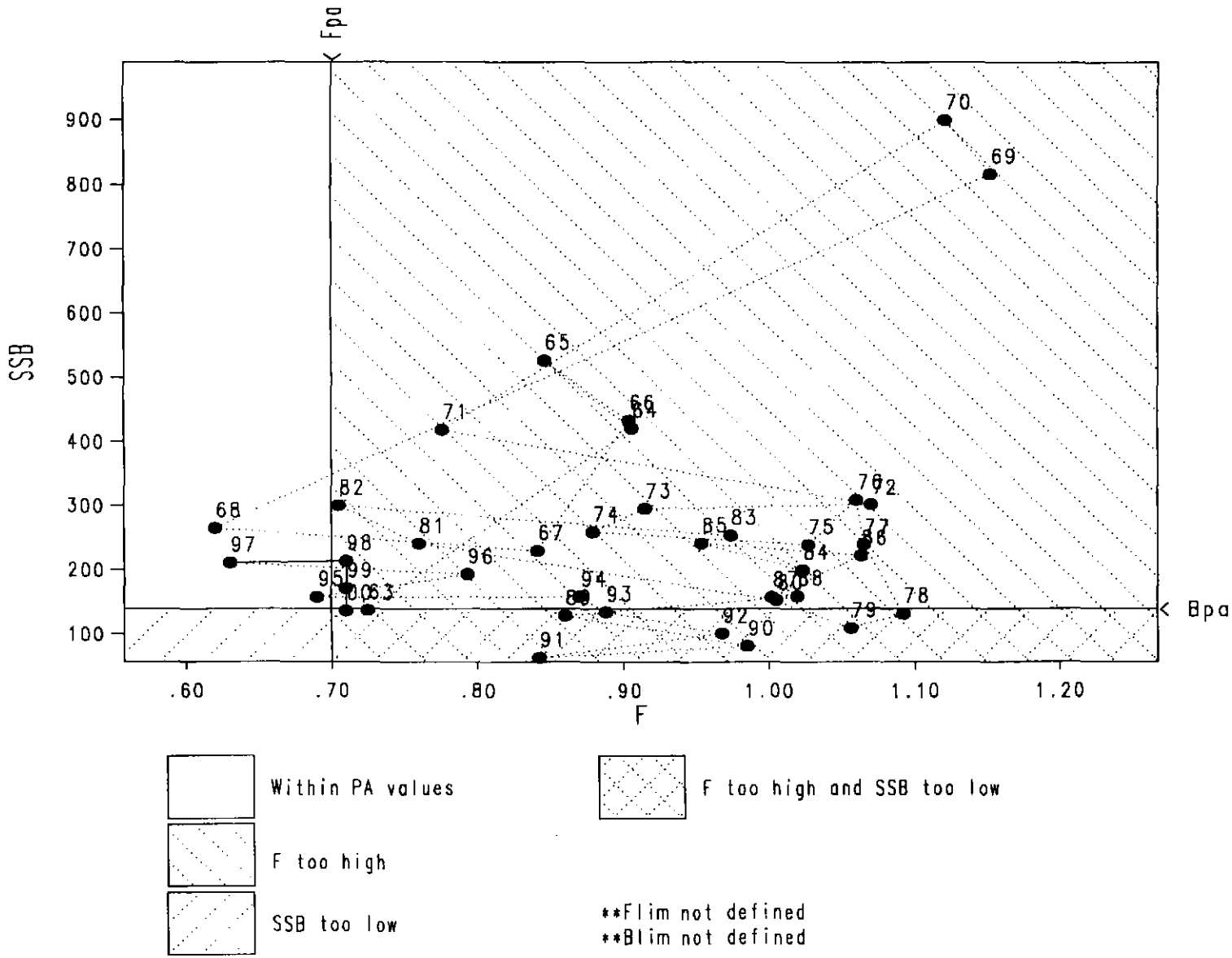

Haddock ,North Sea
Stock-recruit
Prob G(F)>G(loss)= .13
recruits
Spawning stock biomass
Equilibrium SSB
Spawning stock biomass
Fishing mortality
Cumulative F(loss) Distribution
Prob. F>=F(loss)
F
Equilibrium yield
Yield
Fishing mortality

Figure 4.10.4 , Haddock in the North Sea and Skagerrak
Medium-term projections of SSB in 2007 at different F Levels



F-4104.XLS

Figure 4.10.5 Haddock in IV + IIIa, proposed PA reference points



5 WHITING

5.1 Whiting in Sub-area IV and Division VIId

5.1.1 The fishery

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

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

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

5.1.1.1 ACFM advice applicable to 1998

Last year's perception of the stock was that its state was uncertain, but probably within safe biological limits. Advice was that fishing mortality should not be allowed to increase above its then level (0.51).

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

5.1.1.2 Management applicable to 1998

The 1997 and 1998 TACs for area IIa (EC zone), IV are 74,000 t and 60,000 t respectively. The minimum mesh size for vessels fishing in the mixed demersal fishery in this area is 100 mm. For vessels fishing under the whiting derogation, the minimum mesh size is 90 mm. Industrial fishing with small-meshed gear is permitted subject to by-catch limits of protected species such as whiting. Regulations applying to the Norway pout box prevent industrial fishing with small meshes in an area where the by-catch limits are likely to be exceeded. The minimum landing size of whiting from this area is 23 cm, although the UK has adopted a minimum landing size of 27 cm.

There is no separate TAC for Division VIId, landings from this Division are counted against the TAC for Divisions VIIb-k combined. (27,000 t in 1997 and 1998). Minimum mesh size for whiting in Division VIId is 80 mm with a 23 cm minimum landing size.

5.1.1.3 Landings in 1997

For the North Sea, the total international catches were 54,000 t in 1997, of which 31,000 t were human consumption landings, 17,000 t discards and 6,000 t industrial by-catch. This represents a continued decrease in total landings since 1990 (149,000 t), and is 15,000 t less than the 1996 value (69,000 t). The 1997 human consumption landings were the lowest in the time series and 86% of the 1996 value. Discards were the lowest on record (61% of the 1996 value) and industrial by-catch was 6,000 t very close to the lowest-on-record 1996 value.

The total North Sea landings of 37,000 t in 1997 were 68% of last year's *status quo* prediction of 54,000 t. The shortfall comprised 3,000 t industrial by-catch and 14,000 t human consumption landings.

In the eastern Channel recorded landings were 4,600 t in 1997 compared to the *status quo* prediction made last year of 5,800 t.

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

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

The natural mortality and maturity at age values as used are shown in Table 5.1.2.1. These are unchanged from last year.

The natural mortality values are rounded averages of the estimates produced by an earlier key run of the North Sea MSVPA. Information from the key run made in 1997 is not included (see Section 1.3.1.3).

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

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

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

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

Total international catch at age and mean weight at age in the catch (North Sea and eastern Channel combined) are presented in Tables 5.1.2.2 and 5.1.2.3.

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

5.1.3 Catch, Effort and Research Vessel Data

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

Fleet acronyms are:

ScoSei	Scottish seiners	ScoLtr	Scottish light trawlers
FraTrb	French trawlers (large)	FraTro	French trawlers (small)
FraTro7d	VIId French trawlers (small)		

ScoGfs	Scottish QIII survey	EngGfs	English QIII survey
IBTS QI	International QI survey	IBTS QII	International QII survey
IBTS QIV	International QIV survey	FraGfs7d	French VIId survey(VIId)

As final age-based data were not available for all the years of the second and fourth quarter IBTS, 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. (It also means that where IBTS quarter I indices at age are plotted against other values, their listed ages refer to the "dummy" ages used in the catch-at-age calibration and not their true ages).

5.1.4 Catch-at-age analysis

(i) Exploratory Analysis

A separable XSA was run on the basic catch-at-age data using default options, and unit selection and fully-exploited mortality values taken from previous assessments. This was undertaken to examine the consistency of the catch-at-age data. From Figure 5.1.4.1, it can be seen that the largest residuals are on the age 0/1 log catch ratios. These comprise partially

recruited age groups subject to discarding in the human consumption fishery and taken as by-catch in the industrial fisheries. The residuals of the age 1/2 log catch ratios show better balance, suggesting that it is the 0-gp data that show inconsistencies rather than the 1-gp data. Nevertheless, the assessment continued with the inclusion of 0-gp catch-at-age data, although it is questionable whether this should continue in future.

As a further investigation of the catch-at-age and tuning data, XSA runs were made that incorporated one tuning fleet at a time for all available ages. 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 the single-fleet runs, plots were made by age of fleet CPUE corrected to January 1 against XSA population estimates. Within any fleet, ages that demonstrated negative relationships between log CPUE and log XSA abundance were excluded further from the analysis. Subsequent single-fleet tuning runs were made and from plots of the log-catchabilities, age groups that were very noisy were excluded. Last year's exploratory XSA runs showed that excluding the noisiest ages from tuning fleets had little effect on the results of XSA as it had previously downweighted their contribution anyway.

The result of these procedures was to modify the age ranges used for some of the fleets used further in calibrating the XSA, but principally to exclude the entire FraTro7d tuning fleet due to negative relationships between log CPUE and Log XSA abundance for all but one age group.

The exploratory analysis was taken further by examining the effect of treating 0-gp log catchability as dependent or independent of population size. The latter option was chosen last year, but ACFM queried whether the former option might lead to better correspondence between XSA results and survey indices at that age. Figure 5.1.4.2 shows the scatterplot of log abundance for each of the age 0 CPUE series against log XSA abundance for the 10 year tuning period. There is little indication from these results and the XSA diagnostics that log catchability should be treated as proportional to population size for this age. Furthermore, plots of 0 gp index against XSA population estimates from longer time-series fail to indicate positive relationships. Consequently, in the final XSA, 0 gp calibration assumed log catchability to be independent of population size.

(ii) Final Run

The log-catchability residual plots from the final run are shown in Figure 5.1.4.3 and full XSA diagnostics and the basic parameter selections and tuning options of the final run are shown in Table 5.1.4.1. The corrected CPUE log abundance against log XSA abundance plots are shown in Figures 5.1.4.4 (a-j). Some noise is still apparent in the residual plots, and ScoGfs survey shows a trend in log catchabilities. In the case of the ScoGfs series, the earlier single-fleet calibration based on it did not indicate a trend in log catchabilities, suggesting the trend to be imposed by the incorporation of the other fleets. However, the effect of removing the fleet from XSA is marginal, as its estimates of raised F are not heavily weighted (Figure 5.1.4.5, Table 5.1.4.1) and its estimate of terminal exploitation pattern is not inconsistent with some others, suggesting only a slightly lower level of fishing mortality (Figure 5.1.4.6)

Two retrospective XSAs were undertaken. One assumed a ten year tuning window but could only accommodate a limited number of CPUE series due to the relatively short time series of some fleet data. The second incorporated more fleets, but had a diminishing number of years in the retrospective runs. The retrospective plots are shown in Figures 5.1.4.7 and 5.1.4.8 for an assumed F shrinkage mean SE = 0.5. Both retrospective runs show a tendency to overestimate SSB in the most recent year and underestimate mean F. Recruits are poorly estimated in the terminal year.

The relative weighting of the different tuning fleets to the survivors estimates are indicated in Figure 5.1.4.5, where the scaled weights are shown plotted by fleet and age. In general, it can be seen that the weighting of survivors estimates from the commercial fleets from the North Sea increases with the age of fish. The exception to this is the FraTro fleet that is most heavily weighted at age 2 and whose influence then declines with age. The weighting of survivors from the North Sea surveys either decline with age, or are least important at the extremes of the age range. The weighting of the F shrinkage mean is highest at the youngest and oldest ages (58% and 18% respectively).

The individual fleet estimates of survivors given in Table 5.1.4.1 are quite diverse at most ages.

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

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

	1997 Assessment	1998 Assessment
Calibration period	10 years	10 years
Age Range	0–8+	0–8+
Catchability model	Constant (all ages)	Constant (all ages)
Catchability plateau	age 6	age 6
F Shrinkage:		
SE	0.5	0.5
year range	5	5
age range	3	3
Fleets(ages):		
ScoSei	(1–7)	(2–7)
ScoLtr	(1–7)	(1–7)
FraTrb	(1–7)	(2–7)
FraTro	(0–7)	(2–5)
FraTro(VIId)	(1–5)	-----
ScoGfs	(1–6);	(1–6)
EngGfs	(1–5)	(1–5)
IBTS QI	(0–4, age-shifted)	(0–4, age-shifted)
IBTS QII	(1–6)	(1–6)
IBTS QIV	(0–5)	(0–4)
FraGfs(VIId)	(0–3)	(0–2)

5.1.5 Recruitment estimates

There has previously been an inconsistency between survey-based estimates of year class strength used in predictions and tuned values for the same year classes estimated by the Working Group at its subsequent meeting. The tuned values have consistently been lower than RCT3 estimates suggesting that, according to the tuned results, the previous year's predictions will have been based on overestimates of year class strength. 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. For ages 0–3, pairwise plots of log survey index and XSA log abundance, are given in Figures 5.1.5.1 (a-d) (the IBTS QI index is down-aged by 1 year, to permit comparison with 0-gp abundance). There is little indication of positive associations and, furthermore, the plots extend over a limited data range on the log-scale. If the origin of the axes were included in the plots, the scatter would appear as a small "cloud" in the upper right hand corner of the graphs.

Due to this lack of concordance, all the XSA estimates of survivors except age 1 have been used as inputs to catch prediction, and no attempt has been made to use 1998 survey data in RCT3 estimates. Because the retrospective analysis of the XSA indicates that it provides little, if any, information on the strength of the most recent year class the XSA estimate of the 1997 year class has been overwritten for prediction using geometric mean recruitment over the period 1989–1995 (24,691 million). This period was selected as it reflects the currently low recruitment regimen experienced by this stock and has also been used for subsequent year class estimates in prediction. For the 1997 year class, this value was scaled to give 1 year old survivors in 1998 (1,841 million). The scaling factor used was the ratio of 1-year-olds in 1998 to 0-year olds in 1997 taken from the XSA. Given the low F estimated by XSA for age 0 in 1997 (0.05), this is similar to scaling by the assumed value of natural mortality at age 0 (2.55).

There is a degree of arbitrariness in the selection of the period over which the mean has been taken; it has been chosen to reflect the lower levels of recruitment seen during the 1990s. Even so, the XSA and the surveys suggest the 1996 and 1997 year classes are both very poor and the geometric mean values selected here are likely to overestimate those year class strengths.

5.1.6 Historical stock trends

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

Fishing mortalities have been highly variable with no clear trend. Mean F of all catch categories combined is indicated to have been reasonably stable over the period 1991–1996, with a fall in 1997 (consistent with the XSA tendency to underestimate terminal fishing mortality). The human consumption landings component of F appears to have been stable or rising marginally since 1989, with a decline in 1997. Last year, an exploration of an apparent decline in mean F in since 1993 suggested that the evidence from fleet effort and CPUE data supported the view of a decline, but was not unequivocal. The indication from this year's XSA is that there may have been a marginal decline over that period, but that it is dominated by the retrospective pattern inherent in the XSA.

SSB has previously been considered to be stable, although fluctuating around a low level, and above its historical low of 1971 (238,000 t). The current assessment indicates a decline in SSB since 1990 rather than a fluctuation about a stable level, and that SSB since 1993 has been close to or below the historical low. The retrospective analysis for this assessment is to overestimate SSB, and this may partly explain the difference in perspective between years, but if the current SSB is similarly overestimated, the stock is likely to be in an even poorer state than indicated here. SSB is estimated to be at an historical low of 197,000 t at the start of 1997.

Estimates of all year classes between 1989 and 1996 lie below the long term arithmetic and geometric means. This is consistent with previous estimates for this stock.

5.1.7 Short term forecast

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

Input data for combined area short term catch predictions are given in Table 5.1.7.1, and assume a short-term (1989–1995) GM recruitment at age 0 for the 1997 and subsequent year classes (24,691 million).

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

Results of a *status quo* catch forecast are given in Tables 5.1.7.2 (catch options) and 5.1.7.3 (detailed). The proportionate contribution of different year classes to the forecast human consumption landings in 1999 and SSB in 2000 is given in Table 5.1.7.4. It is noted that the year classes for which geometric mean recruitment is assumed, contribute to 27% to the human consumption landings in 1999 and to the to 84% of the forecast SSB in 2000.

At *status quo*, the area-combined human consumption landings are predicted to be 39,000 t in 1999 compared to a forecast of 44,000 t for 1998. This is predicted to result in a spawning biomass in 1999 of 200,000 t and 2000 of 220,000 t.

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

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

The estimates of human consumption landings in 1999 are most sensitive to the overall level of fishing mortality in 1999 and the overall level of natural mortality in 1998. The estimate of spawning biomass at the start of 2000 is sensitive to the overall magnitude of natural mortality in both 1998 and 1999 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. However, the source of variation in the forecasts differs considerably from last year's report. The partial variances in the prediction of human consumption landings in 1999 and spawning biomass in 2000 are dominated by the level of, and uncertainty in, the strength of the 1997 year class, assumed as a recent short-term geometric mean in this assessment.

Probability profiles for the human consumption landings in 1999 and the spawning biomass in 2000 are shown in Figure 5.1.7.2. They indicate approximately a 55% probability, at *status quo* human consumption F, that the spawning biomass at the start of 2000 will fall below its lowest recorded value of 197,000 t (1997) in the short term.

5.1.8 Medium term predictions

Previous reports of this Working Group have commented upon the fact that current recruitment levels are below those indicated by the earlier years of the time series. This may be due to a temporal shift in the overall level of recruitment. Alternatively, it may be due to the extrapolation of discard rates to earlier years from those in which observation have been made (mid-1970s onwards). In either case, it is not obvious that a stock and recruit relationship fitted to the entire time series is appropriate for input to medium term forecasts. This point has been made in earlier reports of this Working Group, and this year it was decide to truncate the time series at 1977 for stock and recruitment model fitting. To comply with ACFM's recommendation that a stock and recruitment relationship should be used to generate diminishing recruitment at low stock sizes in medium term forecasts, several stock and recruitment models were fitted to the data. Residual plots and fitting diagnostics did not permit an obvious model selection. Fits to the Ricker and Beverton-Holt model were virtually identical up to the maximum observed SSB. The Shepherd curve was also little different. For reasons of parsimony, the Ricker curve was chosen for use in medium term forecasting.

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

The results of medium term projections corresponding to *status quo* human consumption F are presented in Figure 5.1.8.1. At the end of the 10 year projection, spawning biomass would, on average, be expected to increase marginally, as would the human consumption landings, although in both cases the 5% - 95% inter-percentile range is broad. Several other projections were made for various multipliers of human consumption F. The outcome of these is summarised for the end of the 10 year projection period in Figure 5.1.8.2. This shows that for the stock and recruitment model used, mean fishing mortality would have to be reduced to 0.4 to risk a 5%-10% probability of breaching B_{loss} in the medium term. (If the full stock and recruitment data series were used in the analysis, then *status quo* human consumption F (0.64) would lead to a 5% probability of breaching B_{loss}).

5.1.9 Long term considerations

Stock and recruitment reference points are shown in Figure 5.1.9.1 for the truncated recruitment time series, and Figure 5.1.9.2 for the full data series

5.1.10 Biological reference points

Yield per recruit results are presented in Table 5.1.10.1 and Figure 5.1.10.1 contingent on variation in the human consumption component of the total international reference F. F_{max} and F_{med} calculations were carried out on the total yield curve. F_{max} is not defined within the range of multipliers used here A summary of F_{loss} calculations are shown in Figure 5.1.10.2, calculated from the GLOSSC program, for a smoother span of 0.9, log transform correction and constraint through the origin of the truncated stock and recruit series.

5.1.11 Comments on the assessment

(i) 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. However, perception of the recent trajectory of SSB has differed to the extent that it is now considered to be at its lowest observed level, following a gradual decline in recent years, rather than fluctuating about a low level as previously perceived. Investigation using XSA showed this change in perception is due to the addition of the 1997 catch-at-age data, and not to the relatively minor changes in fleet age ranges used to calibrate the XSA

(ii) 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 1997 remains unknown. For the catch prediction made at this meeting, year classes with assumed GM recruitment will account for 33% of the 1998 total catch, 58% of the 1999 total catch and 84% of the SSB in 2000 (Table 5.1.7.4).

(iii) 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.

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

(v) Using the full stock and recruitment time series in the medium term forecast leads to the following results for consideration in setting PA reference points:

Reference point	estimate	prob SSB< B_{pa} in 2007	% above historical Human consumption F
$F_{0.1}$	0.33	< 0.05	100%
F_{35SPR}	0.55	= 0.10	95%
F_{med}	0.62	< 0.20	84%
$F_{loss}.e^{(-1.645.\sigma)}$	0.64	= 0.20	79%
F_{loss}	0.89	< 0.50	18%

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

The lowest SSB in the time series, B_{loss}, is 197,000 t, occurring in 1997. Indeed, the current assessment indicates that SSB in 1993–1997 has been close to or below the $B_{loss} = B_{lim}$ suggested by SGPAFM (240,000 t) seen in 1971. This is a new perception created by the inclusion of 1997 catch-at-age data into the assessment. The WG suggests $B_{lim} = B_{loss} = 200,000$ t and $B_{pa} = B_{lim}.e^{(1.645.\sigma)} = 280,000$ t for $\sigma = 0.2$. (This compares with $B_{pa} = B_{lim}.e^{(1.645.\sigma)} = 350,000$ t suggested by SGPAFM).

Table 5.1.12.1 shows point estimates of a number of fishing mortality reference points. These refer to fishing mortality in the human consumption fishery. (The ratio of human consumption $F_{(2-6)}$ to total mean $F_{(2-6)}$ is 0.64/0.68 at *status quo*) In addition, the probability is given of breaching B_{pa} if fishing occurred at those values in the medium term, assuming the truncated data series Ricker recruitment model outlined in Section 5.1.8. The proportion of years in the short time series in which the reference value has been exceeded in the human consumption fishery is also shown. Since 1977 all reference values have been exceeded in more than 95% of years. Only exploitation at $F_{0.1}$ (0.33) indicates a low probability (0.15) of breaching B_{pa} in the medium term. The results of these analyses are sensitive to the truncation of the data series. Equivalent values, assuming the full data series in the stock and recruitment model fit are given in Section 5.1.11.

The SGPAFM suggested $F_{pa} = 0.81$ "based on Ricker curve", using the full data series to fit the model. It did not define F_{lim}. Due to doubts about the true size of earlier year classes in the analysis, F_{pa} values based on the full stock and recruitment data series may be considered to be poorly defined. Table 5.1.12.1 is not particularly helpful in determining F_{pa} for this stock due to doubts over the stock and recruitment model that has been used. In particular, this stock has a long history of withstanding high fishing mortality rates that are not considered to be sustainable under this analysis. Any reference F that this WG could suggest is likely to be low compared to historical F. This conclusion is not affected even if the full stock and recruitment data series is used in the analysis (see results in 5.1.11). In view of this, the WG is unable to propose a candidate reference value for F_{pa}. PA plots assuming the B_{pa} and B_{lim} values proposed here, along with the SGPAFM proposal for F_{pa} are given in Figures 5.1.12.1 and 5.1.12.2 for the truncated and full stock and recruitment series respectively.

5.2 Whiting in Division IIIa

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

Total landings are shown in Table 5.2.1.1

No analytical assessment of this stock was possible.

Table 5.1.1.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1983-1997, as officially reported to ICES.

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
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	391
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	103
Faroe Islands	18	-	6	-	12	222	1	26	-	16	7	2	21	-	6
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]	4,735	5,963[1,2,]	4,704[1,2,]	3,574
Germany, Fed.Rep.	317	286	226	313	274	454	415	692	865	511	441[1]	239	124	187	196
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	2,539
Norway	39	88	103	103	74	52	32	55	103	232	130[1]	79	114	65	75
Poland	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Sweden	44	53	22	33	17	5	17	16	48	22	18	10	1	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	2,638
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	22,098
Total	99,149	98,958	71,934	66,709	64,978	66,294	40,125	41,084	46,607	47,042	43,301	42,216	41,399	35,115	31,621
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	31,000
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	17,000
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	6,000

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

Table 5.1.1.2 WHITING in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1982 to 1997.

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	-	7,088	-	6,623
1995	68	5,202	-	280	1	5,551	-	5,390
1996	84	4,772	1	199	1	5,057	-	4,955
1997[1]	98	n/a	1	147	1	n/a	-	4,623

[1]Preliminary

TABLE 5.1.1.3 Whiting, North Sea and VIId
Annual weight and numbers caught, 1960 to 1997.

Year	Wt.('000t)				Nos.(millions)			
	Total	H cons	Disc	IBC	Total	H cons	Disc	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
1997	59	36	17	6	281	124	101	57
Min.	59	36	17	5	281	124	101	57
Mean	196	70	77	49	1499	243	495	761
Max.	368	108	241	152	2816	382	1646	1974

Table 5.1.1.4 Whiting in VIId. Annual weight and numbers caught, 1976-1997

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	4.952	18
1997	4.623	18

TABLE 5.1.2.1; 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

Table 5.1.2.2

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:02

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE								
0,	60828,	215700,	76257,	105982,	234479,	63912,	84279,	177436,
1,	482896,	1079197,	1022790,	549436,	137590,	342622,	517081,	973202,
2,	259440,	619965,	220148,	751817,	369668,	148166,	343402,	216064,
3,	215393,	219882,	156642,	96115,	164882,	330156,	93851,	122955,
4,	21460,	32745,	31722,	45332,	22843,	72200,	255875,	23958,
5,	23279,	1355,	5998,	9334,	10908,	8002,	37708,	69082,
6,	3634,	4099,	276,	1739,	2770,	3555,	8535,	7886,
7,	892,	385,	407,	9,	435,	765,	1520,	849,
+gp,	2380,	369,	125,	142,	55,	134,	470,	164,
TOTALNUM,	1070202,	2173697,	1514365,	1559905,	943630,	969512,	1342721,	1591596,
TONSLAND,	182361,	326093,	222431,	260771,	149956,	186760,	242233,	236994,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	104751,	1206087,	1187095,	1232837,	553711,	175647,	571476,	238839,	425081,	666975,
1,	830541,	374343,	606831,	621941,	939141,	1155304,	756260,	955910,	479610,	1006082,
2,	523774,	1025996,	83064,	107933,	319094,	666563,	986441,	407207,	1129375,	480939,
3,	111755,	158808,	571696,	18786,	46392,	135507,	234063,	303537,	169611,	279226,
4,	49514,	28972,	52108,	128541,	7833,	19028,	33307,	56549,	88015,	30130,
5,	7494,	13240,	11463,	13640,	59313,	5739,	4977,	9273,	15988,	21334,
6,	31183,	1734,	3723,	2306,	8392,	18186,	1243,	8014,	3163,	5561,
7,	1940,	5989,	1211,	730,	3486,	2504,	5856,	116,	495,	532,
+gp,	127,	697,	1514,	628,	1009,	546,	427,	1525,	675,	419,
TOTALNUM,	1661079,	2815866,	2518706,	2127342,	1938372,	2179025,	2594051,	1980969,	2312014,	2491198,
TONSLAND,	265266,	327617,	271648,	195357,	191320,	270533,	296197,	305010,	368240,	347056,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 5.1.2.2 (Cont'd)

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:02

Table 1 Catch numbers at age Numbers*10**-3 YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	687238,	476383,	332209,	516869,	101058,	668604,	157819,	186723,	225201,	84863,
1,	418910,	615524,	265359,	162899,	192640,	205646,	323408,	203321,	576731,	267051,
2,	313391,	467537,	416008,	346343,	114444,	184746,	175965,	141716,	167077,	368229,
3,	242370,	218283,	286077,	266517,	245247,	118412,	124886,	82037,	169577,	122748,
4,	90047,	100976,	90718,	102295,	88137,	131508,	49505,	37847,	46517,	85240,
5,	7563,	29267,	52969,	27776,	26796,	37231,	59817,	14420,	13367,	11392,
6,	7565,	3111,	10751,	12297,	6909,	8688,	13860,	17445,	3487,	4556,
7,	1851,	1657,	1152,	3540,	2082,	1780,	2964,	3328,	3975,	928,
+gp,	277,	304,	767,	326,	484,	930,	613,	904,	569,	1035,
TOTALNUM,	1769212,	1913041,	1456011,	1438862,	777797,	1357545,	908837,	687741,	1206501,	946042,
TONSLAND,	188186,	243846,	223517,	192049,	140195,	161212,	145741,	106363,	161744,	138775,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	106,	100,	100,

Table 1 Catch numbers at age Numbers*10**-3 YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
0,	416924,	87326,	284755,	1035089,	252963,	622530,	216868,	1571419,	92109,	15759,
1,	430344,	331672,	253745,	128507,	239792,	217539,	163609,	137481,	68419,	50154,
2,	307429,	173676,	505010,	191193,	165354,	167577,	147177,	139010,	109837,	68957,
3,	179502,	191942,	129126,	187195,	89563,	124287,	90611,	111489,	97292,	79827,
4,	39635,	78464,	86324,	36830,	93636,	46543,	47533,	35728,	49847,	42428,
5,	17901,	14367,	32270,	26209,	11967,	46136,	17384,	15161,	14558,	18870,
6,	2175,	5050,	2003,	5519,	6878,	3946,	17264,	5159,	5016,	4009,
7,	544,	516,	735,	543,	2609,	1519,	998,	4515,	1324,	1033,
+gp,	168,	334,	112,	273,	117,	771,	460,	474,	1117,	460,
TOTALNUM,	1394622,	883347,	1294080,	1611359,	862879,	1230849,	701904,	2020436,	439519,	281497,
TONSLAND,	133470,	123753,	153453,	124975,	109704,	116165,	92606,	103268,	73957,	59102,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	99,	100,	100,

Table 5.1.2.3

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:02

Table 2 Catch weights at age (kg) YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE								
0,	.0580,	.0420,	.0550,	.0490,	.0420,	.0580,	.0720,	.0620,
1,	.1170,	.1190,	.1190,	.1120,	.1240,	.1240,	.1090,	.1180,
2,	.1900,	.1930,	.1870,	.1950,	.1740,	.2090,	.1870,	.1990,
3,	.2560,	.2590,	.2670,	.2720,	.2680,	.2420,	.2490,	.2690,
4,	.3140,	.3030,	.3330,	.3530,	.3550,	.3320,	.2880,	.3320,
5,	.3440,	.4120,	.4000,	.4120,	.4440,	.4210,	.3680,	.3400,
6,	.3840,	.4200,	.5200,	.4720,	.4890,	.4990,	.4340,	.4250,
7,	.5010,	.4930,	.5190,	.8200,	.5350,	.5420,	.4730,	.4950,
+gp,	.4490,	.4420,	.5440,	.6130,	.7420,	.6420,	.6970,	.6220,
SOPCOFAC,	1.0013,	.9983,	1.0007,	1.0020,	.9997,	1.0005,	.9996,	.9990,

Table 2 Catch weights at age (kg) YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	.0380,	.0430,	.0200,	.0360,	.0220,	.0270,	.0260,	.0300,	.0190,	.0220,
1,	.1120,	.0970,	.1100,	.1160,	.0710,	.0840,	.0710,	.1000,	.1070,	.1170,
2,	.1880,	.1730,	.2040,	.2190,	.2010,	.1660,	.1500,	.2150,	.1940,	.2100,
3,	.2950,	.2620,	.2410,	.2860,	.2840,	.2780,	.2590,	.2780,	.2940,	.3190,
4,	.3590,	.3630,	.3490,	.3190,	.3890,	.3720,	.3830,	.3760,	.3480,	.3990,
5,	.4840,	.4150,	.4550,	.4330,	.4190,	.4390,	.4710,	.4700,	.4390,	.4440,
6,	.4470,	.4190,	.4520,	.5310,	.5210,	.4630,	.5210,	.3560,	.5010,	.4620,
7,	.6200,	.5350,	.5120,	.6370,	.5750,	.5520,	.5440,	.8170,	.5140,	.5470,
+gp,	.7440,	.6770,	.6440,	.6820,	.8020,	.7770,	.8260,	.6060,	.7020,	.4750,
SOPCOFAC,	1.0007,	.9998,	.9991,	1.0041,	1.0003,	1.0022,	.9992,	1.0027,	.9998,	1.0001,

Table 5.1.2.3 (Cont'd)

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:03

Table 2 Catch weights at age (kg) YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	.0100,	.0090,	.0130,	.0110,	.0290,	.0150,	.0200,	.0140,	.0150,	.0130,
1,	.0740,	.0980,	.0750,	.0830,	.0610,	.1070,	.0890,	.0940,	.1050,	.0770,
2,	.1820,	.1660,	.1760,	.1680,	.1840,	.1910,	.1880,	.1920,	.1830,	.1480,
3,	.2340,	.2590,	.2520,	.2420,	.2530,	.2730,	.2710,	.2840,	.2550,	.2470,
4,	.3220,	.3010,	.3280,	.3210,	.3140,	.3250,	.3370,	.3320,	.3180,	.2970,
5,	.4270,	.4110,	.3370,	.3790,	.3760,	.3840,	.3820,	.4020,	.3780,	.3750,
6,	.4280,	.4550,	.4580,	.4110,	.4780,	.4260,	.3910,	.4350,	.4750,	.3790,
7,	.4660,	.4920,	.4580,	.4440,	.5040,	.4520,	.4630,	.4940,	.4680,	.5420,
+gp,	.6490,	.5820,	.5720,	.7200,	.7350,	.5370,	.5670,	.4380,	.6250,	.5840,
SOPCOFAC,	1.0003,	1.0011,	1.0022,	.9997,	.9996,	.9971,	1.0014,	1.0612,	1.0017,	.9991,

Table 2 Catch weights at age (kg) YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
0,	.0130,	.0230,	.0150,	.0170,	.0130,	.0120,	.0130,	.0100,	.0160,	.0250,
1,	.0540,	.0700,	.0830,	.1030,	.0820,	.0730,	.0800,	.0870,	.0890,	.0890,
2,	.1460,	.1570,	.1370,	.1690,	.1850,	.1750,	.1700,	.1810,	.1680,	.1820,
3,	.2230,	.2250,	.2090,	.2180,	.2570,	.2520,	.2540,	.2580,	.2420,	.2490,
4,	.3010,	.2670,	.2500,	.2900,	.2770,	.3190,	.3230,	.3410,	.3100,	.3030,
5,	.3460,	.3180,	.2790,	.3070,	.3320,	.3290,	.3710,	.3850,	.3920,	.3380,
6,	.4230,	.3910,	.4080,	.3380,	.3460,	.3490,	.3670,	.4300,	.4280,	.4840,
7,	.5060,	.4310,	.4900,	.3650,	.3140,	.4030,	.4140,	.4340,	.4310,	.3840,
+gp,	.6940,	.3940,	.5990,	.4000,	.5030,	.3810,	.4160,	.4200,	.4300,	.4180,
SOPCOFAC,	1.0035,	1.0018,	1.0008,	1.0010,	.9998,	.9988,	.9991,	.9930,	1.0005,	1.0009,

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

Country	Fleet	Code	Initial Year	Age Range
Scotland	Groundfish survey	SCOGFS	1982	0-6
	Seiners	SCOSEI	1976	0-10
	Light trawlers	SCOLTR	1976	0-10
England	Groundfish survey	ENGGFS	1977	0-6
France	Trawlers	FRATRB	1985	0-11
		FRATRO	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

Table 5.1.3.2

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT02: 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
1978	236944	8785.464	19909.945	30722.309	14472.604	956.038	1612.065	635.026
1979	287494	171147.281	42910.398	23154.594	17995.664	4057.925	376.993	285.995
1980	333197	20805.963	58381.992	38436.160	9525.058	9430.050	1864.014	144.001
1981	251504	6576.457	19069.211	21549.754	9706.151	1777.022	1455.034	310.008
1982	250870	5214.103	8196.975	26680.535	12944.739	3333.924	646.980	338.988
1983	244349	37495.680	17925.867	12535.311	19234.307	6123.520	1216.612	182.797
1984	240775	38266.770	16048.092	10784.184	6306.822	9018.982	2371.186	478.594
1985	267393	28760.939	9368.367	7616.928	3085.792	1333.193	2901.185	443.130
1986	279727	8138.433	8571.900	9577.941	4108.819	767.442	425.282	608.602
1987	351131	18761.178	25933.338	16160.769	5954.478	1182.953	388.455	116.035
1988	391988	2397.963	15778.771	22525.543	5127.725	1640.626	207.218	31.033
1989	405883	20318.748	10051.615	21389.719	10836.808	2394.091	448.224	33.084
1990	371493	3676.882	35321.988	7664.570	8960.094	3423.009	159.541	39.935
1991	408056	8726.876	11908.029	22145.619	3192.247	2906.398	628.632	49.904
1992	473955	17580.582	14551.322	11822.715	15417.656	1500.403	1160.443	304.395
1993	447064	16438.910	20513.145	14385.548	6590.755	10105.473	574.199	203.582
1994	480400	4132.650	15771.000	13004.648	6453.762	2710.229	2997.307	171.833
1995	442010	9248.035	15886.830	19322.299	6261.604	2982.508	1092.214	1131.707
1996	445995	6661.924	12461.079	13523.105	9223.331	3012.112	860.730	281.907
1997	479449	2557.224	6767.919	15603.226	9463.723	4535.190	628.015	181.348

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT03: FRATRB_IV

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1978	69739	10312.000	14789.000	8544.000	807.000	1091.000	227.000
1979	89974	12272.000	14379.000	10884.000	3789.000	394.000	315.000
1980	63577	5388.000	11298.000	4605.000	4051.000	1004.000	78.000
1981	76517	6591.000	13139.000	8196.000	2090.000	1644.000	314.000
1982	78523	1643.000	16561.000	11241.000	3948.000	1035.000	539.000
1983	69720	4407.000	8188.000	16698.000	5541.000	1061.000	228.000
1984	76149	4281.000	7465.000	4576.000	5999.000	1596.000	308.000
1985	25915	3653.116	2942.089	1225.275	565.549	598.645	117.274
1986	28611	3830.333	3990.706	1202.062	368.637	93.789	160.456
1987	28692	4822.766	3667.480	2151.592	496.974	166.107	47.911
1988	25208	2717.686	4815.076	1124.874	529.693	100.132	31.077
1989	25184	2064.112	4351.490	1877.197	313.541	106.156	9.858
1990	21758	3798.491	2121.762	2007.736	619.827	54.765	13.437
1991	19840	2226.920	3833.399	819.734	657.402	137.468	15.308
1992	15656	1607.348	1662.241	2129.367	253.904	187.573	49.300
1993	19076	1200.295	2638.254	1154.305	1227.213	98.090	37.609
1994	17316	1795.161	1704.320	1473.856	417.838	424.121	29.853
1995	17794	1029.634	3310.515	1530.410	1163.378	240.803	211.286
1996	18883	655.484	1594.391	1438.238	482.197	199.090	37.912
1997	15574	356.961	1406.893	1138.705	606.014	85.942	15.858

Table 5.1.3.2 (Cont'd)

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT04: FRATRO_IV

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5
1986	56099	1891.942	7145.979	3782.820	599.905
1987	71765	4984.961	1271.294	5713.138	412.560
1988	84052	8981.893	3222.825	704.344	1320.586
1989	88397	3739.547	5628.945	1654.265	208.584
1990	71078	6068.396	3705.817	2427.555	372.059
1991	67846	4343.216	2546.808	1504.166	844.022
1992	51240	4740.270	2100.527	786.528	417.835
1993	62553	3451.685	3896.102	1079.181	273.702
1994	51239	2514.250	1416.993	1112.328	214.243
1995	57823	4631.790	2765.370	899.453	207.141
1996	50163	3338.004	2992.059	1339.228	261.808
1997	48904	3443.828	3157.197	1254.148	373.304

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT05: 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	6.53	9.71	9.72	2.24	0.60	0.16
1983	100	5.63	5.78	4.07	5.11	1.16	0.17
1984	100	10.48	3.71	1.70	0.77	0.92	0.18
1985	100	15.77	9.73	2.47	0.63	0.36	0.18
1986	100	11.11	4.52	2.24	0.27	0.05	0.05
1987	100	14.05	11.50	2.08	0.77	0.16	0.03
1988	100	9.67	16.06	4.52	0.70	0.19	0.02
1989	100	40.43	7.41	7.33	1.57	0.13	0.06
1990	100	22.39	20.53	2.48	2.55	0.47	0.05
1991	100	17.69	9.50	7.59	0.51	0.40	0.09
1992	100	29.25	12.67	5.53	5.85	0.47	0.26
1993	100	31.69	11.68	4.23	1.56	1.82	0.06
1994	100	26.35	9.50	2.54	0.57	0.34	0.23
1995	100	41.76	20.10	9.03	1.96	0.58	0.22
1996	100	28.88	30.47	12.15	4.60	0.43	0.15
1997	100	18.24	14.34	11.91	3.19	1.22	0.17

Table 5.1.3.2 (Cont'd)

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT06: ENGGFS_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5
1977	100	21.95327	7.44128	1.10918	0.21617	0.09084
1978	100	24.71364	5.15057	1.05515	0.34473	0.05065
1979	100	20.06352	7.11693	1.89851	0.84259	0.05720
1980	100	35.32720	12.50796	4.81044	1.20454	0.31363
1981	100	18.31413	28.80394	16.05191	0.61761	0.61630
1982	100	27.72217	7.93387	8.59036	2.22009	0.34039
1983	100	11.85334	10.80295	1.90607	1.69636	0.24207
1984	100	50.61345	10.81812	3.01209	0.88883	0.76876
1985	100	15.87825	17.04257	1.67265	0.98100	0.18171
1986	100	15.16183	6.59195	3.84688	0.40600	0.10373
1987	100	22.76268	13.03649	2.68710	2.00857	0.35157
1988	100	18.80580	13.15962	4.54558	0.64498	0.17371
1989	100	29.47434	11.75997	7.69369	1.67409	0.34480
1990	100	19.00850	12.83600	3.85440	2.31820	0.32540
1991	100	33.30382	7.66534	3.81768	1.08550	0.37095
1992	100	26.55459	13.06984	3.04550	2.61006	0.49326
1993	100	25.10378	9.62914	3.75044	1.16142	0.74167
1994	100	30.54600	10.59436	2.43878	1.12392	0.33328
1995	100	35.50605	23.73796	7.36066	1.87025	0.25078
1996	100	12.37870	10.44014	7.38577	3.22502	0.59415
1997	100	20.29258	9.71907	6.98733	5.40672	1.67550

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT07: IBTS_Q1_IV

Year	Fishing effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4
1973	1	0.3220	0.4960	-1.0000	-1.0000	-1.0000
1974	1	0.8930	0.1530	-1.0000	-1.0000	-1.0000
1975	1	0.6790	0.5350	-1.0000	-1.0000	-1.0000
1976	1	0.4180	0.2190	-1.0000	-1.0000	-1.0000
1977	1	0.5130	0.2930	-1.0000	-1.0000	-1.0000
1978	1	0.4570	0.1830	-1.0000	-1.0000	-1.0000
1979	1	0.6920	0.3910	-1.0000	-1.0000	-1.0000
1980	1	0.2270	0.4850	-1.0000	-1.0000	-1.0000
1981	1	0.1610	0.2320	-1.0000	-1.0000	-1.0000
1982	1	0.1280	0.1260	0.1130	0.0790	0.0330
1983	1	0.4360	0.1790	0.0910	0.0310	0.0260
1984	1	0.3410	0.3590	0.0660	0.0190	0.0070
1985	1	0.4560	0.2610	0.1980	0.0330	0.0070
1986	1	0.6690	0.5440	0.0900	0.0460	0.0050
1987	1	0.3940	0.8620	0.3150	0.0340	0.0120
1988	1	1.4650	0.5420	0.4210	0.1120	0.0120
1989	1	0.5090	0.8870	0.2020	0.0930	0.0170
1990	1	1.0140	0.6750	0.4820	0.0710	0.0380
1991	1	0.9160	0.7480	0.2610	0.1690	0.0160
1992	1	1.0870	0.5240	0.2450	0.0660	0.0590
1993	1	0.7210	0.6370	0.1800	0.0670	0.0120
1994	1	0.6790	0.4570	0.2450	0.0590	0.0120
1995	1	0.5020	0.4860	0.2450	0.0700	0.0230
1996	1	0.2880	0.3420	0.1630	0.0600	0.0180
1997	1	0.5560	0.1620	0.1250	0.0540	0.0160

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT08: IBTS_Q2_SCO_IV

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1991	100	94.90	38.56	22.86	3.74	1.23	0.51
1992	100	129.76	47.50	11.42	4.28	1.14	0.45
1993	100	104.67	41.49	20.86	5.17	4.85	0.36
1994	100	65.40	35.71	8.55	2.38	0.90	0.75
1995	100	191.61	77.30	26.19	4.42	2.21	0.41
1996	100	44.02	49.62	22.30	8.33	1.25	0.59
1997	100	14.07	22.60	18.02	6.43	1.40	0.13

Table 5.1.3.2 (Cont'd)

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT10: FRAGFS_7d

Year	Fishing effort	Catch, age 0	Catch, age 1	Catch, age 2
1988	27	3186	-1	-1
1989	27	1512	-1	-1
1990	27	1674	-1	-1
1991	27	7155	1350	162
1992	27	6291	1674	378
1993	27	1566	675	216
1994	27	1323	6993	837
1995	27	1539	1836	216
1996	27	837	1107	297
1997	27	378	756	351

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT11: IBTS_Q4_ENG_IV

Year	Fishing effort	Catch, age 0	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4
1991	100	46.82647	55.27577	19.64171	15.09189	3.25460
1992	100	94.23306	45.08990	26.46158	5.37850	5.02968
1993	100	78.87058	54.20958	19.47387	7.16071	2.33451
1994	100	69.84756	61.33462	26.41324	4.14012	0.84180
1995	100	71.32800	107.99600	41.71500	11.18600	2.56000
1996	100	29.98300	36.55600	30.33000	8.65300	4.81500

The SAS System 12:23 Saturday, October 10, 1998
WHG-47D: Whiting in the North Sea (Fishing Areas IV and VIId)

FLT01: SCOSEI_IV

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1978	325246	29307.939	43710.809	15390.197	1057.941	1408.921	200.989
1979	316419	41091.742	28124.234	14745.013	6083.678	676.915	155.750
1980	297227	73704.438	37657.648	11914.984	9367.982	2556.000	260.000
1981	289672	22243.637	25047.811	10551.986	2401.997	2084.002	374.000
1982	297730	7032.000	26194.137	13117.107	2713.028	539.005	277.003
1983	333168	14957.378	21690.016	34199.105	9830.623	2154.563	406.795
1984	388035	24015.609	20669.760	14985.589	21269.320	4715.242	959.961
1985	381647	20263.316	19695.992	8956.377	4795.861	8013.077	1362.788
1986	425017	48705.180	34509.258	11340.962	2624.396	1097.504	1771.080
1987	418536	52715.141	38938.770	18440.258	3637.712	1096.908	297.738
1988	377132	28446.105	44869.258	12631.404	4071.612	678.724	63.973
1989	355735	15704.127	41407.430	23710.402	4769.041	1323.229	112.076
1990	252732	124635.820	27694.109	29920.980	14767.797	720.818	206.524
1991	336675	44964.258	63414.281	10436.101	8730.116	1742.927	195.190
1992	300217	19452.012	21217.148	27961.869	2804.536	1958.074	564.870
1993	268413	31623.355	26012.820	12457.879	14446.113	899.254	332.177
1994	264738	21451.654	22570.719	11778.492	5530.941	5611.981	203.907
1995	204545	22152.725	30006.961	9018.667	3874.625	1373.442	1270.024
1996	177092	26020.514	21430.221	10505.521	3483.373	1031.267	295.708
1997	166817	8974.445	16231.232	9922.011	4445.229	575.334	109.846

Table 5.1.4.1

```
Lowestoft VPA Version 3.1

  10-Oct-98  12:37:10

Extended Survivors Analysis

Whiting IV,VIId (run: XSAPAK05/X05)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/whg_47d/FLEET.X05

Catch data for  38 years. 1960 to 1997. Ages  0 to   8.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                ,       year, year,  age ,  age
FLT01: SCOSEI_IV (Ca,   1988, 1997,   2,     7,   .000,  1.000
FLT02: SCOLTR_IV (Ca,   1988, 1997,   1,     7,   .000,  1.000
FLT03: FRATRB_IV (Ca,   1988, 1997,   2,     7,   .000,  1.000
FLT04: FRATRO_IV (Ca,   1988, 1997,   2,     5,   .000,  1.000
FLT05: SCOGFS_IV (Ca,   1988, 1997,   1,     6,   .500,   .750
FLT06: ENGGFS_IV (Ca,   1988, 1997,   1,     5,   .500,   .750
FLT07: IBTS_Q1_IV (C,   1988, 1997,   0,     4,   .990,  1.000
FLT08: IBTS_Q2_SCO_I,   1991, 1997,   1,     6,   .250,   .500
FLT10: FRAGFS_7d (Ca,   1988, 1997,   0,     2,   .750,  1.000
FLT11: IBTS_Q4_ENG_I,   1991, 1997,   0,     4,   .750,  1.000


Time series weights :

     Tapered time weighting not applied


Catchability analysis :

     Catchability independent of stock size for all ages

     Catchability independent of age for ages >=    6


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning converged after   33 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,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997

     0,  .026,  .012,  .042,  .149,  .034,  .088,  .035,  .341,  .038,  .046
     1,  .359,  .129,  .226,  .117,  .241,  .186,  .149,  .138,  .107,  .130
     2,  .431,  .432,  .548,  .486,  .387,  .482,  .327,  .322,  .273,  .262
     3,  .663,  .698,  .913,  .516,  .576,  .754,  .694,  .575,  .505,  .416
     4,  .975,  .843,  .989,  .890,  .631,  .821,  .907,  .790,  .656,  .505
     5, 1.170, 1.550, 1.260, 1.125,  .951,  .844,  .982,  .968, 1.037,  .620
     6, 1.303, 1.636, 1.093,  .809, 1.206, 1.117, 1.015, 1.013, 1.182, 1.032
     7, 1.397, 1.590, 1.401, 1.118, 1.338, 1.041, 1.053,  .858,  .829,  .874
```

Table 5.1.4.1 (Cont'd)

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6	7
1988	5.80E+07	2.30E+06	1.10E+06	4.41E+05	7.39E+04	2.94E+04	3.38E+03	7.99E+02
1989	2.61E+07	4.41E+06	6.20E+05	4.55E+05	1.60E+05	2.07E+04	7.11E+03	7.16E+02
1990	2.50E+07	2.02E+06	1.50E+06	2.57E+05	1.60E+05	5.10E+04	3.41E+03	1.08E+03
1991	2.68E+07	1.88E+06	6.22E+05	5.53E+05	7.26E+04	4.40E+04	1.13E+04	8.92E+02
1992	2.73E+07	1.80E+06	6.45E+05	2.44E+05	2.33E+05	2.21E+04	1.11E+04	3.91E+03
1993	2.65E+07	2.06E+06	5.48E+05	2.80E+05	9.66E+04	9.17E+04	6.65E+03	2.59E+03
1994	2.27E+07	1.90E+06	6.61E+05	2.16E+05	9.26E+04	3.15E+04	3.07E+04	1.69E+03
1995	1.95E+07	1.71E+06	6.33E+05	3.04E+05	7.60E+04	2.77E+04	9.18E+03	8.67E+03
1996	8.79E+06	1.08E+06	5.76E+05	2.92E+05	1.20E+05	2.56E+04	8.20E+03	2.60E+03
1997	1.25E+06	6.60E+05	3.75E+05	2.79E+05	1.24E+05	4.63E+04	7.06E+03	1.96E+03

Estimated population abundance at 1st Jan 1998

.00E+00	9.32E+04	2.24E+05	1.84E+05	1.30E+05	5.56E+04	1.94E+04	1.96E+03

Taper weighted geometric mean of the VPA populations:

3.52E+07	2.90E+06	8.86E+05	3.37E+05	1.03E+05	3.05E+04	8.46E+03	1.89E+03

Standard error of the weighted Log(VPA populations) :

.8018	.6023	.5956	.5737	.6620	.7985	.9006	1.2183

Log catchability residuals.

Fleet : FLT01: SCOSEI_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	-.77	-.73	.85	.40	-.40	.40	-.23	.10	.48	-.10
3	-.25	-.29	.31	-.08	-.21	.04	.15	.30	.11	-.10
4	.00	-.14	.50	-.10	-.27	.00	.03	.17	-.05	-.14
5	-.47	.24	.70	-.01	-.42	-.13	.05	.07	.22	-.24
6	-.05	.06	.32	-.39	.01	-.17	.10	.16	.20	-.24
7	-.95	-.15	.32	.06	-.15	-.28	-.32	.05	-.07	-.70

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

Age	2	3	4	5	6	7
Mean Log q	-15.3208	-14.4148	-14.0350	-13.7194	-13.7209	-13.7209
S.E(Log q)	.5401	.2176	.2104	.3456	.2164	.4383

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.84	.389	15.01	.42	10	.48	-15.32
3	1.57	-1.692	15.41	.52	10	.31	-14.41
4	1.09	-.447	14.26	.75	10	.24	-14.04
5	.94	.246	13.52	.67	10	.34	-13.72
6	1.04	-.334	13.92	.89	10	.24	-13.72
7	.91	.583	13.38	.85	10	.35	-13.94

Table 5.1.4.1 (Cont'd)

Fleet : FLT02: SCOLTR_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	No data for this fleet at this age									
1	-1.15	.20	-.60	.20	.84	.68	-.71	.28	.39	-.14
2	-.29	-.20	.31	-.01	-.04	.56	-.03	.11	-.07	-.33
3	.17	.06	-.21	-.18	-.11	.08	.14	.23	-.13	-.05
4	.21	.10	.06	-.32	-.17	.00	-.02	.19	.05	-.09
5	-.29	.55	-.02	-.18	-.37	.13	-.13	.17	.28	-.15
6	-.10	.02	-.39	-.42	.21	.05	.06	.34	.27	-.03
7	-.53	-.33	-.53	-.32	-.05	-.10	.09	.35	.14	-.07

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	-18.0046	-16.4276	-15.5563	-15.1862	-14.8498	-14.8988	-14.8988
S.E(Log q)	.6406	.2718	.1566	.1611	.2818	.2537	.3220

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	1.09	-.181	18.33	.33	10	.74	-18.00
2	.86	.665	16.01	.74	10	.24	-16.43
3	1.01	-.030	15.57	.79	10	.17	-15.56
4	1.07	-.456	15.44	.84	10	.18	-15.19
5	1.08	-.356	15.21	.70	10	.32	-14.85
6	.89	.958	14.22	.90	10	.23	-14.90
7	.76	4.649	13.24	.98	10	.12	-15.03

Fleet : FLT03: FRATRB_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	-.10	.20	.12	.53	.36	.08	.32	-.22	-.66	-.65
3	.08	-.04	.05	-.20	.05	.25	.14	.39	-.39	-.32
4	.00	-.31	-.04	-.09	-.17	-.02	.39	.55	-.08	-.22
5	-.09	-.12	-.30	-.06	-.15	-.24	-.10	1.02	.19	-.15
6	.34	-.22	-.21	-.50	.22	-.15	-.16	.46	.39	-.17
7	.63	-.34	-.36	-.05	-.04	-.21	.08	.30	-.28	-.66

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

Age	2	3	4	5	6	7
Mean Log q	-15.6288	-14.2661	-13.7496	-13.4323	-13.3181	-13.3181
S.E(Log q)	.4066	.2454	.2698	.3823	.3227	.3810

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.75	.953	15.07	.64	10	.30	-15.63
3	1.22	-.650	14.61	.53	10	.31	-14.27
4	1.62	-1.884	15.07	.53	10	.39	-13.75
5	1.40	-1.035	14.63	.45	10	.53	-13.43
6	1.09	-.440	13.69	.77	10	.37	-13.32
7	.96	.250	13.18	.83	10	.37	-13.41

Table 5.1.4.1 (Cont'd)

Fleet : FLT04: FRATRO_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	-.03	-.38	-.51	.06	.34	.03	-.34	.19	.08	.56
3	-.53	-.04	.41	-.84	.09	.44	-.13	.02	.25	.34
4	-.34	-.37	.30	.61	-1.03	.05	.35	.17	.20	.06
5	1.21	-.20	-.41	.55	.75	-1.34	-.26	-.29	.19	-.19
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	2	3	4	5
Mean Log q	-15.7120	-15.2590	-15.0776	-15.0200
S.E(Log q)	.3332	.4181	.4677	.7109

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	2.39	-2.520	18.88	.29	10	.63	-15.71
3	88.50	-2.995	241.96	.00	10	26.95	-15.26
4	3.89	-2.234	25.03	.07	10	1.51	-15.08
5	19.68	-2.182	100.09	.00	10	11.75	-15.02

Fleet : FLT05: SCOGFS_IV (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	No data for this fleet at this age									
1	-1.08	-.44	-.19	-.42	.20	.11	-.01	.55	.62	.66
2	-.32	-.52	-.32	-.24	-.06	.09	-.40	.39	.87	.53
3	-.57	-.10	-.47	-.37	.17	-.12	-.41	.44	.73	.70
4	-.37	-.41	.17	-.72	.40	.07	-.84	.52	.83	.34
5	-.63	-.42	-.22	-.32	.43	.29	-.23	.42	.25	.44
6	-.65	-.09	.12	-.66	.66	-.34	-.59	.57	.40	.58
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	-15.0932	-14.8666	-14.8931	-15.0148	-15.0429	-15.0266
S.E(Log q)	.5512	.4589	.4869	.5570	.4041	.5393

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	4.54	-2.726	17.56	.07	10	1.91	-15.09
2	2.72	-1.749	17.35	.11	10	1.13	-14.87
3	1.76	-.799	16.57	.12	10	.87	-14.89
4	.66	1.097	13.86	.56	10	.36	-15.01
5	.89	.398	14.54	.62	10	.38	-15.04
6	1.08	-.241	15.50	.54	10	.61	-15.03

Table 5.1.4.1 (Cont'd)

Fleet : FLT06: ENGGFS_IV (Ca

Age	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
0	No data for this fleet at this age									
1	-.38,	-.73,	-.33,	.24,	.13,	-.09,	.16,	.41,	-.20,	.80
2	-.35,	.11,	-.61,	-.28,	.15,	.07,	-.12,	.73,	-.03,	.32
3	-.35,	.17,	.18,	-.84,	-.21,	-.03,	-.23,	.45,	.45,	.39
4	-.48,	-.38,	.04,	.00,	-.44,	-.26,	-.19,	.44,	.44,	.83
5	-.66,	.62,	-.52,	-.33,	.54,	-.54,	-.19,	-.36,	.63,	.82
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	-15.1198	-15.0434	-15.1116	-14.9803	-15.1054
S.E(Log q)	.4397	.3741	.4143	.4426	.5777

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	3.22	-3.411	16.73	.23	10	.96	-15.12
2	3.13	-2.725	18.49	.17	10	.89	-15.04
3	2.53	-1.421	18.85	.10	10	.99	-15.11
4	1.20	-.415	15.64	.36	10	.56	-14.98
5	2.47	-1.512	21.93	.12	10	1.34	-15.11

Fleet : FLT07: IBTS_Q1_IV (C

Age	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
0	-.49,	-.76,	.00,	-.07,	-.03,	-.36,	-.31,	-.16,	-.22,	2.40
1	.01,	-.38,	.22,	.29,	.10,	.11,	-.18,	-.03,	.05,	-.18
2	.12,	-.04,	.06,	.27,	.07,	.02,	-.01,	.03,	-.34,	-.18
3	.08,	-.11,	.41,	.12,	.05,	.11,	.18,	-.11,	-.29,	-.44
4	.12,	-.43,	.52,	.34,	.23,	-.30,	-.17,	.56,	-.28,	-.58
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	-14.4398	-13.9635	-14.0215	-14.2550	-14.4860
S.E(Log q)	.8740	.2031	.1656	.2449	.4062

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	4.03	-5.744	7.57	.31	10	1.65	-14.44
1	1.07	-.450	13.93	.84	10	.23	-13.96
2	.84	1.355	13.93	.90	10	.13	-14.02
3	1.06	-.202	14.35	.59	10	.27	-14.25
4	1.20	-.454	15.05	.40	10	.51	-14.49

Table 5.1.4.1 (Cont'd)

Fleet : FLT08: IBTS_Q2_SCO_I

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	No data for this fleet at this age									
1	99.99	99.99	99.99	.03	.43	.06	-.34	.83	-.19	-.83
2	99.99	99.99	99.99	-.13	.01	.07	-.32	.49	.12	-.24
3	99.99	99.99	99.99	-.37	-.23	.30	-.35	.38	.23	.03
4	99.99	99.99	99.99	.24	-.89	.25	-.45	.32	.44	.10
5	99.99	99.99	99.99	-.35	.20	.18	-.38	.64	.18	-.46
6	99.99	99.99	99.99	.05	.09	.35	-.49	.11	.65	-.76
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	-14.1311	-13.8172	-14.0013	-14.2717	-14.2276	-14.2666
S.E(Log q)	.5361	.2703	.3189	.4870	.4066	.4816

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	.54	1.938	14.17	.78	7	.24	-14.13
2	.72	.673	13.66	.53	7	.20	-13.82
3	1.21	-.362	14.29	.38	7	.42	-14.00
4	6.13	-2.069	28.02	.03	7	2.40	-14.27
5	1.25	-.559	15.17	.49	7	.54	-14.23
6	1.52	-.878	16.85	.37	7	.74	-14.27

Fleet : FLT10: FRAGFS_7d (Ca

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	-.65	-.61	-.44	1.04	.79	-.52	-.58	-.01	-.09	1.07
1	99.99	99.99	99.99	-.36	.00	-1.09	1.30	.06	-.02	.11
2	99.99	99.99	99.99	-.61	.11	-.20	.83	-.48	-.11	.47
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	0	1	2
Mean Log q	-10.2193	-9.2394	-10.1195
S.E(Log q)	.7043	.7090	.5145

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	1.56	-1.786	6.56	.56	10	.99	-10.22
1	1.24	-.253	8.06	.19	7	.96	-9.24
2	3.11	-.600	3.51	.02	7	1.69	-10.12

Table 5.1.4.1 (Cont'd)

Fleet : FLT11: IBTS_Q4_ENG_1

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	99.99	99.99	99.99	-.50	.08	-.02	-.03	.40	.07	99.99
1	99.99	99.99	99.99	-.15	-.21	-.21	-.03	.63	-.02	99.99
2	99.99	99.99	99.99	-.22	-.04	-.10	-.12	.38	.11	99.99
3	99.99	99.99	99.99	-.03	-.20	.11	-.23	.32	.04	99.99
4	99.99	99.99	99.99	.65	-.30	-.03	-.93	.28	.33	99.99
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	0	1	2	3	4
Mean Log q	-15.0182	-13.9530	-13.9335	-14.3236	-14.2310
S.E(Log q)	.2930	.3181	.2130	.2035	.5603

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	1.27	-.671	14.52	.60	6	.39	-15.02
1	1.27	-.311	13.85	.25	6	.45	-13.95
2	.92	.059	13.88	.12	6	.22	-13.93
3	.85	.572	14.07	.79	6	.19	-14.32
4	1.80	-.721	16.36	.17	6	1.06	-14.23

Table 5.1.4.1 (Cont'd)

Terminal year survivor and F summaries :

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

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT02: SCOLTR_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: FRATRB_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FRATRO_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: SCOGFS_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: ENGGFS_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT07: IBTS_Q1_IV (C,	1024554.,	.917,	.000,	.00,	1,	.165,	.000
FLT08: IBTS_Q2_SCO_I,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: FRAGFS_7d (Ca,	272761.,	.739,	.000,	.00,	1,	.254,	.000
FLT11: IBTS_Q4_ENG_I,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	29488.,	.50,,,,				.581,	.139

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
93211.,	.38,	1.51,	3,	3.998,	.046

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

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT02: SCOLTR_IV (Ca,	195352.,	.672,	.000,	.00,	1,	.052,	.148
FLT03: FRATRB_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FRATRO_IV (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: SCOGFS_IV (Ca,	435170.,	.578,	.000,	.00,	1,	.070,	.069
FLT06: ENGGFS_IV (Ca,	497222.,	.461,	.000,	.00,	1,	.110,	.061
FLT07: IBTS_Q1_IV (C,	186201.,	.285,	.011,	.04,	2,	.286,	.155
FLT08: IBTS_Q2_SCO_I,	97908.,	.573,	.000,	.00,	1,	.071,	.277
FLT10: FRAGFS_7d (Ca,	226875.,	.529,	.101,	.19,	2,	.082,	.129
FLT11: IBTS_Q4_ENG_I,	240978.,	.316,	.000,	.00,	1,	.224,	.122
F shrinkage mean ,	166037.,	.50,,,,				.106,	.172

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
224162.,	.15,	.14,	10,	.905,	.130

Table 5.1.4.1 (Cont'd)

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	166292.,	.566,	.000,	.00,	1,	.029,	.286
FLT02: SCOLTR_IV (Ca,	147305.,	.274,	.260,	.95,	2,	.121,	.318
FLT03: FRATRB_IV (Ca,	96400.,	.426,	.000,	.00,	1,	.051,	.452
FLT04: FRATRO_IV (Ca,	321878.,	.349,	.000,	.00,	1,	.075,	.158
FLT05: SCOGFS_IV (Ca,	323985.,	.370,	.041,	.11,	2,	.065,	.157
FLT06: ENGGFS_IV (Ca,	206376.,	.299,	.256,	.86,	2,	.099,	.237
FLT07: IBTS_Q1_IV (C,	170577.,	.208,	.082,	.40,	3,	.201,	.280
FLT08: IBTS_Q2_SCO_I,	146388.,	.266,	.020,	.08,	2,	.128,	.319
FLT10: FRAGFS_7d (Ca,	236605.,	.387,	.171,	.44,	3,	.056,	.209
FLT11: IBTS_Q4_ENG_I,	218652.,	.236,	.213,	.90,	2,	.129,	.225
F shrinkage mean ,	125045.,	.50,,,,				.048,	.365

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
184156.,	.09,	.08,	20,	.854,	.262

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	130447.,	.267,	.219,	.82,	2,	.083,	.415
FLT02: SCOLTR_IV (Ca,	125173.,	.205,	.062,	.30,	3,	.130,	.429
FLT03: FRATRB_IV (Ca,	86038.,	.247,	.150,	.61,	2,	.095,	.576
FLT04: FRATRO_IV (Ca,	157992.,	.276,	.129,	.47,	2,	.071,	.354
FLT05: SCOGFS_IV (Ca,	268615.,	.304,	.085,	.28,	3,	.056,	.223
FLT06: ENGGFS_IV (Ca,	164827.,	.250,	.145,	.58,	3,	.083,	.341
FLT07: IBTS_Q1_IV (C,	96603.,	.173,	.097,	.56,	4,	.171,	.527
FLT08: IBTS_Q2_SCO_I,	152007.,	.212,	.167,	.79,	3,	.118,	.365
FLT10: FRAGFS_7d (Ca,	107702.,	.382,	.165,	.43,	3,	.030,	.484
FLT11: IBTS_Q4_ENG_I,	159637.,	.184,	.188,	1.02,	3,	.126,	.350
F shrinkage mean ,	76127.,	.50,,,,				.037,	.631

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
129798.,	.07,	.07,	29,	.906,	.416

Table 5.1.4.1 (Cont'd)

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

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	53679.,	.207,	.089,	.43,	3,	.121,	.519
FLT02: SCOLTR_IV (Ca,	51102.,	.178,	.085,	.48,	4,	.148,	.539
FLT03: FRATRB_IV (Ca,	42102.,	.199,	.058,	.29,	3,	.127,	.625
FLT04: FRATRO_IV (Ca,	65122.,	.254,	.058,	.23,	3,	.069,	.445
FLT05: SCOGFS_IV (Ca,	83956.,	.286,	.136,	.48,	4,	.052,	.361
FLT06: ENGGFS_IV (Ca,	102952.,	.234,	.138,	.59,	4,	.078,	.304
FLT07: IBTS_Q1_IV (C,	42263.,	.169,	.107,	.63,	5,	.137,	.623
FLT08: IBTS_Q2_SCO_I,	70628.,	.206,	.131,	.64,	4,	.094,	.417
FLT10: FRAGFS_7d (Ca,	52033.,	.383,	.542,	1.41,	3,	.017,	.532
FLT11: IBTS_Q4_ENG_I,	61659.,	.161,	.096,	.60,	4,	.115,	.465
F shrinkage mean ,	31321.,	.50,,,,				.042,	.773

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
55610.,	.07,	.06,	38,	.847,	.505

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	17972.,	.198,	.116,	.58,	4,	.139,	.656
FLT02: SCOLTR_IV (Ca,	19032.,	.173,	.082,	.47,	5,	.184,	.629
FLT03: FRATRB_IV (Ca,	19637.,	.197,	.127,	.65,	4,	.132,	.614
FLT04: FRATRO_IV (Ca,	18152.,	.268,	.122,	.45,	4,	.058,	.651
FLT05: SCOGFS_IV (Ca,	29002.,	.274,	.155,	.57,	5,	.078,	.454
FLT06: ENGGFS_IV (Ca,	29619.,	.249,	.171,	.69,	5,	.071,	.446
FLT07: IBTS_Q1_IV (C,	17694.,	.172,	.067,	.39,	5,	.085,	.663
FLT08: IBTS_Q2_SCO_I,	17434.,	.219,	.198,	.90,	5,	.101,	.670
FLT10: FRAGFS_7d (Ca,	28270.,	.383,	.570,	1.49,	3,	.011,	.463
FLT11: IBTS_Q4_ENG_I,	21513.,	.162,	.109,	.67,	5,	.082,	.573
F shrinkage mean ,	10163.,	.50,,,,				.060,	.970

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
19401.,	.07,	.05,	46,	.716,	.620

Table 5.1.4.1 (Cont'd)

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	1784.,	.212,	.103,	.49,	5,	.197,	1.093
FLT02: SCOLTR_IV (Ca,	2141.,	.195,	.073,	.37,	6,	.218,	.976
FLT03: FRATRB_IV (Ca,	1969.,	.226,	.127,	.56,	5,	.165,	1.028
FLT04: FRATRO_IV (Ca,	2144.,	.292,	.072,	.25,	4,	.025,	.975
FLT05: SCOGFS_IV (Ca,	2916.,	.320,	.112,	.35,	6,	.074,	.795
FLT06: ENGGFS_IV (Ca,	2736.,	.273,	.157,	.58,	5,	.031,	.830
FLT07: IBTS_Q1_IV (C,	2521.,	.182,	.109,	.60,	5,	.033,	.877
FLT08: IBTS_Q2_SCO_I,	1407.,	.283,	.205,	.73,	6,	.090,	1.257
FLT10: FRAGFS_7d (Ca,	2175.,	.386,	.345,	.89,	3,	.003,	.966
FLT11: IBTS_Q4_ENG_I,	1687.,	.173,	.113,	.65,	5,	.030,	1.131
F shrinkage mean ,	1705.,	.50,,,,				.133,	1.123

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1958.,	.10,	.04,	51,	.410,	1.032

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	516.,	.247,	.189,	.77,	6,	.190,	1.034
FLT02: SCOLTR_IV (Ca,	693.,	.219,	.060,	.27,	7,	.279,	.854
FLT03: FRATRB_IV (Ca,	549.,	.255,	.262,	1.03,	6,	.203,	.994
FLT04: FRATRO_IV (Ca,	783.,	.303,	.182,	.60,	4,	.012,	.786
FLT05: SCOGFS_IV (Ca,	872.,	.318,	.157,	.49,	6,	.037,	.729
FLT06: ENGGFS_IV (Ca,	572.,	.281,	.102,	.36,	5,	.016,	.969
FLT07: IBTS_Q1_IV (C,	700.,	.179,	.082,	.46,	5,	.016,	.849
FLT08: IBTS_Q2_SCO_I,	1084.,	.283,	.147,	.52,	6,	.045,	.622
FLT10: FRAGFS_7d (Ca,	583.,	.382,	.182,	.48,	3,	.002,	.956
FLT11: IBTS_Q4_ENG_I,	559.,	.190,	.221,	1.16,	4,	.013,	.982
F shrinkage mean ,	877.,	.50,,,,				.185,	.726

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
669.,	.13,	.06,	53,	.439,	.874

Table 5.1.4.2

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:03

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE								
0,	.0052,	.0103,	.0033,	.0205,	.0234,	.0072,	.0051,	.0054,
1,	.2153,	.7628,	.3319,	.1458,	.1680,	.2216,	.4089,	.4106,
2,	.4675,	.9702,	.6349,	.8740,	.2391,	.5053,	.6945,	.5534,
3,	1.4903,	1.4009,	.9613,	.8620,	.6104,	.4462,	.9711,	.7669,
4,	2.3428,	1.2854,	.9435,	1.0411,	.5977,	.7130,	.9243,	.8670,
5,	1.5743,	1.5244,	.9967,	.9359,	.8686,	.4736,	1.2559,	.7773,
6,	1.9538,	2.0047,	2.8062,	1.0115,	.8927,	.8651,	1.7693,	1.1218,
7,	1.9846,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,	.9321,
+gp,	1.9846,	1.6266,	1.6035,	1.0075,	.7943,	.6903,	1.3333,	.9321,
FBAR 2- 6,	1.5657,	1.4371,	1.2685,	.9449,	.6417,	.6006,	1.1230,	.8173,

Table 8 Fishing mortality (F) at age YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	.0267,	.1698,	.1035,	.0616,	.0206,	.0132,	.0208,	.0137,	.0252,	.0393,
1,	.1582,	.8141,	.7672,	.3989,	.3263,	.2881,	.4009,	.2261,	.1740,	.4265,
2,	.7992,	.5557,	.8249,	.5332,	.7060,	.8016,	.8535,	.7652,	.9250,	.4841,
3,	.8448,	.8065,	.9616,	.5664,	.6008,	1.0497,	1.0324,	.9642,	1.2525,	.8240,
4,	1.0291,	.6468,	.8281,	.6989,	.5793,	.6302,	.9988,	.9276,	1.0533,	.9530,
5,	.8397,	1.0029,	.6420,	.5874,	.9531,	1.4145,	.3600,	.9906,	.8414,	.9059,
6,	1.1436,	.4957,	.9761,	.2647,	.9982,	.9874,	2.0110,	2.2622,	1.3526,	.8900,
7,	1.0156,	.7220,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,	.9263,
+gp,	1.0156,	.7220,	.8238,	.5211,	.8524,	1.0222,	1.1367,	1.4116,	1.0952,	.9263,
FBAR 2- 6,	.9313,	.7015,	.8465,	.5301,	.7675,	.9767,	1.0511,	1.1819,	1.0850,	.8114,

Table 5.1.4.2 (Cont'd)

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:03

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	.0395,	.0297,	.0526,	.0717,	.0161,	.0695,	.0231,	.0133,	.0191,	.0103,
1,	.1565,	.2327,	.1016,	.1653,	.1736,	.2105,	.2235,	.1903,	.2709,	.1407,
2,	.4059,	.4792,	.4409,	.3299,	.2935,	.4559,	.5172,	.2497,	.4261,	.5109,
3,	.6314,	.7344,	.8236,	.7540,	.5326,	.7478,	.8734,	.6368,	.7061,	.8728,
4,	.8465,	.7083,	.9772,	1.0018,	.7239,	.7381,	1.0318,	.8799,	1.2001,	1.2512,
5,	.7477,	.8434,	1.2439,	1.1024,	.9020,	.8937,	1.0609,	1.1795,	1.0668,	1.3789,
6,	1.1122,	.8853,	.9799,	1.3318,	1.0284,	.9409,	1.1720,	1.2288,	1.2023,	1.7972,
7,	.9120,	.8207,	1.0795,	1.1592,	.8943,	.8666,	1.1011,	1.1091,	1.1704,	1.4953,
+gp,	.9120,	.8207,	1.0795,	1.1592,	.8943,	.8666,	1.1011,	1.1091,	1.1704,	1.4953,
FBAR 2- 6,	.7487,	.7301,	.8931,	.9040,	.6961,	.7553,	.9311,	.8350,	.9203,	1.1622,

Table 8 Fishing mortality (F) at age YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
0,	.0261,	.0120,	.0416,	.1488,	.0338,	.0877,	.0348,	.3411,	.0382,	.0462,	.1418,
1,	.3587,	.1289,	.2262,	.1167,	.2406,	.1863,	.1491,	.1385,	.1074,	.1303,	.1254,
2,	.4313,	.4317,	.5477,	.4863,	.3869,	.4825,	.3271,	.3218,	.2731,	.2616,	.2855,
3,	.6634,	.6977,	.9134,	.5162,	.5758,	.7544,	.6935,	.5751,	.5048,	.4163,	.4987,
4,	.9749,	.8429,	.9893,	.8898,	.6308,	.8208,	.9069,	.7899,	.6558,	.5048,	.6502,
5,	1.1703,	1.5503,	1.2602,	1.1246,	.9512,	.8444,	.9825,	.9677,	1.0369,	.6197,	.8747,
6,	1.3028,	1.6361,	1.0927,	.8092,	1.2058,	1.1170,	1.0146,	1.0127,	1.1817,	1.0319,	1.0754,
7,	1.3965,	1.5903,	1.4013,	1.1178,	1.3381,	1.0413,	1.0530,	.8576,	.8288,	.8742,	.8535,
+gp,	1.3965,	1.5903,	1.4013,	1.1178,	1.3381,	1.0413,	1.0530,	.8576,	.8288,	.8742,	
FBAR 2- 6,	.9086,	1.0318,	.9606,	.7652,	.7501,	.8038,	.7849,	.7334,	.7305,	.5669,	

Table 5.1.4.3

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:03

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,	1967,
AGE								
0,	418662,	753409,	836669,	187022,	363404,	319605,	598136,	1175464,
1,	40092,	32520,	58225,	65115,	14307,	27720,	24777,	46468,
2,	8700,	12502,	5865,	16157,	21766,	4677,	8590,	6367,
3,	3312,	3476,	3021,	1982,	4299,	10927,	1799,	2735,
4,	276,	526,	603,	814,	590,	1645,	4928,	480,
5,	333,	20,	108,	174,	213,	240,	597,	1449,
6,	48,	54,	3,	31,	53,	70,	117,	133,
7,	11,	5,	6,	0,	9,	17,	23,	15,
+gp,	30,	5,	2,	2,	1,	3,	7,	3,
TOTAL,	471464,	802516,	904503,	271298,	404641,	364904,	638974,	1233113,

Table 10 Stock number at age (start of year)							Numbers*10**-5			
YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
0,	142165,	276448,	431881,	738870,	970349,	477830,	993438,	627078,	611977,	619446,
1,	91286,	10808,	18215,	30405,	54247,	74219,	36819,	75972,	48296,	46596,
2,	11919,	30139,	1852,	3271,	7891,	15139,	21519,	9536,	23437,	15695,
3,	2334,	3417,	11025,	517,	1224,	2484,	4331,	5844,	2829,	5926,
4,	895,	707,	1075,	2970,	207,	473,	613,	1087,	1570,	570,
5,	149,	237,	274,	348,	1094,	86,	187,	167,	318,	406,
6,	519,	50,	68,	112,	151,	228,	16,	101,	48,	107,
7,	34,	129,	24,	20,	67,	43,	95,	2,	8,	10,
+gp,	2,	15,	29,	17,	19,	9,	7,	22,	11,	8,
TOTAL,	249304,	321950,	464443,	776530,	1035248,	570612,	1057025,	719810,	688495,	688764,

Table 5.1.4.3 (Cont'd)

Run title : Whiting IV,VIId (run: XSAPAK05/X05)

At 10-Oct-98 12:38:03

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-5 YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
0,	635272,	582795,	232017,	267431,	226693,	356460,	247246,	507182,	426974,	297092,
1,	46504,	47683,	44174,	17188,	19437,	17418,	25965,	18864,	39080,	32710,
2,	11764,	15380,	14613,	15434,	5634,	6319,	5457,	8030,	6031,	11527,
3,	6167,	4999,	6073,	5996,	7075,	2679,	2554,	2075,	3989,	2512,
4,	1832,	2312,	1690,	1878,	1988,	2927,	894,	751,	773,	1387,
5,	163,	582,	843,	471,	511,	714,	1037,	236,	231,	173,
6,	128,	60,	195,	189,	122,	161,	228,	279,	56,	62,
7,	34,	33,	19,	57,	39,	34,	49,	55,	64,	13,
+gp,	5,	6,	13,	5,	9,	17,	10,	15,	9,	14,
TOTAL,	701868,	653848,	299638,	308650,	261508,	386731,	283439,	537488,	477208,	345490,

Table 10 Stock number at age (start of year) Numbers*10**-5 YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 60-95	AMST 60-95
AGE													
0,	579862,	261260,	250389,	268000,	272603,	265468,	226673,	194566,	87858,	(12502,)*	0,	401291,	462218,
1,	22960,	44112,	20156,	18755,	18034,	20578,	18989,	17093,	10801,	6603,	(932,)	31044,	35716,
2,	10989,	6203,	14997,	6217,	6454,	5483,	6606,	6326,	5756,	3752,	2242,	9185,	10791,
3,	4410,	4552,	2569,	5530,	2437,	2795,	2158,	3037,	2924,	2793,	1842,	3399,	3975,
4,	739,	1601,	1597,	726,	2326,	966,	926,	760,	1204,	1244,	1298,	1024,	1281,
5,	294,	207,	510,	440,	221,	917,	315,	277,	256,	463,	556,	303,	404,
6,	34,	71,	34,	113,	111,	66,	307,	92,	82,	71,	194,	85,	120,
7,	8,	7,	11,	9,	39,	26,	17,	87,	26,	20,	20,	19,	31,
+gp,	2,	5,	2,	4,	2,	13,	8,	9,	22,	9,	10,		
TOTAL,	619300,	318018,	290264,	299794,	302227,	296312,	255998,	222247,	108927,	27454,	7093,		

* overwritten in prediction by the short term geometric mean (1989-1995).

TABLE 5.1.6.1; Whiting, North Sea and VIId
Mean fishing mortality, biomass and recruitment, 1960 - 1997.

	Mean F			Stock Biomass		Recruits	
	H cons	Disc	IBC	('000 tonnes)		Age 0	
	Ages	Ages	Ages				
Year	2 to 6	2 to 6	0 to 4	Total	Spawning	Yclass	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	61945
1978	.595	.071	.096	776	452	1978	63527
1979	.569	.066	.098	950	514	1979	58279
1980	.624	.200	.088	836	520	1980	23202
1981	.674	.079	.163	636	488	1981	26743
1982	.488	.097	.094	491	378	1982	22669
1983	.563	.138	.066	512	337	1983	35646
1984	.747	.124	.065	484	271	1984	24725
1985	.700	.078	.053	440	270	1985	50718
1986	.721	.142	.052	662	288	1986	42697
1987	.954	.152	.068	536	298	1987	29709
1988	.705	.104	.157	417	294	1988	57986
1989	.617	.186	.136	561	279	1989	26126
1990	.484	.275	.178	483	317	1990	25039
1991	.522	.122	.113	458	277	1991	26800
1992	.542	.123	.094	407	266	1992	27260
1993	.509	.218	.080	381	240	1993	26547
1994	.558	.196	.043	373	229	1994	22667
1995	.567	.142	.107	386	245	1995	19457
1996	.548	.163	.024	317	223	1996	8786
1997	.403	.112	.037	255	197	1997	(1250)*
Min.	.377	.066	.013	255	197	Min.	19457
Mean	.633	.169	.104	681	371	Gmean	28936
Max.	1.106	.443	.284	1380	631	Max.	57986

Min, max and geo. mean recruitment calculated over years 1986 to 1995
(Arithmetic mean recruitment 1986 - 1995 = 30429)
Biomass totals calculated at start of year.

* overwritten in prediction by short term geometric mean recruitment (1989-1995)

Whiting in the North Sea (Fishing Areas IV and VIId)

Multi fleet prediction with mangement option table: Input data

1998	H Cons		Dis		IBC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0010	0.144	0.0120	0.031	0.1290	0.010	24691.469	2.5500	0.0000	0.0000	0.0000	0.017
1	0.0110	0.175	0.0480	0.107	0.0660	0.059	1840.701	0.9500	0.1100	0.0000	0.0000	0.088
2	0.0680	0.236	0.1610	0.165	0.0560	0.149	224.198	0.4500	0.9200	0.0000	0.0000	0.177
3	0.2630	0.286	0.2190	0.205	0.0170	0.268	184.199	0.3500	1.0000	0.0000	0.0000	0.250
4	0.5010	0.343	0.1380	0.228	0.0120	0.314	129.800	0.3000	1.0000	0.0000	0.0000	0.318
5	0.7640	0.388	0.1060	0.254	0.0040	0.397	55.559	0.2500	1.0000	0.0000	0.0000	0.372
6	0.9350	0.417	0.0690	0.256	0.0720	0.624	19.399	0.2500	1.0000	0.0000	0.0000	0.447
7	0.8070	0.423	0.0460	0.418	0.0000	0.000	1.998	0.2000	1.0000	0.0000	0.0000	0.416
8+	0.8390	0.424	0.0140	0.214	0.0000	0.000	0.999	0.2000	1.0000	0.0000	0.0000	0.423
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

1999	H Cons		Dis		IBC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0010	0.144	0.0120	0.031	0.1290	0.010	24691.500	2.5500	0.0000	0.0000	0.0000	0.017
1	0.0110	0.175	0.0480	0.107	0.0660	0.059	.	0.9500	0.1100	0.0000	0.0000	0.088
2	0.0680	0.236	0.1610	0.165	0.0560	0.149	.	0.4500	0.9200	0.0000	0.0000	0.177
3	0.2630	0.286	0.2190	0.205	0.0170	0.268	.	0.3500	1.0000	0.0000	0.0000	0.250
4	0.5010	0.343	0.1380	0.228	0.0120	0.314	.	0.3000	1.0000	0.0000	0.0000	0.318
5	0.7640	0.388	0.1060	0.254	0.0040	0.397	.	0.2500	1.0000	0.0000	0.0000	0.372
6	0.9350	0.417	0.0690	0.256	0.0720	0.624	.	0.2500	1.0000	0.0000	0.0000	0.447
7	0.8070	0.423	0.0460	0.418	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.416
8+	0.8390	0.424	0.0140	0.214	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.423
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

(cont.)

Table 5.1.7.1 (Cont'd)

The SAS System

Whiting in the North Sea (Fishing Areas IV and VIId)

Multi fleet prediction with mangement option table: Input data

(cont.)

2000	H Cons		Dis		IBC							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0010	0.144	0.0120	0.031	0.1290	0.010	24691.500	2.5500	0.0000	0.0000	0.0000	0.017
1	0.0110	0.175	0.0480	0.107	0.0660	0.059	.	0.9500	0.1100	0.0000	0.0000	0.088
2	0.0680	0.236	0.1610	0.165	0.0560	0.149	.	0.4500	0.9200	0.0000	0.0000	0.177
3	0.2630	0.286	0.2190	0.205	0.0170	0.268	.	0.3500	1.0000	0.0000	0.0000	0.250
4	0.5010	0.343	0.1380	0.228	0.0120	0.314	.	0.3000	1.0000	0.0000	0.0000	0.318
5	0.7640	0.388	0.1060	0.254	0.0040	0.397	.	0.2500	1.0000	0.0000	0.0000	0.372
6	0.9350	0.417	0.0690	0.256	0.0720	0.624	.	0.2500	1.0000	0.0000	0.0000	0.447
7	0.8070	0.423	0.0460	0.418	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.416
8+	0.8390	0.424	0.0140	0.214	0.0000	0.000	.	0.2000	1.0000	0.0000	0.0000	0.423
Unit	-	Kilograms	-	Kilograms	-	Kilograms	Millions	-	-	-	-	Kilograms

Notes: Run name : MANPAK03
Date and time: 10OCT98:16:34

Table 5.1.7.2

The SAS System

Whiting in the North Sea (Fishing Areas IV and VIId)

Multi fleet prediction with mangement option table

Year: 1998												
H Cons			Dis			IBC			Total			
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	
1.0000	0.5062	44402	1.0000	0.1386	22513	1.0000	0.0560	18164	85080	739339	172246	
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	

Year: 1999												Year: 2000	
H Cons			Dis			IBC			Total				
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	Stock biomass	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0560	20706	20706	759400	199741	840884	279831
0.1000	0.0506	4918	0.1000	0.0139	2904	1.0000	0.0560	20598	28420	.	199741	833329	272498
0.2000	0.1012	9556	0.2000	0.0277	5737	1.0000	0.0560	20492	35786	.	199741	826146	265537
0.3000	0.1519	13934	0.3000	0.0416	8502	1.0000	0.0560	20390	42826	.	199741	819309	258923
0.4000	0.2025	18070	0.4000	0.0554	11201	1.0000	0.0560	20291	49562	.	199741	812798	252633
0.5000	0.2531	21982	0.5000	0.0693	13837	1.0000	0.0560	20195	56014	.	199741	806590	246645
0.6000	0.3037	25685	0.6000	0.0832	16413	1.0000	0.0560	20102	62200	.	199741	800665	240941
0.7000	0.3543	29192	0.7000	0.0970	18932	1.0000	0.0560	20011	68136	.	199741	795006	235502
0.8000	0.4050	32519	0.8000	0.1109	21396	1.0000	0.0560	19923	73837	.	199741	789596	230311
0.9000	0.4556	35676	0.9000	0.1247	23807	1.0000	0.0560	19836	79319	.	199741	784419	225353
1.0000	0.5062	38676	1.0000	0.1386	26167	1.0000	0.0560	19753	84595	.	199741	779462	220614
1.1000	0.5568	41529	1.1000	0.1525	28478	1.0000	0.0560	19671	89678	.	199741	774709	216079
1.2000	0.6074	44244	1.2000	0.1663	30742	1.0000	0.0560	19591	94578	.	199741	770150	211737
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPAK03
Date and time : 10OCT98:16:34
Computation of ref. F: H Cons: Simple mean, age 2 - 6
Dis: Simple mean, age 2 - 6
IBC: Simple mean, age 0 - 4
Basis for 1998 : F factors

Table 5.1.7.3

Multi fleet prediction: Detailed tables

Year 1998.	H Cons	F-factor 1.0000 and reference F 0.5062
	Dis	F-factor 1.0000 and reference F 0.1386
	IBC	F-factor 1.0000 and reference F 0.0560

	H Cons			Dis			IBC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0010	8551	1231	0.0120	102610	3181	0.1290	1103052	11031	1214213	15443	24691469	419755	0	0	0	0
1	0.0110	12407	2171	0.0480	54138	5793	0.0660	74440	4392	140985	12356	1840701	161982	202477	17818	202477	17818
2	0.0680	10796	2548	0.1610	25562	4218	0.0560	8891	1325	45249	8090	224198	39683	206262	36508	206262	36508
3	0.2630	32648	9337	0.2190	27186	5573	0.0170	2110	566	61943	15476	184199	46050	184199	46050	184199	46050
4	0.5010	41961	14393	0.1380	11558	2635	0.0120	1005	316	54525	17344	129800	41276	129800	41276	129800	41276
5	0.7640	25492	9891	0.1060	3537	898	0.0040	133	53	29162	10842	55559	20668	55559	20668	55559	20668
6	0.9350	10047	4189	0.0690	741	190	0.0720	774	483	11562	4862	19399	8671	19399	8671	19399	8671
7	0.8070	997	422	0.0460	57	24	0.0000	0	0	1054	445	1998	831	1998	831	1998	831
8+	0.8390	518	220	0.0140	9	2	0.0000	0	0	527	222	999	423	999	423	999	423
Total		143416	44402		225397	22513		1190406	18164	1559219	85080	27148322	739339	800693	172246	800693	172246
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year 1999.	H Cons	F-factor 1.0000 and reference F 0.5062
	Dis	F-factor 1.0000 and reference F 0.1386
	IBC	F-factor 1.0000 and reference F 0.0560

	H Cons			Dis			IBC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0010	8551	1231	0.0120	102610	3181	0.1290	1103054	11031	1214214	15443	24691500	419756	0	0	0	0
1	0.0110	11275	1973	0.0480	49198	5264	0.0660	67647	3991	128120	11228	1672731	147200	184000	16192	184000	16192
2	0.0680	30252	7139	0.1610	71626	11818	0.0560	24913	3712	126792	22670	628227	111196	577969	102301	577969	102301
3	0.2630	19054	5449	0.2190	15866	3253	0.0170	1232	330	36152	9032	107504	26876	107504	26876	107504	26876
4	0.5010	25477	8739	0.1380	7018	1600	0.0120	610	192	33105	10530	78808	25061	78808	25061	78808	25061
5	0.7640	23009	8928	0.1060	3192	811	0.0040	120	48	26322	9786	50149	18655	50149	18655	50149	18655
6	0.9350	9351	3899	0.0690	690	177	0.0720	720	449	10761	4525	18055	8071	18055	8071	18055	8071
7	0.8070	2570	1087	0.0460	147	61	0.0000	0	0	2717	1149	5151	2143	5151	2143	5151	2143
8+	0.8390	542	230	0.0140	9	2	0.0000	0	0	552	232	1046	442	1046	442	1046	442
Total		130081	38676		250356	26167		1198297	19753	1578734	84595	27253172	759400	1022683	199741	1022683	199741
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year 2000.	H Cons	F-factor 1.0000 and reference F	0.5062
	Dis	F-factor 1.0000 and reference F	0.1386
	IBC	F-factor 1.0000 and reference F	0.0560

	H Cons			Dis			IBC			Total				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Absolute F	Catch in numbers	Catch in weight	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0	0.0010	8551	1231	0.0120	102610	3181	0.1290	1103054	11031	1214214	15443	24691500	419756	0	0	0	0
1	0.0110	11275	1973	0.0480	49198	5264	0.0660	67647	3991	128120	11228	1672733	147201	184001	16192	184001	16192
2	0.0680	27491	6488	0.1610	65090	10740	0.0560	22640	3373	115221	20601	570899	101049	525227	92965	525227	92965
3	0.2630	53392	15270	0.2190	44459	9114	0.0170	3451	925	101302	25309	301238	75310	301238	75310	301238	75310
4	0.5010	14869	5100	0.1380	4096	934	0.0120	356	112	19321	6146	45995	14626	45995	14626	45995	14626
5	0.7640	13970	5420	0.1060	1938	492	0.0040	73	29	15982	5942	30448	11327	30448	11327	30448	11327
6	0.9350	8440	3520	0.0690	623	159	0.0720	650	406	9713	4085	16297	7285	16297	7285	16297	7285
7	0.8070	2392	1012	0.0460	136	57	0.0000	0	0	2529	1069	4794	1994	4794	1994	4794	1994
8+	0.8390	1122	476	0.0140	19	4	0.0000	0	0	1140	480	2162	915	2162	915	2162	915
Total		141502	40490		268169	29946		1197872	19866	1607543	90302	27336068	779462	1110163	220614	1110163	220614
Unit	-	Thousands	Tonnes	-	Thousands	Tonnes	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

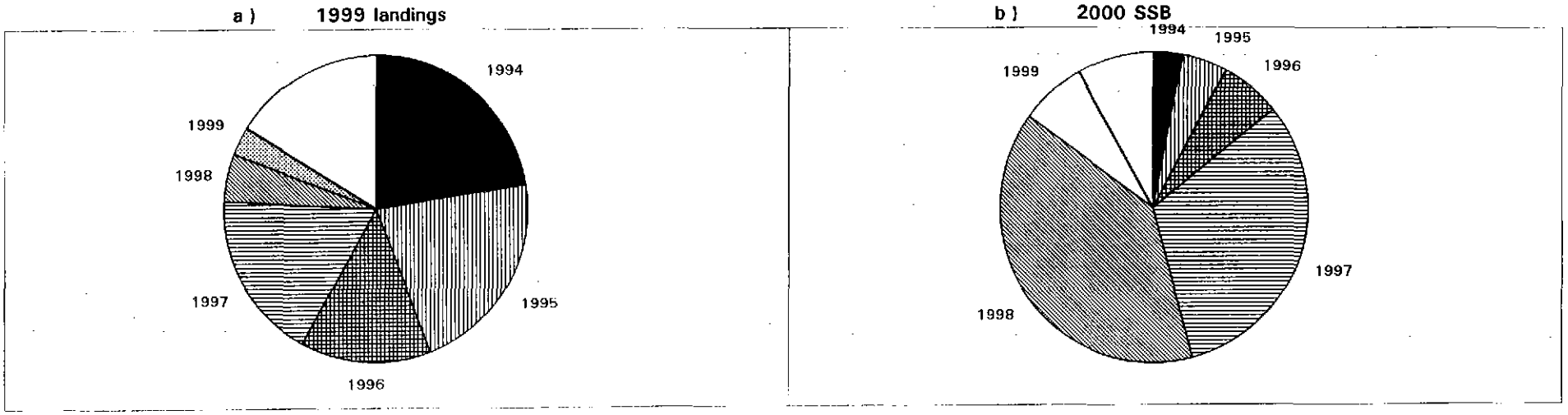
Notes: Run name : SPRPAK01
Date and time : 10OCT98:16:19
Computation of ref. F: H Cons: Simple mean, age 2 - 6
Dis: Simple mean, age 2 - 6
IBC: Simple mean, age 0 - 4
Prediction basis : F factors

Table 5.1.7.4 **Whiting in IV and VIId**
Stock numbers of recruits and their source for recent year classes used inpredictions, and the relative (%) contributions to human consumption landings and SSB (by weight) of these year classes

Year-class	1994	1995	1996	1997	1998	1999
Stock No. (thousands) of 0 year-olds	22667000	19457000	8786000	24691000	24691000	24691000
Source	XSA	XSA	XSA	GM	GM	GM
Status Quo F:						
% in 1998 landings	32.4	21.0	5.7	4.9	2.8	-
% in 1999	23.1	22.6	14.1	18.5	5.1	3.2
% in 1998 SSB	24.0	26.7	21.2	10.3	0.0	-
% in 1999 SSB	9.3	12.5	13.5	51.2	8.1	0.0
% in 2000 SSB	3.3	5.1	6.6	34.1	42.1	7.3

GM : geometric mean recruitment

Whiting in IV and VIId : Year-class % contribution to



T-5174.XLS

Table5.1.7.5 Whiting,North Sea and VIId
Input data for catch forecast and linear sensitivity analysis.

Populations in 1998			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N0	24691469	.12	WS0	.02	.44	M0	2.55	.09	MT0	.00	.10
N1	1840701	1.51	WS1	.09	.01	M1	.95	.11	MT1	.11	.10
N2	224198	.15	WS2	.18	.04	M2	.45	.26	MT2	.92	.10
N3	184199	.09	WS3	.25	.03	M3	.35	.14	MT3	1.00	.10
N4	129800	.07	WS4	.32	.06	M4	.30	.14	MT4	1.00	.00
N5	55599	.07	WS5	.37	.08	M5	.25	.14	MT5	1.00	.00
N6	19399	.07	WS6	.45	.07	M6	.25	.14	MT6	1.00	.00
N7	1998	.10	WS7	.42	.07	M7	.20	.14	MT7	1.00	.00
N8	999	.13	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	1.28	WH0	.14	.04	sD0	.01	1.30	WD0	.03	.02
sH1	.01	.30	WH1	.18	.02	sD1	.05	.23	WD1	.11	.15
sH2	.07	.33	WH2	.24	.07	sD2	.16	.15	WD2	.16	.09
sH3	.26	.16	WH3	.29	.05	sD3	.22	.07	WD3	.20	.04
sH4	.50	.12	WH4	.34	.06	sD4	.14	.02	WD4	.23	.02
sH5	.76	.10	WH5	.39	.08	sD5	.11	.31	WD5	.25	.10
sH6	.93	.05	WH6	.42	.04	sD6	.07	.68	WD6	.26	.04
sH7	.81	.28	WH7	.42	.08	sD7	.05	1.28	WD7	.42	.41
sH8	.84	.20	WH8	.42	.01	sD8	.01	1.23	WD8	.21	.88

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI0	.13	.79	WI0	.01	.46
sI1	.07	.43	WI1	.06	.18
sI2	.06	.77	WI2	.15	.06
sI3	.02	.40	WI3	.27	.14
sI4	.01	.59	WI4	.31	.28
sI5	.00	.96	WI5	.40	.25
sI6	.07	.92	WI6	.62	.89
sI7	.00	.00	WI7	.00	.00
sI8	.00	.00	WI8	.00	.00

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K98	1.00	.23	HF98	1.00	.17	IF98	1.00	.80
K99	1.00	.23	HF99	1.00	.17	IF99	1.00	.80
K**	1.00	.23	HF**	1.00	.17	IF**	1.00	.80

Recruitment		
Labl	Value	CV
R99	24691500	.12
R**	24691500	.12

Proportion F before spawning= .00
Proportion M before spawning= .00
Stock numbers in 1998 are VPA survivors.

Human consumption + discard Fs are obtained from mean exploitation pattern over 1995 to 1997.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1997, i.e. .515
Fs are distributed between consumption and discards by mean proportion retained over 1995 to 1997.
N.B. Above value for H cons+Disc ref F is value for both catch categories combined.

Bycatch Fs are obtained from mean exploitation pattern over 1995 to 1997.
This is scaled to give a value for mean F (ages 0 to 4) equal to that in 1997, i.e. .037

Table 5.1.10.1

Whiting in the North Sea (Fishing Areas IV and VIId)

Multi fleet yield per recruit: Summary table

H Cons			Dis			IBC			Total			1 January		Spawning time	
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	1.0000	0.0560	1	1	1156	50	93	27	93	27
0.1000	0.0506	1	0.1000	0.0139	0	1.0000	0.0560	1	2	1141	44	78	21	78	21
0.2000	0.1012	1	0.2000	0.0277	0	1.0000	0.0560	1	3	1133	41	70	18	70	18
0.3000	0.1519	2	0.3000	0.0416	1	1.0000	0.0560	1	3	1127	38	64	16	64	16
0.4000	0.2025	2	0.4000	0.0554	1	1.0000	0.0560	1	3	1123	37	60	14	60	14
0.5000	0.2531	2	0.5000	0.0693	1	1.0000	0.0560	1	4	1119	36	57	13	57	13
0.6000	0.3037	2	0.6000	0.0832	1	1.0000	0.0560	1	4	1117	35	54	12	54	12
0.7000	0.3543	2	0.7000	0.0970	1	1.0000	0.0560	1	4	1115	34	52	11	52	11
0.8000	0.4050	2	0.8000	0.1109	1	1.0000	0.0560	1	4	1113	33	50	11	50	11
0.9000	0.4556	2	0.9000	0.1247	1	1.0000	0.0560	1	4	1111	33	49	10	49	10
1.0000	0.5062	2	1.0000	0.1386	1	1.0000	0.0560	1	4	1109	32	47	10	47	10
1.1000	0.5568	2	1.1000	0.1525	1	1.0000	0.0560	1	4	1108	32	46	9	46	9
1.2000	0.6074	2	1.2000	0.1663	1	1.0000	0.0560	1	4	1107	32	45	9	45	9
1.3000	0.6581	2	1.3000	0.1802	1	1.0000	0.0560	1	4	1106	31	44	9	44	9
1.4000	0.7087	2	1.4000	0.1940	2	1.0000	0.0560	1	4	1104	31	43	8	43	8
1.5000	0.7593	2	1.5000	0.2079	2	1.0000	0.0560	1	4	1103	31	42	8	42	8
1.6000	0.8099	2	1.6000	0.2218	2	1.0000	0.0560	1	4	1103	30	41	8	41	8
1.7000	0.8605	2	1.7000	0.2356	2	1.0000	0.0560	1	4	1102	30	40	8	40	8
1.8000	0.9112	2	1.8000	0.2495	2	1.0000	0.0560	1	4	1101	30	39	7	39	7
1.9000	0.9618	2	1.9000	0.2633	2	1.0000	0.0560	1	4	1100	30	39	7	39	7
2.0000	1.0124	2	2.0000	0.2772	2	1.0000	0.0560	1	5	1099	30	38	7	38	7
-	-	Tonnes	-	-	Tonnes	-	-	Tonnes	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDPAK02
Date and time : 10OCT98:16:41
Computation of ref. F: H Cons: Simple mean, age 2 - 6
Dis: Simple mean, age 2 - 6
IBC: Simple mean, age 0 - 4
Recruitment : 1000000 (Number)

Table 5.1.12.1 Whiting In IV and VIId Reference points ASSUMING THE TRUNCATED STOCK AND RECRUIT DATA SERIES.

Biomass

WGNSSK

B_{loss}	200,000t
B_{lim}	200,000t
B_{PA}	280,000t
MBAL	not defined

SGPAFM

B_{loss}	240,000t
B_{lim}	240,000t
B_{PA}	350,000t
MBAL	not defined

Fishing Mortality

	estimate	prob SSB<B_{PA} in 2007	% above historical Human consumption F
$F_{0.1}$	0.33	= 0.15	100%
$F_{loss}.e^{(-1.645.\sigma)}$	0.42	<0.50	100%
F_{35SPR}	0.55	> 0.50	95%
F_{med}	0.56	>0.50	95%
F_{loss}	0.58	>0.50	95%

F range from the 1977 to date series: 0.57 - 1.16
F range from the full historic time series: 0.53 - 1.56

SSB range from the 1977 to date series: 197kt - 599kt
SSB range from the full historic time series: 197kt - 631kt

Ricker stock and recruitment plot was fitted to the truncated data series using RECRUIT.EXE

Table 5.2.1.1 Nominal landings (in tonnes) of WHITING from Division IIIa as supplied by the Study Group on Division IIIa Demersal Stocks (Anon., 1992b) and updated by the Working Group.

Year	Denmark			Norway	Sweden	Others	Total
1975		19,018		57	611	4	19,690
1976		17,870		48	1,002	48	18,968
1977		18,116		46	975	41	19,178
1978		48,102		58	899	32	49,091
1979		16,971		63	1,033	16	18,083
1980		21,070		65	1,516	3	22,654
	Total consumption	Total industrial	Total				
1981	1,027	23,915	24,942	70	1,054	7	26,073
1982	1,183	39,758	40,941	40	670	13	41,664
1983	1,311	23,505	24,816	48	1,061	8	25,933
1984	1,036	12,102	13,138	51	1,168	60	14,417
1985	557	11,967	12,524	45	654	2	13,225
1986	484	11,979	12,463	64	477	1	13,005
1987	443	15,880	16,323	29	262	43	16,657
1988	391	10,872	11,263	42	435	24	11,764
1989	917	11,662	12,579	29	675	-	13,283
1990	1,016	17,829	18,845	49	456	73	19,423
1991	871	12,463	13,344	56	527	97	14,041
1992	555	10,675	11,230	66	959	1	12,256
1993	261	3,581	3,565	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	182	-	2,926
1997	38	568	606	18	129		753

[1]Preliminary.

Figure 5.1.4.1 Whiting in Divisions IV and VIId Residuals from a separable VPA fit

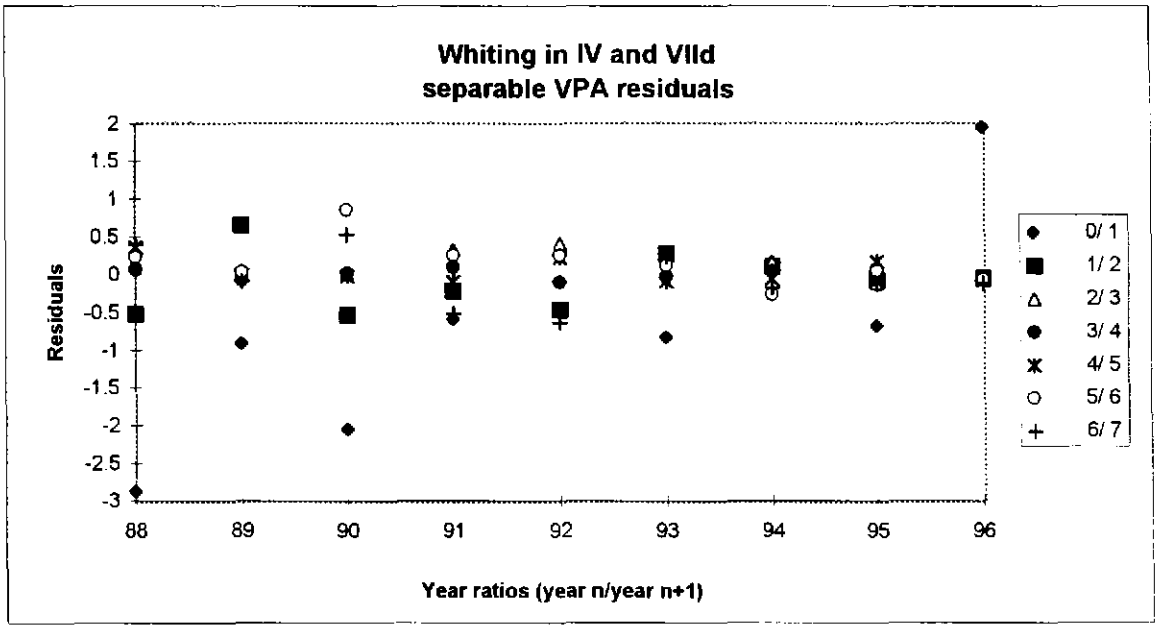


Figure 5.1.4.2 Whiting in Divisions IV and VIId
Effect of 0gp model on index vs XSA relationship at age 0

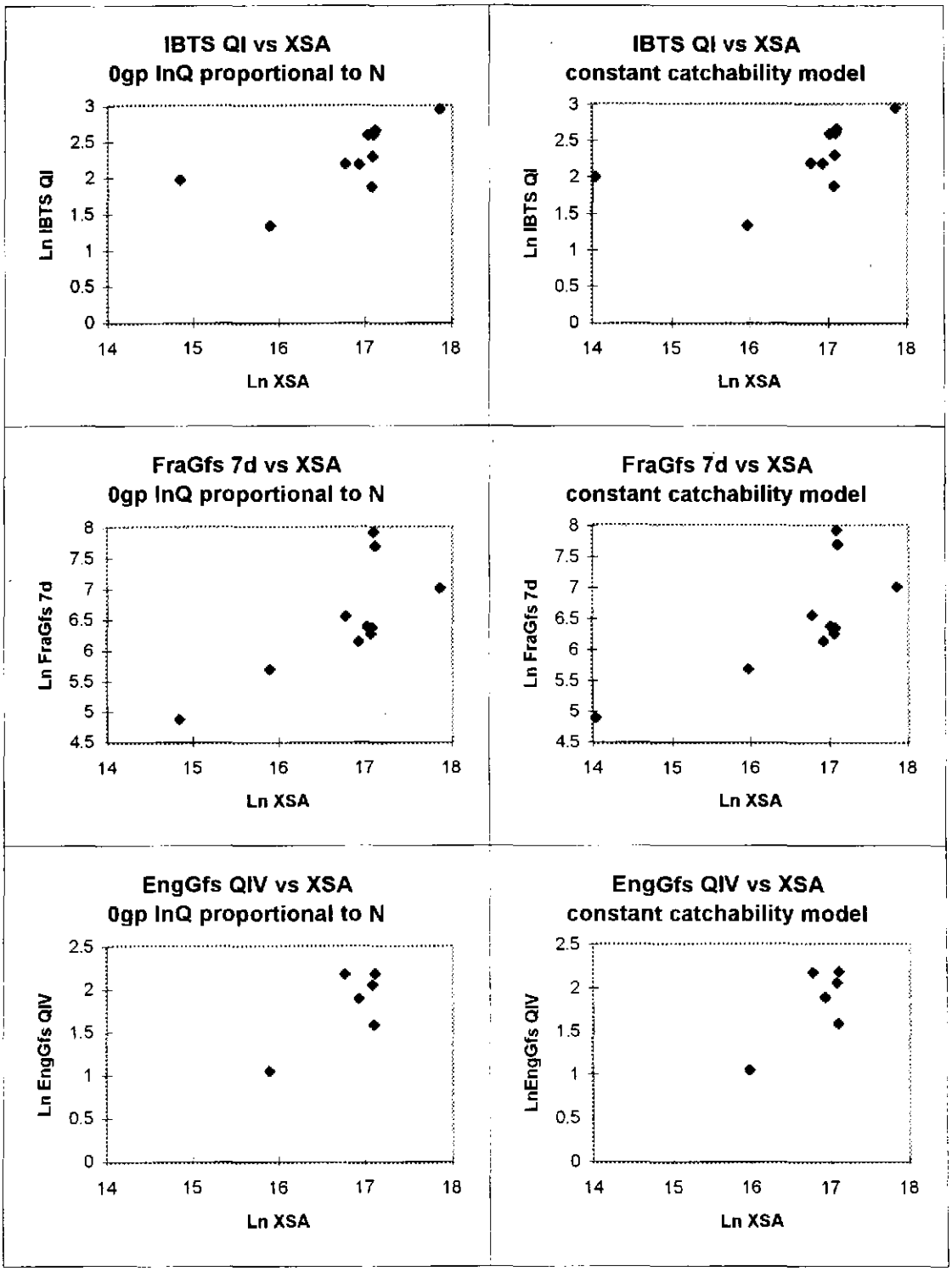


Figure 5.1.4.3 Whiting in Divisions IV and VIId. XSA log catchability residuals.

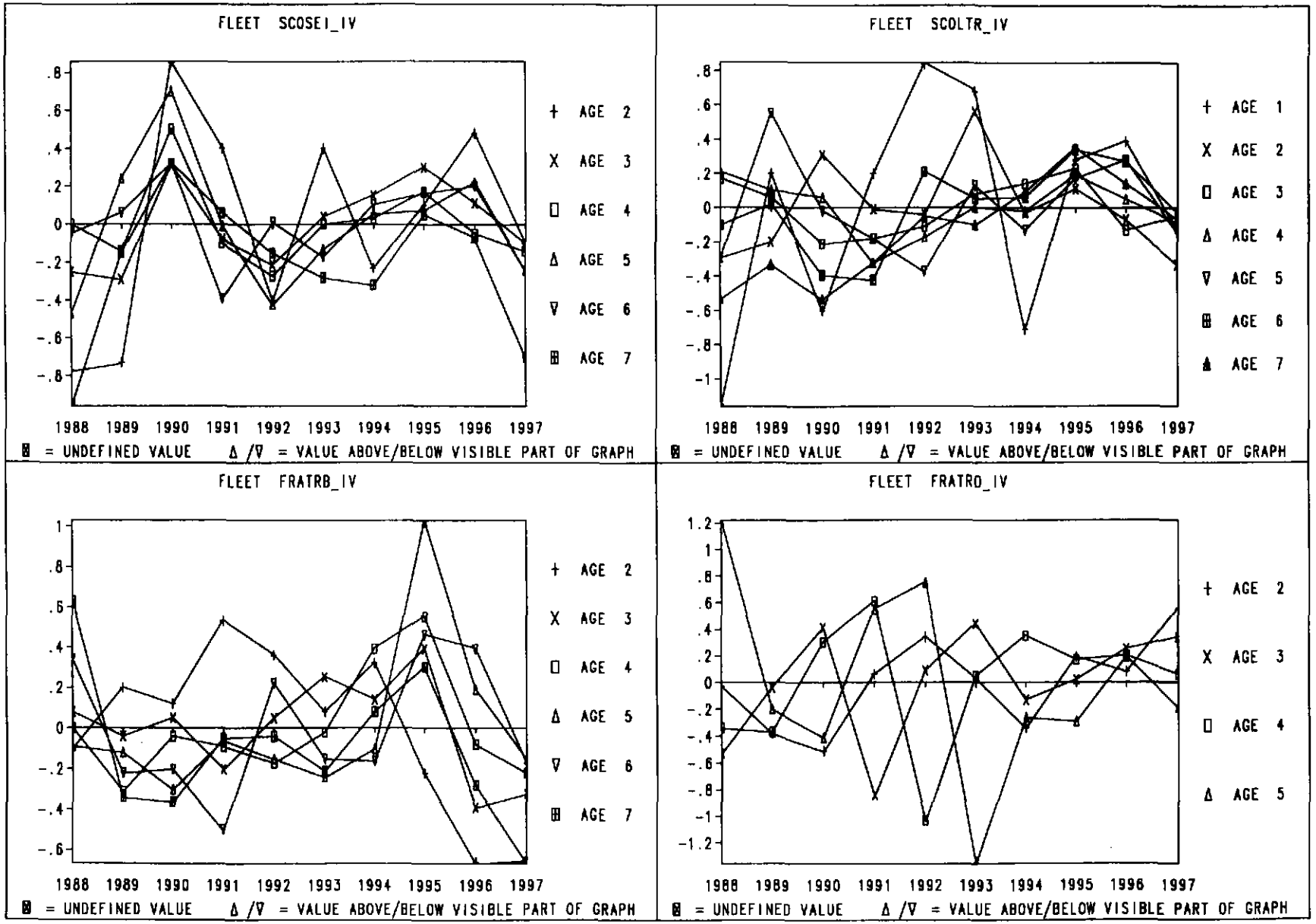


Figure 5.1.4.3 (Cont'd)

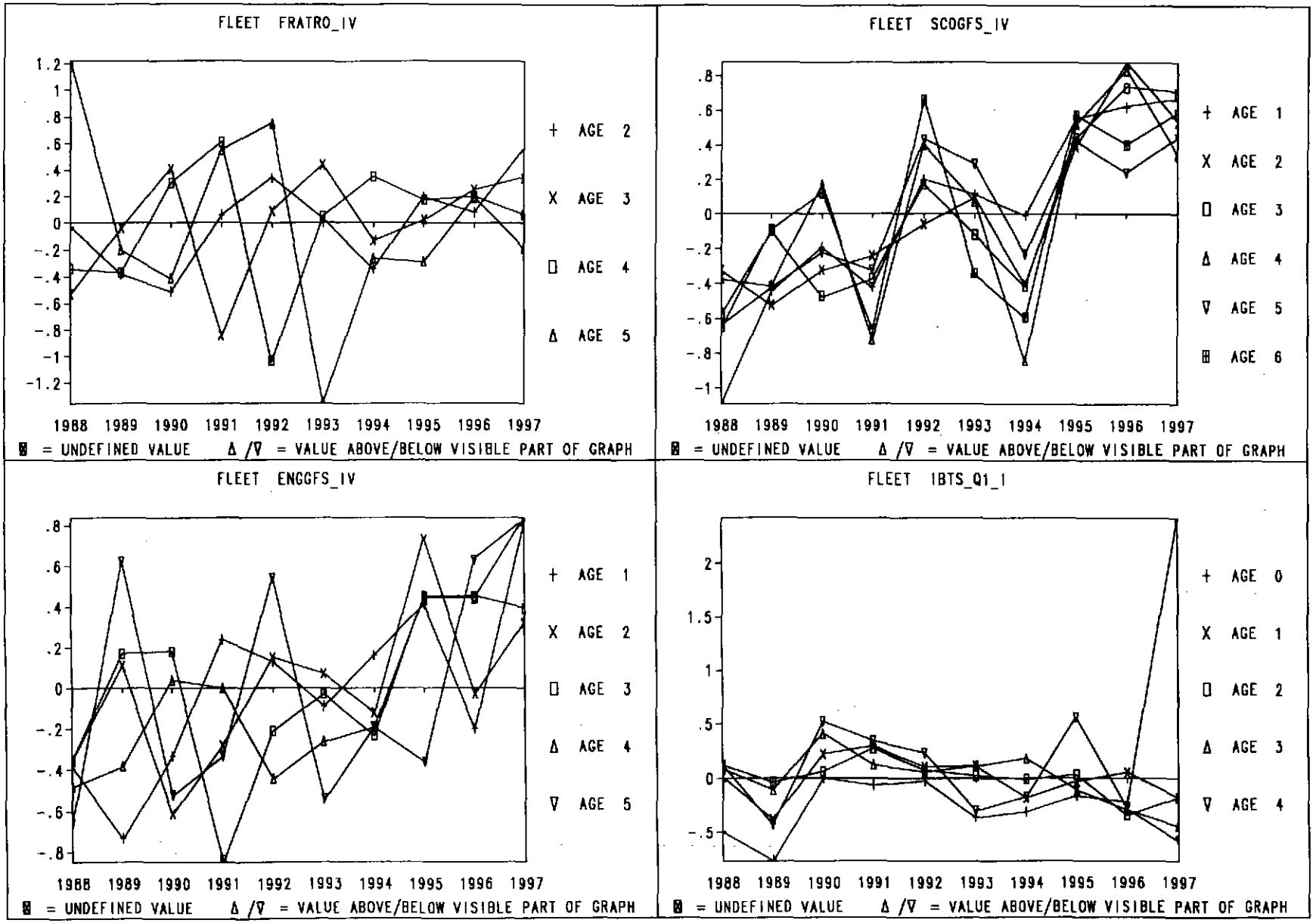


Figure 5.1.4.3 (Cont'd)

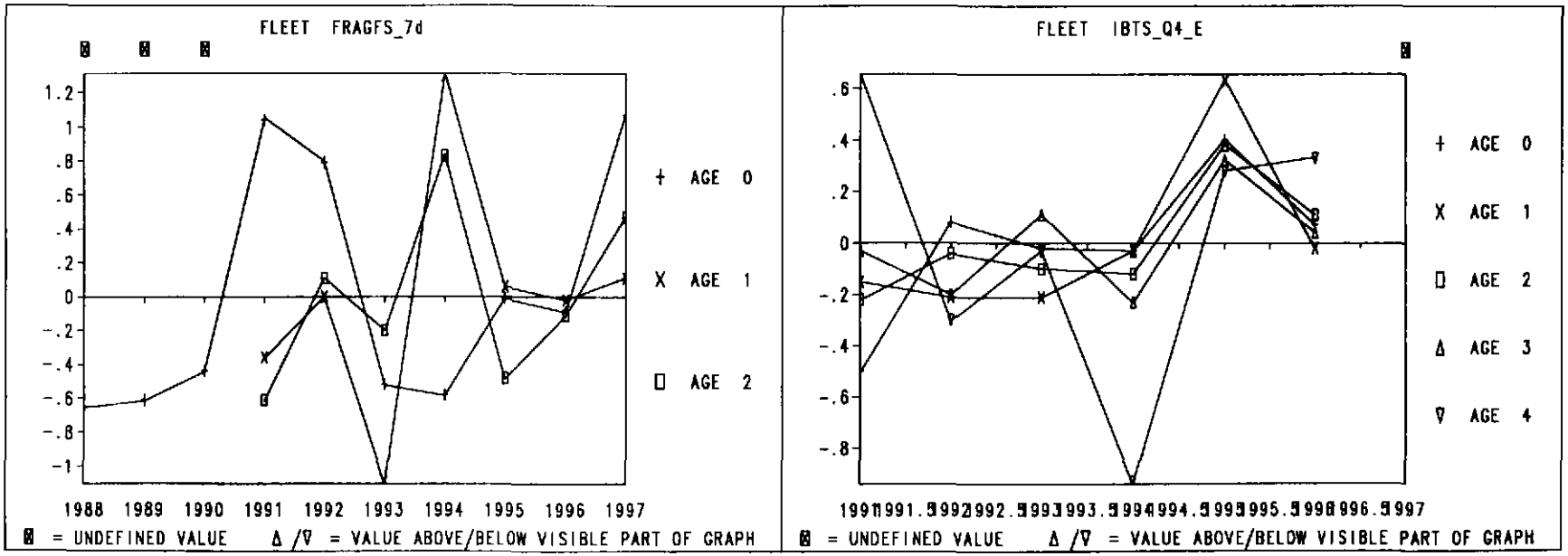


Figure 5.1.4.4a
Whiting in IV and VIId
Log VPA vs. log Index
ScoSei
Year range : 1988-1997

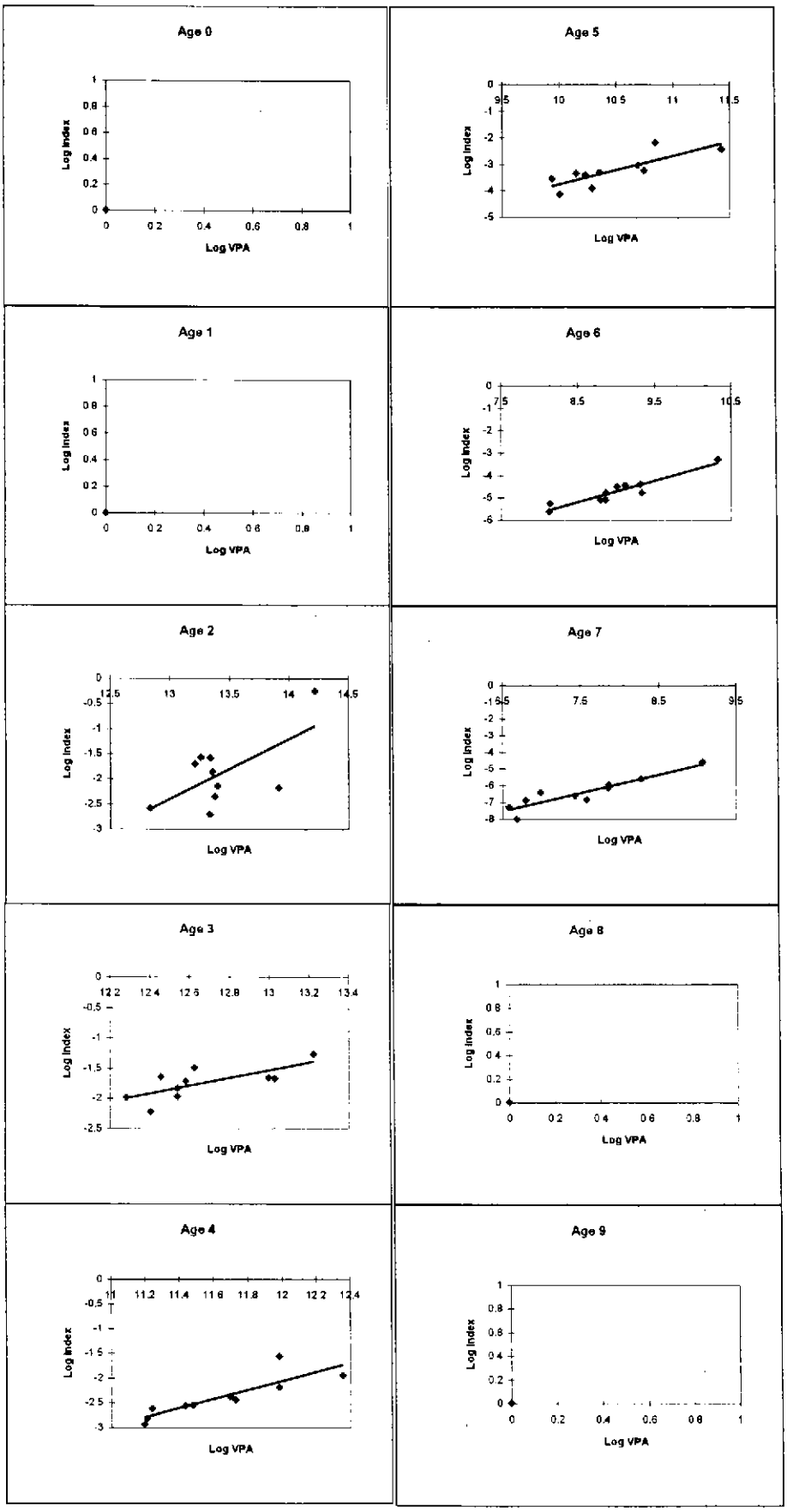
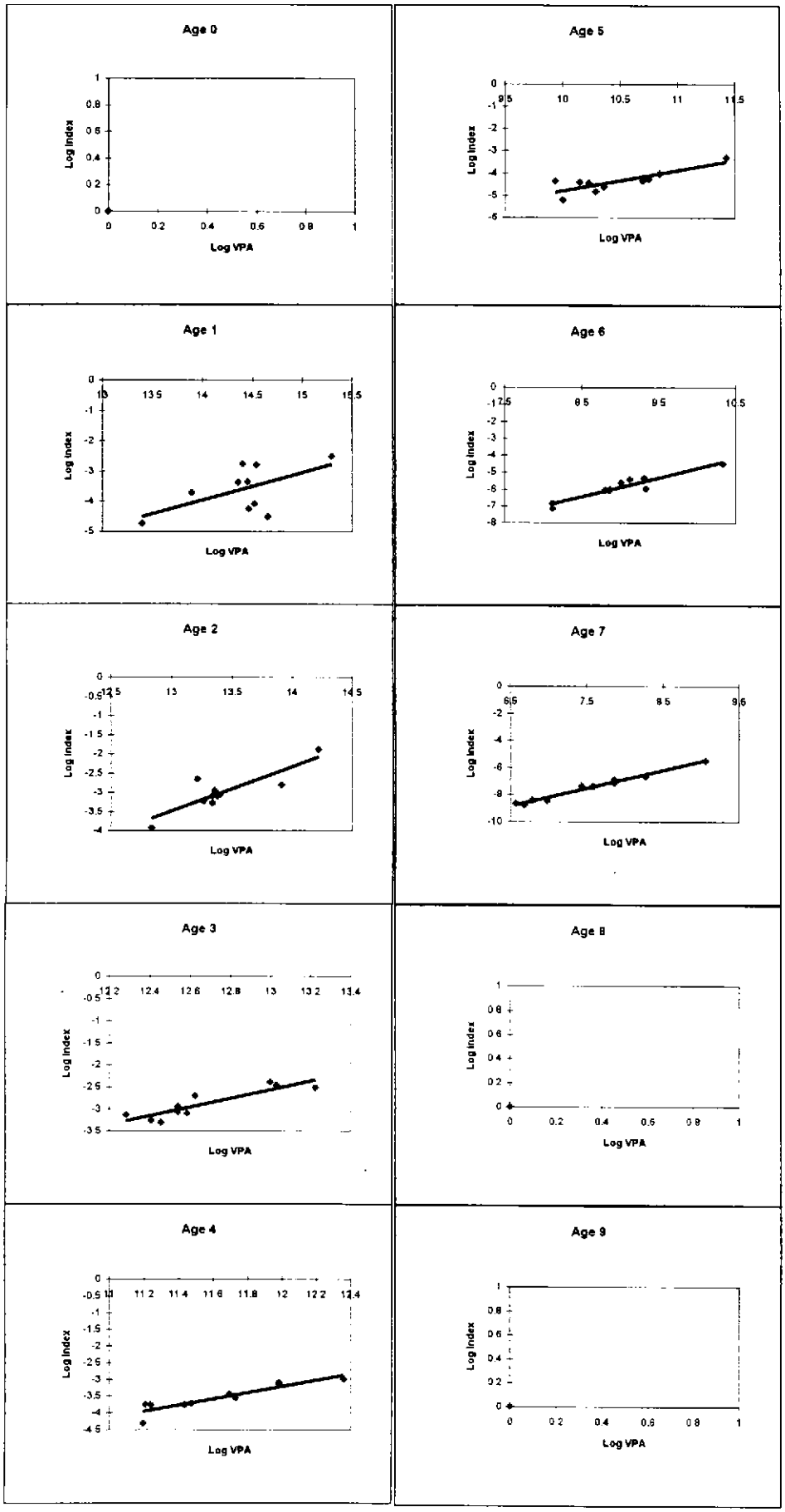


Figure 5.1.4.4 b
Whiting in IV and VIId
Log VPA vs. log Index
ScoLtr
Year range : 1988-1997



F-51448.XLS

Figure 5.1.4.4 c
Whiting in IV and VIId
Log VPA vs. log Index
FraTro IV
Year range : 1988-1997

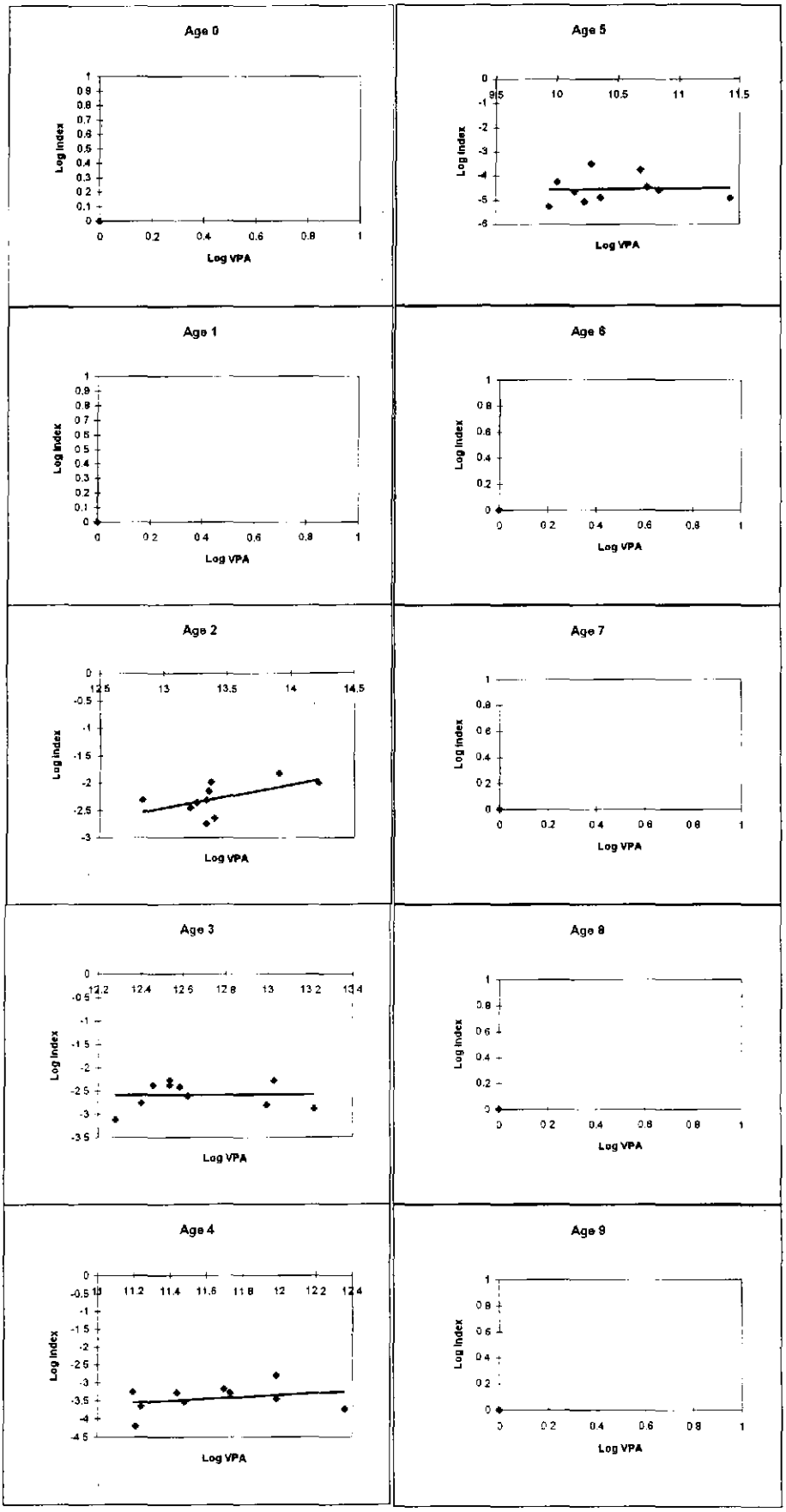


Figure 5.1.4.4.d
Whiting in IV and VIId
Log VPA vs. log Index
FraTrb IV
Year range : 1988-1997

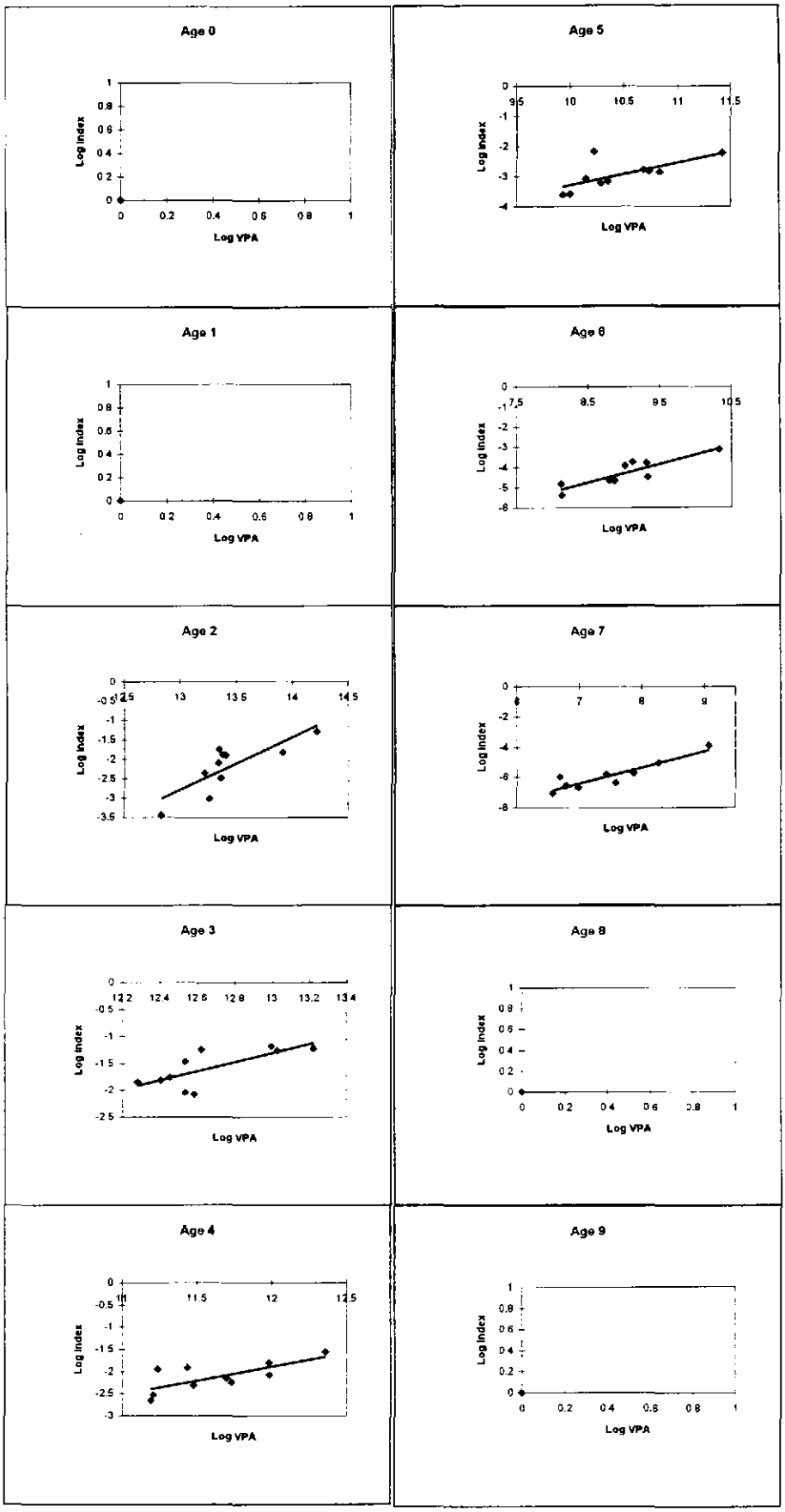


Figure 5.1.4.4.e
Whiting in IV and VIId
Log VPA vs. log Index
ScoGFS
Year range : 1988-1997

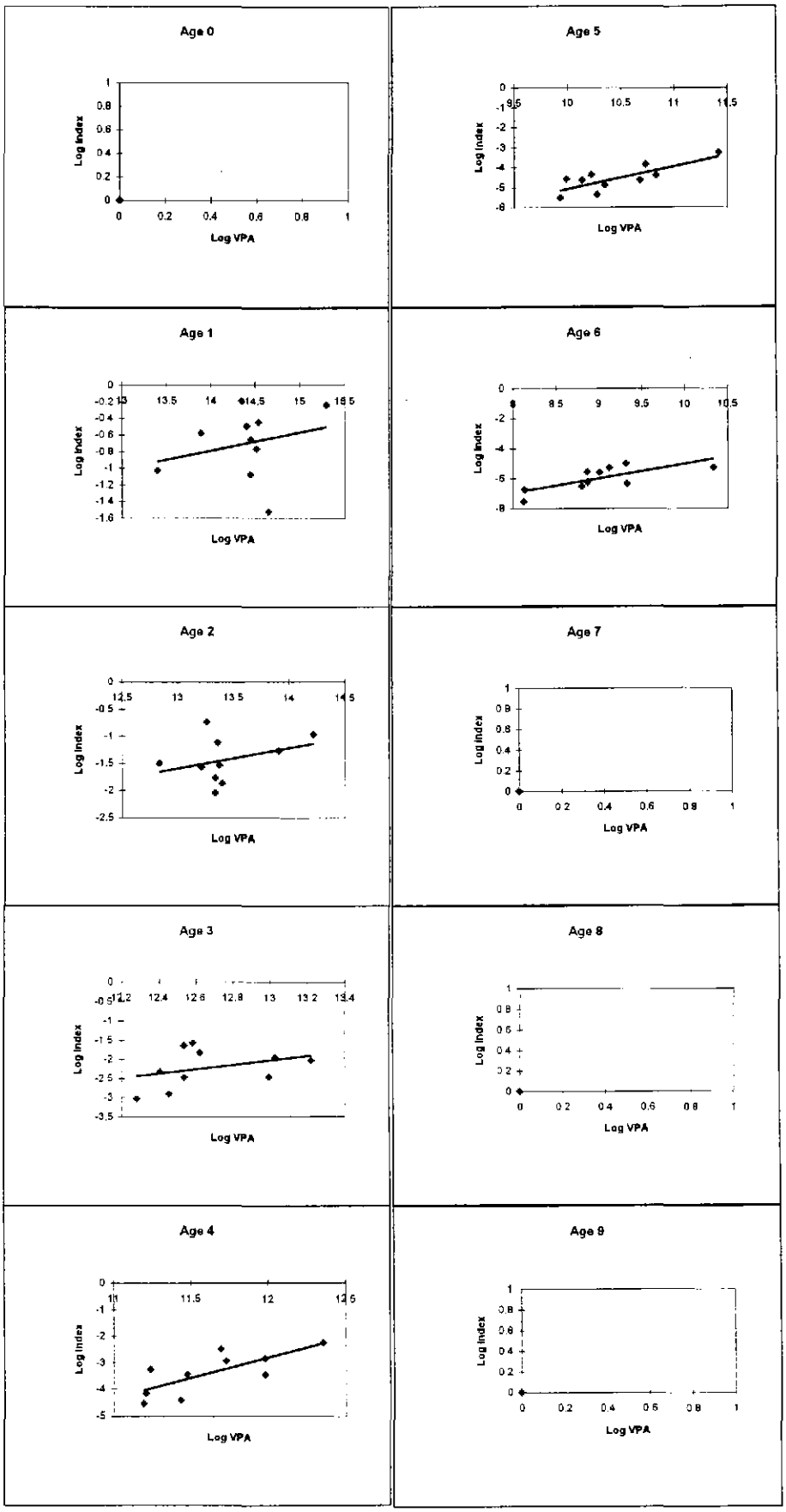


Figure 5.1.4.4 f
Whiting in IV and VIId
Log VPA vs. log Index
EngGFS
Year range : 1988-1997

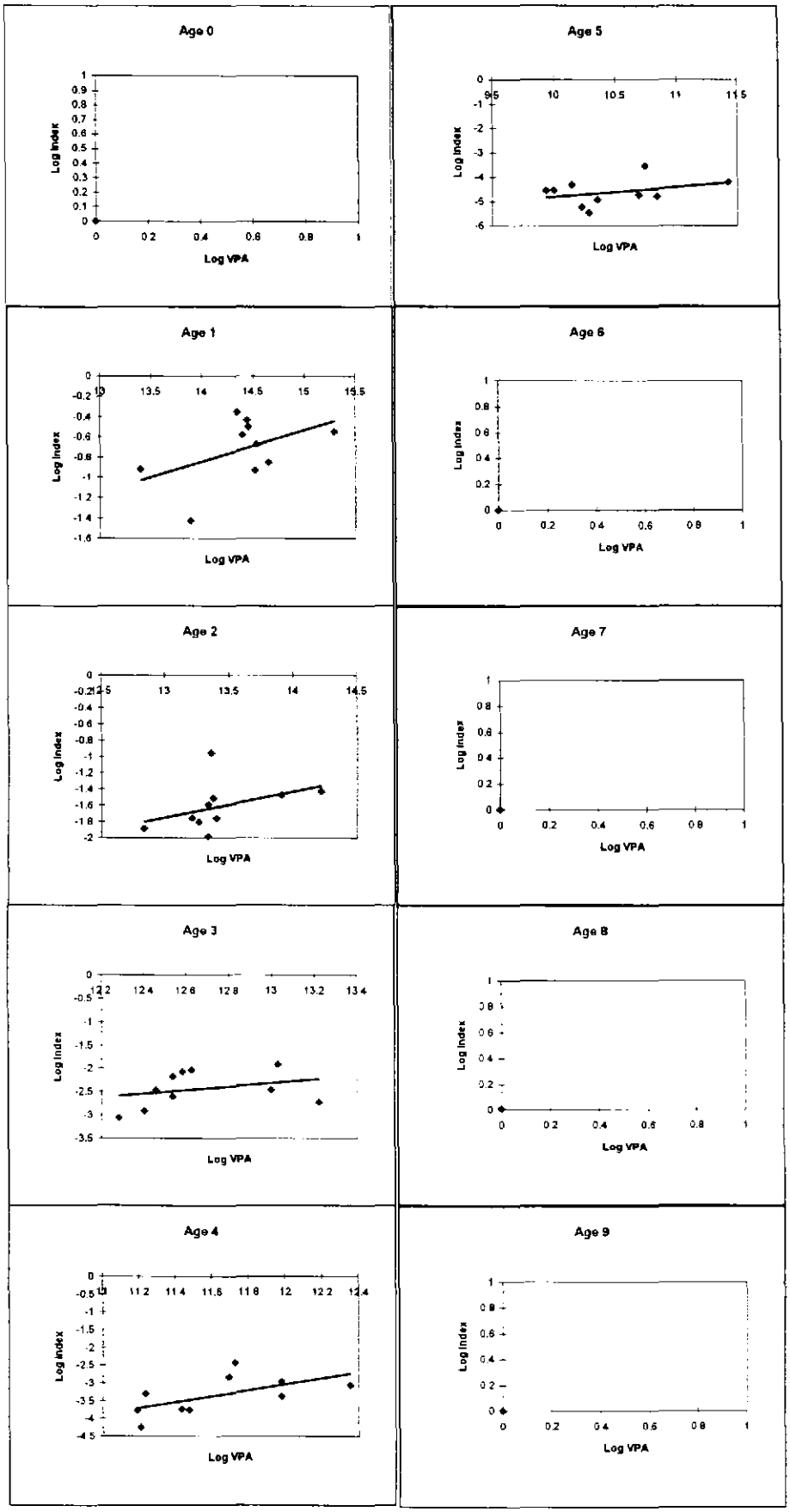


Figure 5.1.4.4 g
Whiting in IV and VIId
Log VPA vs. log Index
IBTS QI
Year range : 1988-1997

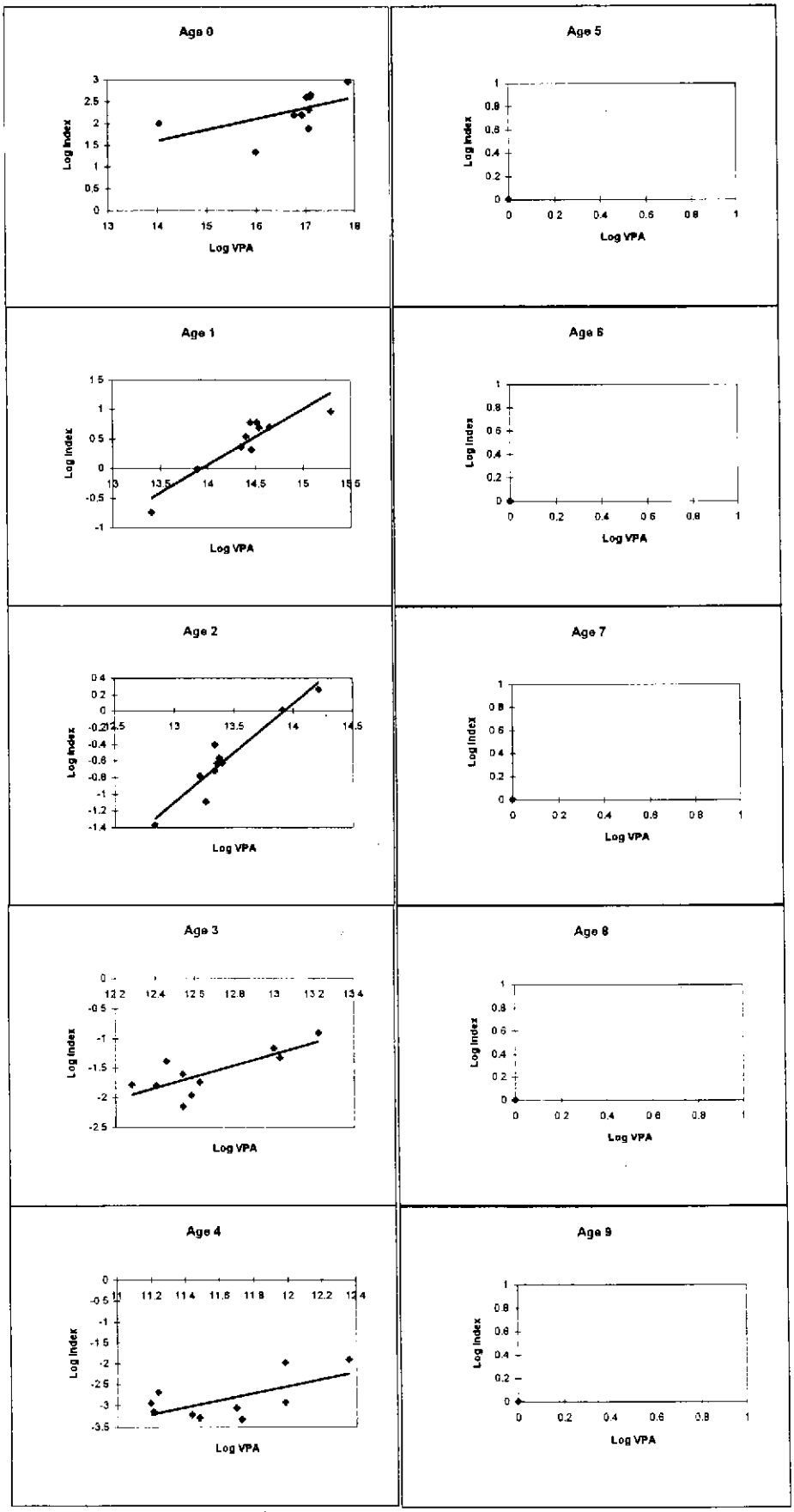


Figure 5.1.4.4 h
Whiting in IV and VIId
Log VPA vs. log Index
IBTS QII
Year range : 1988-1997

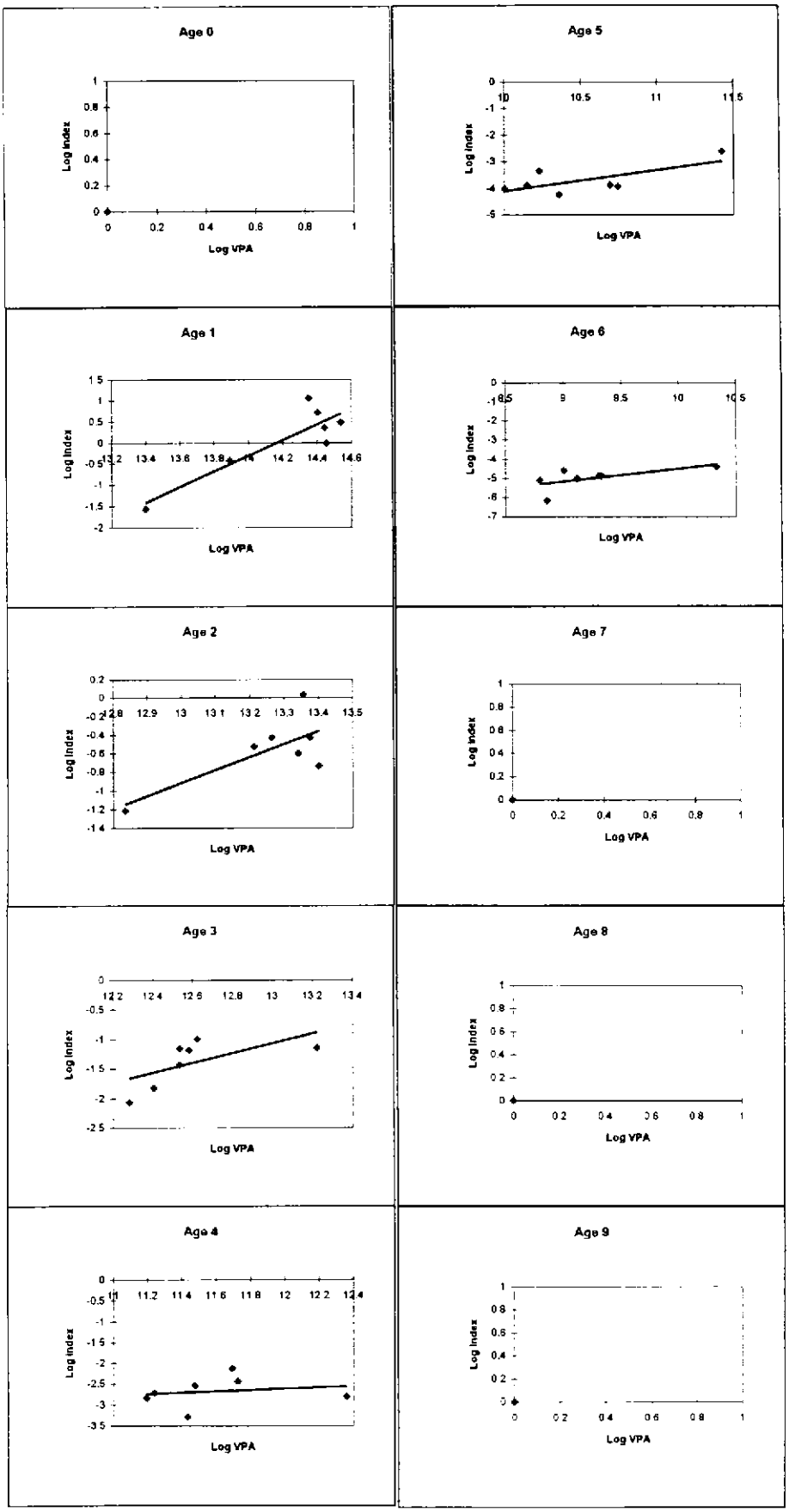


Figure 5.1.4.4. i
Whiting in IV and VIId
Log VPA vs. log Index
IBTS QIV
Year range : 1988-1997

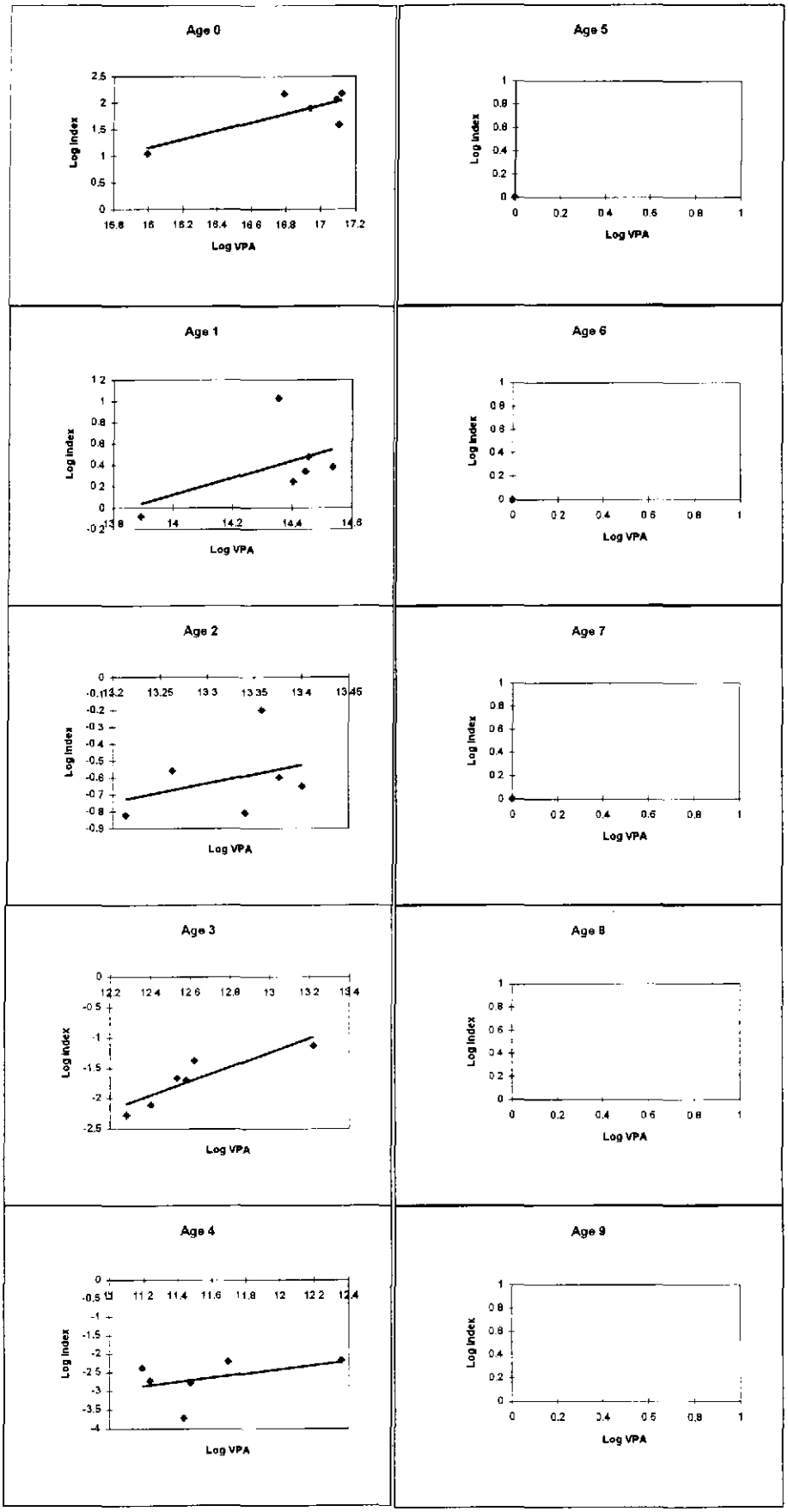


Figure 5.1.4.4 j
Whiting in IV and VIId
Log VPA vs. log Index
FraGFS VIId
Year range : 1988-1997

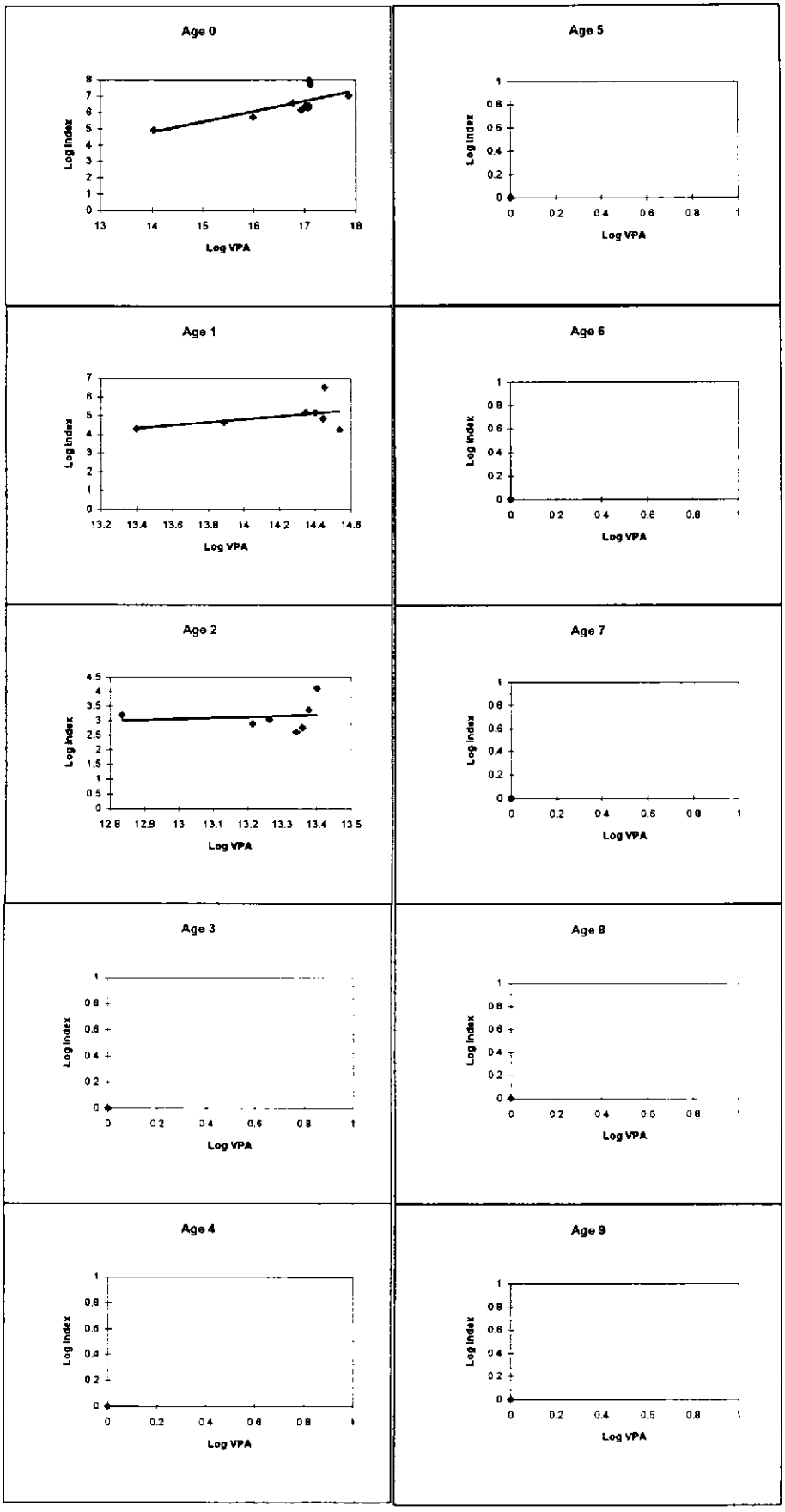


Figure 5.1.4.5 Whiting in Divisions IV and VIId
Tuning fleet scaled weights at age

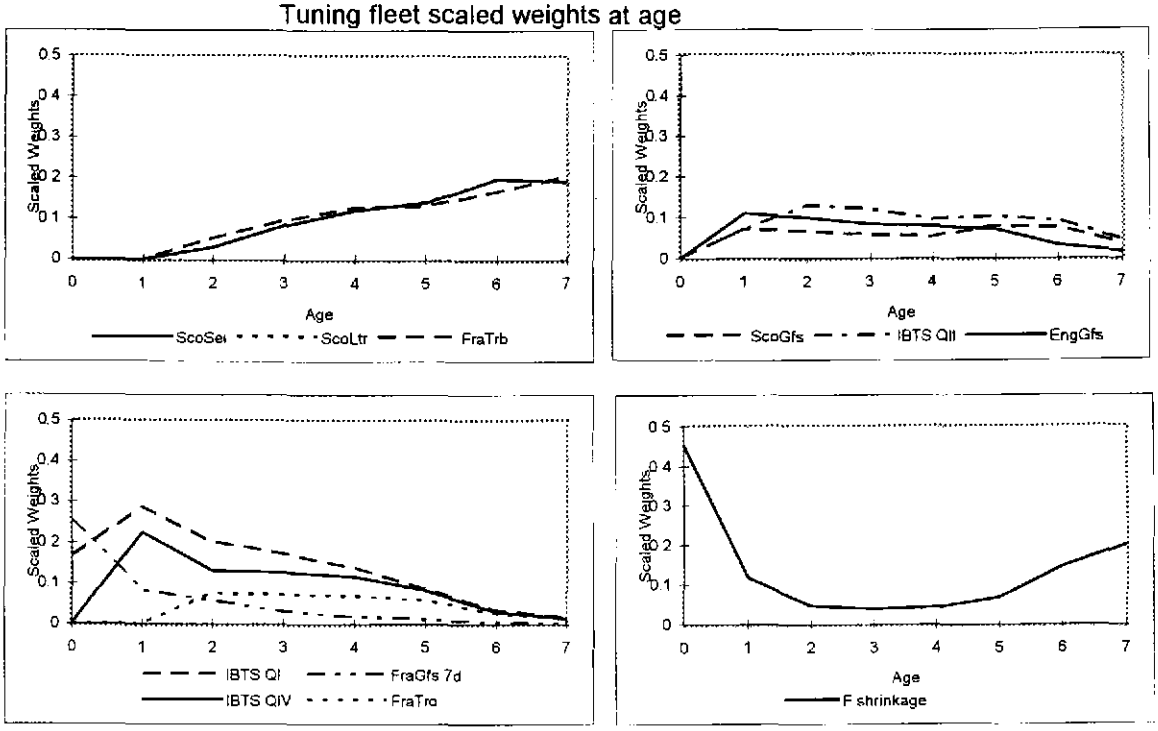


Figure 5.1.4.6 Terminal exploitation pattern by fleet

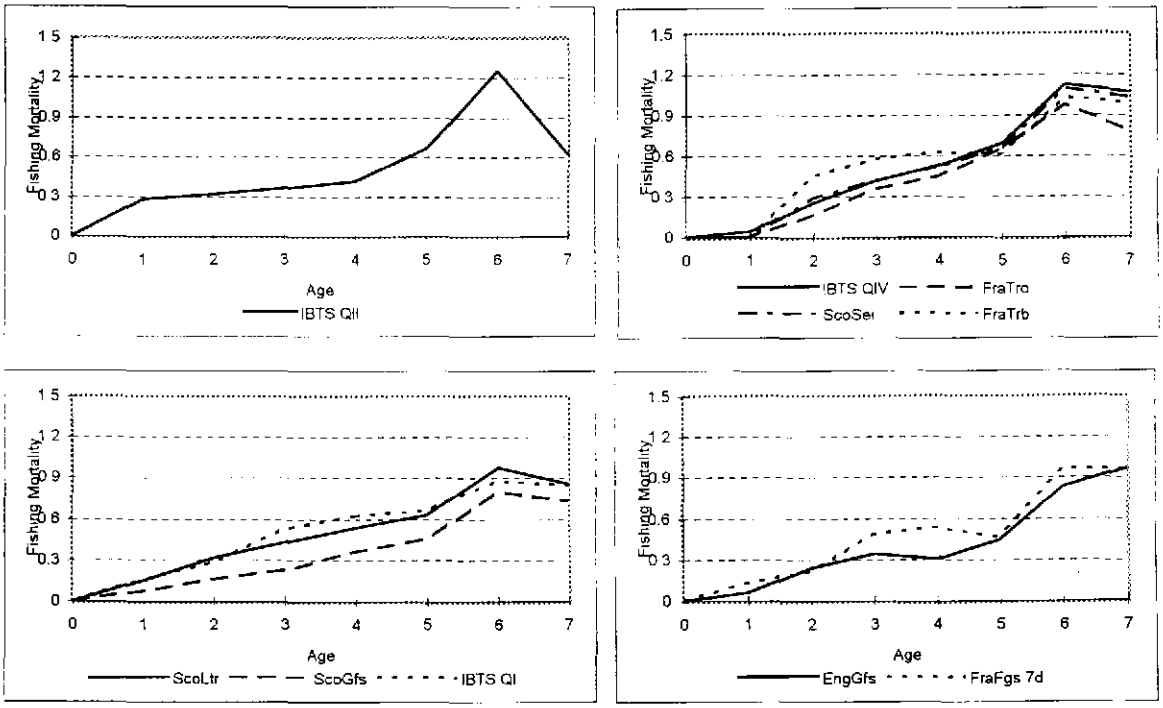
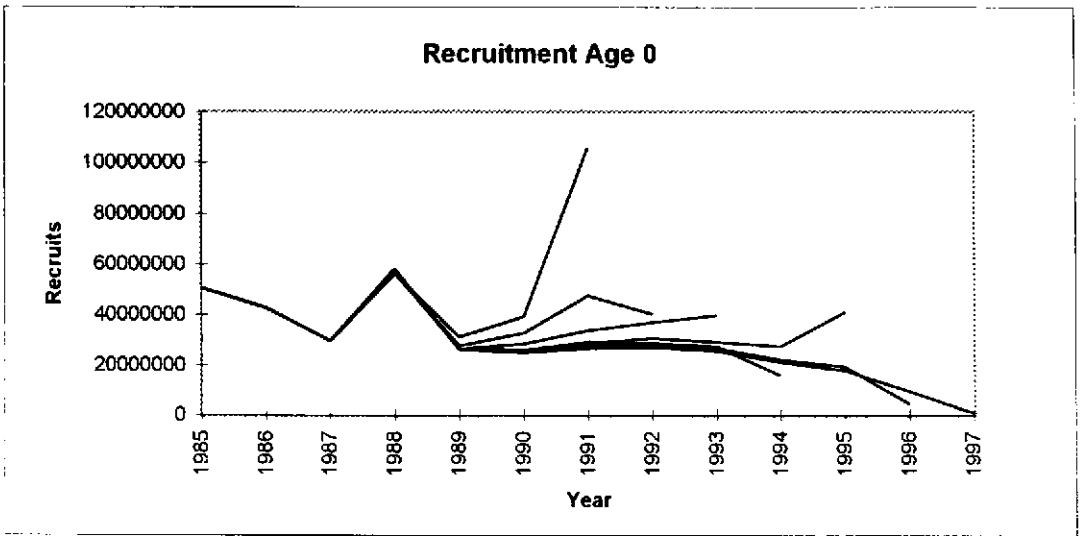
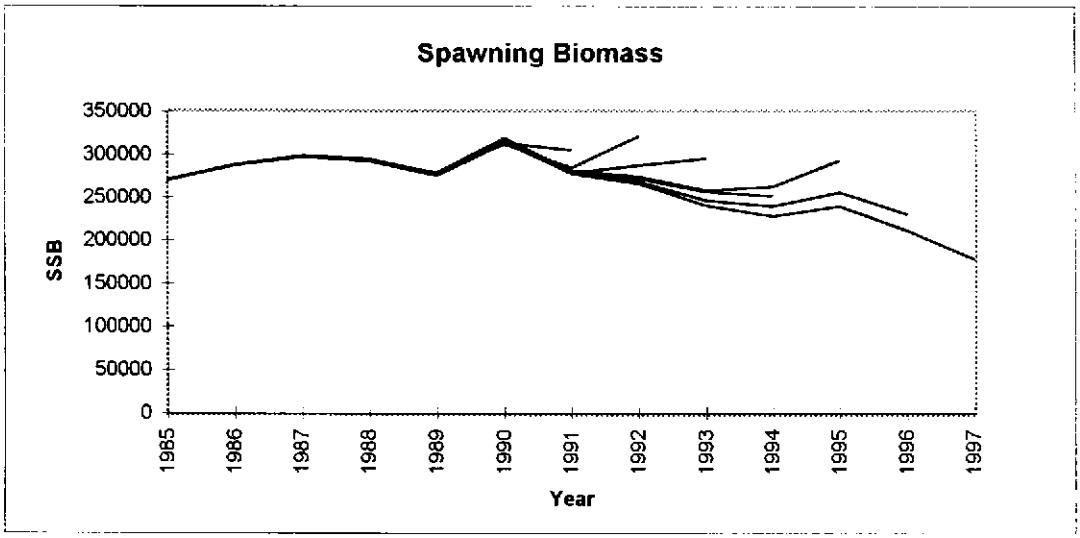


Figure 5.1.4.7 Whiting in IV and VIId. Retospective analysis ("moving window")





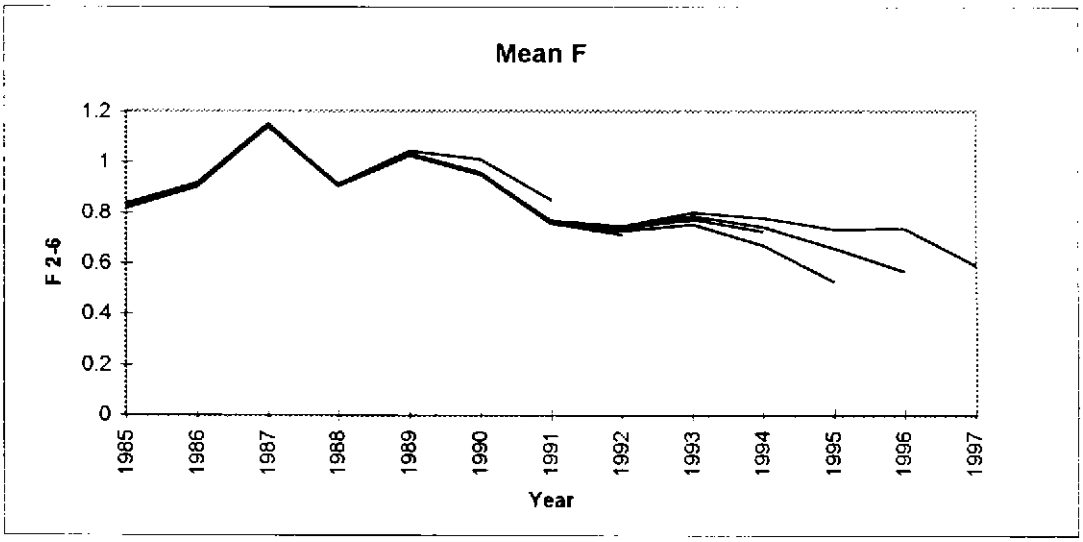


Figure 5.1.4.8 Whiting in IV and VIId. Retospective analysis ("diminishing series")

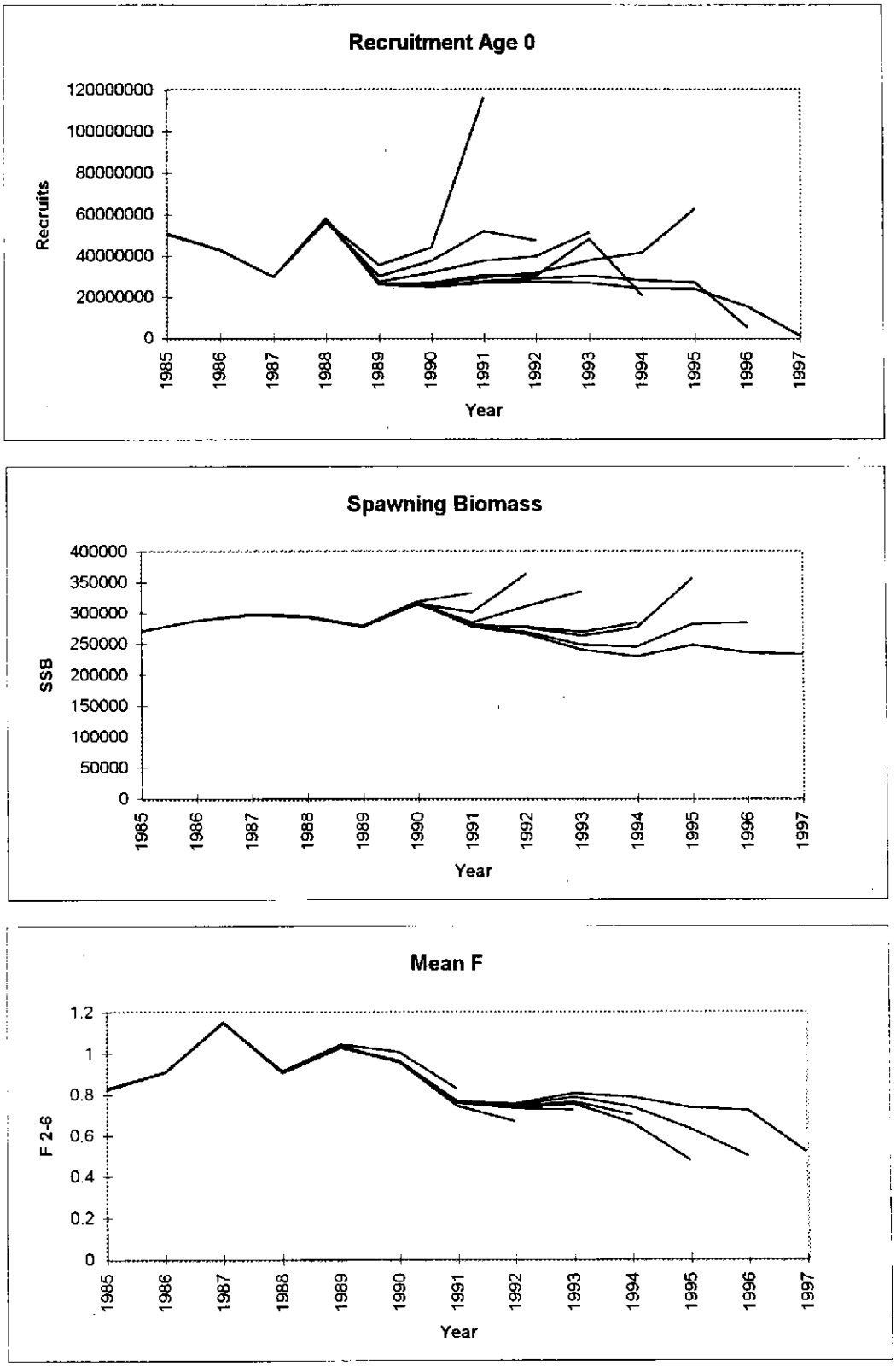


Figure 5.1.5.1a Whiting in Divisions IV and VIId
Pairwise comparisons of indices and XSA numbers for age

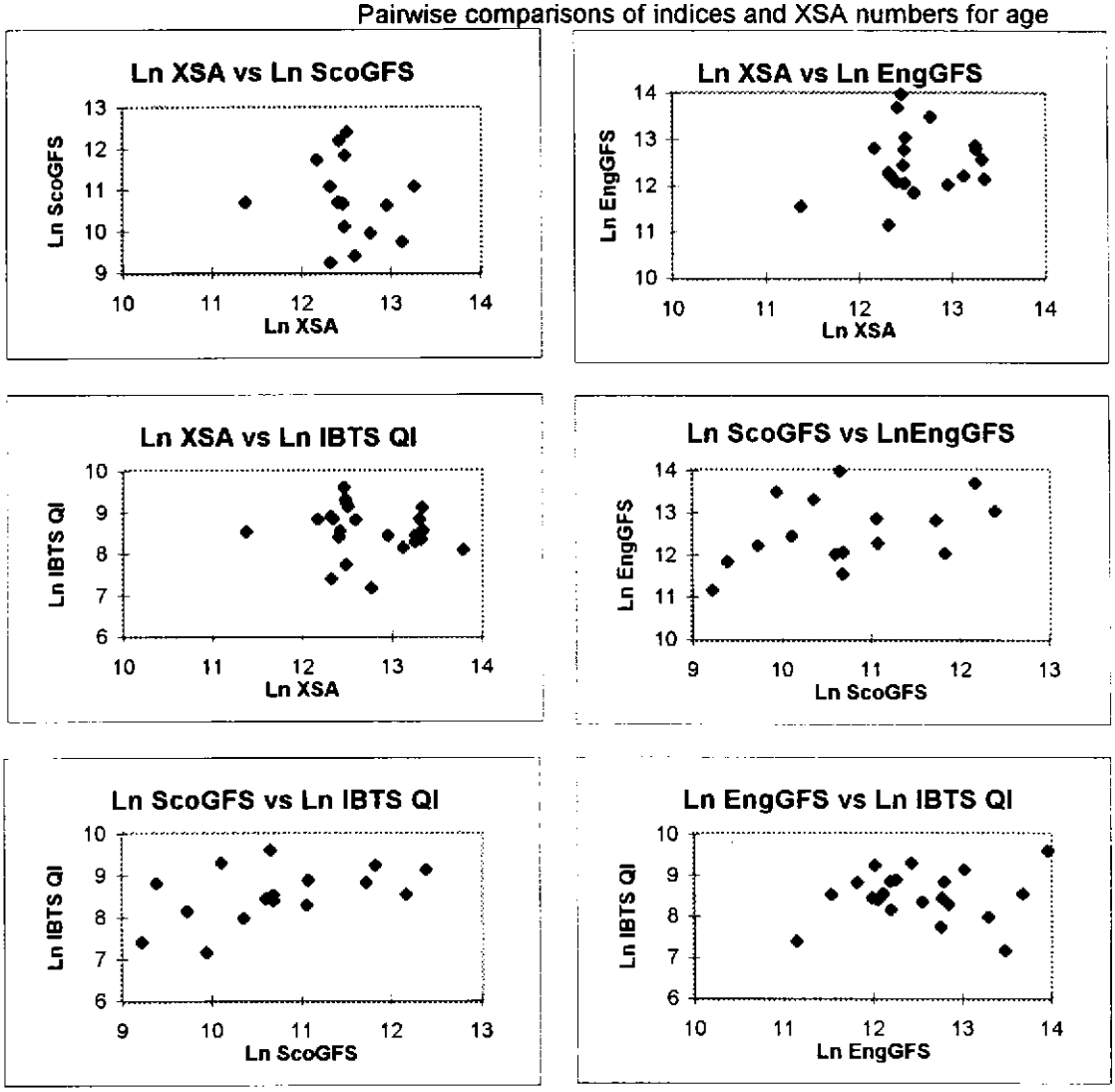


Figure 5.1.5.1 b Whiting in Divisions IV and VIId
'Pairwise comparisons of indices and XSA numbers for age 1

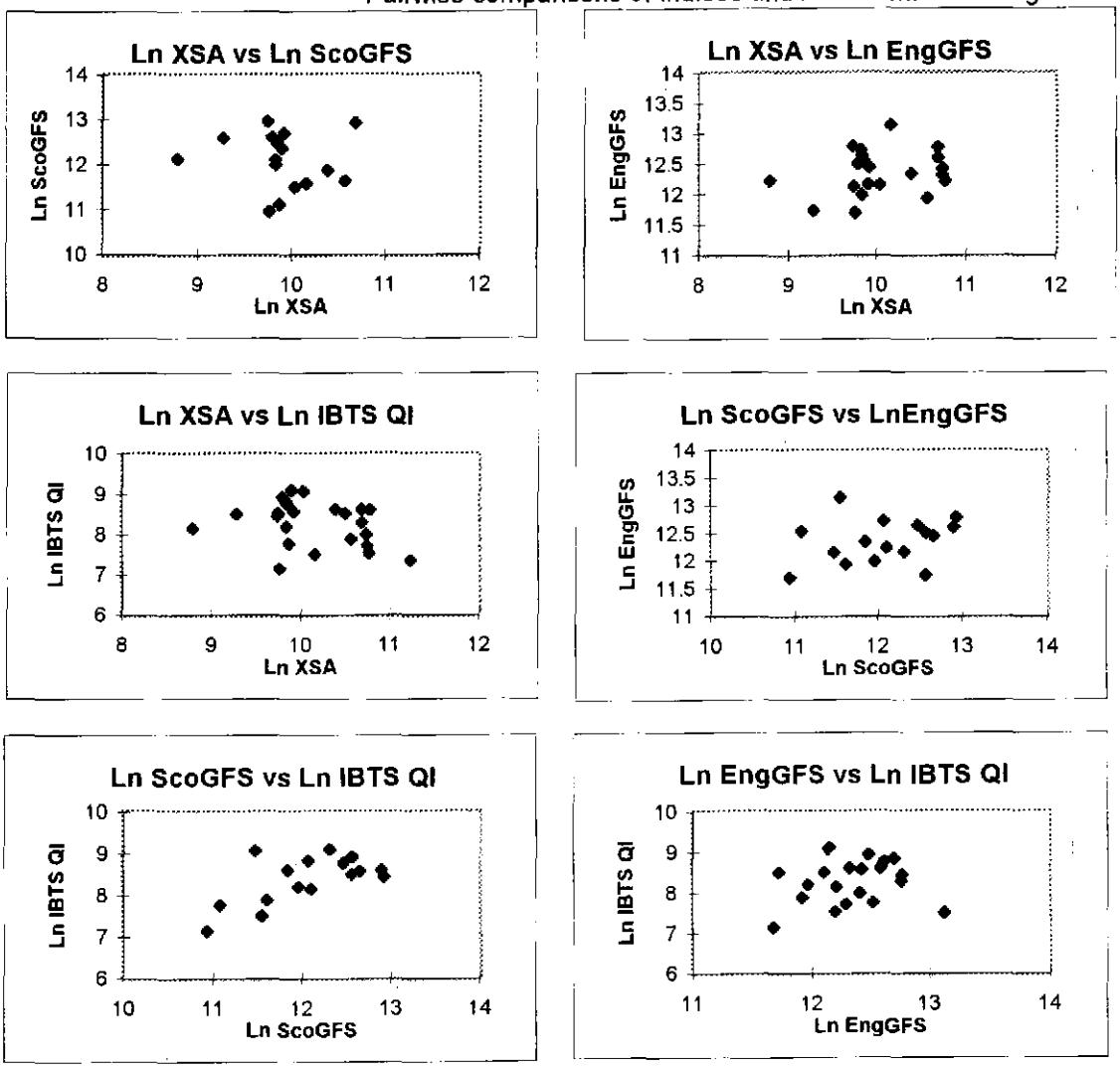


Figure 5.1.5.1 c Whiting in Divisions IV and VIId
'Pairwise comparisons of indices and XSA numbers for age 1

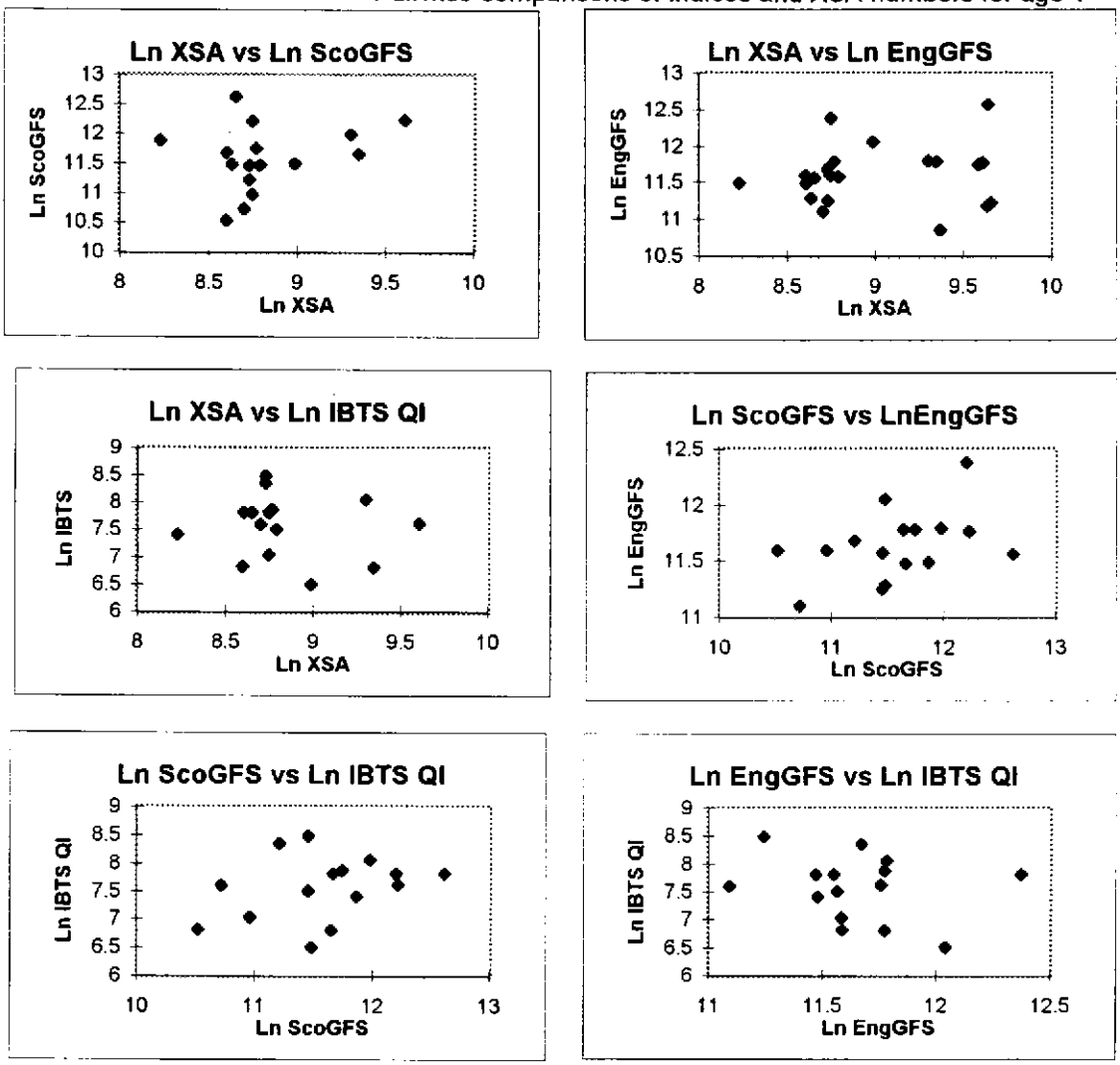


Figure 5.1.5.1d Whiting in Divisions IV and VIId
'Pairwise comparisons of indices and XSA numbers for age 3

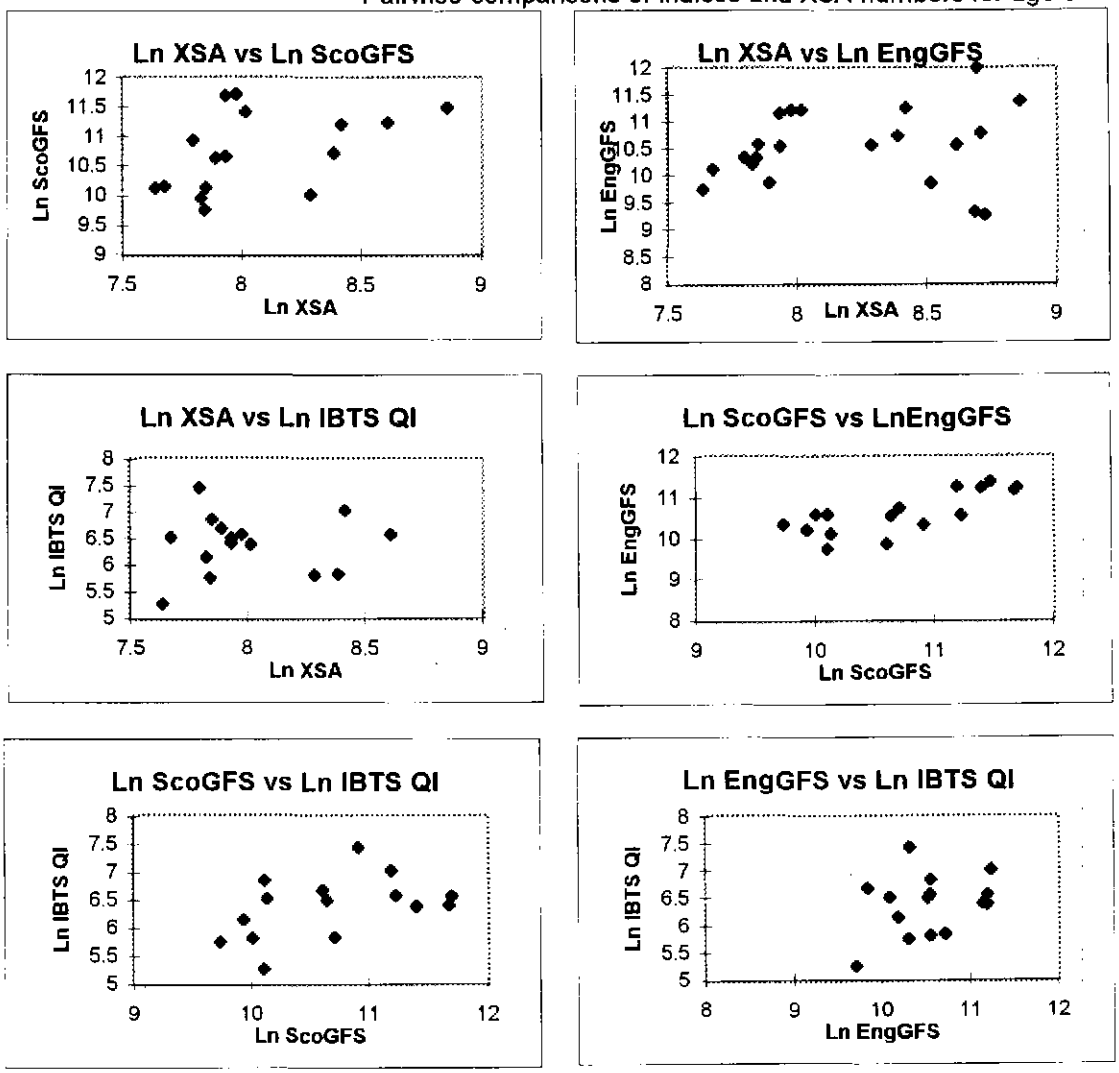


Figure 5.1.6.1 Whiting in Divisions IV and VIId.

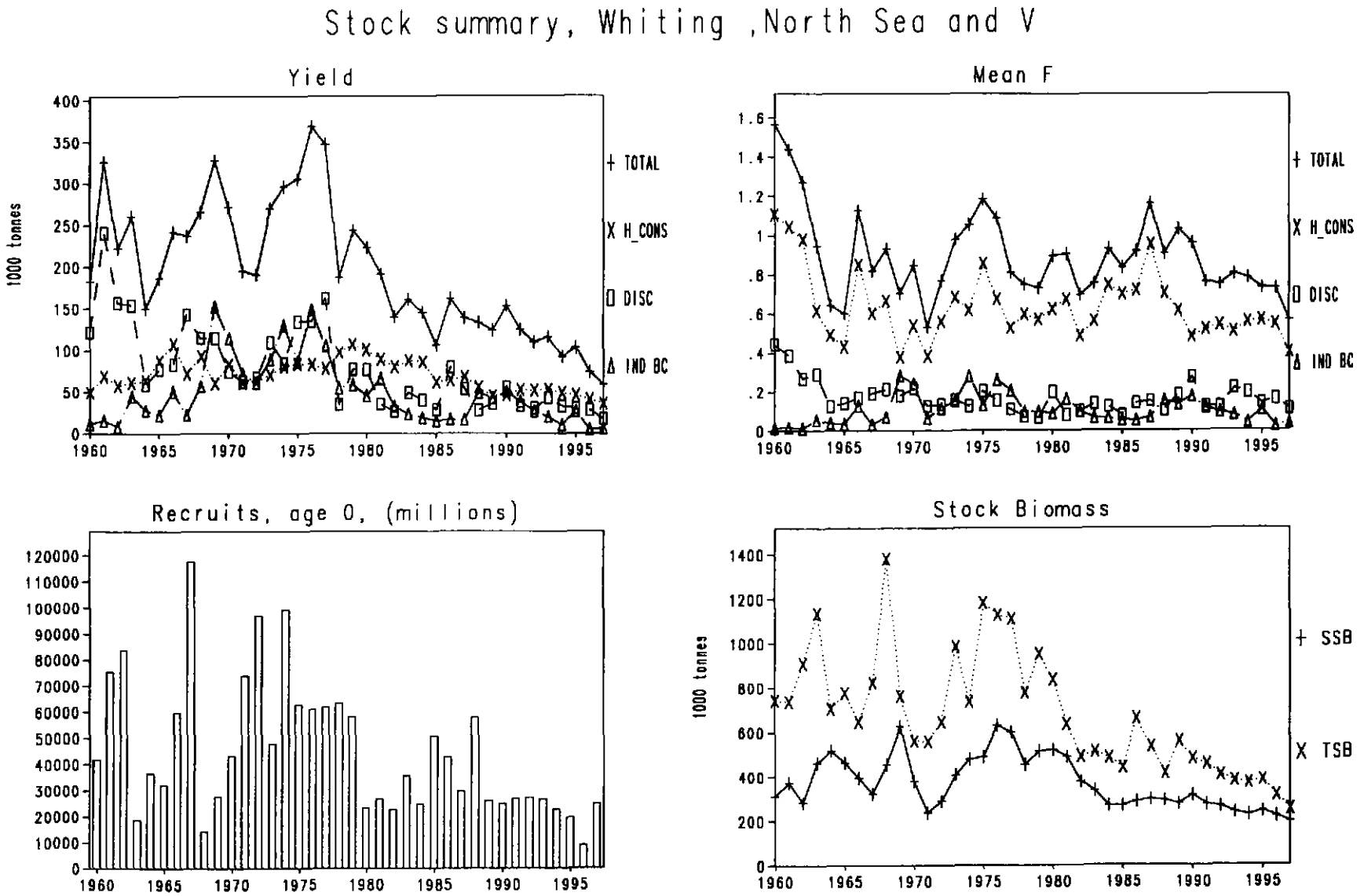


Figure 5.1.7.1

Figure Whiting,North Sea and VIId. Sensitivity analysis of short term forecast.

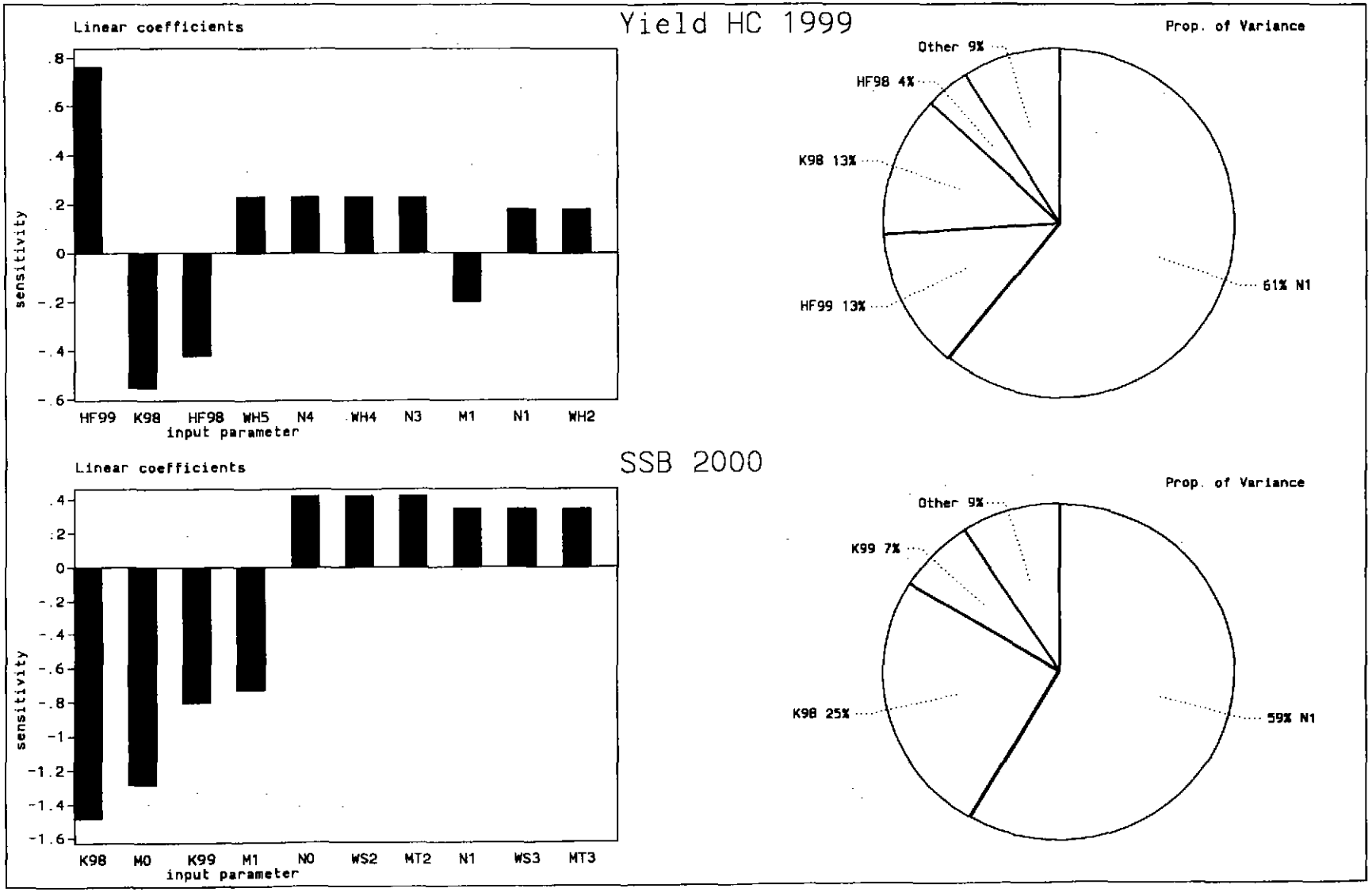


Figure 5.1.7.2

Whiting,North Sea and VIId. Probability profiles for short term forecast.

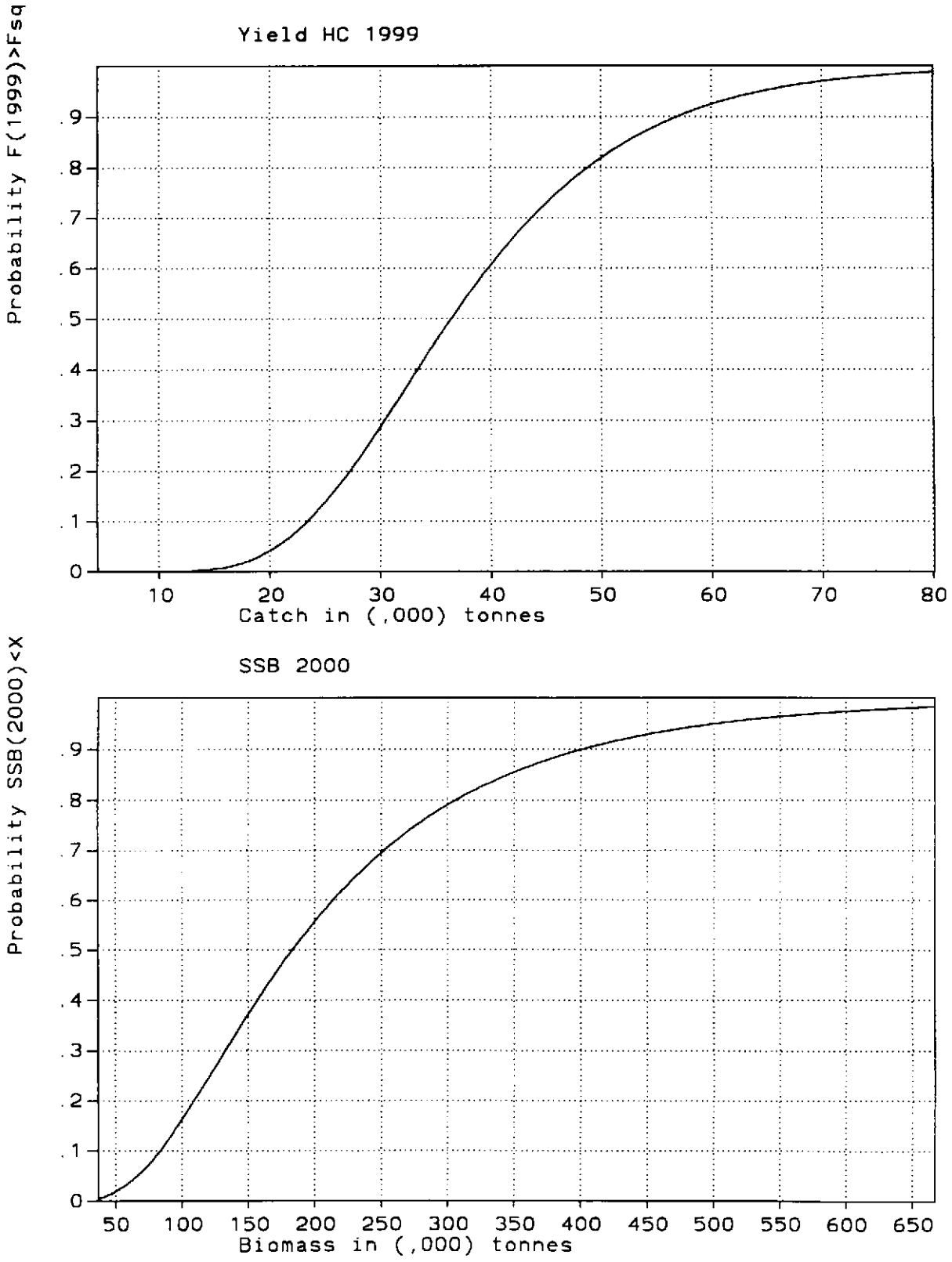


Figure 5.1.8.1 Whiting in Divisions IV and VIId

Medium term stock projection at status quo, showing 5, 10, 20, 50 and 95 percentiles

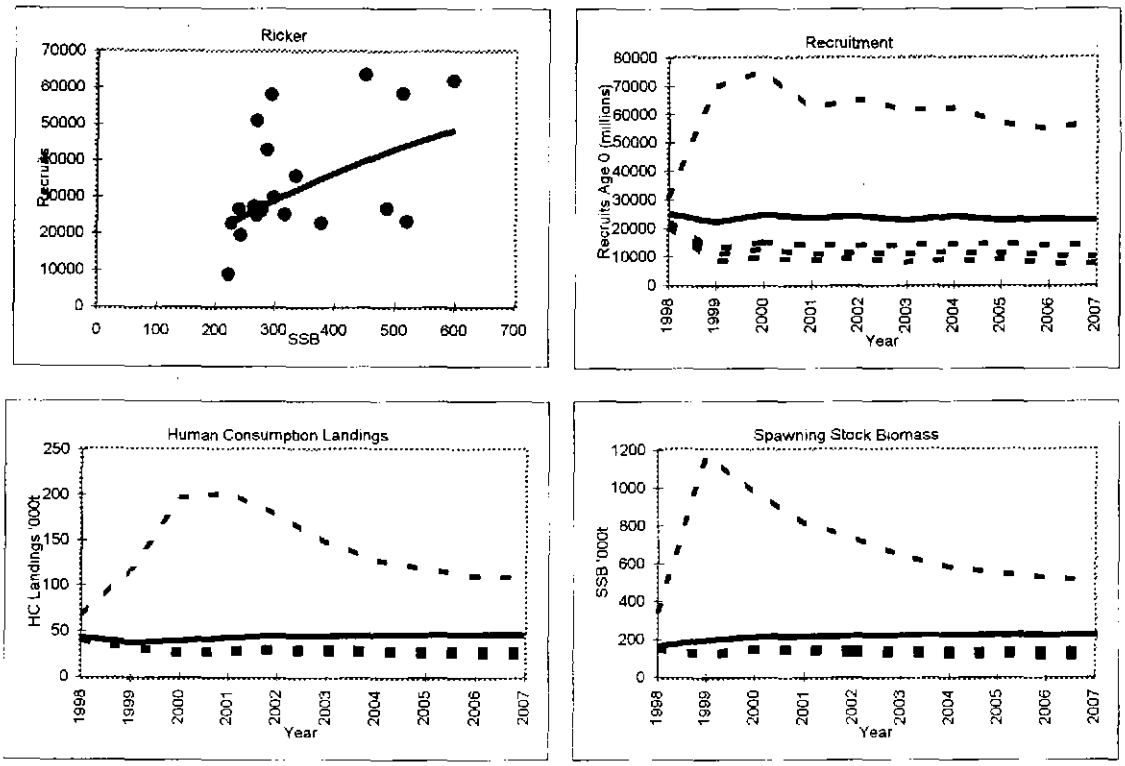


Figure 5.1.8.2 Whiting in Divisions IV and VIId

Probability of SSB 2007 < Y (mean F)

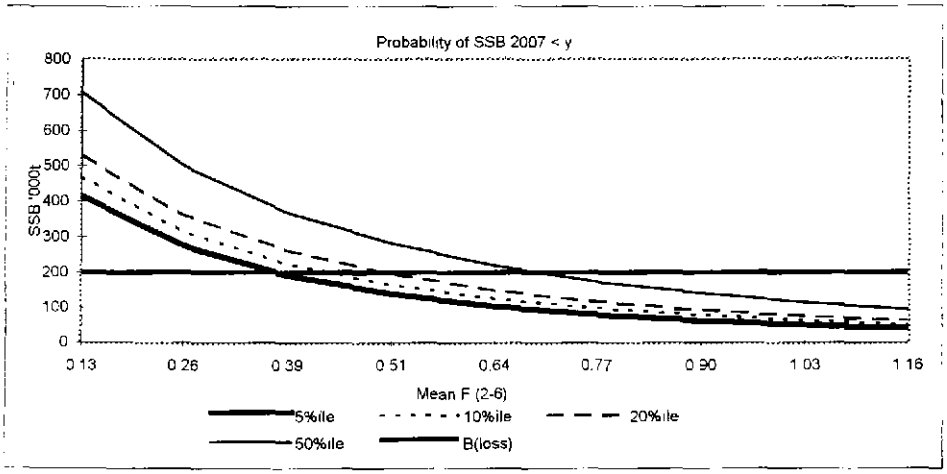


Figure 5.1.9.1

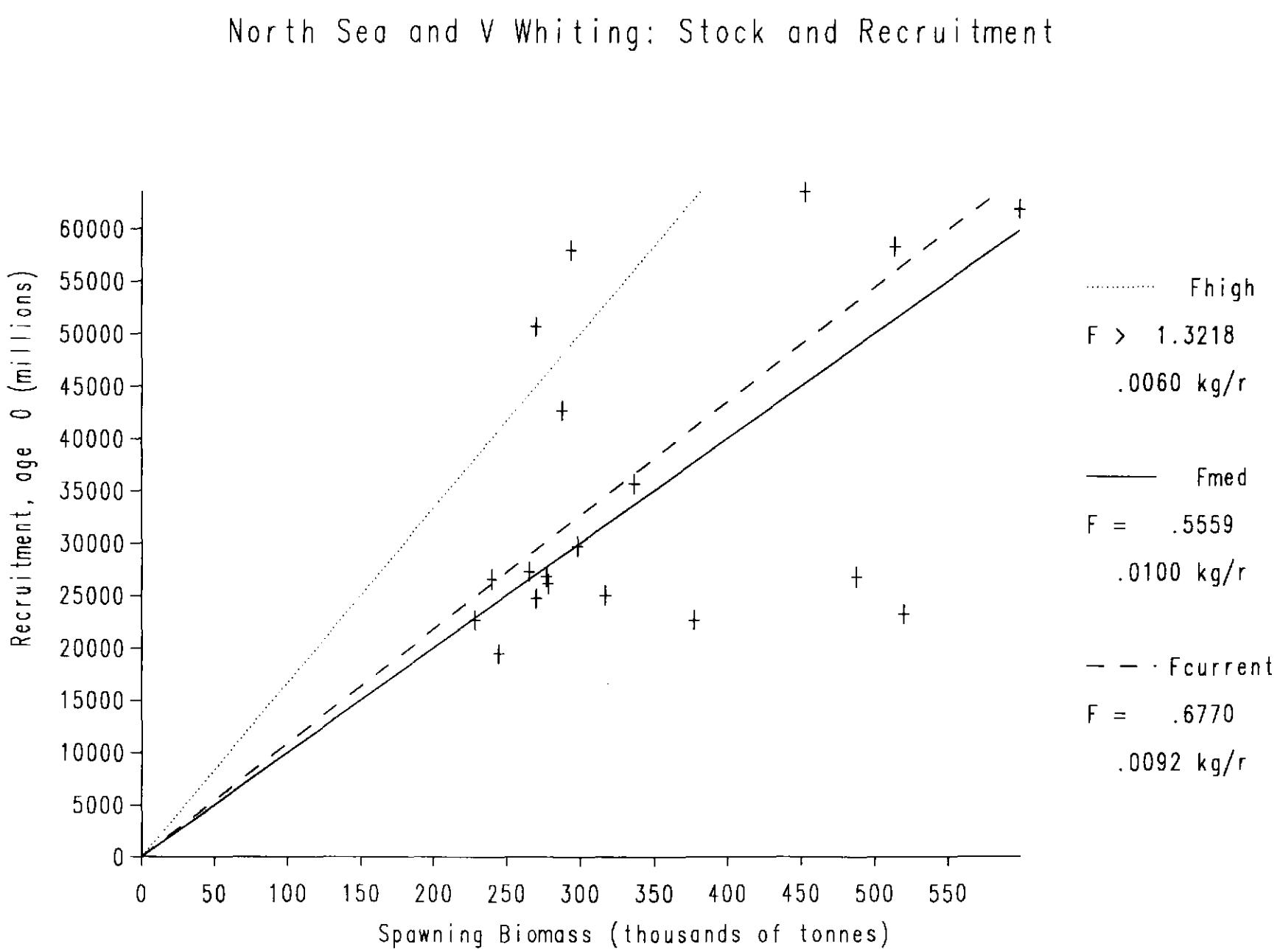

North Sea and V Whiting: Stock and Recruitment
Recruitment, age 0 (millions)
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
50
100
150
200
250
300
350
400
450
500
550
Spawning Biomass (thousands of tonnes)
Fhigh
F > 1.3218
.0060 kg/r
Fmed
F = .5559
.0100 kg/r
Fcurrent
F = .6770
.0092 kg/r

Figure 5.1.9.2

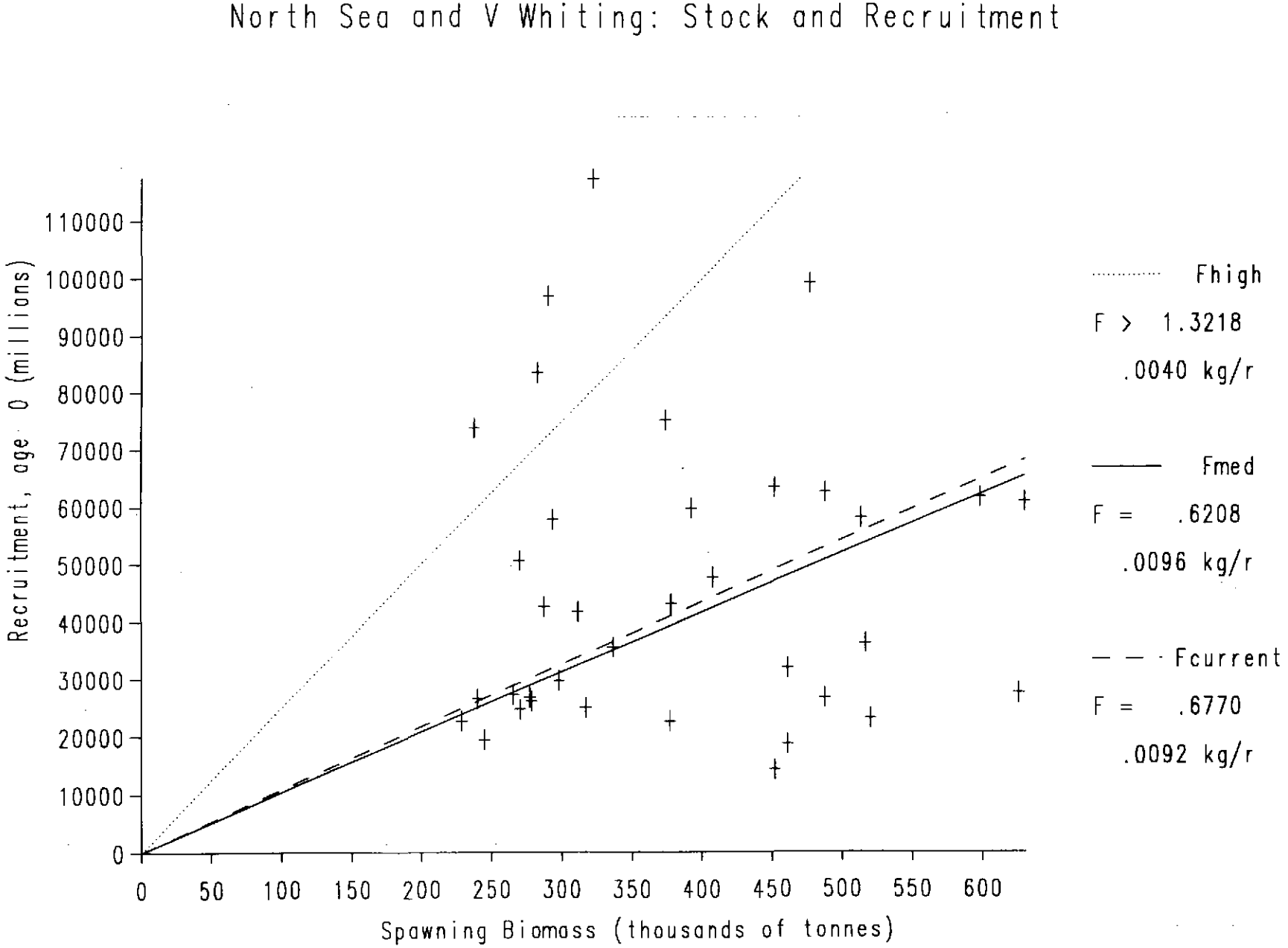

North Sea and V Whiting: Stock and Recruitment
Recruitment, age 0 (millions)
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
50
100
150
200
250
300
350
400
450
500
550
600
Spawning Biomass (thousands of tonnes)
Fhigh
F > 1.3218
.0040 kg/r
Fmed
F = .6208
.0096 kg/r
Fcurrent
F = .6770
.0092 kg/r

Figure 5.1.10.1

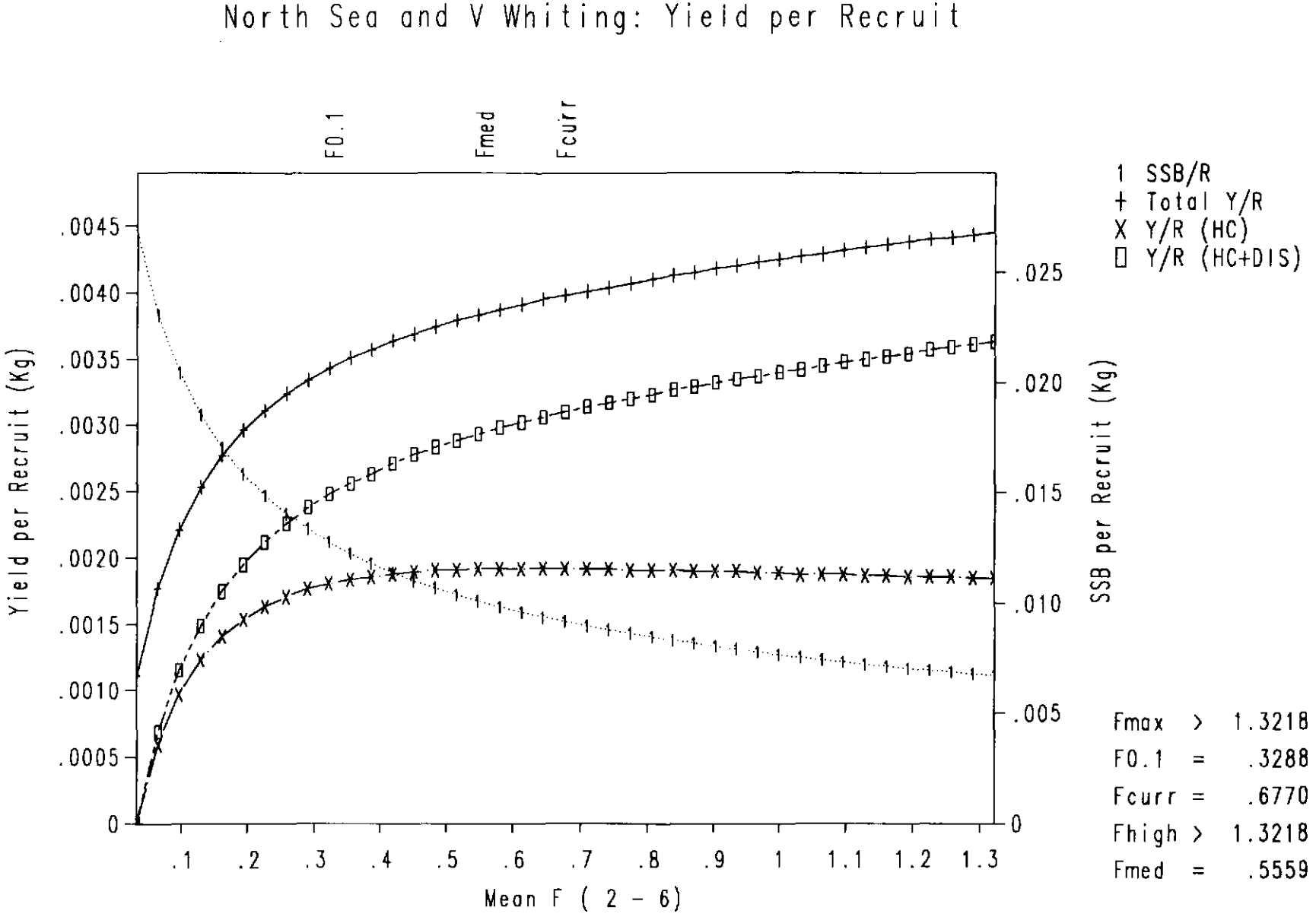


Figure 5.1.10.2

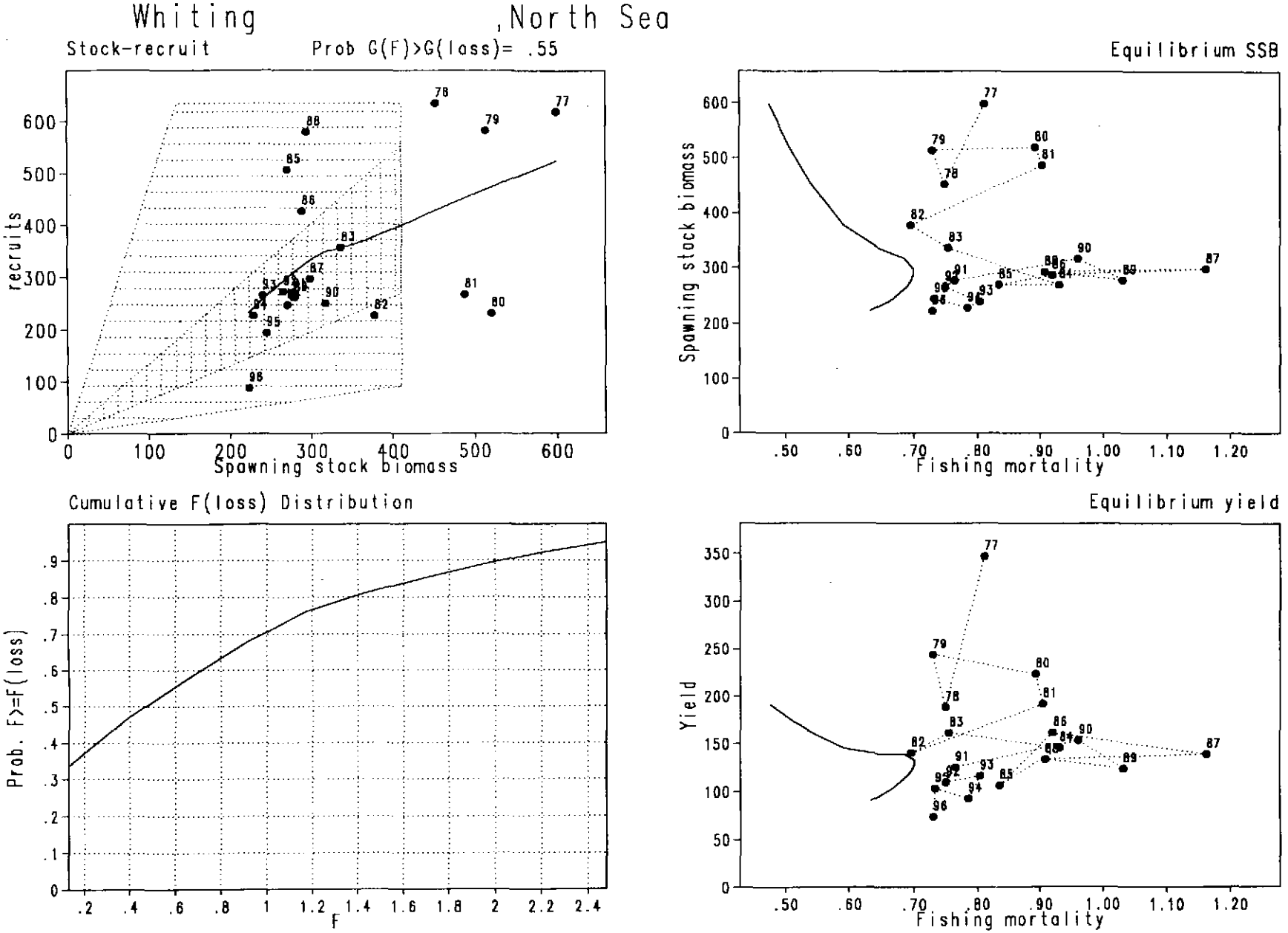


Figure 5.1.12.1

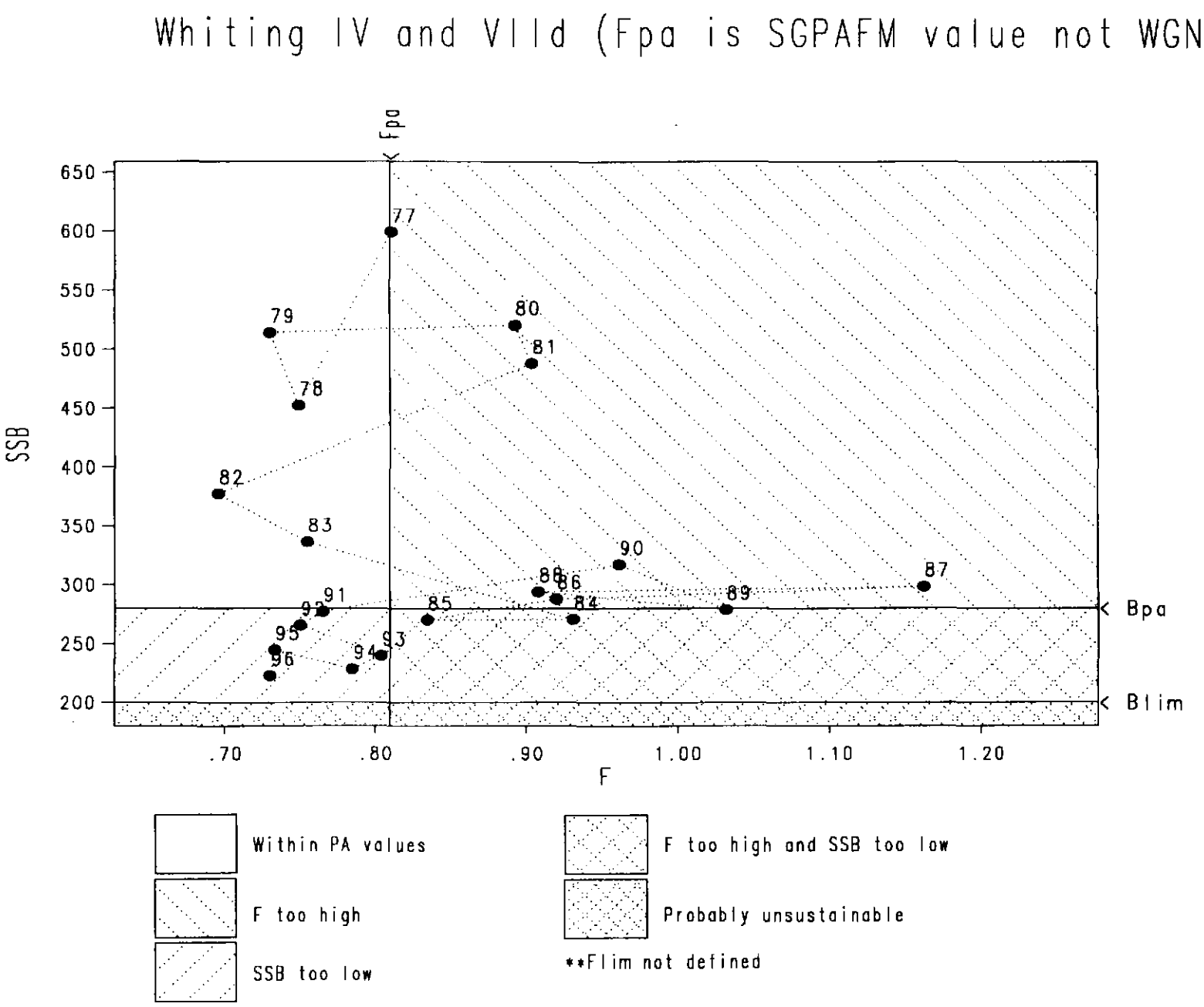


Figure 5.1.12.2