Advisory Committee on Fishery Management

ICES CM 1997/Assess:6

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

ICES Headquarters, Copenhagen, Denmark
7–15 October 1996

PART 1 OF 3

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1 INTRODUCTION

1.1 Participants

The Working Group met in Copenhagen on 7-15 October 1996 with the following participants:

Frans van Beek	Netherlands
Robin Cook (part time)	Scotland
Poul Degnbol (Chairman)	Denmark
Henrik Gislason	Denmark
Holger Hovgaard	Denmark
Laurence Kell	England
Knut Korsbrekke	Norway
Phil Kunzlik	Scotland
Peter Lewy	Denmark
Tim Macer	England
Capucine Mellon	France
Richard Millner	England
Stuart Reeves	Scotland
Adriaan Rijnsdorp	Netherlands
Odd M. Smedstad	Norway
Alain Tétard	France
Willy Vanhee	Belgium
Wolfgang Weber	Germany

1.2 Terms of reference

The Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (Chairman: Mr P. Degnbol, Denmark) will meet at ICES Headquarters from 7-15 October 1996 to:

a) assess the status of and provide catch options for 1997 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 if possible provide catch forecasts for 1997 for, Norway pout and sandeel stocks in Sub-area IV and Divisions IIIa and VIa and advise on the need for any management measures 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 Working Group on Ecosystem Effects of Fishing Activities

d) provide estimates of the minimum biologically acceptable level of spawning stock biomass (MBAL) for as many stocks as possible, with an explanation of the basis on which the estimates are obtained;

e) prepare medium term forecasts under different management scenarios, taking into account uncertainties in data and assessments and possible stock-recruitment relationships, and indicate the associated probability of the stocks falling or remaining below MBAL within a stated time period;

f) provide the data requested by the Multispecies Assessment Working Group (quarterly catches and mean weights at age in the catch and stock for 1995 for all species in the multispecies model that are assessed by this Working Group);

g) Specify the information and research required to provide annual forecasts for sandeels based on the status of the stocks in that year;

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

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

The above terms of reference refer to species and areas to be covered but do not explicitly state stock entities to be used. On the basis of evaluations and recommendations from ACFM 1995, a number of entities, which have formerly been assessed as separate units, have been combined in this years assessments. The new combined stock entities are :

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

Sandeel in Sub-area IV is closely associated to some sandeel components in Division IIIa. However, sandeel landings from IIIa have in recent years been dominated by *Ammodytes tobianus* and *Hyperoplus lanceolatus* contrary to North Sea landings which are dominated by *Ammodytes marinus*. A species split of the landings is not available in the historical time series. It was therefore decided not to merge the Division IIIa and North Sea components.

Details of the merging process is given in section 1.3.3 below.

1.3 Data sources and sampling levels

1.3.1 Data sources: roundfish and flatfish

The data used in assessments are based on :

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

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

The working group estimates of total landings do for most stocks deviate from official figures. This discrepancy is shown in the landings Tables under the heading 'unallocated landings'. These unallocated landings will in most cases include discrepancies which are due to differences in the calculation procedures, for instance that official landings figures use nominal box weights whereas the working group estimates are based on the box weights as measured during market sampling. These Sum Of Products differences are in most cases minor. For all stocks except cod, haddock, saithe and whiting, the working group estimates have been used in assessments. The reason the SOP corrected data have not been used for roundfish stocks is that some data in the historical time series have been SOP corrected and that it has proven difficult to rectify this in a consistent manner.

The unallocated landings do in some cases also include corrections for mis- or unreported landings. Such corrections may be based on direct information such as estimation from alternative data sources, or may be based on softer information. It will be evident from the stock sections whether such corrections have been included or not.

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

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

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

1.3.2 Data sources : Norway pout and sandeel

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

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

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

1.3.3 Stock merging

(based on working group paper by S. Reeves)

At its 1995 meeting, the Working Group on the assessment of demersal stocks in the North Sea and Skagerrak was requested to evaluate the stock units used in the assessment of stocks in the North Sea and adjacent areas, and identify any changes required. As a result of this exercise, the ACFM concluded that the stocks of cod and whiting in VIId (eastern Channel) should be combined with those in the North Sea for assessment purposes. The conclusions for the Skagerrak stocks were less clear, but there were indications that the Cod and Haddock stocks were linked with those in the North Sea and thus there may be grounds for combining the assessments.

This section considers some of the problems involved in combining data across areas in preparation for combined assessments. These are discussed firstly as problems common to all three species, then on a species by species basis.

1.3.3.1 Source data

The data for the roundfish stocks in the North Sea and eastern Channel are all maintained as part of the overall roundfish database, so the procedures used in compiling and raising the data for these stock units are comparable, and the full, fleet-disaggregated databases are available for all stock-units. For the Skagerrak data however, only the raised, fleet-aggregated data from the IFAP system are at present available for years prior to 1995.

In general, the data available for the North Sea cover a longer time span than those from the other areas. In addition the Skagerrak and eastern Channel assessments have tended to use a shorter age-range of data than the North Sea assessments. This is not an issue with the Eastern Channel data, as the full age range is available in the databases, but it is potentially problematic in the Skagerrak stock-units, where the available data are aggregated into a plus-group.

These limitations on year/age range of data mean that, in the first instance, any combined assessment would be limited to the year-range of the stock-unit with the shortest time-series of catch-at-age data. To avoid this problem, the approach used has been to extend the time-series of landings data for the minor-area stocks back to the same starting year as the appropriate North Sea stock, then estimate age-compositions for these landings from North Sea data. This reconstruction of past landings data was not in all cases straightforward. The main problem was that in many cases the official statistics do not distinguish between e.g. Divisions VIId and VIIe or the Skagerrak and the Kattegat. In some cases this limitation was overcome using data for the appropriate area supplied by Working Group members. Where such data were not available, the official statistics for each of the major nations exploiting a stock were split between e.g Divisions VIId and VIIe using the mean split between these areas for the years for which these data were available.

The aggregated plus-group in the Skagerrak data presented another potential problem. In practice this was overcome by expanding the plus-group using the age composition for the appropriate year from the North Sea. Other potential pitfalls, including discards, industrial bycatch and misreporting problems, are discussed under the individual stocks.

1.3.3.2 Biological parameters

One potential problem in combining assessments across areas is the choice of biological parameters (i.e maturity ogive and natural mortality at age) to be used where the values used have previously differed between areas. In the current instance, this is not really a problem; in all cases the North Sea stock is both substantially larger, and more closely studied than those of the other areas. This means that where biological parameters do differ between areas, the North Sea values are the logical choice for the combined assessment. In practice the biological parameters used in the separate assessments tend not to differ, due to the adoption of the North Sea values in recent Skagerrak and eastern Channel assessments.

Weights at age in the stock could also be regarded as biological parameters. In the case of all the stock-units considered here, weights at age in the catch are also used as weights at age in the stock, so there are no differences in practice to consider.

1.3.3.3 Tuning data

Combining catch-at-age data across three areas also has implications for tuning data. Catch rates in one of the small subsidiary areas may not reflect abundance in the North Sea as a whole or in the other minor area. In some cases, where for instance a commercial fleet or a survey operates in both the North Sea and one of the other areas, there may be a case for combining CPUE data into a single series for a combined assessment. For simplicity however, at this stage all tuning data have been kept separate, making it possible to exclude series as necessary at the tuning stage.

One specific example where a survey operates in both the North Sea and Division IIIa is the IBTS first quarter survey. Data from this survey are used in the tuning of both the North Sea and Skagerrak stocks, although the indices used for each species in each area are based on average catch rates over different standard areas. Nonetheless, there is some overlap, with the standard areas for North Sea cod, haddock and whiting including much of the Skagerrak.

1.3.3.4 Cod

The Report of the 1995 Working Group meeting noted that "It may be concluded that the cod in the North Sea, the Skagerrak and the eastern Channel could be considered as a single stock for assessment purposes", although it was also noted that the fish within the North Sea do not form a single, homogeneous stock. The results summarised by the Working Group indicate a net movement of juvenile cod spawned in the eastern channel into the southern North Sea. The cod occurring in the Skagerrak (excluding those from inshore, fjordic stocks) appear to originate from spawning in the North Sea.

Over 1978-1994, the year-range for which landings data are currently available for all three areas, North Sea landings accounted for between 82.7% and 92.1% of the cod taken from the three areas, with a mean of 87.2%. On average the Skagerrak accounted for 10% of the total, and the eastern Channel 2.8%.

Cod : Available data

Table 1.1 summarises the year and age ranges of data used in the most recent (1995) assessment of the three stock units of cod. It can be seen that a combined assessment could be potentially be limited by the availability of catch-at-age data for the Skagerrak, and thus could only extend from 1978 onwards. This contrasts with the North Sea data which extend back to 1963.

Table 1.1 Age and year ranges used in the 1995 Working Group assessments of Cod in the North Sea, Skagerrak, and eastern Channel.

	North Sea	**Skagerrak**	**Eastern Channel**
First Year	1963	1978	1976
Last Year	1994	1994	1994
Youngest age	1	1	1
Plus-group age	11	8	5

Cod : Biological parameters.

The most recent assessment of each of the three stock units used the same maturity ogive. This reflects recent changes in practice in the both the Skagerrak and Eastern Channel assessments to use the maturity ogive from the North Sea stock. In the case of the eastern Channel assessment, the North Sea natural mortality estimates have also been adopted, whereas the Skagerrak assessment has used a value of 0.2 at all ages. All individual assessments calculated spawning biomass at the start of the year. Thus the only change in practice involved in a combined assessment would be the application of the North Sea natural mortalities at age to the Skagerrak cod.

Cod : Bycatch, discards and misreporting problems

In the Skagerrak, the 1995 Working Group Report noted that mis/non-reporting of landings has been a major problem in recent years, although there were no estimates of the extent of this problem. Some cod reported as being taken from the Skagerrak were suspected of having been taken from the North Sea, so a combined assessment would tend to cancel-out this area misreporting effect, although it would not account for suspected misreporting into the Skagerrak from the Kattegat. The catch data used in the Skagerrak assessment do not include industrial bycatch as no historical age-compositions are available for this component of the catch. The industrial bycatch has accounted for up to 25.9% of the annual cod landings from the Skagerrak, with an average of 9.5%. This proportion has tended to be lower in recent years, with the bycatch amounting to 4.8% of the estimated cod landings from the Skagerrak in 1994.

Mis-reporting and non-reporting of cod in the North Sea is known to have occurred in recent years. The estimate of misreported landings used in the Working Group estimate of the 1994 catch (2,000t out of a total catch of 88,454t) indicates that the extent of the problem is relatively small, but this may under-estimate the extent of the problem. Industrial bycatch and discards of cod in the North Sea are considered to be negligible. Discards of cod in the other two areas are also presumed to be small.

The Working Group report makes no reference to any occurrence of misreporting of cod in the eastern Channel. Similarly, no bycatch problems are suspected.

Cod : Discussion

The case for treating cod in the eastern Channel and the Skagerrak as part of the North Sea stock seems to be reasonably well defined. Combining the available data from the three areas does not appear to present any major technical problems. There are misreporting problems with cod in the North Sea and Skagerrak, but these are not likely to be exacerbated by combining the data across the areas. Similarly, the absence of age compositions for the industrial bycatch in the Skagerrak will not be overcome by combining the areas, but the relatively small size of these landings when compared with the overall cod catch means that the problem will be diluted somewhat.

The North Sea cod is a well-studied stock with a long time-series of data available. At present the stock is at a very low level with ACFM having advised measures which should lead to significant reductions in fishing mortality. In view of this, and with the recent decline (and in the case of the Northern Cod, collapse) of other cod stocks, this is clearly a highly critical assessment. Thus any major changes to the data used in the assessment should not be made without careful consideration. In this respect the major problem presented by the incorporation of the Skagerrak and eastern Channel data into the North Sea assessment would be the substantially shorter time series of data available. It is hoped that by using North Sea age compositions applied to the estimated landings from the Skaggerak and the Eastern Channel, this problem has been avoided.

1.3.3.5 Haddock

In the case of Haddock, catches from the eastern Channel are negligible, so the only point at issue is the inclusion of catches from the Skagerrak in with the North Sea assessment. In the report of its 1995 meeting, the Working Group noted that the Skagerrak haddock were probably related to the North Sea stock, but cautioned against merging the two given the problems with the catch data in the Skagerrak. Following on from this, the ACFM noted that 'the stock identity is not clear, but the Skagerrak stock is possibly related to the North Sea stock.'

Over 1975 to 1994, catches from the North Sea amounted to between 93.1% and 98.7% of the haddock taken from the two areas. However, it should be noted that the estimates of total catch from the North Sea include discards, whereas no estimates of discards are available for IIIa.

Haddock : Available data

Table 1.2 summarises the year and age ranges of data used in the most recent (1995) assessment of the two stock-units of haddock. It can be seen that a combined assessment could potentially be limited by the availability of catch-at-age data for the Skagerrak, and thus could only extend from 1981 onwards. This contrasts with the North Sea data which extend back to 1963.

Table 1.2 Age and year ranges used in the 1995 Working Group assessments of Haddock in the North Sea and Skagerrak.

	North Sea	Skagerrak
First Year	1963	1981
Last Year	1994	1994
Youngest age	0	1
Plus-group age	10	8

Reconstructing the past catch data for the Skagerrak involved making assumptions about the proportion of the catch which was taken in the human consumption and industrial fisheries. Investigation indicated that the proportion taken in the industrial fishery in the Skagerrak was correlated with the proportion of haddock taken by the industrial fishery in the North Sea. Thus for the years for which no information was available on the industrial/human consumption split in the Skagerrak, it was assumed that the split was the same as in the North Sea. In practice this assumption will make very little difference to the overall catch data as the catches of haddock from the Skagerrak in the early years were very small.

Haddock : Biological parameters

In recent years, problems with the catch-at-age data in the Skagerrak have been regarded as an obstacle to a full analytical assessment, so current biological parameters are not presented in the Working Group report. The values supplied in files indicate partial maturity only at age 2, when 50% of fish are considered mature, and M = 0.2 for all ages. 25% of natural, and 15% of fishing mortality is considered to occur before spawning. In this case, the adoption of biological parameters from the North Sea stock would change all of these values.

The data supplied for weights at age in the catch and stock in the Skagerrak are incomplete, so North Sea values will be used in the combined assessment.

Haddock : Bycatch, discards and misreporting problems

The figures for catches of haddock in the Skagerrak included estimates of industrial bycatch. Over 1983-1994, The bycatch amounted to an average of 34.7% of the haddock taken, with a range of 8.1% to 54.3%. The bycatch data have caused problems with the catch-at-age data as no age compositions are available for the bycatch over the period 1987-1990. Over this period the bycatch accounted for between 8.1% and 33.8% of the total haddock catch.

Although adding the Skagerrak data into the North Sea assessment would substantially reduce the problem caused by the lack of age composition data for the Skagerrak industrial bycatch, a better approach would be to estimate its age composition using data from the North Sea. As the majority of the bycatch in both areas is taken by the Danish industrial fleet, age compositions from this fleet in the North Sea were used to estimate the Skagerrak bycatch for 1987 and 1988. No Danish age compositions were available for 1989 and 1990, so age compositions from the Norwegian North Sea industrial fleet were used. This is less satisfactory than using Danish age compositions, but rather more satisfactory than treating the problem as insurmountable. The 1995 Working Group report notes that the age distributions for the Skagerrak stock-unit need to be re-evaluated as 0-group fish are not included and the industrial catches of 1-group are rather small. In view of this concern, it may be appropriate to investigate the use of the North Sea bycatch data to estimate the age compositions of the Skagerrak bycatch for other years.

Estimates of discards are available for haddock in the North Sea. These are based on Scottish discard sampling, which is appropriate as Scotland accounts for the large majority of the North Sea haddock landings. The majority of the human consumption landings of haddock in the Skagerrak are taken by Danish trawlers. Discarding of haddock presumably also occurs in the Skagerrak, but no estimates are available. Given this absence of information, no attempt has been made to estimate Skagerrak discards from Scottish data.

Misreporting of catches is known to have been a problem for North Sea haddock in some recent years. The Report of the 1995 Working Group meeting notes a general problem of misreporting of demersal stocks in IIIa in some recent years, but makes no specific reference to haddock.

Haddock : Discussion

The data problems with the Skagerrak haddock can be readily addressed using age compositions from the North Sea catches. A potentially more serious problem is the short time-series available for the Skagerrak, where catch-at-age data only go back to 1981. In the case of haddock the removal of the earlier years data from the assessment would completely change the perspective of the stock by removing the influence of the exceptionally strong 1967 and 1974 year-classes. As with the cod however, the estimation of Skaggerak catches using North Sea age consumptions should avoid this problem.

1.3.3.6 Whiting

The information on stock identity summarised in the 1995 Working Group Report indicates that the whiting in the Eastern channel are closely related to those in the southern North Sea, but that there are some indications of separate stocks in the southern and northern North Sea. The Report does not address the stock identity of whiting in Division IIIa. Based on this, the ACFM concluded that the stock of whiting in the eastern Channel should be combined with the North Sea stock for assessment purposes. No conclusion was reached over whiting in Division IIIa.

Total catches from the North Sea (including discards and industrial bycatch) accounted for between 72.7% and 93.1% of the whiting caught in the three areas over 1976 to 1994, with a mean of 86.1%. Over the same period, landings from Division IIIa (mostly industrial bycatch) accounted, on average, for 10.2% of the total, with the average from the eastern Channel (human consumption landings only) being 3.8%.

Whiting : Available data

Table 1.3 summarises the year and age ranges of data used in the most recent (1995) assessment of the three stock-units of whiting. No assessment was done for Division IIIa; the data stored on IFAP are only total landings, no catch-at-age data are available.

Table 1.3 Age and year ranges used in the 1995 Working Group assessments of Whiting in the North Sea, Division IIIa* and the eastern Channel.

	North Sea	Division IIIa*	Eastern Channel
First Year	1960	1975	1976
Last Year	1994	1994	1994
Youngest age	0	-	1
Plus-group age	10	-	5

*No assessment done, only total catch data available.

Whiting : Biological parameters

Recent assessments of whiting in the eastern Channel have used the North Sea maturity and natural mortality values. No information is available on the biological parameters of whiting in Division IIIa.

Whiting : Bycatch, discards and misreporting problems

In Division IIIa, landings of Whiting are mostly industrial bycatch, with between 78.5% and 95.4% of the landings over 1981-1994 going for reduction. Discards and industrial bycatch form quite large components of the landings of Whiting from the North Sea, and estimates of both are included in the assessment. Discard estimates are based on Scottish data, and bycatch estimates are based on Danish and Norwegian data. No estimates of discards are available for whiting in the Eastern Channel, but there is no industrial fishery in this area.

Misreporting is not considered to be a serious problem in any of the three areas.

Whiting : Discussion

Incorporation of the eastern Channel whiting data with the North Sea assessment would not be problematic. There seems to be a clear case for regarding whiting in this area as part of the North Sea stock, and the landings are sufficiently small that they could probably be incorporated into the North Sea assessment without the need to shorten the North Sea data series to coincide with the first year of eastern Channel data (1976). Even so, age compositions have still been estimated for these earlier years and have been included in the catch at age data. In the case of whiting in Division IIIa there is apparently no information available on either stock identity or age compositions. While this remains the case it would seem inadvisable to consider including the Division IIIa whiting in the North Sea assessment.

1.3.3.7 Norway pout

In its last report, the Working Group on the Assessment of Norway Pout and Sandeel (ICES C.M.1994/Assess:7) concluded that the justification for a separate stock assessment in IIIa is highly questionable and a preliminary run including the IIIa fishery as an additional fleet in the North Sea assessment produced results which were very close to the results produced by the North Sea assessment. A merge was however not made because the main use of the assessment at the time was to provide stock estimates for the North Sea multispecies assessments. With the new request to provide assessments and catch forecasts for Norway pout in Sub-area IV as well as Division IIIa the situation is different. On basis of the lack of justification for a separate stock assessment as concluded earlier, the Working Group has decided to respond to the request by making a combined assessment for the two areas.

For Norway pout, assessments have so far not been carried out for the IIIa stock separately. However, data on age compositions and weights for the catches are available on a quarterly basis from both Sub-area IV and Division IIIa since 1983. The landings reported from IIIa have in recent years constituted 10-25% of the total landings from IV and IIIa.

The data base for the combined stock was then established by adding catch-at-age data from Sub-area IV and Division IIIa. The weight-at-age in the catch was calculated as and average of the two areas, weighted by catch-at-age. North Sea maturities were used for the combined stocks. The fleets used for tuning were the same as used last year, that is North Sea fleets.

1.3.3.8 Summary.

With the exception of Whiting in Division IIIa, there are no major obstacles to including the catches from the Skagerrak and eastern Channel into the North Sea assessments of cod, haddock, whiting and Norway pout. In all cases the catches from the subsidiary areas are substantially smaller than those from the North Sea, so problems with data in these areas, such as absence of information on bycatch or discards, will tend to be diluted substantially once they are combined with the North Sea data. For the three roundfish stocks, catch-at-age data for the subsidiary areas for early years have been estimated from landed weights and North Sea age compositions. In the case of Skagerrak haddock and eastern Channel whiting, the catches are small enough that these age compositions are unlikely to have a noticeable effect on the combined assessment. With cod however, the Skagerrak catches amount to on average 10% of the total, so the Skagerrak age-compositions may have some influence on the results of a combined assessment.

1.3.4 Sampling levels

Sampling levels for the various stocks are presented in Table 1.4

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

1.4 Methods and software

1.4.1 Analysis of catch-at-age data

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

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

Recruitment estimates has in several cases been made with RCT3. This is the case when recruitment indices from 1996 are available and especially when indices are available from later than the first quarter. The present implementation of XSA can not accommodate survey data in the year following the last catch data year and RCT3 is therefore implemented to utilise this information. This does in itself create some inconsistencies in the approaches used. The survey indices may end up being used twice for recruitment estimation - once in the survivors analysis (and thus in the VPA recruitment) and again with the same survey indices in RCT3. Another problem is the use of F-shrinkage for recruiting year classes in the present implementation of the XSA. This can not be turned off and has in some cases been seen to have strong influence on the recruitment estimates originating from XSA. The result of this feature is that the present implementation of XSA does not reproduce RCT3 for recruiting year classes.

1.4.2 Sensitivity analysis and medium-term projections, Roundfish and flatfish

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 Anon. (1995) and more detailed documentation in Reeves and Cook (1994).

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

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

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

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

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

Code	Parameter
N0	Numbers at age 0 in 1995
M0	Natural mortality, age 0
N1	Numbers at age 1 in 1995
M1	Natural mortality, age 1
N2	Numbers at age 2 in 1995
M2	Natural mortality, age 2
etc.	
WS0	Weight in stock at age 0
MT0	Proportion mature, age 0
WS1	Weight in stock at age 1
MT1	Proportion mature, age 1
WS2	Weight in stock at age 2
MT2	Proportion mature, age 2
etc.	
sH0	Selectivity, HC, age 0
WH0	Weight in HC catch, age 0
sH1	Selectivity, HC, age 1
WH0	Weight in HC catch, age 1
sH2	Selectivity, HC, age 2
WH0	Weight in HC catch, age 2
etc.	
sD0	Selectivity, Disc, age 0
WD0	Weight in Discards, age 0
sD1	Selectivity, Disc, age 1
WD0	Weight in Discards, age 1
sD2	Selectivity, Disc, age 2
WD0	Weight in Discards, age 2
etc.	
sI0	Selectivity, Ind BC, age 0
WI0	Weight in Ind Bycatch, age 0
sI1	Selectivity, Ind BC, age 1
WI0	Weight in Ind Bycatch, age 1
sI2	Selectivity, Ind BC, age 2

WI0	Weight in Ind Bycatch, age 2
etc.	
K95	Year effect on natural mortality, 1995
K96	Year effect on natural mortality, 1996
K97	Year effect on natural mortality, 1997
HF95	Year effect on HC/discard fishing mortality, 1995
HF96	Year effect on HC/discard fishing mortality, 1996
HF97	Year effect on HC/discard fishing mortality, 1997
IF95	Year effect on Ind. bycatch fishing mortality, 1995
IF96	Year effect on Ind. bycatch fishing mortality, 1996
IF97	Year effect on Ind. bycatch fishing mortality, 1997
R96	Recruitment in 1996
R97	Recruitment in 1997

For medium term projections, stock-recruitment models were fitted using the program RECRUIT, which generates input data for the medium-term projection program WGMTERM. Both of these programs are 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.

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

Management of industrial fisheries

TACs for many human consumption fisheries are based on so-called analytical assessments. In these assessments, a catch forecast is made for the year in which the TAC is to be set. In essence a stock projection is made for two years ahead of the most recent stock size estimate. It means, in general, that the forecast may depend heavily on recruiting year-classes which must be predicted in some way. This system can only work if the year classes on which the fishery will depend can be predicted with some precision. In the case of sandeel and Norway pout, the fisheries depend heavily on 1-group and 2-group fish and these are not well estimated in conventional catch-at-age analysis. This occurs for a variety of reasons related to the data available, the biology of the species and the variable nature of the fishery. Exploiting fleets, for example, frequently change their area of operation from year to year unpredictably and the amount of effort deployed may depend on the amount of active processing capacity at fishmeal plants.

Although it has proved possible to reduce the time ahead for forecasting to 18 months by using data for the first half of the assessment year, attempting to forecast catches and stock for industrial species is unlikely to be of use in formulating TACs in the usual way for the reasons stated above. If TAC management is to be considered, then alternative approaches to arriving at an appropriate catch constraint will have to be considered. Rather than trying to predict a catch it may be better to consider the possible effects on the stock and the fishery of various management regimes such as fixed or limited flexibility TAC or effort controls. This would require a different approach to the normal ICES assessment procedure. It would be necessary to construct a stochastic simulation model which considered in a probabilistic way the outcomes of potential management actions. Such an exercise would be similar to the IWC 'management procedure' approach and would require the building of a realistic operational model for sandeels and Norway pout. This is a fairly large undertaking and would take some time to develop. An evaluation of possible models could be done appropriately in the Comprehensive Fishery Evaluation Working Group and might be expected to take one or two years to develop.

Catch predictions for sandeel : methodology

A catch prediction for sandeel was made for the first time using software developed to allow the modelling of fisheries management strategies for the Comprehensive Fisheries Evaluation Working Group (Anon 1996). During the CFEWG meeting variance estimates for catch forecasts were discussed and a comparison of survivor estimate CV obtained from the Lowestoft version of XSA and ADAPT (Gavaris, 1988) was made. XSA tended to give lower CVs than ADAPT and further work with a bootstrapped (Efron and Tibshirani, 1993) XSA has shown that there are significant correlation's between the survivor estimates at older ages. It was decided therefore rather than use the analytical CV estimates from XSA to use the bootstrap estimates from the assessment.

A version of the Lowestoft XSA was therefore modified especially for the meeting to include seasonality. It was this version rather than the Seasonal XSA (Skagen 1993) that was used in the assessment that was used in the projection. Whilst Skargen's Seasonal XSA differs from the Lowestoft version in some details of the tuning, a comparison of the assessment results showed only minor differences in the point estimates in the terminal year. The benefits of using the FishLab version of XSA is that it is available as a function for Excel spreadsheets and so can be ran in @Risk to either bootstrap or Monte Carlo the assessment and projection.

The assessment was bootstrapped by taking the catchability estimates from a key run of XSA and replacing the observed values of the tuning fleet catches by their expected values, during the bootstrap the input values for tuning are generated from these expected values plus an error.

The terminal Ns during each iteration were fed to a standard prediction, since the estimates of F and N within the time series will vary then estimates of SSB, recruits and biological reference points will also have a probability distribution attached to them. In addition it will be possible to model growth, natural mortality and maturity as random variables to include a greater range of uncertainty.

1.4.4 Area split predictions

Partial fishing mortality and short term forecast have been calculated for cod and whiting with an EXCELL5 spreadsheet (whipartf.xls and codpartf.xls). Different F multipliers need to be input to obtain the different catch scenarios.

Partial fishing mortality

COD

Total international F-at-age in any year for cod has been partitioned into area partial F's ($F_{a,y,area}$) by use of the ratio of the area catch-at-age in the year divided by the total international catch in the three areas ($C_{a,y,overall}$). For each age, a mean of the F values for n years that precede the final assessment year is calculated. The number of years (n) used to calculate the mean was 5. In the same way, the mean catch at age has been calculated during the same range of years.

$$F_{a,y,area\ IV} = F_{a,y,overall} * \text{mean } C_{a,y,area\ IV} / C_{a,y,overall}$$
$$F_{a,y,area\ VIId} = F_{a,y,overall} * \text{mean } C_{a,y,area\ VIId} / C_{a,y,overall}$$
$$F_{a,y,area\ IIIa} = F_{a,y,overall} * \text{mean } C_{a,y,area\ IIIa} / C_{a,y,overall}$$

$$\text{with } F_{a,y,overall} = \left(\left(\sum_{i=1}^{n} F_{a,yi,overall}\right) / n\right) * \left(\overline{F_{2\text{-}8,95}} / \left(\sum_{i=1}^{n} F_{2\text{-}8,yi}\right)\right)$$

$$\text{with mean } C_{a,y,area} = \left(\left(\sum_{i=1}^{n} C_{a,yi,area}\right) / n\right)$$

WHITING

Whiting overall F has been spread out into partial F's following a different method. This stock concerns two areas (IV and VIId) and three types of catches (human consumption (hc), discards (d) an industrial by-catch (bc)). Then it has been partitioned in two ways, first of all in hcIV, dIV and VIId and in bcIV. Five years have been taken to calculate mean F overall. Then each partial F for hc, d in division IV and hc in VIId has been obtained by multiplying the total F previously obtained by the proportion of each type of catch at age in the total catch. Total catch at age and catch at age per type were averaged over the same range of years than the F at age.

$$F_{a,y,\ type\ (hcIV+dIV+VIId)} = F_{a,y,overall} * C_{a,y,\ type\ (hcIV+dIV+VIId)} / C_{a,y,overall}$$
$$F_{a,y,\ type\ (bc)} = F_{a,y,overall} * C_{a,y,\ type\ (bc)} / C_{a,y,overall}$$

$$\text{with } C_{a,y,type} = ((\sum_{i=1}^{n} C_{a,yi,\ type}) / n)$$

$$\text{with } F_{a,y,overall} = ((\sum_{i=1}^{n} F_{a,yi,overall}) / n) * (F_{2\text{-}6,95} / (\sum_{i=1}^{n} \bar{F}_{2\text{-}6,yi}))$$

$$F_{a,y,\ type\ (hcIV)} = [C_{a,y,\ type\ hcIV} / C_{a,y,\ type\ (hcIV+dIV+VIId)}] * F_{a,y,\ type\ (hcIV+dIV+VIId)}$$
$$F_{a,y,\ type\ (dIV)} = [C_{a,y,\ type\ dIV} / C_{a,y,\ type\ (hcIV+dIV+VIId)}] * F_{a,y,\ type\ (hcIV+dIV+VIId)}$$
$$F_{a,y,\ type\ (VIId)} = [C_{a,y,\ type\ VIId} / C_{a,y,\ type\ (hcIV+dIV+VIId)}] * F_{a,y,\ type\ (hcIV+dIV+VIId)}$$

Short term Forecast

COD

The catch equation has been used to estimate the catch prediction in each area. Natural mortality is the same in IV and VIId but differ in IIIa. The first one has been used to calculate the total mortality.

$$C_{a,y,area} = N_{a,y}\, e^{-(Za,y)}\, (F_{a,y,area} / (Z_{a,y}))(e^{(Za,y)} - 1)$$

$$\text{Plus group : } C_{a+,y,area} = (N_{a,y-1} * F_{a,y,area}) / (Z_{a,y-1})$$

WHITING

Total mortality for whiting is the same in the two areas.

$$C_{a,y,type} = N_{a,y}\, e^{-(Za,y)}\, (F_{a,y,type} / (Z_{a,y}))(e^{(Za,y)} - 1)$$

$$\text{Plus group : } C_{a+,y,type} = (N_{a,y-1} * F_{a,y,type}) / (Z_{a,y-1})$$

For cod and whiting, mean weights at age have been calculated for each type of catch or area over 5 years. Catches in weight have been obtained by multiply catches in number by the mean weight at age. Weights of the number at age have been obtained by multiplying numbers at age by the mean total weight at age averaged over 5 years too.

1.4.5 MBAL considerations

In response to TOR d) concerning provision of MBAL estimates, a discussion of MBAL is presented for each stock. The basis for this discussion and a summary of the conclusions for the stocks covered by this working group is presented in Section 15.

Table 1.4 Sampling levels for 1995

	Section 3a			Section 4			Section 7d		
	# samples	measured	aged	# samples	measured	aged	# samples	measured	aged
COD									
Belgium									
Denmark	122	3830	3821	56	2586	2581			
England				596	79656	8067	76	1642	415
France				86	1680	762	27	119	119
Germany				23	26012	5463			
Netherlands				85	5352	2184			
Norway	53	806	223	222	2871	1053			
Scotland					62329	11671			
Sweden	n/a	n/a	n/a						
Total	**175**	**4636**	**4044**	**1068**	**180486**	**31781**	**103**	**1761**	**534**
HADDOCK									
Belgium									
Denmark	88	4151	4111	54	1751	1716			
England				316	41650	3991			
France				24	1020	350			
Germany									
Netherlands									
Norway	43	829	0	327	20902	1180			
Scotland					139401	12713			
Sweden	n/a	n/a	n/a						
Total	**131**	**4980**	**4111**	**721**	**204724**	**19950**	**0**	**0**	**0**
WHITING									
Belgium									
Denmark	96	3216	3080	74	1185	1129			
England				246	22846	3421	13	495	0
France				107	15547	1373	57	4240	1717
Germany									
Netherlands				96	7703	1250			
Norway	47	870	0	240	12101	783			
Scotland					77098	7283			
Sweden	n/a	n/a	n/a						
Total	**143**	**4086**	**3080**	**763**	**136480**	**15239**	**70**	**4735**	**1717**
SAITHE									
Belgium									
Denmark	10	1064	1057	11	546	545			
England				54	3307	0			
France									
Germany				16	9843	3055			
Netherlands									
Norway	43	653	22	113	4492	758			
Scotland					19414	8166			
Sweden	n/a	n/a	n/a						
Total	**53**	**1717**	**1079**	**194**	**37602**	**12524**	**0**	**0**	**0**

Table 1.4 Continued

	Section 3a			Section 4			Section 7d		
	# samples	measured	aged	# samples	measured	aged	# samples	measured	aged
SOLE									
Belgium				10	3919	600	14	1893	489
Denmark	12	1676	1666	5	626	625			
England				128	13447	1744	196	10191	3426
France				40	2766	0	126	6873	1097
Germany									
Netherlands				75	3944	3944			
Norway									
Scotland									
Sweden									
Total	**12**	**1676**	**1666**	**258**	**24702**	**6913**	**336**	**18957**	**5012**
PLAICE									
Belgium				30	2560	380	14	987	260
Denmark	41	4721	4482	21	3577	3470			
England				167	27285	2521	188	8315	2169
France				53	2382	700	146	6665	1097
Germany									
Netherlands				65	5200	5200			
Norway									
Scotland									
Sweden	n/a	n/a	n/a						
Total	**41**	**4721**	**4482**	**336**	**41004**	**12271**	**348**	**15967**	**3526**
NORWAY POUT									
Belgium									
Denmark	66	4451	4151	38	3574	3469			
England									
France									
Germany									
Netherlands									
Norway				230	23000	800			
Scotland									
Sweden	n/a	n/a	n/a						
Total	**66**	**4451**	**4151**	**268**	**26574**	**4269**	**0**	**0**	**0**
SANDEEL									
Belgium									
Denmark	17	1249	294	76	11072	4150			
England									
France									
Germany									
Netherlands									
Norway				120	12000	500			
Scotland					21662	914			
Sweden									
Total	**17**	**1249**	**294**	**196**	**44734**	**5564**	**0**	**0**	**0**

2 OVERVIEW

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

Description of the fisheries

The 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, pelagic trawls and purse seines.

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

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

A general upward trend in effort can be seen in all beam trawl fleets, in the Scottish light trawl fleet and the English gill netters. Most other demersal effort series show a downward trend. Whether or not this is caused by poor economic results of the fishery is not clear. 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.

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.

In recent years there was misreporting of roundfish landings associated to restrictive TAC's.

Several series of research vessel survey indices are available for most species. Quarterly data were available from the International Bottom Trawl Survey for quarter 2 and 4 for a period of 5 years and were used in the final VPA runs in some stocks.

Analytical assessments were performed on all four main roundfish stocks and the two principal flatfish stocks. Only whiting are subject to a significant by-catch in the industrial fisheries.

A combined assessment was made for the first time for cod in Sub-area IV, Division IIIa Skagerrak and Division VIId. Also combined assessments for whiting in Sub-area VI and Division VIId and haddock in Sub-area IV and Division IIIa were done for the first time. Previously these species were assessed in the areas separately. Following an evaluation of the stock units in 1995, it was concluded that there was little justification for maintaining separate stock assessments for these separate Sub-areas and Divisions, both in terms of biological stock identity and the fisheries. The combined catch prediction for these stocks has, however, been split into the original Sub-areas and Divisions.

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

Stock impressions

In the North Sea all stocks of roundfish and flatfish species are exposed to high levels of fishing mortality which is, with the exception of saithe and whiting, on a high historical level. This is in itself a clear indication of an excessive effort. The roundfish stocks, particularly cod, haddock, and whiting are subjected to a high exploitation rate which removes approximately 60% of the biomass each year. This makes the fisheries on these stocks highly dependent on recruiting year classes. Most of the roundfish stocks have been outside or close to safe biological limits in recent years and several stocks are at this level presently. The plaice stock is outside safe biological levels for a number of years and the sole stock is expected to fall outside these levels in the short term.

ACFM has recommended significant and sustained reductions in fishing mortality on some of these stocks. The TAC regulations resulting from this advice, however, did not lead to the desired reductions in fishing mortality. ACFM has therefore since 1991 indicated that reductions in fishing effort are required to achieve fishing mortality reductions.

Landings of **cod** in 1995 were 139,000 t. Recruitment has been well below averaged in most years since 1985. The cod stock has been stable in recent years but on a very low level. It has increase recently to about 100,000 t in 1996 due to the contribution of a relative abundant 1993 year class. It is expected to remain outside safe biological limits in the short term.

The stock of **saithe** is at a low level compared to the seventies when it was lightly exploited. In recent years it is gradually increasing. Landings in 1995 were 114,000 t. Fishing mortality has declined considerable since 1986. The stock may be within safe biological limits presently.

Human consumption landings of **haddock** in 1995 were 77,500 t. Although the stock of haddock is considered to be within safe biological limits, it is by no means sure that this position will be maintained in the medium term as the present stock size is largely due to the influence of one strong year class.

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; 47,000 t in 1995. Fishing mortalities have been highly variable with no clear trend although a downward shift is indicated for recent years. Estimates of recruitment form surveys do not correlate well with the VPA. In recent years recruitment is stable, but at a level below the long term geometric mean. The state of the whiting stock is uncertain.

The spawning stock of **plaice** has been decreasing and the stock is considered to be outside safe biological limits. Landings have fallen since 1990 to 98,000 t in 1995 and fishing mortality is at a record high level. The stock is expected to increase in the short term but is expected to remain below the MBAL of 300,000t in the medium term at the present rate of exploitation.

Landings and fishing mortality of **sole** were at a high levels in recent years due to 2 strong year classes in the fishery. The 1995 landings were 30,000 t. Recruitment of recent year classes is, however, below average. The stock seems also to have suffered from extra natural mortality in the most recent winter but the level mortality could not be quantified. The spawning stock is declining rapidly and there is a high probability that it will be below the MBAL of 35,000 t in 1998.

Industrial fisheries

Definitions of industrial fisheries

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

Data available

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

Trends in landings and efforts

The level of the sandeel catches in 1976-1986 of about 600,000 t has increased to about 800,000 t in 1987-1995. For Norway pout the there has been a decrease in catches since 1983.

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

Stock impressions

The SSB of Norway pout, which now include both the North Sea and the Skagerrak, has been increasing in the period 1974-1984. The next two years SSB dropped to a low level and has since been increasing. The increase in 1996 is due to the big 1994 year class. It should, however be noted that this year class is poorly estimated. Fishing mortality has generally been decreasing in 1974-1987. In 1995 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.

By-catches of protected species

By-catches of the major projected species, haddock, whiting and saithe in the industrial fisheries are presented in Table 2.1.2 for the years 1974-1995. For the last three years quarterly data are presented. In 1995 the combined by-catch of haddock, whiting and saithe was 36,000 t, which about the half of the average of 73,000 t. 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 1995 is shown in Table 2.1.4 for two areas, North and south of 57 degrees N. This table is based on Danish and Norwegian estimates. 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 large by-catch of sprat, and the sprat fishery with a large by-catch of herring. In the Southern area the sandeel fishery is associated with a large 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.

Table 2.1.1 Landings of demersal and industrial species from the North Sea

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

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Table 2.1.2 Species compositon in the 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		1799
1976	488	622	12	435	36	48	150	67		1791
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1675
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1,039	63	146	162	28	2	36	1	59	1537
1990	591	71	115	140	22	3	50	8	40	1033
1991	843	110	131	155	28	5	38	1	38	1350
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1994	769	281	40	172	11	5	10	-	19	1307
1995	911	278	66	181	64	8	27	1	15	1551
Mean 1974-1993	704	220	70	292	53	15	49	9	42	1454
1993 q1	26	16	23	36	1	2	3	0	6	114
1993 q2	430	5	5	28	6	4	4	0	6	487
1993 q3	88	72	51	59	4	3	7	1	7	293
1993 q4	33	61	23	51	5	1	6		8	189
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

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North Sea

Table 2.1.3 Sum of Danish and Norwegian by-catch by species (excluding those species accounted for in Table 3.1) and year in tonnes.

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

[1]Danish cod and mackerel included.
[2]Only Danish catches.
[3]Norwegian catches. 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 Denmark and Norway by landing categories to the north and south of 57°N, respectively, in 1995.(Data provided by Working Group members.)

Area north	Fishery (target species)	Species composition									Total
		Norway pout	Sandeel	Sprat	Herring	Haddock	Whiting	Saithe	Blue whiting	Other	
	Norway pout	164	0	0	3	6	8	0	65	4	250
	Sandeel	1	373	13	0	0	0	0	0	0	387
	Sprat	0	3	15	5	0	1	0	0	0	24
	Other	11	3	16	9	0	2	1	1	2	45
	Sum	176	379	44	17	6	11	1	66	6	706
Area south	**Fishery (target species)**										
	Norway pout	0	-	0	0	0	0	0	0	0	0
	Sandeel	0	505	16	4	0	3	0	0	2	530
	Sprat	1	10	205	26	0	6	0	0	3	250
	Other	4	19	24	19	0	6	0	0	1	73
	Sum	5	533	245	49	1	15	0	0	6	854

Figure 2.1.1 Fishing effort of demersal fleets in the North Sea

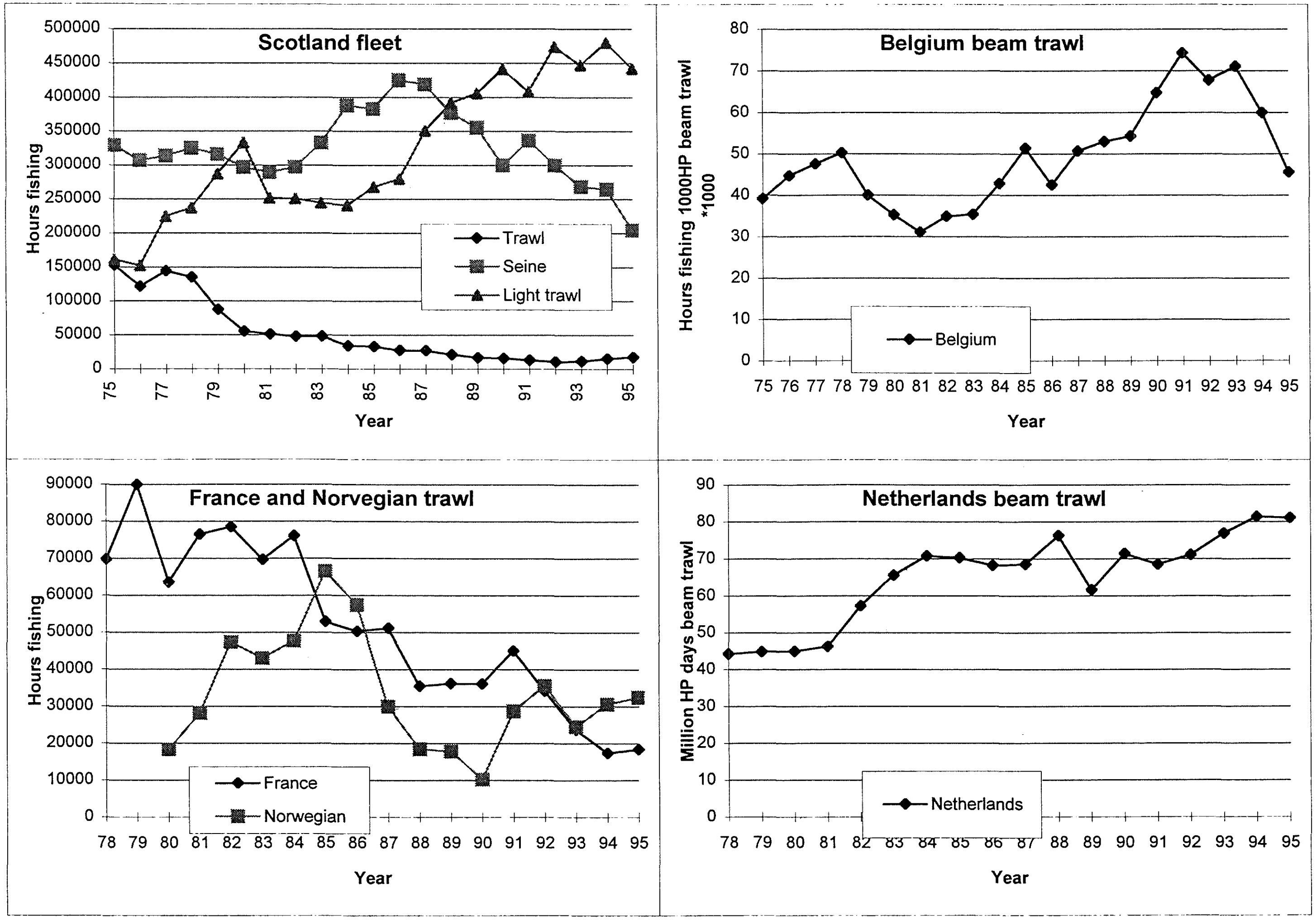

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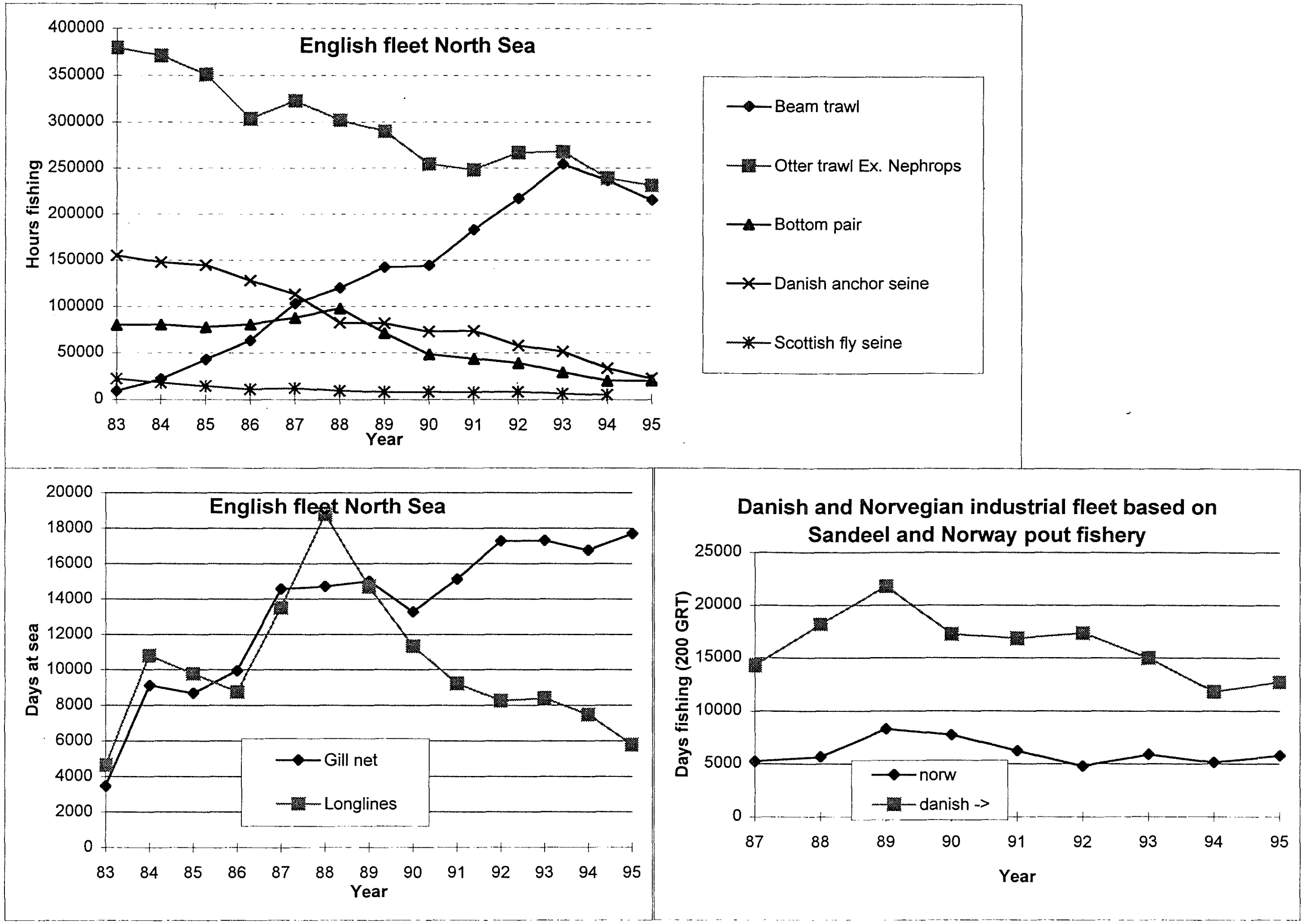
Figure 2.1.1 continued



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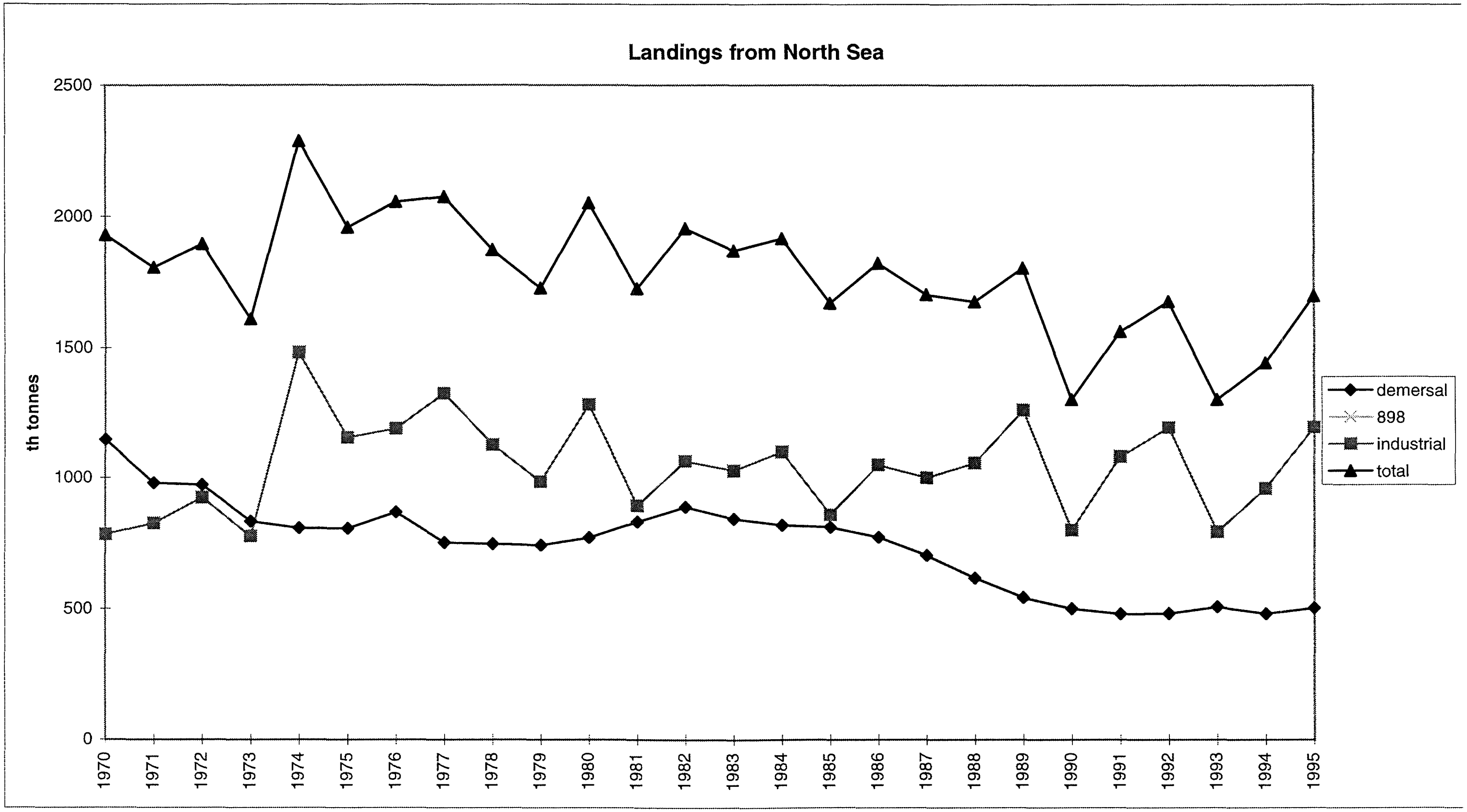

Figure 2.1.2 Landings from the stocks assessed by the WG

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

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

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

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

There are important technical interactions between the fleets. Most of the human consumption demersal fleets are involved in mixed fisheries and the Norway pout and the mixed clupeoid fishery have by-catches of protected species. For whiting and haddock the by-catches taken in industrial fisheries are larger in weight than the landings for human consumption.

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

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

Several of the stocks in the Skagerrak show close affinities to the North Sea stocks, both in terms of population dynamics (similar trends in recruitment and SSB) and biological indicators such as parasites or genetics. Tagging experiments have demonstrated extensive migration between the two areas for several species. Stocks which are believed to be closely associated between the North Sea and Skagerrak include cod (except for coastal populations in fjords), haddock, whiting and Norway pout. For sandeel, the population structure in the North Sea and Skagerrak is probably a complex of several local populations rather than separate populations in the two areas, and there is therefore no biological reason to split these stocks along the North Sea/Skagerrak border.

The landings of <u>cod</u> in the Skagerrak in 1995 were 14,600 t in the human consumption fishery with a supplementary by-catch in the industrial fisheries of 750 t. The catch in the human consumption fishery was slightly above the landings taken in 1994 (13,500 tons). The majority of catches were taken by Denmark and Sweden.

The landings of <u>haddock</u> in Div. IIIa in the human consumption fisheries amounted to 2,200 t in 1995 as compared to 1,800 tons taken in 1994. To this must be added the catches from the industrial by-catch estimated at 2,200 t. Most of the catches are taken in The Skaggerak.

The catches of <u>whiting</u> for human consumption were about 500 t in 1995 which is a slight decline as compared to the reported landings in 1994. Besides this the fisheries for reduction purposes took an by-catch of whiting of about 9,000 t. The by-catches are taken by the mixed-clupeid fisheries and in the fisheries targeting Norway pout and Sandeel and mainly consist of small (age 0) whiting. Most of the catches are taken in the Skagerrak. No analytical assessment of the whiting in Division IIIa was possible.

The <u>plaice</u> catches in Div. IIIa amounted to 10,900 t in 1995 which is slightly below the catch level in 1994. About 85% of the catch were taken in Skagerrak.

The industrial fisheries yielded a total catch of 134,000 t I 1995. Most of the catches consist of Norway pout, which is not regulated with quotas, and sprat with important by-catches of herring (Table 2.2.1). The by-catch of the protected species whiting and haddock amounted to 9,114 and 2,162 t. None of the remaining by-catch species accounted for more than 1,000 t.

Table 2.2.1 Catches of the most important species in the industrial fisheries in Division IIIa ('000 t), 1974–1995[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
Mean 1974–1995	26	41	56	24	14[5]	154

[1]Data from 1974–1984 from Anon. (1986), 1985–1993 provided by Working Group members.
[2]Total landings from all fisheries.
[3]For years 1974–1985, human consumption landings used for reduction are included in these data.
[4]Preliminary.
[5]Mean 1979–1995.

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 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 on the English and French coasts which fish with a variety of gears targeting sole in the spring and autumn and cod in the winter months. The minimum mesh size for trawls was increased from 75mm to 80mm in 1989. There is currently no EU mesh size for fixed nets.

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

Data

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

b) Catch at age: the main landings of cod and whiting are by French fleets who take more than 80% of the total international landings. The level of sampling for age for cod is poor but has improved since 1994 for whiting.

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

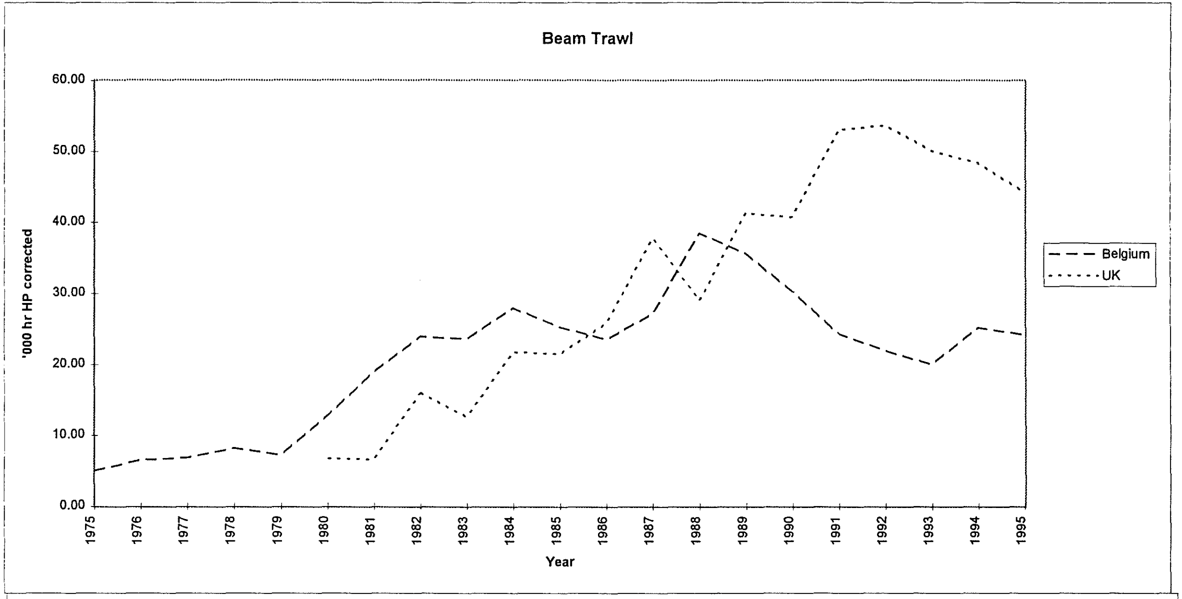
State of the stocks

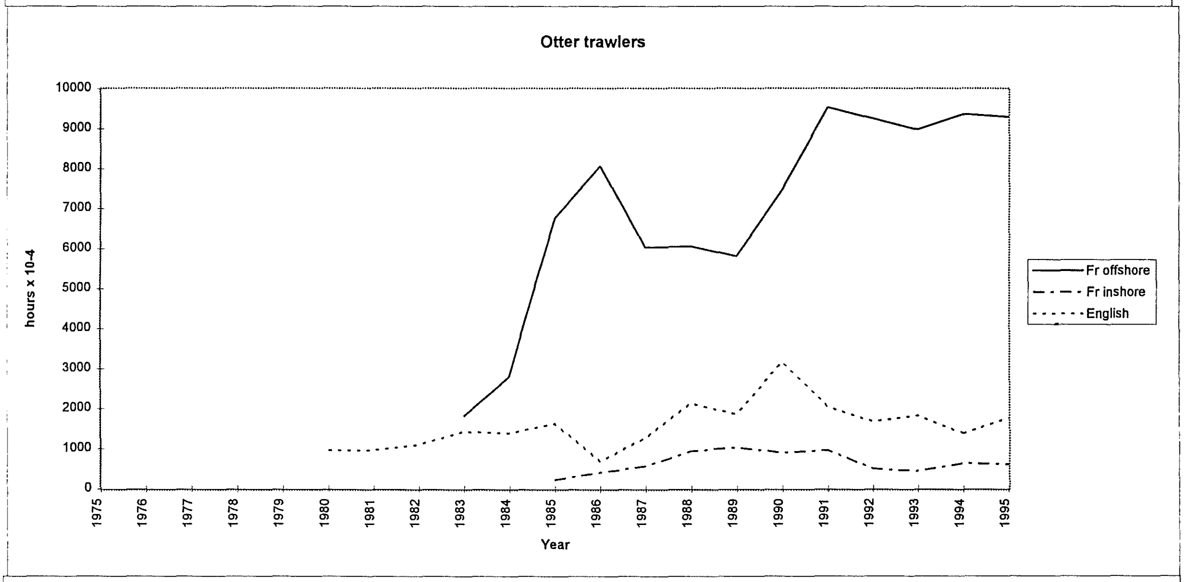
Cod and whiting have been assessed with the North Sea stocks for the first time this year and are included in the overview for the North sea.

An analytical assessment was carried out for **sole** using data from 3 commercial and three survey fleets. Fishing mortality remains high at around 0.48. The spawning stock biomass has increased following strong recruitment in the period 1989-91 and the stock is well above the historical minimum of 7000t. At the current level of fishing mortality the SSB will be expected to decline slightly in 1998.

Plaice was assessed using XSA tuned with 3 commercial and 4 survey fleets. The spawning stock of plaice has declined since the early 1990's following a similar trend to plaice in the North Sea, but has stabilised above the minimum historical level of 6000t. Recruitment since 1985 has fluctuated around the average level and the stock is expected to remain close to current levels up to 1998.

Figure 2.3.1 Division VIId Trends in demersal fleet effort





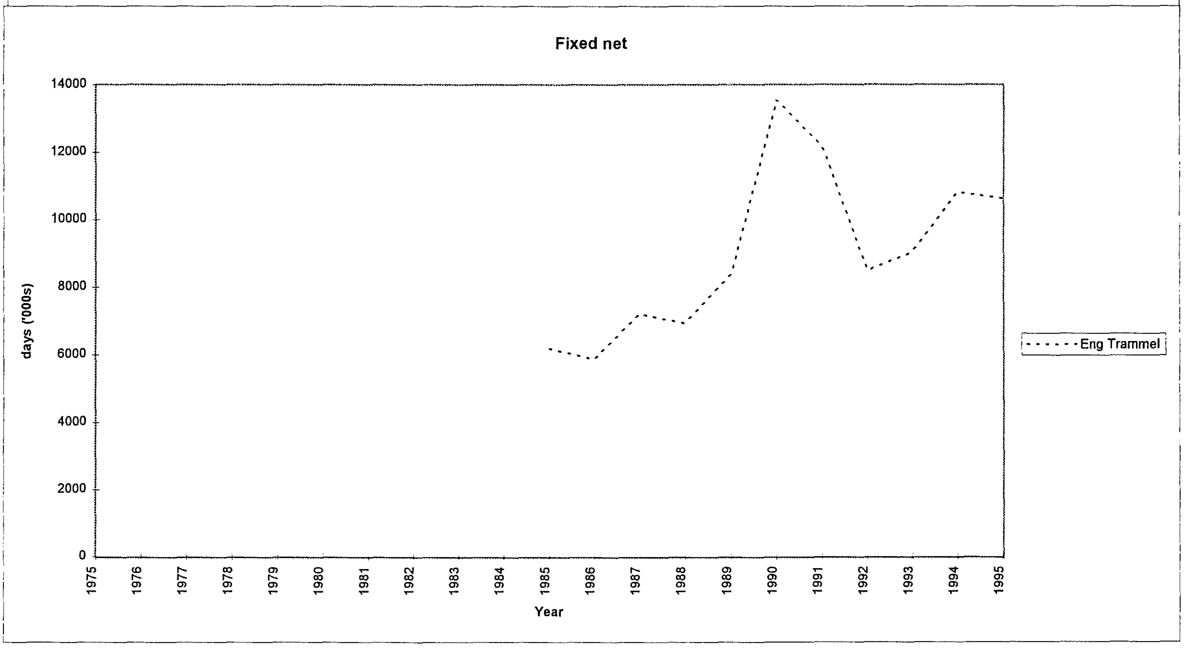


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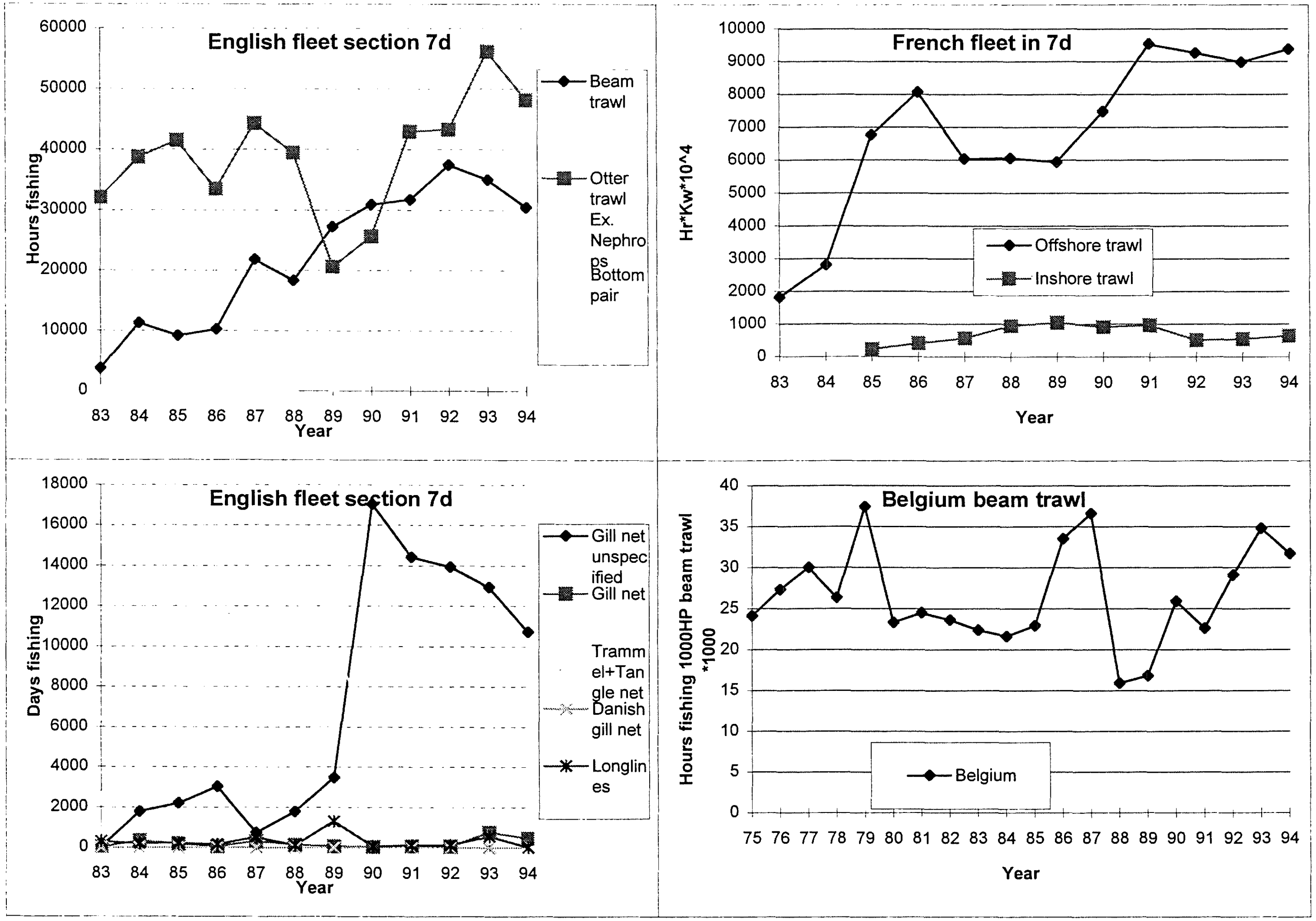
Figure 2.3.1 (Continued) Fishing effort of demersal fleet in section 7d



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

This assessment refers for the first time to a combination of the Skagerrak, the North Sea, and the eastern Channel. In previous Working Group meetings, cod in these areas have been assessed separately.

3.1 Catch Trends

Landings data from human consumption fisheries for recent years as officially reported as well as those estimated by the Working Group are given for each area separately in Tables 3.1.1 to 3.1.3. Working Group estimates of the landings for the combined areas are provided in Table 3.1.4, and the data are graphed in Figure 3.1.1. The Working Group estimate for combined landings in 1995 is 138,764 t, a value which is close to the officially reported figure. It includes about 20,000 t of non- or mis-reported landings, which, however, partly are misreported within the new assessment area. The landings in 1995 represent an increase of 25% compared to 1994. Landings increased in the 1960s and early 1970s to reach a peak of 350,000 t in 1972. After a further peak of 335,000 t in 1981, landings have declined markedly to levels similar to those observed in the early 1960s.

Estimates of total international discards are not available but it is known that discards of 1 year-old cod can be considerable for some fleets in some years (Weber, 1995). The industrial by-catch of cod, other than that which is sorted for human consumption, is small.

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

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

Values for natural mortality and maturity are given in Table 3.2.1, and they are unchanged from those used last year for cod in the North Sea. The sources of these data are multispecies VPA as performed by the Multispecies Working Group in 1986 (natural mortality), and the International Young Fish Survey (maturity). The VPA catch input data are given in Table 3.2.2. They do not include industrial fishery by-catches or discards. For by-catches, estimates are available for the Skagerrak (Table 3.1.2.1). Data for 1994 were updated with minor revisions, and data for 1995 were provided by Denmark, England, France, Germany, The Netherlands, and Scotland. Mean weight at age data for landings are given in Table 3.2.3. These values were also used as stock mean weights, and may not therefore be biologically meaningful. SOP corrections have been applied.

3.3 Catch, Effort, and Research Vessel Data

The fleets used for tuning the VPA are given in Table 3.3.1 and the tuning data are given in Table 3.3.2. Data for a total of 17 fleets were available, including 11 commercial and 6 survey fleets. However, some fleets were excluded from the tuning file because of low predictive weights, trends in catchability or age composition problems. Trends in fishing effort for some fleets are shown in Figure 2.1.1.

3.4 Catch at Age Analysis

The method used to tune the VPA was XSA, the same method as was used last year for the separate stocks. Tuning was performed over a 10 year period 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).

Preliminary tuning included single fleet Laurec-Shepherd runs and an XSA run with all available fleet data included. The results (available in Working Group files) were inspected for evidence of marked trends in catchability and for high values for the residuals. As a result of this analysis it was decided to exclude the IBTS-Quarter 4 for the North Sea and the IBTS-Quarter 1 for the Skagerrak. For the 4 Danish commercial fleets in the Skagerrak, sampling is carried out by market categories and hence there are no fleet-specific age compositions. The residual plots for most of the Danish commercial fleets were very similar. It was therefore decided to select for tuning two fleets which are likely to show the most disparate landings category patterns. On this basis the Nephrops trawlers and gill netters were selected. For the French trawl fleet in VIId, the residuals for ages older than two were erratic, and the data were therefore excluded. These older age groups are relatively less abundant in VIId, probably due to emigration into the North Sea. Inspection of the catchability residual plots from the preliminary runs showed that for some fleets there were some differences between the first and second halves of the 20 year time period available. It was therefore decided to apply tuning to the last 10 years and with zero taper.

The diagnostics from the final XSA run are given in Table 3.4.1. and plots of the log catchability residuals for each fleet from this run are given in Figure 3.4.1. For the estimates of survivors at age 1, the highest weighting is received by some of the survey fleets but for the older ages the commercial fleets receive the greatest weights.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and VPA are given in Tables 3.4.2 and 3.4.3. The results from a retrospective analysis using XSA with the options specified above are shown in Figure 3.4.2. The plot shows that there is a tendency for F values to be slightly underestimated. However, there are no gross discrepancies and the results show reasonable agreement between successive estimates.

3.5 Recruitment Estimates

Recruitment in 1995 (1994 year class) was estimated from the XSA analysis.

Because 1996 survey data are available, research vessel survey indices (Table 3.5.1) were used in program RCT3 to estimate recruitment at age 1 in 1996 and 1997 (1995 and 1996 year classes). The survey data were regressed against VPA population estimates for year classes up to 1992 inclusive, on the criterion of a minimum cumulative F of 1.0. Data for two new German groundfish surveys in the German Bight were available for the first time, replacing former surveys which have been terminated. Due to the short time series of 5 years, it was not possible to include the new IBTS indices for quarters 2 and 4. The indices for the English groundfish surveys after 1991 have been corrected to take account of the change of gear to the GOV trawl in 1992. A plot of VPA number against the new German survey indices are shown in Figure 3.5.1.

The results of the RCT3 estimates of recruitment which were used in the catch forecast are given in Table 3.5.2. The estimate for year class 1995 at age 1 in 1996 is 183 millions. The preliminary estimate for the 1996 year class at age 1 in 1997 is 302 millions, based on a single survey 0-group value but strongly weighted towards the mean. The 1997 year class was assumed to be 257 millions at age 1 in 1998, the shrunk mean value from RCT3. The long-term arithmetic mean is 400 millions and the geometric mean is 344 millions at age 1.

3.6 Historical Stock Trends

Historical trends in mean fishing mortality, landings, spawning stock biomass, and recruitment are shown in Table 3.6.1 and Figure 3.1.1. Mean fishing mortality has shown a more or less continuous increase over the whole period. 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. Only one year class (1993) spawned since 1985 has reached the long term arithmetic mean.

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 or XSA estimate as appropriate. For all other parameters, the values supplied by the program INSENS were used. The mean weight at age is the average for the period 1991-95. The fishing mortality is the mean for the same period calibrated to the mean F(2-8) in 1995. Population numbers in 1996 are XSA survivor estimates, except for age 1 which is an RCT3 estimate.

The results of a *status quo* landings prediction for 1996 and 1997 are given in Table 3.7.3 and shown graphically in Figure 3.7.1. Landings of 168,000 t are predicted for 1996, which is 15% less than the summed prediction of 197,000 t for IIIa, IV, and VIId from last year's assessment. The *status quo* landings for 1997 are predicted to be 158,000 t. Spawning biomass is estimated to be 124,000 t at the start of 1997, and 122,000 t in 1998.

The catch prediction results have been divided between the three areas included in the combined assessment in Table 3.7.4. The methodology used for this process is explained in Section 1.4.4.

The results of sensitivity analyses of the *status quo* catch prediction are shown in Figures 3.7.2 and 3.7.3. The sensitivity of the predictions (Figure 3.7.2) to the various input parameters shows that the predicted yield in 1997 is heavily influenced by the estimates of fishing effort (HF) in 1996 and 1997, as well as the year effect for M (K) in 1996. Year classes (N) which have the most effect are those spawned in 1993, 1994, and 1995. The estimate for SSB in 1998 is sensitive to the 1993 year class (N3), to fishing effort (HF), and to the selectivity (sH) for 3 and 4 year old fish

Figure 3.7.2 shows also the proportion of the total variance contributed by the input parameters to the estimated yield and spawning biomass. For yield in 1997, most of the variance is contributed by the estimate of year class 1995 (N1), but also to the relative fishing effort (HF97, HF96) and recruitment in 1997. The variances of the SSB estimates have important contributions from N1, relative fishing effort (HF) and from the selectivity at age 2 (sH2).

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

3.8 Medium term projections

Projections were run for *status quo* F for a 10 year period, and the stock-recruitment relationship assumed was a Shepherd curve with a moving average term. The results are shown in Figures 3.8.1 and 3.8.2. For *status quo* F, the simulation suggests that there is a high probability that both yield and spawning biomass could increase in the medium term (Figure 3.8.1). Figure 3.8.2 shows for year 2005 the 5, 10, and 20 probabilities for SSB falling below a given value at different levels of relative F. The steepness of the lines around the current level of F shows clearly that this projection is very sensitive to differences in F-levels. The graph suggests that, for example, in the case of underestimation of F by 10% there is a high probability that SSB could drop by 50,000 t within 10 years. The retrospective analysis (Figure 3.4.2) indicates that there is a tendency to underestimate F. With the known uncertainties in estimation of F these projections should treated with extreme caution.

3.9 Long Term Considerations

Landings and spawning biomass are at a relatively low level as compared to the recent past, and fishing mortality shows a continuous upwards trend.

3.10 Comments on the Assessment

Quality control data are given in Table 3.10.1. However, these are of limited use, since the 1996 assessment refers to the combined areas, whereas the data for the earlier years are for the North Sea. The assessment results resemble those for the North Sea produced at last year's Working Group, although they appear to be more pessimistic in terms of the lower catch forecast for 1996. It is likely that a significant factor is that the size of the 1993 year class has been revised downwards. For last year's North Sea assessment this year class was estimated to be 465 millions at age 1, and this compares with a value of 399 millions for this year's combined assessment. Other year classes which are important in the catch prediction show increases in the combined assessment as compared to last year's North Sea assessment, as would be expected. The fishing mortality values are similar to those estimated for the North Sea last year. As with that assessment the retrospective pattern shows that the fishing mortality estimated for 1995 may be slightly too low.

3.11 MBAL considerations

Inspection of the stock-recruitment plot (Figure 3.11.1) shows a similar pattern to that observed for the North Sea. It suggests that recruitment is reduced at spawning stock levels below about 150,000 t, and this value could therefore be considered appropriate for MBAL.

3.12 Biological reference points

The input data used for a yield-per-recruit analysis are given in Table 3.12.1. and results at Table 3.12.2. A scatter plot of stock recruitment is shown in Figure 3.11.1, which also shows F_{high} (1.23), F_{med} (0.86) and F_{low} (0.49). F_{max} is estimated at 0.25 and $F_{0.1}$ at 0.15. A yield per recruit and spawning stock biomass per recruit plot is shown in Figure 3.7.1. The fishing mortality is the mean for ages 2 to 8 for the period 1991-95. It can be seen that the current level of F is close to F_{med}.

Table 3.1.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1984–1995, as officially reported to ICES, and estimated total landings used by the Working Group.

Year	Belgium	Denmark[2]	Faroe Islands	France	Germany	Netherlands	Norway[2]	Poland	Sweden	UK (E+W)	UK Isle of Man	UK (N.Ireland)	UK (Scotland)	Russia	Total	Unallocated landings	Landings as used by Working Group
1984	5,804	46,751	-	8,129	13,453	25,460	7,005	7	575	35,605	-	-	54,359	-	197,148	7,723	204,871
1985	4,815	42,547	71	4,834	7,675	30,844	5,766	-	748	29,692	-	-	60,931	-	187,923	5,043	192,966
1986	6,604	32,892	45	8,402	7,667	25,082	4,864	10	839	25,361	-	-	45,748	-	157,484	5,745	163,229
1987	6,693	36,948	57	8,199	8,230	21,347	5,000	13	688	29,960	-	-	49,671	-	166,806	8,671	175,477
1988	5,508	34,905	46	8,323	7,707	16,968[4]	3,585	19	367	23,496	-	-	41,382	-	142,306	7,815	150,121
1989	3,398	25,782	35	2,578[1,3]	11,430	12,028	4,813	24	501	18,250	1	124	31,480	-	110,444	5,180	115,624
1990	2,934	21,601	96	1,641[1,3]	11,725	8,445[1]	5,168	53	620	15,596	-	26	31,120	-	99,025	5,726	104,751
1991	2,331	18,997	23	975[1,3]	7,278	6,830[1]	5,425	15	784	14,481	-	70	28,748	-	85,957	2,554	88,511
1992	3,356	18,479	109	2,146[1]	8,446	11,133	10,053[1]	-	823	14,836	15	72	28,204	-	97,672	332	97,340
1993*	3,374	19,547	46	2,162[1,3]	6,808	10,220	8,760[1]	-	646	14,894	-	47	28,191	-	94,687	10,009	104,565
1994*	2,648	19,234	80[1]	1,830[1,4]	5,974	6,512	8,268[1]	-	630	13,941	-	54	28,844	-	88,015	6,434	94,449
1995	4,827	24,067	219	2,782	9,457	11,199	7,358	-	709	14,991	-	-	35,848	-	111,457	9,035	120,492

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

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

Year	Open Skagerrak					Total	Landings used	Norwegian Coast
	Denmark	Sweden	Norway	Germany	Others		by the WG	Norway
1971	5,914	2,040	1,355	-	13	9,322	9,322	-
1972	6,959	1,925	1,201	-	22	10,107	10,107	-
1973	6,673	1,690	1,253	-	27	9,643	9,643	-
1974	6,694	1,380	1,197	-	92	9,363	9,363	-
1975	14,171	917	1,190	-	52	16,330	16,330	-
1976	18,847	873	1,241	-	466	21,427	21,427	-
1977	18,618	560	-	-	675	19,853	19,853	-
1978	23,614	592	-	-	260	24,466	23,406	1,305
1979	14,007	1,279	-	-	213	15,499	13,128	1,752
1980	21,551	1,712	402	-	341	24,006	25,110	1,580
1981	25,498	2,835	286	-	294	28,913	29,507	1,792
1982	23,377	2,378	314	-	41	26,110	27,775	1,466
1983	18,467	2,803	346	-	163	21,779	22,576	1,520
1984	17,443	1,981	311	-	156	19,891	20,126	1,187
1985	14,521	1,914	193	-	-	16,628	17,611	990
1986	18,424	1,505	174	-	-	20,103	21,142	917
1987	17,824	1,924	152	-	-	19,900	20,855	838
1988	14,806	1,648	392	-	106	16,952	16,945	769
1989	16,634	1,902	256	12	34	18,838	19,648	888
1990	15,788	1,694	143	110	65	17,800	18,589	846
1991	10,396	1,579	72	12	12	12,071	12,441	854
1992	11,194	2,436	270	-	102	14,002	14,794	923
1993	11,997	2,574	75	-	91	14,735	15,324	909
1994	11,953	1,821	60	301	25	14,161	13,910	760
1995	15,888	5,185	169	200	134	21,578	14,636	846

Table 3.1.2.1 By-catches of Cod in the Skagerrak by the Danish small-meshed fishery (tonnes) as estimated by the Working Group.

Year	By-catch
1979	4,009
1980	4,036
1981	5,376
1982	9,119
1983	4,384
1984	1,084
1985	1,751
1986	997
1987	491
1988	1,103
1989	428
1990	687
1991	953
1992	1,360
1993	511
1994	666
1995	749

Table 3.1.3 COD in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1976 to 1995.

Year	Belgium	France	Denmark	Netherlands	UK (E+W)	UK (S)	Total	Unreported landings	Total as used by Working Group
1982	251	2696	-	1	306	-	3254	726	3980
1983	368	2802	-	4	358	-	3532	308	3840
1984	331	2492	-	-	282	-	3105	415	3520
1985	501	2589	-	-	326	-	3416	- 86	3330
1986	650	9938	4	-	830	-	11422	1398	12820
1987	815	7541	-	-	1044	-	9400	4820	14220
1988	486	8795	+	1	867	-	10149	- 789	9360
1989	173	n/a	+	1	562	-	n/a	-	5540
1990	237	n/a	-	-	420	7	n/a	-	2730
1991	182	n/a	-	-*	340	2	n/a	-	1920
1992	187	2079*	1	2	441	22	2733	-	2680
1993*	157	n/a	1[1]	-	530	2	n/a	-	2430
1994*	228	n/a	9	-	312	+	n/a	-	2850
1995	377	n/a	-	-	336	+	n/a	-	3636

* Preliminary; 1 Includes VIIe.

Details of Program run, 17:40, 10/10/1996

Species	:	COD,
Area	:	347D, SKAG+NSEA+CHAN
Age Range	:	1 - 11+
Year Range	:	1963 - 1995

Catch component	Ref. F age range
1, H.cons.	2 - 8

1

TABLE 3.1.4 : COD, SKAG+NSEA+CHAN
Annual weight and numbers caught, 1963 to 1995.

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

1

TABLE 3.2.1 ; COD, SKAG+NSEA+CHAN
Natural Mortality and proportion mature

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

Table 3.2.2

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 14:55:29

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

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

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	18224,	10803,	5829,	2947,	54493,	44824,	3832,	25966,	15562,	33378,
2,	62516,	70895,	83836,	22674,	33917,	155345,	187686,	31755,	58920,	47143,
3,	29845,	32693,	42586,	31578,	18488,	17219,	48126,	54931,	11404,	18944,
4,	6184,	11261,	12392,	13710,	13339,	6754,	5682,	14072,	15824,	4663,
5,	3379,	3271,	6076,	4565,	6297,	7101,	2726,	2206,	4624,	7563,
6,	1278,	1974,	1414,	2895,	1763,	2700,	3201,	1109,	961,	2067,
7,	477,	888,	870,	588,	961,	893,	1680,	1060,	438,	449,
8,	370,	355,	309,	422,	209,	458,	612,	489,	395,	196,
9,	126,	138,	151,	147,	186,	228,	390,	80,	332,	229,
10,	56,	40,	111,	46,	98,	77,	113,	58,	81,	95,
+gp,	83,	17,	24,	78,	40,	94,	18,	162,	189,	63,
TOTALNUM,	122538,	132335,	153598,	79650,	129791,	235693,	254066,	131888,	108730,	114790,
TONSLAND,	221336,	252977,	288368,	200760,	226124,	328098,	353976,	239051,	214279,	205245,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 3.2.2 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 14:55:29

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	5724,	75413,	29731,	34837,	62605,	20279,	66777,	25733,	64751,	8836,
2,	100283,	51118,	175727,	91697,	104708,	189007,	65299,	129632,	66428,	117484,
3,	18574,	25621,	17258,	44653,	35056,	34821,	60411,	21662,	31276,	18938,
4,	6741,	4615,	9440,	4035,	12316,	9019,	9567,	11900,	4264,	7807,
5,	1741,	2294,	3003,	3395,	1965,	4118,	3476,	2830,	3436,	1362,
6,	3071,	836,	1108,	712,	1273,	785,	2065,	1258,	1019,	1243,
7,	924,	1144,	410,	398,	495,	604,	428,	595,	437,	362,
8,	131,	371,	424,	157,	202,	137,	245,	211,	250,	171,
9,	67,	263,	153,	158,	74,	65,	78,	90,	60,	76,
10,	63,	26,	36,	42,	55,	37,	27,	28,	45,	14,
+gp,	43,	96,	44,	17,	25,	21,	16,	23,	20,	24,
TOTALNUM,	137362,	161797,	237334,	180101,	218774,	258893,	208389,	193962,	171986,	156317,
TONSLAND,	234169,	209154,	297022,	269973,	293644,	335497,	303251,	259287,	228286,	212925,
SOPCOF %,	100,	100,	100,	101,	100,	100,	99,	100,	100,	99,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
1,	99006,	23898,	20187,	23296,	11841,	13628,	27967,	4814,	16173,	16465,
2,	29572,	125863,	53920,	35999,	54692,	23571,	32216,	55560,	25195,	63654,
3,	33544,	10064,	43153,	18252,	11994,	16840,	8697,	11409,	21118,	12932,
4,	5700,	8740,	3150,	10215,	4360,	3319,	4995,	3211,	3078,	5296,
5,	3005,	1502,	2533,	1026,	2462,	1393,	1057,	1578,	862,	800,
6,	586,	1029,	623,	1002,	304,	1032,	479,	430,	513,	283,
7,	538,	226,	282,	238,	293,	220,	321,	201,	137,	147,
8,	169,	207,	71,	136,	70,	135,	58,	111,	59,	41,
9,	65,	50,	57,	24,	58,	26,	39,	18,	31,	13,
10,	42,	33,	13,	25,	11,	3,	17,	10,	7,	13,
+gp,	20,	12,	17,	10,	4,	9,	9,	13,	16,	5,
TOTALNUM,	172247,	171624,	124006,	90223,	86089,	60176,	75855,	77355,	67189,	99649,
TONSLAND,	196147,	209596,	176432,	139859,	125285,	102487,	114026,	121930,	110560,	138764,
SOPCOF %,	99,	100,	100,	99,	99,	100,	99,	99,	99,	100,

Table 3.2.3

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 14:55:29

Table 2 Catch weights at age (kg)

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

Table 2 Catch weights at age (kg)

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	.5790,	.5900,	.6400,	.5440,	.6260,	.5790,	.6160,	.5590,	.5940,	.6190,
2,	.9940,	1.0350,	.9730,	.9210,	.9610,	.9410,	.8360,	.8690,	1.0390,	.8990,
3,	2.4420,	2.4040,	2.2230,	2.1330,	2.0410,	2.1930,	2.0860,	1.9190,	2.2170,	2.3480,
4,	4.1690,	3.1530,	4.0940,	3.8520,	4.0010,	4.2580,	3.9680,	3.7760,	4.1560,	4.2260,
5,	7.0270,	6.8030,	5.3410,	5.7150,	6.1310,	6.5280,	6.0110,	5.4880,	6.1740,	6.4040,
6,	9.5990,	9.6100,	8.0200,	6.7220,	7.9450,	8.6460,	8.2460,	7.4530,	8.3330,	8.6910,
7,	11.7660,	12.0330,	8.5810,	9.2620,	9.9530,	10.3560,	9.7660,	9.0190,	9.8890,	10.1070,
8,	11.9680,	12.4810,	10.1620,	9.7490,	10.1310,	11.2190,	10.2280,	9.8100,	10.7900,	10.9100,
9,	14.0590,	13.5890,	10.7200,	10.3840,	11.9190,	12.8810,	11.8750,	11.0770,	12.1750,	12.3390,
10,	14.7460,	14.2710,	12.4970,	12.7430,	12.5540,	13.1470,	12.5300,	12.3590,	12.4250,	12.9760,
+gp,	15.6720,	19.0160,	11.5950,	11.5670,	14.3670,	15.5440,	14.3500,	12.8860,	13.7310,	14.4310,
SOPCOFAC,	1.0001,	1.0001,	.9999,	.9999,	1.0000,	.9998,	1.0001,	.9999,	.9999,	.9999,

Table 3.2.3 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 14:55:29

Table 2 Catch weights at age (kg)

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.5680,	.5420,	.5720,	.5500,	.5500,	.7230,	.5890,	.6320,	.5940,	.5890,
2,	1.0290,	.9480,	.9370,	.9360,	1.0030,	.8370,	.9620,	.9190,	1.0070,	.9320,
3,	2.4700,	2.1600,	2.0010,	2.4110,	1.9480,	2.1890,	1.8580,	1.8350,	2.1560,	2.1350,
4,	4.5770,	4.6070,	4.1460,	4.4230,	4.4010,	4.6150,	4.1300,	3.8800,	3.9720,	4.1610,
5,	6.4940,	6.7130,	6.5310,	6.5800,	6.1090,	7.0450,	6.7840,	6.4910,	6.1900,	6.3100,
6,	8.6200,	8.8280,	8.6670,	8.4750,	9.1200,	8.8840,	8.9030,	8.4230,	8.3620,	8.4040,
7,	10.1320,	10.0710,	9.6860,	10.6370,	9.5500,	9.9340,	10.3990,	9.8480,	10.3170,	10.3720,
8,	11.3410,	11.0520,	10.9500,	11.2530,	11.8240,	11.4570,	12.5170,	11.8780,	11.4540,	12.0770,
9,	12.8880,	11.8240,	12.4270,	13.0570,	12.7820,	13.3380,	13.4690,	12.7970,	13.5050,	13.0330,
10,	14.1400,	13.1340,	12.7780,	14.1480,	14.0810,	14.8970,	12.8900,	12.5620,	13.4080,	13.2090,
+gp,	14.5570,	14.3620,	13.9810,	15.4780,	15.3920,	16.6290,	14.6080,	14.4260,	13.4720,	14.4150,
SOPCOFAC,	1.0000,	.9999,	1.0030,	1.0082,	.9961,	.9984,	.9942,	.9954,	.9988,	.9950,

Table 2 Catch weights at age (kg)

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
1,	.5760,	.6260,	.5740,	.6690,	.7370,	.6680,	.6990,	.6960,	.6730,	.7180,
2,	.8860,	.9630,	.8670,	1.0570,	.9760,	1.0780,	1.1430,	1.0630,	1.0740,	1.0210,
3,	1.8360,	1.9310,	1.9390,	1.8190,	2.1740,	2.0400,	2.5430,	2.4720,	2.2010,	2.2040,
4,	3.5380,	3.6140,	3.1750,	3.5490,	3.7950,	3.9870,	4.2230,	4.5450,	4.4690,	4.2890,
5,	6.1880,	5.9830,	5.8590,	5.2500,	5.9030,	6.0710,	6.2390,	6.5230,	7.1440,	7.2150,
6,	8.0710,	8.2410,	7.8440,	7.8180,	7.8670,	7.9860,	8.4650,	8.0650,	8.4220,	8.9660,
7,	9.8950,	9.8880,	9.7380,	9.4980,	10.2450,	9.5300,	10.0790,	9.6320,	9.4820,	10.2780,
8,	11.4730,	11.5100,	11.8730,	11.0620,	10.7820,	11.0100,	10.0950,	10.3940,	10.5270,	11.7570,
9,	12.7100,	12.1490,	13.4890,	12.7740,	12.6610,	13.5740,	11.8320,	12.3200,	12.2300,	13.2340,
10,	13.5660,	15.5420,	14.3530,	14.0660,	15.0890,	13.2500,	13.7900,	13.3930,	14.2140,	11.9860,
+gp,	13.1600,	16.4300,	15.7680,	14.5770,	14.6310,	14.9700,	15.5030,	13.9230,	12.4760,	13.8250,
SOPCOFAC,	.9945,	.9953,	.9993,	.9928,	.9914,	.9959,	.9925,	.9946,	.9937,	1.0003,

Table 3.3.1 Tuning fleets

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

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Table 3.3.2

Cod in Fishing Areas IV, Skagerrak and VIId (run name: XSATIM01)
113
FLT01: SCOTRL_IV (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
1 10

121841	128.856	1299.546	676.244	151.830	84.905	86.903	10.988	3.996	2.997	1.998
144348	419.389	575.162	838.778	227.668	69.898	30.955	30.955	5.991	2.996	1.997
135220	303.876	1424.419	285.883	181.926	63.974	15.993	11.995	6.997	2.999	1.000
87467	215.635	914.453	447.243	73.875	46.921	22.961	11.980	3.993	2.995	0.998
55475	154.012	849.920	379.327	127.393	19.965	19.965	7.606	6.655	0.951	1.901
51553	95.989	928.202	387.683	113.695	51.256	13.979	5.592	1.864	0.932	0.932
47889	521.806	305.760	389.066	73.236	17.394	6.408	2.746	0.915	0.915	0.000
48339	178.337	1427.663	208.383	112.430	23.261	9.692	1.938	0.000	0.000	0.969
34574	316.043	772.341	345.964	32.726	16.831	7.480	0.935	0.935	0.000	0.000
33103	82.048	781.283	196.005	79.313	9.116	4.558	2.735	0.912	0.912	0.000
27839	251.300	190.609	256.042	19.914	10.431	0.948	0.948	0.000	0.000	0.000
27208	272.057	606.030	38.463	39.401	8.443	1.876	0.000	0.938	0.000	0.000
21559	27.259	346.285	159.513	8.077	8.077	4.038	1.010	1.010	0.000	0.000
16657	58.153	29.428	134.388	40.929	2.974	2.233	1.194	0.187	0.725	0.080
14325	15.482	327.585	18.792	22.486	5.118	1.215	1.004	0.225	0.000	0.000
13495	45.113	94.909	103.953	7.731	6.998	1.718	0.483	0.000	0.028	0.000
10887	52.261	99.870	30.235	33.291	1.153	1.211	0.120	0.030	0.053	0.000
11657	4.716	124.610	31.231	4.273	6.325	0.634	0.055	0.001	0.000	0.000
15671	54.896	40.799	124.960	9.461	1.713	1.656	0.520	0.373	0.000	0.000
17728	29.099	254.011	93.718	49.032	1.501	0.465	0.538	0.035	0.020	0.199

FLT02: SCOSEI_IV (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
1 11

307165	536.740	14237.110	2889.603	369.821	178.913	112.945	36.982	9.995	3.998
313913	2742.119	4316.187	3069.132	714.031	177.008	51.002	35.002	24.001	6.000
325246	1703.941	14715.490	1385.952	850.971	201.993	47.998	22.999	20.999	8.000
316419	2522.256	8021.633	3257.039	382.887	344.898	66.980	43.987	18.994	11.996
297227	1067.994	5957.458	2341.237	828.826	144.370	89.579	33.049	14.785	8.697
289672	855.604	13328.760	2355.389	698.688	204.816	18.169	10.736	12.388	3.303
297730	4070.478	4794.063	6023.739	822.294	291.107	151.409	25.095	20.913	11.711
333168	1342.728	13320.380	1813.966	1289.703	227.494	98.353	39.341	18.815	15.394
388085	4839.125	9954.796	3783.950	453.752	381.259	108.292	46.539	25.954	6.265
382910	543.929	18367.310	2498.646	835.287	127.187	107.343	26.159	24.355	9.922
425017	5425.851	2656.135	6865.172	824.863	285.816	42.826	38.171	13.965	7.448
418536	1361.396	13452.120	680.241	1423.568	283.434	186.518	24.686	35.658	15.543
377132	842.968	7091.734	4631.826	201.992	471.982	131.995	55.998	15.999	10.000
355735	1684.028	3495.714	3173.118	1092.297	91.156	185.066	44.650	18.698	2.391
270869	379.134	12625.370	1096.540	671.531	291.604	38.807	50.407	11.534	3.699
336675	1708.483	4746.648	2986.177	241.370	173.924	113.164	32.981	25.229	7.592
300217	1056.525	4120.136	942.427	618.214	97.903	59.252	31.805	8.852	8.416
268413	259.816	5561.367	776.714	208.932	142.388	26.401	19.572	9.165	2.347
264738	1172.846	3129.865	2378.035	301.222	60.540	37.716	13.282	5.077	2.267
204545	743.283	8029.209	912.815	496.574	84.516	21.557	16.616	0.914	0.967

FLT03: SCOLTR_IV (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
1 11

152419	263.044	3274.549	415.069	101.017	38.006	39.007	10.002	1.000	1.000	0.000
224824	2069.153	1808.008	774.432	118.066	75.042	24.013	13.007	8.004	2.001	1.001
236929	2255.601	5379.048	670.881	269.952	50.991	27.995	6.999	7.999	4.999	0.000
207494	1973.132	5845.391	1808.121	178.012	61.004	15.001	3.000	4.000	2.000	0.000
333197	1849.470	5356.235	2100.709	549.199	71.405	15.868	4.408	3.526	0.882	0.000
251504	690.987	5236.821	1474.781	293.606	81.839	10.968	5.906	0.000	0.000	0.000
250870	4703.856	2940.357	2301.849	377.382	109.995	39.348	8.048	6.260	3.577	5.366
244349	1321.201	6293.185	1020.032	459.821	111.146	31.372	14.341	5.378	2.689	0.896
240725	2723.570	3022.983	1543.958	180.369	85.675	36.074	9.920	7.215	2.706	0.000
268136	430.874	5959.050	865.407	293.653	39.337	21.041	3.659	2.744	0.915	0.915
279767	4140.451	1166.751	1847.672	250.965	95.651	12.311	8.523	4.735	1.894	0.947
351131	2045.224	5662.771	530.278	468.273	45.347	31.465	10.180	5.553	0.925	0.925
391988	403.133	3300.276	1912.375	133.375	148.417	33.093	14.039	2.006	1.003	0.000
405883	1574.048	1205.534	1594.526	565.712	48.605	45.236	13.343	3.382	0.894	0.257
398153	327.094	5739.588	523.696	456.829	179.523	25.746	11.324	3.712	0.999	0.128
408056	1821.110	1904.532	2125.128	138.039	94.188	48.099	8.199	8.482	1.206	0.028
473955	1401.577	2749.504	747.952	646.729	44.077	36.368	11.912	2.053	2.020	0.220
447064	250.643	4891.675	1262.363	163.983	80.122	9.885	5.161	3.794	0.416	0.211
480400	722.752	1924.201	2364.757	370.592	47.312	42.371	5.792	2.346	0.300	0.224
442010	879.046	5807.931	1579.502	797.169	73.989	8.577	6.861	0.637	0.882	0.554

FLT04: ENGTRL_IV (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
1 11

493436	480.000	6058.000	1508.000	727.000	163.000	395.000	100.000	27.000	10.000
509862	2570.000	1905.000	2013.000	616.000	320.000	98.000	127.000	48.000	14.000
559930	2029.000	10576.000	1093.000	987.000	338.000	117.000	57.000	60.000	22.000
553020	1329.000	7698.000	3341.000	393.000	403.000	99.000	54.000	15.000	30.000
442036	1881.000	3786.000	2106.000	865.000	122.000	114.000	38.000	16.000	6.000
423658	615.000	12703.000	1886.000	535.000	250.000	38.000	48.000	8.000	6.000
424272	4074.000	3063.000	3802.000	587.000	298.000	179.000	35.000	24.000	11.000

Table 3.3.2 (Continued)

392364	711.000	14220.000	1185.000	907.000	127.000	87.000	49.000	16.000	4.000
358387	3469.000	3459.000	2656.000	267.000	217.000	42.000	32.000	16.000	3.000
342844	675.000	8212.000	1047.000	533.000	72.000	54.000	16.000	10.000	4.000
288867	9097.000	2107.000	2388.000	209.000	161.000	15.000	12.000	4.000	2.000
275899	447.000	10435.000	682.000	596.000	36.000	26.000	3.000	4.000	2.000
296092	1173.000	2102.000	2428.000	90.000	126.000	17.000	10.000	0.000	2.000
310444	985.000	1958.000	718.000	501.000	25.000	34.000	5.000	4.000	0.000
255314	573.000	3101.000	513.000	134.000	101.000	11.000	13.000	4.000	1.000
258037	880.000	1559.000	1092.000	88.000	25.000	17.000	2.000	2.000	0.000
223702	1463.000	2171.000	481.000	234.000	19.000	5.000	5.000	0.000	0.000
209869	580.000	4054.000	442.000	96.000	55.000	5.000	3.000	2.000	0.000
184764	1264.802	2454.287	1146.382	78.190	14.284	7.036	1.762	0.673	0.847
173425	821.398	3799.592	871.887	158.030	11.028	2.992	1.896	0.662	0.132

FLT05: ENGSEI_IV (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
1 11

211284	281.000	8523.000	895.000	479.000	116.000	290.000	84.000	17.000	6.000
196103	2630.000	2453.000	1577.000	245.000	182.000	60.000	103.000	31.000	8.000
203382	898.000	12831.000	746.000	547.000	131.000	78.000	21.000	37.000	9.000
187180	1718.000	7004.000	2438.000	162.000	280.000	76.000	35.000	14.000	18.000
201169	2111.000	7760.000	1370.000	611.000	146.000	210.000	54.000	29.000	9.000
185423	343.000	12689.000	1053.000	398.000	359.000	61.000	74.000	12.000	8.000
183209	1486.000	3191.000	2473.000	330.000	294.000	189.000	38.000	31.000	9.000
177004	566.000	4741.000	573.000	557.000	207.000	150.000	104.000	18.000	17.000
167699	1232.000	1513.000	1215.000	147.000	290.000	72.000	50.000	32.000	6.000
157815	125.000	3242.000	326.000	241.000	72.000	117.000	40.000	27.000	13.000
136358	890.000	312.000	572.000	65.000	139.000	34.000	52.000	13.000	7.000
123281	262.000	2395.000	82.000	184.000	44.000	77.000	10.000	22.000	8.000
91178	297.000	879.000	594.000	19.000	80.000	19.000	12.000	3.000	3.000
88782	343.000	748.000	216.000	138.000	9.000	46.000	7.000	8.000	1.000
80537	176.000	1009.000	116.000	45.000	58.000	4.000	15.000	3.000	1.000
84346	129.000	262.000	207.000	33.000	26.000	38.000	6.000	16.000	1.000
67810	408.000	463.000	57.000	42.000	10.000	8.000	8.000	2.000	3.000
54574	44.000	497.000	41.000	19.000	22.000	4.000	3.000	2.000	0.000
39667	163.456	265.085	138.494	11.373	17.040	14.114	3.077	0.889	0.519
28405	91.043	444.628	83.186	21.000	5.216	3.742	5.623	3.043	0.608

FLT06: FRATRB_IV (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
1 11

64396	231.000	912.000	451.000	136.000	41.000	20.000	4.000	1.000	1.000	0.000
80107	347.000	308.000	389.000	116.000	31.000	5.000	3.000	1.000	0.000	0.000
69739	276.000	680.000	130.000	163.000	51.000	12.000	3.000	2.000	0.000	0.000
89974	263.000	639.000	397.000	67.000	41.000	7.000	1.000	0.000	0.000	0.000
63577	204.000	738.000	419.000	194.000	25.000	10.000	2.000	1.000	0.000	0.000
76517	113.000	1529.000	413.000	219.000	65.000	7.000	3.000	1.000	0.000	0.000
78523	420.000	358.000	491.000	245.000	75.000	17.000	3.000	1.000	0.000	0.000
69720	379.000	1273.000	284.000	182.000	37.000	8.000	2.000	1.000	1.000	0.000
76149	974.000	865.000	604.000	121.000	59.000	11.000	3.000	1.000	0.000	0.000
53003	192.000	752.000	239.000	133.000	17.000	6.000	1.000	0.000	0.000	0.000
50350	469.000	169.000	474.000	125.000	36.000	2.000	1.000	0.000	0.000	0.000
51234	415.000	758.000	58.000	118.000	19.000	5.000	0.000	1.000	0.000	0.000
35482	100.000	315.000	345.000	25.000	33.000	4.000	1.000	0.000	0.000	0.000
36133	349.150	151.951	131.981	78.384	3.212	2.160	0.249	0.053	0.010	0.003
36097	45.839	352.149	51.215	28.645	7.475	0.808	0.374	0.072	0.014	0.007
45075	129.353	92.647	109.162	16.003	8.173	2.506	0.343	0.219	0.021	0.002
34138	159.420	203.140	66.287	29.039	2.341	0.721	0.088	0.027	0.002	0.000
23721	79.229	315.897	34.581	9.293	4.253	0.329	0.095	0.017	0.002	0.001
17316	42.678	34.314	44.199	5.225	0.365	0.056	0.009	0.003	0.003	0.000
19227	73.893	245.632	37.719	23.905	1.212	0.105	0.052	0.007	0.002	0.007

FLT07: SCOGFS_IV (Catch: Unknown) (Effort: Unknown)
1982 1995
1 1 0.50 0.75
1 6

100	0.614	0.351	0.571	0.181	0.092	0.060
100	0.325	0.781	0.181	0.197	0.075	0.023
100	0.820	0.390	0.254	0.050	0.057	0.016
100	0.066	1.142	0.196	0.112	0.030	0.024
100	0.801	0.105	0.396	0.058	0.040	0.019
100	0.219	0.749	0.034	0.092	0.029	0.007
100	0.163	0.288	0.165	0.026	0.033	0.012
100	0.562	0.135	0.169	0.094	0.020	0.008
100	0.114	0.491	0.059	0.074	0.026	0.009
100	0.303	0.154	0.133	0.013	0.006	0.004
100	0.643	0.193	0.072	0.067	0.029	0.018
100	0.347	0.749	0.101	0.025	0.011	0.003
100	1.158	0.334	0.288	0.031	0.012	0.007
100	0.475	1.443	0.130	0.085	0.011	0.007

FLT08: ENGGFS_IV (Catch: Unknown) (Effort: Unknown)
1977 1995
1 1 0.50 0.75
1 5

100	6.269	0.448	0.323	0.058	0.011
100	2.284	1.250	0.098	0.099	0.013

Table 3.3.2 (Continued)

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   100   2.423   0.580   0.200   0.027   0.036
   100   5.084   0.670   0.153   0.073   0.011
   100   1.136   1.387   0.127   0.039   0.040
   100   3.238   0.290   0.329   0.053   0.038
   100   1.539   1.096   0.120   0.111   0.028
   100   6.122   0.474   0.178   0.040   0.021
   100   0.430   1.189   0.107   0.056   0.021
   100   3.438   0.115   0.202   0.029   0.011
   100   1.422   1.065   0.027   0.061   0.014
   100   0.836   0.407   0.199   0.001   0.043
   100   2.285   0.248   0.119   0.061   0.006
   100   0.608   0.503   0.060   0.014   0.012
   100   0.752   0.155   0.072   0.013   0.003
   100   2.441   0.158   0.046   0.035   0.008
   100   0.742   0.651   0.082   0.015   0.017
   100   2.637   0.295   0.154   0.019   0.005
   100   1.028   1.277   0.119   0.056   0.002
FLT09: IBTS_Q1_IV (Catch: Unknown) (Effort: Unknown)
1976 1995
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
FLT10: IBTS_Q2_IV (Catch: Unknown) (Effort: Unknown)
1991 1995
1 1 0.25 0.50
1 6
   10     14.9     31.4    39.4     6.1     4.9     2.2
   10    190.8     53.2    13.8     6.1     0.5     0.9
   10     48.2    144.6    22.4     4.0     2.2     0.3
   10     20.3     34.1    24.4     4.5     0.6     1.0
   10     42.7    204.7    29.0     9.3     3.0     1.2
FLT12: DANGIL_3a (Catch: Unknown) (Effort: Unknown)
1987 1995
1 1 0.00 1.00
1 7
   1      0.0     98.7     68.6    19.3     4.8     2.1     0.6
   1     12.8     57.7    146.5    20.9     4.2     1.7     0.2
   1      5.2     67.8     59.2    65.5     8.9     5.6     0.8
   1      8.9     69.9     91.7    22.2    18.4     2.0     2.4
   1      6.6     64.8     75.6    51.2    11.4     4.2     1.6
   1     27.8    114.7     67.9    24.8    14.0     2.3     2.3
   1      9.3    134.1     94.8    32.3     6.5     2.8     0.3
   1     15.9    109.4    107.4    18.0     4.3     0.9     0.2
   1      7.1    127.1    114.6    39.5     3.7     2.1     0.1
FLT13: DANNEP_3a (Catch: Unknown) (Effort: Unknown)
1987 1995
1 1 0.00 1.00
1 7
   1     0.00    18.00     3.00     0.80    0.20    0.10    0.02
   1     1.90     5.50    11.70     1.30    0.40    0.20    0.03
   1     2.30    17.90     7.40     2.50    0.30    0.20    0.03
   1     2.00    16.30     9.60     1.40    1.20    0.10    0.10
   1     2.20    13.20     5.90     2.30    0.50    0.20    0.10
   1     8.10    15.00     4.40     1.30    0.70    0.10    0.10
   1     1.90    25.10     6.70     1.90    0.60    0.20    0.04
   1     4.50    14.10     6.70     1.10    0.30    0.10    0.03
   1     2.10    35.00     8.70     1.40    0.20    0.10    0.01
FLT17: FRATRC_7d (Catch: Unknown) (Effort: Unknown)
1985 1995
1 1 0.00 1.00
1 2
    456831      11.000     870.000
    353839    9094.000    5015.000
    309988    1307.000    5041.000
    260919     791.000    1487.000
    329640     572.000     913.000
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Table 3.3.2 (Continued)

268831	74.000	362.000
361439	61.000	106.000
346545	1426.793	267.854
351004	50.112	497.253
357798	1634.389	83.161
309531	1401.580	774.508

Table 3.4.1

Lowestoft VPA Version 3.1

9-Oct-96 19:16:57

Extended Survivors Analysis

Cod in IV,IIIa,VIId (run: XSATIM01/X01)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/cod_347d/FLEET.X01

Catch data for 33 years. 1963 to 1995. Ages 1 to 11.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT01: SCOTRL_IV (Ca,	1976,	1995,	1,	10,	.000,	1.000
FLT02: SCOSEI_IV (Ca,	1976,	1995,	1,	10,	.000,	1.000
FLT03: SCOLTR_IV (Ca,	1976,	1995,	1,	10,	.000,	1.000
FLT04: ENGTRL_IV (Ca,	1976,	1995,	1,	10,	.000,	1.000
FLT05: ENGSEI_IV (Ca,	1976,	1995,	1,	10,	.000,	1.000
FLT06: FRATRB_IV (Ca,	1976,	1995,	1,	10,	.000,	1.000
FLT07: SCOGFS_IV (Ca,	1982,	1995,	1,	6,	.500,	.750
FLT08: ENGGFS_IV (Ca,	1977,	1995,	1,	5,	.500,	.750
FLT09: IBTS_Q1_IV (C,	1976,	1995,	1,	6,	.000,	.250
FLT10: IBTS_Q2_IV (C,	1991,	1995,	1,	6,	.250,	.500
FLT12: DANGIL_3a (Ca,	1987,	1995,	1,	7,	.000,	1.000
FLT13: DANNEP_3a (Ca,	1987,	1995,	1,	7,	.000,	1.000
FLT17: FRATRC_7d (Ca,	1985,	1995,	1,	2,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 0 over 10 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

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

Catchability independent of age for ages >= 6

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 29 iterations

Table 3.4.1 (Continued)

Regression weights

1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Fishing mortalities

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.235	.138	.169	.134	.142	.128	.144	.046	.062	.104
2	.831	.909	.899	.875	.915	.774	.858	.789	.578	.598
3	1.054	.904	1.159	1.095	.993	.972	.872	1.047	.958	.781
4	.961	.941	.857	1.046	.903	.890	.944	1.031	.980	.702
5	.897	.732	.806	.776	.784	.850	.816	.930	.895	.752
6	.814	.935	.792	.913	.552	.940	.828	.986	.940	.868
7	.823	.898	.729	.829	.761	1.052	.899	1.080	1.062	.789
8	.958	.917	.817	1.000	.623	1.028	.916	.956	1.194	1.176
9	.673	.868	.704	.737	2.249	.498	1.004	.841	.790	.966
10	.933	.904	.578	.792	.941	.767	.726	.780	.985	.959

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8		
1986	7.06E+05	6.24E+04	5.83E+04	1.02E+04	5.61E+03	1.16E+03	1.06E+03	3.03E+02	1.47E+02	7.65E+01
1987	2.77E+05	2.51E+05	1.92E+04	1.58E+04	3.20E+03	1.87E+03	4.22E+02	3.81E+02	9.52E+01	6.13E+01
1988	1.94E+05	1.08E+05	7.12E+04	6.05E+03	5.06E+03	1.26E+03	6.02E+02	1.41E+02	1.25E+02	3.27E+01
1989	2.77E+05	7.35E+04	3.11E+04	1.74E+04	2.10E+03	1.85E+03	4.67E+02	2.38E+02	5.09E+01	5.05E+01
1990	1.34E+05	1.09E+05	2.16E+04	8.10E+03	5.01E+03	7.92E+02	6.08E+02	1.67E+02	7.17E+01	1.99E+01
1991	1.69E+05	5.21E+04	3.07E+04	6.23E+03	2.69E+03	1.87E+03	3.74E+02	2.32E+02	7.32E+01	6.19E+00
1992	3.12E+05	6.66E+04	1.69E+04	9.04E+03	2.09E+03	9.40E+02	5.98E+02	1.07E+02	6.80E+01	3.64E+01
1993	1.59E+05	1.21E+05	1.99E+04	5.52E+03	2.88E+03	7.58E+02	3.36E+02	1.99E+02	3.50E+01	2.04E+01
1994	3.99E+05	6.84E+04	3.88E+04	5.44E+03	1.61E+03	9.30E+02	2.31E+02	9.35E+01	6.27E+01	1.23E+01
1995	2.48E+05	1.68E+05	2.70E+04	1.16E+04	1.67E+03	5.39E+02	2.98E+02	6.55E+01	2.32E+01	2.33E+01

Estimated population abundance at 1st Jan 1996

.00E+00	1.00E+05	6.52E+04	9.65E+03	4.71E+03	6.45E+02	1.85E+02	1.11E+02	1.66E+01	7.23E+00

Taper weighted geometric mean of the VPA populations:

2.55E+05	9.59E+04	3.00E+04	8.77E+03	2.90E+03	1.10E+03	4.57E+02	1.69E+02	6.62E+01	2.70E+01

Standard error of the weighted Log(VPA populations) :

.4919	.4947	.4799	.4249	.4614	.4299	.4379	.5516	.5540	.7637

Table 3.4.1 (Continued)

Log catchability residuals.

Fleet : FLT01: SCOTRL_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.17	.81	-.21	.11	.05	.57	.20	-.81	-.28	-.29
2	.20	.02	.53	-1.30	.88	.38	.44	-.04	-.96	-.15
3	.11	-.71	-.27	.62	-.87	.54	.08	-.05	.34	.21
4	-.52	-.26	-.68	.22	.47	-.28	1.05	-.54	-.05	.60
5	-.20	.10	-.14	-.01	-.18	.84	-.52	.85	-.19	-.54
6	-.92	-.64	.69	.02	.26	-.03	.48	.04	.48	-.39
7	-.83	99.99	.02	.74	.43	.36	-1.35	-1.55	.77	.31
8	99.99	.25	1.51	-.37	.16	99.99	-1.01	-5.08	1.39	-.75
9	99.99	99.99	99.99	2.42	99.99	-1.09	.05	99.99	99.99	-.35
10	99.99	99.99	99.99	.25	99.99	99.99	99.99	99.99	99.99	1.94

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	-15.6921	-15.1899	-15.4298	-15.8190	-15.9589	-15.9589	-15.9589	-15.9589	-15.9589
S.E(Log q)	.6736	.4934	.5685	.4850	.5204	.8985	2.1337	1.5460	1.9532

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.67	.992	16.14	.53	10	.49	-17.96

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	.88	.278	15.20	.41	10	.63	-15.69
3	.80	.716	14.21	.61	10	.41	-15.19
4	.70	.965	13.51	.56	10	.40	-15.43
5	.90	.297	15.04	.53	10	.46	-15.82
6	1.20	-.398	17.77	.32	10	.66	-15.96
7	3.08	-.996	36.80	.03	9	2.74	-16.08
8	2.04	-.341	28.29	.02	8	4.51	-16.45
9	1.09	-.042	16.82	.09	4	2.03	-15.70
10	.00	.000	.00	.00	0	.00	.00

Table 3.4.1 (Continued)

Fleet : FLT02: SCOSEI_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.12	-.10	-.04	.21	-.06	.76	-.15	-.58	-.24	.09
2	-.61	-.33	-.03	-.30	.88	.36	.13	-.09	-.16	.14
3	.40	-.84	-.03	.45	-.01	.41	-.07	-.25	.18	-.23
4	.08	.20	-.72	.04	.53	-.45	.26	-.19	.18	.07
5	-.36	.14	.32	-.40	.17	.09	-.14	.08	-.20	.30
6	-.77	.29	.39	.45	-.14	.01	.12	-.29	-.15	.07
7	-.78	-.25	.24	.37	.47	.44	-.02	.26	.25	.37
8	-.48	.22	.48	.25	.23	.64	.43	-.03	.25	-.86
9	-.50	.76	.09	-.38	.54	.37	.87	.30	-.32	.15
10	-.73	-.01	.16	.83	.63	.36	.42	-.25	.43	.08

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	-14.9778	-14.9172	-15.0323	-15.0733	-15.0306	-15.0306	-15.0306	-15.0306	-15.0306
S.E(Log q)	.4148	.3941	.3649	.2590	.3616	.4167	.4746	.5153	.4947

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	.82	.722	16.78	.67	10	.37	-17.72

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.01	-.034	15.01	.58	10	.44	-14.98
3	.71	1.656	13.57	.80	10	.25	-14.92
4	.74	1.249	13.50	.75	10	.26	-15.03
5	.92	.435	14.51	.79	10	.25	-15.07
6	.76	1.133	13.12	.74	10	.27	-15.03
7	2.17	-2.141	25.17	.29	10	.72	-14.89
8	.83	.712	13.27	.69	10	.39	-14.92
9	1.08	-.243	15.69	.54	10	.54	-14.84
10	1.26	-1.059	17.85	.67	10	.56	-14.84

Table 3.4.1 (Continued)

Fleet : FLT03: SCOLTR_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.25	.52	-.29	.25	-.08	.84	-.05	-.54	-.78	-.11
2	-.11	-.11	.07	-.59	.61	.16	.17	.18	-.34	-.05
3	.10	-.33	-.37	.22	-.55	.47	-.17	.32	.17	.14
4	-.06	-.11	-.55	-.12	.40	-.57	.48	-.31	.43	.40
5	-.04	-.52	.13	-.15	.31	.29	-.39	.00	-.03	.40
6	-.41	-.13	.15	.10	.25	.15	.36	-.60	.56	-.44
7	-.68	.22	.01	.22	-.22	.04	-.27	-.40	.01	-.10
8	.04	-.27	-.45	-.41	-.10	.54	-.30	-.23	.06	-.81
9	-.27	-.70	-1.07	-.31	.03	-.48	.17	-.75	-1.75	.47
10	-.20	-.25	99.99	-1.52	-1.21	-1.66	-1.54	-.92	-.34	.00

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	-15.8828	-15.5075	-15.6646	-16.0784	-16.2154	-16.2154	-16.2154	-16.2154	-16.2154
S.E(Log q)	.3268	.3329	.4048	.2974	.3797	.3079	.4144	.8117	1.1152

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.68	.917	16.26	.51	10	.51	-18.05

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	.94	.290	15.60	.73	10	.32	-15.88
3	.96	.178	15.29	.69	10	.34	-15.51
4	.85	.521	14.70	.61	10	.36	-15.66
5	.94	.278	15.60	.73	10	.30	-16.08
6	.82	.727	14.56	.67	10	.32	-16.22
7	1.49	-1.692	21.37	.59	10	.38	-16.33
8	.79	1.289	14.00	.82	10	.27	-16.41
9	1.60	-.955	24.12	.24	10	1.04	-16.68
10	.80	.875	14.25	.72	9	.53	-17.06

Table 3.4.1 (Continued)

Fleet : FLT04: ENGTRL_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.44	-.81	.21	-.32	.16	.22	.09	.10	-.15	.07
2	-.03	.25	-.59	-.32	-.05	-.07	.20	.26	.37	-.02
3	.17	.01	.00	-.46	-.28	.11	-.01	-.13	.25	.33
4	-.09	.55	-.48	.21	-.21	-.38	.39	.09	.01	-.10
5	.62	-.34	.42	-.38	.35	-.41	-.31	.55	-.11	-.40
6	.09	.25	.10	.41	.17	-.10	-.54	-.20	.05	-.23
7	-.04	-.43	.28	-.17	.69	-.58	-.06	.14	.11	-.12
8	.17	-.03	99.99	.35	.75	-.12	99.99	.21	.10	.50
9	.08	.64	.23	99.99	.81	99.99	99.99	99.99	.57	-.16
10	.84	.40	99.99	99.99	99.99	99.99	99.99	1.73	-1.33	.46

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	-15.3954	-15.3563	-15.8447	-16.2485	-16.5445	-16.5445	-16.5445	-16.5445	-16.5445
S.E(Log q)	.2909	.2393	.3242	.4313	.2729	.3593	.3832	.5426	1.2076

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.73	1.088	16.07	.66	10	.37	-17.44

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.93	.346	15.13	.77	10	.29	-15.40
3	.88	.780	14.77	.85	10	.22	-15.36
4	.69	2.017	13.77	.84	10	.19	-15.84
5	.59	3.146	12.85	.88	10	.18	-16.25
6	.75	1.798	14.12	.86	10	.18	-16.54
7	.85	.631	14.98	.68	10	.32	-16.56
8	1.27	-1.186	19.25	.77	8	.35	-16.30
9	.86	.630	14.47	.83	6	.34	-16.18
10	.63	.789	11.38	.60	5	.73	-16.13

Table 3.4.1 (Continued)

Fleet : FLT05: ENGSEI_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.16	-.38	.42	.22	.38	-.21	.54	-.83	-.11	.13
2	-.79	-.02	.12	.36	.38	-.33	.24	-.09	.08	.04
3	.10	-.68	.39	.20	.01	.18	-.34	-.54	.29	.40
4	-.27	.42	-.62	.41	.10	.00	.11	.06	-.14	-.07
5	.42	-.14	.33	-.96	.14	-.06	-.56	.17	.80	-.15
6	.11	.60	-.16	.42	-1.23	.28	-.42	-.61	.74	.26
7	.63	.04	.09	-.12	.45	.09	.06	-.05	.66	1.23
8	.55	.94	.20	.76	.07	1.54	.41	.02	.38	2.29
9	.54	1.29	.27	.11	.42	-.30	1.30	99.99	.07	1.63
10	1.30	.36	.46	.83	1.23	2.28	99.99	1.53	-.22	.30

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

Age	2	3	4	5	6	7	8	9	10
Mean Log q	-15.7945	-15.9697	-16.0845	-15.4407	-15.0022	-15.0022	-15.0022	-15.0022	-15.0022
S.E(Log q)	.3516	.3887	.3077	.5006	.6093	.5369	1.0382	.9134	1.2211

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.00	.012	17.86	.58	10	.45	-17.87

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.85	.705	15.16	.74	10	.31	-15.79
3	.64	2.743	13.93	.88	10	.19	-15.97
4	.69	2.285	13.89	.87	10	.17	-16.08
5	.75	.898	13.59	.62	10	.38	-15.44
6	.61	1.421	11.89	.63	10	.35	-15.00
7	1.19	-.477	16.35	.43	10	.53	-14.69
8	1.41	-.653	18.06	.24	10	1.04	-14.29
9	1.78	-1.005	22.30	.19	9	1.18	-14.41
10	1.41	-.846	18.55	.38	9	1.10	-14.11

Table 3.4.1 (Continued)

Fleet : FLT06: FRATRB_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.01	.72	-.11	.92	-.66	.03	-.02	.22	-1.04	-.03
2	-.16	-.04	.29	-.08	.39	-.49	.36	.54	-.88	.09
3	.62	-.44	.50	.32	-.30	-.13	.21	-.17	-.31	-.29
4	.89	.37	.11	.26	-.04	-.59	-.07	-.31	-.58	-.04
5	.85	.68	1.18	-.31	-.33	.19	-.55	.14	-1.43	-.43
6	.34	.81	1.29	.32	.04	.25	-.08	-.22	-1.90	-.86
7	-.26	99.99	.62	-.50	-.38	-.08	-1.70	-.61	-2.28	-1.00
8	99.99	.78	99.99	-1.30	-.79	-.07	-1.15	-1.86	-2.42	-1.33
9	99.99	99.99	99.99	-1.53	-.98	-1.48	-3.27	-2.30	-2.19	-1.63
10	99.99	99.99	99.99	-2.71	-.87	-1.24	99.99	-2.48	99.99	-.39

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	-16.0451	-15.6792	-15.5949	-16.2233	-17.0647	-17.0647	-17.0647	-17.0647	-17.0647
S.E(Log q)	.4362	.3788	.4467	.7714	.8812	1.1352	1.4813	2.1954	1.9957

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.14	-.342	18.25	.42	10	.61	-17.54

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.74	1.246	14.85	.74	10	.31	-16.05
3	.66	2.363	13.87	.86	10	.20	-15.68
4	.60	2.384	12.96	.81	10	.22	-15.59
5	.44	3.329	11.60	.82	10	.23	-16.22
6	.46	1.946	11.66	.62	10	.36	-17.06
7	.52	1.528	12.13	.59	9	.42	-17.75
8	.46	2.199	11.10	.74	8	.37	-18.08
9	1.05	-.057	19.66	.24	7	.85	-18.98
10	2.29	-.795	38.78	.11	5	2.44	-18.60

Table 3.4.1 (Continued)

Fleet : FLT07: SCOGFS_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.34	-.56	-.43	.25	-.38	.21	.25	.34	.46	.20
2	-.70	-.08	-.20	-.59	.34	-.18	-.14	.57	.21	.78
3	.54	-.89	-.47	.35	-.40	.05	-.04	.25	.57	.03
4	.08	.09	-.27	.08	.51	-.97	.33	-.11	.09	.17
5	.15	.29	.00	.36	-.24	-1.04	.76	-.46	.19	-.02
6	.77	-.63	.22	-.49	.25	-1.18	.94	-.54	.08	.58
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	-16.4630	-16.2400	-16.0371	-15.9227	-15.7700
S.E(Log q)	.4752	.4696	.4018	.4947	.6876

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	.85	.543	16.70	.63	10	.40	-17.43

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	.68	1.638	14.84	.76	10	.29	-16.46
3	.78	.825	14.96	.65	10	.38	-16.24
4	.74	1.131	14.23	.70	10	.29	-16.04
5	1.25	-.539	17.92	.37	10	.64	-15.92
6	25.26	-2.124	228.37	.00	10	14.73	-15.77

Table 3.4.1 (Continued)

Fleet : FLT08: ENGGFS_IV (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.20	-.04	-.10	.35	.00	-.07	.29	-.07	.06	-.21
2	-.70	.19	.06	-.06	.28	-.25	-.43	.35	.00	.57
3	.18	-.82	.03	.30	-.08	-.26	-.18	.34	.25	.25
4	.24	.53	-2.67	.50	-.30	-.12	.53	.23	.45	.60
5	-.36	.34	1.05	-.06	-.23	-.95	.26	.77	.10	-.94
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	-16.3789	-16.5435	-16.8897	-16.7085
S.E(Log q)	.3802	.3561	.9854	.6550

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	.82	1.349	15.50	.87	10	.20	-16.17

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.64	3.111	14.60	.90	10	.17	-16.38
3	.79	1.056	15.26	.77	10	.28	-16.54
4	.50	1.332	13.01	.47	10	.48	-16.89
5	.73	.777	14.32	.50	10	.49	-16.71

Table 3.4.1 (Continued)

Fleet : FLT09: IBTS_Q1_IV (C

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.30	-.01	-.52	.37	-.20	-.78	.25	.88	.12	.19
2	-.44	.26	-.45	-.03	.46	-.13	-.27	.60	-.36	.36
3	.20	-.28	-.14	.53	-.03	.14	-.32	.05	-.22	.05
4	.59	-.16	-.24	.06	-.02	.02	-.13	.02	.16	-.31
5	.19	-.04	-.08	-.02	.03	-.26	-.30	.09	.48	-.08
6	.43	-.24	.34	-.12	.46	-.35	-.15	-.14	-.13	-.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									

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	-9.1811	-9.1030	-8.8443	-8.4262	-7.2642
S.E(Log q)	.3930	.2577	.2523	.2236	.2931

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.97	.092	10.30	.52	10	.50	-10.23

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.67	2.271	9.94	.85	10	.22	-9.18
3	.89	.701	9.24	.82	10	.23	-9.10
4	1.03	-.148	8.84	.73	10	.28	-8.84
5	1.01	-.073	8.43	.81	10	.24	-8.43
6	1.21	-.754	7.32	.61	10	.36	-7.26

Table 3.4.1 (Continued)

Fleet : FLT10: IBTS_Q2_IV (C

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	99.99	99.99	99.99	99.99	99.99	-1.48	2.58	.67	-1.82	.05
2	99.99	99.99	99.99	99.99	99.99	-.28	.04	.41	-.54	.36
3	99.99	99.99	99.99	99.99	99.99	.31	-.18	.21	-.41	.06
4	99.99	99.99	99.99	99.99	99.99	.20	-.15	-.05	.07	-.07
5	99.99	99.99	99.99	99.99	99.99	.90	-1.14	.06	-.67	.85
6	99.99	99.99	99.99	99.99	99.99	.16	-.09	-.91	.07	.77
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	-9.0237	-8.8194	-9.0270	-9.1209	-8.7838
S.E(Log q)	.4083	.2927	.1367	.9076	.6050

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.83	-.318	9.19	.05	5	2.05	-10.65

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.60	2.350	9.97	.92	5	.17	-9.02
3	1.25	-.400	8.49	.47	5	.41	-8.82
4	1.29	-1.160	9.07	.84	5	.17	-9.03
5	.55	.425	8.47	.23	5	.56	-9.12
6	1.17	-.194	9.12	.29	5	.82	-8.78

Table 3.4.1 (Continued)

Fleet : FLT12: DANGIL_3a (Ca

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	99.99	99.99	.55	-1.32	.31	-.43	1.34	.14	.12	-.71
2	99.99	-.77	-.47	.07	-.28	.32	.68	.21	.49	-.25
3	99.99	.09	-.36	-.46	.30	-.25	.19	.43	-.14	.21
4	99.99	-1.02	-.02	.15	-.23	.86	-.21	.58	-.01	-.10
5	99.99	-.62	-1.18	.44	.30	.47	.91	-.13	.03	-.22
6	99.99	-.61	-.48	.38	.04	.09	.13	.60	-.75	.61
7	99.99	-.39	-1.91	-.23	.58	.78	.61	-.78	-.82	-1.87
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	7
Mean Log q	-6.5032	-5.2019	-5.1686	-5.4538	-5.6702	-5.6702
S.E(Log q)	.4778	.3158	.5317	.6295	.5092	1.1154

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.65	-.735	7.77	.17	8	.88	-9.57

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	4.54	-3.726	-11.24	.14	9	1.34	-6.50
3	2.08	-2.834	-.24	.50	9	.48	-5.20
4	3.05	-1.813	-2.81	.10	9	1.43	-5.17
5	2.79	-1.264	1.08	.07	9	1.69	-5.45
6	1.75	-1.101	4.67	.23	9	.88	-5.67
7	.51	.901	6.08	.33	9	.52	-6.12

Table 3.4.1 (Continued)

Fleet : FLT13: DANNEP_3a (Ca

Age	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
1 ,	99.99,	99.99,	-.19,	-.37,	.22,	.08,	.78,	-.05,	-.09,	-.37
2 ,	99.99,	-.76,	-1.11,	.45,	-.02,	.45,	.37,	.26,	.16,	.18
3 ,	99.99,	-.45,	-.30,	.04,	.63,	-.22,	.04,	.37,	-.33,	.22
4 ,	99.99,	-1.21,	.21,	-.12,	.01,	.76,	-.16,	.75,	.20,	-.44
5 ,	99.99,	-.94,	-.67,	-.09,	.43,	.20,	.78,	.35,	.22,	-.28
6 ,	99.99,	-.81,	.22,	-.11,	-.11,	-.12,	-.17,	.81,	-.11,	.41
7 ,	99.99,	-.94,	-.97,	-.67,	.24,	.85,	.32,	.05,	.13,	-1.34
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,	7
Mean Log q,	-8.2231,	-7.7888,	-8.1696,	-8.3132,	-8.5117,	-8.5117,
S.E(Log q),	.5549,	.3602,	.6029,	.5489,	.4475,	.7868,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	1.01,	-.016,	10.89,	.50,	8,	.40,	-10.90,

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,	2.81,	-1.885,	2.25,	.13,	9,	1.36,	-8.22,
3,	1.54,	-1.270,	6.47,	.44,	9,	.53,	-7.79,
4,	-15.87,	-3.392,	23.24,	.01,	9,	6.29,	-8.17,
5,	1.45,	-.656,	8.50,	.23,	9,	.83,	-8.31,
6,	2.64,	-2.159,	10.99,	.20,	9,	.98,	-8.51,
7,	.97,	.040,	8.68,	.19,	9,	.76,	-8.77,

Table 3.4.1 (Continued)

Fleet : FLT17: FRATRC_7d (Ca

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.13	.20	.45	-.09	.03	-.36	.08	-.37	-.15	.33
2	2.41	1.19	.98	.63	-.46	-1.31	-.55	-.57	-1.90	-.41
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2
Mean Log q	-17.1760
S.E(Log q)	1.2868

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	.33	3.389	14.39	.76	10	.29	-18.35

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	.63	.646	15.08	.28	10	.84	-17.18

Table 3.4.1 (Continued)

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOTRL_IV (Ca,	74623.,	.521,	.000,	.00,	1,	.050,	.138
FLT02: SCOSEI_IV (Ca,	109678.,	.383,	.000,	.00,	1,	.093,	.096
FLT03: SCOLTR_IV (Ca,	90204.,	.540,	.000,	.00,	1,	.047,	.115
FLT04: ENGTRL_IV (Ca,	107547.,	.391,	.000,	.00,	1,	.089,	.098
FLT05: ENGSEI_IV (Ca,	114104.,	.469,	.000,	.00,	1,	.062,	.092
FLT06: FRATRB_IV (Ca,	96771.,	.637,	.000,	.00,	1,	.033,	.108
FLT07: SCOGFS_IV (Ca,	122251.,	.422,	.000,	.00,	1,	.076,	.086
FLT08: ENGGFS_IV (Ca,	81195.,	.300,	.000,	.00,	1,	.151,	.127
FLT09: IBTS_Q1_IV (C,	121129.,	.530,	.000,	.00,	1,	.048,	.087
FLT10: IBTS_Q2_IV (C,	105011.,	2.247,	.000,	.00,	1,	.003,	.100
FLT12: DANGIL_3a (Ca,	49238.,	.961,	.000,	.00,	1,	.015,	.202
FLT13: DANNEP_3a (Ca,	69550.,	.436,	.000,	.00,	1,	.072,	.147
FLT17: FRATRC_7d (Ca,	139770.,	.311,	.000,	.00,	1,	.141,	.076
P shrinkage mean ,	95903.,	.49,,,,				.062,	.109
F shrinkage mean ,	96911.,	.50,,,,				.060,	.108

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
100212.,	.12,	.06,	15,	.516,	.104

Age 2 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: SCOTRL_IV (Ca,	51798.,	.417,	.060,	.14,	2,	.041,	.709
FLT02: SCOSEI_IV (Ca,	61119.,	.289,	.190,	.66,	2,	.087,	.628
FLT03: SCOLTR_IV (Ca,	50995.,	.290,	.328,	1.13,	2,	.088,	.717
FLT04: ENGTRL_IV (Ca,	60875.,	.242,	.062,	.26,	2,	.126,	.630
FLT05: ENGSEI_IV (Ca,	64205.,	.291,	.075,	.26,	2,	.086,	.606
FLT06: FRATRB_IV (Ca,	50010.,	.375,	.523,	1.39,	2,	.052,	.727
FLT07: SCOGFS_IV (Ca,	120483.,	.340,	.161,	.47,	2,	.063,	.367
FLT08: ENGGFS_IV (Ca,	84170.,	.240,	.248,	1.03,	2,	.125,	.492
FLT09: IBTS_Q1_IV (C,	85842.,	.329,	.115,	.35,	2,	.068,	.484
FLT10: IBTS_Q2_IV (C,	87263.,	.440,	.387,	.88,	2,	.039,	.478
FLT12: DANGIL_3a (Ca,	54747.,	.447,	.147,	.33,	2,	.037,	.681
FLT13: DANNEP_3a (Ca,	66121.,	.358,	.134,	.37,	2,	.056,	.592
FLT17: FRATRC_7d (Ca,	55505.,	.303,	.059,	.20,	2,	.077,	.674
F shrinkage mean ,	43788.,	.50,,,,				.055,	.798

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
65220.,	.09,	.07,	27,	.747,	.598

Table 3.4.1 (Continued)

Age 3 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: SCOTRL_IV (Ca,	7634.,	.358,	.381,	1.06,	3,	.038,	.914
FLT02: SCOSEI_IV (Ca,	7176.,	.258,	.113,	.44,	3,	.070,	.952
FLT03: SCOLTR_IV (Ca,	8812.,	.236,	.190,	.81,	3,	.087,	.831
FLT04: ENGTRL_IV (Ca,	13074.,	.197,	.065,	.33,	3,	.123,	.627
FLT05: ENGSEI_IV (Ca,	10779.,	.256,	.294,	1.15,	3,	.071,	.722
FLT06: FRATRB_IV (Ca,	6605.,	.283,	.241,	.85,	3,	.062,	1.004
FLT07: SCOGFS_IV (Ca,	11461.,	.282,	.095,	.34,	3,	.056,	.691
FLT08: ENGGFS_IV (Ca,	10468.,	.211,	.102,	.49,	3,	.100,	.737
FLT09: IBTS_Q1_IV (C,	10291.,	.230,	.237,	1.03,	3,	.097,	.746
FLT10: IBTS_Q2_IV (C,	9038.,	.267,	.182,	.68,	3,	.076,	.817
FLT12: DANGIL_3a (Ca,	12497.,	.275,	.080,	.29,	3,	.071,	.649
FLT13: DANNEP_3a (Ca,	11160.,	.270,	.079,	.29,	3,	.068,	.704
FLT17: FRATRC_7d (Ca,	6044.,	.329,	.367,	1.12,	2,	.030,	1.061
F shrinkage mean ,	6830.,	.50,,,,				.052,	.982

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9647.,	.07,	.06,	39,	.765,	.781

Age 4 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: SCOTRL_IV (Ca,	7307.,	.364,	.112,	.31,	4,	.038,	.504
FLT02: SCOSEI_IV (Ca,	4992.,	.257,	.055,	.22,	4,	.081,	.673
FLT03: SCOLTR_IV (Ca,	6243.,	.249,	.078,	.32,	4,	.079,	.570
FLT04: ENGTRL_IV (Ca,	4951.,	.208,	.097,	.47,	4,	.116,	.677
FLT05: ENGSEI_IV (Ca,	4788.,	.238,	.101,	.42,	4,	.102,	.694
FLT06: FRATRB_IV (Ca,	4432.,	.291,	.136,	.47,	4,	.060,	.733
FLT07: SCOGFS_IV (Ca,	6244.,	.292,	.101,	.35,	4,	.064,	.570
FLT08: ENGGFS_IV (Ca,	6537.,	.242,	.068,	.28,	4,	.048,	.550
FLT09: IBTS_Q1_IV (C,	3803.,	.213,	.133,	.62,	4,	.125,	.815
FLT10: IBTS_Q2_IV (C,	4181.,	.226,	.124,	.55,	4,	.116,	.764
FLT12: DANGIL_3a (Ca,	4401.,	.289,	.119,	.41,	4,	.055,	.737
FLT13: DANNEP_3a (Ca,	3737.,	.310,	.206,	.66,	4,	.045,	.825
FLT17: FRATRC_7d (Ca,	4897.,	.302,	.151,	.50,	2,	.012,	.682
F shrinkage mean ,	2973.,	.50,,,,				.059,	.960

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4707.,	.08,	.04,	51,	.544,	.702

Table 3.4.1 (Continued)

Age 5 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: SCOTRL_IV (Ca,	453.,	.365,	.149,	.41,	5,	.051,	.954
FLT02: SCOSEI_IV (Ca,	835.,	.232,	.072,	.31,	5,	.134,	.624
FLT03: SCOLTR_IV (Ca,	958.,	.238,	.034,	.14,	5,	.125,	.563
FLT04: ENGTRL_IV (Ca,	538.,	.240,	.108,	.45,	5,	.093,	.853
FLT05: ENGSEI_IV (Ca,	548.,	.262,	.073,	.28,	5,	.077,	.842
FLT06: FRATRB_IV (Ca,	441.,	.340,	.124,	.36,	5,	.040,	.971
FLT07: SCOGFS_IV (Ca,	671.,	.312,	.046,	.15,	5,	.061,	.732
FLT08: ENGGFS_IV (Ca,	435.,	.361,	.291,	.81,	5,	.038,	.979
FLT09: IBTS_Q1_IV (C,	632.,	.209,	.065,	.31,	5,	.153,	.763
FLT10: IBTS_Q2_IV (C,	794.,	.246,	.140,	.57,	5,	.060,	.648
FLT12: DANGIL_3a (Ca,	662.,	.345,	.150,	.43,	5,	.044,	.739
FLT13: DANNEP_3a (Ca,	617.,	.355,	.139,	.39,	5,	.047,	.776
FLT17: FRATRC_7d (Ca,	443.,	.325,	.047,	.14,	2,	.004,	.968
F shrinkage mean ,	527.,	.50,,,,				.075,	.864

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
645.,	.08,	.04,	63,	.488,	.752

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: SCOTRL_IV (Ca,	135.,	.353,	.070,	.20,	6,	.053,	1.062
FLT02: SCOSEI_IV (Ca,	177.,	.228,	.061,	.27,	6,	.123,	.893
FLT03: SCOLTR_IV (Ca,	142.,	.236,	.088,	.37,	6,	.113,	1.029
FLT04: ENGTRL_IV (Ca,	157.,	.225,	.046,	.21,	6,	.145,	.969
FLT05: ENGSEI_IV (Ca,	249.,	.302,	.151,	.50,	6,	.056,	.708
FLT06: FRATRB_IV (Ca,	92.,	.412,	.228,	.55,	6,	.028,	1.331
FLT07: SCOGFS_IV (Ca,	241.,	.346,	.130,	.38,	6,	.044,	.724
FLT08: ENGGFS_IV (Ca,	185.,	.340,	.074,	.22,	5,	.018,	.869
FLT09: IBTS_Q1_IV (C,	195.,	.202,	.116,	.57,	6,	.165,	.838
FLT10: IBTS_Q2_IV (C,	238.,	.327,	.250,	.76,	5,	.047,	.731
FLT12: DANGIL_3a (Ca,	294.,	.358,	.104,	.29,	6,	.052,	.627
FLT13: DANNEP_3a (Ca,	267.,	.336,	.063,	.19,	6,	.063,	.672
FLT17: FRATRC_7d (Ca,	176.,	.315,	.324,	1.03,	2,	.002,	.898
F shrinkage mean ,	188.,	.50,,,,				.089,	.858

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
185.,	.09,	.04,	73,	.458,	.868

Table 3.4.1 (Continued)

Age 7 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
FLT01: SCOTRL_IV (Ca,	186.,	.396,	.091,	.23,	7,	.044,	.539
FLT02: SCOSEI_IV (Ca,	133.,	.249,	.092,	.37,	7,	.137,	.693
FLT03: SCOLTR_IV (Ca,	116.,	.231,	.107,	.46,	7,	.189,	.762
FLT04: ENGTRL_IV (Ca,	111.,	.228,	.074,	.32,	7,	.173,	.790
FLT05: ENGSEI_IV (Ca,	266.,	.348,	.186,	.53,	7,	.073,	.405
FLT06: FRATRB_IV (Ca,	49.,	.517,	.314,	.61,	7,	.025,	1.317
FLT07: SCOGFS_IV (Ca,	107.,	.347,	.134,	.39,	6,	.024,	.808
FLT08: ENGGFS_IV (Ca,	167.,	.350,	.206,	.59,	5,	.009,	.586
FLT09: IBTS_Q1_IV (C,	105.,	.203,	.051,	.25,	6,	.091,	.820
FLT10: IBTS_Q2_IV (C,	113.,	.334,	.084,	.25,	4,	.026,	.778
FLT12: DANGIL_3a (Ca,	46.,	.401,	.254,	.63,	7,	.038,	1.363
FLT13: DANNEP_3a (Ca,	67.,	.369,	.261,	.71,	7,	.054,	1.097
FLT17: FRATRC_7d (Ca,	99.,	.299,	.086,	.29,	2,	.001,	.851
F shrinkage mean ,	80.,	.50,,,,				.117,	.982

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
111.,	.10,	.06,	80,	.555,	.789

Age 8 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
FLT01: SCOTRL_IV (Ca,	17.,	.468,	.215,	.46,	8,	.026,	1.177
FLT02: SCOSEI_IV (Ca,	11.,	.288,	.177,	.61,	8,	.144,	1.508
FLT03: SCOLTR_IV (Ca,	10.,	.250,	.139,	.55,	8,	.194,	1.543
FLT04: ENGTRL_IV (Ca,	22.,	.252,	.111,	.44,	8,	.199,	1.001
FLT05: ENGSEI_IV (Ca,	39.,	.408,	.398,	.98,	8,	.052,	.673
FLT06: FRATRB_IV (Ca,	5.,	.671,	.280,	.42,	8,	.020,	2.107
FLT07: SCOGFS_IV (Ca,	14.,	.332,	.306,	.92,	6,	.012,	1.315
FLT08: ENGGFS_IV (Ca,	18.,	.345,	.087,	.25,	5,	.005,	1.126
FLT09: IBTS_Q1_IV (C,	14.,	.196,	.045,	.23,	6,	.045,	1.289
FLT10: IBTS_Q2_IV (C,	10.,	.355,	.405,	1.14,	3,	.012,	1.515
FLT12: DANGIL_3a (Ca,	22.,	.393,	.267,	.68,	7,	.019,	.994
FLT13: DANNEP_3a (Ca,	28.,	.365,	.133,	.36,	7,	.026,	.838
FLT17: FRATRC_7d (Ca,	26.,	.300,	.042,	.14,	2,	.001,	.878
F shrinkage mean ,	23.,	.50,,,,				.245,	.954

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17.,	.15,	.07,	85,	.449,	1.176

Table 3.4.1 (Continued)

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOTRL_IV (Ca,	7.,	.793,	.292,	.37,	9,	.024,	1.014
FLT02: SCOSEI_IV (Ca,	9.,	.340,	.022,	.07,	9,	.180,	.857
FLT03: SCOLTR_IV (Ca,	8.,	.311,	.114,	.37,	9,	.140,	.893
FLT04: ENGTRL_IV (Ca,	7.,	.306,	.070,	.23,	9,	.191,	1.020
FLT05: ENGSEI_IV (Ca,	18.,	.564,	.286,	.51,	9,	.060,	.497
FLT06: FRATRB_IV (Ca,	2.,	.926,	.337,	.36,	9,	.016,	1.871
FLT07: SCOGFS_IV (Ca,	8.,	.339,	.385,	1.14,	6,	.007,	.885
FLT08: ENGGFS_IV (Ca,	5.,	.360,	.269,	.75,	5,	.003,	1.247
FLT09: IBTS_Q1_IV (C,	6.,	.199,	.066,	.33,	6,	.025,	1.056
FLT10: IBTS_Q2_IV (C,	8.,	.579,	.362,	.63,	2,	.004,	.923
FLT12: DANGIL_3a (Ca,	6.,	.385,	.193,	.50,	6,	.010,	1.036
FLT13: DANNEP_3a (Ca,	7.,	.357,	.071,	.20,	6,	.014,	.990
FLT17: FRATRC_7d (Ca,	9.,	.302,	.180,	.59,	2,	.000,	.820
F shrinkage mean ,	6.,	.50,,,,				.326,	1.089

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7.,	.19,	.05,	88,	.254,	.966

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOTRL_IV (Ca,	8.,	.967,	.683,	.71,	9,	.016,	.895
FLT02: SCOSEI_IV (Ca,	7.,	.318,	.055,	.17,	10,	.239,	.979
FLT03: SCOLTR_IV (Ca,	5.,	.335,	.219,	.65,	10,	.117,	1.249
FLT04: ENGTRL_IV (Ca,	10.,	.305,	.082,	.27,	10,	.138,	.779
FLT05: ENGSEI_IV (Ca,	9.,	.571,	.042,	.07,	10,	.058,	.856
FLT06: FRATRB_IV (Ca,	3.,	1.035,	.293,	.28,	10,	.018,	1.630
FLT07: SCOGFS_IV (Ca,	4.,	.345,	.231,	.67,	6,	.005,	1.339
FLT08: ENGGFS_IV (Ca,	7.,	.392,	.110,	.28,	5,	.002,	1.011
FLT09: IBTS_Q1_IV (C,	6.,	.200,	.086,	.43,	6,	.018,	1.084
FLT10: IBTS_Q2_IV (C,	9.,	.663,	.000,	.00,	1,	.002,	.864
FLT12: DANGIL_3a (Ca,	9.,	.401,	.125,	.31,	6,	.007,	.832
FLT13: DANNEP_3a (Ca,	8.,	.370,	.112,	.30,	6,	.010,	.899
FLT17: FRATRC_7d (Ca,	7.,	.333,	.347,	1.04,	2,	.000,	.976
F shrinkage mean ,	8.,	.50,,,,				.371,	.920

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7.,	.21,	.05,	92,	.221,	.959

Table 3.4.2

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 19:18:30

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

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

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	.0551,	.0335,	.0457,	.0213,	.1098,	.0762,	.0335,	.1292,	.0922,	.1080,
2,	.5499,	.4973,	.6353,	.3906,	.5787,	.8862,	.8903,	.6956,	.8119,	.7336,
3,	.6280,	.7286,	.7390,	.6001,	.7465,	.7701,	.9070,	.8377,	.6678,	.7840,
4,	.5283,	.5326,	.7113,	.5816,	.5709,	.7086,	.6528,	.7783,	.6405,	.6663,
5,	.4894,	.5972,	.6228,	.6281,	.5845,	.6944,	.7099,	.5739,	.6400,	.7420,
6,	.4346,	.5988,	.5646,	.6989,	.5316,	.5376,	.8029,	.7209,	.5318,	.6723,
7,	.4452,	.6200,	.5823,	.4867,	.5279,	.5693,	.7789,	.6897,	.7124,	.5118,
8,	.5271,	.7130,	.4542,	.6313,	.3177,	.5188,	1.0275,	.5433,	.6015,	.8389,
9,	.7630,	.3800,	.7773,	.4065,	.6419,	.6898,	1.2286,	.3375,	.9123,	.8771,
10,	.5362,	.5868,	.6054,	.5751,	.5249,	.6073,	.9194,	.5779,	.6859,	.7355,
+gp,	.5362,	.5868,	.6054,	.5751,	.5249,	.6073,	.9194,	.5779,	.6859,	.7355,
FBAR 2- 8,	.5146,	.6125,	.6156,	.5739,	.5511,	.6693,	.8242,	.6913,	.6580,	.7070,

Table 3.4.2 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 19:18:30

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.0352,	.1440,	.0954,	.1042,	.1097,	.1011,	.1758,	.1263,	.1780,	.0906,
2,	.9389,	.8420,	1.0251,	.7949,	.8838,	.9730,	.9392,	1.0877,	.9607,	.9897,
3,	.8574,	.7700,	.9214,	.9495,	.9852,	1.0146,	1.2380,	1.1961,	1.0236,	.9699,
4,	.7559,	.5486,	.7660,	.5851,	.7925,	.7781,	.9288,	.9266,	.8411,	.8152,
5,	.5654,	.6339,	.8694,	.7046,	.6405,	.6807,	.8080,	.8060,	.7725,	.7228,
6,	.7889,	.5903,	.7383,	.5128,	.6321,	.5760,	.9095,	.7977,	.7871,	.7232,
7,	.7412,	.7906,	.6576,	.6525,	.8415,	.7152,	.7312,	.7381,	.7295,	.7327,
8,	.2720,	.7737,	.7882,	.5710,	.8452,	.5908,	.7288,	1.0466,	.8219,	.7202,
9,	.7952,	1.4547,	.8873,	.7895,	.5858,	.7383,	.8213,	.6564,	1.0268,	.6412,
10,	.6382,	.8576,	.7962,	.6520,	.7158,	.6663,	.8080,	.8173,	.8362,	.7148,
+gp,	.6382,	.8576,	.7962,	.6520,	.7158,	.6663,	.8080,	.8173,	.8362,	.7148,
FBAR 2- 8,	.7028,	.7070,	.8237,	.6815,	.8030,	.7612,	.8977,	.9427,	.8481,	.8105,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
1,	.2346,	.1379,	.1690,	.1342,	.1418,	.1285,	.1437,	.0461,	.0624,	.1045,	.0710,
2,	.8307,	.9095,	.8986,	.8755,	.9147,	.7739,	.8577,	.7890,	.5778,	.5985,	.6551,
3,	1.0540,	.9036,	1.1594,	1.0947,	.9933,	.9724,	.8718,	1.0471,	.9579,	.7807,	.9286,
4,	.9606,	.9413,	.8571,	1.0460,	.9033,	.8896,	.9435,	1.0308,	.9803,	.7021,	.9044,
5,	.8969,	.7323,	.8062,	.7755,	.7842,	.8504,	.8162,	.9300,	.8946,	.7521,	.8589,
6,	.8144,	.9346,	.7920,	.9132,	.5517,	.9405,	.8279,	.9862,	.9398,	.8675,	.9312,
7,	.8231,	.8978,	.7289,	.8291,	.7615,	1.0521,	.8992,	1.0799,	1.0617,	.7893,	.9770,
8,	.9578,	.9172,	.8165,	.9996,	.6233,	1.0281,	.9165,	.9561,	1.1943,	1.1756,	1.1087,
9,	.6728,	.8682,	.7038,	.7366,	2.2492,	.4984,	1.0042,	.8411,	.7904,	.9658,	.8658,
10,	.9330,	.9041,	.5781,	.7922,	.9405,	.7673,	.7255,	.7803,	.9847,	.9592,	.9081,
+gp,	.9330,	.9041,	.5781,	.7922,	.9405,	.7673,	.7255,	.7803,	.9847,	.9592,	
FBAR 2- 8,	.9054,	.8909,	.8655,	.9334,	.7903,	.9296,	.8761,	.9741,	.9438,	.8094,	

Table 3.4.3

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 19:18:30

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1963,	1964,	1965,
AGE			
1,	195108,	374091,	415441,
2,	123043,	85513,	164718,
3,	25892,	50953,	41378,
4,	10736,	13961,	21933,
5,	8439,	5591,	7532,
6,	3116,	4386,	2842,
7,	605,	1453,	1946,
8,	1000,	422,	648,
9,	58,	373,	238,
10,	18,	35,	221,
+gp,	0,	11,	23,
TOTAL,	368014,	536790,	656921,

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	506865,	488814,	194597,	209056,	781980,	910985,	173681,	319696,	263657,	486407,
2,	176070,	215533,	212397,	83531,	91960,	314839,	379286,	75471,	126243,	108037,
3,	72517,	71595,	92370,	79297,	39829,	36331,	91458,	109724,	26527,	39501,
4,	16654,	30138,	26907,	34356,	33889,	14704,	13099,	28756,	36976,	10595,
5,	9649,	8039,	14486,	10817,	15723,	15676,	5927,	5583,	10811,	15956,
6,	4007,	4842,	3622,	6362,	4725,	7175,	6409,	2386,	2575,	4667,
7,	1467,	2124,	2178,	1686,	2589,	2274,	3432,	2351,	950,	1239,
8,	998,	770,	936,	996,	849,	1250,	1053,	1289,	966,	381,
9,	261,	482,	309,	486,	434,	506,	609,	309,	613,	433,
10,	149,	100,	270,	116,	265,	187,	208,	146,	180,	202,
+gp,	219,	42,	58,	195,	107,	226,	33,	403,	415,	132,
TOTAL,	788856,	822480,	548130,	426899,	972351,	1304152,	675194,	546115,	469914,	667551,

Table 3.4.3 (Continued)

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 19:18:30

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	246650,	839038,	487662,	525055,	898961,	314491,	617990,	323656,	592335,	152125,
2,	196183,	106990,	326453,	199191,	212570,	361964,	127717,	232919,	128179,	222749,
3,	36558,	54065,	32483,	82532,	63392,	61898,	96408,	35185,	55315,	34562,
4,	14046,	12080,	19495,	10068,	24870,	18433,	17477,	21770,	8285,	15478,
5,	4455,	5400,	5714,	7420,	4592,	9218,	6931,	5652,	7057,	2925,
6,	6220,	2072,	2346,	1961,	3003,	1981,	3821,	2529,	2067,	2668,
7,	1951,	2314,	940,	918,	962,	1307,	912,	1260,	933,	770,
8,	608,	761,	859,	399,	391,	339,	523,	359,	493,	368,
9,	135,	379,	287,	320,	184,	138,	154,	207,	103,	177,
10,	148,	50,	72,	97,	119,	84,	54,	55,	88,	30,
+gp,	100,	181,	87,	39,	53,	47,	31,	45,	38,	51,
TOTAL,	507052,	1023330,	876401,	828000,	1209098,	769900,	872018,	623638,	794892,	431905,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
1,	706392,	276774,	193724,	276670,	133651,	168648,	311647,	159376,	398862,	247588,	0,	3454
2,	62431,	251037,	108344,	73514,	108700,	52116,	66643,	121285,	68385,	168379,	100212,	1431
3,	58346,	19170,	71246,	31085,	21585,	30688,	16939,	19919,	38828,	27040,	65220,	454
4,	10205,	15837,	6048,	17404,	8102,	6226,	9039,	5517,	5444,	11603,	9647,	151
5,	5608,	3197,	5058,	2102,	5006,	2688,	2094,	2880,	1611,	1672,	4707,	61
6,	1162,	1873,	1259,	1849,	792,	1871,	940,	758,	930,	539,	645,	26
7,	1060,	422,	602,	467,	608,	374,	598,	336,	231,	298,	185,	11
8,	303,	381,	141,	238,	167,	232,	107,	199,	94,	66,	111,	4
9,	147,	95,	125,	51,	72,	73,	68,	35,	63,	23,	17,	1
10,	77,	61,	33,	50,	20,	6,	36,	20,	12,	23,	7,	
+gp,	36,	22,	42,	20,	7,	18,	19,	26,	28,	9,	10,	
TOTAL,	845767,	568870,	386621,	403449,	278709,	262940,	408130,	310352,	514489,	457240,	180761,	

Table 3.5.1 COD in IIIa, IV, VIId. RCT3 INPUT VALUES; AGE 1(millions) 9 Oct 1996

Yearclass	'VPA'	'IYFS1'	'EGFS0'	'EGFS1'	'SGFS1'	'GGFSQ1'	'GGFSQ4'
1970	911	9830	-1	-1	-1	-1	-1
1971	174	410	-1	-1	-1	-1	-1
1972	320	3800	-1	-1	-1	-1	-1
1973	264	1470	-1	-1	-1	-1	-1
1974	486	4030	-1	-1	-1	-1	-1
1975	247	790	-1	-1	-1	-1	-1
1976	839	3670	-1	6270	-1	-1	-1
1977	488	1290	1389	2284	-1	-1	-1
1978	525	990	1256	2423	-1	-1	-1
1979	899	1690	1855	5084	-1	-1	-1
1980	314	290	1023	1136	-1	-1	-1
1981	618	920	7424	3237	614	-1	678
1982	324	390	255	1540	325	303	66
1983	592	1520	9510	6122	819	566	406
1984	152	90	38	430	66	2	10
1985	706	1700	828	3438	801	725	197
1986	277	880	121	1422	219	242	21
1987	194	360	38	836	162	20	3
1988	277	1310	1678	2285	561	148	2
1989	134	340	598	608	114	31	1
1990	169	240	383	752	303	34	35
1991	312	1300	4840	2440	642	-1	-1
1992	159	1270	1684	742	347	-1	1
1993	-1	1480	377	2637	1158	8	-1
1994	-1	970	2134	1028	475	133	32
1995	-1	370	26	619	318	41	20
1996	-1	-1	4122	-1	-1	-1	-1

Table 3.5.2

Analysis by RCT3 ver3.1 of data from file :

codiv1b.rct

COD IV "RCT3 RESULTS; AGE 1(millions) Run 9 Oct 1996"

Data for 6 surveys over 27 years : 1970 - 1996

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

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

Forecast/Hindcast variance correction used.

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
IYFS1	1.00	-.87	.74	.403	23	5.92	5.03	.883	.048
EGFS0	.68	1.19	1.10	.233	16	3.30	3.42	1.491	.017
EGFS1	.78	-.06	.24	.862	17	6.43	4.96	.300	.415
SGFS1	.91	.33	.48	.598	12	5.77	5.56	.573	.113
GGFSQ1	.38	3.86	.37	.744	9	3.74	5.29	.474	.166
GGFSQ4	.35	4.55	.45	.666	11	3.04	5.62	.540	.128
					VPA Mean =		5.59	.574	.113

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
IYFS1									
EGFS0	.70	1.03	1.16	.210	16	8.32	6.83	1.468	.127
EGFS1									
SGFS1									
GGFSQ1									
GGFSQ4									
					VPA Mean =		5.55	.560	.873

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	183	5.21	.19	.15	.60		
1996	302	5.71	.52	.43	.67		

Table 3.6.1

Run title : Cod in IV,IIIa,VIId (run: XSATIM01/X01)

At 9-Oct-96 19:18:30

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 8,
1963,	195108,	452115,	151517,	116457,	.7686,	.4734,
1964,	374091,	542257,	166129,	126041,	.7587,	.4933,
1965,	415441,	714023,	205376,	181036,	.8815,	.5459,
1966,	506865,	859771,	230735,	221336,	.9593,	.5146,
1967,	488814,	923782,	250048,	252977,	1.0117,	.6125,
1968,	194597,	788676,	258248,	288368,	1.1166,	.6156,
1969,	209056,	630841,	255985,	200760,	.7843,	.5739,
1970,	781980,	973125,	276932,	226124,	.8165,	.5511,
1971,	910985,	1180429,	277326,	328098,	1.1831,	.6693,
1972,	173681,	809898,	231112,	353976,	1.5316,	.8242,
1973,	319696,	656137,	209226,	239051,	1.1425,	.6913,
1974,	263657,	623693,	231014,	214279,	.9276,	.6580,
1975,	486408,	705026,	211945,	205245,	.9684,	.7070,
1976,	246650,	611040,	182555,	234169,	1.2827,	.7028,
1977,	839037,	822620,	159911,	209154,	1.3079,	.7070,
1978,	487662,	812539,	159805,	297022,	1.8586,	.8237,
1979,	525055,	804579,	164591,	269973,	1.6403,	.6815,
1980,	898961,	1014677,	182039,	293644,	1.6131,	.8030,
1981,	314491,	854186,	195519,	335497,	1.7159,	.7612,
1982,	617990,	838461,	189446,	303251,	1.6007,	.8977,
1983,	323656,	646293,	153489,	259287,	1.6893,	.9427,
1984,	592335,	712412,	131013,	228286,	1.7425,	.8481,
1985,	152125,	492169,	122364,	212925,	1.7401,	.8105,
1986,	706392,	666849,	110425,	196147,	1.7763,	.9054,
1987,	276775,	554848,	100728,	209596,	2.0808,	.8909,
1988,	193724,	412341,	95200,	176432,	1.8533,	.8655,
1989,	276670,	415313,	89698,	139859,	1.5592,	.9334,
1990,	133651,	327383,	77127,	125285,	1.6244,	.7903,
1991,	168648,	294991,	70168,	102487,	1.4606,	.9296,
1992,	311647,	404991,	67463,	114026,	1.6902,	.8761,
1993,	159376,	345446,	63077,	121930,	1.9330,	.9741,
1994,	398862,	475487,	63302,	110560,	1.7466,	.9438,
1995,	247588,	480483,	74684,	138764,	1.8580,	.8094,
Arith. Mean ,	399748,	662027,	163885,	213092,	1.4128,	.7523,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 3.7.1

Cod in Fishing Areas IV, Skagerrak and VIId

Prediction with management option table: Input data

Year: 1996								
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	183000.00	0.8000	0.0100	0.0000	0.0000	0.691	0.0867	0.691
2	100212.00	0.3500	0.0500	0.0000	0.0000	1.076	0.6426	1.076
3	65220.000	0.2500	0.2300	0.0000	0.0000	2.292	0.8271	2.292
4	9647.000	0.2000	0.6200	0.0000	0.0000	4.303	0.8120	4.303
5	4707.000	0.2000	0.8600	0.0000	0.0000	6.638	0.7577	6.638
6	645.000	0.2000	1.0000	0.0000	0.0000	8.381	0.8145	8.381
7	185.000	0.2000	1.0000	0.0000	0.0000	9.800	0.8723	9.800
8	111.000	0.2000	1.0000	0.0000	0.0000	10.757	0.9426	10.757
9	17.000	0.2000	1.0000	0.0000	0.0000	12.638	0.7413	12.638
10	7.000	0.2000	1.0000	0.0000	0.0000	13.327	0.7522	13.327
11+	10.000	0.2000	1.0000	0.0000	0.0000	14.140	0.7522	14.140
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	302000.00	0.8000	0.0100	0.0000	0.0000	0.691	0.0867	0.691
2	.	0.3500	0.0500	0.0000	0.0000	1.076	0.6426	1.076
3	.	0.2500	0.2300	0.0000	0.0000	2.292	0.8271	2.292
4	.	0.2000	0.6200	0.0000	0.0000	4.303	0.8120	4.303
5	.	0.2000	0.8600	0.0000	0.0000	6.638	0.7577	6.638
6	.	0.2000	1.0000	0.0000	0.0000	8.381	0.8145	8.381
7	.	0.2000	1.0000	0.0000	0.0000	9.800	0.8723	9.800
8	.	0.2000	1.0000	0.0000	0.0000	10.757	0.9426	10.757
9	.	0.2000	1.0000	0.0000	0.0000	12.638	0.7413	12.638
10	.	0.2000	1.0000	0.0000	0.0000	13.327	0.7522	13.327
11+	.	0.2000	1.0000	0.0000	0.0000	14.140	0.7522	14.140
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	257000.00	0.8000	0.0100	0.0000	0.0000	0.691	0.0867	0.691
2	.	0.3500	0.0500	0.0000	0.0000	1.076	0.6426	1.076
3	.	0.2500	0.2300	0.0000	0.0000	2.292	0.8271	2.292
4	.	0.2000	0.6200	0.0000	0.0000	4.303	0.8120	4.303
5	.	0.2000	0.8600	0.0000	0.0000	6.638	0.7577	6.638
6	.	0.2000	1.0000	0.0000	0.0000	8.381	0.8145	8.381
7	.	0.2000	1.0000	0.0000	0.0000	9.800	0.8723	9.800
8	.	0.2000	1.0000	0.0000	0.0000	10.757	0.9426	10.757
9	.	0.2000	1.0000	0.0000	0.0000	12.638	0.7413	12.638
10	.	0.2000	1.0000	0.0000	0.0000	13.327	0.7522	13.327
11+	.	0.2000	1.0000	0.0000	0.0000	14.140	0.7522	14.140
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANWOL01
Date and time: 10OCT96:16:14

Table 3.7.2 Input to sensitivity analysis

COD 347D

1 11 1996 3

1 0 0

'N1'	183000	0.57	'WH1'	0.691	0.03	'M1'	0.8	0.1	'R97'	302000	0.57
'N2'	100212	0.12	'WH2'	1.076	0.04	'M2'	0.35	0.1	'R98'	257000	0.56
'N3'	65220	0.09	'WH3'	2.292	0.09	'M3'	0.25	0.1	'HF96'	1	0.07
'N4'	9647	0.07	'WH4'	4.303	0.05	'M4'	0.2	0.1	'HF97'	1	0.07
'N5'	4707	0.08	'WH5'	6.638	0.08	'M5'	0.2	0.1	'HF98'	1	0.07
'N6'	645	0.08	'WH6'	8.381	0.05	'M6'	0.2	0.1	'K96'	1	0.1
'N7'	185	0.09	'WH7'	9.8	0.04	'M7'	0.2	0.1	'K97'	1	0.1
'N8'	111	0.1	'WH8'	10.757	0.06	'M8'	0.2	0.1	'K98'	1	0.1
'N9'	17	0.15	'WH9'	12.638	0.06	'M9'	0.2	0.1			
'N10'	6	0.19	'WH10'	13.327	0.06	'M10'	0.2	0.1			
'N11'	10	0.21	'WH11'	14.14	0.08	'M11'	0.2	0.1			
'sH1'	0.087	0.46	'WS1'	0.691	0.03	'MT1'	0.01	0.1			
'sH2'	0.643	0.17	'WS2'	1.076	0.04	'MT2'	0.05	0.1			
'sH3'	0.827	0.04	'WS3'	2.292	0.09	'MT3'	0.23	0.1			
'sH4'	0.812	0.09	'WS4'	4.303	0.05	'MT4'	0.62	0.1			
'sH5'	0.758	0.02	'WS5'	6.638	0.08	'MT5'	0.86	0.1			
'sH6'	0.814	0.05	'WS6'	8.381	0.05	'MT6'	1	0.1			
'sH7'	0.872	0.07	'WS7'	9.8	0.04	'MT7'	1	0			
'sH8'	0.943	0.16	'WS8'	10.757	0.06	'MT8'	1	0			
'sH9'	0.741	0.29	'WS9'	12.638	0.06	'MT9'	1	0			
'sH10'	0.752	0.17	'WS10'	13.327	0.06	'MT10'	1	0			
'sH11'	0.752	0.17	'WS11'	14.14	0.08	'MT11'	1	0			

Table 3.7.3

14:47 Thursday, October 10, 1996

Cod in Fishing Areas IV, Skagerrak and VIId

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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	0.8098	465325	102505	167946	0.0000	0.0000	512451	123736	0	732285	259878
.	.	.	.	.	0.1000	0.0810	.	123736	21148	700992	240690
.	.	.	.	.	0.2000	0.1620	.	123736	40860	671939	222968
.	.	.	.	.	0.3000	0.2429	.	123736	59240	644959	206599
.	.	.	.	.	0.4000	0.3239	.	123736	76387	619898	191480
.	.	.	.	.	0.5000	0.4049	.	123736	92390	596613	177514
.	.	.	.	.	0.6000	0.4859	.	123736	107333	574971	164612
.	.	.	.	.	0.7000	0.5669	.	123736	121293	554851	152693
.	.	.	.	.	0.8000	0.6479	.	123736	134343	536141	141682
.	.	.	.	.	0.9000	0.7288	.	123736	146547	518734	131508
.	.	.	.	.	1.0000	0.8098	.	123736	157967	502535	122107
.	.	.	.	.	1.1000	0.8908	.	123736	168661	487454	113420
.	.	.	.	.	1.2000	0.9718	.	123736	178680	473409	105393
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANWOL01
Date and time : 10OCT96:16:19
Computation of ref. F: Simple mean, age 2 - 8
Basis for 1996 : F factors

Table 3.7.4

Table : Cod in North Sea, Skagerrak and Eastern Channel
Catch forecast output

	Year							
	1996	1997						
Mean F Ages								
H. cons. TOT 2 to 8	0.81	0.00	0.32	0.49	0.57	0.65	0.81	0.97
H. cons. IV 2 to 8	0.71	0.00	0.28	0.43	0.50	0.57	0.71	0.85
H. cons. IIIa 2 to 8	0.09	0.00	0.04	0.06	0.07	0.08	0.09	0.11
H. cons. VIId 2 to 8	0.005	0.00	0.002	0.003	0.004	0.004	0.005	0.006
Effort relative to 1995								
H. cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	465	513	513	513	513	513	513	513
Spawning	103	124	124	124	124	124	124	124
Catch Weight ('000t)								
H. cons. IV	144	0	66	93	105	116	136	154
H. cons. IIIa	22	0	11	15	15	17	19	24
H. cons. VIId	3	0	1	2	2	3	3	4
Total Landings	169	0	77	108	122	135	159	180
Total Catch	169	0	77	108	122	135	159	180
Biomass at start of 1998								
Total		732	620	575	555	536	503	474
Spawning		260	192	165	153	142	122	106

Table 3.7.4 (Continued)

Forecast for year 1996
F multiplier H.cons = 1

	Populations	Catch number			
Age	Stock No.	IV	VIId	IIIa	Total
1	183000	9007	942	570	10519
2	100212	35458	680	4692	40831
3	65220	27900	339	4785	33024
4	9647	4166	40	721	4927
5	4707	1973	18	304	2295
6	645	297	2	31	330
7	185	89	0	10	99
8	111	57	0	5	62
9	17	8	0	1	8
10	7	3	0	0	3
11+	10	5	0	0	6
Wt	465.383766	144	3	22	169

Forecast for year 1997
F multiplier H.cons=1.00

	Populations	Catch number			
Age	Stock No.	H. Cons IV	Discards IV	By-catch IV	Total
1	302000	14864	1554	941	17359
2	75400	26679	512	3531	30721
3	37141	15888	193	2725	18806
4	22214	9592	92	1661	11345
5	3507	1470	13	227	1710
6	1806	831	6	87	924
7	234	113	0	12	125
8	63	33	0	3	36
9	35	16	0	1	17
10	7	3	0	0	3
11+	11	5	0	0	5
Wt	513	136	3	19	159

Table 3.10.1 Stock: Cod in Sub-areas IIIa (Skagerrak), IV (North Sea), VIId (Eastern Channel)

Assessment Quality Control Diagram 1

Average F(2-8,u)									
Date of assessment	Year								
	1987	1988	1989	1990	1991	1992	1993	1994	1995
1989	0.83	0.80							
1990	0.86	0.83	0.83						
1991	0.89	0.88	0.98	0.75					
1992	0.89	0.89	1.00	0.78	0.93				
1993	0.89	0.88	0.95	0.72	0.85	0.86			
1994	0.91	0.89	0.99	0.71	0.92	0.84	0.94		
1995	0.91	0.89	0.99	0.72	0.93	0.86	0.91	0.85	
1996	0.89	0.87	0.93	0.79	0.93	0.88	0.97	0.94	0.81

Remarks: 1996 data refer to combined assessment for IIIa+IV+VIId, earlier data to IV only.

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: millions									
Date of assessment	Year class								
	1987	1988	1989	1990	1991	1992	1993	1994	1995
1989	193	329[1]							
1990	201	324	161[2]						
1991	142	316	140	216					
1992	143	246	137	155	345				
1993	150	257	113	150	410	199			
1994	150	242	112	143	300	165	406		
1995	151	240	112	142	281	100	465	256	
1996	194	277	134	167	312	159	399	248	183

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

Remarks: 1996 data refer to combined assessment for IIIa+IV+VIId, earlier data to IV only.

Table 3.10.1 Stock: Cod in Sub-area IV (North Sea)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)											
Date of assessment	Year										
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1989	88	91	82[1]	80[1,2]							
1990	84	85	87	78[1]	71[1]						
1991	79	73	66	64	66[1]	68[1]					
1992	79	73	62	56	51	47[1]	52[1]				
1993	82	76	65	60	64	58	62[1]	66[1]			
1994	85	76	64	62	61	57	63	69[1]	74[1]		
1995	85	76	63	62	60	57	59	78	89[1]	103[1]	
1996	95	90	77	70	67	63	63	75	103	124[1]	122[1]

[1]Forecast. Assuming status quo

Remarks : 1996 data refer to combined assessment for IIIa+IV+VIId, earlier data to IV only.

Table 3.12.1

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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	0.691	0.0867	0.691
2	.	0.3500	0.0500	0.0000	0.0000	1.076	0.6426	1.076
3	.	0.2500	0.2300	0.0000	0.0000	2.292	0.8271	2.292
4	.	0.2000	0.6200	0.0000	0.0000	4.303	0.8120	4.303
5	.	0.2000	0.8600	0.0000	0.0000	6.638	0.7577	6.638
6	.	0.2000	1.0000	0.0000	0.0000	8.381	0.8145	8.381
7	.	0.2000	1.0000	0.0000	0.0000	9.800	0.8723	9.800
8	.	0.2000	1.0000	0.0000	0.0000	10.757	0.9426	10.757
9	.	0.2000	1.0000	0.0000	0.0000	12.638	0.7413	12.638
10	.	0.2000	1.0000	0.0000	0.0000	13.327	0.7522	13.327
11+	.	0.2000	1.0000	0.0000	0.0000	14.140	0.7522	14.140
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDWOL01
Date and time: 10OCT96:16:43

Table 3.12.2

14:47 Thursday, October 10, 1996

Cod in Fishing Areas IV, Skagerrak and VIId

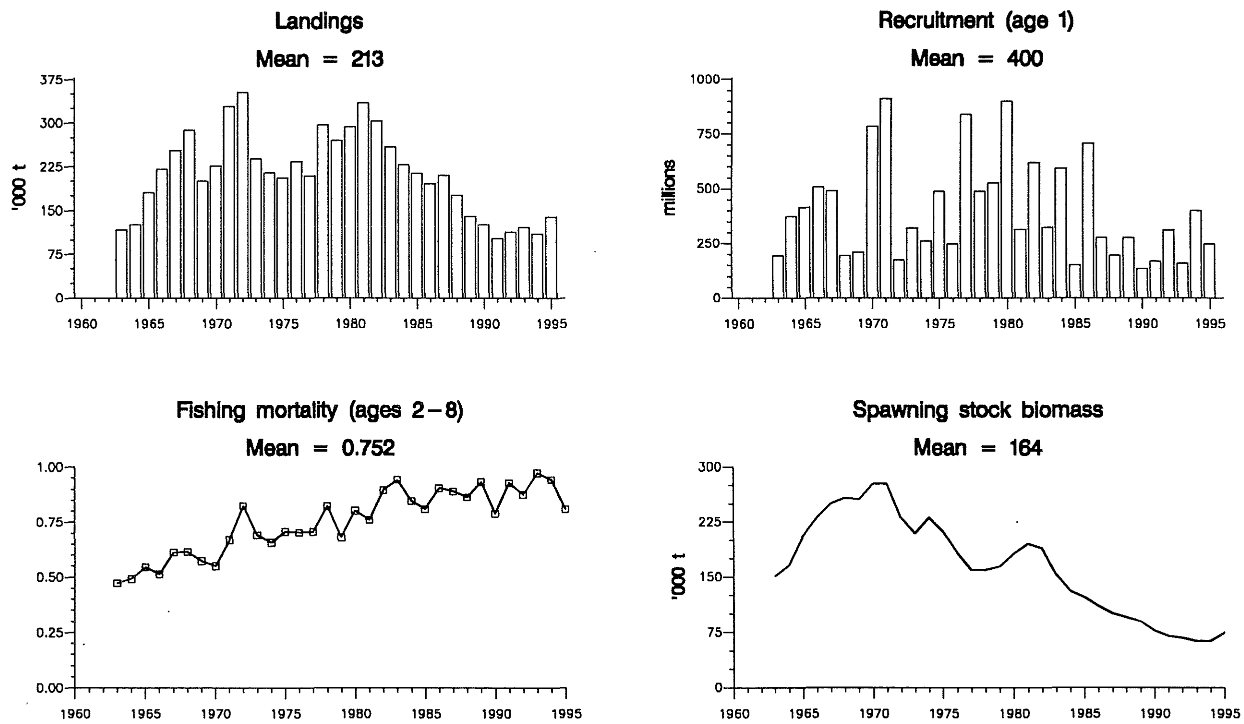
Yield per recruit: Summary table

						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	15084.382	1.344	12791.637	1.344	12791.637
0.1000	0.0810	0.111	600.624	2.603	9347.448	0.861	7195.652	0.861	7195.652
0.2000	0.1620	0.175	780.523	2.311	6519.456	0.605	4489.091	0.605	4489.091
0.3000	0.2429	0.217	818.974	2.125	4925.714	0.451	3000.422	0.451	3000.422
0.4000	0.3239	0.248	806.509	1.996	3942.041	0.350	2108.068	0.350	2108.068
0.5000	0.4049	0.272	776.513	1.900	3292.870	0.281	1538.609	0.281	1538.609
0.6000	0.4859	0.291	742.118	1.827	2841.794	0.231	1157.418	0.231	1157.418
0.7000	0.5669	0.308	708.555	1.768	2515.308	0.193	892.464	0.193	892.464
0.8000	0.6479	0.321	677.784	1.721	2271.068	0.165	702.633	0.165	702.633
0.9000	0.7288	0.334	650.372	1.681	2083.316	0.143	563.190	0.143	563.190
1.0000	0.8098	0.344	626.296	1.647	1935.655	0.125	458.598	0.125	458.598
1.1000	0.8908	0.354	605.295	1.618	1817.245	0.111	378.738	0.111	378.738
1.2000	0.9718	0.363	587.033	1.592	1720.682	0.100	316.812	0.100	316.812
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDWOL01
Date and time : 10OCT96:16:43
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.1874
F-max factor : 0.3104
F-0.1 reference F : 0.1518
F-max reference F : 0.2513
Recruitment : Single recruit

Figure 3.1.1

Cod in Fishing Areas IV, Skagerrak and VIId
9-10-1996



J:\IFAPEXIM\WGNSSK\COD_347D\FIN_VPA4.W6M

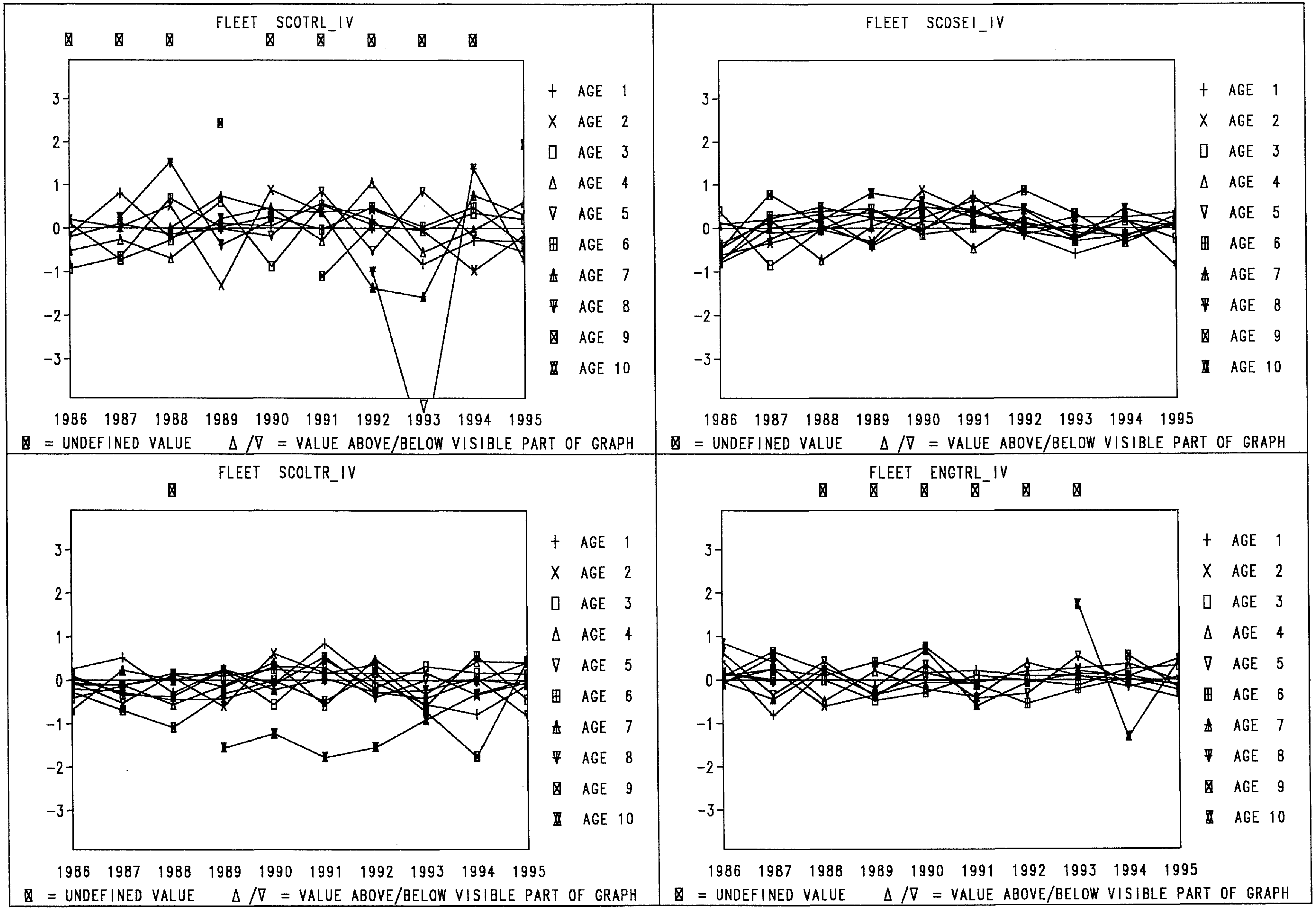

FLEET SCOTRL_IV
FLEET SCOSEI_IV
FLEET SCOLTR_IV
FLEET ENGTRL_IV
3
2
1
0
-1
-2
-3
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995
+ AGE 1
X AGE 2
AGE 3
AGE 4
AGE 5
AGE 6
AGE 7
AGE 8
AGE 9
AGE 10
= UNDEFINED VALUE
Δ /∇ = VALUE ABOVE/BELOW VISIBLE PART OF GRAPH

Figure 3.4.1

Figure 3.4.1 (Continued)

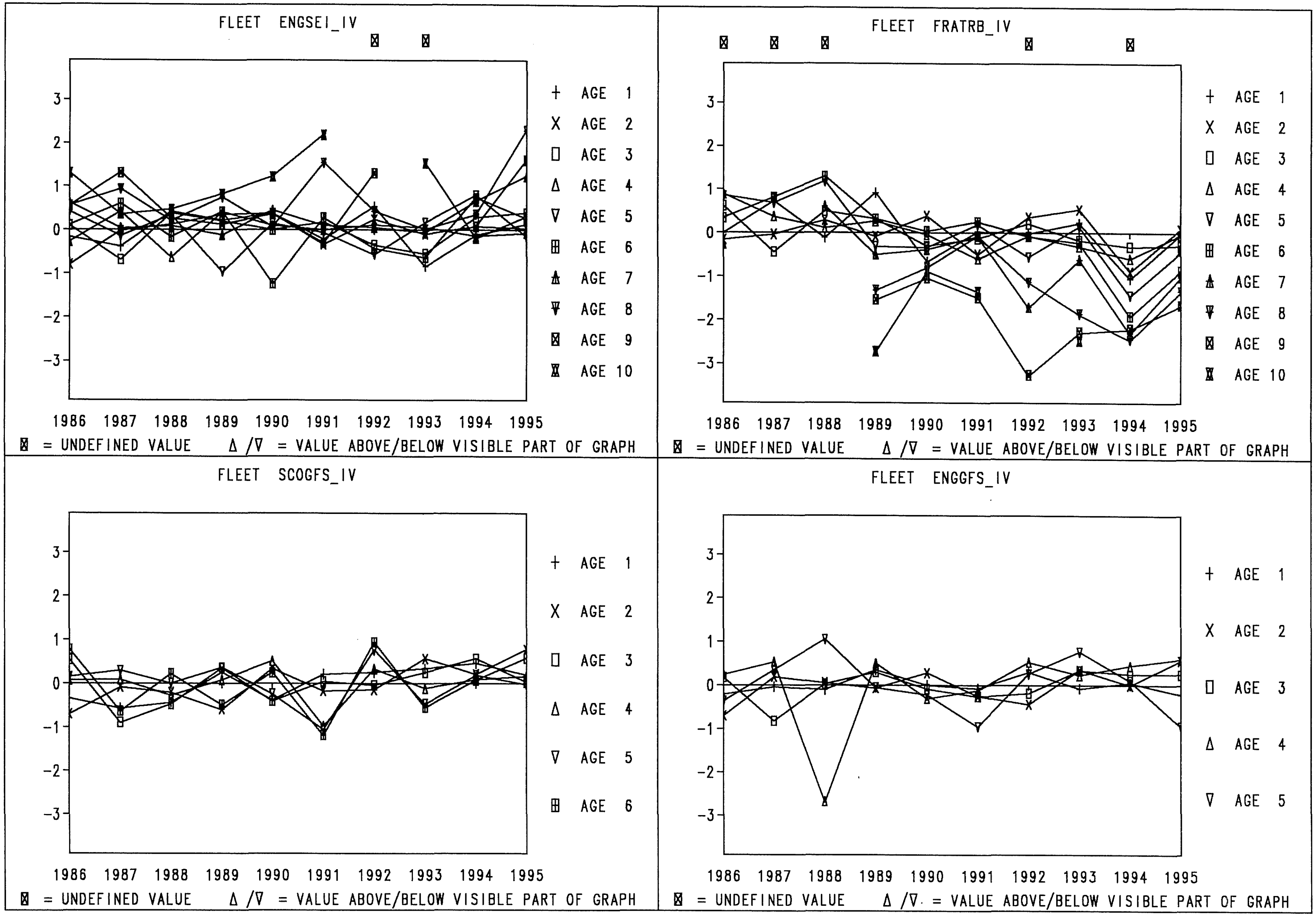
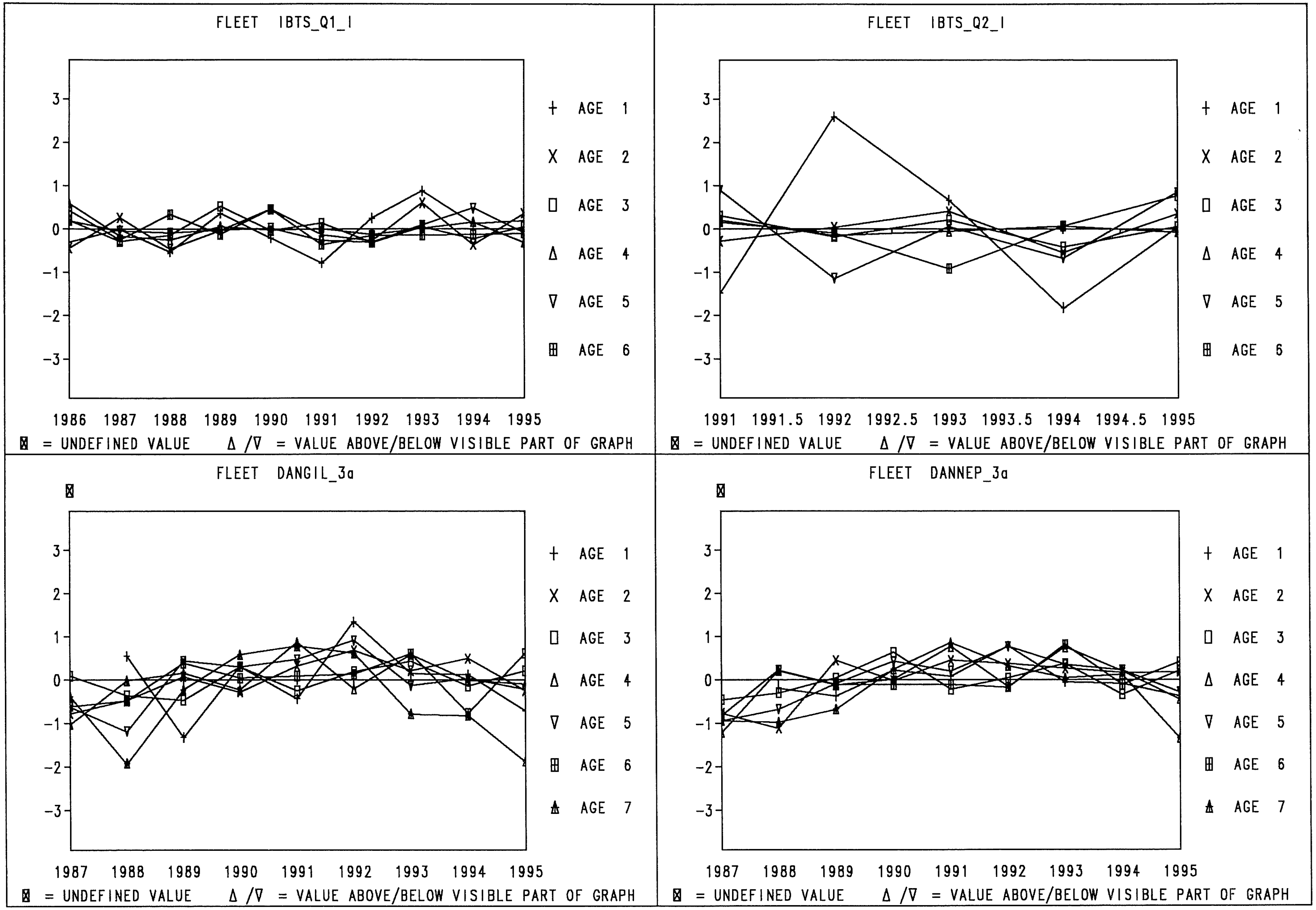


Figure 3.4.1 (Continued)



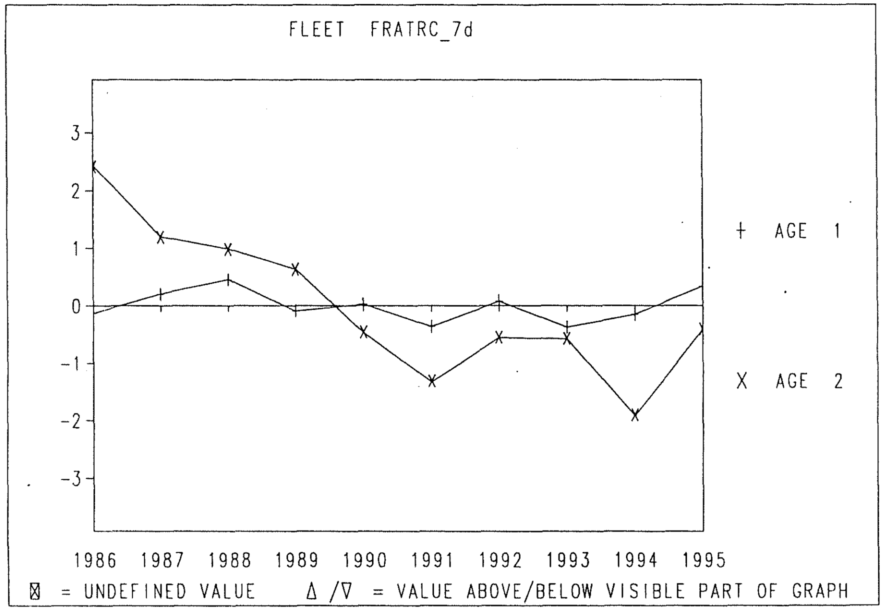


Figure 3.4.1 (Continued)

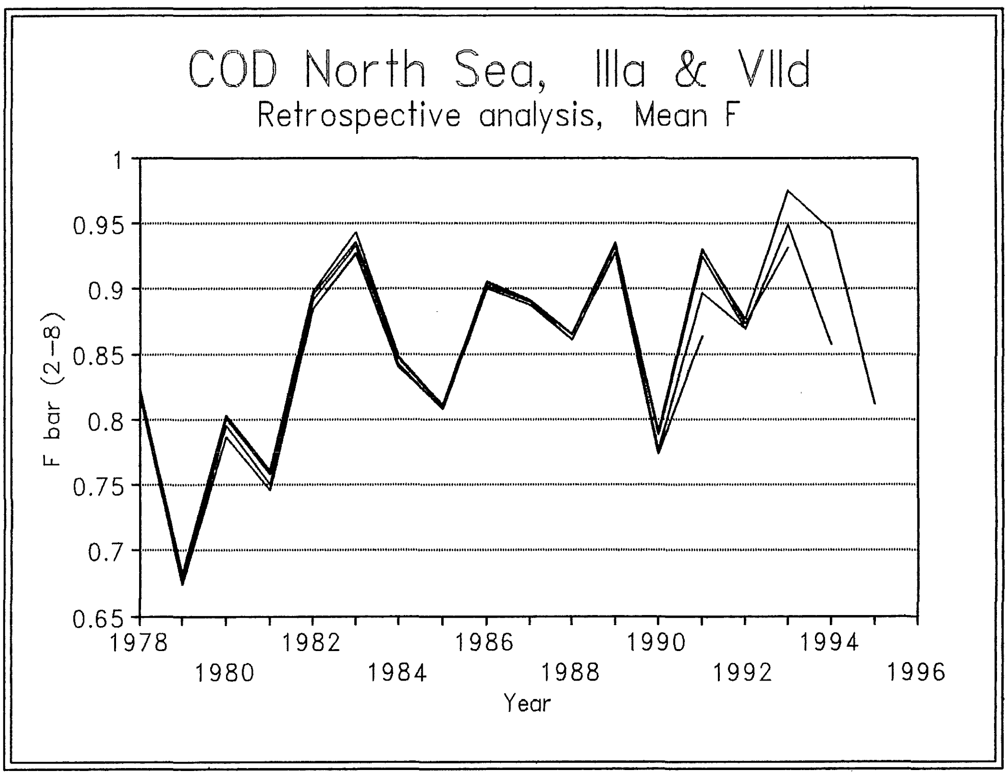

COD North Sea, IIIa & VIId
Retrospective analysis, Mean F
F bar (2-8)
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
Year

Figure 3.4.2

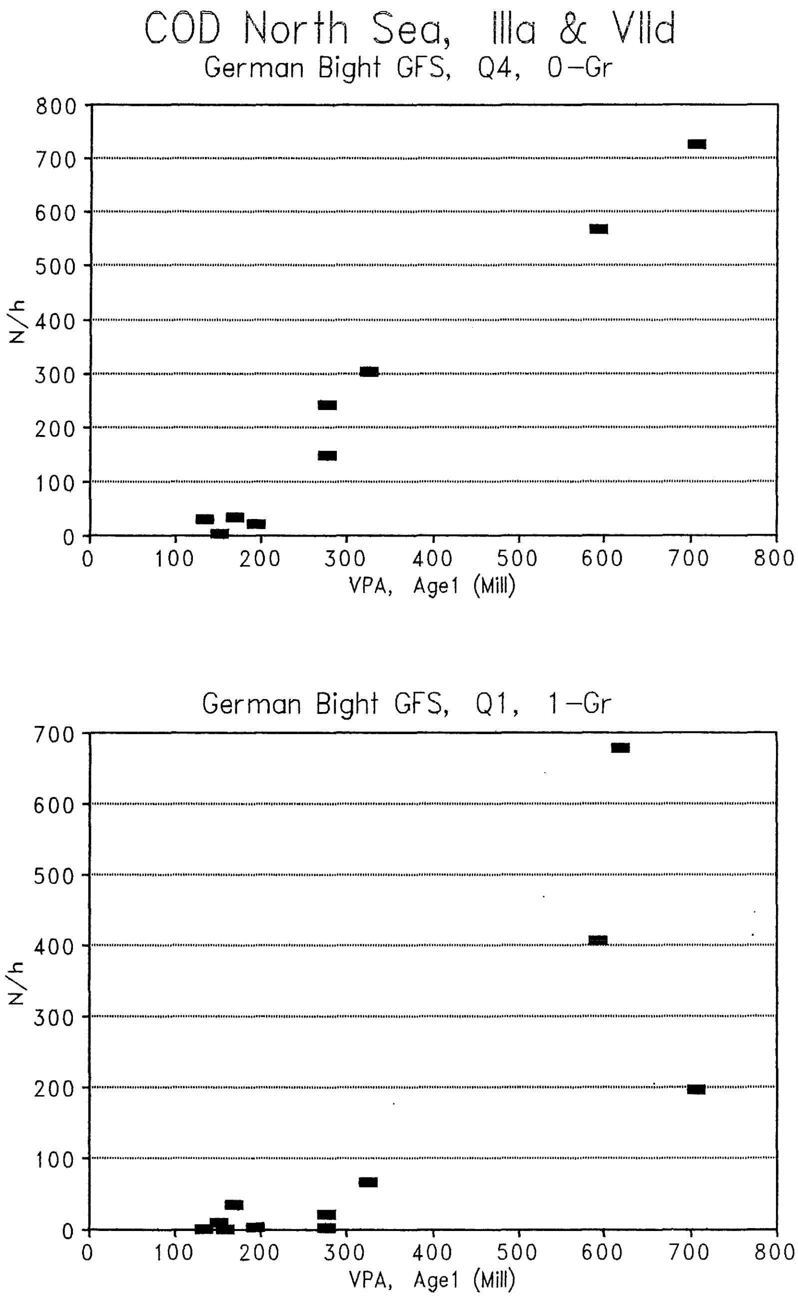
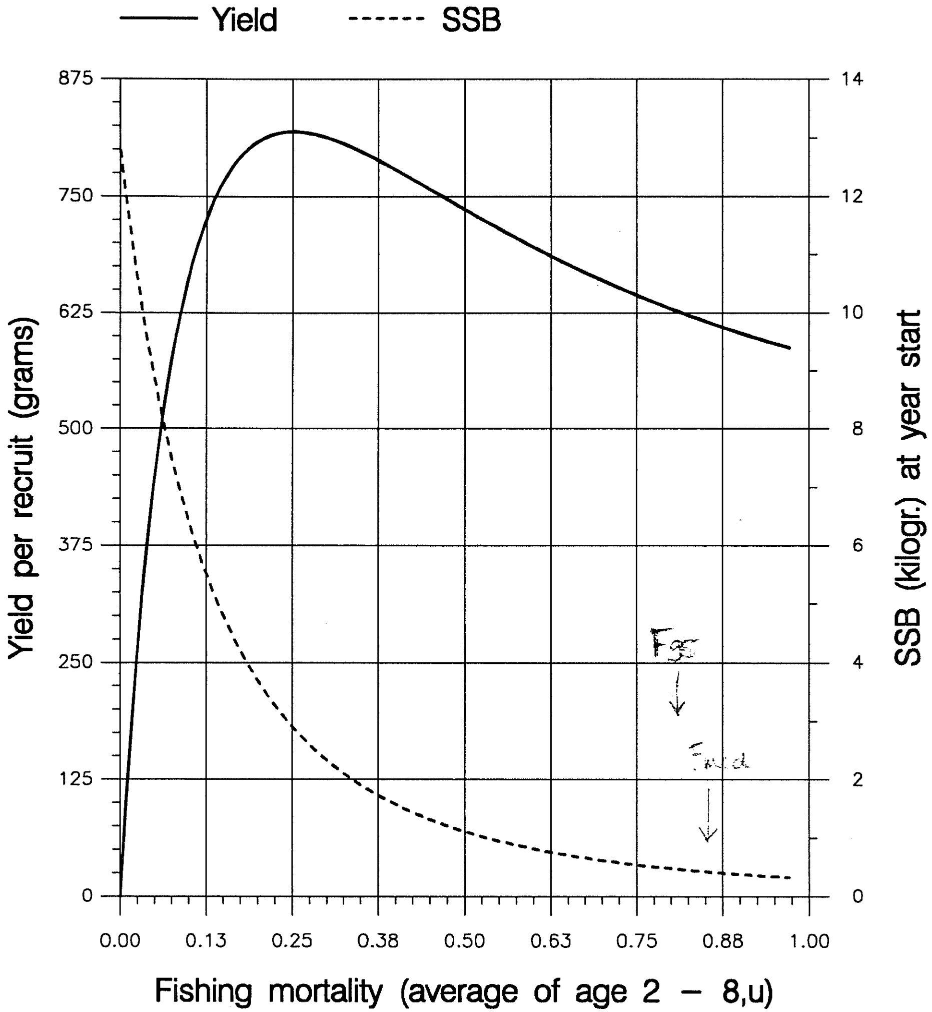

COD North Sea, IIIa & VIId
German Bight GFS, Q4, 0-Gr
N/h
VPA, Age1 (Mill)
German Bight GFS, Q1, 1-Gr
N/h
VPA, Age1 (Mill)

Figure 3.5.1

Figure 3.7.1

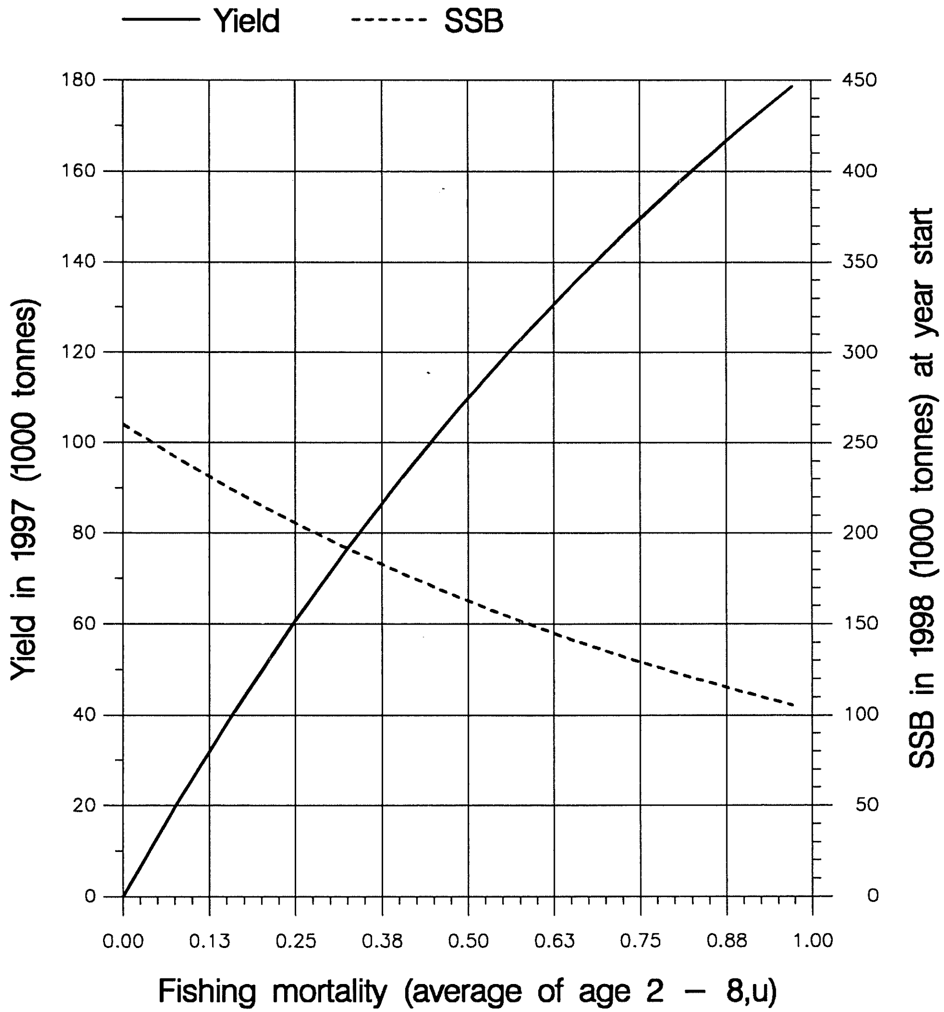
Fish Stock Summary
Cod in Fishing Areas IV, Skagerrak and VIId
10 – 10 – 1996

Long term yield and spawning stock biomass



(run: YLDWOL01) **C**

Short term yield and spawning stock biomass



(run: MANWOL01) **D**

Figure 3.7.2 COD,SKAG+NSEA+CHAN. Sensitivity analysis of short term forecast.

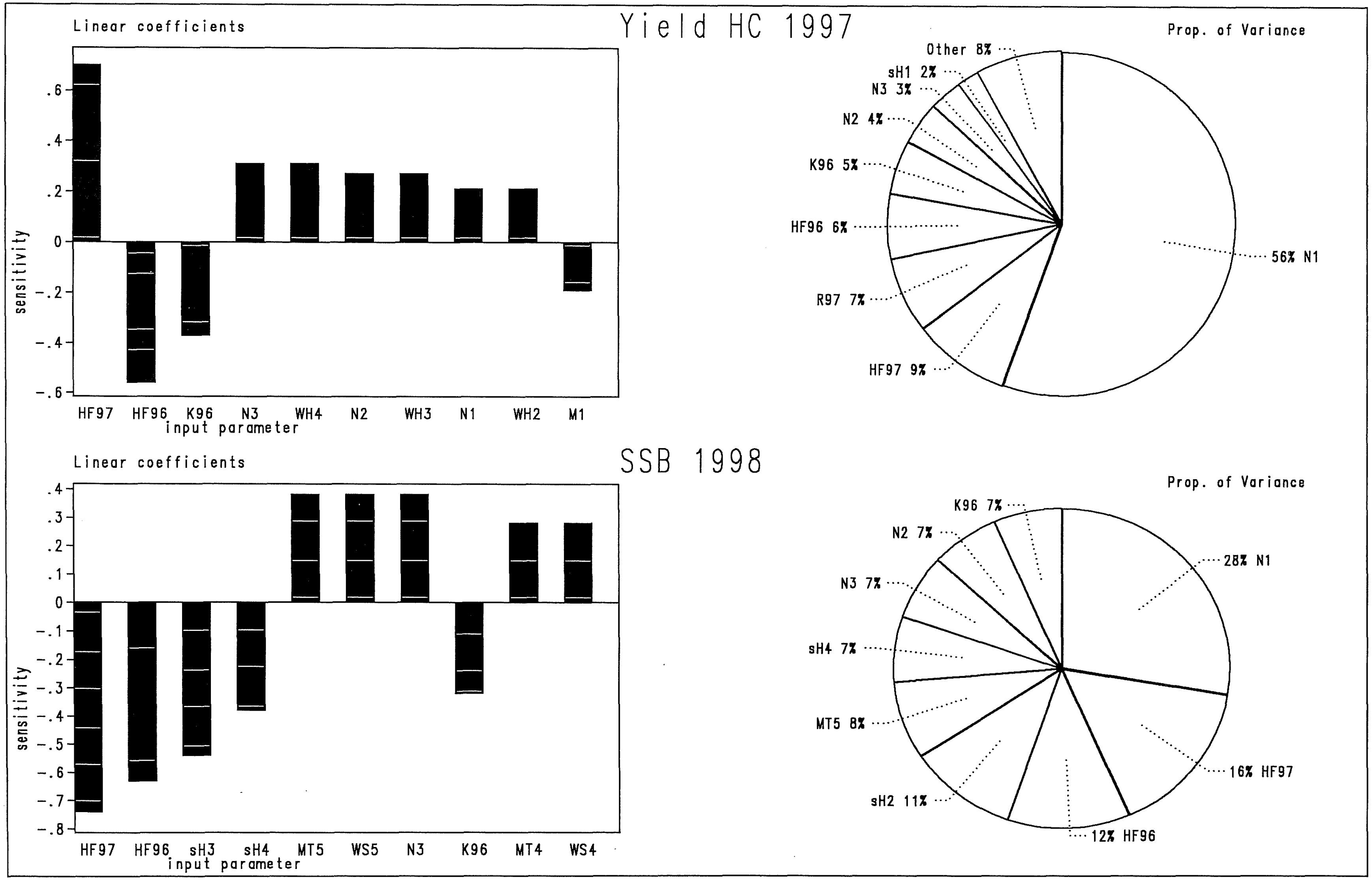
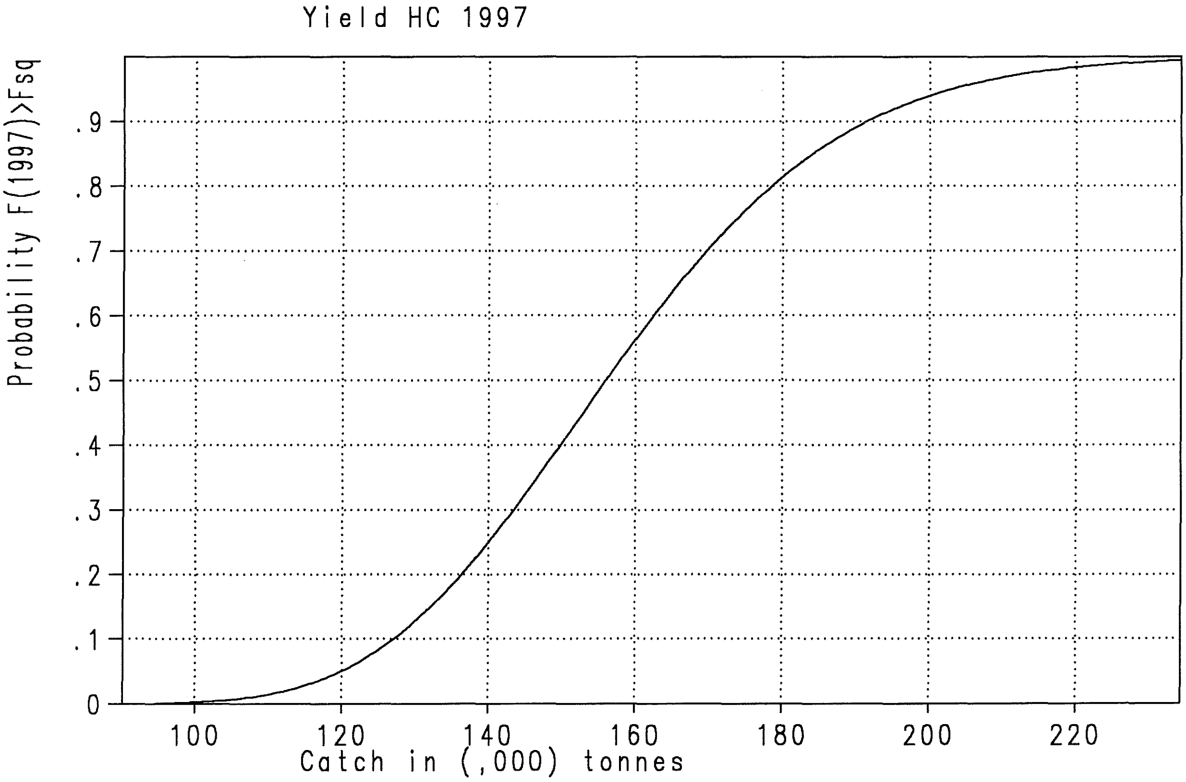


Figure 3.7.3 COD,SKAG+NSEA+CHAN. Probability profiles for short term forecast.



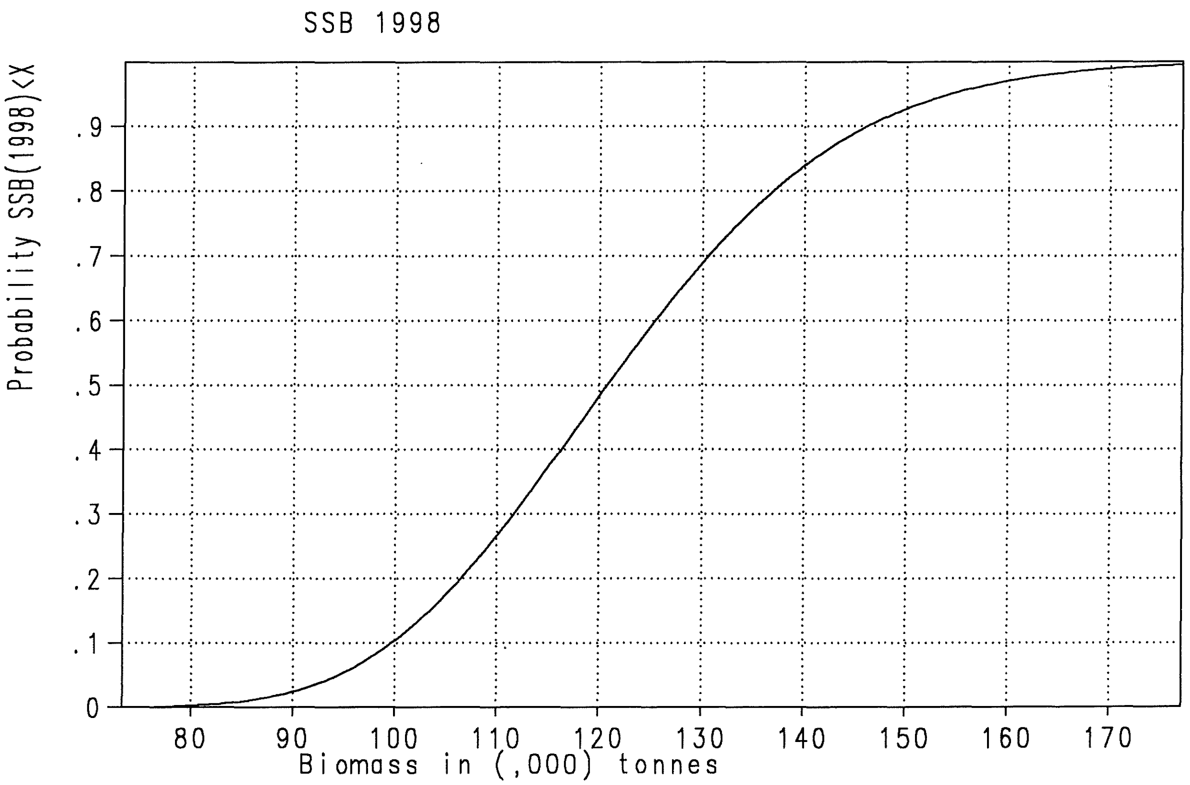


Figure 3.8.1 **North Sea Cod. Medium term projections. Solid lines show 5, 10, 20, 50 and 95 percentiles. Status quo F.**
Shepherd stock-recruitment relationship with moving average.
number of simulations 500 Relative Cons. effort = 1.00

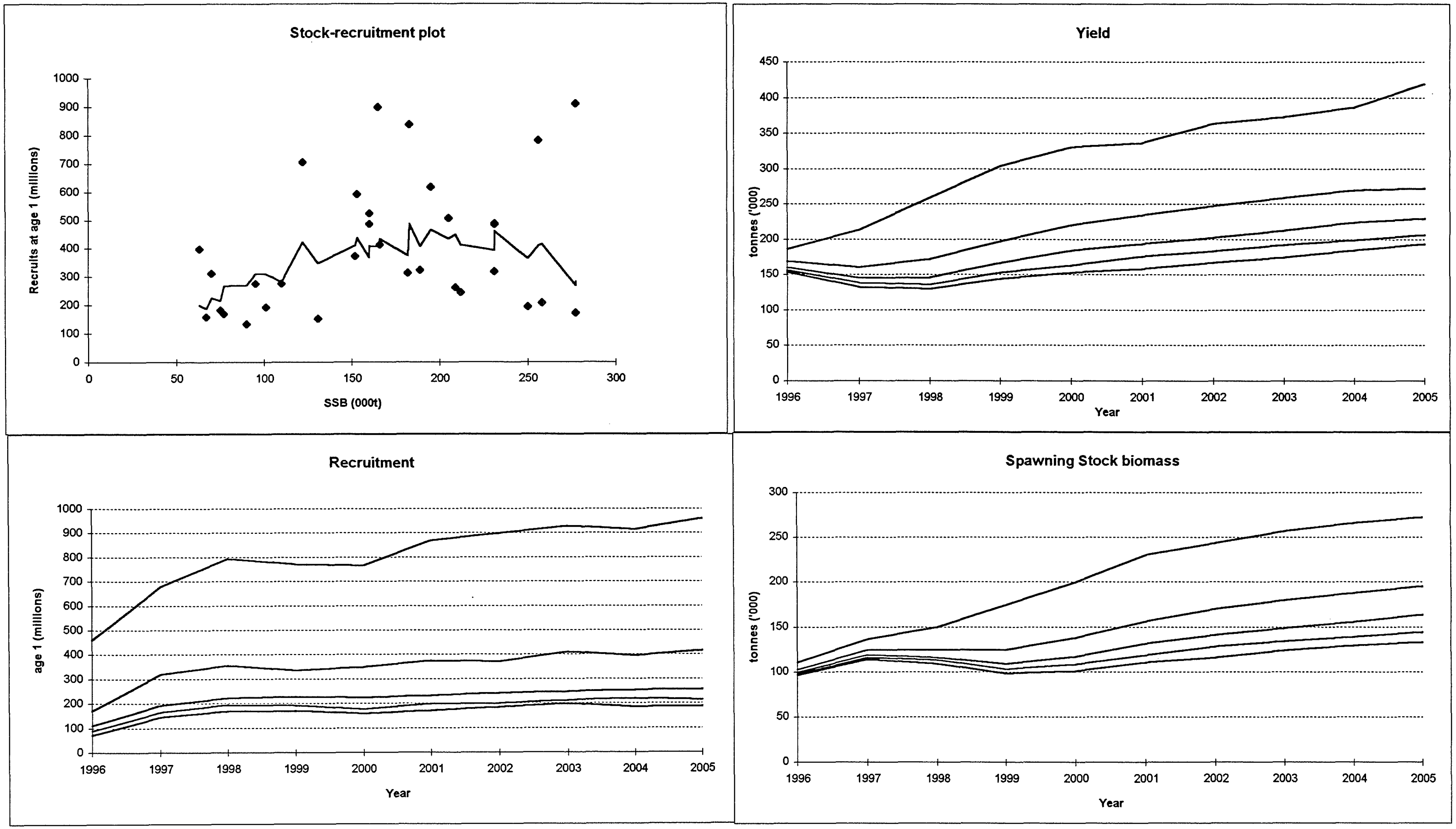


Figure 3.8.2 Cod IIIa+IV+VIId - Medium term predictions showing 5, 10, 20 percentiles of SSB in tenth year (2005) for different F-factors applied to estimated 1995 F Shepherd stock-recruitment relationship, **see Section 16.1.**
500 simulations

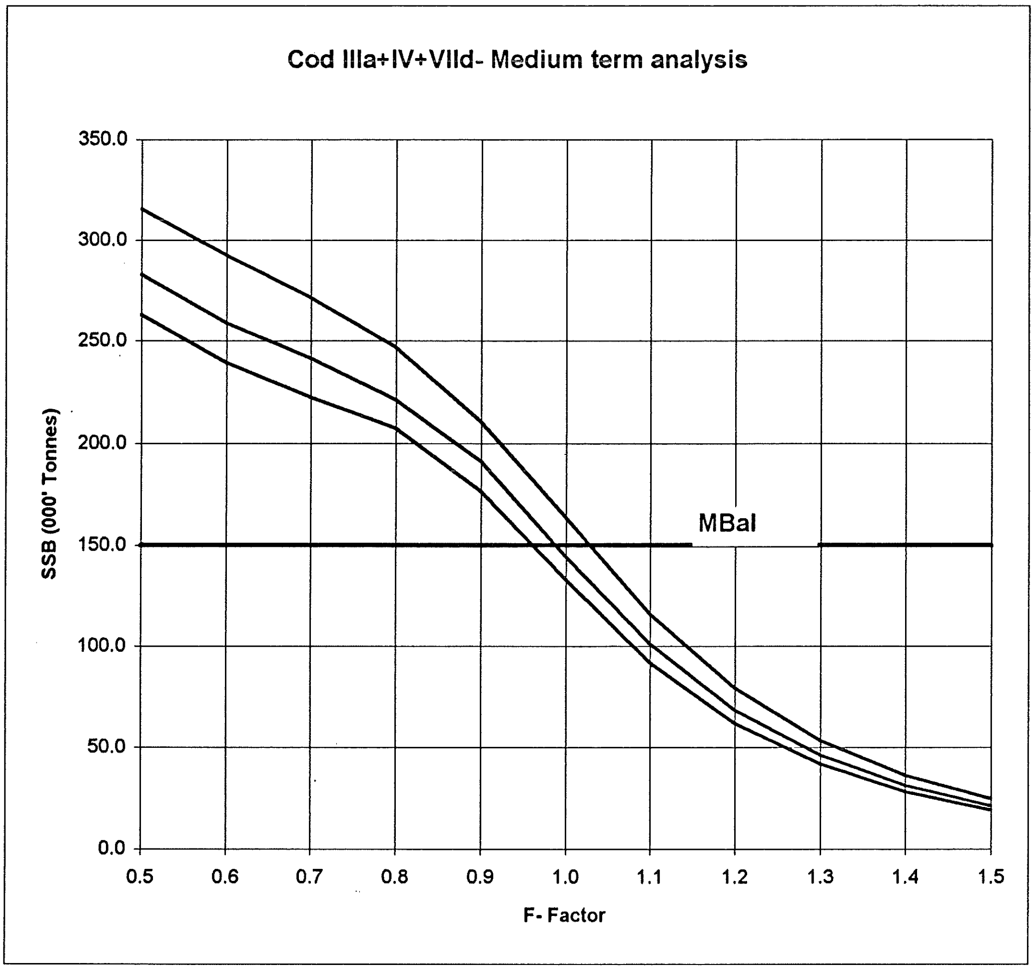
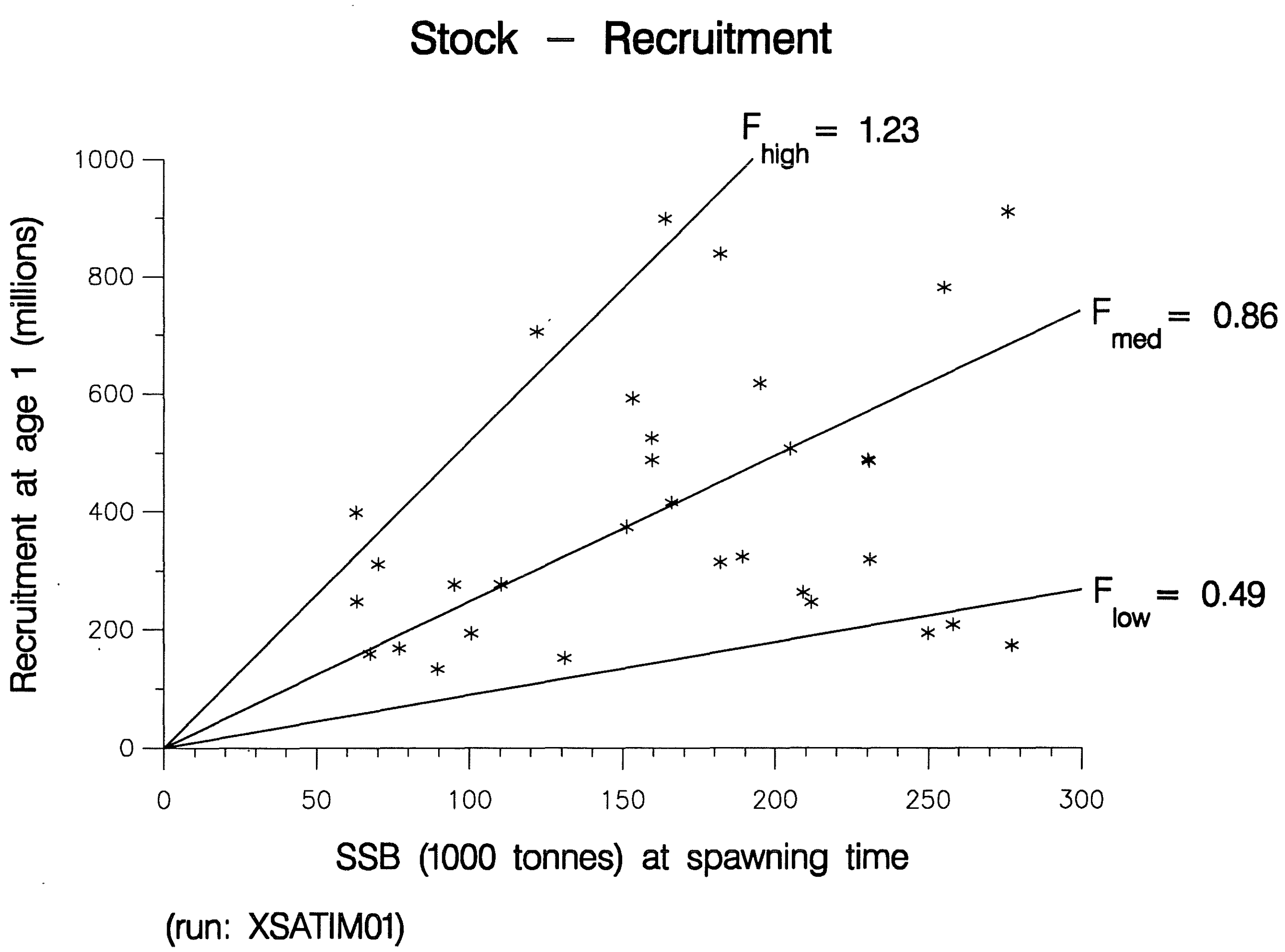


Figure 3.11.1

Cod in Fishing Areas IV, Skagerrak and VIId
9–10–1996



4 HADDOCK IN SUB-AREA IV AND DIVISION IIIA

This is the first assessment to combine the North Sea and Division IIIa haddock into a single stock. Problems with the catch-at-age data have previously prevented an analytical assessment for the Division IIIa haddock.

4.1 Catch trends

In the North Sea, Haddock is taken as part of a mixed demersal fishery, with the large majority of the catch being taken by Scottish light trawlers, seiners and pair trawlers. These gears have a minimum mesh size of 100 mm. Smaller quantities are taken by other Scottish vessels, including Nephrops trawlers which use 70 mm mesh and thus discard higher quantities. The fishery is also exploited by vessels from countries including England, Denmark and Norway. In Division IIIa, haddock are taken as a bycatch in a mixed demersal fishery, and in the industrial fishery. Landings from Division IIIa are small compared to the North Sea, amounting to between 2.5 and 6.9 % of the total catch over 1963-1995.

Nominal landings of haddock from Division IIIa for recent years are given in Table 4.1, along with Working Group estimates of landings and industrial bycatch. Table 4.2 gives the corresponding figures for haddock in the North Sea, and Table 4.3 gives the full time series of Working Group estimates for both areas.

In Division IIIa total landings during 1995 amounted to about 4.4 thousand t, with industrial bycatch accounting for about half of this total. This total is slightly below the series average but landings have been close to this level since about 1986.

In the North Sea, human consumption landings in 1995 were around 75 thousand t, which represent a slight drop compared to landings in the two preceding years which were both around 80 thousand t. The 1995 landing represents a considerable undershoot of the TAC of 120,000t. The level of discarding in 1995 was lower than in the two previous years, but the level of industrial bycatch increased relative to 1994. Misreporting is not considered to have been a problem with this stock in 1995.

As noted in Section 1.3.3, the incorporation of the catch data from Division IIIa in with the North Sea data presented a few technical problems. In particular, extending the time-series of catch-at-age data for Division IIIa back from the first year for which data were available (1981) to the first year for which data are available for the North Sea (1963) was complicated by the lack of information about the split between human consumption landings and industrial bycatch for the earlier years. Investigation indicated that the human consumption/industrial bycatch split in Division IIIa was correlated with that in the North Sea, so the latter proportion was also applied to the Division IIIa catch totals and catch-at-age data estimated accordingly. In practice this will have made very little difference to the overall catch-at-age data as the landings from Division IIIa in the 1960s and early 1970s were negligible compared with those from the North Sea. The catch-at-age data from Division IIIa also suffered from the lack of information on the age composition of the industrial bycatches in 1987-1990. To overcome this problem, age compositions for this component of the catches were estimated using age compositions from the industrial bycatch in the North Sea.

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

Natural mortality estimates are given in Table 4.4 along with the maturity ogive. The natural mortality estimates originate from MSVPA, and the maturities are based on IYFS data. These values are as used in recent assessments of the North Sea haddock stock and as such represent a change in practice for the Division IIIa component. The most recent assessment of this stock-unit used a maturity ogive implying partial maturity only at age 2 when 50% of fish were assumed mature, with M set at 0.2 for all ages and SSB calculated assuming that 25% of natural and 15% of fishing mortality occurred before spawning. This practice has also changed in the current assessment as it follows the practice in the North Sea assessment of calculating SSB at the start of the year.

For Division IIIa in 1995, 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 1995. For the North Sea catches, age composition data for the human consumption landings were supplied by Denmark, England, France and Scotland. These nations accounted for over 90% of the total landings. Industrial bycatch age compositions were supplied by Denmark and Norway. Discard totals and age compositions for the North Sea were estimated from Scottish data. No estimates of discards are available for

Division IIIa. Catch-at-age data are given in Table 4.5. 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.

One year-old fish from the 1994 year class were the most abundant in the catches in 1995, although there were also reasonably high numbers of 0 and 3 year-old fish caught. Comparison with the catches predicted in the previous assessment are not strictly valid due to the incorporation of the Division IIIa data in the current assessment, but nonetheless this comparison indicates that catches at all ages apart from 0 and 5 in 1995 are all rather lower than predicted in the last North Sea assessment. This is particularly marked at age 2 where the estimated catch in 1995 amounts to only 57% of the forecast number.

The mean weight at age data for the Division IIIa catches did not cover the most recent years and were not split by catch category, so only North Sea values have been used. Catch 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 4.6

4.3 Catch, Effort and Research Vessel data

The fleets used in tuning are listed in Table 4.7 along with the age and year ranges used in the tuning file. In practice only the last ten years of data were used in the tuning. This is discussed further in Section 4.4. Indices from the IBTS in quarter 2 and 4 were included in the tuning for the first time. Their use was investigated at the 1995 Working Group meeting, but they were set aside on the general reasoning that at that point the time series were too short. The tuning file is given in Table 4.8

4.4 Catch-at-age analysis

Initial exploratory XSA runs used the same settings as the final XSA run in the 1995 Working Group assessment of the North Sea stock. The first run used all fleets, including the English groundfish survey and the IBTS Q2 and Q4 indices, which were not included in the 1995 assessment. Catchability residuals from this preliminary run indicated a possible year-effect in the Scottish Groundfish survey, as residuals at all ages were positive. This was also reflected in the individual fleet estimates of survivors from this run which were consistently higher for this fleet than for the other fleets. It was a year-effect such as this which led to the exclusion of the English groundfish survey from the 1995 tuning, so subsequent runs concentrated on the effect of excluding the Scottish survey. Comparative retrospective runs were made to investigate the effects of excluding both the Scottish and English surveys. There were no practical differences in the retrospective performance of the assessment whether or not these fleets were included. In addition, excluding either of these surveys made little difference to the survivor estimates in the terminal year. The final run used all of the fleets.

Exploratory runs were also used to investigate the effects of treating the youngest ages as recruits, and of the length and form of the time taper used in the XSA. Runs were made setting the first age for catchability to be independent of stock size at 2 (the default, previously used) and 0, and using a tricubic taper over 20 years (the default, as used previously) and a uniform weighting over 10 years. Neither of these settings made any real difference to the survivor estimates. On the general point that no ages should be treated as recruits unless there is compelling evidence that they should be, no ages were treated as recruits. Similarly, the decision to use a ten-year uniform taper was made on the general grounds that all recent CPUE data should be allowed to influence the XSA fit.

To summarise, the final XSA run used commercial CPUE data for Scottish seiners and light trawlers, and survey data from the first, second and fourth quarter IBTS and from English and Scottish groundfish surveys in the third quarter. In the XSA, no ages were treated as recruits, and the q-plateau was set at age 7. A shrinkage SE of 0.5 was used, and a ten-year tuning window with no taper was used. This differs from the 1995 Working Group assessment of the North Sea stock in the inclusion of the IBTS Q2 and Q4 indices and the English groundfish survey data; in the ages treated as recruits, and in the use of uniform weighting over ten years rather than a tricubic taper over twenty years. The results of exploratory runs indicate that the results of the assessment are rather insensitive to theses options.

The diagnostics from this final XSA run are given in Table 4.9. The diagnostics indicate that the survey data, particularly the IBTS Q1 and Q4 surveys, receive the highest weight in the estimate of survivors from ages 0-2, At age 0, the survivor estimate derived from the F-shrinkage mean is more than twice the size of any of the other estimates, but it still receives 12% of the weight in the combined survivor estimate. The F-shrinkage mean has little influence on the estimate of survivors from ages 1 to 5. Over ages 1 to 5 the survivor estimates from the individual survey series are rather homogeneous, although the estimate arising from the Scottish groundfish survey is consistently higher than the others. The commercial data begin to make a significant contribution to the survivor estimates from age 3 upwards, and they receive the majority of the weight from age 6 upwards, when the F-shrinkage mean also receives some weight.

Log catchability residuals from the final run are given in Figure 4.1. As noted above, these indicate that there may be a year effect in the Scottish groundfish data for 1995. Retrospective trends in mean F from the final run are given in Figure 4.2. The retrospective shows a general trend to over-estimate F in the terminal year, although the present assessment has resulted in a slight upward revision of mean F in 1994.

Fs at age from the final XSA run are given in Table 4.10, and stock numbers at age are given in Table 4.11. The present assessment indicates a mean F in 1995 of 0.74 which is close to the lowest observed for this stock, which was 0.70 in 1982.

4.5 Recruitment estimation

A number of 1996 surveys are available for this stock, so it is appropriate to utilise RCT3 to use this additional information. The RCT3 input file for the run at age 0 is given in Table 4.12; the runs at ages 1 and 2 used the same recruitment indices, but estimates of the strength of each year class at the appropriate age from the current XSA. Indices from the second and fourth quarter IBTS surveys are included in the file, although as RCT3 was run allowing only series with 5 or more points to be included in the regression, not all of these indices contribute to the estimates. Output from the RCT3 runs at ages 0-2 are given in Tables 4.13a-c.

Indices for the 1996 year class at age 0 are available from Scottish and English August surveys. Both indices indicate that this year class is of around average strength, and both receive quite high weighting in the RCT3 estimate of this year class at age 0, so the RCT3 estimate of 21739 million was used in the prediction. This estimate is slightly below the GM value of 26424 million.

Estimates of the 1995 year class at age 1 from the XSA (1962 million) and RCT3 (2078 million) are very similar. The RCT3 estimate was adopted as it receives most of its weight from 1996 survey indices which are not included in the XSA, whereas the XSA estimate receives 12% of its weight from the F-shrinkage mean, where the estimate is more than twice the size of the other fleet estimates. As the F at age 0 is poorly determined, this is undesirable, so the RCT3 value was considered more appropriate.

At age 2 in 1996 the RCT3 gave an estimate of 1473 million and the XSA 1270 million. This is the 1994 year-class which is well above average strength. In recent assessments of the North Sea stock, RCT3 has tended to over-estimate strong year-classes, including the 1994 year class, so there were clear grounds for accepting the XSA estimate of this year class.

At ages 3 and older the XSA estimates of population numbers at the start of 1996 were used in the prediction. For numbers at age 0 in 1997, 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 4.14 and Figure 4.3. Total F has fluctuated around a mean level of 0.93, although the present assessment indicates that it is currently at 0.74, and thus close to the lowest observed level. Recruitment shows considerable variation, with the current estimate of the 1994 year class indicating that it is the strongest since 1974. Spawning biomass has fluctuated, with occasional slight peaks corresponding to the maturation of strong year classes. SSB declined from 1985 to a historic low of 63,000 t in 1991, since when a slight increase is indicated.

4.7 Short-term forecast

Insufficient data were available to split the Division IIIa data for all years into the industrial and human consumption components, so for the purposes of the short-term catch forecast, the Division IIIa catch at age data were included with the human consumption component of the North Sea data. Thus the predicted human consumption catches arising from the prediction include a component which should be allocated to Division IIIa. Over 1963-1995 the mean value for this proportion (i.e the total landings from IIIa expressed as a proportion of the combined total of IIIa landings and North Sea HC landings) has been 4.5%. Information on the split of IIIa landings into industrial and human consumption components is only available for 1981 onwards. Over 1981-1995, an average of 33% of the haddock from Division IIIa have been taken as industrial bycatch.

Mean Fs at age for the human consumption/discard fleet were calculated by first obtaining partial Fs for this fleet over 1993-1995. The mean exploitation pattern over this period was then scaled to the mean F for this fleet in 1995. These Fs at age were then partitioned between the human consumption and discard components according to the mean proportion at each age over 1993-1995. Prediction Fs-at-age for the industrial bycatch were obtained using a similar procedure with the partial Fs for this fleet. It should be noted that the human consumption reference Fs are calculated over different age ranges, reflecting their different exploitation patterns. This means that the mean F obtained from combining the partial Fs across these two fleets may not correspond to the mean total F. Mean weights at age were calculated over 1993-1995. These procedures are performed automatically by the program 'Insens' and reflect recent practice for catch predictions for the North Sea stock.

The inputs to the prediction with sensitivity analysis are given in Table 4.15. The results of this prediction are given in Table 4.16, with more detailed output assuming *status quo* F in 1996 summarised in Table 4.17. The assumption of *status quo* F in 1996 and 1997 leads to predicted human consumption landings of 118,000 t in 1996 rising to 131,000 t in 1997. SSB is predicted to increase from its 1996 level of 233,000 t to 243,000 t at the start of 1997, then decline back to 210,000 t at the start of 1998.

The predicted increase in human consumption landings over 1996 and 1997 reflects the increased contribution of the 1994 year-class to the catches in 1997, this year-class accounts for 63% of the predicted 1997 HC landings in weight, with no other year class contributing more than 14% to this total. This dependence upon the 1994 year-class is shown clearly by the sensitivity analysis of the short term prediction (Figure 4.4) where it can be seen that the prediction is sensitive only to the estimate of the strength of this year class at age 2, and to factors influencing the survival of this year class and its contribution to the catch and spawning stock.

The cumulative probability distributions from the sensitivity analysis (Figure 4.5) indicate that the probability of the SSB falling below the lowest recorded value of 63,000t by 1998 is very low at *status quo* F.

4.8 Medium term projections

As the stock-recruitment data for this stock do not show any indications of a stock-recruitment relationship, the medium-term projections for this stock used bootstrapped random recruitment. The other input data were as used in the short-term catch prediction with sensitivity analysis (Table 4.15). The results of a medium term projection assuming *status quo* F in the medium term are given in Figure 4.6, and Figure 4.7 shows the probability of the SSB in 2005 falling below the lowest observed value at various levels of human consumption F. Assuming *status quo* F, landings and SSB are predicted to decline slightly after 1997 as the 1994 year-class is depleted, after which a slight increase is indicated. The projections also indicate that even if human consumption F were doubled, the probability of SSB falling below the lowest observed level in the medium term would still be less than 20%. This apparently optimistic prognosis may reflect the fact that the current assessment estimates a rather low F in 1995.

4.9 Long-term considerations

Mean total F for this stock has remained close to 1 for at least the last 20 years. This high level of exploitation means that strong year classes do not survive to make much contribution to the spawning stock, and the fishery will continue to depend upon a few recent incoming year classes.

4.10 Comments on the assessment

Quality control tables for the assessment are given in Table 4.18. It should be noted that values for earlier assessments in this Table refer to assessments of the North Sea stock only.

Recent assessments of the North Sea stock have tended to predict catches which have been over-optimistic. This has resulted from assessments tending to over-estimate F in the terminal year, combined with a tendency to over-estimate the strength of large recruiting year classes. The present assessment estimates a rather low F in 1995, which is perhaps unlikely to be an over-estimate. However, the present short-term forecast is strongly dependent upon the strong 1994 year class so it is again possible that the current catch forecasts are over-optimistic.

4.11 MBAL considerations

The stock-recruitment plot for this stock (Figure 4.8) does not show any evidence that the probability of poor recruitment increases as spawning stock decreases. The spawning stock reached its lowest recorded level in 1991, following a series of very poor year classes. Subsequently, the SSB increased due to improved recruitment. On this basis, MBAL for this stock should be set at a level corresponding to the 1991 SSB, which the current assessment estimates at 63,000t. SSB is currently above this level, and the medium-term projections indicate that it is unlikely to fall below this level in the medium term.

4.12 Biological reference points

The stock-recruitment scatter plot is given in Figure 4.8. It is characterised by large variations in year class strength. Over the range of spawning stock sizes for which data are available, there is no clear link between stock biomass and recruitment. The reference points F-high and F-med, as well as current F. are also indicated on the Figure. Current F is slightly above F-med. A yield-per-recruit plot, based on the input values given in Table 4.15 is given in Figure 4.9. Further reference points are indicated on this Figure, and they are also summarised in Table 4.19

Table 4.1 **Nominal catch of HADDOCK in Division IIIa, 1988-1995, as officially reported to ICES.**

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

Table 4.2 **Nominal catch of HADDOCK in Sub-Area IV, 1988-1995, as officially reported to ICES.**

Country	1988	1989	1990	1991	1992	1993	1994	1995
Belgium	220	145	192	168	415	292	306	407
Denmark	9174	2789	1993	1330	1476	3582	3208	2902
Faroe Islands	35	16	6	15	13	25	43	49
France	2193	1702	1115	631	508	960	678	598
Germany	802	447	749	535	764	348	1829	1284
Netherlands	894	328	102	100	148	192	96	147
Norway	1590	1697	1572	2069	3273	2651	2519	2443
Sweden	614	1051	900	957	1289	908	551	722
UK (Engl. & Wales)	5537	2507	2019	2173	2926	4259	4043	3616
UK (Isle of Man)	-	-	-	-	11	-	-	-
UK (N. Ireland)	-	137	11	48	73	18	9	-
UK (Scotland)	84104	53587	34567	36474	39896	66799	73793	63411
Total	105163	64406	43226	44500	50792	80034	87075	75579
WG estimate of H.cons. landings	105111	76186	51459	44624	70176	79654	80871	75318
WG estimate of discards	62053	25712	32603	40257	47938	79675	65371	57364
WG estimate of industrial bycatch	3995	2410	2591	5421	10816	10741	3561	7747
WG estimate of total catch	171159	104308	86653	90302	128930	170070	149803	140429
Unallocated landings	-52	11780	8233	124	19384	-380	-6204	-261

North Sea + Division IIIa

WG estimate of Total Catch	175491	108766	92721	96981	137930	174444	153816	144782

Table 4.3 Catches ('000t) of Haddock from the North Sea and Division IIIa, 1963-1995.

	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	158.9	85.7	6.0	250.6	7.2	1.0	8.1	258.7
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	47.9	10.8	128.9	4.4	4.6	9.0	137.9
1993	79.7	79.7	10.7	170.1	2.0	2.4	4.4	174.4
1994	80.9	65.4	3.6	149.8	1.8	2.2	4.0	153.8
1995	75.3	57.4	7.7	140.4	2.2	2.2	4.4	144.8
Min	44.6	25.7	2.4	86.7	0.4	0.1	0.4	92.7
Mean	144.4	96.9	36.7	278.0	3.8	1.4	5.2	283.2
Max	524.6	260.4	338.4	929.5	10.8	7.2	15.2	930.5

TABLE 4.4; Haddock, North Sea + IIIa
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 4.5; Haddock, North Sea + IIIa
International catch at age ('000), Total , 1963 to 1995.

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

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
0	1671205	306037	11146	72670	925768	333396	244075	60545	614903	46388
1	1007322	838189	1098748	20493	266379	1815054	679205	366830	1220855	2116937
2	25674	89083	439511	3578611	218480	71035	587590	570630	176342	641755
3	6425	4863	19600	303489	1908736	47546	40604	240604	332967	58991
4	412551	3585	1947	7596	57435	400469	21213	6192	54314	109062
5	9980	177857	2529	2411	1178	10374	158000	4470	1875	15813
6	1045	2443	45973	2515	1197	462	3563	39459	1351	983
7	601	215	325	19129	256	195	190	1257	10922	620
8	165	216	40	200	5954	147	34	108	242	2714
9	90	57	13	24	67	1592	27	29	23	266
10+	25	34	5	7	30	168	419	163	41	82

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	174161	120798	305115	881823	399372	646419	278705	639814	95502	139623
1	170529	258923	463554	351451	678499	134470	275686	157259	432193	179244
2	1062943	107675	146957	204046	333261	423059	86126	252258	168273	534670
3	211544	394175	30377	41297	73043	143151	299895	73920	122984	79175
4	9952	40185	113703	7406	10476	15228	41435	127250	22079	37669
5	31311	4318	8708	28024	1901	2034	3407	16480	32658	5349
6	4996	6275	1264	2237	8067	458	713	1708	3789	7462
7	206	1300	2076	262	598	2498	279	297	596	983
8	76	135	402	483	121	124	786	60	81	212
9	759	29	116	152	162	64	29	193	39	55
10+	63	204	94	78	119	61	26	67	139	115

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	56507	13384	16535	12042	57703	123907	270741	141225	85961	273689
1	160336	313967	30039	47620	86811	228504	209713	360191	99234	301747
2	178602	250593	490699	35341	103006	78370	253298	262845	296705	85929
3	324014	47642	90169	182824	18961	23222	32520	108674	100456	167813
4	27754	68046	13458	18128	57900	3885	6544	7125	29596	25871
5	9734	4750	18591	2637	3909	12521	1248	1702	1918	7646
6	1241	2858	1590	4059	897	974	4848	450	573	511
7	1835	540	629	509	1377	400	451	1139	191	126
8	249	772	158	199	206	614	296	145	508	45
9	107	131	141	83	78	141	289	103	115	61
10+	128	135	97	52	66	59	151	210	89	36

TABLE 4.6; Haddock, North Sea + IIIa
International mean weight at age (kg), Total catch, 1963 to 1995.

Age	1963	1964	1965
0	.012	.011	.010
1	.123	.119	.069
2	.253	.239	.225
3	.474	.403	.365
4	.695	.664	.648
5	.806	.814	.844
6	1.004	.908	1.193
7	1.131	1.382	1.173
8	1.173	1.148	1.482
9	1.576	1.470	1.707
10+	1.825	1.781	2.239

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
0	.010	.011	.010	.011	.013	.011	.024	.044	.024	.021
1	.088	.115	.126	.063	.073	.106	.116	.112	.128	.101
2	.247	.281	.253	.216	.222	.247	.242	.241	.226	.241
3	.367	.461	.509	.406	.353	.362	.388	.372	.343	.356
4	.533	.594	.731	.799	.735	.505	.506	.585	.548	.450
5	.949	.639	.857	.891	.873	.887	.606	.648	.891	.680
6	1.265	1.057	.837	1.032	1.191	1.267	1.000	.724	.895	1.245
7	1.525	1.501	1.606	1.094	1.361	1.534	1.366	1.044	.953	1.124
8	1.938	1.922	2.260	2.040	1.437	1.337	2.241	1.302	1.513	1.093
9	1.727	2.069	2.702	3.034	2.571	1.275	2.006	2.796	2.315	1.720
10+	2.889	2.348	2.073	3.264	3.899	2.058	1.684	1.828	2.639	2.420

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	.013	.019	.012	.009	.012	.009	.011	.022	.010	.013
1	.125	.108	.144	.095	.104	.074	.100	.135	.141	.149
2	.224	.241	.253	.291	.284	.262	.292	.297	.300	.279
3	.401	.345	.418	.442	.486	.476	.461	.448	.488	.479
4	.512	.602	.441	.637	.732	.744	.784	.651	.670	.668
5	.588	.613	.719	.664	1.046	1.147	1.166	.916	.805	.859
6	.922	.802	.742	.933	.936	1.479	1.441	1.215	1.097	1.054
7	1.933	1.181	.954	1.187	1.394	1.180	1.672	1.162	1.100	1.470
8	1.784	1.943	1.398	1.187	1.599	1.634	1.456	1.920	1.868	1.844
9	1.306	2.322	2.124	1.468	1.593	1.764	2.634	1.376	2.425	2.137
10+	2.430	1.812	2.158	2.374	2.143	1.709	2.156	1.725	2.046	2.045

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	.025	.008	.024	.027	.044	.029	.018	.010	.017	.013
1	.124	.126	.164	.198	.194	.177	.107	.115	.116	.102
2	.242	.265	.217	.300	.291	.320	.306	.279	.250	.297
3	.396	.405	.417	.372	.429	.471	.486	.447	.420	.363
4	.612	.613	.589	.605	.473	.638	.747	.680	.597	.592
5	.864	1.029	.747	.811	.772	.649	1.016	.894	.943	.764
6	1.260	1.278	1.283	.984	.968	1.042	.896	1.173	1.208	1.099
7	1.202	1.433	1.424	1.375	1.169	1.230	1.391	1.102	1.570	1.425
8	1.719	1.530	1.542	1.659	1.533	1.479	1.526	1.593	1.470	1.683
9	1.526	1.865	1.612	1.695	2.034	1.771	1.899	1.733	1.619	1.866
10+	2.578	2.174	2.298	2.241	2.513	1.985	2.007	1.871	2.439	1.971

Table 4.7; Haddock in the North Sea and Division IIIa
Summary of fleets used in catch-at-age analysis

Fleet	Abbreviation	Year range First	Last	Age range Youngest	Oldest
Scottish Seiners	SCOSEI	1976	1995	0	10
Scottish Light Trawlers	SCOLTR	1976	1995	0	10
Scottish Groundfish Survey (August)	SCOGFS	1982	1995	0	6
English Groundfish Survey (August)	ENGGFS	1977	1995	0	7
International Bottom Trawl Survey, Quarter 1	IBTSQ1	1973	1995	0	5 [1]
International Bottom Trawl Survey, Quarter 2	IBTSQ2_SCO	1991	1995	1	6 [2]
International Bottom Trawl Survey, Quarter 4	IBTSQ4_ENG	1991	1995	0	7 [3]

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

3 - Indices based on English ALKs only

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Table 4.8

Haddock in Fishing Area IV and IIIa (run name: XSASAR02)
107
FLT01: SCOSEI (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
0 10

307165	900.005	35831.210	329388.700	57468.820	2529.042	8069.133	1026.017	54.001	13.0
313913	4408.118	33809.840	37092.650	130091.200	12895.040	1684.006	1480.005	347.001	24.0
325246	1665.021	160842.900	69033.230	14339.890	44151.660	2365.977	481.996	672.993	85.9
316419	542.986	83630.890	78815.420	17214.720	3039.951	8072.871	647.990	69.999	112.9
297227	210.001	131314.300	128306.000	26204.930	3392.990	500.999	2414.993	123.000	20.0
289672	344.996	10366.880	134259.800	55726.170	5180.690	701.958	101.994	578.965	14.9
297730	1444.967	31143.320	30968.580	118897.900	14296.880	681.995	144.999	39.000	229.9
333168	18101.430	29021.010	77288.730	30413.860	50114.900	6394.235	582.521	118.749	14.6
388085	422.095	120868.200	63391.050	49285.750	9426.073	14976.840	1593.925	253.625	18.0
382910	2052.204	29238.560	164839.200	33202.650	15993.390	2292.755	2846.266	308.427	46.9
425017	8265.012	33999.170	72603.500	155836.400	12894.810	4169.091	489.713	620.234	58.4
418734	137.900	43645.950	97730.800	19730.920	28882.720	1989.147	1174.107	198.915	284.6
377132	498.662	11575.790	201533.400	37421.010	4735.789	7414.681	718.065	290.026	80.0
355735	122.757	19003.760	19274.380	91069.770	8388.754	1091.295	1611.435	223.083	88.5
300076	712.190	35843.580	46489.320	9055.270	26705.220	1434.486	302.388	407.550	67.2
336675	2225.837	66143.560	30754.680	9530.928	1484.518	5028.135	307.511	122.391	183.0
300217	1231.550	30384.280	64732.900	8588.196	1511.942	290.016	1179.738	79.037	56.6
268413	2912.944	74523.460	88375.050	34996.900	2349.233	445.716	100.011	314.410	28.5
264738	3230.533	26626.010	125357.300	34126.900	10522.030	415.035	138.226	41.743	94.7
204545	236.434	67772.080	32300.980	70290.070	8734.379	2180.770	116.890	39.103	13.4

FLT02: SCOLTR (Catch: Unknown) (Effort: Unknown)
1976 1995
1 1 0.00 1.00
10

152419	92.002	3355.072	59426.370	11342.740	636.974	1756.928	327.987	7.000	5.000	4
224824	3256.763	10101.390	6440.708	41122.020	3492.063	390.009	787.017	99.002	15.000	
236929	1691.974	45733.130	11470.500	2913.805	12279.120	773.938	109.992	166.987	23.998	
287494	463.914	44561.960	23134.700	4109.341	713.887	3643.626	202.981	19.998	56.995	1
333197	179.995	92519.260	46282.270	8061.933	754.994	196.998	1014.992	61.000	18.000	
251504	436.018	7979.309	58146.380	13652.980	1517.987	160.999	20.000	319.997	12.000	
250870	351.994	24574.580	10169.870	33462.630	3936.959	132.999	66.999	7.000	57.999	
244349	63675.970	19635.390	48680.480	6954.711	11807.150	1258.171	124.417	27.092	4.014	2
240725	514.080	56768.970	22191.480	13374.800	2074.455	3392.161	402.251	98.036	15.160	
268136	3547.814	38850.410	57422.220	4912.630	2787.082	414.117	871.881	127.894	27.406	
279767	4371.354	26322.220	26549.290	32339.220	2796.814	1013.775	123.812	306.884	43.387	3
351128	96.701	26220.210	33647.760	6464.323	7197.125	496.072	377.057	71.620	119.015	2
391988	209.356	2930.596	57588.920	14074.730	2366.963	2923.692	167.036	84.018	28.006	2
405883	1076.998	10415.020	2919.387	24894.510	2753.952	541.324	626.922	108.898	30.131	2
441084	201.380	11886.350	19204.620	2664.623	10237.390	669.340	168.189	264.216	44.836	1
408056	1040.658	44141.130	12393.730	3355.596	564.193	2213.164	226.034	79.589	145.803	3
473955	1838.052	20443.350	31073.280	3889.020	756.982	144.252	765.573	97.505	52.225	5
447064	231.101	39863.390	39175.810	20213.470	1526.971	362.312	83.586	273.529	29.288	2
480400	1482.199	8266.777	49046.740	23557.340	6304.283	474.420	128.143	42.488	63.750	1
442010	143.844	22873.540	13761.650	32063.370	5821.263	1658.212	96.772	14.662	12.648	1

FLT03: ENGGFS (Catch: Unknown) (Effort: Unknown)
1977 1995
1 1 0.50 0.75
0 7

100	53.48	6.68	3.21	6.16	0.92	0.07	0.09	0.01
100	35.83	13.69	2.62	0.24	2.22	0.21	0.01	0.07
100	87.55	29.55	5.46	0.87	0.11	0.44	0.04	0.00
100	37.40	62.33	16.73	2.57	0.27	0.04	0.14	0.02
100	153.75	17.32	43.91	7.56	0.74	0.06	0.00	0.06
100	28.13	31.55	7.98	11.80	1.03	0.24	0.10	0.01
100	83.19	21.82	10.95	2.14	2.17	0.27	0.04	0.01
100	22.85	59.93	6.16	3.08	0.42	0.48	0.10	0.01
100	24.59	18.66	23.82	2.11	0.70	0.20	0.13	0.04
100	26.60	14.97	4.47	3.38	0.28	0.18	0.04	0.04
100	2.24	28.19	4.31	0.53	0.69	0.05	0.03	0.00
100	6.07	2.86	18.35	1.55	0.16	0.28	0.04	0.01
100	9.43	8.17	1.45	3.97	0.25	0.03	0.06	0.01
100	28.19	6.65	1.98	0.29	0.88	0.05	0.03	0.01
100	26.33	11.50	0.96	0.23	0.05	0.22	0.00	0.01
100	82.77	19.69	9.77	0.58	0.05	0.01	0.08	0.00
100	13.58	24.61	5.86	1.66	0.06	0.02	0.00	0.01
100	94.30	8.07	9.02	0.84	0.28	0.02	0.00	0.00
100	17.99	38.31	4.45	3.40	0.28	0.09	0.01	0.00

FLT04: SCOGFS (Catch: Unknown) (Effort: Unknown)
1982 1995
1 1 0.50 0.75
0 6

100	12.35	24.88	9.96	13.36	1.15	0.07	0.02
100	22.03	18.13	16.11	3.72	4.55	0.53	0.12
100	8.73	43.71	7.88	3.36	0.55	0.65	0.09
100	8.18	19.76	29.81	2.32	1.03	0.14	0.22
100	15.88	21.17	5.22	5.44	0.32	0.24	0.03
100	2.77	23.86	7.04	1.06	1.28	0.08	0.05
100	4.06	4.67	19.82	1.70	0.27	0.23	0.02
100	4.32	8.86	2.14	5.74	0.31	0.04	0.07

Table 4.8 (Continued)

100	31.63	10.02	2.40	0.32	1.03	0.07	0.01
100	34.71	17.05	1.78	0.21	0.05	0.16	0.02
100	82.65	38.35	9.63	0.48	0.08	0.03	0.08
100	8.59	58.36	13.80	2.69	0.06	0.04	0.01
100	137.62	12.65	20.80	2.10	0.53	0.02	0.00
100	15.66	81.53	7.34	9.26	0.74	0.28	0.02

FLT05: IBTS_Q1 (Catch: Unknown) (Effort: Unknown)
1973 1995
1 1 0.99 1.00
0 5

1	1.0920	0.1100	-1.0000	-1.0000	-1.0000	-1.0000
1	1.1680	0.3850	-1.0000	-1.0000	-1.0000	-1.0000
1	0.1770	0.6700	-1.0000	-1.0000	-1.0000	-1.0000
1	0.1620	0.0840	-1.0000	-1.0000	-1.0000	-1.0000
1	0.3850	0.1080	-1.0000	-1.0000	-1.0000	-1.0000
1	0.4800	0.2400	-1.0000	-1.0000	-1.0000	-1.0000
1	0.8960	0.4020	-1.0000	-1.0000	-1.0000	-1.0000
1	0.2680	0.6750	-1.0000	-1.0000	-1.0000	-1.0000
1	0.5260	0.2520	-1.0000	-1.0000	-1.0000	-1.0000
1	0.3070	0.4000	0.0890	0.1140	0.0130	0.0020
1	1.0570	0.2190	0.1340	0.0220	0.0220	0.0050
1	0.2290	0.8280	0.1050	0.0340	0.0040	0.0070
1	0.5790	0.2440	0.2940	0.0180	0.0060	0.0020
1	0.8850	0.3260	0.0480	0.0610	0.0050	0.0030
1	0.0920	0.6880	0.0980	0.0130	0.0140	0.0020
1	0.2100	0.0970	0.2810	0.0170	0.0020	0.0050
1	0.2200	0.1100	0.0310	0.0510	0.0030	0.0020
1	0.6790	0.1310	0.0240	0.0040	0.0090	0.0020
1	1.1150	0.3710	0.0190	0.0030	0.0010	0.0020
1	1.2420	0.5430	0.1550	0.0090	0.0010	0.0010
1	0.2290	0.5040	0.0980	0.0230	0.0020	0.0010
1	1.3750	0.2050	0.1810	0.0250	0.0050	0.0010
1	0.2600	0.8170	0.0690	0.0480	0.0073	0.0025

FLT06: IBTS_Q2_SCO (Catch: Unknown) (Effort: Unknown)
1991 1995
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

FLT07: IBTS_Q4_ENG (Catch: Unknown) (Effort: Unknown)
1991 1995
1 1 0.75 1.00
0 7

100	90.712	57.818	5.094	0.747	0.236	0.600	0.101	0.032
100	198.232	74.865	22.977	1.052	0.278	0.025	0.130	0.033
100	42.168	75.000	17.137	3.980	0.112	0.016	0.016	0.023
100	137.483	18.526	22.192	3.003	0.909	0.084	0.000	0.012
100	51.541	160.928	17.995	11.517	0.941	0.257	0.000	0.000

Table 4.9

Lowestoft VPA Version 3.1

9-Oct-96 15:59:43

Extended Survivors Analysis

Haddock in IV, IIIa (run: XSASAR02/X02)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/had_34/FLEET.X02

Catch data for 33 years. 1963 to 1995. Ages 0 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT01: SCOSEI (Catch,	1976,	1995,	0,	9,	.000,	1.000
FLT02: SCOLTR (Catch,	1976,	1995,	0,	9,	.000,	1.000
FLT03: ENGGFS (Catch,	1977,	1995,	0,	7,	.500,	.750
FLT04: SCOGFS (Catch,	1982,	1995,	0,	6,	.500,	.750
FLT05: IBTS_Q1 (Catc,	1973,	1995,	0,	5,	.990,	1.000
FLT06: IBTS_Q2_SCO (,	1991,	1995,	1,	6,	.250,	.500
FLT07: IBTS_Q4_ENG (,	1991,	1995,	0,	7,	.750,	1.000

Time series weights :

Tapered time weighting applied
Power = 0 over 10 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 28 iterations

Regression weights

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

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
0,	.003,	.009,	.005,	.004,	.006,	.013,	.018,	.032,	.004,	.049
1,	.128,	.119,	.137,	.106,	.197,	.155,	.146,	.164,	.156,	.099
2,	1.015,	.902,	.796,	.655,	1.120,	.795,	.732,	.793,	.525,	.525
3,	1.240,	1.049,	1.305,	.987,	1.163,	1.032,	1.194,	1.024,	1.023,	.777
4,	1.294,	1.084,	1.117,	1.185,	1.153,	.864,	1.062,	1.042,	.977,	.888
5,	1.063,	.837,	1.108,	.703,	.949,	.884,	.803,	.957,	.965,	.768
6,	.716,	1.138,	.767,	.779,	.551,	.658,	1.114,	.782,	1.077,	.752
7,	.848,	.811,	.844,	.600,	.671,	.511,	.748,	.885,	.955,	.734
8,	.693,	1.158,	.592,	.717,	.521,	.735,	.923,	.574,	1.491,	.617
9,	1.006,	1.028,	.668,	.730,	.698,	.847,	.979,	1.035,	1.389,	.702

Table 4.9 (Continued)

XSA population numbers (Thousands)

YEAR ,	AGE 0,	1,	2,	3,	4,	5,	6,	7,		
1986 ,	4.99E+07,	3.05E+06,	3.42E+05,	5.17E+05,	4.33E+04,	1.64E+04,	2.68E+03,	3.55E+03,	5.51E+02,	1.86E+02,
1987 ,	4.20E+06,	6.40E+06,	5.15E+05,	8.31E+04,	1.16E+05,	9.26E+03,	4.65E+03,	1.07E+03,	1.24E+03,	2.25E+02,
1988 ,	8.45E+06,	5.36E+05,	1.09E+06,	1.40E+05,	2.27E+04,	3.07E+04,	3.28E+03,	1.22E+03,	3.91E+02,	3.20E+02,
1989 ,	8.63E+06,	1.08E+06,	8.98E+04,	3.30E+05,	2.96E+04,	5.77E+03,	8.29E+03,	1.25E+03,	4.30E+02,	1.77E+02,
1990 ,	2.83E+07,	1.11E+06,	1.87E+05,	3.13E+04,	9.59E+04,	7.05E+03,	2.34E+03,	3.11E+03,	5.61E+02,	1.72E+02,
1991 ,	2.78E+07,	3.63E+06,	1.75E+05,	4.09E+04,	7.61E+03,	2.36E+04,	2.23E+03,	1.10E+03,	1.30E+03,	2.73E+02,
1992 ,	4.30E+07,	3.53E+06,	5.96E+05,	5.29E+04,	1.13E+04,	2.50E+03,	7.98E+03,	9.47E+02,	5.43E+02,	5.12E+02,
1993 ,	1.25E+07,	5.44E+06,	5.86E+05,	1.92E+05,	1.25E+04,	3.05E+03,	9.16E+02,	2.14E+03,	3.67E+02,	1.77E+02,
1994 ,	5.70E+07,	1.56E+06,	8.87E+05,	1.78E+05,	5.38E+04,	3.42E+03,	9.60E+02,	3.43E+02,	7.25E+02,	1.69E+02,
1995 ,	1.60E+07,	7.30E+06,	2.57E+05,	3.52E+05,	4.98E+04,	1.58E+04,	1.07E+03,	2.68E+02,	1.08E+02,	1.34E+02,

Estimated population abundance at 1st Jan 1996

,	.00E+00,	1.96E+06,	1.27E+06,	1.02E+05,	1.26E+05,	1.60E+04,	5.99E+03,	4.12E+02,	1.05E+02,	4.77E+01,

Taper weighted geometric mean of the VPA populations:

,	1.89E+07,	2.51E+06,	3.67E+05,	1.32E+05,	3.14E+04,	8.44E+03,	2.58E+03,	1.14E+03,	5.15E+02,	2.17E+02,

Standard error of the weighted Log(VPA populations) :

,	.8735,	.8751,	.7931,	.9661,	.9177,	.8863,	.8095,	.8359,	.7018,	.3942,

Table 4.9 (Continued)

Log catchability residuals.

Fleet : FLT01: SCOSEI (Catch

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	.97	-.63	.06	-1.31	-.57	.48	-.44	1.78	.37	-.70
1	-.53	-1.01	.25	.09	.91	.20	-.44	.15	.37	.01
2	.02	-.12	-.08	.07	.57	-.02	-.41	.05	-.11	.03
3	.05	-.25	.07	.04	.32	-.06	-.24	-.08	-.02	.18
4	.13	-.12	-.18	.21	.35	-.23	-.42	.03	.06	.17
5	.13	-.11	.22	-.13	.21	.12	-.41	.00	-.17	.14
6	-.19	.33	.14	.08	-.25	-.26	.11	-.21	.20	.05
7	-.07	-.01	.35	.02	-.09	-.44	-.51	.23	.08	.43
8	-.64	.34	.10	.22	-.24	-.11	-.21	-.54	.36	.22
9	-1.05	-.24	.20	.30	.17	.04	-.19	-.28	-.53	-.31

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	-21.7769	-16.1637	-13.9068	-13.5502	-13.6230	-13.8982	-14.0523	-14.1534	-14.1534	-14.1534
S.E(Log q)	.9176	.5371	.2443	.1761	.2344	.2031	.2104	.3040	.3581	.4486

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	.75	.936	20.53	.64	10	.69	-21.78
1	1.53	-1.941	16.92	.62	10	.72	-16.16
2	1.19	-1.665	14.11	.91	10	.26	-13.91
3	.98	.337	13.51	.97	10	.18	-13.55
4	.87	2.104	13.19	.97	10	.17	-13.62
5	.85	3.356	13.17	.98	10	.12	-13.90
6	.92	.943	13.58	.95	10	.20	-14.05
7	1.11	-.791	14.93	.87	10	.34	-14.15
8	1.00	.023	14.17	.80	10	.37	-14.20
9	.82	.630	12.71	.60	10	.34	-14.34

Table 4.9 (Continued)

Fleet : FLT02: SCOLTR (Catch

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	1.51	-.05	-.09	1.49	-1.46	.29	.27	-.51	-.24	-1.21
1	.63	-.34	-.16	.36	.42	.61	-.29	.01	-.39	-.85
2	.72	.27	-.09	-.67	.58	.16	-.32	.01	-.36	-.31
3	.11	.03	.27	-.17	-.06	-.07	-.27	.08	.24	-.15
4	.13	-.22	.21	.09	.13	-.27	-.45	.21	.07	.11
5	.09	-.37	.21	-.01	.02	.06	-.61	.23	.32	.05
6	-.23	.28	-.44	-.08	-.31	.16	.14	.02	.44	.01
7	.44	-.07	-.13	-.03	-.11	-.27	.04	.37	.30	-.53
8	.28	.43	-.20	-.20	-.24	.27	.05	-.23	.16	.18
9	1.33	.62	-.25	.34	-.17	.54	.23	.60	-.02	.30

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	-22.5377	-17.1650	-15.1899	-14.7716	-14.7409	-14.8532	-14.9694	-14.9459	-14.9459	-14.9459
S.E(Log q)	.9757	.4917	.4398	.1783	.2285	.2829	.2731	.2988	.2556	.5927

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	.95	.122	22.27	.47	10	.99	-22.54
1	1.21	-.914	17.67	.71	10	.60	-17.17
2	1.00	.008	15.19	.77	10	.47	-15.19
3	.96	.703	14.64	.97	10	.18	-14.77
4	.93	.892	14.44	.95	10	.22	-14.74
5	.92	.779	14.40	.93	10	.27	-14.85
6	1.06	-.477	15.39	.89	10	.30	-14.97
7	.86	1.429	13.85	.93	10	.24	-14.95
8	.89	1.097	13.91	.92	10	.22	-14.90
9	1.21	-.426	16.54	.34	10	.59	-14.59

Table 4.9 (Continued)

Fleet : FLT03: ENGGFS (Catch

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-.62	-.61	-.32	.10	.01	-.03	.68	.11	.52	.16
1	-.04	-.16	.05	.38	.20	-.46	.10	-.10	.03	.01
2	.25	-.27	.36	.24	.10	-.75	.30	-.16	-.31	.23
3	-.12	-.26	.45	.33	.18	-.40	.37	.03	-.58	-.01
4	.18	-.04	.16	.38	.44	-.07	-.35	-.27	-.23	-.21
5	.60	-.24	.45	-.37	.10	.33	-.57	.02	-.09	-.23
6	.32	-.25	.16	-.36	.07	99.99	.18	99.99	99.99	-.12
7	.58	99.99	.26	.08	-.79	.15	99.99	-.28	99.99	99.99
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6	7
Mean Log q	-17.1620	-15.6855	-15.2200	-15.4996	-15.7759	-15.8435	-15.4736	-15.9244
S.E(Log q)	.4253	.2222	.3591	.3427	.2780	.3739	.2485	.4752

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	.82	1.473	17.09	.89	10	.33	-17.16
1	1.16	-1.773	15.83	.94	10	.23	-15.69
2	.97	.183	15.15	.84	10	.37	-15.22
3	1.00	-.021	15.51	.89	10	.36	-15.50
4	.89	1.219	15.20	.94	10	.24	-15.78
5	.78	2.599	14.33	.94	10	.23	-15.84
6	1.08	-.468	16.03	.88	7	.29	-15.47
7	1.29	-.494	18.33	.43	6	.66	-15.92

Table 4.9 (Continued)

Fleet : FLT04: SCOGFS (Catch

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-1.00	-.27	-.59	-.55	.26	.37	.81	-.22	1.03	.15
1	-.12	-.75	.11	.03	.18	-.50	.33	.33	.05	.33
2	-.01	-.19	.03	.22	-.11	-.55	-.12	.29	.12	.32
3	-.03	.05	.16	.32	-.10	-.87	-.20	.12	-.05	.60
4	-.06	.21	.31	.22	.23	-.44	-.25	-.64	.03	.39
5	.51	-.15	-.13	-.46	.05	-.37	.15	.34	-.47	.52
6	.14	.36	-.44	-.11	-.93	-.12	.27	.15	99.99	.67
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6
Mean Log q	-17.2934	-15.2565	-14.8101	-15.1147	-15.4032	-15.4642	-15.5721
S.E(Log q)	.6409	.3666	.2601	.3833	.3445	.3766	.4718

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	.74	1.567	17.15	.82	10	.44	-17.29
1	1.09	-.545	15.30	.83	10	.41	-15.26
2	.96	.332	14.74	.91	10	.26	-14.81
3	.79	2.532	14.42	.95	10	.24	-15.11
4	.79	2.986	14.32	.96	10	.20	-15.40
5	.98	.158	15.32	.85	10	.39	-15.46
6	1.08	-.317	16.17	.70	9	.54	-15.57

Table 4.9 (Continued)

Fleet : FLT05: IBTS_Q1 (Catc

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

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-.29	-.07	.05	.08	.02	.54	.21	-.23	.02	-.33
1	-.11	-.12	.42	-.19	.06	-.13	.27	-.22	.12	-.10
2	-.10	.09	.29	.44	-.08	-.57	.23	-.15	-.21	.06
3	.07	.16	.16	.09	.08	-.61	.39	-.13	.03	-.24
4	.26	.09	-.18	.02	-.09	-.04	-.24	.34	-.27	.10
5	-.05	-.10	-.12	.23	.28	-.99	.48	.43	.32	-.48
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	-15.5172	-14.1687	-14.2711	-14.5412	-14.6999	-14.2111
S.E(Log q)	.2570	.2115	.2904	.2740	.2040	.4592

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	.96	.409	15.57	.93	10	.26	-15.52
1	1.16	-1.996	14.08	.95	10	.21	-14.17
2	.99	.065	14.26	.88	10	.31	-14.27
3	.99	.096	14.51	.93	10	.29	-14.54
4	.99	.083	14.67	.95	10	.21	-14.70
5	1.72	-3.900	17.95	.78	10	.49	-14.21

Table 4.9 (Continued)

Fleet : FLT06: IBTS_Q2_SCO (

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	No data for this fleet at this age									
1	99.99	99.99	99.99	99.99	99.99	-.30	.42	.37	-.60	.10
2	99.99	99.99	99.99	99.99	99.99	-.34	.16	.14	-.01	.05
3	99.99	99.99	99.99	99.99	99.99	-.48	.17	.47	-.45	.29
4	99.99	99.99	99.99	99.99	99.99	-.14	.13	.31	-.07	-.24
5	99.99	99.99	99.99	99.99	99.99	.29	-.23	-.08	-.48	.51
6	99.99	99.99	99.99	99.99	99.99	.46	.56	-.61	-.55	.14
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	-15.0334	-14.2948	-14.5431	-14.8893	-15.3339	-15.9673
S.E(Log q)	.4424	.2034	.4373	.2189	.3976	.5554

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	.65	1.708	15.07	.89	5	.24	-15.03
2	.83	1.574	14.07	.97	5	.14	-14.29
3	.82	.887	14.04	.89	5	.37	-14.54
4	1.13	-.908	15.52	.95	5	.25	-14.89
5	.75	2.820	13.72	.98	5	.18	-15.33
6	.68	2.285	13.21	.94	5	.26	-15.97

Table 4.9 (Continued)

Fleet : FLT07: IBTS_Q4_ENG (

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	99.99	99.99	99.99	99.99	99.99	-.02	.33	.03	-.33	.00
1	99.99	99.99	99.99	99.99	99.99	-.02	.25	-.16	-.32	.25
2	99.99	99.99	99.99	99.99	99.99	-.10	.13	-.09	-.48	.55
3	99.99	99.99	99.99	99.99	99.99	-.12	.10	-.01	-.21	.24
4	99.99	99.99	99.99	99.99	99.99	.43	.36	-.66	-.08	-.05
5	99.99	99.99	99.99	99.99	99.99	.61	-.40	-.91	.64	.06
6	99.99	99.99	99.99	99.99	99.99	.49	-.14	-.35	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	-.07	.32	-.74	.50	99.99
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6	7
Mean Log q	-15.4231	-14.0570	-13.9102	-14.2739	-14.4409	-14.8454	-14.3493	-14.3592
S.E(Log q)	.2332	.2532	.3765	.1779	.4345	.6649	.4377	.5501

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	1.07	-.330	15.30	.87	5	.28	-15.42
1	.78	1.416	14.29	.93	5	.18	-14.06
2	1.42	-1.075	14.31	.69	5	.52	-13.91
3	.94	.617	14.12	.97	5	.18	-14.27
4	1.15	-.494	15.13	.78	5	.56	-14.44
5	.74	1.108	13.28	.86	5	.48	-14.85
6	.94	.152	13.98	.88	3	.58	-14.35
7	2.89	-2.940	28.59	.55	4	.84	-14.36

Table 4.9 (Continued)

Terminal year survivor and F summaries :

Age 0 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,	972225.,	.962,	.000,	.00,	1,	.030,	.000
FLT02: SCOLTR (Catch,	585762.,	1.023,	.000,	.00,	1,	.027,	.000
FLT03: ENGGFS (Catch,	2299245.,	.446,	.000,	.00,	1,	.141,	.000
FLT04: SCOGFS (Catch,	2282725.,	.672,	.000,	.00,	1,	.062,	.000
FLT05: IBTS_Q1 (Catc,	1410731.,	.300,	.000,	.00,	1,	.311,	.000
FLT06: IBTS_Q2_SCO (,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT07: IBTS_Q4_ENG (,	1956168.,	.300,	.000,	.00,	1,	.311,	.000
F shrinkage mean ,	5702735.,	.50,,,,				.118,	.017

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1962180.,	.17,	.20,	7,	1.209,	.049

Age 1 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,	1401238.,	.486,	.159,	.33,	2,	.049,	.090
FLT02: SCOLTR (Catch,	613569.,	.461,	.243,	.53,	2,	.054,	.195
FLT03: ENGGFS (Catch,	1499720.,	.249,	.236,	.95,	2,	.185,	.085
FLT04: SCOGFS (Catch,	2103324.,	.334,	.299,	.90,	2,	.103,	.061
FLT05: IBTS_Q1 (Catc,	1223171.,	.212,	.059,	.28,	2,	.255,	.103
FLT06: IBTS_Q2_SCO (,	1409233.,	.485,	.000,	.00,	1,	.049,	.090
FLT07: IBTS_Q4_ENG (,	1222031.,	.212,	.291,	1.37,	2,	.255,	.103
F shrinkage mean ,	651593.,	.50,,,,				.051,	.185

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1270026.,	.11,	.10,	14,	.938,	.099

Table 4.9 (Continued)

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

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: SCOSEI (Catch,	124494.,	.256,	.298,	1.17,	3,	.106,	.448
FLT02: SCOLTR (Catch,	71294.,	.327,	.043,	.13,	3,	.063,	.687
FLT03: ENGGFS (Catch,	113875.,	.208,	.063,	.30,	3,	.150,	.481
FLT04: SCOGFS (Catch,	122158.,	.224,	.127,	.57,	3,	.135,	.455
FLT05: IBTS_Q1 (Catc,	100724.,	.175,	.106,	.60,	3,	.213,	.530
FLT06: IBTS_Q2_SCO (,	91166.,	.256,	.283,	1.11,	2,	.107,	.572
FLT07: IBTS_Q4_ENG (,	103534.,	.189,	.235,	1.24,	3,	.178,	.519
F shrinkage mean ,	56295.,	.50,,,,				.049,	.811

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
101845.,	.08,	.07,	21,	.833,	.525

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

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: SCOSEI (Catch,	134430.,	.202,	.091,	.45,	4,	.133,	.743
FLT02: SCOLTR (Catch,	107630.,	.230,	.072,	.31,	4,	.109,	.865
FLT03: ENGGFS (Catch,	124280.,	.189,	.162,	.86,	4,	.134,	.785
FLT04: SCOGFS (Catch,	183956.,	.203,	.136,	.67,	4,	.116,	.591
FLT05: IBTS_Q1 (Catc,	108950.,	.158,	.101,	.64,	4,	.191,	.858
FLT06: IBTS_Q2_SCO (,	146432.,	.234,	.119,	.51,	3,	.088,	.699
FLT07: IBTS_Q4_ENG (,	135386.,	.168,	.163,	.97,	4,	.172,	.739
F shrinkage mean ,	73505.,	.50,,,,				.058,	1.104

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
125949.,	.07,	.06,	28,	.769,	.777

Table 4.9 (Continued)

Age 4 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,	17667.,	.205,	.061,	.30,	5,	.144,	.830
FLT02: SCOLTR (Catch,	18090.,	.216,	.049,	.23,	5,	.136,	.816
FLT03: ENGGFS (Catch,	12668.,	.205,	.088,	.43,	5,	.142,	1.030
FLT04: SCOGFS (Catch,	21455.,	.231,	.080,	.35,	5,	.107,	.725
FLT05: IBTS_Q1 (Catc,	17802.,	.182,	.076,	.42,	5,	.164,	.825
FLT06: IBTS_Q2_SCO (,	13231.,	.230,	.110,	.48,	4,	.124,	1.003
FLT07: IBTS_Q4_ENG (,	14984.,	.203,	.071,	.35,	5,	.103,	.926
F shrinkage mean ,	12588.,	.50,,,,				.080,	1.035

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
15952.,	.08,	.04,	35,	.475,	.888

Age 5 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,	6457.,	.203,	.056,	.28,	6,	.183,	.728
FLT02: SCOLTR (Catch,	6299.,	.207,	.051,	.25,	6,	.179,	.741
FLT03: ENGGFS (Catch,	4910.,	.220,	.060,	.27,	6,	.135,	.879
FLT04: SCOGFS (Catch,	8016.,	.244,	.127,	.52,	6,	.117,	.622
FLT05: IBTS_Q1 (Catc,	4537.,	.209,	.088,	.42,	6,	.123,	.926
FLT06: IBTS_Q2_SCO (,	7671.,	.240,	.141,	.59,	5,	.113,	.643
FLT07: IBTS_Q4_ENG (,	5992.,	.275,	.032,	.12,	5,	.062,	.768
F shrinkage mean ,	4572.,	.50,,,,				.089,	.922

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5989.,	.09,	.04,	41,	.470,	.768

Table 4.9 (Continued)

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	407.,	.205,	.048,	.24,	7,	.220,	.759
FLT02: SCOLTR (Catch,	454.,	.206,	.063,	.31,	7,	.218,	.702
FLT03: ENGGFS (Catch,	366.,	.222,	.044,	.20,	7,	.197,	.817
FLT04: SCOGFS (Catch,	453.,	.279,	.240,	.86,	7,	.101,	.704
FLT05: IBTS_Q1 (Catc,	542.,	.224,	.092,	.41,	6,	.052,	.617
FLT06: IBTS_Q2_SCO (,	401.,	.291,	.162,	.56,	5,	.082,	.766
FLT07: IBTS_Q4_ENG (,	436.,	.327,	.313,	.96,	4,	.023,	.723
F shrinkage mean ,	348.,	.50,,,,				.106,	.845

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
412.,	.10,	.04,	44,	.414,	.752

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	143.,	.213,	.075,	.35,	8,	.333,	.587
FLT02: SCOLTR (Catch,	84.,	.212,	.163,	.77,	8,	.340,	.855
FLT03: ENGGFS (Catch,	94.,	.232,	.092,	.40,	6,	.034,	.797
FLT04: SCOGFS (Catch,	113.,	.258,	.165,	.64,	6,	.029,	.698
FLT05: IBTS_Q1 (Catc,	105.,	.225,	.169,	.75,	6,	.030,	.733
FLT06: IBTS_Q2_SCO (,	82.,	.300,	.165,	.55,	4,	.046,	.869
FLT07: IBTS_Q4_ENG (,	80.,	.336,	.385,	1.14,	3,	.013,	.888
F shrinkage mean ,	100.,	.50,,,,				.175,	.761

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
105.,	.14,	.06,	42,	.441,	.734

Table 4.9 (Continued)

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	51.,	.210,	.070,	.33,	9,	.303,	.583
FLT02: SCOLTR (Catch,	55.,	.196,	.070,	.36,	9,	.391,	.555
FLT03: ENGGFS (Catch,	36.,	.216,	.132,	.61,	6,	.023,	.757
FLT04: SCOGFS (Catch,	50.,	.255,	.090,	.35,	7,	.035,	.594
FLT05: IBTS_Q1 (Catc,	59.,	.205,	.109,	.53,	6,	.021,	.528
FLT06: IBTS_Q2_SCO (,	34.,	.285,	.149,	.52,	3,	.027,	.791
FLT07: IBTS_Q4_ENG (,	55.,	.364,	.243,	.67,	4,	.043,	.557
F shrinkage mean ,	30.,	.50,,,,				.158,	.858

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
48.,	.13,	.05,	45,	.368,	.617

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOSEI (Catch,	50.,	.294,	.099,	.33,	10,	.316,	.739
FLT02: SCOLTR (Catch,	69.,	.274,	.030,	.11,	10,	.274,	.588
FLT03: ENGGFS (Catch,	55.,	.250,	.100,	.40,	8,	.035,	.697
FLT04: SCOGFS (Catch,	56.,	.274,	.130,	.47,	7,	.011,	.683
FLT05: IBTS_Q1 (Catc,	36.,	.221,	.215,	.97,	6,	.006,	.936
FLT06: IBTS_Q2_SCO (,	84.,	.389,	.137,	.35,	2,	.006,	.504
FLT07: IBTS_Q4_ENG (,	34.,	.421,	.276,	.66,	3,	.016,	.969
F shrinkage mean ,	49.,	.50,,,,				.336,	.759

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
54.,	.21,	.04,	47,	.186,	.702

TABLE 4.10; Haddock, North Sea + IIIa
International F at age, Total , 1963 to 1995.

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

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
0	.070	.002	.002	.017	.030	.012	.032	.002	.013	.011
1	1.303	.263	.052	.022	.500	.474	.169	.374	.353	.335
2	.831	1.081	.578	.655	1.038	.659	.793	.565	.933	.969
3	.360	.415	.898	1.376	1.150	.798	1.339	1.158	.950	1.254
4	.779	.372	.307	1.287	1.269	.871	1.201	.802	1.003	1.099
5	1.240	1.014	.508	.814	.711	.864	1.158	.950	.628	.992
6	1.310	1.326	.808	1.626	1.437	.686	.859	1.098	.880	.820
7	1.082	1.139	.597	1.000	.709	1.017	.684	.882	1.125	1.567
8	.970	1.945	.659	.951	1.059	1.285	.471	1.146	.405	.998
9	1.089	1.173	.581	1.149	1.049	.955	.884	.987	.817	1.108
10+	1.089	1.173	.581	1.149	1.049	.955	.884	.987	.817	1.108

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	.030	.013	.022	.035	.074	.057	.038	.027	.015	.016
1	.308	.338	.391	.176	.189	.179	.173	.151	.125	.207
2	.814	1.005	1.012	.882	.707	.450	.431	.659	.667	.614
3	1.371	1.037	1.128	1.141	1.210	.945	.815	1.020	.994	.960
4	.781	1.262	1.123	1.062	1.184	.994	.879	1.158	1.138	1.106
5	1.271	1.031	1.163	1.023	.937	.801	.648	1.210	1.209	1.031
6	1.064	.989	1.036	1.171	.985	.610	.746	.817	1.082	1.066
7	.393	.924	1.146	.617	1.296	1.008	.981	.830	.774	.961
8	.840	.488	.853	.941	.657	1.115	1.104	.576	.563	.708
9	.879	.949	1.077	.974	1.023	.915	.881	.928	.964	.985
10+	.879	.949	1.077	.974	1.023	.915	.881	.928	.964	.985

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	.003	.009	.005	.004	.006	.013	.018	.032	.004	.049
1	.128	.119	.137	.106	.197	.155	.146	.164	.156	.099
2	1.015	.902	.796	.655	1.120	.795	.732	.793	.525	.525
3	1.240	1.049	1.305	.987	1.163	1.032	1.194	1.024	1.023	.777
4	1.294	1.084	1.117	1.185	1.153	.864	1.062	1.043	.977	.888
5	1.063	.837	1.108	.703	.949	.884	.803	.957	.965	.768
6	.716	1.138	.767	.779	.551	.658	1.114	.783	1.077	.752
7	.848	.811	.844	.600	.671	.511	.748	.885	.955	.734
8	.693	1.158	.592	.717	.521	.735	.923	.574	1.491	.617
9	1.006	1.028	.668	.730	.698	.847	.979	1.035	1.389	.702
10+	1.006	1.028	.668	.730	.698	.847	.979	1.035	1.389	.702

TABLE 4.11; Haddock, North Sea + IIIa

Tuned Stock Numbers at age (10**-5), 1963 to 1996, (numbers in 1996 are VPA survivors)

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

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
0	3881118	171025	121955	877639	782847	215392	728983	1334931	115423	164842
1	82821	498537	21977	15439	109661	99584	26853	93628	169646	14693
2	1647	12233	90929	4131	1798	13106	16149	3549	12631	23303
3	162	375	4601	31652	980	623	3975	6153	936	3213
4	131	83	119	905	7806	344	127	972	1853	208
5	3085	70	48	26	198	2545	81	44	278	481
6	37	917	35	17	10	68	654	26	19	84
7	3	8	334	6	3	4	24	179	9	7
8	3	1	4	101	2	1	2	8	48	1
9	1	0	0	1	29	1	1	0	4	14
10+	1	0	0	1	3	8	3	1	1	1

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	257504	395514	721808	156583	325016	206485	670377	172801	240690	498941
1	20596	32716	49822	89758	18725	39522	25582	84005	21903	30484
2	2074	2821	4252	8028	14265	3007	6382	4224	14239	3421
3	6918	509	688	1179	2653	6098	1310	2213	1454	5167
4	635	1909	128	171	274	803	2103	368	638	433
5	74	140	483	35	41	79	260	515	92	164
6	110	22	36	142	11	15	34	63	126	27
7	24	34	6	9	43	5	6	12	18	35
8	4	8	9	3	2	13	2	2	5	6
9	1	2	3	3	1	1	4	1	1	2
10+	4	2	1	2	1	0	1	2	2	2

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	42018	84451	86337	283220	277748	430296	125430	569573	160048	0
1	64028	5361	10812	11071	36253	35311	54423	15641	73016	19622
2	5152	10921	898	1868	1746	5961	5862	8873	2569	12700
3	831	1402	3303	313	409	529	1922	1778	3519	1018
4	1165	227	296	959	76	113	125	538	498	1259
5	93	307	58	70	236	25	31	34	158	160
6	46	33	83	23	22	80	9	10	11	60
7	11	12	12	31	11	9	21	3	3	4
8	12	4	4	6	13	5	4	7	1	1
9	2	3	2	2	3	5	2	2	1	0
10+	2	2	1	1	1	3	4	1	1	1

Table 4.12

HADDOCK IN IIIa/IV, RCT3 INPUT VALUES, XSA run X02, age 2.

18 26 2

'YEARCLASS'	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS0'	'SGFS1'	'SGFS2'	'GGFS1'	'GGFS2'	'IBQ21'	'SCQ21'	'SCQ22'	'IBQ40'	'IBQ41'	'ENQ40'	'ENQ41'	'ENQ42'
1971	16149	740	971	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	3549	187	110	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	12631	1092	385	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	23303	1168	670	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	2074	177	84	-1	-1	32.1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1976	2821	162	108	-1	66.8	26.2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1977	4252	385	240	534.8	136.9	54.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	8028	480	402	358.3	295.5	167.3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1979	14265	896	675	875.5	623.3	439.1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1980	3007	268	252	374	173.2	79.8	-1	-1	99.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1981	6382	526	400	1537.5	315.5	109.5	-1	248.8	161.1	-1	72.8	-1	-1	-1	-1	-1	-1	-1	-1
1982	4224	307	219	281.3	218.2	61.6	123.5	181.3	78.8	93.9	47.2	-1	-1	-1	-1	-1	-1	-1	-1
1983	14239	1057	828	831.9	599.3	238.2	220.3	436.7	298.1	272.9	259.6	-1	-1	-1	-1	-1	-1	-1	-1
1984	3421	229	244	228.5	186.6	44.7	87.3	197.6	57.4	129.7	38	-1	-1	-1	-1	-1	-1	-1	-1
1985	5152	579	326	245.9	149.7	43.1	81.8	232.9	70.4	142.3	154.4	-1	-1	-1	-1	-1	-1	-1	-1
1986	10921	885	688	266	281.9	183.5	174.7	239.3	198.2	307.4	179.9	-1	-1	-1	-1	-1	-1	-1	-1
1987	898	92	97	22.4	28.6	14.5	27.7	46.7	21.4	68.6	45.3	-1	-1	-1	-1	-1	-1	-1	-1
1988	1868	210	114	60.7	81.7	19.8	40.6	88.6	24	135	54.7	-1	-1	-1	-1	-1	-1	-1	-1
1989	1746	219	131	94.3	66.4	9.6	43.2	100.2	17.8	180	54.9	-1	-1	493	-1	-1	-1	-1	5.094
1990	5961	679	371	281.9	115	97.7	316.3	170.5	96.3	601	129.2	502	4087	2854	-1	481	-1	57.818	22.977
1991	5862	1115	543	263.3	196.9	58.6	347.1	383.2	138	480.1	-1	772	8196	2680	1128	845.63	90.712	74.865	17.137
1992	8873	1242	504	827.7	246.1	90.2	827	583.6	208	-1	163.5	1276	11963	3838	2461.76	1005.92	198.232	75	22.192
1993	-1	229	205	135.8	80.7	44.5	85.9	126.5	73.4	186.8	69.4	495	1295	1186	636.18	673.3	42.168	185.26	17.995
1994	-1	1375	817	943	383.1	146.1	1376.2	815.3	470.5	526.6	-1	1549	12539	6889	3519.24	2190.92	137.483	160.928	-1
1995	-1	260	-1	180	82.6	-1	156.6	223.1	-1	-1	-1	790	1922	-1	598.78	-1	51.541	-1	-1
1996	-1	-1	-1	199	-1	-1	198	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Yclass	VPA	IBQ11	IBQ12	egfs0	egfs1	egfs2	sgfs0	sgfs1	sgfs2	ggfs1	ggfs2	IBQ21	SCQ21	SCQ22	IBQ40	IBQ41	ENQ40	ENQ41	ENQ42
Updated ?		Prov	Prov	y	y	y	y	y	y	N/A	N/A	y	y	y	y	y	y	y	y

KEY

index	Survey	Quarter	Age
IBQ11	IBTS	1	1 Provisiopnal (age based) for 96 survey
IBQ12	IBTS	1	2 Provisiopnal (age based) for 96 survey
EGFS0	English GFS	3	0
EGFS1	English GFS	3	1
EGFS2	English GFS	3	2
SGFS0	Scottish GFS	3	0
SGFS1	Scottish GFS	3	1
SGFS2	Scottish GFS	3	2
GGFS1	German GFS	2	1 Survey discontinued
GGFS2	German GFS	2	2 Survey discontinued
IBQ21	IBTS (provisional, length-based)	2	1
SCQ21	IBTS (Scottish, age based)	2	1
SCQ22	IBTS (Scottish, age based)	2	2
IBQ40	IBTS (provisional, length-based)	4	0
IBQ41	IBTS (provisional, length-based)	4	1
ENQ40	IBTS (English, age based)	4	0
ENQ41	IBTS (English, age based)	4	1
ENQ42	IBTS (English, age based)	4	2

Table 4.13a; Haddock in the North Sea and Division IIIa; RCT3 output, age 0

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

 HADDOCK IN IIIa/IV, RCT3 INPUT VALUES,  XSA run X02, age 0

Data for   18 surveys over   26 years :  1971 - 1996
 Regression type = C
 Tapered time weighting applied
 power =    0 over  20 years
 Survey weighting not applied

 Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as    .00
 Minimum of   5 points used for regression

 Forecast/Hindcast variance correction used.

Yearclass =   1995
          I-----------Regression---------I  I-----------Prediction---------I
 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted  Std    WAP
 Series           cept   Error          Pts  Value   Value   Error  Weights

 IYFS1     1.10   5.70    .39   .797     23   5.56   11.83    .422    .209
 IYFS2
 EGFS0      .85   7.55    .46   .751     17   5.20   11.97    .502    .147
 EGFS1     1.04   7.03    .33   .845     18   4.43   11.63    .368    .274
 EGFS2
 SGFS0      .99   7.43    .57   .691     12   5.06   12.43    .651    .087
 SGFS1     1.26   5.63    .37   .835     13   5.41   12.43    .414    .216
 SGFS2
 GGFS1
 GGFS2
 IBQ21
 SCQ21
 SCQ22
 IBQ40
 IBQ41
 ENQ40
 ENQ41
 ENQ42
                                        VPA Mean =   12.29    .743    .067
 Yearclass =   1996

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

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

 IYFS1
 IYFS2
 EGFS0      .85   7.55    .46   .751     17   5.30   12.06    .501    .492
 EGFS1
 EGFS2
 SGFS0      .99   7.43    .57   .691     12   5.29   12.66    .655    .288
 SGFS1
 SGFS2
 GGFS1
 GGFS2
 IBQ21
 SCQ21
 SCQ22
 IBQ40
 IBQ41
 ENQ40
 ENQ41
 ENQ42

                                        VPA Mean =   12.33    .748    .221

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

 1994     721290      13.49    .13     .13      .95
 1995     164040      12.01    .19     .15      .58
 1996     217390      12.29    .35     .18      .26
```

Table 4.13b; Haddock in the North Sea and Division IIIa; RCT3 output, age 1

```
Analysis by RCT3 ver3.1 of data from file :
 hadrct1.inp

 HADDOCK IN IIIa/IV, RCT3 INPUT VALUES,  XSA run X02, age 1.

 Data for   18 surveys over   26 years :  1971 - 1996

 Regression type = C
 Tapered time weighting applied
 power =    0 over  20 years
 Survey weighting not applied

 Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as    .00
 Minimum of   5 points used for regression

 Forecast/Hindcast variance correction used.
```

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	---------I		I-----------	Prediction	---------	I
IYFS1	1.09	3.69	.38	.804	23	5.56	9.76	.411	.223
IYFS2									
EGFS0	.86	5.45	.47	.735	17	5.20	9.90	.521	.138
EGFS1	1.04	4.95	.34	.835	18	4.43	9.55	.379	.261
EGFS2									
SGFS0	.98	5.38	.57	.692	12	5.06	10.36	.649	.089
SGFS1	1.25	3.59	.37	.834	13	5.41	10.36	.414	.220
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		10.22	.740	.069

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	---------I		I-----------	Prediction	---------	I
IYFS1									
IYFS2									
EGFS0	.86	5.45	.47	.735	17	5.30	9.98	.520	.471
EGFS1									
EGFS2									
SGFS0	.98	5.38	.57	.692	12	5.29	10.59	.653	.299
SGFS1									
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		10.25	.746	.230

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1994	91667	11.43	.14	.13	.92		
1995	20783	9.94	.19	.15	.57		
1996	27629	10.23	.36	.18	.26		

Table 4.13c; Haddock in the North Sea and Division IIIa; RCT3 output, age 2

Analysis by RCT3 ver3.1 of data from file :
hadrct2.inp

HADDOCK IN IIIa/IV, RCT3 INPUT VALUES, XSA run X02, age 2.

Data for 18 surveys over 26 years : 1971 - 1996

Regression type = C
Tapered time weighting applied
power = 0 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1994

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
IYFS1	1.16	1.48	.37	.840	23	7.23	9.84	.420	.097
IYFS2	1.24	1.44	.34	.861	23	6.71	9.77	.386	.115
EGFS0	.88	3.51	.52	.699	17	6.85	9.52	.589	.050
EGFS1	1.03	3.15	.32	.853	18	5.95	9.30	.361	.132
EGFS2	.86	4.82	.33	.844	19	4.99	9.11	.367	.128
SGFS0	1.00	3.52	.59	.681	12	7.23	10.73	.816	.026
SGFS1	1.27	1.71	.38	.823	13	6.70	10.20	.500	.069
SGFS2	.96	4.10	.32	.863	14	6.16	10.01	.404	.106
GGFS1	1.90	-1.75	1.01	.422	11	6.27	10.18	1.283	.010
GGFS2									
IBQ21									
SCQ21									
SCQ22	.82	2.23	.15	.963	5	8.84	9.47	.267	.241
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		8.47	.821	.026

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
IYFS1	1.08	1.89	.34	.839	23	5.56	7.93	.371	.264
IYFS2									
EGFS0	.88	3.51	.52	.699	17	5.20	8.07	.570	.112
EGFS1	1.03	3.15	.32	.853	18	4.43	7.72	.357	.285
EGFS2									
SGFS0	1.00	3.52	.59	.681	12	5.06	8.56	.670	.081
SGFS1	1.27	1.71	.38	.823	13	5.41	8.56	.432	.194
SGFS2									
GGFS1									
GGFS2									
IBQ21									
SCQ21									
SCQ22									
IBQ40									
IBQ41									
ENQ40									
ENQ41									
ENQ42									
					VPA Mean =		8.38	.751	.064

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1994	14730	9.60	.13	.13	.97		
1995	3260	8.09	.19	.15	.62		
1996	4549	8.42	.38	.19	.26		

TABLE 4.14; Haddock, North Sea + IIIa
Mean fishing mortality, biomass and recruitment, 1963 - 1995.

Year	Mean F H.cons Ages 2 to 6	Mean F Disc. Ages 2 to 6	Mean F Ind BC Ages 0 to 3	Stock Biomass ('000 tonnes) Total	Stock Biomass ('000 tonnes) Spawning	Recruits Age 0 Yclass	Recruits Age 0 Million
1963	.579	.125	.026	3387	137	1963	2338
1964	.699	.073	.130	1188	420	1964	9172
1965	.647	.067	.341	811	525	1965	26336
1966	.716	.104	.262	780	432	1966	68992
1967	.678	.142	.051	1216	229	1967	388112
1968	.486	.089	.056	6700	265	1968	17103
1969	.843	.093	.198	2344	816	1969	12196
1970	.804	.123	.266	1409	902	1970	87764
1971	.629	.108	.077	1660	417	1971	78285
1972	.901	.145	.050	1677	301	1972	21539
1973	.778	.126	.033	901	295	1973	72898
1974	.641	.140	.099	1568	258	1974	133493
1975	.765	.203	.083	2163	238	1975	11542
1976	.816	.153	.120	885	308	1976	16484
1977	.814	.127	.164	567	239	1977	25750
1978	.880	.185	.058	665	132	1978	39551
1979	.941	.085	.053	673	109	1979	72181
1980	.851	.080	.083	1251	153	1980	15658
1981	.654	.086	.063	671	240	1981	32502
1982	.590	.067	.064	841	300	1982	20649
1983	.802	.145	.048	760	253	1983	67038
1984	.903	.091	.031	1495	199	1984	17280
1985	.857	.078	.017	861	242	1985	24069
1986	.884	.178	.012	716	222	1986	49894
1987	.856	.142	.014	1068	157	1987	4202
1988	.847	.147	.019	427	159	1988	8445
1989	.709	.132	.014	398	129	1989	8634
1990	.725	.233	.015	341	81	1990	28322
1991	.766	.066	.022	743	63	1991	27775
1992	.870	.100	.029	608	101	1992	43030
1993	.763	.140	.037	892	135	1993	12543
1994	.734	.172	.013	517	160	1994	56957
1995	.602	.136	.022	993	162	1995	* 16404
Min.	.486	.066	.012	341	63	Min.	2338
Mean	.759	.124	.078	1248	266	Gmean	26424
Max.	.941	.233	.341	6700	902	Max.	388112

Min, max and geo. mean recruitment calculated over years 1963 to 1993
(Arithmetic mean recruitment 1963 - 1993 = 46573)
Biomass totals calculated at start of year.

* RCT3 estimate

Table 4.15.Haddock,North Sea + IIIa
Input data for catch forecast and linear sensitivity analysis.

Populations in 1996			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N0	21739000	.35	WS0	.01	.26	M0	2.05	.10	MT0	.00	.10
N1	2078300	.19	WS1	.11	.07	M1	1.65	.10	MT1	.01	.10
N2	1269999	.11	WS2	.28	.09	M2	.40	.10	MT2	.32	.10
N3	101799	.08	WS3	.41	.10	M3	.25	.10	MT3	.71	.10
N4	125899	.07	WS4	.62	.08	M4	.25	.10	MT4	.87	.10
N5	15999	.08	WS5	.87	.11	M5	.20	.10	MT5	.95	.10
N6	5998	.09	WS6	1.16	.05	M6	.20	.10	MT6	1.00	.10
N7	400	.10	WS7	1.37	.18	M7	.20	.10	MT7	1.00	.00
N8	100	.14	WS8	1.58	.07	M8	.20	.10	MT8	1.00	.00
N9	0	.13	WS9	1.74	.07	M9	.20	.10	MT9	1.00	.00
N10	100	.21	WS10	2.09	.14	M10	.20	.10	MT10	1.00	.00

HC selectivity			HC.catch wt			Dis selectivity			Discrd catch wt		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
sH0	.00	1.73	WH0	.00	.00	sD0	.00	1.00	WD0	.05	.41
sH1	.00	.49	WH1	.31	.06	sD1	.09	.25	WD1	.13	.06
sH2	.16	.32	WH2	.39	.01	sD2	.36	.16	WD2	.23	.09
sH3	.57	.17	WH3	.46	.08	sD3	.23	.35	WD3	.28	.03
sH4	.81	.07	WH4	.63	.07	sD4	.03	.74	WD4	.34	.09
sH5	.77	.01	WH5	.88	.11	sD5	.01	1.01	WD5	.35	.12
sH6	.74	.11	WH6	1.19	.08	sD6	.02	1.73	WD6	.09	1.73
sH7	.74	.05	WH7	1.37	.17	sD7	.00	1.73	WD7	.12	1.73
sH8	.78	.52	WH8	1.58	.07	sD8	.00	.00	WD8	.00	.00
sH9	.91	.24	WH9	1.74	.07	sD9	.00	.00	WD9	.00	.00
sH10	.46	.26	WH10	2.07	.14	sD10	.00	.00	WD10	.00	.00

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI0	.02	.79	WI0	.01	.20
sI1	.03	.12	WI1	.05	.10
sI2	.02	.34	WI2	.18	.14
sI3	.01	.59	WI3	.37	.21
sI4	.01	.56	WI4	.50	.21
sI5	.00	.98	WI5	.43	.88
sI6	.00	1.72	WI6	.57	1.08
sI7	.00	1.73	WI7	.19	1.73
sI8	.00	1.73	WI8	.44	1.73
sI9	.00	.00	WI9	.00	.00
sI10	.00	.00	WI10	.00	.00

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K96	1.00	.10	HF96	1.00	.11	IF96	1.00	.50
K97	1.00	.10	HF97	1.00	.11	IF97	1.00	.50
K98	1.00	.10	HF98	1.00	.11	IF98	1.00	.50

Recruitment		
Labl	Value	CV
R97	26424400	1.05
R98	26424400	1.05

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

Table 4.16 Haddock, North Sea + IIIa
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	1996	1997						
Mean F Ages								
H.cons 2 to 6	.74	.00	.15	.30	.44	.59	.74	.89
Ind BC 0 to 3	.02	.02	.02	.02	.02	.02	.02	.02
Effort relative to 1995								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Biomass at start of year								
Total	722	673	673	673	673	673	673	673
Spawning	233	243	243	243	243	243	243	243
Catch weight (,000t)								
H.cons	118	0	34	64	90	112	131	148
Discards	87	0	13	25	36	46	56	64
Ind BC	7	8	8	7	7	7	7	7
Total Landings	125	8	42	71	97	119	138	154
Total Catch	212	8	55	97	133	165	194	219
Biomass at start of 1998								
Total		917	858	807	763	725	692	663
Spawning		396	347	305	269	237	210	187

	Year							
	1996	1997						
Effort relative to 1995								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Est. Coeff. of Variation								
Biomass at start of year								
Total	.10	.24	.24	.24	.24	.24	.24	.24
Spawning	.10	.15	.15	.15	.15	.15	.15	.15
Catch weight								
H.cons	.17	.00	.54	.29	.21	.18	.17	.16
Discards	.19	.00	.58	.35	.29	.27	.26	.26
Ind BC	.58	.67	.68	.68	.69	.70	.70	.71
Biomass at start of 1998								
Total		.47	.50	.53	.56	.58	.61	.63
Spawning		.17	.19	.19	.20	.20	.21	.22

Table 4.17.Haddock,North Sea + IIIa
Detailed forecast tables.

Forecast for year 1996
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	21739000	18316	36632	183162	238111
1	2078300	3893	84662	31140	119695
2	1269999	128652	296065	17319	442036
3	101800	35971	14388	813	51172
4	125899	61719	2374	459	64553
5	15999	7825	102	20	7948
6	5999	2842	81	0	2923
7	400	192	0	1	193
8	100	50	0	0	50
9	0	0	0	0	0
10	100	34	0	0	34
Wt	722	118	87	7	212

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

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	26424400	22264	44528	222639	289431
1	2726743	5107	111077	40856	157040
2	352943	35753	82279	4813	122845
3	498085	175997	70399	3979	250375
4	34988	17152	660	128	17940
5	42203	20642	269	54	20965
6	6011	2847	81	0	2929
7	2304	1106	0	6	1112
8	155	77	0	0	77
9	38	21	0	0	21
10	52	17	0	0	17
Wt	673	131	56	7	194

Table 4.18 Stock: Haddock in Sub-area IV (North Sea and Division IIIa

Assessment Quality Control Diagram 1

Average F(2-6,u)									
Date of assessment	Year								
	1987	1988	1989	1990	1991	1992	1993	1994	1995
1989	1.00	1.00							
1990	1.00	1.05	0.95						
1991	1.02	1.05	0.91	0.98					
1992	1.01	1.03	0.91	1.10	1.23				
1993	0.99	0.99	0.87	0.99	0.92	1.31			
1994	1.01	1.06	0.97	0.86	0.81	1.07	1.02		
1995	1.01	1.05	0.96	0.84	0.78	1.00	0.87	0.89	
1996	1.00	1.02	0.86	0.99	0.85	0.99	0.92	0.91	0.74

Remarks: Laurec/Shepherd tuning used 1989-1992, XSA used in 1993. 1996 Assessment combined North Sea and IIIa, all previous figures are North Sea only

Assessment Quality Control Diagram 2

Recruitment (age 0) Unit: millions									
Date of assessment	Year class								
	1988	1989	1990	1991	1992	1993	1994	1995	1996
1989	7650								
1990	10512	1280							
1991	7802	7879	32729						
1992	7265	8351	33509	66763					
1993	8017	7927	25254	45919	83110	17559			
1994	7554	8141	27283	28631	51411	11813	45005		
1995	7591	8220	28190	2795	40711	12504	78532	17128	
1996	8445	8633	28322	27775	43030	12543	56957	16404	21739

Remarks: 1996 Assessment combined North Sea and IIIa, all previous figures are North Sea only

Table 4.18 (Cont'd) Stock: Haddock in Sub-area IV (North Sea) and Division IIIa

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)											
Date of assessment	Year										
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1989	134[2]	117[2]	79[1,2]	72[1,2]							
1990	149	122	86	81[1]	150[1]						
1991	150	122	76	64	99[1]	122[1]					
1992	149	119	71	55	105	201[1]	235[1]				
1993	155	125	77	58	89	165	248[1]	177[1]			
1994	154	121	68	61	99	130	194	158[1]	163[1]		
1995	155	122	69	62	103	133	158	178	230[1]	239[1]	
1996	159	129	81	63	101	135	160	162	233	243	210

[1]Forecast. [2]As revised by ACFM. 1996 Assessment combined North Sea and IIIa, all previous figures are North Sea only

Remarks: 1993 XSA used, 1989-1992 Laurec/Shepherd tuning used

Table 4.19

Reference Point Data
North Sea + III Haddock: Yield per Recruit

Fmax	=	.4021	Fmult =	.5333	Y/R	=	.0066	Kg/R
F0.1	=	.1955	Fmult =	.2534	Y/R	=	.0061	Kg/R
Fcurr	=	.7466	Fmult =	1.0000	SSB/R	=	.0075	Kg/R
Fhigh	>	.9681	Fmult >	1.3000	SSB/R	=	.0021	Kg/R
Fmed	=	.5784	Fmult =	.7721	SSB/R	=	.0101	Kg/R

Human Consumption	Reference age range	2 - 6	Reference F =	.6080
Discard	Reference age range	2 - 6	Reference F =	.1302
Industrial By-catch	Reference age range	0 - 3	Reference F =	.0215

Figure 4.1 Haddock in North Sea and Division IIIa. Log catchability residuals from final XSA run.

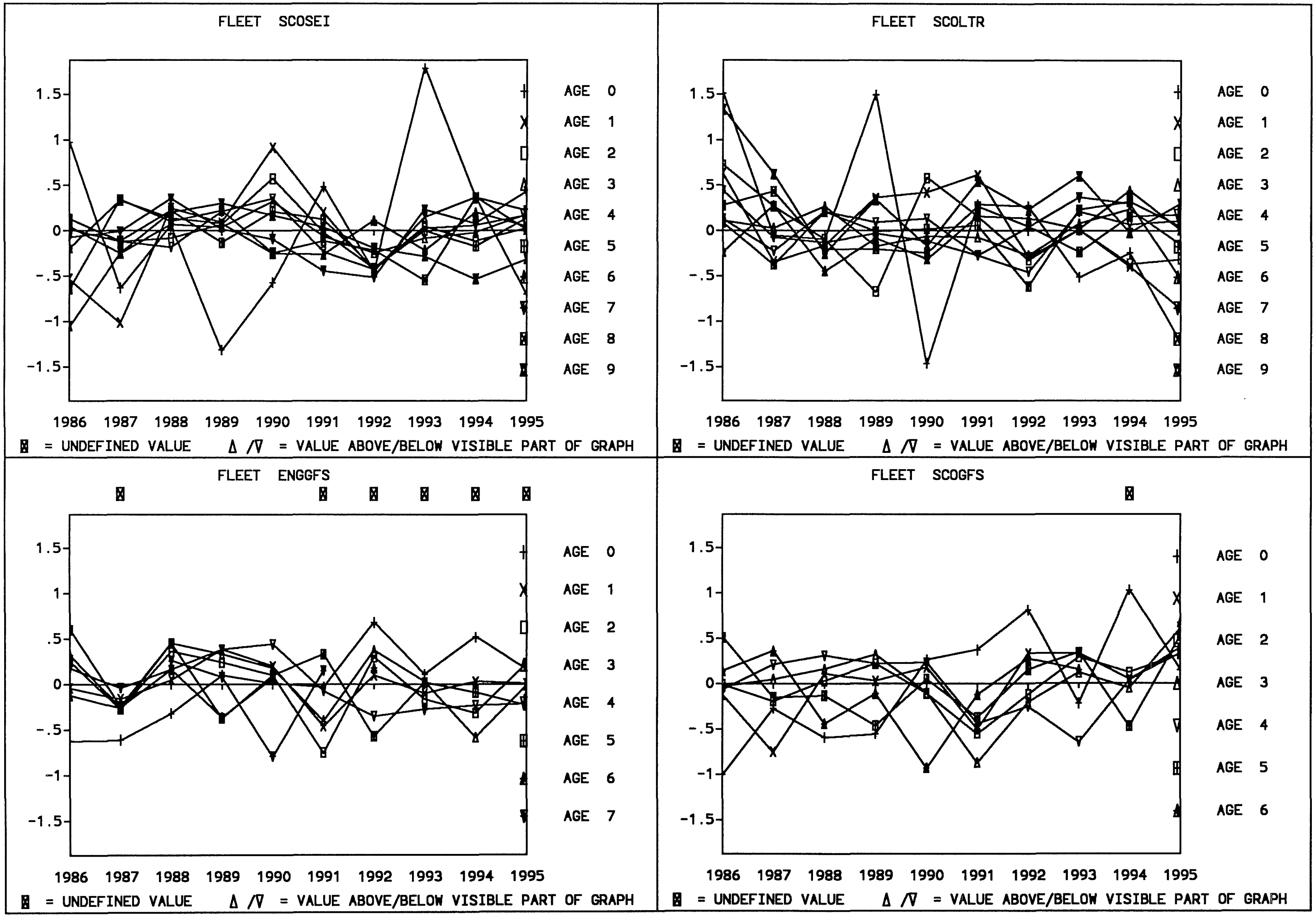


Figure 4.1 (Continued)

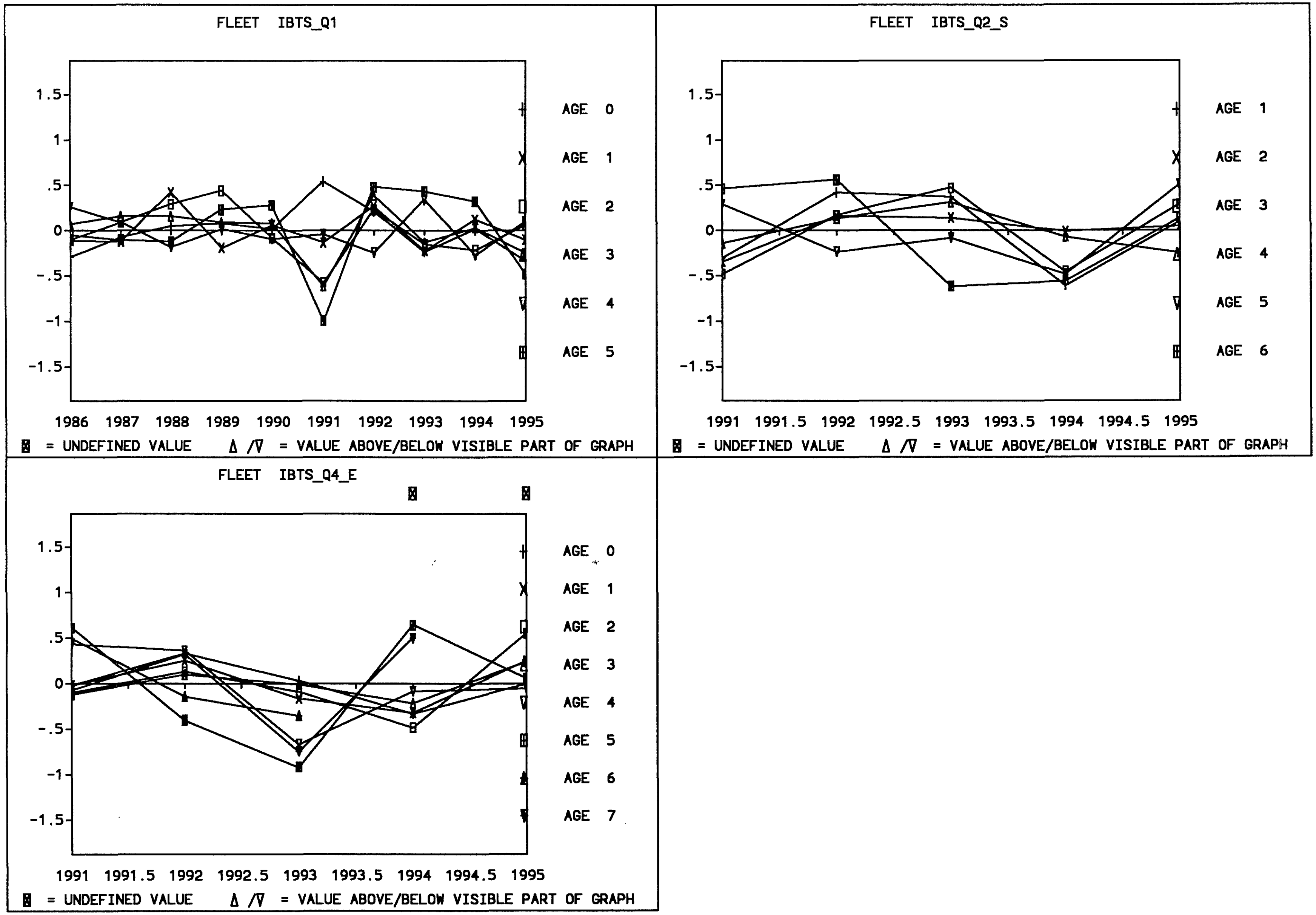


Figure 4.2; Haddock in the North Sea and Division IIIa
Retrospective trends in Mean F

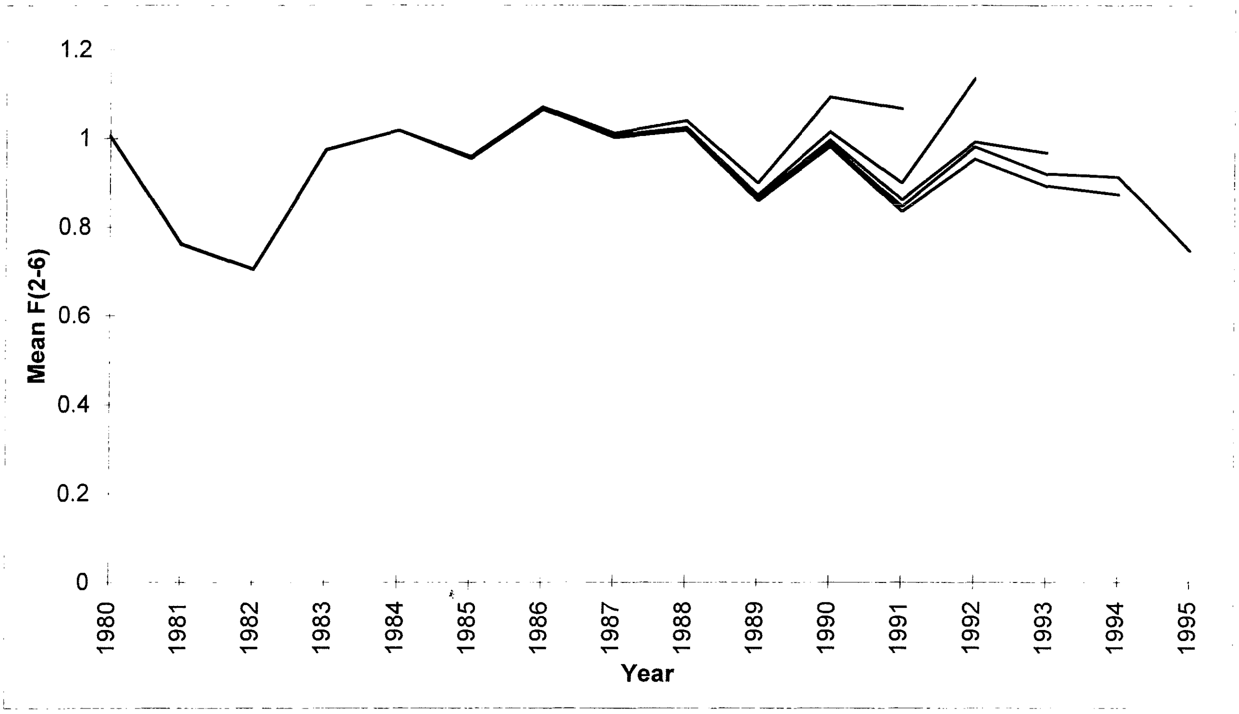


Figure 4.3 Stock summary, Haddock ,North Sea + III

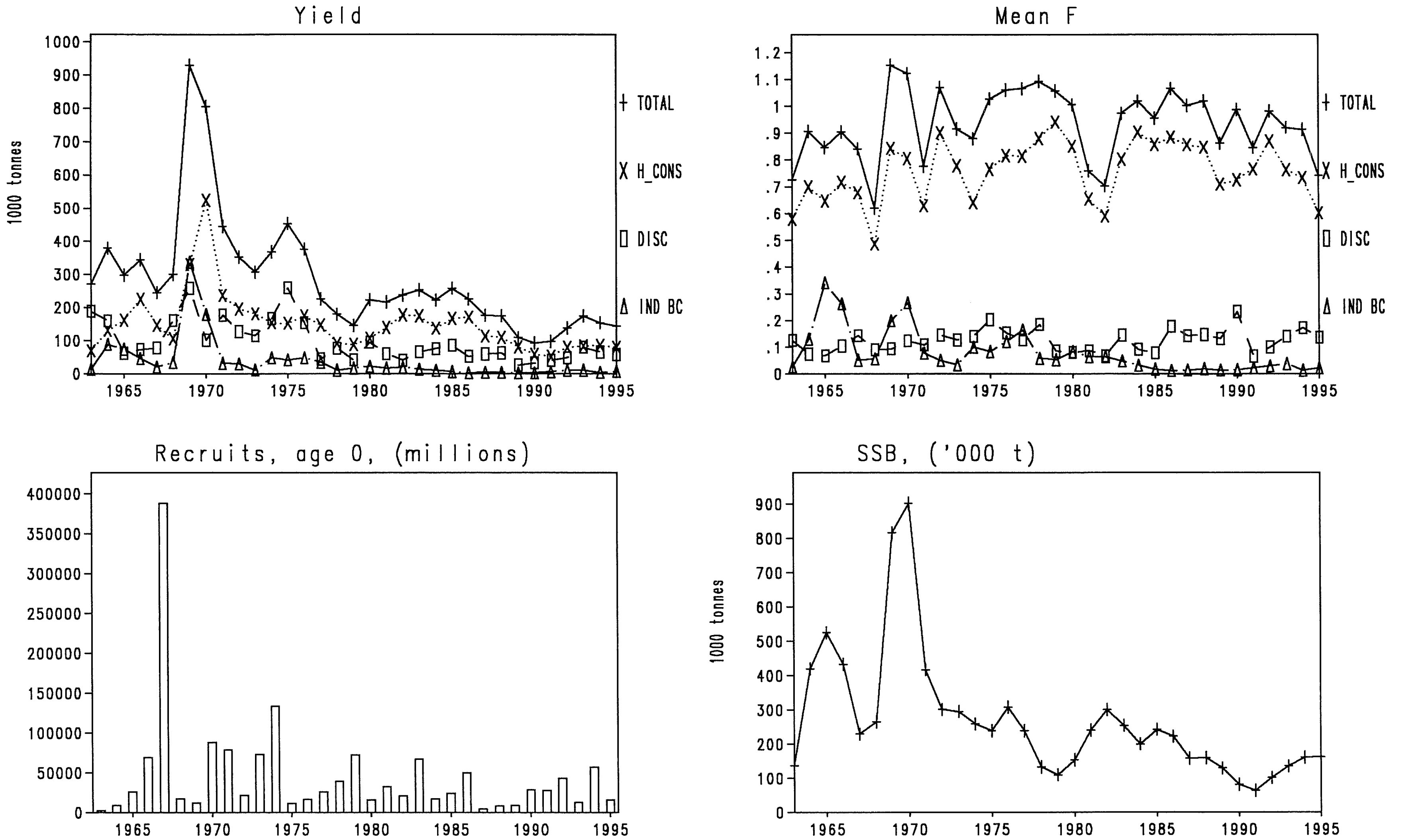


Figure 4.4 Haddock, North Sea + IIIa. Sensitivity analysis of short term forecast.

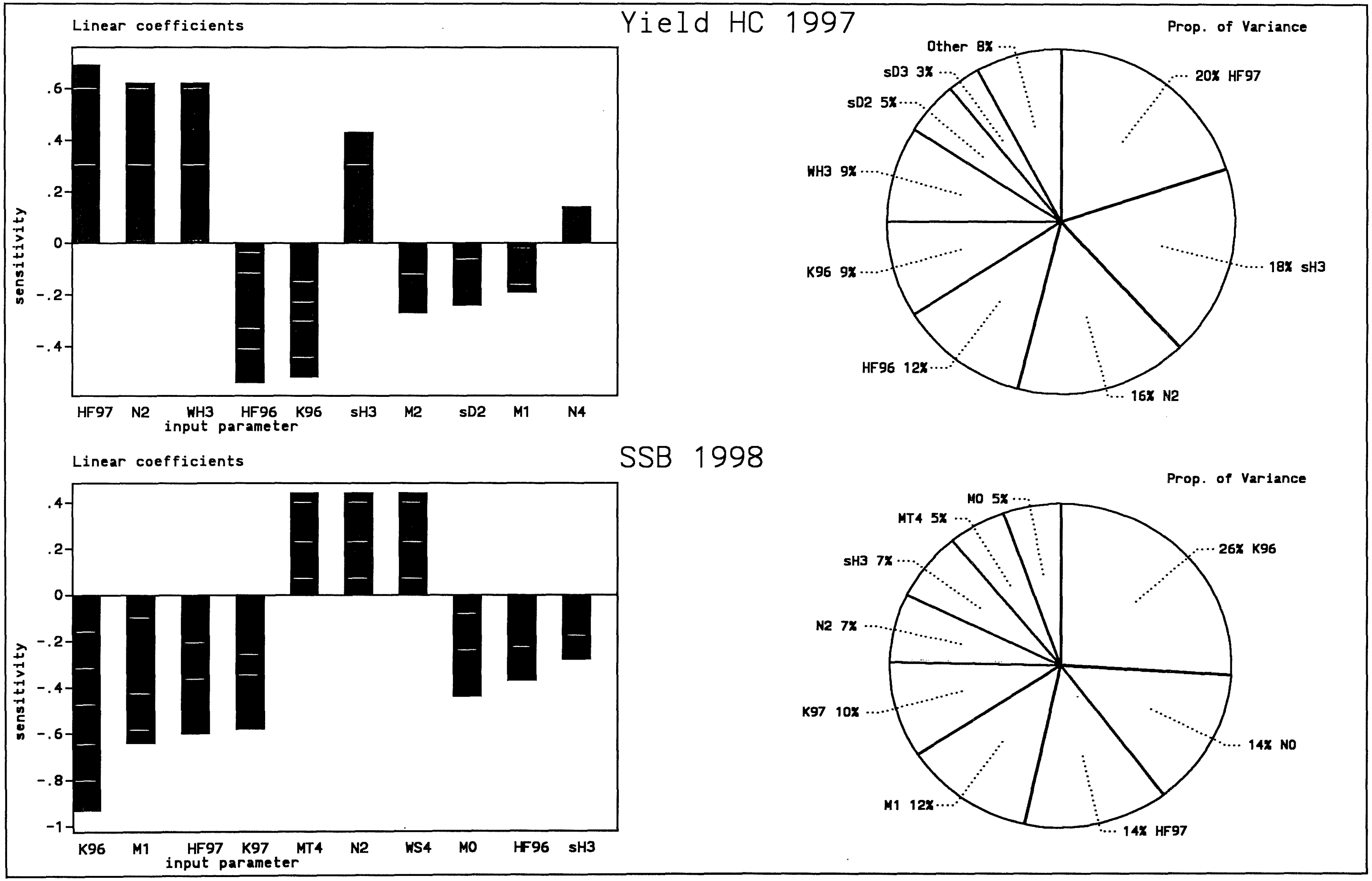
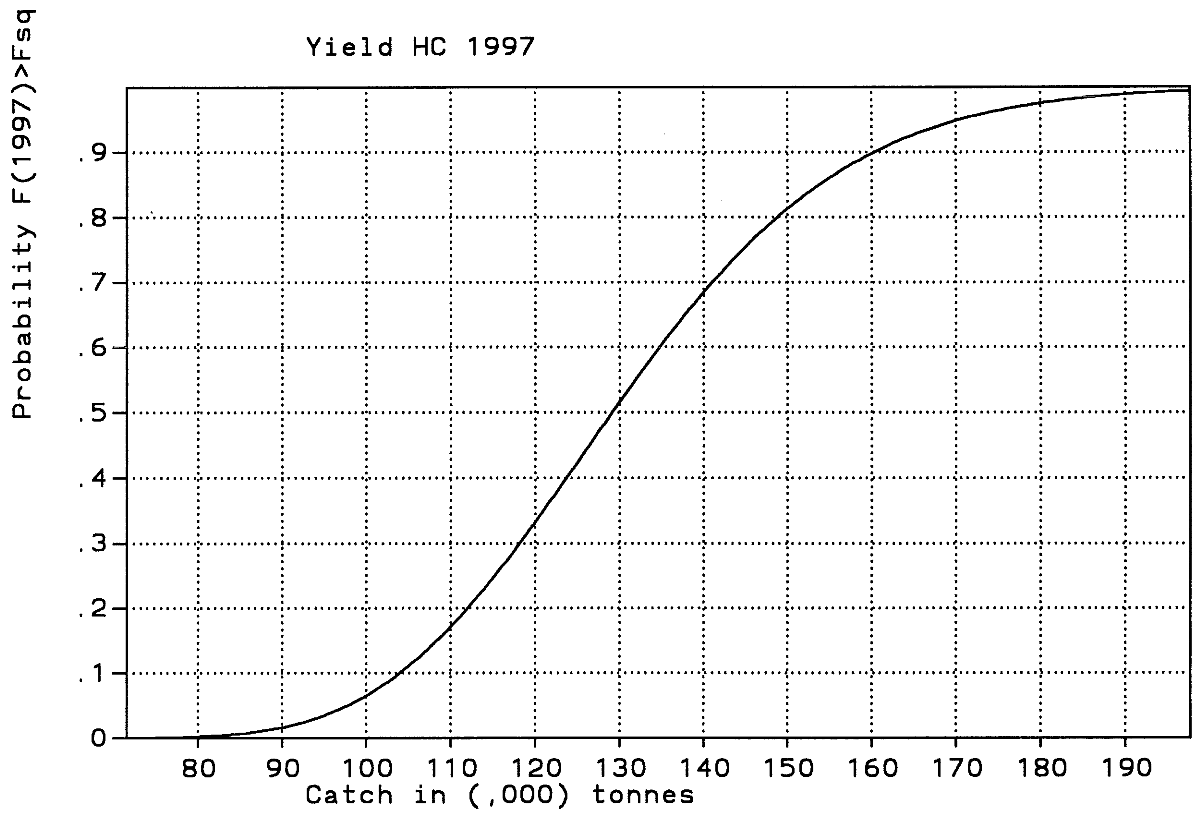


Figure 4.5 Haddock,North Sea + IIIa. Probability profiles for short term forecast.



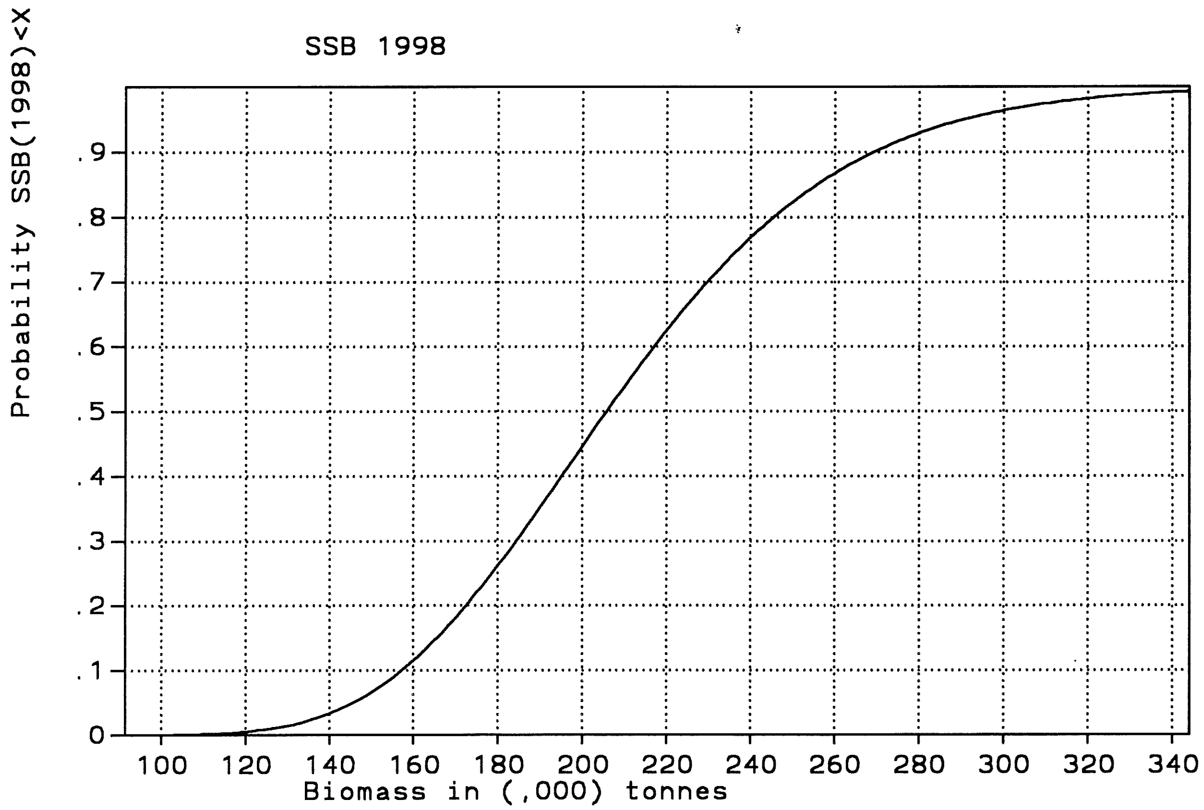


Figure 4.6 **Haddock in the North sea and Division IIIa. Medium term projections.**
Lines show 5,10, 20,50 and 95 percentiles
no stock-recruitment relationship
number of simulations 500 Relative H.Cons. effort = 1.00

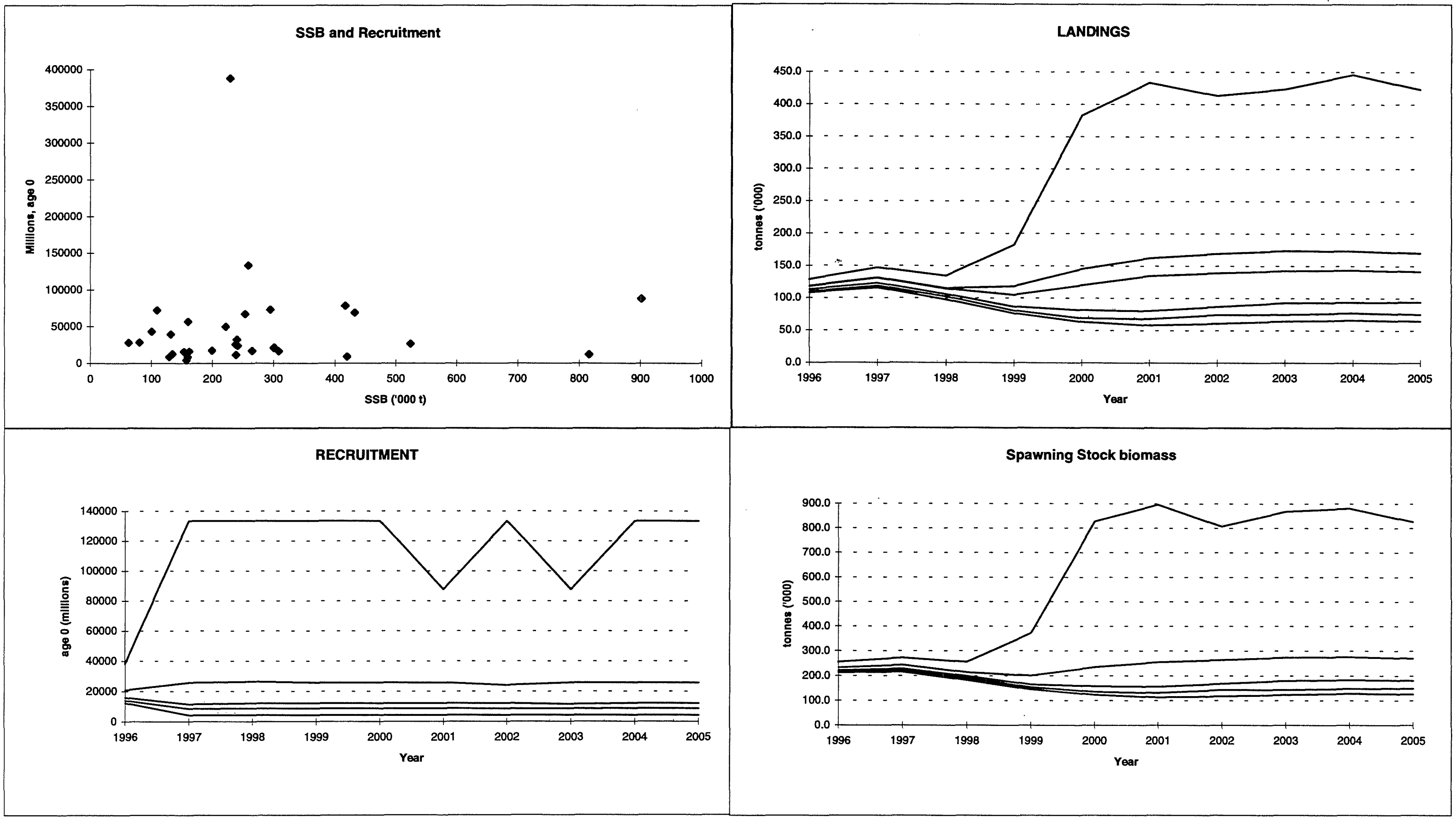


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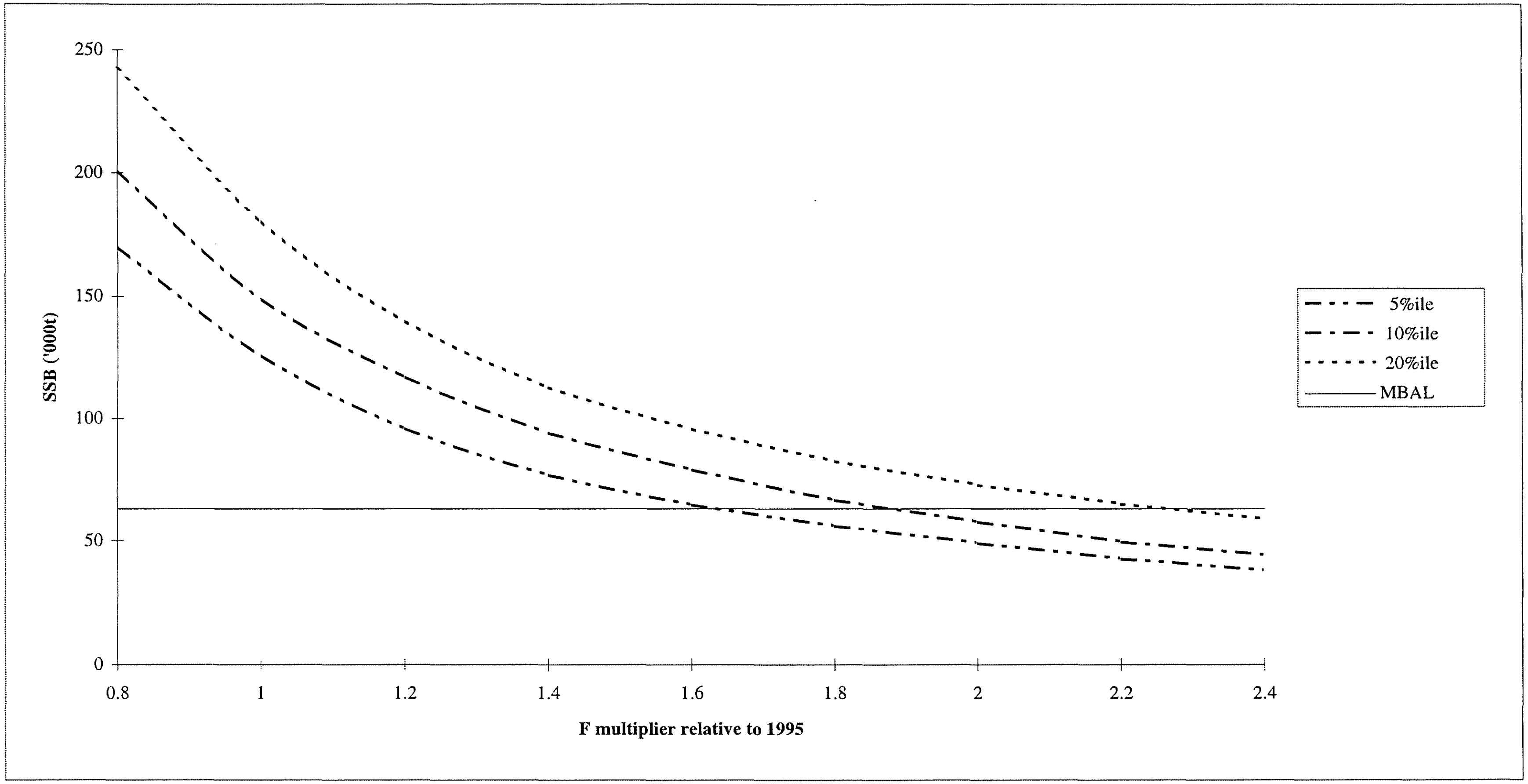
Figure 4.7 'Haddock in the North Sea and Division IIIa
Medium-term projections of SSB in 2005 at different F levels.(See Section 16.1)



E:\acfm\wgnssk97\F-4-7.xls

Figure 4.8 North Sea + III Haddock: Stock and Recruitment

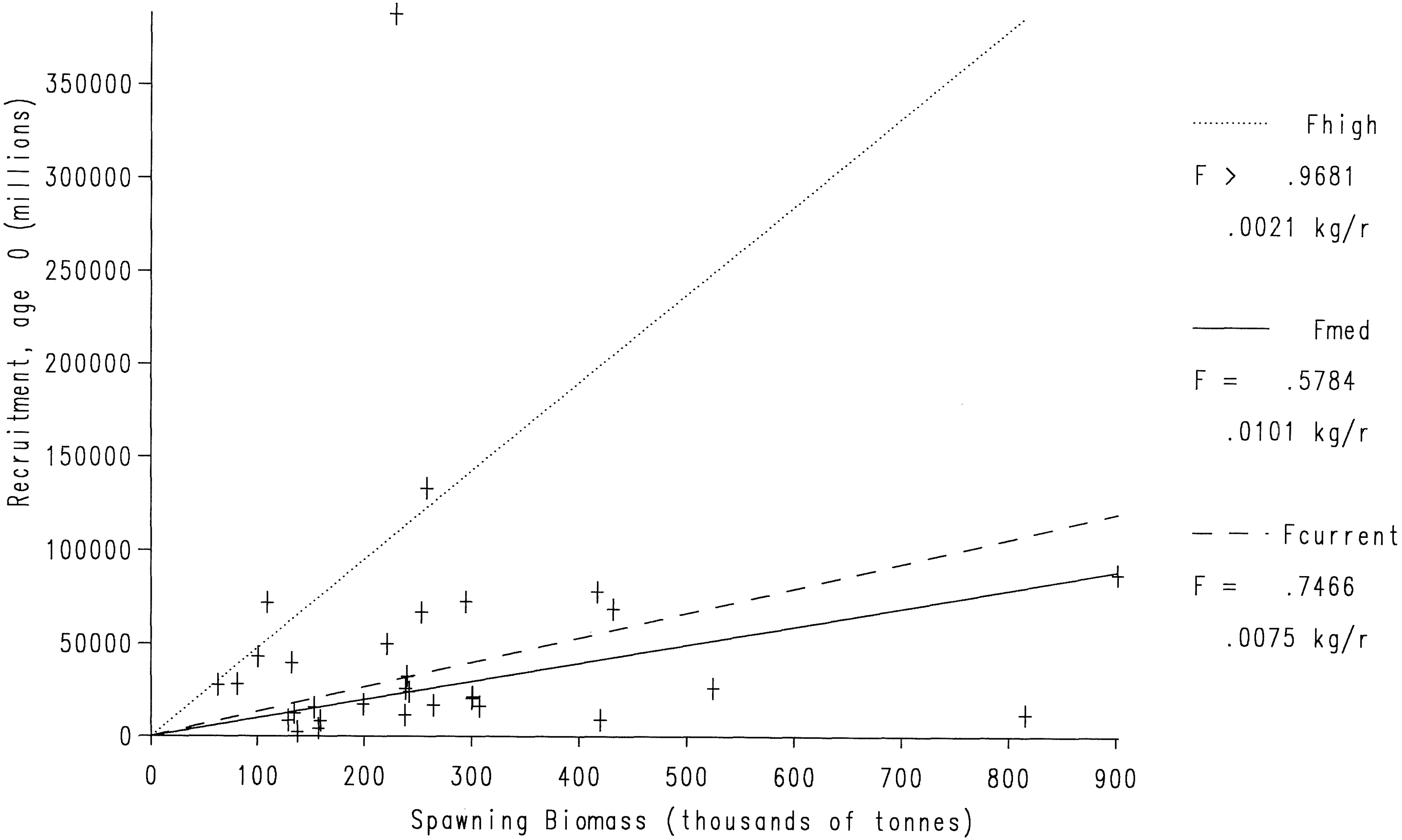
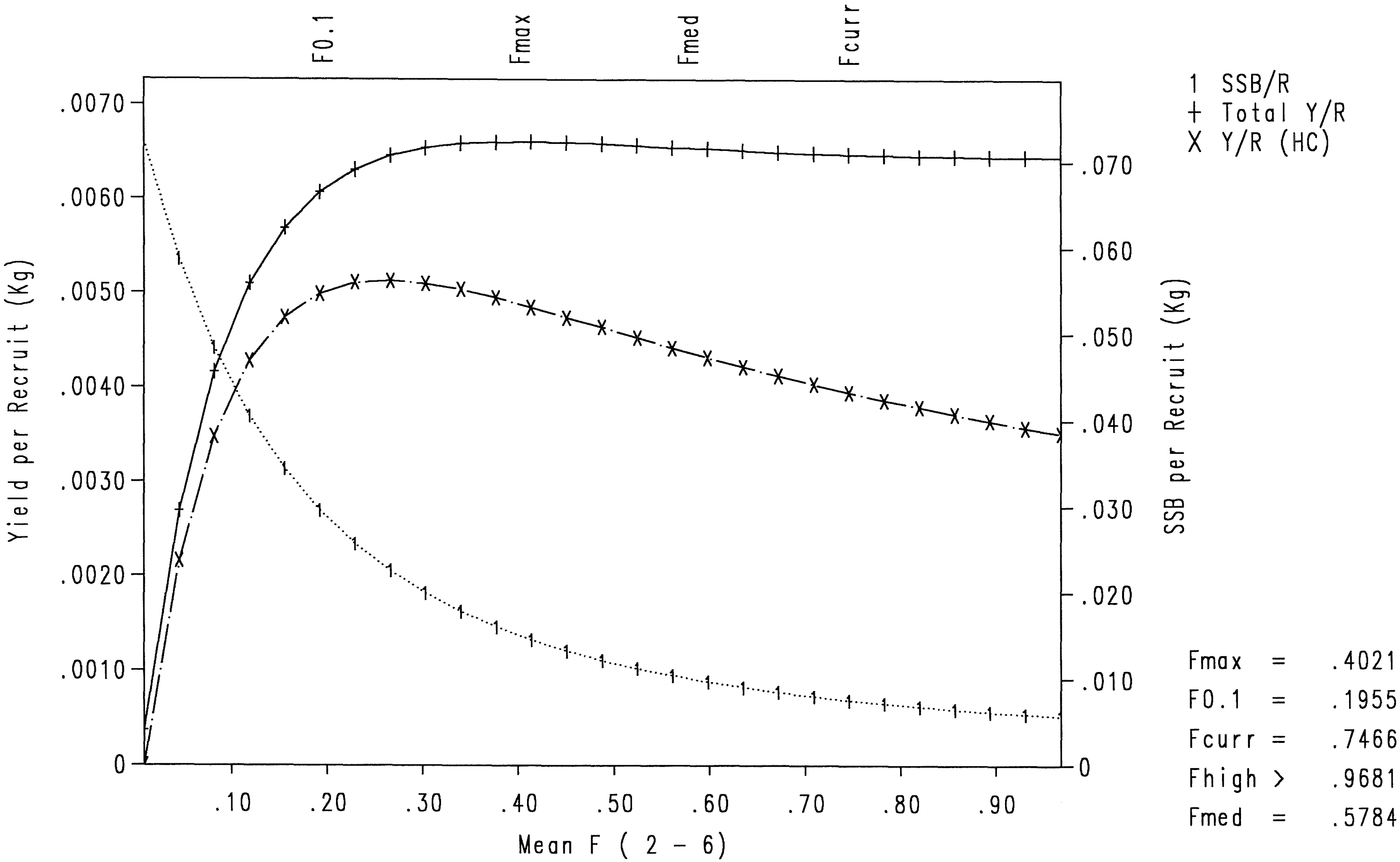


Figure 4.9 North Sea + III Haddock: Yield per Recruit



5 WHITING

5.1 Whiting in Sub-area IV and Division VIId

This is the first assessment undertaken for whiting in the combined area of Sub-area IV and Division VIIa. The rationale behind the merging of these stocks and the procedures undertaken in merging the data are described in Section 1.3.3.

5.1.1 Catch trends

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

For the North Sea, the total international catches were 99,000t in 1995, of which 42,000t were human consumption landings, 31,000t discards and 27,000t industrial by-catch. This represents a continued decrease in total landings since 1990 (149,000t), but is 13,000t greater than the 1994 value. The 1995 human consumption landings were the lowest recorded since 1989. The total North Sea landings of 68,000t in 1995 were 104% of last year's *status quo* prediction (65,000t) and 84% of the 1995 TAC of 81,000t.

In the eastern Channel recorded landings were 4,891t in 1995 compared to the *status quo* prediction made last year of 6,130 t.

In the North Sea, whiting are caught for human consumption in the mixed demersal fisheries for Scotland (seine and light trawl) and England (seine and trawl). They are also caught incidentally in the Dutch and German trawl fisheries where the former may target whiting if cod are unavailable. French trawlers targeting saithe also take an incidental catch of whiting and, closer inshore, whiting may comprise a part of the French trawl mixed demersal fishery for vessels moving into the southern North Sea from the Channel. Whiting comprise a by-catch in the industrial fishery for Norway pout and clupeids.

In the eastern Channel, whiting are caught both by inshore and offshore trawlers in a mixed demersal fishery.

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

The natural mortality and maturity at age values as used are shown in Table 5.1.5. For natural mortality, these are unchanged from last year as both the North Sea and eastern Channel assessments used similar values. For maturity at age, the values used correspond to the North Sea values as used last year.

The natural mortality values are rounded averages of the estimates produced by an earlier key run from MSVPA.

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

For Sub-area IV catches, human consumption landings data and age compositions were provided by Scotland, the Netherlands, England and France. 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. There is no industrial fishery in this area.

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

Total international catch at age and mean weight at age in the catch (North Sea and eastern Channel combined) are presented in Tables 5.1.6 and 5.1.7. The mean weights at age presented were corrected for sum of products differences, to account for SOP discrepancies in the earlier part of the time series.

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

5.1.3 Catch, Effort and Research Vessel Data

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

5.1.4 Catch-at-age analysis

As a preliminary investigations of the catch-at-age and tuning data, single fleet, unshrunk, unweighted Laurec-Shepherd tuning runs were made using 20 years of tuning data. The results from these analyses are retained on the stock file. From plots of the log-catchabilities, strong trends were apparent in the German groundfish survey data and, as last year, this fleet was excluded from subsequent tuning runs. The Dutch groundfish survey series was excluded last year and, as this survey is now discontinued and no new data are forthcoming, the exclusion of the series was continued. Indices for ages 0, 6, 7 and 8 were excluded from the French eastern Channel commercial fleet (FRATRC_7d) tuning series. This was considered appropriate due to their very poor representation in the catch of this fleet.

There was also an indication from these plots that for some important commercial fleets, the log-catchabilities appeared more stable if considered over a shorter, ten year period than over the full 20 year period. For this reason, the tuning period was reduced to 10 years, but with no down-weighting of data within that period.

For a first XSA trial run, the basic parameter selections (pre-recruit age < 2, catchability plateau at age 6, shrinkage SE = 0.5) were unchanged from last year's final run and based on the exploratory runs made then. However, the treatment of age 0 and 1 as recruits was not accepted due to considerable uncertainty regarding both the magnitude and sign of the calculated slopes in the relationships between many of the indices and the estimated abundance of those ages. Consequently, an additional XSA run was made, which ultimately became the final run, in which the catchability of all age groups was considered to be independent of year class strength. The log-catchability residual plots from this run (Figure 5.1.1), although noisy in some cases, demonstrated a marked improvement for the youngest age groups compared to the first trial run, where they were treated as recruits. Because of this, and because some prior selection of fleets and ages had already been undertaken on the basis of log-catchability trends and/or noise, it was decided not to exclude further any fleets and age groups used in this run, and to let the XSA weight them accordingly in the final survivors estimates. Finally, a retrospective analysis was performed to examine the effect of shrinkage.

The retrospective plot for this XSA configuration and tuning data set is shown in Figure 5.1.2 for an assumed F shrinkage mean SE = 0.5. Because of the short time series of the 3 new survey index series, it was not possible to include them the retrospective analysis. Similarly, to make use of the relatively short French eastern Channel commercial fleet series (FRATRC_7d) in the retrospective analysis, it was not possible to select a 'moving window' analysis. Consequently, the available data for each successive run diminished by one year, leading to only a five year tuning period for the retrospective run using 1989 as its terminal year. For this reason, it is not possible to determine whether the extreme spikes in the retrospective estimates of recruitments in the earliest years (Figure 5.1.2) reflect true potential overestimates for those years, or whether they are a result of the diminishing tuning series. This also makes it difficult to judge the effect of varying the level of shrinkage so the default value (SE=0.5) was retained.

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

The relative weighting of the different tuning fleets to the survivors estimates are indicated in Figure 5.1.3, where the scaled weights are shown plotted by fleet and age. In general, it can be seen that the weighting of survivors estimates from the commercial fleets from the North Sea increases with the age of fish and those of the North Sea survey either decline with age, or are least important at the extremes of the age range. Neither of the eastern Channel tuning fleets get more than 6.2% of the weighting in the final survivors estimates of any age group. The weighting of the F shrinkage mean is highest for the oldest ages, at 55%.

In the previous assessment of this stock, the survivors estimates for ages 0 and 1 were dominated by the effects of shrinkage to both the population and F means. This year, for these ages, due to the treatment of catchabilities as independent of abundance, the IBTS QI and QIV surveys are the most heavily weighted tuning fleets, followed in the case of 0-group fish by the F shrinkage mean. The F shrinkage estimate of survivors from this age is higher than all but one (FraTRB) of the tuning fleet estimates and it gets a 17% weighting in the final weighted value.

The individual fleet estimates of survivors given in Table 5.1.10 are quite diverse at ages 0 and 1, appear less so at age 2, and are reasonably consistent for ages 3 to 6.

Although the XSA output present the fleet and shrinkage based estimates of survivors and their weighted average prediction, it was not possible to inspect their derived estimates of fishing mortality (they are presented as zero values in the output).

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

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 last year's report (ICES 1996/Assess:6) where no clearly defined relationships were apparent.

Therefore, as at the two previous meetings, it was decided to incorporate all the XSA estimates of survivors in to the input to catch prediction, including the estimates for recruiting year classes. This decision was made because of the inconsistency between RCT3 and XSA noted above. It is emphasised that the use solely of XSA survivors estimates does not mean that the Working Group believes these to be better estimates of recruitment than those produced by RCT3, as this inconsistency between survey data and commercial data was further apparent in an analysis using survey-based estimates of stock trends for whiting in the North Sea (ICES 1995/Assess:8). It has made this decision for the sake of consistency of population estimates from year to year. The results of a sensitivity analysis of the catch prediction (Section 5.1.7 and Figure 5.1.5) indicates that the prediction of human consumption yield in 1997 and spawning biomass in 1998 is relatively insensitive to the XSA estimates of survivors at age 0 and 1. The apparent inconsistency between XSA and survey based estimates of recruits is further examined in Section 5.1.10.

In the previous assessment of this stock, because recruitment since 1979 had fluctuated around a lower level than in the preceding period a 20 year tapered geometric mean value of recruitment at age 0 was assumed for input to prediction. The same issue arises for this assessment (Figure 5.1.4), but the XSA tuning period has been changed from 20 years to 10 years, and it becomes an arbitrary decision whether to continue with a 20 year tapered geometric mean for input to prediction or to use a 10 year untapered value. Ultimately, the decision was made to use a 20 year tri-cubic weighted geometric mean for input to prediction at age 0 in 1996 and subsequent years (34,100 million), rather than the long term geometric mean of 42,600 million. The tricubic taper-weighted GM was calculated externally to the XSA, using the XSA recruitment estimates.

5.1.6 Historical stock trends

Long term trends in fishing mortality, recruitment and spawning biomass are given in Table 5.1.13 and plotted in Figure 5.1.4.

Fishing mortalities have been highly variable with no clear trend, although the human consumption landings component of F appears to have been reasonably stable since 1989, but indicating a fall in 1995. Estimates of all year classes since 1988 lie between 55% and 80% of the long term arithmetic mean (62%-90% of the long term geometric mean). The spawning stock biomass is estimated to have been stable since 1983, fluctuating around 290,000t, compared with its lowest recorded value of 236,000t (in 1971) and below the long term average of 380,000t. Its estimated level at the start of 1995 is 330,000 t.

5.1.7 Short term forecast

A short term catch prediction was first 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. This prediction served as a check on the area split prediction made subsequently, but also provided the data required for the sensitivity analysis of the overall catch prediction. An area split prediction was then made.

Input data for combined area short term catch predictions are given in Table 5.1.14.

The proportion of fish landed by the human consumption fleet compared to its catch in recent years does not show any consistent changes. Therefore, calculation of the partial Fs at age and mean weights at age in the various catch categories used in prediction continue to be averaged over a 5 year period.

Results of a *status quo* catch forecast are given in Tables 5.1.15 and 5.1.16. The Sub-area IV TAC for 1996 (67,000t) is less than the Sub-area IV landings indicated by this prediction (79,000t). The TACs appear unlikely to be limiting and a TAC constrained prediction has not been made. Results of the area-split forecast are included in Table 5.1.15. The small discrepancies between the sum of the area based values and the tabulated combined area human consumption landings are due to the effects of cumulative rounding errors.

At *status quo*, the area-combined human consumption landings are predicted to be 64,000t in 1997 compared to a forecast of 58,000t for 1996. This is predicted to result in a spawning biomass in 1997 and 1998 of 375,000t.

At *status quo*, the area-split human consumption landings forecast for 1997 is 57,100t in Sub-area IV and 6,200t in Division VIId. An additional 28,000t of industrial by-catch is predicted for Sub-area IV.

A sensitivity analysis of the *status quo* combined area forecast is presented in Table 5.1.15 and Figures 5.1.5 and 5.1.6. The estimates of human consumption landings in 1997 are most sensitive to the overall level of fishing mortality in 1997 and the overall level of natural mortality in 1996. The estimate of spawning biomass at the start of 1998 is sensitive to the overall magnitude of natural mortality in both 1996 and 1997 as well as to the age-specific values of M at age 0 and 1.

The sensitivities (Figure 5.1.5) are very similar to those presented in last year's report, as are the partial variances in the prediction of spawning biomass in 1998 attributable to the uncertainties in the input values. However, the partial variances in the predicted human consumption landings do differ from those reported last year. In this assessment, uncertainty of the overall level of human consumption fishing mortality has contributed much more to the variance of yield than the equivalent indication from the previous assessment. In last year's analysis, the uncertainty in the population size of fish aged 2, and its absolute magnitude, contributed greatly to the variance in yield. This corresponds to the 1994 year class, which was estimated last year to be very weak, but which has been revised upwards this year.

Probability profiles for the human consumption landings in 1997 and the spawning biomass in 1998 are shown in Figure 5.1.6. They indicate approximately a 20% probability, at *status quo* human consumption F, that the spawning biomass at the start of 1998 will fall below its previously lowest recorded value of 236,000 t. and approximately a 25% probability of falling below MBAL (Section 5.1.11) in the short term.

5.1.8 Medium term predictions

The inputs to medium term projection are similar to those for the sensitivity analysis. Because of the scatter of points on the stock and recruitment plot, the non-parametric approach chosen in previous assessments was selected again this year to generate recruitments in the medium term.

The results of medium term projections corresponding to *status quo* human consumption F are presented in Figure 5.1.7. The projection program selected the same bootstrap series of recruitments in each case. At the end of the 10 year projection, spawning biomass would, on average, be expected to increase as would the human consumption landings, although in both cases the 5% - 95% inter-percentile range is very broad. Several other projections were made for various multipliers of human consumption F. The outcome of these is summarised for the end of the 10 year projection period in Figure 5.1.8. According to these projections, there is a less than 5% probability that spawning biomass will fall below the suggested MBAL of 250,000t (see Section 5.1.11) for the range of F multipliers considered here. However, the bootstrap approach that was chosen to generate recruitment, does so from the entire recruitment time series and does not account for the apparent temporal shift in the overall magnitude of recruitment as indicated for whiting over the last decade (Figure 5.1.4). Because of this, it is likely that the medium term prognoses presented Figures 5.1.7 and 5.1.8 may overestimate yield and biomass values.

It is possible that the apparent shift in recruitment levels is an artefact caused by the extrapolation over the period 1960-1977 of discard rates calculated since the inception of the Scottish sampling scheme in the late 1970s. Although this could not be examined further at this meeting, it was possible to re-run the medium term predictions using a truncated series of stock and recruitment data (1980-1995). The *status quo* results from this are summarised in Figure 5.1.9 and these do indicate a less optimistic outcome after a 10 year projection. Nevertheless, the estimate of MBAL would be largely unchanged, and the median estimate of spawning biomass indicates only a marginal decline from the present value with less than a 5% probability of falling below MBAL.

5.1.9 Long term considerations

The present assessment indicates that the stock is stable in the medium term.

The *status quo* human consumption fishing mortality (0.49) is below F_{med} (0.88), calculated as outlined in section 5.1.12. The *status quo* total mean F for ages 2-6 (human consumption landings + discards + industrial by-catch) is estimated to be 0.54, also below F_{med}.

5.1.10 Comments on the assessment

The quality control charts are presented in Tables 5.1.17 and 5.1.18.

Because whiting in IV and VIId have been merged for the first time in assessments this year, it is less easy to make direct comparisons with the previous years' assessments. The landings from Division VIId have been between 7% and 15% of the Sub-area IV human consumption landings since 1982. The merging of data from the 2 areas has required the age compositions from North Sea human consumption landings to be applied to eastern Channel catches from 1960-1976, and there are no estimates for discards in Division VIId. Nevertheless, the overall pattern of stock size, fishing mortality and recruitment resulting from the merged assessment is quite consistent with the pattern observed from last year's assessment of the North Sea stock. The major difference being the estimate of the 1994 year class that has been revised upwards from last year's value of 23,500 million to 35,200 million.

The retrospective analysis made this year does not indicate a consistent pattern of over or under estimation for mean F, and, for the most recent years, the estimates of mean F are reasonably consistent. However, the retrospective analysis does indicate a more obvious retrospective pattern in estimates of recruitment, estimates which are also very noisy. However, constraints on the retrospective analysis due to the short time series of some of the tuning fleets makes it difficult to interpret its results clearly.

Previous meetings have concluded that the survey data and commercial catch data contain different signals concerning the stock, and that there remain inconsistencies in the annual international catch age distributions. This was briefly investigated during this meeting, where the IBTS QI, EngGFS and ScoGFS survey series were used individually to reconstruct the recent history of whiting in Sub-area IV. The results are summarised in Figure 5.1.10 along with the results of the combined stock XSA. It is apparent that there are inconsistencies indicated between the four data sets. XSA and the EngGFS generally follow the same spawning biomass trajectory, which differs from that suggested by both the ScoGFS and IBTS QI surveys. The other stock indicators are harder to interpret in this way. In the time available at the meeting, it was not possible to investigate these associations in more depth.

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

5.1.11 MBAL considerations

A discussion of the general approach taken in estimating MBAL is given in Section 1.4.5 For whiting in IV and VIId, the stock and recruitment scatterplot generated by the XSA analysis (Figure 5.1.11) does not indicate that recruitment is reduced at the lower levels of observed spawning biomass. According to the historical series, stock growth has been seen from the lowest recorded spawning biomass of 236,000t, although this was in a period when the mean level of recruitment appeared to be higher than for recent years. For this reason, the higher level of 250,000t is considered to be an appropriate MBAL according to the criteria outlined in Section 1.4.5.

5.1.12 Biological reference points

The stock and recruitment plot is shown in Figure 5.1.11.

Long term predictions were made assuming various F multipliers applied to the human consumption catches. These multipliers are not applied to the industrial by-catch component of the total catch because effort in the industrial fisheries is assumed to be constant in the restricted management scenarios referred to here. Although the industrial by-catch component of the total international catch is landed and included in the TAC for this stock, it is considered to be invariant with respect to the management options applied to the human consumption fishery.

The biological reference points F_{high} etc. are calculated in terms of the total international $F_{(2\text{-}6)}$.

The *status quo* value of reference F in the human consumption fisheries is 0.49, and is 0.54 for the total international fishery. The value of F_{med} corresponding to this is 0.88; F_{high} is > 1 and $F_{0.1}$ is 0.23. F_{max} is not defined. The equilibrium yield per recruit is shown in Figure 5.1.12 contingent on variation in the human consumption component of the total international reference F.

5.1.13 Summary table

5.2 Whiting in Division IIIa

Since 1981, landings have been reported separately for human consumption and reduction purposes. The Danish landings for reduction have been taken in a mixed clupeoid fishery and at an industrial fishery directed at Norway pout and sandeel. This fishery has a by-catch of small, mainly 0-group, whiting.

The total catch in 1995 was 9,600 t, which is an increase compared with 1993 and 1994. Total landings are shown in Table 5.2.1.

No analytical assessment of the stock was possible.

Table 5.1.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1982-1995, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Belgium	2,272	2,864	2,798	2,177	2,275	1,404	1,984	1,271	1,040	913	1,030	944	1,042	880
Denmark	27,043	18,054	19,771	16,152	9,076	2,047	12,112	803	1,207	1,529	1,377	1,418	549	368
Faroe Islands	57	18	-	6	-	12	222	1	26	-	16	7	2	21
France	23,780	21,263	19,209	10,853	8,250	10,493	10,569	5,277[1,2]	4,951[1]	5,188[1,2]	5,115[1]	5,502[1,2]	5020[2]	5,735
Germany, Fed.Rep.	223	317	286	226	313	274	454	415	692	865	511	441[1]	239	124
Netherlands	12,218	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
Norway	17	39	88	103	103	74	52	32	55	103	232	125[1]	80	114
Poland	-	1	2	-	-	-	-	-	-	-	-	-	-	-
Sweden	11	44	53	22	33	17	5	17	16	48	22	18	10	1
UK (Engl.& Wales)[3]	4,743	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
UK (Scotland)	29,640	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
Total	100,004	99,149	98,958	71,934	66,709	64,978	66,294	40,125	41,084	46,607	47,042	47,296	42,502	41,171
Total h.c. catch used by Working Group	73,000	81,000	79,000	55,000	59,000	64,000	52,000	41,000	43,000	47,000	46,000	48,000	43,000	42,000
Total discards	27,000	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
Total Ind. By-catch	33,000	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

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

Table 5.1.2 WHITING in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1982 to 1995.

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	7,910
1983	84	5,057	1	198	-	5,340	1,600	6,940
1984	79	6,914	-	88	-	7,081	289	7,370
1985	82	7,563	-	186	-	7,831	491	7,340
1986	65	4,551	-	180	-	4,796	704	5,500
1987	136	6,730	-	287	-	7,153	2,463	4,690
1988	69	7,501	-	251	-	7,821	3,391	4,430
1989	38	n/a	-	231	-	n/a	-	4,160
1990	83	n/a	-	237	1	n/a	-	3,480
1991	83	n/a	-	292	1	n/a	-	5,780
1992	66	5,414	-	417	24	5,921	-	5,760
1993	74	n/a	-	321	2	n/a	-	5,200
1994	61	n/a	-	293	-	n/a	-	6,623
1995[1]	68	n/a	-	280	1	n/a	-	4,892

[1]Preliminary

TABLE 5.1.3 Whiting, North Sea and VIId
Annual weight and numbers caught, 1960 to 1995.

Year	Wt.('000t)				Nos.(millions)			
	Total	hcons	dis	ind	Total	hcons	dis	ind
1960	182	49	122	11	1070	198	763	109
1961	326	69	241	16	2174	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	194	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	2312	276	641	1396
1977	347	78	163	106	2491	281	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	1358	290	370	697
1984	146	86	41	19	909	285	327	297
1985	107	62	29	15	731	219	232	280
1986	162	64	80	18	1211	230	583	399
1987	139	68	54	16	947	246	416	285
1988	133	56	28	49	1396	213	231	952
1989	124	45	36	43	883	172	280	431
1990	153	47	56	51	1296	179	539	578
1991	125	53	34	38	1624	212	242	1170
1992	110	52	31	27	874	193	216	465
1993	117	53	43	20	1245	186	345	714
1994	93	50	33	10	711	169	237	304
1995	104	47	31	27	2031	155	217	1659
Min.	93	45	27	8	711	155	173	100
Mean	203	71	80	51	1565	252	515	798
Max.	368	108	241	152	2816	382	1646	1974

Table 5.1.4 Whiting in VIId. Annual weight and numbers caught, 1976-1995

Year	Wt ('000t)	Nos (millions)
1976	7.715	27
1977	4.954	21
1978	9.113	37
1979	8.910	35
1980	9.167	35
1981	8.932	32
1982	7.911	32
1983	6.936	29
1984	7.373	33
1985	7.336	34
1986	5.503	23
1987	4.688	18
1988	4.426	18
1989	4.155	16
1990	3.476	15
1991	5.777	25
1992	5.762	26
1993	5.204	24
1994	6.623	28
1995	4.891	21

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

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

Table 5.1.6

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

At 13-Oct-96 10:38:01

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,
AGE						
0,	60828,	215700,	76257,	105982,	234479,	63912,
1,	482896,	1079197,	1022790,	549436,	137589,	342622,
2,	259440,	619965,	220148,	751817,	369668,	148166,
3,	215393,	219882,	156642,	96114,	164882,	330156,
4,	21460,	32745,	31722,	45332,	22843,	72200,
5,	23278,	1355,	5998,	9334,	10908,	8002,
6,	3634,	4099,	276,	1739,	2770,	3555,
7,	892,	385,	407,	9,	435,	765,
8,	2135,	121,	112,	126,	2,	124,
9,	238,	229,	13,	14,	41,	2,
+gp,	7,	19,	0,	1,	13,	9,
TOTALNUM,	1070201,	2173697,	1514365,	1559904,	943630,	969513,
TONSLAND,	182361,	326093,	222431,	260771,	149956,	186760,
SOPCOF %,	100,	100,	100,	100,	100,	100,

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
0,	84279,	177436,	104751,	1206087,	1187095,	1232837,	553711,	175647,	571476,	238839,
1,	517081,	973202,	830540,	374343,	606831,	621941,	939141,	1155304,	756260,	955910,
2,	343402,	216063,	523774,	1025996,	83064,	107933,	319094,	666563,	986441,	407207,
3,	93851,	122955,	111755,	158808,	571696,	18786,	46392,	135507,	234063,	303537,
4,	255875,	23958,	49514,	28972,	52108,	128541,	7833,	19028,	33307,	56549,
5,	37708,	69081,	7494,	13240,	11463,	13640,	59313,	5739,	4977,	9273,
6,	8535,	7886,	31183,	1734,	3723,	2306,	8392,	18186,	1243,	8014,
7,	1520,	849,	1940,	5989,	1211,	730,	3486,	2504,	5856,	116,
8,	339,	127,	98,	659,	1360,	171,	258,	367,	353,	1383,
9,	131,	33,	24,	36,	137,	429,	71,	125,	52,	141,
+gp,	0,	3,	5,	1,	17,	28,	680,	53,	22,	2,
TOTALNUM,	1342721,	1591593,	1661078,	2815866,	2518706,	2127342,	1938372,	2179023,	2594051,	1980971,
TONSLAND,	242233,	236994,	265266,	327617,	271648,	195357,	191320,	270533,	296197,	305010,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 5.1.6 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

At 13-Oct-96 10:38:01

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
0,	425081,	666975,	687238,	476383,	332209,	516869,	101058,	668604,	157819,	186851,
1,	479610,	1006082,	418910,	615524,	265359,	162899,	192640,	205646,	323408,	204866,
2,	1129375,	480939,	313391,	467537,	416008,	346343,	114444,	184746,	175965,	160568,
3,	169610,	279226,	242370,	218283,	286077,	266517,	245246,	118412,	124886,	101299,
4,	88015,	30130,	90047,	100976,	90718,	102295,	88137,	131508,	49505,	40601,
5,	15988,	21334,	7563,	29267,	52969,	27776,	26796,	37231,	59817,	14454,
6,	3163,	5561,	7565,	3111,	10751,	12297,	6909,	8688,	13860,	18441,
7,	495,	532,	1851,	1657,	1152,	3540,	2082,	1780,	2964,	3210,
8,	18,	237,	253,	264,	689,	244,	400,	794,	410,	889,
9,	627,	20,	11,	35,	58,	45,	53,	101,	182,	96,
+gp,	29,	162,	13,	5,	20,	38,	31,	35,	21,	10,
TOTALNUM,	2312011,	2491198,	1769212,	1913041,	1456011,	1438864,	777796,	1357545,	908837,	731285,
TONSLAND,	368240,	347056,	188186,	243846,	223517,	192049,	140195,	161212,	145741,	106674,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
0,	225173,	84847,	416922,	87274,	284732,	1034831,	252670,	622371,	216843,	1571815,
1,	571722,	266018,	428367,	328054,	249254,	130883,	242394,	219005,	170378,	142324,
2,	168167,	366628,	309809,	176811,	510827,	194213,	169818,	171009,	151288,	144828,
3,	173609,	124017,	181630,	192937,	128877,	189658,	92202,	130426,	90728,	112334,
4,	50045,	87941,	39787,	78554,	86729,	38861,	94652,	47625,	45580,	34690,
5,	13746,	11603,	16575,	14322,	32734,	28217,	12106,	47575,	16911,	14966,
6,	3713,	4536,	2010,	4640,	1985,	6091,	6853,	4212,	17376,	5145,
7,	4070,	882,	436,	420,	664,	651,	2726,	1670,	947,	4571,
8,	555,	844,	61,	290,	96,	305,	107,	741,	381,	318,
9,	74,	105,	74,	37,	16,	3,	8,	65,	75,	103,
+gp,	1,	7,	38,	6,	0,	1,	1,	17,	0,	57,
TOTALNUM,	1210875,	947428,	1395709,	883345,	1295914,	1623713,	873537,	1244716,	710507,	2031152,
TONSLAND,	161749,	138808,	133458,	123755,	153445,	125042,	109718,	116686,	93080,	103875,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	99,

Table 5.1.7

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

At 13-Oct-96 10:38:01

Table 2. Catch weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,
AGE						
0,	.0580,	.0420,	.0550,	.0490,	.0420,	.0580,
1,	.1170,	.1190,	.1190,	.1120,	.1240,	.1240,
2,	.1900,	.1930,	.1870,	.1950,	.1740,	.2090,
3,	.2560,	.2590,	.2670,	.2720,	.2680,	.2420,
4,	.3140,	.3030,	.3330,	.3530,	.3550,	.3320,
5,	.3440,	.4120,	.4000,	.4120,	.4440,	.4210,
6,	.3840,	.4200,	.5200,	.4720,	.4890,	.4990,
7,	.5010,	.4930,	.5190,	.8200,	.5350,	.5420,
8,	.4570,	.3860,	.5390,	.6260,	.6010,	.6350,
9,	.3830,	.4680,	.5850,	.4990,	.7640,	1.2560,
+gp,	.3980,	.4750,	.0000,	.6100,	.6920,	.6140,
SOPCOFAC,	1.0013,	.9983,	1.0007,	1.0020,	.9997,	1.0005,

Table 2 Catch weights at age (kg)

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
0,	.0720,	.0620,	.0380,	.0430,	.0200,	.0360,	.0220,	.0270,	.0260,	.0300,
1,	.1090,	.1180,	.1120,	.0970,	.1100,	.1160,	.0710,	.0840,	.0710,	.1000,
2,	.1870,	.1990,	.1880,	.1730,	.2040,	.2190,	.2010,	.1660,	.1500,	.2150,
3,	.2490,	.2690,	.2950,	.2620,	.2410,	.2860,	.2840,	.2780,	.2590,	.2780,
4,	.2880,	.3320,	.3590,	.3630,	.3490,	.3190,	.3890,	.3720,	.3830,	.3760,
5,	.3680,	.3400,	.4840,	.4150,	.4550,	.4330,	.4190,	.4390,	.4710,	.4700,
6,	.4340,	.4250,	.4470,	.4190,	.4520,	.5310,	.5210,	.4630,	.5210,	.3560,
7,	.4730,	.4950,	.6200,	.5350,	.5120,	.6370,	.5750,	.5520,	.5440,	.8170,
8,	.6980,	.6260,	.7300,	.6700,	.6280,	.5600,	.7480,	.7380,	.7870,	.5950,
9,	.6940,	.6210,	.7790,	.7870,	.7850,	.7280,	.8010,	.8600,	1.0320,	.7130,
+gp,	.0000,	.4860,	.8420,	1.2360,	.8020,	.7290,	.8220,	.8460,	.9660,	1.0220,
SOPCOFAC,	.9996,	.9990,	1.0007,	.9998,	.9991,	1.0041,	1.0003,	1.0022,	.9992,	1.0027,

Table 5.1.7 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

At 13-Oct-96 10:38:01

Table 2 Catch weights at age (kg)

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
0,	.0190,	.0220,	.0100,	.0090,	.0130,	.0110,	.0290,	.0150,	.0200,	.0140,
1,	.1070,	.1170,	.0740,	.0980,	.0750,	.0830,	.0610,	.1070,	.0890,	.0940,
2,	.1940,	.2100,	.1820,	.1660,	.1760,	.1680,	.1840,	.1910,	.1880,	.1850,
3,	.2950,	.3190,	.2340,	.2590,	.2520,	.2420,	.2530,	.2730,	.2710,	.2610,
4,	.3520,	.3990,	.3220,	.3010,	.3280,	.3210,	.3140,	.3250,	.3370,	.3220,
5,	.4440,	.4440,	.4270,	.4110,	.3370,	.3790,	.3760,	.3840,	.3820,	.3880,
6,	.5190,	.4620,	.4280,	.4550,	.4580,	.4110,	.4780,	.4260,	.3910,	.4270,
7,	.5140,	.5470,	.4660,	.4920,	.4580,	.4440,	.5040,	.4520,	.4630,	.4700,
8,	.5540,	.4400,	.6150,	.5780,	.5680,	.6510,	.7020,	.5200,	.5750,	.4230,
9,	.7400,	.6940,	.7020,	.6170,	.5390,	.8330,	.7720,	.6770,	.5140,	.4970,
+gp,	.8930,	.5000,	1.2470,	.5590,	.8120,	1.0320,	1.1010,	.5160,	.8710,	.7890,
SOPCOFAC,	.9979,	1.0001,	1.0003,	1.0011,	1.0022,	.9997,	.9996,	.9971,	1.0014,	1.0015,

Table 2 Catch weights at age (kg)

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
0,	.0140,	.0120,	.0130,	.0230,	.0150,	.0170,	.0130,	.0120,	.0130,	.0100,
1,	.1050,	.0770,	.0540,	.0690,	.0810,	.1030,	.0820,	.0730,	.0850,	.0910,
2,	.1810,	.1480,	.1460,	.1580,	.1370,	.1640,	.1810,	.1710,	.1710,	.1810,
3,	.2500,	.2460,	.2250,	.2260,	.2080,	.2140,	.2480,	.2410,	.2500,	.2520,
4,	.3090,	.2930,	.2990,	.2660,	.2490,	.2750,	.2740,	.3100,	.3120,	.3320,
5,	.3680,	.3710,	.3360,	.3150,	.2770,	.2950,	.3210,	.3270,	.3630,	.3790,
6,	.4530,	.3660,	.4140,	.3860,	.4050,	.3310,	.3380,	.3420,	.3660,	.4250,
7,	.4640,	.4860,	.4290,	.4400,	.4830,	.3530,	.3110,	.3940,	.4080,	.4320,
8,	.5230,	.4620,	.8340,	.3470,	.6320,	.3890,	.4780,	.3720,	.4180,	.4470,
9,	1.1850,	.8480,	.5880,	.5120,	.3160,	.4960,	.7740,	.4070,	.3940,	.3470,
+gp,	.5280,	.6020,	.6420,	.8280,	.0000,	1.0550,	1.7270,	.3530,	.4870,	.4050,
SOPCOFAC,	1.0016,	.9992,	1.0015,	1.0005,	1.0022,	1.0012,	.9992,	.9985,	.9993,	.9917,

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

Country	Fleet	Code	Initial Year	Age Range
Scotland	Groundfish survey	SCOGFS	1982	0-6
	Seiners	SCOSEI	1975	1-9
	Light trawlers	SCOLTR	1975	0-9
Netherlands	Groundfish survey	NETGFS	1980	0-3
England	Groundfish survey	ENGGFS	1977	0-6
France	Trawlers	FRATRB	1976	0-9
		FRATRC-7d	1985	0-8
		FRAGFS-7d	1988	0-3
Germany	Groundfish survey	FRGGFS	1983	1-6
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 5.1.9 Whiting in the North Sea/Eastern Channel. Available tuning series

```
SCOSEI_IV
1976 1995
1 1 0 1
0 10
307165 148.995 22192.289 67580.047 12456.698 10885.747 1889.958 263.994 42.999 0 72.998 1
313913 745.02 22193.598 50660.371 37036.02 3336.092 2528.069 371.01 31.001 10 1 6
325246 5345.922 14993.602 29307.939 43710.809 15390.197 1057.941 1408.921 200.989 35.998 0 7
316419 302.002 90749.852 41091.742 28124.234 14745.013 6083.678 676.915 155.75 2.995 0 0
297227 668.983 27032.33 73704.438 37657.648 11914.984 9367.982 2556 260 229 27 7
289672 92.998 8726.789 22243.637 25047.811 10551.986 2401.997 2084.002 374 41 4 1
297730 43 3720.987 7032 26194.137 13117.107 2713.028 539.005 277.003 81.001 5 0
333168 572.013 11565.39 14957.378 21690.016 34199.105 9830.623 2154.563 406.795 157.779 16.256 0
388035 296.722 4922.5 24015.609 20669.76 14985.589 21269.32 4715.242 959.961 87.283 49.593 6.943
381647 773.215 20067.844 20263.316 19695.992 8956.377 4795.861 8013.077 1362.788 333.952 17.89 5.963
425017 137.759 139498.17 48705.18 34509.258 11340.962 2624.396 1097.504 1771.08 215.94 7.271 0
418536 1358.848 13793.33 52715.141 38938.77 18440.258 3637.712 1096.908 297.738 348.416 15.879 3.97
377132 26.014 2502.074 28446.105 44869.258 12631.404 4071.612 678.724 63.973 20.991 16.993 1.999
355735 10.131 6878.804 15704.127 41407.43 23710.402 4769.041 1323.229 112.076 43.044 10.723 0.711
252732 184.877 14229.828 124635.82 27694.109 29920.98 14767.797 720.818 206.524 23.233 0.017 0
336675 886.651 11951.946 44964.258 63414.281 10436.101 8730.116 1742.927 195.19 93.627 0 0.247
300217 426.209 16613.691 19452.012 21217.148 27961.869 2804.536 1958.074 564.87 32.421 3.386 0
268413 599.768 9563.692 31623.355 26012.82 12457.879 14446.113 899.254 332.177 153.131 7.51 8.252
264738 82.71 9235.936 21451.654 22570.719 11778.492 5530.941 5611.981 203.907 115.772 14.689 0
204545 26.012 8287.879 22152.725 30006.961 9018.667 3874.625 1373.442 1270.024 86.009 14.99 18.127

SCOLTR_IV
1976 1995
1 1 0 1
0 10
152419 28.998 5574.648 30121.129 5297.682 5247.686 875.948 194.988 17.999 1 43.997 5
224824 709.038 24587.139 29945.25 24840.408 1663.95 2418.911 459.981 33.999 17.999 0 4
236944 7158.392 8785.464 19909.945 30722.309 14472.604 956.038 1612.065 635.026 72.003 6 0
287494 367.996 171147.28 42910.398 23154.594 17995.664 4057.925 376.993 285.995 56.999 5 0
333197 868.998 20805.963 58381.992 38436.16 9525.058 9430.05 1864.014 144.001 145.001 3 0
251504 170.986 6576.457 19069.211 21549.754 9706.151 1777.022 1455.034 310.008 9 1 0
250870 6390.155 5214.103 8196.975 26680.535 12944.739 3333.924 646.98 338.988 73.997 15.999 3
244349 20191.061 37495.68 17925.867 12535.311 19234.307 6123.52 1216.612 182.797 140.848 25.969 0.999
240775 2553.165 38266.77 16048.092 10784.184 6306.822 9018.982 2371.186 478.594 13.127 30.293 5.049
267393 1221.645 28760.939 9368.367 7616.928 3085.792 1333.193 2901.185 443.13 173.087 13.847 0
279727 796.708 8138.433 8571.9 9577.941 4108.819 767.442 425.282 608.602 51.637 2.025 0
351131 599.518 18761.178 25933.338 16160.769 5954.478 1182.953 388.455 116.035 128.993 3.933 0
391988 59.996 2397.963 15778.771 22525.543 5127.725 1640.626 207.218 31.033 15.015 6.006 6.006
405883 491.803 20318.748 10051.615 21389.719 10836.808 2394.091 448.224 33.084 54.358 2.388 0.609
371493 371.478 3676.882 35321.988 7664.57 8960.094 3423.009 159.541 39.935 5.339 0.067 0
408056 688.421 8726.876 11908.029 22145.619 3192.247 2906.398 628.632 49.904 40.866 0.447 0.253
473955 1379.234 17580.582 14551.322 11822.715 15417.656 1500.403 1160.443 304.395 12.75 0.341 0.655
447064 614.447 16438.91 20513.145 14385.548 6590.755 10105.473 574.199 203.582 97.351 24.363 4.587
480400 1259.303 4132.65 15771 13004.648 6453.762 2710.229 2997.307 171.833 83.936 13.864 0
442010 208.066 9248.035 15886.83 19322.299 6261.604 2982.508 1092.214 1131.707 88.831 3.479 14.193
```

Table 5.1.9 (Cont'd)

FRATRB_IV

1976 1995

1 1 0 1

0 10

64396	2718.175	12660.21	45922.27	6143.989	4686.481	1283.52	254.502	42	3	156	8
80107	2587.202	24164.32	21838.561	17682.807	1796.613	2279.111	554.182	54	31	6	15
69739	3351.785	7330.05	23791.32	19207.117	9382.748	836.852	1103.904	227	34	4	2
89974	591.579	61937.41	28650.199	18463.207	11830.283	3952.171	397.49	315.873	45	14	0
63577	271.781	9010.2	27059.801	18938.582	5826.699	4984.075	1071.901	78	71	10	1
76517	107.487	6395.469	18560.02	20258.117	9102.926	2249.323	1662.444	315.272	16	10	2
78523	2984.073	8778.596	5953.086	24941.793	14159.488	4423.757	1089.911	542.53	119	14	3
69720	9867.649	21688.24	16261.92	12818.577	19955.342	6139.751	1102.018	231.456	127.298	19	1
76149	1573.497	19189.369	12048.884	9046.985	4993.439	6421.895	1693.265	322.207	32	26	2
53003	570.817	10561.68	7129.542	5883.502	2466.529	1082.139	1285.78	233.338	34	10	2
50350	473.48	24324.67	10512.73	8154.293	2749.571	695.24	237.411	238.763	54.708	3	0
51234	558.88	9268.703	14851.1	6589.581	3721.569	708.607	209.758	76	82.71	10	0
35482	1024.471	3136.269	5860.832	7551.045	1901.38	843.634	160.791	42	7.158	7	3
36133	403.266	8819.171	3329.428	8279.531	3991.409	756.183	229.592	22.13	17.157	1.147	0.003
36097	7597.934	4192.686	15523.179	4221.804	3927.771	1600.354	91.259	35.05	2.702	0.128	0
45075	297.152	3610.561	5309.753	7751.186	1263.168	971.23	211.706	33.269	4.032	0.317	0.085
34138	318.269	4710.702	3987.946	3305.109	4309.879	420.786	274.874	141.951	2.076	0.137	0
23721	2136.246	5610.586	5220.6	4706.608	1886.29	2272.208	160.623	75.755	20.939	4.889	2.41
17316	373.139	3618.307	6213.199	3590.334	1987.011	551.282	566.037	30.46	10.456	1.446	0
19227	2046.048	2927.055	5826.523	6466.316	1989.24	1320.004	280.916	247.767	14.723	7.447	3.345

SCOGFS_IV

1982 1995

1 1 0.5 0.75

0 6

100	1.02	6.53	9.71	9.72	2.24	0.6	0.16
100	2.1	5.63	5.78	4.07	5.11	1.16	0.17
100	4.42	10.48	3.71	1.7	0.77	0.92	0.18
100	1.69	15.77	9.73	2.47	0.63	0.36	0.18
100	4.06	11.11	4.52	2.24	0.27	0.05	0.05
100	1.2	14.05	11.5	2.08	0.77	0.16	0.03
100	6.42	9.67	16.06	4.52	0.7	0.19	0.02
100	4.27	40.43	7.41	7.33	1.57	0.13	0.06
100	19.43	22.39	20.53	2.48	2.55	0.47	0.05
100	13.79	17.69	9.5	7.59	0.51	0.4	0.09
100	24.17	29.25	12.67	5.53	5.85	0.47	0.26
100	2.47	31.69	11.68	4.23	1.56	1.82	0.06
100	6.48	26.35	9.5	2.54	0.57	0.34	0.23
100	12.43	41.76	20.1	9.03	1.96	0.58	0.22

Table 5.1.9 (Cont'd)

ENGGFS_IV

1977	1995						
1	1	0.5	0.75				
0	6						
100	28.42799	21.95327	7.44128	1.10918	0.21617	0.09084	0.08007
100	18.44074	24.71364	5.15057	1.05515	0.34473	0.05065	0.02241
100	35.47581	20.06352	7.11693	1.89851	0.84259	0.0572	0.02919
100	19.90298	35.3272	12.50796	4.81044	1.20454	0.31363	0.05757
100	34.94214	18.31413	28.80394	16.05191	0.61761	0.6163	0.08049
100	6.93202	27.72217	7.93387	8.59036	2.22009	0.34039	0.04907
100	71.67273	11.85334	10.80295	1.90607	1.69636	0.24207	0.06709
100	17.25197	50.61345	10.81812	3.01209	0.88883	0.76876	0.37809
100	19.98966	15.87825	17.04257	1.67265	0.981	0.18171	0.1533
100	16.3337	15.16183	6.59195	3.84688	0.406	0.10373	0.01443
100	13.73128	22.76268	13.03649	2.6871	2.00857	0.35157	0.11751
100	38.16935	18.8058	13.15962	4.54558	0.64498	0.17371	0.01796
100	116.94833	29.47434	11.75997	7.69369	1.67409	0.3448	0.01853
100	87.5315	19.0085	12.836	3.8544	2.3182	0.3254	0.0461
100	16.73223	33.30382	7.66534	3.81768	1.0855	0.37095	0.04239
100	45.5048	26.55459	13.06984	3.0455	2.61006	0.49326	0.58884
100	25.24251	25.10378	9.62914	3.75044	1.16142	0.74167	0.18833
100	21.1433	30.546	10.59436	2.43878	1.12392	0.33328	0.11394
100	36.28171	35.50605	23.73796	7.36066	1.87025	0.25078	0.14433

IBTS_Q2_IV

1973	1995					
1	1	0.99	1			
0	5					
1	0.322	0.496	-1	-1	-1	-1
1	0.893	0.153	-1	-1	-1	-1
1	0.679	0.535	-1	-1	-1	-1
1	0.418	0.219	-1	-1	-1	-1
1	0.513	0.293	-1	-1	-1	-1
1	0.457	0.183	-1	-1	-1	-1
1	0.692	0.391	-1	-1	-1	-1
1	0.227	0.485	-1	-1	-1	-1
1	0.161	0.232	-1	-1	-1	-1
1	0.128	0.126	0.113	0.079	0.033	0.006
1	0.436	0.179	0.091	0.031	0.026	0.011
1	0.341	0.359	0.066	0.019	0.007	0.007
1	0.456	0.261	0.198	0.033	0.007	0.004
1	0.669	0.544	0.09	0.046	0.005	0.002
1	0.394	0.862	0.315	0.034	0.012	0.001
1	1.465	0.542	0.421	0.112	0.012	0.005
1	0.509	0.887	0.202	0.093	0.017	0.004
1	1.014	0.675	0.482	0.071	0.038	0.008
1	0.916	0.748	0.261	0.169	0.016	0.014
1	1.087	0.524	0.245	0.066	0.059	0.012
1	0.721	0.637	0.18	0.067	0.012	0.009
1	0.679	0.457	0.245	0.059	0.012	0.006
1	0.428	0.559	0.25	0.0665	0.0209	0.0103

Table 5.1.9 (Cont'd)

NETGFS_IV

1980	1995			
1	1	0.5	0.75	
0	3			
100	16.6	33	6.2	2.7
100	139.3	20.5	13.1	0.9
100	16.6	64	10.5	5.2
100	264.9	43.1	22.4	1.2
100	14.3	133	14.1	9.1
100	85.9	78.3	89.3	3.2
100	178.4	38.4	7.5	17
100	288.3	200.4	25.2	1.8
100	62.9	144.1	61.2	2.5
100	188.2	104.9	80.3	21.2
100	554.3	96.3	19.6	15.4
100	80.6	155.2	21.4	1.9
100	45.3	27.2	31	4
100	265.5	34	6.1	5
100	179.5	66	35.3	24.7
-1	-1	-1	-1	-1

FRGGFS_IV

1983	1995					
1	1	0.25	0.5			
1	6					
100	0.68	1.53	0.92	0.9	0.23	0.03
100	0.57	1.29	1.05	0.32	0.35	0.08
100	0.96	2.28	0.74	0.18	0.09	0.06
100	1.22	2.46	1.92	0.31	0.09	0.05
100	9.1	7.08	1.88	1.7	0.15	0.04
100	1.51	7.98	4.09	0.53	0.32	0.02
100	60.31	39.23	14.46	5.41	0.43	0.14
100	28.02	24.85	8.6	3.23	2.02	0.39
100	32.43	16.37	11.65	3.71	1.07	1.32
100	12.07	7.33	5.66	3.31	0.78	0.32
100	-1	-1	-1	-1	-1	-1
100	18.18	7.9	2.65	0.88	0.33	0.08
100	10.47	7.45	6.65	1.65	0.5	0.19

IBTS_Q2_SCO_IV

1991	1995					
1	1	0.25	0.5			
1	6					
100	94.9	38.56	22.86	3.74	1.23	0.51
100	129.76	47.5	11.42	4.28	1.14	0.45
100	104.67	41.49	20.86	5.17	4.85	0.36
100	65.4	35.71	8.55	2.38	0.9	0.75
100	191.61	77.3	26.19	4.42	2.21	0.41

Table 5.1.9 (Cont'd)

IBTS_Q4_ENG_IV

1991	1995							
1	1	0.75	1					
0	7							
100	46.82647	55.27577	19.64171	15.09189	3.2546	1.85092	1.32901	0.03016
100	94.23306	45.0899	26.46158	5.3785	5.02968	0.64532	0.5343	0.12175
100	78.87058	54.20958	19.47387	7.16071	2.33451	0.82701	0.23715	0.00829
100	69.84756	61.33462	26.41324	4.14012	0.8418	0.62111	0.10636	0.07947
100	71.328	107.996	41.715	11.186	2.56	0.523	0.204	0.071

FRATRC_7d

1985	1995								
1	1	0	1						
0	8								
456831	41	474	13903	15351	2385	527	197	21	36
353839	0	217	3457	10828	6419	960	258	56	14
309988	2	1939	5352	1467	6436	425	216	38	8
260919	0	1718	10289	3766	488	708	28	4	0
329640	0	1163	6156	6885	1036	25	71	0	0
268831	0	209	8351	2713	1820	273	2	3	2
361439	57	3730	7904	4784	3640	2524	495	58	37
346545	0	5796.459	10983.33	4990.14	1279.827	736.783	269.777	44.681	0.031
351004	272.48	3600.583	7331.001	9349.507	1789.585	487.208	141.427	76.481	11.582
357798	0.001	13816.05	8155.7	3199.448	1566.889	303.335	35.495	12.02	2.622
309531	70.857	5511.647	8178.876	4750.824	942.841	180.513	27.785	0.434	0.052

FRAGFS_7d

1988	1995			
1	1	0.75	1	
0	3			
27	3186	-1	-1	-1
27	1512	-1	-1	-1
27	1674	-1	-1	-1
27	7155	1350	162	27
27	6291	1674	378	54
27	1566	675	216	54
27	1323	6993	837	135
27	1539	1836	216	27

Table 5.1.10

Lowestoft VPA Version 3.1

10-Oct-96 18:58:12

Extended Survivors Analysis

Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/whg_347d/FLEET.X03

Catch data for 36 years. 1960 to 1995. Ages 0 to 10.

Fleet,	First, year,	Last, year,	First, age,	Last, age	Alpha,	Beta
FLT01: SCOSEI_IV (Ca,	1986,	1995,	0,	9,	.000,	1.000
FLT02: SCOLTR_IV (Ca,	1986,	1995,	0,	9,	.000,	1.000
FLT03: FRATRB_IV (Ca,	1986,	1995,	0,	9,	.000,	1.000
FLT04: SCOGFS_IV (Ca,	1986,	1995,	0,	6,	.500,	.750
FLT05: ENGGFS_IV (Ca,	1986,	1995,	0,	6,	.500,	.750
FLT06: IBTS_Q1_IV (C,	1986,	1995,	0,	5,	.990,	1.000
FLT09: IBTS_Q2_SCO_I,	1991,	1995,	1,	6,	.250,	.500
FLT10: IBTS_Q4_ENG_I,	1991,	1995,	0,	7,	.750,	1.000
FLT11: FRATRC_7d (Ca,	1986,	1995,	1,	5,	.000,	1.000
FLT12: FRAGFS_7d (Ca,	1988,	1995,	0,	3,	.750,	1.000

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 6

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 25 iterations

Regression weights

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

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
0,	.019,	.010,	.026,	.012,	.039,	.136,	.028,	.065,	.022,	.161
1,	.267,	.139,	.353,	.126,	.218,	.112,	.218,	.153,	.112,	.089
2,	.426,	.504,	.429,	.433,	.548,	.481,	.372,	.425,	.261,	.228
3,	.716,	.876,	.661,	.689,	.890,	.518,	.576,	.727,	.544,	.401
4,	1.260,	1.324,	.974,	.823,	.960,	.913,	.631,	.813,	.729,	.482
5,	1.073,	1.472,	1.152,	1.517,	1.208,	1.173,	.945,	.874,	.884,	.623
6,	1.359,	1.690,	1.375,	1.507,	1.003,	.823,	1.189,	1.215,	1.063,	.810
7,	1.473,	1.965,	.759,	1.484,	.993,	1.236,	1.259,	1.195,	1.100,	.979
8,	1.506,	1.911,	.730,	2.562,	3.032,	3.063,	.673,	1.815,	1.028,	1.725
9,	1.410,	1.666,	.960,	1.594,	1.640,	1.401,	1.058,	1.248,	1.008,	.899

Table 5.1.10 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6	7		
1986	4.31E+07	3.92E+06	6.08E+05	4.04E+05	8.12E+04	2.37E+04	5.66E+03	5.84E+03	7.88E+02	1.08E+02
1987	3.00E+07	3.30E+06	1.16E+06	2.53E+05	1.39E+05	1.71E+04	6.30E+03	1.13E+03	1.09E+03	1.43E+02
1988	5.85E+07	2.32E+06	1.11E+06	4.47E+05	7.43E+04	2.75E+04	3.05E+03	9.06E+02	1.30E+02	1.33E+02
1989	2.65E+07	4.45E+06	6.30E+05	4.62E+05	1.63E+05	2.08E+04	6.75E+03	6.00E+02	3.47E+02	5.13E+01
1990	2.64E+07	2.05E+06	1.52E+06	2.61E+05	1.63E+05	5.29E+04	3.55E+03	1.17E+03	1.11E+02	2.19E+01
1991	2.92E+07	1.98E+06	6.37E+05	5.59E+05	7.54E+04	4.63E+04	1.23E+04	1.01E+03	3.54E+02	4.40E+00
1992	3.27E+07	1.99E+06	6.84E+05	2.51E+05	2.35E+05	2.24E+04	1.12E+04	4.21E+03	2.41E+02	1.35E+01
1993	3.52E+07	2.49E+06	6.18E+05	3.01E+05	9.94E+04	9.25E+04	6.79E+03	2.65E+03	9.78E+02	1.01E+02
1994	3.52E+07	2.57E+06	8.25E+05	2.58E+05	1.02E+05	3.26E+04	3.01E+04	1.57E+03	6.56E+02	1.30E+02
1995	3.78E+07	2.69E+06	8.90E+05	4.05E+05	1.05E+05	3.66E+04	1.05E+04	8.09E+03	4.28E+02	1.92E+02

Estimated population abundance at 1st Jan 1996

, .00E+00, 2.51E+06, 9.51E+05, 4.52E+05, 1.91E+05, 4.82E+04, 1.53E+04, 3.64E+03, 2.49E+03, 6.24E+01,

Taper weighted geometric mean of the VPA populations:

, 4.22E+07, 3.21E+06, 9.42E+05, 3.47E+05, 1.04E+05, 3.02E+04, 8.27E+03, 1.75E+03, 4.12E+02, 8.43E+01,

Standard error of the weighted Log(VPA populations) :

, .4988, .5105, .5766, .5819, .6776, .8200, .9191, 1.1645, 1.1283, 1.2481,

Log catchability residuals.

Fleet : FLT01: SCOSEI_IV (Ca

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-.60	2.06	-2.45	-2.55	.71	1.92	1.15	1.55	-.43	-1.36
1	1.79	-.39	-1.55	-1.23	.65	.18	.67	-.02	-.10	.00
2	.38	-.14	-.65	-.61	.97	.51	-.34	.39	-.35	-.15
3	-.40	.27	-.14	-.19	.41	.03	-.12	.08	.02	.05
4	-.11	-.13	.09	-.06	.56	-.02	-.17	.06	-.04	-.18
5	-.71	.11	-.27	.36	.79	.09	-.29	.01	.11	-.21
6	-.13	-.11	.13	.11	.30	-.42	.05	-.11	.19	-.01
7	.34	.38	-1.28	.04	.14	.03	-.21	-.19	-.18	.22
8	.25	.56	-.47	-.02	.97	.94	-.45	.26	.10	.75
9	-1.19	-.58	-.60	.19	-5.05	99.99	.34	-.69	-.36	-.51

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	-23.9898	-17.5358	-15.4526	-14.5319	-14.1362	-13.8603	-13.7693	-13.7693	-13.7693	-13.7693
S.E(Log q)	1.7349	.9539	.5331	.2308	.2186	.4066	.2042	.4808	.6010	1.8920

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	-.44	-1.446	14.42	.11	10	.73	-23.99
1	1.45	-.261	18.76	.04	10	1.46	-17.54
2	.82	.387	15.12	.36	10	.46	-15.45
3	1.60	-1.595	15.61	.47	10	.34	-14.53
4	.97	.175	14.05	.77	10	.22	-14.14
5	.81	.870	13.20	.72	10	.33	-13.86
6	1.06	-.507	14.05	.91	10	.23	-13.77
7	.86	.896	12.96	.84	10	.41	-13.84
8	.93	.353	12.92	.74	10	.50	-13.48
9	.65	.841	11.11	.46	9	1.07	-14.71

Table 5.1.10 (Continued)

Fleet : FLT02: SCOLTR_IV (Ca

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	.61	.46	-2.62	.24	.06	.51	.91	.10	.73	-1.02
1	-.06	.67	-1.06	.30	-.51	.25	.84	.58	-.92	-.09
2	.05	.31	-.28	-.20	.32	-.02	-.09	.43	-.26	-.26
3	-.22	.61	.18	.07	-.21	-.16	-.11	.02	-.07	-.11
4	.38	.01	.24	.11	.06	-.31	-.14	.01	-.15	-.23
5	-.42	.26	-.12	.64	.04	-.10	-.28	.24	-.10	-.15
6	.45	.14	.02	.01	-.49	-.53	.18	.04	.08	.10
7	.80	.73	-.93	-.21	-.78	-.42	-.17	-.08	.17	.44
8	.35	.85	.27	1.19	.23	1.02	-.73	.40	.29	1.12
9	-.94	-.69	-.57	-.34	-2.95	.37	-1.31	1.09	.10	-1.63

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	-23.0285	-18.1103	-16.4449	-15.5823	-15.2268	-14.9561	-14.8792	-14.8792	-14.8792	-14.8792
S.E(Log q)	1.0623	.6574	.2694	.2498	.2139	.3068	.2951	.5894	.7794	1.3427

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	-.49	-2.695	14.55	.29	10	.40	-23.03
1	.76	.379	17.33	.25	10	.53	-18.11
2	.88	.489	16.09	.66	10	.25	-16.44
3	1.21	-.594	16.16	.51	10	.31	-15.58
4	1.09	-.413	15.54	.73	10	.24	-15.23
5	.99	.043	14.91	.74	10	.32	-14.96
6	.96	.236	14.67	.84	10	.30	-14.88
7	.73	1.858	12.94	.86	10	.38	-14.92
8	.83	.834	12.96	.75	10	.48	-14.38
9	.95	.170	14.97	.58	10	1.14	-15.57

Table 5.1.10 (Continued)

Fleet : FLT03: FRATRB_IV (Ca

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-1.20	-.70	-.38	-.55	2.40	-1.13	-.93	1.27	-.17	1.40
1	.71	-.16	-.43	-.16	-.09	-.47	.11	.40	.23	-.14
2	.33	.05	-.50	-.52	.19	-.26	-.39	.37	.50	.24
3	-.21	.09	-.06	-.01	-.03	-.56	-.31	.29	.41	.38
4	.14	-.09	.10	-.02	.01	-.59	-.34	.14	.44	.20
5	-.37	.11	.06	.35	.05	-.55	-.48	.13	.07	.62
6	.03	-.10	.61	.20	-.27	-.96	-.18	.15	.18	.33
7	.03	.68	.22	.26	-.13	-.17	.14	.32	.21	.51
8	.57	.78	.38	.91	.33	-.64	-1.46	.25	-.02	.91
9	-.39	.62	.43	-.20	-1.53	.68	-1.14	.87	-.39	.71

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	-20.0189	-16.0686	-14.8104	-14.0322	-13.6713	-13.3998	-13.3279	-13.3279	-13.3279	-13.3279
S.E(Log q)	1.2430	.3668	.3847	.3107	.2890	.3665	.4243	.3407	.7770	.8339

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	11.94	-.514	49.16	.00	10	15.49	-20.02
1	.70	.992	15.69	.58	10	.26	-16.07
2	.93	.186	14.72	.45	10	.38	-14.81
3	1.73	-1.268	14.97	.27	10	.52	-14.03
4	1.17	-.556	14.01	.57	10	.35	-13.67
5	.96	.150	13.29	.68	10	.37	-13.40
6	1.17	-.652	14.06	.65	10	.51	-13.33
7	.96	.434	12.88	.93	10	.26	-13.12
8	.81	.705	11.81	.64	10	.63	-13.13
9	.82	.995	11.67	.79	10	.68	-13.36

Table 5.1.10 (Continued)

Fleet : FLT04: SCOGFS_IV (Ca

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-.74	-1.60	-.58	-.21	1.33	.95	1.33	-1.01	-.07	.60
1	-1.00	-.68	-.57	.07	.32	.05	.61	.43	.18	.59
2	-.60	-.27	.07	-.14	.07	.13	.28	.33	-.27	.39
3	-.74	-.25	-.17	.29	-.09	.03	.55	.20	-.27	.45
4	-.84	-.29	.03	-.04	.52	-.34	.79	.44	-.65	.40
5	-1.49	.25	-.25	-.13	.03	-.02	.73	.62	-.01	.25
6	-.01	-.42	-.30	.09	.24	-.53	.86	-.10	-.34	.52
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6
Mean Log q	-18.4558	-15.6175	-15.2685	-15.3036	-15.4111	-15.3645	-15.2339
S.E(Log q)	1.0156	.5609	.3136	.3892	.5351	.6085	.4387

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	-2.45	-1.010	14.66	.01	10	2.48	-18.46
1	316.67	-1.656	274.29	.00	10	162.58	-15.62
2	.96	.132	15.20	.54	10	.32	-15.27
3	1.01	-.026	15.33	.37	10	.42	-15.30
4	.55	2.032	13.73	.72	10	.25	-15.41
5	.74	.877	14.07	.59	10	.46	-15.36
6	1.01	-.053	15.31	.69	10	.47	-15.23

Table 5.1.10 (Continued)

Fleet : FLT05: ENGGFS_IV (Ca

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-.93	-.75	-.38	1.52	1.25	-.44	.38	-.26	-.47	.09
1	-.82	-.32	-.03	-.37	.02	.55	.39	.07	.20	.30
2	-.24	-.16	-.15	.30	-.41	-.10	.29	.12	-.18	.53
3	-.17	.04	-.13	.38	.38	-.62	-.01	.11	-.28	.29
4	-.59	.51	-.21	-.13	.27	.26	-.18	-.01	-.13	.20
5	-.78	1.01	-.37	.82	-.36	-.12	.75	-.30	-.05	-.61
6	-1.14	1.06	-.29	-.97	.27	-1.17	1.79	1.16	-.92	.21
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6
Mean Log q	-16.8726	-15.4908	-15.2490	-15.3393	-15.2572	-15.3393	-15.3495
S.E(Log q)	.8218	.4093	.2979	.3151	.3156	.6347	1.0707

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	-1.14	-1.878	17.91	.09	10	.83	-16.87
1	-5.24	-4.161	11.17	.05	10	1.28	-15.49
2	1.69	-1.396	16.37	.34	10	.48	-15.25
3	1.46	-.893	16.53	.32	10	.47	-15.34
4	.86	.553	14.77	.67	10	.28	-15.26
5	3.10	-1.843	25.73	.09	10	1.75	-15.34
6	1.30	-.403	17.24	.19	10	1.46	-15.35

Table 5.1.10 (Continued)

Fleet : FLT06: IBTS_Q1_IV (C

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	-.34	-.52	.15	-.14	.59	.48	.43	-.02	-.12	-.52
1	-.44	.06	.17	-.22	.38	.41	.15	.06	-.35	-.21
2	-.68	.00	.26	.10	.20	.39	.15	-.01	-.15	-.24
3	-.54	-.21	.20	.01	.51	.24	.16	.14	-.01	-.49
4	-.46	-.06	.22	-.37	.57	.43	.32	-.23	-.35	-.07
5	-.72	-.69	.12	.54	-.01	.65	.99	-.78	-.13	.03
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	-15.0847	-14.1385	-14.1696	-14.3890	-14.5891	-14.2462
S.E(Log q)	.4030	.2933	.3052	.3287	.3634	.6104

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	1.62	-.670	13.68	.13	10	.67	-15.08
1	4.12	-3.054	12.08	.11	10	.87	-14.14
2	.80	.792	14.06	.65	10	.25	-14.17
3	1.21	-.447	14.73	.37	10	.42	-14.39
4	.84	.582	14.12	.62	10	.32	-14.59
5	1.30	-.558	15.40	.30	10	.83	-14.25

Table 5.1.10 (Continued)

Fleet : FLT09: IBTS_Q2_SCO_I

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	No data for this fleet at this age									
1	99.99	99.99	99.99	99.99	99.99	.00	.35	-.11	-.63	.39
2	99.99	99.99	99.99	99.99	99.99	-.01	.09	.08	-.42	.26
3	99.99	99.99	99.99	99.99	99.99	-.19	-.06	.42	-.39	.22
4	99.99	99.99	99.99	99.99	99.99	.45	-.66	.46	-.38	.12
5	99.99	99.99	99.99	99.99	99.99	-.34	.23	.23	-.41	.28
6	99.99	99.99	99.99	99.99	99.99	.00	.10	.39	-.42	-.07
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	-14.1580	-13.9645	-14.1963	-14.5151	-14.2761	-14.2941
S.E(Log q)	.4148	.2556	.3221	.5000	.3405	.2936

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	5.52	-.525	11.89	.00	5	2.53	-14.16
2	1.21	-.189	14.06	.22	5	.35	-13.96
3	.96	.079	14.14	.55	5	.36	-14.20
4	19.23	-2.390	66.91	.01	5	6.52	-14.52
5	.94	.173	14.06	.73	5	.37	-14.28
6	2.05	-5.313	19.41	.90	5	.22	-14.29

Table 5.1.10 (Continued)

Fleet : FLT10: IBTS_Q4_ENG_I

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	99.99	99.99	99.99	99.99	99.99	-.21	.28	.06	-.10	-.03
1	99.99	99.99	99.99	99.99	99.99	.03	-.09	-.18	-.13	.37
2	99.99	99.99	99.99	99.99	99.99	-.03	.10	-.06	-.18	.17
3	99.99	99.99	99.99	99.99	99.99	.14	-.04	.20	-.36	.06
4	99.99	99.99	99.99	99.99	99.99	.88	-.06	.19	-.94	-.07
5	99.99	99.99	99.99	99.99	99.99	.96	.43	-.80	-.04	-.55
6	99.99	99.99	99.99	99.99	99.99	1.24	.75	.46	-1.97	-.48
7	99.99	99.99	99.99	99.99	99.99	.27	.26	-2.02	.68	-1.17
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	0	1	2	3	4	5	6	7
Mean Log q	-15.4038	-14.1932	-14.1496	-14.5074	-14.4799	-14.4495	-14.0469	-14.0469
S.E(Log q)	.1850	.2222	.1386	.2180	.6513	.7151	1.2666	1.2302

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	.69	.429	16.01	.39	5	.14	-15.40
1	.70	.519	14.33	.49	5	.17	-14.19
2	.85	.350	14.05	.66	5	.13	-14.15
3	.74	1.176	14.04	.87	5	.15	-14.51
4	1.82	-.537	16.82	.12	5	1.31	-14.48
5	2.90	-.952	21.72	.08	5	2.10	-14.45
6	-1.42	-1.871	2.88	.17	5	1.41	-14.05
7	2.99	-.929	27.47	.07	5	3.50	-14.44

Table 5.1.10 (Continued)

Fleet : FLT11: FRATRC_7d (Ca

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	No data for this fleet at this age									
1	-2.66	-.22	.27	-1.10	-1.79	.78	1.30	.56	1.84	1.01
2	-.52	-.57	.27	.09	-.23	.26	.51	.22	-.05	.01
3	.64	-.69	-.23	.12	.04	-.60	.31	.81	-.21	-.18
4	1.65	1.27	-.64	-.97	-.15	1.00	-1.25	.01	-.21	-.71
5	1.11	.91	.99	-2.17	-.62	1.42	.87	-1.00	-.45	-1.05
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	1	2	3	4	5
Mean Log q	-19.3692	-17.0183	-16.5536	-16.2852	-16.5016
S.E(Log q)	1.4399	.3512	.4880	.9907	1.2123

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	-.62	-1.714	11.99	.12	10	.80	-19.37
2	1.58	-1.015	19.00	.27	10	.56	-17.02
3	1.31	-.413	17.71	.19	10	.67	-16.55
4	-3.79	-1.585	-5.90	.01	10	3.48	-16.29
5	2.56	-.751	26.00	.03	10	3.18	-16.50

Table 5.1.10 (Continued)

Fleet : FLT12: FRAGFS_7d (Ca

Age	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
0 ,	99.99,	99.99,	-.29,	-.26,	-.13,	1.31,	.97,	-.46,	-.67,	-.47
1 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.16,	.15,	-1.04,	1.23,	-.17
2 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.37,	.31,	-.11,	.82,	-.64
3 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-1.13,	.41,	.36,	1.27,	-.91
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									

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

Age ,	0,	1,	2,	3
Mean Log q,	-10.5842,	-9.5036,	-10.3851,	-11.3432,
S.E(Log q),	.7265,	.8161,	.5755,	1.0054,

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,	6.48,	-.765,	-26.44,	.00,	8,	4.85,	-10.58,
1,	.73,	.118,	10.91,	.06,	5,	.68,	-9.50,
2,	.83,	.101,	10.92,	.10,	5,	.55,	-10.39,
3,	-.59,	-3.856,	13.55,	.66,	5,	.28,	-11.34,

Table 5.1.10 (Continued)

Terminal year survivor and F summaries :

Age 0 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,	643654.,	1.820,	.000,	.00,	1,	.011,	.000
FLT02: SCOLTR_IV (Ca,	911057.,	1.114,	.000,	.00,	1,	.030,	.000
FLT03: FRATRB_IV (Ca,	10156312.,	1.304,	.000,	.00,	1,	.022,	.000
FLT04: SCOGFS_IV (Ca,	4569914.,	1.065,	.000,	.00,	1,	.033,	.000
FLT05: ENGGFS_IV (Ca,	2738855.,	.862,	.000,	.00,	1,	.050,	.000
FLT06: IBTS_Q1_IV (C,	1502277.,	.423,	.000,	.00,	1,	.207,	.000
FLT09: IBTS_Q2_SCO_I,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: IBTS_Q4_ENG_I,	2441186.,	.300,	.000,	.00,	1,	.411,	.000
FLT11: FRATRC_7d (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT12: FRAGFS_7d (Ca,	1574297.,	.771,	.000,	.00,	1,	.062,	.000
F shrinkage mean ,	5604372.,	.50,,,,				.174,	.075

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2514355.,	.20,	.20,	9,	1.016,	.161

Age 1 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,	861708.,	.877,	.182,	.21,	2,	.018,	.098
FLT02: SCOLTR_IV (Ca,	1090533.,	.586,	.364,	.62,	2,	.040,	.078
FLT03: FRATRB_IV (Ca,	822411.,	.369,	.007,	.02,	2,	.101,	.102
FLT04: SCOGFS_IV (Ca,	1471416.,	.515,	.275,	.53,	2,	.052,	.058
FLT05: ENGGFS_IV (Ca,	1102991.,	.384,	.303,	.79,	2,	.093,	.077
FLT06: IBTS_Q1_IV (C,	793126.,	.249,	.045,	.18,	2,	.221,	.106
FLT09: IBTS_Q2_SCO_I,	1405854.,	.454,	.000,	.00,	1,	.067,	.061
FLT10: IBTS_Q4_ENG_I,	1093556.,	.212,	.235,	1.11,	2,	.303,	.078
FLT11: FRATRC_7d (Ca,	2615329.,	1.510,	.000,	.00,	1,	.006,	.033
FLT12: FRAGFS_7d (Ca,	603650.,	.584,	.244,	.42,	2,	.040,	.137
F shrinkage mean ,	476320.,	.50,,,,				.060,	.170

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
950924.,	.12,	.08,	19,	.700,	.089

Table 5.1.10 (Continued)

Age 2 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,	434204.,	.472,	.279,	.59,	3,	.030,	.236
FLT02: SCOLTR_IV (Ca,	323712.,	.267,	.175,	.65,	3,	.093,	.305
FLT03: FRATRB_IV (Ca,	593217.,	.273,	.142,	.52,	3,	.086,	.178
FLT04: SCOGFS_IV (Ca,	588232.,	.278,	.231,	.83,	3,	.085,	.179
FLT05: ENGGFS_IV (Ca,	660915.,	.243,	.163,	.67,	3,	.110,	.161
FLT06: IBTS_Q1_IV (C,	355497.,	.197,	.085,	.43,	3,	.163,	.282
FLT09: IBTS_Q2_SCO_I,	456603.,	.251,	.401,	1.60,	2,	.105,	.226
FLT10: IBTS_Q4_ENG_I,	469064.,	.174,	.088,	.51,	3,	.206,	.220
FLT11: FRATRC_7d (Ca,	498449.,	.358,	.401,	1.12,	2,	.053,	.209
FLT12: FRAGFS_7d (Ca,	378229.,	.430,	.532,	1.24,	3,	.034,	.267
F shrinkage mean ,	217899.,	.50,,,,				.034,	.426

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
451747.,	.08,	.07,	29,	.901,	.228

Age 3 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,	190348.,	.255,	.117,	.46,	4,	.075,	.402
FLT02: SCOLTR_IV (Ca,	173164.,	.202,	.147,	.73,	4,	.112,	.435
FLT03: FRATRB_IV (Ca,	282294.,	.212,	.112,	.53,	4,	.098,	.288
FLT04: SCOGFS_IV (Ca,	223162.,	.232,	.241,	1.04,	4,	.081,	.352
FLT05: ENGGFS_IV (Ca,	207968.,	.198,	.123,	.62,	4,	.111,	.374
FLT06: IBTS_Q1_IV (C,	168971.,	.173,	.175,	1.01,	4,	.137,	.443
FLT09: IBTS_Q2_SCO_I,	171336.,	.207,	.209,	1.01,	3,	.103,	.438
FLT10: IBTS_Q4_ENG_I,	189805.,	.153,	.105,	.69,	4,	.177,	.403
FLT11: FRATRC_7d (Ca,	175723.,	.296,	.092,	.31,	3,	.051,	.430
FLT12: FRAGFS_7d (Ca,	237837.,	.404,	.512,	1.27,	4,	.024,	.334
F shrinkage mean ,	100388.,	.50,,,,				.031,	.662

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
191262.,	.07,	.06,	39,	.833,	.401

Table 5.1.10 (Continued)

Age 4 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,	45578.,	.205,	.110,	.54,	5,	.118,	.504
FLT02: SCOLTR_IV (Ca,	47068.,	.181,	.145,	.80,	5,	.140,	.491
FLT03: FRATRB_IV (Ca,	62363.,	.189,	.080,	.42,	5,	.129,	.391
FLT04: SCOGFS_IV (Ca,	58836.,	.232,	.166,	.72,	5,	.070,	.410
FLT05: ENGGFS_IV (Ca,	51383.,	.186,	.114,	.62,	5,	.126,	.458
FLT06: IBTS_Q1_IV (C,	49814.,	.175,	.073,	.42,	5,	.125,	.470
FLT09: IBTS_Q2_SCO_I,	46246.,	.208,	.151,	.73,	4,	.085,	.498
FLT10: IBTS_Q4_ENG_I,	39879.,	.159,	.065,	.41,	5,	.117,	.559
FLT11: FRATRC_7d (Ca,	45674.,	.300,	.223,	.74,	4,	.037,	.503
FLT12: FRAGFS_7d (Ca,	80113.,	.413,	.379,	.92,	4,	.014,	.317
F shrinkage mean ,	23399.,	.50,,,,				.040,	.822

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
48190.,	.07,	.05,	48,	.700,	.482

Age 5 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_IV (Ca,	13953.,	.210,	.057,	.27,	6,	.124,	.666
FLT02: SCOLTR_IV (Ca,	13668.,	.183,	.033,	.18,	6,	.174,	.676
FLT03: FRATRB_IV (Ca,	22801.,	.196,	.158,	.81,	6,	.143,	.457
FLT04: SCOGFS_IV (Ca,	16330.,	.264,	.177,	.67,	6,	.065,	.593
FLT05: ENGGFS_IV (Ca,	14556.,	.201,	.167,	.83,	6,	.100,	.646
FLT06: IBTS_Q1_IV (C,	15975.,	.195,	.129,	.67,	6,	.102,	.603
FLT09: IBTS_Q2_SCO_I,	18299.,	.225,	.116,	.52,	5,	.115,	.543
FLT10: IBTS_Q4_ENG_I,	13529.,	.209,	.196,	.94,	5,	.075,	.681
FLT11: FRATRC_7d (Ca,	18623.,	.348,	.343,	.98,	5,	.028,	.536
FLT12: FRAGFS_7d (Ca,	17489.,	.406,	.132,	.33,	4,	.009,	.563
F shrinkage mean ,	7313.,	.50,,,,				.065,	1.032

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
15289.,	.08,	.05,	56,	.707,	.623

Table 5.1.10 (Continued)

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

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: SCOSEI_IV (Ca,	3689.,	.211,	.047,	.22,	7,	.180,	.802
FLT02: SCOLTR_IV (Ca,	3731.,	.192,	.040,	.21,	7,	.198,	.796
FLT03: FRATRB_IV (Ca,	4206.,	.224,	.083,	.37,	7,	.124,	.732
FLT04: SCOGFS_IV (Ca,	5460.,	.300,	.081,	.27,	7,	.083,	.605
FLT05: ENGGFS_IV (Ca,	3727.,	.240,	.079,	.33,	7,	.057,	.797
FLT06: IBTS_Q1_IV (C,	3730.,	.197,	.111,	.56,	6,	.049,	.796
FLT09: IBTS_Q2_SCO_I,	3258.,	.226,	.091,	.40,	5,	.158,	.873
FLT10: IBTS_Q4_ENG_I,	3355.,	.298,	.092,	.31,	5,	.036,	.856
FLT11: FRATRC_7d (Ca,	3893.,	.348,	.189,	.54,	5,	.014,	.773
FLT12: FRAGFS_7d (Ca,	3153.,	.462,	.233,	.50,	3,	.004,	.892
F shrinkage mean ,	2354.,	.50,,,,				.096,	1.074

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3637.,	.09,	.03,	60,	.367,	.810

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

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: SCOSEI_IV (Ca,	2895.,	.233,	.064,	.27,	8,	.178,	.887
FLT02: SCOLTR_IV (Ca,	2968.,	.218,	.089,	.41,	8,	.166,	.873
FLT03: FRATRB_IV (Ca,	3437.,	.242,	.113,	.47,	8,	.216,	.790
FLT04: SCOGFS_IV (Ca,	2389.,	.285,	.167,	.59,	7,	.050,	1.005
FLT05: ENGGFS_IV (Ca,	1634.,	.221,	.102,	.46,	7,	.038,	1.261
FLT06: IBTS_Q1_IV (C,	2493.,	.186,	.182,	.98,	6,	.034,	.978
FLT09: IBTS_Q2_SCO_I,	1879.,	.232,	.159,	.69,	4,	.089,	1.163
FLT10: IBTS_Q4_ENG_I,	1244.,	.508,	.358,	.70,	5,	.029,	1.464
FLT11: FRATRC_7d (Ca,	1328.,	.330,	.185,	.56,	5,	.010,	1.414
FLT12: FRAGFS_7d (Ca,	1224.,	.670,	.421,	.63,	2,	.001,	1.477
F shrinkage mean ,	1860.,	.50,,,,				.189,	1.171

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2491.,	.13,	.05,	61,	.409,	.979

Table 5.1.10 (Continued)

Age 8 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
FLT01: SCOSEI_IV (Ca,	82.,	.325,	.160,	.49,	9,	.134,	1.504
FLT02: SCOLTR_IV (Ca,	94.,	.340,	.198,	.58,	9,	.101,	1.399
FLT03: FRATRB_IV (Ca,	87.,	.303,	.148,	.49,	9,	.128,	1.457
FLT04: SCOGFS_IV (Ca,	61.,	.324,	.130,	.40,	7,	.017,	1.738
FLT05: ENGGFS_IV (Ca,	106.,	.277,	.154,	.56,	7,	.011,	1.315
FLT06: IBTS_Q1_IV (C,	102.,	.226,	.171,	.76,	6,	.008,	1.342
FLT09: IBTS_Q2_SCO_I,	89.,	.254,	.048,	.19,	3,	.032,	1.442
FLT10: IBTS_Q4_ENG_I,	116.,	.802,	.081,	.10,	4,	.008,	1.249
FLT11: FRATRC_7d (Ca,	95.,	.401,	.209,	.52,	5,	.002,	1.396
FLT12: FRAGFS_7d (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	48.,	.50,,,,				.558,	1.949

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
62.,	.29,	.07,	60,	.246,	1.725

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: SCOSEI_IV (Ca,	62.,	.384,	.075,	.20,	10,	.117,	.921
FLT02: SCOLTR_IV (Ca,	45.,	.465,	.267,	.57,	10,	.104,	1.116
FLT03: FRATRB_IV (Ca,	93.,	.421,	.116,	.28,	10,	.170,	.695
FLT04: SCOGFS_IV (Ca,	121.,	.335,	.153,	.46,	7,	.012,	.572
FLT05: ENGGFS_IV (Ca,	100.,	.292,	.300,	1.03,	7,	.007,	.658
FLT06: IBTS_Q1_IV (C,	90.,	.210,	.139,	.66,	6,	.006,	.712
FLT09: IBTS_Q2_SCO_I,	65.,	.271,	.172,	.64,	2,	.022,	.886
FLT10: IBTS_Q4_ENG_I,	24.,	.908,	.975,	1.07,	3,	.005,	1.586
FLT11: FRATRC_7d (Ca,	98.,	.377,	.281,	.75,	5,	.002,	.666
FLT12: FRAGFS_7d (Ca,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	60.,	.50,,,,				.555,	.934

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
64.,	.29,	.05,	61,	.179,	.899

Table 5.1.11

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

At 10-Oct-96 18:59:08

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,
AGE						
0,	.0052,	.0103,	.0033,	.0206,	.0234,	.0073,
1,	.2156,	.7645,	.3319,	.1467,	.1690,	.2222,
2,	.4686,	.9726,	.6378,	.8739,	.2410,	.5098,
3,	1.4891,	1.4096,	.9676,	.8704,	.6103,	.4511,
4,	2.3403,	1.2813,	.9620,	1.0600,	.6097,	.7127,
5,	1.5397,	1.5144,	.9871,	.9846,	.9102,	.4900,
6,	1.8272,	1.7621,	2.6252,	.9853,	1.0186,	.9711,
7,	1.8163,	1.1781,	.9160,	.7402,	.7463,	.9465,
8,	1.9481,	1.9184,	1.6033,	.8369,	.3532,	.4880,
9,	1.9209,	1.5513,	1.4373,	.9315,	.7347,	.7286,
+gp,	1.9209,	1.5513,	1.4373,	.9315,	.7347,	.7286,
FBAR 2- 6,	1.5330,	1.3880,	1.2359,	.9548,	.6779,	.6269,

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
0,	.0051,	.0054,	.0267,	.1697,	.1035,	.0617,	.0206,	.0133,	.0208,	.0137,
1,	.4148,	.4117,	.1581,	.8137,	.7666,	.3988,	.3271,	.2883,	.4012,	.2265,
2,	.6976,	.5666,	.8031,	.5551,	.8240,	.5324,	.7057,	.8052,	.8548,	.7663,
3,	.9899,	.7742,	.8871,	.8151,	.9593,	.5651,	.5993,	1.0486,	1.0443,	.9678,
4,	.9453,	.9100,	1.0538,	.7182,	.8486,	.6951,	.5769,	.6273,	.9959,	.9564,
5,	1.2543,	.8193,	.9448,	1.0725,	.7926,	.6171,	.9412,	1.3978,	.3573,	.9827,
6,	2.0093,	1.1172,	1.3298,	.6295,	1.1847,	.3745,	1.1218,	.9555,	1.8789,	2.1886,
7,	2.1082,	1.6323,	1.0037,	1.1049,	1.4557,	.8150,	1.9653,	1.4858,	1.0362,	1.0446,
8,	1.9200,	1.3401,	.8681,	1.2628,	.8209,	.8369,	.7842,	1.5566,	.8883,	.7434,
9,	1.6699,	1.1779,	1.0521,	.9683,	1.0322,	.6739,	1.0906,	1.2194,	1.0432,	1.1976,
+gp,	1.6699,	1.1779,	1.0521,	.9683,	1.0322,	.6739,	1.0906,	1.2194,	1.0432,	1.1976,
FBAR 2- 6,	1.1793,	.8374,	1.0037,	.7581,	.9218,	.5568,	.7890,	.9669,	1.0262,	1.1724,

Table 5.1.11 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

At 10-Oct-96 18:59:08

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
0,	.0252,	.0393,	.0396,	.0297,	.0526,	.0709,	.0151,	.0674,	.0229,	.0132,
1,	.1740,	.4274,	.1566,	.2333,	.1015,	.1653,	.1714,	.1961,	.2157,	.1904,
2,	.9282,	.4843,	.4073,	.4797,	.4427,	.3295,	.2934,	.4480,	.4673,	.2754,
3,	1.2577,	.8308,	.6318,	.7390,	.8254,	.7598,	.5315,	.7473,	.8437,	.7166,
4,	1.0642,	.9647,	.8629,	.7092,	.9920,	1.0073,	.7357,	.7352,	1.0302,	.9068,
5,	.9073,	.9310,	.7694,	.8825,	1.2482,	1.1516,	.9150,	.9276,	1.0506,	1.1794,
6,	1.3173,	1.0787,	1.2036,	.9463,	1.1035,	1.3491,	1.1740,	.9758,	1.3116,	1.3321,
7,	.9489,	.8574,	1.6559,	1.0208,	1.3130,	1.7767,	.9292,	1.2767,	1.2256,	1.5444,
8,	.4295,	2.5991,	1.5520,	1.3402,	2.3198,	1.2138,	1.1322,	1.2510,	1.2991,	2.1322,
9,	.9438,	1.3024,	1.2237,	.9909,	1.4134,	1.3162,	.9882,	1.0452,	1.1979,	1.4375,
+gp,	.9438,	1.3024,	1.2237,	.9909,	1.4134,	1.3162,	.9882,	1.0452,	1.1979,	1.4375,
FBAR 2- 6,	1.0949,	.8579,	.7750,	.7513,	.9224,	.9195,	.7299,	.7668,	.9407,	.8821,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
0,	.0189,	.0102,	.0258,	.0118,	.0394,	.1358,	.0280,	.0654,	.0223,	.1610,	.0829,
1,	.2673,	.1387,	.3526,	.1262,	.2179,	.1124,	.2182,	.1528,	.1125,	.0890,	.1181,
2,	.4256,	.5036,	.4292,	.4330,	.5478,	.4813,	.3723,	.4254,	.2609,	.2279,	.3047,
3,	.7162,	.8760,	.6613,	.6891,	.8896,	.5175,	.5759,	.7274,	.5440,	.4008,	.5574,
4,	1.2597,	1.3236,	.9735,	.8234,	.9601,	.9127,	.6315,	.8134,	.7286,	.4822,	.6747,
5,	1.0731,	1.4722,	1.1523,	1.5170,	1.2083,	1.1727,	.9455,	.8737,	.8843,	.6226,	.7935,
6,	1.3585,	1.6898,	1.3749,	1.5069,	1.0033,	.8231,	1.1895,	1.2147,	1.0628,	.8102,	1.0292,
7,	1.4735,	1.9650,	.7589,	1.4837,	.9929,	1.2357,	1.2588,	1.1955,	1.0999,	.9785,	1.0913,
8,	1.5063,	1.9114,	.7303,	2.5620,	3.0324,	3.0626,	.6734,	1.8146,	1.0282,	1.7252,	1.5227,
9,	1.4097,	1.6663,	.9601,	1.5939,	1.6404,	1.4013,	1.0584,	1.2479,	1.0085,	.8991,	1.0518,
+gp,	1.4097,	1.6663,	.9601,	1.5939,	1.6404,	1.4013,	1.0584,	1.2479,	1.0085,	.8991,	
FBAR 2- 6,	.9666,	1.1730,	.9183,	.9939,	.9218,	.7814,	.7429,	.8109,	.6961,	.5088,	

Table 5.1.12

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

At 10-Oct-96 18:59:08

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,
AGE						
0,	418036,	753446,	831790,	185973,	362520,	315936,
1,	40045,	32471,	58228,	64734,	14225,	27651,
2,	8684,	12484,	5846,	16158,	21619,	4646,
3,	3313,	3466,	3010,	1970,	4300,	10833,
4,	276,	527,	596,	806,	581,	1646,
5,	336,	20,	108,	169,	207,	234,
6,	49,	56,	3,	31,	49,	65,
7,	12,	6,	7,	0,	9,	14,
8,	28,	2,	2,	2,	0,	4,
9,	3,	3,	0,	0,	1,	0,
+gp,	0,	0,	0,	0,	0,	0,
TOTAL,	470782,	802481,	899590,	269845,	403511,	361028,

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
0,	596913,	1176288,	142212,	276564,	431959,	737409,	969679,	477523,	991811,	626930,
1,	24490,	46372,	91351,	10811,	18224,	30411,	54133,	74167,	36795,	75845,
2,	8563,	6256,	11882,	30164,	1853,	3274,	7893,	15095,	21499,	9527,
3,	1779,	2718,	2264,	3394,	11041,	518,	1226,	2485,	4302,	5831,
4,	4862,	466,	883,	657,	1058,	2981,	208,	474,	614,	1067,
5,	598,	1400,	139,	228,	237,	336,	1102,	86,	188,	168,
6,	112,	133,	480,	42,	61,	84,	141,	335,	17,	102,
7,	19,	12,	34,	99,	17,	14,	45,	36,	100,	2,
8,	4,	2,	2,	10,	27,	3,	5,	5,	7,	29,
9,	2,	1,	0,	1,	2,	10,	1,	2,	1,	2,
+gp,	0,	0,	0,	0,	0,	1,	11,	1,	0,	0,
TOTAL,	637342,	1233647,	249246,	321970,	464481,	775041,	1034445,	570209,	1055333,	719504,

Table 5.1.12 (Continued)

Run title : Whiting IV,IIIa,VIId (run: XSAWHI03/X03)

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
0,	610886,	619003,	633667,	583360,	232074,	270363,	241440,	367142,	249056,	508726,
1,	48284,	46511,	46469,	47557,	44219,	17192,	19666,	18570,	26799,	19006,
2,	23388,	15691,	11731,	15366,	14565,	15451,	5636,	6408,	5903,	8353,
3,	2823,	5895,	6165,	4978,	6065,	5965,	7086,	2680,	2611,	2359,
4,	1561,	566,	1810,	2310,	1675,	1872,	1966,	2935,	894,	791,
5,	304,	399,	160,	566,	842,	460,	507,	698,	1042,	236,
6,	49,	95,	122,	58,	182,	188,	113,	158,	215,	284,
7,	9,	10,	25,	29,	17,	47,	38,	27,	46,	45,
8,	1,	3,	4,	4,	8,	4,	7,	12,	6,	11,
9,	11,	0,	0,	1,	1,	1,	1,	2,	3,	1,
+gp,	1,	2,	0,	0,	0,	1,	1,	1,	0,	0,
TOTAL,	687316,	688176,	700153,	654227,	299648,	311544,	276460,	398632,	286575,	539813,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
0,	431022,	299906,	584770,	265297,	263691,	291648,	327342,	352038,	351972,	378266,	0,	4258
1,	39200,	33026,	23180,	44495,	20471,	19794,	19881,	24853,	25749,	26877,	25144,	324
2,	6076,	11605,	11118,	6301,	15168,	6367,	6841,	6181,	8250,	8899,	9509,	94
3,	4044,	2532,	4472,	4615,	2606,	5592,	2509,	3006,	2576,	4052,	4517,	34
4,	812,	1392,	743,	1627,	1633,	754,	2349,	994,	1023,	1054,	1913,	10
5,	237,	171,	275,	208,	529,	463,	224,	925,	326,	366,	482,	3
6,	57,	63,	30,	68,	36,	123,	112,	68,	301,	105,	153,	
7,	58,	11,	9,	6,	12,	10,	42,	26,	16,	81,	36,	
8,	8,	11,	1,	3,	1,	4,	2,	10,	7,	4,	25,	
9,	1,	1,	1,	1,	0,	0,	0,	1,	1,	2,	1,	
+gp,	0,	0,	1,	0,	0,	0,	0,	0,	0,	1,	1,	
TOTAL,	481515,	348718,	624600,	322620,	304146,	324755,	359302,	388104,	390220,	419706,	41781,	

TABLE 5.1.13 Whiting, North Sea and VIId
Annual weight and numbers caught, 1960 to 1995.

Year	Wt.('000t)				Nos.(millions)			
	Total	hcons	dis	ind	Total	hcons	dis	ind
1960	182	49	122	11	1070	198	763	109
1961	326	69	241	16	2174	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	194	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	2312	276	641	1396
1977	347	78	163	106	2491	281	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	1358	290	370	697
1984	146	86	41	19	909	285	327	297
1985	107	62	29	15	731	219	232	280
1986	162	64	80	18	1211	230	583	399
1987	139	68	54	16	947	246	416	285
1988	133	56	28	49	1396	213	231	952
1989	124	45	36	43	883	172	280	431
1990	153	47	56	51	1296	179	539	578
1991	125	53	34	38	1624	212	242	1170
1992	110	52	31	27	874	193	216	465
1993	117	53	43	20	1245	186	345	714
1994	93	50	33	10	711	169	237	304
1995	104	47	31	27	2031	155	217	1659
Min.	93	45	27	8	711	155	173	100
Mean	203	71	80	51	1565	252	515	798
Max.	368	108	241	152	2816	382	1646	1974

Table 5.1.14 Whiting,North Sea and VIId
Input data for catch forecast and linear sensitivity analysis.

Populations in 1996			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N0	34106100	.51	WS0	.01	.20	M0	2.55	.09	MT0	.00	.10
N1	2514300	.20	WS1	.09	.13	M1	.95	.11	MT1	.11	.10
N2	950900	.12	WS2	.17	.04	M2	.45	.26	MT2	.92	.10
N3	451700	.08	WS3	.24	.06	M3	.35	.14	MT3	1.00	.10
N4	191299	.07	WS4	.30	.08	M4	.30	.14	MT4	1.00	.00
N5	48200	.07	WS5	.34	.10	M5	.25	.14	MT5	1.00	.00
N6	15299	.08	WS6	.36	.11	M6	.25	.14	MT6	1.00	.00
N7	3599	.09	WS7	.38	.13	M7	.20	.14	MT7	1.00	.00
N8	2498	.13	WS8	.42	.10	M8	.20	.14	MT8	1.00	.00
N9	100	.29	WS9	.48	.35	M9	.20	.14	MT9	1.00	.00
N10	100	.29	WS10	.81	.73	M10	.20	.14	MT10	1.00	.00

HC selectivity			HC.catch wt			Dis selectivity			Discrd catch wt		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
sH0	.00	.91	WH0	.14	.21	sD0	.00	.88	WD0	.04	.21
sH1	.01	.38	WH1	.18	.05	sD1	.05	.31	WD1	.09	.06
sH2	.06	.29	WH2	.23	.05	sD2	.13	.21	WD2	.16	.05
sH3	.22	.13	WH3	.27	.07	sD3	.16	.15	WD3	.20	.07
sH4	.39	.17	WH4	.32	.09	sD4	.11	.11	WD4	.23	.05
sH5	.57	.19	WH5	.35	.10	sD5	.09	.41	WD5	.24	.03
sH6	.68	.17	WH6	.38	.10	sD6	.06	.73	WD6	.24	.05
sH7	.74	.19	WH7	.40	.07	sD7	.10	1.36	WD7	.27	.21
sH8	1.26	.58	WH8	.42	.10	sD8	.01	1.71	WD8	.30	1.74
sH9	.86	.14	WH9	.48	.35	sD9	.00	.00	WD9	.00	.00
sH10	.86	.14	WH10	.81	.73	sD10	.00	.00	WD10	.00	.00

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI0	.07	.81	WI0	.01	.24
sI1	.05	.45	WI1	.06	.37
sI2	.08	.26	WI2	.15	.08
sI3	.04	.53	WI3	.25	.15
sI4	.05	.54	WI4	.30	.21
sI5	.03	.76	WI5	.39	.31
sI6	.05	.91	WI6	.26	.77
sI7	.04	1.15	WI7	.28	.61
sI8	.01	1.62	WI8	.17	1.49
sI9	.00	.00	WI9	.00	.00
sI10	.00	.00	WI10	.00	.00

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K96	1.00	.23	HF96	1.00	.14	IF96	1.00	.41
K97	1.00	.23	HF97	1.00	.14	IF97	1.00	.41
K98	1.00	.23	HF98	1.00	.14	IF98	1.00	.41

Recruitment		
Labl	Value	CV
R97	34106100	.51
R98	34106100	.51

Stock numbers in 1996 are VPA survivors. These are overwritten at Age 0
Human consumption + discard Fs are obtained from mean exploitation pattern over 1991 to 1995. This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1995, i.e. .492
Fs are distributed between consumption and discards by mean proportion retained over 1991 to 1995.
N.B. Above value for hcons +dis ref F is value for both catch categories combined.

Bycatch Fs are obtained from mean exploitation pattern over 1991 to 1995.
This is scaled to give a value for mean F (ages 0 to 4) equal to that in 1995, i.e. .058

Table 5.1.15 Whiting,North Sea and VIId
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 1996	1997						
Mean F Ages								
H.cons 2 to 6	.49	.00	.10	.20	.30	.39	.49	.59
Ind BC 0 to 4	.06	.06	.06	.06	.06	.06	.06	.06
Effort relative to 1995								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Biomass at start of year								
Total	575	580	580	580	580	580	580	580
Spawning	367	375	375	375	375	375	375	375
Catch weight (,000t)								
H.cons	58.0	.0	15.0	28.9	41.5	53.2	64.0	73.9
Discards	35.9	.0	7.8	15.3	22.4	29.2	35.6	41.8
Ind BC	28.1	30.3	29.8	29.3	28.9	28.4	28.0	27.6
Total Landings	86.1	30.3	44.8	58.2	70.4	81.7	92.0	101.6
Total Catch	122.0	30.3	52.7	73.5	92.8	110.8	127.6	143.4
Biomass at start of 1998								
Total		674	652	631	612	595	578	563
Spawning		468	446	426	407	390	374	359

Area split forecast:

	1996	1997					
Effort relative to 1995 H. cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Catch weight ('000t)								
IV H. cons	51.0	.0	13.7	26.0	37.3	47.6	57.1	65.8
VIId (H. cons)	7.0	.0	1.4	2.7	4.0	5.1	6.2	7.3

	Year 1996	1997						
Effort relative to 1995								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Est. Coeff. of Variation								
Biomass at start of year								
Total	.10	.39	.39	.39	.39	.39	.39	.39
Spawning	.08	.21	.21	.21	.21	.21	.21	.21
Catch weight								
H.cons	.15	.00	.69	.36	.27	.23	.21	.20
Discards	.19	.00	.74	.45	.37	.34	.33	.32
Ind BC	.55	.57	.57	.58	.58	.58	.59	.59
Biomass at start of 1998								
Total		.43	.44	.45	.46	.47	.48	.49
Spawning		.39	.40	.41	.42	.42	.43	.44

Table 5.1.16 Whiting,North Sea and VIId
Detailed forecast tables.

Forecast for year 1996
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	34106100	0	24162	785256	809418
1	2514300	13969	74502	77606	166077
2	950900	43306	88641	53455	185402
3	451700	69465	50292	13830	133587
4	191300	50817	13543	6320	70679
5	48200	17701	2752	1063	21516
6	15299	6460	544	458	7462
7	3600	1620	226	95	1941
8	2499	1640	13	16	1669
9	100	53	0	0	53
10	100	53	0	0	53
Wt	575	58	36	28	122

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

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	34106100	0	24162	785256	809418
1	2490482	13837	73796	76871	164503
2	873711	39790	81446	49116	170352
3	461005	70896	51328	14115	136339
4	208100	55279	14732	6875	76886
5	81928	30087	4678	1807	36572
6	18866	7967	671	565	9202
7	5451	2454	343	143	2940
8	1219	800	6	8	814
9	569	301	0	0	301
10	69	37	0	0	37
Wt	580	64	36	28	128

Table 5.1.17 Stock: Whiting in Sub-area IV (North Sea) and VIId (Eastern Channel)

Assessment Quality Control Diagram 1

Average F(2-6,u)

Date of assessment	Year								
	1987	1988	1989	1990	1991	1992	1993	1994	1995
1989	1.17	0.81							
1990	1.07	0.78	0.69						
1991	1.10	0.82	0.81	0.77					
1992	1.10	0.82	0.79	0.87	0.96				
1993	1.10	0.82	0.78	0.78	0.70	0.85			
1994	1.09	0.81	0.77	0.74	0.64	0.64	0.68		
1995	1.09	0.81	0.77	0.74	0.64	0.65	0.69	0.65	
1996[1]	1.12	0.82	0.77	0.73	0.66	0.66	0.74	0.67	0.49

Remarks: Reference F is for human consumption landings + discards, age 2-6
[1] First assessment of combined IV and VIId whiting

Assessment Quality Control Diagram 2

Recruitment (age 0) Unit: millions

Date of assessment	Year class								
	1987	1988	1989	1990	1991	1992	1993	1994	1995
1989	39212	70480							
1990	50113	72010	48155						
1991	28474	64780	44169	65840					
1992	26333	46065	38134	45240	43856				
1993	28386	52593	23286	20814	48623	49573			
1994	29365	56305	25500	26834	34605	34700	38551		
1995	29382	56909	25284	25033	29478	29814	30565	23495	
1996[2]	29990	58477	26530	26369	29165	32734	35204	35197	37827

Remarks:
[1] First assessment of combined IV and VIId whiting

Table 5.1.18 Stock: Whiting in Sub-area IV (North Sea) and VIId (Eastern Channel)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)											
Date of assessment	Year										
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1989	265	325	391[1]	354[1]							
1990	283	365	474	444[1]	375[1]						
1991	273	269	351	400	422[1]	347[1]					
1992	267	243	264	291	305	308[1]	286[1]				
1993	279	261	286	228	209	265	315[1]	289[1]			
1994	286	271	301	259	267	284	297	325[1]	360[1]		
1995	286	271	303	259	256	249	256	263	250[1]	267[1]	
1996[2]	297	283	321	277	271	254	274	334	367	375[1]	374[1]

[1]Forecast.

Remarks
[2] First assessment of combined IV and VIId whiting

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Table 5.2 Nominal landings (in tonnes) of WHITING from Division IIIa as supplied by the Study Group on Division IIIa Demersal Stocks (Anon., 1992b) and updated by the Working Group.

Year	Denmark			Norway	Sweden	Others	Total
1975		19,018		57	611	4	19,690
1976		17,870		48	1,002	48	18,968
1977		18,116		46	975	41	19,178
1978		48,102		58	899	32	49,091
1979		16,971		63	1,033	16	18,083
1980		21,070		65	1,516	3	22,654
	Total consumption	Total industrial	Total				
1981	1,027	23,915	24,942	70	1,054	7	26,073
1982	1,183	39,758	40,941	40	670	13	41,664
1983	1,311	23,505	24,816	48	1,061	8	25,933
1984	1,036	12,102	13,138	51	1,168	60	14,417
1985	557	11,967	12,524	45	654	2	13,225
1986	484	11,979	12,463	64	477	1	13,005
1987	443	15,880	16,323	29	262	43	16,657
1988	391	10,872	11,263	42	435	24	11,764
1989	777	11,662	12,439	29	675	-	13,215
1990	1,016	17,829	18,845	46	435	73	19,333
1991	881	12,463	13,344	56	557	97	14,054
1992	538	10,675	11,213	67	959	1	12,240
1993	181	3,581	3,762	42	756	1	4,561
1994	0	5,391	5,391	21	439	1	5,852
1995	85	9,029	9,114	24	431	1	9,570

[1]Preliminary.

Figure 5.1.1 Whiting in Divisions IVa and VIId. Log catchability residual plots.

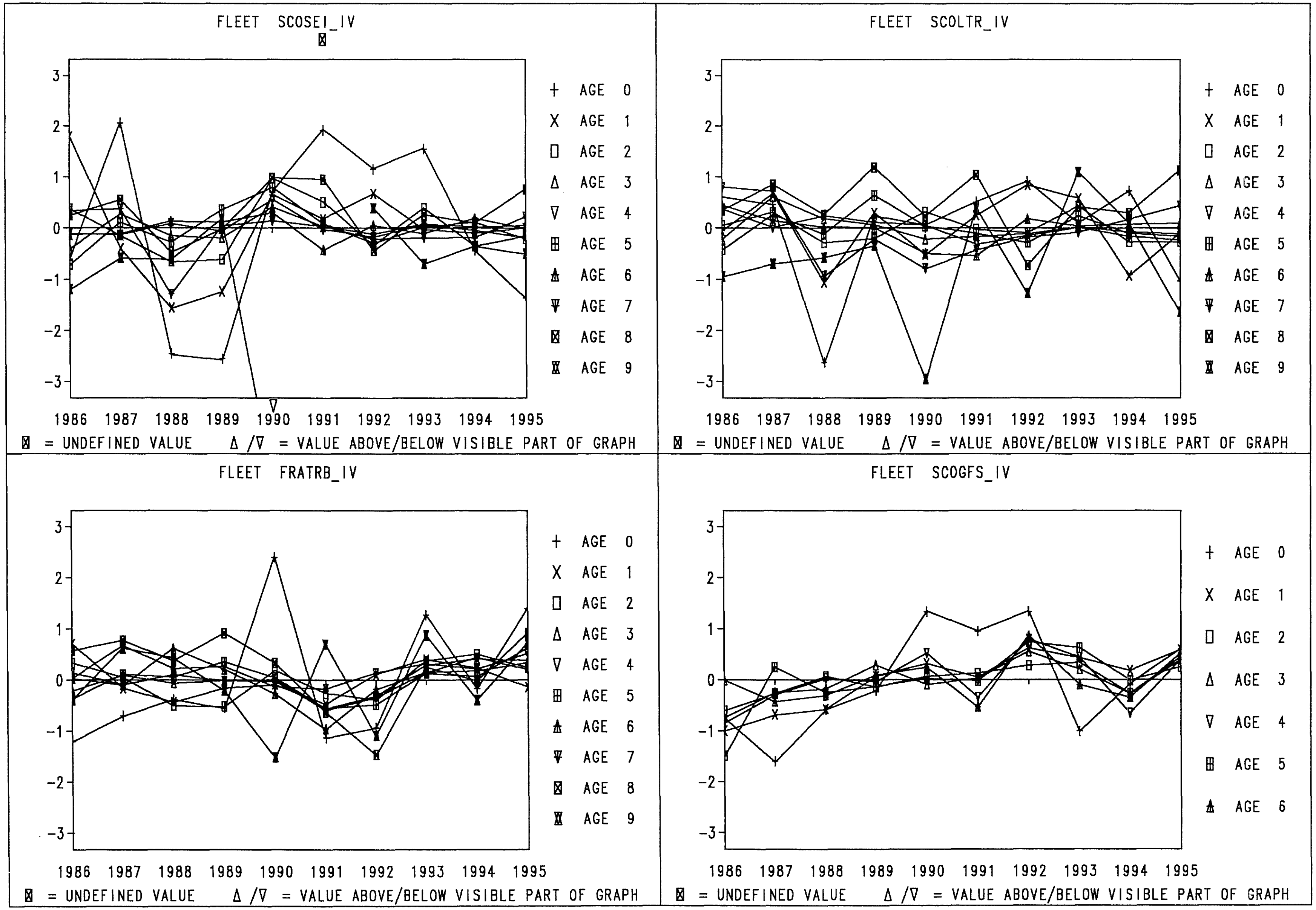


Figure 5.1.1 (Continued)

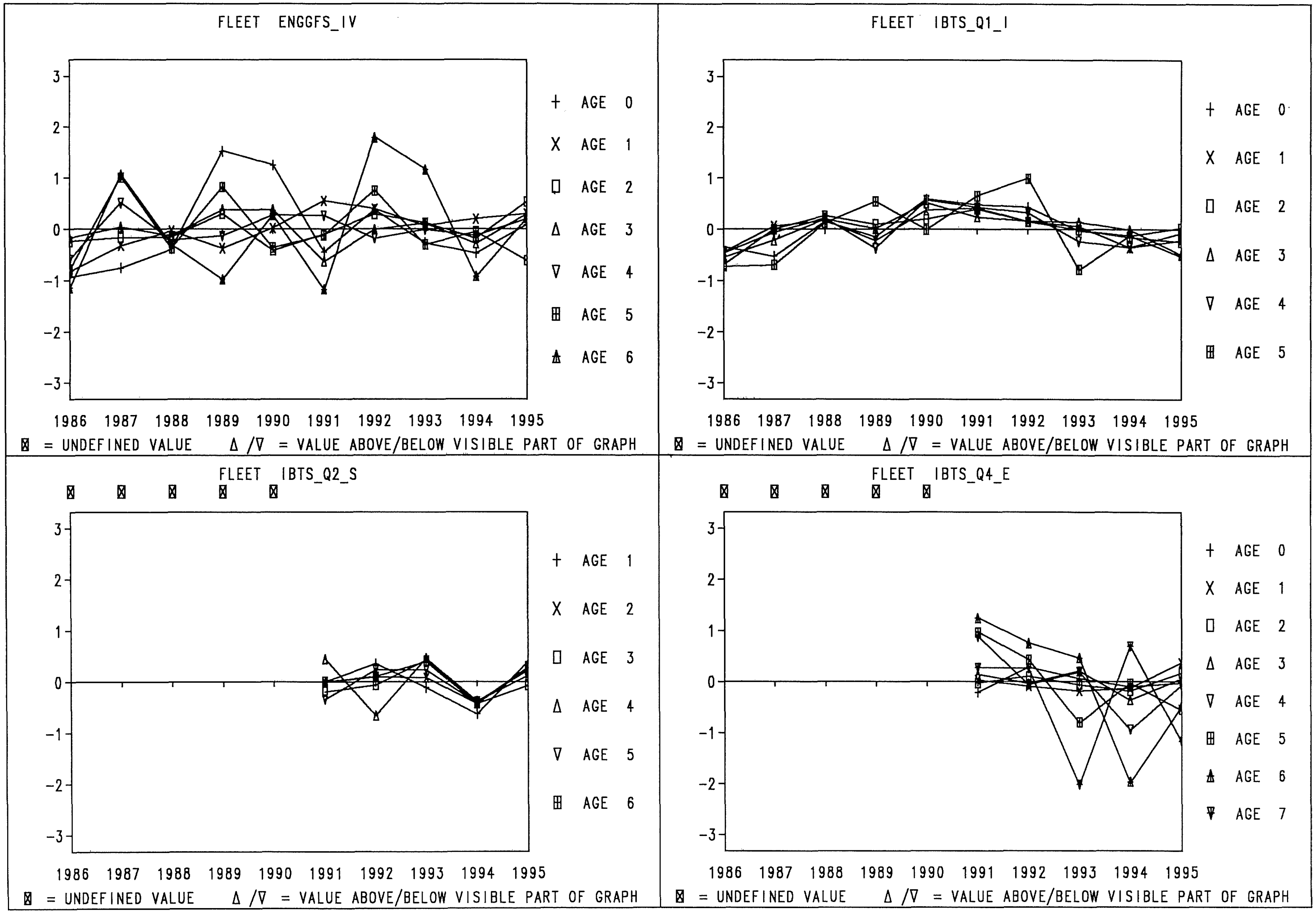


Figure 5.1.1 (Continued)

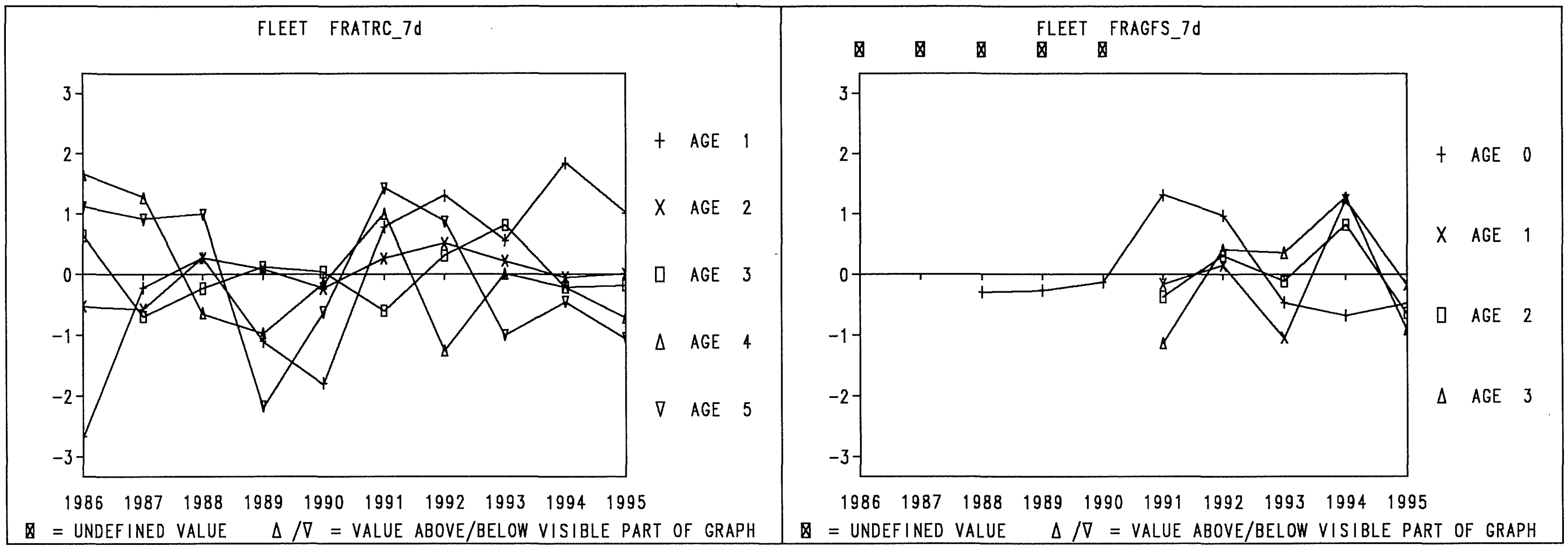
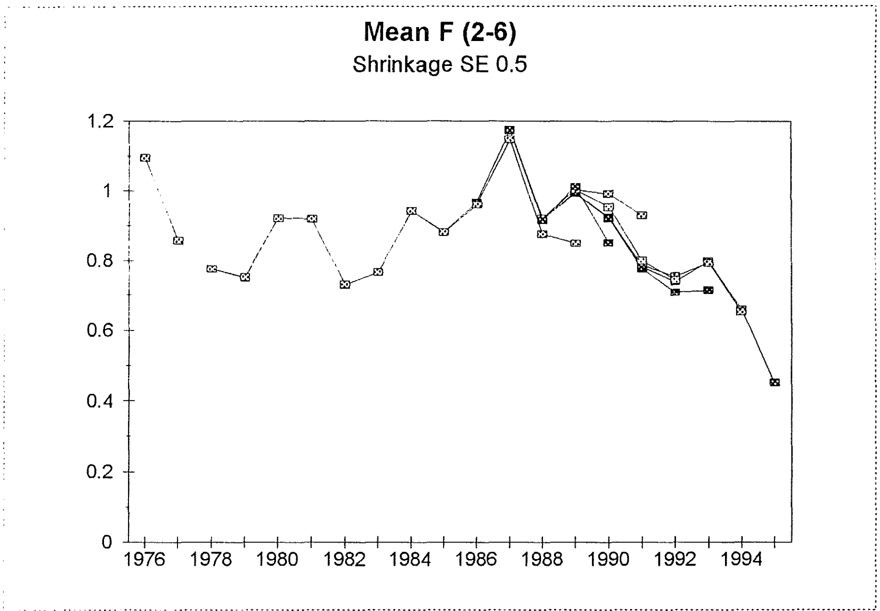


Figure 5.1.2

Whiting (IV & VIId) - retrospective patterns



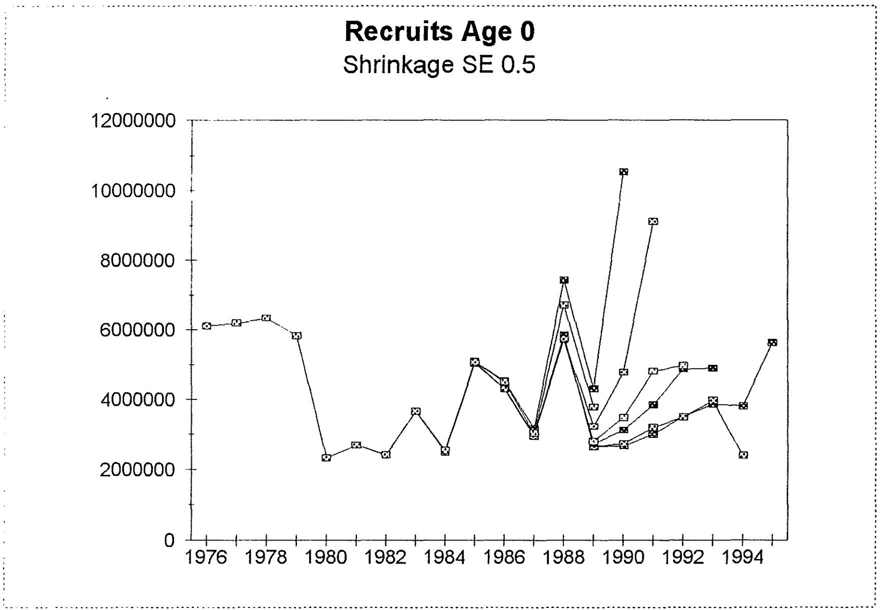
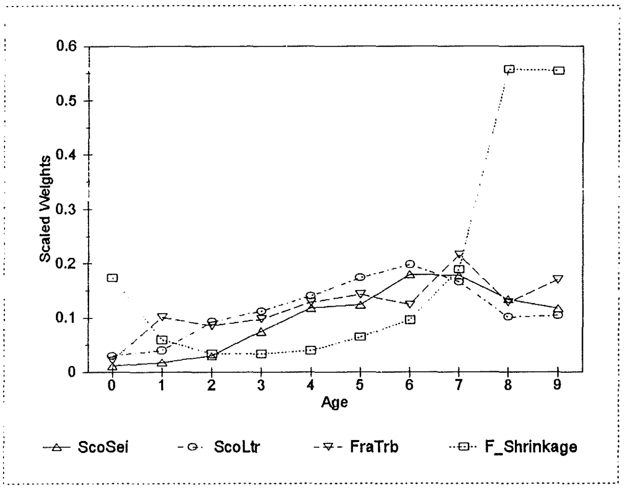
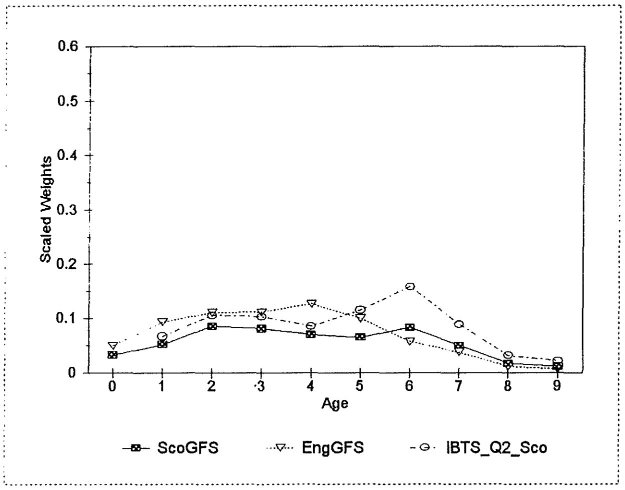


Figure 5.1.3

Whiting in IV and VIId; Tuning fleets contribution to Survivors estimates by age (scaled weights in weighted average prediction)





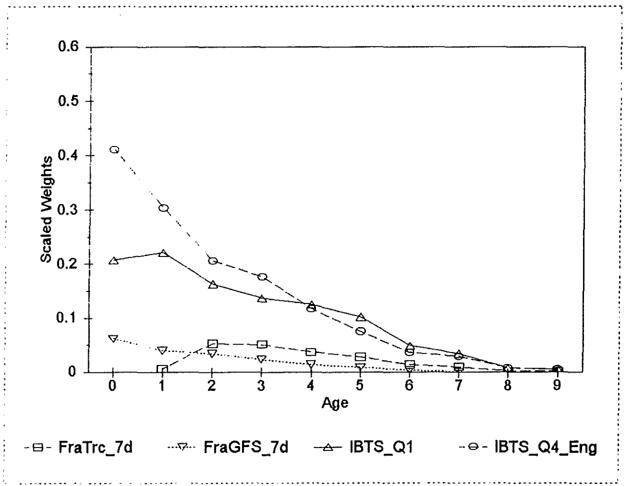


Figure 5.1.4

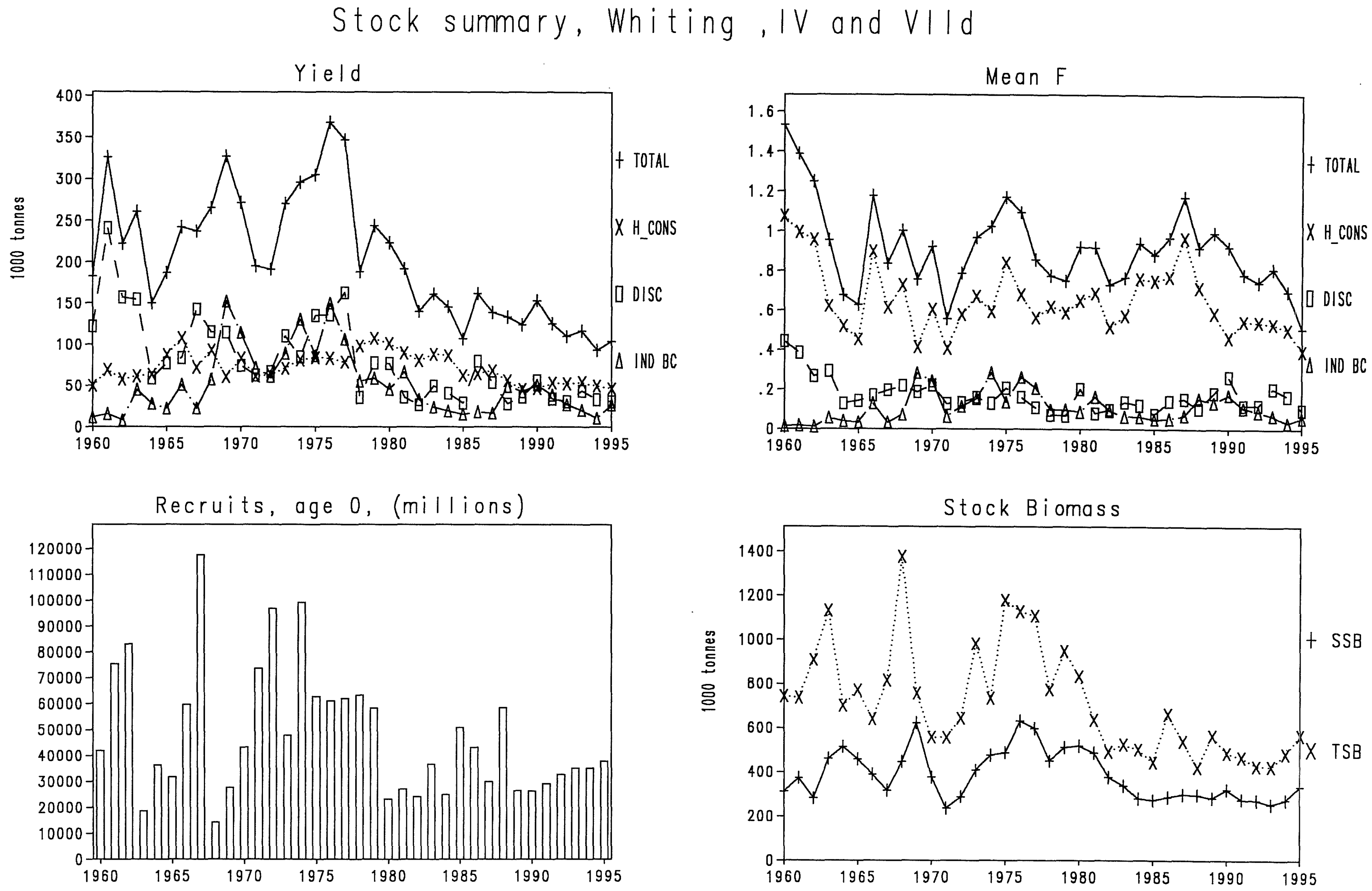

Stock summary, Whiting ,IV and VIId
Yield
1000 tonnes
TOTAL
H_CONS
DISC
IND BC
Mean F
TOTAL
H_CONS
DISC
IND BC
Recruits, age 0, (millions)
Stock Biomass
1000 tonnes
SSB
TSB

Figure 5.1.5 Whiting,North Sea and VIId. Sensitivity analysis of short term forecast.

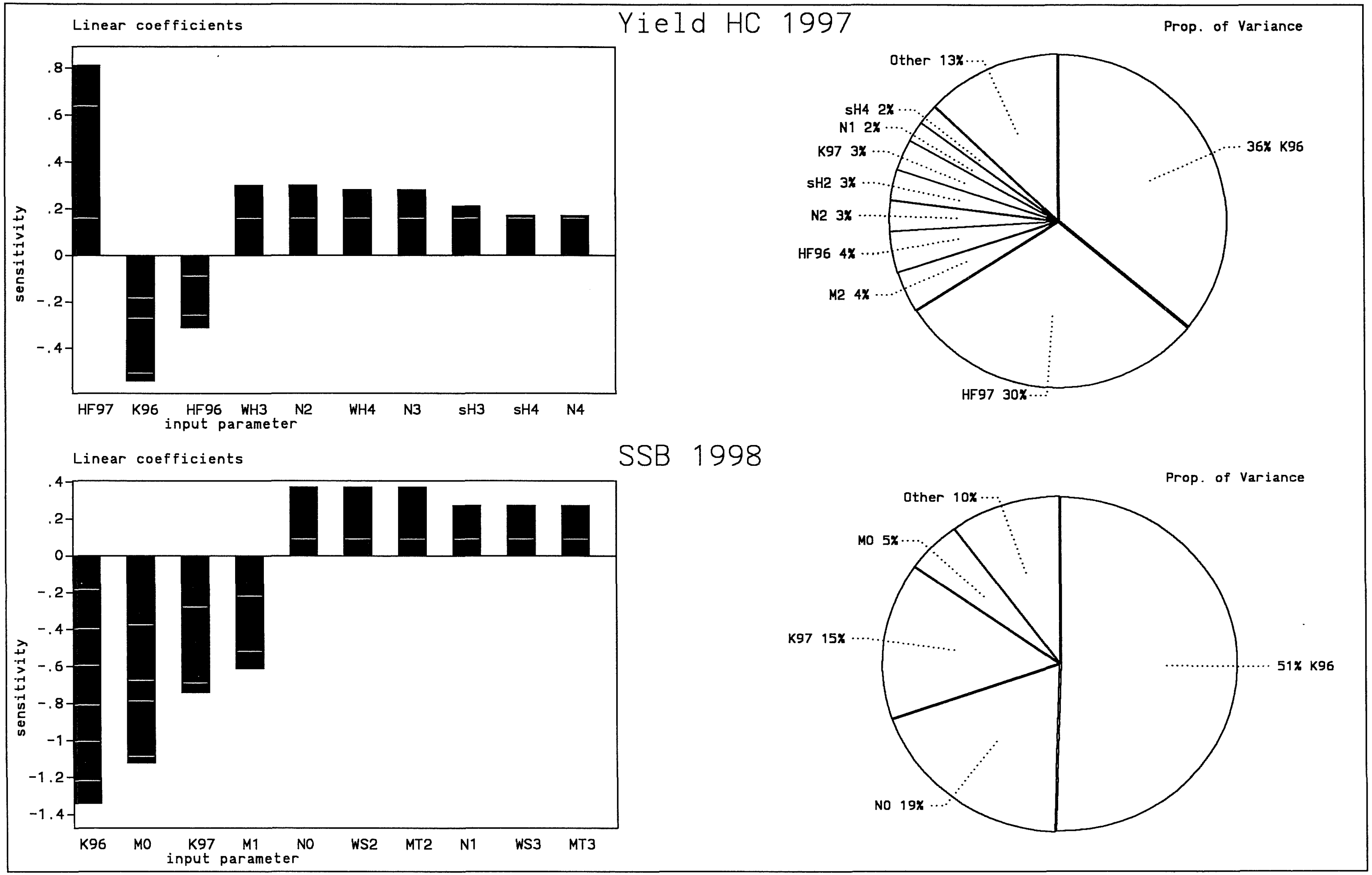
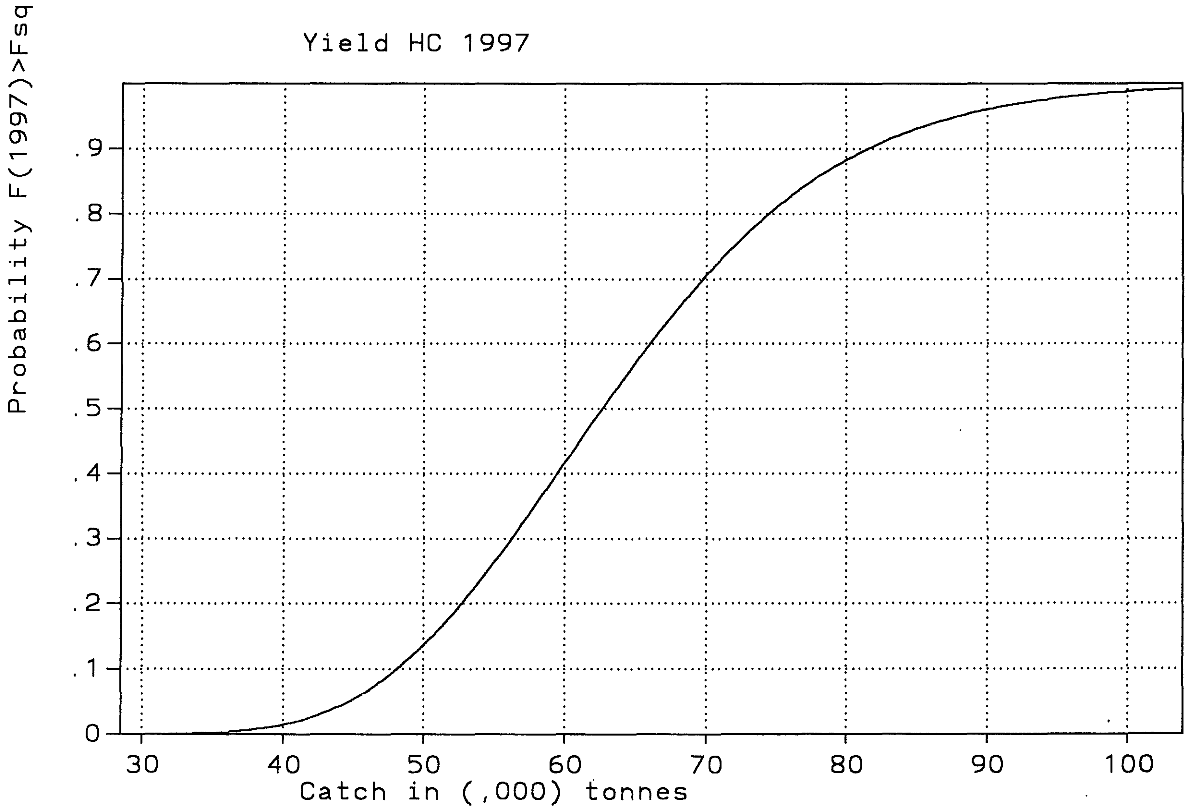


Figure 5.1.6 Whiting,North Sea and VIId. Probability profiles for short term forecast.



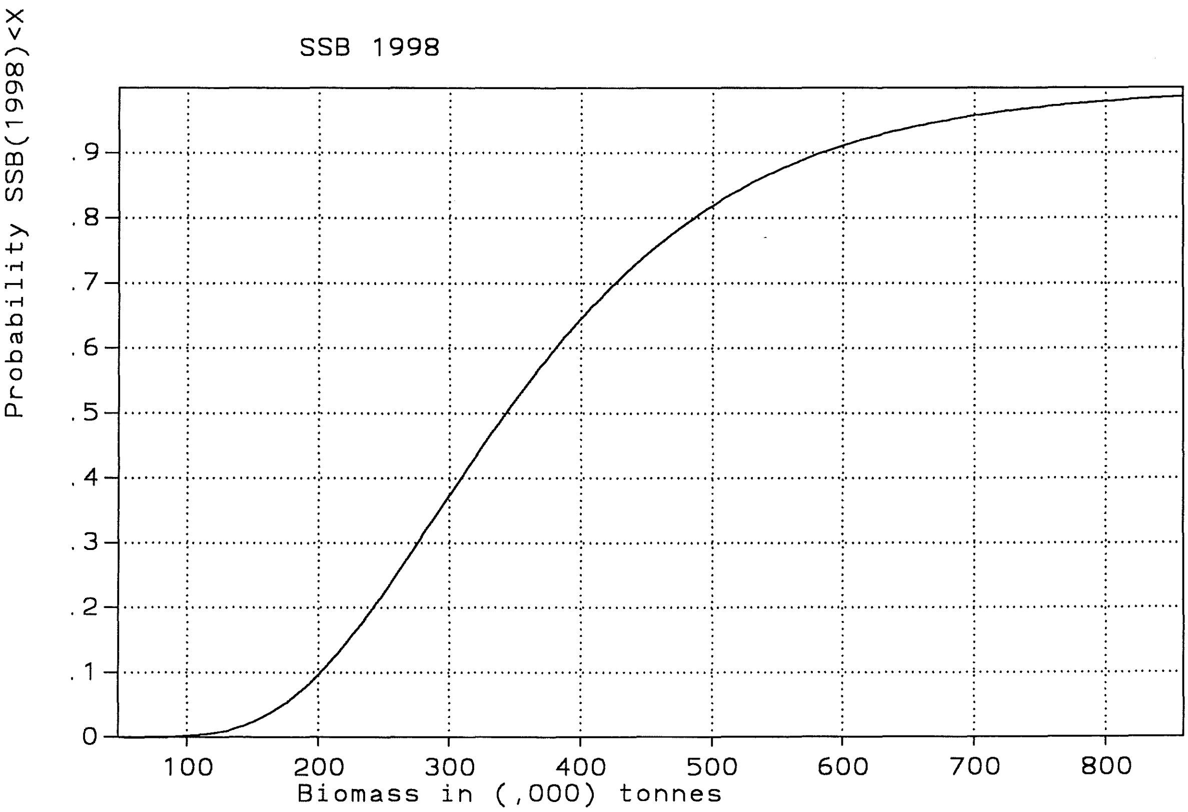
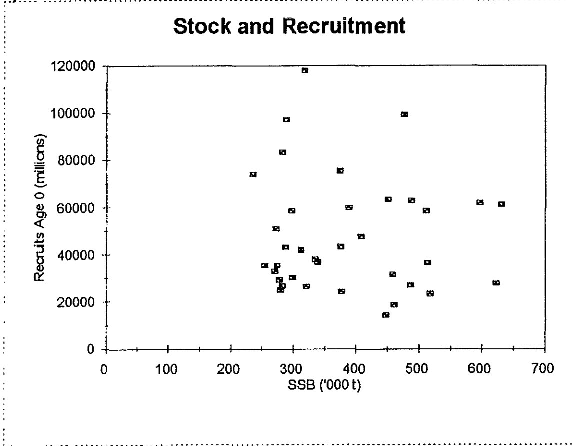


Figure 5.1.7

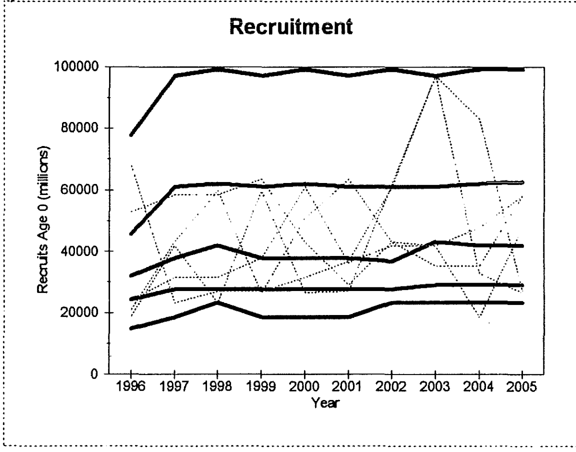
Whiting in IV and VIId. Medium term predictions.

a) stock and recruitment (bootstrapped in simulations)
b) percentiles of recruitment

a)

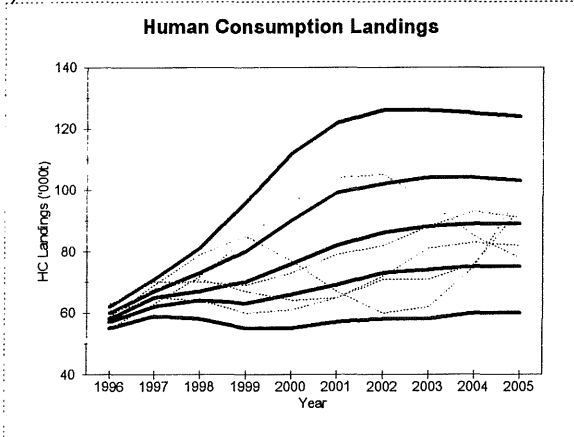


b)

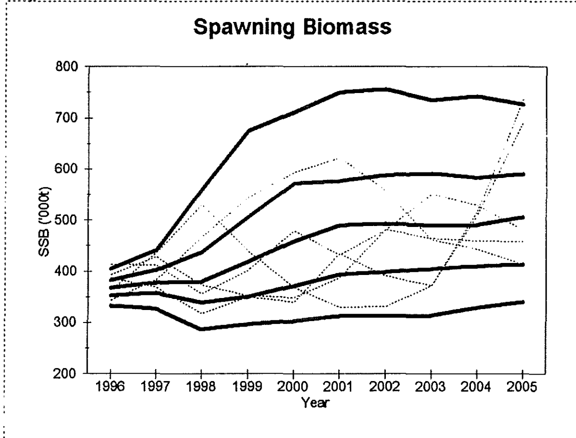


c) percentiles of human consumption landings at status quo F in the human consumption fishery
d) percentiles of spawning biomass at status quo F in the human consumption fishery

c)



d)



Solid lines are 5, 25, 50, 75 and 95 percentiles, dotted lines are 5 realisations of the simulations

Figure 5.1.8

Whiting in IV and VIId. Medium term predictions.

Percentiles of spawning biomass after 10 years for varying F multipliers of the human consumption fishery
Percentiles of Prob(SSB<y) are shown. See Section 16.1.

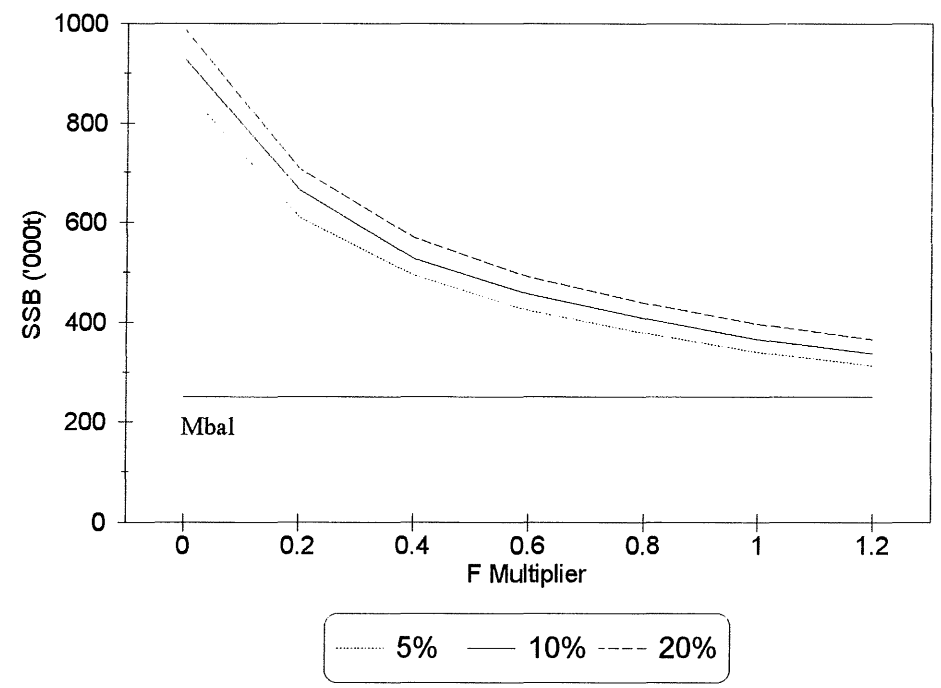
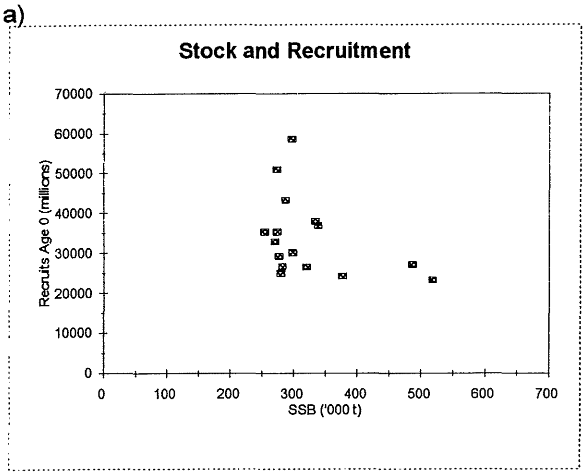
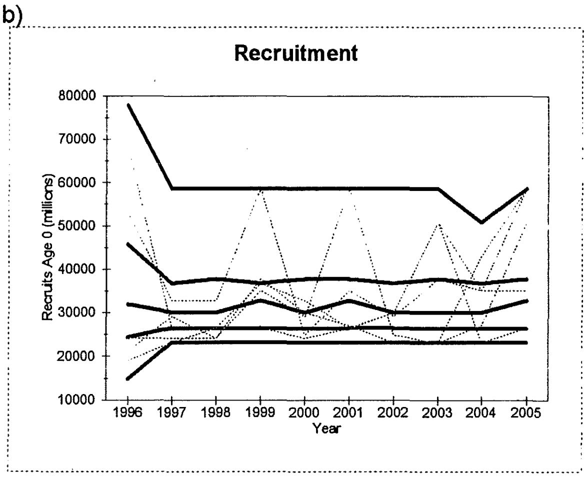


Figure 5.1.9 Forecast using a truncated recruitment series.

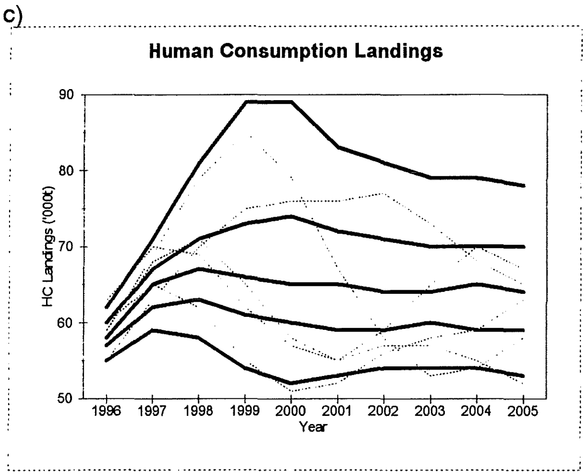
Whiting in IV and VIId. Medium term predictions.

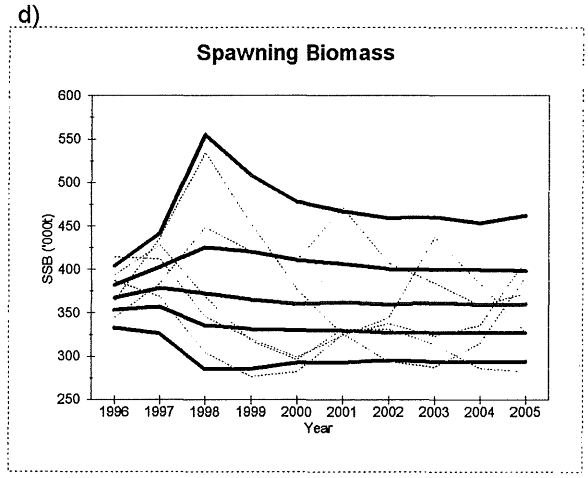
a) stock and recruitment (bootstrapped in simulations)
b) percentiles of recruitment





c) percentiles of human consumption landings at status quo F in the human consumption fishery
d) percentiles of spawning biomass at status quo F in the human consumption fishery





Solid lines are 5, 25, 50, 75 and 95 percentiles, dotted lines are 5 realisations of the simulations

Figure 5.1.10 Survey generated stock indices and XSA results.

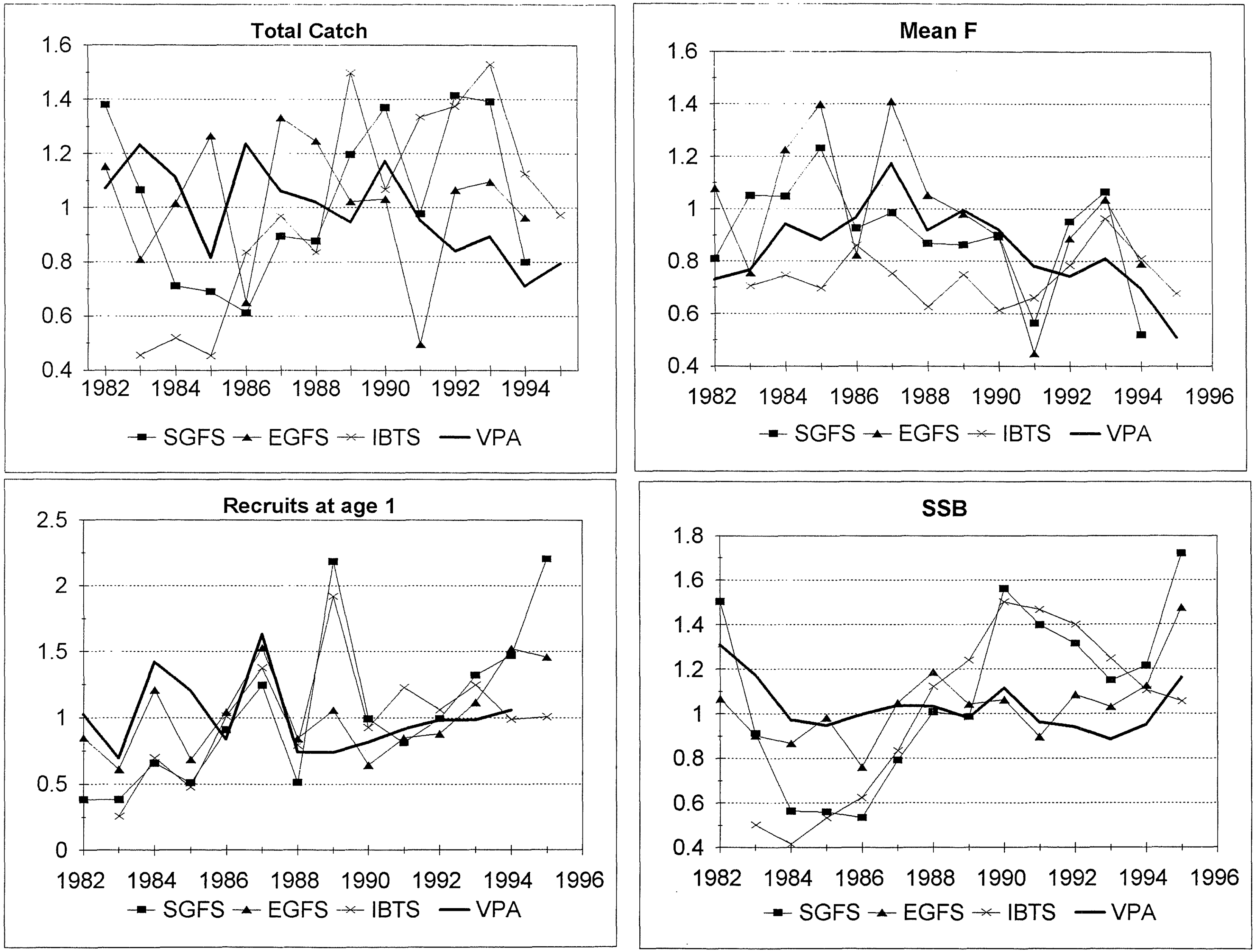
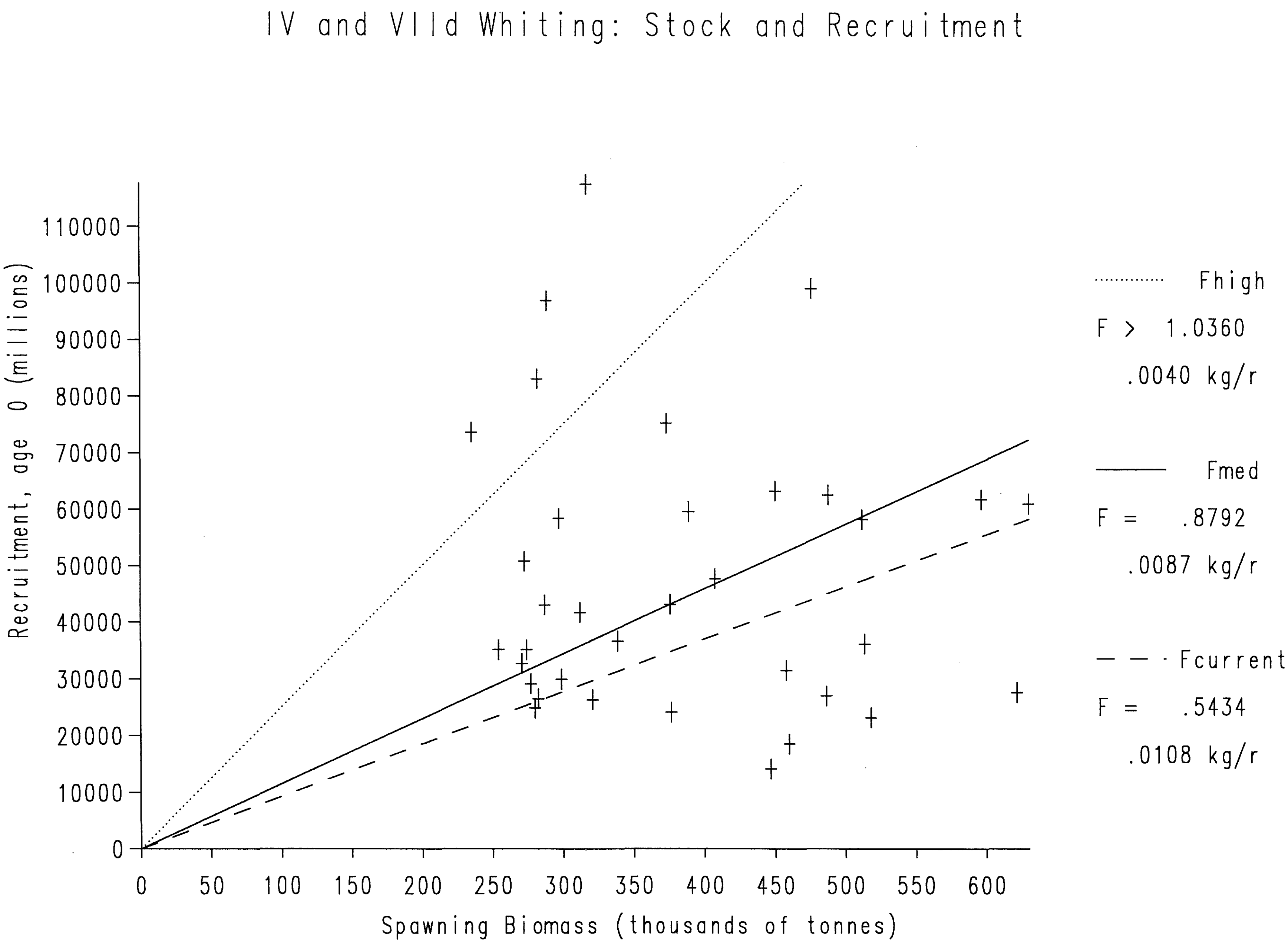
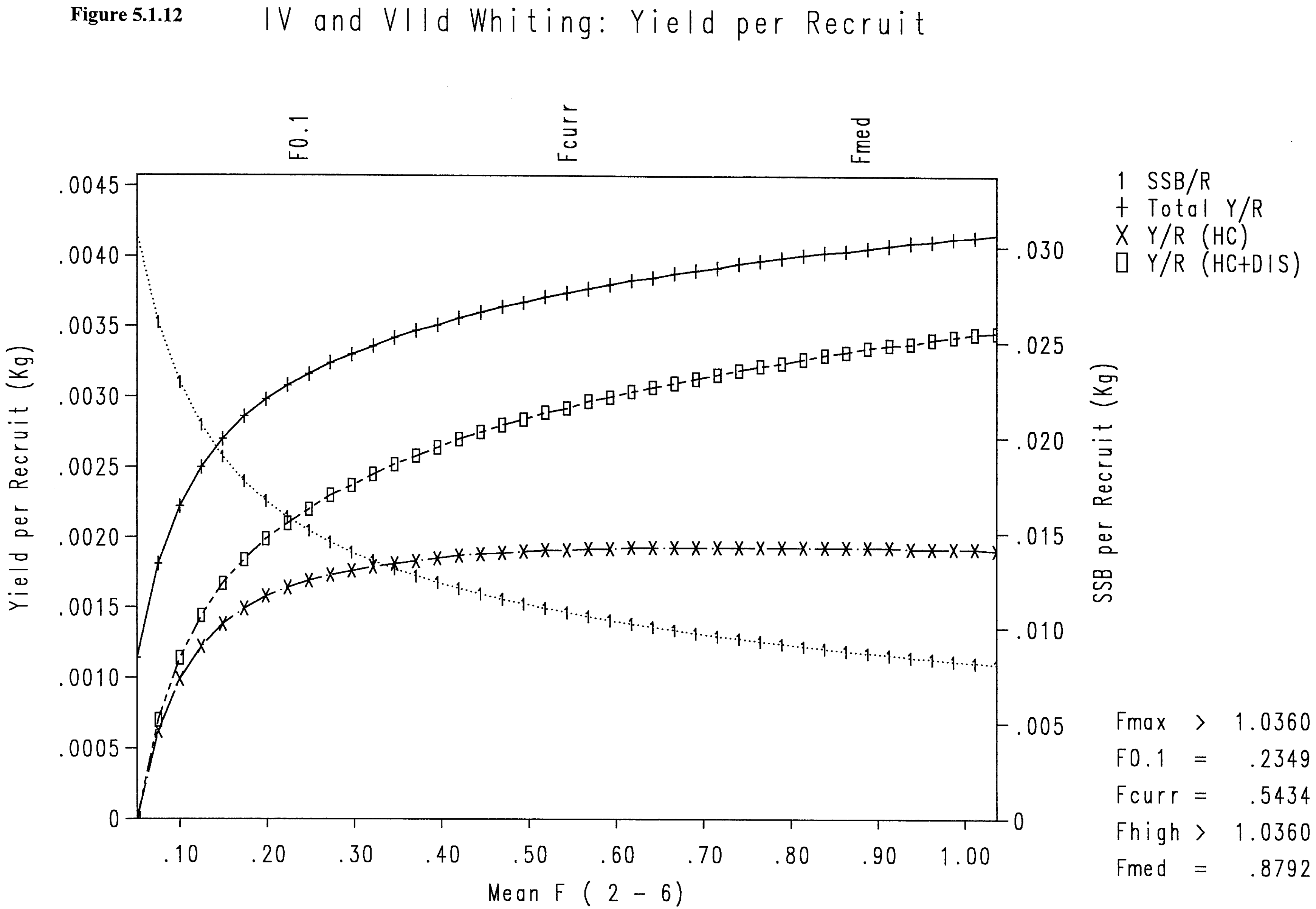


Figure 5.1.11



IV and VIId Whiting: Stock and Recruitment
Recruitment, age 0 (millions)
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
50
100
150
200
250
300
350
400
450
500
550
600
Spawning Biomass (thousands of tonnes)
Fhigh
F > 1.0360
.0040 kg/r
Fmed
F = .8792
.0087 kg/r
Fcurrent
F = .5434
.0108 kg/r

Figure 5.1.12


IV and VIId Whiting: Yield per Recruit
F0.1
Fcurr
Fmed
1 SSB/R
+ Total Y/R
X Y/R (HC)
□ Y/R (HC+DIS)
Yield per Recruit (Kg)
SSB per Recruit (Kg)
Mean F (2 - 6)
.0045
.0040
.0035
.0030
.0025
.0020
.0015
.0010
.0005
0
.030
.025
.020
.015
.010
.005
0
.10
.20
.30
.40
.50
.60
.70
.80
.90
1.00
Fmax > 1.0360
F0.1 = .2349
Fcurr = .5434
Fhigh > 1.0360
Fmed = .8792