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REPORT OF THE ROUNDFISH WORKING GROUP

IJmuiden, Netherlands, 8-18 October 1991

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1 INTRODUCTION

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1.2 Terms of Reference

The terms of reference for this Working Group meeting are given in Council Resolution C.Res.1990/2:5:22:

The Roundfish Working Group (Chairman Mr D. Armstrong, UK) will meet in IJmuiden from 8-18 October 1991 to:

a) assess the status of and provide catch options for 1992 within safe biological limits for the stocks of cod, haddock, whiting and saithe in Sub-areas IV and VI (including IIIa for saithe); cod, haddock, and whiting in Divisions VIId,e and Divisions VIIb,c,h-k (including VIIg for haddock); and saithe in Sub-area VII;

b) provide quarterly catch-at-age and catch and stock mean weight-at-age data by quarter for cod, haddock, whiting and saithe in the North Sea for 1990 to the Multispecies Assessment Working Group as input for the multispecies VPA.

Due to the resignation of Mr D. Armstrong, the meeting was chaired by Dr R.M.Cook (UK).

2 DATA AND METHODS

2.1 Database Revisions

Preliminary data were prepared for 1990 and data for 1989 were finalised with no major revisions.

Problems remain, as described in previous reports in obtaining sufficiently detailed and accurate landing statistics from the Netherlands.

The TACs in 1990 for cod, haddock and whiting in the North Sea and West of Scotland corresponded to a reduction in fishing mortality. These TACs were found to be restrictive by one country's fleets and this resulted in significant misreporting. Estimates of the quantities misreported were available to the Working Group and were used to estimate the actual landings by area. The result is a net transfer of catches from Sub-area VI to Sub-area IV. Although the quantities involved are numerically small, because catches in Division VIa and Division VIb are small compared to the North Sea, the proportionate effect is large in some cases. The figures involved are shown in the unallocated catches of the stock summary tables in Appendix I.

The need to reallocate catches has meant that for 1990 the effort data by fleet have also been reallocated for the country involved. This inevitably makes the effort data used in tuning less reliable and must be considered in evaluating the assessments. Section 2.4 discusses the problem further in relation to methodology.

Very limited sampling of the Danish industrial by-catch was carried out in 1990. Only total quantities caught have been estimated. The age compositions of the by-catch were therefore calculated from research vessel surveys. Age compositions for the first two quarters were based on IYFS hauls while age compositions for quarters 3 and 4 were based on hauls from a Danish survey in August. This survey covered approximately the same area as is exploited by the industrial fleet. One third of the Danish industrial by-catches are taken in August. Sampling in 1991 has improved considerably and this should benefit next year's assessment. The Norwegian industrial by-catch was only sampled in the first two quarters of 1990 and only length composition data were available. Scottish age/length keys were used for the length compositions and Danish research vessel survey data from northern stations were used to estimate age compositions for the second half of the year.

Sampling of discards by Scotland in Division VIa was limited to the first and last quarters of the year. These two quarters were used to fill in the remaining quarters. Sampling in 1991 is expected to improve.

The data for the Channel stocks continue to be unsatisfactory. The time series of data for cod in Division VIId does not give acceptable results when used in VPA. In Division VIIe, cod sampling has only recently started and for whiting there are no age composition data for recent years. Surveys in Division VIId (France) and Division VIId,e (England) have not generated a long enough time series to be used at present.

2.2 Weight at Age in the Sea

The Working Group has so far used the weight at age in the catch and not an estimated weight at age in the sea to raise stock numbers to biomasses. This procedure creates

two problems : one of overall scaling and one of a bias which is variable between years.

The scaling problem is not considered to be serious as long as biomasses are treated as indices only and biological reference points and safe limits are defined on the same scale. If biomasses are to be used as absolute estimates in a wider biological context, proper weights at age in the sea must be used.

The problem of a variable bias arises if the distribution of catches over the year or selectivity patterns differ between years. Differences between years in mean weight at age in the catch of up to 20% are common. This indicates that a variable bias may be a problem in the present procedure.

The Working Group has concluded that estimates of weight at age in the sea must be used for biomass estimates in the future.

The problem is that good estimates of weight at age in the sea are not immediately available. For consistency it could be advisable to utilise the weights at age in the sea in the first quarter as used by the Multispecies Assessment Working Group. These weights are based on a growth curve derived from survey data and are kept constant for all years. One implication of this approach is that changes in growth are ignored. This may actually be desirable in so far as biomass estimates are used to define safe biological limits.

Another possibility would be to use mean weights at age obtained annually from the IYFS in February. The drawback of this approach is that the IYFS weights for older age groups are unreliable.

Given the uncertainties concerning the proper weights to use and the data base revisions which are to take place in connection with the emergence of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, the Roundfish Working Group has decided not to attempt to introduce weights at age in the sea in the present biomass estimates. It is recommended that these problems be resolved prior to the meeting of the new Working Group in 1992, so that an appropriate set of weights at age in the sea can be applied at that time.

2.3 Recruitment Estimates

A revised version of RCRTINX2 and now called RCT3 (but still known as rinkytinx) was available to the Group and was used to combine recruitment estimates. The method is the same as the old version and was applied in the same way as last year; i.e.

a) calibration regression
b) shrinkage towards the mean
c) minimum S.E. of prediction of 0.2 for any survey
d) a minimum of five data points in regression
e) tricubic weighting.

The Working Group noted that the mean population used to shrink the combined prediction is different for each year class within a stock. This appears to be inconsistent and should be investigated by the program authors. Another feature noted at this year's meeting was that one survey last year received very high weight although the predicted value was well beyond the range of observed values. Since the prediction error for such a point should be large, it should have received low weight. This too needs to be investigated by the program authors.

Recently it has been standard practice to use survey data to estimate the population sizes at age 0 (if present), 1 and 2 in the last data year for the purposes of catch prediction. This has been continued this year. However, unlike earlier years, where 0 group populations appear in the VPA, an 0-group VPA/survey RCT3 analysis has been done to estimate 0-group populations. In previous year this was done by back calculating from the I-group VPA regressions. The revised procedure made a negligible difference to the estimates.

Plots of survey indices against VPA recruitment at age I are given in Figures 2.3.1-2.3.6.

For cod and haddock in Division VIa, commercial CPUE estimates were used in previous meetings to predict year class abundance. Due to problems with the effort data in 1990, these estimates have not been used. Only survey indices have been used with the addition of the North Sea recruitment estimates in the case of haddock.

Abbreviations used in the stock sections for the various are as follows:

IYFS - International Young Fish Survey
EGFS - English Groundfish Survey
SGFS - Scottish Groundfish Survey
SWFS -Scottish West Coast Survey
DGFS - Dutch Groundfish Survey
GGFS - German Groundfish survey

Where a 0,1 or 2 appears after the abbreviation, this refers to the age group of the index.

2.4 VPA Tuning

In the past the Working Group has used a standard Laurec-Shepherd tuning procedure to estimate input F for the VPA. In 1988 the Group considered modifying the method to include shrinking the tuned value towards the mean to try to reduce the variance of the predicted values, albeit at the cost of introducing some bias. This approach had been tested at the Working Group on

Methods of Fish Stock Assessment meeting in Reykjavik in 1988 (C.M.1988/Assess:26) but went largely unnoticed. During the 1991 meeting of the Methods Working Group (C.M.1991/Assess:25) retrospective patterns were noted in the estimates of terminal fishing mortality and numbers at age in many stocks. These patterns appeared to be stock rather than method specific and indicated a problem. Either the VPAs were wrong or the terminal estimates were wrong. At the meeting the "symptom" of retrospective patterns was cured by shrinking the terminal Fs towards the mean.

In view of this and the fact that a number of North Sea stocks examined at the 1991 Methods Group meeting exhibited this behaviour, the Working Group embraced the shrinkage procedure at the present meeting. In addition, as has been noted in Section 2.1, there are problems with the effort data used for tuning in 1990. The process of shrinkage should reduce the sensitivity of raw tuned values to poor quality data. The particular implementation used is a modification carried out in Lowestoft to the tuning suite. It calculates a five year average for mean F at each age and requires the user to specify the standard error of the mean which is used in the weighting procedure. The Working Group used the suggested default value of 0.2 for all stocks. It is recognised that this is an *ad hoc* implementation carried out at short notice but it was felt that the method would be preferable to using the raw tuned values.

Tuning was performed over ten years. This period was chosen because it is less likely to be affected by significant changes in catchability than a much longer series. Changes in catchability are likely to adversely affect the Laurec-Shepherd tuning procedure. Fleets used in tuning are shown in Table 2.4.1 and the effort data plotted in Figure 2.4.1a-c. Estimated exploitation patterns for each stock, with and without shrinkage, are shown in Figures 2.4.2-2.4.9. In general, the shrunk patterns are "smoother" and slightly higher than the unshrunk values. This is consistent with the tendency to underestimate F in the retrospective pattern without shrinkage.

The Working Group recommends that the Working Group on Methods of Fish Stock Assessment investigates the use and implementation of shrinkage more thoroughly.

2.5 Sensitivity Analysis

At last years meeting sensitivity analysis was applied to the catch and stock forecasts. The procedure has been repeated this year and the analysis is included in each stock section. The analysis last year was the Fourier Amplitude Sensitivity Test (FAST). It has the advantage of giving global sensitivity coefficients which take into account not only the magnitude of the parameters but also their uncertainty. The analysis is rather time consuming and for this reason the method used this year was a simple linear analysis based on a delta method. This defines the sensitivity of the state variable as

$$\frac{\delta f(\theta)\theta_i}{\delta \theta_i}$$

where $f(\theta)$ is the function defining the state variable (e.g. yield forecast) and θ is the set of parameters on which it is dependent. This analysis is only a local sensitivity analysis but has the advantage of giving the sign of the sensitivity as well as its magnitude. Although the linear analysis gives different results from FAST, the qualitative results are very similar and the general conclusions to be drawn from it are the same.

Each figure in the stock section uses parameter abbreviations. These are as follows:

R1 = recruitment at the youngest age in 1990
N1 = number at age 1 in 1990
N2 = number at age 2 in 1990
N3 etc

F1 = fishing mortality at age 1 in 1990,1991 and 1992
F2 etc

R2 = recruitment at the youngest age in 1991
R3 = recruitment at the youngest age in 1992
R3 etc

The particular implementation is a program written at the Aberdeen Laboratory.

2.6 Safe Biological Limits

For a number of years the terms of reference of the Working Group have referred to "safe biological limits". It is extremely difficult to define these and in the recent past use has been made of the criteria set out by the Irish Sea and Bristol Channel Working Group. The present Working Group discussed the problem once more but was not able to suggest any improvements on the criteria which could be implemented at the meeting.

Although the word "biological" occurs in the phrase, it is clear that the problem is really one of "risk". What is needed is some quantification of the risk of something "bad" happening to the fishery. An example of this would be the risk of the biomass falling below a particular level such as 20% of virgin stock. These issues are currently being actively discussed in various fora and the results of these meetings should assist in responding to the problem of safe biological limits in the future. The Working Group felt that the Methods Working Group would be an appropriate place for ICES to consider the whole issue of risk analysis and how assessment working

groups might implement the procedure.

3 QUARTERLY CATCH AT AGE DATA

Quarterly catch at age data for cod, haddock, whiting and saithe in the North Sea are given in Appendix 2.

4 COD IN SUB-AREA IV

4.1 Catch Trends

Official landings data are given in Table 4.1. Trends in landings from Working Group estimates are given in Table 4.2 and graphed in Figure 4.1. The Working Group estimate of landings in 1990 is 104,000 tonnes, close to the TAC of 105,000 tonnes. The landings were 10 % lower than in 1989, and were the lowest since 1962. Landings have declined markedly since 1981.

4.2 Natural Mortality and Maturity at Age

These values are given in Table 4.3. They are unchanged from those used last year.

4.3 Age Compositions and Mean Weight at Age

The VPA input data for recent years are given in Table 4.4. They do not include discards or industrial fishery by-catches. Data for 1989 were revised, but changes were only minor. Data for 1990 were provided by England, Scotland, Netherlands, Denmark, France, Belgium and Germany. Total international mean weights at age for the catch are given in Table 4.5. These were also used as stock weights at age (see also Section 2.2).

4.4 Commercial Catch per Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates using program RCT3 (see Section 2.3). The fleets used in the tuning are given in Table 2.4.1. The research vessel indices are given in Table 4.6.

4.5 VPA Tuning

The Laurec-Shepherd method was used to tune the VPA to age 9 (see Section 2.4). Tuning was performed for the period 1981-90. F for the oldest age was set as the mean of ages 5 to 9, and the plus group was set at age 11. A summary of the tuning results for each fleet is given in Table 4.7. F at age and numbers at age resulting from the tuned VPA are given in the Tables 4.8 and 4.9 respectively.

4.6 Abundance Estimates of the 1988-1991 Year Classes

Research vessel indices were used for estimating the numbers in the sea for ages 1 and 2 in 1990 and age 1 in 1991. The methods employed for deriving estimates of recruitment are described in Section 2.3. The results from the RCT3 method, used as final values, are given in Table 4.10.1 and 4.10.2.

The RCT3 estimate of the 1988 year class in 1990 is 128 millions at age 2, virtually unchanged from last years estimate. The estimate derived from tuning is 119 millions. The 1989 year class in 1990 was estimated to be 140 millions at age 1, which compares with the tuned value of 92 millions. Last year's estimate of this year class was 169 millions but this was revised to 161 millions in the ACFM assessment in November 1990.

The 1990 year class in 1991 was estimated to be 216 millions at age 1. Last year a preliminary value of 293 millions was used by the WG, and this was subsequently revised to 272 millions by ACFM in November 1990. Additional survey data now available indicate a much lower abundance for this year class.

For the 1991 year class in 1992 the only survey data available at present is the 0-group estimate from the English Groundfish Survey. The RCT3 estimate, with the survey and the mean receiving approximately equal weights, is 520 millions at age 1. It was decided to adopt a more conservative estimate of 324 millions, which is the shrunk mean VPA estimate from program RCT3. Further information on this year class should be available to ACFM from the preliminary results of the Dutch Groundfish Survey in October-November.

The 1992 and later year classes were set at the shrunk VPA mean from program RCT3, which produced a value of 324 millions at age 1.

4.7 Long-Term Trends in Biomass, Fishing Mortality and Recruitment

Historical trends in mean fishing mortality, spawning stock biomass and recruitment are shown in Table 4.11 and Figure 4.1. Fishing mortality has increased almost continuously over the whole period. Spawning stock biomass has declined steadily since 1970 by 76% and is estimated to have reached an historical low level of 64,000 tonnes at the end of 1990. No trend in recruitment is apparent, but all year classes since that spawned in 1985 have been below average.

4.8 Catch Predictions

The input data for catch prediction are given in Table 4.12. The tuned values for F at age 1 and 2 at 1990 were

replaced by the means for the period 1986 - 1990. A sensitivity analysis (see Section 2.5) is shown in Figure 4.2. It shows that yield in 1992 is particularly sensitive to the estimate of recruitment, especially in 1991. Estimates of SSB in 1993 are mainly influenced by F values in 1990.

4.8.1 *Status Quo* Prediction

The results of a *status quo* catch prediction are given in Table 4.13.1 and Figure 4.3. The *status quo* catch in 1991 is 100,000 tonnes (the same value as the TAC), compared to 119,000 tonnes predicted by ACFM last year. The same fishing mortality in 1992 results in a catch of 108,000 tonnes. SSB will increase slightly from 64,000 tonnes in 1991 to 66,000 tonnes in 1992 with a further rise to 68,000 tonnes at the beginning of 1993.

4.8.2 Prediction Assuming 30% Reduction in F in 1991 (ACFM Recommendation)

The results of this catch prediction are given in Table 4.13.2. This prediction scenario is believed to be unlikely (see Appendix 1). If fishing mortality were to be reduced in 1991, spawning stock would be about 20% higher in 1992.

4.9 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 4.4.

4.10 Safe Biological Limits

The stock/recruitment scatter diagram is shown in Figure 4.5, which also shows F_{med} (0.74) and F_{high} (0.94). The current level of F (0.78) is near the F_{med} level. Spawning biomass at the beginning of 1991 was estimated to be 64,000 tonnes, which is the lowest in the historical series. The minimum spawning biomass advised by ACFM is 150,000 tonnes.

The Group is concerned at the continuing decline in spawning biomass relative to the past historical series, and the fact that there has been no strong recruitment since the year class of 1985. The SSB and the fishery are heavily dependent on one or two year classes and even one poor year class can lead to a rapid decline. The present SSB maybe at a level at which recruitment is jeopardised. Most fish in the catch are immature.

5 COD IN SUB-AREA VI

5.1 Cod in Division VIa

5.1.1 Catch Trends

Official landings data are given in Table 5.1.1, and trends in landings are shown in Figure 5.1.1. There has been considerable recent variation in landings and no trend is apparent. Working Group estimates of landings are given in Table 5.1.2, and these show that landings in 1990 were 12,176 tonnes, which is a decrease of 29% on 1989. Officially reported landings may be significantly affected by misreporting in 1990. The agreed TAC for Sub-area VI (Divisions VIa+VIb) for 1990 was 16,000 tonnes.

5.1.2 Natural Mortality and Maturity at Age

Natural mortalities are given in Table 5.1.3 and were unchanged from last year.

5.1.3 Age Compositions and Catch at Age

The VPA input data for recent years are given in Table 5.1.4; they do not include discards. Minor revisions were made to the 1989 data, and data for 1990 were provided by Scotland, England, Ireland and France. The catch in 1990 was dominated by the 1988 year class.

Total international mean weights at age for the catch are given in Table 5.1.5. These values were also used for the stock weights at age.

5.1.4 Commercial Catch-Effort data and Research Vessel Indices

Data from the commercial fleets were used to tune the VPA and together with research vessel data to provide recruitment indices. The fleets used in the tuning are given in Table 2.4.1 in and the research vessel indices are given in Table 5.1.6.

5.1.5 VPA Tuning

The plus group this year was reduced to age 7 from 10 after performing a separable VPA which gave large residuals for the Fs on older age groups (Table 5.1.7.) The Laurec-Shepherd method was used to tune the VPA to age 5 for the period 1981-1990 (see Section 2.4). F for the oldest age was set as the mean of ages 3 - 5. A summary of the tuning results for each fleet is given in Table 5.1.8. F at age and numbers at age resulting from the tuned VPA are given in Tables 5.1.9 and 5.1.10 respectively.

5.1.6 Abundance Estimates of the 1988-1991 Year Classes

The results from the RCT3 method are given in Tables 5.1.11.1 and 5.1.11.2. Various indices of abundance for Divisions VIa, VIIa and Sub-area IV were examined. Problems were encountered in using data from commercial fleets (see Section 2.1) and the indices finally used came solely from the Scottish West Coast Groundfish Survey and these are given in Table 5.1.6. These data were used to estimate the numbers in the sea for ages 1 and 2 in 1990 and age 1 in 1991.

The 1988 year class in 1990 was estimated to be 9.0 millions at age 2, which compares with the tuned estimate of 9.6 millions. The RCT3 estimate compares with the value of 10.6 million predicted in last year's assessment.

The RCT3 estimate for the 1989 year class in 1990 is 8.5 millions at age 1. The preliminary estimate for this year class last year was 11.0 million. The tuned estimate is 3.2 million.

The preliminary estimate for the 1990 year class in 1991, based on the SGFS at age 1, is 13.3 millions at age 1.

The 1991 and later year classes were set at the shrunk VPA mean from the RCT3 program which produced a value of 10.7 million.

5.1.7 Long-Term Trends in Biomass, Fishing Mortality and Recruitment

Estimates of biomass, fishing mortality rate and recruitment are given in Table 5.1.12, and plots are shown in Figure 5.1.1. Spawning stock biomass declined from 1981 to reach a historically low value in 1986 of 18,000 tonnes and was estimated to have increased in the following three years, before falling back again to 18,000 tonnes in 1990. Mean fishing mortality has shown an upward trend over the period for which data exist. Recruitment in the past decade has been highly variable with a particularly strong 1986 year class.

5.1.8 Catch Predictions

Input data for catch prediction are given in Table 5.1.13. Stock numbers for ages 3 and older fish in 1990 result from the tuned VPA values. The values for ages 1 and 2 are estimated as described in Section 2.3 above. The tuned F values for ages 1 and 2 have been replaced by average values for 1986-90. The results of catch predictions are given in Tables 5.1.14 and 5.1.15, and in Figure 5.1.2. The *status quo* catch in 1991 is predicted to be 13,000 tonnes, compared to the TAC for Sub-area VI of 16,000 tonnes. and a *status quo* catch predicted by ACFM last year of 18,000 tonnes. The same F value in 1992 is predicted to result in a catch of 13,000 tonnes. Spawning stock biomass will be little changed in 1992 and 1993.

The predicted catch following ACFM's recommended reduction of 30% in effort is given in Table 5.1.15. It is not expected that this prediction is realistic (see Appendix 1). Should a 30% reduction be achieved there would be a small improvement in the SSB in 1993.

A sensitivity analysis (see Section 2.5) is shown in Figure 5.1.3. It shows that yield in 1992 is particularly sensitive to the estimate of recruitment and numbers in the youngest age-class, especially in 1991. Estimates of SSB in 1993 are mainly influenced by F values in 1990.

5.1.9 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 5.1.4.

5.1.10 Safe Biological Limits

A scatter plot of stock and recruitment is given in Figure 5.1.5. SSB would have consistently declined throughout the 1980s had it not been for the strong 1986 year class; the effect of this year class is now waning and the long-term trend in SSB is downwards. Spawning biomass at 18,000 tonnes is now at the lowest in the historical series.

F_{med} (0.77) and F_{high} (1.00) are shown on the stock recruitment plot in Figure 5.1.5 these compare to a current level of F of 0.82. The SSB and the fishery are heavily dependent on one or two year classes and even one poor year class can lead to a rapid decline. The present SSB may be at a level at which recruitment is jeopardised. Most fish in the catch are immature.

5.2 Cod in Division VIb

Landings of cod in Division VIb are small. Official landings reported to ICES are given in Table 5.2.1.

6 COD IN SUB-AREA VII

6.1 Cod in Division VIId

6.1.1 Catch Trends

Recent nominal landings are given in Table 6.1.1, and the Working Group estimates are given in Table 6.1.2. The declining trend in landings observed since 1987 appears to continue : these have been 5 500 tonnes in 1989 and 2 700 tonnes in 1990. This last value is the lowest on record.

6.1.2 Natural Mortality and Maturity at Age

The values used for VPA are given in Table 6.1.3.

6.1.3 Age Compositions and Mean Weight at Age

The VPA input data are given in Table 6.1.4 and 6.1.5. Data for 1989 were updated and data for 1990 were provided by France and England. Weight at age in the stock was assumed the same as in the landings.

6.1.4 VPA

No data are available for tuning the VPA and therefore a separable VPA was run. Trial values of F and S were input and final values of F = 1 for age 3 and S = 1 were adopted. The log catch ratio residuals are given in Table 6.1.6. In addition of that an unsuccessful attempt has been made to fit a multiplicative model to the data. These two analyses indicate the high variability and the poor quality of the catch at age data. It has therefore been decided to not run a VPA.

6.1.5 Estimates of Recruitment

There are as yet no recruitment data for this area. However a survey was started by France in October 1988, and a groundfish survey by England in November and December 1989 but these time series are at present too short to provide recruitment estimates.

6.1.6 Catch Predictions

After considering the results from the two above-mentioned analyses, as last year the Group came to the conclusion that the age composition data are not sufficiently reliable for a valid catch prediction to be made. Moreover, since no recruitment data are available it was considered that a SHOT forecast would not be advisable.

6.2 Cod in Division VIIe

6.2.1 Catch Trends

Nominal landings for recent years together with Working Group estimates are given in Table 6.2.1. The WG estimates show that landings continued to decrease since 1987 to 1 705 tonnes and 1 007 tonnes in 1989 and 1990 respectively

6.2.2 Catch Prediction

No analytical assessment is possible, although sampling of English landings commenced in 1989. It was decided this year not to attempt a SHOT forecast for this area, since data on recruitment are lacking.

6.3 Cod in Other Divisions of Subarea VII

Cod in Division VIIa, and Divisions VIIf,g are assessed by the Irish Sea and Bristol Channel Working Group.

No age composition data for cod in other areas are available. Landings for recent years are given in Table 6.3.1.

7 HADDOCK IN SUB-AREA IV

7.1 Catch Trends

Official landings figures are given in Table 7.1. Total international catches and total international discards as estimated by the Working Group are given in Table 7.2. Catch trends are plotted in Figure 7.1.

Total human consumption landings were estimated by the Working Group to be 51,000 t although the total nominal landings were reported as 42,000 t. As with the 1989 landings data, the difference is due largely to misreporting in one country. Misreported landings were re-allocated to area on the basis of information available to members of the Working Group. For the second year in succession this raises some uncertainty about the actual level of the catch used in the assessment.

Working Group estimates of total human consumption landings in 1990 are about 67% of those in 1989 which were themselves reductions of roughly 70% of both the 1987 and 1988 landings.

Industrial by-catch remained low at around 3,000 t.

The agreed TAC for 1990 was 50,000 t.

7.2 Natural Mortality and Maturity at Age

These values are given in Table 7.3 and remain unchanged from last year.

7.3 Age Compositions and Mean Weights at Age

Total international catch at age data are given in Table 7.4. Age compositions for human consumption landings in 1990 were provided by Scotland, France, England and Denmark. Age compositions for discards were provided by Scotland. Length frequency data for industrial by-catches were supplied by Norway and attributed to age on the basis of Scottish age-length keys.

Total mean weights at age in the catch are given in Table 7.5. These values are also used as stock mean weights at age in the sea.

7.4 Commercial Catch-Effort Data and Research Vessel Surveys

These data were used to tune the VPA and to provide recruitment estimates. The commercial fleet data and survey data used to tune the VPA are shown in the Table 2.4.1. The fleets and surveys used for tuning remain unchanged from last year.

The research vessel indices used to estimate recent recruitment are presented in Table 7.6. The set of surveys used also remains unchanged from last year.

7.5 VPA Tuning

Table 7.7 gives a summary of the VPA tuning output for the Laurec-Shepherd procedure with shrinkage (see Section 2.4). Tuned estimates of fishing mortality rates at age and population numbers at age are given in Tables 7.8 and 7.9. The plus group age was set to 12, the same as last year.

7.6 Estimates of Abundance of Year Classes 1988-1991

The method used to estimate recruitment in recent years is discussed in section 2.3.

Numbers at age 0, 1 and 2 in 1990 were generated using converged VPA estimates of numbers at age for each of these ages in separate runs of the RCT3 program. Full results are given in Tables 7.10.1 - 7.10.3. For 1990, RCT3 estimated 32729 million fish at age 0, 1011 million at age 1 and 174 million at age 2. These values compare with the tuned VPA values of 43495 million, 1472 million and 198 million respectively.

Recruits at age 0 in 1991, used for prediction, were estimated as the VPA geometric mean recruitment at age 0 from the RCT3 output (Table 7.10.1) giving a value of 23156 million. This is because the two surveys available to estimate this year class at age 0 give conflicting predictions. The SGFS0 predicts above average recruitment but the EGFS0 predicts below average recruitment. The same problem arose last year. On that occasion the combined survey index appears to have over predicted recruitment. It was therefore decided to use mean recruitment this year.

7.7 Long-Term Trends in Biomass, Fishing Mortality and Recruitment

Trends in biomass, fishing mortality and recruitment are given in Table 7.11 and shown in Figure 7.1. Human consumption fishing mortality rate shows a marginal reduction over the 1989 value but remains high. Fishing mortality rate due to discarding in 1990 was almost twice that of 1989. This may be due to fishermen being more selective as to the fish they retain once the catch has been brought on deck. This change could be a response to quota restrictions.

Recruitment of the 1990 year class which, although not as strong as estimated in last year's report, is still much stronger than the 1987 - 1989 year classes.

Total stock biomass (314,000 t) and spawning stock biomass (76,000 t) values at the start of 1990 continue the downward trend evident from recent years with both values at their lowest levels over the 20 year period presented here.

7.8 Catch and Biomass Predictions

The input data for prediction are given in Table 7.12. As numbers at ages 0, 1 and 2 in 1990 were overwritten by RCT3 values, values of F at age for these ages were replaced by recent mean Fs at age from the tuned VPA over the period 1986 - 1990. For prediction, values of F at age are the mean values at age over the period 1986 - 1990, scaled to give a mean value of F over ages 2 - 6 equal to that in 1990.

Two predictions are presented. Table 7.13 gives the results of a *status quo* prediction whilst Table 7.14 shows the results assuming a decrease in fishing effort in 1991 of 30% in accord with ACFM recommendations.

The Working Group suggests that there are good reasons to believe that effort in 1991 has not and will not be reduced by 30% (see Appendix 1). The Working Group believes that the prediction assuming *status quo* in 1991 (Table 7.13) is the more relevant. Results are shown in Figure 7.2. Sensitivity analysis of the prediction is shown in Figure 7.3.

From Table 7.13, total landings in 1991 are expected to be 46,000 t compared to the *status quo* prediction of 61,000 t made last year. This difference is due largely to reductions in the estimated size of the 1988 and 1989 year classes as predicted by the RCT3 program compared to estimates made last year. Inspection of Tables 7.10.1 and 7.10.2 suggest that the problem lies with the German groundfish survey (GGFS) 1 and 2 group indices which gave high predictions last year which were heavily weighted but, although still giving high estimates, are less heavily weighted in the recruit predictions this year.

Estimated spawning stock biomass at the start of 1992, assuming *status quo* in 1991, is 99,000 t, an increase from the low level of 64,000 t estimated for the beginning of 1991. This increase is attributable to the effects of the 1990 year class beginning to enter the spawning stock.

Estimated total landings in 1992, assuming *status quo* in

both 1991 and 1992, are 77,000 t, with the spawning stock biomass rising to 122,000 t at the start of 1993.

It should be noted that the predicted landings and biomasses are greatly influenced by a single year class in the stock (the 1990 year class), which had been preceded by 3 very poor year classes and that the predicted increases in landings and spawning biomass indicate nothing more than a reversal of recent trends.

7.9 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 7.4.

7.10 Safe Biological Limits

The stock and recruitment scatter plot is shown in Figure 7.5. Values of spawning stock biomass per recruit corresponding to F_{med} (0.65) and F_{high} were calculated as 9.8 g per recruit and 2.1 g per recruit respectively.

The decline of the spawning stock biomass will be halted in the short term by the recruitment of the 1990 and 1991 year classes which appear to be average or a little above average. However, the spawning stock biomass and the fishery are heavily dependent on one or two year classes and even one more poor year class can lead to a rapid decline. The present spawning biomass may at a level where recruitment is jeopardised.

8 HADDOCK IN SUB-AREA VI

8.1 Haddock in Division VIa

8.1.1 Catch Trends

Official landings figures are given in Table 8.1.1. Total international catches and total international discards as estimated by the Working Group are given in Table 8.1.2. Catch trends are plotted in Figure 8.1.1.

Total human consumption landings were estimated by the Working Group to be 10,000 t in 1990 with nominal landings of 11,200 t. However, the nominal landings do not currently include French data which , on the basis of earlier years, are likely to inflate the nominal landings figures and increase the difference between nominal landings and Working Group estimates. As with haddock in the North Sea, such differences are mainly due to misreporting in one country. The re-allocation of misreported landings to area, using information available to Working Group members, will for the second successive year, invoke uncertainty as to the probable level of catches used in the assessment.

No TAC is explicitly applicable to Division VIa. The agreed TAC for 1990 for the whole of Sub-area VI was 24,000 t of which a maximum 14,000 t could be taken in Division VIa.

8.1.2 Natural Mortality and Maturity at Age

These values are given in Table 8.1.3 and are the same as those used in last year's report.

8.1.3 Age Compositions and Mean Weights at Age

Total international catch at age data are given in Table 8.1.4. Age compositions for human consumption landings for 1990 were provided by England, France and Scotland. Scottish age-length keys were used to attribute ages to the length distribution of the Irish catch. Age compositions for discards were supplied by Scotland.

Total mean weights at age in the catch are given in Table 8.1.5. These values are also used as stock mean weights in the sea.

8.1.4 Commercial Catch-Effort Data and Research Vessel Surveys

These data were used to tune the VPA and to provide recruitment estimates. The commercial fleet data and survey data used to tune the VPA are given in Table 2.4.1. The fleets and survey data used for tuning are the same as those used by the Working Group at its previous meeting. The indices used to estimate recent recruitment are given in Table 8.1.6.

8.1.5 VPA Tuning

Initial tuning runs using the same age range as in previous years produced inconsistent value of raised F at age for the oldest age groups, suggesting some problems with the catch-at-age data for those ages. A separable VPA was, therefore, performed to try and determine the areas of difficulty with the data. Table 8.1.7 shows the residuals from the fit of the log catch ratios, indicating some high values at the oldest ages but with the largest values on the 0/1 group ratios. Whilst the high values of the 0/1 group residuals are likely to be determined by poorly quantified discard values, the 0 group data were not excluded from the subsequent analysis. However, it was felt that the inconsistencies for the older ages could at least be eliminated by truncating the age range used in the analysis. Therefore the plus group age in the VPA was reduced from 11 to 8.

Table 8.1.8 gives the summary of the VPA tuning output for the Laurec-Shepherd procedure with shrinkage. Tuned estimates of fishing mortality rates at age are given in Table 8.1.9 and of population numbers at age in Table 8.1.10.

At the previous meeting of the Working Group, French catch and effort data were included in the VPA tuning procedure although they were excluded in the final version of the report as produced by ACFM. This was because it was felt that their inclusion produced Fs at age which were too high. These data have been included in the current assessment, and, although they serve to increase the value of raised F for some age groups, it could also be argued that other fleets indicate values of raised F which are also high whilst some fleets indicate values which appear to be very low. As values of raised F are now shrunk to the VPA mean it appears that there are no substantial reasons for excluding the French data from tuning.

8.1.6 Estimates of Abundance of Year Classes 1988-1991

The method used to estimate recruitment in previous years is discussed in Section 2.3. Scottish commercial CPUE data were excluded from the analyses this year because of uncertainties over the level of effort in 1989 and 1990.

Numbers at age 0, 1 and 2 were predicted using converged VPA estimates of numbers at age in separate runs of the RCT3 program. Full results are given in Tables 8.1.11.1 - 8.1.11.3. For 1990, RCT3 predicted 155 million fish at age 0, 47 million at age 1 and 12 million at age 2. These values compare with the tuned VPA values of 6 million, 121 million and 14 million respectively. The 1990 year class is estimated to be above average, but not as strong as was estimated at the previous Working Group meeting, where it was considered to be similar to the 1986 year class strength.

Recruits at age 0 in 1991, used for prediction, were estimated as the VPA geometric mean recruitment at age 0 from the RCT3 output (Table 8.1.11.1) giving a value of 105 million. This represents a change in convention. The past practice is discussed in Section 7.6. Convention has been changed because the Division VIa prediction for the 1991 year class as 1 group fish, effectively depends on the North Sea haddock RCT3 results for the 1991 year class as 1 group fish. This value has, itself, been set aside for reasons discussed in Section 7.6 and the Working Group decided to act conservatively in prediction by choosing the geometric mean 0 group abundance.

8.1.7 Long-Term Trends in Biomass, Fishing Mortality and Recruitment

Trends in biomass, fishing mortality and recruitment are given in Table 8.1.12 and shown in Figure 8.1.1. Human consumption fishing mortality rate in 1990 shows a reduction from the 1989 level, but is still high. Fishing mortality due to discarding has also risen compared to its 1989 value.

Total stock biomass (28,000 t) and spawning stock biomass (21,000 t) are at the lowest levels over the 20 year period presented here.

8.1.8 Catch and Biomass Predictions

The input data for prediction are given in Table 8.1.13. Values of F at age in 1990 and for prediction were treated in the same way as for North Sea haddock (Section 7.8).

Two predictions are presented. Table 8.1.14 gives the results of a *status quo* prediction whilst Table 8.1.15 shows the results assuming a decrease in fishing effort in 1991 of 30% in accord with ACFM recommendations.

For the same reasons as with North Sea haddock (see Appendix 1) the Working Group believes that effort in 1991 is unlikely to have been reduced by 30% and, therefore, believes the results assuming *status quo* in 1991 (Table 8.1.14) are the more relevant. Results are shown in Figure 8.1.2. A sensitivity analysis of the prediction is shown in Figure 8.1.3.

From Table 8.1.14, total landings in 1991 are expected to be 8,600 t compared to the *status quo* prediction of 9,300 t made last year.

Estimated spawning stock biomass at the start of 1992, assuming *status quo* in 1991, is 17,000 t , a marginal increase from the level at the start of 1991 of 15,000 t.

Estimated total landings in 1992, assuming *status quo* in both 1991 and 1992, are 8,000 t, with the spawning stock remaining at about 18,000 t at the start of 1993.

8.1.9 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 8.1.4.

8.1.10 Safe Biological Limits

The stock and recruitment scatter plot is shown in Figure 8.1.5. Values of spawning stock biomass per recruit corresponding to F_{med} (0.25) and F_{high} were calculated as 681 g per recruit and 1 g per recruit respectively.

The decline of the spawning stock biomass will be halted in the short term by recruitment of the 1990 and 1991 year classes which appear to be average or a little above average. However, as for North Sea haddock, the spawning stock and fishery are heavily dependent on one or two year classes and even one more poor year class could lead to a rapid decline. The present spawning biomass may be in an area where recruitment is jeopardised.

8.2 Haddock in Division VIb

8.2.1 Catch Trends

Officially-reported landings for recent years are given in Table 8.2.1. The nominal landings in 1990 were 7469 t which is similar to recent years but is almost certainly inflated by catches taken in the North Sea and misreported as coming from this stock. Landings in 1990 as estimated by the Working Group were 3203 t. For other years, Working Group estimates did not differ from official figures.

8.2.2 Age Compositions

Age compositions were available from Scotland in 1990 which accounted for most of the catch that year. Length compositions were available from the Republic of Ireland. These were converted to age compositions using Scottish age/length keys. Total international catch-at-age data are given in Table 8.2.2.

8.2.3 Mean Weight at Age, Natural Mortality and Maturity

Mean weights at age are given in Table 8.2.3 along with natural mortality and maturity at age.

8.2.4 Abundance Indices

Indices of abundance from research vessel surveys conducted since 1985 are given in Table 8.2.4. Only surveys from 1988 onwards have used the same vessel. As in previous years, a linear model has been fitted to the data to obtain year class estimates with the year (or vessel) effect removed. The data for 0-group fish have been omitted since the catches of these fish do not seem to reflect abundance. The results of fitting the model are given in Table 8.2.5. The analysis provides indices both of recruitment and spawning stock biomass with the "year effect" removed.

8.2.5 Analysis of Catch at Age Data

A conventional VPA was run where F in the last year was tuned using Scottish effort data. The Fs were then shrunk to the overall mean F at age (see Section 2.4). F on the oldest age was set to the average of ages 6-8. The results of this analysis are given in Table 8.2.6. Figure 8.2.1 shows estimated spawning stock biomass from VPA plotted as a time series along side the equivalent estimates from the survey indices. The very close similarity between the two independent estimates is noteworthy.

In previous assessments, a separable model has been fitted to the data. It is clear that this model is not entirely appropriate for this fishery since the separable assumption is almost certainly violated. However, in order to obtain a long series of recruitment to calibrate the survey indices the separable model was fitted. The analysis leads to the results given in Table 8.2.7. The estimated recruitment at age 2 has then been used to calibrate the survey indices. Although the separable assumption may not be entirely justified, it is likely that the year class strength signal is adequately estimated.

8.2.6 Recruitment

Table 8.2.8 gives estimates of year class strength obtained from the research vessel data and commercial catch data respectively. The models permit estimates of year class strength for year classes prior to 1985 to be made and hence provide the longest time series available to calibrate recent abundance estimates. The data are plotted in Figure 8.2.2. Prediction regression has been used to estimate log recruitment values at age 2 in Table 8.2.8. These values have been used in forecasts.

8.2.7 State of the Stock

It is difficult with such a short time series to judge recent trends with any confidence. Table 8.2.9 gives estimates of SSB and mean F. The SSB in 1991 appears to be at around 4700 t but is expected to increase thereafter. This differs from last years assessment which suggested that SSB was stable and at a much higher value. The change is due to a substantial downward revision of the population size at ages 2 and 3 in 1989 in the VPA. The mortality rates on these to ages in 1989 are now estimated to be very much higher.

Fishing mortality is high and has increased reflecting rising effort by the Scottish fleet. The estimated fishing mortality for 1990 must be considered very unreliable in view of the substantial misreporting problem affecting this stock. The analysis suggests that recent recruitment has been fairly stable.

8.2.8 Yield and Biomass per Recruit

Yield and biomass per recruit are plotted on Figure 8.2.3. The curve is flat-topped. Present fishing mortality is well above $F_{0.1}$ which is about 30% of F *status quo*.

8.2.9 *Status Quo* Catch Prediction

A *status quo* catch forecast was run using the population numbers and F at age estimated from conventional VPA. The input values are given in Table 8.2.10. The populations at 2 have been replaced by the corresponding values emerging from the recruitment calibration line. Predicted *status quo* catches and SSBs are given in Table 8.2.11. For 1992 the predicted value is 3830 t. A sensitivity analysis of the forecast is given in shown in Figure 8.2.4. The forecast is heavily dependent on the recruiting

year classes. These cannot be considered to be estimated with great precision.

8.2.10 Safe Biological Limits

It is very difficult to judge whether the present spawning stock is low compared to earlier historical values. The main reason for the decline in the spawning stock is the declining effect of the 1984 year class which was abundant, and largely responsible for the recent development of the fishery. It is likely that if the Rockall stock can only support low catch rates, fishing vessels will find it unattractive to steam all the way to such an exposed fishery. In these circumstances is may not be necessary to be especially concerned about the vulnerability of the stock. The principal reason for needing a catch restriction for this stock is to prevent misreporting of catches from Division VIa or the North Sea to this area.

9 HADDOCK IN SUB-AREA VII

Nominal landings of haddock reported to ICES in Divisions VIIb,c, VIId,e and VIIg-k are given in Tables 9.1a-c.

10 WHITING IN SUB-AREA IV

10.1 Catch Trends

Total nominal landings are given in Table 10.1, total international catches as estimated by the Working Group in Table 10.2. Total international catches in 1990 amounted to 147,000 t, of which 42,000 t were human consumption landings, 54,000 t discards and 51,000 t industrial by-catch. As in 1989 the industrial by-catch was estimated to be larger than the landings for human consumption and similar to the amount discarded.

The total landings of 93,000 t in 1990 are below the prediction of 150,000 t given in last year's report and below the total 1990 TAC of 125,000 t.

Catch trends for the last 20 years are shown in Figure 10.1.

10.2 Natural Mortality and Maturity at Age

The values used are presented in Table 10.3. No changes have been made from last year's report.

10.3 Age Compositions and Mean Weight at Age

The age compositions and weight at age in the catch for 1990 were prepared and minor revisions were made on the 1989 data. Human consumption landings data were provided by Scotland, the Netherlands, England and France. Discard data were provided by Scotland. Industrial by-catch data for Denmark and Norway were prepared from total by-catch estimates split on age groups as described in Section 2.1.

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

Total international catch at age and mean weight at age are presented in Tables 10.4 and 10.5.

10.4 Commercial Catch/Effort Data and Survey Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the VPA tuning and the number of years available for each fleet are listed in Table 2.4.1. Research vessel indices are given in Table 10.6.

10.5 VPA Tuning

Tuning was performed as described in Section 2.4. The summary statistics from the tuning using the shrinking option are given in Table 10.7. Age group 10 was used as plus group and the fishing mortalities for the oldest true age group and the plus group were taken as the mean of the F values of the preceding 5 ages (4-8).

The resultant total international fishing mortality rates and stock numbers at age are presented in Tables 10.8 and 10.9, respectively.

The tuned VPA estimate of the 1987 year class at age 2 (605 million) is considerably lower than the RCRTINX2 estimate used in last years prediction (1255 million). The prediction in last years report was highly influenced by the German Groundfish survey index at age 2, which was 2277 million compared to the VPA average of 924 million and was used with a weight of 39%. Most other surveys indicated an average year class. The plots of survey indices versus tuned VPA stock estimate for age 1 are presented in Figure 2.3.5. It can be seen that the German Ground Fish Survey index of year class 1987 at age 2 represents a value 5 times the largest value of earlier year classes. It should be investigated whether the weighting procedure works properly in cases like these. The standard error of predictions based on far outliers is expected to be so large, that small weights will be assigned even if the standard error of the regression is small.

10.6 Estimates of Abundance of Year Classes 1988-1991

Recruitment estimates were made on basis of survey indices and RCT3 as described in Section 2.3. Estimates of the populations were made for 0,1 and 2-groups in

1990 and for the 0-group in 1991 (see Tables 10.10.1, 10.10.2 and 10.10.3). These estimates were used in predictions. For populations as 0 groups of the year classes 1992 onwards the most recent geometric VPA mean calculated by RCT3 was used.

The estimates of the 1988 and 1989 year classes are very close to the estimates made in last years report. The 1990 year class is now estimated to be approximately 60% larger than predicted last year, where the prediction was based on 0-groups in two surveys which were weighed out against the mean. These two surveys both indicated a year class above average and the surveys which have been added in this years estimate all confirm that the year class is strong.

The tuned VPA estimate of population size of year classes 1988 and 1990 agrees well with the RCT3 estimate. The discrepancy between the predicted and tuned value of the 1989 year class is due to an inconsistency between above-average predictions from the IYFS and the Dutch Ground Fish Survey and relatively low catches in 1990.

10.7 Long-Term Trends in Biomass, Fishing Mortality and Recruitment

The historical development in mean fishing mortality, biomasses and recruitment is presented in Table 10.11 and Figure 10.1. The decrease in mean human fishing consumption mortality in recent years continued in 1990 while discard mortality is increasing. The industrial by-catch mortality is maintained at a higher level than in the mid-1980s and has for the most recent years been back at the level of the late 1970s.

The increasing trend in spawning stock biomass continues and it is now at the average level for the last 20 years although still lower than the high level in the late 1970s. Recruitment has in the second half of the 1980s been on an intermediate level. This is an increase compared to the low levels in the first half of the decade.

10.8 Catch and Biomass Predictions

Input data for catch predictions are given in Table 10.12. Recruitment has been entered as indicated in Section 10.6. F in 1990 has been set at the tuned values except for the ages where VPA stock numbers have been replaced (0-2). For these ages the mean values for 1986-1990 have been used. For 1991 onwards the F array has been set at the average of the period 1986-1990 scaled to the 1990 level.

The results of the *status quo* prediction are given in Table 10.13.1 and Figure 10.2. The predicted landings in 1991 are 68,000 t as human consumption and 70,000 t as industrial by-catch while 58,000 t are predicted to be discarded. In 1992 human consumption landings of 73,000 t, industrial by-catch landings of 62,000 t and discards of 53,000 t are predicted given *status quo* in 1992. Spawning stock biomass will increase in 1991 but decrease again in 1992.

Predictions assuming a reduction of 30% in human consumption fishing mortality in 1990, as was the target of the management, are presented in Table 10.13.2. It is not expected that the 30% reduction in fishing effort in 1991 will be achieved (see Appendix 1). Had the reduction been achieved there would have been an increase in *status quo* catch in 1992 of about 10,000 t and an increase in SSB at the start of 1993 of a similar amount.

A sensitivity analysis (Figure 10.3) shows that catch predictions are sensitive to the estimates of numbers at age 1 and 2 in 1990 which have been estimated from surveys and F at age 2. The latter is dominated by discards and industrial by-catch and the estimation is influenced by the relatively large uncertainties in the catch estimates of this age group.

10.9 Yield and Biomass Estimates

Plots of yield and biomass per recruit are shown in Figure 10.4.

10.10 Safe Biological Limits

The scatter diagram of spawning stock biomass and recruitment is shown in Figure 10.5. The present level of average human consumption fishing mortality (F = 0.78) is above F_{med} (0.56). The spawning stock biomass is predicted to decrease in 1992. It is presently at an average level for the last 20 years. The present level of exploitation of this stock is one of the highest in this area and the SSB has been sustained primarily because recruitment has been better than for the other gadoids in the North Sea.

11 WHITING IN SUB-AREA VI

11.1 Whiting in Division VIa

11.1.1 Catch Trends

Total nominal landings are given in Table 11.1.1, total international catches as estimated by the Working Group in Table 11.1.2. Total human consumption landings in 1990 amounted to 6,000 t. Catches have been reallocated by the Working Group as described in Section 2.1.

The total landings in 1990 are below the prediction given in last year's report and below the total 1990 TAC of 11,000 t.

Catch trends for the last 20 years are shown in Figure 11.1.1. Landings are at their lowest level on record.

11.1.2 Natural Mortality and Maturity at Age

The values used are presented in Table 11.1.3. No changes have been made from last year's report.

11.1.3 Age Compositions and Mean Weight at Age

The age compositions excluding discards and weight at age in the catch for 1990 were prepared and minor revisions were made on the 1989 data. Data were provided by Scotland and Ireland. Data are given in Table 11.1.4.

The mean weight at age in the catch was also used as the stock mean weight at age, and given in Table 11.1.5.

11.1.4 Commercial Catch/Effort Data and Survey Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the VPA tuning and the number of years available for each fleet are listed in Table 2.4.1. Research vessel indices are given in table 11.1.6.

11.1.5 VPA Tuning

Tuning was performed as described in Section 2.4. An initial tuning using 8 as plus group gave unrealistically high F values for the older age groups. A separable VPA gave high residuals for age 7 (Table 11.1.7). A subsequent tuning using 7 as plus group was used as basis for VPA runs. The summary statistics from the tuning using the shrinking option are given in Table 11.1.8.

The resultant total international fishing mortality rates and stock numbers at age are presented in Tables 11.1.9 and 11.1.10, respectively.

The tuned VPA estimate of the 1987 year class at age 2 (12.2 million) is considerably lower than the RCRTINX2 estimate used in last years prediction (32.2 million). The prediction in last years report was influenced by the inclusion of estimates of recruitment to the North Sea stock. The North Sea 87 year class was overestimated in last years report due to a high estimate from a single survey (see Section 10.5) and this overestimate influenced the VIa estimate.

11.1.6 Estimates of Abundance of Year Classes 1988-1991

Recruitment estimates were made on basis of survey indices and RCT3 as described in Section 2.3. The North Sea recruitment estimates were not used in predictions due to the problems arising from last years inclusion of the North Sea recruitment in the prediction (see Section 11.1.5). A plot of the relation between recruitment in Division VIa and in the North Sea (Figure 11.1.2) demonstrates that recent years have shown little relationship. Predictions were thus based on Scottish surveys alone.

Estimates of the populations were made for 1 and 2-groups in 1990 and for 1 groups in 1991 (Tables 11.1.11.1 and 11.1.11.2). These estimates were used in predictions. For the year classes 1991 onwards the most recent geometric VPA mean calculated by RCT3 was used.

All the three year class population estimates made through RCT3 are smaller than last year's estimates. This is mainly due to the fact that recent recruitment to the North Sea has been at about the average level with below-average year classes recruiting to the Division VIa stock. As can be seen from Table 23.9 of last year's report, all recruitment estimates were pulled up by the North Sea estimates. The omission of the North Sea recruitment estimates from the present prediction will thus result in lower estimates.

The estimates of populations resulting from RCT3 agrees well with the corresponding tuned VPA estimates.

11.1.7 Long-Term Trends in Biomass, Fishing Mortality and Recruitment

The historical development in mean fishing mortality, biomasses and recruitment is presented in Table 11.1.12 and Figure 11.1.1. Fishing mortality has in recent years been fluctuating at a level above the long term mean.

The decreasing trend in spawning stock biomass continues and it is at the lowest level for the last 20 years. Recruitment has in the second half of the 1980s been below average

11.1.8 Catch and Biomass Predictions

Input data for catch predictions are given in Table 11.1.13. Recruitment has been entered as indicated in Section 11.1.6. F in 1990 has been set at the tuned values except for the ages where VPA stock numbers have been replaced (1-2). For these ages the mean values have been used in 1990. For 1991 onwards F has been set at a mean F of the period 1986-1990 scaled to the 1990 level.

The results of the *status quo* prediction is given in Table 11.1.14.1 and Figure 11.1.3. The predicted landings in 1991 are 7,000 t. In 1992 landings of 8,000 t are predicted given *status quo* in 1992. Spawning stock biomass will increase in 1991 and 1992.

Predictions assuming a reduction of 30% in human consumption fishing mortality in 1991 (the management target) are presented in Table 11.1.14.2. It is not expected that effort in 1991 will be reduced (see Appendix 1). The effect of any reduction in effort in 1991 is not expected to have a large effect on the 1992 catch or 1993 SSB.

A sensitivity analysis (Figure 11.1.4) shows that predictions of landings are sensitive to estimates of recruitment, less so to estimates of fishing mortality at younger ages. Spawning stock biomass predictions are also sensitive to the fishing mortality estimate for age 2.

11.1.9 Yield and Biomass Estimates

Plots of yield and biomass per recruit are shown in Figure 11.1.5.

11.1.10 Safe Biological Limits

The scatter diagram of recruitment versus Spawning Stock Biomass is presented in Figure 11.1.6. The present average fishing mortality (F = 0.77) is just above F_{med} (0.65) and well below F_{high} (1.84). The spawning stock has continued its decrease and is presently at a historic minimum, but is predicted to increase slightly. Recruitment in recent years has been poor unlike in the North Sea. This combined with high levels of fishing mortality has lead to a rapid decline in the SSB to the lowest levels since 1970. The present SSB is well to the left of the recruitment/SSB scatter plot and hence the probability of the stock producing good recruitment is uncertain. This needs to be considered when formulating advice to managers.

11.2 Whiting in Division VIb

Official landings of whiting from Division VIb are usually insignificant, but have increased considerably in 1990 (Table 11.2.1). This is considered to be due to misreporting of landings taken in other areas.

12 WHITING IN SUB-AREA VII

12.1 Whiting in Division VIId

12.1.1 Catch Trends

Total nominal landings are given in Table 12.1.1 and the Working Group estimates in Table 12.1.2. Total landings have been decreasing since 1980 and were 3,479 tonnes in 1990 (Figure 12.1.1).

12.1.2 Natural Mortality and Maturity at Age

The values used for VPA are given in Table 12.1.3.

12.1.3 Age Composition and Mean Weight at Age

The VPA input data are given in Tables 12.1.4 and 12.1.5.. Data for 1990 were provided by England and France. Weight at age in the stock was assumed to be the same as in the landings.

12.1.4 VPA

No data are available for tuning the VPA and therefore a separable VPA using the Lowestoft package was run. Values of F = 1 for age 3 and S = 1 were adopted. The log catch ratio residuals are given in Table 12.1.6. They indicate the high variability of catch at age data. The separably generated population numbers were used to initiate a conventional VPA and the resulting estimates of F and N at age are given in Tables 12.1.7 and 12.1.8.

12.1.5 Recruitment Estimates

There are no recruitment data for this area. The VPA estimates for age 1 do not correlate with any of the survey indices in the North Sea or with VPA estimates from that area.

In the absence of other data recruitments for 1989 and subsequent year classes have been set to the geometric mean of 37 millions over the period 1976-1989.

12.1.6 Long-Term Trends in Fishing Mortality, Biomass and Recruitment

These are tabulated in Table 12.1.9 and graphed in Figure 12.1.1. Fishing mortality has decreased since 1986 but remains at a high level and is currently 0.98. Total biomass has stabilised over the same time but the spawning stock biomass is currently at its lowest level.

12.1.7 Catch Prediction

The input data for catch prediction are given in Table 12.1.10 and the results in Table 12.1.11 and Figure 12.1.2. Because the numbers at age in 1990 have been generated by separable population numbers, the F values in 1990 have been replaced by the average over the recent years. The predicted *status quo* landings for 1991 are 4,800 tonnes followed by 5,500 tonnes in 1992. Spawning stock biomass is predicted to increase to 6,700 tonnes in 1992 and to 7,100 tonnes in 1993.

A sensitivity analysis (Figure 12.1.3) shows that the catch prediction in 1992 is mainly sensitive to the recruitment in 1991. Hence the reliability of the catch prediction is highly dependent on the actual value of recruitment at age 1 in that year.

12.1.8 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 12.1.4.

12.1.9 Safe Biological Limits

The stock/recruitment scatter diagram is shown in Figure 12.1.5. The values for F_{med} (0.64) and F_{high} (1.43) are show in Figure 12.1.4. The current value of F (1.18) is well above F_{med}. The spawning stock biomass is at its historical minimum. It has been declining for many years due to increasing fishing mortality and poorer recent recruitments. It is difficult to judge whether at the present level of SSB recruitment might be adversely affected.

12.1.10 Reliability of Assessment

Although there has been some improvement in the data base for some years it is pointed out that the reliability of the assessment is lower than for the other stocks dealt with by this Working Group. Therefore the assessment and catch prediction results should be considered with caution.

12.2 Whiting in Division VIIe

12.2.1 Catch Trends

Nominal landings for recent years together with Working Group estimates are given in Table 12.2.1. The Working Group estimates show that after a decrease to 1,541 tonnes in 1989, landings have increased to 1,869 tonnes in 1990.

12.2.2 Catch Prediction

Since there has been no catch at age data since 1987, no analytical assessment is possible. It was decided this year not to attempt a SHOT forecast for this area, since there are no recruitment data.

12.3 Whiting in Other Divisions of Sub-area VII

Whiting in Division VIIa and Divisions VIIf,g are assessed by the Irish Sea and Bristol Channel Working Group.

No age composition data are available for other areas. Nominal landings for the period 1981-1990 are given in Table 12.3.1.

13 SAITHE IN SUB-AREA IV AND DIVISION IIIa

13.1 Catch Trends

Recent nominal landings are given in Table 13.1. Working Group estimates are in Table 13.2 and are plotted in Figure 13.1. Landings were high in the early 1970s, reaching a maximum of 320,000 t in 1976. Subsequently, landings declined to 114,000 t in 1979, mainly due to the cessation of the USSR fishery. After that, the landings followed an increasing trend to reach 200,000 t in 1985. Since then the landings have decreased considerably. In 1989 and 1990, the landings are estimated to be 92,000 t and 88,000 t respectively. Small amounts of saithe are taken as industrial by-catch. Since 1976, the average industrial by-catch has been 3,000 t (Table 13.2). The agreed TAC in 1990 was 120,000 t. 1990 was the fifth successive year that the TAC was not taken.

13.2 Natural Mortality and Maturity at Age

Values of natural mortality rate and maturity at age are given in Table 13.3.

13.3 Age Compositions and Mean Weight at Age

Total international age compositions are given in Table 13.4. Data for 1990 were supplied by Denmark, Germany, France, Norway, UK (England) and UK (Scotland). Discards are not included.

The mean weights at age in the landings are given in Table 13.5. These are also used as stock mean weights.

13.4 Commercial Catch/Effort and Research Vessel Indices

Commercial catch and effort data used to tune the VPA are indicated in Table 2.4.1. There are no research vessel indices of abundance for saithe.

13.5 VPA Tuning

Fishing mortality rates in 1990 for ages 2-8 were estimated from the Laurec-Shepherd tuning method using shrinkage towards the mean (see Section 2.4). The tuning results are given in Table 13.6. Table 13.7 gives the values of fishing mortality rates, and Table 13.8 gives the stock numbers estimated by tuning. The consequence of using shrinkage is that mean F is about 24 % higher than the unshrunk value. The difference between the shrunk and the unshrunk tuned values is seen in Figure 2.4.8. This year's assessment indicates that fishing mortality is about double last year's estimate. However, the fishing mortality is similar to the estimate for Sub-area VI. It seems reasonable to expect this similarity which was absent from last year's assessment.

It should be noted that the 1986 year class has been substantially revised and is now estimated to be only 1/3 of the previous estimate. This is due to the much higher estimate of F on age 4 this year. It also appears that in last year's assessment F on age 3 was far too low. The revised estimate of this year class appears to be consistent with the catches.

Although shrinkage is a new method, it appears that the procedure reduces the vulnerability of the assessment to "year effects" which are likely to occur when only few fleets are available for tuning. The Working Group believes this assessment is more reliable than last year's for this reason.

13.6 Estimates of Abundance of the Year Classes 1988-1991

No data to estimate recent recruitment are available. The Group decided to assume geometric mean recruitment at age 1 over the years 1971-1987 for the year classes 1988 onwards (211 million fish).

13.7 Long-Term Trends in Biomass, Fishing Mortality and Recruitment

Table 13.9 gives a summary of the trends in fishing mortality, biomass and recruitment as estimated by VPA. These data are also plotted in Figure 13.1.

In recent years, mean fishing mortality has increased from 0.31 in 1981 to 0.92 in 1986. Since then the fishing mortality has been decreasing. In 1989 and 1990, the fishing mortalities are estimated to be 0.69 and 0.61, respectively. This reduction is supported by the fact that fishing effort by French and Norwegian trawlers has decreased by 28 % and 83 %, respectively, since 1986 (Figure 2.4.1b). Total biomass has declined from 694,000 t in 1983 to 353,000 t in 1990, and spawning biomass has declined from 465,000 t in 1974 to 74,000 t in 1990 which is the lowest on record. The recent stock biomasses estimated this year are lower than those estimated in last year's report. The reason for this is the upward revision of the fishing mortalities.

13.8 Catch Predictions

Input data for prediction are given in Table 13.10. Average number at age 1 was input for 1990. Number at age 2 in 1990 was produced by taking the average number at age 1 and using the fishing mortality rate at age 1 for the period 1986-1990. Results of the predictions assuming average recruitment are given in Table 13.11 and in Figure 13.2.

13.8.1 *Status Quo* Prediction

Maintenance of the 1990 level of fishing mortality in 1991 will lead to landings of 91,000 t in 1991 and 102,000 t in 1992. Spawning stock size is predicted to increase from 74,000 t in 1990 to 85,000 t in 1993. However, the sensitivity analysis shows that the prediction is very dependent on age 1 and age 2 in 1990 (Figure 13.3). These year classes are assumed to be average, and the prediction is therefore uncertain.

13.8.2 Prediction Assuming TAC Taken in 1991

The Group felt it unrealistic that the TAC of 125,000 t could be taken in 1991. Therefore, no prediction with a TAC constraint was run.

13.9 Yield and Biomass per Recruit

Yield and biomass per recruit are shown in Figure 13.4.

13.10 Safe Biological Limits

The stock/recruitment scatter diagram is shown in Figure 13.5. F_{med} (0.43) and F_{high} (0.64) are shown in Figure 13.4. The current level of F is at F_{high}. Spawning biomass is at a historical low level. It is predicted to increase a little but the prediction is very uncertain because it assumes average recruitment. Fishing at F_{high} implies high recruitment is required to sustain spawning stock biomass.

14 SAITHE IN SUB-AREA VI

14.1 Catch Trends

Recent nominal landings are given in Table 14.1. Working Group estimates are given in Table 14.2 and are plotted in Figure 14.1. Landings increased in the early 1970s reaching 42,000 t in 1976. Landings then declined to 22,000 t in the early 1980s, and then increased to 40,000 t in 1986. Landings declined to 26,000 t in 1989 and 20,000 t in 1990, below the agreed TAC of 29,000 t.

14.2 Natural Mortality and Maturity at Age

Values of natural mortality rate and maturity at age are given in Table 14.3.

14.3 Age Compositions and Mean Weight at Age

Total international age compositions are given in Table 14.4. Data for 1990 were supplied by the Federal Republic of Germany, France, England, and Scotland. Mean weight at age in the landings are given in Table 14.5. These values were also used as stock mean weights.

14.4 Commercial Catch/Effort and Research Vessel Indices

The commercial catch and effort data used to tune the VPA are indicated in Table 2.4.1. There are no research vessel indices of abundance for saithe in this area.

14.5 VPA Tuning

Fishing mortality rates in 1990 for ages 2-8 were estimated from the shrunk Laurec/Shepherd tuning method (Table 14.6). Because there are large numbers of zero catches in the fleets used for tuning, it was not possible to tune the fishing mortality for age 1. Table 14.7 gives the fishing mortality rates and Table 14.8 gives the stock numbers estimated by tuning.

14.6 Estimates of Abundance of Year Classes 1988-1991

No data to estimate recent recruitment are available. The Group decided to assume geometric mean recruitment at age 1 over the years 1971-1987 for the year classes 1989 onwards. The value estimated by tuning for the age 2 in 1990 (1988 year class), being close to the geometric mean at age 2, was used.

14.7 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

Table 14.9 gives a summary of the trends in fishing mortality, biomass, and recruitment as estimated by VPA. These data are also plotted in Figure 14.1.

In the recent years, fishing mortality has increased from 0.24 in 1984 to 0.72 in 1989 and then decreased to 0.54 in 1990. This increase is supported by the fact that the French vessels have increased their effort considerably (Figure 2.4.1c). Total stock biomass increased from 98,000 t in 1977 to 145,000 t in 1985 and then declined to 82,000 t in 1990. The spawning stock biomass has declined from 94,000 t in 1974 to 24,000 t in 1990 which is the lowest on record.

14.8 Catch and Biomass Predictions

Input data for predictions are given in Table 14.10. The fishing mortality rate at age 1 in 1990 is the average of the period 1986-1990. Results of predictions are given in Table 14.11 and Figure 14.2.

14.8.1 *Status Quo* Prediction

Maintenance of the 1990 level of fishing mortality in 1991 will lead to landings of 20,000 t in 1991 and 19,000 t in 1992.

In the last year report, a catch of 27,000 tonnes was predicted for 1990. The actual catch amounted only to 20,000 tonnes. This discrepancy is mainly due to the underestimation of the fishing mortalities in 1989 for ages 4 (0.577 in last year report instead of 0.974 in this assessment) and 5 (0.585 instead of 0.716).

The higher values of F on these ages is largely due to the use of shrinkage. The resulting exploitation pattern appears to reflect that of French fleet and was therefore accepted.

Assuming geometric average recruitment of the 1989 and later year classes, the spawning biomass will decrease to the low level of 20,000 t at the beginning of 1993.

The sensitivity analysis (Figure 14.3) shows that the prediction is very dependent on the population at ages 1 to 4 in 1990 and recruitment at age 1 in 1991. Populations at ages 1 and 2 in 1990 and age 1 in 1991 are assumed to be average, and the prediction is therefore uncertain.

14.8.2 Prediction Assuming TAC Taken in 1991

The agreed TAC in 1991 is 22,000 t which is close to the predicted *status quo* catch. No prediction is therefore presented.

14.9 Yield and Biomass per Recruit

Yield and biomass per recruit are shown in Figure 14.4.

14.10 Safe Biological Limits

The stock/recruitment plot is shown in Figure 14.5. F_{med} (0.27) and F_{high} (0.38) are shown in Figure 14.4. The current level of F is well above F_{high}.

The estimated levels of SSB from 1989 into the prediction period are substantially lower than historical estimates. The values line well to the left of all observation in the stock recruitment plot in Figure 14.5. Clearly it is very uncertain what may happen to recruitment in this region of SSB. The rapid decline in SSB gives reason for concern and management measures should be considered carefully.

15 SAITHE IN SUB-AREA VII

15.1 Landings

The provisional landings of saithe in Sub-area VII are given in Table 15.1. No data on the age composition of the catch were available.

16 MATTERS ARISING FROM RE-ARRANGING WORKING GROUPS

The re-arrangement of working groups will have a number of consequences for the routine procedures which have developed within the species-oriented working groups. The following aspects can be distinguished:

data base problems
uniformity in methodology
timeliness of submitting data
new approaches.

These topics are dealt with in the following sections.

16.1 Data Base Problems

The different assessment working groups have in the past created their own data bases for combining the national catch-at-age information submitted to the groups. These data bases have been adapted to their specific needs. Thus the Roundfish Working Group specifies three categories of catches: human consumption, industrial catches and discards. A limitation refers to the level of disaggregation that can be maintained in the data base. At present, although quarterly data may be submitted, only annual data are maintained and updated. Therefore, for instance the request from the Multispecies Assessment Working Group to produce quarterly catch-at-age data has to be dealt with separately and updates to the annual data base are not automatically transferred to the quarterly data base. The data base of the Flatfish Working Group is different in that there is no allowance for discards or industrial fisheries and that the data base is basically disaggregated by quarter and sex. The different data bases of the working groups which will eventually merge in regional assessment working groups cannot be easily reconciled, unless they will fit into the IFAP data base package. However, the development of this package has been given a high priority by ICES and it is envisaged that it will be ready for use before the next round of working group meetings.

16.2 Uniformity in Methodology

Despite the different data bases and some inherent differences due to the fact that discard data and industrial by-catches are included in some of the roundfish assessments, there are only minor differences in the assessment methodology presently applied by the two groups. It was not felt that these would create major problems.

16.3 Timeliness of Submitting Data

In view of the 9 days available during the first meeting of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, it is absolutely essential that countries provide their catch-at-age information for both roundfish and flatfish on a quarterly basis 3 months in advance of the meeting so that there is enough time to transfer the data to the ICES data base and to carry out preliminary assessments. The time at the meeting can then be used efficiently to develop a consistent assessment methodology. The deadline for submitting the basic information is therefore set at 1 July 1991. Since the Working Group on the Assessment of Northern Shelf Demersal Stocks will be faced with similar problems, a similar deadline should probably be set for submitting data for Sub-Areas VI and VII.

16.4 New Approaches

The intention behind setting up regional assessment working groups is that new methodologies are developed to cope with technical and biological interactions. In respect of roundfish and flatfish, the technical interactions appear the most important ones. In order to make a start in this direction, the members are requested to prepare a brief overview of the principal fleets operating in the national fisheries together with a description of the composition of the catches in these fleets and their spatial distribution. There was some discussion on the criteria on which to base the distinction between fleets, but, because there are practical limitations in this respect for the purpose of updating the annual assessments, it was agreed to leave this open for the time being. Another possibility for refining assessment methods would be if length and age compositions by fleets and possibly sub-areas were included in the data base. This possibility needs further investigation.

17 RECOMMENDATIONS

1. The Working Group on Methods of Fish Stock Assessment should investigate the appropriate use of shrinkage in tuning and suggest how it should be implemented for assessment working groups.

2. The Working Group on Methods of Fish Stock Assessment should investigate the use of risk analysis, especially as to how this might be useful in addressing the definition of safe biological limits.

Table 2.4.1 Fleets used in tuning the VPAs and the initial year

Country	Fleet	Sub-area IV				Division VIa			
		Cod	Had	Whi	Sai	Cod	Had	Whi	Sai
Scotland	GFS	82	82	82					
	TRL	81	81	81		81	81	81	81
	SEI	81	81	81		81	81	81	81
	LTR	81	81	81		81	81	81	81
	NTR					81	81	81	81
England	GFS	81	81	81					
	TRL	81							
	SEI	81							
France	TRB	81	81	81	81				
	ALL					81	81		81
Germany	GFS	83	83	83					
Netherlands	GFS	81		81					
Norway	TRL				81				
Internat.	GFS	81	81	81					

Table 4.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	9,630	8,744	6,604	6,704	5,804
Denmark	56,404	64,968	61,454	48,828	46,751
Faroe Islands	150	38	65	361	-
France	10,910	11,369	8,399	7,159	8,129
Germany	26,343	29,741	18,525	20,333	13,453
Netherlands	45,400	51,281	36,490	34,111	25,460
Norway[2]	4,506	6,766	12,163	6,625	7,005
Poland	28	7	62	75	7
Sweden	293	321	453	422	575
UK (England & Wales)	49,951	59,856	54,277	53,860	35,605
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	45,044	53,921	57,308	58,581	54,359
USSR	-	-	-	-	-
Total	248,722	287,012	255,800	237,059	197,148

Country	1985	1986	1987	1988	1989	1990[1]
Belgium	4,815	6,604	6,693	5,508	3,398	2,934
Denmark	42,547	32,892	36,948	34,905	25,782	21,542[1]
Faroe Islands	71	15	57	46	35	96
France	4,834	8,402	8,199	8,323	2,578[1,3]	n/a
Germany,	7,675	7,667	8,230	7,707	11,430	10,938[1]
Netherlands	30,844	25,082	21,347	16,968[4]	12,028	n/a
Norway[2]	5,766	4,864	5,000	3,585	5,166[1]	4,830[1]
Poland	-	10	13	19	24	53
Sweden	748	839	688	367	501	620
UK (England & Wales)	29,692	25,361	29,960	23,496	18,250	15,596
UK (Isle of Man)	-	-	-	-	1	-
UK (N.Ireland)	-	-	-	-	124	26
UK (Scotland)	60,931	45,748	49,671	41,382	31,480	31,120
Total	187,923	157,484	166,806	142,306	110,797	

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

Table 4.2 Annual Weight and Numbers of COD caught in IV between 1963 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1963	108	108	0	0	57	57	0	0
1964	116	116	0	0	52	52	0	0
1965	173	173	0	0	94	94	0	0
1966	212	212	0	0	117	117	0	0
1967	242	242	0	0	127	127	0	0
1968	277	277	0	0	148	148	0	0
1969	194	194	0	0	77	77	0	0
1970	219	219	0	0	126	126	0	0
1971	315	315	0	0	226	226	0	0
1972	341	341	0	0	245	245	0	0
1973	228	228	0	0	126	126	0	0
1974	202	202	0	0	103	103	0	0
1975	185	185	0	0	103	103	0	0
1976	209	209	0	0	123	123	0	0
1977	182	182	0	0	137	137	0	0
1978	263	263	0	0	210	210	0	0
1979	249	249	0	0	168	168	0	0
1980	265	265	0	0	200	200	0	0
1981	301	301	0	0	236	236	0	0
1982	273	273	0	0	191	191	0	0
1983	234	234	0	0	178	178	0	0
1984	205	205	0	0	158	158	0	0
1985	193	193	0	0	144	144	0	0
1986	163	163	0	0	140	140	0	0
1987	175	175	0	0	145	145	0	0
1988	150	150	0	0	109	109	0	0
1989	116	116	0	0	75	75	0	0
1990	104	104	0	0	75	75	0	0

Table 4.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.800	0.010
2	0.350	0.050
3	0.250	0.230
4	0.200	0.620
5	0.200	0.860
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000
11	0.200	1.000

Table 4.4 Total International Catch at Age (1000's) of COD in IV between 1963 and 1990

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Age
1	2979	4621	15078	17450	10339	5601	2842	52719	42972	3692	1
2	39475	20665	49476	59861	67849	80549	21867	32813	148927	180834	2
3	6516	18478	16825	28578	31289	40916	30453	17886	16507	46369	3
4	3278	3958	8755	5922	10777	11906	13222	12904	6475	5474	4
5	2584	1762	2276	3235	3131	5838	4403	6092	6808	2627	5
6	1124	1670	906	1224	1889	1359	2792	1705	2588	3084	6
7	75	551	627	457	850	836	567	930	856	1618	7
8	456	108	284	354	340	297	407	202	439	589	8
9	13	86	49	121	132	145	142	180	219	376	9
10	5	11	72	54	38	107	45	95	74	108	10
11		4	8	80	16	23	75	39	90	17	11

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Age
1	24742	14690	30081	5182	62751	24933	34116	60874	19835	64839	1
2	30259	55617	42487	90267	42276	158837	85845	96115	175922	59947	2
3	52342	10765	17073	16172	22918	13094	40459	29562	27563	53239	3
4	13409	14937	4203	6016	4104	8417	3332	10272	7649	7287	4
5	2102	4365	6816	1542	2055	2809	3130	1590	3802	3193	5
6	1057	907	1863	2764	752	941	675	1172	740	1883	6
7	1010	414	405	837	1030	366	365	412	555	355	7
8	466	373	176	119	335	372	129	191	131	218	8
9	76	313	206	61	237	140	145	71	63	72	9
10	55	76	86	57	23	33	39	54	36	25	10
11	154	178	57	39	87	40	16	25	20	15	11

Age	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	23838	63860	7894	82594	21635	17717	21314	11374	1
2	121828	57774	111120	20828	105618	49802	28689	49384	2
3	17518	27765	15712	28919	6962	35706	14634	8415	3
4	10104	3461	6875	3954	7625	2508	8023	3751	4
5	2501	3119	1150	2584	1348	2227	868	1945	5
6	1167	939	1116	521	955	558	884	251	6
7	562	415	328	498	209	274	219	244	7
8	142	233	162	148	188	58	124	37	8
9	70	57	73	60	46	52	22	43	9
10	22	43	13	39	31	11	24	9	10
11	18	19	23	19	11	16	9	3	11

Table 4.5 Total International Mean Weight at Age (Kg.) of COD in IV between 1963 and 1990

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Age
1	0.538	0.496	0.581	0.579	0.590	0.640	0.544	0.626	0.579	0.616	1
2	1.004	0.863	0.965	0.994	1.035	0.973	0.921	0.961	0.941	0.836	2
3	2.657	2.377	2.304	2.442	2.404	2.223	2.133	2.041	2.193	2.086	3
4	4.491	4.528	4.512	4.169	3.153	4.094	3.852	4.001	4.258	3.968	4
5	6.794	6.447	7.274	7.027	6.803	5.341	5.715	6.131	6.528	6.011	5
6	9.409	8.520	9.498	9.599	9.610	8.020	6.722	7.945	8.646	8.246	6
7	11.562	10.606	11.898	11.766	12.033	8.581	9.262	9.953	10.356	9.766	7
8	11.942	10.758	12.041	11.968	12.481	10.162	9.749	10.131	11.219	10.228	8
9	13.383	12.340	13.053	14.060	13.589	10.720	10.384	11.919	12.881	11.875	9
10	13.756	12.540	14.441	14.746	14.271	12.497	12.743	12.554	13.147	12.530	10
11		7.090	15.667	15.672	19.016	11.595	11.176	14.367	15.544	14.350	11

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Age
1	0.559	0.594	0.619	0.568	0.542	0.568	0.549	0.546	0.725	0.587	1
2	0.869	1.039	0.899	1.027	0.973	0.938	0.940	0.998	0.827	0.948	2
3	1.919	2.217	2.348	2.477	2.161	2.025	2.447	2.002	2.256	1.851	3
4	3.776	4.156	4.226	4.575	4.603	4.242	4.583	4.578	4.759	4.512	4
5	5.488	6.174	6.404	6.505	6.716	6.599	6.687	6.390	7.188	6.848	5
6	7.453	8.333	8.691	8.630	8.832	8.945	8.557	9.156	8.851	8.993	6
7	9.019	9.889	10.107	10.137	10.075	9.972	10.938	9.805	10.059	10.740	7
8	9.810	10.791	10.910	11.341	11.052	11.099	11.550	11.867	11.519	12.500	8
9	11.077	12.175	12.339	12.888	11.824	12.427	13.057	12.782	13.338	13.469	9
10	12.359	12.425	12.976	14.140	13.134	12.778	14.148	14.081	14.895	12.890	10
11	12.886	13.731	14.431	14.371	14.361	13.981	15.478	15.392	18.784	14.608	11

Age	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.634	0.593	0.582	0.570	0.621	0.561	0.672	0.712	1
2	0.917	0.996	0.920	0.909	0.937	0.836	1.044	0.933	2
3	1.814	2.144	2.126	1.823	1.955	1.912	1.832	2.144	3
4	3.960	4.041	4.228	3.890	3.671	3.242	3.604	3.755	4
5	6.589	6.255	6.457	6.426	6.017	5.971	5.175	6.112	5
6	8.454	8.423	8.475	8.158	8.280	7.864	7.842	8.348	6
7	9.919	10.317	10.406	9.956	9.911	9.723	9.498	10.523	7
8	11.837	11.352	12.034	11.713	11.413	11.607	11.087	10.742	8
9	12.797	13.505	13.033	12.710	12.149	13.489	12.774	12.610	9
10	12.562	13.408	13.209	13.566	15.542	14.353	14.066	15.285	10
11	14.427	13.471	14.415	13.160	16.430	15.767	14.578	14.631	11

Table 4.6 Cod in the North Sea. Research Vessel Indices.

YEARCLASS	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS1	SGFS2	DGFS0	DGFS1	DGFS2	FRGS	GGFS1	GGFS2
1970	98.3	34.5	-1	-1	-1	-1	-1	-1	-1	-1	90.4	-1	-1
1971	4.1	10.6	-1	-1	-1	-1	-1	-1	-1	-1	1.3	-1	-1
1972	38	9.5	-1	-1	-1	-1	-1	-1	-1	-1	1.6	-1	-1
1973	14.7	6.2	-1	-1	-1	-1	-1	-1	-1	-1	3.6	-1	-1
1974	40.3	19.9	-1	-1	-1	-1	-1	-1	-1	-1	8.0	-1	-1
1975	7.9	3.2	-1	-1	4.5	-1	-1	-1	-1	-1	7.8	-1	-1
1976	36.7	29.3	-1	62.7	12.5	-1	-1	-1	-1	-1	28.2	-1	-1
1977	12.9	9.3	13.9	22.8	5.8	-1	-1	-1	-1	-1	27.2	-1	-1
1978	9.9	14.8	12.6	24.2	6.7	-1	-1	-1	-1	4.5	31.1	-1	-1
1979	16.9	25.5	18.6	50.8	13.9	-1	-1	-1	163.8	11.2	35.5	-1	-1
1980	2.9	6.7	10.2	11.4	2.9	-1	3.5	43.2	46.9	1.6	14.1	-1	-1
1981	9.2	16.6	74.2	32.4	11.0	6.1	7.8	176.8	83.0	2.3	23.2	-1	3.5
1982	3.9	8.0	2.5	15.4	4.7	3.3	3.9	26.9	21.8	1.6	9.0	5.9	2.4
1983	15.2	17.6	95.1	61.2	11.9	8.2	11.4	121.5	121.3	3.1	43.0	2.6	22.4
1984	0.9	3.6	0.4	4.3	1.2	0.7	1.0	1.3	3.6	0.2	0.9	2.3	2.6
1985	17.0	28.8	8.3	34.4	10.7	8.0	6.9	143.6	111.2	8.0	9.5	15.4	11.4
1986	8.8	6.1	1.2	14.2	4.1	2.2	2.9	37.0	41.5	1.7	2.3	7.0	9.5
1987	3.6	6.3	0.4	8.4	2.5	1.6	1.3	36.2	17.8	2.2	2.1	2.0	7.2
1988	13.1	15.2	16.8	22.8	5.1	5.6	4.9	16.6	16.6	1.9	4.2	90.2	14.7
1989	3.4	4.1	6.0	6.1	1.6	1.1	1.5	13.7	9.2	-1	0.6	11.9	6.2
1990	2.4	-1	3.9	7.5	-1	3	-1	23.5	-1	-1	-1	15.5	-1
1991	-1	-1	48.4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 4.7

```
VPA Version 2.1 - May 1988
NORTH SEA COD
with cpue data from file COD4EF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,ENGTRL            , has terminal q estimated as the mean
Fleet  2 ,ENGSEI            , has terminal q estimated as the mean
Fleet  3 ,FRATRB            , has terminal q estimated as the mean
Fleet  4 ,SCOTRL            , has terminal q estimated as the mean
Fleet  5 ,SCOSEI            , has terminal q estimated as the mean
Fleet  6 ,SCOLTR            , has terminal q estimated as the mean
Fleet  7 ,INTGFS            , has terminal q estimated as the mean
Fleet  8 ,ENGGFS            , has terminal q estimated as the mean
Fleet  9 ,NETGFS            , has terminal q estimated as the mean
Fleet 10 ,FRGGFS            , has terminal q estimated as the mean
Fleet 11 ,SCOGFS            , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd
Regression weights
     , 0.020, 0.116, 0.284, 0.482, 0.670, 0.820, 0.921, 0.976, 0.997, 1.000
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
Fishing mortalities
  Age,  1981,  1982,  1983,  1984,  1985,  1986,  1987,  1988,  1989,  1990

    1, 0.112, 0.183, 0.137, 0.189, 0.111, 0.233, 0.137, 0.196, 0.107, 0.204
    2, 1.003, 1.005, 1.115, 1.003, 1.036, 0.805, 0.922, 0.920, 0.986, 0.686
    3, 0.992, 1.237, 1.165, 1.019, 1.022, 1.038, 0.828, 1.186, 0.928, 1.150
    4, 0.732, 0.835, 0.886, 0.803, 0.807, 0.832, 0.931, 0.874, 1.036, 0.685
    5, 0.680, 0.798, 0.793, 0.774, 0.695, 0.842, 0.778, 0.797, 0.893, 0.778
    6, 0.651, 0.885, 0.788, 0.810, 0.715, 0.809, 0.905, 0.902, 0.891, 0.714
    7, 0.736, 0.770, 0.733, 0.736, 0.761, 0.840, 0.936, 0.728, 1.202, 0.665
    8, 0.630, 0.740, 0.836, 0.792, 0.734, 0.987, 0.933, 0.748, 0.896, 0.673
    9, 0.775, 0.879, 0.568, 1.012, 0.626, 0.679, 1.028, 0.731, 0.735, 0.959
   10, 0.694, 0.814, 0.744, 0.825, 0.706, 0.831, 0.916, 0.781, 0.924, 0.758

Log catchability estimates

 Age  1
 Fleet ,1981 ,1982 ,1983 ,1984 ,1985 ,1986 ,1987 ,1988 ,1989 ,1990
   1 ,-18.62,-17.42,-18.38,-17.37,-17.40,-16.24,-18.40,-16.94,-17.95,-17.10
   2 ,-18.38,-17.59,-17.81,-17.65,-18.31,-17.81,-18.13,-17.14,-17.76,-17.13
   3 ,-18.61,-18.01,-17.28,-17.09,-16.79,-17.45,-16.79,-17.28,-16.84,-17.67
   4 ,-18.37,-17.30,-17.67,-17.43,-17.17,-17.49,-16.58,-18.09,-17.86,-17.83
   5 ,-17.91,-17.07,-17.58,-17.12,-17.73,-17.14,-17.70,-17.52,-17.55,-17.57
   6 ,-17.99,-16.75,-17.29,-17.21,-17.61,-16.99,-17.12,-18.29,-17.75,-18.10
   7 ,-17.90,-17.49,-17.59,-16.93,-18.08,-16.85,-16.68,-16.93,-16.54,-16.81
   8 ,-16.57,-16.21,-16.24,-15.53,-16.62,-16.15,-16.23,-16.20,-15.98,-16.10
   9 ,-15.15,-15.27,-15.88,-14.84,-16.69,-14.98,-15.14,-15.43,-16.27,-15.71
  10 ,      ,      ,-17.18,-18.54,-17.39,-16.98,-16.93,-17.63,-14.61,-15.42
  11 ,      ,-17.87,-17.80,-17.54,-18.49,-17.61,-18.10,-17.83,-17.38,-17.78


                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,  SLOPE   ,   SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F  ,          ,   Slope  ,       ,Intrcpt
-------'--------'------'-------'------'----------'----------'-------'-------
   1  ,-17.41  , 0.614,0.0070 ,0.1498,  0.000E+00,  0.000E+00,-17.410,  0.228
   2  ,-17.67  , 0.373,0.0017 ,0.1181,  0.000E+00,  0.000E+00,-17.674,  0.138
   3  ,-17.17  , 0.320,0.0013 ,0.3349,  0.000E+00,  0.000E+00,-17.175,  0.119
   4  ,-17.53  , 0.432,0.0003 ,0.2760,  0.000E+00,  0.000E+00,-17.530,  0.160
   5  ,-17.50  , 0.192,0.0068 ,0.2202,  0.000E+00,  0.000E+00,-17.497,  0.071
   6  ,-17.60  , 0.432,0.0090 ,0.3369,  0.000E+00,  0.000E+00,-17.605,  0.160
   7  ,-16.97  , 0.406,0.0000 ,0.1740,  0.000E+00,  0.000E+00,-16.970,  0.150
   8  ,-16.14  , 0.222,0.0000 ,0.1963,  0.000E+00,  0.000E+00,-16.143,  0.082
   9  ,-15.61  , 0.523,0.0000 ,0.2251,  0.000E+00,  0.000E+00,-15.614,  0.194
  10  ,-16.61  , 1.217,0.0000 ,0.0621,  0.000E+00,  0.000E+00,-16.614,  0.455
  11  ,-17.81  , 0.305,0.0000 ,0.1979,  0.000E+00,  0.000E+00,-17.808,  0.113
   Fbar     SIGMA(int.)    SIGMA(ext.)    SIGMA(overall)  Variance ratio
  0.204       0.100          0.888E-01       0.100           0.782
```

cont'd.

Table 4.7 cont'd.

Age 2

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	-15.58	-15.93	-14.92	-15.60	-15.31	-15.08	-14.92	-15.85	-15.34	-15.65
2	-14.76	-15.05	-15.22	-15.67	-15.47	-16.24	-15.59	-15.54	-15.06	-15.62
3	-15.99	-16.39	-15.60	-15.44	-15.84	-15.86	-15.86	-15.62	-15.75	-15.87
4	-16.09	-16.05	-15.12	-14.76	-15.33	-15.14	-15.45	-15.03	-16.62	-15.02
5	-15.15	-15.13	-14.82	-14.62	-14.62	-15.24	-15.09	-14.87	-14.90	-14.30
6	-15.95	-15.44	-15.26	-15.34	-15.39	-15.64	-15.78	-15.68	-16.10	-15.48
7	-15.72	-15.96	-15.68	-15.79	-15.60	-15.68	-15.19	-16.02	-15.39	-15.44
8	-16.35	-16.84	-16.12	-16.32	-16.01	-16.93	-16.19	-16.40	-16.28	-16.53
9	No data for this fleet at this age									
10				-17.12	-17.18	-15.40	-15.97	-16.16	-15.50	-15.24	-15.44
11			-16.65	-16.45	-16.51	-16.06	-17.02	-16.54	-16.75	-16.89	-16.56

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.38	0.295	0.0532	0.8952	0.000E+00	0.000E+00	-15.384	0.109
2	-15.55	0.306	0.0142	0.7346	0.000E+00	0.000E+00	-15.551	0.113
3	-15.77	0.141	0.0051	0.7567	0.000E+00	0.000E+00	-15.771	0.052
4	-15.39	0.519	0.0030	0.4705	0.000E+00	0.000E+00	-15.395	0.192
5	-14.82	0.264	0.0989	0.4088	0.000E+00	0.000E+00	-14.823	0.098
6	-15.64	0.223	0.0640	0.5822	0.000E+00	0.000E+00	-15.643	0.083
7	-15.58	0.235	0.0000	0.5948	0.000E+00	0.000E+00	-15.582	0.087
8	-16.39	0.241	0.0000	0.7911	0.000E+00	0.000E+00	-16.388	0.089
9	No data for this fleet at this age							
10	-15.81	0.603	0.0000	0.4757	0.000E+00	0.000E+00	-15.805	0.225
11	-16.64	0.256	0.0000	0.6356	0.000E+00	0.000E+00	-16.638	0.095

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.686	0.781E-01	0.701E-01	0.781E-01	0.805

Age 3

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	-15.65	-15.38	-15.42	-15.12	-15.43	-15.03	-15.04	-15.12	-15.74	-15.13
2	-15.40	-14.98	-15.35	-15.14	-15.82	-15.71	-16.35	-15.35	-15.68	-15.46
3	-15.45	-15.74	-15.12	-15.05	-15.04	-14.90	-15.82	-14.95	-15.28	-15.48
4	-15.12	-15.48	-15.06	-14.82	-14.77	-14.92	-15.60	-15.22	-14.49	-15.55
5	-15.04	-14.57	-14.83	-14.84	-14.67	-14.36	-15.46	-14.71	-14.39	-14.43
6	-15.37	-15.36	-15.10	-15.26	-15.38	-15.26	-15.53	-15.64	-15.21	-15.55
7	No data for this fleet at this age									
8	-16.90	-16.39	-16.34	-16.54	-16.48	-16.44	-17.24	-16.53	-16.40	-16.33
9	No data for this fleet at this age									
10				-15.83	-17.12	-15.45	-15.20	-13.55	-15.61	-15.19	-14.73
11			-15.83	-15.93	-16.19	-15.87	-15.77	-17.02	-16.72	-16.05	-16.36

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.25	0.225	0.0609	1.0195	0.000E+00	0.000E+00	-15.248	0.083
2	-15.64	0.323	0.0130	0.9596	0.000E+00	0.000E+00	-15.642	0.120
3	-15.25	0.284	0.0086	1.4442	0.000E+00	0.000E+00	-15.248	0.105
4	-15.09	0.355	0.0040	1.8250	0.000E+00	0.000E+00	-15.092	0.132
5	-14.69	0.324	0.1131	0.8856	0.000E+00	0.000E+00	-14.689	0.120
6	-15.40	0.154	0.0814	1.3341	0.000E+00	0.000E+00	-15.403	0.057
7	No data for this fleet at this age							
8	-16.56	0.265	0.0000	0.9153	0.000E+00	0.000E+00	-16.557	0.098
9	No data for this fleet at this age							
10	-15.15	0.895	0.0000	0.7568	0.000E+00	0.000E+00	-15.145	0.335
11	-16.29	0.405	0.0000	1.2276	0.000E+00	0.000E+00	-16.291	0.150

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.149	0.901E-01	0.743E-01	0.901E-01	0.680

cont'd.

Table 4.7 cont'd.

Age 4

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	-15.93	-15.66	-15.41	-15.57	-15.52	-15.70	-15.15	-16.06	-15.38	-16.16
2	-15.40	-15.39	-15.10	-15.41	-15.53	-16.12	-15.52	-16.44	-15.42	-16.10
3	-15.11	-14.84	-15.29	-14.81	-15.04	-14.47	-15.08	-15.22	-15.09	-15.75
4	-15.37	-15.56	-15.41	-15.33	-15.08	-15.71	-15.55	-15.85	-14.96	-15.07
5	-15.28	-14.97	-14.90	-15.12	-15.18	-14.71	-14.69	-15.49	-14.74	-14.61
6	-16.01	-15.57	-15.62	-15.57	-15.87	-15.48	-15.63	-15.95	-15.53	-15.38
7	No data for this fleet at this age									
8	-17.11	-16.62	-16.15	-16.19	-16.54	-16.60	-16.41	-19.19	-16.35	-17.57
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11		-15.39	-15.57	-15.97	-15.84	-15.93	-16.00	-16.23	-15.92	-15.82

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.66	0.314	0.0405	1.1375	0.000E+00	0.000E+00	-15.656	0.116
2	-15.79	0.370	0.0112	0.9362	0.000E+00	0.000E+00	-15.788	0.137
3	-15.11	0.326	0.0099	1.2984	0.000E+00	0.000E+00	-15.110	0.121
4	-15.37	0.293	0.0030	0.5041	0.000E+00	0.000E+00	-15.374	0.108
5	-14.91	0.278	0.0902	0.5052	0.000E+00	0.000E+00	-14.915	0.103
6	-15.62	0.172	0.0652	0.5368	0.000E+00	0.000E+00	-15.625	0.064
7	No data for this fleet at this age							
8	-17.03	0.918	0.0000	1.1769	0.000E+00	0.000E+00	-17.034	0.340
9	No data for this fleet at this age							
10	No data for this fleet at this age							
11	-15.94	0.163	0.0000	0.6086	0.000E+00	0.000E+00	-15.936	0.060

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.685	0.898E-01	0.118	0.118	1.721

Age 5

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	-16.06	-15.56	-16.09	-15.71	-15.88	-15.52	-16.40	-15.70	-16.31	-15.66
2	-14.88	-14.73	-14.81	-14.66	-15.10	-14.92	-15.40	-14.97	-16.08	-15.06
3	-15.70	-15.25	-15.60	-15.46	-15.46	-15.27	-15.36	-14.92	-16.21	-16.31
4	-15.54	-16.21	-15.70	-15.93	-15.61	-15.92	-15.54	-15.82	-15.51	-15.76
5	-15.88	-15.22	-15.35	-15.23	-15.42	-15.33	-14.75	-14.62	-15.15	-14.66
6	-16.66	-16.03	-15.75	-16.24	-16.24	-16.01	-16.41	-15.81	-15.91	-15.53
7	No data for this fleet at this age									
8	-16.44	-16.18	-16.22	-16.78	-15.90	-17.15	-16.31	-15.69	-16.62	-16.88
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11		-15.28	-15.26	-15.77	-15.52	-15.85	-15.61	-15.97	-15.41	-16.08

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.91	0.290	0.0316	0.6085	0.000E+00	0.000E+00	-15.905	0.107
2	-15.19	0.385	0.0203	0.6802	0.000E+00	0.000E+00	-15.195	0.143
3	-15.59	0.440	0.0061	1.5894	0.000E+00	0.000E+00	-15.592	0.163
4	-15.72	0.152	0.0021	0.8106	0.000E+00	0.000E+00	-15.720	0.056
5	-15.00	0.284	0.0826	0.5514	0.000E+00	0.000E+00	-15.003	0.105
6	-15.98	0.256	0.0458	0.4958	0.000E+00	0.000E+00	-15.979	0.095
7	No data for this fleet at this age							
8	-16.45	0.435	0.0000	1.1990	0.000E+00	0.000E+00	-16.451	0.161
9	No data for this fleet at this age							
10	No data for this fleet at this age							
11	-15.72	0.248	0.0000	1.1179	0.000E+00	0.000E+00	-15.721	0.092

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.778	0.927E-01	0.117	0.117	1.602

cont'd.

Table 4.7 cont'd.

Age 6

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	-16.35	-15.43	-15.71	-16.11	-16.11	-16.33	-16.23	-16.19	-16.02	-15.91
2	-15.06	-14.54	-14.37	-14.81	-14.56	-14.77	-14.34	-14.90	-14.46	-15.77
3	-16.34	-16.10	-16.37	-15.90	-16.44	-16.60	-16.20	-15.52	-16.62	-16.57
4	-15.25	-16.58	-15.81	-15.49	-16.24	-16.76	-16.54	-15.01	-15.82	-15.24
5	-16.71	-15.25	-15.43	-15.24	-15.53	-15.67	-14.68	-14.39	-14.46	-14.71
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									
11		-15.09	-15.69	-15.81	-15.68	-15.05	-16.55	-15.49	-16.32	-15.13

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-16.09	0.163	0.0261	0.5960	0.000E+00	0.000E+00	-16.094	0.060
2	-14.80	0.419	0.0302	1.8913	0.000E+00	0.000E+00	-14.797	0.155
3	-16.28	0.350	0.0031	0.9521	0.000E+00	0.000E+00	-16.281	0.130
4	-15.86	0.558	0.0019	0.3822	0.000E+00	0.000E+00	-15.861	0.207
5	-14.92	0.439	0.0899	0.5812	0.000E+00	0.000E+00	-14.918	0.163
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							
11	-15.71	0.512	0.0000	0.4013	0.000E+00	0.000E+00	-15.709	0.190

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.714	0.125	0.175	0.175	1.958

Age 7

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	-15.71	-15.54	-15.63	-15.66	-16.04	-16.47	-16.84	-16.23	-16.24	-15.79
2	-14.45	-14.61	-14.08	-14.45	-14.35	-14.26	-14.83	-14.87	-14.65	-14.49
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	-16.83	-15.52	-15.69	-15.36	-15.66	-15.70	-15.15	-14.75	-14.19	-14.49
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									
11	No data for this fleet at this age									

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-16.18	0.342	0.0241	0.4515	0.000E+00	0.000E+00	-16.176	0.127
2	-14.56	0.212	0.0383	0.6217	0.000E+00	0.000E+00	-14.559	0.078
3	No data for this fleet at this age							
4	No data for this fleet at this age							
5	-15.01	0.505	0.0822	0.3971	0.000E+00	0.000E+00	-15.008	0.187
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							
11	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.665	0.170	0.125	0.170	0.541

cont'd.

Table 4.7 cont'd.

Age 8

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	No data for this fleet at this age									
2	-14.98	-14.37	-14.33	-14.25	-14.07	-14.27	-13.94	-14.67	-14.25	-14.22
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	-15.40	-15.25	-14.92	-15.30	-15.06	-15.34	-14.68	-14.42	-14.79	-14.08
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									
11	No data for this fleet at this age									

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	No data for this fleet at this age							
2	-14.26	0.196	0.0518	0.6472	0.000E+00	0.000E+00	-14.256	0.073
3	No data for this fleet at this age							
4	No data for this fleet at this age							
5	-14.76	0.375	0.1056	0.3427	0.000E+00	0.000E+00	-14.758	0.139
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							
11	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.672	0.174	0.261	0.261	2.253

Age 9

Fleet	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	No data for this fleet at this age									
2	-14.46	-14.33	-14.07	-14.27	-14.17	-14.37	-13.45	-14.58	-14.80	-15.11
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	-15.79	-14.55	-14.80	-15.06	-15.32	-15.44	-14.01	-14.80	-15.32	-15.01
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									
11	No data for this fleet at this age									

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	No data for this fleet at this age							
2	-14.41	0.454	0.0445	1.9281	0.000E+00	0.000E+00	-14.410	0.168
3	No data for this fleet at this age							
4	No data for this fleet at this age							
5	-14.96	0.411	0.0865	1.0136	0.000E+00	0.000E+00	-14.957	0.152
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							
11	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.959	0.304	0.320	0.320	1.104

cont'd.

Table 4.8 Total International Fishing Mortality Rate at Age of COD in IV between 1963 and 1990

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Age
1	0.024	0.019	0.057	0.054	0.033	0.045	0.021	0.110	0.076	0.034	1
2	0.523	0.363	0.466	0.547	0.494	0.630	0.391	0.582	0.882	0.897	2
3	0.362	0.574	0.655	0.625	0.724	0.735	0.601	0.751	0.772	0.918	3
4	0.447	0.404	0.618	0.528	0.531	0.710	0.584	0.578	0.713	0.667	4
5	0.450	0.461	0.429	0.489	0.595	0.622	0.630	0.591	0.699	0.724	5
6	0.557	0.592	0.459	0.434	0.596	0.564	0.701	0.538	0.542	0.817	6
7	0.157	0.590	0.465	0.445	0.616	0.581	0.489	0.534	0.574	0.792	7
8	0.767	0.354	0.704	0.523	0.707	0.453	0.632	0.323	0.523	1.043	8
9	0.306	0.312	0.266	0.754	0.375	0.768	0.408	0.646	0.693	1.242	9
10	0.447	0.462	0.465	0.529	0.578	0.598	0.572	0.526	0.606	0.923	10
11	0.447	0.462	0.465	0.529	0.578	0.598	0.572	0.526	0.606	0.923	11

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Age
1	0.132	0.096	0.107	0.039	0.133	0.088	0.116	0.116	0.112	0.183	1
2	0.708	0.833	0.737	0.931	0.862	1.022	0.838	0.959	1.003	1.005	2
3	0.853	0.691	0.787	0.830	0.763	0.862	0.966	0.951	0.992	1.237	3
4	0.794	0.663	0.671	0.755	0.536	0.751	0.579	0.737	0.732	0.835	4
5	0.589	0.660	0.742	0.561	0.638	0.890	0.711	0.611	0.680	0.798	5
6	0.737	0.550	0.668	0.786	0.593	0.691	0.550	0.643	0.651	0.885	6
7	0.706	0.737	0.511	0.736	0.784	0.656	0.639	0.788	0.736	0.770	7
8	0.556	0.622	0.836	0.275	0.758	0.745	0.510	0.846	0.630	0.740	8
9	0.346	0.930	0.867	0.796	1.419	0.869	0.751	0.599	0.775	0.879	9
10	0.587	0.700	0.725	0.631	0.839	0.772	0.634	0.704	0.694	0.815	10
11	0.587	0.700	0.725	0.631	0.839	0.772	0.634	0.704	0.694	0.815	11

Age	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.137	0.189	0.111	0.233	0.137	0.197	0.113	0.204	1
2	1.115	1.003	1.036	0.805	0.922	0.920	0.998	0.686	2
3	1.165	1.019	1.022	1.038	0.828	1.186	0.929	1.150	3
4	0.886	0.803	0.807	0.832	0.931	0.874	1.036	0.685	4
5	0.793	0.774	0.695	0.842	0.778	0.797	0.893	0.778	5
6	0.788	0.810	0.715	0.809	0.905	0.902	0.891	0.714	6
7	0.733	0.736	0.761	0.840	0.936	0.728	1.202	0.665	7
8	0.836	0.792	0.734	0.987	0.933	0.748	0.896	0.673	8
9	0.568	1.012	0.626	0.679	1.028	0.731	0.735	0.959	9
10	0.744	0.825	0.706	0.831	0.916	0.781	0.924	0.758	10
11	0.744	0.825	0.706	0.831	0.916	0.781	0.924	0.758	11

Table 4.9 Stock Numbers at Age (1000's) of COD in IV between 1963 and 1990

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Age
1	181549	352106	390851	478050	461346	184184	197008	729579	847020	159493	1
2	113165	79634	155199	165815	203451	200562	79114	86669	293656	352680	2
3	24079	47271	39039	68598	67634	87505	75268	37693	34125	85645	3
4	9965	13060	20741	15792	28592	25540	32674	32144	13853	12275	4
5	7817	5220	7142	9153	7627	13759	10280	14922	14771	5561	5
6	2878	4083	2694	3805	4595	3444	6045	4480	6767	6014	6
7	568	1350	1848	1393	2018	2073	1604	2456	2141	3223	7
8	927	398	613	951	731	892	949	805	1178	987	8
9	52	352	229	248	462	295	465	413	477	572	9
10	16	31	211	143	96	260	112	253	177	196	10
11		11	23	212	41	56	188	104	216	30	11

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Age
1	288994	231557	426209	195804	725985	425707	449084	799899	271038	556338	1
2	69260	113841	94517	172010	84606	285605	175103	179688	319988	108933	2
3	101314	24043	34865	31862	47795	25172	72397	53392	48511	82690	3
4	26644	33628	9383	12365	10820	17364	8280	21465	16062	14005	4
5	5159	9858	14186	3927	4756	5184	6706	3798	8407	6324	5
6	2208	2343	4171	5532	1835	2057	1744	2696	1688	3487	6
7	2175	865	1107	1750	2064	830	844	823	1160	721	7
8	1196	879	339	543	686	772	352	365	307	455	8
9	285	562	387	120	338	263	300	173	128	134	9
10	135	165	181	133	44	67	90	116	78	48	10
11	380	386	121	91	167	81	36	53	44	29	11

Age	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	268259	532767	108480	568676	243833	141917	287958	88226	1
2	208161	105116	198218	43628	202427	95566	52352	115579	2
3	28105	48097	27177	49564	13745	56725	26827	13601	3
4	18693	6828	13521	7620	13678	4679	13492	8254	4
5	4973	6308	2504	4942	2715	4415	1598	3921	5
6	2330	1842	2383	1023	1744	1021	1629	536	6
7	1179	867	671	954	373	578	339	547	7
8	273	464	340	257	337	120	229	83	8
9	178	97	172	134	78	109	46	76	9
10	45	82	29	75	55	23	43	18	10
11	38	36	50	36	20	31	17	6	11

Table 4.10.1 Results of RCT3 for North Sea Cod Age 1

Analysis by RCT3 ver3.1 of data from file :

CODIV1.RCX

COD IV RCRTINX2 INPUT VALUES; AGE 1; 1990 WG

Data for 13 surveys over 22 years : 1970 - 1991

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

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1988

	I----------Regression----------				I	I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.91	3.76	.48	.644	18	2.65	6.16	.557	.025
IYFS2	1.04	3.24	.28	.841	18	2.79	6.13	.326	.072
EGFS0	.51	4.69	.46	.686	11	2.88	6.16	.541	.026
EGFS1	.85	3.22	.20	.917	12	3.17	5.92	.238	.135
EGFS2	1.06	3.78	.19	.928	13	1.81	5.71	.217	.163
SGFS1	1.05	4.10	.14	.964	7	1.89	6.08	.189	.192
SGFS2	1.01	4.06	.17	.943	8	1.77	5.85	.209	.176
DGFS0	.51	3.75	.35	.793	8	2.87	5.20	.444	.039
DGFS1	.62	3.40	.24	.901	9	2.87	5.19	.303	.084
DGFS2	1.18	4.25	.47	.691	10	1.06	5.50	.559	.025
FRGSF	.66	4.22	.38	.747	18	1.65	5.31	.441	.040
GGFS1	1.66	2.69	.98	.370	6	4.51	10.18	2.624	.001
GGFS2	1.98	1.65	1.37	.227	7	2.75	7.10	1.877	.002
					VPA Mean =		5.81	.621	.020

Yearclass = 1989

	I----------Regression----------				I	I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.91	3.78	.46	.678	18	1.48	5.13	.546	.030
IYFS2	1.04	3.22	.28	.848	18	1.63	4.92	.348	.073
EGFS0	.51	4.70	.46	.688	11	1.95	5.69	.543	.030
EGFS1	.85	3.22	.21	.917	12	1.96	4.89	.265	.126
EGFS2	1.06	3.79	.19	.931	13	.96	4.80	.238	.156
SGFS1	1.05	4.10	.14	.964	7	.74	4.88	.202	.217
SGFS2	1.01	4.06	.17	.943	8	.92	4.98	.225	.176
DGFS0	.51	3.74	.36	.791	8	2.69	5.11	.458	.042
DGFS1	.62	3.40	.24	.900	9	2.32	4.85	.323	.085
DGFS2									
FRGSF	.66	4.21	.38	.753	18	.47	4.52	.497	.036
GGFS1	1.65	2.71	.98	.374	6	2.56	6.92	1.469	.004
GGFS2	1.97	1.66	1.36	.232	7	1.97	5.54	1.743	.003
					VPA Mean =		5.81	.629	.022

Yearclass = 1990

	I----------Regression----------				I	I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.91	3.80	.43	.715	18	1.22	4.92	.534	.065
IYFS2									
EGFS0	.51	4.71	.46	.691	11	1.59	5.51	.556	.060
EGFS1	.85	3.21	.21	.917	12	2.14	5.03	.265	.266
EGFS2									
SGFS1	1.05	4.10	.15	.964	7	1.39	5.55	.188	.466
SGFS2									
DGFS0	.51	3.73	.36	.787	8	3.20	5.37	.459	.089
DGFS1									
DGFS2									
FRGSF									
GGFS1	1.63	2.73	.97	.381	6	2.80	7.30	1.576	.008
GGFS2									
					VPA Mean =		5.79	.639	.046

Yearclass = 1991

	I----------Regression----------				I	I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.50	4.71	.47	.694	11	3.90	6.68	.611	.532
EGFS1									
EGFS2									
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
					VPA Mean =		5.78	.651	.468

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	333	5.81	.09	.09	1.15		
1989	140	4.95	.09	.07	.61		
1990	216	5.38	.14	.13	.86		
1991	520	6.25	.45	.45	1.02		

Table 4.10.2 Results of RCT3 for North Sea Cod Age 2

Analysis by RCT3 ver3.1 of data from file :

CODIV2.RCX

COD IV RCRTINX2 INPUT VALUES; AGE 2; 1990 WG

Data for 13 surveys over 22 years : 1970 - 1991

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

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1988

	I----------Regression---------I				I----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.88	2.88	.47	.651	18	2.65	5.21	.537	.029
IYFS2	1.04	2.30	.32	.802	18	2.79	5.20	.365	.062
EGFS0	.50	3.76	.45	.680	11	2.88	5.21	.539	.029
EGFS1	.85	2.29	.23	.898	12	3.17	4.97	.264	.120
EGFS2	1.06	2.86	.21	.907	13	1.81	4.77	.245	.139
SGFS1	1.01	3.19	.16	.951	7	1.89	5.10	.211	.187
SGFS2	.96	3.18	.15	.948	8	1.77	4.88	.190	.208
DGFS0	.49	2.85	.36	.771	8	2.87	4.26	.453	.041
DGFS1	.61	2.49	.25	.889	9	2.87	4.25	.315	.084
DGFS2	1.17	3.31	.48	.675	10	1.06	4.56	.568	.026
FRGSF	.64	3.33	.35	.766	18	1.65	4.39	.411	.049
GGFS1	1.58	1.86	.94	.370	6	4.51	9.00	2.500	.001
GGFS2	1.97	.71	1.38	.211	7	2.75	6.13	1.882	.002
					VPA Mean =		4.88	.609	.022

Yearclass = 1989

	I----------Regression---------I				I----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.89	2.89	.45	.680	18	1.48	4.21	.532	.034
IYFS2	1.05	2.27	.32	.807	18	1.63	3.98	.393	.062
EGFS0	.50	3.77	.46	.683	11	1.95	4.74	.539	.033
EGFS1	.85	2.28	.23	.898	12	1.96	3.94	.293	.112
EGFS2	1.05	2.86	.21	.910	13	.96	3.87	.271	.131
SGFS1	1.01	3.19	.16	.951	7	.74	3.94	.227	.188
SGFS2	.96	3.18	.15	.949	8	.92	4.06	.204	.232
DGFS0	.49	2.84	.36	.768	8	2.69	4.17	.468	.044
DGFS1	.61	2.49	.25	.888	9	2.32	3.91	.336	.085
DGFS2									
FRGSF	.64	3.32	.35	.772	18	.47	3.62	.462	.045
GGFS1	1.57	1.88	.93	.375	6	2.56	5.89	1.399	.005
GGFS2	1.95	.73	1.36	.216	7	1.97	4.58	1.746	.003
					VPA Mean =		4.87	.617	.025

Yearclass = 1990

	I----------Regression---------I				I----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.89	2.90	.42	.711	18	1.22	3.99	.528	.074
IYFS2									
EGFS0	.50	3.78	.46	.687	11	1.59	4.57	.550	.068
EGFS1	.85	2.28	.23	.898	12	2.14	4.09	.291	.242
EGFS2									
SGFS1	1.01	3.19	.16	.951	7	1.39	4.59	.211	.462
SGFS2									
DGFS0	.50	2.83	.37	.764	8	3.20	4.42	.469	.093
DGFS1									
DGFS2									
FRGSF									
GGFS1	1.55	1.91	.92	.381	6	2.80	6.26	1.501	.009
GGFS2									
					VPA Mean =		4.85	.627	.052

Yearclass = 1991

	I----------Regression---------I				I----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.49	3.78	.46	.691	11	3.90	5.71	.602	.528
EGFS1									
EGFS2									
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
					VPA Mean =		4.83	.637	.472

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	128	4.85	.09	.09	1.05		
1989	55	4.02	.10	.08	.60		
1990	84	4.44	.14	.13	.77		
1991	199	5.30	.44	.44	1.00		

Table 4.11 Mean Fishing Mortality , Biomass and Recruitment of COD in IV between 1963 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 1	
	2 to 8		1 to 1				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1963	0.466	0.000	0.000	419	140	62	182
1964	0.477	0.000	0.000	507	155	63	352
1965	0.542	0.000	0.000	674	194	64	391
1966	0.513	0.000	0.000	813	219	65	478
1967	0.609	0.000	0.000	873	237	66	461
1968	0.614	0.000	0.000	747	245	67	184
1969	0.575	0.000	0.000	598	243	68	197
1970	0.557	0.000	0.000	915	263	69	730
1971	0.672	0.000	0.000	1102	261	70	847
1972	0.837	0.000	0.000	755	217	71	159
1973	0.706	0.000	0.000	603	194	72	289
1974	0.680	0.000	0.000	561	210	73	232
1975	0.707	0.000	0.000	621	188	74	426
1976	0.696	0.000	0.000	525	162	75	196
1977	0.705	0.000	0.000	712	142	76	726
1978	0.802	0.000	0.000	709	143	77	426
1979	0.685	0.000	0.000	705	148	78	449
1980	0.791	0.000	0.000	887	161	79	800
1981	0.775	0.000	0.000	741	174	80	271
1982	0.896	0.000	0.000	737	168	81	556
1983	0.902	0.000	0.000	557	135	82	268
1984	0.848	0.000	0.000	624	116	83	533
1985	0.824	0.000	0.000	411	107	84	108
1986	0.879	0.000	0.000	540	96	85	569
1987	0.890	0.000	0.000	459	86	86	244
1988	0.879	0.000	0.000	327	79	87	142
1989	0.977	0.000	0.000	393	73	88	316
1990	0.749	0.000	0.000	316	66	89	140
Arit-mean recruits at age 1 for period 1963 to 1990							381
Geom-mean recruits at age 1 for period 1963 to 1990							327

Table 4.12 Input for catch prediction of COD in IV

	1990				Values used in Prediction						
	Stock and Fishing Mortality				F at age , Mean Wt. and Propn. Retained by Consumption Fishery						
					Scaled mean F			Mean values for period 1986 to 1990			
Age	Stock	Fishing Mortality			1986 to 1990			Mean Weight (Kg.)			Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	140000	0.159		0.000	0.142		0.000	0.627		0.330	0.627	1.000
2	128000	0.847		0.000	0.760		0.000	0.932		0.808	0.932	1.000
3	13723	1.131		0.000	0.917		0.000	1.933		2.182	1.933	1.000
4	8265	0.683		0.000	0.781		0.000	3.632		4.879	3.632	1.000
5	3921	0.778		0.000	0.733		0.000	5.940		7.051	5.940	1.000
6	536	0.714		0.000	0.757		0.000	8.099		8.655	8.099	1.000
7	547	0.665		0.000	0.784		0.000	9.922		10.737	9.922	1.000
8	83	0.672		0.000	0.760		0.000	11.312		11.000	11.312	1.000
9	76	0.959			0.741			12.746			12.746	1.000
10	18	0.758			0.755		0.000	14.562		13.000	14.562	1.000
11	6	0.758			0.755		0.000	14.913		14.000	14.913	1.000

Mean F	Age 2 to 8	Age 1 1	Age 2 to 8	Age 1 1
Unscaled	0.784	0.000	0.875	0.000
Scaled			0.784	0.000

Recruits at age 1 in 1991 = 216000
Recruits at age 1 in 1992 = 323759
Recruits at age 1 in 1993 = 323759
Recruits at age 1 in 1994 = 323759

M at age and proprtion mature at age are as shown in Table 4.3

Mean F for ages 2 to 8 in 1990 for human consumption landings + discards = 0.784 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 2 to 8 equal to that for 1990

Mean F for ages 1 to 1 in 1990 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 4.13.1 Predicted Catches and Biomasses (1000's of tonnes) of COD in IV 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	316	311	386	386	386	386	386	386	386	386	386	
Spawning	66	64	66	66	66	66	66	66	66	66	66	
Mean F Ages												
Human Cons. 2 to 8	0.78	0.78	0.00	0.16	0.31	0.47	0.63	0.78	0.94	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	
Catch weight												
Human Consumption	104	100	0	28	52	73	91	108	123	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	104	100	0	28	52	73	91	108	123	0	0	
Total catch	104	100	0	28	52	73	91	108	123	0	0	
Biomass 1 Jan of Year+1												
Total	311	386	589	548	513	483	457	434	414	0	0	
Spawning	64	66	143	123	106	91	79	68	59	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	216000	19902		1	19903
2	53677	24635		0	24636
3	38657	20913		0	20913
4	3448	1716		0	1717
5	3416	1628		0	1628
6	1475	719		0	719
7	215	107		0	107
8	230	113		0	113
9	35	17			17
10	24	12		0	12
11	7	3		0	3
Wt	310636	100361	0	2	100363

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	323759	29830		2	29832
2	84184	38637		1	38637
3	17693	9572		0	9572
4	12040	5993		0	5993
5	1292	616		0	616
6	1344	655		0	655
7	567	283		0	283
8	80	39		0	39
9	88	42			42
10	14	7		0	7
11	12	6		0	6
Wt	386054	107917	0	2	107919

Table 4.13.2 Predicted Catches and Biomasses (1000's of tonnes) of COD in IV 1991 to 1992

	Year										
	1990	1991	1992								
Biomass 1 Jan of Year											
Total	316	311	419	419	419	419	419	419	419	419	419
Spawning	66	64	84	84	84	84	84	84	84	84	84
Mean F Ages											
Human Cons. 2 to 8	0.78	0.55	0.00	0.16	0.31	0.47	0.63	0.78	0.94	0.00	0.00
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean F(Year)/Mean F(1990)										F0.1	Fmax
Human Consumption	1.00	0.70	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	104	77	0	32	60	84	106	124	141	0	0
Discards	0	0	0	0	0	0	0	0	0	0	0
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0
Total landings	104	77	0	32	60	84	106	124	141	0	0
Total catch	104	77	0	32	60	84	106	124	141	0	0
Biomass 1 Jan of Year+1											
Total	311	419	632	585	544	509	479	453	430	0	0
Spawning	64	84	175	150	129	111	96	83	71	0	0

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	216000	14186		1	14187
2	53677	18970		0	18971
3	38657	16412		0	16412
4	3448	1329		0	1329
5	3416	1253		0	1253
6	1475	555		0	555
7	215	83		0	83
8	230	87		0	87
9	35	13			13
10	24	9		0	9
11	7	3		0	3
Wt	310636	77204	0	2	77206

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	323759	29830		2	29832
2	87855	40321		1	40322
3	22223	12022		0	12022
4	15850	7890		0	7890
5	1634	779		0	779
6	1674	816		0	816
7	711	355		0	355
8	102	50		0	50
9	111	53			53
10	17	8		0	8
11	15	7		0	7
Wt	418831	124400	0	3	124402

Table 5.1.1 Nominal catch (in tonnes) of COD in Division VIa, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	57	30	35	21	22
Denmark	27[2]	-	3	-	-
Faroe Islands	3	-	2	-	-
France	5,495	7,601	7,160	8,140	7,637
Germany, Fed. Rep.	1	21	8	205	75
Ireland	2,331	2,725	3,527	2,695	2,316
Netherlands	1	-	-	-	-
Norway	48	40	238	267	231
Spain	-	-	41	52	64
Sweden	-	-	1	-	-
UK (England and Wales)	2,302	3,187[3]	2,948	1,141	692
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	2	7	33	37	32
UK (Scotland)	7,603	10,339	7,969	8,933	9,483
Total	17,870	23,950	21,965	21,491	20,552

Country	1985	1986	1987	1988	1989	1990
Belgium	48	88	33	44	28	-
Denmark	-	-	4	1	3	2[1]
Faroe Islands	-	-	-	11	26	-
France	7,411	5,096	5,044	7,669	3,640[1,4]	n/a
Germany, Fed. Rep.	66	53	12	25	281	391[1,2]
Ireland	2,564	1,704	2,442	2,335	n/a	n/a
Netherlands	1	-	-	n/a	-	n/a
Norway	204	174	77	186	200[1]	150[1]
Spain	28	-	-	-	n/a	n/a
Sweden	-	-	-	-	-	-
UK (England & Wales)	243	106	306	184	439	379
UK (Isle of Man)	-	-	-	-	3	-
UK (N. Ireland)	17	54	138	46	129	93
UK (Scotland)	8,032	4,251	11,143	8,465	8,942	7,151
Total	18,164	11,526	19,199	18,966		

[1]Preliminary.
[2]Includes Division VIb.
[3]Including 37 tonnes caught in Sub-area VI.
[4]Includes Divisions Vb (EC) and VIb.
n/a = Not available.

Table 5.1.2 Annual Weight and Numbers of COD caught in VIA between 1966 and 1990

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1966	17	17	0	0	6	6	0	0
1967	23	23	0	0	8	8	0	0
1968	24	24	0	0	7	7	0	0
1969	22	22	0	0	6	6	0	0
1970	13	13	0	0	4	4	0	0
1971	11	11	0	0	4	4	0	0
1972	15	15	0	0	6	6	0	0
1973	12	12	0	0	5	5	0	0
1974	14	14	0	0	5	5	0	0
1975	13	13	0	0	5	5	0	0
1976	17	17	0	0	7	7	0	0
1977	13	13	0	0	5	5	0	0
1978	14	14	0	0	5	5	0	0
1979	16	16	0	0	6	6	0	0
1980	18	18	0	0	8	8	0	0
1981	24	24	0	0	12	12	0	0
1982	22	22	0	0	8	8	0	0
1983	21	21	0	0	10	10	0	0
1984	21	21	0	0	8	8	0	0
1985	19	19	0	0	9	9	0	0
1986	12	12	0	0	5	5	0	0
1987	19	19	0	0	15	15	0	0
1988	20	20	0	0	12	12	0	0
1989	17	17	0	0	8	8	0	0
1990	12	12	0	0	6	6	0	0

Table 5.1.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.520
3	0.200	0.860
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000

Table 5.1.4 Total International Catch at Age (1000's) of COD in VIA between 1966 and 1990

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Age
1	384	261	333	64	256	254	735	1015	843	1207	1
2	2883	2571	1364	1974	1176	1903	2891	1524	2318	1898	2
3	629	3705	3289	1332	1638	550	1591	1442	778	1187	3
4	999	670	1838	1943	571	841	409	583	1068	533	4
5	825	442	215	759	476	240	501	161	288	325	5
6	78	264	171	149	153	201	108	193	72	90	6
7	52	67	151	170	74	95	110	104	102	35	7

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	970	1265	723	929	1195	461	1827	2335	2143	1355	1
2	3682	1314	1761	1612	3294	7016	1673	4515	2360	5069	2
3	1467	1639	999	2125	2001	3220	3206	1118	2564	1269	3
4	638	624	695	682	796	904	1189	1400	448	1091	4
5	256	269	286	342	191	182	367	468	555	140	5
6	215	87	97	134	77	29	111	148	185	167	6
7	56	79	75	69	37	20	33	60	59	79	7

Age	1986	1987	1988	1989	1990	Age
1	792	7873	1008	2017	513	1
2	1486	4837	8336	1082	4024	2
3	2055	988	2193	3858	432	3
4	411	905	278	709	924	4
5	191	137	210	113	170	5
6	40	56	39	69	23	6
7	30	26	20	33	11	7

Table 5.1.5 Total International Mean Weight at Age (Kg.) of COD in VIA between 1966 and 1990

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Age
1	0.730	0.681	0.745	0.860	0.595	0.674	0.609	0.597	0.611	0.603	1
2	1.466	1.470	1.776	1.284	0.955	1.046	1.192	1.181	1.103	1.369	2
3	3.474	2.906	2.766	2.821	2.533	2.536	2.586	2.784	2.834	3.078	3
4	5.240	4.560	4.721	4.259	4.678	4.167	4.417	4.601	4.750	5.302	4
5	4.868	6.116	6.304	6.169	6.016	6.023	6.226	5.625	6.144	6.846	5
6	8.711	7.394	7.510	6.374	7.120	6.835	7.585	7.049	7.729	8.572	6
7	9.250	8.058	8.278	7.928	8.190	8.100	8.538	8.611	9.339	10.328	7

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	0.616	0.629	0.630	0.693	0.624	0.550	0.692	0.583	0.735	0.628	1
2	1.397	1.160	1.373	1.373	1.375	1.166	1.468	1.265	1.402	1.183	2
3	3.161	2.605	3.389	2.828	3.002	2.839	2.737	2.995	3.168	2.597	3
4	5.005	4.715	5.262	4.853	5.277	4.923	4.749	4.398	5.375	4.892	4
5	6.290	6.269	7.096	6.433	7.422	7.518	6.113	6.305	6.601	6.872	5
6	8.017	7.525	8.686	7.784	8.251	9.314	7.227	8.084	8.606	8.344	6
7	9.001	9.511	9.857	9.636	9.331	10.328	9.856	9.744	10.350	9.766	7

Age	1986	1987	1988	1989	1990	Age
1	0.710	0.531	0.806	0.704	0.613	1
2	1.211	1.312	1.182	1.298	1.275	2
3	2.785	2.783	2.886	2.425	2.815	3
4	4.655	4.574	5.145	4.737	4.314	4
5	6.336	6.161	6.993	7.027	7.021	5
6	8.283	7.989	8.204	7.520	9.033	6
7	9.441	10.062	9.803	9.594	11.671	7

Table 5.1.6 Cod to the West of Scotland. Research Vessel Indices.

YEAR	SWFS1	SWFS2
1969	-1	-1
1970	-1	-1
1971	-1	-1
1972	-1	-1
1973	-1	-1
1974	-1	-1
1975	-1	-1
1976	-1	-1
1977	-1	-1
1978	-1	-1
1979	-1	0.62
1980	0.06	0.61
1981	0.1	3.28
1982	0.18	-1
1983	-1	2.38
1984	0.15	0.69
1985	0.15	1.62
1986	1.05	6.49
1987	0.0	0.72
1988	0.45	2.46
1989	0.2	0.54
1990	0.48	-1
1991	-1	-1

Table 5.1.7

Title : WEST SCOTLAND COD

Separable analysis
from 1966 to 1990 on ages 1 to 9
with Terminal F of 0.859 on age 4 and Terminal S of 1.000

Initial sum of squared residuals was 203.624 and
final sum of squared residuals is 53.648 after 63 iterations

Matrix of Residuals

Years	1966/67	1967/68	1968/69	1969/70
Ages				
1/ 2	-0.595	-0.516	-0.388	-2.041
2/ 3	-0.351	-0.534	-0.028	-0.413
3/ 4	-0.463	0.103	0.153	-0.091
4/ 5	0.190	0.305	0.275	0.212
5/ 6	0.508	0.109	-0.252	0.396
6/ 7	-0.104	-0.157	-0.088	0.444
7/ 8	0.008	-0.101	-0.021	0.224
8/ 9	0.871	0.204	-0.326	-0.389
	0.000	0.000	0.000	0.000
WTS	1.000	1.000	1.000	1.000

Years	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
Ages										
1/ 2	-0.871	-1.059	0.365	0.367	0.112	0.216	0.683	0.813	0.581	-0.279
2/ 3	0.473	0.119	0.314	0.386	0.113	0.132	0.306	-0.047	-0.303	-0.798
3/ 4	0.072	-0.081	0.281	-0.329	-0.520	0.165	0.003	0.204	-0.089	0.001
4/ 5	0.037	-0.093	-0.041	-0.174	0.034	0.037	-0.248	-0.120	-0.015	0.007
5/ 6	0.028	0.183	-0.030	-0.091	-0.003	-0.294	-0.045	0.106	0.017	0.195
6/ 7	-0.069	0.364	-0.521	-0.041	0.527	-0.064	0.115	-0.375	0.285	0.221
7/ 8	-0.318	0.363	-0.145	0.652	0.538	-0.187	0.181	0.183	0.265	-0.012
8/ 9	0.003	-0.611	-0.334	0.061	-1.085	0.178	-0.848	-0.747	-0.892	1.140
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Years	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90		WTS
Ages												
1/ 2	-0.967	-0.045	0.301	1.100	0.304	0.646	-0.606	0.851	1.196	-0.166	0.000	0.226
2/ 3	-0.703	0.556	0.095	0.121	0.188	0.013	0.051	0.096	0.432	-0.219	0.000	0.485
3/ 4	-0.304	0.430	0.155	0.079	0.004	-0.198	0.069	0.152	0.369	-0.164	0.000	0.729
4/ 5	0.102	0.086	-0.003	-0.189	0.022	0.103	0.073	0.044	-0.147	-0.498	0.000	1.000
5/ 6	0.505	-0.331	-0.044	-0.208	0.030	-0.420	0.168	-0.178	0.035	-0.383	0.000	0.697
6/ 7	0.114	-0.625	-0.032	0.089	-0.130	0.556	0.446	-0.163	-0.657	-0.134	0.000	0.520
7/ 8	0.751	-0.395	-0.720	-0.136	-0.116	0.130	-0.985	-1.042	-0.409	1.294	0.000	0.334
8/ 9	0.096	0.165	0.371	-0.183	-0.582	-0.877	-0.182	0.952	-0.857	3.870	0.000	0.172
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Table 5.1.8 Summary of Tuning Statistics for West of Scotland cod.

VPA Version 2.1 - May 1988
WEST SCOTLAND COD
with cpue data from file COD6AEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 SCOTRL has terminal q estimated as the mean
Fleet 2 SCOSEI has terminal q estimated as the mean
Fleet 3 SCOLTR has terminal q estimated as the mean
Fleet 4 SCONTR has terminal q estimated as the mean
Fleet 5 FRAALL has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd

Age 1

Fleet	SUMMARY STATISTICS Pred. q	SE(q)	Partial F	Raised F
1	-15.22	1.310	0.0012	0.0884
2	-14.39	0.948	0.0131	0.0845
3	-15.35	0.707	0.0308	0.1027
4	-17.22	1.032	0.0129	0.077
5	-16.65	1.260	0.0081	0.1158

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.194	0.436	0.672	0.436	0.024

Age 2

Fleet	SUMMARY STATISTICS Pred. q	SE(q)	Partial F	Raised F
1	-13.75	0.453	0.005	0.3598
2	-13.43	0.616	0.0343	0.2578
3	-13.72	0.272	0.1562	0.4799
4	-15.81	0.415	0.053	1.3102
5	-13.49	0.610	0.1917	0.8377

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.618	0.184	0.252	0.252	1.872

Age 3

Fleet	SUMMARY STATISTICS Pred. q	SE(q)	Partial F	Raised F
1	-13.39	0.336	0.0072	0.595
2	-13.75	0.448	0.0248	0.3451
3	-13.73	0.166	0.1556	0.7721
4	-15.96	0.244	0.0456	0.9154
5	-12.43	0.403	0.5581	1.48

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.818	0.117	0.154	0.154	1.730

Age 4

Fleet	SUMMARY STATISTICS Pred. q	SE(q)	Partial F	Raised F
1	-13.18	0.562	0.0089	0.4285
2	-13.63	0.596	0.0281	0.4307
3	-13.7	0.207	0.1604	0.7311
4	-16.46	0.341	0.0277	1.0686
5	-12.26	0.522	0.6567	1.5395

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.859	0.155	0.170	0.170	1.194

Age 5

Fleet	SUMMARY STATISTICS Pred. q	SE(q)	Partial F	Raised F
1	-13.39	0.922	0.0072	0.2598
2	-13.51	0.670	0.0317	0.4527
3	-13.65	0.424	0.169	0.77
4	-16.72	0.876	0.0215	0.8533
5	-12.37	0.569	0.5874	1.3472

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.939	0.274	0.236	0.274	0.742

cont'd.

cont'd.

Age 6

Fleet	SUMMARY STATISTICS Pred. q	SE(q)	Partial F	Raised F
1	No data for this fleet at this age			
2	-13.45	0.827	0.0333	0.378
3	-13.78	0.764	0.1473	0.4965
4	No data for this fleet at this age			
5	-12.32	0.715	0.6179	2.4061

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.068	0.441	0.590	0.590	1.788

Age 7

Fleet	SUMMARY STATISTICS Pred. q	SE(q)	Partial F	Raised F
1	No data for this fleet at this age			
2	No data for this fleet at this age			
3	No data for this fleet at this age			
4	No data for this fleet at this age			
5	-12.44	0.626	0.5502	1.0994

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.214	0.626	0.000	0.626	0.000

Table 5.1.9 Total International Fishing Mortality Rate at Age of COD in VIA between 1966 and 1990

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Age
1	0.027	0.044	0.038	0.017	0.036	0.027	0.137	0.139	0.117	0.123	1
2	0.269	0.256	0.339	0.325	0.480	0.408	0.467	0.464	0.531	0.416	2
3	0.332	0.655	0.604	0.651	0.492	0.434	0.718	0.450	0.459	0.576	3
4	0.657	0.711	0.820	0.906	0.654	0.508	0.677	0.636	0.718	0.664	4
5	0.819	0.697	0.522	1.018	0.585	0.644	0.656	0.626	0.766	0.496	5
6	0.603	0.688	0.649	0.858	0.577	0.529	0.683	0.571	0.648	0.579	6
7	0.603	0.688	0.649	0.858	0.577	0.529	0.683	0.571	0.648	0.579	7

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	0.182	0.153	0.086	0.071	0.066	0.089	0.143	0.331	0.171	0.284	1
2	0.661	0.398	0.328	0.279	0.378	0.657	0.525	0.620	0.657	0.760	2
3	0.663	0.711	0.601	0.837	0.664	0.787	0.730	0.824	0.898	0.935	3
4	0.713	0.671	0.768	1.144	0.912	0.732	0.777	0.849	0.979	1.387	4
5	0.803	0.767	0.762	1.176	1.305	0.541	0.766	0.829	1.038	1.006	5
6	0.726	0.716	0.710	1.054	0.971	0.687	0.758	0.834	0.972	1.110	6
7	0.726	0.716	0.710	1.054	0.971	0.687	0.758	0.834	0.972	1.110	7

Age	1986	1987	1988	1989	1990	Age
1	0.070	0.351	0.343	0.174	0.194	1
2	0.577	0.761	0.777	0.761	0.617	2
3	0.827	0.992	0.994	1.081	0.812	3
4	0.947	1.166	0.878	1.109	0.848	4
5	1.035	1.023	0.990	1.182	0.906	5
6	0.936	1.060	0.954	1.124	0.856	6
7	0.936	1.060	0.954	1.124	0.856	7

Table 5.1.10 Stock Numbers at Age (1000's) of COD in VIA between 1966 and 1990

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Age
1	15693	6648	9897	4197	7884	10647	6299	8635	8396	11476	1
2	13442	12502	5208	7802	3378	6224	8488	4495	6155	6114	2
3	2445	8413	7923	3039	4615	1712	3388	4358	2314	2963	3
4	2264	1437	3577	3545	1298	2311	908	1353	2275	1197	4
5	1607	961	578	1290	1174	552	1138	378	587	909	5
6	188	580	392	281	382	535	237	484	165	223	6
7	125	147	346	321	185	254	243	262	235	88	7

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	6430	9837	9676	15036	20735	5978	15052	9094	15034	6015	1
2	8308	4391	6914	7269	11472	15898	4479	10677	5348	10379	2
3	3303	3512	2416	4078	4502	6436	6747	2168	4705	2269	3
4	1364	1393	1412	1084	1446	1898	2398	2663	779	1570	4
5	504	548	583	536	283	476	748	903	933	240	5
6	453	185	208	223	135	63	227	284	323	270	6
7	119	167	160	115	64	44	68	115	102	127	7

Age	1986	1987	1988	1989	1990	Age
1	12951	29170	3808	13884	3196	1
2	3706	9888	16812	2212	9551	2
3	3975	1705	3781	6330	846	3
4	729	1423	518	1146	1758	4
5	321	232	363	176	310	5
6	72	93	68	111	44	6
7	53	44	36	54	20	7

Table 5.1.11.1 Results of RCT3 for West of Scotland Sea Cod Age 1

Analysis by RCT3 ver3.1 of data from file :

codvia1.tr2

COD VIa RCRTINX2 INPUT VALUES; AGE 1; 1990 WG

Data for 2 surveys over 23 years : 1969 - 1991

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

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1988

	I----------Regression----------				I	I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	3.53	8.49	.56	.648	7	.37	9.80	.750	.292
SWFS2	1.68	7.67	.71	.541	8	1.24	9.77	.891	.207
					VPA Mean =		9.27	.572	.502

Yearclass = 1989

	I----------Regression----------				I	I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	3.51	8.49	.56	.654	7	.18	9.13	.726	.318
SWFS2	1.66	7.69	.69	.558	8	.43	8.40	.916	.200
					VPA Mean =		9.27	.589	.483

Yearclass = 1990

	I----------Regression----------				I	I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	3.49	8.48	.56	.660	7	.39	9.85	.769	.384
SWFS2									
					VPA Mean =		9.28	.608	.616

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	13699	9.53	.41	.18	.21		
1989	8540	9.05	.41	.23	.33		
1990	13332	9.50	.48	.28	.34		
1991	No valid surveys						

Table 5.1.11.2 Results of RCT3 for West of Scotland Cod Age 2

Analysis by RCT3 ver3.1 of data from file :

codvia2.tr2

COD VIa RCRTINX2 INPUT VALUES; AGE 2; 1990 WG

Data for 2 surveys over 23 years : 1969 - 1991

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

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1988

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	4.07	7.95	.76	.513	7	.37	9.46	1.016	.218
SWFS2	1.98	6.99	.93	.430	8	1.24	9.45	1.166	.166
					VPA Mean =		8.88	.605	.616

Yearclass = 1989

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	4.04	7.95	.76	.519	7	.18	8.69	.984	.240
SWFS2	1.94	7.01	.91	.447	8	.43	7.85	1.199	.162
					VPA Mean =		8.88	.623	.599

Yearclass = 1990

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	4.01	7.95	.77	.526	7	.39	9.52	1.043	.275
SWFS2									
					VPA Mean =		8.88	.642	.725

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	8990	9.10	.47	.20	.17		
1989	5827	8.67	.48	.26	.29		
1990	8588	9.06	.55	.28	.27		
1991	No valid surveys						

Table 5.1.12 Mean Fishing Mortality , Biomass and Recruitment of COD in VIA between 1966 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 1	
	2 to 5		1 to 1				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1966	0.519	0.000	0.000	62	40	65	16
1967	0.580	0.000	0.000	65	48	66	7
1968	0.571	0.000	0.000	65	50	67	10
1969	0.725	0.000	0.000	50	40	68	4
1970	0.553	0.000	0.000	37	29	69	8
1971	0.499	0.000	0.000	37	26	70	11
1972	0.629	0.000	0.000	38	28	71	6
1973	0.544	0.000	0.000	37	27	72	9
1974	0.618	0.000	0.000	36	27	73	8
1975	0.538	0.000	0.000	40	28	74	11
1976	0.710	0.000	0.000	41	30	75	6
1977	0.637	0.000	0.000	33	24	76	10
1978	0.615	0.000	0.000	39	27	77	10
1979	0.859	0.000	0.000	43	27	78	15
1980	0.815	0.000	0.000	54	31	79	21
1981	0.679	0.000	0.000	54	39	80	6
1982	0.700	0.000	0.000	54	38	81	15
1983	0.781	0.000	0.000	46	33	82	9
1984	0.893	0.000	0.000	48	31	83	15
1985	1.022	0.000	0.000	35	24	84	6
1986	0.846	0.000	0.000	31	18	85	13
1987	0.985	0.000	0.000	42	20	86	29
1988	0.910	0.000	0.000	40	26	87	4
1989	1.033	0.000	0.000	36	23	88	13
1990	0.809	0.000	0.000	28	18	89	7
Arit-mean recruits at age 1 for period 1966 to 1990							11
Geom-mean recruits at age 1 for period 1966 to 1990							10

Table 5.1.13 Input for catch prediction of COD in VIA

	1990 Stock and Fishing Mortality				Values used in Prediction F at age , Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F 1986 to 1990			Mean values for period 1986 to 1990 Mean Weight (Kg.)				Prop.
Age	Stock Number	Fishing Mortality H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	8540	0.200			0.186			0.673			0.673	1.000
2	8990	0.709			0.634			1.256			1.256	1.000
3	846	0.812			0.841			2.739			2.739	1.000
4	1758	0.848			0.884			4.685			4.685	1.000
5	310	0.906			0.918			6.708			6.708	1.000
6	44	0.855			0.881			8.206			8.206	1.000
7	20	0.855			0.881			10.114			10.114	1.000

	Mean F	Age 2 to 5	Age 1 1	Age 2 to 5	Age 1 1
Unscaled		0.819	0.000	0.917	0.000
Scaled				0.819	0.000

Recruits at age 1 in 1991 = 13332
Recruits at age 1 in 1992 = 10721
Recruits at age 1 in 1993 = 10721
Recruits at age 1 in 1994 = 10721

M at age and proprtion mature at age are as shown in Table 5.1.3

Mean F for ages 2 to 5 in 1990 for human consumption landings + discards = 0.819 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 2 to 5 equal to that for 1990

Mean F for ages 1 to 1 in 1990 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 5.1.14 Predicted Catches and Biomasses (1000's of tonnes) of COD in VIA 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	28	33	34	34	34	34	34	34	34	34	34	34
Spawning	18	19	20	20	20	20	20	20	20	20	20	20
Mean F Ages												
Human Cons. 2 to 5	0.82	0.82	0.00	0.16	0.33	0.49	0.66	0.82	0.98	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	12	13	0	4	7	10	12	14	16	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	12	13	0	4	7	10	12	14	16	0	0	
Total catch	12	13	0	4	7	10	12	14	16	0	0	
Biomass 1 Jan of Year+1												
Total	33	34	57	52	47	42	38	35	32	0	0	
Spawning	19	20	42	37	32	28	25	22	19	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	13332	2052			2052
2	5681	2442			2442
3	3622	1892			1892
4	307	166			166
5	616	340			340
6	102	55			55
7	15	8			8
Wt	32593	13227	0	0	13227

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	10721	1650			1650
2	9067	3897			3897
3	2468	1290			1290
4	1279	690			690
5	104	57			57
6	202	109			109
7	40	22			22
Wt	34108	14264	0	0	14264

Table 5.1.15 Predicted Catches and Biomasses (1000's of tonnes) of COD in VIA 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	28	33	39	39	39	39	39	39	39	39	39	39
Spawning	18	19	25	25	25	25	25	25	25	25	25	25
Mean F Ages												
Human Cons. 2 to 5	0.82	0.57	0.00	0.16	0.33	0.49	0.66	0.82	0.98	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)										F0.1	Fmax	
Human Consumption	1.00	0.70	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	12	10	0	4	8	11	14	17	19	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	12	10	0	4	8	11	14	17	19	0	0	
Total catch	12	10	0	4	8	11	14	17	19	0	0	
Biomass 1 Jan of Year+1												
Total	33	39	63	57	51	46	41	38	34	0	0	
Spawning	19	25	48	42	36	32	28	25	22	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	13332	1475			1475
2	5681	1858			1858
3	3622	1474			1474
4	307	130			130
5	616	267			267
6	102	43			43
7	15	6			6
Wt	32593	10186	0	0	10186

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	10721	1650			1650
2	9586	4120			4120
3	2985	1560			1560
4	1646	888			888
5	136	75			75
6	265	143			143
7	52	28			28
Wt	38753	16677	0	0	16677

Table 5.2.1 Nominal catch (in tonnes) of COD in Division VIb, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Faroe Islands	75	2	77	112	18
France	1	4	27	97	9
Germany, Fed. Rep.	136	443	+	195	-
Norway	80	134	51	462	373
Spain	-	70	58	42	241
UK (England and Wales)	1	67	3	163	161
UK (Isle of Man)	-	-	-	-	-
UK (N.Ireland)	-	-	-	-	-
UK (Scotland)	370	143	157	35	221
Total	696	863	373	1,106	1,023

Country	1985	1986	1987	1988	1989	1990
Faroe Islands	-	1	-	31	5	-
France	17	5	7	2	...[2]	n/a
Germany, Fed. Rep.	3	-	-	3	+	...[1,2]
Norway	202	95	130	195	148[1]	119[1]
Spain	1,200	1,219	808	1,345	n/a	n/a
UK (England & Wales)	114	93	69	56	130	25
UK (Isle of Man)	-	-	-	-	1	-
UK (N. Ireland)	-	1	-	-	3	2
UK (Scotland)	437	187	284	254	262	739
Total	1,973	1,601	1,298	1,886		

[1]Preliminary.
[2]Included in Division VIa.
n/a = Not available.

Table 6.1.1 Nominal catch (in tonnes) of COD in Division VIId, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	151	329	251	368	331
Denmark	...[1]	-	-	-	-
France	3,203	3,707	2,696	2,802	2,492
Netherlands	-	4	1	4	-
UK (England and Wales)	160	206	306	358	282
Total	3,514	4,246	3,254	3,532	3,105

Country	1985	1986	1987	1988	1989	1990
Belgium	501	650	815	486	173	237
Denmark	-	4	-	+	+	5[2,3]
France	2,589	9,938	7,541	8,795	n/a	n/a
Netherlands	...[1]	...[1]	-	n/a	1	n/a
UK (England and Wales)	326	830	1,044	867	562	420
UK (Scotland)	-	-	-	-	-	7
Total	3,416	11,422	9,400	10,148		

[1]Included in Division VIIe.
[2]Includes Division VIIe.
[3]Preliminary.
n/a = Not available.

Table 6.1.2 Annual Weight and Numbers of COD caught in 7D between 1976 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1976	3.67	3.67	0.00	0.00	2	2	0	0
1977	6.86	6.86	0.00	0.00	10	10	0	0
1978	9.70	9.70	0.00	0.00	8	8	0	0
1979	5.90	5.90	0.00	0.00	3	3	0	0
1980	5.02	5.02	0.00	0.00	4	4	0	0
1981	5.34	5.34	0.00	0.00	3	3	0	0
1982	3.98	3.98	0.00	0.00	3	3	0	0
1983	3.84	3.84	0.00	0.00	3	3	0	0
1984	3.52	3.52	0.00	0.00	3	3	0	0
1985	3.33	3.33	0.00	0.00	2	2	0	0
1986	12.81	12.81	0.00	0.00	19	19	0	0
1987	14.22	14.22	0.00	0.00	12	12	0	0
1988	9.36	9.36	0.00	0.00	5	5	0	0
1989	5.54	5.54	0.00	0.00	3	3	0	0
1990	2.74	2.74	0.00	0.00	1	1	0	0

Table 6.1.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	0.200	0.000
1	0.200	0.000
2	0.200	0.000
3	0.200	0.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000

Table 6.1.4 Total International Catch at Age (1000's) of COD in 7D between 1976 and 1990

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
0										4	0
1	11	5840	464	292	671	57	860	125	555	14	1
2	765	4242	5717	1528	2001	2056	904	1786	1588	1210	2
3	745	209	1275	1239	673	1056	520	776	405	453	3
4	108	64	248	223	296	202	271	187	72	75	4
5	40	16	12	63	26	28	41	40	36	5	5
6	26	5	1	4	8	1	7	7	10	4	6

Age	1986	1987	1988	1989	1990	Age
0		2		1	0	0
1	7779	2837	595	232	259	1
2	8941	8320	2517	1712	695	2
3	1734	167	1793	821	285	3
4	545	216	225	281	107	4
5	63	6	6	108	35	5
6	8	1		1	2	6

Table 6.1.5 Total International Mean Weight at Age (Kg.) of COD in 7D between 1976 and 1990

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
0										0.283	0
1	0.615	0.537	0.560	0.626	0.585	0.599	0.660	0.780	0.701	0.614	1
2	1.315	0.672	1.067	0.951	0.780	0.963	0.707	0.750	0.870	1.356	2
3	2.309	2.014	1.991	2.457	2.297	2.142	2.493	1.744	2.883	2.718	3
4	4.683	4.860	2.907	4.032	4.484	4.407	4.383	4.123	4.293	5.138	4
5	6.046	6.332	6.003	4.682	5.655	5.934	5.827	5.705	5.882	7.391	5
6	7.399	7.813	7.934	6.092	5.830	6.847	6.976	7.705	6.425	7.768	6

Age	1986	1987	1988	1989	1990	Age
0		0.328		0.232	0.165	0
1	0.418	0.687	0.951	0.809	1.129	1
2	0.616	1.329	1.041	1.100	1.332	2
3	1.256	2.512	2.888	2.120	2.820	3
4	2.729	3.452	4.235	4.164	4.656	4
5	5.201	6.071	6.887	5.077	6.078	5
6	7.953	7.689		8.440	3.501	6

Table 6.1.6

COD IN THE EASTERN CHANNEL (7D)

Separable analysis
from 1976 to 1990 on ages 1 to 5
with Terminal F = 1.000 on age 3 and Terminal S = 1.000

Initial sum of squared residuals was 230.844
Final sum of squared residuals is 56.094 after 51 iterations

Matrix of Residuals

Years	1976/77	1977/78	1978/79	1979/80
Ages				
1/ 2	-4.028	1.989	.600	-.049
2/ 3	.233	.155	.238	-.341
3/ 4	1.356	-1.266	.400	.229
4/ 5	.180	-.087	-.663	.289
	.000	.000	.000	.000
WTS	1.000	1.000	1.000	1.000

Years	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90		WTS
Ages												
1/ 2	.709	-.897	1.351	-.820	.456	-3.076	.955	1.625	1.008	.425	.248	.250
2/ 3	-.560	.271	-.720	.135	-.443	.297	.932	-.224	.164	.110	.248	1.000
3/ 4	-.027	.236	.111	.998	.038	.379	-1.206	-2.130	.829	.301	.248	.455
4/ 5	.460	-.180	.387	-.448	.363	.346	.018	.917	-.923	-.411	.248	.860
	.000	.000	.000	.000	.000	.000	.637	.000	.000	.000	.993	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1976	1977	1978	1979	1980
F-values	1.0633	1.0972	1.2411	1.1436	1.1369

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
F-values	1.0436	.9761	1.2249	.9964	.3913	3.0000	1.5922	1.0958	1.4857	1.0000

Selection-at-age (S)

	1	2	3	4	5
S-values	.0684	.8933	1.0000	1.3319	1.0000

Table 6.2.1 Nominal catch (in tonnes) of COD in Division VIIe, 1980-1990, as officially reported to ICES, where available, and Working Group estimates elsewhere.

Country	1980	1981	1982	1983	1984
Belgium	12	34	42	21	15
Denmark	660[1]	-	-	-	-
France	798	779	653	567	390
Netherlands	-	-	-	-	-
UK (England and Wales)	205	222	262	292	236
UK (Scotland)	-	-	-	-	-
Total	1,675	1,035	957	880	641
WG Estimate	1,774	1,170	956	906	805

Country	1985	1986	1987	1988	1989	1990
Belgium	12	8	10	12	19	6
Denmark	-	-	+	+	+	...[2]
France	359	1,305	1,122	1,758	n/a	n/a
Netherlands	1[1]	66[1]	-	n/a	-	n/a
UK (England and Wales)	243	406	524	840	734	605
UK (Scotland)	-	-	-	-	2	4
Total	615	1,785	1,656	2,610		
WG Estimate	733	1,028	2,699	2,387	1,705	1,007

[1]Includes Division VIId.
[2]Included in Division VIId.
n/a = Not available.

Table 6.3.1 Nominal catch (t) of COD in Divisions VIIb,c,h-k, 1980-1990 as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	-	-	-	-	-
Denmark	-	-	-	-	-
France	983	1,465	587	636	946
Germany, Fed. Rep.	7	-	-	-	-
Ireland	782	1,434	1,764	1,192	1,211
Netherlands	5	-	+	80	325
Norway	-	-	-	4	1
Spain	17	37	29	28	56
UK (England and Wales)	1	171	304	41	408
UK (Scotland)	12	+	-	-	45
Total	1,807	3,107	2,684	1,981	2,991

Country	1985	1986	1987	1988	1989	1990
Belgium	13	3	63	102	229	86
Denmark	-	-	+[2]	+[2]	-	-
France	1,115	1,599	1,214	2,551	n/a	n/a
Germany, Fed. Rep.	-	-	-	-	1[1]	n/a
Ireland	1,176	1,283	1,301	1,256	n/a	n/a
Netherlands	208	1	-	n/a	-	n/a
Norway	22	106	1	2	22[1,2]	49[1,2]
Spain	26	-	-	-	n/a	n/a
UK (England and Wales)	546	455	275	127	137	203
UK (Scotland)	+	17	19	7	33	422
UK (Northern Ireland)	-	-	-	-	-	2
Total	3,106	3,464	2,873	4,045		

[1]Preliminary.
[2]Includes Division VIIg.
n/a = Not available.

Table 7.1 Nominal catch (tonnes) of HADDOCK in Sub-area IV, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	1,414	1,217	966	985	494
Denmark	12,928	13,198	22,704	25,653	16,368
Faroe Islands	27	46	6	51	-
France	7,407	11,966	15,988	11,250	8,103
Germany, Fed. Rep.	2,354	3,387	4,510	3,654	2,571
Netherlands	1,557	2,279	1,021	1,722	1,052
Norway[2]	1,191	2,283	2,888	3,862	3,959
Poland	59	31	317	150	17
Sweden	1,165	1,301	1,874	1,360	1,518
UK (England and Wales)	12,195	14,570	16,403	15,476	12,340
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	64,058	82,798	107,773	100,390	87,479
Total	104,391	133,076	174,450	164,553	133,901

Country	1985	1986	1987	1988	1989	1990[1]
Belgium	719	317	165	220	145	192
Denmark	23,821	16,397	7,767	9,174	2,789	1,977
Faroe Islands	5	4	23	35	16	6
France	5,389	4,802	3,889	2,193	1,702[1]	n/a
Germany, Fed. Rep.	2,796	1,984	1,231	802	447	714
Netherlands	3,875	1,627	1,093	895[3]	328	n/a
Norway[2]	3,498	5,190	2,610	1,590	1,664[1]	1,483
Poland	-	1	-	-	-	-
Sweden	1,942	1,550	937	614	1,051	900
UK (England & Wales)	13,614	8,137	7,491	5,537	2,704	2,093
UK (N. Ireland)	-	-	-	-	137	11
UK (Scotland)	112,549	126,650	84,063	84,104	53,252	34,459
Total	168,208	166,659	109,269	104,269	64,235	

[1]Preliminary.
[2]Figures do not include haddock caught as industrial by-catch.
[3]Working Group estimate.

Table 7.2 Annual Weight and Numbers of HADDOCK caught in IV between 1971 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1971	444	235	177	32	2669	473	1282	914
1972	351	193	128	30	1722	428	760	534
1973	305	179	115	11	1280	449	660	171
1974	364	150	167	48	2384	357	1091	936
1975	448	147	260	41	2958	362	1862	734
1976	368	166	154	48	1631	396	788	447
1977	217	137	44	35	896	320	226	350
1978	174	86	77	11	1030	192	418	420
1979	141	83	42	16	1461	189	286	985
1980	216	99	95	22	1447	218	541	687
1981	207	130	60	17	1352	274	298	780
1982	226	166	41	19	971	311	181	480
1983	238	159	66	13	1256	293	389	574
1984	213	128	75	10	866	247	412	207
1985	251	159	86	6	971	359	458	154
1986	220	166	52	3	755	371	308	75
1987	172	108	59	4	657	228	334	95
1988	171	105	62	4	644	254	362	29
1989	104	76	26	2	296	168	111	17
1990	87	51	33	3	314	108	192	14

Table 7.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	2.050	0.000
1	1.650	0.010
2	0.400	0.320
3	0.250	0.710
4	0.250	0.870
5	0.200	0.950
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000
11	0.200	1.000
12	0.200	1.000

Table 7.4 Total International Catch at Age (1000's) of HADDOCK in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	330673	240896	59872	601412	44946	167173	114954	285843	841439	374960	0
1	1809964	675831	364822	1213867	2096827	167599	250138	454092	344756	659594	1
2	70735	584076	567133	174389	632672	1046110	104310	142668	198147	323151	2
3	47224	40150	237498	326659	57630	204506	376976	28695	39551	68715	3
4	397328	20948	6099	53137	106048	9555	38062	107172	7068	9837	4
5	10288	155922	4399	1832	15320	30044	4087	8153	26742	1784	5
6	458	3516	38829	1320	952	4793	5939	1190	2134	7573	6
7	193	188	1237	10672	601	198	1230	1942	250	562	7
8	146	33	106	236	2628	73	128	377	461	114	8
9	1578	27	28	23	258	728	27	108	145	153	9
10	159	402	108	31	61	58	190	14	52	70	10
11	3	11	48	3	11	3	2	60	11	29	11
12	5		5	5	7		1	14	11	13	12

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	646419	278705	639815	95502	139623	56507	9419	10808	10705	55400	0
1	134440	275372	156146	432175	179244	160285	277273	29040	47212	80153	1
2	413156	83827	247634	161719	526391	177699	246818	482791	33538	99707	2
3	138189	287840	71192	118503	75488	320291	46723	87436	179456	16995	3
4	14457	40322	123246	21366	36620	27068	67312	13155	17549	55436	4
5	1883	3198	15955	32134	5271	9504	4628	18433	2540	3565	5
6	374	691	1645	3638	7286	1208	2816	1547	4001	828	6
7	2462	268	286	590	954	1808	530	615	496	1276	7
8	123	780	59	76	209	235	768	152	195	189	8
9	63	29	189	37	54	101	130	135	82	73	9
10	23	15	52	110	22	43	32	48	28	39	10
11	30	7	6	14	88	29	47	13	12	8	11
12	8	4	8	8	4	48	64	34	11	16	12

Table 7.5 Total International Mean Weight at Age (Kg.) of HADDOCK in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	0.011	0.024	0.044	0.024	0.021	0.013	0.019	0.012	0.009	0.012	0
1	0.106	0.116	0.112	0.128	0.101	0.125	0.108	0.144	0.095	0.104	1
2	0.247	0.242	0.241	0.226	0.241	0.224	0.241	0.253	0.291	0.284	2
3	0.362	0.388	0.372	0.343	0.356	0.401	0.345	0.418	0.442	0.486	3
4	0.505	0.506	0.585	0.548	0.450	0.512	0.602	0.441	0.637	0.732	4
5	0.887	0.606	0.648	0.891	0.680	0.588	0.613	0.719	0.664	1.046	5
6	1.267	1.000	0.724	0.895	1.245	0.922	0.802	0.742	0.933	0.936	6
7	1.534	1.366	1.044	0.953	1.124	1.933	1.181	0.954	1.187	1.394	7
8	1.337	2.241	1.302	1.513	1.093	1.784	1.943	1.398	1.187	1.599	8
9	1.275	2.006	2.796	2.315	1.720	1.306	2.322	2.124	1.468	1.593	9
10	1.969	1.651	1.726	2.508	2.217	2.425	1.780	2.868	2.679	1.726	10
11	4.306	2.899	2.020	4.152	2.854	2.528	3.189	1.849	1.624	3.328	11
12	3.543		2.158	2.264	3.426		4.119	2.812	1.748	1.773	12

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	0.009	0.011	0.022	0.010	0.013	0.025	0.008	0.024	0.027	0.044	0
1	0.074	0.100	0.135	0.141	0.149	0.124	0.126	0.164	0.198	0.194	1
2	0.262	0.292	0.297	0.300	0.279	0.242	0.265	0.217	0.300	0.291	2
3	0.476	0.461	0.448	0.488	0.479	0.396	0.405	0.417	0.372	0.429	3
4	0.744	0.784	0.651	0.670	0.668	0.612	0.613	0.589	0.605	0.473	4
5	1.147	1.166	0.916	0.805	0.859	0.864	1.029	0.747	0.811	0.772	5
6	1.479	1.441	1.215	1.097	1.054	1.260	1.278	1.283	0.984	0.968	6
7	1.180	1.672	1.162	1.100	1.470	1.202	1.433	1.424	1.375	1.169	7
8	1.634	1.456	1.920	1.868	1.844	1.719	1.530	1.542	1.653	1.534	8
9	1.764	2.634	1.376	2.425	2.137	1.526	1.865	1.612	1.695	2.035	9
10	1.554	2.164	1.395	1.972	2.193	2.482	2.040	1.674	2.240	2.658	10
11	1.492	1.924	1.907	2.247	1.991	2.632	1.902	3.122	2.159	2.310	11
12	2.972	2.532	3.776	2.841	2.434	2.625	2.499	2.880	2.217	2.588	12

Table 7.6 Haddock in the North Sea. Research Vessel Indices.

YEARCLASS	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS0	SGFS1	SGFS2	GGFS1	GGFS2
1970	855	299	-1	-1	-1	-1	-1	-1	-1	-1
1971	740	971	-1	-1	-1	-1	-1	-1	-1	-1
1972	187	110	-1	-1	-1	-1	-1	-1	-1	-1
1973	1092	385	-1	-1	-1	-1	-1	-1	-1	-1
1974	1168	670	-1	-1	-1	-1	-1	-1	-1	-1
1975	177	84	-1	-1	32.1	-1	-1	-1	-1	-1
1976	162	108	-1	66.8	26.2	-1	-1	-1	-1	-1
1977	385	240	534.8	136.9	54.6	-1	-1	-1	-1	-1
1978	480	402	358.3	295.5	167.3	-1	-1	-1	-1	-1
1979	896	675	875.5	623.3	439.1	-1	-1	-1	-1	-1
1980	268	252	374	173.2	79.8	-1	-1	99.6	-1	-1
1981	526	400	1537.5	315.5	109.5	-1	248.8	161.1	-1	72.8
1982	307	219	281.3	218.2	61.6	123.5	181.3	78.8	93.9	47.2
1983	1057	828	831.9	599.3	238.2	220.3,	436.7	298.1	272.9	259.6
1984	229	244	228.5	186.6	44.7	87.3	197.6	57.4	129.7	38
1985	579	326	245.9	149.7	43.1	81.8	232.9	70.4	142.3	154.4
1986	885	688	266	281.9	183.5	174.7	239.3	198.2	307.4	179.9
1987	92	97	22.4	28.6	14.5	27.7	46.7	21.4	68.6	45.3
1988	210	114	60.7	81.7	20.4	40.6	88.6	24	135	54.7
1989	219	131	94.3	65.7	9.6	43.2	100.2	17.8	180	54.9
1990	679	-1	281.9	115.0	-1	316.3	170.5	-1	601.0	-1
1991	-1	-1	263.3	-1	-1	347.1	-1	-1	-1	-1

Table 7.7 North Sea haddock. VPA tuning summary.

```
VPA Version 2.1 - May 1988
HADDOCK IN THE NORTH SEA: 1991 WG
with cpue data from file had4zef.dat
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,SCOGFS              , has terminal q estimated as the mean
Fleet  2 ,SCOTRL              , has terminal q estimated as the mean
Fleet  3 ,SCOSEI              , has terminal q estimated as the mean
Fleet  4 ,SCOLTR              , has terminal q estimated as the mean
Fleet  5 ,ENGGFS              , has terminal q estimated as the mean
Fleet  6 ,FRATRB              , has terminal q estimated as the mean
Fleet  7 ,FRGGFS              , has terminal q estimated as the mean
Fleet  8 ,INTGFS              , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd
Regression weights
      , 0.020, 0.116, 0.284, 0.482, 0.670, 0.820, 0.921, 0.976, 0.997, 1.000
Oldest age F = 1.000*average of 5 younger ages.
Fleets combined by variance of predictions

Log catchability estimates

Age  0
                    SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  ,-18.28  , 0.296,0.0000 ,0.0020,
     2  , No data for this fleet at this age
     3  ,-22.05  , 0.846,0.0001 ,0.0062,
     4  , No data for this fleet at this age
     5  ,-17.81  , 0.286,0.0000 ,0.0036,
     6  ,-21.48  , 0.856,0.0000 ,0.0009,
     7  , No data for this fleet at this age
     8  , No data for this fleet at this age
 Fbar      SIGMA(int.)     SIGMA(ext.)
0.003        0.195           0.243
   SIGMA(overall)  Variance ratio
     0.243            1.557

Age  1
                    SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  ,-15.71  , 0.278,0.0000 ,0.1204,
     2  , No data for this fleet at this age
     3  ,-16.26  , 0.442,0.0261 ,0.0584,
     4  , No data for this fleet at this age
     5  ,-15.85  , 0.231,0.0000 ,0.1567,
     6  ,-16.86  , 0.287,0.0017 ,0.0995,
     7  ,-15.61  , 0.507,0.0000 ,0.0738,
     8  ,-14.90  , 0.165,0.0000 ,0.1236,
 Fbar      SIGMA(int.)     SIGMA(ext.)
0.116        0.106           0.109
   SIGMA(overall)  Variance ratio
     0.109            1.067

Age  2
                    SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,
        ,   q    ,      ,   F   ,   F   ,          ,
 _______,________,______,_______,_______,__________,
     1  ,-14.98  , 0.219,0.0000 ,1.3003,  0.000E+00,
     2  ,-14.38  , 0.413,0.0090 ,0.9324,  0.000E+00,
     3  ,-13.94  , 0.273,0.2662 ,0.5709,  0.000E+00,
     4  ,-15.01  , 0.385,0.1336 ,0.6936,  0.000E+00,
     5  ,-15.24  , 0.227,0.0000 ,1.2105,  0.000E+00,
     6  ,-14.95  , 0.221,0.0116 ,0.7392,  0.000E+00,
     7  ,-14.76  , 0.521,0.0000 ,0.7023,  0.000E+00,
     8  , No data for this fleet at this age
 Fbar      SIGMA(int.)     SIGMA(ext.)
0.897        0.105           0.127
   SIGMA(overall)  Variance ratio
     0.127            1.463

Age  3
                    SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,
        ,   q    ,      ,   F   ,   F   ,          ,
 _______,________,______,_______,_______,__________,
     1  ,-15.15  , 0.206,0.0000 ,1.3974,  0.000E+00,
     2  ,-14.04  , 0.502,0.0126 ,2.0824,  0.000E+00,
     3  ,-13.51  , 0.180,0.4086 ,0.7669,  0.000E+00,
     4  ,-14.74  , 0.211,0.1747 ,1.1146,  0.000E+00,
     5  ,-15.45  , 0.271,0.0000 ,1.1630,  0.000E+00,
     6  ,-14.48  , 0.196,0.0186 ,1.2007,  0.000E+00,
     7  ,-14.48  , 0.858,0.0000 ,0.4852,  0.000E+00,
     8  , No data for this fleet at this age
 Fbar      SIGMA(int.)     SIGMA(ext.)
1.102        0.907E-01       0.106
   SIGMA(overall)  Variance ratio
     0.106            1.354

Age  4
                    SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,
        ,   q    ,      ,   F   ,   F   ,          ,
 _______,________,______,_______,_______,__________,
     1  ,-15.29  , 0.229,0.0000 ,1.2290,  0.000E+00,
     2  ,-13.84  , 0.313,0.0154 ,1.7248,  0.000E+00,
     3  ,-13.50  , 0.140,0.4099 ,0.8509,  0.000E+00,
     4  ,-14.65  , 0.169,0.1906 ,1.0323,  0.000E+00,
     5  ,-15.64  , 0.197,0.0000 ,1.0153,  0.000E+00,
     6  ,-14.28  , 0.124,0.0227 ,1.0880,  0.000E+00,
     7  ,-14.78  , 0.977,0.0000 ,1.6309,  0.000E+00,
     8  , No data for this fleet at this age
 Fbar      SIGMA(int.)     SIGMA(ext.)
1.057        0.695E-01       0.670E-01
   SIGMA(overall)  Variance ratio
     0.695E-01        0.928

Age  5
                    SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,
        ,   q    ,      ,   F   ,   F   ,          ,
 _______,________,______,_______,_______,__________,
     1  ,-15.48  , 0.301,0.0000 ,0.9594,  0.000E+00,
     2  ,-13.73  , 0.315,0.0173 ,0.9355,  0.000E+00,
     3  ,-13.69  , 0.168,0.3397 ,0.8442,  0.000E+00,
     4  ,-14.78  , 0.254,0.1687 ,0.8985,  0.000E+00,
     5  ,-15.66  , 0.402,0.0000 ,1.1622,  0.000E+00,
     6  ,-14.11  , 0.190,0.0268 ,0.9253,  0.000E+00,
     7  ,-14.71  , 1.041,0.0000 ,0.2086,  0.000E+00,
     8  , No data for this fleet at this age
 Fbar      SIGMA(int.)     SIGMA(ext.)
0.914        0.966E-01       0.637E-01
   SIGMA(overall)  Variance ratio
     0.966E-01        0.434
```

cont'd.

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE
1	-15.52	0.403	0.0000	1.4252	0.000E+00
2	-13.84	0.438	0.0155	0.8409	0.000E+00
3	-13.83	0.191	0.2960	0.8106	0.000E+00
4	No data for this fleet at this age				
5	-15.42	0.315	0.0000	0.6291	0.000E+00
6	-13.90	0.150	0.0333	0.8539	0.000E+00
7	No data for this fleet at this age				
8	No data for this fleet at this age				

Fbar	SIGMA(int.)	SIGMA(ext.)
0.852	0.104	0.836E-01

SIGMA(overall)	Variance ratio
0.104	0.652

Age 7

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE
1	-15.45	0.416	0.0000	0.8112	0.000E+00
2	-13.76	0.361	0.0167	1.3135	0.000E+00
3	-13.99	0.185	0.2521	0.7896	0.000E+00
4	No data for this fleet at this age				
5	-15.71	0.559	0.0000	1.5400	0.000E+00
6	-13.70	0.158	0.0406	0.8414	0.000E+00
7	No data for this fleet at this age				
8	No data for this fleet at this age				

Fbar	SIGMA(int.)	SIGMA(ext.)
0.867	0.108	0.884E-01

SIGMA(overall)	Variance ratio
0.108	0.672

Age 8

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE
1	-15.37	0.892	0.0000	0.3781	0.000E+00
2	-13.78	0.622	0.0165	0.4614	0.000E+00
3	-14.29	0.572	0.1874	0.5260	0.000E+00
4	No data for this fleet at this age				
5	No data for this fleet at this age				
6	-13.62	0.364	0.0437	0.6891	0.000E+00
7	No data for this fleet at this age				
8	No data for this fleet at this age				

Fbar	SIGMA(int.)	SIGMA(ext.)
0.728	0.263	0.119

SIGMA(overall)	Variance ratio
0.263	0.206

Age 9

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE
1	No data for this fleet at this age				
2	-13.91	0.790	0.0144	0.7383	0.000E+00
3	-14.41	0.781	0.1655	0.4195	0.000E+00
4	No data for this fleet at this age				
5	No data for this fleet at this age				
6	-13.63	0.438	0.0433	0.6437	0.000E+00
7	No data for this fleet at this age				
8	No data for this fleet at this age				

Fbar	SIGMA(int.)	SIGMA(ext.)
0.814	0.344	0.134

SIGMA(overall)	Variance ratio
0.344	0.152

Age 10

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE
1	No data for this fleet at this age				
2	No data for this fleet at this age				
3	No data for this fleet at this age				
4	No data for this fleet at this age				
5	No data for this fleet at this age				
6	-13.53	0.378	0.0479	1.2218	0.000E+00
7	No data for this fleet at this age				
8	No data for this fleet at this age				

Fbar	SIGMA(int.)	SIGMA(ext.)
0.874	0.378	0.000

SIGMA(overall)	Variance ratio
0.378	0.000

Table 7.8 Total International Fishing Mortality Rate at Age of HADDOCK in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	0.011	0.029	0.002	0.012	0.010	0.027	0.012	0.018	0.030	0.062	0
1	0.427	0.155	0.341	0.324	0.307	0.284	0.306	0.357	0.161	0.171	1
2	0.660	0.795	0.572	0.938	0.378	0.826	1.007	1.009	0.892	0.704	2
3	0.803	1.323	1.163	0.960	1.264	1.380	1.040	1.110	1.133	1.195	3
4	0.876	1.194	0.783	1.004	1.110	0.788	1.248	1.099	1.034	1.116	4
5	0.879	1.165	0.942	0.599	0.988	1.285	1.030	1.113	0.994	0.862	5
6	0.587	0.886	1.113	0.855	0.732	1.031	1.005	1.023	1.060	0.891	6
7	0.751	0.511	0.945	1.157	1.369	0.323	0.838	1.172	0.618	0.935	7
8	0.546	0.270	0.614	0.462	1.069	0.584	0.357	0.676	1.043	0.641	8
9	1.297	0.179	0.387	0.253	1.473	1.042	0.452	0.584	0.610	1.343	9
10	1.932	1.727	2.634	1.021	2.425	2.379	0.881	0.454	0.623	0.685	10
11	1.023	0.715	1.139	0.750	1.413	1.073	0.707	0.784	0.793	0.909	11
12	1.023	0.715	1.139	0.750	1.413	1.073	0.707	0.784	0.793	0.909	12

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	0.051	0.035	0.024	0.014	0.015	0.003	0.006	0.003	0.002	0.003	0
1	0.166	0.161	0.142	0.115	0.191	0.120	0.098	0.128	0.088	0.116	1
2	0.454	0.434	0.664	0.665	0.613	1.027	0.908	0.787	0.667	0.897	2
3	0.940	0.811	1.013	0.988	0.953	1.243	1.086	1.311	0.974	1.102	3
4	0.981	0.980	1.147	1.121	1.100	1.306	1.102	1.228	1.203	1.057	4
5	0.690	0.629	1.200	1.221	1.032	1.065	0.877	1.177	0.892	0.914	5
6	0.434	0.590	0.797	1.072	1.088	0.709	1.160	0.852	0.911	0.853	6
7	0.846	0.645	0.523	0.764	0.935	0.912	0.804	0.882	0.748	0.867	7
8	0.538	0.725	0.280	0.254	0.687	0.628	1.451	0.571	0.798	0.729	8
9	0.943	0.229	0.380	0.284	0.290	0.874	0.886	1.214	0.701	0.814	9
10	0.761	0.626	0.834	0.400	0.267	0.395	0.768	1.019	0.924	0.874	10
11	0.704	0.563	0.563	0.555	0.653	0.704	1.014	0.908	0.816	0.827	11
12	0.704	0.563	0.563	0.555	0.653	0.704	1.014	0.908	0.816	0.827	12

Table 7.9 Stock Numbers at Age (1000's) of HADDOCK in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	73986640	19743660	66808670	122282600	10476540	14869880	23152490	36694170	66932870	14484600	0
1	10056290	9424671	2469068	8582479	15560200	1335104	1863852	2945780	4637494	8362940	1
2	173829	1259551	1550260	337283	1191800	2198112	193055	263667	395701	758231	2
3	95087	60224	381438	586516	88512	300397	645243	47294	64439	108703	3
4	756139	33166	12498	92874	174826	19481	58847	177638	12137	16162	4
5	19137	245356	7830	4444	26505	44886	6896	13159	46090	3361	5
6	1128	6507	62664	2498	1999	8083	10166	2016	3541	13967	6
7	398	513	21971	16858	870	787	2360	3046	593	1005	7
8	379	154	252	699	4341	181	467	836	772	262	8
9	2347	180	96	112	361	1221	83	267	348	223	9
10	199	526	123	53	71	68	352	43	122	155	10
11	5	24	76	7	16	5	5	120	22	54	11
12	8	1	8	11	11	1	3	29	22	23	12

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	30298640	19063960	63506020	161394600	22542340	46846910	37823680	87906450	114595100	43494680	0
1	1752220	3706282	2370245	7982380	2048849	2859793	6013726	484150	1128391	1471997	1
2	1353136	284921	606037	395089	1366056	324917	487335	1047570	81781	198404	2
3	251428	576010	123780	209175	136148	496113	77999	131772	319522	28133	3
4	25617	76488	199412	35014	60675	40867	111425	20515	27662	93988	4
5	4122	7477	24709	49310	8885	15731	8619	28838	4681	6467	5
6	1163	1693	3262	6095	11911	2593	4442	2936	7275	1571	6
7	4693	617	768	1204	1707	3285	1044	1140	1026	2395	7
8	323	1649	265	373	459	549	1081	383	386	397	8
9	113	154	654	164	237	189	240	207	177	142	9
10	48	36	101	366	101	145	65	81	50	72	10
11	64	18	16	36	201	63	80	25	24	16	11
12	18	10	21	19	10	103	109	62	22	30	12

Table 7.10.1 North Sea haddock RCT3 Results Age 0

Analysis by RCT3 ver3.1 of data from file :

HADIV0.RCX

HADDOCK IV RCRTINX2 INPUT VALUES; AGE 0; 1991 WG

Data for 10 surveys over 21 years : 1971 - 1991

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 = 1988

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.17	3.09	.29	.907	17	5.35	9.34	.340	.179
IYFS2	1.32	2.54	.44	.807	17	4.74	8.82	.542	.071
EGFS0	.90	4.85	.61	.681	11	4.12	8.57	.790	.033
EGFS1	1.00	4.76	.31	.883	12	4.42	9.18	.383	.142
EGFS2	.91	6.04	.34	.862	13	3.06	8.83	.430	.112
SGFS0	1.41	3.45	.27	.946	6	3.73	8.70	.396	.132
SGFS1	1.40	2.61	.30	.920	7	4.50	8.91	.414	.121
SGFS2	1.11	4.88	.29	.913	8	3.22	8.45	.418	.118
GGFS1	1.86	.66	.49	.839	6	4.91	9.78	.650	.049
GGFS2	1.61	2.75	.90	.561	7	4.02	9.21	1.175	.015
					VPA Mean =		10.11	.863	.028

Yearclass = 1989

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.16	3.11	.28	.912	17	5.39	9.38	.336	.188
IYFS2	1.32	2.50	.42	.824	17	4.88	8.97	.516	.080
EGFS0	.90	4.88	.61	.687	11	4.56	8.98	.762	.037
EGFS1	1.01	4.73	.31	.888	12	4.20	8.96	.394	.137
EGFS2	.92	6.00	.35	.865	13	2.36	8.17	.482	.092
SGFS0	1.41	3.45	.27	.947	6	3.79	8.79	.392	.139
SGFS1	1.40	2.61	.30	.920	7	4.62	9.08	.410	.127
SGFS2	1.11	4.88	.29	.915	8	2.93	8.14	.446	.107
GGFS1	1.86	.65	.49	.840	6	5.20	10.30	.659	.049
GGFS2	1.61	2.72	.90	.563	7	4.02	9.21	1.188	.015
					VPA Mean =		10.09	.866	.028

Yearclass = 1990

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.16	3.12	.28	.917	17	6.52	10.67	.332	.281
IYFS2									
EGFS0	.89	4.93	.61	.695	11	5.65	9.97	.729	.058
EGFS1	1.01	4.71	.31	.894	12	4.75	9.51	.376	.219
EGFS2									
SGFS0	1.41	3.46	.27	.948	6	5.76	11.57	.432	.166
SGFS1	1.40	2.62	.31	.920	7	5.14	9.82	.395	.199
SGFS2									
GGFS1	1.86	.64	.49	.843	6	6.40	12.53	.935	.035
GGFS2									
					VPA Mean =		10.07	.873	.041

Yearclass = 1991

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.89	4.98	.61	.705	11	5.58	9.93	.742	.226
EGFS1									
EGFS2									
SGFS0	1.41	3.47	.27	.949	6	5.85	11.70	.450	.615
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		10.05	.883	.160

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	8085	9.00	.14	.12	.73		
1989	7883	8.97	.15	.17	1.38		
1990	32729	10.40	.18	.33	3.57		
1991	61954	11.03	.35	.59	2.82		

Table 7.10.2 North Sea haddock RCT3 Results Age 1

Analysis by RCT3 ver3.1 of data from file :

HADIV1.RCX

HADDOCK IV RCRTINX2 INPUT VALUES; AGE 1; 1991 WG

Data for 10 surveys over 22 years : 1970 - 1991

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 = 1988

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.17	1.01	.29	.908	18	5.35	7.27	.339	.188
IYFS2	1.33	.40	.46	.798	18	4.74	6.74	.558	.069
EGFS0	.91	2.72	.63	.664	11	4.12	6.48	.818	.032
EGFS1	1.01	2.67	.33	.875	12	4.42	7.11	.398	.136
EGFS2	.91	3.96	.35	.857	13	3.06	6.76	.438	.113
SGFS0	1.41	1.39	.27	.942	6	3.73	6.64	.408	.130
SGFS1	1.40	.57	.30	.916	7	4.50	6.84	.423	.121
SGFS2	1.11	2.79	.31	.905	8	3.22	6.38	.439	.112
GGFS1	1.84	-1.33	.47	.847	6	4.91	7.71	.629	.055
GGFS2	1.59	.78	.87	.571	7	4.02	7.15	1.146	.016
					VPA Mean =		8.05	.864	.029

Yearclass = 1989

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.16	1.04	.28	.913	18	5.39	7.31	.334	.198
IYFS2	1.33	.41	.43	.821	18	4.88	6.89	.523	.081
EGFS0	.91	2.76	.63	.671	11	4.56	6.90	.790	.035
EGFS1	1.01	2.65	.33	.880	12	4.20	6.88	.410	.131
EGFS2	.92	3.93	.35	.860	13	2.36	6.10	.491	.092
SGFS0	1.41	1.40	.27	.943	6	3.79	6.72	.403	.136
SGFS1	1.40	.57	.31	.916	7	4.62	7.01	.419	.126
SGFS2	1.11	2.80	.31	.907	8	2.93	6.06	.468	.101
GGFS1	1.84	-1.34	.47	.848	6	5.20	8.23	.637	.054
GGFS2	1.59	.75	.88	.572	7	4.02	7.15	1.159	.016
					VPA Mean =		8.02	.866	.029

Yearclass = 1990

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.15	1.06	.27	.919	18	6.52	8.60	.329	.296
IYFS2									
EGFS0	.90	2.81	.63	.679	11	5.65	7.90	.755	.056
EGFS1	1.01	2.62	.32	.885	12	4.75	7.44	.392	.208
EGFS2									
SGFS0	1.41	1.40	.27	.945	6	5.76	9.50	.444	.162
SGFS1	1.40	.57	.31	.916	7	5.14	7.75	.403	.197
SGFS2									
GGFS1	1.84	-1.35	.47	.851	6	6.40	10.44	.905	.039
GGFS2									
					VPA Mean =		8.00	.871	.042

Yearclass = 1991

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.90	2.86	.63	.689	11	5.58	7.85	.769	.221
EGFS1									
EGFS2									
SGFS0	1.40	1.41	.27	.946	6	5.85	9.63	.463	.611
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		7.97	.881	.168

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	1031	6.94	.15	.12	.72		
1989	1011	6.92	.15	.17	1.37		
1990	4196	8.34	.18	.33	3.47		
1991	7773	8.96	.36	.60	2.71		

Table 7.10.3 North Sea haddock RCT3 Results Age 2

Analysis by RCT3 ver3.1 of data from file :

HADIV2.RCX

HADDOCK IV RCRTINX2 INPUT VALUES; AGE 2; 1991 WG

Data for 10 surveys over 22 years : 1970 - 1991

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 = 1988

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.15	-.71	.24	.934	18	5.35	5.45	.283	.245
IYFS2	1.29	-1.15	.37	.857	18	4.74	4.95	.453	.096
EGFS0	.94	.74	.69	.627	11	4.12	4.63	.891	.025
EGFS1	1.01	.83	.31	.885	12	4.42	5.29	.383	.134
EGFS2	.92	2.11	.34	.871	13	3.06	4.93	.419	.112
SGFS0	1.42	-.46	.29	.936	6	3.73	4.84	.435	.104
SGFS1	1.42	-1.32	.34	.902	7	4.50	5.04	.465	.091
SGFS2	1.12	.96	.31	.902	8	3.22	4.57	.449	.098
GGFS1	1.85	-3.14	.46	.855	6	4.91	5.93	.613	.052
GGFS2	1.56	-.88	.83	.599	7	4.02	5.38	1.088	.017
					VPA Mean =	6.22		.863	.026

Yearclass = 1989

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.15	-.70	.24	.937	18	5.39	5.49	.281	.256
IYFS2	1.29	-1.19	.35	.872	18	4.88	5.10	.428	.110
EGFS0	.94	.79	.68	.635	11	4.56	5.06	.857	.027
EGFS1	1.01	.81	.32	.887	12	4.20	5.07	.400	.126
EGFS2	.93	2.08	.34	.872	13	2.36	4.27	.472	.091
SGFS0	1.42	-.45	.29	.937	6	3.79	4.93	.430	.109
SGFS1	1.42	-1.32	.34	.902	7	4.62	5.22	.460	.095
SGFS2	1.12	.97	.31	.905	8	2.93	4.26	.477	.089
GGFS1	1.85	-3.14	.46	.857	6	5.20	6.46	.621	.052
GGFS2	1.56	-.91	.84	.600	7	4.02	5.38	1.100	.017
					VPA Mean =	6.20		.866	.027

Yearclass = 1990

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.14	-.69	.23	.941	18	6.52	6.77	.278	.389
IYFS2									
EGFS0	.93	.85	.68	.645	11	5.65	6.09	.818	.045
EGFS1	1.02	.78	.32	.889	12	4.75	5.62	.388	.200
EGFS2									
SGFS0	1.42	-.45	.29	.938	6	5.76	7.74	.474	.134
SGFS1	1.41	-1.32	.34	.902	7	5.14	5.96	.443	.154
SGFS2									
GGFS1	1.85	-3.16	.46	.859	6	6.40	8.67	.882	.039
GGFS2									
					VPA Mean =	6.18		.873	.039

Yearclass = 1991

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.92	.92	.68	.657	11	5.58	6.05	.830	.212
EGFS1									
EGFS2									
SGFS0	1.42	-.44	.29	.940	6	5.85	7.87	.494	.600
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =	6.16		.884	.187

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	174	5.16	.14	.12	.75		
1989	171	5.14	.14	.17	1.47		
1990	712	6.57	.17	.32	3.44		
1991	1292	7.16	.38	.61	2.56		

Table 7.11' Mean Fishing Mortality , Biomass and Recruitment of HADDOCK in IV between 1971 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 0	
	2 to 6		0 to 3				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1971	0.613	0.108	0.074	1553	403	71	73987
1972	0.902	0.146	0.049	1594	290	72	19744
1973	0.776	0.128	0.031	852	283	73	66809
1974	0.629	0.143	0.099	1452	246	74	122283
1975	0.745	0.208	0.083	1990	225	75	10477
1976	0.809	0.158	0.120	827	290	76	14870
1977	0.805	0.132	0.165	523	222	77	23152
1978	0.852	0.191	0.057	604	123	78	36694
1979	0.903	0.088	0.053	630	103	79	66933
1980	0.796	0.082	0.082	1169	144	80	14485
1981	0.591	0.089	0.060	636	229	81	30299
1982	0.551	0.069	0.063	796	286	82	19064
1983	0.789	0.148	0.047	715	241	83	63506
1984	0.895	0.094	0.031	1416	190	84	16139
1985	0.857	0.079	0.017	818	231	85	22542
1986	0.885	0.181	0.011	677	212	86	46847
1987	0.876	0.146	0.014	1006	149	87	3783
1988	0.895	0.151	0.019	402	150	88	7802
1989	0.769	0.138	0.014	372	122	89	7879
1990	0.732	0.244	0.015	314	76	90	32729
Arit-mean recruits at age 0 for period 1971 to 1990							35001
Geom-mean recruits at age 0 for period 1971 to 1990							24724

Table 7.12 Input for catch prediction of HADDOCK in IV

	1990 Stock and Fishing Mortality				Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F 1986 to 1990			Mean values for period 1986 to 1990				
		Fishing Mortality						Mean Weight (Kg.)				Prop.
Age	Stock Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
0	32728980	0.000	0.001	0.002	0.000	0.001	0.003	0.001	0.053	0.011	0.026	0.000
1	1011000	0.007	0.038	0.019	0.007	0.091	0.021	0.285	0.170	0.085	0.161	0.068
2	174000	0.350	0.529	0.020	0.326	0.493	0.023	0.357	0.202	0.224	0.263	0.400
3	28133	0.821	0.257	0.023	0.836	0.212	0.019	0.445	0.245	0.389	0.404	0.792
4	93988	0.834	0.194	0.028	1.009	0.065	0.028	0.597	0.310	0.654	0.578	0.935
5	6467	0.796	0.060	0.058	0.888	0.014	0.019	0.851	0.422	0.949	0.844	0.983
6	1571	0.747	0.080	0.026	0.810	0.017	0.010	1.169	0.588	1.114	1.155	0.979
7	2395	0.814		0.053	0.771		0.015	1.325		1.198	1.321	1.000
8	397	0.711		0.017	0.774	0.000	0.004	1.599	2.572	1.243	1.597	1.000
9	142	0.814		0.000	0.836		0.000	1.747		1.319	1.747	1.000
10	72	0.874			0.738	0.003	0.000	2.216	3.048	1.400	2.219	0.997
11	16	0.827			0.795			2.425			2.425	1.000
12	30	0.827			0.795			2.562			2.562	1.000

Mean F	Age 2 to 6	Age 0 3	Age 2 to 6	Age 0 3
Unscaled	0.934	0.016	1.003	0.015
Scaled			0.934	0.016

Recruits at age 0 in 1991 = 23155790
Recruits at age 0 in 1992 = 23155790
Recruits at age 0 in 1993 = 23155790
Recruits at age 0 in 1994 = 23155790

M at age and proprtion mature at age are as shown in Table 7.3

Mean F for ages 2 to 6 in 1990 for human consumption landings + discards = 0.934 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1990

Mean F for ages 0 to 3 in 1990 for small-mesh fisheries = 0.016 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 0 to 3 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 0
Age 1
Age 2

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 7.13 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in IV 1991 to 1992

	Year										
	1990	1991	1992								
Biomass 1 Jan of Year											
Total	314	771	708	708	708	708	708	708	708	708	708
Spawning	76	64	99	99	99	99	99	99	99	99	99
Mean F Ages											
Human Cons. 2 to 6	0.93	0.93	0.00	0.19	0.37	0.56	0.75	0.93	1.12	0.00	0.00
Small-mesh 0 to 3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00
Mean F(Year)/Mean F(1990)										F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	51	41	0	19	35	49	61	72	81	0	0
Discards	33	43	0	16	30	43	54	65	74	0	0
Small-mesh Fisheries	3	5	6	6	6	6	5	5	5	0	0
Total landings	54	46	6	25	41	55	67	77	86	0	0
Total catch	87	89	6	41	71	98	121	142	160	0	0
Biomass 1 Jan of Year+1											
Total	771	708	858	819	786	757	732	711	693	0	0
Spawning	64	99	226	197	174	153	136	122	109	0	0

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
0	23155790	0	12246	27103	39349
1	4197246	12976	178845	41059	232879
2	171599	32183	48290	2226	82699
3	47417	21893	5733	497	28124
4	7281	4012	277	110	4399
5	25439	13560	229	288	14077
6	2123	1069	23	13	1105
7	548	269		5	274
8	824	407	0	2	409
9	157	82		0	82
10	52	25	0	0	25
11	25	12			12
12	6	3			3
Wt	771465	41362	42508	4842	88712

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	23155790	0	12246	27103	39349
1	2369047	9179	126511	29044	164734
2	716149	134310	201535	9289	345134
3	49587	22895	5996	520	29410
4	12704	7001	483	193	7676
5	1884	1004	17	21	1042
6	8301	4180	91	52	4323
7	753	369		7	376
8	204	101	0	1	101
9	310	161		0	161
10	56	27	0	0	27
11	20	10			10
12	11	6			6
Wt	707521	71719	64666	5257	141642

Table 7.14 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in IV 1991 to 1992

	Year										
	1990	1991	1992								
Biomass 1 Jan of Year											
Total	314	771	726	726	726	726	726	726	726	726	726
Spawning	76	64	111	111	111	111	111	111	111	111	111
Mean F Ages											
Human Cons. 2 to 6	0.93	0.65	0.00	0.19	0.37	0.56	0.75	0.93	1.12	0.00	0.00
Small-mesh 0 to 3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00
Mean F(Year)/Mean F(1990)										F0.1	Fmax
Human Consumption	1.00	0.70	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	51	32	0	21	40	55	68	80	89	0	0
Discards	33	31	0	16	31	44	56	66	76	0	0
Small-mesh Fisheries	3	5	7	6	6	6	6	5	5	0	0
Total landings	54	37	7	28	46	61	74	85	95	0	0
Total catch	87	68	7	44	76	105	130	151	171	0	0
Biomass 1 Jan of Year+1											
Total	771	726	877	835	798	768	741	719	699	0	0
Spawning	64	111	242	211	185	163	144	128	114	0	0

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
0	23155790	0	8573	27106	35680
1	4197246	9179	126519	41494	177192
2	171599	24907	37373	2461	64741
3	47417	17409	4559	565	22533
4	7281	3198	221	126	3544
5	25439	10631	180	322	11133
6	2123	831	18	15	864
7	548	208		6	214
8	824	315	0	2	317
9	157	64		0	64
10	52	19	0	0	19
11	25	10			10
12	6	2			2
Wt	771465	32149	30856	5003	68008

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	23155790	0	12246	27103	39349
1	2970158	9182	126559	29055	164796
2	737332	138294	207513	9565	355372
3	63393	29269	7665	665	37599
4	17399	9587	661	264	10513
5	2600	1386	23	29	1439
6	10878	5477	120	68	5665
7	965	473		9	482
8	258	127	0	1	128
9	391	203		0	203
10	72	34	0	0	34
11	25	13			13
12	14	7			7
Wt	725719	79645	66367	5451	151463

Table 8.1.1 Nominal catch (tonnes) of HADDOCK in Divisions VIa, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	3	1	2	1	6
Denmark	-	-	+	-	-
Faroe Islands	-	-	-	-	-
France	2,808	3,403	3,760	4,520	4,240
Germany, Fed.Rep.	3	7	71	65	83
Ireland	726	1,891	4,402	3,450	3,932
Netherlands	2	3	391	25	-
Norway	16	29	37	68	33
Spain	-	-	97	201	129
UK (England & Wales)	1,279	1,052	2,035	1,376	1,042
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	+	-	1	4	5
UK (Scotland)	8,198	12,051	19,249	21,593	18,472
Total	13,935	18,437	30,045	400	27,942

Country	1985	1986	1987	1988	1989	1990
Belgium	7	-	29	8	9	-
Denmark	-	-	4	+	+	+
Faroe Islands	-	1	-	-	13	-
France	5,930	4,956	5,456	3,001	1,335[1,2]	n/a
Germany, Fed.Rep.	38	25	21	4	4	15[1,3]
Ireland	3,512	2,026	2,628	2,731	n/a	n/a
Netherlands	-	-	-	n/a	-	n/a
Norway	76	45	13	54	74[1]	46[1]
Spain	166	-	-	-	n/a	n/a
UK (England & Wales)	348	222	425	114	476	271
UK (Isle of Man)	-	-	-	-	4	-
UK (N. Ireland)		155	1	35	73	56
UK (Scotland)	115,036	12,955	18,503	15,151	19,651	10,803
Total	25,114	20,385	27,080	21,098		

[1]Preliminary.
[2]Includes Divisions Vb(EC) and VIb.
[3]Includes Division VIb.
n/a = Not available.

Table 8.1.2 Annual Weight and Numbers of HADDOCK caught in VIA between 1971 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1971	58	46	12	0	166	86	81	0
1972	57	41	16	0	180	86	93	0
1973	40	29	11	0	138	58	81	0
1974	33	18	15	0	173	32	141	0
1975	47	14	33	0	233	27	207	0
1976	34	19	15	0	121	41	80	0
1977	24	19	4	0	65	39	26	0
1978	20	17	2	0	48	31	17	0
1979	29	15	14	0	106	26	81	0
1980	17	13	5	0	55	25	30	0
1981	33	18	15	0	109	39	69	0
1982	40	30	10	0	104	57	47	0
1983	36	29	7	0	83	49	34	0
1984	46	30	16	0	153	48	105	0
1985	42	24	17	0	125	43	82	0
1986	27	20	7	0	74	38	36	0
1987	43	27	16	0	147	50	97	0
1988	28	19	9	0	89	40	49	0
1989	20	17	3	0	47	30	17	0
1990	16	10	5	0	59	17	43	0

Table 8.1.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	0.200	0.000
1	0.200	0.000
2	0.200	0.570
3	0.200	1.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000

Table 8.1.4 : Total International Catch at Age (1000's) of HADDOCK in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	6604	14215	19589	63698	6849	4227	4552	57	5697	13	0
1	71481	20713	47387	68837	179349	24337	13109	15942	70070	22729	1
2	3915	85141	16907	11562	34957	72330	3468	2095	17282	21927	2
3	3328	2718	19477	10757	3339	15224	35948	971	1865	5636	3
4	79966	2336	258	6317	3350	1588	5705	24357	470	922	4
5	545	53823	1222	83	1882	1491	680	2938	9863	143	5
6	127	504	33193	447	95	868	495	351	833	3082	6
7	7	50	150	11463	98	21	308	247	114	229	7
8	212	86	163	174	3534	1119	304	575	221	54	8

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	764	136	2084	269	155	2979	1498	6684	3773	437	0
1	251	15492	14524	98976	22820	8127	89021	8399	5010	37247	1
2	83911	5019	20233	8626	78922	11235	16824	52343	3420	5856	2
3	20697	73676	6040	12910	4667	45367	10150	7250	25724	1884	3
4	1768	8167	36122	6242	4184	1823	23857	3765	2755	12158	4
5	194	898	3398	22790	1789	916	1452	9104	1556	871	5
6	39	108	597	2449	11189	449	1116	323	3634	279	6
7	822	272	41	371	964	2611	642	183	255	519	7
8	60	332	444	162	157	409	2203	1118	666	85	8

Table 8.1.5 : Total International Mean Weight at Age (Kg.) of HADDOCK in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.068	0.032	0.077	0
1	0.160	0.160	0.159	0.159	0.159	0.159	0.161	0.134	0.182	0.134	1
2	0.248	0.249	0.251	0.248	0.260	0.256	0.274	0.278	0.325	0.319	2
3	0.341	0.380	0.384	0.368	0.428	0.459	0.406	0.388	0.457	0.572	3
4	0.546	0.530	0.597	0.527	0.581	0.592	0.684	0.516	0.730	0.719	4
5	1.040	0.546	0.512	0.764	0.832	0.831	0.800	0.827	0.777	0.998	5
6	1.313	0.984	0.571	0.685	1.027	1.095	1.128	1.045	1.040	0.985	6
7	1.651	1.499	1.185	0.798	1.001	1.585	1.337	1.152	1.491	1.143	7
8	1.506	1.548	1.581	1.183	1.016	1.246	1.325	1.338	1.754	1.747	8

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	0.082	0.038	0.050	0.059	0.019	0.064	0.028	0.085	0.052	0.073	0
1	0.252	0.157	0.178	0.149	0.138	0.182	0.168	0.162	0.226	0.112	1
2	0.245	0.273	0.282	0.319	0.268	0.270	0.270	0.252	0.301	0.355	2
3	0.467	0.376	0.461	0.456	0.486	0.362	0.418	0.434	0.402	0.445	3
4	0.887	0.746	0.557	0.688	0.636	0.637	0.566	0.519	0.625	0.534	4
5	0.975	1.126	1.002	0.667	0.802	0.903	0.880	0.690	0.749	0.891	5
6	1.376	1.539	1.370	1.087	0.868	1.115	1.105	0.969	0.894	1.108	6
7	1.294	1.549	1.716	1.392	1.272	1.043	1.250	1.162	1.115	1.280	7
8	1.379	1.555	1.572	1.724	1.694	1.462	1.183	0.913	1.109	1.860	8

Table 8.1.6 Haddock in VIa. Recruitment Indices.

YEARCLASS	NSVPA1	SWFS1	SWFS2
1970	10056	-1	-1
1971	9425	-1	-1
1972	2469	-1	-1
1973	8582	-1	-1
1974	15561	-1	-1
1975	1335	-1	-1
1976	1864	-1	-1
1977	2946	-1	-1
1978	4638	-1	-1
1979	8363	-1	317.1
1980	1752	2.3	9.5
1981	3706	7.9	103.7
1982	2370	19.3	-1
1983	7982	-1	408.5
1984	2049	110.4	166.9
1985	2860	62.1	44.6
1986	6014	551.8	361
1987	484	43.6	48.8
1988	1031	17.8	8.7
1989	1011	257.7	176.3
1990	4196	159.3	-1
1991	7773	-1	-1

Table 8.1.7 Haddock in Division VIa. Separable VPA log catch ratio residuals.

Title : HADDOCK IN VIA: 1991 WG At 10:10:22 on 16-OCT-91

Separable analysis
from 1981 to 1990 on ages 0 to 10
with Terminal F of 0.700 on age 3 and Terminal S of 1.000

Initial sum of squared residuals was 214.795 and
final sum of squared residuals is 47.916 after 88 iterations

Matrix of Residuals

Years	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90		WTS
Ages											
0/ 1	0.185	-1.419	-0.598	-1.727	-1.211	0.146	1.005	3.251	0.368	0.000	0.129
1/ 2	-2.557	0.194	0.925	0.056	0.629	-0.063	0.303	0.927	-0.415	0.000	0.186
2/ 3	0.102	-0.222	0.304	-0.139	-0.063	0.207	-0.034	0.120	-0.276	0.000	1.000
3/ 4	0.599	0.360	-0.519	-0.001	-0.025	0.411	-0.296	-0.011	-0.518	0.000	0.491
4/ 5	0.236	0.417	-0.129	0.008	0.440	-0.101	-0.438	-0.202	-0.232	0.000	0.649
5/ 6	0.195	0.005	-0.194	-0.453	0.371	-0.456	0.194	-0.082	0.420	0.000	0.605
6/ 7	-2.105	0.770	0.147	-0.021	0.658	-0.439	0.700	-0.570	0.858	0.000	0.207
7/ 8	0.619	-0.120	-0.656	0.228	-0.053	0.015	0.037	-0.331	0.260	0.000	0.541
8/ 9	-0.175	-0.064	0.902	1.259	-0.294	-0.279	-0.734	-0.563	-0.050	0.000	0.300
9/10	-0.259	-0.658	0.466	0.524	-1.739	0.379	0.898	-0.254	0.644	0.000	0.239
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
F-values	0.3374	0.4166	0.5620	0.7984	0.6369	0.5159	1.0067	0.8497	0.9158	0.7000

Selection-at-age (S)

	0
S-values	0.0151

	1	2	3	4	5	6	7	8	9	10
S-values	0.3937	0.7495	1.0000	1.0393	0.9604	0.9123	1.1031	1.0620	1.0017	1.0000

Table 8.1.8. Haddock in Division VIa. VPA tuning summary.

```
VPA Version 2.1 - May 1988
HADDOCK IN VIA: 1991 WG
with cpue data from file HAD6AEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,SCOTRL              , has terminal q estimated as the mean
Fleet  2 ,SCOSEI              , has terminal q estimated as the mean
Fleet  3 ,SCOLTR              , has terminal q estimated as the mean
Fleet  4 ,SCONTR              , has terminal q estimated as the mean
Fleet  5 ,FRAALL              , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd
Regression weights
      , 0.020, 0.116, 0.284, 0.482, 0.670, 0.820, 0.921, 0.976, 0.997, 1.000
Oldest age F = 1.000*average of 5 younger ages.
Fleets combined by variance of predictions

Log catchability estimates

Age  0
                SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  , No data for this fleet at this age
     2  ,-16.16  , 1.764,0.0021 ,0.0182,
     3  , No data for this fleet at this age
     4  , No data for this fleet at this age
     5  ,-16.98  , 1.053,0.0059 ,0.0448,
  Fbar     SIGMA(int.)    SIGMA(ext.)
 0.080       0.904          0.397
    SIGMA(overall)  Variance ratio
       0.904            0.193

Age  1
                SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  , No data for this fleet at this age
     2  ,-13.32  , 0.499,0.0351 ,0.3787,
     3  , No data for this fleet at this age
     4  , No data for this fleet at this age
     5  ,-14.37  , 0.580,0.0796 ,0.6066,
  Fbar     SIGMA(int.)    SIGMA(ext.)
 0.410       0.378          0.233
    SIGMA(overall)  Variance ratio
       0.378            0.379

Age  2
                SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  ,-13.16  , 0.359,0.0083 ,0.8583,
     2  ,-12.77  , 0.498,0.0608 ,0.1877,
     3  ,-13.81  , 0.259,0.1326 ,0.6002,
     4  , No data for this fleet at this age
     5  ,-14.25  , 0.384,0.0903 ,0.7918,
  Fbar     SIGMA(int.)    SIGMA(ext.)
 0.591       0.173          0.263
    SIGMA(overall)  Variance ratio
       0.263            2.321

Age  3
                SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  ,-12.83  , 0.396,0.0116 ,1.1011,
     2  ,-12.63  , 0.447,0.0699 ,0.2689,
     3  ,-13.49  , 0.260,0.1817 ,0.6325,
     4  , No data for this fleet at this age
     5  ,-14.11  , 0.408,0.1033 ,1.0880,
  Fbar     SIGMA(int.)    SIGMA(ext.)
 0.706       0.176          0.273
    SIGMA(overall)  Variance ratio
       0.273            2.397

Age  4
                SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  ,-12.74  , 0.446,0.0127 ,1.0595,
     2  ,-12.71  , 0.540,0.0650 ,0.2367,
     3  ,-13.56  , 0.268,0.1688 ,0.5831,
     4  ,-17.31  , 0.363,0.0119 ,1.3184,
     5  ,-13.60  , 0.569,0.1726 ,1.6121,
  Fbar     SIGMA(int.)    SIGMA(ext.)
 0.778       0.174          0.278
    SIGMA(overall)  Variance ratio
       0.278            2.559

Age  5
                SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  ,-12.43  , 0.279,0.0173 ,1.3523,
     2  ,-12.93  , 0.818,0.0519 ,0.1596,
     3  ,-13.74  , 0.443,0.1414 ,0.5763,
     4  , No data for this fleet at this age
     5  ,-13.48  , 0.325,0.1942 ,1.6422,
  Fbar     SIGMA(int.)    SIGMA(ext.)
 1.002       0.186          0.336
    SIGMA(overall)  Variance ratio
       0.336            3.253

Age  6
                SUMMARY STATISTICS
  Fleet , Pred.  , SE(q),Partial,Raised,
        ,   q    ,      ,   F   ,   F   ,
 _______,________,______,_______,_______,
     1  ,-12.71  , 0.537,0.0131 ,0.4325,
     2  ,-13.40  , 0.800,0.0324 ,0.1436,
     3  , No data for this fleet at this age
     4  , No data for this fleet at this age
     5  ,-13.49  , 0.736,0.1931 ,1.4191,
  Fbar     SIGMA(int.)    SIGMA(ext.)
 0.741       0.381          0.570
    SIGMA(overall)  Variance ratio
       0.570            2.235
```

Table 8.1.9 Total International Fishing Mortality Rate at Age of HADDOCK in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	0.075	0.150	0.099	0.122	0.155	0.153	0.066	0.000	0.012	0.000	0
1	0.386	0.353	1.054	0.587	0.586	1.263	0.959	0.346	0.560	0.058	1
2	0.666	1.130	0.546	0.818	0.682	0.499	0.591	0.381	0.784	0.339	2
3	0.449	1.565	0.886	0.825	0.595	0.733	0.499	0.324	0.697	0.645	3
4	0.421	0.661	0.588	0.833	0.671	0.639	0.684	0.761	0.257	0.933	4
5	0.424	0.560	0.906	0.378	0.644	0.732	0.630	0.956	0.830	0.115	5
6	0.824	0.897	0.828	1.070	1.021	0.711	0.578	0.805	0.811	0.682	6
7	0.557	0.963	0.751	0.785	0.723	0.663	0.597	0.646	0.678	0.547	7
8	0.557	0.963	0.751	0.785	0.723	0.663	0.597	0.646	0.678	0.547	8

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	0.009	0.003	0.005	0.004	0.003	0.011	0.066	0.232	0.028	0.080	0
1	0.007	0.239	0.441	0.346	0.447	0.189	0.484	0.623	0.273	0.410	1
2	0.312	0.192	0.560	0.513	0.513	0.415	0.737	0.592	0.562	0.591	2
3	0.623	0.497	0.372	0.871	0.584	0.634	0.828	0.850	0.662	0.706	3
4	0.428	0.540	0.487	0.831	0.800	0.476	0.836	0.876	0.970	0.778	4
5	0.508	0.403	0.453	0.657	0.607	0.400	0.890	0.937	1.215	1.002	5
6	0.042	0.596	0.515	0.697	0.812	0.297	1.283	0.498	1.394	0.741	6
7	0.386	0.446	0.477	0.714	0.663	0.445	0.915	0.751	0.961	0.764	7
8	0.386	0.446	0.477	0.714	0.663	0.445	0.915	0.751	0.961	0.764	8

Table 8.1.10 ; Stock Numbers at Age (1000's) of HADDOCK in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	100589	1120151	228528	6100791	52342	32852	78043	2183571	5495591	47444	0
1	244770	76397	78902	169437	4420671	36683	23089	59789	178724	444796	1
2	8791	136241	43947	22521	77140	201482	8492	7246	34633	83614	2
3	10083	3699	36031	20845	8134	31933	100159	3850	4052	12944	3
4	255208	5272	633	12160	7480	3673	12556	49797	2280	1652	4
5	1728	137212	2229	288	4327	3131	1587	5185	19041	1444	5
6	247	926	64168	737	161	1860	1233	692	1632	6800	6
7	17	89	309	22957	207	48	748	566	253	594	7
8	542	151	336	348	7489	2521	738	1320	490	140	8

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	98627	546741	4559631	849401	635431	3132711	258241	354551	1525011	62621	0
1	388321	80059	446411	3714291	693001	518851	2537951	197911	230131	1214511	1
2	3436561	315661	516081	235241	2152041	362761	351611	1280161	86941	143361	2
3	48761	2059531	213251	241441	115341	1055041	196211	137731	579871	40571	3
4	5560	214171	1026121	120361	82711	52671	458241	70191	40181	244911	4
5	532	29671	102231	516421	42921	30421	26791	162601	23941	14951	5
6	1054	262	16231	53231	219171	19141	16691	9011	52131	5821	6
7	2815	827	1181	7941	21701	79701	11641	3791	4481	10581	7
8	207	1010	1280	3471	3531	12491	39941	23091	11721	1731	8

Table 8.1.11.1 Haddock in Division VIa RCT3 Results for Age 0

Analysis by RCT3 ver3.1 of data from file :
HADVIA0.RCX

HADDOCK VIa RCRTINX2 INPUT VALUES; AGE 0; 1991 WG

Data for 3 surveys over 21 years : 1971 - 1991

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 = 1988

	I----------Regression----------				I	I----------Prediction---------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.33	.89	.51	.819	17	6.94	10.13	.624	.559
SWFS1	.80	8.23	1.18	.360	7	2.93	10.58	1.532	.093
SWFS2	1.06	6.69	.80	.695	8	2.27	9.11	1.220	.146
					VPA Mean =		11.60	1.040	.202

Yearclass = 1989

	I----------Regression----------				I	I----------Prediction---------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.33	.91	.51	.824	17	6.92	10.12	.630	.529
SWFS1	.80	8.19	1.18	.365	7	5.56	12.66	1.660	.076
SWFS2	1.07	6.66	.81	.696	8	5.18	12.19	1.016	.203
					VPA Mean =		11.59	1.046	.192

Yearclass = 1990

	I----------Regression----------				I	I----------Prediction---------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.33	.95	.51	.827	17	8.34	12.03	.603	.682
SWFS1	.81	8.14	1.19	.371	7	5.08	12.25	1.620	.094
SWFS2									
					VPA Mean =		11.57	1.053	.224

Yearclass = 1991

	I----------Regression----------				I	I----------Prediction---------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.32	1.03	.52	.828	17	8.96	12.86	.658	.722
SWFS1									
SWFS2									
					VPA Mean =		11.56	1.059	.278

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	30300	10.32	.47	.44	.87		
1989	60962	11.02	.46	.57	1.55		
1990	155116	11.95	.50	.15	.09		
1991	268488	12.50	.56	.58	1.09		

Table 8.1.11.2 Haddock in Division VIa RCT3 Results for Age 3

Analysis by RCT3 ver3.1 of data from file :
HADVIA1.RCX

HADDOCK VIa RCRTINX2 INPUT VALUES; AGE 1; 1991 WG

Data for 3 surveys over 22 years : 1970 - 1991

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 = 1988

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.32	.74	.50	.828	18	6.94	9.92	.604	.584
SWFS1	.82	7.97	1.23	.340	7	2.93	10.38	1.593	.084
SWFS2	1.08	6.40	.83	.687	8	2.27	8.86	1.256	.135
					VPA Mean =		11.38	1.040	.197

Yearclass = 1989

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.32	.77	.49	.836	18	6.92	9.92	.604	.559
SWFS1	.82	7.93	1.23	.344	7	5.56	12.51	1.729	.068
SWFS2	1.09	6.36	.83	.688	8	5.18	11.99	1.046	.186
					VPA Mean =		11.37	1.047	.186

Yearclass = 1990

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.32	.83	.48	.842	18	8.34	11.82	.571	.710
SWFS1	.83	7.87	1.24	.349	7	5.08	12.10	1.692	.081
SWFS2									
					VPA Mean =		11.36	1.053	.209

Yearclass = 1991

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.31	.93	.48	.846	18	8.96	12.64	.615	.748
SWFS1									
SWFS2									
					VPA Mean =		11.35	1.059	.252

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	24409	10.10	.46	.43	.87		
1989	46717	10.75	.45	.56	1.56		
1990	126314	11.75	.48	.15	.10		
1991	223689	12.32	.53	.56	1.10		

Table 8.1.11.3 Haddock in Division VIa RCT3 Results for Age 2

Analysis by RCT3 ver3.1 of data from file :
HADVIA2.RCX

HADDOCK VIa RCRTINX2 INPUT VALUES; AGE 2; 1991 WG

Data for 3 surveys over 22 years : 1970 - 1991

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 = 1988

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.51	-1.36	.61	.797	18	6.94	9.08	.747	.604
SWFS1	1.21	5.98	2.04	.166	7	2.93	9.53	2.646	.048
SWFS2	1.30	4.88	1.22	.530	8	2.27	7.83	1.845	.099
					VPA Mean =		10.75	1.161	.249

Yearclass = 1989

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.49	-1.18	.59	.812	18	6.92	9.11	.727	.594
SWFS1	1.21	5.96	2.03	.172	7	5.56	12.65	2.840	.039
SWFS2	1.30	4.83	1.22	.531	8	5.18	11.58	1.535	.133
					VPA Mean =		10.75	1.161	.233

Yearclass = 1990

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.46	-.93	.56	.828	18	8.34	11.26	.660	.723
SWFS1	1.20	5.93	2.01	.180	7	5.08	12.02	2.741	.042
SWFS2									
					VPA Mean =		10.76	1.159	.235

Yearclass = 1991

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
NSVPA1	1.43	-.62	.53	.845	18	8.96	12.16	.675	.746
SWFS1									
SWFS2									
					VPA Mean =		10.76	1.156	.254

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	12028	9.40	.58	.50	.75		
1989	21193	9.96	.56	.63	1.28		
1990	71194	11.17	.56	.20	.12		
1991	134117	11.81	.58	.61	1.10		

Table 8.1.12 Mean Fishing Mortality , Biomass and Recruitment of HADDOCK in VIA between 1971 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 0	
	2 to 6		1 to 11				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1971	0.443	0.113	0.000	187	147	71	101
1972	0.749	0.213	0.000	127	100	72	112
1973	0.645	0.106	0.000	76	59	73	229
1974	0.634	0.151	0.000	66	37	74	610
1975	0.604	0.118	0.000	110	31	75	52
1976	0.565	0.098	0.000	82	54	76	33
1977	0.504	0.093	0.000	60	55	77	78
1978	0.586	0.060	0.000	45	36	78	218
1979	0.605	0.071	0.000	65	28	79	550
1980	0.507	0.036	0.000	104	33	80	47
1981	0.305	0.077	0.000	128	82	81	99
1982	0.378	0.067	0.000	121	105	82	55
1983	0.370	0.107	0.000	104	90	83	456
1984	0.613	0.101	0.000	124	65	84	85
1985	0.575	0.089	0.000	104	70	85	64
1986	0.345	0.093	0.000	76	62	86	313
1987	0.815	0.100	0.000	97	50	87	26
1988	0.656	0.095	0.000	60	43	88	32
1989	0.856	0.104	0.000	42	36	89	61
1990	0.647	0.149	0.000	28	21	90	155
Arit-mean recruits at age 0 for period 1971 to 1990							169
Geom-mean recruits at age 0 for period 1971 to 1990							107

Table 8.1.13 Input for catch prediction of HADDOCK in VIA

	1990 Stock and Fishing Mortality				Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery						
					Scaled mean F 1986 to 1990			Mean values for period 1986 to 1990			
		Fishing Mortality						Mean Weight (Kg.)			
Age	Stock Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Prop. Ret.
0	155116		0.082			0.082			0.060		0.060	
1	46717	0.032	0.675		0.032	0.670		0.312	0.159		0.170	0.073
2	12028	0.272	0.340		0.270	0.337		0.378	0.219		0.290	0.438
3	4057	0.503	0.203		0.571	0.159		0.465	0.248		0.412	0.767
4	24491	0.605	0.173		0.740	0.041		0.595	0.336		0.576	0.948
5	1495	0.975	0.027		0.876	0.006		0.827	0.523		0.823	0.994
6	582	0.741			0.837	0.000		1.038	1.423		1.038	1.000
7	1058	0.764			0.761			1.170			1.170	1.000
8	173	0.764			0.761			1.305	2.810		1.306	1.000

Mean F	Age 2 to 6	Age 1 1	Age 2 to 6	Age 1 1
Unscaled	0.768	0.000	0.773	0.000
Scaled			0.768	0.000

Recruits at age 0 in 1991 = 104820
Recruits at age 0 in 1992 = 104820
Recruits at age 0 in 1993 = 104820
Recruits at age 0 in 1994 = 104820

M at age and proprtion mature at age are as shown in Table 8.1.3

Mean F for ages 2 to 6 in 1990 for human consumption landings + discards = 0.768 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1990

Mean F for ages 1 to 1 in 1990 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 0
Age 1
Age 2

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 8.1.14 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in VIA 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	28	37	36	36	36	36	36	36	36	36	36	36
Spawning	21	15	17	17	17	17	17	17	17	17	17	17
Mean F Ages												
Human Cons. 2 to 6	0.77	0.77	0.00	0.15	0.31	0.46	0.61	0.77	0.92	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	10	9	0	2	4	6	7	8	9	0	0	
Discards	5	10	0	2	4	6	7	9	10	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	10	9	0	2	4	6	7	8	9	0	0	
Total catch	16	18	0	4	8	11	14	17	19	0	0	
Biomass 1 Jan of Year+1												
Total	37	36	58	53	47	43	39	36	33	0	0	
Spawning	15	17	36	31	27	24	21	18	16	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
0	104820		7449		7449
1	116984	3969	50139		54108
2	18856	3447	4417		7864
3	5338	1948	590		2538
4	1639	773	43		816
5	9208	4932	31		4963
6	450	234	0		234
7	227	111			111
8	404	197	0		197
Wt	37351	8613	9554	0	18167

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	104820		7449		7449
1	79100	2684	33902		36585
2	47463	8675	11118		19793
3	8406	3068	930		3997
4	2105	993	55		1048
5	614	329	2		331
6	3120	1625	0		1625
7	159	78			78
8	241	118	0		118
Wt	36134	8335	8517	0	16852

Table 8.1.15 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in VIA 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	28	37	42	42	42	42	42	42	42	42	42	42
Spawning	21	15	21	21	21	21	21	21	21	21	21	21
Mean F Ages												
Human Cons. 2 to 6	0.77	0.54	0.00	0.15	0.31	0.46	0.61	0.77	0.92	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)											F0.1	Fmax
Human Consumption	1.00	0.70	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	10	7	0	3	5	7	9	10	12	0	0	
Discards	5	7	0	2	4	6	8	9	11	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	10	7	0	3	5	7	9	10	12	0	0	
Total catch	16	14	0	5	9	13	17	19	22	0	0	
Biomass 1 Jan of Year+1												
Total	37	42	65	58	52	47	43	39	35	0	0	
Spawning	15	21	42	37	32	28	24	21	19	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
0	104820		5275		5275
1	116984	3045	38459		41504
2	18856	2615	3351		5965
3	5338	1499	454		1954
4	1639	599	33		632
5	9208	3860	24		3885
6	450	182	0		182
7	227	96			96
8	404	152	0		153
Wt	37351	6670	7295	0	13964

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	104820		7449		7449
1	81059	2750	34741		37491
2	58591	10709	13725		24434
3	10087	3682	1116		4797
4	2620	1236	68		1305
5	777	416	3		419
6	4065	2117	0		2117
7	205	100			100
8	303	148	0		148
Wt	41931	10203	9272	0	19475

Table 8.2.1 Nominal catch (tonnes) of HADDOCK in Divisions VIb, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Faroe Islands	5	1	21	3	3
France	1	10	32	48	12
Germany, Fed. Rep.	17	-	4	1	-
Norway	2	10	3	20	45
Spain	6	88	121	79	128
UK (England & Wales)	6,261	9,005	3,736	113	788
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	1,051	27	5	136	1,654
Total	7,343	9,141	3,992	400	2,630

Country	1985	1986	1987	1988	1989	1990
Faroe Islands	1	-	-	5	-	-
France	116	103	99	5	---[3]	n/a
Germany, Fed. Rep.	4	-	-	4	1	---[3]
Norway	31	83	33	20	47[1]	38[1]
Spain	892	756	371	245	n/a	n/a
UK (England & Wales)	1,876	703	1,271	753	1,007	568
UK (Isle of Man)	-	-	-	-	+	-
UK (N. Ireland)	-	157	-	-	8	6
UK (Scotland)	6,397	2,961	6,221	6,542	5,210	6,797
Total	9,317	4,763	7,995	7,574	6,273	7,469[2]

[1]Preliminary.
[2]Working Group estimated total.
[3]Included in Division VIa.
n/a = Not available.

Table 8.2.2. Total international catch at age ('000) of haddock in Division VIb between 1985 and 1990.

Age	1985	1986	1987	1988	1989	1990
1	0	0	77	256	59	6
2	65	717	747	2284	2586	1569
3	758	467	17330	2114	4439	2198
4	12971	1021	278	11991	1474	1514
5	3699	3948	353	100	5472	281
6	124	1233	1506	121	115	677
7	6	73	579	256	24	52
8	70	34	36	128	59	4
9	220	84	4	5	21	27
10+	1	106	55	8	6	2

Table 8.2.3. Total international mean weight at age (Kg.) of haddock in Division VIb between 1985 and 1990. Natural mortality and proportion mature.

Age	1985	1986	1987	1988	1989	1990
1	-	-	0.154	0.233	0.271	0.267
2	0.348	0.305	0.276	0.335	0.358	0.396
3	0.479	0.477	0.339	0.377	0.378	0.472
4	0.507	0.624	0.466	0.461	0.424	0.532
5	0.543	0.646	0.601	0.724	0.526	0.596
6	0.668	0.697	0.715	0.582	0.617	0.725
7	1.208	0.868	0.688	1.017	0.705	0.935
8	0.778	0.825	0.865	0.745	1.045	0.789
9	0.879	0.841	0.852	1.797	1.023	0.941
10+	1.370	1.133	0.823	2.191	1.022	1.055

age	Natural Mortality	Proportion Mature
1	.2	0
2	.2	0
3	.2	1
4	.2	1
5	.2	1
6	.2	1
7	.2	1
8	.2	1
9	.2	1

Table 8.2.4. Abundance indices for haddock in Division VIb obtained by research vessel surveys conducted in August since 1985.

age	1985	1986	1987	1988	1989	1990	1991
0	489	3577	698	8640	23580	16388	14458
1	51284	17309	11672	8170	10799	10612	16398
2	214	62196	2917	5799	3531	1231	4431
3	31	85	8530	810	1889	388	683
4	4218	139	105	2107	268	307	315
5	676	2568	267	5	765	39	228
6	1	225	249	2	2	140	37
7	2	0	71	91	7	2	64
R.V	C	R	D	S	S	S	S

C=Clarkwood
R=G.A.Reay
D=Dawn Sky
S=Scotia

Table 8.2.5 Results from fitting the linear model to the abundance indices for haddock in Division VIb. The year class effects are the recriutment indices (in logs). Spawning stock estimates after removing the year effect are shown.

RESIDUAL SUM OF SQUARES= .861E+01

NUMBER OF OBSERVATIONS = 42

NUMBER OF PARAMETERS = 22

		PARAMETER	S.D.
Year effects			
	1	0-input	
	2	1.1329	.3955
	3	1.2087	.3943
	4	.3391	.3780
	5	.7383	.3463
	6	.0825	.2982
Age effects			
	1	0-input	
	2	-1.1288	.3703
	3	-2.7455	.3859
	4	-3.2796	.4001
	5	-4.3657	.4154
	6	-6.3299	.4379
Year class effects			
	1	6.3299	.7888
	2	10.7475	.6360
	3	11.1163	.5758
	4	7.1722	.5393
	5	6.2391	.5091
	6	10.7528	.4550
	7	8.4651	.4647
	8	9.0049	.4684
	9	8.5070	.4722
	10	8.3752	.4863
	11	8.9276	.5337
	12	8.8478	.6981

YEAR	SSB index
1985	1733.2
1986	610.1
1987	1394.1
1988	1069.5
1989	676.6
1990	392.8
1991	286.4

Table 8.2.6. Total international fishing mortality at age and numbers at age of haddock in Division VIb between 1985 and 1990. Natural mortality is assumed to be 0.2.

F-at-age

Age	1985	1986	1987	1988	1989	1990
1	.0000	.0000	.0058	.0274	.0048	.0100
2	.0398	.0141	.1270	.2337	.4168	.1702
3	.3162	.4369	.5382	.6243	.9611	.7631
4	.9834	.9309	.5074	.9134	1.3108	1.1117
5	.8703	.9735	1.0435	.3441	1.7258	1.0045
6	.5912	.8330	1.4356	1.4492	.8493	1.2139
7	.1178	.8608	1.3462	1.1033	1.5534	1.3225
8	.3913	1.8491	1.6720	1.4539	.8423	1.4279
9	.3668	1.1810	1.4846	1.3355	1.0816	1.3214
10	.3668	1.1810	1.4846	1.3355	1.0816	1.3214

N-at-age ('000)

Age	1985	1986	1987	1988	1989	1990
1	68900.	8421.	14799.	10437.	13539.	665.
2	1837.	56411.	6895.	12047.	8314.	11031.
3	3069.	1445.	45536.	4972.	7808.	4487.
4	22499.	1831.	764.	21765.	2180.	2445.
5	6923.	6890.	591.	377.	7148.	481.
6	304.	2374.	2131.	170.	219.	1042.
7	59.	138.	845.	415.	33.	77.
8	237.	43.	48.	180.	113.	6.
9	786.	131.	6.	7.	34.	40.
10	4.	166.	77.	12.	10.	3.

Table 8.2.7. Results from fitting separable model to catch at age data for haddock in VIb. Estimates log recruitment at age 2 is shown.

Number of observations= 48
Number of parameters = 24
Residual mean square = .5132
Coefficient of determination = .9448
Adj. coeff. of determination = .8918

	Parameter	s.d.
year effects		
	1.0000	.0000
	1.8066	.6617
	2.3080	.7905
	1.8658	.6066
	1.8775	.5049
	1.0459	.2754
age effects		
	.0362	.0164
	.2243	.0885
	.4114	.1467
	.4745	.1641
	.5717	.1849
	.5427	.1684
	.4984	.1522
	.4000	.0000
y/c effects		
	6.5950	.7164
	5.5770	.5204
	3.8148	.4230
	5.7479	.3788
	8.6757	.3528
	9.6485	.3308
	7.8834	.3256
	7.8361	.3246
	10.6371	.3411
	8.9542	.3741
	9.9230	.4400
	10.1263	.5710
	10.7492	.8602

Standardised log recruitment at age 2

Year	log R	s.d.
1978	11.1179	.8094
1979	9.4999	.6425
1980	7.0394	.5457
1981	8.2298	.4837
1982	10.3858	.4251
1983	10.6842	.3725
1984	8.3077	.3374
1985	7.8361	.3246
1986	10.6371	.3411
1987	8.9542	.3741
1988	9.9230	.4400
1989	10.1263	.5710
1990	10.7492	.8602

Table 8.2.8. Recruitment estimates for haddock in VIb. Figures in brackets are the predicted log recruitment values from the regression.

Year class	Survey index age 1	Separable estimate age 2
1979	6.32	8.22
1980	10.75	10.39
1981	11.11	10.68
1982	7.17	8.31
1983	6.23	7.83
1984	10.75	10.64
1985	8.46	8.95
1986	9.00	9.92
1987	8.50	10.12
1988	8.37	(9.26)
1989	8.92	(9.57)
1990	8.84	(9.53)

Predicted values back transformed

1990	10561.89
1991	14417.94
1992	13779.81

Regression Output:

Constant		4.528787
Std Err of Y Est		.3857392
R Squared(Adj,Raw)	.8829458	.8975776
No. of Observations		9
Degrees of Freedom		7
Coefficient(s)	.5658566	
Std Err of Coef.	.0722468	

Table 8.2.9. Estimates mean fishing mortality and spawning stock biomas for haddock in VIb from VPA.

Year	Mean F(1-10)	SSB
1985	.4044	17790.9
1986	.8260	8391.0
1987	.9645	18362.3
1988	.8820	12875.0
1989	.9827	7956.8
1990	.9667	4577.3

Table 8.2.10. Input values used for catch prediction for haddock in VIb.

age	N(1990)	F	Wt
2	11031	.17	.324
3	4487	.76	.410
4	2445	1.11	.496
5	481	1.00	.608
6	1042	1.21	.656
7	77	1.32	.897
8	6	1.42	.852
9	40	1.32	1.078
10	3	1.32	1.308

recruitment at age 2

1991	14417
1992	13779
1993	12722 (geometric mean 1981-1989)

Table 8.2.11. Predicted yield and spawning stock biomass for haddock in VIb.

Year	Yield tonnes	SSB tonnes
1991	3200	4720
1992	3830	6020
1993	4040	6420

Table 9.1a Nominal landings (tonnes) of HADDOCK in Divisions VIIb,c, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
France	523	658	750	1,443	1,840
Ireland	150	335	464	450	277
Netherlands	-	-	1	-	-
Norway	-	-	-	54	17
Spain	5	85	129	58	240
UK (England & Wales)	1	-	3	-	275
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	56	-	-	-	63
Total	735	1,078	1,347	2,005	2,712

Country	1985	1986	1987	1988	1989	1990
France	1,183	1,243	1,079	487	n/a	n/a
Ireland	388	202	156	101	n/a	n/a
Netherlands	-	-	-	-	-	-
Norway	4	77	-	+	26[1]	21[1]
Spain	291	-	-	-	n/a	n/a
UK (England & Wales)	35	58	30	33	3	7
UK (N. Ireland)	-	-	-	+	-	-
UK (Scotland)	7	51	79	3	17	165
Total	1,908	1,631	1,344	624		

[1]Preliminary.
n/a = Not available.

Table 9.1b Nominal landings (tonnes) of HADDOCK in Divisions VIId,e, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	+	2	1	1	-
Denmark	15	-	-	-	-
France	298	421	344	232	273
Ireland	+	-	-	-	-
Netherlands	-	-	94	1	-
UK (England & Wales)	59	119	60	41	26
UK (Scotland)	-	-	-	-	-
Total	372	542	499	275	299

Country	1985	1986	1987	1988	1989	1990
Belgium	2	1	+	1	1	+
Denmark	-	-	-	-	-	+
France	138	249	268	411	n/a	n/a
Ireland	-	-	-	-	n/a	n/a
Netherlands	-	-	-	n/a	-	-
UK (England & Wales)	27	21	43	102	70	23
UK (Scotland)	-	-	-	-	1	1
Total	167	271	311	514		

n/a = Not available

Table 9.1c Nominal landings (tonnes) of HADDOCK in Divisions VIIg-k, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	2	3	3	1	-
France	1,696	1,913	1,255	1,145	1,161
Ireland	124	344	440	491	369
Netherlands	-	-	6	-	-
Norway	-	-	-	3	-
Spain	-	192	119	109	292
UK (England & Wales)	49	92	179	23	34
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	-	4	-	-	-
Total	1,871	2,548	2,002	1,772	1,856

Country	1985	1986	1987	1988	1989	1990
Belgium	2	-	8	11	18	6
France	1,075	824	928	1,960	n/a	n/a
Ireland	406	115	158	174	n/a	n/a
Netherlands	-	-	-	n/a	-	-
Norway	-	9	-	-	1[1]	10[1]
Spain	270	-	-	-	n/a	n/a
UK (England & Wales)	100	100	98	184	100	49
UK (N. Ireland)	-	-	-	+	1	1
UK (Scotland)	-	6	-	1	-	38
Total	1,853	1,054	1,192	2,330		

[1]Preliminary.
n/a = Not available.

Table 10.1 Nominal catch (tonnes) of WHITING in Sub-area IV, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	3,153	2,623	2,272	2,864	2,798
Denmark	17,916	16,430	27,043	18,054	19,771
Faroe Islands	21	12	57	18	-
France	23,626	24,744	23,780	21,263	19,209
Germany, Fed. Rep.	1,267	601	223	317	286
Netherlands	14,389	14,600	12,218	10,935	8,767
Norway	27	27	17	39	88
Poland	1	-	-	1	2
Sweden	16	9	11	44	53
UK (England and Wales)	6,778	5,964	4,743	4,366	5,017
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	42,218	31,399	29,640	41,248	42,967
Total	109,412	96,409	100,004	99,149	98,958

Country	1985	1986	1987	1988	1989	1990
Belgium	2,177	2,275	1,404	1,984	1,271	1,040
Denmark	16,152	9,076	2,047	12,112	803	1,195[1]
Faroe Islands	6	-	12	222	1	26
France	10,853	8,250	10,493	10,569	5,277[1,2]	n/a
Germany, Fed. Rep.	226	313	274	454	415	679[1]
Netherlands	6,973	13,741	8,542	5,087[3]	3,860	n/a
Norway	103	103	74	52	34[1]	48[1]
Poland	-	-	-	-	-	-
Sweden	22	33	17	5	17	16
UK (England & Wales)	5,024	3,805	4,485	4,007	1,896	2,124
UK (N. Ireland)	-	-	-	1	61	30
UK (Scotland)	30,398	29,113	37,630	31,804	26,491	27,632
Total	71,934	66,709	64,978	66,297	40,397	

[1]Preliminary.
[2]Includes Division IIa (EC).
[3]Working Group estimate.
n/a = Not available.

Table 10.2 Annual Weight and Numbers of WHITING caught in IV between 1971 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1971	192	58	63	72	2118	184	458	1475
1972	188	60	67	61	1927	177	398	1352
1973	266	66	110	90	2164	232	659	1273
1974	290	75	85	130	2572	249	477	1846
1975	300	79	135	86	1965	247	699	1018
1976	361	75	136	150	2285	248	641	1396
1977	342	73	163	106	2470	259	547	1663
1978	178	88	35	55	1727	322	240	1165
1979	233	98	77	59	1869	344	640	886
1980	212	91	76	46	1411	301	466	645
1981	181	79	35	67	1396	257	210	929
1982	129	71	26	33	733	231	168	333
1983	151	79	48	24	1310	253	360	697
1984	135	77	39	19	858	245	317	297
1985	97	54	28	15	686	180	226	280
1986	154	58	78	18	1173	202	572	399
1987	132	62	53	16	917	224	408	285
1988	127	51	28	49	1370	191	227	952
1989	118	40	35	43	859	153	275	431
1990	147	42	54	51	1262	160	524	578

Table 10.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	2.550	0.000
1	0.950	0.110
2	0.450	0.920
3	0.350	1.000
4	0.300	1.000
5	0.250	1.000
6	0.250	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000

Table 10.4 Total International Catch at Age (1000's) of WHITING in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	1232837	553711	175647	571415	238839	425081	666975	687017	476345	332172	0
1	620700	938136	1153018	755217	954765	479081	1004731	417292	611121	263938	1
2	106187	314926	660398	976000	403599	1119601	474222	305020	457585	406641	2
3	18145	44793	131353	226168	295629	163420	268897	222079	202924	266938	3
4	123135	7445	18039	31516	53896	79425	29031	79704	89752	82466	4
5	13021	56265	5404	4660	8792	14188	20033	6935	26698	47604	5
6	2191	7933	17226	1163	7524	2733	5225	6864	2988	9858	6
7	693	3284	2375	5496	109	488	505	1707	1528	1003	7
8	162	243	345	325	1303	18	228	247	250	653	8
9	408	67	118	47	132	527	17	11	33	58	9
10	26	641	50	20	2	28	159	13	5	20	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	516852	100512	666558	157321	186585	225026	84650	416511	87146	280675	0
1	160949	187614	197608	313029	200262	563912	260597	425292	323985	246737	1
2	334230	102148	168127	159701	143659	161516	355267	296398	169309	493601	2
3	253428	226317	107271	108562	83358	159440	120294	174813	183129	123725	3
4	92315	82807	124479	45938	37180	42550	78955	38549	76225	82576	4
5	24065	24577	35013	57100	13531	12526	10892	15476	14049	31597	5
6	10819	6293	8290	13142	17769	3376	4205	1937	4447	1937	6
7	2770	1956	1669	2832	3098	3935	822	417	404	642	7
8	238	385	760	376	831	530	818	60	286	90	8
9	43	49	96	176	94	72	101	73	37	16	9
10	37	30	33	21	9	1	7	38	6		10

Table 10.5 Total International Mean Weight at Age (Kg.) of WHITING in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	0.036	0.022	0.027	0.026	0.030	0.019	0.022	0.010	0.009	0.013	0
1	0.116	0.071	0.084	0.070	0.100	0.107	0.116	0.074	0.098	0.075	1
2	0.219	0.200	0.166	0.149	0.215	0.194	0.211	0.181	0.166	0.176	2
3	0.285	0.282	0.277	0.257	0.277	0.294	0.322	0.235	0.260	0.253	3
4	0.318	0.388	0.371	0.381	0.376	0.352	0.401	0.327	0.304	0.332	4
5	0.433	0.418	0.439	0.469	0.470	0.443	0.450	0.436	0.419	0.340	5
6	0.531	0.520	0.462	0.519	0.356	0.519	0.468	0.438	0.457	0.466	6
7	0.637	0.575	0.550	0.541	0.817	0.514	0.551	0.477	0.502	0.479	7
8	0.560	0.748	0.738	0.786	0.596	0.554	0.440	0.613	0.584	0.573	8
9	0.728	0.801	0.860	1.032	0.712	0.740	0.734	0.702	0.618	0.539	9
10	0.729	0.822	0.846	0.966	1.022	0.893	0.500	1.247	0.559	0.812	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	0.011	0.029	0.014	0.020	0.014	0.015	0.012	0.013	0.023	0.015	0
1	0.082	0.059	0.105	0.088	0.094	0.105	0.076	0.054	0.068	0.081	1
2	0.166	0.182	0.189	0.188	0.186	0.182	0.146	0.143	0.156	0.136	2
3	0.241	0.252	0.275	0.275	0.265	0.252	0.246	0.222	0.224	0.207	3
4	0.326	0.314	0.326	0.338	0.324	0.315	0.293	0.298	0.264	0.247	4
5	0.394	0.378	0.387	0.384	0.391	0.373	0.371	0.335	0.316	0.277	5
6	0.423	0.484	0.427	0.393	0.429	0.462	0.368	0.413	0.383	0.405	6
7	0.473	0.506	0.457	0.464	0.469	0.465	0.492	0.428	0.438	0.484	7
8	0.649	0.703	0.520	0.586	0.424	0.525	0.458	0.834	0.347	0.639	8
9	0.828	0.783	0.670	0.514	0.497	1.194	0.852	0.588	0.512	0.316	9
10	1.032	1.101	0.502	0.871	0.789	0.528	0.602	0.642	0.828		10

Table 10.6 Survey indices used to estimate recruitment for North Sea Whiting.

WHITING IV RCT3 INPUT VALUES 1991 WG

YEARCLASS	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS0'	'SGFS1'	'SGFS2'	'DGFS0'	'DGFS1'	'DGFS2'	'GGFS1'	'GGFS2'
1970	274	190	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1971	332	763	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	1156	496	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	322	153	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	893	535	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	679	219	-1	-1	74	-1	-1	-1	-1	-1	-1	-1	-1
1976	418	293	-1	220	52	-1	-1	-1	-1	-1	-1	-1	-1
1977	513	183	284	247	71	-1	-1	-1	-1	-1	-1	-1	-1
1978	457	391	184	201	125	-1	-1	-1	-1	-1	62	-1	-1
1979	692	485	355	353	288	-1	-1	-1	-1	330	131	-1	-1
1980	227	232	199	183	79	-1	-1	97	166	205	105	-1	-1
1981	161	126	349	277	109	-1	65	58	1393	640	224	-1	15.3
1982	128	179	69	119	108	102	56	37	166	431	141	6.8	12.9
1983	436	359	717	506	170	210	108	97	2649	1330	893	5.7	22.8
1984	341	261	173	159	66	454	158	45	143	783	75	9.6	24.6
1985	456	544	200	152	130	169	111	115	859	384	252	12.2	70.8
1986	669	862	163	228	132	406	141	161	1784	2004	612	91	79.8
1987	394	542	137	188	118	120	97	74	2883	1441	803	15.1	392.3
1988	1465	887	382	295	129	642	404	205	629	1049	196	603.1	248.3
1989	509	675	1170	194	77	427	224	95	1882	963	-1	280.2	163.7
1990	1014	-1	882	333	-1	1943	177	-1	5543	-1	-1	324.3	-1
1991	-1	-1	167	-1	-1	1379	-1	-1	-1	-1	-1	-1	-1

Table 10.7 VPA summary statistics for North Sea Whiting

```
VPA Version 2.1 - May 1988
WHITING IV
with cpue data from file WHIIVEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,SCOGFS              , has terminal q estimated as the mean
Fleet  2 ,SCOTRL              , has terminal q estimated as the mean
Fleet  3 ,SCOSEI              , has terminal q estimated as the mean
Fleet  4 ,SCOLTR              , has terminal q estimated as the mean
Fleet  5 ,ENGGFS              , has terminal q estimated as the mean
Fleet  6 ,FRATRB              , has terminal q estimated as the mean
Fleet  7 ,FRGGFS              , has terminal q estimated as the mean
Fleet  8 ,NETGFS              , has terminal q estimated as the mean
Fleet  9 ,INTGFS              , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd
Regression weights  , 0.020, 0.116, 0.284, 0.482, 0.670, 0.820, 0.921, 0.976, 0.997, 1.000
```

Age 0

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	-17.44	0.732	0.0000	0.0038
2	No data for this fleet at this age			
3	-24.38	1.535	0.0000	0.0099
4	No data for this fleet at this age			
5	-17.55	0.722	0.0000	0.0076
6	-20.24	0.837	0.0001	0.0022
7	No data for this fleet at this age			
8	-16.13	0.847	0.0000	0.0050
9	No data for this fleet at this age			

Fbar	SIGMA(int.)	SIGMA(ext.)
0.010	0.377	0.240

SIGMA(overall)	Variance ratio
0.377	0.406

Age 1

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	-13.89	0.529	0.0001	0.1023
2	-18.86	1.248	0.0001	0.8139
3	-17.68	1.005	0.0053	0.0918
4	-17.72	0.989	0.0075	0.5032
5	-15.83	0.352	0.0000	0.1724
6	-15.95	0.418	0.0043	0.2519
7	-17.33	1.535	0.0000	0.0263
8	-14.30	0.552	0.0000	0.1577
9	-14.94	0.293	0.0000	0.1570

Fbar	SIGMA(int.)	SIGMA(ext.)
0.186	0.168	0.152

SIGMA(overall)	Variance ratio
0.168	0.816

Age 2

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	-13.31	0.312	0.0001	0.3987
2	-16.20	0.663	0.0012	0.9960
3	-15.56	0.510	0.0441	0.1747
4	-16.27	0.343	0.0318	0.4446
5	-15.37	0.303	0.0000	0.8151
6	-14.87	0.318	0.0125	0.3984
7	-15.84	1.053	0.0000	0.2615
8	-14.41	0.805	0.0000	1.3887
9	No data for this fleet at this age			

Fbar	SIGMA(int.)	SIGMA(ext.)
0.471	0.144	0.181

SIGMA(overall)	Variance ratio
0.181	1.574

Age 3

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	-13.31	0.392	0.0001	0.8296
2	-15.24	0.641	0.0032	3.7746
3	-14.54	0.250	0.1230	0.5496
4	-15.34	0.287	0.0809	1.3062
5	-15.41	0.229	0.0000	0.6494
6	-13.97	0.106	0.0308	0.9040
7	-15.55	0.873	0.0000	0.2529
8	-14.88	0.882	0.0000	0.2782
9	No data for this fleet at this age			

Fbar	SIGMA(int.)	SIGMA(ext.)
0.832	0.820E-01	0.124

SIGMA(overall)	Variance ratio
0.124	2.279

Age 4

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	-13.36	0.473	0.0001	0.5121
2	-14.73	0.403	0.0053	2.3538
3	-14.04	0.253	0.2026	0.5592
4	-14.91	0.204	0.1240	1.1428
5	-15.44	0.323	0.0000	0.7042
6	-13.54	0.100	0.0475	0.9992
7	-15.58	0.889	0.0000	0.4402
8	No data for this fleet at this age			
9	No data for this fleet at this age			

Fbar	SIGMA(int.)	SIGMA(ext.)
0.964	0.787E-01	0.120

SIGMA(overall)	Variance ratio
0.120	2.306

Age 5

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	-13.31	0.717	0.0001	1.1200
2	-14.42	0.673	0.0073	3.7879
3	-13.73	0.435	0.2761	0.5908
4	-14.67	0.324	0.1578	1.4569
5	-15.54	0.566	0.0000	1.7317
6	-13.23	0.190	0.0646	1.2764
7	-15.34	0.887	0.0000	0.3432
8	No data for this fleet at this age			
9	No data for this fleet at this age			

Fbar	SIGMA(int.)	SIGMA(ext.)
1.267	0.140	0.166

SIGMA(overall)	Variance ratio
0.166	1.399

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	-13.21	0.401	0.0002	0.7126
2	-14.28	0.496	0.0084	2.0145
3	-13.58	0.283	0.3195	0.8587
4	-14.55	0.318	0.1777	2.1576
5	-15.70	0.692	0.0000	0.6322
6	-13.08	0.201	0.0750	1.5913
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			

Fbar	SIGMA(int.)	SIGMA(ext.)
1.371	0.130	0.181

SIGMA(overall)	Variance ratio
0.181	1.956

Age 7

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	No data for this fleet at thi			
2	-14.25	0.900	0.0087	2.5000
3	-13.70	0.556	0.2835	0.8816
4	-14.67	0.608	0.1585	2.5493
5	No data for this fleet at this age			
6	-12.99	0.180	0.0822	1.5068
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			

Fbar	SIGMA(int.)	SIGMA(ext.)
1.475	0.162	0.132

SIGMA(overall)	Variance ratio
0.162	0.664

Age 8

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F
1	No data for this fleet at this age			
2	No data for this fleet at this age			
3	No data for this fleet at this age			
4	No data for this fleet at this age			
5	No data for this fleet at this age			
6	-12.88	0.354	0.0923	3.0666
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			

Fbar	SIGMA(int.)	SIGMA(ext.)
1.983	0.354	0.000

SIGMA(overall)	Variance ratio
0.354	0.000

Table 10.8 Total International Fishing Mortality Rate at Age of WHITING in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	0.051	0.017	0.011	0.017	0.012	0.021	0.033	0.033	0.025	0.045	0
1	0.396	0.326	0.289	0.398	0.229	0.180	0.435	0.161	0.235	0.104	1
2	0.544	0.719	0.822	0.873	0.783	0.956	0.517	0.429	0.502	0.454	2
3	0.577	0.611	1.064	1.059	1.005	1.257	0.872	0.644	0.757	0.836	3
4	0.706	0.588	0.636	1.007	0.984	1.041	0.985	0.853	0.707	1.008	4
5	0.626	0.959	1.407	0.365	1.025	0.879	0.949	0.761	0.905	1.248	5
6	0.384	1.122	0.999	1.866	2.136	1.238	1.087	1.183	0.989	1.185	6
7	0.820	1.966	1.497	1.161	1.063	0.973	0.852	1.621	1.012	1.238	7
8	0.839	0.788	1.570	0.881	1.013	0.489	2.524	1.575	1.307	2.274	8
9	0.675	1.082	1.216	1.036	1.202	1.925	1.280	1.199	0.983	1.411	9
10	0.675	1.082	1.216	1.036	1.202	1.925	1.280	1.199	0.983	1.411	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	0.062	0.013	0.058	0.019	0.011	0.016	0.008	0.019	0.008	0.010	0
1	0.174	0.181	0.209	0.223	0.189	0.265	0.139	0.344	0.113	0.186	1
2	0.337	0.289	0.457	0.493	0.273	0.426	0.506	0.432	0.419	0.471	2
3	0.763	0.520	0.735	0.812	0.688	0.727	0.882	0.664	0.690	0.832	3
4	0.984	0.734	0.731	1.028	0.905	1.184	1.293	0.991	0.842	0.965	4
5	1.111	0.894	0.924	1.047	1.196	1.062	1.447	1.167	1.647	1.267	5
6	1.286	1.152	0.979	1.298	1.327	1.335	1.643	1.362	1.653	1.371	6
7	1.601	0.916	1.278	1.243	1.549	1.476	1.907	0.754	1.436	1.475	7
8	1.236	1.132	1.234	1.251	2.061	1.495	1.907	0.738	2.504	1.983	8
9	1.244	0.966	1.029	1.173	1.408	1.310	1.640	1.002	1.616	1.412	9
10	1.244	0.966	1.029	1.173	1.408	1.310	1.640	1.002	1.616	1.412	10

Table 10.9 Stock Numbers at Age (1000's) of WHITING in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0	68556940	90667310	44711120	92400790	57429930	55823560	56804420	58843990	53916470	20633160	0
1	2852781	5089352	6960260	3453263	7091807	4432758	4267365	4292242	4447188	4107497	1
2	308203	742604	1420221	2016317	896748	2180768	1431304	1068253	1413094	1360381	2
3	48267	114111	230649	398162	537116	261266	534359	544255	443441	545375	3
4	276593	19108	43654	56087	97271	138539	52358	157494	201454	146642	4
5	31218	101139	7864	17113	15181	26941	36230	14485	49743	73608	5
6	7704	12998	30201	1500	9256	4244	8715	10920	5271	15670	6
7	1348	4086	3297	8663	181	852	959	2289	2606	1527	7
8	311	486	469	604	2221	51	264	335	371	776	8
9	906	110	181	80	205	660	26	17	57	82	9
10	58	1050	77	33	2	36	237	20	9	28	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
0	23619040	20696870	32383870	23211370	47562080	38899350	28474040	60588100	28725190	79457040	0
1	1539951	1733902	1594395	2386221	1778528	3673514	3066955	2205048	4641195	2224121	1
2	1431686	500432	559737	500138	738526	569597	1089726	1031677	604667	1602545	2
3	550805	651530	239071	226013	194736	358304	237302	418756	426866	253559	3
4	166636	181059	272924	80748	70680	68970	122077	69251	151851	150861	4
5	39637	46165	64396	97351	21402	21179	15638	24809	19037	48468	5
6	16465	10159	14712	19909	26614	5042	5704	2865	6017	2855	6
7	3732	3542	2500	4305	4235	5498	1033	859	572	898	7
8	363	616	1160	570	1017	737	1029	126	331	111	8
9	65	86	163	276	134	106	135	125	49	22	9
10	56	53	56	33	13	2	9	64	8		10

Table 10.10.1 North Sea Whiting RCT3 Results for age 0.

Analysis by RCT3 ver3.1 of data from file :

WHIIVO.RCX

WHITING IV RCRTINX2 INPUT VALUES; AGE 0; 1991 WG

Data for 13 surveys over 22 years : 1970 - 1991

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 = 1988

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.01	4.51	.35	.648	18	7.29	11.87	.487	.198
IYFS2	1.87	-.33	1.02	.181	18	6.79	12.38	1.297	.028
EGFS0	2.22	-1.49	1.39	.087	11	5.95	11.69	1.706	.016
EGFS1	3.45	-8.14	1.41	.086	12	5.69	11.49	1.686	.017
EGFS2	4.94	-12.80	2.21	.038	13	4.87	11.24	2.565	.007
SGFS0	2.79	-4.59	1.89	.034	6	6.47	13.46	3.157	.005
SGFS1	1.65	2.67	.59	.247	7	6.00	12.60	1.312	.027
SGFS2	.83	6.64	.29	.582	8	5.33	11.06	.435	.249
DGFS0	.40	7.61	.45	.359	8	6.45	10.20	.559	.151
DGFS1	3.95	-15.41	3.21	.014	9	6.96	12.06	3.959	.003
DGFS2	8.37	-35.14	8.66	.002	10	5.28	9.10	10.304	.000
GGFS1	.69	8.46	.65	.231	6	6.40	12.89	1.636	.018
GGFS2	.55	8.21	.63	.222	7	5.52	11.24	.920	.056
					VPA Mean =		10.52	.456	.226

Yearclass = 1989

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.99	4.60	.35	.644	18	6.23	10.78	.408	.229
IYFS2	1.78	.19	.97	.189	18	6.52	11.76	1.198	.027
EGFS0	2.19	-1.34	1.39	.086	11	7.07	14.13	2.200	.008
EGFS1	3.41	-7.93	1.42	.085	12	5.27	10.06	1.669	.014
EGFS2	4.23	-9.49	1.86	.052	13	4.36	8.92	2.235	.008
SGFS0	2.85	-4.88	1.94	.033	6	6.06	12.36	2.871	.005
SGFS1	1.68	2.56	.60	.242	7	5.42	11.64	.998	.038
SGFS2	.82	6.67	.28	.590	8	4.56	10.43	.355	.301
DGFS0	.40	7.59	.46	.355	8	7.54	10.64	.589	.110
DGFS1	3.83	-14.66	3.12	.015	9	6.87	11.63	3.844	.003
DGFS2									
GGFS1	.69	8.46	.65	.230	6	5.64	12.36	1.412	.019
GGFS2	.55	8.19	.64	.217	7	5.10	11.01	.893	.048
					VPA Mean =		10.49	.445	.192

Yearclass = 1990

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.97	4.70	.35	.636	18	6.92	11.43	.466	.320
IYFS2									
EGFS0	2.16	-1.17	1.39	.084	11	6.78	13.48	2.085	.016
EGFS1	3.38	-7.73	1.43	.082	12	5.81	11.88	1.790	.022
EGFS2									
SGFS0	2.91	-5.22	1.99	.031	6	7.57	16.80	4.890	.003
SGFS1	1.71	2.41	.61	.237	7	5.18	11.26	.917	.083
SGFS2									
DGFS0	.41	7.57	.47	.350	8	8.62	11.09	.674	.153
DGFS1									
DGFS2									
GGFS1	.69	8.47	.65	.230	6	5.78	12.45	1.479	.032
GGFS2									
					VPA Mean =		10.46	.432	.372

Yearclass = 1991

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	2.13	-.99	1.39	.083	11	5.12	9.91	1.699	.056
EGFS1									
EGFS2									
SGFS0	2.98	-5.61	2.06	.030	6	7.23	15.94	4.611	.008
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =		10.44	.417	.936

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	67667	11.12	.22	.20	.85		
1989	45087	10.72	.20	.16	.63		
1990	65840	11.09	.26	.25	.91		
1991	34480	10.45	.40	.35	.76		

Table 10.10.2 North Sea Whiting RCT3 Results for age 1.

Analysis by RCT3 ver3.1 of data from file :

WHIIV1.RCX

WHITING IV RCRTINX2 INPUT VALUES; AGE 1; 1991 WG

Data for 13 surveys over 22 years : 1970 - 1991

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 = 1988

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.01	1.95	.35	.658	18	7.29	9.28	.479	.197
IYFS2	1.86	-2.82	1.01	.185	18	6.79	9.78	1.283	.028
EGFS0	2.48	-5.48	1.57	.069	11	5.95	9.26	1.926	.012
EGFS1	3.66	-11.84	1.51	.077	12	5.69	8.97	1.797	.014
EGFS2	5.21	-16.67	2.34	.034	13	4.87	8.71	2.713	.006
SGFS0	2.49	-5.56	1.68	.039	6	6.47	10.55	2.811	.006
SGFS1	1.52	.68	.53	.273	7	6.00	9.83	1.188	.032
SGFS2	.82	4.09	.29	.571	8	5.33	8.47	.435	.239
DGFS0	.39	5.07	.45	.356	8	6.45	7.62	.551	.149
DGFS1	3.30	-13.76	2.68	.020	9	6.96	9.19	3.299	.004
DGFS2	8.78	-39.91	9.08	.002	10	5.28	6.46	10.801	.000
GGFS1	.59	6.15	.54	.284	6	6.40	9.95	1.354	.025
GGFS2	.49	5.86	.54	.265	7	5.52	8.55	.793	.072
					VPA Mean =	7.94		.458	.216

Yearclass = 1989

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.99	2.04	.34	.654	18	6.23	8.20	.400	.227
IYFS2	1.75	-2.27	.96	.195	18	6.52	9.16	1.178	.026
EGFS0	2.45	-5.35	1.58	.067	11	7.07	12.00	2.491	.006
EGFS1	3.62	-11.63	1.51	.075	12	5.27	7.45	1.779	.012
EGFS2	4.42	-12.97	1.94	.048	13	4.36	6.27	2.342	.007
SGFS0	2.54	-5.80	1.72	.037	6	6.06	9.56	2.552	.006
SGFS1	1.54	.58	.54	.268	7	5.42	8.95	.903	.045
SGFS2	.81	4.13	.28	.580	8	4.56	7.84	.355	.289
DGFS0	.40	5.06	.45	.353	8	7.54	8.05	.579	.109
DGFS1	3.18	-13.05	2.59	.021	9	6.87	8.83	3.188	.004
DGFS2									
GGFS1	.59	6.15	.54	.284	6	5.64	9.49	1.169	.027
GGFS2	.49	5.84	.55	.260	7	5.10	8.35	.769	.062
					VPA Mean =	7.91		.447	.183

Yearclass = 1990

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.97	2.16	.34	.647	18	6.92	8.84	.456	.319
IYFS2									
EGFS0	2.43	-5.20	1.58	.066	11	6.78	11.28	2.370	.012
EGFS1	3.58	-11.42	1.52	.073	12	5.81	9.39	1.909	.018
EGFS2									
SGFS0	2.59	-6.07	1.77	.036	6	7.57	13.51	4.339	.004
SGFS1	1.57	.46	.55	.263	7	5.18	8.60	.830	.096
SGFS2									
DGFS0	.40	5.04	.46	.349	8	8.62	8.48	.662	.152
DGFS1									
DGFS2									
GGFS1	.59	6.15	.54	.283	6	5.78	9.56	1.223	.044
GGFS2									
					VPA Mean =	7.88		.433	.355

Yearclass = 1991

	I----------Regression---------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	2.40	-5.05	1.59	.064	11	5.12	7.26	1.940	.044
EGFS1									
EGFS2									
SGFS0	2.65	-6.39	1.82	.034	6	7.23	12.73	4.083	.010
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =	7.85		.416	.947

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	5126	8.54	.21	.20	.84		
1989	3430	8.14	.19	.15	.63		
1990	4973	8.51	.26	.24	.90		
1991	2632	7.88	.40	.35	.76		

Table 10.10.3 North Sea Whiting RCT3 Results for Age 2.

Analysis by RCT3 ver3.1 of data from file :

WHIIV2.RCX

WHITING IV RCRTINX2 INPUT VALUES; AGE 2; 1991 WG

Data for 13 surveys over 22 years : 1970 - 1991

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 = 1988

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.98	.94	.32	.686	18	7.29	8.08	.447	.231
IYFS2	1.83	-3.84	.99	.189	18	6.79	8.59	1.263	.029
EGFS0	2.35	-5.96	1.48	.083	11	5.95	8.04	1.815	.014
EGFS1	3.32	-11.17	1.35	.095	12	5.69	7.71	1.614	.018
EGFS2	3.80	-11.18	1.67	.066	13	4.87	7.32	1.945	.012
SGFS0	1.62	-2.07	1.06	.105	6	6.47	8.40	1.764	.015
SGFS1	1.55	-.59	.54	.289	7	6.00	8.70	1.195	.032
SGFS2	.81	2.98	.27	.610	8	5.33	7.30	.410	.275
DGFS0	.47	3.42	.57	.262	8	6.45	6.45	.702	.094
DGFS1	6.94	-38.59	5.67	.005	9	6.96	9.65	6.985	.001
DGFS2	-30.26	171.10	31.33	.000	10	5.28	11.22	37.271	.000
GGFS1	.59	5.00	.51	.334	6	6.40	8.75	1.288	.028
GGFS2	.72	3.81	.88	.132	7	5.52	7.79	1.278	.028
					VPA Mean =	6.77		.456	.223

Yearclass = 1989

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.97	.97	.33	.675	18	6.23	7.03	.382	.252
IYFS2	1.76	-3.47	.96	.194	18	6.52	8.00	1.183	.026
EGFS0	2.33	-5.85	1.49	.081	11	7.07	10.64	2.350	.007
EGFS1	3.31	-11.13	1.37	.092	12	5.27	6.32	1.613	.014
EGFS2	3.45	-9.55	1.49	.081	13	4.36	5.46	1.795	.011
SGFS0	1.63	-2.13	1.07	.103	6	6.06	7.75	1.584	.015
SGFS1	1.57	-.69	.54	.285	7	5.42	7.81	.907	.045
SGFS2	.80	3.01	.27	.619	8	4.56	6.68	.335	.327
DGFS0	.48	3.38	.58	.257	8	7.54	6.97	.742	.067
DGFS1	6.47	-35.65	5.31	.006	9	6.87	8.80	6.527	.001
DGFS2									
GGFS1	.58	5.00	.51	.334	6	5.64	8.30	1.112	.030
GGFS2	.73	3.75	.90	.127	7	5.10	7.50	1.251	.023
					VPA Mean =	6.75		.447	.184

Yearclass = 1990

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.96	1.02	.33	.661	18	6.92	7.68	.445	.347
IYFS2									
EGFS0	2.31	-5.73	1.49	.080	11	6.78	9.96	2.240	.014
EGFS1	3.31	-11.11	1.40	.088	12	5.81	8.11	1.749	.023
EGFS2									
SGFS0	1.64	-2.18	1.08	.102	6	7.57	10.24	2.655	.010
SGFS1	1.59	-.81	.55	.280	7	5.18	7.45	.832	.099
SGFS2									
DGFS0	.48	3.33	.59	.252	8	8.62	7.49	.855	.094
DGFS1									
DGFS2									
GGFS1	.58	5.01	.52	.333	6	5.78	8.38	1.165	.051
GGFS2									
					VPA Mean =	6.72		.436	.362

Yearclass = 1991

Survey/ Series	Regression: Slope	Inter-cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	2.29	-5.60	1.50	.077	11	5.12	6.14	1.836	.049
EGFS1									
EGFS2									
SGFS0	1.65	-2.23	1.10	.101	6	7.23	9.69	2.455	.027
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =	6.69		.423	.924

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	1729	7.46	.21	.19	.76		
1989	1071	6.98	.19	.16	.66		
1990	1623	7.39	.26	.25	.88		
1991	852	6.75	.41	.36	.78		

Table 10.11 Mean Fishing Mortality , Biomass and Recruitment of WHITING in IV between 1971 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 0	
	2 to 6		0 to 4				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1971	0.411	0.134	0.061	520	220	71	68557
1972	0.578	0.141	0.116	603	269	72	90667
1973	0.671	0.169	0.159	921	381	73	44711
1974	0.581	0.136	0.294	682	441	74	92401
1975	0.838	0.220	0.142	1102	453	75	57430
1976	0.640	0.169	0.272	1036	581	76	55824
1977	0.565	0.118	0.217	1013	547	77	56804
1978	0.604	0.078	0.103	701	404	78	58844
1979	0.595	0.073	0.105	871	465	79	53916
1980	0.651	0.219	0.093	768	474	80	20633
1981	0.649	0.083	0.171	575	444	81	23619
1982	0.491	0.103	0.100	440	341	82	20697
1983	0.561	0.145	0.068	461	303	83	32384
1984	0.743	0.129	0.068	441	247	84	23211
1985	0.735	0.082	0.055	401	242	85	47562
1986	0.737	0.149	0.055	614	263	86	39899
1987	0.940	0.157	0.070	495	275	87	28474
1988	0.712	0.107	0.157	390	273	88	64780
1989	0.613	0.192	0.135	579	269	89	44169
1990	0.505	0.267	0.149	617	351	90	65840
Arit-mean recruits at age 0 for period 1971 to 1990							49521
Geom-mean recruits at age 0 for period 1971 to 1990							44972

Table 10.12 Input for catch prediction of WHITING in IV

	1990				Values used in Prediction							
	Stock and Fishing Mortality				F at age , Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F			Mean values for period 1986 to 1990				
Age	Stock	Fishing Mortality			1986 to 1990			Mean Weight (Kg.)				Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
0	65840020	0.000	0.002	0.010	0.000	0.002	0.014	0.138	0.026	0.013	0.016	0.000
1	3430001	0.003	0.081	0.110	0.002	0.072	0.150	0.194	0.091	0.055	0.077	0.034
2	1729002	0.076	0.203	0.164	0.067	0.180	0.222	0.225	0.151	0.122	0.153	0.292
3	253559	0.275	0.217	0.340	0.328	0.192	0.234	0.265	0.190	0.207	0.230	0.622
4	150861	0.555	0.267	0.143	0.672	0.168	0.147	0.305	0.204	0.275	0.283	0.784
5	48468	0.698	0.468	0.101	0.901	0.184	0.130	0.352	0.226	0.372	0.334	0.834
6	2855	0.954	0.174	0.242	1.144	0.050	0.172	0.411	0.235	0.467	0.406	0.953
7	898	1.220	0.195	0.060	1.141	0.043	0.102	0.472	0.290	0.506	0.461	0.965
8	111	1.941		0.042	1.369	0.044	0.180	0.568	0.277	0.652	0.560	0.966
9	22	1.412			1.225		0.019	0.694		0.701	0.693	1.000
10		1.412			1.225		0.019	0.650			0.650	1.000

Mean F	Age 2 to 6	Age 0 4	Age 2 to 6	Age 0 4
Unscaled	0.777	0.153	0.876	0.113
Scaled			0.777	0.153

Recruits at age 0 in 1991 = 34480000
Recruits at age 0 in 1992 = 34200070
Recruits at age 0 in 1993 = 34200070
Recruits at age 0 in 1994 = 34200070

M at age and proprtion mature at age are as shown in Table 10.3

Mean F for ages 2 to 6 in 1990 for human consumption landings + discards = 0.777 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1990

Mean F for ages 0 to 4 in 1990 for small-mesh fisheries = 0.153 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 0 to 4 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 0
Age 1
Age 2

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 10.13.1 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1991 to 1992

	Year										
	1990	1991	1992								
Biomass 1 Jan of Year											
Total	617	760	622	622	622	622	622	622	622	622	622
Spawning	351	400	422	422	422	422	422	422	422	422	422
Mean F Ages											
Human Cons. 2 to 6	0.78	0.78	0.00	0.16	0.31	0.47	0.62	0.78	0.93	0.00	0.00
Small-mesh 0 to 4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.00	0.00
Mean F(Year)/Mean F(1990)										F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	42	68	0	18	34	49	62	73	84	0	0
Discards	54	58	0	12	23	34	44	53	62	0	0
Small-mesh Fisheries	51	70	72	69	67	65	64	62	60	0	0
Total landings	93	139	72	88	102	114	125	135	144	0	0
Total catch	147	196	72	99	125	148	169	188	206	0	0
Biomass 1 Jan of Year+1											
Total	760	622	650	623	598	576	555	537	520	0	0
Spawning	400	422	460	432	408	386	366	347	331	0	0

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
0	34480000	2	19331	169212	188545
1	5080490	7659	214876	447147	669681
2	1092354	51584	125277	158402	335262
3	708229	138739	84244	100520	323503
4	77773	28801	7949	6436	43186
5	42600	20247	4019	2896	27162
6	10636	6000	296	909	7206
7	565	336	12	30	378
8	168	107	4	14	125
9	13	8		0	8
10	4	3		0	3
Wt	760357	68464	57643	70159	196266

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	34200070	2	19174	167838	187014
1	2651655	3997	112150	233379	349526
2	1570535	74165	180117	227742	482024
3	435624	85337	51817	61829	198983
4	234673	86905	23985	19420	130309
5	21465	10202	2025	1459	13687
6	9847	5556	274	842	6672
7	2112	1256	46	112	1414
8	128	81	3	11	95
9	28	18		0	18
10	4	3		0	3
Wt	622099	73143	53220	61908	188272

Table 10.13.2 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1991 to 1992

	Year										
	1990	1991	1992								
Biomass 1 Jan of Year											
Total	617	760	651	651	651	651	651	651	651	651	651
Spawning	351	400	450	450	450	450	450	450	450	450	450
Mean F Ages											
Human Cons. 2 to 6	0.78	0.54	0.00	0.16	0.31	0.47	0.62	0.78	0.93	0.00	0.00
Small-mesh 0 to 4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.00	0.00
Mean F(Year)/Mean F(1990)										F0.1	Fmax
Human Consumption	1.00	0.70	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	42	52	0	20	39	55	69	82	93	0	0
Discards	54	42	0	13	24	35	46	56	65	0	0
Small-mesh Fisheries	51	73	75	73	71	69	67	65	63	0	0
Total landings	93	124	75	93	109	123	136	147	157	0	0
Total catch	147	166	75	106	134	159	181	202	221	0	0
Biomass 1 Jan of Year+1											
Total	760	651	672	641	614	590	568	548	530	0	0
Spawning	400	450	481	451	424	400	378	358	340	0	0

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
0	34480000	1	13534	169236	182771
1	5080490	5410	151780	451211	608401
2	1092354	37273	90523	163511	291307
3	708229	103629	62925	107259	273813
4	77773	22330	6163	7128	35621
5	42600	16115	3199	3293	22607
6	10636	4820	238	1043	6101
7	565	270	10	34	315
8	168	88	3	16	107
9	13	7		0	7
10	4	2		0	2
Wt	760357	51547	41872	72807	166225

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	34200070	2	19174	167838	187014
1	2652894	3999	112202	233488	349690
2	1605999	75839	184185	232885	492909
3	469211	91917	55813	66590	214325
4	274301	101580	28035	22699	152314
5	27619	13127	2606	1878	17610
6	13637	7693	380	1166	9239
7	3022	1797	66	160	2023
8	182	116	4	15	135
9	43	28		0	28
10	6	4		0	4
Wt	650630	81935	55590	64765	202290

Table 11.1.1 Nominal catch (tonnes) of WHITING in Division VIa, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	+	-	2	-	-
Denmark	32	-	+	-	-
France	2,609	1,637	1,798	2,029	1,887
Germany, Fed.Rep.	1	49	53	43	6
Ireland	4,407	8,148	3,406	3,578	3,454
Netherlands	2	6	285	811	-
Spain	-	-	99	76	40
UK (England & Wales)	227	145	166	157	162
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	-	-	-	52	40
UK (Scotland)	7,386	8,519	8,419	10,019	11,270
Total	14,664	18,504	14,235	16,765	16,859

Country	1985	1986	1987	1988	1989	1990
Belgium	3	-	4	3	1	-
Denmark	-	-	5	-	1	+[1]
France	1,502	829	1,644	1,249	199[1,2]	n/a
Germany, Fed. Rep.	9	1	+	4	+	-[1]
Ireland	1,917	1,683	2,868	2,640	n/a	n/a
Netherlands	14	-	-	n/a	-	-
Spain	61	-	-	-	n/a	n/a
UK (England & Wales	63	26	62	30	83	82
UK (Isle of Man)	-	-	-	-	2	n/a
UK (N. Ireland)	17	5	13	89	18	73
UK (Scotland)	9,051	5,848	7,803	7,864	6,047	4,718
Total	12,637	8,392	12,399	11,879		

[1]Preliminary.
[2]Includes Divisions Vb(EC) and VIb.
n/a = Not available.

Table 11.1.2 Annual Weight and Numbers of WHITING caught in VIA between 1971 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1971	16	16	0	0	52	52	0	0
1972	15	15	0	0	50	50	0	0
1973	17	17	0	0	62	62	0	0
1974	17	17	0	0	72	72	0	0
1975	20	20	0	0	71	71	0	0
1976	25	25	0	0	90	90	0	0
1977	17	17	0	0	63	63	0	0
1978	15	15	0	0	54	54	0	0
1979	17	17	0	0	61	61	0	0
1980	13	13	0	0	45	45	0	0
1981	12	12	0	0	46	46	0	0
1982	14	14	0	0	48	48	0	0
1983	16	16	0	0	49	49	0	0
1984	16	16	0	0	50	50	0	0
1985	13	13	0	0	43	43	0	0
1986	8	8	0	0	31	31	0	0
1987	12	12	0	0	41	41	0	0
1988	11	11	0	0	41	41	0	0
1989	8	8	0	0	27	27	0	0
1990	6	6	0	0	19	19	0	0

Table 11.1.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	1.000
3	0.200	1.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000

Table 11.1.4 Total International Catch at Age (1000's) of WHITING in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	2387	16777	14078	9083	14917	8500	16120	17670	6334	11650	1
2	8617	12028	36142	51036	16778	46421	13376	18175	34221	11378	2
3	4122	4013	5592	10049	36318	15757	25144	6682	13282	14860	3
4	34784	1363	1461	1166	2819	17423	3127	9400	3407	4155	4
5	1338	14796	357	180	281	1508	4719	941	3488	1244	5
6	240	793	4292	52	57	66	292	1433	276	1085	6
7	223	148	310	849	245	57	24	68	384	190	7

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	3593	2991	3418	7209	4139	2674	6430	1842	2529	3203	1
2	24395	5783	7094	12765	19520	14824	13935	20587	5887	8028	2
3	11297	29094	8040	8221	8574	9770	13988	9638	11889	2393	3
4	4611	6821	22757	4387	3351	2653	5442	6168	4767	4009	4
5	1518	2043	6070	14825	1997	532	837	1949	1266	1326	5
6	452	803	1439	1953	4764	291	330	290	468	204	6
7	201	348	540	858	822	529	259	207	71	37	7

Table 11.1.5 Total International Mean Weight at Age (Kg.) of WHITING in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	0.209	0.211	0.196	0.193	0.209	0.201	0.200	0.199	0.218	0.172	1
2	0.247	0.258	0.235	0.215	0.245	0.242	0.244	0.235	0.232	0.242	2
3	0.276	0.345	0.362	0.317	0.305	0.309	0.296	0.286	0.306	0.330	3
4	0.316	0.368	0.479	0.444	0.471	0.361	0.392	0.389	0.404	0.420	4
5	0.426	0.426	0.485	0.591	0.651	0.497	0.431	0.516	0.536	0.492	5
6	0.551	0.494	0.532	0.641	0.615	0.687	0.629	0.549	0.678	0.595	6
7	0.712	0.638	0.666	0.584	0.717	0.856	0.819	0.612	0.693	0.817	7

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.192	0.184	0.216	0.216	0.185	0.174	0.188	0.176	0.171	0.225	1
2	0.228	0.220	0.249	0.259	0.238	0.236	0.237	0.215	0.220	0.251	2
3	0.289	0.276	0.280	0.313	0.306	0.294	0.304	0.301	0.279	0.324	3
4	0.382	0.352	0.340	0.371	0.402	0.365	0.373	0.400	0.348	0.359	4
5	0.409	0.505	0.409	0.412	0.430	0.468	0.511	0.483	0.459	0.417	5
6	0.409	0.513	0.494	0.458	0.461	0.482	0.520	0.567	0.425	0.583	6
7	0.547	0.526	0.510	0.458	0.538	0.499	0.576	0.600	0.555	0.544	7

Table 11.1.6 Survey indices used to estimate recruitment for Whiting in VIa.

WHITING VIa RCT3 INPUT VALUES; 1991 WG

'YEARCLASS'	'SWFS1'	'SWFS2'
1979	-1	246.7
1980	212.4	14.1
1981	35.2	51.9
1982	142.8	-1
1983	-1	179.2
1984	314	152.6
1985	145.6	105.4
1986	693.8	346.9
1987	56.7	50.5
1988	91	57.2
1989	181.8	27.7
1990	320.3	-1

Table 11.1.7 Residuals from separable VPA for Whiting in VIa.

Title : WHITING VIA At 15:23:31 on 11-OCT-91

Separable analysis
from 1965 to 1990 on ages 0 to 7
with Terminal F of 1.049 on age 4 and Terminal S of 1.000

Matrix of Residuals

Years	1965/66	1966/67	1967/68	1968/69	1969/70
Ages					
0/ 1	-5.029	-5.735	-6.344	-4.303	-4.376
1/ 2	0.788	-1.154	0.137	-0.022	-0.988
2/ 3	0.738	0.094	0.795	0.321	-0.618
3/ 4	-0.242	0.853	0.377	0.502	0.030
4/ 5	0.141	0.218	-0.074	0.177	0.248
5/ 6	-0.148	0.340	0.136	-0.013	0.548
6/ 7	0.027	-0.164	-0.199	-0.304	0.673
	0.000	0.000	0.000	0.000	0.000
WTS	1.000	1.000	1.000	1.000	1.000

Years	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
Ages										
0/ 1	-5.002	-6.937	-6.847	-6.897	-7.173	-0.774	-2.907	-3.233	-3.969	-2.858
1/ 2	-0.930	-0.127	0.571	-0.395	0.524	0.206	0.515	0.935	0.564	0.451
2/ 3	0.490	0.685	0.436	0.464	-0.146	-0.232	-0.087	0.155	-0.016	0.339
3/ 4	-0.586	0.565	0.155	0.186	0.280	-0.065	0.380	-0.043	-0.116	0.217
4/ 5	0.379	0.154	0.296	0.502	0.254	-0.354	-0.125	0.005	0.046	-0.088
5/ 6	0.440	-0.270	0.082	0.204	-0.119	0.368	0.095	-0.104	0.190	-0.014
6/ 7	0.391	0.206	-0.240	-0.213	0.565	0.255	-0.083	0.076	0.156	-0.155
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Years	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90		WTS
Ages												
0/ 1	-0.344	-1.469	-5.228	-6.065	-5.612	-5.890	-5.951	-4.789	-5.265	-5.730	*******	0.118
1/ 2	0.199	0.819	0.853	0.252	0.418	-0.508	-0.093	0.245	0.053	-0.145	3.167	0.390
2/ 3	-0.518	-0.290	-0.040	-0.079	0.230	-0.130	0.099	0.174	0.084	0.218	3.167	0.620
3/ 4	0.237	0.020	0.157	0.252	0.258	-0.141	0.195	0.139	-0.296	-0.146	3.167	0.742
4/ 5	-0.055	0.218	-0.087	-0.064	-0.015	0.356	0.621	0.177	0.389	-0.154	3.167	0.974
5/ 6	-0.123	-0.023	0.080	0.562	0.237	0.340	-0.138	0.110	0.117	0.270	3.167	1.000
6/ 7	0.406	-0.243	0.281	-0.027	-0.079	0.557	0.093	-0.033	0.388	0.834	3.167	0.704
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-99.725	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1965	1966	1967	1968	1969	1970
F-values	0.5891	0.5301	0.7295	0.7692	0.7501	0.5632

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
F-values	0.7456	1.0160	1.2890	0.9887	0.9426	1.1579	0.9394	0.7913	0.7825	0.6136

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
F-values	0.4096	0.3841	0.5761	0.7976	1.0079	0.6112	0.8481	1.0908	1.2034	1.0491

Selection-at-age (S)

	0	1	2	3	4	5	6	7
S-values	0.0009	0.1044	0.5628	0.8633	1.0000	1.0845	1.1346	1.0000

Table 11.1.8 VPA tuning summary statistics for Whiting in VIa.

```
VPA Version 2.1 - May 1988
WHITING VIA
with cpue data from file WHVIAEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,SCOTRL              , has terminal q estimated as the mean
Fleet  2 ,SCOSEI              , has terminal q estimated as the mean
Fleet  3 ,SCOLTR              , has terminal q estimated as the mean
Fleet  4 ,SCONTR              , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd
regression weights  , 0.020, 0.116, 0.284, 0.482, 0.670, 0.820, 0.921, 0.976, 0.997, 1.000
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions

Age  1

                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised
       ,   q    ,      ,   F   ,  F
-------,--------,------,-------,------
    1  , No data for this fleet at this age
    2  ,-14.59  , 0.304,0.0127 ,0.0648
    3  ,-16.21  , 0.428,0.0154 ,0.0982
    4  ,-16.82  , 0.590,0.0194 ,0.0462
     Fbar      SIGMA(int.)     SIGMA(ext.)
    0.083        0.228           0.176
                SIGMA(overall)  Variance ratio
                  0.228            0.593

Age  2

                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised
       ,   q    ,      ,   F   ,  F
-------,--------,------,-------,------
    1  ,-15.04  , 0.974,0.0016 ,2.4414
    2  ,-12.56  , 0.310,0.0971 ,0.4095
    3  ,-14.06  , 0.256,0.1333 ,0.4304
    4  ,-16.10  , 0.344,0.0399 ,0.5931
     Fbar      SIGMA(int.)     SIGMA(ext.)
    0.511        0.169           0.185
                SIGMA(overall)  Variance ratio
                  0.185            1.203

Age  3

                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised
       ,   q    ,      ,   F   ,  F
-------,--------,------,-------,------
    1  ,-13.55  , 0.688,0.0074 ,3.5638
    2  ,-12.26  , 0.226,0.1304 ,0.6195
    3  ,-13.57  , 0.137,0.2168 ,0.7618
    4  ,-16.25  , 0.364,0.0341 ,1.7800
     Fbar      SIGMA(int.)     SIGMA(ext.)
    0.809        0.110           0.210
                SIGMA(overall)  Variance ratio
                  0.210            3.637

Age  4

                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised
       ,   q    ,      ,   F   ,  F
-------,--------,------,-------,------
    1  ,-12.86  , 0.523,0.0147 ,2.3966
    2  ,-12.12  , 0.432,0.1503 ,0.7417
    3  ,-13.42  , 0.143,0.2517 ,0.8575
    4  ,-16.18  , 0.543,0.0365 ,2.3757
     Fbar      SIGMA(int.)     SIGMA(ext.)
    0.972        0.128           0.193
                SIGMA(overall)  Variance ratio
                  0.193            2.272

Age  5

                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised
       ,   q    ,      ,   F   ,  F
-------,--------,------,-------,------
    1  ,-13.04  , 0.864,0.0122 ,1.6026
    2  ,-12.32  , 0.327,0.1234 ,0.6343
    3  ,-13.59  , 0.321,0.2116 ,0.7945
    4  ,-16.60  , 0.836,0.0241 ,3.6488
     Fbar      SIGMA(int.)     SIGMA(ext.)
    0.862        0.214           0.260
                SIGMA(overall)  Variance ratio
                  0.260            1.470
```

Table 11.1.9 Total International Fishing Mortality Rate at Age of WHITING in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	0.089	0.219	0.081	0.158	0.111	0.193	0.234	0.186	0.090	0.066	1
2	0.755	0.831	1.011	0.465	0.485	0.583	0.522	0.448	0.651	0.230	2
3	1.005	1.019	1.310	0.903	0.717	1.232	0.740	0.541	0.699	0.667	3
4	0.811	1.195	1.519	1.174	0.702	0.947	0.896	0.694	0.592	0.490	4
5	0.588	1.042	1.326	0.786	1.076	1.083	0.742	0.763	0.607	0.448	5
6	0.650	0.861	1.050	0.697	0.618	0.808	0.627	0.527	0.530	0.383	6
7	0.650	0.861	1.050	0.697	0.618	0.808	0.627	0.527	0.530	0.383	7

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.103	0.096	0.090	0.124	0.074	0.058	0.112	0.128	0.099	0.083	1
2	0.192	0.238	0.342	0.559	0.570	0.410	0.475	0.619	0.751	0.511	2
3	0.375	0.366	0.606	0.948	0.942	0.633	0.867	0.716	0.921	0.809	3
4	0.447	0.409	0.547	0.806	1.085	0.896	0.913	1.337	0.992	0.972	4
5	0.333	0.365	0.788	0.859	1.154	0.484	0.819	1.052	1.222	0.862	5
6	0.290	0.295	0.475	0.639	0.765	0.496	0.637	0.771	0.797	0.648	6
7	0.290	0.295	0.475	0.639	0.765	0.496	0.637	0.771	0.797	0.648	7

Table 11.1.10 Stock Numbers at Age (1000's) of WHITING in VIA between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	30960	93753	199181	68321	156589	53295	85017	114774	81337	200831	1
2	17714	23195	61658	150376	47753	114754	35980	55101	78056	60880	2
3	7057	6815	8272	18367	77369	24062	52421	17479	28816	33324	3
4	68161	2115	2014	1827	6093	30921	5747	20480	8328	11732	4
5	3286	24800	524	361	462	2472	9819	1921	8373	3770	5
6	549	1494	7163	114	135	129	685	3828	734	3735	6
7	509	279	518	1844	580	112	55	181	1021	654	7

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	40554	36141	43591	67913	63558	52245	66580	16868	29605	44106	1
2	153914	29962	26892	32606	49104	48302	40361	48714	12150	21958	2
3	39605	104048	19328	15645	15271	22735	26246	20555	21475	4695	3
4	14007	22284	59065	8634	5486	4875	9881	9031	8225	7003	4
5	5883	7334	12125	27985	3158	1518	1630	3247	1941	2497	5
6	1971	3453	4170	4514	9708	815	765	589	928	468	6
7	879	1499	1564	1985	1675	1480	600	420	140	86	7

Table 11.1.11.1 Whiting in VIa RCT3 Results for Age 1.

Analysis by RCT3 ver3.1 of data from file :

WHI6A10.RCX

WHITING VIa RCRTINX2 INPUT VALUES; AGE 1; 1991 WG

Data for 2 surveys over 12 years : 1979 - 1990

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 = 1988

	I----------Regression----------				I	I----------Prediction----------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	.62	7.50	.45	.572	7	4.52	10.32	.587	.477
SWFS2	1.06	5.96	.90	.410	8	4.06	10.28	1.133	.128
					VPA Mean =		10.86	.646	.395

Yearclass = 1989

	I----------Regression----------				I	I----------Prediction----------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	.63	7.49	.45	.577	7	5.21	10.75	.583	.488
SWFS2	1.06	5.94	.89	.411	8	3.36	9.51	1.232	.109
					VPA Mean =		10.85	.642	.403

Yearclass = 1990

	I----------Regression----------				I	I----------Prediction----------			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	.63	7.47	.46	.584	7	5.77	11.10	.615	.518
SWFS2									
					VPA Mean =		10.84	.638	.482

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	37358	10.53	.41	.19	.21		
1989	42346	10.65	.41	.28	.49		
1990	58306	10.97	.44	.13	.09		

Table 11.1.11.2 Whiting in VIa RCT3 Results for age 2.

Analysis by RCT3 ver3.1 of data from file :

WHI6A20.RCX

WHITING VIa RCRTINX2 INPUT VALUES; AGE 2; 1991 WG

Data for 2 surveys over 12 years : 1979 - 1990

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 = 1988

	Regression					Prediction			
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	.66	7.04	.49	.547	7	4.52	10.01	.637	.449
SWFS2	1.10	5.50	.93	.401	8	4.06	9.97	1.178	.131
					VPA Mean =		10.56	.659	.420

Yearclass = 1989

	Regression					Prediction			
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	.66	7.02	.49	.552	7	5.21	10.46	.633	.459
SWFS2	1.10	5.49	.93	.401	8	3.36	9.17	1.282	.112
					VPA Mean =		10.55	.655	.429

Yearclass = 1990

	Regression					Prediction			
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SWFS1	.66	7.00	.49	.558	7	5.77	10.83	.668	.487
SWFS2									
					VPA Mean =		10.54	.651	.513

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	27891	10.24	.43	.20	.21		
1989	31427	10.36	.43	.30	.48		
1990	43571	10.68	.47	.14	.10		

Table 11.1.12 Mean Fishing Mortality , Biomass and Recruitment of WHITING in VIA between 1971 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 1	
	2 to 4		2 to 4				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1971	0.857	0.000	0.000	36	30	70	31
1972	1.015	0.000	0.000	40	21	71	94
1973	1.280	0.000	0.000	62	23	72	199
1974	0.847	0.000	0.000	54	40	73	68
1975	0.635	0.000	0.000	72	39	74	157
1976	0.921	0.000	0.000	58	48	75	53
1977	0.719	0.000	0.000	48	31	76	85
1978	0.561	0.000	0.000	52	29	77	115
1979	0.647	0.000	0.000	54	36	78	81
1980	0.462	0.000	0.000	70	35	79	201
1981	0.338	0.000	0.000	63	56	80	41
1982	0.338	0.000	0.000	56	49	81	36
1983	0.498	0.000	0.000	49	40	82	44
1984	0.737	0.000	0.000	46	31	83	68
1985	0.866	0.000	0.000	37	25	84	64
1986	0.646	0.000	0.000	31	22	85	52
1987	0.751	0.000	0.000	35	23	86	67
1988	0.891	0.000	0.000	25	22	87	17
1989	0.888	0.000	0.000	19	13	88	37
1990	0.720	0.000	0.000	22	12	89	42
Arit-mean recruits at age 1 for period 1971 to 1990							78
Geom-mean recruits at age 1 for period 1971 to 1990							64

Table 11.1.13 Input for catch prediction of WHITING in VIA

	1990 Stock and Fishing Mortality				Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery						
					Scaled mean F 1986 to 1990			Mean values for period 1986 to 1990			
								Mean Weight (Kg.)			Prop.
Age	Stock Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	42346	0.093			0.092			0.187			0.187	1.000
2	27891	0.527			0.520			0.232			0.232	1.000
3	4695	0.809			0.779			0.301			0.301	1.000
4	7003	0.972			1.009			0.369			0.369	1.000
5	2497	0.862			0.877			0.468			0.468	1.000
6	468	0.648			0.661			0.515			0.515	1.000
7	86	0.648			0.661			0.555			0.555	1.000

	Mean F	Age 2 to 4	Age 2 4	Age 2 to 4	Age 2 4
	Unscaled	0.769	0.000	0.779	0.000
	Scaled			0.769	0.000

Recruits at age 1 in 1991 = 58306
Recruits at age 1 in 1992 = 51021
Recruits at age 1 in 1993 = 51021
Recruits at age 1 in 1994 = 51021

M at age and proprtion mature at age are as shown in Table 11.1.3

Mean F for ages 2 to 4 in 1990 for human consumption landings + discards = 0.769 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1990

Mean F for ages 2 to 4 in 1990 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1980 to 1990 .
rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 11.1.14.1 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in VIA 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	22	24	27	27	27	27	27	27	27	27	27	27
Spawning	12	14	17	17	17	17	17	17	17	17	17	17
Mean F Ages												
Human Cons. 2 to 4	0.77	0.77	0.00	0.15	0.31	0.46	0.62	0.77	0.92	0.00	0.00	
Small-mesh 2 to 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	6	7	0	2	4	6	7	8	9	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	6	7	0	2	4	6	7	8	9	0	0	
Total catch	6	7	0	2	4	6	7	8	9	0	0	
Biomass 1 Jan of Year+1												
Total	24	27	37	35	33	31	29	28	27	0	0	
Spawning	14	17	28	25	23	21	20	18	17	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	58306	4635			4635
2	31596	11713			11713
3	13485	6700			6700
4	1711	1002			1002
5	2169	1164			1164
6	864	383			383
7	201	89			89
Wt	24474	6756	0	0	6756

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	51021	4056			4056
2	43556	16146			16146
3	15379	7641			7641
4	5065	2965			2965
5	511	274			274
6	739	328			328
7	450	199			199
Wt	26992	8300	0	0	8300

Table 11.1.14.2 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in VIA 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	22	24	29	29	29	29	29	29	29	29	29	29
Spawning	12	14	19	19	19	19	19	19	19	19	19	19
Mean F Ages												
Human Cons. 2 to 4	0.77	0.54	0.00	0.15	0.31	0.46	0.62	0.77	0.92	0.00	0.00	
Small-mesh 2 to 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)										F0.1	Fmax	
Human Consumption	1.00	0.70	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	6	5	0	2	4	6	8	9	10	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	6	5	0	2	4	6	8	9	10	0	0	
Total catch	6	5	0	2	4	6	8	9	10	0	0	
Biomass 1 Jan of Year+1												
Total	24	29	39	36	34	32	30	29	27	0	0	
Spawning	14	19	29	27	24	22	21	19	18	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	58306	3288			3288
2	31596	8791			8791
3	13485	5184			5184
4	1711	795			795
5	2169	911			911
6	864	292			292
7	201	68			68
Wt	24474	5118	0	0	5118

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	51021	4056			4056
2	44770	16596			16596
3	17975	8931			8931
4	6399	3746			3746
5	691	371			371
6	961	426			426
7	549	243			243
Wt	28800	9201	0	0	9201

Table 11.2.1 Nominal catch (tonnes) of WHITING in Division VIb, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Denmark	...[2]	-	-	-	-	-	-	-	-	-	-
France	3	-	-	-	3	2	-	-	-	...[1,2]	n/a
Spain	-	196	112	88	16	123	-	-	-	n/a	n/a
UK(Engl. & Wales)	+	-	-	+	2	+	5	4	-	2	5
UK (N. Ireland)	-	-	-	-	-	-	-	-	-	15	-
UK(Scotland)	59	+	-	5	25	6	13	108	23	18	482
Total	62	196	112	93	46	131	18	112	23	35	

[1]Provisional.
[2]Included in Division VIa.
n/a = Not available.

Table 12.1.1 Nominal catch (tonnes) of WHITING in Division VIId, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	52	88	93	84	79
Denmark	-	2	-	-	-
France	7,110	8,145	7,012	5,057	6,914
Netherlands	-	1	2	1	-
UK(England and Wales)	122	120	170	198	88
Total	7,284	8,356	7,277	5,340	7,081

Country	1985	1986	1987	1988	1989	1990[1]
Belgium	82	65	136	69	38	83
Denmark	-	-	-	-	-	-
France	7,563	4,551	6,730	7,501	n/a	n/a
Netherlands	-	...[2]	-	n/a	-	n/a
UK(England and Wales)	186	180	287	251	231	237
UK (Scotland)	-	-	-	-	-	1
Total	7,831	4,796	7,153	7,821		

[1]Provisional.
[2]Included in Division VIIe.
n/a = Not available.

Table 12.1.2 Annual Weight and Numbers of WHITING caught in 7D between 1976 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1976	7.72	7.72	0.00	0.00	27	27	0	0
1977	4.95	4.95	0.00	0.00	21	21	0	0
1978	9.11	9.11	0.00	0.00	38	38	0	0
1979	8.91	8.91	0.00	0.00	36	36	0	0
1980	9.17	9.17	0.00	0.00	36	36	0	0
1981	8.93	8.93	0.00	0.00	34	34	0	0
1982	7.91	7.91	0.00	0.00	33	33	0	0
1983	6.94	6.94	0.00	0.00	29	29	0	0
1984	7.37	7.37	0.00	0.00	33	33	0	0
1985	7.34	7.34	0.00	0.00	34	34	0	0
1986	5.50	5.50	0.00	0.00	23	23	0	0
1987	4.69	4.69	0.00	0.00	18	18	0	0
1988	4.43	4.43	0.00	0.00	18	18	0	0
1989	4.16	4.16	0.00	0.00	16	16	0	0
1990	3.48	3.48	0.00	0.00	15	15	0	0

Table 12.1.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.530
3	0.200	0.840
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000

Table 12.1.4 Total International Catch at Age (1000's) of WHITING in 7D between 1976 and 1990

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	529	1351	1105	413	163	952	3199	3441	4105	493	1
2	9774	6717	6763	8072	5742	9204	10391	12546	12308	14184	2
3	6190	10329	18945	14018	16492	10274	14132	8486	13266	15979	3
4	8590	1099	9770	10512	7365	8548	3151	3537	2274	2494	4
5	1800	1301	579	2358	4806	3308	1553	1229	1075	578	5
6	430	336	650	98	776	1275	453	154	317	203	6
7	7	26	130	116	138	717	68	63	45	29	7
8	101	15	4	14	28	2	5	14	22	36	8

Age	1986	1987	1988	1989	1990	Age
1	228	2160	1753	1193	237	1
2	3661	6132	10713	6337	8955	2
3	11455	1667	4058	7351	3052	3
4	6774	7442	572	1130	2133	4
5	1015	493	807	42	302	5
6	274	248	35	129	2	6
7	61	43	10	10	5	7
8	18	11			4	8

Table 12.1.5 Total International Mean Weight at Age (Kg.) of WHITING in 7D between 1976 and 1990

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	0.220	0.191	0.280	0.189	0.157	0.150	0.146	0.174	0.172	0.137	1
2	0.225	0.179	0.215	0.205	0.211	0.229	0.197	0.211	0.194	0.167	2
3	0.284	0.242	0.223	0.247	0.243	0.278	0.257	0.258	0.239	0.242	3
4	0.312	0.352	0.275	0.272	0.286	0.272	0.318	0.296	0.310	0.301	4
5	0.414	0.357	0.328	0.325	0.312	0.264	0.346	0.307	0.261	0.318	5
6	0.381	0.378	0.319	0.398	0.347	0.305	0.410	0.376	0.305	0.290	6
7	0.467	0.475	0.328	0.357	0.309	0.331	0.436	0.324	0.379	0.477	7
8	0.481	0.468	0.721	0.458	0.444	1.046	0.575	0.602	0.388	0.388	8

Age	1986	1987	1988	1989	1990	Age
1	0.131	0.192	0.183	0.176	0.152	1
2	0.164	0.219	0.215	0.210	0.206	2
3	0.228	0.256	0.319	0.287	0.265	3
4	0.268	0.298	0.356	0.371	0.318	4
5	0.310	0.369	0.355	0.405	0.369	5
6	0.335	0.322	0.466	0.484	0.409	6
7	0.415	0.369	0.458	0.530	0.402	7
8	0.451	0.759			0.475	8

Table 12.1.6

WHITING IN THE EASTERN CHANNEL (7D)

Separable analysis
from 1976 to 1990 on ages 0 to 6
with Terminal F = 1.000 on age 3 and Terminal S = 1.000

Initial sum of squared residuals was1406.382
Final sum of squared residuals is 370.549 after 64 iterations

Matrix of Residuals

Years	1976/77	1977/78	1978/79	1979/80
Ages				
0/ 1	-6.003	-4.923	-4.435	-3.225
1/ 2	-.685	1.104	.235	-.141
2/ 3	-.009	-.138	-.335	-.066
3/ 4	.872	.100	.082	.397
4/ 5	.658	.350	.550	.180
5/ 6	.161	.141	.634	.249
	.000	.000	.000	.000
WTS	1.000	1.000	1.000	1.000

Years	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90		WTS
Ages												
0/ 1	-4.654	-6.254	-6.559	-6.511	-4.581	1.638	-5.677	-3.559	-5.433	-3.990	-64.168	.180
1/ 2	-1.261	-.027	.778	1.078	.930	.330	-.815	.492	.859	-.009	2.869	.505
2/ 3	.250	-.096	.316	.257	-.136	.491	1.101	.291	.334	.610	2.869	1.000
3/ 4	.526	.418	.369	.523	.654	.006	-.460	-.400	-.070	-.150	2.869	.947
4/ 5	.294	.495	-.547	-.055	-.126	-.417	1.237	.168	.695	-.615	2.869	.718
5/ 6	.604	.567	.601	-.100	-.046	-.773	-.140	.420	-.261	.814	2.869	.854
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-49.824	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1976	1977	1978	1979	1980
F-values	.4994	.3062	.4530	.4079	.4862

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
F-values	.8148	.9280	.8375	.9469	.8844	.9927	1.3676	1.2699	1.2306	1.0000

Selection-at-age (S)

	0	1	2	3	4	5	6
S-values	.0009	.0277	.3762	1.0000	1.3401	1.3658	1.0000

Table 12.1.7 Total International Fishing Mortality Rate at Age of WHITING in 7D between 1976 and 1990

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	0.008	0.026	0.021	0.013	0.004	0.030	0.073	0.065	0.080	0.060	1
2	0.231	0.126	0.176	0.204	0.252	0.315	0.515	0.450	0.343	0.428	2
3	1.002	0.407	0.611	0.659	0.818	0.962	1.158	1.095	1.286	1.026	3
4	1.173	0.473	0.857	0.841	0.905	1.571	0.932	1.102	1.054	0.928	4
5	0.980	0.539	0.493	0.514	1.312	1.607	1.847	1.309	1.357	0.874	5
6	1.455	0.483	0.572	0.142	0.316	2.038	1.117	1.062	1.865	1.106	6
7	0.497	0.286	0.349	0.186	0.303	0.541	0.586	0.433	1.147	0.978	7
8	0.497	0.286	0.349	0.186	0.303	0.541	0.586	0.433	1.147	0.978	8

Age	1986	1987	1988	1989	1990	Age
1	0.014	0.072	0.106	0.053	0.105	1
2	0.807	0.612	0.601	0.675	0.678	2
3	0.744	1.161	1.131	1.152	0.833	3
4	2.393	1.972	2.335	1.246	1.441	4
5	1.406	2.179	1.723	1.895	1.631	5
6	1.606	2.351	1.141	2.239	0.457	6
7	1.327	1.427	0.669	1.416	0.457	7
8	1.327	1.427	0.669	1.416	0.457	8

Table 12.1.8 Stock Numbers at Age (1000's) of WHITING in 7D between 1976 and 1990

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	77146	57893	60001	35095	45808	35553	49862	60604	58985	9333	1
2	52123	62684	46179	48127	28360	37358	28249	37937	46513	44589	2
3	10618	33880	45267	31716	32136	18055	22315	13822	19811	27026	3
4	13467	3192	18471	20119	13441	11612	5646	5742	3786	4482	4
5	3128	3412	1628	6421	7106	4450	1976	1819	1562	1080	5
6	605	961	1629	815	3145	1567	730	255	402	329	6
7	20	116	485	753	579	1877	167	196	72	51	7
8	283	67	15	92	118	5	12	44	35	63	8

Age	1986	1987	1988	1989	1990	Age
1	18116	34042	19144	25553	2619	1
2	7197	14626	25922	14093	19844	2
3	23784	2629	6492	11641	5877	3
4	7933	9251	674	1716	3013	4
5	1451	593	1054	53	404	5
6	369	291	55	154	7	6
7	89	61	23	14	13	7
8	26	16			12	8

Table 12.1.9 Mean Fishing Mortality , Biomass and Recruitment of WHITING in 7D between 1976 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages 2 to 4		Ages 1 to 1	1000 tonnes		Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1976	0.802	0.000	0.000	37.59	14.62	75	77
1977	0.335	0.000	0.000	33.27	15.63	76	58
1978	0.548	0.000	0.000	43.13	20.04	77	60
1979	0.568	0.000	0.000	32.53	20.00	78	35
1980	0.658	0.000	0.000	28.37	17.12	79	46
1981	0.950	0.000	0.000	24.35	14.19	80	36
1982	0.868	0.000	0.000	21.44	10.63	81	50
1983	0.882	0.000	0.000	24.56	9.68	82	61
1984	0.894	0.000	0.000	25.65	10.50	83	59
1985	0.794	0.000	0.000	17.10	11.28	84	9
1986	1.315	0.000	0.000	11.72	7.93	85	18
1987	1.248	0.000	0.000	13.52	5.37	86	34
1988	1.356	0.000	0.000	11.80	5.34	87	19
1989	1.024	0.000	0.000	11.54	5.12	88	26
1990	0.984	0.000	0.000	12.39	4.60	89	37
Arit-mean recruits at age 1 for period 1976 to 1990							42
Geom-mean recruits at age 1 for period 1976 to 1990							37

Table 12.1.10 Input for catch prediction of WHITING in 7D

	1990 Stock and Fishing Mortality			Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery							
				Scaled mean F 1986 to 1990			Mean values for period 1986 to 1990				
							Mean Weight (Kg.)			Prop.	
Age	Stock Number	Fishing Mortality H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	37000	0.051			0.051			0.167			0.167	1.000
2	19044	0.674			0.674			0.203			0.203	1.000
3	5877	1.024			1.024			0.271			0.271	1.000
4	3013	1.876			1.876			0.322			0.322	1.000
5	404	1.756			1.756			0.362			0.362	1.000
6	7	1.558			1.558			0.403			0.403	1.000
7	13	1.063			1.063			0.435			0.435	1.000
8	12	0.457			1.059			0.562			0.562	1.000

	Mean F	Age 2 to 4	Age 1 1	Age 2 to 4	Age 1 1
Unscaled		1.185	0.000	1.185	0.000
Scaled				1.185	0.000

Recruits at age 1 in 1991 = 37000
Recruits at age 1 in 1992 = 37000
Recruits at age 1 in 1993 = 37000
Recruits at age 1 in 1994 = 37000

M at age and proportion mature at age are as shown in Table 12.1.3

Mean F for ages 2 to 4 in 1990 for human consumption landings + discards = 1.185 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1990

Mean F for ages 1 to 1 in 1990 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 1
Age 2
Age 3
Age 4
Age 5
Age 6
Age 7

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 12.1.11 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in 7D 1991 to 1992

	Year										
	1990	1991	1992								
Biomass 1 Jan of Year											
Total	12.4	15.0	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2
Spawning	4.6	5.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Mean F Ages											
Human Cons. 2 to 4	1.19	1.19	0.00	0.24	0.47	0.71	0.95	1.19	1.42	0.00	0.00
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean F(Year)/Year F(1990)										F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Catch weight											
Human Consumption	3.5	4.8	0.0	1.5	2.8	3.9	4.7	5.5	6.2	0.0	0.0
Discards	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Small-mesh Fisheries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total landings	3.5	4.8	0.0	1.5	2.8	3.9	4.7	5.5	6.2	0.0	0.0
Total catch	3.5	4.8	0.0	1.5	2.8	3.9	4.7	5.5	6.2	0.0	0.0
Biomass 1 Jan of Year+1											
Total	15.0	16.2	22.7	21.0	19.6	18.4	17.4	16.6	15.9	0.0	0.0
Spawning	5.7	6.7	12.6	11.1	9.8	8.7	7.9	7.1	6.5	0.0	0.0

Stock at start of and catch during 1991

Age	Stock No	M.Cons	Discards	By-catch	Total
1	37000	1654			1654
2	28900	12948			12948
3	9277	4931			4931
4	1763	1393			1393
5	278	291			291
6	57	42			42
7	1	1			1
8	4	2			2
Wt	14996	4784	0	0	4784

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	M.Cons	Discards	By-catch	Total
1	37000	1654			1654
2	28900	12948			12948
3	12012	7011			7011
4	2483	1962			1962
5	221	171			171
6	53	39			39
7	10	6			6
8	1	1			1
Wt	16174	5515	0	0	5515

Table 12.2.1 Nominal catch (tonnes) of WHITING in Division VIIe, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	33	14	8	10	4
Denmark	6	-	-	-	-
France	580	697	1,039	651	325
Netherlands	2	1	68	398	-
UK (England and Wales)	717	1,016	1,052	1,012	723
UK (Scotland)	-	-	-	-	-
Total	1,338	1,728	2,167	2,071	1,052
WG Estimate	1,487	1,681	1,649	2,075	1,369

Country	1985	1986	1987	1988	1989	1990
Belgium	2	2	2	4	3	4
Denmark	-	-	-	-	-	+[1]
France	544	788	1,486	1,439	n/a	n/a
Netherlands	-	124[2]	-	n/a	-	n/a
UK (England and Wales)	418	629	753	1,183	917	1,344
UK (Scotland)	-	-	-	-	5	41
Total	964	1,543	2,241	2,626		
WG Estimate	1,942	1,282	1,921	2,294	1,541	1,869

[1]Preliminary.
[2]Includes Division VIId.
n/a = Not available.

Table 12.3.1 Nominal catch (in tonnes) of WHITING in Divisions VIIb,c,h-k, 1980-1990, based on officially reported figures (where available) and Working Group estimates.

Country	1980	1981	1982	1983	1984
Belgium	-	-	-	-	-
France	656	516	204	356	398
Germany, Fed. Rep.	+	-	-	-	-
Ireland	3,499	3,550	4,011	2,590	1,872
Netherlands	1	21	78	363	169
Spain	-	-	85	91	57
UK (England and Wales)	-	67	49	18	58
UK (Scotland)	80	1	-	-	4
Total	4,236	4,155	4,427	3,418	2,558

Country	1985	1986	1987	1988	1989	1990
Belgium[2]	75	33	29	19	39	67
France	583	614	487	890	n/a	n/a
Germany, Fed. Rep.	-	-	-	+	1[1]	n/a
Ireland	2,719	2,165	2,421	2,693	n/a	n/a
Netherlands	90	7	-	n/a	-	n/a
Spain	76	-	-	-	n/a	n/a
UK (England and Wales)	165	168	95	121	117	47
UK (Scotland)	-	-	7	1	32	65
Total	3,708	2,987	3,039	3,724		

[1]Preliminary.
[2]Includes Division VIIg.
n/a = Not available.

Table 13.1 Nominal catch (in tonnes) of SAITHE in Sub-area IV and Division IIIa, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	13	12	4	7	32
Denmark	10,370	6,454	10,114	10,530	8,526
Faroe Islands	1,020	614	746	806	-
France	37,306	42,649	47,064	38,782	43,592
German, Dem. Rep.	925	-	-	-	-
Germany, Fed. Rep.	11,095	8,246	13,517	13,649	25,262
Netherlands	245	123	36	89	181
Norway	47,959	55,882	72,669	81,330	88,420
Poland	2,404	698	793	415	413
Sweden	342	156	372	548	522
UK (England and Wales)	4,879	4,309	5,627	6,845	8,183
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	6,525	6,529	8,136	6,321	6,970
Total	123,083	125,672	159,078	159,322	182,101

Country	1985	1986	1987	1988	1989	1990
Belgium	31	16	4	60	13	23
Denmark	9,033	10,343	7,928	6,868	6,550	5,797[1]
Faroe Islands	895	224	691	276	739	1,650
France	42,200	43,958	38,356	28,913	30,761[1,2]	n/a
German, Dem. Rep.	-	-	-	-	-	-
Germany, Fed. Rep.	22,551	22,277	22,400	18,528	14,339	13,222
Netherlands	233	134	334	346[3]	257	n/a
Norway	101,808	67,341	66,400	40,021	25,941[1]	19,735[1]
Poland	-	495	832	1,016	809	1,244
Sweden	1,764	1,987	1,732	2,064	797	838
UK (England & Wales)	5,455	4,480	3,233	3,790	4,441	3,654
UK (N. Ireland)	-	-	-	-	24	-
UK (Scotland)	9,932	15,520	11,911	10,850	8,726	7,383
Total	193,902	166,775	153,821	112,732	93,397	

[1]Preliminary.
[2]Includes Divisions IIa, and IIIa (EC).
[3]Working Group estimate.
n/a = Not available.

Table 13.2 Annual Weight and Numbers of SAITHE caught in IV between 1971 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1971	253	218	0	35	176	143	0	33
1972	246	218	0	28	176	153	0	23
1973	226	195	0	31	169	142	0	27
1974	273	231	0	42	165	120	0	45
1975	278	240	0	38	189	142	0	47
1976	320	253	0	67	310	223	0	87
1977	196	190	0	6	121	117	0	4
1978	135	132	0	3	97	96	0	2
1979	114	113	0	2	68	67	0	1
1980	120	120	0	0	72	72	0	0
1981	123	121	0	1	70	68	0	2
1982	166	161	0	5	115	110	0	5
1983	169	167	0	1	112	111	0	1
1984	198	192	0	6	167	161	0	6
1985	200	192	0	8	206	195	0	11
1986	164	163	0	1	158	156	0	2
1987	149	145	0	4	167	159	0	8
1988	105	104	0	1	93	92	0	1
1989	92	90	0	2	77	74	0	3
1990	88	86	0	2	64	59	0	5

Table 13.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.000
3	0.200	0.000
4	0.200	0.150
5	0.200	0.700
6	0.200	0.900
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000

Table 13.4 Total International Catch at Age (1000's) of SAITHE in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	594	379	4416	3947	312	235	2015	1215	907	1276	1
2	10773	20189	31275	16150	71766	31335	12891	16503	16787	23095	2
3	68424	40162	47388	61201	50672	199669	22890	30972	14504	14159	3
4	53348	62290	32955	31387	23406	50339	52270	24935	13022	11399	4
5	30846	23108	24967	12123	9005	9902	13082	16771	10031	8338	5
6	3650	20779	15228	20080	6706	5137	4753	2616	7991	6086	6
7	3783	3363	7998	13734	12650	3317	3218	849	2437	5189	7
8	2481	2790	1689	4308	8650	4845	3062	790	577	956	8
9	1574	1550	1165	988	3304	3003	3522	607	349	418	9
10	536	1445	1927	1094	2347	2128	3780	2165	1333	1486	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	5309	1932	270	59	214	104	780	11	4186	289	1
2	18195	28263	32798	34455	6622	6078	28876	4887	9119	3391	2
3	22267	27405	23363	75449	124122	47110	29029	27388	14375	30512	3
4	6362	38946	17980	29769	54405	85116	90577	23173	25767	13722	4
5	6151	7934	25161	12081	13039	12197	12429	32280	11554	9165	5
6	3265	5410	4903	12330	4045	4269	1942	2910	9826	3741	6
7	2994	1761	4380	1357	2524	1592	1120	1132	1267	2108	7
8	3173	1210	1333	1113	461	1044	813	452	536	493	8
9	504	846	929	279	267	265	689	492	293	147	9
10	1863	794	819	487	254	487	498	394	318	184	10

Table 13.5 Total International Mean Weight at Age (Kg.) of SAITHE in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	0.495	0.304	0.154	0.268	0.198	0.461	0.429	0.353	0.434	0.253	1
2	0.609	0.510	0.392	0.494	0.494	0.501	0.416	0.520	0.389	0.411	2
3	0.838	0.743	0.780	0.849	0.887	0.690	0.753	0.781	1.080	0.905	3
4	1.357	1.158	1.407	1.556	1.497	1.302	1.251	1.294	1.590	1.812	4
5	2.203	1.897	1.575	2.489	2.478	2.175	1.900	2.120	2.219	2.370	5
6	3.007	2.364	2.543	2.729	3.275	3.036	3.097	3.210	3.071	2.975	6
7	3.804	3.869	3.339	3.353	3.684	4.007	4.146	4.466	3.966	4.047	7
8	4.635	4.184	4.657	4.386	4.190	4.325	4.551	4.784	5.128	5.044	8
9	5.168	4.543	4.502	5.538	5.481	4.981	4.779	5.309	5.947	5.812	9
10	5.691	6.120	6.046	7.525	7.419	6.768	6.257	6.748	7.170	7.322	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.274	0.249	0.418	0.181	0.142	0.481	0.360	0.429	0.426	0.217	1
2	0.585	0.498	0.455	0.482	0.481	0.481	0.387	0.547	0.684	0.608	2
3	0.937	1.087	0.982	0.772	0.649	0.648	0.641	0.699	0.832	0.785	3
4	1.859	1.566	1.701	1.600	1.244	1.000	0.838	0.902	0.982	1.155	4
5	2.694	2.497	2.118	2.270	1.889	1.674	1.770	1.326	1.377	1.540	5
6	3.529	3.144	3.058	2.645	2.603	2.294	2.921	2.644	1.905	2.191	6
7	4.470	3.958	3.533	3.715	3.141	3.559	3.782	3.685	3.885	3.193	7
8	5.424	4.908	4.432	4.524	4.521	4.245	4.902	4.654	4.879	4.617	8
9	6.907	5.606	5.336	5.897	5.094	5.779	5.491	5.681	6.350	6.054	9
10	8.349	7.748	6.948	7.720	7.218	7.900	7.040	7.144	8.432	8.211	10

Table 13.6 SAITHE in Sub-area IV. Tuning results

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DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,NORTRL              , has terminal q estimated as the mean
Fleet  2 ,FRATRB              , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd

SUMMARY STATISTICS
Age  2
 Fleet , Pred.  , SE(q),Partial,Raised,
       ,   q    ,      ,   F   ,   F   ,
--------'--------'------'-------'------'
    1  , No data for this fleet at this age
    2  ,-15.81  , 0.586,0.0049 ,0.0352,
Fbar     SIGMA(int.)    SIGMA(ext.)
0.098       0.586            0.000
SIGMA(overall)  Variance ratio
   0.586            0.000

Age  3
 Fleet , Pred.  , SE(q),Partial,Raised,
       ,   q    ,      ,   F   ,   F   ,
--------'--------'------'-------'------'
    1  ,-13.60  , 0.571,0.0118 ,0.4887,
    2  ,-13.92  , 0.505,0.0324 ,0.2070,
 Fbar     SIGMA(int.)    SIGMA(ext.)
 0.337       0.378          0.426
SIGMA(overall)   Variance ratio
   0.426            1.271

Age  4
 Fleet , Pred.  , SE(q),Partial,Raised,
       ,   q    ,      ,   F   ,   F   ,
--------'--------'------'-------'------'
    1  ,-12.26  , 0.338,0.0447 ,0.8673,
    2  ,-12.59  , 0.420,0.1232 ,0.3877,
Fbar     SIGMA(int.)    SIGMA(ext.)
0.801       0.263          0.393
SIGMA(overall)  Variance ratio
   0.393            2.235

Age  5
 Fleet , Pred.  , SE(q),Partial,Raised,
       ,   q    ,      ,   F   ,   F   ,
--------'--------'------'-------'------'
    1  ,-12.28  , 0.265,0.0441 ,0.4864,
    2  ,-12.16  , 0.177,0.1887 ,0.6765,
Fbar     SIGMA(int.)    SIGMA(ext.)
0.703       0.147          0.153
SIGMA(overall)  Variance ratio
   0.153            1.072

Age  6
 Fleet , Pred.  , SE(q),Partial,Raised,
       ,   q    ,      ,   F   ,   F   ,
--------'--------'------'-------'------'
    1  ,-12.52  , 0.508,0.0345 ,0.2758,
    2  ,-12.47  , 0.302,0.1388 ,0.9884,
Fbar     SIGMA(int.)    SIGMA(ext.)
0.716       0.260          0.561
SIGMA(overall)  Variance ratio
   0.561            4.665

Age  7
 Fleet , Pred.  , SE(q),Partial,Raised,
       ,   q    ,      ,   F   ,   F   ,
--------'--------'------'-------'------'
    1  ,-12.38  , 0.465,0.0399 ,0.4595,
    2  ,-13.02  , 0.287,0.0800 ,0.3402,
Fbar     SIGMA(int.)    SIGMA(ext.)
0.474       0.244          0.134
SIGMA(overall)  Variance ratio
   0.244            0.303

Age  8
 Fleet , Pred.  , SE(q),Partial,Raised,
       ,   q    ,      ,   F   ,   F   ,
--------'--------'------'-------'------'
    1  ,-12.45  , 0.842,0.0371 ,0.3150,
    2  ,-13.48  , 0.276,0.0504 ,0.3652,
Fbar     SIGMA(int.)    SIGMA(ext.)
0.464       0.262          0.438E-01
SIGMA(overall)  Variance ratio
   0.262            0.028
```

Table 13.7 Total International Fishing Mortality Rate at Age of SAITHE in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	0.003	0.002	0.018	0.007	0.002	0.002	0.018	0.013	0.004	0.009	1
2	0.065	0.129	0.195	0.086	0.165	0.242	0.133	0.197	0.248	0.124	2
3	0.281	0.362	0.499	0.714	0.422	0.925	0.280	0.538	0.266	0.343	3
4	0.378	0.446	0.572	0.737	0.667	0.996	0.671	0.558	0.457	0.345	4
5	0.404	0.279	0.322	0.427	0.483	0.674	0.784	0.472	0.458	0.601	5
6	0.273	0.525	0.300	0.467	0.447	0.566	0.826	0.346	0.433	0.562	6
7	0.349	0.435	0.393	0.485	0.610	0.416	0.868	0.332	0.633	0.559	7
8	0.404	0.471	0.407	0.382	0.651	0.500	0.861	0.538	0.395	0.551	8
9	0.342	0.477	0.367	0.444	0.569	0.494	0.852	0.406	0.487	0.558	9
10	0.342	0.477	0.367	0.444	0.569	0.494	0.852	0.406	0.487	0.558	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.031	0.007	0.001	0.000	0.002	0.001	0.011	0.000	0.090		1
2	0.164	0.225	0.149	0.105	0.023	0.056	0.244	0.086	0.068	0.098	2
3	0.169	0.395	0.293	0.597	0.660	0.225	0.403	0.386	0.389	0.337	3
4	0.254	0.498	0.490	0.747	1.242	1.481	0.879	0.656	0.770	0.801	4
5	0.317	0.578	0.708	0.729	0.899	1.126	0.944	0.948	0.929	0.703	5
6	0.501	0.510	0.885	0.953	0.579	0.874	0.526	0.601	0.888	0.716	6
7	0.603	0.559	1.054	0.659	0.513	0.475	0.596	0.676	0.577	0.474	7
8	0.815	0.526	1.160	0.872	0.492	0.415	0.476	0.516	0.816	0.464	8
9	0.640	0.532	1.033	0.828	0.528	0.588	0.533	0.598	0.760	0.551	9
10	0.640	0.532	1.033	0.828	0.528	0.588	0.533	0.598	0.760	0.551	10

Table 13.8 Stock Numbers at Age (1000's) of SAITHE in IV between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	224734	237594	267347	637057	196082	139004	126269	103753	266577	163166	1
2	188985	183460	194183	214898	518013	160256	113594	101560	83849	217436	2
3	306758	145006	132006	130823	161376	359463	103015	81384	68291	53548	3
4	185742	189631	82659	65622	52470	86668	116645	63760	38901	42868	4
5	101774	104183	99402	38186	25716	22046	26217	48803	29884	20175	5
6	16766	55647	64520	58950	20391	12985	9204	9799	24925	15474	6
7	14087	10444	26952	39137	30265	10681	6034	3300	5673	13240	7
8	8181	8136	5534	14888	19736	13466	5769	2075	1939	2466	8
9	5961	4471	4160	3016	8323	8428	6684	1996	991	1070	9
10	2029	4169	6882	3341	5912	5972	7174	7116	3784	3801	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	194397	319922	465043	393127	151641	178882	80364	186767	53437		1
2	132436	154365	260185	380501	321812	123960	146363	65092	152902	39974	2
3	157202	92039	100948	183467	280458	257498	96005	93853	48885	116958	3
4	31123	108648	50761	61647	82722	118708	168424	52553	52257	27121	4
5	24860	19759	54061	25449	23909	19557	22099	57242	22319	19802	5
6	9060	14826	9079	21796	10053	7969	5193	7038	18154	7977	6
7	7222	4493	7292	3068	6879	4611	2723	2513	3160	6116	7
8	6195	3235	2103	2081	1299	3372	2348	1228	1046	1453	8
9	1164	2244	1565	540	713	651	1824	1195	600	379	9
10	4304	2107	1380	941	677	1197	1318	957	652	476	10

Table 13.9 Mean Fishing Mortality , Biomass and Recruitment of SAITHE in IV between 1971 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 1	
	3 to 6		1 to 4				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1971	0.291	0.000	0.045	1144	374	70	225
1972	0.360	0.000	0.044	943	410	71	238
1973	0.328	0.000	0.096	833	451	72	267
1974	0.429	0.000	0.162	985	465	73	637
1975	0.404	0.000	0.111	930	400	74	196
1976	0.689	0.000	0.121	776	269	75	139
1977	0.625	0.000	0.013	531	211	76	126
1978	0.470	0.000	0.006	454	196	77	104
1979	0.395	0.000	0.007	492	190	78	267
1980	0.460	0.000	0.002	451	187	79	163
1981	0.308	0.000	0.004	545	194	80	194
1982	0.478	0.000	0.017	585	165	81	320
1983	0.588	0.000	0.004	694	171	82	465
1984	0.735	0.000	0.019	641	138	83	393
1985	0.807	0.000	0.032	568	107	84	152
1986	0.922	0.000	0.004	526	101	85	179
1987	0.665	0.000	0.020	384	103	86	80
1988	0.644	0.000	0.003	352	106	87	187
1989	0.694	0.000	0.016	379	87	88	212
1990	0.612	0.000	0.024	353	74	89	211
Arit-mean recruits at age 1 for period 1971 to 1990							238
Geom-mean recruits at age 1 for period 1971 to 1990							211

Table 13.10 Input for catch prediction of SAITHE in IV

	1990				Values used in Prediction						
	Stock and Fishing Mortality				F at age , Mean Wt. and Propn. Retained by Consumption Fishery						
					Scaled mean F			Mean values for period 1986 to 1990			
Age	Stock	Fishing Mortality			1986 to 1990			Mean Weight (Kg.)			Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	211000	0.007			0.006			0.382			0.382	1.000
2	170000	0.094		0.001	0.082		0.002	0.545		0.366	0.542	1.000
3	116958	0.295		0.043	0.286		0.028	0.737		0.496	0.721	1.000
4	27121	0.749		0.051	0.763		0.058	0.993		0.674	0.975	1.000
5	19802	0.690		0.013	0.777		0.020	1.546		1.050	1.537	1.000
6	7977	0.715		0.001	0.622		0.004	2.393		1.056	2.391	1.000
7	6116	0.474			0.484			3.621			3.621	1.000
8	1453	0.464			0.465			4.659			4.659	1.000
9	379	0.551			0.525			5.871			5.871	1.000
10	476	0.551			0.525			7.745			7.745	1.000

Mean F	Age 3 to 6	Age 2 5	Age 3 to 6	Age 2 5
Unscaled	0.612	0.027	0.707	0.016
Scaled			0.612	0.027

Recruits at age 1 in 1991 = 211000
Recruits at age 1 in 1992 = 211000
Recruits at age 1 in 1993 = 211000
Recruits at age 1 in 1994 = 211000

M at age and proprtion mature at age are as shown in Table 13.3

Mean F for ages 3 to 6 in 1990 for human consumption landings + discards = 0.612 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 3 to 6 equal to that for 1990

Mean F for ages 2 to 5 in 1990 for small-mesh fisheries = 0.027 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 2 to 5 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 13.11 Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in IV 1991 to 1992

	Year										
	1990	1991	1992								
Biomass 1 Jan of Year											
Total	353	398	420	420	420	420	420	420	420	420	420
Spawning	74	70	79	79	79	79	79	79	79	79	79
Mean F Ages											
Human Cons. 3 to 6	0.61	0.61	0.00	0.12	0.24	0.37	0.49	0.61	0.73	0.00	0.00
Small-mesh 2 to 5	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.00
Mean F(Year)/Mean F(1990)										F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	86	87	0	24	46	65	83	99	113	0	0
Discards	0	0	0	0	0	0	0	0	0	0	0
Small-mesh Fisheries	2	3	5	5	4	4	4	4	4	0	0
Total landings	88	91	5	29	50	70	87	102	116	0	0
Total catch	88	91	5	29	50	70	87	102	116	0	0
Biomass 1 Jan of Year+1											
Total	398	420	555	524	496	472	450	431	414	0	0
Spawning	70	79	163	143	125	110	97	85	75	0	0

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	211000	1154			1154
2	171548	12205		226	12430
3	126533	28324		2761	31085
4	68348	32683		2500	35183
5	9971	4906		124	5030
6	8028	3400		19	3420
7	3191	1119			1119
8	3118	1059			1059
9	748	279			279
10	179	67			67
Wt	397868	87303	0	3287	90590

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	211000	1154			1154
2	171709	12216		226	12442
3	129239	28930		2820	31750
4	75662	36181		2768	38948
5	24602	12104		307	12410
6	3679	1558		9	1567
7	3516	1233			1233
8	1610	547			547
9	1603	598			598
10	449	168			168
Wt	420397	98627	0	3677	102304

Table 14.1 Nominal catch (tonnes) of SAITHE in Sub-area VI, 1980-1990, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	2	2	-	-	-
Denmark	-	-	4	-	-
Faroe Islands	4	3	5	-	-
France	15,427	16,654	17,102	13,470	19,706
Germany, Fed. Rep.	49	581	441	179	713
Ireland	295	250	322	698	599
Netherlands	91	-	-	32	-
Norway	62	25	19	55	66
Spain	-	120	243	330	882
UK (England and Wales)	1,594	1,364	1,966	2,760	1,800
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	9	10	7	12	49
UK (Scotland)	2,902	3,117	2,141	2,642	3,170
Total	20,435	22,126	22,250	26,178	26,985

Country	1985	1986	1987	1988	1989	1990
Belgium	2	-	12	14	15	-
Denmark	-	-	7	+	2	-[1]
Faroe Islands	-	-	-	8	-	-
France	19,120	26,521	24,581	24,656	17,106[1,2]	n/a
Germany, Fed. Rep.	838	2,345	1,486	1,584	1,116	539[1]
Ireland	670	660	704	544	n/a	n/a
Netherlands	-	-	-	n/a	22	n/a
Norway	51	72	38	50	72[1]	64[1]
Spain	624	824	533	857	n/a	n/a
UK (England and Wales)	1,349	1,259	1,708	1,193	555	1,027
UK (Isle of Man)	-	-	-	-	+	n/a
UK (N. Ireland)	15	21	26	13	21	53
UK (Scotland)	3,118	3,697	3,442	3,925	2,851	3,035
Total	25,787	35,399	32,537	32,844		

[1]Preliminary.
[2]Includes Division Vb(EC).
n/a = Not available.

Table 14.2 Annual Weight and Numbers of SAITHE caught in VI between 1971 and 1990

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1971	20	20	0	0	11	11	0	0
1972	29	29	0	0	19	19	0	0
1973	34	34	0	0	23	23	0	0
1974	36	36	0	0	18	18	0	0
1975	31	31	0	0	16	16	0	0
1976	42	42	0	0	20	20	0	0
1977	27	27	0	0	13	13	0	0
1978	31	31	0	0	15	15	0	0
1979	22	22	0	0	7	7	0	0
1980	22	22	0	0	8	8	0	0
1981	24	24	0	0	11	11	0	0
1982	24	24	0	0	11	11	0	0
1983	29	29	0	0	14	14	0	0
1984	22	22	0	0	13	13	0	0
1985	27	27	0	0	14	14	0	0
1986	40	40	0	0	23	23	0	0
1987	31	31	0	0	16	16	0	0
1988	34	34	0	0	19	19	0	0
1989	26	26	0	0	18	18	0	0
1990	20	20	0	0	14	14	0	0

Table 14.3 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.000
3	0.200	0.000
4	0.200	0.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000

Table 14.4 Total International Catch at Age (1000's) of SAITHE in VI between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1		51	292	806	23	35	157	38	9	45	1
2	382	3644	6557	3056	2465	2776	1234	4048	969	1005	2
3	1385	7913	6944	5737	6315	8154	4571	4087	1828	3335	3
4	4444	3805	4743	2353	2458	2721	2697	2334	1194	942	4
5	1891	2209	1882	2000	1314	1794	1673	1291	1151	677	5
6	1085	428	833	608	860	1116	737	696	708	632	6
7	465	309	430	932	1007	659	559	289	368	469	7
8	362	154	311	891	707	517	385	243	156	194	8
9	300	91	192	489	197	583	290	161	191	91	9
10	238	162	454	861	340	1362	921	1319	756	816	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	148	38	42	147	5	233	1	22	22	59	1
2	2449	1307	4026	2932	2224	750	1874	3604	746	1494	2
3	3911	4490	4879	5484	4982	6918	2314	5713	7258	5617	3
4	1977	1641	2624	2403	2992	8380	7156	3521	5689	3743	4
5	588	1240	852	876	1454	3764	1953	2630	2253	1198	5
6	410	568	775	681	1222	1395	1369	1051	1399	789	6
7	341	384	513	300	608	1054	780	892	375	526	7
8	223	244	161	139	186	469	454	698	258	245	8
9	153	136	107	56	104	185	261	330	157	133	9
10	673	460	508	159	223	345	217	329	183	159	10

Table 14.5 Total International Mean Weight at Age (Kg.) of SAITHE in VI between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1		0.507	0.311	0.309	0.460	0.444	0.383	0.412	0.513	0.417	1
2	0.640	0.764	0.621	0.590	0.737	0.681	0.577	0.502	0.700	0.650	2
3	0.935	1.139	1.102	0.987	0.939	1.005	0.794	1.128	1.323	1.165	3
4	1.240	1.815	1.400	1.622	1.504	1.442	1.353	1.676	1.980	1.932	4
5	1.762	2.631	2.516	1.743	2.575	2.732	2.207	2.603	2.405	2.651	5
6	2.697	2.598	3.080	3.534	3.497	3.230	3.199	3.829	3.366	3.560	6
7	3.454	2.979	3.694	4.542	4.779	4.174	4.253	4.687	4.609	4.560	7
8	4.626	5.018	4.833	5.038	5.589	4.930	5.030	5.279	5.815	5.531	8
9	5.196	6.118	6.705	6.066	6.522	5.785	5.829	5.979	6.967	6.524	9
10	7.227	8.166	8.138	8.279	8.549	7.739	7.711	8.470	9.339	9.651	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.400	0.432	0.378	0.472	0.405	0.672	0.453	0.557	0.500	0.551	1
2	0.676	0.717	0.665	0.723	0.707	0.746	0.607	0.675	0.718	0.724	2
3	1.096	1.078	1.246	1.109	1.056	0.872	0.960	1.003	0.886	0.857	3
4	1.699	1.779	1.833	1.786	1.677	1.335	1.183	1.306	1.099	1.178	4
5	2.963	2.736	3.074	2.663	2.613	2.172	2.043	1.683	1.510	1.767	5
6	4.047	3.946	3.642	3.503	3.237	2.896	3.248	3.210	2.445	2.502	6
7	5.115	5.348	5.036	4.714	4.316	3.614	4.725	4.428	4.175	3.592	7
8	6.240	6.202	6.285	5.791	6.002	4.145	6.130	5.619	5.382	5.420	8
9	7.222	7.765	6.975	7.609	7.377	5.505	7.731	7.226	6.628	6.620	9
10	9.761	10.680	10.880	10.781	11.097	8.592	12.082	10.193	8.392	8.481	10

Table 14.6 SAITHE in Sub-area VI. Tuning results.

```
with cpue data from file SAIGZEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 SCOTRL    has terminal q estimated as the mean
Fleet  2 SCOSEI    has terminal q estimated as the mean
Fleet  3 SCOLTR    has terminal q estimated as the mean
Fleet  4 SCONTR    has terminal q estimated as the mean
Fleet  5 FRAALL    has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using shrunk Laurec/Shepherd
Regression weights
      0     .020     .116     .284     .482          .670     .820     .921     .976     .997    1.000
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
Fishing mortalities

 Age  2
          Pred.      SE(q)  Partial   Raised
   Fleet    q                 F        F

 --------- --------   ------  -------  ------
     1      -15.120    1.052     .002     .346
     2      -16.740     .800     .002     .125
     3      -16.440     .753     .014     .064
     4      -18.320     .853     .004     .101
     5      -15.270     .606     .033     .058
Fbar     SIGMA(int.)    SIGMA(ext.)
0.085       0.347          0.277
         SIGMA(overall)  Variance ratio
         0.347           0.638
 Age  4
          Pred.      SE(q)  Partial   Raised
   Fleet    q                 F        F

 --------- --------   ------  -------  ------
     1      -14.800    1.311     .003     .057
     2      -16.620     .931     .002     .463
     3      -15.890     .614     .025     .261
     4      -19.680     .889     .001     .286
     5      -12.360     .319     .597     .830
Fbar     SIGMA(int.)    SIGMA(ext.)
0.654       0.254          0.329
         SIGMA(overall)  Variance ratio
         0.329           1.681
 Age  6
          Pred.      SE(q)  Partial   Raised
   Fleet    q                 F        F

 --------- --------   ------  -------  ------
     1      -14.760    1.179     .003     .047
     2    No data for this fleet at this age
     3      -16.630     .353     .012     .416
     4    No data for this fleet at this age
     5      -12.510     .115     .513     .647
Fbar     SIGMA(int.)    SIGMA(ext.)
0.595       0.109          0.191
         SIGMA(overall)  Variance ratio
         0.191           3.081
 Age  8
          Pred.      SE(q)  Partial   Raised
   Fleet    q                 F        F

 --------- --------   ------  -------  ------
     1    No data for this fleet at this age
     2    No data for this fleet at this age
     3    No data for this fleet at this age
     4    No data for this fleet at this age
     5      -12.550     .286     .492     .577
Fbar     SIGMA(int.)    SIGMA(ext.)
0.601       0.286          0.000
         SIGMA(overall)  Variance ratio
         0.286           0.000

SUMMARY STATISTICS
 Age  3
          Pred.      SE(q)  Partial   Raised
   Fleet    q                 F        F

 --------- --------   ------  -------  ------
     1      -14.240     .852     .004     .128
     2      -16.320     .373     .003     .328
     3      -15.500     .313     .037     .317
     4      -18.500    1.223     .004    2.073
     5      -13.030     .308     .306     .436
Fbar     SIGMA(int.)    SIGMA(ext.)
0.365       0.183          0.186
         SIGMA(overall)  Variance ratio
         0.186           1.037
 Age  5
          Pred.      SE(q)  Partial   Raised
   Fleet    q                 F        F

 --------- --------   ------  -------  ------
     1      -15.160    1.526     .002     .027
     2      -17.080     .939     .001     .299
     3      -16.370     .469     .015     .320
     4    No data for this fleet at this age
     5      -12.530     .259     .505     .670
Fbar     SIGMA(int.)    SIGMA(ext.)
0.557       0.218          0.313
         SIGMA(overall)  Variance ratio
         0.313           2.054
 Age  7
          Pred.      SE(q)  Partial   Raised
   Fleet    q                 F        F

 --------- --------   ------  -------  ------
     1    No data for this fleet at this age
     2    No data for this fleet at this age
     3      -16.750     .523     .011     .220
     4    No data for this fleet at this age
     5      -12.540     .283     .499     .609
Fbar     SIGMA(int.)    SIGMA(ext.)
0.520       0.249          0.426
         SIGMA(overall)  Variance ratio
         0.426           2.935
```

Table 14.7 Total International Fishing Mortality Rate at Age of SAITHE in VI between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1		0.002	0.010	0.027	0.001	0.002	0.010	0.002	0.000	0.002	1
2	0.014	0.154	0.307	0.141	0.108	0.163	0.102	0.356	0.067	0.061	2
3	0.089	0.431	0.488	0.484	0.476	0.614	0.439	0.564	0.270	0.341	3
4	0.322	0.372	0.500	0.303	0.394	0.388	0.420	0.421	0.317	0.217	4
5	0.365	0.262	0.318	0.408	0.276	0.562	0.439	0.365	0.379	0.299	5
6	0.255	0.130	0.149	0.160	0.308	0.399	0.476	0.329	0.350	0.371	6
7	0.280	0.107	0.187	0.247	0.431	0.411	0.357	0.346	0.290	0.413	7
8	0.467	0.141	0.150	0.725	0.301	0.412	0.450	0.258	0.317	0.244	8
9	0.338	0.202	0.261	0.369	0.342	0.434	0.429	0.345	0.332	0.311	9
10	0.338	0.202	0.261	0.369	0.342	0.434	0.429	0.345	0.332	0.311	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	0.005	0.001	0.001	0.004	0.000	0.009	0.000	0.001	0.001		1
2	0.112	0.061	0.147	0.103	0.071	0.046	0.088	0.163	0.033	0.085	2
3	0.352	0.307	0.334	0.305	0.254	0.325	0.194	0.416	0.567	0.365	3
4	0.348	0.244	0.296	0.272	0.271	0.886	0.659	0.505	0.974	0.654	4
5	0.204	0.384	0.193	0.152	0.263	0.647	0.525	0.544	0.716	0.557	5
6	0.297	0.310	0.441	0.232	0.327	0.434	0.519	0.603	0.632	0.595	6
7	0.351	0.502	0.511	0.305	0.335	0.521	0.463	0.774	0.449	0.520	7
8	0.353	0.457	0.408	0.251	0.315	0.469	0.446	1.013	0.534	0.601	8
9	0.311	0.380	0.370	0.243	0.302	0.591	0.522	0.688	0.661	0.585	9
10	0.311	0.380	0.370	0.243	0.302	0.591	0.522	0.688	0.661	0.585	10

Table 14.8 Stock Numbers at Age (1000's) of SAITHE in VI between 1971 and 1990

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
1	34268	33282	31661	33174	24779	17159	18264	20251	22946	31165	1
2	30671	28056	27203	25659	26433	20266	14016	14812	16546	18779	2
3	17940	24766	19687	16379	18253	19419	14092	10363	8492	12672	3
4	17727	13439	13180	9896	8269	9285	9607	7438	4827	5308	4
5	6787	10521	7586	6542	5987	4564	5159	4628	3996	2879	5
6	5289	3858	6627	4520	3561	3720	2131	2724	2630	2239	6
7	2090	3354	2773	4675	3153	2143	2044	1085	1605	1517	7
8	1062	1293	2468	1883	2990	1678	1163	1171	628	983	8
9	1147	545	920	1740	747	1812	910	607	741	375	9
10	910	972	2174	3062	1290	4236	2893	4964	2939	3356	10

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Age
1	30085	39625	40405	43972	22523	30200	32194	31105	24727		1
2	25475	24498	32408	33043	35869	18436	24515	26357	25447	20225	2
3	14468	18649	18878	22906	24410	27360	14417	18381	18333	20161	3
4	7380	8334	11234	11072	13825	15504	16185	9720	9924	8514	4
5	3498	4266	5346	6838	6904	8628	5233	6857	4804	3067	5
6	1748	2335	2380	3610	4810	4345	3700	2535	3259	1922	6
7	1266	1063	1401	1254	2343	2839	2306	1804	1136	1418	7
8	822	730	527	688	757	1371	1381	1189	681	593	8
9	631	473	378	287	438	452	703	724	353	327	9
10	2766	1597	1802	810	939	846	583	722	414	391	10

Table 14.9 Mean Fishing Mortality , Biomass and Recruitment of SAITHE in VI between 1971 and 1990

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 1	
	3 to 6		1 to 11				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1971	0.258	0.000	0.000	109	51	70	34
1972	0.299	0.000	0.000	156	65	71	33
1973	0.364	0.000	0.000	152	86	72	32
1974	0.339	0.000	0.000	152	94	73	33
1975	0.363	0.000	0.000	136	76	74	25
1976	0.490	0.000	0.000	139	85	75	17
1977	0.443	0.000	0.000	98	60	76	18
1978	0.420	0.000	0.000	119	79	77	20
1979	0.329	0.000	0.000	106	62	78	23
1980	0.307	0.000	0.000	113	63	79	31
1981	0.300	0.000	0.000	118	61	80	30
1982	0.311	0.000	0.000	121	52	81	40
1983	0.316	0.000	0.000	139	58	82	40
1984	0.240	0.000	0.000	141	52	83	44
1985	0.279	0.000	0.000	145	62	84	23
1986	0.573	0.000	0.000	136	57	85	30
1987	0.474	0.000	0.000	117	55	86	32
1988	0.517	0.000	0.000	113	47	87	31
1989	0.722	0.000	0.000	87	29	88	25
1990	0.542	0.000	0.000	82	24	89	29
Arit-mean recruits at age 1 for period 1971 to 1990							30
Geom-mean recruits at age 1 for period 1971 to 1990							29

Table 14.10 Input for catch prediction of SAITHE in VI

	1990 Stock and Fishing Mortality				Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F 1986 to 1990			Mean values for period 1986 to 1990				
								Mean Weight (Kg.)				Prop.
Age	Stock Number	Fishing Mortality H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	29000	0.003			0.002			0.547			0.547	1.000
2	20225	0.085			0.080			0.694			0.694	1.000
3	20161	0.365			0.358			0.915			0.915	1.000
4	8514	0.654			0.705			1.220			1.220	1.000
5	3067	0.557			0.573			1.835			1.835	1.000
6	1922	0.595			0.534			2.860			2.860	1.000
7	1418	0.520			0.523			4.107			4.107	1.000
8	593	0.601			0.587			5.340			5.340	1.000
9	327	0.585			0.584			6.742			6.742	1.000
10	391	0.585			0.584			9.548			9.548	1.000

	Mean F	Age 3 to 6	Age 1 1	Age 3 to 6	Age 1 1
Unscaled		0.542	0.000	0.566	0.000
Scaled				0.542	0.000

Recruits at age 1 in 1991 = 28656
Recruits at age 1 in 1992 = 28656
Recruits at age 1 in 1993 = 28656
Recruits at age 1 in 1994 = 28656

M at age and proprtion mature at age are as shown in Table 14.3

Mean F for ages 3 to 6 in 1990 for human consumption landings + discards = 0.542 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1986 to 1990
rescaled to produce a mean value of F for ages 3 to 6 equal to that for 1990

Mean F for ages 1 to 1 in 1990 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1986 to 1990 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1990

Values of N in 1990 from VPA have been overwritten
for the following ages .....

Age 1

Values of F for these ages in 1990 from VPA have been overwritten
with scaled mean values used for predictions for 1991 onwards

Table 14.11 Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in VI 1991 to 1992

	Year											
	1990	1991	1992									
Biomass 1 Jan of Year												
Total	82	81	81	81	81	81	81	81	81	81	81	81
Spawning	24	21	22	22	22	22	22	22	22	22	22	22
Mean F Ages												
Human Cons. 3 to 6	0.54	0.54	0.00	0.11	0.22	0.33	0.43	0.54	0.65	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1990)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	20	20	0	5	9	13	16	19	22	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	20	20	0	5	9	13	16	19	22	0	0	
Total catch	20	20	0	5	9	13	16	19	22	0	0	
Biomass 1 Jan of Year+1												
Total	81	81	105	99	94	89	85	81	78	0	0	
Spawning	21	22	37	33	29	26	23	20	18	0	0	

Stock at start of and catch during 1991

Age	Stock No	H.Cons	Discards	By-catch	Total
1	28656	63			63
2	23683	1643			1643
3	15211	4174			4174
4	11463	5319			5319
5	3626	1447			1447
6	1439	544			544
7	868	323			323
8	690	281			281
9	267	108			108
10	149	60			60
Wt	81259	19826	0	0	19826

Stock at start of and catch during 1992
for F(1992) = F(1991)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	28656	63			63
2	23405	1624			1624
3	17908	4914			4914
4	8706	4039			4039
5	4636	1850			1850
6	1674	633			633
7	691	257			257
8	421	171			171
9	314	127			127
10	190	77			77
Wt	81241	19355	0	0	19355

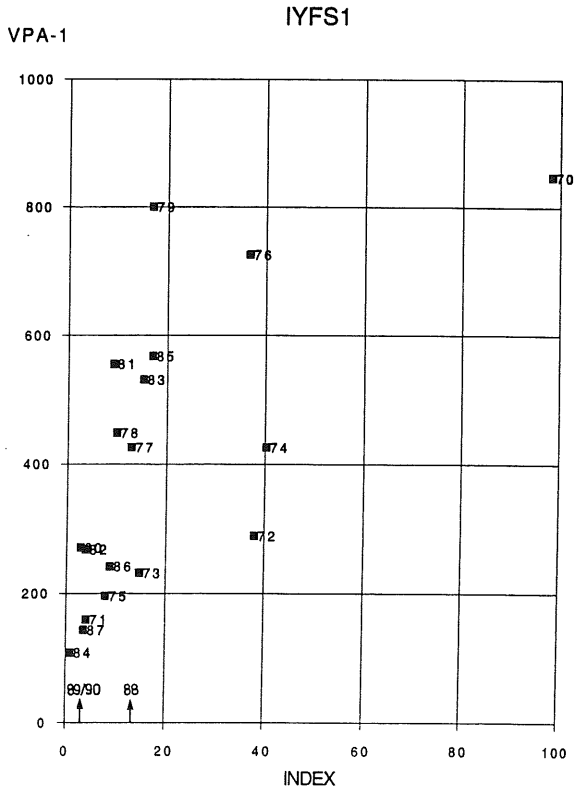
Table 15.1 Nominal catch (tonnes) of SAITHE in Sub-area VII, 1980-1990, as officially reported to ICES.

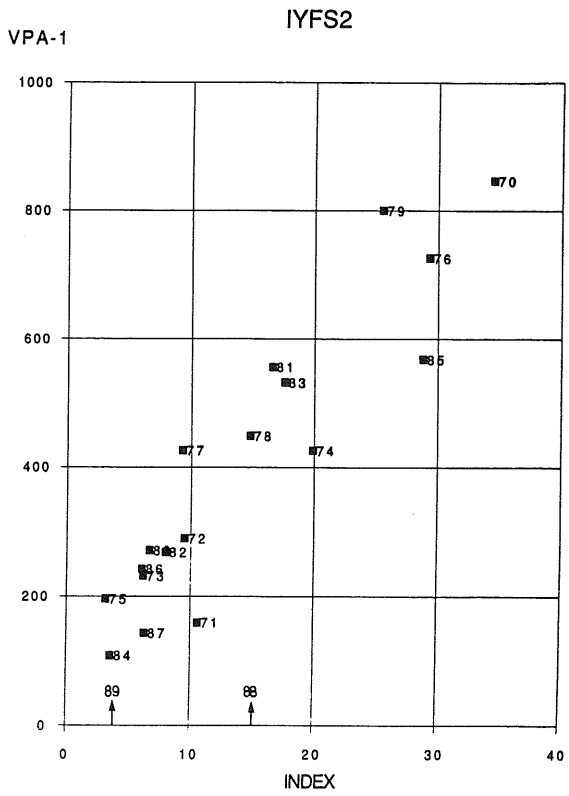
Country	1980	1981	1982	1983	1984
Belgium	19	12	13	6	10
Denmark	6	-	-	-	-
France	2,317	4,563	4,061	4,760	3,697
Germany, Fed. Rep.	46	-	-	11	5
Ireland	2,220	2,197	2,367	2,383	2,374
Netherlands	84	100	22	7	-
Norway	-	-	-	3	+
Spain	-	266	179	70	118
UK (England and Wales)	109	236	526	235	974
UK (Isle of Man)	19	36	34	16	27
UK (N. Ireland)	301	577	872	668	411
UK (Scotland)	56	94	119	138	140
Total	5,177	8,081	8,193	8,297	7,756

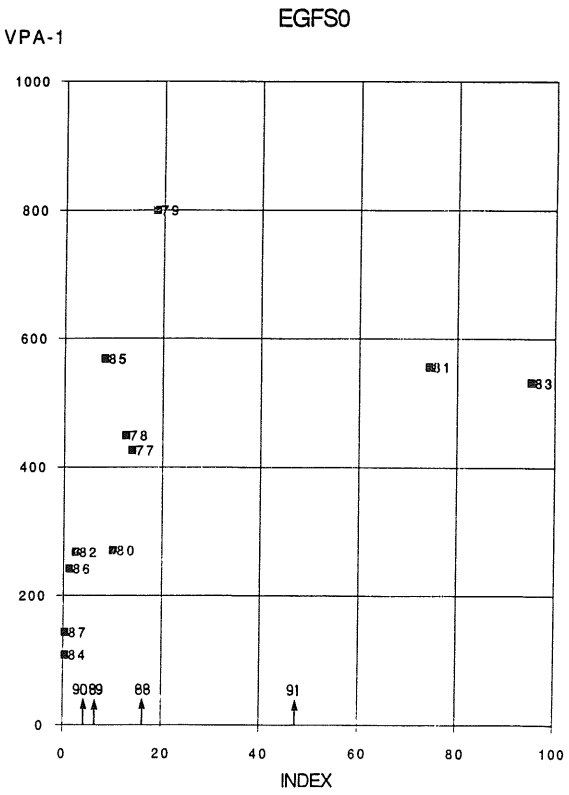
Country	1985	1986	1987	1988	1989	1990
Belgium	31	25	20	23	15	9
Denmark	-	-	-	+	-	-[1]
France	6,101	8,256	6,210	6,185	8,278[2]	n/a
Germany, Fed. Rep.	-	-	-	124	30	n/a
Ireland	2,177	1,739	1,624	1,400	n/a	n/a
Netherlands	-	-	-	n/a	-	-
Norway	3	40	2	1	16[1]	24[1]
Spain	118	-	-	-	n/a	n/a
UK (England and Wales)	722	648	375	766	699	494
UK (Isle of Man)	9	6	3	4	2	3
UK (N. Ireland)	665	635	571	491	524	551
UK (Scotland)	477	488	1,064	142	66	1,008
Total	10,303	11,837	9,869	9,136		

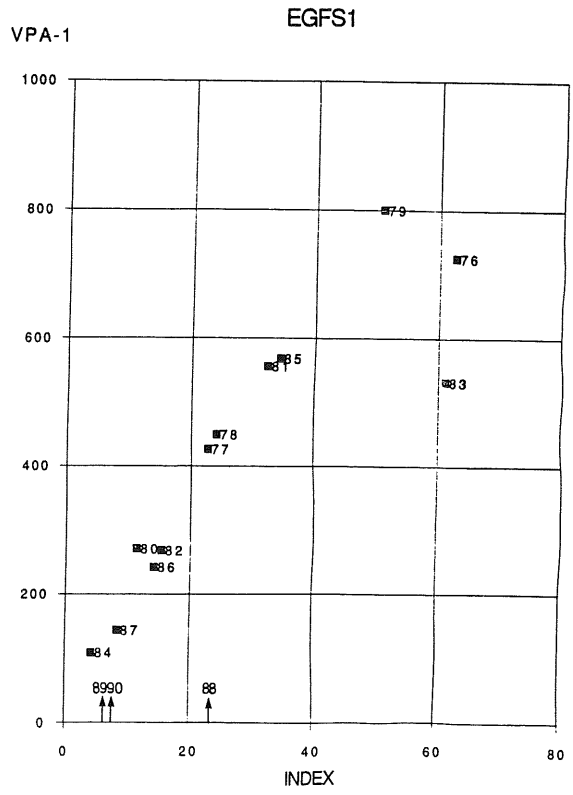
[1]Preliminary.
[2]Includes Sub-area VIII.
n/a = Not available.

Figure 2.3.1 Plots of survey indices against VPA recruitment at age 1.



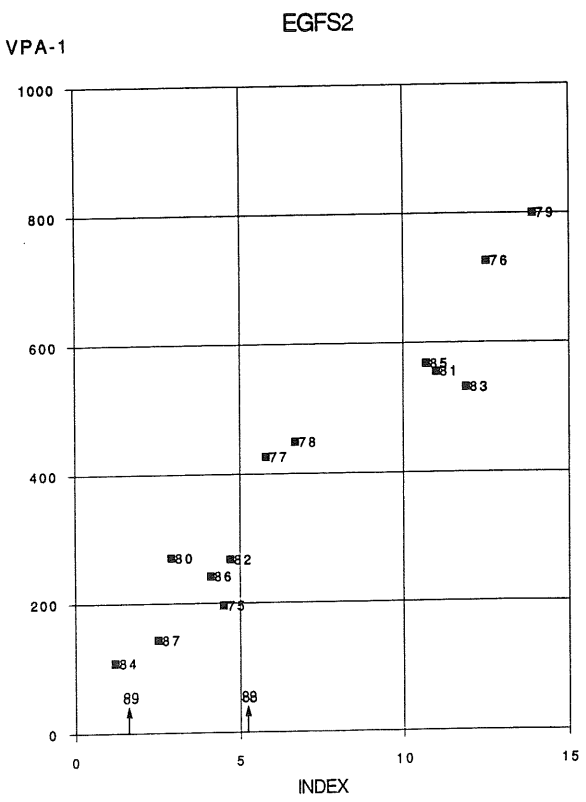


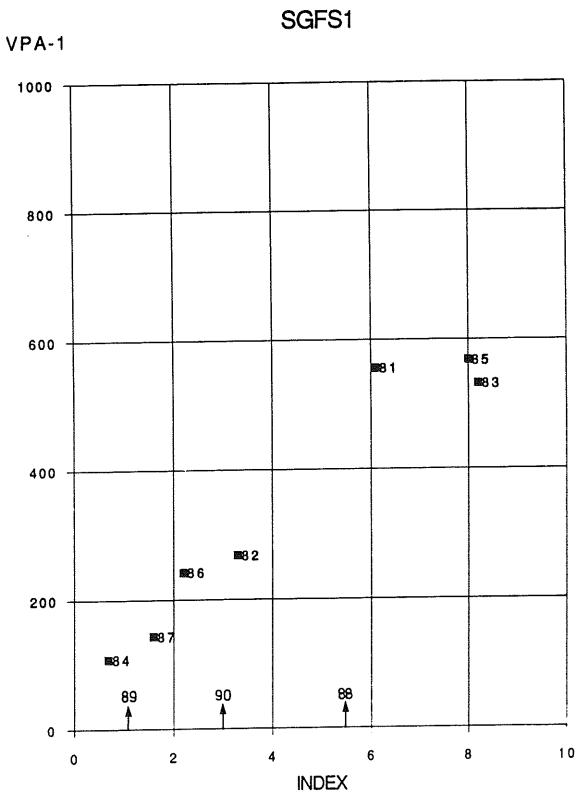


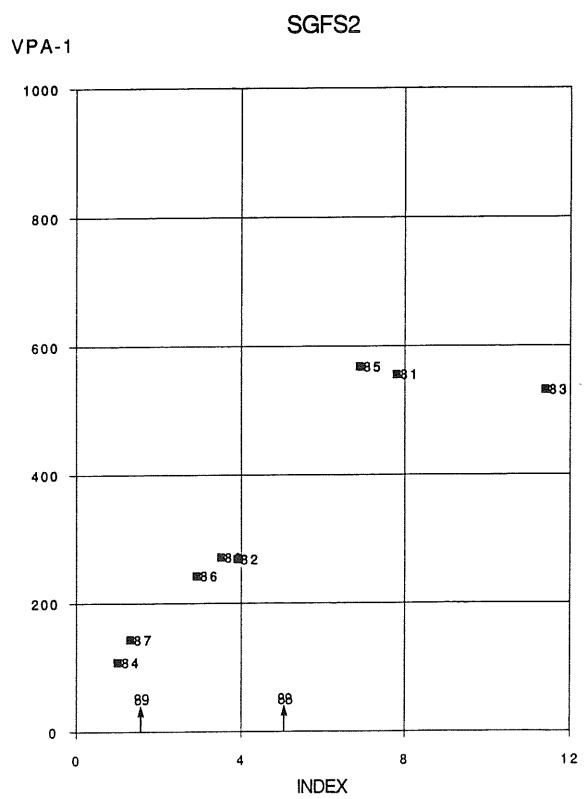


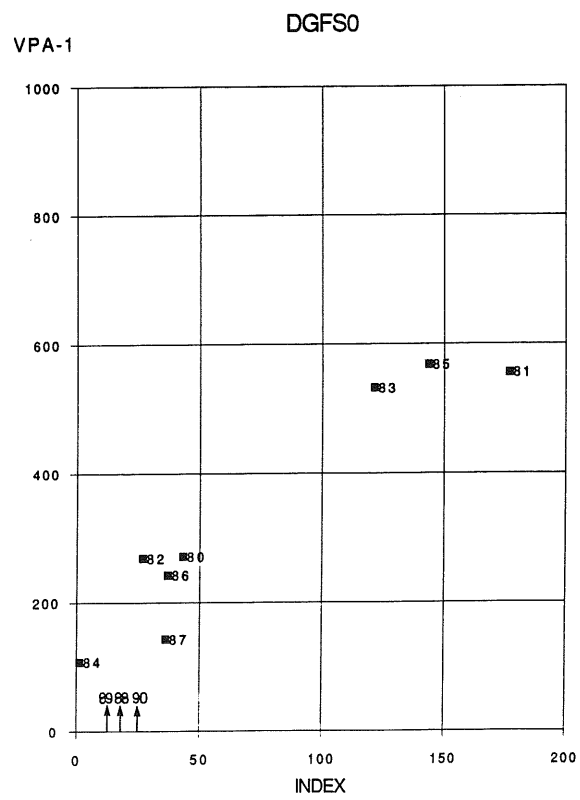
cont'd.

Figure 2.3.1 cont'd.



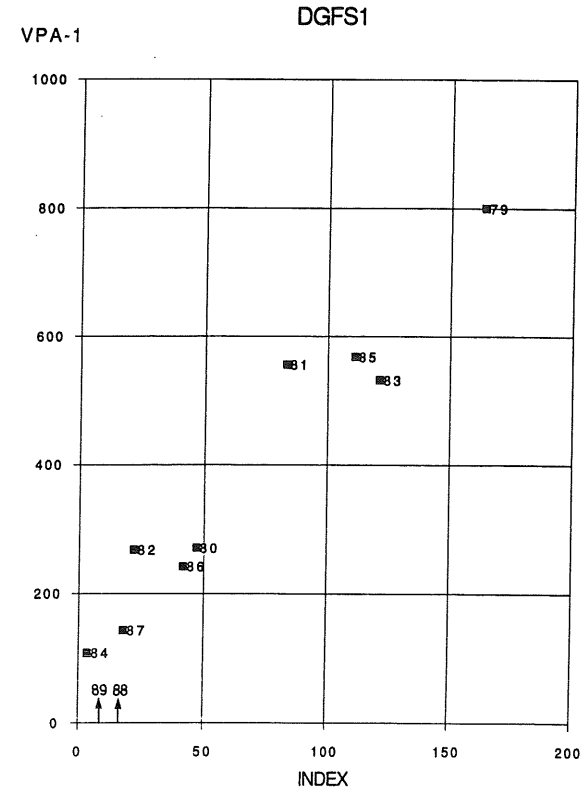


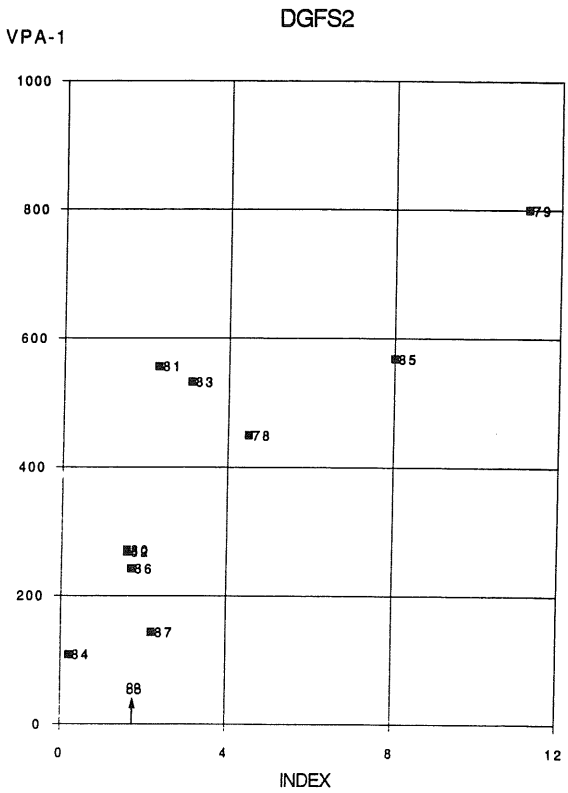


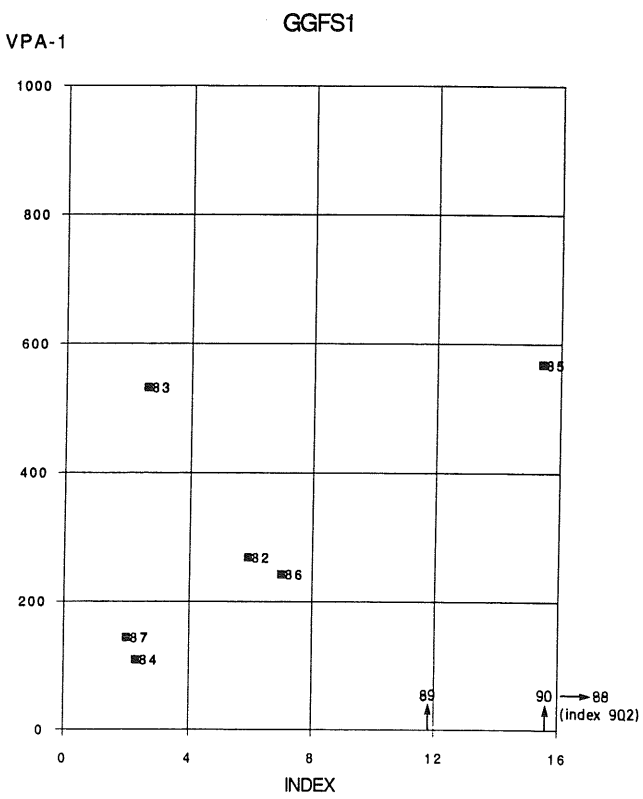


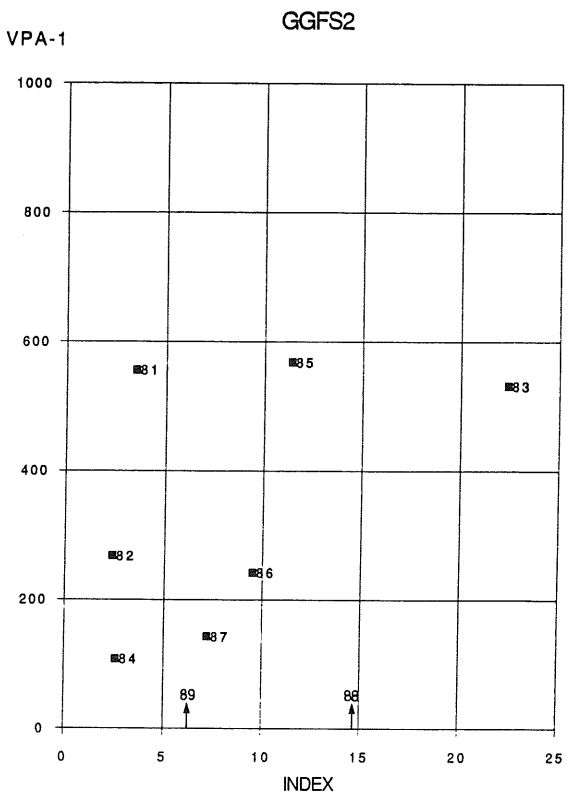
cont'd.

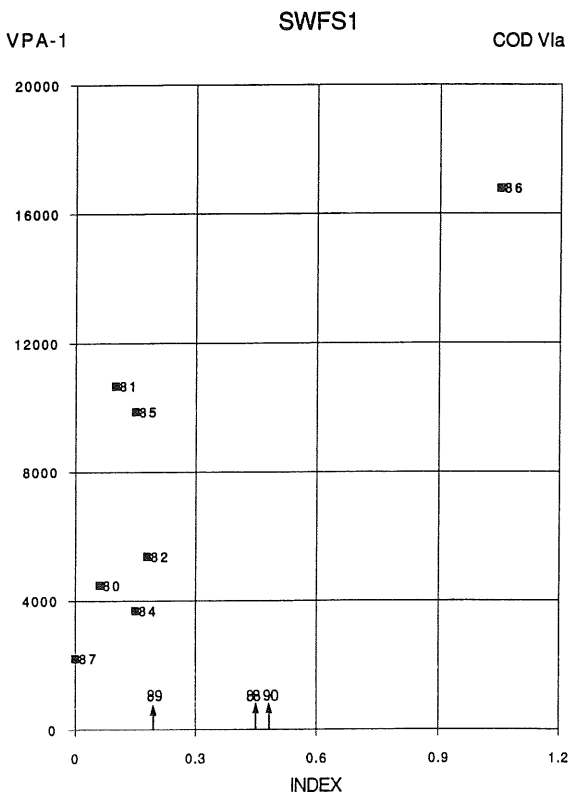
Figure 2.3.1 cont'd.











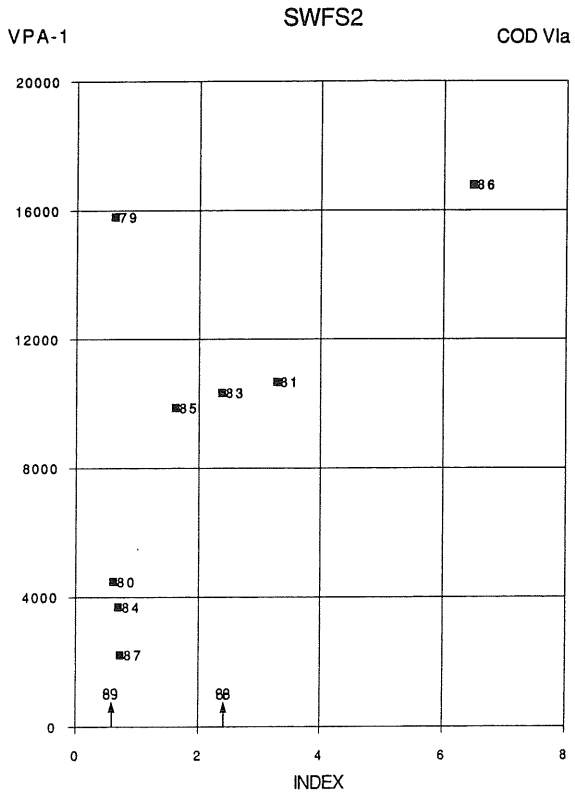
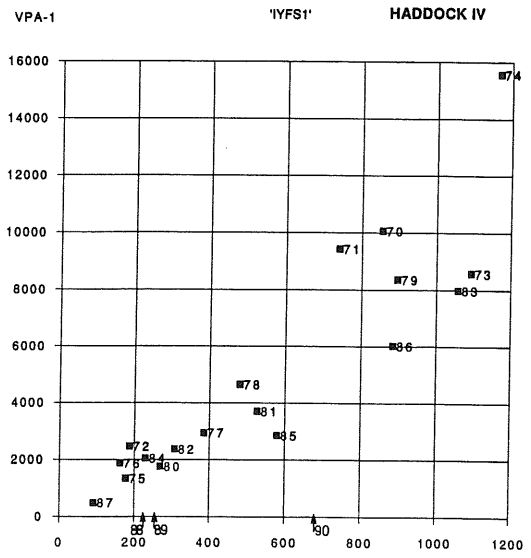
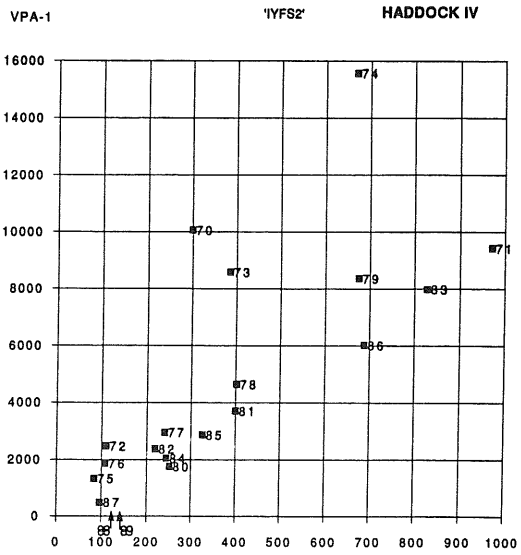
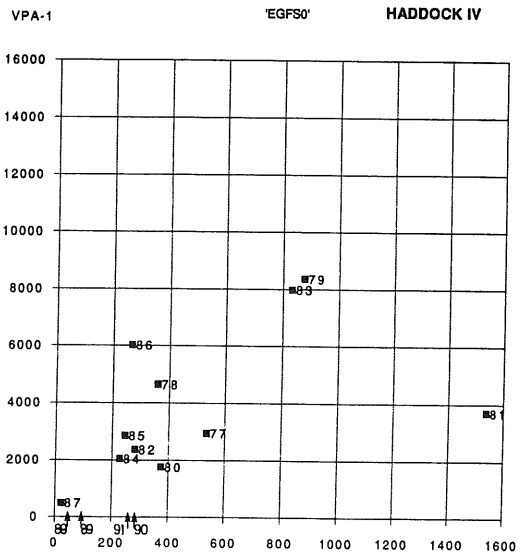


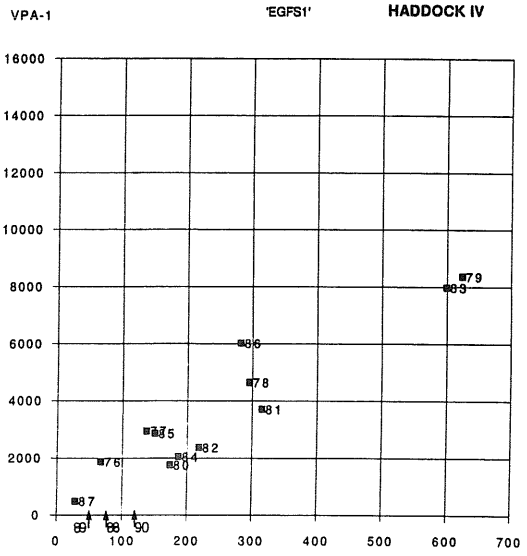
Figure 2.3.2 Plots of survey indices against VPA recruitment at age 1.

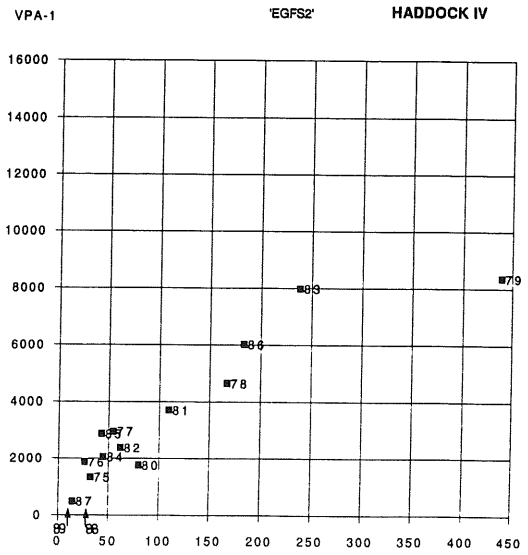
Figure 2.3.3 Plots of survey indices against VPA recruitment at age 1.

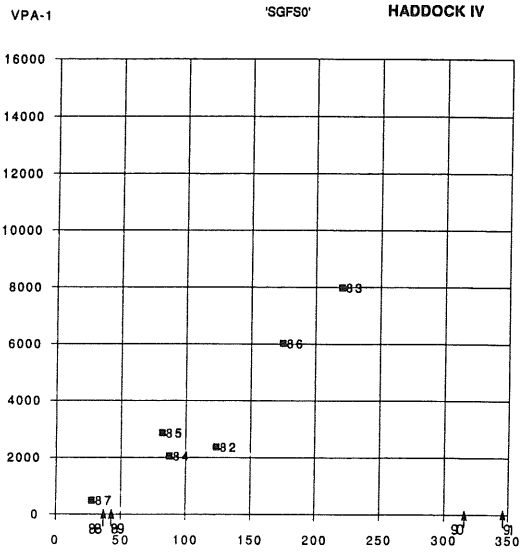






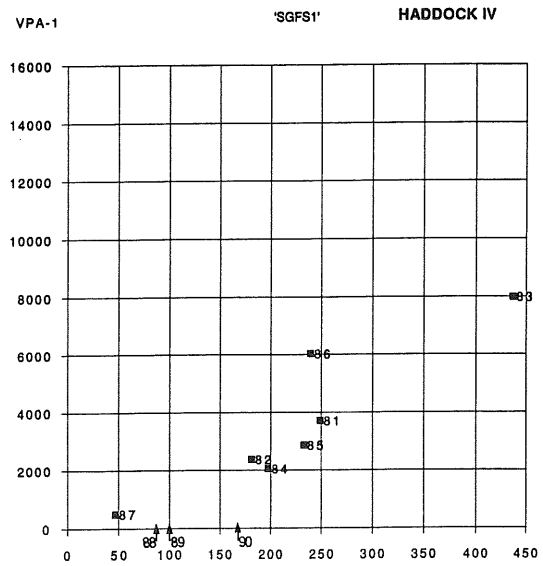


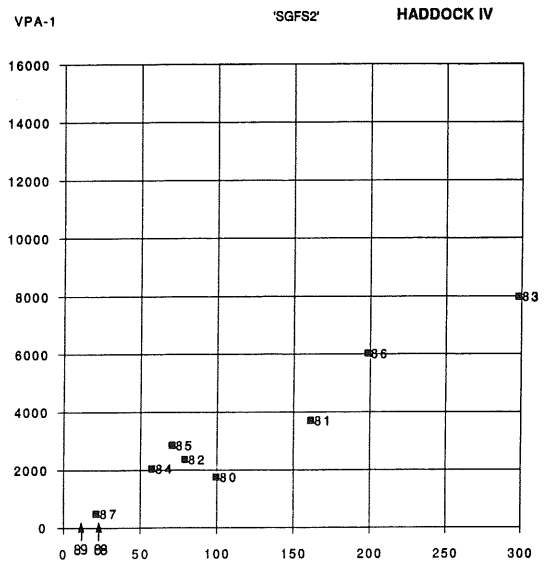


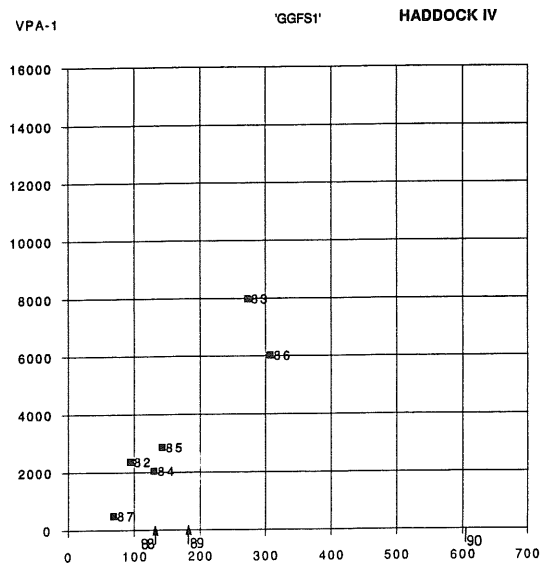


cont'd.

Figure 2.3.3. cont'd.







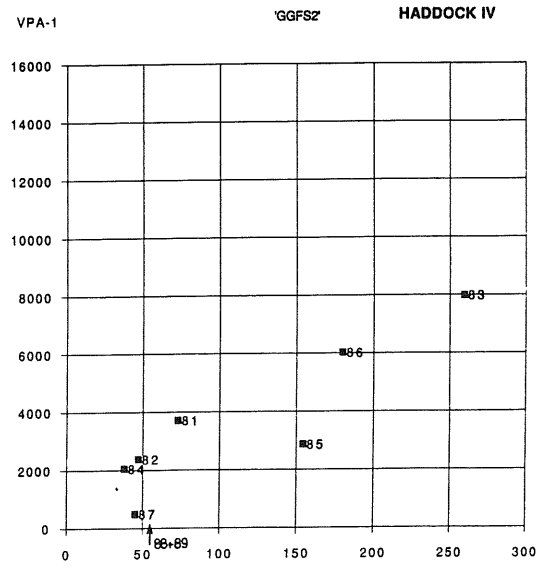
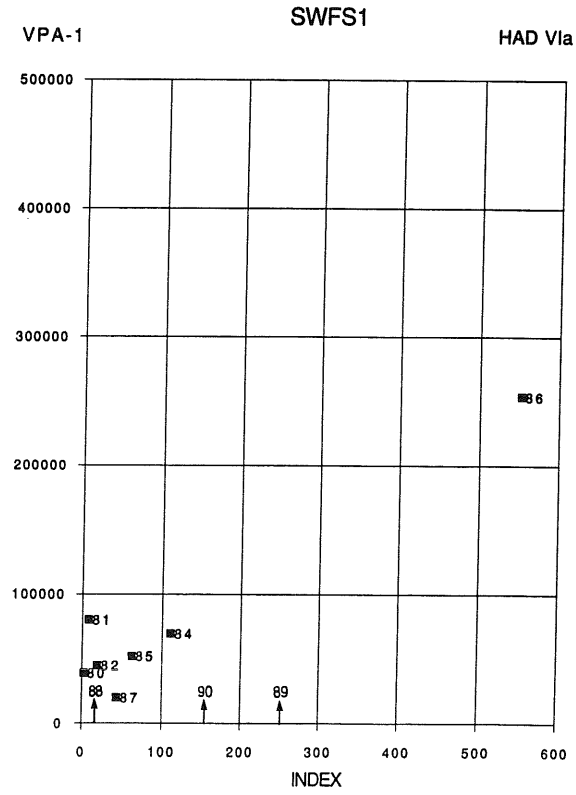
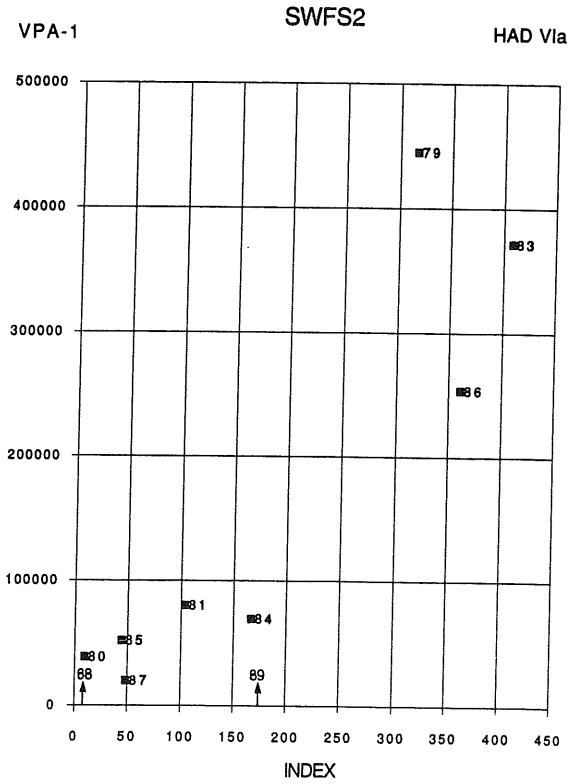


Figure 2.3.4 Plots of survey indices against VPA recruitment at age 1.





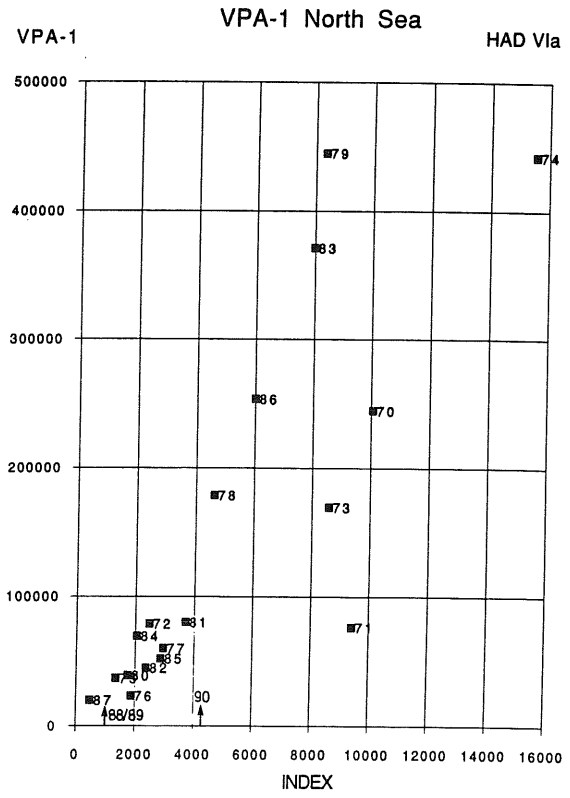
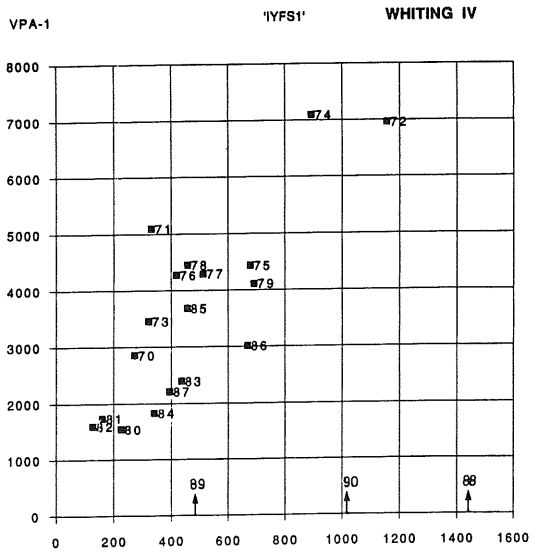
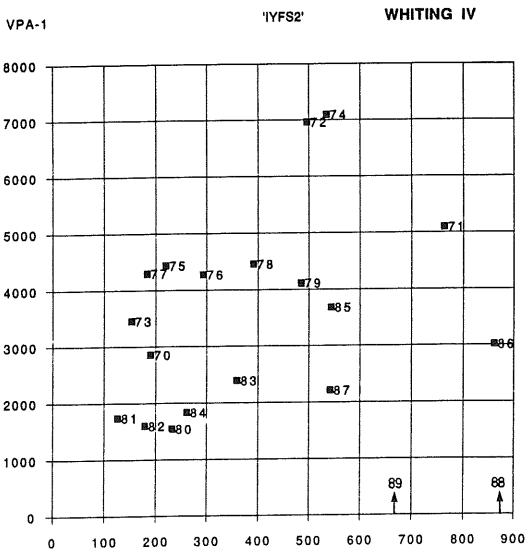
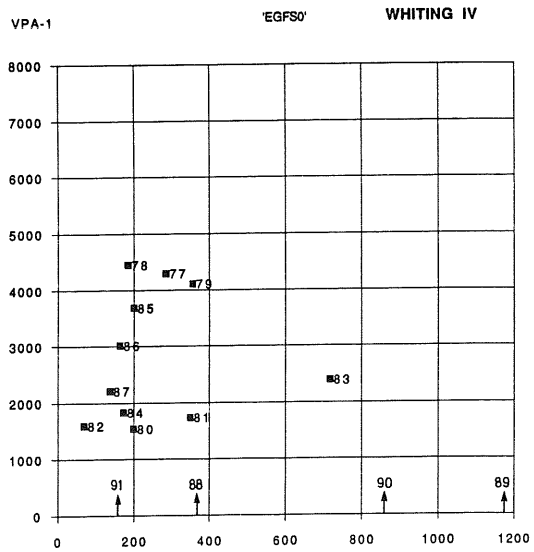
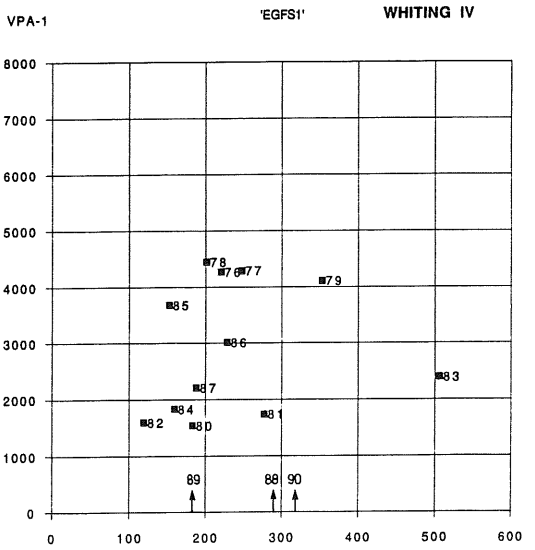


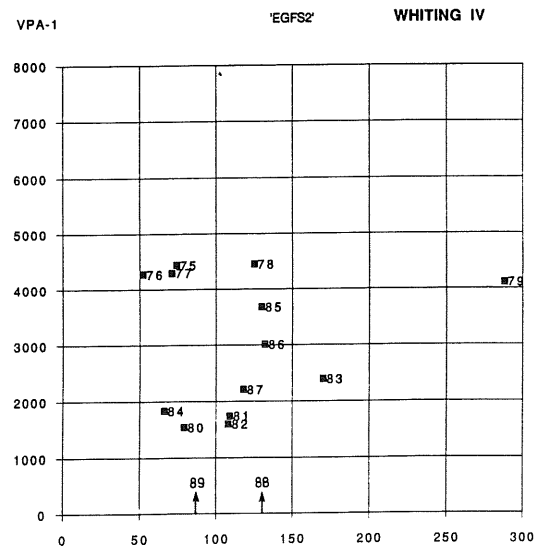
Figure 2.3.5 Plots of survey indices against VPA recruitment at age 1.











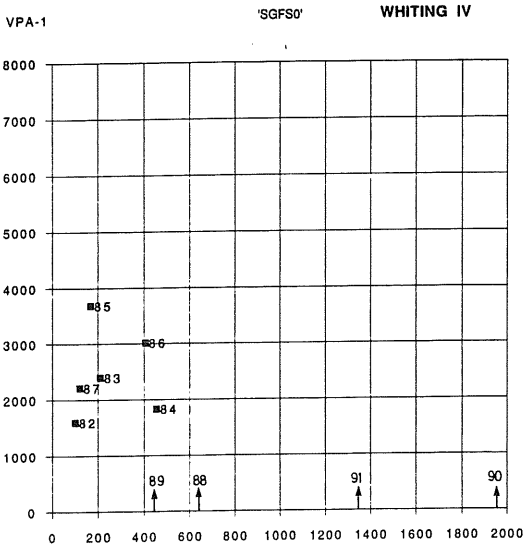


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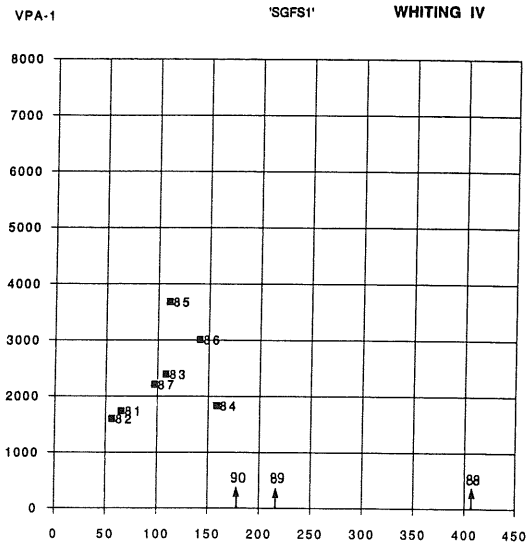
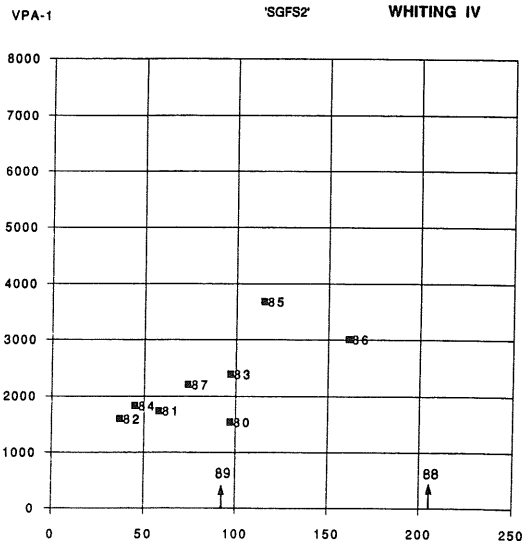
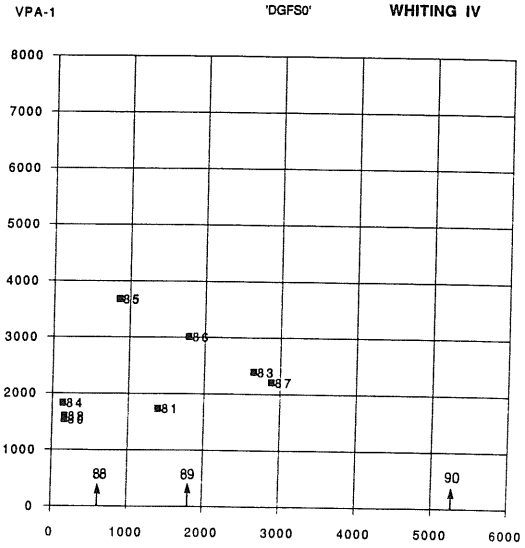
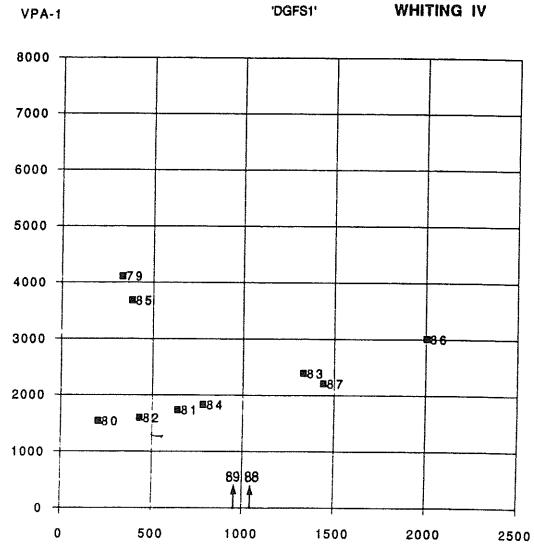
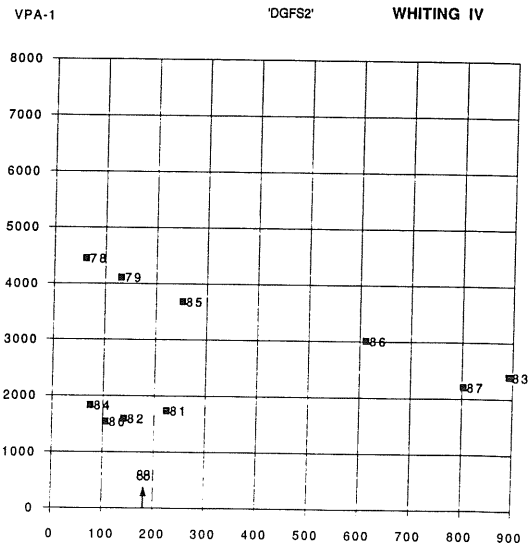
Figure 2.3.5 cont'd.











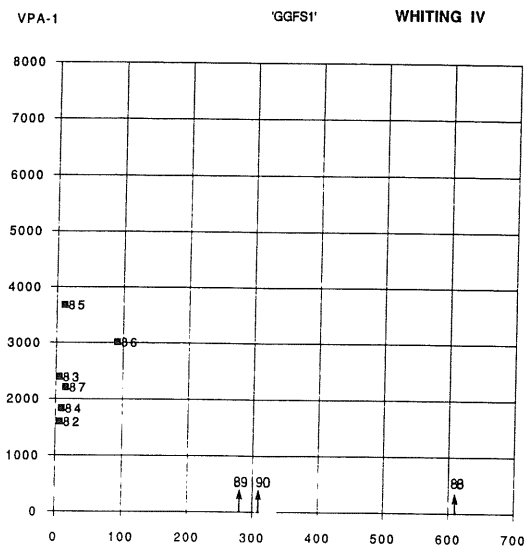


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Figure 2.3.5 cont'd.

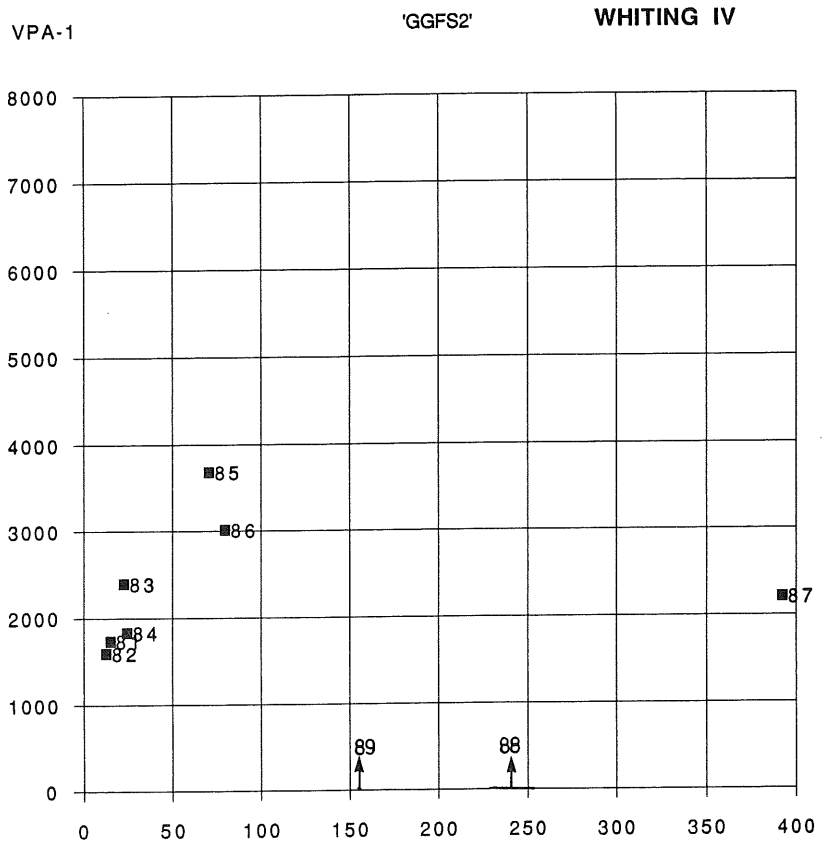
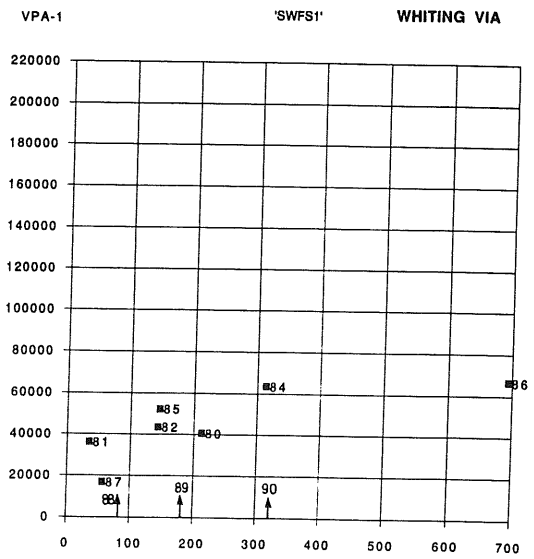
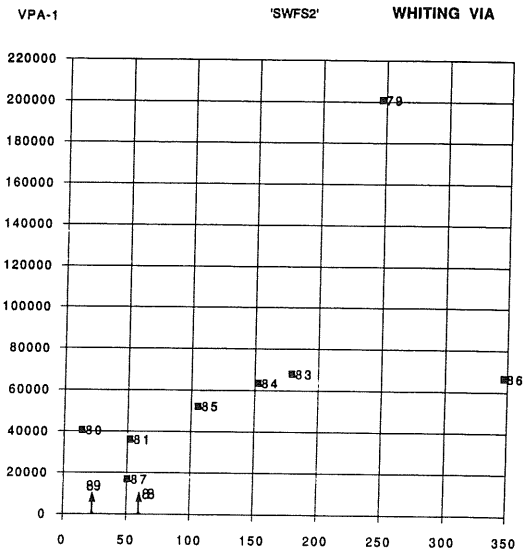


Figure 2.3.6 Plots of survey indices against VPA recruitment at age 1.





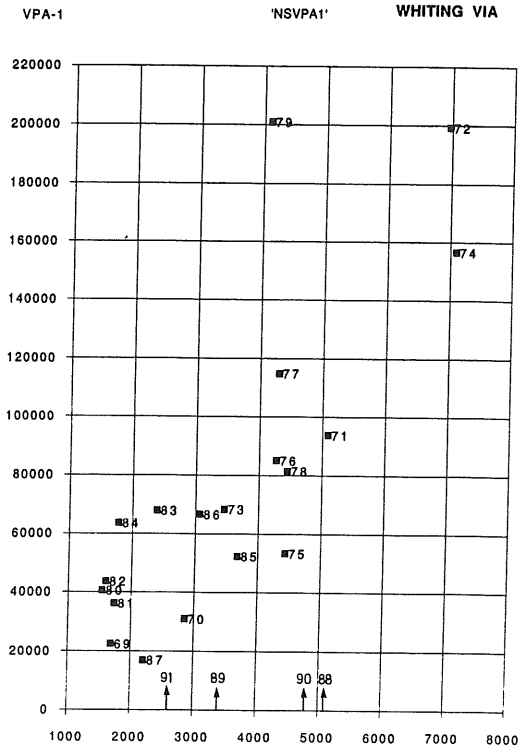


Figure 2.4.1a

Hours Fished by Scottish Gears in the North Sea 1965-90

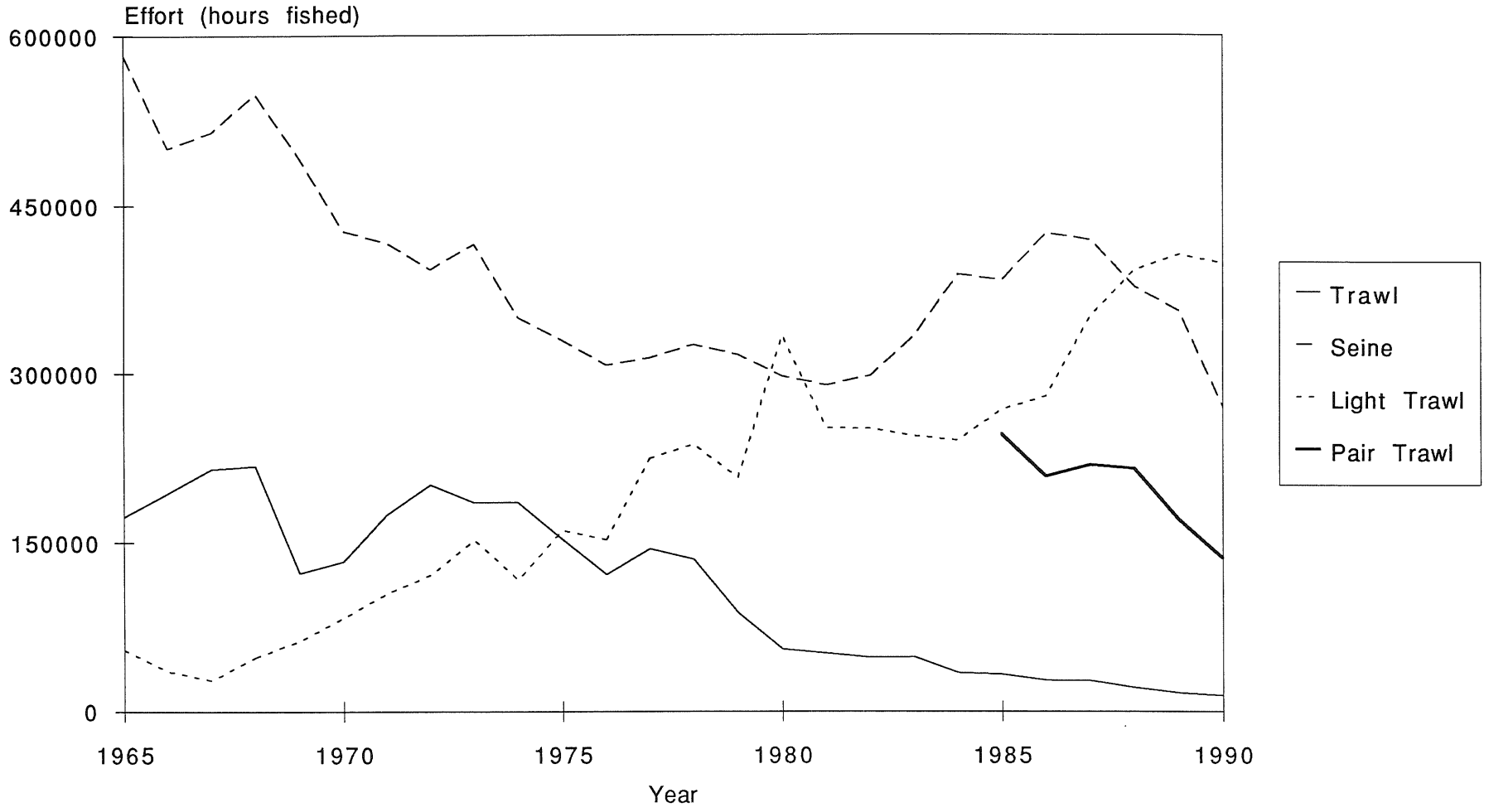


Figure 2.4.1b

Hours Fished by Other Gears in the North Sea 1965-90

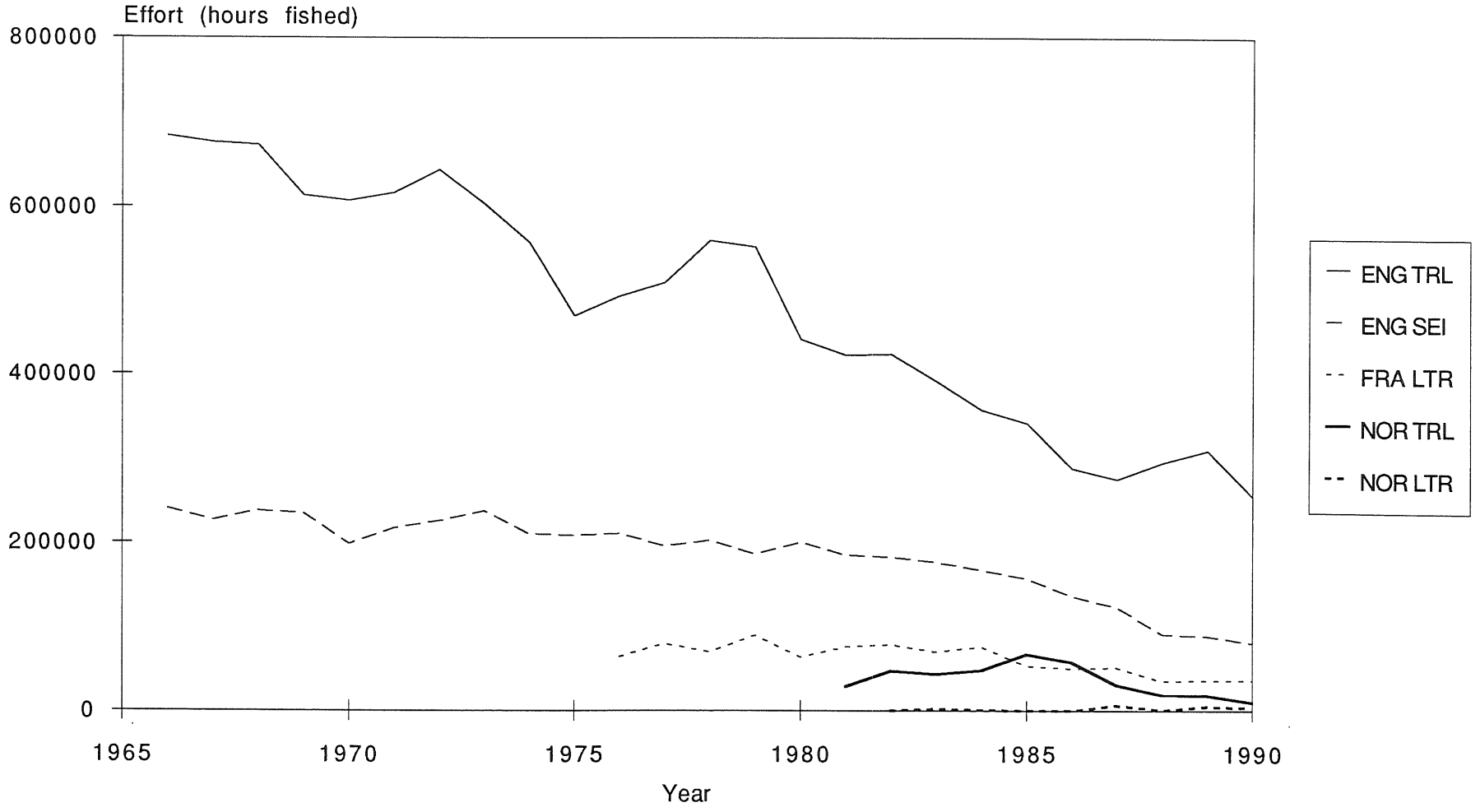


Figure 2.4.1c

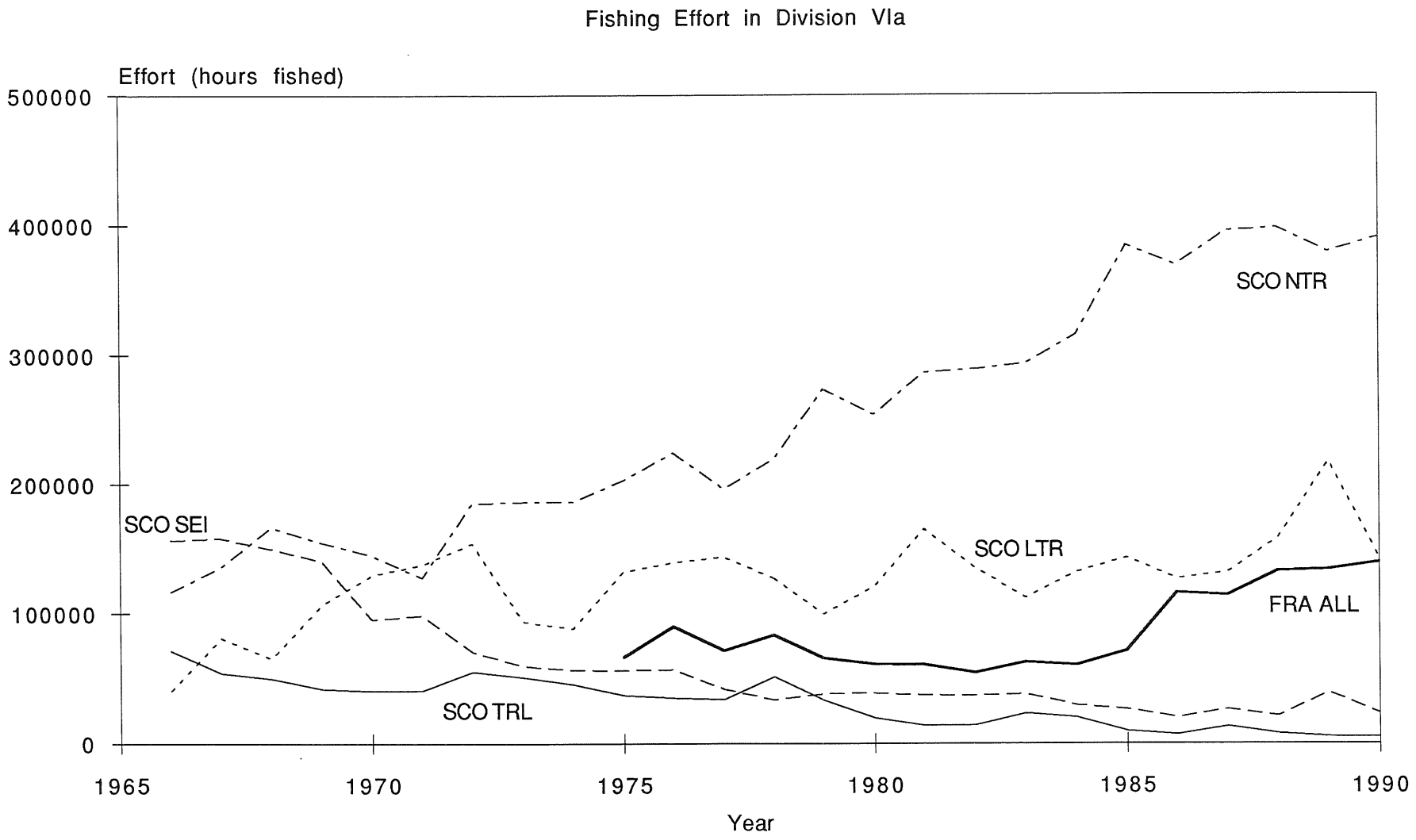

Fishing Effort in Division VIa
Effort (hours fished)
500000
400000
300000
200000
100000
0
SCO NTR
SCO SEI
SCO LTR
FRA ALL
SCO TRL
1965
1970
1975
1980
1985
1990
Year

Fig. 2.4.2 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
CODIV
F VALUES

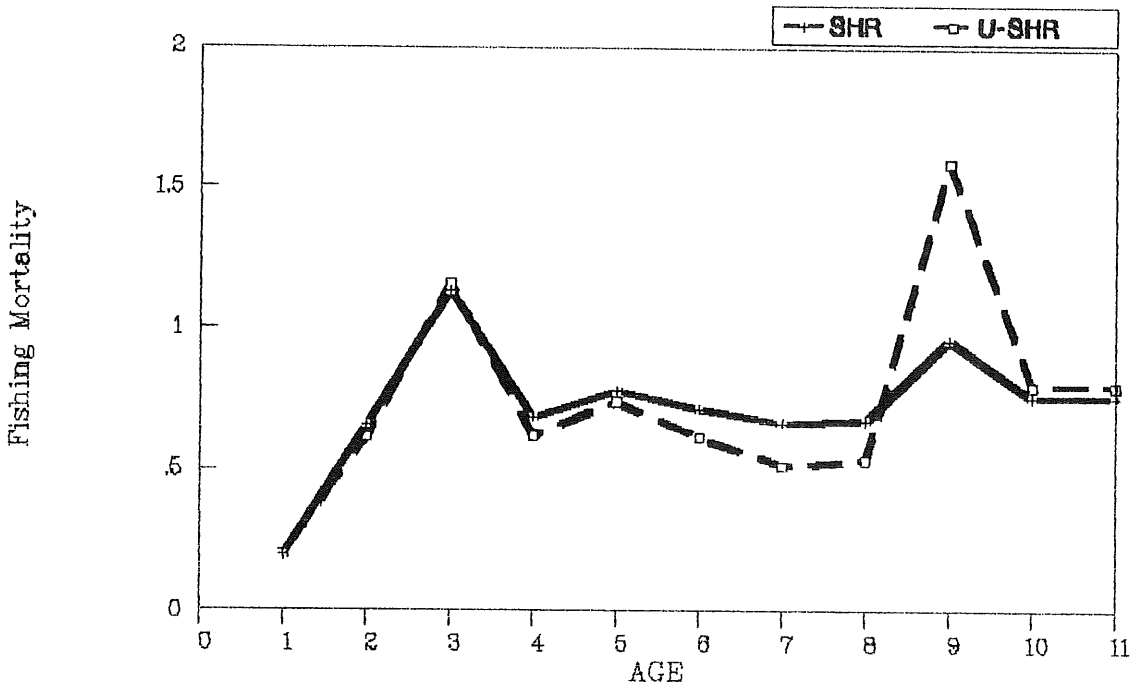


Fig.2.4.3 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
CODVIA
F VALUES

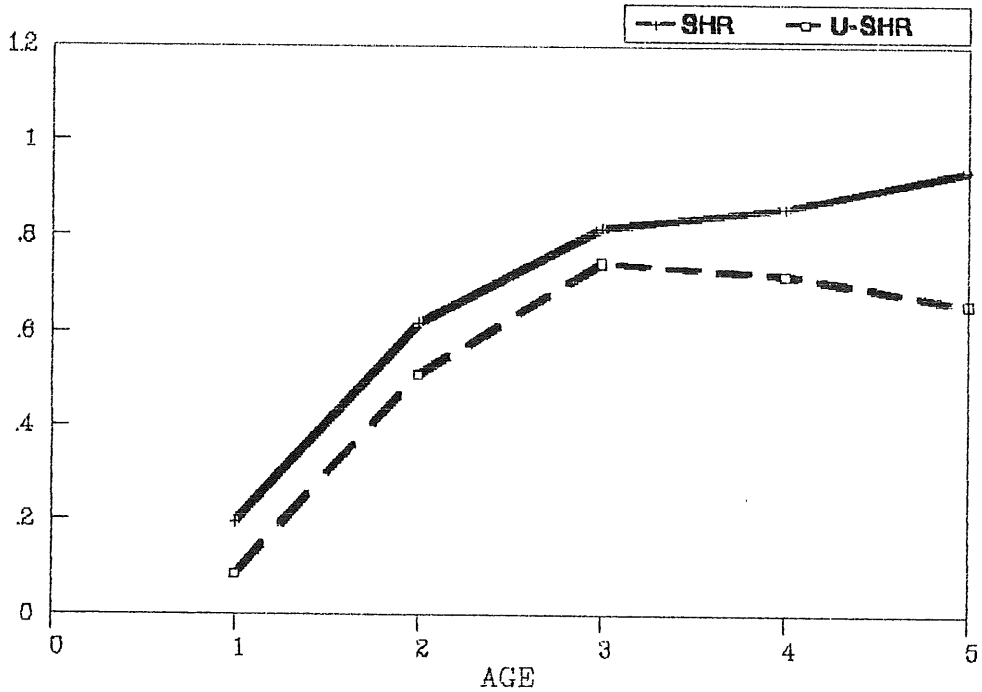


Fig. 2.4.4 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
HADIV
F VALUES

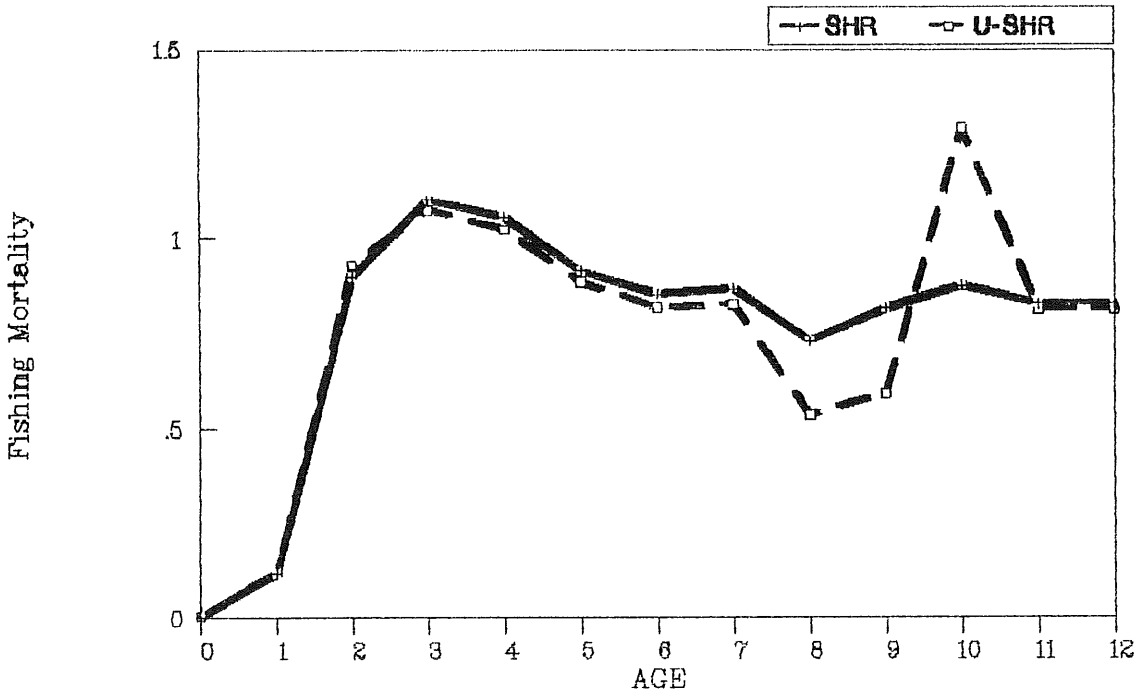


Fig. 2.4.5 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
HADVIA
F VALUES

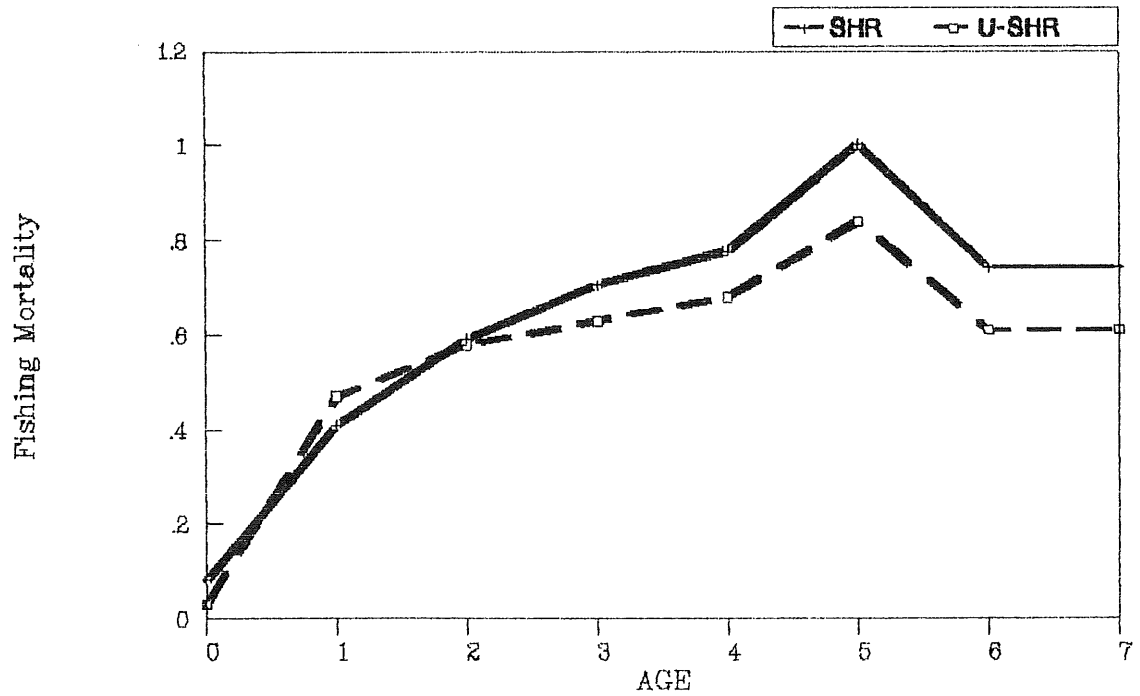


Fig. 2.4.6 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
WHIIV
F VALUES

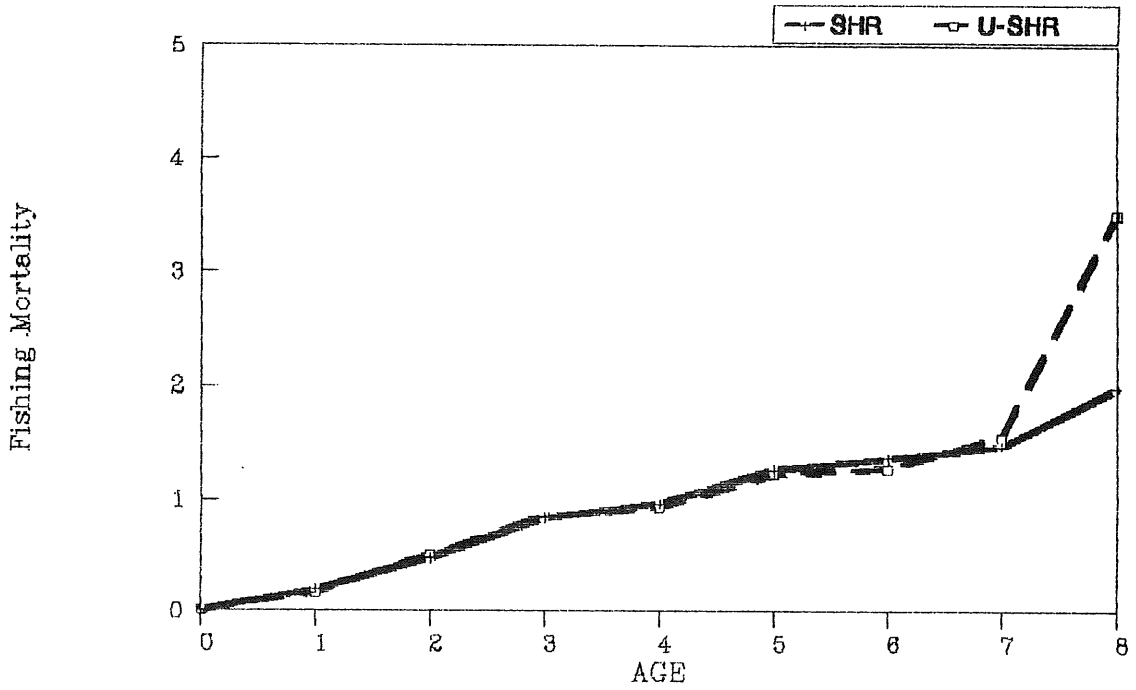


Fig. 2.4.7 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
WHIVIA
F VALUES

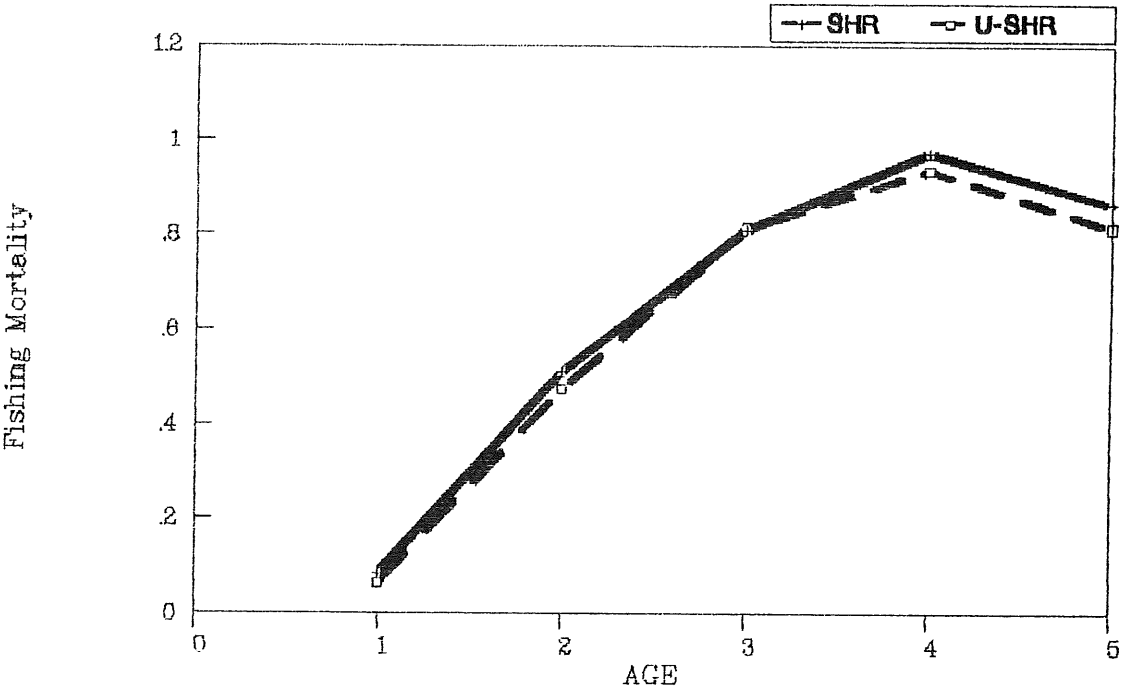


Fig. 2.4.8 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
SAIIV
F VALUES

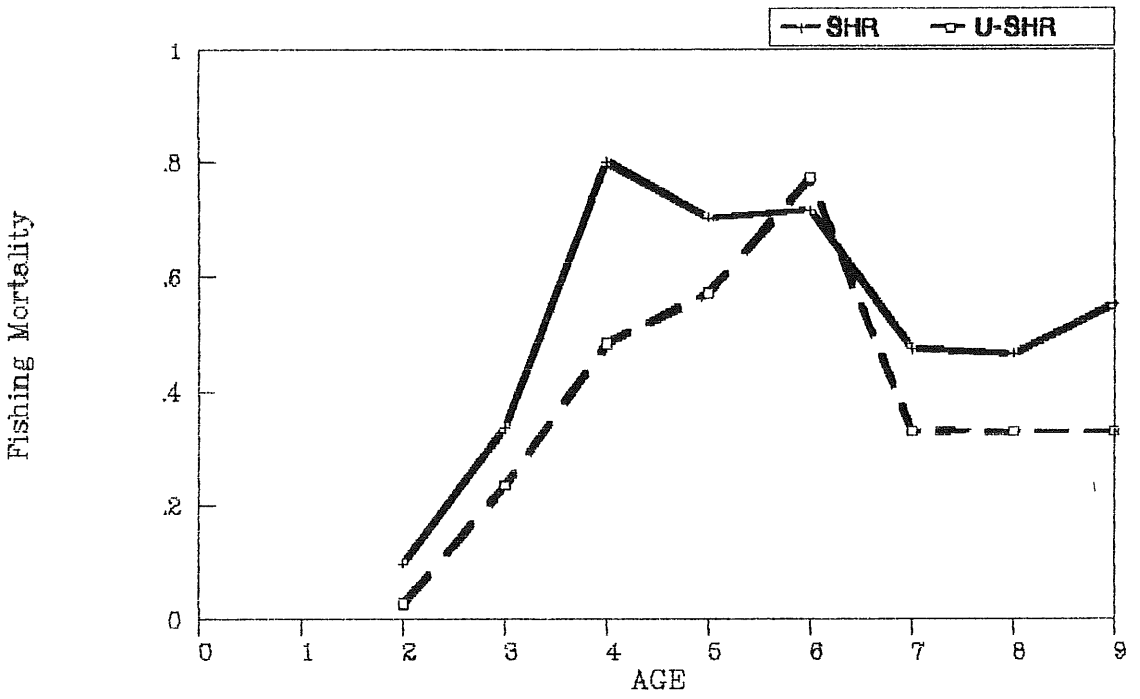


Fig. 2.4.9 Exploitation patterns derived from Laurec-Shepherd tuning with and without shrinkage to the mean.
SAIVI
F VALUES

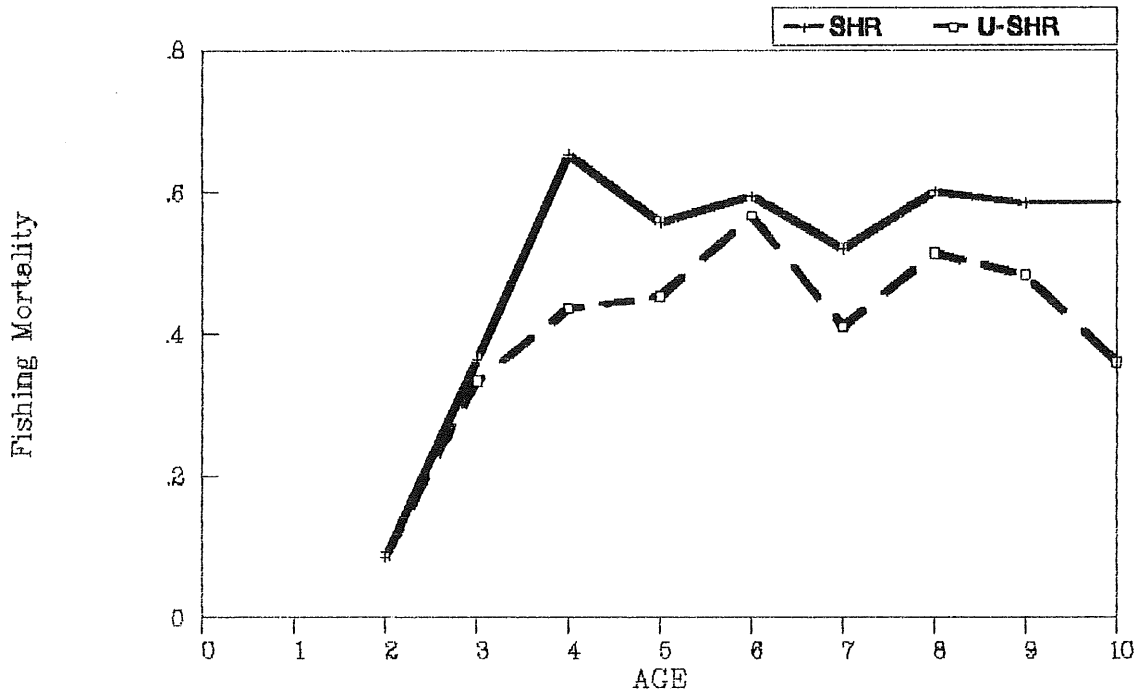
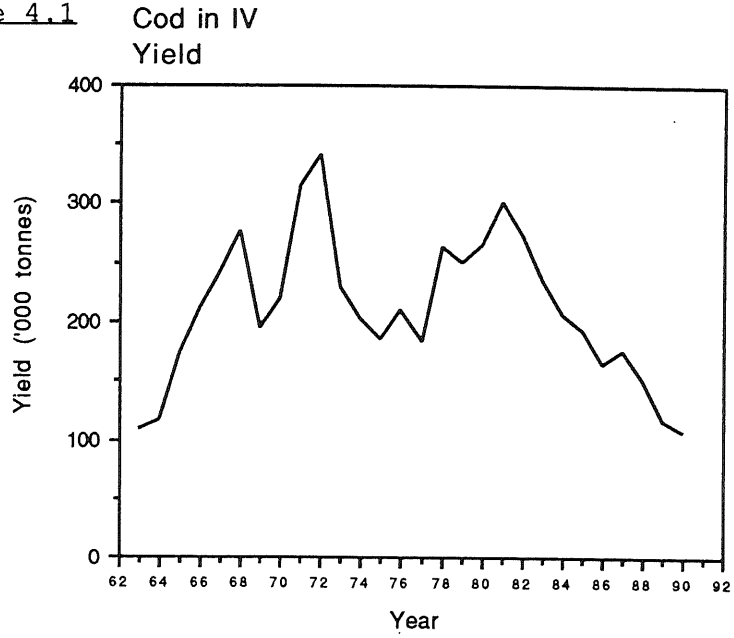
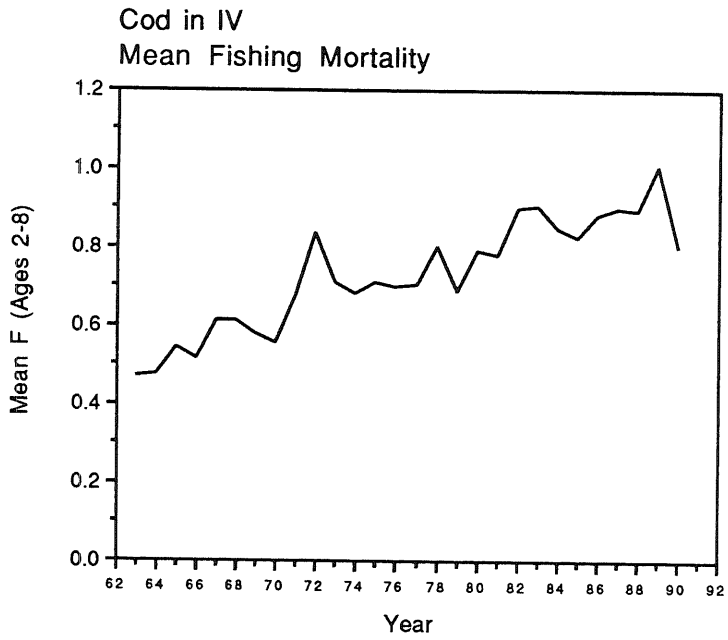
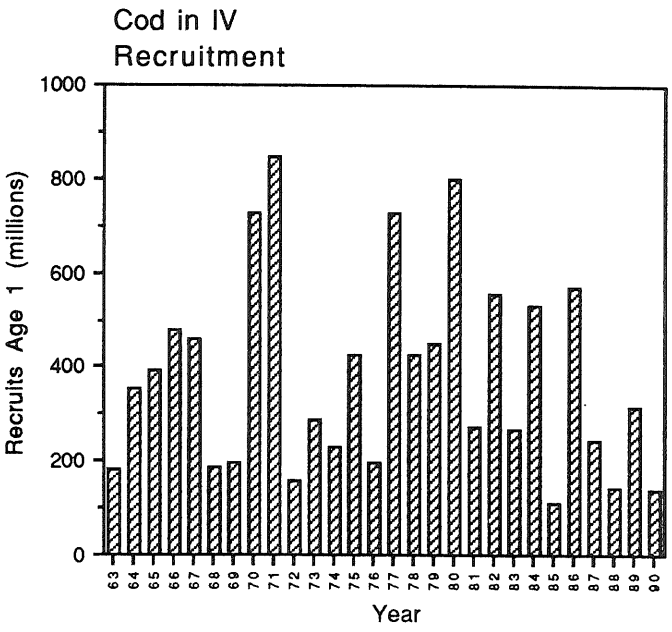


Figure 4.1


Cod in IV
Yield
Yield ('000 tonnes)
400
300
200
100
0
62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92
Year


Cod in IV
Mean Fishing Mortality
Mean F (Ages 2-8)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92
Year


Cod in IV
Recruitment
Recruits Age 1 (millions)
1000
800
600
400
200
0
63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
Year

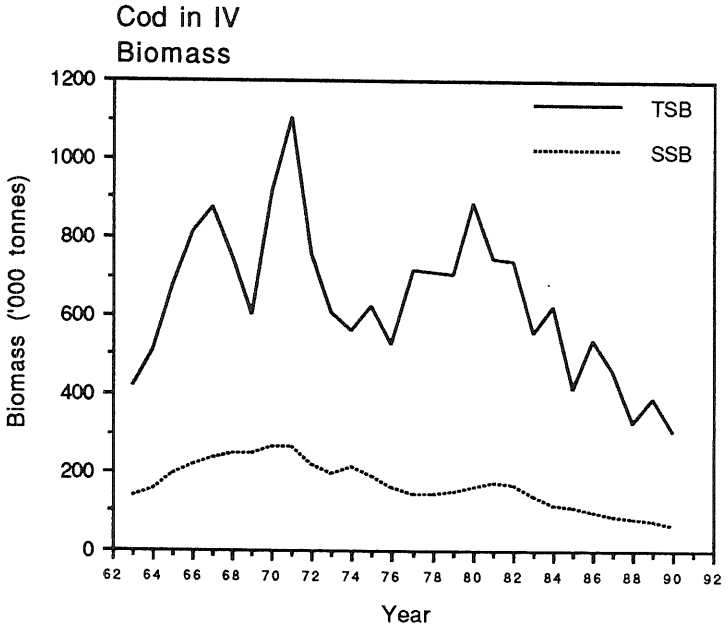
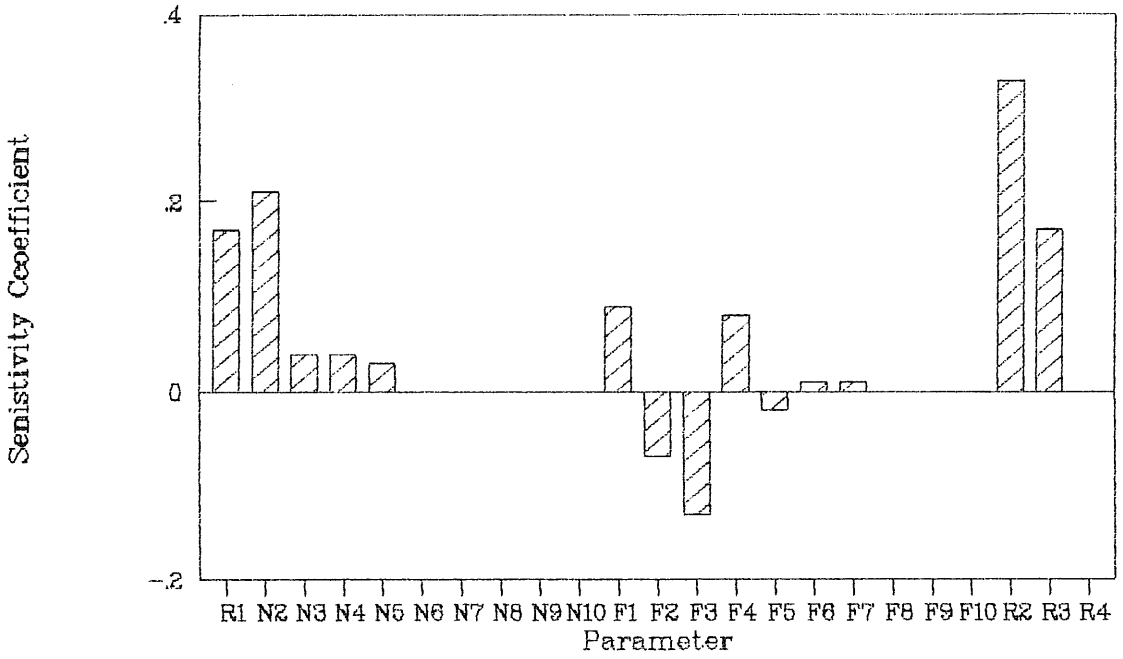

Cod in IV
Biomass
Biomass ('000 tonnes)
TSB
SSB
1200
1000
800
600
400
200
0
62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92
Year

Figure 4.2

COD IN IV
YIELD IN 1992

Sensitivity Analysis



COD IN IV
SSB IN 1993

Sensitivity Analysis

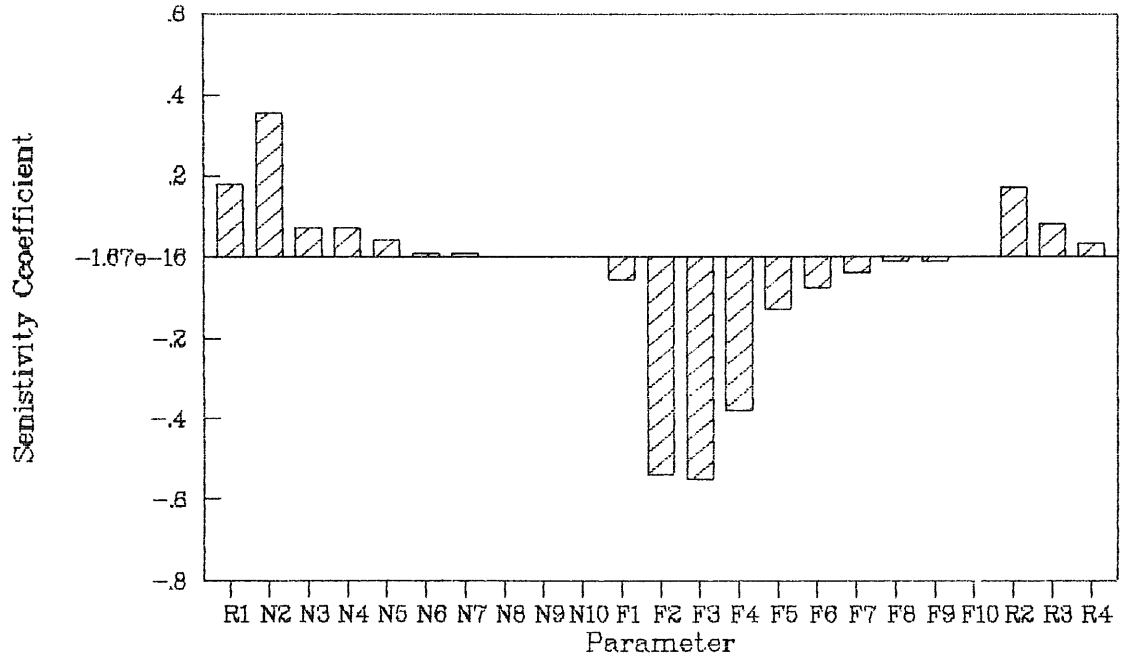


Figure 4.3

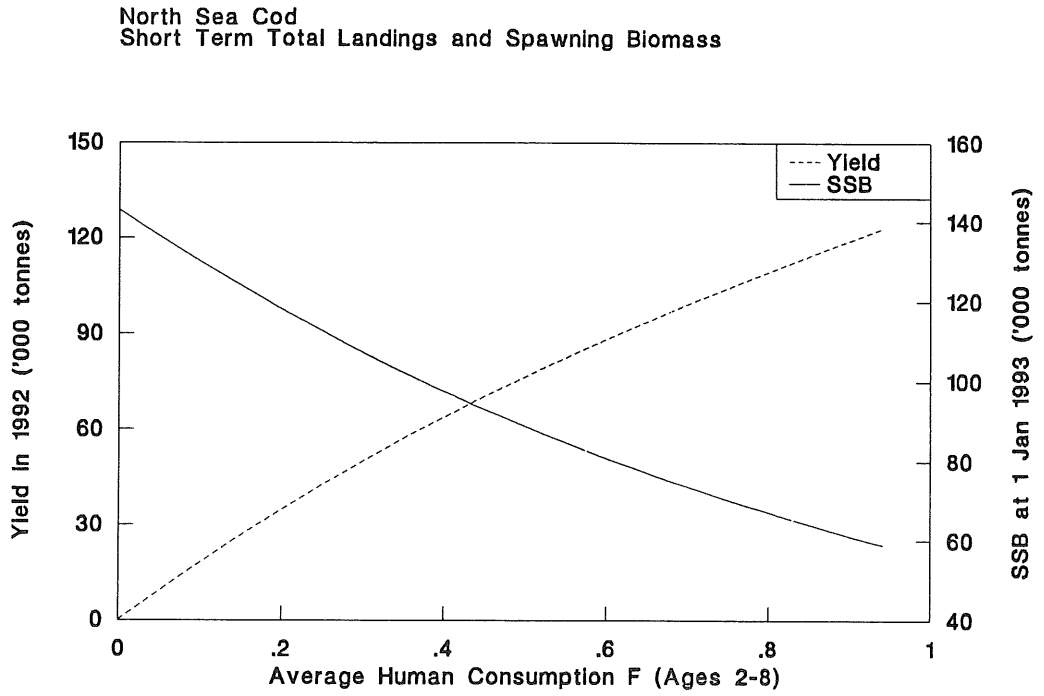


Figure 4.4

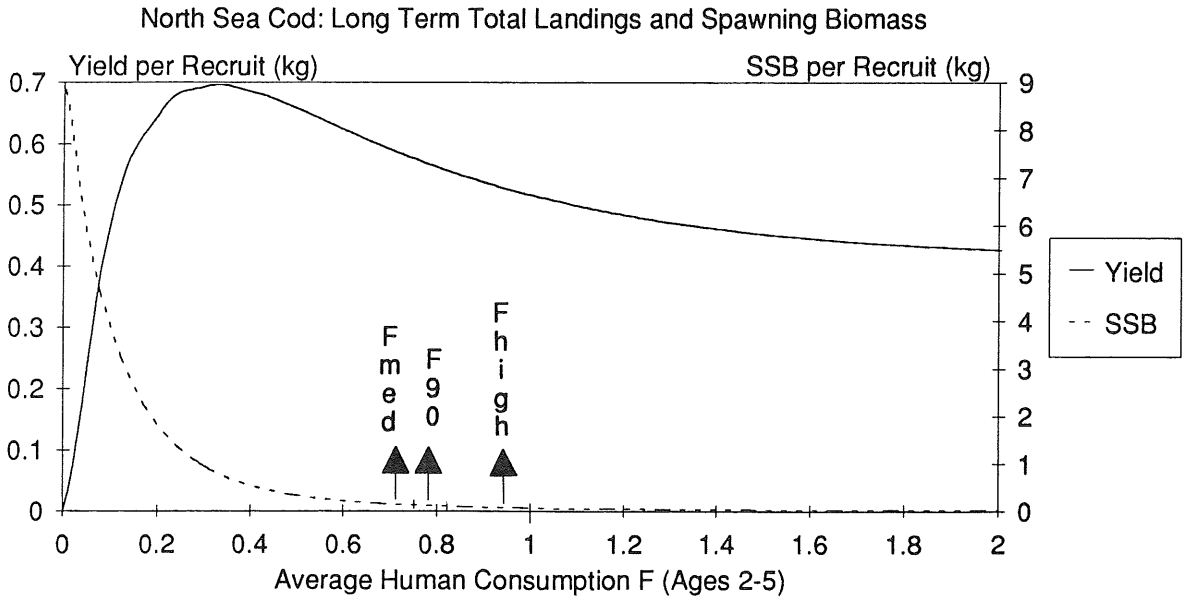


Figure 4.5

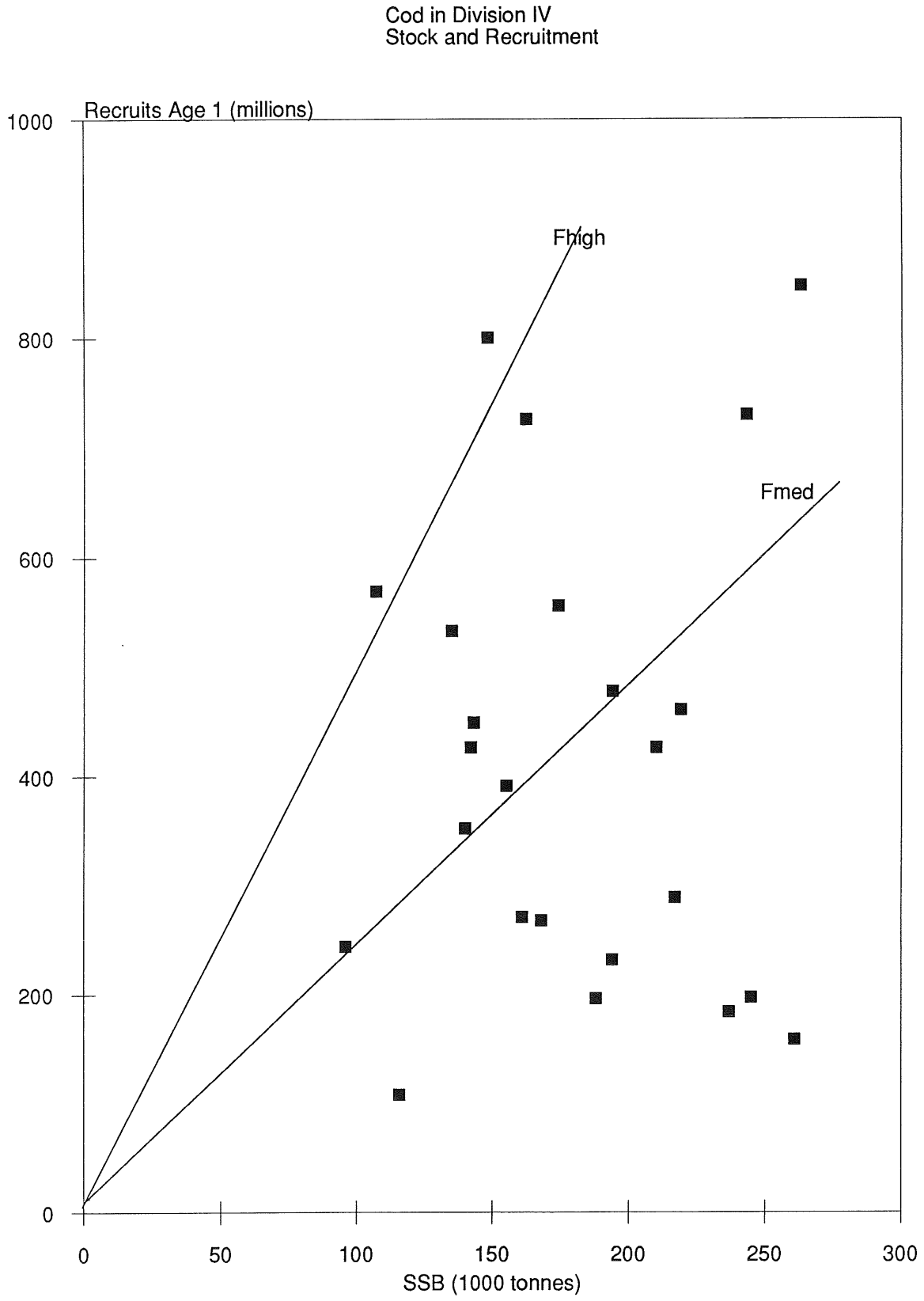
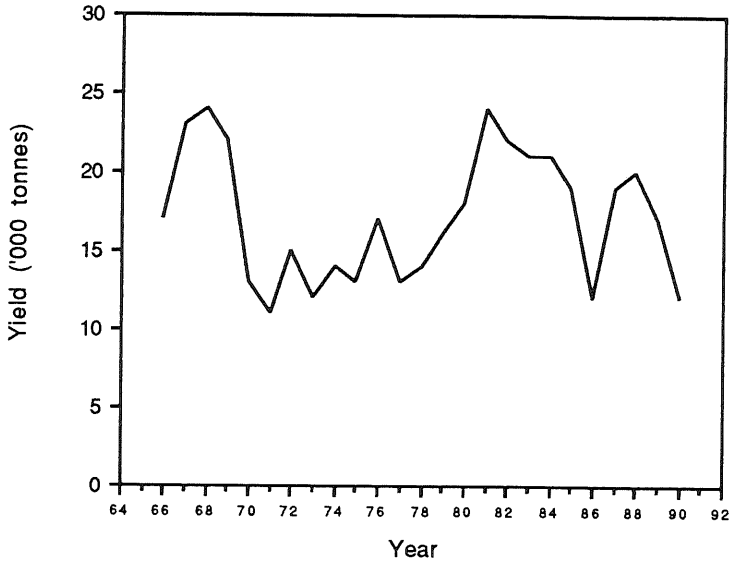
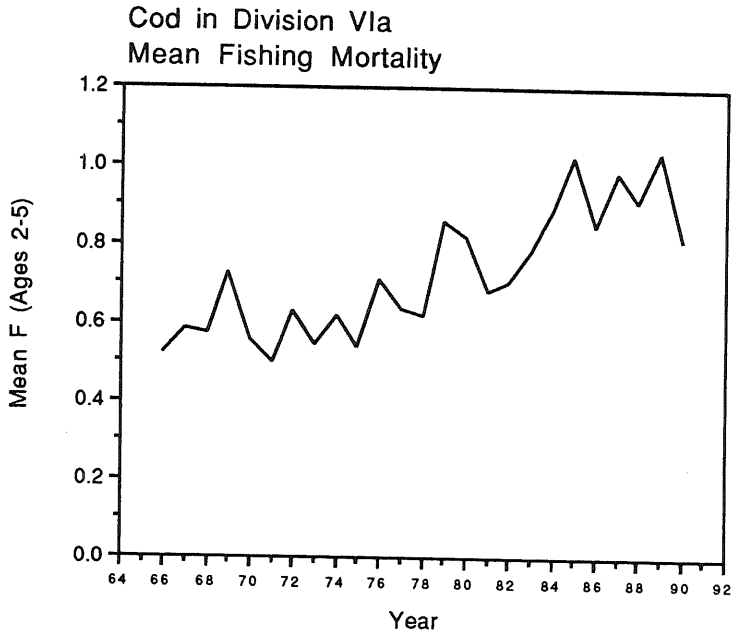
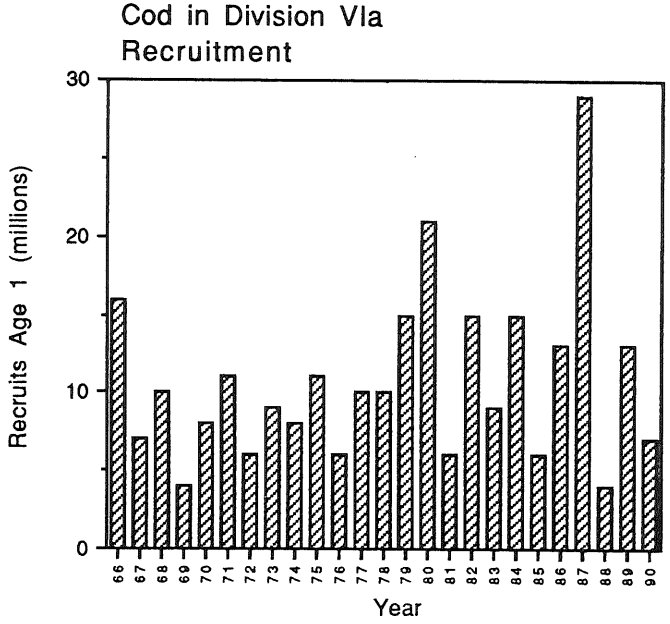

Cod in Division IV
Stock and Recruitment
Recruits Age 1 (millions)
1000
800
600
400
200
0
Fhigh
Fmed
0
50
100
150
200
250
300
SSB (1000 tonnes)

Figure 5.1.1 Cod in Division VIa







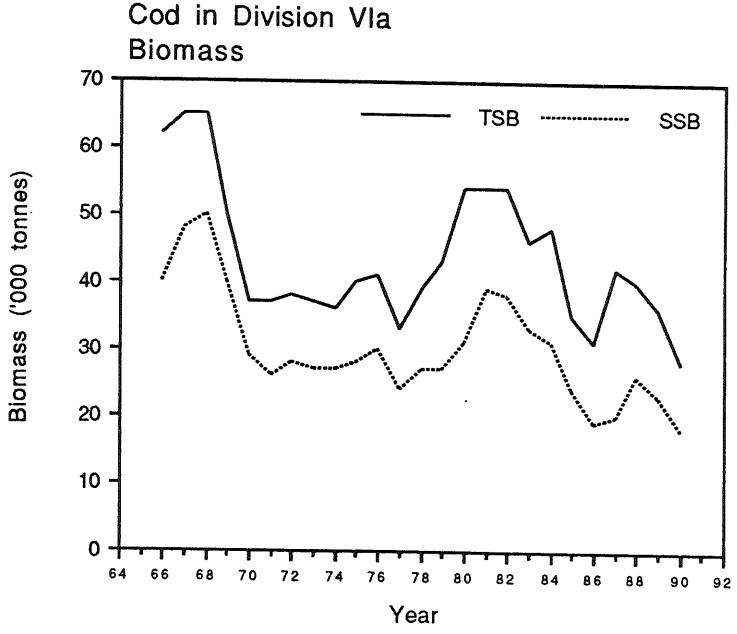


Figure 5.1.2

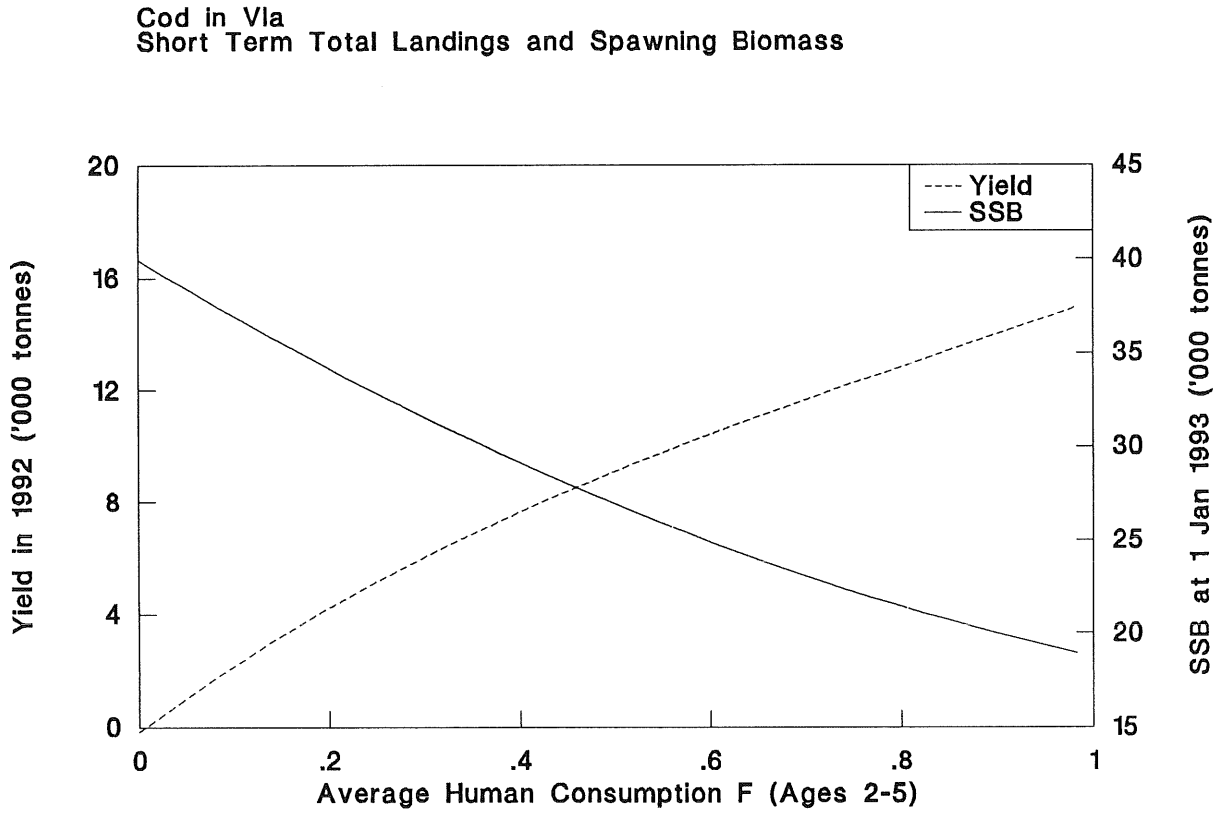
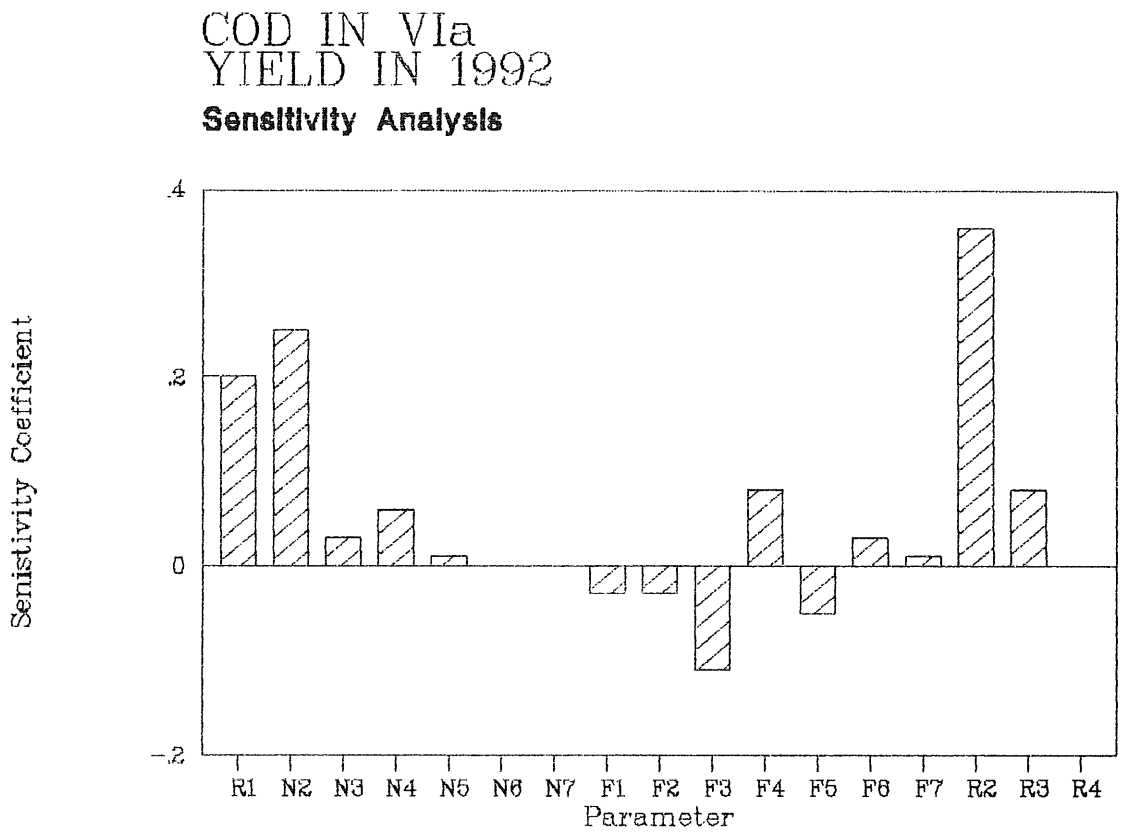

Cod in VIa
Short Term Total Landings and Spawning Biomass
Yield
SSB
Yield in 1992 ('000 tonnes)
SSB at 1 Jan 1993 ('000 tonnes)
Average Human Consumption F (Ages 2-5)
0
4
8
12
16
20
15
20
25
30
35
40
45
0
.2
.4
.6
.8
1

Figure 5.1.3


COD IN VIa
YIELD IN 1992
Sensitivity Analysis
Senistivity Coefficient
.4
.2
0
-.2
R1 N2 N3 N4 N5 N6 N7 F1 F2 F3 F4 F5 F6 F7 R2 R3 R4
Parameter

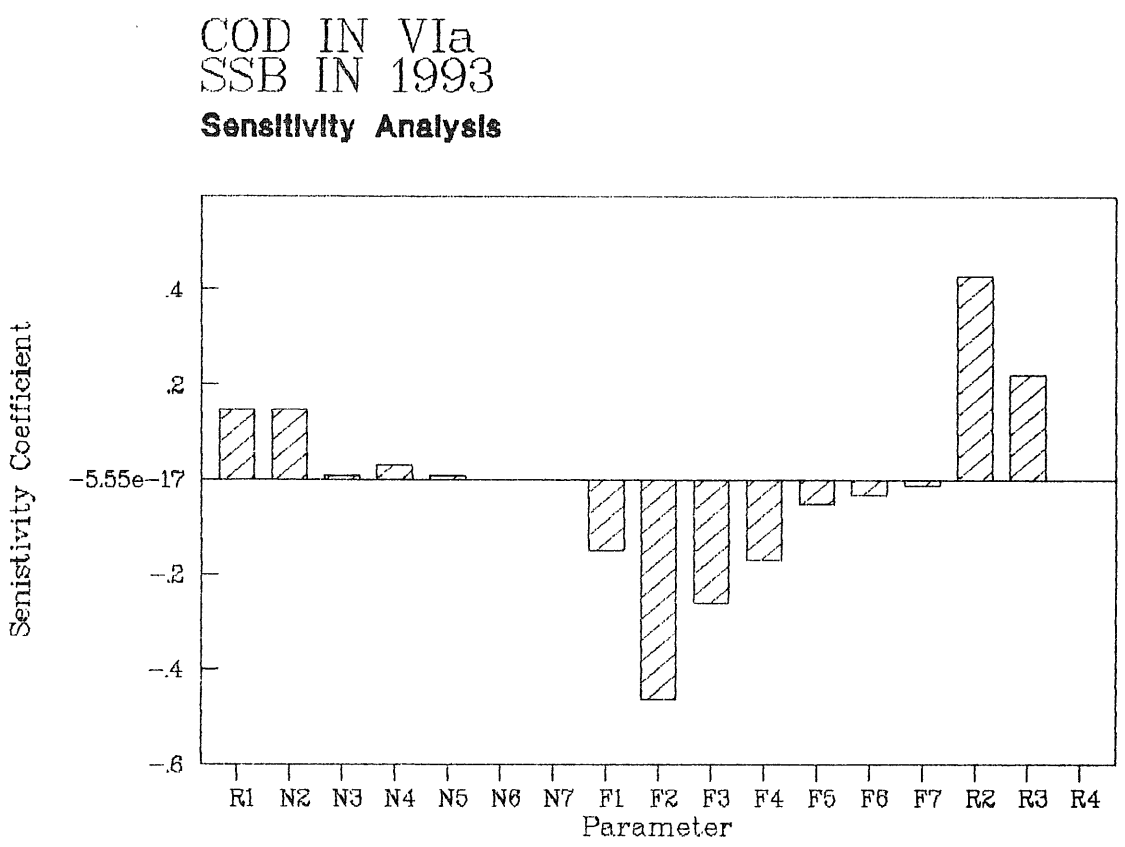

COD IN VIa
SSB IN 1993
Sensitivity Analysis
Senistivity Coefficient
.4
.2
-5.55e-17
-.2
-.4
-.6
R1 N2 N3 N4 N5 N6 N7 F1 F2 F3 F4 F5 F6 F7 R2 R3 R4
Parameter

Figure 5.1.4

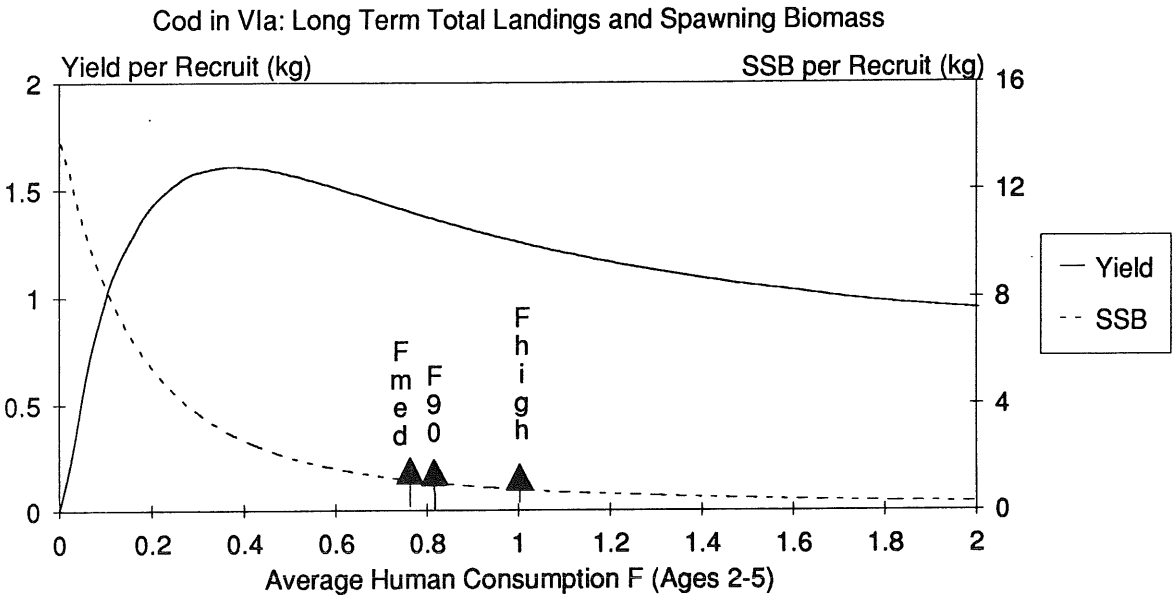

Cod in VIa: Long Term Total Landings and Spawning Biomass
Yield per Recruit (kg)
SSB per Recruit (kg)
2
1.5
1
0.5
0
16
12
8
4
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
F med
F 90
F high
Yield
SSB
Average Human Consumption F (Ages 2-5)

Figure 5.1.5

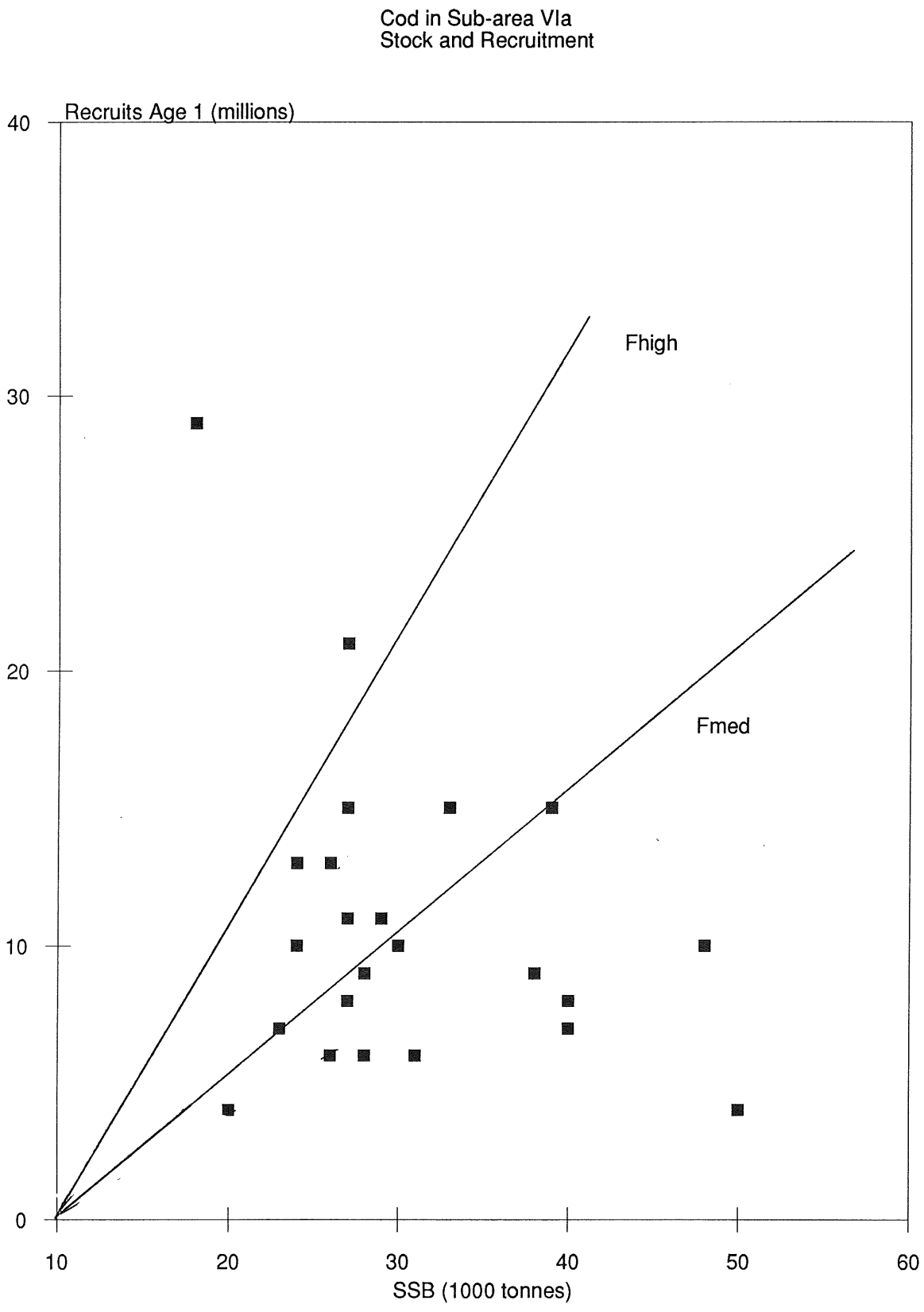
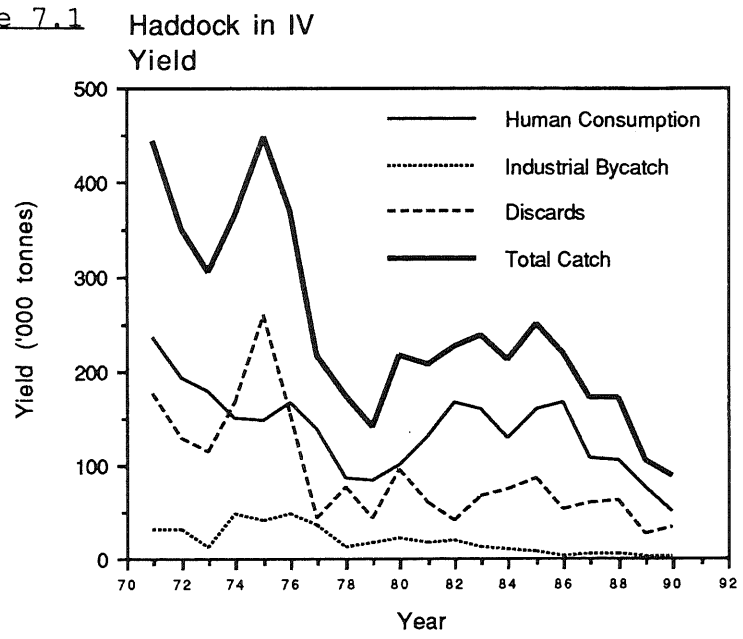
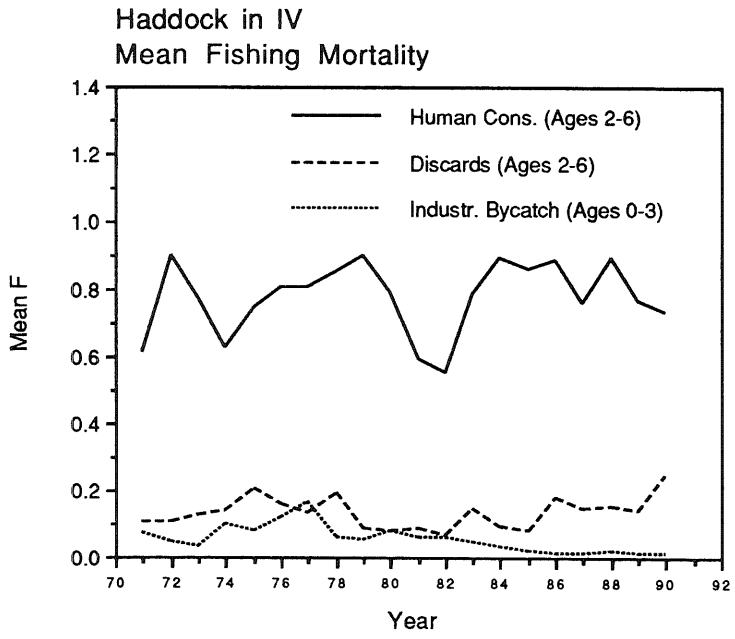
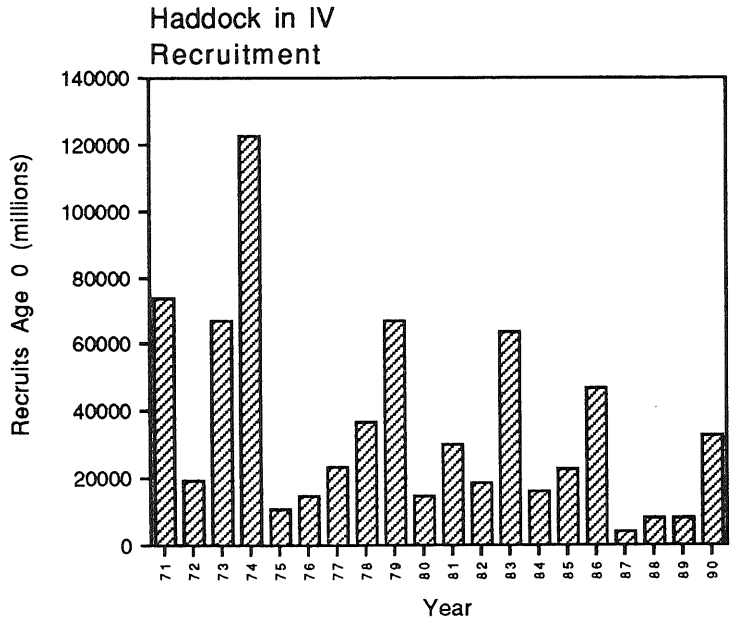

Cod in Sub-area VIa
Stock and Recruitment
Recruits Age 1 (millions)
40
30
20
10
0
Fhigh
Fmed
10
20
30
40
50
60
SSB (1000 tonnes)

Figure 7.1


Haddock in IV
Yield
Human Consumption
Industrial Bycatch
Discards
Total Catch
Yield ('000 tonnes)
Year


Haddock in IV
Mean Fishing Mortality
Human Cons. (Ages 2-6)
Discards (Ages 2-6)
Industr. Bycatch (Ages 0-3)
Mean F
Year


Haddock in IV
Recruitment
Recruits Age 0 (millions)
Year

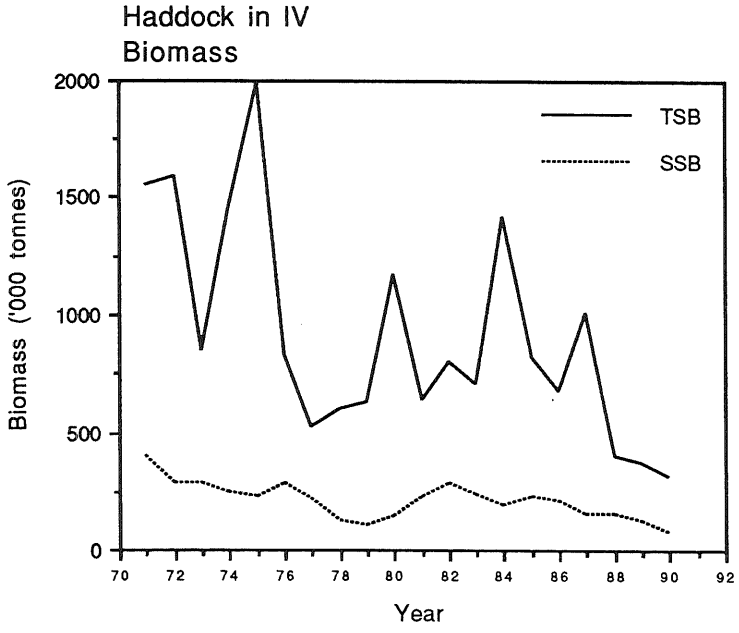

Haddock in IV
Biomass
TSB
SSB
Biomass ('000 tonnes)
Year

Figure 7.2

North Sea Haddock
Short Term Total Landings and Spawning Biomass

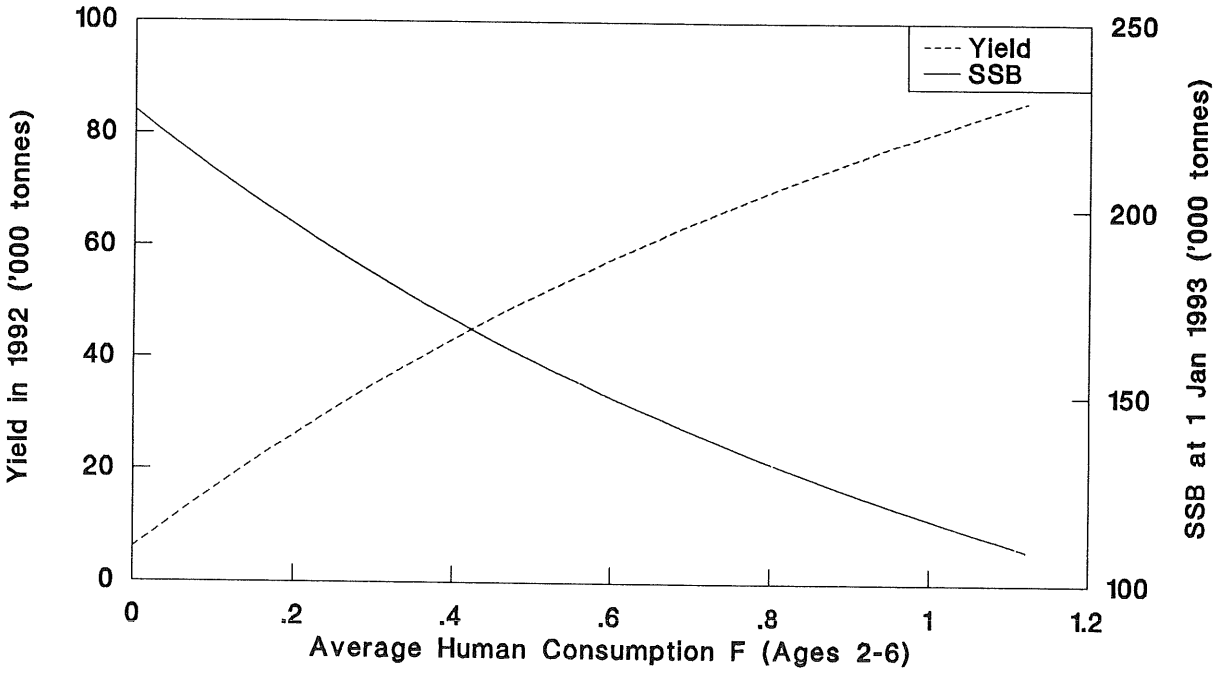
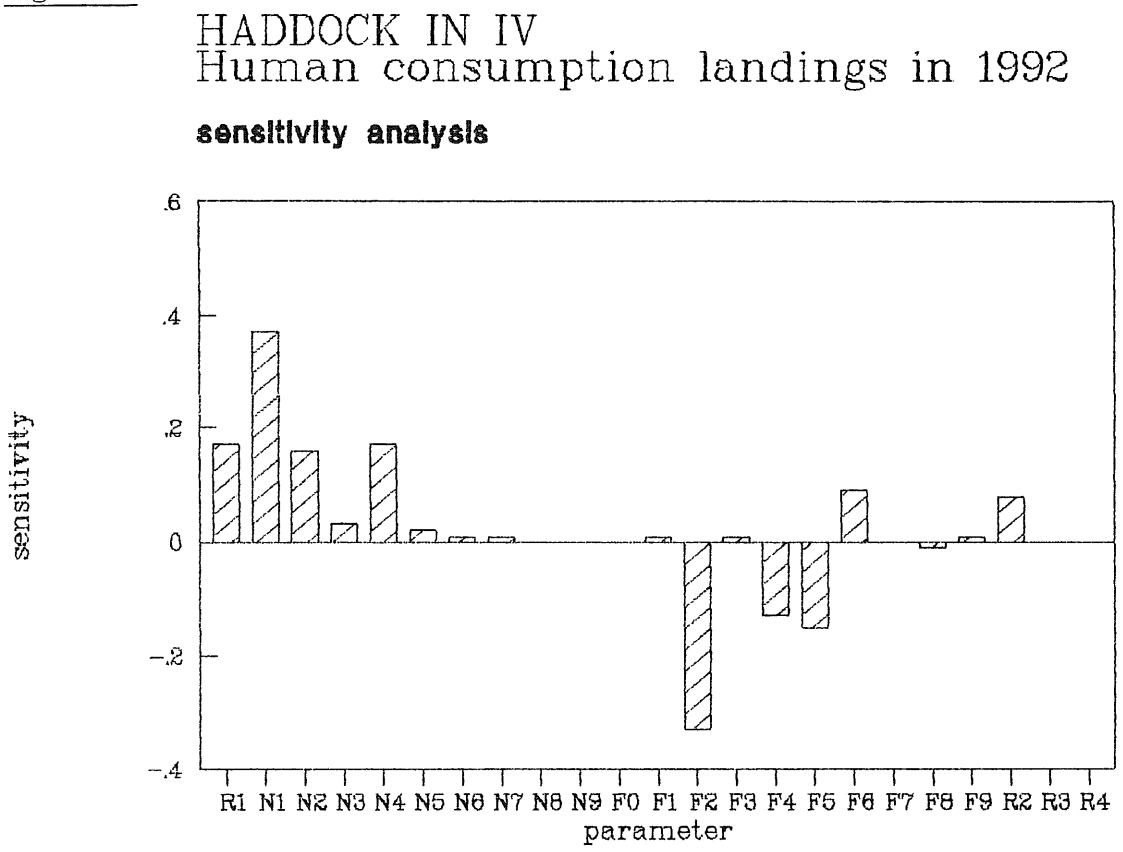


Figure 7.3


HADDOCK IN IV
Human consumption landings in 1992
sensitivity analysis
sensitivity
.6
.4
.2
0
-.2
-.4
R1 N1 N2 N3 N4 N5 N6 N7 N8 N9 F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 R2 R3 R4
parameter

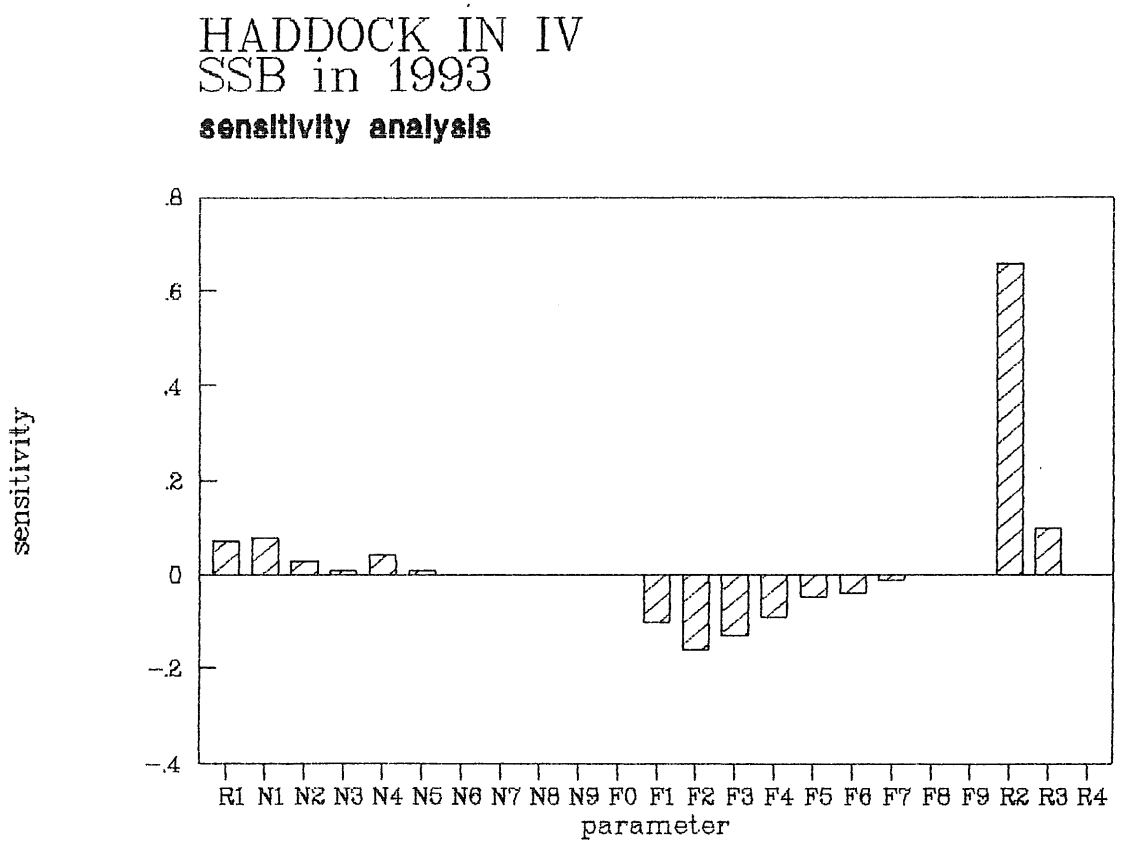

HADDOCK IN IV
SSB in 1993
sensitivity analysis
sensitivity
.8
.6
.4
.2
0
-.2
-.4
R1 N1 N2 N3 N4 N5 N6 N7 N8 N9 F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 R2 R3 R4
parameter

Figure 7.4 **North Sea Haddock**

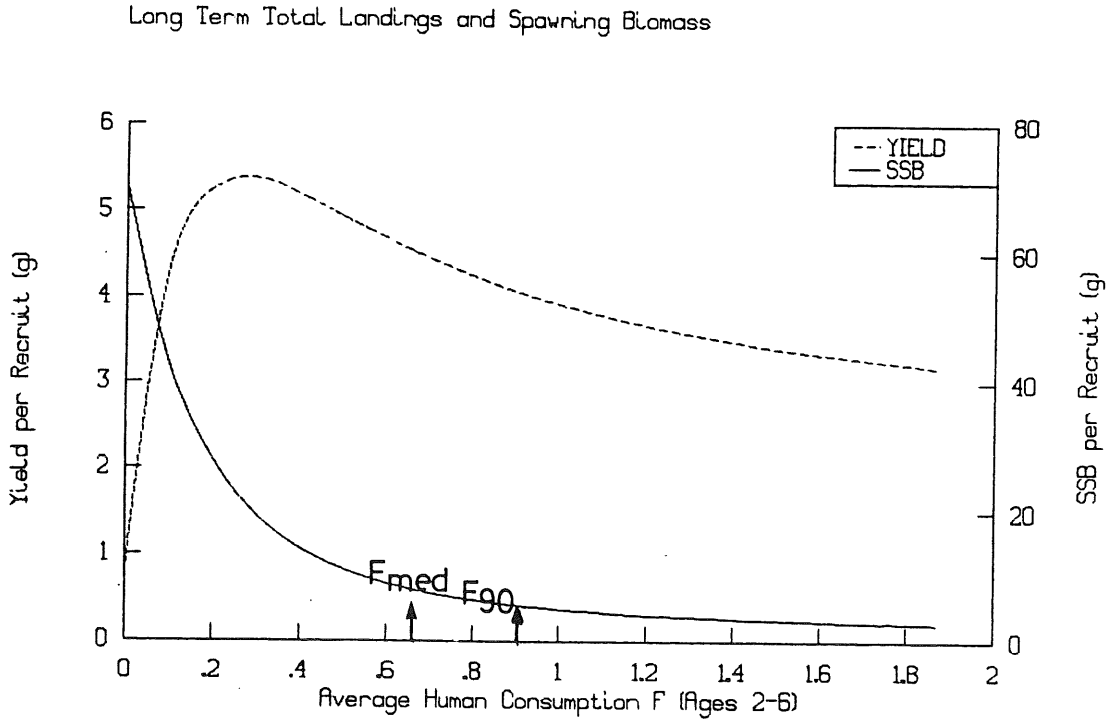


Figure 7.5

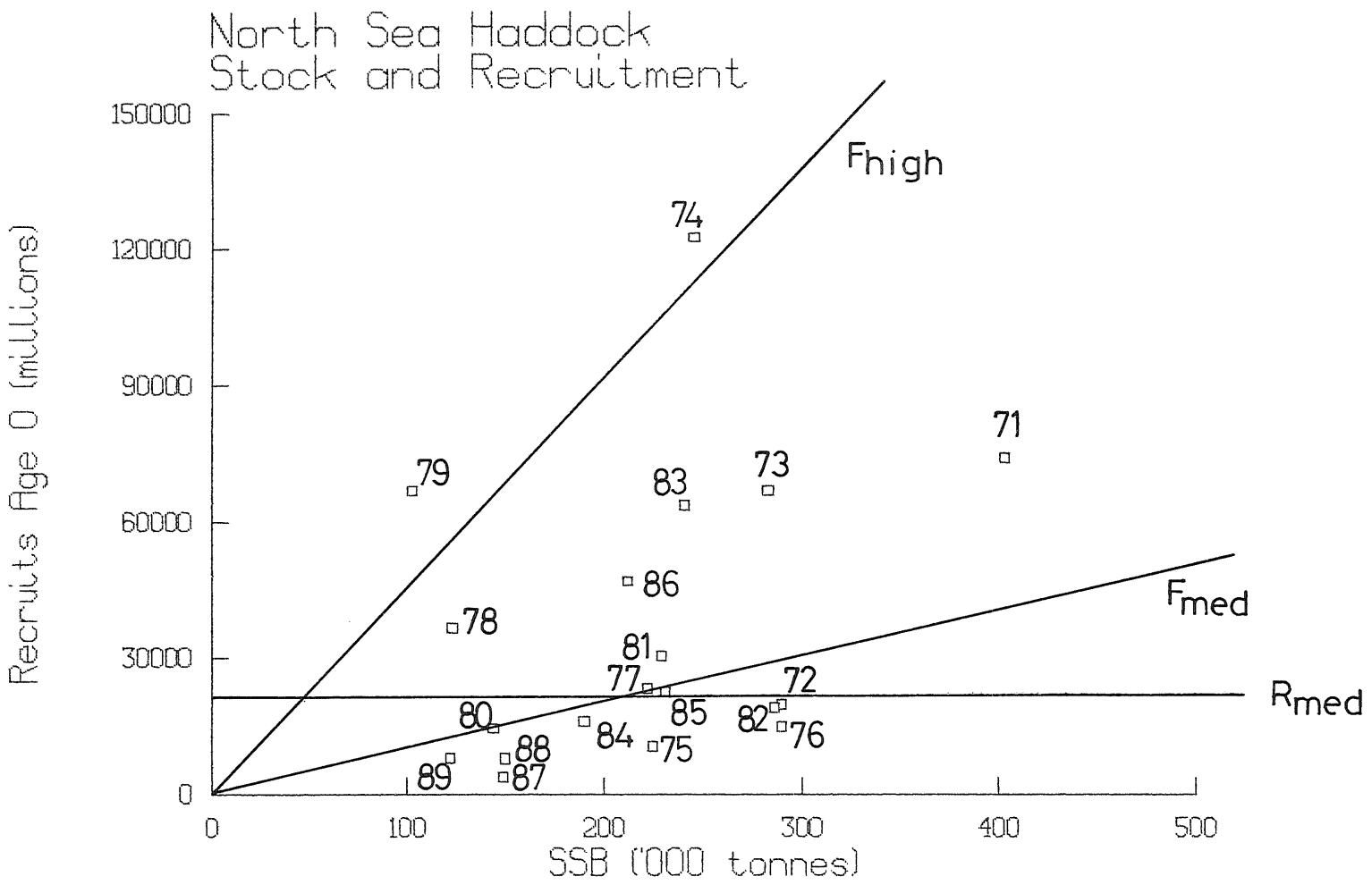
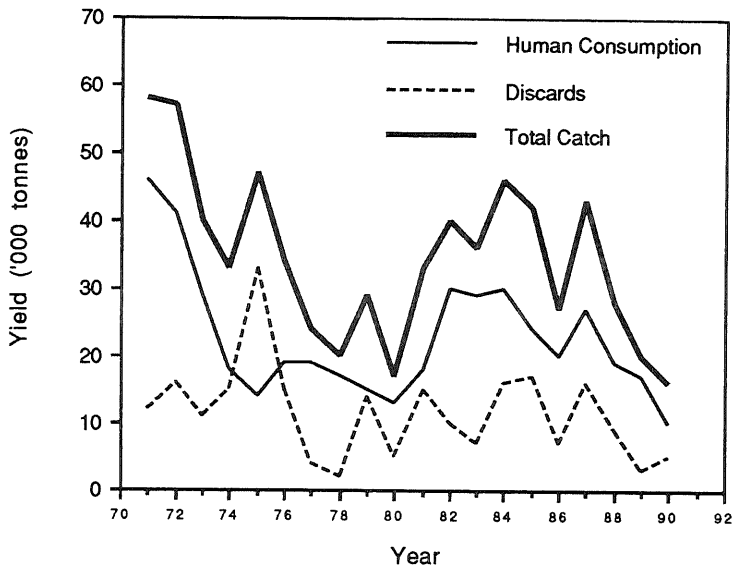
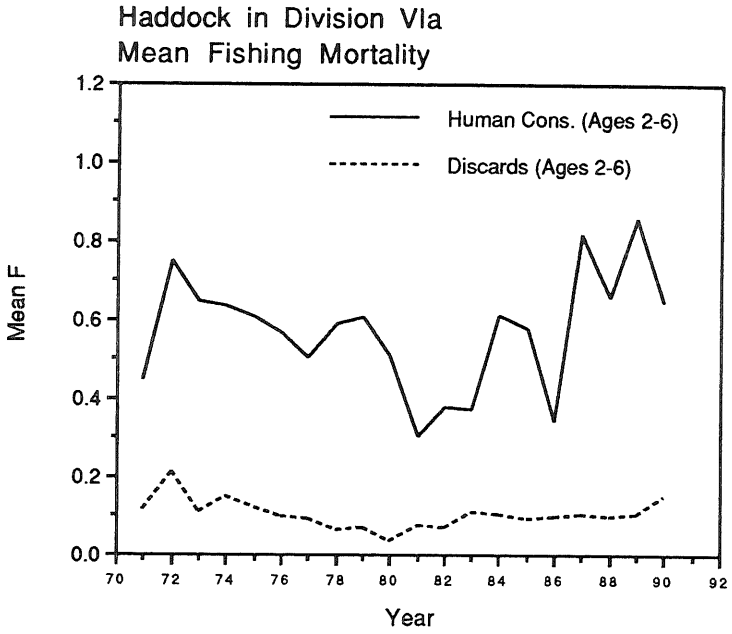
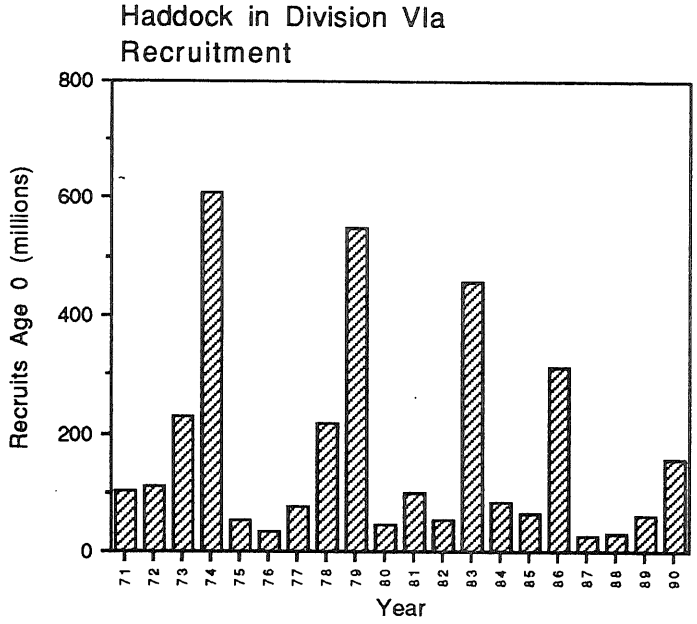

North Sea Haddock
Stock and Recruitment
Recruits Age 0 (millions)
150000
120000
90000
60000
30000
0
0
100
200
300
400
500
SSB ('000 tonnes)
Fhigh
Fmed
Rmed
74
79
83
73
71
86
78
81
77
72
80
85
82
84
75
76
88
89
87

Figure 8.1.1 Haddock in Division VIa







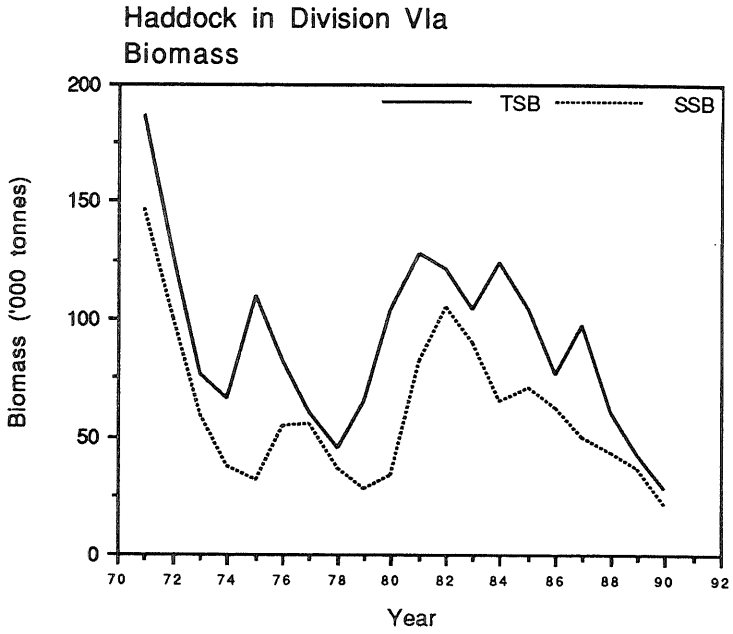


Figure 8.1.2

Haddock in VIa
Short Term Total Landings and Spawning Biomass

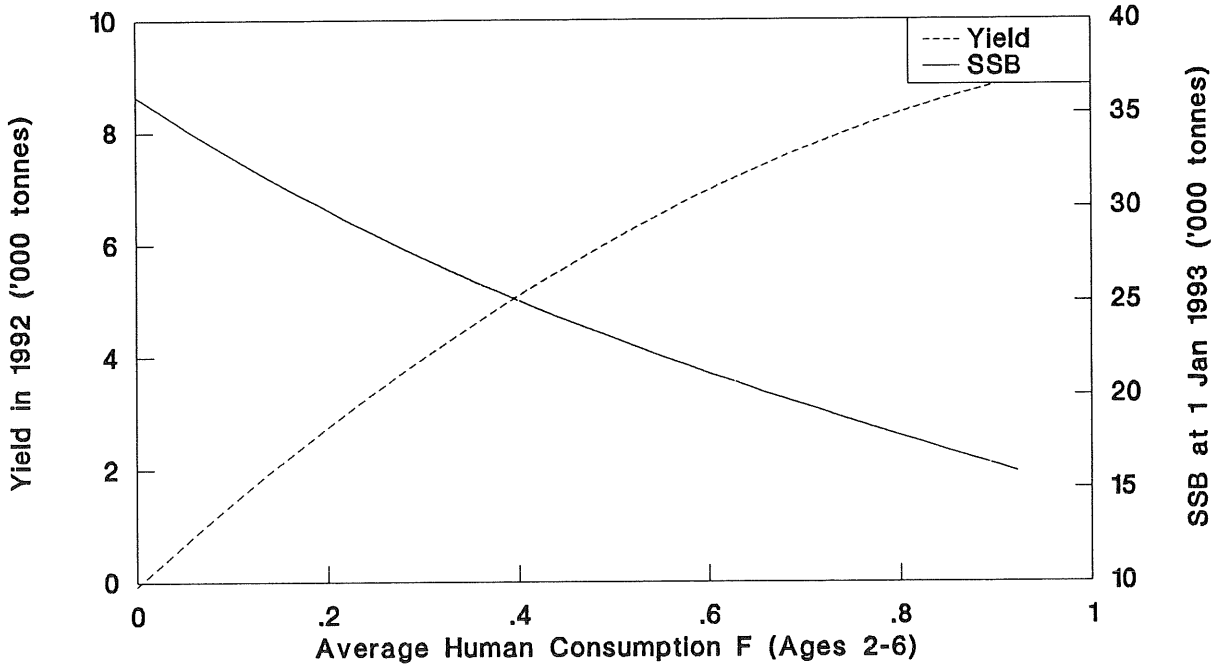
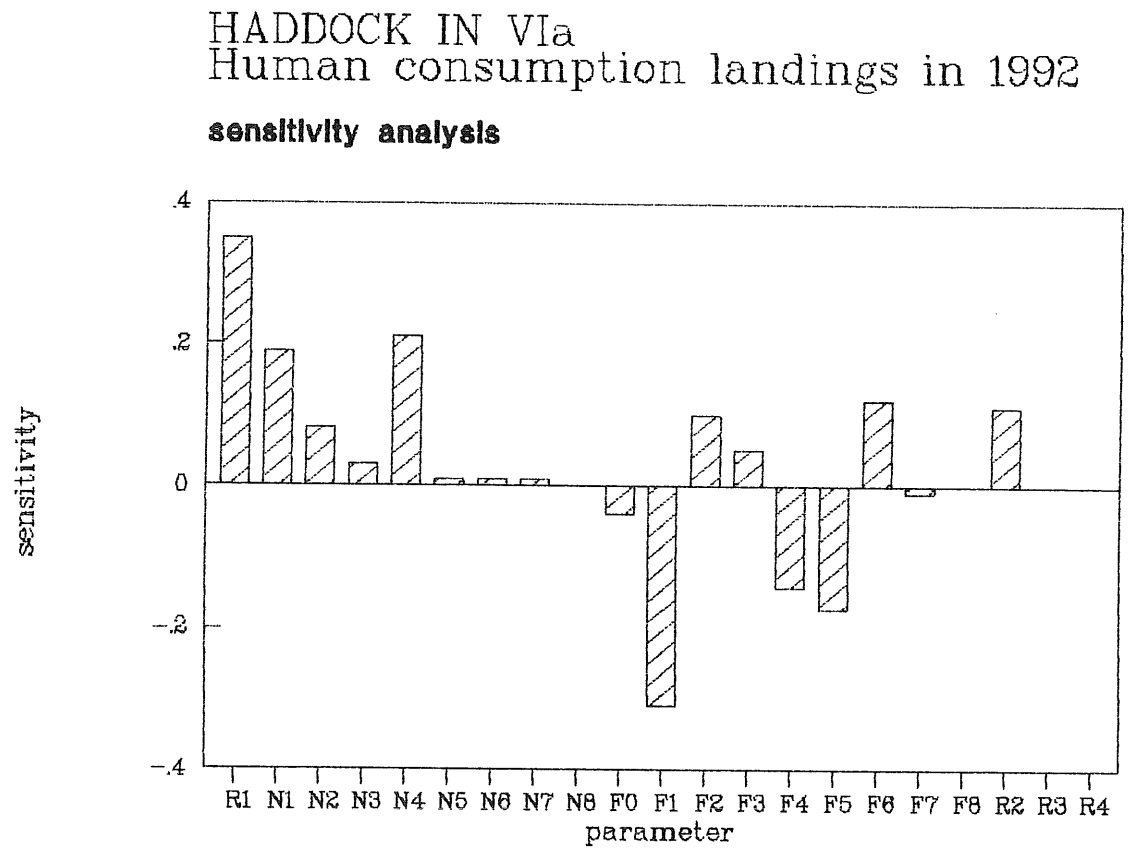


Figure 8.1.3


HADDOCK IN VIa
Human consumption landings in 1992
sensitivity analysis
sensitivity
.4
.2
0
-.2
-.4
R1 N1 N2 N3 N4 N5 N6 N7 N8 F0 F1 F2 F3 F4 F5 F6 F7 F8 R2 R3 R4
parameter

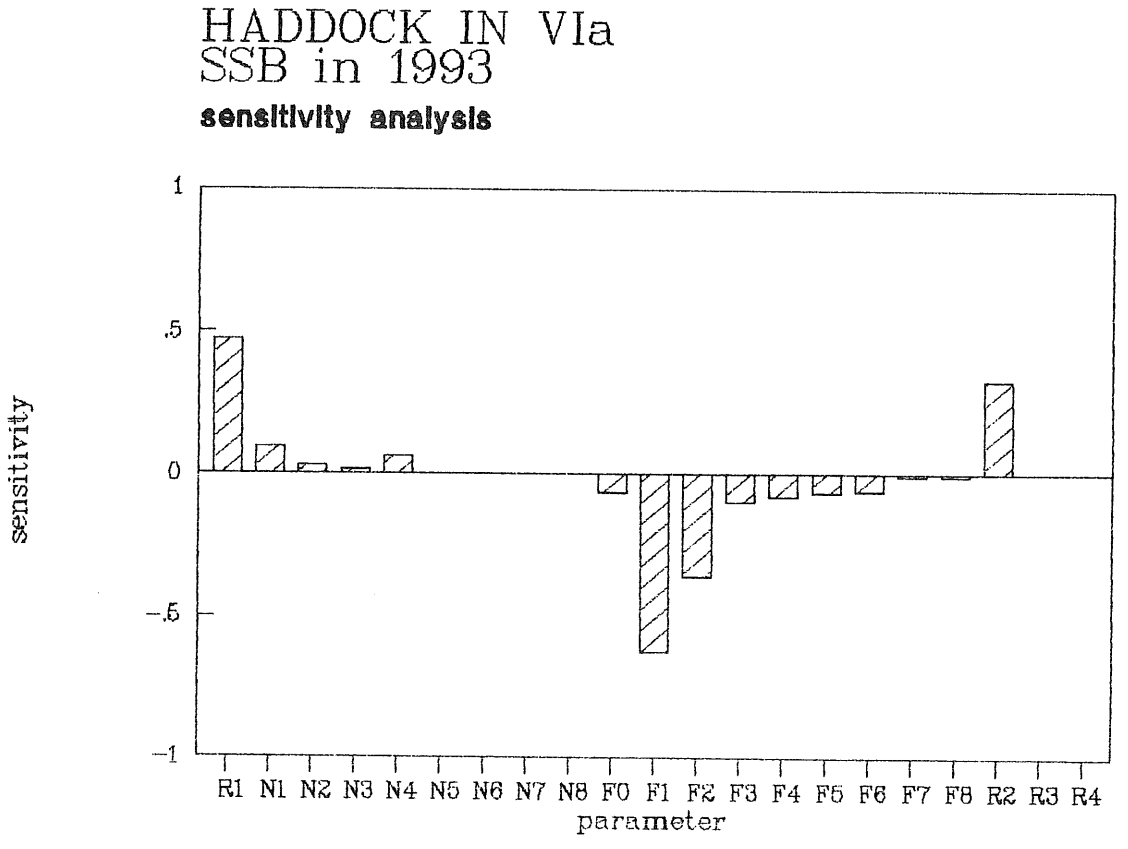

HADDOCK IN VIa
SSB in 1993
sensitivity analysis
sensitivity
1
.5
0
-.5
-1
R1 N1 N2 N3 N4 N5 N6 N7 N8 F0 F1 F2 F3 F4 F5 F6 F7 F8 R2 R3 R4
parameter

Figure 8.1.4 **Haddock in VIa**

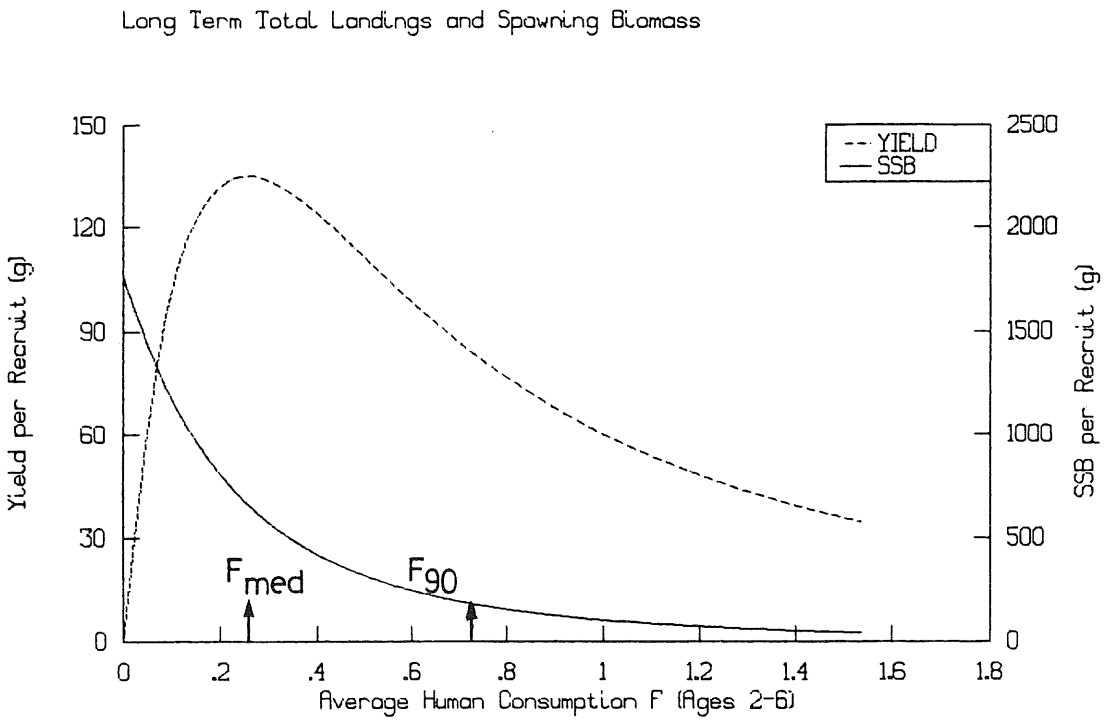


Figure 8.1.5

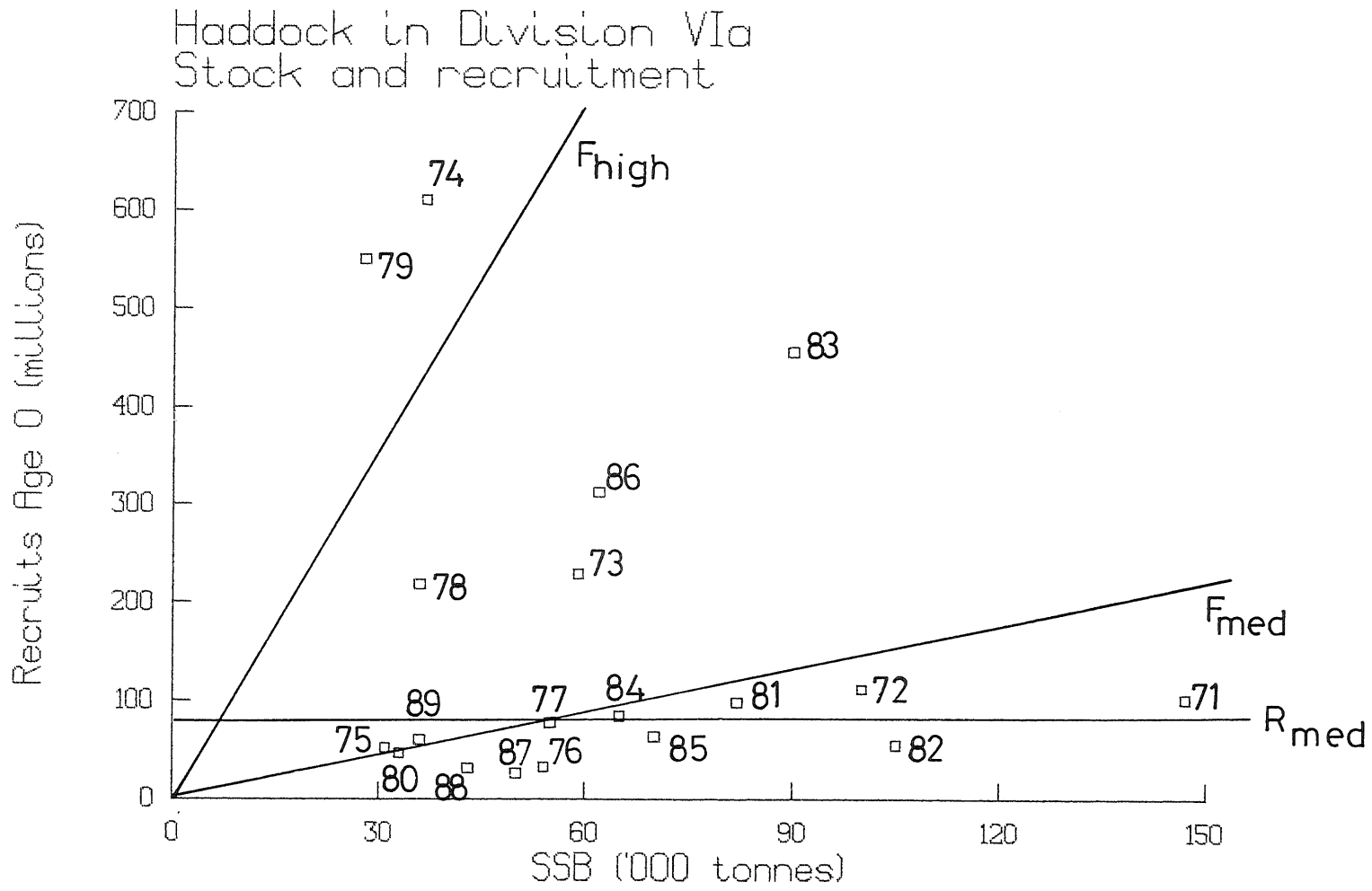

Haddock in Division VIa
Stock and recruitment
Recruits Age 0 (millions)
SSB ('000 tonnes)
Fhigh
Fmed
Rmed
74
79
83
86
73
78
89
77
84
81
72
71
75
87
76
85
82
80
88
0
100
200
300
400
500
600
700
0
30
60
90
120
150

Fig. 8.2.1. Estimates of spawning stock biomass for haddock in VIb

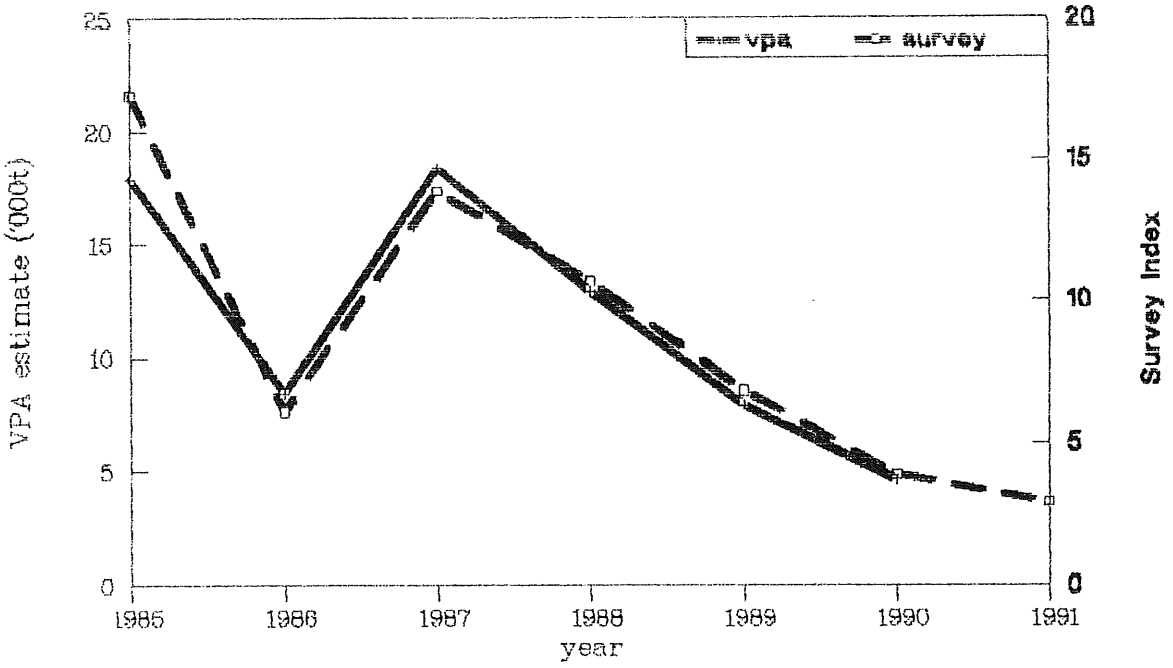


Fig. 8.2.2. Haddock in VIb. Recruitment from survey indices plotted against estimates from separable model

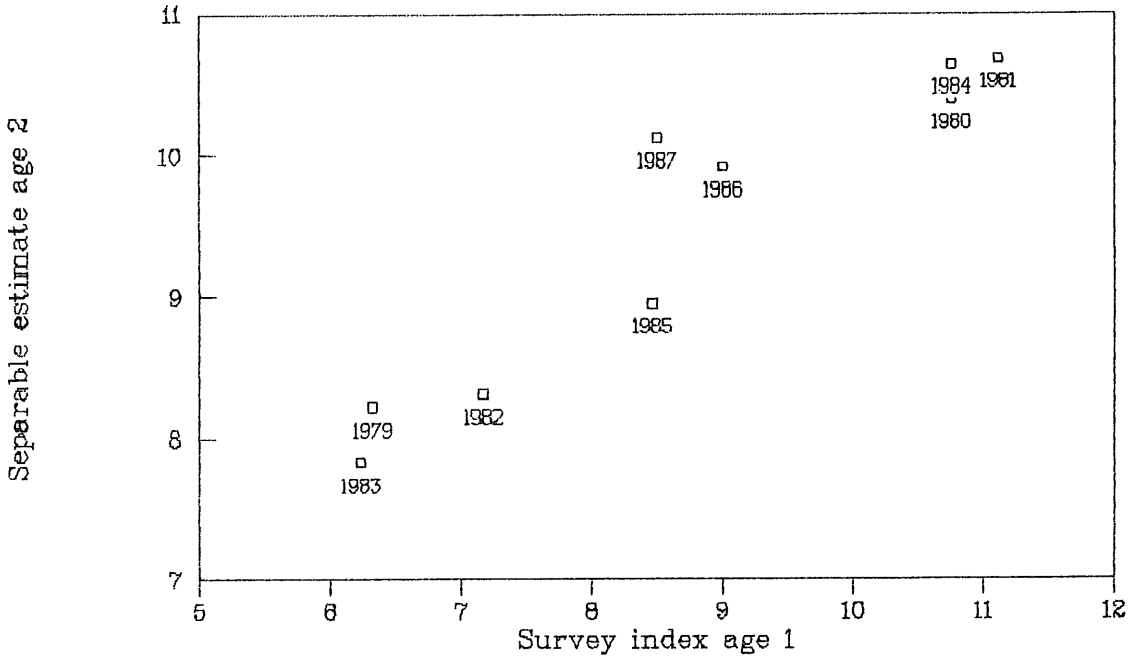


Fig. 8.2.3. Yield per recruit analysis for haddock in VIb

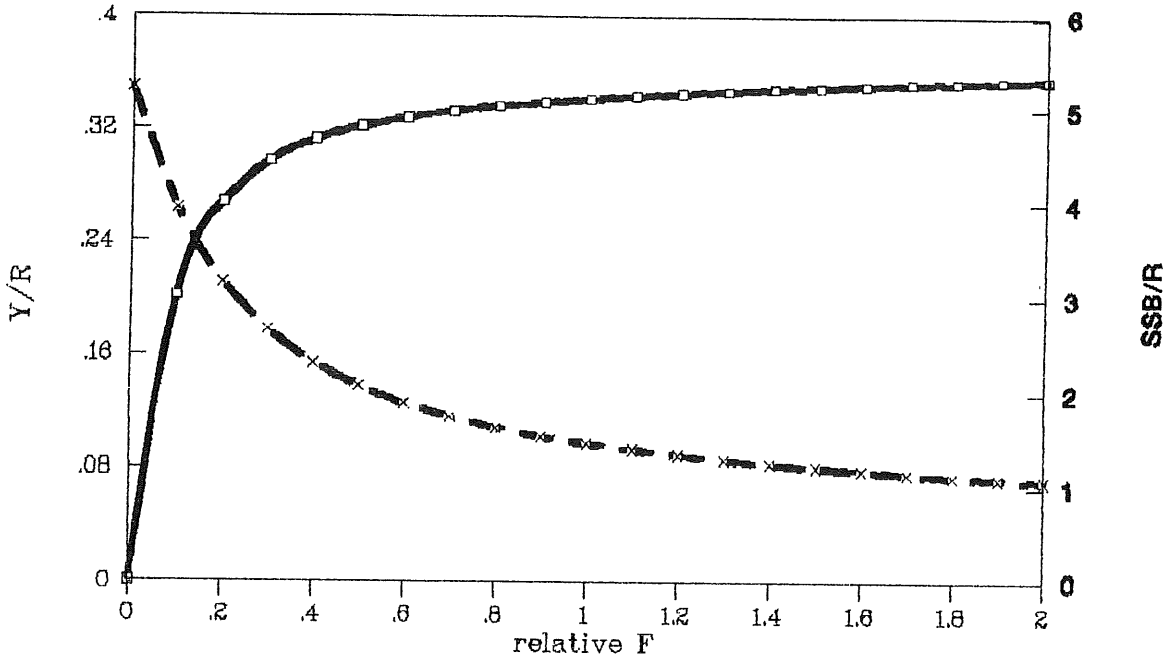
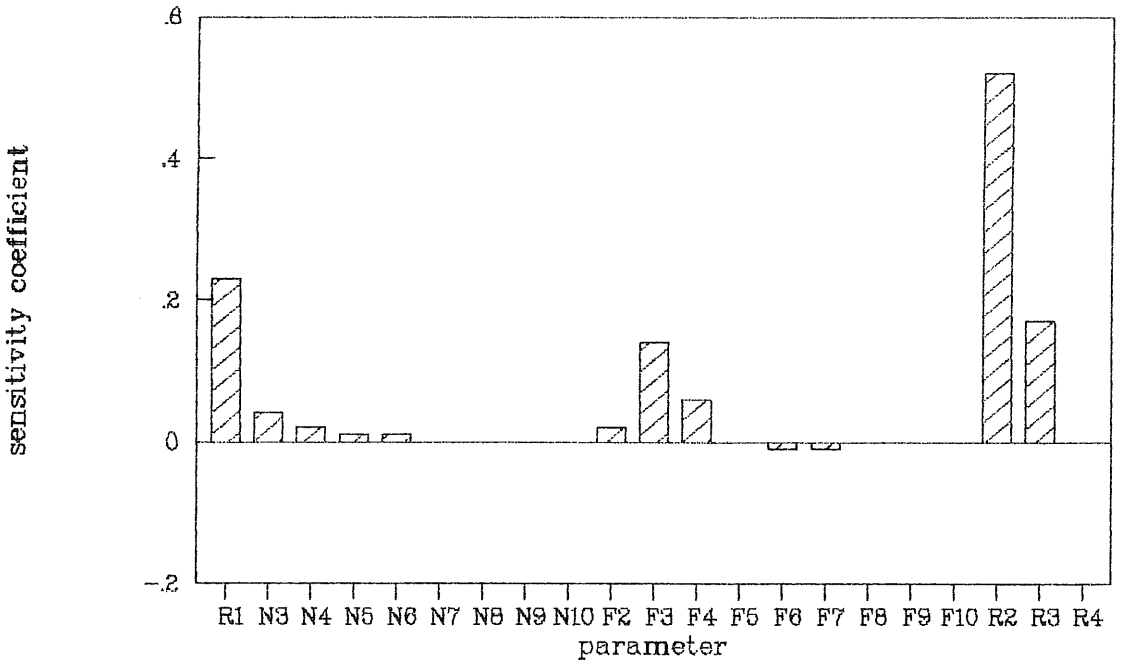


Fig. 8.2.4. Sensitivity analysis of forecast yield in 1992 for haddock in VIb



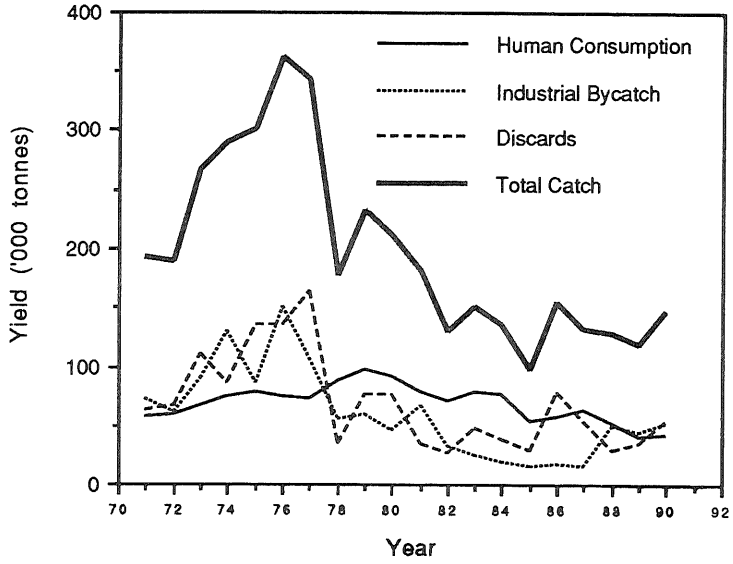
Parameters

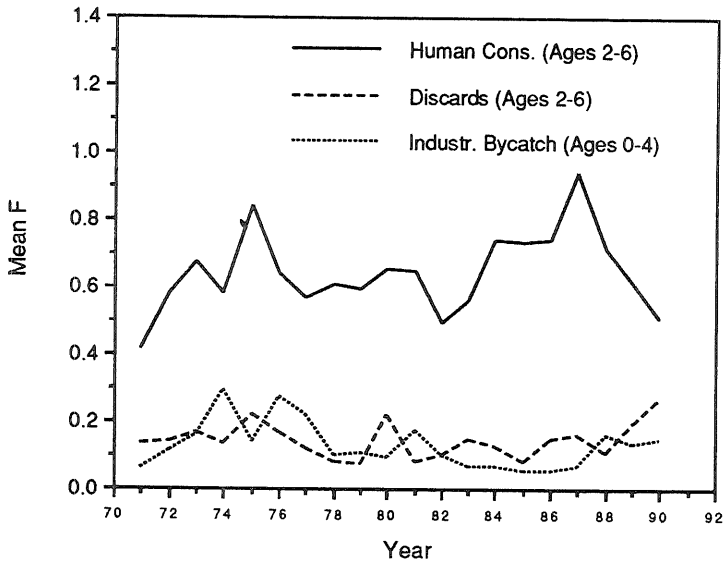
R1=recruitment at age 2 in 1990
R2=recruitment at age 2 in 1991
R3 etc

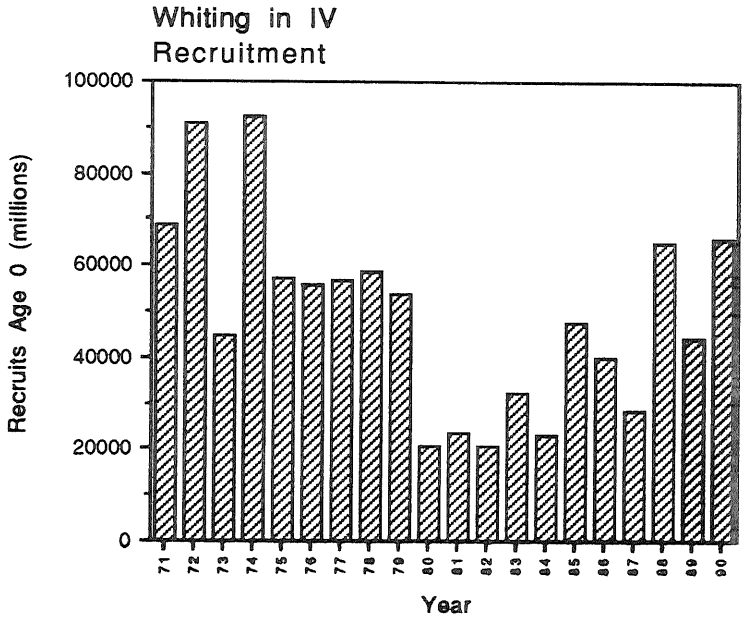
N3=number at age 2 in 1990
N4 etc

F2=fishing mortality at age 2 in 1990
F3 etc

Figure 10.1 Whiting in IV







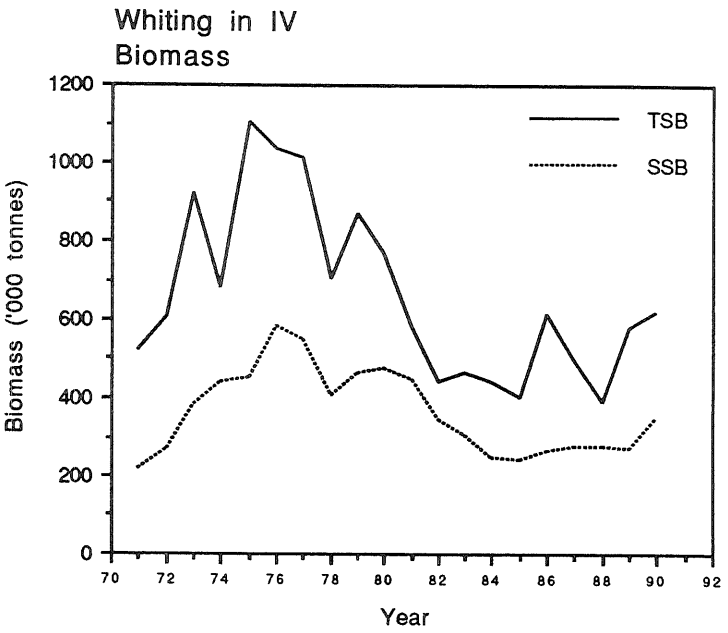


Figure 10.2

North Sea Whiting
Short Term Total Landings and Spawning Biomass

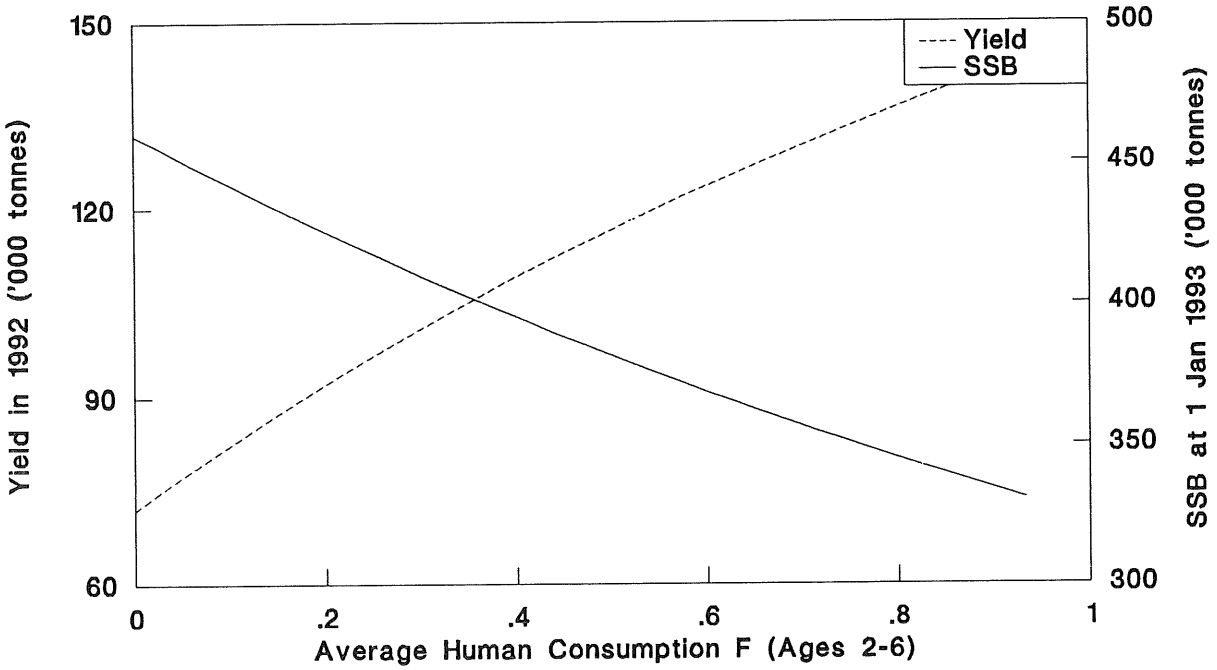
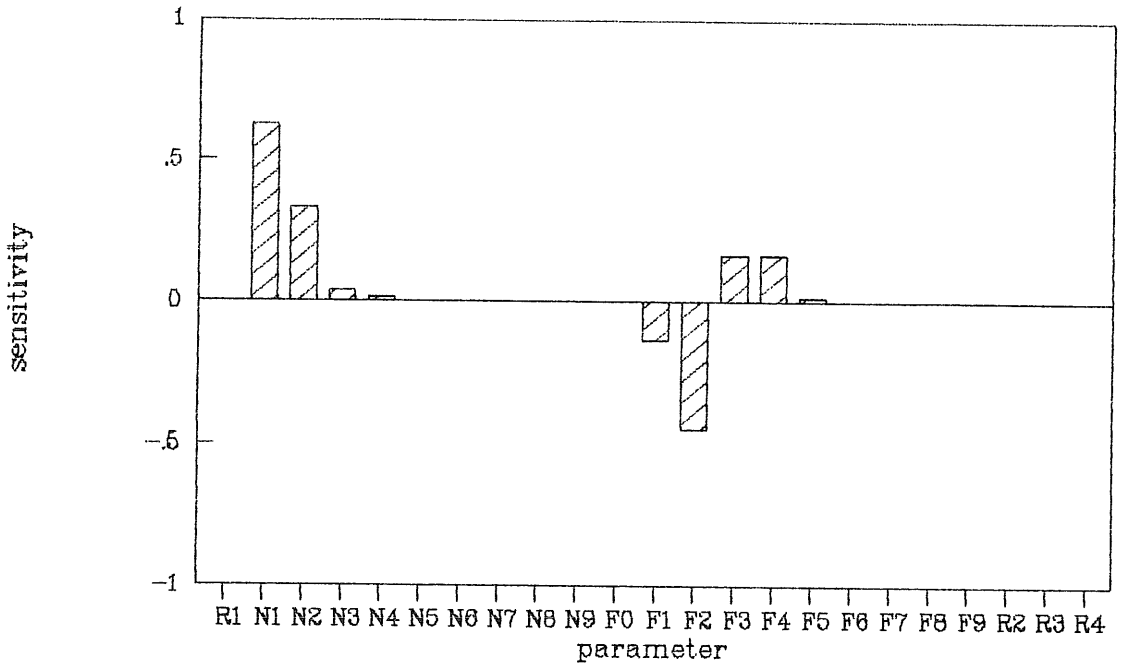


Figure 10.3 WHITING IN IV
Human consumption landings in 1992

sensitivity analysis



WHITING IN IV
SSB in 1993

sensitivity analysis

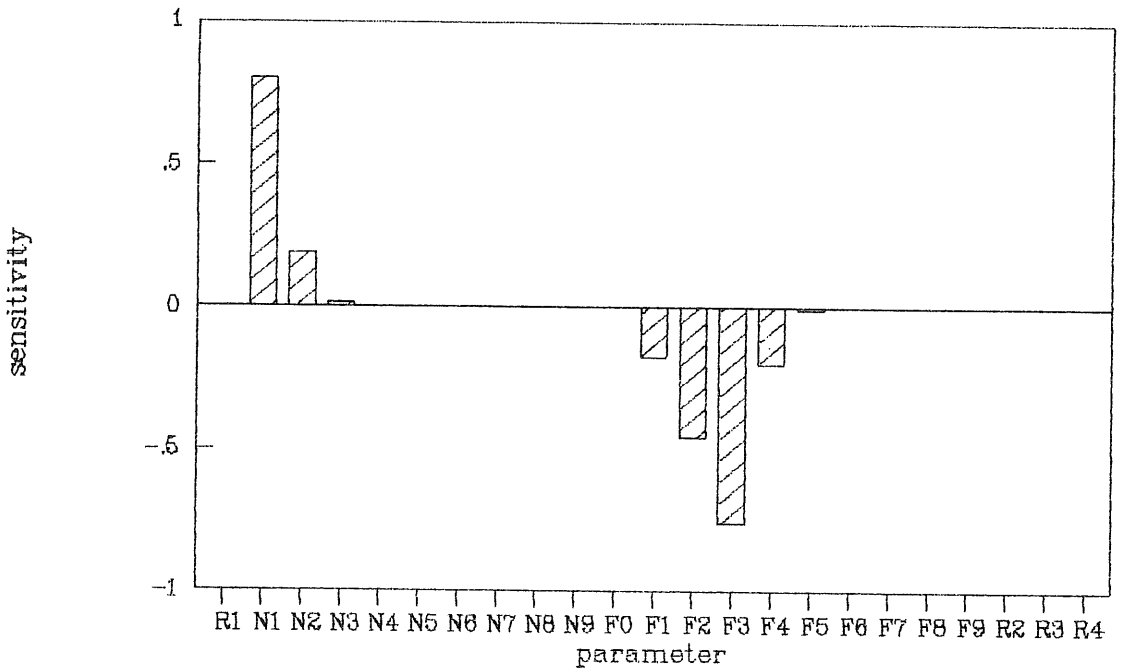


Figure 10.4 **North Sea Whiting**

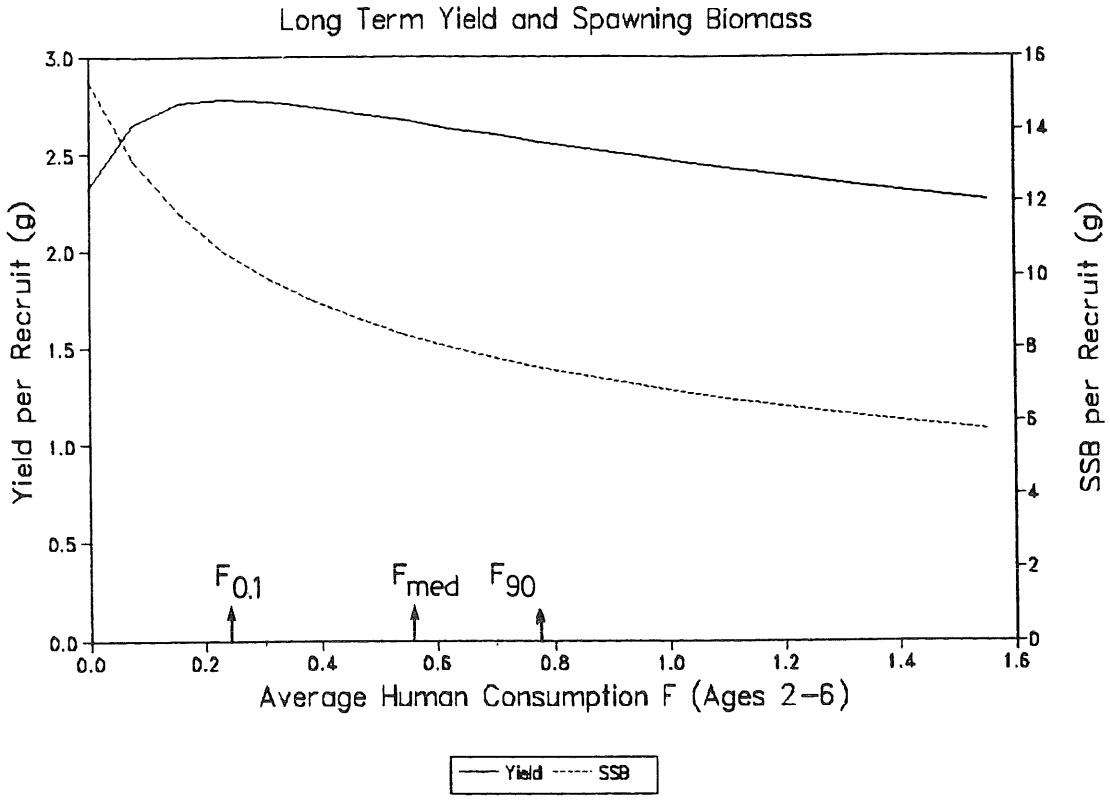


Figure 10.5

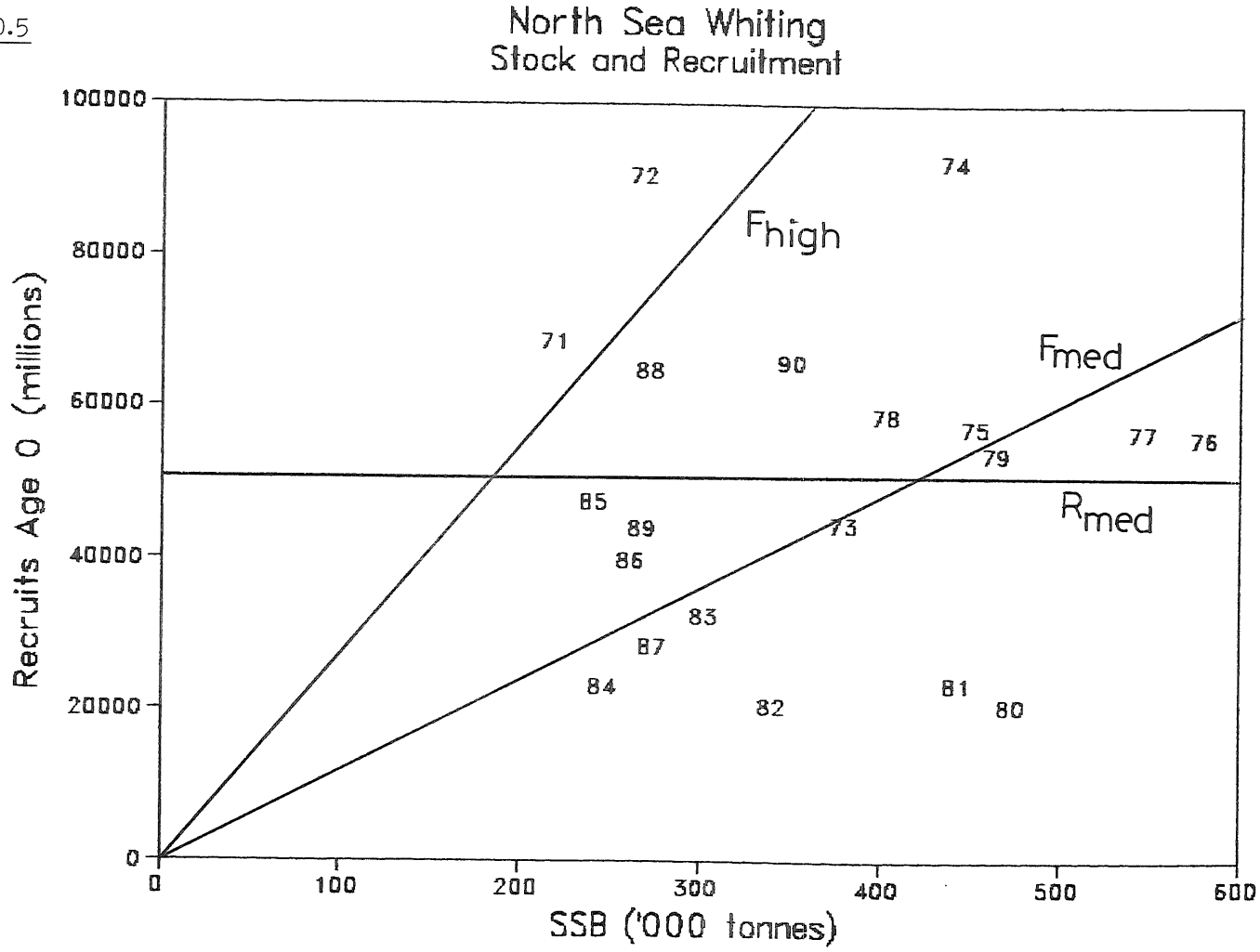
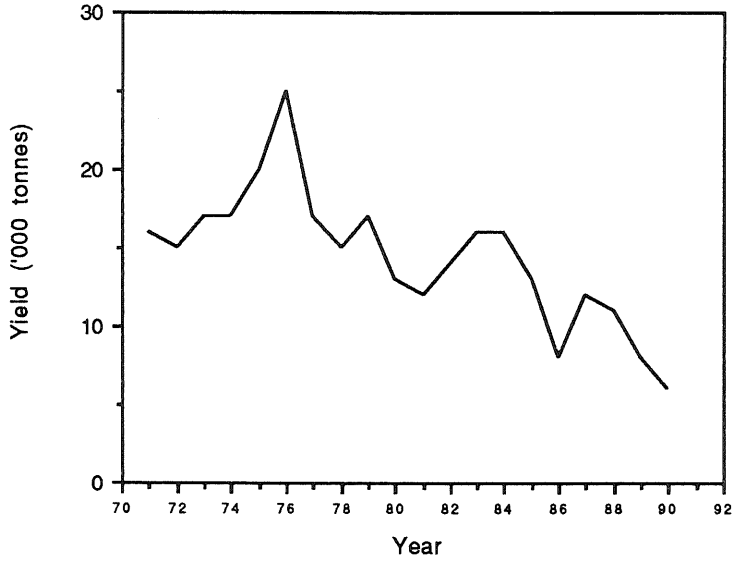
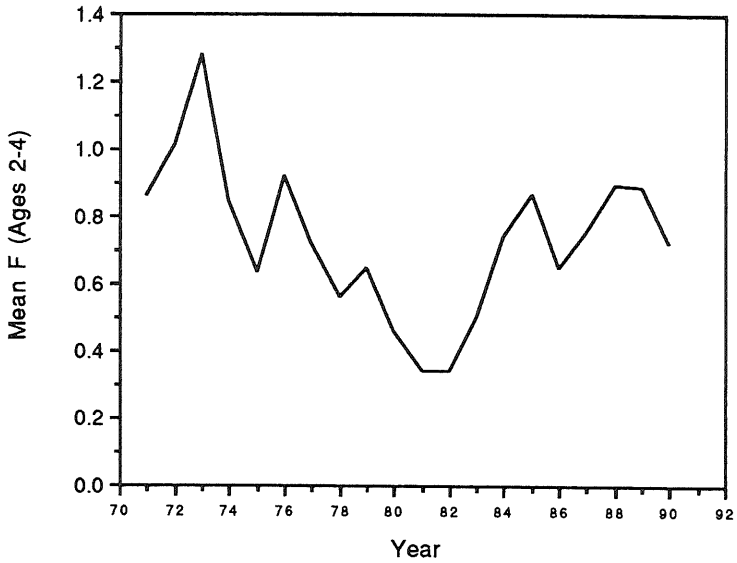
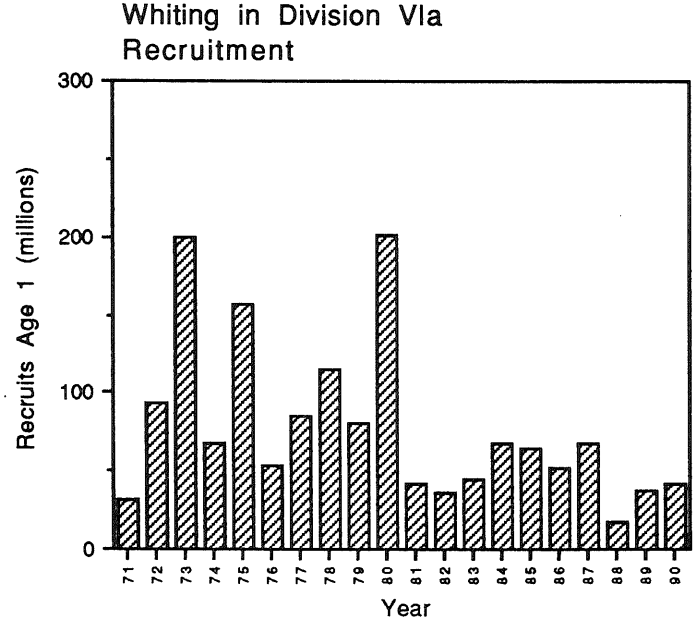

North Sea Whiting
Stock and Recruitment
Recruits Age 0 (millions)
SSB ('000 tonnes)
Fhigh
Fmed
Rmed
100000
80000
60000
40000
20000
0
0
100
200
300
400
500
600
72
74
71
88
90
78
75
77
76
79
85
89
73
86
83
87
84
82
81
80

Figure 11.1.1 Whiting in Division VIa







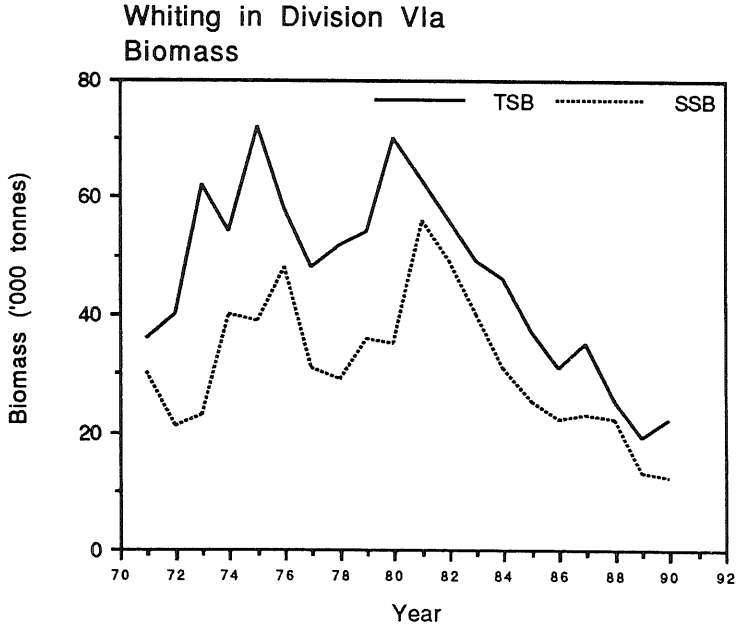


Figure 11.1.2 Whiting in Division VIa. North Sea recruitment at age 1 from VPA plotted against Division VIa VPA at age 1.

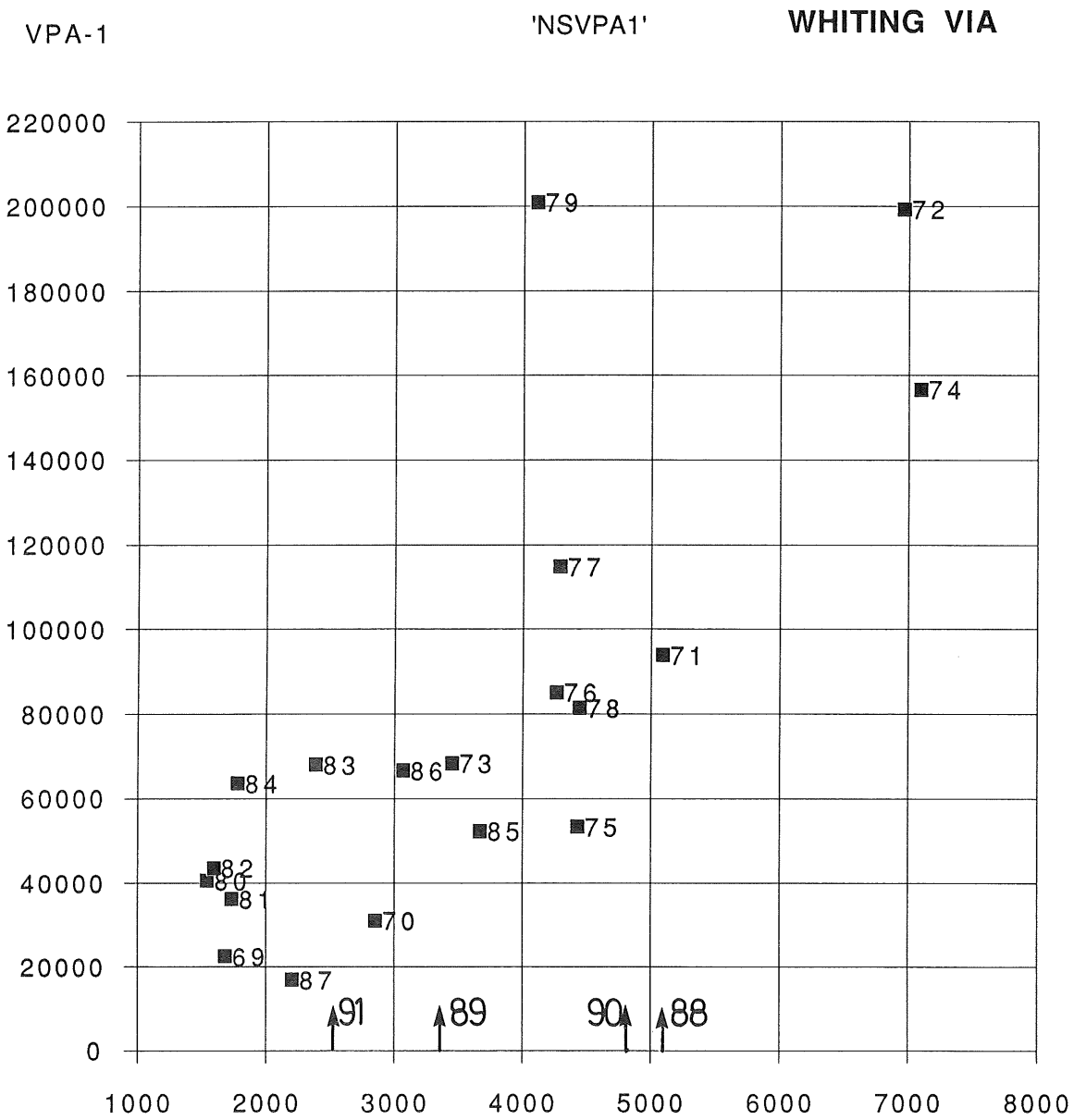


Figure 11.1.3

Whiting in VIa
Short Term Total Landings and Spawning Biomass

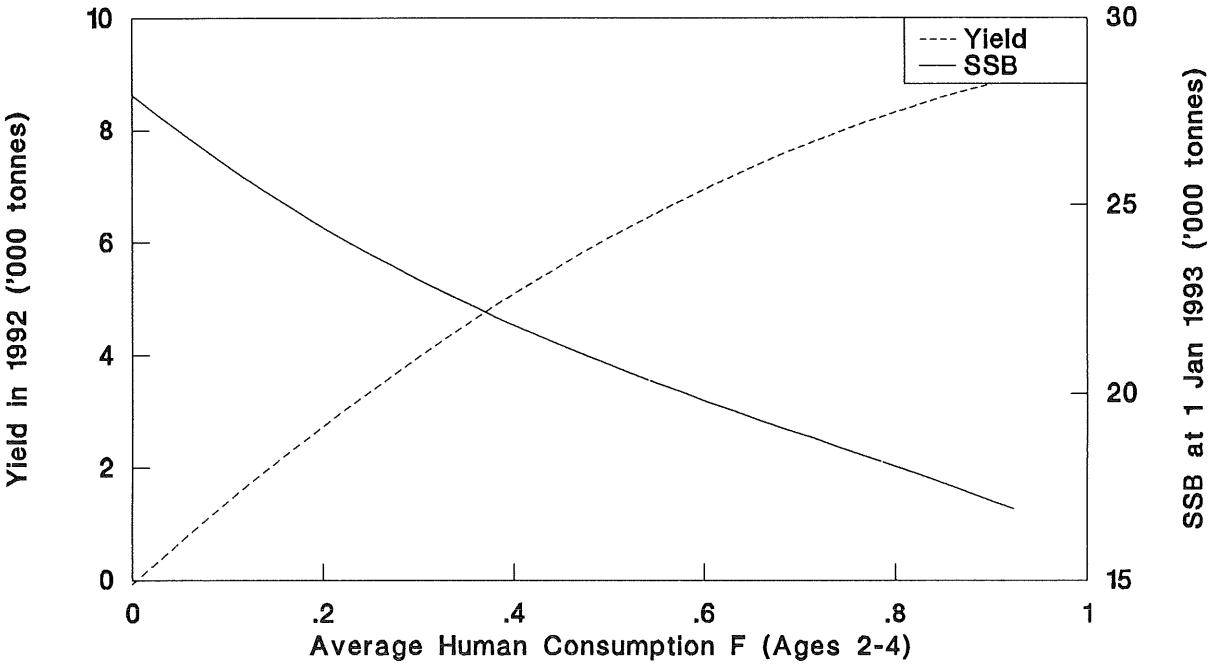
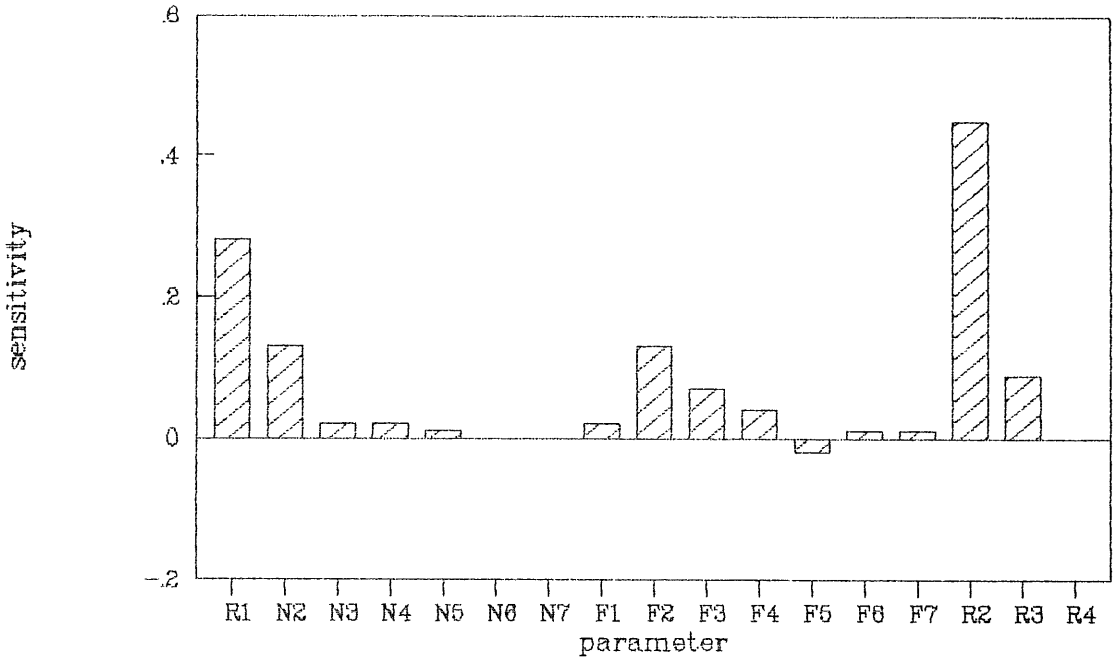


Figure 11.1.4

WHITING IN VIa
Human consumption landings in 1992

sensitivity analysis



WHITING IN VIa
SSB in 1993

sensitivity analysis

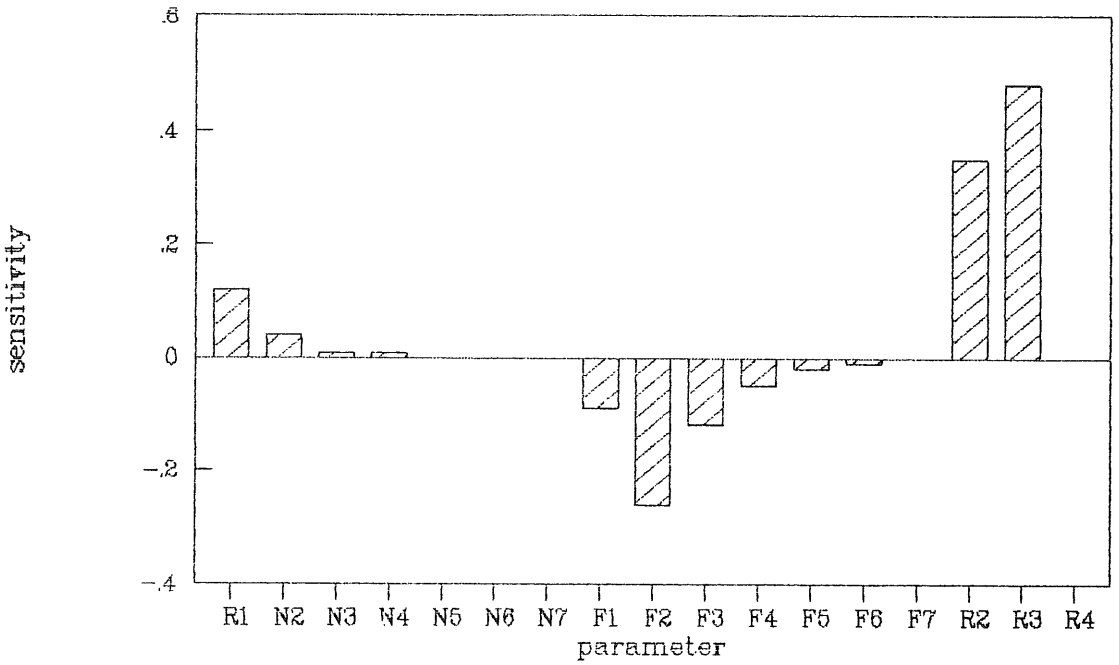


Figure 11.1.5

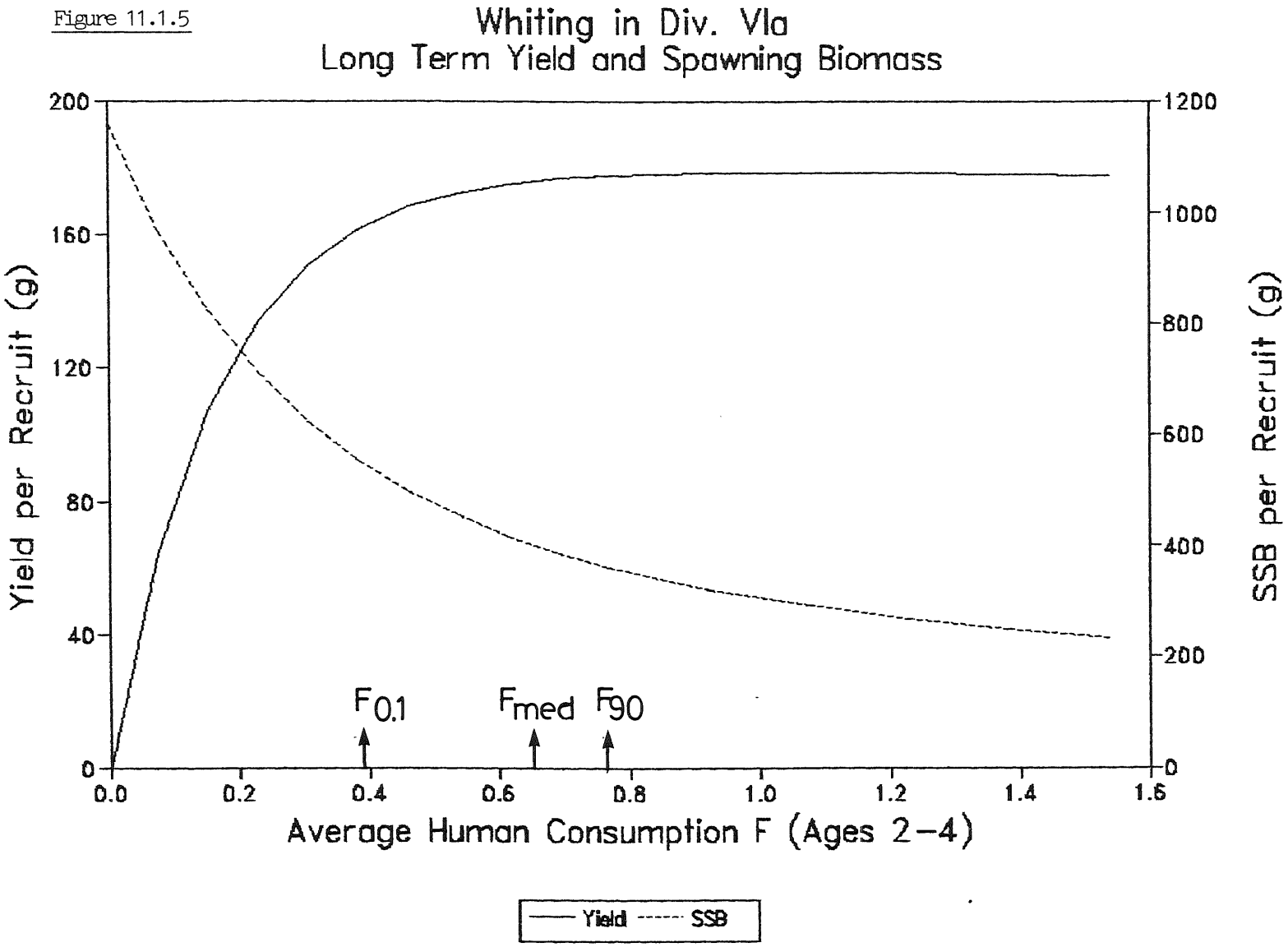

Whiting in Div. VIa
Long Term Yield and Spawning Biomass
Yield per Recruit (g)
SSB per Recruit (g)
200
160
120
80
40
0
1200
1000
800
600
400
200
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
F0.1
Fmed
F90
Average Human Consumption F (Ages 2-4)
Yield
SSB

Figure 11.1.6

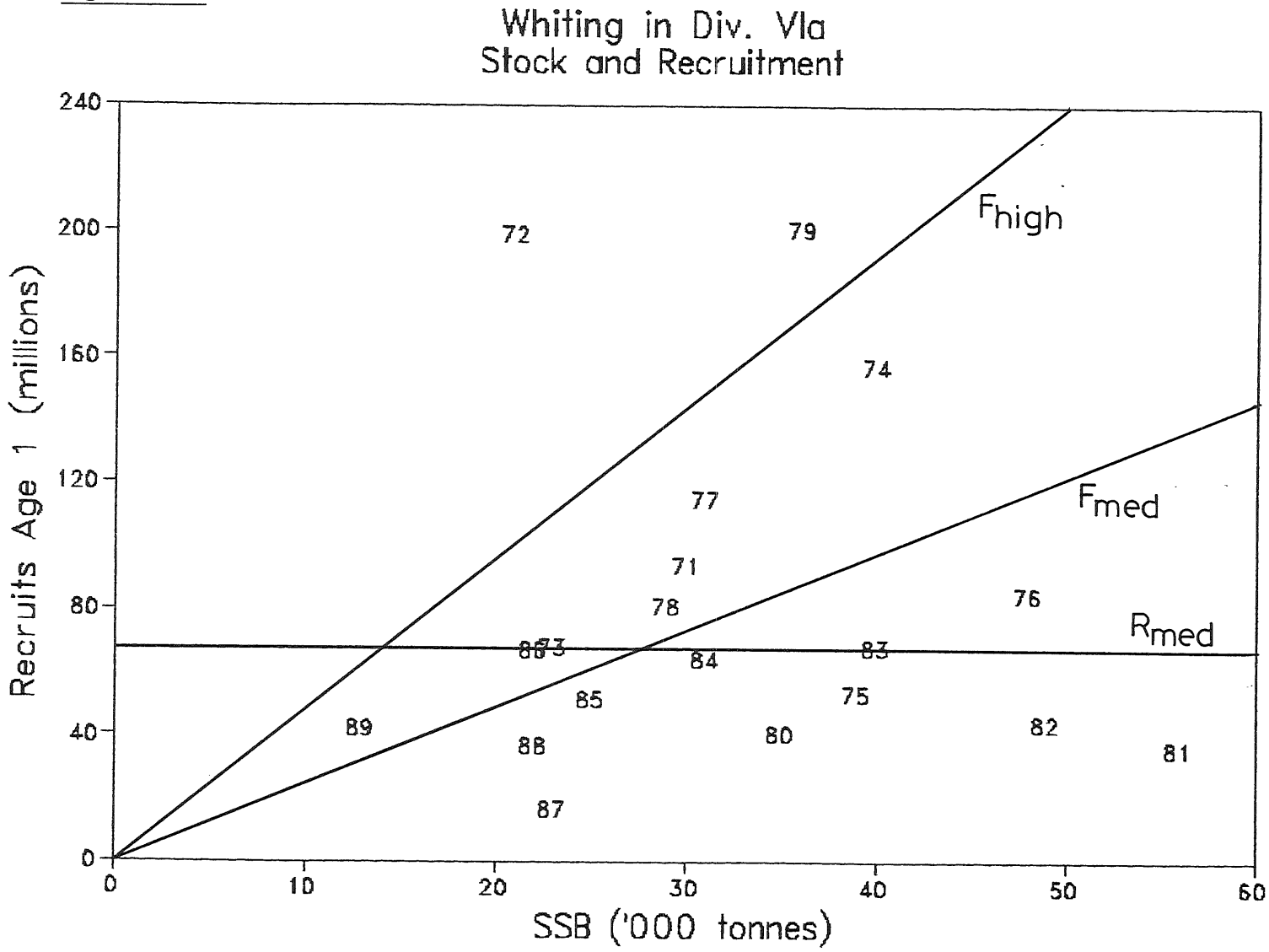
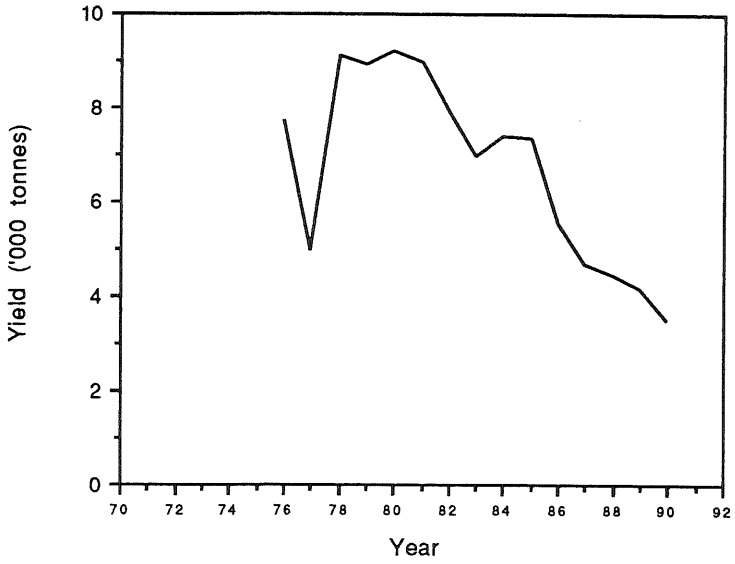
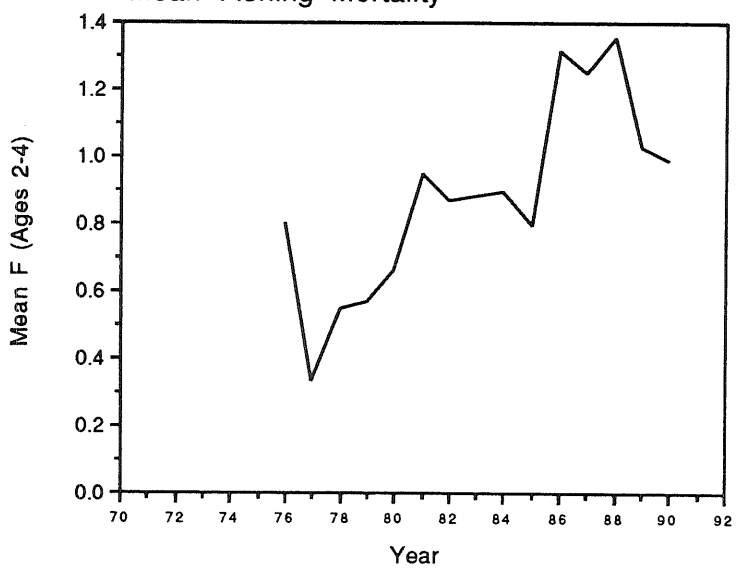
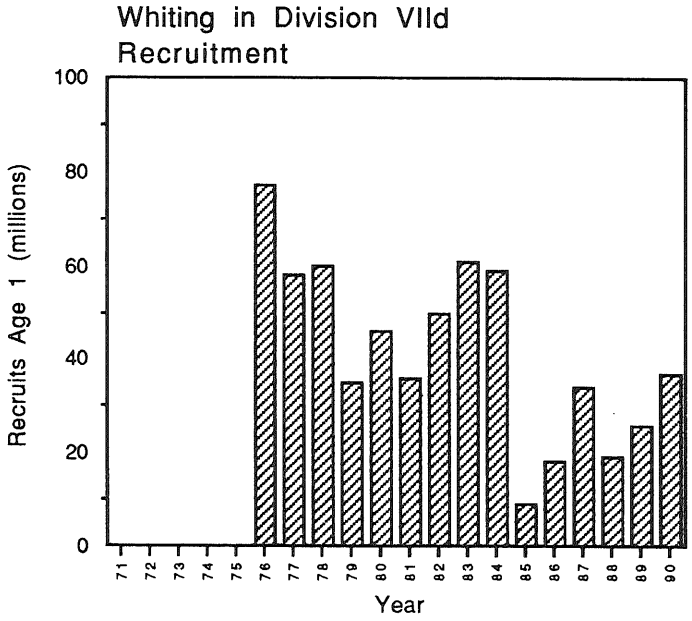

Whiting in Div. VIa
Stock and Recruitment
Recruits Age 1 (millions)
SSB ('000 tonnes)
Fhigh
Fmed
Rmed
240
200
160
120
80
40
0
0
10
20
30
40
50
60
72
79
74
77
71
78
76
73
84
83
85
75
89
88
80
82
81
87

Figure 12.1.1 Whiting in Division VIId







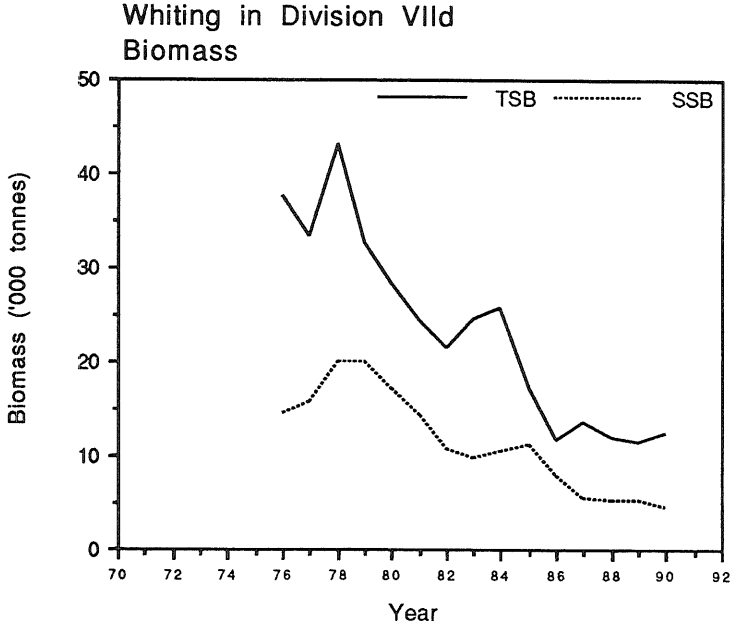


Figure 12.1.2

Whiting in VIId
Short Term Total Landings and Spawning Biomass

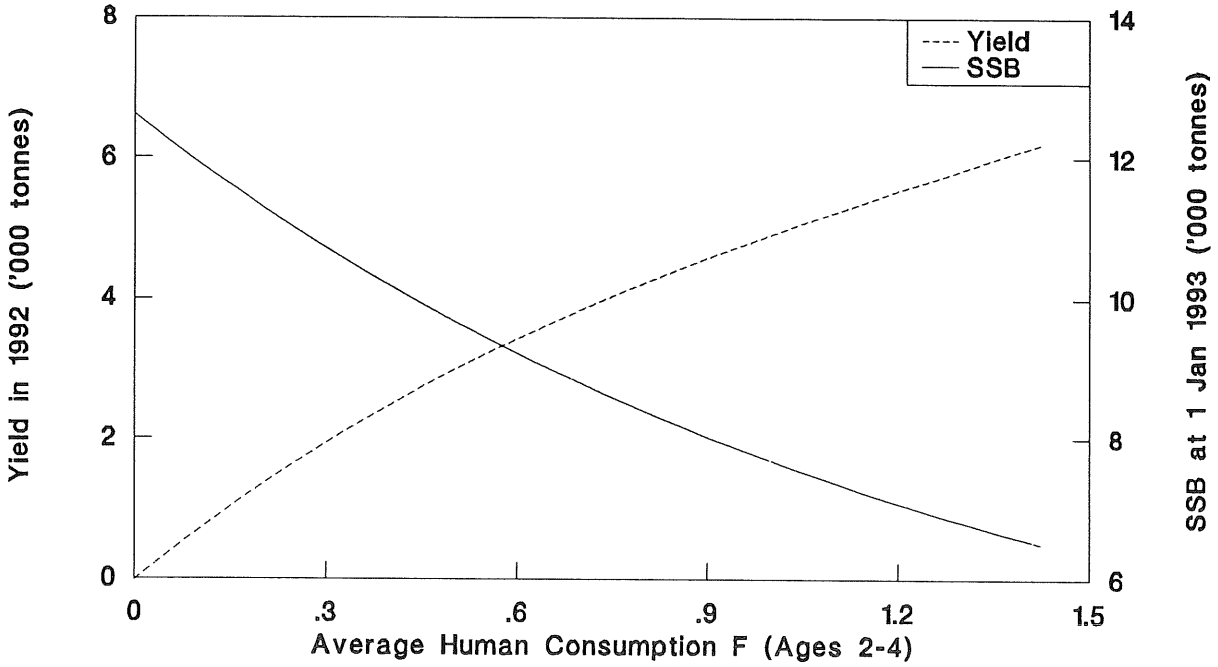
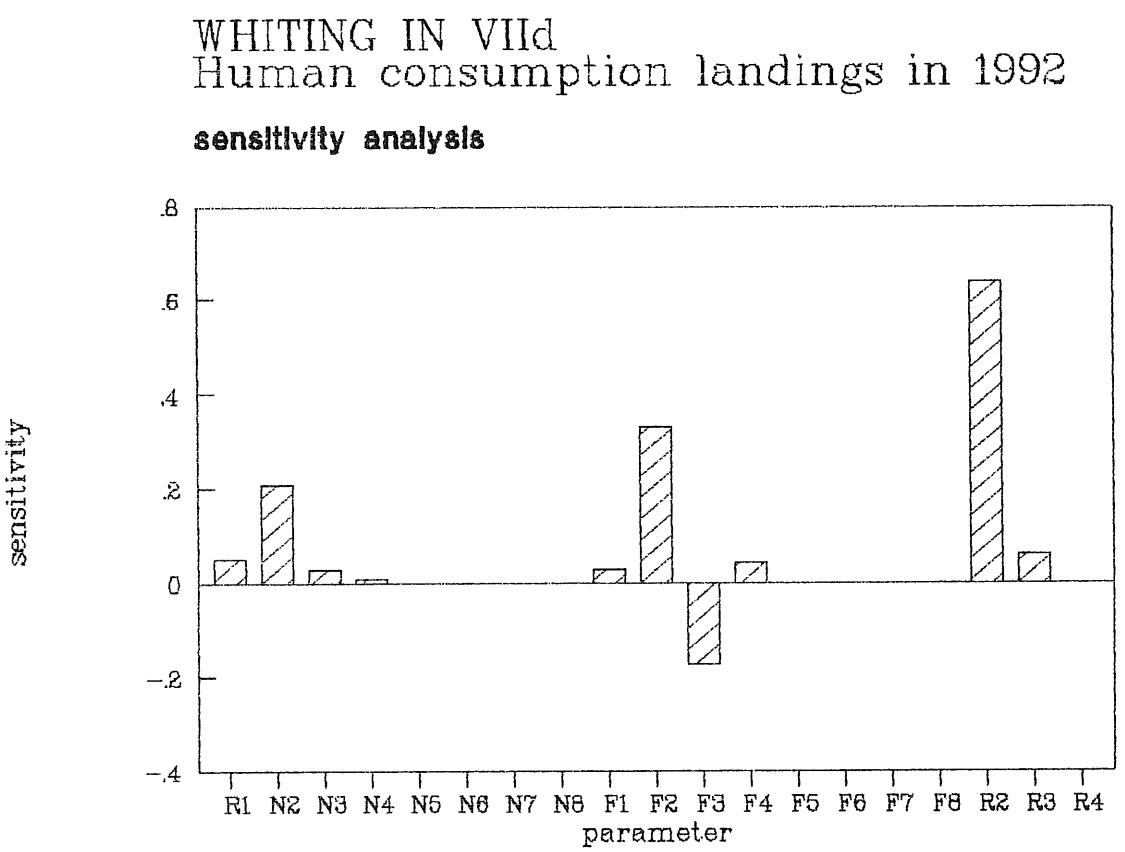


Figure 12.1.3


WHITING IN VIId
Human consumption landings in 1992
sensitivity analysis
sensitivity
.8
.6
.4
.2
0
-.2
-.4
R1 N2 N3 N4 N5 N6 N7 N8 F1 F2 F3 F4 F5 F6 F7 F8 R2 R3 R4
parameter

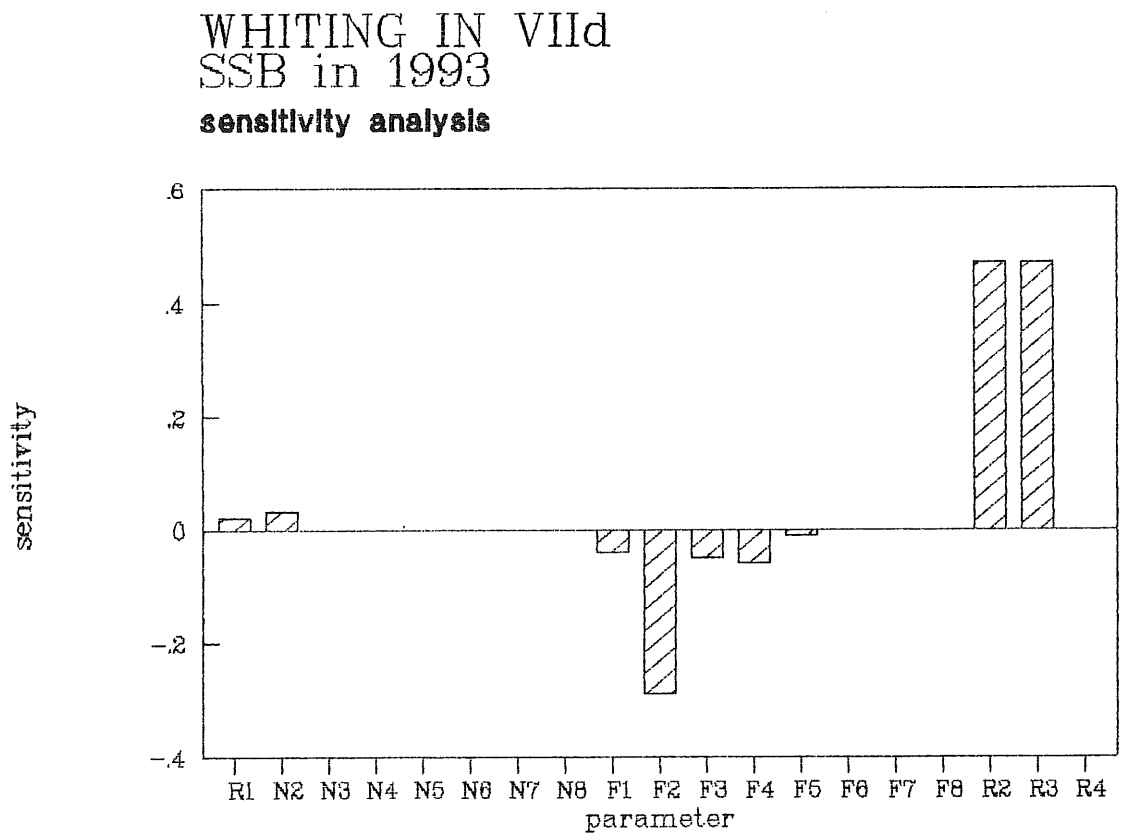

WHITING IN VIId
SSB in 1993
sensitivity analysis
sensitivity
.6
.4
.2
0
-.2
-.4
R1 N2 N3 N4 N5 N6 N7 N8 F1 F2 F3 F4 F5 F6 F7 F8 R2 R3 R4
parameter

Figure 12.1.4

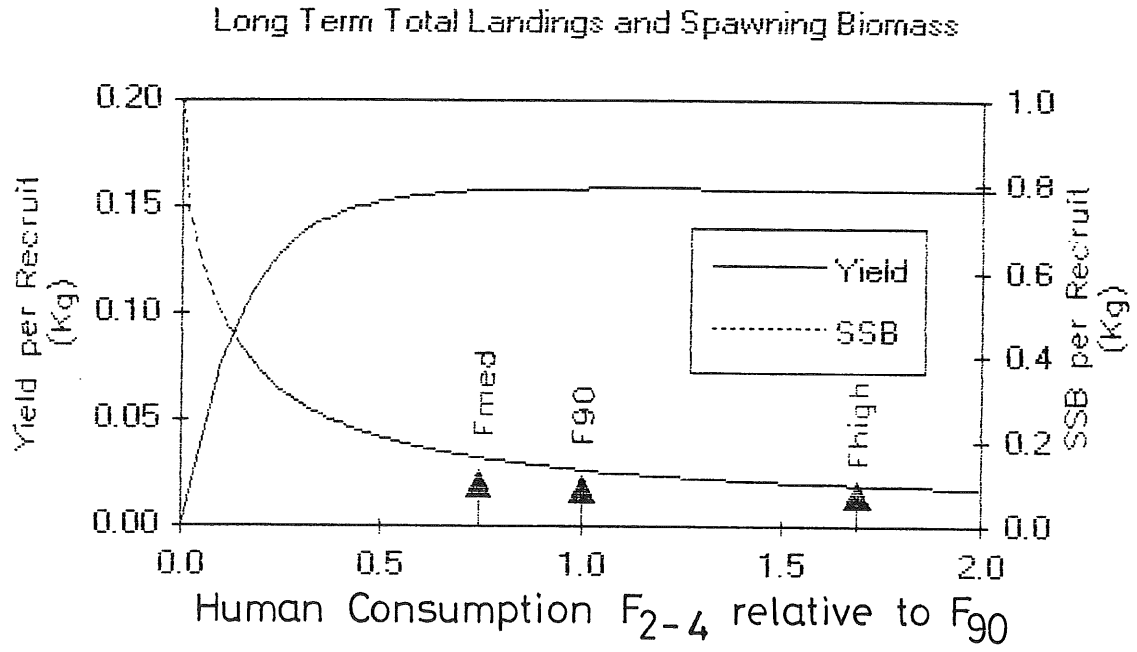


Figure 12.1.5

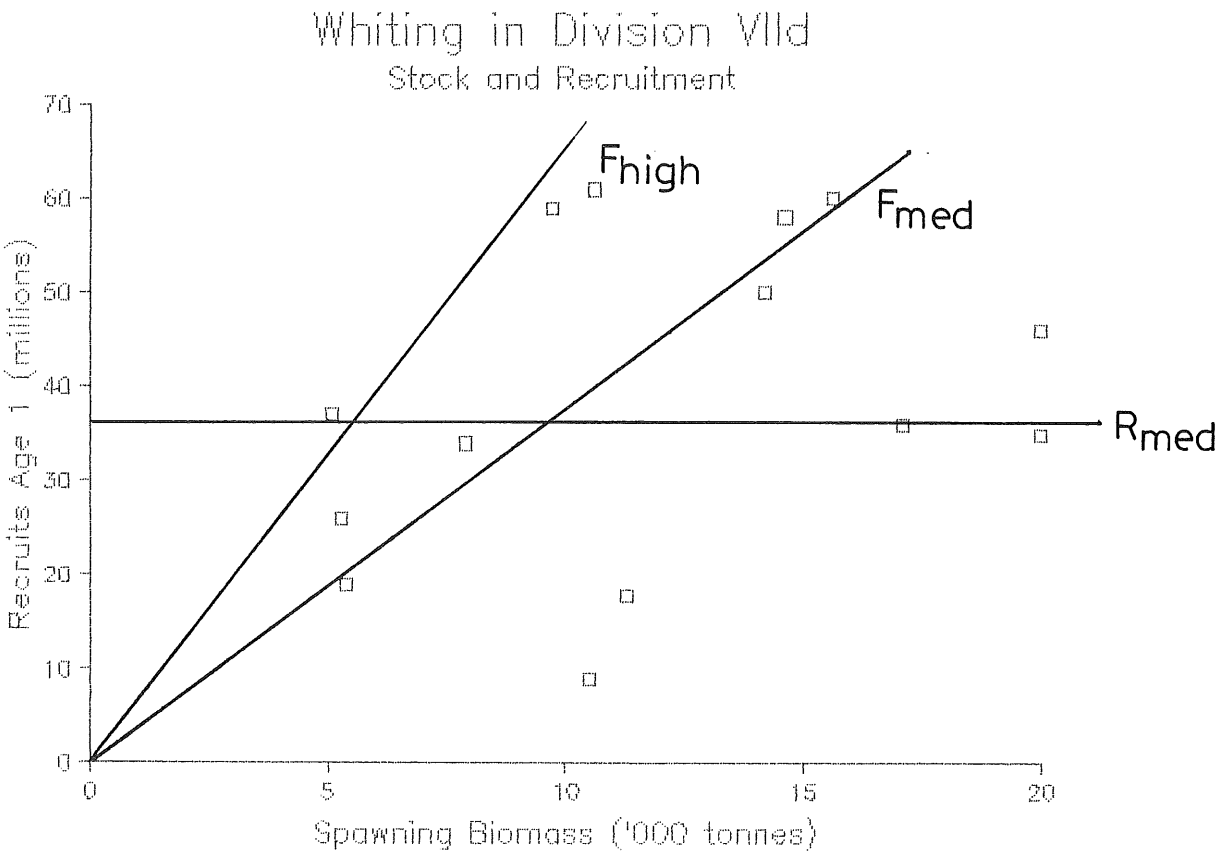
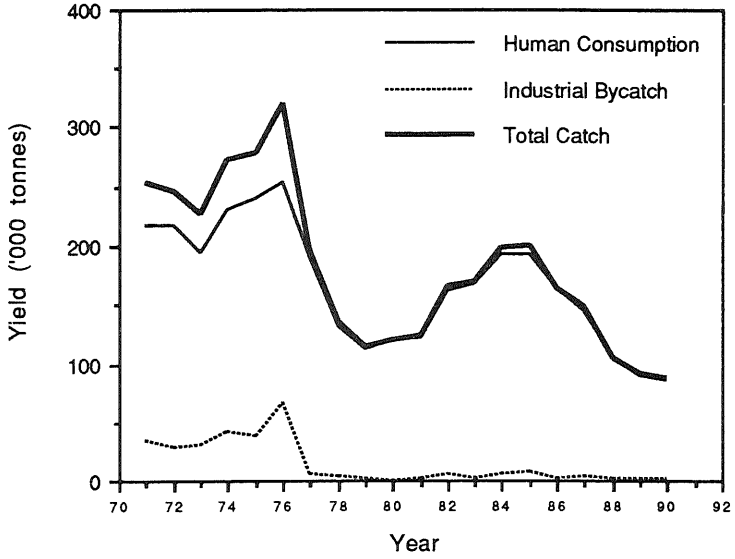
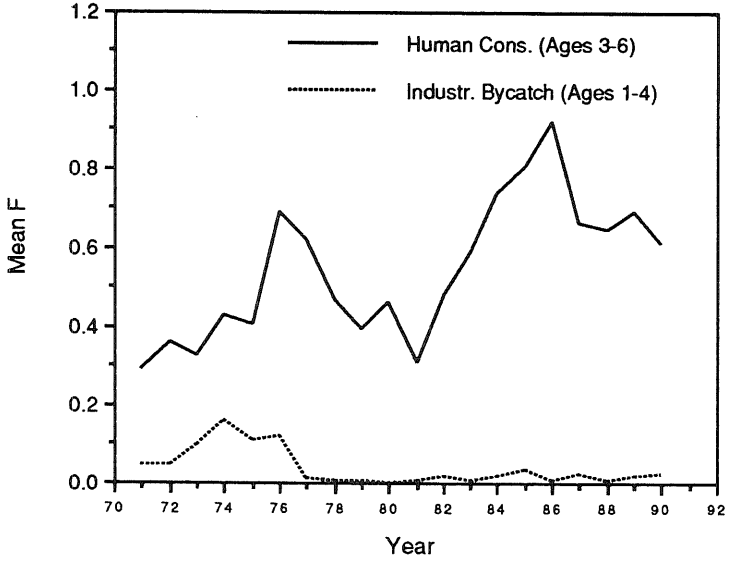


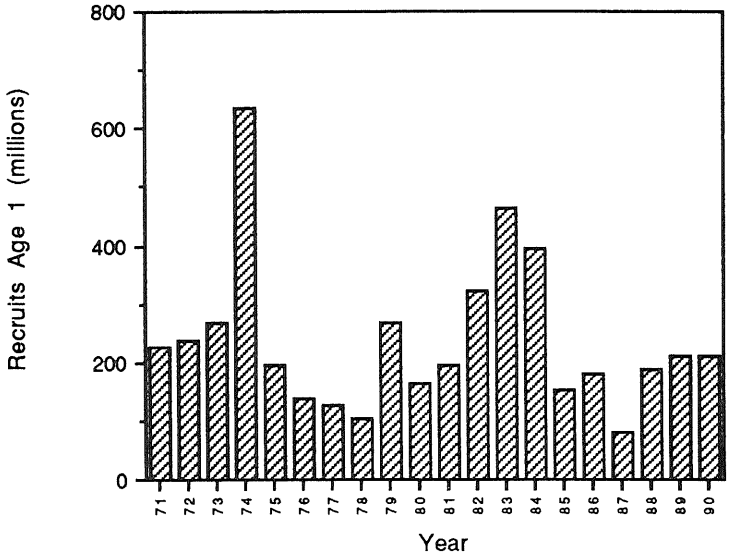
Figure 13.1 Saithe in IV and IIIa
Yield



Saithe in IV and IIIa
Mean Fishing Mortality



Saithe in IV and IIIa
Recruitment



Saithe in IV and IIIa
Biomass

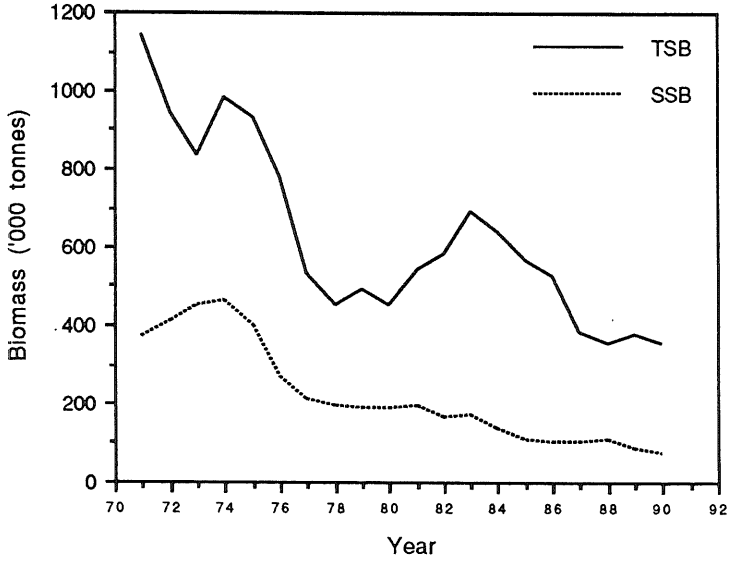


Figure 13.2

North Sea Saithe
Short Term Total Landings and Spawning Biomass

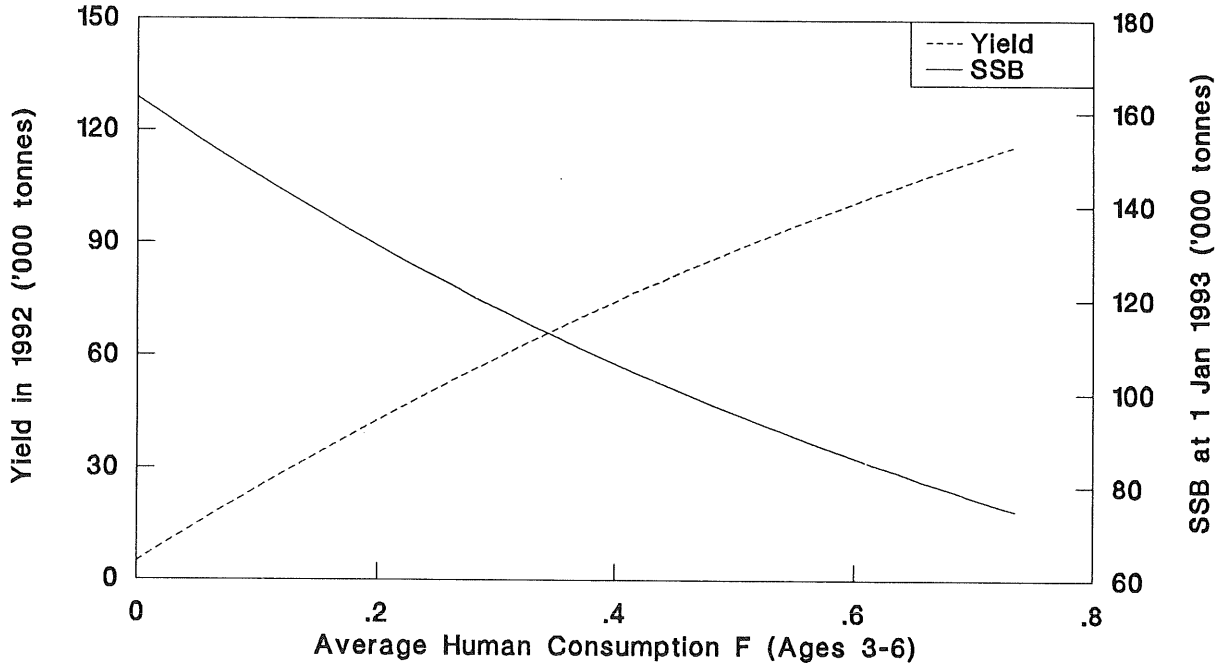
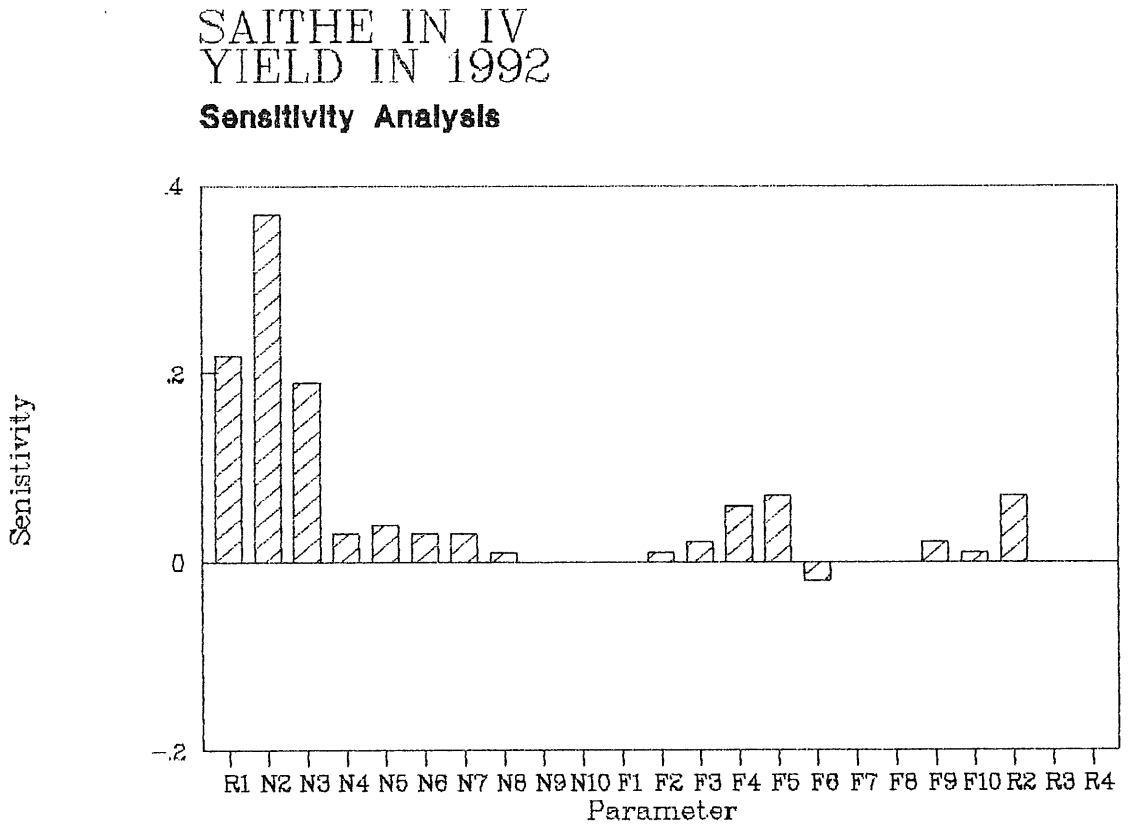


Figure 13.3


SAITHE IN IV
YIELD IN 1992
Sensitivity Analysis
Senistivity
.4
.2
0
-.2
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

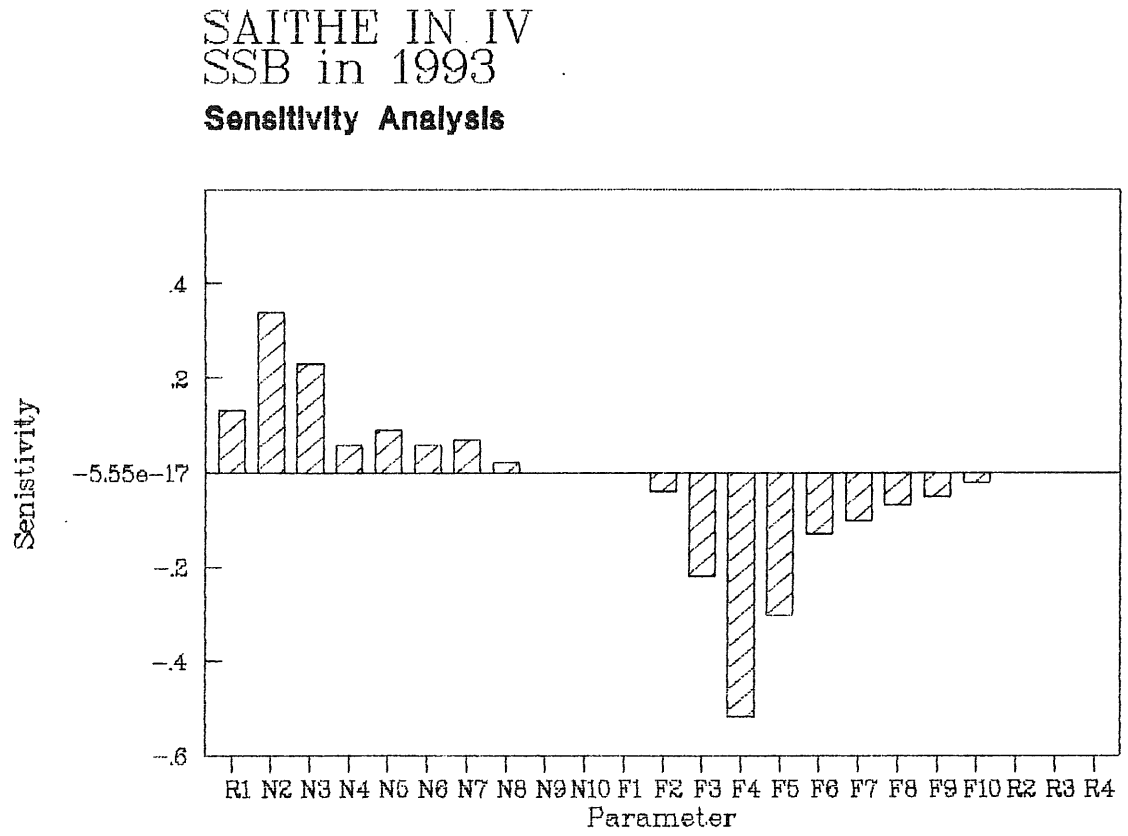

SAITHE IN IV
SSB in 1993
Sensitivity Analysis
Senistivity
.4
.2
-5.55e-17
-.2
-.4
-.6
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

Figure 13.4

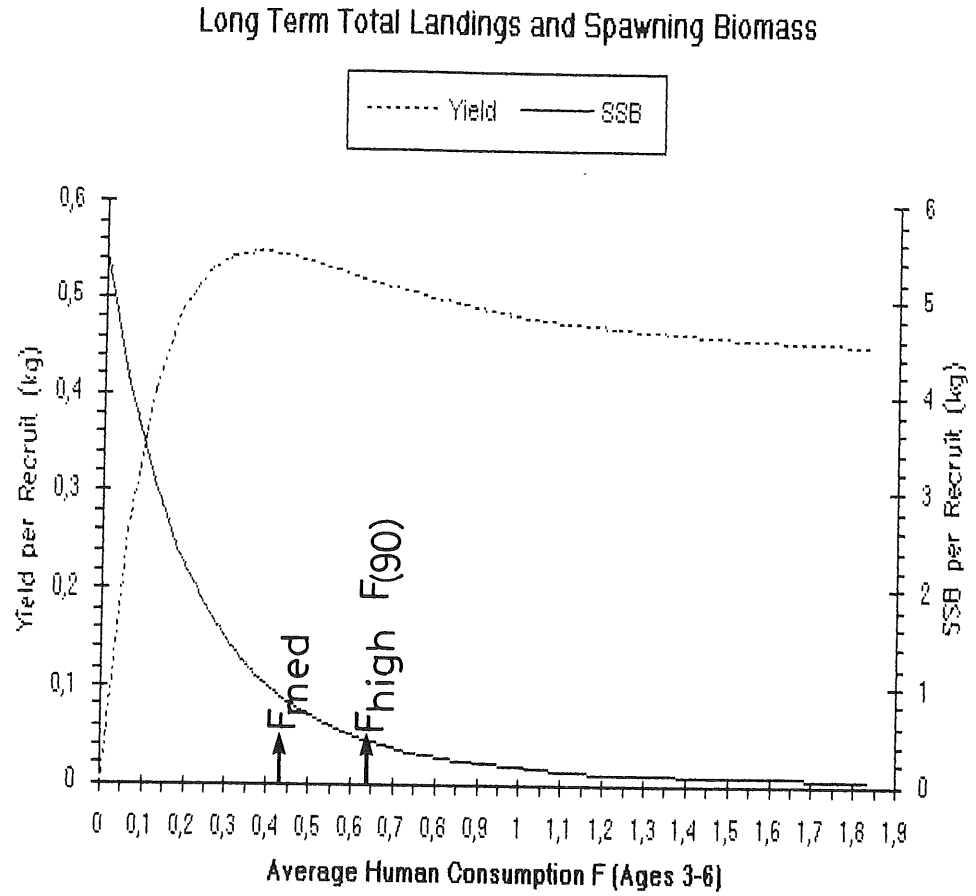


Figure 13.5 Saithe in Sub-area IV and Division IIIa.

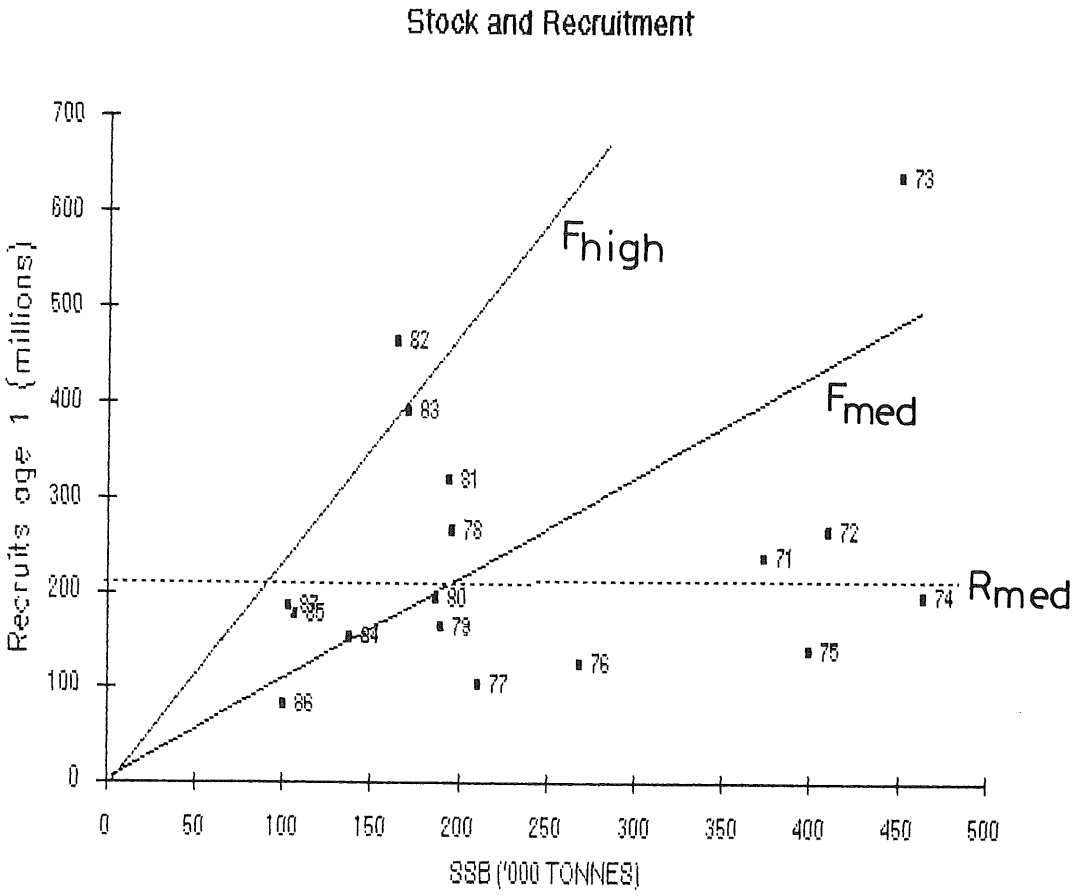
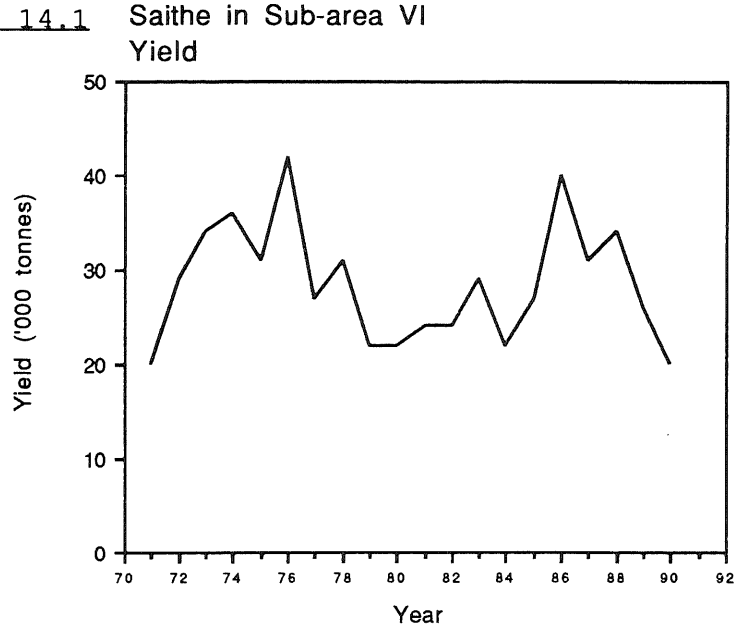
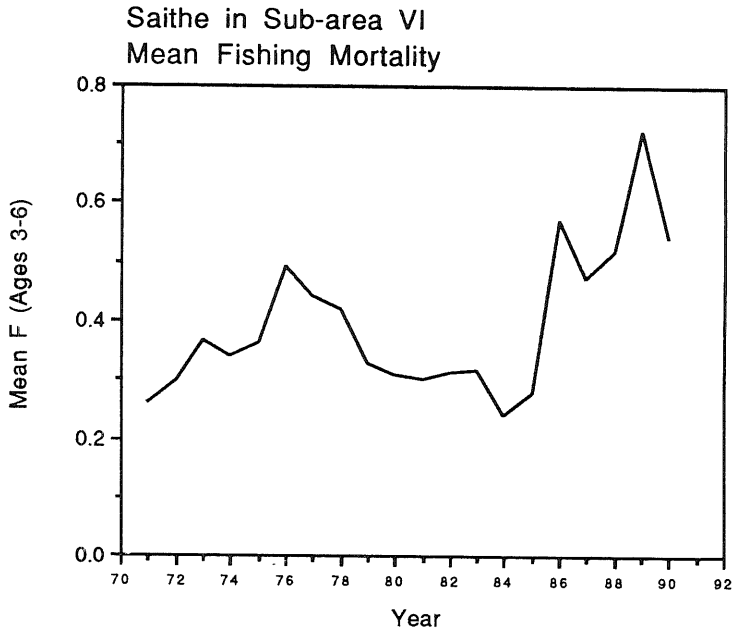
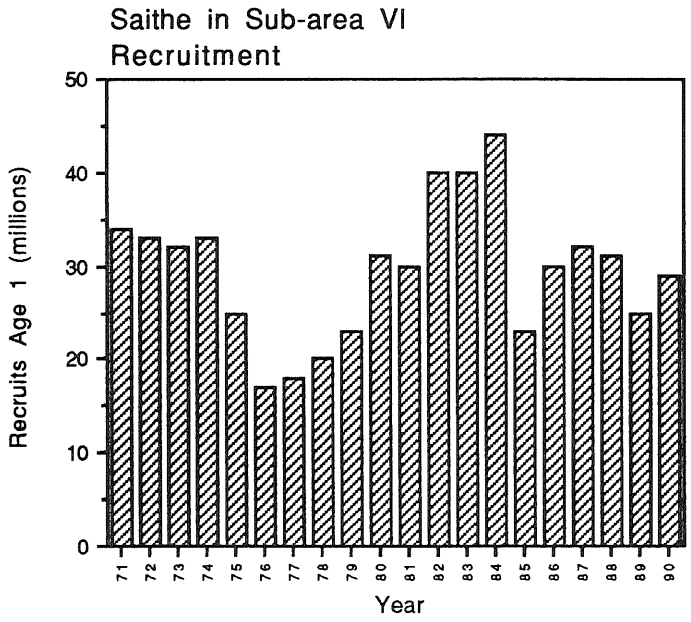


Figure 14.1


Saithe in Sub-area VI
Yield
Yield ('000 tonnes)
Year


Saithe in Sub-area VI
Mean Fishing Mortality
Mean F (Ages 3-6)
Year


Saithe in Sub-area VI
Recruitment
Recruits Age 1 (millions)
Year

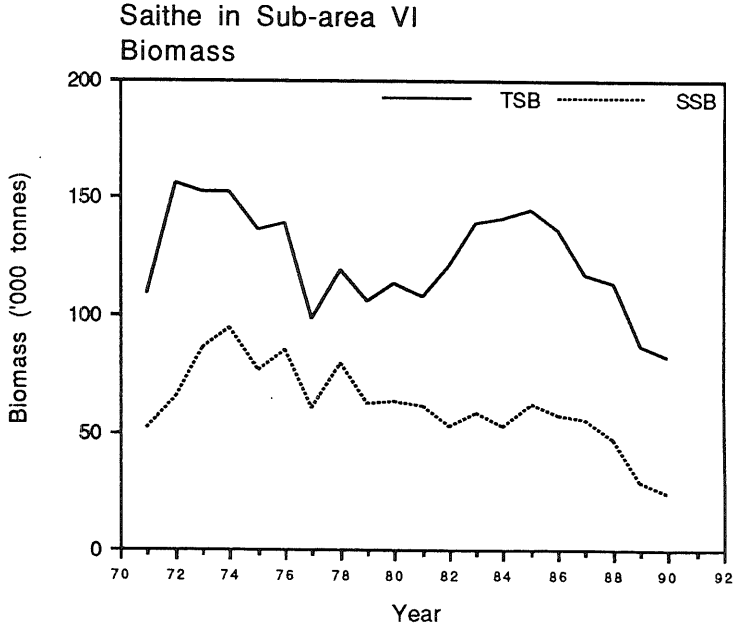

Saithe in Sub-area VI
Biomass
TSB
SSB
Biomass ('000 tonnes)
Year

Figure 14.2

Saithe in VI
Short Term Total Landings and Spawning Biomass

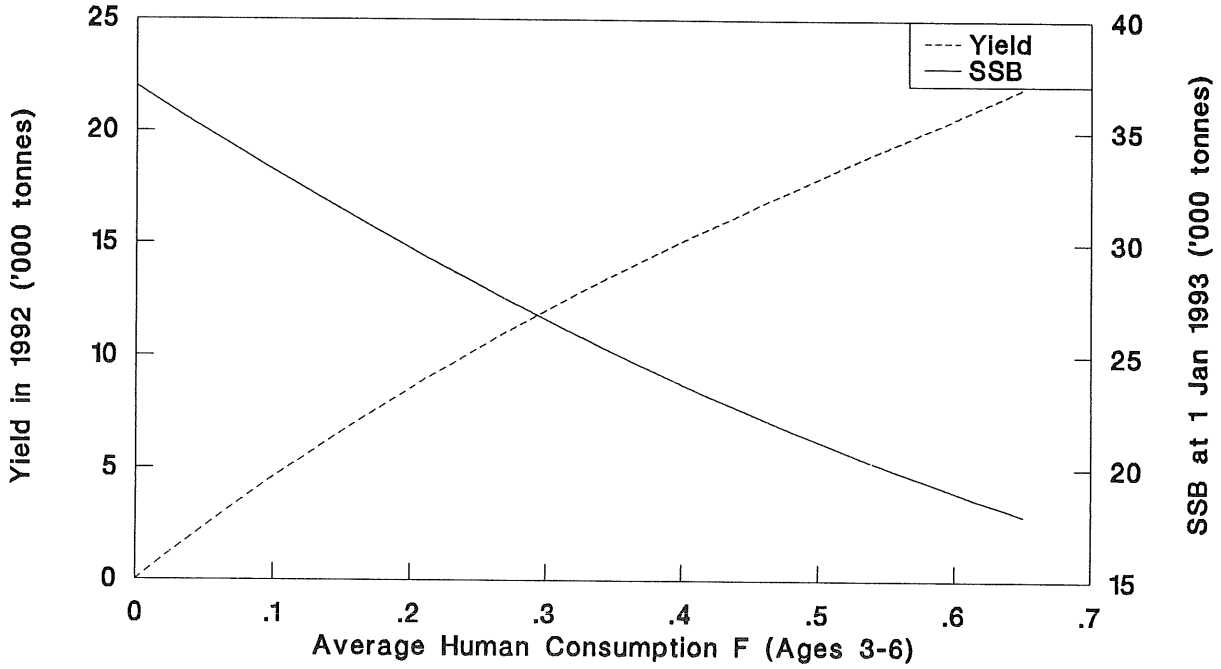
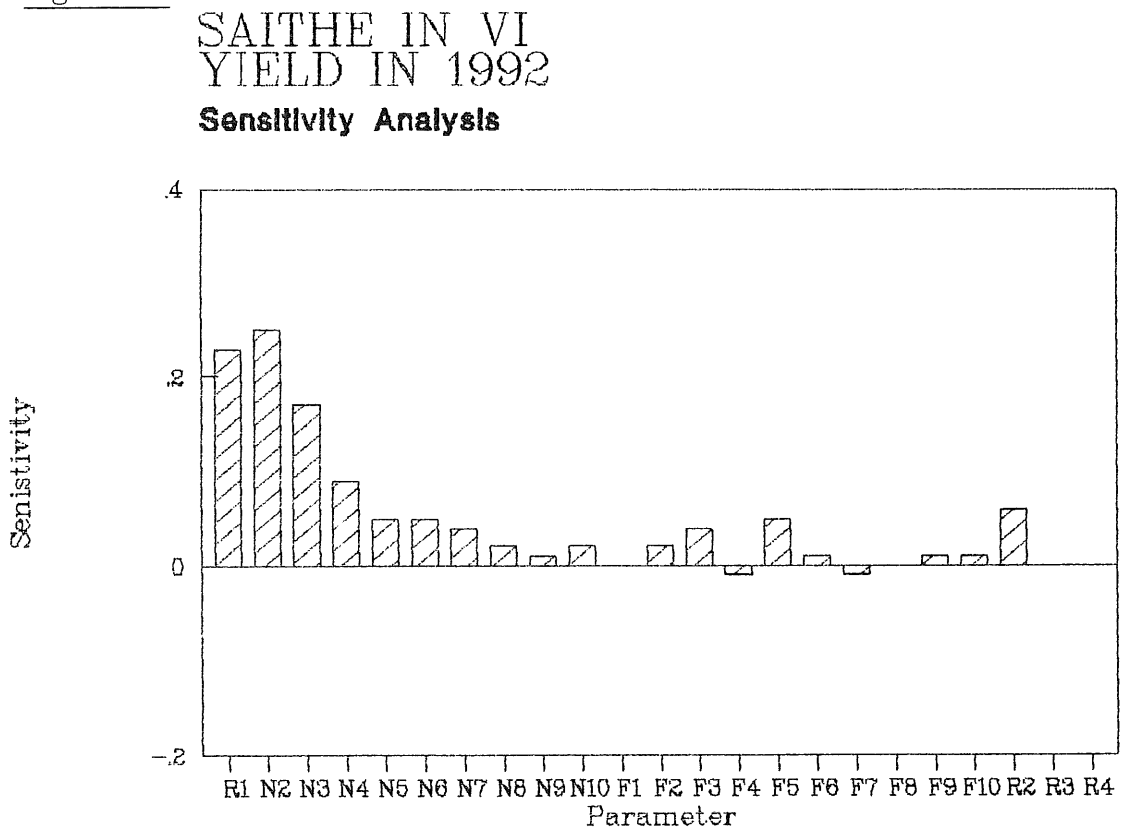


Figure 14.3


SAITHE IN VI
YIELD IN 1992
Sensitivity Analysis
Senistivity
.4
.2
0
-.2
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

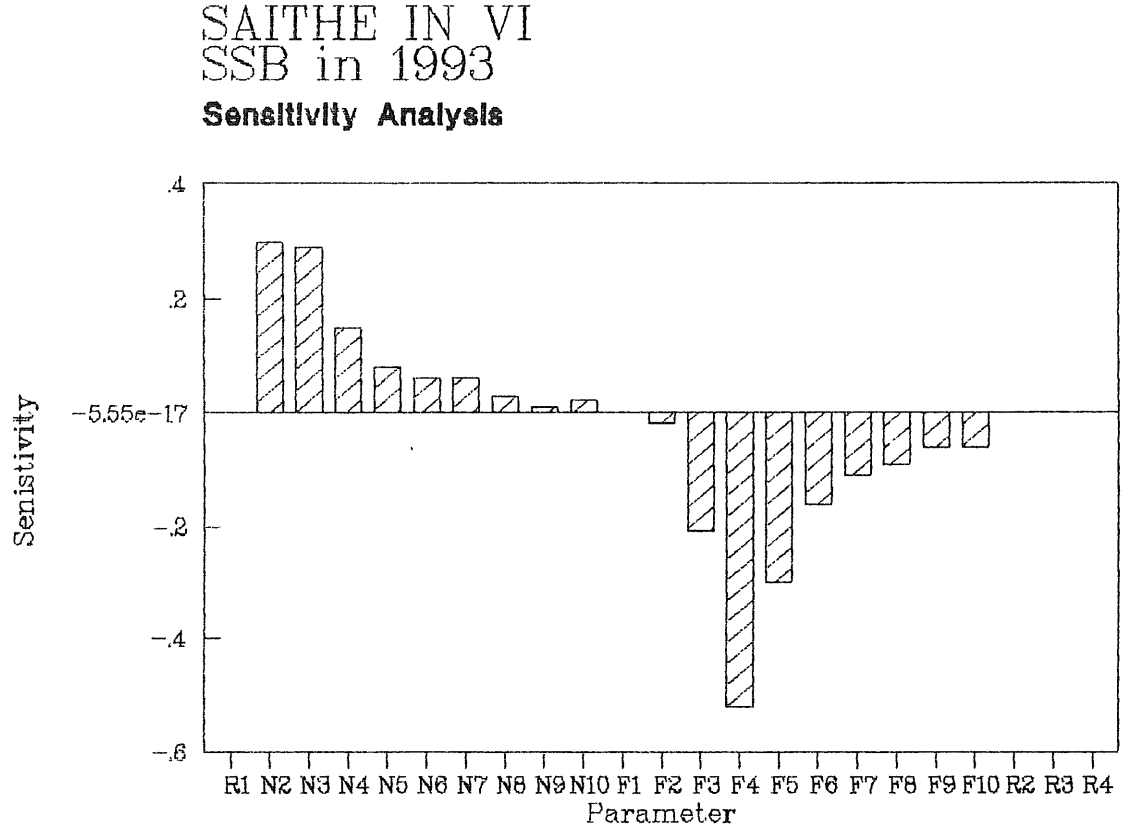

SAITHE IN VI
SSB in 1993
Sensitivity Analysis
Senistivity
.4
.2
-5.55e-17
-.2
-.4
-.6
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

Figure 14.4

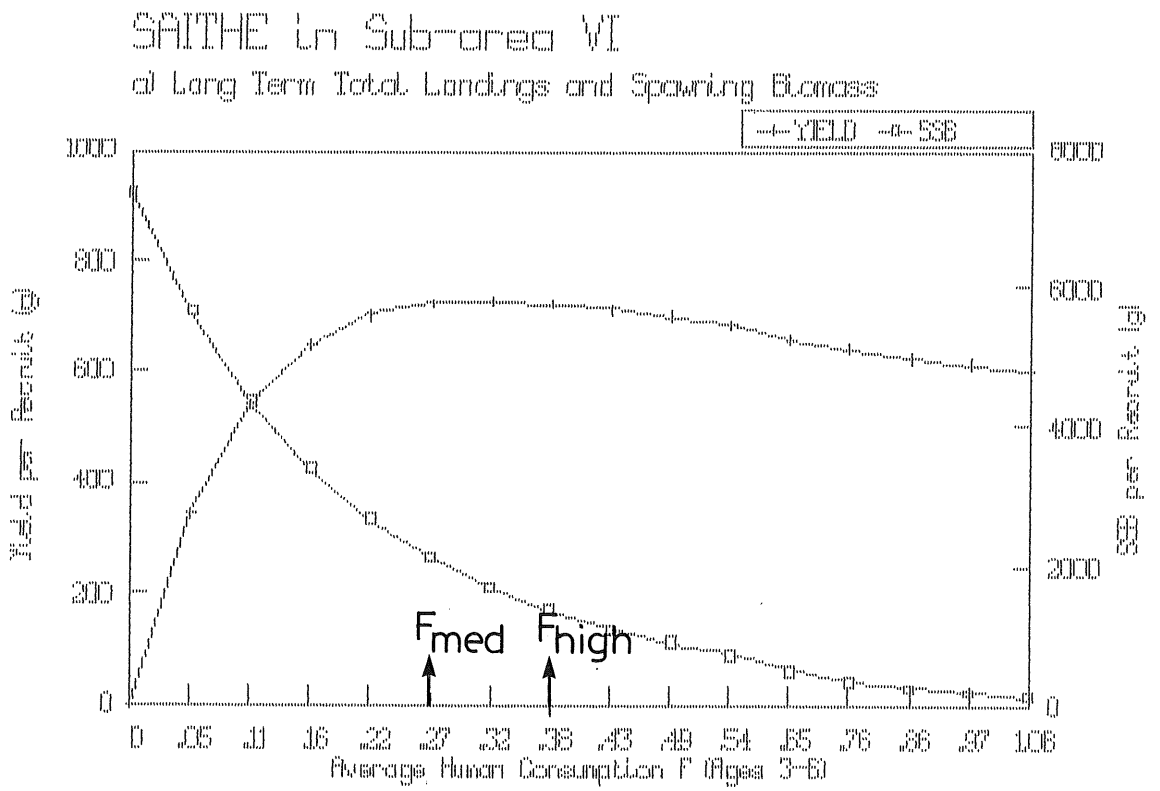
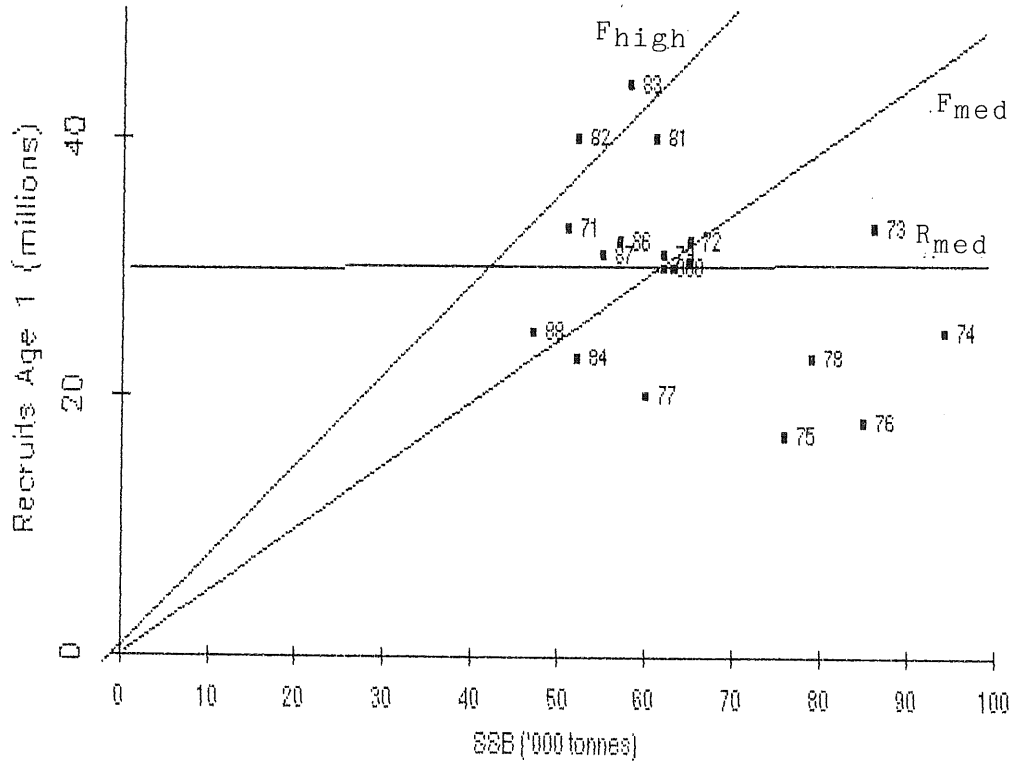


Figure 14.5 Saithe in Sub-area VI. Stock and Recruitment.



APPENDIX 1

DRAFT ACFM REPORT AND QUALITY CONTROL DIAGRAMS

3.5 Overview of the Roundfish Fisheries in Sub-areas IV and VI

All the stocks in Sub-areas IV and VI assessed by the Roundfish Working Group show significant declines in recent years except perhaps for North Sea whiting. Although much of the decline is attributable to lower levels of recruitment in the past decade, the decline is frequently associated with increasing levels of fishing mortality. For many stocks the present levels of spawning stocks are the lowest observed since the 1970s, and it is possible that recruitment is suffering from these low levels. Despite the recent tendency to set TACs at levels corresponding to lower than *status quo* fishing mortality, there is very little evidence as yet that exploitation rates are decreasing. This is partly because enforcement of TACs may lead simply to discarding or misreporting but it is also due to a tendency for assessments to overpredict catches in the short term. This seems to have happened again in last year's assessments. This means that even had TACs been successfully applied, the reduction in fishing mortality would have been less than desired.

ACFM recognised these problems at its November 1990 meeting and sought to reduce fishing effort directly by 30% in 1991. Initially it was proposed by managers that this could be achieved by requiring vessels to remain in port for a continuous period of 10 days each month. However, this proposal did not take into account the fact that many vessels would be in port anyway for a number of days, perhaps five out of the 10. In the end the regulation agreed was that vessels with a track record of catching significant quantities of cod and haddock should remain in port for 8 days per month. Given the fact that vessels would be in port anyway for perhaps five of these, and that by lengthening trips, turn around times could be concatenated within the 8 day period, it seems very unlikely that the 8 day rule would have any detectable effect on fishing effort. Furthermore, a number of countries successfully argued that the rule should not apply to them. In the UK, vessels could choose between the 8 day rule or using a 110mm codend net as an alternative. Many vessels took up the larger mesh option. Although the mesh size could be considered an alternative to effort reduction, the difficulties of enforcing mesh size regulations mean that the measure was probably ineffective. It is known, for example, that some vessels using the 110mm mesh option were prosecuted for landing undersized whiting. It is also worth noting that the mesh size option does the wrong thing in conservation terms in the short term given the present stock circumstances because it allows a larger escapement of whiting (a stock in a better state in the North Sea) while having an almost negligible effect on protecting the spawning stock of cod which is at a particularly low level. Thus although mesh size increases are desirable, they should not be considered an alternative to effort reduction as a short-term measure.

The difficulties of enforcing the effort reduction measure should not be seen as reasons for abandoning the approach. On the contrary, it remains highly desirable that effort is reduced directly as soon as possible. Future attempts to reduce effort should be designed to overcome the difficulties of the implementation experienced in 1991.

Saithe is recognised to be a rather separate fishery from the mixed cod, haddock and whiting fishery. Measures to protect saithe need not be the same as those for the mixed roundfish fishery. However, the saithe stocks also appear to be in decline and careful consideration needs to be given to their management. Although the Sub-area VI and North Sea stocks are assessed separately, and are subject to separate TACs, the management of these two stocks should not be considered in isolation. The saithe fishery is prosecuted along the Northern shelf edge on both sides of the 4 degree line which is a fairly arbitrary division. Management measures for the two stocks should, therefore, be compatible.

3.5.2 Cod in Sub-area IV (North Sea)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	<215	<259	<130	125-200	148	124	113	-[4]	-	-	-
Agreed TAC	215	250	170	175	160	124	105	100	-	-	-
Official landings[3]	197	187	157	167	142	113	N/A	-	-	-	-
Unallocated landings	8	6	6	8	-	6	-	-	-	-	-
Catch as used by WG	205	193	163	175	150	116	104	-	341	104	211
Sp. stock biomass	116	107	96	86	79	73	66	64[1]	263	66	165
Recruitment (age 1)	533	108	569	244	142	316	140	216[1]	847	108	381
Mean F(2-8 ,u)	0.85	0.82	0.88	0.89	0.88	0.98	0.75	-	0.90	0.47	0.72

[1]Predicted or assumed. [2]Over period 1963-1990. [3]Not including some cod caught as industrial by-catch. [4]30% reduction in fishing effort. Weights in '000 t, recruitment in millions.

Catches: Landings in 1990 were the lowest since 1963 and have fallen sharply since 1981 (Figure 4.1).

Data and assessment: Analytical assessment of catch-at-age data, using CPUE and reserach vessel data. Discard data only available for Scottish fleets, and not used in assessment.

Fishing mortality: Has increased more or less continuously, since the start of the data series in 1963.

Recruitment: The 1985 year class was the last one above average. The 1988 year class is of average abundance; the 1989 and 1990 year classes are well below average.

State of stock: Spawning stock biomass has declined since 1970 and is estimated to have reached a record low level of 64,000 t at the end of 1990.

Forecast for 1992:

Assuming F(91) = 0.78, Basis: F(90), Catch(91) = 100, Landings (91) =100.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	0.6F(90)	0.47	66	73	73	91	} SSB increases from current low level
B	0.8F(90)	0.63		91	91	79	
C	1.0F(90)	0.78		108	108	68	SSB remains low.

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to no increase in the present low level of SSB.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: COD IN SUB-AREA IV (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(2-8,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	0.91				
1988	0.80	0.86[1]			
1989	0.83	0.83	0.80		
1990	0.86	0.86	0.83	0.83	
1991	0.88	0.89	0.88	0.98	0.75

Remarks: [1]1987 value may be inflated by high estimate for age 3.

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	151	253	233				
1988		174[1]	177	160			
1989			150	136	143		
1990				179	142	119	
1991					121	100	108
					\ Actual	\ Current	\ Forecast

$$\text{Actual SQC} = \text{Landings}(y) \times \frac{F(y-1)}{F(y)} \times \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks: [1]No correction applied because 1987 value may be inflated by about 0.05.

STOCK: COD IN SUB-AREA IV (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 1) Unit: millions					
Date of assessment	Year class				
	1986	1987	1988	1989	1990
1987	410				
1988	254	277[1]			
1989	258	193	329[2]		
1990	257	201	324	161[3]	
1991	244	142	316	140	216

Remarks: [1]Amended by ACFM to 205.
[2]Amended by ACFM to 299.
[3]As revised by ACFM.

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	95	106	106[1]	128[1,3]				
1988	100	95	96	105[1]	122[1,2]			
1989	99	93	88	91	82[1]	80[1,2]		
1990[5]	97	89	84	85	87	78[1,4]	71[1,4]	
1991	96	86	79	73	66	64	66[1,4]	68[1,4]

[1]Forecast.

Remarks: [2]Assuming TAC taken in 1988, F(89) = 0.7 F(87).
[3]Assuming catch (87) = 190 kt, F(88) = 0.7 F(86).
[4]Assuming status quo F in 1990.
[5]As revised by ACFM.

3.5.3 Haddock in Sub-area IV (North Sea)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	172	209	239	120	185	68	50	-[5]			
Agreed TAC	170	207	230	140	185	68	50	50			
Official landings[3]	134	168	167	109	104	64	42	-			
Unallocated landings	4	-3	2	3	5	14	12	-			
Landings as used by WG[4]	138	165	169	112	109	78	54	-	267	54	155
Industrial by-catch	10	6	3	4	4	2	3	-	48	2	19
Discards	75	86	52	59	62	26	33	-	260	26	91
Catch as used by WG	213	251	221	171	171	104	87	-	448	87	246
Sp. stock biomass	190	231	212	149	150	122	76	64[1]	403	76	211
Recruitment (age 0)	16.1	22.5	46.8	3.8	7.8	7.9	32.8	23.1[1]	122.3	3.8	35.0
Mean F(2-6,u)	0.99	0.94	1.07	1.02	1.05	0.91	0.98	-	1.07	0.62	0.92

[1]Predicted or assumed. [2]Over period 1971-1990. [3]Not including some haddock caught as industrial by-catch. [4]Includes industrial by-catch. [5]30% reduction in fishing effort. Weights in '000 t, recruitment in thousand millions.

Catches: Continue to decline and are currently at a very low level.

Data and assessment: Uncertainty over the true level of catch and effort in both 1989 and 1990 due to suspected misreporting of landings. Catch, effort and survey data used in the assessment.

Fishing mortality: Remains at a high level. Mean F is greater than F_{med}.

Recruitment: 1990 year class above average but below last year's estimate. Scottish Ground Fish Survey 0-index in 1991 is, again, high but experience since last year suggests that this may be due to an overestimate of actual recruitment.

State of stock: Cause for concern remains. The 1990 year class is likely to halt the declining trend but does not in itself indicate a recovery of the stocks. SSB is currently estimated to be very low.

Forecast for 1992:

Assuming F(91) = 0.93, Basis: F(91) = F(90), Catch(91) = 89, Landings (91) = 46.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	0.6F(90)	0.56	99	98	55	153 }	
B	0.8F(90)	0.75		121	67	136 }	SSB at or above 1989 level
C	F(90)	0.93		142	77	122 }	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to recurrence of intermittent crises if and when recruitment is poor.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: HADDOCK IN SUB-AREA IV (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(2-6,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	1.09				
1988	1.14	1.12			
1989	1.07	1.00	1.00		
1990	1.05	1.00	1.05	0.95	
1991	1.07	1.02	1.05	0.91	0.98

Remarks: Human consumption and discards.

Natural mortality assumptions change in 1987/1988 - based on Multispecies Working Group recommendations.

Laurec/Shepherd tuning implemented in 1988.

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	169	164	194				
1988		112	113	88			
1989			109	85	53		
1990				83	63	61	
1991					52	46	77
					\ Actual	\ Current	\ Forecast

Actual SQC = $\text{Landings}(y) \times \frac{F(y-1)}{F(y)} \times \exp\left[-\frac{1}{2}(F(y-1) - F(y))\right]$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks:

STOCK: HADDOCK IN SUB-AREA IV (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 0) Unit: millions					
Date of assessment	Year class				
	1986	1987	1988	1989	1990
1987	58392				
1988	33155	6434			
1989[1]	34000	4318	7650		
1990	45252	5736	10512	12800	
1991	46847	3783	7802	7879	32729

Remarks: [1]As revised by ACFM.

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	225	213	251[1]	286[1]				
1988	207	140	140	112[1]	126[1]			
1989	213	152	134[2]	117[2]	79[1,2]	72[1,2]		
1990	213	150	149	122	86	81[1]	150[1]	
1991	212	149	150	122	76	64	99[1]	122[1]

[1]Forecast.

Remarks: [1]1988 Laurec/Shepherd tuning implemented.
[2]As revised by ACFM.

3.5.4 Whiting in Sub-area IV (North Sea)

Source of information: Report of the Roundfish Working Group (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	102	118	135	127	134	115	130	-[4]			
Agreed TAC	149	160	135	135	120	115	125	141			
Official landings	99	72	67	65	66	40	33[5]	-			
Unallocated landings	-3	-3	9	13	39	44	-	-			
Landings used by WG[3]	96	69	76	78	100	84	93	-			
Industrial by-catch	19	15	18	16	49	43	51	-			
Discards/slipping	39	28	78	53	28	35	54	-			
Catch as used by WG	135	97	154	132	127	119	147	-	361	97	197
Sp. stock biomass	247	242	263	275	273	269	351		581	220	362
Recruitment (age 0)	23211	47562	39899	28474	64780	44169	65840		92401	20633	49521
Mean F(2-6,u)	.872	.817	.886	1.097	.819	.805	.772		1.097	0.545	0.785

[1]Predicted or assumed. [2]Over period 1971-1990. [3]Includes industrial by-catch. [4]30% reduction in fishing effort. [5]Landings data incomplete. Weights in '000 t, recruitment in millions.

Catches: Human consumption landings stable on lower level than in the 1980s. Industrial by-catch and discards each higher than human consumption landings.

Data and assessment: Analytical assessment of catch-at-age data using CPUE and recruit survey indices. Discard data available are incomplete. Age composition in industrial by-catches estimated from survey data in recent years.

Fishing mortality: Human consumption F has decreased in recent years while discard F and industrial by-catch F have increased. Discard F at its highest level since 1980.

Recruitment: The 1988 year class was the strongest since 1974. The 1989 year class is about average and the 1990 year class is as strong as the 1988 year class.

State of stock: SSB is at its highest level since 1981. Current F above F_{med}.

Forecast for 1992:

Assuming F(91) = 0.78, Basis: F(91) = F(90), Catch(91) = 196, Landings (91) = 139.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	$F_{92}=0.6F_{90}$	0.47	422	148	114	386 }	
B	$F_{92}=0.8F_{90}$	0.62		169	125	366 }	Decline in SSB
C	$F_{92}=F_{90}$	0.78		188	135	347 }	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to increased landings but decreasing SSB.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: WHITING IN SUB-AREA IV (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(2-6,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	0.85				
1988	0.78	0.89			
1989	0.89	1.17	0.81		
1990	0.88	1.07	0.78	0.69	
1991	0.89	1.10	0.82	0.81	0.77

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	74	106	134				
1988		79	149	146			
1989			100	138	140		
1990				83	151	152	
1991					96	139	135
					\ Actual	\ Current	\ Forecast

Actual SQC = Landings(y) x $\frac{F(y-1)}{F(y)}$ x exp$\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks:

STOCK: WHITING IN SUB-AREA IV (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 0) Unit: millions					
Date of assessment	Year class				
	1986	1987	1988	1989	1990
1987	73355				
1988	66449	45109			
1989	37619	39219	70480		
1990	39166	50113	72010	48155	
1991	39899	28474	64780	44169	65840

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	294	368	500[1]	490[1]				
1988	294	360	527	478[1]	452[1]			
1989	263	270	265	325	391[1]	354[1]		
1990	266	278	283	365	474[1]	444[1,2]	375[1]	
1991	263	275	273	269	351	400	422[1]	347[1]

[1] Forecast.

Remarks: [2] As revised by ACFM.

3.5.5 Saithe in Sub-area IV and Division IIIa (North Sea)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	160	195	195	<198	156	170	120	125			
Agreed TAC	180	200	240	173	165	170	120	125			
Official landings[3]	182	194	167	154	112	92	-[4]	-			
Unallocated landings	16	6	-3	-5	-7	-		-			
Industrial by-catch	6	8	1	4	1	2		-			
Catch as used by WG	198	200	164	149	105	92	88	-	320	88	181
Sp. stock biomass	138	107	101	103	106	87	74	70[1]	465	74	220
Recruitment (age 1)	393	152	179	80	187	212	211	211[1]	637	80	238
Mean F(3-6,u)	0.76	0.85	0.93	0.69	0.65	0.72	0.64	-	0.93	0.31	0.58

[1]Predicted or assumed. [2]Over period 1971-1990. [3]Includes industrial by-catch. [4]Landings data incomplete. Weights in '000 t, recruitment in millions.

Catches: Since 1986, the catches have been considerably less than the agreed TAC (Table 3.5.5).

Data and assessment: Analytical assessment of catch-at-age data using CPUE data. No independent estimates of year-class strength. Interpretation of data difficult and uncertain.

Fishing mortality: Has increased up to 1986 with a shift towards heavy exploitation of fairly young fish. Fishing mortality has decreased since 1986 (Figure 3.5.5.1).

Recruitment: Has fluctuated without trend for many years.

State of stock: The stock is declining and is now at a historical low level. The assessment is, however, uncertain.

Forecast for 1992:

Assuming F(91) = 0.64, Basis: F(90), Catch(91) = 91, Landings (91) = 91.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	0.6F(90)	0.40	79	70	70	110 }	
B	0.8F(90)	0.52		87	87	97 }	SSB increases slightly.
C	1.0F(90)	0.64		102	102	85 }	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to a slight increase in SSB, assuming average year classes at ages 1 and 2 in 1990.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: SAITHE IN SUB-AREA IV AND DIVISION IIIA (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(3-6,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	0.74				
1988	0.63	0.40			
1989	0.75	0.46	0.40		
1990	0.89	0.62	0.51	0.39	
1991	0.93	0.69	0.65	0.72	0.64

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	180	223	198				
1988		205	168	170			
1989			109	118	120		
1990				94	116	125	
1991					95	91	102
					\ Actual	\ Current	\ Forecast

Actual SQC = Landings(y) x $\frac{F(y-1)}{F(y)}$ x exp$\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks:

STOCK: SAITHE IN SUB-AREA IV AND DIVISION IIIA (NORTH SEA).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 1) Unit: millions					
Date of assessment	Year class				
	1986	1987	1988	1989	1990
1987	242				
1988	280	283			
1989	207	166	237		
1990	245	235[1]	230[1]	232[1]	
1991	80[2]	187	212[1]	211[1]	211[1]

Remarks: [1]Geometric average recruitment.[2]See Section 13.5 in Roundfish Working Group Report.

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	106	178	158[1]	136[1]				
1988	150	182	297	301[1]	310[1]			
1989	115	140	186	236	244[1]	240[1]		
1990	99	107	125	122	166	206[1]	233[1]	
1991	101	103	106	87	74	70	79[1]	85[1]

[1]Forecast.

Remarks:

3.6.2. Cod in Division VIa (West of Scotland)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	23.0	27.0	25.0	22.0	16.0	16.0	15.0	-[4]			
Agreed TAC[3]	25.0	25.0	25.0	22.0	18.4	18.4	16.0	16.0			
Official landings	21	19	12	19	19	14	8[5]	-			
Unallocated landings	-	-	-	-	1	-3	-4	-			
Catch as used by WG	21	19	12	19	20	17	12	-	24	11	17
Sp. stock biomass	31	24	18	20	26	23	18	18[1]	50	18	30
Recruitment (age 1)	15	6	13	29	4	13	7	13[1]	29	4	11
Mean F(2-5,u)	0.89	1.02	0.85	0.99	0.91	1.03	0.81	-	1.03	0.50	0.72

[1]Predicted or assumed. [2]Over period 1966-1990. [3]TAC is for the whole of Sub-area VI. [4]30% reduction in fishing effort. [5]Incomplete data. Weights in '000 t, recruitment in millions.

Catches: Landings in 1990 decreased to the second lowest level since 1966. Annual variations in catch are considerable, and there appears to be no trend. Unallocated landings increased in 1990.

Data and assessment: Analytical assessment based on catch-at-age data, CPUE data and research vessel data. Recruitment indices from survey data in Division VIa.

Fishing mortality: Increasing trend to 1985 and has subsequently fluctuated around 1.0.

Recruitment: The 1986 year class was the last strong one. The 1988 year class is above average but those spawned in 1987 and 1989 are below average.

State of stock: The spawning stock has again fallen to a low level after a recovery in 1988.

Forecast for 1992:

Assuming F(91) = 0.82, Basis: F(90), Catch(91) = 13, Landings (91) = 13.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	0.6F(90))	0.49	19	9	9	27 }	
B	0.8F(90)	0.66		11	11	24 }	SSB increases
C	1.0F(90)	0.82		13	13	21 }	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to a continuation of the relatively low level of SSB.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: COD IN DIVISION VIA (WEST OF SCOTLAND).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(2-5,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	0.78				
1988	0.73	0.84			
1989	0.85	1.01	0.95		
1990	0.80	0.87	0.75	0.70	
1991	0.85	0.99	0.91	1.03	0.81

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	14	15	16				
1988		17	18	18			
1989			20	20	17		
1990				17	19	18	
1991					14	13	13
					\ Actual	\ Current	\ Forecast

$$\text{Actual SQC} = \text{Landings}(y) \times \frac{F(y-1)}{F(y)} \times \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks:

STOCK: COD IN DIVISION VIA (WEST OF SCOTLAND).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 1) Unit: millions					
Date of assessment	Year class				
	1986	1987	1988	1989	1990
1987	13				
1988	16	13			
1989	28	10	10		
1990	31	7	15	11	
1991	29	4	13	7	13

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	19	21	24[1]	27[1]				
1988	20	22	24	25[1]	24[1]			
1989	18	20	25	27	23[1]	19[1]		
1990	19	21	29	30	31	30[1]	29[1]	
1991	18	20	26	23	18	18	19[1]	21[1]

[1] Forecast.

Remarks: Forecast assuming status quo.

3.6.4. Haddock in Division VIa (West of Scotland)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	<27.0	<25.0	-	<23.0	25.0	15.0	14.0	-[4]			
Agreed TAC[3]	40.0	36.0	34.5	32.0	35.0	35.0	24.0	15.2			
Official landings	28	25	20	27	21	22	11	-			
Unallocated landings	2	-1	-	-	-2	-5	-1	-			
Landings as used by WG	30	24	20	27	19	17	10	-	46	10	23
Discards/slipping	16	17	7	16	9	3	5	-	33	2	12
Catch as used by WG	46	42	27	43	28	20	16	-	58	16	35
Sp. stock biomass	65	70	62	50	43	36	21	15[1]	147	21	60
Recruitment (age 0)	85	64	313	26	32	61	155	105[1]	610	26	169
Mean F(2-6,u)	0.71	0.66	0.44	0.92	0.75	0.96	0.80	-	0.96	0.38	0.67

[1]Predicted or assumed. [2]Over period 1971-1990. [3]TAC is set for Divisions VIa and VIb combined. [4]30% reduction in fishing effort. Weights in '000 t, recruitment in millions.

Catches: Continue to decline and are currently at a very low level.

Data and assessment: Uncertainty about the true level of catches and effort in both 1989 and 1990 due to suspected misreporting of landings. Catch, effort and survey data used in assessment.

Fishing mortality: Remains at a high level. Mean F continues to be considerably greater than F_{med}.

Recruitment: 1990 year class was overestimated last year but still appears above average. No survey data to indicate the strength of the 1991 year class.

State of stock: SSB is currently at a very low level. The 1990 year class will ease pressure on the stock but will only halt the declining trend. In itself it does not indicate a recovery of the stock.

Forecast for 1992:

Assuming F(91) = 0.77, Basis: F(91) = F(90), Catch(91) = 18, Landings (91) = 9.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	0.6F(90)	17	17	11	6	24 }	SSB continues to
B	0.8F(90)			14	7	21 }	remain at a low
C	F(90)			17	8	18 }	level

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to a continuation of the low level of SSB.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: HADDOCK IN DIVISION VIA (WEST OF SCOTLAND).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(2-6,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	0.67				
1988	0.37	0.61			
1989	0.40	0.77	0.59		
1990[1]	0.43	0.85	0.65	0.73	
1991	0.44	0.92	0.75	0.96	0.80

Remarks: 1988 Laurec/Shepherd tuning implemented.
Human consumption and discards.
[1]As revised by ACFM.

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	24	31	25				
1988		19	21	18			
1989			21	23	17		
1990[1]				17	12	10	
1991					11	9	8
					\ Actual	\ Current	\ Forecast

$$\text{Actual SQC} = \text{Landings}(y) \times \frac{F(y-1)}{F(y)} \times \exp\left[-\frac{1}{2}(F(y-1) - F(y))\right]$$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks: [1]As revised by ACFM.

STOCK: HADDOCK IN DIVISION VIA (WEST OF SCOTLAND).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 0) Unit: millions					
Date of assessment	Year class				
	1986	1987	1988	1989	1990
1987	247				
1988	143	22			
1989	346	51	49		
1990[1]	307	31	44	61	
1991	313	26	32	61	155

Remarks: [1]As revised by ACFM.

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	59	62	60[1]	64[1]				
1988	69	62	55	41[1]	32[1]			
1989	67	58	56	57	41[1]	29[1]		
1990[2]	64	54	45	39	25	18[1]	31[1]	
1991	62	50	43	36	21	15	17[1]	18[1]

[1]Forecast. [2]As revised by ACFM.

Remarks: 1988 Laurec/Shepherd tuning implemented.

3.6.5 Haddock in Division VIb (Rockall)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4)

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[1]	Min[1]	Mean[1]
Recommended TAC	20.0	8.0	5.0	10.0	10.0	18.0	5.5	5.5	-	-	-
Agreed TAC	Included in Sub-area VI combined TAC										
Official landings	2.6	9.3	4.8	8.0	7.6	6.3	7.5[3]	-	9.3	0.4	6.1
Unallocated landings	-	-	-	-	-0.3	-	-4.3	-	-	-	-
Discards/slipping	Not known										
Catch as used by WG	2.6	9.3	4.8	8.0	7.3	6.3	3.2	-	9.3[4]	4.8[4]	5.95[4]
Sp. stock biomass	-	17.7	8.4	18.3	12.8	7.9	4.6	4.7[2]	18.3[5]	4.6[5]	10.6[5]
Recruitment (age 2)	-	1.8	56.4	6.9	12.0	8.3	11.0	10.5[2]	54.4[5]	1.8[5]	17.8[5]
Mean F(1-10,u)	-	.40	.83	.96	.88	.98	.97	-	.98[4]	.4[4]	1.00[4]

[1]Over period 1980-1990. [2]Predicted or assumed. [3]Preliminary. [4]Over period 1985-1990. [5]Over period 1985-1991. Weights in '000 t, recruitment in millions.

Catches: Catches for this stock are very variable because recruitment is very variable and also because the fishery depends on the profitability of steaming as far as Rockall. The 1990 catch appears to be low but is unreliable due to misreporting.

Data and assessment: Catch-at-age data, effort data and survey data. Conventional effort-tuned VPA but time series too short for reliable tuning. Survey data used to predict recruitment.

Fishing mortality: Appears to be high but stable. Difficult to be certain of trends due to short time series.

Recruitment: Very variable though the 1986-1989 year classes appear to be of similar abundance. Mean recruitment in above table is heavily influenced by 1986 value.

State of stock: The VPA and survey data suggest the SSB has declined since 1987 as the very large 1984 year class gets older. The decline is expected to continue in 1991 but should then level off. The stock is currently being fished above $F_{0.1}$.

Forecast for 1992:

Assuming F(91) = 0.97, Basis: F *status quo*, Catch(91) = 3.2, Landings (91) = 3.2.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	*Status quo*	0.97	6.0	3.8	3.8	6.4	SSB stable or increases slightly.

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to a slight increase in SSB from the 1992 level.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

3.6.6 Whiting in Division VIa (West of Scotland)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	6.4	12.0	13.0	15.0	15.0	13.0	11.0	-[4]			
Agreed TAC[3]	16.4	16.4	16.4	16.4	16.4	16.4	11.0	9.0			
Official landings	17	13	8	12	12	8	5[5]	-			
Unallocated landings	-1	-	-	-	-1	-	-	-			
Catch as used by WG	16	13	8	12	11	8	6	-	25	6	14
Sp. stock biomass	31	25	22	23	22	13	12	14[1]	56	12	31
Recruitment (age 1)	68	64	52	67	17	37	42	58[1]	201	17	78
Mean F(2-4,u)	.74	.87	.65	.75	.89	.89	.72	-	1.28	0.34	0.73

[1]Predicted or assumed. [2]Over period 1971-1990. [3]TAC is set for Divisions VIa and VIb combined. [4]30% reduction in fishing effort. [5]Landings data incomplete. Weights in '000 t, recruitment in millions.

Catches: Landings remain at low level (Table 3.6.6). The 1990 landings are less than the predicted level and the TAC, and at their lowest level on record.

Data and assessment: Analytical assessment of catch-at-age data, excluding discards. CPUE data used.

Fishing mortality: Fluctuating above mean.

Recruitment: The 1987 and 1988 year classes are well below average, the 1989 year class around average.

State of stock: The spawning stock biomass remains far below the average and is at its lowest level of the last 20 years.

Forecast for 1992:

Assuming F(91) = 0.77, Basis: F(91) = F(90), Catch(91) = 8, Landings (91) = 8.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	F(92)=0.6F(90)	0.46	17	6	6	21 }	Increase in SSB, but still
B	F(92)=0.8F(90)	0.62		7	7	20 }	at low level
C	F(92)=F(90)	0.77		8	8	18 }	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to landings and SSB remaining at or about their current low levels.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: WHITING IN DIVISION VIA (WEST OF SCOTLAND).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(2-4,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	0.46				
1988	0.63	0.62			
1989	0.70	0.83	0.89		
1990	0.67	0.75	0.88	1.04	
1991	0.65	0.75	0.89	0.89	0.72

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	8	11	15				
1988		10	12	13			
1989			11	11	11		
1990				8	10	10	
1991					7	7	8
					\ Actual	\ Current	\ Forecast

$$\text{Actual SQC} = \text{Landings}(y) \times \frac{F(y-1)}{F(y)} \times \exp\left[-\frac{1}{2}(F(y-1) - F(y))\right]$$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks:

STOCK: WHITING IN DIVISION VIA (WEST OF SCOTLAND).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 1) Unit: millions					
Date of assessment	Year class				
	1985	1986	1987	1988	1989
1987	84				
1988	49	94			
1989	47	80	40		
1990	51	64	41	49	
1991	52	67	17	37	42

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	25	31	47[1]	46[1]				
1988	21	22	29	31[1]	33[1]			
1989	21	21	23	19	19[1]	20[1]		
1990	21	23	22	17	15	16[1]	18[1]	
1991	22	23	22	13	12	14	17[1]	18[1]

[1] Forecast.

Remarks:

3.6.8 Saithe in Sub-area VI (West of Scotland and Rockall)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[2]	Min[2]	Mean[2]
Recommended TAC	27	26	20	23	35	20	24	21			
Agreed TAC	27.0	27.8	27.8	27.8	35.0	30.0	29	22			
Official landings	27	26	35	33	33	23	-[3]	-			
Unallocated landings	-5	1	5	-2	1	3		-			
Catch as used by WG	22	27	40	31	34	26	20	-	42	20	29
Sp. stock biomass	52	62	57	55	47	29	24	21[1]	94	24	61
Recruitment (age 1)	44	23	30	32	31	25	29[1]	29[1]	44	17	30
Mean F(3- 6,u)	0.24	0.28	0.57	0.47	0.52	0.72	0.54	-	0.72	0.24	0.39

[1]Predicted or assumed. [2]Over period 1971-1990. [3]Landings data incomplete. Weights in '000 t, recruitment in millions.

Catches: Estimated catches have in recent years been on the level of the recommended TAC except for the years 1986, 1987 and 1989. The catch in 1990 was below the TAC.

Data and assessment: Analytical assessment of catch-at-age data using CPUE data. No independent estimates of year-class strength.

Fishing mortality: Increased sharply in 1986 and has remained at that level in 1987 and 1988. Increased to highest on record in 1989 and then decreased to the level of 1986 in 1990.

Recruitment: Fluctuating without any long-term trend.

State of stock: The spawning stock biomass has declined since 1974 and is predicted to stay at a historically low level.

Forecast for 1992:

Assuming F(91) = 0.54, Basis: F(91) = F(90), Catch(91) = 20, Landings (91) = 20.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	0.6F(90)	0.33	22	13	13	26	Slight recovery of SSB.
B	0.8F(90)	0.43		16	16	23	SSB stable at low level.
C	1.0F(90)	0.54		19	19	20	SSB at historically low level

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to the SSB remaining at a historically low level.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

STOCK: SAITHE IN SUB-AREA VI (WEST OF SCOTLAND AND ROCKALL).

ASSESSMENT QUALITY CONTROL DIAGRAM 1

Average F(3-6,u)					
Date of assessment	Year				
	1986	1987	1988	1989	1990
1987	0.48				
1988	0.42	0.41			
1989	0.58	0.48	0.55		
1990	0.60	0.51	0.53	0.53	
1991	0.57	0.47	0.52	0.72	0.54

Remarks:

ASSESSMENT QUALITY CONTROL DIAGRAM 2

Estimated total landings ('000 t) at status quo F							
Date of assessment	Year						
	1986	1987	1988	1989	1990	1991	1992
1987	27	46	42				
1988		31	32	31			
1989			42	30	29		
1990				27	27	25	
1991					24.3	20	19
					\ Actual	\ Current	\ Forecast

$$\text{Actual SQC} = \text{Landings}(y) \times \frac{F(y-1)}{F(y)} \times \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y) and F(y-1) are as estimated in the assessment made in year (y+1).

Remarks:

STOCK: SAITHE IN SUB-AREA VI (WEST OF SCOTLAND AND ROCKALL).

ASSESSMENT QUALITY CONTROL DIAGRAM 3

Recruitment (age 1) Unit: millions					
Date of assessment	Year class				
	1986	1987	1988	1989	1990
1987	33				
1988	33	33			
1989	44	29	29		
1990	45	29[1]	29[1]	29[1]	
1991	32	31	25	29[1]	29[1]

Remarks: [1]Geometric mean.

ASSESSMENT QUALITY CONTROL DIAGRAM 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
1987	58	79	77[1]	62[1]				
1988	114	112	107	88[1]	79[1]			
1989	57	54	48	34	29[1]	30[1]		
1990	55	51	44	28	31	33[1]	29[1]	
1991	57	55	47	29	24	21	22[1]	20[1]

[1]Forecast.

Remarks:

3.6.10.1 Whiting in Division VIId (Eastern English Channel)

Source of information: Report of the Roundfish Working Group, October 1991 (C.M.1992/Assess:4).

Year	1984	1985	1986	1987	1988	1989	1990	1991	Max[1]	Min[1]	Mean[1]
Recommended TAC	-	-	-	-	-	-	8.0	5.1	-	-	-
Agreed TAC	Precautionary TAC for Sub-area VII excluding Division VIIa										
Official landings	7.1	7.8	4.8	7.2	7.8	n/a[3]	n/a[3]	-	-	-	-
Unallocated landings	0.3	-0.5	0.7	-2.5	-3.4	-	-	-	-	-	-
Catch as used by WG	7.4	7.3	5.5	4.7	4.4	4.1	3.5	[-2]	9.2	3.5	6.7
Sp. stock biomass	10.5	11.3	7.9	5.4	5.3	5.1	4.6	5.9[2]	20.0	4.6	11.5
Recruitment (age 1)	59	9	18	34	19	26	37	37[2]	7.7	9	42
Mean F(2-4,u)	0.89	0.79	1.32	1.25	1.36	1.02	0.98	-	1.32	0.34	0.88

[1]Over period 1976-1990. [2]Predicted or assumed. [3]No report for one country. Weights in '000 t, recruitment in millions.

Catches: Continue to decrease since 1984. They are currently at their lowest level on record.

Data and assessment: Analytical assessment based on separable VPA. No discard data, although discards are believed to be important. No recruit indices. Data of poor quality.

Fishing mortality: Slightly decreasing but remains at a high level. Well in excess from F_{med}.

Recruitment: Highly variable. No correlation with the recruitment of whiting in the North Sea.

State of stock: SSB at its lowest level, but the state of stock is not clear due to poor quality of the data.

Forecast for 1992:

Assuming F(91) = 1.18, Basis: $F_{91} = F_{90}$, Catch(91) = 4.8, Landings (91) = 4.8.

Option	Basis	F(92)	SSB(92)	Catch(92)	Landgs(92)	SSB(93)	Consequences/implications
A	$F_{92}=0.6F_{90}$	0.71	6.7	3.9	3.9	8.7 }	
B	$F_{92}=0.8F_{90}$	0.95		4.7	4.7	7.9 }	Increase of SSB
C	$F_{92}=F_{90}$	1.18		5.5	5.5	7.1 }	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to increase both landings and SSB.

Recommendation:

ACFM prefers/recommends that fishing mortality should
, corresponding to a TAC in 1992 of t.

Special comments:

COD IV 1990 Qu 1 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	5	0.529					5	0.529
2	8954	0.746					8954	0.746
3	2629	1.871					2629	1.871
4	1336	3.439					1336	3.439
5	764	5.601					764	5.601
6	135	8.458					135	8.458
7	88	10.462					88	10.462
8	17	10.329					17	10.329
9	16	12.185					16	12.185
10	1	16.572					1	16.572
11	2	14.029					2	14.029
12								
13								
14								
15	0	17.719					0	17.719
No.	13948		0		0		13948	
Wt.	22971		0		0		22971	

COD IV 1990 Qu 2 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	468	0.461					468	0.461
2	19575	0.812					19575	0.812
3	2599	2.033					2599	2.033
4	1299	3.510					1299	3.510
5	741	6.124					741	6.124
6	52	7.788					52	7.788
7	76	9.991					76	9.991
8	14	10.690					14	10.690
9	6	13.374					6	13.374
10	6	14.660					6	14.660
11	0	15.600					0	15.600
12	0	16.310					0	16.310
13								
14	0	16.714					0	16.714
15								
No.	24835		0		0		24835	
Wt.	32025		0		0		32025	

COD IV 1990 Qu 3 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0	0	0.176					0	0.176
1	2923	0.566					2923	0.566
2	13355	0.956					13355	0.956
3	1293	2.523					1293	2.523
4	513	4.497					513	4.497
5	293	6.758					293	6.758
6	36	8.053					36	8.053
7	38	10.542					38	10.542
8	4	11.979					4	11.979
9	2	13.645					2	13.645
10	0	18.353					0	18.353
11	0	13.015					0	13.015
12	0	18.156					0	18.156
13								
14								
15								
No.	18458		0		0		18458	
Wt.	22847		0		0		22847	

COD IV 1990 Qu 4 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	7862	0.779					7862	0.779
2	7528	1.419					7528	1.419
3	1915	2.405					1915	2.405
4	627	4.296					627	4.296
5	159	7.323					159	7.323
6	28	9.207					28	9.207
7	41	11.639					41	11.639
8	3	11.515					3	11.515
9	19	12.631					19	12.631
10	0	15.480					0	15.480
11	0	18.613					0	18.613
12								
13								
14								
15								
No.	18183		0		0		18183	
Wt.	26307		0		0		26307	

HADDOCK IV 1990 Qu 1 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1			2608	0.092	94	0.057	2702	0.091
2	5859	0.306	27621	0.215	112	0.308	33591	0.231
3	3824	0.409	2982	0.236	113	0.408	6919	0.334
4	14465	0.471	7201	0.264	430	0.491	22096	0.404
5	1254	0.733	90	0.323	38	0.613	1382	0.703
6	276	0.972	76	0.333	6	0.661	358	0.831
7	449	1.157			18	0.639	467	1.138
8	67	1.357					67	1.357
9	41	2.083					41	2.083
10	30	2.855					30	2.855
11	6	2.440					6	2.440
12	9	2.452					9	2.452
13								
14	3	1.810					3	1.810
15	2	4.776					2	4.776
No.	26285		40577		811		67673	
Wt.	12244		8839		336		21419	

HADDOCK IV 1990 Qu 2 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0			302	0.028	1734	0.005	2036	0.008
1	25	0.290	8451	0.122	4215	0.105	12691	0.117
2	10979	0.324	18791	0.221	1113	0.225	30882	0.258
3	4292	0.448	677	0.276	150	0.546	5119	0.428
4	14347	0.485	2301	0.256	646	0.652	17295	0.461
5	806	0.819	147	0.269	114	0.884	1066	0.750
6	185	1.077			12	0.878	197	1.065
7	289	1.090			36	0.837	326	1.062
8	45	1.581			3	0.954	48	1.543
9	11	1.833					11	1.833
10	3	2.087					3	2.087
11	0	2.732					0	2.732
12	1	1.607					1	1.607
13	0	2.636					0	2.636
14	0	2.271					0	2.271
15	0	4.549					0	4.549
No.	30983		30670		8023		69676	
Wt.	13910		6005		1349		21264	

HADDOCK IV 1990 Qu 3 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0			12221	0.027	553	0.005	12774	0.026
1	1319	0.306	42609	0.204	1343	0.105	45271	0.204
2	14226	0.397	8467	0.287	354	0.225	23047	0.354
3	3114	0.555	177	0.356	48	0.546	3339	0.545
4	9831	0.571	461	0.314	205	0.652	10498	0.561
5	735	0.858			36	0.884	771	0.859
6	156	1.075			4	0.878	159	1.070
7	325	1.192			12	0.837	337	1.180
8	47	1.591			1	0.954	48	1.575
9	7	1.851					7	1.851
10	5	1.820					5	1.820
11	1	2.287					1	2.287
12	0	0.000					0	0.000
13	0	0.000					0	0.000
14								
15								
No.	29765		63936		2557		96257	
Wt.	14769		11642		430		26841	

HADDOCK IV 1990 Qu 4 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0			40618	0.053	487	0.005	41105	0.052
1	3020	0.308	14483	0.237	1184	0.105	18686	0.240
2	10272	0.450	1080	0.274	312	0.225	11664	0.428
3	1479	0.619	82	0.280	42	0.546	1603	0.600
4	5301	0.615	99	0.317	181	0.652	5580	0.611
5	320	0.898			32	0.884	352	0.896
6	111	1.092			3	0.878	114	1.086
7	138	1.519			10	0.837	148	1.472
8	26	1.938			1	0.954	27	1.885
9	14	2.135					14	2.135
10	0	2.316					0	2.316
11	1	1.762					1	1.762
12	0	4.219					0	4.219
13	0	6.105					0	6.105
14								
15	0	4.296					0	4.296
No.	20681		56362		2254		79296	
Wt.	10465		5915		379		16759	

WHITING IV 1990 Qu 1 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	139	0.156	5684	0.048	3825	0.041	9648	0.047
2	5534	0.197	79581	0.118	6882	0.119	91997	0.123
3	9755	0.246	13425	0.184	2077	0.200	25256	0.209
4	15610	0.285	12248	0.179	1536	0.252	29394	0.239
5	6300	0.337	9285	0.192	344	0.305	15928	0.252
6	384	0.505	168	0.251	60	0.381	612	0.423
7	195	0.505	83	0.302	15	0.248	293	0.435
8	47	0.648					47	0.648
9	0	0.468					0	0.468
10								
11								
12								
13								
14								
15								
No.	37964		120474		14738		173176	
Wt.	10417		16193		1912		28522	

WHITING IV 1990 Qu 2 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0			9	0.019			9	0.019
1	282	0.172	23740	0.054	17754	0.047	41775	0.052
2	5746	0.200	84958	0.106	28317	0.116	119022	0.113
3	7744	0.238	9911	0.169	7644	0.193	25299	0.197
4	8858	0.267	6466	0.187	5105	0.242	20429	0.236
5	3291	0.300	1071	0.212	1020	0.308	5382	0.284
6	206	0.459	14	0.196	139	0.420	359	0.433
7	110	0.400			9	0.476	120	0.406
8	6	0.535			2	0.458	8	0.518
9	9	0.200					9	0.200
10								
11								
12								
13								
14								
15								
No.	26251		126170		59990		212411	
Wt.	6554		13408		7213		27174	

WHITING IV 1990 Qu 3 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0			25642	0.011	105964	0.006	131606	0.007
1	639	0.205	14287	0.116	110647	0.077	125572	0.082
2	11780	0.214	34863	0.175	129119	0.124	175762	0.140
3	10141	0.254	4502	0.200	30847	0.177	45491	0.197
4	11077	0.292	2056	0.200	4087	0.143	17220	0.246
5	3739	0.339	271	0.265	838	0.246	4849	0.319
6	443	0.398			110	0.278	553	0.374
7	152	0.460					152	0.460
8	28	0.641					28	0.641
9	5	0.330					5	0.330
10								
11								
12								
13								
14								
15								
No.	38005		81621		381612		501238	
Wt.	10008		9430		31458		50896	

WHITING IV 1990 Qu 4 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0			122767	0.027	33565	0.006	156332	0.022
1	1097	0.179	33968	0.125	34914	0.077	69979	0.102
2	26784	0.227	33349	0.177	41447	0.124	101581	0.169
3	13224	0.282	3679	0.201	9983	0.177	26887	0.232
4	11900	0.303	1472	0.216	1297	0.144	14669	0.280
5	4078	0.338	854	0.202	265	0.247	5197	0.311
6	314	0.415	64	0.258	30	0.278	408	0.380
7	73	0.813					73	0.813
8	5	0.745					5	0.745
9	2	0.684					2	0.684
10								
11								
12								
13								
14								
15								
No.	57478		196154		121501		375133	
Wt.	15224		14719		10057		40000	

SAITHE IV 1990 Qu 1 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	206	0.201					206	0.201
2	549	0.334					549	0.334
3	4840	0.856			128	0.713	4967	0.853
4	2614	1.101			143	0.895	2757	1.090
5	3156	1.447			82	0.953	3238	1.434
6	1696	2.062			2	1.063	1698	2.061
7	900	3.135					900	3.135
8	124	4.749					124	4.749
9	56	5.838					56	5.838
10	39	6.715					39	6.715
11	18	7.827					18	7.827
12	10	9.147					10	9.147
13	3	8.654					3	8.654
14	3	9.735					3	9.735
15	6	10.216					6	10.216
No.	14220		0		354		14575	
Wt.	20964		0		299		21263	

SAITHE IV 1990 Qu 2 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	61	0.200					61	0.200
2	693	0.593			32	0.230	725	0.577
3	6066	0.840			1628	0.424	7694	0.752
4	4478	1.174			141	0.518	4619	1.154
5	3114	1.503			20	0.666	3134	1.498
6	1212	2.172			1	1.063	1213	2.171
7	659	3.134					659	3.134
8	174	4.326					174	4.326
9	41	5.982					41	5.982
10	15	6.722					15	6.722
11	7	7.872					7	7.872
12	6	7.976					6	7.976
13	2	6.909					2	6.909
14	3	9.447					3	9.447
15	1	9.387					1	9.387
No.	16531		0		1822		18353	
Wt.	26574		0		785		27359	

SAITHE IV 1990 Qu 3 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	9	0.252					9	0.252
2	960	0.751			27	0.230	987	0.737
3	8673	0.871			1291	0.421	9964	0.813
4	3828	1.286			189	0.500	4018	1.249
5	1829	1.578			23	0.635	1852	1.566
6	529	2.207			1	1.063	530	2.205
7	286	3.117					286	3.117
8	85	4.500					85	4.500
9	25	6.649					25	6.649
10	3	6.743					3	6.743
11	3	8.342					3	8.342
12	6	8.499					6	8.499
13	3	9.576					3	9.576
14	0	8.677					0	8.677
15	2	10.115					2	10.115
No.	16242		0		1531		17773	
Wt.	24515		0		660		25175	

SAITHE IV 1990 Qu 4 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
0								
1	16	0.471					16	0.471
2	1102	0.656			22	0.230	1124	0.648
3	7035	0.801			814	0.409	7849	0.760
4	1913	1.232			408	0.469	2320	1.098
5	919	1.858			38	0.597	957	1.808
6	312	2.671			1	1.063	313	2.666
7	268	3.600					268	3.600
8	109	5.097					109	5.097
9	25	6.266					25	6.266
10	11	6.975					11	6.975
11	17	8.658					17	8.658
12	4	7.847					4	7.847
13	12	8.921					12	8.921
14	0	8.739					0	8.739
15	12	13.567					12	13.567
No.	11755		0		1283		13037	
Wt.	13903		0		553		14456	