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SECTION I

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

Copenhagen, 7-15 October 1993

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Part A

1 INTRODUCTION

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1.2 Terms of Reference

a) assess the status of and provide catch options for 1994 for the stocks of cod, haddock, whiting, saithe, sole and plaice in Sub-area IV, Division IIIa (excluding sole in Division IIIa and cod in the Kattegat), and Division VIId (excluding haddock and saithe), taking into account as far as possible the technical interactions among stocks due to the mixed-species fisheries.

b) provide data requested by the Multispecies Assessment Working Group.

1.3 Report Structure

Over the course of time the amount of detailed output from analytical assessments has multiplied considerably and is reaching unmanageable proportions. In an effort to simplify access to the most important information contained in the assessments, the report has been divided into two parts. Part A contains as much of the essential information on the conventional assessments as possible in as standard a format as could be achieved. Part B contains more information on the assessments in a free format to allow commentary on the analysis which helps to explain the background of what was done. This format has not been entirely successful and in the future it is intended to include much more of the bulky diagnostic output and peripheral input data in Part B. The Working Group would welcome any comments from ACFM on the report layout which would assist them in simplifying access to essential information while retaining as much information as possible.

Data requested by the Multispecies Assessment Working Group are not provided in the report and will be transmitted to the Working Group separately.

1.4 Methods

1.4.1 Catch at age analysis

Recent developments in the analysis of catch at age and CPUE data have meant that *ad hoc* methods are now in decline. It was decided this year to use XSA (Shepherd, unpublished) as implemented by a new version of the Lowestoft VPA program (Darby and Flatman, 1992) made available at the meeting. The theoretical advantages of this type of analysis are well known and there is no need here to reiterate them. Since the method differs from the *ad hoc* tuning used for most stocks last year, last year's method was repeated for each stock to check that the revised assessment was not due to the change of method. In general there was very little difference between the two methods.

In running XSA there are a number of ways of configuring the analysis. These include, for example, specifying the age range for fixed catchability etc. The procedure for the choice of configuring the run was the same as that described in detail in the report of the Working Group on the Assessment of the Northern Shelf Demersal Stocks (Anon., 1993b).

While recognising the valuable contribution which the maintenance of the program makes, the Working Group would welcome more detailed documentation of the program so that many of its features may be better appreciated and understood.

1.4.2 Sensitivity analysis

From time to time the Working Group has performed a sensitivity analysis on the catch forecasts for some stocks. This year the method has been applied systematically to the North Sea stocks to show sensitivity coefficients for the catch and SSB forecast. In addition, the method has been used to generate probability profiles for the forecast. The method used is the linear method described in Cook (1993). Implementing the method requires estimates of the coefficients of variation (CVs) for the input parameters to the forecast. For the starting populations in 1993, the CVs of these values generated by XSA or from RCT3 were used. For fishing mortality, the CVs have been taken either from a separable VPA (for North Sea cod) or simply by calculating the CV of the estimated Fs over a range of years (for other stocks). The latter method does not estimate quite the correct CV since it will include both measurement error and process error. It will tend to over-estimate the CV. Provided the year on year level of F over short periods is stable, however, the estimate should be adequate for the purpose.

Sensitivity coefficients are presented in the form of pie charts for the TAC year which show the proportion of the variance in the forecast quantity (eg catch) which is due to each input parameter. These charts show immediately which input values cause the most problems.

An important point to note in the analysis is the modelling of natural mortality. The analysis tries to examine the effect of natural variability in M, ie the process error. It, therefore, considers variability which might be due, for example, to changes in the predator population during the forecast period. For some stocks where M is large on young age groups, there is important sensitivity to M. CVs for M were set at 0.1 for both the year and age effect. This value was obtained by examining variability in predation mortality estimated in MSVPA.The analysis does not consider the problem of uncertainty in the estimate of M used in the assessment. The latter is not likely to be a major problem in forecasts because uncertainty in M in the assessment is compensated for when the forecast is performed with the same value of M.

The probability profiles presented assume that the distribution of the catch and SSB estimates are lognormal. This may not be the case but tests on North Sea cod reported in Cook (1993) suggest that, for a variety of input parameter distributions, the output variable tends to have a distribution of approximately this type. Comparative runs performed at the Methods Working Group in 1993 for North Sea cod also suggested that this method gave very similar results to full Monte-Carlo simulations of the whole assessment-projection process. Thus, while better methods may well evolve in the near future, the present method appears to perform as well as any other.

1.4.3 Medium-term projections

Following work done at the Methods Working Group in 1993 it was recommended that assessment working groups should include medium-term analyses (Anon., 1993a). A first attempt has been made to do this for the North Sea stocks. The simulation includes only variability in recruitment and the initial population estimates (in 1993). This is rather limited but most variability beyond two years is due to recruitment so simulations are probably adequate as a first attempt.

Appropriate modelling of recruitment is crucial to this type of analysis. Fitting conventional stock-recruitment curves usually fails to produce an adequate model. Much more work needs to be done on this problem. For the present meeting two models were tried. The first was the non-parametric kernel method described by Evans and Rice (1988) and Skagen (1991). The Cauchy algorithm was used and the weighting parameter estimated by cross validation.

The second model, referred to as the parametric model, fitted a Shepherd-type stock recruit model with a time series effect ie:

$$R=\frac{aS}{1+(\frac{S}{b})^c}\exp(d\epsilon_{t-1})$$

(Cook and Forbes, 1993) where R=recruits,S=spawning stock biomass and a,b,c,d are parameters. The time-lagged error, ϵ , allows for autocorrelation between successive recruitment values. This model was used for some stocks for comparison with the kernel method. In simulations, recruitment was estimated from the model and a bootstrapped error after fitting the model was added to simulate variability.

An important problem with the simulations occurs when the simulated populations give SSBs which are outside the range of observations. This inevitably means that the estimated population trajectory must be viewed with appropriate scepticism.

The results of the simulations show the stock-recruitment data with the locus of expected recruitment indicated. For a ten-year horizon, the mean and upper and lower 5 percentiles are plotted for yield, SSB and recruitment.

1.4.4 Data

All assessments depend on data of good quality. The data available at the meeting this year showed some improvements and some deterioration.

The problem of misreporting continues to grow, particularly in the roundfish fisheries which have recently been the subject of restrictive TACs. The problem of misreporting of North Sea haddock, mentioned in last year's report, has worsened substantially (see Section 6) and severely impairs the assessment. Although the total catch for North Sea cod used by the Working Group is the same as the official landings, it is known that misreporting has occurred (Section 6.2). The effect on the assessment is unknown. Problems of misreporting also affect sole and plaice in the North Sea. Misreporting will affect effort data used in tuning.

In Division IIIa existing age composition data have been revised for cod and plaice. This has improved the fleet data for tuning. There are still problems with the plaice data, however. Another difficulty with Division IIIa is the inadequate data on the industrial by-catch especially in earlier years. This has ruled out an assessment for the haddock in this area although more data are now being assembled which should be suitable for analysis in the future.

In Division VIId, data for both cod and whiting have been revised. Unfortunately, this does not appear to have improved the assessment sufficiently to provide a basis for advice. Even if the age composition problems could be resolved, conventional short-term forecasting would not be useful since there is no adequate recruitment index.

For nearly all stocks there are inadequate data for discards. A number of countries have undertaken *ad hoc* discard studies but the data cannot be incorporated into assesssment databases until some pre-processing of the data has been performed to estimate discards for a range of years. It would be desirable to hold a workshop to assemble the discard data which might be used in assessments and investigate appropriate ways of using them.

The increasing problems with data from the commercial fishery combined with the need to reallocate resources to cover, for instance, discard sampling implies an increased emphasis on survey information.

The increased dependence on survey information is highlighted in the present report by the loss of tuning fleets for one stock due to problems with data from commercial fleets, and the VPA tuning for this stock is now heavily dependent on survey data.

The strain on resources used for data collection could be partly alleviated by a better utilization of available data. Age-length keys are presently obtained both from commercial samples and from surveys. This situation represents an oversampling relative to other types of data which are heavily undersampled - the most important example being discards. Age-length keys by quarter and area, based on international surveys, could be applied on length frequency information from commercial samples, thus reducing the cost of commercial sampling considerably. International cooperation on the establishment on such survey-based age-length keys could be extended to include quality control and would make the application of age-length keys consistent between countries.

1.4.5 Quality control

Prior to the meeting nearly all the basic data had been prepared and checked and preliminary VPAs had been run. This meant that is was possible to embark on the main assessments immediately. A difficulty, however, is that the large number of stocks requiring full analytical assessment precludes the possibility of full plenary sessions to discuss each assessment in detail during its preparation. This really is a necessary step in quality control of the assessment. Some cross checking was done in small groups but there is little escape from the conclusion that overall quality control during the meeting was inadequate. Solving this problem within the existing organisational structure will require that more or less completed assessments will have to be done before the meeting. This will only succeed if basic data are prepared even earlier than at present and if analytical procedures are agreed months before the meeting. This will be a difficult task but attempts will be made to do this in advance of next year's meeting.

A good deal of time at the meeting was spent preparing tables and figures of high enough quality for the draft report to be ready for ACFM in time for their meeting. It should be possible to reduce the time spent on essentially clerical activities if authors of programs wrote these to produce output ready for plotting etc. It would also help if the ICES Secretariat automated the production of quality control tables and ACFM summaries.

2 COD IN THE SKAGERRAK AND HADDOCK, WHITING AND PLAICE IN DIVISION IIIA

2.1 Overview

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

The reported landings of cod increased in 1992, but the TAC was not reached. Haddock landings for human consumption, 4,746 t, were about 700 t above the 1991 reported landings and just above the TAC of 4,600 t. The total landings, i.e. including those for reduction, were 9,000 t. Of the whiting TAC of 17,000 t, only 1,565 tonnes were landed for human consumption. The by-catches in the Danish industrial fisheries added more than 10,000 t to this figure. The total reported catch is somewhat below the average for the previous ten years. The plaice TAC of 11,300 t was exceeded by about 500 t. About 80 % of the plaice catch was reported from the Skagerrak.

The databases for the assessments are generally poor. The major deficiencies are insufficient age sampling or lack of age compositions from fisheries for industrial purposes and some other minor fleets, lack of discard data, lack of effort data with associated catches by age and lack of recruitment indices with a convincing relationship to VPA-derived recruitment estimates. Also, misreporting and non-reporting of catches occurred particularly in cod. Estimates of the amount of cod not reported vary considerably. According to some sources these landings are comparable to the total reported fishery while other sources guess at much more limited amounts. It has not been possible to document any of these guesses.

Indices from the International Bottom Trawl Surveys (IBTS) in April, September and November exist, but are not yet useful in the assessments because the time-series cover only the period 1991 - 1993.

For cod and plaice there is, however, significant improvement in the database since the last assessment, and data have now become available which permit analytical assessments. Analytical assessments were only attempted for cod and plaice.

The analytical assessment for cod in the Skagerrak provided reasonable results in spite of the considerable variance in the estimates.

For haddock, only survey data for the IBTS (February) are available for tuning. The haddock has not been aged in all years. Furthermore, the IBTS data are most reliable for the younger age groups, i.e. age group 1. Commercial catch data for this age group are not reliable, however, not reliable as the age compositions only cover the human consumption fisheries, while the predominant part of the fishing mortality on age group 1 haddock is exerted by the industrial fleets.

Assessments of whiting cannot be made due to lack of basic age information.

For plaice available data allow a formal analytical assessment. However, the data series are not internally consistent and the estimated fishing mortalities, and hence stock sizes, vary depending on which set of data is considered the more reliable. This is analysed in detail in Section 2.5. The conclusion is that no reliable analytical assessment can be presented.

The general trend of the stocks in Division IIIa is an increase in abundance. For all four stocks several average or above-average yearclasses seem to be present.

2.2 Cod in the Skagerrak (part of Division IIIa)

2.2.1 Catch trends

Annual landings in the period 1971 to 1992 by country are presented in Table 2.2.1. Norwegian catches taken in the fjord areas are not included in the assessment as these cod are considered to belong to a separate stock (Anon., 1991).

Total catches in 1992 amounted to 14,002 t compared to 12,059 t in 1991. Almost all of the catch was taken by Denmark and Sweden (80% and 17% of the total). The annual yield since 1978 is shown in Figure 2.2.1a.

The estimated cod landings from the Danish small-mesh trawl fishery from 1979 to 1992 are shown in Table 2.2.2. Catches from this fishery have not been included in the analysis as catch at age data for this fishery were not available.

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

Catch at age information was only available from Denmark and the Danish age distribution was hence raised to the total catch (Table 2.2.3). The Danish weight-at-age data (Table 2.2.4) are applied to the total catch. Weight at age in the stock is assumed to be identical to weight at age in the catches.

Natural mortality is assumed to be 0.2 per year for all ages and years. Age groups 3+ constitute the spawning stock biomass; age groups 2 and younger were considered to be immature. It should be noted that this maturity ogive is significantly different from that used for North Sea cod (see Section 3.2.2).

2.2.3 Catch, effort and research vessel data

CPUE data are available from two Swedish fleets accounting for 50-80% of the total Swedish cod landings (Table 2.2.5). From Denmark, CPUE data are available for three fleets. The fleet definitions as well as the way of deriving age-disaggregated CPUE values are given in Section B. These fleets account for about 10% of the annual Danish catches. As no age information was available from the Swedish fisheries only the Danish CPUE data were used in the tunings. Catch/effort by fleet is shown in Table 2.2.6 while Table 2.2.7 shows CPUE disaggregated by age for these Danish fleets.

The IBTS survey provides abundance indices for age groups 1 and 2. Only the February time series (former IYFS survey) covering the years 1981 to 1993 are of sufficient length to be useful for tuning (Table 2.2.8).

2.2.4 Catch-at-age analysis

Tuning of the VPA was carried out by the XSA method using the three Danish CPUE series (1987-1992) and the IBTS (February) data (1981-1992). Tri-cubic tapering over 20 years and standard shrinkage was used (Table 2.2.9). Plots of the log catchability residuals are presented in Figure 2.2.2. As the age disaggregation of CPUE data have been approximated using market size categories the residuals have been plotted by age groups. A clear dominance of negative residuals is observed for 1987.

Estimated fishing mortality and stock size in numbers as produced by the VPA based on the XSA analysis are presented in Tables 2.2.10 and 2.2.11.

Results from retrospective XSA analysis are presented in figure 2.2.3. The XSA_{92} run estimates the F(3-6) for 1991 at about 0.1 higher than the XSA_{91} while for 1990 little difference is seen in average F values between the three retrospective runs. Larger differences are seen in the retrospective analyses of year-class size. This is to be expected due to the high standard errors on the catchabilities of age 1 cod.

Figure 2.2.4 compares F(3-6) estimated in the assessment presented in Anon (1992) and that in the present assessment. The 1992 assessment was based on a Laurec/Shepherd analysis using different tuning fleets. Figure 2.2.4 shows that the assessments in 1992 and 1993 do not differ significantly.

2.2.5 Recruitment

The 1991 year class index of 96 obtained on the 1992 IBTS survey was the highest since the start of the survey series in 1981 and about three times the average. This year-class also produced the largest CPUE in the Danish fleets used for tuning (1987 to 1992 data). However, the index value of the 1991 year class as age 2 in the 1993 IBTS February survey was below average. The 1992 year-class index was 110 as age 1 cod in the 1993 IBTS survey. This is the highest index value on record.

The IBTS indices were compared to VPA year class strength by the RCT3 computer program (Table 2.2.12). The estimates were shrunk towards the mean. By this procedure, the 1991 and 1992 year classes were estimated to 16.3 million and 20.0 million age 1 respectively. The geometric mean of age 1 abundance (VPA, 1978-1990) amounts to 17.3 million cod.

2.2.6 Long-term trends

The long-term trends in the fisheries are given in Table 2.2.13 and shown in Figure 2.2.1.

Yield and SSB peaked in 1981-1982, caused by the strong year class of 1979. Since then catches and stock size have declined. Recruitment has fluctuated without trend. Except for two strong year classes, 1979 and 1985, where recruitment exceeded 30 million individuals, annual recruitment has varied between 10 and 20 million.

2.2.7 Biological reference points

Input data to yield per recruit calculations are given in Table 2.2.14 and the results in Table 2.2.15. Yield and SSB per recruit are shown in Figure 2.2.5. Figure 2.2.6 shows the stock recruitment relationship. This graph shows no apparent relationship between SSB and recruitment and it is difficult to establish a minimum biologically acceptable level (MBAL) on this basis. However, the estimate of SSB may be unreliable due to uncertainties about the appropriate maturity ogive (see Section 2.2.2)

The present fishing mortality (F(3-6) of 0.75 is well above the calculated F_{max} of 0.24 and also above the F_{med} of 0.66.

2.2.8 Catch forecast

Input for the predictions are given in Table 2.2.16. The exploitation pattern is taken as the average Fs from 1990-1992, adjusted to the reference F level of 1992. Weights at age are taken as the average of the 1988-1992 period. Stock sizes for age groups 1 to 3 in 1993 are derived from the RCT3 (Table 2.2.12) whereas the stock size of the older age groups was taken from the VPA (Table 2.2.11). The RCT3 estimate of age 3 cod was used due to its lower standard error (the two estimates are, however, not very different: VPA at 4.3 million - RCT3 at 3.8 million). Recruitment of age 1 cod in 1994 to 1995 is taken as 17.3 million calculated as the geometric mean of recruitment derived from the VPA results for the period 1978-1990.

The results of the predictions are given in Table 2.2.17. The *status quo* catch is estimated to 18,756 t in 1994, up from 15,324 t expected in 1993. The SSB, at *status quo* F is predicted to 19,625 t in 1994 and 24,230 t in 1995.

2.2.9 Long-term management considerations

The assessment indicates that the stock has fluctuated without significant trend in either biomass 3+ (proxy to SSB), recruitment, fishing mortality or yield. However, the fishing mortality is currently at a high level.

2.2.10 Comments on the assessment

The assessment is based on incomplete data in so far as data on the small mesh catches and discards are not included. Also misreporting and non-reporting of catches occurred, but estimates of the amount of cod not reported vary considerably. According to some sources these landings are comparable to the total reported fishery while other sources guess at much more limited amounts. It has not been possible to document any of these guesses.

The assessment quality control diagrams are shown in Table 2.2.18.

The high level of fishing mortality makes the forecast very dependent on the estimates of recruitment. At *status quo* $F(F_{1993})$ the recruiting year classes (1992 and 1993) will in 1994 account for 82% in numbers and 60% of stock weight. The assessment provides information on the level of exploitation while the estimate of stock abundance is of little relevance in forecasting future yields.

2.3 Haddock

2.3.1 Catch trends

The landings for the period 1975-1992 are presented in Table 2.3.1. After 1983 landings are given separately for human consumption and reduction purposes. About 43% of haddock catches in 1992 came from landings for reduction. Figure 2.3.1 shows trends in landings.

2.3.2 Age composition and weight at age

Age compositions (and weight at age) are available for Danish landings; for human consumption landings for the period 1981-91 and for small-mesh landings from the periods 1981-1986 and 1991-1992. The age compositions are presented in Table 2.3.2.

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

2.3.3 Research Vessel indices and catch per unit of effort

An index for 1-group haddock in Division IIIa is available from the IBTS February survey (Figure 2.3.2).

CPUE data for the commercial fisheries are not available.

2.3.4 Long-term trends

Long-term trends in landings and the 1-group index from the IBTS in February are presented in Figures 2.3.1 and 2.3.2. Total landings reached a maximum of more than 15,000 t in 1983 which was associated with the large 1979 year class. In the last decade the catches have been about half this level. In 1992 the catches increased to 9,000 t due to higher catches of 1-group and also 2-group. The IBTS index for 1-group was in 1992 the highest in the series, and the 1993 index was even higher. The 1991 and 1992 year classes may thus be strong. In 1992 O-group haddock were abundant in Danish industrial landings.

2.3.5 Comments on assessment

No analytical assessment was made due to deficiencies in primary data: fish sampled from the small-mesh landings were not aged for the period 1987-1990; therefore, the catches in numbers of 1-group haddock are not reliable. The IBTS survey series, which may be used for tuning the VPA, mainly provide reliable estimates of juveniles.

CPUE data for the commercial fisheries are not available.

The Division IIIa haddock was not combined with the North Sea haddock. Anon. (1992) found that the recruitment pattern for Division IIIa and North Sea haddock are similar. Also other vital parameters appear to be similar between these two populations. However, no analysis was presented which could help in the discussion of whether Division IIIa haddock should be assessed as a separate unit or included in the North Sea assessment. The Working Group did, therefore, not change the status of Division IIIa haddock at this meeting.

2.4 Whiting

The landings have since 1981 been reported separately for human consumption and reduction purposes. The Danish landings for reduction purposes have been taken in a mixed clupeoid fishery and in an industrial fishery directed at Norway pout and sandeel. In 1992 an estimated 480 million 0-group whiting were included in the landings for industrial purposes. The total landings are shown in Table 2.4.1 and Figure 2.4.1.

IBTS February indices for 1-group whiting have been very high in recent years (Figure 2.4.2), but this is not reflected in the landings.

An analytical assessment of the stock was not possible on the basis of this database.

2.5 Plaice

2.5.1 Catch trends

Total international landings are presented in Table 2.5.1. The landings data are very uncertain for the period 1983-1988. Anon. (1991) adjusted the catch data assuming that misreporting was a serious source of bias. The major part of the Kattegat landings since 1984 are from the northern part of the Kattegat. The total 1992 catch was 11,796 t. Long-term trends in yield are plotted in Figure 2.5.5.

Division IIIa fisheries are affected by TAC constraints for cod and sole and there are some unreported catches of these species. There seems to be no strong incentive to under-report plaice landings, but unreported plaice catches may result from illegal activities aimed at landing other species. Also misreporting between areas or misreporting of other species as plaice may invalidate the data base. It is, however, not considered that such unreported catches are seriously affecting the quality of the Division IIIa plaice database.

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

The natural mortality was assumed to be 0.1 per year for all age groups. For calculation of the spawning stock biomass age groups 2 and younger are considered to be immature, while all plaice of ages 3 and older are assumed to contribute to the mature stock component. For North Sea plaice half of the plaice population of age groups 2 and 3 are assumed to be mature. This difference should be discussed in the light of data to be made available at the next Working Group meeting.

Catch at age for 1992 was supplied by Denmark accounting for 90% of the total. These data were raised to the total international catch (Table 2.5.2). Mean weights at age for the catches are available for the Danish landings from the Skagerrak and Kattegat separately. The weights at age applied for the combined stock have been calculated as a mean of weights at age in the Kattegat and Skagerrak, weighted by landings (Table 2.5.3).

The catch data are apparently not consistent with the assumption of a stable exploitation pattern. Age group 5 is the first age group which is fully recruited and, on the assumption that mortality remains fairly stable, ln[Catch-5(year)/Catch-6(year+1)] should be reasonably constant, but as shown in the text table below:

Year	ln[Catch-5(year)/Catch-6(year+1)]
78/79	1.2
79/80	1.2
80/81	1.1
81/82	0.64 *
82/83	1.4
83/84	1.4
84/85	1.0
85/86	0.3 *
86/87	0.6 *
87/88	1.0
88/89	1.6
89/90	0.7 *
90/91	1.2
91/92	0.03 *

The ratio is not constant over years. The years marked with an asterisk (81/82, 85/86, 86/87, 89/90 and 91/92) seem out of line with the rest of the series. Either the mortality generated by the fishery is highly variable - making reliable predictions based on procedures used at present impossible - or the sampling data do not reflect the true age composition of the catch.

2.5.3 Effort, CPUE, and research vessel indices

2.5.3.1 Catch/effort data for the commercial fisheries

The Swedish C/E series were updated (Table 2.5.4a). The data are shown for the Skagerrak and Kattegat separately in Figure 2.5.1. This figure shows different trends in CPUE between the Kattegat and Skagerrak plaice fisheries. At present the fishery is dominated by the catches in the Skagerrak.

Log-book information for the Danish fisheries was analyzed as described in Part B. CPUE data (no/age group/day at sea) for three fleets are presented in Table 2.5.4b.

2.5.3.2 Research vessel data

The data series previously used in the plaice assessment, from a bottom trawl survey by R/V DANA in May, (Anon., 1992) did not correlate well with stock size derived from VPA. The survey has now been abandoned. There are thus no research vessel data available which are considered to reflect stock trends in Division IIIa plaice.

2.5.4 Catch-at-age analysis

As indicated in Section 2.5.2, the catch at age data show considerable variability. Separable VPA conducted on the catch at age data also indicates this high variability and possibly the lack of an exploitation pattern which is fairly constant over the present time series (1983-1992). The variability is clearly demonstrated by the large log-ratio residuals as seen in Figure 2.5.2.

The catch-at-age analysis presented in Anon. (1992) was based on a Laurec-Shepherd analysis of total international catch tuned with Swedish effort data. However, these effort data were obtained from CPUE data (kg/trawl hr) from Swedish logbook information. The ALKs applied to this information were the total international catch age composition, i.e. aggregated information from the Danish fisheries. These fisheries, however, are carried out by trawl, Danish seine and gillnet and the relevant ALKs are rather different between these vessel categories. This tuning procedure was abandoned.

Three Danish commercial catch rate series were constructed (see Part B) covering the period 1987-1992. An XSA analysis (no shrinkage, equal weighting between fleets, all age groups to have catchability as free parameters and no time tapering) based on these data together with the catch data was run and the results are presented in Table 2.5.5. The residuals are plotted for each fleet in Figure 2.5.3.

Tables 2.5.6-8 give fishing mortality, stock sizes and a summary of the VPA calculations based on results from this XSA run. The recruitment series (2-group) is compared with the corresponding recruitment series from Anon. (1992) in Figure 2.5.4a. The XSA analysis based on the new tuning fleets presents a major revision to the previous assessment particularly with respect to the 1988 and 1989 year classes. To confirm that this difference was the result of the change in the data used for tuning Laurec-Shepherd tuning was also applied to these data and the estimated average fishing mortalities over the age range 5 to 8 are compared in Figure 2.5.4b. This figure also shows the corresponding fishing mortality calculated in Anon. (1992). The conclusion appears to be that the change in methods is of minor importance compared to the change in the database.

The quality control diagrams for spawning stock biomass and recruitment demonstrate a very variable assessment over the years (Table 2.5.9). SSB and recruitment for assessment years prior to 1992 were obtained by summing results from the two separate assessments for the Kattegat and Skagerrak plaice.

Table 2.5.5 also gives the slopes (ln CPUE vs. ln stock numbers (VPA)) obtained from the XSA analysis. From this analysis age group 4 data appear to fit the model rather badly, particularly for Danish trawl and Danish seine CPUE. Removing these two fleets, i.e. running XSA analysis using only the commercial gill net fleet for tuning, provided a completely different level of fishing mortality from that obtained by the combined assessment. The stock sizes also change accordingly. The slope for, particularly, age group 4 is now more reasonable (1.6 with standard error 0.52). Checking this result by tuning XSA with trawl and Danish seine data confirmed that these data imply a total mortality of approximately twice that implied by the gillnet data. In this two-fleet analysis, the slope estimated for age group 4 (17.40 standard error 5.17) is very far from what could be desired (slope = 0).

A catch curve analysis on the CPUE data indicates a Z of approximately 0.7 per year using the gill net data and 1.2 - 1.3 per year using the trawl and Danish seine data.

It is concluded that the data series are not internally consistent and that the analytical assessment cannot be used for prediction purposes.

2.5.5 Recruitment estimates

No research vessel index is available.

2.5.6 Historical stock trends

Figure 2.5.5 shows rather fluctuating recruitment and SSB. The present trend in the stock is an increasing SSB and possibly increasing recruitment.

2.5.7 Biological reference points

The stock recruitment scatter diagram presented in Figure 2.5.6 does not indicate any lower limit below which a significant stock-recruitment relationship seems to be in effect. A minimum biologically acceptable level of SSB is, therefore, not possible to estimate for this stock. However, the assessment is dominated by the Skagerrak stock component and a possible stock recruitment relationship is most likely to be seen in the Kattegat component. For this southern stock component a rather low level of recruitment has been experienced over a longer time period.

F_{med} can be estimated from the stock-recruitment diagram, but is found to be very sensitive to the inclusion of the most recent data points. F_{med} is, therefore, not considered to provide any guidance on appropriate exploitation levels. F_{max} is well below the estimated level of fishing mortality. However, as discussed above in Section 2.5.4 (Catch-at-age analysis), the CPUE and catch data are open to different interpretations and prudence in interpretation of these biological reference points is warranted.

2.5.8 Short-term forecasts

A formal catch projection is not presented. The fishery up to the end of September 1993 does not indicate any major change in yield compared to 1992.

2.5.9 Medium-term forecasts

Medium-term forecasts for this stock are not considered to be of much value.

2.5.10 Long-term forecast

Yield per recruit analysis indicates that the current F level is much higher than the F_{max} reference point.

2.5.11 Comments on the assessment

The assessment presented is formally analytical, but no clear conclusions can be drawn. The catch data show large variability and the tuning data are in internal conflict. Any conclusion depends critically on which of the data sets are considered to be the more reliable. The Danish seine fleet should be a good guess for an appropriate tuning fleet, but the results particularly for age group 4 indicate that an interpretation of this data series is not simple.

3 NORTH SEA (SUB-AREA IV)

3.1 Overview

Virtual population analyses were carried out for four stocks of roundfish (cod, haddock, whiting, and saithe) and two stocks of flatfish (sole and plaice), all harvested for human consumption purposes in the North Sea.

The data from biological sources for age compositions and research vessel surveys are generally of good quality, but these are undermined by inadequate landings data. Misreporting and underreporting is known to occur to an increasing extent for cod, haddock and sole in several countries, and this affects the quality of the predictions.

Fishing mortalities in the most recent year were substantially higher in roundfish (0.8-1.2) than in flatfish (around 0.5). All stocks are being overexploited in terms of growth overfishing.

The SSB of cod seems to have stabilised at a very low level, and approximately one third of the level of 150,000 t which is considered by ACFM to be the lowest desirable biological level. Only one of the year classes recruited since the strong 1985 year class appears to be around average; the other year classes are all below average. Preliminary information on the 1993 year class indicates that this year class is also below average.

For cod, continued fishing at the current high F levels is likely to result in continued low levels of SSB, which, in conjunction with the recent series of poor recruitment, gives rise to serious concern that the stock is no longer able to replenish itself.

The SSB of haddock declined from 1985 to reach a historical low level in 1991. Since then a slight increase is indicated due to the recruitment of year classes that, since 1990, have been average or above average.

The estimates of the 1989 and 1990 year classes of whiting have been adjusted downwards to a considerable extent. The SSB appears to have stabilised close to the historical minimum level. The major part of the SSB now consists of two poor year classes. In the medium term, however, a slight increase in SSB is expected with the present exploitation pattern.

The SSB of saithe shows a continuous downwards trend and is at a historically low level.

The sole is considered to be within safe biological limits. The SSB is presently well above the minimum level due to the abundant 1987 year class. After a short period of decline the SSB is expected to rise again in 1994 due to the recruitment of the strong 1991 year class.

The plaice stock is declining slightly, but, as the result of a series of average year classes, the SSB is estimated to be at a relatively safe level. Recruitment seems to have been overestimated in recent years. This may explain the observed decline in catches in all fleets. In the medium term SSB is expected to decline to a lower level, close to the minimum desirable level of 300,000 tonnes.

The effort data for commercial fleets, some of which were used in tuning the VPA, are shown in Figure 3.1. In the fleets directed at flatfish, it is apparent that the increase in effort observed throughout the 1980s, has leveled off in the most recent years.

3.2 Cod in Sub-area IV

3.2.1 Catch Trends

Landings data from human consumption fisheries for recent years as officially reported as well as those estimated by the Working Group are given in Table 3.2.1. A longer time series of landings from Working Group estimates is given in Table 3.2.2 and Figure 3.2.1. It is known that there were unreported landings in some countries in 1992, but these cannot be quantified, and the Working Group estimate and those officially reported were identical at 98,000 t. The agreed TAC for 1992 was 100,000 t. The landings in 1991 were 13% higher than in 1990, but they have declined markedly since 1981, when they were at a level of 300,000 t.

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

Values for natural mortality and maturity are given in Table 3.2.3, and are unchanged from those used last year. The sources of these data are multispecies VPA as performed by the Multispecies Assessment Working Group (natural mortality), and the International Young Fish Survey (maturity). The VPA catch input data are given in Table 3.2.4. They do not include discards or industrial fishery by-catches (see Section 6.4.2). Data for 1991 were updated with minor revisions, and data for 1992 were provided by Denmark, England, France, Germany, the Netherlands, and Scotland. Mean weight at age data for landings are given in Table 3.2.5. These values were also used as stock mean weights, and are therefore not biologically meaningful. SOP corrections have been applied to the mean weights at age for all fleets except those for Scotland, where the numbers at age have been corrected instead.

3.2.3 Catch, effort, and research vessel data

The data used to tune the VPA are given in Table 3.2.6. The same fleets were used as in last year's assessment, but the IYFS data were revised to include ages 3 to 6 (denoted as INTGFS2 in the data file) in addition to ages 1 and 2. Data are included for 6 commercial fleets and 5 surveys.

3.2.4 Catch at age analysis

The method used to tune the VPA was XSA (v3.1), and this was a change from last year's assessment when the Laurec-Shepherd method was used (see Section 6.4.1). Tuning was performed over a 20 year period, with shrinkage of 0.5 and a tricubic time taper. Inspection of preliminary runs indicated that there was no evidence of a correlation between catchability and abundance. The recruiting age was therefore set at age 1, and catchability was fixed for ages 6 and above. The age range used for VPA was 1 to 11 (the plus group), and F for the oldest age was set at the mean of the 5 younger ages (5-9).

The tuning results for the XSA method are given in Table 3.2.7, and the fleet residuals are plotted in Figure 3.2.2. Last year ACFM drew attention to apparent trends in catchability in some of the fleets. Some slight trends are still apparent in the current tuning results using XSA, but it is not thought that they have seriously affected the estimates of the surviving populations.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and VPA are given in Tables 3.2.8. and 3.2.9. The results from a retrospective analysis using XSA are shown in Figure 3.2.3. There is good agreement in the last three years but before that period there was a tendency for F values to be underestimated. However, there are no gross discrepancies and it may be concluded that the results show reasonable agreement between successive estimates.

3.2.5 Recruitment estimates

The research vessel indices used in the RCT3 program estimating recruitment are given in Table 3.2.10, the same surveys being used as in last year's assessment. The indices for the English groundfish surveys in 1992 and 1993 have been corrected to take account of the change of gear to the GOV trawl in 1992 (Cotter, 1993). The results of the RCT3 analyses are given in Tables 3.2.11 and 3.2.12. They were used as estimates for ages 1 and 2 in 1993 (year classes 1992 and 1991), and age 1 in 1994 (1993 year class). The RCT3 estimate for age 2 in 1993 (159 millions) was used in preference to that from XSA (138 millions), since it is based on additional survey information in 1993.

The latest estimate for the 1990 year class (149 million at age 1) is close to that estimated last year (155 million), but the estimate for the 1991 year class has increased from 342 million last year to 410 million this year, just above the long-term arithmetic mean. The 1992 year class has also been revised upwards, from a preliminary estimate of 176 million last year to 199 millions this year. The preliminary estimate for the 1993 year class (based on a single survey 0-group index and shrunk to the mean) is 224 million at age 1. The 1994 year class at age 1 was set at 268 million, the VPA mean from the RCT3 program. The estimate has a coefficient of variation of 64%.

3.2.6 Historical stock trends

Historical trends in mean fishing mortality, spawning stock biomass, and recruitment are shown in Table 3.2.13 and Figure 3.2.1. Mean fishing mortality increased over the period 1963 to 1982, but subsequently appears to have stabilised at a value around 0.9. Spawning biomass decreased from a peak of 266,000 t in 1970 to a historical low level of 60,000 t in 1991, and is estimated to have fallen to 58,000 t at the start of 1993. Recruitment has fluctuated considerably over the period but the frequency of good year classes has decreased in recent years. The year classes spawned since 1985 have been below average, with the exception of the 1991 year class, which is near average.

3.2.7 Biological reference points

A stock-recruitment scatter plot is shown in Figure 3.2.4, which also shows F_{med} (0.72) and $F_{status\ quo}$ (0.86) replacement lines. For *status quo* F, stock replacement in the long term will occur only at atypical levels of recruitment. The minimum spawning stock level advised by ACFM is 150,000 t, which is the lowest level of SSB from which the stock has been seen to recover. A yield per recruit and spawning stock biomass per recruit plot is shown in Figure 3.2.5, and it can be seen that the current F is well above F_{max}.

3.2.8 Catch predictions

The input data for catch prediction are given in Table 3.2.14, and the results are given in Tables 3.2.15 and 3.2.16, and Figure 3.2.5.

The predicted *status quo* landings for 1993 (Table 3.2.15) are 142,000 t, which compares with a value of 118,000 t predicted in last year's ACFM assessment. Spawning biomass is predicted to be 62,000 t by the end of the year. The same level of F in 1994 would result in a catch of 131,000 t, with spawning biomass at 66,000 t by the end of the year.

The agreed TAC for 1993 is 100,700 t, and Table 3.2.16 indicates that this would imply a reduction in F of 38% and an SSB of 85,000 t at the start of 1994. The same level of F in 1994 would produce landings of 165,000 t, and SSB would reach 87,000 t by the end of the year.

The results of a sensitivity analysis of the catch prediction (see Section 1.4.2) are given in Table 3.2.17 and Figure 3.2.6. The Table shows the coefficient of variation of the various parameters, and the Figure shows the contribution to the variance of prediction for the main parameters. For yield, the prediction is most sensitive to F in 1994 (21%), survivors at age 1 in 1993 (18%), F in 1993 (17%), and recruitment in 1994 (15%). The prediction of SSB in 1995 is most sensitive to F in 1993 (21%) and 1994 (31%), with the population number at age 2 in 1993 (10%) next in importance. Figure 3.2.7 shows probability profiles for landings and SSB in 1994. For landings, the Figure shows, for example that, in order to reduce F in 1994, the TAC will need to be set significantly below 125,000 t. It also suggests that the SSB is likely to remain at the current level in the next year or two.

3.2.9 Medium-term projections

The inputs for these analyses (see Section 1.4.3) are shown in Tables 3.2.17 and 3.2.18, and the results are presented in Figures 3.2.8 and 3.2.9.

Assuming a non-parametric stock-recruitment relationship (Figure 3.2.8), in 9 years out of 10 the yield could be expected to fluctuate between about 80,000 t and 250,000 t, but would average 150,000 t. Similarly, SSB could be expected to fluctuate between about 50,000 t and 120,000 t, and on average would slowly increase to 80,000 t.

If a parametric stock-recruitment relationship is assumed (Figure 3.2.9), although the confidence intervals are similar to those above, the mean yield falls to around 125,000 t, while SSB declines to about 58,000 t. However, the simulation is generating levels of SSB well below those indicated by the observed data, so the results should be treated with caution.

The more optimistic of the two scenarios suggests that it is very unlikely that SSB will reach the ACFM target level of 150,000 t.

3.2.10 Long-term considerations

The state of this stock continues to give rise to concern. The analyses presented here all indicate that the current level of fishing mortality, which is above F_{med}, is not sustainable in the long term. SSB remains at a historically low level, and only one year class in the past 8 years has been at a near-average level. Unless F is reduced, SSB is unlikely to rise in the medium term or in the long term. SSB could also be increased by improving the exploitation pattern, and this question is shortly to be considered at an EC Task Force meeting.

3.2.11 Comments on assessment

It was not possible to include discards in the assessment, as had been requested by ACFM (see Section 6.4.2). The current stock size is now indicated to be slightly higher than that estimated at last year's meeting, the reasons identified being a small upwards revision of numbers caught in 1991, and lower estimates of F values (see Section 6.4.1). However, these changes do not affect the overall conclusion as to the state of the stock. Quality control data are given in Table 3.2.19.

It is known that in some countries restrictive TACs in recent years have led to misreporting, but unfortunately it has not been possible to quantify this problem. It is suspected that for some fleets this effect is non trivial (see Section 6.4.3).

3.3 Haddock in Sub-Area IV

3.3.1 Catch Trends

In recent years there have been considerable problems with non-reporting and misreporting in this stock. This is reflected in the discrepancy between official and Working Group estimates of human-consumption landings (Table 3.3.1). The Working Group estimate of the landings during 1992 is 70,000 t, which is a slight increase on recent years, but still close to the historic low of 51,000 t in 1990. The Working Group estimate of the 1992 human consumption catch includes correction for suspected non-reporting. Further details of this are given in Section 6.3.1. Working Group estimates of the total catch broken down by catch category are given in Table 3.3.2. Quantities of discards and industrial by-catch have increased since 1989, reflecting the relative strength of the recruiting year-classes.

Long-term trends in catches by category are shown in Figure 3.3.1.

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

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

Age composition data for the human consumption landings were supplied by Denmark, England, France and Scotland. Discards were estimated from Scottish data. For the industrial by-catch, Denmark supplied age compositions, and Norway supplied length compositions which were converted to ages using Scottish discard age-length keys. The catch at age data are given in Table 3.3.4. The age composition data are SOP corrected during the raising process. For purely atavistic reasons the correction is applied to the weights at age, so these are not biologically meaningful. The weights at age in the total catch, which are also used as stock weights at age, are given in Table 3.3.5.

3.3.3 Catch, effort and research vessel data

The non-reporting outlined in Section 3.3.1 means that the commercial CPUE series which has formerly been used in VPA tuning for this stock is likely to have deteriorated considerably in quality. In view of this, most of these fleets were excluded from the tuning, although the French trawler CPUE series were retained as this fleet accounts for a small proportion of the total catch and is not thought to be affected by non-reporting. In addition to this series, data from four research vessel surveys were used in the tuning. These included indices for older ages from the International Young Fish Survey which had not previously been available. Full details of the tuning data used are given in Table 3.3.6, and the tuning data are given in Table 3.3.7.

3.3.4 Catch-at-age analysis

The catch-at-age analysis for this stock used XSA. Previously, Laurec-Shepherd tuning has been used. For comparison purposes a Laurec-Shepherd run, using the same settings as in the previous assessment, was also done. The results from this run, which are summarised in Section 6.3.2, were very similar to the XSA results.

Following initial runs detailed in Section 6.3.3, the final XSA treated ages younger than 3 as recruits, with catchability constant with respect to age and older. Otherwise, all defaults were accepted, i.e. a tricubic taper over 20 years was applied, with a shrinkage S.E. of 0.5. Diagnostics from this XSA run are given in Table 3.3.8, and plots of log catchability residuals for each tuning fleet are given in Figure 3.3.2. There appear to be trends in all the tuning fleets and in some cases the trend appears to be quite large.

The Scottish and English groundfish surveys receive most of the weight in the estimates of survivors from the 1991 and 1992 year classes at the start of 1993, although the shrinker also has a large weight. For the 1991 year class the estimate resulting from the Scottish survey is approximately twice that from the English survey. Both estimates receive equal weight so the estimate is clearly rather uncertain. There may be additional problems due to the change of gear on the English GFS in 1992 and 1993, although attempts have been made to correct for this (Cotter, 1993). Formatting problems in the diagnostics mean that the individual fleet estimates of the survivors of the 1992 year class are not readily available. At older ages the French trawlers and the International Young Fish Survey indices contribute more to the weighted estimates of survivors, and the individual estimates from the fleets which receive the most weight tend to be more homogeneous.

The stock numbers at age as estimated by the final XSA run are given in Table 3.3.9, and estimates of total fishing mortality are given in Table 3.3.10. Trends in mean total F from a retrospective analysis are plotted in Figure 3.3.3. The retrospective analysis does not indicate any consistent bias, but the results for the most recent years indicate clear problems. With 1991 as the terminal year, terminal F was estimated as being at a historic high, whereas with 1992 as the terminal year, mean F in 1991 is reduced considerably, and the 1992 F is estimated as being above 1.3. Given the known problems with the catch data this value seems highly likely to be an over-estimate of the 1992 fishing mortality.

3.3.5 Recruitment estimates

As a comparison with the XSA estimates of survivors in 1993, RCT3 estimates of the strength of recent year classes at ages 0-2 were made. The RCT3 input file for the run at age 0 is given in Table 3.3.11; the runs for ages 1 and 2 used the same recruitment indices but estimates of the strength of each year class at the appropriate age from the current XSA. Output from the RCT3 runs for each age are given in Tables 3.3.12a-c. The RCT3 estimates for the 1991 and 1992 year classes in 1993 (996 million and 11185 million, respectively) are similar to the XSA estimates (802 million and 10635 million), although the RCT3 estimates are slightly larger. The Working Group decided to adopt the RCT3 estimates as they are less influenced by the commercial catch data. At the previous Working Group meeting the RCT3 estimate of the 1991 year class at age 2 (1425 million) was higher than the current estimate but the estimate of the 1992 year class at age 1 (7112 million) was lower.

RCT3 estimated the 1993 year class at age 0 as being very close to the tapered geometric mean of 176 million. This latter figure was used to estimate recruitment in 1994 and subsequent years.

3.3.6 Historical stock trends

Trends in fishing mortality, recruitment and biomass since 1960 are given in Table 3.3.13 and Figure 3.3.1. Mean total fishing mortality has fluctuated around 1, and the present assessment indicates that it is at a historic high. Recruitment shows considerable variation, with the 1992 year class being the largest since 1974. Total biomass shows peaks corresponding to the recruitment of the occasional strong year classes, but these year classes do not survive to have much impact on the spawning stock, which declined from 1985 to a historic low in 1991. Since then, a slight increase is indicated.

3.3.7 Biological reference points

The stock-recruitment plot is shown in Figure 3.3.4, and F_{med} and F_{1992} are indicated. F_{1992} is apparently in excess of F_{med}, which would mean that the stock will decline unless recruitment is above average. These two reference points are also indicated on the yield-per-recruit curve (Figure 3.3.5). This yield-per-recruit curve uses the Fs and mean weights at age given in the input to prediction table (Table 3.3.14). The plotted values are human consumption yield-per-recruit.

3.3.8 Short-term forecast

The population numbers, fishing mortalities and stock and catch weights at age used in the short-term catch forecast are given in Table 3.3.14. Natural mortalities and the maturity ogive are given in Table 3.3.3. Two predictions were run; one assuming *status quo* in 1993, and the other assuming a 30% reduction in F relative to 1992. The latter prediction was made as this results in a mean F in 1993 close to the mean over 1988 to 1992, which is considered to be more realistic than using the very high value which the *status quo* option implies. The results from the *status quo* prediction are given in Table 3.3.15, and output from the prediction assuming 30% F reduction in 1993 is given in Table 3.3.16. Trends in SSB and human consumption catch for the *status quo* forecast are given in Figure 3.3.6.

Under both scenarios the SSB at the start of 1994 is predicted to be higher than that in 1993 but this recovery is predicted to be short-lived as assuming *status quo* in 1994 results in a decline in both cases. Both scenarios indicate an increase in the human consumption landings in 1993 and 1994. Assuming *status quo* in both years indicates human consumption landings of 158,000 t in 1993 and 244,000 t in 1994. The prediction assuming 30% F reduction indicates 1993 landings of 126,000 t. This figure is closer to the agreed TAC for 1993 (133,000 t) and it is thought to be more in line with what is actually happening in the fishery in 1993. The *status quo* prediction made at the previous Working Group meeting indicated 1993 human consumption landings of 182,000 t.

A sensitivity analysis of the forecast was run using the input values given in Table 3.3.17 and corresponding to the *status quo* forecast. The estimation of uncertainties was done as described in Section 1.4.2. The results for the 1994 human consumption landings and spawning stock at the start of 1995 are shown in Figures 3.3.7 and 3.3.8. The partial variances (Figure 3.3.7) indicate the dependence of the forecast on the estimate of one-year-old fish in 1993. This year class is not well estimated. The landings are also influenced to a large degree by natural mortality at age 1. This occurs because M at this age is large, and small percentage changes can have a large effect on survival.

The probability profiles in Figure 3.3.8 indicate the very large uncertainty in the forecast. This will make effective management by TAC extremely difficult.

3.3.9 Medium-term projections

These projections have been performed using the kernel model for the stock-recruitment data. The input values are the same as the starting values for the sensitivity analysis (Table 3.3.12) and the catch prediction (Table 3.3.14). Results of the simulations are shown in Figure 3.3.9. The upper and lower percentiles suggest that the 1995 SSB and landings can be estimated with similar precision and that the values of these quantities in 1995 will be comparable to 1993. Beyond 1995 the interval increases substantially. The upper 5 percentile appears to be unrealistically high implying that the stock recruitment relationship (essentially random recruitment) is unhelpful and needs to be further investigated.

3.3.10 Long-term considerations

Recently the stock has gone through a period of very low spawning stock biomass. This was the result of a succession of poor year classes combined with a high exploitation rate. Year classes since 1990 have been at or above the long-term geometric mean, and the SSB has increased slightly. Fishing mortality is presently estimated to be above F_{med} but a simple statistical test suggests that this difference is not significant. Furthermore, the present level of F appears higher than expected and may be distorted due to misreporting. It seems likely, therefore, that the stock is being exploited near to F_{med}. This and the medium-term projections suggest that the stock might be expected to fluctuate around an equilibrium SSB value of about 200,000 t which is in line with historical precedent.

It is well known that the demersal fisheries in the North Sea generate large quantities of discards and haddock suffers from this problem. Undoubtedly, the productivity of the fishery would improve if smaller fish were allowed to live longer. Unfortunately, the incentive to improve the selectivity of gears is only likely to occur if the overall level of exploitation is reduced (see Section 6.3.4).

3.3.11 Comments on the assessment

This assessment is seriously affected by misreporting in 1992 which undermines the whole analysis. A severe problem is the uncertainty surrounding the magnitude of recent year classes. These all have large log-standard errors as estimated from RCT3. The sensitivity analysis on the forecast shows that the uncertain 1992 year class dominates the prediction.

The quality control diagrams (Tables 3.3.18) indicate that, in general, recent assessments have been fairly consistent. However, there is evidence that problems began with the 1992 assessment. The retrospective analysis for XSA also indicates this problem (Figure 3.3.3).

3.4 Whiting in Sub-area IV

3.4.1 Catch trends

Total nominal landings are given in Table 3.4.1 and total international catches as estimated by the Working Group in Table 3.4.2. Total international catches decreased from 117,000 t in 1991 to 102,000 t in 1992, of which 45,000 t were human consumption landings, 30,000 t discards and 27,000 t industrial by-catch. The total catches have decreased in recent years from 147,000 t in 1990. The reduction reflects stable human consumption landings and reductions in both discards and industrial by-catch. The total landings of 72,000 t in 1992 are only 68% of last year's prediction and are also well below the total 1992 TAC of 135,000 t. Catch trends for the last 20 years are shown in Figure 3.4.1a.

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

The natural mortality and maturity at age values used are given in Table 3.4.3.

The natural mortalities used are rounded averages of the estimates produced by a key MSVPA run (Anon., 1992).

The maturity ogive is based on IYFS data, average 1981-1985.

Human consumption landings data and age compositions were provided by Scotland, the Netherlands, England and France. Discard data were provided by Scotland. In 1991 and 1992 the age composition of the industrial by-catch was directly sampled by Denmark, whereas in earlier years the industrial by-catch age compositions were calculated from research vessel surveys. Length distributions of the industrial by-catch from Norway were available. The Norwegian industrial by-catch was separated into age groups by using the age composition of the Danish industrial by-catches. Mean weights at age were available separately for the human consumption, discard and industrial by-catch component. Total international catch at age and mean weight at age in the catch are presented in Tables 3.4.4 and 3.4.5. The mean weights at age presented are corrected for sum of products and have no biological meaning.

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

3.4.3 Commercial catch/effort data and survey indices

Catch and effort data from commercial and survey vessels were used to tune the VPA. CPUE data from surveys were used to provide recruitment estimates. The fleets used in the VPA tuning and the ages and number of years available for each fleet are listed in Table 3.4.6 while the actual values are presented in Table 3.4.7. The International Ground Fish Survey series is available for a longer period for ages 1 and 2 than for the older ages due to lack of proper sampling/ageing of these age groups in the earlier part of the time series. The data from this survey were, therefore, split into two series. Research vessel indices used for recruitment estimates are given in Table 3.4.12.

3.4.4 Catch at age analysis

The VPA was tuned using the extended survivors analysis (XSA) approach (see Section 1.4.2). The diagnostics of the tuning are presented in Table 3.4.8. Catchability residuals by age and fleet are presented in Figure 3.4.2.

The basic input parameters and conditions of the tuning are presented in Table 3.4.8. The full time series was used. On the basis of experience from trial runs the catchability was assumed to be independent of age for ages above 5 years. The estimates of terminal Fs only changed marginally with variations in this choice. Catchability was allowed to be dependent on stock size below age group 2.

There are apparent trends in the catchability residuals in some survey fleets which are difficult to explain. The fleets receiving highest weight in the estimation of terminal fishing mortality are the French trawlers, the Scottish light trawlers and the Scottish seiners. The mean gives some weight for the youngest and oldest age groups, but weights below 0.25 for ages 1 to 5 inclusive.

The results of a retrospective analysis are presented in Figure 3.4.3. The F level has historically been quite variable, and the method has not been able to pick this variation up in a series of years with underestimates of the terminal F.

In the assessment made in 1992 (Anon., 1992) the VPA was tuned using a Laurec-Shepherd approach. A L-S tuning was run with the same input parameters and run conditions as used in last year's assessment. The fishing mortalities by age in the terminal year were not found to be different from those estimated with the XSA method employed this year (Table 3.4.9).

The stock numbers and fishing mortalities at age estimated with the XSA-tuned VPA are presented in Tables 3.4.10 and 3.4.11.

The fishing mortalities in 1991 have been revised down by 25-40% for ages 2 - 5 relative to last year's assessment. This is also reflected in the retrospective analysis (Figure 3.4.3).

The VPA estimates of the sizes of the 1989 and 1990 year classes have been reduced considerably relative to the estimates used in last year's prediction, which were based on survey indices for these cohorts. The present VPA- based estimates for the two year classes are 1794 and 1548 million at age 1 compared to 3219 and 3472 million estimated by RCT3 in last year's assessment.

3.4.5 Recruitment estimates

Recruitment at ages 0, 1 and 2 in 1993 was estimated using the regression technique implemented in the RCT3 program. Input parameters and run conditions are presented in Table 3.4.12.

The results are given in Tables 3.4.13-3.4.15.

The year class estimates are close to the estimates made in the 1992 assessment. The main deviation is the 1992 year class which is now estimated to be approximately 25% larger than last year's estimate. The mean is now receiving a weight of 0.52 for the estimate of this year class recruiting at age 1 compared to 0.88 in last year's estimate of recruitment at age 0.

The RCT3 estimates of the stock at ages 1 and 2 in 1993 are approximately double the numbers emerging from the VPA and are used instead of these for the predictions.

The estimates used for the year classes 1992 onwards are the mean VPA value of recruitment at age 0 calculated in RCT3.

3.4.6 Historical stock trends

Long-term trends in fishing mortality, recruitment and spawning stock biomass are given in Table 3.4.16 and plotted in Figure 3.4.1.

Fishing mortalities have been highly variable with no clear trend.

Recruitment since 1985 has been variable between the long-term mean and 40% of this value.

The spawning stock biomass has fluctuated within the range 210,000-290,000 t over the same period. The spawning stock biomass has been decreasing for the last two years and is presently the lowest in 20 years. The decrease in the last two years is associated with the recruitment of two small year classes (1989 and 1990) to the spawning stock, which is now dominated by these cohorts. This decrease in the spawning stock estimate was not clear in the 1992 assessment. The present revision is associated with the downward revision of the estimates of these two cohorts.

3.4.7 Biological reference points

A stock-recruitment plot is shown in Figure 3.4.4. F_{med} (0.54) is below the present *status quo* value of 0.85 $year^{-1}$. Given the high catch by small mesh fisheries it is not clear which yield/recruit reference point is the appropriate one to use. The equilibrium yield (landings) per recruit is plotted in Figure 3.4.5. The input for equilibrium yield prognosis is given in Table 3.4.17.

3.4.8 Short-term forecast

Input data for the short-term catch forecast are given in Table 3.4.17. Results of a *status quo* forecast are presented in Table 3.4.18 and Figure 3.4.6. The TAC in 1993 is considerably higher than the landings with *status quo* fishing mortality. This TAC is not likely to be taken and a separate forecast based on the TAC has not been made.

The catches in 1993 are similar to the predictions made in 1992 for discards and industrial by-catch but 25% lower for human consumption landings. This is connected to the downward revision of the estimate of the 1989 and 1990 year classes, which are expected to dominate the human consumption landings in 1993 both in numbers and weight.

A sensitivity analysis of the *status quo* forecast is presented in Table 3.4.19 (inputs) and Figure 3.4.7 (results). The estimate of landings in 1994 is sensitive to those year classes which are poorly estimated, to the F level and natural mortality levels in 1993 and to the F pattern at ages 2 and 3. The estimate of the spawning stock biomass in 1995 is mainly affected by recruitment at ages 0 and 1 in 1993, and the natural mortality level and pattern at the youngest ages.

Probability profiles for the yield in 1993 and the spawning stock biomass in 1994 are presented in Figures 3.4.8 and 3.4.9, respectively. Under *status quo* conditions there is a probability of 25% that the spawning stock biomass will be below 200,000 t in 1995.

3.4.9 Medium-term projection

The inputs for a medium-term projection are similar to the inputs for sensitivity analysis and are presented in Table 3.4.19. Due to the appearance of the SSB-R scatter plot only a non-parametric model was implemented. The scatter of points is so wide that the non-parametric model is equivalent to independence between SSB and recruitment.

The results are presented in Figure 3.4.10. The SSB is on average expected to increase in the medium term, with a probability of 5% that it will be below 200,000 t in the average long-term situation.

The human consumption landings are likewise expected to increase on average, but the probability distribution is very wide, from 40,000 to 100,000 t within 90% probability in the average long-term situation.

3.4.10 Long-term considerations

The present assessment indicates that the stock has been stable in the medium term but with a decrease in SSB in the last few years due to two consecutive year classes around half the long-term average.

The short-term forecast predicts increases in SSB from 1993 onwards based on the fact that estimates of the three most recent year classes are close to the long-term average.

The fishing mortality rates are high in comparison to many other stocks, especially on the older ages. Another whiting stock in Division VIa does not appear to be sustaining itself under similar or lower exploitation levels. The present mortality rate is well above F_{med}. Whiting, though a valuable fishery in some countries, tends to be a by-catch species in the mixed gadoid fisheries so the exploitation regime needs to take into account the management of other target species. Although recent experiments have shown that it is possible to fish selectively for whiting at certain times of the year in certain areas, it appears that few fish are taken this way at present.

3.4.11 Comments on the assessment.

The forecasts have been shown to be very sensitive to the estimates of recruiting year classes (Figure 3.4.7). The estimates of the 1989 and 1990 year classes have been adjusted considerably downwards in successive assessments (see Table 3.4.20). The regular occurrence of trends in the survey data in the VPA tuning (Figure 3.4.2) and the difference in recruitment estimates between the VPA and the prediction based on survey indices indicates that the surveys and the commercial fleet data are providing inconsistent information.

The survey fleets used for recruitment estimates are also the fleets showing relative trends in catchability residuals in the catchability analysis (Figure 3.4.2). The net result is that the set of fleets receiving most weight in the VPA tuning is different from the set receiving most weight in recruitment estimation and that the two sets contain conflicting signals concerning the stock. The problem with substantial revisions of the size of recruiting year classes as they are transferred from RCT3 to VPA estimates is, therefore, bound to prevail for some years into the future. There is no simple solution to this problem if all the information available is still to be used.

Primary discard data are missing for all countries except Scotland. Discards from other fleets are estimated by extrapolation from Scottish data. This introduces an error in the assessment, but the extent of this error is limited by the fact that Scotland lands 67% of the total international landings for human consumption.

The North Sea assessment of whiting has a history of being unreliable (see Table 3.4.20). Recruitment indices do not correlate well with VPA estimates and there is no doubt that there are problems with the age composition estimates of the small mesh by-catch in some years.

These problems suggest that the catch forecasts presented should be treated with caution.

3.5 Saithe in Sub-area IV and Division IIIa

3.5.1 Catch trends

Recent nominal landings are given in Table 3.5.1. Working Group estimates are given in Table 3.5.2 and plotted in Figure 3.5.1. Landings were high in the early 1970s, reaching a maximum of 320,000 t in 1976. Subsequently, landings declined to 114,000 t in 1979, mainly due to the discontinuation of the fishery of the USSR. After that, the landings followed an increasing trend to reach 200,000 t in 1985. Since then the landings have decreased considerably. In 1991 and 1992, the landings are estimated to be 99,000 t and 92,000 t, respectively (lowest on record). Small amounts of saithe are taken as industrial by-catch. Since 1976, the average industrial by-catch has been 3,000 t (Table 3.5.2). The agreed TAC in 1992 was 110,000 t. 1992 was the seventh successive year in which the TAC was not taken. In 1993 catch rates appear to be higher than expected,and the TAC will most probably be taken.

3.5.2 Natural mortality, maturity, age compositions, mean weight at age

Conventional values of natural mortality rate and maturity at age based on biological sampling are given in Table 3.5.11. Total international age compositions are given in Table 3.5.3. Data for 1991 were updated with major revisions, which led to a significant reduction in estimates of age 2 and 3 fish. Data for 1992 were supplied by Denmark, Germany, Fr , Norway, UK (England and Scotland) accounting for 94% of the catches. Discards are not included.

The mean weights at age in the landings are given in Table 3.5.4. These are also used as stock mean weights. The weights are corrected for SOP.

3.5.3 Catch, effort and research vessel data

Commercial catch and effort data used to tune the VPA are given in Table 3.5.5. There are no research vessel indices of abundance for saithe, but a series of 0-group indices estimated by observers are given in Table 3.5.9. The index appears to be able to predict extreme year classes. A limited amount of survey data is available (Table 3.5.9) but these are insufficient and cannot be used in the analysis.

3.5.4 Catch-at-age analysis

The method used to tune the VPA was XSA (v3.1), and this was a change from last year's assessment when the Laurec-Shepherd method was used (see Section B). Tuning was performed over a 15-year period, with shrinkage of 0.5 and a tricubic time taper. Inspection of preliminary runs indicated that there was no evidence for a correlation between catchability and abundance. The recruiting age was, therefore, set at age 1, and catchability was fixed for ages 4 and above. The age range used for VPA was 1 to 10 (the plus group), and F for the oldest ages was set to the mean of the 3 younger ages. The tuning results are given in Table 3.5.6. and the residuals of the log catchability are plotted in Figure 3.5.2. Table 3.5.7 gives the values of fishing mortality rate, and Table 3.5.8 the stock numbers estimated by tuning. The F(3-6) for 1991 is reduced compared to last year's assessment.

A retrospective analysis was run for six years backwards. The results are plotted in Figure 3.5.3. There is good agreement for all runs.

3.5.5 Recruitment estimates

The time series of 0-group indices obtained from observations along the western coast of Norway is shown in Table 3.5.9. In addition, there exist some indices from a Norwegian 0-group survey, but the time series is very short. The observation indices indicate average or above-average year classes from 1990 onwards.

In the absence of reliable abundance estimates the Group decided to assume mean geometric recruitment at age 1 over the years 1970-1989 for the year classes 1990 onwards (191 million fish).

3.5.6 Historical stock trends

Table 3.5.10 gives a summary of the trends in fishing mortality, biomass and recruitment as estimated by VPA. These data are also plotted in Figure 3.5.1.

Mean fishing mortality increased substantially from 1981 to 1986. Since then it has decreased to a level of about 0.6. Total biomass and spawning biomass show a continous downward trend and are now at their lowest historical levels.

3.5.7 Biological reference points

Yield and biomass per recruit are shown in Figure 3.5.5, and input data are in Table 3.5.11. A stock/recruitment plot is shown in Figure 3.5.4. F_{high} (0.65), F_{med} (0.44) and F*status quo* (0.59) replacement lines are shown in Figure 3.5.4. For *status quo* F, stock replacement in the long term will occur only with atypical levels of recruitment.

3.5.8 Short-term forecast

Input data for prediction are given in Table 3.5.11. Ages 1, 2 and 3 are estimated from the average number at age 1. The time period for calculation of mean exploitation pattern and mean weights was 1988 to 1992. Results of the predictions assuming average recruitment are given in Table 3.5.12 and Figure 3.5.5. Input data for a sensitivity analysis (see Section 1.4.2) are given in Table 3.5.13 and the results of this analysis are shown in Figures 3.5.6 and 3.5.7.

Maintenance of the 1992 level of fishing mortality in 1993 will lead to landings of 89,000 t in 1993 and 97,000 t in 1994. Spawning stock size is predicted to stabilize around 80,000 t.

The sensitivity analysis shows that the prediction is dependent on age 2 and especially age 3 in 1993 (Figure 3.5.6). These ages are assumed to be of average abundance, and the prediction is, therefore, only a steady state prediction.

The probability plots show that there is about a 40% probability that the spawning stock will drop below 70,000 t (the lowest previous record) in 1995 if the current level of fishing mortality is maintained (Figure 3.5.7) and, with a catch of 97,000 t in 1994, there is about a 60% probability that fishing mortality will be higher than in 1993.

The predicted *status quo* catch for 1993 of 89,000 t was so close to the TAC of 93,000 t that no prediction with a TAC constraint was run.

3.5.9 Medium-term projections

The input for these analyses (see Section 1.4.3) are shown in Tables 3.5.13 and 3.5.14, and the results are presented in Figures 3.5.8 and 3.5.9. Assuming a parametric stock-recruitment relationship (Figure 3.5.8) the yield in 9 years out of 10 is expected to be between about 50,000 t and 180,000 t, but would average 100,000 t. SSB is expected in 9 years out of 10 to be between 50,000 t and 170,000 t, and average 100,000 t. If a non-parametric stock-recruitment relationship is assumed (Figure 3.5.9), the confidence intervals will be almost the same, but the mean yield will increase to 130,000 t, and the mean SSB will increase to 120,000 t.

3.5.10 Long-term considerations

The current level of F is at F_{high}, which implies that high recruitment is required to sustain spawning stock biomass. However, at *status quo* fishing mortality the medium-term projections indicate that the probability of reaching a spawning stock biomass at the level seen in the 1970s is very small.

3.5.11 Comments on the assessment

Table 3.5.15 shows the quality control diagrams. This year's assessment is consistent with the assessment last year. The 1988 and 1989 year classes have been reduced from last year's assessment. This is mainly due to the revision of the catch-at-age data for 1991 and to the fact that they have been replaced by VPA values rather than being long-term means. The 0-group indices indicate that using average recruitment for the period 1988 -1993 may be reasonable.

As mentioned above, the prediction is really only a steady-state prediction, and this will make effective management by TAC difficult.

3.6 North Sea Sole

3.6.1 Catch trends

The total nominal landings in 1992 reported to ICES were 25,744 t. The Working Group estimate of the landings in 1992 was 29,116 t compared to 38,342 t in the previous year (Table 3.6.1). The agreed TAC for 1992 was 25,000 t but this has been increased by 10% to 27,500 t due to a mid-year TAC revision. Historical trends in landings are given in Figure 3.6.5.a. In recent years landings have been at a high level and are dominated by the outstanding 1987 year class. There is continuing uncertainty about the actual level of the unreported landings. The estimate of the unreported landings is the lowest in the last 10 years (Table 3.6.1).

3.6.2 Natural mortality, maturity, age compositions, mean weight at age

Age compositions, weight and length at age were available for the 1992 landings on a quarterly basis from Belgium, Denmark, the Netherlands, UK (England and Wales) and France, accounting for about 92% of the total international landings. The SOP of the combined 1992 age composition was 2% lower than the total landings. Minor revisions were made to the 1991 data as a consequence of revisions in the national 1991 landings. No estimates of discards are available to the Working Group.

Weights at age in the stock are measured second quarter weights in the catch. The age compositions and weights at age in the catch and in the stock are given in Tables 3.6.2, 3.6.3 and 3.6.4.

A knife-edged maturity ogive was used in all years, assuming full maturation at age 3. Natural mortality has been assumed constant over ages and years at a level of 0.1, except for 1963, when a value of 0.9 was used to take account of the effects of a severe winter (Anon., 1979).

3.6.3 Catch, effort and research vessel data

Catch and effort data used in the tuning were the same series as used in last year's assessment. The tuning data are presented in Table 3.6.5. The "Netherlands all Fleets" is in fact the beam trawl fleet effort measured in million horse power days. The other 2 fleets are surveys. The SNS (Sole Net Survey) is carried out by the Netherlands with a 6 m beam trawl in autumn along the continental coast. The German Solea survey is also a beam trawl survey carried out in May. CPUE and effort data not used in the tuning are presented in Section 6.6.1.

3.6.4 Catch at age analysis

The tuning procedure used in the assessment is XSA with shrinkage; the same as used in last year's assessment. However, following a recommendation of the Methods Working Group, a weaker shrinkage to the VPA mean (0.5) has been applied compared to last year (0.3). The tuning was carried out using a 10-year period with no taper. Table 3.6.6 specifies the configuration of the method.

The diagnostics of the tuning are presented in Table 3.6.6. Figures 3.6.1, 3.6.2 and 3.6.3 present the trends in log catchability in the tuning fleets. The residuals in the Dutch fleet show an increasing trend in the last 4 years for most age groups, which may be related to a change in directivity of the beam trawl fleet from plaice towards sole. The residuals in log catchability in the other fleets fluctuate without clear trend although in general the level of catchability in the German survey data since 1987 is somewhat lower than in the previous period and the opposite pattern can be observed in the Dutch "Tridens" survey.

In the determination of the estimated survivors and the associated fishing mortalities for each age group most weight has been given by the tuning procedure to the Dutch beam trawl fleet for most age groups. The "Tridens" survey gives most weight to the ages 1 and 2 estimates but also contributes considerably to the age 3 estimates. In age groups older than 10, which are generally less well sampled in the age composition, the influence of the shrinker on the combined estimated is increasing. In general the estimates of the survivors by the shrinker are higher than those by the fleets. Consequently the fishing mortalities estimated by the shrinker are lower than those estimated by the fleets.

Retrospective runs were carried out in order to inspect the performance of the method. The retrospective results with respect to mean fishing mortality are shown in Figure 3.6.4. The mean fishing mortality estimated for 1991 appears to be close to the one estimated in last year's assessment.

In addition, trial runs were made using other tuning configurations. In general, the VPA results from these runs are not very different from the final method. A summary of the results of these trials is presented in Section 6.6.2.

The results of the VPA are presented in Tables 3.6.7 and 3.6.8. All measures of mean fishing mortality fluctuate in the last 10 years around a level of 0.5. The SSB increased from 37,000 t in 1989 to 93,000 t in 1990 due to the recruitment of the outstanding 1987 year class and decreased thereafter to 78,000 t and 66,000 t in 1991 and 1992, respectively.

3.6.5 Recruitment estimates

Average recruitment in the period 1957-1989 was 134 million (arithmetic mean) or 97 million (geometric mean) 1-year-old fish.

No independent indices of recruitment were available from pre-recruit surveys carried out in 1993 since the surveys were not yet completed. It is expected that these indices will become available after the meeting of the present Working Group and will be available to ACFM in November 1993.

A preliminary estimate of recent year classes was made using the log regressions between the indices available from surveys carried out in previous years (the same as those available at last year's meeting) with the 1-year-olds from the VPA using RCT3. The indices are given in Table 3.6.9. The options used in RCT3 were the same as those used last year and are listed in Table 3.6.10. The results are given in the same table. The S.E. of the estimated recruitments is about 20%, which is quite large. The year-class strength estimated by the surveys has been used in the short-term forecast.

Recent recruitment is characterized by the occurrence of two poor year classes and one very good one.

<u>1990 year class</u>: Almost all surveys indicate this year class to be well below GM recruitment. However, in the UK nurseries it was the strongest in the series as 1--group. The mean estimate from the surveys is 52 million 1-year-olds. Also the VPA estimates it to be poor: 37 million.

<u>1991 year class</u>: The available indices indicate that this year class appears to be a very good one. On the UK coast it was around average strength as 0-group. The mean estimate from the surveys is 274 million 1-year--olds. The VPA estimate is 435 million but this is based on the catches at age 1 in 1992 only.

<u>1992 year class</u>: This year class is virtually absent as 0-group in the continental suveys. In the UK nurseries it was about average strength. The RCT3 program estimates it at 55 million. However, most of this estimate is due to the effect of shrinking to the VPA mean recruitment. Without shrinking it is about 11 million 1-year olds.

3.6.6 Historical stock trends

Trends in landings, recruitment, fishing mortality and SSB are shown in Figures 3.6.5a-d and in the assessment summary table (Table 3.6.11).

The recruitment of North Sea sole shows considerable variation from year to year. The pattern of recruitment is characterized by the occasional occurrence of outstanding year classes (3 to 5 times average). In the period 1957-1992 these have occurred 4 times: in 1958 and 1963 and recently in 1987 and 1991.

Fishing mortality increased gradually in the period 1957-1966. It increased sharply in the mid-1960s, mainly because of the introduction of the beam trawl in the fishery and continued to increase gradually until the mid-1980s. It has remained high in recent years with fluctuating trends. The recent observed fluctuations do not reflect changes in effort but they may indicate the deteriorated quality of the estimates of landings.

Trends in SSB are associated with the occurrence of strong year classes. SSB was at a historically high level of 147,000 t in the years 1961-1963 but decreased sharply thereafter due to high natural mortality in the cold 1963 winter. The 1963 year class built it up again to 105,000 t in 1966. Thereafter it decreased almost continuously due to an increase in fishing mortality, the absence of very strong year classes and a number of poor year classes. Its lowest level was 25,000 t in 1981. It recovered sharply in 1990 to 93,000 t when the 1987 year class recruited to the SSB. It has decreased in recent years to 51,000 t in 1993.

3.6.7 Biological reference points

Figure 3.6.6 shows the SSB/recruitment scatter plot. At the observed levels of biomass there are no indications that recruitment has declined. Most historical observations of recruitment are made at SSB levels higher than 35,000 t. Only two observations are available at levels of SSB below 35,000 t, in both cases associated with above-average recruitment. The plot does not indicate a particular "Minimum biologically acceptable level" (MBAL) based on biological arguments. Since recruitment is uncertain at SSB levels below 35,000 t, however, the MBAL should not be set below 35,000 t.

The SSB recruitment plot also shows the position of F_{med} and F_{92}. F_{92} is higher than F_{med} but the difference is not significant.

The input parameters for the yield and biomass-per-recruit calculations are given in Table 3.6.12. The weights at age used were the averages of the last 3 years in the catch and in the stock. The exploitation pattern used was the average of the last 3 years in the VPA scaled to the 1992 level. The results of the calculations are given in Table 3.6.13 and Figure 3.6.7.

The biological reference points are almost at the same position as last year and are as follows:

F0.1	Fmax	Fmed	F92
0.10	0.26	0.35	0.5

3.6.8 Short-term forecast

Catch forecasts for 1993 and 1994 were obtained using the IFAP prediction program. The inputs are given in Table 3.6.12. The stock numbers for ages 1-3 were estimated from recruitment surveys and may have to be changed by ACFM when new information on the recruitment of recent year classes becomes available from the 1993 recruitment surveys.

The management options are presented in Table 3.6.14 and Figure 3.6.8. A *status quo* level of fishing mortality has been assumed for 1993 in the prediction.

The expected catch at *status quo* fishing mortality in 1993 is 27,500 t. The spawning stock biomass will increase from 50,000 t in 1993 to 66,000 t in 1994 when the strong 1991 year class recruits to the SSB. At *status quo* level of fishing mortality, the expected catch in 1994 is 30,000 t leaving a SSB of 51,000 t in 1995.

A sensitivity analysis was carried out by the Working Group using a linear model PREFAST3. The input data used in this model are given in Table 3.6.15.

Estimates of the 95% confidence intervals of the expected *status quo* catch in 1993 are 20,000 and 37,000 t, respectively. The agreed TAC of 32,000 t for 1993 is higher than the expected catch but is between these limits. If this TAC is taken, there is a 90% probability that this would require an increase of fishing mortality.

Probability profiles of the expected yield in 1994 and the SSB in 1995 are given in Figures 3.6.9 and 3.6.10. Figure 3.6.11 shows the partial variances (proportions), estimated from a linear analysis for the forecast. They show how variability in the parameters used in the forecast (recruitment, M, F, age composition of the stock in 1993) contribute to the uncertainty in the prediction of yields in 1993 and 1994 and SSB in 1994 and 1995. The analysis shows that the measurement error of the 1991 year class contributes most to the predictions of yield and SSB in 1994, but also contributes considerably to those in the other years.

3.6.9 Medium-term projections

Medium-term predictions were made for a period of 9 years to estimate 95% confidence intervals of the predicted yields, SSB and recruitment at *status quo* fishing mortality. Recruitment was modelled using the kernel method described in Section 1.4.3. The model was run over 10 years with 1000 simulations. The results are presented in Figure 3.6.12.

The estimates of the 95% confidence intervals of the predicted yield and SSB increase with time and stabilize after 1996, indicating that from this year onwards the prediction of yield and SSB is uncertain. The estimate of recruitment is uncertain from 1994 onwards.

3.6.10 Long-term considerations

In the past, management advice for North Sea sole was based on the following objective: "To prevent the spawning stock from falling below the historically safe level of 40,000 t and maintain it at a level of 50,000 t. This objective comprised a buffer of 10,000 t to allow for two successive poor year classes."

Experience from the late 1980s has confirmed that the stock can recover from 40,000 t, and one case of strong recruitment has been observed from a SSB of 31,000 t. The SSB recruitment plot (Figure 3.6.6) indicates that good recruitment can occur at a minimum level of SSB of 35,000 t.

The SPLIR model has been used to estimate the probability that SSB will decrease below this level in the long term. This model was described in Appendix IV in last year's report (ICES, C.M.1993/Assess:5) and in the Report of the Long Term Management Measures Working Group (ICES, C.M.1993/Assess:7). Basically the model estimates the variability on the yield- and biomass per recruit curves due to the observed variablity in recruitment. The model was run over 1000 years.

The results are shown in Figures 3.6.13 and 3.6.14. At the present level of fishing mortality (F(2-8)=0.50) the probability that the spawning stock will be below the level of 35,000 t in any year in the long term is 0.3. To reduce this probability to 0.1, fishing mortality should be reduced to F(2-8)=0.40. This indicates the requirement of a reduction of 20% in the presently assumed level of F. The distribution of expected yields is almost the same for all levels of fishing mortality, which corresponds to the flat-topped yield/recruit curve for this stock (Figure 3.6.7).

3.6.11 Comments on the assessment

The consistency of this assessment and previous assessments is shown in the quality control diagrams (Tables 3.6.16a-d). The quality control diagrams show that there is a tendency to revise F downwards and this is a reason of concern.

The present 1993 assessment is reasonably consistent with the 1992 assessment. A comparison with the results of other tuning methods is given in Section 6.6. The choice of tuning method does not seem to make much difference to the results of the assessment.

It has already been pointed out that the reason for the problems in the assessment probably originate from the quality of the data in a number of years, especially in the level of landings and in the effort data. Effort data used in the tuning are from a mixed fishery on plaice and sole and contain a certain proportion of effort exclusively directed at plaice. Changes in the directivity of this fishery towards one or both species or other species have been observed depending on the availability of the species (catch rates, catch restrictions) but cannot be quantified. The increasing trend in catchability in the last 4 years could be explained by a change in directivity from plaice towards sole; the plaice assessment shows an opposite trend in catchability in the same years.

In the past, weights at age of sole have shown significant trends. In the mid-1960s and early 1970s a significant increase in weight at age (about 40%) was observed. This increase has been explained by an increase in growth. In recent years a relatively small, but probably significant, decrease in weight at age has been observed in sole as well as in plaice. Figure 3.6.15 shows the residuals of the weight at age for age group 3-10 from the mean in the period 1973-1993. The reasons for these changes are not yet fully understood. The short-term forecasts take account of the change in weight at age by assuming an extrapolation of the mean weight at age of the last 3 years. The long-term models used by the Working Group do not.

3.7 North Sea plaice

3.7.1 Catch trends

Total international catches in 1992 dropped by 23% from 1991 to about 121,000 t (Table 3.7.1, Figure 3.7.1), which compares with agreed TAC of 175,000 t. The 1992 catch was the lowest since 1979. None of the major fisheries exhausted their quotas; underreporting is therefore assumed to be of little importance in 1992.

3.7.2 Natural mortality, maturity, age composition and mean weight at age

Natural mortality and maturity were the conventional values used in previous years (Table 3.7.15). The age composition of the landings (not SOP-corrected) based on a sampling coverage of roughly 90% of the landings is given in Table 3.7.2. No discards were included in the assessment. Mean weights at age (Tables 3.7.3 and 3.7.4) are estimated from market samples; mean weights in the stock are the values from catches in the first quarter of the year.

3.7.3 Catch, effort, and research vessel data

Data used in the tuning run are given in Table 3.7.5. These originate from two commercial fleets (NL all fleets = beam trawlers, UK seiners) and two surveys (NL beam trawl survey, "Tridens" survey). The English groundfish survey was excluded this year because of a change in gear which could not be corrected in a convincing way. The "Tridens" survey covers only age groups 1, 2 and 3. All available commercial CPUE data indicate declines in both 1991 and 1992 (Table 6.7.1).

3.7.4 Catch at age analysis

Tuning was done using the XSA (with shrinkage) model. The model formulation is described in Table 3.7.6. Comparisons of this model with others attempted in tuning the VPA are contained in Section 6.7 of this report. The summary statistics for the XSA tuning (Table 3.7.6) show that the "Tridens" pre-recruit survey data have the largest influence in determining terminal Fs at the youngest ages, particularly ages 1 and 2. The Netherlands fleet data have the largest influence on all ages above 9. There is no clear pattern at the intermediate ages of any one index being particularly dominant.

Figure 3.7.2 shows the log catchability residual plots. There are large residuals at ages 3, 7, and 8 in the 1991 Netherlands fleet data, but the reasons for these values are not clear. One reason may be changes in the proportions of the catch at these ages in the Netherlands landings compared to total landings. There is also some evidence of a decline in q for this fleet in recent years. A possible explanation could be a diversion of some effort away from plaice toward sole by the Dutch fleet. There is no indication of a change in catchability in the other commercial fleet used in tuning (English seine). The "Tridens" index shows an increase in q at age 3.

A retrospective analysis was conducted using the same formulation of XSA to explore variability in estimated terminal Fs. Figure 3.7.3 shows that the current analysis estimated F to be higher in 1991 but lower in previous years compared to the analysis with 1991 as the terminal year. Both these analyses indicate lower Fs than the analyses with 1989 and 1990 as terminal years. This pattern was also seen in last year's assessment (Anon., 1993).

Figure 3.7.4 shows that the exploitation pattern peaked at age 5 in 1992, continuing the pattern of a shift in the peak F away from ages 3 and 4 (Table 3.7.8). It was noted in last year's report (Anon., 1993) that this change had occurred before the introduction of the plaice box in 1989. The mean F in 1992 of 0.46 is about the same as in 1991, which is above the recent values. The number of survivors in 1993 estimated by XSA was below the 1983-1989 average for ages 3-5, and above average for ages 6-8 (Table 3.7.7).

3.7.5 Recruitment estimates

For the forecast, the numbers of age groups 1, 2, and 3 (year classes 1992, 1991, and 1990 in 1993) were estimated from pre-recruit survey series covering the continental and UK coast. The "Tridens" spring and autumn indices are used directly to provide 6 indices (autumn: 0, 1, 2, and 3-group; spring: 1 and 2-group), while the Netherlands/Belgian, German, and UK surveys are combined into one index for each of 0-group and 1-group (Table 6.7.3). Input data for the 8 indices in total are shown in Table 3.7.9; detailed output from RCT3 is in Tables 3.7.10, 3.7.11, and 3.7.12.

Estimated numbers of 1-year-old fish from RCT3 for the most recent year classes (1989-1992) are 582, 676, 699 and 529 million, respectively. These figures look quite favourable compared to a mean of 555 (arithmetic) or 511 (geometric). (See, however, discussion in Section 3.7.11.). The RCT3 prediction was also run to predict age group 2 and 3 recruitment in 1993, yielding values of 631 and 489 millions at ages 2 and 3 with their associated log SEs of, 0.16 and 0.14, respectively. The log SE for the age 1 estimate (529 million) was 0.24.

There is no estimate for the 1993 year class because the survey had not been completed at the time of the meeting.

3.7.6 Historical stock trends

Table 3.7.13 and Figure 3.7.1 show the trends in mean F, SSB, and recruitment from 1958-1992. F increased in 1991 to the highest value in the series, and remained at about this level in 1992. After increasing throughout most of the 1980s, SSB has declined by 25% from a peak of over 400,000 t in 1989. SSB estimates for this stock have never fallen below 300,000 t. There was a general increase in recruitment in this stock from the early 1970s, although the 1988 and 1989 year classes are estimated to be the lowest in the past decade.

3.7.7 Biological reference points

The stock/recruitment relationship is shown in Figure 3.7.5 with lines indicating $F_{status\ quo}$ and F_{med}. The current value of F (0.46) is above $F_{med} = 0.3$ but below the calculated value for $F_{high} = 0.6$. Input data for the yield-per-recruit analysis are contained in Table 3.7.15 and the results in Table 3.7.14. From the yield-per-recruit curve (Figure 3.7.6) it can be seen that the present level of F is about twice F_{max}.

3.7.8 Short-term forecast

A short-term forecast was carried out using the data in Table 3.7.15. As in the past, the exploitation pattern was taken as the mean of the last 3 years scaled to the F(2-10,u) of the most recent year. Weight at age in the catch and stock were also averaged over the last 3 years only to take into account the decline in recent years. The predicted *status quo* catch for 1993 is 143,000 t, well below the agreed TAC of 175,000 t, but above the 1992 catch of 121,000 t. This projected catch in 1993 is also likely to be much higher than the actual catch in 1993, based on landings to date. The *status quo* predicted catch for 1994 is 147,000 t. With these catches, the SSB is projected to decline slightly from 338,000 t at the beginning of 1993 to 329,000 t at the beginning of 1995 (Table 3.7.16, Figure 3.7.6).

An analysis was conducted to determine the sensitivity of the short-term forecast to uncertainties in the input parameters (Cook, 1993). The inputs to this analysis are contained in Table 3.7.17. Figure 3.7.7 indicates that the level of F in 1994 is responsible for almost half the variance in the forecast yield for 1994. The population sizes at ages 2 and 3 in 1993 are responsible for 16% and 12% of the variance, respectively. For SSB, the 1994 recruitment estimate was most important, followed by the population estimates at age 2 and age 1 in 1993. Probability profiles indicate that SSB in 1995 is likely to decline at *status quo* F in 1994 (Figure 3.7.8).

3.7.9 Medium-term projections

Table 3.7.18 contains the input data for medium-term projections. A Cauchy smoothing (kernel method) was applied to the stock/recruitment data (Figure 3.7.9). The simulation forecasts slightly declines over 10 years in both mean yield and SSB, with the latter decreasing to just under 300,000 t (Figure 3.7.9).

3.7.10 Long-term considerations

For the lowest levels of SSB calculated for this stock (around 300,000 t from 1978-1982), there was no indication of a decline in recruitment (Figure 3.7.1). The level of the SSB during this time period has been proposed as the acceptable minimum SSB (Anon., 1993).

The SPLIR model was used to estimate the probability that SSB will fall below a certain level in the long term. This model estimates the variability in the yield and biomass-per-recruit curves due to observed variability in recruitment (see Appendix IV in last year's North Sea Demersal Working Group report and also the Report of the Long-Term Management Measures Working Group). The results (Figure 3.7.10), which assumed that recruitment is independent of stock size, show that at the present F level (0.456), there is a slightly greater than 50% probability that SSB will decline below 250,000 t, and more than 80% probability that it will decline below 300,000 t. To reduce this latter probability to 50%, F would have to be reduced to about 0.37. The distribution of expected yield is about the same for all levels of F in the simulation, corresponding to the flat-topped yield-per--recruit curve for this stock.

In last year's assessment there were indications from "Tridens" survey data that survival of young plaice in the southeastern North Sea had improved since the establishment of the "plaice box". This analysis could not be extended this year because the 1993 survey data were not available.

It was noted that there will be a meeting in 1994 to discuss potential modifications to the "plaice box".

3.7.11 Comments on the assessment

Some concerns are evident from this assessment:

1) Fs in 1991 and 1992 are at the highest observed level, about 50% above F_{med};

2) the 1988 and 1989 year classes as estimated from VPA are about the same size as the lowest in the past 15 years;

3) SSB has declined to just above the previously observed low level in 1978-1982.

Many of the concerns expressed in last year's assessment (Anon., 1993) must be reiterated , eg. uncertainty about the accuracy of the total international landings and resulting age compositions for many years prior to 1992 and their possible effects on the VPA, and the continued decline in all CPUE indices. It was also clear that the choice of the tuning method, and options within a method, could have substantial impacts on population sizes and Fs in the terminal year. Table 3.7.19 shows also that there has been substantial downward revision in the estimated size of the 1988 and 1989 year classes. These data suggest a discrepancy between the year class sizes estimated by the recruitment indices at young ages and their subsequent estimates in the VPA. In this assessment, the size of the 1989 year class estimated by the recruitment indices was about 25% larger than the VPA estimate. At present it is not possible to explain these differences, but the Working Group recommends that these be investigated, including possible biological causes.

4 DEMERSAL STOCKS IN DIVISION VIId

4.1 Overview

Landings of cod, whiting, sole and plaice are made by France, Belgium and the UK with less than 1% taken by other countries, in recent years. Landings of cod and whiting are both at historically low levels while those of plaice and sole, in contrast, remain near their peak. Effort by small inshore vessels has increased in both France and the UK while the effort of the larger, more mobile, beam and otter trawlers is more difficult to quantify as these vessels switch effort between areas.

Trends in effort by vessels fishing for sole and plaice are shown in Sections 6.9 and 6.10.

Analytical assessments were carried out on cod, whiting, sole and plaice stocks, using Extended Survivors Analysis for the first time in each stock. The database for cod and whiting remains poor with uncertainties over the level of landings and no information available on discards. Tuning was carried out using commercial and research vessel indices of catch and CPUE. Recruitment estimates were available from the French groundfish survey in Division VIId for whiting but there were no usable estimates for cod. Recruitment estimates were available from French and English young fish surveys for sole and plaice and from the English beam trawl and French groundfish surveys in August and October, respectively.

The SSB of cod is near to the minimum level observed following a period of low recruitment since 1985. Fishing mortality remains at a high level and, at current levels of F, the SSB is expected to decline further. The SSB of whiting is close to historically low levels but appears to be relatively stable and fishing at current F is not expected to lead to a reduction in the near future. However, recruitment since 1983 appears to be at a lower level than in the period 1975-1983 and this will prevent recovery of the SSB to former high levels. The assessment for both of these stocks is rather uncertain.

The SSB of sole has declined since 1988 to close to historically low levels while F remains high. Fishing at current levels of F is likely to lead to a further slight decline in SSB, although recent recruitment appear to be above average and this could temporarily reverse the situation.

The SSB of plaice remains at a high level following recruitment of the very strong 1985 year class. Recruitment in recent years remains close to average but the spawning biomass remains within safe historical limits.

4.2 Cod in Division VIId

4.2.1 Catch trends

Total nominal landings by country and total international landings as estimated by the Working Group are given in Table 4.2.1. Total international landings have been very low in 1991 and 1992 (1,920 t and 2,680 t, respectively, which are the two lowest figures on record). In general, the catches have been rather stable over the period 1976-1992 except for two peaks in 1977-1978 (7,000 and 10,000 t) and in 1986-1987 (13,000 and 14,000 t). These peaks could be explained either by very strong year classes or by migration from other areas (e.g. the North Sea). Catch trends for the period 1976-1992 are shown in Figure 4.2.1. The TAC for the whole Sub-area VII (excluding Division VIIa) was 20,000 t in 1992.

4.2.2 Natural mortality, maturity at age, age composition and mean weight at age

Conventional values of natural mortality and maturity at age are given in Table 4.2.9.

Completely revised compositions and mean weights at age in the catch are given in Tables 4.2.2 and 4.2.3. A SOP correction to the age composition has been carried out on the weight at age data. Weight at age in the stock was assumed to be the same as in the landings. The French catch age composition data have been revised for the period 1985-1991.

4.2.3 Catch, effort and research vessel data

CPUE data were available from the French coastal trawlers fleet since 1985 and from the French groundfish survey (CGFS) conducted in this area since 1988. Unfortunately, the catch rates on the survey are very low (see Table 4.2.4) which means the abundance estimates have a high variance.

4.2.4 VPA tuning and VPA results

Due to the poor quality of data, it was impossible to tune the VPA last year. Therefore, a separable VPA was run. Because of revised data, a tuning VPA has been done this year.

Three tuning runs were made using the shrunk Extended Survivors Analysis (XSA) method. Tuning was performed for the period 1985-1992 with a shrinkage value of 0.5. In the first run there was no constraint on catchability at age below the plus group (age 7). Results showed that q is independent of the abundance for all ages. For the second run, the input ages were 2 and 5. The mean catchability of the commercial fleet became constant at age 3. The results for the survey fleet were not considered. As a result the input data for the last run assumed catchability dependent on stock size for ages less than 2 and independent of age for ages older than 5. Summary statistics from this run are given in Table 4.2.5 and the log catchability residuals for each fleet are plotted in Figure 4.2.2. There is no significant trend of log catchability residuals for the commercial fleet. Five years of data for the survey fleet are not enough to indicate a trend.

A retrospective analysis of XSA with a shrinkage value of 0.5 has been done for the commercial fleet. The results plotted in Figure 4.2.3 seem to be consistent.

Probably due to the revision of the catch at age data mentioned above, the results of the VPA seem to be more realistic than last year, but F at age values are in general very high. Fishing mortality at age from this tuned VPA and stock numbers at age are given in Tables 4.2.6 and 4.2.7, respectively.

4.2.5 Recruitment estimates

As stated above, it was impossible to derive abundance indices from the French survey. It was, therefore, decided to assume mean geometric recruitment at age 1 over the years 1976-1990 for the year classes 1991 onwards (5.00 million fish).

4.2.6 Historical stock trends

Long-term trends in mean fishing mortality, biomass and recruitment are given in Table 4.2.8 and plotted in Figure 4.2.1. The fishing mortality is variable but shows no trend in time. It is currently at its highest level. The spawning stock biomass is currently at its historical minimum of 410 t.

4.2.7 Biological reference points

F_{med} and F_{max} are indicated on the yield and biomass-per-recruit curves in Figure 4.2.5. F_{med} has a value of 1.15, which compares with a *status quo* F of 1.49. F_{max} for total landings is 0.30, well below the current F. F_{med} is shown on the stock-recruitment plot in Figure 4.2.4.

4.2.8 Short-term forecast

The input data for short-term predictions are given in Table 4.2.9. The numbers at age 1 at the beginning of 1992 was overwritten with the geometric mean at age 1 over the period 1976-1990. For prediction, values of F at age are the mean values over 1988 to 1992 scaled to give a mean value of F over ages 2 to 4 as in 1992. Numbers at age 1 in the years 1993 onwards are the geometric mean over the years 1976-1990.

In the absence of any recommendation, only the *status quo* prediction has been run. The results of this prediction are given in Table 4.2.10. The catches are predicted to increase to 3,900 t in 1993 and to 4,900 t in 1994. From 1992 the SSB changes erratically from 400 t to 100 t in 1993 and then to 500 t in 1995. This is due to the assumed maturity ogive and the input population estimates. A more realistic ogive should be considered in the future.

4.2.9 Long-term considerations

This first trial assessment of cod in Division VIId indicates that the stock is at a very low level. The current mortality rate is well above F_{max}. The very low level of SSB should give great concern about this stock if it is really a separate stock.

4.2.10 Comments on the assessment

There is no recruitment index. The tuning process is based on data from only one commercial fleet and one survey vessel. These considerations lead to the conclusion that this assessment should be used with caution. Furthermore, it seems that "the eastern Channel acts as a nursery ground for many cod which subsequently migrate to the southern North Sea and do not return" (Meurou *et al.*, 1993). It would, therefore, be interesting to examine the correlation between the eastern Channel and North Sea stocks in order to know if the assessment in the two areas could be merged in the future. To investigate whether such as relationship exists, a comparison between recruits at age 1 in each stock has been done for the period 1976-1992. The results show that the two stocks are uncorrelated.

4.3 Whiting in Division VIId

4.3.1 Catch trends

Total nominal landings by country and total international landings as estimated by the Working Group are given in Table 4.3.1 for the period 1976-1991. Total international landings decreased from 9,110 t in 1978 to 3,480 t in 1990. They increased to 5,800 t in 1991 and 1992. Catch trends for the period 1976-1992 are shown in Figure 4.3.1. Data are provided only for the human consumption landings. The TAC for the whole of Sub-area VII (excluding Division VIIa) is 22,000 t.

4.3.2 Natural mortality, maturity at age, age composition and mean weight at age

Conventional values of natural mortality and maturity at age are given in Table 4.3.11.

The maturity ogive has been derived from data from the Channel ground fish survey (CGFS). Completely revised age compositions and mean weights at age in the catch are given in Tables 4.3.2 and 4.3.3. A SOP correction to the age composition has been carried out on the weight at age data. Weight at age in the stock was assumed to be the same as in the landings. The French catch age composition data have been revised for the period 1985-1991.

4.3.3 Catch, effort and research vessel data

CPUE data were available for the French coastal trawler fleet (FRATRC) since 1985 and for the French groundfish survey (FRAGFS) conducted in this area since 1988. Effort data and abundance indices at ages 1 and 2 provided by this survey are given in Table 4.3.4.

4.3.4 Catch at age analysis

Last year, it was impossible to tune the VPA due to the low quality of data. Therefore, a separable VPA was run. Because of revised data, this year a tuned VPA has been carried out.

Three tuning runs were made using the shrunk Extended Survivors Analysis (XSA) method. Tuning was performed for the period 1985-1992 with a shrinkage value of 0.5. In the first run there was no constraint on catchability at age below the plus group (age 8). Results showed a correlation between q and abundance but it was not clear that the catchability was dependent on stock size for ages older than 4. For the second run, the input ages were 4 and 6. The mean catchability of the commercial fleet became constant at age 4. The results for the survey fleet were not considered. As a result, the input data for the last run was catchability-dependent on stock size for ages less than 4 and independent of age for ages older than 6. Summary statistics from this run are given in Table 4.3.5 and the log catchability residuals for each fleet are plotted in Figure 4.3.2. There is no significant trend of log catchability residuals for the commercial fleet. Five years of data for the survey fleet are not enough to indicate a trend.

A retrospective analysis of XSA with a shrinkage value of 0.5 has been done for the commercial fleet. The results are plotted in Figure 4.3.3. The five years of survey data were not sufficient to do a retrospective analysis of XSA.

Probably due to the above-mentioned revision of the catch at age data, the results of VPA seem to be more realistic than last year, even if F at age values are still rather variable. Fishing mortality at age from this tuned VPA and stock numbers at age are given in Tables 4.3.6 and 4.3.7, respectively.

4.3.5 Recruitment estimates

Recruitment indices were available from the French groundfish survey in the Eastern Channel.

Estimates of numbers at age 1 and 2 in 1992 were made using the RCT3 program. Input data are given in Table 4.3.8 and outputs in Table 4.3.9a-b. For 1992, RCT3 estimates 26.5 million fish at age 1 and 22.4 million at age 2. These are effectively the VPA mean.

4.3.6 Historical stock trends

Long-term trends in mean fishing mortality, biomass and recruitment are given in Table 4.3.10 and plotted in Figure 4.3.1. The fishing mortality is highly variable but shows no trend in time. It is currently near the average level. The spawning stock biomass has remained low since 1986 and is currently at its second lowest level of 6,090 t.

4.3.7 Biological reference points

F_{med} is indicated on the yield and biomass-per-recruit curve in Figure 4.3.5. It has a value of 0.65 which is below the *status quo* F of 0.87. F_{max} for total landings is 1.1, well above the current level of F and close to F_{high} (1.07) but the curve is flat-topped. F_{med} and F_{high} are also shown on the stock-recruitment plot in Figure 4.3.4. F_{high} is largely determined by a few large year classes.

4.3.8 Short-term forecast

The input data for short-term predictions are given in Table 4.3.11. Numbers at ages 1 and 2 at the beginning of 1992 were overwritten with RCT3 estimates. For prediction, values of F at age are the mean values over 1988 to 1992 scaled to give a mean value of F over ages 2 to 4 as in 1992. Numbers at age 1 in the years 1993 onwards are the geometric mean over the years 1976-1992.

In the absence of a separate TAC for Division VIId, only the *status quo* prediction has been run. The results of this prediction are given in Table 4.3.12. The catches are predicted to decrease to 4,800 t in 1993 and then to increase slightly to 5,200 t in 1994. At the same time, the spawning stock biomass is predicted to increase to 6,300 t and 6,800 t at the beginning of 1994 and 1995, respectively.

4.3.9 Long-term considerations

This first trial assessment of whiting in Division VIId indicates that the stock is stable at a low level. The current mortality rate is above F_{med} and may not be sustainable in the long term. Increasing the current level of fishing mortality will lead to a reduction in the SSB. No benefit in terms of long-term yield can be gained by increasing fishing mortality above the current level.

4.3.10 Comments on the assessment

Recruitment indices provided by only one survey for 5 years do not correlate well with VPA estimates. The tuning process is based on data from only one commercial fleet and one survey vessel. These considerations lead to the conclusion that this assessment should be used with caution. Furthermore, it seems that there is a relationship between whiting in Divisions VIId and IVc (Meurou *et al.*, 1993). To investigate whether this relationship exists, a comparison between recruits at age 1 in each stock has been done for the period 1976-1992. The results show that the two stocks are uncorrelated.

There are large year effects. The F at age results are indicative of a potentially large problem with the assessment. The cause of this feature is not known.

4.4 Sole in Division VIId

4.4.1 Catch trends

Landings data reported to ICES are shown in Table 4.4.1 together with the total landings estimated by the Working Group. The trend in landings is shown in Figure 4.4.3. Landings have been stable over the past 5 years since peaking at about 4,867 t in 1987. The landings in 1992 were estimated to be 4,061 t, approximately 16% higher than the agreed TAC and the figure predicted at *status quo* fishing mortality. Under-reporting of landings of up to 30% occurred in some years.

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

As in previous assessments natural mortality was assumed to be constant over ages and years at 0.1. The maturity ogive used was knife-edged with sole regarded as fully mature at age 3 and older. Quarterly catch and weight at age compositions for 1985-1992 were available from Belgium, France and England. Prior to this, age data were provided from Belgium and England only and the data base prior to 1980 was considered unreliable due to poor sampling for age. The age composition data and the mean weight at age in the catch and stock are shown in Table 4.4.2. Stock weights were calculated from a smoothed curve of catch weights interpolated to 1 January. Data for 1982-1991 were updated with minor revisions. The data do not include discards which are not sampled for this stock.

4.4.3 Catch, effort and research vessel data

Data were available from 5 commercial fleets covering inshore and offshore trawlers and fixed net vessels. Age compositions were also available from the English beam trawl surveys in August in the eastern Channel since 1988. Both commercial and survey indices show that CPUE declined steadily from 1988 to 1990 with an increase in 1991 and 1992. Trends in CPUE and effort are shown in Section 6.9 (Tables 6.9.1-6.9.3 and Figures 6.9.1 and 6.9.2).

These data were used to tune the VPA. The range of ages and years used in each fleet is shown below and the input file is given in Table 4.4.3.

4.4.4 Catch at age analysis

Analysis was carried out on ages 1-10+ because the older age groups showed high levels of variance.

Fleet	Years	Ages
1. Belgian beam trawl	1980-92	2-15+
2. Hastings trammel	1981-92	2-15+
3. UK >40' beam trawl	1981-92	2-15+
4. French offshore trawlers	1983-92	2-15+
5. French inshore trawlers	1985-92	2-15+
6. English beam trawl survey	1988-92	1-6+

A four stage process was used to select the final tuning method.

1. Trial runs were made using XSA to select the ages to be treated as recruits and the ages for which catchability can be assumed to be constant;

2. Trends in catchability were examined for fleet problems;

3. A retrospective analysis was then made to compare the effect of different SE weightings on shrinking to the mean;

4. Once the level of SE had been selected, the XSA run was compared with a Laurec-Shepherd analysis and the most appropriate method adopted.

1.1 Selection of ages to be treated as recruits (i.e. catchability likely to be influenced by year class strength).

A trial run was made with all ages below 8 treated as recruits. Examination of the regression statistics showed that the slopes +/- 2 x SE for ages 2-7 were not significantly different from 1.0. The catchabilities were, therefore, assumed to be independent of year-class strength above age 1 for all subsequent runs.

1.2 Selection of ages above which catchability is constant. Catchability was set constant above age 6, 7 and 8 in trial runs. There was little difference between the results and no obvious age at which catchability levelled off. Age 6 was selected for the final analysis.

2. Trends in fleet catchability were examined from the initial runs. There were no unacceptable trends in q and the results from the final run are plotted in Figure 4.4.1.

3. Retrospective analysis was carried out using SEs of 0.3, 0.5 and 0.8. There was no apparent tendency to over- or underestimate F in previous years and shrinkage

had a relatively small effect on the result. A medium shrinkage of 0.5 was, therefore, selected and the results are shown in Figure 4.4.2.

4. Comparison was made with Laurec-Shepherd tuning, since this was the method used last year. The XSA run gave mean F values which were up to 10% higher than the L-S result from last year and up to 20% higher if compared with L-S from the current year. However, since the Belgian effort series had been revised and a survey fleet added to the tuning fleets, the results were not directly comparable. A further difference comes from the way the terminal Fs are set on the older age groups. In the XSA the mean of 5 older ages is used but in the L-S the average of 4 years downweighted by a ratio of 0.8 is used for historic reasons. This will tend to give lower F values on the older age groups in the L-S analysis with a resultant effect down the cohort.

In view of the fact that the XSA method is regarded as a more robust method giving less year to year variability, the results were accepted to initiate the VPA. The diagnostics from the final run are given in Table 4.4.4 and the fishing mortality and stock numbers from the VPA output in Table 4.4.5.

4.4.5 Recruitment estimates

Research vessel survey indices of 0-, 1- and 2-year-olds were available and are shown in Table 6.9.4. The input file and results from the RCT3 program are shown in Tables 4.4.6 and 4.4.7.

The estimates of the 1990-1992 year classes as 1- year-olds from XSA and RCT3 are shown below:

	XSA	RCT3
1990	26.3	28.1
1991	12.2	12.8
1992	-	16.4

The estimate of the 1990 year class from both methods was similar and the XSA output was accepted. The 1991 year class estimate from RCT3 was strongly influenced by the English beam trawl survey which had a weighting factor of 0.65 but was based on only 3 points. If this survey was excluded, the 1991 year class was estimated to be about 19 million. As the RCT3 output including the English survey was similar to the XSA figure, the year class estimate of 12.2 million from XSA was accepted. However, in view of the strong signal from the English beam trawl survey this estimate is rather uncertain and may need to be revised. The 1992 year class was estimated from only two surveys with low correlation coefficients and the GM (19.8 million) over the period 1983-1990 was used for this and subsequent year classes. The 1989 year class which was set at average last year appears to be about 70% above the AM of 21 million. Preliminary information from the English YFS in Division VIId (Table 6.9.4) suggests that the 1993 year class may be significantly above average.

4.4.6 Historical stock trends

Trends in yield, fishing mortality, SSB and recruitment are shown in Table 4.4.8 and Figure 4.4.3. Fishing mortality has increased since 1982 to peak in the period 1987-1989. Since then it has stabilised at around 0.5. Recruitment has shown alternate weak and moderate year classes since 1984 with only the 1989 year class substantially above average but the 1991 and 1993 year classes may also be above average.

4.4.7 Biological reference points

A stock-recruitment scatter plot is shown in Figure 4.4.4. The value of F_{med} from the plot corresponds to 0.38 kg/recruit which is equivalent to a reference F_{3-8} of 0.45 and is 20% below current F (0.559). The yield per recruit input values are given in Table 4.4.9. and the output summary in Table 4.4.10. YPR and SSB/R curves are shown in Figure 4.4.5. Assuming AM recruitment of 21 million, the equilibrium yield will average 3,690 t with a corresponding SSB of 5,700 t, approximately 20% below current levels of biomass. Since there is only a relatively short time series available, it is not clear what level of SSB could be used to determine the minimum biologically acceptable level.

4.4.8 Short-term forecast

The input data for the catch forecasts are given in Table 4.4.9. Stock numbers in 1993 were taken from the VPA output for ages 2-10+ and the GM recruitment of 19.8 million was used for age 1 in 1993, 1994 and 1995. The exploitation pattern was the mean of the period 1990-1992, scaled to the 1992 F(3-8) value of 0.559. Catch and stock weights at age were the mean for the period 1990-1992 and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Table 4.4.11 and Figure 4.4.5. The predicted catch in 1993 is 4,500 t from a SSB of 7,800 t. This compares with a figure of 3,600 t forecast last year. The main difference is due to the influence of the 1989 year class which was estimated to be average last year because none of the surveys were well correlated with recruitment. This was recognised as a likely underestimate and attention was drawn to the possible mismatch between predicted and observed catches in the comments on the assessment. Continuing with the same level of F implies a drop in catch to 3,800 t in 1994 and a fall in SSB from 6,000 t in 1994 to 5,700 t in 1995.

4.4.9 Medium-term predictions

No simulation was carried out on this stock.

4.4.10 Long-term considerations

The current level of F is about 20% above F_{med} and, at this level, the equilibrium SSB is predicted to fall to below 5,700 t which is slightly lower than the minimum observed in the short time series available. There does not appear to be any danger of recruitment failure even at this level of stock since the 1989 year class was very strong and it is possible that the 1991 and 1993 recruitments will also be above average. Since the fishery is so dependent on the recruiting year classes, measures to improve the exploitation pattern will benefit the fishery in the long term. The minimum landing size of 24 cm is below the 50% length of maturity which is approximately 28 cm for female sole. The Working Group notes that protection of juveniles could result in a larger sustainable yield and SSB.

4.4.11 Comments on the assessment

The quality control diagrams are shown in Table 4.4.12.

There have been a number of changes in the current assessment compared with previous years. The main difference is the use of XSA tuning which has resulted in a slightly different exploitation pattern with slightly lower Fs at younger ages and higher Fs on the older age groups. It is expected that in future years the use of XSA together with shrinkage to the mean will result in a more consistent assessment from year to year. Differences in SSB in 1992 and 1993 compared with last year's assessment are largely the result of better estimtes of recruitment, particularly of the 1989 year class.

The addition of the English beam trawl survey age composition to the tuning fleets is a further change which has influenced the F on the younger age groups because the survey was well correlated with the VPA.

It should be noted that there are indications that the 1991 year class was conservatively estimated and this could lead to some discrepancy between predicted and observed catches in 1994.

4.5 Plaice

4.5.1 Catch trends

Landings data reported to ICES are shown in Table 4.5.1 together with the total landings estimated by the Working Group. The trend in landings is shown in Figure 4.5.5. Landings peaked at 10,400 t in 1988 and have declined since then to 6,337 t in 1992 which was close to the figure of 6,600 t predicted in last year's assessment.

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

As in previous assessments natural mortality was assumed to be constant over ages and years at 0.12. The maturity ogive used is shown in Table 4.5.10 (input to YPR). Age compositions for 1980-1992 were available for the UK and for 1981-1992 for Belgium. However, levels of sampling prior to 1985 were poor and those data are considered to be less reliable. Age compositions were only available for France since 1989.

Quarterly catch weights were available from the UK since 1980 and from Belgium since 1986. French catch weights have been collected since 1989. The age-composition data and the mean weight at age in the catch and stock are shown in Table 4.5.2. Stock weights were calculated from a smoothed curve of catch weights interpolated to 1 January. Data for 1980-1992 were updated with minor revisions. The data do not include discards which are not sampled for this stock.

4.5.3 Catch, effort and research vessel data

Commercial effort and CPUE data were available from 4 commercial fleets covering inshore and offshore trawlers and fixed net vessels. Most fleets show a decline in CPUE from 1988/1989 to 1992. Effort has increased in all fleets since 1983 but showed a decrease in 1992. Trends in CPUE and effort are shown in Tables 6.10.1-6.10.2 and Figures 6.10.1-6.10.2.

Age compositions were available since 1988 from the English beam trawl survey in August and the French groundfish survey in October in the eastern Channel.

The commercial and survey data were used to tune the VPA. The range of ages and years used in each fleet is shown below and the input file is given in Table 4.5.3.

Fleet	Years	Ages
1.Hastings trammel	1984-92	2-15+
2.Rye Trawl	1984-92	2-15+
3.Belgian beam trawl	1981-92	2-15+
3.UK >40' beam trawl	1983-92	2-15+
4.English beam trawl survey	1988-92	1-6+
6.French groundfish survey	1988-92	1-6+

4.5.4 Catch at age analysis

An analysis was carried out on ages 1-8+ because the older age groups showed high levels of variance.

A four stage process was used to select the final tuning method.

1. Trial runs were made using XSA to select the ages to be treated as recruits and the ages for which catchability can be assumed to be constant.

2. Trends in catchability were examined for fleet problems.

3. A retrospective analysis was then made to compare the effect of different SE weightings on shrinkage to the mean.

4. Once the level of SE had been selected, the XSA run was compared with a Laurec-Shepherd analysis and the most appropriate method adopted.

1.1 Selection of ages to be treated as recruits (ie. catchability likely to be influenced by year-class strength). A trial run was made with all ages below 7 treated as recruits. Examination of the regression statistics showed that the slopes +/- 2 x SE for ages 2-6 were mostly not significantly different from 1.0. The catchabilities were, therefore, assumed to be independent of year-class strength above age 1 for all subsequent runs.

1.2 Selection of ages above which catchability is constant. Catchability was set constant above age 5, 6 and 7 in trial runs. There was little difference between the results and no obvious age at which catchability levelled off. Age 6 was selected for the final analysis.

2. Trends in fleet catchability were examined from the initial runs. There were no unacceptable trends in q and the results from the final run are plotted in Figures 4.5.1.

3. Retrospective analysis was carried out without including the survey fleets as the time series for these fleets was too short. Shrinking to SEs of 0.3, 0.5 and 0.8 was examined There was an apparent tendency to underestimate F in previous years. Strong shrinkage was avoided in order not to give undue weight to the historic pattern of fishing mortality. A weak shrinkage of 0.8 was, therefore, selected and the results are shown in Figure 4.5.2.3.

4. Comparison was made with Laurec-Shepherd tuning, since this was the method used last year. The XSA run gave mean F values which were slightly higher in the period 1983-1986 and up to 20% lower in more recent years (Figures 4.5.3- and 4.5.4). Since two survey fleets had been added to the tuning file, a run was made without the fleets as a comparison. The results obtained were similar, with the XSA giving lower mean F values in recent years. A separable VPA was run to see if there was any indication of a change in fishing pattern and the results are shown in Table 4.5.4. There was no clear pattern but examination of the catch at age table showed a decrease in abundance of catch at ages 3, 4 and 5 in 1992 which was clearly reflected in the XSA results. There was also a decrease in effort indices in 4 of 6 commercial fleets in 1992 which would confirm the reduction seen in the XSA output for the 1992 F values.

Despite the differences between the XSA and L-S runs, it was decided to proceed with the VPA using the final XSA run. The diagnostics from this run are given in Table 4.5.5 and the fishing mortality and stock numbers from the VPA output in Table 4.5.6.

4.5.5 Recruitment estimates

Research vessel survey indices of 0-, 1- and 2-year-olds were available and are shown in Table 6.10.4. The English beam trawl survey and French groundfish survey indices were included in the XSA tuning for ages 1 and 2 but it was still necessary to obtain a recruit estimate using RCT3 for 1-year-olds in 1993 and to check the values of the 2- and 3-year-olds in 1993. The input for RCT3 and the output results are given in Tables 4.5.7 and 4.5.8.

The estimates of the 1990-1992 year classes as 2- and 3-year-olds in 1993 from XSA and comparable values from RCT3 are shown below:

Year class	XSA est. from 1993	RCT3
1990	17.2	15.4
1991	28.2	26.2

The estimates of the 1990 and 1991 year classes from both methods were similar and the XSA output was accepted. GM recruitment of 29.2 million at age 1 was used for the 1992 year class and for later year classes.

4.5.6 Historical stock trends

Trends in fishing mortality, SSB and recruitment are shown in Table 4.5.9 and Figure 4.5.5. Fishing mortality has been relatively constant over the period 1980-1991 with an apparent decrease in 1992. Spawning stock biomass increased rapidly in 1988 following recruitment of the strong 1985 year class. Since 1990 it has declined steadily. Apart from one large year class, recruitment has been close to the GM level of 29 million since 1981.

4.5.7 Biological reference points

A stock-recruitment scatter plot is shown in Figure 4.5.6. The value of F_{med} from the plot corresponds to 0.42 kg/recruit which is equivalent to a reference F_{2-6} of 0.4 and is at the same level as current F (0.42). The yield per recruit input values are given in Table 4.5.10 and the output summary in Table 4.5.11. The YPR and SSB/R curves are shown in Figure 4.5.7. Assuming a recruitment of 29 million, the equilibrium yield will average 7,400 t with a corresponding SSB of 13,100 t, slightly above the current levels of biomass. Since recruitment has been very stable at levels of SSB ranging from 6,000 t to 18,000 t it is not clear what level the Minimum Biologically Acceptable Level (MBAL) should be set at from the relatively short time series available.

4.5.8 Short-term forecast

The input data for the catch forecasts are given in Table 4.5.10. Stock numbers in 1993 were taken from the VPA output for ages 2-8+ and the recruitment of 29.2 million was used for age 1 in 1993, 1994 and 1995. The exploitation pattern was the mean of the period 1990-1992, scaled to the 1992 $F_{(2-6)}$ value of 0.42. Catch and stock weights at age were the mean for the period 1990-1992 and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Table 4.5.12 and Figure 4.5.7. The predicted catch in 1993 will be 6,600 t from a SSB of 9,500 t. This compares with a figure of 6,400 t forecast for the catch for last year. Continuing with the same level of F implies an increase in catch to 7,162 t and in SSB to 10,500 t in 1994 and 11,000 t in 1995.

4.5.9 Medium-term predictions

No simulation was carried out on this stock.

4.5.10 Long-term considerations

The current level of F is close to F_{med} and, at this level, the SSB is predicted to increase slightly. This may be an optimistic view as a result of using new procedures for tuning the VPA. The stock is being fished down from an historically high level following the strong recruitment in 1985 and, at average levels of recruitment, the decline will continue if fishing mortality increases.

4.5.11 Comments on the assessment

There have been a number of changes in the current assessment compared with previous years. The main difference is the use of XSA tuning which has resulted in a different exploitation pattern with lower Fs at all ages in 1992 and reduced mean F in recent years. The addition of the English and French trawl survey age compositions to the tuning fleets is a further change although this does not appear to have influenced the outcome of the tuning significantly. The quality control diagram are given in Table 4.5.13.

This assessment appears to be similar to that for North Sea plaice where there is a discrepancy between a high stock as indicated from the assessment and decreasing CPUE and landings in the fishery. In both areas, fishermen have complained of the absence of fish and an inability to take their quota. Also in both stocks, XSA indicates historically low fishing mortality. In the North Sea fishermen have been unable to catch the landings predicted in 1992 and in Division VIId the 1992 landings were also lower than the predicted catch but only slightly. It is not clear what is causing this anomaly but it is possible that recruitment is being over-estimated possibly as a result of using historical data series which may not reflect possible changes in plaice recruitment brought about by increasing sea temperatures in recent years.

5 SAMPLING LEVELS

Sampling levels have been reported regularly in the administrative report of the Demersal Fish Commitee. The numbers given are, however, not entirely comparable between years and between countries and can thus not be presented in an overview format.

It is suggested that the countries involved prepare comparable sampling overviews for the next meeting of the Working Group. The overview should give annual figures for the period 1988-1993 and should contain:

No. of samples, no. measured and number aged.

The data should be given by stock and separately for the following categories:

Human consumption, discards, industrial by-catch and survey data.

PART B

6 ASSESSMENT COMMENTARY

6.1 Cod in the Skagerrak and Plaice in the Kattegat/Skagerrak

Assessments previously presented for cod in the Skagerrak and plaice in the Kattegat (Anon.,1992) included CPUE data broken down by age groups based on the overall age distribution estimated in Danish landings. However, the log-book primary information only provided catch (kg) by species and sorting category per trip. This procedure makes the CPUE series correlated between fleets. As a result tuning fleets have been defined for the present assessment.

The Danish log-book system, established in 1987, records landings by value and by weight for each species and market size category. The sampling unit is the trip. Also information on vessel size, fishing gear and fishing area is available.

The biological data - age and length compositions - refer to the market category of each species and the sampling is stratified between harbours and time periods. The sampling unit is the market size category by harbour and time period. It is thus not possible to make a direct estimate of the catch by age for any fleet. The age distribution may, however, be approximated using the difference in market size categories between fleets, e.g. trawler landings will have a higher share of small cod than landings from gill-netters.

The approach presented here only includes vessels between 10 and 20 GRT in order to standardize fishing effort. These vessels account for almost 50% of the annual numbers of trips in the Danish human consumption fishery. Trips which cover two areas (eg. Skagerrak/North Sea, Kattegat/The Belts) or trips where more than one type of gear have been used have been omitted from this analysis.

Fleets were defined by gear and target species. Gear included are trawl, gill net and Danish seine. Target species are inferred from the value of the landings, as follows:

Target	Rule species
Cod	Cod accounts for the largest value. The value of cod exceeds 20% of the total value of that landing.
Plaice	Plaice accounts for the largest value. The value of plaice exceeds 20% of the total value of that landing.
Nephrops	*Nephrops* accounts for the largest value. The value of *Nephrops* exceeds 40% of the total value of that landing.
Others	All other trips.

This grouping is then supplemented with information on the gear used by the vessel.

Three cod and three plaice fleets have been selected. For cod these are:

Gill netters Trawlers directed at cod
Nephrops trawl fishery

The *Nephrops* trawl fishery shows low catch rates of cod, but is based on a large number of observations.

For plaice three directed fisheries were identified

Gill netters Trawlers directed at plaice
Danish seiners directed at plaice

These data were presented as CPUE (no/age group/trip) and are given in Table 2.2.7 and 2.5.4.

6.2 Cod in Sub-area IV

6.2.1 Change in tuning method

Table 6.2.1 gives a comparison of results for 1991 and 1992 between (a) the 1992 Working Group assessment, (b) the Laurec-Shepherd method used in the same way as in last year's assessment, and (c) the XSA results. The three data sets in general give similar results, but this year's assessment produces slightly lower Fs and slightly higher stock sizes than those estimated in the1992 assessment. This is true for both tuning methods but in addition the effect is accentuated by the use of XSA. A further reason is that there have been slight upwards revisions to the catch numbers for 1991.

6.2.2 Inclusion of discards in the assessment

ACFM recommended that the North Sea cod assessment should include discards. An historical series of discard data is available only for the Scottish fleets which fish mainly in the northern North Sea. Given this, and the fact that the Scottish fleets do not take as high a proportion of the total international catch as is the case for haddock and whiting, it is not considered appropriate to estimate total international discards from the Scottish data. Intermittent observations are available for other fleets, and these have indicated that at times substantial quantities of young cod are discarded. The Working Group, therefore, recognises the importance of including estimates of discards in the cod assessment. It recommends that the data which are currently available, including survey data, should be examined to see whether they could be used to construct an historical series of discard data for all fleets.

6.2.3 Data problems

The validity of the assessment is not only limited by the lack of discards in the assessment but also by problems with non-reporting and/or misreporting. The fishery has been operating under a restrictive regulation regime in recent years and various fisheries have been stopped, officially at least.

In the mixed human consumption fisheries this may lead to an increase in discards which is not reflected in the present assessment. But there are also reports of extensive misreporting and non-reporting from 1992 onwards. The apparent correspondence between the Working Group landings estimates and the official landings (Table 3.2.1) covers various levels of mismatch between these data sets for various fleets, which happen to be the same in total. It seems that there is a large spread in the local trend in stock abundance around the average emerging from the assessment. For this reason extensive unreported landings are taking place in some areas while it has been impossible to catch the quota in others.

Some adjustment has been made for some fleets, but this has been based on discussions with the industry and various semi-quantitative checks on alternative sources of information, and not on systematic sampling of landing activities outside official channels.

There is reason for concern about the possibilities to provide useful assessments in the future if this problem persists without moves being taken to quantify the extent of non reporting and misreporting.

6.3 North Sea Haddock

6.3.1 Estimation of non-reported catch

The TAC for North Sea haddock in 1992 was 60,000 t while the reported landings amount to only 50,000 t. In the UK, which has the largest share of the TAC, the fishery closed before the end of the year due to exhaustion of the quota. It is well known that significant quantities of haddock were landed without being recorded officially. It seems very unlikely, therefore, that the TAC was undershot and that there is a need to account of the non-reported landings in the assessment.

Non-reporting by its nature is problematic to estimate and reports in the popular press are likely to be highly exaggerated. A figure of about 20-50% of the landings being non-reported seems likely, however. A guesstimate for the non-reported landings would be about 20,000 t. It would be desirable to obtain some objective support for this figure to provide independent corroboration.

In order to try to verify the non-reported catch estimate two analyses were performed using models which can estimate missing data within catch-at-age analysis. The first method is a model (SSV) described by Cook and Reeves (in press) which is basically a separable VPA with auxiliary data. The second approach was an extended XSA analysis developed by Skagen (personal communication). The latter is described in the 1993 Norway Pout and Sandeel Working Group report.

In the SSV analysis, the data for 1991 and 1992 were assumed to be missing since misreporting is believed to have occurred in both years. Survey data were used in the analysis. The survey indices used were obtained by combining the English, Scottish, German and IYFS groundfish surveys using factor analysis. Results from SSV are shown in Table 6.3.1. For 1991, there was little difference between the observed 1991 catches and those actually estimated from sampling.

In the XSA analysis, only the 1992 catches were treated as missing and tuning was performed with both commercial CPUE and research vessel data. A summary of the results is given in Table 6.3.2.

Table 6.3.3 shows the age compositions estimated by the two methods and the age compositions obtained from sampling. Both the analytical methods suggest that the official catch for 1992 is too low, although the XSA estimates are close to the unadjusted age compositions. This may well be due to the use of CPUE data from those fleets affected by misreporting.The addition of 20,000 t to the official landings improves the agreement between the estimates for some year classes, but not consistently. However, the disparity between the age compositions both between the models and the sampled landings does not offer sufficient basis to use the model-estimated age compositions in the assessment.

Although the model estimates support the need to augment the official landings, it remains a matter of speculation which figure to use. In the absence of any better estimates, the guess of 20,000 t has been used. This implies 13,000 t of discards. An important feature to note is that the estimated catch of one-year-old fish in 1992 appears to be very low compared with last year's prediction and the model estimates. It is difficult to explain this discrepancy. The introduction of a larger mesh size may be responsible but this seems unlikely. Unfortunately, the year class involved makes a large impact on the catch forecast since it is believed to be above average. This problem undermines the whole assessment and needs to be investigated further.

6.3.2 Comparison with previous tuning method

At the 1992 Working Group meeting the VPA for this stock used Laurec-Shepherd tuning with a tricubic taper over 10 years, and a shrinkage SE of 0.2. To determine what effect the change in tuning method had on the catch-at-age analysis, a run was made using this metho d with the current data. Trends in mean F from the two methods are shown in Figure 6.3.1. It can be seen that the trends from the two methods are very similar, suggesting that difference in the current and previous assessments result from the data rather than the methodology.

6.3.3 XSA settings

The regression statistics from an XSA run with all ages treated as recruits indicated that for all ages the slope did not differ significantly from unity. In the absence of information to the contrary, ages below three were treated as recruits. This reflects previous practice with this stock where tuned estimates of population numbers in the most recent year have typically been overwritten with RCT3 estimates. Similarly, the diagnostics from a run where catchability was allowed to vary with age for the full age range did not show any significant differences in catchability with age. Previous experience suggests that the convergence properties of the XSA are improved if the youngest age at which catchability is regarded as constant is lowered. For this reason catchability was set as constant at ages 8 and older.

6.3.4 Improving exploitation pattern

In heavily exploited stocks older and larger fish are rare because the probability of a fish reaching a high age is very low. In these circumstances, if a fisherman wishes to increase his catch, he has to catch more small fish. This can only be done if he decreases the selectivity of his gear. There is, therefore, an incentive to reduce selectivity. If managers seek to reverse this effect by increasing the mesh size, for example, they are working against the economic imperative. Enforcement of gear measures is generally poor for practical reasons. This means that fishermen will only adopt larger mesh sizes if it is to their advantage. Lowering the overall exploitation rate, to increase the probability of fish reaching a higher age, is one of the few ways to do this unless specific economic incentives are applied. Simply trying to increase the mesh size without addressing the problem of enforcability is unlikely to be effective.

6.4 Whiting in Sub-area IV

6.4.1 Split of the North Sea whiting assessment

The quarterly distribution of the total international whiting catches in 1989 (Figure 6.4.1 taken from the STCF database) indicates a division between a northwestern and a southeastern component. Similar distribution patterns are found in some survey data, but closer inspection of preliminary distribution charts of the abundance of 0, 1 and 2+ age-groups from the quarterly IBTS 1991-1993 shows that the pattern changes between years and quarters.

The consistency of a division of landings and abundance should be checked further.

Based on such investigations it might be possible to split the catch at age data on areas in order to make separate assessments for the two areas and, conditional on the outcome from such experiments, to separate the North Sea whiting into two stocks in future assessments and predictions.

The usefulness of such an approach should, however, be evaluated carefully. Managers may have little interest in a split due to the practicalities involved. A more realistic assessment of the main piscivorous predator in the North Sea may, on the other hand, represent an important improvement to the realism of multispecies assessments.

6.4.2 Age determination problems

Otolith exchange programmes have demonstrated serious inconsistencies in age determination of whiting between and within countries. These problems are still not solved. The Working Group is of the opinion that it is important that moves are taken to improve the age determination of whiting. A workshop to this end should be held in 1994.

6.5 Saithe in Sub-area IV

6.5.1 Change in tuning methods

Table 6.5.1. gives a comparison of results for 1991 and 1992 between (a) the 1992 Working Group assesment, (b) the Laurec-Shepherd method used in the same way as in last year's assessment and (c) the XSA results. The differences between last year's assessment and this year's is the revision of the catch-at-age data for 1991. The XSA give slightly lower Fs and higher stock sizes than the Laurec-Shepherd tuning method.

6.5.2 Recruitment estimates

The indices of the observers in Table 3.5.9 are derived from 11 observers along the western coast of Norway. From May to November they send in each month a form in which they have evaluated the number of 0-group saithe which have been observed along the shores. The evaluation is on a scale from 0 to 10 where 5 is an average year class.

The cruise indices are derived from a survey in April-May specially conducted for 0-group saithe. However, the trawl used (a capelin trawl) was not appropriate for the purpose. In 1993 a new time series has been started using a new 0-group trawl.

6.6 North Sea Sole

6.6.1 Catch, effort and research vessel data

Table 6.6.1 gives all available series of "measured" and "derived" indices of effort and CPUE in the fleets. Figure 6.6.1 shows the CPUE trends in units standardized to the mean value in each series. Trends in effort are using similar units are plotted in Figure 3.1. The nature of and trends in these series have been described in detail in previous reports. The general trends in effort are increasing since 1983. CPUE has fluctuated but decreased in 1992 in all fleets.

The results of the Dutch, Belgian and German beam trawl surveys are given in Table 6.6.2. The 1993 results are preliminary. The German indices are derived from a subset (coastal stations) of the total indices and therefore differ from those used in the tuning. No data from 1993 were available at the Working Group meeting. The available recruitment indices from the "Tridens" SNS surveys are given in Table 6.6.3. The national indices from the DFS series, from which the international 0-group and 1-group indices are derived, are also given in Table 6.6.3.

6.6.2 VPA tuning and results

In addition to the final tuning, a number or trial tuning runs was made using various methods. The results of these methods on the VPA estimates of mean fishing mortality, SSB and recruits at age 1 have been summarized in Table 6.6.4. In general the methods without shrinkage show higher levels of fishing mortality compared to those with shrinkage. The trends in SSB are similar in all runs and the difference between the highest and lowest SSB estimate is about 10%. Recruitment patterns are also similar. All methods estimate recruitment in 1991 to be well below average. All tuning runs, except the separable, estimate recruitment in 1992 (1991 year class) to be around 430 million 1-year old recruits (4 times average). The separable analyses estimate it much higher at a level never historically observed. The exploitation patterns estimated by the various methods are shown in Figure 6.6.2.

6.6.3 Management advice

Apart from changes in technical measures such as mesh size, closed areas and closed seasons, which are directed to changes in the exploitation pattern or protection of certain stock components, most management advice given by ACFM relates to changes in the level of fishing mortality. Many heavily exploited commercial stocks require a reduction in the level of fishing mortality, either to maintain these within historically observed safe levels or to improve the expected yields. The most popular way to reduce fishing mortality is by reducing fishing effort.

In the case of North Sea sole the relationship between the level of fishing mortality and various indices of international fishing effort (derived from Table 6.6.1) is, however, rather poor. Figure 6.6.3.a-b shows the relationship between mean F and international effort derived from Dutch and Belgian CPUE indices. Over a wide range of effort levels, F remains rather constant, suggesting that catchablity decreases with increasing effort. Similar poor relationships have been demonstated in the reports of the Flatfish Working Group and the Irish Sea Working Group in the early 1980s for various different stocks, when these relationships were used to tune the final VPA.

In the case of sole it is obvious that effort has increased significantly in the observed period, while the increasing trend in all popular measures of mean F (F2-8, F3-10, Fbarc, Fbarp) is less clear. Is it possible that this relationship is not genuine? This problem clearly needs to be investigated in much more detail. In the meantime this problem should also be kept in mind when reduction is required in fishing mortality by reduction in effort.

6.7 North Sea Plaice

6.7.1 Other CPUE and survey data

Table 6.7.1 shows CPUE trends for 6 fleets, 2 of which are used in the VPA tuning (UK seine, NL beam). All 6 show a decline from 1990 to 1991 and a further decline in 1992. Four are at historical low levels (Figure 6.7.1). The NL beam trawl survey also shows a decline in recent years (Figure 6.7.2, Table 6.7.2), although this decline was reversed in 1993 for the 2+ and 3+ numbers. Table 6.7.3 shows the survey data used to derive the recruitment estimates.

6.7.2 Comments on VPA tuning

Several preliminary tuning runs were completed for this stock, revealing some substantial differences in results. Figure 6.7.3 shows Fs at age in 1992 from three different analyses: XSA shrunk, LS shrunk, and ADAPT. XSA and ADAPT gave very similar results, but the Fs from the LS-shrunk analysis were much higher at some ages, notably 3,4,9, and 10. All three models estimated the exploitation pattern to be sharply peaked at age 5. It was thought that the Fs at ages 3 and 4 from the LS-shrunk were unrealistically high (about one-third higher than the mean F at ages 3 and 4 from 1988-1990) given the apparent trend in exploitation away from younger fish in recent years (Anon., 1993). If exploitation is shifting towards small fish again, the XSA-shrunk model used in this assessment may have underestimated F on the younger ages. Results from a LS without shrinking estimated substantially higher Fs at most ages than other methods, which was expected given the decline in the tuning indices in 1991 and 1992.

The exclusion of the English groundfish survey from the tuning for reasons noted previously had minimal effect on the results; mean F(2-10,u) = 0.47 compared to 0.46 for XSA shrunk.

Figure 6.7.4 compares the exploitation pattern in 1991 from the three models described above with that from the 1992 assessment. All three models run in 1993 show a more dome-shaped F pattern in 1991 compared with last year's assessment.

The choice of lower and upper ages in the catchability analysis module of XSA also affected tuning results. The choice of 5 as the lower limit was made after examination of preliminary analyses with 3 as the choice. It was thought that the choice of 5 improved some of the tuning relationships at ages 3 and 4. The Fs at younger ages were lower when 5 was used.

6.7.3 Comments on the catch forecast

About 40% of the *status quo* forecast for 1993 is made up of catch at ages 1-3, for which estimates of recruitment were used as input (GM at age 1, RCT3 estimates for ages 2 and 3). This figure increases to 65% at ages 2-4 in 1994. If there is a tendency for the recruitment indices to overestimate recruitment, the resulting catch forecasts will obviously be too high. This may be a factor contributing to the continued decline in catch expected in 1993.

6.8 Eastern Channel Whiting

The retrospective analysis of XSA with a shrinkage value of 0.5 was not satisfactory (Figure 4.3.3). An attempt was, therefore, made to improve the result with a shrinkage value of 0.2. The result was quite similar (Figure 6.8.1).

6.9 Eastern Channel Sole

Indices of CPUE and effort from Belgian, French and UK fleets are given in Tables 6.9.1 and 6.9.2 and the trends shown in Figures 6.9.1 and 6.9.2. The Belgian effort and CPUE series have been completely revised using new fishing power corrections where

FP = 0.000204 x HP**.23

A strong decline in CPUE was evident in the Hastings trammel and French fleets between 1986 and 1990 with some recovery in recent years. A similar decline in catch rate was seen in the English beam trawl CPUE (Table 6.9.3) followed by a recovery in 1992 and 1993 as the strong 1989 year class recruited to the fishery.

Recruit indices were available from English and French young fish surveys and the English beam trawl survey in Division VIId. The results are shown in Table 6.9.4. Preliminary data from the English young fish survey in September 1993 suggest that the 1993 year class as 0-group could be the second highest in the series and the 1992 year class as 1 group appeared to be below average.

6.10 Eastern Channel Plaice

Indices of CPUE and effort from Belgian, French and UK fleets are given in Tables 6.10.1 and 6.10.2 and the trends shown in Figures 6.10.1 and 6.10.2. The Belgian effort and CPUE series have ben completely revised using new fishing power corrections where

FP= 0.000341 x HP**0.823

There was no clear trend in CPUE among the different fleets but effort showed a general increase until 1992. Four out of the 6 fleets showed a decline in effort in 1992. Results from the English beam trawl survey in Division VIId show CPUE for age 3+ declining from a peak in 1988 to a minimum in 1993 (Table 6.10.3).

Recruit indices were available from English and French young fish surveys, the English beam trawl survey and French groundfish surveys in Division VIId. The results are shown in Table 6.10.4. Preliminary data from the English young fish survey in September 1993 suggest that the 1993 year class as 0-group could be about average while the 1992 year class as 1-group appeared to be below average.

7 TECHNICAL INTERACTIONS

The STCF North Sea database for 1991 was used as a basis for the descriptions of technical interactions. The database includes catch at age data including discards for haddock and whiting for 7 countries split up on 59 fleets. The 59 fleets were combined into 8 "main fleets" representing the types of gear used. Table 7.1 shows the grouping of STCF fleets into the 8 main fleets.

The catch composition by fleet (Table 7.2) is a result of the fleet definitions used in the STCF database and the subsequent combining of fleets and therefore gives only a preliminary picture of the fleets fishing in the North Sea and their catches.

The main catch for the "HC. TRAWL" fleet was roundfish with a catch of more than 1/3 of the total of cod, haddock, saithe and whiting. The "SEINE NETS" fleet had a relatively smaller catch of saithe and a larger catch of plaice.

The "BEAM TRAWL" fleet catches more than 2/3 of the total catch of plaice and sole and 6% of the total catch of cod.

The catch of saithe was 88% of the total catch for the "SAITHE" fleet.

The "FIXED GEAR" fleet catches mainly cod, plaice and sole.

The fleet "OTHER" represents catches from countries not included in the STCF database and non-reported catches (Working Group estimate).

The ABC model (Lewy *et al.*, 1992) was used to predict equilibrium catches. Fishing mortality was estimated using catch data from the 8 fleets, the stock number estimated by the Working Group and the natural mortality estimated by the Multispecies Working Group. The Working Group recruitment estimates and the Multispecies Working Group maturity at age data were, furthermore, used in the prediction.

Eight predictions were made assuming an increase of fishing mortality of 10% for each fleet. The Fs for the other fleets in the scenario were unchanged. The results of these eight predictions were compared to the result of a *status quo* prediction. Decreasing the Fs by 10% would give the same magnitude of relative changes - of course with a reverse sign. A fixed percentage change of Fs has the largest effect for fleets having the largest catch (partial F). The changes seen are, therefore, a combination of catch weight and the exploitation pattern by fleet.

Table 7.3 gives the relative changes in the biomass by species for the eight scenarios. Because the ABC model does not include biological interaction effects, an increase in effort always reduces the biomass. The changes in biomass, therefore, reflect only the partial Fs for the particular fleet. The exploitation pattern is different for the fleets giving a different ratio between change in stock biomass and change in spawning stock biomass for the fleets.

Table 7.4 gives the change in yield by fleet and species for the eight scenarios. For all species except whiting an increase in effort resulted in a *status quo* or decreased yield.

The catch data have not included discards for cod, saithe, plaice and sole. The negative effects on the *status quo* fleets, of an increased effort in a high discard rate fleet (BEAM TRAWL, HC.TRAWL and SEINE NETS), are therefore underestimated.

The fixed gears (gillnet) fleet is the overall "loser" with an increase in effort of all other fleets. The fixed gear fleet catches older fish and an increase in effort in other fleets will result in fewer older fish for the fleet. An increase in effort for the fixed gear fleet, however, results in only an insignificant "loss" for other fleets and a *status quo* total yield. This is caused by the relatively low total catch weight and the exploitation pattern for the "FIXED GEAR" fleet.

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Table 2.2.1. COD in the Skagerrak (part of Div. IIIa). Landings in tonnes as estimated by Working Group (same as official landings, preliminary for 1992).

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

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

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

Run title : Cod in the Skagerrak (part of Fishing Area IIIa) (run name: FINSOP)

At 12-Oct-93 17:49

Table 2.2.3

Catch numbers at age Numbers*10**-3

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
1,	4337,	432,	1066,	389,	1080,
2,	11174,	4325,	6593,	11030,	4448,
3,	2889,	2956,	4821,	6202,	6653,
4,	775,	480,	1748,	1169,	2009,
5,	182,	202,	349,	288,	242,
6,	166,	34,	94,	44,	175,
7,	44,	33,	82,	49,	73,
+gp,	52,	28,	11,	6,	27,
TOTALNUM,	19619,	8490,	14764,	19177,	14707,
TONSLAND,	24466,	15499,	24006,	28913,	26110,
SOPCOF %,	105,	118,	96,	98,	94,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	1771,	341,	928,	3253,	165,	1035,	794,	846,	432,	1792,
2,	6020,	7067,	5156,	4101,	12289,	2645,	6237,	5243,	2922,	4793,
3,	3368,	3107,	2773,	3441,	2245,	5251,	3163,	3326,	1763,	1654,
4,	1609,	731,	856,	1748,	503,	592,	1564,	529,	871,	493,
5,	290,	280,	207,	347,	137,	150,	172,	432,	194,	233,
6,	85,	70,	124,	60,	69,	56,	104,	49,	81,	49,
7,	32,	22,	33,	39,	17,	8,	18,	50,	32,	43,
+gp,	69,	17,	9,	21,	19,	13,	12,	33,	15,	12,
TOTALNUM,	13244,	11635,	10086,	13010,	15444,	9750,	12064,	10508,	6310,	9069,
TONSLAND,	21784,	19891,	16628,	20103,	19900,	16952,	18697,	17800,	12059,	14002,
SOPCOF %,	96,	99,	94,	95,	95,	100,	95,	96,	97,	95,

Run title : Cod in the Skagerrak (part of Fishing Area IIIa) (run name: FINSOP)

At 12-Oct-93 17:49

Table 2.2.4

Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
1,	.5990,	.5990,	.7460,	.6190,	.6560,
2,	.8600,	.8600,	1.1460,	.9720,	1.2040,
3,	1.8940,	1.8940,	1.5700,	1.9020,	1.8650,
4,	3.4980,	3.4980,	3.3470,	3.7110,	2.7090,
5,	5.5100,	5.5100,	4.8650,	5.2610,	6.1070,
6,	7.0930,	7.0930,	8.9320,	9.4910,	8.0180,
7,	7.3040,	7.3040,	8.3010,	8.5140,	8.7380,
+gp,	9.8880,	9.8880,	11.0850,	10.0940,	12.6580,
SOPCOFAC,	1.0453,	1.1806,	.9560,	.9799,	.9401,

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	.5900,	.6470,	.6490,	.6830,	.5800,	.6370,	.6120,	.6030,	.5880,	.6580,
2,	1.0070,	1.1300,	1.0940,	1.1330,	1.0480,	1.1950,	1.0640,	1.1500,	1.2100,	1.2390,
3,	1.9670,	2.1700,	2.0890,	2.0400,	1.8590,	1.8630,	1.7040,	2.1100,	2.1320,	2.3010,
4,	3.3500,	3.6160,	3.5370,	2.6360,	3.8960,	2.9780,	3.2240,	3.7030,	3.3350,	3.6010,
5,	5.7510,	5.5050,	5.4720,	4.7020,	5.8490,	5.8300,	5.6370,	4.6780,	4.9290,	5.1580,
6,	8.0740,	7.8140,	7.7460,	7.5380,	7.9140,	8.0950,	7.8900,	5.5460,	6.9710,	7.9610,
7,	8.5860,	10.3190,	10.2550,	9.1640,	9.6070,	10.2450,	9.6860,	8.5000,	9.0680,	9.3050,
+gp,	11.9630,	12.8560,	12.8540,	9.7770,	12.4670,	13.0600,	10.8000,	10.7450,	11.7800,	8.6220,
SOPCOFAC,	.9649,	.9883,	.9442,	.9508,	.9542,	1.0004,	.9516,	.9576,	.9693,	.9464,

Table 2.2.5 COD in the Skagerrak. CPUE by gear type for the Swedish fishery CPUE as catch in kg/hour.

Year	Catch (t)	Effort	CPUE
	Bottom trawl		
1978	86	-	24.5
1979	104	-	28.4
1980	263	6,651	39.6
1981	318	7,297	43.6
1982	462	8,178	56.5
1983	329	8,478	38.8
1984	371	11,991	30.9
1985	392	13,168	29.8
1986	347	11,977	29.0
1987	503	13,527	37.7
1988	344	14,405	23.9
1989	178	11,310	28.2
1990	323	11,815	27.3
1991	249	9,561	26.6
1992	417	15,112	27.6
	Nephrops trawl (single trawl)		
1978	572	-	18.2
1979	936	-	27.2
1980	1,287	42,987	29.9
1981	1,619	43,785	37.0
1982	1,384	40,815	33.9
1983	1,239	52,536	23.6
1984	1,077	69,779	15.4
1985	1,149	70,869	16.2
1986	736	74,913	9.8
1987	1,062	91,875	11.5
1988	1,002	109,337	9.2
1989	1,243	85,833	12.8
1990	803	71,775	11.2
1991	508	71,854	8.1
1992	811	73518	11.0

Table 2.2.6 COD in the Skagerrak. CPUE (kg/day) by gear type for the Danish cod fishery.

Year	Catch (tonnes)	Effort	CPUE
Gill-nets			
1987	1,102	2,531	435
1988	1,211	2,202	550
1989	1,208	2,112	572
1990	1,367	2,398	570
1991	1,316	2,419	544
1992	1,415	2,532	559
Nephrops trawl			
1987	218	8,174	27
1988	234	7,224	32
1989	332	8,541	39
1990	384	8,494	45
1991	311	8,536	36
1992	243	5,975	41
Danish cod trawl			
1987	644	2,534	254
1988	472	1,429	330
1989	459	1,354	339
1990	614	2,132	288
1991	406	1,888	215
1992	455	2,002	227

Table 2.2.7 Cod in the Skagerrak. CPUE by fleet and age.

Danish trawlers (code: FLT06)

Year	Effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1987	1	1.8	180.7	39.3	6.1	1.4	0.5	0.1
1988	1	32.2	69.7	130.6	11.1	2.2	0.7	0.1
1989	1	17.0	136.2	69.9	27.5	2.2	1.0	0.2
1990	1	9.8	96.0	66.3	10.0	7.1	0.8	0.5
1991	1	16.5	69.0	32.9	16.9	3.4	1.2	0.3
1992	1	34.2	88.1	32.2	8.4	3.3	0.6	0.5

Danish Nephrops tr. (code: FLT05)

Year	Effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1987	1	0.3	18.0	3.0	0.8	0.2	0.1	0.0
1988	1	1.9	5.5	11.7	1.3	0.4	0.2	0.0
1989	1	2.3	17.9	7.4	2.5	0.3	0.2	0.0
1990	1	2.0	16.3	9.6	1.4	1.2	0.1	0.1
1991	1	2.2	13.2	5.9	2.3	0.5	0.2	0.1
1992	1	8.1	15.0	4.4	1.3	0.7	0.1	0.1

Danish gill-net (code: FLT04)

Year	Effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1987	1	0.8	98.7	68.6	19.3	4.8	2.1	0.6
1988	1	12.8	57.7	146.5	20.9	4.2	1.7	0.2
1989	1	5.2	67.8	59.2	65.5	8.9	5.6	0.8
1990	1	8.9	69.9	91.7	22.2	18.4	2.0	2.4
1991	1	6.6	64.8	75.6	51.2	11.2	4.2	1.6
1992	1	27.8	114.7	67.9	24.8	14.0	2.3	2.3

Table 2.2.8 Indices of 0-group COD from the Norwegian Skagerrak coast and indices of I- and II-groups from the IBTS in February, and I-group whiting and haddock from the February IBTS.

Year class	Cod			Whiting	Haddock
	IBTS	IBTS	Norw.sur.		
	I - gr	II - gr	0 -gr.	I - gr.	I - gr.
1974				499	
1975			6.1	236	
1976			11.4	99	
1977			3.4	392	
1978			6	561	
1979		85	21.4	722	40.4
1980	15	31	7.1	968	4.3
1981	36	30.4	5	690	47.7
1982	28.4	18.6	12.4	262	33.8
1983	23.4	51.8	1.9	500	71.7
1984	13.5	10.5	4.2	940	160.8
1985	77.9	113	20.3	1,379	57
1986	5.4	18.1	4.5	2,178	250.6
1987	77	23.8	10.1	2,978	125.2
1988	56	9.6	0.2	478	20.2
1989	30.9	25.3	15.9	2255	8
1990	9.3	5	1.9	1,636	74
1991	96	16	5.7	1,672	258
1992	110		6.6	1,359	405
1993			3.5		

Table 2.2.9 XSA run specifications and tuning diagnosdic

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VPA Version 3.1 (MSDOS)

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Extended Survivors Analysis

Cod in the Skagerrak (part of Fishing Area IIIa) (run name: FINAL2)

CPUE data from file j:\ifapexim\wg_200\cod_skag\FLEET.FF2


Data for    4 fleets over   15 years
Age range from    1 to    7


     Fleet,              Alpha,    Beta
FLT04: Danish gill-n   ,  .000   , 1.000
FLT05: Danish Nephro   ,  .000   , 1.000
FLT06: Danish trawle   ,  .000   , 1.000
FLT08: IBTS (Catch:    ,  .050   ,  .150


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years


Catchability analysis :

     Catchability independent of stock size for all ages

     Catchability independent of age for ages >=    6


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning converged after   35 iterations

1


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

Continued

Table 2.2.9 continued :
Fleet disaggregated estimates of survivors :

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

Year class = 1991

FLT04: Danish gill-n

Age	1,
Estimated Survivors	49937.,
Raw Weights	.993,

FLT05: Danish Nephro

Age	1,
Estimated Survivors	51037.,
Raw Weights	1.398,

FLT06: Danish trawle

Age	1,
Estimated Survivors	30900.,
Raw Weights	1.137,

FLT08: IBTS (Catch:

Age	1,
Estimated Survivors	43224.,
Raw Weights	1.703,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Danish gill-n	49937.	1.004	.000	.00	1	.108	.032
FLT05: Danish Nephro	51037.	.846	.000	.00	1	.151	.031
FLT06: Danish trawle	30900.	.938	.000	.00	1	.123	.051
FLT08: IBTS (Catch:	43224.	.766	.000	.00	1	.184	.037
F shrinkage mean	26700.	.50				.433	.059

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
35057.	.33	.17	5	.527	.045

Continued

Table 2.2.9 continued :

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

Year class = 1990

FLT04: Danish gill-n

Age	2,	1,
Estimated Survivors	6923.,	4852.,
Raw Weights	3.139,	.498,

FLT05: Danish Nephro

Age	2,	1,
Estimated Survivors	5173.,	5673.,
Raw Weights	1.819,	.702,

FLT06: Danish trawle

Age	2,	1,
Estimated Survivors	4080.,	6101.,
Raw Weights	5.529,	.571,

FLT08: IBTS (Catch:

Age	2,	1,
Estimated Survivors	1065.,	1719.,
Raw Weights	.906,	.854,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Danish gill-n	6594.	.524	.122	.23	2	.202	.505
FLT05: Danish Nephro	5308.	.630	.041	.07	2	.140	.597
FLT06: Danish trawle	4236.	.405	.117	.29	2	.339	.705
FLT08: IBTS (Catch:	1344.	.754	.240	.32	2	.098	1.442
F shrinkage mean	4337.	.50				.222	.693

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4296.	.24	.15	9	.652	.698

Continued

Table 2.2.9 continued :

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

Year class = 1989

FLT04: Danish gill-n

Age	3,	2,	1,
Estimated Survivors	1207.,	1379.,	2308.,
Raw Weights	4.568,	1.400,	.207,

FLT05: Danish Nephro

Age	3,	2,	1,
Estimated Survivors	995.,	1606.,	1819.,
Raw Weights	3.746,	.811,	.292,

FLT06: Danish trawle

Age	3,	2,	1,
Estimated Survivors	856.,	1127.,	1278.,
Raw Weights	4.568,	2.466,	.238,

FLT08: IBTS (Catch:

Age	3,	2,	1,
Estimated Survivors	0.,	1952.,	1965.,
Raw Weights	.000,	.404,	.356,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Danish gill-n	1272.	.402	.088	.22	3	.268	.778
FLT05: Danish Nephro	1118.	.454	.153	.34	3	.210	.850
FLT06: Danish trawle	952.	.371	.099	.27	3	.315	.945
FLT08: IBTS (Catch:	1958.	1.147	.003	.00	2	.033	.568
F shrinkage mean	748.	.50				.173	1.099

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1045.	.21	.08	12	.387	.889

Continued

Table 2.2.9 continued :

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

Year class = 1988

FLT04: Danish gill-n

Age	4,	3,	2,	1,
Estimated Survivors	391.,	491.,	447.,	364.,
Raw Weights	5.128,	1.989,	.452,	.069,

FLT05: Danish Nephro

Age	4,	3,	2,	1,
Estimated Survivors	414.,	487.,	596.,	564.,
Raw Weights	5.128,	1.631,	.262,	.097,

FLT06: Danish trawle

Age	4,	3,	2,	1,
Estimated Survivors	339.,	319.,	471.,	598.,
Raw Weights	4.718,	1.989,	.797,	.079,

FLT08: IBTS (Catch:

Age	4,	3,	2,	1,
Estimated Survivors	0.,	0.,	202.,	972.,
Raw Weights	.000,	.000,	.131,	.118,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Danish gill-n	418.	.362	.058	.16	4	.287	.727
FLT05: Danish Nephro	437.	.375	.056	.15	4	.268	.703
FLT06: Danish trawle	347.	.363	.071	.20	4	.285	.826
FLT08: IBTS (Catch:	426.	2.005	.784	.39	2	.009	.716
F shrinkage mean	302.	.50				.150	.906

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
382.	.19	.05	15	.259	.773

Continued

Table 2.2.9 continued :

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

Year class = 1987

FLT04: Danish gill-n

Age	5,	4,	3,	2,	1,
Estimated Survivors	271.,	331.,	220.,	176.,	399.,
Raw Weights	1.739,	2.452,	.862,	.244,	.037,

FLT05: Danish Nephro

Age	5,	4,	3,	2,	1,
Estimated Survivors	261.,	300.,	293.,	265.,	208.,
Raw Weights	2.976,	2.452,	.707,	.141,	.052,

FLT06: Danish trawle

Age	5,	4,	3,	2,	1,
Estimated Survivors	201.,	280.,	238.,	271.,	505.,
Raw Weights	2.919,	2.256,	.862,	.429,	.042,

FLT08: IBTS (Catch:

Age	5,	4,	3,	2,	1,
Estimated Survivors	0.,	0.,	0.,	218.,	597.,
Raw Weights	.000,	.000,	.000,	.070,	.064,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Danish gill-n	282.	.433	.091	.21	5	.239	.558
FLT05: Danish Nephro	279.	.398	.036	.09	5	.284	.563
FLT06: Danish trawle	236.	.392	.082	.21	5	.292	.638
FLT08: IBTS (Catch:	352.	2.733	.503	.18	2	.006	.470
F shrinkage mean	164.	.50				.179	.828

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
242.	.21	.06	18	.294	.626

Continued

Table 2.2.9 continued :

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

Year class = 1986

FLT04: Danish gill-n

Age	6,	5,	4,	3,	2,	1,
Estimated Survivors	44.,	69.,	40.,	33.,	36.,	7.,
Raw Weights	5.366,	.586,	.834,	.215,	.080,	.013,

FLT05: Danish Nephro

Age	6,	5,	4,	3,	2,	1,
Estimated Survivors	36.,	60.,	51.,	52.,	20.,	9.,
Raw Weights	2.769,	1.004,	.834,	.176,	.046,	.018,

FLT06: Danish trawle

Age	6,	5,	4,	3,	2,	1,
Estimated Survivors	40.,	66.,	46.,	58.,	33.,	8.,
Raw Weights	5.366,	.985,	.767,	.215,	.141,	.014,

FLT08: IBTS (Catch:

Age	6,	5,	4,	3,	2,	1,
Estimated Survivors	0.,	0.,	0.,	0.,	44.,	12.,
Raw Weights	.000,	.000,	.000,	.000,	.023,	.022,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Danish gill-n	44.	.375	.074	.20	6	.302	.692
FLT05: Danish Nephro	43.	.454	.109	.24	6	.206	.710
FLT06: Danish trawle	44.	.365	.086	.24	6	.319	.699
FLT08: IBTS (Catch:	23.	4.731	.652	.14	2	.002	1.066
F shrinkage mean	32.	.50				.170	.874

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
41.	.21	.05	21	.246	.728

Continued

Table 2.2.9 continued :

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

Year class = 1985

FLT04: Danish gill-n

Age	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	44.,	35.,	50.,	44.,	34.,	23.,	0.,
Raw Weights	4.297,	3.037,	.303,	.348,	.122,	.030,	.000,

FLT05: Danish Nephro

Age	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	37.,	32.,	63.,	34.,	35.,	24.,	0.,
Raw Weights	3.374,	1.567,	.519,	.348,	.100,	.018,	.000,

FLT06: Danish trawle

Age	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	34.,	35.,	61.,	47.,	45.,	33.,	0.,
Raw Weights	5.432,	3.037,	.509,	.321,	.122,	.053,	.000,

FLT08: IBTS (Catch:

Age	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	0.,	0.,	0.,	0.,	0.,	90.,	50.,
Raw Weights	.000,	.000,	.000,	.000,	.000,	.009,	.007,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Danish gill-n	40.	.351	.057	.16	6	.295	.675
FLT05: Danish Nephro	37.	.411	.080	.20	6	.215	.721
FLT06: Danish trawle	36.	.325	.064	.20	6	.344	.735
FLT08: IBTS (Catch:	69.	7.879	.295	.04	2	.001	.447
F shrinkage mean	35.	.50				.145	.750

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
37.	.19	.03	21	.175	.716

1

Table 2.2.10

Run title : Cod in the Skagerrak (part of Fishing Area IIIa) (run name: HS1)

At 20-Oct-93 11:31

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
1,	.2467,	.0195,	.0381,	.0307,	.0716,
2,	.9314,	.4168,	.4561,	.6743,	.5704,
3,	1.1071,	.6871,	1.2172,	1.0907,	1.2352,
4,	.8804,	.5294,	1.2501,	1.2180,	1.5232,
5,	.5540,	.5969,	.9672,	.6956,	.9209,
6,	.9506,	.1850,	.6238,	.2891,	1.3699,
7,	.8942,	.4868,	.9127,	.8016,	1.1374,
+gp,	.8942,	.4868,	.9127,	.8016,	1.1374,
FBAR 3- 6,	.8730,	.4996,	1.0146,	.8234,	1.2623,

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
1,	.1019,	.0254,	.0876,	.1131,	.0170,	.0655,	.0716,	.1035,	.0364,	.0452,	.0617,
2,	.7036,	.7394,	.6460,	.6813,	.8047,	.4101,	.6901,	.9122,	.6161,	.6979,	.7421,
3,	1.2422,	1.0316,	.7436,	1.3474,	1.0581,	1.0358,	1.3491,	1.0425,	.9465,	.8888,	.9593,
4,	1.2745,	1.0583,	.9354,	1.8949,	.7101,	.9309,	1.0820,	.8747,	.8852,	.7733,	.8444,
5,	1.0007,	.7935,	1.0520,	1.4551,	.7788,	.4727,	.7882,	1.0732,	.9843,	.6257,	.8944,
6,	1.0456,	.7076,	1.0644,	1.0778,	1.5985,	.8880,	.7170,	.5402,	.5812,	.7278,	.6164,
7,	1.0656,	.8753,	.8979,	1.3074,	1.1108,	.8181,	.8244,	.9560,	.8472,	.7156,	.8396,
+gp,	1.0656,	.8753,	.8979,	1.3074,	1.1108,	.8181,	.8244,	.9560,	.8472,	.7156,	
FBAR 3- 6,	1.1407,	.8977,	.9488,	1.4438,	1.0364,	.8318,	.9841,	.8827,	.8493,	.7539,	

Table 2.2.11

Run title : Cod in the Skagerrak (part of Fishing Area IIIa) (run name: HS1)

At 20-Oct-93 11:31

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
1,	21923,	24776,	31533,	14241,	17279,
2,	20378,	14025,	19894,	24853,	11308,
3,	4769,	6574,	7569,	10322,	10367,
4,	1463,	1291,	2707,	1835,	2839,
5,	473,	497,	622,	635,	444,
6,	299,	223,	224,	194,	259,
7,	82,	95,	151,	98,	119,
+gp,	96,	80,	20,	12,	43,
TOTAL,	49483,	47558,	62721,	52190,	42660,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE											
1,	20211,	15002,	12231,	33605,	10795,	18033,	12705,	9510,	13355,	44800,	0,
2,	13170,	14945,	11974,	9174,	24570,	8689,	13827,	9684,	7021,	10544,	35057,
3,	5233,	5336,	5842,	5138,	3800,	8997,	4720,	5677,	3184,	3104,	4296,
4,	2468,	1237,	1557,	2274,	1093,	1080,	2615,	1003,	1639,	1012,	1045,
5,	507,	565,	352,	500,	280,	440,	349,	725,	342,	554,	382,
6,	145,	153,	209,	101,	96,	105,	225,	130,	203,	105,	242,
7,	54,	42,	62,	59,	28,	16,	35,	90,	62,	93,	41,
+gp,	114,	32,	17,	31,	31,	25,	23,	58,	29,	26,	47,
TOTAL,	41903,	37311,	32242,	50882,	40693,	37385,	34499,	26877,	25835,	60236,	41112,

Table 2.2.12 Input to RCT3 Analysis

```
IBTS, Skagerak, VPA age 1 Vs. Survey Index
 2 14 2
 'year-class' 'VPA' 'age1' 'age2'
 1979 31533  79    85
 1980 14241  15    31
 1981 17279  36    30.4
 1982 20211  28.4  18.6
 1983 15002  23.4  51.8
 1984 12231  13.5  10.5
 1985 33605  77.9 113
 1986 10795   5.4  18.1
 1987 18033  77    23.8
 1988 12705  56     9.6
 1989  9510  30.9  25.3
 1990    -1   9.3   5
 1991    -1  96    16
 1992    -1 110    -1
IBTS, Skagerak, VPA age 2 Vs. Survey Index
 2 14 2
 'year-class' 'VPA' 'age1' 'age2'
 1979 24853  79    85
 1980 11308  15    31
 1981 13170  36    30.4
 1982 14945  28.4  18.6
 1983 11974  23.4  51.8
 1984  9174  13.5  10.5
 1985 24570  77.9 113
 1986  8689   5.4  18.1
 1987 13827  77    23.8
 1988  9684  56     9.6
 1989    -1  30.9  25.3
 1990    -1   9.3   5
 1991    -1  96    16
 1992    -1 110    -1
IBTS, Skagerak, VPA age 3 Vs. Survey Index
 2 14 2
 'year-class' 'VPA' 'age1' 'age2'
 1979 10367  79    85
 1980  5233  15    31
 1981  5336  36    30.4
 1982  5842  28.4  18.6
 1983  5138  23.4  51.8
 1984  3800  13.5  10.5
 1985  8997  77.9 113
 1986  4720   5.4  18.1
 1987  5677  77    23.8
 1988    -1  56     9.6
 1989    -1  30.9  25.3
 1990    -1   9.3   5
 1991    -1  96    16
 1992    -1 110    -1
```

Continued

Table 2.2.12. continued :

IBTS, Skagerak, **VPA age 1 Vs. Survey Index**

Data for 2 surveys over 14 years : 1979 - 1992

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 = 1989

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction			--------I	
age1	.60	7.67	.38	.540	10	3.46	9.75	.448	.251
age2	.59	7.75	.30	.655	10	3.27	9.68	.352	.406
					VPA Mean =		9.75	.383	.343

Yearclass = 1990

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction			--------I	
age1	.76	7.07	.50	.421	11	2.33	8.83	.646	.204
age2	.73	7.25	.39	.546	11	1.79	8.55	.551	.279
					VPA Mean =		9.68	.406	.517

Yearclass = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction			--------I	
age1	.76	7.04	.52	.411	11	4.57	10.53	.668	.178
age2	.73	7.24	.40	.541	11	2.83	9.31	.482	.341
					VPA Mean =		9.68	.406	.481

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction			--------I	
age1	.77	7.01	.53	.400	11	4.71	10.63	.713	.246
age2									
					VPA Mean =		9.67	.407	.754

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	16679	9.72	.22	.02	.01	9510	9.16
1990	9827	9.19	.29	.36	1.56		
1991	16339	9.70	.28	.30	1.11		
1992	20016	9.90	.35	.42	1.38		

Continued

Table 2.2.12 continued :

IBTS, Skagerak, **VPA age 2 Vs. Survey Index**

Data for 2 surveys over 14 years : 1979 - 1992

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 = 1989

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	-----------Prediction---------			I
age1	.59	7.44	.38	.517	10	3.46	9.49	.452	.210
age2	.55	7.63	.25	.707	10	3.27	9.43	.301	.474
					VPA Mean =		9.48	.369	.316

Yearclass = 1990

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	-----------Prediction---------			I
age1	.59	7.44	.39	.510	10	2.33	8.82	.504	.209
age2	.55	7.64	.25	.708	10	1.79	8.62	.363	.402
					VPA Mean =		9.48	.369	.389

Yearclass = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	-----------Prediction---------			I
age1	.59	7.44	.40	.501	10	4.57	10.13	.521	.174
age2	.54	7.65	.25	.709	10	2.83	9.19	.314	.479
					VPA Mean =		9.47	.369	.347

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	-----------Prediction---------			I
age1	.59	7.43	.41	.490	10	4.71	10.21	.556	.306
age2									
					VPA Mean =		9.47	.369	.694

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	12791	9.46	.21	.02	.01		
1990	8061	8.99	.23	.28	1.45		
1991	12744	9.45	.22	.24	1.20		
1992	16187	9.69	.31	.34	1.23		

Continued

Table 2.2.12 continued :

IBTS, Skagerak, **VPA age 3 Vs. Survey Index**

Data for 2 surveys over 14 years : 1979 - 1992

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 = 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
age1	.46	7.11	.29	.561	9	3.46	8.70	.356	.217
age2	.47	7.01	.19	.745	9	3.27	8.55	.237	.491
						VPA Mean =	8.66	.308	.291

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
age1	.45	7.12	.30	.556	9	2.33	8.18	.393	.232
age2	.47	7.02	.19	.746	9	1.79	7.86	.303	.388
						VPA Mean =	8.66	.307	.380

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
age1	.45	7.14	.30	.550	9	4.57	9.19	.414	.180
age2	.46	7.04	.19	.748	9	2.83	8.35	.250	.491
						VPA Mean =	8.65	.305	.330

Yearclass = 1992

	I-----Regression	-----I			I-----Prediction	-----	-----	----I	
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
age1	.44	7.16	.31	.543	9	4.71	9.24	.440	.323
age2									
						VPA Mean =	8.65	.304	.677

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	5525	8.62	.17	.04	.07		
1990	3788	8.24	.19	.25	1.71		
1991	5453	8.60	.18	.22	1.52		
1992	6915	8.84	.25	.28	1.23		

Table 2.2.13

Run title : Cod in the Skagerrak (part of Fishing Area IIIa) (run name: HS1)

At 20-Oct-93 11:31

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 6,
1978,	21923,	51081,	20424,	24466,	1.1979,	.8730,
1979,	24776,	49659,	22757,	15499,	.6811,	.4996,
1980,	31533,	73772,	27450,	24006,	.8745,	1.0146,
1981,	14241,	65549,	32576,	28913,	.8876,	.8234,
1982,	17279,	58353,	33403,	26110,	.7817,	1.2623,
1983,	20211,	49663,	24476,	21784,	.8900,	1.1407,
1984,	15002,	47787,	21192,	19891,	.9386,	.8977,
1985,	12231,	43136,	22098,	16628,	.7525,	.9488,
1986,	33605,	53777,	20431,	20103,	.9839,	1.4438,
1987,	10795,	46380,	14370,	19900,	1.3849,	1.0364,
1988,	18033,	45757,	23887,	16952,	.7097,	.8318,
1989,	12705,	43292,	20804,	18697,	.8987,	.9841,
1990,	9510,	38066,	21195,	17800,	.8398,	.8827,
1991,	(13355,)[1]	32603,	16255,	12059,	.7419,	.8493,
1992,	(44800,)[2]	58104,	15562,	14002,	.8998,	.7539,
Arith. Mean ,	20000,	50465,	22459,	19787,	.8975,	.9495,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

[1]**Replaced in prediction by 12599 from RCT3 estimate of N_3 in 1993 back-calculated to N_1, in 1991 based on Pope's cohort analysis.**

[2]**Replaced in prediction by 17546 from RCT3 estimate of N_2 in 1993 back-calculated to N_1 in 1992 based on Pope's cohort analysis.**

Table 2.2.14

Cod in the Skagerrak (part of Fishing Area IIIa)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.2000	0.0000	0.0000	0.0000	0.620	0.0561	0.620
2	.	0.2000	0.0000	0.0000	0.0000	1.172	0.6752	1.172
3	.	0.2000	1.0000	0.0000	0.0000	2.022	0.8728	2.022
4	.	0.2000	1.0000	0.0000	0.0000	3.368	0.7682	3.368
5	.	0.2000	1.0000	0.0000	0.0000	5.246	0.8137	5.246
6	.	0.2000	1.0000	0.0000	0.0000	7.293	0.5608	7.293
7	.	0.2000	1.0000	0.0000	0.0000	9.361	0.7639	9.361
8+	.	0.2000	1.0000	0.0000	0.0000	11.001	0.7639	11.001
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YPREC
Date and time: 13OCT93:11:44

Table 2.2.15

Cod in the Skagerrak (part of Fishing Area IIIa)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	27608.496	3.698	26029.671	3.698	26029.671
0.1000	0.0754	0.228	1096.243	4.384	17312.235	2.570	15738.777	2.570	15738.777
0.2000	0.1508	0.357	1444.252	3.740	12000.794	1.930	10432.671	1.930	10432.671
0.3000	0.2262	0.441	1527.145	3.325	8907.406	1.520	7344.590	1.520	7344.590
0.4000	0.3016	0.500	1510.004	3.036	6960.189	1.236	5402.650	1.236	5402.650
0.5000	0.3769	0.544	1456.908	2.824	5664.562	1.028	4112.269	1.028	4112.269
0.6000	0.4523	0.577	1394.172	2.662	4764.971	0.870	3217.896	0.870	3217.896
0.7000	0.5277	0.603	1332.603	2.534	4118.449	0.747	2576.562	0.747	2576.562
0.8000	0.6031	0.625	1276.317	2.431	3640.141	0.649	2103.415	0.649	2103.415
0.9000	0.6785	0.643	1226.490	2.347	3277.319	0.568	1745.723	0.568	1745.723
1.0000	0.7539	0.658	1183.038	2.276	2995.979	0.502	1469.485	0.502	1469.485
1.1000	0.8293	0.671	1145.379	2.215	2773.511	0.446	1252.090	0.446	1252.090
1.2000	0.9047	0.682	1112.784	2.163	2594.482	0.398	1078.107	0.398	1078.107
1.3000	0.9800	0.692	1084.529	2.118	2448.115	0.357	936.756	0.357	936.756
1.4000	1.0554	0.700	1059.959	2.078	2326.731	0.322	820.361	0.322	820.361
1.5000	1.1308	0.708	1038.504	2.043	2224.756	0.291	723.347	0.291	723.347
1.6000	1.2062	0.715	1019.682	2.012	2138.082	0.264	641.606	0.264	641.606
1.7000	1.2816	0.722	1003.089	1.984	2063.629	0.240	572.058	0.240	572.058
1.8000	1.3570	0.727	988.388	1.958	1999.058	0.218	512.366	0.218	512.366
1.9000	1.4324	0.733	975.300	1.935	1942.570	0.199	460.729	0.199	460.729
2.0000	1.5078	0.738	963.593	1.914	1892.762	0.182	415.744	0.182	415.744
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YPREC
Date and time : 13OCT93:11:44
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.1958
F-max factor : 0.3203
F-0.1 reference F : 0.1476
F-max reference F : 0.2414
Recruitment : Single recruit

Table 2.2.16

Cod in the Skagerrak (part of Fishing Area IIIa)
Cod in the Skagerrak (part of Fishing Area IIIa)

Prediction with management option table: Input data

Year: 1993								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	20016.000	0.2000	0.0000	0.0000	0.0000	0.620	0.0561	0.620
2	12744.000	0.2000	0.0000	0.0000	0.0000	1.172	0.6752	1.172
3	3788.000	0.2000	1.0000	0.0000	0.0000	2.022	0.8728	2.022
4	1045.000	0.2000	1.0000	0.0000	0.0000	3.368	0.7682	3.368
5	382.000	0.2000	1.0000	0.0000	0.0000	5.246	0.8137	5.246
6	242.000	0.2000	1.0000	0.0000	0.0000	7.293	0.5608	7.293
7	41.000	0.2000	1.0000	0.0000	0.0000	9.361	0.7639	9.361
8+	47.000	0.2000	1.0000	0.0000	0.0000	11.001	0.7639	11.001
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	17291.000	0.2000	0.0000	0.0000	0.0000	0.620	0.0561	0.620
2	.	0.2000	0.0000	0.0000	0.0000	1.172	0.6752	1.172
3	.	0.2000	1.0000	0.0000	0.0000	2.022	0.8728	2.022
4	.	0.2000	1.0000	0.0000	0.0000	3.368	0.7682	3.368
5	.	0.2000	1.0000	0.0000	0.0000	5.246	0.8137	5.246
6	.	0.2000	1.0000	0.0000	0.0000	7.293	0.5608	7.293
7	.	0.2000	1.0000	0.0000	0.0000	9.361	0.7639	9.361
8+	.	0.2000	1.0000	0.0000	0.0000	11.001	0.7639	11.001
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1995								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	17291.000	0.2000	0.0000	0.0000	0.0000	0.620	0.0561	0.620
2	.	0.2000	0.0000	0.0000	0.0000	1.172	0.6752	1.172
3	.	0.2000	1.0000	0.0000	0.0000	2.022	0.8728	2.022
4	.	0.2000	1.0000	0.0000	0.0000	3.368	0.7682	3.368
5	.	0.2000	1.0000	0.0000	0.0000	5.246	0.8137	5.246
6	.	0.2000	1.0000	0.0000	0.0000	7.293	0.5608	7.293
7	.	0.2000	1.0000	0.0000	0.0000	9.361	0.7639	9.361
8+	.	0.2000	1.0000	0.0000	0.0000	11.001	0.7639	11.001
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : CODPRED1
Date and time: 14OCT93:10:42

Table 2.2.17

Cod in the Skagerrak (part of Fishing Area IIIa)

Cod in the Skagerrak (part of Fishing Area IIIa)

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.7539	43182	15849	15324	0.0000	0.0000	48490	19625	0	77914	50615
.	.	.	.	.	0.2000	0.1508	.	19625	4885	70695	43580
.	.	.	.	.	0.4000	0.3016	.	19625	9118	64467	37536
.	.	.	.	.	0.6000	0.4523	.	19625	12791	59090	32340
.	.	.	.	.	0.8000	0.6031	.	19625	15981	54444	27872
.	.	.	.	.	1.0000	0.7539	.	19625	18756	50424	24030
.	.	.	.	.	1.2000	0.9047	.	19625	21173	46943	20723
.	.	.	.	.	1.4000	1.0554	.	19625	23282	43924	17877
.	.	.	.	.	1.6000	1.2062	.	19625	25124	41303	15427
.	.	.	.	.	1.8000	1.3570	.	19625	26737	39023	13317
.	.	.	.	.	2.0000	1.5078	.	19625	28152	37038	11499
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : CODPRED1
Date and time : 14OCT93:10:36
Computation of ref. F: Simple mean, age 3 - 6
Basis for 1993 : F factors

Table 2.2.18 Cod in the Skagerrak (part of Division IIIa).

Assessment Quality Control Diagram 1

Average F(3-6,)						
Date of assessment	Year					
	1987	1988	1989	1990	1991	1992
1989	1.12	1.02				
1990	1.05	0.85	1.14			
1991	0.96	0.80	1.05	1.05		
1992	1.02	0.83	0.95	0.86	0.75	
1993	1.04	0.83	0.98	0.88	0.85	0.75

Remarks: New tuning data in 1993.

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F							
Date of assessment	Year						
	1988	1989	1990	1991	1992	1993	1994
1989	16.7	21.3	25.7				
1990		18.6	23.0	19.4			
1991			17.8	17.0	17.5		
1992				13.1	14.3	16.9	
1993				12.2	15.1	15.3	18.8
				\ SQC[1]	\ SQC[2]	\ Current	\ Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2) - F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y), F(y−1) and F(y−2) are as estimated in the assessment made in year (y+1).

Remarks: New tuning data in 1993.

Continued

Table 2.2.18 Contimued.

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: millions						
Date of assessment	Year class					
	1987	1988	1989	1990	1991	1992
1989	30.0	27.0				
1990	22.3	15.0	16.7			
1991	17.1	14.0	16.4	17.0		
1992	17.8	16.9	16.6[1]	10.2[1]	20.7[1]	
1993	18.0	12.7	16.7	9.8[1]	16.3[1]	20.0[1]

[1]RCT3 estimates.

Remarks: New tuning data in 1993.

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	20.8	14.0	24.0[1]	27.2[1]				
1990	21.9	18.6	24.0	17.5[1]	15.6[1]			
1991	23.3	19.5	18.7	15.1	15.5[1]	16.1[1]		
1992	23.5	20.7	21.5	17.5	20.8	19.2[1]	25.9[1]	
1993	23.9	19.8	20.3	15.8	14.7	14.6	19.1[1]	26.4[1]

[1]Forecast.

Remarks: New tuning datya in 1993.

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

Year	Denmark			Norway	Sweden	Others	Total	Total
	Human consumption	Reduction	Total	Human consumption			Total consumption	Total reduction and consumption
1975	-	-	5,015	122	921	57	-	6,115
1976	-	-	7,488	191	1,075	301	-	9,055
1977	-	-	6,907	156	2,485	215	-	9,763
1978	-	-	4,978	168	1,435[2]	56	-	6,637
1979	-	-	4,120	248	361	56	-	4,785
1980	-	-	7,172	288	373	57	-	7,890
1981	-	-	9,568	271	391	120	-	10,350
1982	-	-	11,151	196	396	329	-	12,072
1983	6,425	7,225	13,650	756	608	221	8,010	15,235
1984	5,516	2,707	8,223	321	499	30	6,366	9,073
1985	6,522	954	7,476	279	351	15	7,167	8,121
1986	3,265	1,682	4,947	226	151	5	3,647	5,329
1987	3,584	1,449	5,033	148	71	36	3,803	5,288
1988	2,543	1,480	4,023	245	64	48	2,852	4,380
1989	3,889	360	4,249	138	66	5	4,098	4,458
1990	3,887	1,968	5,855	84	102	27	4,100	6,068
1991	3,894	2,593	6,487	111[1]	80	1	4,086[1]	6,679[1]
1992	3,811	4,254	8,065	177[1]	744[2]	14	4,746[1]	9,000[1]

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

Table 2.3.2. HADDOCK in Division IIIa. Catch in numbers (thousands).

1987 - 1990 Human consumption fishery only

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

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

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

[1]Preliminary.

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

Year	Denmark		Sweden		Germany		Belgium	Norway	Total IIIa
	Kattegat	Skagerrak	Kattegat	Skagerrak	Kat.	Skag.			
1972	15504	5095	348	70					21017
1973	10021	3871	231	80					14203
1974	11401	3429	255	70					15155
1975	10158	4888	369	77					15492
1976	9487	9251	271	81					19090
1977	11611	12855	300	142					24908
1978	12685	13383	368	94					26530
1979	9721	11045	281	105					21152
1980	5582	9514	289	92					15477
1981	3803	8115	232	123					12273
1982	2717	7789	201	140					10847
1983	3280	6828	291	170			133	14	10716
1984	3252	7560	323	356	32		27	22	11572
1985	2979	9646	403	296	4		136	18	13482
1986	2468	10653	170	215			505	24	14035
1987	2868	11370	283	222	104		907	25	15779
1988	1818	9781	210	281	2.8		716	41	12850
1989	1596	5387	135	320	4	0.1	230	33	7705
1990	1831	8726	201	777	2	0.7	471	69	12078
1991	1756	5849	267	472	5.6	3.9	315	68	8737
1992[1]	2071	8522	208	381			507	107	11796

[1]Preliminary.

Table 2.5.2

Run title : Plaice in Skagerak and Kattegat combined (run name: PLAICE3A9)

At 13-Oct-93 16:53

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

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
2,	503,	1105,	363,	191,	552,
3,	16129,	9791,	4792,	4059,	2168,
4,	40633,	29662,	16421,	13135,	9653,
5,	25613,	20812,	12627,	11001,	11119,
6,	8234,	7648,	6058,	4318,	5825,
7,	637,	2515,	2403,	1431,	1941,
8,	65,	170,	953,	548,	795,
9,	65,	75,	204,	214,	316,
10,	49,	50,	54,	119,	118,
+gp,	62,	55,	50,	97,	50,
TOTALNUM,	91990,	71883,	43925,	35113,	32537,
TONSLAND,	26530,	21152,	15477,	12273,	10847,
SOPCOF %,	97,	100,	100,	100,	95,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	1569,	2184,	1462,	395,	592,	100,	1045,	3205,	2363,	934,
3,	10292,	12880,	8990,	4479,	4235,	3121,	3977,	8993,	8735,	3995,
4,	9143,	12555,	22548,	15549,	13081,	12374,	7365,	8905,	9602,	12219,
5,	8503,	4590,	6434,	20027,	18620,	14159,	6489,	10042,	4640,	18212,
6,	2832,	2043,	1767,	4915,	10691,	7055,	2813,	3333,	2878,	4493,
7,	980,	906,	725,	680,	2184,	2822,	1215,	1015,	888,	1078,
8,	563,	750,	275,	273,	386,	973,	568,	495,	304,	308,
9,	272,	592,	209,	130,	237,	331,	265,	360,	156,	119,
10,	102,	300,	175,	122,	126,	140,	140,	161,	86,	28,
+gp,	112,	107,	164,	84,	165,	162,	226,	256,	135,	119,
TOTALNUM,	34368,	36907,	42749,	46654,	50317,	41237,	24103,	36765,	29787,	41505,
TONSLAND,	10716,	11572,	13482,	14035,	15774,	12850,	7674,	12078,	8746,	11823,
SOPCOF %,	94,	97,	97,	94,	94,	97,	96,	97,	100,	95,

Table 2.5.3

Run title : Plaice in Skagerak and Kattegat combined (run name: PLAICE3A9)

At 13-Oct-93 16:53

Table 2 Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
2,	.2360,	.2220,	.2610,	.2300,	.2700,
3,	.2480,	.2550,	.2740,	.2630,	.3010,
4,	.2680,	.2670,	.3060,	.2960,	.2860,
5,	.3220,	.2970,	.3450,	.3570,	.3180,
6,	.4170,	.3780,	.4140,	.4320,	.3860,
7,	.5980,	.4510,	.5790,	.5370,	.5440,
8,	.7520,	.6550,	.6400,	.6710,	.7040,
9,	.8180,	.9220,	.7530,	.8130,	.8130,
10,	.9140,	1.0200,	.8110,	.9120,	.9120,
+gp,	.8430,	1.0440,	.9100,	.9990,	.9860,
SOPCOFAC,	.9729,	.9998,	.9959,	.9972,	.9535,

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	.2850,	.2770,	.2790,	.2520,	.3400,	.2490,	.2740,	.2910,	.2630,	.3090,
3,	.2740,	.2930,	.2840,	.2770,	.2850,	.2680,	.2630,	.2880,	.2700,	.3100,
4,	.2930,	.3090,	.3070,	.2840,	.2860,	.2690,	.2820,	.2940,	.2590,	.2730,
5,	.3560,	.3770,	.3520,	.3210,	.3030,	.2900,	.3200,	.3370,	.2740,	.2800,
6,	.4230,	.4200,	.4370,	.3980,	.3740,	.3500,	.3760,	.3970,	.3650,	.3360,
7,	.4830,	.4190,	.5470,	.5380,	.5380,	.4740,	.4660,	.4980,	.4920,	.5000,
8,	.5310,	.3900,	.6610,	.6740,	.7380,	.5670,	.6350,	.6850,	.5860,	.6460,
9,	.6470,	.3600,	.7420,	.7910,	.9440,	.7570,	.7390,	.7740,	.6710,	.8170,
10,	.9860,	.4460,	.7540,	.8620,	1.0230,	.8320,	.8260,	.9570,	.8690,	.8040,
+gp,	1.1840,	1.1060,	.9180,	1.0260,	1.1180,	1.1920,	1.0100,	1.1520,	1.0110,	.9710,
SOPCOFAC,	.9439,	.9656,	.9674,	.9366,	.9397,	.9724,	.9581,	.9724,	1.0030,	.9500,

Table 2.5.4 a PLAICE in Division IIIa. CPUE in four Swedish fleets.

Year	Nephrops trawl Skagerrak	Nephrops trawl Kattegat	Cod bottom trawl Skagerrak	Cod bottom trawl Kattegat
1980	1.73	3.40	2.50	6.12
1981	1.74	4.04	1.74	7.69
1982	1.95	2.92	2.24	9.05
1983	1.98	3.75	2.63	10.25
1984	3.09	4.94	4.54	7.60
1985	3.10	7.93	3.55	9.47
1986	1.81	2.78	2.87	5.05
1987	1.39	4.27	1.90	7.50
1988	1.66	3.96	2.66	7.65
1989	2.36	2.52	3.39	4.72
1990	2.91	3.31	5.62	6.27
1991	1.36	3.82	3.42	6.27
1992	2.18	3.67	2.69	2.77

Table 2.5.4b

Plaice in Skagerak and Kattegat combined

Danish Gill-net (code: FLT09)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1987	1	8.1	64.8	254.0	450.7	344.6	112.7	21.3	13.2	6.8
1988	1	0.6	44.6	243.9	315.5	215.2	150.5	62.9	26.4	9.6
1989	1	9.2	33.3	128.0	136.4	103.2	101.0	84.3	39.7	23.3
1990	1	51.5	167.2	181.8	285.7	142.3	65.1	46.9	41.2	21.5
1991	1	41.4	218.1	320.3	209.1	242.5	113.5	44.1	18.5	16.0
1992	1	34.8	185.0	605.2	916.0	235.0	85.4	31.2	14.2	3.9

Danish trawlers (code: FLT10)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1987	1	4.5	59.4	212.6	319.7	157.9	20.4	2.2	1.1	0.7
1988	1	2.1	80.2	359.6	415.3	165.3	40.5	8.6	1.9	1.2
1989	1	20.0	72.5	186.4	225.6	89.5	23.1	8.2	3.3	1.2
1990	1	84.4	236.8	244.7	248.5	72.9	17.8	6.5	3.0	1.0
1991	1	51.1	231.9	283.9	138.5	75.7	17.2	5.6	3.4	1.5
1992	1	17.9	96.5	286.2	468.2	126.6	33.5	8.6	1.1	0.1

Danish Seiners (code: FLT11)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1987	1	9.6	93.9	351.1	607.4	329.2	40.3	5.3	3.2	1.6
1988	1	3.3	145.4	495.9	582.1	269.7	83.8	19.9	4.6	1.8
1989	1	41.4	183.3	323.4	329.1	142.5	53.9	17.1	6.9	3.2
1990	1	108.8	350.4	358.1	402.1	121.7	31.7	10.6	6.3	2.1
1991	1	95.3	341.3	376.3	201.2	133.3	36.5	10.7	4.7	1.5
1992	1	26.7	134.4	555.6	845.8	210.4	35.6	7.4	2.3	0.4

Table 2.5.5 XSA analysis results on plaice in Div. IIIa.

VPA Version 3.1 (MSDOS)

14/10/1993 16:54

Extended Survivors Analysis

plaice in div 3 a

CPUE data from file pla3a\pla3atun.dat

Data for 3 fleets over 10 years
Age range from 2 to 10

Fleet,	Alpha,	Beta
Danish Gill-net	, .000	, 1.000
Danish trawlers	, .000	, 1.000
Danish Seiners	, .000	, 1.000

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 9

Terminal population estimation :

Final estimates not shrunk towards mean F

Prior weighting applied :

Fleet	Weight
Danish G	1.00
Danish t	1.00
Danish S	1.00

Tuning converged after 38 iterations

1

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

Fishing mortalities

Age,	1987,	1988,	1989,	1990,	1991,	1992
2,	.017,	.003,	.014,	.033,	.047,	.013
3,	.138,	.108,	.146,	.140,	.106,	.095
4,	.478,	.648,	.352,	.491,	.195,	.191
5,	1.036,	1.323,	.751,	1.008,	.454,	.599
6,	1.216,	1.430,	.928,	1.008,	.802,	.952
7,	.827,	1.179,	.930,	.941,	.718,	.711
8,	.443,	1.003,	.694,	1.174,	.728,	.515
9,	.752,	.750,	.734,	1.209,	1.504,	.623
10,	1.336,	1.319,	.739,	1.300,	.970,	1.186

1

Continued

Table 2.5.5 Continued

XSA population numbers

YEAR	AGE 2	3	4	5	6	7	8	9	10
1987	3.61E+04	3.46E+04	3.62E+04	3.03E+04	1.60E+04	4.08E+03	1.13E+03	4.71E+02	1.80E+02
1988	3.42E+04	3.21E+04	2.73E+04	2.03E+04	9.75E+03	4.29E+03	1.61E+03	6.59E+02	2.01E+02
1989	8.12E+04	3.09E+04	2.61E+04	1.29E+04	4.89E+03	2.11E+03	1.19E+03	5.36E+02	2.82E+02
1990	1.04E+05	7.25E+04	2.41E+04	1.66E+04	5.52E+03	1.75E+03	7.53E+02	5.39E+02	2.33E+02
1991	5.36E+04	9.10E+04	5.70E+04	1.34E+04	5.49E+03	1.82E+03	6.18E+02	2.11E+02	1.46E+02
1992	7.88E+04	4.63E+04	7.41E+04	4.25E+04	7.69E+03	2.23E+03	8.04E+02	2.70E+02	4.24E+01

Estimated population abundance at 1st Jan 1993

, 0.00E+00, 7.04E+04, 3.80E+04, 5.54E+04, 2.11E+04, 2.68E+03, 9.89E+02, 4.34E+02, 1.31E+02, 1.17E+01,

Taper weighted geometric mean of the VPA populations:

, 6.02E+04, 5.12E+04, 3.76E+04, 1.90E+04, 6.49E+03, 2.27E+03, 1.00E+03, 4.96E+02, 2.15E+02,

Standard error of the weighted Log(VPA populations) :

, .4155, .4015, .4594, .5069, .4537, .3482, .3732, .5157, .7053,

AGE

YEAR ,

1987 ,
1988 ,
1989 ,
1990 ,
1991 ,
1992 ,

Estimated population abundance at 1st Jan 1993

, 1.17E+01,

Taper weighted geometric mean of the VPA populations:

,

Standard error of the weighted Log(VPA populations) :

,

1

Log catchability residuals.

Fleet : Danish Gill-net

Age	1987	1988	1989	1990	1991	1992
2	.09	-2.47	-.60	.89	1.34	.76
3	-.05	-.37	-.60	.16	.18	.69
4	.06	.38	-.36	.14	-.29	.08
5	.03	.19	-.43	.16	-.17	.22
6	-.14	-.04	-.28	-.05	.41	.10
7	-.39	-.01	.20	-.05	.37	-.12
8	-1.02	-.05	.41	.49	.44	-.26
9	-.75	-.40	.21	.44	.69	-.18
10	-.22	.01	.32	.66	.70	.61

Mean catchability and Standard error.

Age	2	3	4	5	6	7	8	9	10
Mean Q	-8.4302	-6.1110	-4.7438	-3.7246	-3.1076	-2.7665	-2.6929	-2.4242	-2.4242

Continued

Table 2.5.5 Continued

S.E ,	1.3870,	.4527,	.2773,	.2552,	.2355,	.2644,	.5865,	.5421,	.5404,

Regression statistics :

Ages with q constant w.r.t. time

Age,	Slope,	Intercept,	S.e.,	RSquare,	No Pts,	Fleet Mean Q
2,	.38,	10.01,	.50,	.51,	6,	-8.43,
3,	.64,	7.78,	.27,	.78,	6,	-6.11,
4,	1.13,	3.99,	.34,	.69,	6,	-4.74,
5,	.74,	5.37,	.16,	.92,	6,	-3.72,
6,	1.12,	2.42,	.29,	.75,	6,	-3.11,
7,	1.67,	-.61,	.39,	.56,	6,	-2.77,
8,	2.44,	-3.34,	1.50,	.07,	6,	-2.69,
9,	1.99,	-1.13,	1.10,	.17,	6,	-2.42,
10,	1.23,	1.40,	.50,	.70,	6,	-2.08,

1

Fleet : Danish trawlers

Age ,	1987,	1988,	1989,	1990,	1991,	1992
2 ,	-.75,	-1.46,	-.07,	1.13,	1.30,	-.15
3 ,	-.31,	.05,	.00,	.33,	.07,	-.14
4 ,	-.12,	.76,	.02,	.43,	-.42,	-.67
5 ,	-.18,	.60,	.20,	.16,	-.45,	-.32
6 ,	-.32,	.31,	.18,	-.11,	-.15,	.09
7 ,	-.67,	.11,	.16,	.09,	-.08,	.38
8 ,	-1.31,	-.05,	.07,	.50,	.36,	.43
9 ,	-.83,	-.62,	.14,	.23,	1.41,	-.33
10 ,	-.08,	.34,	-.23,	.01,	.75,	-.64

Mean catchability and Standard error.

Age ,	2,	3,	4,	5,	6,	7,	8,	9,	10
Mean Q,	-8.1834,	-5.9383,	-4.7415,	-3.8559,	-3.7139,	-4.2026,	-4.6794,	-4.8368,	-4.8368,
S.E ,	1.0685,	.2162,	.5308,	.3901,	.2324,	.3596,	.6755,	.8027,	.4785,

Regression statistics :

Ages with q constant w.r.t. time

Age,	Slope,	Intercept,	S.e.,	RSquare,	No Pts,	Fleet Mean Q
2,	.39,	9.88,	.35,	.68,	6,	-8.18,
3,	.80,	6.92,	.16,	.91,	6,	-5.94,
4,	******,	******,	304.71,	.00,	6,	-4.74,
5,	1.28,	2.14,	.54,	.49,	6,	-3.86,
6,	1.18,	2.78,	.29,	.75,	6,	-3.71,
7,	1.76,	1.44,	.62,	.34,	6,	-4.20,
8,	15.09,	-26.25,	9.93,	.00,	6,	-4.68,
9,	-10.04,	17.99,	7.10,	.00,	6,	-4.84,
10,	.76,	4.87,	.36,	.81,	6,	-4.81,

1

Fleet : Danish Seiners

Age ,	1987,	1988,	1989,	1990,	1991,	1992
2 ,	-.53,	-1.55,	.12,	.85,	1.39,	-.29
3 ,	-.37,	.13,	.42,	.21,	-.06,	-.32
4 ,	-.07,	.63,	.12,	.36,	-.59,	-.46

Continued

Table 2.5.5 Continued

5	-.01,	.47,	.11,	.17,	-.54,	-.20
6	-.13,	.25,	.10,	-.14,	-.13,	.05
7	-.59,	.23,	.40,	.06,	.07,	-.16
8	-1.00,	.21,	.23,	.41,	.44,	-.29
9	-.51,	-.48,	.12,	.22,	.98,	-.34
10	.00,	.00,	.00,	.00,	.00,	.00

Mean catchability and Standard error.

Age ,	2,	3,	4,	5,	6,	7,	8,	9,	10
Mean Q,	-7.6476,	-5.4233,	-4.2915,	-3.3887,	-3.1680,	-3.5950,	-4.1061,	-4.0879,	-4.0879,
S.E ,	1.0414,	.3091,	.4702,	.3449,	.1609,	.3467,	.5558,	.5715,	.0000,

Regression statistics :

Ages with q constant w.r.t. time

Age,	Slope,	Intercept,	S.e.,	RSquare,	No Pts,	Fleet Mean Q
2,	.43,	9.56,	.40,	.62,	6,	-7.65,
3,	1.06,	5.12,	.36,	.66,	6,	-5.42,
4,	10.00,	-51.79,	2.46,	.04,	6,	-4.29,
5,	1.01,	3.34,	.39,	.65,	6,	-3.39,
6,	.99,	3.23,	.18,	.89,	6,	-3.17,
7,	1.47,	1.58,	.53,	.42,	6,	-3.59,
8,	1.65,	2.31,	.99,	.14,	6,	-4.11,
9,	3.47,	-.70,	1.84,	.07,	6,	-4.09,
10,	1.00,	4.09,	.00,	1.00,	6,	-4.09,

1

Terminal year survivor and F summaries :

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	150699.	1.508	.000	.00	1	.224	.006
Danish trawlers	60558.	1.161	.000	.00	1	.378	.015
Danish Seiners	52866.	1.132	.000	.00	1	.398	.017

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
70388.	.71	.29	3	.410	.013

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	80185.	.489	.188	.39	2	.138	.046
Danish trawlers	34980.	.240	.274	1.14	2	.571	.103
Danish Seiners	31486.	.336	.457	1.36	2	.291	.114

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
38039.	.18	.20	6	1.101	.095

1

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

Fleet	Estimated	Int	Ext	Var	N	Scaled	Estimated

Continued

Table 2.5.5 Continued

	Survivors	s.e	s.e	Ratio		Weights	F
Danish Gill-net	62668.	.281	.092	.33	3	.318	.170
Danish trawlers	54837.	.245	.238	.97	3	.420	.192
Danish Seiners	48443.	.310	.211	.68	3	.263	.215

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
55382.	.16	.10	9	.653	.191

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	21472.	.266	.144	.54	4	.396	.592
Danish trawlers	22567.	.289	.191	.66	4	.336	.570
Danish Seiners	18933.	.324	.167	.52	4	.268	.650

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
21110.	.17	.09	12	.535	.599

1

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	2640.	.295	.126	.43	5	.299	.963
Danish trawlers	2680.	.310	.122	.39	5	.273	.954
Danish Seiners	2719.	.247	.128	.52	5	.428	.945

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2684.	.16	.07	15	.417	.952

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	1039.	.297	.115	.39	6	.357	.687
Danish trawlers	1090.	.346	.111	.32	6	.263	.663
Danish Seiners	883.	.288	.041	.14	6	.380	.771

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
989.	.18	.05	18	.310	.711

1

Age 8 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	474.	.359	.135	.38	6	.366	.481
Danish trawlers	445.	.426	.111	.26	6	.261	.505
Danish Seiners	392.	.355	.073	.20	6	.374	.558

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
434.	.22	.06	18	.287	.515

Continued

Table 2.5.5 Continued

Age 9 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	125.	.483	.102	.21	6	.384	.645
Danish trawlers	139.	.622	.118	.19	6	.232	.596
Danish Seiners	133.	.484	.124	.26	6	.384	.617

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
131.	.30	.06	18	.210	.623

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Danish Gill-net	21.	.881	.071	.08	6	.000	.828
Danish trawlers	8.	.856	.249	.29	6	.000	1.491
Danish Seiners	12.	.000	.000	.20	6	1.000	1.186

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
12.	.00	.00	18	.277	1.186

Table 2.5.6

Run title : Plaice in Skagerak and Kattegat combined (run name: PLAICE3A9)

At 13-Oct-93 16:45

Terminal Fs derived using XSA (Without F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
2,	.0086,	.0253,	.0108,	.0075,	.0112,
3,	.2393,	.2050,	.1308,	.1442,	.0987,
4,	.7692,	.7974,	.5477,	.5502,	.5239,
5,	1.0915,	1.0657,	.8529,	.7765,	1.1592,
6,	1.0270,	1.0585,	.9472,	.7111,	1.1614,
7,	.6049,	.9291,	1.0599,	.5312,	.7231,
8,	.2608,	.2812,	1.0263,	.6451,	.5628,
9,	.4533,	.4779,	.5631,	.5878,	.8614,
10,	.6685,	.6685,	.6685,	.6685,	.6685,
+gp,	.6685,	.6685,	.6685,	.6685,	.6685,
FBAR 4- 8,	.7507,	.8264,	.8868,	.6428,	.8261,

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
2,	.0170,	.0317,	.0306,	.0108,	.0174,	.0031,	.0136,	.0329,	.0475,	.0125,	.0310,
3,	.2634,	.1691,	.1582,	.1113,	.1377,	.1077,	.1456,	.1397,	.1063,	.0952,	.1138,
4,	.6611,	.5212,	.4409,	.3970,	.4782,	.6477,	.3517,	.4906,	.1948,	.1905,	.2920,
5,	1.1099,	.7336,	.4901,	.7850,	1.0356,	1.3227,	.7508,	1.0084,	.4536,	.5992,	.6871,
6,	.9563,	.7767,	.6172,	.7635,	1.2158,	1.4305,	.9279,	1.0080,	.8019,	.9525,	.9208,
7,	.5242,	.8357,	.6172,	.4511,	.8270,	1.1785,	.9298,	.9410,	.7182,	.7115,	.7902,
8,	.4156,	.8745,	.5767,	.4390,	.4426,	1.0035,	.6940,	1.1735,	.7282,	.5154,	.8057,
9,	.3364,	.9132,	.5629,	.5236,	.7525,	.7501,	.7340,	1.2094,	1.5044,	.6226,	1.1121,
10,	.6685,	.6685,	.6685,	.6685,	1.3358,	1.3191,	.7386,	1.3001,	.9697,	1.1860,	1.1519,
+gp,	.6685,	.6685,	.6685,	.6685,	1.3358,	1.3191,	.7386,	1.3001,	.9697,	1.1860,	
FBAR 4- 8,	.7334,	.7483,	.5484,	.5671,	.7999,	1.1166,	.7308,	.9243,	.5793,	.5938,	

Table 2.5.7

Run title : Plaice in Skagerak and Kattegat combined (run name: PLAICE3A9)

At 13-Oct-93 16:45

Terminal Fs derived using XSA (Without F shrinkage)

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

YEAR,	1978,	1979,	1980,	1981,	1982,
AGE					
2,	61899,	46587,	35491,	26990,	52225,
3,	79673,	55530,	41103,	31768,	24240,
4,	79603,	56749,	40932,	32633,	24884,
5,	40533,	33376,	23133,	21417,	17033,
6,	13485,	12312,	10403,	8920,	8914,
7,	1476,	4369,	3866,	3651,	3964,
8,	298,	729,	1561,	1212,	1942,
9,	187,	208,	498,	506,	575,
10,	106,	108,	116,	257,	254,
+gp,	133,	118,	107,	208,	107,
TOTAL,	277393,	210086,	157211,	127562,	134140,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	GMST
AGE												
2,	97818,	73672,	50927,	38664,	36139,	34217,	81212,	103965,	53593,	78771,	0,	492
3,	46730,	87017,	64584,	44690,	34609,	32137,	30866,	72490,	91023,	46245,	70387,	442
4,	19871,	32493,	66484,	49886,	36176,	27287,	26110,	24145,	57037,	74052,	38044,	377
5,	13334,	9283,	17459,	38709,	30348,	20291,	12920,	16620,	13377,	42476,	55382,	210
6,	4836,	3977,	4033,	9677,	15975,	9749,	4891,	5518,	5486,	7690,	21110,	80
7,	2525,	1681,	1655,	1969,	4081,	4285,	2110,	1750,	1822,	2226,	2684,	27
8,	1741,	1353,	660,	808,	1135,	1615,	1193,	753,	618,	804,	989,	10
9,	1001,	1039,	510,	335,	471,	659,	536,	539,	211,	270,	434,	4
10,	220,	647,	377,	263,	180,	201,	282,	233,	146,	42,	131,	2
+gp,	240,	229,	352,	180,	233,	230,	452,	366,	227,	178,	61,	
TOTAL,	188316,	211392,	207041,	185181,	159347,	130670,	160571,	226379,	223538,	252754,	189223,	

Table 2.5.8

Run title : Plaice in Skagerak and Kattegat combined (run name: PLAICE3A9)

At 13-Oct-93 16:45

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (Without F shrinkage)

,	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 8,
1978,	61899,	75844,	61236,	26530,	.4332,	.7507,
1979,	46587,	57094,	46752,	21152,	.4524,	.8264,
1980,	35491,	49143,	39880,	15477,	.3881,	.8868,
1981,	26990,	39348,	33141,	12273,	.3703,	.6428,
1982,	52225,	41701,	27600,	10847,	.3930,	.8261,
1983,	97818,	56589,	28711,	10716,	.3732,	.7334,
1984,	73672,	63262,	42855,	11572,	.2700,	.7483,
1985,	50927,	63196,	48988,	13482,	.2752,	.5484,
1986,	38664,	54847,	45104,	14035,	.3112,	.5671,
1987,	36139,	51589,	39302,	15774,	.4014,	.7999,
1988,	34217,	37656,	29136,	12850,	.4410,	1.1166,
1989,	81212,	46532,	24280,	7674,	.3161,	.7308,
1990,	103965,	68470,	38216,	12078,	.3160,	.9243,
1991,	53593,	60867,	46772,	8746,	.1870,	.5793,
1992,	78771,	75430,	51089,	11823,	.2314,	.5938,
Arith. Mean ,	58145,	56105,	40204,	13669,	.3440,	.7516,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.5.9 Plaice in Division IIIa.

Assessment Quality Control Diagram 3

Recruitment (age 2) Unit: Millions.						
Date of assessment	Year class					
	1986	1987	1988	1989	1990	1991
1989	25.3	-				
1990	73.7	-	-			
1991	38.6	81.4	47.5	-		
1992	26.0	41.8	69.3	104.2	-	
1993	34.2	81.2	104.0	53.6	78.8	

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	36.6	-	[1]	[1]				
1990	40.7	43.0		[1]	[1]			
1991	31.3	27.2	42.3	62.0	[1]	[1]		
1992	27.8	20.9	24.9	28.0	23.4	24.3[1]	24.8[1]	
1993	29.1	24.3	38.2	46.8	51.1	56.9	50.7[1]	46.4[1]

[1]Forecast.

Remarks:

Table 3.2.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1981-1991, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
Belgium	6,604	6,704	5,804	4,815	6,604	6,693	5,508	3,398	2,934	2,331	3,356
Denmark	61,454	48,828	46,751	42,547	32,892	36,948	34,905	25,782	21,601	18,997	18,479
Faroe Islands	65	361	-	71	15	57	46	35	96	23	166
France	8,399	7,159	8,129	4,834	8,402	8,199	8,323	2,578[1,3]	1,641[1,3]	975[1,3]	1,947[3]
Germany	18,525	20,333	13,453	7,675	7,667	8,230	7,707	11,430	11,725	7,278	8,446
Netherlands	36,490	34,111	25,460	30,844	25,082	21,347	16,968[4]	12,028	8,445[1]	6,830[1]	11,133
Norway[2]	12,163	6,625	7,005	5,766	4,864	5,000	3,585	4,813	5,168	5,425	10,053
Poland	62	75	7	-	10	13	19	24	53	15	-
Sweden	453	422	575	748	839	688	367	501	620	784	823
UK (Engl.& Wales)	54,277	53,860	35,605	29,692	25,361	29,960	23,496	18,250	15,596	14,481	14,790
UK (Isle of Man)	-	-	-	-	-	-	-	1	-	-	-
UK (N. Ireland)	-	-	-	-	-	-	-	124	26	70	37
UK (Scotland)	57,308	58,581	54,359	60,931	45,748	49,671	41,382	31,480	31,120	28,748	28,367
Russia	-	-	-	-							
Total	255,800	237,059	197,148	187,923	157,484	166,806	142,306	110,444	99,025	85,957	97,597
Unreported landings	17,360	-3,397	7,723	5,043	5,745	8,671	7,815	5,180	5,483	559	333
vLandings as used by Working Group	273,160	233,662	204,871	192,966	163,229	175,477	150,121	115,624	q104,508	86,516	97,930

[1]Preliminary.
[2]Figures do not include cod caught as industrial by-actch.
[3]Includes Division IIa (EC).

Table 3.2.2 Cod, North Sea. Annual weight and numbers caught, 1963-1992

	Weight (1000 tonnes)				Numbers (millions)			
Year	Total	H.Cons	Disc.	Ind BC	Total	H.Cons	Disc.	Ind BC
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	105	105	0	0	76	76	0	0
1991	87	87	0	0	54	54	0	0
1992	98	98	0	0	64	64	0	0

Table 3.2.3 Cod, North Sea. Natural Mortality and proportion mature

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

Table 3.2.4 Cod, North Sea. International catch at age ('000), total, 1963-1992.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	2979	4621	15078	17450	10339	5601	2842	52719	42972	3692
2	39475	20665	49476	59861	67849	80549	21867	32813	148927	180833
3	6516	18478	16825	28578	31289	40916	30453	17886	16507	46369
4	3278	3958	8755	5922	10777	11906	13222	12904	6475	5474
5	2584	1762	2276	3235	3131	5838	4403	6092	6808	2627
6	1124	1670	906	1224	1889	1359	2792	1705	2588	3084
7	75	551	627	457	850	836	567	930	856	1618
8	456	108	284	354	340	297	407	202	439	589
9	13	86	49	121	132	145	142	180	219	376
10	5	11	72	54	38	107	45	95	74	108
11+	0	4	8	80	16	23	75	39	90	17
Age	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**
1	24742	14690	30081	5182	62744	24930	34113	60868	19833	64836
2	30259	55617	42487	90267	42275	158836	85844	96114	175920	59947
3	52342	10765	17073	16172	22918	13094	40458	29562	27563	53238
4	13409	14937	4203	6016	4104	8417	3332	10272	7649	7287
5	2102	4365	6816	1542	2055	2809	3130	1590	3802	3193
6	1057	907	1863	2764	752	941	675	1172	740	1883
7	1010	414	405	837	1030	366	365	412	555	355
8	466	373	176	119	335	372	129	191	131	218
9	76	313	206	61	237	140	145	71	63	72
10	55	76	86	57	23	33	39	54	36	25
11+	154	178	57	39	87	40	16	25	20	15
Age	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**
1	23837	63854	7894	84620	21404	18093	21773	11345	13542	23126
2	121826	57773	111118	19284	105466	49353	28351	49632	20808	27024
3	17518	27764	15713	28626	7208	35878	14484	8468	14706	7100
4	10104	3461	6874	3759	7755	2425	8150	3762	2311	4579
5	2501	3119	1150	2587	1351	2287	829	1977	1143	850
6	1167	939	1116	520	956	561	888	253	896	441
7	562	415	328	498	209	274	219	244	179	289
8	142	233	162	148	188	58	124	38	118	49
9	70	57	73	60	46	52	22	44	23	36
10	22	43	13	39	31	11	24	9	3	16
11+	18	19	23	19	11	16	9	3	8	9

Table 3.2.5 Cod, North Sea. International mean weight at age (kg), total 1963-1992.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	.538	.496	.581	.579	.590	.640	.544	.626	.579	.616
2	1.004	.863	.965	.994	1.035	.973	.921	.961	.941	.836
3	2.657	2.377	2.304	2.442	2.404	2.223	2.133	2.041	2.193	2.086
4	4.491	4.528	4.512	4.169	3.153	4.094	3.852	4.001	4.258	3.968
5	6.794	6.447	7.274	7.027	6.803	5.341	5.715	6.131	6.528	6.011
6	9.409	8.520	9.498	9.599	9.610	8.020	6.722	7.945	8.646	8.246
7	11.562	10.606	11.898	11.766	12.033	8.581	9.262	9.953	10.356	9.766
8	11.942	10.758	12.041	11.968	12.481	10.162	9.749	10.131	11.219	10.228
9	13.383	12.340	13.053	14.059	13.589	10.720	10.384	11.919	12.881	11.875
10	13.756	12.540	14.441	14.746	14.271	12.497	12.743	12.554	13.147	12.530
11+	.000	7.090	15.667	15.672	19.016	11.595	11.176	14.367	15.544	14.350

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.559	.594	.619	.568	.542	.568	.549	.546	.725	.587
2	.869	1.039	.899	1.027	.973	.938	.940	.998	.827	.948
3	1.919	2.217	2.348	2.477	2.161	2.025	2.447	2.002	2.256	1.851
4	3.776	4.156	4.226	4.575	4.603	4.242	4.583	4.578	4.759	4.512
5	5.488	6.174	6.404	6.505	6.716	6.599	6.687	6.390	7.188	6.848
6	7.453	8.333	8.691	8.630	8.832	8.945	8.557	9.156	8.851	8.993
7	9.019	9.889	10.107	10.137	10.075	9.972	10.938	9.805	10.059	10.740
8	9.810	10.790	10.910	11.341	11.052	11.099	11.550	11.867	11.519	12.500
9	11.077	12.175	12.339	12.888	11.824	12.427	13.057	12.782	13.338	13.469
10	12.359	12.425	12.976	14.140	13.134	12.778	14.148	14.081	14.897	12.890
11+	12.886	13.731	14.431	14.371	14.361	13.981	15.478	15.392	18.784	14.609

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	.634	.593	.582	.576	.620	.560	.671	.707	.652	.693
2	.917	.996	.920	.929	.933	.838	1.049	.932	1.027	1.127
3	1.814	2.144	2.126	1.834	1.948	1.909	1.830	2.140	1.981	2.591
4	3.960	4.041	4.228	3.975	3.647	3.190	3.599	3.743	4.117	4.268
5	6.589	6.255	6.457	6.421	6.011	5.924	5.179	6.091	6.156	6.476
6	8.454	8.423	8.475	8.153	8.276	7.848	7.832	8.339	7.985	8.484
7	9.919	10.317	10.406	9.956	9.911	9.723	9.500	10.523	9.637	10.172
8	11.837	11.352	12.034	11.713	11.413	11.607	11.087	10.742	10.937	10.422
9	12.797	13.505	13.033	12.710	12.149	13.489	12.774	12.610	13.547	11.774
10	12.562	13.408	13.209	13.566	15.542	14.353	14.066	15.285	13.250	13.799
11+	14.427	13.471	14.415	13.160	16.430	15.768	14.578	14.631	13.161	15.577

Table 3.2.6 Tuning input data for cod in IV

Cod; North Sea; 20 years of effort data.
112
SCOGFS
1982 1992
1 1 .50 .75
1 6

77.000	.474	.270	.441	.139	.071	.046
79.000	.257	.617	.143	.156	.059	.018
82.000	.672	.320	.208	.041	.047	.013
83.000	.055	.948	.163	.093	.025	.020
80.000	.641	.084	.317	.046	.032	.015
73.000	.160	.547	.025	.067	.021	.005
86.000	.140	.248	.142	.022	.028	.010
86.000	.483	.116	.145	.081	.017	.007
85.000	.097	.415	.050	.063	.022	.008
90.000	.273	.139	.120	.012	.005	.004
87.000	.559	.168	.063	.058	.025	.016

SCOTRL
1973 1992
1 1 .00 1.00
1 6

185241.000	323.113	1405.493	2629.921	471.165	61.021	67.023
185432.000	565.196	1179.408	926.321	820.284	144.050	34.012
152977.000	350.988	1596.945	430.985	264.991	271.991	37.999
121841.000	128.856	1299.546	676.244	151.830	84.905	86.903
144348.000	419.389	575.162	838.778	227.668	69.898	30.955
135220.000	303.876	1424.419	285.883	181.926	63.974	15.993
87467.000	215.635	914.453	447.243	73.875	46.921	22.961
55475.000	154.012	849.920	379.327	127.393	19.965	19.965
51553.000	95.989	928.202	387.683	113.695	51.256	13.979
47889.000	521.806	305.760	389.066	73.236	17.394	6.408
48339.000	178.337	1427.663	208.383	112.430	23.261	9.692
34574.000	316.043	772.341	345.964	32.726	16.831	7.480
33103.000	82.048	781.283	196.005	79.313	9.116	4.558
27839.000	251.300	190.609	256.042	19.914	10.431	.948
27208.000	272.057	606.030	38.463	39.401	8.443	1.876
21559.000	27.259	346.285	159.513	8.077	8.077	4.038
16657.000	58.153	29.428	134.388	40.929	2.974	2.233
14325.000	15.482	327.585	18.792	22.486	5.118	1.215
13495.000	45.113	94.909	103.953	7.731	6.998	1.718
10887.000	52.261	99.870	30.235	33.291	1.153	1.211

SCOSEI
1973 1992
1 1 .00 1.00
1 9

414898.000	2657.429	7446.202	6165.995	870.141	137.022	98.016	42.007	31.005	12.002
349604.000	3859.718	6285.798	1610.717	1085.483	252.112	54.024	38.017	23.010	15.007
329432.000	1821.095	8678.213	1784.072	556.334	471.283	79.048	9.005	5.003	13.008
307165.000	536.740	14237.110	2889.603	369.821	178.913	112.945	36.982	9.995	3.998
313913.000	2742.119	4316.187	3069.132	714.031	177.008	51.002	35.002	24.001	6.000
325246.000	1703.941	14715.490	1385.952	850.971	201.993	47.998	22.999	20.999	8.000
316419.000	2522.256	8021.633	3257.039	382.887	344.898	66.980	43.987	18.994	11.996
297227.000	1067.994	5957.458	2341.237	828.826	144.370	89.579	33.049	14.785	8.697
289672.000	855.604	13328.760	2355.389	698.688	204.816	18.169	10.736	12.388	3.303
297730.000	4070.478	4794.063	6023.739	822.294	291.107	151.409	25.095	20.913	11.711
333168.000	1342.728	13320.380	1813.966	1289.703	227.494	98.353	39.341	18.815	15.394
388085.000	4839.125	9954.796	3783.950	453.752	381.259	108.292	46.539	25.954	6.265
382910.000	543.929	18367.310	2498.646	835.287	127.187	107.343	26.159	24.355	9.922
425017.000	5425.851	2656.135	6865.172	824.863	285.816	42.826	38.171	13.965	7.448
418536.000	1361.396	13452.120	680.241	1423.568	283.434	186.518	24.686	35.658	15.543
377132.000	842.968	7091.734	4631.826	201.992	471.982	131.995	55.998	15.999	10.000
355735.000	1684.028	3495.714	3173.118	1092.297	91.156	185.066	44.650	18.698	2.391
270869.000	379.134	12625.370	1096.540	671.531	291.604	38.807	50.407	11.534	3.699
336675.000	1708.483	4746.648	2986.177	241.370	173.924	113.164	32.981	25.229	7.592
300217.000	1056.525	4120.136	942.427	618.214	97.903	59.252	31.805	8.852	8.416

Continued

Table 3.2.6 Continued

SCOLTR
1973 1992
1 1 .00 1.00
1 7

152514.000	760.513	1255.847	1899.281	202.136	20.014	23.016	12.008
116982.000	459.202	1185.520	438.192	376.165	40.018	5.002	8.004
161009.000	964.444	1558.102	775.553	119.931	112.935	5.997	.999
152419.000	263.044	3274.549	415.069	101.017	38.006	39.007	10.002
224824.000	2069.153	1808.008	774.432	118.066	75.042	24.013	13.007
236929.000	2255.601	5379.048	670.881	269.952	50.991	27.995	6.999
207494.000	1973.132	5845.391	1808.121	178.012	61.004	15.001	3.000
333197.000	1849.470	5356.235	2100.709	549.199	71.405	15.868	4.408
251504.000	690.987	5236.821	1474.781	293.606	81.839	10.968	5.906
250870.000	4703.856	2940.357	2301.849	377.382	109.995	39.348	8.048
244349.000	1321.201	6293.185	1020.032	459.821	111.146	31.372	14.341
240725.000	2723.570	3022.983	1543.958	180.369	85.675	36.074	9.920
268136.000	430.874	5959.050	865.407	293.653	39.337	21.041	3.659
279767.000	4140.451	1166.751	1847.672	250.965	95.651	12.311	8.523
351131.000	2045.224	5662.771	530.278	468.273	45.347	31.465	10.180
391988.000	403.133	3300.276	1912.375	133.375	148.417	33.093	14.039
405883.000	1574.048	1205.534	1594.526	565.712	48.605	45.236	13.343
398153.000	327.094	5739.588	523.696	456.829	179.523	25.746	11.324
408056.000	1821.110	1904.532	2125.128	138.039	94.188	48.099	8.199
473955.000	1401.577	2749.504	747.952	646.729	44.077	36.368	11.912

ENGGFS
1977 1992
1 1 .50 .75
1 5

111.000	6.968	.498	.359	.064	.012
113.000	2.577	1.410	.111	.112	.015
117.000	2.835	.679	.234	.032	.042
115.000	5.839	.770	.176	.084	.013
114.000	1.296	1.582	.145	.044	.046
72.000	2.329	.209	.237	.038	.027
74.000	1.138	.810	.089	.082	.021
82.000	5.014	.388	.146	.033	.017
73.000	.314	.868	.078	.041	.015
82.000	2.817	.094	.166	.024	.009
77.000	1.095	.820	.021	.047	.011
75.000	.627	.305	.149	.001	.032
85.000	1.943	.211	.101	.052	.005
86.000	.523	.433	.052	.011	.010
87.000	.654	.135	.063	.011	.003
74.000	1.716	.111	.033	.025	.006

ENGTRL
1973 1992
1 1 .00 1.00
1 7

603481.000	1289.000	2361.000	5481.000	1626.000	461.000	190.000	133.000
557947.000	821.000	4129.000	792.000	1925.000	617.000	157.000	68.000
469958.000	1866.000	2623.000	1156.000	303.000	738.000	267.000	44.000
493436.000	480.000	6058.000	1508.000	727.000	163.000	395.000	100.000
509862.000	2570.000	1905.000	2013.000	616.000	320.000	98.000	127.000
559930.000	2029.000	10576.000	1093.000	987.000	338.000	117.000	57.000
553020.000	1329.000	7698.000	3341.000	393.000	403.000	99.000	54.000
442036.000	1881.000	3786.000	2106.000	865.000	122.000	114.000	38.000
423658.000	615.000	12703.000	1886.000	535.000	250.000	38.000	48.000
424272.000	4074.000	3063.000	3802.000	587.000	298.000	179.000	35.000
392364.000	711.000	14220.000	1185.000	907.000	127.000	87.000	49.000
358387.000	3469.000	3459.000	2656.000	267.000	217.000	42.000	32.000
342844.000	675.000	8212.000	1047.000	533.000	72.000	54.000	16.000
288867.000	9097.000	2107.000	2388.000	209.000	161.000	15.000	12.000
275899.000	447.000	10435.000	682.000	596.000	36.000	26.000	3.000
296092.000	1173.000	2102.000	2428.000	90.000	126.000	17.000	10.000
310444.000	985.000	1958.000	718.000	501.000	25.000	34.000	5.000
255314.000	573.000	3101.000	513.000	134.000	101.000	11.000	13.000
258037.000	880.000	1559.000	1092.000	88.000	25.000	17.000	2.000
223702.000	1463.000	2171.000	481.000	234.000	19.000	5.000	5.000

Continue

ENGSEI
1973 1992
1 1 .00 1.00
1 9

237907.000	831.000	1968.000	3952.000	1225.000	174.000	127.000	102.000	40.000	5.000
210623.000	597.000	2764.000	411.000	1085.000	487.000	116.000	40.000	32.000	45.000
208508.000	2585.000	2437.000	764.000	127.000	350.000	145.000	14.000	13.000	27.000
211284.000	281.000	8523.000	895.000	479.000	116.000	290.000	84.000	17.000	6.000
196103.000	2630.000	2453.000	1577.000	245.000	182.000	60.000	103.000	31.000	8.000
203382.000	898.000	12831.000	746.000	547.000	131.000	78.000	21.000	37.000	9.000
187180.000	1718.000	7004.000	2438.000	162.000	280.000	76.000	35.000	14.000	18.000
201169.000	2111.000	7760.000	1370.000	611.000	146.000	210.000	54.000	29.000	9.000
185423.000	343.000	12689.000	1053.000	398.000	359.000	61.000	74.000	12.000	8.000
183209.000	1486.000	3191.000	2473.000	330.000	294.000	189.000	38.000	31.000	9.000
177004.000	566.000	4741.000	573.000	557.000	207.000	150.000	104.000	18.000	17.000
167699.000	1232.000	1513.000	1215.000	147.000	290.000	72.000	50.000	32.000	6.000
157815.000	125.000	3242.000	326.000	241.000	72.000	117.000	40.000	27.000	13.000
136358.000	890.000	312.000	572.000	65.000	139.000	34.000	52.000	13.000	7.000
123281.000	262.000	2395.000	82.000	184.000	44.000	77.000	10.000	22.000	8.000
91178.000	297.000	879.000	594.000	19.000	80.000	19.000	12.000	3.000	3.000
88782.000	343.000	748.000	216.000	138.000	9.000	46.000	7.000	8.000	1.000
80537.000	176.000	1009.000	116.000	45.000	58.000	4.000	15.000	3.000	1.000
84346.000	129.000	262.000	207.000	33.000	26.000	38.000	6.000	16.000	1.000
67810.000	408.000	463.000	57.000	42.000	10.000	8.000	8.000	2.000	3.000

FRATRB
1976 1992
1 1 .00 1.00
1 6

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

FRGGFS
1983 1992
1 1 .25 .50
1 3

1.000	.006	.004	.002
1.000	.003	.002	.001
1.000	.002	.022	.003
1.000	.015	.003	.007
1.000	.007	.011	.011
1.000	.002	.010	.005
1.000	.090	.007	.004
1.000	.012	.015	.003
1.000	.015	.006	.004
1.000	.013	.004	.001

NETGFS
1980 1992
1 1 .50 .75
1 2

1.000	.164	.005
1.000	.047	.011
1.000	.083	.002
1.000	.022	.002
1.000	.121	.002
1.000	.004	.003
1.000	.111	.000
1.000	.042	.008
1.000	.018	.002
1.000	.017	.002
1.000	.009	.002
1.000	.007	.001
1.000	.045	.001

Continued

Table 3.2.6 Continued

```
INTGFS
 1973 1992
 1 1  .00  .25
  1  2
       1.000         .038         .011
       1.000         .015         .010
       1.000         .040         .006
       1.000         .008         .020
       1.000         .037         .003
       1.000         .013         .029
       1.000         .010         .009
       1.000         .017         .015
       1.000         .003         .026
       1.000         .009         .007
       1.000         .004         .017
       1.000         .015         .008
       1.000         .001         .018
       1.000         .017         .004
       1.000         .009         .029
       1.000         .004         .006
       1.000         .013         .006
       1.000         .003         .015
       1.000         .002         .004
       1.000         .013         .005

INTGFS2
 1983 1992
 1 1  .00  .25
  3 6
       1.000 2.73 1.86  .84 1.51
       1.000 3.96  .91 1.01  .94
       1.000 3.54 1.70  .51 1.00
       1.000 6.85 2.30 1.30 1.11
       1.000 1.43 1.72  .60  .92
       1.000 5.87  .67  .97 1.14
       1.000 5.00 2.32  .42 1.09
       1.000 1.82 1.03  .98  .64
       1.000 3.34  .74  .39  .85
       1.000 1.09 1.03  .27  .54
```

Table 3.2.7 Tuning diagnostics for cod in IV

VPA Version 3.1 (MSDOS)

9/10/1993 9:17

Extended Survivors Analysis

Cod in the North Sea; 1963-1992.

CPUE data from file c:\demwg93\cod2\cod20ef.dat

Data for 12 fleets over 30 years
Age range from 1 to 10

Fleet,	Alpha,	Beta
SCOGFS	, .500	, .750
SCOTRL	, .000	, 1.000
SCOSEI	, .000	, 1.000
SCOLTR	, .000	, 1.000
ENGGFS	, .500	, .750
ENGTRL	, .000	, 1.000
ENGSEI	, .000	, 1.000
FRATRB	, .000	, 1.000
FRGGFS	, .250	, .500
NETGFS	, .500	, .750
INTGFS	, .000	, .250
INTGFS2	, .000	, .250

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

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

Catchability independent of age for ages >= 6

Terminal population estimation :

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

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

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

Prior weighting not applied

Continued

Table 3.2.7 Continued

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	172795.	.355	.000	.00	1	.146	.086
SCOTRL	159050.	.949	.000	.00	1	.020	.093
SCOSEI	89991.	.554	.000	.00	1	.060	.159
SCOLTR	83567.	.499	.000	.00	1	.074	.170
ENGGFS	144792.	.316	.000	.00	1	.184	.102
ENGTRL	200321.	.976	.000	.00	1	.019	.075
ENGSEI	183551.	.423	.000	.00	1	.103	.081
FRATRB	118406.	1.166	.000	.00	1	.014	.123
FRGGFS	239144.	3.324	.000	.00	1	.002	.063
NETGFS	138162.	.316	.000	.00	1	.184	.106
INTGFS	194743.	.488	.000	.00	1	.077	.077
INTGFS2	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	107045.	.66				.042	.135
F shrinkage mean	88405.	.50				.074	.162

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
138092.	.14	.08	13	.596	.106

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	20825.	.341	.285	.84	2	.145	.737
SCOTRL	26673.	.797	.086	.11	2	.027	.615
SCOSEI	25546.	.481	.326	.68	2	.073	.636
SCOLTR	21548.	.386	.300	.78	2	.113	.719
ENGGFS	13967.	.345	.238	.69	2	.142	.965
ENGTRL	26684.	.576	.027	.05	2	.051	.615
ENGSEI	16480.	.464	.086	.18	2	.078	.866
FRATRB	24100.	.495	.118	.24	2	.069	.663
FRGGFS	18014.	1.109	.396	.36	2	.014	.815
NETGFS	13881.	.377	.026	.07	2	.119	.969
INTGFS	16188.	.406	.138	.34	2	.102	.876
INTGFS2	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	14767.	.50				.067	.931

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
18358.	.13	.07	23	.516	.805

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	3951.	.452	.036	.08	3	.094	.950
SCOTRL	5001.	.655	.177	.27	3	.045	.812
SCOSEI	4426.	.469	.144	.31	3	.087	.882
SCOLTR	3868.	.389	.085	.22	3	.126	.963
ENGGFS	3775.	.391	.056	.14	3	.125	.978
ENGTRL	5063.	.432	.020	.05	3	.103	.805
ENGSEI	3014.	.491	.254	.52	3	.079	1.124
FRATRB	3688.	.499	.250	.50	3	.077	.993
FRGGFS	3824.	1.160	.400	.34	3	.014	.970
NETGFS	4360.	.626	.080	.13	2	.049	.891
INTGFS	4320.	.666	.101	.15	2	.043	.896
INTGFS2	2886.	.484	.000	.00	1	.082	1.154
F shrinkage mean	3686.	.50				.077	.993

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3904.	.14	.04	33	.313	.957

Continued

Table 3.2.7 Continued

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	3999.	.414	.138	.33	4	.093	.711
SCOTRL	7928.	.490	.095	.19	4	.066	.420
SCOSEI	4789.	.388	.127	.33	4	.106	.623
SCOLTR	5505.	.333	.037	.11	4	.144	.561
ENGGFS	3734.	.480	.190	.39	4	.069	.747
ENGTRL	4239.	.343	.021	.06	4	.136	.682
ENGSEI	2989.	.435	.132	.30	4	.084	.870
FRATRB	2705.	.445	.210	.47	4	.081	.929
FRGGFS	5877.	1.560	.484	.31	3	.007	.534
NETGFS	3274.	.842	.076	.09	2	.023	.818
INTGFS	7061.	.898	.052	.06	2	.020	.462
INTGFS2	3221.	.383	.163	.43	2	.109	.827
F shrinkage mean	2738.	.50				.064	.921

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4076.	.13	.06	42	.452	.701

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	412.	.644	.380	.59	5	.060	1.053
SCOTRL	355.	.488	.088	.18	5	.105	1.152
SCOSEI	520.	.479	.110	.23	5	.108	.908
SCOLTR	391.	.421	.091	.22	5	.140	1.087
ENGGFS	568.	.683	.096	.14	5	.053	.856
ENGTRL	376.	.453	.046	.10	5	.121	1.114
ENGSEI	350.	.552	.112	.20	5	.082	1.162
FRATRB	253.	.595	.093	.16	5	.070	1.396
FRGGFS	666.	3.195	.310	.10	3	.002	.767
NETGFS	625.	1.800	.099	.06	2	.008	.802
INTGFS	519.	1.892	.003	.00	2	.007	.909
INTGFS2	423.	.415	.069	.17	3	.144	1.036
F shrinkage mean	661.	.50				.099	.772

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
419.	.16	.05	51	.310	1.042

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	357.	.676	.384	.57	6	.056	.750
SCOTRL	583.	.522	.085	.16	6	.095	.521
SCOSEI	443.	.536	.071	.13	6	.090	.642
SCOLTR	473.	.461	.052	.11	6	.121	.612
ENGGFS	185.	.937	.284	.30	5	.029	1.148
ENGTRL	162.	.440	.103	.23	6	.133	1.241
ENGSEI	220.	.540	.072	.13	6	.088	1.035
FRATRB	195.	.506	.117	.23	6	.101	1.113
FRGGFS	402.	4.477	.091	.02	3	.001	.690
NETGFS	359.	2.514	.156	.06	2	.004	.748
INTGFS	265.	2.659	.326	.12	2	.004	.919
INTGFS2	283.	.386	.088	.23	4	.174	.879
F shrinkage mean	312.	.50				.103	.823

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
297.	.16	.07	59	.406	.851

Continued

Table 3.2.7 Continued

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	97.	1.120	.220	.20	6	.035	1.305
SCOTRL	170.	.847	.064	.08	6	.061	.929
SCOSEI	237.	.682	.039	.06	7	.094	.743
SCOLTR	207.	.606	.103	.17	7	.118	.816
ENGGFS	151.	1.564	.156	.10	5	.018	1.006
ENGTRL	149.	.542	.107	.20	7	.148	1.014
ENGSEI	190.	.499	.036	.07	7	.175	.865
FRATRB	132.	.829	.120	.14	6	.063	1.090
FRGGFS	132.	8.012	.070	.01	3	.001	1.093
NETGFS	228.	4.585	.260	.06	2	.002	.765
INTGFS	249.	4.815	.186	.04	2	.002	.718
INTGFS2	165.	.628	.106	.17	4	.110	.950
F shrinkage mean	193.	.50				.174	.856

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
176.	.21	.04	63	.169	.909

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	36.	1.328	.165	.12	6	.031	.801
SCOTRL	39.	1.048	.132	.13	6	.050	.751
SCOSEI	56.	.582	.155	.27	8	.162	.582
SCOLTR	42.	.787	.104	.13	7	.089	.714
ENGGFS	22.	1.752	.304	.17	5	.018	1.106
ENGTRL	25.	.720	.149	.21	7	.106	1.019
ENGSEI	32.	.562	.210	.37	8	.174	.872
FRATRB	25.	1.015	.088	.09	6	.053	1.026
FRGGFS	96.	7.663	.746	.10	3	.001	.376
NETGFS	28.	5.211	.000	.00	1	.002	.939
INTGFS	33.	4.447	.264	.06	2	.003	.849
INTGFS2	46.	.778	.085	.11	4	.091	.670
F shrinkage mean	38.	.50				.220	.771

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
37.	.23	.06	64	.235	.781

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	45.	1.623	.158	.10	6	.020	.547
SCOTRL	54.	1.239	.042	.03	6	.035	.479
SCOSEI	90.	.482	.045	.09	9	.229	.311
SCOLTR	62.	.890	.079	.09	7	.067	.427
ENGGFS	108.	2.270	.139	.06	5	.010	.266
ENGTRL	75.	.797	.047	.06	7	.084	.365
ENGSEI	94.	.470	.109	.23	9	.240	.300
FRATRB	61.	1.202	.184	.15	6	.037	.432
FRGGFS	72.	11.084	.318	.03	3	.000	.378
NETGFS	57.	6.623	.227	.03	2	.001	.459
INTGFS	60.	6.955	.009	.00	2	.001	.437
INTGFS2	59.	.914	.041	.04	4	.064	.446
F shrinkage mean	21.	.50				.212	.948

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
60.	.23	.08	67	.360	.440

Continued

Table 3.2.7 Continued

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	18.	2.205	.042	.02	6	.017	.596
SCOTRL	22.	1.705	.169	.10	6	.028	.522
SCOSEI	28.	.638	.038	.06	9	.204	.424
SCOLTR	19.	1.234	.141	.11	7	.054	.574
ENGGFS	19.	3.050	.035	.01	5	.009	.572
ENGTRL	12.	1.111	.061	.05	7	.067	.784
ENGSEI	13.	.636	.078	.12	9	.204	.756
FRATRB	31.	1.660	.097	.06	6	.030	.388
FRGGFS	10.	14.520	.416	.03	3	.000	.931
NETGFS	14.	8.569	.044	.01	2	.001	.727
INTGFS	13.	8.989	.105	.01	2	.001	.763
INTGFS2	22.	1.263	.135	.11	4	.052	.504
F shrinkage mean	12.	.50				.331	.813

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
16.	.29	.05	67	.184	.648

TABLE 3.2.8; Cod, North Sea
International F at age, Total , 1963 to 1992.

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	.024	.020	.058	.055	.033	.046	.021	.111	.077	.034
2	.526	.364	.468	.549	.495	.635	.392	.585	.889	.905
3	.362	.575	.658	.627	.726	.738	.602	.753	.776	.922
4	.446	.403	.619	.528	.531	.711	.584	.577	.713	.668
5	.449	.461	.429	.489	.596	.622	.631	.590	.698	.724
6	.557	.594	.459	.434	.596	.565	.701	.537	.541	.819
7	.157	.590	.465	.444	.618	.582	.489	.533	.573	.793
8	.773	.355	.707	.525	.709	.454	.633	.322	.520	1.051
9	.308	.313	.267	.760	.376	.774	.410	.649	.696	1.254
10	.452	.466	.469	.535	.584	.604	.578	.531	.611	.938
11+	.452	.466	.469	.535	.584	.604	.578	.531	.611	.938

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.133	.097	.108	.039	.134	.089	.117	.117	.112	.184
2	.714	.840	.742	.940	.870	1.032	.843	.967	1.009	1.012
3	.857	.694	.789	.833	.764	.866	.970	.956	.996	1.245
4	.796	.663	.672	.756	.534	.750	.578	.736	.731	.834
5	.589	.660	.742	.561	.638	.890	.709	.609	.677	.797
6	.738	.550	.669	.786	.595	.691	.546	.638	.648	.881
7	.707	.738	.511	.739	.785	.660	.639	.782	.725	.765
8	.555	.623	.840	.273	.765	.747	.514	.848	.618	.718
9	.347	.938	.875	.805	1.449	.888	.755	.607	.778	.849
10	.592	.709	.735	.640	.862	.808	.660	.711	.715	.822
11+	.592	.709	.735	.640	.862	.808	.660	.711	.715	.822

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	.138	.190	.115	.240	.141	.198	.135	.162	.145	.106
2	1.127	1.014	1.044	.756	.919	.968	.944	.879	.849	.805
3	1.173	1.027	1.036	1.022	.844	1.176	1.042	1.003	.830	.957
4	.886	.804	.811	.786	.924	.819	1.015	.908	.892	.701
5	.789	.772	.695	.854	.743	.793	.753	.737	.796	1.041
6	.785	.801	.710	.809	.939	.820	.851	.541	.923	.851
7	.723	.727	.743	.830	.943	.789	.932	.601	.969	.909
8	.825	.770	.715	.937	.908	.759	1.097	.389	.665	.781
9	.534	.983	.591	.646	.897	.685	.756	1.913	.438	.440
10	.688	.736	.657	.743	.824	.575	.804	.810	.712	.648
11+	.688	.736	.657	.743	.824	.575	.804	.810	.712	.648

TABLE 3.2.9; Cod, North Sea

Tuned Stock Numbers at age (10**-3), 1963 to 1993, (numbers in 1993 are VPA survivors)

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	184163	357636	398056	486382	469941	187273	200685	748942	869039	162744
2	114955	80753	157599	168751	206848	204228	80393	88269	301183	361679
3	24301	47870	39559	69525	68666	88807	76299	38295	34657	87222
4	10061	13175	20974	15960	28926	25865	33054	32547	14040	12423
5	7890	5271	7206	9251	7709	13931	10403	15099	14971	5636
6	2910	4121	2721	3840	4646	3479	6124	4534	6850	6097
7	571	1366	1863	1408	2037	2095	1619	2487	2169	3266
8	936	400	620	958	740	898	959	812	1195	1001
9	52	354	229	250	464	298	467	417	482	581
10	16	31	212	144	96	261	113	254	178	197
11+	0	11	22	210	41	55	187	104	215	30

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	296282	236914	437672	200675	747837	436682	462081	824759	279285	574528
2	70650	116543	96606	176494	86696	293966	179503	184760	329787	112196
3	103069	24386	35438	32411	48599	25605	73819	54431	49514	84720
4	27008	34079	9491	12532	10970	17624	8386	21786	16303	14237
5	5218	9979	14385	3968	4817	5268	6813	3851	8542	6427
6	2238	2370	4221	5610	1853	2084	1772	2746	1714	3553
7	2202	876	1120	1770	2092	837	855	840	1188	734
8	1210	889	343	550	692	781	354	370	315	471
9	286	568	391	121	343	264	303	173	130	139
10	136	166	182	133	44	66	89	117	77	49
11+	377	382	120	90	164	79	35	53	43	29

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	275902	549926	108145	591529	242873	150005	257406	113326	149823	341827
2	214691	107993	204295	43301	209069	94783	55274	101065	43316	58242
3	28741	49022	27603	50685	14326	58794	25363	15151	29555	13057
4	18997	6924	13677	7631	14211	4796	14127	6970	4327	10039
5	5063	6411	2537	4977	2846	4618	1732	4192	2302	1451
6	2373	1883	2427	1036	1734	1108	1712	668	1643	850
7	1206	886	692	976	378	555	400	598	318	534
8	280	479	351	269	349	120	206	129	269	99
9	188	100	182	140	86	115	46	56	71	113
10	49	90	31	82	60	29	48	18	7	38
11+	40	39	52	39	22	39	19	6	18	21

Age	1993
1	0
2	138092
3	18358
4	3904
5	4076
6	419
7	297
8	176
9	37
10	60
11+	25

Table 3.2.10 Cod in the North Sea. Research vessel indices.

YEARCLASS	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS1	SGFS2	DGFS0	DGFS1	DGFS2	FRGSF	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	38.0	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	.9	3.6	.4	4.3	1.2	.7	1.0	1.3	3.6	.2	.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	.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	.7	.6	11.9	6.2
1990	2.4	4.5	3.9	7.5	1.5	3.0	1.9	23.5	7.2	1.1	-1	15.5	3.6
1991	13.0	19.9	48.4	23.2	6.2	6.4	7.5	39.8	45.4	-1	-1	13.4	-1
1992	12.7	-1	16.0	7.1	-1	3.5	-1	11.6	-1	-1	-1	-1	-1
1993	-1	-1	3.6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 3.2.11 Recruitment analysis of cod in IV: age 1

Analysis by RCT3 ver3.1 of data from file :

c:\demwg93\cod2\codiv1.rcx

Data for 13 surveys over 24 years : 1970 - 1993

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 = 1990

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.03	3.47	.50	.657	20	1.22	4.74	.605	.029
IYFS2	1.12	2.98	.33	.820	20	1.70	4.90	.390	.071
EGFS0	.66	4.25	.67	.523	13	1.59	5.30	.781	.018
EGFS1	.90	3.04	.23	.904	14	2.14	4.97	.280	.137
EGFS2	1.09	3.74	.17	.943	15	.92	4.74	.215	.233
SGFS1	1.10	3.97	.24	.900	9	1.39	5.49	.291	.127
SGFS2	1.09	3.89	.21	.911	10	1.06	5.06	.261	.158
DGFS0	.57	3.55	.39	.758	10	3.20	5.37	.460	.051
DGFS1	.64	3.38	.25	.894	11	2.10	4.73	.317	.107
DGFS2	1.24	4.19	.43	.733	12	.74	5.11	.515	.041
FRGSF									
GGFS1	2.95	-1.02	3.61	.037	8	2.80	7.25	4.533	.001
GGFS2	2.45	.37	1.59	.172	9	1.53	4.11	2.004	.003
					VPA Mean =		5.71	.664	.024

Yearclass = 1991

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.01	3.56	.46	.702	21	2.64	6.22	.531	.037
IYFS2	1.11	3.01	.31	.838	21	3.04	6.39	.366	.079
EGFS0	.69	4.17	.68	.517	14	3.90	6.85	.836	.015
EGFS1	.90	3.06	.22	.912	15	3.19	5.91	.255	.163
EGFS2	1.05	3.83	.17	.942	16	1.97	5.90	.201	.263
SGFS1	1.17	3.81	.29	.849	10	2.00	6.16	.366	.079
SGFS2	1.10	3.88	.20	.915	11	2.14	6.23	.253	.165
DGFS0	.60	3.40	.40	.732	11	3.71	5.63	.475	.047
DGFS1	.62	3.48	.25	.894	12	3.84	5.86	.289	.127
DGFS2									
FRGSF									
GGFS1	4.07	-3.87	4.75	.019	9	2.67	6.99	5.780	.000
GGFS2									
					VPA Mean =		5.63	.668	.024

Continued

Table 3.2.11 Continued

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I----------	Regression	----------	---------I	I----------	Prediction	----------	----------	---------I
IYFS1	1.00	3.55	.43	.708	22	2.62	6.17	.503	.107
IYFS2									
EGFS0	.65	4.15	.68	.490	15	2.83	6.00	.790	.043
EGFS1	.89	3.06	.21	.912	16	2.09	4.92	.251	.430
EGFS2									
SGFS1	1.14	3.83	.29	.841	11	1.50	5.54	.339	.237
SGFS2									
DGFS0	.62	3.36	.40	.718	12	2.53	4.92	.482	.117
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
						VPA Mean =	5.62	.643	.066

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I----------	Regression	----------	---------I	I----------	Prediction	----------	----------	---------I
IYFS1									
IYFS2									
EGFS0	.65	4.15	.69	.484	15	1.53	5.14	.810	.384
EGFS1									
EGFS2									
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
						VPA Mean =	5.59	.640	.616

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	149	5.01	.10	.08	.65	150	5.02
1991	410	6.02	.10	.07	.49	342	5.84
1992	199	5.29	.16	.20	1.47		
1993	224	5.41	.50	.22	.18		

Table 3.2.12 Recruitment analysis of cod in IV: age 2

Analysis by RCT3 ver3.1 of data from file :

c:\demwg93\cod2\codiv2.rcx

Data for 13 surveys over 24 years : 1970 - 1993

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 = 1990

Survey/ Series	I-----------Regression----------I					I-----------Prediction---------I			
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.02	2.56	.50	.653	20	1.22	3.80	.602	.032
IYFS2	1.13	2.02	.36	.787	20	1.70	3.95	.426	.063
EGFS0	.65	3.32	.67	.521	13	1.59	4.36	.774	.019
EGFS1	.90	2.11	.25	.891	14	2.14	4.03	.297	.130
EGFS2	1.08	2.80	.20	.925	15	.92	3.80	.245	.191
SGFS1	1.06	3.06	.23	.899	9	1.39	4.53	.282	.144
SGFS2	1.05	3.00	.20	.919	10	1.06	4.12	.240	.198
DGFS0	.56	2.63	.40	.728	10	3.20	4.41	.481	.050
DGFS1	.63	2.46	.27	.879	11	2.10	3.79	.335	.102
DGFS2	1.23	3.24	.45	.713	12	.74	4.16	.531	.041
FRGSF									
GGFS1	2.64	-1.29	3.21	.042	8	2.80	6.10	4.041	.001
GGFS2	2.42	-.53	1.58	.163	9	1.53	3.17	1.991	.003
					VPA Mean =		4.76	.654	.027

Yearclass = 1991

Survey/ Series	I-----------Regression----------I					I-----------Prediction---------I			
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.00	2.63	.46	.696	21	2.64	5.27	.532	.040
IYFS2	1.11	2.06	.33	.810	21	3.04	5.45	.398	.071
EGFS0	.68	3.24	.67	.516	14	3.90	5.88	.825	.016
EGFS1	.89	2.13	.23	.900	15	3.19	4.96	.269	.155
EGFS2	1.04	2.90	.19	.927	16	1.97	4.95	.224	.224
SGFS1	1.13	2.91	.28	.848	10	2.00	5.17	.353	.090
SGFS2	1.05	2.99	.19	.923	11	2.14	5.25	.232	.208
DGFS0	.59	2.48	.42	.703	11	3.71	4.67	.493	.046
DGFS1	.61	2.56	.26	.880	12	3.84	4.90	.303	.122
DGFS2									
FRGSF									
GGFS1	3.55	-3.64	4.13	.024	9	2.67	5.83	5.026	.000
GGFS2									
					VPA Mean =		4.68	.658	.026

Continued

Table 3.2.12 Continued

Yearclass = 1992

Survey/ Series	I-----------Regression----------I Slope	Inter- cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.01	2.62	.45	.705	21	2.62	5.26	.533	.109
IYFS2									
EGFS0	.68	3.24	.68	.510	14	2.83	5.15	.798	.048
EGFS1	.89	2.13	.23	.901	15	2.09	3.98	.279	.396
EGFS2									
SGFS1	1.13	2.91	.29	.846	10	1.50	4.61	.343	.262
SGFS2									
DGFS0	.60	2.46	.43	.695	11	2.53	3.97	.522	.113
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
						VPA Mean =	4.65	.659	.071

Yearclass = 1993

Survey/ Series	I-----------Regression----------I Slope	Inter- cept	Std Error	Rsquare	No. Pts	I-----------Prediction---------I Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.68	3.23	.69	.500	14	1.53	4.26	.818	.392
EGFS1									
EGFS2									
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
FRGSF									
GGFS1									
GGFS2									
						VPA Mean =	4.61	.657	.608

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	59	4.09	.11	.08	.60	59	4.08
1991	159	5.07	.11	.07	.45		
1992	80	4.39	.18	.21	1.37		
1993	87	4.47	.51	.17	.11		

TABLE 3.2.13; Cod, North Sea
Mean fishing mortality, biomass and recruitment, 1963 - 1992.

	Mean Fishing Mortality			Stock Biomass ('000 tonnes)		Recruits Age 1	
	H.Cons	Disc.	Ind BC				
Year	Ages 2 to 8	Ages 2 to 8	Ages 1 to 1	Total	Spawning	Yclass	Million
1963	.467	.000	.000	424	142	1962	184
1964	.477	.000	.000	513	156	1963	358
1965	.544	.000	.000	683	197	1964	398
1966	.514	.000	.000	825	221	1965	486
1967	.610	.000	.000	887	240	1966	470
1968	.615	.000	.000	758	248	1967	187
1969	.576	.000	.000	607	246	1968	201
1970	.557	.000	.000	933	266	1969	749
1971	.673	.000	.000	1127	265	1970	869
1972	.840	.000	.000	770	220	1971	163
1973	.708	.000	.000	613	196	1972	296
1974	.681	.000	.000	571	213	1973	237
1975	.709	.000	.000	634	191	1974	438
1976	.698	.000	.000	536	164	1975	201
1977	.707	.000	.000	729	144	1976	748
1978	.805	.000	.000	726	145	1977	437
1979	.686	.000	.000	722	150	1978	462
1980	.791	.000	.000	910	164	1979	825
1981	.772	.000	.000	760	177	1980	279
1982	.893	.000	.000	757	171	1981	575
1983	.901	.000	.000	571	138	1982	276
1984	.845	.000	.000	641	118	1983	550
1985	.822	.000	.000	419	109	1984	108
1986	.856	.000	.000	561	98	1985	592
1987	.889	.000	.000	467	89	1986	243
1988	.875	.000	.000	336	82	1987	150
1989	.948	.000	.000	358	76	1988	257
1990	.723	.000	.000	273	65	1989	113
1991	.846	.000	.000	253	60	1990	150
1992	.864	.000	.000	404	64	1991	410

Arithmetic mean recruits at age 1 for the period 1963 to 1992 : 380
Geometric mean recruits at age 1 for the period 1963 to 1992 : 323

TABLE 3.2.14; Cod, North Sea
Input for Catch Prediction

Age	1993 Stock Numbers (10**-3)	Scaled Mean F 1988 - 1992 H.Cons	Disc.	Ind BC	Mean Wt. at age (kg) 1988 - 1992 Stock	H.Cons	Disc.	Ind BC
1	199000	.151	.000	.000	.656	.656	.000	.000
2	159000	.902	.000	.000	.994	.994	.000	.000
3	18358	1.017	.000	.000	2.090	2.090	.000	.000
4	3904	.880	.000	.000	3.784	3.784	.000	.000
5	4076	.836	.000	.000	5.965	5.965	.000	.000
6	419	.809	.000	.000	8.097	8.097	.000	.000
7	297	.852	.000	.000	9.911	9.911	.000	.000
8	176	.749	.000	.000	10.959	10.959	.000	.000
9	37	.859	.000	.000	12.839	12.839	.000	.000
10	60	.720	.000	.000	14.151	14.151	.000	.000
11	25	.720	.000	.000	14.743	14.743	.000	.000

(F and mean Wt at age used in prediction)

Mean F	(2 - 8)	(1 - 1)
Unscaled	.851	.000
Scaled	.864	.000

Recruits at age 1 in 1994 = 224000
Recruits at age 1 in 1995 = 268000

Stock numbers in 1993 are VPA survivors.
These are overwritten at Ages 1 and 2.

TABLE 3.2.15; Cod, North Sea
Catch Prediction output; Cod IV Status Quo

		Year						
	1993	1994						
Biomass at start of Year								
Total	376	362	362	362	362	362	362	362
Spawning	58	62	62	62	62	62	62	62
Mean F Ages								
H.Cons 2 to 8	.86	.00	.17	.35	.52	.69	.86	1.04
Ind BC 1 to 1	.00	.00	.00	.00	.00	.00	.00	.00
Effort relative to 1992								
H.Cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight ('000t)								
H.Cons	142	0	35	65	91	113	131	147
Disc.	0	0	0	0	0	0	0	0
Ind BC	0	0	0	0	0	0	0	0
Total Catch	142	0	35	65	91	113	131	147
Total Landings	142	0	35	65	91	113	131	147
Biomass at start of 1995								
Total		572	518	473	435	404	377	355
Spawning		162	135	112	94	79	66	56

Stock at start of and catch during 1993

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
1	199000	19390	0	0	19390
2	159000	81797	0	0	81797
3	18358	10585	0	0	10585
4	3904	2101	0	0	2101
5	4076	2122	0	0	2122
6	419	213	0	0	213
7	297	157	0	0	157
8	176	85	0	0	85
9	37	20	0	0	20
10	60	28	0	0	28
11	25	12	0	0	12
Wt.	376002	141793	0	0	141793

Stock at start of and catch during 1994
For F(1994) = F(1992)

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
1	224000	21825	0	0	21825
2	76885	39553	0	0	39553
3	45463	26214	0	0	26214
4	5171	2783	0	0	2783
5	1326	690	0	0	690
6	1446	737	0	0	737
7	153	81	0	0	81
8	104	50	0	0	50
9	68	36	0	0	36
10	13	6	0	0	6
11	24	11	0	0	11
Wt.	361632	131095	0	0	131095

(Numbers in thousands, weights in tonnes.)

TABLE 3.2.16 Cod, North Sea
Catch Prediction output; Cod IV TAC Option

	Year							
	1993	1994						
Biomass at start of Year								
Total	376	423	423	423	423	423	423	423
Spawning	58	85	85	85	85	85	85	85
Mean F Ages								
H.Cons 2 to 8	.54	.00	.17	.35	.52	.69	.86	1.04
Ind BC 1 to 1	.00	.00	.00	.00	.00	.00	.00	.00
Effort relative to 1992								
H.Cons	.62	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight ('000t)								
H.Cons	101	0	45	83	115	142	165	185
Disc.	0	0	0	0	0	0	0	0
Ind BC	0	0	0	0	0	0	0	0
Total Catch	101	0	45	83	115	142	165	185
Total Landings	101	0	45	83	115	142	165	185
Biomass at start of 1995								
Total		654	586	529	481	442	409	381
Spawning		216	180	150	125	104	87	73

Stock at start of and catch during 1993

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
1	199000	12356	0	0	12356
2	159000	58544	0	0	58544
3	18358	7714	0	0	7714
4	3904	1505	0	0	1505
5	4076	1511	0	0	1511
6	419	151	0	0	151
7	297	112	0	0	112
8	176	60	0	0	60
9	37	14	0	0	14
10	60	20	0	0	20
11	25	8	0	0	8
Wt.	376002	100699	0	0	100699

(Numbers in thousands, weights in tonnes.)

Stock at start of and catch during 1994
For F(1994) = F(1992)

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
1	224000	21825	0	0	21825
2	81401	41876	0	0	41876
3	63935	36864	0	0	36864
4	7595	4087	0	0	4087
5	1849	963	0	0	963
6	1984	1011	0	0	1011
7	207	109	0	0	109
8	143	69	0	0	69
9	90	48	0	0	48
10	18	8	0	0	8
11	31	15	0	0	15
Wt.	422812	165172	0	0	165172

Table 3.2.17. Cod catch prediction - linear analysis

Input Values

Name	Value	CV	Name	Value	CV
Population at age in 1993			Fishing mortality pattern		
PLN1	199000	0.2	SEL1	0.151	0.16
PLN2	159000	0.11	SEL2	0.902	0.08
PLN3	18358	0.13	SEL3	1.017	0.07
PLN4	3904	0.14	SEL4	0.88	0.06
PLN5	4076	0.13	SEL5	0.836	0.06
PLN6	419	0.16	SEL6	0.809	0.06
PLN7	297	0.16	SEL7	0.852	0.06
PLN8	196	0.21	SEL8	0.749	0.08
PLN9	37	0.23	SEL9	0.859	0.08
PN10	60	0.23	SL10	0.72	0.08
Natural mortality pattern			Recruitment		
m1	0.8	0.1	R94	224000	0.5
m2	0.35	0.1	R95	268000	0.5
m3	0.25	0.1	Effort multipliers		
m4	0.2	0.1	F93	1	0.1
m5	0.2	0.1	F94	1	0.1
m6	0.2	0.1	F95	1	0.1
m7	0.2	0.1	Natural mortality multipliers		
m8	0.2	0.3	k93	1	0.1
m9	0.2	0.3	k94	1	0.1
m10	0.2	0.3	k95	1	0.1

Table 3.2.18. Values used for parametric stock-recruitment relationship.
(Parameters defined in Section 1.4.3)

Adjusted coefficient of determination = 0.3331

	Parameter	SD
a	2.8745	0.3123
b	221.0737	13.2487
c	6.1518	2.202
d	-0.3101	0.1653

Table 3.2.19 Cod in Sub-area IV (North Sea)

Assessment Quality Control Diagram 1

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

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F							
Date of assessment	Year						
	1988	1989	1990	1991	1992	1993	1994
1989	150	136	143				
1990		179	142	119			
1991			121	100	108		
1992				87	100	124	
1993					97	142	131
				SQC[1]	SQC[2]	Current	Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2) - F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y), F(y-1) and F(y-2) are as estimated in the assessment made in year (y+1).

Remarks:

Continued

Table 3.2.19 Continued

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: Millions						
Date of assessment	Year class					
	1987	1988	1989	1990	1991	1992
1989	193	329[1]				
1990	201	324	161[2]			
1991	142	316	140	216		
1992	143	246	137	155	345	
1993	150	257	113	150	410	199

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

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	88	91	82[1]	80[1,2]				
1990	84	85	87	78[1,3]	71[1,3]			
1991	79	73	66	64	66[1,3]	68[1,3]		
1992	79	73	62	56	51	47[1,4]	52[1,5]	
1993	82	76	65	60	64	58	62[1,5]	66[1,5]

[1]Forecast. [2]Assuming TAC taken in 1988, F(89) = 0.7 (87). [3]Assuming *status quo* F in 1990. [4]Assuming *status quo* F in 1991. [5]Assuming *status quo* F in 1993.

Remarks:

Table 3.3.1 Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1982-1993, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991[1]	1992[1]
Belgium	966	985	494	719	317	165	220	145	192	168	415
Denmark	22,704	25,653	16,368	23,821	16,397	7,767	9,174	2,789	1,993	1,330	1,467
Faroe Islands	6	51	-	5	4	23	35	16	6	15	20
France	15,988	11,250	8,103	5,389	4,802	3,889	2,193	1,702[1,3]	1,115[1,3]	631[1,3]	546[3]
Germany, Fed.Rep.	4,510	3,654	2,571	2,796	1,984	1,231	802	447	714	535	764
Netherlands	1,021	1,722	1,052	3,875	1,627	1,093	894	328	n/a	103	148
Norway[2]	2,888	3,862	3,959	3,498	5,190	2,610	1,590	1,697[1]	1,572	1,946	3,133
Poland	317	150	17	-	1	-	-	-	-	-	-
Sweden	1,874	1,360	1,518	1,942	1,550	937	614	1,051	900	957	1,289
UK (Engl.& Wales)	16,403	15,476	12,340	13,614	8,137	7,491	5,537	2,704	2,093	2,154	3,223
UK (N. Ireland)	-	-	-	-	-	-	-	137	11	46	4
UK (Scotland)	107.773	100,390	87,479	112,549	126,650	84,063	84,104	53,252	34,459	36,443	39,734
Total	174,450	164,553	133,901	168,208	166,659	109,269	105,163	64,235	n/a	44,330	50,743
WG estimates human consumption landings	166,000	159,000	128,000	159,000	166,000	108,000	105,000	76,000	51,000	45,000	70,000
Inallocated landings	-8,450	-5,553	-5,901	-9,208	-659	-1,269	-163	11,732	n/a	670	19,257

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

TABLE 3.3.2 Haddock, North Sea
Annual weight and numbers caught, 1960 to 1992.

Year	Weight (1000 tonnes) Total	H.Cons	Disc.	Ind BC	Numbers (millions) Total	H.Cons	Disc.	Ind BC
1960	218	75	130	12	1191	207	842	143
1961	219	75	133	11	2061	189	889	983
1962	453	59	383	11	3108	149	2674	286
1963	271	68	189	14	1683	181	1246	256
1964	379	131	160	89	1594	352	644	599
1965	298	162	62	75	1717	370	254	1093
1966	346	226	74	47	3128	407	490	2232
1967	246	147	78	21	1420	272	448	700
1968	302	105	162	34	1617	221	838	558
1969	929	331	260	338	4003	910	1203	1890
1970	806	525	101	180	3382	1245	515	1622
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	315	109	192	14
1991	90	45	40	5	458	99	215	143
1992	129	70	48	11	758	157	267	334

TABLE 3.3.3 Haddock, North Sea
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
0	2.050	.000
1	1.650	.010
2	.400	.320
3	.250	.710
4	.250	.870
5	.200	.950
6	.200	1.000
7	.200	1.000
8	.200	1.000
9	.200	1.000
10	.200	1.000
11	.200	1.000
12+	.200	1.000

TABLE 3.3.4; Haddock, North Sea
International catch at age ('000), Total , 1960 to 1992.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	51506	1006475	26880	1359	139777	649768	1666972	305249	11105	72559
1	687709	755531	2949187	1305614	7425	367490	1005889	837010	1096962	20469
2	402287	185823	72429	334239	1294531	15136	25640	88979	438696	3574797
3	13697	93131	32385	20858	134823	647618	6412	4853	19538	303070
4	7521	4035	21229	12952	9039	29385	411562	3576	1940	7584
5	23929	1872	1479	5746	5333	4642	9954	177394	2519	2407
6	3082	12294	605	499	2398	1963	1043	2437	45804	2512
7	1065	936	3839	649	286	450	599	214	324	19099
8	435	430	272	562	235	107	164	216	40	200
9	49	150	59	58	230	90	89	57	13	24
10	33	7	27	18	25	40	23	33	5	7
11	0	1	1	0	0	0	2	0	0	0
12+	0	0	0	0	0	0	0	0	0	0

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	924601	330673	240896	59872	601412	44946	167173	114954	285842	841439
1	266147	1809964	675831	364822	1213867	2096827	167599	250138	454092	344756
2	218293	70735	584076	567133	174389	632672	1046110	104310	142668	198147
3	1906573	47224	40150	237498	326659	57630	204506	376976	28695	39551
4	57362	397328	20948	6099	53137	106048	9555	38062	107172	7068
5	1176	10288	155922	4399	1832	15320	30044	4087	8153	26742
6	1195	458	3516	38829	1320	952	4793	5939	1190	2134
7	256	193	188	1237	10672	601	198	1230	1942	250
8	5946	146	33	106	236	2628	73	128	377	461
9	67	1578	27	28	23	258	728	27	108	145
10	11	159	402	108	31	61	58	190	14	52
11	19	3	11	48	3	11	3	2	60	11
12+	0	5	0	5	5	7	0	1	14	11

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	374960	646419	278705	639814	95502	139623	56507	9419	10808	10704
1	659594	134440	275372	156146	432175	179244	160285	277273	29040	47211
2	323151	413156	83827	247634	161719	526391	177699	246818	482791	33538
3	68715	138189	287840	71192	118503	75488	320292	46723	87436	179457
4	9837	14457	40322	123246	21366	36620	27068	67312	13155	17549
5	1784	1883	3198	15955	32134	5271	9504	4628	18433	2540
6	7573	374	691	1645	3698	7286	1208	2816	1547	4001
7	562	2462	268	286	590	954	1808	530	615	496
8	114	123	780	59	76	209	235	768	152	195
9	153	63	29	189	37	54	101	130	135	82
10	70	23	15	52	110	22	43	32	48	28
11	29	30	7	6	14	88	29	47	13	12
12+	13	8	4	8	8	4	48	64	34	11

Age	1990	1991	1992
0	55509	123818	270731
1	80338	218581	193504
2	100217	75563	248480
3	17124	22128	31583
4	55872	3424	6254
5	3594	12120	1140
6	835	908	4795
7	1288	388	443
8	190	600	293
9	73	138	286
10	39	48	122
11	9	5	21
12+	16	5	8

TABLE 3.3.5 ; Haddock, North Sea
International mean weight at age (kg), Total , 1960 to 1992.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	.020	.013	.045	.012	.011	.010	.010	.011	.010	.011
1	.135	.142	.135	.123	.119	.069	.088	.115	.126	.063
2	.236	.267	.277	.253	.239	.225	.247	.281	.253	.216
3	.403	.372	.475	.474	.403	.365	.367	.461	.509	.406
4	.459	.605	.569	.695	.664	.648	.533	.594	.731	.799
5	.635	.574	.732	.806	.814	.844	.949	.639	.857	.891
6	.809	.756	.768	1.004	.908	1.193	1.265	1.057	.837	1.032
7	1.020	.961	.932	1.131	1.382	1.173	1.525	1.501	1.606	1.094
8	1.311	1.274	1.368	1.173	1.148	1.482	1.938	1.922	2.260	2.040
9	1.989	1.412	1.722	1.576	1.470	1.707	1.727	2.069	2.702	3.034
10	2.251	1.702	2.277	1.825	1.781	2.239	2.963	2.348	2.073	3.264
11	.000	1.849	1.514	.000	.000	.000	2.040	.000	.000	.000
12+	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.013	.011	.024	.044	.024	.021	.013	.019	.012	.009
1	.073	.106	.116	.112	.128	.101	.125	.108	.144	.095
2	.222	.247	.242	.241	.226	.241	.224	.241	.253	.291
3	.353	.362	.388	.372	.343	.356	.401	.345	.418	.442
4	.735	.505	.506	.585	.548	.450	.512	.602	.441	.637
5	.873	.887	.606	.648	.891	.680	.588	.613	.719	.664
6	1.191	1.267	1.000	.724	.895	1.245	.922	.802	.742	.933
7	1.361	1.534	1.366	1.044	.953	1.124	1.933	1.181	.954	1.187
8	1.437	1.337	2.241	1.302	1.513	1.093	1.784	1.943	1.398	1.187
9	2.571	1.275	2.006	2.796	2.315	1.720	1.306	2.322	2.124	1.468
10	3.950	1.969	1.651	1.726	2.508	2.217	2.425	1.780	2.868	2.679
11	3.869	4.306	2.899	2.020	4.152	2.854	2.528	3.189	1.849	1.624
12+	.000	3.543	.000	2.158	2.264	3.426	.000	4.119	2.812	1.748

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.012	.009	.011	.022	.010	.013	.025	.008	.024	.027
1	.104	.074	.100	.135	.141	.149	.124	.126	.164	.198
2	.284	.262	.292	.297	.300	.279	.242	.265	.217	.300
3	.486	.476	.461	.448	.488	.479	.396	.405	.417	.372
4	.732	.744	.784	.651	.670	.668	.612	.613	.589	.605
5	1.046	1.147	1.166	.916	.805	.859	.864	1.029	.747	.811
6	.936	1.479	1.441	1.215	1.097	1.054	1.260	1.278	1.283	.984
7	1.394	1.180	1.672	1.162	1.100	1.470	1.202	1.433	1.424	1.375
8	1.599	1.634	1.456	1.920	1.868	1.844	1.719	1.530	1.542	1.659
9	1.593	1.764	2.634	1.376	2.425	2.137	1.526	1.865	1.612	1.695
10	1.726	1.554	2.164	1.395	1.972	2.193	2.482	2.040	1.674	2.240
11	3.328	1.492	1.924	1.907	2.247	1.991	2.632	1.902	3.122	2.159
12+	1.773	2.972	2.532	3.776	2.841	2.434	2.625	2.499	2.880	2.217

Age	1990	1991	1992
0	.044	.029	.018
1	.194	.177	.107
2	.291	.321	.306
3	.429	.471	.486
4	.473	.638	.747
5	.772	.649	1.016
6	.968	1.042	.896
7	1.169	1.230	1.391
8	1.533	1.479	1.526
9	2.034	1.771	1.899
10	2.658	1.943	1.993
11	2.310	2.231	2.034
12+	2.580	2.409	2.167

Table 3.3.6 Haddock, North Sea
Details of CPUE series used in tuning.

Series name	Series code	First year	Last year	Youngest age	Oldest age
Scottish Groundfish Survey	SCOGFS	1982	1992	0	6
English Groundfish Survey	ENGGFS	1977	1992	0	7
German Groundfish Survey	FRGGFS	1983	1992	1	5
International Young Fish Survey	INTGFS	1973	1992	1	2
International Young Fish Survey	INTGFS_old	1983	1992	3	6
French Trawlers	FRATRB	1976	1992	0	10

Table 3.3.7 Haddock, North Sea tuning input file.

HADDOCK; NORTH SEA; Survey Data only

106

SCOGFS

1982 1992

1 1 .50 .75

0 6

77	9.493	19.13	7.659	10.273	0.888	0.056	0.015
79	17.375	14.301	12.703	2.933	3.592	0.419	0.097
82	7.185	35.963	6.483	2.763	0.449	0.538	0.077
83	6.802	16.425	24.784	1.932	0.854	0.116	0.18
88	13.943	18.586	4.581	4.774	0.284	0.213	0.03
73	2.026	17.442	5.147	0.775	0.938	0.06	0.034
86	3.487	4.016	17.032	1.46	0.235	0.194	0.02
86	3.71	7.613	1.835	4.932	0.267	0.033	0.058
85	26.859	8.509	2.038	0.272	0.875	0.06	0.009
90	31.242	15.347	1.602	0.189	0.045	0.144	0.018
87	71.902	33.363	8.378	0.418	0.07	0.026	0.07

ENGGFS

1977 1992

1 1 .50 .75

0 7

89	47.549	5.94	2.85	5.479	0.822	0.064	0.081	0.012
93	33.297	12.721	2.432	0.222	2.064	0.199	0.005	0.069
94	82.191	27.745	5.126	0.819	0.102	0.41	0.033	0.004
89	33.317	55.523	14.904	2.289	0.243	0.038	0.126	0.02
91	139.525	15.717	39.848	6.858	0.673	0.058	0.003	0.055
58	16.328	18.308	4.631	6.848	0.595	0.137	0.057	0.008
58	48.171	12.635	6.341	1.241	1.259	0.154	0.024	0.008
63	14.36	37.672	3.871	1.935	0.262	0.3	0.065	0.008
54	13.247	10.051	12.833	1.137	0.376	0.106	0.069	0.022
64	16.995	9.567	2.857	2.161	0.178	0.112	0.024	0.023
61	1.367	17.195	2.628	0.325	0.419	0.029	0.02	0.002
57	3.462	1.628	10.462	0.883	0.091	0.159	0.023	0.007
63	5.945	5.151	0.912	2.502	0.159	0.019	0.038	0.009
64	18.077	4.262	1.272	0.183	0.563	0.031	0.017	0.008
64	16.853	7.363	0.615	0.148	0.031	0.14	0.003	0.004
57	67.7	14.139	6.164	0.324	0.024	0.005	0.031	0.001

FRATRB

1976 1992

1 1 .00 1.00

0 10

64396	58.443	2678.21	23497.19	3472.049	210.884	462.649	130	12	5	43	5
80107	501.444	4213.926	2566.949	11834.39	1611.667	226.384	444	121	18	5	28
69739	263.359	16183.23	6280.941	1147.044	5427.23	447.61	73.306	143	39	11	2
89974	131.049	15228.38	12553.55	2224.192	383.42	2193.059	198	31	65	32	5
63577	37.197	21343.17	15297.45	4106.429	558.224	153	830	71	20	33	11
76517	113.457	2513.759	27949.25	9779.402	1208.453	145.235	27	355	18	14	6
78523	306.855	7902.072	4242.989	23759.18	3745.898	202	58	32	112	1	2
69720	8784.263	5079.885	11493.89	3742.155	7380.415	1247.696	162.101	32	8	31	7
76149	147.481	16183.16	6588.765	5577.591	1014.54	1972.163	304	53	13	8	20
53003	491.555	4642.845	12659.35	2188.01	1078.182	166.122	337.23	56	12	6	4
50350	572.051	2715.021	3694.833	6570.452	666.745	374.288	65	150	31	8	5
51234	30.937	5041.058	5126.018	1319.211	1840.937	185	146	31	55	10	4
35482	23.647	381.534	6139.916	1344.869	230.195	465.029	57	33	10	8	2
36133	27.186	630.615	375.117	2272.491	293.114	58.779	126.378	26.956	13.863	5.313	3.136
36097	1045.297	1382.888	1567.523	262.887	1154.713	103.099	32.281	61.516	11.967	4.899	1.51
45075	94.405	2719.413	763.973	216.594	34.659	186.361	21.289	10.809	18.391	5.12	2.076
34138	223.841	938.972	1810.415	217.942	45.138	8.71	38.315	4.697	2.912	3.404	1.162

FRGGFS

1983 1992

1 1 .25 .50

1 5

1	0.094	0.073	0.019	0.019	0.001
1	0.274	0.047	0.02	0.004	0.003
1	0.13	0.26	0.015	0.007	0.001
1	0.142	0.038	0.055	0.005	0.001
1	0.307	0.154	0.034	0.009	0.003
1	0.069	0.18	0.117	0.009	0.006
1	0.135	0.045	0.07	0.035	0.003
1	0.18	0.055	0.018	0.013	0.007
1	0.601	0.055	0.018	0.003	0.002
1	0.48	0.129	0.016	0.005	0.001

Continued

Table 3.3.7 Continued

INTGFS
1973 1992
1 1 .00 .25
1 2

1	0.187	0.971
1	1.092	0.11
1	1.168	0.385
1	0.177	0.67
1	0.162	0.084
1	0.385	0.108
1	0.48	0.24
1	0.896	0.402
1	0.268	0.675
1	0.526	0.252
1	0.307	0.4
1	1.08	0.224
1	0.229	0.829
1	0.592	0.25
1	0.897	0.33
1	0.092	0.688
1	0.21	0.097
1	0.223	0.111
1	0.676	0.13
1	1.106	0.368

INTGFS_old
1983 1992
1 1 .00 .25
3 6

1	0.089	0.114	0.013	0.002
1	0.137	0.022	0.023	0.005
1	0.105	0.034	0.004	0.007
1	0.301	0.018	0.006	0.002
1	0.048	0.062	0.005	0.003
1	0.098	0.013	0.014	0.002
1	0.28	0.017	0.002	0.005
1	0.032	0.051	0.003	0.002
1	0.024	0.004	0.008	0.002
1	0.018	0.003	0.0005	0.002

Table 3.3.8 Haddock, North Sea, XSA diagnostics.

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VPA Version 3.1 (MSDOS)

  10/10/1993  10:10

Extended Survivors Analysis

Haddock; North Sea; 1960-1992; Including under-reporting correction.

CPUE data from file hadrvef.dat

Data for    6 fleets over   33 years
Age range from    0 to   11


     Fleet,                  Alpha,    Beta
SCOGFS                     ,  .500   ,  .750
ENGGFS                     ,  .500   ,  .750
FRATRB                     ,  .000   , 1.000
FRGGFS                     ,  .250   ,  .500
INTGFS                     ,  .000   ,  .250
INTGFS_old                 ,  .000   ,  .250


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years

Catchability analysis :

     Catchability dependent on stock size for ages <    3

        Regression type = C
        Minimum of   5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  3

     Catchability independent of age for ages >=    8


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning converged after    18 iterations


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


Terminal year survivor and F summaries :

Age  0   Catchability dependent on age and year class strength

Fleet                    Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights      F
SCOGFS                  ********      .592       .000     .00     1   .227      .000
ENGGFS                  ********      .534       .000     .00     1   .279      .000
FRATRB                  4938720.     1.107       .000     .00     1   .065      .000
FRGGFS                         1.     .000       .000     .00     0   .000      .000
INTGFS                         1.     .000       .000     .00     0   .000      .000
INTGFS_old                     1.     .000       .000     .00     0   .000      .000

  P shrinkage mean      2592905.       .85                            .110      .037

  F shrinkage mean      ********       .50                            .319      .007

Weighted prediction :

Survivors        Int       Ext      N     Var      F
at end of year   s.e       s.e           Ratio
********          .28       .30     5   1.048    .009
```

Continued

Table 3.3.8 Continued

Age 1 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	1231863.	.299	.019	.06	2	.304	.067
ENGGFS	628292.	.304	.133	.44	2	.294	.127
FRATRB	225059.	.619	.226	.37	2	.071	.320
FRGGFS	2029231.	1.209	.000	.00	1	.019	.041
INTGFS	1408099.	.401	.000	.00	1	.169	.058
INTGFS_old	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	409962.	.87				.036	.188
F shrinkage mean	473863.	.50				.109	.165

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
801636.	.16	.19	10	1.147	.101

Age 2 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	148563.	.324	.222	.69	3	.274	.863
ENGGFS	138135.	.352	.273	.78	3	.232	.905
FRATRB	107018.	.504	.393	.78	3	.113	1.065
FRGGFS	327348.	1.061	.590	.56	2	.026	.483
INTGFS	185191.	.368	.102	.28	2	.211	.741
INTGFS_old	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	125142.	1.00				.029	.965
F shrinkage mean	136709.	.50				.115	.912

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
148309.	.17	.10	15	.609	.864

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	6769.	.545	.140	.26	4	.208	1.633
ENGGFS	7434.	.632	.225	.36	4	.155	1.558
FRATRB	5010.	.715	.159	.22	4	.121	1.881
FRGGFS	10806.	1.467	.123	.08	3	.029	1.275
INTGFS	8189.	.806	.103	.13	2	.095	1.482
INTGFS_old	4535.	.652	.000	.00	1	.146	1.966
F shrinkage mean	12437.	.50				.247	1.176

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7495.	.25	.11	19	.425	1.552

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	1219.	.585	.145	.25	5	.209	1.710
ENGGFS	987.	.707	.102	.14	5	.143	1.886
FRATRB	827.	.822	.157	.19	5	.106	2.038
FRGGFS	3133.	1.810	.187	.10	4	.022	1.016
INTGFS	1248.	1.722	.180	.10	2	.024	1.691
INTGFS_old	1005.	.585	.155	.26	2	.209	1.870
F shrinkage mean	2582.	.50				.286	1.143

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1381.	.27	.11	24	.427	1.609

Continued

Table 3.3.8 Continued

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	427.	.615	.221	.36	6	.168	1.228
ENGGFS	290.	.700	.092	.13	6	.129	1.517
FRATRB	188.	.713	.126	.18	6	.125	1.869
FRGGFS	1028.	1.662	.165	.10	5	.023	.694
INTGFS	472.	2.068	.173	.08	2	.015	1.159
INTGFS_old	342.	.469	.210	.45	3	.287	1.391
F shrinkage mean	687.	.50				.253	.917

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
396.	.25	.10	29	.415	1.281

1

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	1576.	.764	.131	.17	7	.134	1.322
ENGGFS	1631.	.907	.046	.05	7	.095	1.297
FRATRB	806.	.723	.117	.16	7	.150	1.854
FRGGFS	902.	2.690	.143	.05	5	.011	1.760
INTGFS	1895.	3.238	.092	.03	2	.007	1.191
INTGFS_old	1020.	.520	.213	.41	4	.289	1.659
F shrinkage mean	3660.	.50				.313	.782

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1634.	.28	.13	33	.468	1.296

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	221.	.976	.036	.04	7	.093	1.036
ENGGFS	97.	.865	.208	.24	8	.118	1.634
FRATRB	121.	.638	.162	.25	8	.217	1.464
FRGGFS	1203.	3.535	.202	.06	5	.007	.288
INTGFS	278.	5.252	.106	.02	2	.003	.892
INTGFS_old	326.	.649	.091	.14	4	.209	.803
F shrinkage mean	421.	.50				.353	.669

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
243.	.30	.12	35	.417	.976

1

Age 8 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	76.	1.145	.182	.16	7	.078	1.498
ENGGFS	92.	1.082	.118	.11	8	.087	1.354
FRATRB	66.	.642	.137	.21	9	.248	1.619
FRGGFS	262.	3.891	.237	.06	5	.007	.700
INTGFS	121.	5.468	.293	.05	2	.003	1.159
INTGFS_old	147.	.779	.130	.17	4	.168	1.033
F shrinkage mean	233.	.50				.409	.760

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
133.	.32	.12	36	.379	1.097

Continued

Table 3.3.8 Continued

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	130.	1.985	.047	.02	7	.037	1.098
ENGGFS	103.	1.721	.128	.07	8	.049	1.258
FRATRB	104.	.774	.141	.18	10	.244	1.253
FRGGFS	124.	7.377	.276	.04	5	.003	1.127
INTGFS	184.	9.194	.094	.01	2	.002	.880
INTGFS_old	168.	1.333	.046	.03	4	.082	.933
F shrinkage mean	220.	.50				.583	.779

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
169.	.38	.09	37	.239	.930

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	34.	1.984	.080	.04	7	.036	1.442
ENGGFS	45.	1.795	.127	.07	8	.044	1.243
FRATRB	29.	.720	.132	.18	11	.273	1.570
FRGGFS	48.	6.883	.328	.05	5	.003	1.194
INTGFS	39.	8.308	.017	.00	2	.002	1.340
INTGFS_old	51.	1.344	.101	.08	4	.078	1.146
F shrinkage mean	70.	.50				.565	.943

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
51.	.38	.10	38	.268	1.146

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	12.	5.143	.055	.01	6	.008	.978
ENGGFS	11.	4.093	.046	.01	8	.012	1.022
FRATRB	10.	1.186	.072	.06	11	.145	1.050
FRGGFS	4.	18.884	.098	.01	4	.001	1.867
INTGFS	10.	22.461	.078	.00	2	.000	1.096
INTGFS_old	10.	3.456	.038	.01	4	.017	1.105
F shrinkage mean	10.	.50				.817	1.102

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
10.	.45	.02	36	.043	1.093

TABLE 3.3.9 ; Haddock, North Sea
Tuned Stock Numbers at age (10**-5), 1960 to 1993, (numbers in 1993 are VPA survivors)

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	200382	849778	1980949	23622	91573	263067	688489	3870524	170386	121422
1	33123	25611	105785	254921	3036	11287	31535	82651	497176	21895
2	7215	3348	1608	7392	43236	551	557	1648	12205	90675
3	269	1543	723	485	2218	18383	245	164	376	4590
4	146	88	379	277	193	538	8602	134	85	121
5	512	47	33	108	101	71	159	3067	73	49
6	53	203	22	14	37	35	16	41	906	37
7	19	15	55	12	7	8	11	4	11	327
8	7	6	4	10	4	3	3	3	1	6
9	1	2	1	1	3	1	1	1	1	0
10	0	0	0	0	0	0	0	0	0	1
11	0	0	0	0	0	0	0	0	0	0
12+	0	0	0	0	0	0	0	0	0	0

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	871020	771268	212310	715977	1303740	111701	159308	248805	383701	699589
1	15371	108813	98103	26467	91956	165679	14219	19909	31617	48370
2	4115	1786	12966	15879	3484	12341	22630	1996	2727	4082
3	31514	971	618	3909	6001	908	3092	6604	484	660
4	900	7717	340	127	949	1791	198	604	1817	124
5	27	195	2504	80	45	270	459	70	134	469
6	18	11	66	639	25	20	82	104	21	36
7	8	4	5	22	172	9	8	24	31	6
8	95	4	2	3	7	44	2	5	9	8
9	3	24	2	1	1	4	12	1	3	4
10	0	2	5	1	1	1	1	4	0	1
11	0	0	0	1	0	0	0	0	1	0
12+	0	0	0	0	0	0	0	0	0	0

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	152074	318413	199950	662691	171150	235766	483179	38428	80173	79269
1	87043	18232	38672	24740	83016	21690	29850	61999	4913	10282
2	7779	13826	2912	6220	4067	14049	3380	5030	10692	816
3	1114	2568	5885	1266	2142	1402	5108	811	1351	3214
4	165	261	781	2043	358	622	426	1151	219	281
5	34	42	76	252	504	90	162	93	303	55
6	142	12	17	33	62	122	26	46	34	81
7	10	48	6	8	12	17	34	10	12	14
8	3	3	17	3	4	5	6	11	4	5
9	2	1	2	7	2	2	2	2	2	2
10	2	0	0	1	4	1	1	1	1	1
11	1	1	0	0	0	2	1	1	0	0
12+	0	0	0	0	0	0	1	1	1	0

Age	1990	1991	1992	1993
0	252536	361989	833636	0
1	10166	32311	46156	106347
2	1768	1600	5247	8016
3	273	364	454	1483
4	920	61	89	75
5	64	223	17	14
6	22	20	73	4
7	30	10	8	16
8	7	13	5	2
9	2	4	5	1
10	1	1	2	2
11	0	0	0	1
12+	0	0	0	0

TABLE 3.3.10; Haddock, North Sea
International F at age, Total , 1960 to 1992.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	.007	.034	.000	.002	.043	.071	.070	.002	.002	.017
1	.642	1.118	1.011	.124	.057	1.359	1.301	.263	.052	.022
2	1.143	1.133	.799	.804	.455	.409	.826	1.077	.578	.657
3	.863	1.153	.709	.669	1.167	.510	.352	.410	.888	1.379
4	.878	.729	1.005	.755	.754	.965	.781	.359	.301	1.247
5	.727	.577	.679	.885	.871	1.289	1.171	1.020	.480	.789
6	1.030	1.110	.368	.512	1.290	.979	1.277	1.093	.818	1.387
7	.974	1.104	1.496	.876	.632	.927	.968	1.046	.388	1.036
8	1.081	1.679	1.257	.967	.969	.513	1.141	1.264	.549	.444
9	1.685	1.725	1.295	1.073	1.683	1.438	1.160	2.301	.206	.752
10	2.710	1.706	16.799	16.413	16.727	2.813	16.646	17.025	15.161	.158
11	.000	1.484	4.299	.000	.000	.000	4.294	.000	.000	.000
12+	.000	1.484	4.299	.000	.000	.000	4.294	.000	.000	.000

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.030	.012	.032	.002	.013	.011	.030	.013	.021	.034
1	.503	.477	.171	.378	.358	.341	.313	.338	.397	.177
2	1.044	.661	.799	.573	.945	.984	.831	1.017	1.019	.899
3	1.157	.801	1.333	1.166	.959	1.271	1.384	1.041	1.114	1.136
4	1.281	.876	1.200	.787	1.007	1.112	.789	1.254	1.104	1.042
5	.658	.878	1.165	.942	.599	.988	1.287	1.031	1.114	.995
6	1.303	.585	.884	1.113	.853	.734	1.033	1.003	1.025	1.062
7	.468	.752	.507	.943	1.158	1.378	.322	.837	1.171	.615
8	1.175	.537	.268	.606	.455	1.070	.584	.356	.672	1.036
9	.260	1.294	.174	.384	.247	1.465	1.044	.451	.584	.602
10	1.037	1.954	1.741	2.662	1.022	2.450	2.404	.881	.452	.623
11	.858	1.036	.722	1.156	.754	1.438	1.090	.710	.781	.796
12+	.858	1.036	.722	1.156	.754	1.438	1.090	.710	.781	.796

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.071	.058	.040	.027	.016	.017	.003	.007	.004	.004
1	.190	.184	.177	.155	.126	.209	.131	.108	.145	.111
2	.708	.454	.433	.666	.665	.612	1.028	.914	.802	.697
3	1.200	.941	.808	1.014	.986	.942	1.240	1.058	1.322	1.002
4	1.125	.987	.880	1.151	1.130	1.099	1.274	1.086	1.140	1.233
5	.867	.691	.627	1.201	1.222	1.043	1.050	.801	1.118	.722
6	.890	.435	.590	.795	1.072	1.086	.723	1.117	.696	.789
7	.938	.844	.650	.522	.759	.930	.904	.840	.793	.500
8	.637	.536	.719	.282	.252	.677	.617	1.434	.621	.633
9	1.326	.937	.227	.372	.287	.288	.850	.859	1.155	.830
10	.670	.725	.614	.834	.389	.271	.391	.720	.944	.801
11	.916	.674	.512	.542	.551	.626	.726	1.013	.790	.680
12+	.916	.674	.512	.542	.551	.626	.726	1.013	.790	.680

Age	1990	1991	1992
0	.006	.010	.009
1	.199	.168	.101
2	1.179	.860	.864
3	1.244	1.164	1.552
4	1.166	1.005	1.609
5	.977	.918	1.281
6	.553	.715	1.296
7	.639	.543	.976
8	.363	.713	1.097
9	.522	.491	.930
10	1.395	.804	1.146
11	.613	.631	1.093
12+	.613	.631	1.093

Table 3.3.11 Haddock, North Sea, RCT3 Input file (Age 0)

HADDOCK IV RCT3 INPUT VALUES; AGE 0; 1993 WG.

10	23	2									
'YEARCLASS'	'VPA'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS0'	'SGFS1'	'SGFS2'	'GGFS1'	'GGFS2'
1971	771268	740	971	-1	-1	-1	-1	-1	-1	-1	-1
1972	212310	187	110	-1	-1	-1	-1	-1	-1	-1	-1
1973	715977	1092	385	-1	-1	-1	-1	-1	-1	-1	-1
1974	1303740	1168	670	-1	-1	-1	-1	-1	-1	-1	-1
1975	111701	177	84	-1	-1	32.1	-1	-1	-1	-1	-1
1976	159308	162	108	-1	66.8	26.2	-1	-1	-1	-1	-1
1977	248805	385	240	534.8	136.9	54.6	-1	-1	-1	-1	-1
1978	383701	480	402	358.3	295.5	167.3	-1	-1	-1	-1	-1
1979	699589	896	675	875.5	623.3	439.1	-1	-1	-1	-1	-1
1980	152074	268	252	374	173.2	79.8	-1	-1	99.6	-1	-1
1981	318413	526	400	1537.5	315.5	109.5	-1	248.8	161.1	-1	72.8
1982	199950	307	219	281.3	218.2	61.6	123.5	181.3	78.8	93.9	47.2
1983	662691	1057	828	831.9	599.3	238.2	220.3	436.7	298.1	272.9	259.6
1984	111150	229	244	228.5	186.6	44.7	87.3	197.6	57.4	129.7	38
1985	235766	579	326	245.9	149.7	43.1	81.8	232.9	70.4	142.3	154.4
1986	483179	885	688	266	281.9	183.5	174.7	239.3	198.2	307.4	179.9
1987	38428	92	97	22.4	28.6	14.5	27.7	46.7	21.4	68.6	45.3
1988	80173	210	114	60.7	81.7	19.8	40.6	88.6	24	135	54.7
1989	79269	219	131	94.3	65.7	9.6	43.2	100.2	17.8	180	54.9
1990	-1	679	371	281.9	115.0	108.1	316.3	170.5	96.3	601.0	129.2
1991	-1	1115	543	263.3	248.0	64.8	347.1	383.2	138.0	480.1	-1
1992	-1	1242	-1	1187.6	310.1	-1	827.0	583.6	-1	-1	-1
1993	-1	-1	-1	194.8	-1	-1	85.9	-1	-1	-1	-1

Table 3.3.12a Haddock, North Sea, RCT3 Output file, Age 0

Analysis by RCT3 ver3.1 of data from file :

hadiv0.rcx

HADDOCK IV RCT3 INPUT VALUES; AGE 0; 1993 WG.

Data for 10 surveys over 23 years : 1971 - 1993

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 = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction				--------I
IYFS1	1.27	4.66	.28	.923	19	7.02	13.60	.357	.189
IYFS2	1.33	4.73	.37	.874	19	6.30	13.11	.446	.121
EGFS0	.89	7.27	.57	.748	13	5.58	12.26	.662	.055
EGFS1	1.09	6.60	.37	.874	14	5.52	12.60	.428	.132
EGFS2	.87	8.60	.38	.863	15	4.19	12.24	.441	.124
SGFS0	1.39	5.87	.31	.922	8	5.85	14.02	.479	.105
SGFS1	1.49	4.47	.37	.883	9	5.95	13.31	.497	.098
SGFS2	.99	7.86	.34	.890	10	4.93	12.72	.421	.136
GGFS1	2.50	-.60	.86	.606	8	6.18	14.86	1.398	.012
GGFS2									
					VPA Mean =		12.16	.927	.028

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction				--------I
IYFS1	1.26	4.69	.27	.932	19	7.13	13.71	.354	.361
IYFS2									
EGFS0	.89	7.29	.57	.754	13	7.08	13.61	.736	.083
EGFS1	1.09	6.59	.36	.880	14	5.74	12.84	.438	.236
EGFS2									
SGFS0	1.39	5.88	.31	.923	8	6.72	15.22	.605	.123
SGFS1	1.48	4.48	.38	.883	9	6.37	13.93	.557	.145
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		12.12	.934	.052

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction				--------I
IYFS1									
IYFS2									
EGFS0	.89	7.31	.57	.760	13	5.28	12.02	.684	.218
EGFS1									
EGFS2									
SGFS0	1.39	5.89	.31	.925	8	4.46	12.09	.391	.667
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		12.08	.944	.115

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	459188	13.04	.16	.21	1.76		
1992	831095	13.63	.21	.34	2.63		
1993	175595	12.08	.32	.02	.00		

Table 3.3.12b Haddock, North Sea, RCT3 Output file, Age 1

Analysis by RCT3 ver3.1 of data from file :

hadiv1.rcx

HADDOCK IV RCT3 INPUT VALUES; AGE 1; 1993 WG.

Data for 10 surveys over 24 years : 1970 - 1993

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 = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
IYFS1	1.26	2.73	.30	.907	20	7.02	11.54	.386	.127
IYFS2	1.29	2.94	.33	.893	20	6.30	11.04	.397	.120
EGFS0	.87	5.38	.54	.757	13	5.58	10.22	.631	.047
EGFS1	1.04	4.80	.30	.910	14	5.52	10.54	.347	.156
EGFS2	.85	6.65	.37	.866	15	4.19	10.20	.425	.104
SGFS0	1.35	4.05	.23	.954	8	5.85	11.94	.355	.150
SGFS1	1.41	2.82	.26	.937	9	5.95	11.22	.348	.156
SGFS2	.97	5.90	.34	.887	10	4.93	10.68	.420	.107
GGFS1	2.48	-2.50	.86	.599	8	6.18	12.82	1.397	.010
GGFS2									
						VPA Mean =	10.12	.906	.023

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
IYFS1	1.25	2.75	.30	.914	20	7.13	11.65	.393	.221
IYFS2									
EGFS0	.87	5.40	.54	.764	13	7.08	11.54	.699	.070
EGFS1	1.04	4.79	.29	.916	14	5.74	10.77	.351	.276
EGFS2									
SGFS0	1.35	4.06	.23	.956	8	6.72	13.11	.445	.172
SGFS1	1.41	2.81	.26	.936	9	6.37	11.82	.392	.221
SGFS2									
GGFS1									
GGFS2									
						VPA Mean =	10.08	.914	.041

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
IYFS1									
IYFS2									
EGFS0	.87	5.42	.54	.773	13	5.28	9.99	.646	.152
EGFS1									
EGFS2									
SGFS0	1.35	4.06	.23	.957	8	4.46	10.08	.286	.774
SGFS1									
SGFS2									
GGFS1									
GGFS2									
						VPA Mean =	10.04	.925	.074

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	61181	11.02	.14	.20	2.15		
1992	111853	11.62	.18	.37	4.02		
1993	23419	10.06	.25	.02	.01		

Table 3.3.12c Haddock, North Sea, RCT3 Output file, Age 2

Analysis by RCT3 ver3.1 of data from file :

hadiv2.rcx

HADDOCK IV RCT3 INPUT VALUES; AGE 2; 1993 WG.

Data for 10 surveys over 24 years : 1970 - 1993

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 = 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	1.24	.99	.26	.929	20	7.02	9.70	.335	.163
IYFS2	1.27	1.22	.28	.920	20	6.30	9.21	.338	.160
EGFS0	.89	3.45	.59	.726	13	5.58	8.41	.687	.039
EGFS1	1.04	2.97	.29	.914	14	5.52	8.72	.340	.158
EGFS2	.85	4.81	.36	.872	15	4.19	8.38	.417	.105
SGFS0	1.37	2.16	.25	.948	8	5.85	10.17	.385	.123
SGFS1	1.44	.89	.29	.923	9	5.95	9.45	.390	.120
SGFS2	.98	4.05	.35	.887	10	4.93	8.89	.426	.101
GGFS1	2.51	-4.45	.87	.600	8	6.18	11.06	1.414	.009
GGFS2									
					VPA Mean =		8.30	.907	.022

Yearclass = 1992

	I-----------Regression---------I					I-----------Prediction--------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	1.24	.98	.26	.932	20	7.13	9.82	.347	.289
IYFS2									
EGFS0	.89	3.48	.59	.735	13	7.08	9.76	.758	.060
EGFS1	1.05	2.95	.29	.917	14	5.74	8.96	.351	.281
EGFS2									
SGFS0	1.37	2.16	.25	.949	8	6.72	11.37	.484	.148
SGFS1	1.44	.88	.30	.923	9	6.37	10.05	.440	.180
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		8.27	.917	.041

Yearclass = 1993

	I-----------Regression---------I					I-----------Prediction--------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1									
IYFS2									
EGFS0	.89	3.50	.58	.746	13	5.28	8.18	.700	.151
EGFS1									
EGFS2									
SGFS0	1.37	2.16	.25	.951	8	4.46	8.28	.312	.763
SGFS1									
SGFS2									
GGFS1									
GGFS2									
					VPA Mean =		8.23	.930	.086

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	9955	9.21	.14	.20	2.16		
1992	17710	9.78	.19	.37	3.86		
1993	3875	8.26	.27	.03	.01		

TABLE 3.3.13 Haddock, North Sea
Mean fishing mortality, biomass and recruitment, 1960 - 1992.

Year	Mean Fishing Mortality H.Cons Ages 2 to 6	Disc. Ages 2 to 6	Ind BC Ages 0 to 3	Stock Biomass ('000 tonnes) Total	Spawning	Recruits Age 0 Yclass	Million
1960	.723	.172	.053	676	111	1960	20038
1961	.746	.191	.022	536	98	1961	84978
1962	.575	.136	.025	1540	82	1962	198095
1963	.579	.126	.026	3385	137	1963	2362
1964	.700	.073	.130	1184	418	1964	9157
1965	.633	.067	.341	809	523	1965	26307
1966	.695	.103	.261	779	431	1966	68849
1967	.630	.142	.051	1216	229	1967	387052
1968	.479	.089	.056	6668	264	1968	17039
1969	.787	.093	.199	2338	814	1969	12142
1970	.773	.124	.267	1400	897	1970	87102
1971	.612	.108	.078	1651	412	1971	77127
1972	.905	.147	.051	1652	297	1972	21231
1973	.777	.128	.034	886	289	1973	71598
1974	.629	.144	.102	1540	253	1974	130374
1975	.747	.209	.086	2105	232	1975	11170
1976	.810	.159	.124	857	298	1976	15931
1977	.806	.133	.171	545	228	1977	24881
1978	.855	.192	.061	640	126	1978	38370
1979	.906	.089	.056	654	106	1979	69959
1980	.800	.083	.086	1212	148	1980	15207
1981	.593	.089	.065	652	234	1981	31841
1982	.550	.069	.066	821	292	1982	19995
1983	.790	.149	.049	739	247	1983	66269
1984	.896	.094	.032	1469	195	1984	17115
1985	.856	.079	.018	850	237	1985	23577
1986	.878	.181	.012	703	219	1986	48318
1987	.845	.146	.015	1038	154	1987	3843
1988	.839	.152	.020	412	155	1988	8017
1989	.724	.142	.015	380	125	1989	7927
1990	.736	.256	.017	317	77	1990	25254
1991	.842	.074	.024	666	58	1991	45919
1992	1.182	.124	.026	694	89	1992	83110

Arithmetic mean recruits at age 0 for the period 1960 to 1992 : 53354
Geometric mean recruits at age 0 for the period 1960 to 1992 : 29679

TABLE 3.3.14; Haddock, North Sea
Input for Catch Prediction

Age	1993 Stock Numbers (10**-5)	F: Scaled Mean F 1988 - 1992 H.Cons	Disc.	Ind BC	Mean Wt. at age (kg) 1988 - 1992 Stock	H.Cons	Disc.	Ind BC
0	175595	.000	.002	.006	.028	.000	.061	.016
1	111853	.010	.151	.026	.168	.306	.174	.093
2	9955	.503	.591	.040	.287	.369	.223	.220
3	1483	1.338	.248	.033	.435	.466	.277	.381
4	75	1.453	.097	.035	.610	.629	.333	.552
5	14	1.245	.024	.024	.799	.806	.370	.681
6	4	1.009	.025	.010	1.035	1.050	.318	.978
7	16	.876	.000	.013	1.318	1.322	.000	1.198
8	2	.880	.000	.003	1.548	1.550	.514	1.099
9	1	1.012	.000	.000	1.802	1.802	.000	.955
10	2	1.307	.004	.000	2.102	2.099	.610	.560
11	1	.981	.000	.000	2.371	2.371	.000	.000
12	0	.981	.000	.000	2.451	2.451	.000	.000

Mean F	(2 - 6)	(0 - 3)
Unscaled	1.014	.020
Scaled	1.306	.026

Recruits at age 0 in 1994 = 176310
Recruits at age 0 in 1995 = 176310

Stock numbers in 1993 are VPA survivors.
These are overwritten at Age 0 Age 1 Age 2

Human consumption + discard Fs are obtained from mean exploitation pattern over 1988 to 1992.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1992, i.e. 1.306
Fs are distributed between consumption and discards by mean proportion retained over 1988 to 1992.
N.B. Above value for H.Cons+Disc. ref F is value for both catch categories combined.

Bycatch Fs are obtained from mean exploitation pattern over 1988 to 1992.
This is scaled to give a value for mean F (ages 0 to 3) equal to that in 1992, i.e. .026

TABLE 3.3.15; Haddock, North Sea
Catch Prediction output; Assuming status quo in 1993.

		Year 1993	1994						
Biomass at start of Year									
Total		2239	998	998	998	998	998	998	998
Spawning		165	248	248	248	248	248	248	248
Mean F	**Ages**								
H.Cons	2 to 6	1.31	.00	.26	.52	.78	1.04	1.31	1.57
Ind BC	0 to 3	.03	.03	.03	.03	.03	.03	.03	.03
Effort relative to 1992									
H.Cons		1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight ('000t)									
H.Cons		158	0	73	131	177	214	244	268
Disc.		207	0	43	78	108	133	155	174
Ind BC		19	19	17	16	15	14	13	12
Total Catch		384	19	133	225	300	361	412	454
Total Landings		176	19	90	147	192	228	257	280
Biomass at start of 1995									
Total			1114	981	875	792	725	672	629
Spawning			498	400	323	262	214	177	146

Stock at start of and catch during 1993

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
0	17559500	0	14885	44656	59541
1	11185300	51190	772964	133093	957247
2	995500	256025	300816	20360	577201
3	148300	89787	16642	2214	108644
4	7500	4991	333	120	5444
5	1400	905	17	17	940
6	400	231	6	2	239
7	1600	854	0	13	867
8	200	107	0	0	108
9	100	59	0	0	59
10	200	135	0	0	135
11	100	58	0	0	58
12	0	0	0	0	0
Wt.	2238713	157910	207215	18511	383636

Stock at start of and catch during 1994
For F(1994) = F(1992)

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
0	17631000	0	14946	44838	59784
1	2242508	10263	154969	26683	191916
2	1781758	458236	538405	36440	1033081
3	214701	129989	24094	3206	157289
4	22879	15225	1016	367	16608
5	1197	774	15	15	804
6	315	182	4	2	188
7	115	62	0	1	62
8	538	289	0	1	290
9	68	40	0	0	40
10	30	20	0	0	20
11	44	25	0	0	25
12	31	18	0	0	18
Wt.	998089	243943	154960	12654	411557

(Numbers in thousands, weights in tonnes.)

TABLE 3.3.16; Haddock, North Sea
Catch Prediction output; 1993 F assumed 70% of 1992.

		Year						
	1993	1994						
Biomass at start of Year								
Total	2239	1070	1070	1070	1070	1070	1070	1070
Spawning	165	291	291	291	291	291	291	291
Mean F Ages								
H.Cons 2 to 6	.91	.65	.78	.91	1.04	1.18	1.31	1.44
Ind BC 0 to 3	.03	.03	.03	.03	.03	.03	.03	.03
Effort relative to 1992								
H.Cons	.70	.50	.60	.70	.80	.90	1.00	1.10
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight ('000t)								
H.Cons	126	181	206	228	248	266	282	297
Disc.	154	99	114	128	141	153	164	174
Ind BC	20	16	16	15	15	14	14	13
Total Catch	299	296	336	372	404	433	460	484
Total Landings	146	197	222	243	263	280	296	310
Biomass at start of 1995								
Total		867	823	784	749	718	690	665
Spawning		320	288	259	234	211	191	174

Stock at start of and catch during 1993

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
0	17559500	0	10422	44665	55087
1	11185300	36455	550475	135405	722336
2	995500	203643	239271	23135	466048
3	148300	74944	13891	2641	91476
4	7500	4153	277	143	4573
5	1400	736	14	20	771
6	400	184	5	3	191
7	1600	668	0	14	682
8	200	84	0	0	85
9	100	47	0	0	47
10	200	110	0	0	111
11	100	46	0	0	46
12	0	0	0	0	0
Wt.	2238713	126058	153723	19516	299297

Stock at start of and catch during 1994
For F(1994) = F(1992)

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
0	17631000	0	14946	44838	59784
1	2243854	10269	155062	26699	192031
2	1869929	480912	565048	38244	1084204
3	298105	180486	33453	4451	218391
4	36820	24501	1636	590	26727
5	1906	1232	24	24	1280
6	460	266	7	3	275
7	157	84	0	1	85
8	700	376	0	1	378
9	88	52	0	0	52
10	40	27	0	0	27
11	65	38	0	0	38
12	41	24	0	0	24
Wt.	1069563	282381	163720	13657	459759

(Numbers in thousands, weights in tonnes.)

Table 3.3.17 Haddock, North Sea
Input values to linear sensitivity analysis

name	value	uncertainty	Interpretation			
PLN0	17559500	0.32	Population Numbers. 1993, age			0
PLN1	11185300	0.37				1
PLN2	995500	0.2				2
PLN3	148300	0.17				3
PLN4	7500	0.25				4
PLN5	1400	0.27				5
PLN6	2600	0.25				6
SHC0	0.0001	0.42	Selectivity	H.cons	age	0
SHC1	0.01	0.27				1
SHC2	0.503	0.17				2
SHC3	1.338	0.07				3
SHC4	1.453	0.15				4
SHC5	1.245	0.27				5
SHC6	1.009	0.21				6
SHD0	0.002	1	Selectivity	Discards	age	0
SHD1	0.151	0.28				1
SHD2	0.591	0.27				2
SHD3	0.248	0.49				3
SHD4	0.097	0.98				4
SHD5	0.024	1				5
SHD6	0.025	1				6
SIN0	0.006	0.73	Selectivity	Ind BC	age	0
SIN1	0.026	0.46				1
SIN2	0.04	0.34				2
SIN3	0.033	0.46				3
SIN4	0.035	0.68				4
SIN5	0.024	1				5
SIN6	0.01	1				6
m0	2.05	0.1	Natural Mortality	age		0
m1	1.65	0.1				1
m2	0.4	0.1				2
m3	0.25	0.1				3
m4	0.25	0.1				4
m5	0.2	0.1				5
m6	0.2	0.1				6
R94	17631000	0.94	Recruitment		1994	
R95	17631000	0.94			1995	
fh93	1	0.1	Relative F	H cons.	1993	
fh94	1	0.1			1994	
fh95	1	0.1			1995	
fi93	1	0.1	Relative F	Ind BC	1993	
fi94	1	0.1			1994	
fi95	1	0.1			1995	
k93	1	0.1	Year effect on M		1993	
k94	1	0.1			1994	
k95	1	0.1			1995	

Table 3.3.18 Haddock, North Sea

Assessment Quality Control Diagram 1

Average F(2-6,u)						
Date of assessment	Year					
	1987	1988	1989	1990	1991	1992
1989	1.00	1.00				
1990	1.00	1.05	0.95			
1991	1.02	1.05	0.91	0.98		
1992	1.01	1.03	0.91	1.10	1.23	
1993	0.991	0.99	0.87	0.99	0.92	1.31

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

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F							
Date of assessment	Year						
	1988	1989	1990	1991	1992	1993	1994
1989	109	85	53				
1990	83	63	61				
1991			52	46	77		
1992				47	102	195	
1993				52	69	176	257
				SQC[1]	SQC[2]	Current	Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2) - F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y), F(y−1) and F(y−2) are as estimated in the assessment made in year (y+1).

Remarks: Human consumption and by-catch used as landings F_{hc} and F_{disc} used as F for calculating SQC.

Continued

Table 3.3.18 Continued

Assessment Quality Control Diagram 3

Recruitment (age 0) Unit:						
Date of assessment	Year class					
	1988	1989	1990	1991	1992	1993
1989	7650					
1990	10512	1280				
1991	7802	7879	32729			
1992	7265	8351	33509	66763		
1993	8017	7927	25254	36199	831095	175595

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	134[2]	117[2]	79[1,2]	72[1,2]				
1990	149	122	86	81[1]	150[1]			
1991	150	122	76	64	99[1]	122[1]		
1992	149	119	71	55	105	201[1]	235[1]	
1993	155	125	77	58	89	165	248[1]	177[1]

[1]Forecast. [2]As revised by ACFM.

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

Table 3.4.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1981-1992, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
Belgium	2,623	2,272	2,864	2,798	2,177	2,275	1,404	1,984	1,271	1,040	913	1,030
Denmark	16,430	27,043	18,054	19,771	16,152	9,076	2,047	12,112	803	1,207	1,529	1,377
Faroe Islands	12	57	18	-	6	-	12	222	1	26	-	24
France	24,744	23,780	21,263	19,209	10,853	8,250	10,493	10,569	5,277[1,2]	4,951[1]	5,188[1,2]	4,728
Germany, Fed.Rep.	601	223	317	286	226	313	274	454	415	692	865	511
Netherlands	14,600	12,218	10,935	8,767	6,973	13,741	8,542	5,087[3]	3,860	3,272[1]	4,029[1]	5,390
Norway	27	17	39	88	103	103	74	52	32	55	98[1]	223
Poland	-	-	1	2	-	-	-	-	-	-	-	-
Sweden	9	11	44	53	22	33	17	5	17	16	48	22
UK (Engl.& Wales)	5,964	4,743	4,366	5,017	5,024	3,805	4,485	4,007	1,896	2,124	2,423	2,663
UK (N. Ireland)	-	-	-	-	-	-	-	1	61	30	47	1
UK (Scotland)	31,399	29,640	41,248	42,967	30,398	29,113	37,630	31,804	26,491	27,632	30,452	30,674
Total	96,409	100,004	99,149	99,958	71,934	66,709	64,978	66,294	40,124	n/a	45,828	46,643
Total h,c, catch used by Working Group	79,000	71,000	79,000	77,000	54,000	58,000	62,000	51,000	40,000	42,000	46,000	45,000

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

TABLE 3.4.2 ; Whiting, North Sea
Annual weight and numbers caught, 1960 to 1992.

Year	Weight (1000 tonnes) Total	H.Cons	Disc.	Ind BC	Numbers (millions) Total	H.Cons	Disc.	Ind BC
1960	180	48	122	11	1063	191	763	109
1961	325	68	241	16	2168	290	1646	232
1962	221	56	157	8	1508	222	1185	100
1963	258	58	154	45	1549	215	854	480
1964	147	60	59	28	931	221	341	369
1965	185	86	77	22	964	313	490	161
1966	240	105	84	51	1334	366	546	422
1967	234	68	143	23	1579	246	1103	231
1968	261	88	115	58	1646	299	754	593
1969	324	57	115	152	2803	204	626	1974
1970	268	79	74	115	2507	272	381	1854
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
1991	117	46	33	38	1590	185	235	1170
1992	102	45	30	27	837	164	209	465

TABLE 3.4.3; Whiting, North Sea
Natural Mortality and proportion mature

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

TABLE 3.4.4; Whiting, North Sea
International catch at age ('000), Total , 1960 to 1992.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	60827	215700	76256	105982	234479	63912	84279	177436	104751	1206087
1	482294	1078401	1021577	549043	137315	342410	516853	971232	828855	374122
2	257330	617300	218127	745486	364670	147628	342260	213111	516865	1019744
3	212115	218122	154305	93558	159602	326417	92701	119813	108548	154798
4	20948	32172	31151	43791	21861	71183	250807	23128	47737	27811
5	22431	1331	5846	8947	10413	7873	36933	65886	7170	12712
6	3498	4019	269	1653	2646	3498	8347	7520	29652	1664
7	858	377	396	8	414	752	1486	809	1845	5658
8	2053	118	109	120	2	122	333	122	93	621
9	229	225	13	13	39	2	128	31	23	34
10+	7	19	0	1	12	9	0	3	5	1

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	1187095	1232837	553711	175647	571415	238839	425081	666975	687017	476345
1	606631	620700	938136	1153018	755217	954765	479081	1004731	417292	611121
2	82358	106187	314926	660398	976000	403599	1119601	474222	305020	457585
3	563090	18145	44793	131353	226168	295629	163420	268897	222079	202924
4	50200	123135	7445	18039	31516	53896	79425	29031	79704	89752
5	11023	13021	56265	5404	4660	8792	14188	20033	6935	26698
6	3577	2191	7933	17226	1163	7524	2733	5225	6864	2988
7	1162	693	3284	2375	5496	109	488	505	1707	1528
8	1302	162	243	345	325	1303	18	228	247	250
9	131	408	67	118	47	132	527	17	11	33
10+	16	26	641	50	20	2	28	159	13	5

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	332172	516852	100516	666558	157321	186585	225026	84650	416511	87147
1	263938	160949	187656	197608	313029	200262	563918	260597	425291	324019
2	406641	334230	102216	168127	159701	143659	161518	355268	296398	169332
3	266938	253428	226384	107272	108563	83358	159440	120294	174814	183158
4	82466	92315	82823	124479	45938	37180	42550	78955	38549	76235
5	47604	24065	24581	35013	57101	13531	12525	10892	15476	14051
6	9858	10819	6294	8290	13142	17769	3376	4205	1937	4448
7	1003	2770	1956	1669	2832	3098	3935	822	417	404
8	653	238	385	760	376	831	530	818	60	286
9	58	43	49	96	176	94	72	101	73	37
10+	20	37	30	33	21	9	1	7	38	6

Age	1990	1991	1992
0	280695	1034586	252455
1	246748	124868	233443
2	493643	183793	156011
3	123736	180527	84662
4	82588	34769	90770
5	31601	25155	11019
6	1937	5440	6395
7	642	578	2601
8	90	263	104
9	16	2	7
10+	0	1	1

TABLE 3.4.5; Whiting, North Sea
International mean weight at age (kg), Total , 1960 to 1992.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	.058	.042	.055	.049	.042	.058	.072	.062	.038	.043
1	.117	.118	.119	.112	.124	.124	.109	.118	.112	.097
2	.190	.193	.187	.195	.174	.209	.187	.198	.187	.173
3	.256	.259	.266	.272	.267	.242	.249	.268	.294	.261
4	.315	.303	.334	.352	.354	.332	.288	.331	.358	.362
5	.344	.412	.400	.411	.443	.421	.368	.340	.484	.414
6	.383	.420	.521	.472	.488	.499	.434	.426	.447	.416
7	.501	.493	.519	.820	.535	.542	.473	.495	.620	.535
8	.457	.386	.539	.626	.601	.635	.697	.625	.730	.670
9	.383	.468	.585	.499	.764	1.256	.694	.621	.779	.787
10+	.398	.475	.000	.610	.692	.614	.000	.486	.842	1.236

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.020	.036	.022	.027	.026	.030	.019	.022	.010	.009
1	.110	.116	.071	.084	.070	.100	.107	.116	.074	.098
2	.203	.219	.200	.166	.149	.215	.194	.211	.181	.166
3	.240	.285	.282	.277	.257	.277	.294	.322	.235	.260
4	.348	.318	.388	.371	.381	.376	.352	.401	.327	.304
5	.455	.433	.418	.439	.469	.470	.443	.450	.436	.419
6	.452	.531	.520	.462	.519	.356	.519	.468	.438	.457
7	.512	.637	.575	.550	.541	.817	.514	.551	.477	.502
8	.628	.560	.748	.738	.786	.596	.554	.440	.613	.584
9	.785	.728	.801	.860	1.032	.712	.740	.734	.702	.618
10+	.802	.729	.822	.846	.966	1.022	.893	.500	1.247	.559

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.013	.011	.029	.014	.020	.014	.015	.012	.013	.023
1	.075	.082	.059	.105	.088	.094	.105	.076	.054	.068
2	.176	.166	.182	.189	.188	.186	.182	.146	.143	.156
3	.253	.241	.252	.275	.275	.265	.252	.246	.222	.224
4	.332	.326	.314	.326	.338	.324	.315	.293	.298	.265
5	.340	.394	.378	.387	.384	.391	.373	.371	.335	.316
6	.466	.423	.484	.427	.393	.429	.462	.368	.413	.383
7	.479	.473	.506	.457	.464	.469	.465	.492	.428	.438
8	.573	.649	.703	.520	.586	.424	.525	.458	.834	.347
9	.539	.828	.783	.670	.514	.497	1.194	.852	.588	.512
10+	.812	1.032	1.101	.502	.871	.789	.528	.602	.642	.828

Age	1990	1991	1992
0	.015	.017	.012
1	.081	.100	.081
2	.136	.161	.177
3	.207	.212	.246
4	.247	.271	.273
5	.277	.292	.318
6	.405	.331	.334
7	.484	.356	.312
8	.639	.381	.478
9	.316	.495	.774
10+	.000	1.055	1.727

Table 3.4.6. North Sea Whiting: Fleets used in tuning the VPA, the initial year and the age-groups

Country	Fleet	init.year	age-groups
Scotland	GFS	82	0-6
	TRL	73	1-7
	SEI	73	1-7
	LTR	73	0-8
Netherlands	GFS	80	0-3
England	GFS	77	0-6
France	TRB	76	0-9
Germany	GFS	83	1-5
Internat.	GFS	73	1-2
		83	3-6

Table 3.4.7 Whiting in the North Sea. Effort and catch data used for VPA tuning

SCOGFS
1982 1992
1 1 .50 .75
0 6

77.000	7.854	50.282	74.768	74.845	17.248	4.620	1.232
79.000	16.393	44.025	45.218	31.816	39.968	9.083	1.322
80.000	36.755	87.080	30.528	14.090	6.367	7.615	1.453
83.000	13.977	130.466	80.535	20.425	5.251	6.971	1.471
80.000	32.824	89.944	36.564	18.118	2.160	.433	.419
73.000	8.777	102.533	82.989	15.199	5.633	1.177	.253
86.000	54.154	83.516	135.424	38.113	5.863	1.635	.172
86.000	37.218	352.367	64.560	63.882	13.645	1.093	.530
85.000	165.038	190.180	174.382	21.065	21.660	3.992	.425
90.000	124.111	159.212	85.501	68.311	4.590	3.600	.810
87.000	21.062	25.429	11.022	4.811	5.090	.409	.226

SCOTRL
1973 1992
1 1 .00 1.00
1 7

182541.000	9830.593	16097.090	4607.541	793.930	81.993	2169.819	215.982
185432.000	1726.041	17080.360	7424.137	987.017	207.004	35.001	533.009
152977.000	1676.704	5987.146	13287.950	2165.922	278.986	41.999	7.000
121841.000	279.872	8119.534	2847.945	3928.029	691.022	121.005	14.001
144348.000	884.881	6341.339	13055.870	1521.048	2332.069	211.009	26.001
135220.000	2270.091	12979.390	15501.090	8631.781	549.985	751.980	70.997
87467.000	2855.941	14814.150	11068.370	7828.330	2945.143	166.010	212.012
55475.000	625.943	10603.400	10100.220	3441.270	2396.287	875.041	30.005
51553.000	237.937	6655.895	8101.873	3501.369	552.285	544.279	105.053
47889.000	272.975	886.006	6625.793	2713.545	932.213	195.056	70.020
48339.000	295.644	1113.679	3203.453	7485.245	1597.008	558.467	52.001
34574.000	343.663	1561.406	1502.289	1157.083	2428.888	487.177	79.841
32674.000	1764.179	3418.456	1703.326	526.947	400.881	635.597	87.990
27839.000	714.358	3647.608	1873.731	496.387	131.373	73.208	68.194
27208.000	1336.682	2434.041	1772.188	615.308	164.303	31.263	11.463
21559.000	18.998	822.592	1300.012	361.688	65.941	9.991	.999
16657.000	452.200	302.676	1013.396	701.924	171.853	21.469	9.080
13366.000	25.991	607.437	105.071	187.550	60.755	8.082	2.235
13495.000	49.073	179.071	661.456	24.734	65.288	10.626	.982
10887.000	34.050	78.615	95.576	247.458	4.114	14.341	22.906

Continued

Table 3.4.7 Continued

SCOSEI
1973 1992
1 1 .00 1.00
0 7

414898.000	1542.020	72080.050	49677.450	12692.610	2514.138	245.014	4100.240	487.029
349604.000	1666.939	44932.440	55720.080	25559.150	4326.063	720.013	102.002	1175.022
329432.000	27.001	54358.360	31190.790	39772.010	10131.260	835.021	103.003	19.000
307165.000	148.995	22192.290	67580.050	12456.700	10885.750	1889.958	263.994	42.999
313913.000	745.020	22193.600	50660.370	37036.020	3336.092	2528.069	371.010	31.001
325246.000	5345.922	14993.600	29307.940	43710.810	15390.200	1057.941	1408.921	200.989
316419.000	302.002	90749.850	41091.740	28124.230	14745.010	6083.678	676.915	155.750
297227.000	668.983	27032.330	73704.440	37657.650	11914.980	9367.982	2556.000	260.000
289672.000	92.998	8726.789	22243.640	25047.810	10551.990	2401.997	2084.002	374.000
297730.000	43.000	3720.987	7032.000	26194.140	13117.110	2713.028	539.005	277.003
333168.000	572.013	11565.390	14957.380	21690.020	34199.110	9830.623	2154.563	406.795
388035.000	296.722	4922.500	24015.610	20669.760	14985.590	21269.320	4715.242	959.961
381647.000	773.215	20067.840	20263.320	19695.990	8956.377	4795.861	8013.077	1362.788
425017.000	137.759	139498.200	48705.180	34509.260	11340.960	2624.396	1097.504	1771.080
418536.000	1358.848	13793.330	52715.140	38938.770	18440.260	3637.712	1096.908	297.738
377132.000	26.014	2502.074	28446.110	44869.260	12631.400	4071.612	678.724	63.973
355735.000	10.131	6878.804	15704.130	41407.430	23710.400	4769.041	1323.229	112.076
252732.000	184.877	14229.830	124635.800	27694.110	29920.980	14767.800	720.818	206.524
336675.000	886.651	11951.950	44964.260	63414.280	10436.100	8730.116	1742.927	195.190
300217.000	426.209	16613.690	19452.010	21217.150	27961.870	2804.536	1958.074	564.870

SCOLTR
1973 1992
1 1 .00 1.00
0 8

152514.000	824.036	34374.240	15191.560	3506.705	709.914	72.990	1429.808	182.975	38.995
116982.000	632.940	18995.250	16611.790	5207.721	773.964	147.994	14.999	422.982	34.999
161009.000	4.000	26421.100	13339.210	18383.220	3496.889	423.989	33.999	5.000	185.995
152419.000	28.998	5574.648	30121.130	5297.682	5247.686	875.948	194.988	17.999	1.000
224824.000	709.038	24587.140	29945.250	24840.410	1663.950	2418.911	459.981	33.999	17.999
236929.000	7158.392	8785.464	19909.950	30722.310	14472.600	956.038	1612.065	635.026	72.003
287494.000	367.996	171147.300	42910.400	23154.590	17995.660	4057.925	376.993	285.995	56.999
333197.000	868.998	20805.960	58381.990	38436.160	9525.058	9430.050	1864.014	144.001	145.001
251504.000	170.986	6576.457	19069.210	21549.750	9706.151	1777.022	1455.034	310.008	9.000
250870.000	6390.155	5214.103	8196.975	26680.540	12944.740	3333.924	646.980	338.988	73.997
244349.000	20191.060	37495.680	17925.870	12535.310	19234.310	6123.520	1216.612	182.797	140.848
240775.000	2553.165	38266.770	16048.090	10784.180	6306.822	9018.982	2371.186	478.594	13.127
267393.000	1221.645	28760.940	9368.367	7616.928	3085.792	1333.193	2901.185	443.130	173.087
279767.000	796.708	8138.433	8571.900	9577.941	4108.819	767.442	425.282	608.602	51.637
351131.000	599.518	18761.180	25933.340	16160.770	5954.478	1182.953	388.455	116.035	128.993
391988.000	59.996	2397.963	15778.770	22525.540	5127.725	1640.626	207.218	31.033	15.015
405883.000	491.803	20318.750	10051.620	21389.720	10836.810	2394.091	448.224	33.084	54.358
371493.000	371.478	3676.882	35321.990	7664.570	8960.094	3423.009	159.541	39.935	5.339
408056.000	688.421	8726.876	11908.030	22145.620	3192.247	2906.398	628.632	49.904	40.866
473955.000	1379.234	17580.580	14551.320	11822.710	15417.660	1500.403	1160.443	304.395	12.750

Continued

Table 3.4.7 Continued

ENGGFS
1977 1992
1 1 .50 .75
0 6

111.000	31.558	24.371	8.261	1.231	.240	.100	.089
113.000	20.788	27.858	5.806	1.189	.389	.057	.025
117.000	41.620	23.538	8.350	2.227	.989	.067	.034
115.000	22.788	40.448	14.321	5.508	1.379	.359	.066
114.000	39.731	20.824	32.751	18.251	.702	.701	.092
72.000	5.004	20.011	5.727	6.201	1.602	.246	.035
74.000	55.002	8.765	8.063	1.409	1.257	.179	.050
82.000	14.118	41.417	8.853	2.465	.725	.629	.309
73.000	14.572	11.575	12.424	1.219	.715	.133	.112
82.000	13.385	12.425	5.402	3.152	.333	.085	.012
77.000	10.565	17.514	10.030	2.075	1.546	.271	.090
75.000	28.676	14.128	9.887	3.415	.485	.130	.013
85.000	99.586	25.098	10.014	6.552	1.426	.294	.016
86.000	75.279	16.347	11.039	3.315	1.994	.280	.040
87.000	14.557	28.974	6.669	3.321	.944	.323	.037
74.000	30.980	18.078	8.898	2.073	1.777	.336	.401

FRATRB
1976 1992
1 1 .00 1.00
0 9

64396.000	2718.175	12660.210	45922.270	6143.989	4686.481	1283.520	254.502	42.000	3.000	156.000
80107.000	2587.202	24164.320	21838.560	17682.810	1796.613	2279.111	554.182	54.000	31.000	6.000
69739.000	3351.785	7330.050	23791.320	19207.120	9382.748	836.852	1103.904	227.000	34.000	4.000
89974.000	591.579	61937.410	28650.200	18463.210	11830.280	3952.171	397.490	315.873	45.000	14.000
63577.000	271.781	9010.200	27059.800	18938.580	5826.699	4984.075	1071.901	78.000	71.000	10.000
76517.000	107.487	6395.469	18560.020	20258.120	9102.926	2249.323	1662.444	315.272	16.000	10.000
78523.000	2984.073	8778.596	5953.086	24941.790	14159.490	4423.757	1089.911	542.530	119.000	14.000
69720.000	9867.649	21688.240	16261.920	12818.580	19955.340	6139.751	1102.018	231.456	127.298	19.000
76149.000	1573.497	19189.370	12048.880	9046.985	4993.439	6421.895	1693.265	322.207	32.000	26.000
53003.000	570.817	10561.680	7129.542	5883.502	2466.529	1082.139	1285.780	233.338	34.000	10.000
50350.000	473.480	24324.670	10512.730	8154.293	2749.571	695.240	237.411	238.763	54.708	3.000
51234.000	558.880	9268.703	14851.100	6589.581	3721.569	708.607	209.758	76.000	82.710	10.000
35482.000	1024.471	3136.269	5860.832	7551.045	1901.380	843.634	160.791	42.000	7.158	7.000
36133.000	403.266	8819.171	3329.428	8279.531	3991.409	756.183	229.592	22.130	17.157	1.147
36097.000	7597.934	4192.686	15523.180	4221.804	3927.771	1600.354	91.259	35.050	2.702	.128
45075.000	297.152	3610.561	5309.753	7751.186	1263.168	971.230	211.706	33.269	4.032	.317
34138.000	318.269	4710.702	3987.946	3305.109	4309.879	420.786	274.874	141.951	2.076	.137

FRGGFS
1983 1992
1 1 .25 .50
1 5

1.000	.007	.015	.009	.009	.002
1.000	.006	.013	.011	.003	.004
1.000	.010	.023	.007	.002	.001
1.000	.012	.025	.019	.003	.001
1.000	.091	.071	.019	.017	.002
1.000	.015	.080	.041	.005	.003
1.000	.603	.392	.145	.054	.004
1.000	.280	.249	.086	.032	.020
1.000	.324	.164	.117	.037	.011
1.000	.120	.073	.057	.033	.008

Continued

Table 3.4.7 Continued

NETGFS
1980 1992
1 1 .50 .75
0 3

1.000	.166	.330	.062	.027
1.000	1.393	.205	.131	.009
1.000	.166	.640	.105	.052
1.000	2.649	.431	.224	.012
1.000	.143	1.330	.141	.091
1.000	.859	.783	.893	.032
1.000	1.784	.384	.075	.170
1.000	2.883	2.004	.252	.018
1.000	.629	1.441	.612	.025
1.000	1.882	1.049	.803	.212
1.000	5.544	.963	.196	.154
1.000	.806	1.552	.214	.019
1.000	.452	.271	.309	.040

IGFS12
1973 1992
1 1 .00 .25
1 2

1.000	1.156	.763
1.000	.322	.496
1.000	.893	.153
1.000	.679	.535
1.000	.418	.219
1.000	.513	.293
1.000	.457	.183
1.000	.692	.391
1.000	.227	.485
1.000	.161	.232
1.000	.128	.126
1.000	.441	.181
1.000	.342	.360
1.000	.464	.265
1.000	.682	.555
1.000	.396	.866
1.000	1.465	.542
1.000	.508	.884
1.000	1.014	.675
1.000	.915	.747

IGFS36
1983 1992
1 1 .00 .25
3 6

1.000	.112	.079	.033	.006
1.000	.092	.031	.026	.011
1.000	.066	.019	.007	.007
1.000	.202	.034	.007	.004
1.000	.091	.047	.005	.002
1.000	.316	.034	.012	.001
1.000	.421	.112	.012	.005
1.000	.201	.092	.017	.003
1.000	.482	.071	.038	.008
1.000	.260	.169	.016	.014

Table 3.4.8 Whiting in the North Sea, XSA tuning diagnostics

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 VPA Version 3.1 (MSDOS)

    9/10/1993  14:18

 Extended Survivors Analysis

 Whiting in the North Sea; 1960-1992.

Input :

 CPUE data from file whi20ef.dat

 Data for   10 fleets over   33 years
 Age range from    0 to    9

      Fleet,             Alpha,    Beta
 SCOGFS                ,  .500   ,  .750
 SCOTRL                ,  .000   , 1.000
 SCOSEI                ,  .000   , 1.000
 SCOLTR                ,  .000   , 1.000
 ENGGFS                ,  .500   ,  .750
 FRATRB                ,  .000   , 1.000
 FRGGFS                ,  .250   ,  .500
 NETGFS                ,  .500   ,  .750
 IGFS12                ,  .000   ,  .250
 IGFS36                ,  .000   ,  .250

 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years

 Catchability analysis :

      Catchability dependent on stock size for ages <    2

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


      Catchability independent of age for ages >=    6

 Terminal population estimation :

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

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

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

      Prior weighting not applied

 Tuning converged after   23 iterations
```

Continued

Table 3.4.8 Continued

Terminal year survivor and F summaries :

Age 0 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	********	3.607	.000	.00	1	.007	.000
SCOTRL	1.	.000	.000	.00	0	.000	.000
SCOSEI	********	3.730	.000	.00	1	.007	.000
SCOLTR	1961630.	2.564	.000	.00	1	.014	.000
ENGGFS	860868.	2.553	.000	.00	1	.014	.000
FRATRB	********	13.914	.000	.00	1	.000	.000
FRGGFS	1.	.000	.000	.00	0	.000	.000
NETGFS	84024.	5.689	.000	.00	1	.003	.000
IGFS12	1.	.000	.000	.00	0	.000	.000
IGFS36	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	2453708.	.40				.583	.028
F shrinkage mean	1144390.	.50				.371	.060

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1841365.	.30	.20	8	.644	.038

Age 1 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	83034.	1.314	.696	.53	2	.036	1.011
SCOTRL	430340.	.817	.000	.00	1	.093	.291
SCOSEI	1314739.	1.136	.616	.54	2	.048	.105
SCOLTR	776535.	1.274	.208	.16	2	.038	.171
ENGGFS	1812919.	2.060	.464	.23	2	.015	.077
FRATRB	616666.	.674	.377	.56	2	.137	.211
FRGGFS	6916940.	5.902	.000	.00	1	.002	.021
NETGFS	36572.	5.949	5.645	.95	2	.002	1.603
IGFS12	1902122.	1.105	.000	.00	1	.051	.074
IGFS36	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	795373.	.43				.329	.168
F shrinkage mean	591209.	.50				.249	.220

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
671688.	.25	.16	17	.655	.196

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	78015.	.689	.771	1.12	3	.082	.954
SCOTRL	106052.	.722	.641	.89	2	.074	.777
SCOSEI	246108.	.713	.089	.13	3	.076	.410
SCOLTR	193678.	.515	.194	.38	3	.146	.497
ENGGFS	335113.	.547	.408	.74	3	.129	.316
FRATRB	182196.	.416	.344	.83	3	.223	.521
FRGGFS	378118.	1.481	.930	.63	2	.018	.285
NETGFS	472913.	1.215	.894	.74	3	.026	.234
IGFS12	650809.	.733	.219	.30	2	.072	.175
IGFS36	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	180591.	.50				.155	.525

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
207325.	.20	.15	25	.781	.471

Continued

Table 3.4.8 Continued

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	40404.	.644	.555	.86	4	.070	1.015
SCOTRL	26242.	.763	.206	.27	3	.050	1.311
SCOSEI	97202.	.490	.242	.49	4	.122	.549
SCOLTR	58972.	.381	.104	.27	4	.202	.791
ENGGFS	77027.	.577	.222	.38	4	.088	.654
FRATRB	66211.	.353	.034	.10	4	.235	.729
FRGGFS	192716.	1.210	.292	.24	3	.020	.314
NETGFS	99160.	1.259	.202	.16	4	.018	.540
IGFS12	141939.	1.096	.233	.21	2	.024	.406
IGFS36	137449.	.734	.000	.00	1	.054	.417
F shrinkage mean	59791.	.50				.117	.783

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
68254.	.17	.09	34	.530	.714

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	35167.	.636	.360	.57	5	.075	1.170
SCOTRL	35713.	.862	.123	.14	4	.041	1.159
SCOSEI	71447.	.484	.188	.39	5	.130	.739
SCOLTR	46381.	.371	.093	.25	5	.221	.987
ENGGFS	50272.	.650	.173	.27	5	.072	.938
FRATRB	48166.	.359	.112	.31	5	.236	.964
FRGGFS	98543.	1.307	.224	.17	4	.018	.584
NETGFS	18586.	1.955	.230	.12	4	.008	1.649
IGFS12	80135.	1.754	.367	.21	2	.010	.681
IGFS36	88261.	.668	.074	.11	2	.068	.634
F shrinkage mean	42353.	.50				.122	1.045

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
50420.	.17	.06	42	.368	.936

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	2217.	1.033	.248	.24	6	.053	1.684
SCOTRL	498.	1.413	.246	.17	5	.028	3.022
SCOSEI	4433.	.782	.111	.14	6	.092	1.161
SCOLTR	2637.	.535	.080	.15	6	.197	1.545
ENGGFS	7770.	1.115	.176	.16	6	.045	.812
FRATRB	2856.	.474	.077	.16	6	.250	1.483
FRGGFS	14545.	1.744	.127	.07	5	.019	.512
NETGFS	17145.	4.630	.317	.07	4	.003	.449
IGFS12	4886.	4.004	.326	.08	2	.004	1.095
IGFS36	6822.	.819	.093	.11	3	.084	.886
F shrinkage mean	3421.	.50				.225	1.346

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3345.	.24	.08	50	.336	1.363

Continued

Table 3.4.8 Continued

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	964.	.852	.262	.31	7	.091	1.925
SCOTRL	1047.	1.358	.124	.09	6	.036	1.854
SCOSEI	2805.	.783	.079	.10	7	.108	1.103
SCOLTR	1856.	.658	.063	.10	7	.153	1.396
ENGGFS	6134.	1.368	.383	.28	7	.035	.652
FRATRB	1684.	.554	.081	.15	7	.215	1.471
FRGGFS	4181.	3.011	.130	.04	5	.007	.854
NETGFS	5347.	7.090	.421	.06	4	.001	.720
IGFS12	2961.	5.954	.108	.02	2	.002	1.067
IGFS36	4341.	.877	.128	.15	4	.086	.833
F shrinkage mean	2024.	.50				.265	1.332

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2030.	.26	.07	57	.274	1.330

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	561.	1.413	.065	.05	7	.045	1.648
SCOTRL	596.	1.527	.428	.28	7	.038	1.599
SCOSEI	698.	.950	.114	.12	8	.099	1.475
SCOLTR	466.	.880	.091	.10	8	.115	1.800
ENGGFS	420.	2.266	.170	.07	7	.017	1.888
FRATRB	666.	.560	.179	.32	8	.284	1.512
FRGGFS	1581.	5.062	.316	.06	5	.003	.912
NETGFS	354.	11.450	.299	.03	4	.001	2.035
IGFS12	559.	9.975	.207	.02	2	.001	1.650
IGFS36	721.	1.465	.118	.08	4	.041	1.450
F shrinkage mean	774.	.50				.356	1.396

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
668.	.30	.05	61	.177	1.509

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	15.	6.138	.089	.01	7	.005	1.974
SCOTRL	4.	5.924	.209	.04	7	.006	3.087
SCOSEI	15.	3.748	.025	.01	8	.015	1.957
SCOLTR	10.	2.164	.117	.05	9	.044	2.352
ENGGFS	15.	10.517	.155	.01	7	.002	1.954
FRATRB	8.	1.443	.072	.05	9	.099	2.500
FRGGFS	11.	25.855	.281	.01	5	.000	2.223
NETGFS	4.	65.797	.421	.01	4	.000	3.145
IGFS12	8.	55.925	.043	.00	2	.000	2.569
IGFS36	13.	6.490	.120	.02	4	.005	2.078
F shrinkage mean	9.	.50				.824	2.401

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9.	.45	.02	63	.041	2.401

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	2.	17.767	.088	.00	7	.001	1.401
SCOTRL	1.	.000	.000	.00	0	.000	.000
SCOSEI	2.	9.741	.055	.01	8	.002	1.373
SCOLTR	2.	6.421	.289	.05	9	.006	1.432
ENGGFS	1.	29.216	.227	.01	7	.000	1.825
FRATRB	1.	.000	.000	.00	0	.000	.000
FRGGFS	1.	64.556	.224	.00	5	.000	1.703
NETGFS	6.	166.218	.278	.00	4	.000	.741
IGFS12	2.	137.301	.019	.00	2	.000	1.684
IGFS36	2.	18.257	.115	.01	4	.001	1.436
F shrinkage mean	2.	.50				.909	1.528

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2.	.48	.08	64	.157	1.573

Table 3.4.9. North Sea Whiting
Comparison of tuning methods

Fishing pattern in 1992

age	XSA	LS
0	0.038	0.036
1	0.196	0.202
2	0.471	0.494
3	0.714	0.752
4	0.936	0.929
5	1.363	1.347
6	1.33	1.285
7	1.505	1.38
8	2.401	2.608
9	1.573	1.51

TABLE 3.4.10; Whiting, North Sea
Tuned Stock Numbers at age (10**-5), 1960 to 1993, (numbers in 1993 are VPA survivors)

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	414102	744747	816307	183679	357600	310589	587833	1157327	140629	272865
1	39677	32164	57548	63526	14046	27267	24073	45663	89870	10688
2	8590	12345	5733	15903	21154	4578	8416	6096	11620	29602
3	3258	3423	2943	1914	4188	10576	1740	2633	2185	3282
4	269	515	581	778	563	1611	4713	448	850	629
5	325	19	105	162	200	229	581	1333	133	219
6	47	55	3	30	47	64	109	126	456	40
7	11	6	7	0	9	14	19	11	32	94
8	27	2	1	2	0	3	4	2	2	10
9	3	3	0	0	1	0	2	1	0	1
10+	0	0	0	0	0	0	0	0	0	0

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	424637	724684	949836	469858	966659	593383	585212	590712	612416	556015
1	17936	29839	53140	72618	36196	73882	45665	44507	44260	45899
2	1807	3164	7680	14717	20914	9302	22636	14681	10964	14522
3	10732	494	1169	2382	4111	5542	2708	5493	5574	4555
4	1013	2836	196	448	576	998	1423	537	1613	2064
5	226	319	1041	81	177	156	276	371	148	509
6	58	79	133	314	16	96	44	89	112	54
7	17	14	42	34	93	2	9	10	24	27
8	26	3	5	5	6	26	1	3	3	4
9	2	9	1	2	1	2	10	0	0	1
10+	0	1	10	1	0	0	1	2	0	0

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	215012	247515	214549	339800	241232	493127	409618	283857	525926	232837
1	42084	15860	17882	16471	24670	18396	37983	31355	21927	39901
2	13950	14634	5133	5749	5141	7594	5869	11183	10506	5835
3	5606	5648	6662	2457	2323	2003	3695	2453	4293	4332
4	1507	1710	1853	2794	831	726	712	1265	718	1558
5	757	406	472	660	999	220	218	161	258	200
6	161	169	104	151	205	274	52	59	29	64
7	16	38	36	26	44	43	57	11	9	6
8	8	4	6	12	6	10	8	11	1	3
9	1	1	1	2	3	1	1	1	1	1
10+	0	1	1	1	0	0	0	0	1	0

Age	1990	1991	1992	1993
0	208136	307534	244861	0
1	17937	15467	21122	18414
2	13416	5402	5205	6717
3	2369	4613	1977	2073
4	1515	630	1735	683
5	498	412	168	504
6	32	109	99	33
7	11	8	37	20
8	1	3	1	7
9	0	0	0	0
10+	0	0	0	0

TABLE 3.4.11; Whiting, North Sea
International F at age, Total , 1960 to 1992.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	.005	.010	.003	.021	.024	.007	.005	.005	.027	.172
1	.218	.775	.336	.150	.171	.226	.424	.419	.161	.827
2	.470	.984	.647	.884	.243	.517	.712	.576	.814	.565
3	1.494	1.424	.980	.873	.605	.458	1.007	.781	.896	.825
4	2.338	1.293	.976	1.061	.600	.720	.963	.915	1.058	.722
5	1.528	1.526	1.000	.981	.894	.494	1.275	.822	.944	1.075
6	1.816	1.775	2.711	.978	1.002	.977	2.033	1.120	1.333	.631
7	1.803	1.187	.927	.809	.733	.950	2.125	1.637	1.008	1.100
8	1.932	1.912	1.626	.833	.325	.491	1.946	1.333	.867	1.255
9	1.910	1.559	1.467	.943	.718	.733	1.691	1.179	1.054	.967
10+	1.910	1.559	1.467	.943	.718	.733	1.691	1.179	1.054	.967

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.105	.063	.021	.014	.021	.014	.026	.041	.041	.031
1	.785	.407	.334	.295	.409	.233	.185	.451	.164	.241
2	.846	.545	.721	.825	.878	.784	.966	.518	.428	.502
3	.981	.575	.609	1.069	1.065	1.009	1.268	.875	.644	.756
4	.857	.702	.582	.631	1.009	.987	1.045	.990	.853	.704
5	.803	.622	.948	1.403	.355	1.023	.876	.947	.759	.901
6	1.196	.378	1.123	.970	1.884	2.152	1.242	1.085	1.184	.990
7	1.467	.821	1.973	1.505	1.064	1.066	.960	.845	1.621	1.001
8	.828	.841	.788	1.583	.883	.798	.486	2.535	1.570	1.296
9	1.042	.679	1.096	1.234	1.051	1.220	.922	1.292	1.186	.959
10+	1.042	.679	1.096	1.234	1.051	1.220	.922	1.292	1.186	.959

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.057	.078	.017	.073	.024	.014	.020	.011	.029	.014
1	.106	.178	.185	.214	.228	.192	.273	.144	.374	.140
2	.454	.337	.287	.456	.493	.270	.423	.507	.436	.452
3	.838	.765	.519	.734	.813	.685	.722	.878	.664	.701
4	1.010	.987	.733	.729	1.029	.905	1.186	1.291	.976	.840
5	1.248	1.112	.892	.920	1.044	1.194	1.056	1.454	1.140	1.581
6	1.183	1.291	1.155	.978	1.299	1.328	1.334	1.653	1.384	1.534
7	1.239	1.596	.910	1.279	1.236	1.548	1.469	1.915	.744	1.521
8	2.278	1.241	1.104	1.218	1.252	2.081	1.487	1.890	.729	2.587
9	1.372	1.219	.969	.956	1.122	1.419	1.343	1.608	.947	1.607
10+	1.372	1.219	.969	.956	1.122	1.419	1.343	1.608	.947	1.607

Age	1990	1991	1992
0	.049	.128	.038
1	.250	.139	.196
2	.618	.555	.471
3	.974	.628	.714
4	1.003	1.024	.936
5	1.269	1.180	1.363
6	1.149	.833	1.330
7	1.072	1.639	1.509
8	3.444	3.185	2.401
9	1.690	1.522	1.574
10+	1.690	1.522	1.574

Table 3.4.12 Whiting in the North Sea. Research vessel indices for recruitment estimation

WHITING IV RCT3 INPUT VALUES; 1993 WG

'YEARCLASS'	'IYFS1'	'IYFS2'	'EGFS0'	'EGFS1'	'EGFS2'	'SGFS0'	'SGFS1'	'SGFS2'	'DGFS0'	'DGFS1'	'DGFS2'	'GGFS1'	'GGFS2'
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	214	280.2	163.7
1990	1014	748	875	333	120	1943	177	127	5543	1552	310	324.3	73.3
1991	916	524	167	244	89	1379	293	117	806	272	-1	120.7	-1
1992	1087	-1	419	231	-1	2417	317	-1	453	-1	-1	-1	-1
1993	-1	-1	232	-1	-1	247	-1	-1	-1	-1	-1	-1	-1

Table 3.4.13 Whiting in the North Sea, recruitment estimates at age 0

Analysis by RCT3 ver3.1 of data from file :

whiiv0.rcx

WHITING IV RCT3 INPUT VALUES; AGE 0; 1993 WG

Data for 13 surveys over 23 years : 1971 - 1993

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 = 1992

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
IYFS1	.88	5.10	.44	.485	19	6.99	11.26	.564	.269
IYFS2									
EGFS0	9.66	-43.45	8.18	.003	13	6.04	14.87	9.817	.001
EGFS1	2.74	-4.35	1.06	.134	14	5.45	10.59	1.245	.055
EGFS2									
SGFS0	1.79	.36	1.28	.083	8	7.79	14.32	2.497	.014
SGFS1	1.21	4.45	.70	.222	9	5.76	11.41	.959	.093
SGFS2									
DGFS0	1.00	3.58	1.20	.089	10	6.12	9.73	1.471	.040
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =		10.45	.402	.528

Continued

Table 3.4.13 Continued

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
IYFS1									
IYFS2									
EGFS0	13.76	-66.49	12.00	.001	13	5.45	8.51	14.400	.001
EGFS1									
EGFS2									
SGFS0	1.82	.18	1.31	.080	8	5.51	10.22	1.663	.052
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =		10.43	.391	.947

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	48636	10.79	.29	.26	.76		
1993	33437	10.42	.38	.05	.02		

Table 3.4.14 Whiting in the North Sea, recruitment estimates at age 1

Analysis by RCT3 ver3.1 of data from file :

whiiv1.rcx

WHITING IV RCT3 INPUT VALUES; AGE 1; 1993WG

Data for 13 surveys over 24 years : 1970 - 1993

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 = 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	.92	2.32	.45	.495	20	6.82	8.58	.545	.154
IYFS2	1.62	-1.77	.97	.170	20	6.26	8.34	1.132	.036
EGFS0	11.54	-56.47	9.56	.002	13	5.12	2.68	11.315	.000
EGFS1	3.16	-9.20	1.23	.106	14	5.50	8.20	1.428	.022
EGFS2	2.70	-4.88	1.02	.149	15	4.50	7.29	1.194	.032
SGFS0	1.77	-2.07	1.25	.083	8	7.23	10.72	2.077	.011
SGFS1	1.16	2.13	.66	.243	9	5.68	8.71	.877	.059
SGFS2	.83	4.04	.29	.626	10	4.77	7.98	.351	.369
DGFS0	.97	1.24	1.16	.095	10	6.69	7.74	1.383	.024
DGFS1	3.85	-17.80	2.79	.019	11	5.61	3.82	3.672	.003
DGFS2									
GGFS1	.55	5.83	.99	.127	8	4.80	8.48	1.267	.028
GGFS2									
						VPA Mean =	7.89	.418	.261

Continued

Table 3.4.14 Continued

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression---------I					I-----------Prediction---------I			
IYFS1	.87	2.57	.43	.500	20	6.99	8.67	.551	.283
IYFS2									
EGFS0	15.43	-78.24	13.09	.001	13	6.04	14.96	15.698	.000
EGFS1	3.09	-8.81	1.21	.107	14	5.45	8.03	1.425	.042
EGFS2									
SGFS0	1.80	-2.23	1.28	.081	8	7.79	11.75	2.504	.014
SGFS1	1.18	2.01	.67	.235	9	5.76	8.81	.927	.100
SGFS2									
DGFS0	1.04	.74	1.25	.084	10	6.12	7.12	1.532	.037
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =		7.87	.405	.524

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression---------I					I-----------Prediction---------I			
IYFS1									
IYFS2									
EGFS0	29.64	******	25.85	.000	13	5.45	3.74	31.031	.000
EGFS1									
EGFS2									
SGFS0	1.83	-2.42	1.32	.079	8	5.51	7.65	1.669	.052
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =		7.85	.393	.947

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	3329	8.11	.21	.15	.50		
1992	3728	8.22	.29	.26	.76		
1993	2536	7.84	.38	.05	.02		

Table 3.4.15 Whiting in the North Sea, recruitment estimates at age 2

Analysis by RCT3 ver3.1 of data from file :

whiiv2.rcx

WHITING IV RCT3 INPUT VALUES; AGE 2; 1993WG

Data for 13 surveys over 24 years : 1970 - 1993

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 = 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	.96	.95	.44	.524	20	6.92	7.56	.541	.154
IYFS2	1.90	-4.59	1.15	.140	20	6.62	8.00	1.373	.024
EGFS0	7.90	-37.28	6.41	.005	13	6.78	16.25	8.189	.001
EGFS1	2.93	-9.13	1.11	.137	14	5.81	7.92	1.334	.025
EGFS2	2.77	-6.32	1.06	.150	15	4.80	6.96	1.219	.030
SGFS0	1.35	-.90	.91	.168	8	7.57	9.33	1.635	.017
SGFS1	1.14	1.08	.62	.287	9	5.18	6.96	.761	.078
SGFS2	.85	2.77	.29	.651	10	4.85	6.89	.348	.373
DGFS0	1.36	-2.51	1.66	.053	10	8.62	9.19	2.236	.009
DGFS1	6.08	-33.63	4.44	.009	11	7.35	11.06	5.500	.001
DGFS2	-21.09	121.66	19.44	.001	12	5.74	.58	22.713	.000
GGFS1	.51	4.81	.89	.175	8	5.78	7.77	1.203	.031
GGFS2	.88	2.95	1.09	.116	9	4.31	6.73	1.315	.026
					VPA Mean =		6.74	.443	.230

Continued

Table 3.4.15 Continued

Yearclass = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	I	I-----------	Prediction	---------		I
IYFS1	.93	1.10	.44	.521	20	6.82	7.42	.536	.158
IYFS2	1.72	-3.59	1.04	.161	20	6.26	7.20	1.214	.031
EGFS0	8.79	-42.31	7.28	.004	13	5.12	2.75	8.612	.001
EGFS1	2.90	-8.95	1.11	.137	14	5.50	7.01	1.287	.027
EGFS2	2.55	-5.32	.94	.182	15	4.50	6.16	1.104	.037
SGFS0	1.36	-.96	.92	.167	8	7.23	8.87	1.523	.020
SGFS1	1.15	1.00	.63	.283	9	5.68	7.53	.847	.063
SGFS2	.85	2.77	.29	.657	10	4.77	6.82	.346	.378
DGFS0	1.47	-3.30	1.80	.046	10	6.69	6.56	2.154	.010
DGFS1	5.90	-32.52	4.29	.010	11	5.61	.56	5.647	.001
DGFS2									
GGFS1	.52	4.78	.90	.172	8	4.80	7.26	1.153	.034
GGFS2									
					VPA Mean =		6.72	.433	.241

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	I	I-----------	Prediction	---------		I
IYFS1	.89	1.27	.43	.521	20	6.99	7.52	.552	.294
IYFS2									
EGFS0	10.53	-52.06	8.92	.002	13	6.04	11.53	10.703	.001
EGFS1	2.87	-8.77	1.10	.137	14	5.45	6.85	1.299	.053
EGFS2									
SGFS0	1.37	-1.04	.93	.165	8	7.79	9.65	1.824	.027
SGFS1	1.17	.89	.65	.277	9	5.76	7.63	.894	.112
SGFS2									
DGFS0	1.65	-4.49	2.02	.038	10	6.12	5.58	2.479	.015
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =		6.70	.423	.499

Continued

Table 3.4.15 Continued

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
IYFS1									
IYFS2									
EGFS0	14.55	-74.63	12.68	.001	13	5.45	4.66	15.222	.001
EGFS1									
EGFS2									
SGFS0	1.39	-1.13	.95	.164	8	5.51	6.51	1.207	.106
SGFS1									
SGFS2									
DGFS0									
DGFS1									
DGFS2									
GGFS1									
GGFS2									
					VPA Mean =		6.68	.415	.894

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	1232	7.12	.21	.16	.58		
1991	1062	6.97	.21	.15	.49		
1992	1235	7.12	.30	.26	.73		
1993	782	6.66	.39	.05	.02		

TABLE 3.4.16; Whiting, North Sea
Mean fishing mortality, biomass and recruitment, 1960 - 1992.

Year	Mean Fishing Mortality H.Cons Ages 2 to 6	Disc. Ages 2 to 6	Ind BC Ages 0 to 4	Stock Biomass ('000 tonnes) Total	Spawning	Recruits Age 0 Yclass	Million
1960	1.062	.451	.015	735	308	1960	41410
1961	.999	.393	.017	727	369	1961	74475
1962	.962	.276	.013	895	277	1962	81631
1963	.613	.302	.057	1112	451	1963	18368
1964	.507	.132	.040	684	500	1964	35760
1965	.454	.146	.034	757	448	1965	31059
1966	.910	.175	.133	625	380	1966	58783
1967	.612	.204	.034	796	307	1967	115733
1968	.723	.227	.073	1350	435	1968	14063
1969	.408	.195	.290	741	607	1969	27287
1970	.608	.232	.249	542	364	1970	42464
1971	.409	.134	.065	540	226	1971	72468
1972	.577	.140	.118	626	278	1972	94984
1973	.670	.169	.161	958	395	1973	46986
1974	.583	.137	.298	709	457	1974	96666
1975	.842	.220	.143	1145	469	1975	59338
1976	.642	.170	.276	1071	602	1976	58521
1977	.565	.118	.222	1048	562	1977	59071
1978	.604	.078	.105	721	415	1978	61242
1979	.594	.073	.106	897	478	1979	55602
1980	.651	.219	.095	788	487	1980	21501
1981	.651	.084	.175	589	454	1981	24752
1982	.491	.102	.101	451	349	1982	21455
1983	.560	.145	.071	475	311	1983	33980
1984	.743	.129	.069	454	254	1984	24123
1985	.735	.081	.056	414	249	1985	49313
1986	.735	.148	.056	634	271	1986	40962
1987	.942	.157	.070	507	283	1987	28386
1988	.710	.107	.164	396	279	1988	52593
1989	.589	.191	.145	511	261	1989	23284
1990	.492	.289	.199	429	286	1990	20814
1991	.561	.143	.126	373	228	1991	48623
1992	.682	.166	.111	368	209	1992	49573

Arithmetic mean recruits at age 0 for the period 1960 to 1992 : 48038
Geometric mean recruits at age 0 for the period 1960 to 1992 : 42133

TABLE 3.4.17; Whiting, North Sea
Input for Catch Prediction

Age	1993 Stock Numbers (10**-5)	F and mean Wt at age used in prediction: Scaled Mean F 1988 - 1992 H.Cons	Disc.	Ind BC	Mean Wt. at age (kg) 1988 - 1992 Stock	H.Cons	Disc.	Ind BC
0	334370	.000	.006	.034	.016	.075	.033	.014
1	37280	.005	.078	.106	.077	.188	.085	.069
2	10620	.099	.192	.176	.155	.224	.154	.132
3	2073	.346	.247	.138	.222	.255	.188	.209
4	683	.661	.224	.101	.271	.296	.207	.248
5	504	1.051	.235	.085	.308	.328	.223	.321
6	33	1.120	.063	.111	.373	.381	.245	.367
7	20	1.092	.172	.094	.403	.430	.228	.382
8	7	2.418	.064	.126	.536	.541	.338	.388
9	0	1.568	.000	.011	.537	.538	.000	.080
10	0	.975	.244	.000	.850	.850	.000	.000

Mean F	(2 - 6)	(0 - 4)
Unscaled	.786	.149
Scaled	.848	.111

Recruits at age 0 in 1994 = 338600
Recruits at age 0 in 1995 = 338600

Stock numbers in 1993 are VPA survivors.
These are overwritten at Age 0 Age 1 Age 2

Human consumption + discard Fs are obtained from mean exploitation pattern over 1988 to 1992.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1992, i.e. .848
Fs are distributed between consumption and discards by mean proportion retained over 1988 to 1992.
N.B. Above value for H.Cons+Disc. ref F is value for both catch categories combined.

Bycatch Fs are obtained from mean exploitation pattern over 1988 to 1992.
This is scaled to give a value for mean F (ages 0 to 4) equal to that in 1992, i.e. .111

TABLE 3.4.18; Whiting, North Sea
Catch Prediction output; North Sea whiting, status quo

	Year							
	1993				1994			
Biomass at start of Year								
Total	534	501	501	501	501	501	501	501
Spawning	265	315	315	315	315	315	315	315
Mean F Ages								
H.Cons 2 to 6	.85	.00	.17	.34	.51	.68	.85	1.02
Ind BC 0 to 4	.11	.11	.11	.11	.11	.11	.11	.11
Effort relative to 1992								
H.Cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight ('000t)								
H.Cons	46	0	14	26	37	46	55	63
Disc.	47	0	11	22	32	41	50	58
Ind BC	44	50	48	47	46	45	44	43
Total Catch	137	50	73	95	114	132	149	164
Total Landings	90	50	62	73	82	91	99	106
Biomass at start of 1995								
Total		567	545	524	506	489	473	459
Spawning		381	359	339	321	304	289	276

Stock at start of and catch during 1993

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
0	33437000	0	71649	406012	477661
1	3728000	11126	173567	235873	420566
2	1062000	68825	133479	122356	324660
3	207300	43841	31297	17486	92624
4	68300	25404	8609	3882	37894
5	50400	26217	5862	2120	34200
6	3300	1883	106	187	2175
7	2000	1107	174	95	1376
8	700	566	15	30	611
9	0	0	0	0	0
10	0	0	0	0	0
Wt.	534131	46306	46717	43524	136548

Stock at start of and catch during 1994
For F(1994) = F(1992)

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
0	33860001	0	72556	411148	483704
1	2508445	7486	116787	158711	282985
2	1193478	77346	150004	137504	364854
3	424499	89776	64089	35807	189671
4	70328	26158	8864	3997	39019
5	18876	9819	2196	794	12809
6	9964	5685	320	563	6568
7	705	390	61	34	485
8	421	341	9	18	368
9	42	31	0	0	31
10	0	0	0	0	0
Wt.	501500	55124	49890	43814	148828

(Numbers in thousands, weights in tonnes.)

Table 3.4.19. Whiting catch prediction - linear analysis

Input values

Name	Value	CV	Name	Value	CV
Population at age in 1993			Fishing mortality pattern		
			Human consumption		
PLN0	33437000	0.38	SHC0	0.0001	0.82
PLN1	3728000	0.29	SHC1	0.005	0.29
PLN2	1062000	0.21	SHC2	0.099	0.13
PLN3	207300	0.2	SHC3	0.346	0.17
PLN4	68300	0.17	SHC4	0.661	0.16
PLN5	50400	0.17	SHC5	1.051	0.27
PLN6	12300	0.24	SHC6	1.12	0.22
Natural mortality pattern			Discards		
m0	2.55	0.1	SHD0	0.006	1
m1	0.95	0.1	SHD1	0.078	0.16
m2	0.45	0.1	SHD2	0.192	0.16
m3	0.35	0.1	SHD3	0.247	0.11
m4	0.3	0.1	SHD4	0.224	0.29
m5	0.25	0.1	SHD5	0.235	0.81
m6	0.25	0.1	SHD6	0.063	1
			Indust. bycatch		
Natural mortality multipliers			SIN0	0.034	0.74
k93	1	0.1	SIN1	0.106	0.16
k94	1	0.1	SIN2	0.176	0.16
k95	1	0.1	SIN3	0.138	0.19
			SIN4	0.101	0.54
Recruitment			SIN5	0.085	0.95
R94	33860000	0.4	SIN6	0.111	1
R95	33860000	0.4			
Effort multipliers			Effort multipliers		
Human consumption fish.			Industrial fishery		
fh93	1	0.1	fi93	1	0.1
fh94	1	0.1	fi94	1	0.1
fh95	1	0.1	fi95	1	0.1

Table 3.5.1 Nominal catch (in tonnes) of saithe in Sub-area IV and Division IIIa, 1981-1991, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
Belgium	4	7	32	31	16	4	60	13	23	29	70
Denmark	10,114	10,530	8,526	9,033	10,343	7,928	6,868	6,550	5,800	6,314	4,669
Faroe Islands	746	806	-	895	224	691	276	739	1,650	671[1]	2,430
France	47,064	38,782	43,592	42,200	43,958	38,356	28,913	30,761[1,2]	29,892[1,2]	14,795[1,2]	8,869[2]
Germany	13,517	13,649	25,262	22,551	22,277	22,400	18,528	14,339	15,006	19,574	13,177
Netherlands	36	89	181	233	134	334	345	257	207[1]	190[1]	180
Norway	72,669	81,330	88,420	101,808	67,341	66,400	40,021	24,737	19,122	34,938[1]	50,065
Poland	793	415	413	-	495	832	1,016	809	1,244	1,336	1,238
Sweden	372	548	522	1,764	1,987	1,732	2,064	797	838	1,514	3,302
UK (Engl.& Wales)	5,627	6,845	8,183	5,455	4,480	3,233	3,790	4,441	3,654	4,709[1]	3,158
UK (N. Ireland)	-	-	-	-	-	-	-	24	-	-	-
UK (Scotland)	8,136	6,321	6,970	9,932	15,520	11,911	10,850	8,26	7,383	3,471[1]	6,763
USSR	-	-	-	-	-	-	-	-	-	116	-
Total reported to ICES	159,078	159,322	182,101	193,902	166,775	153,821	112,731	92,193	84,819	92,148	93,921
Unreported landings	6,899	9,562	15,900	5,839	-2,459	-4,627	-7,630	-200	3,256	6,659	-1,829
Landings as used by W G	165,977	168,884	198,001	199,741	164,297	149,194	105,101	91,993	88,075	98,807	92,092

[1]Preliminary.
[2]Includes IIa(EC), IIIa-d(EC).
n/a = not available.

Table 3.4.20 Whiting, North Sea

Assessment Quality Control Diagram 1

Average F(2-6,u)						
Date of assessment	Year					
	1987	1988	1989	1990	1991	1992
1989	1.17	0.81				
1990	1.07	0.78	0.69			
1991	1.10	0.82	0.81	0.77		
1992	1.10	0.82	0.79	0.87	0.96	
1993	1.10	0.82	0.78	0.78	0.70	0.85

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F							
Date of assessment	Year						
	1988	1989	1990	1991	1992	1993	1994
1989	100	138	140				
1990		83	151	152			
1991			96	139	135		
1992				84	106	108	
1993				88	94	90	99
				SQC[1]	SQC[2]	Current	Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2) - F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y), F(y-1) and F(y-2) are as estimated in the assessment made in year (y+1).

Remarks:

Continued

Table 3.4.20 Continued

Assessment Quality Control Diagram 3

Recruitment (age 0) Unit: Millions						
Date of assessment	Year class					
	1987	1988	1989	1990	1991	1992
1989	39219	70480				
1990	50113	72010	48155			
1991	28474	64780	44169	65840		
1992	26333	46065	38134	45240	43856	
1993	28386	52593	23286	20814	48623	49573

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	265	325	391[1]	354[1]				
1990	283	365	474	444[1]	375[1]			
1991	273	269	351	400	422[1]	347[1]		
1992	267	243	264	291	305	308[1]	286[1]	
1993	279	261	286	228	209	265	315[1]	289[1]

[1]Forecast.

Remarks:

TABLE 3.5.2; Saithe, North Sea
Annual weight and numbers caught, 1970 to 1992.

Year	Weight (1000 tonnes) Total	H.Cons	Disc.	Ind BC	Numbers (millions) Total	H.Cons	Disc.	Ind BC
1970	222	163	0	59	142	95	0	47
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
1991	99	98	0	1	96	95	0	1
1992	92	92	0	0	70	70	0	0

TABLE 3.5.3 ; Saithe, North Sea
International catch at age ('000), Total , 1970 to 1992.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	234	594	379	4416	3947	312	235	2015	1215	907
2	2228	10773	20189	31275	16150	71766	31335	12891	16503	16787
3	34392	68424	40162	47388	61201	50672	199669	22890	30972	14504
4	74326	53348	62290	32955	31387	23406	50339	52270	24935	13022
5	13194	30846	23108	24967	12123	9005	9902	13082	16771	10031
6	11529	3650	20779	15228	20080	6706	5137	4753	2616	7991
7	3654	3783	3363	7998	13734	12650	3317	3218	849	2437
8	1596	2481	2790	1689	4308	8650	4845	3062	790	577
9	278	1574	1550	1165	988	3304	3003	3522	607	349
10+	144	536	1445	1927	1094	2347	2128	3780	2165	1333

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	1276	5309	1932	270	59	214	104	780	11	4186
2	23095	18195	28263	32798	34455	6622	6078	28876	4887	9119
3	14159	22267	27405	23363	75449	124122	47110	29029	27388	14375
4	11399	6362	38946	17980	29769	54405	85116	90577	23173	25767
5	8338	6151	7934	25161	12081	13039	12197	12429	32280	11554
6	6086	3265	5410	4903	12330	4045	4269	1942	2910	9826
7	5189	2994	1761	4380	1357	2524	1592	1120	1132	1267
8	956	3173	1210	1333	1113	461	1044	813	452	536
9	418	504	846	929	279	267	265	689	492	293
10+	1486	1863	794	819	487	254	487	498	394	318

Age	1990	1991	1992
1	291	364	294
2	3399	12383	5486
3	30502	44340	16361
4	13685	27281	30422
5	9135	6478	11850
6	3726	2969	2827
7	2095	1304	1401
8	490	726	626
9	146	283	459
10+	184	205	311

TABLE 3.5.4 ; Saithe, North Sea
International mean weight at age (kg), Total , 1970 to 1992.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.434	.495	.304	.154	.268	.198	.461	.429	.353	.434
2	.697	.609	.510	.392	.494	.494	.501	.416	.520	.389
3	.931	.838	.743	.780	.849	.887	.690	.753	.781	1.080
4	1.442	1.357	1.158	1.407	1.556	1.497	1.302	1.251	1.294	1.590
5	2.073	2.203	1.897	1.575	2.489	2.478	2.175	1.900	2.120	2.219
6	2.708	3.007	2.364	2.543	2.729	3.275	3.036	3.097	3.210	3.071
7	3.598	3.804	3.869	3.339	3.353	3.684	4.007	4.146	4.466	3.966
8	4.420	4.635	4.184	4.657	4.386	4.190	4.325	4.551	4.784	5.128
9	5.615	5.168	4.543	4.502	5.538	5.481	4.981	4.779	5.309	5.947
10+	6.659	5.691	6.120	6.046	7.525	7.419	6.768	6.257	6.748	7.170

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.253	.274	.249	.418	.181	.142	.481	.360	.429	.426
2	.411	.585	.498	.455	.482	.481	.481	.387	.547	.684
3	.905	.937	1.087	.982	.772	.649	.648	.641	.699	.832
4	1.812	1.859	1.566	1.701	1.600	1.244	1.000	.838	.902	.982
5	2.370	2.694	2.497	2.118	2.270	1.889	1.674	1.770	1.326	1.377
6	2.975	3.529	3.144	3.058	2.645	2.603	2.294	2.921	2.644	1.905
7	4.047	4.470	3.958	3.533	3.715	3.141	3.559	3.782	3.685	3.885
8	5.044	5.424	4.908	4.432	4.524	4.521	4.245	4.902	4.654	4.879
9	5.812	6.907	5.606	5.336	5.897	5.094	5.779	5.491	5.681	6.350
10+	7.322	8.349	7.748	6.948	7.720	7.218	7.900	7.040	7.144	8.432

Age	1990	1991	1992
1	.216	.441	.623
2	.607	.499	.570
3	.785	.757	.936
4	1.154	1.120	1.163
5	1.540	1.711	1.567
6	2.193	2.352	2.177
7	3.195	3.163	3.621
8	4.621	4.124	4.248
9	6.051	5.903	5.291
10+	8.209	7.211	6.071

Table 3.5.5 Saithe in the North Sea; 20 years of effort data.

102
FRATRB
1978 1992
1 1 .00 1.00
2 14

69739.000	248.000	1853.000	3183.000	5447.000	762.000	190.000	154.000	122.000	163.000	152.000
89974.000	230.000	4525.000	3618.000	4128.000	2809.000	329.000	87.000	51.000	84.000	87.000
63577.000	528.000	3149.000	4450.000	2322.000	1412.000	746.000	104.000	45.000	29.000	63.000
76517.000	4538.000	9067.000	2893.000	2423.000	939.000	456.000	258.000	36.000	48.000	43.000
78523.000	1285.000	6001.000	10009.000	2630.000	1328.000	543.000	164.000	98.000	21.000	22.000
69720.000	799.000	3487.000	5770.000	8617.000	1183.000	270.000	86.000	37.000	29.000	10.000
76149.000	1311.000	5482.000	8632.000	5121.000	3837.000	232.000	155.000	33.000	49.000	24.000
53003.000	810.000	8447.000	10230.000	3677.000	1194.000	596.000	33.000	40.000	18.000	13.000
50350.000	721.000	4648.000	12454.000	3291.000	1124.000	291.000	213.000	33.000	15.000	14.000
51234.000	873.000	2062.000	11802.000	3537.000	566.000	268.000	104.000	76.000	20.000	18.000
35482.000	451.000	2038.000	2263.000	7860.000	723.000	178.000	54.000	33.000	37.000	10.000
36133.000	553.077	3197.885	5199.979	2726.086	2846.718	143.775	37.077	13.706	11.566	8.199
36097.000	475.076	4783.261	4360.992	2555.746	525.267	495.450	67.964	31.461	16.020	11.603
45075.000	458.002	2493.662	5483.608	1560.596	673.786	230.058	136.771	26.868	13.350	8.251
34138.000	385.622	1302.925	3058.332	1080.604	153.874	57.665	24.037	18.272	5.552	1.943

NORTRL
1980 1992
1 1 .00 1.00
3 10

18317.000	186.000	1290.000	658.000	980.000	797.000	261.000	60.000	82.000
28229.000	88.000	844.000	1345.000	492.000	670.000	699.000	119.000	64.000
47412.000	6624.000	12016.000	2737.000	2112.000	341.000	234.000	19.000	77.000
43099.000	4401.000	4963.000	8176.000	1950.000	2367.000	481.000	357.000	84.000
47803.000	20576.000	7328.000	2207.000	3358.000	433.000	444.000	106.000	51.000
66607.000	27088.000	21401.000	5307.000	1569.000	637.000	56.000	46.000	4.000
57468.000	5297.000	29612.000	3589.000	818.000	393.000	122.000	25.000	33.000
30008.000	2645.000	18454.000	2217.000	290.000	235.000	201.000	198.000	64.000
18402.000	3132.000	2042.000	2214.000	141.000	157.000	74.000	134.000	43.000
17781.000	649.000	2126.000	835.000	694.000	309.000	154.000	65.000	7.000
10249.000	804.000	781.000	924.000	519.000	203.000	63.000	12.000	3.000
28768.000	14348.000	4968.000	1194.000	518.000	203.000	51.000	56.000	1.000
35440.000	3296.000	9342.000	4018.000	1085.000	452.000	162.000	106.000	5.000

Table3.5.6 SAITHE in Sub-area IV. Tuning results

Extended Survivors Analysis
Saithe in the North Sea; 1960-1992.
CPUE data from file c:\ices\nsdem93\sai20ef.dat

Data for 2 fleets over 33 years
Age range from 1 to 9

Fleet,	Alpha,	Beta
FRATRB	, .000	, 1.000
NORTRL	, .000	, 1.000

Time series weights :
Tapered time weighting applied
Power = 3 over 20 years
Catchability analysis :
Catchability dependent on stock size for ages < 2
Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 2
Catchability independent of age for ages >= 4
Terminal population estimation :
Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.
S.E. of the mean to which the estimates are shrunk = .500
Minimum standard error for population
estimates derived from each fleet = .300
Prior weighting not applied
Tuning converged after 15 iterations

Fleet disaggregated estimates of survivors :

Age 1 Catchability dependent on age and year class strength
Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	1.	.000	.000	.00	0	.000	.000
NORTRL	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	144880.	.54				.463	.002
F shrinkage mean	32712.	.50				.537	.008

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
65125.	.37	11.11	2	30.310	.004

Age 2 Catchability constant w.r.t. time, dependent on age
Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	90766.	.723	.000	.00	1	.324	.053
NORTRL	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	39778.	.50				.676	.118

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
51949.	.41	.68	2	1.650	.091

Age 3 Catchability constant w.r.t. time, dependent on age
Year class = 1989

FRATRB

Age	3,	2,	1,
Estimated Survivors	34720.,	45022.,	0.,
Raw Weights	3.115,	1.241,	.000,

NORTRL

Age	3,	2,	1,
Estimated Survivors	58973.,	0.,	0.,
Raw Weights	.414,	.000,	.000,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	37388.	.479	.117	.24	2	.497	.334
NORTRL	58973.	1.554	.000	.00	1	.047	.224
F shrinkage mean	30588.	.50				.456	.395

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
34859.	.34	.12	4	.351	.354

Continued

Table 3.5.6 continued

Age 4 Catchability constant w.r.t. time, dependent on age
Year class = 1988

FRATRB

Age	4,	3,	2,	1,
Estimated Survivors	20536.,	18593.,	21979.,	0.,
Raw Weights	2.204,	1.328,	.611,	.000,

NORTRL

Age	4,	3,	2,	1,
Estimated Survivors	39342.,	116842.,	0.,	0.,
Raw Weights	1.825,	.176,	.000,	.000,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	20092.	.491	.041	.08	3	.408	.863
NORTRL	43305.	.707	.309	.44	2	.197	.492
F shrinkage mean	25769.	.50				.394	.727

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
25789.	.31	.14	6	.447	.726

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1987

FRATRB

Age	5,	4,	3,	2,	1,
Estimated Survivors	7605.,	12598.,	22317.,	13190.,	0.,
Raw Weights	1.299,	1.262,	.856,	.374,	.000,

NORTRL

Age	5,	4,	3,	2,	1,
Estimated Survivors	17734.,	11644.,	9209.,	0.,	0.,
Raw Weights	3.833,	1.045,	.114,	.000,	.000,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	12112.	.514	.231	.45	4	.297	.634
NORTRL	15998.	.448	.135	.30	3	.391	.513
F shrinkage mean	7983.	.50				.313	.851

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11851.	.28	.16	8	.570	.644

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1986

FRATRB

Age	6,	5,	4,	3,	2,	1,
Estimated Survivors	1078.,	3557.,	5485.,	6770.,	5039.,	0.,
Raw Weights	1.507,	.679,	.686,	.478,	.207,	.000,

NORTRL

Age	6,	5,	4,	3,	2,	1,
Estimated Survivors	4769.,	2776.,	2253.,	1946.,	0.,	0.,
Raw Weights	1.678,	2.004,	.568,	.064,	.000,	.000,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	2595.	.530	.388	.73	5	.300	.686
NORTRL	3316.	.481	.173	.36	4	.363	.572
F shrinkage mean	2457.	.50				.337	.713

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2785.	.29	.16	10	.557	.652

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1985

FRATRB

Age	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	406.,	1585.,	3080.,	2341.,	1393.,	1899.,	0.,
Raw Weights	1.230,	.834,	.333,	.273,	.177,	.064,	.000,

NORTRL

Age	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	1997.,	1243.,	2553.,	1266.,	2878.,	0.,	0.,
Raw Weights	1.593,	.929,	.983,	.226,	.024,	.000,	.000,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	994.	.586	.356	.61	6	.273	.822
NORTRL	1847.	.516	.140	.27	5	.352	.523
F shrinkage mean	1402.	.50				.375	.644

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1406.	.31	.15	12	.501	.643

Continued

Table 3.5.6 continued

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1984

FRATRB

Age	8,	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	166.,	517.,	613.,	1178.,	391.,	389.,	700.,	0.,
Raw Weights	.708,	.641,	.382,	.140,	.132,	.084,	.036,	.000,

NORTRL

Age	8,	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	700.,	465.,	1388.,	477.,	443.,	594.,	0.,	0.,
Raw Weights	.586,	.830,	.425,	.414,	.109,	.011,	.000,	.000,

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	376.	.686	.255	.37	7	.250	.919
NORTRL	628.	.649	.182	.28	6	.279	.643
F shrinkage mean	694.	.50				.471	.597

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
579.	.34	.13	14	.391	.682

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1983

FRATRB

Age	9,	8,	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	122.,	306.,	621.,	1191.,	979.,	323.,	203.,	187.,	0.,
Raw Weights	.561,	.399,	.340,	.145,	.045,	.033,	.024,	.011,	.000,

NORTRL

Age	9,	8,	7,	6,	5,	4,	3,	2,	1,
Estimated Survivors	443.,	117.,	583.,	384.,	346.,	562.,	141.,	0.,	[illegible]
Raw Weights	.529,	.330,	.441,	.162,	.131,	.027,	.003,	.000,	[illegible]

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FRATRB	298.	.801	.300	.37	8	.217	.872
NORTRL	352.	.785	.238	.30	7	.226	.779
F shrinkage mean	430.	.50				.557	.676

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
380.	.37	.13	16	.353	.739

TABLE 3.5.7; Saithe, North Sea
International F at age, Total , 1970 to 1992.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.001	.003	.002	.018	.007	.002	.002	.018	.013	.004
2	.007	.065	.128	.194	.086	.164	.241	.133	.198	.250
3	.157	.280	.364	.499	.716	.419	.935	.278	.539	.268
4	.506	.388	.445	.579	.740	.670	.997	.682	.558	.457
5	.549	.407	.289	.321	.434	.485	.680	.783	.484	.457
6	.569	.284	.532	.314	.464	.458	.571	.846	.343	.449
7	.328	.367	.462	.401	.522	.606	.432	.889	.343	.626
8	.228	.389	.511	.447	.393	.749	.494	.939	.561	.414
9	.440	.370	.451	.415	.515	.599	.641	.837	.474	.522
10+	.440	.370	.451	.415	.515	.599	.641	.837	.474	.522

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.009	.030	.007	.001	.000	.002	.001	.009	.000	.023
2	.125	.164	.223	.148	.104	.023	.055	.247	.075	.071
3	.347	.170	.398	.292	.593	.656	.226	.402	.392	.327
4	.349	.258	.504	.496	.748	1.247	1.496	.901	.659	.801
5	.603	.322	.595	.727	.749	.905	1.137	.962	1.013	.838
6	.560	.504	.524	.951	1.022	.609	.888	.530	.620	1.056
7	.597	.600	.565	1.142	.770	.588	.516	.613	.688	.610
8	.540	.942	.521	1.211	1.084	.656	.518	.546	.540	.851
9	.606	.618	.714	1.026	.923	.853	1.048	.792	.770	.837
10+	.606	.618	.714	1.026	.923	.853	1.048	.792	.770	.837

Age	1990	1991	1992
1	.003	.005	.004
2	.024	.169	.091
3	.359	.480	.354
4	.598	.639	.726
5	.759	.641	.644
6	.728	.600	.651
7	.669	.612	.643
8	.506	.517	.682
9	.591	.623	.739
10+	.591	.623	.739

TABLE 3.5.8 ; Saithe, North Sea
Tuned Stock Numbers at age (10**-3), 1970 to 1993, (numbers in 1993 are VPA survivors)

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	232043	226872	240043	270840	643291	197886	140236	126364	103676	267076
2	380819	189769	185209	196187	217749	523111	161733	114602	101634	83784
3	261850	309772	145622	133369	132326	163665	363350	104063	82164	68279
4	206776	183265	191707	82885	66315	52962	88147	116818	64488	39246
5	34495	102040	101773	100594	38041	25894	22183	26620	48346	30236
6	29352	16303	55633	62416	59768	20177	13052	9202	9958	24408
7	14424	13599	10045	26747	37322	30765	10451	6038	3233	5786
8	8642	8503	7711	5181	14661	18130	13742	5555	2032	1879
9	862	5631	4717	3788	2713	8106	7017	6867	1778	949
10+	445	1902	4358	6214	2975	5692	4912	7257	6277	3586

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	163724	196346	324542	472343	393741	153039	178369	92391	178909	200976
2	217843	132891	155951	263964	386477	322314	125104	145942	74937	146469
3	53407	157457	92339	102109	186439	285244	257897	96927	93359	56932
4	42778	30914	108767	50804	62459	84374	121228	168521	53090	51654
5	20349	24710	19554	53811	25326	24201	19852	22237	56016	22498
6	15678	9116	14665	8831	21291	9803	8016	5216	6960	16653
7	12753	7329	4509	7111	2794	6275	4366	2701	2514	3066
8	2532	5746	3292	2098	1859	1060	2853	2134	1198	1034
9	1017	1208	1834	1600	512	515	450	1391	1012	571
10+	3570	4415	1698	1385	878	482	813	991	799	611

Age	1990	1991	1992	1993
1	107531	85306	79869	0
2	160757	87776	69514	65125
3	111667	128541	60660	51949
4	33604	63826	65121	34859
5	18976	15130	27572	25789
6	7965	7271	6526	11851
7	4744	3150	3267	2785
8	1364	1989	1399	1406
9	361	673	971	579
10+	452	483	649	634

Table 3.5.9. Norwegian 0-group indices for SAITHE

YEAR	OBSERV.	VPA	CRUISE
1981	5.4	325	
1982	7.6	472	
1983	5.0	394	
1984	4.6	153	
1985	5.3	178	
1986	2.3	92	20
1987	5.1	179	61
1988	4.3	201	
1989	3.9	108	
1990	6.0		89
1991	7.3		63
1992	5.1		132
1993	5.0		

TABLE 3.5.10 Saithe, North Sea
Mean fishing mortality, biomass and recruitment, 1970 - 1992.

Year	Mean Fishing Mortality H.Cons Ages 3 to 6	Disc. Ages 3 to 6	Ind BC Ages 2 to 5	Stock Biomass ('000 tonnes) Total	Spawning	Recruits Age 1 Yclass	Million
1970	.374	.000	.071	1157	264	1969	232
1971	.296	.000	.045	1141	370	1970	227
1972	.365	.000	.044	941	406	1971	240
1973	.332	.000	.097	824	439	1972	271
1974	.431	.000	.162	980	455	1973	643
1975	.407	.000	.111	928	392	1974	198
1976	.694	.000	.122	769	256	1975	140
1977	.632	.000	.014	534	212	1976	126
1978	.472	.000	.008	447	189	1977	104
1979	.399	.000	.008	491	188	1978	267
1980	.463	.000	.002	448	184	1979	164
1981	.310	.000	.004	544	193	1980	196
1982	.488	.000	.017	582	159	1981	325
1983	.610	.000	.006	698	170	1982	472
1984	.757	.000	.021	644	135	1983	394
1985	.816	.000	.038	569	101	1984	153
1986	.932	.000	.005	523	95	1985	178
1987	.676	.000	.023	383	98	1986	92
1988	.666	.000	.004	350	102	1987	179
1989	.730	.000	.023	372	84	1988	201
1990	.586	.000	.025	321	69	1989	108
1991	.585	.000	.006	319	70	1990	
1992	.593	.000	.001	306	81	1991	

Arithmetic mean recruits at age 1 for the period 1970 to 1992 : 221
Geometric mean recruits at age 1 for the period 1970 to 1992 : 191

Table 3.5.11. Input for catch prediction of SAITHE in Sub-area IV

Stock Data for 1993

Age	Stock N	Stock W.	M	Mat
1	190550	0.427	0.2	0
2	154990	0.582	0.2	0
3	117320	0.802	0.2	0.15
4	34859	1.064	0.2	0.7
5	25789	1.504	0.2	0.9
6	11851	2.254	0.2	1
7	2785	3.51	0.2	1
8	1406	4.505	0.2	1
9	579	5.855	0.2	1
10+	634	7.413	0.2	1
Units	Thousand	Kg		

Catch Data

	H.cons		Disc.		Ind. BC	
Age	F.Ref	W.Cat	F.Ref	W.Cat	F.Ref	W.Cat
1	0.007	0.427	0	0	0	0
2	0.08	0.586	0	0	0	0.357
3	0.345	0.817	0	0	0.001	0.507
4	0.623	1.079	0	0	0.002	0.618
5	0.722	1.512	0	0	0.001	0.822
6	0.684	2.257	0	0	0	0.635
7	0.605	3.51	0	0	0	0
8	0.581	4.505	0	0	0	0
9	0.668	5.855	0	0	0	0
10+	0.668	7.413	0	0	0	0

Recruits in 1994 190550
Recruits in 1995 190550

TABLE 3.5.12 Saithe, North Sea
Catch Prediction output; Status quo

	1993	1994						
Biomass at start of Year								
Total	392	412	412	412	412	412	412	412
Spawning	81	76	76	76	76	76	76	76
Mean F Ages								
H.Cons 3 to 6	.59	.00	.12	.24	.36	.47	.59	.71
Ind BC 2 to 5	.00	.00	.00	.00	.00	.00	.00	.00
Effort relative to 1992								
H.Cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight ('000t)								
H.Cons	89	0	23	45	64	81	97	111
Disc.	0	0	0	0	0	0	0	0
Ind BC	0	0	0	0	0	0	0	0
Total Catch	89	0	24	45	64	81	97	111
Total Landings	89	0	24	45	64	81	97	111
Biomass at start of 1995								
Total		545	516	490	466	445	426	409
Spawning		156	138	122	108	96	85	75

Stock at start of and catch during 1993

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
1	190551	1205	0	0	1205
2	154922	10810	0	0	10810
3	117322	31190	0	90	31281
4	34859	14788	0	47	14835
5	25789	12158	0	17	12175
6	11851	5381	0	0	5381
7	2785	1157	0	0	1157
8	1406	567	0	0	567
9	579	259	0	0	259
10	634	283	0	0	283
Wt.	392410	89045	0	89	89134

Stock at start of and catch during 1994
For F(1994) = F(1992)

Age	Stock No.	H.Cons	Disc.	Ind BC	Total
1	190551	1205	0	0	1205
2	154922	10810	0	0	10810
3	117088	31128	0	90	31218
4	67960	28830	0	93	28922
5	15276	7202	0	10	7212
6	10247	4653	0	0	4653
7	4896	2034	0	0	2034
8	1245	502	0	0	502
9	644	288	0	0	288
10	243	109	0	0	109
Wt.	412181	96670	0	111	96781

(Numbers in thousands, weights in tonnes.)

Table 3.5.13 Saithe catch prediction -linear analysis

Input Values

Name	value	CV	Name	Value	CV
Population at age in 1993			Fishing mortality pattern		
PLN1	190551	0.7	SEL1	0.007	0.59
PLN2	154922	0.7	SEL2	0.08	0.31
PLN3	117322	0.7	SEL3	0.346	0.25
PLN4	34859	0.34	SEL4	0.625	0.2
PLN5	25789	0.31	SEL5	0.723	0.14
PLN6	11851	0.28	SEL6	0.684	0.12
PLN7	2785	0.29	SEL7	0.605	0.11
PLN8	1406	0.31	SEL8	0.581	0.12
PLN9	579	0.34	SEL9	0.668	0.12
PN10	634	0.37	SL10	0.668	0.09
Natural mortality pattern			Recruitment		
m1	0.2	0.1	R94	190551	0.7
m2	0.2	0.1	R95	190551	0.7
m3	0.2	0.1	Effort multipliers		
m4	0.2	0.1	F93	1	0.1
m5	0.2	0.1	F94	1	0.1
m6	0.2	0.1	F95	1	0.1
m7	0.2	0.1	Natural mortality multipliers		
m8	0.2	0.1	k93	1	0.1
m9	0.2	0.1	k94	1	0.1
m10	0.2	0.1	k95	1	0.1

Table 3.5.14. Values used for parametric stock-recruitment relationship
(Parameters defined in section 1.4.3)

Adjusted coefficient of determination = 0.3560

	Parameter	SD
a	1.571	0.2377
b	349.1294	153.2304
c	3.8615	4.1325

Table 3.5.15 Saithe in Sub-area IV

Assessment Quality Control Diagram 1

Average F(3-6,u)						
Date of assessment	Year					
	1987	1988	1989	1990	1991	1992
1989	0.46	0.40				
1990	0.62	0.51	0.39			
1991	0.69	0.65	0.72	0.64		
1992	0.68	0.67	0.75	0.65	0.73	
1993	0.68	0.67	0.73	0.59	0.59	0.59

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F							
Date of assessment	Year						
	1988	1989	1990	1991	1992	1993	1994
1989	109	118	120				
1990	162	94	116	125			
1991		102	95	91	102		
1992			96	90	123	121	
1993				99	92	89	97
				\ SQC[1]	\ SQC[2]	\ Current	\ Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2) - F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y), F(y−1) and F(y−2) are as estimated in the assessment made in year (y+1).

Remarks:

Continued

Table 3.5.15 Continued

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: Millions						
Date of assessment	Year class					
	1987	1988	1989	1990	1991	1992
1989	166	237				
1990	235[1]	230[1]	232[1]			
1991	187	212[1]	211[1]	211[1]		
1992	168	308	214[1]	214[1]	214[1]	
1993	179	201	108	191[1]	191[1]	191[1]

[1]Geometric average recruitment.

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	186	236	244[1]	240[1]				
1990	125	122	166	206[1]	233[1]			
1991	106	87	74	70	79[1]	85[1]		
1992	102	82	66	56	68	83[1]	79[1]	
1993	102	84	69	70	81	81	76[1]	85[1]

[1]Forecast.

Remarks:

Table 3.6.1 Nominal catch (tonnes) of SOLE in Sub-area IV and landings as estimated by the Working Group, 1982-1992

Year	Belgium	Denmark	France	Germany Fed. Rep.	Netherlands	UK (Engl. & Wales)	Other countries	Total reported	Unreported landings	Grand Total
1982	1,927	522	686	290	17,749	403		21,577	2	21,579
1983	1,740	730	332	619	16,101	435		19,957	4,970	24,927
1984	1,771	818	400	1,034	14,330	586	1	18,940	7,899	26,839
1985	2,390	692	875	303	14,897	774	3	19,934	4,313	24,247
1986	1,833	443	296	155	9,558	647	2	12,934	5,267	18,201
1987	1,644	342	318	210	10,635	676	4	13,829	3,539	17,368
1988	1,199	616	487	452	9,841	740	28	13,363	8,227	21,590
1989	1,596	1,020	312	864	9,620	966	65	14,443	7,378	21,821
1990	2,389	1,428	352	2,296		1,484	276	8,225	26,908	35,133
1991	2,977	1,307	465	2,107	18,771	1,605	361	27,593	10,749	38,342
1992	2,058	1,358	538	1,880	18,601	1,221	88	25,744	3,372	29,116

all landings reported to ICES
unreported landings estimated by the Working Group
1992 data are provisional
No data on discards available

Table 3.6.2

At 9/10/1993 9:46

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	389,	191,	165,	373,	92,	10,	115,	837,	125,	961,
2,	34408,	30734,	16618,	9351,	29208,	13187,	46140,	12023,	14658,	6821,
3,	41386,	43931,	43213,	18494,	21703,	47140,	18211,	103898,	28892,	44089,
4,	21189,	22554,	20286,	17703,	9210,	15248,	22583,	9779,	89536,	16082,
5,	624,	8791,	9403,	7745,	6623,	4400,	4700,	9360,	7592,	37458,
6,	1378,	741,	3556,	5522,	3133,	3890,	1695,	3824,	4262,	2453,
7,	1950,	854,	209,	2272,	1527,	1554,	1455,	1164,	1958,	3039,
8,	978,	1043,	379,	110,	892,	898,	655,	1273,	820,	784,
9,	386,	524,	637,	282,	94,	526,	467,	604,	819,	424,
10,	301,	242,	200,	620,	114,	38,	240,	268,	356,	474,
11,	423,	209,	192,	355,	176,	34,	45,	324,	347,	174,
12,	31,	146,	189,	173,	142,	86,	36,	59,	421,	240,
13,	14,	30,	94,	126,	69,	42,	49,	28,	19,	142,
14,	177,	24,	33,	105,	56,	10,	27,	63,	17,	7,
+gp,	230,	243,	267,	305,	167,	111,	95,	215,	177,	253,
TOTALNUM,	103864,	110257,	95441,	63536,	73206,	87174,	96511,	143719,	149999,	113399,
TONSLAND,	24927,	26839,	24248,	18200,	17367,	21590,	21821,	35133,	38342,	29116,
SOPCOF %,	100,	100,	99,	99,	99,	100,	99,	99,	99,	98,

Run title : North Sea Sole, sexes combined *** reduced data set *** RSOLIND.DAT

At 9/10/1993 9:46

Table 3.6.3

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	.1340,	.1530,	.1220,	.1350,	.1390,	.1270,	.1180,	.1240,	.1280,	.1460,
2,	.1820,	.1710,	.1870,	.1790,	.1860,	.1750,	.1730,	.1820,	.1860,	.1770,
3,	.2170,	.2210,	.2160,	.2130,	.2050,	.2170,	.2160,	.2260,	.2090,	.2130,
4,	.3010,	.2860,	.2880,	.2990,	.2710,	.2700,	.2880,	.2900,	.2620,	.2590,
5,	.3890,	.3610,	.3570,	.3570,	.3530,	.3530,	.3350,	.3680,	.3140,	.2990,
6,	.4160,	.3860,	.4270,	.4070,	.3740,	.4280,	.3740,	.3900,	.4300,	.3800,
7,	.4670,	.4650,	.4470,	.4850,	.4280,	.4830,	.4560,	.4010,	.4360,	.4100,
8,	.4890,	.5550,	.5440,	.5430,	.4800,	.5190,	.4900,	.4970,	.4610,	.4590,
9,	.5050,	.5750,	.6120,	.5680,	.3800,	.5580,	.4720,	.4570,	.5060,	.4840,
10,	.6090,	.5120,	.6340,	.5360,	.5770,	.5940,	.5090,	.5640,	.5500,	.5270,
11,	.6220,	.6550,	.5090,	.5750,	.6370,	.8070,	.6810,	.6220,	.5230,	.5900,
12,	.6000,	.6310,	.6560,	.6330,	.6120,	.7140,	.6300,	.5170,	.5130,	.4710,
13,	.3340,	.7220,	.7670,	.6310,	.6590,	.7540,	.7110,	.5710,	.8510,	.6100,
14,	.6310,	.8450,	.8010,	.7880,	.7260,	.7710,	.6360,	.4610,	.7690,	.7760,
+gp,	.7560,	.7070,	.6800,	.7150,	.6980,	.6940,	.7290,	.6300,	.5570,	.6390,
SOPCOFAC,	1.0040,	1.0034,	.9898,	.9936,	.9932,	.9990,	.9855,	.9901,	.9876,	.9848,

Run title : North Sea Sole, sexes combined *** reduced data set *** RSOLIND.DAT

At 9/10/1993 9:46

Table 3.6.4

Table 3 Stock weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,
2,	.1400,	.1330,	.1270,	.1330,	.1540,	.1330,	.1330,	.1480,	.1380,	.1560,
3,	.2000,	.2030,	.1850,	.1910,	.1920,	.1930,	.1950,	.2030,	.1830,	.1950,
4,	.2850,	.2680,	.2670,	.2780,	.2590,	.2600,	.2900,	.2920,	.2520,	.2590,
5,	.3290,	.3480,	.3240,	.3440,	.3490,	.3350,	.3480,	.3560,	.2980,	.3080,
6,	.4350,	.3860,	.3810,	.4230,	.3810,	.4080,	.3390,	.4380,	.4060,	.3990,
7,	.4640,	.4880,	.3800,	.4940,	.4050,	.4170,	.4100,	.3910,	.4330,	.4060,
8,	.4830,	.5910,	.6260,	.4870,	.4570,	.4720,	.4750,	.4860,	.5010,	.4700,
9,	.5100,	.5670,	.5540,	.5870,	.3080,	.4850,	.4180,	.4710,	.5420,	.4950,
10,	.5830,	.5590,	.5890,	.5460,	.5120,	.4550,	.4620,	.4960,	.5370,	.5440,
11,	.6010,	.6320,	.5170,	.6810,	.6240,	.8290,	.7040,	.6820,	.5110,	.4880,
12,	.7210,	.7310,	.7340,	.6450,	.5800,	.6550,	.7870,	.5500,	.5510,	.4420,
13,	.7410,	.8730,	.7400,	.7370,	.5720,	.5350,	.7160,	.7890,	.4300,	.5780,
14,	.6800,	.9520,	.6420,	.9390,	.6900,	.8470,	.6160,	.4580,	1.1090,	.6720,
+gp,	.7190,	.7000,	.6730,	.8870,	.6810,	.6870,	.7300,	.7490,	.6500,	.6280,

Table 3.6.5

```
NS SOLE Tuning data  <<NETH>> <<TRI>> <<GER>>  VBEEK (7/10/93) RSOLEF.DAT
103
>>NETHERLANDS ALL FLEETS<<
79, 92
1, 1, 0, 1
1, 15
44.9,   9.99,  7721.2, 35400.6, 12904.4,  2096.5, 2657.4, 1490.0,  641.6, 177.2, 323.3, 104.9,  85.5,  77.0,  53.7, 476.1
45.0,  462.1,   938.3, 11061.0, 14294.5,  4914.8,  938.1, 1731.7, 1133.1, 214.3,  17.0, 347.8,  16.5,  32.5,  23.7, 432.2
46.3,  391.2, 26036.0,  2756.0,  5720.5,  6094.5, 2265.5,  586.6,  531.3, 439.4 , 98.9,  15.3, 102.4,  56.9,   4.4, 173.2
57.3, 2572.0, 24290.1, 38683.0,  1085.1,  2638.3, 3214.2,  961.1,  234.8, 352.9, 287.6,  80.2,  41.7, 157.3,   7.9, 141.1
65.6,  381.0, 31274.7, 36706.2, 16386.3,   375.1,  768.9, 1117.8,  531.2, 237.5, 168.1, 338.6,  15.0,   2.0, 157.6, 143.2
70.7,  186.7, 26976.3, 37398.3, 18212.1,  6529.0,  301.2,  492.0,  633.5, 321.8, 123.7, 130.9,  90.3,   6.4,  14.5, 155.4
70.3,  126.2, 12923.7, 34685.4, 16979.4,  7239.6, 2536.8,  146.5,  285.1, 426.8,  84.9,  68.7, 113.3,  61.9,   9.1, 134.5
68.1,  354.6,  8027.0, 13755.0, 13809.8,  6353.7, 4342.4, 1712.2,   71.8, 223.4, 405.6, 211.1, 124.6,  73.4,  88.5, 247.6
68.4,   73.7, 23918.9, 18282.7,  7081.1,  5313.1, 2608.3, 1095.7,  566.4,  57.0,  78.0,  79.7,  80.1,  36.4,  32.0, 123.4
76.3,   9.99, 12191.9, 40595.2, 12448.9,  2982.9, 2955.6, 1274.8,  652.4, 384.5,  30.4,  25.4,  42.7,  26.1,   3.2,  60.9
61.6,   9.99, 40284.3, 13165.6, 17489.4,  2688.9, 1099.4, 1134.4,  409.4, 333.9, 161.6,   8.9,  22.7,  16.2,  10.0,  40.0
71.2,  119.3,  9071.1, 84629.7,  7242.0,  6586.7, 1965.0,  634.6,  819.2, 375.9, 137.6, 134.1,  42.5,  10.1,  12.6, 138.2
68.7,   48.0,  8803.9, 20618.9, 71704.8,  5568.0, 2565.1,  819.3,  374.5, 470.7, 187.9, 118.1, 216.6,   7.6,   7.2,  57.8
71.6,  833.9,  5055.0, 34088.9, 11138.4, 29622.1, 1458.1, 2063.2,  447.7, 216.0, 272.3,  74.5, 170.3,  74.4,   3.9, 107.5
tridens sns survey
70, 92
1, 1, 0, 1
1, 4
1,  4938,   745,  204,  31
1,   613,  1961,   99,   7
1,  1410,   341,  161,   0.1
1,  4686,   905,   73,  35
1,  1924,   397,   69,   0.1
1,   597,   887,  174,  44
1,  1413,    79,  187,  70
1,  3724,   762,   77,  85
1,  1552,  1379,  267,  27
1,   104,   388,  325,  60
1,  4483,    80,   99,  45
1,  3739,  1411,   51,  13
1,  5098,  1124,  231,   7
1,  2640,  1137,  107,  43
1,  2359,  1081,  307, 102
1,  2151,   709,  159,  59
1,  3791,   465,   67,  30
1,  1890,   955,   59,  15
1, 11227,   594,  284,  81
1,  3052,  5369,  248,  50
1,  2900,  1078,  907, 100
1,  1265,  2515,  527, 607
1, 11081,   114,  319, 194
ger survey
80,92
1, 1, 0, 1
2, 10
1,   3.8,  27.6,  26.1,  15.0,  1.3,  3.5,  1.8,  0.5,  0.1
1,  43.6,   2.7,   7.6,   4.6,  2.2,  0.4,  0.6,  0.5,  0.2
1,  17.1,  48.4,   1.4,   5.3,  2.9,  2.1,  0.4,  1.0,  0.4
1,  74.0,  50.0,  23.3,   0.8,  1.8,  1.1,  0.9,  0.1,  0.2
1,  13.1,  84.4,  34.4,  14.9,  0.5,  1.5,  1.5,  0.8,  0.2
1,   4.9,  32.8,  40.4,   9.0,  3.0,  0.2,  0.3,  0.2,  0.1
1,   7.1,   9.5,   8.4,   7.1,  2.3,  0.6,  0.0,  0.2,  0.1
1,  11.8,  17.3,   7.4,   3.4,  1.8,  0.5,  0.2,  0.0,  0.0
1,   4.2,  16.3,   7.9,   1.5,  1.1,  0.9,  0.2,  0.1,  0.0
1,  24.4,  24.9,  21.4,   4.6,  1.2,  1.0,  0.9,  0.2,  0.1
1,   7.0,  52.6,   7.8,   2.8,  0.8,  0.2,  0.1,  0.1,  0.0
1,   9.5,  34.1,  87.2,  10.0,  6.9,  1.1,  0.4,  0.2,  0.4
1,   1.2,  25.4,  11.0,  25.1,  3.5,  0.8,  0.7,  0.0,  0.1
```

Table 3.6.6

VPA Version 3.1 (MSDOS)

9/10/1993 9:44

Extended Survivors Analysis

North Sea Sole, sexes combined *** reduced data set *** RSOLIND.DAT

CPUE data from file RSOLEF.DAT

Data for 3 fleets over 23 years
Age range from 1 to 14

Fleet,	Alpha,	Beta
>>NETHERLANDS ALL FL	, .000	, 1.000
tridens sns survey	, .000	, 1.000
ger survey	, .000	, 1.000

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 23 iterations

Terminal year survivor and F summaries :

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	912795.	1.670	.000	.00	1	.023	.001
tridens sns survey	390115.	.300	.000	.00	1	.718	.002
ger survey	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	366702.	.50				.259	.002

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
391563.	.25	.10	3	.376	.002

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	25690.	.470	.107	.23	2	.208	.225
tridens sns survey	22841.	.290	.541	1.87	2	.546	.250
ger survey	9975.	.853	.000	.00	1	.063	.501
F shrinkage mean	34220.	.50				.184	.174

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
23924.	.21	.22	6	1.029	.240

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	38950.	.343	.242	.71	3	.372	.731
tridens sns survey	51788.	.351	.292	.83	3	.356	.593
ger survey	38047.	.675	.034	.05	2	.096	.743
F shrinkage mean	61891.	.50				.175	.517

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
46647.	.21	.13	9	.638	.641

Continued

Table 3.6.6 (cont.)

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	14545.	.302	.107	.35	4	.459	.719
tridens sns survey	28495.	.418	.240	.57	4	.239	.430
ger survey	16055.	.557	.194	.35	3	.135	.669
F shrinkage mean	18294.	.50				.167	.608

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
17992.	.20	.11	12	.552	.615

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	46460.	.287	.164	.57	5	.528	.569
tridens sns survey	55064.	.525	.139	.27	4	.158	.499
ger survey	40289.	.556	.184	.33	4	.141	.634
F shrinkage mean	50678.	.50				.174	.532

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
47487.	.21	.08	14	.396	.560

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	3713.	.264	.110	.42	6	.596	.487
tridens sns survey	4901.	.685	.182	.27	4	.088	.389
ger survey	6087.	.527	.239	.45	5	.150	.324
F shrinkage mean	3762.	.50				.166	.483

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4107.	.20	.09	16	.425	.450

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	4348.	.251	.070	.28	7	.650	.510
tridens sns survey	3538.	.914	.121	.13	4	.049	.597
ger survey	3754.	.544	.278	.51	6	.138	.571
F shrinkage mean	5139.	.50				.163	.446

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4335.	.20	.07	18	.350	.511

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	1066.	.261	.034	.13	8	.682	.530
tridens sns survey	1029.	1.230	.223	.18	4	.031	.545
ger survey	1199.	.676	.259	.38	7	.102	.484
F shrinkage mean	1521.	.50				.186	.399

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1152.	.22	.06	20	.289	.499

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	487.	.254	.026	.10	9	.725	.603
tridens sns survey	488.	1.555	.280	.18	4	.019	.603
ger survey	351.	.824	.191	.23	7	.069	.765
F shrinkage mean	890.	.50				.187	.374

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
533.	.22	.07	21	.335	.563

#

Continued

Table 3.6.6 (Cont.)

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	674.	.280	.022	.08	10	.653	.512
tridens sns survey	474.	1.820	.145	.08	4	.015	.669
ger survey	344.	.635	.159	.25	9	.127	.837
F shrinkage mean	1180.	.50				.205	.324

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
690.	.23	.09	24	.381	.503

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	306.	.313	.087	.28	10	.640	.432
tridens sns survey	346.	3.513	.135	.04	3	.005	.391
ger survey	472.	.773	.249	.32	9	.105	.300
F shrinkage mean	357.	.50				.251	.381

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
333.	.25	.07	23	.289	.403

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	205.	.374	.131	.35	10	.606	.748
tridens sns survey	177.	5.446	.504	.09	2	.003	.828
ger survey	147.	1.284	.184	.14	7	.051	.935
F shrinkage mean	248.	.50				.340	.653

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
215.	.29	.08	20	.279	.724

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	102.	.501	.134	.27	10	.468	.841
tridens sns survey	66.	8.699	.000	.00	1	.002	1.108
ger survey	57.	1.399	.272	.19	7	.060	1.208
F shrinkage mean	152.	.50				.470	.636

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
119.	.34	.11	19	.322	.759

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLANDS ALL FL	7.	.500	.140	.28	10	.494	.612
tridens sns survey	1.	.000	.000	.00	0	.000	.000
ger survey	10.	3.374	.112	.03	3	.011	.491
F shrinkage mean	8.	.50				.495	.593

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
8.	.35	.08	14	.235	.601

Table 3.6.7

Run title : North Sea Sole, sexes combined *** reduced data set *** RSOLIND.DAT

At 9/10/1993 9:46

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
1,	.0028,	.0028,	.0021,	.0024,	.0013,	.0000,	.0012,	.0064,	.0035,	.0023,	.0041,
2,	.3077,	.2851,	.3110,	.1415,	.2332,	.2244,	.1265,	.1493,	.1331,	.2400,	.1741,
3,	.5947,	.7100,	.7187,	.5955,	.4941,	.6321,	.4845,	.4089,	.5579,	.6414,	.5361,
4,	.6744,	.6722,	.7501,	.6467,	.5941,	.6855,	.6287,	.4619,	.6561,	.6153,	.5778,
5,	.3120,	.5825,	.5827,	.6375,	.4715,	.5593,	.4087,	.5123,	.7005,	.5598,	.5909,
6,	.4837,	.6551,	.4360,	.7202,	.5086,	.4959,	.3842,	.6050,	.4106,	.4499,	.4885,
7,	.4425,	.5552,	.3403,	.4875,	.3891,	.4516,	.3084,	.4395,	.6357,	.5110,	.5287,
8,	.4482,	.3991,	.4527,	.2689,	.3183,	.3698,	.3089,	.4298,	.5615,	.4993,	.4969,
9,	.3619,	.4078,	.4020,	.6364,	.3444,	.2800,	.2971,	.4603,	.4811,	.5633,	.5015,
10,	.3136,	.3597,	.2387,	.7599,	.5066,	.2030,	.1777,	.2481,	.4788,	.5029,	.4099,
11,	.5471,	.3322,	.4774,	.7527,	.4416,	.2452,	.3517,	.3434,	.5160,	.4034,	.4209,
12,	.2277,	.3254,	.5006,	.9398,	.6858,	.3565,	.3892,	.9305,	.8877,	.7236,	.8473,
13,	.1756,	.3194,	.3197,	.6515,	1.1628,	.3887,	.3120,	.5242,	.7803,	.7587,	.6877,
14,	.3187,	.4520,	.6116,	.6256,	.5998,	.4341,	.4156,	.7396,	.6198,	.6009,	.6534,
+gp,	.3187,	.4520,	.6116,	.6256,	.5998,	.4341,	.4156,	.7396,	.6198,	.6009,	
FBARC,	.4910,	.5611,	.5707,	.5429,	.4444,	.5249,	.4433,	.4061,	.5290,	.5149,	
FBAR 2- 8,	.4662,	.5513,	.5131,	.4997,	.4298,	.4884,	.3786,	.4295,	.5222,	.5024,	
FBAR 3-10,	.4539,	.5427,	.4901,	.5941,	.4533,	.4597,	.3748,	.4457,	.5603,	.5429,	

Table 3.6.8

Run title : North Sea Sole, sexes combined *** reduced data set *** RSOLIND.DAT

At 9/10/1993 9:46

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	GMST 83-89	AMST 83-89
AGE													
1,	144356,	72432,	82516,	163520,	76317,	451121,	100850,	137489,	37276,	433755,	0,	125482,	155873,
2,	136577,	130248,	65357,	74506,	147604,	68967,	408182,	91143,	123609,	33610,	391563,	120077,	147349,
3,	97051,	90850,	88619,	43330,	58521,	105774,	49860,	325449,	71033,	97902,	23924,	72422,	76286,
4,	45411,	48448,	40416,	39080,	21615,	32308,	50867,	27793,	195647,	36791,	46647,	38414,	39735,
5,	2447,	20934,	22383,	17273,	18521,	10797,	14729,	24545,	15846,	91859,	17992,	12865,	15298,
6,	3778,	1621,	10579,	11309,	8262,	10459,	5584,	8856,	13306,	7117,	47487,	6203,	7370,
7,	5733,	2107,	762,	6190,	4980,	4496,	5763,	3441,	4376,	7986,	4107,	3567,	4290,
8,	2846,	3332,	1094,	490,	3440,	3054,	2590,	3831,	2006,	2097,	4335,	2023,	2407,
9,	1336,	1645,	2023,	630,	339,	2264,	1909,	1720,	2255,	1035,	1152,	1224,	1449,
10,	1175,	842,	990,	1225,	302,	217,	1548,	1283,	983,	1261,	533,	740,	900,
11,	1055,	777,	532,	706,	518,	164,	161,	1173,	906,	551,	690,	458,	559,
12,	160,	553,	504,	298,	301,	302,	116,	102,	753,	489,	333,	282,	319,
13,	91,	115,	361,	277,	106,	137,	191,	71,	36,	280,	215,	162,	183,
14,	682,	69,	76,	237,	131,	30,	84,	127,	38,	15,	119,	116,	187,
+gp,	883,	700,	610,	686,	387,	330,	294,	429,	401,	585,	298,		
TOTAL,	443582,	374673,	316823,	359757,	341343,	690419,	642728,	627452,	468471,	715335,	539394,		
TOTALBIO,	68457,	66234,	54945,	53994,	57753,	73599,	96537,	113108,	97195,	93134,			
TOTSPBIO,	42118,	45290,	42519,	35909,	31206,	41871,	37207,	92744,	78273,	66203,			

Table : 3.6.9

SOLE NORTH SEA (IV) - Indices of Recruitment (input data for RCT3)

Year	VPA	INT-0	TR1S	INT-1	TR2S	TR3S	SOL3
1968	50368	-11	-11	-11	745	99	-11
1969	141450	-11	4938	-11	1961	161	-11
1970	41865	-11	613	-11	341	73	-11
1971	76841	-11	1410	-11	905	69	-11
1972	106521	-11	4686	-11	397	174	-11
1973	110792	-11	1924	-11	887	187	31.5
1974	41896	-11	597	1.49	79	77	16.3
1975	114173	167.88	1413	5.93	762	267	34.4
1976	140657	81.91	3724	6.97	1379	325	-11
1977	47111	32.31	1552	0.87	388	99	41.5
1978	11865	95.38	104	2.27	80	51	1.9
1979	154652	391.51	4483	-11	1411	231	76.1
1980	149696	401.63	3739	12.1	1124	107	77.1
1981	153737	293.04	5098	14.58	1137	307	147.1
1982	144356	340.58	2640	21.81	1081	159	77.8
1983	72432	109.4	2359	11.23	709	67	10.8
1984	82516	194.2	2151	3.29	465	59	29.8
1985	163520	300.66	3791	11.62	955	284	24.6
1986	76317	72.36	1890	5.16	594	248	20.3
1987	451121	534.21	11227	17.08	5369	907	66.9
1988	100850	61.73	3052	6.5	1078	527	86.4
1989	137489	83	2900	8.72	2515	319	54.6
1990	-11	62.56	1265	11.21	114	-11	-11
1991	-11	369.69	11081	11.87	-11	-11	-11
1992	-11	32.81	-11	-11	-11	-11	-11
1993	-11	-11	-11	-11	-11	-11	-11

INT-0 INT-1 : International DFS survey
TR1S TR2S TR3S : Tridens SNS beam trawl survey
SOL3 : Solea beam trawl survey

Table 3.6.10

Analysis by RCT3 ver3.1 of data from file :

RCRTSOL.CSV

"SOLE NORTH SEA (IV)",,,,,,,

Data for 6 surveys over 26 years : 1968 - 1993
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1990

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
"INT-0	1.56	3.65	1.07	.367	15	4.15	10.14	1.238	.032
"TR1S"	.78	5.45	.27	.882	21	7.14	11.04	.293	.570
"INT-1	1.45	8.52	.72	.582	15	2.50	12.14	.805	.076
"TR2S"	.85	5.81	.40	.772	22	4.74	9.85	.466	.227
						VPA Mean =	11.45	.719	.095

Yearclass = 1991

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
"INT-0	1.56	3.65	1.07	.367	15	5.92	12.90	1.232	.045
"TR1S"	.78	5.45	.27	.882	21	9.31	12.74	.309	.717
"INT-1	1.45	8.52	.72	.582	15	2.55	12.22	.808	.105
						VPA Mean =	11.45	.719	.133

Yearclass = 1992

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
"INT-0	1.56	3.65	1.07	.367	15	3.52	9.15	1.321	.228
						VPA Mean =	11.45	.719	.772

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	52317	10.87	.22	.33	2.17		
1991	274263	12.52	.26	.26	.99		
1992	55527	10.92	.63	.96	2.33		
1993	No valid surveys						

Table 3.6.11 North Sea Sole assessment Summary (without SOP correction)
Traditional vpa Terminal Fs estimated using XSA -shrunk method

Year	Yield ('000 t)	SOP ('000 t)	Sopfact	SSB ('000 t)	Tot Biom ('000 t)	Recruits age 1 (mill)	F(bar)c	F(2-8)u	Yield/ SSB
1957	12.1	11.6	1.04	79	88	164	0.147	0.137	0.15
1958	14.3	14.2	1.01	85	99	143	0.172	0.161	0.17
1959	13.8	13.7	1.01	93	116	552	0.148	0.133	0.15
1960	18.6	18.7	0.99	101	137	66	0.180	0.168	0.18
1961	23.6	23.2	1.01	147	154	115	0.179	0.161	0.16
1962	26.9	27.0	0.99	147	155	28	0.206	0.183	0.18
1963	26.2	26.4	0.99	147	149	23	0.194	0.249	0.18
1964	11.3	11.7	0.97	54	68	552	0.268	0.228	0.21
1965	17.0	17.8	0.96	49	122	121	0.242	0.246	0.35
1966	33.3	33.7	0.99	105	113	41	0.278	0.240	0.32
1967	33.4	32.7	1.02	101	109	75	0.359	0.308	0.33
1968	33.2	33.3	1.00	89	99	100	0.495	0.372	0.37
1969	27.6	27.0	1.02	70	84	50	0.514	0.423	0.39
1970	19.7	19.8	1.00	63	73	141	0.461	0.351	0.31
1971	23.7	23.4	1.01	52	73	42	0.479	0.444	0.46
1972	21.1	21.3	0.99	56	64	77	0.467	0.393	0.38
1973	19.3	19.0	1.02	42	56	107	0.526	0.453	0.46
1974	18.0	18.2	0.99	42	60	111	0.498	0.464	0.43
1975	20.8	20.6	1.01	43	59	42	0.469	0.463	0.48
1976	17.3	17.0	1.02	43	53	114	0.459	0.406	0.40
1977	18.0	17.7	1.02	36	56	141	0.437	0.383	0.50
1978	20.3	20.4	1.00	39	58	47	0.461	0.498	0.52
1979	22.6	22.3	1.01	46	53	12	0.511	0.464	0.49
1980	15.8	15.5	1.02	36	44	155	0.484	0.442	0.44
1981	15.4	15.0	1.03	25	51	150	0.458	0.448	0.62
1982	21.6	21.3	1.01	35	60	154	0.515	0.496	0.62
1983	24.9	24.8	1.00	42	68	144	0.491	0.466	0.59
1984	26.8	26.7	1.00	45	66	72	0.561	0.551	0.60
1985	24.2	24.4	0.99	43	55	83	0.571	0.513	0.56
1986	18.2	18.3	0.99	36	54	164	0.543	0.450	0.51
1987	17.4	17.5	0.99	31	58	76	0.444	0.430	0.56
1988	21.6	21.6	1.00	42	74	451	0.525	0.488	0.51
1989	21.8	22.1	0.99	37	97	101	0.443	0.379	0.59
1990	35.1	35.4	0.99	93	113	137	0.406	0.430	0.38
1991	38.3		0.99	78	98	*52*	0.529	0.522	0.49
1992	29.1		0.98	66	87	*274*	0.515	0.502	0.44
1993				51	88	*56*			
arith. mean	22.3	21.6	1.00	65	84	133	0.407	0.374	0.40

italic: indicated by recruitment surveys

Average recruitment (arithmetic) 134
Average recruitment (geometric) 97
in millions at age 1 (period 1957-1990)

corrected for recruitment adjustments

Table 3.6.12

Sole in the North Sea (Fishing Area IV)

Sole in the North Sea (Fishing Area IV)

Prediction with management option table: Input data

Year: 1993								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	55527.000	0.1000	0.0000	0.0000	0.0000	0.050	0.0042	0.133
2	247585.00	0.1000	0.0000	0.0000	0.0000	0.147	0.1805	0.182
3	33577.000	0.1000	1.0000	0.0000	0.0000	0.194	0.5557	0.216
4	46647.000	0.1000	1.0000	0.0000	0.0000	0.268	0.5989	0.270
5	17992.000	0.1000	1.0000	0.0000	0.0000	0.321	0.6125	0.327
6	47487.000	0.1000	1.0000	0.0000	0.0000	0.414	0.5063	0.400
7	4107.000	0.1000	1.0000	0.0000	0.0000	0.410	0.5480	0.416
8	4335.000	0.1000	1.0000	0.0000	0.0000	0.486	0.5150	0.472
9	1152.000	0.1000	1.0000	0.0000	0.0000	0.501	0.5198	0.482
10	533.000	0.1000	1.0000	0.0000	0.0000	0.526	0.4249	0.547
11	690.000	0.1000	1.0000	0.0000	0.0000	0.560	0.4363	0.578
12	333.000	0.1000	1.0000	0.0000	0.0000	0.541	0.8782	0.500
13	215.000	0.1000	1.0000	0.0000	0.0000	0.602	0.7128	0.677
14	119.000	0.1000	1.0000	0.0000	0.0000	0.746	0.6772	0.669
15+	298.000	0.1000	1.0000	0.0000	0.0000	0.676	0.6772	0.609
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Recruitment 1994 : 97 Millions (GM)
Recruitment 1995 : 97 Millions (GM)

Table 3.6.13

Sole in the North Sea (Fishing Area IV)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	4434.441	8.603	4251.430	8.603	4251.430
0.1000	0.0502	0.312	129.605	7.396	2550.855	5.492	2367.900	5.492	2367.900
0.2000	0.1005	0.452	169.537	5.991	1772.126	4.087	1589.226	4.087	1589.226
0.3000	0.1507	0.535	184.091	5.174	1353.889	3.270	1171.045	3.270	1171.045
0.4000	0.2010	0.589	189.271	4.634	1096.652	2.730	913.864	2.730	913.864
0.5000	0.2512	0.628	190.520	4.250	924.639	2.347	741.907	2.347	741.907
0.6000	0.3014	0.657	190.021	3.962	802.851	2.060	620.175	2.060	620.175
0.7000	0.3517	0.679	188.743	3.740	712.928	1.838	530.307	1.838	530.307
0.8000	0.4019	0.698	187.146	3.562	644.340	1.660	461.776	1.660	461.776
0.9000	0.4522	0.712	185.455	3.417	590.637	1.516	408.128	1.516	408.128
1.0000	0.5024	0.725	183.785	3.297	547.662	1.396	365.208	1.396	365.208
1.1000	0.5527	0.735	182.191	3.196	512.626	1.295	330.228	1.295	330.228
1.2000	0.6029	0.744	180.699	3.109	483.601	1.208	301.259	1.208	301.259
1.3000	0.6531	0.752	179.316	3.033	459.214	1.134	276.927	1.134	276.927
1.4000	0.7034	0.759	178.043	2.968	438.466	1.068	256.235	1.068	256.235
1.5000	0.7536	0.765	176.876	2.909	420.618	1.010	238.442	1.010	238.442
1.6000	0.8039	0.770	175.808	2.857	405.110	0.959	222.990	0.959	222.990
1.7000	0.8541	0.775	174.831	2.811	391.515	0.913	209.450	0.913	209.450
1.8000	0.9043	0.780	173.936	2.769	379.500	0.871	197.490	0.871	197.490
1.9000	0.9546	0.784	173.117	2.731	368.803	0.833	186.849	0.833	186.849
2.0000	1.0048	0.787	172.366	2.696	359.215	0.798	177.317	0.798	177.317
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YIELD1
Date and time : 09OCT93:13:40
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.1948
F-max factor : 0.5092
F-0.1 reference F : 0.0979
F-max reference F : 0.2558
Recruitment : Single recruit

Table 3.6.14

Sole in the North Sea (Fishing Area IV)

Sole in the North Sea (Fishing Area IV)

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.5024	89256	50085	27503	0.0000	0.0000	78089	65885	0	103337	85585
.	.	.	.	.	0.1000	0.0502	.	65885	3798	98983	81236
.	.	.	.	.	0.2000	0.1005	.	65885	7398	94861	77120
.	.	.	.	.	0.3000	0.1507	.	65885	10810	90959	73223
.	.	.	.	.	0.4000	0.2010	.	65885	14045	87264	69534
.	.	.	.	.	0.5000	0.2512	.	65885	17112	83766	66041
.	.	.	.	.	0.6000	0.3014	.	65885	20019	80454	62734
.	.	.	.	.	0.7000	0.3517	.	65885	22777	77317	59602
.	.	.	.	.	0.8000	0.4019	.	65885	25392	74346	56637
.	.	.	.	.	0.9000	0.4522	.	65885	27872	71532	53829
.	.	.	.	.	1.0000	0.5024	.	65885	30225	68867	51169
.	.	.	.	.	1.1000	0.5527	.	65885	32458	66342	48649
.	.	.	.	.	1.2000	0.6029	.	65885	34576	63950	46263
.	.	.	.	.	1.3000	0.6531	.	65885	36586	61684	44002
.	.	.	.	.	1.4000	0.7034	.	65885	38493	59536	41860
.	.	.	.	.	1.5000	0.7536	.	65885	40304	57501	39830
.	.	.	.	.	1.6000	0.8039	.	65885	42023	55572	37907
.	.	.	.	.	1.7000	0.8541	.	65885	43656	53744	36084
.	.	.	.	.	1.8000	0.9043	.	65885	45206	52011	34357
.	.	.	.	.	1.9000	0.9546	.	65885	46678	50369	32719
.	.	.	.	.	2.0000	1.0048	.	65885	48077	48811	31167
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED2
Date and time : 10OCT93:20:06
Computation of ref. F: Simple mean, age 2 - 8
Basis for 1993 : F factors

Table 3.6.15 North Sea sole catch prediction - linear analysis

Input Values

Population at age in 1993

name	value	CV
pln1	55527	0.96
pln2	247585	0.26
pln3	33577	0.33
pln4	46647	0.21
pln5	17992	0.2
pln6	47487	0.21
pln7	4107	0.2
pln8	4335	0.2
pln9	1152	0.22
pln10	533	0.22
pln11	690	0.23
pln12	333	0.25
pln13	215	0.29
pln14	417	0.35

Natural mortality pattern

name	value	CV
m1	0.1	0.1
m2	0.1	0.1
m3	0.1	0.1
m4	0.1	0.1
m5	0.1	0.1
m6	0.1	0.1
m7	0.1	0.1
m8	0.1	0.1
m9	0.1	0.1
m10	0.1	0.1
m11	0.1	0.1
m12	0.1	0.1
m13	0.1	0.1
m14	0.1	0.1

Fishing mortality pattern

name	value	CV
sel1	0.0042	0.41
sel2	0.1805	0.27
sel3	0.5557	0.18
sel4	0.5989	0.14
sel5	0.6125	0.14
sel6	0.5063	0.17
sel7	0.5480	0.15
sel8	0.5150	0.11
sel9	0.5198	0.09
sel10	0.4249	0.28
sel11	0.4363	0.17
sel12	0.8782	0.10
sel13	0.7128	0.17
sel14	0.6772	0.09

Recruitment

name	value	CV
R94	97000	0.5
R95	97000	0.5

Effort multipliers

name	value	CV
F93	1	0.1
F94	1	0.1
F95	1	0.1

Natural mortality multipliers

name	value	CV
M93	1	0.1
M94	1	0.1
M95	1	0.1

Table 3.6.16 a-b   Sole in the North Sea

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: Millions						
Date of assessment	Year class					
	1988	1989	1990	1991	1992	1993
1989	101[1]	52[1]				
1990	106[1]	99[1]	15[1]			
1991	117[1]	125[1]	70[1]	137[1]		
1992	105	147[1]	51[1]	275[1]	55[1]	
1993	101	137	52[1]	274[1]	56[1]	97[2]

[1]Predicted from surveys. [2]GM.

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	32.2	27.1	n/a[1]	n/a[1]				
1990	37.8	29.8	69.9	58.0[1]	46.0[1]			
1991	40.5	34.1	67.6	56.0	47.0[1]	37.0[1]		
1992	42.9	38.2	94.2	80.2	73.7	54.4[1]	69.8[1]	
1993	41.9	37.2	92.7	78.3	66.2	50.1	65.9[1]	51.2[1]

[1]Forecast.

Remarks:

Continued

Table 3.6.16 c-d Sole in the North Sea

Assessment Quality Control Diagram 1

Average F(2-8,u)						
Date of assessment	Year					
	1987	1988	1989	1990	1991	1992
1989	0.51	0.55				
1990	0.48	0.58	0.53			
1991	0.45	0.52	0.42	0.55		
1992	0.41	0.46	0.36	0.40	0.47	
1993	0.43	0.49	0.38	0.43	0.52	0.50

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F							
Date of assessment	Year						
	1988	1989	1990	1991	1992	1993	1994
1989	17.6	24.0	29.0				
1990		23.2	38.0	31.0			
1991			28.8	32.0	25.0		
1992				33.6	32.4	28.9	
1993				33.0	30.0	27.5	30.2
				\ SQC[1]	\ SQC[2]	\ Current	\ Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2) - F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y), F(y−1) and F(y−2) are as estimated in the assessment made in year (y+1).

Remarks:

Table 3.7.1 North Sea PLAICE. Nominal landings (tonnes) in Sub-area IV as officially reported to ICES, 1982-1992.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
Belgium	7,103	8,916	10,220	9,965	7,232	8,554	11,527	10,939	13,940	14,328	12,066
Denmark	24,532	19,114	23,361	28,236	26,332	21,597	20,259	23,481	26,474	24,355	20,891
Faroe Islands	-	-	-	-	-	-	43	-	-	-	-
France	1,046	1,185	1,145	1,010	751	1,580	1,773	2,037[1]	1,339	508[1]	512
Germany	3,628	2,397	2,485	2,197	1,809	1,794	2,566	5,341	8,747	7,926	6,818
Netherlands	55,715	53,608	61,478	90,950	74,447	76,612	77,724	84,173	n/a	68,266[1]	51,064
Norway	16	17	17	23	21	12	21	321	1,756	554[1]	843
Sweden	6	22	14	18	16	7	2	12	169	103	53
UK (Engl. & Wales)	16,534	13,248	12,988	11,335	12,428	14,891	17,613	19,735	17,563	17,672	20,095
UK (N.Ireland)	-	-	-	-	-	-	-	540	176	992	1,163
UK (Scotland)	4,355	4,159	4,195	4,577	4,866	5,747	6,884	5,516	6,789	9,047	6,510
Total reported	112,935	102,666	115,903	148,311	127,902	130,794	138,412	152,095	76,953	143,751	119,955
Unreported landings[2]	41,614	41,369	40,244	11,526	37,445	29,700	24,059	17,547	90,753	13,721	1,356
Landings as used by WG	154,549	144,035	156,147	159,837	165,347	160,494	162,471	169,642	167,706	157,472	121,311

[1]Provisional.
[2]Estimated by the Working Group.

Table 3.7.2

Run title : Plaice in the North Sea (Fishing Area IV) (run name: FIN2)

At 10-Oct-93 13:51

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	1214,	108,	121,	1674,	0,	0,	1260,	1527,	1467,	3097,
2,	119695,	63252,	73552,	67125,	104754,	16122,	46709,	35077,	45949,	40163,
3,	115034,	274209,	144316,	163717,	120173,	264648,	105820,	105040,	87318,	79291,
4,	99076,	53549,	185203,	93801,	104295,	77610,	231176,	116753,	121155,	68348,
5,	29359,	37468,	32520,	84479,	58646,	49739,	52854,	171396,	76532,	69610,
6,	12906,	13661,	15544,	24049,	31737,	26343,	19227,	28652,	83025,	32641,
7,	8216,	6465,	6871,	9299,	9987,	17531,	10556,	8959,	16037,	29733,
8,	4193,	5544,	3650,	4490,	3838,	5667,	7553,	4664,	5756,	7028,
9,	3013,	2720,	2698,	2733,	1951,	3329,	2118,	3874,	3410,	3343,
10,	2947,	2088,	1543,	2026,	1471,	1759,	1691,	1246,	2638,	2420,
11,	2144,	1307,	1030,	1178,	908,	970,	926,	801,	1071,	1731,
12,	1219,	1143,	1070,	1084,	589,	963,	630,	511,	681,	975,
13,	581,	455,	727,	806,	484,	526,	446,	339,	401,	605,
14,	344,	310,	371,	628,	269,	533,	327,	244,	339,	609,
+gp,	1052,	1262,	1057,	1228,	1160,	1703,	1555,	1230,	1298,	1597,
TOTALNUM,	400993,	463541,	470273,	458317,	440262,	467443,	482848,	480313,	447077,	341191,
TONSLAND,	144038,	156147,	159838,	165347,	153670,	162475,	169643,	167707,	157472,	121311,
SOPCOF %,	99,	98,	98,	99,	99,	98,	99,	98,	97,	98,

Table 3.7.3

Run title : Plaice in the North Sea (Fishing Area IV) (run name: FIN2)

At 10-Oct-93 13:51

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	.2000,	.2330,	.2470,	.2210,	.2210,	.2210,	.2360,	.2710,	.2270,	.2510,
2,	.2500,	.2630,	.2640,	.2690,	.2490,	.2540,	.2800,	.2840,	.2860,	.2630,
3,	.3000,	.2830,	.2900,	.3040,	.3080,	.2780,	.3090,	.2980,	.2950,	.2910,
4,	.3830,	.3750,	.3370,	.3470,	.3590,	.3520,	.3320,	.3180,	.3070,	.3200,
5,	.5150,	.4910,	.4620,	.4250,	.4080,	.4540,	.3920,	.3680,	.3670,	.3440,
6,	.6040,	.6130,	.5770,	.4880,	.5050,	.5120,	.5330,	.4470,	.4550,	.4270,
7,	.6770,	.6840,	.6780,	.6750,	.5880,	.6080,	.6030,	.5950,	.5260,	.5310,
8,	.7710,	.7250,	.7290,	.7510,	.7390,	.7000,	.6700,	.6880,	.6650,	.6030,
9,	.8150,	.8370,	.8040,	.8530,	.8410,	.8150,	.7920,	.7540,	.7390,	.7040,
10,	.8930,	.9160,	.9000,	.9210,	.8260,	.9370,	.8190,	.8200,	.8280,	.7370,
11,	.9130,	.9810,	1.0010,	.9480,	.9990,	.9700,	.9230,	1.0240,	.9110,	.8090,
12,	.9840,	1.0260,	.9500,	1.0630,	1.0030,	1.0450,	.9520,	1.0860,	.9240,	.9240,
13,	1.2400,	1.1120,	1.0710,	1.0780,	1.0350,	1.1400,	1.1570,	1.1040,	.9850,	.9690,
14,	1.2090,	1.2500,	1.1390,	1.0740,	1.0950,	1.1280,	1.0840,	.9760,	.9570,	.8790,
+gp,	1.1670,	1.2140,	1.2150,	1.1100,	1.1360,	1.0460,	.9940,	1.0830,	1.0100,	1.0590,
SOPCOFAC,	.9938,	.9844,	.9799,	.9877,	.9872,	.9849,	.9854,	.9837,	.9667,	.9827,

Table 3.7.4

Run title : Plaice in the North Sea (Fishing Area IV) (run name: FIN2)

At 10-Oct-93 13:51

Table 3 Stock weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
1,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1310,	.1310,
2,	.2110,	.2030,	.2080,	.1950,	.1940,	.2110,	.2150,	.2450,	.2080,	.2620,
3,	.2480,	.2420,	.2430,	.2530,	.2650,	.2380,	.2480,	.2710,	.2620,	.2670,
4,	.3290,	.3380,	.3100,	.3360,	.3300,	.3140,	.2820,	.2820,	.2750,	.3010,
5,	.4940,	.4640,	.4520,	.4400,	.4010,	.4250,	.3620,	.3420,	.3410,	.3180,
6,	.5590,	.5710,	.5360,	.5330,	.5030,	.4670,	.4840,	.4200,	.4000,	.4030,
7,	.6240,	.6490,	.6350,	.6920,	.5730,	.5470,	.5530,	.5550,	.4610,	.5000,
8,	.7120,	.6920,	.6560,	.7790,	.7110,	.6450,	.6160,	.6460,	.6330,	.5730,
9,	.7540,	.7870,	.7640,	.8880,	.7470,	.7070,	.7590,	.7040,	.6500,	.6830,
10,	.7910,	.8980,	.8690,	.9710,	.8170,	.8980,	.8370,	.7630,	.7470,	.7300,
11,	.8240,	.9320,	.9550,	.9530,	1.0090,	.9440,	.7910,	1.0220,	.8340,	.8030,
12,	1.0110,	1.0420,	.9060,	1.1070,	1.0180,	1.0130,	.9680,	1.1510,	.9660,	.8520,
13,	1.1300,	1.2350,	1.0680,	1.1530,	1.0190,	1.0760,	1.2150,	1.0090,	.9620,	.9580,
14,	1.2570,	1.1270,	1.1080,	1.1260,	1.2140,	1.1490,	.8990,	1.0500,	.8380,	.7740,
+gp,	1.1240,	1.2350,	1.3080,	1.3540,	1.1140,	.9840,	.8570,	1.0760,	.9010,	1.0160,

Table 3.7.5 Tuning input data.

```
Plaice in the North Sea (Fishing Area IV) (run name: NSPLAICE)
104
>>NETHERLAND BTS<<
1985, 1992
1, 1, 0.0, 1.0
1, 10,
     1  113.50  184.90   44.80   17.48    2.43    1.27    0.44    0.22    0.19    0.56
     1  596.00  121.40   52.80   14.35    6.87    0.74    0.47    0.23    0.16    0.28
     1  203.80  710.80   30.00    6.40    3.08    1.14    0.46    0.15    0.13    0.24
     1  541.70  134.40  188.00   13.38    3.58    1.76    1.05    0.47    0.20    0.42
     1  398.00  340.20   51.30   55.00    6.63    0.80    0.39    0.61    0.14    0.30
     1  123.48  112.81   68.75   32.02    8.58    0.84    0.21    0.48    0.22    0.16
     1  174.74  133.63   32.32   12.35    4.19    5.83    0.22    0.20    0.13    0.16
     1  166.33  108.69   21.64    5.23    2.97    2.79    1.44    0.22    0.07    0.09
>>NETHERLANDS ALL FLEETS<<
1979, 1992
1, 1, 0, 1
1, 15
44.9, 1267.5, 44268.9,  65005.3,  18310.6, 18066.6, 13360.2, 9189.9, 2410.3, 1539.7,  961.2,  691.6,  488.4, 429.3, 308.5, 811.4
45.0,  943.7, 50726.9,  77105.9,  35404.3,  8928.9,  8739.5, 5909.8, 3245.6, 1004.0,  794.8,  365.1,  200.9, 169.5, 142.8, 366.4
46.3,  122.0, 74461.7,  79996.2,  25008.9, 19061.8,  6615.2, 5223.6, 4203.2, 2372.4,  974.6,  688.7,  356.3, 276.9, 207.9, 455.3
57.3, 3199.6, 39899.6, 137177.0,  36203.3, 14979.8,  9577.3, 5399.5, 3713.5, 2034.8, 1924.7,  760.2,  450.6, 313.9, 141.3, 676.0
65.6, 1134.4, 96297.5,  78330.5,  55221.0, 15280.3,  7432.7, 5033.9, 2798.9, 2025.0, 1702.1, 1257.6, 1008.0, 365.2, 213.3, 385.5
70.8,    9.9, 53837.3, 180607.0,  30489.5, 22212.2,  7308.2, 3717.4, 3363.3, 1791.5, 1323.1,  768.1,  649.4, 248.6, 179.8, 465.1
70.3,  732.0, 66003.4, 105584.0, 102925.0, 17163.2,  9669.2, 4187.8, 2329.9, 1681.1,  940.6,  679.0,  599.6, 450.1, 274.9, 383.4
68.1, 1615.0, 59619.2, 119586.0,  57103.8, 46190.2, 12357.8, 5803.6, 2609.8, 1724.7, 1385.8,  828.3,  696.8, 528.4, 317.3, 415.8
68.4,    9.9, 83963.3,  80818.0,  69416.2, 34033.2, 13962.1, 4851.9, 1854.3,  836.7,  707.0,  454.7,  288.4, 195.4, 124.7, 313.3
76.2,    9.9, 11893.0, 171923.2,  41104.4, 29294.3, 15543.9, 9482.8, 3539.2, 2064.5, 1087.3,  482.6,  403.0, 263.3, 222.9, 377.1
72.5, 1151.3, 40443.3,  73696.3, 131915.1, 23063.6,  9633.8, 5239.6, 2714.5,  947.4,  630.6,  304.1,  168.4, 149.0,  68.7, 143.5
71.2,  199.2, 25173.0,  68833.9,  57166.2, 87730.9, 13972.2, 4221.7, 2052.5, 1330.8,  563.5,  287.6,  196.4, 116.7,  73.0, 135.7
68.7,  487.9, 31429,8,  48430.2,  60744.8, 35082.8, 38962.7, 7861.6, 2233.6, 1299.9,  745.3,  326.7,  139.9,  76.5,  83.4, 127.6
71.6, 1810.1, 24270.5,  44306.1,  31854.1, 27165.2, 12219.3, 9485.1, 2463.9,  992.8,  508.2,  312.9,  262.8,  95.2,  75.3, 129.3
>>TRIDENS SNS September survey<<
1982 1992
1 1 0.0 1.0
1 3
     1  70108    8503    1146
     1  34884   14708     308
     1  44667   10413    2480
     1  27832   13789    1584
     1  93573    7558    1155
     1  33426   33021    1232
     1  36672   14430   13140
     1  37238   14952    3709
     1  24903    7287    3248
     1  57349   11148    1507
     1  48223   13742    2257
>>English seine<<
1982 1992
1 1 0.0 1.0
2 15
   160.6     44.4   3887.4   3202.2   1996.9    985.3    332.2    132.2    371.6    427.1     85.4     45.4     36.4     37.1    244.8
   156.0   1539.7   2602.1   5926.2   1993.0    911.9    536.5    122.0     68.9    184.8    117.3     10.4     30.6     12.7    142.5
   144.7    400.0   5372.1   2497.3   2169.5    679.8    378.2    283.3    120.9     74.6     65.3    104.4     71.0     37.0    222.1
   138.9   1168.0   2968.5   5471.5    663.2    622.2    284.0    175.1    104.1     25.6     38.9     36.1     30.3     20.8    136.4
   121.0    282.5   4316.2   2631.9   1953.4    270.5    206.3    169.4    205.9    106.4     56.5     31.7     46.3     26.3    272.6
   112.7    792.7   1896.1   2729.0   2078.0   1085.3    362.0    188.6     58.6     67.2     30.6     15.1     33.9      9.7     65.4
    78.8    129.0   3071.8   1508.6   1048.7    819.5    402.0     91.1     78.4     37.8     23.9     13.4    104.8     20.8    117.3
    83.6     48.2    625.2   4324.9   1915.1    898.0    385.9    515.6     73.1    108.0     71.9     56.5     26.2     16.4    129.6
    73.1    120.2   1227.3   1673.6   4296.7    495.0    332.1    169.9    146.8     45.8     25.8     19.0     14.5     14.3     90.5
    67.0    130.0    504.1   1078.5   1002.9   1517.4    246.9    116.6     64.1     87.7     33.8     26.2     18.1     17.4     69.0
    60.0    177.4   1039.2   1015.8   1145.5    549.2    497.3    140.6     56.9     39.3     52.5     12.3     14.7     10.4     44.6
```

Table 3.7.6 Tuning diagnostics.

VPA Version 3.1 (MSDOS)

8/10/1993 14:14

Extended Survivors Analysis

North Sea PLAICE, sexes combined *** full data set ***

CPUE data from file fleet4.dat

Data for 4 fleets over 14 years
Age range from 1 to 14

Fleet,	Alpha,	Beta
>>NETHERLAND BTS<<	, .000	, 1.000
>>NETHERLANDS ALL FL	, .000	, 1.000
>>TRIDENS SNS Septem	, .000	, 1.000
>>English seine<<	, .000	, 1.000

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 5

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

Catchability independent of age for ages >= 12

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning had not converged after 210 iterations

1
Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	321228.	1.087	.000	.00	1	.035	.009
>>NETHERLANDS ALL FL	1742415.	1.380	.000	.00	1	.022	.002
>>TRIDENS SNS Septem	659945.	.301	.000	.00	1	.458	.004
>>English seine<<	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	568833.	.36				.320	.005
F shrinkage mean	1581348.	.50				.165	.002

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
724223.	.20	.21	5	1.024	.004

1
Age 2 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	318599.	.301	.027	.09	2	.219	.113
>>NETHERLANDS ALL FL	331852.	.515	.313	.61	2	.075	.109
>>TRIDENS SNS Septem	573218.	.221	.140	.63	2	.407	.065
>>English seine<<	482339.	.484	.000	.00	1	.085	.076
P shrinkage mean	442069.	.38				.134	.083
F shrinkage mean	399902.	.50				.080	.091

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
447311.	.14	.10	9	.682	.082

Continued

Table 3.7.6 Continued

Age 3 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	201546.	.247	.135	.55	3	.284	.318
>>NETHERLANDS ALL FL	270249.	.502	.068	.14	3	.069	.246
>>TRIDENS SNS Septem	246776.	.216	.163	.76	3	.373	.267
>>English seine<<	255580.	.418	.038	.09	2	.100	.259
P shrinkage mean	265825.	.41				.104	.250
F shrinkage mean	187594.	.50				.070	.338

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
232595.	.13	.06	13	.468	.281

1

Age 4 Catchability dependent on age and year class strength

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	102995.	.250	.129	.52	4	.321	.489
>>NETHERLANDS ALL FL	80383.	.364	.265	.73	4	.152	.593
>>TRIDENS SNS Septem	117829.	.288	.145	.51	3	.242	.439
>>English seine<<	85785.	.433	.160	.37	3	.107	.564
P shrinkage mean	134668.	.45				.097	.394
F shrinkage mean	92037.	.50				.080	.534

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
102213.	.14	.08	16	.545	.493

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	59895.	.286	.145	.50	5	.343	.745
>>NETHERLANDS ALL FL	52119.	.333	.083	.25	5	.254	.820
>>TRIDENS SNS Septem	69583.	.428	.101	.24	3	.154	.669
>>English seine<<	50608.	.455	.241	.53	4	.136	.837
F shrinkage mean	75139.	.50				.113	.632

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
59318.	.17	.07	18	.412	.750

1

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	45894.	.308	.134	.43	6	.289	.517
>>NETHERLANDS ALL FL	38349.	.288	.167	.58	6	.330	.593
>>TRIDENS SNS Septem	44221.	.501	.124	.25	3	.109	.532
>>English seine<<	33300.	.412	.128	.31	5	.161	.659
F shrinkage mean	40333.	.50				.110	.571

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
40325.	.17	.07	21	.424	.571

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

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	51831.	.343	.101	.30	7	.259	.435
>>NETHERLANDS ALL FL	42885.	.351	.102	.29	7	.248	.507
>>TRIDENS SNS Septem	53319.	.713	.033	.05	3	.060	.426
>>English seine<<	45970.	.313	.056	.18	6	.311	.479
F shrinkage mean	44077.	.50				.122	.496

Continued

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
46791.	.17	.04	24	.247	.473

1

Age 8 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	7893.	.351	.151	.43	8	.273	.614
>>NETHERLANDS ALL FL	10145.	.363	.221	.61	8	.255	.506
>>TRIDENS SNS Septem	7669.	.875	.080	.09	3	.044	.627
>>English seine<<	10586.	.339	.070	.21	7	.293	.490
F shrinkage mean	13901.	.50				.134	.393

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9885.	.18	.08	27	.449	.517

Age 9 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	3354.	.286	.087	.30	8	.340	.667
>>NETHERLANDS ALL FL	5520.	.313	.171	.55	9	.284	.455
>>TRIDENS SNS Septem	5184.	1.224	.108	.09	3	.019	.478
>>English seine<<	6741.	.335	.067	.20	8	.247	.386
F shrinkage mean	8125.	.50				.111	.330

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5103.	.17	.08	29	.508	.484

1

Age 10 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	3471.	.313	.150	.48	8	.284	.509
>>NETHERLANDS ALL FL	3517.	.283	.138	.49	10	.346	.503
>>TRIDENS SNS Septem	3628.	1.291	.025	.02	3	.017	.491
>>English seine<<	4710.	.339	.052	.15	9	.242	.398
F shrinkage mean	6296.	.50				.111	.312

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4015.	.17	.07	31	.429	.453

Age 11 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	4184.	.346	.153	.44	7	.226	.332
>>NETHERLANDS ALL FL	2991.	.273	.116	.43	10	.364	.439
>>TRIDENS SNS Septem	2985.	1.957	.006	.00	2	.007	.439
>>English seine<<	5993.	.302	.082	.27	10	.296	.243
F shrinkage mean	5256.	.50				.108	.273

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4211.	.16	.08	30	.479	.330

1

Age 12 Catchability constant w.r.t. time, dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	1844.	.404	.126	.31	6	.190	.407
>>NETHERLANDS ALL FL	1534.	.278	.108	.39	10	.402	.473
>>TRIDENS SNS Septem	1009.	3.139	.000	.00	1	.003	.652
>>English seine<<	1734.	.332	.096	.29	10	.281	.428

Continued

Table 3.7.6 Continued

F shrinkage mean	2765.	.50				.124	.289

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1767.	.18	.07	28	.376	.422

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 12

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	1407.	.494	.174	.35	5	.145	.343
>>NETHERLANDS ALL FL	925.	.285	.126	.44	10	.438	.484
>>TRIDENS SNS Septem	1.	.000	.000	.00	0	.000	.000
>>English seine<<	1374.	.359	.139	.39	10	.275	.350
F shrinkage mean	1937.	.50				.142	.260

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1217.	.19	.09	26	.480	.387

1
Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 12

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
>>NETHERLAND BTS<<	782.	.599	.142	.24	4	.118	.554
>>NETHERLANDS ALL FL	495.	.315	.099	.32	10	.429	.775
>>TRIDENS SNS Septem	1.	.000	.000	.00	0	.000	.000
>>English seine<<	931.	.387	.152	.39	10	.283	.484
F shrinkage mean	1121.	.50				.170	.417

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
718.	.21	.10	25	.470	.592

Table 3.7.7

Run title : Plaice in the North Sea (Fishing Area IV) (run name: FIN2)

At 10-Oct-93 13:51

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	GMST 83-89	AMST 83-89
AGE													
1,	586055,	604838,	542699,	1355217,	570334,	567987,	403569,	470648,	594465,	803568,	0,	617108,	661528,
2,	927027,	529130,	547177,	490939,	1224658,	516060,	513936,	363966,	424407,	536499,	724222,	637515,	678418,
3,	301039,	724951,	418609,	425141,	380368,	1008472,	451614,	420598,	295964,	340312,	447310,	489442,	530028,
4,	204032,	162968,	395127,	241496,	228951,	229860,	660762,	307978,	280655,	184740,	232595,	272064,	303314,
5,	75358,	90372,	96522,	181356,	129288,	107955,	134161,	377981,	167611,	138701,	102213,	112156,	116430,
6,	38388,	40260,	46131,	56403,	83738,	61199,	50369,	71117,	178974,	78862,	59317,	52071,	53784,
7,	27811,	22458,	23434,	26955,	28159,	45580,	30317,	27286,	37095,	82967,	40324,	28521,	29245,
8,	15538,	17349,	14171,	14668,	15545,	15980,	24567,	17391,	16168,	18310,	46790,	16563,	16831,
9,	12243,	10071,	10425,	9351,	9001,	10415,	9068,	15044,	11299,	9154,	9884,	10031,	10082,
10,	9439,	8212,	6525,	6866,	5861,	6289,	6257,	6191,	9928,	6980,	5103,	6972,	7064,
11,	8107,	5737,	5444,	4436,	4286,	3904,	4017,	4053,	4416,	6474,	4014,	4976,	5133,
12,	4163,	5296,	3948,	3947,	2894,	3014,	2610,	2754,	2905,	2977,	4211,	3599,	3696,
13,	2539,	2607,	3705,	2555,	2540,	2058,	1811,	1762,	2006,	1981,	1767,	2490,	2545,
14,	1370,	1744,	1926,	2661,	1545,	1838,	1362,	1215,	1272,	1433,	1217,	1735,	1778,
+gp,	4177,	7086,	5475,	5188,	6647,	5852,	6457,	6108,	4855,	3739,	2590,		
TOTAL,	2217285,	2233079,	2121318,	2827178,	2693816,	2586461,	2300877,	2094091,	2032021,	2216695,	1681556,		

Table 3.7.8

Run title : Plaice in the North Sea (Fishing Area IV) (run name: FIN2)

At 10-Oct-93 13:51

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
1,	.0022,	.0002,	.0002,	.0013,	.0000,	.0000,	.0033,	.0034,	.0026,	.0041,	.0034,
2,	.1459,	.1343,	.1524,	.1552,	.0942,	.0334,	.1004,	.1068,	.1208,	.0820,	.1032,
3,	.5137,	.5069,	.4501,	.5189,	.4037,	.3228,	.2828,	.3045,	.3713,	.2810,	.3189,
4,	.7143,	.4238,	.6787,	.5248,	.6518,	.4384,	.4586,	.5084,	.6048,	.4926,	.5352,
5,	.5269,	.5724,	.4373,	.6728,	.6479,	.6623,	.5347,	.6476,	.6540,	.7499,	.6838,
6,	.4361,	.4412,	.4373,	.5946,	.5082,	.6024,	.5130,	.5509,	.6688,	.5711,	.5969,
7,	.3719,	.3604,	.3685,	.4505,	.4666,	.5181,	.4558,	.4234,	.6060,	.4728,	.5007,
8,	.3336,	.4094,	.3158,	.3883,	.3005,	.4665,	.3904,	.3312,	.4688,	.5167,	.4389,
9,	.2994,	.3340,	.3176,	.3671,	.2586,	.4095,	.2817,	.3157,	.3817,	.4844,	.3939,
10,	.3978,	.3110,	.2858,	.3714,	.3063,	.3482,	.3342,	.2377,	.3276,	.4533,	.3395,
11,	.3258,	.2738,	.2217,	.3273,	.2520,	.3027,	.2775,	.2329,	.2943,	.3300,	.2857,
12,	.3680,	.2573,	.3354,	.3407,	.2408,	.4093,	.2927,	.2170,	.2829,	.4220,	.3073,
13,	.2752,	.2027,	.2310,	.4030,	.2236,	.3129,	.2996,	.2260,	.2360,	.3872,	.2830,
14,	.3065,	.2068,	.2263,	.2852,	.2022,	.3637,	.2909,	.2372,	.3288,	.5918,	.3859,
+gp,	.3065,	.2068,	.2263,	.2852,	.2022,	.3637,	.2909,	.2372,	.3288,	.5918,	
FBAR 2-10,	.4155,	.3882,	.3826,	.4493,	.4042,	.4224,	.3724,	.3807,	.4671,	.4560,	
FBARC,	.4930,	.4269,	.4500,	.4749,	.4798,	.4494,	.3783,	.4160,	.4701,	.4537,	
FBARP,	.2503,	.2317,	.2385,	.2506,	.2303,	.2044,	.2060,	.2156,	.2360,	.2152,	

Table 3.7.9 Recruitment prediction input data.

```
"Plaice North Sea - 1-Y-Rcr.",,,,,,,,,
8,26,2,,,,,,,
1967,245,-11,-11,-11,-11,-11,2813,-11,-11
1968,326,-11,-11,-11,7708,9450,1008,-11,-11
1969,369,-11,8641,8032,-11,23848,4484,-11,-11
1970,274,3678,-11,18101,14840,9584,1631,-11,-11
1971,234,6708,9799,6437,8738,4191,1261,-11,-11
1972,540,9242,32980,57238,43774,17985,10744,-11,-11
1973,451,5451,5835,15648,15583,9171,791,-11,-11
1974,335,2193,3903,9781,4610,2274,1720,105.73,69.34
1975,324,1151,1739,9037,3424,2900,435,68.29,77.88
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1977,428,4378,5054,13924,7041,9540,456,158.38,66.25
1978,441,3252,6922,21681,10778,12084,785,213.62,153.28
1979,657,27835,16425,58049,37468,16106,1146,355.51,197.67
1980,421,4039,2594,19611,11132,8503,308,136.2,131.45
1981,1020,31542,20251,70108,45588,14708,2480,616.99,263.58
1982,586,23987,7615,34884,17459,10413,1584,476.36,148.97
1983,605,36722,11869,44667,37339,13788,1155,398.7,113.91
1984,543,7958,16557,27832,16277,7557,1232,260.99,103.51
1985,1360,47385,56559,93573,62290,33021,13140,721.87,260
1986,570,8818,8523,33426,16213,14429,3709,357.8,188.31
1987,568,21270,12835,36672,34218,14952,3248,473.62,98.16
1988,404,15598,10387,37238,16677,7287,1507,341.71,128.37
1989,-11,24198,10235,24903,-11,11148,2257,469.64,121.31
1990,-11,9559,-11,57349,-11,13742,-11,465.84,136.88
1991,-11,17120,-11,48223,-11,-11,-11,497.11,151.17
1992,-11,5398,-11,-11,-11,-11,-11,365.17,-11
"T-0",,,,,,,,,
"T-1april",,,,,,,,,
"T-1october",,,,,,,,,
"T-2april",,,,,,,,,
"T-2october",,,,,,,,,
"T-3october",,,,,,,,,
"com-0",,,,,,,,,
"com-1",,,,,,,,,
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"Plaice North Sea - 2-Y-Recr.",,,,,,,,,
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1968,271,-11,-11,-11,7708,9450,1008,-11,-11
1969,341,-11,8641,8032,-11,23848,4484,-11,-11
1970,272,3678,-11,18101,14840,9584,1631,-11,-11
1971,208,6708,9799,6437,8738,4191,1261,-11,-11
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1982,529,23987,7615,34884,17459,10413,1584,476.36,148.97
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1985,1220,47385,56559,93573,62290,33021,13140,721.87,260
1986,516,8818,8523,33426,16213,14429,3709,357.8,188.31
1987,514,21270,12835,36672,34218,14952,3248,473.62,98.16
1988,364,15598,10387,37238,16677,7287,1507,341.71,128.37
1989,-11,24198,10235,24903,-11,11148,2257,469.64,121.31
1990,-11,9559,-11,57349,-11,13742,-11,465.84,136.88
1991,-11,17120,-11,48223,-11,-11,-11,497.11,151.17
1992,-11,5398,-11,-11,-11,-11,-11,365.17,-11
"T-0",,,,,,,,,
"T-1april",,,,,,,,,
"T-1october",,,,,,,,,
"T-2april",,,,,,,,,
"T-2october",,,,,,,,,
"T-3october",,,,,,,,,
"com-0",,,,,,,,,
"com-1",,,,,,,,,
```

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"Plaice North Sea - 3-Y-Recr.",,,,,,,,,
8,26,2,,,,,,,
1967,185,-11,-11,-11,-11,-11,2813,-11,-11
1968,242,-11,-11,-11,7708,9450,1008,-11,-11
1969,273,-11,8641,8032,-11,23848,4484,-11,-11
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1973,341,5451,5835,15648,15583,9171,791,-11,-11
1974,238,2193,3903,9781,4610,2274,1720,105.73,69.34
1975,205,1151,1739,9037,3424,2900,435,68.29,77.88
1976,322,11544,8344,19119,15364,12714,1577,226.29,128.65
1977,291,4378,5054,13924,7041,9540,456,158.38,66.25
1978,295,3252,6922,21681,10778,12084,785,213.62,153.28
1979,437,27835,16425,58049,37468,16106,1146,355.51,197.67
1980,301,4039,2594,19611,11132,8503,308,136.2,131.45
1981,725,31542,20251,70108,45588,14708,2480,616.99,263.58
1982,419,23987,7615,34884,17459,10413,1584,476.36,148.97
1983,425,36722,11869,44667,37339,13788,1155,398.7,113.91
1984,380,7958,16557,27832,16277,7557,1232,260.99,103.51
1985,1010,47385,56559,93573,62290,33021,13140,721.87,260
1986,452,8818,8523,33426,16213,14429,3709,357.8,188.31
1987,421,21270,12835,36672,34218,14952,3248,473.62,98.16
1988,296,15598,10387,37238,16677,7287,1507,341.71,128.37
1989,-11,24198,10235,24903,-11,11148,2257,469.64,121.31
1990,-11,9559,-11,57349,-11,13742,-11,465.84,136.88
1991,-11,17120,-11,48223,-11,-11,-11,497.11,151.17
1992,-11,5398,-11,-11,-11,-11,-11,365.17,-11
"T-0",,,,,,,,,
"T-1april",,,,,,,,,
"T-1october",,,,,,,,,
"T-2april",,,,,,,,,
"T-2october",,,,,,,,,
"T-3october",,,,,,,,,
"com-0",,,,,,,,,
"com-1",,,,,,,,,
```

Table 3.7.10 Recruitment prediction of 1-year old

Analysis by RCT3 ver3.1 of data from file :

pla4rec1.csv

"Plaice North Sea - 1-Y-Rcr.",,,,,,,,,

Data for 8 surveys over 26 years : 1967 - 1992

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 = 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
"T-0",	.50	1.64	.34	.584	19	10.09	6.67	.394	.091
"T-1ap	.55	1.22	.26	.703	19	9.23	6.34	.298	.159
"T-1oc	.71	-1.03	.22	.766	20	10.12	6.15	.256	.216
"T-2ap									
"T-2oc	.84	-1.53	.28	.669	21	9.32	6.33	.323	.135
"T-3oc	.54	2.38	.38	.533	22	7.72	6.52	.431	.076
"com-0	.79	1.78	.28	.669	15	6.15	6.66	.330	.130
"com-1	1.22	.31	.33	.598	15	4.81	6.19	.379	.098
					VPA Mean =		6.35	.384	.095

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
"T-0",	.52	1.45	.35	.567	19	9.17	6.19	.409	.117
"T-1ap									
"T-1oc	.74	-1.37	.23	.760	20	10.96	6.74	.270	.268
"T-2ap									
"T-2oc	.86	-1.71	.28	.681	21	9.53	6.50	.320	.191
"T-3oc									
"com-0	.83	1.54	.29	.654	15	6.15	6.66	.346	.163
"com-1	1.25	.18	.34	.588	15	4.93	6.33	.392	.127
					VPA Mean =		6.37	.383	.133

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
"T-0",	.55	1.15	.37	.545	19	9.75	6.48	.435	.137
"T-1ap									
"T-1oc	.78	-1.80	.23	.754	20	10.78	6.62	.275	.342
"T-2ap									
"T-2oc									
"T-3oc									
"com-0	.88	1.23	.31	.637	15	6.21	6.71	.368	.191
"com-1	1.28	.02	.35	.576	15	5.02	6.46	.410	.154
					VPA Mean =		6.38	.383	.177

Yearclass = 1992

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
"T-0",	.59	.75	.39	.520	19	8.59	5.79	.504	.225
"T-1ap									
"T-1oc									
"T-2ap									
"T-2oc									
"T-3oc									
"com-0	.95	.84	.32	.621	15	5.90	6.42	.384	.388
"com-1									
					VPA Mean =		6.40	.384	.387

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	582	6.37	.12	.07	.36		
1990	676	6.52	.14	.09	.38		
1991	699	6.55	.16	.06	.13		
1992	529	6.27	.24	.18	.59		

Table 3.7.11 Recruitment prediction of 2-year old

Analysis by RCT3 ver3.1 of data from file :

pla4rec2.csv

"Plaice North Sea - 2-Y-Recr.",,,,,,,,,

Data for 8 surveys over 26 years : 1967 - 1992

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 = 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
"T-0",	.50	1.53	.34	.591	19	10.09	6.56	.391	.091
"T-1ap	.56	1.10	.26	.710	19	9.23	6.23	.295	.160
"T-1oc	.71	-1.16	.22	.772	20	10.12	6.04	.253	.218
"T-2ap									
"T-2oc	.85	-1.66	.28	.672	21	9.32	6.22	.323	.134
"T-3oc	.54	2.28	.37	.540	22	7.72	6.42	.428	.076
"com-0	.79	1.68	.28	.682	15	6.15	6.56	.323	.134
"com-1	1.23	.15	.33	.597	15	4.81	6.08	.384	.095
					VPA Mean =		6.24	.387	.093

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
"T-0",	.52	1.34	.35	.574	19	9.17	6.08	.406	.118
"T-1ap									
"T-1oc	.74	-1.50	.22	.765	20	10.96	6.64	.268	.271
"T-2ap									
"T-2oc	.87	-1.86	.28	.682	21	9.53	6.40	.321	.188
"T-3oc									
"com-0	.83	1.45	.29	.666	15	6.15	6.55	.339	.169
"com-1	1.26	.02	.34	.586	15	4.93	6.23	.396	.124
					VPA Mean =		6.26	.385	.131

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
"T-0",	.55	1.05	.37	.552	19	9.75	6.38	.432	.137
"T-1ap									
"T-1oc	.78	-1.92	.23	.759	20	10.78	6.51	.273	.344
"T-2ap									
"T-2oc									
"T-3oc									
"com-0	.88	1.15	.30	.649	15	6.21	6.61	.361	.196
"com-1	1.29	-.13	.35	.575	15	5.02	6.35	.413	.150
					VPA Mean =		6.28	.385	.173

Yearclass = 1992

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
"T-0",	.59	.66	.39	.526	19	8.59	5.69	.499	.226
"T-1ap									
"T-1oc									
"T-2ap									
"T-2oc									
"T-3oc									
"com-0	.94	.76	.31	.632	15	5.90	6.32	.376	.397
"com-1									
					VPA Mean =		6.29	.386	.377

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	525	6.26	.12	.07	.37		
1990	610	6.41	.14	.09	.39		
1991	631	6.45	.16	.06	.13		
1992	476	6.17	.24	.18	.59		

Table 3.7.12 Recruitment prediction of 3-year old

Analysis by RCT3 ver3.1 of data from file :

pla4rec3.csv

"Plaice North Sea - 3-Y-Recr.",,,,,,,,,

Data for 8 surveys over 26 years : 1967 - 1992

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 = 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
"T-0",	.52	1.11	.35	.591	19	10.09	6.35	.406	.085
"T-1ap	.58	.65	.27	.707	19	9.23	6.00	.309	.147
"T-1oc	.74	-1.64	.22	.781	20	10.12	5.80	.257	.214
"T-2ap									
"T-2oc	.87	-2.11	.28	.688	21	9.32	5.99	.323	.135
"T-3oc	.53	2.13	.34	.609	22	7.72	6.18	.387	.094
"com-0	.80	1.38	.27	.715	15	6.15	6.33	.310	.146
"com-1	1.27	-.27	.34	.607	15	4.81	5.84	.390	.092
					VPA Mean =		6.01	.402	.087

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
"T-0",	.54	.93	.36	.573	19	9.17	5.85	.422	.110
"T-1ap									
"T-1oc	.77	-1.98	.23	.773	20	10.96	6.42	.272	.266
"T-2ap									
"T-2oc	.89	-2.28	.28	.700	21	9.53	6.17	.319	.193
"T-3oc									
"com-0	.84	1.16	.28	.700	15	6.15	6.32	.326	.185
"com-1	1.29	-.37	.35	.599	15	4.93	6.00	.400	.123
					VPA Mean =		6.03	.399	.123

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
"T-0",	.57	.63	.38	.548	19	9.75	6.15	.449	.129
"T-1ap									
"T-1oc	.81	-2.39	.23	.766	20	10.78	6.29	.277	.339
"T-2ap									
"T-2oc									
"T-3oc									
"com-0	.89	.87	.29	.682	15	6.21	6.38	.347	.216
"com-1	1.32	-.49	.35	.591	15	5.02	6.13	.414	.152
					VPA Mean =		6.05	.398	.164

Yearclass = 1992

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
"T-0",	.61	.22	.41	.519	19	8.59	5.44	.522	.208
"T-1ap									
"T-1oc									
"T-2ap									
"T-2oc									
"T-3oc									
"com-0	.95	.51	.30	.663	15	5.90	6.10	.362	.433
"com-1									
					VPA Mean =		6.07	.398	.359

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	419	6.04	.12	.07	.39		
1990	489	6.19	.14	.09	.39		
1991	507	6.23	.16	.06	.13		
1992	383	5.95	.24	.18	.60		

Table 3.7.13 North Sea Plaice VPA summary (with SOP corrected weights)

YEAR	RECRUITS millions	TOTBIO kt	SSBIO kt	LANDINGS kt	SOP	F2_10u	FBC	FBP
58	431	472	362	73	1.063	0.21	0.25	0.14
59	434	469	354	79	1.022	0.22	0.24	0.14
60	406	503	373	88	1.007	0.24	0.28	0.15
61	359	472	361	86	1.016	0.23	0.28	0.14
62	317	550	436	87	0.967	0.23	0.28	0.14
63	314	562	453	107	1.019	0.26	0.32	0.15
64	1019	634	432	111	1.008	0.27	0.30	0.16
65	309	589	422	97	1.006	0.27	0.30	0.16
66	305	602	428	102	1.018	0.26	0.31	0.15
67	276	607	508	109	1.020	0.24	0.29	0.14
68	245	567	472	112	1.029	0.22	0.23	0.14
69	327	560	446	122	1.058	0.25	0.26	0.16
70	369	515	392	130	0.974	0.33	0.38	0.20
71	275	521	389	114	1.033	0.32	0.30	0.18
72	234	511	389	123	1.028	0.34	0.31	0.20
73	540	514	353	130	1.051	0.38	0.39	0.23
74	451	484	320	113	1.037	0.39	0.43	0.22
75	335	524	339	109	1.062	0.37	0.38	0.19
76	324	461	322	114	1.025	0.31	0.30	0.19
77	470	479	330	119	1.002	0.33	0.33	0.21
78	428	456	311	114	0.964	0.33	0.34	0.21
79	441	471	309	145	0.998	0.46	0.45	0.25
80	657	491	299	140	1.014	0.40	0.50	0.26
81	421	493	310	140	1.018	0.40	0.46	0.26
82	1020	559	300	155	1.006	0.44	0.55	0.26
83	586	546	324	144	0.994	0.42	0.49	0.25
84	605	552	323	158	0.984	0.39	0.43	0.23
85	543	537	351	160	0.980	0.38	0.45	0.24
86	1355	656	355	165	0.988	0.45	0.47	0.25
87	570	643	391	160	1.000	0.40	0.48	0.23
88	568	636	380	162	0.985	0.42	0.45	0.20
89	404	592	423	170	0.989	0.37	0.38	0.21
90	471	569	400	168	0.984	0.38	0.42	0.22
91	676	489	333	154	0.967	0.47	0.47	0.24
92	699	537	319	121	0.983	0.46	0.45	0.22
93	529							

Recruits age 1 in the given year; values 1991 - 93 are RCT3 predictions

Table 3.7.14

Plaice in the North Sea (Fishing Area IV)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	6223.336	8.647	5869.012	8.647	5869.012
0.2000	0.0912	0.409	212.622	6.423	2747.639	4.571	2395.809	4.571	2395.809
0.4000	0.1824	0.555	243.181	4.970	1683.207	3.127	1333.816	3.127	1333.816
0.6000	0.2736	0.627	244.515	4.261	1236.826	2.427	889.824	2.427	889.824
0.8000	0.3648	0.668	241.086	3.850	1013.568	2.025	668.902	2.025	668.902
1.0000	0.4560	0.696	237.762	3.583	886.544	1.766	544.165	1.766	544.165
1.2000	0.5472	0.715	235.351	3.395	806.388	1.586	466.246	1.586	466.246
1.4000	0.6384	0.730	233.777	3.253	751.367	1.453	413.414	1.453	413.414
1.6000	0.7295	0.741	232.824	3.141	710.977	1.349	375.167	1.349	375.167
1.8000	0.8207	0.751	232.300	3.049	679.734	1.265	346.021	1.265	346.021
2.0000	0.9119	0.759	232.064	2.972	654.572	1.196	322.912	1.196	322.912
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YIELD1
Date and time : 10OCT93:16:35
Computation of ref. F: Simple mean, age 2 - 10
F-0.1 factor : 0.2345
F-max factor : 0.5127
F-0.1 reference F : 0.1069
F-max reference F : 0.2338
Recruitment : Single recruit

Table 3.7.15 Prediction and Y/R input.

Plaice in the North Sea (Fishing Area IV)
Plaice in the North Sea (Fishing Area IV)

Prediction with management option table: Input data

Year: 1993								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	529000.00	0.1000	0.0000	0.0000	0.0000	0.137	0.0036	0.250
2	631000.00	0.1000	0.5000	0.0000	0.0000	0.238	0.1083	0.278
3	489000.00	0.1000	0.5000	0.0000	0.0000	0.267	0.3346	0.295
4	232595.00	0.1000	1.0000	0.0000	0.0000	0.286	0.5616	0.315
5	102213.00	0.1000	1.0000	0.0000	0.0000	0.334	0.7175	0.360
6	59317.000	0.1000	1.0000	0.0000	0.0000	0.408	0.6263	0.443
7	40324.000	0.1000	1.0000	0.0000	0.0000	0.505	0.5254	0.551
8	46790.000	0.1000	1.0000	0.0000	0.0000	0.617	0.4605	0.652
9	9884.000	0.1000	1.0000	0.0000	0.0000	0.679	0.4133	0.732
10	5103.000	0.1000	1.0000	0.0000	0.0000	0.747	0.3562	0.795
11	4014.000	0.1000	1.0000	0.0000	0.0000	0.886	0.2998	0.915
12	4211.000	0.1000	1.0000	0.0000	0.0000	0.990	0.3224	0.978
13	1767.000	0.1000	1.0000	0.0000	0.0000	0.976	0.2969	1.019
14	1217.000	0.1000	1.0000	0.0000	0.0000	0.887	0.4049	0.937
15+	2590.000	0.1000	1.0000	0.0000	0.0000	0.998	0.4049	1.051
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	511000.00	0.1000	0.0000	0.0000	0.0000	0.137	0.0036	0.250
2	.	0.1000	0.5000	0.0000	0.0000	0.238	0.1083	0.278
3	.	0.1000	0.5000	0.0000	0.0000	0.267	0.3346	0.295
4	.	0.1000	1.0000	0.0000	0.0000	0.286	0.5616	0.315
5	.	0.1000	1.0000	0.0000	0.0000	0.334	0.7175	0.360
6	.	0.1000	1.0000	0.0000	0.0000	0.408	0.6263	0.443
7	.	0.1000	1.0000	0.0000	0.0000	0.505	0.5254	0.551
8	.	0.1000	1.0000	0.0000	0.0000	0.617	0.4605	0.652
9	.	0.1000	1.0000	0.0000	0.0000	0.679	0.4133	0.732
10	.	0.1000	1.0000	0.0000	0.0000	0.747	0.3562	0.795
11	.	0.1000	1.0000	0.0000	0.0000	0.886	0.2998	0.915
12	.	0.1000	1.0000	0.0000	0.0000	0.990	0.3224	0.978
13	.	0.1000	1.0000	0.0000	0.0000	0.976	0.2969	1.019
14	.	0.1000	1.0000	0.0000	0.0000	0.887	0.4049	0.937
15+	.	0.1000	1.0000	0.0000	0.0000	0.998	0.4049	1.051
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1995								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	.	0.1000	0.0000	0.0000	0.0000	0.137	0.0036	0.250
2	.	0.1000	0.5000	0.0000	0.0000	0.238	0.1083	0.278
3	.	0.1000	0.5000	0.0000	0.0000	0.267	0.3346	0.295
4	.	0.1000	1.0000	0.0000	0.0000	0.286	0.5616	0.315
5	.	0.1000	1.0000	0.0000	0.0000	0.334	0.7175	0.360
6	.	0.1000	1.0000	0.0000	0.0000	0.408	0.6263	0.443
7	.	0.1000	1.0000	0.0000	0.0000	0.505	0.5254	0.551
8	.	0.1000	1.0000	0.0000	0.0000	0.617	0.4605	0.652
9	.	0.1000	1.0000	0.0000	0.0000	0.679	0.4133	0.732
10	.	0.1000	1.0000	0.0000	0.0000	0.747	0.3562	0.795
11	.	0.1000	1.0000	0.0000	0.0000	0.886	0.2998	0.915
12	.	0.1000	1.0000	0.0000	0.0000	0.990	0.3224	0.978
13	.	0.1000	1.0000	0.0000	0.0000	0.976	0.2969	1.019
14	.	0.1000	1.0000	0.0000	0.0000	0.887	0.4049	0.937
15+	.	0.1000	1.0000	0.0000	0.0000	0.998	0.4049	1.051
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PRED1
Date and time: 10OCT93:15:21

Table 3.7.16 Catch prediction

Plaice in the North Sea (Fishing Area IV)

Plaice in the North Sea (Fishing Area IV)

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4560	551144	338101	143089	0.0000	0.0000	531424	336098	0	581085	468445
.	.	.	.	.	0.2000	0.0912	.	336098	35129	546240	434873
.	.	.	.	.	0.4000	0.1824	.	336098	67139	514604	404483
.	.	.	.	.	0.6000	0.2736	.	336098	96343	485846	376945
.	.	.	.	.	0.8000	0.3648	.	336098	123021	459673	351968
.	.	.	.	.	1.0000	0.4560	.	336098	147423	435824	329288
.	.	.	.	.	1.2000	0.5472	.	336098	169773	414064	308674
.	.	.	.	.	1.4000	0.6384	.	336098	190269	394185	289918
.	.	.	.	.	1.6000	0.7295	.	336098	209090	376002	272833
.	.	.	.	.	1.8000	0.8207	.	336098	226397	359348	257256
.	.	.	.	.	2.0000	0.9119	.	336098	242333	344075	243036
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED4
Date and time : 10OCT93:16:31
Computation of ref. F: Simple mean, age 2 - 10
Basis for 1993 : F factors

Table 3.7.17 Sensitivity by analysis input

NS Plaice sensitivity analysis input

Input Values

name,	value,	uncertainty
pn1 ,	529000.0000,	.24
pn2 ,	631000.0000,	.16
pn3 ,	489000.0000,	.14
pn4 ,	233000.0000,	.13
pn5 ,	102000.0000,	.14
pn6 ,	59000.0000,	.17
pn7 ,	40000.0000,	.17
pn8 ,	47000.0000,	.17
pn9 ,	10000.0000,	.18
pn10,	5000.0000,	.17
pn11,	4000.0000,	.17
pn12,	4000.0000,	.16
pn13,	2000.0000,	.18
pn14,	1000.0000,	.19
sl1 ,	.0040,	.20
sl2 ,	.1080,	.19
sl3 ,	.3350,	.15
sl4 ,	.5620,	.11
sl5 ,	.7180,	.08
sl6 ,	.6260,	.11
sl7 ,	.5250,	.19
sl8 ,	.4610,	.22
sl9 ,	.4130,	.21
sl10,	.3560,	.32
sl11,	.3000,	.18
sl12,	.3220,	.34
sl13,	.2970,	.31
sl14,	.4050,	.48
m1 ,	.1000,	.10
m2 ,	.1000,	.10
m3 ,	.1000,	.10
m4 ,	.1000,	.10
m5 ,	.1000,	.10
m6 ,	.1000,	.10
m7 ,	.1000,	.10
m8 ,	.1000,	.10
m9 ,	.1000,	.10
m10 ,	.1000,	.10
m11 ,	.1000,	.10
m12 ,	.1000,	.10
m13 ,	.1000,	.10
m14 ,	.1000,	.10
r94 ,	511000.0000,	.42
r95 ,	511000.0000,	.42
f93 ,	1.0000,	.10
f94 ,	1.0000,	.10
f95 ,	1.0000,	.10
m93 ,	1.0000,	.10
m94 ,	1.0000,	.10
m95 ,	1.0000,	.10

Table 3.7.18 Medium term prediction input

```
Plaice in area IV
Minimum and maximum ages
1,14
Number of fleets
1
Type of fleet
1
Base stock levels (numbers)
529000, .24
631000, .16
489000, .14
233000, .13
102000, .14
 59000, .17
 40000, .17
 47000, .17
 10000, .18
  5000, .17
  4000, .17
  4000, .16
  2000, .18
  1000, .19
Natural mortality at age
.1
.1
.1
.1
.1
.1
.1
.1
.1
.1
.1
.1
.1
.1
Weight at age (catch)
.25
.278
.259
.315
.360
.443
.551
.652
.732
.795
.915
.978
1.019
.937
Weight at age (stock)
.137
.238
.267
.286
.334
.408
.505
.617
.679
.747
.886
.990
.976
.887
Fishing selectivity at age (F)
.004
.108
.335
.562
.718
.626
.525
.461
.413
.356
.300
.322
.297
.405
Proportional maturity at age
0
.5
.5
1
1
1
1
1
1
1
1
1
1
1
Mean and variance of log(recruitment)
1203, 47
```

Table 3.7.19 Plaice, North Sea

Assessment Quality Control Diagram 1

Average F(2-10,u)						
Date of assessment	Year					
	1987	1988	1989	1990	1991	1992
1989	0.39	0.44				
1990	0.48	0.60	0.55			
1991	0.48	0.56	0.53	0.56		
1992	0.43	0.44	0.38	0.39	0.46	
1993	0.40	0.42	0.37	0.38	0.47	0.46

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F							
Date of assessment	Year						
	1988	1989	1990	1991	1992	1993	1994
1989	172.6	182.0	171.0				
1990	172.6	180.5	189.0	169.0			
1991		169.6	167.7	164.0	160.0		
1992			167.7	153.7	170.6	170.2	
1993				165.8	123.6	143	147
				SQC[1]	SQC[2]	Current	Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2) - F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1) - F(y)\}\right]$$

where F(y), F(y-1) and F(y-2) are as estimated in the assessment made in year (y+1).

Remarks:

Continued

Table 3.7.19 Continued

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: Millions						
Date of assessment	Year class					
	1988	1989	1990	1991	1992	1993
1989	612	750				
1990	574[1]	584[1]	588[1]			
1991	594[1]	617[1]	696[1]	690[1]		
1992	581[1]	598[1]	750[1]	687[1]	567[1]	
1993	404	471	676[1]	699[1]	529[1]	n/a

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	361	385	364[1]	361[1]				
1990	348	382	377	345[1]	326[1]			
1991	341	383	376	355	354[1]	357[1]		
1992	377	433	402	346	385	378[1]	369[1]	
1993	386	429	406	345	325	388	336[1]	329[1]

[1]Forecast.

Remarks: