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PART 1

REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

Aberdeen, UK, 18-29 April 1988

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ROUNDFISH WORKING GROUP MOTTO

Wherever you go
And whatever you do
Y'all remember to KEEP IT COUNTRY (old horse)
'Cos if you ain't COUNTRY
You ain't about to be one bit COOL!!

Cannon N. (1979-present)

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1 PARTICIPANTS

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2 TERMS OF REFERENCE

The terms of reference for this Working Group are given in C.Res.1987/2:3:13:

"The North Sea Roundfish Working Group (Chairman: Mr D.W. Armstrong) will meet in Aberdeen from 18-29 April 1988 to:

a) describe the areas of distribution of the stocks assessed and the areas of the various fisheries exploiting these stocks and evaluate the validity of the present stock unit definitions for assessment and management purposes;

b) assess the status of and provide catch options for 1989 within safe biological limits for the stocks of cod, haddock, whiting, and saithe in Sub-areas IV and VI (including Division IIIa for saithe); cod, haddock, and whiting in Divisions VIId,e and Divisions VIIb,c,h-k (including Division VIIg for haddock); and saithe in Sub-area VII;

c) provide quarterly catch-at-age and catch and stock mean weight-at-age data and information on the relative distribution at different ages by quarter for cod, haddock, whiting, and saithe in the North Sea for 1986 and 1987 as input for the multispecies VPA;

d) assess the effects of the cod box in the German Bight;

e) consider and propose technical measures to improve the exploitation pattern for North Sea cod."

2.1 Data Base Revisions

Preliminary data were prepared for 1987 and amendments were made to the data for 1986.

Source data files for 1986 and 1987 were supplied to ICES on floppy disk and these can be worked up on the IBM microcomputer using programs made available to ICES at last year's meeting.

Revised Norwegian age composition data were presented for saithe in the North Sea for the period 1980-1985 and the appropriate data base was amended.

2.2 Problems in Maintaining a Valid Data Base

Problems are still in evidence in obtaining sufficiently detailed and accurate landings statistics for the Netherlands. No information is available on the weight landed by gear or the composition of these weights by market category and this leads to problems and possibly to errors in assemblin catch-at-age data. In addition, effort data per gear are still not available.

Problems in sampling the by-catch in the Danish industrial fisheries appear to have been resolved in the last two quarters of 1987 and it is t be hoped that this situation persists.

3 MANAGEMENT AREAS AND ASSESSMENT AREAS

This topic is raised in the context of the first of the terms of reference given in Section 2 of this report. If interpreted literally, this term of reference would have given rise to an amount of work which the Group could not have encompassed at this meeting. A restricted interpretation was, therefore, applied, and the Group attempted to identify situations where assessment and management areas are in some way inappropriate.

The Group is not aware of major problems for the majority of the stocks dealt with in this report.

The following problems were, however, identified:

3.1 Haddock in Sub-area VI

This Group, ACFM, and the Scientific and Technical Committee for Fisheries of the EEC (STCF) have all commented previously that this management area is inappropriate. The haddock stocks in Divisions VIa (West of Scotland) and VIb (Rockall) are completely distinct. The Rockall haddock stock is subject to extreme fluctuations in abundance. When abundance is high at Rockall, a high TAC for this area is justified. However, under the current management regime, this TAC would be added to the TAC for West of Scotland. Thus, there is nothing to prevent attempts being made to take the whole of the combined TAC from West of Scotland or from Rockall. This could result in very deleterious effects on either stock.

The Group recognizes that there are problems in enforcing separate TACs for Rockall and West of Scotland, but would appreciate being informed of how these problems differ in principle from the enforcement of, for example, the existing TACs for the North Sea (Sub-area IV) and Sub-area VI.

3.2 Cod in Sub-areas VII (excluding Division VIIa), VIII, IX, and X and CECAF (EEC zone) and Whiting in Sub-area VII (excluding Division VIIa)

In this report, analytical assessments of the cod and whiting stocks in Divisions VIId,e are presented together with associated catch and biomass predictions. The catch-at-age data on which these assessments are based are poor, and the Group has little confidence in the results presented.

Catch-at-age data for other parts of the management areas are virtually non-existent and are certainly not good enough to allow the construction of catch-at-age arrays.

Furthermore, adequate indices of recruitment for either species do not exist for any part of the respective management areas.

Given this state of affairs, it is not possible for the Group to propose a more rational system of management areas.

4 QUARTERLY DATA

The terms of reference for the Working Group include the provision of quarterly catch-at-age and catch and stock weight-at-age data for roundfish stocks in the North Sea for 1986 and 1987. These data are required as input to the MSVPA. The Group was not able to supply these data on computer files, but will supply the source data to the chairman of the Multispecies Working Group.

A request for information on the relative distribution of roundfish stocks by age and by quarter for 1986 and 1987 has also been made - again as input to the Multispecies Working Group. It is the opinion of the Working Group that such information would most easily be obtained directly from the coordinators of various national surveys in the form of CPUE by rectangle and quarter.

5 EFFECTS OF THE COD BOX IN THE GERMAN BIGHT

Although the Working Group was asked in its terms of reference to assess the effects of the cod box in the German Bight, the Group did not consider this topic in detail, because it did not have available the necessary data, e.g., catch data per statistical rectangle from commercial fisheries and surveys, information on the displacement of the fishery from the cod box to other fishing grounds, and information on the enforcement of the minimum mesh size inside the cod box (quarters 1 and 4 in 1987, quarter 1 in 1988).

The Working Group stresses the need to reduce the fishing mortality on the youngest age groups to give the spawning stock a chance to recover. Although measures like the cod box are likely to have a positive effect on the management of the North Sea cod, it was doubted whether any effect is to be expected as long as the minimum mesh size for bottom trawls fishing in the cod box is 100 mm and not 120 mm, as recommended by ACFM and STCF.

6 IMPROVEMENT IN THE EXPLOITATION PATTERN OF NORTH SEA COD

6.1 Mesh Change as a Measure to Improve the Exploitation Pattern of North Sea Roundfish Stocks

The long-term effects on yield and biomass resulting from changes in minimum mesh size for the fishery on North Sea roundfish species have previously been considered in the context of single-species yield-per-recruit models. Results of these analyses show that appropriate increases in mesh size will increase long-term yield and biomass.

In view of the growing acceptance for the use of the multispecies approach and mixed-fishery models, these classical results may be questioned.

A working paper (Lewy and Gislason, 1988), which compares mixed-fishery models, mesh assessment to single-species mesh assessment was presented to the Group.

The paper combines multispecies predictions made by last year's Multispecies Working Group and standard mesh assessment techniques. The multispecies predictions are made under the assumption that all demersal roundfish stocks are subject to the same changes in legal minimum mesh size. A single-species mesh assessment was further carried out under conditions similar to multispecies predictions in order to compare the two approaches. Both methods assume that present mesh size is 85 mm, and changes are related to this mesh size.

The results are summarized in the Figures 1-4 of the working paper.

The results indicate that multispecies mesh assessment not surprisingly deviates considerably from the single-species approach.

For North Sea cod, haddock, and whiting, the multispecies approach results in declining landings and, in the case of haddock, in declining biomasses too.

The discrepancies between the two approaches are caused by predators in the multispecies model which apparently are important competitors to the fishery.

The main conclusion of these new results is that reduction in fishing pressure on young demersal fish, for instance by mesh size increases, does not necessarily lead to long-term gains in yields and biomasses.

The Group stresses that the above results should be treated with extreme caution.

The problems indicated in last year's Working Group report still apply to the present assessments. Furthermore, the realism of long-term multispecies predictions could be questioned, especially when major changes in stock and food composition occur. Are, for instance, suitability coefficients independent of food composition, or may switching change them? Such problems may be relevant when minimum mesh size is raised to 120 mm.

Against this background, the Group recommends that further investigations on the subject have to be encouraged before more specific mesh assessment advice can be given.

6.2 Other Technical Measures

It would be possible to propose other technical measures such as seasonal closures of the fishery for cod. However, while it may be demonstrable that such measures should be beneficial to cod, it is equally important to quantify the effects on all other major stocks and associated fisheries. Expertise and information not available to the Group are required to do the latter.

It should be noted that the STCF has recently initiated a programme of work to allow quantification of the effect of any technical measure on all of the major stocks and fisheries in the North Sea. The first stage of this process is to create an appropriate data base, and this is currently in progress. STCF is willing to make this data base and associated programmes available to ICES and any other competent party.

The Group, therefore, considers it wiser to await the outcome of these developments before suggesting new technical measures.

7 ESTIMATES OF RECRUITMENT

7.1 Recruitment Indices

The ICES IYFS data base is now fully operational and final indices for the International Young Fish Surveys in 1986 and 1987 were available (Anon., 1987a). At the beginning of the meeting, the data base contained all length compositions for the 1988 IYFS and age/length keys for all areas from England, Scotland, and the Netherlands. Indices calculated from these data were provided by the ICES Secretariat. Although these indices are still to be considered preliminary, they are not expected to deviate significantly from the final ones.

The indices for the English and Scottish groundfish surveys were recalculated resulting in slight differences from the ones which were used last year. The indices for the Dutch Groundfish Survey were updated.

The indices for the by-catch of cod in the shrimp fisheries by the Federal Republic of Germany were updated. But since this index is essentially based on the catch of 0- and 1-group fish, the index for the 1987 year class is provisional.

7.2 Use of Indices

In recent years, the number of survey indices available for the estimation of recruitment for many stocks has multiplied. This has given rise to the need for a combined recruitment estimate which uses the information from all the surveys and the VPA. The ACFM recommended procedure for doing this is the simple calibration method as performed by the program RCRTINX2. This method was used with the following options:

a) calibration regression,

b) shrinkage towards the mean,

c) minimum variance of prediction of 0.2 for any estimate,

d) a minimum of 5 data points in regression,

e) tri-cubic weighting.

In addition to the simple calibration method outlined above, two other methods were tried. These were multicalibration and factor analysis. Multicalibration is an extension of the RCRTINX2 method in which the unknown recruitment value is treated as a parameter common to all the regressions. In RCRTINX2, the unknown parameter is estimated separately from each regression and the estimates are combined by inverse variance weighting. Multicalibration is described in Appendix E of the 1987 Methods Working Group report (Anon., 1987b) and was implemented in program CALIB (available in the ICES computer).

Factor analysis is a standard statistical technique (Harman, 1967). It differs from the calibration methods in accommodating errors in the VPA. In effect, it treats the VPA as another survey and calculates the regressions of the surveys and VPA on an unobserved true recruitment series. The recruitment values are then estimated as parameters using the regression coeffients. The implementation used here was least squares factor analysis with the unobserved recruitment values estimated using Bartlett's method. The program used was LSFACT which is also available on the ICES computer.

The results of the methods for the major Sub-area IV and Division VIa stocks are given in Tables 7.1 and 7.2. The values obtained from RCRTINX2 were adopted throughout since it is the ACFM recommended procedure. The values obtained from the other methods are generally very similar.

8 TUNING METHODS

The Group employed the Laurec/Shepherd tuning method, described in Pope and Shepherd (1985), to estimate terminal fishing

mortalities. The method uses log-transformed, disaggregated fleet data, combining estimated Fs by inverse variance weighting. The method was chosen because its assumption of locally constant catchability results in more robust fishing mortality estimates compared to those obtained using less constrained methods such as the Hybrid method (Pope and Shepherd, 1985), in which trends in catchability are permitted.

All VPAs have been tuned using the same method as described above with data from 1971-1987 using a tri-cubic taper to estimate mean catchabilities and with Fs on the oldest ages being estimated as the unweighted mean of the five younger ages.

The text table below indicates which commercial effort data and associated age compositions, together with survey effort and CPUE-at-age compositions have been used by the Working Group to tune each stock. The survey data have been included in the relevant stock sections of this report (Sub-section 5 of Sections 10-20 where appropriate); the commercial data have not been reproduced, but are available from the ICES Secretariat or the Chairman of this Working Group. Also included for diagnostic purposes (Sub-section 6 of Sections 10-20 where appropriate) are summary statistics from tuning runs and plots of estimated catchability at age through time (Flatman and Stevens, 1987).

Tuning Data Sources as used for Eight Major Stocks

		Stock							
Country	Fleet	COD IV	COD VIa	HAD IV	HAD VIa	WHI IV	WHI VIa	SAI IV	SAI VIa
Scotland	GFS	+		+		+			
	TRL	+	+	+	+	+	+	+	+
	SEI	+	+	+	+	+	+	+	+
	LTR	+	+	+	+	+	+	+	+
	NTR	+	+	+	+	+	+		
England	GFS	+		+		+			
	TRL	+							
	SEI	+							
France	ALL		+		+			+	+
Netherlands	DGFS	+				+			
International	IYFS	+		+		+			
Norway	TRL							+	

There is no discussion this year concerning which fleets have been used to tune the various VPAs. This is because all available fleets have been used for each stock; the Laurec/Shepherd method utilizes all the data and combines the estimates of fishing mortality as described above.

9 OTHER MATTERS

9.1 Name of the Working Group

At present, the Group is called "The North Sea Roundfish Working Group". It is suggested that the name be changed to "The Roundfish Working Group" since activities are no longer restricted to stocks in the North Sea and also because specific reference to the North Sea has inhibited participation of scientists whose immediate research interest lies in other areas.

9.2 Increase in the Minimum Legal Mesh Size in the North Sea

From 1 January 1989, the legal minimum mesh size in the North Sea will be 90 mm. The Group was not specifically requested to take account of this change when carrying out its catch and biomass predictions for 1989.

The Group has previously commented on difficulties in carrying out a valid mesh assessment for the North Sea. In particular, the true mesh size in use and the true number of vessels using each mesh size is not sufficiently well known. However, the proposed mesh increase is small and is unlikely to create major problems in the short or long term.

In addition to these considerations, new information (mostly unpublished at present) indicates that selectivity is by no means solely determined by mesh size, but is also determined by the dimensions of other parts of the nets. It appears that the effect of any increase in mesh size can be nullified by (legally acceptable) alterations to other parts of the nets, and this possibility needs to be considered when carrying out mesh assessments.

9.3 Collection of Data on Discards

The Group notes that UK (Scotland) is currently the only nation routinely collecting appropriate data on the age composition, mean weight at age, and quantity discarded of the species dealt with in this report. These data are used to estimate discards for all other nations.

The Working Group on Methods of Fish Stock Assessments has previously commented that collection of data on discards is desirable where the level of discarding is significant (Anon., 1986).

Discarding is believed to occur at high levels in many fisheries relevant to the work of this Group and is not exclusively confined to the Scottish fleets. To enhance the quality of the assessments and predictions made by this Group, it is highly desirable that more sampling of discards is carried out. ACFM is requested to encourage other nations to initiate sampling programmes similar to that carried out in Scotland.

9.4 The Mixed Fishery for Gadoids

Following the suggestion of ACFM, the Working Group carried out a preliminary analysis of the likely catches of all four species in the North Sea using the MSFP multispecies catch forecast program made available by B. Mesnil. It was assumed that all species were caught together in two completely mixed fisheries (human consumption and industrial by-catch) as also assumed by ACFM in 1987, even though this is a considerable over-simplification of the situation. Starting data for the forecast were identical with those given in the tables giving results of the prediction.

The results are given for three assumptions: (a) maintenance of the 1987 levels of effort through 1988 and 1989, (b) reduction in effort in the human consumption fishery to 86% of the 1987 level in 1988, maintained at that level in 1989, (c) reduction in effort in the human consumption fishery to 86% of the 1987 level in 1988, and to 70% of the 1987 level in 1989.

Scenario (a) represents status quo, whilst (b) corresponds to the reduction required to take the cod TAC in 1988, and (c) corresponds to a further reduction along the lines previously recommended by ACFM for cod (but applied to all species as the fishery is taken to be completely mixed).

The calculated catches and spawning stock biomasses for 1988 and 1989 are summarized in Tables 9.4.1-9.4.4 together with the effective agreed TACs for 1988.

It can be seen that neither of the assumptions for 1988 correspond to the TACs for that year. With a 14% reduction in effort (to take the cod TAC), there will be a substantial undershooting of the haddock TAC (as expected from information from the fishery), a small overshooting of the whiting TAC (which would probably be manifest as increased discarding in practice), and a small undershooting of the saithe TAC.

Apart from haddock, the mismatches are, however, probably within the margin of error of the calculations, and the assumption of a completely mixed fishery is in any case an over-simplification.

Under scenario (b), the forecast catches for 1989 differ very little from those calculated for the individual species separately (where status quo for 1988 was assumed for all species except cod).

Scenario (c) of course implies substantially reduced catches of all species, because of the reduced effort, with corresponding increases in biomasses above those which would otherwise be expected.

The simplest way to summarize these results is to observe that the total landings for cod, haddock, whiting, and saithe in 1989 are expected to be approximately in the ratio 1.00 : 0.60 : 0.95 : 1.00 and for consistency, the TACs for these species should be set in similar ratios.

10 COD IN SUB-AREA IV

10.1 Catch Trends

Official landings data are given in Table 10.1. Trends in landings (Working Group estimates) are shown in Figure 10.2A, which shows that they have declined since 1981. Recent landings are also given in Table 10.2. Landings in 1987 (provisional) were 173,585 t, an increase of 15,000 t on the estimate for 1986 of 158,348 t. Landings in 1987 were close to the agreed TAC of 175,000 t.

10.2 Natural Mortality and Maturity at Age

These values are given in Table 10.3.

10.3 Age Compositions

The VPA input data for recent years are given in Table 10.4, and they do not include discards or industrial fishery by-catches. Data for 1986 were revised, the main difference from last year's data being a 10% reduction in the number at age 2. Data for 1987 were provided by England, Scotland, Netherlands, Denmark, France, Belgium, and the Federal Repuplic of Germany. The 1985 year class was prominent in the landings in 1987, contributing 56% by weight and 73% by number.

10.4 Mean Weight at Age

Total international mean weights at age for the catch are given in Table 10.5. These were also used as stock weights at age.

10.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the analyses are given in the text table in Section 8. The research vessel indices and associated effort are given in Table 10.6.

10.6 VPA Tuning

Summary statistics of VPA tuning using the Laurec/Shepherd method are given in Table 10.7 and catchability plots are shown in Figure 10.1. F for the oldest age was set as the mean of ages 7-11. F at age and numbers at age resulting from the tuning are given in Tables 10.8 and 10.9, respectively.

10.7 Abundance Estimates of the 1986-1988 Year Classes at Age 1

The methods employed for deriving estimates of recruitment are described in Section 7 and the results are given in Table 7.1. The results from the RCRTINX2 method, used to derive final values, are given in Table 10.10.

10.7.1 The 1986 year class in 1987

This was estimated to be 254 million at age 1, which is close to the value of 268 million estimated by ACFM last year, and is also close to the value of 249 million implied by the tuned F in the VPA. The number at age 2 in 1988 implied by the use of mean F (see Section 8) is 97 million, which is identical to the estimate for age 2 in 1988 based on a predictive regression of IYFS index at age 2 against VPA number at age 2.

10.7.2 The 1987 year class in 1988

This was estimated to be 277 million at age 1. This may be compared to the preliminary value of 151 million estimated by ACFM last year, based on survey indices of 0-group cod only.

10.7.3 The 1988 and later year classes

These were set at 412 million at age 1, the mean value for the period 1968-1987.

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

Historical trends in mean fishing mortality, spawning stock biomass, and recruitment are shown in Table 10.11 and Figures 10.2B,C,D. Mean F peaked in 1982, after which it declined. Although the value estimated for 1987 reverses this trend, it may be artificially inflated by the high F value at age 3 for the poor 1984 year class. Spawning biomass is estimated to have fallen to a record low level of 95,000 t in 1987. No trend in recruitment is apparent. The two latest year classes (1986 and 1987) are estimated to be about 60% of average strength.

10.9 Catch Predictions

The input data for catch prediction are given in Table 10.12. The F value for age 1 (0.158) is the mean for the period 1983-1987 and differs from the tuned value (0.130) shown in the VPA (Table 10.8).

10.9.1 Status quo prediction

The results of the catch predictions are given in Tables 10.13 and 10.14 and Figure 10.3B. The status quo catch in 1988 (Table 10.13) is predicted to be 177,000 t, compared to 187,000 t predicted by ACFM last year. Spawning biomass is predicted to fall slightly from 96,000 t in 1988 to 92,000 t in 1989, with a further fall to 86,000 t in 1990.

10.9.2 Prediction assuming TAC taken in 1988

The TAC of 160,000 t for 1988 implies a reduction in F of 14% (Table 10.14). The same level of F in 1989 will result in a catch of 155,000 t, leading to a spawning stock of 105,000 t in 1990.

In its November 1987 assessment, ACFM assumed a catch of 190,000 t for 1987, including 15,000 t of discards. It indicated that estimates of discards should be included in future assessments. However, the Working Group was not able to provide estimates of discards for 1987, or to predict their magnitude in 1988 and 1989.

10.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 10.3A.

10.11 Safe Biological Limits

The stock/recruit relationship is shown in Figure 10.4. Values for F_{med} (0.72) and F_{high} (0.92) are shown in Figure 10.3A. The current level of F (0.86) is between F_{med} and F_{high} and spawning biomass is at the lowest level recorded in the VPA. The minimum spawning biomass advised by ACFM is 150,000 t.

11 COD IN DIVISION VIa

11.1 Catch Trends

Official landings data are given in Table 11.1. Trends in landings are shown in Figure 11.3A. Working Group estimates of landings are given in Table 11.2. Landings in 1987 were 19,456 t, which is 7,636 t greater than the landings in 1986 of 11,820 t. The agreed TAC for Sub-area VI was 22,000 t.

11.2 Natural Mortality and Maturity at Age

These values are given in Table 11.3.

11.3 Age Compositions

The VPA input data for recent years are given in Table 11.4 and they do not include discards or industrial fishery by-catches. Minor revisions were made to the 1986 data, and data for 1987 were provided by Scotland, England, Ireland, and France. The outstanding feature of the 1987 age composition was the number of 1-year-olds landed which, at 8 million fish, was 3.5 times greater than the previous highest value.

11.4 Mean Weight at Age

Total international mean weights at age for the catch are given in Table 11.5. These values were also used for the stock weights at age.

11.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the analyses are given in the text table in Section 8. The research vessel indices and associated effort are given in Table 11.6.

11.6 VPA Tuning

Summary statistics of VPA tuning using the Laurec/Shepherd method are given in Table 11.7 and catchability plots are shown in Figure 11.1. F for the oldest age was set as the mean of ages 4-8. F at age and number at age resulting from the tuning are given in Tables 11.8 and 11.9, respectively.

11.7 Abundance Estimates of the 1986-1988 Year Classes at Age 1

The results from the RCRTINX2 method are given in Table 11.10. These are presented for information since they were not used in the analysis (see below).

11.7.1 The 1986 year class in 1987

The tuned value at age 1 implies a stock number of 44.8 million which is twice the previous highest value, and it was decided not to accept that value. In past years, the 1-year-old recruits in the last data year have been estimated from a plot of CPUE of Scottish seiners against VPA. However, in 1987, this CPUE value was an order of magnitude higher than any previous value (Figure 11.2B), implying a correspondingly high year class. It was decided that it would not be valid to extrapolate the plot to the extent implied by the CPUE value. Various other abundance indices were examined and it was decided to use the relationship between CPUE for Scottish light trawlers and VPA (Figure 10.2C). This procedure resulted in an estimate of 16 million at age 1. This value is supported by the catches of 2-year-old cod in 1988 during the Scottish Division VIa Groundfish Survey (Table 11.6), which indicates a similar abundance to that of the 1983 year class. The estimate of 16 million implies an F of 0.8 in 1987 which is high for age 1, but not for other ages.

11.7.2 The 1987 and later year classes

The 1987 and later year classes were set at 12.9 million, the mean value for the period 1979-1987. This period was selected, following recent practice, in order to take account of increased recruitment in recent years.

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

Estimates of biomass, fishing mortality rates, and recruitment are given in Table 11.11 and plots are shown in Figure 11.3B,C,D. Spawning biomass has declined since 1981 to reach an historical low level in 1986 and has slightly increased in 1987. Mean fishing mortality shows a positive trend. Recruitment in the past decade has been at a higher level than in previous years.

11.9 Catch Predictions

11.9.1 Status quo prediction

The input data for catch prediction are given in Table 11.12. The F value for age 1 (0.208) is the mean for the period 1983-1986 and differs from the tuned value (0.221) shown in the VPA (Table 11.8). The results of the catch predictions are given in Table 11.13 and Figure 11.4B. The status quo catch in 1988 is predicted to be 18,000 t, with spawning biomass at 25,000 t at the start of 1989. The same F in 1989 would imply a catch of 18,000 t and a spawning biomass of 24,000 t at the start of 1990.

11.9.2 Prediction assuming TAC taken in 1988

This is not significantly different from the status quo catch prediction.

11.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 11.4A.

11.11 Safe Biological Limits

The stock/recruitment relationship is shown in Figure 11.5. Values for F_{med} (0.50) and F_{high} (0.64) are shown in Figure 11.4A. The current level of F (0.84) is well above F_{high} and spawning biomass is at an historically low level.

12 COD IN DIVISION VIb

No age composition data are available for the stock. Landings are small and are given in Table 12.1.

13 COD IN SUB-AREA VII

13.1 Cod in Divisions VIId,e

13.1.1 Catch trends

Recent official landings data are given in Table 13.1.1. Working Group estimates of landings are given in Table 13.1.2 and Figure 13.1.1A. Landings increased significantly to 6,897 t in 1986 and to 8,987 t in 1987. There is at present no separate TAC for this area.

13.1.2 Natural mortality and maturity at age

These values are given in Table 13.1.3.

13.1.3 Age compositions

The VPA input data are given in Table 13.1.4. Major revisions were made to the age composition data for 1986. Data for 1987 were provided by France and England. As for past years, the sampling levels for some fleets were low.

13.1.4 Mean weight at age

Total international mean weights at age for the landings are given in Table 13.1.5. These values were also used for the stock weights at age.

13.1.5 Commercial catch/effort data and research vessel indices

At present, no data are available for tuning the VPA or for providing recruitment indices.

13.1.6 VPA tuning

In the absence of any tuning data, mean values for the period 1980-1984 were used as input for 1987. A value of 1.0 was input for the oldest age in all years, based on inspection of trial VPA data. F at age and N at age are shown in Tables 13.1.6 and 13.1.7, respectively. The estimates of F in the VPA are rather erratic between years and between ages.

13.1.7 Abundance estimates of the 1986-1988 year classes at age 1

There are no recruitment surveys in this area. The VPA estimates for age 1 do not correlate with any index of recruitment in the North Sea (Table 10.6) or with VPA estimates from the North Sea (Figure 13.1.4). Output from RCTINX2 using North Sea abundance indices are provided for reference (Table 13.1.8).

13.1.7.1 The 1986 year class in 1987

In the absence of other data, the number implied by the use of mean F was accepted. The value is 13.5 million at age 1, which is the second highest on record.

13.1.7.2 The 1987 and later year classes

Mean recruitment for the period 1974-1987 was used, resulting in a value of 8 million at age 1.

13.1.8 Long-term trends in biomass, fishing mortality, and recruitment

Historical values are given in Table 13.1.9 and plotted in Figure 13.1.1B,C,D. Total biomass has apparently increased in recent years as a result of increased recruitment.

13.1.9 Catch predictions

13.1.9.1 Status quo prediction

The input data for catch prediction are given in Table 13.1.10, and the results are given in Table 13.1.11 and Figure 13.1.2B. The status quo catch in 1988 is predicted to be 10,000 t followed by 9,000 t in 1989. Spawning biomass is predicted to increase from 3,000 t in 1989 to 4,000 t in 1990.

13.1.9.2 Prediction assuming TAC taken in 1988

This is not significantly different from the status quo prediction.

13.1.10 Yield and biomass per recruit

Plots of yield and biomass per recruit are shown in Figure 13.1.2A.

13.1.11 Safe biological limits

The stock/recruit relationship is shown in Figure 13.1.3. Values for F_{med} (1.13) and F_{high} (1.90) are shown in Figure 13.1.2A. The current level of F is 1.13. There are no maturity data for cod in Divisions VIId,e, and spawning biomass has been calculated using a nominal knife-edge value. Therefore, no minimum spawning biomass level can be advised at present.

13.1.12 Validity of assessment

The data on which the assessment is based are less reliable than those for the North Sea stocks, and the reliability of the assessment is accordingly lower.

13.2 Cod in Divisions VIIb,c,h-k and Sub-areas VIII and IX

No age composition data are available. Official nominal landings data are given in Table 13.2.1.

14 NORTH SEA HADDOCK

14.1 Catch Trends

Official landings figures are given in Table 14.1. Total international catches and total international discards estimated by the Working Group are given in Table 14.2. Catch trends are plotted in Figure 14.2A for the period 1968-1987. Total human consumption landings in 1987 were 107,000 t, rather lower than the fairly stable range of catches (130,000-166,000 t) during the period 1981-1986. The industrial by-catch remains relatively low at 5,000 t.

The TAC for 1987 was 140,000 t, while preliminary data indicate that the human consumption catch was 107,000 t.

14.2 Natural Mortality and Maturity at Age

These values are given in Table 14.3.

14.3 Age Compositions

Total international catch-at-age data are given in Table 14.4. Age compositions for human consumption landings were provided by France, the Federal Republic of Germany, England, Denmark, Belgium, Netherlands, and Scotland. Age compositions for discards were provided by Scotland and for industrial by-catch by Denmark and Norway.

14.4 Mean Weights at Age

Total international mean weights at age for the catch are shown in Table 14.5. These weights were also used as stock mean weights at age.

14.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the analyses are given in the text table in Section 8. The research vessel indices and associated effort data are given in Table 14.6.

14.6 VPA Tuning

In common with other stocks, the Laurec/Shepherd method was used to tune the VPA (see Section 8). Summary statistics and catchability plots from tuning are given in Table 14.7 and Figure 14.1. The tuned F values for 1987 are in line with historical

values. Estimated F at age and numbers at age are given in Tables 14.8 and 14.9, respectively.

14.7 Abundance Estimates of the 1986-1988 Year Classes at Age 0 or 1

Methods for estimating recruitment are described in Section 7. Values derived from RCRTINX2 were used for the 1986 and 1987 year classes (Table 14.10).

14.7.1 The 1986 year class in 1987

The abundance of this year class at age 1 is estimated by RCRTINX2 to be 4,255 million which is close to the value obtained from the tuned F value of 4,740 million. The former value was used in predictions. The estimate of this year class represents a considerable downward revision of the previous estimate. This is because the earlier estimate was based only on the IYFS index. The current estimate uses additional data, and high weight is given to the SGFS index which predicts a lower value.

14.7.2 The 1987 year class in 1988

The 1987 year class at age 1 as estimated from RCRTINX2 is 825 million. This value is based on the IYFS index at age 1 and the EGFS index at age 0. The estimate is dominated by the IYFS value and has, to some extent, been shrunk towards the mean (Table 14.10). This appears to be the lowest year class for at least 20 years, but its precise size is uncertain. The size of this year class at age 0 is estimated to be 6,424 million (see input to prediction, Table 14.12).

14.7.3 The 1988 and subsequent year classes

These year classes were set to the mean for the period 1968-1987 at age 0 of 37,442 million.

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

Trends in biomass, mean fishing mortality rate, and recruitment are given in Table 14.11 and plotted in Figures 14.2B,C,D. Human consumption fishing mortality has increased from a low value in 1982 and is now estimated to be slightly higher than the previous highest value. Industrial by-catch fishing mortality has declined steadily since the early 1980s and is now at a very low level. Recruitment to this stock is highly variable but shows no trend. Year classes since the moderately good 1983 year class have been no better than average. Total stock biomass and spawning stock biomass have been relatively stable for the last 10 years. The present spawning stock biomass (140,000 t) is above the lowest value of 103,000 t.

14.9 Catch Predictions

Input data for catch predictions are given in Table 14.12. The F value at age 1 in 1987 used in the prediction is the mean value for the period 1983-1987 (0.145), higher than the tuned value of 0.137.

14.9.1 Status quo prediction

Table 14.13 and Figure 14.3B give the catch prediction results. The predicted total landings in 1988 are 112,000 t, well below the TAC of 185,000 t. This low estimate is the result of the downward revision of the 1986 year class from above average to average and the low estimate of the 1987 year class. The total status quo landings for 1989 are estimated to be 88,000 t. This low figure represents a fall to the catch levels in the late 1970s.

Spawning stock biomass is projected to fall from 140,000 t in 1987 to 112,000 t in 1989, assuming status quo catches and mean recruitment in 1988 and 1989.

14.9.2 Prediction assuming TAC taken in 1988

This prediction was not carried out since the TAC is unlikely to be taken.

14.10 Yield and Biomass per Recruit

Plots of yield per recruit and biomass per recruit are shown in Figure 14.3A

14.11 Safe Biological Limits

A stock and recruitment plot is given in Figure 14.4. There is no evidence at present that recruitment to this stock is reduced at the lowest levels of spawning stock which have been observed. However, recruitment in the last decade has not seen the very large year classes observed in the 1960s, and it may be that the stock is returning to recruitment values typical of the pre-1960s.

In the 1987 Working Group report, it was suggested that 100,000 t should be the lowest acceptable value for the spawning stock biomass. At present, the spawning stock is above this value, but appears to be in decline. The failure of another year class could easily precipitate the stock towards the lowest acceptable value.

15 HADDOCK IN DIVISION VIa

15.1 Catch Trends

Officially reported landings are given in Table 15.1. Total international catches and total international discards estimated by the Working Group are given in Table 15.2. Catch trends are plotted in Figure 15.4A for the period 1968-1987. Total human consumption landings in 1987 were 27,000 t, a slight increase over the previous two years.

15.2 Natural Mortality and Maturity at Age

These values are given in Table 15.3.

15.3 Age Compositions

Total international catch-at-age data are given in Table 15.4. Age compositions for human consumption landings were provided by France, England, Ireland, and Scotland. Age compositions for discards were provided by Scotland.

15.4 Mean Weights at Age

Total international mean weights at age for the catch are shown in Table 15.5. These weights were also used as stock mean weights at age.

15.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the analyses are given in the text table in Section 8. The research vessel indices and associated effort data are given in Table 15.6.

15.6 VPA Tuning

In common with other stocks, the Laurec/Shepherd method was used to tune the VPA (see Section 8). Summary statistics and catchability plots from tuning are given in Table 15.7 and Figure 15.1. The tuned F values for 1987 are in line with historical values. The 1986 Fs at age are very low compared to the 1987 and 1985 values, and this was not apparent in the 1987 Working Group assessment. The low Fs in 1986 can be explained, at least in part, by the effort data from Scottish fleets. Figure 15.2 shows partial F for four Scottish gears and effort plotted against year. It can be seen that the effort data track the partial Fs.

Estimated F at age and numbers at age are given in Tables 15.8 and 15.9, respectively.

15.7 Abundance of the 1986-1988 Year Classes at Age 1

Methods for estimating recruitment are described in Section 7. Values derived from RCRTINX2 using North Sea surveys only were used for the 1986 and 1987 year classes (Table 15.10). Table 15.11 shows RCRTINX2 output when abundance indices from Scottish Division VIa surveys (Table 15.6) are included in the analysis. This gives values for the 1986 and 1987 year classes which are somewhat higher. The Scottish indices, however, are of a very preliminary nature, and it was decided not to use them pending further investigation.

15.7.1 The 1986 year class in 1987

The abundance of this year class at age 1 is estimated by RCRTINX2 to be 115 million (Table 15.10). This contrasts with the value obtained from the tuned F of 472 million. There was considerable discussion of this apparent discrepancy, since the former estimate implies an F in excess of 4. The problem could not be resolved. However, it can be said that the RCRTINX2 value based on North Sea indices is not inconsistent with scatter plots of Scottish seine and light trawl CPUE against VPA and Sub-area IV VPA against Division VIa VPA (Figures 15.3A,B,C). For lack of any clear evidence, it was decided to follow the conventional procedure of setting aside the 1987 catch and adopting the RCRTINX2 value.

15.7.2 The 1987 year class in 1988

The 1987 year class at age 1 as estimated from RCRTINX2 (Table 15.10) is 17 million. This value is based on the IYFS index at age 1 and the EGFS index at age 0. The estimate is dominated by the IYFS value and has been considerably shrunk towards the mean. This appears to be the lowest year class for at least 20 years, but the precision of the estimate is poor. The size of this year class at age 0 is estimated to be 22 million (see input to prediction, Table 15.13). In view of the problems in assessing the 1986 year class, this estimate must also be treated with caution.

15.7.3 The 1988 and subsequent year classes

These year classes were set to the mean for the period 1968-1987 at age 0 of 168 million.

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

Trends in biomass, mean fishing mortality rate, and recruitment are given in Table 15.12 and plotted in Figures 15.4B,C,D. Human consumption fishing mortality in 1987 shows an apparent increase over 1986 but the long-term trend appears to be downward. Recruitment to this stock is highly variable, but shows no trend. Year classes since the moderately good 1983 year class have been no better than average. Total stock biomass and

spawning stock biomass have been relatively stable for the last 10 years. The present spawning stock biomass of 62,000 t is above the lowest value of 26,000 t.

15.9 Catch Predictions

Input data for catch predictions are given in Table 15.13. The F value at age 1 in 1987 used in the prediction is the mean value for the period 1983-1987 (0.325), higher than the tuned value of 0.232.

15.9.1 Status quo catch prediction

Table 15.14 gives the catch prediction results. The predicted total landings in 1988 are 21,000 t. This estimate is smaller than the prediction of 25,000 t in the 1987 Working Group report and is the result of the downward revision of the 1986 year class from above average to average and the low estimate of the 1987 year class. The total status quo landings for 1989 are estimated to be 18,000 t. This low figure represents a fall to the catch levels in the late 1970s.

Spawning stock biomass is projected to fall further from 62,000 t in 1987 to 41,000 t in 1989, assuming status quo catches and mean recruitment in 1988 and 1989.

15.9.2 Prediction assuming TAC taken in 1988

This prediction was not carried out because the TAC is set for the whole of Sub-area VI, and it is not known what proportion of the TAC applies to Division VIa.

15.10 Yield and Biomass per Recruit

Plots of yield per recruit and biomass per recruit are shown in Figure 15.5A.

15.11 Safe Biological Limits

The stock/recruit relationship is shown in Figure 15.6. There is no evidence at present that recruitment to this stock is reduced at the lowest levels of spawning stock which have been observed. Spawning stock biomass is projected to remain above the minimum acceptable level of 25,000 t. Fishing mortalities are intermediate compared with historical values.

16 HADDOCK IN DIVISION VIb

16.1 Catch Trends

Officially reported landings for recent years are given in Table 16.1. The nominal catch in 1987 amounted to 7,287 t, which is an increase over the 1986 value of 4,661 t.

16.2 Age Compositions

Age compositions were available from Ireland, England, and Scotland. These were used to estimate the total international catch at age given in Table 16.2. The strong 1984 year class is apparent in the commercial catches at age 3 and is responsible for about 75% of the landed weight.

16.3 Mean Weight at Age

Mean weights at age in the catch are given in Table 16.3.

16.4 Abundance Indices

Table 16.4 gives the abundance indices obtained from various surveys since 1967. In August 1987, Scotland conducted a survey on the charter vessel 'Dawn Sky', and the results from this survey are also given in Table 16.4. The 1986 year class appears to be a strong one on the basis of the 1986 and 1987 surveys.

16.5 Analysis of Survey and Commercial Catch Data

A continuing problem with the survey data in Table 16.4 is the frequent change in survey vessel which makes the comparison of annual surveys difficult. In an attempt to place all the survey indices on the same scale, the multiplicative model described by Shepherd and Nicholson (1986) was used. This model describes the catch rate data in terms of year effects, age effects, and year-class effects. The year effects should remove the variability caused by the changes in survey vessel. The year-class effects then give the required year-class abundance index. The model was fitted to the survey data from 1979-1987 and for ages 1-6 using the program SRMCM which was modified to allow for missing values. In fitting the model, it was assumed that there is no trend in the year effects. Output from this analysis is given in Table 16.5 which shows the estimated parameter values and fitted catch rates. Visual inspection of the fitted catch rates suggests the fit is acceptable. The estimated year-class effects and age effects are plotted in Figures 16.1 and 16.2.

The same model can be fitted to the commercial catch data. The result of fitting the model to the catch data for 1985-1987 and for ages 2-9 is given in Table 16.6. Once again, the fitted catches suggest that the model fit is adequate. The year-class and age effects are plotted in Figures 16.1 and 16.2. The agreement between the year-class effects from the survey data and commercial catch data seen in Figure 16.1 is striking and

suggests that the recent 1984, 1985, and 1986 year classes are all above average.

16.6 Catch Prediction

A status quo catch forecast can be made (Shepherd, pers. comm.) using the parameters estimated in Tables 16.5 and 16.6. Firstly, assume that the age effects (s) (Table 16.6) which are a measure of total mortality are retained in 1988 and 1989. Secondly, assume that the year effects (f) in 1988 and 1989 are the same as for 1987. Finally, it is necessary to provide estimates for the year-class effects (r) for 1986 and 1987. The year-class abundance for 1986 (1.01) can be taken directly from the analysis of the survey data (Table 16.5 and Figure 16.1). For 1987, a mean value of -0.45 was used. Now the log catch (c) of fish of age a in year y of year class k is given by:

$$c(a,y,k) = u + s(a) + f(y) + r(k)$$

where u is the overall mean and is estimated as 5.63 (Table 16.6).

This gives an age composition for the catch in the prediction years. These values have been multiplied by the mean weight at age values given in Table 16.7 to obtain a predicted landed weight (Table 16.8).

The predicted status quo catches for 1988 and 1989 are 15,705 t and 18,255 t, respectively. This represents a substantial increase over the catch in 1987. This is due to the strong 1984, 1985, and 1986 year classes entering the fishery.

It should be emphasized that the fishery in Division VIb is sporadic, and there is no strong reason to expect the fishery to behave in a status quo fashion in the near future. In particular, the Rockall fishery depends on the fortunes of the fisheries in Sub-area IV and Division VIa. It should also be remembered that the model assumption of separability of age and year effects may not be adequate for this fishery. These are reasons to interpret the catch predictions cautiously.

17 HADDOCK IN SUB-AREA VII

Nominal landings in Divisions VIId,e are shown in Table 17.1 and landings in Divisions VIIb,c,g-k in Table 17.2.

18 WHITING IN SUB-AREA IV

18.1 Catch Trends

Total nominal landings and total international catches as estimated by the Working Group are given in Tables 18.1 and 18.2, respectively. Total international catches amounted to 132,000 t, of which 62,000 t were human consumption landings and 17,000 t were industrial by-catch. Total estimated landings

were, therefore, well below both the predicted landings for 1987 of 106,000 t given in last year's report and the 1987 TAC of 135,000 t. Catch trends for the last 20 years are shown in Figure 18.2A. Declining catches and landings in the late 1970s and early 1980s appear to have stabilized.

18.2 Natural Mortality and Maturity at Age

Natural mortality coefficients at age and the proportions mature at age used as inputs to the tuning/VPA are shown in Table 18.3.

18.3 Age Compositions

Age compositon data for 1986 were updated and provisional age compositions for 1987 were prepared (Table 18.4). Human consumption landings data were provided by England, France, the Netherlands, Belgium, and Scotland. Only Scotland provided discard data. Denmark and Norway provided industrial by-catch data. The 1985 year class was numerically the most important, contributing 39% by number.

18.4 Mean Weight at Age

Total international mean weights at age for the catch (also used as the stock mean weight) are given in Table 18.5.

18.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used as input to tune the VPA. Commercial fleet data used are referred to in Section 8. Research vessel indices are shown in Table 18.6.

18.6 VPA Tuning

Summary statistics from the Laurec/Shepherd tuning method are shown for ages 0-6 in Table 18.7. The eight fleets incorporated are listed in Section 8. Catchability plots for ages 0-5 are shown in Figure 18.1. Total international fishing mortality rates at age are given in Table 18.8, and stock numbers at age are given in Table 18.9. Fs for the oldest age groups (9 and 10) were set at the mean of the F values of the preceding five ages (4-8).

18.7 Abundance Estimates of the 1986 and 1987 Year Classes at Age 1

The methods employed for deriving estimates of recruitment are described in Section 7. Recruitment estimates from the various methods are given in Table 7.1. Table 18.10 shows summary statistics and results from the RCRTINX2 analysis of whiting in Sub-area IV.

18.7.1 The 1986 year class in 1987

This was estimated to be 5,133 million, compared with a tuned VPA value of 4,604 million 1-group in 1987.

18.7.2 The 1987 year class in 1988

This was estimated to be 3,500 million which corresponds to 45,109 million 0-group fish in 1986 (Table 18.12).

18.7.3 The 1988 and later year classes

These were set at an average recruitment (for the period 1968-1987) at age 0 of 47,593 million.

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

These are tabulated in Table 18.11 and illustrated in Figure 18.2B,C,D. Mean fishing mortality (ages 2-6) in the human consumption fishery continued to rise and is currently 0.774, the second highest value since the 1975 high of 0.865. Industrial by-catch F remained at a low level. Spawning stock biomass also rose and is approaching average levels. Recruitment was lower in 1987 than in 1986, but appeared to be about average.

18.9 Catch Predictions

The input data for catch predictions are given in Table 18.12. The F value for age 1 (0.176) is the mean for the period 1983-1987 and differs from the tuned F value (0.091) shown in the VPA (Table 18.8).

18.9.1 Status quo prediction

The results of the status quo prediction are given in Table 18.13 and Figure 18.3B. The predicted human consumption landings in 1988 are 113,000 t and the industrial by-catch 29,000 t. In 1989, the human consumption landings are expected to be 124,000 t and industrial by-catch 27,000 t. Spawning stock biomass is expected to rise to 527,000 t in 1988 followed by a fall in 1989 to 493,000 t with a further drop to 458,000 t in 1990.

18.9.2 TAC prediction

The agreed TAC for North Sea whiting in 1988 is 120,000 t. Landings of whiting consist of landings for human consumption and industrial by-catch. Before allocating its share of the TAC to Member States, the EEC deducts a nominal (but not unreasonable) 20,000 t to represent unavoidable industrial by-catch. The Group believes that Norway does not undertake a similar procedure. Thus, the effective TAC for human consumption landings is 100,000 t.

To simulate this scenario, the Group ran a prediction (Table 18.14, Figure 18.3B) in which human consumption landings in 1988 equalled 100,000 t. To achieve this, the human consumption F in 1988 was reduced by 16% compared to the F in 1987. The corresponding predicted industrial by-catch for 1988 is 29,000 t (129,000 t landings). Maintenance of the reduced level of human consumption F in 1989 will produce human consumption landings of 117,000 t and industrial by-catch of 29,000 t (147,000 t total landings).

Predicted spawning biomass values in 1988, 1989, and 1990 for the assumptions made above are 527,000 t, 516,000 t, and 492,000 t, respectively.

18.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 18.3A.

18.11 Safe Biological Limits

The relationship between recruitment and spawning stock biomass is shown in Figure 18.4. The value for F_{med} (1.05) is shown in Figure 18.3A; the current value of F (0.89) is below this. F_{high} was considerably higher than the range of F values considered here. The recent rise in spawning stock biomass to 360,000 t takes it well above the minimum spawning stock biomass of 219,000 t advised by ACFM; future predictions are also encouraging.

19 WHITING IN DIVISION VIa

19.1 Catch Trends

Total nominal landings and total international catches as estimated by the Working Group are given in Tables 19.1 and 19.2, respectively. Total international catches amounted to 10,000 t, all of which were landed for human consumption. Landings were just below the predicted status quo landings for 1987 of 11,000 t given in last year's report and well below the 1987 TAC of 16,400 t. Catch trends for the last 20 years are shown in Figure 19.3A. Landings remain at a low level.

19.2 Natural Mortality and Maturity at Age

Natural mortality coefficients at age and the proportions mature at age used as inputs to the tuning/VPA are shown in Table 19.3.

19.3 Age Compositions

Age compositon data for 1986 were updated and provisional age composition data for 1987, provided by Ireland and Scotland, were compiled (Table 19.4). Catches were dominated by 2- and 3-

year old whiting which contributed 68% by number.

19.4 Mean Weight at Age

Total international mean weights at age for the catch (also used as the stock mean weight) are given in Table 19.5.

19.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used as input to tune the VPA. Commercial fleet data used are referred to in Section 8.

19.6 VPA Tuning

Summary statistics from the Laurec/Shepherd tuning method are shown for ages 1-6 in Table 19.6. The four fleets incorporated are listed in Section 8. Catchability plots for ages 1-6 are shown in Figure 19.1. Total international fishing mortality rates at age are given in Table 19.7 and stock numbers at age are given in Table 19.8. Fs for the oldest age groups (7 and 8) were set at the mean of the F values of the preceding five ages (2-6).

19.7 Abundance Estimates of the 1986 and 1987 Year Classes at Age 1

The methods employed for deriving estimates of recruitment are described in Section 7, and estimates from the various methods are given in Table 7.2. Results from the RCRTINX2 (Table 19.9) analysis were adopted.

19.7.1 The 1986 year class in 1987

The estimate of recruitment was 94 million age 1 whiting (Figure 19.2A,B.C), which compares with a value of 91.1 million from the tuned VPA (Table 19.8).

19.7.2 The 1987 year class in 1988

The estimate was 76 million.

19.7.3 The 1988 and later year classes

These were set at an average recruitment (for the period 1968-1987) at age 1 of 85 millions.

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

These are tabulated in Table 19.10 and illustrated in Figure 19.3B,C,D. Mean fishing mortality on ages 2-4 (0.62) was

similar to that in 1986, remaining below average. Spawning stock biomass also remains low following the decline during the 1980s. Recruitment in 1987 was, however, higher than in the previous six years and above the average (85 million) for the period 1968-1987.

19.9 Catch Predictions

The input data for catch predictions are given Table 19.11. The F value for age 1 (0.084) is the mean for the period 1983-1987 and differs from the tuned F value (0.07) shown in the VPA (Table 19.7).

19.9.1 Status quo prediction

The results of the status quo prediction are given in Table 19.12. The predicted catch in 1988 is 12,000 t (there is no by-catch or discards). In 1989, the catch is expected to be 13,000 t. Spawning stock biomass is expected to rise in the next few years to 29,000 t in 1988, 31,000 t in 1989, and to 33,000 t in 1990.

19.9.2 TAC prediction

Assuming adherence to the 1988 TAC of 16,450 t implies an unrealistic increase in fishing mortality rate and a prediction is not included here.

19.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 19.4A.

19.11 Safe Biological Limits

The stock/recruit relationship is shown in Figure 19.5. The value for F_{med} (0.55) is shown in Figure 19.4A. F_{high} was estimated to be about 2.2, just beyond the range of Fs shown in Figure 19.4A. The current value of F (0.621) is just above F_{med}. Spawning stock biomass at 22,000 t in 1987 was just above the minimum (20,000 t) advised by ACFM. The predicted increases will improve this position somewhat.

20 WHITING IN DIVISION VIb

Landings of whiting from Division VIb are insignificant (Table 20.1).

21 WHITING IN SUB-AREA VII

21.1 Whiting in Divisions VIId,e

21.1.1 Catch trends

Official nominal landings for 1986 have been revised to 12,706 t (Table 21.1.1). Provisional nominal landings for 1987 were 12,144 t. The Working Group estimates for 1986 and 1987 were respectively, 7,507 t and 8,374 t (Table 21.1.2 and Figure 21.1.2A). These discrepancies are mainly due to the fact that French nominal landings include landings for Sub-areas VII (excluding Division VIIa) and VIII. The 1987 landings were a little higher than in 1986, but remain at a low level.

21.1.2 Natural mortality and maturity at age

The natural mortality coefficients at age and the proportion of maturity at age are given in Table 21.1.3.

21.1.3 Age compositions

The total international catch at age is shown in Table 21.1.4. Data have been supplied by England and France. In 1987, the data base had been revised. However,there are still some uncertainties, and the values should be considered with caution.

21.1.4 Mean weight at age

The mean weights at age in the catch are given in Table 21.1.5. They have been used as mean weights at age in the stock.

21.1.5 Commercial catch/effort data and research vessels indices

At present, no data are available for tuning the VPA or for providing recruitment indices.

21.1.6 VPA tuning

In the absence of any tuning data, mean F values for the period 1980-1984 were used as input for the VPA in 1987. For the oldest age, a value of 1.0 has been adopted for all years. The results of the VPA are given in Tables 21.1.6 and 21.1.7.

21.1.7 Abundance estimates of the 1986-1988 year classes

There is no recruitment survey at present in Divisions VIId,e. Numbers at age 1 from VPA have been examined in relation to indices of recruitment in the North Sea and estimates of recruitment in the North Sea from VPA (Table 21.1.8). No significant relationship appeared between recruitment in the North Sea and in the Channel (Figure 21.1.1)

21.1.7.1 The 1986 and 1987 year classes at age 1

In the absence of other data, the numbers implied by the use of mean F were accepted. These values are 32.5 million and 46.6 million, respectively.

21.1.7.2 The 1988 and later year classes

Mean recruitment for the period 1977-1987 was used, resulting in a value of 64 million at age 1.

21.1.8 Long-term trends in biomass, fishing mortality, and recruitment

Estimates of fishing mortality rates, stock numbers, and biomasses are given in Table 21.1.9. Historical trends in fishing mortality, recruitment, and total and spawning stock biomasses are shown in Figure 21.1.2B,C,D. Mean F values are high and variable between years, but do not show any trend. Recruitment at age 1 also appears to be variable around a mean of 64 million fish, without showing any trend. Both the catch-at-age data and the VPA suggest that the 1983 year class was a strong one.

21.1.9 Catch predictions

The input data for catch prediction are given in Table 21.1.10. The F values are the mean for the period 1980-1984, and the recruitment at age 1 in 1988-1990 is equal to the mean for the period 1977-1987.

The results of catch prediction are given in Table 21.1.11 and shown in Figure 21.1.3B. The status quo catch in 1988 and 1989 is predicted to be 6,000 t for both years. Spawning stock biomass is predicted to increase slightly from 12,000 t in 1988 to 13,000 t in 1989, with a further increase to 15,000 t in 1990.

21.1.10 Yield and biomass per recruit

Plots of yield and biomass per recruit are shown in Figure 21.1.3A.

21.1.11 Safe biological limits

The stock/recruit relationship is shown in Figure 21.1.4. Values for F_{med} (0.69) and F_{high} (2.59) are shown in Figure 21.1.3A. The current level of F is 0.80. There are no maturity data for whiting in Divisions VIId,e, and spawning biomass has been calculated using a nominal knife-edge value. Therefore, no minimum spawning biomass level can be advised at present.

21.1.12 Validity of assessment

The data on which the assessment is based are, to some extent, less reliable than those for the North Sea stocks, and the reliability of the assessment is accordingly lower.

21.2 Whiting in Divisions VIIb,c,g-k

Nominal landings for the period 1983-1987 are given in Table 21.2.1. The provisional figure for 1987 is 1,521 t, but it does not include landings by France, which are included in the data for Divisions VIId,e.

22 SAITHE IN SUB-AREA IV AND DIVISION IIIa

22.1 Catch Trends

Recent nominal landings are given in Table 22.1. Working Group estimates are in Table 22.2 and are plotted in Figure 22.2A. Landings were high in the early 1970s, reaching a maximum of 320,000 t in 1976. Subsequently, landings declined to a minimum of 126,000 t in 1979. Since then, landings have followed an increasing trend to reach 199,000 t in 1985. In 1986 and 1987, the catches are estimated to be 167,000 t and 147,000 t respectively. Some saithe are taken as by-catch in the industrial fisheries. Since 1976, this quantity has averaged 3,500 t (Table 22.2). The agreed TAC for this stock in 1987 was 173,000 t.

22.2 Natural Mortality and Maturity at Age

These values are given in Table 22.3.

22.3 Age Compositions

Total international age compositions used as input to the VPA are given in Table 22.4. Data for 1986 were updated, and new data were added for 1987. However, the Norwegian data were revised back to 1977. Data are currently being supplied by the following countries: Denmark, Federal Republic of Germany, France, Norway, UK (England), and UK (Scotland). Discards are not included.

22.4 Mean Weight at Age

The mean weights at age in the landings are given in Table 22.5. These weights are also used as stock weights.

22.5 Commercial Catch/Effort and Research Vessel Indices

No research vessel indices could be used for saithe, but abundance indices of 0-group saithe obtained by Norwegian observers are presented for information in Table 22.7. The commercial catch/effort data were used to tune the VPA. The fleets used in the analysis are given in the text table in Section 8.

22.6 VPA Tuning

Fishing mortality rates in 1987 for ages 1-13 were estimated from the Laurec/Shepherd tuning method. Summary statistics are given in Table 22.6. Catchability plots are shown in Figure 22.1. For the oldest age groups, the mean over ages 9-13 was used. Table 22.8 gives the values of fishing mortality estimated by VPA, and estimates of numbers of fish in the stock are given in Table 22.9.

22.7 Recruitment

Recruitment indices obtained by observers along the Norwegian coast for the years 1980-1987 were provided (Table 22.7). Because of the subjectivity of the indices, the Group decided to use average recruitment for the prediction. However, the data indicate that the 1985 year class may be well above the average, the 1986 year class seems to be a very poor one, and the 1987 year class seem to be about average.

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

Table 22.10 gives a summary of trends in fishing mortality, biomass, and recruitment as estimated by VPA. These data are also plotted in Figure 22.2B,C,D.

The results indicate that, in recent years, fishing mortality has been increasing from a value of 0.34 in 1981 to 0.63 in 1986. The fishing mortality is estimated to be 0.40 in 1987. Total stock biomass has remained relatively stable in the last decade, but spawning stock biomass has been declining from 535,000 t in 1974 to 150,000 t in 1986, which is the lowest on record. The spawning stock in 1987 is estimated to be 182,000 t. The 1983 year class is now estimated to be 510 million at age 1, while last year the estimate was 252 million. This year class is now estimated to be stronger than the 1982 year class.

22.9 Catch Predictions

Input data used for the catch predictions are given in Table 22.11. The F of age 1 is the average of the period 1983-1987. The results of the catch predictions are given in Table 22.12 and Figure 22.3B.

22.9.1 Status quo prediction

If fishing mortality in 1988 is assumed to remain at the 1987 level, a total catch of 168,000 t is predicted. The status quo landings predicted for 1989 are 170,000 t. Assuming an average recruitment, the predicted spawning stock should increase from 182,000 t in 1987 to about 300,000 t in 1990.

22.9.2 Prediction assuming TAC taken in 1988

The agreed TAC of 165,000 t is so close to the status quo prediction that no prediction was necessary.

22.10 Yield and Biomass per Recruit

Yield and biomass per recruit are shown in Figure 22.3A.

22.11 Safe Biological Limits

The stock-recruitment plot is given in Figure 22.4. F_{med} (0.40) and F_{high} (0.62) are shown in Figure 22.3A. The current level of F is about F_{med}, and spawning biomass is predicted to increase.

23 SAITHE IN SUB-AREA VI

23.1 Catch Trends

Recent nominal landings are given in Table 23.1. Working Group estimates are given in Table 23.2 and are plotted in Figure 23.3A. The landings followed an increasing trend in the early 1970s to reach 42,000 t in 1976. They then dropped to a level of about 25,000 t in the early 1980s. In 1986 and 1987, the estimates are 42,000 t and 31,000 t, respectively. The agreed TAC in 1987 was 35,000 t.

23.2 Natural Mortality and Maturity at Age

These values are given in Table 23.3.

23.3 Age Compositions

Total international age compositions used as input to the VPA are given in Table 23.4. Data for 1986 were updated and new data were added for 1987. Data are currently being supplied by the following countries: the Federal Republic of Germany, France, UK (England), and UK (Scotland).

23.4 Mean Weight at Age

The mean weights in the landings are given in Table 23.5. These weights are also used as stock weights.

23.5 Commercial Catch/Effort and Research Vessel Indices

No research vessel indices are available for saithe. The commercial catch/effort data were used to tune the VPA. The fleets used in the analysis are given in the text table in Section 8.

23.6 VPA Tuning

Fishing mortality rates in 1987 for ages 1-13 were estimated from the Laurec/Shepherd tuning method. Summary statistics are given in Table 23.6. Catchability plots are shown in Figure 23.1. For the oldest age groups, the means over the ages 9-13 were used. Table 23.7 gives the values of fishing mortality estimated by VPA, and estimates of numbers of fish in the stock are given in Table 23.8.

23.7 Recruitment

No recruitment data were available for saithe in Sub-area VI. The Group, therefore, decided to use average recruitment for the 1985 and onwards year classes.

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

Table 23.9 gives a summary of the trends in fishing mortality, biomass, and recruitment as estimated by VPA. These trends are also plotted in Figure 23.3B,C,D.

The results indicate that, in the most recent years, fishing mortality has been increasing from 0.19 in 1984 to the present level of 0.41. Both total stock and spawning stock biomass have been declining since 1975. The total stock biomass has declined from 357,000 t in 1975 to 174,000 t in 1987, while the spawning stock biomass has declined from 284,000 t in 1975 to 112,000 t in 1987. The biomass estimates for 1987 are the lowest on record.

23.9 Catch Predictions

Input data used for the catch predictions are given in Table 23.10. The F of age 1 is the average of the period 1983-1987. The results of the catch predictions are given in Table 23.11 and Figure 23.4B.

23.9.1 Status quo prediction

If fishing mortality in 1988 is assumed to remain at the 1987 level, a total catch of 32,000 t is predicted. The status quo landings predicted for 1989 are 31,000 t. Assuming average recruitment, the predicted spawning stock will continue to decrease from 112,000 t in 1987 to about 80,000 t in 1990.

23.9.2 Prediction assuming TAC taken in 1988

The agreed TAC of 35,000 t is so close to the status quo prediction that no prediction was necessary.

23.10 Yield and Biomass per Recruit

The stock/recruit relationship is shown in Figure 23.5. Yield and biomass per recruit are shown in Figure 23.4A.

23.11 Safe Biological Limits

F_{med} (0.14) and F_{high} (0.29) are shown in Figure 23.4A. The current level of F is well above F_{high}, and spawning biomass is at the lowest level recorded in the VPA.

24 SAITHE IN SUB-AREA VII

24.1 Landings

The provisional landings of saithe in Sub-area VII are given in Table 24.1. No data on the age composition of the catch were available.

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Table 7.1 **Evaluation of recruitment indices in Sub-area IV. Estimated year class size given as millions at age 1.**

	Species					
	Cod		Had.		Whi.	
Yrcl.	86	87	86	87	86	87
Method :						
RC NX2						
incl. 2,0 gr.	254*	277*	4255*	825*	5133*	3500*
excl. 2,0 gr.	267	277	3963	825	4349	3500
Factor Analysis						
incl. 2,0 gr.	336	364	6073	1196	3359	3398
excl. 2,0 gr.	316	364	4326	682	3892	3142
Multicalibration						
incl. 2,0 gr.	259	294	3667	625	5989	3814
excl. 2,0 gr.	265	294	3475	625	5134	3814
Tuned VPA result	249		4740		4604	

* : used by WG

Table 7.2 **Evaluation of recruitment indices in Sub-area IV. Estimated year class size given as millions at age 1.**

	Cod		Had.		Whi.	
Yrcl.	86	87	86	87	86	87
Method :						
RCRTINX2	10	9	115*	17*	94*	76*
Factor Analysis	10	11	170	16	71	71
Multicalibration	8	7	104	10	121	81
Tuned VPA Result	45		472		91	

* : used by WG, for Cod see Sect. 13.7

Table 9.4.1 Summary of results of mixed fishery forecasts.

	1988 TAC	1988 Total Land.	1989 SSB	1989 Total Land.	1990 SSB
		Scenario (a)			
Cod	160	177	92	160	86
Haddock	185	111	112	88	126
Whiting	120	142	492	152	458
Saithe	165	169	329	170	337
		Scenario (b)			
Cod	160	161	105	156	107
Haddock	185	102	125	90	141
Whiting	120	130	514	147	489
Saithe	165	149	348	156	374
		Scenario (c)			
Cod	160	161	105	135	122
Haddock	185	102	125	79	155
Whiting	120	130	514	131	516
Saithe	165	149	348	132	398

Table 9.4.2

"Mixed fisheries" Scenario (a)

NORTH SEA GADOIDS - 1988 RFWG
PREDICTION of CATCHES and BIOMASSES in 1988 - Season £ 1

Metier	E1988/E Ref	COD Catches	HADDOCK Catches	WHITING Catches	SAITHE Catches	TOTAL
H.C.	1.000	177.30	108.44	112.92	164.84	563.50
Val		177.30	108.44	112.92	164.84	563.50
DISC.	1.000	.00	54.09	86.93	.00	141.01
Val		.00	.00	.00	.00	.00
IND. BY-C.	1.000	.00	3.05	28.62	3.57	35.24
Val		.00	3.05	28.62	3.57	35.24
TOTALS	x1000 t.	177.30	165.57	228.47	168.41	
VALUE kU		177.30	111.49	141.54	168.41	
BIOMASS Start		451.75	1000.59	1555.02	741.85	
BIOMASS Final		494.17	1400.02	1524.39	761.17	
Final Sp. St. B.		92.25	111.86	492.33	328.84	
Recr. (M) 1988		277.00	37442.00	47593.00	283.00	
Recr. (M) 1989		412.00	37442.00	47593.00	283.00	

NORTH SEA GADOIDS - 1988 RFWG
PREDICTION of CATCHES and BIOMASSES in 1989 - Season £ 1

Metier	E1989/E Ref	COD Catches	HADDOCK Catches	WHITING Catches	SAITHE Catches	TOTAL
H.C.	1.000	160.15	83.92	124.12	165.56	533.75
Val		160.15	83.92	124.12	165.56	533.75
DISC.	1.000	.00	56.04	78.65	.00	134.69
Val		.00	.00	.00	.00	.00
IND. BY-C.	1.000	.00	3.86	27.50	3.94	35.30
Val		.00	3.86	27.50	3.94	35.30
TOTALS	x1000 t.	160.15	143.82	230.28	169.50	
VALUE kU		160.15	87.78	151.62	169.50	
BIOMASS Start		494.17	1400.02	1524.39	761.17	
BIOMASS Final		526.40	1517.91	1490.94	781.54	
Final Sp. St. B.		85.56	125.87	458.21	336.95	
Recr. (M) 1989		412.00	37442.00	47593.00	283.00	
Recr. (M) 1990		412.00	37442.00	47593.00	283.00	

Table 9.4.3

NORTH SEA GADOIDS - 1988 RFWG
PREDICTION of CATCHES and BIOMASSES in 1988 - Season £ 1

"Mixed fisheries" Scenario (b)

Metier	E1988/E Ref	COD Catches	HADDOCK Catches	WHITING Catches	SAITHE Catches	TOTAL
H.C.	.860	160.56	98.65	100.84	145.34	505.39
Val		160.56	98.65	100.84	145.34	505.39
DISC.	.860	.00	48.49	76.25	.00	124.75
Val		.00	.00	.00	.00	.00
IND. BY-C.	1.000	.00	3.15	29.27	3.66	36.08
Val		.00	3.15	29.27	3.66	36.08
TOTALS	x1000 t.	160.56	150.29	206.36	149.00	
VALUE	kU	160.56	101.79	130.11	149.00	
BIOMASS Start		451.75	1000.59	1555.02	741.85	
BIOMASS Final		518.58	1417.70	1546.41	786.01	
Final Sp. St. B.		104.58	125.21	513.96	348.05	
Recr. (M) 1988		277.00	37442.00	47593.00	283.00	
Recr. (M) 1989		412.00	37442.00	47593.00	283.00	

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NORTH SEA GADOIDS - 1988 RFWG
PREDICTION of CATCHES and BIOMASSES in 1989 - Season £ 1

Metier	E1989/E Ref	COD Catches	HADDOCK Catches	WHITING Catches	SAITHE Catches	TOTAL
H.C.	.860	156.33	85.76	118.31	152.39	512.80
Val		156.33	85.76	118.31	152.39	512.80
DISC.	.860	.00	49.91	70.56	.00	120.46
Val		.00	.00	.00	.00	.00
IND. BY-C.	1.000	.00	4.06	29.07	4.17	37.30
Val		.00	4.06	29.07	4.17	37.30
TOTALS	x1000 t.	156.33	139.73	217.93	156.56	
VALUE	kU	156.33	89.83	147.37	156.56	
BIOMASS Start		518.58	1417.70	1546.41	786.01	
BIOMASS Final		563.35	1538.35	1522.24	826.20	
Final Sp. St. B.		106.98	141.38	489.09	373.86	
Recr. (M) 1989		412.00	37442.00	47593.00	283.00	
Recr. (M) 1990		412.00	37442.00	47593.00	283.00	

Table 9.4.4

NORTH SEA GADOIDS - 1988 RFWG
PREDICTION of CATCHES and BIOMASSES in 1988 - Season £ 1

"Mixed fisheries"
Scenario (c)

Metier	E1988/E Ref	COD Catches	HADDOCK Catches	WHITING Catches	SAITHE Catches	TOTAL
H.C.	.860	160.56	98.64	100.84	145.34	505.39
Val		160.56	98.64	100.84	145.34	505.39
DISC.	.860	.00	48.49	76.25	.00	124.75
Val		.00	.00	.00	.00	.00
IND. BY-C.	1.000	.00	3.15	29.27	3.66	36.08
Val		.00	3.15	29.27	3.66	36.08
TOTALS	x1000 t.	160.56	150.29	206.36	149.00	
VALUE kU		160.56	101.79	130.11	149.00	
BIOMASS Start		451.75	1000.59	1555.01	741.85	
BIOMASS Final		518.58	1417.70	1546.41	786.01	
Final Sp. St. B.		104.58	125.21	513.95	348.05	
Recr. (M) 1988		277.00	37442.00	47593.00	283.00	
Recr. (M) 1989		412.00	37442.00	47593.00	283.00	

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NORTH SEA GADOIDS - 1988 RFWG
PREDICTION of CATCHES and BIOMASSES in 1989 - Season £ 1

Metier	E1989/E Ref	COD Catches	HADDOCK Catches	WHITING Catches	SAITHE Catches	TOTAL
H.C.	.700	134.57	74.98	101.10	127.58	438.22
Val		134.57	74.98	101.10	127.58	438.22
DISC.	.700	.00	41.56	58.85	.00	100.41
Val		.00	.00	.00	.00	.00
IND. BY-C.	1.000	.00	4.17	29.93	4.30	38.40
Val		.00	4.17	29.93	4.30	38.40
TOTALS	x1000 t.	134.57	120.71	189.89	131.88	
VALUE kU		134.57	79.15	131.03	131.88	
BIOMASS Start		518.58	1417.70	1546.41	786.01	
BIOMASS Final		594.36	1557.14	1550.00	857.61	
Final Sp. St. B.		122.25	154.98	516.38	398.08	
Recr. (M) 1989		412.00	37442.00	47593.00	283.00	
Recr. (M) 1990		412.00	37442.00	47593.00	283.00	

Table 10.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1978-1987. as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	17,473	12,576	9,630	8,744	6,604
Denmark	41,858	48,509	56,404	64,968	61,454
Faroe Islands	56	113	150	38	65
France	11,944	12,559	10,910	11,369	8,399
German Dem.Rep.	75	84	63	-	-
Germany, Fed.Rep.	37,040	20,411	26,343	29,741	18,525
Ireland	174	1	-	-	-
Netherlands	48,817	34,752	45,400	51,281	36,490
Norway[2]	2,747	3,575	4,506	6,766	12,163
Poland	115	142	28	7	62
Sweden	...[3]	298	293	321	453
UK (England & Wales)	59,127	54,923	49,951	59,856	54,277
UK (Scotland)	41,984	42,811	45,044	53,921	57,308
USSR	17	17	-	-	-
Total IV	261,427	230,771	248,722	287,012	255,800
WG total	260,890	248,051	260,278	300,599	255,934

Country	1983	1984	1985	1986	1987[1]
Belgium	6,704	5,804	4,815	6,604	6,722
Denmark	48,828	46,751	41,737	32,920	36,612
Faroe Islands	361	-	71	15	-
France	7,159	8,129	4,834	7,024[1,4]	6,813[4]
German Dem.Rep.	-	-	-	-	-
Germany, Fed.Rep.	20,333	13,453	7,675	7,667	9,558
Ireland	-	-	-	-	-
Netherlands	34,111	25,460	30,844	25,082	21,333
Norway[2]	6,625	7,005	5,766	6,011	4,395
Poland	75	7	-	10	13
Sweden	422	575	748	839	292[5]
UK (England & Wales)	53,860	35,605	29,692	25,361	29,187
UK (Scotland)	58,581	54,359	60,931	45,748	49,469
USSR	-	-	-	-	-
Total IV	237,059	197,148	187,113	157,281	164,394
WG total	229,499	206,014	192,253	158,348	173,585

[1] Provisional.
[2] Figures from Norway do not include cod caught in Rec. 2 fisheries.
[3] Included in Division IIIa.
[4] Includes Division IIa.
[5] Jan-Sep.

Table 10.2 Annual weight and numbers of cod caught in Sub-area IV between 1968 and 1987.

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
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	210	210	0	0	124	124	0	0
1977	181	181	0	0	136	136	0	0
1978	261	261	0	0	209	209	0	0
1979	248	248	0	0	169	169	0	0
1980	264	264	0	0	201	201	0	0
1981	301	301	0	0	237	237	0	0
1982	273	273	0	0	192	192	0	0
1983	233	233	0	0	177	177	0	0
1984	206	206	0	0	159	159	0	0
1985	192	192	0	0	144	144	0	0
1986	158	158	0	0	133	133	0	0
1987	174	174	0	0	144	144	0	0

Table 10.3 Values of natural mortality rate and proportion mature at age.

Age	Nat Mor	Mat.
0	2.700	0.000
1	0.800	0.010
2	0.350	0.050
3	0.250	0.230
4	0.200	0.620
5	0.200	0.860
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000
11	0.200	1.000
12	0.200	1.000
13	0.200	1.000

Table 10.4 Total international catch at age ('000's) cod in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	26368	35319	59344	20416	65348	23877	62720	7780	78732	21099	1
2	156479	86133	98856	177309	60167	121789	60215	111078	18119	104604	2
3	13358	39843	29578	26739	53398	17279	27801	15705	28352	7124	3
4	8386	3584	9988	7352	7090	9890	3493	6841	3946	7821	4
5	2850	3188	1595	3829	3206	2507	3126	1172	2622	1371	5
6	980	713	1164	757	1889	1177	956	1120	551	984	6
7	383	371	411	571	355	563	413	327	519	215	7
8	376	131	191	135	218	142	233	162	151	196	8
9	141	145	71	65	72	70	57	73	62	51	9
10	33	39	54	37	25	22	43	13	39	30	10
11	15	2	18	17	10	13	13	20	17	10	11
12	22	13	6	1	5	5	4	3	1	2	12
13	2			3				0	1	2	13

Table 10.5 Total international mean weight at age (Kg) of cod in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.567	0.548	0.546	0.722	0.585	0.630	0.592	0.584	0.577	0.619	1
2	0.937	0.945	0.985	0.830	0.948	0.916	0.982	0.917	0.932	0.924	2
3	1.967	2.432	1.996	2.252	1.857	1.857	2.142	2.118	1.815	1.935	3
4	4.201	4.306	4.576	4.773	4.514	3.954	4.044	4.221	3.821	3.591	4
5	6.538	6.558	6.373	7.214	6.820	6.592	6.251	6.403	6.353	5.952	5
6	8.766	8.277	9.173	8.861	8.981	8.439	8.396	8.468	7.975	8.203	6
7	9.794	10.858	9.815	10.060	10.707	9.920	10.316	10.410	9.775	9.885	7
8	11.053	11.490	11.874	11.513	12.499	11.825	11.357	12.034	11.656	11.443	8
9	12.427	13.057	12.782	13.324	13.452	12.747	13.505	13.033	12.627	11.956	9
10	12.778	14.148	14.081	14.876	12.852	12.562	13.408	13.209	13.566	15.563	10
11	13.847	15.982	16.475	16.867	13.991	14.117	12.886	14.425	13.328	15.807	11
12	13.739	15.394	12.166	18.129	15.879	15.238	14.086	14.348	13.232	17.113	12
13	17.148			28.496				15.568	10.461	18.060	13

Table 10.6 Fishing effort and catch at age of cod in Sub-area IV by INT GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0											0
1	98.300	4.098	38.000	14.698	40.299	7.899	36.701	12.901	9.901	16.799	1
2	25.900	34.497	10.600	9.500	6.201	19.812	3.200	29.301	9.299	14.799	2
3											3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
11											11
12											12
13											13
Eff	190	143	110	242	304	346	405	385	395	338	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0								0
1	2.901	9.317	3.899	15.201	0.900	17.000	8.800	1
2	25.498	6.701	16.599	8.000	17.600	3.600	28.800	2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10								10
11								11
12								12
13								13
Eff	313	341	397	433	470	490	491	Eff

cont'd.

Table 10.6 cont'd. Fishing effort and catch at at of cod in Sub-area IV by ENG GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0							14.261	12.558	18.556	9.757	0
1							62.333	22.832	24.231	51.287	1
2							4.459	12.522	5.803	6.826	2
3							3.234	0.965	2.000	1.435	3
4							0.577	0.973	0.274	0.730	4
5							0.108	0.133	0.359	0.113	5
6							0.009	0.062	0.060	0.052	6
7							0.072	0.035		0.017	7
8							0.018	0.009	0.051	0.035	8
9								0.018	0.051	0.009	9
10										0.139	10
11											11
12											12
13											13
Eff	No data	No data	No data	No data	No data	No data	111	113	117	115	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0	74.211	2.542	95.108	0.354	8.277	1.207	0.377	0
1	11.386	32.500	15.392	61.183	4.301	34.366	14.156	1
2	13.833	2.778	10.959	4.805	11.867	1.171	10.714	2
3	1.289	3.347	1.203	1.768	1.096	2.024	0.299	3
4	0.526	0.500	1.108	0.415	0.554	0.293	0.597	4
5	0.386	0.375	0.284	0.207	0.205	0.110	0.143	5
6	0.395	0.208	0.216	0.073	0.217	1.085		6
7	0.228	0.097	0.108	0.037	0.145	0.012		7
8	0.035	0.083		0.024	0.060		0.013	8
9	0.070	0.014		0.024				9
10	0.114	0.028		0.012				10
11								11
12								12
13								13
Eff	114	72	74	82	83	82	77	Eff

cont'd.

Table 10.6 cont'd.

Fishing effort and Catch at age of COD in IV by NET GFS

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0										43.214	0
1										163.786	1
2										4.500	2
3											3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
11											11
12											12
13											13
Eff	No data	No data	No data	No data	No data	No data	No data	No data	No data	14	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0	176.833	26.875	121.461	1.310	143.600	37.000	36.205	0
1	46.917	83.000	21.789	121.310	3.600	111.190	41.500	1
2	11.167	1.625	2.319	1.595	3.100	0.190	8.000	2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10								10
11								11
12								12
13								13
Eff	12	16	25	42	40	42	44	Eff

cont'd.

Table 10.6 cont'd.

Fishing effort and Catch at age of COD in IV by SCO GFS

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0											0
1											1
2											2
3											3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
11											11
12											12
13											13
Eff	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0		0.013	0.228			0.075		0
1		6.143	3.253	8.195	0.671	8.013	2.192	1
2		3.506	7.810	3.902	11.561	1.050	6.945	2
3		5.714	1.810	2.537	1.988	3.963	0.342	3
4		1.805	1.975	0.500	1.134	0.575	0.918	4
5		0.922	0.747	0.573	0.305	0.400	0.288	5
6		0.597	0.228	0.159	0.244	0.188	0.068	6
7		0.143	0.152	0.049	0.061	0.063	0.014	7
8		0.052		0.012	0.098			8
9		0.052		0.012	0.012			9
10						0.013		10
11		0.013						11
12		0.013						12
13								13
Eff	No data	77	79	82	82	80	73	Eff

cont'd.

Table 10.6 cont'd.
Cod in Sub-area IV. Abundance index of 0-1-group cod from Federal Republic of Germany shrimp trawl.

Year class	Germany Fed.Rep. SF index
1968	6.1
1969	34.1
1970	90.4
1971	1.3
1972	1.6
1973	3.6
1974	8.0
1975	7.8
1976	28.2
1977	27.2
1978	31.1
1979	35.5
1980	14.1
1981	23.2
1982	9.0
1983	43.0
1984	0.9
1985	9.5
1986	2.3
1987	1.6[1]

[1] Provisional - 0-group only.

Table 10.7 Cod in Sub-area IV. Summary statistics from Laurec/Shepherd tuning.

Age 1

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-17.89	0.311	0.0000	0.1644	0.000	0.000	-17.886	0.119
2	-17.86	0.648	0.0005	0.0369	0.000	0.000	-17.861	0.192
3	-17.61	0.403	0.0094	0.1461	0.000	0.000	-17.610	0.120
4	-17.44	0.376	0.0093	0.0963	0.000	0.000	-17.444	0.112
5	-19.24	0.628	0.0008	0.1172	0.000	0.000	-19.242	0.187
6	-17.94	0.642	0.0042	0.2000	0.000	0.000	-17.944	0.191
7	-17.85	0.306	0.0021	0.1717	0.000	0.000	-17.847	0.091
8	-17.16	0.477	0.0000	0.0846	0.000	0.000	-17.160	0.142
9	-15.39	0.633	0.0000	0.1058	0.000	0.000	-15.386	0.216
10	-16.20	0.281	0.0000	0.1380	0.000	0.000	-16.195	0.087

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.130	0.128	0.115	0.128	0.815

Age 2

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-16.53	0.279	0.0000	0.9936	0.000	0.000	-16.534	0.106
2	-15.62	0.444	0.0045	0.7705	0.000	0.000	-15.623	0.132
3	-14.99	0.213	0.1295	1.0068	0.000	0.000	-14.989	0.063
4	-15.55	0.176	0.0623	1.1501	0.000	0.000	-15.545	0.052
5	-17.99	0.275	0.0028	0.7084	0.000	0.000	-17.992	0.082
6	-15.57	0.417	0.0453	0.4543	0.000	0.000	-15.575	0.124
7	-15.26	0.362	0.0284	1.2420	0.000	0.000	-15.256	0.108
8	-15.75	0.262	0.0001	0.5266	0.000	0.000	-15.747	0.078
9	-17.33	0.676	0.0000	0.3906	0.000	0.000	-17.326	0.231
10	-16.40	0.262	0.0000	0.7340	0.000	0.000	-16.404	0.981

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.857	0.876E-01	0.104	0.104	1.414

Age 3

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-16.06	0.333	0.0000	2.2100	0.000	0.000	-16.058	0.127
2	-15.24	0.291	0.0066	1.2330	0.000	0.000	-15.235	0.087
3	-14.89	0.213	0.1435	1.5033	0.000	0.000	-14.886	0.063
4	-15.39	0.185	0.0725	0.9746	0.000	0.000	-15.393	0.055
5	-18.13	0.373	0.0024	0.8276	0.000	0.000	-18.133	0.111
6	-15.44	0.321	0.0520	0.5430	0.000	0.000	-15.437	0.095
7	-15.42	0.273	0.0241	2.0977	0.000	0.000	-15.419	0.081
8	No data for this age							
9	No data for this age							
10	-16.58	0.231	0.0000	1.5007	0.000	0.000	-16.581	0.072

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.261	0.509E-01	0.145	0.145	2.525

cont'd.

Table 10.7 cont'd.
Cod in Sub-area IV. Summary statistics from Laurec/Shepherd tuning.

Age 4

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.85	0.320	0.0000	1.1183	0.000	0.000	-15.846	0.122
2	-15.54	0.194	0.0049	0.9755	0.000	0.000	-15.537	0.058
3	-15.15	0.226	0.1102	0.6053	0.000	0.000	-15.150	0.067
4	-15.86	0.231	0.0453	0.7571	0.000	0.000	-15.863	0.069
5	-18.97	0.377	0.0011	0.7547	0.000	0.000	-18.965	0.112
6	-15.66	0.155	0.0417	0.5452	0.000	0.000	-15.658	0.046
7	-15.52	0.250	0.0218	0.9261	0.000	0.000	-15.522	0.074
8	No data for this age							
9	No data for this age							
10	-16.55	0.245	0.0000	0.8495	0.000	0.000	-16.551	0.076

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.746	0.801E-01	0.932E-01	0.932E-01	1.354

Age 5

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.59	0.290	0.0000	0.8097	0.000	0.000	-15.588	0.111
2	-15.79	0.212	0.0038	0.6448	0.000	0.000	-15.794	0.063
3	-15.39	0.249	0.0866	0.4194	0.000	0.000	-15.391	0.074
4	-16.31	0.239	0.0290	0.8847	0.000	0.000	-16.308	0.071
5	-19.48	0.643	0.0006	0.8660	0.000	0.000	-19.484	0.191
6	-15.84	0.229	0.0346	1.3188	0.000	0.000	-15.843	0.068
7	-15.04	0.203	0.0354	1.1016	0.000	0.000	-15.039	0.060
8	No data for this age							
9	No data for this age							
10	-16.58	0.442	0.0000	0.6055	0.000	0.000	-16.579	0.137

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.819	0.918E-01	0.137	0.137	2.216

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.73	0.669	0.0000	2.1240	0.000	0.000	-15.727	0.255
2	-16.00	0.453	0.0031	1.5116	0.000	0.000	-15.997	0.135
3	-15.66	0.396	0.0661	0.3479	0.000	0.000	-15.661	0.118
4	-16.66	0.413	0.0203	0.6456	0.000	0.000	-16.664	0.123
5	-20.02	0.737	0.0004	1.8098	0.000	0.000	-20.025	0.219
6	-15.91	0.288	0.0324	0.8179	0.000	0.000	-15.909	0.086
7	-14.76	0.229	0.0467	0.5967	0.000	0.000	-14.760	0.068
8	No data for this age							
9	No data for this age							
10	-16.96	1.451	0.0000	######	0.000	0.000	-16.964	0.450

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.746	0.139	0.206	0.206	2.245

Table 10.8 Total international fishing mortality rate at age of cod in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.093	0.119	0.113	0.114	0.184	0.134	0.182	0.129	0.216	0.130	1
2	1.022	0.844	0.988	1.006	1.009	1.106	1.031	1.003	0.854	0.857	2
3	0.849	0.964	0.963	0.974	1.236	1.142	0.998	1.027	0.920	1.261	3
4	0.745	0.604	0.721	0.711	0.801	0.851	0.790	0.760	0.840	0.746	4
5	0.879	0.721	0.599	0.684	0.800	0.757	0.733	0.680	0.761	0.819	5
6	0.698	0.567	0.638	0.645	0.891	0.798	0.748	0.642	0.817	0.739	6
7	0.694	0.630	0.767	0.765	0.731	0.743	0.742	0.628	0.711	0.918	7
8	0.795	0.543	0.802	0.625	0.768	0.748	0.813	0.750	0.676	0.652	8
9	1.030	0.851	0.654	0.723	0.834	0.610	0.784	0.661	0.731	0.514	9
10	1.086	0.938	0.929	0.864	0.686	0.657	0.958	0.422	0.937	1.041	10
11	0.367	0.178	2.174	0.919	0.625	0.997	1.122	2.281	1.528	0.680	11
12	0.801	0.629	1.065	0.774	0.726	0.742	0.894	0.963	0.923	0.761	12
13	0.801	0.629	1.065	0.774	0.726	0.742	0.894	0.963	0.923	0.761	13

Table 10.9 Stock numbers at age ('000) of cod in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	427312	454838	802190	272201	559221	274188	539936	92453	580617	249026	1
2	281437	174892	181492	321986	109079	209124	107749	202144	36505	210207	2
3	25927	71361	53016	47612	82974	28032	48774	27084	52272	10955	3
4	17402	8637	21188	15760	14007	18775	6969	14006	7554	16218	4
5	5299	6765	3866	8431	6339	5147	6561	2591	5365	2669	5
6	2127	1801	2692	1738	3483	2331	1977	2582	1075	2053	6
7	835	866	837	1164	747	1170	860	766	1113	389	7
8	747	342	378	318	444	294	456	335	335	448	8
9	237	276	163	139	139	169	114	165	130	139	9
10	54	69	96	69	55	50	75	43	70	51	10
11	55	15	22	31	24	23	21	24	23	22	11
12	44	31	10	2	10	10	7	6	2	4	12
13	5			6				0	2	4	13

Table 10.10 Cod in Sub-area IV. Output from program RCRTINX2.

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	2.8904	0.864	3.788	0.5595	15	6.2858	0.58575	0.61637	0.03032
EGFS1	3.5667	0.843	3.252	0.9050	9	6.2577	0.23183	0.24762	0.18788
DGFS1	4.7203	0.596	3.576	0.9527	6	6.3872	0.19247	0.21664	0.24543
SGFS1	2.1972	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFS0	2.2300	0.566	4.403	0.6773	8	5.6646	0.50138	0.53576	0.04013
DGFS0	4.9740	0.428	4.142	0.9831	5	6.2704	0.11066	0.12937	0.28798
IYFS2	3.3945	1.081	3.169	0.8129	15	6.8375	0.31672	0.35576	0.09101
FRGSF	2.3514	0.650	4.162	0.7845	15	5.6907	0.34602	0.36164	0.08808
MEAN						5.8814	0.62847	0.62847	0.02916

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	2.2824	0.873	3.806	0.5879	16	5.7984	0.54550	0.56856	0.02718
EGFS1	2.7213	0.854	3.226	0.9045	10	5.5499	0.22357	0.24083	0.15151
DGFS1	3.7495	0.593	3.583	0.9567	7	5.8066	0.17130	0.18366	0.21967
SGFS1	1.1632	1.118	3.962	0.9768	5	5.2620	0.14033	0.16170	0.21967
EGFS0	0.7885	0.620	4.341	0.5916	9	4.8297	0.57987	0.67361	0.01936
DGFS0	3.6376	0.437	4.123	0.9827	6	5.7137	0.10583	0.11454	0.21967
IYFS2	2.0412	1.032	3.259	0.8143	16	5.3667	0.31112	0.33278	0.07935
FRGSF	1.1939	0.712	4.044	0.7136	16	4.8944	0.41285	0.46413	0.04079
MEAN						5.9218	0.62092	0.62092	0.02279

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	1.8083	0.872	3.846	0.6170	16	5.4217	0.52159	0.55456	0.09927
EGFS1									
DGFS1									
SGFS1									
EGFS0	0.3365	0.618	4.345	0.5938	9	4.5525	0.58471	0.71275	0.06010
DGFS0	3.6163	0.437	4.124	0.9831	6	5.7054	0.10557	0.11439	0.76323
IYFS2									
FRGSF									
MEAN						5.9237	0.62799	0.62799	0.07741

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1981	6.21	499.48	0.15	0.08	6.33	560.08	0.56
1982	5.73	307.29	0.15	0.11	5.62	274.97	0.75
1983	6.57	715.74	0.14	0.13	6.29	539.88	0.91
1984	4.92	136.41	0.16	0.19	4.54	93.41	1.14
1985	6.26	524.30	0.11	0.11	6.37	581.64	1.00
1986	5.54	254.43	0.09	0.10			1.02
1987	5.62	277.23	0.17	0.17			0.96

Table 10.11 Mean fishing mortality, biomass and recruitment of cod in Sub-area IV between 1968 and 1987.

	Mean Fishing Mortality			Biomass		Recruits	
	Ages 2 to 8		Ages 1 to 1	1000 tonnes		Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1968	0.595	0.000	0.000	755	252	67	185
1969	0.536	0.000	0.000	606	250	68	197
1970	0.535	0.000	0.000	924	271	69	729
1971	0.649	0.000	0.000	1110	269	70	847
1972	0.810	0.000	0.000	764	225	71	160
1973	0.690	0.000	0.000	608	197	72	293
1974	0.663	0.000	0.000	565	210	73	234
1975	0.673	0.000	0.000	626	191	74	426
1976	0.712	0.000	0.000	533	164	75	207
1977	0.720	0.000	0.000	704	143	76	710
1978	0.812	0.000	0.000	705	143	77	427
1979	0.696	0.000	0.000	703	145	78	455
1980	0.783	0.000	0.000	885	160	79	802
1981	0.773	0.000	0.000	741	173	80	272
1982	0.891	0.000	0.000	739	168	81	559
1983	0.878	0.000	0.000	562	136	82	274
1984	0.836	0.000	0.000	633	119	83	540
1985	0.784	0.000	0.000	409	111	84	92
1986	0.797	0.000	0.000	553	100	85	581
1987	0.856	0.000	0.000	475	95	86	254
Mean recruits at age 1 for period 1968 to 1987							412

Table 10.12 Input for catch prediction of cod in Sub-area IV.

	1987				Values used in Prediction						
	Stock and Fishing Mortality				F at age , Mean Wt. and Propn. Retained by Consumption Fishery						
					Scaled mean F			Mean values for period 1983 to 1987			
Age	Stock	Fishing Mortality			1983 to 1987			Mean Weight (Kg.)			Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	253731	0.158			0.163			0.600			0.600	1.000
2	210175	0.857			1.000			0.934			0.934	1.000
3	10955	1.261			1.103			1.974			1.974	1.000
4	16217	0.746			0.822			3.926			3.926	1.000
5	2669	0.819			0.773			6.310			6.310	1.000
6	2053	0.739			0.772			8.296			8.296	1.000
7	389	0.918			0.772			10.061			10.061	1.000
8	448	0.652			0.750			11.663			11.663	1.000
9	139	0.514			0.680			12.774			12.774	1.000
10	51	1.041			0.828			13.662			13.662	1.000
11	22	0.680			1.362			14.113			14.113	1.000
12	4	0.761			0.883			14.804			14.804	1.000
13	4	0.761			0.883			14.696			14.696	1.000

	Mean F	Age 2 to 8	Age 1 1	Age 2 to 8	Age 1 1
	Unscaled	0.856	0.000	0.830	0.000
	Scaled			0.856	0.000

Recruits at age 1 in 1988 = 277000
Recruits at age 1 in 1989 = 412000
Recruits at age 1 in 1990 = 412000

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

Mean F for ages 2 to 8 in 1987 for human consumption landings + discards = 0.856 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1983 to 1987
rescaled to produce a mean value of F for ages 2 to 8 equal to that for 1987

Mean F for ages 1 to 1 in 1987 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1983 to 1987 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1987

Table 10.13 Predicted catches and biomasses ('000) of cod in Sub-area IV - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	475	452	494	494	494	494	494	494	494	494	494	494
Spawning	95	96	92	92	92	92	92	92	92	92	92	92
Mean F Ages												
Human Cons. 2 to 8	0.86	0.86	0.00	0.17	0.34	0.51	0.68	0.86	1.03	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1987)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	174	177	0	43	79	110	137	160	180	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	174	177	0	43	79	110	137	160	180	0	0	
Total catch	174	177	0	43	79	110	137	160	180	0	0	
Biomass 1 Jan of Year+1												
Total	452	494	763	697	643	597	559	527	499	0	0	
Spawning	96	92	199	167	141	119	101	86	73	0	0	

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
1	277000	28943	0	0	28943
2	97361	53421	0	0	53421
3	62856	37989	0	0	37989
4	2418	1245	0	0	1245
5	6299	3113	0	0	3113
6	963	476	0	0	476
7	803	396	0	0	396
8	127	62	0	0	62
9	191	86	0	0	86
10	68	35	0	0	35
11	15	10	0	0	10
12	9	5	0	0	5
13	2	1	0	0	1
Wt	451862	177261	0	0	177261

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	412000	43049	0	0	43049
2	105772	58036	0	0	58036
3	25241	15255	0	0	15255
4	16253	8368	0	0	8368
5	870	430	0	0	430
6	2381	1175	0	0	1175
7	365	180	0	0	180
8	304	147	0	0	147
9	49	22	0	0	22
10	79	41	0	0	41
11	24	17	0	0	17
12	3	2	0	0	2
13	4	2	0	0	2
Wt	494428	160158	0	0	160158

Table 10.14 Predicted catches and biomasses ('000 t) of cod in Sub-area IV - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	475	452	519	519	519	519	519	519	519	519	519	519
Spawning	95	96	105	105	105	105	105	105	105	105	105	105
Mean F Ages												
Human Cons. 2 to 8	0.86	0.74	0.00	0.17	0.34	0.51	0.68	0.86	1.03	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1987)										F0.1	Fmax	
Human Consumption	1.00	0.86	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	174	161	0	46	86	120	148	173	195	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	174	161	0	46	86	120	148	173	195	0	0	
Total catch	174	161	0	46	86	120	148	173	195	0	0	
Biomass 1 Jan of Year+1												
Total	452	519	795	725	666	616	575	540	510	0	0	
Spawning	96	105	223	187	158	133	112	95	81	0	0	

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
1	277000	25132	0	0	25132
2	97361	48562	0	0	48562
3	62856	34733	0	0	34733
4	2418	1124	0	0	1124
5	6299	2803	0	0	2803
6	963	428	0	0	428
7	803	357	0	0	357
8	127	55	0	0	55
9	191	77	0	0	77
10	68	32	0	0	32
11	15	9	0	0	9
12	9	5	0	0	5
13	2	1	0	0	1
Wt	451862	160531	0	0	160531

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	412000	43049	0	0	43049
2	108209	59374	0	0	59374
3	29034	17548	0	0	17548
4	18965	9765	0	0	9765
5	976	482	0	0	482
6	2653	1309	0	0	1309
7	406	200	0	0	200
8	339	164	0	0	164
9	55	25	0	0	25
10	87	45	0	0	45
11	27	19	0	0	19
12	4	2	0	0	2
13	4	2	0	0	2
Wt	518828	173389	0	0	173369

Table 10.15

ASSESSMENT QUALITY CONTROL DIAGRAM 1

STOCK: Cod in Sub-area IV (North Sea).

AVERAGE F(2-8,u)					
DATE OF ASSESSMENT	YEAR				
	1983	1984	1985	1986	1987
1984	0.93				
1985	0.95	0.91			
1986	0.95	0.96	1.00		
1987	0.89	0.88	0.85	0.91	
1988	0.88	0.84	0.78	0.80	0.86[1]

REMARKS: [1] 1987 value may be inflated by high estimate for age 3.

ESTIMATED TOTAL LANDINGS ('000 T) AT STATUS QUO F							
ASSESSED IN	YEAR						
	1983	1984	1985	1986	1987	1988	1989
FORECAST YR	n/a	n/a	188	210	243	233	160
CURRENT YR	n/a	196	248	167	253	177	
ACTUAL	232	202	186	151	174[1]		

$$\text{Actual SQC} \approx \text{Landings (t)} * \frac{\text{F(assumed)}}{\text{F(actual)}} * \exp\left[\frac{1}{2}(\text{F(assumed)} - \text{F(actual)})\right]$$

REMARKS: [1] No correction applied because 1987 value may be inflated by about 0.05.

cont'd.

Table 10.15 Cont'd

ASSESSMENT QUALITY CONTROL DIAGRAM 2

STOCK: Cod in Sub-area IV (North Sea).

RECRUITMENT (AGE 1) UNIT: millions					
DATE OF ASSESSMENT	YEAR CLASS				
	1983	1984	1985	1986	1987
1984	214				
1985	393	164			
1986	527	57	790[2]		
1987	552	93	730[1]	410[1]	
1988	540	92	581	254	277

REMARKS: [1]Amended by ACFM to 572 and 268.
[2]Amended by ACFM to 500.

SPAWNING STOCK BIOMASS ('000 T)								
DATE OF ASSESSMENT	YEAR							
	1983	1984	1985	1986	1987	1988	1989	1990
1984	133	119	100[1,4]	86[1,4]				
1985	131	107	94	93[1]	95[1,4]			
1986	132	108	91	80	74[1]	73[1,4]		
1987	134	114	104	95	106	106[1]	128[1,3]	
1988	136	119	111	100	95	96	105[1]	122[1,2]

[1]Forecast.

REMARKS: [2]Assuming TAC taken in 1988, F(89) = 0.7 F(87).
[3]Assuming catch (87) = 190 kt, F(88) = 0.7 F(86).
[4]Assuming status quo.

Table 11.1 Nominal catch (in tonnes) of COD in Division VIa, 1978-1987, as officially reported to ICES.

Country	1978	1979	1982	1981	1982
Belgium	-	4	57	30	35
Denmark	-	-	27[2]	-	3
Faroe Islands	-	40	3	-	2
France	4,499	4,590	5,495	7,601	7,160
Germany, Fed. Rep.	31	40	1	21	8
Ireland	1,214	2,237	2,331	2,725	3,527
Netherlands	3	20	1	-	-
Norway	40	32	48	40	238
Spain	108[2]	-	-	-	41
Sweden	-	-	-	-	1
UK (England and Wales)	2,082	2,348	2,302	3,187[3]	2,948
UK (Scotland)	5,539	6,929	7,603	10,339	7,969
UK (Northern Ireland)	5	2	2	7	33
Total	13,521	16,242	17,870	23,950	21,965

Country	1983	1984	1985	1986	1987[1]
Belgium	21	22	48	88	60
Denmark	-	-	-[1]	-	4[2]
Faroe Islands	-	-	-	-	-
France	8,140	7,637	7,411	8,386[1,4]	6,776[4]
Germany, Fed. Rep.	205	75	66	53	23[2]
Ireland	2,695	2,316	2,564	1,704	1,524
Netherlands	-	-	1	-	-
Norway	267	231	204	176[1]	558
Spain	52	64	28	-	...
Sweden	-	-	-	-	-
UK (England and Wales)	1,141	692	243	106	269
UK (Scotland)	8,933	9,483	8,032	4,251	11,144
UK (Northern Ireland)	37	32	17	54	138
Total	21,491	20,552	18,614	14,818	20,496

[1] Provisional.
[2] Includes Division VIb.
[3] Including 37 tonnes caught in Sub-area VI and landed abroad.
[4] Includes Divisions VIb and Vb.

Table 11.2 Annual weight and numbers of cod caught in Sub-area IV between 1968 and 1987.

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

Table 11.3 Values of natural mortality rate and proportion mature at age.

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.520
3	0.200	0.860
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000

Table 11.4 Total international catch at age ('000 t) of cod in Division VIa.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	723	929	1195	461	1827	2335	2143	1355	792	8089	1
2	1761	1612	3294	7016	1673	4515	2360	5069	1486	4969	2
3	999	2125	2001	3220	3206	1118	2564	1269	2055	1015	3
4	695	682	796	904	1189	1400	448	1091	411	929	4
5	286	342	191	182	367	468	555	140	191	140	5
6	97	134	77	29	111	148	185	167	40	58	6
7	47	32	27	16	22	40	40	60	16	8	7
8	18	16	8	3	10	16	14	13	9	15	8
9	8	17	1	1	1	2	5	6	4	3	9
10	1	4	1		1	1		0		1	10

Table 11.5 Total international mean weight at age (Kg) of cod in Divisions VIa.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.630	0.693	0.624	0.550	0.692	0.583	0.735	0.628	0.710	0.530	1
2	1.373	1.373	1.375	1.166	1.468	1.265	1.402	1.183	1.211	1.310	2
3	3.389	2.828	3.002	2.839	2.737	2.995	3.168	2.597	2.785	2.776	3
4	5.262	4.853	5.277	4.923	4.749	4.398	5.375	4.892	4.655	4.569	4
5	7.096	6.433	7.422	7.518	6.113	6.305	6.601	6.872	6.336	6.146	5
6	8.686	7.784	8.251	9.314	7.227	8.084	8.606	8.344	8.283	7.987	6
7	9.932	8.570	9.293	10.176	9.587	9.064	10.461	9.540	9.091	9.786	7
8	10.060	9.452	9.473	10.668	10.264	10.979	10.464	10.061	8.742	9.467	8
9	8.694	11.097	8.500	11.271	11.449	12.467	9.131	11.357	12.128	11.299	9
10	10.548	12.736	10.875		10.404	11.882		13.442		16.056	10

Table 11.6 Cod in Division VIa. Scottish research vessel survey indices for cod aged 1- and 2 in Division VIa.

Year	age 1	age 2
1979	0.0	6.0
1980	33.0	123.0
1981	0.2	0.8
1982	1.0	6.0
1983	2.0	35.0
1984	6.0	2.8
1985	1.5	23.7
1986	0.8	8.3
1987	108.0	20.0
1988	0.0	25.7

Table 11.7 Cod in Division VIa. Summary statistics from Laurec/Shepherd tuning.

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 1	1	-16.64	0.986	0.0067	0.3858	0.000	0.000	-16.644	0.314
	2	-15.55	1.037	0.0023	0.2787	0.000	0.000	-15.554	0.308
	3	-14.74	0.631	0.0104	0.0573	0.000	0.000	-14.738	0.187
	4	-15.55	0.549	0.0232	0.3163	0.000	0.000	-15.550	0.163
	5	-17.27	0.770	0.0125	0.5115	0.000	0.000	-17.273	0.229

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.221	0.325	0.416	0.416	1.638

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 2	1	-13.57	0.640	0.1452	0.9954	0.000	0.000	-13.572	0.204
	2	-13.94	0.323	0.0116	0.8840	0.000	0.000	-13.943	0.096
	3	-13.82	0.431	0.0262	0.2604	0.000	0.000	-13.817	0.128
	4	-13.99	0.379	0.1104	0.5251	0.000	0.000	-13.991	0.112
	5	-15.68	0.331	0.0613	1.7715	0.000	0.000	-15.679	0.098

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.795	0.173	0.323	0.323	3.503

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 3	1	-12.37	0.321	0.4851	1.4107	0.000	0.000	-12.366	0.102
	2	-13.60	0.223	0.0163	0.7882	0.000	0.000	-13.599	0.066
	3	-13.86	0.312	0.0252	0.5214	0.000	0.000	-13.857	0.093
	4	-13.76	0.179	0.1398	0.9856	0.000	0.000	-13.755	0.053
	5	-15.75	0.408	0.0569	1.6983	0.000	0.000	-15.754	0.121

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.932	0.114	0.160	0.160	1.990

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 4	1	-12.18	0.452	0.5832	1.2869	0.000	0.000	-12.182	0.144
	2	-13.40	0.333	0.0200	0.4754	0.000	0.000	-13.397	0.099
	3	-13.77	0.394	0.0275	0.3754	0.000	0.000	-13.769	0.117
	4	-13.79	0.146	0.1351	1.0726	0.000	0.000	-13.790	0.043
	5	-16.12	0.552	0.0394	3.3295	0.000	0.000	-16.121	0.164

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.937	0.119	0.240	0.240	4.046

cont'd.

Table 11.7 cont'd.
Cod in Division VIa. Summary statistics from Laurec/Shepherd tuning.

Age 5

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.37	0.615	0.4843	2.2600	0.000	0.000	-12.367	0.196
2	-13.47	0.544	0.0186	0.6518	0.000	0.000	-13.466	0.162
3	-13.70	0.438	0.0294	0.2170	0.000	0.000	-13.700	0.130
4	-13.82	0.239	0.1311	0.6555	0.000	0.000	-13.820	0.071
5	-16.39	0.701	0.0301	4.2077	0.000	0.000	-16.392	0.208

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.683	0.180	0.376	0.376	4.349

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.18	0.694	0.5847	2.1196	0.000	0.000	-12.179	0.221
2	-13.22	1.041	0.0238	0.6915	0.000	0.000	-13.219	0.309
3	-13.66	0.426	0.0306	0.3555	0.000	0.000	-13.660	0.127
4	-14.06	0.428	0.1030	0.4595	0.000	0.000	-14.061	0.127
5	-16.87	0.899	0.0186	5.4063	0.000	0.000	-16.870	0.267

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.646	0.257	0.428	0.428	2.778

Age 7

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.26	0.458	0.5412	1.4433	0.000	0.000	-12.256	0.146
2	-12.94	0.812	0.0315	0.1258	0.000	0.000	-12.942	0.241
3	-14.49	0.925	0.0133	0.1066	0.000	0.000	-14.493	0.275
4	-14.37	0.794	0.0754	3.0174	0.000	0.000	-14.372	0.236
5	-16.89	0.840	0.0183	0.7321	0.000	0.000	-16.888	0.250

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.773	0.309	0.586	0.586	3.598

Age 8

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.34	0.685	0.4966	1.4899	0.000	0.000	-12.342	0.218
2	-12.81	0.748	0.0361	2.7047	0.000	0.000	-12.805	0.222
3	-13.98	0.813	0.0222	0.3332	0.000	0.000	-13.982	0.241
4	-14.25	0.728	0.0851	6.3862	0.000	0.000	-14.251	0.216
5	-16.13	0.859	0.0391	2.9298	0.000	0.000	-16.130	0.255

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.978	0.340	0.479	0.479	1.988

Table 11.8 Total international fishing mortality rate at age of cod in Division VIa.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.087	0.071	0.066	0.089	0.142	0.323	0.165	0.275	0.070	0.221	1
2	0.330	0.283	0.380	0.663	0.528	0.612	0.633	0.723	0.549	0.795	2
3	0.577	0.845	0.677	0.794	0.742	0.832	0.875	0.863	0.744	0.932	3
4	0.779	1.040	0.933	0.763	0.791	0.882	1.003	1.285	0.781	0.937	4
5	0.857	1.219	0.982	0.566	0.838	0.864	1.147	1.075	0.825	0.683	5
6	0.992	1.468	1.078	0.369	0.830	1.030	1.080	1.545	1.125	0.646	6
7	1.149	1.158	1.706	0.663	0.531	0.863	0.899	1.439	0.592	0.773	7
8	0.516	2.211	1.163	0.941	1.195	0.990	0.847	0.852	0.919	1.978	8
9	0.869	1.455	1.204	0.657	0.849	0.924	1.005	1.259	0.855	1.004	9
10	0.869	1.455	1.204	0.657	0.849	0.924	1.005	1.259	0.855	1.004	10

Table 11.9 Stock numbers at age ('000 t) of cod in Division VIa.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	9578	14981	20616	5957	15166	9273	15475	6185	12926	44808	1
2	6883	7189	11427	15801	4462	10770	5494	10740	3846	9868	2
3	2489	4053	4436	6399	6668	2154	4780	2388	4268	1818	3
4	1399	1144	1426	1845	2368	2599	767	1631	825	1660	4
5	540	526	331	459	705	879	881	230	370	309	5
6	167	187	127	102	213	249	303	229	64	133	6
7	74	51	35	35	57	76	73	84	40	17	7
8	49	19	13	5	15	28	26	24	16	18	8
9	14	24	2	3	2	4	8	9	8	5	9
10	2	6	1		2	2		0		2	10

Table 11.10 Cod in Division VIa. Output from program RCRTINX2.

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	2.8904	0.806	0.472	0.2286	15	2.8011	0.72257	0.76035	0.03432
EGFS1	3.5667	0.621	0.496	0.6065	9	2.7119	0.34785	0.37153	0.14376
DGFS1	4.7203	0.449	0.780	0.6415	6	2.9003	0.39986	0.45008	0.09796
SGFS1	2.1972	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFS0	2.2300	0.420	1.397	0.4925	8	2.3332	0.46655	0.49854	0.07984
DGFS0	4.9740	0.323	1.218	0.5991	5	2.8224	0.40580	0.47442	0.08817
IYFS2	3.3945	0.759	0.518	0.5845	15	3.0960	0.33166	0.37255	0.14297
FRGFS	2.3514	0.496	1.113	0.4792	15	2.2787	0.41009	0.42861	0.10802
SWCS1	0.6098	0.534	1.752	0.5644	6	2.0778	0.46997	0.52612	0.07169
SWCS2	3.0445	0.617	0.902	0.5318	6	2.7802	0.40896	0.46502	0.09176
MEAN						2.4241	0.37448	0.37448	0.14150

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	2.2824	0.768	0.587	0.2661	16	2.3397	0.64037	0.66744	0.02757
EGFS1	2.7213	0.609	0.531	0.6245	10	2.1888	0.31619	0.34059	0.10587
DGFS1	3.7495	0.433	0.805	0.6395	7	2.4297	0.36123	0.38731	0.08187
SGFS1	1.1632	0.534	1.621	0.9011	5	2.2414	0.13834	0.15940	0.30703
EGFS0	0.7885	0.426	1.415	0.4711	9	1.7511	0.45362	0.52695	0.04423
DGFS0	3.6376	0.305	1.256	0.6309	6	2.3645	0.34080	0.36884	0.09027
IYFS2	2.0412	0.714	0.607	0.5960	16	2.0643	0.31744	0.33954	0.10653
FRGFS	1.1939	0.526	1.060	0.4573	16	1.6888	0.42005	0.47222	0.05507
SWCS1	4.6913	0.575	1.783	0.4666	7	4.4788	0.51437	0.85567	0.01677
SWCS2	3.2847	0.593	0.938	0.5649	7	2.8858	0.35617	0.40791	0.07381
MEAN						2.4483	0.36743	0.36743	0.09097

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	1.8083	0.740	0.692	0.3010	16	2.0303	0.59817	0.63598	0.12085
EGFS1									
DGFS1									
SGFS1									
EGFS0	0.3365	0.419	1.434	0.4778	9	1.5748	0.44983	0.54833	0.16257
DGFS0	3.6163	0.302	1.269	0.6353	6	2.3608	0.33819	0.36645	0.36399
IYFS2									
FRGFS									
SWCS1									
SWCS2									
MEAN						2.4564	0.37234	0.37234	0.35259

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1981	2.48	11.89	0.23	0.09	2.82	16.80	0.42
1982	2.13	8.39	0.23	0.18	2.33	10.27	0.76
1983	2.79	16.30	0.22	0.19	2.80	16.47	0.86
1984	1.91	6.74	0.17	0.23	1.97	7.19	1.35
1985	2.64	14.03	0.14	0.10	2.63	13.93	0.72
1986	2.30	9.95	0.11	0.12			1.11
1987	2.23	9.27	0.22	0.18			0.82

Table 11.11 Mean fishing mortality, biomass and recruitment of cod in Division VIa between 1968-1987.

	Mean Fishing Mortality			Biomass			Recruits
	Ages		Ages	1000 tonnes			Age 1
	2 to 5		1 to 1				
Year	H.Con	Disc	By-cat	Total	Sp St	%C.	Million
1968	0.592	0.000	0.000	63	49	67	9
1969	0.782	0.000	0.000	47	38	68	4
1970	0.613	0.000	0.000	34	27	69	8
1971	0.478	0.000	0.000	36	25	70	10
1972	0.698	0.000	0.000	36	26	71	6
1973	0.592	0.000	0.000	34	25	72	9
1974	0.649	0.000	0.000	35	25	73	8
1975	0.562	0.000	0.000	39	26	74	11
1976	0.727	0.000	0.000	40	29	75	7
1977	0.675	0.000	0.000	33	23	76	10
1978	0.636	0.000	0.000	38	26	77	10
1979	0.847	0.000	0.000	43	26	78	15
1980	0.743	0.000	0.000	53	31	79	21
1981	0.697	0.000	0.000	54	39	80	6
1982	0.725	0.000	0.000	53	37	81	15
1983	0.798	0.000	0.000	46	33	82	9
1984	0.915	0.000	0.000	48	31	83	15
1985	0.986	0.000	0.000	35	25	84	6
1986	0.725	0.000	0.000	33	20	85	13
1987	0.837	0.000	0.000	37	22	86	16
Mean recruits at age 1 for period 1968 to 1987							10

Table 11.12 Input for catch prediction of cod in Division VIa.

	1987				Values used in Prediction						
	Stock and Fishing Mortality				F at age , Mean Wt. and Propn. Retained by Consumption Fishery						
					Scaled mean F			Mean values for period 1983 to 1987			
Age	Stock	Fishing Mortality			1983 to 1987			Mean Weight (Kg.)			Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	15758	0.208			0.325			0.637			0.637	1.000
2	9868	0.795			0.651			1.274			1.274	1.000
3	1818	0.932			0.834			2.864			2.864	1.000
4	1660	0.937			0.960			4.778			4.778	1.000
5	309	0.683			0.903			6.452			6.452	1.000
6	133	0.646			1.066			8.261			8.261	1.000
7	17	0.773			0.897			9.588			9.588	1.000
8	18	1.978			1.097			9.942			9.942	1.000
9	5	1.004			0.991			11.276			11.276	1.000
10	2	1.004			0.991			13.793			13.793	1.000

	Mean F	Age 2 to 5	Age 1 1	Age 2 to 5	Age 1 1
	Unscaled	0.837	0.000	0.852	0.000
	Scaled			0.837	0.000

Recruits at age 1 in 1988 = 12900
Recruits at age 1 in 1989 = 12900
Recruits at age 1 in 1990 = 12900

M at age and proprtion mature at age are as shown in Table 11.3

Mean F for ages 2 to 5 in 1987 for human consumption landings + discards = 0.837 ,
Human consumption + discard F-at-age values in prediction are mean values for the period 1983 to 1987
rescaled to produce a mean value of F for ages 2 to 5 equal to that for 1987

Mean F for ages 1 to 1 in 1987 for small-mesh fisheries = 0.000 ,
Industrial fishery F-at-age in the prediction are averages for the period 1983 to 1987 ,
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1987

Table 11.13 Predicted catches and biomasses ('000 t) of cod in Division VIa - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	37	40	40	40	40	40	40	40	40	40	40	40
Spawning	22	24	25	25	25	25	25	25	25	25	25	25
Mean F Ages												
Human Cons. 2 to 5	0.84	0.84	0.00	0.17	0.33	0.50	0.67	0.84	1.00	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1987)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	19	18	0	5	9	13	16	18	21	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	19	18	0	5	9	13	16	18	21	0	0	
Total catch	19	18	0	5	9	13	16	18	21	0	0	
Biomass 1 Jan of Year+1												
Total	40	40	67	60	53	48	43	39	35	0	0	
Spawning	24	25	50	43	37	32	28	24	21	0	0	

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
1	12900	3258	0	0	3258
2	10479	4591	0	0	4591
3	3649	1897	0	0	1897
4	586	333	0	0	333
5	533	291	0	0	291
6	128	77	0	0	77
7	57	31	0	0	31
8	6	4	0	0	4
9	2	1	0	0	1
10	2	1	0	0	1
Wt	39968	17830	0	0	17830

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	12900	3258	0	0	3258
2	7635	3345	0	0	3345
3	4476	2327	0	0	2327
4	1297	737	0	0	737
5	184	100	0	0	100
6	177	107	0	0	107
7	36	20	0	0	20
8	19	12	0	0	12
9	2	1	0	0	1
10	1	1	0	0	1
Wt	40180	18380	0	0	18380

Table 11.14

ASSESSMENT QUALITY CONTROL DIAGRAM 1

STOCK: Cod in Division VIa (West of Scotland).

AVERAGE F(2-5,u)					
DATE OF ASSESSMENT	YEAR				
	1983	1984	1985	1986	1987
1984	0.72				
1985	0.65	0.74			
1986	0.74	0.76	0.72		
1987	0.80	0.91	0.97	0.78	
1988	0.80	0.92	0.99	0.73	0.84

REMARKS:

ESTIMATED TOTAL LANDINGS ('000 T) AT STATUS QUO F							
ASSESSED IN	YEAR						
	1983	1984	1985	1986	1987	1988	1989
FORECAST YR	n/a	n/a	29	25	22	16	18
CURRENT YR	n/a	29	26	21	15	18	
ACTUAL	22	18	18	14	17		

$$\text{Actual SQC} \approx \text{Landings (t)} * \frac{\text{F(assumed)}}{\text{F(actual)}} * \exp\left[-\frac{1}{2}(\text{F(assumed)} - \text{F(actual)})\right]$$

REMARKS:

cont'd.

Table 11.14 Cont'd

ASSESSMENT QUALITY CONTROL DIAGRAM 2

STOCK: Cod in Division VIa (West of Scotland).

RECRUITMENT (AGE 1) UNIT: millions					
DATE OF ASSESSMENT	YEAR CLASS				
	1983	1984	1985	1986	1987
1984	13				
1985	19	13			
1986	18	13	15		
1987	15	6	15	13	
1988	15	6	13	16	13

REMARKS:

SPAWNING STOCK BIOMASS ('000 T)								
DATE OF ASSESSMENT	YEAR							
	1983	1984	1985	1986	1987	1988	1989	1990
1984	23	33	37[1]	34[1]				
1985	24	22	27	29[1]	27[1]			
1986	34	34	30	35	36[1]	37[1]		
1987	33	31	24	19	21	24[1]	27[1]	
1988	33	31	25	20	22	24	25[1]	24[1]

[1] Forecast.

REMARKS: Forecast assuming status quo.

Table 12.1 Nominal catch (in tonnes) of COD in Division VIb, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Denmark	-	-	-[2]	2	-
Faroe Islands	10	92	75	4	77
France	1	2	1	443	27
Germany, Fed. Rep.	-	111	136	-	+
Ireland	3	-	-	134	-
Norway	69	138	80	70	51
Spain	-	-	-	-	58
UK (England and Wales)	285	129	1	67	3
UK (N.Ireland	-	-	-	-	-
UK (Scotland)	384	198	370	143	157
Total	752	670	696	863	373

Country	1983	1984	1985	1986	1987[1]
Denmark	-	-	-[1]	-	...[2]
Faroe Islands	112	18	-	1[2]	-[2]
France	97	9	17	...[2]	...[2]
Germany, Fed. Rep.	195	-	3	-[2]	...[2]
Ireland	-	-	-	-[2]	-
Norway	462	373	202	98[1]	-
Spain	42	241	1,200	1,219	...
UK (England and Wales)	163	161	114	93	42
UK (N.Ireland)	-	-	-	1	-
UK (Scotland)	35	221	437	187	280
Total	1,106	1,023	1,973	1,599	322

[1] Provisional.
[2] Included in Division VIa.

Table 13.1.1 Nominal catch (in tonnes) of COD in Divisions VIId,e, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	435	699	163	363	293
Denmark	2,160	2,052	660[2]	-	-
France	8,044	4,848	4,001	4,486	3,349
Netherlands	+	-	-	4	1
UK (England and Wales)	654	485	365	428	568
Total	11,293	8,084	5,189	5,281	4,211

Country	1983	1984	1985	1986	1987[1]
Belgium	389	346	513	658	793
Denmark	-	-	-[1]	4	+[3]
France	3,369	2,882	2,948	12,335[1,3]	14,505[3]
Netherlands	4	-	1	66	-
UK (England and Wales)	650	518	569	1,236	1,312
Total	4,412	3,746	4,031	14,299	16,610

[1] Provisional.
[2] Includes Divisions VIIb,c.
[3] Includes all of Sub-areas VII (except Division VIIa) and VIII.

Table 13.1.2 Annual weight and numbers of cod caught in Divisions VIId,e, between 1978-1987.

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1978	11	11	0	0	9	9	0	0
1979	8	8	0	0	5	5	0	0
1980	5	5	0	0	4	4	0	0
1981	5	5	0	0	4	4	0	0
1982	4	4	0	0	3	3	0	0
1983	4	4	0	0	3	3	0	0
1984	4	4	0	0	3	3	0	0
1985	2	2	0	0	1	1	0	0
1986	7	7	0	0	10	10	0	0
1987	9	9	0	0	8	8	0	0

Table 13.1.3 Values of natural mortality rate and proportion mature at age.

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

Table 13.1.4 Total international catch at age ('000) of cod in Divisions VIId,e, between 1978-1987.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	922	627	922	75	1063	217	225	6	228	1353	1
2	5769	2198	2067	2456	926	1922	2361	867	7127	5792	2
3	2229	1376	651	924	656	854	427	355	2451	325	3
4	423	490	288	207	197	218	93	85	568	412	4
5	76	145	76	35	48	48	52	19	78	19	5
6	7	48	32	2	10	8	18	4	21	8	6
7	1	3	6		1	2		3	5		7

Table 13.1.5 Total international mean weight at age (Kg.) of cod in Divisions VIId,e between 1978-1987.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.624	0.617	0.591	0.472	0.601	0.792	0.493	0.534	0.338	0.685	1
2	1.023	1.021	0.774	0.938	0.696	0.777	0.706	1.281	0.478	1.083	2
3	1.642	2.346	2.304	2.016	2.662	1.736	2.677	2.465	0.835	2.015	3
4	2.077	3.100	3.673	4.176	4.301	4.181	4.110	4.016	1.566	2.403	4
5	2.981	3.444	3.933	5.739	5.205	5.708	6.197	5.154	4.147	4.579	5
6	5.587	3.959	4.632	6.887	7.772	7.358	6.683	8.584	5.389	5.823	6
7	6.595	5.396	5.467		6.497	10.336		4.166	6.549		7

Table 13.1.6 Total international fishing mortality rate at age of cod in Divisions VIId,e between 1978-1987

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.202	0.134	0.189	0.028	0.279	0.048	0.039	0.001	0.020	0.117	1
2	1.286	1.032	0.842	1.096	0.547	1.207	1.033	0.207	2.591	0.945	2
3	1.418	1.431	1.058	1.261	1.050	1.642	1.015	0.409	1.496	1.205	3
4	0.985	1.807	1.667	1.300	1.080	1.389	0.823	0.564	3.022	1.252	4
5	0.601	1.205	3.003	1.033	1.408	0.868	2.032	0.387	1.790	1.669	5
6	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	6
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	7

Table 13.1.7 Stock numbers at age ('000) of cod in Divisions VIId,e between 1978-1987.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	5540	5517	5898	3018	4792	5098	6488	9997	12825	13543	1
2	8616	3706	3952	3999	2403	2967	3978	5109	8179	10294	2
3	3172	1950	1081	1394	1094	1138	727	1159	3403	502	3
4	733	629	381	307	323	313	180	216	631	624	4
5	184	224	84	59	69	90	64	65	100	25	5
6	12	82	55	3	17	14	31	7	36	14	6
7	2	5	10		2	3		5	9		7

Table 13.1.8 Cod in Divisions VIId,e. Ouput from program RCRTINX2.

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	2.8904	7.891	-16.474	0.0037	12	6.3339	7.47716	7.96555	0.00147
EGFS1	3.5667	2.898	-7.344	0.0284	9	2.9926	2.55031	2.72394	0.01254
DGFS1	4.7203	-0.521	3.863	0.2309	6	1.4054	0.67887	0.76412	0.15937
SGFS1	2.1972	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFSO	2.2300	-0.602	3.473	0.1077	8	2.1307	0.88671	0.94751	0.10365
DGFSO	4.9740	-0.351	3.135	0.3737	5	1.3873	0.55246	0.64588	0.22307
IYFS2	3.3945	******	143.180	0.0001	12	-49.2894	39.33567	44.74215	0.00005
FRGSF	2.3514	-6.666	20.204	0.0045	12	4.5300	6.83244	7.20312	0.00179
VPAIV	6.3658	-9.286	56.713	0.0055	12	-2.4030	6.13366	6.58858	0.00
MEAN						1.9584	0.43318	0.43318	0.49592

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	2.2824	3.592	-6.469	0.0209	13	1.7294	3.27185	3.41846	0.01410
EGFS1	2.7213	2.720	-6.784	0.0403	10	0.6163	2.25684	2.43102	0.02789
DGFS1	3.7495	-2.208	10.665	0.0221	7	2.3866	3.03157	3.25046	0.01560
SGFS1	1.1632	-4.133	9.013	0.0166	5	4.2061	3.37814	3.89256	0.01088
EGFSO	0.7885	-0.874	4.235	0.0958	9	3.5461	1.21551	1.41201	0.08266
DGFSO	3.6376	-1.507	7.751	0.0332	6	2.2707	2.72683	2.95124	0.01892
IYFS2	2.0412	4.075	-8.463	0.0269	13	-0.1461	2.87608	3.08689	0.01730
FRGSF	1.1939	-3.474	11.429	0.0193	13	7.2812	3.40796	3.95977	0.01051
VPAIV	5.5216	32.025	-188.124	0.0005	13	-11.2944	20.89044	22.26374	0.00033
MEAN						2.0195	0.45338	0.45338	0.80180

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	1.8083	3.324	-5.750	0.0238	13	0.2608	3.04923	3.24856	0.01691
EGFS1									
DGFS1									
SGFS1									
EGFSO	0.3365	-0.865	4.213	0.0973	9	3.9214	1.22007	1.48724	0.08
DGFSO	3.6163	-1.504	7.738	0.0330	6	2.3010	2.74165	2.97080	0.02022
IYFS2									
FRGSF									
VPAIV									
MEAN						2.0234	0.44979	0.44979	0.88218

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1985	1.77	5.89	0.31	0.20	2.63	13.82	0.64
1986	2.15	8.59	0.41	0.28			0.70
1987	2.15	8.61	0.42	0.33			0.78

Table 13.1.9 Mean fishing mortality, biomass and recruitment of cod in Divisions VIId,e between 1974-1987.

	Mean Fishing Mortality			Biomass		Recruits	
	Ages 2 to 4		Ages 1 to 1	1000 tonnes		Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1974	0.679	0.000	0.000	10	3	73	3
1975	0.958	0.000	0.000	10	4	74	3
1976	1.109	0.000	0.000	16	2	75	12
1977	0.473	0.000	0.000	18	1	76	16
1978	1.230	0.000	0.000	20	2	77	6
1979	1.423	0.000	0.000	15	3	78	6
1980	1.189	0.000	0.000	11	2	79	6
1981	1.219	0.000	0.000	10	2	80	3
1982	0.892	0.000	0.000	9	2	81	5
1983	1.412	0.000	0.000	10	2	82	5
1984	0.957	0.000	0.000	9	1	83	6
1985	0.393	0.000	0.000	16	1	84	10
1986	2.370	0.000	0.000	13	2	85	13
1987	1.134	0.000	0.000	23	2	86	13
Mean recruits at age 1 for period 1974 to 1987							8

Table 13.1.10 Input for catch prediction of cod in Divisions VIId,e.

	1987			Values used in Prediction						
	Stock and Fishing Mortality			F at age , Mean Wt. and Propn. Retained by Consumption Fishery						
				Scaled mean F			Mean values for period 1983 to 1987			
Age	Stock	Fishing Mortality		1983 to 1987			Mean Weight (Kg.)			Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	13494	0.117			0.041			0.568			0.568	1.000
2	10293	0.945			1.083			0.865			0.865	1.000
3	502	1.205			1.044			1.946			1.946	1.000
4	624	1.252			1.276			3.255			3.255	1.000
5	25	1.669			1.221			5.157			5.157	1.000
6	14	1.000			0.905			6.767			6.767	1.000
7		1.000			0.905			7.017			7.017	1.000

	Mean F	Age 2 to 4	Age 1 1	Age 2 to 4	Age 1 1
	Unscaled	1.134	0.000	1.253	0.000
	Scaled			1.134	0.000

Recruits at age 1 in 1988 = 8000
Recruits at age 1 in 1989 = 8000
Recruits at age 1 in 1990 = 8000

M at age and proprtion mature at age are as shown in Table 13.1.3

Mean F for ages 2 to 4 in 1987 for human consumption landings + discards = 1.134 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1983 to 1987
rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1987

Mean F for ages 1 to 1 in 1987 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1983 to 1987 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1987

Table 13.1.11 Predicted catches and biomasses ('000 t) of cod in Divisions VIId,e - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	23	21	19	19	19	19	19	19	19	19	19	19
Spawning	2	1	3	3	3	3	3	3	3	3	3	3
Mean F Ages												
Human Cons. 2 to 4	1.13	1.13	0.00	0.23	0.45	0.68	0.91	1.13	1.36	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1987)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	9	10	0	3	5	6	8	9	10	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	9	10	0	3	5	6	8	9	10	0	0	
Total catch	9	10	0	3	5	6	8	9	10	0	0	
Biomass 1 Jan of Year+1												
Total	21	19	32	28	24	21	19	17	16	0	0	
Spawning	1	3	12	9	7	6	5	4	3	0	0	

Stock at start of and catch during 1988

Age	Stock No	M.Cons	Discards	By-catch	Total
1	8000	289	0	0	289
2	9828	5995	0	0	5995
3	3276	1956	0	0	1956
4	123	82	0	0	82
5	146	95	0	0	95
6	4	2	0	0	2
7	4	2	0	0	2
Wt	20629	9944	0	0	9944

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	M.Cons	Discards	By-catch	Total
1	8000	289	0	0	289
2	6289	3836	0	0	3836
3	2726	1628	0	0	1628
4	944	630	0	0	630
5	28	18	0	0	18
6	35	19	0	0	19
7	3	1	0	0	1
Wt	18765	8935	0	0	8935

Table 13.2.1 Nominal catch (in tonnes) of COD in Divisions VIIb,c,h-k, 1978-1987, as offically reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	-	-	-	-	-
Denmark	-	18	-	-	-
France	443	546	983	1,465	587
Germany, Fed. Rep.	-	-	7	-	-
Ireland	293	480	782	1,434	1,764
Netherlands	279	-	5	-	+
Norway	-	-	-	-	-
Poland	-	2	-	-	-
Spain	11	-	17	37	29
UK (England and Wales)	-	1	1	171	304
UK (Scotland)	2	1	12	+	-
Total	1,028	1,048	1,807	3,107	2,684

Country	1983	1984	1985	1986	1987[1]
Belgium	-	-	13	25[1]	-
Denmark	-	-	-	-	+[3]
France	636	946	1,115	...[2]	...[2]
Germany, Fed. Rep.	-	-	-	-	-
Ireland	1,192	1,211	1,176	1,283	849[4]
849 Netherlands	80	-	208	1	-
Norway	4	1	22	107	-
Poland	-	-	-	-	-
Spain	28	-	26	-	...
UK (England and Wales)	41	408	546	496[1]	84
UK (Scotland)	-	45	+	17	16
Total	1,981	2,611	3,106	1,929	949

[1] Provisional.
[2] Included in Divisions VIId,e.
[3] Includes Division VIIg.
[4] Divisions VIIb,c: 402 t; Divisions VIIg,h: 149 t; Divisions VIIj,k: 298 t.

Table 14.1 Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	1,295	732	1,414	1,217	966
Denmark	8,093	8,248	12,928	13,198	22,704
Faroe Islands	12	7	27	46	6
France	5,122	7,208	7,407	11,966	15,988
German Dem. Rep.	37	12	36	-	-
Germany, Fed. Rep.	2,589	2,549	2,354	3,387	4,510
Ireland	101	-	-	-	-
Netherlands	857	955	1,557	2,279	1,021
Norway[2]	609	968	1,191	2,283	2,888
Poland	62	106	59	31	317
Sweden	-[3]	907	1,165	1,301	1,874
UK (England and Wales)	12,200	10,774	12,195	14,570	16,403
UK (Scotland)	58,406	54,119	64,058	82,798	107,773
USSR	54	18	-	-	-
Total IV	89,437	86,603	104,391	133,076	174,450
WG total incl. discards	163,890	141,858	217,107	206,930	225,789

Country	1983	1984	1985	1986	1987[1]
Belgium	985	494	719	317	188
Denmark	25,653	16,368	23,619[1]	16,441	7,552
Faroe Islands	51	-	5	4	-
France	11,250	8,103	5,389	7,060[1,4]	4,286[4]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	3,654	2,571	2,796	1,984	1,281
Ireland	-	-	-	-	-
Netherlands	1,722	1,052	3,875	1,627	1,087
Norway[2]	3,862	3,959	3,498	4,881[1]	2,378
Poland	150	17	-	1	-
Sweden	1,360	1,518	1,942	1,550	541[4]
UK (England and Wales)	15,476	12,340	13,614	8,137	7,211
UK (Scotland)	100,390	87,479	112,549	126,650	83,903
USSR	-	-	-	-	-
Total	164,553	133,901	168,006	168,652	108,427
WG total incl. discards	232,203	213,252	250,000	220,000	175,000

[1] Provisional.
[2] Figures from Norway do not include haddock caught in Rec. 2 fisheries.
[3] Included in Division IIIa.
[4] Includes Division IIa.
[5] Jan-Sep.

Table 14.2 Annual weight and numbers of haddock caught in Sub-area IV between 1968-1987.

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
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	1633	398	788	447
1977	217	137	44	35	896	320	226	350
1978	174	86	77	11	1031	192	419	420
1979	142	84	42	16	1463	190	288	985
1980	217	99	95	22	1451	219	545	687
1981	207	130	60	17	1353	275	299	779
1982	226	166	41	19	970	310	181	480
1983	238	159	66	13	1254	292	387	574
1984	213	128	75	10	865	246	412	207
1985	250	159	86	6	971	359	457	154
1986	220	166	52	3	755	371	308	75
1987	175	107	63	4	696	230	372	95

Table 14.3 Values of natural mortality rate and proportion mature at age.

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

Table 14.4 Total international catch at age ('000) of haddock in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	285827	841391	374946	646340	278692	639333	95484	139593	56476	9638	0
1	454387	345753	662216	134459	275373	155723	431513	179114	160134	302776	1
2	141133	198939	323179	413329	83699	243480	159811	526914	176728	261166	2
3	28447	39818	69878	139259	286750	74124	119681	75145	320756	46583	3
4	109117	7139	10021	14663	40511	122291	22200	36318	27596	67058	4
5	8578	26932	1818	1901	3229	16683	32003	5235	9663	4509	5
6	1186	2135	7842	376	700	1675	3635	7154	1302	2746	6
7	1912	248	579	2478	273	272	586	925	1826	522	7
8	385	451	116	130	799	64	77	197	272	766	8
9	113	136	155	63	29	179	34	50	107	127	9
10	23	52	71	22	15	48	92	20	68	35	10

Table 14.5 Total international mean weight at age (Kg.) of haddock in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	0.012	0.009	0.012	0.009	0.011	0.022	0.010	0.013	0.025	0.009	0
1	0.144	0.095	0.104	0.074	0.100	0.135	0.141	0.149	0.124	0.122	1
2	0.252	0.291	0.284	0.262	0.292	0.295	0.298	0.280	0.241	0.259	2
3	0.416	0.443	0.487	0.474	0.461	0.447	0.486	0.480	0.395	0.403	3
4	0.444	0.635	0.730	0.735	0.786	0.649	0.673	0.669	0.606	0.609	4
5	0.694	0.659	1.038	1.131	1.168	0.912	0.804	0.862	0.854	1.016	5
6	0.709	0.924	0.925	1.456	1.456	1.225	1.100	1.061	1.225	1.252	6
7	0.924	1.173	1.377	1.148	1.678	1.220	1.128	1.466	1.176	1.402	7
8	1.302	1.167	1.621	1.583	1.452	1.937	1.929	1.817	1.569	1.514	8
9	1.806	1.455	1.597	1.690	2.624	1.425	2.462	2.103	1.445	1.748	9
10	1.923	2.639	1.710	1.531	2.173	1.484	1.871	2.129	2.041	1.987	10

Table 14.6 Fishing effort and catch at age of haddock in Sub-area IV by INT GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0											0
1	855.000	740.000	187.000	1092.000	1168.000	177.000	162.000	385.000	480.000	896.000	1
2	32.000	299.000	971.000	110.000	385.000	670.000	84.000	108.000	240.000	402.000	2
3											3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
11											11
12											12
Eff	190	143	110	242	304	346	405	385	395	338	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0								0
1	268.000	526.000	307.000	1057.000	229.000	579.000	885.000	1
2	675.000	252.000	400.000	219.000	828.000	244.000	326.000	2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10								10
11								11
12								12
Eff	313	341	397	433	470	490	491	Eff

cont'd.

Table 14.6 cont'd.
Fishing effort and catch at age of haddock in Sub-area IV by ENG GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0							534.652	336.731	872.553	368.764	0
1							67.101	158.409	298.500	620.158	1
2							32.034	25.086	54.606	177.405	2
3							61.551	2.387	8.723	23.978	3
4							9.270	22.828	1.085	2.719	4
5							0.719	2.613	4.372	0.404	5
6							0.921	0.054	0.351	1.472	6
7							0.056	0.742	0.043	0.247	7
8							0.045	0.086	0.181		8
9							0.067				9
10									0.032		10
11											11
12											12
Eff	No data	No data	No data	No data	No data	No data	89	93	94	89	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0	1537.132	281.345	831.931	227.127	245.870	265.953	22.410	0
1	162.813	315.397	218.207	599.064	186.556	149.781	281.934	1
2	450.868	79.862	112.621	63.000	238.185	44.719	43.098	2
3	72.473	118.207	21.431	30.143	21.111	33.813	5.328	3
4	9.505	10.034	21.741	5.238	6.981	2.766	6.869	4
5	0.659	2.362	2.655	4.746	1.963	1.750	0.475	5
6	0.033	0.983	0.397	1.063	1.278	0.375	0.328	6
7	0.549	0.138	0.138	0.127	0.407	0.359	0.033	7
8	0.077	0.069	0.017	0.016	0.093	0.125		8
9	0.011		0.034	0.063	0.019	0.047	0.016	9
10	0.066			0.111	0.019			10
11								11
12								12
Eff	91	58	58	63	54	64	61	Eff

cont'd.

Table 14.6 cont'd.
Fishing effort and catch at age of haddock in Sub-area IV by SCO GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0											0
1											1
2											2
3											3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
11											11
12											12
Eff	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0		123.468	220.316	87.329	82.805	174.688	27.718	0
1		248.818	181.342	436.744	199.963	232.850	239.311	1
2		99.623	161.076	78.805	301.720	57.388	70.408	2
3		133.610	37.190	33.585	23.524	59.813	10.603	3
4		11.545	45.544	5.463	10.402	35.650	12.838	4
5		0.727	5.316	6.537	1.415	2.663	0.825	5
6		0.195	1.228	0.939	2.195	0.375	0.459	6
7		0.065	0.089	0.488	0.366	0.325	0.089	7
8		0.234	0.063	0.098	0.220	0.013	0.249	8
9		0.052	0.190	0.073	0.073		0.036	9
10				0.049				10
11				0.012				11
12								12
Eff	No data	77	79	82	82	80	73	Eff

Table 14.7 Haddock in Sub-area IV. Summary statistics from Laurec/Shepherd tuning.

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 0	1	-18.31	0.266	0.0000	0.0039	0.000	0.000	-18.312	0.101
	2	No data for this age							
	3	-17.28	0.660	0.0000	0.0134	0.000	0.000	-17.283	0.205
	4	-24.13	1.499	0.0000	0.0002	0.000	0.000	-24.126	0.445
	5	-21.80	0.921	0.0001	0.0099	0.000	0.000	-21.803	0.274
	6	-21.54	1.202	0.0002	0.0027	0.000	0.000	-21.542	0.357
	7	-23.04	2.024	0.0000	0.0005	0.000	0.000	-23.037	0.601

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.004	0.229	0.314	0.314	1.882

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 1	1	-15.71	0.272	0.0000	0.1894	0.000	0.000	-15.715	0.104
	2	-15.06	0.194	0.0001	0.0985	0.000	0.000	-15.061	0.057
	3	-15.69	0.263	0.0000	0.1641	0.000	0.000	-15.694	0.082
	4	-17.21	0.917	0.0009	0.0107	0.000	0.000	-17.209	0.272
	5	-16.23	0.488	0.0376	0.2616	0.000	0.000	-16.226	0.145
	6	-16.47	0.354	0.0247	0.2037	0.000	0.000	-16.471	0.105
	7	-18.72	0.973	0.0014	0.0556	0.000	0.000	-18.720	0.289

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.137	0.120	0.199	0.199	2.733

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 2	1	-14.84	0.253	0.0000	1.3266	0.000	0.000	-14.844	0.097
	2	-13.86	0.214	0.0005	0.7697	0.000	0.000	-13.855	0.064
	3	-15.08	0.333	0.0000	1.7184	0.000	0.000	-15.076	0.103
	4	-14.46	0.434	0.0143	0.4811	0.000	0.000	-14.461	0.129
	5	-14.09	0.275	0.3192	0.8500	0.000	0.000	-14.086	0.082
	6	-14.92	0.252	0.1164	0.9085	0.000	0.000	-14.919	0.075
	7	-18.06	0.532	0.0026	0.6016	0.000	0.000	-18.056	0.158

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.934	0.109	0.135	0.135	1.540

cont'd.

Table 14.7 cont'd.

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 3	1	-14.97	0.303	0.0000	1.3862	0.000	0.000	-14.969	0.116
	2	No data for this age							
	3	-15.26	0.489	0.0000	2.0573	0.000	0.000	-15.262	0.152
	4	-13.81	0.370	0.0275	0.5750	0.000	0.000	-13.806	0.110
	5	-13.59	0.146	0.5237	1.2364	0.000	0.000	-13.591	0.043
	6	-14.73	0.170	0.1406	1.0208	0.000	0.000	-14.731	0.050
	7	-18.17	0.431	0.0024	0.7160	0.000	0.000	-18.170	0.128

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.110	0.957E-01	0.114	0.114	1.421

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 4	1	-14.72	0.853	0.0000	2.1245	0.000	0.000	-14.715	0.326
	2	No data for this age							
	3	-15.29	0.431	0.0000	2.2305	0.000	0.000	-15.292	0.134
	4	-13.62	0.280	0.0330	1.1597	0.000	0.000	-13.621	0.083
	5	-13.60	0.175	0.5209	1.2087	0.000	0.000	-13.597	0.052
	6	-14.75	0.179	0.1384	1.2962	0.000	0.000	-14.747	0.053
	7	-18.61	0.457	0.0015	1.0430	0.000	0.000	-18.614	0.136

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.279	0.106	0.745E-01	0.106	0.490

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 5	1	-15.19	0.355	0.0000	1.3868	0.000	0.000	-15.191	0.136
	2	No data for this age							
	3	-15.28	0.398	0.0000	2.1907	0.000	0.000	-15.281	0.123
	4	-13.69	0.404	0.0310	1.1262	0.000	0.000	-13.686	0.120
	5	-13.79	0.284	0.4298	0.9763	0.000	0.000	-13.789	0.084
	6	-14.92	0.384	0.1158	1.0591	0.000	0.000	-14.925	0.114
	7	-19.31	0.828	0.0008	1.6976	0.000	0.000	-19.309	0.246

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.250	0.156	0.125	0.156	0.644

cont'd.

Table 14.7 cont'd.

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 6	1	-15.10	0.449	0.0000	1.6268	0.000	0.000	-15.103	0.171
	2	No data for this age							
	3	-15.52	0.831	0.0000	1.5254	0.000	0.000	-15.519	0.258
	4	-13.61	0.499	0.0333	0.9413	0.000	0.000	-13.615	0.148
	5	-13.99	0.269	0.3513	0.8253	0.000	0.000	-13.990	0.080
	6	-14.96	0.411	0.1114	0.8159	0.000	0.000	-14.963	0.122
	7	-19.41	0.959	0.0007	9.3275	0.000	0.000	-19.412	0.285

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.044	0.179	0.220	0.220	1.513

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 7	1	-15.15	0.607	0.0000	1.4314	0.000	0.000	-15.151	0.232
	2	No data for this age							
	3	-15.35	0.809	0.0000	3.4191	0.000	0.000	-15.354	0.251
	4	-13.40	0.544	0.0411	0.6705	0.000	0.000	-13.403	0.162
	5	-14.09	0.251	0.3170	0.8314	0.000	0.000	-14.093	0.074
	6	-14.95	0.450	0.1130	0.8305	0.000	0.000	-14.950	0.134
	7	-18.93	0.868	0.0011	2.8718	0.000	0.000	-18.929	0.258

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.969	0.183	0.190	0.190	1.071

SUMMARY STATISTICS

	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
Age 8	1	-14.96	1.260	0.0000	0.9850	0.000	0.000	-14.964	0.481
	2	No data for this age							
	3	-15.97	1.594	0.0000	******	0.000	0.000	-15.974	0.495
	4	-13.72	0.376	0.0301	1.0010	0.000	0.000	-13.716	0.112
	5	-14.51	0.320	0.2098	0.5659	0.000	0.000	-14.506	0.095
	6	-14.96	0.291	0.1121	0.7214	0.000	0.000	-14.958	0.086
	7	-18.61	0.721	0.0015	1.1646	0.000	0.000	-18.606	0.214

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.780	0.178	0.207	0.207	1.361

Table 14.8 Total international fishing mortality rate at age of haddock in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	0.018	0.030	0.061	0.051	0.035	0.024	0.014	0.014	0.004	0.004	0
1	0.355	0.161	0.172	0.163	0.161	0.143	0.116	0.193	0.115	0.137	1
2	1.002	0.886	0.699	0.455	0.422	0.652	0.669	0.624	1.033	0.934	2
3	1.113	1.147	1.200	0.936	0.809	1.025	0.992	0.978	1.305	1.110	3
4	1.113	1.077	1.184	0.987	0.868	1.134	1.156	1.079	1.493	1.279	4
5	1.178	1.012	0.971	0.788	0.634	1.242	1.185	1.042	1.053	1.250	5
6	1.015	1.149	0.975	0.539	0.774	0.819	1.071	0.972	0.820	1.044	6
7	1.127	0.602	1.251	1.012	0.991	0.810	0.780	0.911	0.722	0.969	7
8	0.885	0.922	0.634	1.155	1.166	0.673	0.567	0.665	0.767	0.780	8
9	1.064	0.952	1.003	0.895	0.887	0.935	0.952	0.934	0.971	1.065	9
10	1.064	0.952	1.003	0.895	0.887	0.935	0.952	0.934	0.971	1.065	10

Table 14.9 Stock numbers at age ('000) of haddock in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	36868130	66887540	147350800	30192440	18798020	62811050	16015880	23314410	36956160	5281757	0
1	2964327	4659891	8357119	1784450	3692640	2336020	7893066	2032946	2959191	4740451	1
2	261888	399103	762144	1351041	291082	603425	388693	1349184	321925	506448	2
3	46809	64432	110327	253987	574479	127986	210659	133396	484538	76785	3
4	17955	11975	15936	25887	77549	19915	35776	60824	39051	102333	4
5	1341	4593	3178	3799	7511	2536	4990	8773	16095	6834	5
6	2019	3384	1367	985	1415	3263	5995	1249	2533	4597	6
7	3065	599	878	4224	470	534	1178	1682	3872	914	7
8	714	813	269	206	1257	143	195	442	554	1541	8
9	187	241	265	117	53	321	60	90	186	211	9
10	38	92	122	41	28	86	164	35	119	57	10

Table 14.10 Haddock in Sub-area IV. Output from program RCRTINX2.

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.3630	1.130	1.378	0.9088	15	8.5693	0.25037	0.26275	0.48643
EGFS	5.0160	0.983	2.713	0.8046	9	7.6446	0.31709	0.34527	0.28170
SGFS	5.4549	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFS0	5.5090	1.422	-0.690	0.3949	8	7.1466	0.79882	0.91415	0.04019
IYFS2	5.7900	1.226	1.217	0.7279	15	8.3139	0.48326	0.50365	0.13239
MEAN						8.2458	0.75258	0.75258	0.05929

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.7867	1.148	1.208	0.8650	16	9.0026	0.29479	0.32073	0.19008
EGFS	5.6451	0.977	2.780	0.7862	10	8.2932	0.31461	0.33257	0.17679
SGFS	5.4819	1.602	-0.722	0.9541	5	8.0603	0.13576	0.14894	0.48884
EGFS0	5.5872	1.332	-0.032	0.3919	9	7.4082	0.75032	0.82588	0.02867
IYFS2	6.5568	1.230	1.142	0.7273	16	9.2072	0.45702	0.50406	0.07696
MEAN						8.2072	0.71115	0.71115	0.03866

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	4.5747	1.140	1.248	0.8649	16	6.4613	0.29033	0.36980	0.74306
EGFS									
SGFS									
EGFS0	3.1527	1.319	0.046	0.3963	9	4.2056	0.74801	1.45951	0.04770
IYFS2									
MEAN						8.1878	0.69687	0.69687	0.20924

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1981	8.56	5208.35	0.21	0.06	8.21	3693.70	0.28
1982	8.00	2974.35	0.20	0.10	7.76	2337.00	0.52
1983	9.19	9796.40	0.22	0.17	8.97	7894.10	0.77
1984	7.75	2327.44	0.19	0.15	7.62	2034.00	0.80
1985	8.20	3636.06	0.18	0.22	7.99	2960.20	1.22
1986	8.36	4254.82	0.14	0.20			1.45
1987	6.71	824.64	0.32	0.63			1.99

Table 14.11 Mean fishing mortality, Biomass and Recruitment of haddock in Sub-area between 1968-1987.

	Mean Fishing Mortality			Biomass			Recruits
	Ages		Ages	1000 tonnes			Age 0
	2 to 6		0 to 3				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1968	0.487	0.090	0.056	6470	258	68	16437
1969	0.841	0.093	0.197	2276	793	69	11161
1970	0.806	0.123	0.257	1360	875	70	80239
1971	0.632	0.109	0.074	1553	404	71	74055
1972	0.902	0.147	0.049	1594	289	72	19734
1973	0.785	0.128	0.031	852	282	73	67102
1974	0.648	0.143	0.099	1457	246	74	%122384
1975	0.772	0.207	0.083	1993	225	75	10412
1976	0.827	0.157	0.119	826	290	76	14798
1977	0.801	0.132	0.166	522	223	77	23296
1978	0.864	0.192	0.057	606	123	78	36868
1979	0.935	0.088	0.053	633	103	79	66888
1980	0.847	0.082	0.081	1171	144	80	14735
1981	0.633	0.089	0.059	637	228	81	30192
1982	0.585	0.068	0.062	796	285	82	18799
1983	0.802	0.147	0.047	709	241	83	62811
1984	0.895	0.095	0.031	1400	189	84	16016
1985	0.837	0.081	0.017	810	229	85	23314
1986	0.952	0.185	0.011	682	207	86	33155
1987	0.964	0.155	0.016	760	140	87	6434
Mean recruits at age 0 for period 1968 to 1987							37442

Table 14.12 Input for catch prediction of haddock in Sub-area IV.

	1987 Stock and Fishing Mortality				Values used in Prediction F at age , Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F 1983 to 1987			Mean values for period 1983 to 1987 Mean Weight (Kg.)				
Age	Stock Number	Fishing Mortality H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Prop. Ret.
0	6434007		0.001	0.003		0.002	0.006		0.045	0.009	0.016	
1	4251050	0.005	0.106	0.034	0.006	0.115	0.020	0.283	0.158	0.043	0.134	0.055
2	506448	0.398	0.522	0.014	0.349	0.479	0.015	0.362	0.215	0.203	0.275	0.430
3	76785	0.878	0.225	0.007	0.959	0.194	0.017	0.475	0.279	0.406	0.442	0.835
4	102333	1.251	0.025	0.003	1.305	0.025	0.008	0.647	0.362	0.659	0.641	0.980
5	6839	1.248			1.234	0.014	0.008	0.895	0.444	0.883	0.890	0.989
6	4597	1.044			1.022	0.011	0.000	1.179	0.606	0.555	1.173	0.987
7	914	0.969			0.917			1.278			1.278	1.000
8	1541	0.780			0.755			1.753			1.753	1.000
9	211	1.065			1.063			1.836			1.836	1.000
10	57	1.065			1.063			1.903			1.903	1.000

	Mean F	Age 2 to 6	Age 0 3	Age 2 to 6	Age 0 3
	Unscaled	1.118	0.014	1.022	0.024
	Scaled			1.118	0.014

Recruits at age 0 in 1988 = 37442000
Recruits at age 0 in 1989 = 37442000
Recruits at age 0 in 1990 = 37442000

M at age and proprtion mature at age are as shown in Table 14.3

Mean F for ages 2 to 6 in 1987 for human consumption landings + discards = 1.118 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1983 to 1987
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1987

Mean F for ages 0 to 3 in 1987 for small-mesh fisheries = 0.014 .
Industrial fishery F-at-age in the prediction are averages for the period 1983 to 1987 .
rescaled to produce a mean value of F for ages 0 to 3 equal to that for 1987

Table 14.13 Predicted catches and biomasses ('000 t) of haddock in Sub-area IV - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	760	401	802	802	802	802	802	802	802	802	802	802
Spawning	140	140	112	112	112	112	112	112	112	112	112	112
Mean F Ages												
Human Cons. 2 to 6	1.12	1.12	0.00	0.22	0.45	0.67	0.89	1.12	1.34	0.00	0.00	
Small-mesh 0 to 3	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	
Mean F(Year)/Mean F(1987)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	
Catch weight												
Human Consumption	107	110	0	24	44	61	74	85	94	0	0	
Discards	63	54	0	13	24	35	46	56	65	0	0	
Small-mesh Fisheries	4	3	4	4	4	4	4	4	4	0	0	
Total landings	112	113	4	29	49	65	78	88	97	0	0	
Total catch	175	166	4	41	73	100	124	144	163	0	0	
Biomass 1 Jan of Year+1												
Total	401	802	1063	1023	990	962	939	919	902	0	0	
Spawning	140	112	233	202	177	156	139	126	114	0	0	

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
0	37442000	0	35067	92584	127651
1	825364	2568	43942	7566	54077
2	706659	144151	190817	6068	341036
3	133423	68549	13593	1190	83333
4	19710	12874	261	74	13209
5	22172	14424	153	89	14667
6	1608	942	12	0	955
7	1324	731	0	0	731
8	284	138	0	0	138
9	578	349	0	0	349
10	59	36	0	0	36
Wt	401348	109714	53584	2961	166260

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	37442000	0	35067	92584	127651
1	4781477	14879	254565	43832	313276
2	137689	28087	37180	1182	66449
3	203842	104729	20767	1819	127315
4	32273	21081	427	122	21629
5	4031	2622	28	16	2666
6	5170	3031	39	1	3071
7	468	259	0	0	259
8	433	211	0	0	211
9	109	66	0	0	66
10	180	109	0	0	109
Wt	801532	84689	55833	3742	144264

Table 14.14

ASSESSMENT QUALITY CONTROL DIAGRAM 1

STOCK: Haddock in Sub-area IV (North Sea).

AVERAGE F(2-6,u)					
DATE OF ASSESSMENT	YEAR				
	1983	1984	1985	1986	1987
1984	1.02				
1985	0.93	0.87			
1986	0.97	1.06	1.08		
1987	0.96	1.03	0.99	1.09	
1988	0.95	0.99	0.92	1.14	1.12

REMARKS: - Human consumption and discards.

- Natural mortality assumptions change in 1986/1987/1988 - based on Multispecies Working Group recommendations.

- Laurec/Shepherd tuning implemented in 1988.

ESTIMATED TOTAL LANDINGS ('000 T) AT STATUS QUO F							
ASSESSED IN	YEAR						
	1983	1984	1985	1986	1987	1988	1989
FORECAST YR	n/a	n/a	217	300	117	194	88
CURRENT YR	n/a	155	263	141	164	113	
ACTUAL	168[1]	138	167	161	113		

$$\text{Actual SQC} \approx \text{Landings (t)} * \frac{\text{F(assumed)}}{\text{F(actual)}} * \exp\left[-\frac{1}{2}(\text{F(assumed)} - \text{F(actual)})\right]$$

REMARKS: [1]Provisional figure in 1984; not corrected here.

cont'd.

Table 14.14 Cont'd

ASSESSMENT QUALITY CONTROL DIAGRAM 2

STOCK: Haddock in Sub-area IV (North Sea).

RECRUITMENT (AGE 0) UNIT: millions					
DATE OF ASSESSMENT	YEAR CLASS				
	1983	1984	1985	1986	1987
1984	4419				
1985	4396	766			
1986	44203	11070	23617		
1987	64948	20609	31400	58392	
1988	62811	16016	23314	33155	6434

REMARKS: - 1984 and 1985 result from M = 0.2 assumption.

- From 1986 on, Multispecies Working Group estimates have been used.

SPAWNING STOCK BIOMASS ('000 T)								
DATE OF ASSESSMENT	YEAR							
	1983	1984	1985	1986	1987	1988	1989	1990
1984	210	240	490[1]	420[1]				
1985	226	180	315	379[1]	308[1]			
1986	232	174	189	169	144[1]	178[1]		
1987	239	187	232	225	213	251[1]	286[1]	
1988	241	189	229	207	140	140	112[1]	126[1]

[1] Forecast.

REMARKS: - 1985 maturity ogive introduced; 1984 used knife-edge at 2+.

- 1988 Laurec/Shepherd tuning implemented.

Table 15.1 Nominal catch (in tonnes) of HADDOCK in Division VIa, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	-	2	3	1	2
Denmark	-	37	-	-	+
Faroe Islands	-	2	-	-	-
France	4,255	4,786	2,808	3,403	3,760
Germany, Fed. Rep.	20	2	3	7	71
Ireland	441	877	726	1,891	4,402
Netherlands	13	2	2	3	391
Norway	13	9	16	29	37
Spain	-	-	-	-	97
UK (England & Wales)	2,805	1,654	1,279	1,052	2,035
UK (Scotland)	9,629	7,459	8,198	12,051	19,249
UK (Northern Ireland)	-	-	+	-	1
Total	17,176	14,830	13,935	18,437	30,045
WG total incl. discards	19,510	28,847	17,478	33,306	39,681

Country	1983	1984	1985	1986	1987[1]
Belgium	1	6	7	-	21
Denmark	-	-	-[1]	-	4[3]
Faroe Islands	-	-	-	1	-
France	4,520	4,240	5,930	3,553[1,2]	3,201[2]
Germany, Fed. Rep.	65	83	38	25	22[3]
Ireland	3,450	3,932	3,512	2,026	2,204
Netherlands	25	-	-	-	-
Norway	68	33	76	47[1]	-
Spain	201	129	166	-	...
UK (England & Wales)	1,376	1,042	348	222	356
UK (Scotland)	21,593	18,472	15,036	12,955	18,498
UK (Northern Ireland)	4	5	1	155	2
Total	31,303	27,942	25,114	18,984	24,308
WG total incl. discards	37,630	46,364	41,737	27,000	43,000

[1] Provisional.
[2] Includes Divisions VIb and Vb.
[3] Includes Division VIb.

Table 15.2 Annual weight and numbers of haddock caught in Division VIa between 1968 and 1987.

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1968	46	20	25	0	233	55	178	0
1969	51	26	25	0	232	88	144	0
1970	40	34	6	0	163	117	47	0
1971	58	46	12	0	225	132	93	0
1972	57	41	16	0	237	127	110	0
1973	40	29	11	0	179	86	92	0
1974	33	18	15	0	207	50	157	0
1975	47	14	33	0	280	41	240	0
1976	34	19	15	0	155	59	96	0
1977	24	19	4	0	88	58	30	0
1978	20	17	2	0	67	48	19	0
1979	29	15	14	0	135	41	95	0
1980	17	13	5	0	72	38	34	0
1981	33	18	15	0	142	58	84	0
1982	40	30	10	0	144	87	57	0
1983	36	29	7	0	83	49	34	0
1984	46	30	16	0	153	48	105	0
1985	42	24	17	0	125	43	82	0
1986	27	20	7	0	74	38	36	0
1987	43	27	16	0	147	50	97	0

Table 15.3 Values of natural mortality rate and proportion mature at age.

Age	Nat Mor	Mat.
0	0.200	0.000
1	0.200	0.000
2	0.200	0.570
3	0.200	1.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000

Table 15.4 Total international catch at age ('000) of haddock in Division VIa.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	57	5697	13	764	136	2084	269	155	2979	1497	0
1	15942	70070	22729	251	15492	14524	98976	22820	8127	88956	1
2	2095	17282	21927	83911	5019	20233	8626	78922	11235	16811	2
3	971	1865	5636	20697	73676	6040	12910	4667	45367	10143	3
4	24357	470	922	1768	8167	36122	6242	4184	1823	23839	4
5	2938	9863	143	194	898	3398	22790	1789	916	1451	5
6	351	833	3082	39	108	597	2449	11189	449	1115	6
7	247	114	229	822	272	41	371	964	2611	641	7
8	338	145	22	39	288	194	43	84	344	1817	8
9	7	28	5	14	31	195	44	4	38	326	9

Table 15.5 Total international mean weight at age (Kg.) of haddock in Division VIa.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	0.068	0.032	0.077	0.082	0.038	0.050	0.059	0.019	0.064	0.028	0
1	0.134	0.182	0.134	0.252	0.157	0.178	0.149	0.138	0.182	0.168	1
2	0.278	0.325	0.319	0.245	0.273	0.282	0.319	0.268	0.270	0.270	2
3	0.388	0.457	0.572	0.467	0.376	0.461	0.456	0.486	0.362	0.418	3
4	0.516	0.730	0.719	0.887	0.746	0.557	0.688	0.636	0.637	0.566	4
5	0.827	0.777	0.998	0.975	1.126	1.002	0.667	0.802	0.903	0.880	5
6	1.045	1.040	0.985	1.376	1.539	1.370	1.087	0.868	1.115	1.105	6
7	1.152	1.491	1.143	1.294	1.549	1.716	1.392	1.272	1.043	1.250	7
8	1.399	1.944	1.565	1.347	1.514	1.558	2.075	1.277	1.418	1.147	8
9	2.126	1.735	1.632	1.366	1.738	1.556	1.882	1.695	1.517	1.149	9

Table 15.6 Haddock in Division VIa. Scottish research vessel survey indices for haddock aged 1- and 2 in Division VIa.

Year	age 1	age 2
1979	683	894
1980	8943	879
1981	18	2657
1982	75	92
1983	108	64
1984	22389	457
1985	1263	344
1986	663	1898
1987	5745	464
1988	858	3580

Table 15.7 Haddock in Division VIa. Summary statistics from Laurec/Shepherd tuning.

Age 0

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-18.48	0.306	0.0011	0.0054	0.000	0.000	-18.480	0.117
2	-18.89	2.192	0.0001	0.0013	0.000	0.000	-18.891	0.651
3	-17.67	1.402	0.0006	0.0098	0.000	0.000	-17.673	0.416
4	-19.11	1.480	0.0007	0.0120	0.000	0.000	-19.115	0.440
5	-20.82	1.637	0.0004	0.0007	0.000	0.000	-20.823	0.486

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.005	0.286	0.223	0.286	0.611

Age 1

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-14.21	0.705	0.0767	0.4015	0.000	0.000	-14.210	0.269
2	-14.86	1.504	0.0046	0.0764	0.000	0.000	-14.862	0.447
3	-13.75	1.133	0.0280	0.1799	0.000	0.000	-13.751	0.336
4	-15.02	1.150	0.0394	0.1925	0.000	0.000	-15.022	0.341
5	-17.14	1.163	0.0142	0.1601	0.000	0.000	-17.143	0.346

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.232	0.460	0.265	0.460	0.332

Age 2

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-14.08	0.425	0.0877	0.6694	0.000	0.000	-14.076	0.162
2	-12.98	0.437	0.0302	0.5544	0.000	0.000	-12.983	0.130
3	-13.06	0.290	0.0556	0.5189	0.000	0.000	-13.065	0.086
4	-14.30	0.429	0.0811	0.3375	0.000	0.000	-14.300	0.127
5	-17.09	0.481	0.0149	0.4889	0.000	0.000	-17.093	0.143

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.506	0.176	0.103	0.176	0.346

Age 3

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-13.97	0.417	0.0972	0.9523	0.000	0.000	-13.974	0.159
2	-12.37	0.450	0.0556	0.7848	0.000	0.000	-12.372	0.134
3	-12.95	0.317	0.0626	0.6455	0.000	0.000	-12.946	0.094
4	-13.99	0.363	0.1106	0.4051	0.000	0.000	-13.990	0.108
5	-17.08	0.385	0.0151	0.7118	0.000	0.000	-17.081	0.114

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.652	0.169	0.141	0.169	0.691

cont'd.

Table 15.7 cont'd.

Age 4

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-13.31	0.790	0.1889	1.1256	0.000	0.000	-13.309	0.302
2	-12.41	0.544	0.0538	0.6488	0.000	0.000	-12.406	0.161
3	-13.24	0.247	0.0465	0.5925	0.000	0.000	-13.243	0.073
4	-14.17	0.475	0.0927	0.3418	0.000	0.000	-14.166	0.141
5	-17.40	0.312	0.0110	0.7294	0.000	0.000	-17.402	0.093

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.610	0.166	0.130	0.166	0.611

Age 5

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-13.27	0.584	0.1964	0.8609	0.000	0.000	-13.270	0.223
2	-12.56	0.548	0.0462	0.6144	0.000	0.000	-12.559	0.163
3	-13.63	0.583	0.0317	0.4381	0.000	0.000	-13.626	0.173
4	-14.43	0.447	0.0715	0.4167	0.000	0.000	-14.426	0.133
5	-18.03	0.582	0.0058	1.0547	0.000	0.000	-18.035	0.173

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.602	0.241	0.182	0.241	0.569

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.85	1.006	0.2995	1.1557	0.000	0.000	-12.848	0.384
2	-12.84	1.064	0.0349	0.5412	0.000	0.000	-12.837	0.316
3	-14.03	0.733	0.0212	0.7619	0.000	0.000	-14.030	0.218
4	-14.56	0.721	0.0628	0.3629	0.000	0.000	-14.555	0.214
5	-18.10	1.128	0.0054	1.5153	0.000	0.000	-18.102	0.335

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.676	0.394	0.250	0.394	0.403

Age 7

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.70	0.807	0.3472	1.5672	0.000	0.000	-12.700	0.308
2	-12.70	0.880	0.0402	0.5849	0.000	0.000	-12.698	0.261
3	-14.08	1.004	0.0202	0.3923	0.000	0.000	-14.077	0.298
4	-14.35	0.656	0.0772	0.5321	0.000	0.000	-14.349	0.195
5	-17.58	0.845	0.0092	2.9407	0.000	0.000	-17.579	0.251

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.889	0.364	0.364	0.364	1.000

Table 15.8 Total international fishing mortality rate at age of haddock in Division VIa between 1968 and 1987.

Age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Age
0	0.002	0.130	0.061	0.075	0.151	0.100	0.123	0.153	0.152	0.067	0
1	0.159	0.006	0.489	0.383	0.352	1.060	0.590	0.591	1.222	0.951	1
2	1.077	0.301	0.046	0.647	1.111	0.543	0.830	0.689	0.507	0.547	2
3	0.800	1.000	0.293	0.459	1.436	0.848	0.818	0.612	0.749	0.512	3
4	0.503	1.182	0.840	0.430	0.688	0.473	0.755	0.658	0.673	0.714	4
5	0.625	0.905	0.410	0.384	0.580	0.994	0.271	0.531	0.706	0.697	5
6	1.099	0.885	0.903	0.607	0.744	0.890	1.408	0.573	0.502	0.539	6
7	1.045	1.561	1.081	0.147	0.519	0.515	0.928	1.721	0.237	0.332	7
8	0.900	0.900	0.900	0.407	0.793	0.744	0.838	0.830	0.573	0.559	8
9	0.900	0.900	0.900	0.407	0.793	0.744	0.838	0.830	0.573	0.559	9

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	0.000	0.012	0.000	0.008	0.003	0.005	0.003	0.002	0.006	0.005	0
1	0.350	0.555	0.058	0.007	0.232	0.419	0.324	0.409	0.147	0.232	1
2	0.376	0.799	0.335	0.313	0.192	0.534	0.473	0.466	0.362	0.506	2
3	0.288	0.679	0.669	0.611	0.498	0.371	0.794	0.510	0.538	0.652	3
4	0.800	0.220	0.880	0.457	0.522	0.489	0.827	0.656	0.383	0.610	4
5	1.057	0.930	0.096	0.454	0.445	0.429	0.663	0.602	0.287	0.602	5
6	1.001	1.050	0.882	0.035	0.495	0.605	0.634	0.828	0.293	0.676	6
7	0.571	1.147	0.979	0.622	0.348	0.354	0.987	0.556	0.461	0.889	7
8	0.744	0.804	0.703	0.436	0.462	0.450	0.781	0.630	0.393	0.686	8
9	0.744	0.804	0.703	0.436	0.462	0.450	0.781	0.630	0.393	0.686	9

Table 15.9 Stock numbers at age ('000) of haddock in Division VIa between 1968 and 1987.

Age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Age
0	19031	24846	319826	100815	111704	227684	606354	53122	32992	77412	0
1	970734	15556	17870	246340	76582	78648	168745	439018	37321	23203	1
2	63142	678171	12660	8971	137524	44098	22316	76578	199000	9001	2
3	6088	17616	410793	9897	3846	37059	20968	7968	31475	98136	3
4	987	2239	5305	250827	5120	749	12991	7580	3538	12186	4
5	1601	489	562	1876	133636	2106	382	5000	3212	1478	5
6	22855	702	162	305	1046	61256	638	238	2408	1298	6
7	1216	6234	237	54	136	407	20602	128	110	1194	7
8	79	350	1071	66	38	66	199	6668	19	71	8
9	16	16	25	575		12	65	140	2765	29	9

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	219616	548588	47527	101391	56952	481205	91354	80229	580248	318330	0
1	59272	179755	444001	38900	82322	46506	392095	74552	65547	472376	1
2	7338	34210	84453	343005	31622	53459	25046	232093	40562	46341	2
3	4265	4127	12602	49447	205421	21370	25652	12775	119276	23122	3
4	48148	2619	1713	5282	21975	102178	12073	9491	6279	57036	4
5	4884	17705	1722	581	2739	10678	51289	4322	4032	3504	5
6	603	1389	5720	1281	302	1437	5694	21629	1939	2478	6
7	620	181	398	1939	1013	151	643	2472	7737	1184	7
8	701	287	47	122	852	585	87	196	1161	3994	8
9	14	56	11	42	90	589	88	8	130	717	9

Table 15.10 **Haddock in Division VIA. Output from program RCRTINX2- North Sea indices only.**

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.3630	1.595	-5.064	0.7759	15	5.0839	0.55391	0.58130	0.27754
EGFS	5.0160	1.593	-4.207	0.8689	9	3.7843	0.42088	0.45829	0.44651
SGFS	5.4549	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFS0	5.5090	3.070	-14.453	0.2121	8	2.4604	1.96745	2.25149	0.01850
IYFS2	5.7900	1.674	-4.974	0.6632	15	4.7204	0.73449	0.76548	0.16005
MEAN						4.6274	0.98125	0.98125	0.09740

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.7867	1.668	-5.578	0.7304	16	5.7424	0.60510	0.65834	0.08709
EGFS	5.6451	1.574	-4.066	0.8587	10	4.8213	0.41234	0.43587	0.19869
SGFS	5.4819	2.475	-9.091	0.9451	5	4.4791	0.22931	0.25158	0.59638
EGFS0	5.5872	2.695	-11.941	0.2443	9	3.1186	1.69288	1.86336	0.01087
IYFS2	6.5568	1.704	-5.197	0.6753	16	5.9721	0.69060	0.76168	0.06506
MEAN						4.5872	0.94910	0.94910	0.04190

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	4.5747	1.780	-6.231	0.7501	17	1.9124	0.61456	0.77803	0.62502
EGFS									
SGFS									
EGFS0	3.1527	5.469	-28.496	0.0729	10	-11.2554	3.71661	6.93825	0.00786
IYFS2									
MEAN						4.7128	1.01518	1.01518	0.36712

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1985	4.35	77.67	0.31	0.31	4.20	66.54	1.02
1986	4.74	114.89	0.19	0.23	6.16	473.00	1.17
1987	2.84	17.06	0.62	1.30			2.12

Table 15.11 Haddock in Division VIa. Output from program RCRTINX2, including Scottish Division VIa survey indices.

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.3630	1.595	-5.064	0.7759	15	5.0839	0.55391	0.58130	0.22239
EGFS	5.0160	1.593	-4.207	0.8689	9	3.7843	0.42088	0.45829	0.35779
SGFS	5.4549	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFSO	5.5090	3.070	-14.453	0.2121	8	2.4604	1.96745	2.25149	0.01482
SWCS1	6.4983	0.479	1.772	0.6629	6	4.8849	0.72202	0.78653	0.12147
SWCS2	6.1420	1.010	-2.028	0.5572	6	4.1773	0.90255	0.98645	0.07723
IYFS2	5.7900	1.674	-4.974	0.6632	15	4.7204	0.73449	0.76548	0.12825
MEAN						4.6274	0.98125	0.98125	0.07805

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.7867	1.668	-5.578	0.7304	16	5.7424	0.60510	0.65834	0.08036
EGFS	5.6451	1.574	-4.066	0.8587	10	4.8213	0.41234	0.43587	0.18336
SGFS	5.4819	2.475	-9.091	0.9451	5	4.4791	0.22931	0.25158	0.55038
EGFSO	5.5872	2.695	-11.941	0.2443	9	3.1186	1.69288	1.86336	0.01003
SWCS1	8.6563	0.508	1.495	0.5969	7	5.8890	0.75095	0.89913	0.04309
SWCS2	8.1834	1.009	-2.021	0.5613	7	6.2334	0.80793	1.01169	0.03404
IYFS2	6.5568	1.704	-5.197	0.6753	16	5.9721	0.69060	0.76168	0.06005
MEAN						4.5872	0.94910	0.94910	0.03867

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	4.5747	1.780	-6.231	0.7501	17	1.9124	0.61456	0.77803	0.38968
EGFS									
SGFS									
EGFSO	3.1527	5.469	-28.496	0.0729	10	-11.2554	3.71661	6.93825	0.00490
SWCS1	6.7558	0.543	1.298	0.6681	8	4.9686	0.74165	0.79149	0.37654
SWCS2									
IYFS2									
MEAN						4.7128	1.01518	1.01518	0.22888

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1981	5.04	154.79	0.31	0.09	4.42	83.32	0.30
1982	4.31	74.16	0.34	0.18	3.86	47.51	0.52
1983	5.82	336.26	0.37	0.28	5.97	393.10	0.75
1984	4.77	117.62	0.23	0.37	4.32	75.55	1.57
1985	4.40	81.74	0.27	0.24	4.20	66.54	0.87
1986	4.84	126.98	0.19	0.23	6.16	473.00	1.21
1987	3.64	38.08	0.49	1.03			2.12

Table 15.12 Mean fishing mortality, biomass and recruitment of haddock in Division VIa between 1968-1987.

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 0	
	2 to 6		1 to 1				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1968	0.648	0.173	0.000	197	35	68	19
1969	0.781	0.074	0.000	187	113	69	25
1970	0.480	0.018	0.000	164	160	70	320
1971	0.394	0.111	0.000	185	145	71	101
1972	0.706	0.206	0.000	125	98	72	112
1973	0.645	0.105	0.000	75	58	73	228
1974	0.664	0.152	0.000	64	35	74	606
1975	0.493	0.120	0.000	109	31	75	53
1976	0.528	0.099	0.000	82	54	76	33
1977	0.514	0.088	0.000	59	54	77	77
1978	0.645	0.059	0.000	43	34	78	220
1979	0.664	0.072	0.000	64	26	79	549
1980	0.537	0.036	0.000	103	32	80	48
1981	0.297	0.077	0.000	127	81	81	101
1982	0.363	0.067	0.000	122	105	82	57
1983	0.383	0.103	0.000	105	90	83	481
1984	0.584	0.095	0.000	128	66	84	91
1985	0.532	0.080	0.000	110	73	85	80
1986	0.287	0.085	0.000	86	69	86	143
1987	0.539	0.070	0.000	86	62	87	22
Mean recruits at age 0 for period 1968 to 1987							168

Table 15.13 Input for catch prediction of haddock in Division VIa.

	1987 Stock and Fishing Mortality				Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F 1983 to 1987			Mean values for period 1983 to 1987 Mean Weight (Kg.)				
Age	Stock Number	Fishing Mortality H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Prop. Ret.
0	22336		0.077			0.024			0.044		0.044	
1	114098	0.016	0.309		0.031	0.655		0.321	0.156		0.163	0.047
2	46341	0.222	0.284		0.190	0.326		0.374	0.228		0.282	0.373
3	23122	0.591	0.061		0.516	0.117		0.475	0.281		0.436	0.808
4	57036	0.602	0.008		0.638	0.017		0.624	0.318		0.617	0.977
5	3504	0.602			0.554	0.016		0.861	0.412		0.851	0.977
6	2478	0.676			0.668	0.003		1.110	0.353		1.109	0.997
7	1184	0.889			0.717			1.334			1.334	1.000
8	3994	0.686			0.649			1.495			1.495	1.000
9	717	0.686			0.649			1.560			1.560	1.000

	Mean F	Age 2 to 6	Age 1	Age 2 to 6	Age 1
Unscaled		0.609	0.000	0.552	0.000
Scaled				0.609	0.000

Recruits at age 0 in 1988 = 168000
Recruits at age 0 in 1989 = 168000
Recruits at age 0 in 1990 = 168000

M at age and proprtion mature at age are as shown in Table 15.3

Mean F for ages 2 to 6 in 1987 for human consumption landings + discards = 0.609 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1983 to 1987
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1987

Mean F for ages 1 to 1 in 1987 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1983 to 1987 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1987

Table 15.14 Predicted catches and biomasses ('000 t) of haddock in Division VIa - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	86	66	64	64	64	64	64	64	64	64	64	64
Spawning	62	55	41	41	41	41	41	41	41	41	41	41
Mean F Ages												
Human Cons. 2 to 6	0.61	0.61	0.00	0.12	0.24	0.37	0.49	0.61	0.73	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1987)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	27	21	0	5	9	12	15	18	20	0	0	
Discards	16	6	0	3	5	7	9	10	12	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	27	21	0	5	9	12	15	18	20	0	0	
Total catch	43	27	0	7	13	19	24	28	32	0	0	
Biomass 1 Jan of Year+1												
Total	66	64	97	88	80	73	66	61	56	0	0	
Spawning	55	41	62	54	48	42	37	32	28	0	0	

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
0	168000	0	3660	0	3660
1	16937	364	7344	0	7707
2	67522	9292	15619	0	24911
3	22881	7937	1887	0	9823
4	9866	4242	101	0	4342
5	25378	9861	230	0	10091
6	1572	702	2	0	704
7	1033	485	0	0	485
8	398	174	0	0	174
9	1647	720	0	0	720
Wt	65746	21302	5516	0	26818

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	168000	0	3660	0	3660
1	134242	2883	58205	0	61088
2	6983	961	1615	0	2576
3	32971	11436	2719	0	14155
4	9952	4279	101	0	4380
5	4197	1631	38	0	1669
6	11748	5244	15	0	5259
7	658	309	0	0	309
8	413	181	0	0	181
9	875	383	0	0	383
Wt	63838	17890	10402	0	28292

Table 15.15

ASSESSMENT QUALITY CONTROL DIAGRAM 1

STOCK: Haddock in Division VIa (West of Scotland).

AVERAGE F(2-6,u)					
DATE OF ASSESSMENT	YEAR				
	1983	1984	1985	1986	1987
1984	0.70				
1985	0.52	0.57			
1986	0.51	0.77	0.90		
1987	0.53	0.83	0.89	0.67	
1988	0.49	0.68	0.61	0.37	0.61

REMARKS: - 1988 Laurec/Shepherd tuning implemented.

- Human consumption and discards.

ESTIMATED TOTAL LANDINGS ('000 T) AT STATUS QUO F							
ASSESSED IN	YEAR						
	1983	1984	1985	1986	1987	1988	1989
FORECAST YR	n/a	n/a	25	28	23	25	18
CURRENT YR	n/a	27	32	34	31	21	
ACTUAL	29[1]	28	22	24	19		

$$\text{Actual SQC} \approx \text{Landings (t)} * \frac{\text{F(assumed)}}{\text{F(actual)}} * \exp\left[-\frac{1}{2}(\text{F(assumed)} - \text{F(actual)})\right]$$

REMARKS: [1]Provisional figure in 1984; not corrected here.

cont'd.

Table 15.15 Cont'd

ASSESSMENT QUALITY CONTROL DIAGRAM 2

STOCK: Haddock in Division VIa (West of Scotland).

RECRUITMENT (AGE 0) UNIT: millions					
DATE OF ASSESSMENT	YEAR CLASS				
	1983	1984	1985	1986	1987
1984	308				
1985	331	50			
1986	409	71	121		
1987	477	80	135	247	
1988	481	91	80	143	22

REMARKS:

SPAWNING STOCK BIOMASS ('000 T)								
DATE OF ASSESSMENT	YEAR							
	1983	1984	1985	1986	1987	1988	1989	1990
1984	67	54	72[1]	70[1]				
1985	95	74	80	67[1]	58[1]			
1986	89	64	62	62	38[1]	33[1]		
1987	84	59	65	59	62	60[1]	64[1]	
1988	90	66	73	69	62	55	41[1]	32[1]

[1] Forecast.

REMARKS: - 1988 Laurec/Shepherd tuning implemented.

Table 16.1 Nominal catch (in tonnes) of HADDOCK in Division VIb, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Denmark	-	-	-	-	-
Faroe Islands	11	20	5	1	21
France	3	4	1	10	32
Germany, Fed. Rep.	-	-	17	-	4
Ireland	61	-	-	-	-
Norway	4	16	2	10	3
Spain	-	-	6	88	121
UK (England & Wales)	2,365	1,654	6,261	9,005	3,736
UK (Scotland)	2,060	548	1,051	27	5
Total	4,504	2,242	7,343	9,141	3,992

Country	1983	1984	1985	1986	1987[1]
Denmark	-	-	-[1]	-	...[2]
Faroe Islands	3	3	1	-	-[2]
France	48	12	116	...[1,2]	...[2]
Germany, Fed. Rep.	1	-	4	-[1,2]	...[2]
Ireland	-	-	-	-	-
Norway	20	45	31	84[1]	-
Spain	79	128	892	756	...
UK (England & Wales)	113	788	1,876	703	1,121
UK (Scotland)	136	1,654	6,397	2,961	6,166
UK (Northern Ireland)	-	-	-	157	-
Total	400	2,630	9,317	4,661	7,287

[1] Provisional.
[2] Included in Division VIa.

Table 16.2 Haddock in Division VIb. Total international catch age, excluding discards.

Year	1985	1986	1987
age			
1	0	0	82
2	65	588	721
3	758	383	16732
4	12971	837	269
5	3669	3236	341
6	124	1101	1454
7	6	60	559
8	70	28	35
9	22	69	4
10+	1	87	58

Table 16.3 Haddock in Division VIb. Total international weight at age (Kg.).

Year	1985	1986	1987
age			
1	-	-	0.154
2	0.348	0.305	0.276
3	0.479	0.477	0.339
4	0.507	0.624	0.466
5	0.543	0.646	0.601
6	0.668	0.697	0.715
7	1.208	0.868	0.688
8	0.778	0.825	0.865
9	0.879	0.841	0.852
10+	1.370	1.133	0.823

Table 16.4 HADDOCK. Division VIb (Rockall). Scottish, English and German trawl surveys. Numbers per 10 hours fishing (weighted average of surveys).

Survey year	Vessel	Age								
		0	1	2	3	4	5	6	7	8+
1967	E	9	11	153	115	124	150	174	168	215
1968	E	21,302	69	11	76	66	66	60	50	58
1969	E	-	7,431	78	8	28	25	13	19	29
1970	E	[-]	11	9,746	68	25	27	22	20	34
1971	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-
1974	H	42,250	5,410	400	180	20	50	-	20	-
1975	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-
1977	H	-	6,117	13,581	2,587	4,366	54	-	80	163
1978	-	-	-	-	-	-	-	-	-	-
1979	EH	-	212	819	6,110	686	843	119	-	3
1980	?	-	153	796	4,927	11,943	292	1,373	458	311
1981	RH	32,329	32,098	16,596	613	1,675	17,320	-	236	808
1982	RSH	[-]	24,940	17,677	300	249	1,172	4,363	71	534
1983	-	1	6	18,541	7,961	233	24	193	1,210	103
1984	-	-	-	-	-	-	-	-	-	-
1985	C	489	51,284	214	31	4,218	676	1	2	145
1986	R	3,577	17,309	62,196	85	139	2,568	225	-	52
1987	D	698	1,167	2,917	8,530	105	267	249	71	1

[ ] Indicates surveys early in year before O-group are available.

Vessel Key
E = "Explorer"
H = "Walter Herwig"
R = "G.A. Reay"
S = "Scotia"
C = "Clarkwood"
D = "Dawn Sky"

Table 16.5 Haddock in Division VIb. Analysis by SRMCM of research vessel survey data.

CATCH-AT-AGE DATA

YEAR / AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	212.0	153.0	32098.0	24940.0	6.0	-	51284.0	17309.0	11672.0
2	918.0	796.0	16596.0	17677.0	18541.0	-	214.0	62196.0	2917.0
3	6110.0	4927.0	613.0	300.0	7961.0	-	31.0	85.0	8530.0
4	686.0	11943.0	1675.0	249.0	233.0	-	4218.0	139.0	105.0
5	843.0	292.0	17320.0	1172.0	24.0	-	676.0	2568.0	267.0
6	119.0	1373.0	0.0	4363.0	193.0	-	1.0	225.0	249.0
TAL	8888.0	19484.0	68302.0	48701.0	26958.0	-	56424.0	82522.0	23740.0

CV = 0.481 RANK= 29

CONSTANT = 7.98

EFFECTS	YEAR	AGE	YEARCLASS
1	0.00	0.00	0.00
2	1.48	0.11	0.96
3	2.56	-0.71	-0.35
4	1.85	-1.62	1.54
5	1.48	-2.21	-0.89
6	2.84	-3.20	-3.02
7	1.25	-	-1.90
8	1.53	-	-0.17
9	0.38	-	0.45
10	-	-	-1.73
11	-	-	-3.56
12	-	-	1.48
13	-	-	-0.12
14	-	-	1.01

MEAN YEARCLASS EFFECT = -0.45

FITTED CATCH-AT-AGE

YEAR / AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	142.9	1934.2	32148.1	29370.2	2295.1	1426.4	44735.7	11971.4	11672.0
2	1339.6	701.8	6333.7	17670.8	22612.2	9960.7	322.6	66167.8	4217.6
3	6714.3	2593.8	906.2	1372.7	5364.3	38695.0	888.2	188.1	9191.6
4	406.4	11895.8	3064.3	179.7	381.3	8399.4	3157.1	474.0	23.9
5	844.4	998.7	19491.1	842.8	69.2	828.0	950.5	2336.5	83.6
6	119.0	1371.0	1081.2	3542.1	214.5	99.3	61.9	464.8	272.2
TOTAL	9566.6	19495.4	63024.7	52978.4	30936.7	59408.9	50116.0	81602.6	25460.8

Table 16.6 Haddock in Division VIb. Analysis by SRMCM commercial catch-at-age data.

CATCH-AT-AGE DATA

YEAR / AGE	1985	1986	1987
2	65.0	588.0	721.0
3	758.0	383.0	16732.0
4	12971.0	837.0	269.0
5	3699.0	3236.0	341.0
6	124.0	1101.0	1454.0
7	6.0	60.0	559.0
8	70.0	28.0	35.0
9	220.0	69.0	4.0
TOTAL	17913.0	6302.0	20115.0

CV = 0.143 RANK= 22

CONSTANT = 5.63

EFFECTS	YEAR	AGE	YEARCLASS
1	0.00	0.00	0.00
2	-0.16	2.99	-1.09
3	0.00	3.01	-2.46
4	-	1.89	-1.63
5	-	0.86	0.68
6	-	0.02	0.78
7	-	-0.21	-1.84
8	-	-0.24	-2.62
9	-	-	1.03
10	-	-	0.95

MEAN YEARCLASS EFFECT = -0.62

YEAR EFFECTS

YEAR	1988	1989
EFFECT	0.00	0.00

YEARCLASS EFFECTS

YEARCLASS	1986	1987
EFFECT	1.01	-0.45

FITTED AND FORECAST CATCH-AT-AGE

YEAR / AGE	1985	1986	1987	1988	1989
2	20.4	668.3	721.0	760.5	176.6
3	883.5	344.3	15518.6	14268.0	15049.9
4	12356.9	772.0	414.2	15912.5	14630.1
5	3654.2	3438.4	295.8	135.2	5195.6
6	129.3	1108.7	1436.4	105.3	48.1
7	24.5	47.8	564.2	623.0	45.7
8	76.5	16.6	44.6	448.2	494.9
9	220.0	63.1	18.8	43.1	433.7
TOTAL	17365.3	6459.2	19013.6	32295.8	36074.6

Table 16.7 Mean weight at age for the period 1985-1987 from commercial catch data used in prediction.

AGE	MEAN WEIGHT (Kg)
2	0.31
3	0.43
4	0.53
5	0.60
6	0.69
7	0.92
8	0.83
9	0.86

Table 16.8 Predicted status quo catches for haddock in Division VIb.

year	1988	1989
catch (tonnes)	15,705	18,255

Table 17.1 Nominal catch (in tonnes) of HADDOCK in Divisions VIId,e, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987[1]
Belgium	-	1	+	2	1	1	-	2[1]	1	-
Denmark	22	21	15	-	-	-	-	-[1]	-	-
France	356	333	298	421	344	232	273	138	...[2]	...[2]
Ireland	-	-	+	-	-	-	-	-	-	-
Netherlands	-	-	-	-	94	1	-	-	-	-
UK (Engl.& Wales)	22	51	59	119	60	41	26	27	21	42
Total	400	406	372	542	499	275	299	167	22	42

[1] Provisional.
[2] Included in Divisions VIIb,c,g-k.

Table 17.2 Nominal catch (in tonnes) of HADDOCK in Divisions VIIb,c,g-k, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	5	2	2	3	3
Denmark	-	1	-	-	-
France	1,479	1,931	2,219	2,571	2,005
Ireland	111	155	274	679	904
Netherlands	-	16	-	-	7
Norway	-	-	-	-	-
Spain	-	-	5	277	248
UK (England and Wales)	13	19	50	92	182
UK (Scotland)	8	22	56	4	-
Total	1,616	2,146	2,606	3,626	3,349

Country	1983	1984	1985	1986	1987[1]
Belgium	1	-	2	-	9
Denmark	-	-	-[1]	-	-
France	2,588	3,001	2,258	3,222[1,2]	3,817[2]
Ireland	941	646	794	317	286
Netherlands	-	-	-	-	-
Norway	57	17	4	86[1]	-
Spain	167	532	561	-	...
UK (England and Wales)	23	309	135	158	34
UK (Scotland)	-	63	7	57	75
Total	3,777	4,568	3,761	3,840	4,221

[1] Provisional.
[2] Includes all of Sub-areas VII and VIII.

Table 18.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	3,304	3,941	3,153	2,623	2,272
Denmark	15,741	41,965	17,916	16,430	27,043
Faroe Islands	42	581	21	12	57
France	22,525	27,590	23,626	24,744	23,780
German Dem. Rep.	22	5	-	-	-
Germany, Fed. Rep.	348	1,280	1,267	601	223
Ireland	38	-	-	-	-
Netherlands	11,030	13,417	14,389	14,600	12,218
Norway	64	49	27	27	17
Poland	8	3	1	-	-
Sweden	...[2]	31	16	9	11
UK (England and Wales)	7,542	7,581	6,778	5,964	4,743
UK (Scotland)	42,779	44,841	42,218	31,399	29,640
Total Sub-area IV	103,443	141,284	109,412	96,409	100,004
WG total incl. discards	179,192	236,712	215,979	182,272	131,881

Country	1983	1984	1985	1986	1987[1]
Belgium	2,864	2,798	2,177	2,275	1,436
Denmark	18,054	19,771	16,142[1]	9,076	2,005
Faroe Islands	18	-	6	-	-
France	21,263	19,209	10,853	11,840[1,3]	15,313[3]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	317	286	226	313	443
Ireland	-	-	-	-	-
Netherlands	10,935	8,767	6,973	13,741	8,535
Norway	39	88	103	84[1]	59
Poland	1	2	-	-	-
Sweden	44	53	22	33	13[4]
UK (England and Wales)	4,366	5,017	5,024	3,805	4,384
UK (Scotland)	41,248	42,967	30,398	29,113	37,507
Total Sub-area IV	99,149	98,958	71,924	70,280	69,695
WG total incl. discards	154,236	137,000	96,000	145,000	132,000

[1] Provisional.
[2] Included in Division IIIa.
[3] Includes Division IIa.
[4] Jan-Sep.

Table 18.2 Annual weight and numbers of whiting caught in Sub-area IV between 1969 and 1987.

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
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	358	74	134	150	2269	240	633	1396
1977	346	74	165	106	2485	266	555	1663
1978	179	88	35	55	1729	323	242	1165
1979	237	99	78	59	1885	348	652	886
1980	216	93	78	46	1445	325	476	644
1981	181	79	35	67	1395	255	211	929
1982	131	72	26	33	739	238	167	333
1983	154	81	50	24	1328	261	370	697
1984	137	78	40	19	868	250	322	296
1985	96	53	28	15	681	178	224	280
1986	145	54	73	18	1118	186	534	398
1987	132	62	53	16	917	224	408	285

Table 18.3 Values of natural mortality rate and proportion mature at age.

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

Table 18.4 Total international catch at age ('000) of whiting in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	687251	476388	332221	516817	100400	668570	157528	186418	224454	84636	0
1	418866	618700	268943	160561	189667	201325	316288	198117	536766	260655	1
2	335869	463937	427299	332043	102501	168470	161096	146731	148539	355601	2
3	203546	210759	268838	261197	229821	107975	111357	78161	149493	120524	3
4	69034	86158	80782	90632	83286	133391	47003	36984	39318	79154	4
5	7601	24995	57361	21493	24425	37121	58202	13416	11932	10945	5
6	5369	3089	7931	10067	6297	8656	13534	17593	3207	4207	6
7	1409	1147	808	1735	1691	1711	2750	3027	3733	827	7
8	245	187	517	236	360	699	379	887	517	824	8
9	7	14	42	41	58	81	159	95	72	100	9
10	7	1	12	35	23	33	22	14		7	10

Table 18.5 Total international mean weight at age (Kg.) of whiting in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	0.010	0.009	0.013	0.011	0.029	0.014	0.020	0.014	0.014	0.012	0
1	0.074	0.098	0.076	0.082	0.060	0.105	0.088	0.094	0.104	0.076	1
2	0.185	0.165	0.176	0.165	0.181	0.188	0.187	0.187	0.182	0.146	2
3	0.240	0.260	0.246	0.241	0.254	0.274	0.274	0.268	0.254	0.246	3
4	0.338	0.318	0.325	0.333	0.313	0.323	0.338	0.324	0.319	0.292	4
5	0.462	0.436	0.333	0.417	0.386	0.381	0.381	0.393	0.375	0.370	5
6	0.462	0.496	0.476	0.437	0.494	0.427	0.393	0.430	0.466	0.368	6
7	0.515	0.544	0.492	0.573	0.532	0.461	0.473	0.471	0.468	0.490	7
8	0.689	0.614	0.594	0.654	0.717	0.532	0.570	0.422	0.528	0.458	8
9	0.742	0.668	0.570	0.835	0.734	0.700	0.536	0.488	1.199	0.847	9
10	1.828	0.737	0.795	1.051	1.153	0.513	0.850	0.636		0.601	10

Table 18.6 Fishing effort and catch at age of whiting in Sub-area IV by INT GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0											0
1	274.085	332.003	1141.825	320.723	908.528	666.527	418.022	522.297	461.399	696.810	1
2	31.010	190.002	753.644	494.033	155.660	525.172	219.013	298.310	184.762	393.718	2
3											3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
Eff	190	143	110	242	304	346	405	385	395	338	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0								0
1	223.493	160.664	126.980	437.616	343.647	447.358	652.163	1
2	477.506	231.516	124.996	179.664	361.787	256.054	530.309	2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10								10
Eff	313	341	397	433	470	490	491	Eff

cont'd.

Table 18.6 cont'd.
Fishing effort and catch at age of whiting in Sub-area IV by ENG GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0							282.041	168.134	349.987	198.659	0
1							217.508	256.626	203.911	338.534	1
2							73.781	53.095	70.979	129.680	2
3							10.848	54.440	18.957	45.400	3
4							2.207	7.867	8.379	10.067	4
5							0.956	0.227	0.571	3.759	5
6							0.876	0.504	0.290	0.537	6
7							0.876	0.221	0.051	0.349	7
8								0.142	0.026		8
9										0.017	9
10											10
Eff	No data	No data	No data	No data	No data	No data	111	113	117	115	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0	347.590	52.982	716.940	153.230	199.982	163.322	111.467	0
1	182.181	291.095	112.937	527.866	158.853	151.824	228.404	1
2	286.526	81.486	108.710	106.972	170.503	66.163	130.409	2
3	159.676	85.818	19.006	30.149	16.734	38.008	26.983	3
4	6.091	22.312	16.941	9.418	9.813	4.097	20.098	4
5	6.187	3.513	2.420	8.036	1.823	0.988	3.521	5
6	0.803	0.500	0.678	4.085	1.535	0.146	1.169	6
7	0.131	0.083	0.194	0.294	0.302	0.232	0.052	7
8	0.009		0.065	0.037	0.069	0.171		8
9		0.014	0.048		0.014		0.052	9
10		0.042	0.048					10
Eff	114	72	62	82	73	82	77	Eff

cont'd.

Table 18.6 cont'd.
Fishing effort and catch at age of whiting in Sub-area IV by NET GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0										166.071	0
1										330.141	1
2										62.026	2
3										27.012	3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
Eff	No data	No data	No data	No data	No data	No data	No data	No data	No data	14	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0	1393.154	166.089	2644.001	143.488	857.419	1779.633	2854.948	0
1	205.023	640.342	430.187	1334.542	781.559	383.060	1984.501	1
2	131.015	105.056	223.577	141.482	891.356	74.816	249.548	2
3	9.001	52.028	11.977	91.311	31.941	169.584	17.825	3
4								4
5								5
6								6
7								7
8								8
9								9
10								10
Eff	12	16	25	43	40	42	44	Eff

cont'd.

Table 10.6 cont'd.
Fishing effort and catch at age of whiting in Sub-area IV by SCO GFS.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Age
0											0
1											1
2											2
3											3
4											4
5											5
6											6
7											7
8											8
9											9
10											10
Eff	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	Eff

Age	1981	1982	1983	1984	1985	1986	1987	Age
0		10.241	20.929	44.238	16.865	40.518	12.027	0
1		67.782	56.189	104.810	157.442	111.036	140.483	1
2		97.333	57.718	37.046	97.186	45.139	115.033	2
3		97.398	40.606	17.005	24.648	22.370	20.820	3
4		22.472	51.008	7.668	6.340	2.673	7.712	4
5		6.012	11.589	9.167	3.597	0.537	1.616	5
6		1.614	1.694	1.755	1.780	0.375	0.342	6
7		0.169	0.278	0.463	1.035	0.062	0.014	7
8		0.039	0.468	0.037	0.036		0.027	8
9				0.037				9
10								10
Eff	No data	77	79	82	83	80	73	Eff

Table 10.7 Whiting in Sub-area IV. Summary statistics from Laurec/Shepherd tuning.

Age 0

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-20.33	0.750	0.0000	0.0104	0.000	0.000	-20.328	0.286
2	-16.65	1.107	0.0000	0.0017	0.000	0.000	-16.654	0.379
3	No data for this age							
4	-18.06	0.757	0.0000	0.0109	0.000	0.000	-18.063	0.235
5	-27.88	1.449	0.0000	0.0004	0.000	0.000	-27.885	0.430
6	-23.35	0.974	0.0000	0.0019	0.000	0.000	-23.350	0.289
7	-21.96	1.589	0.0001	0.0143	0.000	0.000	-21.965	0.472
8	-22.23	1.727	0.0000	0.0009	0.000	0.000	-22.235	0.513

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.005	0.389	0.453	0.453	1.357

Age 1

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-16.56	0.414	0.0000	0.1187	0.000	0.000	-16.564	0.158
2	-14.77	0.806	0.0000	0.0500	0.000	0.000	-14.772	0.276
3	-15.40	0.214	0.0001	0.0798	0.000	0.000	-15.402	0.064
4	-15.87	0.559	0.0000	0.1457	0.000	0.000	-15.874	0.173
5	-18.72	0.714	0.0002	0.0395	0.000	0.000	-18.716	0.212
6	-17.35	0.689	0.0123	0.2317	0.000	0.000	-17.346	0.205
7	-17.04	0.828	0.0140	0.1938	0.000	0.000	-17.041	0.246
8	-17.32	1.125	0.0055	0.0388	0.000	0.000	-17.317	0.334

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.091	0.161	0.157	0.161	0.953

Age 2

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.76	0.373	0.0000	0.4420	0.000	0.000	-15.760	0.142
2	-15.04	1.018	0.0000	0.4162	0.000	0.000	-15.037	0.348
3	-14.62	0.292	0.0002	0.2931	0.000	0.000	-14.618	0.087
4	-15.55	0.531	0.0000	0.4829	0.000	0.000	-15.547	0.165
5	-15.98	0.476	0.0031	0.4581	0.000	0.000	-15.976	0.141
6	-15.81	0.370	0.0571	0.3851	0.000	0.000	-15.808	0.110
7	-15.99	0.380	0.0400	0.5485	0.000	0.000	-15.988	0.113
8	-17.33	0.496	0.0054	0.1622	0.000	0.000	-17.334	0.147

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.372	0.147	0.127	0.147	0.740

cont'd.

Table 18.7 cont'd.

SUMMARY STATISTICS

Age	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
3	1	-15.68	0.470	0.0000	0.8976	0.000	0.000	-15.679	0.180
	2	-15.68	1.189	0.0000	1.0335	0.000	0.000	-15.684	0.407
	3	No data for this age							
	4	-15.83	0.720	0.0000	0.5946	0.000	0.000	-15.832	0.224
	5	-14.85	0.232	0.0097	0.6601	0.000	0.000	-14.846	0.069
	6	-14.86	0.217	0.1477	0.4573	0.000	0.000	-14.857	0.065
	7	-15.12	0.240	0.0948	0.7070	0.000	0.000	-15.125	0.071
	8	-17.22	0.341	0.0061	0.4139	0.000	0.000	-17.224	0.101

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.583	0.117	0.987E-01	0.117	0.711

SUMMARY STATISTICS

Age	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
4	1	-15.74	0.550	0.0000	1.5046	0.000	0.000	-15.736	0.210
	2	No data for this age							
	3	No data for this age							
	4	-15.94	0.655	0.0000	0.4731	0.000	0.000	-15.935	0.203
	5	-14.46	0.346	0.0143	1.8413	0.000	0.000	-14.458	0.103
	6	-14.47	0.249	0.2168	0.9304	0.000	0.000	-14.474	0.074
	7	-14.76	0.280	0.1359	1.8062	0.000	0.000	-14.765	0.083
	8	-17.17	0.304	0.0064	0.5399	0.000	0.000	-17.168	0.090

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.085	0.136	0.222	0.222	2.648

SUMMARY STATISTICS

Age	Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
5	1	-15.62	0.757	0.0000	1.1150	0.000	0.000	-15.619	0.289
	2	No data for this age							
	3	No data for this age							
	4	-16.04	0.720	0.0000	0.3354	0.000	0.000	-16.043	0.224
	5	-14.20	0.469	0.0185	1.2350	0.000	0.000	-14.201	0.139
	6	-14.35	0.387	0.2459	0.7399	0.000	0.000	-14.348	0.115
	7	-14.65	0.351	0.1521	1.4069	0.000	0.000	-14.652	0.104
	8	-17.25	0.548	0.0059	0.5362	0.000	0.000	-17.253	0.163

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.918	0.195	0.198	0.198	1.035

cont'd.

Table 18.7 cont'd.

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.59	0.321	0.0000	2.0849	0.000	0.000	-15.589	0.122
2	No data for this age							
3	No data for this age							
4	-15.90	0.734	0.0000	0.4470	0.000	0.000	-15.901	0.228
5	-13.91	0.560	0.0248	3.3658	0.000	0.000	-13.908	0.166
6	-14.05	0.506	0.3298	1.2648	0.000	0.000	-14.054	0.150
7	-14.31	0.440	0.2147	2.3275	0.000	0.000	-14.308	0.131
8	-17.13	0.717	0.0066	0.5273	0.000	0.000	-17.131	0.213

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.692	0.197	0.260	0.260	1.744

Age 7

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-16.12	1.385	0.0000	6.0246	0.000	0.000	-16.120	0.529
2	No data for this age							
3	No data for this age							
4	-16.20	1.008	0.0000	1.4654	0.000	0.000	-16.201	0.313
5	-13.97	0.388	0.0233	1.7484	0.000	0.000	-13.972	0.115
6	-13.97	0.472	0.3587	0.9955	0.000	0.000	-13.970	0.140
7	-14.14	0.414	0.2533	1.8062	0.000	0.000	-14.142	0.123
8	-17.23	0.813	0.0060	0.7093	0.000	0.000	-17.233	0.241

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.487	0.224	0.172	0.224	0.593

Age 8

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-16.36	1.713	0.0000	2.3587	0.000	0.000	-16.361	0.654
2	No data for this age							
3	No data for this age							
4	-16.92	1.590	0.0000	######	0.000	0.000	-16.915	0.493
5	-13.77	0.859	0.0286	0.6545	0.000	0.000	-13.766	0.255
6	-14.06	0.855	0.3286	0.7780	0.000	0.000	-14.057	0.254
7	-14.11	0.706	0.2605	1.6640	0.000	0.000	-14.114	0.210
8	-17.44	1.421	0.0049	0.1338	0.000	0.000	-17.442	0.422

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.079	0.410	0.444	0.446	1.174

Table 18.8 Total international fishing mortality rate at age of whiting in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	0.032	0.024	0.045	0.061	0.013	0.057	0.016	0.009	0.010	0.005	0
1	0.161	0.230	0.104	0.172	0.182	0.213	0.221	0.159	0.203	0.091	1
2	0.463	0.507	0.462	0.327	0.287	0.455	0.501	0.274	0.311	0.372	2
3	0.587	0.798	0.844	0.766	0.509	0.733	0.836	0.638	0.647	0.583	3
4	0.852	0.633	1.040	0.968	0.715	0.760	1.047	0.923	0.967	1.085	4
5	0.825	1.027	1.446	1.033	0.874	0.949	1.058	1.194	1.038	0.918	5
6	1.190	1.094	1.298	1.322	1.139	1.006	1.331	1.295	1.222	1.692	6
7	1.702	0.962	1.062	1.323	0.884	1.289	1.177	1.525	1.236	1.487	7
8	2.276	1.311	2.078	1.123	1.204	1.245	1.247	2.064	1.390	1.079	8
9	1.373	1.009	1.371	1.159	0.985	1.035	1.169	1.402	1.171	1.252	9
10	1.373	1.009	1.371	1.159	0.985	1.035	1.169	1.402	1.171	1.252	10

Table 18.9 Stock numbers at age ('000) of whiting in Sub-area IV.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
0	60610030	55015750	20754420	23746000	20719070	32933610	26876400	57457290	59589620	50963410	0
1	4315038	4585007	4193311	1549406	1743816	1596152	2428694	2064640	4446170	4604478	1
2	1106732	1420973	1409093	1461897	504306	562367	498664	753007	681244	1402975	2
3	534328	444257	545532	565881	672402	241261	227416	192745	365132	318119	3
4	136419	209384	141010	165249	185355	284691	81709	69448	71734	134750	4
5	15038	43090	82381	36924	46518	67144	98640	21241	20443	20213	5
6	8514	5133	12013	15105	10232	15110	20244	26680	5015	5638	6
7	1851	2017	1339	2554	3135	2552	4304	4167	5690	1151	7
8	291	276	631	379	557	1061	576	1086	743	1353	8
9	10	24	61	65	101	137	250	135	113	151	9
10	10	2	18	55	40	56	34	21		11	10

Table 18.10 Whiting in Sub-area IV. Output from program RCRTINX2.

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.1247	0.912	2.645	0.7710	15	8.2332	0.28156	0.29449	0.40885
EGFS	5.0291	3.016	-8.562	0.1089	9	6.6077	1.38045	1.53635	0.01502
DGFS	5.9532	******	111.411	0.0011	6	12.7812	12.29838	13.54285	0.00019
SGFS	4.7185	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFSO	5.3033	1.762	-1.692	0.1048	8	7.6519	1.40033	1.49058	0.01596
DGFSO	6.7551	0.213	6.273	0.2958	5	7.7106	0.28640	0.32191	0.34218
IYFS2	6.3008	1.574	-0.767	0.4049	15	9.1479	0.62632	0.70555	0.07123
AN						8.0660	0.49187	0.49187	0.14656

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.5073	0.930	2.547	0.7673	16	8.6000	0.27781	0.30039	0.56274
EGFS	5.4350	5.527	-21.970	0.0327	10	8.0698	2.61688	2.75451	0.00669
DGFS	7.6034	-4.736	37.254	0.0210	7	1.2452	3.17017	4.49521	0.00251
SGFS	4.9523	2.001	-1.356	0.2423	5	8.5552	0.81980	0.98780	0.05204
EGFSO	5.1017	2.260	-4.303	0.0748	9	7.2283	1.70318	1.81872	0.01535
DGFSO	7.4847	0.715	3.286	0.1675	6	8.6343	0.92928	1.09205	0.04258
IYFS2	6.7405	1.462	-0.205	0.4262	16	9.6500	0.58534	0.71837	0.09840
MEAN						8.0725	0.48076	0.48076	0.21969

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.0753	0.930	2.541	0.7679	16	8.1927	0.27879	0.29210	0.68744
EGFS									
DGFS									
SGFS									
EGFSO	4.7230	2.235	-4.170	0.0750	9	6.3875	1.70438	1.89653	0.01631
DGFSO	7.9571	0.716	3.276	0.1679	6	8.9753	0.93465	1.17088	0.04278
IYFS2									
AN						8.0493	0.48105	0.48105	0.25347

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1981	7.79	2417.26	0.22	0.32	7.48 1777.54	1.44
1982	7.55	1895.62	0.22	0.32	7.39 1619.34	1.48
1983	8.34	4191.46	0.19	0.18	7.80 2450.37	0.97
1984	8.00	2992.55	0.22	0.11	7.63 2066.74	0.52
1985	8.06	3172.32	0.19	0.17	8.40 4447.08	0.91
1986	8.54	5133.16	0.23	0.22		0.97
1987	8.16	3499.56	0.24	0.17		0.69

Table 18.11 Mean fishing mortality, biomass and recruitment of whiting in Sub-area IV between 1968-1987.

	Mean Fishing Mortality			Biomass			Recruits
	Ages		Ages	1000 tonnes			Age 0
	2 to 6		0 to 4				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1968	0.720	0.226	0.072	1312	426	68	13064
1969	0.408	0.195	0.278	716	589	69	24820
1970	0.606	0.231	0.238	520	352	70	39723
1971	0.413	0.135	0.061	519	219	71	68240
1972	0.583	0.141	0.116	600	268	72	89748
1973	0.685	0.170	0.161	912	378	73	44939
1974	0.606	0.139	0.299	677	435	74	90002
1975	0.865	0.227	0.146	1078	446	75	57156
1976	0.669	0.173	0.277	1018	566	76	57394
1977	0.596	0.127	0.218	1020	537	77	57097
1978	0.807	0.082	0.104	710	410	78	60610
1979	0.630	0.075	0.104	888	470	79	55016
1980	0.713	0.229	0.093	781	477	80	20754
1981	0.638	0.083	0.168	583	451	81	23746
1982	0.484	0.100	0.098	450	349	82	20719
1983	0.575	0.147	0.068	466	308	83	32934
1984	0.759	0.131	0.067	444	247	84	26876
1985	0.724	0.080	0.053	430	247	85	57457
1986	0.657	0.122	0.047	714	294	86	66449
1987	0.774	0.114	0.048	722	360	87	45109
Mean recruits at age 0 for period 1968 to 1987							47593

Table 18.12 Input for catch prediction of whiting in Sub-area IV.

	1987 Stock and Fishing Mortality				Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F 1983 to 1987			Mean values for period 1983 to 1987				
								Mean Weight (Kg.)				Prop.
Age	Stock Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
0	45108650	0.000	0.001	0.005	0.000	0.002	0.016	0.131	0.028	0.014	0.015	0.000
1	5140025	0.004	0.122	0.050	0.005	0.132	0.046	0.193	0.107	0.052	0.093	0.034
2	1402975	0.066	0.207	0.098	0.118	0.220	0.066	0.234	0.162	0.141	0.178	0.359
3	318119	0.333	0.165	0.084	0.482	0.176	0.076	0.283	0.212	0.260	0.263	0.726
4	134750	0.930	0.132	0.024	0.854	0.120	0.056	0.327	0.232	0.360	0.319	0.874
5	20213	0.870	0.048		0.981	0.077	0.054	0.383	0.257	0.488	0.380	0.927
6	5638	1.672	0.019		1.362	0.054	0.007	0.423	0.254	0.431	0.417	0.961
7	1151	1.487			1.425	0.029	0.006	0.476	0.257	0.593	0.473	0.979
8	1353	1.039	0.039		1.510	0.019		0.505	0.323		0.502	0.986
9	151	1.252			1.312			0.754			0.754	1.000
10	11	1.252			1.312			0.650			0.650	1.000

	Age 2 to 6	Age 0 4	Age 2 to 6	Age 0 4
Mean F Unscaled	0.889	0.052	0.817	0.057
Scaled			0.889	0.052

Recruits at age 0 in 1988 = 47593000
Recruits at age 0 in 1989 = 47593000
Recruits at age 0 in 1990 = 47593000

M at age and proprtion mature at age are as shown in Table 18.3

Mean F for ages 2 to 6 in 1987 for human consumption landings + discards = 0.889 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1983 to 1987
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1987

Mean F for ages 0 to 4 in 1987 for small-mesh fisheries = 0.052 .
Industrial fishery F-at-age in the prediction are averages for the period 1983 to 1987 .
rescaled to produce a mean value of F for ages 0 to 4 equal to that for 1987

Table 18.13 Predicted catches and biomasses ('000 t) of whiting in Sub-area IV - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	722	842	811	811	811	811	811	811	811	811	811	811
Spawning	360	527	493	493	493	493	493	493	493	493	493	493
Mean F Ages												
Human Cons. 2 to 6	0.89	0.89	0.00	0.18	0.36	0.53	0.71	0.89	1.07	0.00	0.00	
Small-mesh 0 to 4	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	
Mean F(Year)/Mean F(1987)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	
Catch weight												
Human Consumption	62	113	0	32	60	84	105	124	141	0	0	
Discards	53	87	0	18	35	50	65	79	92	0	0	
Small-mesh Fisheries	16	29	33	32	31	30	28	27	27	0	0	
Total landings	79	142	33	64	90	113	134	152	167	0	0	
Total catch	132	229	33	82	125	164	199	230	259	0	0	
Biomass 1 Jan of Year+1												
Total	842	811	976	926	883	844	809	778	750	0	0	
Spawning	527	493	653	604	561	523	489	458	431	0	0	

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
0	47593000	3	33791	276092	309886
1	3503899	9779	277263	95760	382802
2	1667731	136362	243019	73722	453103
3	616865	179739	67942	28641	276322
4	125189	58926	8491	3896	71312
5	33718	18051	1431	993	20476
6	6287	4153	170	21	4344
7	809	562	12	2	576
8	213	153	2	0	155
9	377	255	0	0	255
10	35	24	0	0	24
Wt	841781	113217	86855	28586	228658

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	47593000	3	33791	276092	309886
1	3649448	10186	288780	99738	398703
2	1128991	92312	164515	49907	306734
3	709955	206863	78195	32963	318022
4	208720	98243	14156	6495	118894
5	33108	17725	1405	975	20105
6	8638	5706	234	28	5968
7	1180	820	18	3	841
8	154	110	2	0	112
9	38	26	0	0	26
10	91	61	0	0	61
Wt	811334	124028	78831	27492	230351

Table 18.14 Predicted catches and biomasses ('000 t) of whiting in Sub-area IV - 1988-1989.

	Year										
	1987	1988	1989								
Biomass 1 Jan of Year											
Total	722	842	835	835	835	835	835	835	835	835	835
Spawning	360	527	516	516	516	516	516	516	516	516	516
Mean F Ages											
Human Cons. 2 to 6	0.89	0.76	0.00	0.18	0.36	0.53	0.71	0.89	1.07	0.00	0.00
Small-mesh 0 to 4	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00
Mean F(Year)/Mean F(1987)										F0.1	Fmax
Human Consumption	1.00	0.85	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	62	100	0	34	64	90	112	132	156	0	0
Discards	53	75	0	18	35	51	67	81	94	0	0
Small-mesh Fisheries	16	29	35	33	32	31	29	28	27	0	0
Total landings	79	129	35	67	96	120	142	161	178	0	0
Total catch	132	205	35	86	131	172	208	242	272	0	0
Biomass 1 Jan of Year+1											
Total	842	835	995	943	897	856	820	787	758	0	0
Spawning	527	516	672	621	576	536	500	468	439	0	0

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
0	47593000	3	28725	276117	304845
1	3503899	8382	237658	96566	342607
2	1667731	118475	211142	75355	404971
3	616865	159167	60166	29839	249171
4	125189	53084	7649	4129	64862
5	33718	16339	1295	1057	18691
6	6287	3822	157	22	4001
7	809	518	11	2	532
8	213	141	2	0	143
9	377	234	0	0	234
10	35	22	0	0	22
Wt	841781	100184	75419	29286	204888

Stock at start of and catch during 1989 for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	47593000	3	33791	276092	309886
1	3650528	10189	288866	99767	398822
2	1152412	94227	167928	50942	313097
3	746910	217631	82265	34679	334575
4	230358	108428	15623	7168	131219
5	38315	20513	1626	1128	23267
6	10124	6687	274	33	6994
7	1460	1014	22	4	1040
8	191	137	2	0	139
9	48	32	0	0	32
10	111	75	0	0	75
Wt	834999	132465	80667	28405	241536

Table 18.15

ASSESSMENT QUALITY CONTROL DIAGRAM 1

STOCK: Whiting in Sub-area IV (North Sea).

AVERAGE F(2-6,u)					
DATE OF ASSESSMENT	YEAR				
	1983	1984	1985	1986	1987
1984	0.86				
1985	0.81	0.85			
1986	0.70	0.84	0.74		
1987	0.72	0.89	0.84	0.85	
1988	0.73	0.89	0.80	0.78	0.89

REMARKS:

ESTIMATED TOTAL LANDINGS ('000 T) AT STATUS QUO F							
ASSESSED IN	YEAR						
	1983	1984	1985	1986	1987	1988	1989
FORECAST YR	n/a	n/a	118	135	112	134	146
CURRENT YR	n/a	102	117	114	106	149	
ACTUAL	150	94	68	74	79		

$$\text{Actual SQC} \approx \text{Landings (t)} * \frac{\text{F(assumed)}}{\text{F(actual)}} * \exp\left[-\frac{1}{2}(\text{F(assumed)} - \text{F(actual)})\right]$$

REMARKS:

cont'd.

Table 18.15 Cont'd

ASSESSMENT QUALITY CONTROL DIAGRAM 2

STOCK: Whiting in Sub-area IV (North Sea).

RECRUITMENT (AGE 0) UNIT: Millions					
DATE OF ASSESSMENT	YEAR CLASS				
	1983	1984	1985	1986	1987
1984	3174				
1985	2724	1870			
1986	39424	25363	39127		
1987	29912	33808	41515	73355	
1988	32934	26876	57457	66449	45109

REMARKS:

SPAWNING STOCK BIOMASS ('000 T)								
DATE OF ASSESSMENT	YEAR							
	1983	1984	1985	1986	1987	1988	1989	1990
1984	243	191	297[1]	342[1]				
1985	269	237	308	339[1]	370[1]			
1986	310	261	352	414	476[1]	515[1]		
1987	309	244	234	294	368	500[1]	490[1]	
1988	308	247	247	294	360	527	478[1]	452[1]

[1] Forecast.

REMARKS:

Table 19.1 Nominal catch (in tonnes) of WHITING in Division VIa, 1978-1987, as officially reported to ICES.

Country	1978	1979	1980	1981	1982
Belgium	-	-	+	-	2
Denmark	119	92	32	-	+
Faroe Islands	-	770	-	-	-
France	3,610	2,779	2,609	1,637	1,798
Germany, Fed.Rep.	2	4	1	49	53
Ireland	2,080	2,791	4,407	8,148	3,406
Netherlands	23	17	2	6	285
Spain	-	-	-	-	99
UK (England & Wales)	669	320	227	145	166
UK (Scotland)	8,174	10,613	7,386	8,519	8,419
UK (N. Ireland)	-	-	-	-	
Total	14,677	17,386	14,664	18,504	14,235
WG total	14,677	17,081	12,816	12,203	13,871

Country	1983	1984	1985	1986	1987[1]
Belgium	-	-	3[1]	-	-
Denmark	-	-	-	-	5[2]
Faroe Islands	-	-	-	-	-
France	2,029	1,887	1,502	1,998[1,3]	1,961[3]
Germany, Fed.Rep.	43	6	9	1	74[2]
Ireland	3,578	3,454	1,917	1,683	2,835
Netherlands	811	-	14	-	-
Spain	76	40	61	-	...
UK (England & Wales)	157	162	63	26	46
UK (Scotland)	10,019	11,270	9,051	5,848	7,797
UK (N. Ireland)	52	40	17	5	13
Total	16,765	16,859	12,637	9,561	12,731
WG total	15,971	15,902	13,000	8,000	10,000

[1] Provisional.
[2] Includes Division VIb.
[3] Includes Divisions VIb and Vb.

Table 19.2 Annual weight and numbers of whiting caught in Division VIa between 1968-1987.

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1968	14	14	0	0	42	42	0	0
1969	12	12	0	0	41	41	0	0
1970	11	11	0	0	40	40	0	0
1971	16	16	0	0	52	52	0	0
1972	15	15	0	0	50	50	0	0
1973	17	17	0	0	62	62	0	0
1974	17	17	0	0	72	72	0	0
1975	20	20	0	0	71	71	0	0
1976	25	25	0	0	90	90	0	0
1977	17	17	0	0	63	63	0	0
1978	15	15	0	0	54	54	0	0
1979	17	17	0	0	61	61	0	0
1980	13	13	0	0	45	45	0	0
1981	12	12	0	0	46	46	0	0
1982	14	14	0	0	48	48	0	0
1983	16	16	0	0	49	49	0	0
1984	16	16	0	0	50	50	0	0
1985	13	13	0	0	43	43	0	0
1986	8	8	0	0	31	31	0	0
1987	10	10	0	0	36	36	0	0

Table 19.3 Values of natural mortality rate and proportion mature at age.

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	1.000
3	0.200	1.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000

Table 19.4 Total international catch at age ('000) of whiting in Division VIa between 1978-1987.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	17670	6334	11650	3593	2991	3418	7209	4139	2674	5559	1
2	18175	34221	11378	24395	5783	7094	12765	19520	14826	12049	2
3	6682	13282	14860	11297	29094	8040	8221	8574	9771	12094	3
4	9400	3407	4155	4611	6821	22757	4387	3351	2653	4705	4
5	941	3488	1244	1518	2043	6070	14825	1997	532	724	5
6	1433	276	1085	452	803	1439	1953	4764	291	286	6
7	63	374	84	197	254	399	723	748	474	108	7
8	1	10	101	5	77	131	94	56	47	112	8
9	3		4		18	10	41	18	6	4	9

Table 19.5 Total international mean weight at age (Kg.) of whiting in Division VIa between 1978-1987.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.199	0.218	0.172	0.192	0.184	0.216	0.216	0.185	0.174	0.188	1
2	0.235	0.232	0.242	0.228	0.220	0.249	0.259	0.238	0.236	0.237	2
3	0.286	0.306	0.330	0.289	0.276	0.280	0.313	0.306	0.294	0.304	3
4	0.389	0.404	0.420	0.382	0.352	0.340	0.371	0.402	0.365	0.373	4
5	0.516	0.536	0.492	0.409	0.505	0.409	0.412	0.430	0.468	0.511	5
6	0.549	0.678	0.595	0.409	0.513	0.494	0.458	0.461	0.482	0.520	6
7	0.602	0.694	0.722	0.542	0.503	0.526	0.438	0.531	0.496	0.575	7
8	0.973	0.644	0.876	0.751	0.603	0.441	0.601	0.604	0.522	0.569	8
9	0.639		1.278		0.506	0.801	0.488	0.649	0.555	0.833	9

Table 19.6 Whiting in Division VIa. Summary statistics from Laurec/Shepherd tuning.

Age 1

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-17.08	0.778	0.0005	0.0232	0.000	0.000	-17.075	0.231
2	-14.46	0.486	0.0138	0.0823	0.000	0.000	-14.456	0.144
3	-15.82	0.549	0.0178	0.0744	0.000	0.000	-15.818	0.163
4	-16.72	0.576	0.0217	0.0931	0.000	0.000	-16.717	0.171

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.070	0.286	0.255	0.286	0.796

Age 2

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-14.27	0.362	0.0084	0.4220	0.000	0.000	-14.266	0.107
2	-12.99	0.478	0.0598	0.3101	0.000	0.000	-12.991	0.142
3	-14.14	0.351	0.0955	0.4731	0.000	0.000	-14.136	0.104
4	-16.08	0.385	0.0410	0.4804	0.000	0.000	-16.081	0.114

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.429	0.193	0.882E-01	0.193	0.209

Age 3

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-13.04	0.278	0.0286	0.6933	0.000	0.000	-13.037	0.083
2	-12.54	0.307	0.0942	0.5801	0.000	0.000	-12.537	0.091
3	-13.59	0.221	0.1645	0.7879	0.000	0.000	-13.593	0.066
4	-15.75	0.256	0.0568	0.9118	0.000	0.000	-15.755	0.076

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.753	0.130	0.891E-01	0.130	0.470

Age 4

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.52	0.345	0.0478	1.0719	0.000	0.000	-12.523	0.102
2	-12.64	0.327	0.0851	0.4439	0.000	0.000	-12.639	0.097
3	-13.59	0.267	0.1657	0.6455	0.000	0.000	-13.585	0.079
4	-15.69	0.398	0.0609	0.7767	0.000	0.000	-15.686	0.118

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.679	0.162	0.177	0.177	1.198

Age 5

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.29	0.352	0.0605	0.5844	0.000	0.000	-12.287	0.104
2	-12.58	0.331	0.0903	0.4603	0.000	0.000	-12.580	0.098
3	-13.63	0.464	0.1589	0.7775	0.000	0.000	-13.627	0.138
4	-15.82	0.654	0.0535	0.8800	0.000	0.000	-15.816	0.194

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.587	0.203	0.133	0.203	0.431

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.19	0.403	0.0670	2.3936	0.000	0.000	-12.187	0.120
2	-12.75	0.440	0.0758	1.1408	0.000	0.000	-12.755	0.131
3	-13.59	0.399	0.1642	1.0923	0.000	0.000	-13.594	0.118
4	-15.67	0.642	0.0621	5.9230	0.000	0.000	-15.666	0.191

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.725	0.223	0.330	0.330	2.181

Table 19.7 Total international fishing mortality rate of age of whiting in Division VIa between 1968-1987.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	0.190	0.093	0.069	0.105	0.099	0.090	0.122	0.077	0.062	0.070	1
2	0.484	0.677	0.240	0.203	0.244	0.356	0.552	0.558	0.428	0.429	2
3	0.581	0.806	0.720	0.397	0.395	0.626	0.916	0.919	0.609	0.753	3
4	0.855	0.673	0.644	0.512	0.444	0.617	0.863	1.351	0.845	0.679	4
5	0.930	0.947	0.560	0.518	0.450	0.924	1.119	1.409	0.821	0.587	5
6	0.992	0.801	0.915	0.406	0.576	0.669	0.909	1.628	0.813	1.725	6
7	0.768	0.781	0.616	0.407	0.422	0.638	0.872	1.173	0.702	0.835	7
8	0.768	0.781	0.616	0.407	0.422	0.638	0.872	1.173	0.702	0.835	8

Table 19.8 Stock numbers at age ('000) of whiting in Division VIa between 1968-1987.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Age
1	112138	78680	191543	39856	35024	43939	68898	61553	49154	91123	1
2	51808	75900	58705	146310	29391	25977	32891	49910	46661	37831	2
3	16573	26130	31571	37826	97826	18861	14898	15503	23392	24905	3
4	17789	7590	9554	12583	20831	53983	8254	4882	5063	10414	4
5	1688	6192	3170	4108	6173	10939	23848	2850	1035	1781	5
6	2473	545	1966	1482	2004	3222	3555	6374	570	373	6
7	129	751	200	645	808	923	1352	1173	1025	207	7
8	31	21	239	15	245	304	176	88	102	215	8

Table 19.9 Whiting in Division VIa. Output from program RCRTINX2.

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.1247	1.102	-2.247	0.6755	15	4.5005	0.40471	0.42330	0.45245
EGFS	5.0291	2.972	-11.992	0.1579	9	2.9530	1.32206	1.47136	0.03745
DGFS	5.9532	******	241.739	0.0006	6	15.7682	28.18386	31.03580	0.00008
SGFS	4.7185	0.000	0.000	0.0000	0	0.0000	0.00000	0.00000	0.00000
EGFS0.	5.3033	2.253	-7.993	0.1034	8	3.9530	1.79177	1.90726	0.02229
DGFS0	6.7551	1.183	-3.279	0.0299	5	4.7097	1.86800	2.09957	0.01839
IYFS2	6.3008	1.562	-4.470	0.5249	15	5.3726	0.55555	0.62582	0.20699
EAN						4.2986	0.55589	0.55589	0.26235

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.5073	1.162	-2.648	0.6151	16	4.9153	0.44645	0.48274	0.23309
EGFS	5.4350	2.626	-10.023	0.1859	10	4.2504	1.14067	1.20066	0.03768
DGFS	7.6034	******	-730.608	0.0001	7	167.4989	79.90921	113.30906	0.00000
SGFS	4.9523	0.889	-0.105	0.5291	5	4.2998	0.28721	0.34608	0.45353
EGFS0	5.1017	2.245	-7.962	0.1053	9	3.4937	1.66386	1.77673	0.01721
DGFS0	7.4847	1.142	-3.161	0.0305	6	5.3852	1.60235	1.88302	0.01532
IYFS2	6.7405	1.863	-6.293	0.3283	16	6.2668	0.80720	0.99066	0.05535
MEAN						4.2562	0.53778	0.53778	0.18782

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS	6.0753	1.153	-2.584	0.6127	16	4.4185	0.44623	0.46755	0.52953
EGFS									
DGFS									
SGFS									
EGFS0	4.7230	2.221	-7.836	0.1044	9	2.6560	1.66660	1.85449	0.03366
DGFS0	7.9571	1.142	-3.163	0.0305	6	5.9236	1.60860	2.01518	0.02850
IYFS2									
EAN						4.2409	0.53245	0.53245	0.40830

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1981	4.63	102.80	0.20	0.43	3.58	36.03	2.20
1982	3.45	31.49	0.35	0.49	3.81	44.94	1.40
1983	4.66	105.43	0.31	0.32	4.25	69.90	1.02
1984	4.16	64.19	0.30	0.15	4.14	62.55	0.49
1985	4.56	95.84	0.28	0.21	3.92	50.15	0.75
1986	4.55	94.21	0.23	0.23			1.01
1987	4.33	75.91	0.34	0.24			0.71

Table 19.10 Mean fishing mortality, biomass and recruitment of whiting in Division VIa between 1968-1987.

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 1	
	2 to 4		1 to 1				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1968	0.898	0.000	0.000	68	25	67	210
1969	0.649	0.000	0.000	52	49	68	20
1970	0.527	0.000	0.000	43	38	69	22
1971	0.874	0.000	0.000	35	29	70	31
1972	1.049	0.000	0.000	40	20	71	93
1973	1.337	0.000	0.000	61	22	72	195
1974	0.881	0.000	0.000	52	39	73	68
1975	0.668	0.000	0.000	70	38	74	152
1976	0.982	0.000	0.000	56	46	75	52
1977	0.777	0.000	0.000	45	29	76	81
1978	0.640	0.000	0.000	49	26	77	112
1979	0.719	0.000	0.000	50	33	78	79
1980	0.534	0.000	0.000	65	32	79	192
1981	0.370	0.000	0.000	59	52	80	40
1982	0.361	0.000	0.000	52	45	81	35
1983	0.533	0.000	0.000	46	37	82	44
1984	0.777	0.000	0.000	43	28	83	69
1985	0.943	0.000	0.000	35	23	84	62
1986	0.627	0.000	0.000	30	21	85	49
1987	0.620	0.000	0.000	39	22	86	94
Mean recruits at age 1 for period 1968 to 1987							85

Table 19.11 Input for catch prediction of whiting in Division VIa.

	1987				Values used in Prediction						
	Stock and Fishing Mortality				F at age , Mean Wt. and Propn. Retained by Consumption Fishery						
					Scaled mean F			Mean values for period 1983 to 1987			
Age	Stock	Fishing Mortality			1983 to 1987			Mean Weight (Kg.)			Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	93627	0.084			0.074			0.196			0.196	1.000
2	37831	0.429			0.412			0.244			0.244	1.000
3	24905	0.753			0.678			0.300			0.300	1.000
4	10414	0.679			0.772			0.370			0.370	1.000
5	1781	0.587			0.862			0.446			0.446	1.000
6	373	1.725			1.018			0.483			0.483	1.000
7	207	0.835			0.748			0.513			0.513	1.000
8	215	0.835			0.748			0.547			0.547	1.000

	Age 2 to 4	Age 1 1	Age 2 to 4	Age 1 1
Mean F Unscaled	0.621	0.000	0.700	0.000
Mean F Scaled			0.621	0.000

Recruits at age 1 in 1988 = 76000
Recruits at age 1 in 1989 = 85000
Recruits at age 1 in 1990 = 85000

M at age and proprtion mature at age are as shown in Table 19.3

Mean F for ages 2 to 4 in 1987 for human consumption landings + discards = 0.621 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1983 to 1987
rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1987

Mean F for ages 1 to 1 in 1987 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1983 to 1987 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1987

Table 19.12 Predicted catches and biomasses ('000 t) of whiting in Division VIa - 1988-1989.

	Year											
	1987	1988	1989									
Biomass 1 Jan of Year												
Total	39	44	48	48	48	48	48	48	48	48	48	48
Spawning	22	29	31	31	31	31	31	31	31	31	31	31
Mean F Ages												
Human Cons. 2 to 4	0.62	0.62	0.00	0.12	0.25	0.37	0.50	0.62	0.74	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1987)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	10	12	0	3	6	9	11	13	15	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	10	12	0	3	6	9	11	13	15	0	0	
Total catch	10	12	0	3	6	9	11	13	15	0	0	
Biomass 1 Jan of Year+1												
Total	44	48	65	61	58	55	52	50	48	0	0	
Spawning	29	31	48	44	41	38	36	33	31	0	0	

Stock at start of and catch during 1988

Age	Stock No	H.Cons	Discards	By-catch	Total
1	76000	4931	0	0	4931
2	70500	21714	0	0	21714
3	20166	9099	0	0	9099
4	9600	4740	0	0	4740
5	4323	2295	0	0	2295
6	811	477	0	0	477
7	54	26	0	0	26
8	74	36	0	0	36
Wt	44057	12027	0	0	12027

Stock at start of and catch during 1989
for F(1989) = F(1988)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	85000	5515	0	0	5515
2	57774	17795	0	0	17795
3	38239	17252	0	0	17252
4	8383	4139	0	0	4139
5	3632	1928	0	0	1928
6	1496	880	0	0	880
7	240	116	0	0	116
8	50	24	0	0	24
Wt	47789	13478	0	0	13478

Table 19.13

ASSESSMENT QUALITY CONTROL DIAGRAM 1

STOCK: Whiting in Division VIa (West of Scotland).

AVERAGE F(2-4,u)					
DATE OF ASSESSMENT	YEAR				
	1983	1984	1985	1986	1987
1984	0.68				
1985	0.48	0.59			
1986	0.53	0.71	0.49		
1987	0.54	0.78	0.90	0.46	
1988	0.53	0.78	0.94	0.63	0.62

REMARKS:

ESTIMATED TOTAL LANDINGS ('000 T) AT STATUS QUO F							
ASSESSED IN	YEAR						
	1983	1984	1985	1986	1987	1988	1989
FORECAST YR	n/a	n/a	12	13	15	15	13
CURRENT YR	n/a	13	14	15	11	12	
ACTUAL	15	16	13	8	10		

$$\text{Actual SQC} \approx \text{Landings (t)} * \frac{\text{F(assumed)}}{\text{F(actual)}} * \exp\left[-\frac{1}{2}(\text{F(assumed)} - \text{F(actual)})\right]$$

REMARKS:

cont'd.

Table 19.13 Cont'd

ASSESSMENT QUALITY CONTROL DIAGRAM 2

STOCK: Whiting in Division VIa (West of Scotland).

RECRUITMENT (AGE 1) UNIT: millions					
DATE OF ASSESSMENT	YEAR CLASS				
	1982	1983	1984	1985	1986
1984	30				
1985	54	78			
1986	47	153	55		
1987	48	73	74	84	
1988	44	69	62	49	94

REMARKS:

SPAWNING STOCK BIOMASS ('000 T)								
DATE OF ASSESSMENT	YEAR							
	1983	1984	1985	1986	1987	1988	1989	1990
1984	31	37	23[1]	28[1]				
1985	39	33	31	29[1]	32[1]			
1986	37	29	41	38	39[1]	40[1]		
1987	36	29	25	25	31	47[1]	46[1]	
1988	37	28	23	21	22	29	31[1]	33[1]

[1] Forecast.

REMARKS: