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REPORT OF THE SAITHE (COALFISH) WORKING GROUP

Copenhagen, 29 February - 6 March 1984

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REPORT OF THE SAI THE (COALFISH) WORKING GROUP

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K Hoydal attended the meeting as ICES Statistician.

2. TERMS OF REFERENCE

At the 71st Statutory Meeting of ICES it was decided (C.Res.1983/2:8:2) that the Saithe Working Group should meet at ICES headquarters from 29 February to 6 March 1984 to:

- (i) assess catch options for (a) the saithe stocks and (b) cod and haddock in Faroese waters inside safe biological limits for 1985 and, where meaningful, for 1986,
- (ii) take into account the levels of predation mortality implied by the results of the stomach sampling project,
- (iii) analyse the effect of changes in the data sets of weight at age and age at first maturity on the time series of stock and spawning stock biomass.

In addition, the Working Group was asked by ACFM to consider possible alternative methods to improve the fishing pattern for the North-East Arctic and the North Sea saithe.

3. LANDINGS OF SAI THE IN THE NORTH-EAST ATLANTIC

The estimated landings of saithe from the North-East Atlantic (Table 3.1) amounted to 462 000 tonnes in 1982 and 448 000 tonnes (provisional) in 1983. These figures indicate an increase in catches as compared to the late 1970s, but they are still much lower than the peak landings in the period 1970-76.

4. NORTH-EAST ARCTIC SAI THE (Sub-areas I and II)

4.1 Landings (Table 4.1, Figure 4.1.A)

The provisional estimate of landings in 1983 is 158 206 tonnes, which is 20 000 tonnes less than in 1982.

4.2 Age Composition (Table 4.2)

The age composition from Norwegian landings in 1982 was revised after the 1983 Working Group meeting. A new assessment was presented to the ACFM and used as a basis for the recommendations. Subsequently, only minor revisions have been made to the 1982 data. Provisional age compositions for 1983 were available from the Federal Republic of Germany and Norway, accounting for 98% of the landings.

4.3 Weight at Age (Table 4.3)

For 1960-79 the same weights at age as in previous assessments have been used. These are the same weights for each year and are used for both catch and stock. For 1980-83, annual weights at age in the catch for each year are used for catch and stock weights.

The weight at age data used in the yield per recruit and prediction calculations were derived by averaging the weights at age for the years 1981-83.

4.4 Fishing Mortality and Stock Size Estimate from VPA

4.4.1 Estimates of fishing mortality

Quota restrictions on trawlers from countries other than Norway reduced the total landings by 60 000 tonnes from 1976 to 1977, but during the period 1977-83 landings have been relatively stable. Landings by main gears in the fishery - purse-seine, trawl and gill-net - also show the same stable trend from 1977 onwards (Figure 4.2). These three gears exploit different components of the stock, the purse-seine age groups 2-5, the trawls age groups 4-8 and the gill-nets age groups 6 and older. The relatively stable fishery with each of these gears from 1977 to 1983 indicates that the total exploitation pattern may also have been relatively stable during this period.

For gill-net, no data on effort are available at present, and there is no other information about changes in the gill-net fishery in recent years.

Also for purse-seine, no data on effort are available. Account made every other year indicates no significant changes in number and size distribution of the vessels taking part in the fishery for saithe in recent years. In 1983, there were market problems which may have reduced fishing effort by purse-seiners. Fishermen in the southern part of the area claim that the maximum landing size of 35 cm has restricted their fishing in the most recent years, which could mean reduced fishing mortalities on 2, and to a lesser extent, 3 year old fish. However, the geographical distribution of both the fishing and the year classes may vary from year to year, and this can change the fishing mortality even if the total effort is constant. It is, therefore, probably not advisable to assume changes in fishing mortalities unless there is evidence of significant changes in the fishing pattern.

Although the total trawl landings from 1977-83 have been stable, Norwegian landings have made up an increasingly larger part. This may have changed the total fishing pattern for trawl, but variations in the geographical distribution of the saithe are just as likely to have caused changes in the fishing mortality. However, the data available do not provide evidence of changed exploitation pattern by trawlers in recent years.

Data on effort and catch per unit of effort are available for 11 categories of Norwegian trawlers for the period 1973-82. For 1983, data are available from the larger trawlers. The data from Division IIIa are given in Table 4.6. For the side-trawlers the data for 1982 and 1983 are not included in the table because errors have been found in the 1982 data, and lack of data from smaller trawlers makes the 1983 data incomparable with earlier years. For stern-trawlers, however, only the larger vessels are of significance.

Following restrictions in quotas of cod and haddock in 1980, there was a shift in effort towards saithe by Norwegian stern trawlers which is evident from the sudden increase in cpue. A further increase in effort on saithe seems to have taken place in 1981. If the proportion of the effort directed towards saithe has been stable in 1981-83, the total effort by trawlers shows a slightly decreasing trend. The cpue for

stern-trawlers from 1981-83 follows a similar pattern as estimates of the biomass exploited by trawlers. However, the time series is too short to be of any help in estimating the level of fishing mortalities in 1983.

With little conclusive evidence of major changes in exploitation pattern and level of fishing mortalities during the period 1977-83, it seemed appropriate to run a separable VPA for this period. The log catch ratio residuals indicated that there may have been some changes in the exploitation pattern. Two ordinary VPA runs were then made, setting fishing mortalities in 1983 equal to those in 1977-79 and 1980-82, respectively. The two resulting exploitation patterns were clearly different and indicated a shift in effort towards larger fish for both purse-seiners and trawlers in the most recent years. It is not clear if this reflects a trend or a temporary change. However, the Working Group felt that fishing mortalities in 1983 were more likely to be similar to the 1980-82 pattern than suddenly being changed back to the 1977-79 pattern. It was, therefore, agreed to use 1980-82 as a basis for both the exploitation pattern and the level of fishing mortality for 1983 and in the assessment.

The result (Table 4.4) shows a higher level of fishing mortality in 1980-83 compared with 1977-79, but an improvement in the exploitation pattern.

4.4.2 Spawning stock biomass and recruitment

Estimates of spawning stock biomass are given in Table 4.5 and Figure 4.1.B. There is a decline from 1970 onwards to 102×10^3 tonnes in 1983, the lowest observed spawning biomass in the time series. This level represents 72% of the 1983 Working Group estimate.

Estimates of stock numbers at each age are given in Table 4.5, and recruitment at age 1 is plotted in Figure 4.1.B. The 1978 year class appears to be as large as those in 1973 and 1966-68, however the more recent year classes, from 1979-81, to be amongst the lowest in the period reported.

4.5 Yield per Recruit

The Y/R curve is given in Figure 4.1.C. It was calculated using the 1980-82 average exploitation pattern and the 1981-83 average weight at age data as given in Table 4.7. Current exploitation (\bar{F}_{3-8} unweighted) at $F = 0.55$ is clearly in excess of $F_{max} = 0.30$ and $F_{0.1} = 0.17$.

4.6 Catch Predictions

The data used for catch predictions are given in Table 4.7. Average recruitment ($R_1 = 318 \times 10^6$ = average of year classes 1960-79) is assumed for the year classes 1982-85. The assessment gave very low values for the 1980 and 1981 year classes and both may be seriously underestimated. However, reports from different parts of the coast indicate that they are both clearly less than average size, and it was therefore decided to use the values from the VPA in the predictions. The 1982 year class appears to be more abundant and the 1983 year class may be very abundant.

The fishing mortality is assumed to remain at the 1983 level of $\bar{F}_{(3-8)} = 0.55$. Predicted catches and stock biomasses for 1984 and for a range of exploitation levels in 1985 are given in Table 4.8. Predicted yield in 1985 and the spawning stock biomass for 1986 are shown in Figure 4.1.D. On the assumption that F remains unchanged from the 1983 level, the yields in 1984 and 1985 are predicted

to be 126 000 tonnes and 137 000 tonnes, respectively. Landings in 1985 corresponding to F_{max} are 85 000 tonnes. The spawning stock biomass will decrease slightly in 1985 and 1986 as the effect of the 1978 year class declines.

4.7 Comments to the Assessment

Assessments on the North-East Arctic saithe in recent years have generally given increased fishing mortalities and decreased spawning stock biomasses compared to earlier assessments. With no useful data series on effort presently available, this trend may very well continue. The current regulations do not effectively put any limit on the total fishing effort and if there is an increasing trend, this is difficult to detect if no data on effort are available. The purse-seine fishery represents a special threat to the stock because catches may not significantly decline before a recruitment failure is evident.

4.8 Improvement of the Exploitation Pattern

The exploitation pattern for North-East Arctic saithe cannot be significantly improved unless there is a reduction in the purse-seine fishery. Such a reduction can probably most effectively be obtained either by increasing the minimum landing size or by imposing quota regulations on the purse-seine fishery. There are three different minimum landing sizes in the area, and the effects of an increase are very difficult to estimate. A total quota for the purse-seine fishery will probably mean that the fishery in the north with a later peak season than in the south will be most reduced. Since the smallest fish are caught in the south, this is hardly a desirable effect. Regional quotas or quotas by vessels may solve this problem.

5. NORTH SEA SAITHE (Sub-area IV and Division IIIa)

5.1 Landings (Table 5.1)

Officially reported landings of saithe from the North Sea had declined to a relatively low level of about 120 000 tonnes in the period 1979-82 but subsequently increased to 162 000 tonnes in 1982 (revised from a preliminary estimate last year of 154 000 tonnes). The preliminary figure reported for 1983 is 163 000 tonnes, which exceeds the agreed TAC of 158 000 tonnes by 5 000 tonnes. By-catches of saithe in the industrial fisheries amounted to 5 000 tonnes in 1982 and 1 400 tonnes in 1983.

5.2 Age Composition (Table 5.2)

Provisional age compositions for 1982 used last year were updated. New data for 1983 were provided by Denmark, England, France, Federal Republic of Germany, Norway and Scotland. The landings of these countries together accounted for 163 000 tonnes out of a total of 165 000 tonnes (WG estimate of total landings). As in previous years, the reported age compositions for the human consumption fisheries were summed and then raised to the total landings of the human consumption fisheries. The age composition for the industrial by-catch was then added to give the total for the North Sea.

5.3 Weight at Age (Table 5.3)

Weight at age data were provided by all countries which provided age composition data. National data sets of either age composition or

weight at age were adjusted to eliminate sums of products discrepancies. Annual average weight at age estimates, weighted by numbers in the catch, were calculated.

Weight at age data have been reported annually only from 1979. For the earlier years a single weight at age array has been used for stock biomass calculations. SOP checks give significant discrepancies for the years prior to 1972, which could indicate that the weight at age data used may not be appropriate for these years.

Weight at age data as described above have been used to calculate annual stock biomass estimates for past years. The weight at age data used in catch and stock biomass predictions were derived by averaging the annual estimates of weight at age for the years 1981-83.

5.4 Fishing Mortality and Stock Estimates from VPA

5.4.1 Estimates of fishing mortality

Separable VPAs were made for a range of values of F (5), the fishing mortality on the reference age group 5 in 1983, and of S (14), the relative selection factor on age group 14. The analysis was performed on data for the years 1978-83 to exclude years when there were big catches made by the USSR and when there were large by-catches from the industrial fisheries. A value of $S(14) = 0.75$ was accepted as the value giving the internally most consistent selection pattern. This selection pattern and the table of log catch ratio residuals are shown in Table 5.7. There appear to be no systematic trends in the residuals, but there are some high values in the column for 1981/82 which suggest a catch data anomaly in one of these years. It was decided to use the exploitation pattern as determined by separable VPA as the basis for input F values for 1983 for the conventional VPA.

Effort and catch per unit effort data were available for French trawlers from 1974 and for Norwegian side-trawlers and stern-trawlers from 1978 and 1979 (Table 5.6). All three fleet data sets showed an increase in cpue in 1983, compared with 1982, and a reduction in total fishing effort. A VPA was made using $\bar{F}_{(3-6)} = 0.25$ to scale the exploitation pattern determined from separable VPA. The calculated F values for 1974 to 1983 were then compared with the trend in total fishing effort estimated in French units (Figure 5.2). Apart from an obvious anomaly with the values for 1975, the F and effort values correlated well ($r = 0.92$, excluding 1975). As the trend in F values closely followed the trend in estimated total effort, the trial input F values for 1983 were considered to be acceptable. The calculated F values from this analysis are given in Table 5.4, and the trend of $\bar{F}_{(3-6)}$ with time is plotted in Figure 5.1.A.

5.4.2 Spawning stock biomass and recruitment

Stock numbers calculated from VPA are given in Table 5.5, and the estimates of year class strength at age 1 have been plotted in Figure 5.1.B. The estimate for the 1982 year class at age 1 from VPA is considered unreliable, and for prediction purposes this year class has been assumed to be of average abundance. Also the VPA gives the abundance of the 1981 year class to be equal to the big 1978 year class. The Working Group has some reservations about this estimate, and it is thought that due to sampling problems in 1983 the catch may have been incorrectly allocated between age groups 2 and 3. It has not been possible to confirm or to correct for this, but any error would not be expected to have any substantial effect on catch predictions.

Spawning stock biomass (Table 5.5, Figure 5.1.B) increased to a peak value in 1973 and then declined up to 1978. Since then spawning stock biomass has been increasing, probably as a result of the lower level of fishing mortality in recent years.

5.5 Yield per Recruit

A Y/R curve (Figure 5.1.C) was calculated using the exploitation pattern and the weight at age data given in Table 5.8. Expressed as the average fishing mortality on age groups 3-6, $F_{max} = 0.24$ and $F_{0.1} = 0.14$. The current level of F is estimated to be 0.25.

5.6 Catch Predictions

Input data used in the catch predictions are given in Table 5.8. Recruitment of the 1982 and later year classes has been assumed to be of average abundance as no pre-recruit abundance data are available.

The catch for 1984, predicted on the basis of no change in fishing mortality, is 185 000 tonnes, which is close to the TAC agreed for that year of 180 000 tonnes. For 1985, catch predictions have been made for a range of values of fishing mortality, and the results are given in Table 5.9 and are presented graphically in Figure 5.1.D.

5.7 Possibilities for Improving the Exploitation Pattern by increasing the Minimum Landing Size

The current minimum landing sizes are 32 cm in the Norwegian zone and 30 cm in the EC zone. The corresponding minimum trawl mesh sizes are 100 mm and 80 mm. Using a selection factor of 3.8, the 50% selection lengths are 38 cm and 30.4 cm. For trawlers, the minimum landing size can be related to the minimum mesh size. However, the purse-seiners, which take the majority of the smaller fish, use non-selective gear and tend to catch fish mainly in the 30-37 cm length range. A significant increase in the minimum landing size is likely to affect the viability of the purse-seine fishery.

6. ICELANDIC SAITHE (Division Va)

6.1 Landings

Landings of saithe from Division Va are given in Table 6.1 and are shown in Figure 6.1.A. Since 1977 landings have been fluctuating without trend between 50 000 and 70 000 tonnes. The 1981 catch was 59 000 tonnes, followed by an increase to 69 000 tonnes in 1982. Preliminary figures for 1983 show a decrease to 59 000 tonnes.

6.2 Age Composition

There was no need to revise the 1982 age composition used last year. Provisional age composition data for 1983 were available for landings by Iceland, which represented 97% of the total landings. These data have been used to calculate the age composition of the total landings used as input for VPA (Table 6.2).

6.3 Weight at Age (Table 6.3)

Weight at age data were available for the Icelandic catch in 1983. For the predictions, the average of the catch weight at age data for the years 1981-83 were used for both catch and stock biomass calculations.

6.4 Fishing Mortality and Stock Values from VPA

6.4.1 Estimates of fishing mortality (Table 6.5)

The Icelandic saithe fishery can generally be divided into two components, i.e., gill-net fishery during the winter season, and a trawl fishery throughout the year. The gill-net fishery, which accounts for 1/3 of the total saithe catches, exploits mainly the spawning saithe, whereas the trawl fishery is more directed towards the age groups 4-8. This fishery accounts for about 60% of the annual total landings. The saithe fished by trawlers are more or less by-catch in the fishery for cod and redfish. Depending on the availability of saithe, cod and redfish, the exploitation pattern on saithe may vary from year to year. Bearing this in mind, the Working Group decided that the use of separable VPA to estimate fishing mortalities was not an appropriate method as it assumes a constant exploitation pattern. It was, therefore, decided to use the same method as the Working Group has used in the most recent assessments, i.e., to determine an exploitation pattern from a reference period (1978-1980) and then to scale this to the estimated level of fishing mortality in 1983.

A plot for $\bar{F}(4-8)$ derived from this VPA versus effort of Icelandic trawlers diverted to saithe (Table 6.6) showed no clear relationship (Figure 6.2.2). On the other hand, there was significant correlation ($r = 0.87$) when the cpue was plotted against the biomass of 5-8 year old saithe plus a 50% proportion of the biomass of the 4 year olds (Figure 6.2). This VPA was adopted and the calculated F values for earlier years from the VPA are given in Table 6.5, and the trend in $\bar{F}(4-9)$ with time is plotted in Figure 6.1.A.

6.4.2 Spawning stock biomass and recruitment

Spawning stock biomasses are shown in Figure 6.1.B and Table 6.4. After a decline from 1969-77, the spawning stock biomass appears to have stabilised at a level similar to that in the mid-1960s of 160 000 tonnes.

Back-calculated estimates of recruitment at age 1 are plotted in Figure 6.1.B. Recruitment has fluctuated in recent years without any clear trend. Information so far available indicates that the 1980 year class is a poor one. Therefore it has been set at the same low level as the 1978 year class (22 million at age 3) (Table 6.4). Accordingly, the F input value for this year class at age 3 was adjusted to give this result. No information is available on the strength of the year classes recruiting to the fishery except for the 1981 year class where there is some preliminary indication that this year class is at least of average size. For the catch projections, the 1981 year class was set at the same value as the long-term average ($R_3 = 49\ 000$), but the 1982 and 1983 year classes have been taken to be equal to average abundance of 3 year olds in the recent 1976-80 period ($R_3 = 37\ 000$).

6.5 Yield per Recruit

The yield per 1-year old recruit and spawning stock biomass per recruit shown in Figure 6.1.C have been calculated by using the exploitation pattern and weight at age data given in Table 6.7. Compared to the present fishing mortality, $\bar{F}(4-9) = 0.34$, the reference values $F_{\max} = 0.42$ and $F_{0.1} = 0.16$.

6.6 Catch Predictions

The input data for catch projections are shown in Table 6.7. The projections are based on the 1978-80 exploitation pattern which was also used as input to the VPA.

National catch quota on saithe in 1984 is the same as the recommended TAC of 70 000 tonnes, thus $F_{(4-6)}$ was set at a value of 0.46 in 1984. Due to a restricted cod fishery in 1984, it is expected that the enforced quota on saithe will be taken. The results of the catch options for 1985 and the spawning stock and total biomasses in 1986 are given in Table 6.8 and Figure 6.1.D.

7. WEST OF SCOTLAND SAITHE (Sub-area VI)

7.1 Landings

Officially recorded landings of saithe from Sub-area VI are shown in Table 7.1. French landings recorded in Bulletin Statistique for recent years (1980-82) have been lower than scientific estimates of landings. It was felt that the scientific estimates were more representative of true landings, and these figures were used in the assessments. Estimated landings for the years 1980 onwards have, therefore, been revised upwards by about 10%. The trends in landings are shown in Figure 7.1.A. Landings in 1983 are estimated to be 26 127 tonnes, which is a small increase over recent years.

7.2 Age Composition (Table 7.2)

Age compositions for 1983 were provided by England, France and Scotland and they accounted for 97% of the total landings. Minor changes and corrections were made to the catch at age data from 1981 onwards in line with the revised total landings.

7.3 Weight at Age

Weight at age data for 1983 were provided by England, France and Scotland. The estimated mean weights at age for 1983 shown in Table 7.3 are similar to previous years. Values of weight at age used in predictions are shown in Table 7.7 and are the means for the period 1981-83.

7.4 Fishing Mortality and Stock Values from VPA

7.4.1 Estimates of fishing mortality

Estimates at previous Working Groups have indicated that fishing mortality on the West of Scotland stock is low and is not substantially different from the assumed natural mortality of 0.2. It should be noted that a characteristic of VPA is that it is convergent for Z at age regardless of input mortalities. This means that Z also has a low value and makes estimates of F very sensitive to alternative hypotheses about M.

No demonstrably effective methods for determining terminal Fs for this stock are known to the Working Group. A self-tuning method was, therefore, adopted. Mean values of F at age over the period 1979-81 were used as input values to VPA and iterations were performed until the new calculated means differed negligibly from the input values. Fs on ages 1 and 2 were then adjusted to reduce recruits in 1982 and 1983 at age 1 corresponding to the mean recruitment for the years 1977-81. This particular solution depends on the assumed value of F on the oldest age group of 0.1.

A new cpue index based on French data was presented to the Working Group. This index is based on data disaggregated into area and time strata and employs a multiplicative model of the kind described in the Working Group on the Use of Effort Data in Assessments (Anon., 1981). The index was used to derive an index of overall international effort (Table 7.6 and Figure 7.2). The index of effort indicated a continued decline, which is reflected in the value of $\bar{F}_{(3-6)}$. Decreasing terminal F in VPA in order to reproduce the effort changes more closely was unsuccessful.

7.4.2 Spawning stock biomass and recruitment

Historical spawning stock biomass figures are shown in Table 7.7 and Figure 7.1.B. The estimates of spawning stock for the years 1977 onwards indicate a gradual declining trend though year classes recruiting to the spawning stock in the future are likely to check this trend.

The estimated number of recruits at age 1 is shown in Table 7.5 and Figure 7.1.B. For catch predictions a recruitment value of 26 000 was used for 1984-86, which approximates to the mean value for the period 1977-81 obtained from VPA.

7.5 Yield per Recruit

The Y/R and spawning stock biomass per recruit curves are shown in Figure 7.1.C. The analysis suggests that the present level of $\bar{F}_{(3-6)}$ lies between $F_{0,1}$ and F_{max} (see Table 7.8) and is close to $F_{0,1}$. Management recommendations in recent years have assumed that the level of fishing mortality is close to $F_{0,1}$ (Anon., 1983). It should be stressed that equally valid alternate hypotheses concerning natural mortality alone can radically alter the level of fishing mortality in relation to $F_{0,1}$ obtained from the Y/R analysis (see Appendix).

The analysis presented in Figure 7.1.C offers no basis whatsoever for assuming that $F_{83(3-6)} \approx F_{0,1}$. Status quo recommendations should be made without reference to $F_{0,1}$.

7.6 Catch Predictions

Input data for catch predictions are shown in Table 7.7. Catch options for 1985 are shown in Figure 7.1.D and Table 7.8. Status quo catches for 1984 and 1985 are expected to be 25 000 tonnes and 24 000 tonnes, respectively.

7.7 Separable VPA

Trial runs were made using SVPA for the years 1976-83. Log catch ratio residuals were generally rather high (e.g., see Table 7.9). Values of terminal F which produced declining trends in time of $F(I)$ comparable to effort data were low and implied very low fishing mortalities in 1983 ($\bar{F}_{3-6} = 0.07$). The fishing pattern calculated by SVPA was similar to that obtained for the conventional VPA as expected. The value of using SVPA for this stock is inconclusive. In view of the high residuals and exceptionally low F suggested by the method it was not used in the assessments.

8. THE DEMERSAL FISHERIES ON THE FAROE PLATEAU

8.1 Catch and Effort Data

Based on the Faroese FISKHAG statistical system introduced in 1973 (see Coop.Res.Rep., No.91), catch and effort data are available for the Faroese vessels fishing for saithe, cod and haddock on the Faroe

Plateau. For the smaller boat groups these data are available by trips, and for the larger vessels by hauls.

The data have been split on vessel categories, the details of which are given in Table 8.1. In this table and Figure 8.1 the trends in nominal effort and corresponding catches of the three main species are shown. The nominal effort is total effort by vessel category, irrespective of which species it has been directed at. A real problem, therefore, in using these data is how to account for eventual shifts in directivity.

Although these data go back to 1973 it is difficult to make use of the data before 1977, because of the profound changes in the fishery in the Faroe area following the introduction of the 200 mile fishery zone.

8.2 Statistical Analysis of the Catch/Effort Data

The Working Group on the Use of Effort Data in Assessments (C.M. 1981/G:5) had a look at these data. They tried to estimate the catch rate of cod as a result of a vessel category factor, a month factor and a year factor. The result showed good general correspondence with trends estimated from VPA analysis.

Some later runs on the data show that the fleet category factor explains a large part of the variation.

The question about the directivity of the effort might be solved by including an area factor. A change in directivity would be expected to show up also as a change in fishing area.

During the meeting it was not possible to make any closer analysis of the data.

The Group recommends that for next year a more thorough statistical analysis of the effort data should be ready prior to the Working Group meeting, as the time available during a Working Group meeting is far too limited to perform any analysis in depth of the basic data. This analysis should attempt to correct for changes in directivity, so the effort data can be correlated with the fishing mortality on the different species.

8.3 Qualitative Description of the Different Demersal Fisheries

Before describing any further analysis, a qualitative description of the characteristics for the main vessel categories is given below.

The catchability of the two long-line categories would not be expected to have increased over the period 1977-83 because of technical improvements. The long-line fishery is a mixed fishery for cod and haddock and is known to have a lot of variability due to features inherent in the gear (saturation, influence of the relative abundance of the two stocks, bait quality and size, etc.).

The two size categories of single-boat bottom trawlers would be expected to show an increase in efficiency due to technical improvements and also to a learning factor as the Faroe area was relatively unknown ground for Faroese trawlers, when the Faroese fishing zone was established in 1977. From 1980 and onwards there is a shift from single-boat trawling to pair trawling, and the same increases will apply for the two pair trawl categories.

In addition to the vessel categories mentioned there are gill-netters, hand-liners and open boats participating in the fishery.

The increase in effort by trawlers has especially meant an increase in the landings of saithe and other species (redfish and blue ling in deeper waters), but the smaller trawler groups have during all the years taken a fair amount of cod and haddock.

Some special features in the 1983 situation should be mentioned. The relation of price/catch rates between cod/haddock and saithe went in favour of cod/haddock and in the spring difficulties in selling saithe at a reasonable price led to a stop in saithe landings for 3 weeks.

The fishery for cod and haddock will take place generally in shallower water than the main fishery for saithe. A movement of trawlers to shallower waters could also mean a shift towards exploiting younger age groups of saithe.

8.4 Analysis of the Data during the 1984 Working Group Meeting

Data for 1983 were only complete for some vessel categories. For the larger vessels, data for the first 6 months were available in the database. Values for total annual nominal effort by the larger vessel categories were estimated by raising the half-year value by a factor calculated on data from the previous year.

The Working Group agreed to try to use the total nominal effort data in the Rho-method (C.M.1982/Assess:8). It was realised that it would have been advantageous to use a model which made it possible to estimate changes in catchability by fleets, but no program was available to make these calculations. It was also appreciated that the Rho-method with total effort data does not take into account changes over the years in directivity and/or area-time of the fisheries of the different fleets.

The Rho-method gave for all three species very unlikely results and it was agreed not to rely on it.

The apparent changes in directivity (see below) might precisely be the reason for the failure of the Rho-method.

8.5 Calculation of a Crude Index of Changes in Total Effort

In order to get some use of the effort data, a crude index of total effort over the years was calculated by the formula:

$$\frac{F_{83}}{F_{79-81}} = \frac{\sum_i \frac{E_{79-81,i}}{E_{83,i}} \times \bar{C}_{83,i}}{\sum_i \bar{C}_{83,i}} \times \frac{\sum_i \bar{C}_{83,i}}{\bar{C}_{83}} \times \frac{C_{79-81}}{\sum_i C_{79-81,i}}$$

$E_{83,i}$ = Effort 1983 fleet i;

$C_{79-81,i}$ = Average catch 1979-81 fleet i, etc.

This formula is essentially the same as given in the Appendix to the North Sea Roundfish Working Group report 1982 (C.M.1982/Assess:8), but using nominal catches instead of catch in numbers. The problems with the change in the directivity remain unsolved. The following text table gives some indication of the shift in directivity for two groups of single-boat trawlers:

Catches in numbers, per effort of cod and saithe for some selected age groups by two Faroese trawler classes.

Year	Trawlers < 1 000 HP			Trawlers > 1 000 HP		
	Saithe (4-8)	Cod (3-6)	Cod/Saithe ratio	Saithe (4-8)	Cod (3-6)	Cod/Saithe ratio
1980	37	8	0.22	27	19	0.70
1981	30	9	0.30	71	43	0.61
1982	82	11	0.13	33	41	1.24
1983	56	40	0.71	33	65	1.97

The calculated index of total demersal effort is shown in Table 8.2. Basic data for the calculation are given in Table 8.1.

As it can be seen, the cod/saithe ratio more than doubles from the period 1980-81 to 1983 for both categories for the age groups contributing the majority of the catch. It was not possible during the meeting to estimate how much of this increase can be ascribed to a change in directivity and how much to changes in recruitment, but there can be no doubt that there has been a change in directivity. This means that by using the crude uncorrected effort index for calibrations of the VPAs, the fishing mortality in 1983 for cod will probably be underestimated and the fishing mortality for saithe overestimated, at least for the older age groups of saithe in deeper waters.

9. FAROE SAITHE (Division Vb)

9.1 Landings

Preliminary catch data indicate a total catch of 39 274 tonnes from the Faroese saithe stock in 1983 (Table 9.1, Figure 9.1.A). This is an increase of 8 294 tonnes compared to 1982. Foreign catches constituted less than 1% of the total catch in 1982. The Faroese catch increased by 8 156 tonnes in 1983.

9.2 Age Composition

Age compositions for 1983 were available for the Faroese landings only. The French and Federal Republic of Germany landings were distributed according to the age distribution of catches by Faroese trawlers of more than 1 000 HP. The Norwegian catch at age was estimated from Faroese gill-net catch at age compositions.

9.3 Weight at Age (Table 9.3)

The weight at age data used by the 1983 Working Group were used for the years prior to 1983. No weight at age data were available for the 1983 landings. The 1982 data for 1983 gave an SOP discrepancy within 3% of the nominal landings and were used in the assessment.

For the predictions, the average weight at age used for the years 1981 and 1982 was used.

9.4 Fishing Mortality and Stock Values from VPA

9.4.1 Estimates of fishing mortality

The exploitation pattern in 1983 was assumed to be average of the pattern for the period 1979-81. The level of fishing mortality in 1983 was chosen by using estimates of total effort for saithe (Table 8.2).

The table indicates that the effort was constant for 1979-81. As the effort in 1983 was found to be 51% higher than the average effort for 1979-81, \bar{F}_{83} was estimated in accordance with this.

The VPA results are given in Table 9.4, and trends in fishing mortality are shown in Figure 9.1.A.

9.4.2 Spawning stock biomass and recruitment (Table 9.5, Figure 9.1.B)

The spawning stock biomass has been declining since 1972. No independent estimates are available for the strengths of recruiting year classes. From the VPA the recruitment appears to have varied extensively with the recruitment of 1-year olds between 20 and 40 millions in the period 1961-66, between 50 and 70 millions in the period 1967-70, and between 15 and 35 millions in the period 1971-78. In recent years, the 1978 year class is of the same order as the 1971-73 year classes, and the same seems to be the case for the 1980 year class.

9.5 Yield per Recruit

Curves of yield and spawning stock biomass per 1-year old recruit are plotted in Figure 9.1.C. Fishing mortalities in 1983 ($\bar{F}(4-8) = 0.45$) is equal to F_{max} . $F_{0.1}$ equals 0.19.

9.6 Catch Predictions (Table 9.7, Figure 9.1.D)

Input data for the catch predictions are given in Table 9.6. The year classes 1981 onwards are assumed to be average of the 1970-80 year classes ($R_1 = 27.2 \times 10^6$). In Table 9.7, the yield in 1985 and the spawning stock biomass for 1986 are given for different assumptions of fishing mortality in 1985 on the basis that fishing mortality in 1984 is unchanged from the 1983 level.

The estimate of landings in 1984 and 1985 is, to a large extent, dependent on the estimate of the 1980 year class. Assuming an average year class strength in 1980 will reduce the predicted landings in 1984 with approximately 7 000 tonnes.

10. FAROE COD

10.1 Faroe Plateau Cod

10.1.1 Landings (Table 10.1)

Preliminary catch figures indicate a total catch in 1983 of 38 119 tonnes from the Faroe Plateau stock. This is an increase of 16 635 tonnes or 77% compared to 1982. Non-Faroese landings of cod from the Faroe Plateau were less than 1% of the total landings. The total landings in 1960-82 are shown graphically in Figure 10.1.A.

10.1.2 Age composition (Table 10.3)

Age compositions were provided only for the Faroese landings. The Norwegian and United Kingdom (Scotland) catch at age was estimated using the age composition in the larger Faroese long-liners' landings. The Federal Republic of Germany data were distributed according to the age distribution of catches by the larger Faroese trawlers (more than 1 000 HP).

10.1.3 Weight at age (Table 10.4)

As no weight at age data were available for the 1983 landings, the weight at age for 1982 was used. This resulted in a SOP discrepancy of 10%. For the predictions, the average weight at age for the period 1977-82 was used. However, these weights needed to be corrected by 10% to account for SOP discrepancies.

10.1.4 Estimates of fishing mortality

The fishing mortality for 1983 was estimated in the same way as for Faroe saithe (Section 9.4.1), using the relative effort figures arrived at in Table 8.2 (see also Section 8). This gives an $\bar{F}_{83} = 1.15 \times \bar{F}_{79-81}$. The exploitation pattern in 1983 was set equal to the average exploitation pattern for the years 1979-81.

10.1.5 Results of VPA (Tables 10.5 and 10.6)

10.1.5.1 Fishing mortality

Fishing mortalities in each calculated from VPA are given in Table 10.5, together with input values for 1982 and for the oldest age group in each year. The trend in fishing mortalities is shown graphically in Figure 10.1.A.

10.1.5.2 Spawning stock biomass and recruitment

Estimates of spawning stock biomass (age groups 4 to 10+) are given in Table 10.6 and shown graphically in Figure 10.1.B. The estimated number of recruits at age 1 for the year classes 1961-81 are given in Figure 10.1.B. Estimates of year class strength from 0-group surveys are not sufficiently reliable to predict the abundance of recruiting year classes and, therefore, the 1982-83 year classes have been assumed to be equal to the average calculated for year classes 1961-80 (22.7 million at age 1). The current assessment indicates the 1978 year class to be above average and the 1980 year class of the same order of magnitude as the very good 1972-73 year classes.

10.1.6 Yield per recruit

Curves of yield and spawning stock biomass per 1-year old recruit are plotted in Figure 10.1.C, using the data given in Table 10.7. The estimated fishing mortality in 1983 ($\bar{F}_{(3-6)} = 0.42$) is larger than $F_{max} = 0.26$, and $F_{0.1} = 0.13$.

10.1.7 Catch predictions

Data used in the catch predictions are given in Table 10.7, and the results are given in Table 10.8 and plotted graphically in Figure 10.1.D. If fishing mortality is maintained at the 1983 level ($\bar{F}_{(3-6)} = 0.42$), landings of 37 000 tonnes are predicted in 1984 and of 35 000 tonnes in 1985.

These predictions depend on provisional weight at age data and are liable to be revised.

10.2 Faroe Bank Cod (Table 10.2)

The landings of cod from the Faroe Bank are presented in Table 10.2. No attempt was made to assess this stock.

11. FAROE HADDOCK

The assessment was made for the stock of haddock for the total Faroe area (Division Vb).

11.1 Landings (Tables 11.1 and 11.2, Figure 11.1.A)

Landings in 1983 were 12 800 tonnes, which is a slight increase of 1 000 tonnes compared to 1982. The landings were almost exclusively by Faroese vessels.

11.2 Age Composition (Table 11.3)

Age composition data for the Faroese landings from the Faroe Plateau were provided. These were used to calculate the age composition for the total landings from the Faroe Plateau and Faroe Bank combined.

11.3 Weight at Age (Table 11.4)

The weight at age data used by the 1983 Working Group were used for the years up to 1982. For 1983, no weight at age data were available, and for this year's landings the weight at age data from the 1982 landings were used. These gave a SOP discrepancy of 12%. In the predictions the average weight at age for the years 1977-80 and 1982 was used (no original data were available for 1981).

11.4 Estimates of Fishing Mortality

The fishing mortality for 1983 was estimated in the same way as for saithe and cod in the Faroe area, using the relative effort values arrived at in Table 8.1 (see Section 8). This gives an $\bar{F}_{83} = 1.22 \times \bar{F}_{79-81}$. The exploitation pattern was assumed to be the same as the average exploitation pattern for the period 1979-81.

11.5 Results of VPA

11.5.1 Fishing mortality

Estimates of fishing mortality in each year calculated by the VPA are given in Table 11.5, together with the input values for 1983 and for the oldest age in each year. The trend in fishing mortalities is shown graphically in Figure 11.1.C.

11.5.2 Spawning stock biomass and recruitment

Spawning stock biomass (Table 11.6, Figure 11.1.B) was relatively stable at about 60 000 tonnes up to 1974. Subsequently, the spawning stock benefitted from the recruitment of the abundant 1972 and 1973 year classes, which increased the spawning stock to about 110 000 tonnes. By 1981, the spawning stock had returned to a lower level. The estimated numbers of recruits at age 1 are given in Table 11.6 and Figure 11.1.B.

In recent years, the 1972-74 year classes were the largest on record, but the recruitment subsequently declined and the 1977 year class appears to have failed completely, and the 1978 and 1979 year classes have also been very small compared to the average. The 1980 year class seems to be above average.

11.6 Yield per Recruit

The Y/R curve given in Figure 11.1.C has been calculated using the exploitation pattern assumed for 1983 and the mean weight at age for the years 1977-80 and 1982.

The present level of $\bar{F}_{(4-6)} = 0.28$ is close to $F_{0.1} = 0.29$ and below $F_{\max} = 0.60$.

11.7 Catch Predictions

Catch predictions were made for a recruitment level of 37.7 million 1 year old fish (average of year classes 1966-80) for the year classes 1982-85, and using the input data given in Table 11.7. The results are given in Table 11.8 and Figure 11.1.C.

12. PREDATION MORTALITY

Reference was made to papers by Daan (1983) and Gislason (1983) reporting results of stomach sampling in the North Sea. The latter was more specifically devoted to predation by saithe and emphasized the low number of fish encountered during surveys, especially in the second and fourth quarters, and the limited range of length groups sampled. Both papers summarise results of predation by saithe but not on saithe.

No quantitative evidence on cannibalism was available to the Working Group and its effect is undetermined.

Thus, at present there are no adequate data available for estimating the effect of predation on the magnitude of natural mortality and its variations with time.

13. COMMENTS ON WEIGHT AT AGE DATA

For most of the stocks dealt with by the Working Group, constant weights at age in the stock have been used up to the late 1970s, and only in recent years were these weights estimated according to the values observed each year in the catches. It is possible that weight at age could be estimated annually for the earlier part of the time series. If this were to be done, estimates of stock biomass may be changed. However, the magnitude or direction of any changes cannot be anticipated.

Although highly desirable, a better description of maturity at age using an ogive instead of the usual knife-edge array is not possible at present; past values would still be more difficult to revise, since one may suspect that fecundity is very sensitive to environmental conditions.

The appropriateness of mean weight in the catch as an estimate of weight in the stock on the 1st of January is also questionable as the former is mainly influenced by the seasonality and geographical distribution of the different fisheries aimed at saithe and their relative level of effort in each year, while the latter should be independent of this effect. In addition, the consistency of the catch weight data raises questions, since different countries estimate them in different ways and adjust either catch numbers or mean weights for SOP discrepancies.

These effects are of minor importance for short-term predictions, but the Working Group recommends that the data series of weight at age, as they exist in ICES data files or reports' tables, should be used with extreme caution for any other purpose.

14. OTHER ITEMS

The Working Group agreed to prepare for the next meeting a review of national fleets participating in saithe fisheries, either regularly or potentially during the mixed demersal stock fishery. This review need not be based on very detailed data, but should aim

at providing a synthetic of information on such items as physical characteristics of the fleet categories (number, length or power class, gear, possibly crew, and usual trip duration), seasonality and grounds worked. Comments on the evolution of these categories during recent years and, if possible, expected changes in the near future would be particularly useful to provide the Working Group with the necessary information, when trends in fishing mortality or fishing pattern are discussed.

An example of the type of data required can be found in the report of the Industrial Fisheries Working Group 1983 (Doc. C.M.1983/Assess:7).

The review will be prepared by correspondence and eventually annexed to next year's report.

REFERENCES

- Anon. 1981. Report of the ad hoc Working Group on the Use of Effort Data in Assessments. ICES, Doc. C.M.1981/G:5.
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- Daan, N. 1983. The ICES Stomach Sampling Project 1981: aims, outline and some results. NAFO Res.Doc. SCR 83/IX/93 (N.759).
- Gislason, H. 1983. A preliminary estimate of the yearly intake of fish by saithe in the North Sea. ICES, Doc. C.M.1983/G:52.

Table 3.1 Summary of total landings of SAITHE from the main fishing areas (in tonnes, whole weight). This table is based on the biological data supplied to the Working Group and used in the assessments. These figures differ to some extent from the official Bulletin Statistique data which are used for Tables 4.1, 5.1, 6.1, 7.1 and 9.1.

(IV + IIIa includes industrial fishery by-catch by Denmark and Norway)

Year	Fishing area					Total
	I+II	IV+IIIa	Va	Vb	VI	
1960	136 006	31 515	48 120	11 845	8 349	235 835
1961	109 821	35 489	50 826	9 592	6 724	212 452
1962	122 841	24 559	50 514	10 454	7 159	215 527
1963	148 036	30 300	48 011	12 693	6 609	245 649
1964	198 110	58 669	60 257	21 893	13 596	352 525
1965	184 548	73 274	60 177	22 181	18 395	358 575
1966	201 860	96 353	52 003	25 563	18 534	394 313
1967	191 191	76 759	75 712	21 319	16 034	381 015
1968	107 181	98 179	77 549	20 387	12 787	316 083
1969	140 379	115 550	115 853	27 437	17 214	416 433
1970	260 404	222 100	116 601	29 110	14 539	642 754
1971	244 732	252 619	136 764	32 706	19 863	686 684
1972	210 508	245 801	111 301	42 186	29 225	639 021
1973	215 659	225 771	110 888	57 574	35 812	645 704
1974	262 301	272 944	97 568	47 188	36 298	716 299
1975	233 453	278 126	87 954	41 578	30 949	672 060
1976	242 486	319 758	82 003	33 067	41 807	719 121
1977	182 808	194 858	62 026	34 835	28 554	503 081
1978	154 465	142 077	49 672	28 135	31 535	405 884
1979	164 234	115 668	63 504	27 246	21 708	392 360
1980	154 379	123 445	58 347	25 230	22 102	383 503
1981	175 516	126 972	59 001	30 103	23 647	415 239
1982	178 327	160 430	68 923	30 980	23 722	462 382
1983 ^{*)}	158 206	165 912	58 280	39 274	26 127	447 799

^{*)} Provisional

Table 4.1 Nominal catch (tonnes) of SAITHE in Sub-area I and Divisions IIa and IIb, 1974-83.

(Data for 1974-82 from Bulletin Statistique.)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 ^x)
Belgium	5	47	1	-	-	-	-	-	-	-
Faroe Islands	46	28	20	270	809	1 117	532	236	339	539
France	7 119	3 156	5 609	5 658	4 345	2 601	1 016	194	82	537
German Dem. Rep.	29 466	28 517	10 266	7 164	6 484	2 435	-	-	-	-
Germany, Fed. Rep.	33 155	41 260	49 056	19 985	18 190	14 823	12 511	8 413	7 224	4 931
Netherlands	-	-	64	-	-	-	-	-	-	-
Norway	152 699	122 598	131 675	139 705	121 069	141 346	128 878	166 139	169 936	150 741
Poland	2 521	3 860	3 164	1	35	-	-	-	-	-
Portugal	-	6 430	7 233	783	203	-	-	-	-	-
Spain	7 075	11 397	21 661	1 327	121	685	780	-	-	-
Sweden	-	8	-	-	-	-	-	-	-	-
U.K. (England & Wales)	3 001	2 623	4 651	6 853	2 790	1 170	794	395	731	1 252
U.K. (Scotland)	103	140	73	82	37	-	-	-	1	-
USSR	28 931	13 389	9 013	989	381	3	43	121	14	206
Total	264 121	233 453	242 486	182 817	154 464	164 180	144 554	175 498	178 327	158 206

*) Preliminary

Table 4.2

VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC SAITHE

CATCH IN NUMBERS	UNIT: THOUSANDS									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	1	1	52	171	1711	907	436	127	157	481
2	21159	81001	54151	51062	45758	28334	13220	10467	17225	11139
3	36782	60832	125030	99049	48969	61963	40796	85954	34733	19399
4	44027	11691	57576	54317	27665	23326	36644	21672	65052	22297
5	15671	16366	7947	10140	12476	14122	9211	21528	13160	35266
6	20419	4436	3712	2062	4554	4400	6379	3619	8212	5097
7	12148	7873	3435	4332	1463	2901	5200	2550	1054	2725
8	4302	6789	3212	1456	1643	963	1356	2006	1251	1081
9	3259	2914	2679	1606	738	1356	747	369	461	573
10	2505	2350	1724	563	776	436	730	279	263	195
11	1436	1937	1091	463	655	305	411	252	120	171
12	1444	1245	652	244	661	761	454	39	112	110
13	432	459	489	211	224	168	257	144	76	134
14	263	260	140	53	231	222	239	95	97	69
15+	246	239	303	158	299	216	268	49	43	164
TOTAL	164593	198926	240396	166842	146515	139904	113786	147352	141696	97401

Table 4.3 VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC SAITHE

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.250	0.250	0.250	0.250	0.250	0.250	0.180	0.290	0.360	0.180
2	0.340	0.340	0.340	0.340	0.340	0.340	0.450	0.430	0.510	0.600
3	0.710	0.710	0.710	0.710	0.710	0.710	0.790	0.730	0.770	0.990
4	1.110	1.110	1.110	1.110	1.110	1.110	1.270	1.400	1.120	1.440
5	1.630	1.630	1.630	1.630	1.630	1.630	2.050	2.050	2.020	1.830
6	2.330	2.330	2.330	2.330	2.330	2.330	2.550	2.760	2.670	2.700
7	3.160	3.160	3.160	3.160	3.160	3.160	3.290	3.300	3.270	3.310
8	4.030	4.030	4.030	4.030	4.030	4.030	4.540	4.580	3.970	4.210
9	4.870	4.870	4.870	4.870	4.870	4.870	5.150	5.950	4.690	5.560
10	5.630	5.630	5.630	5.630	5.630	5.630	5.750	6.390	5.630	5.600
11	6.440	6.440	6.440	6.440	6.440	6.440	6.710	6.610	7.180	7.570
12	7.110	7.110	7.110	7.110	7.110	7.110	7.110	6.880	7.270	8.700
13	7.820	7.820	7.820	7.820	7.820	7.820	6.640	6.750	7.000	8.470
14	8.920	8.920	8.920	8.920	8.920	8.920	7.730	7.130	8.050	9.040
15+	9.500	9.500	9.500	9.500	9.500	9.500	9.470	7.660	9.440	10.350

Table 4.4 VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC SAITH

FISHING MORTALITY COEFFICIENT	UNIT: Year-1											NATURAL MORTALITY COEFFICIENT = 0.20
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1980-82	
1	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.12	0.28	0.22	0.22	0.20	0.21	0.00	0.08	0.23	0.12	0.12	0.12
3	0.64	0.59	0.90	0.78	0.61	0.45	0.52	0.38	0.44	0.45	0.45	0.45
4	0.58	0.45	0.67	0.67	0.52	0.67	0.55	0.60	0.58	0.57	0.57	0.57
5	0.53	0.45	0.60	0.49	0.56	0.55	0.63	0.68	0.91	0.74	0.74	0.74
6	0.61	0.32	0.46	0.30	0.45	0.59	0.52	0.54	0.61	0.56	0.56	0.56
7	0.51	0.51	0.43	0.43	0.37	0.54	0.55	0.40	0.50	0.42	0.42	0.42
8	0.55	0.60	0.40	0.35	0.33	0.44	0.51	0.63	0.55	0.56	0.56	0.56
9	0.36	0.37	0.50	0.36	0.37	0.44	0.11	0.26	0.45	0.27	0.27	0.27
10	0.36	0.47	0.38	0.34	0.39	0.29	0.44	0.31	0.30	0.35	0.35	0.35
11	0.44	0.53	0.42	0.17	0.40	0.20	0.49	0.27	0.21	0.32	0.32	0.32
12	0.79	0.87	0.47	0.15	0.39	0.30	0.52	0.18	0.18	0.30	0.30	0.30
13	0.37	0.65	1.10	0.20	0.27	0.16	0.50	0.31	0.24	0.35	0.35	0.35
14	0.30	0.40	0.40	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
15+	0.30	0.40	0.40	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
(3-8)U	0.55	0.46	0.56	0.50	0.47	0.51	0.54	0.57	0.53	0.55	0.55	0.55

Table 4.5 VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC SAITHE

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIOMASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	451315	370210	216911	541422	203099	455964	175561	112979	132654		
2	206243	369505	303101	177545	279424	164664	372509	141677	92585	108468	*****
3	84578	149781	229150	199413	116362	187574	109309	266535	106553	60138	76764
4	108831	36370	68207	76316	74932	51287	98013	52961	160376	56092	31395
5	39049	49713	19292	26526	31374	36553	21641	47430	23641	73514	25971
6	48565	17949	26027	3686	14270	14889	17286	9482	19603	7896	28717
7	33450	21503	10709	13496	5258	7616	8241	8439	4523	8706	3692
8	18031	16504	10610	5637	7166	2987	3638	3883	4621	2756	4683
9	11924	10449	7440	5605	3348	4217	1562	1780	1390	2660	1289
10	9059	6827	5939	3691	3310	1859	2226	1163	1126	724	1662
11	4410	5168	3491	3315	2157	1834	1161	1170	701	635	418
12	279	2223	2496	1580	2297	1172	1227	582	731	466	407
13	1529	1070	793	1280	1319	1269	712	596	397	498	283
14	1114	864	465	215	858	825	336	353	360	256	287
15+	1042	795	1024	587	1111	602	595	162	160	609	499
TOTAL NO	1022019	1059040	905655	867872	747146	934169	813011	671215	549901	5630746	
SFS NO	132004	83461	63955	44644	41094	37507	37959	27637	33617	25256	
TOT. BIO 1	904718	785011	694357	605598	536206	567466	596976	584426	519612	499973	
SFS BIO 1	481264	339079	267223	187081	172429	147070	143344	108735	114361	102806	

Table 4.6 North-East Arctic SAITHE.
Catch, effort and catch per unit of effort from Norwegian
trawlers in Division IIA 1973-1983.

YEAR	Side trawlers			Stern trawlers		
	Catch (tonnes)	Effort (hours)	Cpue (kg/hour)	Catch (tonnes)	Effort (hours)	Cpue (kg/hour)
1973	10 920	31 487	347	3 602	54 159	67
1974	13 878	33 026	420	4 837	91 398	53
1975	10 545	24 636	428	3 009	82 274	37
1976	11 594	27 854	416	5 060	114 430	44
1977	13 609	32 801	415	8 004	138 597	58
1978	10 048	25 823	389	13 077	169 930	77
1979	13 566	28 306	479	14 364	202 702	71
1980	11 935	23 396	510	25 390	108 727	234
1981	14 581	24 098	605	43 241	124 896	346
1982				36 489	116 868	312
1983 ^{*)}				33 716	86 764	389

^{*)} Preliminary, log-books from only the larger trawlers

Table 4.7

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

SAITHE-ARCTIC PRED

FIRST YEAR: 1984

LAST YEAR: 1990

YEAR	RECRUITMENT thousands
1984	318000.
1985	318000.
1986	318000.

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AGE	STOCK SIZE thousands	F AT AGE	M	MATURITY OGIVE	WEIGHT IN THE CATCH	WEIGHT IN THE STOCK
1	318000.0	0.000	0.20	0.000	0.280	0.280
2	260356.0	0.120	0.20	0.000	0.510	0.510
3	78764.0	0.450	0.20	0.000	0.830	0.830
4	31395.0	0.570	0.20	0.000	1.320	1.320
5	25971.0	0.740	0.20	0.000	1.970	1.970
6	28717.0	0.560	0.20	1.000	2.690	2.690
7	3692.0	0.420	0.20	1.000	3.290	3.290
8	4885.0	0.560	0.20	1.000	4.170	4.170
9	1289.0	0.270	0.20	1.000	5.400	5.400
10	1062.0	0.350	0.20	1.000	5.960	5.960
11	418.0	0.320	0.20	1.000	7.120	7.120
12	407.0	0.300	0.20	1.000	7.600	7.600
13	285.0	0.350	0.20	1.000	7.410	7.410
14	287.0	0.350	0.20	1.000	8.070	8.070
15+	499.0	0.350	0.20	1.000	9.150	9.150

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Table 4.8. Catch predictions and management options.

Species: SAITHE

Area: North-East Arctic

1983		1984				Management option for 1985	1985				1986	
Total landings	$\bar{F}(3-8)$	Stock biomass	Spawn. stock biom.	$\bar{F}(3-8)$	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}(3-8)$	Total landings	Stock biomass	Spawn. stock biom.
158	0.55	521	141	0.55	126	$\bar{F}_{85}=0.1$	574	112	0.17	49	748	123
						\bar{F}_{max}			0.30	85	702	108
						$\bar{F}_{85}=\bar{F}_{83}$			0.55	137	634	87
						$\bar{F}_{85}=0$			0	0	812	143
						$\bar{F}_{85}=0.2 \bar{F}_{83}$			0.11	32	770	129
						$\bar{F}_{85}=0.5 \bar{F}_{83}$			0.28	76	714	112
						$\bar{F}_{85}=1.5 \bar{F}_{83}$			0.83	186	571	69
						$\bar{F}_{85}=2.0 \bar{F}_{83}$			1.10	225	520	55

Weights = $t \times 10^3$

Recruitment = 1960-79, $R_1 = 318 \times 10^6$

Stock biomass = 1+ fish

Spawning stock biomass = 6+ fish

Exploitation pattern = 1980-82 average.

Table 5.1 Nominal catch (tonnes) of SAITHE in Sub-area IV and Division IIIa, 1974-1983
(Data for 1974-1982 from Bulletin Statistique)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 [¶]
Belgium	33	81	127	107	44	14	13	12	4	8
Denmark	8 388	10 149	15 111	17 334	10 372	10 461	10 370	6 454	10 114	10 392
Faroe Islands	581	287	425	318	213	407	1 020	614	746	346
France	28 619	24 396	32 552	41 022	38 122	40 983	37 306	42 649	47 064	49 697
German Dem.Rep.	5 816	5 882	2 088	2 430	2 404	1 504	925	-	-	-
Germany Fed.Rep.	20 589	18 622	38 698	26 860	25 982	18 780	11 095	8 246	13 517	14 614
Iceland	5	1	-	-	-	-	-	-	-	-
Ireland	-	-	119	126	88	-	-	-	-	-
Netherlands	14 504	8 917	6 101	7 270	5 135	1 466	245	123	36	-
Norway ^{b)}	9 246	12 483	17 856	14 949	17 627	17 575	47 959	55 882	70 464	77 439
Poland	22 203	35 304	35 819	12 378	5 661	6 104	2 404	698	793	415
Spain	308	249	-	-	-	-	-	-	-	-
Sweden	1 187	913	1 271	1 275	990	211	342	156	372	369
UK (Engl./Wales)	4 353	3 472	6 300	6 822	8 382	6 256	4 879	4 309	5 627	2 993
UK (Scotland)	10 956	8 898	13 034	11 366	14 330	8 257	6 525	6 529	8 136	5 752
USSR	104 500	110 743	83 669	46 385	10 161	2 015	-	-	-	-
Sub-total	231 288	240 397	253 170	188 642	139 511	114 033	123 083	125 672	156 873	162 025
By-catch from Industrial Fisheries:										
Denmark ^{a)}	38 800	27 800	53 684	1 805	72	493	-	-	-	-
Norway ^{a)}	3 469	9 878	13 082	4 392	2 494	1 142	363	1 280	5 003	1 445
TOTAL	273 557	278 075	319 936	194 839	142 077	115 668	123 446	126 952	161 876	163 470

¶) Preliminary

a) Data from national Laboratories

b) In 1974 estimates of industrial by-catches were included in the Norwegian catches reported to ICES. These estimates have later been revised and the sum of industrial by-catch and human consumption landings therefore deviate somewhat from the Bulletin Statistique figures.

Table 5.2 VIRTUAL POPULATION ANALYSIS

NORTH SEA SAITHE (FISHING AREA IV)

CATCH IN NUMBERS	UNIT: THOUSANDS									
-----	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	3670	311	228	2586	1237	894	974	5595	1467	176
2	14750	72546	25125	12993	16970	16959	17642	17674	22474	33655
3	60680	51287	223680	22567	29504	10067	10493	14941	23636	19497
4	31603	23585	51407	51801	27679	14756	11029	9079	53759	16454
5	12431	9028	9852	12914	17251	12843	9601	7199	10654	25842
6	20595	6717	5111	4684	3737	6876	6503	4413	6466	4866
7	14504	12660	3509	3173	1167	2641	4512	3207	1816	4752
8	5028	8656	4842	2902	1009	873	935	3269	1346	1360
9	1427	3299	2973	3466	707	470	500	673	978	955
10	819	1100	1066	1695	736	262	406	293	274	318
11	412	616	420	875	640	402	303	349	108	118
12	222	254	255	342	415	343	254	345	129	30
13	132	275	121	341	213	157	216	297	98	95
14	30	77	161	123	95	154	147	253	146	38
15+	27	25	66	129	109	101	90	235	146	47
TOTAL	166521	190435	326521	120791	101573	67320	63660	71672	103512	106293

Table 5.3 VIRTUAL POPULATION ANALYSIS

NORTH SEA SAITHE (FISHING AREA IV)

MEAN WEIGHT AT AGE OF THE STOCK UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.300	0.300	0.300	0.300	0.300	0.430	0.270	0.280	0.270	0.370
2	0.450	0.450	0.450	0.450	0.450	0.470	0.390	0.550	0.550	0.440
3	0.750	0.750	0.750	0.750	0.750	0.920	0.370	0.390	1.100	0.950
4	1.100	1.100	1.100	1.100	1.100	1.500	1.750	1.020	1.550	1.740
5	1.790	1.790	1.790	1.790	1.790	2.240	2.350	2.470	2.500	2.130
6	2.400	2.400	2.400	2.400	2.400	3.060	2.900	3.340	3.020	3.060
7	3.300	3.300	3.300	3.300	3.300	3.920	4.040	4.370	4.070	3.520
8	4.200	4.200	4.200	4.200	4.200	5.120	5.000	5.300	4.920	4.480
9	4.970	4.970	4.970	4.970	4.970	6.070	5.070	6.290	5.300	5.430
10	5.550	5.550	5.550	5.550	5.550	6.470	6.550	7.220	6.570	6.210
11	6.450	6.450	6.450	6.450	6.450	6.970	7.430	7.400	7.530	6.630
12	7.100	7.100	7.100	7.100	7.100	7.590	7.010	7.910	7.900	6.560
13	8.070	8.070	8.070	8.070	8.070	8.200	7.900	8.070	8.130	9.130
14	9.000	9.000	9.000	9.000	9.000	8.140	8.150	8.590	8.490	7.460
15+	9.000	9.000	9.000	9.000	9.000	8.020	9.140	8.710	9.400	10.130

Table 5.4 VIRTUAL POPULATION ANALYSIS

NORTH SEA SAITHE (FISHING AREA IV)

	UNIT: Year ⁻¹										
	NATURAL MORTALITY COEFFICIENT = 0.20										
FISHING MORTALITY COEFFICIENT -----	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1978-80
1	0.006	0.002	0.002	0.017	0.009	0.003	0.005	0.026	0.004	0.007	0.006
2	0.076	0.157	0.157	0.114	0.146	0.172	0.087	0.118	0.157	0.131	0.126
3	0.675	0.403	0.495	0.226	0.435	0.121	0.153	0.095	0.224	0.159	0.226
4	0.647	0.612	0.922	0.665	0.475	0.364	0.169	0.192	0.245	0.245	0.343
5	0.406	0.371	0.565	0.629	0.434	0.423	0.429	0.179	0.361	0.300	0.445
6	0.442	0.402	0.366	0.581	0.378	0.382	0.594	0.353	0.245	0.278	0.378
7	0.440	0.539	0.354	0.442	0.274	0.496	0.429	0.344	0.245	0.236	0.400
8	0.383	0.516	0.407	0.602	0.261	0.341	0.347	0.640	0.257	0.292	0.316
9	0.253	0.467	0.335	0.577	0.234	0.175	0.334	0.424	0.399	0.263	0.264
10	0.262	0.316	0.270	0.369	0.228	0.175	0.224	0.334	0.332	0.217	0.209
11	0.302	0.326	0.190	0.370	0.204	0.137	0.233	0.342	0.193	0.215	0.226
12	0.190	0.306	0.215	0.234	0.300	0.161	0.173	0.616	0.165	0.220	0.211
13	0.330	0.279	0.236	0.492	0.224	0.177	0.144	0.313	0.354	0.202	0.182
14	0.400	0.400	0.400	0.400	0.250	0.250	0.250	0.250	0.250	0.225	0.250
15+	0.400	0.400	0.400	0.400	0.250	0.250	0.250	0.250	0.250	0.225	0.250
(3-6)U	0.543	0.449	0.717	0.525	0.436	0.317	0.291	0.206	0.270	0.248	

Table 5.5 VIRTUAL POPULATION ANALYSIS

NORTH SEA SAITHE (FISHING AREA IV)

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIO.MASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	676388	214487	162556	179676	145442	367966	215216	242197	370195	27635	++++++
2	223287	550464	175326	132885	137403	117968	299722	175324	193243	301768	22630
3	134921	169504	385318	122709	97982	97203	61302	229473	127609	137956	216731
4	72389	56254	92755	116663	80156	53010	70503	57105	170793	83207	95388
5	40797	31252	24966	30193	49230	40818	30152	47795	38579	109462	53521
6	63130	22748	17433	11673	13179	24847	21893	16075	32729	22019	66392
7	44592	33216	12188	9726	5325	7390	14167	17095	9198	20979	13652
8	17330	23502	15761	7007	5113	3315	3684	7552	7020	5897	12904
9	7617	9676	11489	6642	3141	3226	1950	2132	3261	4536	3605
10	3859	4461	4965	6731	3974	1936	2220	1131	1142	1792	2855
11	1735	2432	2664	3104	3609	2591	1531	1452	663	671	1181
12	1411	1051	1438	1803	1756	2543	1760	817	339	445	443
13	457	955	652	950	1166	1065	1765	1212	561	571	295
14	100	256	535	409	472	765	730	1257	725	207	382
15+	90	85	219	429	536	502	447	1664	725	475	446
TOTAL NO	1283005	1119844	904598	623555	547791	724241	746840	797279	957080	717822	
SFS NO	180520	129134	92440	60621	87708	89008	60092	93179	95241	167054	
TOT. BIO.1	1025192	933226	843940	617136	525076	661631	653466	800265	920908	874327	
SFS BIO.1	536055	428788	319691	273775	253627	302223	234347	339280	312988	455405	

Table 5.6 North Sea SAITHE.
Effort and catch per unit of effort from
Norwegian and French trawlers.

YEAR	Norwegian side trawlers		Norwegian stern trawlers		French CPUE index	TOTAL EFFORT (in French units)
	CPUE kg/h	EFFORT h	CPUE kg/h	EFFORT h		
1974					.54	505 451
1975					.32	869 143
1976					.49	652 567
1977					.45	433 018
1978	542	194			.38	373 887
1979	721	368	446	5 324	.39	297 585
1980	607	1 355	704	16 918	.36	342 903
1981	619	2 974	782	25 102	.36	352 700
1982	731	3 047	918	42 286	.48	334 229
1983 ^{**}	870	4 029	1 244	26 965	.58	284 814

** Preliminary

Table 5.7

North Sea SAITHE. Separable VPA.

NATURAL MORTALITY = 0.200
 TERMINAL F = 0.350
 TERMINAL S = 0.750

REFERENCE AGE (FOR UNIT SELECTION) IS 5

ITERATION SSQ
 1 02.8405
 50 8.2234

APPROX. COEFF. VARIATION OF CATCH DATA = 29.3 %

YEAR 1978 1979 1980 1981 1982 1983
 F(I) 0.3895 0.5200 0.3457 0.4528 0.3587 0.3500

AGE 1 2 3 4 5 6 7 8 9 10 11 12 13 14
 S(J) 0.0242 0.4430 0.5674 0.8169 1.0000 0.9278 0.9550 0.9787 0.9872 0.7330 0.7256 0.7379 0.6761 0.7500

LOG CATCH RATIO RESIDUALS

78/79 79/80 80/81 81/82 82/83

1/ 2	-0.180	-0.235	-0.055	1.045	-0.552	-0.007
2/ 3	0.198	0.426	0.013	-0.630	-0.077	-0.002
3/ 4	0.423	-0.087	0.275	-0.370	0.262	0.005
4/ 5	0.256	0.200	0.325	-0.705	-0.072	0.000
5/ 6	0.102	0.154	0.366	-0.757	0.143	0.007
6/ 7	-0.342	0.007	0.407	0.755	-0.219	0.000
7/ 8	-0.430	0.559	0.008	0.118	-0.252	0.004
8/ 9	-0.008	0.017	-0.042	0.344	-0.310	0.000
9/10	0.038	-0.446	0.066	-0.081	0.420	-0.003
10/11	-0.061	-0.456	-0.215	0.300	0.421	-0.003
11/12	-0.016	0.101	-0.362	0.440	-0.165	-0.001
12/13	0.235	0.008	-0.483	0.496	-0.250	0.002
13/14	-0.219	-0.198	-0.296	0.143	0.577	0.006
	-0.004	0.002	0.007	0.006	0.005	0.016

Table 5.8

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

NORTH SEA SAITHE.

FIRST YEAR: 1984

LAST YEAR: 1990

YEAR	RECRUITMENT thousands
1984	210000.
1985	210000.
1986	210000.

AGE	STOCK SIZE thousands	F AT AGE	M	MATURITY GIVE	WEIGHT IN THE CATCH kilogram	WEIGHT IN THE STOCK kilogram
1	210000.0	0.007	0.20	0.000	0.310	0.310
2	171000.0	0.131	0.20	0.000	0.510	0.510
3	216731.0	0.169	0.20	0.000	0.980	0.980
4	95388.0	0.245	0.20	0.000	1.630	1.630
5	53321.0	0.300	0.20	1.000	2.300	2.300
6	66392.0	0.273	0.20	1.000	3.140	3.140
7	13652.0	0.266	0.20	1.000	3.970	3.970
8	12904.0	0.292	0.20	1.000	4.970	4.900
9	3605.0	0.263	0.20	1.000	5.840	5.640
10	2655.0	0.220	0.20	1.000	6.670	6.670
11	1181.0	0.220	0.20	1.000	7.220	7.220
12	443.0	0.220	0.20	1.000	7.390	7.390
13	293.0	0.220	0.20	1.000	6.660	8.660
14	382.0	0.220	0.20	1.000	8.180	8.180
15+	446.0	0.220	0.20	1.000	9.410	9.410

Table 5.9. Catch predictions and management options.

Species: SAITHE

Area: North Sea (SA IV & Div.IIIa)

1983		1984				Management option for 1985	1985				1986	
Total landings	$\bar{F}(3-6)$	Stock biomass	Spawn. stock biom.	$\bar{F}(3-6)$	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}(3-6)$	Total landings	Stock biomass	Spawn. stock biom.
163	0.25	1 030	510	0.25	185	$\bar{F}_{0.1}$	1 053	536	0.14	117	1 141	713
						\bar{F}_{max}			0.24	191	1 050	639
						$\bar{F}_{85} = \bar{F}_{83}$			0.25	195	1 045	634
						$\bar{F}_{85} = 0$			0	0	1 284	831
						$\bar{F}_{85} = 0.2 \bar{F}_{83}$			0.05	43	1 232	787
						$\bar{F}_{85} = 0.6 \bar{F}_{83}$			0.15	123	1 134	707
						$\bar{F}_{85} = 0.8 \bar{F}_{83}$			0.20	160	1 088	670
						$\bar{F}_{85} = 1.2 \bar{F}_{83}$			0.30	229	1 004	601

Weights in thousands of tonnes.
 Recruitment 1982-86, $R_1 = 210$ millions
 Stock biomass = fish at age 1+
 Spawning stock biomass = fish at age 5+
 Exploitation pattern: as for 1983.

Table 6.1 Nominal catch (tonnes) of SAITHE in Division Va, 1974-1983.
(Data for 1974-82 from Bulletin Statistique)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 ^{x)}
Belgium	2 371	1 638	1 615	1 448	1 092	980	980	532	203	224
Faroe Isl.	1 712	1 366	3 267	3 013	4 250	5 457	4 930	3 545	3 582	2 157
France	94	32	51	-	-	-	-	-	23	-
Germany, Fed.Rep.	18 627	13 820	13 785	10 575	-	-	-	-	-	-
Iceland	65 169	61 430	56 811	46 973	44 327	57 066	52 436	54 921	65 124	55 899
Norway	-	6	5	4	3	1	1	3	1	-
U.K.(Engl. & Wales)	8 845	8 643	6 024	13	-	-	-	-	-	-
U.K.(Scotland)	731	1 021	443	-	-	-	-	-	-	-
Total	97 549	87 956	82 001	62 026	49 672	63 504	58 347	59 001	68 933	58 280

x) Preliminary

Table 6.2 VIRTUAL POPULATION ANALYSIS

ICELANDIC SAITHE

CATCH IN NUMBERS

UNIT: THOUSANDS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
2	111	16	29	5	0	0	0	0	0	0
3	1209	520	329	59	543	400	135	257	406	40
4	3404	2997	3234	2099	1145	3704	2303	1550	1221	1469
5	2348	2479	3045	2050	2435	1991	4034	4310	2526	1344
6	3704	1329	2530	1801	1550	3610	2551	5464	4317	2411
7	5452	3490	2154	1030	1275	1506	2419	1504	4301	4366
8	3384	2994	2307	1063	961	718	1012	1470	1375	2407
9	1303	1434	1530	1520	537	292	402	589	1119	460
10	824	710	1064	553	575	609	245	192	343	346
11	351	325	295	530	470	509	132	67	65	71
12	141	170	191	160	279	489	102	175	37	36
13	43	100	94	71	139	150	59	130	38	11
14	13	30	68	12	91	72	29	136	37	24
15+	20	61	18	49	55	0	23	72	75	42
TOTAL	19827	17179	16943	12243	10072	14390	14720	15916	16500	13027

Table 6.3

VIRTUAL POPULATION ANALYSIS

ICELANDIC SAITHE

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	1.120	1.120	1.120	1.120	1.120	1.120	1.445	1.477	1.477	1.865
4	1.760	1.760	1.760	1.760	1.760	1.760	1.893	2.004	2.004	2.229
5	2.730	2.730	2.730	2.730	2.730	2.730	2.682	2.574	2.574	3.151
6	4.290	4.290	4.290	4.290	4.290	4.290	3.671	3.457	3.457	4.199
7	5.540	5.540	5.540	5.540	5.540	5.540	5.324	4.431	4.431	4.115
8	7.270	7.270	7.270	7.270	7.270	7.270	6.143	6.156	6.156	5.930
9	8.420	8.420	8.420	8.420	8.420	8.420	6.848	6.820	6.820	7.509
10	9.410	9.410	9.410	9.410	9.410	9.410	8.227	8.047	8.047	8.615
11	10.000	10.000	10.000	10.000	10.000	10.000	9.062	9.409	9.409	9.357
12	10.560	10.560	10.560	10.560	10.560	10.560	9.299	9.205	9.205	9.557
13	11.870	11.870	11.870	11.870	11.870	11.870	10.502	9.439	9.439	10.235
14	13.120	13.120	13.120	13.120	13.120	13.120	11.375	10.146	10.146	9.578
15+	14.000	14.000	14.000	14.000	14.000	13.120	11.672	10.756	10.756	11.256

Table 6.4 VIRTUAL POPULATION ANALYSIS

ICELANDIC SAITHE

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIOMASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1978-80
2	31954	39116	27126	61639	65140	30519	19587	32062	38529	0+*****		38415
3	22823	26061	32011	22183	50461	53332	24987	16036	26250	31545	0	42927
4	18050	17545	20862	25911	18109	40819	43231	20336	12897	21053	25791	34053
5	15937	11715	11666	14163	19321	13793	30026	35316	15251	9458	15912	21047
6	19787	10933	7362	6816	9029	13625	9499	20410	23394	10213	6533	10718
7	16669	13351	7305	3760	5963	5992	7907	5436	11803	14820	6194	5954
8	9875	10723	7790	4047	2148	2101	3499	4303	3141	5757	8215	2583
9	4183	5052	6091	4254	2354	900	1077	1425	2206	1343	2561	1444
10	2486	2258	2349	3612	2114	1445	475	451	640	898	687	1345
11	342	1260	1210	1579	2097	1215	565	170	197	218	352	1299
12	626	376	756	725	648	1289	469	361	80	103	115	802
13	193	336	151	446	445	281	617	292	159	32	52	448
14	43	120	226	40	303	239	96	452	123	80	16	213
15+	66	203	60	163	153	0	76	239	249	140	120	86
TOTAL NO	143740	139115	125465	149146	176314	165549	142132	135341	134900	95571		
SPS NO	54971	44678	33796	25244	23282	27085	24501	35083	38151	38836		
TOT. BIOM	428339	380390	336867	283000	296768	329547	326250	299743	284408	296478		
SPS BIOM	327497	288341	232443	178871	156634	160318	129773	143627	159975	163690		

Table 6.5 VIRTUAL POPULATION ANALYSIS

ICELANDIC SAITHE

	FISHING MORTALITY COEFFICIENT				UNIT: Year ⁻¹	NATURAL MORTALITY COEFFICIENT = 0.20						
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1976-80	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.06	0.02	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.00	0.01	
4	0.23	0.21	0.19	0.09	0.07	0.11	0.06	0.09	0.11	0.08	0.08	
5	0.18	0.26	0.34	0.25	0.15	0.17	0.19	0.15	0.20	0.17	0.17	
6	0.19	0.20	0.47	0.34	0.21	0.34	0.35	0.35	0.26	0.30	0.30	
7	0.25	0.34	0.39	0.36	0.43	0.34	0.41	0.36	0.52	0.39	0.39	
8	0.47	0.37	0.40	0.34	0.67	0.47	0.70	0.47	0.65	0.61	0.61	
9	0.42	0.37	0.32	0.50	0.29	0.44	0.67	0.60	0.60	0.47	0.47	
10	0.46	0.42	0.52	0.34	0.35	0.70	0.62	0.63	0.67	0.63	0.63	
11	0.61	0.35	0.31	0.56	0.29	0.75	0.26	0.56	0.45	0.44	0.44	
12	0.23	0.71	0.32	0.79	0.64	0.54	0.27	0.75	0.71	0.48	0.48	
13	0.28	0.35	1.15	0.19	0.42	0.67	0.11	0.66	0.36	0.47	0.47	
14	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
15+	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
(4- 9)0	0.29	0.29	0.35	0.31	0.30	0.31	0.40	0.34	0.42	0.34		

Table 6.6. Icelandic SAITHE.
Calculation of effort from 1978-83.

Year	Tonnes/hr trawling	Total landings by trawlers	Total effort (hrs)	Effort relative to 1983
1978	0.96	25 027	26 071	1.21
1979	1.19	37 105	31 179	1.44
1980	1.22	33 254	27 259	1.26
1981	1.43	31 060	21 719	1.01
1982	1.35	30 448	24 444	1.13
1983	1.15	27 704	21 580	1.00

Table 6.7

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

SAITHE ICELAND

FIRST YEAR: 1984

LAST YEAR: 1986

YEAR RECRUITMENT

 thousands

1984 49000.
1985 37000.
1986 37000.

AGE	STOCK SIZE thousands	F AT AGE	I	MATURITY OGIVE	WEIGHT IN THE CATCH kilogram	WEIGHT IN THE STOCK kilogram
3	49000.0	0.010	0.20	0.030	1.627	1.627
4	18046.0	0.060	0.20	0.270	2.127	2.127
5	15912.0	0.170	0.20	0.600	2.892	2.692
6	6533.0	0.300	0.20	0.550	3.567	3.567
7	6194.0	0.390	0.20	0.650	4.520	4.520
8	3215.0	0.610	0.20	0.730	6.039	6.039
9	2561.0	0.470	0.20	0.960	7.193	7.193
10	587.0	0.650	0.20	0.970	8.511	8.511
11	352.0	0.440	0.20	1.000	9.229	9.229
12	115.0	0.460	0.20	1.000	9.714	9.714
13	52.0	0.470	0.20	1.000	9.939	9.939
14	10.0	0.400	0.20	1.000	10.272	10.272
15+	120.0	0.400	0.20	1.000	10.719	10.719

Table 6.8. Catch predictions and management options.

Species: SAITHE

Area: Iceland (Div. Va)

1983		1984				Management option for 1985	1985				1986	
Total landings	$\bar{F}(4-9)$	Stock biomass	Spawn. stock biom.	$\bar{F}(4-9)$	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}(4-9)$	Total landings	Stock biomass	Spawn. stock biom.
59	0.34	296	156	0.46	70	$\bar{F}_{0.1}$	289	134	0.16	24	335	172
						\bar{F}_{max}			0.42	56	303	145
						$\bar{F}_{85} = \bar{F}_{83}$			0.34	46	313	153
						$\bar{F}_{85} = 0.6 \bar{F}_{83}$			0.20	29	331	168
						$\bar{F}_{85} = 1.2 \bar{F}_{83}$			0.40	53	305	147
						$\bar{F}_{85} = 1.4 \bar{F}_{83}$			0.47	60	297	141
						$\bar{F}_{85} = 1.6 \bar{F}_{83}$			0.54	66	290	135

Weights in thousand tonnes.

Recruitment 1984 $R_3 = 49$ millions, 1985 and 1986 $R_3 = 37$ millions.

Stock biomass: fish at age 3+

Spawning stock biomass on maturity ogive.

Exploitation pattern 1984 and 1985 based on 1978-80 average.

Table 7.1. Nominal catch (tonnes) of SAITHE in Sub-area VI from 1974-83.
(Data for 1974-82 from Bulletin Statistique.)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 ^{*)}
Belgium	209	21	95	-	-	1	2	2		
Denmark	-	-	3	-	-	-	-	-	4	
Faroe Islands	6	6	7	11	-	14	4	3	5	2
France	22 802	19 946	29 216	19 686	21 519	15 662	15 427	16 654	17 102	22 027 ^{*)}
German Dem.Rep.	-	8	3	-	-	-	-	-		
Germany, Fed.Rep.	16	481	511	254	604	131	49	581	441	295
Ireland	-	-	375	240	266	246	295	250	322	300
Iceland	-	+	-	-	-	-	-	-	-	
Netherlands	124	702	547	531	623	256	91	-	-	
Norway	22	10	17	91	122	20	62	25	19 ^{*)}	55
Poland	125	164	91	-	-	-	-	-	-	
Spain	1 862	1 882	1 012	346	-	-	-	120	-	
U.K. (Eng. & Wales)	1 333	1 571	1 560	2 758	3 193	1 765	1 594	1 364	1 966	798
U.K. (N. Ireland)	3	12	13	9	27	11	9	10	7	8
U.K. (Scotland)	9 527	6 131	5 807	4 628	5 181	3 602	2 902	3 117	2 141	2 587
USSR	269	15	2 550	-	-	-	-	-	-	
Total	36 298	30 949	41 807	28 554	31 535	21 708	20 435	22 126	22 007	26 072

*) Preliminary

Table 7.2

VIRTUAL POPULATION ANALYSIS

SAITHE IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

CATCH IN NUMBERS

UNIT: THOUSANDS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	750	25	56	154	58	9	44	143	56	27
2	2865	2382	2641	1276	3927	964	994	2395	1522	2670
3	5653	5994	8904	4467	4056	1640	5555	5637	4545	5759
4	2376	2399	2637	2680	2347	1260	956	1942	1657	2151
5	1916	1537	1602	1675	1507	1146	676	597	1255	756
6	622	867	1124	740	703	707	650	413	550	666
7	951	1051	665	565	297	376	466	544	572	470
8	890	723	524	583	245	156	194	225	259	146
9	495	202	536	295	162	152	97	154	156	94
10	423	89	323	295	504	154	113	122	65	80
11	197	36	402	275	562	165	175	127	51	52
12	129	87	181	107	266	158	148	176	63	61
13	56	46	186	55	276	152	139	126	68	55
14	57	14	139	103	64	171	34	97	77	86
15+	57	25	102	107	35	62	119	97	152	175
TOTAL	17382	15301	19597	15106	14402	7348	2166	10807	10526	11254

Table 7.3

VIRTUAL POPULATION ANALYSIS

SAITHE IN FISHING AREA VIA (NW. COAST OF SCOTLAND, IRLAND)

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.310	0.453	0.444	0.437	1.412	0.512	0.417	0.400	0.432	0.432
2	0.592	0.739	0.691	0.686	0.506	0.699	0.651	0.679	0.719	0.748
3	1.002	0.957	1.030	1.070	1.155	1.324	1.166	1.100	1.064	1.366
4	1.638	1.528	1.470	1.426	1.673	1.982	1.935	1.703	1.767	1.974
5	1.774	2.585	2.345	2.284	2.606	2.470	2.654	2.969	2.739	3.180
6	3.546	3.523	3.300	3.293	3.831	3.373	3.573	4.030	3.982	3.758
7	4.506	4.782	4.271	4.377	4.691	4.615	4.500	5.120	5.373	5.090
8	5.092	5.593	5.040	5.178	5.279	5.333	5.334	6.235	6.241	6.398
9	6.123	6.523	5.913	5.936	5.962	6.974	6.526	7.235	7.784	7.095
10	7.363	7.136	6.554	6.739	6.655	7.561	7.972	8.394	9.143	8.506
11	8.011	8.007	7.100	7.132	7.692	8.391	8.634	8.489	9.413	8.664
12	8.959	9.031	8.006	8.326	9.030	9.795	9.466	9.321	10.432	9.630
13	9.849	9.071	8.776	9.025	10.037	10.760	9.737	10.176	10.319	11.576
14	10.604	10.635	9.700	9.951	10.977	11.054	10.766	11.036	10.614	12.035
15+	12.003	11.840	10.532	10.663	9.557	11.759	11.962	12.370	12.155	13.309

Table 7.4 VIRTUAL POPULATION ANALYSIS

SAITHE IN FISHING AREA VIA (NW. COAST OF SCOTLAND, F. ISLANDS)

	UNIT: Year ⁻¹												
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1977-81		
1	0.02	0.09	0.09	0.07	0.09	0.09	0.06	0.07	0.08	0.08	0.00	0.00	
2	0.13	0.09	0.14	0.09	0.28	0.05	0.06	0.10	0.07	0.07	0.00	0.00	
3	0.34	0.42	0.48	0.37	0.41	0.19	0.20	0.37	0.27	0.15	0.07	0.07	
4	0.23	0.24	0.52	0.29	0.34	0.21	0.14	0.24	0.27	0.27	0.27	0.27	
5	0.17	0.19	0.26	0.35	0.23	0.29	0.17	0.12	0.24	0.20	0.20	0.20	
6	0.07	0.11	0.25	0.18	0.25	0.19	0.24	0.15	0.15	0.20	0.19	0.19	
7	0.11	0.10	0.11	0.19	0.10	0.20	0.13	0.20	0.20	0.19	0.19	0.19	
8	0.16	0.12	0.11	0.09	0.12	0.07	0.15	0.12	0.21	0.11	0.11	0.11	
9	0.10	0.05	0.13	0.06	0.05	0.12	0.05	0.17	0.10	0.12	0.12	0.12	
10	0.16	0.02	0.11	0.09	0.12	0.06	0.10	0.09	0.10	0.08	0.08	0.08	
11	0.03	0.05	0.15	0.12	0.10	0.09	0.07	0.10	0.05	0.11	0.11	0.11	
12	0.04	0.05	0.12	0.05	0.17	0.06	0.10	0.06	0.11	0.08	0.08	0.08	
13	0.18	0.02	0.13	0.05	0.14	0.12	0.15	0.12	0.06	0.12	0.13	0.13	
14	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
15+	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
C 3- 030	0.20	0.24	0.53	0.30	0.51	0.21	0.20	0.22	0.23	0.23	0.21	0.21	

FISHING MORTALITY COEFFICIENT -----

----- TOTAL MORTALITY COEFFICIENT = 0.20

Table 7.5 VIRTUAL POPULATION ANALYSIS

SAITHE IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

STOCK SIZE IN NUMBERS UNIT: THOUSARDS

BIOMASS TOTALS UNIT: TUNNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	35143	27121	21220	23295	25099	21745	34472	27830	25809	26679	*****
2	20754	30552	22184	17341	18931	20515	17795	28200	22056	21096	21817
3	21462	19305	22865	15782	13100	11967	15926	13673	20928	17356	14366
4	12874	12512	10426	11546	8911	7067	6141	10041	7705	13049	10848
5	13639	3402	8085	6174	7045	5187	4722	5820	6438	4818	8747
6	10258	9482	5661	4999	3551	4597	3214	3257	4232	4162	3282
7	9335	7837	6961	3640	3427	2274	3127	2065	2294	2937	2790
8	6617	7235	5487	5116	2473	2543	1529	2139	1361	1544	2023
9	5535	4615	5272	4020	3639	1804	1941	1077	1550	915	1132
10	3157	4085	3596	3786	3027	2997	1504	1507	743	1147	665
11	2892	2199	3264	2649	2836	2204	2515	966	1124	550	667
12	3468	2117	1721	2310	1921	1977	1656	1739	676	674	405
13	238	2723	1654	1246	1300	1333	1695	1230	1319	497	661
14	428	162	2166	1192	972	1265	972	1053	691	1019	357
15+	660	289	1181	1239	964	716	1377	1353	1528	2026	2255
TOTAL NO	155950	138657	121608	104335	97916	88254	100006	101647	99275	96716	
SPS NO	56736	49147	45111	36372	31874	26919	25652	21905	22177	20537	
TOT. BIOM	535349	331512	298778	250731	231939	216836	207364	198714	193049	207290	
SPS BIOM	265105	253920	235065	197271	162196	161472	147093	136294	134156	130517	

Table 7.6 West of Scotland SAITHE. Calculation of international fishing effort.

YEAR	Effective CPUE (France)	Total landings	Effective inter- national effort
1974	.16	36 298	227
1975	.13	30 949	238
1976	.14	41 809	246
1977	.12	28 554	238
1978	.12	31 535	263
1979	.12	21 708	181
1980	.11	20 435	186
1981	.12	22 003	183
1982	.17	23 722	140
1983	.17	26 127	154

Table 7.7

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

SAITHE WEST OF SCOTLAND

FIRST YEAR: 1984

LAST YEAR: 1986

YEAR RECRUITMENT
 thousands

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1984 26000.
1985 26000.
1986 26000.

AGE	STOCK SIZE thousands	F AT AGE	M	MATURITY OGIVE	WEIGHT IN THE CATCH kilogram	WEIGHT IN THE STOCK kilogram
1	26000.0	0.001	0.20	0.000	0.421	0.421
2	21317.0	0.150	0.20	0.000	0.715	0.715
3	14666.0	0.270	0.20	0.000	1.183	1.183
4	10348.0	0.200	0.20	0.000	1.821	1.821
5	8747.0	0.190	0.20	1.000	2.962	2.962
6	3262.0	0.200	0.20	1.000	3.930	3.930
7	2790.0	0.190	0.20	1.000	5.196	5.196
8	2023.0	0.110	0.20	1.000	6.298	6.298
9	1132.0	0.120	0.20	1.000	7.371	7.371
10	665.0	0.030	0.20	1.000	8.602	8.602
11	367.0	0.110	0.20	1.000	8.923	8.923
12	403.0	0.030	0.20	1.000	9.861	9.861
13	661.0	0.130	0.20	1.000	10.730	10.730
14	357.0	0.100	0.20	1.000	11.310	11.310
15+	2255.0	0.100	0.20	1.000	12.611	12.611

Table 7.8. Catch predictions and management options.

Species: SAITHE Area: West of Scotland (SA VI)

1984				Management option for 1985	1985				1986	
Stock biomass	Spawn. stock biom.	$\bar{F}(3-6)$	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}(3-6)$	Total landings	Stock biomass	Spawn. stock biom.
195	131	0.21	25	$\bar{F}_{0.1}$	191	130	0.18	21	192	129
				\bar{F}_{max}			0.29	32	178	119
				$\bar{F}_{85}=0$			0	0	217	148
				$\bar{F}_{85}=0.2\bar{F}_{83}$			0.04	5	211	143
				$\bar{F}_{85}=1.4\bar{F}_{83}$			0.30	33	178	119
				$\bar{F}_{85}=2.0\bar{F}_{83}$			0.43	45	164	109
				$\bar{F}_{85}=\bar{F}_{83}$			0.21	24	188	127

Weights in thousands of tonnes.

Recruitment 1984-86, $R_1 = 26\ 000$ tonnes.

Stock biomass: fish age 1+.

Spawning stock biomass: fish aged 5+

Exploitation pattern 1984-86 based on 1983.

Table 7.9 Results of separable VPA. SAITHE - West of Scotland.

NATURAL MORTALITY = 0.200
 TERMINAL F = 0.100
 TERMINAL S = 0.400

REFERENCE AGE (FOR UNIT SELECTION) IS 3

NO. OF ITERATIONS CHOSEN IS 30
 MINIMUM DIFFERENCE BETWEEN ITERATIONS IS 10⁻⁴-5

ITERATION SSQ
 1 141.8390
 30 13.6611

APPROX. COEFF. VARIATION OF CATCH DATA = 30.3 %

YEAR 1976 1977 1978 1979 1980 1981 1982 1983
 F(I) 0.2472 0.1734 0.1793 0.1191 0.1282 0.1360 0.1015 0.1000

AGE 1 2 3 4 5 6 7 8 9 10 11 12 13 14
 S(J) 0.0061 0.3089 1.0000 0.7157 0.6520 0.5542 0.5217 0.4017 0.3523 0.3543 0.3633 0.3261 0.3690 0.4000

LOG CATCH RATIO RESIDUALS

76/77 77/78 78/79 79/80 80/81 81/82 82/83

1/ 2	-0.178	0.491	0.062-0.928-0.236	1.190-0.559	-0.157
2/ 3	-0.028-0.379	1.238-0.273-0.415-0.029-0.144			0.040
3/ 4	0.015-0.010	0.140	0.107-0.069-0.031	0.112	0.213
4/ 5	-0.373	0.313-0.121	0.240	0.107-0.224	0.375
5/ 6	0.076	0.466-0.221	0.269	0.142-0.587	0.181
6/ 7	-0.039	0.612-0.109	0.159	0.333-0.513-0.209	0.233
7/ 8	-0.378	0.323-0.319	0.201	0.273-0.447	0.413
8/ 9	-0.243	0.453-0.612	0.177-0.143-0.233	0.492	-0.114
9/10	0.077-0.256-0.603	0.366-0.472	0.336	0.289	-0.261
10/11	-0.217-0.353	0.086-0.150-0.163	0.474	0.110	-0.323
11/12	0.588-0.356	0.193-0.168	0.050	0.003-0.591	-0.283
12/13	0.724-0.836	0.164-0.360	0.026	0.124	0.010
13/14	0.003-0.614	0.052	0.359	0.620	0.050-0.430
	-0.073-0.083-0.050	0.001	0.047	0.064	0.047

Table 8.1 Catch and effort by various fishing fleets at Faeroes for COD, HADDOCK, SAITHE and total catches including all fleet categories.

YEAR	TRAWLERS <400 HP						TRAWLERS 400-1000 HP						TRAWLERS > 1000 HP						PAIR TRAWLERS <1000 HP			PAIR TRAWLERS >1000 HP		
	C A T C H			C A T C H			C A T C H			C A T C H			C A T C H			C A T C H			C A T C H					
	Effort	COD	HAD-DOCK	SAITHE	Effort	COD	HAD-DOCK	SAITHE	Effort	COD	HAD-DOCK	SAITHE	Effort	COD	HAD-DOCK	SAITHE	Effort	COD	HAD-DOCK	SAITHE	Effort	COD	HAD-DOCK	SAITHE
1973	29	2 343	779		1	155	42																	
1974	31	2 660	805		4	557	111		+	88	6													
1975	37	3 842	1 255		11	1 879	326			1	761	75												
1976	29	4 170	929		16	2 732	408			5	650	218												
1977	28	3 820	549		88	3 322	754	456		7	1 127	391	915											
1978	34	3 738	497		589	6 366	1 537	3 866	16		1 352	790	6 595											
1979	43	2 990	417		471	68	4 985	1 232	7 204	21	1 997	876	10 606											
1980	26	2 383	862		1 583	34	2 318	2 299	5 786	36	2 078	1 728	10 065	12			659			2 480				
1981	29	1 925	778		1 644	32	2 723	1 654	6 644	43	2 120	1 192	10 586	12			754		564	3 915	4	470	266	3 095
1982	25	1 697	787		1 160	32	3 430	1 725	4 432	26	1 929	1 022	8 581	15			1 555		1 244	6 163	10	981	764	4 979
1983	28	3 614	634		878	44	7 969	1 272	6 617	37	4 791	748	11 573	22			5 358		2 489	6 005	13	3 550	1 198	7 592

YEAR	LONGLINERS <100 GRP						LONGLINERS >100 GRP						U. K. TRAWLERS			T O T A L C A T C H		
	C A T C H			C A T C H			C A T C H			C A T C H			I N C L U D I N G A L L F L E E T C A T E G O R I E S					
	Effort	COD	HAD-DOCK	SAITHE	Effort	COD	HAD-DOCK	SAITHE	Effort	COD	HAD-DOCK	SAITHE	COD	HADDOCK	SAITHE			
1973	27	2 816	3 037		2	120	39		86	9 570	5 168		22 581	14 887	57 431			
1974	25	2 469	3 205		4	211	154		106	10 356	6 616		24 581	13 405	47 188			
1975	39	4 716	5 907		17	1 282	816		98	10 287	6 401		36 775	18 302	41 576			
1976	49	8 509	8 279		31	2 120	1 409		95	7 546	8 222		39 799	24 035	33 065			
1977	40	8 567	13 447		61	1 929	2 133	20	64	4 880	3 983		34 927	24 540	34 835			
1978	40	6 018	10 220		13	1 682	1 617	6	22	1 978	415		26 585	16 124	28 138			
1979	31	5 258	6 932		23	30	1 037	1 128	23	8	910	242	23 112	11 597	27 246			
1980	33	6 437	6 210		117	28	1 891	1 035	40	+	771	+	20 513	14 123	25 230			
1981	32	7 430	4 619		95	25	2 773	1 146	38				22 963	11 109	30 103			
1982	32	6 526	3 191		22	30	1 603	988	18				21 484	10 334	30 980			
1983	25	4 878	3 278		17	25	1 765	1 126	25				38 450	11 911	39 274			

Table 8.2 Demersal stocks at Faroes

$\frac{F \text{ year}}{F83}$			
YEAR	SAITHE	COD	HADDOCK
1977	3.83	0.88	0.98
1978	0.93	0.82	0.85
1979	0.63	0.94	0.80
1980	0.67	0.79	0.84
1981	0.69	0.88	0.82
1982	0.86	0.88	1.12
1983	1.00	1.00	1.00
1979-1981	0.66	0.87	0.82

Table 9.1 Nominal catch (tonnes) of SAITHE in Division Vb, 1974-1983
(Data for 1974- to 1982 from Bulletin Statistique)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 ^{*)}
Belgium	-	-	6	-	-	-	-	-	-	-
Faroe Islands	3 726	2 517	2 560	5 153	15 892	22 003	23 810	29 682	30 808	38 964
France	20 457	23 980	15 367	17 038	8 128	2 974	1 110	258	137	230
German Dem.Rep.	130	26	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	6 661	5 229	2 605	3 806	1 088	581	197	20	19	47
Netherlands	-	491	232	58	-	-	-	-	-	-
Norway	1 660	486	2 232	1 279	1 124	1 137	62	134	15	33
Poland	1 925	815	1 007	-	-	-	-	-	-	-
Spain	500	654	117	-	-	-	-	-	-	-
UK (Engl.and Wales)	3 827	2 428	3 063	2 613	557	190	13	-	-	-
UK (Scotland)	8 302	4 950	5 860	5 608	1 349	361	38	9	1	-
USSR	-	-	16	-	-	-	-	-	-	-
TOTAL	47 188	41 576	33 065	34 835	28 138	27 246	25 230	30 103	30 980	39 274

^{*)} Preliminary

Table 9.2 VIRTUAL POPULATION ANALYSIS

FAROE SAITHE

CATCH IN NUMBERS

UNIT: THOUSANDS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	5	0	1	0	7	0	0	0	0	0
2	133	189	148	124	20	1	424	0	221	0
3	3504	2062	3178	1609	611	287	996	411	337	2486
4	4126	3361	3217	2937	1743	933	677	1804	4076	1104
5	4011	3801	1720	2034	1736	1341	720	769	994	5760
6	2784	1939	1250	1288	548	1033	673	932	1114	1146
7	1401	1045	877	767	373	584	726	908	380	578
8	640	714	641	705	479	414	264	734	417	340
9	368	302	468	493	466	247	212	343	296	273
10	340	192	223	333	473	473	171	192	105	98
11	197	193	141	272	407	368	196	92	88	98
12	124	126	96	129	211	206	156	128	56	99
13	45	64	60	80	146	136	261	176	49	25
14	44	41	54	57	95	96	133	310	110	127
15+	52	67	77	64	83	251	236	407	687	289
TOTAL	17774	14096	12151	10905	7391	6372	6065	7296	8980	11723

Table 9.3 VIRTUAL POPULATION ANALYSIS

FAROE SAITHE

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.928	0.749	0.653	0.817	0.448	0.000	0.000	0.450	0.650	0.850
3	1.430	1.114	1.088	1.223	1.493	1.320	1.230	1.310	1.337	1.337
4	1.525	1.658	1.676	1.641	2.324	1.860	2.210	2.130	1.851	1.851
5	2.207	2.260	2.378	2.660	3.063	2.620	3.320	3.000	2.951	2.951
6	2.500	3.120	3.031	3.790	3.746	3.400	4.230	3.810	3.577	3.577
7	3.120	3.557	4.237	4.239	4.913	4.180	5.160	4.750	4.927	4.927
8	4.601	4.096	4.352	5.597	4.363	4.950	6.420	5.250	6.243	6.243
9	5.559	5.128	4.790	5.350	5.276	5.690	6.870	5.950	7.232	7.232
10	5.714	6.094	5.912	5.912	5.332	6.360	7.090	6.430	7.239	7.239
11	6.259	7.196	6.619	6.837	6.053	7.020	7.930	7.000	8.346	8.346
12	6.861	7.782	6.619	6.727	6.706	7.620	6.070	7.470	8.345	8.345
13	7.758	8.602	7.311	6.948	7.686	8.150	8.590	8.140	8.956	8.956
14	9.100	8.810	7.806	6.424	7.219	8.640	9.790	8.550	9.534	9.534
15+	10.000	10.000	10.000	10.000	10.000	10.000	10.340	10.100	10.330	10.330

Table 9.4 VIRTUAL POPULATION ANALYSIS

FAROE SAITHE

FISHING MORTALITY COEFFICIENT

UNIT: Year⁻¹

NATURAL MORTALITY COEFFICIENT = 0.20

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1979-81
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00
3	0.20	0.15	0.21	0.14	0.09	0.04	0.10	0.01	0.07	0.08	0.05
4	0.31	0.31	0.36	0.30	0.22	0.16	0.16	0.28	0.17	0.30	0.21
5	0.31	0.53	0.26	0.41	0.30	0.26	0.21	0.21	0.24	0.34	0.23
6	0.28	0.24	0.53	0.31	0.16	0.29	0.20	0.45	0.52	0.49	0.31
7	0.14	0.16	0.16	0.35	0.14	0.30	0.34	0.46	0.34	0.57	0.37
8	0.16	0.10	0.14	0.19	0.38	0.23	0.24	0.69	0.40	0.57	0.38
9	0.17	0.10	0.09	0.16	0.19	0.34	0.17	0.50	0.67	0.49	0.34
10	0.23	0.12	0.10	0.06	0.22	0.30	0.42	0.23	0.28	0.49	0.32
11	0.27	0.19	0.12	0.18	0.14	0.26	0.19	0.42	0.16	0.46	0.29
12	0.28	0.27	0.14	0.16	0.20	0.09	0.17	0.18	0.49	0.27	0.15
13	0.21	0.22	0.20	0.16	0.27	0.20	0.16	0.29	0.10	0.43	0.22
14	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.40	0.30
15+	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.40	0.30
(4- 8)U	0.24	0.27	0.25	0.31	0.24	0.25	0.23	0.42	0.33	0.45	
(4-14)U	0.24	0.23	0.20	0.24	0.23	0.25	0.23	0.37	0.33	0.44	

Table 9.5 VIRTUAL POPULATION ANALYSIS

FAROE SAITHE

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIOHAZS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	27339	20598	12432	12279	16480	52283	9157	53449	0	0	*****
2	20218	22736	16664	10177	10053	13493	42606	7497	43760	0	0
3	20795	16433	13437	13674	8220	8213	11046	34664	6138	35628	0
4	16900	13871	11596	12275	9745	6179	6465	8145	28009	4676	26927
5	16524	10129	8336	6605	7410	6410	4219	4503	5047	19260	2836
6	12431	9924	4689	5276	3583	4506	4042	2606	2995	3238	11224
7	11843	7674	6381	2880	3164	2440	2761	2733	1462	1454	1624
8	4316	8434	5342	4434	1669	2254	1473	1608	1399	855	673
9	2639	3366	6261	3796	2993	936	1473	950	661	771	396
10	1847	1829	2434	4704	2659	2031	545	1015	471	277	387
11	924	1206	1524	1832	3546	1751	1237	293	658	291	139
12	563	579	314	957	1255	2537	1105	637	157	460	150
13	262	350	361	580	667	838	1891	762	570	78	287
14	166	174	229	241	402	415	565	1313	466	422	42
15+	220	284	326	271	352	1063	1000	1724	2910	961	759
TOTAL NO	138007	117633	96124	79935	72199	105349	69760	122269	94702	68372	
SPS NO	52254	43948	36745	31578	27700	25181	20306	18514	16795	28068	
TOT. BIOM	241731	223036	206724	195631	171147	146059	147668	166938	193409	165733	
SPS BIOM	167459	164663	156163	130450	131716	124422	119794	100605	96161	109442	

Table 9.6

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

SAITHE IN THE WATERS AROUND FAROES

FIRST YEAR: 1984

LAST YEAR: 1986

YEAR	RECRUITMENT thousands
1984	22251.
1985	22251.
1986	22251.

AGE	STOCK SIZE thousands	F AT AGE	M	MATURITY OGIVE	WEIGHT IN THE CATCH kilogram	WEIGHT IN THE STOCK kilogram
2	22251.0	0.000	0.20	0.000	0.650	0.650
3	18212.0	0.080	0.20	0.000	1.324	1.324
4	26927.0	0.300	0.20	0.000	1.991	1.991
5	2336.0	0.340	0.20	1.000	2.976	2.976
6	11224.0	0.490	0.20	1.000	3.694	3.694
7	1624.0	0.570	0.20	1.000	4.834	4.834
8	573.0	0.570	0.20	1.000	5.747	5.747
9	396.0	0.490	0.20	1.000	6.591	6.591
10	387.0	0.490	0.20	1.000	6.635	6.635
11	139.0	0.460	0.20	1.000	7.673	7.673
12	150.0	0.270	0.20	1.000	7.908	7.908
13	287.0	0.430	0.20	1.000	8.548	8.548
14	42.0	0.400	0.20	1.000	9.076	9.076
15+	759.0	0.400	0.20	1.000	10.215	10.215

Table 9.7 Results of predictions.

Species: <u>Saithe</u>				Area: <u>Faroes</u>						
Stock biom.	Spawn. stock biom.	\bar{F} (4-8)	Catch	Management option for	1985				1986	
					Stock biom.	Spawn. stock biom.	\bar{F} (4-8)	Catch	Stock biom.	Spawn. stock biom.
172	80	0.45	42	$\bar{F}_{85} = 0$	164	98	0	0	199	130
				$\bar{F}_{0.1}$			0.19	19	178	110
				$\bar{F}_{85} = 0.8 \bar{F}_{83}$			0.36	33	162	95
				$\bar{F}_{85} = \bar{F}_{83}$ $= \bar{F}_{max}$			0.45	39	154	88
				$\bar{F}_{85} = 1.2 \bar{F}_{83}$			0.54	46	147	82

Weights in thousands of tonnes

Recruitment 1983-86 $R_1 = 27.2$ millions

Stock biomass: fish at 1 and older

Spawning stock biomass: fish at age 5 and older

Exploitation pattern 1984-86 based on 1983

Table 10.1. Faroe Plateau COD. Nominal catches by countries, 1974-1983 (tonnes)
 (Data for 1974-1982 from Bulletin Statistique).

Year	Faroe Islands	France	Germany Fed.Rep.	Norway	Poland	UK England	UK Scotland	Others	TOTAL
1974	12 541	567 [¶]	292	446	320	2 879	7 516	20	24 581
1975	22 608	1 531	408	1 353	432	2 538	7 815	90	36 775
1976	28 502	1 535	247	1 282	496	2 179	5 491	67	39 799
1977	28 177	1 450	332	864	-	811	3 291	2	34 927
1978	24 076	213 [¶]	71 ^{¶¶¶}	245	-	518	1 460	2	26 585
1979	21 774	117 [¶]	23 ^{¶¶¶}	274	-	263	661	-	23 112
1980	19 966	40 [¶]	- ^{¶¶¶}	127	-	13	367	-	20 513
1981	22 616	47	- ^{¶¶¶}	240	-	-	60	-	22 963
1982	21 387	10	-	85 [¶]	-	-	2	-	21 484
1983 ^{¶¶¶}	37 916	-	127 [¶]	69 [¶]	-	-	7	-	38 119

¶) Vb₂ included

¶¶) Preliminary

¶¶¶) Working Group data

Table 10.2. Faroe Bank COD. Nominal catches by countries, 1974-83 (tonnes).
(Data for 1974-82 from Bulletin Statistique)

Year	Faroe Isl.	France	Germany Fed.Rep.	Norway	Poland	UK England	UK Scotland	Others	Total
1974	696	*)	-	-	-	829	503	40	2 068
1975	378	81	50	-	-	749	804	55	2 117
1976	457	72	+	1	-	877	912	11	2 330
1977	851	219	-	99	-	9	780	-	1 958
1978	4 194	*)	-	183	-	2	1 071	-	5 450
1979	1 273	*)	-	33	-	-	677	-	1 983
1980	724	*)	-	54	-	85	340	-	1 203
1981	975	-	-	120	-	-	134	-	1 229
1982	2 184	-	-	16	-	-	152	-	2 352
1983 ^{***)}	2 284						59		2 343

*) Catches included in Vb1.

***) Preliminary.

Table 10.3 VIRTUAL POPULATION ANALYSIS

COD IN THE FAROE PLATEAU		UNIT: THOUSANDS									
CATCH IN HUMBERS		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	271	97	16	31	160	19	41	16	5		
2	2161	2584	1497	425	555	575	1129	646	1139	2169	
3	1206	5689	4158	3282	1219	1732	2203	4157	1965	3822	
4	1811	2157	3799	6844	2643	1672	1461	1981	3072	2782	
5	934	2211	1360	5716	3216	1601	395	947	1286	2768	
6	563	813	1427	788	1941	1906	807	582	471	1215	
7	452	295	617	1160	203	495	352	487	314	515	
8	149	190	273	239	201	134	339	527	169	159	
9	141	113	120	134	66	87	42	123	254	105	
10+	91	150	186	9	56	38	18	55	122	104	
TOTAL	7859	14304	13475	16630	9425	8256	7627	9501	8797	15720	

Table 10.4 SUM OF PRODUCTS CHECK

COD IN THE FAROE PLATEAU		UNIT: KILOGRAM									
CATEGORY: TOTAL		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.360	0.380	0.580	0.580	0.394	0.493	0.430	0.750	0.715	0.715	
2	1.060	1.060	1.060	0.680	1.112	0.897	0.927	1.080	1.280	1.280	
3	1.690	1.890	1.690	1.170	1.365	1.652	1.452	1.470	1.413	1.413	
4	2.920	2.920	2.920	1.871	2.140	2.211	2.220	2.180	2.138	2.138	
5	4.070	4.070	4.070	2.067	3.125	3.032	3.105	3.210	3.107	3.107	
6	5.300	5.300	5.300	3.588	4.363	3.642	3.539	3.700	4.012	4.012	
7	6.580	6.580	6.580	4.760	5.927	4.719	4.392	4.240	5.442	5.442	
8	7.850	7.850	7.850	5.916	6.343	7.272	6.100	4.430	5.563	5.563	
9	9.060	9.060	9.060	5.446	6.715	8.368	7.003	6.090	5.216	5.216	
10+	10.270	10.270	10.270	6.003	12.299	13.042	9.668	10.000	6.707	6.707	

Table 10.5 VIRTUAL POPULATION ANALYSIS

COD IN THE FAROE PLATEAU

FISHING MORTALITY COEFFICIENT

UNIT: Year⁻¹

NATURAL MORTALITY COEFFICIENT = 0.20

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1979-81
1	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2	0.08	0.08	0.09	0.05	0.05	0.04	0.05	0.04	0.04	0.10	0.04
3	0.16	0.31	0.17	0.30	0.18	0.23	0.21	0.24	0.17	0.28	0.23
4	0.20	0.43	0.36	0.46	0.42	0.40	0.31	0.29	0.29	0.38	0.33
5	0.28	0.40	0.54	0.71	0.40	0.48	0.39	0.33	0.31	0.46	0.40
6	0.35	0.43	0.49	0.69	0.44	0.45	0.48	0.46	0.23	0.55	0.47
7	0.46	0.31	0.68	0.98	0.54	0.39	0.36	0.61	0.52	0.55	0.45
8	0.29	0.36	0.55	0.63	0.44	0.57	0.51	0.41	0.44	0.55	0.50
9	0.25	0.40	0.40	0.54	0.35	0.35	0.35	0.35	0.35	0.55	0.35
10+	0.25	0.40	0.40	0.54	0.35	0.35	0.35	0.35	0.35	0.55	0.35
(3-6)U	0.25	0.39	0.39	0.54	0.36	0.39	0.35	0.34	0.26	0.42	
(3-9)U	0.28	0.38	0.45	0.62	0.40	0.41	0.37	0.39	0.34	0.47	

Table 10.6 VIRTUAL POPULATION ANALYSIS

COD II, THE FAROE PLATEAU

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIOMASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1974-81
1	47821	22935	12656	14641	20503	32763	21721	40609	50670	27125+++++		20086
2	30702	38908	13690	10345	11992	16478	26607	17746	33233	25106	22135	21459
3	9665	23187	29524	15552	6086	9317	12972	20929	13946	26181	16599	15954
4	10944	6773	13872	20426	3473	5523	6070	3534	13413	9648	16200	10083
5	4139	7350	3610	7946	10538	4566	5020	3656	5247	6220	5402	5607
6	2093	2549	4017	1720	3136	5783	2304	1670	2143	3740	4249	2916
7	1345	1212	1356	2010	775	1675	3025	1163	345	1331	1483	1562
8	643	696	723	560	615	337	929	1730	517	411	629	780
9	700	392	599	551	245	323	156	457	943	271	194	378
10+	452	499	613	74	273	141	87	204	453	269	255	277
TOTAL NO	103510	104431	65471	72077	64403	76907	77071	96746	101411	101702		
SPS NO	20322	19451	24602	33023	24019	18348	15571	17464	23562	23290		
TOT. BIOM	153803	179022	181529	165075	110429	103712	104559	134739	153135	160036		
SPS BIOM	84320	85241	101100	127161	76994	62107	51795	54321	69012	71513		

Table 10.7

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

 COD FAROE PLATEAU

FIRST YEAR: 1984

LAST YEAR: 1986

YEAR	RECRUITMENT thousands
1984	22722.
1985	22722.
1986	22722.

AGE	STOCK SIZE thousands	F AT AGE	1	MATURITY GIVE	WEIGHT IN THE CATCH kiloqram	WEIGHT IN THE STOCK kiloqram
1	22722.0	0.001	0.20	0.000	0.580	0.580
2	18418.0	0.100	0.20	0.000	1.100	1.100
3	13644.0	0.260	0.20	0.000	1.570	1.570
4	16200.0	0.380	0.20	1.000	2.340	2.340
5	5402.0	0.460	0.20	1.000	3.340	3.340
6	4249.0	0.550	0.20	1.000	4.190	4.190
7	1483.0	0.550	0.20	1.000	5.400	5.400
8	629.0	0.550	0.20	1.000	6.350	6.350
9	194.0	0.550	0.20	1.000	7.710	7.710
10+	255.0	0.550	0.20	1.000	10.580	10.580

Table 10.8 Results of predictions.

Species: COD				Area: Faroe Plateau.						
1984				Management option for	1985				1986	
Stock biom.	Spawn. stock biom.	\bar{F} (3-6)	Catch		Stock biom.	Spawn. stock biom.	\bar{F} (3-6)	Catch	Stock biom.	Spawn. stock biom.
145	90	0.42	37	$\bar{F}_{85} = 0$	137	82	0	0	169	112
				$\bar{F}_{0.1}$			0.13	12	155	98
				F_{max}			0.26	23	142	86
				$\bar{F}_{85} = 0.8 \bar{F}_{83}$			0.33	29	136	80
				$\bar{F}_{85} = \bar{F}_{83}$			0.42	35	129	73
				$F_{85} = 1.2 \bar{F}_{83}$			0.5	40	122	68

Weight in thousands of tonnes

Recruitment 1983-86 $R_1 = 22.7$ millions

Stock biomass: fish at age 1 and older

Spawning stock biomass: fish at age 4 and older

Exploitation pattern 1984-86 based on 1983.

Table 11.1 Faroe Plateau HADDOCK. Nominal catches by countries, 1974-83 (tonnes).
(Data for 1974-82 from Bulletin Statistique)

Year	Faroe Islands	France	Germany, Fed. Rep.	Norway	Poland	UK England	UK Scotland	Others	Total
1974	4 538	1 461 ^{*)}	70	5	685	1 044	5 572	30	13 405
1975	8 625	2 173	120	56	544	1 505	4 896	383	18 302
1976	12 670	2 472	22	20	448	1 551	6 671	181	24 035
1977	19 806	623	49	46	5	707	3 278	26	24 540
1978	15 539	71 ^{*)}	8	91	-	48	367	-	16 124
1979	11 259	50 ^{*)}	2	39	-	35	212	-	11 597
1980	13 633	31 ^{*)}	4	9	-	6	434	6	14 123
1981	10 891	113	+	20	-	-	85	-	11 109
1982	10 319	2	1	11	-	-	1	-	10 334
1983 ^{**)}	11 898	-	+ ^{*)}	11 ^{*)}	-	-	2	-	11 911

^{*)} Catches including Vb1

^{**)} Preliminary

Table 11.2 Faroe Bank HADDOCK. Nominal catches by countries, 1974-83 (tonnes).
(Data for 1974-82 from Bulletin Statistique)

Year	Faroe Islands	France	Germany Fed.Rep.	Norway	Poland	UK England	UK Scotland	Others	Total
1974	273	⌘)	-	-	-	573	500	22	1 368
1975	132	125	53	-	-	921	1 182	-	2 413
1976	44	70	+	-	-	733	1 329	-	2 176
1977	273	77	-	11	-	4	650	-	1 015
1978	2 643	⌘)	-	39	-	-	394	-	3 076
1979	716	⌘)	-	-	-	-	105	-	821
1980	690	⌘)	-	8	-	152	43	-	893
1981	1 103	⌘)	-	7	-	-	14	-	1 124
1982	1 153	-	⌘)	1	-	-	48	-	1 602
1983 ^{⌘⌘}	967						13		980

⌘) Catches included in Vb1.

⌘⌘) Preliminary.

Table 11.3 VIRTUAL POPULATION ANALYSIS

HADDOCK IN THE FAROE REGION

CATCH IN NUMBERS	UNIT: THOUSANDS									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	221	110	56	0	0	1	0	0	0	0
2	5633	7337	4396	255	32	1	143	74	539	441
3	2899	7952	7856	4639	1022	1161	56	455	934	1968
4	3970	2097	6798	5168	4248	1754	3724	202	764	383
5	451	1371	1251	4916	4054	3341	2565	2566	298	422
6	976	247	1189	2128	1841	1850	2496	1354	2182	93
7	466	352	296	946	717	772	1566	1559	973	1444
8	535	237	720	443	635	212	660	608	1166	740
9	68	419	258	731	243	155	99	177	1263	947
10+	147	187	318	855	312	74	86	36	214	795
TOTAL	15366	20309	23124	19483	15104	9321	11417	7051	8573	7233

Table 11.4 VIRTUAL POPULATION ANALYSIS

HADDOCK IN THE FAROE REGION

MEAN WEIGHT AT AGE OF THE STOCK	UNIT: KILOGRAM									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.300	0.300	0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.470	0.470	0.470	0.311	0.357	0.357	0.643	0.452	0.700	0.700
3	0.730	0.730	0.730	0.633	0.790	0.672	0.713	0.725	0.896	0.896
4	1.130	1.130	1.130	1.044	1.055	0.694	0.941	0.957	1.150	1.150
5	1.550	1.550	1.550	1.476	1.594	1.156	1.157	1.237	1.444	1.444
6	1.970	1.970	1.970	1.652	1.670	1.590	1.495	1.651	1.498	1.498
7	2.410	2.410	2.410	2.241	2.350	2.070	1.759	2.053	1.829	1.829
8	2.760	2.760	2.760	2.205	2.397	2.525	2.095	2.406	1.667	1.667
9	3.070	3.070	3.070	2.570	3.014	2.696	2.465	2.725	1.967	1.967
10+	3.550	3.550	3.550	2.591	2.920	3.519	3.310	3.250	2.856	2.856

Table 11.5 VIRTUAL POPULATION ANALYSIS

HADDOCK II. THE FAROE REGION

FISHING MORTALITY COEFFICIENT UNI: Year-1 NATURAL MORTALITY COEFFICIENT = 0.20

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1979-81
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.13	0.13	0.09	0.01	0.00	0.00	0.03	0.02	0.02	0.03	0.02
3	0.23	0.28	0.19	0.11	0.05	0.05	0.04	0.15	0.34	0.10	0.07
4	0.41	0.25	0.41	0.19	0.17	0.12	0.20	0.27	0.33	0.23	0.18
5	0.14	0.24	0.24	0.59	0.22	0.19	0.27	0.21	0.52	0.30	0.23
6	0.13	0.11	0.34	0.30	0.46	0.15	0.22	0.22	0.28	0.30	0.19
7	0.23	0.09	0.19	0.50	0.70	0.35	0.16	0.20	0.25	0.30	0.24
8	0.24	0.13	0.23	0.46	0.74	0.46	0.58	0.10	0.23	0.30	0.38
9	0.30	0.30	0.50	0.50	0.50	0.40	0.40	0.30	0.30	0.30	0.37
10+	0.30	0.30	0.30	0.50	0.50	0.40	0.40	0.30	0.30	0.30	0.37
(4- 6)U	0.25	0.20	0.33	0.52	0.26	0.15	0.25	0.21	0.38	0.28	

Table 11.6 VIRTUAL POPULATION ANALYSIS

Haddock in the Faroe Region

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIOMASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	84177	67581	52206	42563	2293	6487	5561	34709	20098	n+++++++	
2	49997	68716	55252	26334	34348	1861	5510	4390	26417	16455	0
3	15753	35857	49648	41255	21530	24502	1539	4215	3527	22779	13074
4	12965	10277	22207	35572	30135	16541	22266	1206	3044	2049	16875
5	3705	7052	6527	12092	22232	20846	11962	14895	307	1782	1333
6	6431	2627	4540	4219	5492	15045	14059	7470	9667	594	1084
7	2461	4386	1923	2649	1557	2846	10650	9264	4898	6117	239
8	2766	1596	3274	1310	1322	634	1657	7306	6161	5155	5710
9	248	1775	1093	2033	676	515	529	750	5635	4011	1901
10+	623	792	1347	2373	666	746	766	152	916	3367	4475
TOTAL (1)	179141	200662	178002	168395	121357	93543	73421	84364	83180	60095	
SPS (1)	44967	64362	90565	99496	64211	85175	62750	45265	34665	43639	
TOT. (1)	109955	129735	137340	114607	114332	92379	64022	76096	76366	72042	
SPS (1)	61133	77151	102219	106413	101391	91706	80606	74112	56474	60523	

Table 11.7

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

HADDOCK IN THE FAROE AREA

FIRST YEAR: 1984

LAST YEAR: 1986

YEAR	RECRUITMENT thousands
1984	37159.
1985	37159.
1986	37159.

AGE	STOCK SIZE thousands	F AT AGE	M	MATURITY GIVE	WEIGHT IN THE CATCH kilogram	WEIGHT IN THE STOCK kilogram
1	37159.0	0.000	0.20	0.000	0.300	0.300
2	30423.0	0.030	0.20	0.000	0.470	0.470
3	13774.0	0.100	0.20	1.000	0.740	0.740
4	16675.0	0.250	0.20	1.000	1.010	1.010
5	1335.0	0.300	0.20	1.000	1.320	1.320
6	1084.0	0.300	0.20	1.000	1.660	1.660
7	239.0	0.300	0.20	1.000	2.050	2.050
8	3710.0	0.300	0.20	1.000	2.260	2.260
9	1901.0	0.300	0.20	1.000	2.540	2.540
10+	4475.0	0.300	0.20	1.000	3.040	3.040

Table 11.8 Results of predictions.

Species: HADDOCK

Area: Faroe Area

1984				Management option for 1985	1985				1986	
Stock biom.	Spawn. stock biom.	\bar{F} (4-6)	Catch		Stock biom.	Spawn. stock biom.	\bar{F} (4-6)	Catch	Stock biom.	Spawn. stock biom.
83	58	0.28	12	$\bar{F}_{85} = 0$	88	63	0	0	107	82
				$\bar{F}_{85} = 0.8 \bar{F}_{83}$			0.22	10	97	71
				$\bar{F}_{85} = \bar{F}_{83}$			0.28	12	94	69
				$\bar{F}_{0.1}$			0.29	12	94	68
				$\bar{F}_{85} = 1.2 \bar{F}_{83}$			0.33	14	92	66
				F_{max}			0.60	23	82	57

Weights in thousands of tonnes

Recruitment 1983-86 $R_1 = 37.2$ millions

Stock biomass: fish at age 1 and older

Spawning stock biomass: fish at age 3 and older

Exploitation pattern 1984-86 based on 1983

Figure 4.1. FISH STOCK SUMMARY

(Stock) North-East Arctic SAITHE

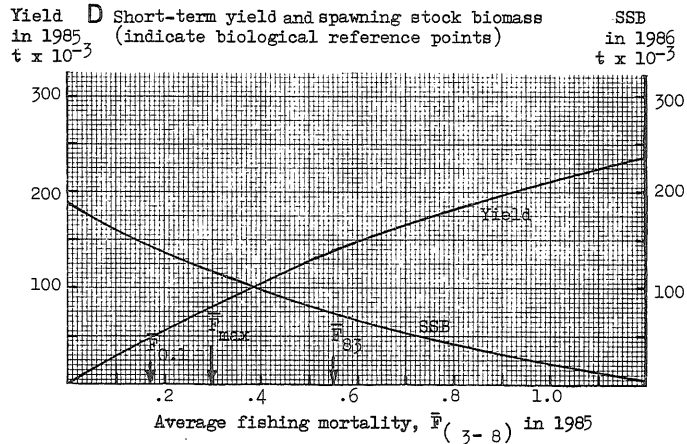
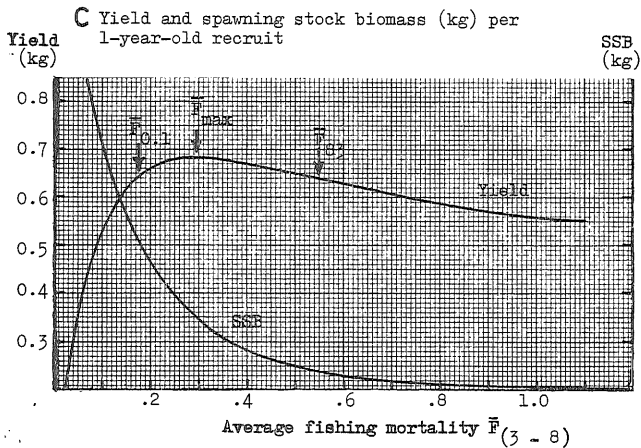
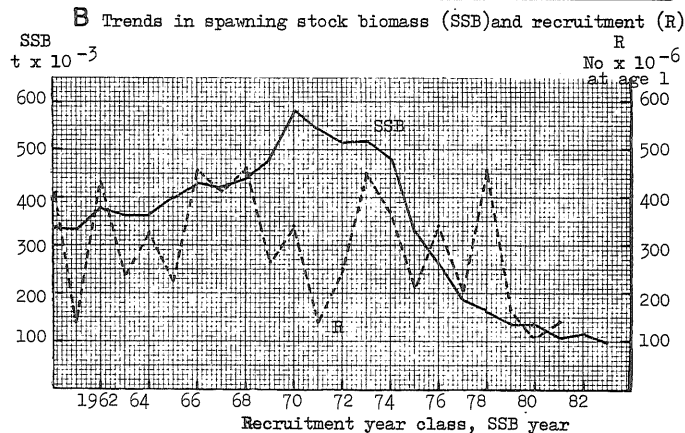
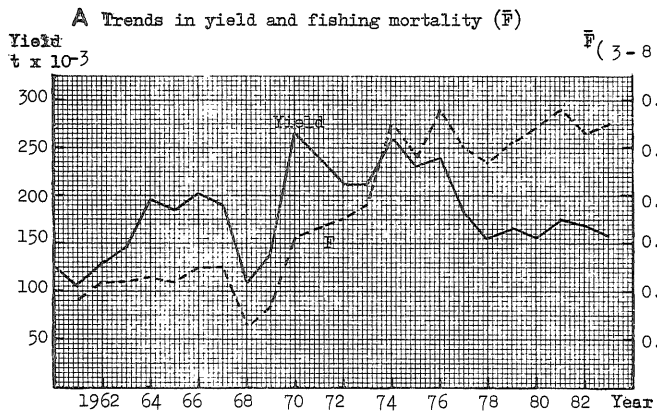


Figure 4.2. North-East Arctic SAUWU, landings by gear categories 1977-83.

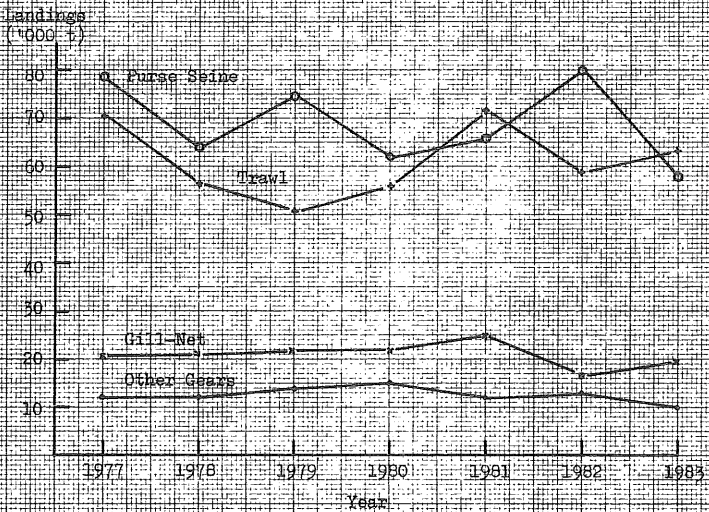
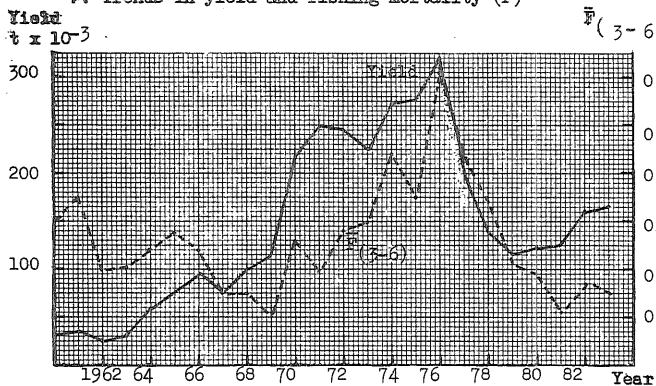


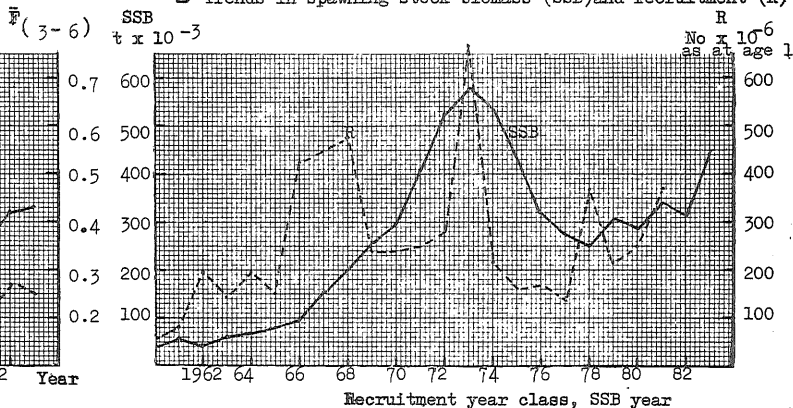
Figure 5.1. FISH STOCK SUMMARY

(Stock) North Sea SAITHE

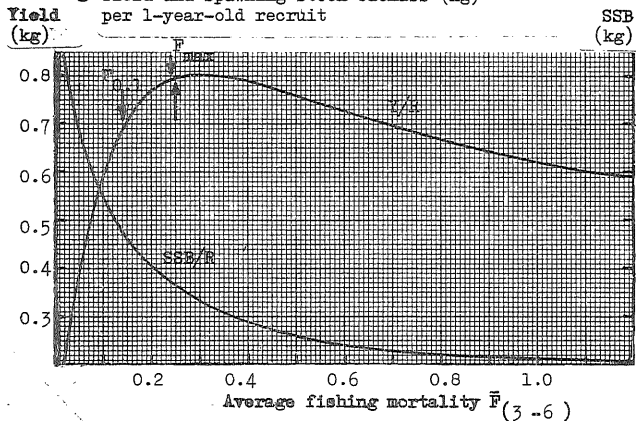
A Trends in yield and fishing mortality (\bar{F})



B Trends in spawning stock biomass (SSB) and recruitment (R)



C Yield and spawning stock biomass (kg) per 1-year-old recruit



D Short-term yield and spawning stock biomass in 1985 (indicate biological reference points)

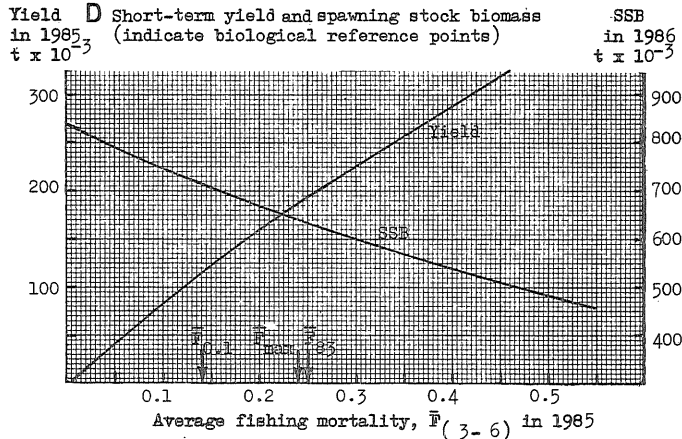


Figure 3.2 North Sea SAUFB.
 Fishing mortality versus effort (French units).

Fishing mortality
 (3-6)

0.8

0.6

0.4

0.2

Effort Index

0

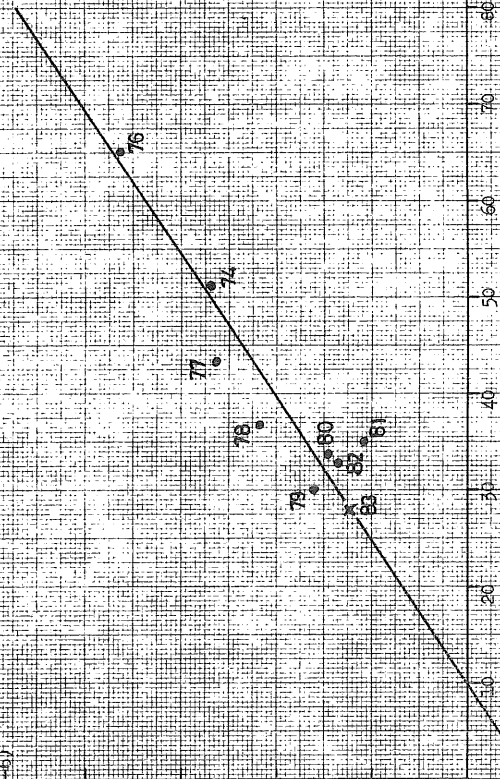
20

40

60

80

100



$y = 0.0075x + 0.132$
 (based on 1975)

(73)

Figure 5.3. North Sea SAHML.
Stock biomass of age groups 3-6 versus French cope indices.

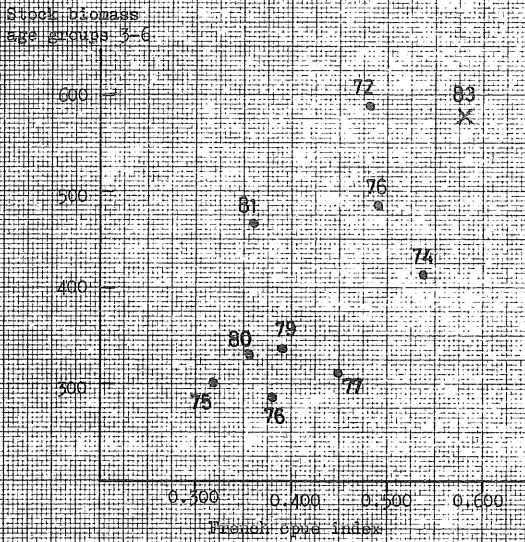


Figure 6.1. FISH STOCK SUMMARY

(Stock) Icelandic SAITHE

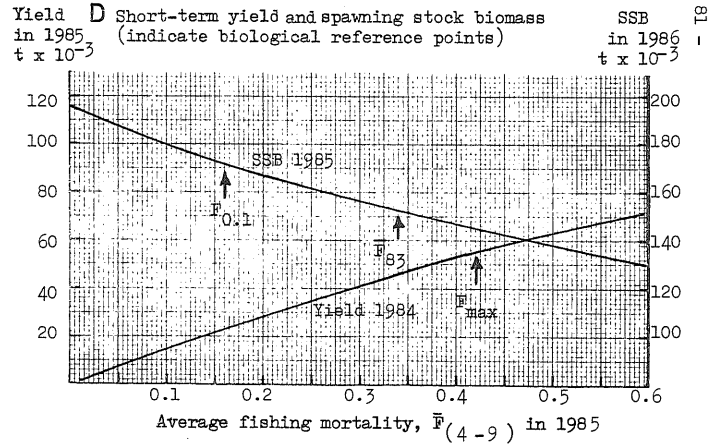
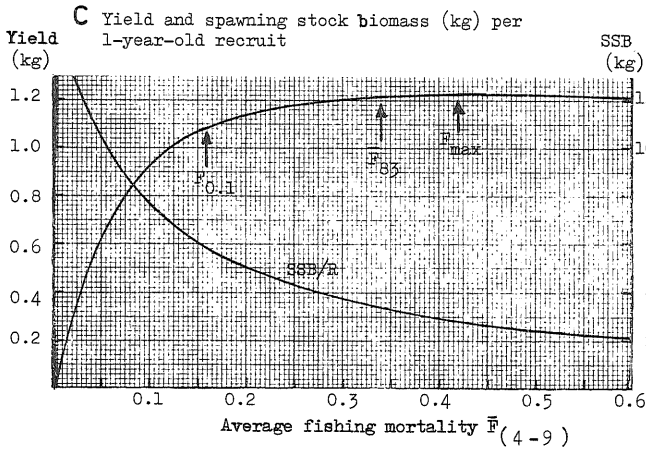
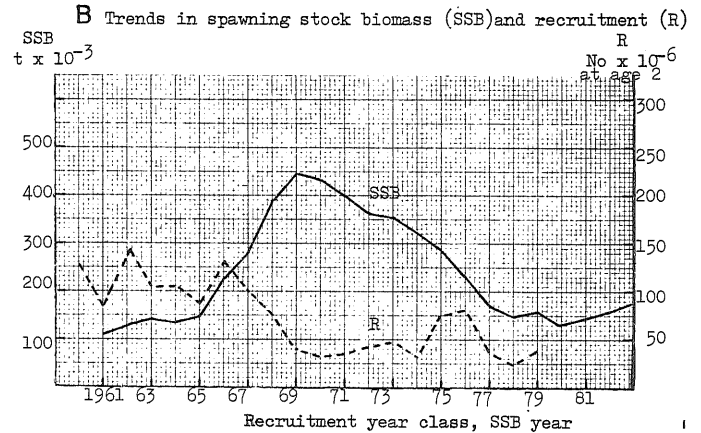
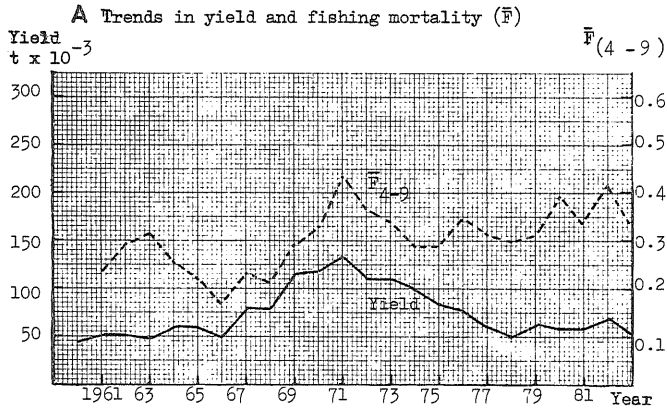


Figure 6.2 Icelandic SAITHUS.

- 1. C_{pus} versus biomass (ages 4-8)
- 2. F₄₋₈ versus fishing effort

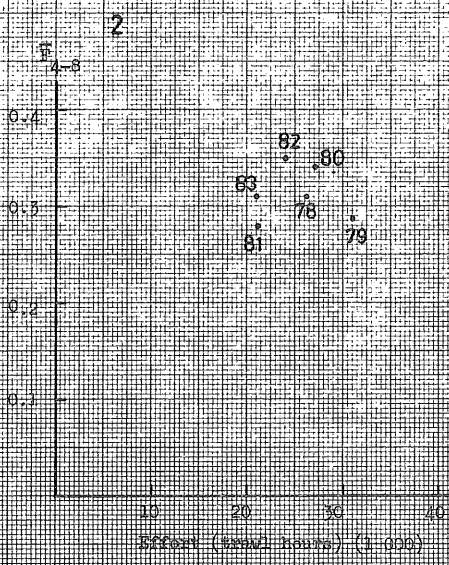
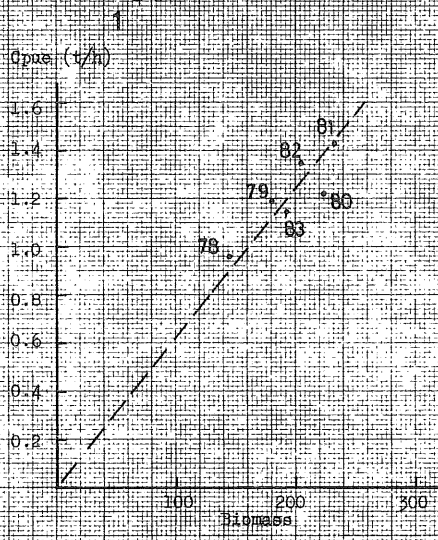


Figure 7.1 FISH STOCK SUMMARY

(Stock) West of Scotland SAITHE

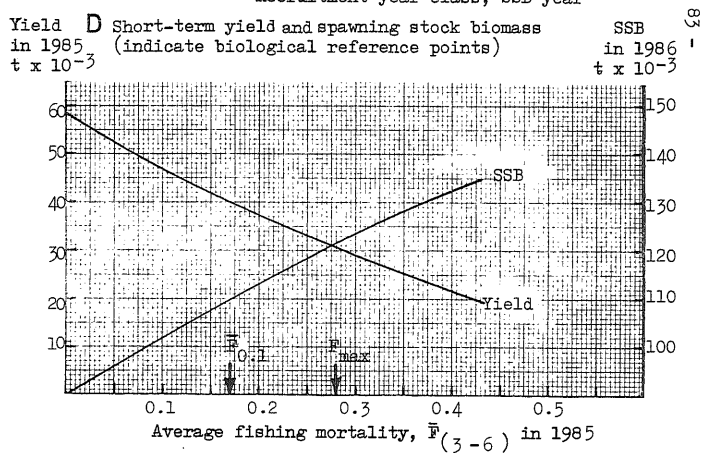
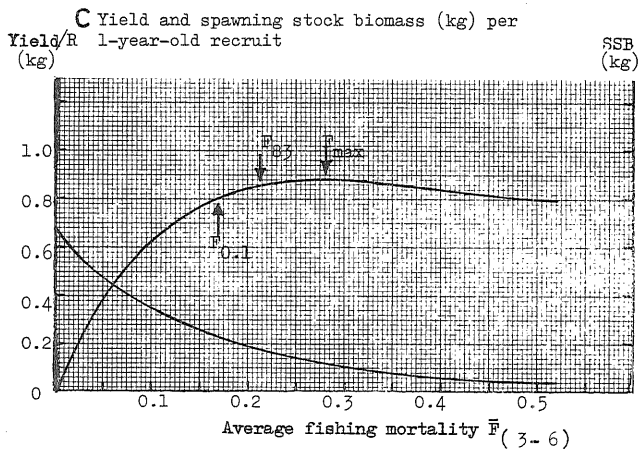
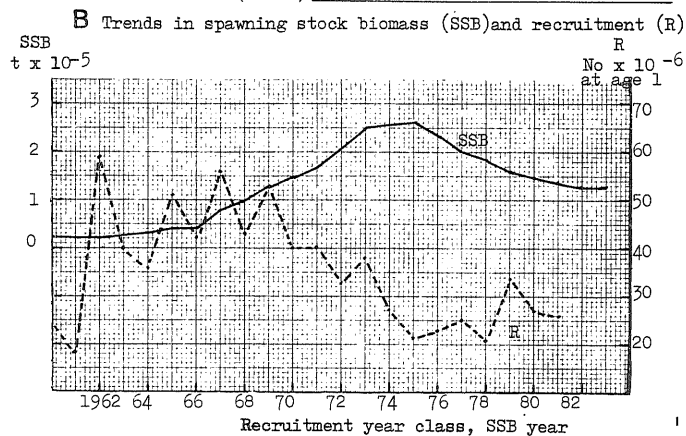
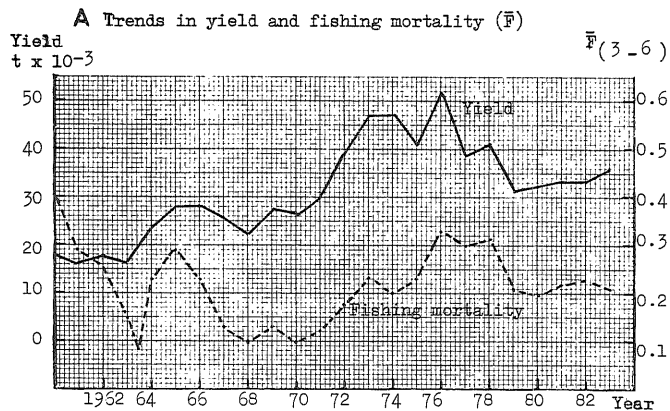


Table 7.2. West of Scotland SAIME.
Fishing mortality versus fishing effort.

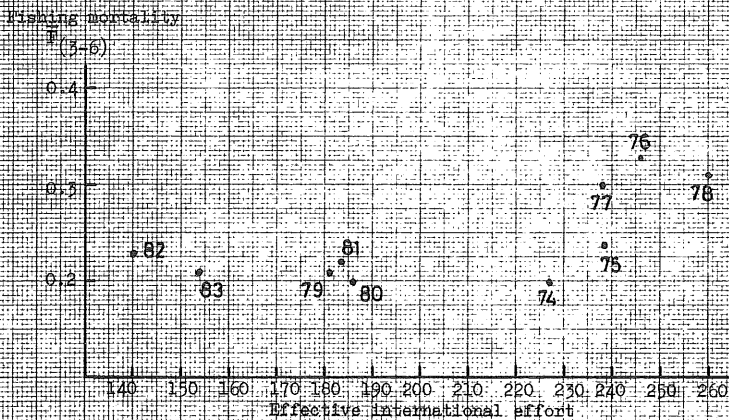


Figure 8.3. Fishing effort by Japanese vessels.

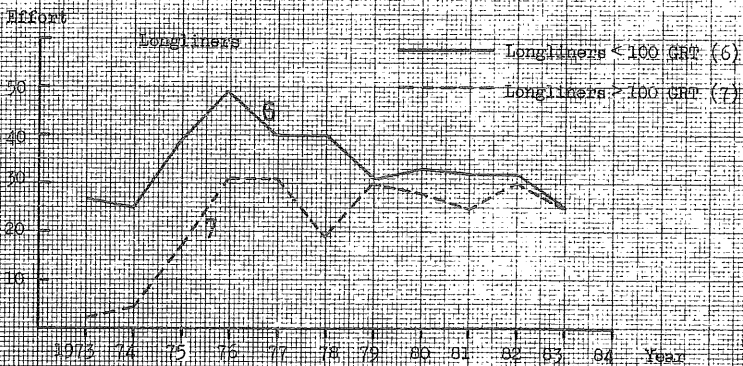
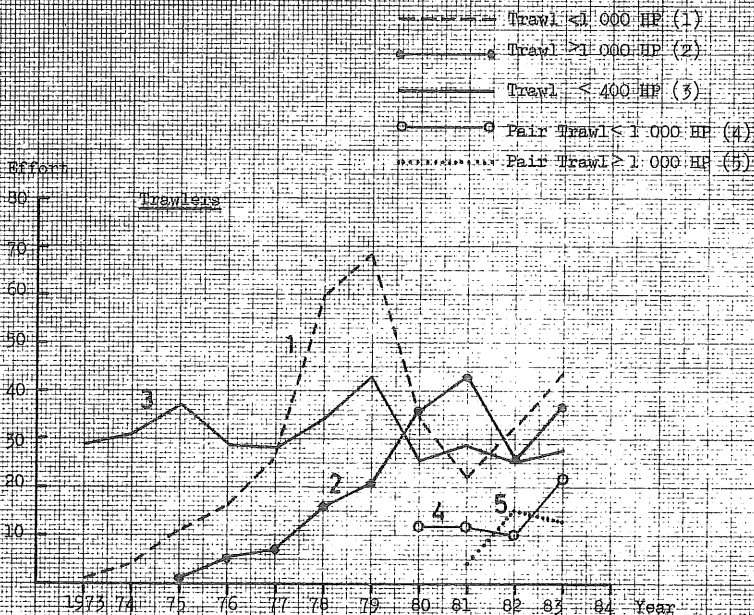


Figure 9.1 FISH STOCK SUMMARY

(Stock) Faroe SAITHE

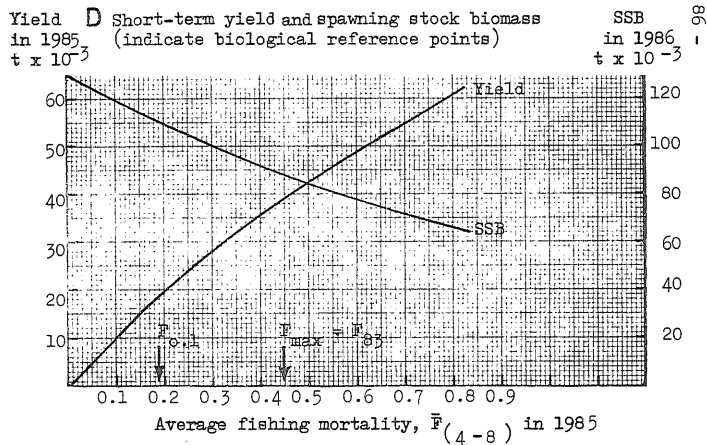
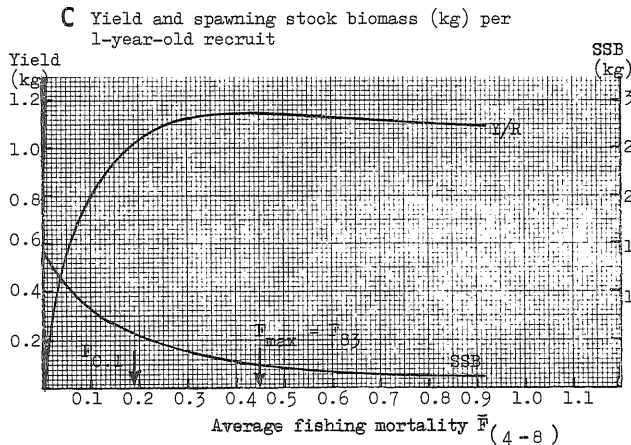
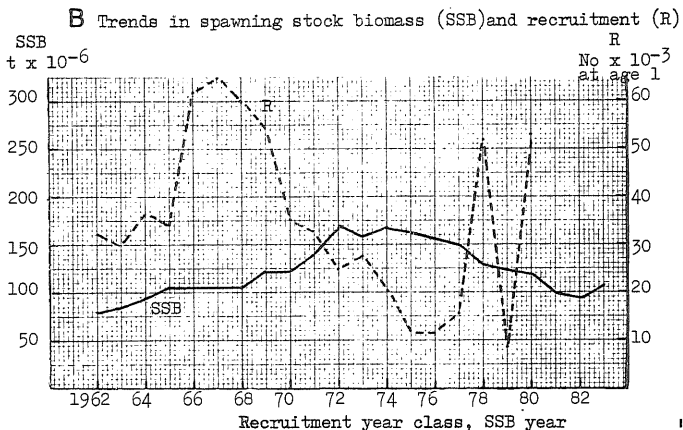
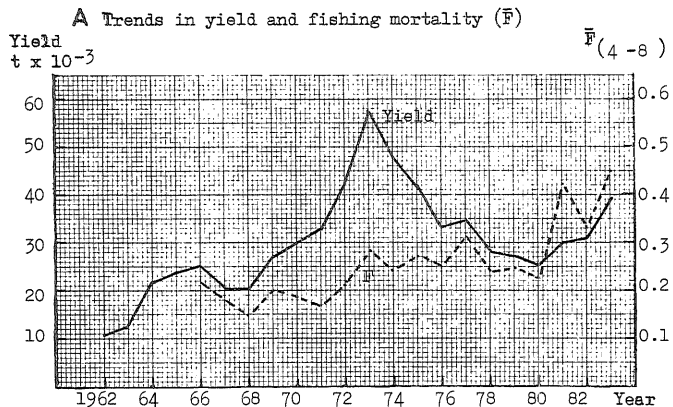
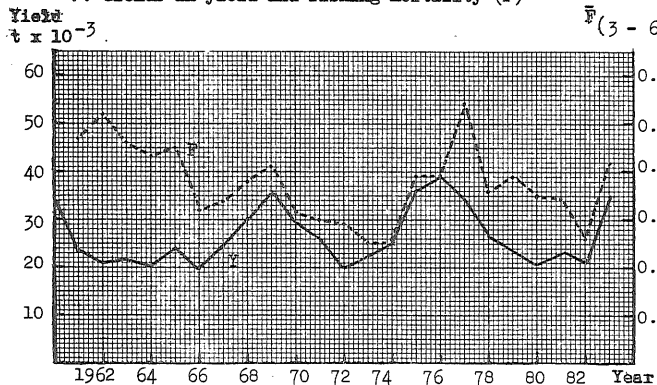


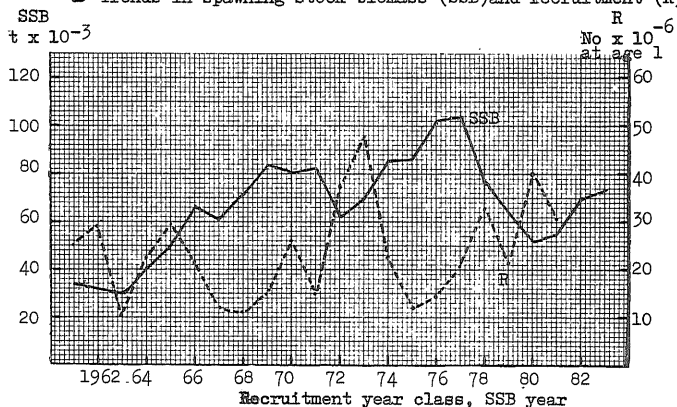
Figure 10.1 FISH STOCK SUMMARY

(Stock) Faroe Plateau COD

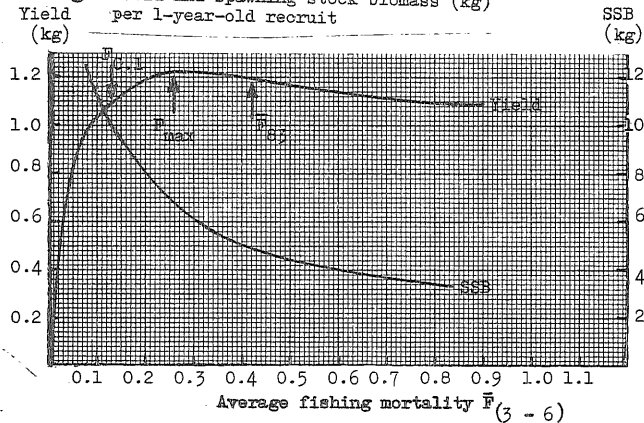
A Trends in yield and fishing mortality (\bar{F})



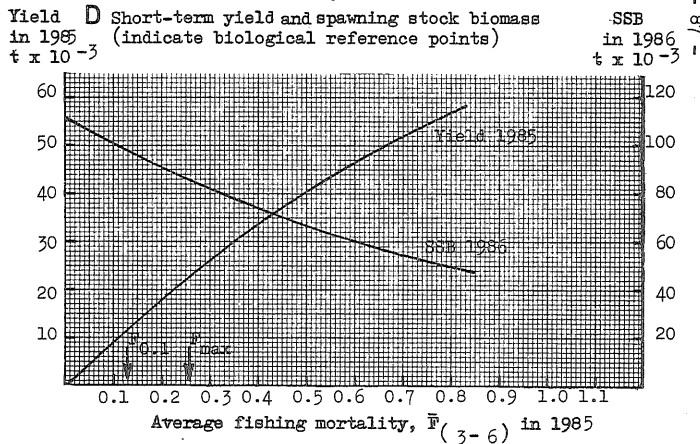
B Trends in spawning stock biomass (SSB) and recruitment (R)

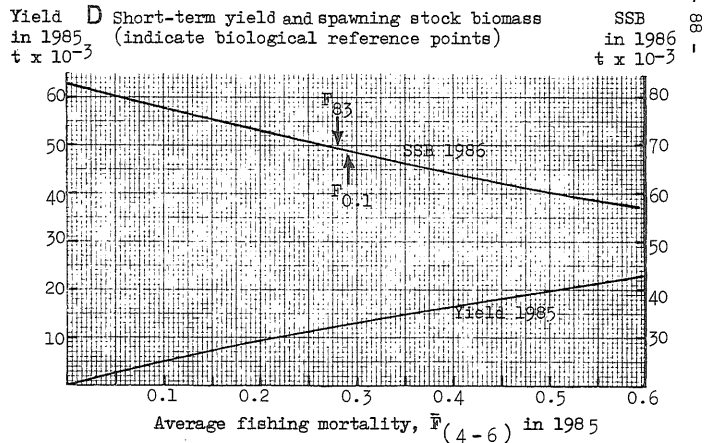
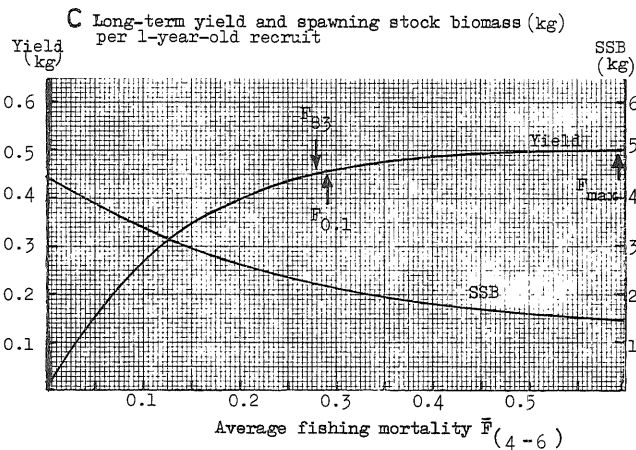
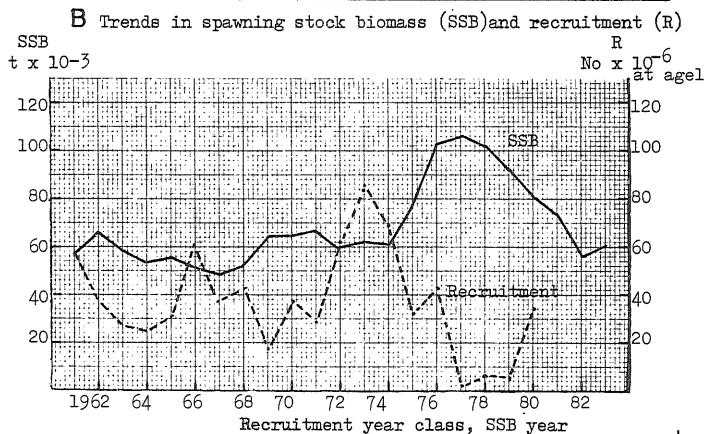
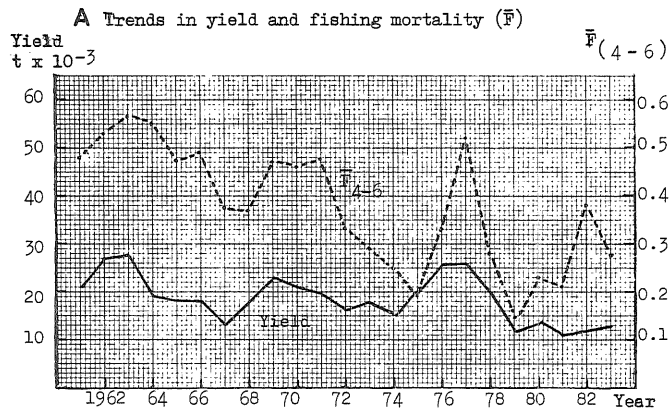


C Yield and spawning stock biomass (kg) per 1-year-old recruit



D Short-term yield and spawning stock biomass in 1985 (indicate biological reference points)





APPENDIX

COMMENTS ON Y/R ANALYSIS FOR WEST OF SCOTLAND SAITHE

In common with a number of other stocks, natural mortality for West Scotland saithe is assumed to take a value of 0.2. Although this assumption is a desirable expedient for consistency in the absence of contrary evidence, it is important to appreciate the consequences of the assumption for Y/R analysis, if this model is to take an active role in management recommendations. The following assessment is offered as an illustration.

The hypothesis that $M = 0.2$ can equally be replaced by $M = 0.1$ with no loss of validity. A VPA was therefore run with a natural mortality of 0.1 and tuned in precisely the same way as that given in the main assessment (Section 7). The results of this VPA are given in Appendix Tables 1 and 2. It should be noted that this analysis gives almost identical status quo catch predictions in 1984 and 1985 of 24 000 tonnes when compared to the main assessment (Section 7). The Y/R curve (Appendix Figure 1), however, gives quite different results and implies that the stock is considerably overfished. The sensitivity of the analysis to arbitrary assumptions should be borne in mind when using biological reference points.

VIRTUAL POPULATION ANALYSIS

Appendix Table 1

SAITHE IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

FISHING MORTALITY COEFFICIENT	UNIT: Year-1										NATURAL MORTALITY COEFFICIENT = 0.10
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1979-81
1	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00
2	0.17	0.13	0.20	0.12	0.43	0.08	0.09	0.15	0.10	0.25	0.11
3	0.53	0.57	0.70	0.52	0.65	0.32	0.39	0.54	0.41	0.41	0.42
4	0.36	0.40	0.46	0.47	0.50	0.36	0.24	0.38	0.41	0.31	0.33
5	0.34	0.31	0.53	0.54	0.39	0.43	0.31	0.21	0.38	0.30	0.32
6	0.13	0.23	0.42	0.33	0.40	0.34	0.39	0.29	0.26	0.33	0.34
7	0.21	0.30	0.25	0.34	0.22	0.34	0.35	0.34	0.40	0.35	0.34
8	0.31	0.22	0.22	0.20	0.21	0.16	0.27	0.25	0.37	0.24	0.23
9	0.22	0.10	0.25	0.17	0.11	0.23	0.12	0.31	0.22	0.22	0.22
10	0.33	0.05	0.20	0.17	0.23	0.13	0.19	0.21	0.19	0.17	0.17
11	0.17	0.09	0.29	0.23	0.31	0.17	0.18	0.29	0.11	0.20	0.22
12	0.09	0.09	0.25	0.10	0.32	0.16	0.19	0.16	0.21	0.17	0.17
13	0.35	0.04	0.25	0.10	0.27	0.23	0.29	0.24	0.17	0.25	0.25
14	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
15+	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
(3- 6)U	0.34	0.38	0.53	0.48	0.49	0.36	0.33	0.35	0.37	0.34	

VIRTUAL POPULATION ANALYSIS

Appendix Table 2

SAITHE IN FISHING AREA VIA (NW. COAST OF SCOTLAND, R. IRELAND)

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIO MASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	23809	17266	12249	13269	14369	13045	20052	15904	14029	15252	*****
2	18990	20830	15601	11049	11530	12900	11795	16102	14254	12658	13773
3	14303	14462	16585	11609	3843	7011	10816	9726	14105	11642	8920
4	3253	7609	7413	7440	6275	4100	4599	6020	5123	6458	6991
5	6922	5215	4612	4216	4194	3454	2632	3271	4118	3066	5613
6	5225	4440	3457	2467	2229	2502	2036	1740	2399	2558	2055
7	5262	4137	3200	2063	1531	1351	1043	1247	1183	1068	1064
8	3507	3858	2705	2265	1533	1169	371	1047	602	718	1063
9	2663	2329	2005	2005	1631	973	355	674	736	499	511
10	1583	1944	1910	1980	1530	1367	690	637	401	537	363
11	1343	1026	1675	1422	1513	1101	1091	525	506	301	410
12	1525	1026	845	1134	1026	1007	340	623	554	409	223
13	127	1257	848	593	330	576	780	627	634	261	313
14	214	81	1094	590	486	842	466	527	446	509	184
15+	330	145	590	619	492	359	649	527	724	1013	1128
TOTAL NO	94059	85635	75655	62727	58297	51788	59390	61980	59355	59548	
SPS NO	28705	25467	23805	19359	16950	14601	12623	11624	12343	11538	
TOT. BIOM	179131	179833	166146	136210	127070	116772	113797	111922	110941	111152	
SPS BIOM	132658	131064	121902	107449	94539	83492	76240	71405	70533	66142	

Appendix Table 3

West of Scotland SAITHE. Estimates of biological reference points under two assumptions of M.

M	F _{0.1}	F _{max}	F ₆₃
0.1	0.10	0.15	0.34
0.2	0.18	0.29	0.21

Appendix Figure 1. West of Scotland SAITHB.
Yield per recruit ($M = 0.2$)

